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PROBING THE LARGE-SCALE STRUCTURE OF THE UNIVERSE: AN ANALYSIS OF 55 BRIGHT SOUTHERN CLUSTERS OF GALAXIES

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THE UNIVERSITY OF OKLAHOMA
GRADUATE COLLEGE

PROBING THE LARGE-SCALE STRUCTURE OF THE UNIVERSE: AN ANALYSIS OF 55 BRIGHT SOUTHERN CLUSTERS OF GALAXIES

A DISSERTATION
SUBMITTED TO THE GRADUATE FACULTY
in partial fulfillment of the requirements for the
degree of
Doctor of Philosophy

by
Ronald Paul Olowin
Norman, Oklahoma

PROBING THE LARGE-SCALE STRUCTURE OF THE UNIVERSE: AN ANALYSIS OF 55 BRIGHT SOUTHERN CLUSTERS OF GALAXIES

A DISSERTATION
APPROVED FOR THE DEPARTMENT OF
PHYSICS AND ASTRONOMY

By

Guido L. Chincarini, Chair

David R. Branch

Tibor J. Herczeg

Ronald Kantowski

Thomas M. Smith

DEDICATION

This thesis is dedicated to my family:
in loving memory of my parents
Clement Jan and Sophia Ann Olowin
and with grateful appreciation of
Mary Dreisbach, Aaron Benjamin and Frederick Alexander.

DESIDERATUM

Melius est enim in via claudicare quam
praeter viam fortiter ambulare.
Nam qui in via claudicat, etiam si parum
proficiscatur, appropinquat ad
terminum; qui vero extra viam ambulat,
quanto fortius currit, tanto magis
a termino elongatur.

— Aquinas
In Iaonnem

ACKNOWLEDGEMENTS

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During the production of this thesis the special assistance of Judith Tucker at Printing Concepts, Inc. has been extremely helpful. Likewise, my thanks go to Richard Henry and, in particular, to Michael Morrison who unraveled the mysteries of TeX for me.

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The special help and encouragement of Tibor Herczeg has been sustaining. His deep grasp of the History of Astronomy and his impeccable scholarship will always be an influence. The expert guidance and help from Harold Corwin has been immeasurable. The eager and generous support and advice he has given has illuminated for me what it means to do professional astronomy.

To Doris Jane Chediak I owe a sincere debt of gratitude and thanks. She has made a living and deep contribution to my growth and development and has been an invaluable asset to my family.

The advice and guidance of my thesis advisor, Guido Chincarini, has been indispensable. He has provided my first exposure to research on clusters of galaxies and throughout this effort has given me encouragement and unencumbered opportunities to broaden my astronomical experience. For this, for his sometimes painful honesty, and for his deep scientific integrity, I give Professor Chincarini my great and sincere thanks. I am extremely grateful for his time and friendship.

Finally, I wish to express my deepest appreciation to my family. That they tolerated this effort and suffered my neglect with patience, unselfishness and wit is remarkable.

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ABSTRACT

Here was very fine discourses
— and experiments;
but I do lack philosophy enough
to understand them,
and so cannot remember them.
— Samuel Pepys
Diary, 1 march 1665

This dissertation presents the description of 55 bright, close ($z \leq 0.1$) clusters of galaxies as a homogeneous sample taken from a new effort to catalogue galaxy clusters in the Southern Hemisphere. The positions of some 21,000 galaxies in clusters have been catalogued along with visual magnitudes, morphological types, position angles of extended objects and pertinent remarks. For all of the clusters, various cluster parameters have been determined and form the basis of comparative studies for these fundamental aggregates of matter in the universe.

The aims of this study are to produce a homogeneous sample of galaxy clusters measured to a uniform limiting magnitude of m_v=19.0; catalogued with accurate positions relative to nearby astrometric standard stars; morphologically classified and population typed; and statistically analysed in a uniform fashion to deduce certain cluster parameters. The cluster parameters of interest include an estimate of cluster distance, center and richness; galaxy distributions as a function of morphological type, magnitude distribution and core radius. The core radius has been determined by fitting surface density information to an Isothermal Model by means of a χ^2 minimization procedure.

PROBING THE LARGE-SCALE STRUCTURE OF THE UNIVERSE: AN ANALYSIS OF 55 BRIGHT SOUTHERN CLUSTERS OF GALAXIES

CHAPTER I

THE DISCOVERY OF CLUSTERS OF GALAXIES

Nothing can astound the stars.
They have long lived.
And you are not the first
To come to such a place
seeking the most
difficult knowledge.
— Robert Penn Warren

The history of the studies of the physical properties of clusters of galaxies is short by the standards of many other astronomical topics, but it has been elaborated in the service of the history of astronomy with many interesting and varied lines of development.

In the great flurry of astronomical cataloguing during the eighteenth and nineteenth centuries astronomers not only busied themselves with the positions of stars, but also with the mysterious "nebulae" as well. In 1755 de la Caille published a catalogue of 42 southern nebulae which was followed in 1781 by the famous catalogue of Charles Messier of 104 nebulae used by comet hunters to avoid spurious identifications (Lundmark (1927), Jones: (1968)). Thirty-three of the objects identified by Messier (1781) in his third and last catalogue are now recognized to be extragalactic, but even at the time the catalogue was published, these objects served to illustrate an unusual concentration of nebulae in the constellations of Coma Berenices and Virgo. In 1784 William Herschel (Herschel, 1784) published an even larger catalogue of stars and nebulae of which over a thousand are extra-galactic objects. He further confirmed the concentration of these objects in the region modern astronomers regard as the galactic poles (Herschel, 1785). Sir William Herschel's catalogue was extended to the Southern Hemisphere by Sir John Herschel during his residence in the Cape Province in South Africa. Here he published his General Catalogue of Nebulae and Star Clusters in 1864 which contains 5079 entries (Herschel, 1864). The distribution of the nebulae found in this catalogue was investigated by Proctor (1869) who confirmed their striking avoidance of the Milky Way and used this information to prove the connection of our galaxy with the nebulae as independent stellar systems. Probable multiple clustering (Waters, 1873) and the appearance of "nebular spots" (von Humboldt, 1866) were noticed in these catalogues as well as being more clearly detectable in the later catalogues of Dreyer (1888, 1895, 1908) by Waters (1894).

With the advent of astronomical photography, the structures of the spiral nebulae were catalogued and studied in large numbers. A photographic catalogue was compiled by Isaac Roberts in 1885-1904 and later published by his wife in 1922 (see Lundmark (1927), p. 15). A similar catalogue was published by James Keeler in 1908 (Keeler (1908)). A whole-sky photographic survey was undertaken by Franklin-Adams at this time, obtaining 206 overlapping plates at a scale of approximately 30 arcmin/cm (Hardcastle (1914)).

Other distinct groupings located in the constellations Ursa Major, Virgo and Fornax were noticed in the distribution of nebulae found in the first widely used catalogue of galaxies compiled by Shapley and Ames (1932a,b) which listed a total of 1249 objects and claimed to be complete to the 13th magnitude. This important work gleaned its source material from several existing catalogues including the NGC of Dreyer, the Fath list (1914), the Reinmuth catalogues (1926,1928) and those of the Harvard Observatory, and was put to use in later years with investigations by de Vaucouleurs (1953) and Humason, Mayall and Sandage (1956). Here, the most important work is the catalogue by Sandage and Tammann (1974a,b,c,d; 1975a,b) – the Revised Shapley-Ames Catalogue – and the resulting analysis by Sandage, Tammann and Yahil (1979).

It is now known that these concentrations can be treated as isolated entities, as nearby clusters of galaxies, their whole-sky distribution masked to some extent by obscuration by the plane of our Galaxy. It was in the early part of this century that astronomers paid them serious scrutiny within the larger context of the whole-sky distribution of the nebulae (Hinks, 1911). Lundmark (1927) compiled a list of 55 concentrations of galaxies from various sources as did Shapley (1933). Galaxy counts by Holmberg (1937, p.52) using the apparent magnitude of galaxies as an indication of their distance and allowing for any dispersion in luminosity, indicated the existence of a local metagalactic cloud with a density of more than five times that of the surrounding background. But by 1934, only about twenty great clusters of galaxies were known within 40 million light-years (on the old distance scale) (Zwicky, 1938). Not so surprisingly, this caused Hubble (1934,1936) to comment that rich clusters of galaxies were "relatively rare."

Subsequently, the rate of discovery of clusters of galaxies soon overtook the abilities of astronomers to study them in detail and it was Hubble himself who declared that an estimated 1% of all visible galaxies are members of rich clusters which are distributed on the average of one per 50 square degrees of the celestial sphere. Zwicky (1952) likened the cosmos as divided into cluster cells of a given volume; something similar to a bubble-raft of soap suds. At the time, Zwicky (1957a) estimated these cells to average $37.5/h\ Mpc$ in diameter and $440,000/(h^3)$ cubic Mpc in volume ($h = H_0/100\ km/sec/Mpc$) with a cluster membership on the order of two to four thousand galaxies.

The belief of many that the universe was homogeneous and smooth prompted astronomers to suggest that given a large enough volume of space, these irregularities would tend to average out, and the overall distribution of galaxies would tend towards randomness. But tests of this *Cosmological Principle* were impossible at that time since the volume of space sampled till then were actually quite limited.

With the appearance of extensive sky surveys, most notably those made by Shapley and colleagues (Shapley, 1933,1938,1947) and in particular the deep photographic plates of the Lick Observatory and the National Geographic Society-Palomar Observatory Sky Survey, there was recognized the truly vast numbers of clusters of galaxies. Shapley and, later, Shane and Wirtanen (1954), were interested in the distribution of galaxies at large. Shapley's main point was the irregular distribution of the galaxies he surveyed. This conclusion was in contrast to the idea of Hubble who, at that time, considered clusters rare. As a result, we may consider Shapley a precursor to the modern studies of the large-scale structure of the universe.

The continued search for and the description of the properties of galaxies showed a general hierarchy of organization indicating a smooth transition between double galaxies, multiple galaxies, groups of galaxies and clusters of galaxies. In other words, there seemed to be clustering at all observable levels. Pioneering work on clustering was taken up by Zwicky at the California Institute of Technology using plates taken with various Schmidt telescopes. Not only did he discover new clusters such as *Pisces* (Zwicky (1937)) but also he reinvestigated those clusters already known (*Cancer*: Zwicky (1950ab); *Coma*: Zwicky (1937a, 1951); *Hydra*: Zwicky (1941); *Pegasus*: Edson and Zwicky (1941); *Perseus*: Zwicky (1942cd)). He deduced that clusters, not galaxies, constituted the fundamental building blocks of the universe.

Zwicky believed that clusters represented very large entities and that they were physically connected to each other and superposed onto a uniform background of galaxies. This concept, however, has recently been modified. Clusters of galaxies are in fact imbedded in large structures which characterize the distribution of visible matter in the universe (Chincarini and Martins, (1975); Chincarini, (1984)), and a background of galaxies is not observed (Vettolani, de Sousa and Chincarini (1985)). Further, large regions with a literal absence of galaxies, called *voids*, have now been observed between large structures or superclusters (Chincarini (1978); Vettolani et al. (1985)).

The conclusion that clustering is a fact urged the introduction of statistical methods to interpret the data being amassed from galaxy counts made from photographic plates (Neyman and Scott ,1952, 1955; Neyman, Scott and Shane, 1953, 1954; Scott, Shane and Swanson, 1954). These investigations indicated that clusters of galaxies may be fundamental units of matter and are far more numerous than formerly thought. In a major survey, Abell (1958) compiled a catalogue of 2712 rich clusters of galaxies discovered on the National Geographic-Palomar Observatory Sky Survey (POSS) and selected a homogeneous sample of 1682 clusters for statistical study.

In the catalogue, a cluster was defined operationally as an association of galaxies containing at least 50 members not more than two magnitudes fainter than the third brightest member. The so-defined cluster must be compact enough for the galaxies to be counted to within an arbitrary distance r from the center of the cluster where $r = 4.6 \times 10^5/cz$ mm on the plate which transplates into a linear distance of 1.5/h Mpc ($h = H_0/100$) at the scale of the POSS. The object of these efforts was to study the distribution of the clusters as a function of depth in space, the isotropy of the distribution of clusters and the evidence available for second-order clustering, that is, for the existence of clusters of clusters of galaxies. We must stress that this is the most fundamental survey work to date on the clustering of galaxies because of its and completeness and homogeneity.

Extensions of these surveys and catalogues are continuing with lists of Southern clusters of galaxies made by Klemola (1969), Snow (1970), Sersic (1974), Rose (1976) and Braid and MacGillivray (1977). More recently, new cataloguing efforts to include a homogeneous sample of clusters of galaxies in the Southern hemisphere have begun. Before his untimely death in 1984, Abell had planned and organized a large Southern effort as an all-sky completion of his work carried out in the Northern hemisphere. The project (in progress) will be carried out by his successors (Abell et al. (1985)) and initially analysed for the distribution of rich clusters by Chincarini et al. (1985).

In general, the limit of most previous and current surveys has been $z \leq 0.5$, but various groups are now searching for clusters at $z \geq 0.5$. Deep surveys giving counts of galaxies have been undertaken by Kron and colleagues (Kron, et al. (1977)) as well as by Tyson and Jarvis (1980) and Gunn et al. (1985) in an effort to detect clusters at redshifts $z \geq 0.4 - 0.5$. This is the extreme limit of Abell's effort which was essentially imposed by limitations of the Schmidt telescope.

These fundamental surveys and studies have been undertaken with the aim of understanding the distribution of galaxies as fundamental aggregates of matter in the universe. Current findings suggest that galaxies and clusters of galaxies are parts of very large structures. In addition, regions devoid of galaxies have been detected (Chincarini and Rood (1976); Gregory and Thompson (1978); Tarenghi et al. (1979); Kirshner et al. 1983)) as well as large irregular structures. Using this material, Peebles (1980) has developed the powerful statistical methods of the autocorrelation function directed at understanding the distribution of matter in the universe at large and its implications, as well as opening the possibility of discriminating between various cosmological models.

The observed distribution of galaxies appears at this time to be very clumpy. These agglomerations define very large structures (Chincarini (1984)) of which no boundary has been found. These very irregular forms have density peaks which coincide with the observed clusters of galaxies, and such structures seem to be connected to each other and never seem to be isolated. This model was spawned on the basis of early observational evidence gathered by Chincarini and Rood (1978), motivated by the theories of Zel'dovich and colleagues (1978) and Einasto et al. (1978), in which it would appear unlikely to detect an isolated cluster of galaxies. Indeed, if positive density fluctuations form, as we see with clusters of galaxies, one can also expect negative density fluctuations where the density of galaxies is very low. And these regions have been observed. For instance, a particularly large void has been detected by Kishner et al. (1981, 1983) in the direction of the constellation Bootes. The perhaps unexpected result of the observations (Chincarini, (1984)) is that *no* galaxy has been seen in such voids. What is less clear, as pointed out by Peebles (1983), is whether these voids have some physical significance or are a natural by-product of a hierarchical clustering of galaxies.

It is now seen that the distribution of galaxies in space is characterized in various surveys by clustering on a large scale, observed as superclusters or chains, and by voids, regions of space where galaxies have not been detected (Oort, (1983); Vettolani et al. (1984)). There is general agreement on the fact that a *uniform background* of galaxies upon which clusters and groups of galaxies are superposed as conceived by the pioneering efforts of Hubble and Zwicky does not exist.

CHAPTER II

DATA ACQUISITION AND PREPARATION

The explorations of space end
on a note of uncertainty...
we measure shadows...
we search among the ghostly
errors of measurement...
– Edwin Hubble, 1935

The most recent collection of positions of clusters of galaxies is the data gleaned by Abell and Corwin (unpublished). This important body of information will be incorporated into a new Southern Galaxy Cluster Survey (Abell et al. (1986)) and will be consistent throughout with the Northern Survey of Abell (1957). It is from this preliminary data that we have acquired the cooordinates of the positions of 50 clusters of galaxies found in the Southern Hemisphere. These were chosen for their proximity ($z < 0.1$) and their richness, with the intent to measure the clusters in a consistent fashion and produce a homogeneous sample.

We are interested in the extent of the clusters on the sky; the accurate positions and orientations of the cluster members; the morphological types of the galaxies in the clusters and their total mix and the brightness of each of the cluster galaxies measured consistently to some limiting magnitude. The result of this effort is a homogeneous catalogue of data for 50 clusters of galaxies in the Southern Hemisphere. We have also chosen to measure 5 Abell clusters of galaxies located in the Equatorial Region to serve as a basis of comparison and provide a link of compatability with earlier work.

In the following sections we address the acquisition of the data and the preparation of the catalogue. We begin with the digitization of the position of galaxies in a selected cluster. Once accurate positions have been measured, estimates are made of position angle and individual morphological type as well as magnitude. The positions as measured conform to the standard astrometric conventions of East preceding, West following; and position angles adhere to the convention of angles being measured from the North, positive Eastwards. Similarly, magnitudes are measured as visual magnitudes, m_v, by virtue of a step-scale calibrated against photoelectric magnitudes of Virgo Cluster and Indus Supercluster galaxies as well as $M87$ globular clusters. The morphological classification is based on the coding of revised morphological types by de Vaucouleurs and de Vaucouleurs (1964), but due to the small size of the images of cluster galaxies on the photographic plates, only a general classification of E, SO, SA, SB, or P are given. Relevant comments complete the entry, the comments being a coded visual appearance of the observed galaxies. With the completion of the measurements of a given cluster, the positional data recovered from the plates are transformed to celestial coordinates to assist in later observations of the cluster members.

From the final form of the catalogued data we obtain several important cluster parameters that are useful in comparing cluster information from other sources. Of the many schemes that we will describe, we select the ***Abell type*** and ***Abell richness*** classifications as well as the ***Bautz-Morgan Classification*** as most compatible with and representative of earlier work.

2.1 Measuring the Clusters

The data are contained on photographic film negative copies of the ESO/SERC Southern Sky Atlas. The 606 J plates were taken on the UK 1.2m Schmidt Telescope on Siding Spring Mountain, near Coonabarabran in New South Wales, Australia. The basic optical parameters of the telescope are very similar to the Palomar 48-inch Schmidt: aperture 1.24m, focal length 3.07m, giving a plate scale of 67.2 arcsec/mm, f-ratio of $f/2.5$, and a full field of $6.4° \times 6.4°$, with an unvingnetted field of 5.4° diameter. The J refers to the Eastman-Kodak type IIIaJ emulsion used for the atlas survey; the plates were hypersensitised before exposure by a combination of nitrogen and hydrogen gas soaking techniques. All exposures were done through a 2mm-thick Schott (Jena) GG395 glass filter. The effective bandpass is thus from about 3950Å to 5400Å

Measurements of the positions of galaxies on the ESO/SERC J Plates were made using a Houston Instrument Series 7000 precision microprocessor-based Digitizer for converting plate positions into Cartesian ($X - Y$) digital data, which then inputs the data to a VAX 11/780 host computer for analysis. The digitizer employs a translucent active digitizing surface (including a 30mm wide perimeter set aside as a Menu area) which allows backlighting and provides uniform high resolution and accuracy over the entire Specification Area (see **Figure 2.1.1**).

The resolution setting was fixed at 0.025 mm (0.001") with a maximum digitization rate of one $X - Y$ coordinate point per second. A serial single coordinate record format was chosen for the data in which the X and Y magnitudes are represented by seven characters in millimeter scale, plus a sign character, field delimiters and a tag character. The digitizer was set to automatically average eight consecutive strobe-scans per reading with the resultant Coordinate output to the host computer. This averaging yields coordinate values deviating none or only ±0.025

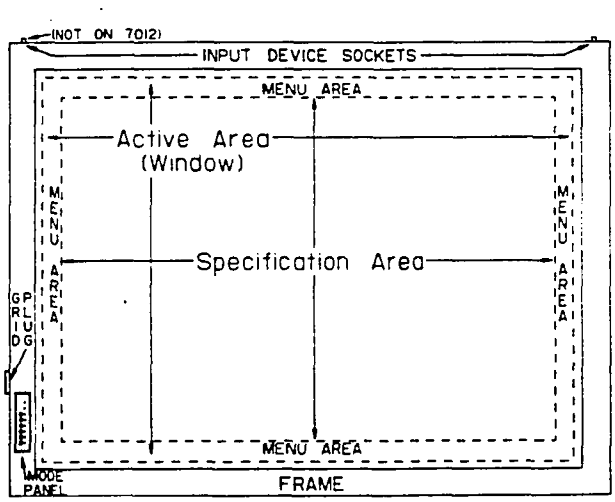


Figure 2.1.1 *Schematic of X-Y Digitizer*

mm of each other if the data cursor is maintained in the same position. The input device is a 12 button cursor with crosshairs modified to include a 7X eyepiece and a second set of crosshairs to eliminate parallax during measurement.

During the measurement operation, a plate was secured to the digitizing surface within the Specification Area and the coordinates of the fiducial marks on the plate were digitized. These points were used to determine digitizer offsets, the skew correction angle, and finally the metric plate center as found by the intersection of the $N-S$, $E-W$ fiducial marks. All measures were subsequently referred to this point with the convention chosen such that North and East are taken positive, that is, with the x-axis reversed in the Cartesian sense. Position angles follow a similar convention with angles being measured positive East of North, with the North point (as measured from the intersection of the $N-S$ fiducial marks) as the origin.

The actual measurement of a galaxy position consisted of laying the cursor over the geometric center of the image, digitizing the point, and optionally measuring the major and minor axes of the image under program control. The errors found in determining the geometric center of the image have been estimated by repeatedly measuring the same point on differing occasions and combining the results to assess our ability to recover a given object from a given field. We find that the measurements are repeatable in this fashion to $\sigma_{x,y} = 0.286$ mm or approximately 19.4 arcseconds for the worst case on the ESO/SERC fields. This virtually excludes misidentifications of galaxies in the field, in particular if morphological information is available.

For extended objects, the procedure was generally to measure along the assumed major and minor axes of the object until the image faded into the background density. A word of caution, however, is that although the major axis measurements are repeatable to within $\sigma = 0.06$ mm, the minor axis measurement fluctuates as a result of the inability to bisect the major axis readily. Similarly, the construction of position angles is such that the poles of the major axis are projected to intersect the line connecting the $N - S$ fiducial marks with $\sigma = 6.08$ degrees. In general, major and minor axes and position angles were not measured for objects whose diameter was less than 0.1 mm or did not display an obvious ellipticity.

The preliminary cluster center was taken from Corwin's (1985) unpublished data and each cluster was located on finding charts prepared both by the author and the RGO. The cluster counting area was determined by using the criteria set down by Abell (1956) the radius being a function of m_{10}. The counts themselves were done in the defined circle which was divided into eight segments and masked so that only a sector at a time was available for measurement. The circle is shown in **Figure 2.1.2**. This was done to facilitate and standardize the measurement process.

During measurement, the cursor was positioned over the central portion of the image, the coördinates of the center of the galaxy image digitized, the major

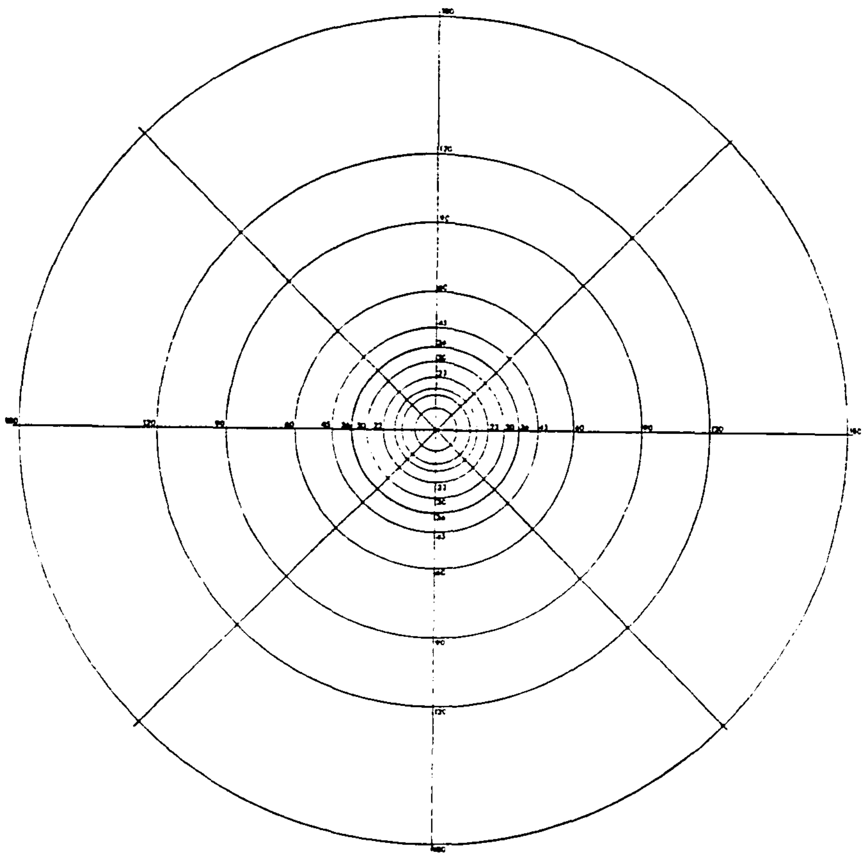


Figure 2.1.2 *Circle counting mask divided into Abell-radii and sectors.*

and minor axes digitized when desired. A step scale estimate was made using a 10X loup and entered as input data, an estimate of morphological type made and entered, and finally, any remarks concerning the object entered. An on-line reduction program then converted these inputs from digitizer units to distances and angles measured from the geometric plate center under the above conventions. Similarly, the step-scale estimate was converted to a magnitude measure by virtue of an interpolation routine using the step scale calibration curve described later. All of this data provides the raw material for later reduction and construction of the cluster catalogue.

2.2 The Step-Scale Calibrations

At the moment the writer and Dr. H. Corwin are curently engaged in extending the rich galaxy cluster survey (Abell, 1957) to the south celestial pole using the ESO/SERC IIIa-J plates. As in the 1957 work, the magnitude of the cluster members is estimated with a step-scale of galaxy images. A typical set of step-scales for various morphological types of galaxies is shown in **Figure 2.2.1**.

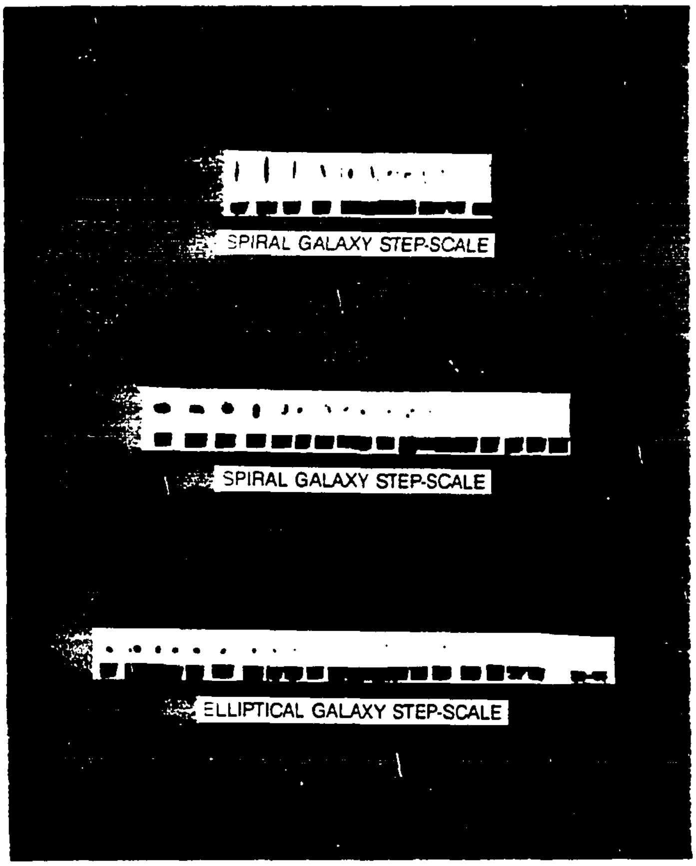


Figure 2.2.1 *Typical Step-Scales for Magnitude Determination*

Step-scales of this type are produced by locating photoelectrically or otherwise calibrated galaxy images on a film copy of a galaxy cluster field. The galaxy images are then excised from the film and mounted in a sequential array of increasing magnitude. This template is then compared to images on program plates and the magnitudes estimated by direct comparison.

The step scale used in this work is entirely composed of elliptical galaxy images. A calibration curve for this step scale was generated by estimating step readings to one tenth of a step for galaxies in the central thirty-six square degrees of the Virgo Cluster as seen on UK Schmidt plate J2137. Many galaxies to $m_J \sim 14.0$ in this field have well determined total magnitudes listed by de Vaucouleurs and Head (1978). These are in the system of RC2, but with the addition of data from other sources and with a small systematic error depending on inclination removed (see de Vaucouleurs and Corwin, 1977 and de Vaucouleurs et al., 1977).

In the poorly observed range $14.0 \leq m_J \leq 17.0$, a large portion of the photoelectric calibrating data come from Corwin (1980). The data for the 19 Indus area galaxies plus one galaxy in A2670 act as secondary standards in this range.

The calibration at fainter levels rests on photoelectric observations of three galaxies in the galaxy cluster A1553 by Sandage (1972), and on photoelectrically calibrated photographic photometry of galaxies, stars and globular clusters around M87 by Hanes (1975, 1977). Hanes' work verifies earlier photographic photometry of objects around M87 by Racine(1968) and Ables et al. (1974).

The mean errors in the calibrating data at all magnitude levels are better than $\sigma_{B,V} \sim \pm 0.15$. However, systematic errors in estimating step-scale readings depend on surface brightness. Low surface brightness galaxies are generally estimated too faint because "integration" by eye of the light in the object's image is difficult (this is the primary reason for surface brightness errors in the survey photometry of Shapley and Ames 1932 and in the CGCG. See Holmberg (1958), de Vaulcouleurs

(1957), de Vaucouleurs and Pence (1979), and Corwin (1979) for details.) Similarly, compact high surface brightness objects have their magnitudes underestimated because their light is concentrated in overexposed star-like "dots" and the eye has only the diameter of these objects to use as a clue to luminosity.

In both cases – high and low surface brightness – the luminosity profile of the unknown object generally does not match that of the elliptical galaxies on the step scale. At faint levels, the effects cannot yet be quantified with any certainty because of a lack of precise photometry for comparison. However, preliminary indications of order-of-magnitude reliability come from the studies of Pickup (1979) and Hawkins (1981). These seem to indicate that systematic errors are indeed present, but that they do not exceed ±0.5 magnitudes. Another indication of systematic error is related to magnitude determinations of different morphological types, but for the moment the reliability of the step scale is taken as being able to provide total magnitudes of about ±0.5 magnitude accuracy.

The step scale calibration curve is shown in **Figure 2.2.2**.

Prime calibrators are photoelectrically (*step* < 12) or photographically (*step* > 12) observed galaxies in the Virgo Cluster area; secondary calibrators are photoelectrically observed galaxies in the Indus area; in addition there is a photoelectrically observed galaxy in A2670, and photographically observed globular clusters and stars around M87. The step scale has been calibrated using both originals and film copies of the ESO/SERC *J* plates. We then calibrate our measurements against those made by Abell and Corwin by remeasuring those same galaxies, recording the appropriate step-scale readings and comparing the two. The results are in quite good agreement and once more suggest the ±0.5 magnitude accuracy. An independent source of comparison comes from our measurements of m_1,m_3 and m_{10} which do not deviate by more than a few tenths of calculated magnitudes from estimates

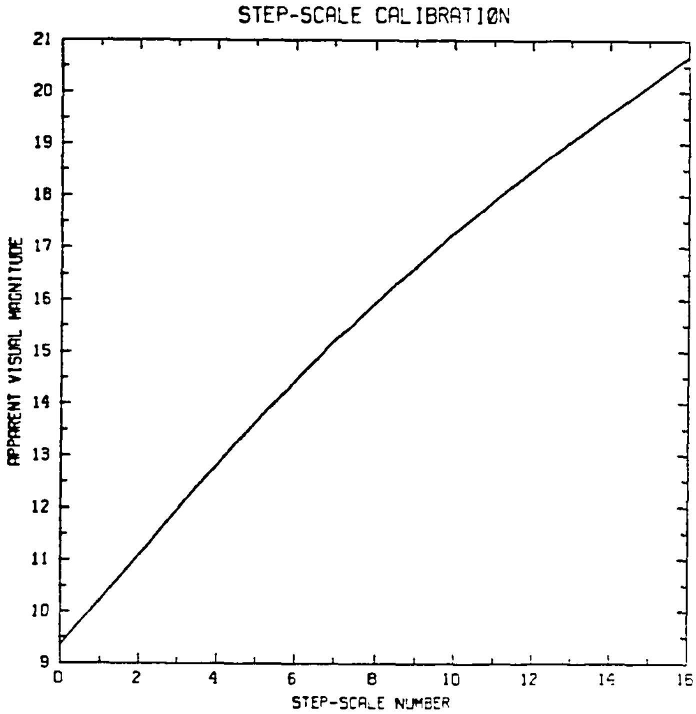


Figure 2.2.2 *Step-scale Calibration Curve*

made by Corwin.

It had been suspected (Corwin, 1985) that because of differences in background density between originals ($D \sim 1.0$) and copies ($D \sim 0.35$) of the ESO/SERC J plates there would be a small zero point difference in the sense that magnitudes will be estimated brighter on the copies, but no such difference was found in the actual numbers. On the J plates the calibration is made using visual magnitudes, on the assumption that all galaxies have the same color index, that is, the step scale is calibrated for zero velocity E galaxies of intrinsic color $B - V \sim 0.9$. This means that *K-reddening* between J and V plates introduces a scale error in magnitude. The counts of galaxies in a particular cluster are unaffected since one can define a counting interval, say $m_v(3) + 2$, and all galaxies in a given cluster having the same z will have the same *K-correction*. However, background counts will be affected.

2.3 Coordinate Transformation of Measurements

Once a given plate has been measured, the resulting rectangular plate coordinates must be transformed to the celestial sphere in order to provide positions of objects for telescopic observations. These positions form an important subgroup of data in the cluster catalogue and constitute the main spacial representation of the projected surface density of clusters of galaxies.

Since the earliest days of astronomy stellar positions have been determined by measuring absolute right ascensions and declinations. This fundamental approach to spherical astrometry has been extended to fainter stars and galaxies by measuring their positions on photograpic plates with respect to a set of standard stars such as those found in the Smithsonian Astrophysical Observatory Star Catalog which gives the positions and proper motions of a large number of stars for the epoch and equinox of 1950.0. Measurements on wide-angle photographs such as the ESO/SERC J plates yield plane coordinates, which are then reduced to spherical (equatorial) coordinates in accordance with the *SAO* positions. The procedure requires our ability to project a portion of the celestial sphere onto a plane and relate the resulting ideal standard coordinates to the measured standard coordinates. The underlying projective geometry assumes that the telescope is equivalent to a pinhole camera for which the gnomic projection is appropriate. The ideal standard coordinates ξ, η comprise a rectangular coordinate system on the photographic plate which is assumed to be planar. For Schmidt plate astrometry this assumption breaks down and one must introduce the effects of plate curvature in the analysis, but over small enough regions it is thought that the gnomic projection is adequate (Eichorn, 1985). The measured standard coordinates x, y are approximations to the ideal coordinates. Our first task is to relate the ideal standard coordinates to the corresponding equatorial coordinates.

We are primarily concerned with the portrayal of a portion of the celestial sphere on an image plane registered by a photographic plate, so we consider the relationships between spherical coordinates and the corresponding coordinates on a plane tangent to the sphere. The plane tangential coordinate system is defined as lying in the plane tangent to the celestial sphere, the tangent point T being the origin of the coordinates, with right ascension α_0 and declination δ_0 as seen in **Figure 2.3.1**.

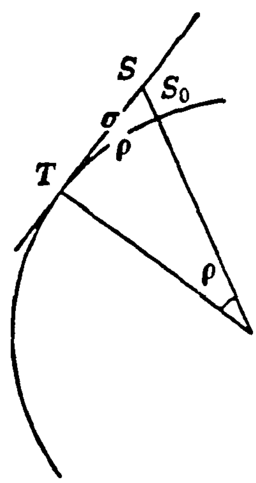


Figure 2.3.1. *Plane coordinates. Cross section of the celestial sphere and the tangential plane. T = tangential point; S = central projection of star S_0 onto the plane tangent to the celestial sphere.*

The $y-axis$ is tangent to the hour circle through T, and its positive direction is the direction in which the distance of T to the celestial pole is $< 180°$. The $x-axis$ is perpendicular to the $y-axis$, and is counted positive in the direction of increasing right ascension as shown in **Figure 2.3.2**.

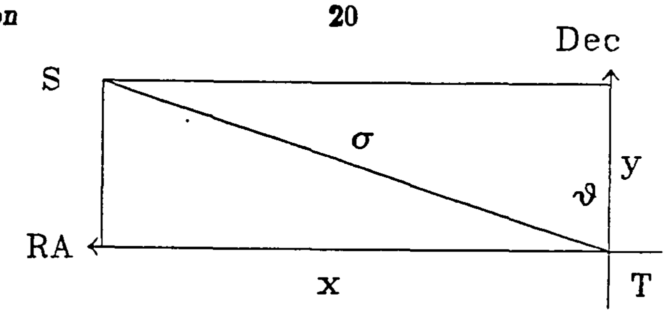


Figure 2.3.2. *Tangential or standard coordinate system, as seen from inside of the celestial sphere. As opposed to the usual Cartesian convention, the direction of increasing RA (i.e., -x) is considered positive.*

A point S_0 on the celestial sphere, or its image on a photographic plate, corresponds, therefore, to the plane rectangular coordinates X and Y of a point S, that point being the central projection of S_0 on the tangential plane or on its image, the photographic plate, which is assumed to be parallel to the tangential plane. The linear distance σ on the plate corresponding to the spherical distance ρ from a star or galaxy to the tangent point is given by

$$\sigma = \tan \rho. \tag{2.3.1}$$

It follows that the rectangular components are related to the equatorial coordinates by

$$x = \tan \rho \sin \theta, \tag{2.3.2}$$

$$y = \tan \rho \cos \theta \tag{2.3.3}$$

where θ is the position angle of the segment ρ (or σ).

In our case, a maximum of 25 SAO stars were identified in a field 2×2 degrees and their locations digitized. Positions of these standard stars in X and Y Cartesian coordinates were calculated with reference to the published nominal plate center and the measured geometric center correcting these positions by allowing for proper motion to the epoch of the plate. Then the X and Y positions as measured by the digitizer were fitted to these positions by least squares and the resulting Right

Ascensions and Declinations of these same stars calculated from the fit. While the above procedure can give some estimate of the errors of measurement it should also be emphasized that the images of the *SAO* stars are so large, some 400 to 600 microns in diameter, and often show considerable diffraction "spikes" and "rings" and sometimes even a blaze, that the determination of the coordinates of the center of the image is very much less accurate than that for the smaller star images in the 100 micron range.

The positions of the *SAO* standard stars were then transformed into a plate-centered ***zenith-azimuth*** system, ρ and θ :

$$\cos\rho = \cos\delta_0 \cos\delta_* \cos(\alpha_* - \alpha_0) + \sin\delta_0 \sin\delta_* \qquad (2.3.4)$$

$$\sin\theta = \frac{\cos\delta_* \sin(\alpha_* - \alpha_0)}{\sin\rho} \qquad (2.3.5)$$

$$\cos\theta = \frac{\sin\delta_* - \sin\delta_0 \cos\rho}{\cos\delta_0 \sin\rho} \qquad (2.3.6)$$

where α_*,δ_*, and α_0, δ_0 are, respectively, the right ascension and declination of the star and the nominal plate center and ρ is expressed in degrees and decimal fractions of a degree.

We next scale and translate the corresponding measured plate coordinates of the *SAO* stars by

$$X = F(x_m - x_0), \quad Y = F(y_m - y_0). \qquad (2.3.7)$$

Here F is the plate scale – 67.2 arcseconds per millimeter – expressed in degrees and x_m and y_m are the measured coordinates of the standard stars.

Now if:

a.) the plate centers (α_0,δ_0) and (x_0,y_0) coincided exactly;

b.) the plate ordinate as defined by the digitizer ran exactly North-South;

c.) the scale factor were exact;

d.) and the plate relaxed precisely along radial lines with no stretch as it was released from the telescope plate holder,

then, if $\xi = \tan\rho\sin\theta$ and $\eta = \tan\rho\cos\theta$ are the measured coordinates on the plate, $\xi = g(X,Y)$, and $\eta = h(X,Y)$ would be identically the same as X and Y.

However, this is not usually the case, so we fit by least squares:

$$\xi = g(X,Y) = A_0 + A_1X + A_2Y + A_3X^3 + A_4XY^2 \tag{2.3.8}$$

$$\eta = h(X,Y) = B_0 + B_1X + B_2Y + B_3XY^2 + B_4Y^3 \tag{2.3.9}$$

where A_0 and B_0 represent the *celestial:physical* plate center translation alignment, A_1 and B_2 primarily represent scale factor corrections, A_2 and B_1 primarily represent *ordinate:North-South* rotation alignment; and $A_3 - B_4$ represent corrections for elastic distortions introduced between the Schmidt plate holder and the relaxed planar plate. An estimate of the quality of the reduction can be seen in **Figure 2.3.3** which shows the dispersion of the standard stars used to determine the position of cluster members. Here we have plotted the $O-C$ residuals of the standard stars along the East-West absissa and the North-South ordinate. We note that $\sigma_x = 0.24$mm and $\sigma_y = 0.29$mm which gives rise to a distribution somewhat elongated along the North-South direction. We attribute this to internal bias in the digitizer.

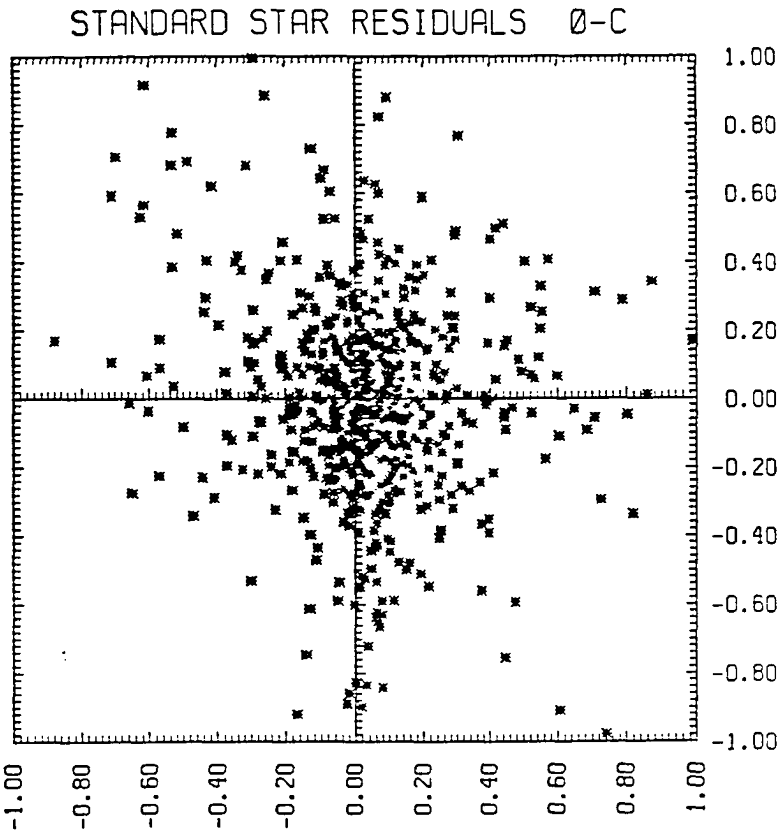


Figure 2.3.3 *O-C Diagram for Standard Star Reductions.*

The plate constants A_i and B_i, so determined, were used to obtain the coordinates of the galaxies from their measured positions and constitute the major positional information in the cluster catalogue. The transformation from standard to equatorial coordinates for the measured objects is straightforward.

We apply the sine, cosine and extended cosine rules to the spherical triangle GTP, formed by a galaxy's position G, the tangent point T, and the North Celestial Pole, P as in **Figure 2.3.4**. This gives us several important relationships between the measured and known positions on the plate.

Thus we have:

$$\cos\rho = \sin\delta_g \sin\delta_0 + \cos\delta_g \cos\delta_0 \cos\Delta\alpha \tag{2.3.10}$$

$$\sin\rho\sin\theta = \cos\delta_g \sin\Delta\alpha \tag{2.3.11}$$

$$\sin\rho\cos\theta = \sin\delta_g \cos\delta_0 - cos\delta_g \sin\delta_0 \cos\Delta\alpha \tag{2.3.12}$$

where

$$\Delta\alpha = \alpha_g - \alpha_0, \qquad \Delta\delta = \delta_g - \delta_0.$$

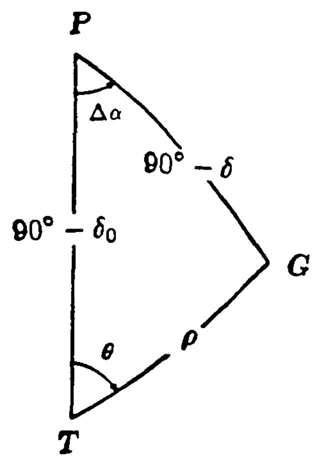


Figure 2.3.4. *Spherical Triangle GTP formed by the galaxy G, tangential point T, and North Pole P.*

The above equations are identical to (2.3.4), (2.3.5) and (2.3.6). Now, if we set the measured position of a galaxy to be

$$x_g = \tan\rho\sin\theta \tag{2.3.13}$$

$$y_g = \tan\rho\cos\theta \tag{2.3.14}$$

and divide (2.3.11) and (2.3.12) by (2.3.10), respectively, and substituting in (2.3.13) and (2.3.14) we obtain

$$x_g = \frac{\cos\delta \sin\Delta\alpha}{\sin\delta\sin\delta_0 + \cos\delta\cos\delta_0\cos\Delta\alpha} \tag{2.3.15}$$

and

$$y_g = \frac{\sin\delta\cos\delta_0 - \cos\delta\sin\delta_0\cos\Delta\alpha}{\sin\delta\sin\delta_0 + \cos\delta\cos\delta_0\cos\Delta\alpha}. \tag{2.3.16}$$

We can now express $\Delta\alpha$ and δ_g for a measured galaxy in terms of the measured positions x_g and y_g and the celestial coordinates of the nominal plate center $(\alpha_0,\ \delta_0)$. Equation (2.3.16) can be written

$$y_g(\sin\delta_g\sin\delta_0 + \cos\delta_g\cos\delta_0\cos\Delta\alpha) = \sin\delta_g\cos\delta_0 - \cos\delta_g\sin\delta_0\cos\Delta\alpha$$

or

$$\sin\delta_g(\cos\delta_0 - y_g\sin\delta_0) = \cos\delta_g(y_g\cos\delta_0 + \sin\delta_0)\cos\Delta\alpha,$$

from which we find

$$\tan\delta_g = \left[\frac{\sin\delta_0 + y_g\cos\delta_0}{\cos\delta_0 - y_g\sin\delta_0}\right]\cos\Delta\alpha. \tag{2.3.17}$$

The quantity $\Delta\alpha$ may be found by writing (2.3.15) as

$$\begin{aligned}\sin\Delta\alpha &= \frac{x_g}{\cos\delta_g}(\sin\delta_g\sin\delta_0 + \cos\delta_g\cos\delta_0\cos\Delta\alpha)\\ &= x_g(\tan\delta_g\sin\delta_0 + \cos\delta_0\cos\Delta\alpha).\end{aligned}$$

Since from (2.3.17) we have

$$\cos\Delta\alpha = \tan\delta_g\left[\frac{\cos\delta_0 - y_g\sin\delta_0}{\sin\delta_0 + y_g\cos\delta_0}\right] \tag{2.3.18}$$

we can write

$$\begin{aligned}\sin\Delta\alpha &= x_g\left[\tan\delta_g\sin\delta_0 + \tan\delta_g\cos\delta_0\frac{\cos\delta_0 - y_g\sin\delta_0}{\sin\delta_0 + y_g\cos\delta_0}\right]\\ &= x_g\tan\delta_g\left[\frac{\sin^2\delta_0 + y_g\sin\delta_0\cos\delta_0 + \cos^2\delta_0 - y_g\sin\delta_0\cos\delta_0}{\sin\delta_0 + y_g\cos\delta_0}\right]\end{aligned}$$

from which

$$\sin \Delta\alpha = \frac{x_g \tan \delta_g}{\sin \delta_0 + y_g \cos \delta_0}. \tag{2.3.19}$$

Also, by dividing (2.3.19) by (2.3.18), we finally obtain:

$$\tan \Delta\alpha = \frac{x_g}{\cos \delta_0 - y_g \sin \delta_0}. \tag{2.3.20}$$

The catalogued positions of both cluster centers and positions of galaxies are determined by applying the plate constants A_i and B_i to the measured galaxy positions and substituting the resulting quantities in equations (2.3.17) and (2.3.20). This yields the equatorial coordinates α_g and δ_g which are reduced to the epoch 1950. We assume the errors in position are similar to those of the standard star positions.

It is also of interest to transform the equatorial coordinates of the cluster centers to new galactic coordinates. This is useful to give estimates of galactic extinction which effects the determination of m_{10} and hence, the cluster redshift. The conversion formulae to galactic latitude, b, and galactic longitude, l, are given by:

$$b = \sin^{-1}\left\{\cos \delta_g \cos \delta_G \cos(\alpha_g - \alpha_G) + \sin \delta_g \sin \delta_G\right\}, \tag{2.3.21}$$

and

$$l = \tan^{-1}\left\{\frac{\sin \delta_g - \sin b \sin \delta_G}{\cos \delta_g \sin(\alpha_g - \alpha_G) \cos \delta_G}\right\} + l_G. \tag{2.3.22}$$

where the epoch 1950 coordinates of the North Galactic Pole are given by $\alpha_G = 192^\circ\ 15'$ and $\delta_G = +27^\circ\ 24'$ with the ascending node of the galactic plane on the equator as $l_G = 33^\circ$.

2.4 Determination of Cluster Centers

Once we obtain a set of coordinate values for the position of galaxies in a cluster, an important parameter to be derived is the center of the cluster. We have determined the center of each cluster by various means. Here we accept the fact that we are merely displaying our ignorance of just what constitutes a cluster and our inability to determine other than operationally the nature of such an ensemble of objects. Up to this point the term cluster has been used in an intuitive sense without attempting any formal definition, such as a group of contiguous elements in a statistical population.

A discription of what constitutes a cluster which probably agrees with our intuitive understanding of the term is given by considering our galaxies as points in Euclidean space. Clusters may now be described as continuous regions of this space containing a relatively high density of points, separated from other such regions by regions containing a relatively low density of points. Care must be taken, however, not to restrict the definition. For example, there is no *a priori* reason for believing that any clusters present in the data are of one particular shape and we must guard against imposing a particular structure on the data, rather than finding the actual structure present.

So to determine the center of a clusters depends on just what we think a cluster is. In the case of clusters of galaxies, the notion of cluster center at its simplest refers to the geometric centre of a bivariate distribution of points projected onto the plane; the notion can be further compounded by the realization that in actuality we are dealing with a multivariate population of objects of different morphological classes or sub-populations, effected by selection and possible mass segregations. For the sake of simplicity and homogeneity, we choose a geometric approach.

Initially, a center was constructed by considering the cluster members as merely points projected to a plane tangent to the celestial sphere and whose positions and coordinates were accurately known. Then the standard bivariate analysis of their positions performed to yield the geometric center of the population, and a bivariate ellipse within which a known fraction of the population resides.

The analysis proceeds as follows: we assume that the positions of galaxies in a cluster given by their measured coordinates $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$ are a random sample from a bivariate population. We can say that the two quantities, x and y are *jointly distributed* since, in general, x and y depend on each other. However, we also assume that different pairs (x_i, y_i) and (x_j, y_j) are independent of each other.

We concentrate on the data reduction by means of purely *descriptive* statistical tools. Whereas the mean, $\bar{x}$, and the standard deviation, σ, usually suffice to represent a univariate sample, our case demands five statistics, two means, two standard deviations, and a correlation coefficient. It is not only important to what extent the member galaxies are dispersed in a cluster, but also to see how their positional scatter is oriented on the plane tangent to the celestial sphere. These requirements can be satisfied graphically by the so-called *dispersion ellipse.*

After amassing the coordinates of the position of cluster members, we calculate the arithmetic means

$$\bar{x} = \frac{1}{n} \sum x_i \tag{2.4.1}$$

$$\bar{y} = \frac{1}{n} \sum y_i \tag{2.4.2}$$

and define the variances

$${\sigma_1}^2 = \frac{1}{n-1} \sum (x_i - \bar{x})^2 \tag{2.4.3}$$

$$\sigma_2{}^2 = \frac{1}{n-1}\sum(y_i - \bar{y})^2 \tag{2.4.4}$$

so that by taking the square root of these, we define the ***standard deviations***, σ_1 and σ_2, in the $x-$ and $y-$directions, respectively.

We also construct the familiar measures of the joint behavior of x and y, the ***covariance***

$$Cov(x,y) = \frac{1}{n-1}\sum(x_i - \bar{x})(y_i - \bar{y}) \tag{2.4.5}$$

and the ***correaltion coefficient***

$$r = corr\ x, y = \frac{Cov(x,y)}{\sigma_1\sigma_2} \tag{2.4.6}$$

provided that σ_1 and σ_2 do not vanish.

From these quantities we construct a ***dispersion ellipse*** such that

$$\frac{1}{1-r^2}\left[\frac{(x-\bar{x})^2}{\sigma_1{}^2} - 2r\frac{(x-\bar{x})(y-\bar{y})}{\sigma_1\sigma_2} + \frac{(y-\bar{y})^2}{\sigma_2^2}\right] = 1 \tag{2.4.7}$$

or writing this expression without fractions

$$\sigma_2(x-\bar{x})^2 - 2r\sigma_1\sigma_2(x-\bar{x})(y-\bar{y}) + \sigma_1{}^2(y-\bar{y})^2 = (1-r^2)\sigma_1{}^2\sigma_2{}^2$$

We can rewrite this equation in the quadratic form

$$A(x-\bar{x})^2 + 2B(x-\bar{x})(y-\bar{y}) + C(y-\bar{y})^2 = D \tag{2.4.8}$$

where the coefficients are given by

$$A = \sigma_2^2, \quad B = -r\sigma_1\sigma_2 = -Cov(x,y)$$

$$C = \sigma_1^2, \quad D = (1-r^2)\sigma_1^2\sigma_2^2.$$

Given the above quadratic form where we assume that $D > 0$ we let

$$H = AC - B^2.$$

Then the graph of our quadratic equation is an *ellipse* if, and only if, all three inequalities

$$A > 0, \quad C > 0, \quad H > 0$$

hold. The *midpoint* of the ellipse is then located at $\bar{x}$, $\bar{y}$.

Two special cases can be treated separately:

(1) $A = C, B = 0$. The ellipse is a *circle* with radius $r = (D/a)^{\frac{1}{2}}$.

(2) $A > C, B = 0$. The major axis is parallel to the Y axis. The semi-axes are $a = (D/C)^{\frac{1}{2}}$ and $b = (D/A)^{\frac{1}{2}}$.

Excluding these special cases, we calculate the following quantities for each cluster:

$$\begin{gathered} R = \left[(A-C)^2 + 4B^2\right]^{1/2} \\ a = \left(\frac{2D}{A+C-R}\right)^{1/2}, \quad b = \left(\frac{2D}{A+C+R}\right)^{1/2} \\ \theta = \arctan\frac{2B}{A-C-R}. \end{gathered} \tag{2.4.9}$$

Here, a and b are the semi-axes $(a > b)$, and θ is the angle by which the major axis is inclined with respect to the X axis with $(-90° < \theta < 90°)$.

For the plots of Cluster Membership and Morphology, we have used the parametric form of the ellipse to plot several important contour lines:

$$x = \bar{x} + a\cos\theta\cos\varphi - b\sin\theta\sin\varphi \tag{2.4.10}$$

$$y = \bar{y} + a \sin\theta \cos\varphi + b \cos\theta \sin\varphi \tag{2.4.11}$$

with φ a variable angle increasing from 0 to $\frac{\pi}{2}$.

It is of some interest to inquire what fraction of the cluster population determined by their positions x_i, y_i fall inside of the dispersion ellipse. We have designated these as the *core population*. Following Trumpler and Weaver (1953) we note that if μ_1 is the expectation and σ_1 the standard deviation of the random positional variable, X, then the probability density is given by:

$$f_1(x) = (2\pi)^{-1/2}\sigma_1^{-1} exp\left[-(x-\mu_1)^2/2{\sigma_1}^2\right]. \tag{2.4.12}$$

Correspondingly, if μ_2 is the expectation and σ_2 the standard deviation of the random positional variable Y, the probability density is

$$f_2(y) = (2\pi)^{-1/2}\sigma_2^{-1} exp\left[-(y-\mu_2)^2/2{\sigma_2}^2\right]. \tag{2.4.13}$$

If we assume that x and y are *independent* of each other we can multiply $f_1(x)$ and $f_2(y)$ in order to obtain the probability of the *joint distribution*:

$$f(x,y) = f_1(x) \bullet f_2(y) = (2\pi\sigma_1\sigma_2)^{-1} exp\left[-\frac{1}{2}g(x,y)\right]. \tag{2.4.14}$$

Here, the auxiliary function $g(x,y)$ is

$$g(x,y) = \frac{(x-\mu_1)^2}{\sigma_1^2} + \frac{(y-\mu_2)^2}{\sigma_2^2}. \tag{2.4.15}$$

To study the density function $f(x,y)$ we consider the *contour lines* or *isolines* with equations

$$f(x,y) = constant.$$

Since the variables x and y only occur in $g(x,y)$, it suffices to study the lines $g(x,y) = c$ or

$$\frac{(x-\mu_1)^2}{{\sigma_1}^2} + \frac{(y-\mu_2)^2}{{\sigma_2}^2} = c. \tag{2.4.16}$$

where each isoline is associated with a particular constant c.

A comparison of equation (2.4.16) with

$$\frac{(x-\mu_1)^2}{a^2}+\frac{(y-\mu_2)^2}{b^2}=1. \tag{2.4.17}$$

reveals that the isoline represents an *ellipse* with its center at the point (μ_1, μ_2) and with semi-axes

$$a=c^{\frac{1}{2}}\sigma_1, b=c^{\frac{1}{2}}\sigma_2.$$

In general,

$$a:b=\sigma_1:\sigma_2$$

Hence, given σ_1 and σ_2, the isolines are *similar* in the geometric sense. $f(x,y)$ reaches its highest value at the central point (μ_1, μ_2) where $c=0$ and $f(x,y)=(2\pi\sigma_1\sigma_2)^{-1}$. An example is shown in **Figure 2.4.1.** Here, as in the plots of Cluster Membership and Morphology, c takes on the values 0,1,2 . The parameter c indicates the size of the ellipse; and all those galaxies inside the dispersion ellipse that comprise the *core population* have $c \leq 1$.

Now the area of an ellipse defined by the above parameters is $\pi\sigma_1\sigma_2c^2$. The element of area dA corresponding to the change of c from $c-d\frac{c}{2}$ to $c+d\frac{c}{2}$ is $2\pi\sigma_1\sigma_2cdc$ the frequency along such an infinitesimal ring is constant and equals

$$\frac{1}{2\pi\sigma_1\sigma_2}e^{-c^2/2}.$$

The fraction of the population $d\nu$ contained within the ring is thus $ce^{-\frac{c^2}{2}}dc$ and the fraction ν of the galaxy population contained within the dispersion ellipse is therefore

$$\nu=\int_0^1 ce^{-\frac{c^2}{2}}dc=e^{-t}\Big|_{\frac{1}{2}}^{0}=1-e^{-\frac{1}{2}}=0.39347. \tag{2.4.18}$$

The dispersion ellipse thus encloses some 39 percent of the total galaxy population and can be used to estimate cluster density and richness.

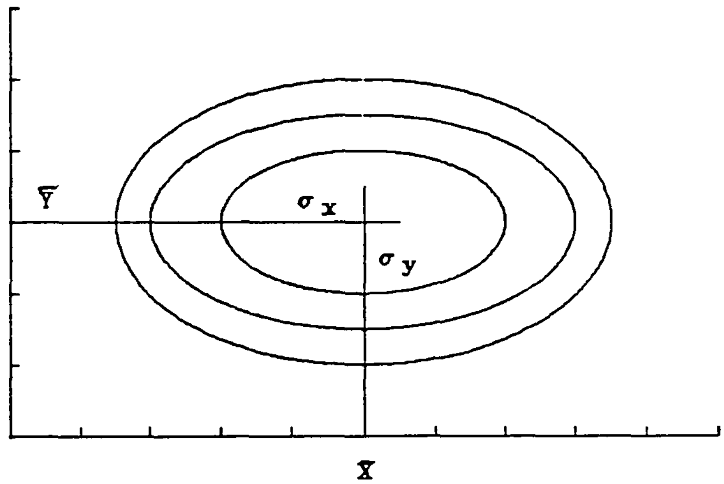


Figure 2.4.1 *Isolines representing a* bivariate normal distribution *of independent random variables. The shaded ellipse is the* dispersion ellipse *with standard deviations, σ_1 and σ_2, as semi-axes.*

To serve a a check on the center determined by bivariate methods, the galaxy positions were also analysed using the traditional strip counting method. Here we have determined the center of each cluster by performing galaxy strip counts as a function of distance for mutually orthogonal directions on the plate as is shown in **Figure 2.4.2**. The orientation was chosen to coincide with the axes on the ESO/SERC plates determined by the intersection of lines drawn by connecting opposite fiducial marks on the plate edges. The initial width of the strips was chosen to be one arcminute on the plate, but this was varied somewhat from cluster to cluster depending mainly on distance (that is, from the apparent size of the cluster as determined by m_{10}) and the projected density. The range of the strip width was from about 0.5' for $z < 0.1$ to about 5.0' for $z \sim 0.02$. The length of the strips was determined individually for each cluster and was found by constructing that rectangle whose extent completely enclosed the counting circle. Recall that the counting diameter corresponds to that determined by Abell (1958).

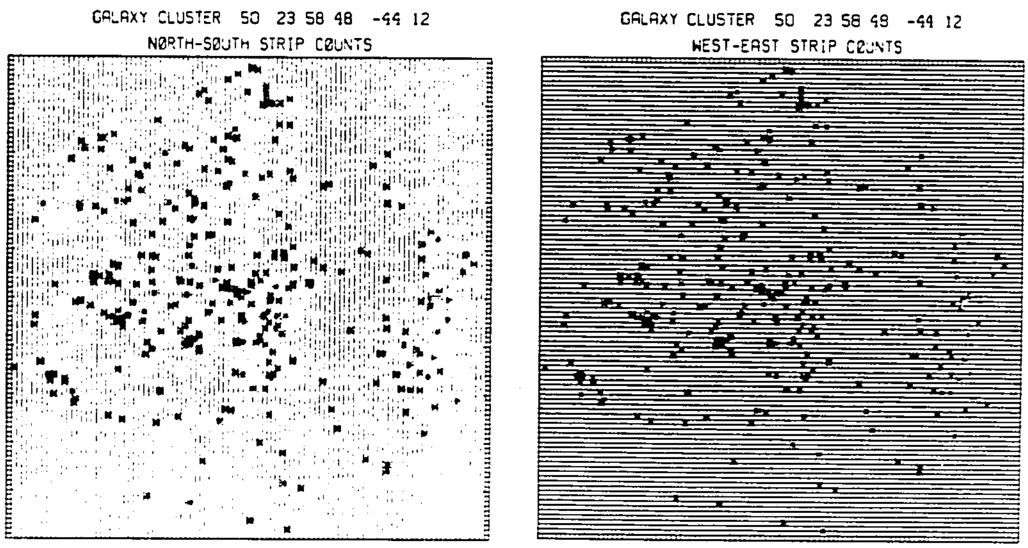


Figure 2.4.2 *N-S and E-W Strip Counts for Galaxy Clusters.*

All galaxies were counted down to a limiting magnitude of 19.0 even though some clusters had fainter members. The strip densities were then plotted as histograms as a function of distance in the different directions and a normal probability curve drawn for the each distibution. The center of the cluster was determined for each direction from the high density peak in the histogram and the corresponding peak in the normal distribution. In the more irregular clusters, or those with density concentrations, the most highly concentrated and symmetrical peak served to locate the center of the cluster. The positions of the center determined in this way was then converted to the 1950 epoch coordinates relative to the astrometric standard SAO stars and plate constants calculated for each cluster region.

2.5 The Classification of Galaxy Clusters

Having measured the cluster members within an *Abell radius* we attempt to discover a basis for comparisons from cluster to cluster. Over the years numerous classification schemes for clusters of galaxies have been designed and continue to be developed based on the morphological, physical and optical properties of the cluster members. As Hubble (1936) remarked: *"In a certain sense each cluster may be characterized by a most frequent type, although the dispersion around that type is considerable."*

To categorize clusters in his catalogue, Abell (1957) sorted his rich clusters in groups of increasing population. He defines the *richness*, R, of a cluster as the number of galaxies intermediate in brightness between the third brightest galaxy in the cluster and two magnitudes fainter counted within a projected radius r from the apparent cluster center. This distance, known as the *Abell radius*, is an operationally defined boundary scaled inversely as the mean cluster recession velocity and therefor subtends an approximately constant metric length at the distance of the cluster. For the Palomar Sky Survey plates with a scale of $67''.2\ mm^{-1}$ we have $r = 4.6 \times 10^5 / cd\lambda/\lambda$ mm and in terms of the galaxies counted within r, the richness subdivisions are shown in **Table 2.5.1**

ABELL RICHNESS GRØUP INTERVALS					
RICHNESS GRØUP	CØUNTS	RICHNESS GRØUP	CØUNTS	RICHNESS GRØUP	CØUNTS
0......	30-49	2......	80-129	4......	200-299
1......	50-79	3......	130-199	5......	300

Table 2.5.1 *Abell Richness subdivisions for galaxy clusters.*

Abell's richness estimates are still widely used to complement other cluster descriptions which do not incorporate such a *population* parameter.

Zwicky et al. (1961-1968) provide the other main source of data on clustering and use the criterion of classifiying galaxy clusters according to the distribution of their bright members. The classification scheme proceeds as follows:

Compact clusters show a single outstanding concentration among the bright member galaxies. Within this concentration, ten or more galaxies appear in actual contact. Many of these clusters display a high degree of spherical symmetry.

Medium-Compact clusters are characterized by either a single concentration where, however, the ten brightest galaxies are not in contact but are separated by several of their own diameters, or by several distinct condensations, some of which may be quite compact.

Open clusters contain no very obvious condensations, but in various locations, the number of galaxies per square degree is at least five times as great as in the surrounding field, so that the cluster appears to be as a cloud superposed on the background.

Hubble's early ideas were enhanced by de Vaucouleurs (1961) who recognized three distinct classes of galaxy clusters, each divided by size and form: clusters of spiral and irregular galaxies, comprised of small, low-density groups and large elliptical clouds of diameter $2-3$ Mpc; clusters of mainly elliptical and lenticular galaxies, either small and dense or large and globular; and clouds of mixed types, including large elliptical clouds or cloud complexes like the multiple Hercules cluster, and vast supersystems, the latter exemplified by the Local Supercluster.

After examining the 20 nearest clusters in Abell's (1957) catalogue, Morgan (1961, 1962) suggested that the Coma and Virgo (and Ursa Major) clusters could be considered as prototypes for a cluster morphology that paralleled that of open star clusters in the Galaxy. In *Virgo-type* clusters, appreciable numbers of galaxies of low central light concentration (in effect, spirals and irregulars) appear $1/2^m$ to 1^m fainter than the brightest members, whereas *Coma-type* clusters are populated in the range of the brightest two magnitudes exclusively by galaxies of high light concentration. Incidental mention was afforded *Ursa Major-type* clouds which represent ill-defined physical groups of exceedingly low volume density.

The de Vaucouleures and Morgan systems, based as they are on the morphology of the brighter galaxies of a cluster, suffer from the disadvantage that only the nearby clusters of galaxies can be so classified. However on a first order approach, there are marked correlations between these systems and the system of Zwicky. Their main features are preserved in the two-part classification scheme of Abell (1965, 1966):

Regular clusters show strong central concentration and tend to be spherically symetric. All are rich, containing $\geq 10^3$ galaxies in the range of the brightest seven magnitudes, the first $3^m - 4^m$ of which are populated entirely or almost entirely by E and SO galaxies. One or two giant elliptical galaxies are often centrally located, and there is no strong evidence of subclustering. Most of Zwicky's compact clusters and Morgan's sl Coma-type clusters are regular; examples are the Coma cluster (*Abell 1656*) and the Corona Borealis cluster (*Abell 2065*).

Irregular clusters exhibit little or no spherical symmetry and no marked central condensation; often multiple nuclei exist indicating some substructuring. Cluster populations vary widely and galaxies of all types are normally present, although poor groups may not contain giant elliptical galaxies. To this classification belong

Morgan's *Virgo-type* clusters and Zwicky's *Medium compact* and *Open* clusters. Examples are the Local and M81 groups, the Virgo cluster, and *Abell 2151*, the Hercules cluster.

The particular advantage of Abell's classification is that it can be applied to clusters over a great range of distances.

A five-part classification scheme depending on the relative optical contrast of the brightest galaxy in a cluster to other cluster members was devised by Bautz and Morgan (1970). To the initial list of types for 76 rich clusters were added the classification for a further 111 by Bautz (1972). Their scheme is shown in **Table 2.5.2**.

BAUTZ-MØRGAN CLASSIFICATIØN SYSTEM	
TYPE I	THE CLUSTER IS DØMINATED BY A SINGLE, CENTRALLY LØCATED, CD GALAXY.
TYPE II	THE BRIGHTEST MEMBERS ARE INTERMEDIATE IN APPEARANCE BETWEEN CD GALAXIES (WHICH HAVE EXTENDED ENVELØPES) AND NØRMAL GIANT ELLIPTICALS.
TYPE III	THE CLUSTER CØNTAINS NØ DØMINANT GALAXIES
	AND TWØ INTERMEDIATE TYPES, TYPE I-II AND TYPE II-III.

Table 2.5.2 *The Bautz-Morgan Classification.*

There are three main difficulties encountered with the practical use of Bautz and Morgan's *brightest galaxy* morphology (van den Bergh, 1977). Initially, the classification scheme is extremely vulnerable— to contamination by foreground field galaxies; for example, missassigning cluster membership to a forground galaxy can change a cluster's classification from III to I. Conversely, a dominant cD galaxy in a distant cluster might be regarded as a member of a sparse clustering of brighter foreground objects. Secondly, the *K-dimming* effect will reduce the surface brightness of the faint outer envelopes of distance cD galaxies and hence systematically reduce the contrast between the cD and normal giant elliptical galaxies in the cluster. Finally, clusters in which three or more bright galaxies obviously dominate the remaining members do not fit naturally into the Bautz-Morgan classification system.

Rood and Sastry (1971) introduced a scheme strongly reminiscent of Hubble's early *single-galaxy* classification system which is based on the distribution of the ten brightest cluster members:

cD*(super giant)*: These clusters contain an outstandingly bright member, a cD galaxy. As an operational definition, the size of the cD galaxy (i.e. semimajor axis plus semiminor axis) is ≥ 3 times that of any other member. If the main body is multiple or shows any peculiarity, a subscript p is added to the type designation. Prototypical examples include *Abell 0401 (cD)* and *Abell 2199 (cDp)*.

B*(binary)*: Here, two supergiant galaxies are separated by ≤ 10 diameters of the larger galaxy, with combined size ≥ 3 times that of any other cluster member. A subscript b indicates a connecting bridge between the subergiant binary or the components of one or both of its members. Examples include *Abell 1656 (b)* and *Abell 0154 (Bb)*.

L*(line)*: In this case, ≥ 3 brightest galaxies among the top ten members are arreanged with comparable separations in a line, with numerous fainter members distibuted around them. A typical example includes *Abell 0426 (L)*.

C*(core-halo)*: Here, ≥ 4 of the ten brightest members are located near the center of the cluster with comparable separations as well as being surrounded by fainter galaxies. An example is *Abell 2065 (C)*.

F*(flat)*: In this case, several of the ten brightest members and a large fraction of the fainter galaxies are distributed in a flattened configuration, for example, as in *Abell 0397 (F)*.

I(*irregular*): In this last description, the galaxies in the cluster are distributed irregularly and the center is not well-defined. Examples include *Abell 0400 (I)* and *Abell 2151 (L)*.

The classification system can be represented by a tuning fork diagram as shown in **Table 2.5.3**.

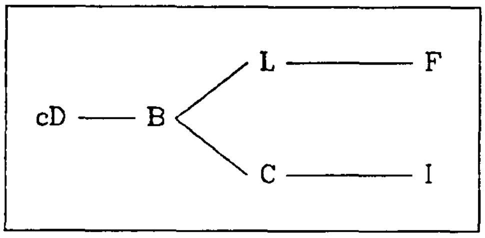


Table 2.5.3 *The Rood-Sastry Cluster Classification Scheme.*

Here the size and luminosity of the first-ranked galaxy declines systematically from left to right while, Rood and Sastry suggest, the angular momentum per unit mass simultaneously increases.

After photometrically studying some 15 rich clusters of varying populations, Oemler (1974) has suggested a further classification scheme with three categories of clusters:

cD clusters are dominated by central supergiant galaxies. They are deficient in spirals (which are completely absent in their cores) and contain the greatest proportion of ellipticals of the three cluster types, with *(E:SO:Sp)* ratios of about (3 : 4 : 2). Physically, they are dense, centrally concentrated, and apparently spherical. They also exhibit segregation by mass and morphological type of galaxy, although the observational evidence for the former is marginal. Examples are *Abell 1656*, *Abell 2199* and *Abell 2670*.

Spiral-poor clusters are intermediate in type and are dominated by *SO* galaxies, with *(E:SO:Sp)* ratios of about (1 : 2 : 1). These, too according to Oemler, are segregated clusters, but they are less regular, compact, and centrally condensed than the **cD** clusters. Examples include *Abell 0400* and *Abell 1314*.

Spiral-rich clusters are irregular in appearance, possess a low mean density and have no tendency toward central condensation. Their composition is fairly homogeneous, without perceptible segregation by morphological type, and they show no evidence of dynamical relaxation or mass segregation. Spiral galaxies predominate and the *(E:SO:Sp)* ratios are typically (1 : 2 : 3). Examples include *Abell 1367*, *Abell 2151* and *Abell 2197*.

Oemler finds his system to relate most closely to that of Morgan, although the dividing lines between the types do not precisely coincide.

The most recent proposals regarding classification have been advanced by Melnick and Sargent (1977). From a study of six X-ray clusters they suggest subdivision according to the relative radial distributions of different morphological types of member galaxies in each cluster:

Spiral or **Sp** clusters have a flat integral distribution of ellipticals but steep cumulative distributions of spirals and lenticulars; the *SO's* dominate in the cluster cores and the spirals in the outer regions, so that the integral radial frequency distributions cross. Examples are the Hydra I (*Abell 1060*) and Virgo clusters.

SO clusters have less flat E distributions, although the cumulative radial SO and Sp profiles are again steep. Here, however, the lenticulars dominate the galaxy populations throughout the clusters, and the integral distributions of SO and Sp galaxies do not cross. To this class belong the clusters *Abell 0376* and *Abell 0576.*

Abell 0426 (the Perseus cluster) appears to be unique in Melnick and Sargent's sample. Here it is the few spirals which exhibit a flat integral distribution, whereas the SO's and the E's show steep parallel distributions at all radii. The number of ellipticals remains larger than the number of SO's throughout the cluster.

Comparison with the system of Oemler suggests similarities between *SO* and *Sp* clusters described above and Oemler's ***spiral-rich*** and ***spiral-poor*** clusters. Moreover the distribution for the Perseus cluster resembles that of Oemler's *cD* clusters, with almost no spiral galaxies and with a somewhat larger number of ellipticals.

An important and desirable attribute for any cluster clasification system is that it should be applicable to aggregates at large distances, as is Abell's simple two-part scheme. Ultimately, however, the usefullness of any system must depend on how well it elucidates the nature of clusters by correlating their many varying traits.

For our purposes, however, we shall conform to the *Abell Two-Part Classification* and the *Bautz-Morgan Classification* schemes. We do this primarily to be consistent with the Abell catalogue of galaxy clusters made for the Northern Hemisphere, and the forthcoming catalogue of galaxy clusters of the Southern Hemisphere.

CHAPTER III

THE CLUSTER CATALOGUE

But by measure and number and weight,
Thou didst order all things.
– Solomon

A catalogue of the positions of the galaxy clusters is given in **Table 3.1.1**. The initial tabular data consists of a galaxy cluster identification number. Next the rectangular coordinates of the cluster center as determined by the dispersion ellipse analysis and measured from the geometric center of the plate; we note the use of the standard astrometric conventions with x directed positively in the Eastward direction, contrary to the Cartesian sense. The next two entries are the celestial and new-galactic coordinates of the cluster center for the epoch 1950. These coordinates are determined by applying the ***plate constants*** derived from the least-squares fitting of the standard SAO stars to the cluster center rectangular position. Appropriate transformations (see **Section 2.3**) convert the rectangular coordinates to Right Ascension and Declination and these to new-galactic longitude and latitude. Finally, an estimate of the cluster distance derived from m_{10} is given to complete the table.

The measured positions of cluster members, magnitude estimates, and position angle measurements are collected in the following descriptive sections. In **Section 3.1** we present the cluster catalogue. The catalogue is in tabular form and gives the locations of the cluster centers for the epoch 1950 as well as their locations on the ESO/SERC J plates. In addition, an estimate of redshift by virtue of m_{10} is given as a distance indicator.

In **Section 3.2** we give in both graphical form and narrative the following information:

1. *Cluster Field.* We present an enlargement of the field of every galaxy cluster taken from film copies of the ESO/SERC survey plates. The print scale is typically 10 arcsec/mm and shows the galaxy cluster and its environs.

2. *Cluster Membership and Morphology.* Here, the measured positions of the cluster members are plotted as they occur on the ESO/SERC Fields alligned with the standard convention of orientation. The plotting grid is based on locations determined from the plate center derived from extending and intersecting the four fiducial marks found on the plate edges. Following this convention, East is located in the Cartesian $-x$ direction. The grids have been prepared in uniform size so as to facilitate intercluster comparisons. The member galaxies have been plotted with various symbols to indicate their morphological type as specified by the legend on the plot.

3. *Surface Density Distribution.* In this plot, the cluster surface density is plotted as increasingly dense tones and isopleths corresponding to the number of galaxies counted per unit area. The extent of the plots is determined by the actual extreme positions of the member galaxies and so the scale of the plot will vary from cluster to cluster. The central portions of the cluster are emphasized in this case

and thus the plot gives an intuitive, albeit qualitative, impression of the projected surface density of the cluster.

4. *Cluster Magnitude Distribution.* Here, the estimated magnitudes of the cluster members has been plotted as a histogram in bins corresponding to a change in magnitude of 0.5 as determined by step-scale readings which were converted to visual magnitudes by the appropriate transformations. The data has been smoothed and a "smoothed version" of the data is plotted as a curve over the binned data. This information extends to the limiting magnitude $m_v = 19.0$ uniformly for all clusters and is useful in determining the Luminosity Function of the cluster.

5. *Position Angle Distribution.* As an attempt was made to measure the physical extent of galaxies that were larger than 10 microns, a body of data was acquired for each cluster that included an estimate of the major and minor axes of the appropriate galaxy images as well as their position angles. We use the standard convention for the sense of orientation with angles measured in degrees positive Eastward of North. The data is then tabulated in ten degree bins and plotted in histogram form with a smoothed curve of the same data over the histogram. We also present a sector plot which shows by means of a radial vector whose magnitude is directly proportional to the number of galaxies in a given ten degree sector, the position angle distribution of the cluster members.

6. *Cluster Membership by Morphological Type.* In similar fashion to the initial figure, we plot a to-scale version of the cluster members but sorted by morphological type. The original dispersion ellipse is maintained to assist comparative studies by virtue of location while the cluster members have been separated into elliptical, SO and spiral galaxies and plotted. The center of the cluster is marked and refers to the center of the dispersion ellipse as determined by bivariate methods described elsewhere.

7. *Cluster Data Table.* The data table consolidates the general body of information about the cluster. We indicate the cluster number designated by increasing Right Ascension as well as the position of the cluster center as determined by the dispersion analysis in coordinates of Right Ascension and Declination of epoch 1950. These coordinates are derived from least-squares fitting to the set of standard SAO stars used in the measuring analysis. For each cluster we give the appropriate ESO/SERC Plate and Field number to assist in locating the given cluster. In addition, the table lists the x and y coordinates of the cluster center in the usual convention as measured from the derived plate center, the epoch 1950 ecliptic and new galactic coordinates, and the cluster redshift as determined by the visual magnitude of the tenth brightest cluster member. Several subtables show the cluster morphology separated and counted to give the number of Elliptical, SO, normal and barred Spiral and Peculiar galaxies; parameters of the calculated dispersion ellipse to include major and minor axes measures in millimeters on the plate and position angle, this time referred to the E-W absissa, with angles measured West to North as positive in the Cartesian convention; and finally some population statistics to include the number of galaxies in the sample, the core population, or the number of galaxies found in the primary dispersion ellipse, and the limiting magnitude of the sample.

8. *Cluster Discription.* Here, we note individual discriptions of the galaxy clusters. General features of the cluster and its environs are noted along with estimates of cluster Richness and Type. Special attention is paid to unique properties of the cluster, peculiarities discovered and items of special interest.

3.1 Catalogue of Southern Galaxy Clusters

In this section we present a uniform catalogue of the clusters of galaxies in our sample. For each of the clusters, we present the position of the cluster center as determined by the dispersion ellipse analysis. In this case we give the Cartesian coordinates of the cluster center as found on the ESO/SERC J plates, measured from the plate center found by orthogonal extension of the plate fiducial marks; the Right Ascension and Declination for the epoch 1950 found by the plate transformation equations developed in **Section 2.3**; and the galactic latitude and longitude of the cluster center for the epoch 1950. In addition, we give a value of the cluster redshift as determined by m_{10}. Finally, we present the ESO/SERC J plate location of the clusters for quick identification of observation fields.

CATALØGUE ØF BRIGHT SØUTHERN GALAXY CLUSTERS									
N	X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z	FIELD	PLATE
01	005.543	-070.735	00 00 45.6	-36 19 39.4	348 51 23.1	-76 26 01.2	0.042	349	J6145
02	035.621	-003.767	00 03 13.9	-35 04 01.6	352 02 54.5	-77 35 08.1	0.072	349	J6145
03	071.702	-039.543	00 06 49.1	-35 43 49.9	347 29 52.6	-77 45 43.8	0.057	349	J6145
04	051.069	-119.610	00 07 28.7	-57 14 52.8	313 59 38.0	-59 15 32.8	0.044	149	J6501
05	-107.031	024.617	00 18 08.3	-49 32 34.3	315 55 27.3	-67 04 38.6	0.050	194	J1861
06	-015.272	094.597	00 22 49.7	-33 17 33.7	345 09 53.8	-81 50 34.0	0.038	350	J4601
07	-005.774	-082.259	01 29 33.8	-51 32 55.7	288 10 19.5	-64 40 13.3	0.040	196	J5467
08	-043.427	-127.677	01 39 50.0	-42 23 49.0	271 41 23.9	-71 46 58.0	0.050	297	J3593
09	087.306	109.669	02 55 44.0	-52 56 09.1	269 10 28.4	-55 20 33.5	0.049	154	J4716
10	-103.679	-070.538	03 44 04.7	-41 21 11.8	245 59 33.1	-51 44 56.9	0.050	302	J3580
11	101.219	054.375	04 04 04.0	-39 00 28.8	241 56 20.8	-48 06 22.5	0.042	302	J3580
12	-115.824	-001.271	05 24 00.3	-45 01 46.1	250 45 41.6	-33 34 17.9	0.061	253	J6748
13	-083.921	004.016	06 21 39.4	-64 56 34.9	274 42 10.3	-27 29 35.5	0.038	087	J8249
14	-088.653	070.926	06 25 02.5	-53 39 26.8	262 21 36.2	-25 11 15.9	0.049	161	J5538
15	-076.713	032.793	06 26 25.1	-54 22 29.4	263 10 56.4	-25 08 49.3	0.048	161	J5538
16	146.553	065.348	12 51 41.2	-28 44 33.4	303 42 32.9	33 51 13.3	0.048	442	J5760
17	-095.233	-121.728	13 03 25.3	-37 17 59.6	306 10 10.3	25 12 41.6	0.049	382	J1530
18	005.223	069.735	14 00 40.6	-33 44 13.9	319 37 09.5	26 32 41.9	0.020	384	J4851
19	102.148	117.241	14 09 17.9	-32 50 02.6	321 51 15.5	26 48 60.0	0.044	384	J4851
20	102.819	053.059	14 09 28.3	-34 01 38.5	321 26 22.7	25 40 56.0	0.038	384	J4851
21	-043.965	-081.811	14 30 26.3	-31 32 40.5	327 01 28.9	26 17 33.7	0.054	447	J1472
22	003.581	080.348	19 56 35.4	-38 32 47.9	002 03 26.0	-29 14 54.4	0.026	339	J2378
23	-105.191	-022.456	20 38 34.4	-35 23 58.1	007 43 35.8	-36 50 15.1	0.065	401	J6109
24	-095.831	-115.415	20 48 40.7	-52 08 45.6	346 31 00.9	-39 25 40.1	0.037	235	J3329
25	-131.705	018.574	21 13 10.0	-59 36 24.2	336 02 49.4	-41 23 39.8	0.042	145	J1759

Table 3.1.1 *(a.) Catalogue of Southern Galaxy Clusters*

N	X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z	FIELD	PLATE
26	-144.719	-001.784	21 22 58.0	-35 00 38.8	009 47 57.8	-45 46 32.8	0.052	403	J5290
27	-033.381	-057.179	21 26 09.6	-51 04 18.4	346 46 32.5	-45 20 16.5	0.048	236	J2391
28	-075.807	-019.961	21 29 13.5	-35 22 50.6	009 24 15.7	-47 04 43.0	0.044	403	J5290
29	-008.471	-118.667	21 31 14.2	-62 15 40.3	331 40 36.2	-42 31 56.4	0.048	145	J1759
30	028.755	064.519	21 31 05.9	-53 50 08.2	342 41 57.2	-45 23 37.9	0.050	188	J1592
31	039.266	123.490	21 32 18.2	-52 44 02.1	344 08 48.2	-45 51 52.5	0.044	188	J1592
32	096.553	-093.917	21 41 46.5	-51 43 57.4	344 58 17.5	-47 32 00.7	0.043	236	J2391
33	074.215	134.600	21 42 50.8	-57 29 48.5	336 58 51.8	-45 44 51.4	0.042	145	J1759
34	-119.835	051.560	21 43 46.1	-44 06 15.9	356 06 55.3	-49 31 23.7	0.048	288	J4594
35	-107.000	-061.752	21 44 40.6	-46 13 32.3	352 51 36.7	-49 19 04.4	0.043	288	J4594
36	127.534	102.014	21 50 32.0	-58 03 48.4	335 38 09.9	-46 27 19.6	0.050	145	J1759
37	-098.536	-032.630	21 55 17.4	-60 35 13.4	331 59 31.8	-45 51 03.0	0.048	146	J6201
38	-080.549	-010.760	21 58 08.7	-60 11 45.0	332 14 19.1	-46 20 56.5	0.065	146	J6201
39	-063.530	090.895	22 01 11.1	-58 18 36.8	334 23 10.0	-47 35 52.6	0.043	146	J6201
40	008.125	-014.404	22 01 6.9	-50 18 11.9	345 35 47.8	-50 52 6.4	0.042	237	J3658
41	-101.125	-022.117	22 19 59.2	-50 23 8.1	343 35 50.1	-53 37 12.6	0.040	190	J5332
42	-087.461	-088.514	22 21 25.9	-56 38 22.8	334 28 44.6	-50 47 22.1	0.043	190	J5332
43	-079.768	-059.436	22 22 36.0	-56 05 57.1	335 3 58.2	-51 12 57.0	0.043	190	J5332
44	-143.511	-045.125	22 24 46.3	-30 51 42.7	017 55 41.2	-58 26 58.1	0.038	468	J6435
45	-075.547	-126.152	23 16 35.3	-42 22 36.6	348 24 55.0	-65 59 02.5	0.030	347	J2413
46	038.794	021.784	23 27 57.5	-39 37 6.8	351 47 36.1	-69 14 01.1	0.049	347	J2413
47	038.221	025.705	23 34 24.3	-69 34 43.5	312 19 10.5	-46 27 04.8	0.057	077	J3664
48	-086.526	-026.689	23 38 44.8	-30 30 4.2	017 24 7.9	-74 20 20.9	0.044	471	J6138
49	-015.479	085.995	23 44 55.4	-28 24 42.6	025 10 13.4	-75 49 04.7	0.023	471	J6138
50	104.794	047.058	23 59 05.8	-44 06 46.5	330 42 13.2	-70 30 40.1	0.038	292	J4504

Table 3.1.1 *(b.) Catalogue of Southern Galaxy Clusters*

3.2 Descriptions of Southern Galaxy Clusters

In this section we present a uniform description of the clusters of galaxies in our sample. Rather than publish the data in numerical form, we choose a graphical and tabular format for ease of comparison between cluster and cluster. Although nearly 21,000 individual galaxies have been measured the final sample is magnitude-limited and uniform to $m_v = 19.0$.

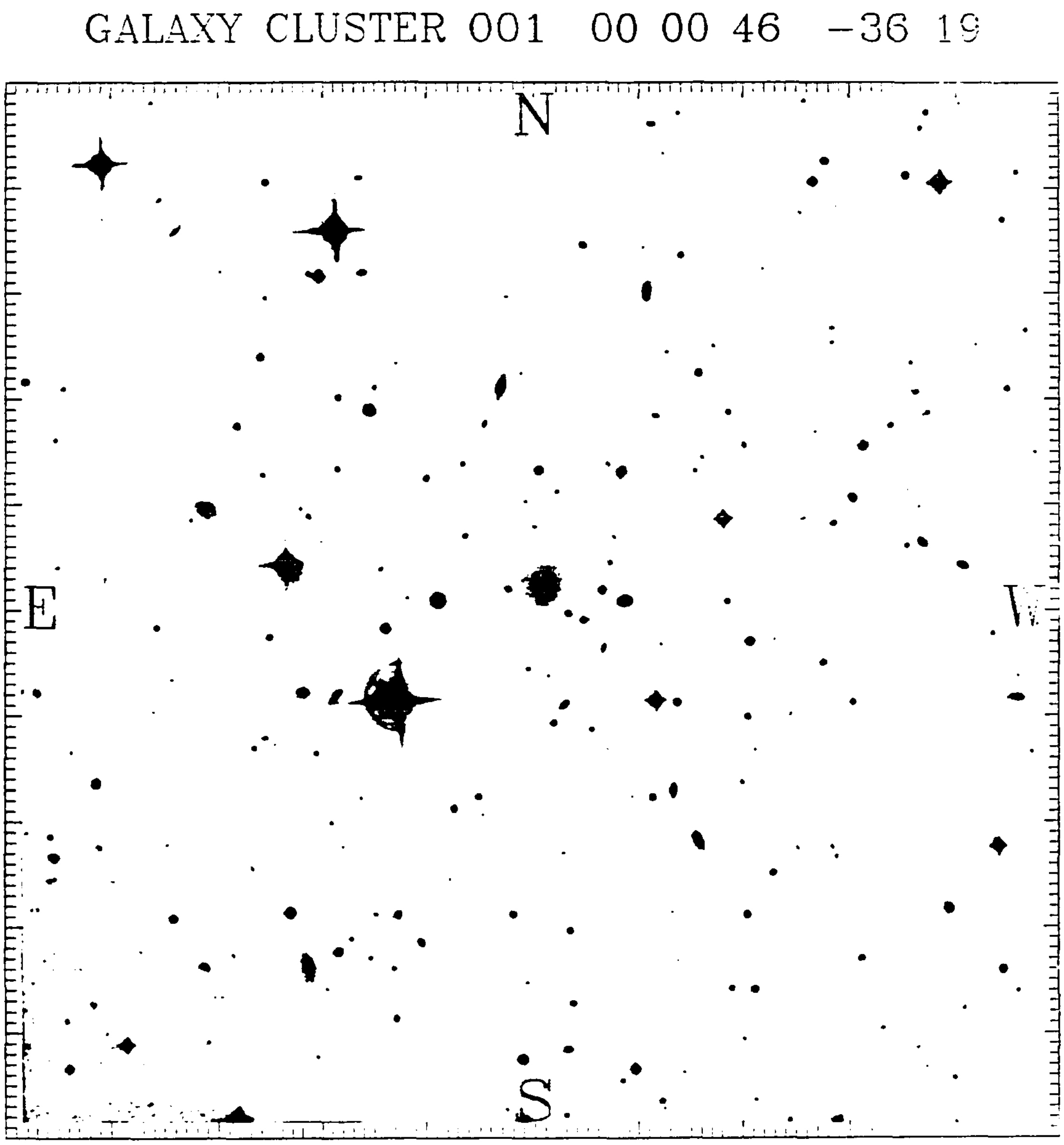


Figure 3.2.01 *(a) Field of GALAXY CLUSTER 001: 00 00 46 -36 19*

GALAXY CLUSTER 001 00 00 46 −36 19

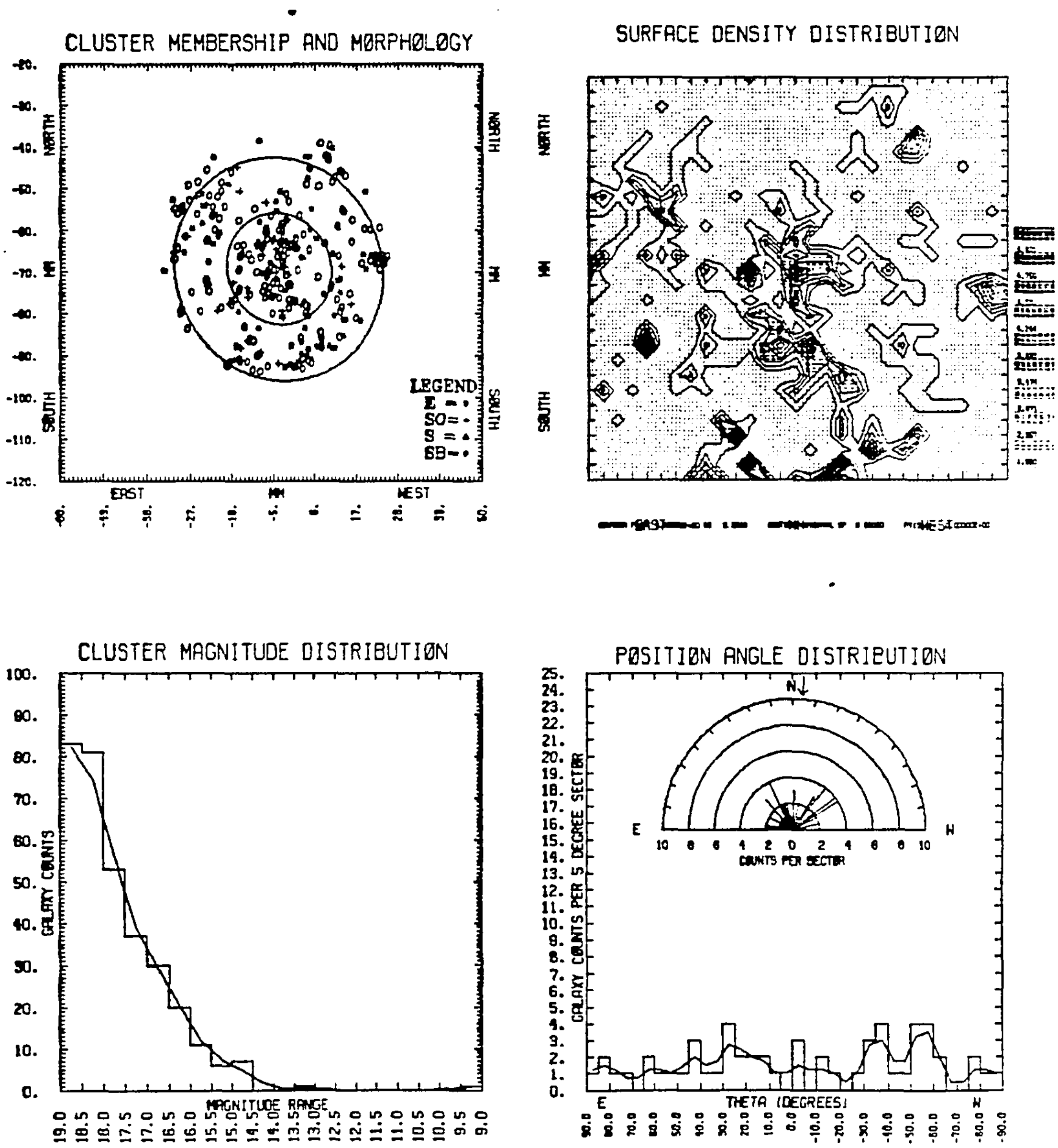
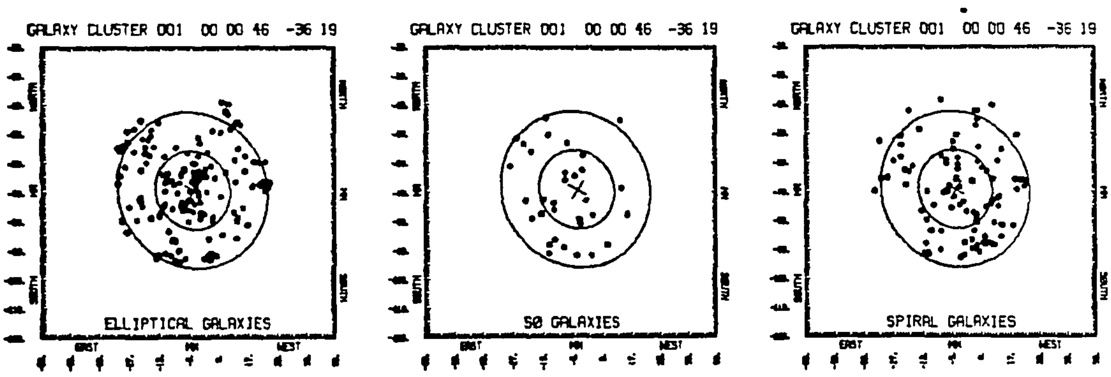


Figure 3.2.01 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 001 00 00 46 −36 19

FIELD 349 — ESO/SERC PLATE J6145

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
005.543	-070.735	0 0 45.6	-36 19 39.4	348 51 23.1	-76 26 1.2	0.042

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	180	MAJOR AXIS	14.15	SAMPLE POPULATION	330
S0	33	MINOR AXIS	13.10	CORE POPULATION	119
S	99	ECCENTRICITY	0.38	LIMITING MAGNITUDE	19.0
SB	13	POSN. ANGLE	-30.20		
P	5				

Figure 3.2.01 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.01 *Cluster Population Description.*

GALAXY CLUSTER 001: 00 00 46 -36 19 : The cluster is located in the South-East quadrant of ESO/SERC Field 349. Within a diameter of 60mm as determined by m_{10} we count 863 galaxies in this cluster and 330 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified as Abell type R but displays a somewhat elongated $N - S$ concentration of galaxies within the primary dispersion ellipse.

We count over 50 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 1. The brightest galaxy in the cluster has a corona and is highly centrally condensed suggesting a $B-M$ type I-II classification for the cluster. For m_1, m_3, and m_{10} we give 13.5, 14.6 and 15.1, respectively. The value of m_{10} implies a redshift of 0.042.

We have counted the galaxies in this cluster to a limiting magnitude of $m_{\rm lim} =$ 19.0 and see a smooth distribution of magnitudes from the brightest to faintest galaxies. The measured position angles of the appear to show no preferred orientation and we find the population mix of elliptical and spiral galaxies to be about evenly scattered throughout the cluster. The number of elliptical galaxies, however, is about a factor of two higher than that of the spirals with an apparently poor number of SO galaxies. There seem to be several concentrations of elliptical galaxies: one, in particular, lies to the West near the periphery of the cluster; another concentration is seen near the center of the cluster, to the North. There appears to be a slight enhancement of spirals in the South-West quadrant of the cluster and a relative paucity in the South-East.

The dispersion ellipse measures 14.15 mm for the major axis and 13.10 mm for the minor axis on the plate. We calculate an eccentricity of 0.38 for the dispersion ellipse which is oriented -30.0 degrees South of West. The core population of the cluster is 119, or some 36% of the galaxies counted and is contained in an area of some 0.2 square degrees. This yields a surface density of 583 galaxies per square degree.

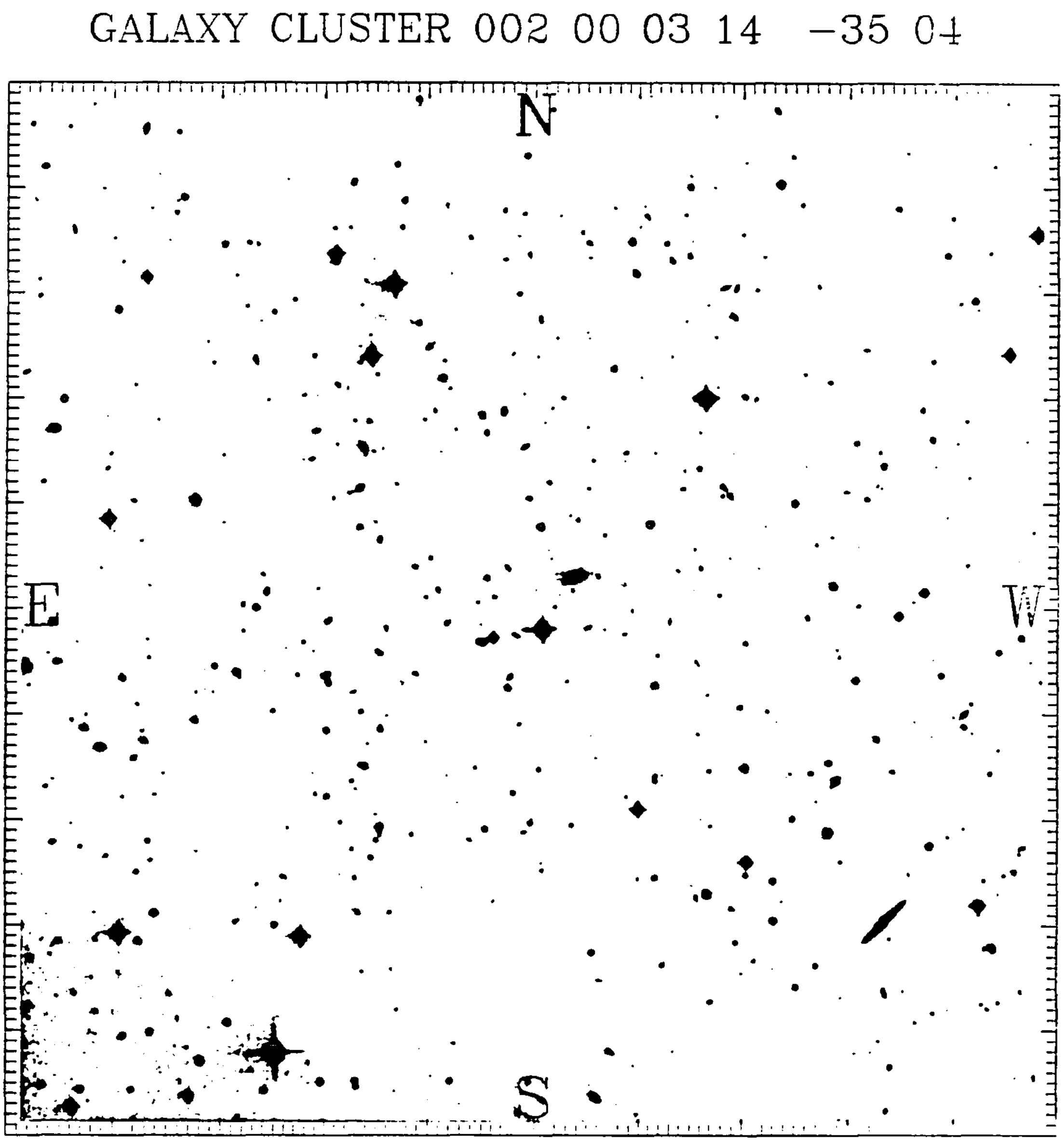


Figure 3.2.02 *(a) Field of GALAXY CLUSTER 002: 00 03 14 -35 04*

GALAXY CLUSTER 002 00 03 14 −35 04

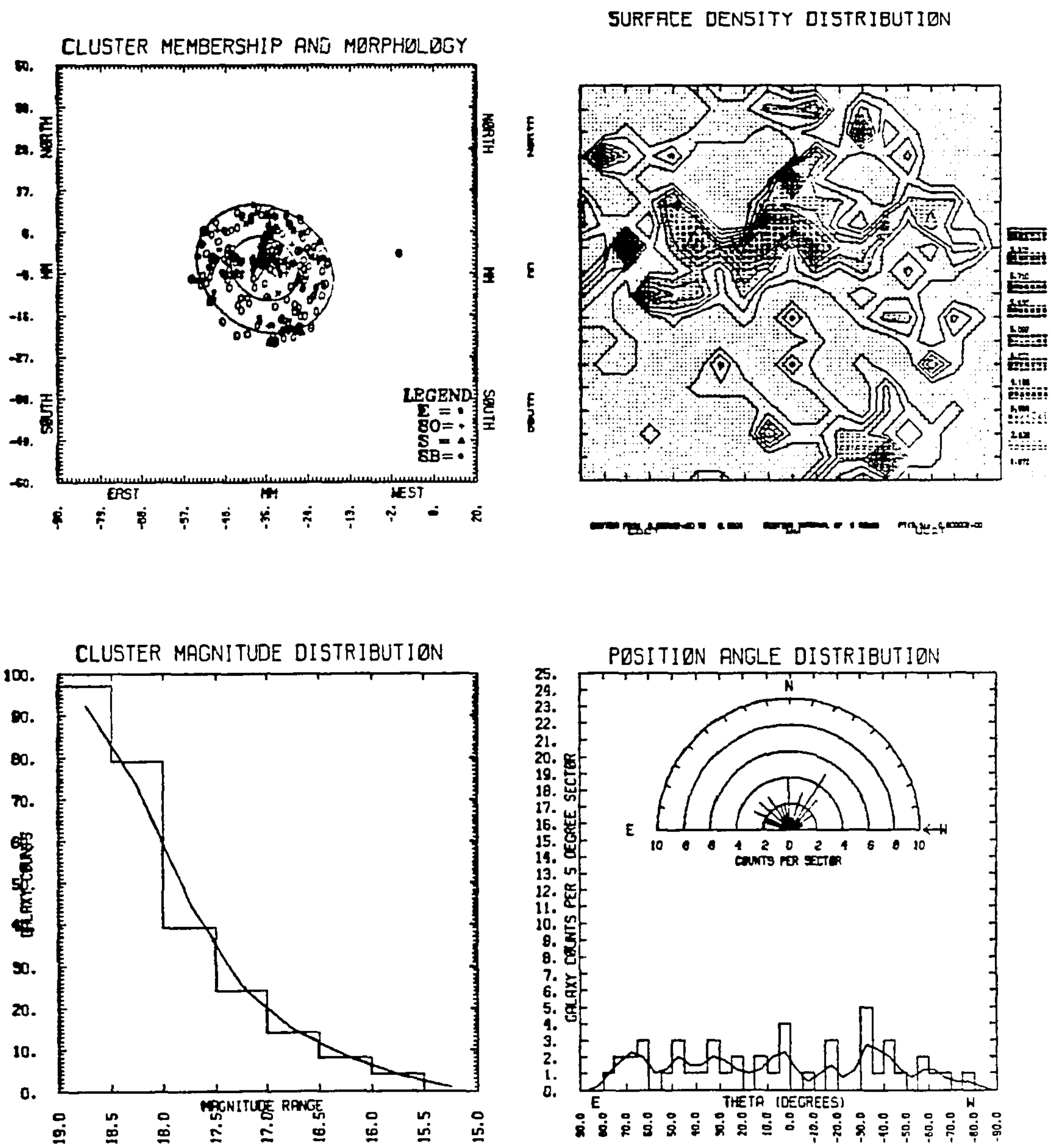
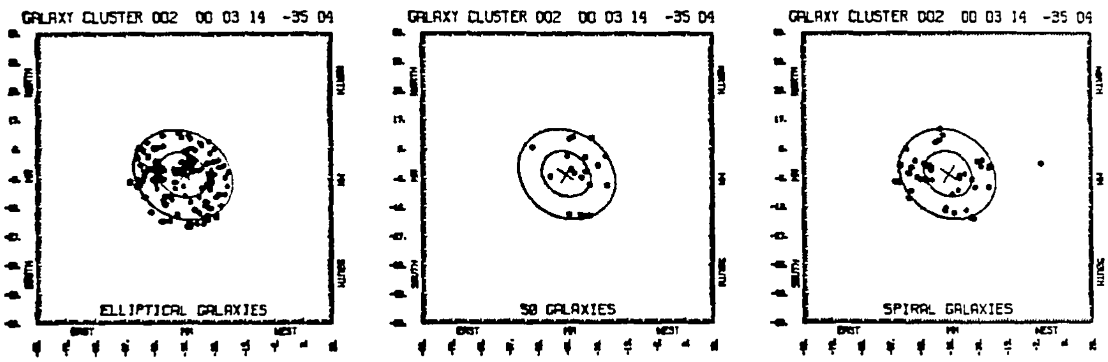


Figure 3.2.02 ***(b)*** ***Cluster Morphology.*** ***(c)*** ***Surface Density Distribution.*** ***(d)*** ***Magnitude Distribution and (e) Position Angle Distribution.***



GALAXY CLUSTER 002 00 03 14 −35 04						
FIELD 349						ESØ/SERC PLATE J6145
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
035.621	-003.767	0 3 13.9	-35 4 1.6	352 2 54.5	-77 35 8.1	0.072

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	159	MAJØR AXIS	9.50	SAMPLE PØPULATIØN	265
SØ	20	MINØR AXIS	7.96	CØRE PØPULATIØN	86
S	46	ECCENTRICITY	0.55	LIMITING MAGNITUDE	19.0
SB	2	PØSN. ANGLE	-34.26		
P	38				

Figure 3.2.02 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.02 *Cluster Population Description.*

GALAXY CLUSTER 002: 00 03 14 -35 04 : The cluster is located in South-East quadrant of ESO/SERC Field 349. Within a diameter of 36mm as determined by m_{10} we count 608 galaxies in this cluster and 265 to a limiting magnitude of $m_{\rm lim} = 19.0$ that are predominantly elliptical. The cluster is classified as Abell type R but seems to have several concentrations of elliptical galaxies in the North-East and North-West quadrants.

We count over 80 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 2. The brightest galaxy in the cluster has a corona and is intermediate in appearance between the class cD and normal giant elliptical galaxies suggesting a $B - M$ type II classification for the cluster. For m_1, m_3, and m_{10} we give 15.6, 15.8 and 16.3, respectively. The value of m_{10} implies a redshift of 0.072.

The surface density distribution of this cluster shows several concentrations, one running almost linearly East-West across the cluster, two East of center, and another to the South-Southwest. The magnitude distribution is somewhat steep from $m_v = 15$ to $m_v = 19$ albeit smooth. There appear to be no unusual irregularities in the position angle distribution with perhaps a very slightly higher of galaxies measured with a position angle near $-30°$.

The dispersion ellipse holds nearly a third of the cluster population located in an area of some 0.08 square degrees. With a core membership of 86 galaxies this repersents a surface density of 1033 galaxies per square degree. The dispersion ellipse is inclined 34 degrees South of West and is somewhat eccentric.

The cluster is rich in elliptical galaxies with nearly four times as many ellipticals as spirals. The few SO galaxies identified appear to be loosely scattered throughout the Western portion of the cluster. The spirals in the cluster appear somewhat evenly divided East and West, but there appears to be a region perpendicular to the dispersion ellipse major axis that is devoid of this type of galaxy. There are several superposed faint pairs of galaxies, often pairs with an early and late type elliptical. In addition, there are several subgroups dominated by a bright elliptical with fainter elliptical attendants as, for example, one located at $x = 52.39, y = 2.87$. We also note the appearance of several faint "chains" of galaxies, comprised of four or more galaxies in what looks like a line, such as those found at $x = 31.15, y = -7.02$.

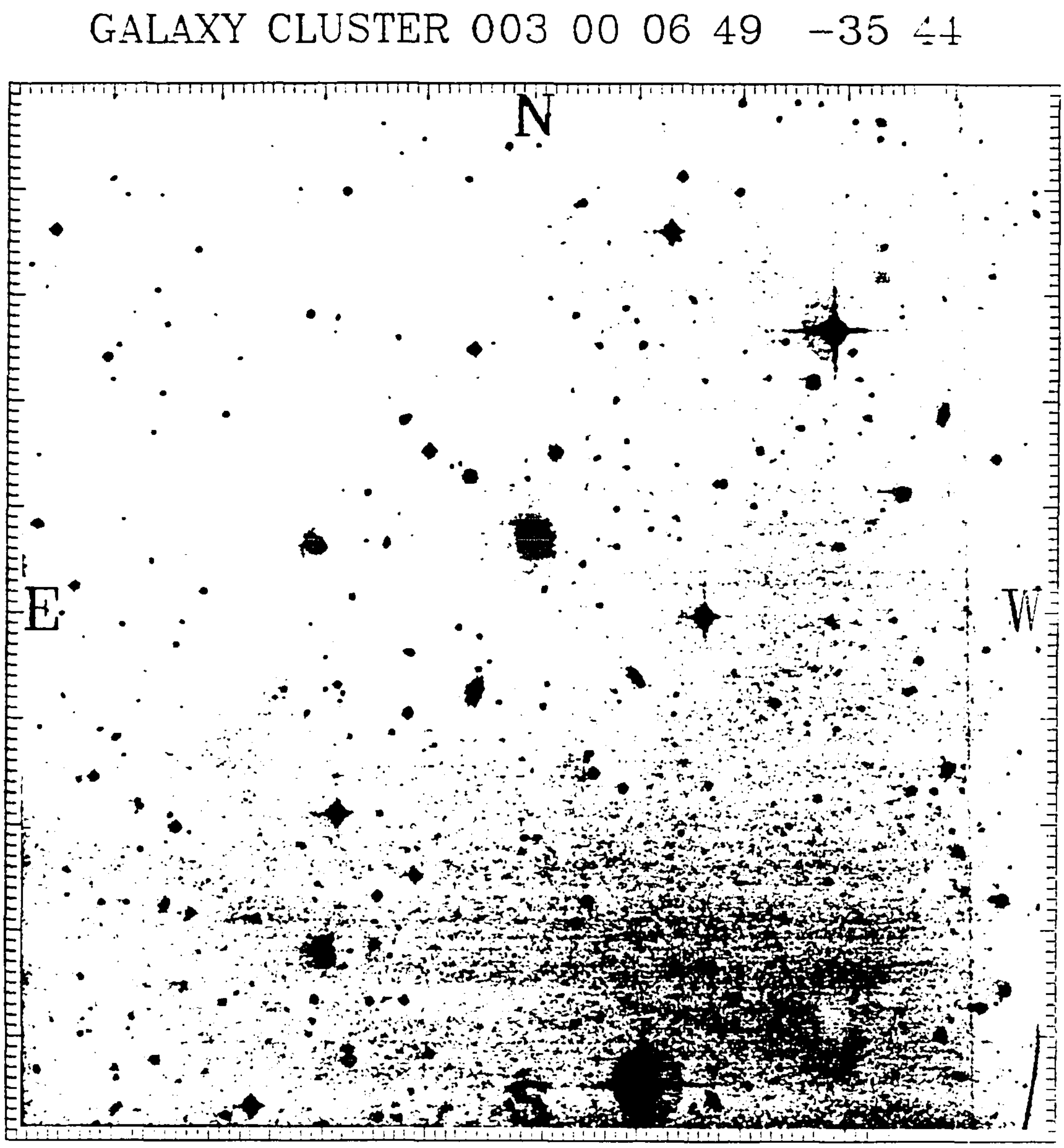


Figure 3.2.03 *(a) Field of GALAXY CLUSTER 003: 00 06 49 -35 44*

GALAXY CLUSTER 003 00 06 49 −35 43

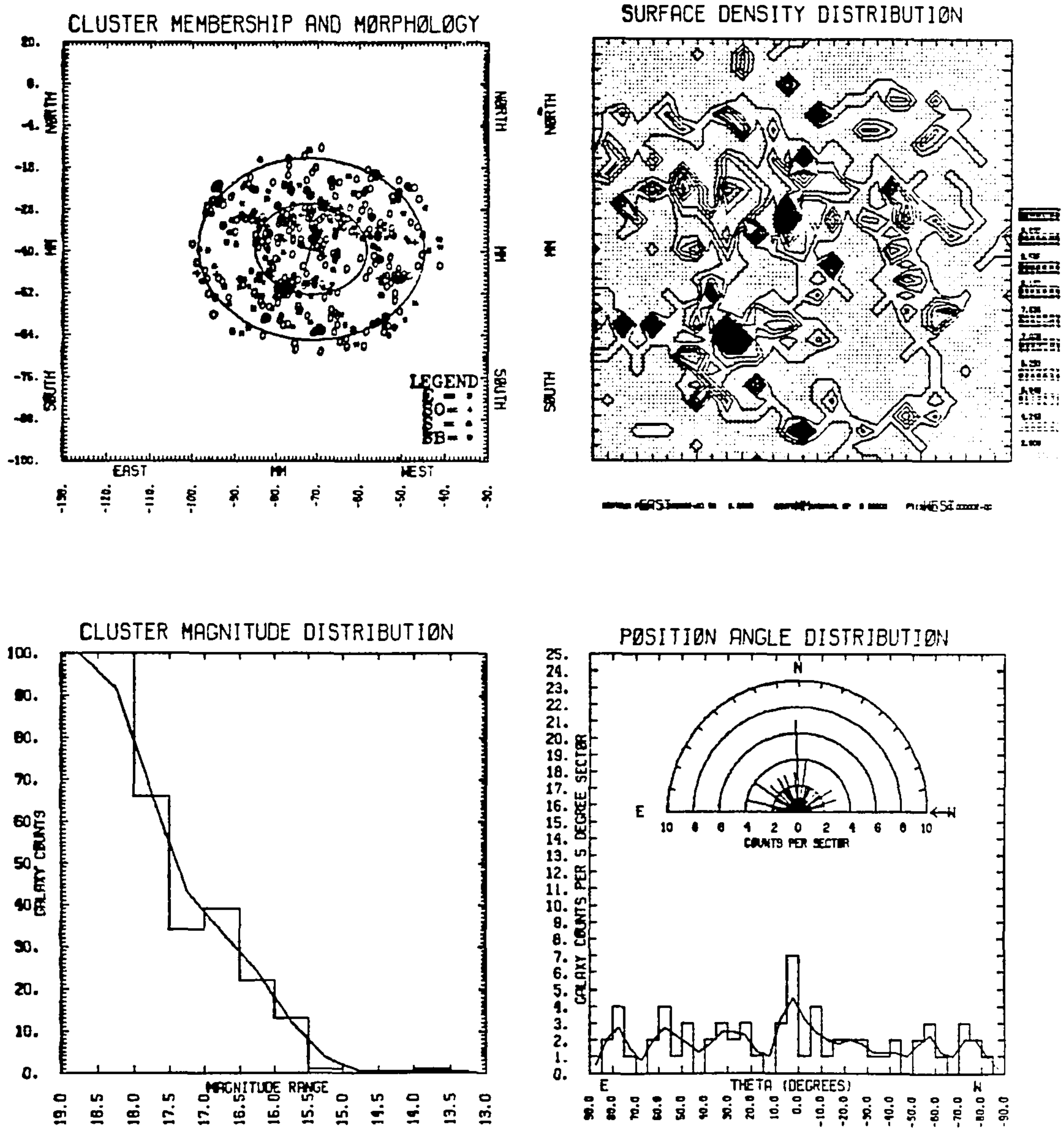
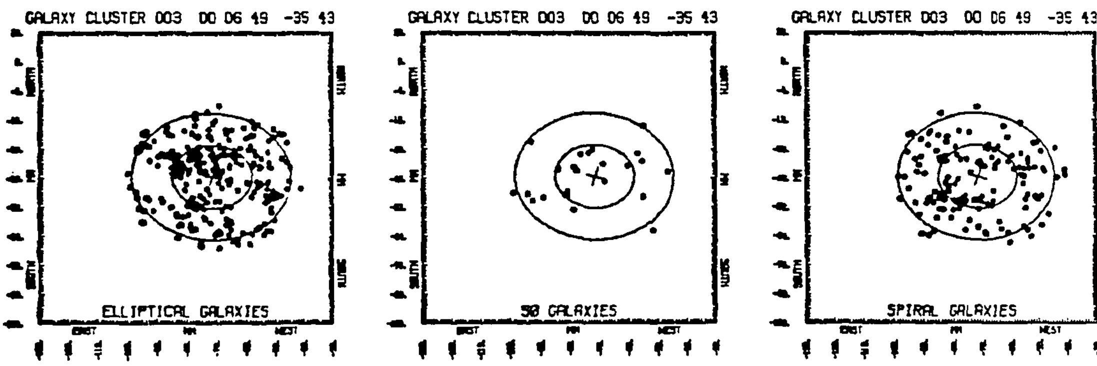


Figure 3.2.03 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 003 00 06 49 −35 43						
FIELD 349						ESØ/SERC PLATE J6145
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
071.702	-039.543	0 6 49.1	-35 43 49.9	347 29 52.6	-77 45 43.8	0.057

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	295	MAJØR AXIS	13.48	SAMPLE PØPULATIØN	483
SØ	24	MINØR AXIS	13.00	CØRE PØPULATIØN	163
S	149	ECCENTRICITY	0.26	LIMITING MAGNITUDE	19.0
SB	7	PØSN. ANGLE	-15.73		
P	8				

Figure 3.2.03 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.03 *Cluster Population Description.*

GALAXY CLUSTER 003: 00 06 49 -35 44 : The cluster is located in South-East quadrant of ESO/SERC Field 349. Within a diameter of 60mm as determined by m_{10} we count 868 galaxies in this cluster and 265 to a limiting magnitude of $m_{\rm lim} = 19.0$ that are predominantly elliptical. The cluster is classified as Abell type IR and there are several concentrations of galaxies of all types in the South-East and North-West quadrants. These dense concentrations suggest the possibility of two clusters superposed.

We count over 100 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 2. Since the brightest galaxy in the cluster has a corona and is intermediate in appearance between the class cD and normal giant elliptical galaxies, it suggests perhaps a $B - M$ type II-III classification for the cluster. For m_1, m_3, and m_{10} we give 13.9, 15.6 and 16.3, respectively. The value of m_{10} implies a redshift of 0.057.

The brightest galaxy in the cluster has a halo, whilst the third brightest appears to be a spindle. The Northern portion of the cluster is more densly populated than the Southern, yet there appears to be a relatively high concentration of galaxies in a small region Southeast of the cluster center. This concentration is located at $x = 77.87, y = -52.15$, is dominated by a bright elliptical ($m_v = 15.8$), and appears to be populated equally with both ellipticals and spirals, although the main cluster has nearly twice the number of ellipticals as spirals. There are a few obvious barred-spirals, several displaying rings around a dense nucleus, as the one located at $x = 89.46, y = -27.24$. A small faint group predominately composed of spirals is located at $x = 57.35, y = -35.85$ and there are several elliptical galaxies apparently surrounded by a constellation of very faint attendants. Several galaxies are termed peculiar because of possible superposition or irregularities and there are a number of very low surface brightness galaxies with very faint but distinguishable nucleii.

The dispersion ellipse has a core population of 163, or some 34% of the sample with a limiting magnitude of $m_v = 19.0$. With an eccentricity of 0.26 and a position angle of 15.73° South of West, the dispersion ellipse spans 0.19 square degrees and gives a core surface density of 845 galaxies per square degree on the sky.

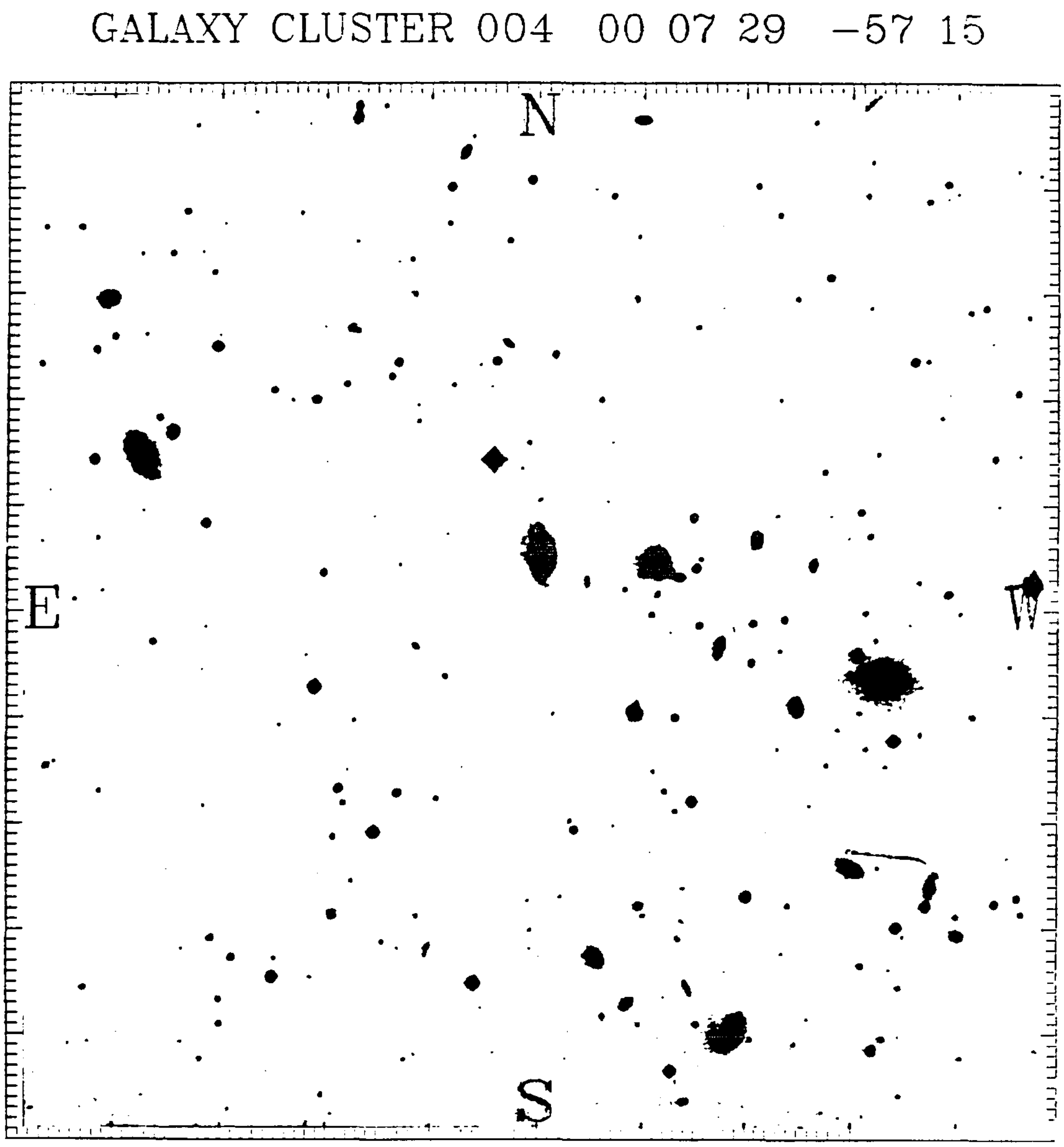


Figure 3.2.04 *(a) Field of GALAXY CLUSTER 004: 00 07 29 -57 15*

GALAXY CLUSTER 004 00 07 29 −57 15

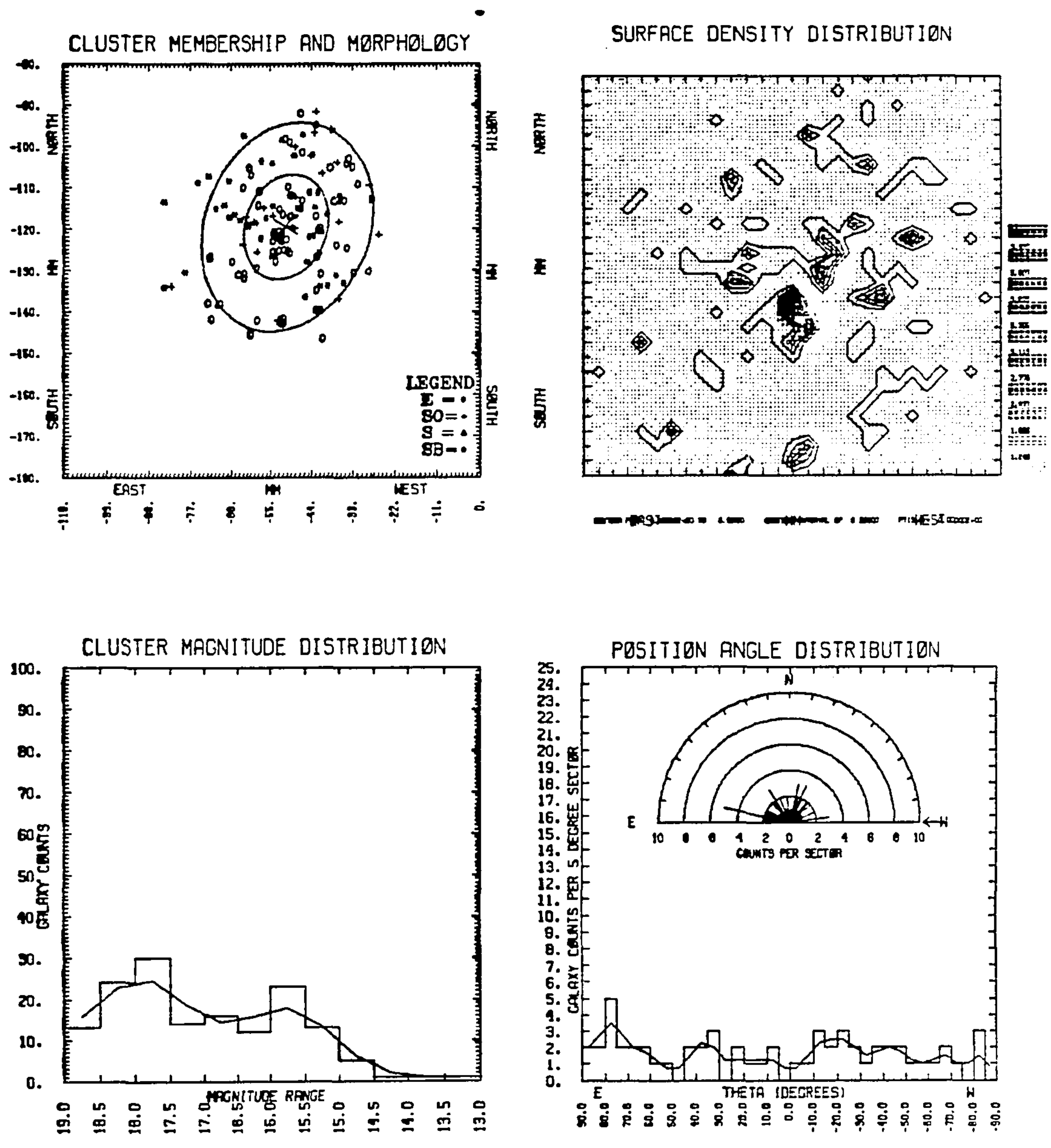
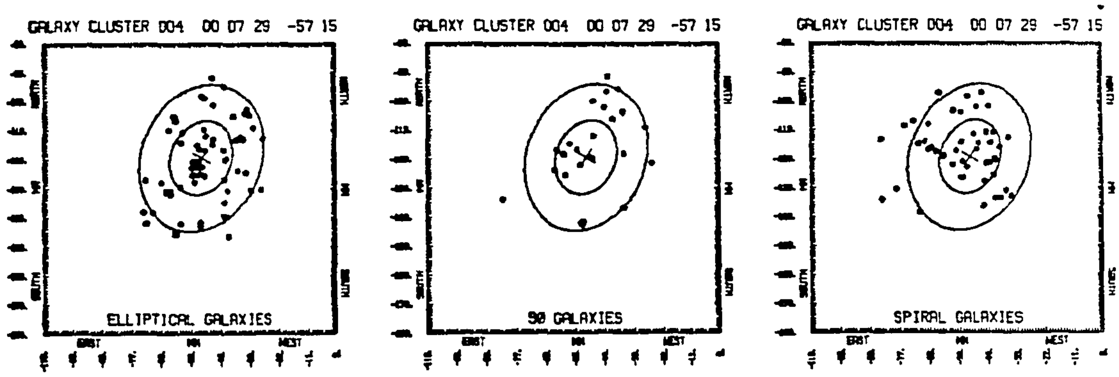


Figure 3.2.04 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 004 00 07 29 −57 15						
FIELD 149						ESØ/SERC PLATE J6501
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
051.069	-119.610	0 7 28.7	-57 14 52.8	313 59 38.0	-59 15 32.8	0.044

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	71	MAJØR AXIS	13.24	SAMPLE PØPULATIØN	153
SØ	27	MINØR AXIS	10.89	CØRE PØPULATIØN	63
S	50	ECCENTRICITY	0.57	LIMITING MAGNITUDE	19.0
SB	3	PØSN. ANGLE	58.20		
P	2				

Figure 3.2.04 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.04 *Cluster Population Description.*

GALAXY CLUSTER 004: 00 07 29 -57 15 : The cluster is located in South-West quadrant of ESO/SERC Field 149. Within a diameter of 60mm as determined by m_{10} we count 157 galaxies in this cluster and 153 to a limiting magnitude of $m_{\text{lim}} = 19.0$. The cluster is classified as Abell type IR mainly because of the concentrations of galaxies being non-uniform.

We count over 50 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 1. We suggest a $B-M$ type III classification for the cluster which has several normal giant ellipticals, the brightest of which appears to be superposition of an early and a late elliptical. For m_1, m_3, and m_{10} we give 13.2, 14.3 and 15.1, respectively. The value of m_{10} implies a redshift of 0.044.

The cluster magnitude distribution is depressed near $m_v = 16.5$ and tapers off after $m_v = 18.5$ suggesting several populations making up the cluster. We also note a very slight excess of galaxies with orientation of $75-80^o$ but do not deem it significant.

We find a slight concentration of predominately elliptical galaxies just South of the cluster center and there is a large region, comprising nearly half of the Southern portion of the dispersion ellipse that is practically devoid of spirals. The third brightest galaxy appears to be a spindle. The morphological distribution $(E : SO : S)$ goes as $(3:1:2)$ while the core population represents 41% of the total magnitude limited sample. The dispersion ellipse spans some 0.16 of a square degree which implies a surface density of some 397 galaxies per square degree. The position angle of the dispersion ellipse is inclined some 58 degrees North of West.

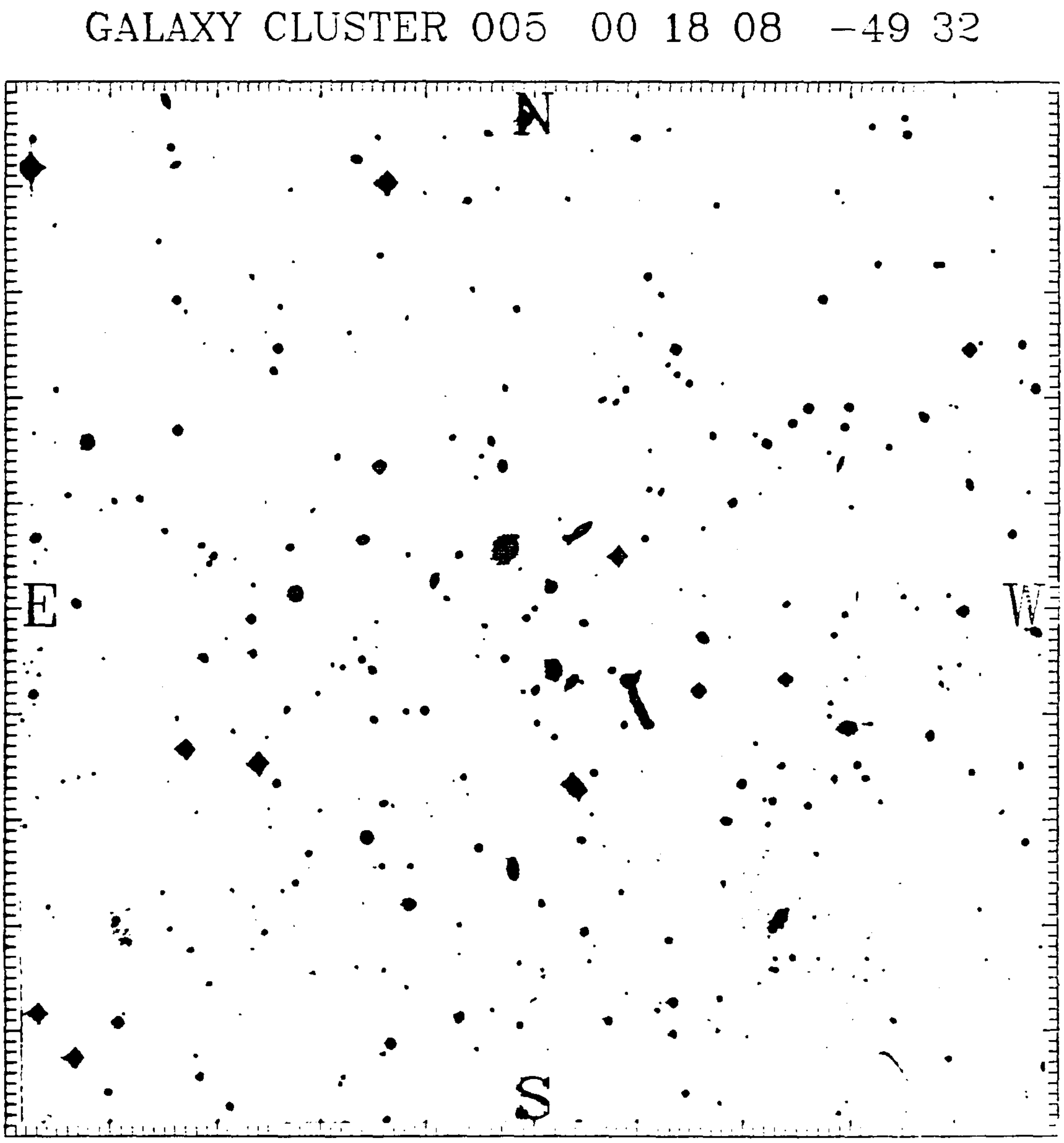


Figure 3.2.05 *(a) Field of GALAXY CLUSTER 005: 00 18 08 -49 32*

GALAXY CLUSTER 005 00 18 08 −49 32

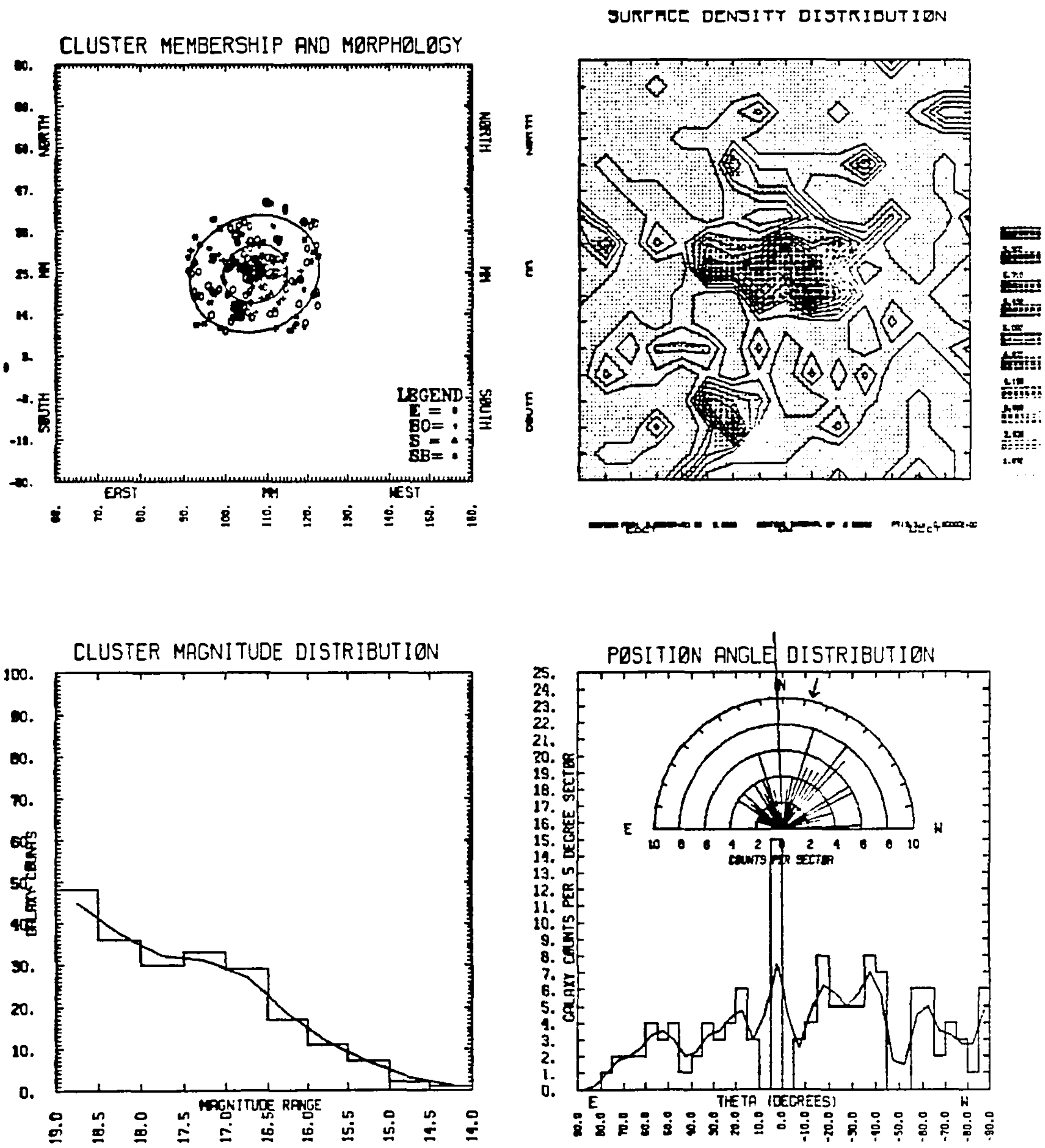
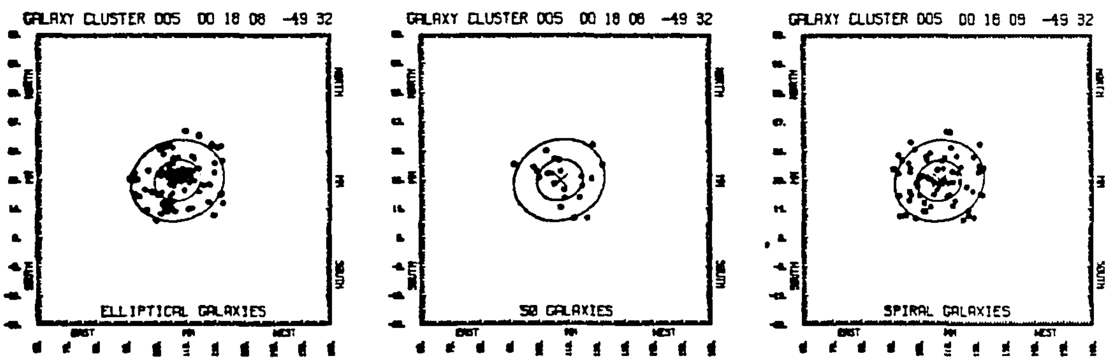


Figure 3.2.05 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 005 00 18 08 −49 32						
FIELD 194						ESØ/SERC PLATE J1861
X	Y	RA (1950)	DEC (1950)	L (1850)	B (1950)	Z
-107.031	024.617	0 18 8.3	-49 32 34.3	315 55 27.3	-67 4 38.6	0.050

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	115	MAJØR AXIS	8.18	SAMPLE PØPULATIØN	214
SØ	23	MINØR AXIS	7.37	CØRE PØPULATIØN	84
S	70	ECCENTRICITY	0.43	LIMITING MAGNITUDE	19.0
SB	6	PØSN. ANGLE	42.09		
P	0				

Figure 3.2.05 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.05 *Cluster Population Description.*

GALAXY CLUSTER 005: 00 18 08 -49 32 : The cluster is located in North-West quadrant of ESO/SERC Field 149. Within a diameter of 36mm as determined by m_{10} we count 281 galaxies in this cluster and 214 to a limiting magnitude of m_{lim} = 19.0. The cluster is classified as Abell type *R* because of its compact center and relatively smooth distribution of galaxies.

We count 67 galaxies brighter than m_3+2 and thus classify the cluster as having an Abell richness of 1. We suggest a $B-M$ type II classification for the cluster which has several giant ellipticals, intermediate between cD and normal giant ellipticals. The brightest cluster member appears to be a superposition between an early and a late elliptical. For m_1, m_3, and m_{10} we give 14.2, 15.0 and 15.4, respectively. The value of m_{10} implies a redshift of 0.050.

Two concentrations seem to be evident in this cluster. The largest is evident just North of the cluster center spanning some 20 minutes of arc from East to West and the second, a much smaller concentration South-West of the cluster center. The magnitude range spans five magnitudes, shows a gentle rise of population with increasing magnitude, a plateau region near $m_v = 17.0$, and then a sharper rise to the limiting magnitude. The position angle distribution shows a marked increase of galaxies oriented with position angles West of North with a large fraction oriented nearly North-South. The former concentration most likely reflects the higher density of galaxies in the first and fourth quadrants rather than an intrinsically preferred orientation.

The number of elliptical galaxies in the cluster exceeds that of any other population group being nearly one-and-one-half times as numerous as spirals, with spirals being nearly three times as numerous as SO's. The core population represents 39% of the population and with the dispersion ellipse spanning 0.066 square degrees, it suggests a surface density of galaxies of 1265 galaxies per square degree.

We note that the cluster contains several close pairs of elliptical galaxies of early and late type, as for example, those located at $x = -101.90, y = 15.60$.

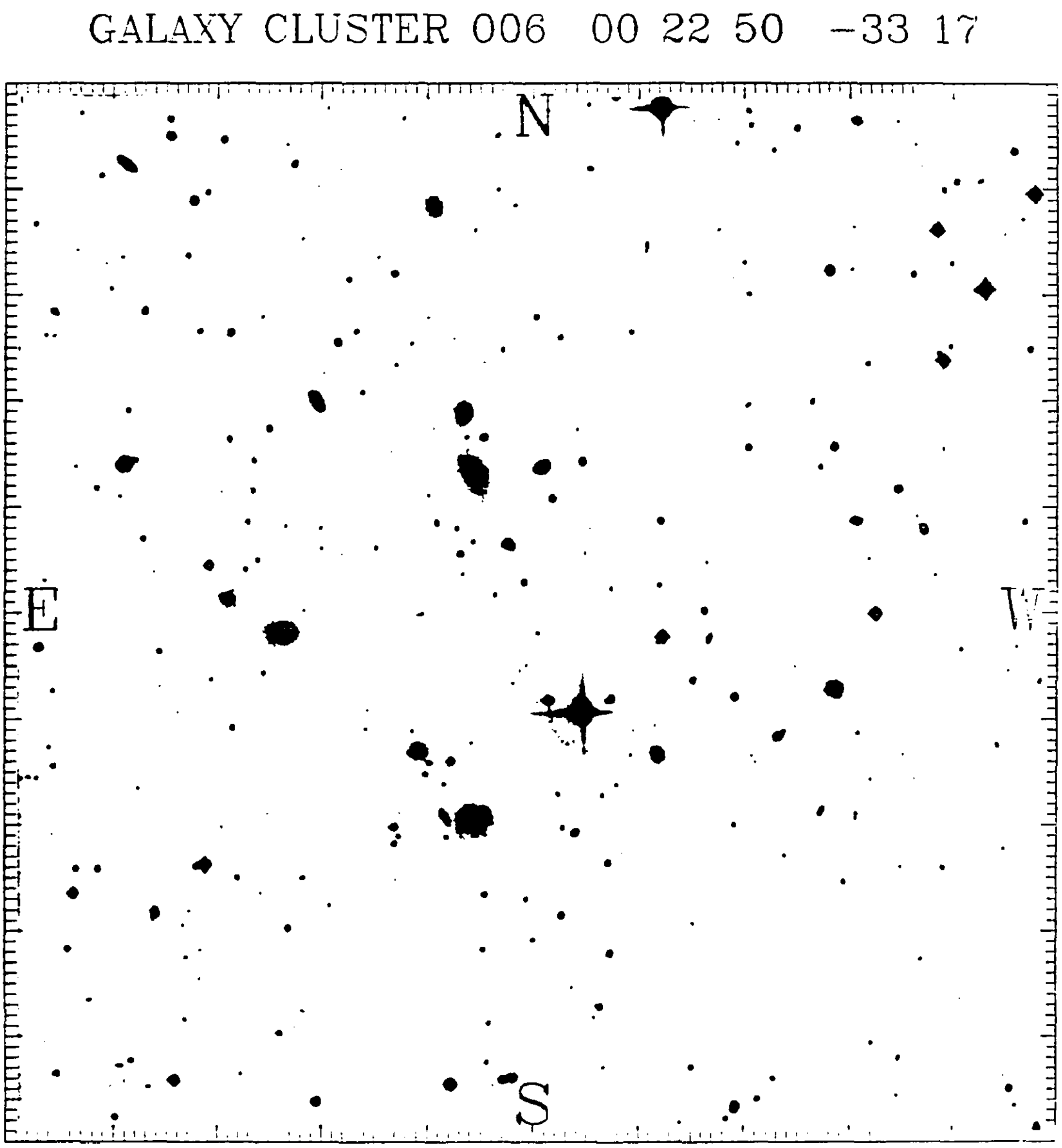


Figure 3.2.06 *(a) Field of GALAXY CLUSTER 006: 00 22 50 -33 17*

GALAXY CLUSTER 006 00 22 50 −33 17

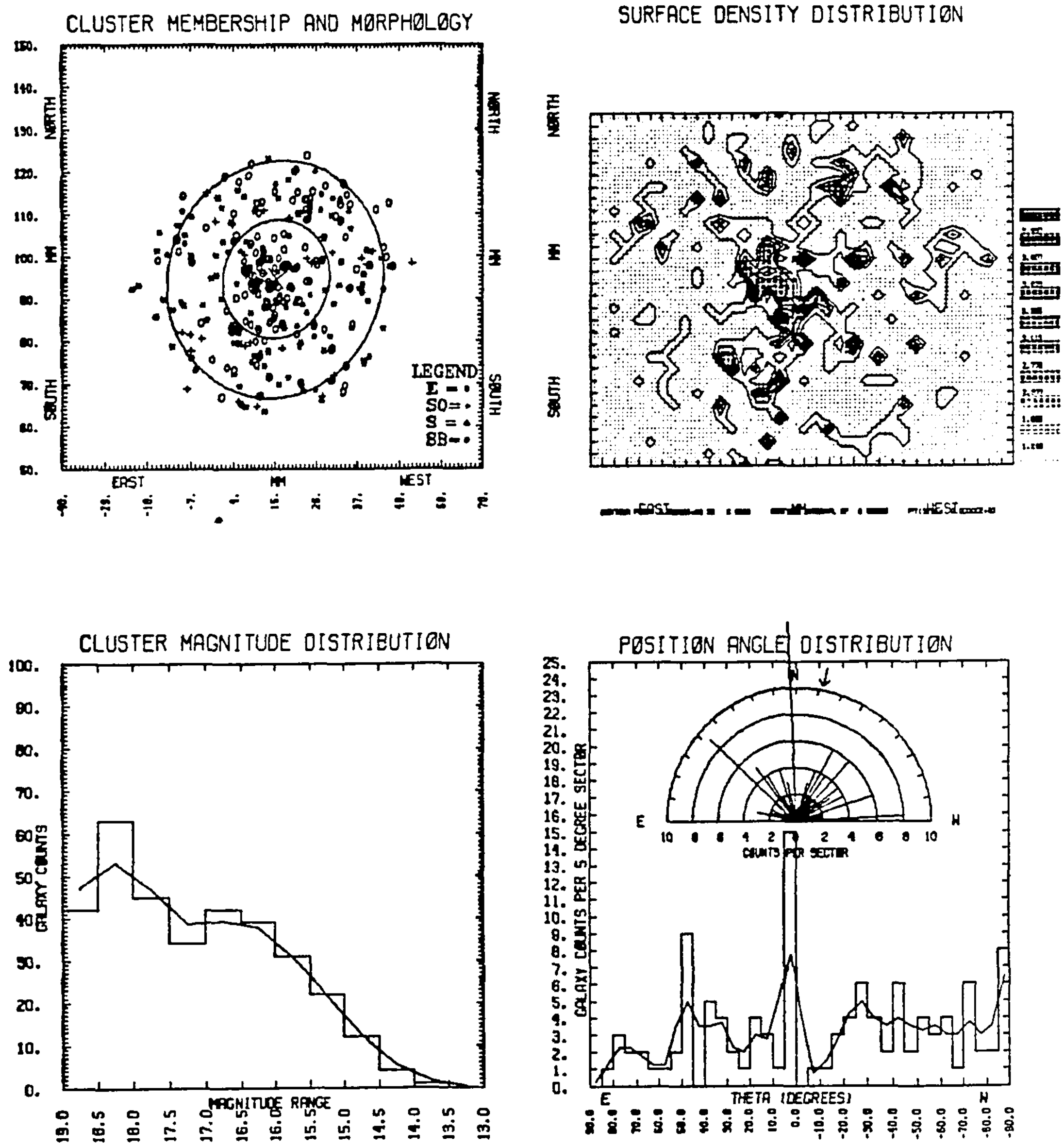
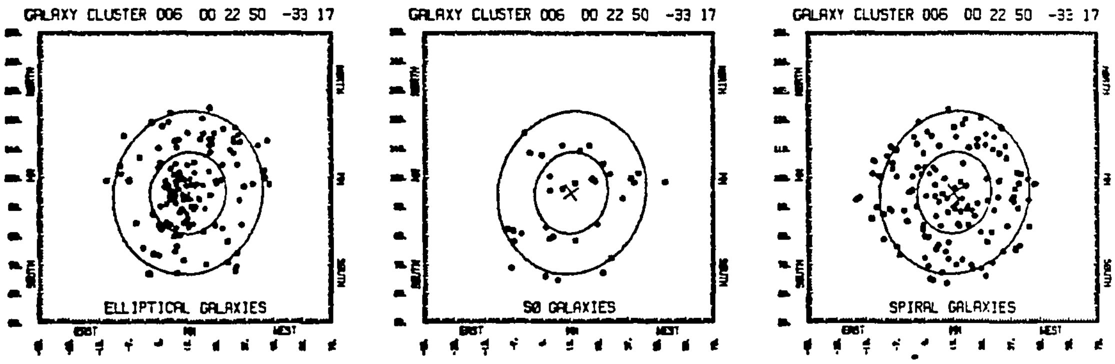


Figure 3.2.06 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 006 00 22 50 −33 17						
FIELD 350						ESØ/SERC PLATE J4501
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-015.272	094.597	0 22 49.7	-33 17 33.7	345 9 53.8	-81 50 34.0	0.038

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	150	MAJØR AXIS	14.51	SAMPLE PØPULATIØN	335
SØ	34	MINØR AXIS	13.70	CØRE PØPULATIØN	114
S	144	ECCENTRICITY	0.33	LIMITING MAGNITUDE	19.0
SB	5	PØSN. ANGLE	36.77		
P	2				

Figure 3.2.06 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.06 *Cluster Population Description.*

GALAXY CLUSTER 006: 00 22 50 -33 17 : The cluster is located in North-West quadrant of ESO/SERC Field 350. Within a diameter of 60mm as determined by m_{10} we count 347 galaxies in this cluster and 335 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *RI* because of it being somewhat regular but with some concentrations.

We count 97 galaxies brighter than m_3+2 and thus classify the cluster as having

an Abell richness of 2. We suggest a $B-M$ type II classification for the cluster which has a mild core-halo configuration with the brightest galaxies intermediate between the class cD and normal giant ellipticals. For m_1,m_3, and m_{10} we give 13.9, 14.3 and 14.9,respectively. The value of m_{10} implies a redshift of 0.038.

As mentioned above the cluster displays a mile core halo configuration with a somewhat diagonal concentration of cluster members running South- West to North-East about 20mm long on the plate located just South-East of the cluster center. There appears to be a small concentration of galaxies slightly more South-East of this structure.

The brightest galaxy in the cluster appears to have a corona; likewise, othe bright members are seen to possess extended envelopes and halos. The cluster magnitude distribution displays a gentle rise from thirteenth to about sixteenth magnitude where it appears to flatten off somewhat. An enhancement of the number of faint galaxies appears to occur in the eighteenth magnitude range.

The position angle distribution for the brighter galaxies seems dominated by inclinations West of North with two other noticable peaks occurring near 0.0 degrees and 50.0 degrees East of North.

We notice a heavier concentration of elliptical galaxies near the center of the cluster and within the dispersion ellipse, whereas the spirals appear to be more uniformly distributed. The elliptical-spiral ratio appears to be nearly 1 : 1 with a relative paucity of SO galaxies, which may be due to selection.

The core population of the cluster represents nearly 34% of the sample in an area of nearly 0.22 square degrees yielding a surface density of 521 galaxies per square degree in the dispersion ellipse.

GALAXY CLUSTER 007 01 29 34 −51 33

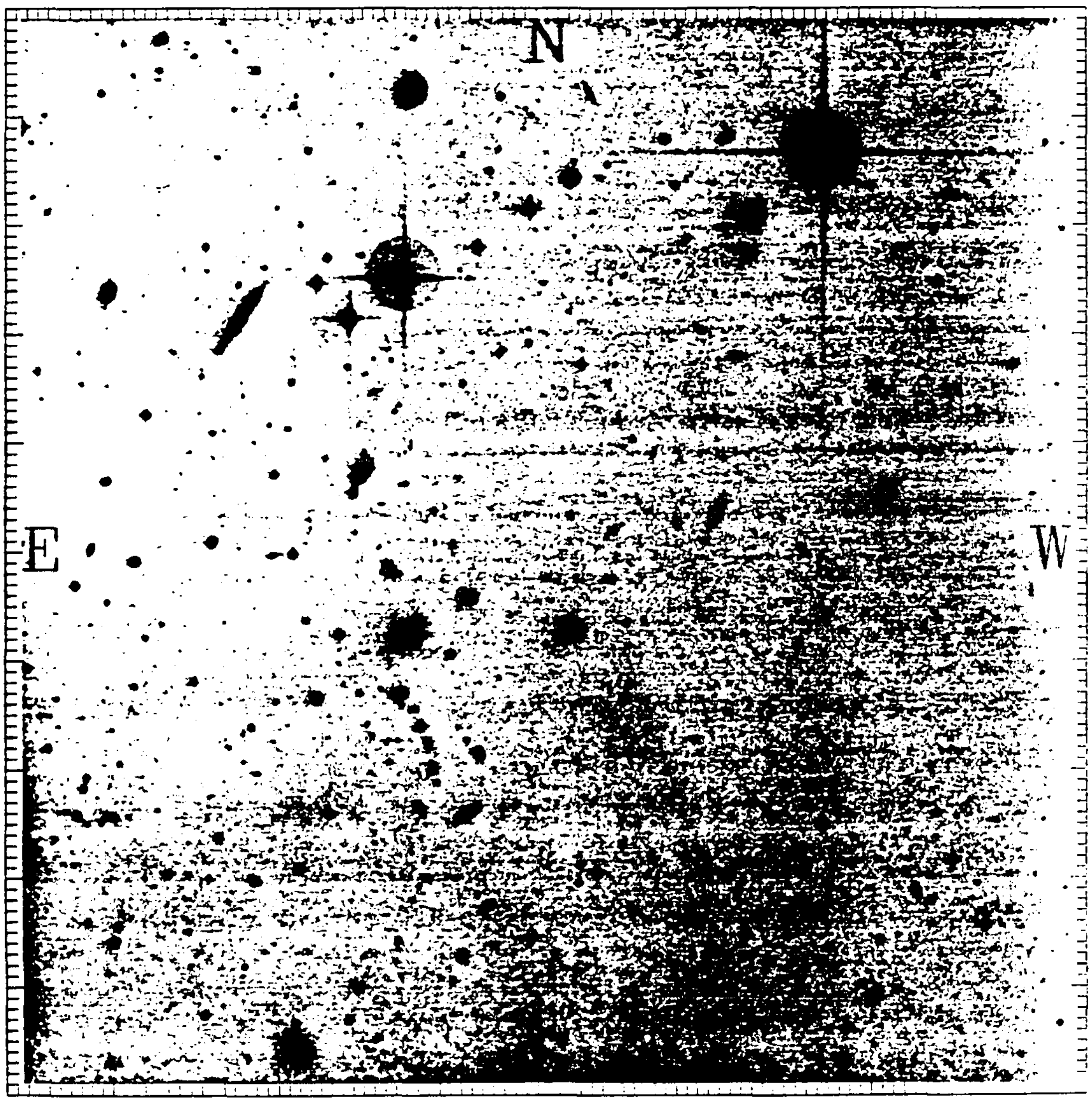


Figure 3.2.07 *(a) Field of GALAXY CLUSTER 007: 01 29 34 -51 33*

GALAXY CLUSTER 007 01 29 34 −51 33

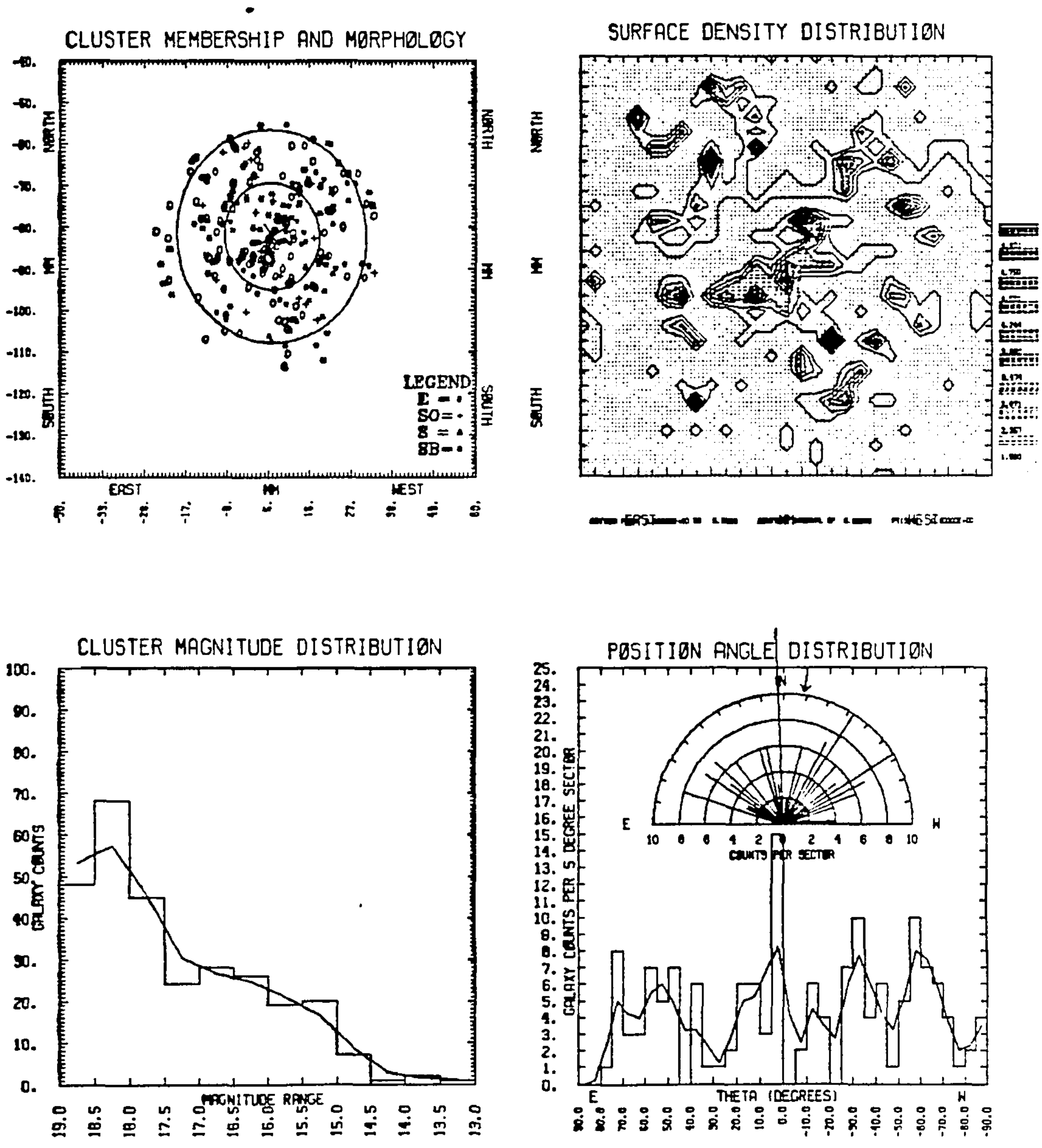
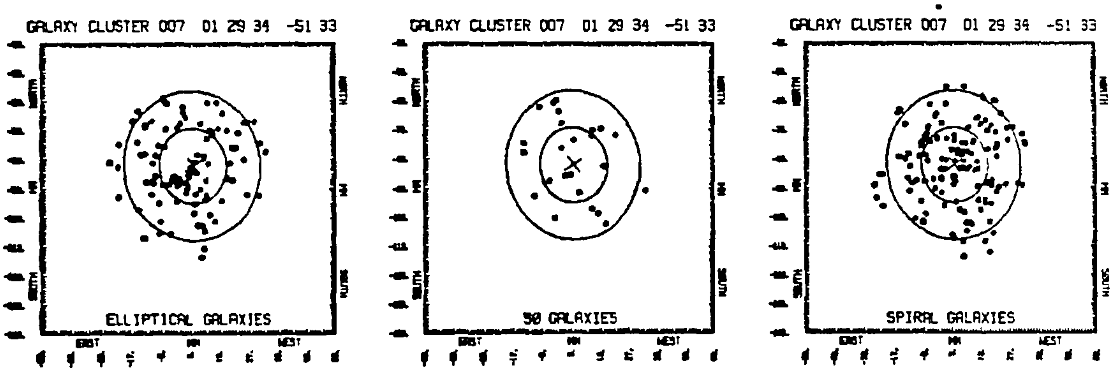


Figure 3.2.07 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 007 01 29 34 −51 33							
FIELD 196						ESØ/SERC PLATE J5467	
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z	
-005.774	-082.259	1 29 33.8	-51 32 55.7	288 10 19.5	-64 40 13.3	0.040	
MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS			
E	118	MAJØR AXIS	12.91	SAMPLE PØPULATIØN	289		
SØ	25	MINØR AXIS	12.56	CØRE PØPULATIØN	96		
S	140	ECCENTRICITY	0.23	LIMITING MAGNITUDE	19.0		
SB	5	PØSN. ANGLE	-57.00				
P	1						

Figure 3.2.07 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.07 *Cluster Population Description.*

GALAXY CLUSTER 007: 01 29 34 -51 33 : The cluster is located in South-West quadrant of ESO/SERC Field 196. Within a diameter of 60mm as determined by m_{10} we count 300 galaxies in this cluster and 289 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *RI* because of its somewhat linear concentration of galaxies near the center of the cluster surrounded by a somewhat uniform scatter of cluster members.

We count 37 galaxies brighter than m_3+2 and thus classify the cluster as having an Abell richness of 0. We suggest a $B-M$ type III classification for the cluster which has no really dominant galaxies other than what appears to be a superposed field spiral. For m_1,m_3, and m_{10} we give 14.0, 14.7 and 15.1,respectively. The value of m_{10} implies a redshift of 0.040.

We note a concentration of galaxies South-East of the cluster center with a few small very dense concentrations such as the one at $x = 10.0, y = -93.0$. There is a slow increase in fainter populations with increasing magnitude reaching a plateau near $m_v = 17.0$ and then a dramatic increase of members in the next magnitude range. Position angles show a slight concentration of brighter galaxies with inclinations West of North with an apparent enhancement near zero degrees.

The cluster population appears somewhat spiral enhanced with a $E : S$ ratio of $1 : 1.2$ with apparently fewer SO galaxies noted in the population. We notice a concentration of elliptical galaxies South-East of the cluster center and a concentration of spiral galaxies North-West of center.

The core population comprises slightly over a third of the galaxies in the sample and resides in an area of nearly 0.18 square degrees, giving a core surface density of 538 galaxies per square degree.

We find several superposed galaxies in this cluster such as the centrally condensed diffuse ovoid superposed at its pole with a faint elliptical galaxy at $x = -22.2, y = -79.41$. In addition, we discover another elliptical spiral combination apparently superposed with (or possibly connected by) a luminous bridge at $x = -6.52, y = -95.01$. Another luminous bridge combination is found at $x = -18.26, y = -88.56$. Finally, several superposed pairs are seen such as the set at $x = -22.03, y = -91.31$.

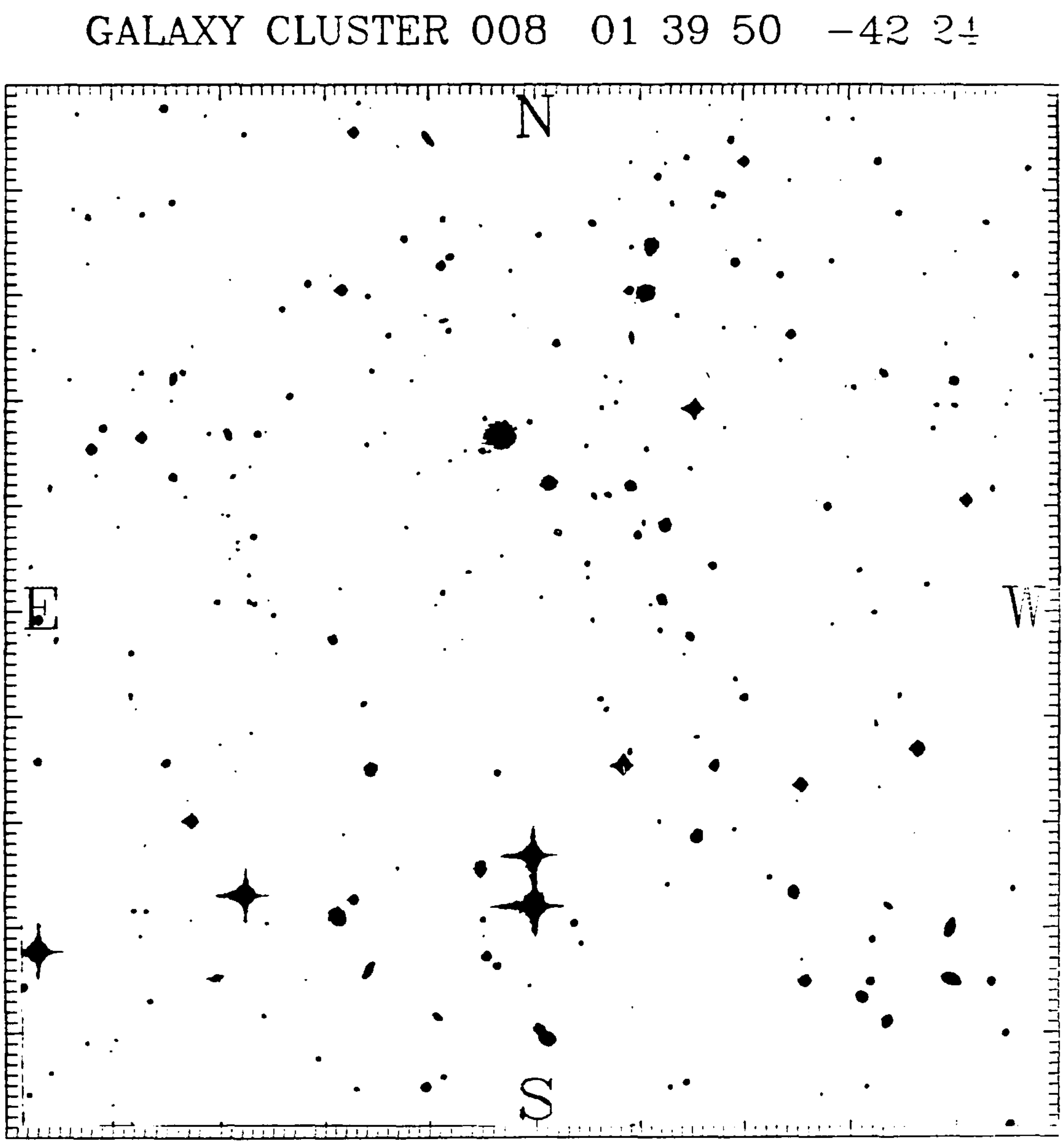


Figure 3.2.08 *(a) Field of GALAXY CLUSTER 008: 01 39 50 -42 24*

GALAXY CLUSTER 008 01 39 50 −42 23

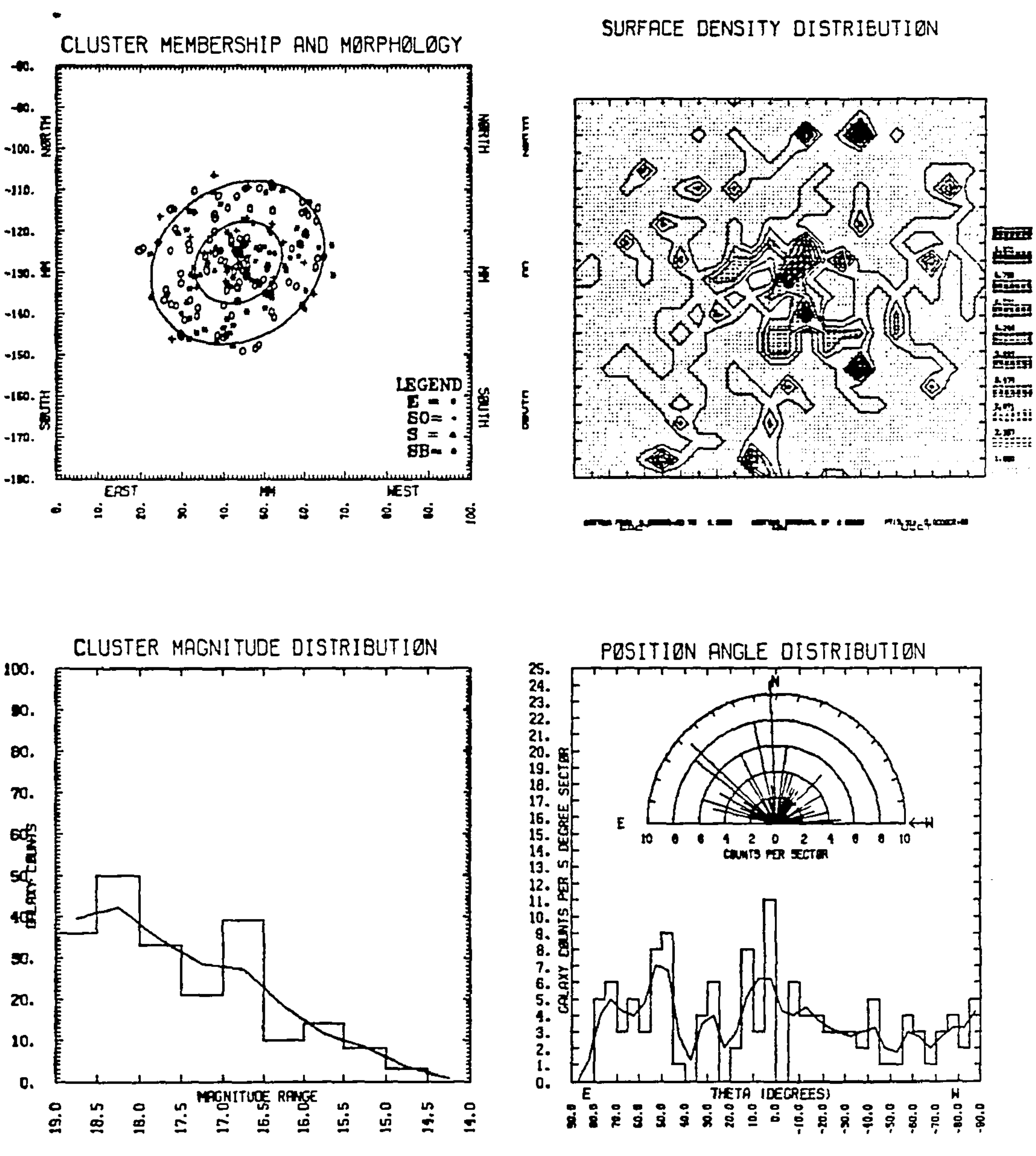
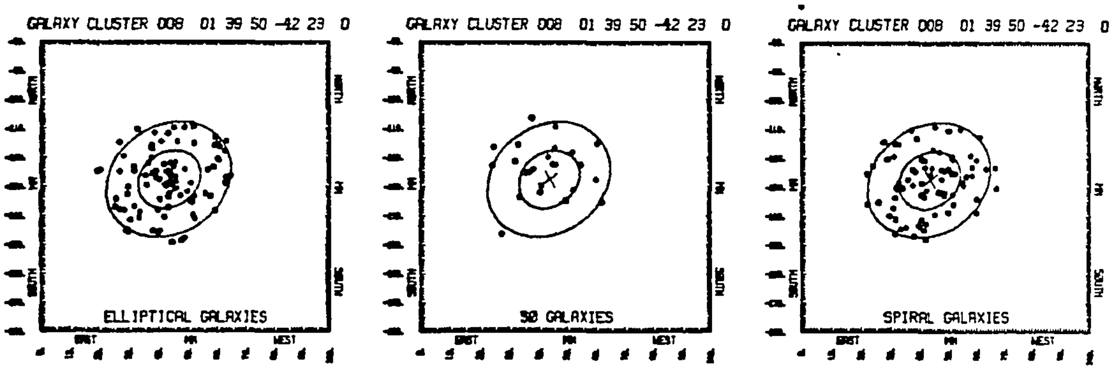


Figure 3.2.08 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 008 01 39 50 −42 23$						
FIELD 297						ESO/SERC PLATE J3593
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-043.427	-127.677	1 39 50.0	-42 23 49.0	271 41 23.9	-71 46 58.0	0.050

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	103	MAJOR AXIS	11.16	SAMPLE POPULATION	214
S0	24	MINOR AXIS	9.20	CORE POPULATION	76
S	75	ECCENTRICITY	0.57	LIMITING MAGNITUDE	19.0
SB	10	POSN. ANGLE	34.75		
P	2				

Figure 3.2.08 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.08 *Cluster Population Description.*

GALAXY CLUSTER 008: 01 39 50 -42 24 : The cluster is located in South-West quadrant of ESO/SERC Field 297. Within a diameter of 45mm as determined by m_{10} we count 265 galaxies in this cluster and 214 to a limiting magnitude of $m_{\lim} = 19.0$. The cluster is classified Abell type RI and shows a slight somewhat linear enhancement of galaxies near the core of the cluster.

We count 62 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B-M$ type I-II classification for the cluster which lies somewhat intermediate between those clusters domimated by a single cD galaxy and those with several giant ellipticals. For m_1,m_3, and m_{10} we give 14.5, 14.8 and 15.4,respectively. The value of m_{10} implies a redshift of 0.050.

We notice a nearly North-South linear concentration of galaxies near the cluster center as well as several regions of slight enhancement of numbers. This cluster is found to be somewhat centrally condensed as shown in the surface density distribution plot.

The cluster magnitude distribution shows a ramp-like increase in the population form $m_v = 14.5$ to $m_v = 18.5$ with two enhancements in the range $16.5 - 17.0$ and $18.0 - 18.5$. For the brighter members of the cluster, we find position angles more positive in the sense East of North and slightly more inclined at zero and near fifty degrees than average.

The population is dominated by elliptical galaxies with a $(E : SO : S)$ ratio of $(4 : 1 : 3)$. The ellipticals are scattered throughout the dispersion ellipses, but somewhat concentrated in the core. SO galaxies seem to be concentrated in the Northerly portions of the clusters whereas the spirals show little concentration at all, but a more uniform scatter. The core population represents nearly thirty-five percent of the sample in an area of 0.11 square degees giving a cluster core surface density of 672 galaxies per square degree.

We note several superposed or very close pairs of galaxies (of which we find seven) which seem consistently to be composed of an early elliptical and a later one which is usually fainter. Examples can be found at the following locations: $x = -51.76, y = -115.22$; $x = -38.19, y = -145.40$ and $x = -29.41, y = -145.09$.

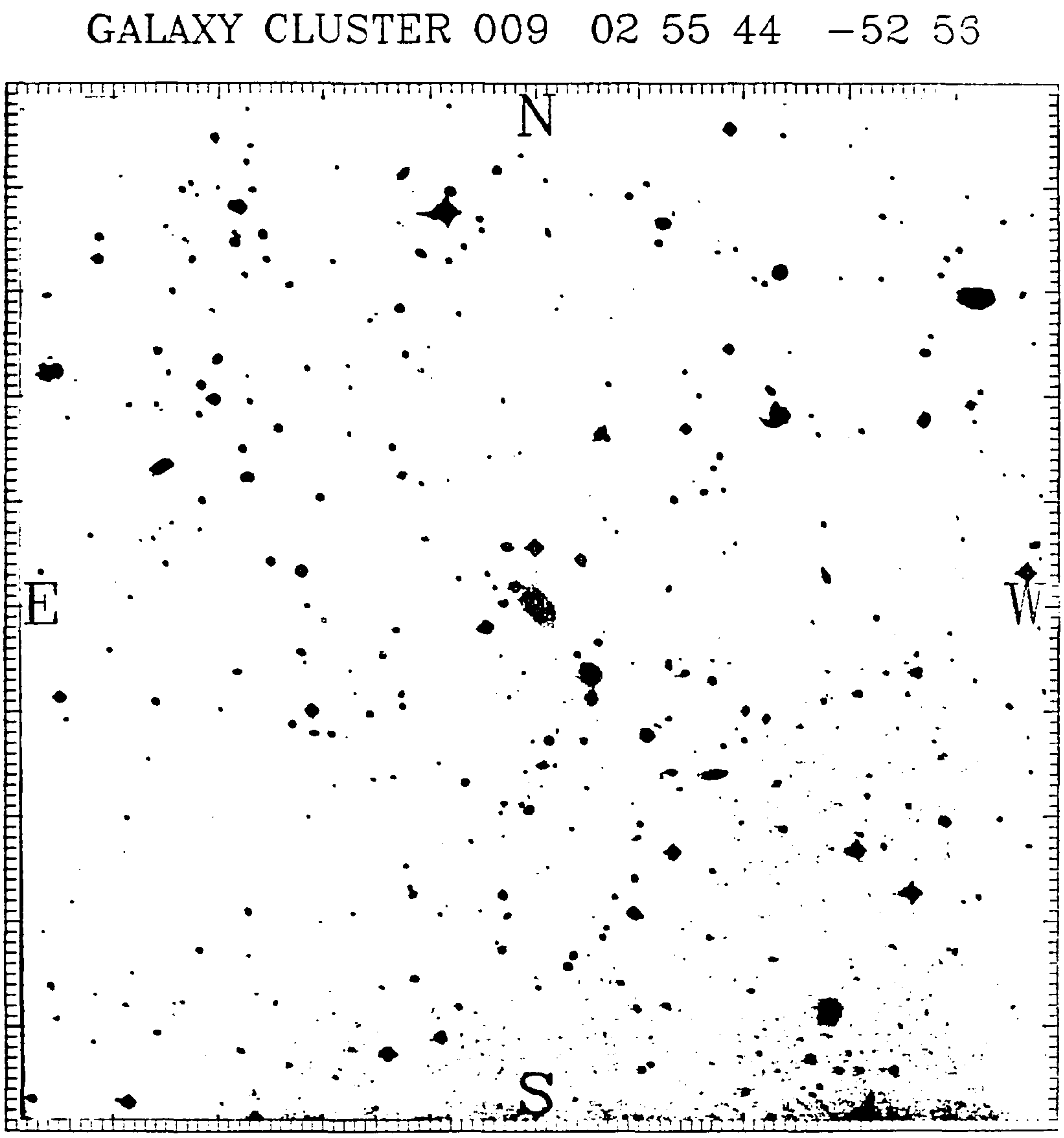


Figure 3.2.09 *(a) Field of GALAXY CLUSTER 009: 02 55 44 -52 56*

GALAXY CLUSTER 009 02 55 44 −52 56

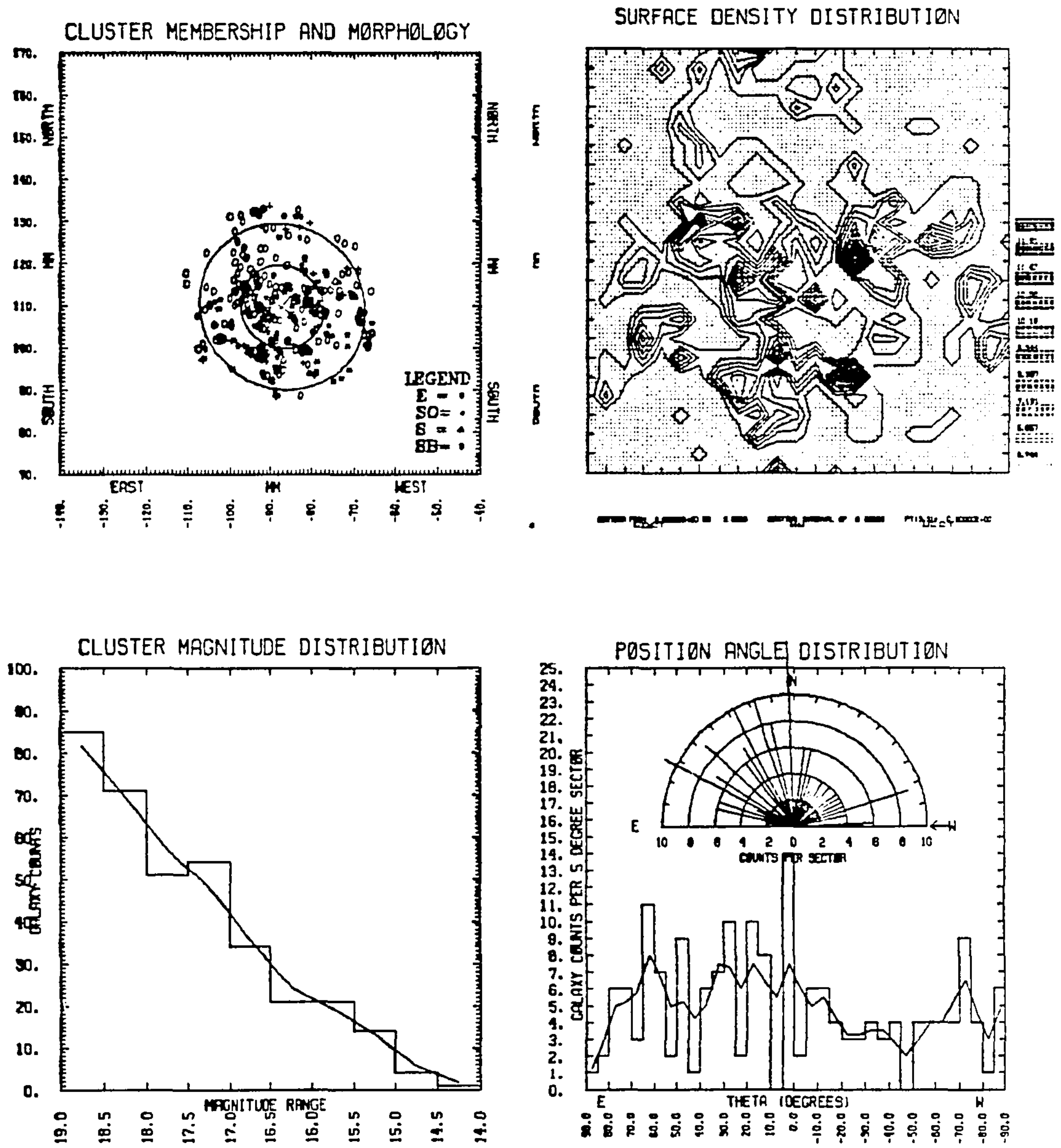
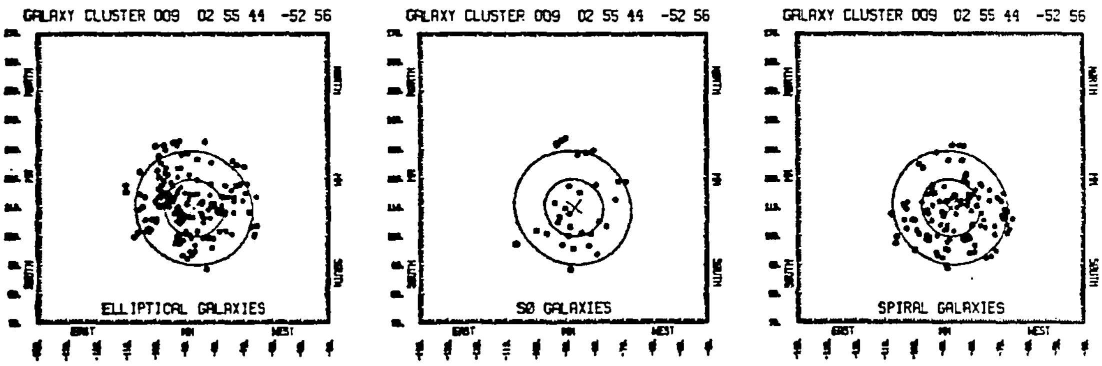


Figure 3.2.09 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 009 02 55 44 −52 56

FIELD 154 | ESØ/SERC PLATE J4716

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
087.306	109.669	2 55 44.0	-52 56 9.1	269 10 28.4	-55 20 33.5	0.049

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	190	MAJØR AXIS	10.26	SAMPLE PØPULATIØN	356
SØ	33	MINØR AXIS	9.58	CØRE PØPULATIØN	126
S	129	ECCENTRICITY	0.36	LIMITING MAGNITUDE	19.0
SB	4	PØSN. ANGLE	-38.14		
P	0				

Figure 3.2.09 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.09 *Cluster Population Description.*

GALAXY CLUSTER 009: 02 55 44 -52 56 : The cluster is located in North-East quadrant of ESO/SERC Field 154. Within a diameter of 45mm as determined by m_{10} we count 438 galaxies in this cluster and 356 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *I* due to the several concentrations of galaxies found and the general lack of smoothness in the distribution of cluster members.

We count 86 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 2. We suggest a $B - M$ type II classification for the cluster which has as its first brightest member an elliptical galaxy with a corona. The third brightest object in the cluster is a spiral. For m_1,m_3, and m_{10} we give 14.4, 14.8 and 15.4,respectively. The value of m_{10} implies a redshift of 0.049.

The distribution of cluster membership shows several small concentrations of galaxies within the cluster. The main subgroup consists of a knotty chain of galaxies running North-East to South-West, South-East of the cluster center. A relatively dense region is located at $x = -82, y = 101$ where several galaxies form a subgroup dominated by a bright pair.

The magnitude distribution exhibits a somewhat uniform increase in brightness at all magnitudes although a slight change of slope occurs near $m_v = 16.5$. We find that the position angle distribution of the brighter galaxies shows a preference for those galaxies aligned in projection to the direction of the major axis of the dispersion ellipse, that is, East of North.

We note an $(E : SO : S)$ ratio of $(1 : 0.17 : 0.68)$ with the ellipticals occuring scattered throughout the cluster as well as being in present in several clumps. The spirals are located predominantly in the Southern quadrants of the cluster, with a relative paucity in the Northern quadrants. We find similar behavior with the SO galaxies but are aware of possible misidentifications that might arise with confusion of this class with that of the ellipticals at large distances.

The core population contains some 35% of the galaxies in the sample within an area of nearly 0.11 square degrees. This provides some 1164 galaxies per square degree for the core population, which resides in a somewhat eccentric (0.36) dispersion ellipse aligned nearly forty degrees South of West.

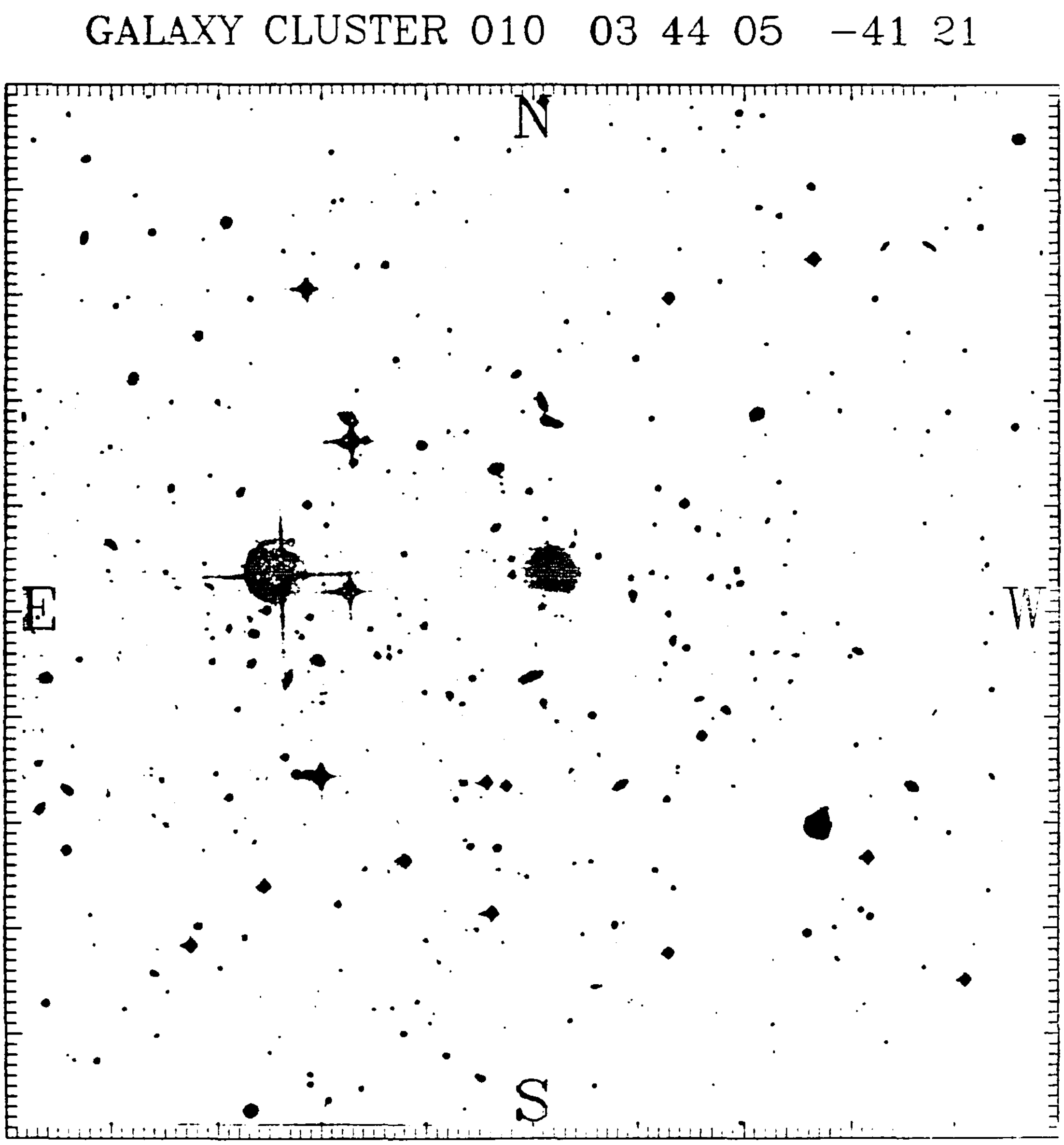


Figure 3.2.10 *(a) Field of GALAXY CLUSTER 010: 03 44 05 -41 21*

GALAXY CLUSTER 010 03 44 05 -41 21

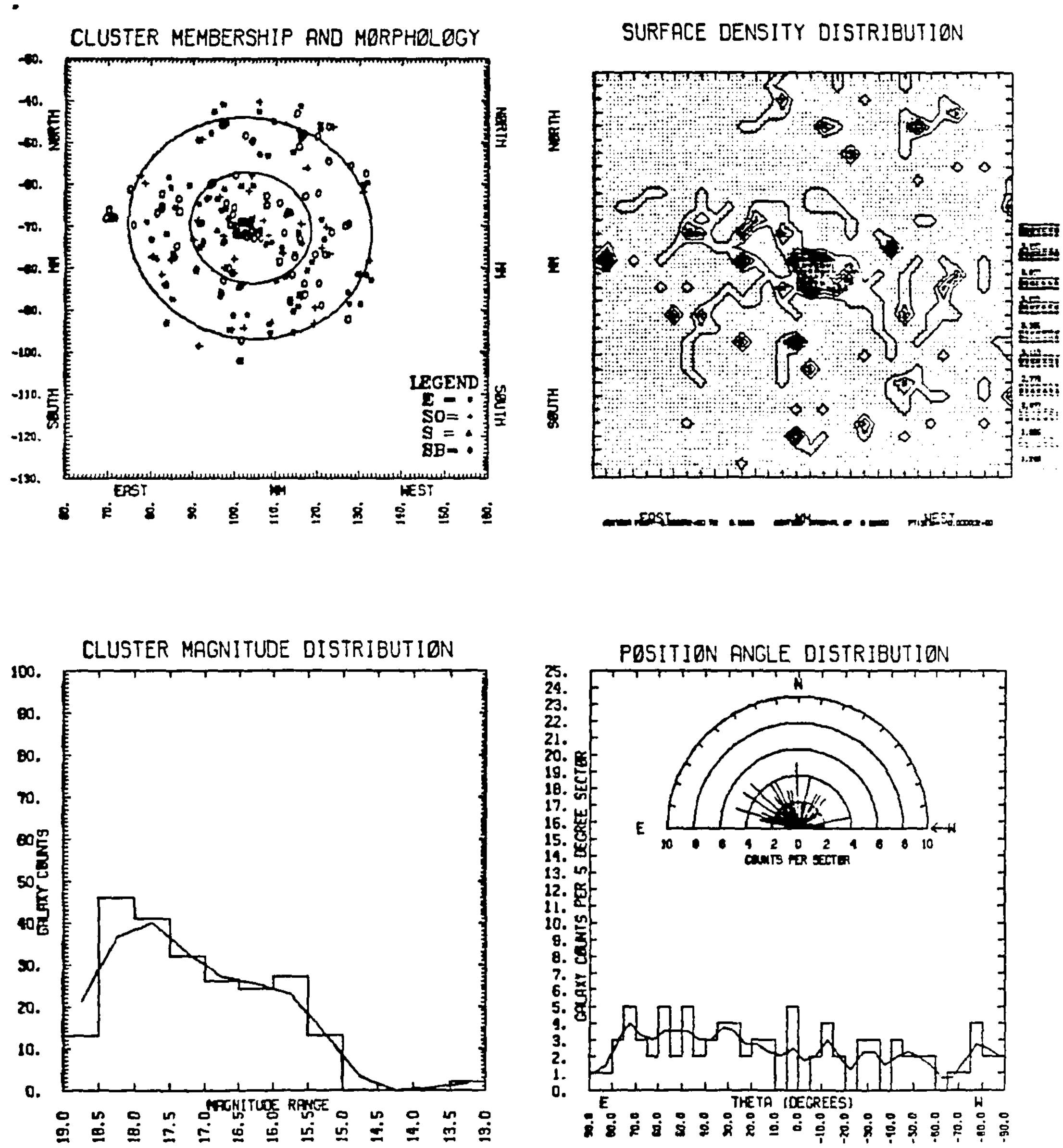
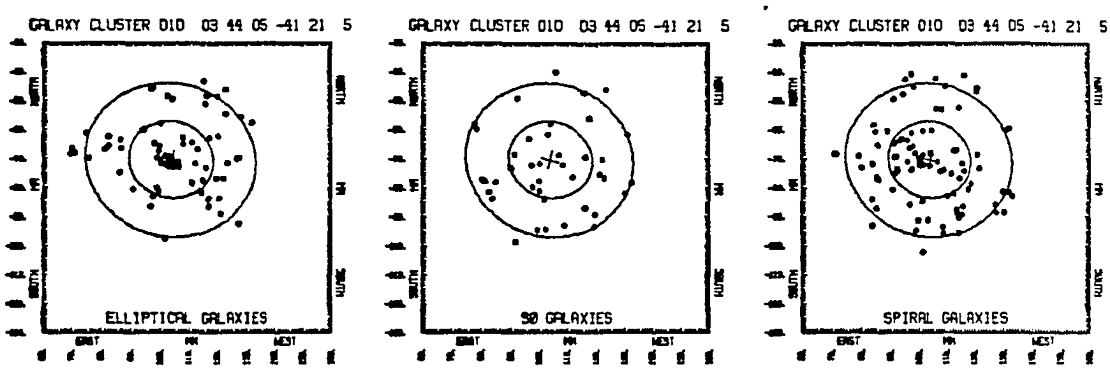


Figure 3.2.10 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 010 03 44 05 −41 21S

FIELD 302 — ESO/SERC PLATE J3550

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-103.679	-070.538	3 44 4.7	-41 21 11.8	245 59 33.1	-51 44 56.9	0.050

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	78	MAJOR AXIS	14.66	SAMPLE POPULATION	224
S0	40	MINOR AXIS	13.15	CORE POPULATION	90
S	96	ECCENTRICITY	0.44	LIMITING MAGNITUDE	19.0
SB	8	POSN. ANGLE	-14.11		
P	2				

Figure 3.2.10 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.10 *Cluster Population Description.*

GALAXY CLUSTER 010: 03 44 05 -41 21 : The cluster is located in South-West quadrant of ESO/SERC Field 302. Within a diameter of 60mm as determined by m_{10} we count 227 galaxies in this cluster and 224 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type R due to its inherent regularity and central condensation.

We count 93 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B - M$ type I classification for the cluster which has a dominant cD galaxy near the cluster center. We notice also, that the third brightest galaxy has a corona For m_1,m_3, and m_{10} we give 13.5, 15.1 and 15.4,respectively. The value of m_{10} implies a redshift of 0.050.

The central cD galaxy is surrounded by faint attendants and dominates the cluster. This central condensation provides the highest surface density in the cluster. We find a rapid rise of population with magnitude to a plateau near $m_v = 16.5$ a quick jump to $m_v = 18.0$ and then a sudden fall at fainter magnitudes. The distribution of bright galaxy position angles is practically uniform and appears to show no preferential position angle.

In this cluster we find the spiral galaxies more numerous with an (E:SO:S) ratio of (1.0:0.5:1.2). The ellipticals seem to be concentrated near the center of the cluster with an obvious enrichment near the central cD. SO galaxies are scattered throughout the cluster as are the spirals, which have a slight preference for the Eastern portions of the cluster.

The core population represents some 40% of the sample in an area of 0.21 square degrees. This represents a core surface density of 424 galaxies per square degree.

We notice the occurence of several close pairs and groups of galaxies in the cluster. For instance a pair of superposed and somewhat peculiar dense ovoid galaxies with extended envelopes is located at $x = -130.26, y = -88.78$. In addition there are many low surface brightness galaxies with bright nucleii and a few concentrations of galaxies above the general field, notably that located at $x = -91.06, y = -68.77$. The latter is composed primarily of spiral-type galaxies.

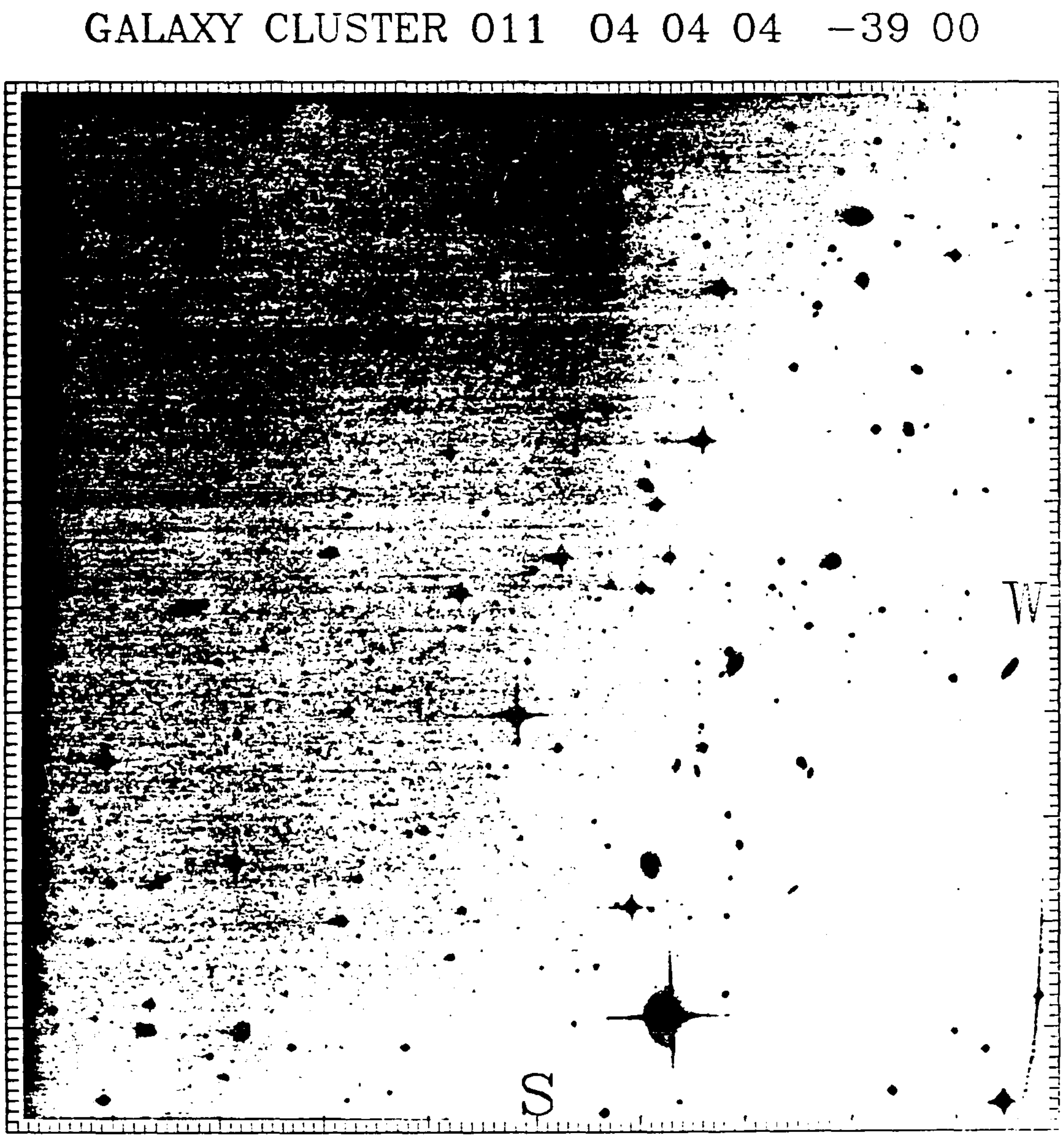


Figure 3.2.11 *(a) Field of GALAXY CLUSTER 011: 04 04 04 -39 00*

GALAXY CLUSTER 011 04 04 04 −39 00

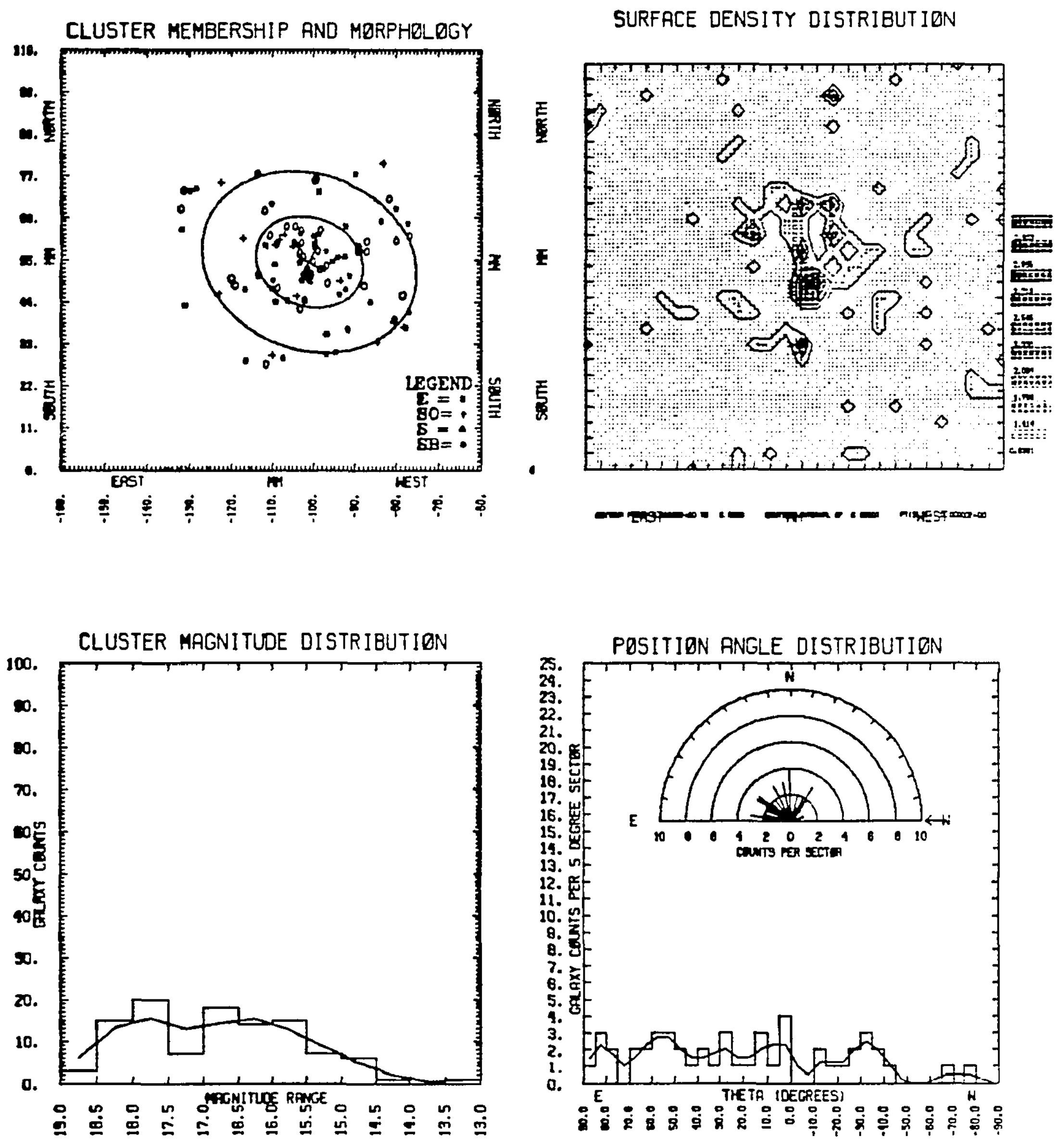
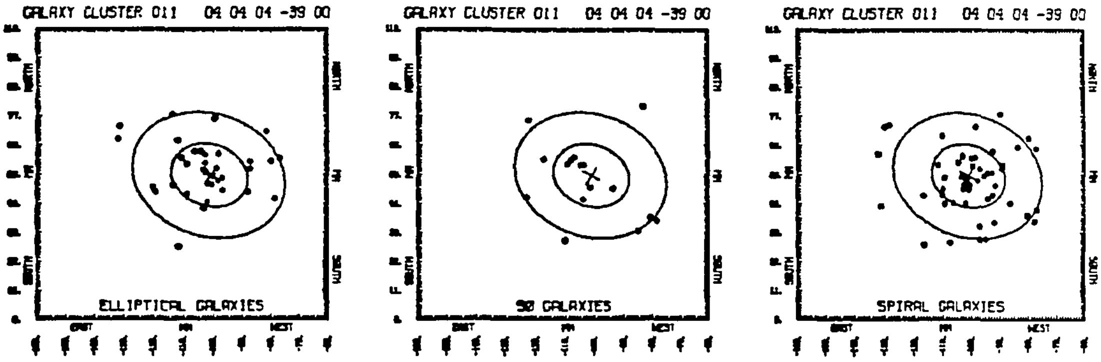


Figure 3.2.11 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 011 04 04 04 −39 00

FIELD 302 — ESO/SERC PLATE J3583

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
101.219	054.375	4 4 4.0	-39 0 28.8	241 56 20.8	-48 6 22.5	0.042

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	36	MAJOR AXIS	13.49	SAMPLE POPULATION	107
S0	16	MINOR AXIS	11.29	CORE POPULATION	55
S	50	ECCENTRICITY	0.55	LIMITING MAGNITUDE	19.0
SB	4	POSN. ANGLE	-29.58		
P	1				

Figure 3.2.11 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.11 *Cluster Population Description.*

GALAXY CLUSTER 011: 04 04 04 -39 00 : The cluster is located in North-East quadrant of ESO/SERC Field 302 . Within a diameter of 60mm as determined by m_{10} we count 112 galaxies in this cluster and 107 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *IR* because of its somewhat irregular surface density, although it is centrally condensed.

We count 53 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a possible $B-M$ type II classification for the cluster which displays a number of bright elliptical galaxies of intermediate appearance. For m_1,m_3, and m_{10} we give 13.4, 14.7 and 15.1,respectively. The value of m_{10} implies a redshift of 0.042.

The cluster membership is widely scattered save for the central portions of the dispersion ellipse. We note a high concentration of galaxies just South of the cluster center and a more dispersed collection of members distributed Northward of the cluster center.

The total cluster membership is somewhat small, and the magnitude distribution shows a gentle rise to a plateau at $m_v = 16.0$. There apears to be an isolated group of faint galaxies from seventeenth to nineteenth magnitude. The position angle distribution appears to be concentrated in the positive sense, that is, East of North with a zone of avoidance of large angles of the opposite sense.

We find an $(E : SO : S)$ ratio of $(1.0 : 0.44 : 1.39)$ and thus a relatively spiral-rich cluster. Both the ellipticals and spirals are somewhat uniform in their distribution with a higher concentration of spirals in the core population than ellipticals. The cluster core contains over 51% of the sample population within an area of nearly 0.17 square degrees. This yields a surface density of 328 galaxies per square degree.

GALAXY CLUSTER 012 05 24 00 −45 01

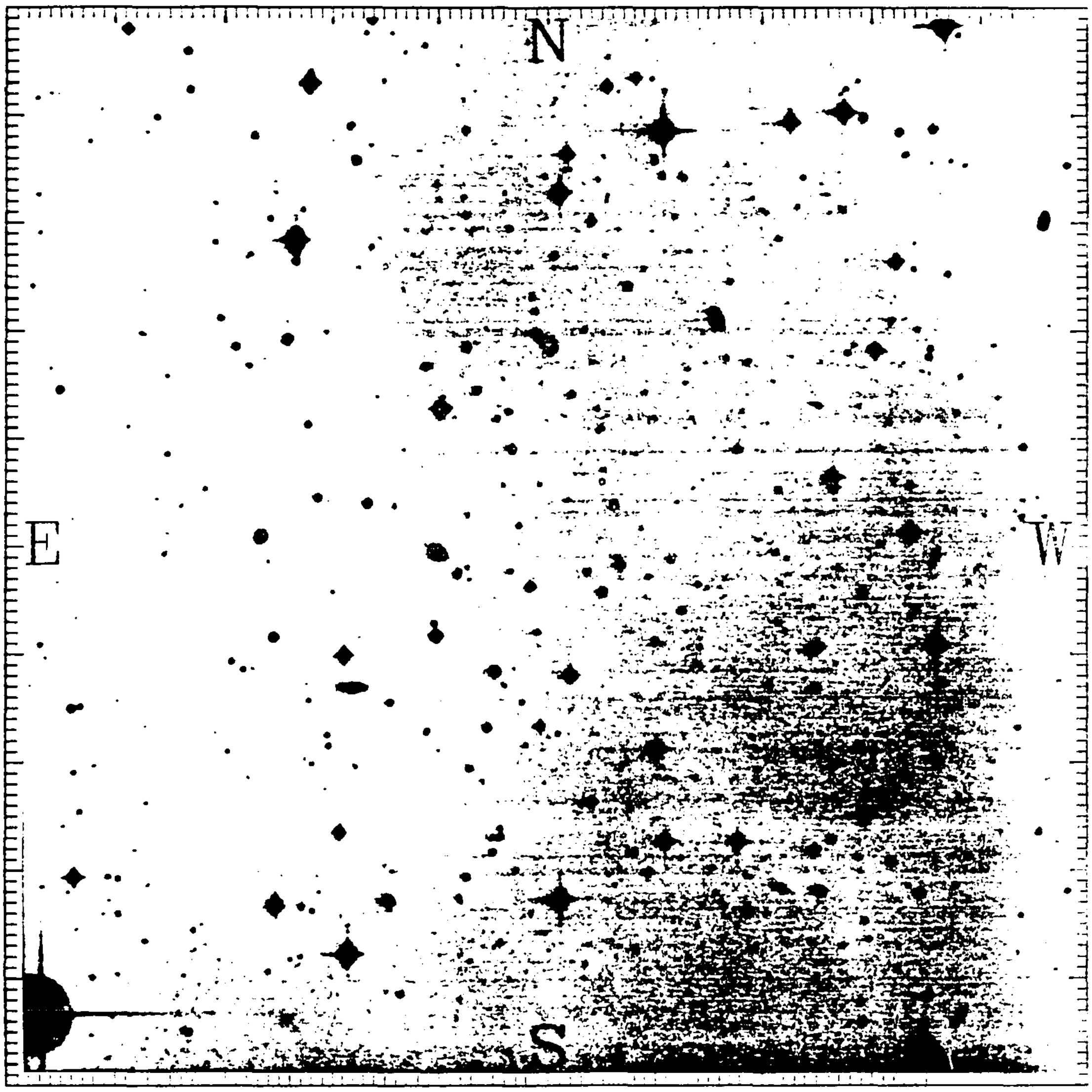


Figure 3.2.12 *(a) Field of GALAXY CLUSTER 012: 05 24 00 -45 01*

GALAXY CLUSTER 012 05 24 00 −45 01

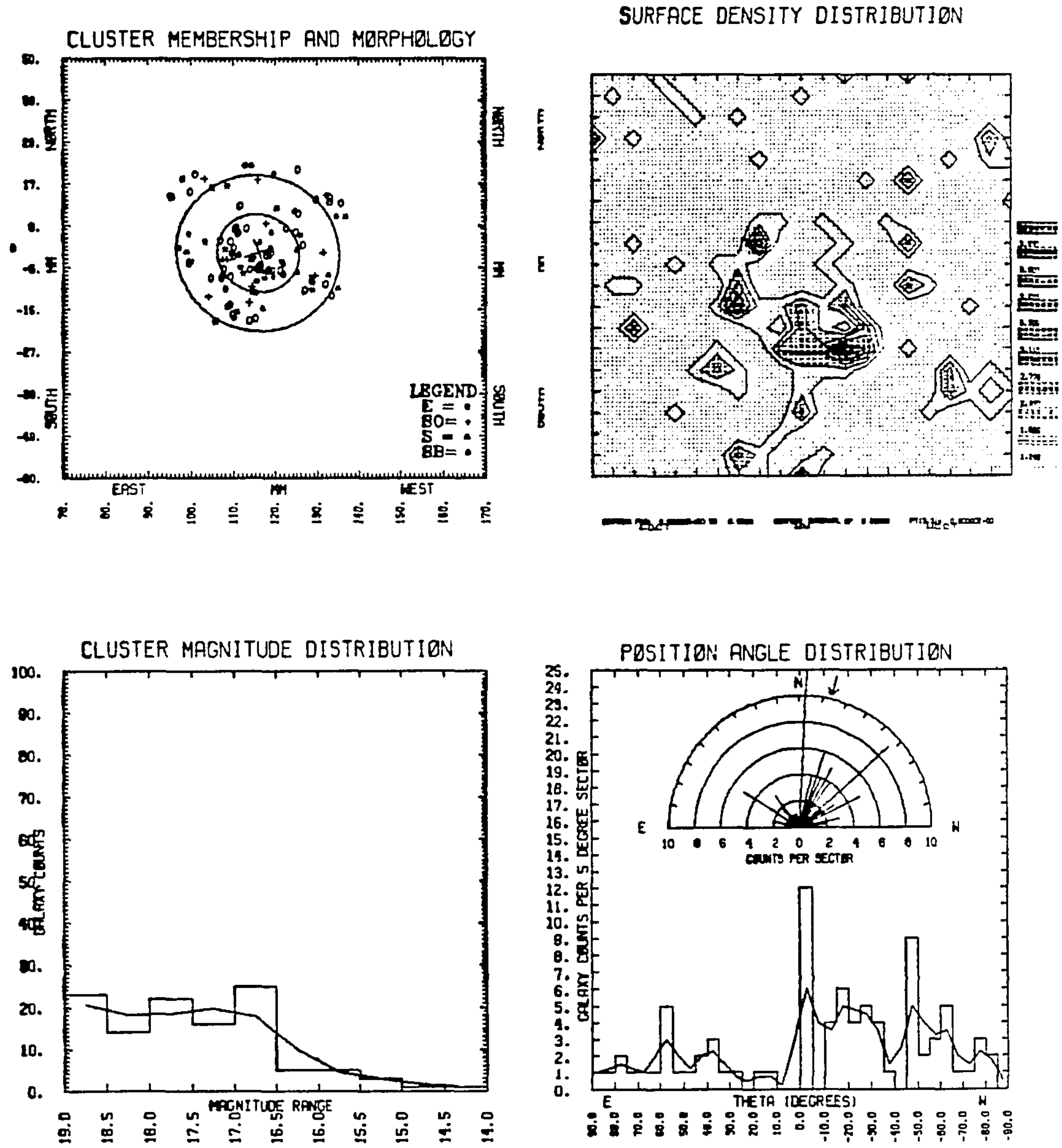
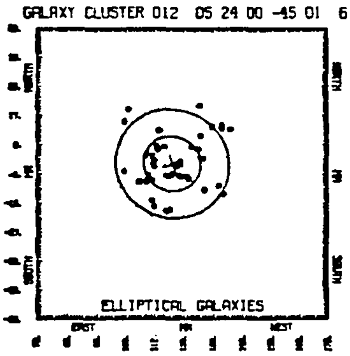
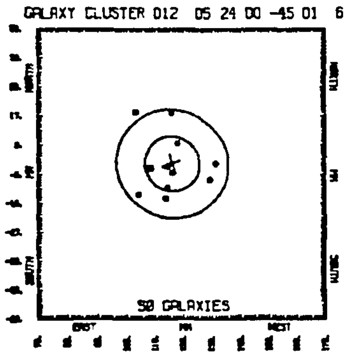
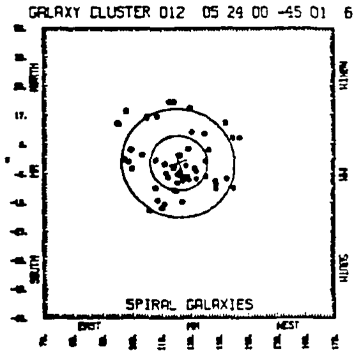


Figure 3.2.12 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*







GALAXY CLUSTER 012 05 24 00 −45 01$

FIELD 253 ESØ/SERC PLATE J6748

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-115.824	-001.271	5 24 0.3	-45 1 46.1	250 45 41.6	-33 34 17.9	0.061

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	46	MAJØR AXIS	10.30	SAMPLE PØPULATIØN	115
SØ	12	MINØR AXIS	9.65	CØRE PØPULATIØN	52
S	55	ECCENTRICITY	0.35	LIMITING MAGNITUDE	19.0
SB	2	PØSN. ANGLE	-71.62		
P	0				

Figure 3.2.12 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.12 *Cluster Population Description.*

GALAXY CLUSTER 012: 05 24 00 -45 01 : The cluster is located in South-West quadrant of ESO/SERC Field 253. Within a diameter of 45mm as determined by m_{10} we count 168 galaxies in this cluster and 115 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *I* due to its inherent irregularity; we note a general scatter of the member galaxies with a single concentration South of the cluster center.

We count 38 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 0. We suggest a $B-M$ type III classification for the cluster which has no dominant galaxies in the field, but just an enhancement of the number of galaxies over and above the nominal field density. For m_1,m_3, and m_{10} we give 14.1, 15.1 and 15.2,respectively. The value of m_{10} implies a redshift of 0.061.

The cluster member galaxies are scattered throughout the measured region with a concentration South of the cluster center and an enhancement in the third quadrant. The cluster density distribution suggests a "U-shaped" grouping in the region of highest galaxy surface density.

The cluster magnitude distribution is practically flat, with a few bright galaxies in the tail of the range rising in number to a plateau after $m_v = 16.5$ and continuing to the faint limit. The position angles of the brighter galaxies appears to be concentrated in the negative sense with the majority of the population having position angles West of North. We note two peaks in the distribution, one at zero degrees, that is, running North-South, and another at fifty degrees, or to the North-West.

We find the cluster to be somewhat spiral rich with an $(E : SO : S)$ ratio of $(1.0 : 0.3 : 1.2)$. Whereas the elliptical galaxies appear to be concentrated in an area South and East of the cluster center, the spirals appear in greater numbers South of center with relatively few North of center. The core population, where 45% of the galaxies reside, is located in an area of some 0.11 square degrees. This yields a surface density of 475 galaxies per square degree within the dispersion ellipse.

We notice several pairs of elliptical galaxies composed of an early and late member such as found at $x = -99.4, y = -3.9$ and $x = -109.4, y = -2.9$.

GALAXY CLUSTER 013 06 21 39 −64 56

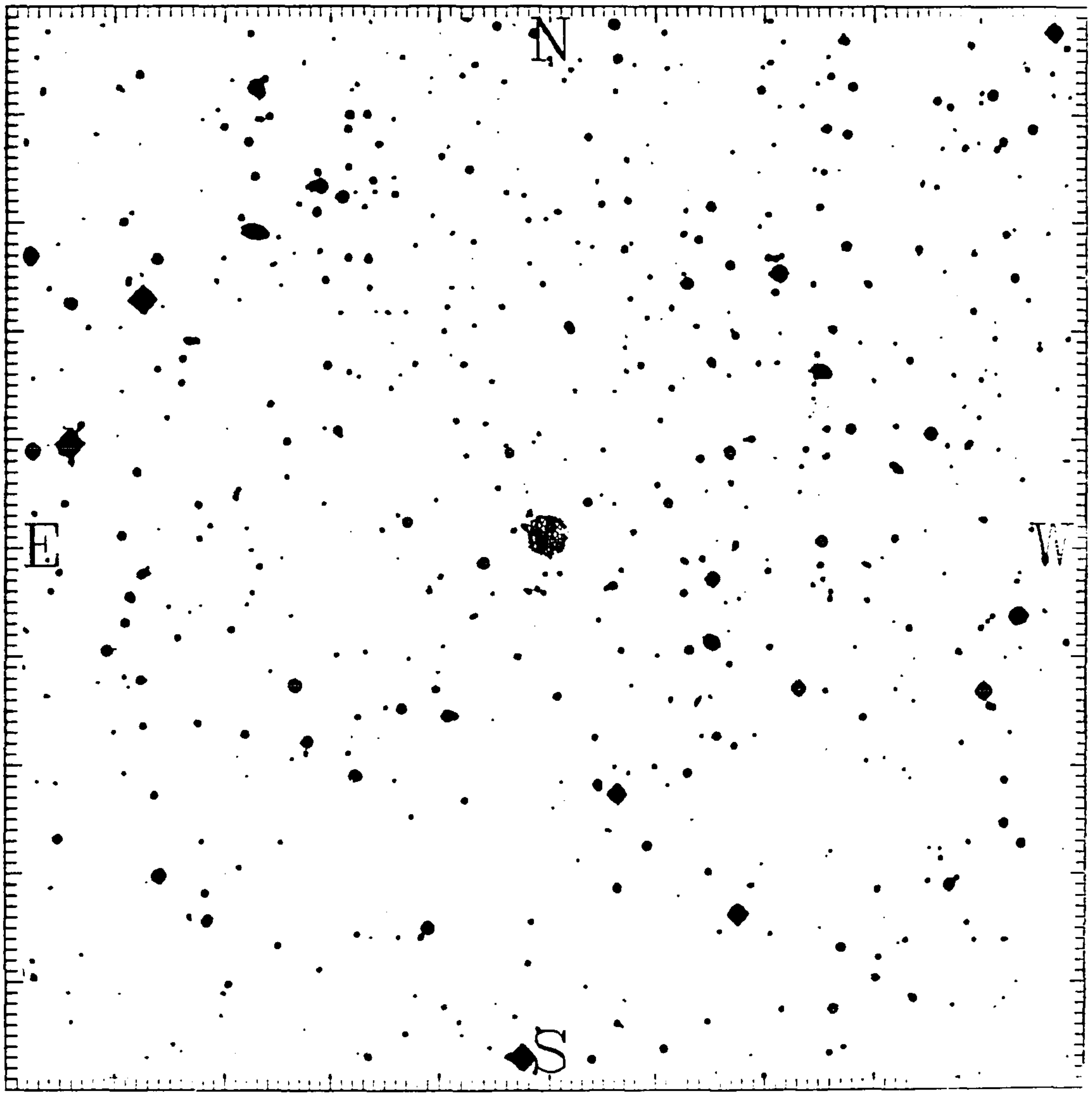


Figure 3.2.13 *(a) Field of GALAXY CLUSTER 013: 06 21 39 -64 56*

GALAXY CLUSTER 013 06 21 39 −64 56

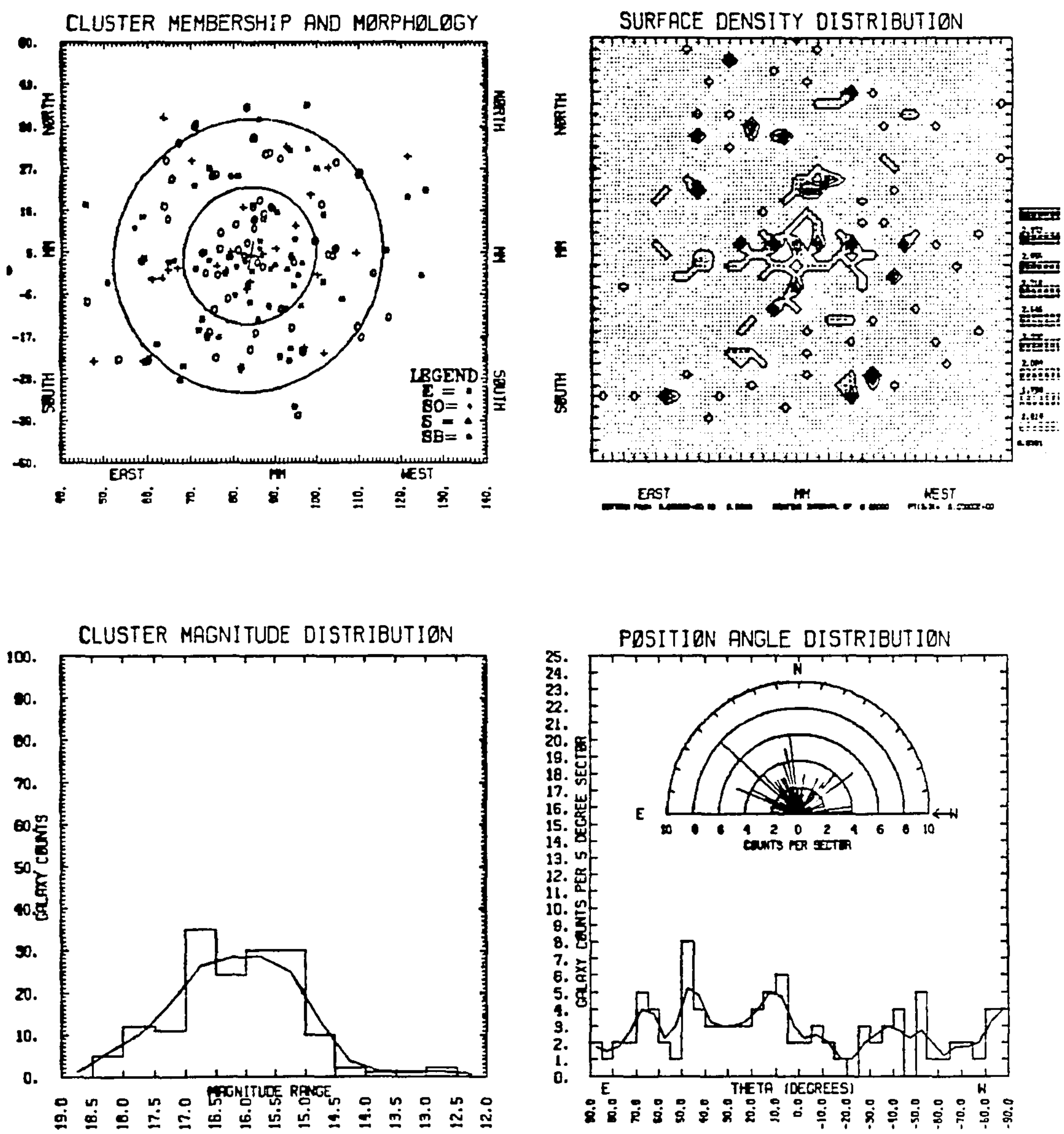
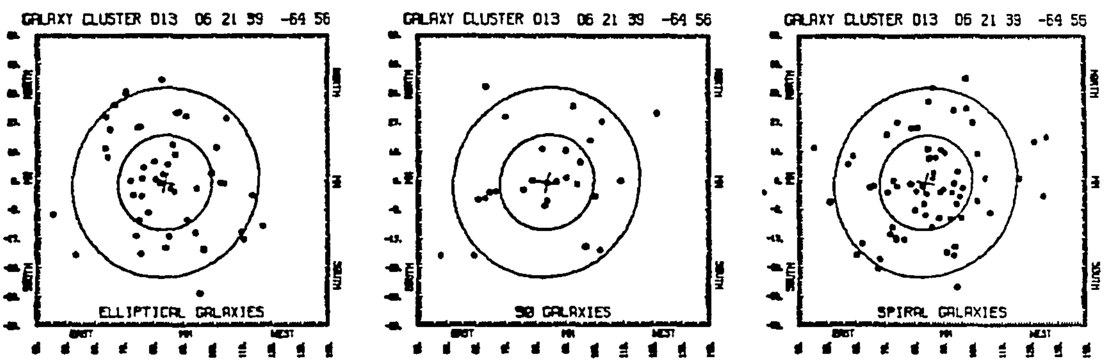


Figure 3.2.13 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 013 06 21 39 −64 56

FIELD 087 — ESO/SERC PLATE J8249

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-083.921	004.016	6 21 39.4	-64 56 34.9	274 42 10.3	-27 29 35.5	0.038

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	52	MAJOR AXIS	17.95	SAMPLE POPULATION	163
S0	28	MINOR AXIS	15.73	CORE POPULATION	65
S	66	ECCENTRICITY	0.48	LIMITING MAGNITUDE	19.0
SB	12	POSN. ANGLE	81.11		
P	5				

Figure 3.2.13 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.13 *Cluster Population Description.*

GALAXY CLUSTER 013: 06 21 39 -64 56 : The cluster is located in North-West quadrant of ESO/SERC Field 087. Within a diameter of 90mm as determined by m_{10} we count 163 galaxies in this cluster, all of which are measured to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type R because of its uniform distribution of surface density which appears to smoothly diminish radially from the cluster center.

We count only 25 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 0. We suggest a $B - M$ type II-III classification for the cluster which has an intermediate population with only a single dominant galaxy which appears to be a normal giant elliptical. For m_1,m_3, and m_{10} we give 12.9, 13.2 and 14.7,respectively. The value of m_{10} implies a redshift of 0.038.

The cluster appears to be relatively smooth in its distribution with few concentrations, the density gradually decreasing radially form the cluster center. The surface density has a few spots where galaxies congregate in slightly higher numbers, but this is due in part to what appears to be, for example, an elliptical galaxy surrounded by faint attendants as we find at $x = -103.6, y = 3.8$.

We find a somewhat symmetrical distribution of magnitudes in the cluster reminiscent of a "bell-shaped" spread rising from the brightest cluster members to a peak near $m_v = 16.0$ and tapering off to $m_v = 18.5$ with very few measured faint galaxies near the magnitude limit. The position angle distribution shows a preference for the brighter galaxies to lie inclined to the North-East whereas there is a relative sparsity found to be inclined to the West of North. The positions of elliptical galaxies are scattered throughout the cluster but with a preference for the second and third quadrants. The spirals, on the other hand appear to have a slightly larger population in the third and fourth quadrants. The cluster is spiral rich with an $(E : SO : S)$ ratio of $(1.0 : 0.5 : 1.5)$. We find a core population representing nearly 40% of the membership within an area of 0.31 square degrees. On the sky, this represents a surface density of 209 galaxies per square degree.

Several pairs of superposed galaxies are noted with an early and a late elliptical as that found at $x = -65.5, y = 23.9$. Some of the spirals appear distressed and/or superposed and we note a peculiar galaxy at $x = -81.7, y = -25.4$ which displays a thin diffuse bar with concentrations at its poles.

GALAXY CLUSTER 014 06 25 02 −53 39

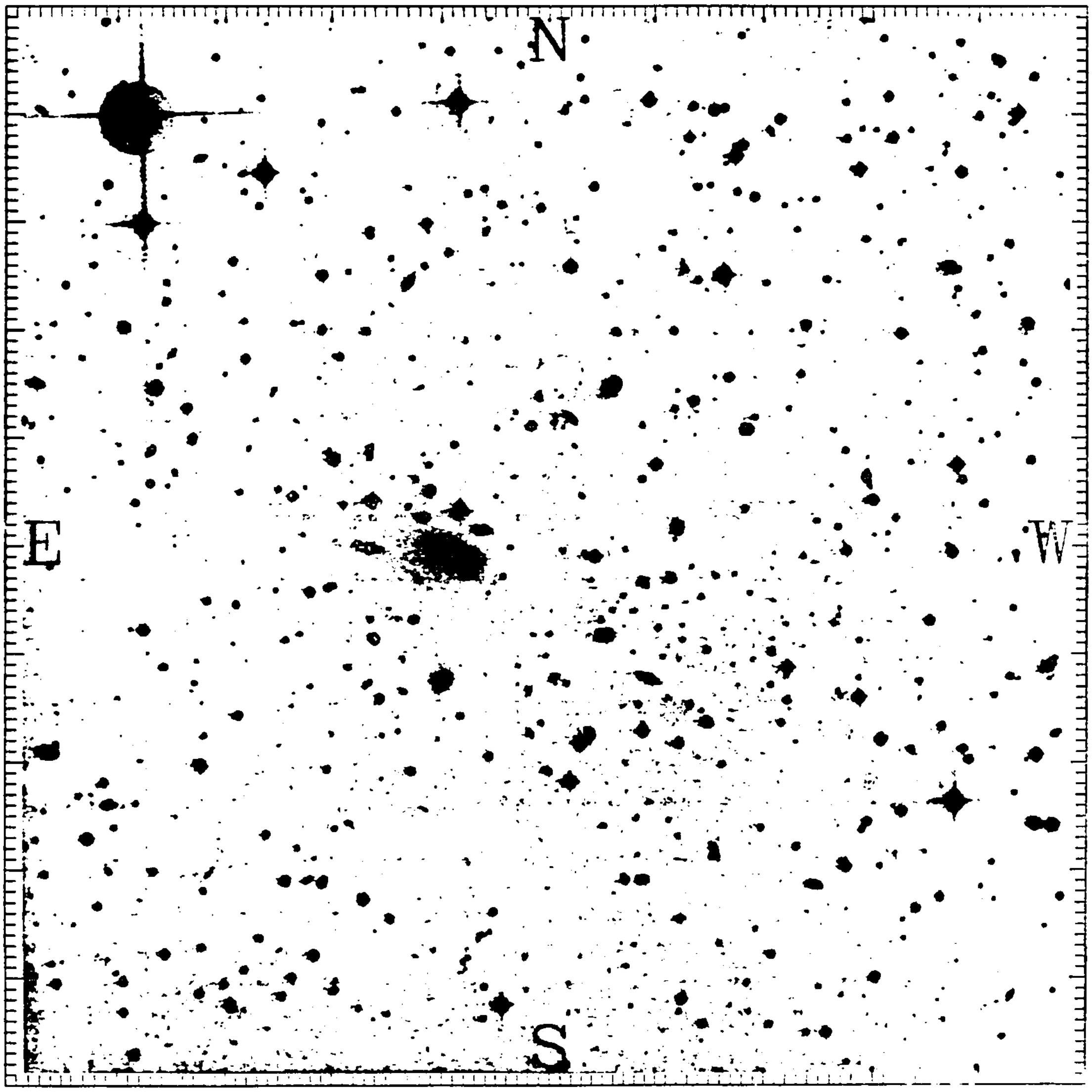


Figure 3.2.14 *(a) Field of GALAXY CLUSTER 014: 06 25 02 -53 39*

GALAXY CLUSTER 014 06 25 02 −53 39

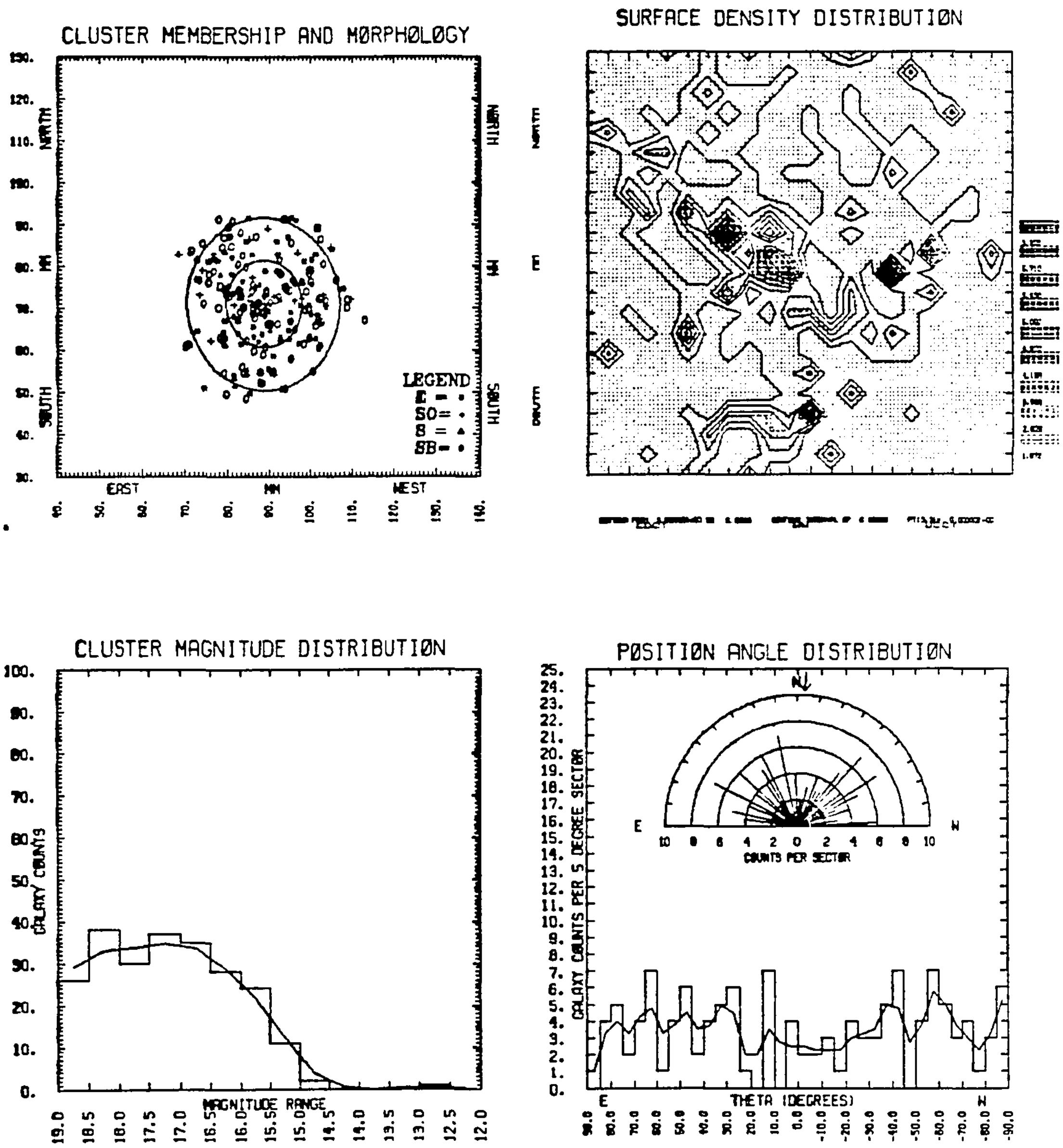
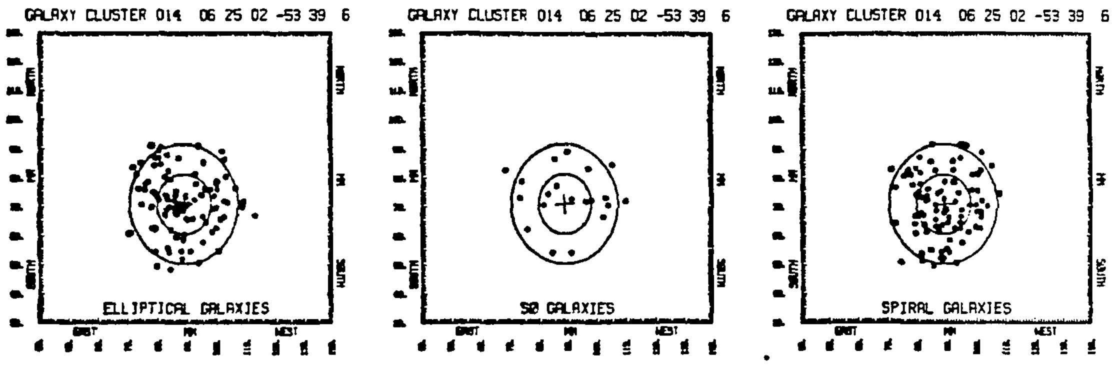


Figure 3.2.14 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 014 06 25 02 −53 39$						
FIELD 161						ESO/SERC PLATE J5538
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-088.653	070.926	6 25 2.5	-53 39 26.8	262 21 36.2	-25 11 15.9	0.049
MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS		
E	109	MAJOR AXIS	10.30	SAMPLE POPULATION	232	
S0	20	MINOR AXIS	9.13	CORE POPULATION	79	
S	98	ECCENTRICITY	0.46	LIMITING MAGNITUDE	19.0	
SB	4	POSN. ANGLE	-86.72			
P	1					

Figure 3.2.14 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.14 *Cluster Population Description.*

GALAXY CLUSTER 014: 06 25 02 -53 39 : The cluster is located in North-West quadrant of ESO/SERC Field 161. Within a diameter of 45mm as determined by m_{10} we count 239 galaxies in this cluster and 232 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type R because of its fairly uniform distribution of galaxies.

We count over 100 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 2. We suggest a $B - M$ type I classification for the cluster which has a dominant centrally located cD galaxy with an apparent double nucleus and a corona. For m_1,m_3, and m_{10} we give 12.9, 15.0 and 15.4, respectively. The value of m_{10} implies a redshift of 0.049.

The cluster appears centrally condensed with a smooth distribution decreasing radially from the center. There is, however, a slight concentration North-East of center where we find a slightly enhanced group of elliptical galaxies.

The magnitude distribution rises gradually from about $m_v = 14.5$ to $m_v = 17.0$ where it tapers off to a nearly flat plateau. For the position angle distribution, we find no aparent preference for orientation and have nearly the same number of galaxies oriented North-East as we have oriented North-West.

We find the positional distribution of elliptical and spiral galaxies to be similar and somewhat oriented North-South. The $(E : SO : S)$ ratio is $(1.0 : 0.2 : 0.9)$ giving a somewhat similar population of ellipticals and spirals. The core population holds 34% of the cluster membership in an area of some 0.10 square degrees. This yields a surface density of 763 galaxies per square degree. We note that the dispersion ellipse is nearly oriented North-South which agrees well with the apparent distribution of elliptical and spiral galaxies.

Aside from the remarkable cD galaxy with an apparent double nucleus and corona, we note several complicated spiral galaxies that are centrally condensed and have ring-like structures as, for example, one found at $x = -79.3, y = 66.9$.

GALAXY CLUSTER 015 06 26 25 −54 22

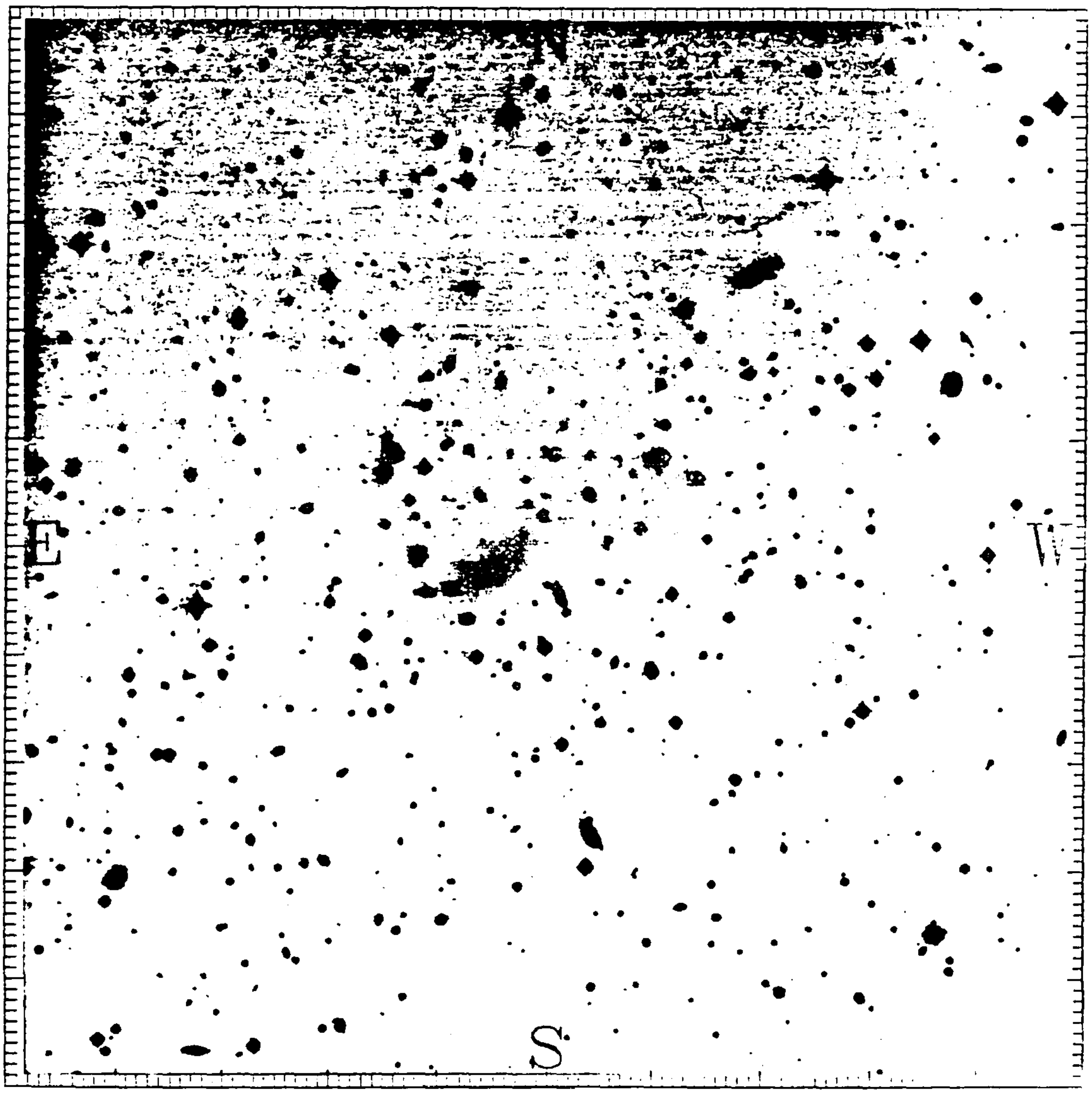


Figure 3.2.15 *(a) Field of GALAXY CLUSTER 015: 06 26 25 -54 22*

GALAXY CLUSTER 015 06 26 25 −54 22

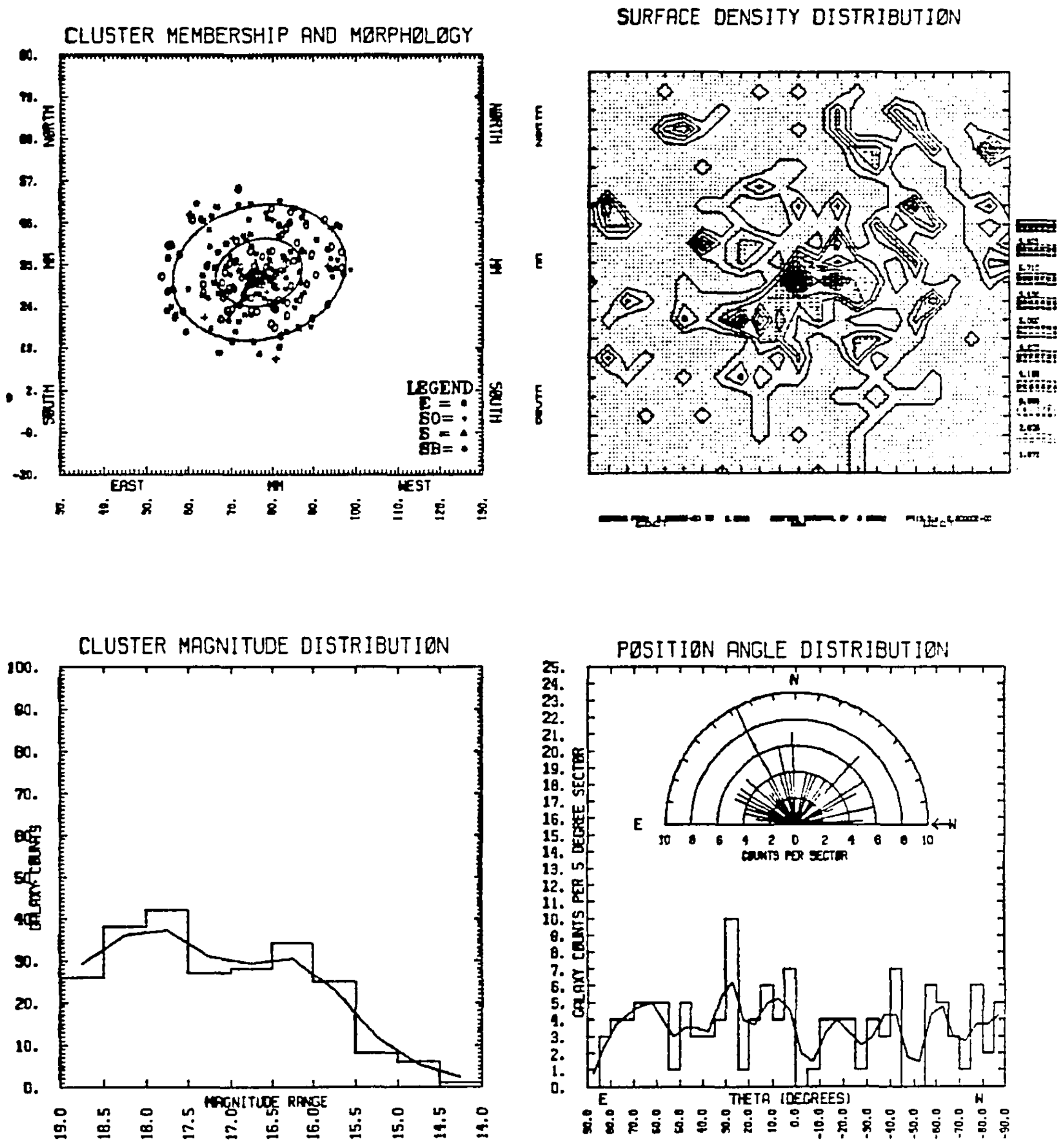
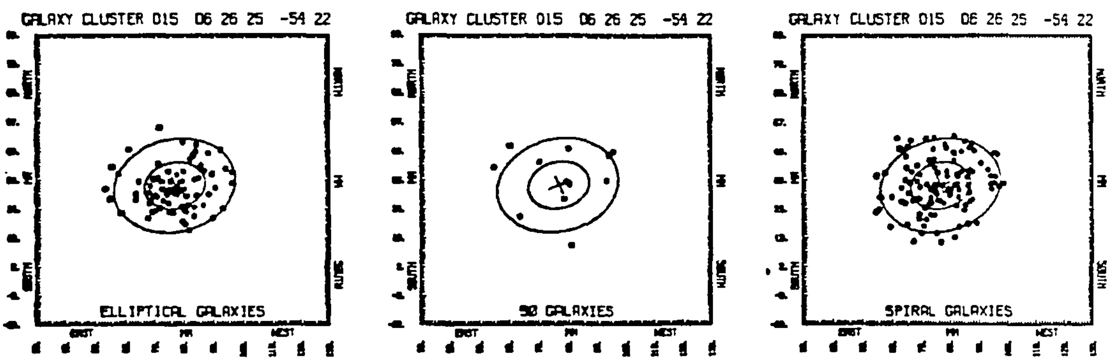


Figure 3.2.15 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 015 06 26 25 −54 22

FIELD 161 — ESØ/SERC PLATE J5538

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-076.713	032.793	6 26 25.1	-54 22 29.4	263 10 56.4	-25 8 49.3	0.048

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	89	MAJØR AXIS	10.55	SAMPLE PØPULATIØN	235
SØ	14	MINØR AXIS	8.67	CØRE PØPULATIØN	90
S	127	ECCENTRICITY	0.57	LIMITING MAGNITUDE	19.0
SB	4	PØSN. ANGLE	21.06		
P	1				

Figure 3.2.15 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.15 *Cluster Population Description.*

GALAXY CLUSTER 015: 06 26 25 -54 22 : The cluster is located in North-West quadrant of ESO/SERC Field 161. Within a diameter of 45mm as determined by m_{10} we count 247 galaxies in this cluster and 235 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type R because of its regular appearance and smooth radial distribution of galaxies outward from a rather dense core.

We count 85 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 2. We suggest a $B-M$ type II classification for the cluster which has a dominant elliptical galaxy somewhat intermediate between a cD class galaxy and a normal giant elliptical. For m_1,m_3, and m_{10} we give 14.3, 14.7 and 15.3, respectively. The value of m_{10} implies a redshift of 0.048.

The cluster membership form a dense, rich and diverse cluster. There is an obvious central condensation to the cluster with several concentrations South-East of the cluster center. The core of the cluster appears somewhat elongated and "dumbell" shaped.

The magnitude distribution rises rapidly from the relatively few very bright galaxies to a plateau near $m_v = 16.0$ then rises to another peak near $m_v = 18.0$ after which it falls off.

Position angles for the brighter galaxies are distributed about equally in both the positive and negative sense, with a slight peak near $+30°$, that is to the North North-East.

We find the cluster center dominated by elliptical galaxies, with the spirals, on the other hand, scattered throughout the cluster-at-large. The $(E : SO : S)$ ratio is $(1.0 : 0.2 : 1.5)$ making this a spiral-rich cluster. The core population represents some 38% of the sample population and is located in an area of 0.10 square degrees. This yields a core surface density of 894 galaxies per square degree.

We note that the m_1,m_3, and $m_1 0$ brightest galaxies are elliptical galaxies, all possessing a corona. Other ellipticals are seen with coronae as well. Several superpositions occur, for example at $x = -84.1, y = 45.6$, where we find a spiral-elliptical combination.

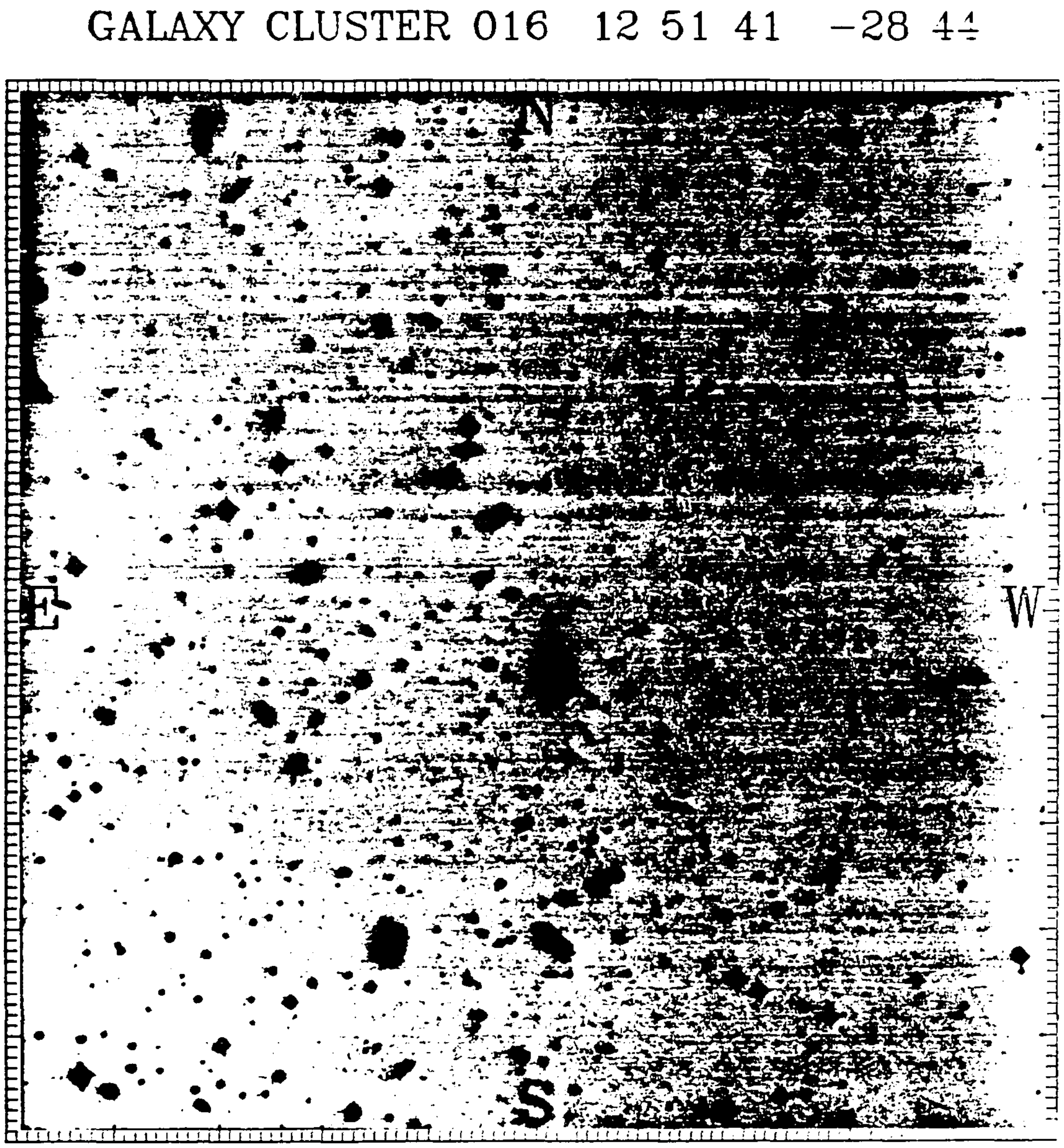


Figure 3.2.16 *(a) Field of GALAXY CLUSTER 016: 12 51 41 -28 44*

GALAXY CLUSTER 016 12 51 41 −28 44

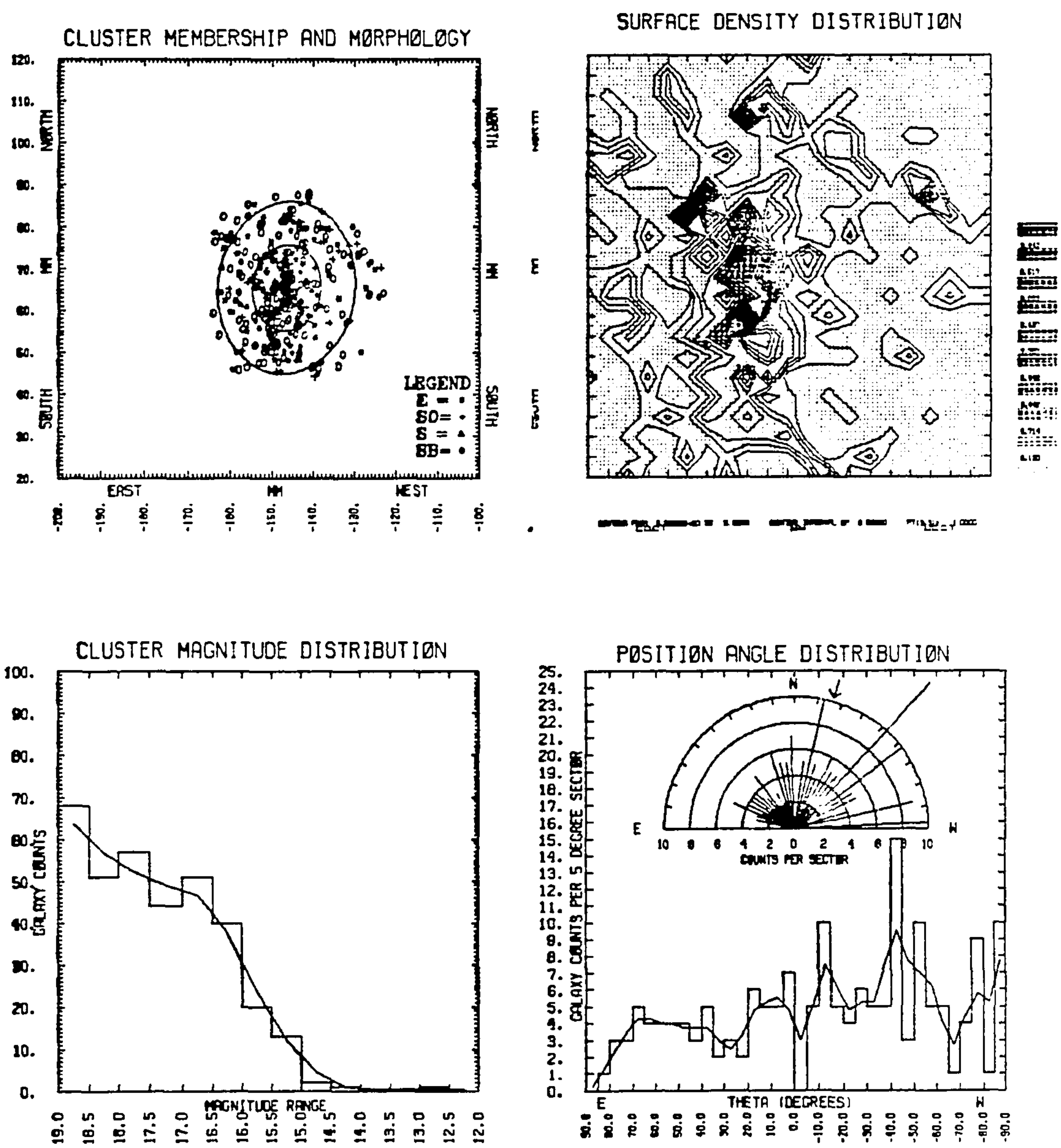
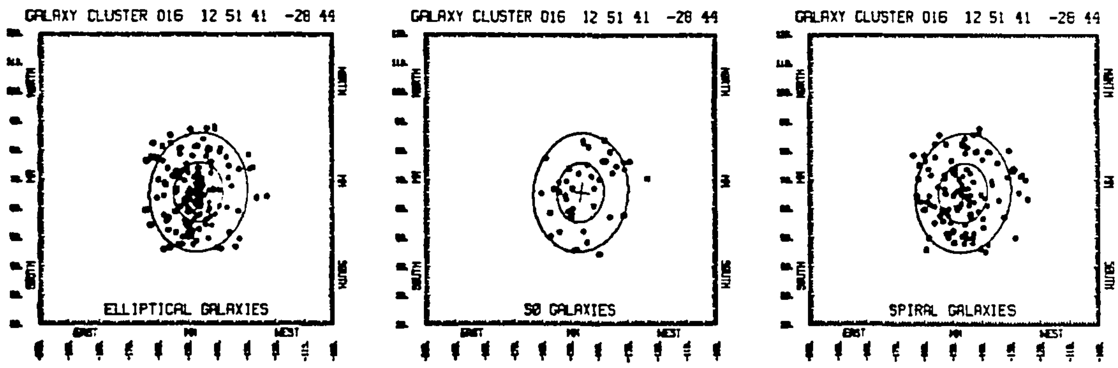


Figure 3.2.16 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 016 12 51 41 −28 44

FIELD 442 — ESØ/SERC PLATE J5760

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
146.553	065.348	12 51 41.2	-28 44 33.4	303 42 32.9	33 51 13.3	0.048

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	175	MAJØR AXIS	10.29	SAMPLE PØPULATIØN	348
SØ	45	MINØR AXIS	8.26	CØRE PØPULATIØN	145
S	121	ECCENTRICITY	0.60	LIMITING MAGNITUDE	19.0
SB	7	PØSN. ANGLE	82.44		
P	0				

Figure 3.2.16 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.16 *Cluster Population Description.*

GALAXY CLUSTER 016: 12 51 41 -28 44 : The cluster is located in North-East quadrant of ESO/SERC Field 422. Within a diameter of 45mm as determined by m_{10} we count 420 galaxies in this cluster and 348 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *RI* because of its linear core with fairly large extended scatter. There is a suggestion of the superposition of two clusters.

We count 86 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 2. We suggest a possible $B - M$ type II: classification for the cluster which appears to have several bright elliptical galaxies intermediate in appearance between the class cD and normal giant ellipticals. For m_1,m_3, and m_{10} we give 12.9, 14.5 and 15.2, respectively. The value of m_{10} implies a redshift of 0.048.

The cluster membership appears to be aligned preferentially North-South, giving the core of the cluster an almost linear appearance. We note a strong concentration just South of center and a smaller one, somewhat isolated, North of the cluster center.

The cluster magnitude distribution rises rapidly with increasing magnitude range till about $m_v = 17.0$ where there is a change in slope, rising once more, but not as steeply. The position angles of the brighter galaxies seem to concentrate in the negative sense, that is, to the North-West with a dominant peak at approximately -45 degrees.

The cluster is dominated by a somewhat linear distribution of elliptical galaxies. We find the $(E : SO : S)$ ratio to be $(1.0 : 0.3 : 0.7)$ with the ellipticals densly occupying the cluster core. The spirals are more evenly distributed, but have their concentrations as well, the major one being quite near the cluster center. The dense core of the cluster contains some 42% of the population within an area of 0.09 square degrees. This yields a core surface density of 1549 galaxies per square degree.

The cluster contains an obvious subgroup centered on a elliptical galaxy at $x = 146.5, y = 61.6$. This subgroup appears to be composed primarily of elliptical galaxies. We also notice several pairs of galaxies, the pairs formed by an early and a late elliptical as found at $x = 147.0, y = 60.3$.

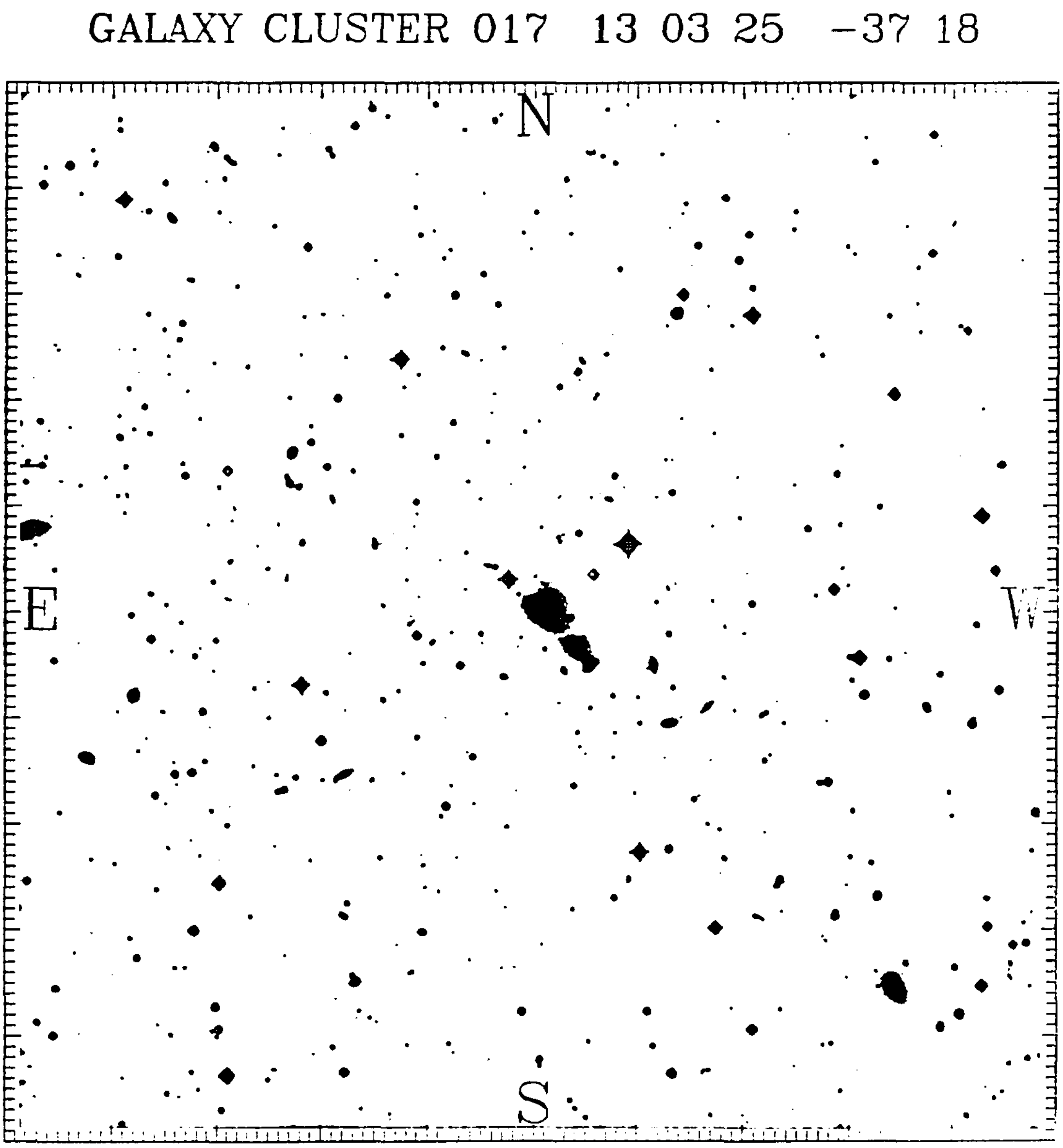


Figure 3.2.17 *(a) Field of GALAXY CLUSTER 017: 13 03 25 -37 18*

GALAXY CLUSTER 017 13 03 25 −37 18

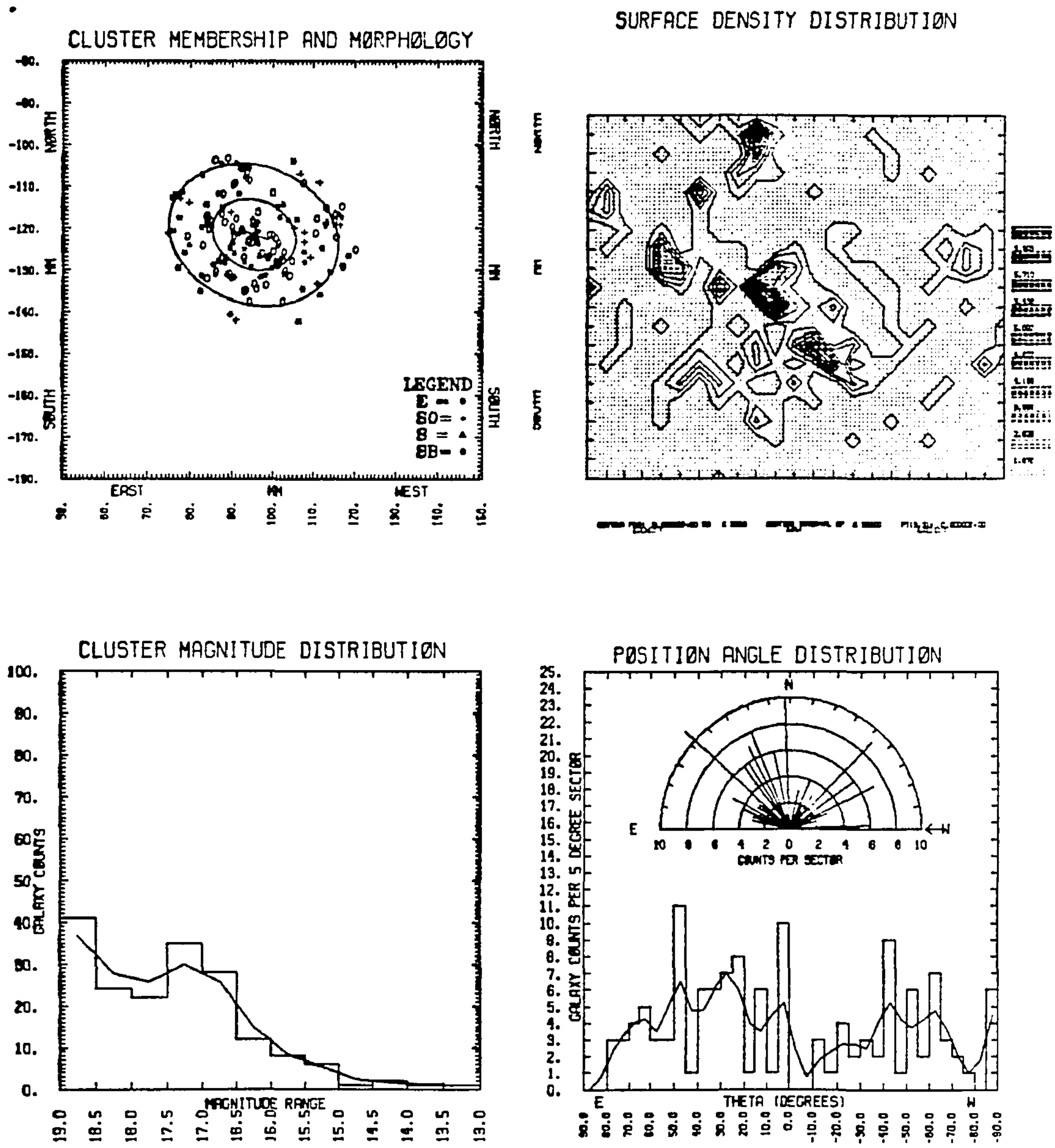
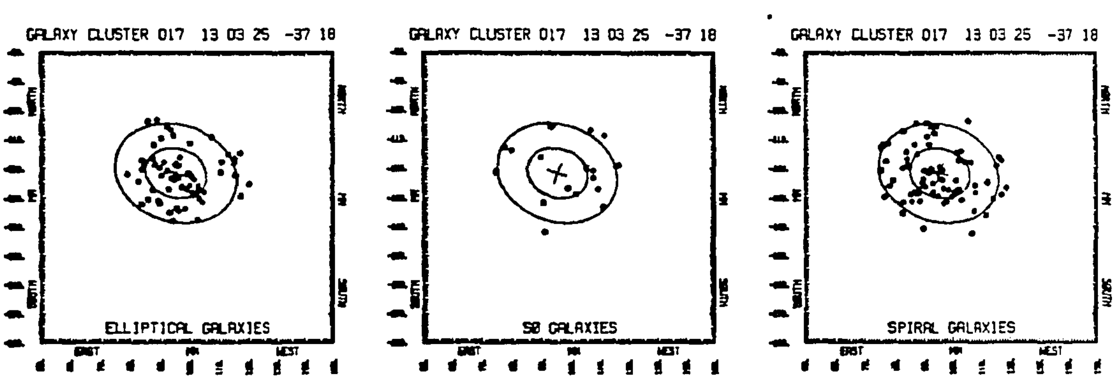


Figure 3.2.17 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 017 13 03 25 −37 18

FIELD 382 ESØ/SERC PLATE J1530

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-095.233	-121.728	13 3 25.3	-37 17 59.6	306 10 10.3	25 12 41.6	0.049

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	69	MAJØR AXIS	10.48	SAMPLE PØPULATIØN	181
SØ	18	MINØR AXIS	8.26	CØRE PØPULATIØN	65
S	81	ECCENTRICITY	0.61	LIMITING MAGNITUDE	19.0
SB	12	PØSN. ANGLE	-19.01		
P	1				

Figure 3.2.17 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.17 *Cluster Population Description.*

GALAXY CLUSTER 017: 13 03 25 -37 18 : The cluster is located in South-West quadrant of ESO/SERC Field 382. Within a diameter of 45mm as determined by m_{10} we count 255 galaxies in this cluster and 181 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *R* because of its somewhat smooth distribution of galaxies and high central condensation.

We count 28 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 0. We suggest a $B - M$ type II classification for the cluster which has several bright elliptical galaxies with coronae that are intermediate between the class cD and normal giant elliptical galaxies. For m_1,m_3, and m_{10} we give 13.2, 14.2 and 15.4, respectively. The value of m_{10} implies a redshift of 0.049.

The cluster members form a distribution with several surface density concentrations. The highest concentration exists at the cluster center with less dense regions located South-West of center and North of center.

The magnitude distribution gently rises to an initial maximum at $m_v = 17.0$ then falls some thirty percent to a plateau near $m_v = 18.5$ and then rises once more to the limiting magnitude. The position angle distribution shows an enhancement towards the North-East with peaks to the North-East, North and North-West respectively.

In the core of the cluster we find the elliptical galaxies somewhat aligned along the major axis of the dispersion ellipse and then scattered about the cluster with a diminished number towards the Western end of the cluster. Similar behavoir is found with the spiral galaxies which have a tendency to congregate in their greatest numbers South of the cluster center. We find an $(E : SO : S)$ ratio of (1.0:0.3:1.3) making this a slightly spiral enriched cluster. The core population amounts to some 36% of the sample located in an area of 0.09 square degrees. This represents a surface density of 682 galaxies per square degree on the sky.

We note that the brightest five galaxies are classed as ellipticals having a corona. At least two of these brightest galaxies appear superposed. Also found in this cluster are several pairs of galaxies composed of an early and a late elliptical such as the one located at $x = -98.8, y = -126.9$.

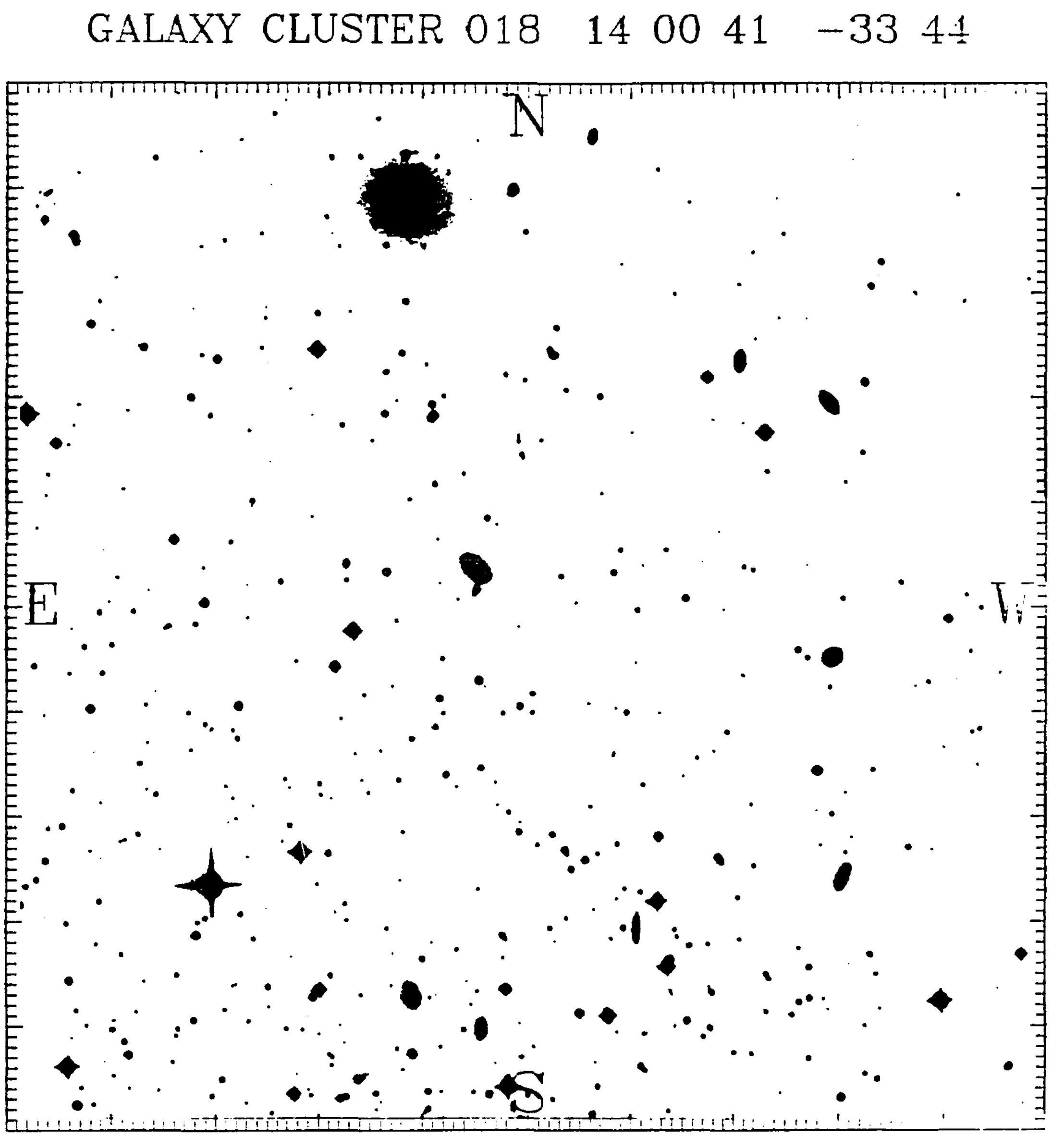


Figure 3.2.18 *(a) Field of GALAXY CLUSTER 018: 14 00 41 -33 44*

GALAXY CLUSTER 018 14 00 41 −33 44

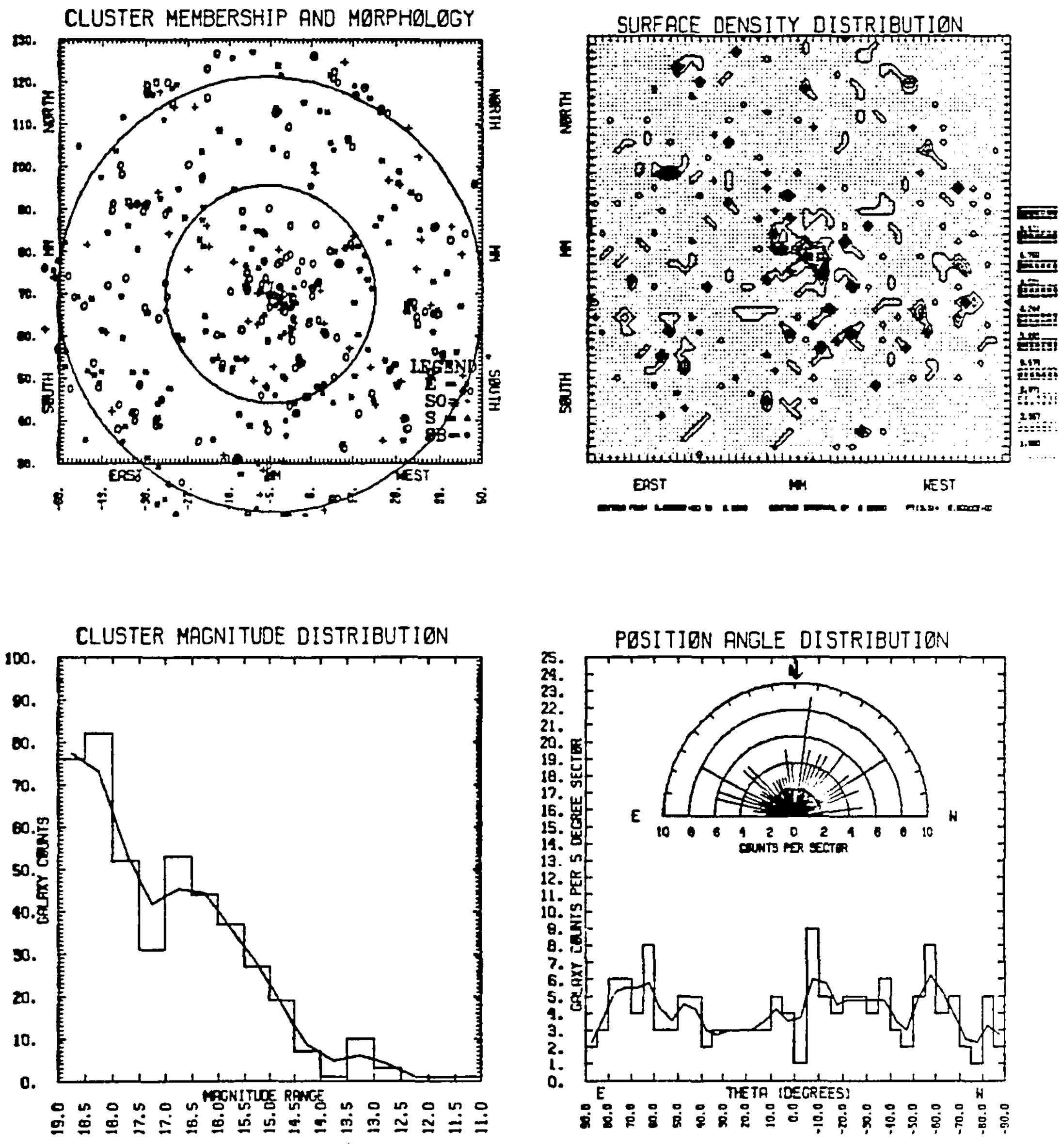
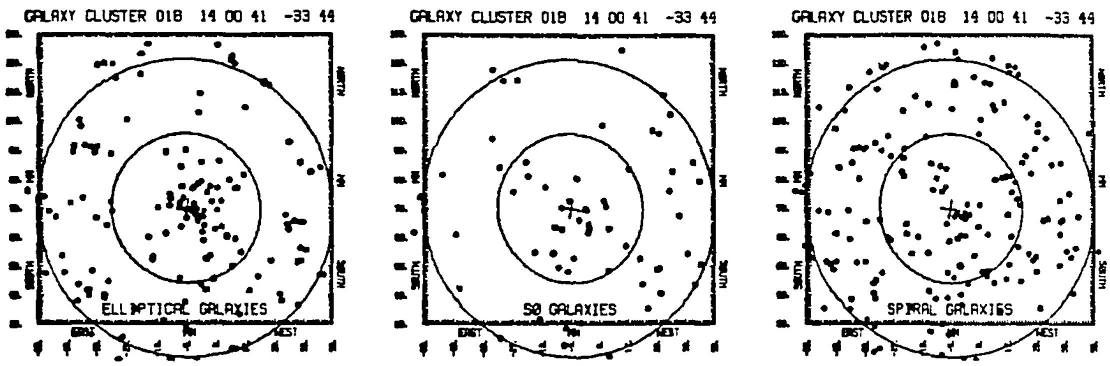


Figure 3.2.18 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 018 14 00 41 −33 44						
FIELD 384						ESØ/SERC PLATE J4851
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
005.223	069.735	14 0 40.6	-33 44 13.9	319 37 9.5	26 32 41.9	0.020

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	165	MAJØR AXIS	27.65	SAMPLE PØPULATIØN	444
SØ	63	MINØR AXIS	25.63	CØRE PØPULATIØN	155
S	172	ECCENTRICITY	0.38	LIMITING MAGNITUDE	19.0
SB	96	PØSN. ANGLE	-8.07		
P	8				

Figure 3.2.18 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.18 *Cluster Population Description.*

GALAXY CLUSTER 018: 14 00 41 -33 44 : The cluster is located in the North-East quadrant of ESO/SERC Field 384. Within a diameter of 120mm as determined by m_{10} we count 479 galaxies in this cluster and 444 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *RI* due to the presence of several concentrations within the body of the cluster.

We count 24 galaxies brighter than m_3+2 and thus classify the cluster as having

an Abell richness of 0. We suggest a $B-M$ type I classification for the cluster which has a dominant cD galaxy in its core. We note that the cD is rather elliptical and has a corona. For m_1,m_3, and m_{10} we give 11.2, 12.6 and 13.3, respectively. The value of m_{10} implies a redshift of 0.020.

The cluster membership is sparsely distributed over some 1000 mm^2 and is has a relatively high central density. We note that the surface density is generally quite low except for the core where there is an elongated group of galaxies forming the highest concentration of galaxies in the cluster.

The magnitude distribution shows two peaks suggesting a bright population of galaxies that cuts off beyond $m_v = 17.0$ and perhaps a background population of many very faint galaxies near $m_v = 18.5$. The position angle distribution shows a preference of the brighter galaxies to be oriented West of North with peaks in the distribution near -10 and -60 degrees.

We find the $(E : SO : S)$ ratio to be $(1.0 : 0.4 : 1.3)$ showing an excess of spirals. The core population represents nearly 35occupies an area of 0.78 square degrees. This yields a cluster surface density of 199 galaxies per square degree.

Several elliptical galaxies are seen in groups reminiscent of "chains" such as the set found at $x = -23.8, y = 112.9$. Other groups of spirals or SO galaxies with faint elliptical companions are seen at, for example, $x = 4.5, y = 104.1$ or $x = 38.3, y = 90.5$. We find a large proportion of barred-spiral galaxies in the cluster, several with ring-like structures about the nucleus such as the object located at $x = -18.5, y = 62.1$.

Figure 3.2.19 *(a) Field of GALAXY CLUSTER 019: 14 09 18 -32 50*

GALAXY CLUSTER 019 14 09 18 −32 50

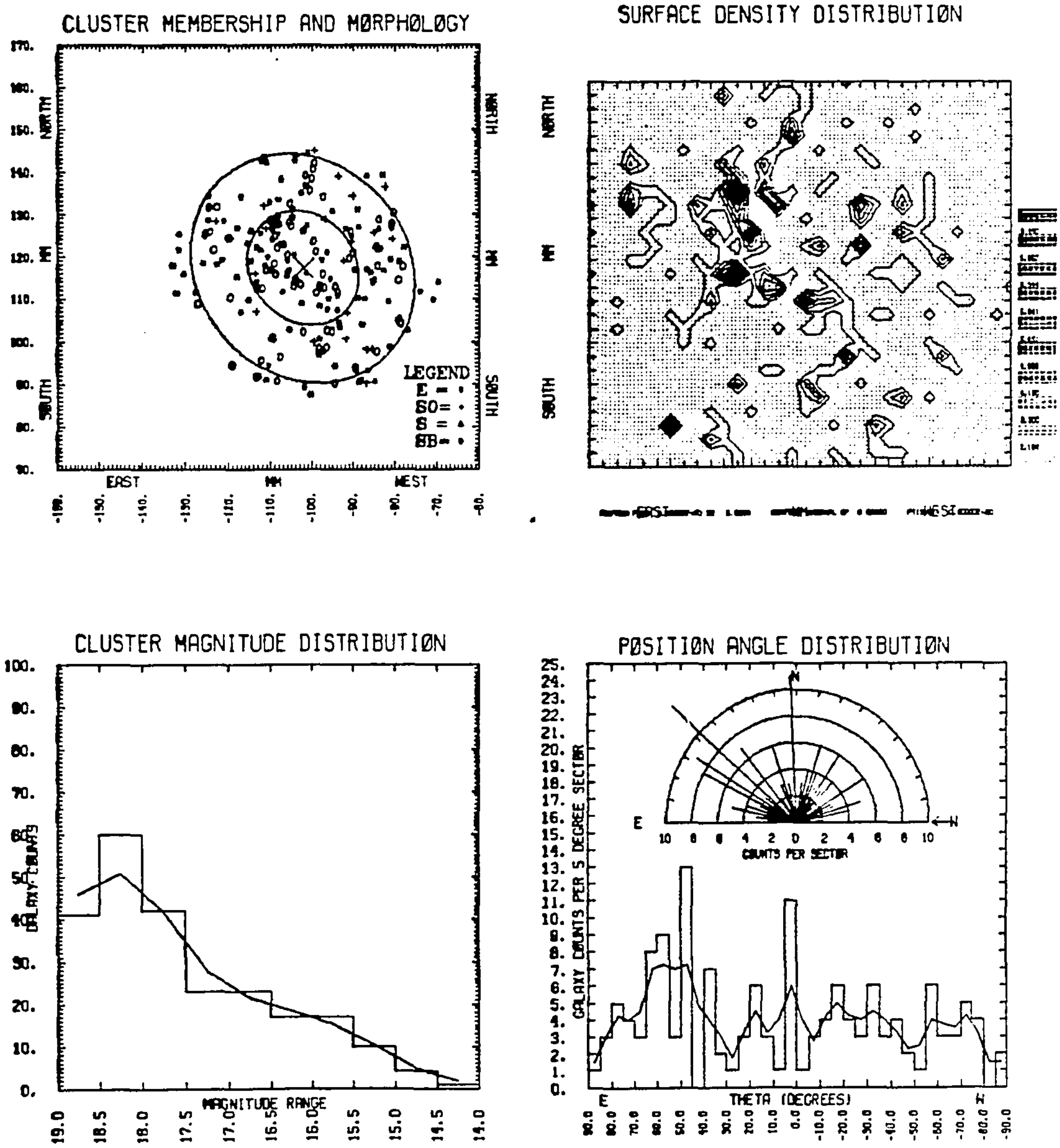
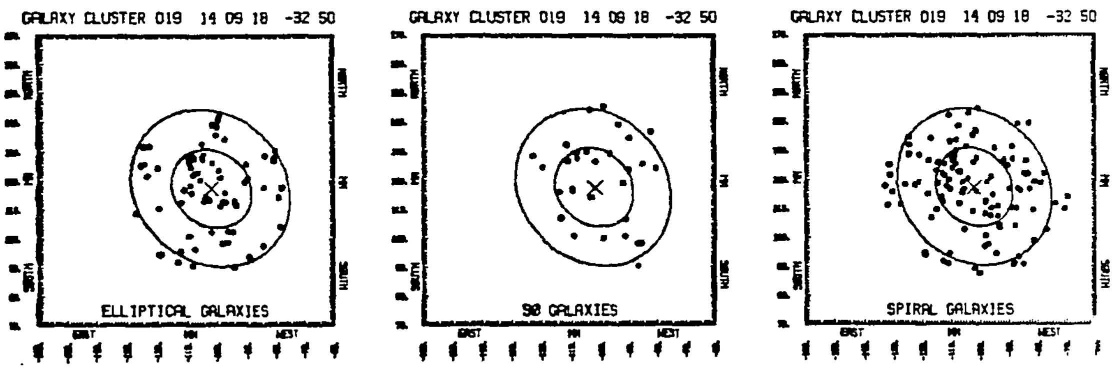


Figure 3.2.19 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 019 14 09 18 −32 50

FIELD 384 — ESO/SERC PLATE J4851

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
102.148	117.241	14 9 17.9	−32 50 2.6	321 51 15.5	26 48 60.0	0.044

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	77	MAJOR AXIS	14.36	SAMPLE POPULATION	238
S0	31	MINOR AXIS	12.43	CORE POPULATION	91
S	118	ECCENTRICITY	0.50	LIMITING MAGNITUDE	19.0
SB	8	POSN. ANGLE	−46.51		
P	3				

Figure 3.2.19 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.19 *Cluster Population Description.*

GALAXY CLUSTER 019: 14 09 18 -32 50 : The cluster is located in the North-East quadrant of ESO/SERC Field 384. Within a diameter of 60mm as determined by m_{10} we count 265 galaxies in this cluster and 238 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* because of the high degree of scatter.

We count 64 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B-M$ type III classification for the cluster which has no significantly dominant galaxies. For m_1,m_3, and m_{10} we give 14.3, 14.8 and 15.2, respectively. The value of m_{10} implies a redshift of 0.044.

The cluster appears to have several concentrations not located near the cluster center: the most dense lies East of center while another lies North-East of center. There are other smaller condensations scattered throughout the cluster.

The magnitude distribution rises slowly from the brightest galaxies to those at $m_v = 17.5$ after which the slope changes, rapidly rising to fainter magnitudes. Position angles seem to be concentrated East of North, in the positive sense, with peaks in the distribution near zero and forty-five degrees.

The elliptical galaxies appear to be scattered throughout the cluster with a slight concentration in the core, especially in the second quadrant. Likewise, the spirals concentrate in the core with a similar enhancement towards the North-East. We find the $(E : SO : S)$ ratio to be $(1.0 : 0.4 : 1.6)$ suggesting a spiral-rich cluster.

We note that the core population comprises some 38% of the sample within an area of 0.19 square degrees. This yields a core surface density of 463 galaxies per square degree.

The great diversity of spiral galaxies in the cluster gives rise to the discovery of several peculiar members. What appears to be a barred- spiral with concentrations at the poles of the bar can be found at $x = 84.7, y = 122.1$. Another peculiar object lies at $x = 79.3, y = 104.9$, and appears as an "exclamation point" with a fine whisp.

GALAXY CLUSTER 020 14 09 28 −34 01

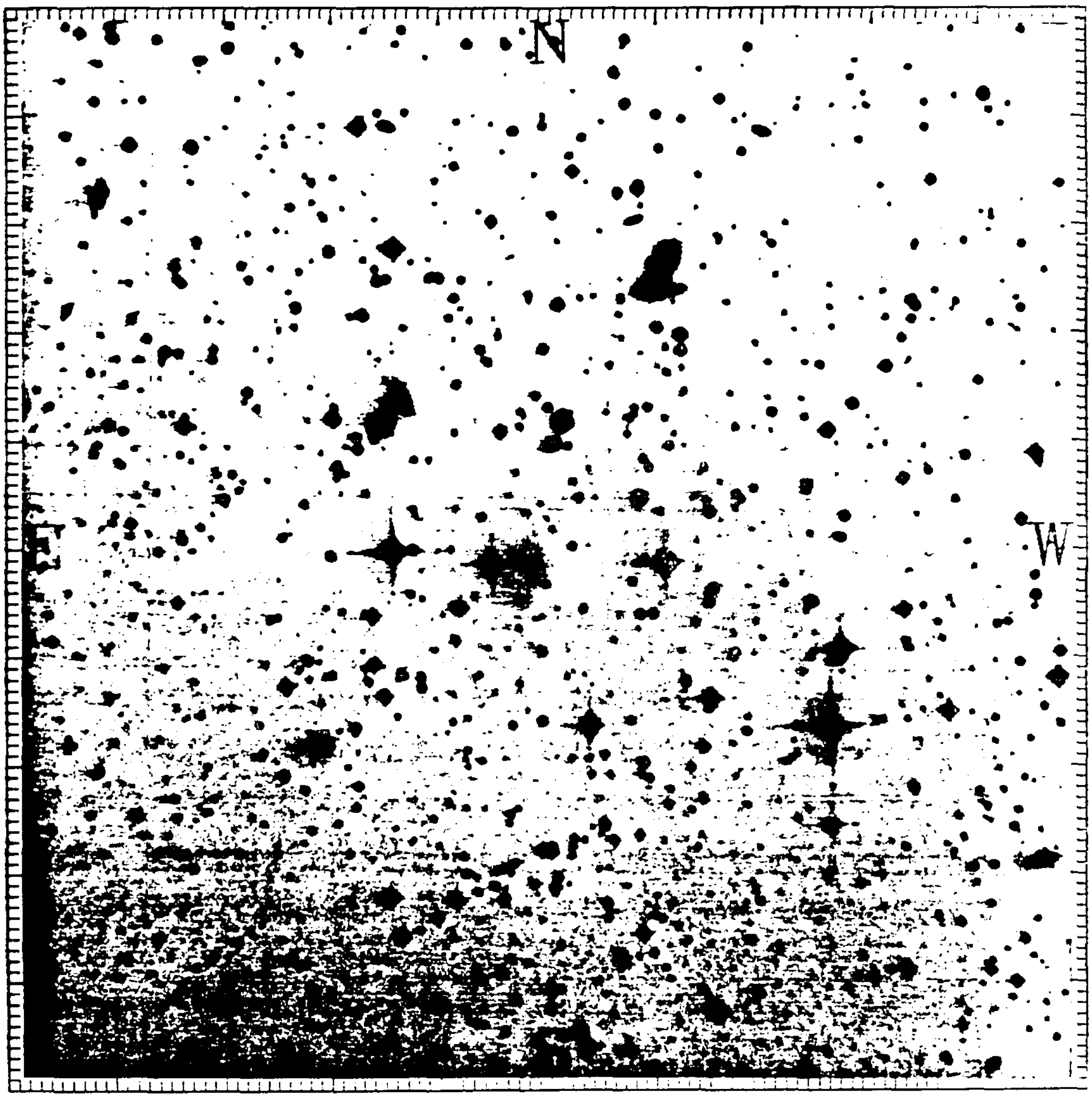


Figure 3.2.20 *(a) Field of GALAXY CLUSTER 020: 14 09 28 -34 01*

GALAXY CLUSTER 020 14 09 28 −34 01

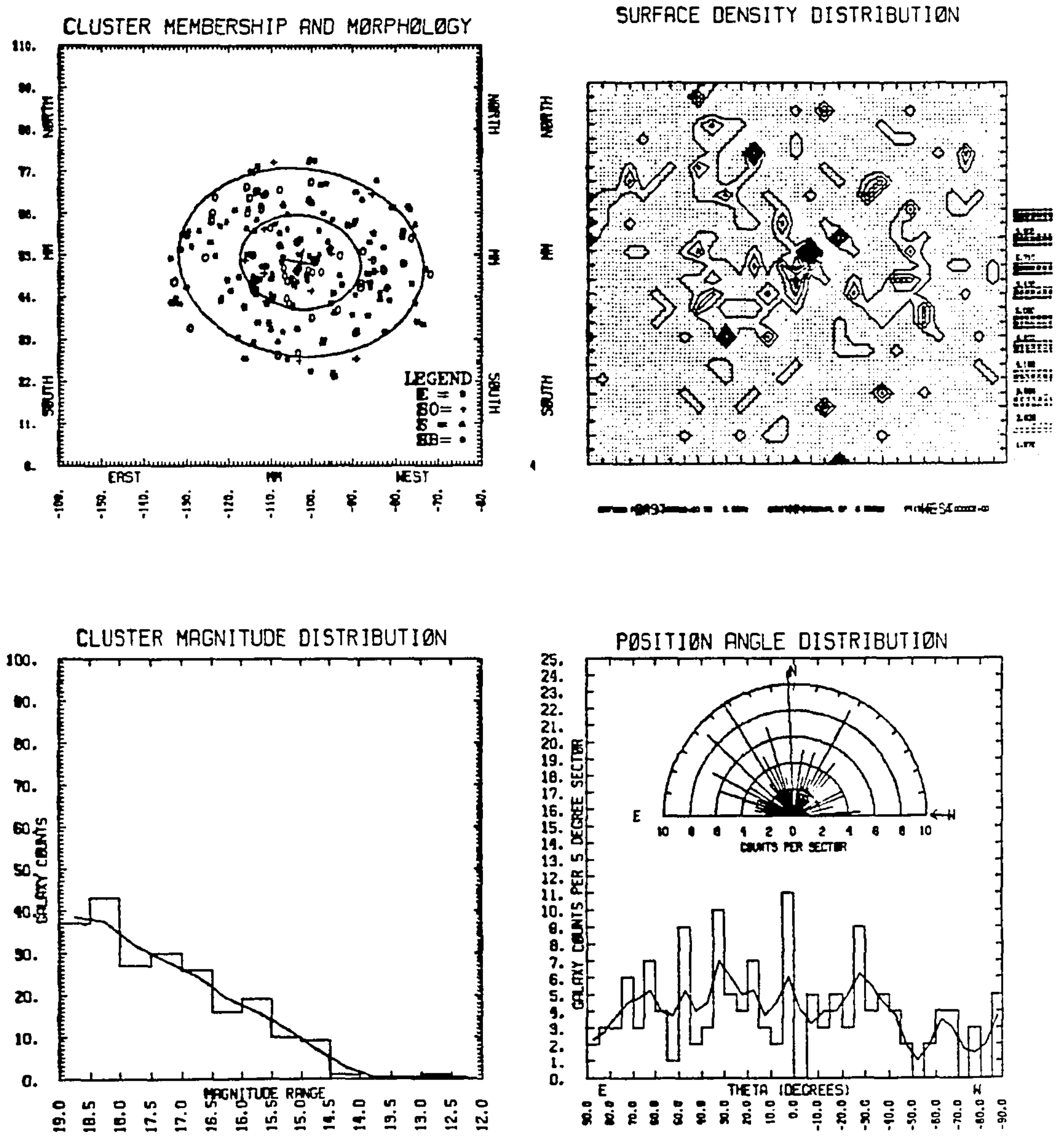
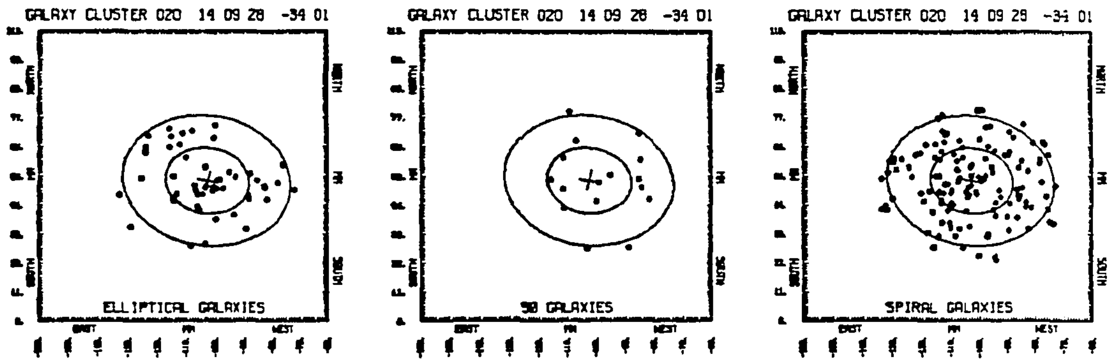


Figure 3.2.20 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 020 14 09 28 −34 01						
FIELD 384						ESO/SERC PLATE J4851
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
102.819	053.059	14 9 28.3	-34 1 38.5	321 26 22.7	25 40 56.0	0.038

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	53	MAJOR AXIS	14.68	SAMPLE POPULATION	219
S0	17	MINOR AXIS	12.21	CORE POPULATION	75
S	140	ECCENTRICITY	0.55	LIMITING MAGNITUDE	19.0
SB	7	POSN. ANGLE	-12.16		
P	2				

Figure 3.2.20 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.20 *Cluster Population Description.*

GALAXY CLUSTER 020: 14 09 28 -34 01 : The cluster is located in the North-East quadrant of ESO/SERC Field 384. Within a diameter of 60mm as determined by m_{10} we count 238 galaxies in this cluster and 219 to a limiting magnitude of m_{lim} = 19.0. The cluster is classified Abell type *RI* because of its scattered, somewhat irregular appearance.

We count 61 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B - M$ type II classification for the cluster which has a number of bright galaxies intermediate between the type cD and normal giant elliptical galaxies. For m_1,m_3, and m_{10} we give 12.7, 14.5 and 14.8, respectively. The value of m_{10} implies a redshift of 0.038.

The cluster shows a slight central condensation of the core with several small concentrations, somewhat less dense than that found West of center. We find the magnitude distribution to be ramp-like from brightest to faintest in a practically uniform rise. Position angles tend to lean East of North with a few concentrations at 0, 30 and 50 degrees, respectively.

The elliptical galaxies appear more frequently in the Southern portions of the cluster with a slight enchancement in the core. On the other hand, the spirals are fairly uniformly scattered throughout the cluster. We find an $(E : SO : S)$ ratio of $(1.0 : 0.3 : 2.8)$ giving a spiral-rich cluster.

The core population comprises some 34% of the sample in an area of 0.2 square degrees. This gives a surface density of 380 galaxies per square degree on the sky.

We call attention to a peculiar triplet of galaxies located at $x = 98.7, y = 53.6$ that appear to be superposed. Another superposition reminiscent of an "exclamation point", of a lenticular and an elliptical, is found at $x = 108.4, y = 46.3$. Also noted are pairs of galaxies consisting of an early and a late elliptical, such as the set residing at $x = 82.0, y = 46.1$.

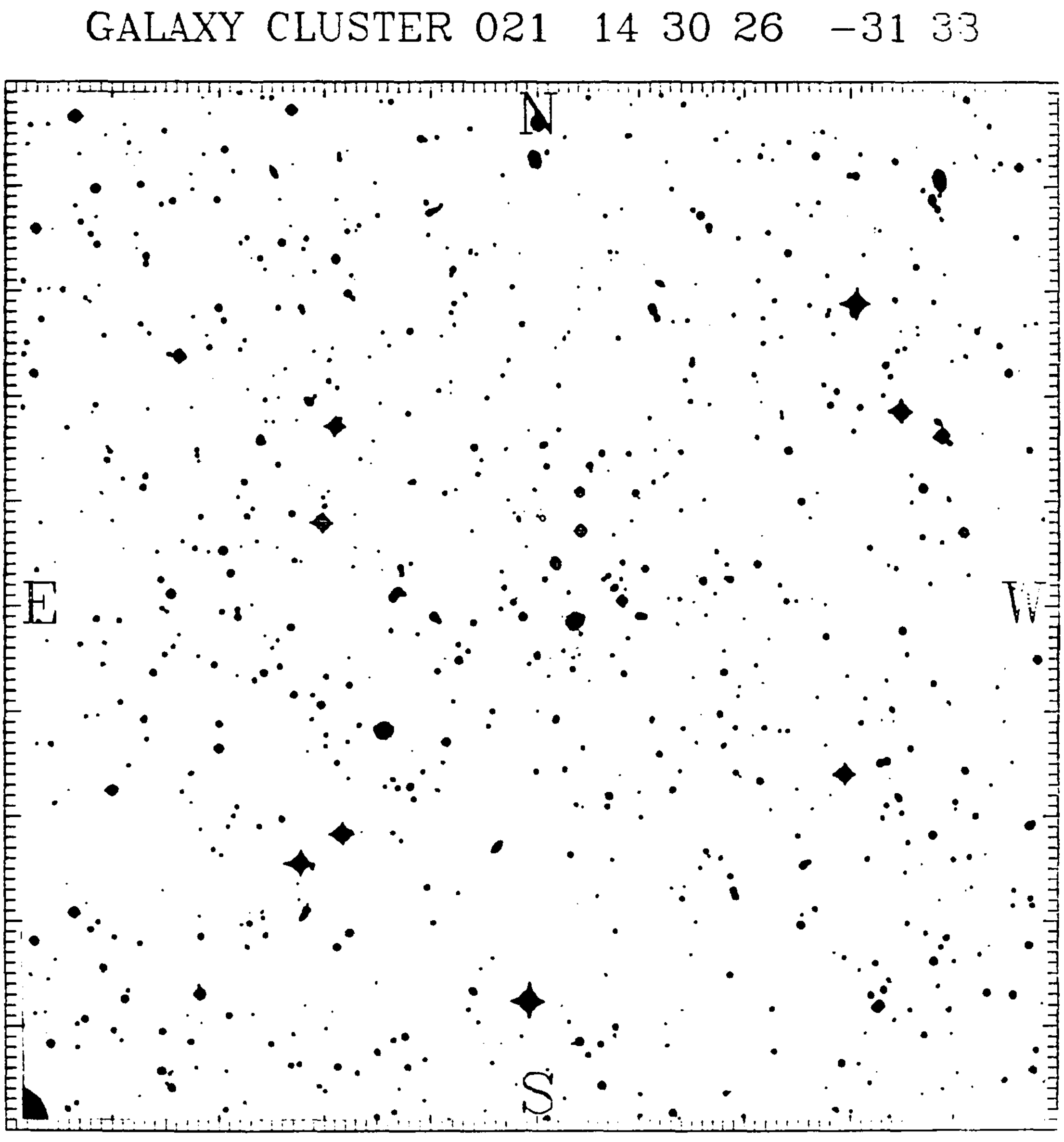


Figure 3.2.21 *(a) Field of GALAXY CLUSTER 021: 14 30 26 -31 33*

GALAXY CLUSTER 021 14 30 26 −31 32

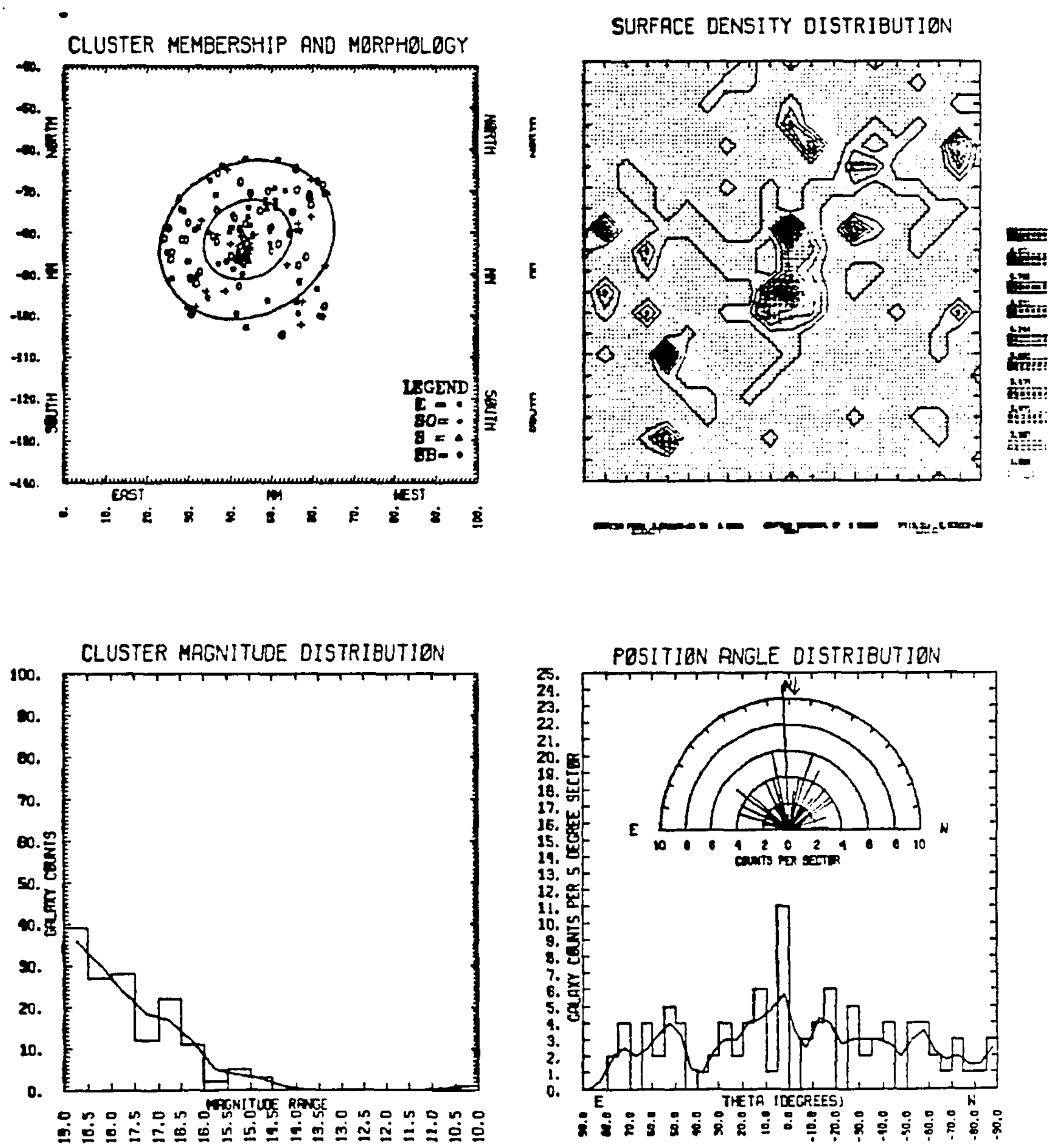
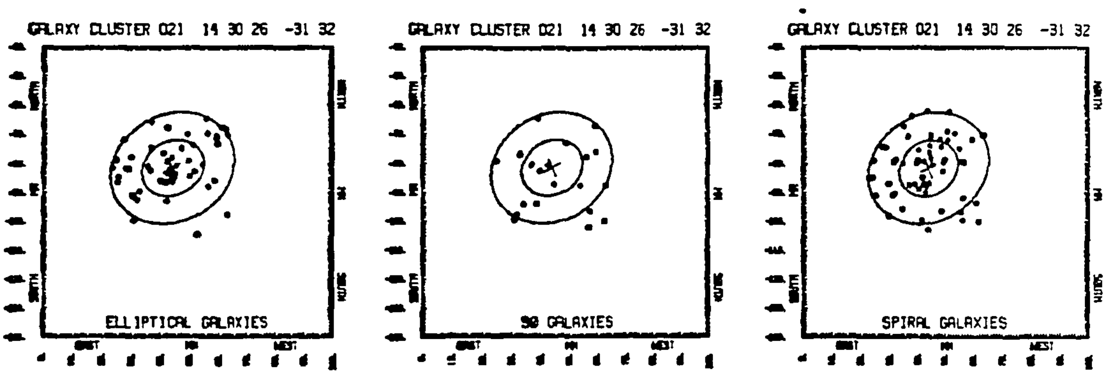


Figure 3.2.21 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 021 14 30 26 −31 32						
FIELD 447						ESØ/SERC PLATE J1472
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-043.965	-081.811	14 30 26.3	-31 32 40.5	327 1 28.9	26 17 33.7	0.054
MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS		
E	63	MAJØR AXIS	10.96	SAMPLE PØPULATIØN	150	
SØ	20	MINØR AXIS	9.14	CØRE PØPULATIØN	58	
S	61	ECCENTRICITY	0.55	LIMITING MAGNITUDE	19.0	
SB	6	PØSN. ANGLE	28.24			
P	0					

Figure 3.2.21 *(f,g,h) Cluster Morphological Population Distributions.*

Table 3.2.21 *Cluster Population Description.*

GALAXY CLUSTER 021: 14 30 26 -31 33 : The cluster is located in the South-West quadrant of ESO/SERC Field 447. Within a diameter of 45mm as determined by m_{10} we count 193 galaxies in this cluster and 150 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *RI* due to its regular appearance, and fairly smooth distribution of galaxies radially from the core. Whatever irregularities occur can probably be traced to a large concentration South of center.

We count 13 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 0. We suggest a $B - M$ type II-III classification for the cluster which has no really dominant galaxies albeit several bright ellipticals which could not be considered giant. For m_1,m_3, and m_{10} we give 12.1, 12.6 and 13.9, respectively. The value of m_{10} implies a redshift of 0.054.

We find the cluster smooth with the exception of the fourth quadrant which has a paucity of galaxies. There is a strong concentration of cluster members just South of center, and a smaller group North of this. At the South-East extremity of the cluster we find another small concentration.

The cluster magnitude distribution rises somewhat linearly from brightest to faintest galaxies, with a noticable drop in population in the range $m_v = 17.0$ to $m_v = 17.5$. The position angle distribution shows no preference for sense other than perhaps the peak at zero degrees indicating a North-South orientation.

We note the concentration of elliptical galaxies in the core, their scatter elsewhere and their avoidance of the fourth quadrant. The spirals, on the other hand, are more uniform in their distribution, are somewhat concentrated towards the center of the cluster, and are also found at its periphery. The $(E : SO : S)$ ratio is $(1.0 : 0.3 : 1.0)$ suggesting a nearly evenly divided population of ellipticals and spirals. The core population comprises nearly 39% of the sample and is found in an area of 0.11 square degrees. The core surface density is thus some 526 galaxies per square degree on the sky.

We notice five pairs of elliptical galaxies comprised of an early and late member, the brightest of which is located at $x = -42.3, y = -67.9$. The dense galaxy concentration South of center has an unusual elliptical galaxy, centrally condensed and supporting a halo, that is surrounded by a very faint population of attendants.

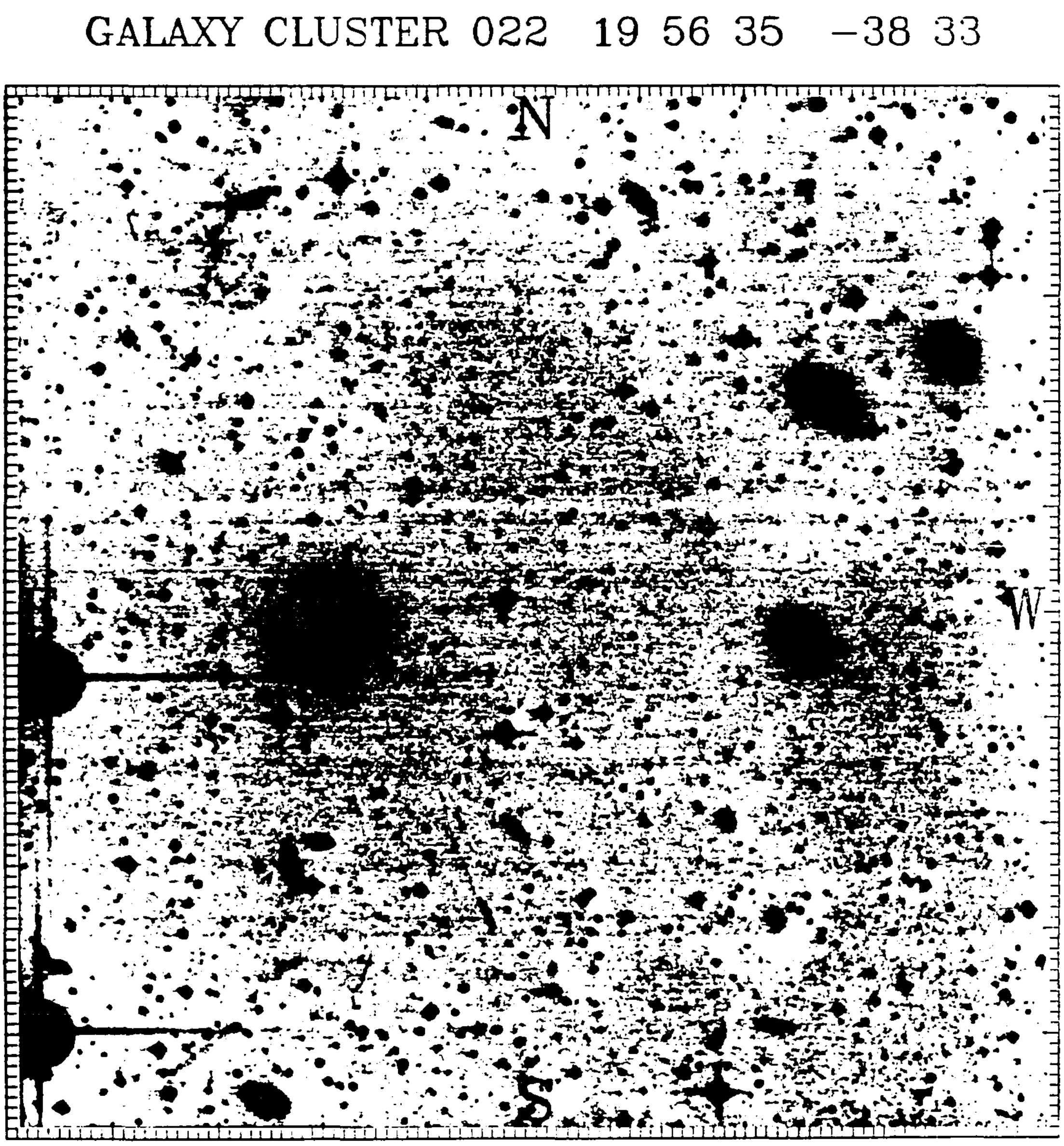


Figure 3.2.22 *(a) Field of GALAXY CLUSTER 022: 19 56 35 -38 33*

GALAXY CLUSTER 022 19 56 35 −38 32

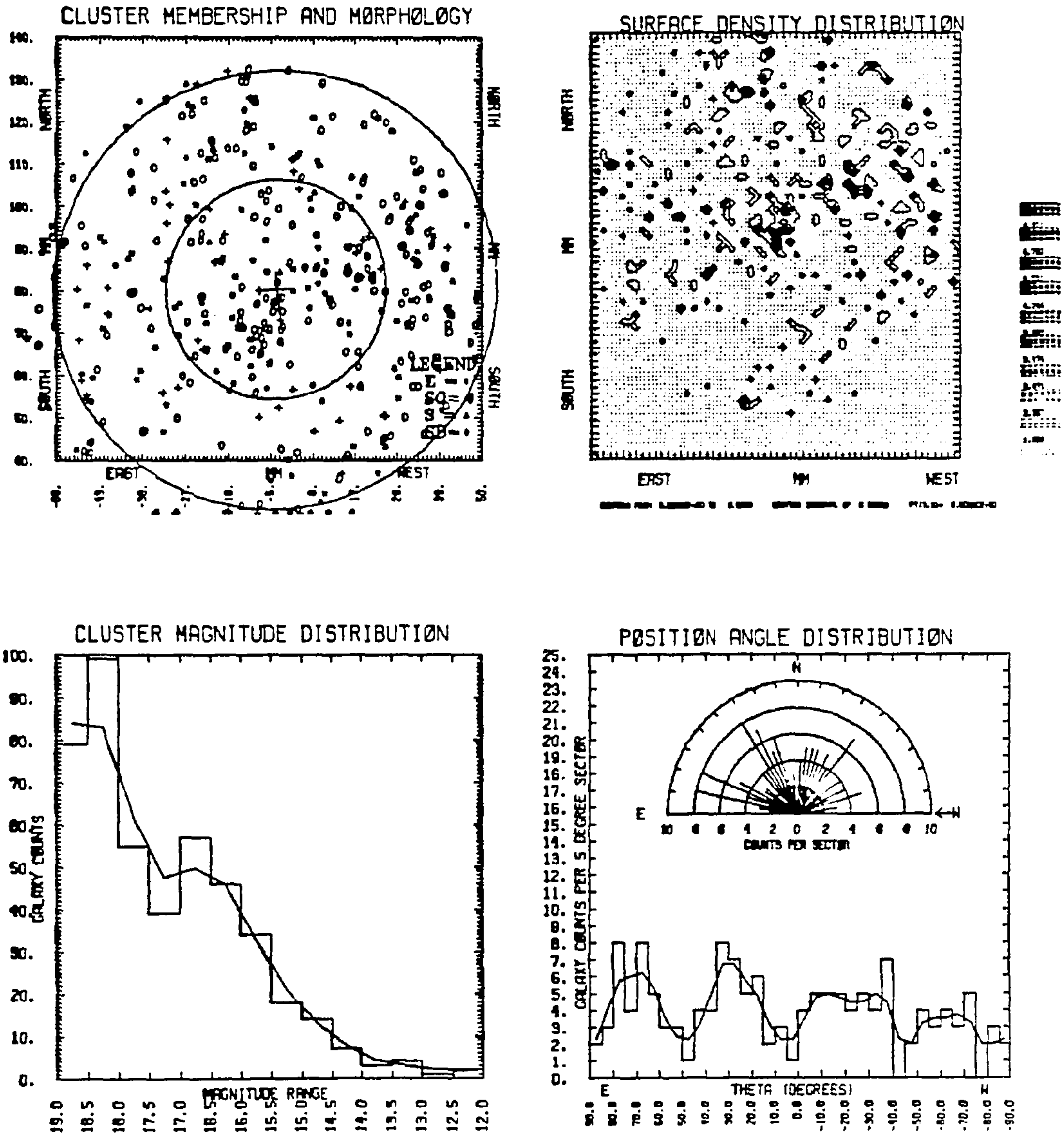
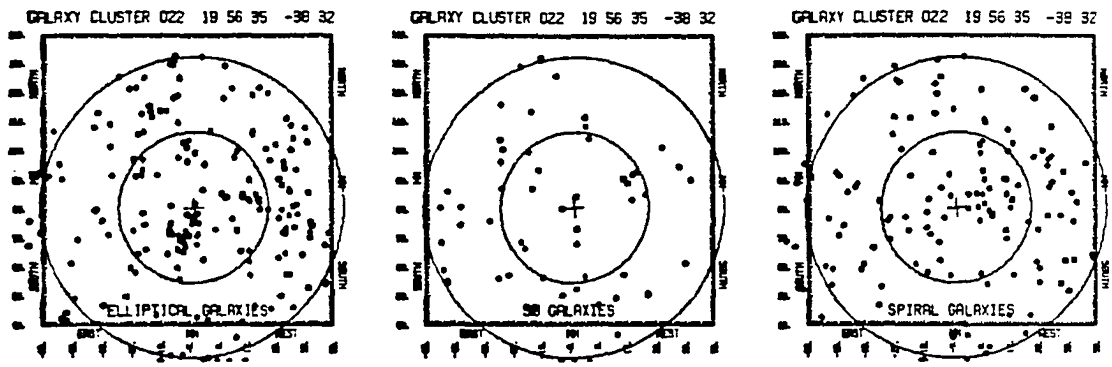


Figure 3.2.22 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 022 19 56 35 −38 32

FIELD 339 — ESØ/SERC PLATE J2378

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
003.581	080.348	19 56 35.4	-38 32 47.9	002 3 26.0	-29 14 54.4	0.026

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	220	MAJØR AXIS	28.60	SAMPLE PØPULATIØN	458
SØ	58	MINØR AXIS	25.89	CØRE PØPULATIØN	157
S	137	ECCENTRICITY	0.43	LIMITING MAGNITUDE	19.0
SB	31	PØSN. ANGLE	4.55		
P	12				

Figure 3.2.22 ***(f,g,h) Cluster Morphological Population Distributions.***
Table 3.2.22 ***Cluster Population Description.***

GALAXY CLUSTER 022: 19 56 35 -38 33 : The cluster is located in the North-East quadrant of ESO/SERC Field 339. Within a diameter of 90mm as determined by m_{10} we count 493 galaxies in this cluster and 458 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* due to the paucity of galaxies found South of center, giving a nonuniform radial distribution.

We count 80 galaxies brighter than m_3+2 and thus classify the cluster as having

an Abell richness of 2. We suggest a $B-M$ type I-II classification for the cluster which has a dominant cD type galaxy as well as a number of giant ellipticals. For m_1,m_3, and m_{10} we give 15.4, 15.8 and 16.1,respectively. The value of m_{10} implies a redshift of 0.026.

This cluster is spread out over a region in excess of $1000mm^2$ and is sparsely populated. We note a slight concentration of galaxies South of the cluster center as well as several small concentrations North-West of center. The magnitude distribution is somewhat bifurcated showing a fairly rapid increase of population from the brightest to $m_v = 16.5$ then dropping rapidly only to rise quickly to near the limiting magnitude. Given the size of the cluster, one might assume that the second peak represents a background population of galaxies.

We find most of the elliptical galaxies scattered throughout the cluster, save for a virtually empty zone South of center. There appears to be a slight concentration of these in the region South of the cluster center. The spiral galaxies appear to be more uniformly distributed, save for the zone of avoidance. The $(E : SO : S)$ ratio gives $(1.0 : 0.3 : 0.8)$ implying a cluster marginally rich in elliptical galaxies.

The core population comprises nearly 34% of the sample contained in a area of 0.81 square degrees. This implies a surface density of 193 galaxies per square degree on the sky.

We note several groups composed of a spiral with what appears to be a number of faint attendant galaxies, for example, as that located at $x = -40.4, y = 85.3$. In addition there are several pairs of ellipticals consisting of an early and late member as is found, for example, at $x = -1.9, y = 28.6$.

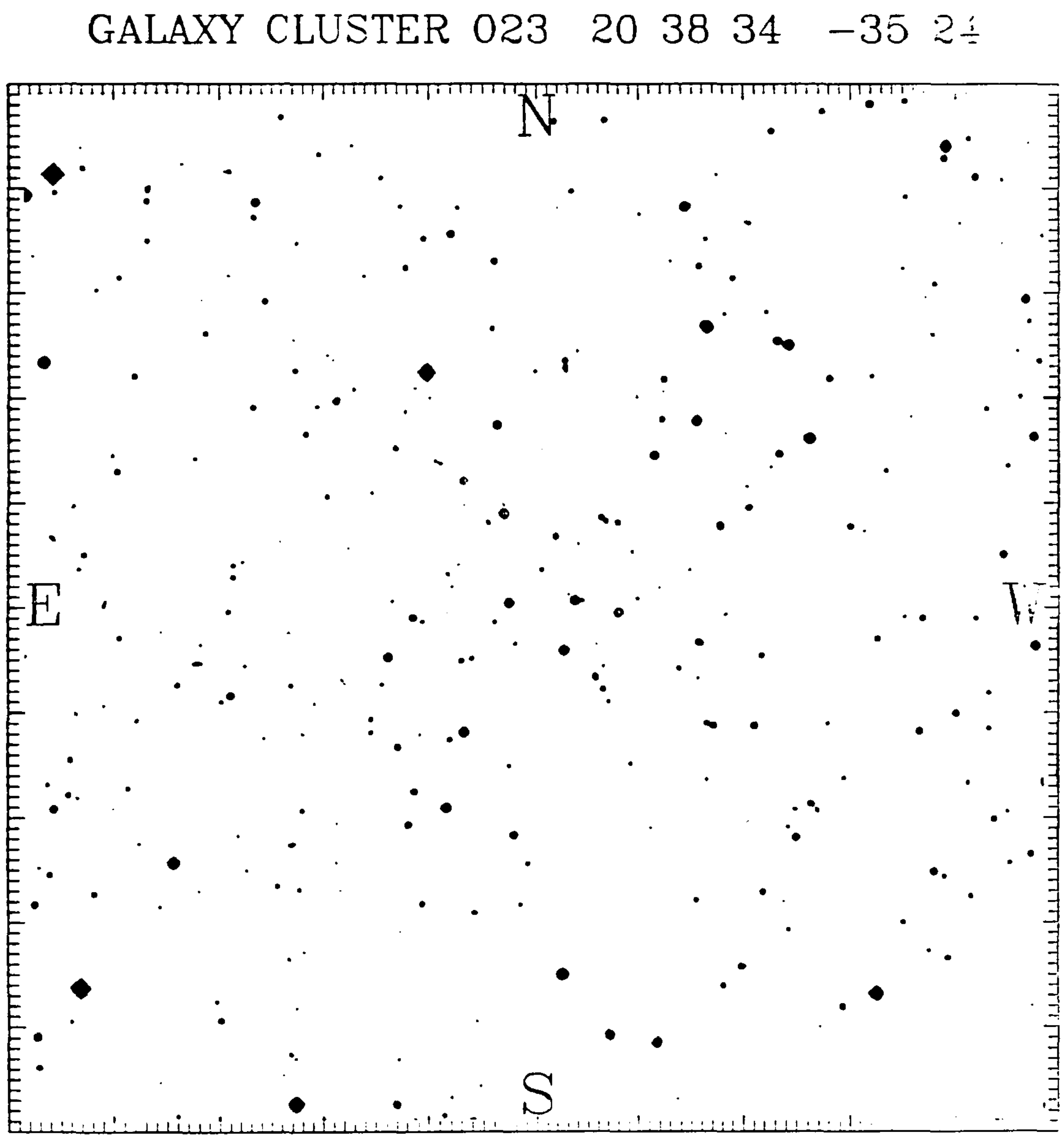


Figure 3.2.23 *(a) Field of GALAXY CLUSTER 023: 20 38 34 -35 24*

GALAXY CLUSTER 023 20 38 34 −35 24

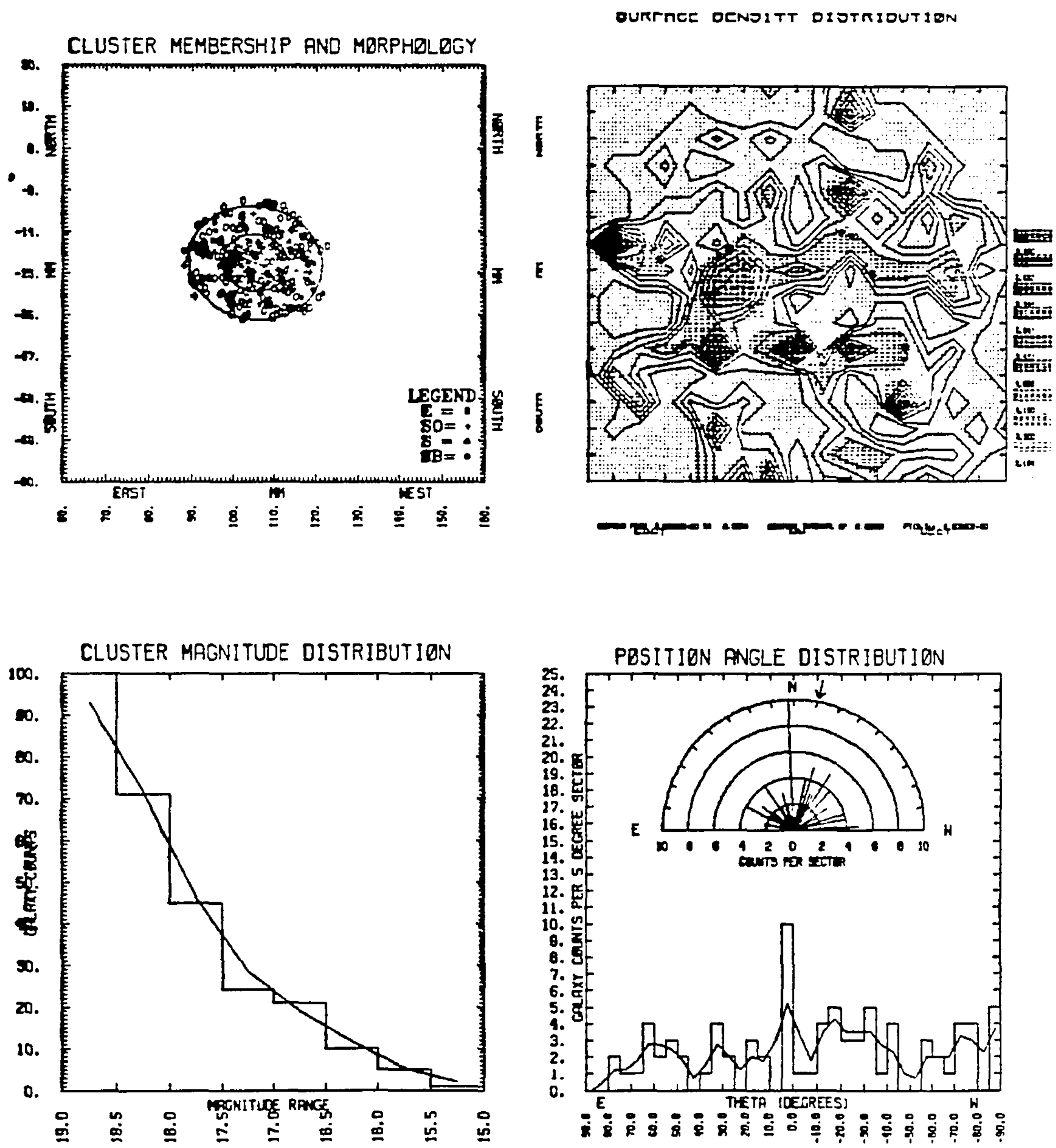
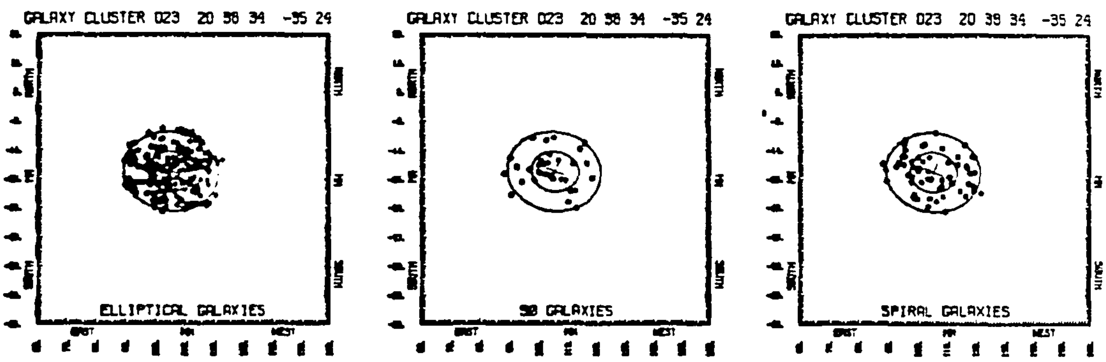


Figure 3.2.23 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 023 20 38 34 −35 24						
FIELD 401						ESØ/SERC PLATE J6109
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-105.191	-022.456	20 38 34.4	-35 23 58.1	007 43 35.8	-36 50 15.1	0.065

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	235	MAJØR AXIS	8.12	SAMPLE PØPULATIØN	334
SØ	32	MINØR AXIS	7.43	CØRE PØPULATIØN	109
S	64	ECCENTRICITY	0.40	LIMITING MAGNITUDE	19.0
SB	2	PØSN. ANGLE	-21.52		
P	1				

Figure 3.2.23 ***(f,g,h) Cluster Morphological Population Distributions.***
Table 3.2.23 ***Cluster Population Description.***

GALAXY CLUSTER 023: 20 38 34 -35 24 : The cluster is located in the South-West quadrant of ESO/SERC Field 401. Within a diameter of 36mm as determined by m_{10} we count 651 galaxies in this cluster and 334 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type R due to its inherent regularity.

We count 65 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B - M$ type III classification for the cluster which has no dominant galaxies in the field. For m_1,m_3, and m_{10} we give 15.3, 15.8 and 16.1, respectively. The value of m_{10} implies a redshift of 0.065.

This rich cluster shows a dense concentration of galaxies with a radial population fall-off and several dense subgroups. The main subgroup is located somewhat East of the cluster center with another concentration lying South of it. A similar group is found just South of center. We note also the presence of another very dense subgroup to the East North-East at the periphery of the cluster.

The magnitude distribution rises nearly exponentially from the brightest galaxies to the magnitude limit with the majority of the cluster members being fainter than $m_v = 17.5$. We note that the position angle distribution displays a greater number of bright galaxies oriented West of North in the negative sense, with a noticable excess at zero degrees. We note the heavy concentration of elliptical galaxies distributed throughout the cluster, whereas the spirals are fewer in number and show no obvious grouping. The $(E : SO : S)$ ratio favors the elliptical galaxies and gives $(1.0 : 0.1 : 0.3)$.

The core population represents some 33% of the sample population but since this cluster is so rich with faint galaxies, we must view this number with caution. The dispersion ellipse spans 0.07 square degrees on the sky giving a core density of 1641 galaxies per square degree.

The rich core density may be further enhanced if we count the faint galaxies that comprise the population fainter than $m_v = 19.0$. We note 16 pairs of galaxies in very close proximity or superposed, the brightest of which is located at $x = -99.7, y = -13.2$. These are generally pairs of elliptical galaxies with an early and a late member.

GALAXY CLUSTER 024 20 48 41 −52 08

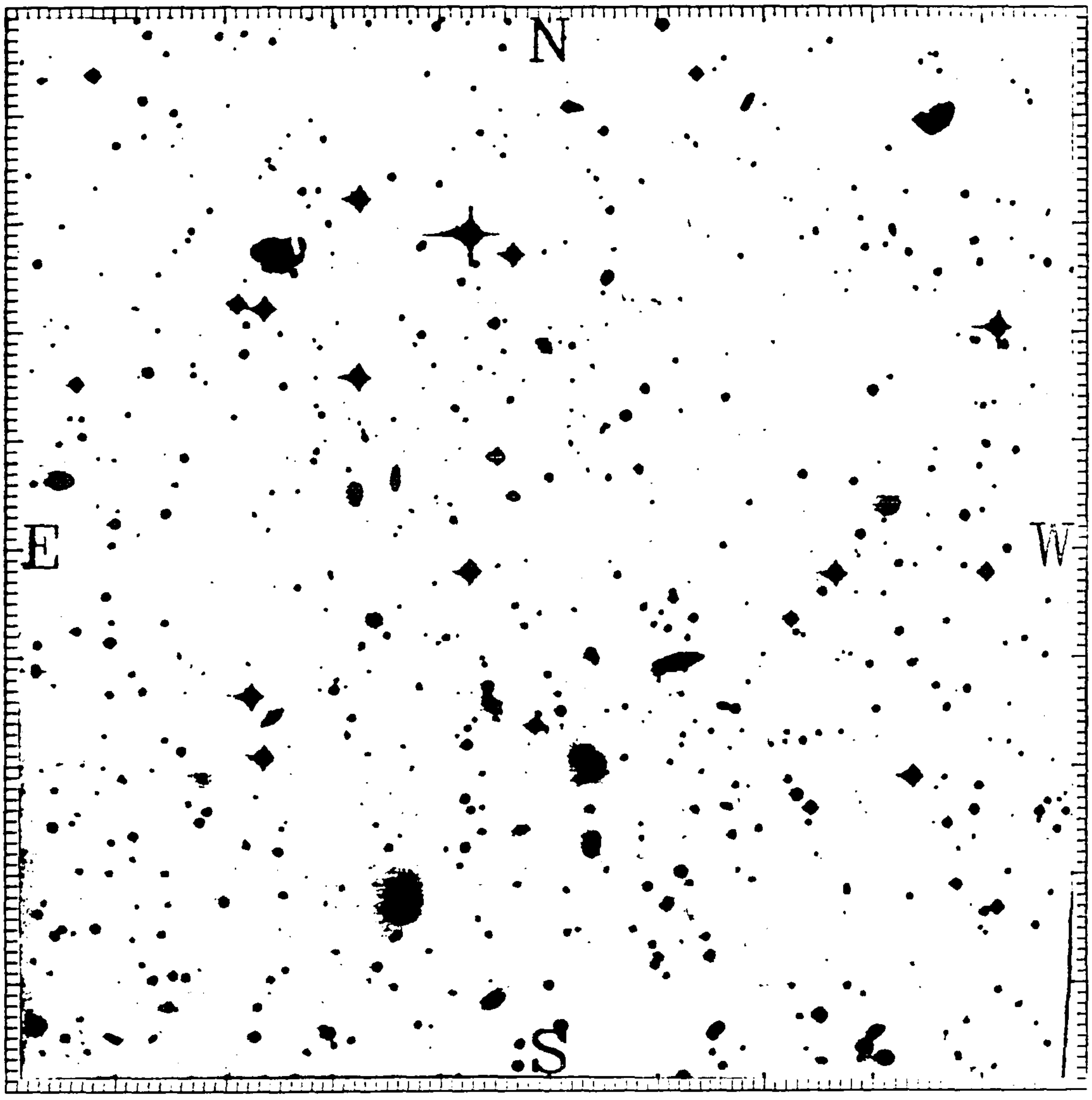


Figure 3.2.24 *(a) Field of GALAXY CLUSTER 024: 20 48 41 -52 08*

GALAXY CLUSTER 024 20 48 41 −52 08

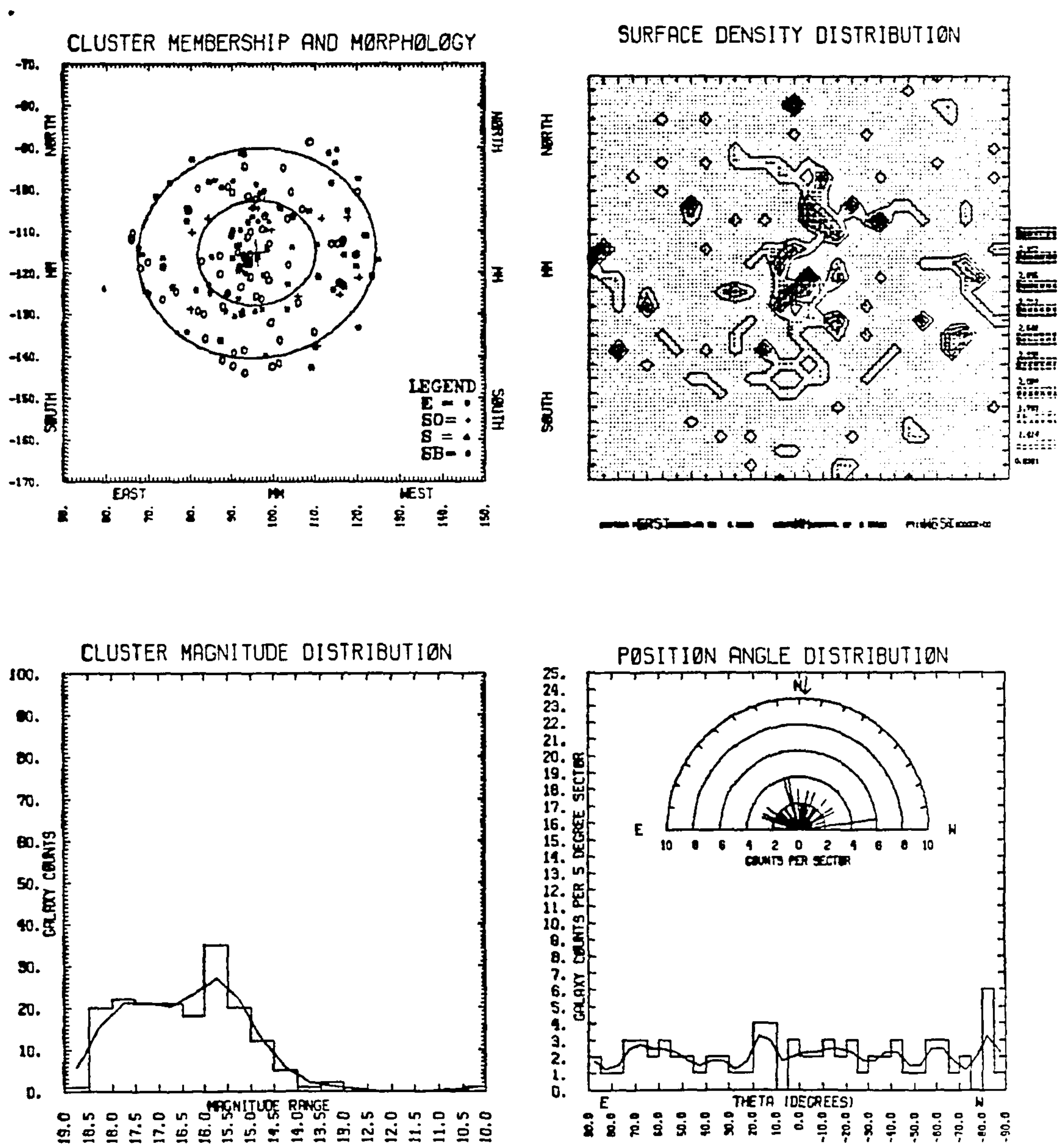
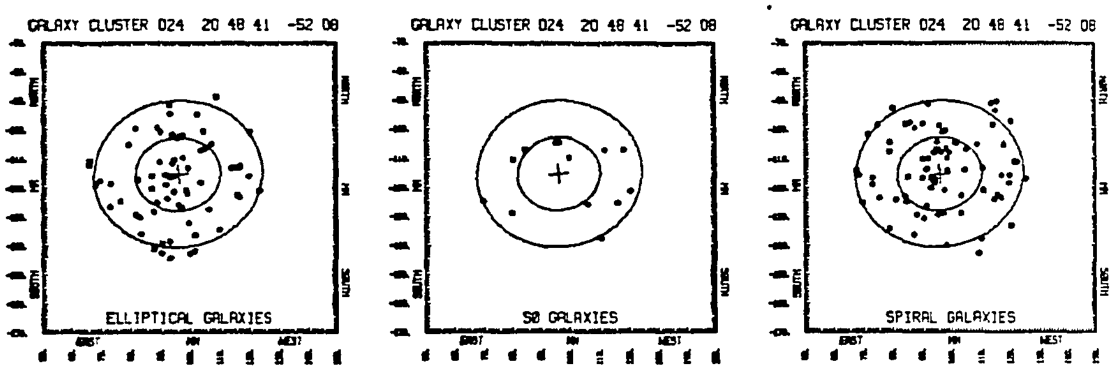


Figure 3.2.24 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 024 20 48 41 −52 08							
FIELD 235						ESØ/SERC PLATE J3385	
X	Y	RA (1950)	DEC (1950)	L (1950)		B (1950)	Z
-095.831	-115.415	20 48 40.7	-52 8 45.6	346 31	0.9	-39 25 40.1	0.037
MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS			
E	71	MAJØR AXIS	14.21	SAMPLE PØPULATIØN			179
SØ	13	MINØR AXIS	12.57	CØRE PØPULATIØN			65
S	79	ECCENTRICITY	0.47	LIMITING MAGNITUDE			19.0
SB	12	PØSN. ANGLE	6.47				
P	4						

Figure 3.2.24 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.24 *Cluster Population Description.*

GALAXY CLUSTER 024: 20 48 41 -52 08 : The cluster is located in the South-West quadrant of ESO/SERC Field 235. Within a diameter of 60mm as determined by m_{10} we count 183 galaxies in this cluster and 179 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* because of the level of inherent scatter of the cluster members.

We count 64 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B - M$ type III classification for the cluster which has no dominant galaxies in the field. For m_1,m_3, and m_{10} we give 13.2, 13.7 and 14.9, respectively. The value of m_{10} implies a redshift of 0.037.

We find the general characteristics of the cluster to be somewhat irregular with a slight concentration of galaxies immediately South-East of the cluster center, another loose aggregate North of center and a sparse scattering of galaxies throughout the rest of the cluster. The cluster magnitude distribution rises rapidly from the brightest galaxies to a slight excess at $m_v = 15.5$ then drops to a plateau terminating at $m_v = 18.5$ with a sudden drop of membership to the limiting magnitude. We find little preferred orientation of the brightest cluster members with respect to position angle save for the slight excess at orientations almost directly West of North which appears to lie along the major axis of the dispersion ellipse.

The cluster appear to be divided almost equally between ellipticals and spirals with a slight enhancement of the spirals the $(E : SO : S)$ ratio being $(1.0 : 0.2 : 1.3)$. We note a relative enrichment of barred spirals in the sample and several peculiar galaxies. The elliptical galaxies appear to be scattered throughout the cluster without apparent concentrations with perhaps the exception of their paucity in the Western portions of the cluster. Likewise, the spirals show no obvious concentrations save for a small group North of the cluster center. The core population houses some 36% of the population in an area discribed by the dispersion ellipse of 0.2 square degrees. This yields a cluster core surface density of 330 galaxies per square degree.

We note several distressed spiral galaxies, perhaps superposed, such as the object located at $x = -95.4, y = -129.4$ and another found at $x = -78.9, y = -107.6$. At least seven of the spirals in the sample appear to have ring-like structures, the brightest of which lies at $x = -116.4, y = -117.6$.

GALAXY CLUSTER 025 21 13 10 −59 36

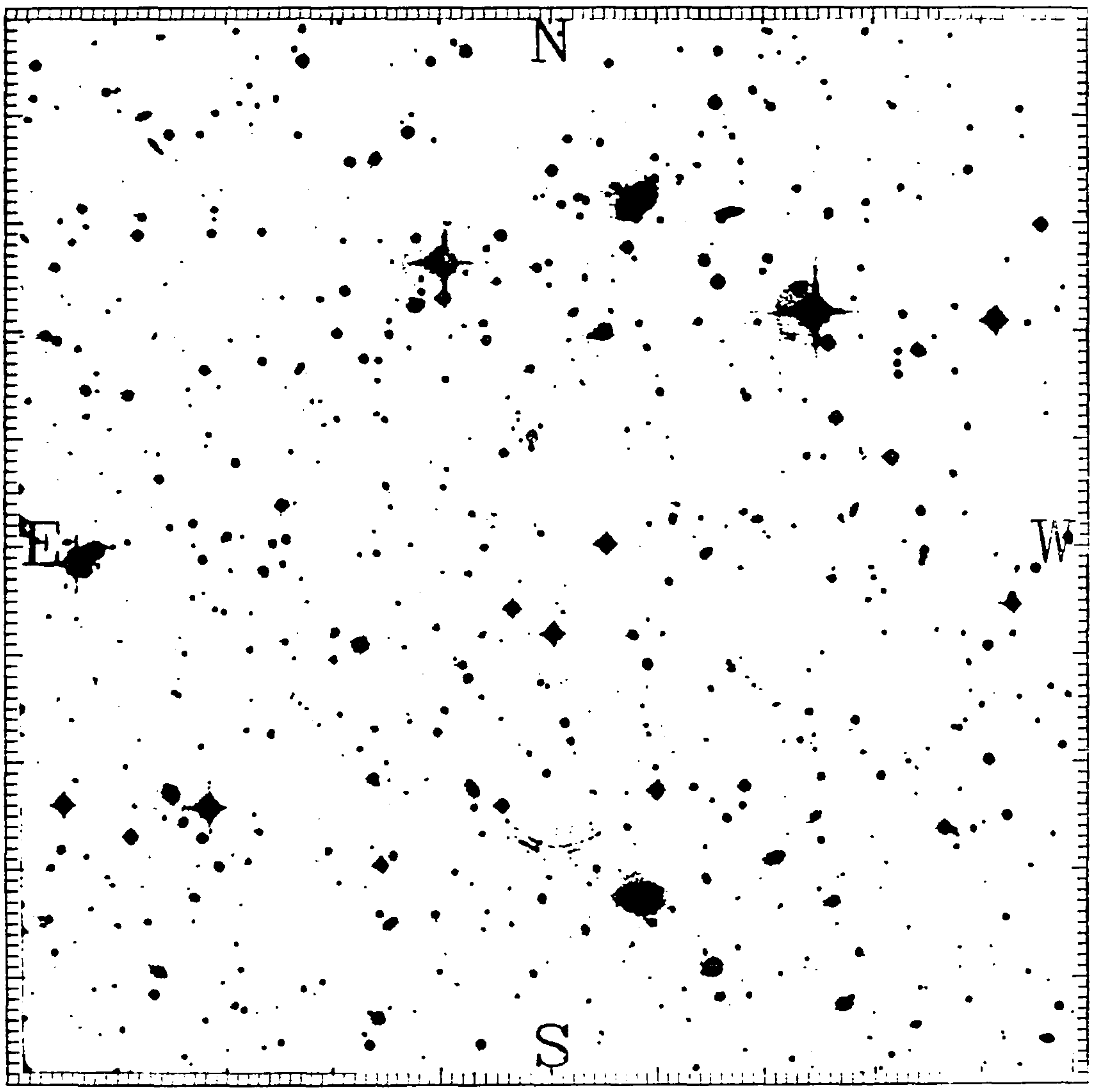


Figure 3.2.25 *(a) Field of GALAXY CLUSTER 025: 21 13 10 -59 36*

GALAXY CLUSTER 025 21 13 10 −59 36

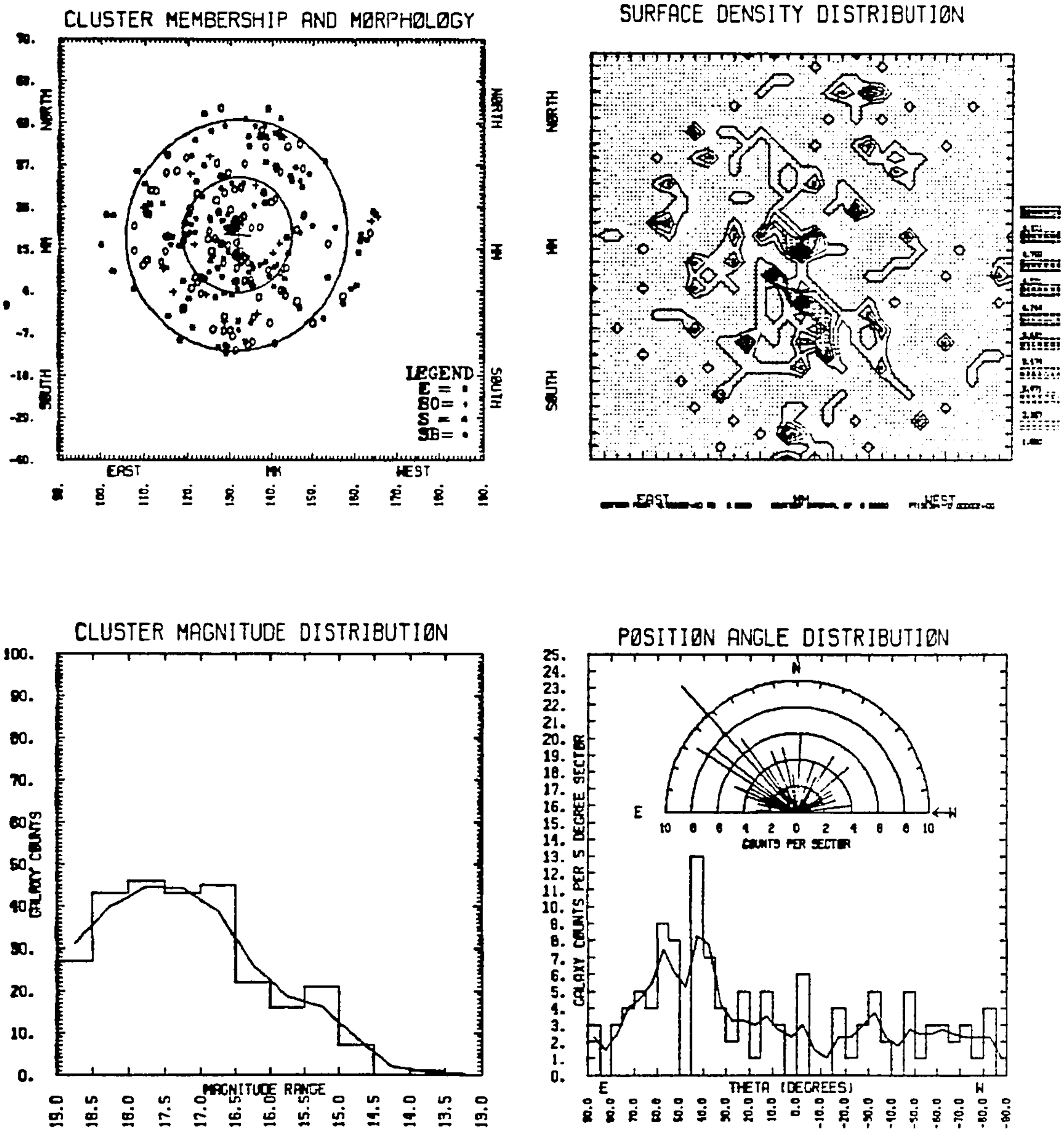
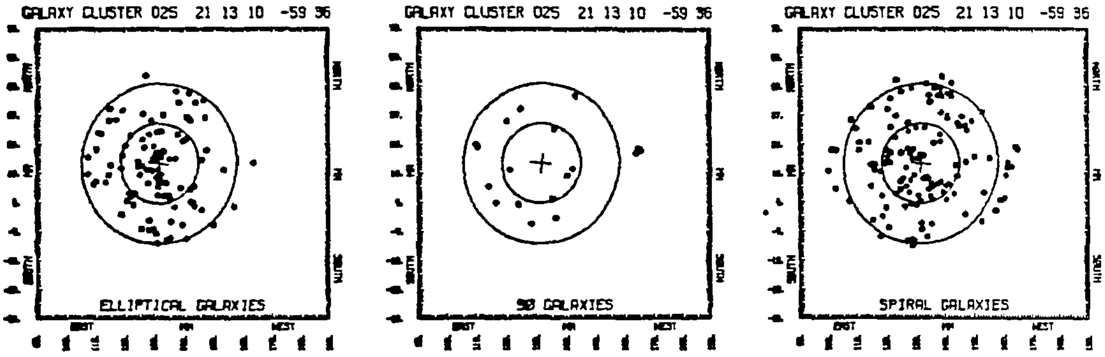


Figure 3.2.25 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 025 21 13 10 −59 36

FIELD 145 ESØ/SERC PLATE J1759

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-131.705	018.574	21 13 10.0	-59 36 24.2	336 2 49.4	-41 23 39.8	0.042

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	113	MAJØR AXIS	15.11	SAMPLE PØPULATIØN	271
SØ	19	MINØR AXIS	13.10	CØRE PØPULATIØN	106
S	135	ECCENTRICITY	0.50	LIMITING MAGNITUDE	19.0
SB	4	PØSN. ANGLE	86.09		
P	0				

Figure 3.2.25 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.25 *Cluster Population Description.*

GALAXY CLUSTER 025: 21 13 10 -59 36 : The cluster is located in the North-West quadrant of ESO/SERC Field 145. Within a diameter of 45mm as determined by m_{10} we count 296 galaxies in this cluster and 271 to a limiting magnitude of $m_{lim} = 19.0$. The cluster is classified Abell type *I* because of its large nonuniform scatter and clumpy appearance.

We count 80 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B-M$ type II classification for the cluster which has several very bright galaxies intermediate in appearance between the cD class and normal giant ellipticals. For m_1,m_3, and m_{10} we give 13.9, 14.6 and 15.1, respectively. The value of m_{10} implies a redshift of 0.042.

We find the general appearance of the cluster to be irregular and somewhat clumpy. The cluster has several density concentrations located North and South of the cluster center as well as another found to the East. There are regions apparently devoid of galaxies, such as that found to the North-West at the periphery of the cluster.

The magnitude distribution rises slowly from the brightest members to about $m_v = 16.5$ after which we find the bulk of the sample population under a large plateau ranging from $m_v = 16.5$ to $m_v = 18.5$ after which the numbers decrease rapidly to the magnitude limit. We find the position angle distribution skewed to the North-East with a disproportionate number of bright galaxies oriented between forty and sixty degrees in the positive sense.

The cluster appear somewhat spiral rich with the $(E : SO : S)$ ratio of (1.0 : 0.2 : 1.2). The elliptical galaxies display several concentrations, especially North and South of center whereas the spirals appear to show a single concentration South-West of center. We note a slight single group of SO galaxies at the cluster periphery. The core population represents some 39% of the sample in an area of nearly 0.22 square degrees. This yields a core density of 486 galaxies per square degree.

We note several pairs of superposed galaxies that appear to be spirals such as those located at $x = -138.0, y = 29.4$ and $x = -130.4, y = 2.8$. We also note a peculiar group of galaxies whose brightest member is located at $x = -135.5, y = 5.2$.

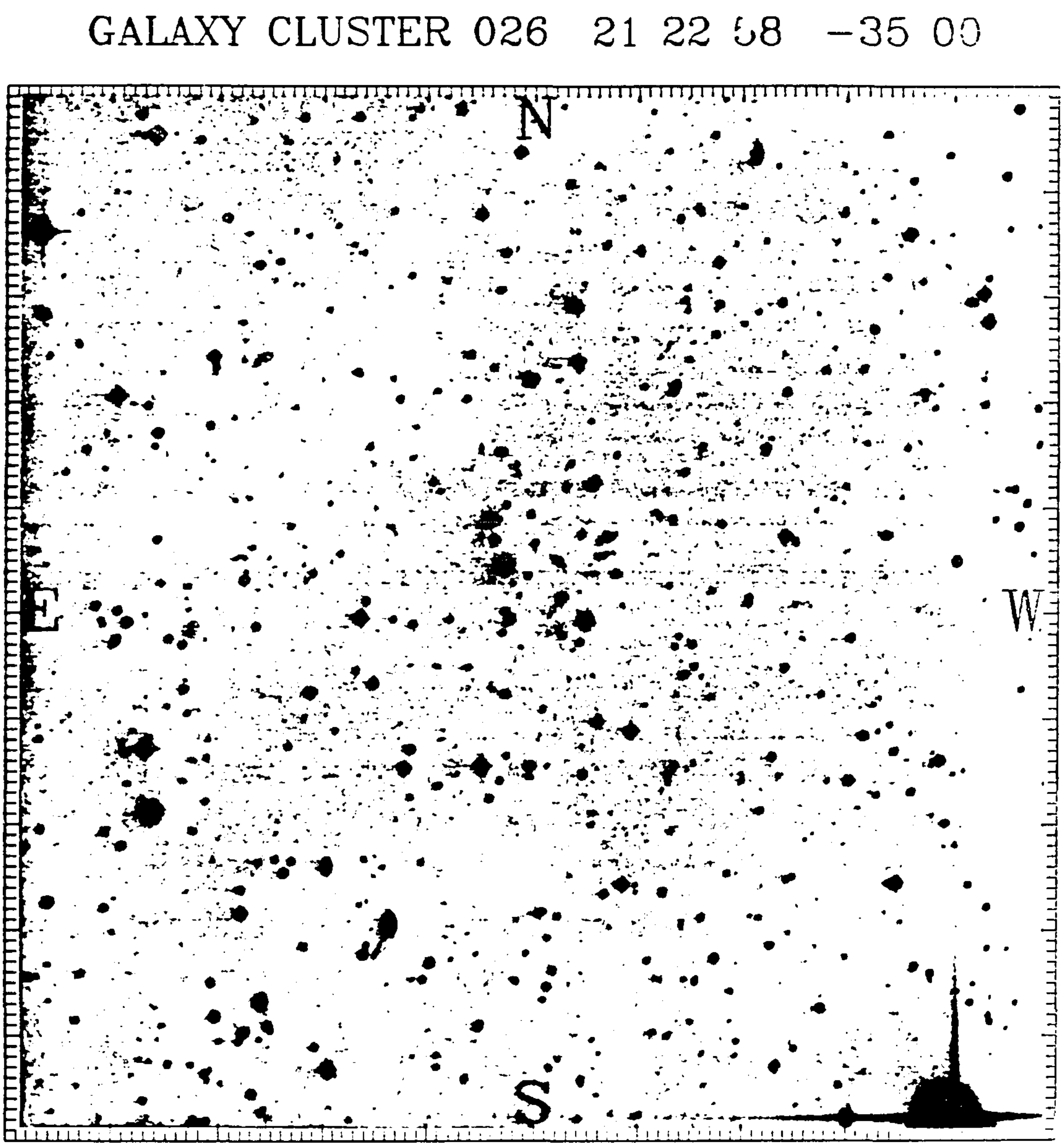


Figure 3.2.26 *(a) Field of GALAXY CLUSTER 026: 21 22 58 -35 00*

GALAXY CLUSTER 026 21 22 58 −35 00

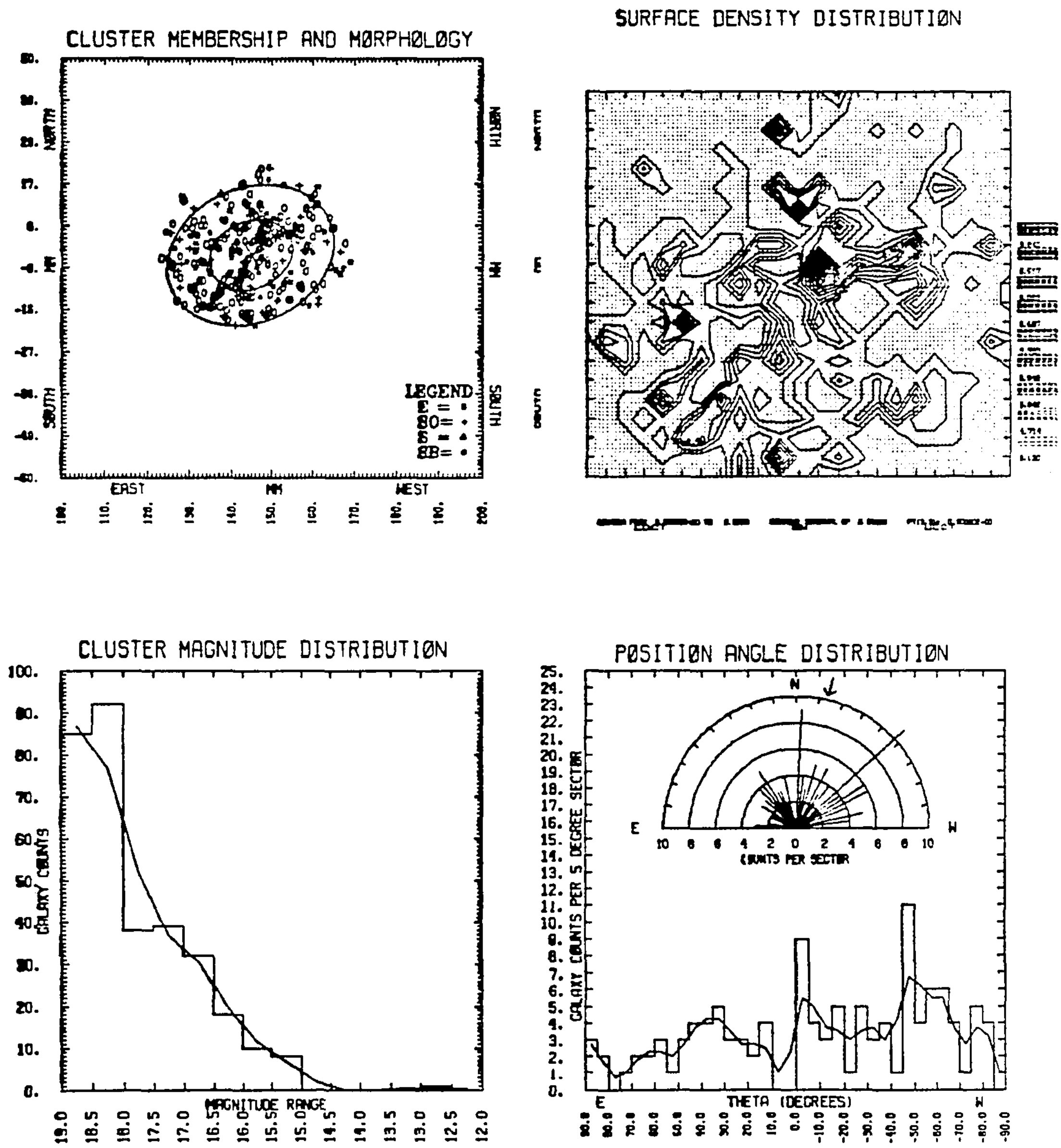
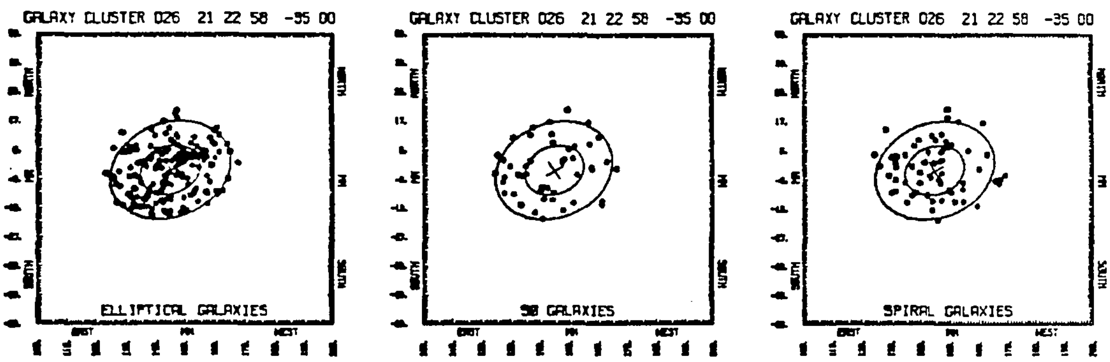


Figure 3.2.26 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 026 21 22 58 −35 00

FIELD 403 ESØ/SERC PLATE J5293

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-144.719	-001.784	21 22 58.0	-35 0 38.8	009 47 57.8	-45 46 32.8	0.052

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	209	MAJØR AXIS	10.61	SAMPLE PØPULATIØN	323
SØ	48	MINØR AXIS	8.66	CØRE PØPULATIØN	103
S	65	ECCENTRICITY	0.58	LIMITING MAGNITUDE	19.0
SB	0	PØSN. ANGLE	32.21		
P	1				

Figure 3.2.26 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.26 *Cluster Population Description.*

GALAXY CLUSTER 026: 21 22 58 -35 00 : The cluster is located in the South-West quadrant of ESO/SERC Field 403. Within a diameter of 45mm as determined by m_{10} we count 547 galaxies in this cluster and 323 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *RI* because of its somewhat regular appearance, but we note several clumps of galaxies throughout the sample.

We count 81 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 2. We suggest a $B - M$ type III classification for the cluster which has no really dominant galaxies save for a few bright members near the cluster center. For m_1,m_3, and m_{10} we give 15.1, 15.3 and 15.5, respectively. The value of m_{10} implies a redshift of 0.052.

We find the cluster somewhat elongated with several concentrations, the main ones located North-West of center and South-East of center. The cluster appears to reside in a sea of faint galaxies below the sample magnitude limit. We find the magnitude distribution gently rising from the brightest members to a plateau terminating at $m_v = 18.0$ after which there is an extremely rapid rise to the magnitude limit. This may suggest the cluster is a cloud of galaxies superposed on a faint background. We find the position angle distribution somewhat skewed with a preference of the brighter galaxies to be oriented West of North with an obvious peak located at 45 degrees in the negative sense.

The elliptical galaxies in the sample are scattered throughout the cluster with a major concentration to the North-West of cluster center along the major axis of the dispersion ellipse. The spirals appear to be located more to the periphery of the cluster with some avoidance of the Western portions. The $(E : SO : S)$ ratio greatly favors the elliptical galaxies with divisions distributed as $(1.0 : 0.2 : 0.3)$.

We find nearly 32% of the galaxies in the core of the dispersion ellipse which spans an area of 0.1 square degrees. This yields a core surface density of 1018 galaxies per square degree.

We note nine pairs of elliptical galaxies in very close proximity that consist of an early and a late member, the brightest of which is located at $x = -158.2, y = 10.3$.

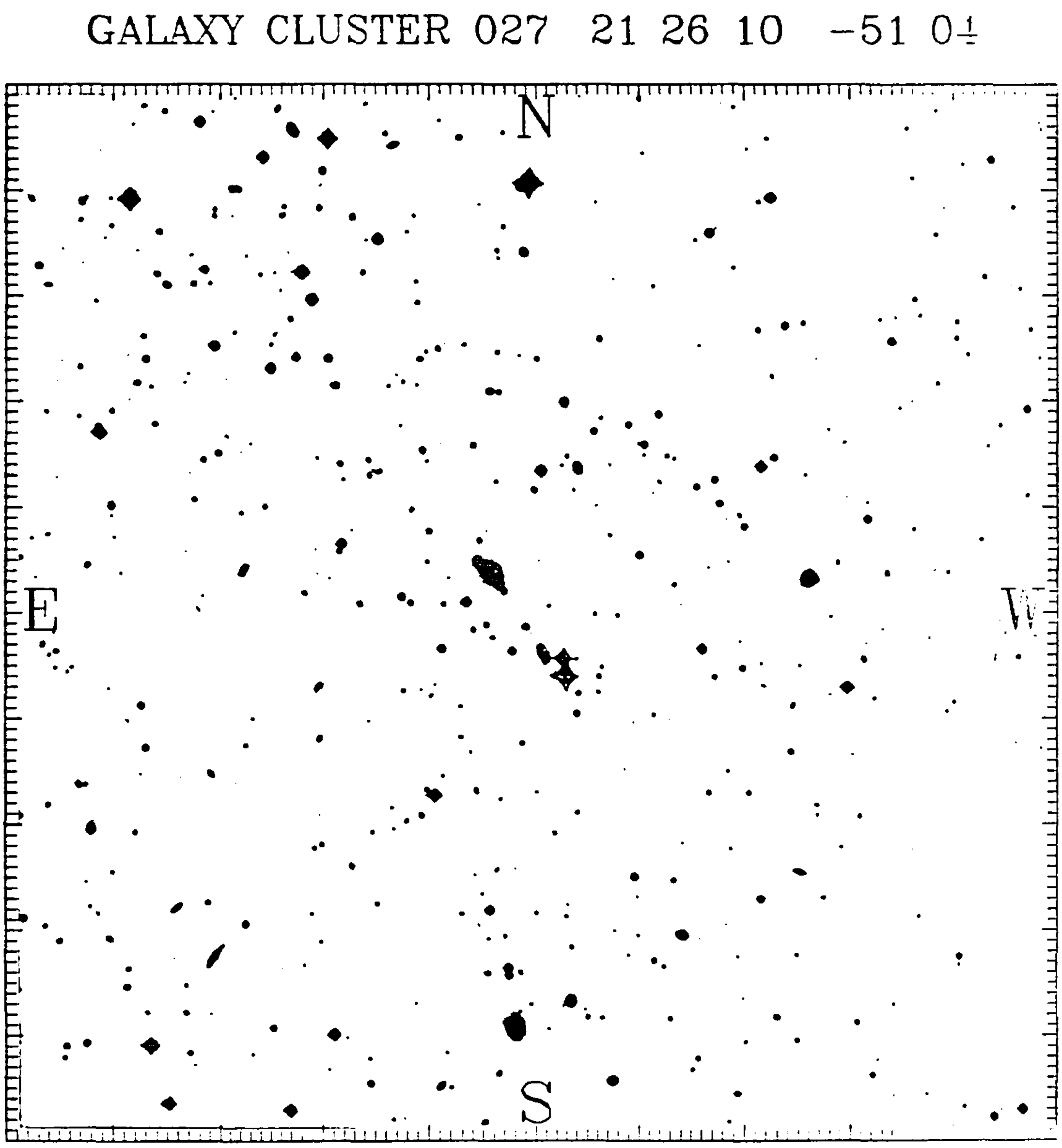


Figure 3.2.27 *(a) Field of GALAXY CLUSTER 027: 21 26 10 -51 0½*

GALAXY CLUSTER 027 21 26 10 −51 04

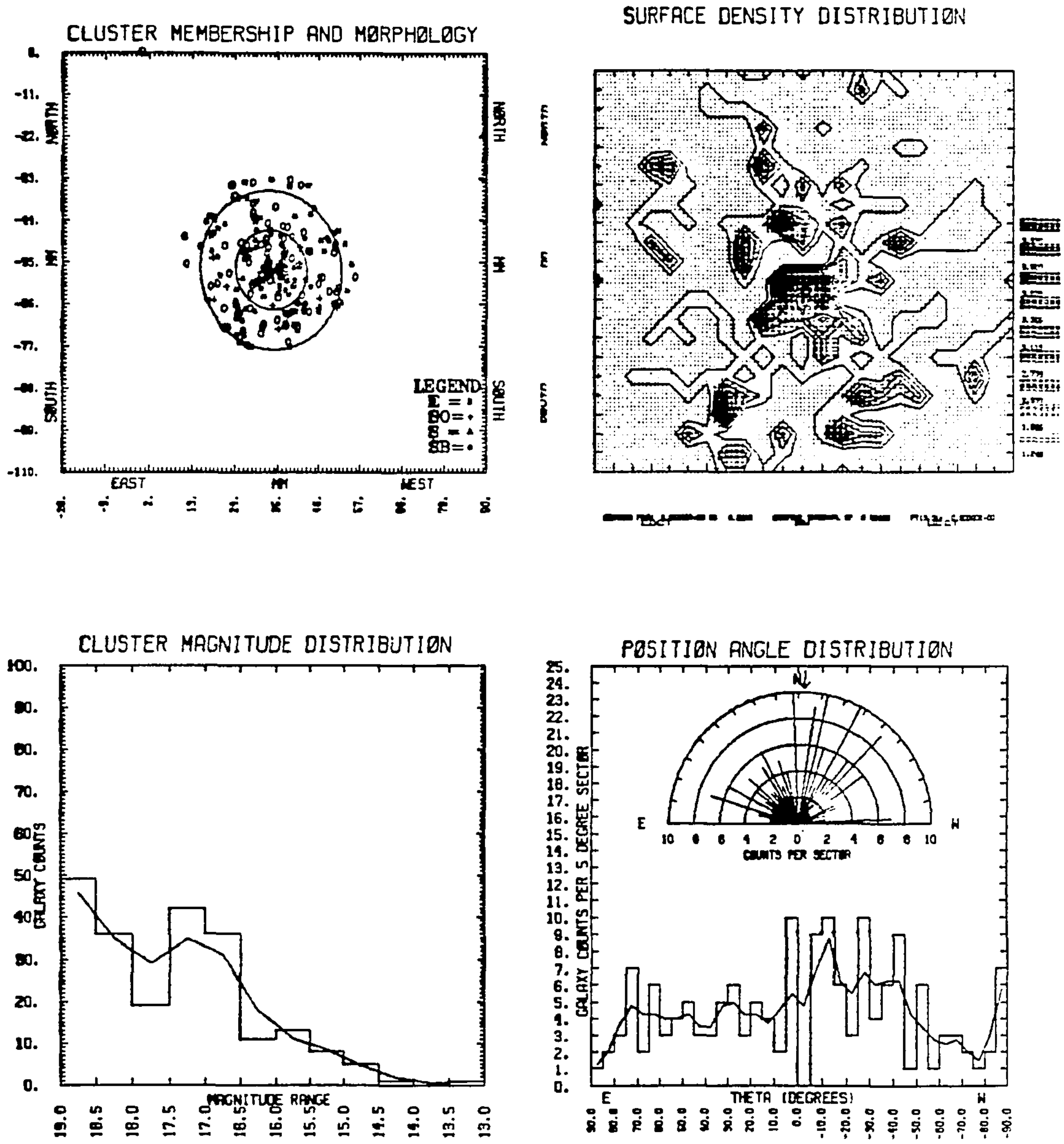
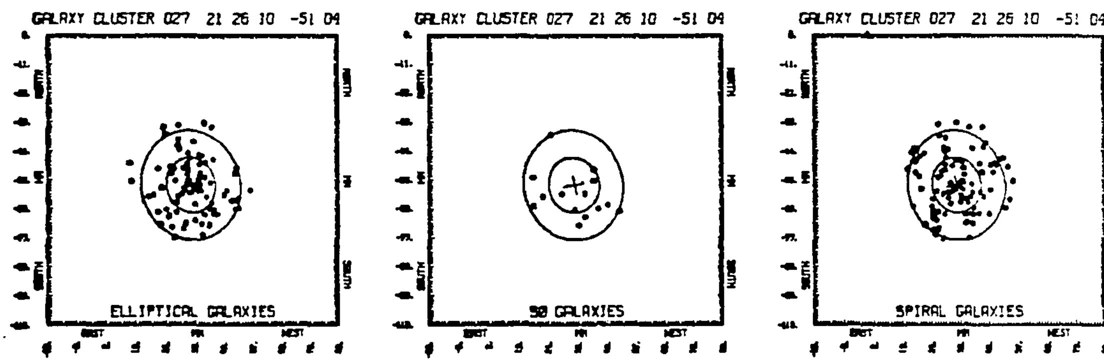


Figure 3.2.27 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 027 21 26 10 −51 04

FIELD 236 ESØ/SERC PLATE J2391

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-033.381	-057.179	21 26 9.6	-51 4 18.4	346 46 32.5	-45 20 16.5	0.048

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	92	MAJØR AXIS	10.44	SAMPLE PØPULATIØN	221
SØ	14	MINØR AXIS	9.24	CØRE PØPULATIØN	80
S	107	ECCENTRICITY	0.46	LIMITING MAGNITUDE	19.0
SB	7	PØSN. ANGLE	-79.15		
P	1				

Figure 3.2.27 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.27 *Cluster Population Description.*

GALAXY CLUSTER 027: 21 26 10 -51 04 : The cluster is located in the South-West quadrant of ESO/SERC Field 236. Within a diameter of 45mm as determined by m_{10} we count 263 galaxies in this cluster and 221 to a limiting magnitude of $m_{\mathrm{lim}} = 19.0$. The cluster is classified Abell type *I* because of its irregular appearance.

We count 43 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 0. We suggest a $B-M$ type III classification for the cluster which lacks any dominant galaxy. For m_1,m_3, and m_{10} we give 13.5, 14.5 and 15.3, respectively. The value of m_{10} implies a redshift of 0.048.

We find that the cluster contains several major concentrations, in particular, those located near the cluster center, North of center and South-East of center. These appear to be other smaller groups scattered throughout the sample.

The magnitude distribution is far from smooth, with a gentle rise from the brightest galaxies to about $m_v \simeq 16.5$ where a sharp rise in membership occurs. The distribution then drops rapidly and rises again to the magnitude limit. Position angles are irratic as well with the suggestion of a larger number of bright galaxies oriented West of North, with a greater population having position angles less than forty-five degrees.

We find a high concentration of elliptical galaxies near the center of the cluster with the spirals somewhat less concentrated and away from center. The $(E:SO:S)$ ratio suggests a slighly spriral enriched cluster with a distribution of $(1.0:0.2:1.2)$. Those galaxies identified as SO appear to be located in the Southern portion of the cluster.

We note that the core population comprises some 36% of the sample within an area of 0.11 square degrees giving a core surface density of 753 galaxies per square degree.

We find four pairs of elliptical galaxies in the cluster which appear to be comprised of two early type ellipticals, the brightest of which is located at $x=-32.3, y=-55.5$. The majority of the spirals are noticed to be lens-like in appearance with central condensations.

GALAXY CLUSTER 028 21 29 13 −35 23

Figure 3.2.28 *(a) Field of GALAXY CLUSTER 028: 21 29 13 -35 23*

GALAXY CLUSTER 028 21 29 13 −35 23

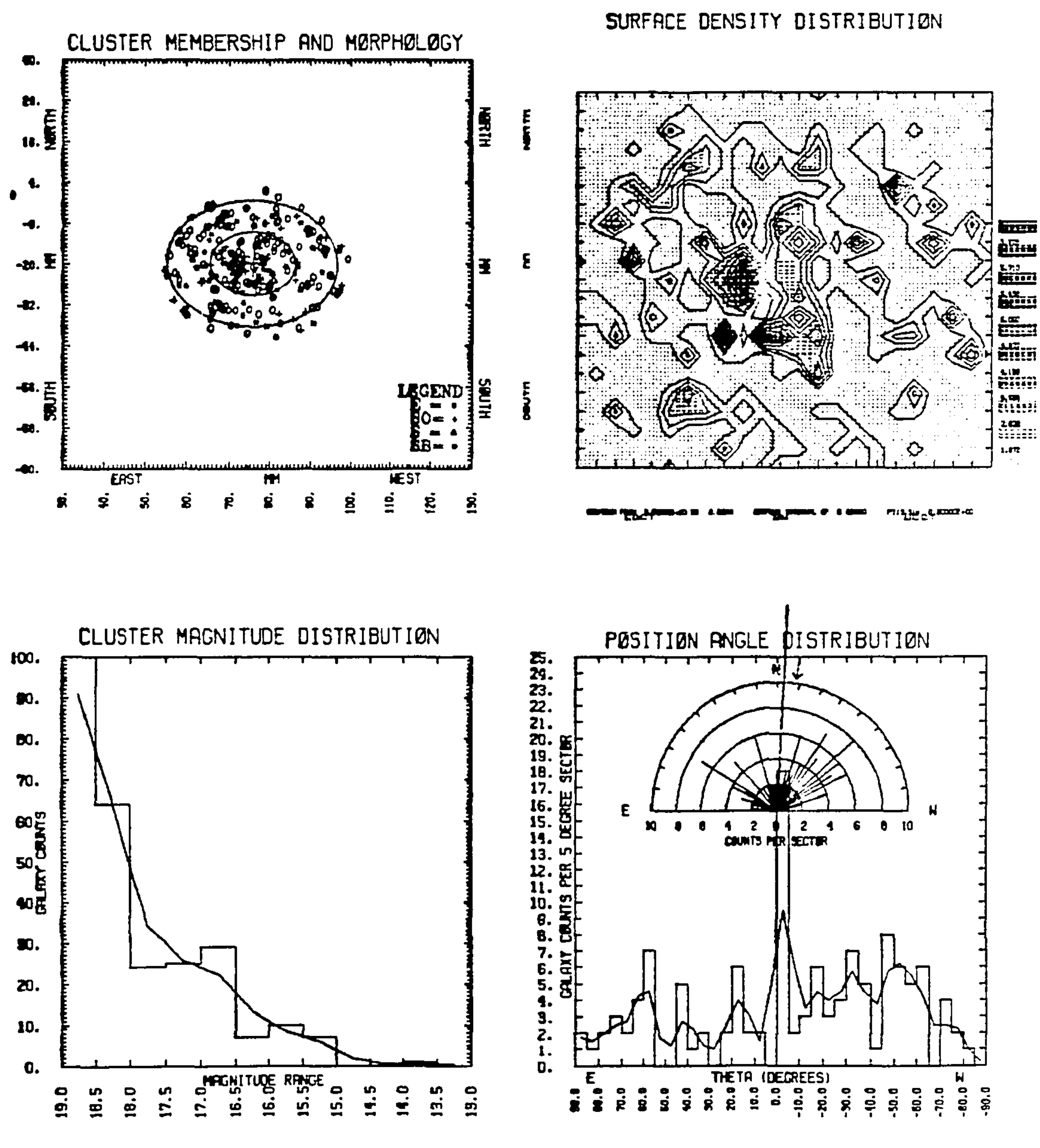
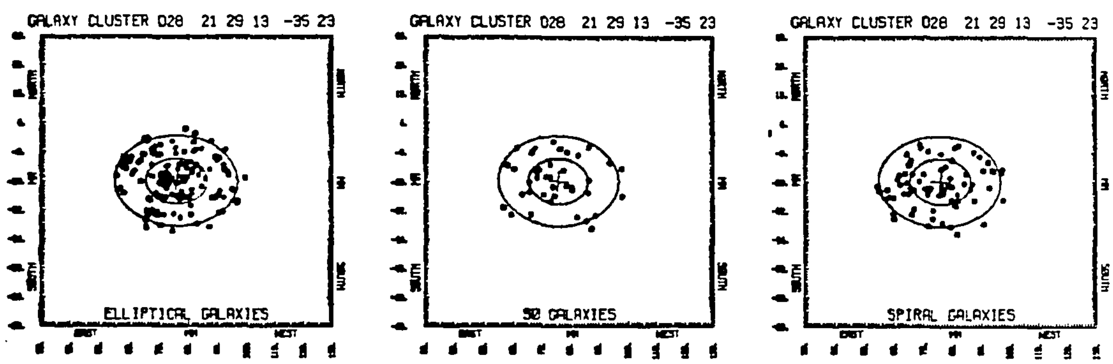


Figure 3.2.28 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 028 21 29 13 −35 23						
FIELD 403					ESØ/SERC PLATE J5290	
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-075.807	-019.961	21 29 13.5	-35 22 50.6	009 24 15.7	-47 4 43.0	0.044

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	151	MAJØR AXIS	10.39	SAMPLE PØPULATIØN	270
SØ	40	MINØR AXIS	9.28	CØRE PØPULATIØN	102
S	73	ECCENTRICITY	0.45	LIMITING MAGNITUDE	19 0
SB	5	PØSN. ANGLE	-4.36		
P	1				

Figure 3.2.29 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.29 *Cluster Population Description.*

GALAXY CLUSTER 028: 21 29 13 -35 23 : The cluster is located in the South-West quadrant of ESO/SERC Field 403. Within a diameter of 45mm as determined by m_{10} we count 430 galaxies in this cluster and 270 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *I* because of its scattered appearance and several condensations.

We count 55 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B - M$ type 00 classification for the cluster which has... For m_1,m_3, and m_{10} we give 13.8, 15.0 and 15.5, respectively. The value of m_{10} implies a redshift of 0.044.

The cluster membership appears somewhat concentrated towards the core of the dispersion ellipse with several density enhancements noticed directly South and East of the cluster center. There appear to be several smaller concentrations distributed throughtout the cluster giving it a somewhat irregular shape.

The magnitude distribution of the cluster shows a general rise from the brightest galaxies to the magnitude limit of the sample with an obvious plateau centered at $m_v = 17.0$. The position angle distribution shows an excess of bright galaxies oriented West of North, in the negative sense, with a significantly larger peak almost directly North, along the minor axis of the dispersion ellipse.

We find the elliptical galaxies somewhat concentrated towards the center of the cluster with the spirals more scattered about. The $(E : SO : S)$ ratio is $(1.0 : 0.3 : 0.5)$ suggesting an elliptical-rich cluster.

The core population comprises some 38% of the sample contained in an area of 0.11 square degrees on the sky. This yields a core surface density of 961 galaxies per square degree for this cluster.

We notice some fifteen pairs of elliptical galaxies, some superposed, and most comprised of an early and a late elliptical galaxy, the brightest of which is located at $x = -94.8, y = -23.4$. In addition, we point out several interesting spiral galaxies with ring-like structures such as the object located at $x = -66.3, y = -16.6$.

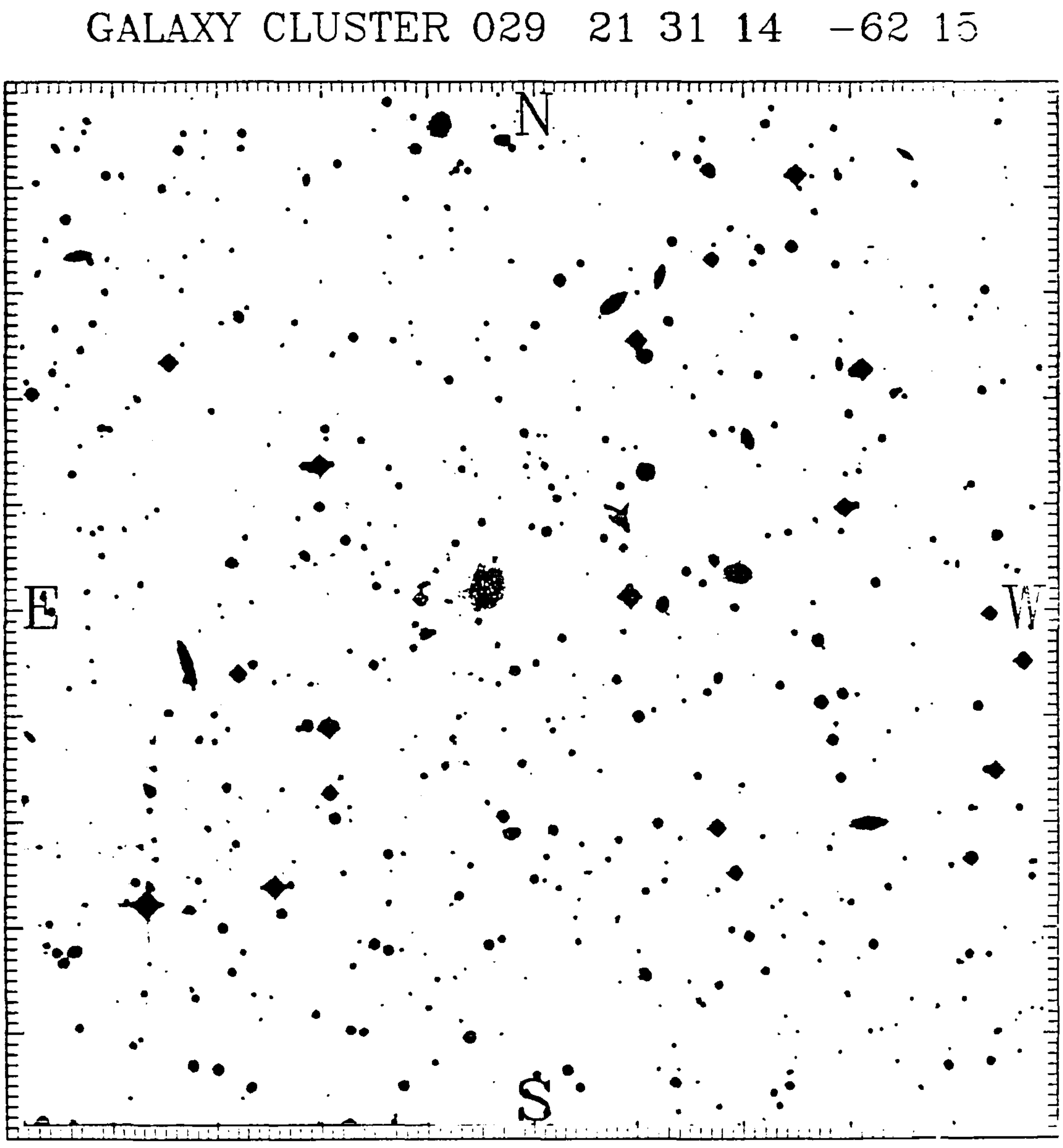


Figure 3.2.29 *(a) Field of GALAXY CLUSTER 029: 21 31 14 -62 15*

GALAXY CLUSTER 029 21 31 14 −62 15

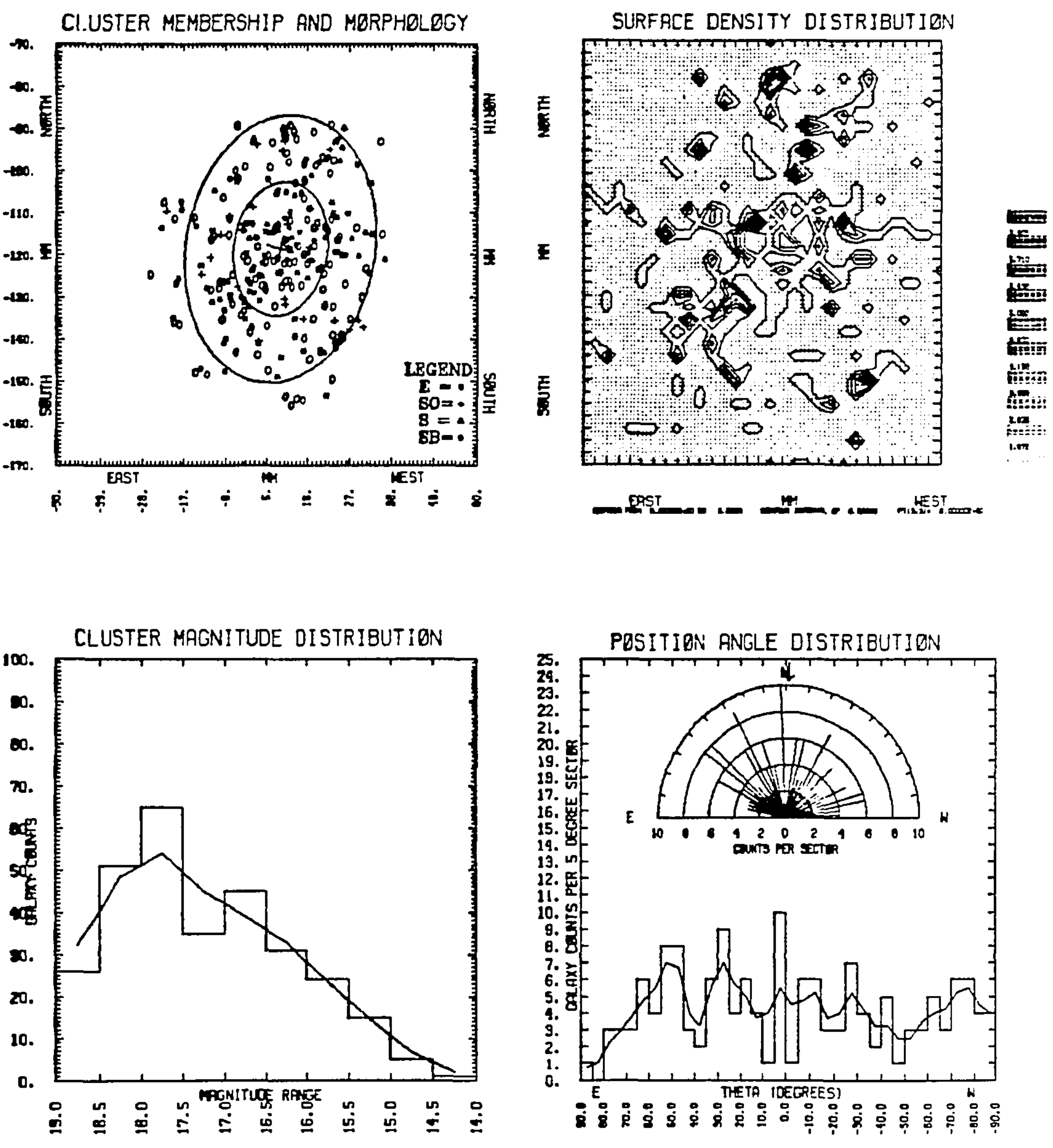
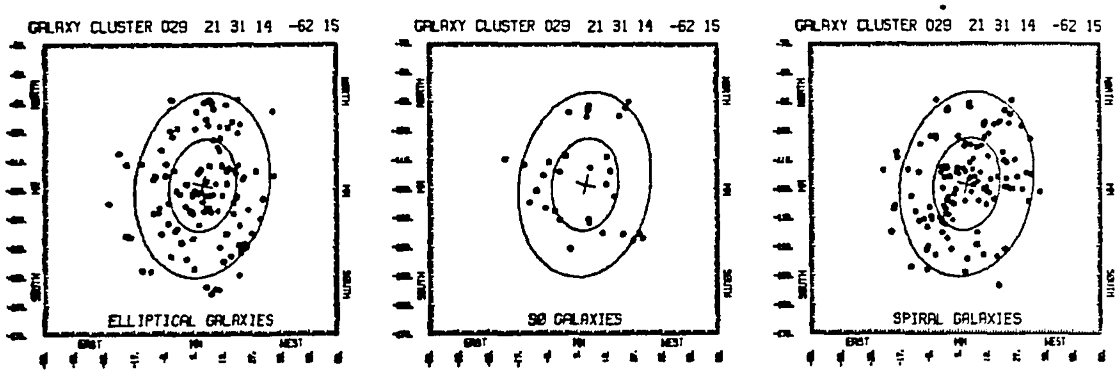


Figure 3.2.29 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 029 21 31 14 −62 15

FIELD 145 — ESØ/SERC PLATE J1759

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-008.471	-118.667	21 31 14.2	-62 15 40.3	331 40 36.2	-42 31 56.4	0.048

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	126	MAJØR AXIS	16.05	SAMPLE PØPULATIØN	298
SØ	31	MINØR AXIS	12.46	CØRE PØPULATIØN	107
S	132	ECCENTRICITY	0.63	LIMITING MAGNITUDE	19.0
SB	8	PØSN. ANGLE	76.36		
P	1				

Figure 3.2.29 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.29 *Cluster Population Description.*

GALAXY CLUSTER 029: 21 31 14 -62 15 : The cluster is located in the South-West quadrant of ESO/SERC Field 145. Within a diameter of 45mm as determined by m_{10} we count 306 galaxies in this cluster and 298 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *R* because of its regular appearance and fairly uniform distribution of galaxies.

We count 93 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B-M$ type I classification for the cluster which has a dominant and centrally located cD galaxy. For m_1,m_3, and m_{10} we give 14.0, 14.7 and 15.4, respectively. The value of m_{10} implies a redshift of 0.048.

This rather elongated cluster displays a higher concentration of galaxies towards the cluster center, falling off radially to the cluster periphery. Dominated by a centrally placed cD galaxy the cluster has a few density concentrations, primarily located North of the cluster center, although a single condensation is noticed South-West of center near the edge of the cluster.

We notice that the cluster magnitude distribution rises somewhat uniformly from the brightest cluster members to about $m_v = 18.0$ after which it declines rapidly suggesting few very faint galaxies in the field. The position angle distribution displays a higher numbers of member galaxies oriented East of North with several peaks, the largest of which lies nearly North-South.

The elliptical galaxies are scatered throughout the cluster in few concentrations, save the minor one located South-West at the cluster periphery. The numbers of spirals on the other hand, appear to be somewhat enhanced near the center of the cluster, within the dispersion ellipse. We find the $(E : SO : S)$ ratio to favor the spirals being $(1.0 : 0.2 : 1.1)$. The core population of the sample comprises some 36% of the galaxies resident within the dispersion ellipse. Since the cluster spans 0.22 square degrees, this amounts to some 486 galaxies per square degree in the core.

We note several close pairs of elliptical galaxies composed of an early and a late member such as that located at $x = 7.0, y = -135.5$, as well as a virtually superposed pair of late ellipticals of similar brightness at $x = 9.1, y = -114.3$.

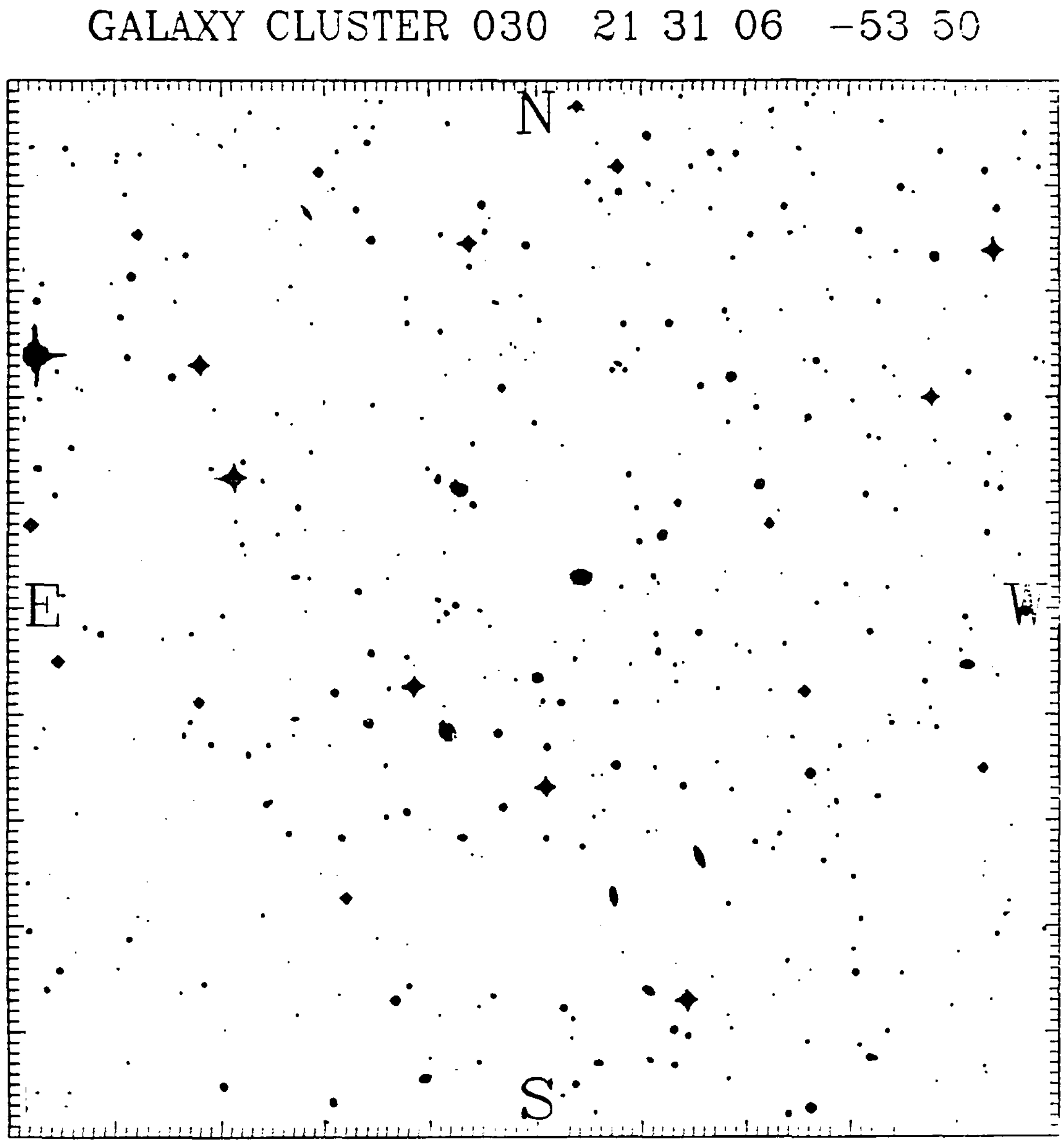


Figure 3.2.30 *(a) Field of GALAXY CLUSTER 030: 21 31 06 -53 50*

GALAXY CLUSTER 030 21 31 06 −53 50

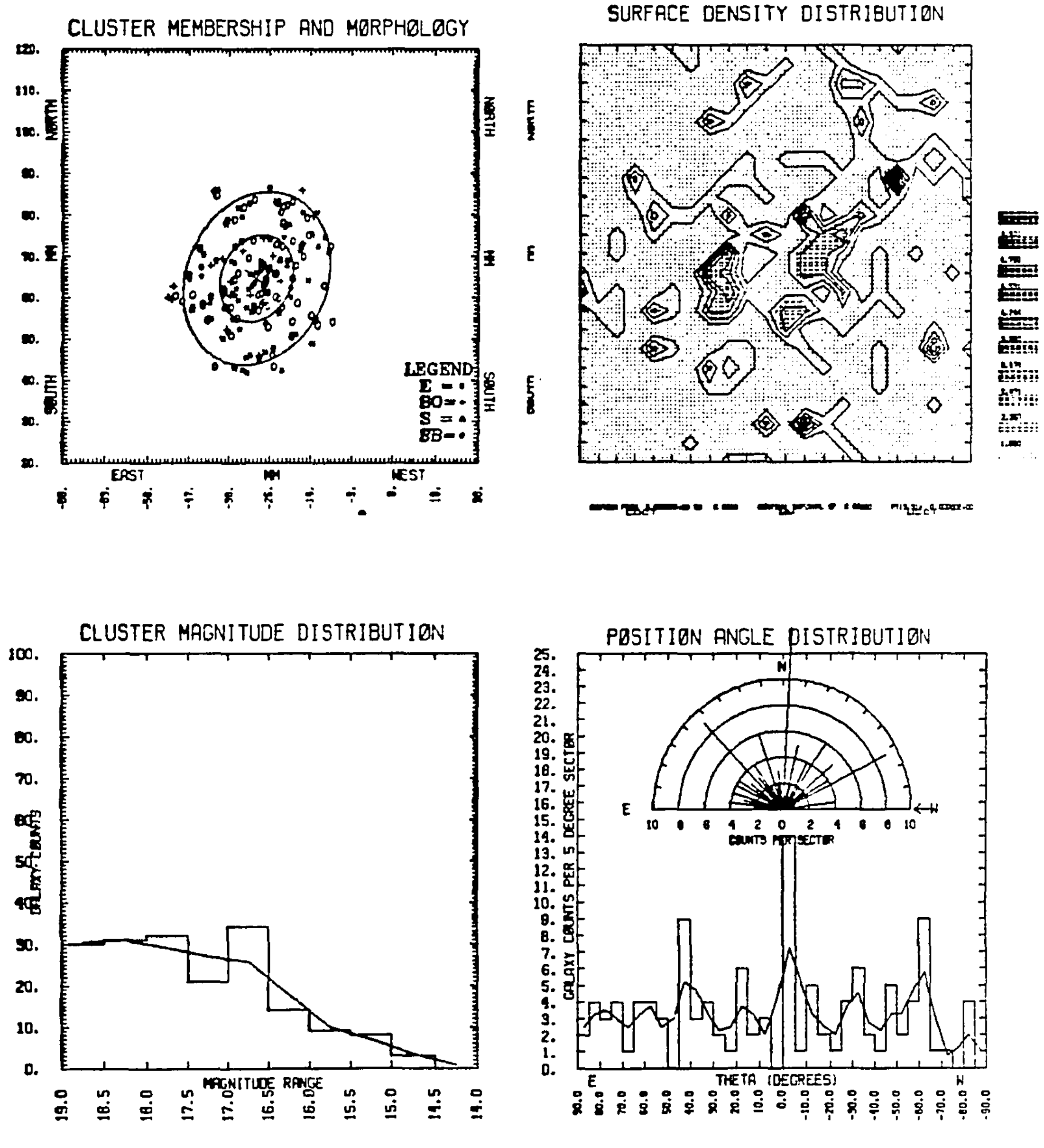
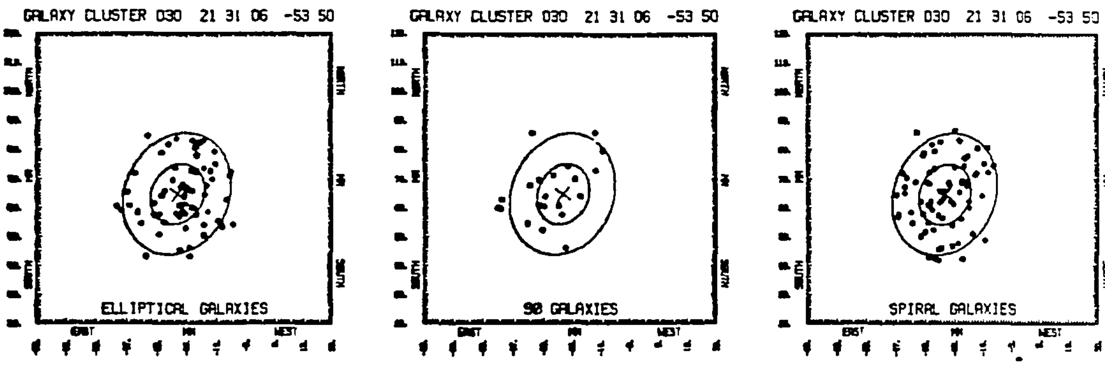


Figure 3.2.30 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 030 21 31 06 −53 50						
FIELD 188						ESØ/SERC PLATE J1592
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
028.755	064.519	21 31 5.9	-53 50 8.2	342 41 57.2	-45 23 37.9	0.050

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	77	MAJØR AXIS	11.04	SAMPLE PØPULATIØN	182
SØ	21	MINØR AXIS	9.28	CØRE PØPULATIØN	70
S	78	ECCENTRICITY	0.54	LIMITING MAGNITUDE	19.0
SB	5	PØSN. ANGLE	53.13		
P	1				

Figure 3.2.30 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.30 *Cluster Population Description.*

GALAXY CLUSTER 030: 21 31 06 -53 50 : The cluster is located in the North-East quadrant of ESO/SERC Field 188. Within a diameter of 45mm as determined by m_{10} we count 225 galaxies in this cluster and 182 to a limiting magnitude of m_{lim} = 19.0. The cluster is classified Abell type *I* because of its inherently high level of scatter.

We count 62 galaxies brighter than m_3+2 and thus classify the cluster as having

an Abell richness of 1. We suggest a $B - M$ type II classification for the cluster which has its brightest galaxies intermediate between the class cD and normal giant ellipticals. For m_1,m_3, and m_{10} we give 14.6, 14.9 and 15.4, respectively. The value of m_{10} implies a redshift of 0.050.

We note that the cluster has a somewhat higher concentration of galaxies in its central regions with a number of dense groups found North-West of the cluster center, East of center and slightly South of center.

The magnitude distribution rises gently from the brightest galaxies to about $m_v = 17.0$ upon where it levels off nearly horizontally to the magnitude limit. The position angle distribution displays an erratic scatter but has peaks, however, running East of North, North-South and North of West.

We notice that the elliptical galaxies tend to be more centrally situated than otherwise and that the spirals appear to be scattered more uniformly. The $(E : SO : S)$ ratio is $(1.0 : 0.3 : 1.1)$ indicating a slight excess of spirals. The core population contains some 38% of the sample in an area of 0.11 square degrees. This implies a surface density of 620 galaxies per square degree on the sky.

We notice several of the galaxies in this cluster to be superposed or in very close pairs. An unusual early elliptical galaxy with a corona appears superposed with a later elliptical at $x = 26.3, y = 63.5$. Another pair of bright paired early and late ellipticals is seen at $x = 37.4, y = 61.4$. A number of distressed barred spiral galaxies are seen, for example, like that at $x = 34.9, y = 59.5$. Finally, we notice what appears to a planetary nebula in the field located at $x = 41.2, y = 59.8$.

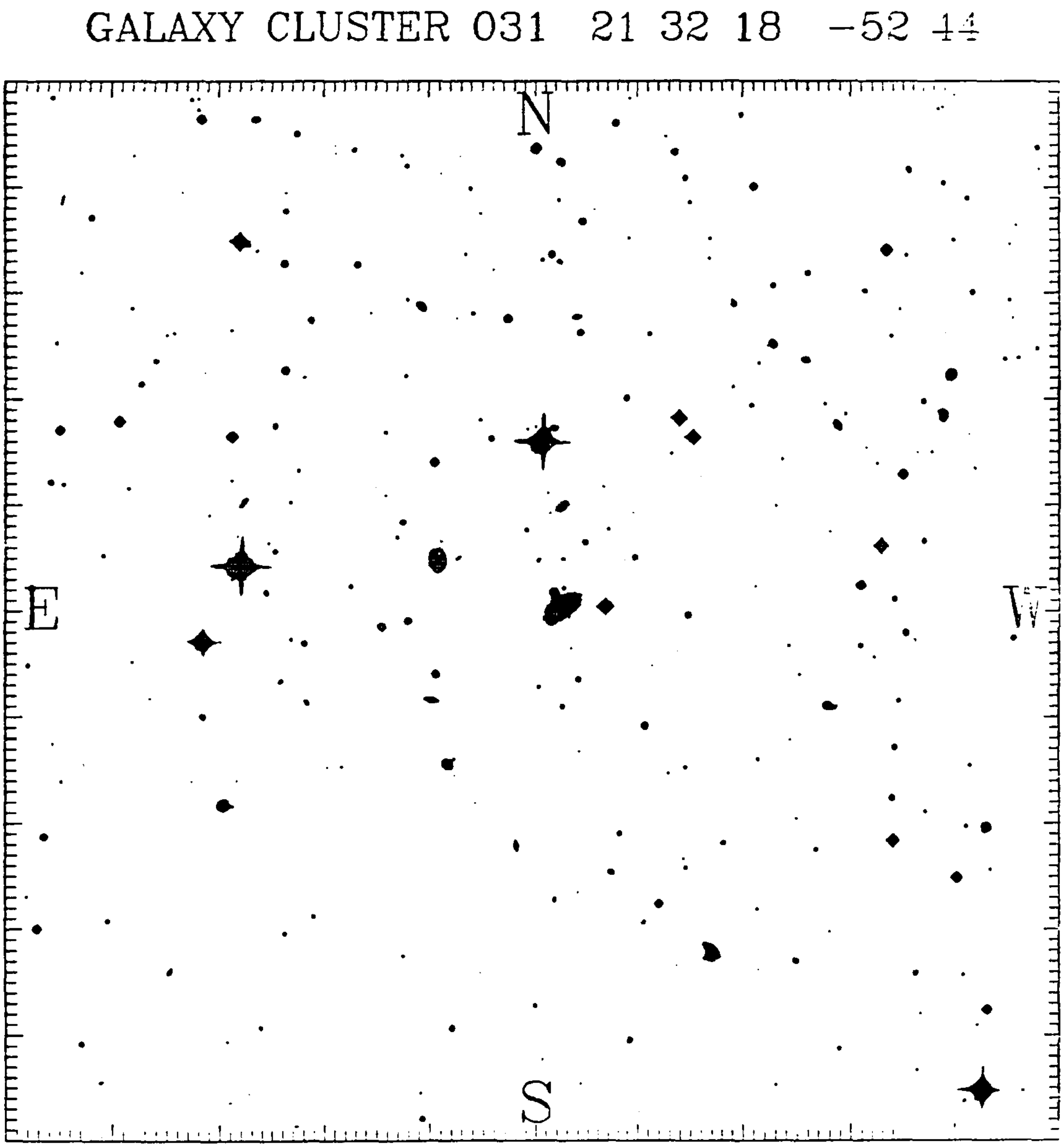


Figure 3.2.31 *(a) Field of GALAXY CLUSTER 031: 21 32 18 -52 44*

GALAXY CLUSTER 031 21 32 18 −52 44

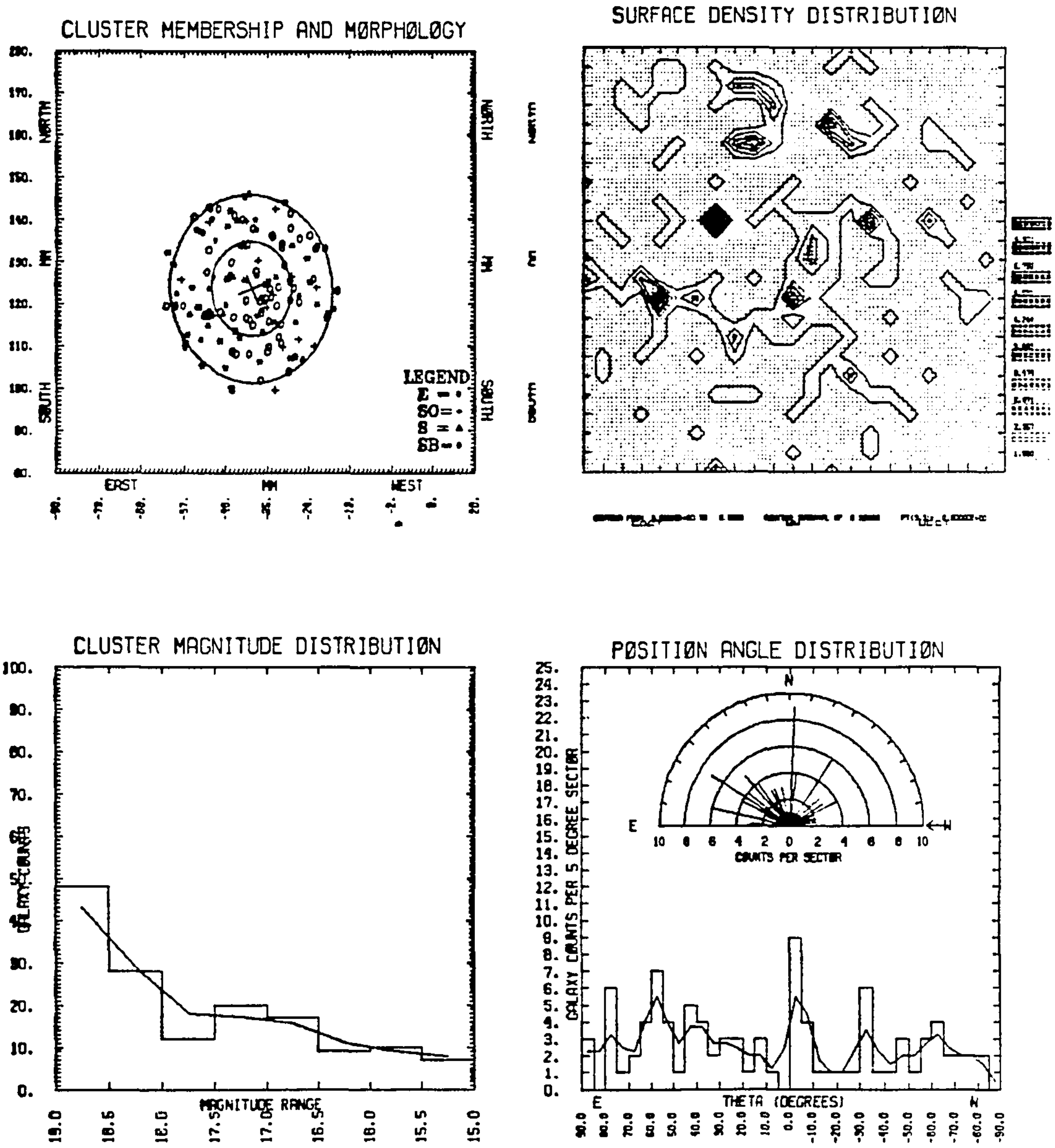
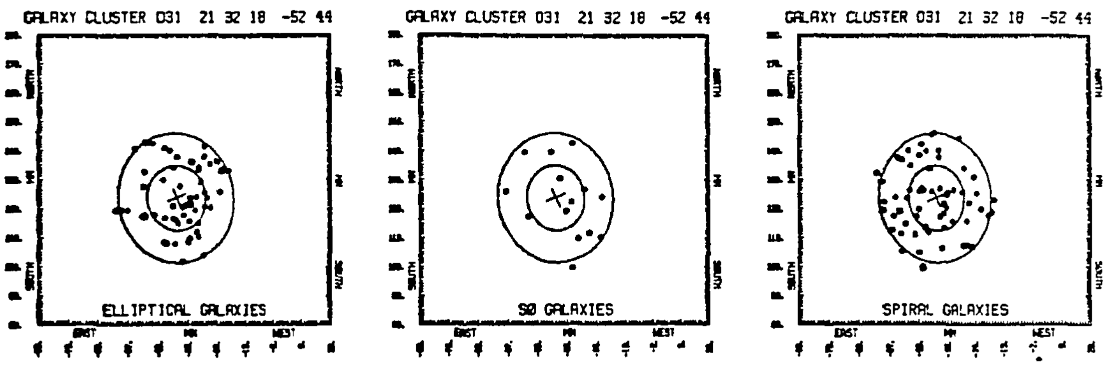


Figure 3.2.31 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 031 21 32 18 −52 44						
FIELD 188						ESØ/SERC PLATE J1552
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
039.266	123.490	21 32 18.2	−52 44 2.1	344 8 48.2	−45 51 52.5	0.044

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	61	MAJØR AXIS	11.20	SAMPLE PØPULATIØN	151
SØ	14	MINØR AXIS	10.66	CØRE PØPULATIØN	48
S	67	ECCENTRICITY	0.30	LIMITING MAGNITUDE	19.0
SB	7	PØSN. ANGLE	−68.94		
P	2				

Figure 3.2.31 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.31 *Cluster Population Description.*

GALAXY CLUSTER 031: 21 32 18 -52 44 : The cluster is located in the North-East quadrant of ESO/SERC Field 188. Within a diameter of 45mm as determined by m_{10} we count 227 galaxies in this cluster and 151 to a limiting magnitude of m_{lim} = 19.0. The cluster is classified Abell type *I* because of its irregular and scattered appearance.

We count 57 galaxies brighter than m_3+2 and thus classify the cluster as having

an Abell richness of 1. We suggest a $B - M$ type III classification for the cluster which has no major dominant galaxies save the first brightest that appears to be an edgewise spiral. For m_1,m_3, and m_{10} we give 15.0, 15.4 and 15.5, respectively. The value of m_{10} implies a redshift of 0.044.

We find this cluster possessing a rather scattered appearance, with few concentrations, except for two small density enhancements, the greater located somewhat East of center, the lesser located East South-East.

The cluster magnitude distribution shows a very slow rise from the brightest galaxies with a greater change of slope occurring near $m_v = 18.0$ to the magnitude limit. The position angle distribution appears to have a slight concentration of galaxies oriented East of North and a peak running North-South.

We find the elliptical galaxies slightly more concentrated in the third and fourth quadrants, whereas the spirals occur more frequently in the second and third quadrants. The cluster appears somewhat spiral enhanced with an $(E : SO : S)$ ratio of $(1.0 : 0.2 : 1.2)$. This scattered cluster has a core population comprising nearly 32% of the sample in a region spanning 0.13 square degrees. This represents a core surface density of 365 galaxies per square degree on the sky.

We notice six close pairs of elliptical galaxies consisting of an early and a late elliptical, the brightest occurring at $x = 40.5, y = 133.9$. There are also a number of spiral galaxies with ring-like structures or ansae such as the object located at $x = 52.4, y = 136.7$. Several rather peculiar galaxies are also noted, such as that residing at $x = 56.7, y = 110.0$ which appears to possess a double nucleus within a diffuse ovoid mass.

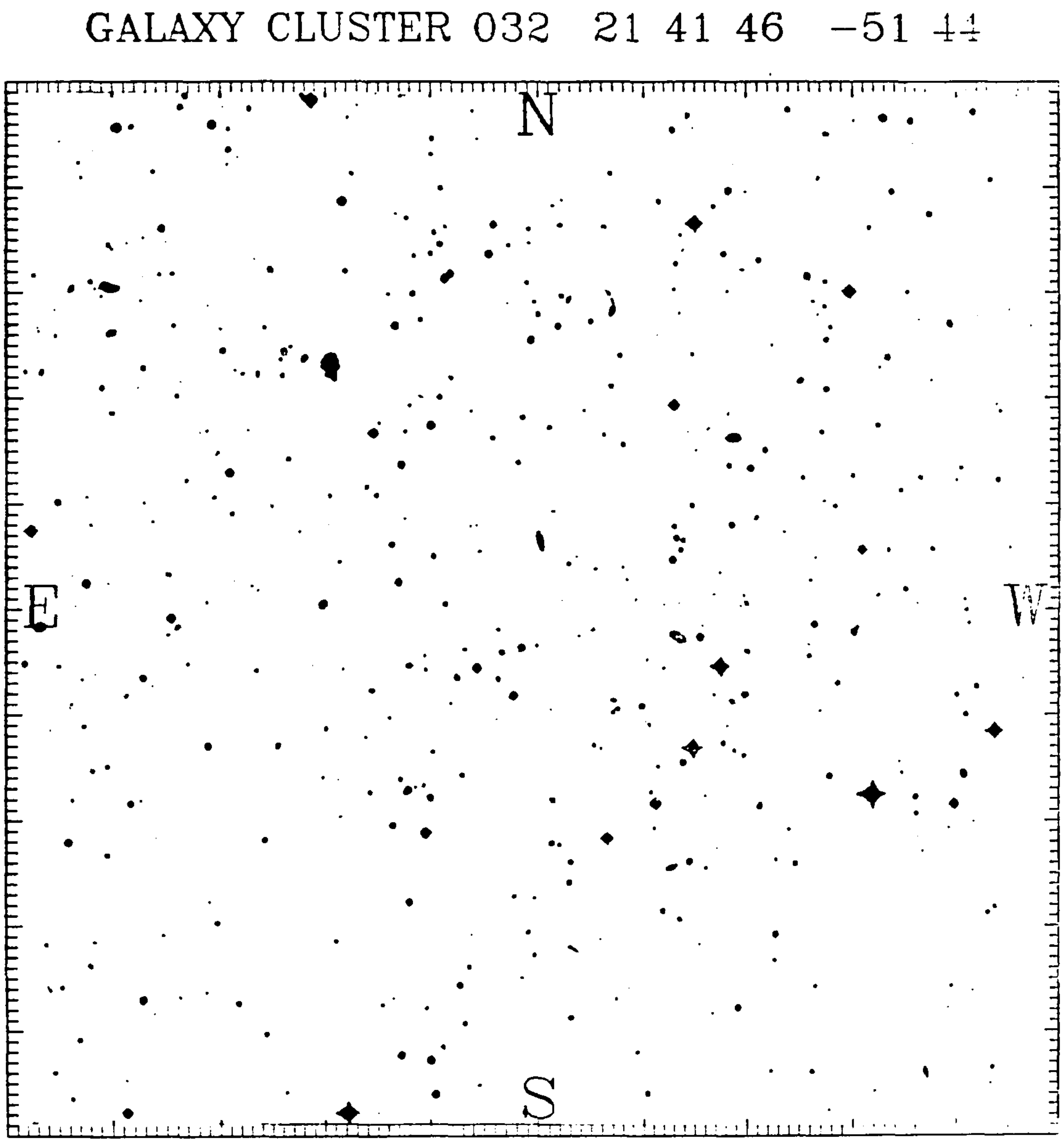


Figure 3.2.32 *(a) Field of GALAXY CLUSTER 032: 21 41 46 -51 44*

GALAXY CLUSTER 032 21 41 46 −51 44

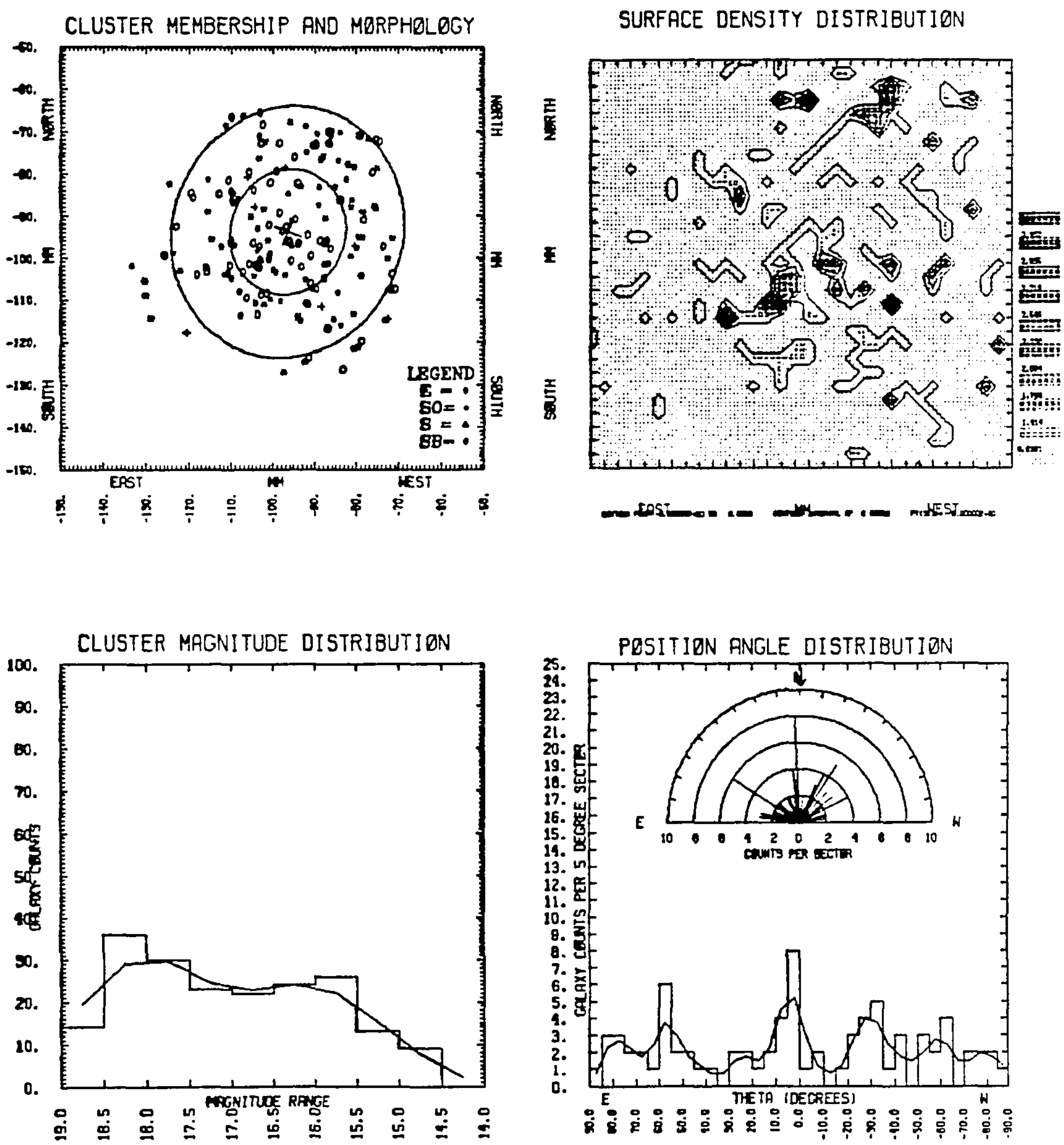
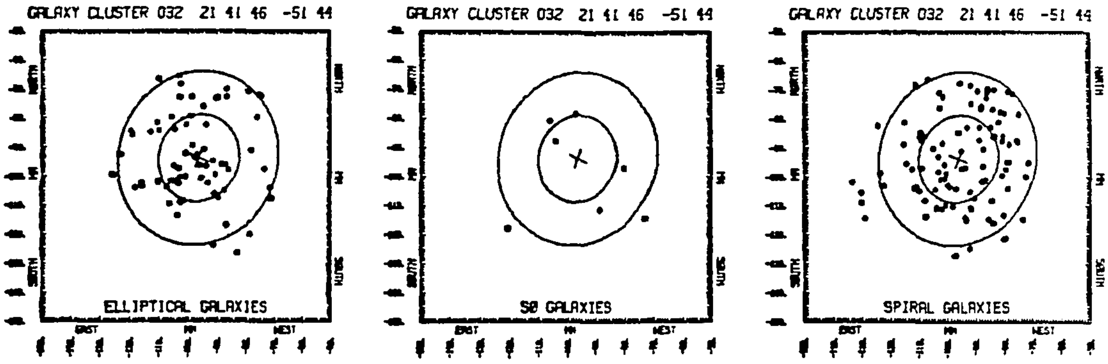


Figure 3.2.32 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 032 21 41 46 −51 44							
FIELD 236						ESO/SERC PLATE J2331	
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)		Z
096.553	-093.917	21 41 46.5	-51 43 57.4	344 58 17.5	-47 32	0.7	0.043

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	80	MAJOR AXIS	15.07	SAMPLE POPULATION	197
S0	7	MINOR AXIS	13.71	CORE POPULATION	62
S	100	ECCENTRICITY	0.42	LIMITING MAGNITUDE	19.0
SB	9	POSN. ANGLE	68.77		
P	1				

Figure 3.2.32 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.32 *Cluster Population Description.*

GALAXY CLUSTER 032: 21 41 46 -51 44 : The cluster is located in the South-East quadrant of ESO/SERC Field 236. Within a diameter of 60mm as determined by m_{10} we count 202 galaxies in this cluster and 197 to a limiting magnitude of m_{lim} = 19.0. The cluster is classified Abell type *I* because of its irregular structure and wide scatter.

We count 85 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B - M$ type I-II classification for the cluster which has an intermediate appearance without a dominant centrally located bright galaxy. For m_1,m_3, and m_{10} we give 14.5, 14.8 and 15.1, respectively. The value of m_{10} implies a redshift of 0.043.

We find few concentrations in this irregular cluster save for a slight enhancement South of center and another to the South-East. The magnitude distribution shows a slow rise from the brightest members to about a magnitude fainter, near $m_v = 15.5$ where the distribution tapers off to a plateau spanning some three magnitudes. Beyond the plateau the distribution falls off rapidly to the sample limit. The position angles vary irratically for the brighter members with a slightly greater number of galaxies oriented West of North and a few peaks indicating North-South orientations and North-East orientations.

The elliptical galaxies in this cluster appear to be somewhat concentrated towards the center of the cluster whereas the spirals seem to be more uniformly spread throughout the cluster. We note that the cluster is a bit spiral enhanced with the $(E : SO : S)$ ratio being $(1.0 : 0.1 : 1.4)$.

The core population represents slightly over 34% of the sample contained in an area of 0.23 square degrees. This yields a core surface density of 273 galaxies per square degree on the sky.

We notice an unusual collection of a pair of close pairs of elliptical galaxies located at $x = 90.5, y = -73.5$. There also appear to be a number of apparently superposed spiral galaxies such as the object located at $x = 130.1, y = -108.9$. Finally, we make notice of an early elliptical galaxy with two faint companions situated at $x = 95.7, y = -100.8$.

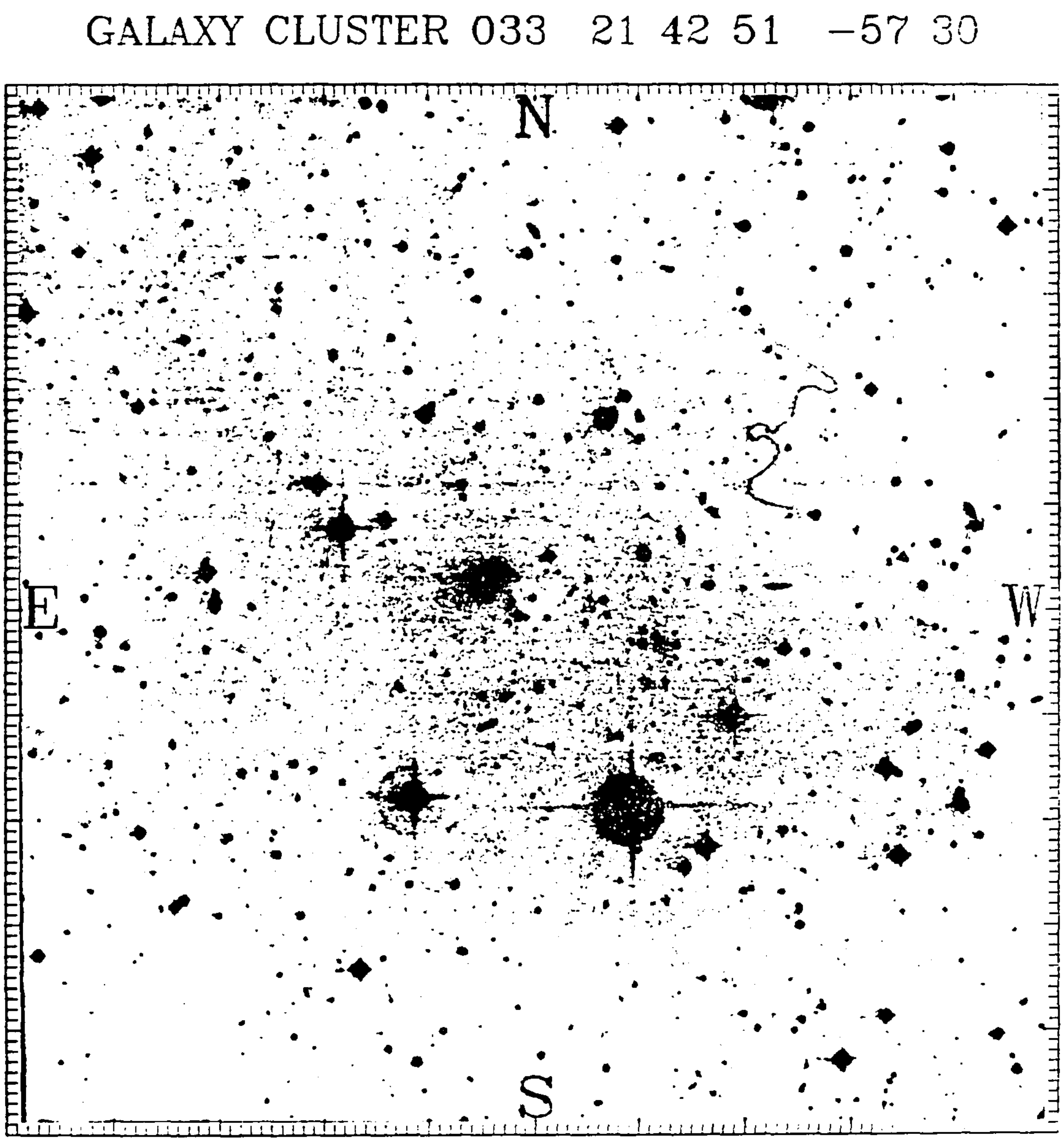


Figure 3.2.33 *(a) Field of GALAXY CLUSTER 033: 21 42 51 -57 30*

GALAXY CLUSTER 033 21 42 51 −57 29

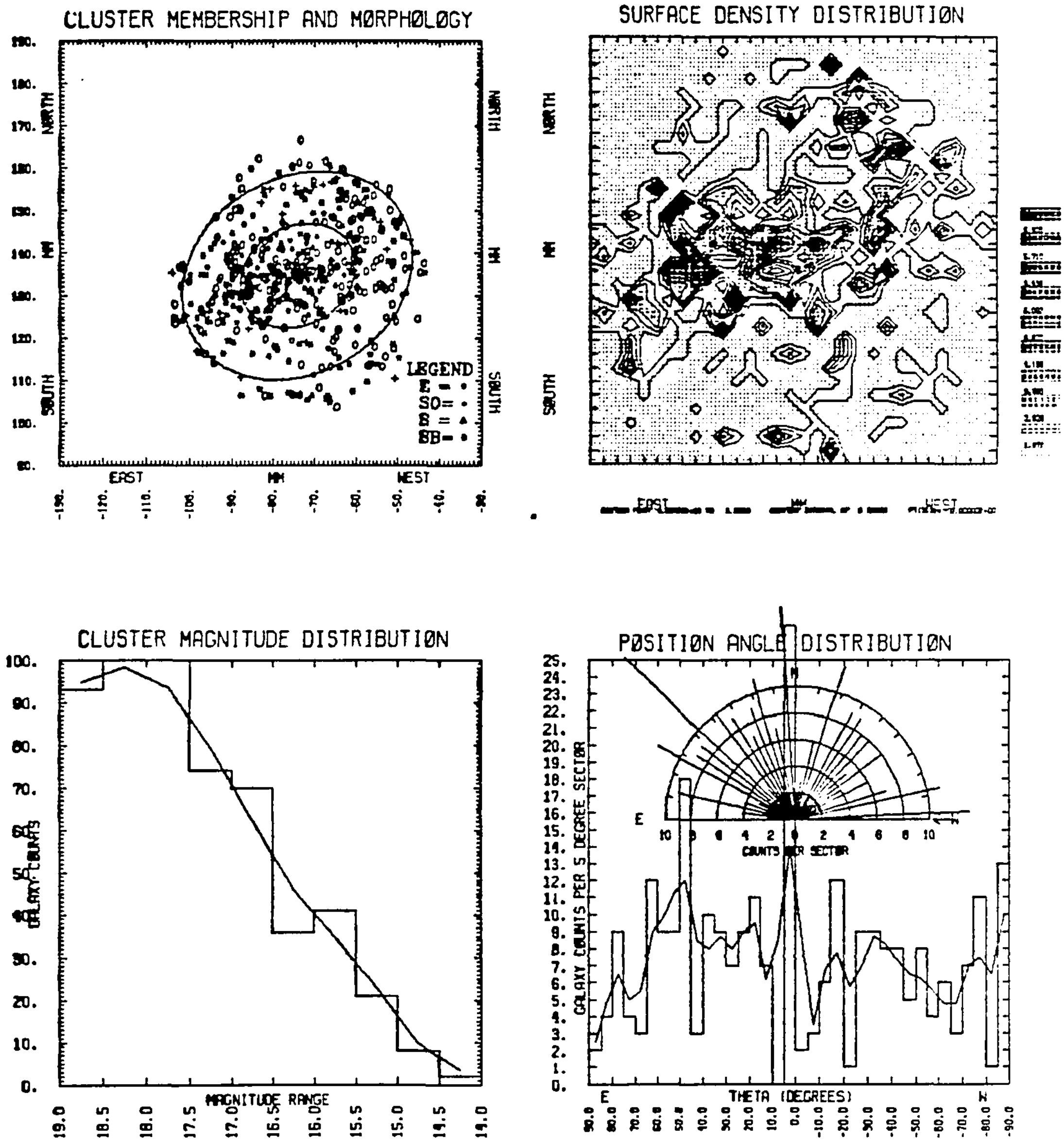
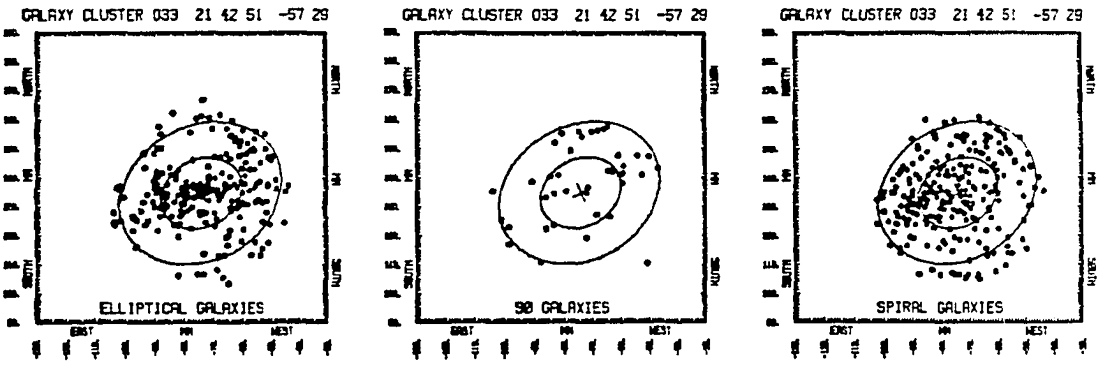


Figure 3.2.33 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 033 21 42 51 −57 29						
FIELD 145						ESØ/SERC PLATE J1759
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
074.215	134.600	21 42 50.8	-57 29 48.5	336 58 51.8	-45 44 51.4	0.042

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	262	MAJØR AXIS	14.45	SAMPLE PØPULATIØN	574
SØ	39	MINØR AXIS	11.56	CØRE PØPULATIØN	214
S	258	ECCENTRICITY	0.60	LIMITING MAGNITUDE	19.0
SB	15	PØSN. ANGLE	28.39		
P	0				

Figure 3.2.33 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.33 *Cluster Population Description.*

GALAXY CLUSTER 033: 21 42 51 -57 30 : The cluster is located in the North-East quadrant of ESO/SERC Field 145. Within a diameter of 45mm as determined by m_{10} we count 604 galaxies in this cluster and 574 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type R because of its smooth albeit dense distribution of galaxies.

We count 110 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B - M$ type II classification for the cluster which has the brightest galaxies intermediate between the class cD and normal giant ellipticals. For m_1,m_3, and m_{10} we give 14.1, 14.6 and 15.0, respectively. The value of m_{10} implies a redshift of 0.042.

This dense cluster presents an almost linear concentration within the dispersion ellipse with several dense subgroups to the East and South-East of the cluster center. Other concentrations occur throughout the cluster namely to the North of center and slightly West of North.

The cluster magnitude distribution rises rapidly with an almost linear slope from the brightest to the faintest magnitude, with the bulk of the sample population lying between the single magnitude range from $m_v = 17.5$ to $m_v = 18.5$. The position angle distribution shows bright galaxies oriented at virtually all directions with major peaks located North-South and East of North.

We note that the distribution of elliptical galaxies in this cluster is curiously linear, along the major axis of the dispersion ellipse, whereas the spirals seem to be more uniformly scattered throughout the cluster save for a slight zone of avoidance to the West of cluster center. The population is practically evenly divided between ellipticals and spirals with an $(E : SO : S)$ ratio of $(1.0 : 0.1 : 1.0)$. The core population comprises some 37% of the sample contained in an area of 0.18 square degrees. We thus find a core surface density of 1163 galaxies per square degree on the sky.

We find very few pairs of galaxies in this cluster, and those observed do appear to be combinations of early and late ellipticals, although several spiral galaxies in the sample appear to be superposed. Attention is drawn to a small group of elliptical galaxies in a faint subcluster located at $x = 86.8, y = 130.4$.

GALAXY CLUSTER 034 21 43 46 −44 06

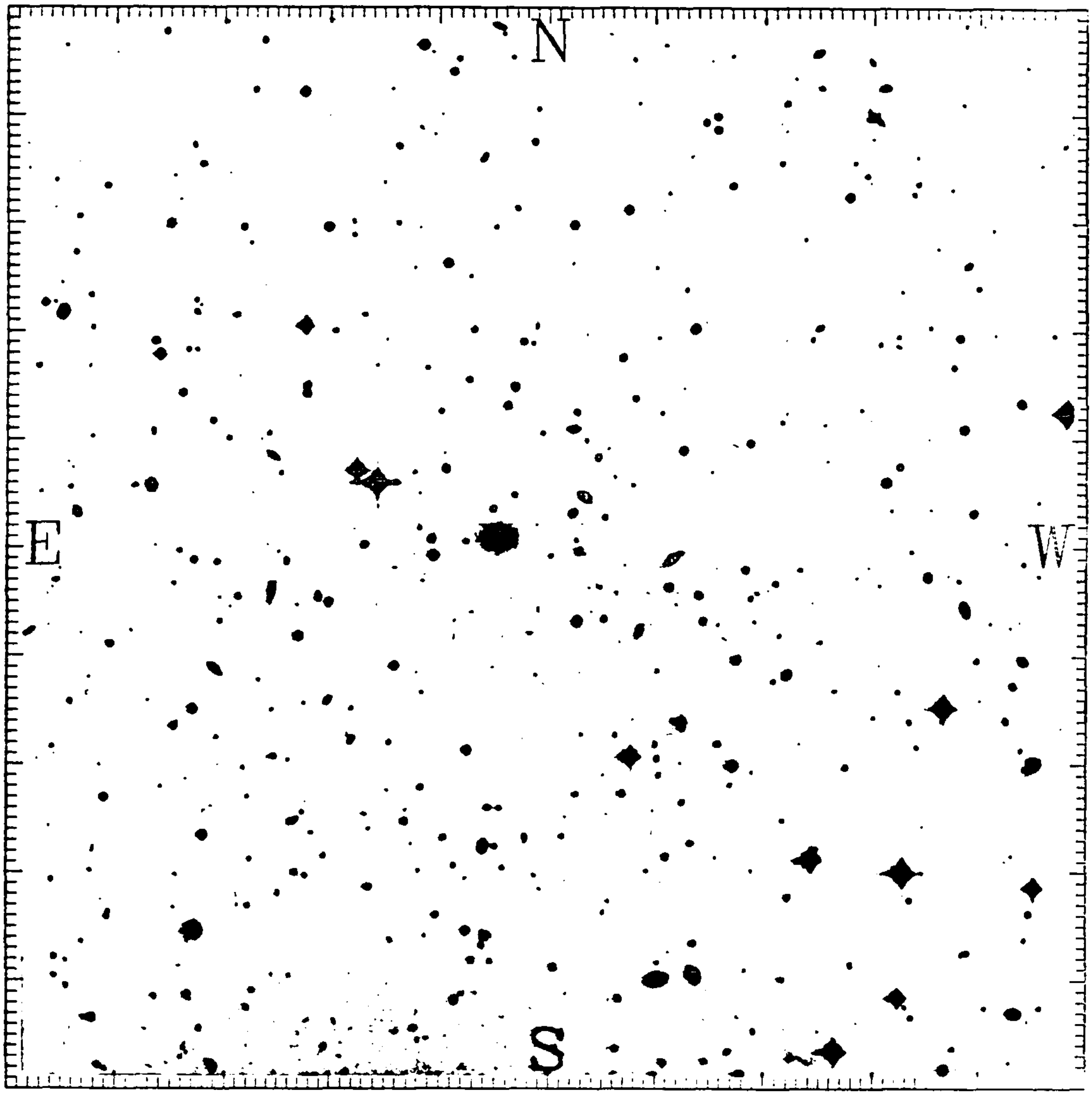


Figure 3.2.34 *(a) Field of GALAXY CLUSTER 034: 21 43 46 -44 06*

GALAXY CLUSTER 034 21 43 46 −44 06

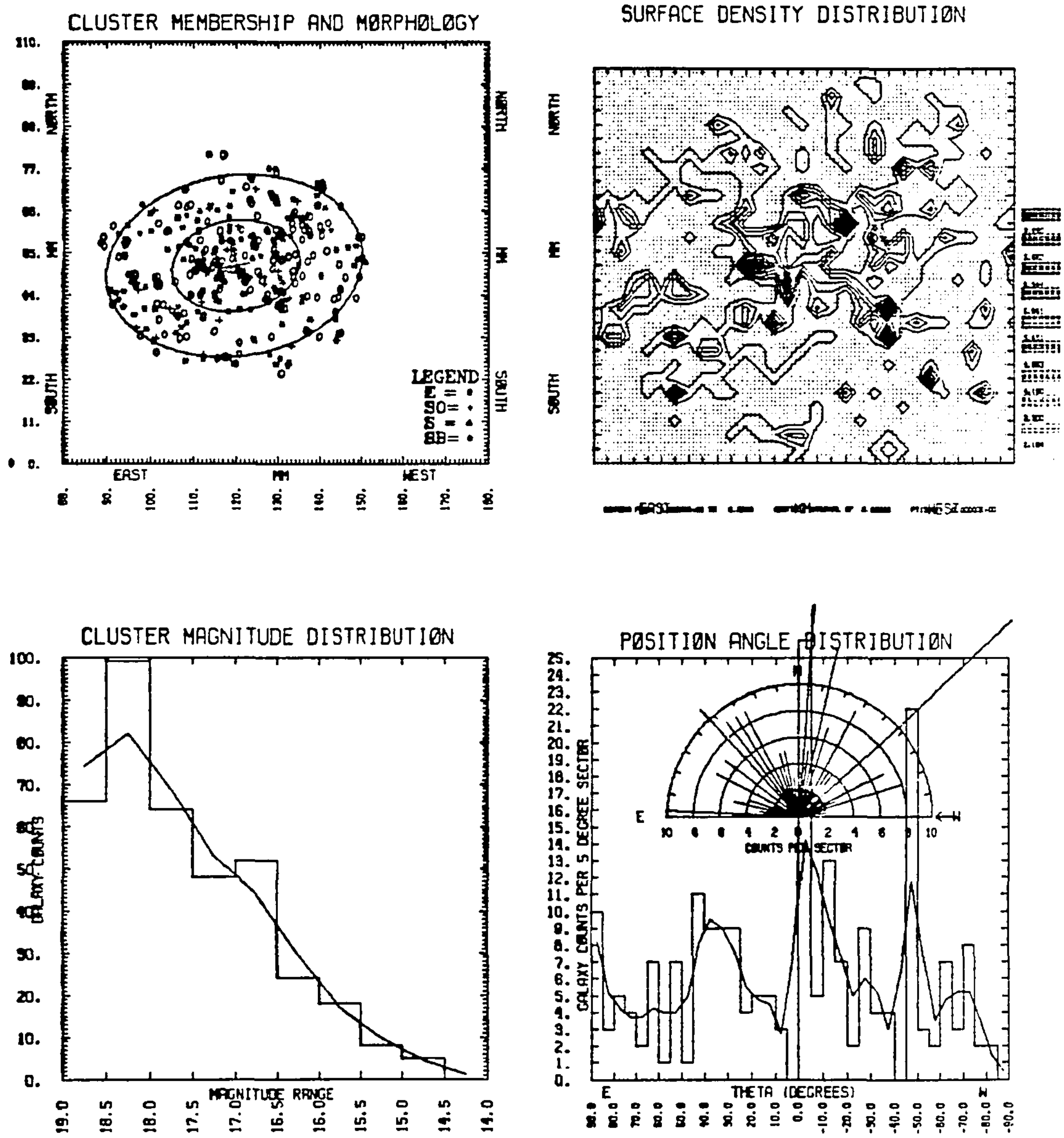
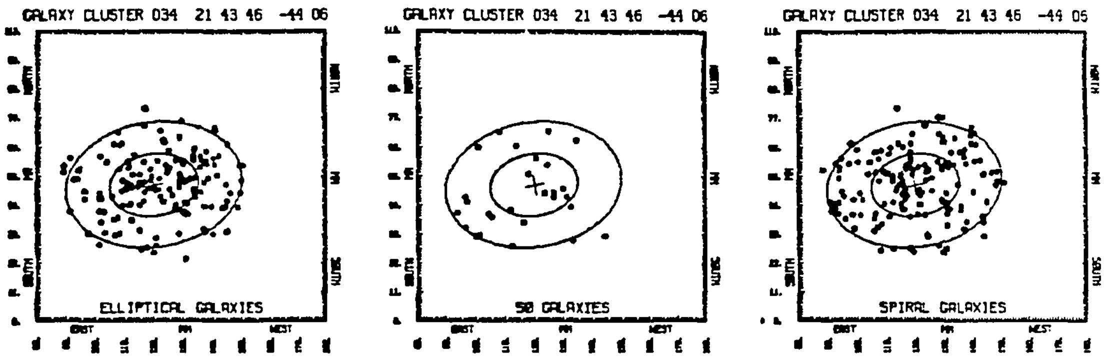


Figure 3.2.34 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 034 21 43 46 −44 06						
FIELD 288						ESØ/SERC PLATE J4594
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-119.835	051.560	21 43 46.1	-44 6 15.9	356 6 55.3	-49 31 23.7	0.049

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	167	MAJØR AXIS	15.18	SAMPLE PØPULATIØN	384
SØ	27	MINØR AXIS	11.74	CØRE PØPULATIØN	147
S	169	ECCENTRICITY	0.63	LIMITING MAGNITUDE	19.0
SB	20	PØSN. ANGLE	11.76		
P	1				

Figure 3.2.34 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.34 *Cluster Population Description.*

GALAXY CLUSTER 034: 21 43 46 -44 06 : The cluster is located in the North-West quadrant of ESO/SERC Field 288. Within a diameter of 60mm as determined by m_{10} we count 440 galaxies in this cluster and 384 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *I* because of its irregularity and possibility of being superposed on a more distant cluster.

We count 97 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B-M$ type II classification for the cluster which has a bright dominant galaxy with a corona that is intermediate in appearance between the class cD and normal giant ellipticals. For m_1,m_3, and m_{10} we give 14.8, 14.9 and 15.3, respectively. The value of m_{10} implies a redshift of 0.048.

We find this cluster to be somewhat linearly distributed with several small concentrations, lying East of center, North-West of center and South-West of center. There are numerous small voids in the cluster as well.

The magnitude distribution rises steeply from the brightest galaxies to the fainter with a nearly exponential rise to about $m_v = 17.0$ where a change of slope occurs. There appears to be a large concentration of galaxies near $m_v = 18.0$ offering a mild suggestion of a subpopulation perhaps consisting of a faint background cluster. The position angle distribution is chaotic at best, with several peaks, namely at the North-East, the North-South and the North-West orientations.

We note the high central concentration of the dispersion ellipse, with a similar population of ellipticals and spirals. The $(E : SO : S)$ ratio is almost equally divided between ellipticals and spirals and is $(1.0 : 0.2 : 1.1)$. The core population comprises some 38% of the sample and is contained in an area of 0.2 square degrees. This gives a core surface density of 749 galaxies per square degree on the sky.

We notice only three pairs of close elliptical galaxies in this cluster, so rich in elliptical galaxies. The brightest of these is located at $x = -124.5, y = 56.4$. Over a dozen of the spiral galaxies in the sample appear to have obvious ring-like structures, for example, as that found at $x = -94.6, y = 61.8$. In addition we note a spiral with what appears to be a double nucleus at $x = -132.7, y = 59.3$.

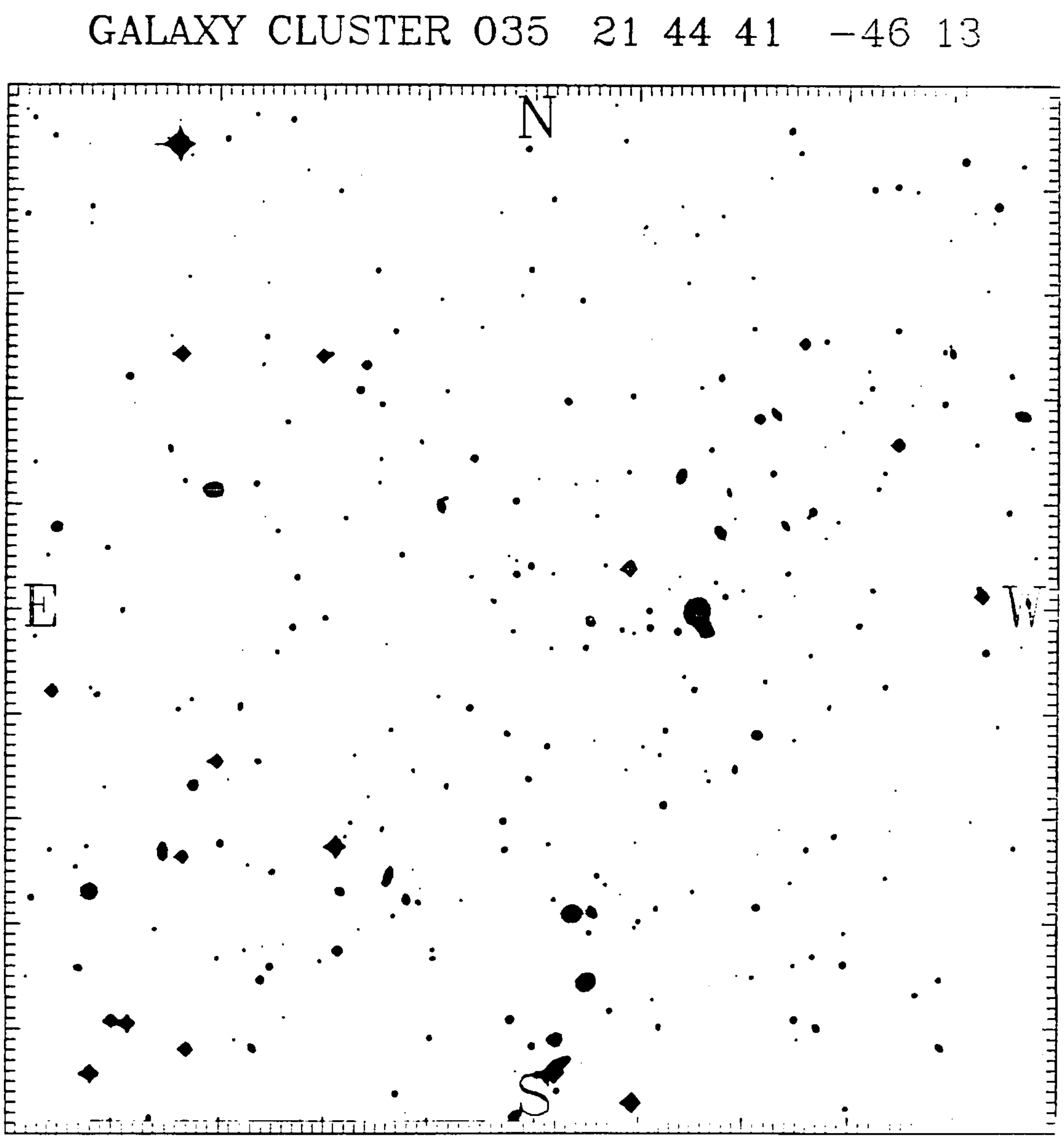


Figure 3.2.35 *(a) Field of GALAXY CLUSTER 035: 21 44 41 -46 13*

GALAXY CLUSTER 035 21 44 41 −46 13

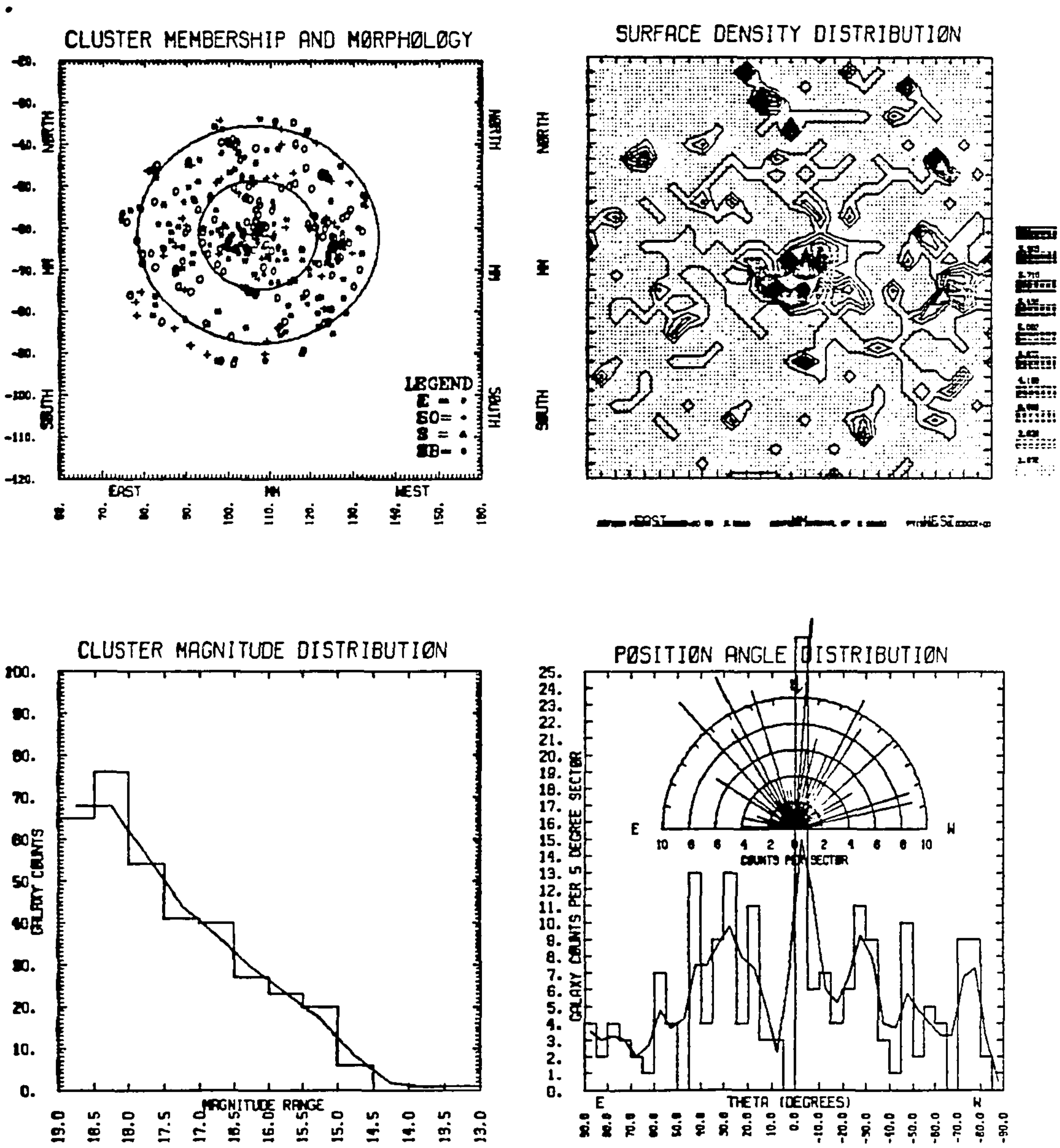
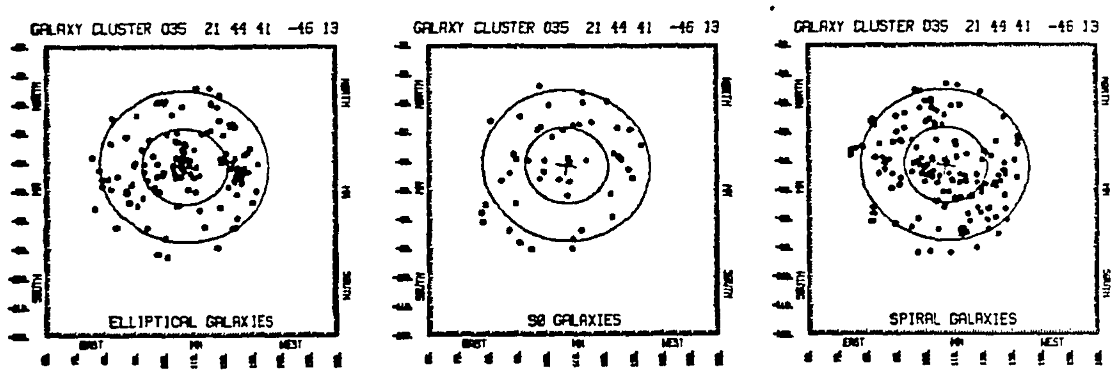


Figure 3.2.35 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 035 21 44 41 −46 13						
FIELD 288						ESØ/SERC PLATE J4594
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-107.000	-061.752	21 44 40.6	-46 13 32.3	352 51 36.7	-49 19 4.4	0.043

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	141	MAJØR AXIS	14.38	SAMPLE PØPULATIØN	354
SØ	48	MINØR AXIS	12.98	CØRE PØPULATIØN	114
S	156	ECCENTRICITY	0.43	LIMITING MAGNITUDE	19.0
SB	9	PØSN. ANGLE	-8.05		
P	0				

Figure 3.2.35 *(f,g,h) Cluster Morphological Population Distributions.*

Table 3.2.35 *Cluster Population Description.*

GALAXY CLUSTER 035: 21 44 41 -46 13 : The cluster is located in the South-West quadrant of ESO/SERC Field 288. Within a diameter of 60mm as determined by m_{10} we count 395 galaxies in this cluster and 354 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *R* because of the strong central condensation found in this cluster.

We count 86 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B-M$ type II-III classification for the cluster which appears to have bright and dominant galaxies but no strikingly giant ellipticals. For m_1,m_3, and m_{10} we give 13.4, 14.6 and 15.1, respectively. The value of m_{10} implies a redshift of 0.043.

We notice that the cluster is centrally condensed with several density enhancements, most notably near the cluster center. Slight groupings are also apparent North of center and West of center.

The cluster magnitude distribution is nearly linear from the brightest galaxies to the faintest, with a slight falloff near the magnitude limit. We find the position angle distribution for the brighter galaxies to be generally non-preferential, but with an excess running North-South and a relative depletion at small angles oriented Eastward.

We find the elliptical galaxies somewhat concentrated towards the center of the cluster with another slight concentration West of center near the periphery of the dispersion ellipse. The spirals appear more dispersed and are found without significant concentration throughout the cluster. The morphological distribution is somewhat skewed towards the spiral galaxies with an $(E : SO : S)$ ratio of $(1.0 : 0.3 : 1.2)$. The core population comprises some 32% of the sample and spans 0.2 square degrees. The core surface density thus derived is 555 galaxies per square degree on the sky.

We find several bright elliptical galaxies to posses a corona. There are very few pairs of galaxies seen in this cluster. Those that are seen are pairs of ellipticals with a curious group of three faint pairs located near $x = -125.3, y = -62.7$. We also note several spiral galaxies with ring-like structures, for example, as that located at $x = -104.1, y = -67.7$.

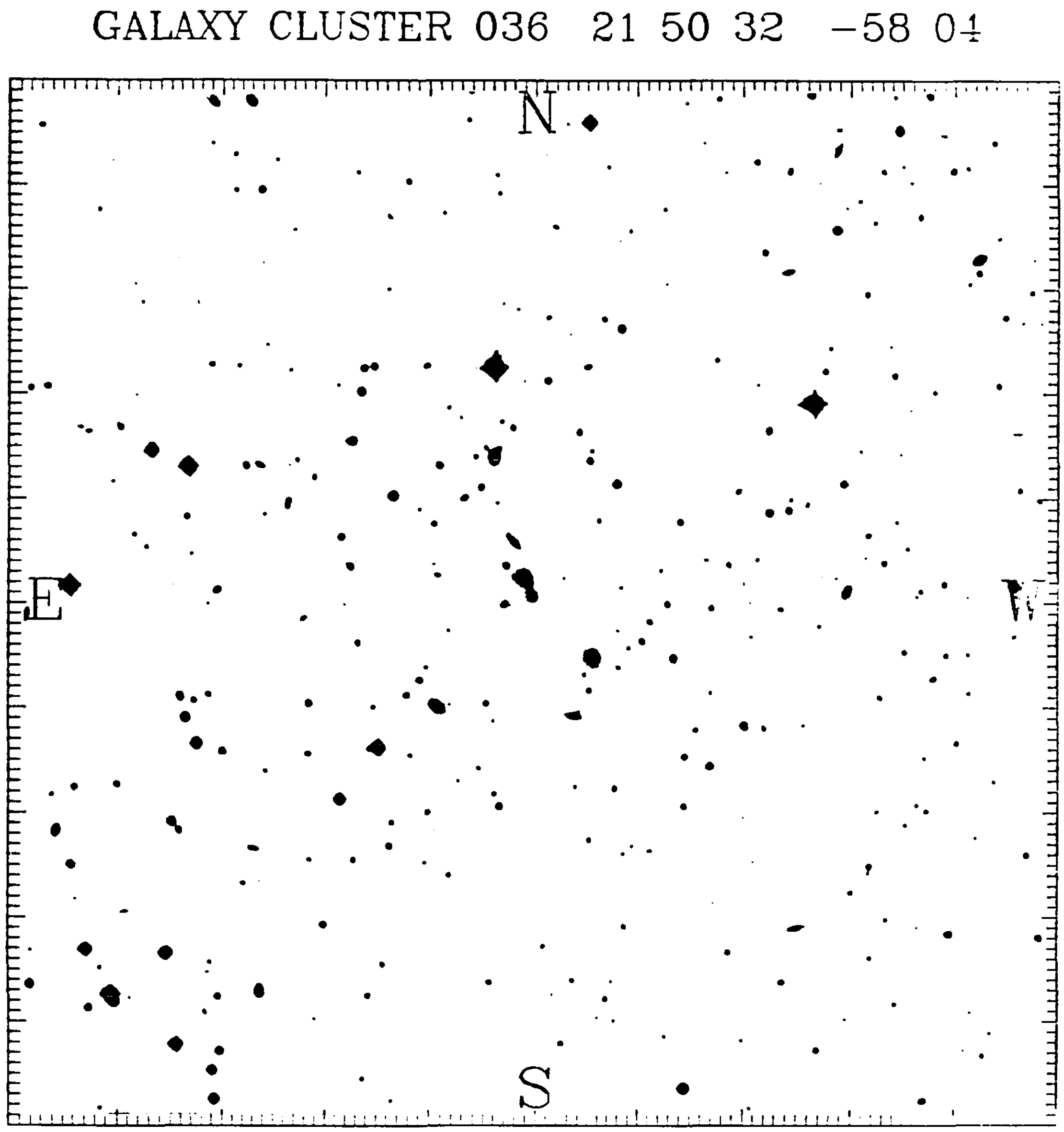


Figure 3.2.36 *(a) Field of GALAXY CLUSTER 036: 21 50 32 -58 04*

GALAXY CLUSTER 036 21 50 32 −58 04

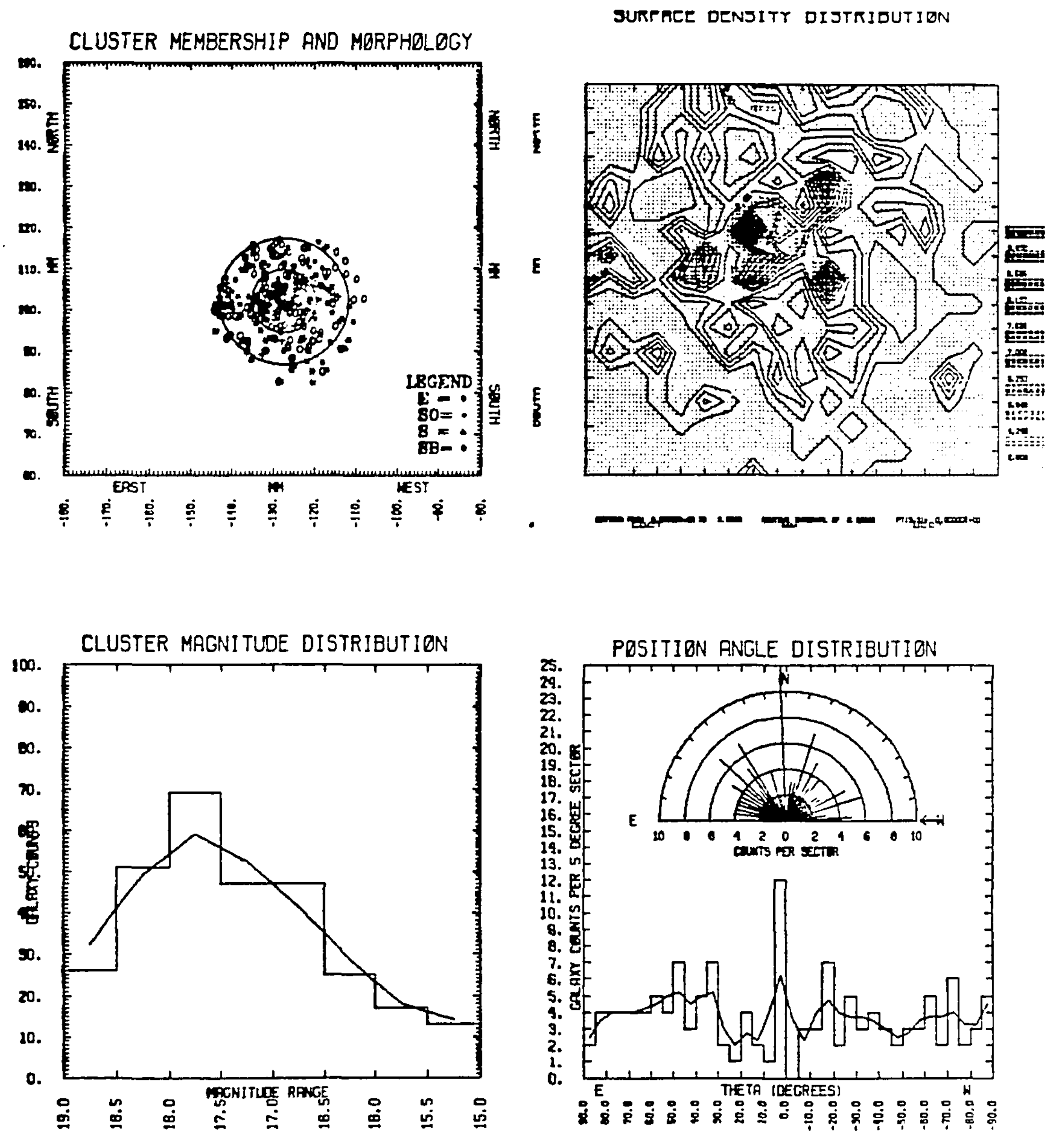
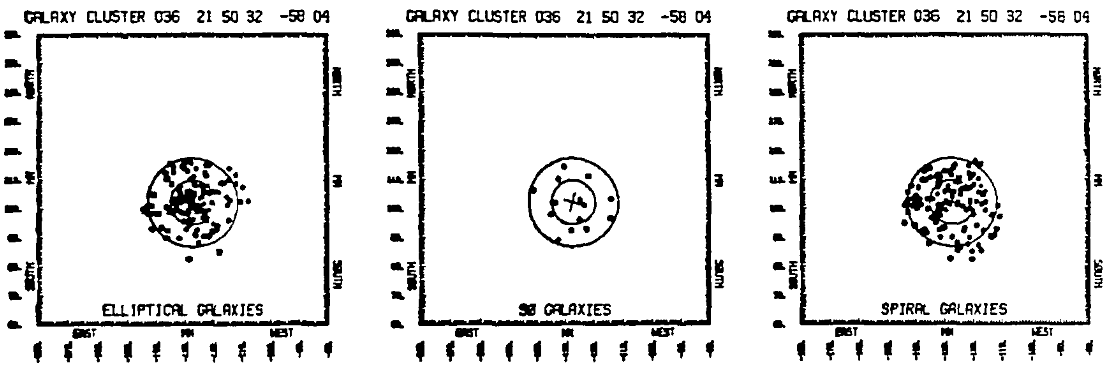


Figure 3.2.36 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 036 21 50 32 −58 04						
FIELD 145						ESØ/SERC PLATE J1759
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
127.534	102.014	21 50 32.0	-58 3 48.4	335 38 9.9	-46 27 19.6	0.050

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	147	MAJØR AXIS	7.80	SAMPLE PØPULATIØN	295
SØ	14	MINØR AXIS	7.59	CØRE PØPULATIØN	112
S	129	ECCENTRICITY	0.23	LIMITING MAGNITUDE	19.0
SB	3	PØSN. ANGLE	-16.53		
P	2				

Figure 3.2.36 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.36 *Cluster Population Description.*

GALAXY CLUSTER 036: 21 50 32 -58 04 : The cluster is located in the North-East quadrant of ESO/SERC Field 145. Within a diameter of 36mm as determined by m_{10} we count 302 galaxies in this cluster and 295 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type R because of its high central condensation.

We count 105 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B - M$ type II-III classification for the cluster which has several bright galaxies, but none that could be considered other than normal giant ellipticals. For m_1,m_3, and m_{10} we give 15.0, 15.1 and 15.4, respectively. The value of m_{10} implies a redshift of 0.050.

We note the high central condensation of this cluster as well as its near circular appearance. There are several major concentrations within the body of the cluster, most notably a mass of galaxies East of center. Other less dense groups are found North-West and South-West of the center of the cluster.

The cluster magnitude distribution rises gradually from the brightest galaxies to a plateau a full magnitude in width centered on $m_v = 17.0$. The distribution then suffers a rise for half a magnitude then drops in several steps to the magnitude limit. The position angle distribution shows no significant preference for orientation save for the excess noted with a North-South inclination.

We notice the strong concentration of elliptical galaxies towards the center of the cluster, whereas the spirals appear to be more evenly distributed except for a slight paucity of members a little South-West of cluster center. The cluster is about divided equally between ellipticals and spirals with an $(E : SO : S)$ ratio of $(1.0 : 0.1 : 0.9)$ with a slight enhancenent of elliptical galaxies of about ten percent. The core population represents nearly 38% of the sample and resides in an area of some 0.06 square degrees. The core surface density is then determined as 1718 galaxies per square degree on the sky.

We notice very few pairs of galaxies in this sample, one, a set of faint early ellipticals at $x = 123.6, y = 90.3$ and another a set of lenticulars apparently superposed at $x = 132.8, y = 98.9$. There appear to be several elliptical galaxies with a corona such as the one located at $x = 128.6, y = 101.1$.

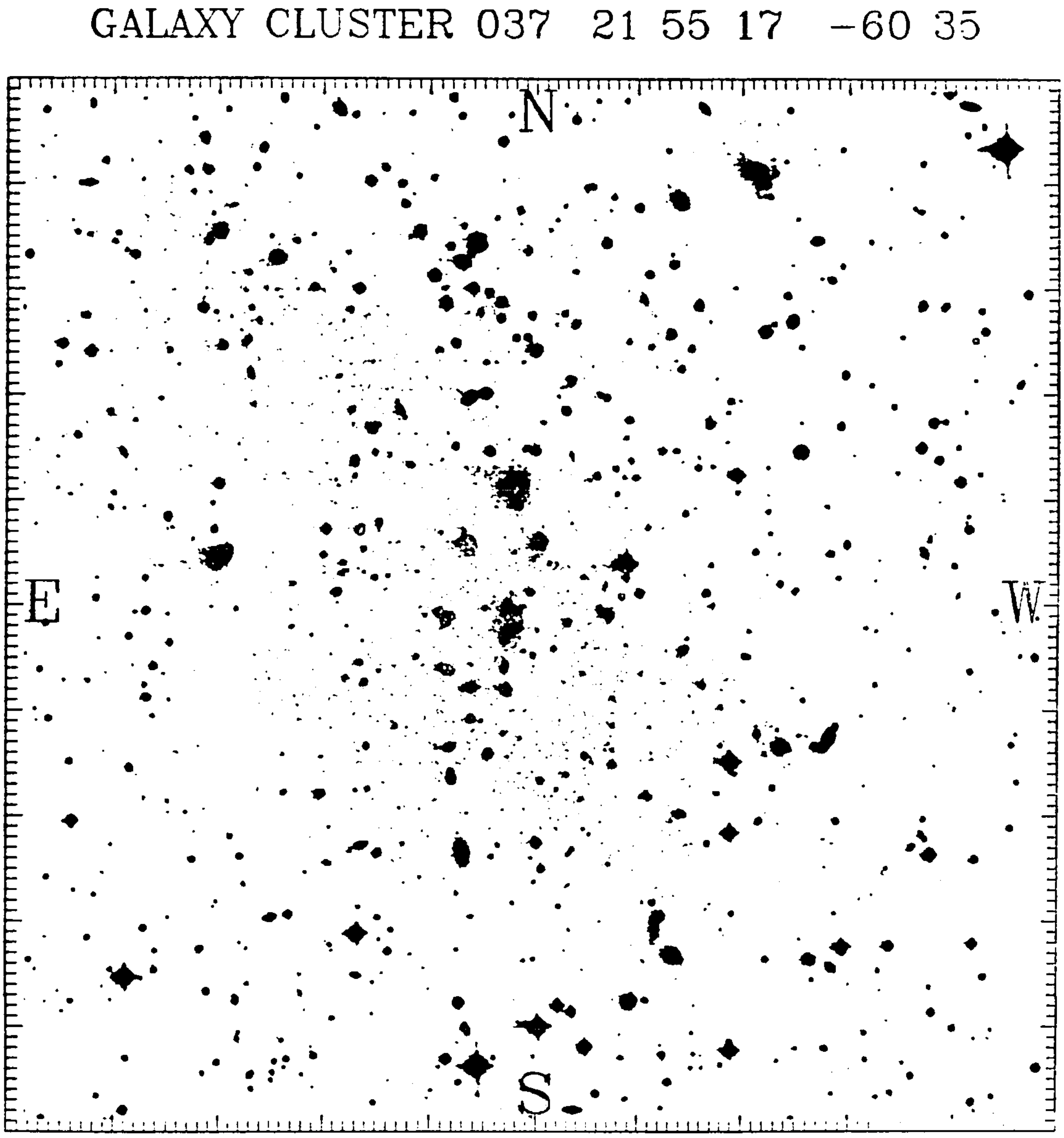


Figure 3.2.37 *(a) Field of GALAXY CLUSTER 037: 21 55 17 -60 35*

GALAXY CLUSTER 037 21 55 17 −60 35

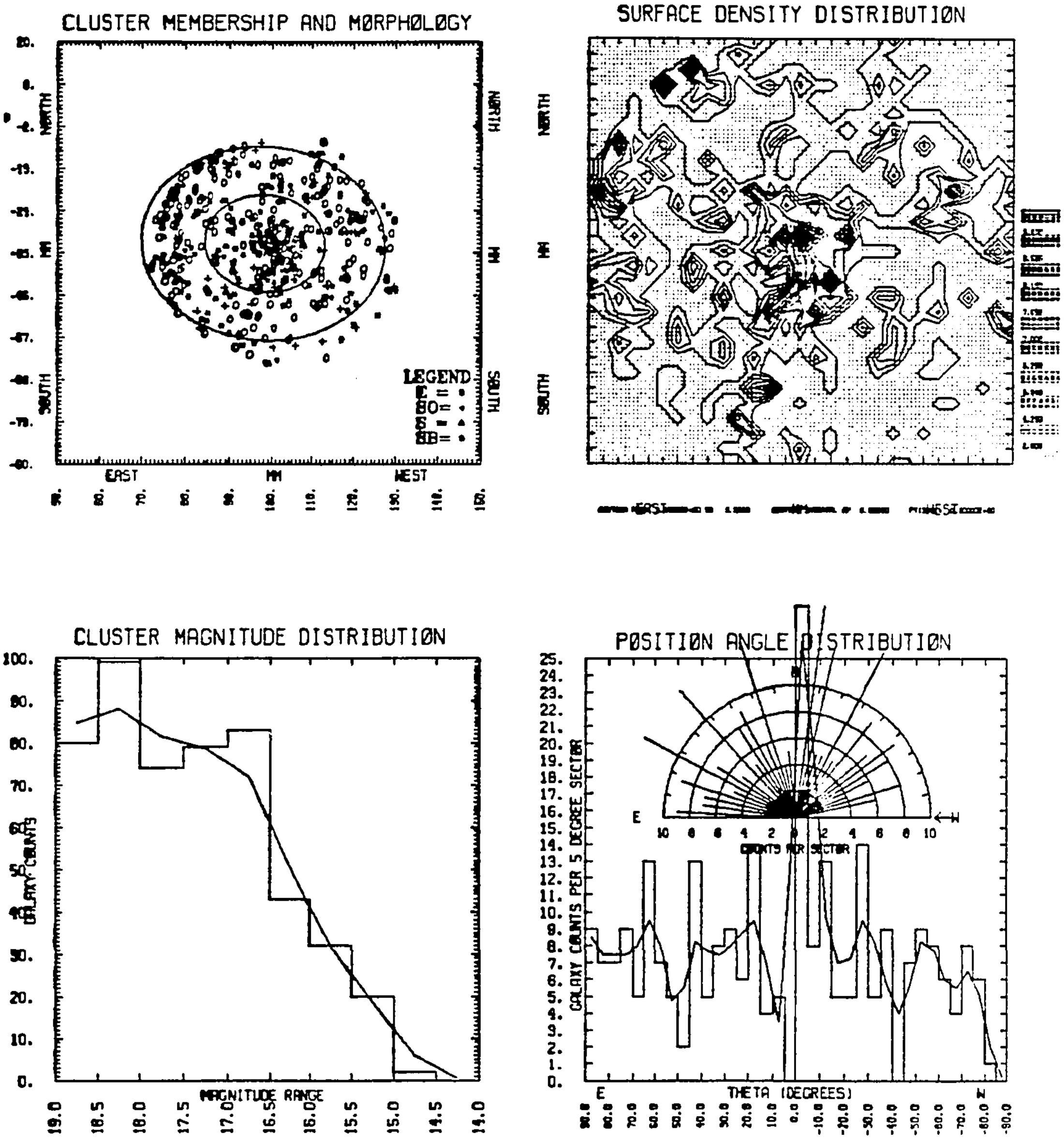
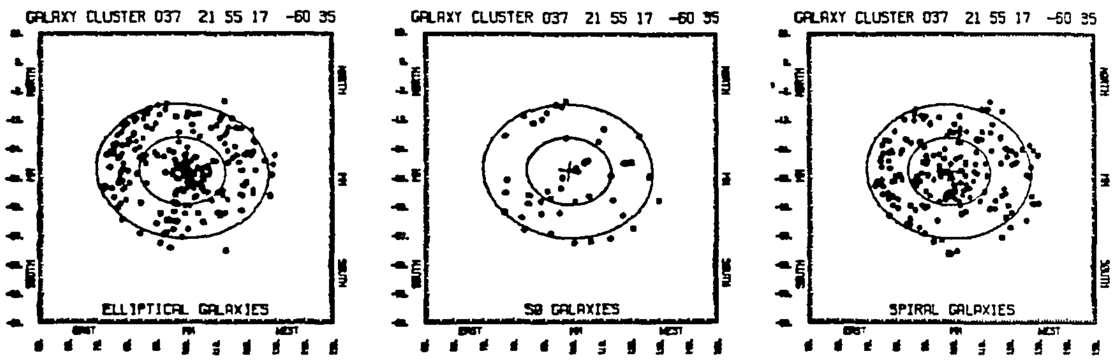


Figure 3.2.37 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 037 21 55 17 −60 35						
FIELD 146						ESØ/SERC PLATE J6201
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-098.536	-032.630	21 55 17.4	-60 35 13.4	331 59 31.8	-45 51 3.0	0.048

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	244	MAJØR AXIS	14.41	SAMPLE PØPULATIØN	512
SØ	49	MINØR AXIS	12.61	CØRE PØPULATIØN	173
S	202	ECCENTRICITY	0.48	LIMITING MAGNITUDE	19.0
SB	11	PØSN. ANGLE	-8.49		
P	6				

Figure 3.2.37 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.37 *Cluster Population Description.*

GALAXY CLUSTER 037: 21 55 17 -60 35 : The cluster is located in the South-West quadrant of ESO/SERC Field 146. Within a diameter of 60mm as determined by m_{10} we count 575 galaxies in this cluster and 512 to a limiting magnitude of $m_{v_{IIm}} = 19.0$. The cluster is marginally classified Abell type R because of its high central condensation, but we do note some slight irregularities in the cluster membership distribution.

We count 112 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 2. We suggest a $B - M$ type III classification for the cluster which has no major dominant galaxies, although several bright ellipticals are noted. For m_1,m_3, and m_{10} we give 14.6, 15.0 and 15.3, respectively. The value of m_{10} implies a redshift of 0.048.

The cluster membership displays a somewhat extended distribution with high central condensation. The dense core of the cluster appears elongated and aligned with the minor axis of the dispersion ellipse. Several concentrations are noted near the cluster center and to the West as well as North of center. In addition, we find a few concentrations at the North-East periphery of the cluster. The magnitude distribution rises rapidly from the brightest galaxies to a near plateau spanning almost two magnitudes. The bulk of the population resides in this range and may suggest the possibility of a bright cluster superposed on a faint background. The position angle varies wildly with an excess noted in the number of galaxies West of North primarily caused by the peak indicating the North-South orientation.

We note the high concentration of elliptical galaxies in the sample, many of which are concentrated towards the center of the cluster. A large number of spiral galaxies are scattered throughout the cluster but without as high a central condensation as the ellipticals. The $(E : SO : S)$ ratio is $(1.0 : 0.2 : 0.9)$ indicating some ten percent more ellipticals than spirals. The core population comprises nearly 34% of the sample and resides in an area of 0.2 square degrees. This yields a core surface density of 865 galaxies per square degree on the sky. Five bright elliptical galaxies in the sample appear to have coronas. The brightest of these is located at $x = -101.2, y = -36.8$, and we find an interesting pair with a faint elliptical galaxy imbedded in the corona of a brighter one at $x = -96.5, y = -51.8$. Of the several peculiar galaxies seen we note an unusual barred spiral with a ring-like structure and a large spur or luminous bridge located at $x = -91.7, y = -39.2$.

GALAXY CLUSTER 038 21 58 08 −60 11

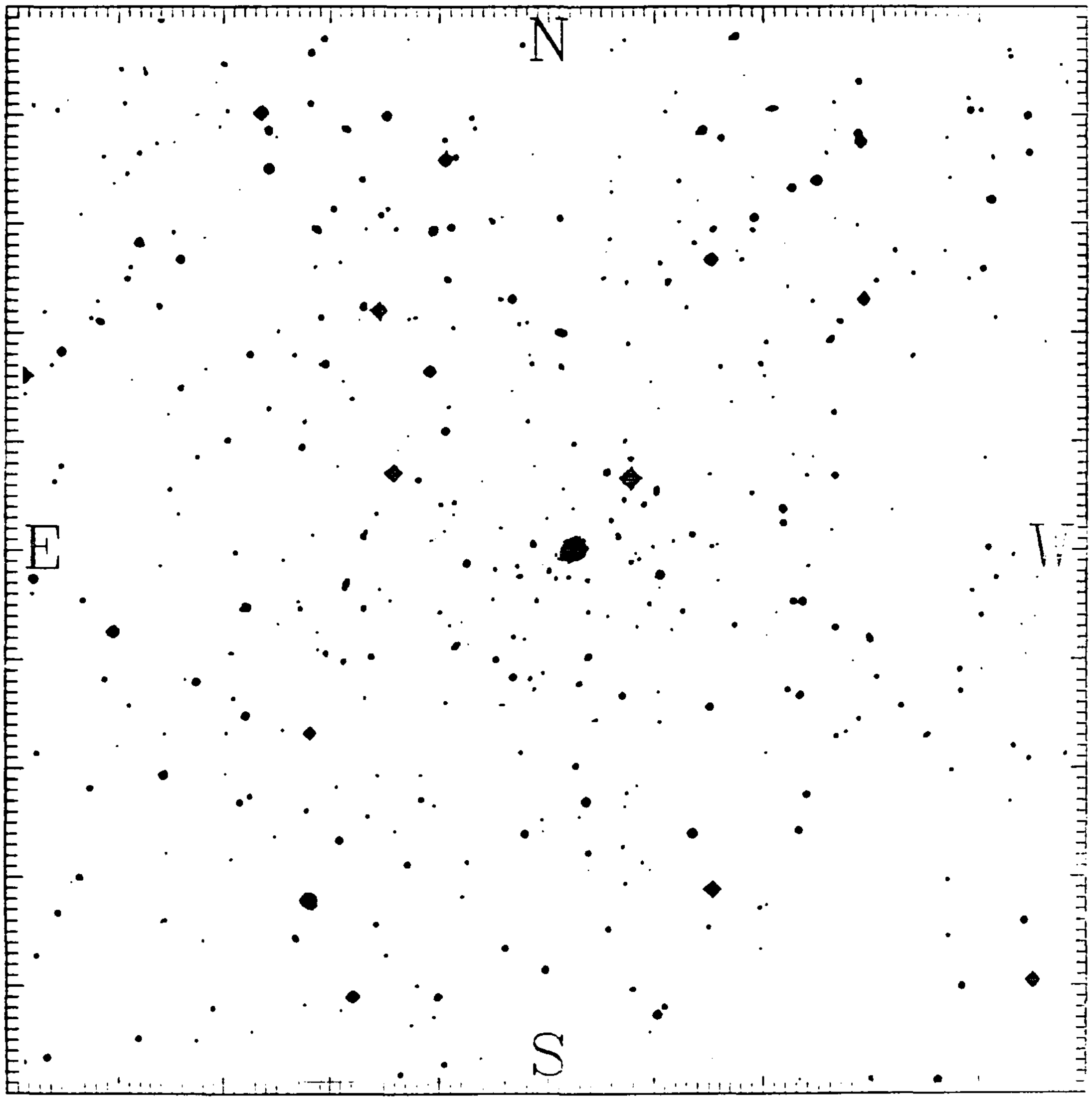


Figure 3.2.38 *(a) Field of GALAXY CLUSTER 038: 21 58 08 -60 11*

GALAXY CLUSTER 038 21 58 09 −60 11

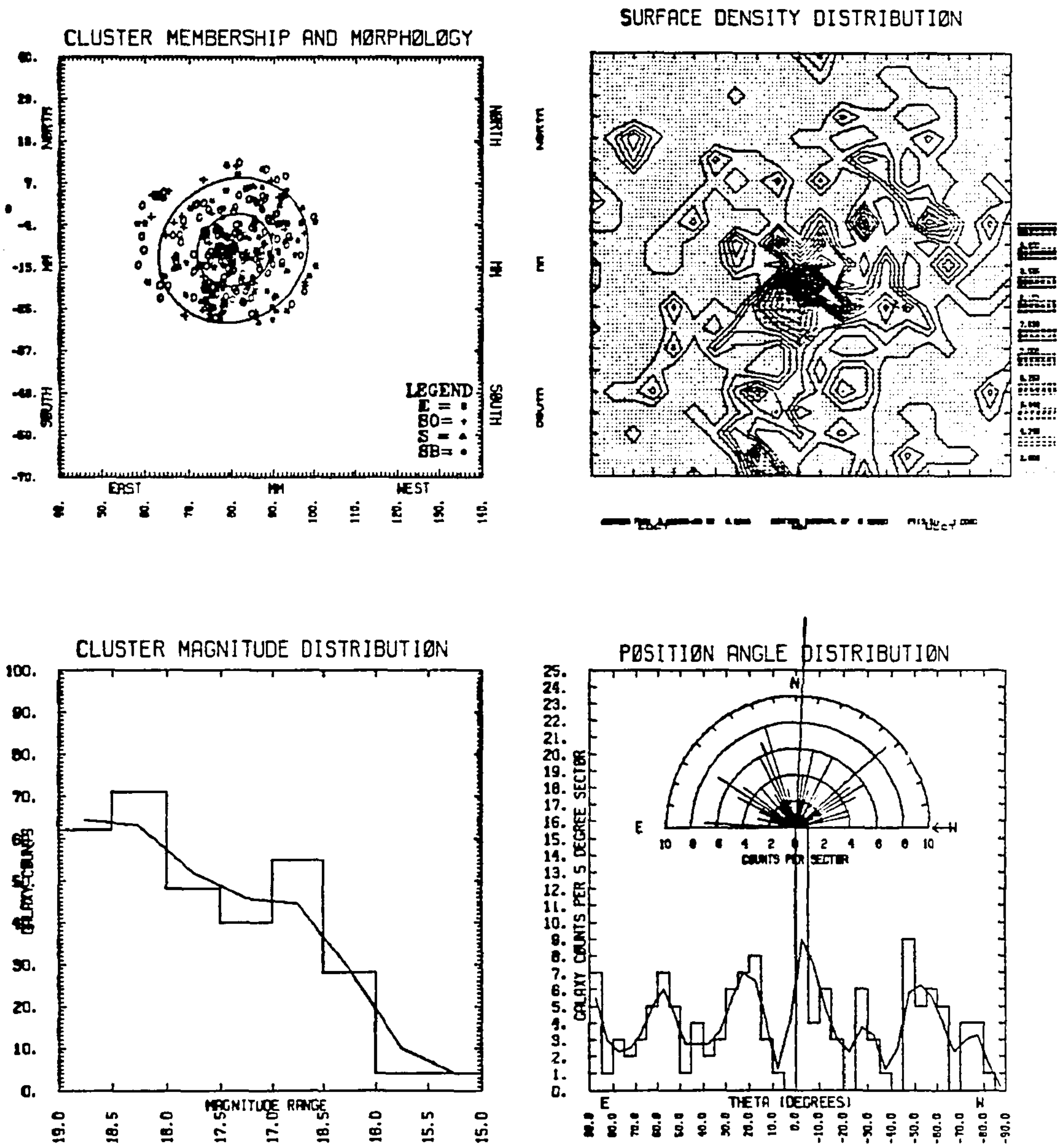
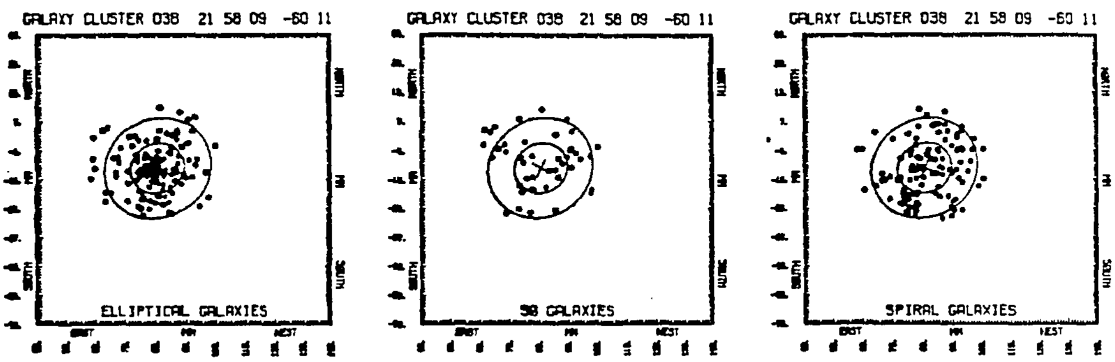


Figure 3.2.38 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 038 21 58 09 −60 11

FIELD 146 — ESO/SERC PLATE J6201

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-080.549	-010.760	21 58 8.7	-60 11 45.0	332 14 19.1	-46 20 56.5	0.055

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	149	MAJOR AXIS	9.74	SAMPLE POPULATION	312
S0	43	MINOR AXIS	8.63	CORE POPULATION	121
S	114	ECCENTRICITY	0.46	LIMITING MAGNITUDE	19.0
SB	6	POSN. ANGLE	63.04		
P	0				

Figure 3.2.38 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.38 *Cluster Population Description.*

GALAXY CLUSTER 038: 21 58 08 -60 11 : The cluster is located in the South-West quadrant of ESO/SERC Field 146. Within a diameter of 45mm as determined by m_{10} we count 364 galaxies in this cluster and 312 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type R because its high central concentration of elliptical galaxies.

We count 110 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B-M$ type I classification for the cluster which has a multiple cD type galaxy as its brightest member. For m_1,m_3, and m_{10} we give 15.0, 15.4 and 16.0, respectively. The value of m_{10} implies a redshift of 0.065.

We note the high central condensation of this cluster displaying a complicated density distribution. In addition we notice a concentration South of cluster center near the periphery of the dispersion ellipse.

The cluster magnitude distribution can be described as a rapid rise in the numbers of galaxies fainter than$m_v = 16.0$ and then a gentler rise beyond $m_v = 17.0$ to the magnitude limit. The position angle distribution is somewhat chaotic and appears to show a slight preference for orientations West of North although this is motivated strongly by the peak near zero degrees.

We find the elliptical galaxies in this cluster strongly concentrated towards the center of the cluster. The spirals, on the other hand, appear less concentrated although there is a small group located South South-East of the cluster center. We find an $(E : SO : S)$ ratio of $(1.0 : 0.3 : 0.8)$ indicating an increase of ellipticals over spirals of about twenty percent. The core population of this cluster represents nearly 39% of the sample residing in an area of 0.09 square degrees. This yields a cluster core surface density of 1307 galaxies per square degree.

We note a peculiar grouping of galaxies in the center of this cluster which is dominated by a bright cD type galaxy. The cD is apparently surrounded by several much fainter elliptical attendant galaxies in a tight group located at $x = -79.1, y = -10.4$. We also notice a very close pair of lenticular galaxies found at $x = -77.7, y = -27.1$, and a pair of ellipticals at $x = -80.3, y = -9.6$.

GALAXY CLUSTER 039 22 01 11 −58 18

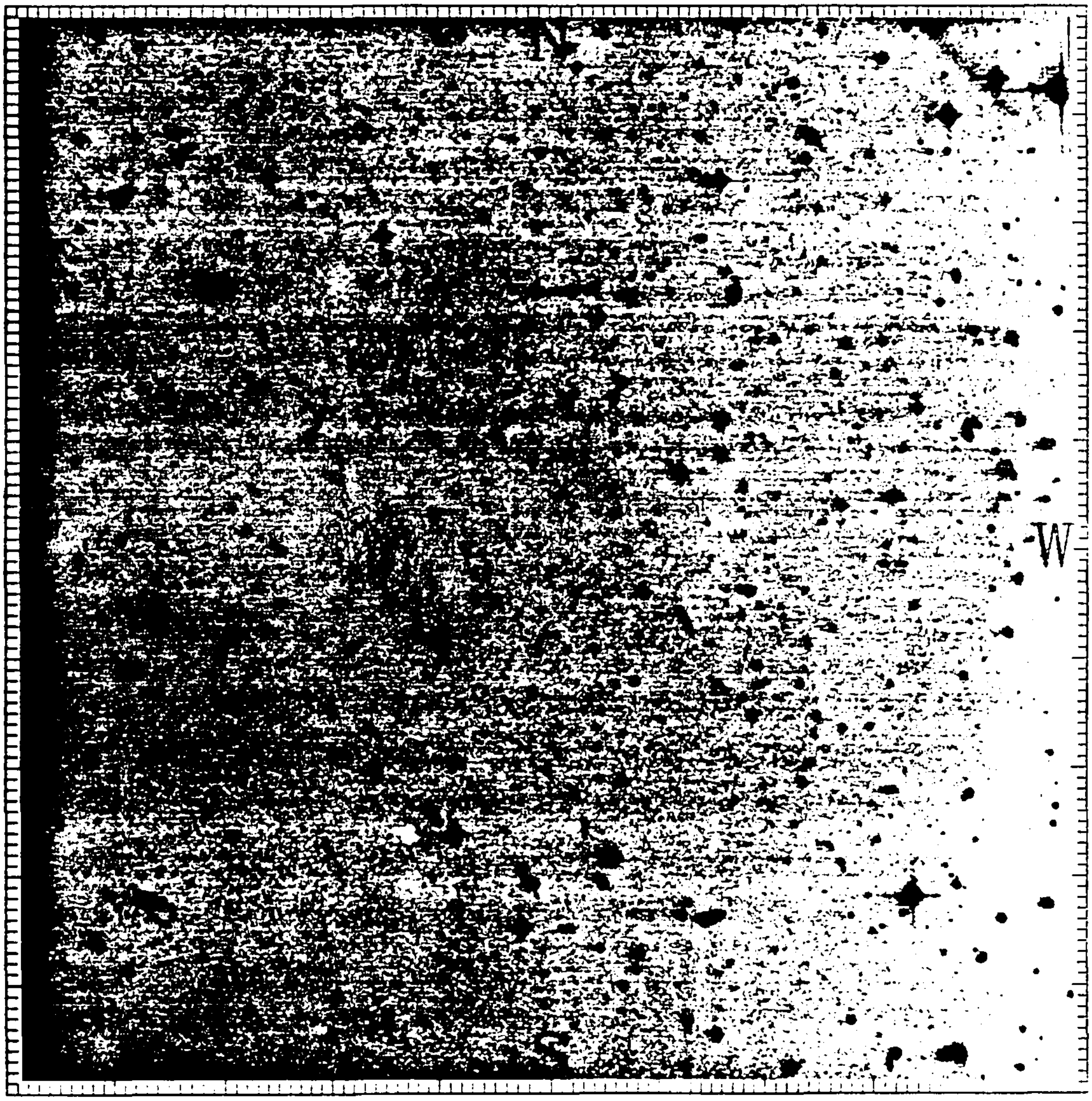


Figure 3.2.39 *(a) Field of GALAXY CLUSTER 039: 22 01 11 -58 18*

GALAXY CLUSTER 039 22 01 11 −58 18

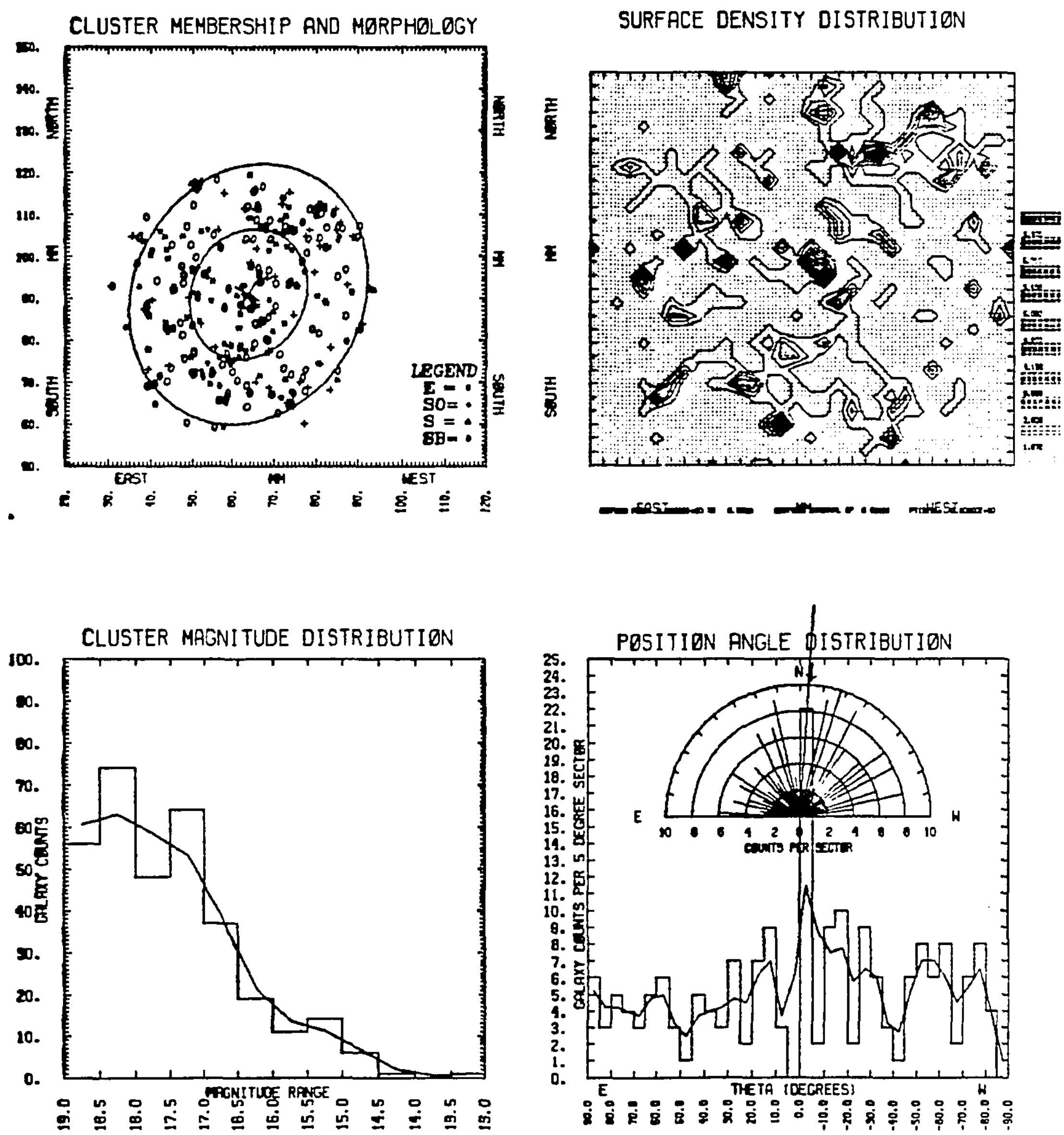
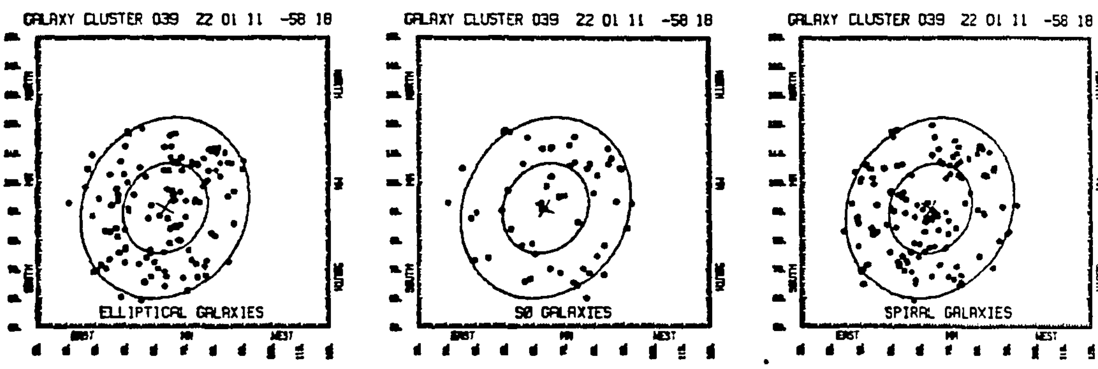


Figure 3.2.39 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 039 22 01 11 −58 18

FIELD 146 ESO/SERC PLATE J6201

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-063.530	090.895	22 1 11.1	-58 18 36.8	334 23 10.0	-47 35 52.6	0.043

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	132	MAJOR AXIS	16.06	SAMPLE POPULATION	331
S0	56	MINOR AXIS	13.77	CORE POPULATION	90
S	131	ECCENTRICITY	0.51	LIMITING MAGNITUDE	19.0
SB	9	POSN. ANGLE	59.82		
P	3				

Figure 3.2.39 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.39 *Cluster Population Description.*

GALAXY CLUSTER 039: 22 01 11 -58 18 : The cluster is located in the North-West quadrant of ESO/SERC Field 146. Within a diameter of 60mm as determined by m_{10} we count 374 galaxies in this cluster and 331 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type *I* because of its inherent irregularity.

We count 62 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B-M$ type I-II classification for the cluster which appears intermediate between prototypical cD dominated clusters and those with normal giant ellipticals. For m_1,m_3, and m_{10} we give 13.5, 14.6 and 15.1, respectively. The value of m_{10} implies a redshift of 0.043.

We find this irregular appearing cluster loosely bound and with numerous small condensations. The largest group lies just South of the cluster center, whereas other smaller groups are located to the East, South-East and North of the cluster center.

The cluster magnitude distribution rises slowly at first from the brightest galaxies through a span of over two magnitudes. From $m_v = 16.0$ there is a steeper rise for another two magnitudes and then a gradual tapering of the distribution to the magnitude limit. The position angle distribution, although erratic, suggests a preference of the brighter galaxies to be oriented West of North with a peak near zero degrees. This direction is consistent with the direction of the major axis of the dispersion ellipse. We find the elliptical galaxies in this cluster to be widely scattered with only few concentrations. The spirals are distributed similarly with the exceptions of a centrally located concentration and a zone of avoidance North of the cluster center. We note an $(E : SO : S)$ ratio of $(1.0 : 0.4 : 1.1)$ indicating a ten percent increase of spirals over ellipticals. The core population comprises only 27% of the sample and resides in an area of 0.24 square degrees. This yields a core surface density of 370 galaxies per square degree.

We notice several elliptical galaxies with coronas, in particular, a bright early elliptical with a fainter elliptical located in its corona found at $x = -47.8, y = 95.3$. We also note the diversity of spiral galaxies: several are found to possess ring-like structures such as the one located at $x = -62.9, y = 114.4$; and several are seen to be superposed as we find at $x = -45.2, y = 82.8$. We note a very peculiar galaxy at $x = -61.7, y = 78.3$.

GALAXY CLUSTER 040 22 01 07 −50 18

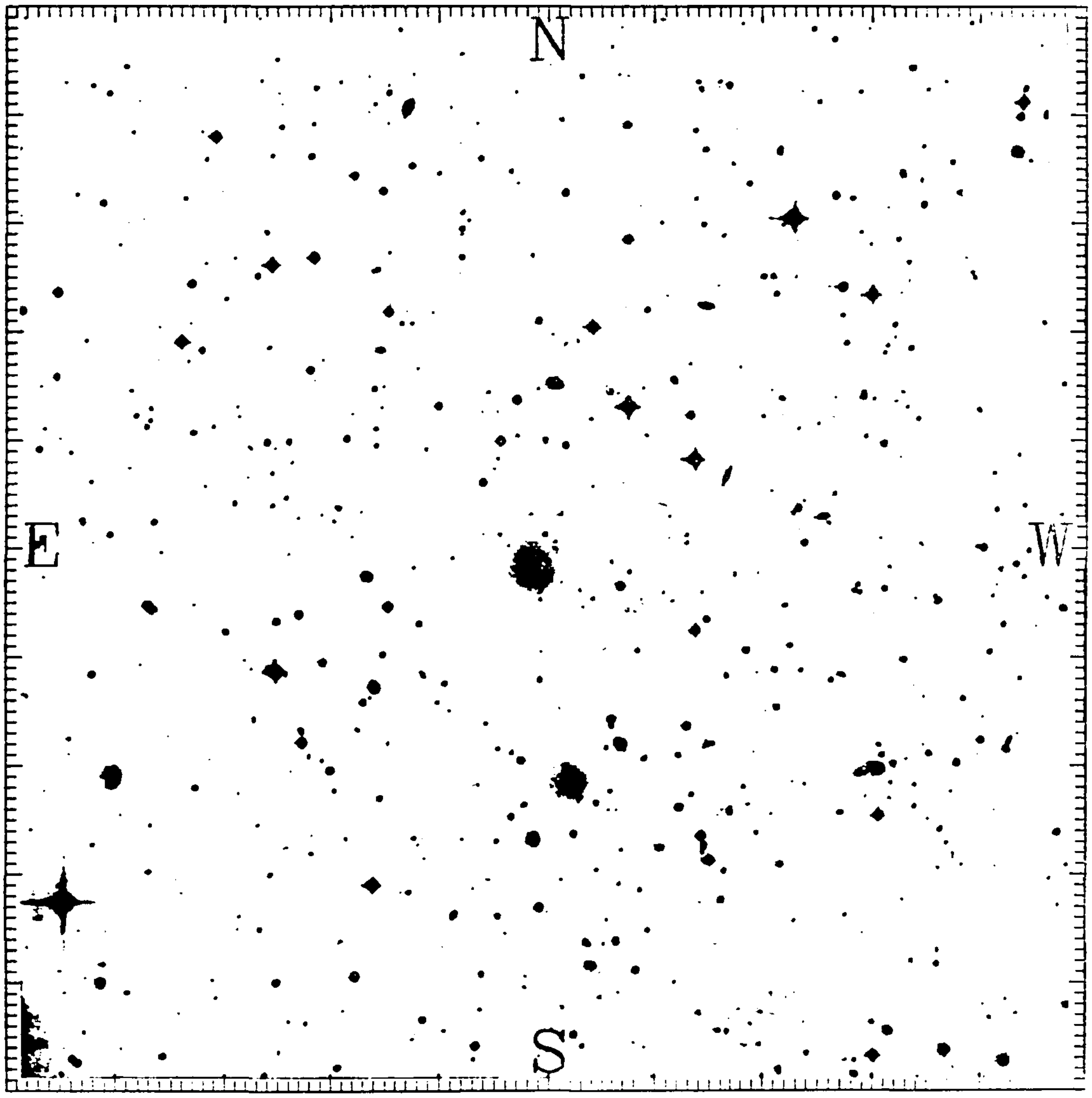


Figure 3.2.40 *(a) Field of GALAXY CLUSTER 040: 22 01 07 -50 18*

GALAXY CLUSTER 040 22 01 07 −50 18

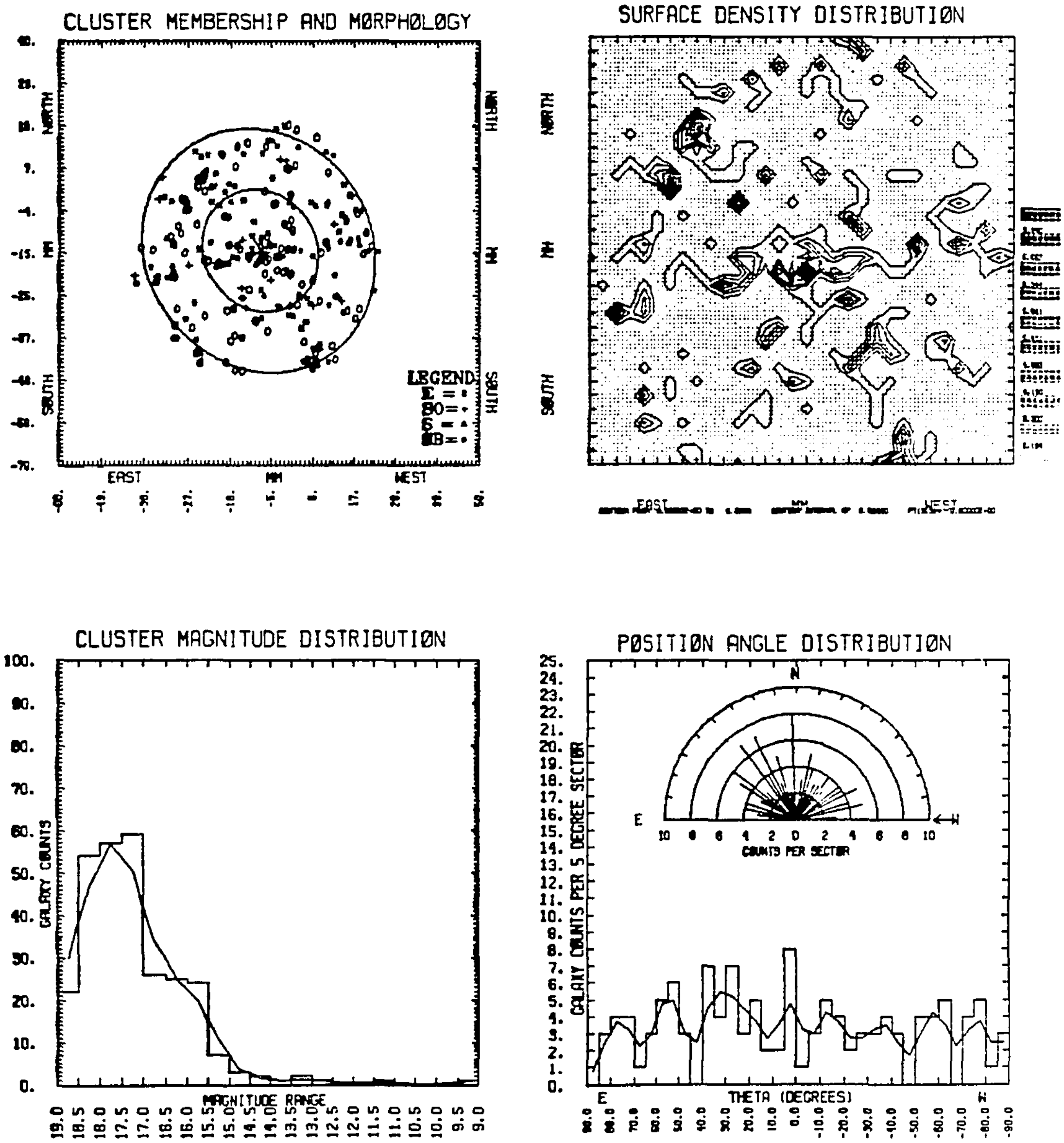
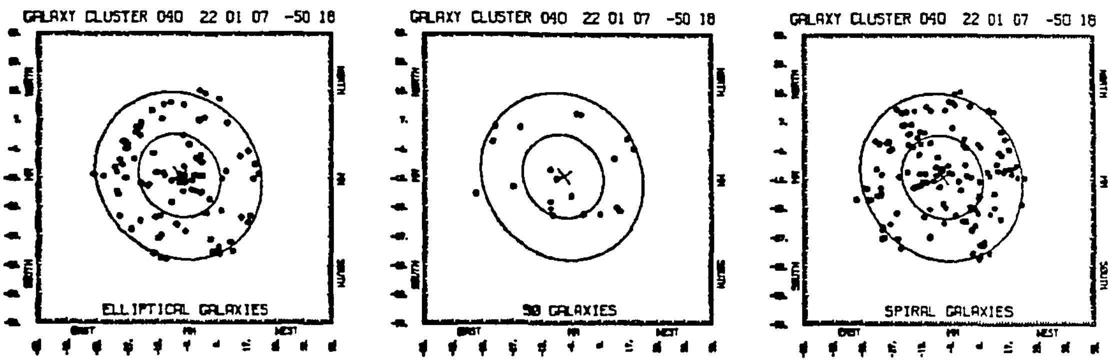


Figure 3.2.40 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 040 22 01 07 −50 18						
FIELD 237						ESØ/SERC PLATE J3658
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
008.125	-014.404	22 1 6.9	-50 18 11.9	345 35 47.8	-50 52 6.4	0.042

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	117	MAJØR AXIS	16.38	SAMPLE PØPULATIØN	284
SØ	22	MINØR AXIS	14.71	CØRE PØPULATIØN	93
S	137	ECCENTRICITY	0.44	LIMITING MAGNITUDE	19.0
SB	4	PØSN. ANGLE	-54.22		
P	4				

Figure 3.2.40 *(f,g,h) Cluster Morphological Population Distributions.*

Table 3.2.40 *Cluster Population Description.*

GALAXY CLUSTER 040: 22 01 07 -50 18 : The cluster is located in the South-East quadrant of ESO/SERC Field 237. Within a diameter of 60mm as determined by m_{10} we count 296 galaxies in this cluster and 284 to a limiting magnitude of $m_{lim} = 19.0$. The cluster is classified Abell type R because of its central condensation and fairly regular scatter.

We count 15 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 0. We suggest a $B - M$ type I-II classification for the cluster which has an intermediate appearance between the class cD and those clusters having as their brightest galaxies normal giant ellipticals. For m_1,m_3, and m_{10} we give 12.6, 13.4 and 15.1, respectively. The value of m_{10} implies a redshift of 0.042.

We find this cluster somewhat centrally condensed, with a small high density concentration right at cluster center. There also appear to be two other concentrations to the North-East near the cluster periphery.

The cluster magnitude distribution rises steeply from the brightest members to a plateau over a magnitude in width terminating at $m_v = 17.0$ and then rising quickly once more to a peak at $m_v = 17.5$ and then falling somewhat rapidly to the magnitude limit. The position angle distribution shows a slight excess in position angles oriented East of North.

We find a relatively dense concentration of elliptical galaxies towards the center of the cluster, dominated by a group just South-West of center. The spirals appear to be more evenly distibuted with perhaps a small group located South-East of center. The $(E : SO : S)$ ratio gives $(1.0 : 0.2 : 1.2)$ indicating an excess of spirals over ellipticals of some twenty percent. The core population reflects some 33% of the sample in an area of 0.26 square degrees. This yields a core surface density of 350 galaxies per square degree.

We note only a single pair of close elliptical galaxies at $x = 11.4, y = 13.3$; and we see what appears to be a elliptical-spiral superposition at $x = 16.6, y = -13.1$. An unusual low surface brightness galaxy with a small bright nucleus and very large faint envelope is seen at $x = 18.5, y = 16.8$.

GALAXY CLUSTER 041 22 19 59 −50 23

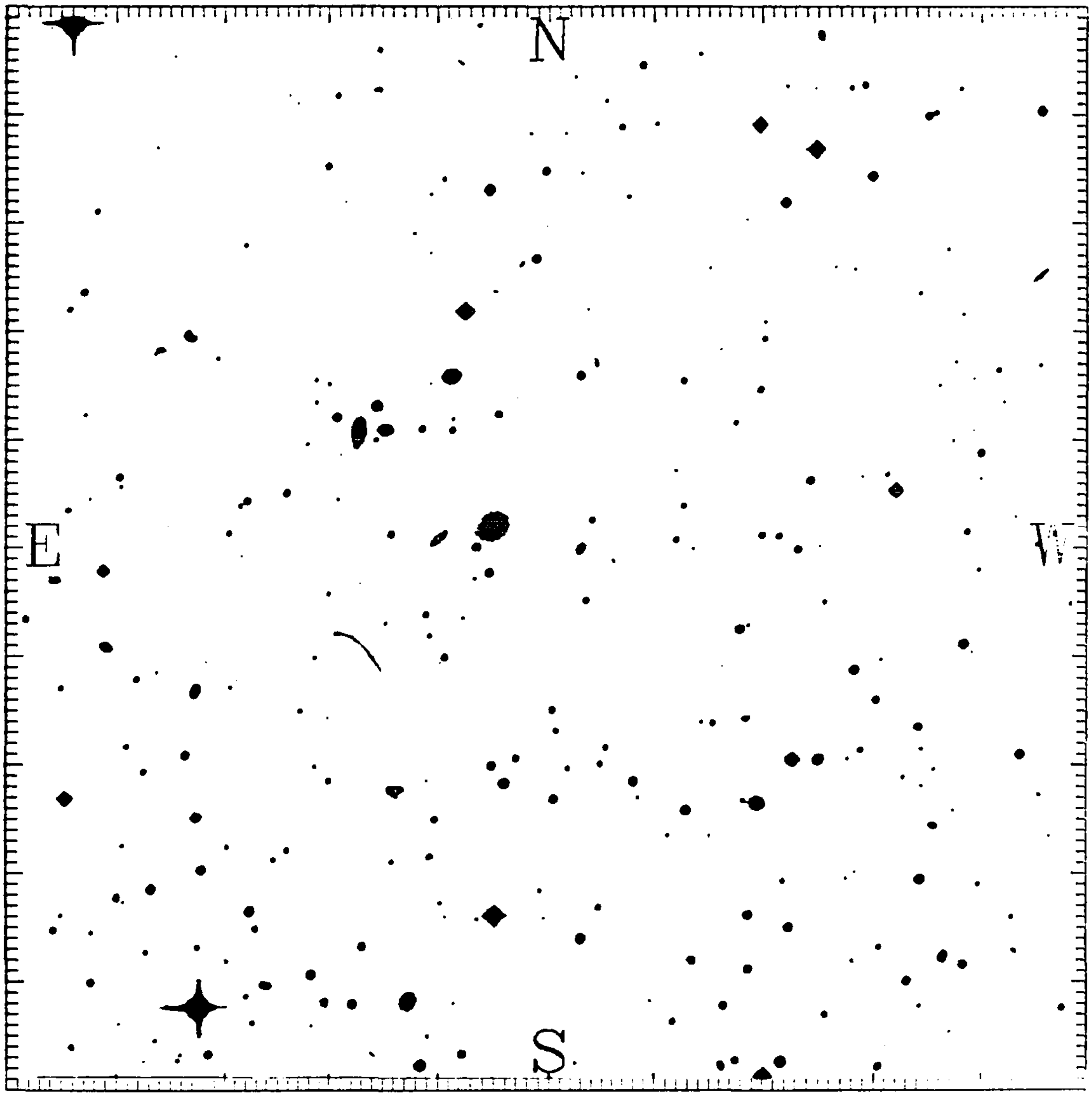


Figure 3.2.41 *(a) Field of GALAXY CLUSTER 041: 22 19 59 -50 23*

GALAXY CLUSTER 041 22 19 59 −55 23

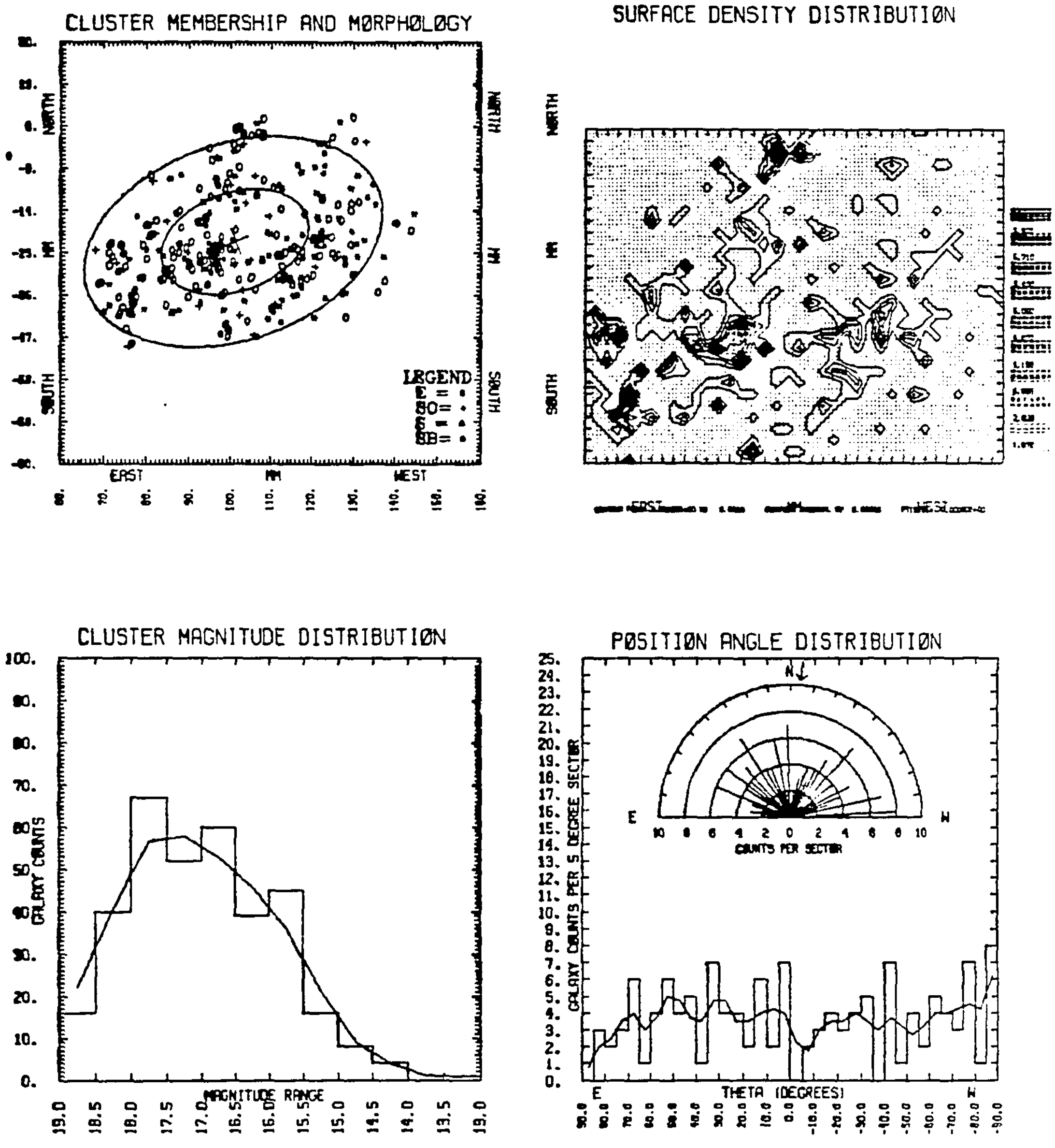
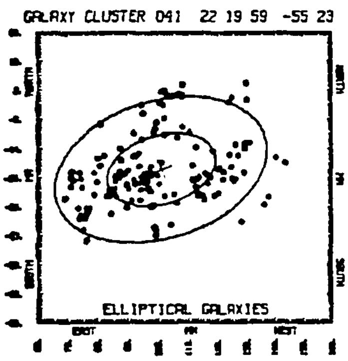
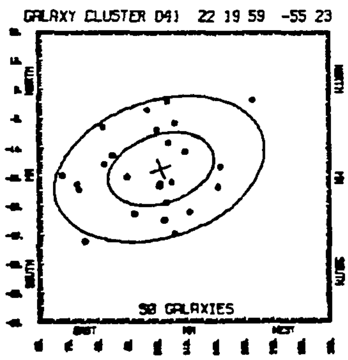
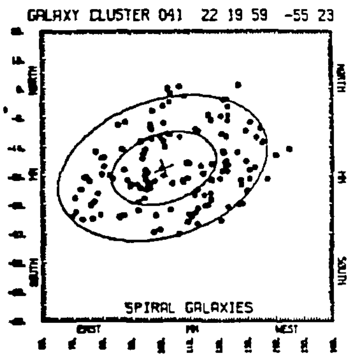


Figure 3.2.41 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*







GALAXY CLUSTER 041 22 19 59 −55 23

FIELD 190 ESØ/SERC PLATE J5332

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-101.125	-022.117	22 19 59.2	-50 23 8.1	343 35 50.1	-53 37 12.6	0.040

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	163	MAJØR AXIS	18.63	SAMPLE PØPULATIØN	348
SØ	25	MINØR AXIS	12.67	CØRE PØPULATIØN	109
S	150	ECCENTRICITY	0.73	LIMITING MAGNITUDE	19.0
SB	9	PØSN. ANGLE	22.83		
P	1				

Figure 3.2.41 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.41 *Cluster Population Description.*

GALAXY CLUSTER 041: 22 19 59 -50 23 : The cluster is located in the South-West quadrant of ESO/SERC Field 190. Within a diameter of 60mm as determined by m_{10} we count 366 galaxies in this cluster and 348 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* because of its irregular appearance and subgrouping; it appears to have three major concentrations.

We count 97 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B-M$ type II-III classification for the cluster which has an intermediate population of bright galaxies that are intermediate between having no dominant galaxies and having giant ellipticals. For m_1,m_3, and m_{10} we give 14.0, 14.3 and 14.9, respectively. The value of m_{10} implies a redshift of 0.040.

This cluster appears somewhat elongated and has several obvious concentrations. The main one is located just South-East of the cluster center. There are several smaller concentrations: South-West of the center near the periphery of the cluster; West of center; and a binary grouping North of center. The magnitude distribution rises in a serpentine manner from the brightest galaxies to a peak at about magnitude $m_v = 18.0$ after which the distribution falls off rapidly. We notice that the cluster is almost devoid of very faint galaxies. The position angle distribution shows no very strong peaks and thus no significantly preferred orientation of the brightest galaxies. The population of elliptical galaxies is scattered throughout the cluster with a major concentration along the major axis of the dispersion ellipse just South-East of center. Likewise, the spiral population has a similar enhancement of numbers, albeit not as dense. We find the $(E:SO:S)$ ratio to be $(1.0:0.2:1.0)$ giving a nearly equal distribution of ellipticals and spirals. The core population of the cluster represents some 31% of the sample residing in an area of 0.26 square degrees. This gives a core surface density of 419 galaxies per square degree on the sky.

We notice three pairs of ellipticals composed of an early and later member in very close proximity or superposed, the brightest of which is located at $x = -117.6, y = -24.8$. A subgroup of many faint spirals is located at $x = -122.3, y = -19.4$. Finally, we call attention to several close pairs of what appear to be barred spiral galaxies with double nucleii located at $x = -93.1, y = 4.1$ and $x = -81.9, y = -40.2$.

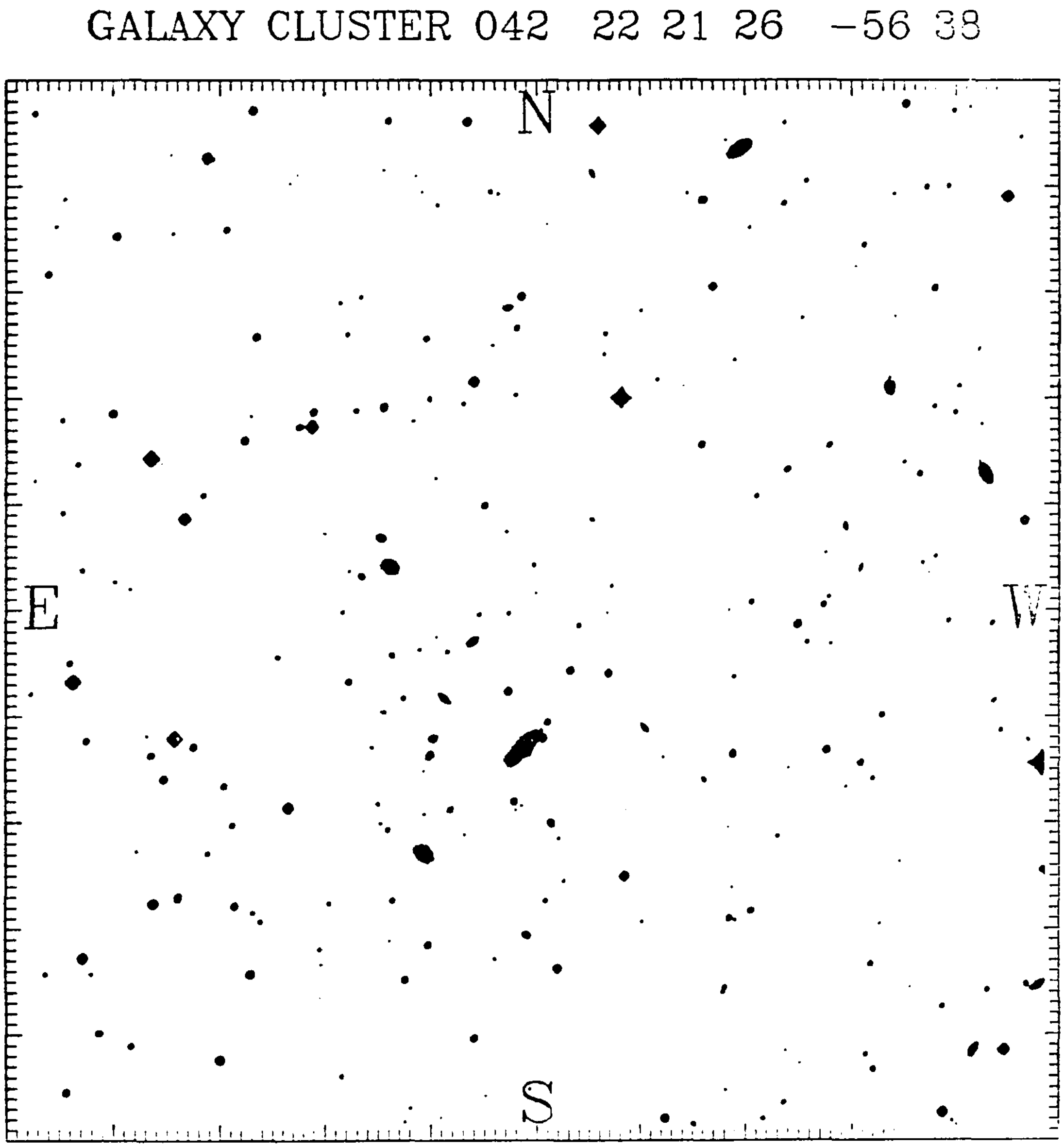


Figure 3.2.42 *(a) Field of GALAXY CLUSTER 042: 22 21 26 -56 38*

GALAXY CLUSTER 042 22 21 26 −56 38

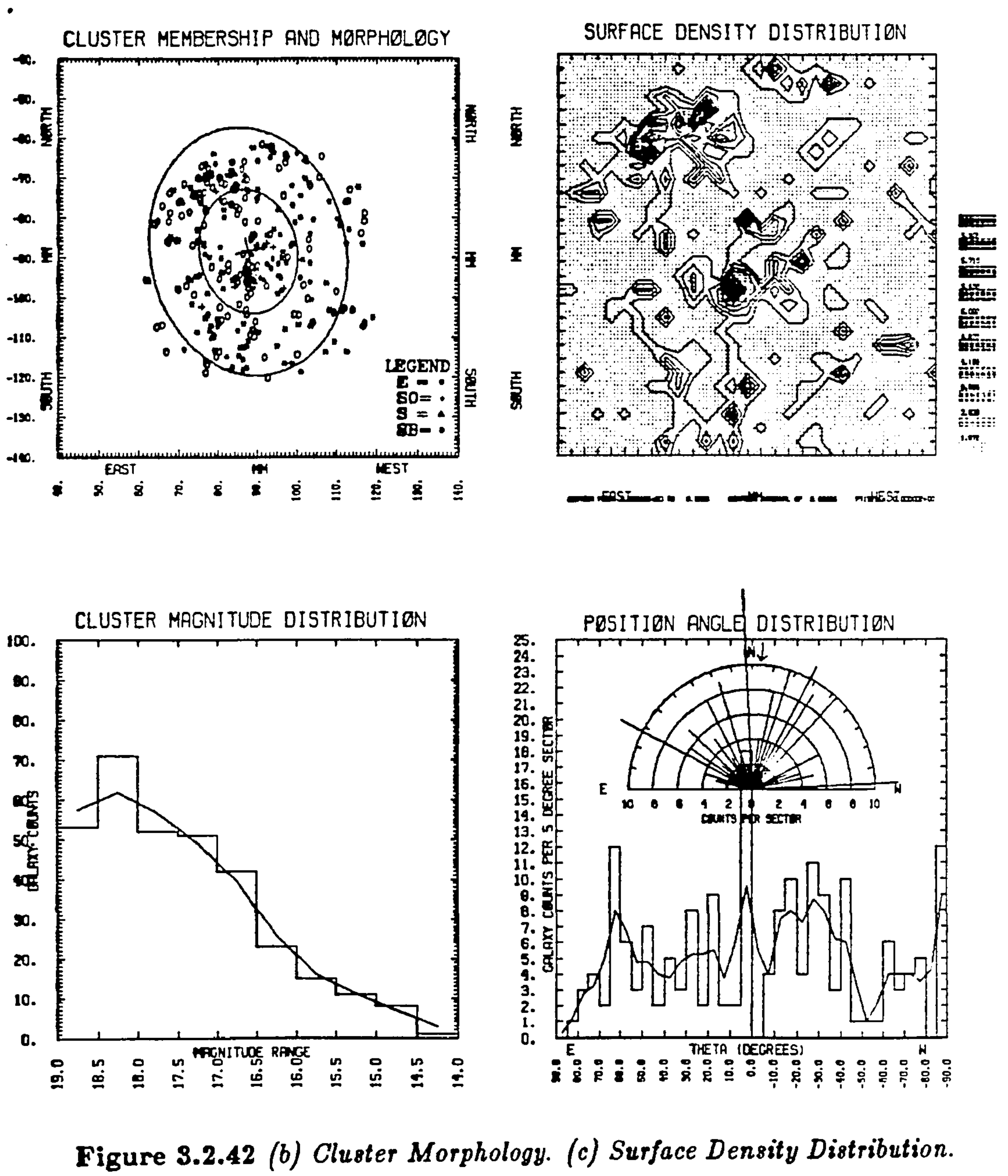
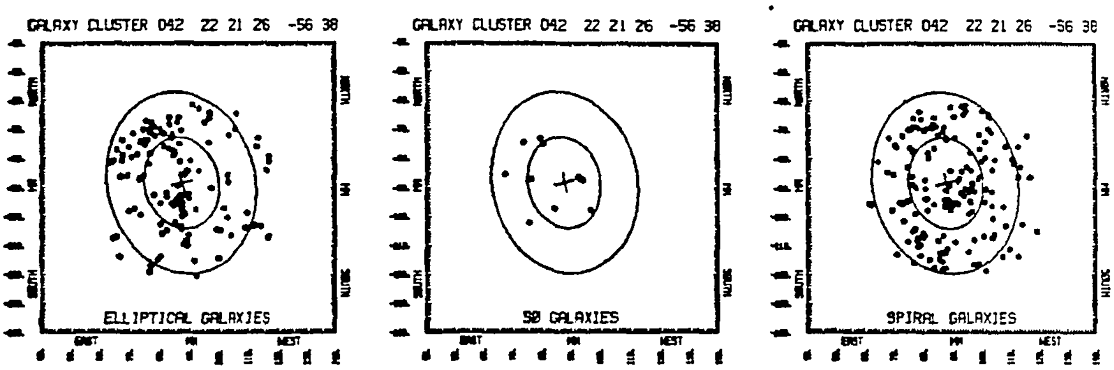


Figure 3.2.42 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 042 22 21 26 −56 38						
FIELD 190						ESO/SERC PLATE J5332
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-087.461	-088.514	22 21 25.9	-56 38 22.8	334 28 44.6	-50 47 22.1	0.043
MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS		
E	139	MAJOR AXIS	15.72	SAMPLE POPULATION		327
S0	10	MINOR AXIS	12.37	CORE POPULATION		96
S	165	ECCENTRICITY	0.62	LIMITING MAGNITUDE		19.0
SB	11	POSN. ANGLE	-77.80			
P	2					

Figure 3.2.42 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.42 *Cluster Population Description.*

GALAXY CLUSTER 042: 22 21 26 -56 38 : The cluster is located in the South-West quadrant of ESO/SERC Field 190. Within a diameter of 60mm as determined by m_{10} we count 352 galaxies in this cluster and 327 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* because the cluster has no spherical symmetry and no marked central condensation.

We count 120 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B - M$ type II-III classification for the cluster which has the brightest galaxies somewhat intermediate between giant ellipticals and normal ellipticals. For m_1,m_3, and m_{10} we give 14.0, 14.6 and 15.1, respectively. The value of m_{10} implies a redshift of 0.043.

We find this cluster somewhat elongated with a few general concentrations in the field. The main concentration is located just South of cluster center, and there are other smaller groups concentrated to the North-East of center near the cluster periphery.

The magnitude distribution rises smoothly from the very brightest galaxies to a plateau spanning nearly two magnitudes from about $m_v = 17.0$ to $m_v = 19.0$ with a peak at $m_v = 18.0$. The position angle distribution is rather erratic with slightly more contributions made from bright galaxies oriented East of North and with large peaks near zero and sixty degrees in the positive sense as well as near ninty degrees in the negative sense.

We notice the distribution of elliptical galaxies to be loosely scattered except for a subgrouping South of center and a slight density enhancement of the second quadrant. The spirals also appear to be scattered again with a slight subgrouping South of center. We find an $(E : SO : S)$ ratio of $(1.0 : 0.1 : 1.3)$ indicating a slightly spiral-rich cluster. The core population represents 29% of the sample enclosed in an area of 0.21 square degrees. This yields a core surface density of 448 galaxies per square degree on the sky. We notice several elliptical galaxies with coronas, the brightest of which is located at $x = -64.5, y = -107.5$. Several close pairs of elliptical galaxies are seen, like the pair at $x = -76.2, y = -82.0$; and amidst the diversity of spirals, several distressed pairs, as the one found at $x = -116.5, y = -86.8$ which has a luminous bridge between its members.

GALAXY CLUSTER 043 22 22 36 −56 06

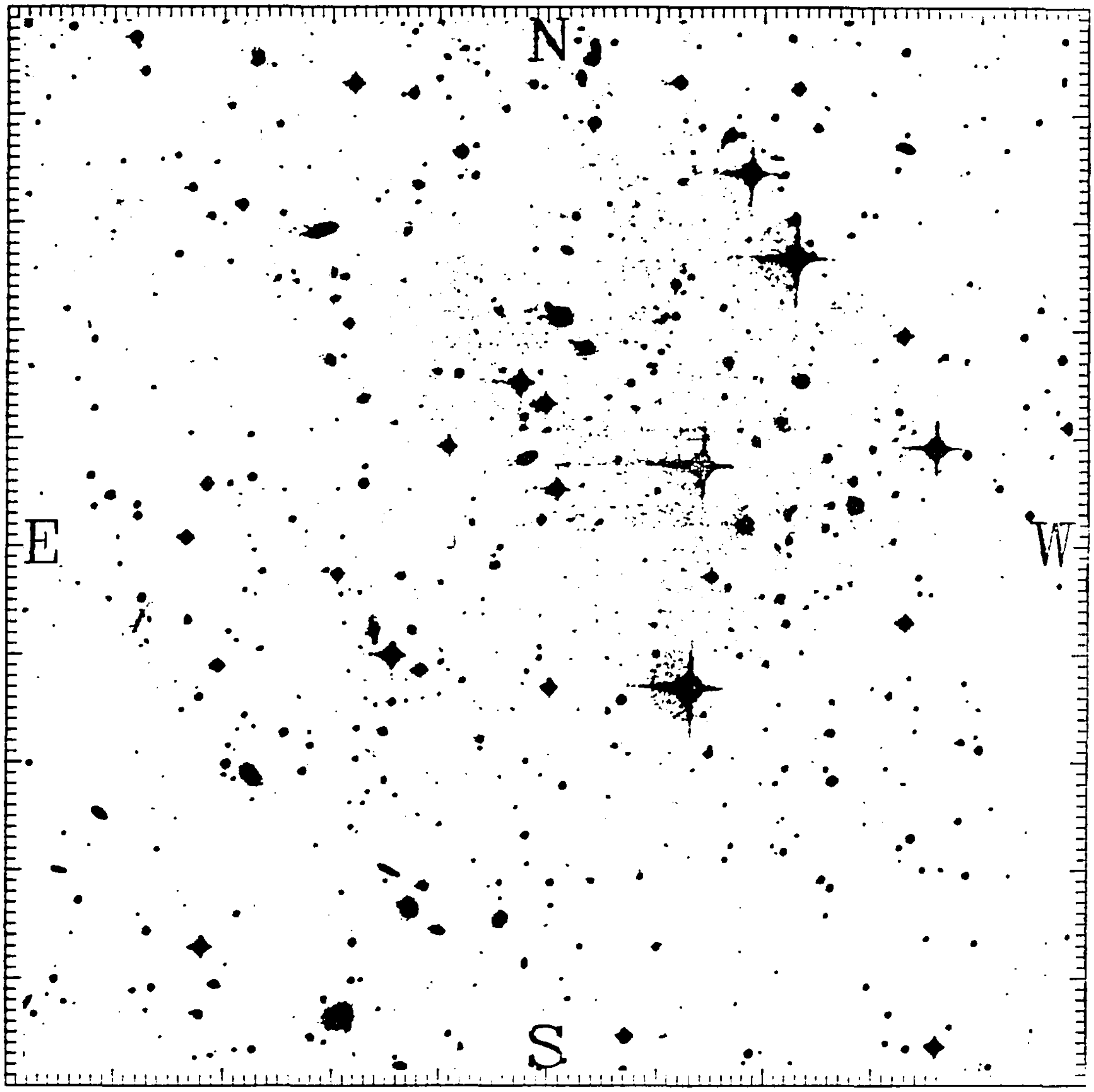


Figure 3.2.43 *(a) Field of GALAXY CLUSTER 043: 22 22 36 -56 06*

GALAXY CLUSTER 043 22 22 36 −56 06

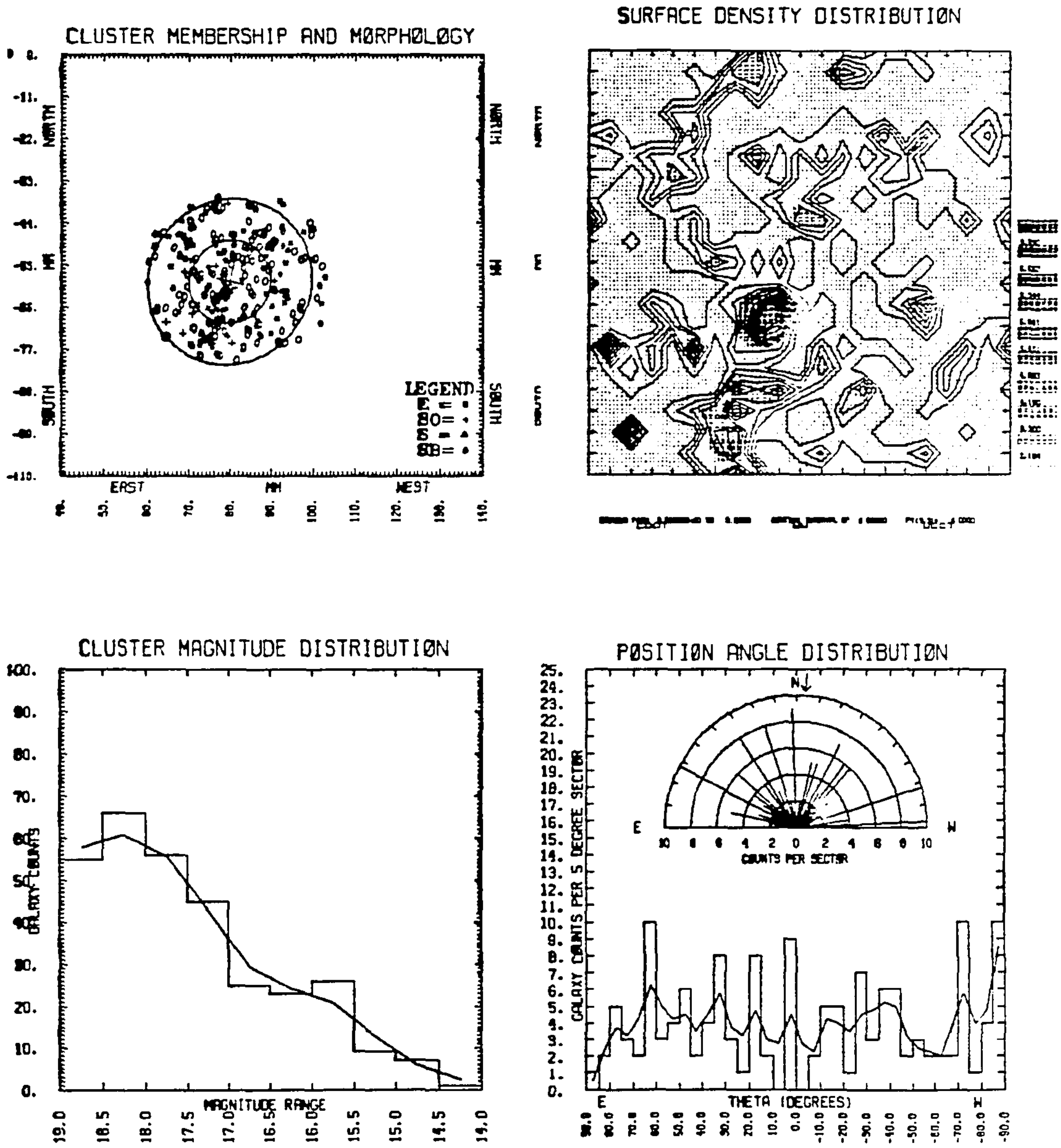
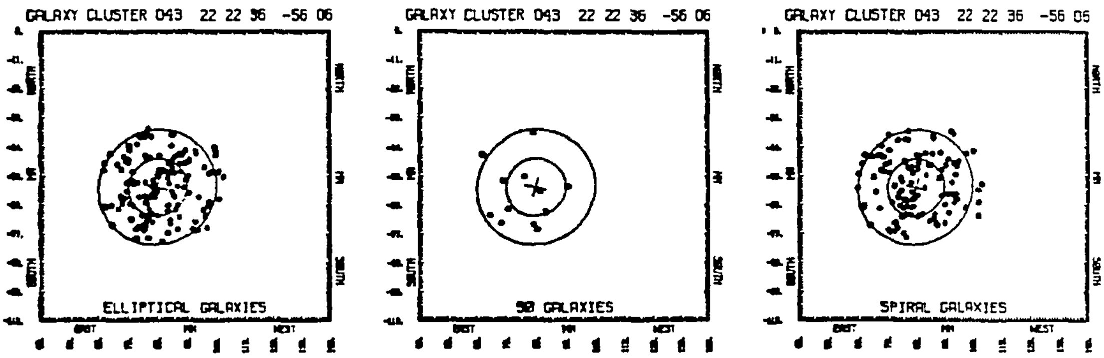


Figure 3.2.43 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 043 22 22 36 −56 06						
FIELD 190						ESØ/SERC PLATE J5332
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
−079.768	−059.436	22 22 36.0	−56 5 57.1	335 3 58.2	−51 12 57.0	0.043

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	166	MAJØR AXIS	10.89	SAMPLE PØPULATIØN	313
SØ	13	MINØR AXIS	9.84	CØRE PØPULATIØN	99
S	120	ECCENTRICITY	0.43	LIMITING MAGNITUDE	19.0
SB	14	PØSN. ANGLE	77.02		
P	0				

Figure 3.2.43 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.43 *Cluster Population Description.*

GALAXY CLUSTER 043: 22 22 36 -56 06 : The cluster is located in the South-West quadrant of ESO/SERC Field 190. Within a diameter of 45mm as determined by m_{10} we count 334 galaxies in this cluster and 313 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* because it appears more nearly linearly symmetric than otherwise; there are several cases of subclustering.

We count 72 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B - M$ type III classification for the cluster which has no dominant galaxies. For m_1,m_3, and m_{10} we give 14.1, 14.7 and 15.1, respectively. The value of m_{10} implies a redshift of 0.043.

The cluster is slightly linearly condensed with concentrations found along the major axis of the dispersion ellipse. The major subclustering occurs a little East of South of the cluster center. There are other slight concentrations, but none as dense as the previously mentioned one.

We find the cluster magnitude distribution rising from the brightest members to a minor plateau about a magnitude and a half wide after which it rises more steeply to a peak near $m_V = 18.0$ and falls to the magnitude limit. Perhaps we see here the suggestion of a two-population cluster. The position angle distribution appears to be erratic and somewhat skewed to position angles East of North.

The population of elliptical galaxies is scattered throughout the cluster but with a linear concentration along the major axis of the dispersion ellipse. The spirals show a slight enhancement just South of the cluster center a little East of South. The $(E : SO : S)$ ratio gives $(1.0 : 0.1 : 0.8)$ suggesting a slightly elliptical-rich cluster. The core population represents nearly 32% of the sample and lies in an area of nearly 0.12 square degrees. This yields a core surface density of 839 galaxies per square degree on the sky.

We note six pairs of elliptical galaxies consisting of an early and late member, the brightest of which is located at $x = -64.7, y = -73.9$. Several of the elliptical galaxies are seen with coronas as we find at $x = -77.8, y = -63.0$. We also notice, amidst the diversity of spirals, several possessing ring-like structures such as the object located at $x = -77.2, y = -51.9$.

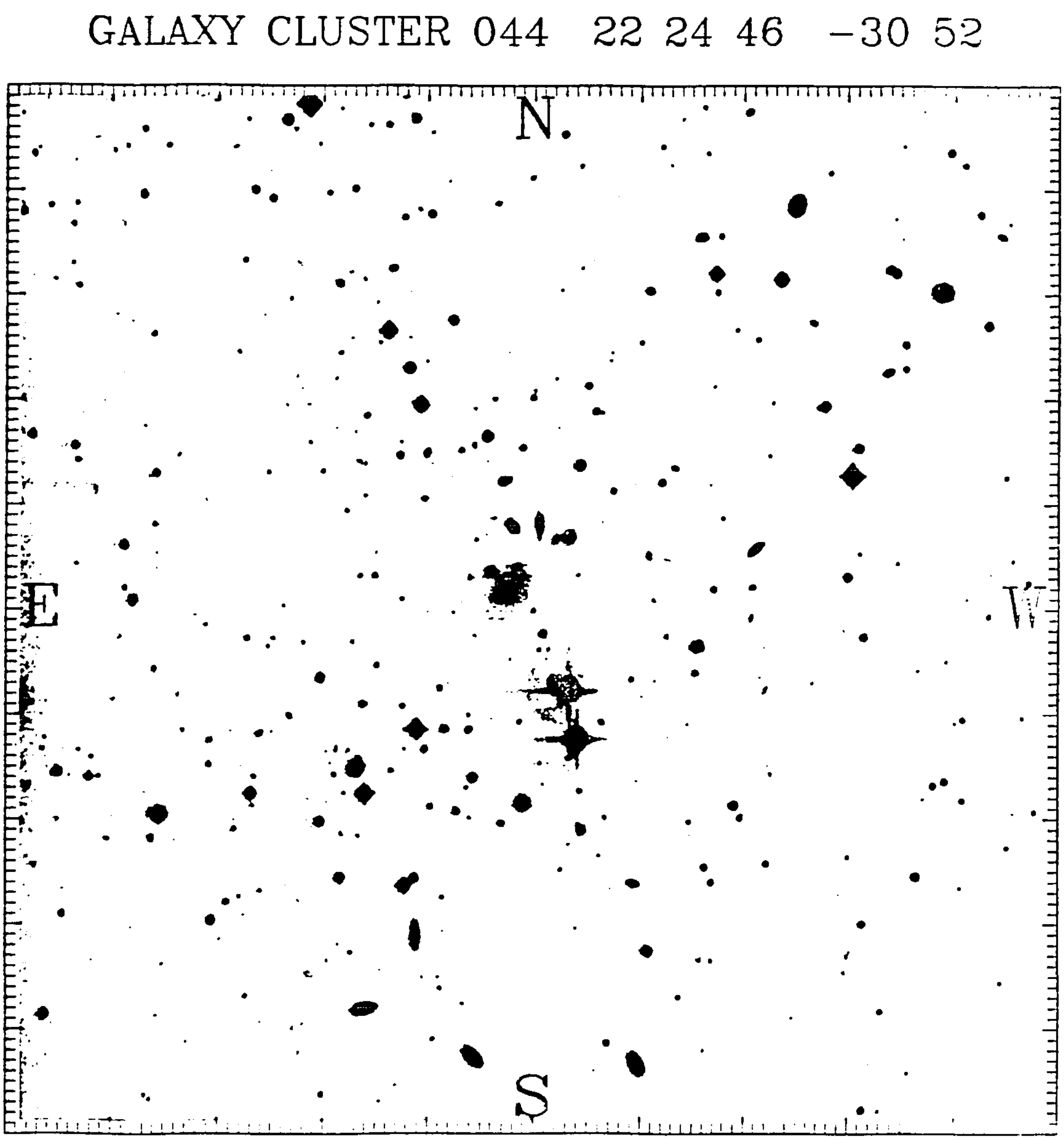


Figure 3.2.44 *(a) Field of GALAXY CLUSTER 044: 22 24 46 -30 52*

GALAXY CLUSTER 044 22 24 46 −30 51

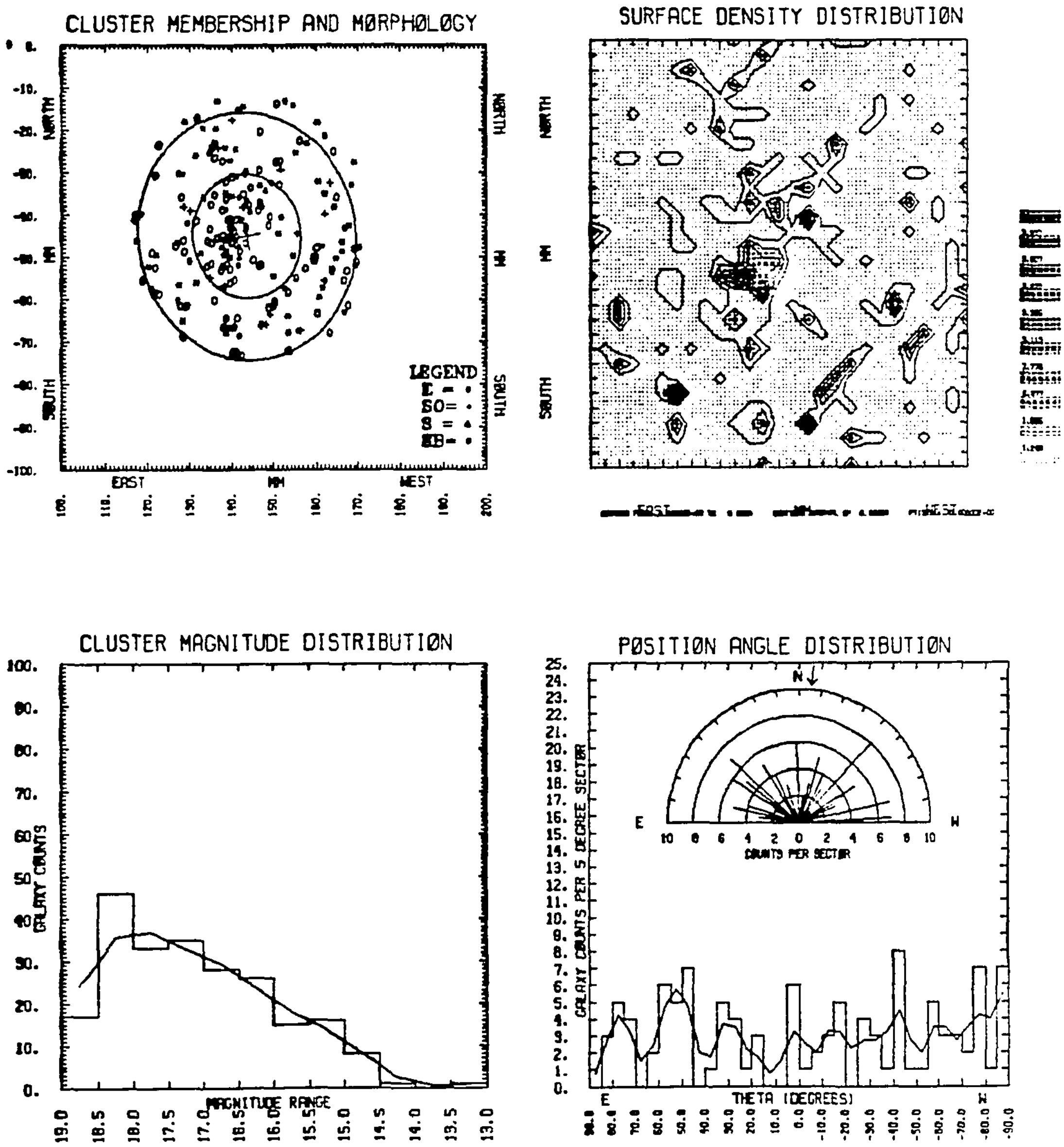
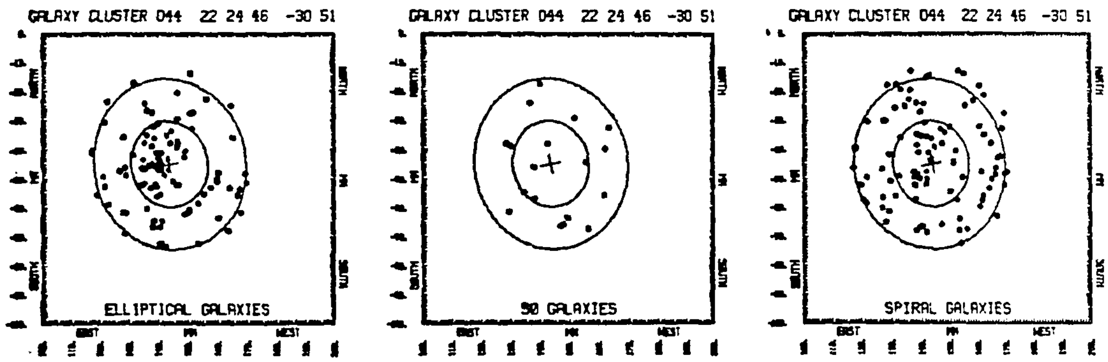


Figure 3.2.44 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 044 22 24 46 −30 51

FIELD 468 — ESO/SERC PLATE J6436

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-143.511	-045.125	22 24 46.3	-30 51 42.7	017 55 41.2	-58 26 58.1	0.038

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	105	MAJOR AXIS	14.69	SAMPLE POPULATION	226
S0	18	MINOR AXIS	12.91	CORE POPULATION	81
S	100	ECCENTRICITY	0.48	LIMITING MAGNITUDE	19.0
SB	2	POSN. ANGLE	-80.07		
P	1				

Figure 3.2.44 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.44 *Cluster Population Description.*

GALAXY CLUSTER 044: 22 24 46 -30 52 : The cluster is located in the South-West quadrant of ESO/SERC Field 468. Within a diameter of 60mm as determined by m_{10} we count 229 galaxies in this cluster and 226 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *RI* because of its approach to central condensation even though somewhat scattered; it appears more nearly regular than irregular.

We count 73 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 1. We suggest a $B - M$ type II classification for the cluster which has as its brightest member a galaxy intermediate between the class cD and normal giant ellipticals. For m_1,m_3, and m_{10} we give 13.5, 14.7 and 14.8, respectively. The value of m_{10} implies a redshift of 0.038.

The cluster appears somewhat scattered, but has several density concentrations the main one of which lies slightly East of the cluster center. Several smaller concentrations are noted, most of them lying North of center whilst a single small high density region lies South-East of the center of the cluster.

The cluster magnitude distribution rises in ramp-like fashion from the brightest galaxies in the cluster to a maximum near $m_v = 18.0$ and drops off rapidly half a magnitude later. The position angle distribution of the brighter galaxies shows no obvious trend; but a slight peak is found at orientations West of North.

We find the elliptical galaxies somewhat more concentrated towards the center of the cluster with their highest density in a region East of center. The spirals appear to have a similar distribution, albeit more sparsely scattered. The $(E : SO : S :)$ ratio is $(1.0 : 0.2 : 1.0)$ giving a similar number of ellipticals and spirals in the cluster. The core population comprises nearly 36% of the sample contained in 0.21 square degrees. This yields a core surface density of 388 galaxies per square degree.

We note that the brightest galaxy in the cluster has a corona. There appears to be a small subgroup of elliptical galaxies located at $x = -159.5, y = -50.3$. Of the myriad and diverse spirals, we find several superposed such as those found at $x = -140.3, y = -66.7$ and at $x = -136.1, y = -19.6$. Several peculiar galaxies are seen such as the object located at $x = -131.6, y = -17.9$ which boasts a broken ring-like structure.

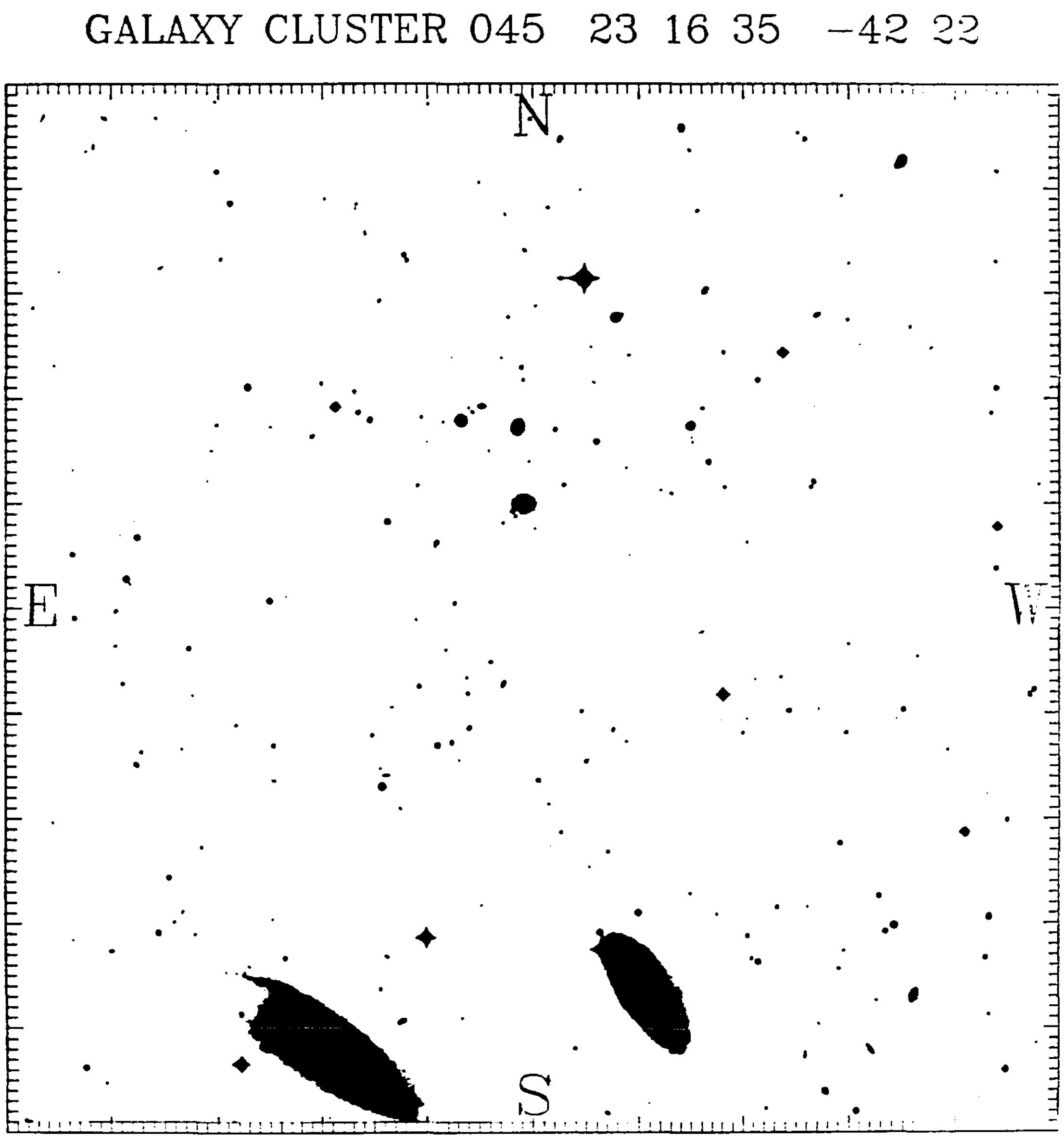


Figure 3.2.45 *(a) Field of GALAXY CLUSTER 045: 23 16 35 -42 22*

GALAXY CLUSTER 045 23 16 35 −42 22

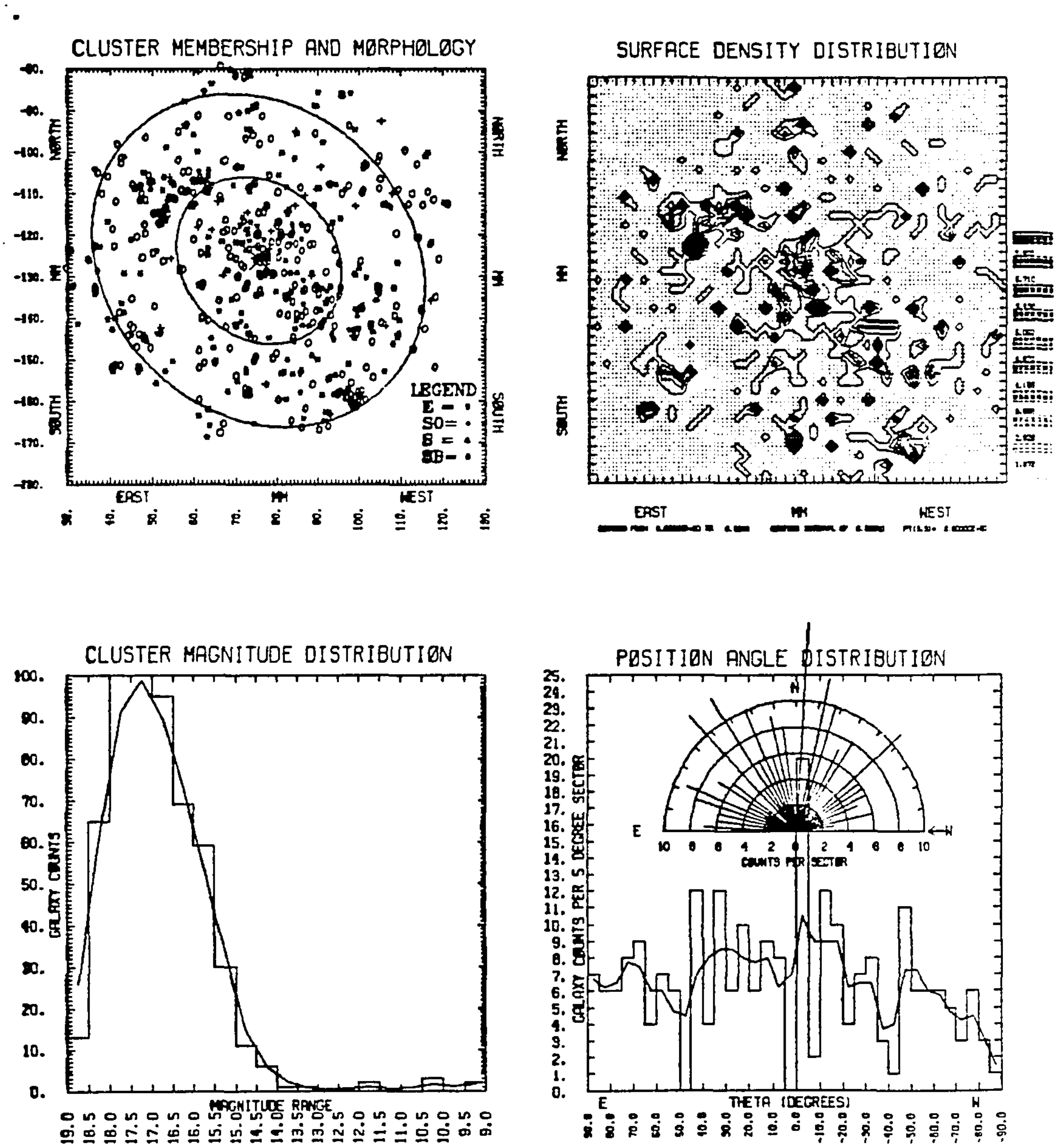
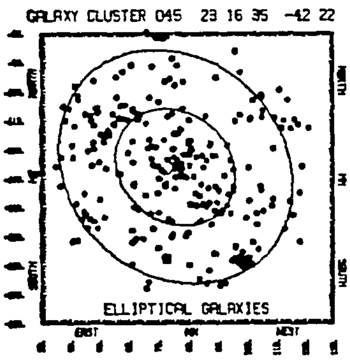
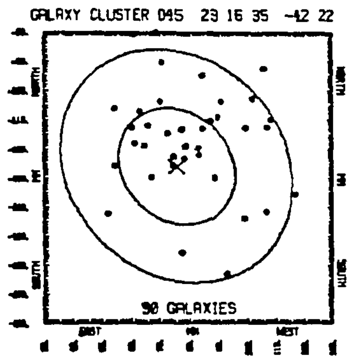
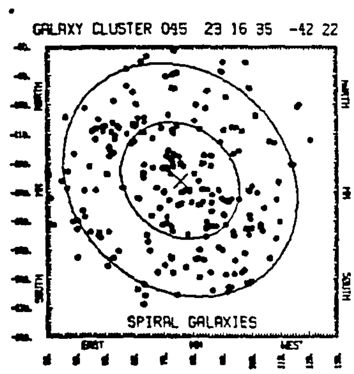


Figure 3.2.45 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*







GALAXY CLUSTER 045 23 16 35 −42 22						
FIELD 347						ESØ/SERC PLATE J2413
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-075.547	-126.152	23 16 35.3	-42 22 36.6	348 24 55.0	-65 59 2.5	0.030

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	283	MAJØR AXIS	21.60	SAMPLE PØPULATIØN	585
SØ	37	MINØR AXIS	18.30	CØRE PØPULATIØN	208
S	238	ECCENTRICITY	0.53	LIMITING MAGNITUDE	19.0
SB	15	PØSN. ANGLE	-45.66		
P	12				

Figure 3.2.45 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.45 *Cluster Population Description.*

GALAXY CLUSTER 045: 23 16 35 -42 22 : The cluster is located in the South-West quadrant of ESO/SERC Field 347. Within a diameter of 90mm as determined by m_{10} we count 591 galaxies in this cluster and 585 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* because of its lack of spherical symmetry and the presence of multiple nuleii, or subclustering.

We count 120 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B-M$ type III classification for the cluster which has no dominant galaxies. For m_1,m_3, and m_{10} we give 13.5, 14.2 and 14.8, respectively. The value of m_{10} implies a redshift of 0.030.

We note a general tendency of subclustering in this cluster of galaxies. There appears to be a concentration of membership near the center of the cluster, but even this is made of several small groups. We point out a dense group lying North-East of center.

The cluster magnitude distribution shows nearly an exponential rise from the brightest to the faintest galaxies, peaking at about $m_v = 17.5$, after which there is a rapid fall with relatively very few found near the magnitude limit. The position angle distribution is erratic with a few outstanding peaks with the major one showing an slight excess of orientation along the North-South direction.

We find the elliptical galaxies somewhat centrally condensed with dense subpopulations near the cluster center and in particular to the South-West near the cluster periphery. We notice a more scattered distribution for the spirals save perhaps for the very slight enhancement of numbers found just North of the cluster center. The $(E : SO : S :)$ ratio is $(1.0 : 0.1 : 0.9)$ giving an almost ten percent increase of ellipticals over spirals. The core population comprises some 35% of the sample and is located in an area of nearly 0.44 square degrees. This yields a core surface density of 478 galaxies per square degree on the sky.

With the diversity of the cluster in mind we point out several interesting members: a tight group of bright ellipticals at $x = -74.9, y = -119.8$; a group of superposed peculiar galaxies at $x = -63.4, y = -109.8$; an early elliptical galaxy with a host of faint attendant galaxies at $x = -52.7, y = -114.4$; and a pair of peculiar galaxies with unusual ansae located at $x = -46.5, y = -151.9$.

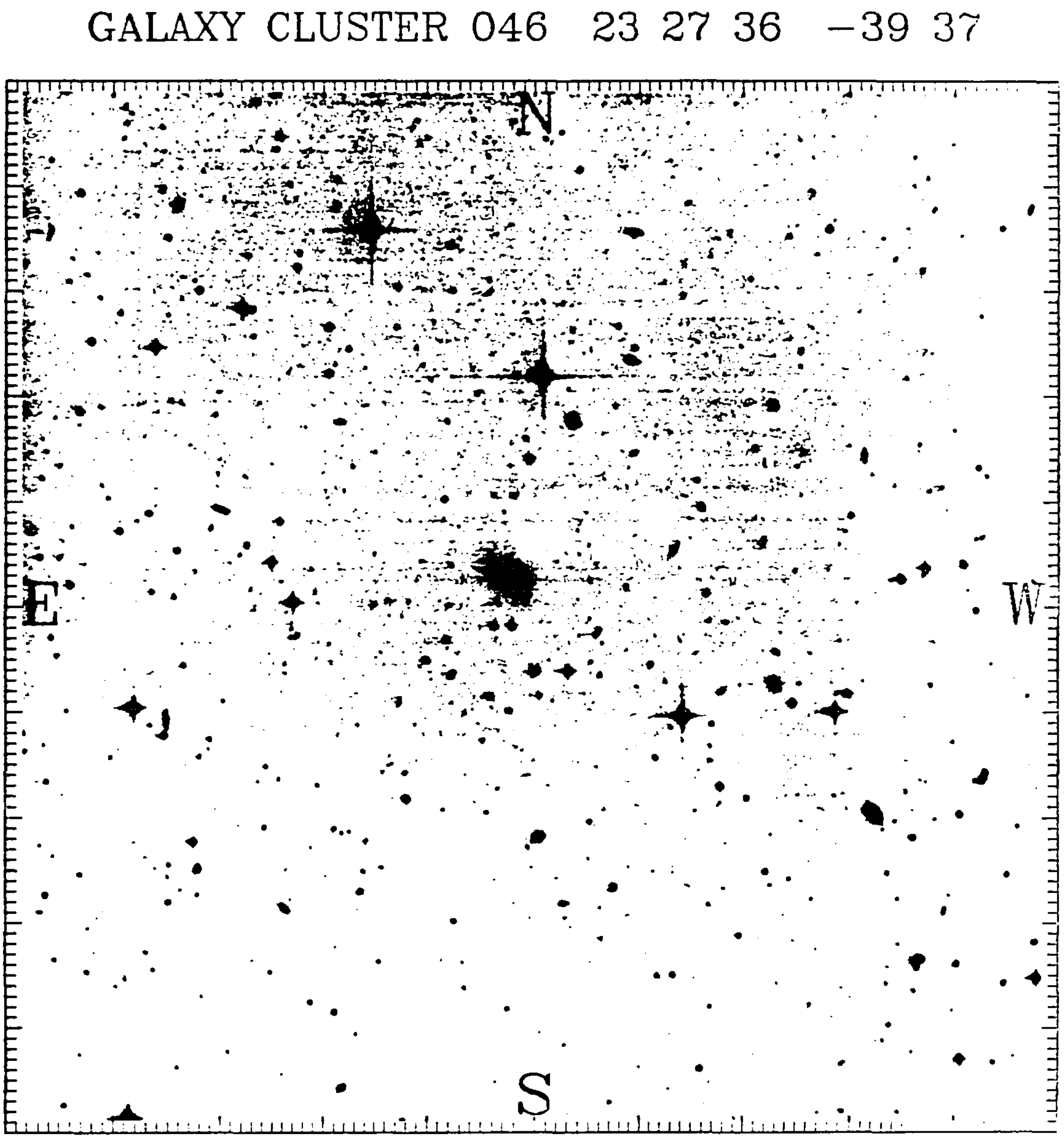


Figure 3.2.46 *(a) Field of GALAXY CLUSTER 046: 23 27 36 -39 37*

GALAXY CLUSTER 046 23 27 36 −39 36

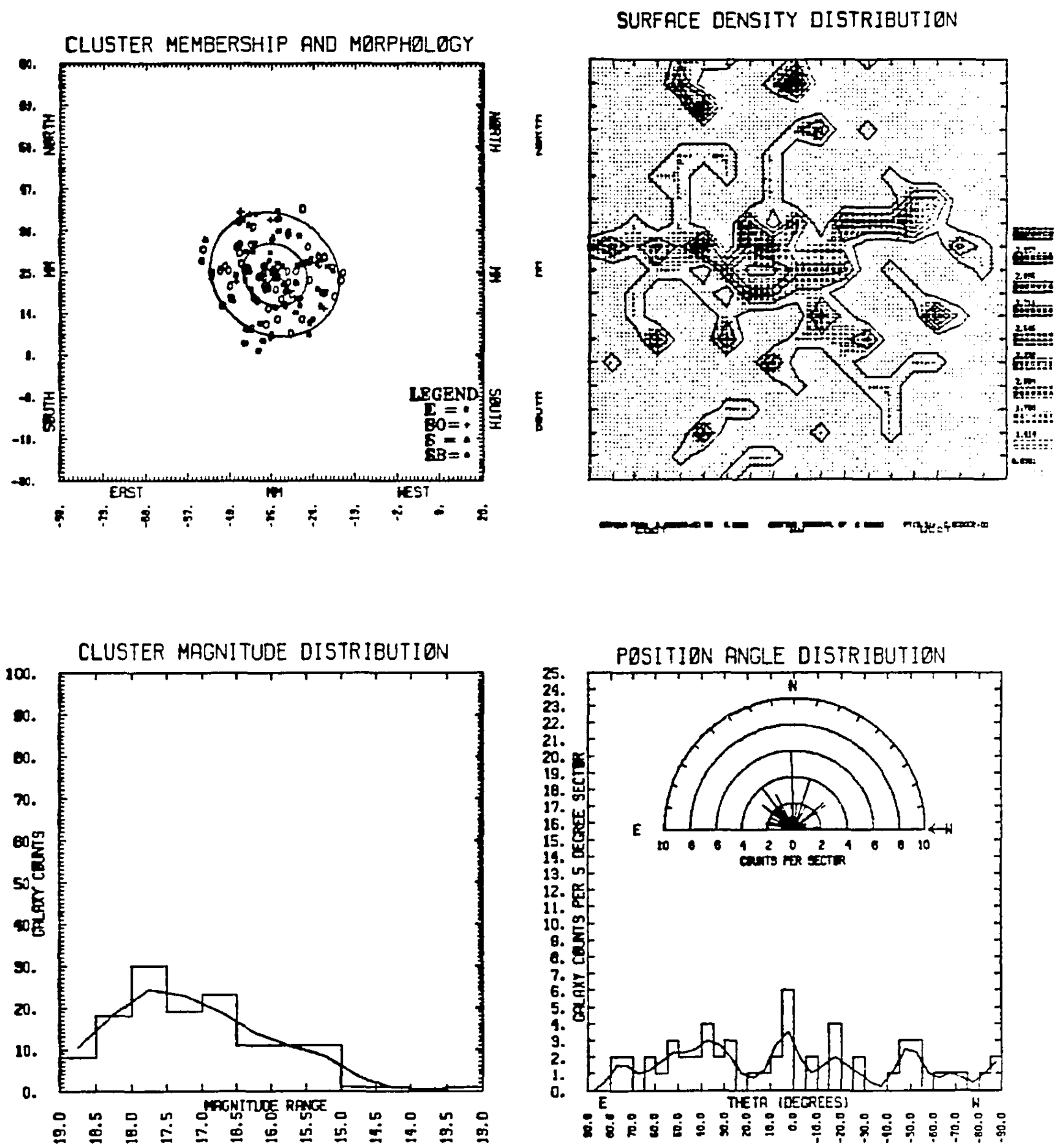
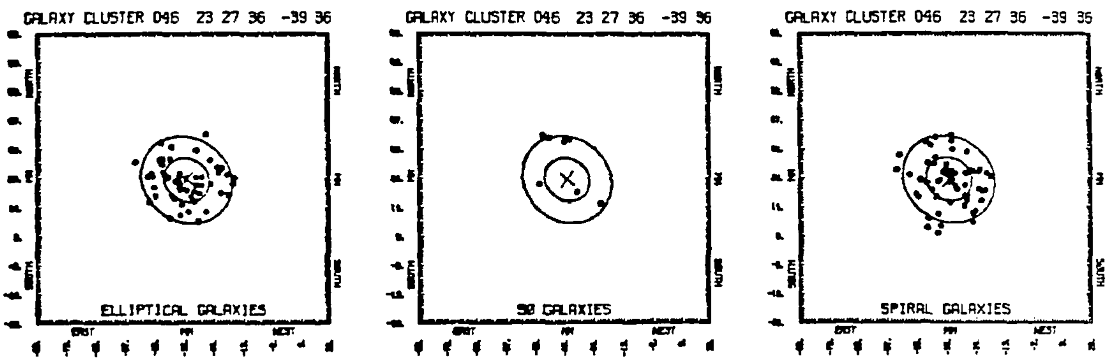


Figure 3.2.46 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 046 23 27 36 −39 36						
FIELD 347						ESO/SERC PLATE J2413
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
038.794	021.784	23 27 57.5	−39 37 6.8	351 47 36.1	−69 14 1.1	0.049

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	58	MAJOR AXIS	8.85	SAMPLE POPULATION	134
S0	7	MINOR AXIS	7.80	CORE POPULATION	45
S	62	ECCENTRICITY	0.47	LIMITING MAGNITUDE	19.0
SB	0	POSN. ANGLE	−37.24		
P	7				

Figure 3.2.46 *(f,g,h) Cluster Morphological Population Distributions.*

Table 3.2.46 *Cluster Population Description.*

GALAXY CLUSTER 046: 23 27 36 -39 37 : The cluster is located in the North-East quadrant of ESO/SERC Field 347. Within a diameter of 36mm as determined by m_{10} we count 138 galaxies in this cluster and 134 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* because of its lack of spherical symmetry and due to its mild, but multiple, subclustering.

We count 62 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B - M$ type I classification for the cluster which has a dominant cD type galaxy located near the cluster center. For m_1,m_3, and m_{10} we give 13.4, 15.1 and 15.3, respectively. The value of m_{10} implies a redshift of 0.049.

We notice that the cluster is mildly centrally condensed with slight condensations immediately surrounding the center. A somewhat high density grouping lies North of the center of the cluster near its periphery.

The cluster magnitude distribution shows a gentle rise from the brightest galaxies to a maximum near $m_v = 17.5$ afer which it rapidly falls off. The position angle distribution shows little preference for orientation save for the slight excess in the North-South direction.

We find the elliptical galaxies in the cluster to be slightly more concentrated in the Southern portions of the cluster with a preference for the third and fourth quadrants. The spirals, on the other hand, appear to be slightly more concentrated towards the center of the cluster. The $(E : SO : S)$ ratio is $(1.0 : 0.1 : 1.2)$ suggesting a slightly spiral enriched cluster.

The core population comprises almost 34% of the sample, and resides in an area of nearly 0.08 square degrees. This yields a core surface density of 592 galaxies per square degree on the sky.

We note several galaxies in this cluster that possess ring-like structures such as the objects located at $x = 35.4, y = 7.8$ and $x = 50.9, y = 24.4$. In addition we point out that there are several peculiar galaxies in the cluster such as the one found at $x = 24.9, y = 27.7$.

GALAXY CLUSTER 047 23 34 24 −69 35

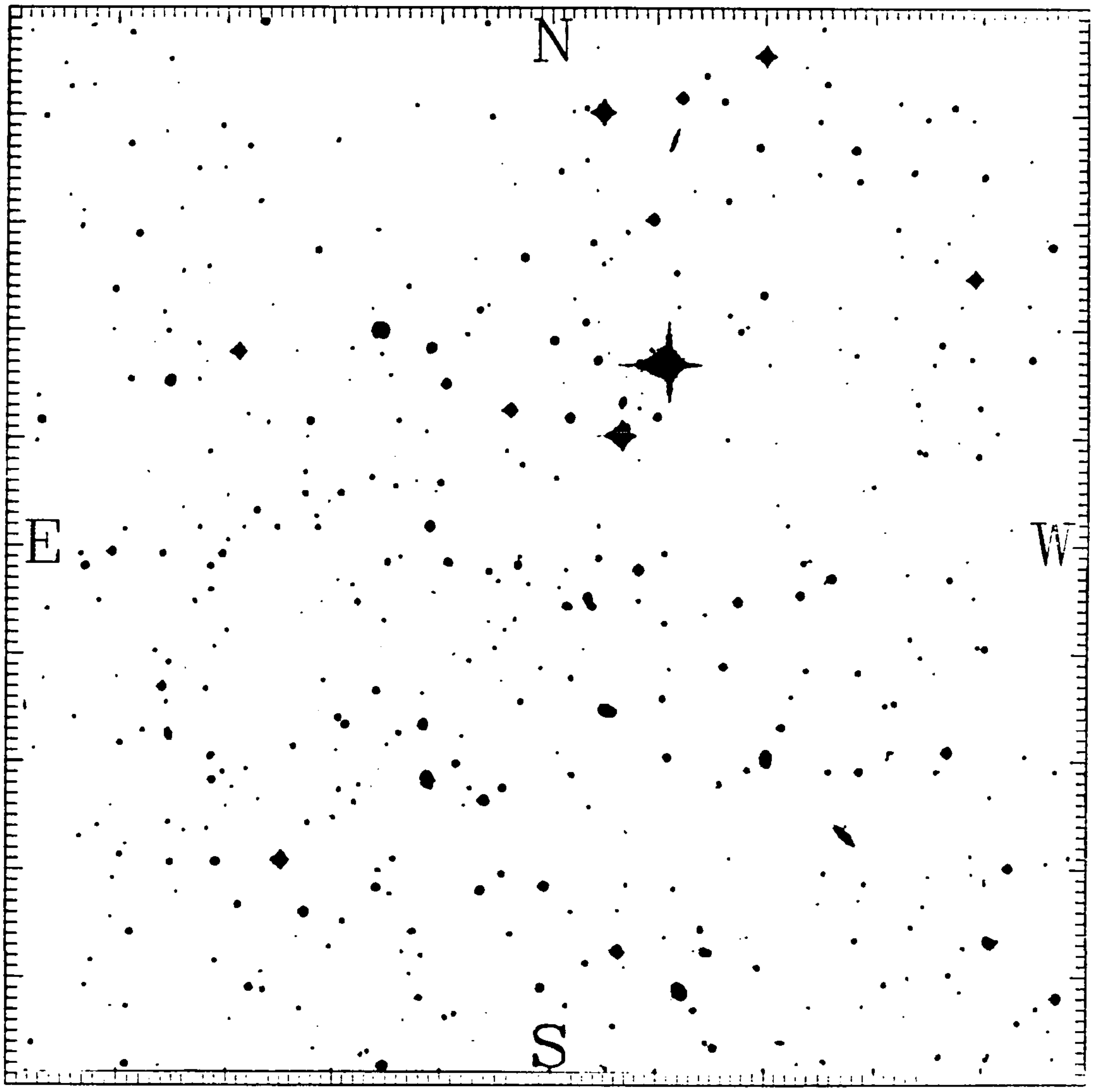


Figure 3.2.47 *(a) Field of GALAXY CLUSTER 047: 23 34 24 -69 35*

GALAXY CLUSTER 047 23 34 24 −69 34

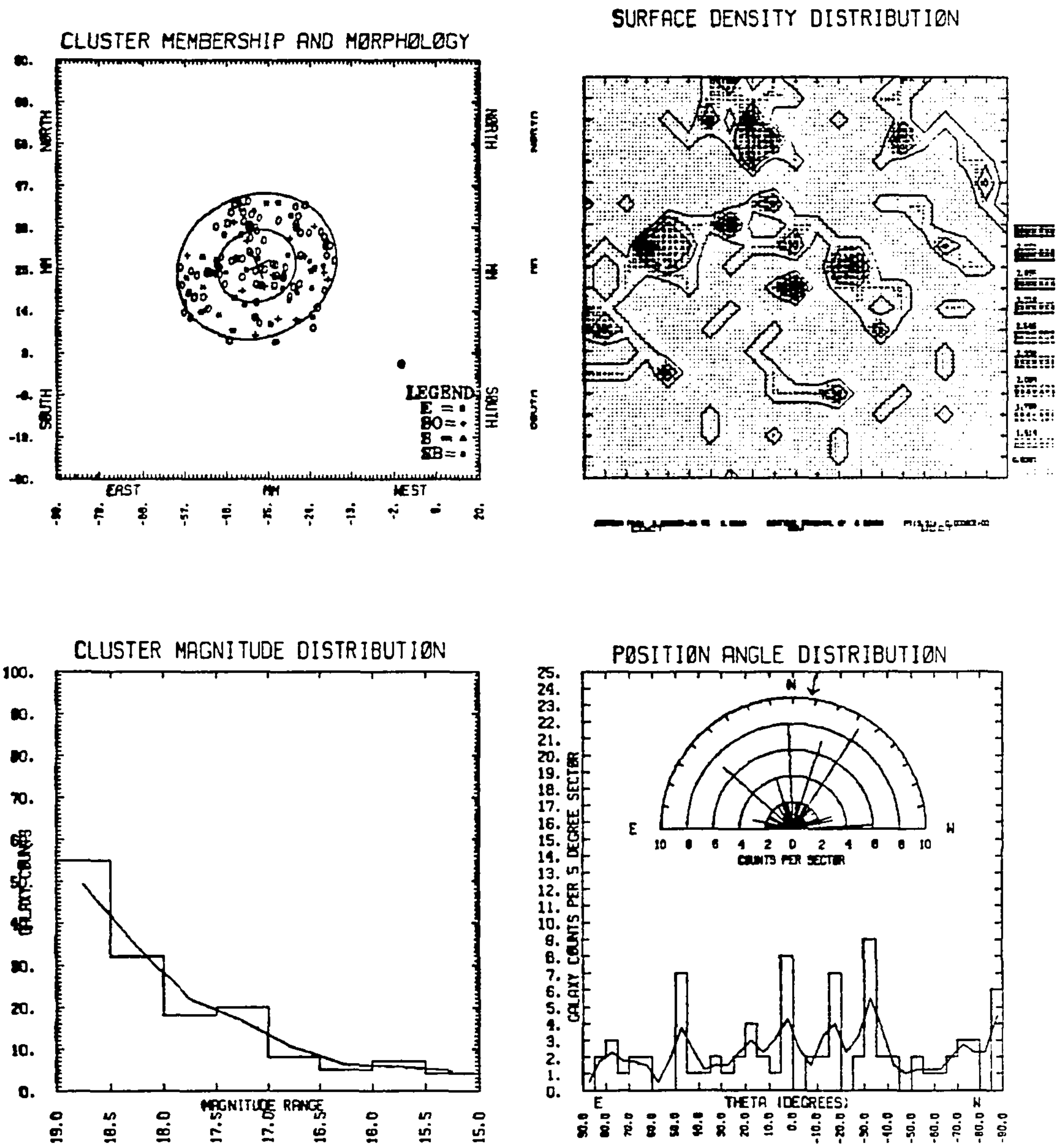
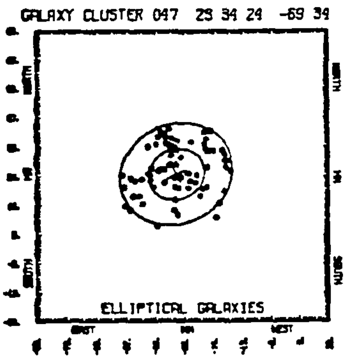
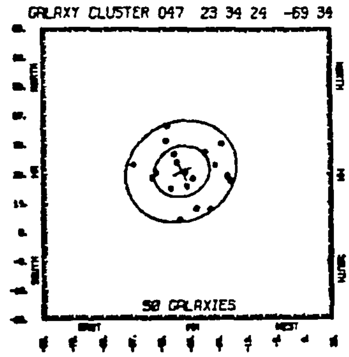
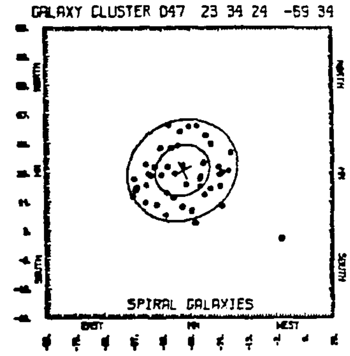


Figure 3.2.47 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*







GALAXY CLUSTER 047 23 34 24 −69 34

FIELD 077 — ESØ/SERC PLATE J3664

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
038.221	025.705	23 34 24.3	-69 34 43.5	312 19 10.5	-46 27 4.8	0.057

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	76	MAJØR AXIS	10.77	SAMPLE PØPULATIØN	149
SØ	20	MINØR AXIS	9.30	CØRE PØPULATIØN	43
S	47	ECCENTRICITY	0.51	LIMITING MAGNITUDE	19.0
SB	6	PØSN. ANGLE	25.49		
P	0				

Figure 3.2.47 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.47 *Cluster Population Description.*

GALAXY CLUSTER 047: 23 34 24 -69 35 : The cluster is located in the North-East quadrant of ESO/SERC Field 077. Within a diameter of 45mm as determined by m_{10} we count 258 galaxies in this cluster and 149 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* because of its lack of spherical symmetry and the presence of multiple subclustering.

We count 42 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 0. We suggest a $B - M$ type III classification for the cluster which has no dominant galaxies. For m_1,m_3, and m_{10} we give 15.1, 15.4 and 15.7, respectively. The value of m_{10} implies a redshift of 0.057.

We find the cluster somewhat scattered in appearance, with several density concentrations to the North, East and West of cluster center. Several others abound as is noticed, for example, just South of center.

The cluster magnitude distribution suffers a slow rise from the brightest cluster members to the faintest in a steady increase. The position angle distribution shows a few dominant peaks most notably the slight excess West of North at about 35 degrees in the negative sense.

We notice the elliptical galaxies in several concentrations, one near the center of the cluster and another at a location North of center. There appears to be a relative paucity of elliptical galaxies in the third and fourth quadrants. The spiral galaxies, on the other hand, appear in larger numbers towards the outskirts of the cluster. The $(E : SO : S)$ ratio gives $(1.0 : 0.3 : 0.7)$ indicating a 30% increase of ellipticals over spirals. The core population comprises nearly 29% of the sample and is contained in an area of 0.11 square degrees. This gives a core surface density of 390 galaxies per square degree on the sky.

We count eleven close faint pairs of galaxies in the sample the brightest of which lies at $x = 20.2, y = 33.2$; these are typically composed of an early and a later elliptical. A number of the galaxies in the cluster appear superposed such as the object located at $x = 29.7, y = 16.7$. Finally, we note the presence of several distressed galaxies such as that seen at $x = 49.5, y = 13.8$.

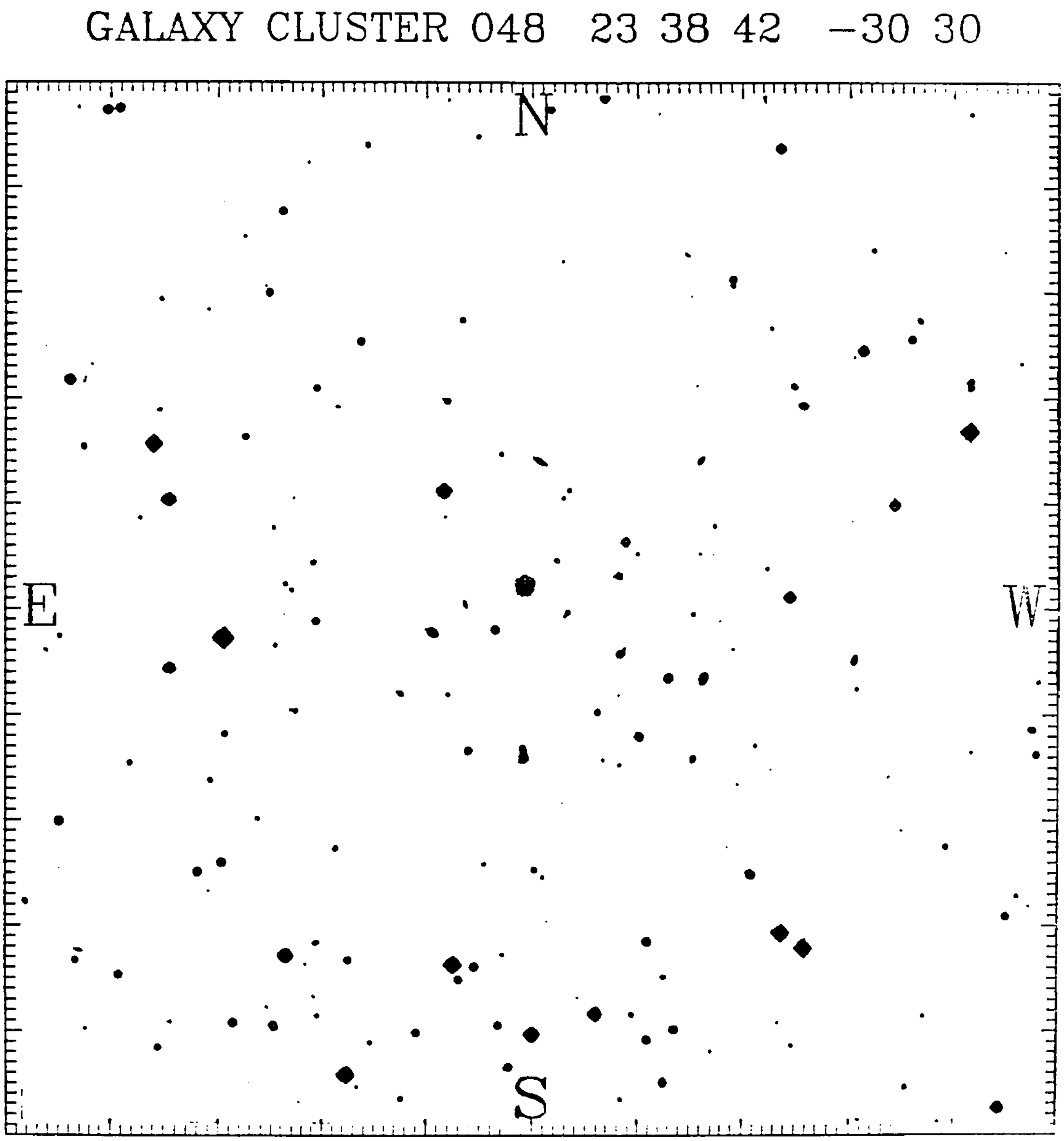


Figure 3.2.48 *(a) Field of GALAXY CLUSTER 048: 23 38 42 -30 30*

GALAXY CLUSTER 048 23 38 42 −30 30

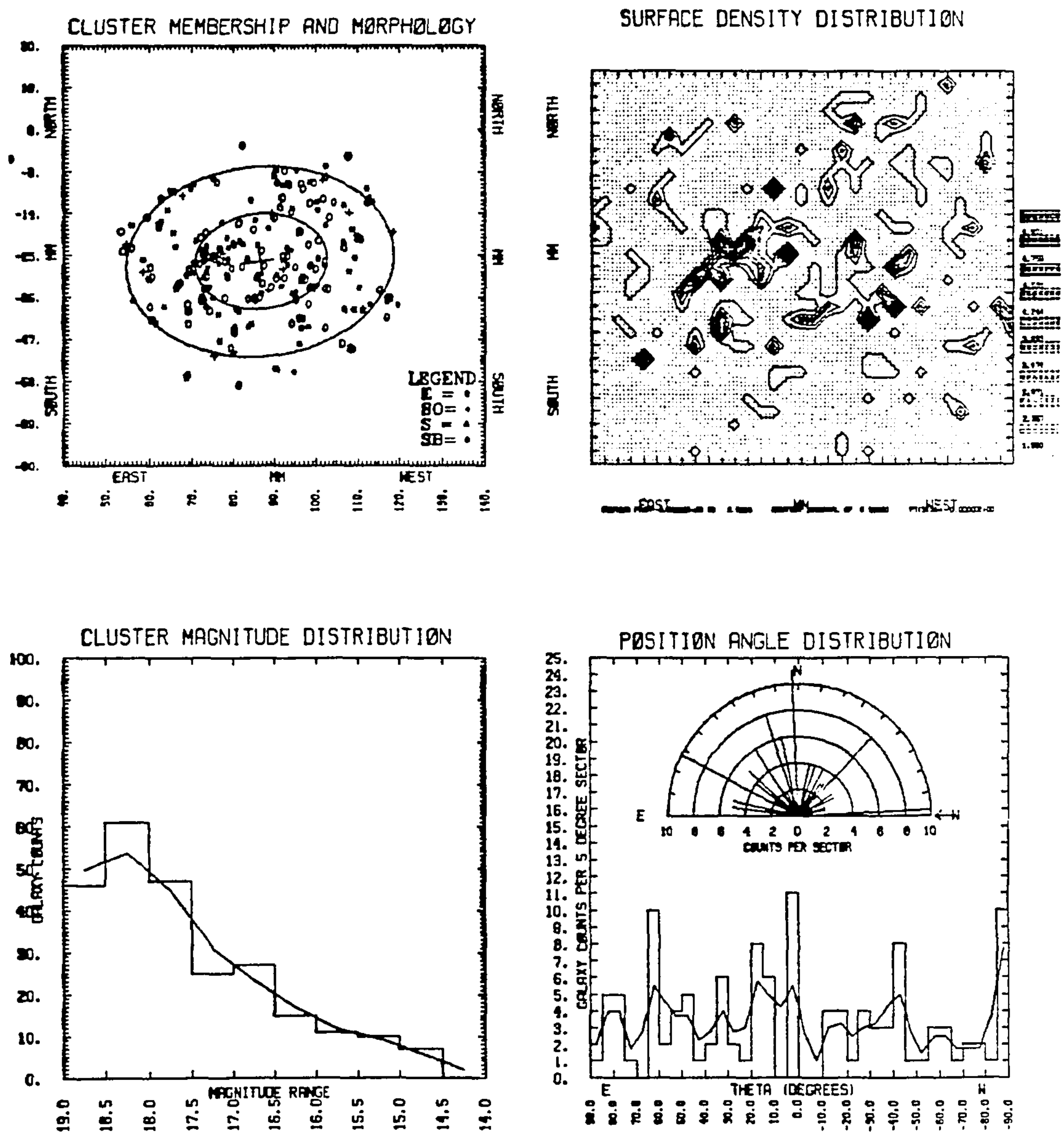
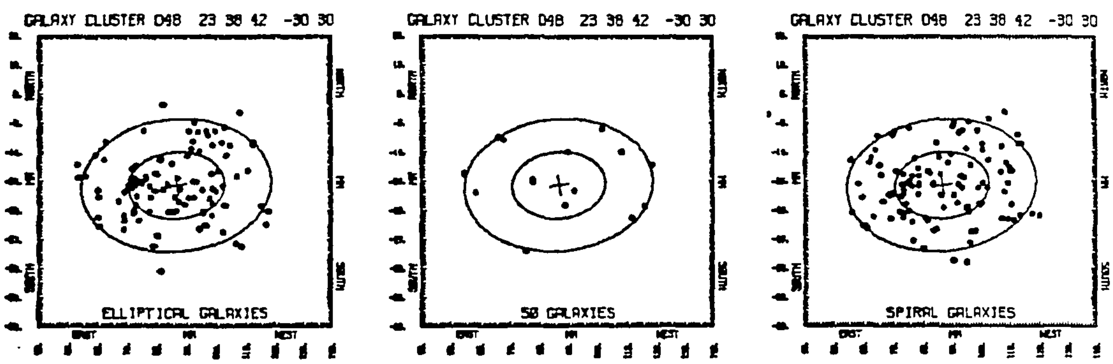


Figure 3.2.48 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*



GALAXY CLUSTER 048 23 38 42 −30 30

FIELD 471 ESO/SERC PLATE J6138

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-086.526	-026.689	23 38 44.8	-30 30 4.2	017 24 7.9	-74 20 20.9	0.044

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	113	MAJOR AXIS	16.03	SAMPLE POPULATION	249
S0	15	MINOR AXIS	12.45	CORE POPULATION	95
S	113	ECCENTRICITY	0.63	LIMITING MAGNITUDE	19.0
SB	4	POSN. ANGLE	7.12		
P	4				

Figure 3.2.48 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.48 *Cluster Population Description.*

GALAXY CLUSTER 048: 23 38 42 -30 30 : The cluster is located in the South-West quadrant of ESO/SERC Field 471. Within a diameter of 00mm as determined by m_{10} we count 266 galaxies in this cluster and 249 to a limiting magnitude of $m_{\text{lim}} = 19.0$. The cluster is classified Abell type *I* because of its lack of spherical symmetry and the presence of several concentrations in the body of the cluster.

We count 65 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 1. We suggest a $B - M$ type I classification for the cluster which has a dominant centrally located cD galaxy. For m_1,m_3, and m_{10} we give 14.6, 14.8 and 15.1, respectively. The value of m_{10} implies a redshift of 0.044.

We note the elongation of the cluster and its several density concentrations. A somewhat linear concentration of galaxies to the East of center appears to run diagonally from South-East to North-West. There is another concentration just South of this feature as well as a pair North and South of its North-West pole. The cluster magnitude distribution shows a gentle rise to a maximum from the brightest galaxies in the cluster to about $m_v = 18.0$. It then falls off slightly. We point out that the distribution appears somewhat bifurcated and may indicate, along with the several density concentrations, a multi-population cluster. The position angle distribution for the brighter galaxies seems skewed to an excess of galaxies oriented East of North.

There appears to be a higher concentration of elliptical galaxies towards the center of the cluster as opposed to the outskirts, with a slight enhancement in the area of the Eastward density concentration mentioned earlier. There seems to be a relative scarcity of elliptical galaxies in the second quadrant. The spiral galaxies seem to follow a similar pattern with a slight concentration of their numbers Eastward of cluster center. The $(E : SO : S)$ ratio is $(1.0 : 0.1 : 1.1)$ suggesting nearly a ten percent increase of spirals over ellipticals in this cluster. The core population comprises some 38% of the cluster sample and resides in an area of 0.22 square degrees. This yields a core surface density of 432 galaxies per square degree on the sky.

We note that the brightest member of the Eastern concentration lies at $x = -76.2, y = -24.9$ and appears to be an elliptical galaxy with a corona.

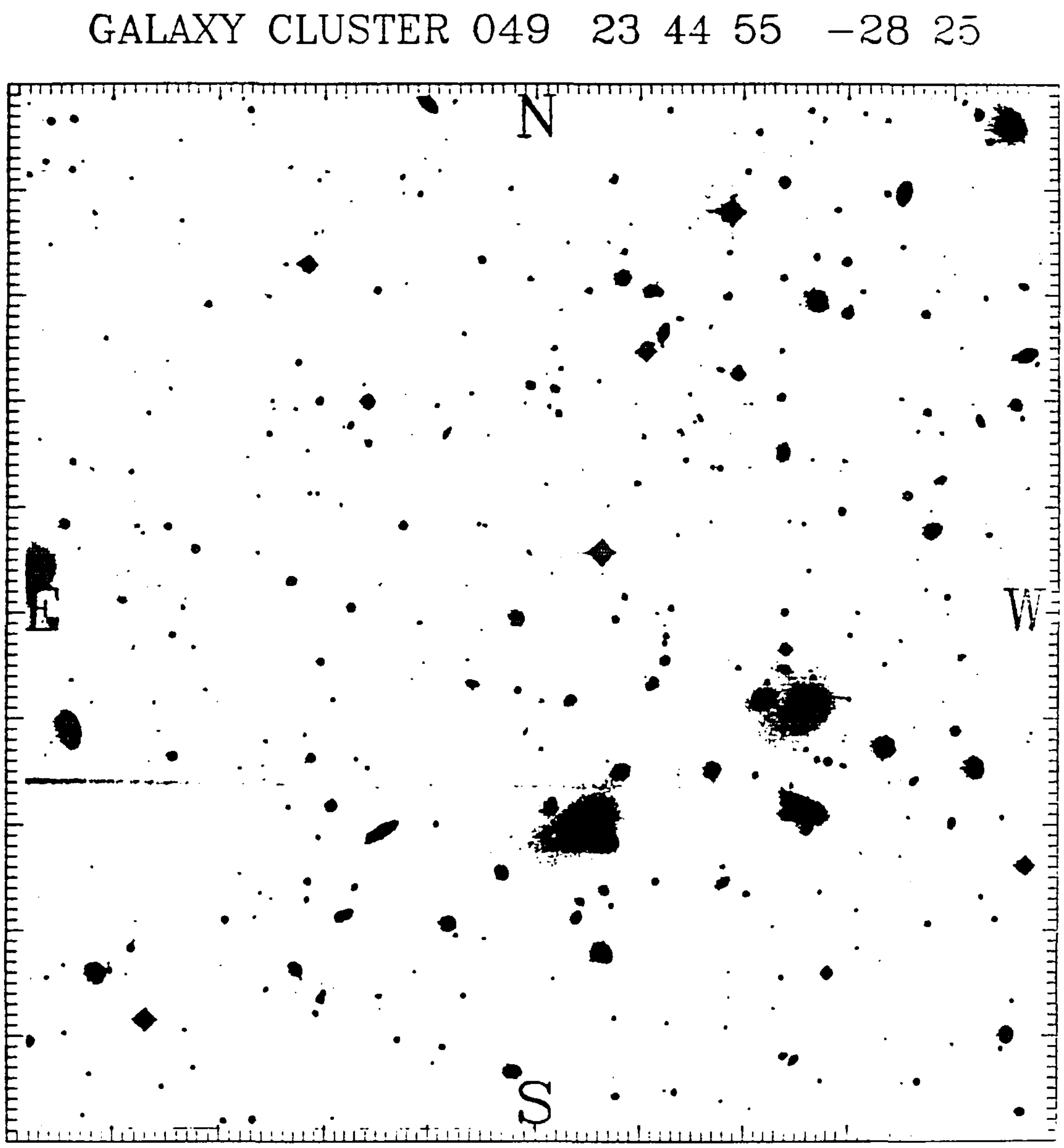


Figure 3.2.49 *(a) Field of GALAXY CLUSTER 049: 23 44 55 -28 25*

GALAXY CLUSTER 049 23 44 55 −28 24

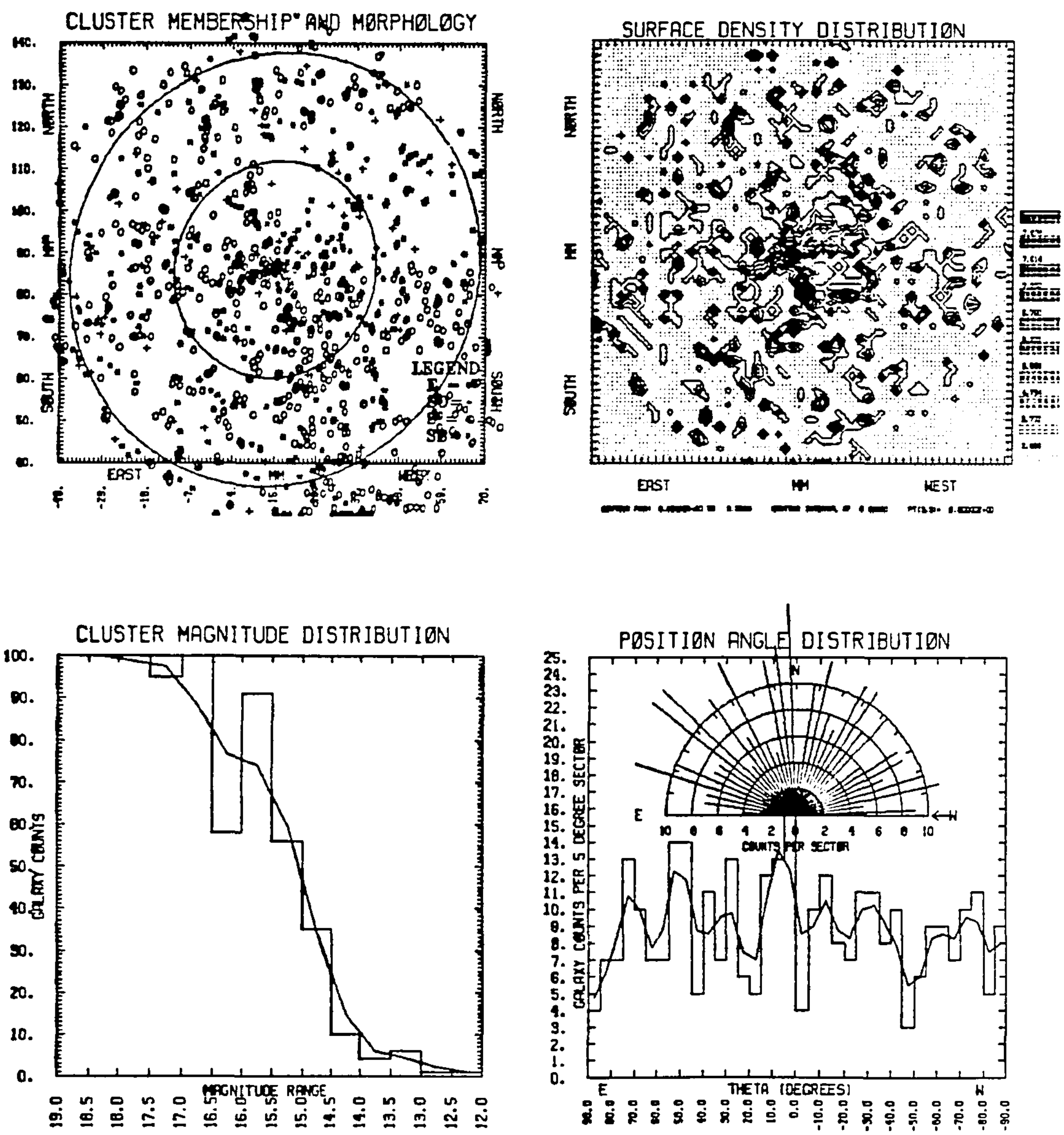
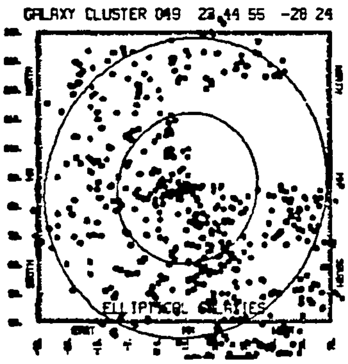
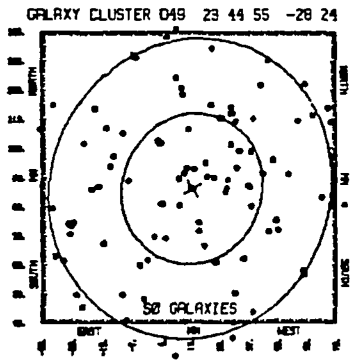
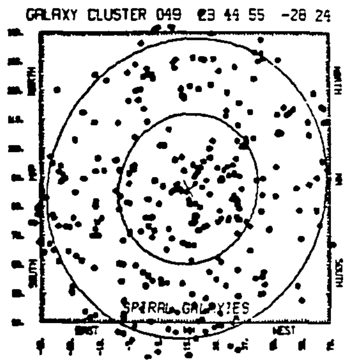


Figure 3.2.49 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*







GALAXY CLUSTER 049 23 44 55 −28 24						
FIELD 471						ESØ/SERC PLATE J6138
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-015.479	085.995	23 44 55.4	-28 24 42.6	025 10 13.4	-75 49 4.7	0.023

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	626	MAJØR AXIS	27.03	SAMPLE PØPULATIØN	1140
SØ	97	MINØR AXIS	25.34	CØRE PØPULATIØN	409
S	324	ECCENTRICITY	0.35	LIMITING MAGNITUDE	19.0
SB	66	PØSN. ANGLE	32.81		
P	27				

Figure 3.2.49 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.49 *Cluster Population Description.*

GALAXY CLUSTER 049: 23 44 55 -28 25 : The cluster is located in the North-West quadrant of ESO/SERC Field 471. Within a diameter of 120mm as determined by m_{10} we count 1260 galaxies in this cluster and 1140 to a limiting magnitude of $m_{\rm lim}$ = 19.0. The cluster is classified Abell type R because of its strong central concentration and tendency to be sphericall symmetric.

We count 68 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 1. We suggest a $B - M$ type I-II classification for the cluster which has an intermediate appearance with several bright normal giant elliptical galaxies near the central regions of the cluster. For m_1,m_3, and m_{10} we give 12.5, 13.1 and 13.6, respectively. The value of m_{10} implies a redshift of 0.023.

This large rich cluster appears centrally condensed with the central regions resolved into a myriad of minor density enriched groups of galaxies. The concentration located at the center of the cluster appears somewhat elongated and slightly inclined North of West. The cluster magnitude distribution rises nearly exponentially from the brightest cluster members to a peak near $m_v = 16.0$ where the distribution falls off some 30%, suffers a change in slope and rises again to the magnitude limit. Since the numbers of faint galaxies are very large we may be seeing the effects of our cluster being superposed on a faint background of galaxies, but to resolve that question we require a series of nearby galaxy counts to determine the background. The position angle measurements suggest an excess of orientations East of North in this case.

We notice a certain clumpyness to the distribution of the elliptical galaxies in this cluster in particular near cluster center. We note also, a peculiar avoidance by these galaxies of the interior first quadrant. The spiral galaxies seem to be more uniformly scattered throughout the cluster. We find an $(E : SO : S)$ ratio of $(1.0 : 0.2; 0.7)$ suggesting a nearly 30% increase of ellipticals over spirals. The core population embraces some 36% of the sample in an area 0.75 square degrees. This yields a core surface density of 542 galaxies per square degree on the sky.

We note thirty-nine objects close enough to be considered superposed as well as thirty-five close pairs composed of what are generally an early and a late elliptical. We find several small groups dominated by a brightest elliptical with many faint attendants such as that found at $x = -18.3, y = 76.4$.

GALAXY CLUSTER 050 23 59 06 −44 07

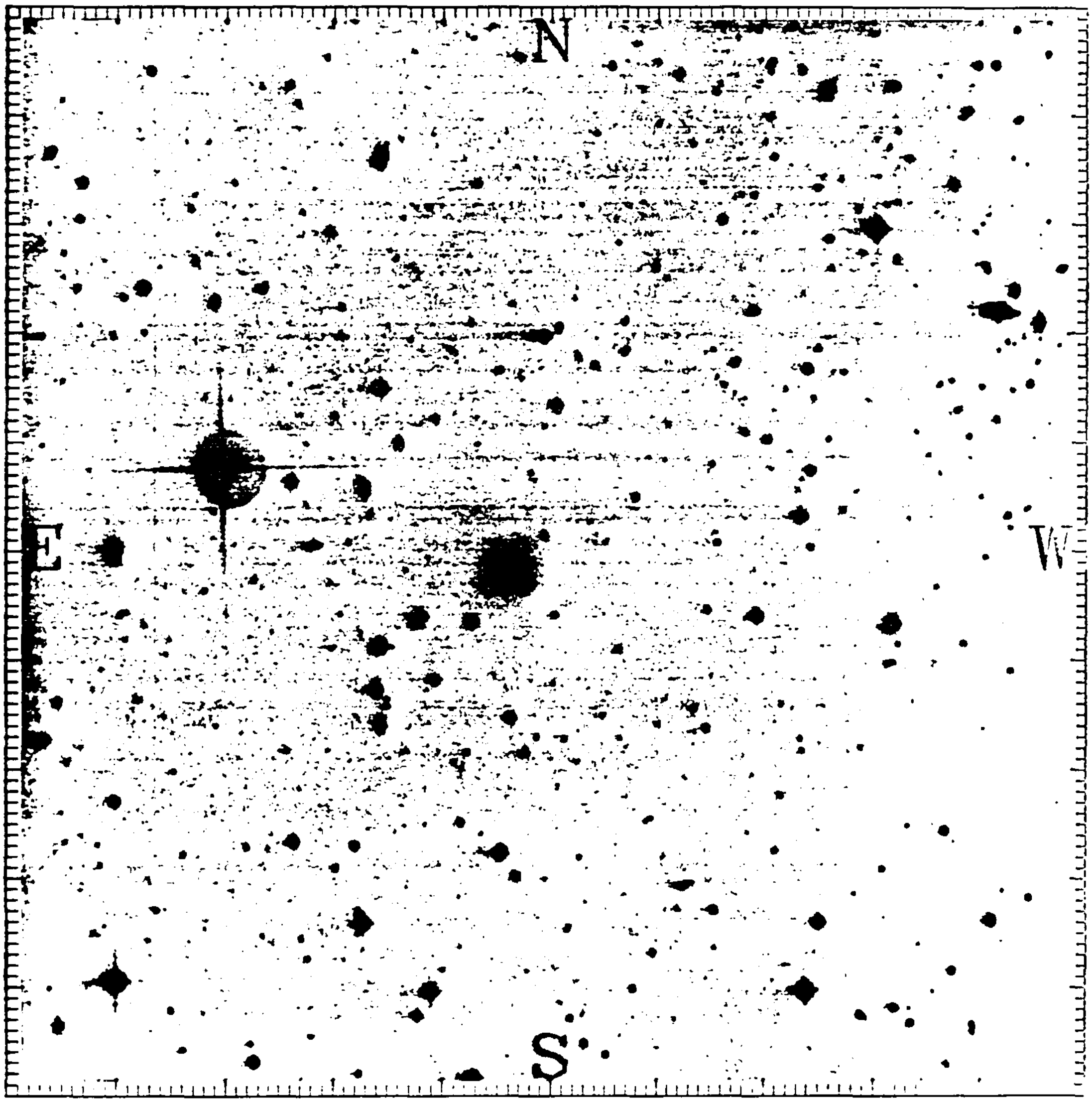


Figure 3.2.50 *(a) Field of GALAXY CLUSTER 050: 23 59 06 -44 07*

GALAXY CLUSTER 050 23 59 06 −44 07

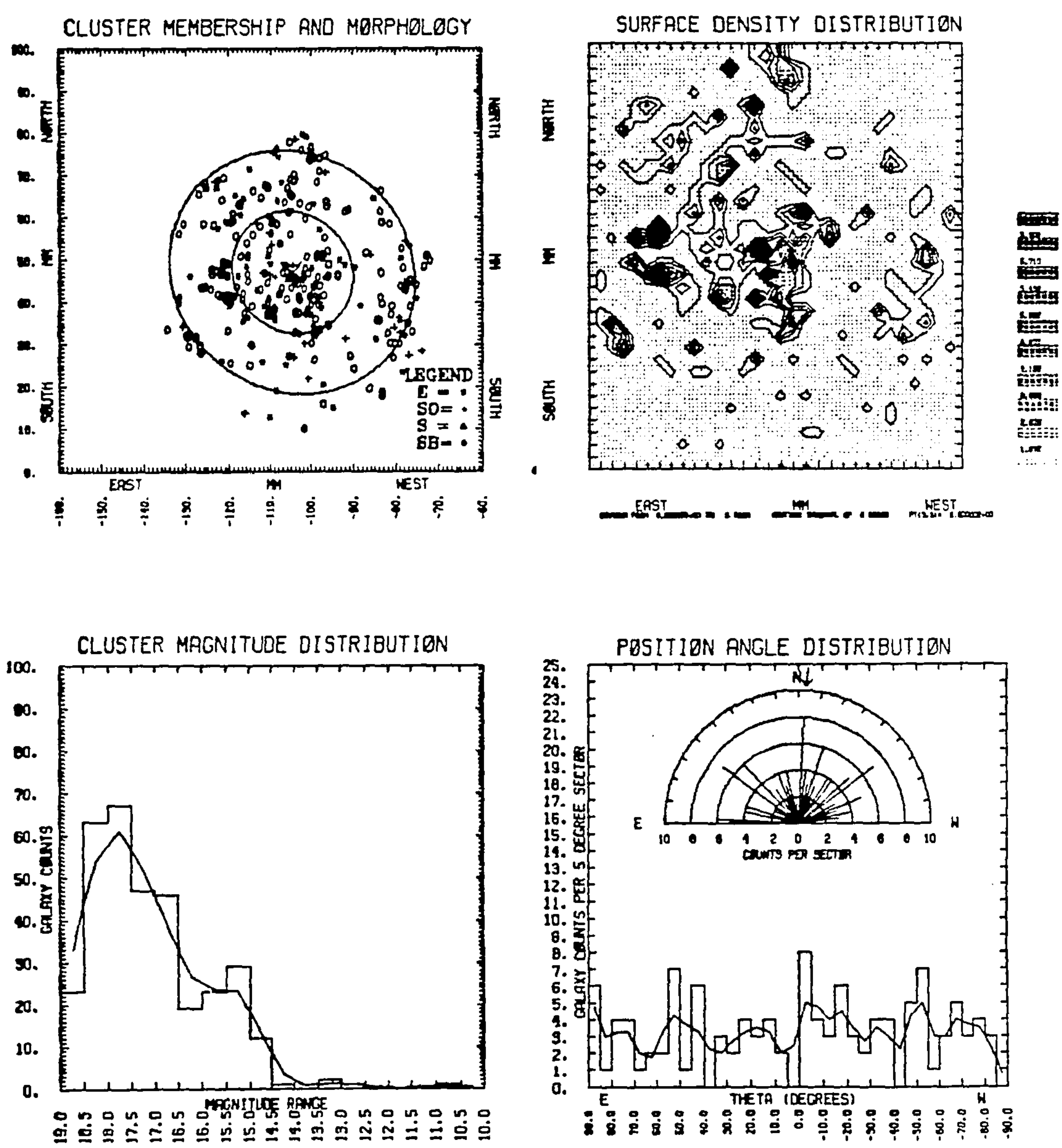
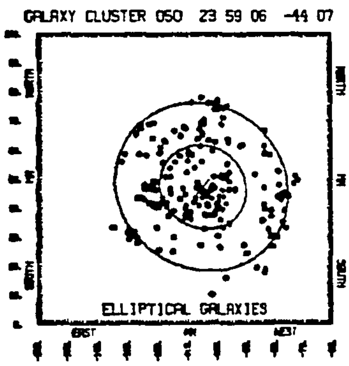
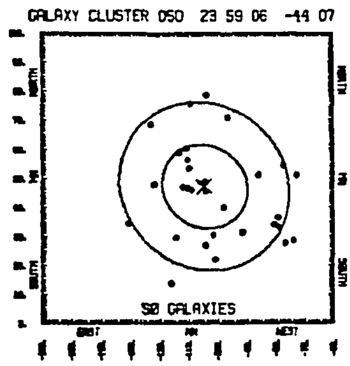
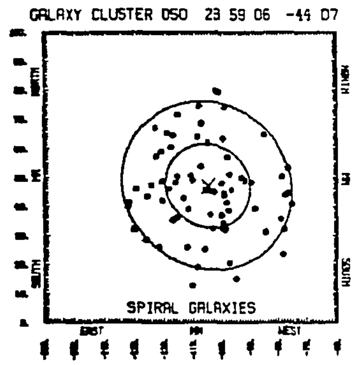


Figure 3.2.50 *(b) Cluster Morphology. (c) Surface Density Distribution. (d) Magnitude Distribution and (e) Position Angle Distribution.*







GALAXY CLUSTER 050 23 59 06 −44 07						
FIELD 292						ESO/SERC PLATE J4504
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
104.794	047.058	23 59 5.8	-44 6 46.5	330 42 13.2	-70 30 40.1	0.038

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	224	MAJOR AXIS	15.18	SAMPLE POPULATION	334
S0	30	MINOR AXIS	13.89	CORE POPULATION	123
S	77	ECCENTRICITY	0.40	LIMITING MAGNITUDE	19.0
SB	2	POSN. ANGLE	-40.06		
P	1				

Figure 3.2.50 *(f,g,h) Cluster Morphological Population Distributions.*
Table 3.2.50 *Cluster Population Description.*

GALAXY CLUSTER 050: 23 59 06 -44 07 : The cluster is located in the North-East quadrant of ESO/SERC Field 292. Within a diameter of 60mm as determined by m_{10} we count 342 galaxies in this cluster and 334 to a limiting magnitude of $m_{\rm lim} = 19.0$. The cluster is classified Abell type *I* because of its lack of spherical symmetry and presence of several concentrations indicating subclustering.

We count 43 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 0. We suggest a $B - M$ type II classification for the cluster which has as its brightest galaxies those intermediate in appearance between class cD and normal giant ellipticals. For m_1,m_3, and m_{10} we give 12.7, 13.4 and 14.8, respectively. The value of m_{10} implies a redshift of 0.038.

The cluster appears somewhat elongated and has several noticable concentrations, notably that immediately South of center and that East of center, which are the most dense and a number of less dense groups scattered throughout mainly the third and fourth quadrants of the cluster.

The cluster magnitude distribution appears somewhat bifurcated rising rapidly from the brightest galaxies to a small peak near $m_v = 15.0$ then falling to a trough a magnitude later only to rise rapidly to another peak near $m_v = 18.0$ after which it falls rapidly to the magnitude limit. This phenomenon may be interpreted as the possible superposition of two clusters. The position angle distribution is scattered, but suggests an excess in the numbers of bright galaxies oriented West of North.

We note the central condensation of elliptical galaxies and their paucity in the Southernmost regions of the cluster. The spirals appear to be loosely scattered throughout the cluster. We find the $(E : SO : S)$ ratio to be $(1.0 : 0.1 : 0.4)$ indicating nearly sixty percent more ellipticals in this cluster than spirals. The core population comprises nearly 37% of the sample enclosed in 0.23 square degrees. This gives a core surface density of 530 galaxies per square degree on the sky.

We note a few pairs of galaxies in this cluster like that found at $x = 120.9, y = 40.4$. In addition, we find some peculiarities in some galaxies ranging from superposition as we see at $x = 98.0, y = 73.9$ or structural peculiarities as is evident at $x = 79.1, y = 35.6$.

CHAPTER IV

AN ISOTHERMAL ANALYSIS OF CLUSTERS OF GALAXIES

Although the myriad things are many,
their order is one.
– Chuang-Tzu

One of the earliest attempts to determine the extent and population characteristics of rich clusters of the "nebulae", but excluding the Virgo Group of galaxies, was done by d'Arrest (1865) when he visually observed some twenty-five of the brightest nebulae in what is now known as the Coma cluster. Some time later nearly thirty such nebulae were catalogued in this area by Dreyer (1888) in his New General Catalogue with an additional twenty listed in his Index Catalogues.

Some time later, Wolf (1901) photographed a minimally obscured region of the North Galactic Pole in the Constellation Coma Berenices and identified 108 nebulae within a circle of half a degree. This aggregate of galaxies, the Coma cluster, is considered a cluster prototype because of its richness, closeness and lack of obscuration. He continued his research and catalogued the positions of 1528 nebulae in the Coma field and described them in terms of Herschel's system. Working in the same area with the 36-inch Crossley reflector at the Lick Observatory, Curtis (1918) counted some 304 galaxies in an area of only 40×50 minutes of arc and remarked that the region contained "the most remarkable aggregate of closely packed small nebulae known to me."

While discussing the velocity-distance relation for galaxies Hubble and Humason (1931) commented on the "sizes" of several clusters discovered till that time. These included the Perseus cluster studied by Wolf (1906), the Ursa Major cluster observed by Baade (1928), the Leo cluster by Christie (1929) and the well-known clusters in Corona Borealis, Gemini and Cancer. The Perseus cluster was said to have some 500 nebulae within a radius of nearly one degree; the Coma cluster to have nearly 800 within a radius somewhat less than a degree; and the Leo and Ursa Major groups some 300 galaxies within radii corresponding to nearly 0.3 degrees.

The Coma cluster was given preliminary study by Lundmark (1927) to determine the distance and dimensions of the group and later, using Wolf's material, Wallenquist (1933) gave the first study of the volume structure of the cluster. He discovered a strongly peaked number density profile common to member galaxies of differing luminosities. During the next decade Zwicky (1937c, 1941, 1942a,b,c,d) carried out a systematic study of the distribution of galaxies in clusters which was to be the prototype of such analyses. For example, his examination of the Coma cluster (Zwicky, 1937c) revealed 670 galaxies brighter than 16.5m within 160 arcminutes of the cluster center. He extended the total cluster membership to 1500 galaxies while noting that even 4.5 degrees from the cluster center the average projected number of galaxies still exceeded that of the surrounding field. He later claimed that as a result of studies to fainter limiting magnitudes (Zwicky, 1951) that the true population brighter than the limiting magnitude of 19.0 was detectable to a diameter of nearly twelve degrees and contained some ten thousand galaxies. Zwicky maintained this point until 1972, in spite of the study by Oemler, Page and Wilson

(1965) who assigned a diameter of about 100 minutes of arc to the cluster. It was to solve this dichotomy and after discussions with Zwicky in 1971 that Chincarini and Rood (1971) decided to study the extent of the Coma cluster by using redshifts. The hallmark result is the paper in *Nature* by Chincarini and Rood (1975) in which the first evidence of superclustering was discovered using the space distribution (i.e. RA, D and $redshift$) of galaxies.

The definition, however, of what is meant by cluster radii is not clear. Similar to the distribution of light in globular clusters of stars, the projected surface density distribution of galaxies in clusters falls off gradually and some realistic operational definition should be agreed on. The observational situation is much more complicated because of the presence of an optically indistinguishable background population of galaxies and early size measurements were governed in part as to how conspicuously a cluster of galaxies stood out from its environment.

An attempt at modeling the distribution of galaxies in clusters was undertaken by Zwicky in 1937 when he noticed that the projected density distribution of the Coma cluster was similar to the luminosity distributions previously seen in elliptical galaxies by Hubble (1930). These approximated the distribution of mass in an isothermal gas sphere which refer to a self-gravitating assembly of mass points in hydrostatic equilibrium (Emden 1907). Subsequently, Zwicky (1957) found that the distributions of galaxies in Cancer, Hydra I and Perseus could likewise be interpreted by a bounded isothermal gas sphere model. The model was further extended by Bahcall (1972, 1973a,b,c, 1974a, 1975), Austin and Peach (1974a), MacGillivray et al. (1976), and others more recently. We mention in passing that the analysis of Zwicky of the Virial mass of the Coma cluster uncovered for the first time the mass discrepancy problem (or *missing mass*) in clusters of galaxies.

The isothermal procedures are based on the following relation (Bahcall 1972):

$$R_{(obs)}(r) = \alpha \bullet R_{(iso)}(r/\beta) + \gamma$$

where: $R_{(obs)}$ and $R_{(iso)}$ are the observed and theoretical projected density distrbutions and α is a density normalization factor. β is a scaling factor in distance which relates the linear distance r from the center of the cluster to Emden's dimensionless radius ξ such that $r = \beta\xi$. The term has been named the ***structural index*** of the cluster and is one of the primary cluster parameters. Values of $R_{(iso)}$ as a function of ξ have been tabulated by Chandrasekhar (1942) and Zwicky (1957, Table XXXV).

The values of β found by Zwicky (1957) were 22.4, 39.2, 40.5 and 52.3 $/h$ kpc for the Cancer, Coma, Hydra I and Perseus clusters respectively and took this rather small spread as evidence that all regular clusters are similar in size and structure. Abell (1966), however, notes that the spread is practically over a factor of two. Nevertheless, the possibility of a consistent measure is attractive, and the idea was pursued further by Bahcall (1973a, 1975) who introduced the notion of the cluster ***core radius***, R_c, as the angular radius at which the observed surface density of galaxies falls to one-half of its central value at which $r = 3\beta$. For at least four of the five clusters Bahcall studied in 1973, the linear core radii were found to be within 15 percent of an average value even though their redshifts ranged over a factor of twenty. Later, in a fairly homogeneous sample of 15 low-redshift clusters she found similar agreement with the isothermal gas sphere model and an average linear core radius of $R_c = (126 \pm 23)/h$ kpc. However, the matter is not clear; but the model ***is*** useful as a first approximation. We must point out that all clusters may not be stable and that in the final analysis, X-ray observations may be a better way to estimate the cluster potential. Nevertheless, it is this model that we have adapted to our analysis and is explained in detail in the next section.

4.1 Theory of the Isothermal Gas Sphere

The theory of the isothermal sphere is well described, for instance, by Chandrasekhar (1942), and its application to clusters of galaxies by Zwicky (1957) but we follow the derivation of Chincarini (1980) to establish our method of analysis.

We consider a spherically symmetric distribution of mass in equilibrium as shown in **Figure 4.1.1.**

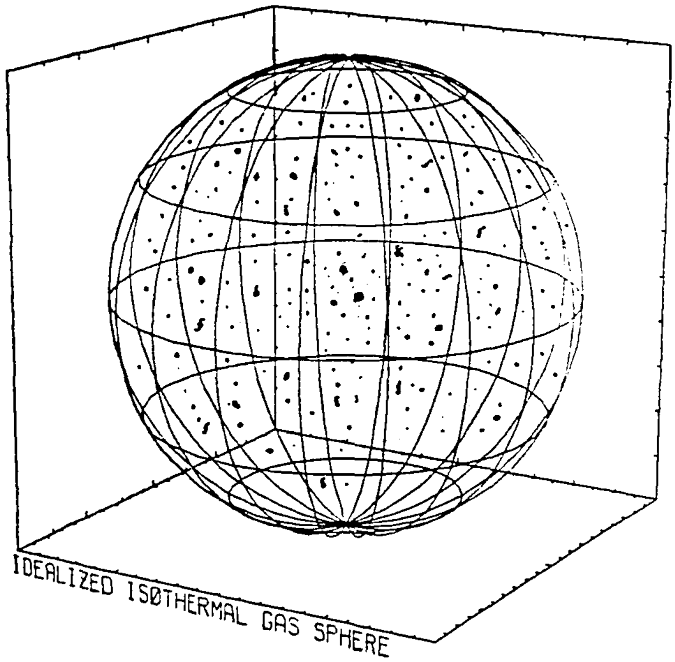


Figure 4.1.1 *Idealized Isothermal Sphere of Galaxies*

Using Poisson's equation expressed in spherical coordinates we can write

$$\nabla^2\Phi = \frac{1}{\xi^2}\frac{\partial}{\partial\xi}(\xi^2\frac{\partial\Phi}{\partial\xi}) = -4\pi G\rho. \tag{4.1.1}$$

Because of spherical symmetry the radial part remains while the polar and azimuthal components vanish. We assume that the potential is entirely determined by the mass distribution and that the system is in hydrostatic equilibrium, so that

$$\frac{dP}{d\xi} = -g\rho. \tag{4.1.2}$$

From the equation of state of an ideal gas we have

$$P = \rho\frac{kT}{\mu} \tag{4.1.3}$$

and we derive , in terms of the density, the relation

$$\frac{d}{d\xi}\left(\frac{\xi^2}{\rho}\frac{d\rho}{d\xi}\right) + 4\pi G\frac{\mu}{kT}\xi^2\rho = 0. \tag{4.1.4}$$

Using dimensionless quantities we can write:

$$\xi' = \frac{\xi}{\beta}\ ; \quad \rho_1(\xi) = \frac{\rho(\xi)}{\rho(0)}\ ; \quad \frac{4\pi G\mu}{kT}\beta^2\rho_0 = 1 \tag{4.1.5}$$

from which we obtain

$$\frac{d}{d\xi'}\left[\xi'^2\frac{d}{d\xi'}\ln\rho_1(\xi')\right] + \xi'^2\rho_1(\xi') = 0. \tag{4.1.6}$$

Tables exist for the solution of the above equation and we use that of Zwicky (1957) giving both the numerical solution and its projection on the celestial sphere. For small radii, however, King (1972) has shown that a good approximation is given by the relation

$$\rho = \rho_0\left[1 + \left(\frac{\xi}{R_c}\right)^2\right]^{-3/2} \tag{4.1.7}$$

where $R_c = 3\beta$ with beta being a structural length.

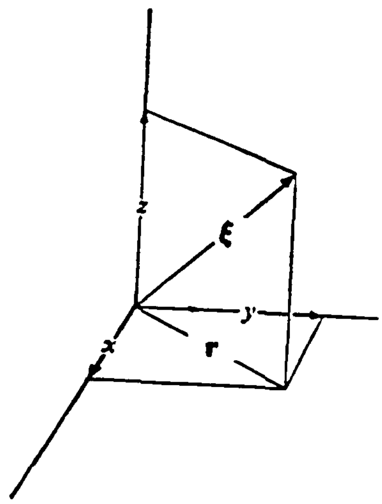


Figure 4.1.2 *Coordinate Projections on the Celestial Sphere*
$r^2 = x^2 + y^2$ with $\xi^2 = r^2 + z^2$

The use of the above equation facilitates the visualization of its projection onto the celestial sphere as shown in **Figure 4.1.2**.

Using the relations $r^2 = x^2 + y^2$ with $\xi^2 = r^2 + z^2$ Thus we can derive the projected surface density as

$$\begin{aligned} \sigma(r) &= 2\rho_0 \int_0^\infty \left(1 + \frac{r^2 + z^2}{{R_c}^2}\right)^{\frac{-3}{2}} dz \\ &= 2\rho_0 R_c^3 \int_0^\infty \frac{dz}{(R_c^2 + r^2 + z^2)^{\frac{3}{2}}} \end{aligned} \tag{4.1.8}$$

Now:

$$\int_0^\infty \frac{x^a dx}{(m + x^b)^c} = m^{\frac{a+1-bc}{b}} \left[\frac{\Gamma(\frac{a+1}{b})\Gamma(c - \frac{a+1}{b})}{\Gamma(c)} \right] \tag{4.1.9}$$

so we substitute

$$a = 0, \;\; b = 2, \;\; c = \frac{3}{2}, \;\; \frac{a+1}{b} = \frac{1}{2}, \;\; m = r^2 + R_c^2$$

to obtain

$$\sigma(r) = 2\rho_0 \frac{R_c^3}{(r^2 + R_c^2)} \tag{4.1.10}$$

where σ is the projected density.

A special case of interest occurs when

$$\frac{\sigma(r = R_c)}{\sigma(r = 0)} = \frac{1}{2}. \tag{4.1.11}$$

. Here, R_c is called the *core radius* and is defined as the distance from the center of the cluster at which the projected density is 50% that of the central density. We use the isothermal formula to fit the observational data. The data are derived from ring counts which yield the number of galaxies per square degree as a function of the distance from the cluster center in minutes of arc.

In fitting the isothermal function we have several free parameters which need to be optimized. In particular, we write the density as:

$$\rho(r) = \alpha \bullet q(r/\beta) + \gamma \tag{4.1.12}$$

with $q(r/\beta)$ the non-dimensional tabulated projected density, α a normalization constant which depends on the population in the cluster, and γ, a quantity which is a function of the "background" and eventual cut-off radius. Once α,β and γ have been determined by minmizing the χ^2 function we can estimate various cluster parameters.

4.2 Isothermal Fitting Procedure Utilizing χ^2

We choose a non-linear technique for fitting the surface density data to the required function

$$\rho(r) = \alpha \bullet q(r/\beta) + \gamma. \tag{4.2.1}$$

Now, we can define a measure of goodness of fit χ^2

$$\chi^2 \equiv \sum \left\{ \frac{1}{\sigma_i^2} [\rho_i - \rho(r_i)]^2 \right\}. \tag{4.2.2}$$

According to the method of least squares, the optimum values of the parameters a_j are obtained by minimizing χ^2 with respect to each of the parameters simultaneously. That is,

$$\frac{\delta}{\delta a_j}\chi^2 = \frac{\delta}{\delta a_j} \sum \left\{ \frac{1}{\sigma_i^2} [\rho_i - \rho(r_i)]^2 \right\} = 0. \tag{4.2.3}$$

In our case, the parameters a_j to be applied to the fitting function are α, the normalization constant; β, a *core radius* modification constant; and γ, a "background" constant.

It is generally not convenient to derive an analytical expression for calculating the parameters of a non-linear function, so we consider χ^2 to be a continuous function if the n parameters a_j describing a hypersurface in n-dimensional space where we search for the appropriate minimum value of χ^2 as shown in **Figure 4.2.1.**

One of the difficulties of such a search is that for a given function there may be more than one local minimum for χ^2 within a reasonable range of values for the parameters a_j. Nevertheless, we begin by determining the variation of χ^2 in the neighborhood of the starting point χ_0^2.

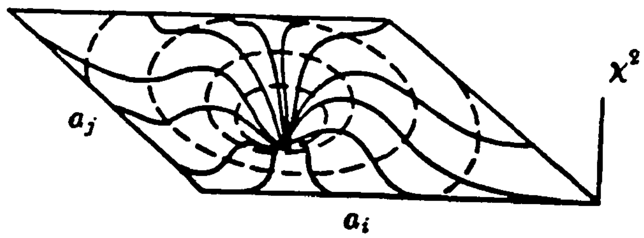


Figure 4.2.1 χ^2 *Function in an n-Dimensional Hyperspace*

We compute the following derivatives of χ^2 with respect to each of the chosen parameters and combinations of parameters a_j:

$$\frac{\partial \chi_0^2}{\partial a_i} \simeq \frac{\chi_0^2(a_i + \Delta a_i, a_j) - \chi_0^2(a_i - \Delta a_i, a_j)}{2\Delta a_i} \tag{4.2.4}$$

and

$$\frac{\partial^2 \chi_0^2}{\partial a_i^2} \simeq \frac{\chi_0^2(a_i + \Delta a_i, a_j) - 2\chi_0^2(a_i, a_j) + \chi_0^2(a_i - \Delta a_i, a_j)}{\Delta a_i^2} \tag{4.2.5}$$

and finally,

$$\begin{aligned} \frac{\partial^2 \chi_0^2}{\partial a_i \partial a_j} \simeq & \frac{\chi_0^2(a_i + \Delta a_i, a_j + \Delta a_j) - \chi_0^2(a_i + \Delta a_i, a_j)}{\Delta a_i \Delta a_j} \\ & - \frac{\chi_0^2(a_i, a_j + \Delta a_j) + \chi_0^2(a_i, a_j)}{\Delta a_i \Delta a_j} \end{aligned} \tag{4.2.6}$$

where the Δa_i are step sizes which must be large enough to prevent roundoff error in the computation and small enough to furnish reasonable answers near the minimum where the derivatives may be changing rapidly with the parameters.

In practice, we calculate $\delta a_i/\epsilon$, where ϵ is some small integer $1 \leq \epsilon \leq 10$, and compute χ^2 and its derivatives as described above monitoring its variation until

χ^2 begins to increase. The size of the increments is decreased still further if the first increment in a_i does not yield a decrease in χ^2. The last three points of the search are used to locate the minimum χ^2 by parabolic interpolation, provided uncertainties in the interpolation do not yield a higher value of χ^2 than the lowest already found.

Since the solution of our fit is the result of a search along the χ^2 hypersurface rather than an exact analytical solution, there is no analytical form for the uncertainties σ_{a_i} in the final values of the parameters. Following Bevington (1969) we use an algorithm which gives a reasonable definition of this uncertainty to approximate our error such that

$$\sigma_{a_j}^2 = \sum \left[\sigma_i^2 \left(\frac{\partial a_j}{\partial \rho_i}\right)^2\right] \tag{4.2.7}$$

and

$$\sigma_i^2 = \sigma^2 \simeq s^2 = \frac{1}{N-n-1} \sum \left\{\rho_i - \sum_{j=0}^{n} [a_j \rho_j(r_i)]\right\}^2 \tag{4.2.8}$$

where σ^2 is the sample varaiance for the fit and $\nu = N - n - 1$ is the number of degrees of freedom after fitting N points with $n+1$ parameters. Combining the above two equations, the uncertainty in the coefficient a_j is given by

$$\sigma_{a_j}^2 \simeq s^2 \epsilon_{jj}(\sigma_i = 1) \tag{4.2.9}$$

where $\epsilon_{jj}(\sigma_i = 1)$ is the error matrix evaluated with $\sigma_i = 1$.

4.3 The Isothermal Analysis

This section is concerned with the Isothermal Fitting of the surface density distribution of galaxy clusters. The general approach initially demands the calculation of a cluster's surface density on the sky. We achieve this by the traditional means of ring counts, that is, by constructing a series of concentric annuli outwards from the cluster center and counting the number of galaxies found within the bounds of each annulus. The cluster center is that determined by the dispersion ellipse analysis. Once the counts have been performed the surface density is derived as the number of galaxies found per unit area of the annulus in question. The observed surface density is then corrected for "background" contamination from data derived from the predicted "field" count of galaxies on the ESO/SERC J-plates corresponding to limiting magnitudes calibrated on the assumption of $z = 0$ colors for elliptical galaxies as determined by Corwin (1985) and Rainey (1977).

Given the corrected surface density as a radial function of distance we can then apply our isothermal fitting function to the data. As a test of our procedure, we applied our analysis to Zwicky's (1957) study of the Coma cluster of galaxies. Our results, particularly that of the *core radius* as determined by the parameter β, yield

$$\beta = 1.579 \pm 0.316.$$

In comparison, we quote the values obtained by Bahcall (1973) and Austin and Peach (1974) for the Coma cluster:

$$\beta = 2.0 \qquad \textit{Bahcall } (1973)$$

$$\beta = 1.75 \pm 0.24 \quad \textit{Austin and Peach } (1974),$$

and find our values in reasonable agreement.

In practice, however, we must point out that our method of analysis appears to be quite sensitive to starting values of the initial parameters and the non-uniform radial distribution of surface density as a result of the effects of subclustering seen in a number of clusters in our sample. We also note that the χ^2 fitting procedure experiences severe difficulty when test values of β are iterated to very small quantities forcing a near divide-by-zero condition that is catastrophic to the calculating algorithm.

To offer the results of the Isothermal Fitting calculations, we present several informative plots of the data as an aid to understanding the observations and the scope of the analysis. The data are given in the following form:

1. *Cluster Ring Counts.* With the proper orientation of the positions of the cluster members, we locate the center of the cluster and proceed to draw concentric rings outward from the center of the cluster. The center is determined from the dispersion ellipse computations and the rings are drawn at two arcminute intervals to describe a counting annulus. The number of rings is derived from the average range along both the ordinate and absissa calculated from the positions of the most extended galaxies measured in the field. The resulting, generally rectangular shape, is then measured for both major and minor axes which are averaged to give a length which is then used as our maximum counting radius. Using this technique, we will often miss the outermost galaxies in our ring counts as can be seen in the plots.

2. *Quadrant Counts.* Given the positions of the cluster members and their relation to the cluster center we construct Cartesian axes with ordinate running North-South and absissa running East-West. Then, with the usual convention, we define the four quadrants in such a way that I:North-West, II:North-East, III:South-East, and IV:South-West. Once the orientations are set, we begin to construct in each quadrant an annulus that is typically 2.0 minutes of arc in width and continue doing so to the maximum counting radius. We count all galaxies that fall within the bounds of each annulus terminating with the intersection of the annulus with

the ordinate and absissa defining the quadrant of interest. Given the number of galaxies within each annulus, or ring, we then plot a histogram and a smoothed curve through the data and this is displayed as four plots, one for each quadrant.

3. *Cluster Strip Counts.* As a qualitative tool, this plot is essentially a pair of orthogonal histograms that assist in determining the horizontal and vertical symmetry of the cluster. The range of the plot is determined by the extrema of the data as described above and the observations are then segregated into 1.0 millimeter bins and counted. Once the counts have been performed, we plot a histogram of the data and using the observed count frequency and given bin width, determine the mean value and standard deviation of the mean. These values are used to plot a normally distributed probability curve through the data to give the eye a qualitative appreciation of the distribution of the galaxy positions along each of the orthogonal axes. And by noticing peaks in the data, one can easily find, for instance, the location of concentrations in the cluster and also get some idea of the dispersion of the cluster members from the center of the cluster.

4. *Cluster Surface Density.* This histogram is a composite of the data found in the Quadrant Counts. For a given annulus, we count all galaxies found within its bounds and for all quadrants. The total count is then plotted as a histogram, the ordinate being the number of galaxies counted per annulus, and the absissa being the annulus number with each succeeding annulus extending radially away from the cluster center by increments of 2.0 minutes of arc.

5. *Table of Data.* The data table presents in numerical form the results of the preceeding operations. We give the ring, or annulus number, the total count of galaxies in that annulus, and the location of those counts in their respective quadrants. Next, we determine the counting radius as the one which, for a given annulus, divides it into sub-annuli of equal area. We then calculate the density

of galaxies within the annulus and express that density as the number of galaxies per square degree found in that circumscribed region. We also repeat the latter two data with the values of their logarithms. Finally, the total number of galaxies counted and the magnitude cutoff are given along with the coordinates of the cluster center and the ring width used for counting.

6. *The Isothermal Fit.* This plot uses the data from the preceeding table as the input to the Isothermal Fitting Procedure. This procedure attempts to minimize χ^2 while independently varying three parameters. We plot the observations consisting of the cluster surface density as measured in units of galaxies per square degree against the radial distance from the center of the cluster as measured in minutes of arc. The observed data is plotted as a broken line on a log-log scale. We then plot with a solid line the best fit from the isothermal analysis for the same input data, also on a log-log scale. Finally, we give the calculated value of the *core radius* in units of Mpc.

7. *Cluster Parameters.* The last table gives the calculated values of the cluster parameters and their variance. Beginning with the cluster identification, we display the isothermal fitting equation

$$\rho(r) = \alpha \bullet q(r/\beta) + \gamma$$

and the values and variance of the free parameters α, β, and γ. We then print the *best fit* values of the parameters in equation form. Finally, we give the calulated *core radius*, R_c, of the cluster as determined by the isothermal fit in units of Mpc ($H = 100/h\ km/sec/Mpc$) and the cluster redshift, z, as determined by m_{10}.

4.4 Isothermal Analysis of Southern Galaxy Clusters

In this section we present a uniform description of the Isothermal Analysis of galaxies in our sample. Rather than publish the data in numerical form, we choose a graphical and tabular format for ease of comparison between cluster and cluster. The sample is magnitude-limited and uniform to $m_v = 19.0$. In addition, ring-counts were performed uniformly with annulae of 2.0 arcminute widths.

GALAXY CLUSTER 001 00 00 46 −36 19

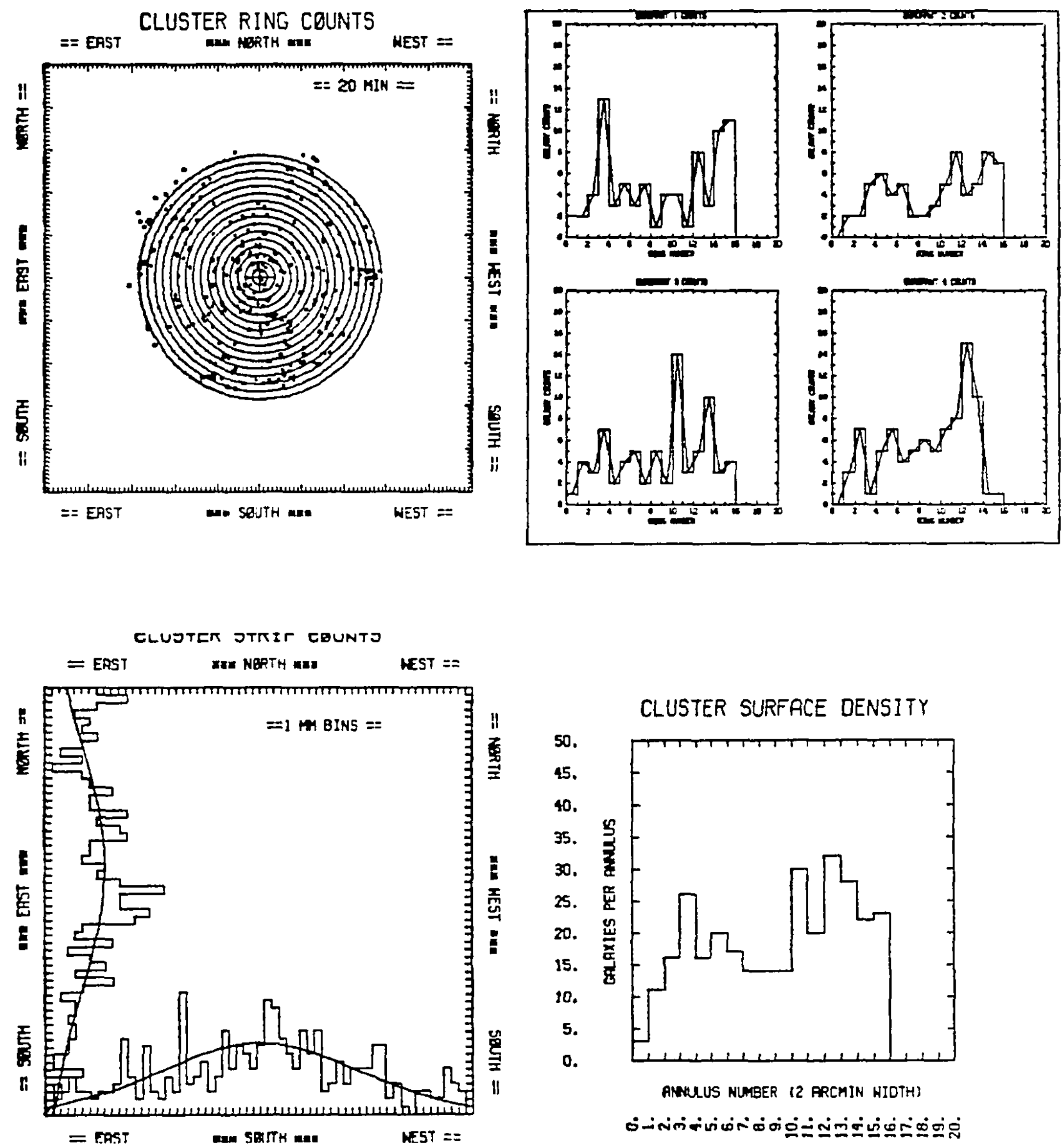


Figure 4.4.01. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 001 00 00 46 -36 19

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	3	2	0	1	0	1.259	1084.50	0.10001	3.03523
2	11	2	2	4	3	2.815	1325.51	0.44949	3.12238
3	16	4	2	3	7	4.539	1156.80	0.65698	3.06326
4	25	13	4	7	1	6.295	1291.08	0.79898	3.11095
5	17	3	7	2	5	8.061	682.84	0.90640	2.83432
6	20	5	4	4	7	9.833	657.28	0.99267	2.81775
7	16	3	4	5	4	11.607	444.92	1.06472	2.64829
8	15	5	3	2	5	13.383	361.50	1.12655	2.55811
9	14	1	2	5	6	15.160	297.71	1.18069	2.47379
10	14	4	3	2	5	16.937	266.37	1.22885	2.42548
11	29	4	5	13	7	18.716	499.22	1.27220	2.69829
12	19	1	7	3	8	20.494	298.63	1.31163	2.47514
13	33	8	5	6	14	22.273	477.18	1.34778	2.67868
14	28	3	4	10	11	24.052	374.89	1.38115	2.57390
15	23	10	9	3	1	25.831	286.71	1.41215	2.45744
16	22	10	7	4	1	27.611	256.55	1.44108	2.40917
17	16	9	6	1	0	29.390	175.27	1.46820	2.24372
18	5	0	5	0	0	31.170	51.64	1.49374	1.71301
19	4	3	1	0	0	32.950	39.08	1.51785	1.59197
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 330 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = -3.684 Y0 = -69.349

RING WIDTH (ARCMIN) = 2.0

Table 4.4.01. *(a) Ring-Count Data for Galaxy Cluster 01.*

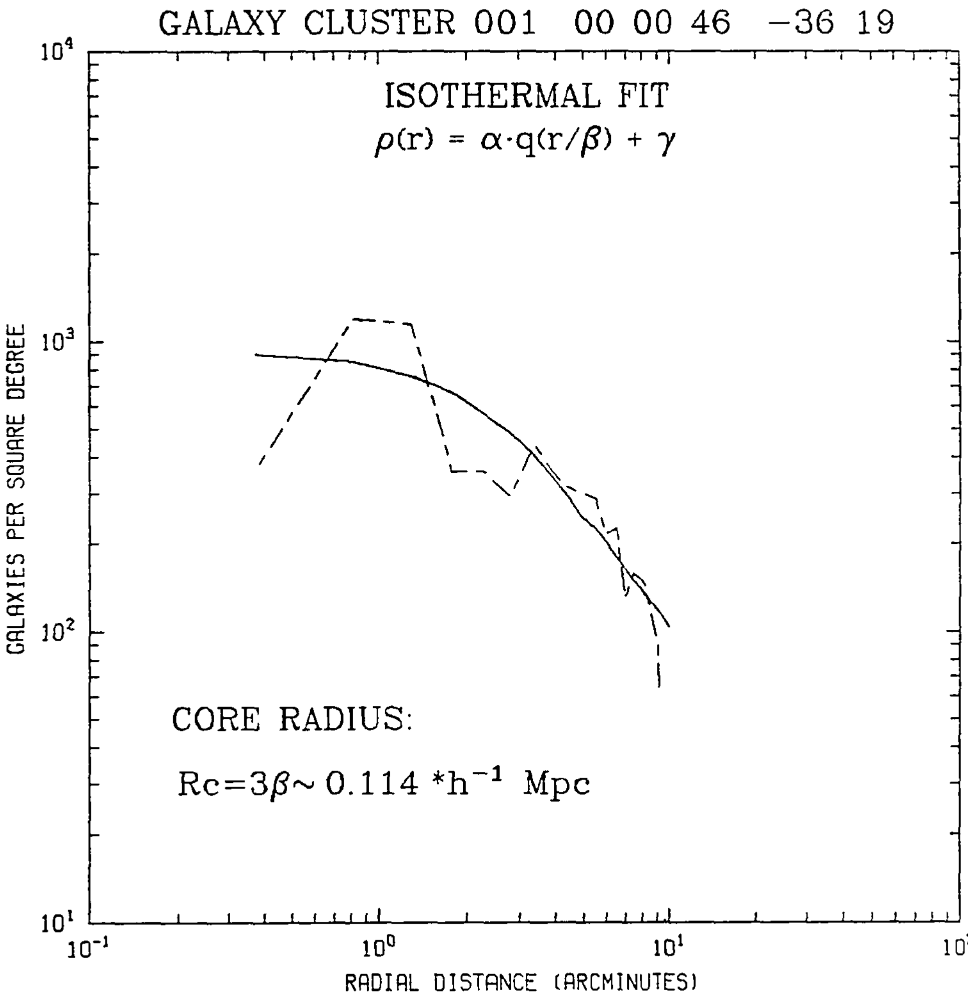


Figure 4.4.01. *(e) Isothermal Fit for Galaxy Cluster 01.*

CLUSTER PARAMETERS		
GALAXY CLUSTER 001 00 00 46 −36 19		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
α = 491.99±274.88	β = 1.05±0.16	γ = 11.70±3.20
$\rho(r)_{\text{BEST FIT}}$ = 896.43 ·q(r/1.04) + 12.36		
CORE RADIUS: Rc=3β~ 0.114 *h^{-1} Mpc		REDSHIFT: Z = 0.042

Table 4.4.01. *(b) Cluster Parameters for Galaxy Cluster 01.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 330 galaxies within 19 rings of width 2.0 arcminutes and to the limiting magnitude m_v = 19.0. The East-West strip counts show a fairly smooth distribution along the absissa, perhaps with a little more deviation to the East, while the North-South distribution shows somewhat more scatter. The quadrant counts reveal the effect of subclustering as is evident in the extremities of the counting radii and apparent in all quadrants. The cluster surface density reveals a similar situation with an apparent bifurcation of the data. Rings 13 and 14 show considerable concentrations in the South-West quadrant.

The isothermal fit of this data is best in the regions of radial distance $10^{0.5} \leq r \leq 10^{1.0}$. Near the "center" of the cluster, the surface density rises and falls and rises again giving a non-smooth distribution for the fitting. The large variance in the fitting parameters are likely due to this effect. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" from the χ^2 mimimization procedure.

GALAXY CLUSTER 002 00 03 14 -35 04$

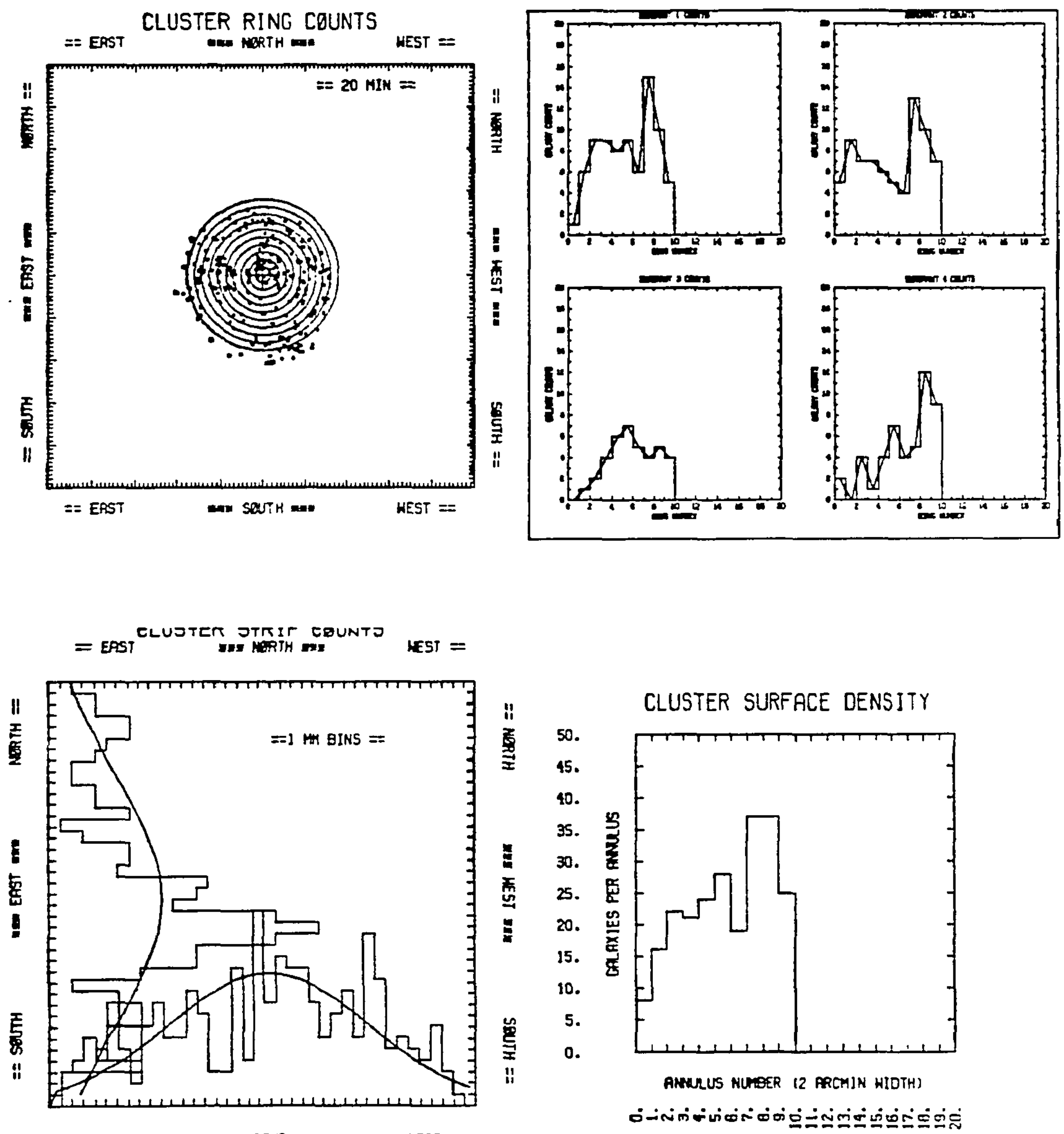


Figure 4.4.02. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 002 00 03 14 -35 04

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	8	1	5	0	2	1.259	2892.01	0.10001	3.46120
2	16	6	9	1	0	2.815	1928.01	0.44949	3.28511
3	22	9	7	2	4	4.539	1590.61	0.65698	3.20156
4	20	9	7	3	1	6.295	1032.86	0.79898	3.01404
5	25	8	6	7	4	8.061	1004.17	0.90640	3.00181
6	28	9	5	7	7	9.833	920.19	0.99267	2.96388
7	19	6	4	5	4	11.607	528.35	1.06472	2.72292
8	35	15	12	3	5	13.383	843.50	1.12655	2.92609
9	37	9	11	5	12	15.160	786.80	1.18069	2.89586
10	25	6	5	5	9	16.937	475.66	1.22885	2.67730
11	26	0	8	5	13	18.716	447.57	1.27220	2.65086
12	4	0	0	1	3	20.494	62.87	1.31163	1.79844
13	0	0	0	0	0	22.273	0.00	1.34778	0.00000
14	0	0	0	0	0	24.052	0.00	1.38115	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 265 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = -35.621 Y0 = -3.767

RING WIDTH (ARCMIN) = 2.0

Table 4.4.02. *(a) Ring-Count Data for Galaxy Cluster 02.*

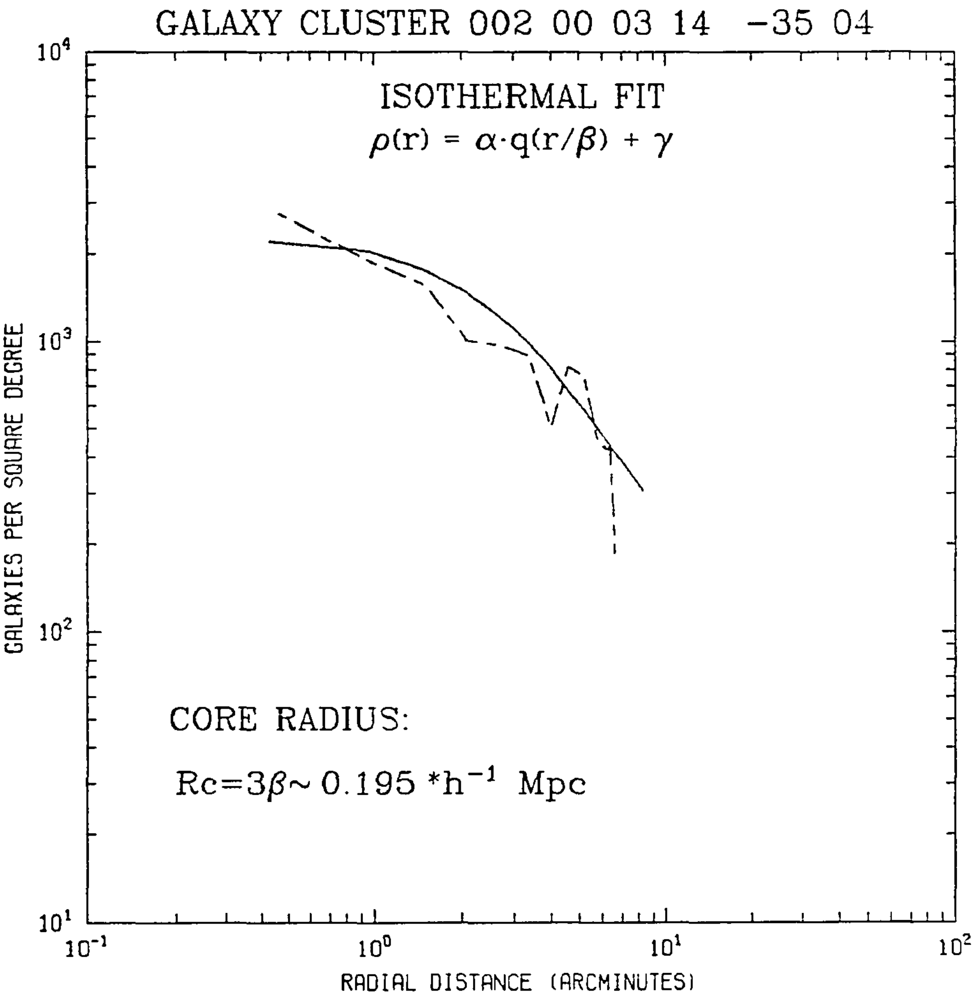


Figure 4.4.02. *(e) Isothermal Fit for Galaxy Cluster 02.*

CLUSTER PARAMETERS
GALAXY CLUSTER 002 00 03 14 −35 04
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
α = 1648.92±393.19 β = 1.02±0.01 γ = 10.01±0.00
$\rho(r)_{\text{BEST FIT}}$ = 2234.48 ·q(r/1.03) + 10.02
CORE RADIUS: Rc=3β~ 0.195 *h^{-1} Mpc — REDSHIFT: Z = 0.072

Table 4.4.02. *(b) Cluster Parameters for Galaxy Cluster 02.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 265 galaxies within 12 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The strip counts in the East-West direction give a fairly uniform distribution along the absisa. The North-South ordinate appears more at variance dir to the effects of subclustering in this compact cluster. The quadrant counts reveal a rise in counts radially from the center except in the second, where we see a dramatic drop in counts beyond the second ring. The cluster surface density is seen to increase radially from center with the maximum number of counts seen in eighth and ninth rings.

The isothermal fit to this relatively smooth set of data appears to be fair, although somewhat dominated by the relatively high value for the central density. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 003 00 06 49 −35 43

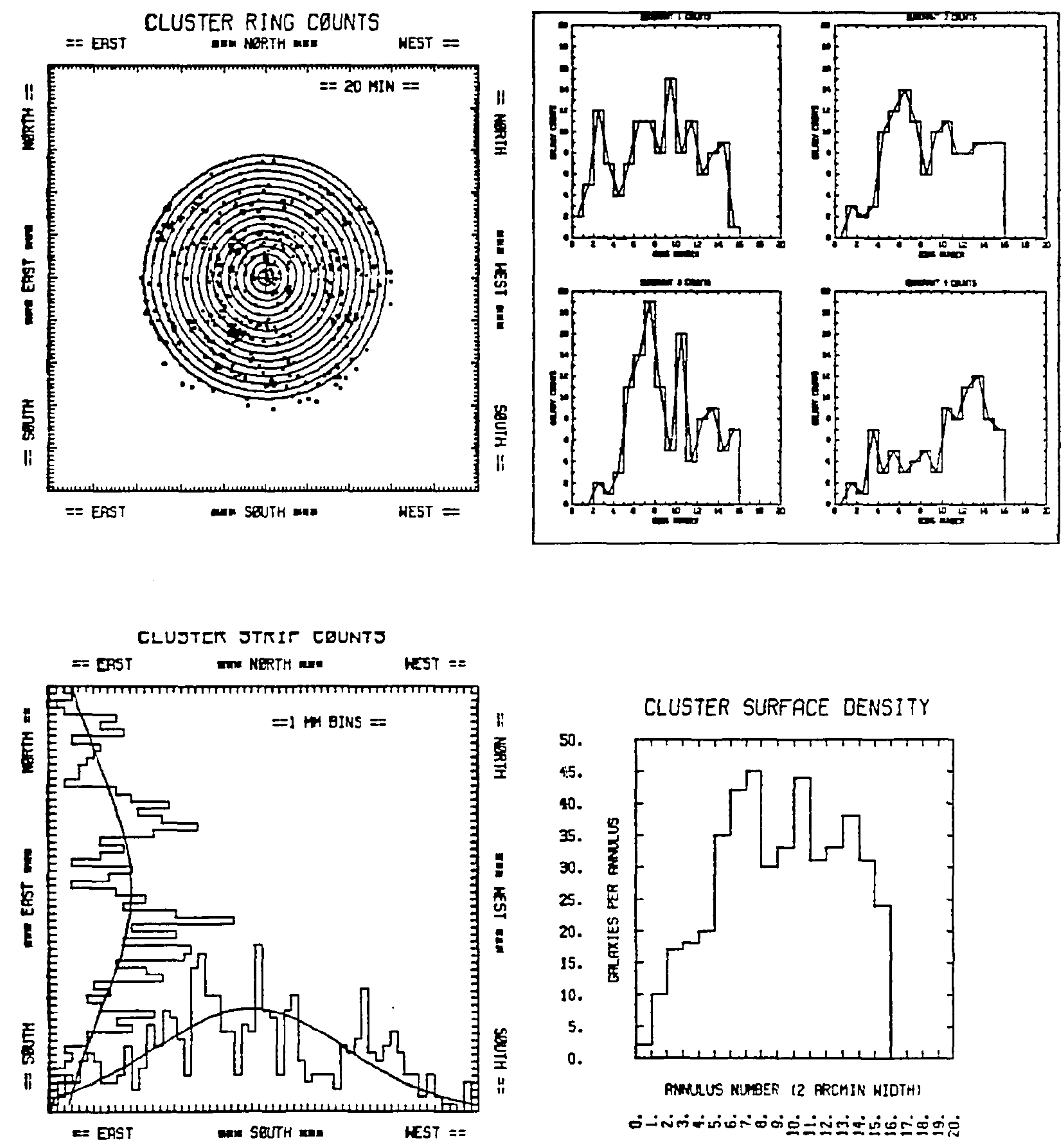


Figure 4.4.03. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 003 00 06 49 -35 43

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	2	0	0	0	1.259	723.00	0.10001	2.85914
2	10	5	3	0	2	2.815	1205.00	0.44949	3.08099
3	16	12	2	1	1	4.539	1156.80	0.65698	3.06326
4	19	7	3	2	7	6.295	981.22	0.79898	2.99177
5	19	4	9	3	3	8.061	763.17	0.90640	2.88262
6	34	6	13	10	5	9.833	1117.37	0.99267	3.04820
7	42	11	14	14	3	11.607	1167.93	1.06472	3.06742
8	46	12	11	19	4	13.383	1108.60	1.12655	3.04478
9	30	8	6	12	4	15.160	637.94	1.18069	2.80478
10	32	14	10	4	4	16.937	608.84	1.22885	2.78451
11	45	9	10	17	9	18.716	774.65	1.27220	2.88910
12	31	11	9	4	7	20.494	487.24	1.31163	2.68774
13	32	5	8	7	12	22.273	462.72	1.34778	2.66532
14	39	8	9	10	12	24.052	522.17	1.38115	2.71781
15	29	9	9	3	8	25.831	361.50	1.41215	2.55811
16	26	2	8	9	7	27.611	303.19	1.44108	2.48172
17	25	8	4	4	9	29.390	273.86	1.46820	2.43754
18	6	3	0	0	3	31.170	61.97	1.49374	1.79219
19	0	0	0	0	0	32.950	0.00	1.51785	0.00000
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 483 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = -71.702 Y0 = -39.543

RING WIDTH (ARCMIN) = 2.0

Table 4.4.03. *(a) Ring-Count Data for Galaxy Cluster 03.*

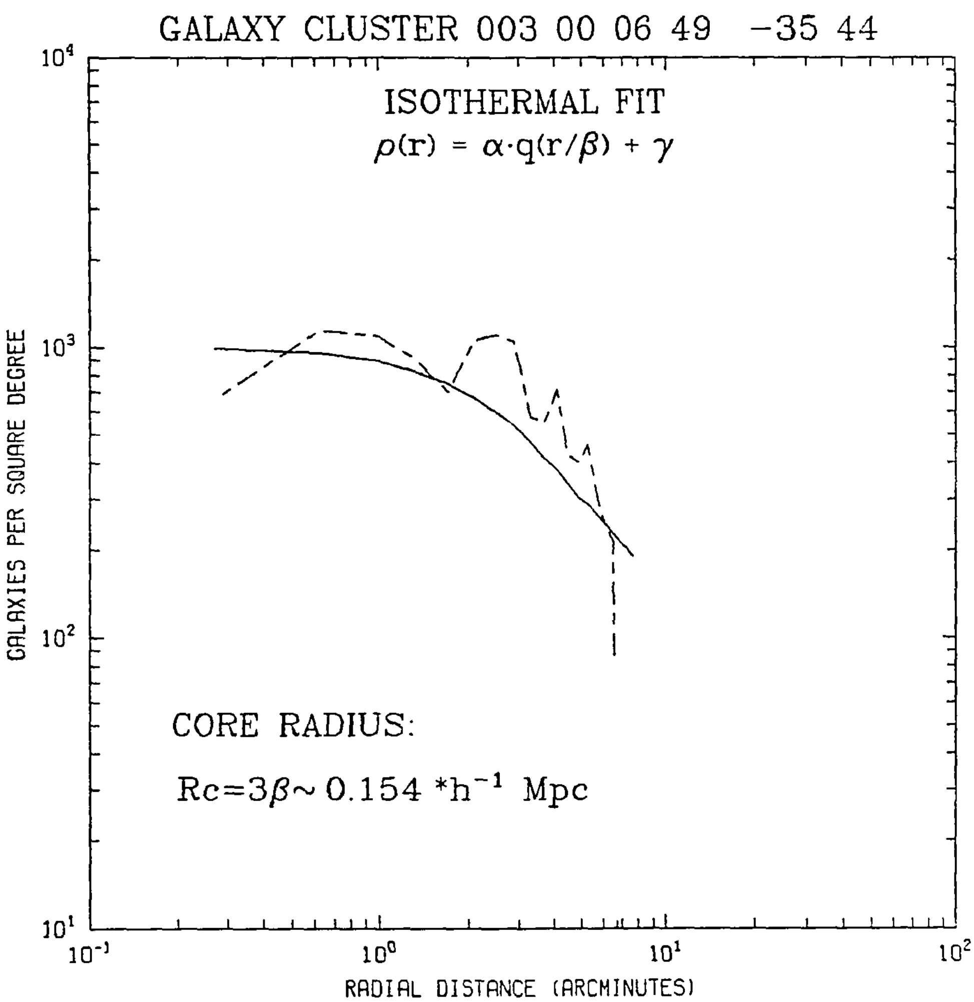


Figure 4.4.03. *(e) Isothermal Fit for Galaxy Cluster 03.*

CLUSTER PARAMETERS		
GALAXY CLUSTER 003 00 06 49 −35 44		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
$\alpha =$ 717.24±419.18	$\beta =$ 1.05±0.15	$\gamma =$ 50.64±1.50
$\rho_{\text{BEST FIT}}(r) =$ 943.23 $\cdot q(r/1.03) +$ 50.54		
CORE RADIUS: $Rc=3\beta\sim$ 0.154 $*h^{-1}$ Mpc		REDSHIFT: Z = 0.057

Table 4.4.03. *(b) Cluster Parameters for Galaxy Cluster 03.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 483 galaxies within 18 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts reveal a fairly symmetric distribution of galaxies along the East-West absissa whilst the North-South ordinate shows nearly ten percent more scatter. The quadrant counts tend to show a general increase in population toward the extremities of the cluster, but with a noticeable void in the central regions of the cluster at the third quadrant. The cluster surface density rises sharply from cluster center and then falls off gradually. We notice several peaks in the distribution namely at rings 8 and 11.

We find a general paucity of galaxies in the cluster center; the counts rise and then fall in that area. The largest inrease in density occurs near 12 arcsec from the center of the cluster and may seriously affect the isothermal fit. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 004 00 07 29 −57 15

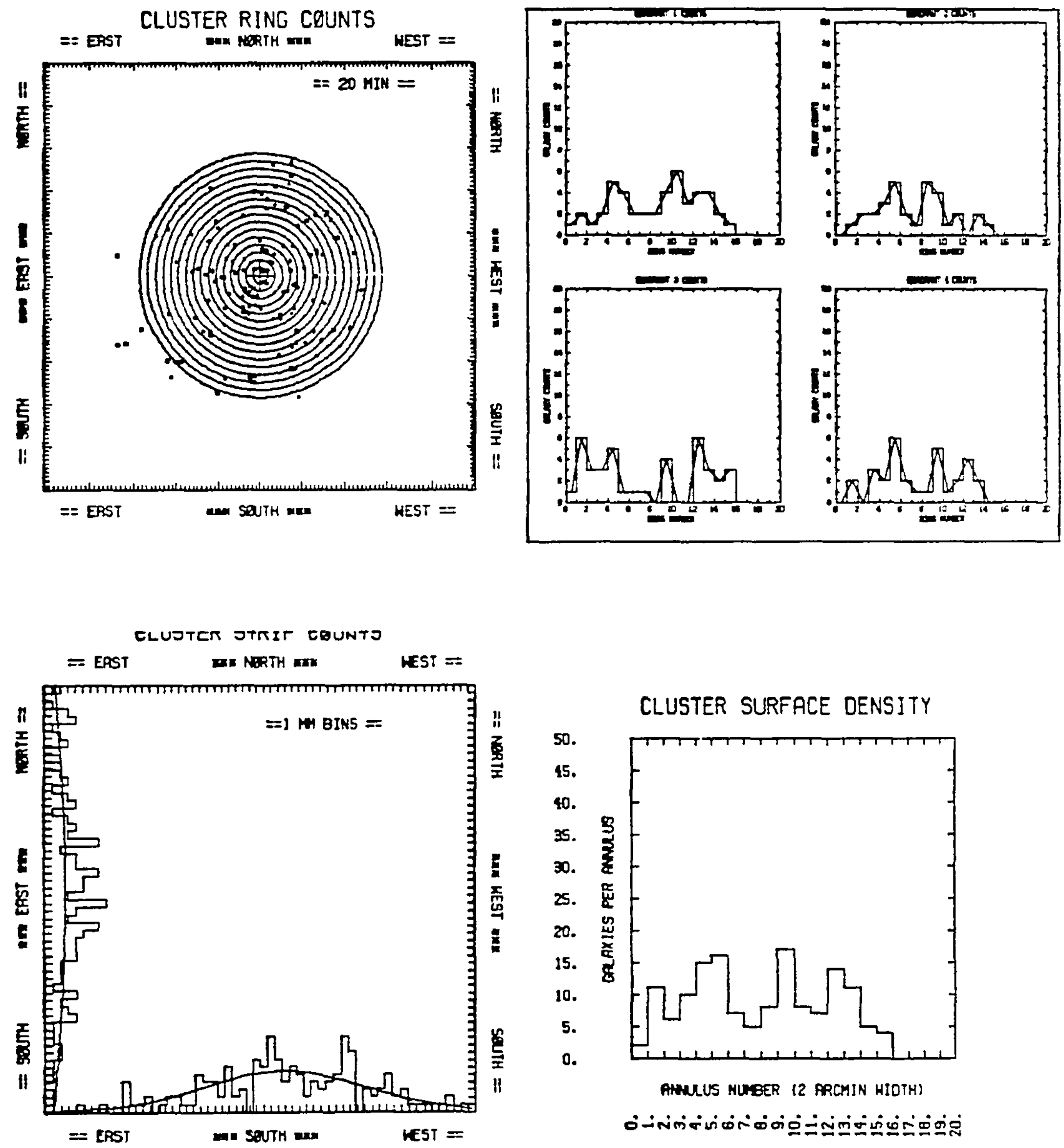


Figure 4.4.04. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 004 00 07 29 -57 15

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	1	1	0	0	0	1.259	361.50	0.10001	2.55811
2	12	2	1	7	2	2.815	1446.01	0.44949	3.16017
3	6	1	2	3	0	4.539	433.80	0.65698	2.63729
4	10	2	2	3	3	6.295	516.43	0.79898	2.71301
5	15	5	3	5	2	8.061	602.50	0.90640	2.77996
6	16	4	5	1	6	9.833	525.82	0.99267	2.72084
7	7	2	2	1	2	11.607	194.65	1.06472	2.28926
8	4	1	1	1	1	13.383	96.40	1.12655	1.98408
9	9	3	5	0	1	15.160	191.38	1.18069	2.28190
10	16	4	4	4	4	16.937	304.42	1.22885	2.48348
11	9	6	1	0	2	18.716	154.93	1.27220	2.19013
12	6	3	2	0	1	20.494	94.30	1.31163	1.97453
13	15	4	0	6	5	22.273	216.90	1.34778	2.33626
14	11	4	2	3	2	24.052	147.28	1.38115	2.16814
15	4	2	1	1	0	25.831	49.86	1.41215	1.69777
16	5	1	0	4	0	27.611	58.31	1.44108	1.76572
17	3	1	0	1	1	29.390	32.86	1.46820	1.51672
18	1	0	0	1	0	31.170	10.33	1.49374	1.01404
19	1	0	1	0	0	32.950	9.77	1.51785	0.98991
20	1	0	0	1	0	34.730	9.27	1.54070	0.96705

TØTAL NUMBER ØF GALAXIES CØUNTED = 153 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = -51.069 Y0 = -119.610

RING WIDTH (ARCMIN) = 2.0

Table 4.4.04. *(a) Ring-Count Data for Galaxy Cluster 04.*

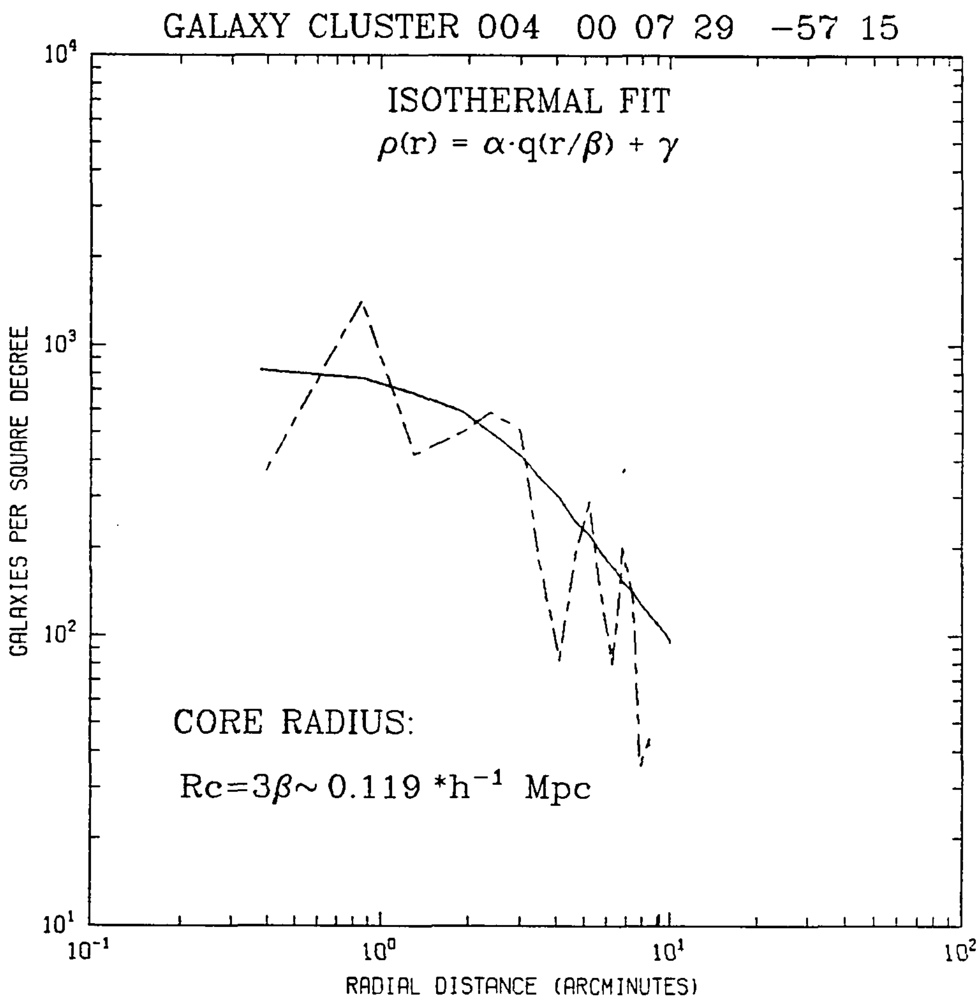


Figure 4.4.04. *(e) Isothermal Fit for Galaxy Cluster 04.*

CLUSTER PARAMETERS		
GALAXY CLUSTER 004 00 07 29 −57 15		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
α = 451.15±247.89	β = 1.05±0.16	γ = 11.57±3.24
$\rho_{\text{BEST FIT}}(r)$ = 816.94 ·q(r/1.04) + 12.07		
CORE RADIUS: Rc=3$\beta\sim$ 0.119 *h^{-1} Mpc		REDSHIFT: Z = 0.044

Table 4.4.04. *(b) Cluster Parameters for Galaxy Cluster 04.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 153 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. Within this rather diffuse cluster the East-West strip counts reveal a less pronounced scatter than the North-South counts; but neither shows a small variance. The quadrant counts are low and erratic due to the diffuse nature of the cluster and the cluster surface density shows similar characteristics with rising and falling surface density as a function of radial distance from the cluster center. The highest density of counts comes at rings 6 and 10.

The isothermal analysis tends to try to fit the observed distribution with an apparent bias towards the larger surface densities as seen in the preceeding figure. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 005 00 18 08 −49 32

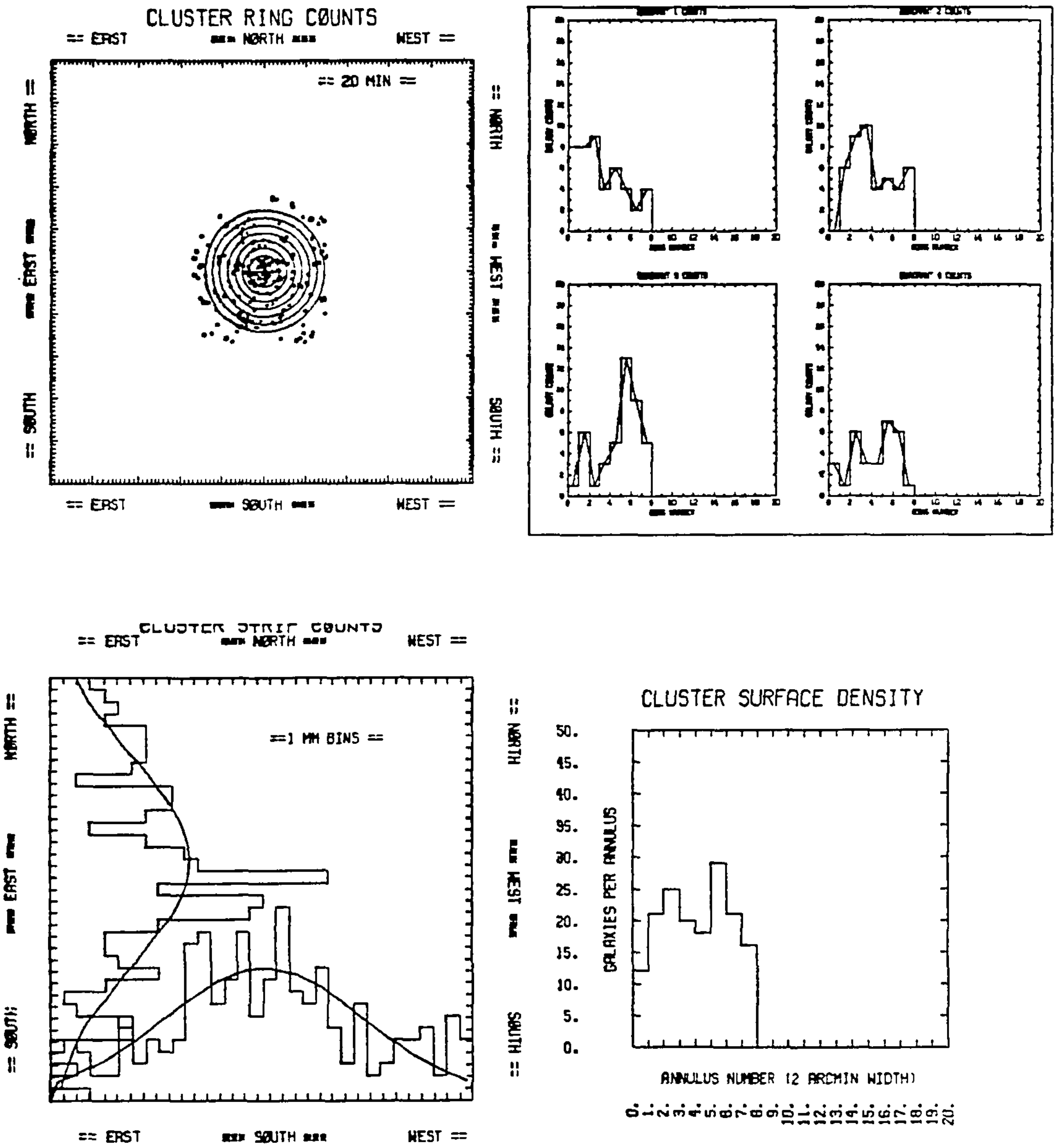


Figure 4.4.05. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 005 00 18 08 -49 32

RING NUMBER	TØTAL COUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	12	8	0	1	3	1.259	4338.02	0.10001	3.63729
2	21	8	6	6	1	2.815	2530.51	0.44949	3.40321
3	25	9	9	1	6	4.539	1807.51	0.65698	3.25708
4	20	4	10	3	3	6.295	1032.86	0.79898	3.01404
5	18	6	4	5	3	8.061	723.00	0.90640	2.85914
6	28	4	4	13	7	9.833	920.19	0.99267	2.96388
7	22	2	5	9	6	11.607	611.77	1.06472	2.78659
8	15	3	6	5	1	13.383	361.50	1.12655	2.55811
9	21	4	6	6	5	15.160	446.56	1.18069	2.64988
10	18	5	5	3	5	16.937	342.48	1.22885	2.53463
11	12	8	0	1	3	18.716	206.57	1.27220	2.31507
12	2	2	0	0	0	20.494	31.43	1.31163	1.49741
13	0	0	0	0	0	22.273	0.00	1.34778	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 214 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT XO = 107.031 YO = 24.617

RING WIDTH (ARCMIN) = 2.0

Table 4.4.05. *(a) Ring-Count Data for Galaxy Cluster 05.*

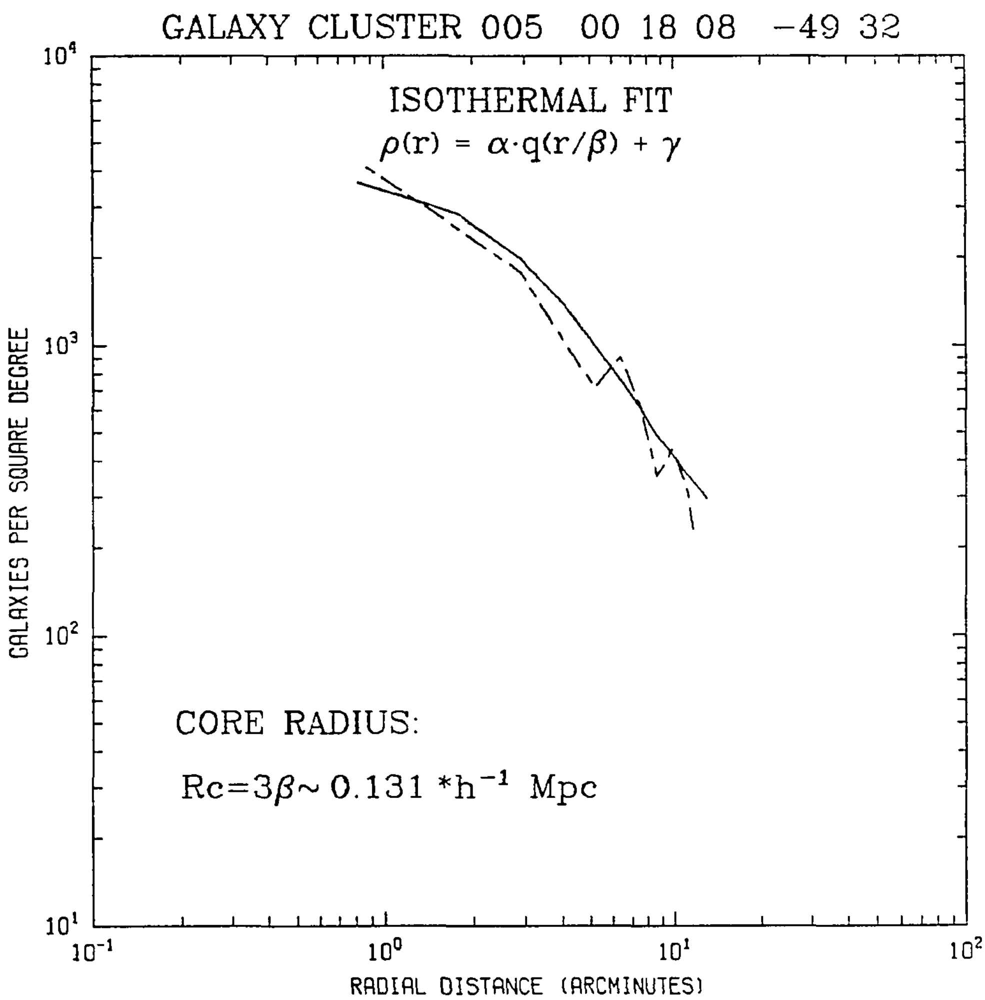


Figure 4.4.05. *(e) Isothermal Fit for Galaxy Cluster 05.*

CLUSTER PARAMETERS
GALAXY CLUSTER 005 00 18 08 −49 32
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
α = 3000.05±594.06 β = 1.00±0.00 γ = 13.06±0.63
$\rho_{\text{BEST FIT}}(r) = 3875.44 \cdot q(r/1.00) + 13.98$
CORE RADIUS: Rc=3β~ 0.131 *h^{-1} Mpc — REDSHIFT: Z = 0.050

Table 4.4.05. *(b) Cluster Parameters for Galaxy Cluster 05.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 214 galaxies within 12 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We note the high central condensation of this compact cluster as is shown by the cluster strip counts; there is a slightly larger dispersion in the North-South direction than along the East-West absissa, but a large peak rises out of the ordinate at a location spanning the cluster center. The quadrant counts show a strong enhancement of galaxies in the first quadrant near the center of the cluster; a large peak is seen in the third quadrant near the periphery of the cluster. The cluster surface density shows a gradual rise to maximum density at ring 6 and then a quick fall.

The isothermal fit seems to mimic the data well at all radii and densities. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 006 00 22 50 −33 17

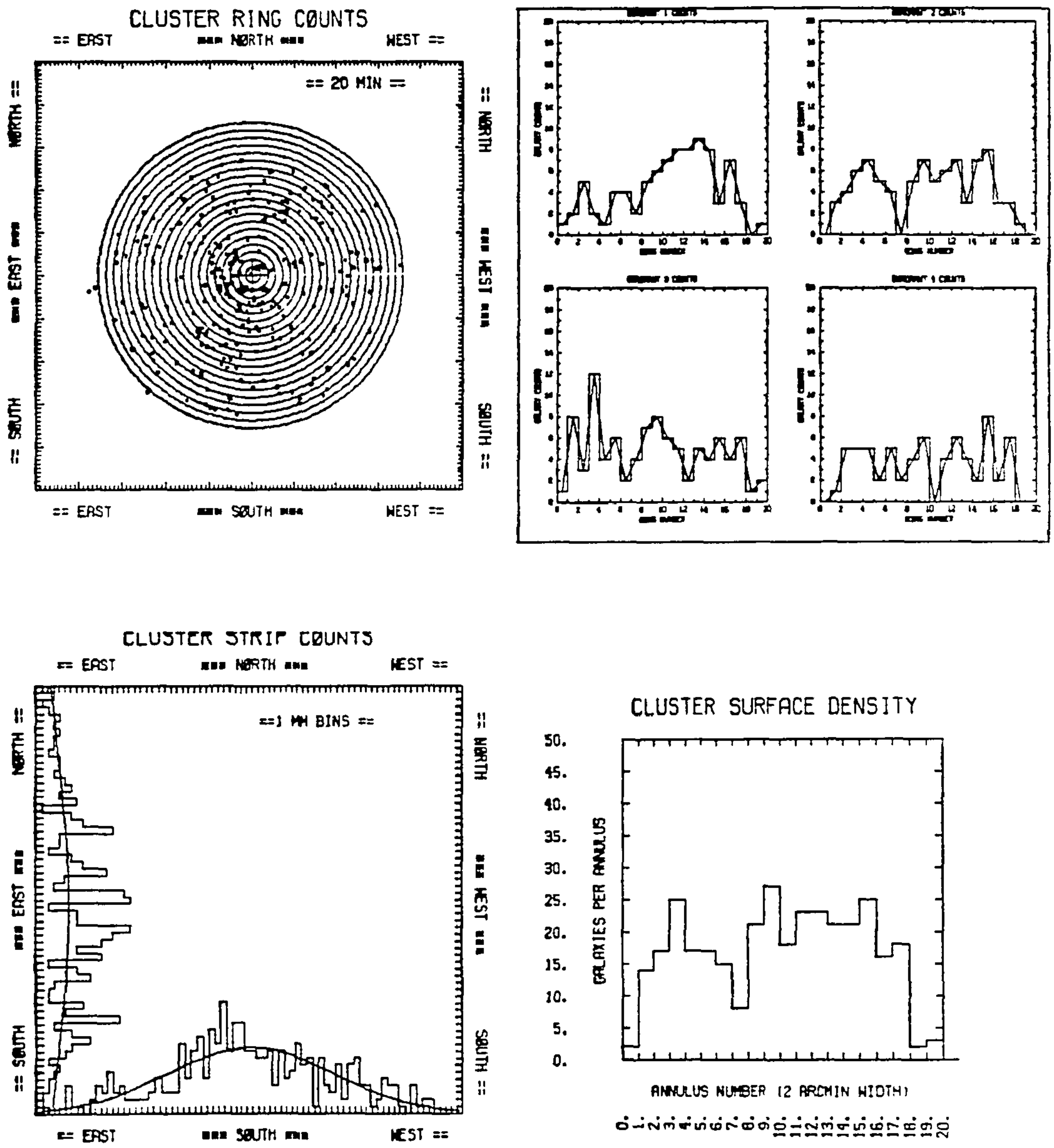


Figure 4.4.06. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 006 00 22 50 -33 17									
RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	1	0	1	0	1.259	723.00	0.10001	2.85914
2	14	2	3	8	1	2.815	1687.01	0.44949	3.22712
3	17	5	4	3	5	4.539	1229.10	0.65698	3.08959
4	24	2	6	11	5	6.295	1239.43	0.79898	3.09322
5	18	1	7	5	5	8.061	723.00	0.90640	2.85914
6	16	3	5	6	2	9.833	525.82	0.99267	2.72084
7	16	5	4	2	5	11.607	444.92	1.06472	2.64829
8	8	2	0	4	2	13.383	192.80	1.12655	2.28511
9	20	5	5	6	4	15.160	425.30	1.18069	2.62869
10	27	6	7	8	6	16.937	513.71	1.22885	2.71072
11	19	7	5	7	0	18.716	327.07	1.27220	2.51464
12	21	8	4	5	4	20.494	330.07	1.31163	2.51860
13	24	7	9	2	6	22.273	347.04	1.34778	2.54038
14	20	8	3	5	4	24.052	267.78	1.38115	2.42778
15	23	10	7	4	2	25.831	286.71	1.41215	2.45744
16	24	3	7	6	8	27.611	279.87	1.44108	2.44696
17	16	7	4	3	2	29.390	175.27	1.46820	2.24372
18	18	3	3	7	5	31.170	185.92	1.49374	2.26931
19	3	0	1	1	1	32.950	29.31	1.51785	1.46703
20	2	1	0	1	0	34.730	18.54	1.54070	1.26806

TØTAL NUMBER ØF GALAXIES CØUNTED = 335 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 15.272 Y0 = 94.597

RING WIDTH (ARCMIN) = 2.0

Table 4.4.06. *(a) Ring-Count Data for Galaxy Cluster 06.*

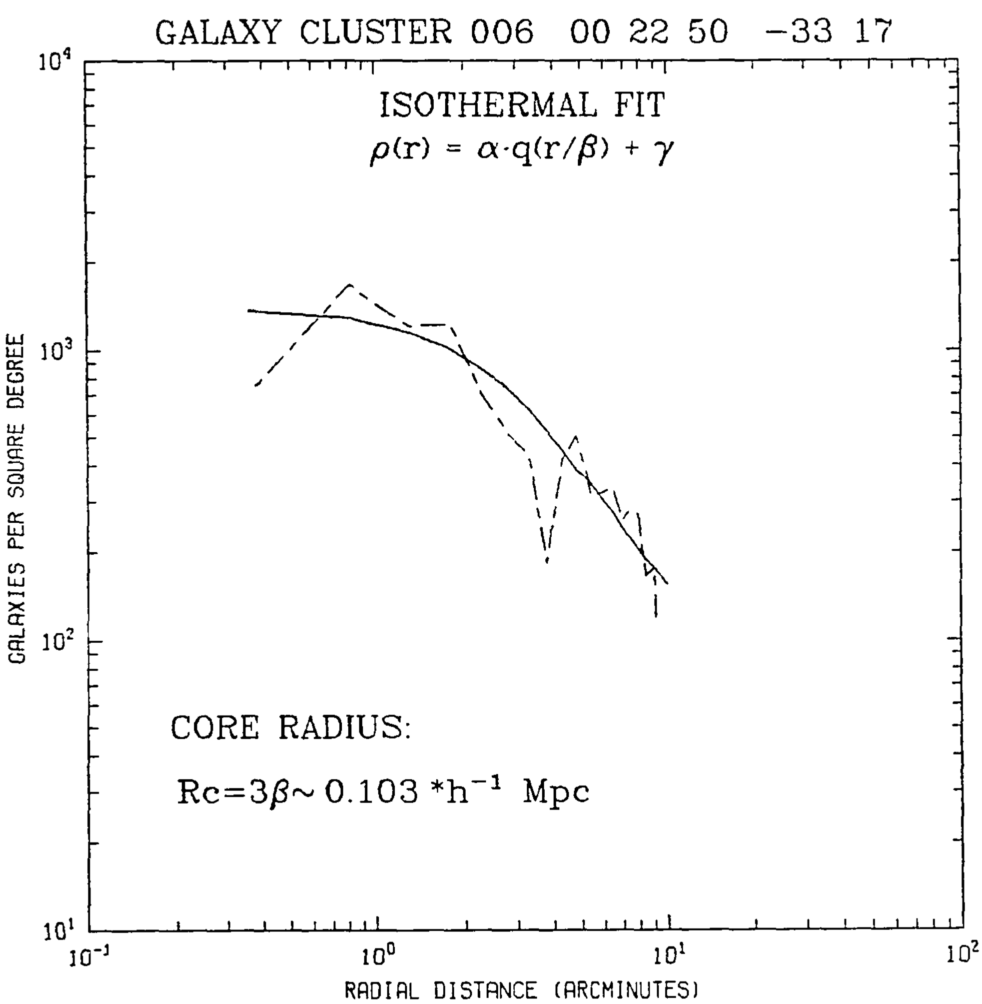


Figure 4.4.06. *(e) Isothermal Fit for Galaxy Cluster 06.*

CLUSTER PARAMETERS
GALAXY CLUSTER 006 00 22 50 −33 17
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
α = 715.43±436.32 β = 1.05±0.16 γ = 11.71±3.20
$\rho_{\text{BEST FIT}}(r)$ = 1363.33·q(r/1.04) + 12.39
CORE RADIUS: Rc=3β~ 0.103 *h^{-1} Mpc — REDSHIFT: Z = 0.038

Table 4.4.06. *(b) Cluster Parameters for Galaxy Cluster 06.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 335 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This extended cluster displays a fairly large variance along both ordinate and absissa of the cluster strip count axes with a peak in the data somewhat East of the accepted cluster "center." The quadrant counts show a general increase in number as a function of radial distance, in particular in the first quadrant. The surface density distribution appears to have two-population characteristics as it displays a bifurcated appearance.

The isothermal fit appears to match better at the periphery of the cluster and not as well near cluster center or at the major troughs in the data as is seen some 13 arcminutes from the center of the cluster. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 007 01 29 34 −51 33

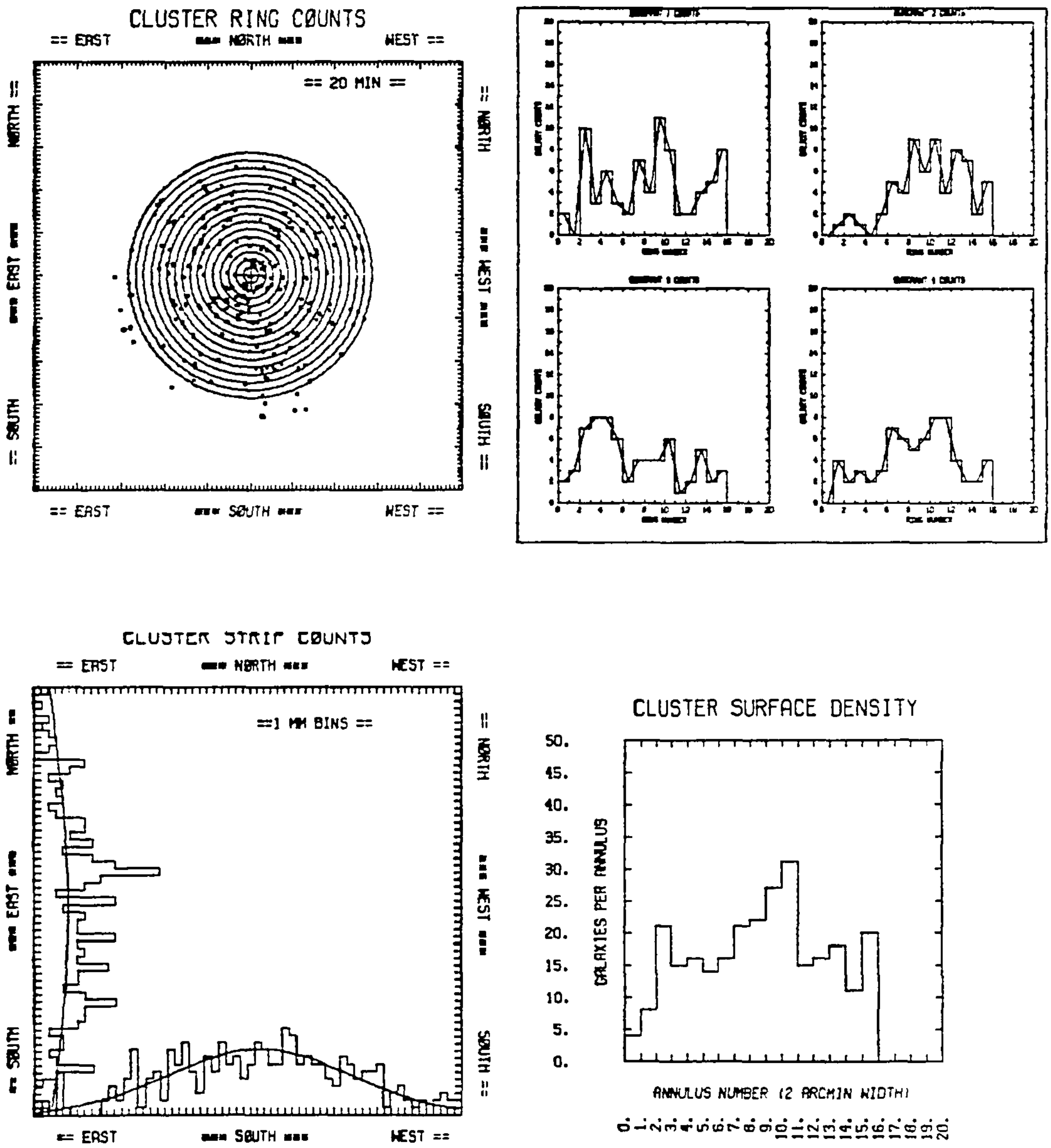


Figure 4.4.07. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 007 01 29 34 -51 33

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	4	2	0	2	0	1.259	1446.01	0.10001	3.16017
2	8	0	1	3	4	2.815	964.00	0.44949	2.98408
3	21	10	2	7	2	4.539	1518.31	0.65698	3.18136
4	15	3	1	8	3	6.295	774.65	0.79898	2.88910
5	16	6	0	8	2	8.061	642.67	0.90640	2.80799
6	14	3	2	6	3	9.833	460.09	0.99267	2.66285
7	14	2	5	2	5	11.607	389.31	1.06472	2.59029
8	22	7	4	3	8	13.383	530.20	1.12655	2.72444
9	22	3	9	5	5	15.160	467.83	1.18069	2.67008
10	28	12	6	4	6	16.937	532.74	1.22885	2.72651
11	31	8	9	6	8	18.716	533.64	1.27220	2.72725
12	15	2	4	1	8	20.494	235.76	1.31163	2.37247
13	14	2	7	2	3	22.273	202.44	1.34778	2.30630
14	19	3	8	5	3	24.052	254.39	1.38115	2.40550
15	12	6	2	2	2	25.831	149.59	1.41215	2.17489
16	20	8	5	3	4	27.611	233.23	1.44108	2.36778
17	6	0	0	3	3	29.390	65.73	1.46820	1.81775
18	6	0	1	3	2	31.170	61.97	1.49374	1.79219
19	2	0	0	0	2	32.950	19.54	1.51785	1.29094
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 289 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 5.774 Y0 = -82.259

RING WIDTH (ARCMIN) = 2.0

Table 4.4.07. *(a) Ring-Count Data for Galaxy Cluster 07.*

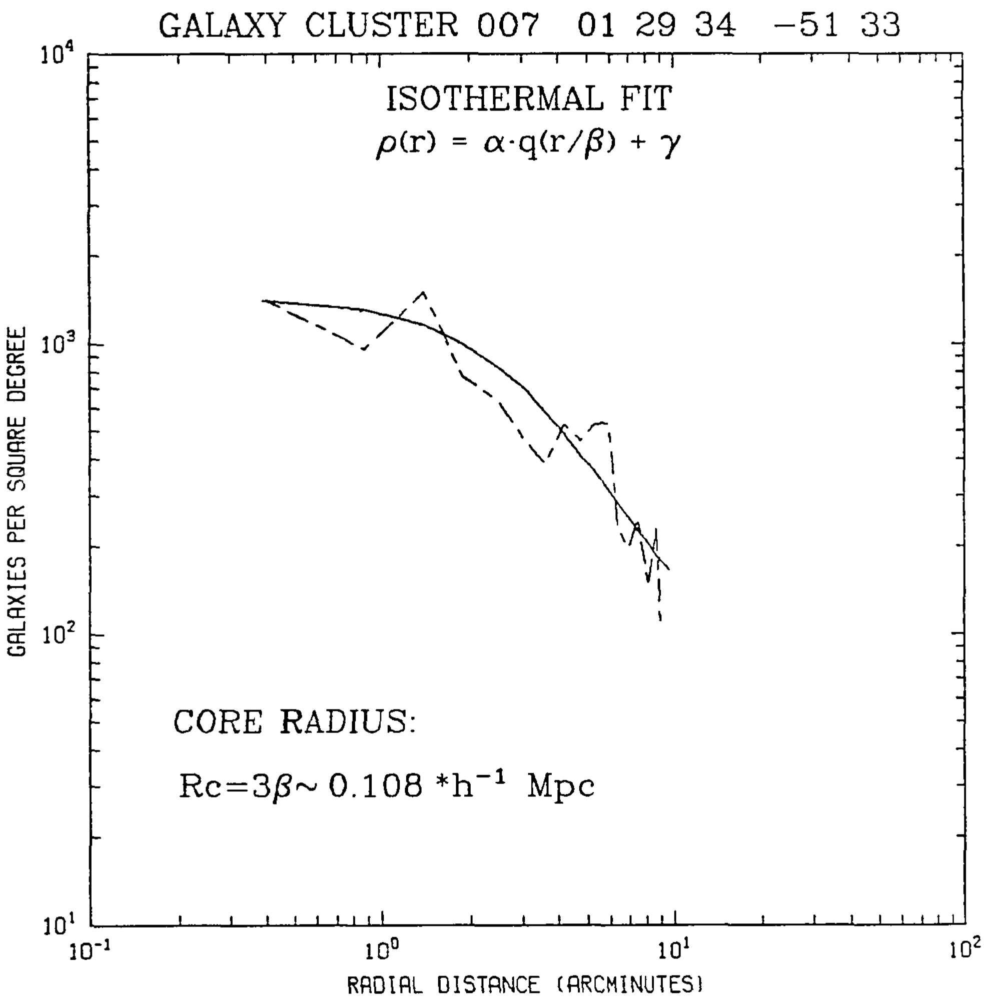


Figure 4.4.07. *(e) Isothermal Fit for Galaxy Cluster 07.*

CLUSTER PARAMETERS
GALAXY CLUSTER 007 01 29 34 −51 33
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
$\alpha =$ 728.69 ± 456.34 $\beta =$ 1.05 ± 0.17 $\gamma =$ 11.72 ± 3.29
$\rho_{\text{BEST FIT}}(r) =$ 1405.10 · q(r/1.04) + 12.37
CORE RADIUS: REDSHIFT:
Rc=3$\beta\sim$ 0.108 *h^{-1} Mpc Z = 0.040

Table 4.4.07. *(b) Cluster Parameters for Galaxy Cluster 07.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 289 galaxies within 19 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts appear less variant along the East-West absissa, whereas along the North-South ordinate we find a much larger spread in the positional data. The quadrant counts are erratic at best, in particular in the first quadrant where we see three major peaks. There appears to be a general increase of surface density to about 19 arcminutes from center after which the density drops rapidly.

The isothermal fit is complicated by several dips in the data, especially that near the cluster center. We find the fit attempting to bridge the gap between the highs and lows in the data and settling on a compromise between them. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 008 01 39 50 −42 23

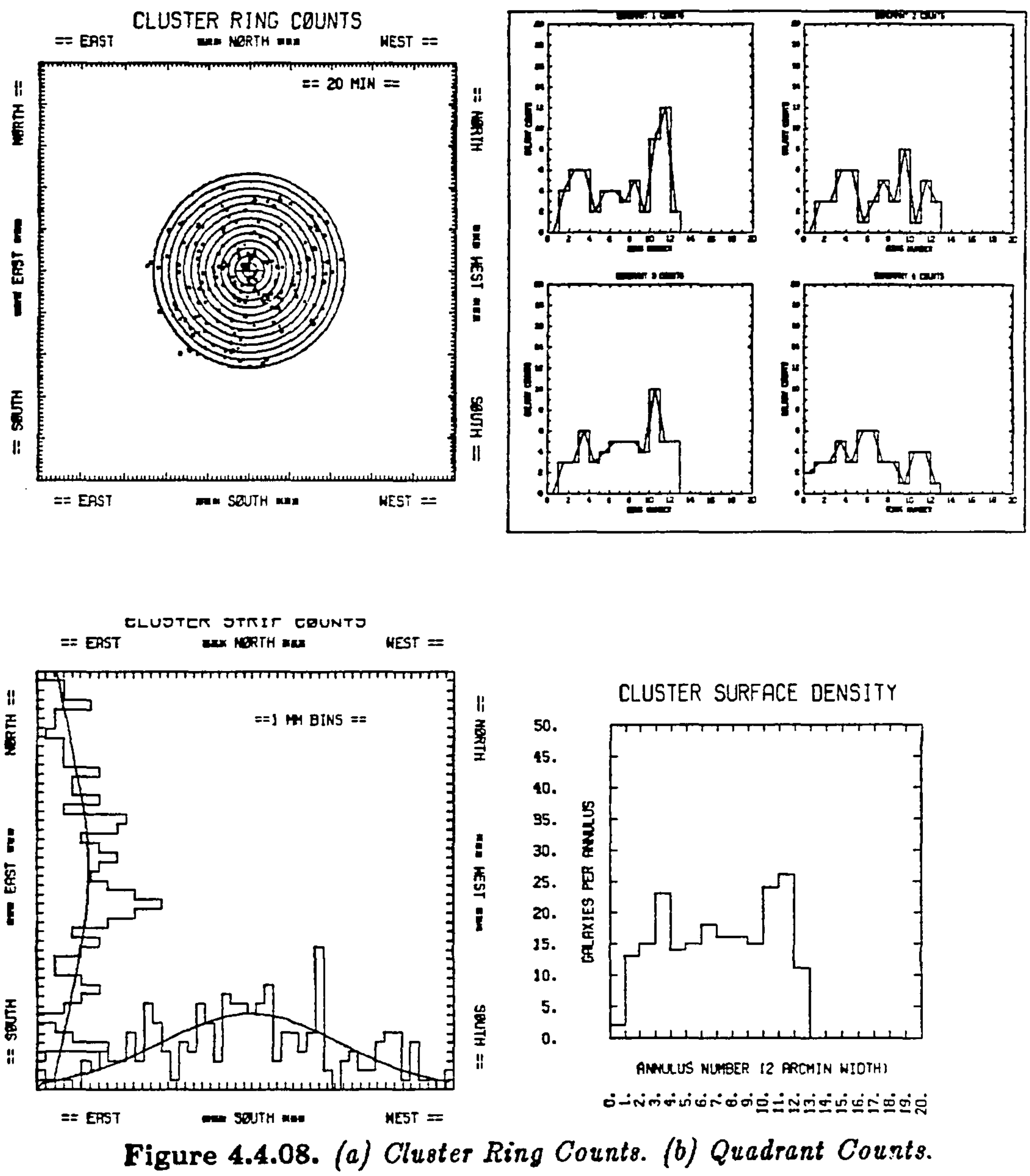


Figure 4.4.08. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 008 01 39 50 -42 23 0

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	0	0	2	1.259	723.00	0.10001	2.85914
2	13	4	3	3	3	2.815	1566.51	0.44949	3.19493
3	15	6	3	3	3	4.539	1084.50	0.65698	3.03523
4	22	6	6	6	4	6.295	1136.15	0.79898	3.05543
5	14	2	5	3	4	8.061	562.34	0.90640	2.75000
6	15	4	2	4	5	9.833	492.96	0.99267	2.69281
7	19	4	3	5	7	11.607	528.35	1.06472	2.72292
8	16	3	5	5	3	13.383	385.60	1.12655	2.58614
9	16	5	3	5	3	15.160	340.24	1.18069	2.53178
10	14	2	8	3	1	16.937	266.37	1.22885	2.42548
11	25	9	1	11	4	18.716	430.36	1.27220	2.63383
12	25	11	5	5	4	20.494	392.94	1.31163	2.59432
13	12	3	3	5	1	22.273	173.52	1.34778	2.23935
14	6	2	2	1	1	24.052	80.33	1.38115	1.90490
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 214 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 43.427 Y0 = -127.677

RING WIDTH (ARCMIN) = 2.0

Table 4.4.08. *(a) Ring-Count Data for Galaxy Cluster 08.*

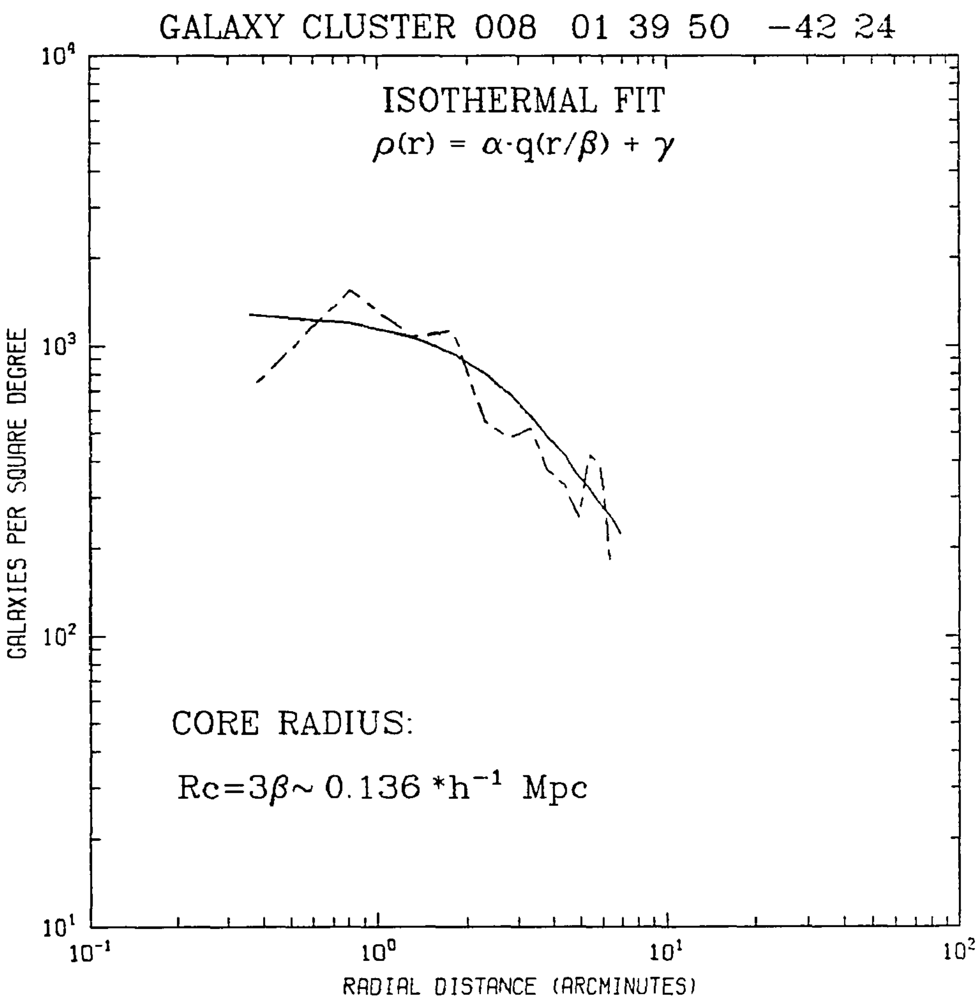


Figure 4.4.08. *(e) Isothermal Fit for Galaxy Cluster 08.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 008 01 39 50 −42 24	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 666.59 ± 401.44 $\beta =$ 1.05 ± 0.16 $\gamma =$ 11.61 ± 3.20	
$\rho_{\text{BEST FIT}}(r) =$ 1267.54 ·q(r/1.04) + 12.20	
CORE RADIUS:	REDSHIFT:
Rc=3β~ 0.136 *h^{-1} Mpc	Z = 0.050

Table 4.4.08. *(b) Cluster Parameters for Galaxy Cluster 08.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 214 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude m_v = 19.0. This cluster appears to have more variance in the North-South ordinant than is seen in the East-West absissa. There are several obvious concentrations of peaks towards the Eastern portion of the cluster. The quadrant counts reveal an erratic scatter of galaxies throughout the cluster with an strong peak in ther first quadrant at ring 12. The cluster surface density distribution has a curious double peaked appearance with concentrations near the center of the cluster and periphery as well.

The isothermal analysis trys to fit rather erratic data to the standard function; there are several depressions in the data, in particular at the cluster center. The fit tends to ride above these and the results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 009 02 55 44 −52 56

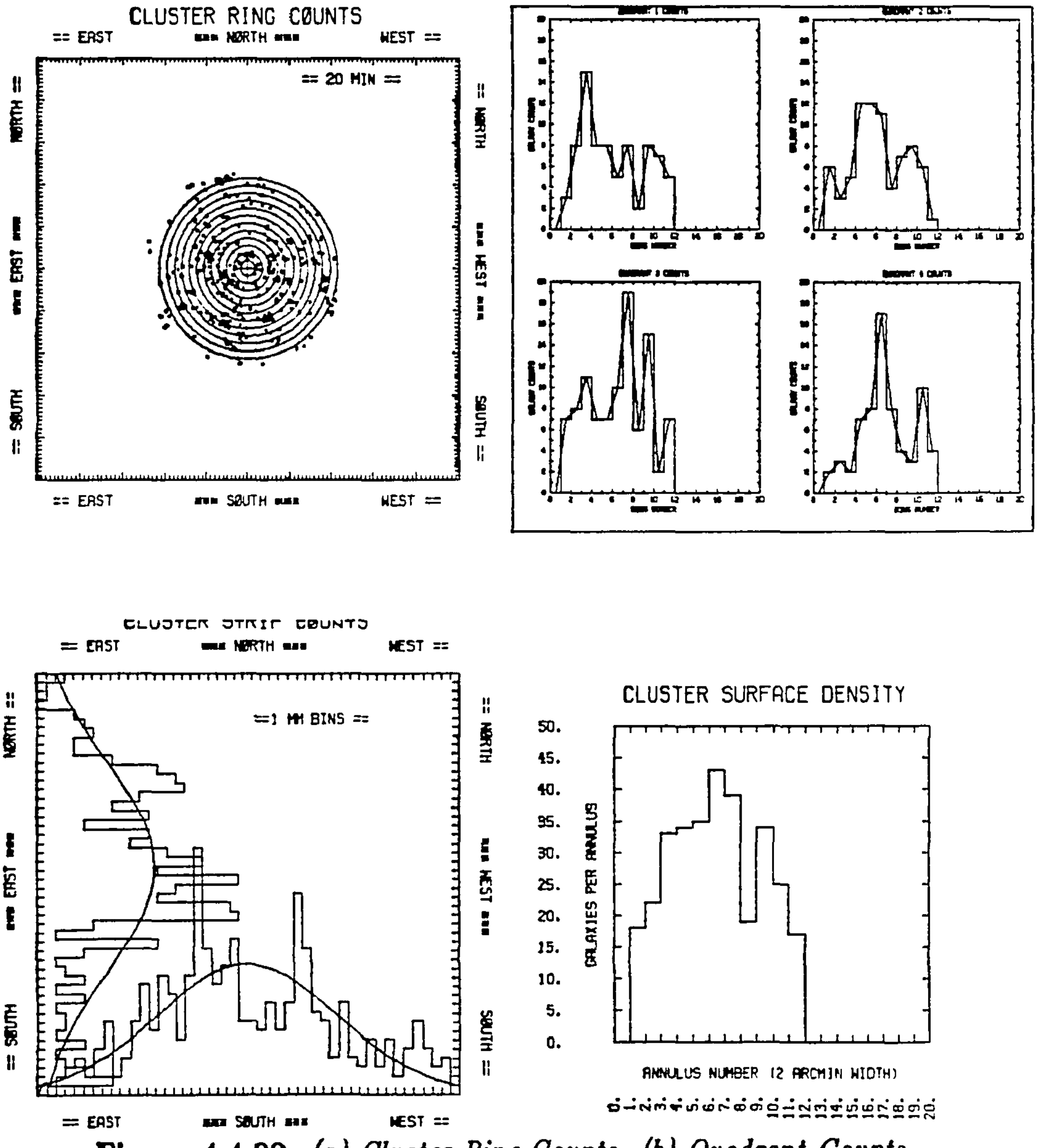


Figure 4.4.09. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 009 02 55 44 -52 56									
RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	0	0	0	0	0	1.259	0.00	0.10001	0.00000
2	18	3	6	7	2	2.815	2169.01	0.44949	3.33626
3	22	8	3	8	3	4.539	1590.61	0.65698	3.20156
4	33	15	5	11	2	6.295	1704.22	0.79898	3.23153
5	33	8	11	7	7	8.061	1325.51	0.90640	3.12238
6	36	8	13	7	8	9.833	1183.10	0.99267	3.07302
7	43	5	11	10	17	11.607	1195.74	1.06472	3.07764
8	38	8	4	18	8	13.383	915.80	1.12655	2.96180
9	20	2	7	7	4	15.160	425.30	1.18069	2.62869
10	33	7	8	15	3	16.937	627.87	1.22885	2.79787
11	25	8	5	2	10	18.716	430.36	1.27220	2.63383
12	16	5	2	6	3	20.494	251.48	1.31163	2.40050
13	25	5	5	4	11	22.273	361.50	1.34778	2.55811
14	14	1	13	0	0	24.052	187.45	1.38115	2.27287
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 356 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = -87.306 Y0 = 109.669

RING WIDTH (ARCMIN) = 2.0

Table 4.4.09. *(a) Ring-Count Data for Galaxy Cluster 09.*

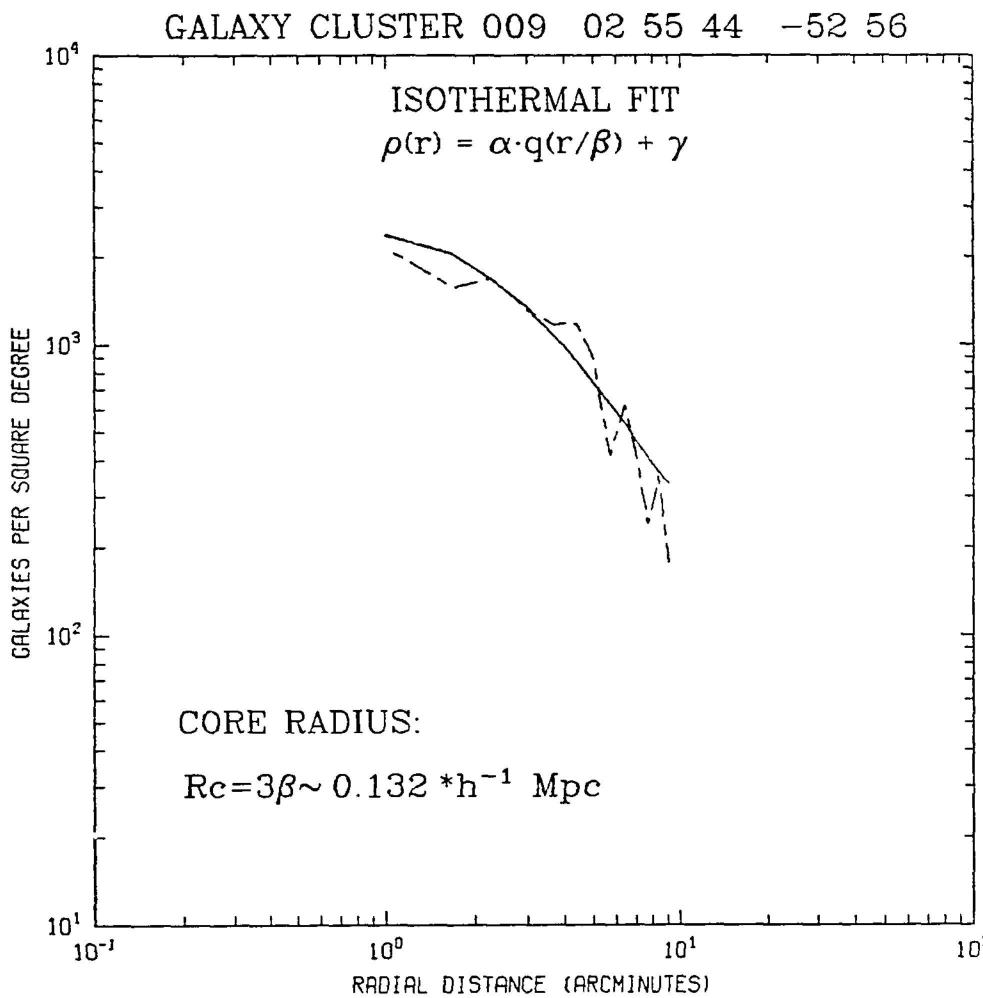


Figure 4.4.09. *(e) Isothermal Fit for Galaxy Cluster 09.*

CLUSTER PARAMETERS GALAXY CLUSTER 009 02 55 44 −52 56	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
α = 1973.14±495.13 β = 1.02±0.01	γ = 11.21±0.32
$\rho(r)_{\text{BEST FIT}}$ = 2699.83 ·q(r/1.03) +	11.68
CORE RADIUS: Rc=3β~ 0.132 *h^{-1} Mpc	REDSHIFT: Z = 0.049

Table 4.4.09. *(b) Cluster Parameters for Galaxy Cluster 09.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 356 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This rich cluster shows several peaks in the East-West strip count data that straddle the cluster center along the absissa; the North-South counts tend to reach their maximum near the cluster center as well, but with slightly more variance. The quadrant counts show a virtual absence of galaxies at the cluster center, but there is a quick rise in counts soon after with the counts then increasing in all directions. The surface density rises to a maximum at ring 7 and then slowly falls to the the cluster periphery.

The isothermal fit is seriously affected by the lack of data at small radii, but the fit tends to mimic the data fairly well beyond that point until the outer reaches of the cluster where the fit begins to overshoot the data. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 010 03 44 05 -41 21

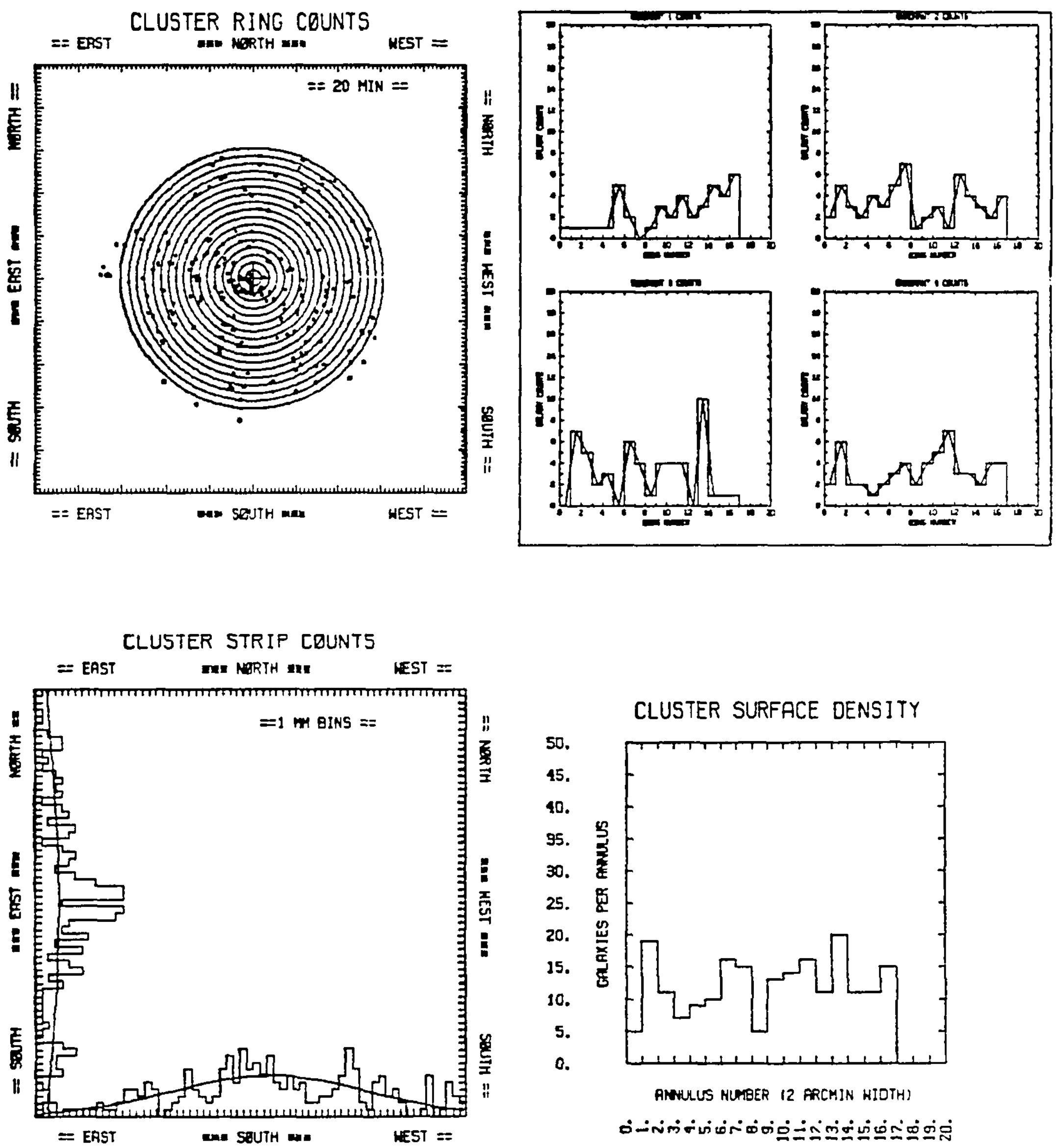


Figure 4.4.10. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 010 03 44 05 -41 21 5

RING NUMBER	TØTAL COUNT	QUADRANT COUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	5	1	2	0	2	1.259	1807.51	0.10001	3.25708
2	19	1	5	7	6	2.815	2289.51	0.44949	3.35974
3	10	1	2	5	2	4.539	723.00	0.65698	2.85914
4	8	1	3	2	2	6.295	413.14	0.79898	2.61610
5	9	1	4	3	1	8.061	361.50	0.90640	2.55811
6	10	5	3	0	2	9.833	328.64	0.99267	2.51672
7	16	2	5	6	3	11.607	444.92	1.06472	2.64829
8	15	0	7	4	4	13.383	361.50	1.12655	2.55811
9	5	1	1	1	2	15.160	106.32	1.18069	2.02663
10	11	3	1	4	3	16.937	209.29	1.22885	2.32075
11	15	2	4	3	6	18.716	258.22	1.27220	2.41198
12	17	4	1	5	7	20.494	267.20	1.31163	2.42683
13	10	2	6	0	2	22.273	144.60	1.34778	2.16017
14	21	3	4	10	4	24.052	281.17	1.38115	2.44897
15	11	5	3	1	2	25.831	137.12	1.41215	2.13710
16	10	3	2	1	4	27.611	116.61	1.44108	2.06675
17	16	7	4	1	4	29.390	175.27	1.46820	2.24372
18	8	4	1	2	1	31.170	82.63	1.49374	1.91713
19	6	0	3	0	3	32.950	58.62	1.51785	1.76806
20	2	0	2	0	0	34.730	18.54	1.54070	1.26803

TØTAL NUMBER ØF GALAXIES CØUNTED = 224 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 103.679 Y0 = -70.538

RING WIDTH (ARCMIN) = 2.0

Table 4.4.10. *(a) Ring-Count Data for Galaxy Cluster 10.*

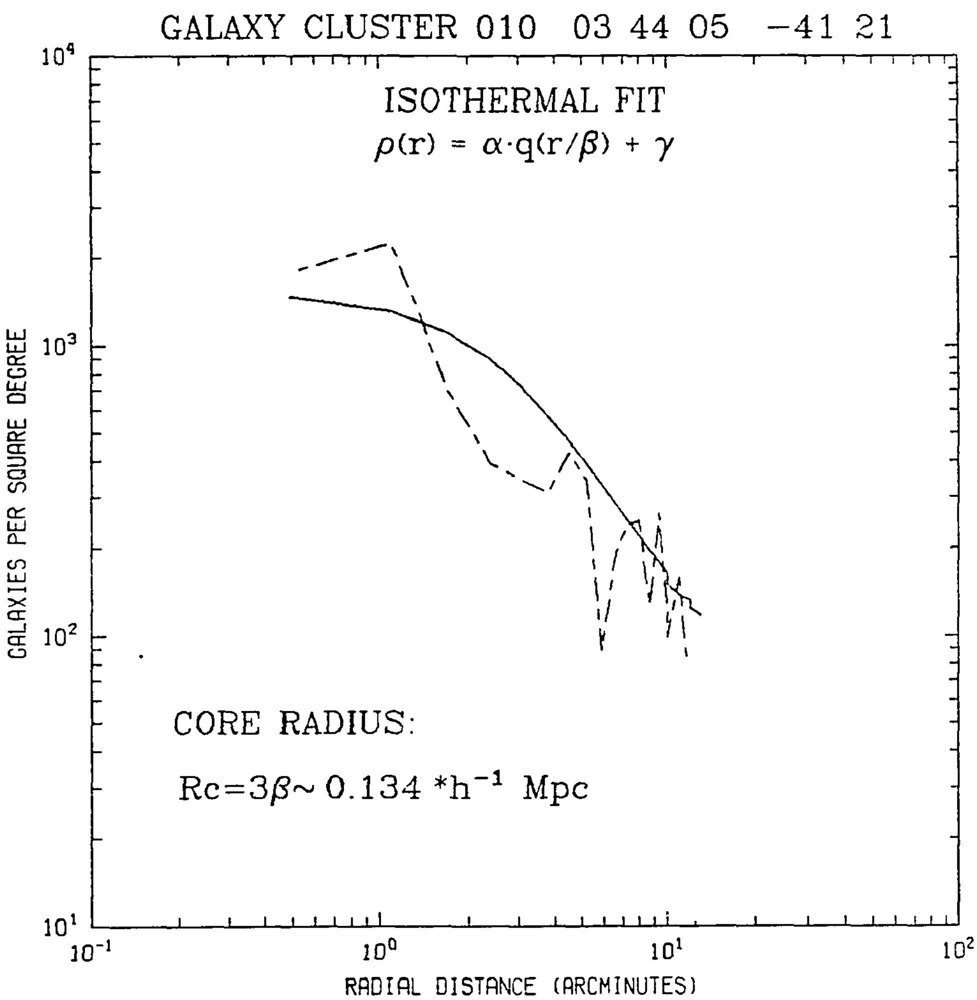


Figure 4.4.10. *(e) Isothermal Fit for Galaxy Cluster 10.*

CLUSTER PARAMETERS
GALAXY CLUSTER 010 03 44 05 −41 21
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
$\alpha =$ 757.01 ±503.96 $\beta =$ 1.05±0.18 $\gamma =$ 11.56± 3.49
$\rho_{\text{BEST FIT}}(r) =$ 1481.83 ·q(r/1.03) + 11.90
CORE RADIUS: Rc=3β~ 0.134 *h^{-1} Mpc — REDSHIFT: Z = 0.050

Table 4.4.10. *(b) Cluster Parameters for Galaxy Cluster 10.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 224 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show a wide variance in this somewhat diffuse cluster. There appears to be a slight concentration of galaxies Eastward of cluster center along the absissa, whereas the North-South ordinate shows a concentration very near cluster center. The quadrant counts show an erratic distribution of points in all directions, whereas the cluster surface density appears appears somewhat flat especially beyond ring 7.

The isothermal fit finds difficulty contouring itself along the quasi-plateau from the fourth to eighth rings. In addition, the density peak at the second ring is considerably disproportionate and appears to be caused by the density concentration seen in the third quadrant. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 011 04 04 04 -39 00

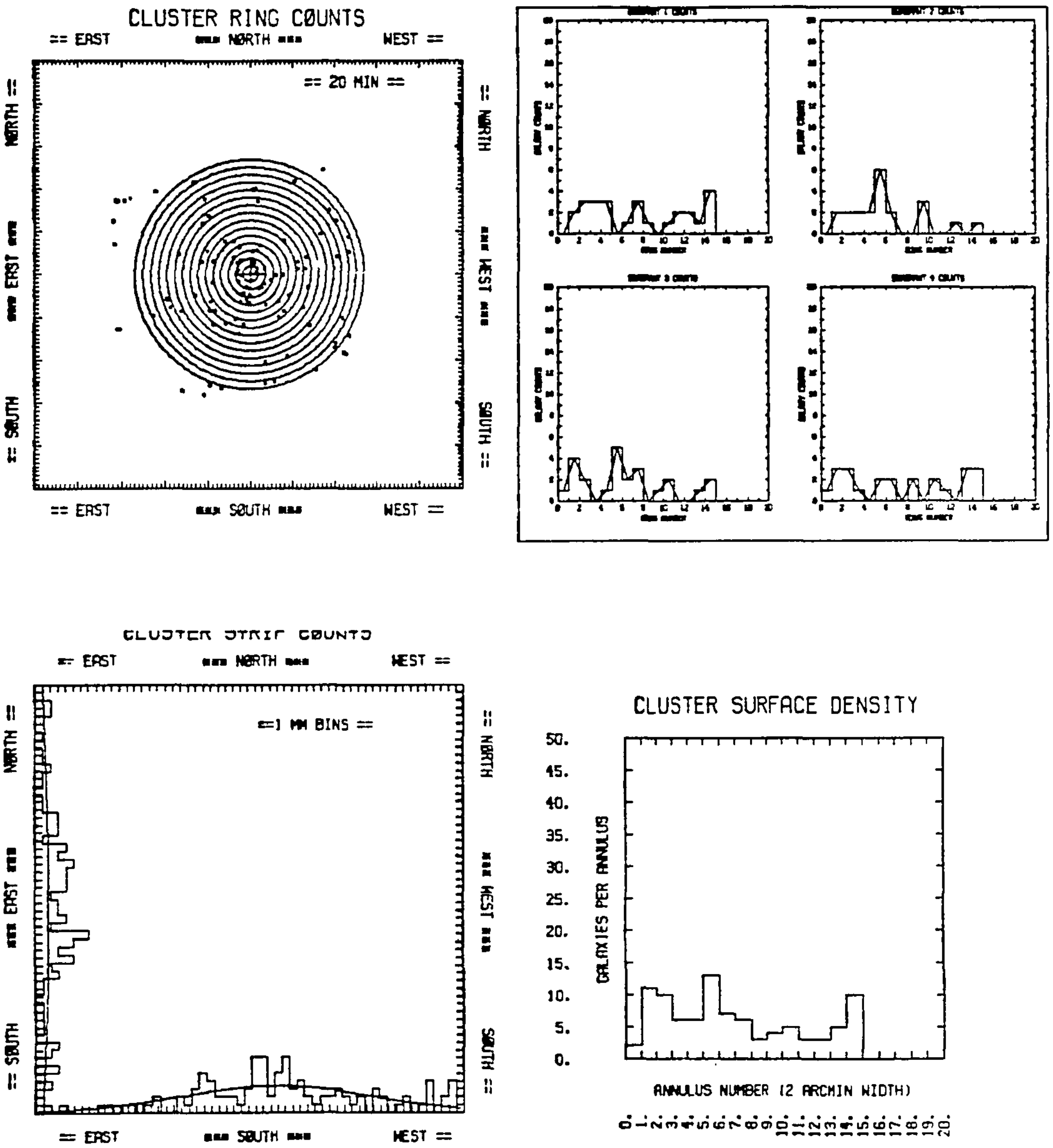


Figure 4.4.11. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 011 04 04 04 -39 00

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	0	1	1	1.259	723.00	0.10001	2.85914
2	11	2	2	4	3	2.815	1325.51	0.44949	3.12238
3	10	3	2	2	3	4.539	723.00	0.65698	2.85914
4	5	3	2	0	0	6.295	258.22	0.79898	2.41198
5	7	3	2	1	1	8.061	281.17	0.90640	2.44897
6	13	0	6	5	2	9.833	427.23	0.99267	2.63066
7	7	1	2	2	2	11.607	194.65	1.06472	2.28926
8	6	3	0	3	0	13.383	144.60	1.12655	2.16017
9	3	1	0	0	2	15.160	63.79	1.18069	1.80478
10	4	0	3	1	0	16.937	76.11	1.22885	1.88142
11	5	1	0	2	2	18.716	86.07	1.27220	1.93486
12	3	2	0	0	1	20.494	47.15	1.31163	1.67350
13	3	2	1	0	0	22.273	43.38	1.34778	1.63729
14	4	0	0	1	3	24.052	53.56	1.38115	1.72881
15	11	5	1	2	3	25.831	137.12	1.41215	2.13710
16	2	0	0	0	2	27.611	23.32	1.44108	1.36778
17	4	0	1	2	1	29.390	43.82	1.46820	1.64166
18	3	1	1	1	0	31.170	30.99	1.49374	1.49116
19	1	0	1	0	0	32.950	9.77	1.51785	0.98991
20	3	0	3	0	0	34.730	27.81	1.54070	1.44417

TØTAL NUMBER ØF GALAXIES CØUNTED = 107 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT XO = -101.219 YO = 54.375

RING WIDTH (ARCMIN) = 2.0

Table 4.4.11. *(a) Ring-Count Data for Galaxy Cluster 11.*

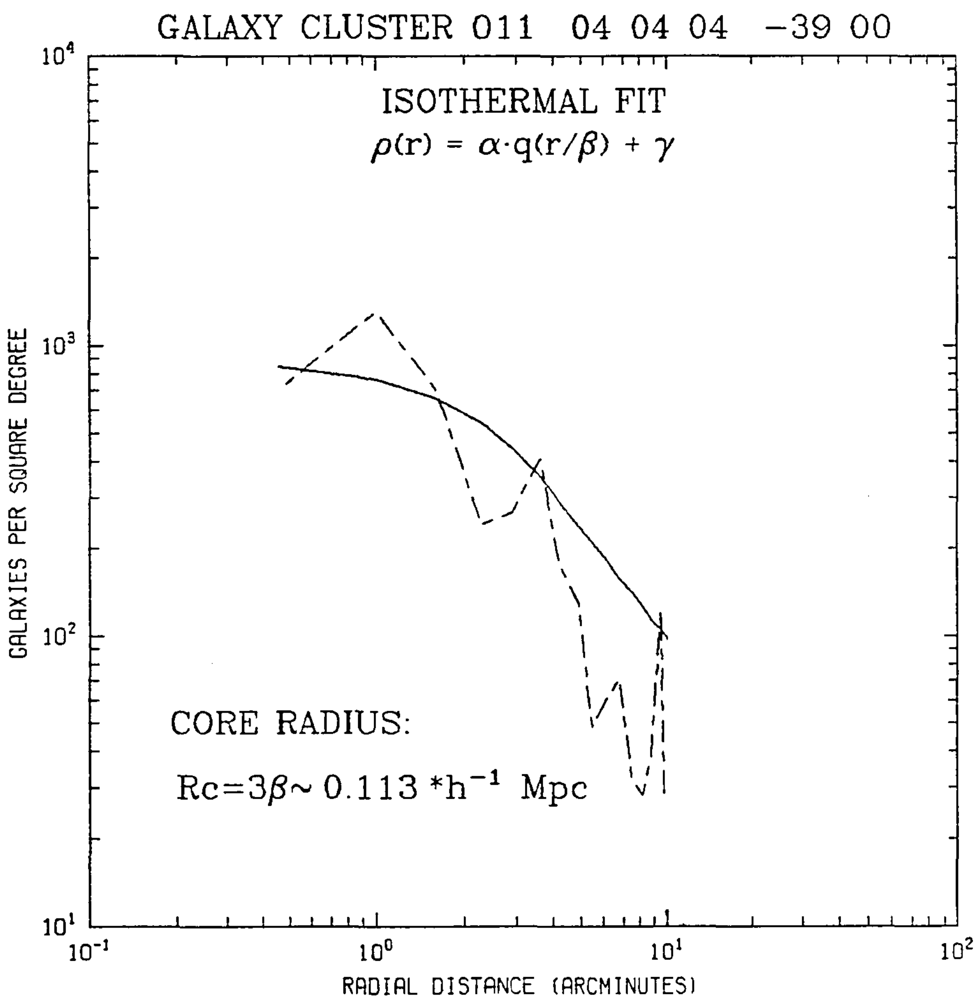


Figure 4.4.11. *(e) Isothermal Fit for Galaxy Cluster 11.*

CLUSTER PARAMETERS GALAXY CLUSTER 011 04 04 04 −39 00	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 454.53±261.26 $\beta =$ 1.04±0.17 $\gamma =$ 11.42±3.39	
$\rho_{\text{BEST FIT}}(r) =$ 842.85 ·q(r/1.03) + 11.70	
CORE RADIUS: Rc=3β~ 0.113 *h^{-1} Mpc	REDSHIFT: Z = 0.042

Table 4.4.11. *(b) Cluster Parameters for Galaxy Cluster 11.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 107 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This rather diffuse cluster shows a high near-central density distribution with a slight concentration of counts East of center as shown in the strip counts. The North-South distribution of galaxies is centrally concentrated but with a rather large variance. Likewise, the quadrant counts show somewhat larger numbers of galaxies near the cluster center and falling off slightly at larger radii. There is a peak at ring 6 in both the second and third quadrants. This also appears in the cluster surface density distribution as a dominant peak. Otherwise the distribution tails off to a slight increase at the cluster periphery.

The isothermal fit tends to fit the peaks in the data at the expense of the troughs and the results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 012 05 24 00 −45 01

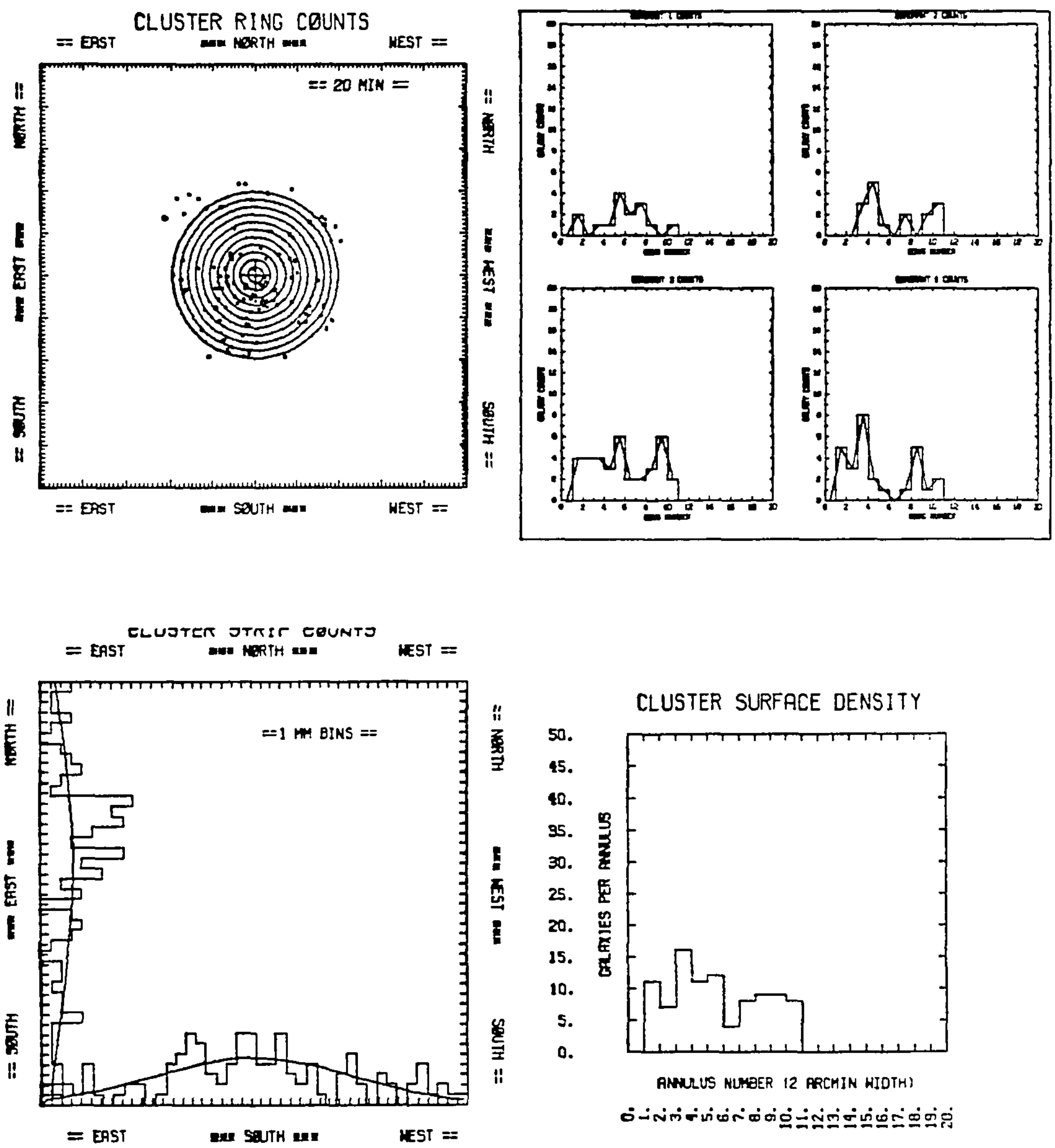


Figure 4.4.12. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 012 05 24 00 -45 01

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	0	0	0	0	0	1.259	0.00	0.10001	0.00000
2	11	2	0	4	5	2.815	1325.51	0.44949	3.12238
3	7	0	0	4	3	4.539	506.10	0.65698	2.70424
4	15	1	2	4	8	6.295	774.65	0.79898	2.88910
5	12	1	6	3	2	8.061	482.00	0.90640	2.68305
6	12	4	1	6	1	9.833	394.37	0.99267	2.59590
7	4	2	0	2	0	11.607	111.23	1.06472	2.04623
8	7	3	2	2	0	13.383	168.70	1.12655	2.22712
9	9	1	0	2	6	15.160	191.38	1.18069	2.28190
10	10	0	2	7	1	16.937	190.26	1.22885	2.27936
11	7	0	3	2	2	18.716	120.50	1.27220	2.08099
12	7	3	1	1	2	20.494	110.02	1.31163	2.04148
13	6	4	2	0	0	22.273	86.76	1.34778	1.93832
14	4	2	2	0	0	24.052	53.56	1.38115	1.72881
15	4	0	4	0	0	25.831	49.86	1.41215	1.69777
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 115 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 115.824 Y0 = -1.271

RING WIDTH (ARCMIN) = 2.0

Table 4.4.12. *(a) Ring-Count Data for Galaxy Cluster 12.*

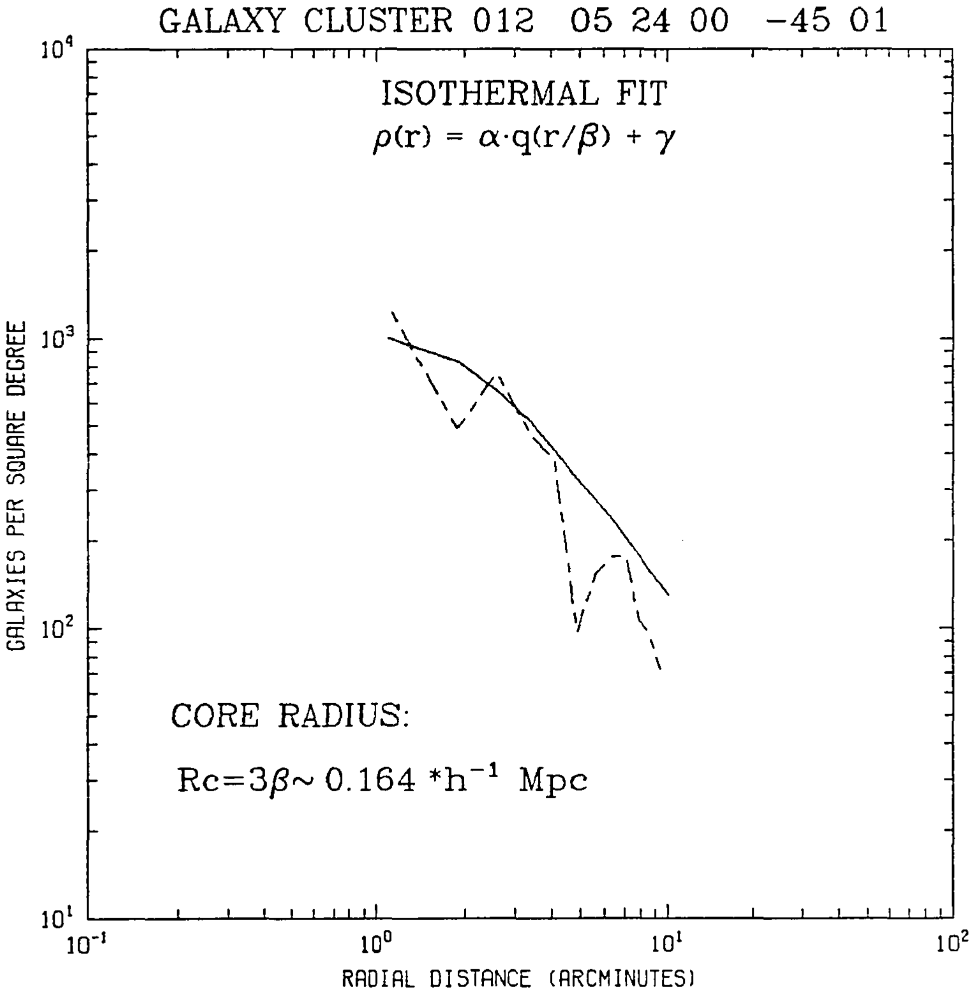


Figure 4.4.12. *(e) Isothermal Fit for Galaxy Cluster 12.*

CLUSTER PARAMETERS GALAXY CLUSTER 012 05 24 00 −45 01	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 576.86±395.24 $\beta =$ 1.05±0.19 $\gamma =$ 11.37±3.76	
$\rho_{\text{BEST FIT}}(r) =$ 1150.88 ·q(r/1.03) + 11.34	
CORE RADIUS: Rc=3$\beta\sim$ 0.164 *h^{-1} Mpc	REDSHIFT: Z = 0.061

Table 4.4.12. *(b) Cluster Parameters for Galaxy Cluster 12.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 115 galaxies within 15 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This fairly sparce cluster shows a fairly wide scatter and variance in the determination of the cluster center. We find the quadrant counts to be virtually devoid of galaxies near the cluster center witha significant increase of counts at ring 4. Another minimum is seen West of center at ring 7. The surface density distribution is slightly bifurcated with peaks centered at rings 4 and 10. The largest number of counts appear in the North-East quadrant of ring 5.

The isothermal fit successfully models the core of the cluster but seriously overshoots the surface density data at radii greater than $r = 10^{0.3}$ minutes of arc. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 013 06 21 39 −64 56

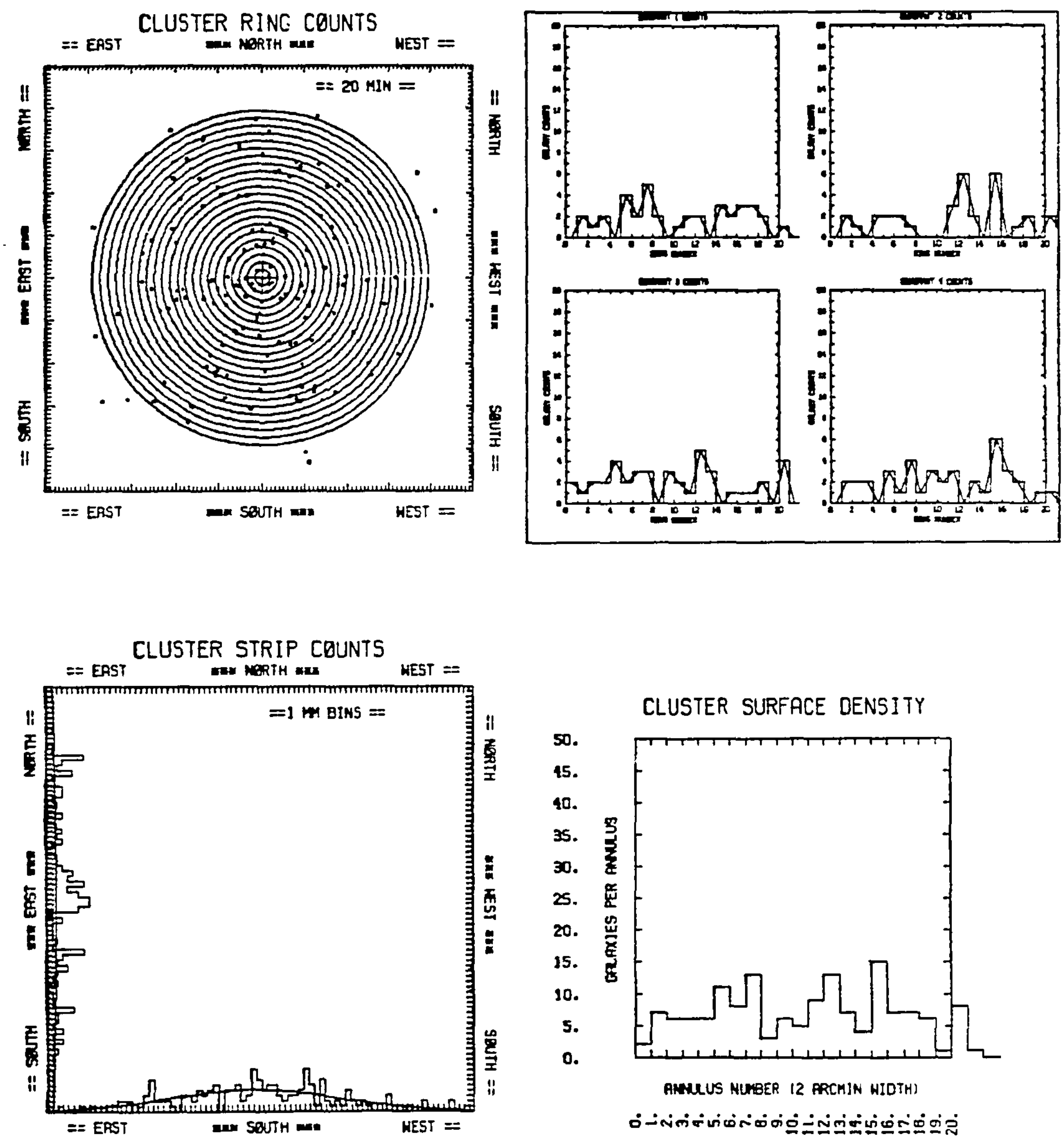


Figure 4.4.13. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 013 06 21 39 -64 56

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	0	2	0	1.259	723.00	0.10001	2.85914
2	7	2	2	1	2	2.815	843.50	0.44949	2.92609
3	6	1	1	2	2	4.539	433.80	0.65698	2.63729
4	6	2	0	2	2	6.295	309.86	0.79898	2.49116
5	6	0	2	4	0	8.061	241.00	0.90640	2.38202
6	11	4	2	2	3	9.833	361.50	0.99267	2.55811
7	8	2	2	3	1	11.607	222.46	1.06472	2.34726
8	13	5	1	3	4	13.383	313.30	1.12655	2.49596
9	3	2	0	0	1	15.160	63.79	1.18069	1.80478
10	6	0	0	3	3	16.937	114.16	1.22885	2.05751
11	5	1	0	2	2	18.716	86.07	1.27220	1.93486
12	9	2	3	1	3	20.494	141.46	1.31163	2.15063
13	13	2	6	5	0	22.273	187.98	1.34778	2.27411
14	6	0	2	2	2	24.052	80.33	1.38115	1.90490
15	4	2	0	1	1	25.831	49.86	1.41215	1.69777
16	16	3	6	1	6	27.611	186.58	1.44108	2.27087
17	7	3	0	1	3	29.390	76.68	1.46820	1.88469
18	7	3	1	1	2	31.170	72.30	1.49374	1.85914
19	6	2	2	2	0	32.950	58.62	1.51785	1.76806
20	1	0	0	0	1	34.730	9.27	1.54070	0.95705

TØTAL NUMBER ØF GALAXIES CØUNTED = 163 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT XO = 83.921 YO = 4.016

RING WIDTH (ARCMIN) = 2.0

Table 4.4.13. *(a) Ring-Count Data for Galaxy Cluster 13.*

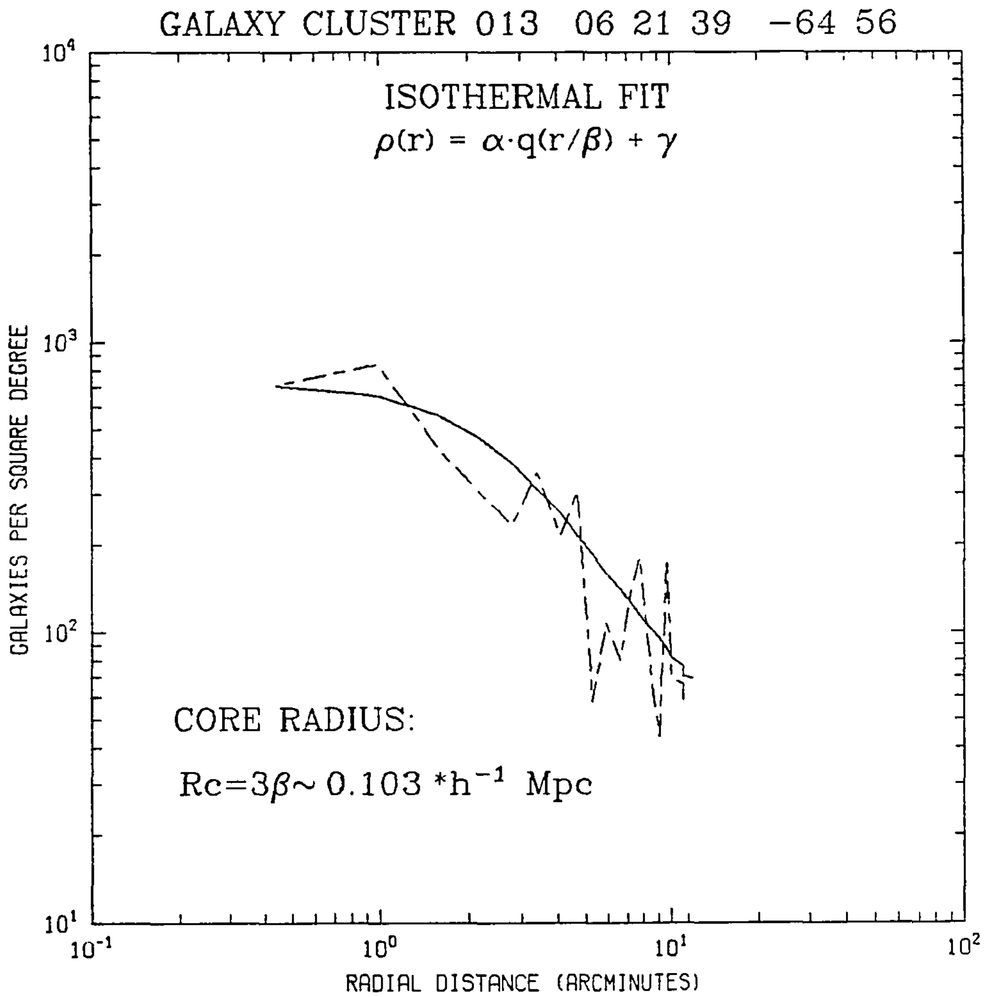


Figure 4.4.13. *(e) Isothermal Fit for Galaxy Cluster 13.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 013 06 21 39 −64 56	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 389.27 ±210.97 $\beta =$ 1.05±0.17 $\gamma =$ 11.66± 3.38	
$\rho_{\text{BEST FIT}}(r) = 700.75 \cdot q(r/1.03) + 12.19$	
CORE RADIUS:	REDSHIFT:
$R_c = 3\beta \sim 0.103 * h^{-1}$ Mpc	Z = 0.038

Table 4.4.13. *(b) Cluster Parameters for Galaxy Cluster 13.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 163 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This sparsely populated cluster shows wide variance in its center determination. The member galaxies are distributed somewhat uniformly East and West of center, while there appears to be more scatter in the North-South directions. The quadrant counts show low count levels as well as erratic peaks and valleys. The cluster surface density distribution similarly shows a pattern of rising and falling several times. We find the highest number of counts under the peak found at ring sixteen.

The resulting surface densities force the isothermal fit to contend with an erratic distribution giving a relatively poor fit at large radii. The mimimum at ring 15 appears to be a significant source of noise. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 014 06 25 02 -53 39

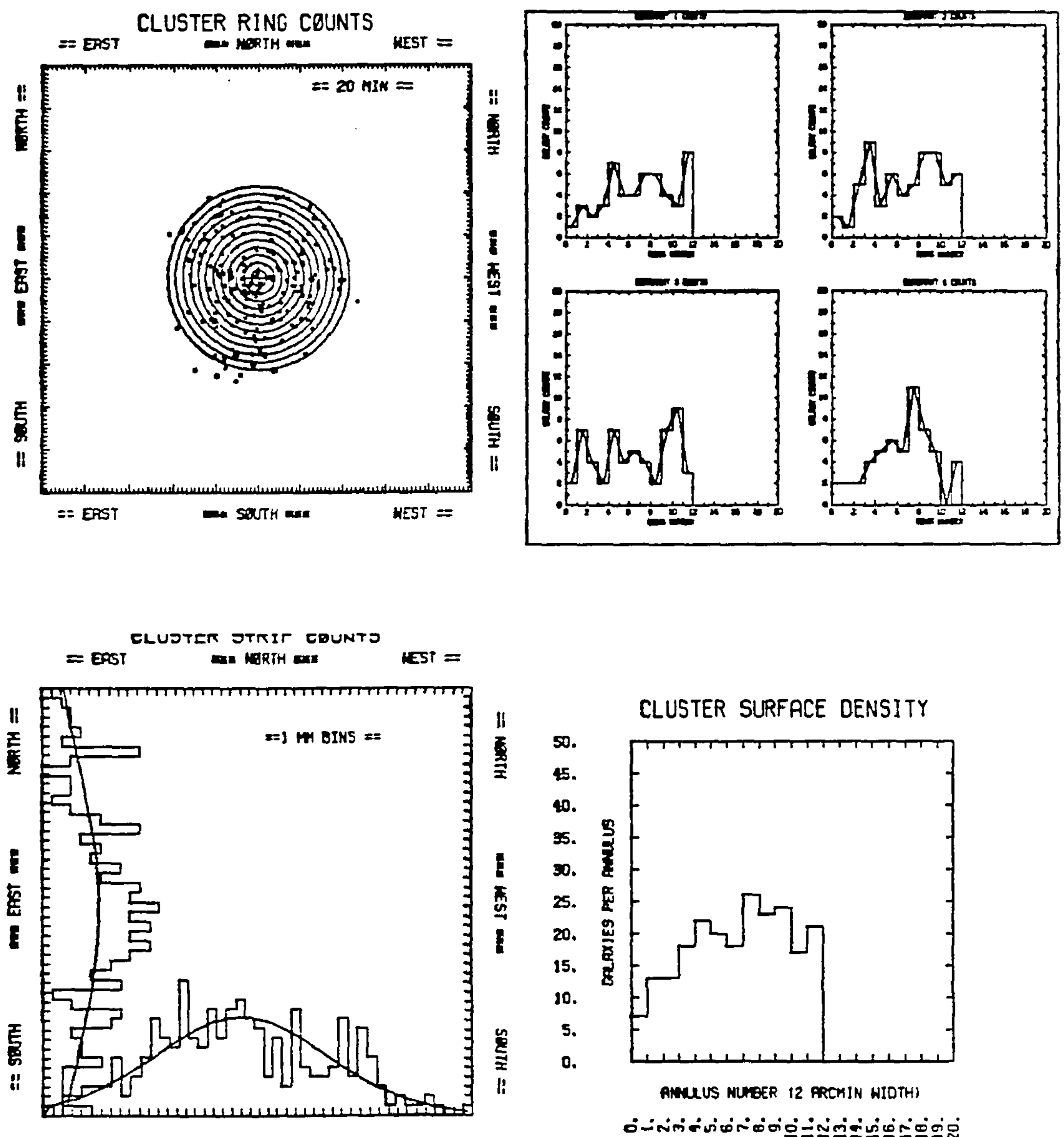


Figure 4.4.14. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 014 06 25 02 -53 39

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	7	1	2	2	2	1.259	2530.51	0.10001	3.40321
2	13	3	1	7	2	2.815	1566.51	0.44949	3.19493
3	13	2	5	4	2	4.539	939.90	0.65698	2.97308
4	17	3	8	2	4	6.295	877.93	0.79898	2.94346
5	22	6	4	7	5	8.061	883.67	0.90640	2.94629
6	21	5	6	4	6	9.833	690.14	0.99267	2.83894
7	17	4	3	5	5	11.607	472.73	1.06472	2.67462
8	27	6	6	4	11	13.383	650.70	1.12655	2.81338
9	23	6	8	2	7	15.160	489.09	1.18069	2.68939
10	24	4	8	7	5	16.937	456.63	1.22885	2.65957
11	17	3	5	9	0	18.716	292.64	1.27220	2.46634
12	20	7	6	3	4	20.494	314.35	1.31163	2.49741
13	7	4	1	2	0	22.273	101.22	1.34778	2.00527
14	4	0	1	2	1	24.052	53.56	1.38115	1.72881
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 232 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 88.653 Y0 = 70.926

RING WIDTH (ARCMIN) = 2.0

Table 4.4.14. *(a) Ring-Count Data for Galaxy Cluster 14.*

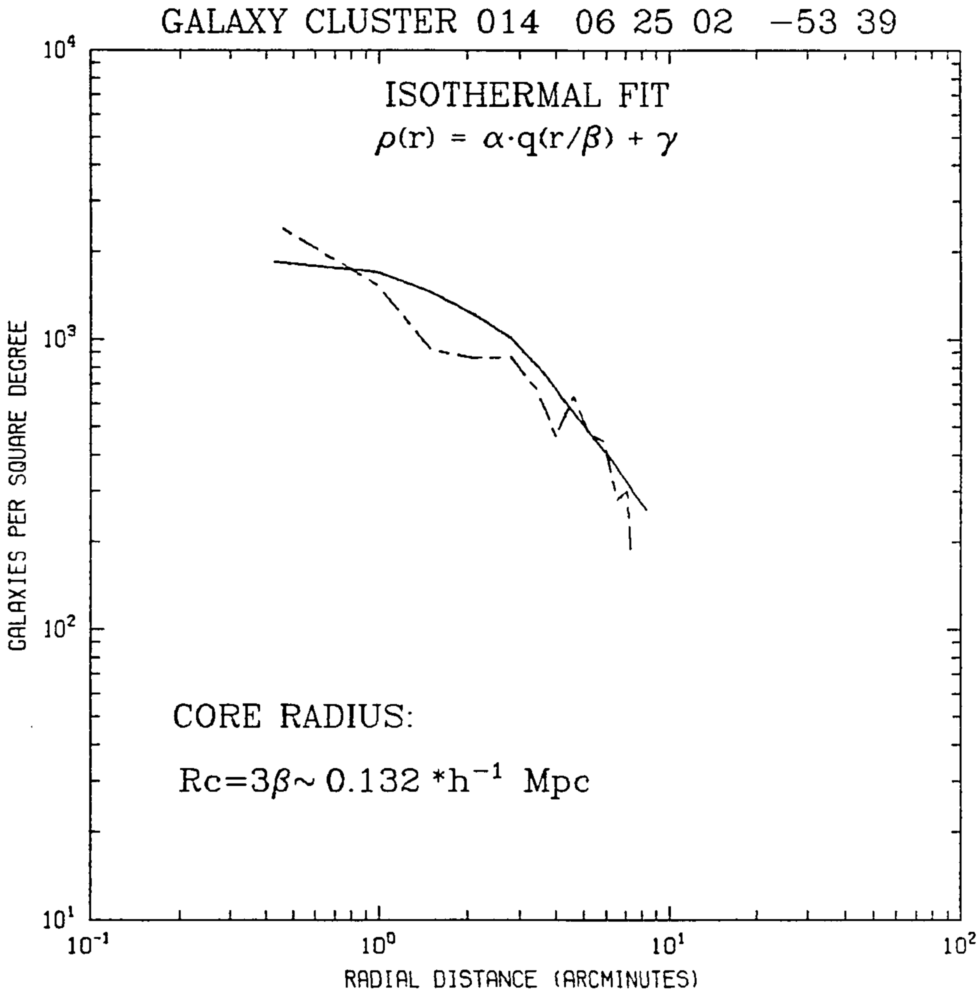


Figure 4.4.14. *(e) Isothermal Fit for Galaxy Cluster 14.*

CLUSTER PARAMETERS GALAXY CLUSTER 014 06 25 02 −53 39	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
α = 1211.57±460.22 β = 1.04±0.10 γ = 11.77±1.79	
$\rho_{\text{BEST FIT}}(r)$ = 1856.17·q(r/1.03) + 12.15	
CORE RADIUS: Rc=3β~ 0.132 *h^{-1} Mpc	REDSHIFT: Z = 0.049

Table 4.4.14. *(b) Cluster Parameters for Galaxy Cluster 14.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 232 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude m_v = 19.0. This compact cluster shows less scatter in the East-West absissa of the strip counts than does the North-South variance. The quadrant counts show a general increase of galaxy population with increasing radial distance. There appears to be a significant excess of counts in the fourth quadrant at ring 9. The cluster surface density increases slowly to about ring 8 after which there is a slow decline of population to the cluster periphery.

The isothermal fit overshoots the data at rings 4 and 5 but manages to conform to the data at radial distances slightly in excess of 13 arcminutes. Nevertheless, the fit seems to override the data and apparently could better mimic the observations having been lowered somewhat. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 015 06 26 25 −54 22

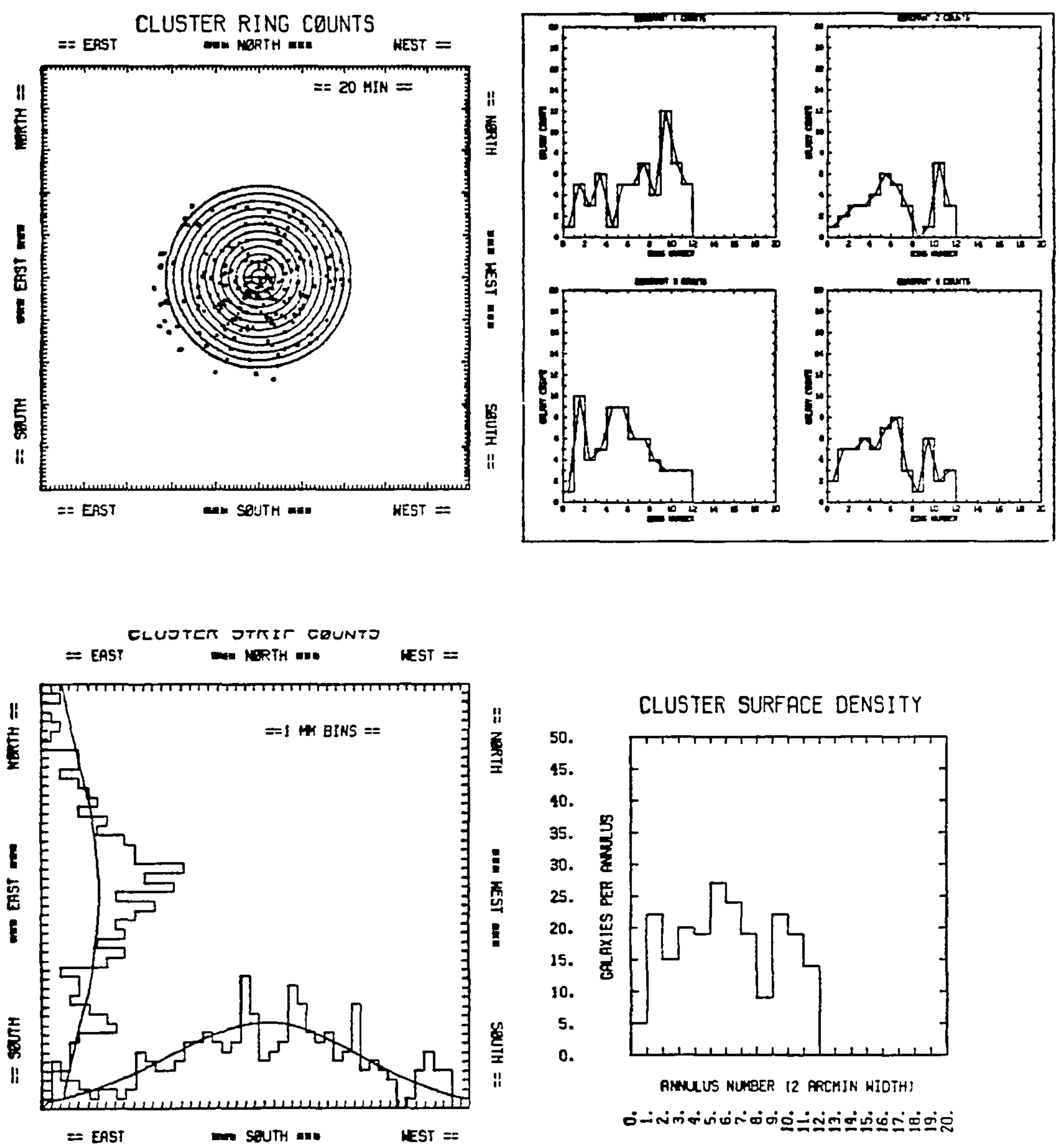


Figure 4.4.15. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 015 06 26 25 -54 22

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	5	1	1	1	2	1.259	1807.51	0.10001	3.25708
2	22	5	2	10	5	2.815	2651.01	0.44949	3.42341
3	15	3	3	4	5	4.539	1084.50	0.65698	3.03523
4	18	4	3	5	6	6.295	929.57	0.79898	2.96828
5	20	3	4	8	5	8.061	803.34	0.90640	2.90490
6	28	5	6	10	7	9.833	920.19	0.99267	2.96388
7	24	5	5	6	8	11.607	667.39	1.06472	2.82438
8	19	7	3	6	3	13.383	457.90	1.12655	2.66077
9	9	4	0	4	1	15.160	191.38	1.18069	2.28190
10	21	11	1	3	6	16.937	399.55	1.22885	2.60158
11	18	8	5	3	2	18.716	309.86	1.27220	2.49116
12	15	5	5	3	2	20.494	235.76	1.31163	2.37247
13	17	4	7	4	2	22.273	245.82	1.34778	2.39062
14	4	0	1	3	0	24.052	53.56	1.38115	1.72881
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 235 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 76.713 Y0 = 32.793

RING WIDTH (ARCMIN) = 2.0

Table 4.4.15. *(a) Ring-Count Data for Galaxy Cluster 15.*

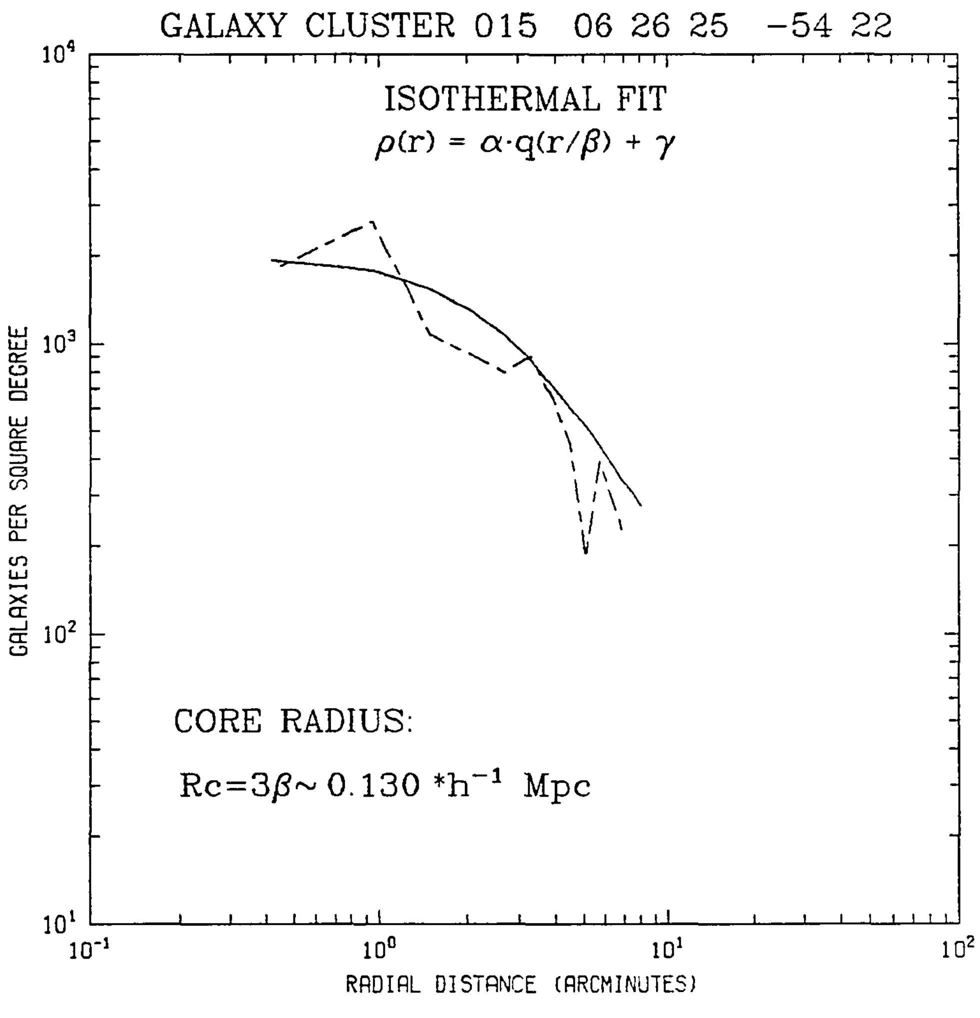


Figure 4.4.15. *(e) Isothermal Fit for Galaxy Cluster 15.*

CLUSTER PARAMETERS
GALAXY CLUSTER 015 06 26 25 −54 22
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
$\alpha = 1342.45 \pm 382.24$ $\beta = 1.02 \pm 0.01$ $\gamma = 11.34 \pm 0.41$
$\rho_{\text{BEST FIT}}(r) = 1933.29 \cdot q(r/1.03) + 11.98$
CORE RADIUS: $Rc = 3\beta \sim 0.130 * h^{-1}$ Mpc REDSHIFT: $Z = 0.048$

Table 4.4.15. *(b) Cluster Parameters for Galaxy Cluster 15.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 235 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This rather compact cluster shows a slightly larger variance in the North-South ordinate than in the East-West absissa, but nevertheless, the cluster remains centrally condensed. The quadrant counts show a steady increase of counts at increasing radii, save for the void observed at ring 9 in the first and fourth quadrants. The cluster surface density displays a quick rise to a maximum at annulus 6 falling slowly with the exception of the above mentioned minimum.

The isothermal fit tends to envelope the surface density data with poor modeling near the periphery of the cluster.

The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 016 12 51 41 −28 44

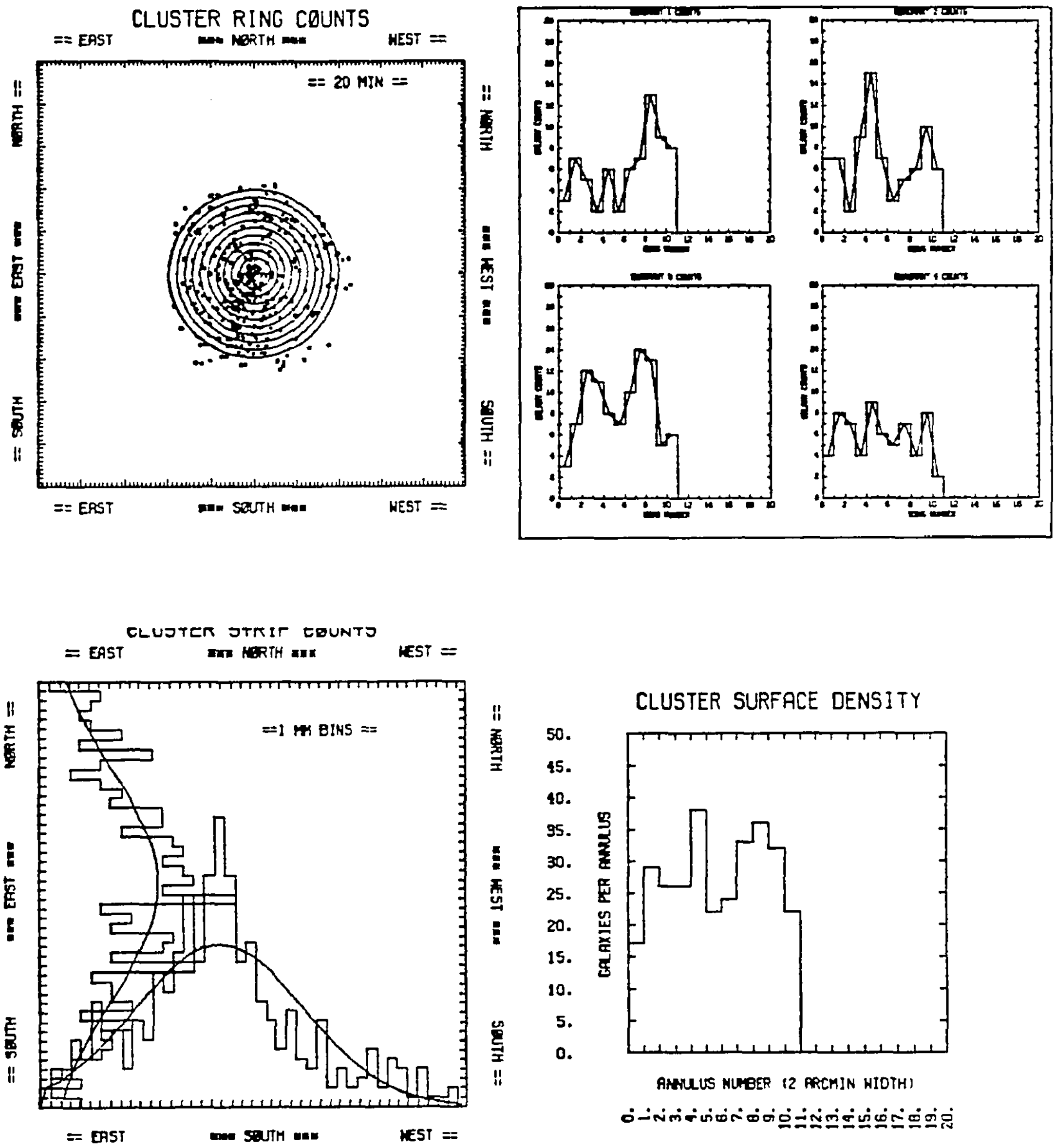


Figure 4.4.16. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 016 12 51 41 -28 44

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	17	3	7	3	4	1.259	6145.52	0.10001	3.78856
2	29	7	7	7	8	2.815	3494.51	0.44949	3.54339
3	26	5	2	12	7	4.539	1879.81	0.65698	3.27411
4	26	2	9	11	4	6.295	1342.72	0.79898	3.12799
5	37	6	14	8	9	8.061	1486.17	0.90640	3.17207
6	21	2	8	5	6	9.833	690.14	0.99267	2.83894
7	26	6	3	12	5	11.607	723.00	1.06472	2.85914
8	32	7	4	14	7	13.383	771.20	1.12655	2.88717
9	36	12	7	13	4	15.160	765.53	1.18069	2.88396
10	32	10	9	5	8	16.937	608.84	1.22885	2.78451
11	23	8	7	6	2	18.716	395.93	1.27220	2.59762
12	21	7	3	4	7	20.494	330.07	1.31163	2.51860
13	18	7	5	1	5	22.273	260.28	1.34778	2.41544
14	4	1	0	1	2	24.052	53.56	1.38115	1.72881
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 348 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = -146.553 Y0 = 65.348

RING WIDTH (ARCMIN) = 2.0

Table 4.4.16. *(a) Ring-Count Data for Galaxy Cluster 16.*

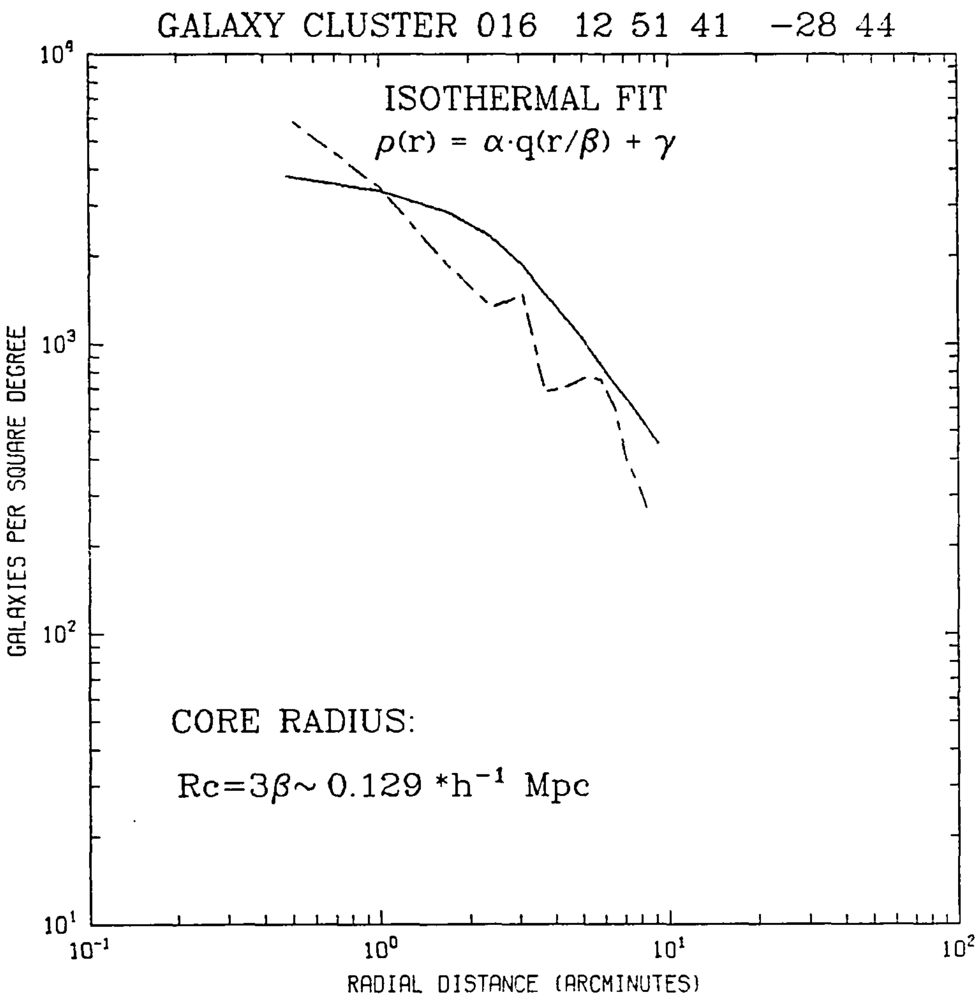


Figure 4.4.16. *(e) Isothermal Fit for Galaxy Cluster 16.*

CLUSTER PARAMETERS GALAXY CLUSTER 016 12 51 41 −28 44	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
α = 3543.86 ± 275.51 β = 1.03 ± 0.00 γ = 11.78 ± 0.14	
$\rho_{\text{BEST FIT}}(r)$ = 3819.37 · q(r/1.03) + 11.92	
CORE RADIUS: Rc=3β~ 0.129 *h^{-1} Mpc	REDSHIFT: Z = 0.048

Table 4.4.16. *(b) Cluster Parameters for Galaxy Cluster 16.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 348 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster appears to have a somewhat linear constiution with a large number of galaxies aligned slightly Eastward of center along the absissa at the peak of the distribution. We find more scatter along the North-South ordinate and a wider distribution of galaxies. The quadrant counts are by no means symmetrical, and each quadrant possesses at least a single significant maximum. We find the cluster surface density to reflect the high central density of the cluster with significant peaks at rings 5 and 9.

The isothermal fit envelopes a quickly descending density distribution and is likely effected by the relatively high central density which is not quite twice as large as the value in the adjacent annulus. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 017 13 03 25 −37 18

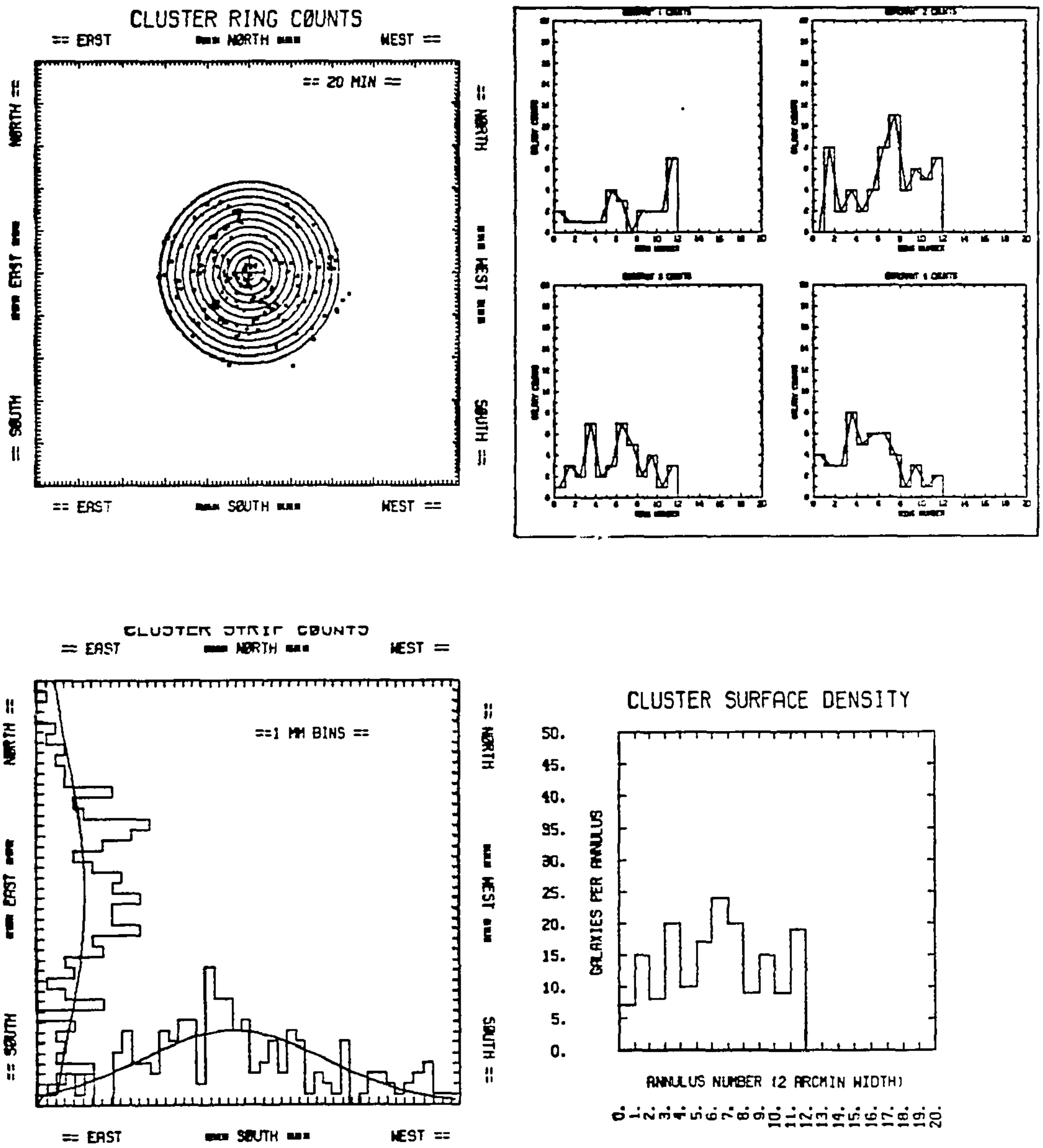


Figure 4.4.17. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 017 13 03 25 -37 18

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	7	2	0	1	4	1.259	2530.51	0.10001	3.40321
2	15	1	8	3	3	2.815	1807.51	0.44949	3.25708
3	8	1	2	2	3	4.539	578.40	0.65698	2.76223
4	20	1	4	7	8	6.295	1032.86	0.79898	3.01404
5	10	1	2	2	5	8.061	401.67	0.90640	2.60387
6	17	4	4	3	6	9.833	558.68	0.99267	2.74717
7	23	3	7	7	6	11.607	639.58	1.06472	2.80589
8	21	0	12	5	4	13.383	506.10	1.12655	2.70424
9	8	2	3	2	1	15.160	170.12	1.18069	2.23075
10	16	2	7	4	3	16.937	304.42	1.22885	2.48348
11	9	2	5	1	1	18.716	154.93	1.27220	2.19013
12	17	7	5	3	2	20.494	267.20	1.31163	2.42683
13	7	2	2	0	3	22.273	101.22	1.34778	2.00527
14	2	0	0	0	2	24.052	26.78	1.38115	1.42778
15	1	0	0	0	1	25.831	12.47	1.41215	1.09571
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 181 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 95.233 Y0 = -121.728

RING WIDTH (ARCMIN) = 2.0

Table 4.4.17. *(a) Ring-Count Data for Galaxy Cluster 17.*

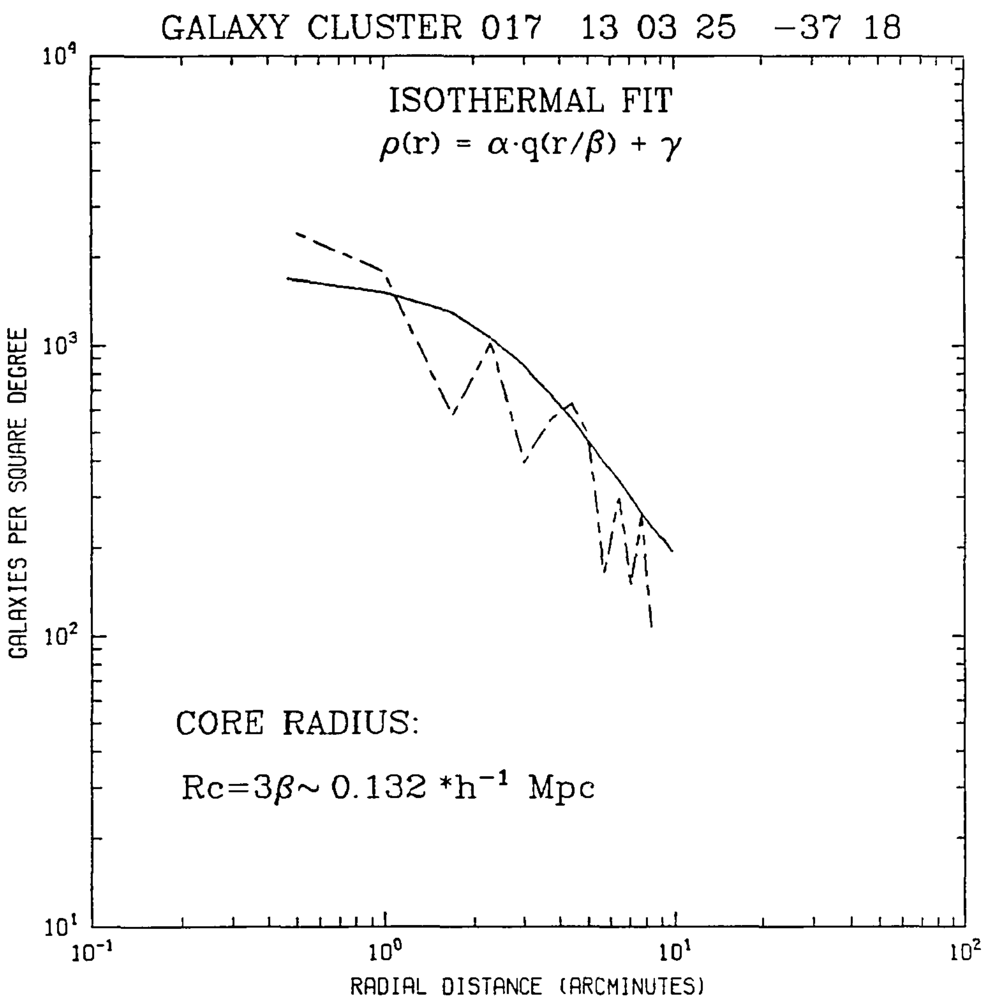


Figure 4.4.17. *(e) Isothermal Fit for Galaxy Cluster 17.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 017 13 03 25 −37 18	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha = 894.39 \pm 575.74$ $\beta = 1.05 \pm 0.18$ $\gamma = 11.63 \pm 3.54$	
$\rho_{BEST\ FIT}(r) = 1712.15 \cdot q(r/1.03) + 11.92$	
CORE RADIUS:	REDSHIFT:
$Rc=3\beta\sim 0.132 * h^{-1}$ Mpc	Z = 0.049

Table 4.4.17. *(b) Cluster Parameters for Galaxy Cluster 17.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 181 galaxies within 15 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We find the cluster strip counts to be somewhat skewed Eastward of center along the East-West absissa, but somewhat more symmetrical along the North-South ordinate but with larger variance. The quadrant counts show a relative avoidance of the first quadrant and a well-populated second quadrant with a significant maximum located at ring 8. The cluster surface surface density displays erratic behavior with peaks in the distribution located some twelve arcminutes from cluster center.

The isothermal fit is effected by the somewhat erratic distribution of surface densities and is able to form an envelope over the data fitting well at only a few points. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 018 14 00 41 −33 44

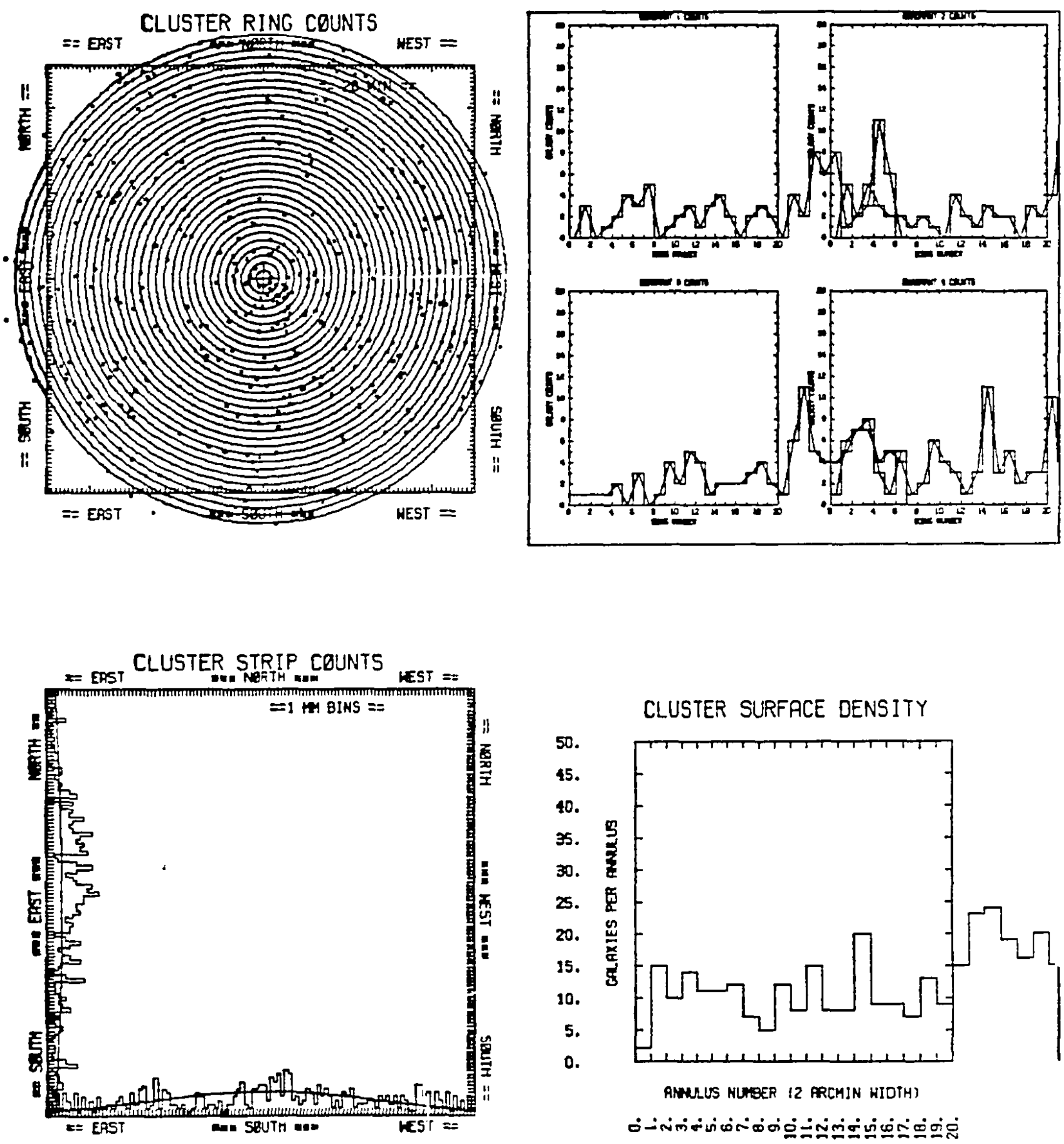


Figure 4.4.18. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 018 14 00 41 -33 44

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	0	1	1	1.259	723.00	0.10001	2.85914
2	14	3	5	1	5	2.815	1687.01	0.44949	3.22712
3	11	0	2	1	8	4.539	795.30	0.65698	2.90053
4	14	1	5	1	7	6.295	723.00	0.79898	2.85914
5	11	2	3	2	4	8.061	441.84	0.90640	2.64526
6	10	3	2	0	5	9.833	328.64	0.99267	2.51672
7	13	4	2	3	4	11.607	361.50	1.06472	2.55811
8	7	5	1	0	1	13.383	168.70	1.12655	2.22712
9	3	0	2	0	1	15.160	63.79	1.18069	1.80478
10	13	1	1	5	6	16.937	247.34	1.22885	2.39330
11	9	2	0	2	5	18.716	154.93	1.27220	2.19013
12	15	3	4	5	3	20.494	235.76	1.31163	2.37247
13	8	1	2	4	1	22.273	115.68	1.34778	2.06326
14	7	3	1	1	2	24.052	93.72	1.38115	1.97184
15	21	4	3	2	12	25.831	261.78	1.41215	2.41793
16	9	2	2	2	3	27.611	104.95	1.44108	2.02099
17	8	0	1	2	5	29.390	87.64	1.46820	1.94269
18	7	1	1	3	2	31.170	72.30	1.49374	1.85914
19	14	4	3	4	3	32.950	136.78	1.51785	2.13604
20	8	2	2	2	2	34.730	74.15	1.54070	1.87014

TØTAL NUMBER ØF GALAXIES CØUNTED = 444 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT XO = -5.223 YO = 69.735

RING WIDTH (ARCMIN) = 2.0

Table 4.4.18. *(a) Ring-Count Data for Galaxy Cluster 18.*

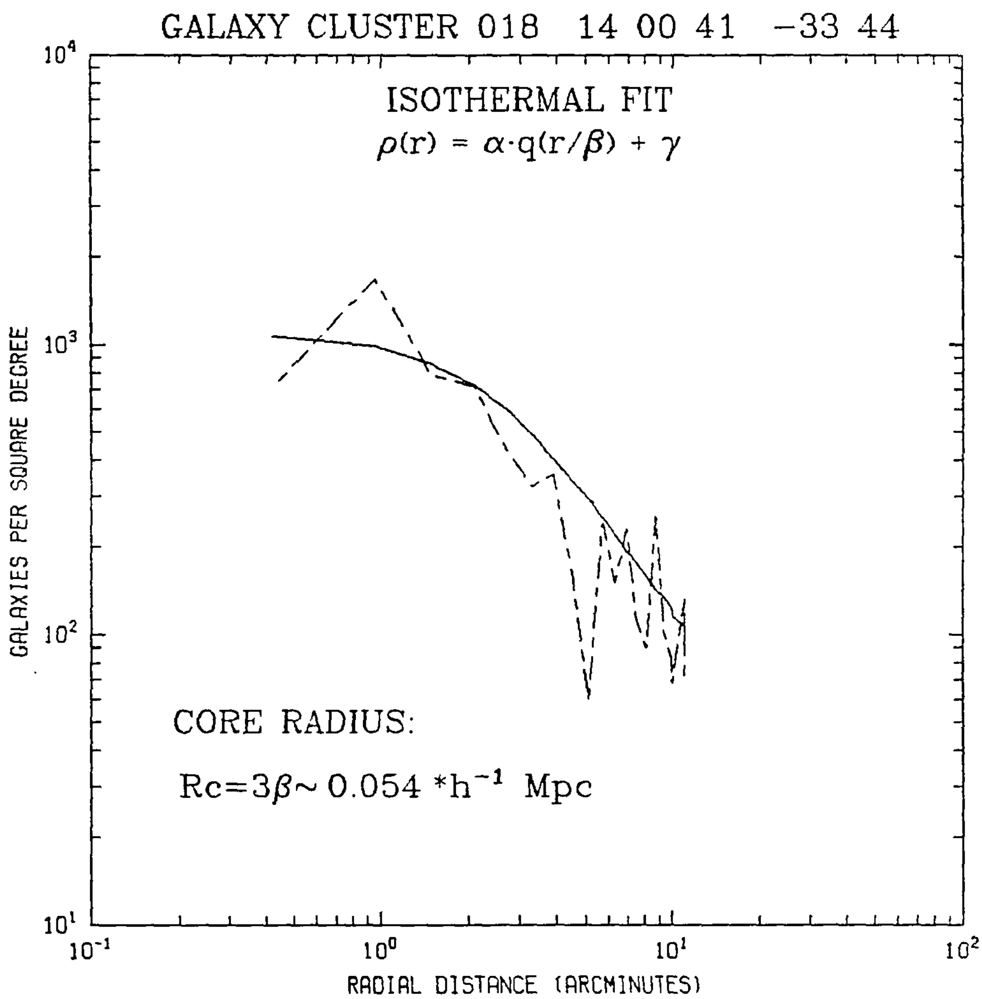


Figure 4.4.18. *(e) Isothermal Fit for Galaxy Cluster 18.*

CLUSTER PARAMETERS GALAXY CLUSTER 018 14 00 41 −33 44	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 570.20 ± 342.73 $\beta =$ 1.05 ± 0.17 $\gamma =$ 11.57 ± 3.33	
$\rho_{\text{BEST FIT}}(r) = 1067.88 \cdot q(r/1.03) + 12.01$	
CORE RADIUS: $Rc = 3\beta \sim 0.054 * h^{-1}$ Mpc	REDSHIFT: Z = 0.020

Table 4.4.18. *(b) Cluster Parameters for Galaxy Cluster 18.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 204 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. Although somewhat large in extent this cluster displays a slight central condensation; the East-West stripcounts have a wide variance as do the North-South counts which have a slightly higher population about the cluster center. The quadrant counts show no significant peaks until the cluster periphery is reached and the greater area encloses a larger number of objects. As a result, the cluster surface density is somewhat flat until at larger radii, the contribution made as a result of that increase in area grows.

The isothermal fit attempts to model the surface density and with exception made for the deep trough at ring 6 and the peak at ring 2, the fit is a fair representation of the data. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 019 14 09 18 −32 50

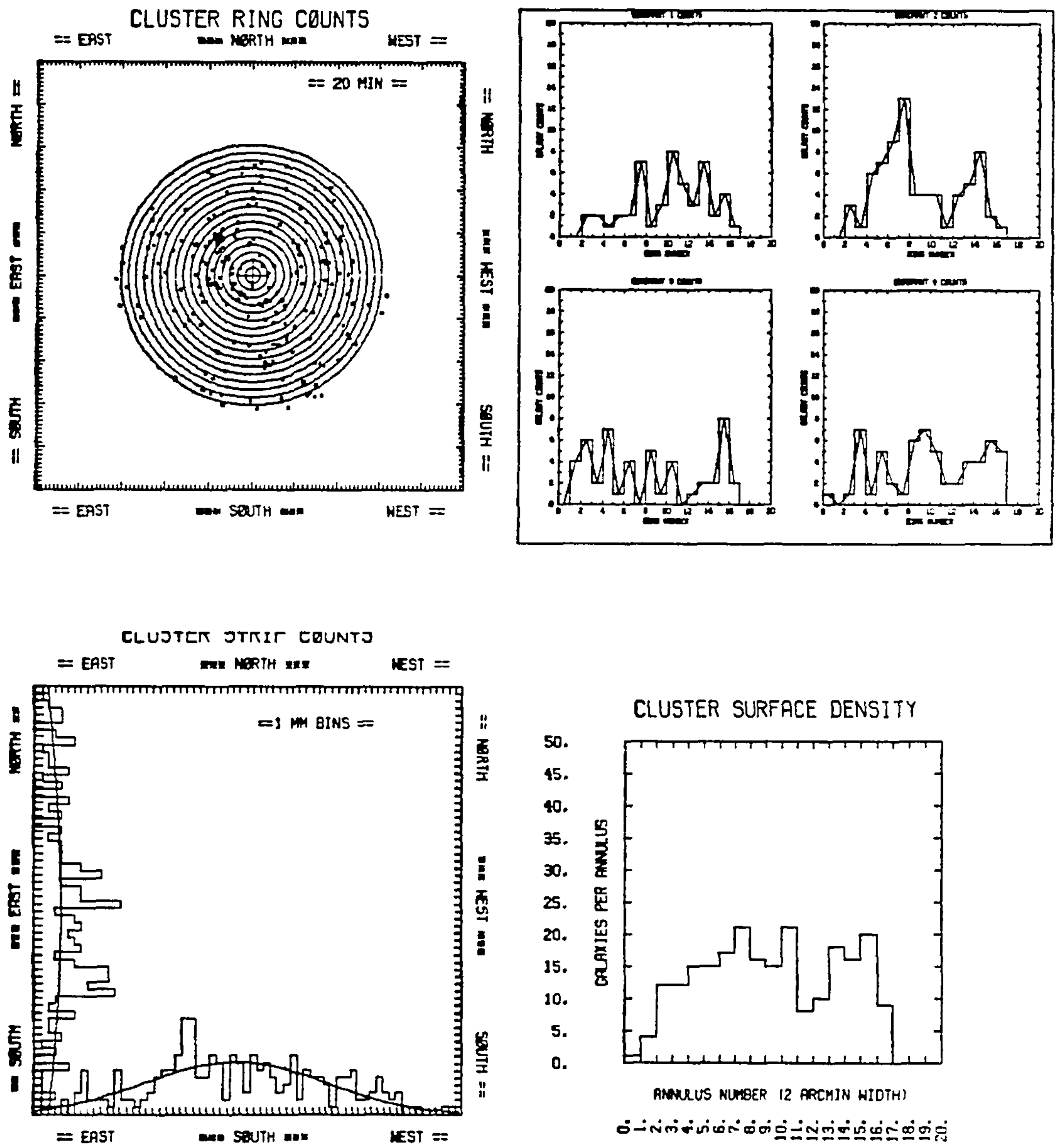


Figure 4.4.19. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 019 14 09 18 -32 50

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	1	0	0	0	1	1.259	361.50	0.10001	2.55811
2	3	0	0	3	0	2.815	361.50	0.44949	2.55811
3	13	2	3	7	1	4.539	939.90	0.65698	2.97308
4	11	2	0	2	7	6.295	568.07	0.79898	2.75440
5	16	1	7	7	1	8.061	642.67	0.90640	2.80799
6	15	2	7	1	5	9.833	492.96	0.99267	2.69281
7	17	2	9	4	2	11.607	472.73	1.06472	2.67462
8	21	7	13	0	1	13.383	506.10	1.12655	2.70424
9	16	1	4	5	6	15.160	340.24	1.18069	2.53178
10	14	2	4	1	7	16.937	266.37	1.22885	2.42548
11	22	9	4	4	5	18.716	378.72	1.27220	2.57831
12	8	5	1	0	2	20.494	125.74	1.31163	2.09947
13	9	2	4	1	2	22.273	130.14	1.34778	2.11441
14	19	8	5	2	4	24.052	254.39	1.38115	2.40550
15	15	2	7	2	4	25.831	186.98	1.41215	2.27180
16	19	4	3	7	5	27.611	221.57	1.44108	2.34550
17	11	1	1	3	6	29.390	120.50	1.46820	2.08099
18	7	0	2	1	4	31.170	72.30	1.49374	1.85914
19	1	0	0	0	1	32.950	9.77	1.51785	0.98991
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 238 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = -102.148 Y0 = 117.241

RING WIDTH (ARCMIN) = 2.0

Table 4.4.19. *(a) Ring-Count Data for Galaxy Cluster 19.*

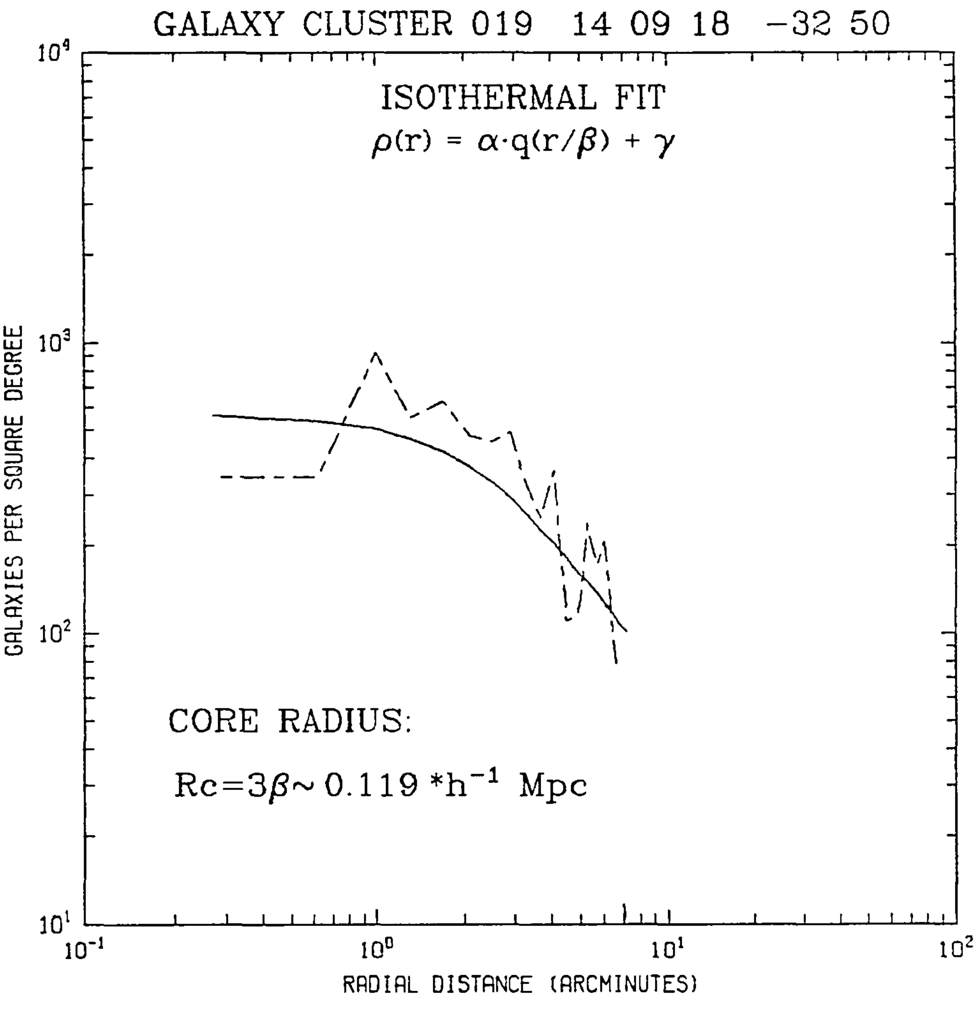


Figure 4.4.19. *(e) Isothermal Fit for Galaxy Cluster 19.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 019 14 09 18 −32 50	
$\rho(r) = \alpha\cdot q(r/\beta) + \gamma$	
$\alpha =$ 418.95±213.09 $\beta =$ 1.05±0.15 $\gamma =$ 12.00±3.02	
$\rho_{\text{BEST FIT}}(r) =$ 549.30·q(r/1.03) + 12.17	
CORE RADIUS:	REDSHIFT:
Rc=3$\beta\sim$ 0.119 *h^{-1} Mpc	Z = 0.044

Table 4.4.19. *(b) Cluster Parameters for Galaxy Cluster 19.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 238 galaxies within 19 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We fine a fairly wide variance in the East-West strip count data with a slight density enhancement of counts Eastward of cluster center. Similar behavior is noted Southward of center alond the North-South ordinate. Quadrant counts show an avoidance for the center of the cluster and a large peak at the eighth ring of the second quadrant primarily due to subclustering. The surface density has a mildly bifurcated appearance with a trough near ring 12.

As a result of the low central density the isothermal fit is biased low and undershoots most of the data; models excluding data in the first two rings appear to have a better fit than using the full range of the data. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 020 14 09 28 −34 01

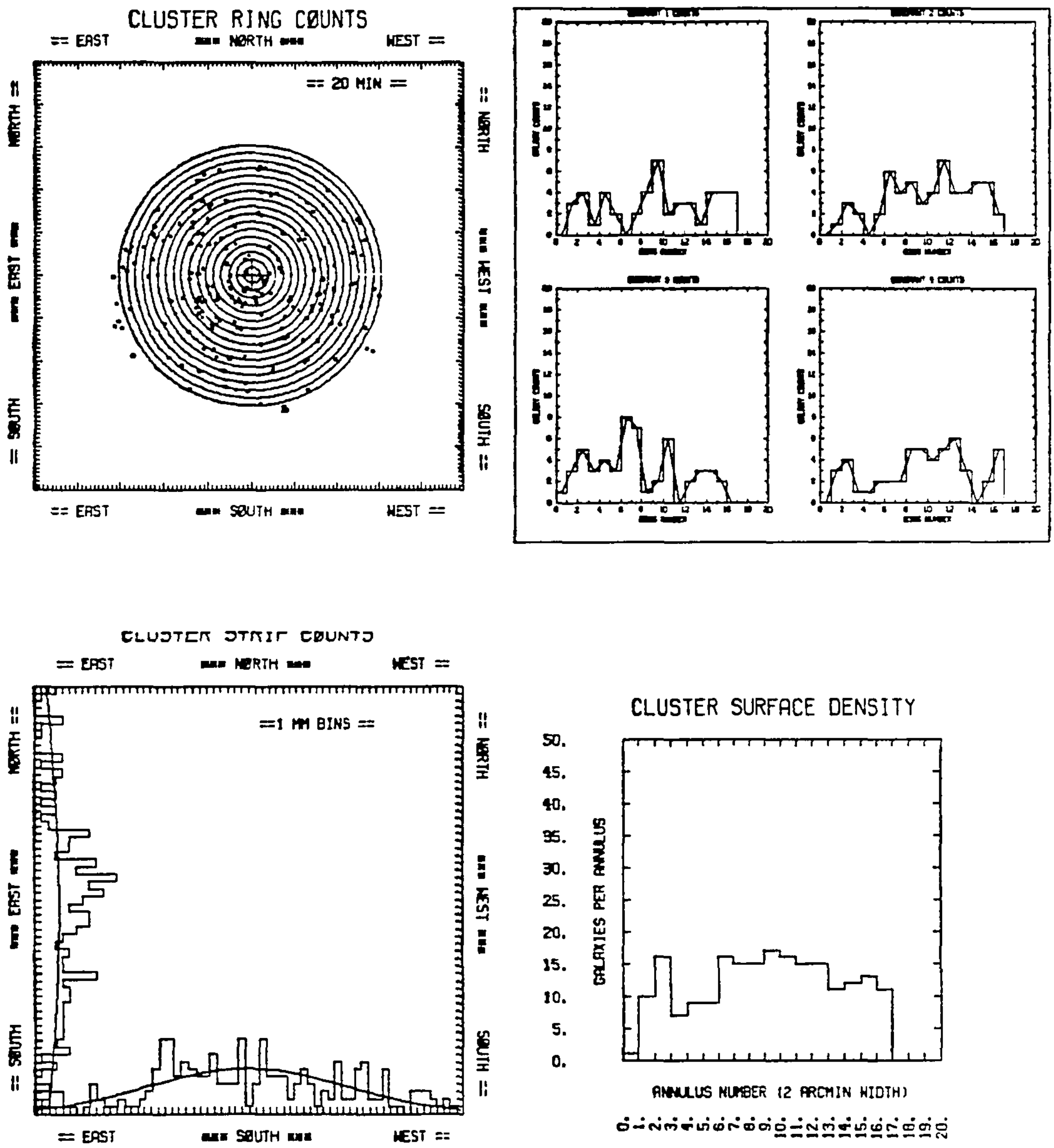


Figure 4.4.20. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 020 14 09 28 -34 01

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	1	0	0	1	0	1.259	361.50	0.10001	2.55811
2	10	3	1	3	3	2.815	1205.00	0.44949	3.08099
3	16	4	3	5	4	4.539	1156.80	0.65698	3.06326
4	7	1	2	3	1	6.295	361.50	0.79898	2.55811
5	9	4	0	4	1	8.061	361.50	0.90640	2.55811
6	9	2	2	3	2	9.833	295.77	0.99267	2.47096
7	16	0	6	8	2	11.607	444.92	1.06472	2.64829
8	15	2	4	7	2	13.383	361.50	1.12655	2.55811
9	15	4	5	1	5	15.160	318.97	1.18069	2.50375
10	16	7	3	2	4	16.937	304.42	1.22885	2.48348
11	17	2	4	6	5	18.716	292.64	1.27220	2.46634
12	14	3	6	0	5	20.494	220.04	1.31163	2.34251
13	16	3	5	2	6	22.273	231.36	1.34778	2.36429
14	10	1	4	3	2	24.052	133.89	1.38115	2.12675
15	13	4	5	3	1	25.831	162.05	1.41215	2.20966
16	13	4	5	2	2	27.611	151.60	1.44108	2.18069
17	11	4	2	0	5	29.390	120.50	1.46820	2.08099
18	9	0	1	4	4	31.170	92.96	1.49374	1.96828
19	2	0	0	1	1	32.950	19.54	1.51785	1.29094
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 219 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = -102.819 Y0 = 53.059

RING WIDTH (ARCMIN) = 2.0

Table 4.4.20. *(a) Ring-Count Data for Galaxy Cluster 20.*

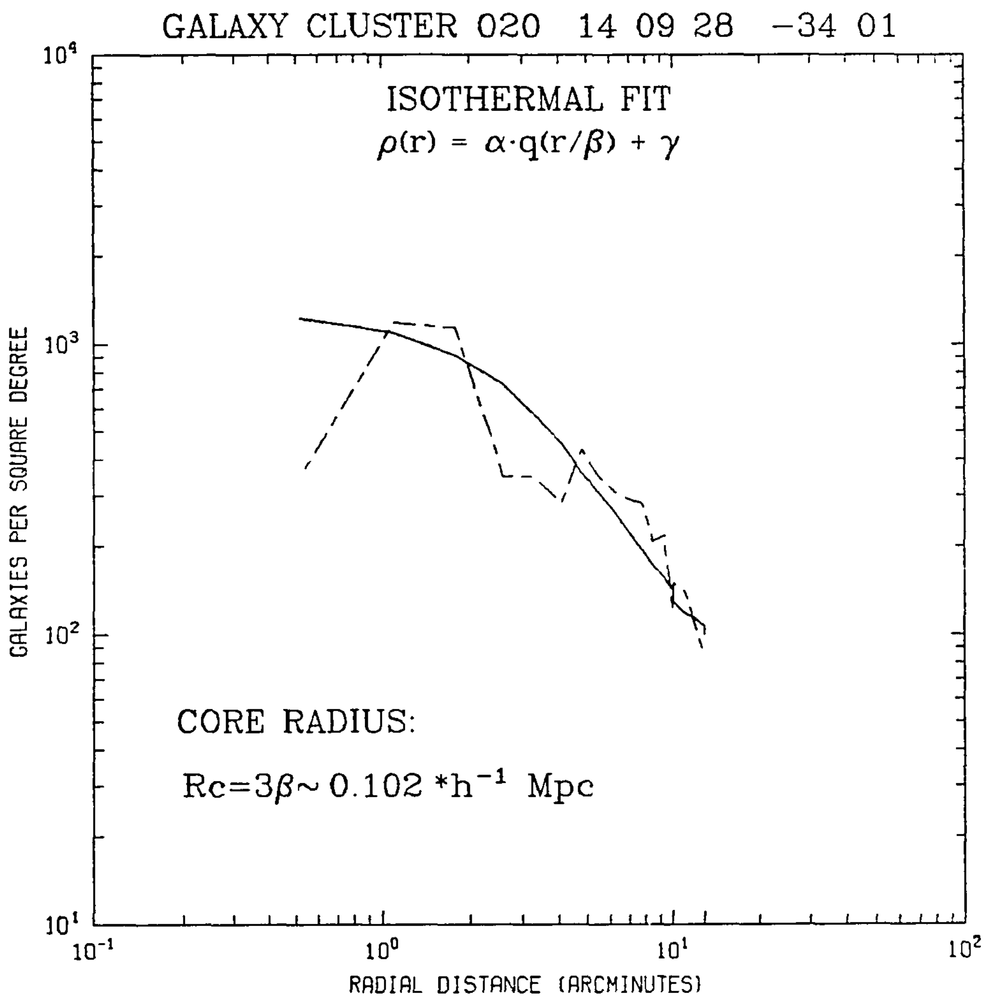


Figure 4.4.20. *(e) Isothermal Fit for Galaxy Cluster 20.*

CLUSTER PARAMETERS GALAXY CLUSTER 020 14 09 28 −34 01	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 637.12±442.73 $\beta =$ 1.05±0.19 $\gamma =$ 11.50±3.75	
$\rho_{\text{BEST FIT}}(r) =$ 1257.33 ·q(r/1.03) + 11.60	
CORE RADIUS: Rc=3β~ 0.102 *h^{-1} Mpc	REDSHIFT: Z = 0.038

Table 4.4.20. *(b) Cluster Parameters for Galaxy Cluster 20.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 219 galaxies within 19 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This somewhat centrally condensed cluster shows a wide variance along the East-West absissa with a slight enhancement East of center; likewise the North-South distibution has wide variance and an excess North of center. The quadrant counts are erratic with an avöidance of the derived cluster center and an overall excess at large radii in the second quadrant. The cluster surface density distribution id for the most part flat with the exception of the dip seen near the fourth ring.

The low central density appears to effect the isothermal fit somewhat but with the exception of the trough seen near $r = 8.1$ arcminutes, the fit seems to reproduce the general trend of the data. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 021 14 30 26 −31 32

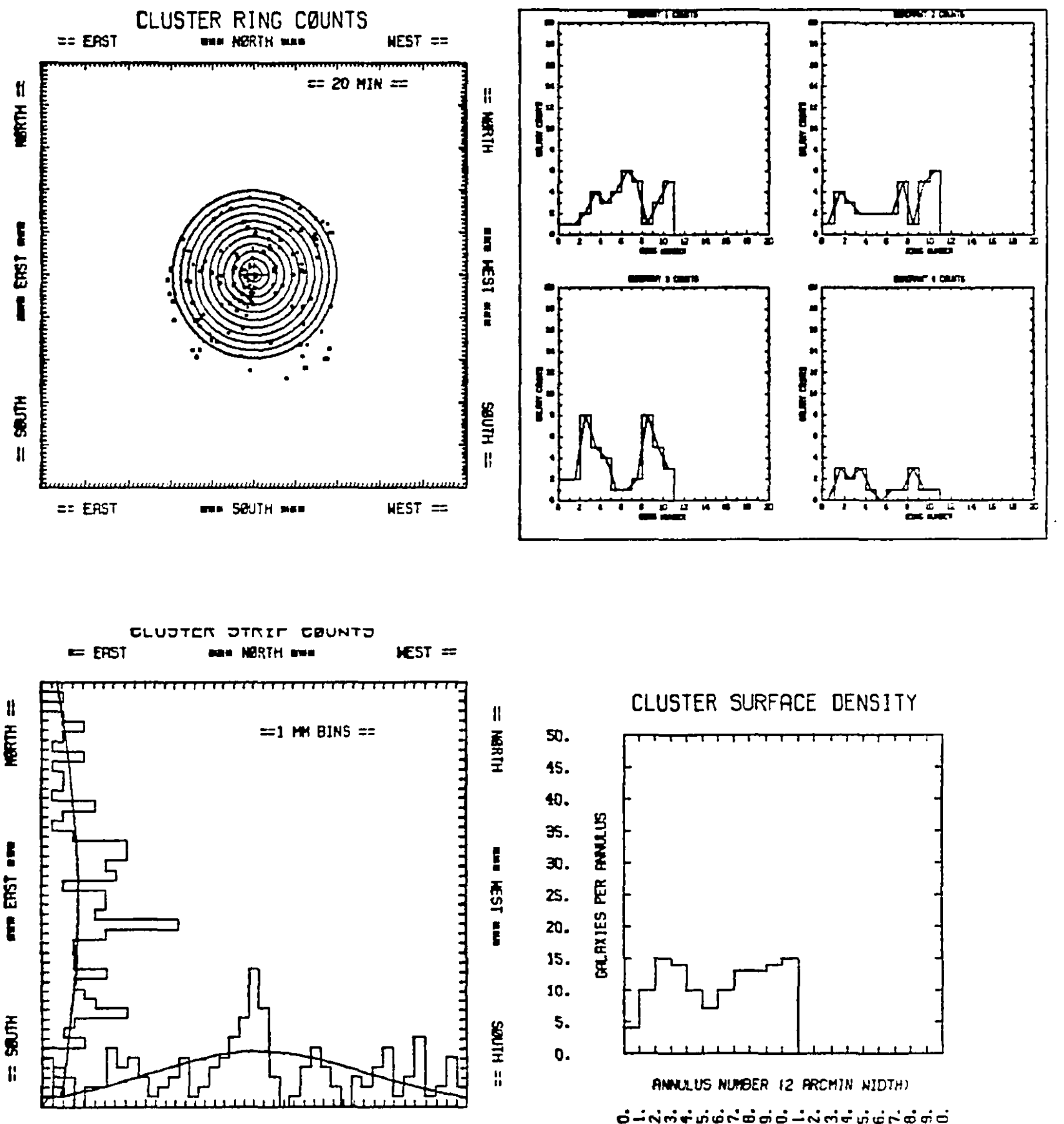


Figure 4.4.21. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 021 14 30 26 -31 32

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	4	1	1	2	0	1.259	1446.01	0.10001	3.16017
2	10	1	4	2	3	2.815	1205.00	0.44949	3.08099
3	13	1	3	7	2	4.539	939.90	0.65698	2.97308
4	15	5	1	6	3	6.295	774.65	0.79898	2.88910
5	11	3	3	4	1	8.061	441.84	0.90640	2.64526
6	6	3	2	1	0	9.833	197.18	0.99267	2.29487
7	11	7	2	1	1	11.607	305.89	1.06472	2.48556
8	13	5	5	2	1	13.383	313.30	1.12655	2.49596
9	12	1	1	7	3	15.160	255.18	1.18069	2.40684
10	14	3	4	6	1	16.937	266.37	1.22885	2.42548
11	16	5	7	3	1	18.716	275.43	1.27220	2.44001
12	11	3	1	4	3	20.494	172.89	1.31163	2.23778
13	9	5	0	3	1	22.273	130.14	1.34778	2.11441
14	3	0	0	0	3	24.052	40.17	1.38115	1.60387
15	2	0	0	0	2	25.831	24.93	1.41215	1.39674
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 150 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 43.965 Y0 = -81.811

RING WIDTH (ARCMIN) = 2.0

Table 4.4.21. *(a) Ring-Count Data for Galaxy Cluster 21.*

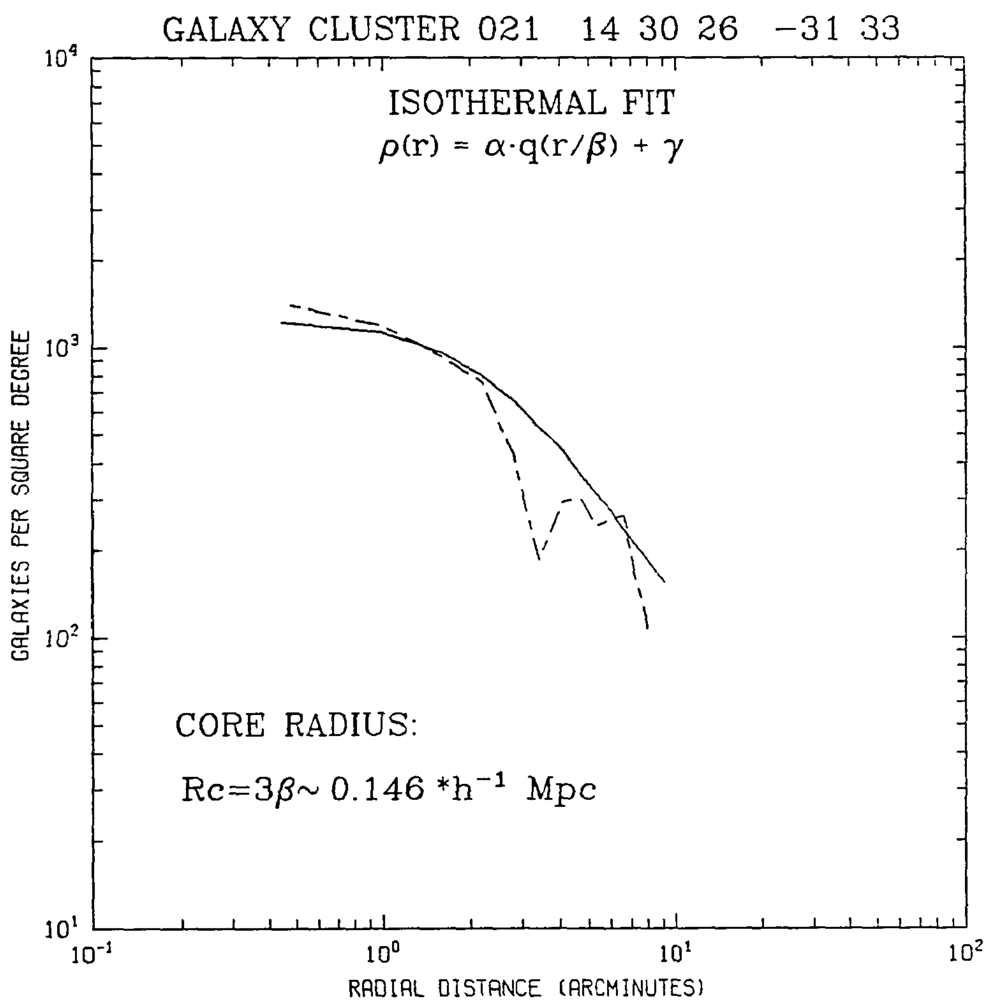


Figure 4.4.21. *(e) Isothermal Fit for Galaxy Cluster 21.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 021 14 30 26 −31 33	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 634.30 ± 397.18 $\beta =$ 1.05 ± 0.17 $\gamma =$ 11.54 ± 3.38	
$\rho_{\text{BEST FIT}}(r) =$ 1221.45 $\cdot q(r/1.03) +$ 11.94	
CORE RADIUS:	REDSHIFT:
$Rc = 3\beta \sim$ 0.146 $*h^{-1}$ Mpc	Z = 0.054

Table 4.4.21. *(b) Cluster Parameters for Galaxy Cluster 21.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 150 galaxies within 15 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. From the cluster strip counts we notice a significant peak East of the cluster center along the East-West absissa suggesting a strong linear component of concentration near the cluster center. The effect is corroborated by a Southward enhancement along the North-South ordinant. Quadrant counts reveal several minima especially near ring 6 and two relatively large peaks in the third quadrant at rings 2 and 9. The cluster surface density reflects this behavior being somewhat flat with a minimum at ring 6.

The isothermal fit agrees rather well with the data save for the minimum mentioned above seen at a distance of some ten arcminutes from cluster center. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 022 19 56 35 −38 32

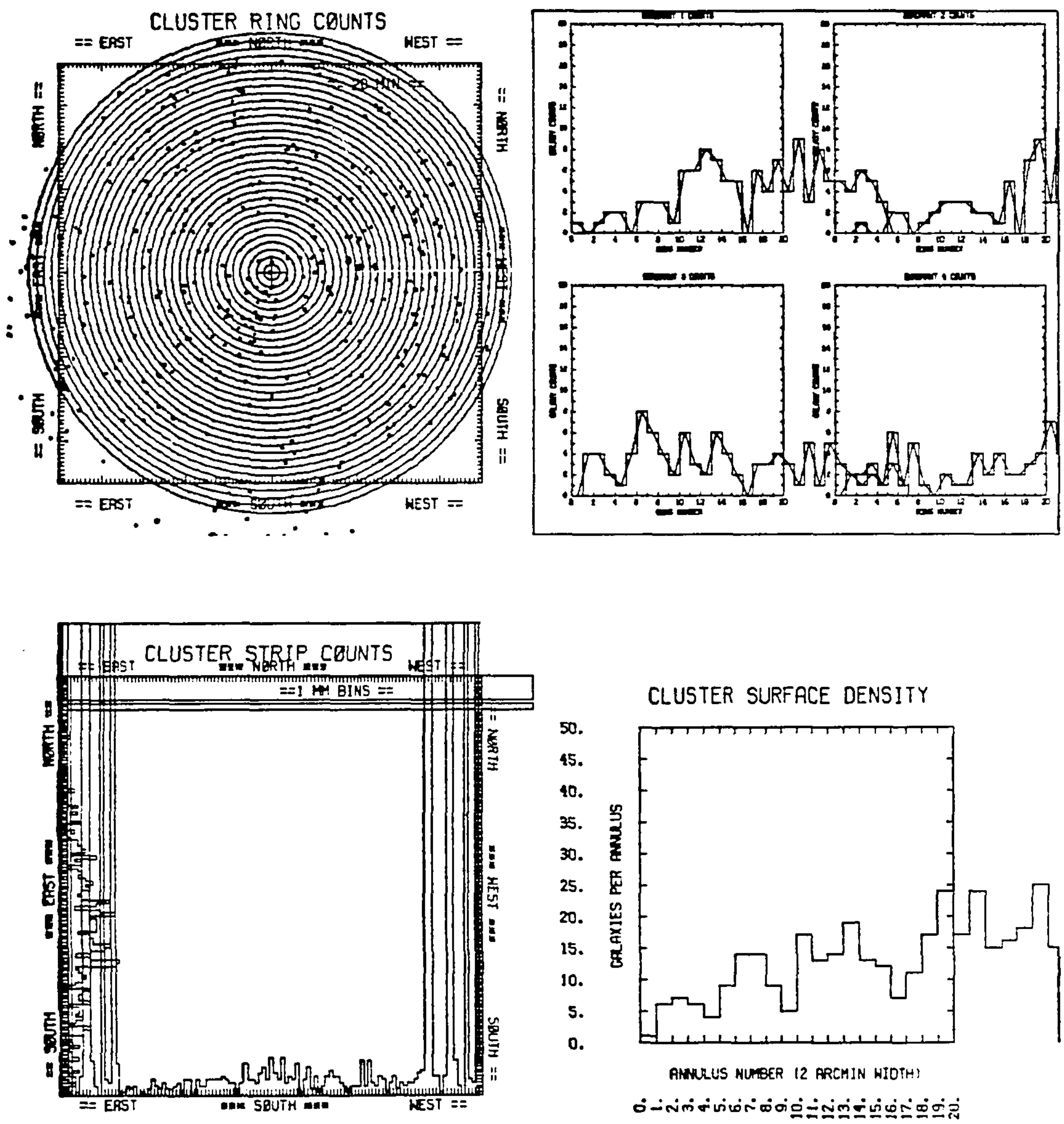


Figure 4.4.22. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 022 19 56 35 -38 32

RING NUMBER	TØTAL COUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	1	1	0	0	0	1.259	361.50	0.10001	2.55811
2	6	0	0	4	2	2.815	723.00	0.44949	2.85914
3	7	1	1	4	1	4.539	506.10	0.65698	2.70424
4	6	2	0	2	2	6.295	309.86	0.79898	2.49116
5	3	1	0	1	1	8.061	120.50	0.90640	2.08099
6	10	1	2	4	3	9.833	328.64	0.99267	2.51672
7	14	3	2	8	1	11.607	389.31	1.06472	2.59029
8	14	3	0	6	5	13.383	337.40	1.12655	2.52815
9	9	3	1	4	1	15.160	191.38	1.18069	2.28190
10	5	1	2	2	0	16.937	95.13	1.22885	1.97833
11	17	6	3	6	2	18.716	292.64	1.27220	2.46634
12	13	6	3	3	1	20.494	204.33	1.31163	2.31033
13	11	7	2	1	1	22.273	159.06	1.34778	2.20156
14	20	7	3	6	4	24.052	267.78	1.38115	2.42778
15	15	6	2	5	2	25.831	186.98	1.41215	2.27180
16	11	5	1	2	3	27.611	128.27	1.44108	2.10814
17	8	0	5	0	3	29.390	87.64	1.46820	1.94269
18	10	5	0	3	2	31.170	103.29	1.49374	2.01404
19	18	5	7	3	3	32.950	175.87	1.51785	2.24518
20	23	7	8	4	4	34.730	213.19	1.54070	2.32877

TØTAL NUMBER ØF GALAXIES CØUNTED = 458 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT XO = -3.581 YO = 80.348

RING WIDTH (ARCMIN) = 2.0

Table 4.4.22. *(a) Ring-Count Data for Galaxy Cluster 22.*

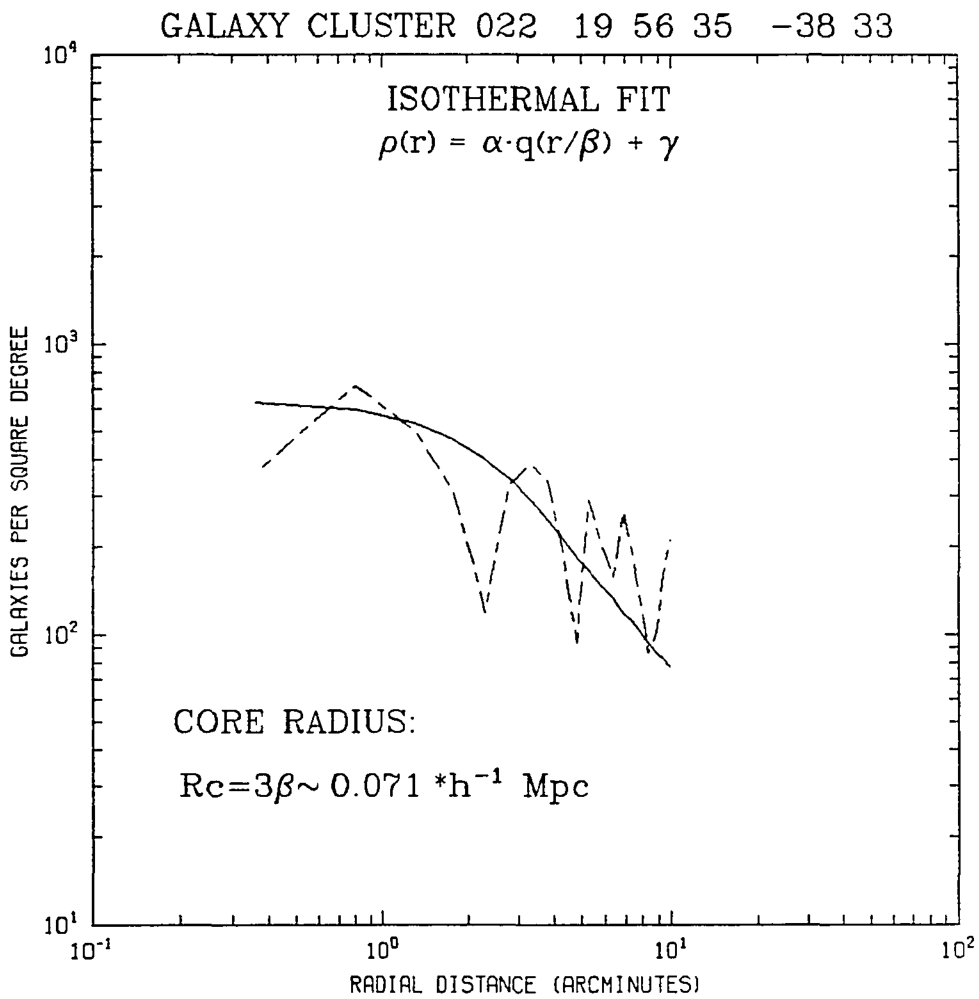


Figure 4.4.22. *(e) Isothermal Fit for Galaxy Cluster 22.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 022 19 56 35 −38 33	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 356.22±177.24 $\beta =$ 1.05±0.16 $\gamma =$ 12.01±3.21	
$\rho(r)_{\text{BEST FIT}} =$ 618.61 $\cdot q(r/1.04) +$ 13.00	
CORE RADIUS:	REDSHIFT:
$Rc=3\beta\sim$ 0.071 $*h^{-1}$ Mpc	Z = 0.026

Table 4.4.22. *(b) Cluster Parameters for Galaxy Cluster 22.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 221 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The stripcounts for this cluster burst out of range because of the large counting radius and increased number of galaxies counted in both orthogonal directions. The quadrant counts are erratic and display several significant peaks. More importantly, the cluster surface density appears to show a general trend of increasing surface density with increasing radial distance.

With the exception of troughs in the data, in particular, those seen at radial distances of $r = 8.1$ and $r = 16.9$ arcminutes, the isothermal fit approximates the data. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 023 20 38 34 −35 24

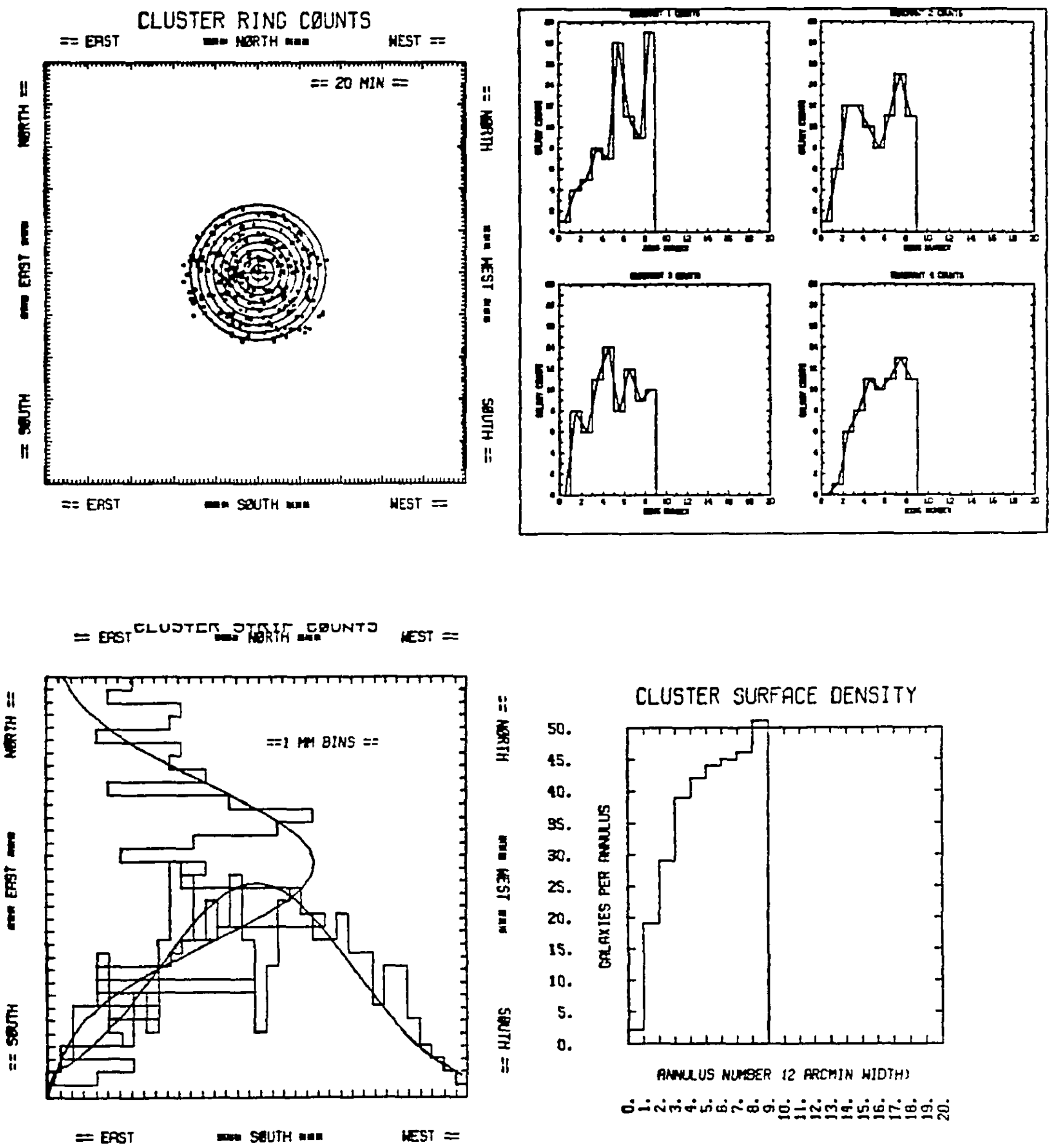


Figure 4.4.23. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 023 20 38 34 -35 24

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	1	1	0	0	1.259	723.00	0.10001	2.85914
2	19	4	6	8	1	2.815	2289.51	0.44949	3.35974
3	29	5	12	6	6	4.539	2096.71	0.65698	3.32154
4	39	8	12	11	8	6.295	2014.08	0.79898	3.30408
5	41	7	10	13	11	8.061	1646.84	0.90640	3.21665
6	45	18	8	9	10	9.833	1478.87	0.99267	3.16993
7	45	11	11	12	11	11.607	1251.35	1.06472	3.09738
8	43	9	13	8	13	13.383	1036.30	1.12655	3.01549
9	53	18	13	11	11	15.160	1127.03	1.18069	3.05194
10	16	3	6	2	5	16.937	304.42	1.22885	2.48348
11	2	0	0	0	2	18.716	34.43	1.27220	1.53692
12	0	0	0	0	0	20.494	0.00	1.31163	0.00000
13	0	0	0	0	0	22.273	0.00	1.34778	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 334 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 105.191 Y0 = -22.456

RING WIDTH (ARCMIN) = 2.0

Table 4.4.23. *(a) Ring-Count Data for Galaxy Cluster 23.*

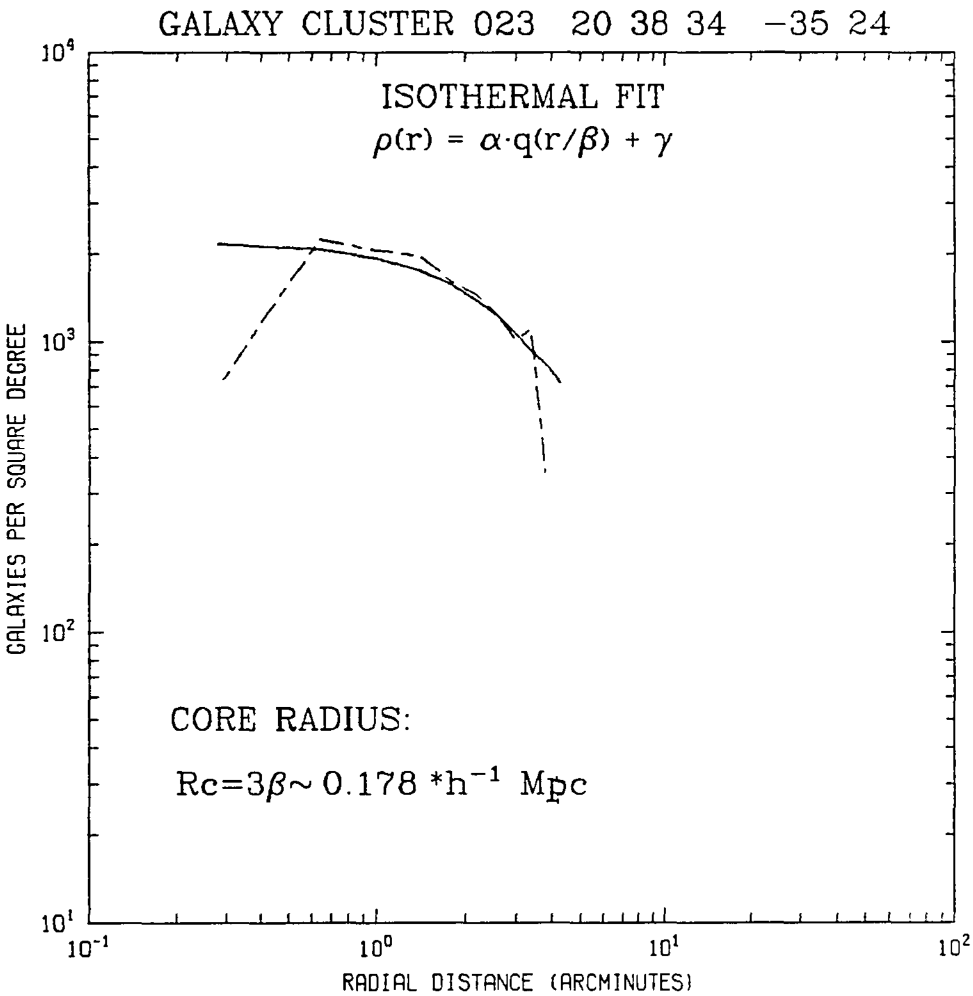


Figure 4.4.23. *(e) Isothermal Fit for Galaxy Cluster 23.*

CLUSTER PARAMETERS GALAXY CLUSTER 023 20 38 34 −35 24
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
α = 1808.25±243.74 β = 1.04±0.01 γ = 11.95±0.28
$\rho_{\text{BEST FIT}}(r) = 2160.93 \cdot q(r/1.05) + 12.35$
CORE RADIUS: Rc=3$\beta\sim$ 0.178 *h^{-1} Mpc   REDSHIFT: Z = 0.065

Table 4.4.23. *(b) Cluster Parameters for Galaxy Cluster 23.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 334 galaxies within 11 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This dense cluster displays a curious bifurcation of the data about the cluster center as determined by the dispersion ellipse analysis. The feature is seen both in the East-West and North-South data and is confirmed in the quadrant counts which show a strong avoidance for the cluster center in virtually all quadrants. The quadrant counts also show a tendency for counts to increase radially with distance with peaks in the first quadrant distribution found at rings 6 and 9. The cluster surface density also increases at a decreasing rate with increasing radial distance.

The low central density is seen to effect the isothermal fit, however the data appears to be modeled better at larger radii. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 024 20 48 41 −52 08

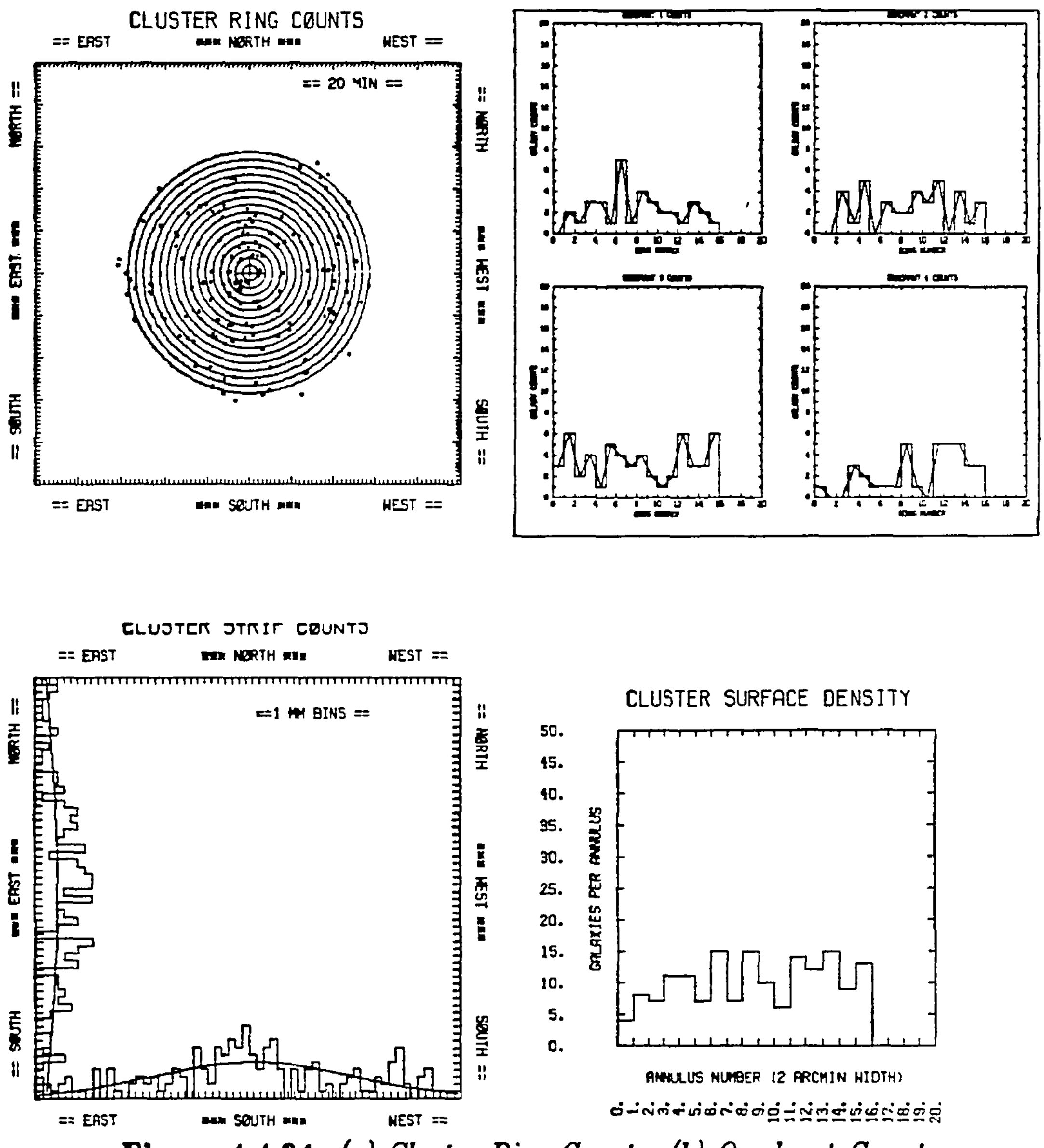


Figure 4.4.24. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 024 20 48 41 -52 08

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	4	0	0	3	1	1.259	1446.01	0.10001	3.16017
2	8	2	0	6	0	2.815	964.00	0.44949	2.98408
3	7	1	4	2	0	4.539	506.10	0.65698	2.70424
4	11	3	1	4	3	6.295	568.07	0.79898	2.75440
5	11	3	5	1	2	8.061	441.84	0.90640	2.64526
6	7	1	0	5	1	9.833	230.05	0.99267	2.36182
7	13	5	3	4	1	11.607	361.50	1.06472	2.55811
8	9	3	2	3	1	13.383	216.90	1.12655	2.33626
9	15	4	2	4	5	15.160	318.97	1.18069	2.50375
10	9	3	3	2	1	16.937	171.24	1.22885	2.23360
11	6	1	4	1	0	18.716	103.29	1.27220	2.01404
12	15	3	5	2	5	20.494	235.76	1.31163	2.37247
13	12	1	0	6	5	22.273	173.52	1.34778	2.23935
14	15	3	4	3	5	24.052	200.83	1.38115	2.30284
15	8	2	0	3	3	25.831	99.72	1.41215	1.99880
16	14	1	4	6	3	27.611	163.26	1.44108	2.21288
17	12	4	5	1	2	29.390	131.45	1.46820	2.11878
18	2	1	0	0	1	31.170	20.66	1.49374	1.31507
19	1	1	0	0	0	32.950	9.77	1.51785	0.98991
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 179 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT XO = 95.831 YO = -115.415

RING WIDTH (ARCMIN) = 2.0

Table 4.4.24. *(a) Ring-Count Data for Galaxy Cluster 24.*

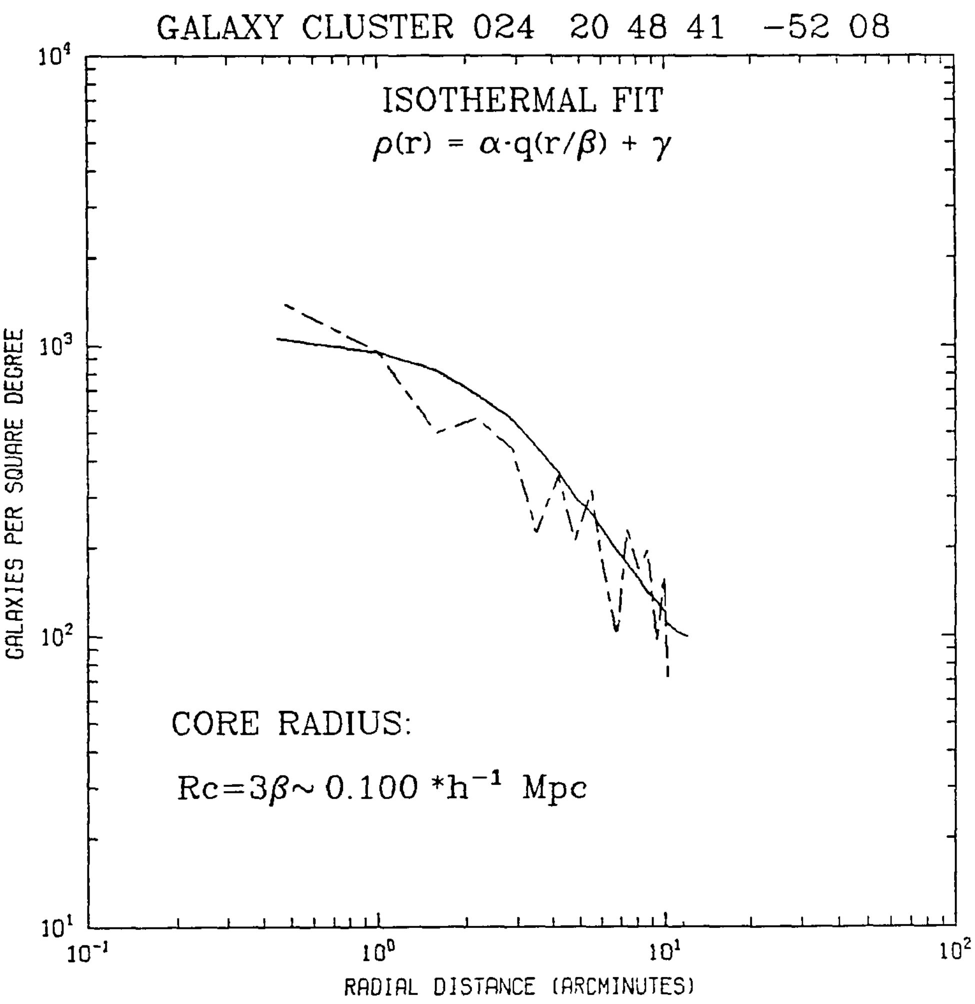


Figure 4.4.24. *(e) Isothermal Fit for Galaxy Cluster 24.*

CLUSTER PARAMETERS		
GALAXY CLUSTER 024 20 48 41 −52 08		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
$\alpha =$ 553.96 ±340.43	$\beta =$ 1.05±0.17	$\gamma =$ 11.68± 3.43
$\rho_{\text{BEST FIT}}(r) =$ 1053.68 ·q(r/1.03) + 12.20		
CORE RADIUS: $Rc=3\beta\sim$ 0.100 $*h^{-1}$ Mpc		REDSHIFT: Z = 0.037

Table 4.4.24. *(b) Cluster Parameters for Galaxy Cluster 24.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 179 galaxies within 19 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We note a wide variance in both the east-West and North-South strip count data with slight concentrations Eastward of center along the absissa and Northward along the ordinant. Several peaks are noticed in the quadrant counts, in particular the first quadrant maximum near ring 7. The cluster surface density shows several peaks and troughs but no really significant deviations.

The isothermal fit to the data achieves some success, but appears somewhat high in the sense of enveloping the data peaks, perhaps being influenced by the apparently high central density as well as the wild variations seen at relatively large radial distances from the cluster center. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 025 21 13 10 −59 36

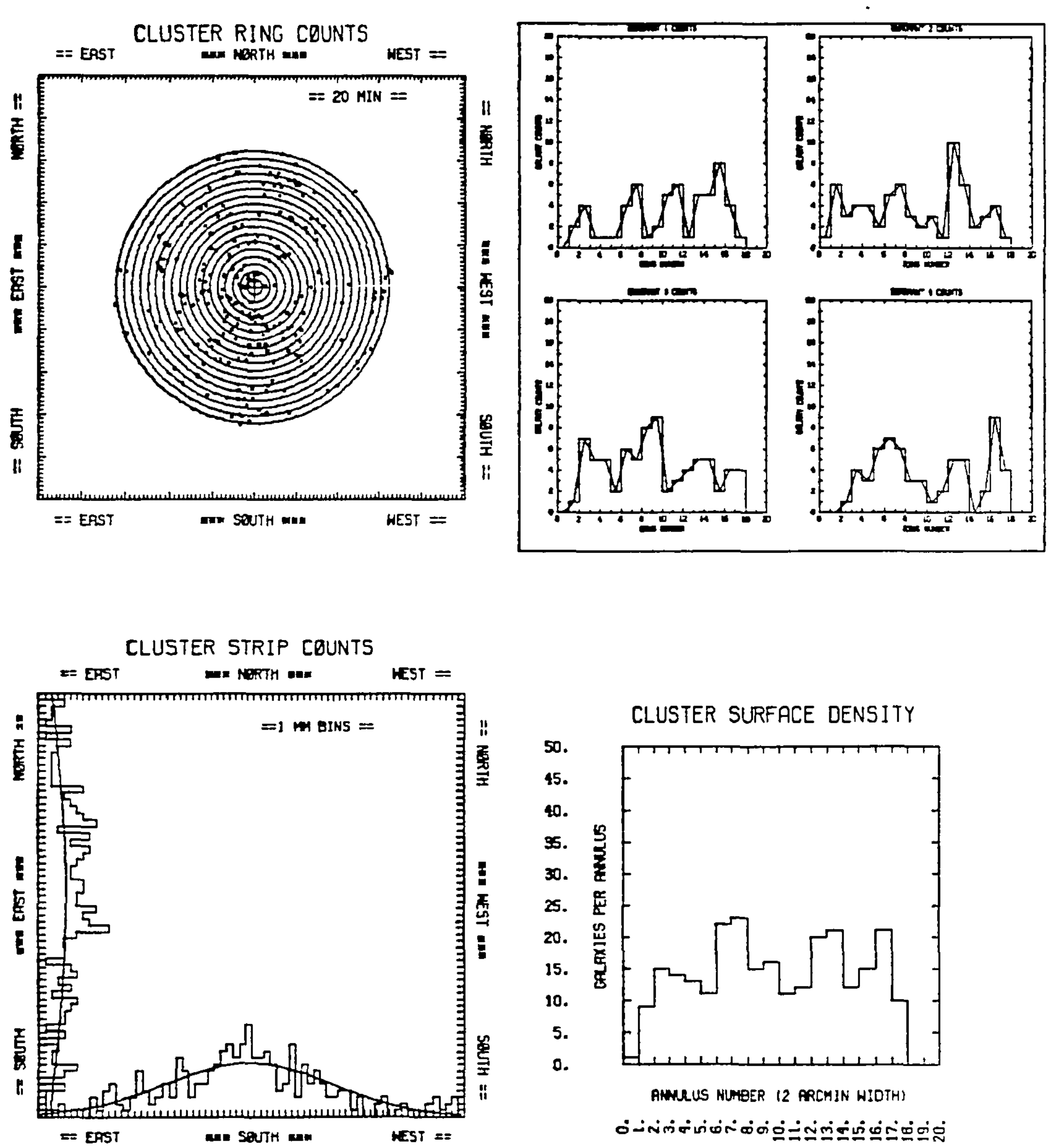


Figure 4.4.25. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 025 21 13 10 -59 36

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	1	0	1	0	0	1.259	361.50	0.10001	2.55811
2	9	2	6	1	0	2.815	1084.50	0.44949	3.03523
3	15	4	3	7	1	4.539	1084.50	0.65698	3.03523
4	14	1	4	5	4	6.295	723.00	0.79898	2.85914
5	13	1	4	5	3	8.061	522.17	0.90640	2.71781
6	11	1	2	2	6	9.833	361.50	0.99267	2.55811
7	22	4	5	6	7	11.607	611.77	1.06472	2.78659
8	22	5	6	5	6	13.383	530.20	1.12655	2.72444
9	13	2	2	7	2	15.160	276.44	1.18069	2.44160
10	18	2	3	10	3	16.937	342.48	1.22885	2.53463
11	12	5	3	2	2	18.716	206.57	1.27220	2.31507
12	12	6	1	3	2	20.494	188.61	1.31163	2.27556
13	19	1	10	3	5	22.273	274.74	1.34778	2.43892
14	21	5	6	5	5	24.052	281.17	1.38115	2.44897
15	12	4	2	6	0	25.831	149.59	1.41215	2.17489
16	15	8	3	2	2	27.611	174.92	1.44108	2.24284
17	21	4	4	4	9	29.390	230.05	1.46820	2.36182
18	11	2	1	4	4	31.170	113.61	1.49374	2.05543
19	8	6	2	0	0	32.950	78.16	1.51785	1.89300
20	2	2	0	0	0	34.730	18.54	1.54070	1.26808

TØTAL NUMBER ØF GALAXIES CØUNTED = 271 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 131.705 Y0 = 18.574

RING WIDTH (ARCMIN) = 2.0

Table 4.4.25. *(a) Ring-Count Data for Galaxy Cluster 25.*

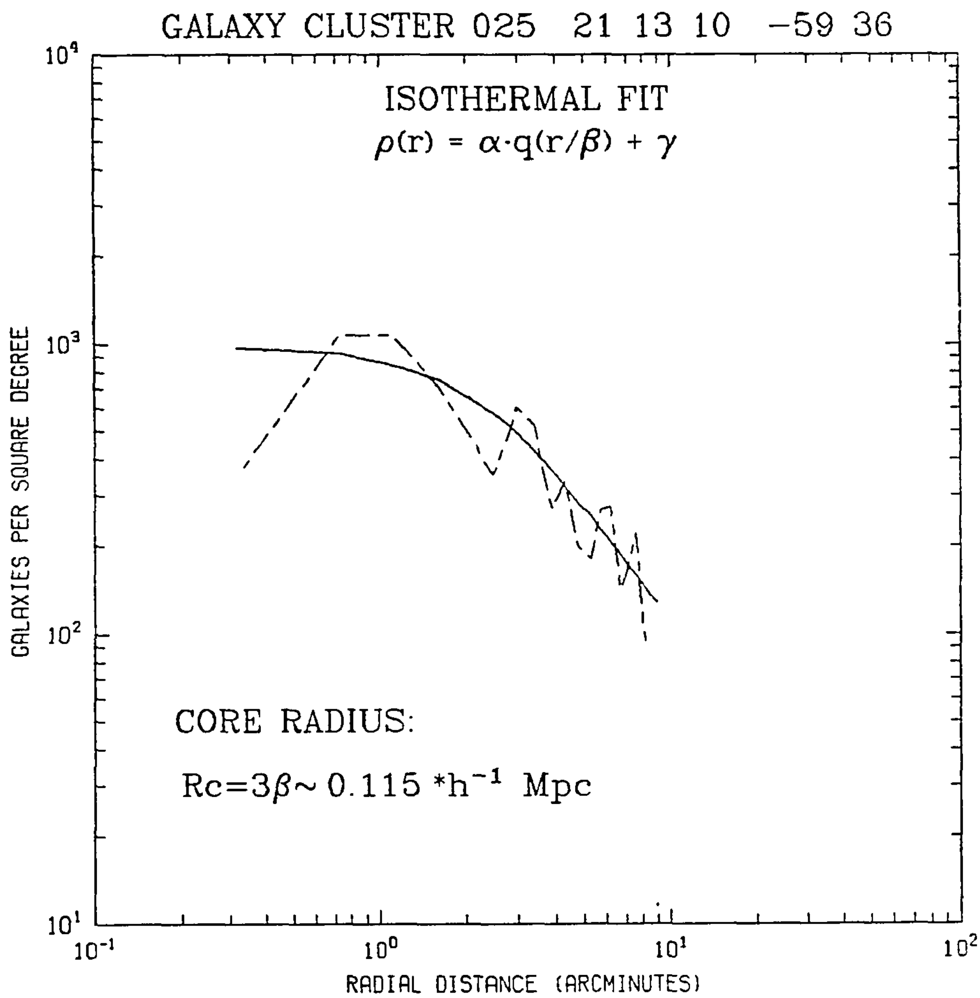


Figure 4.4.25. *(e) Isothermal Fit for Galaxy Cluster 25.*

CLUSTER PARAMETERS GALAXY CLUSTER 025 21 13 10 −59 36	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 525.08 ± 293.09 $\beta =$ 1.05 ± 0.16 $\gamma =$ 11.80 ± 3.12	
$\rho_{\text{BEST FIT}}(r) =$ 964.43 $\cdot$ q(r/1.04) + 12.63	
CORE RADIUS: Rc=3β~ 0.115 *h^{-1} Mpc	REDSHIFT: Z = 0.042

Table 4.4.25. *(b) Cluster Parameters for Galaxy Cluster 25.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 271 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show a rather symmetric spread about the cluster center along the East-West absissa and a slight Northward increase along the North-South ordinate. We find several peaks amongst the quadrant counts, the largest occuring in the third quadrant near ring 10. We notice a general avoidance of the cluster center. This effect is also seen in the cluster surface density distribution which otherwise shows several major peaks and troughs above some mean value.

The isothermal fit is no doubt influenced by the paucity of data near the cluster center, but the rest of the observed data appears to be well discribed by the isothermal model. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 026 21 22 58 -35 00

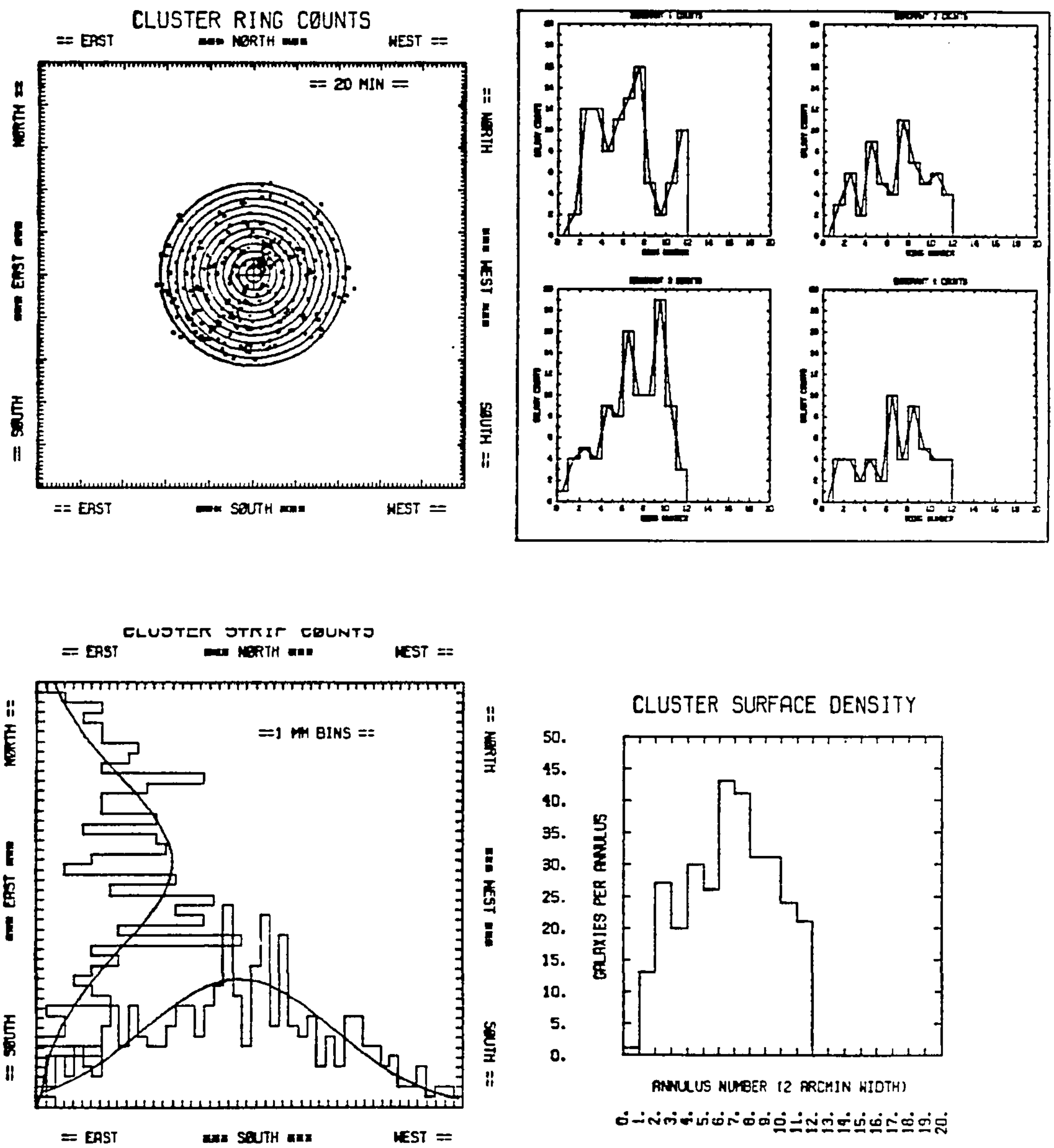


Figure 4.4.26. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 026 21 22 58 -35 00

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	1	0	0	1	0	1.259	361.50	0.10001	2.55811
2	13	2	3	4	4	2.815	1566.51	0.44949	3.19493
3	26	12	6	4	4	4.539	1879.81	0.65698	3.27411
4	20	12	1	5	2	6.295	1032.86	0.79898	3.01404
5	30	8	10	8	4	8.061	1205.00	0.90640	3.08099
6	27	11	5	9	2	9.833	887.32	0.99267	2.94808
7	42	13	4	15	10	11.607	1167.93	1.06472	3.06742
8	40	16	10	10	4	13.383	964.00	1.12655	2.98408
9	32	5	8	10	9	15.160	680.47	1.18069	2.83281
10	31	2	5	19	5	16.937	589.82	1.22885	2.77072
11	25	5	6	10	4	18.716	430.36	1.27220	2.63383
12	19	9	3	3	4	20.494	298.63	1.31163	2.47514
13	13	7	2	2	2	22.273	187.98	1.34778	2.27411
14	4	3	0	0	1	24.052	53.56	1.38115	1.72881
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 323 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 144.719 Y0 = -1.784

RING WIDTH (ARCMIN) = 2.0

Table 4.4.26. *(a) Ring-Count Data for Galaxy Cluster 26.*

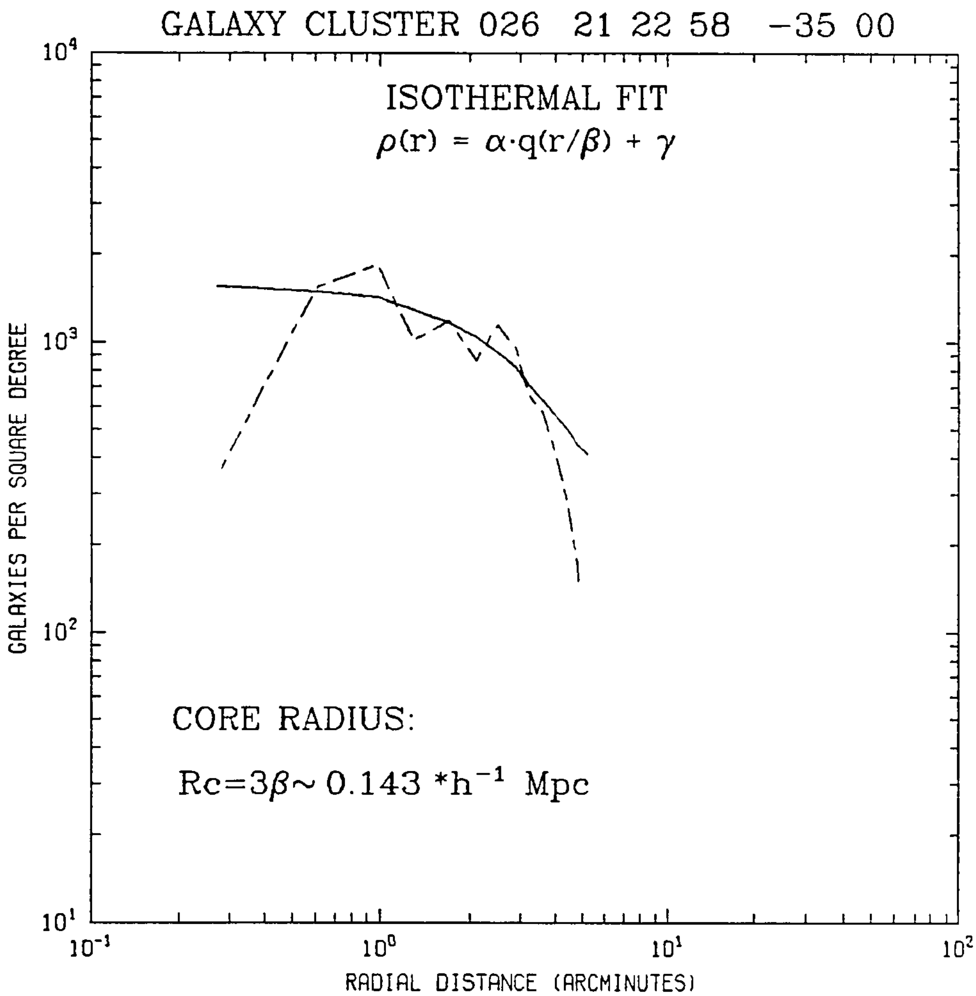


Figure 4.4.26. *(e) Isothermal Fit for Galaxy Cluster 26.*

CLUSTER PARAMETERS		
GALAXY CLUSTER 026 21 22 58 −35 00		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
$\alpha =$ 957.43 ±395.58	$\beta =$ 1.06±0.11	$\gamma =$ 12.13± 2.07
$\rho_{\text{BEST FIT}}(r) =$ 1545.68 ·q(r/1.05) + 12.62		
CORE RADIUS: Rc=3β~ 0.143 *h^{-1} Mpc		REDSHIFT: Z = 0.052

Table 4.4.26. *(b) Cluster Parameters for Galaxy Cluster 26.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 323 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This fairly compact cluster shows a relatively uniform distribution along the East-West absissa while the North-South ordinate displays considerably more scatter. The quadrant counts show a strong avoidance of the cluster center with a strong peak shown in the first quadrant as a result of subclustering in that region. We find the cluster surface density rising fairly rapidly from the central void to a maximum near $r = 11.6$ arcminutes and then descending more slowly to the periphery of the cluster.

As a result of the relatively low central densities, the isothermal fit seeks to model the middle regions of the cluster where $10^{0.5} \leq r \leq 10^{1.3}$. In this region we feel the isothermal model adequately describes the observations. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 027 21 26 10 -51 04

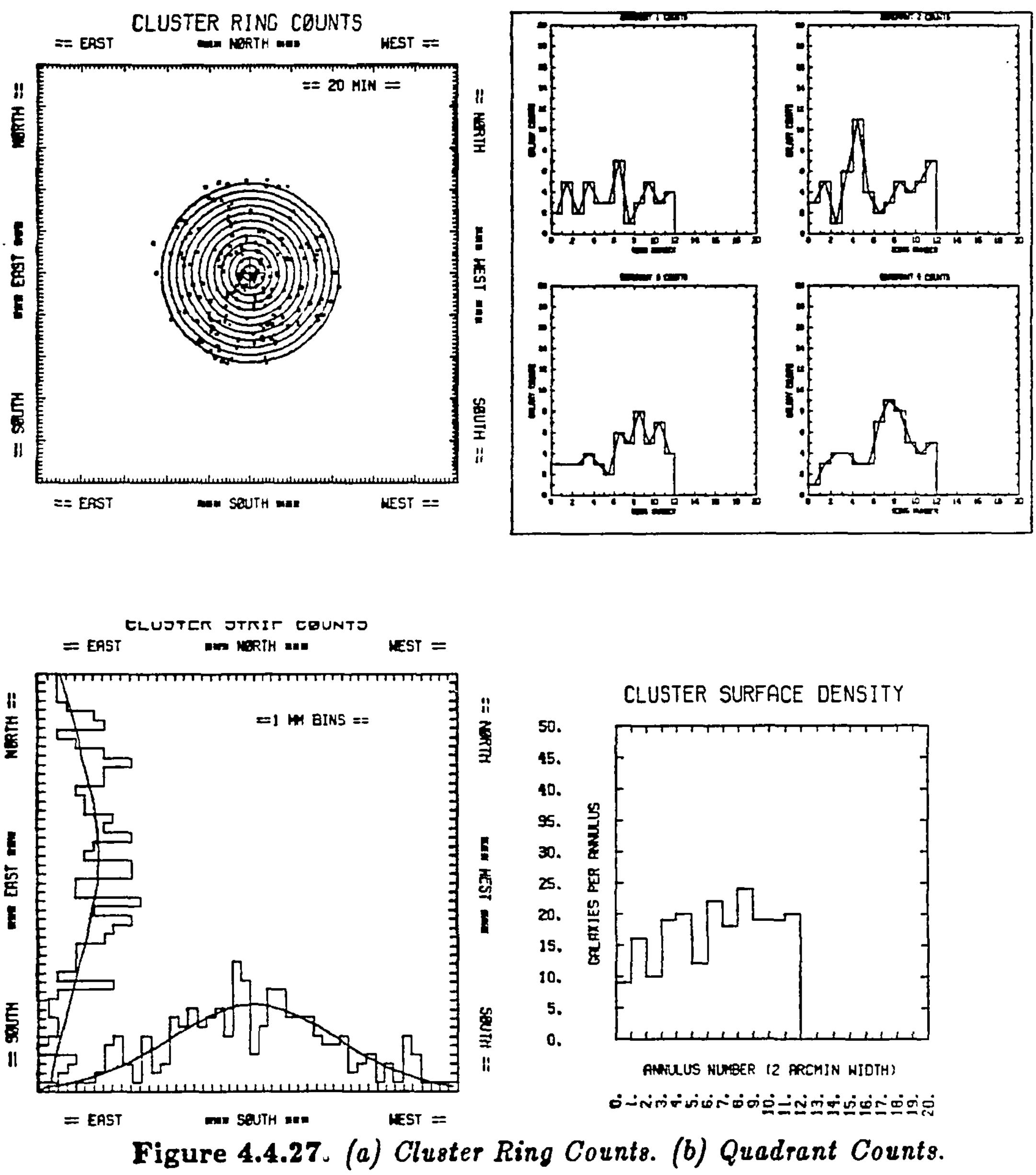


Figure 4.4.27. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 027 21 26 10 -51 04

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	9	2	3	3	1	1.259	3253.51	0.10001	3.51235
2	16	5	5	3	3	2.815	1928.01	0.44949	3.28511
3	10	2	1	3	4	4.539	723.00	0.65698	2.85914
4	19	5	6	4	4	6.295	981.22	0.79898	2.99177
5	19	3	10	3	3	8.061	763.17	0.90640	2.88262
6	13	3	5	2	3	9.833	427.23	0.99267	2.63066
7	21	7	2	6	6	11.607	583.96	1.06472	2.76639
8	18	1	3	4	10	13.383	433.80	1.12655	2.63729
9	25	3	5	9	8	15.160	531.62	1.18069	2.72560
10	18	4	4	5	5	16.937	342.48	1.22885	2.53463
11	20	4	5	7	4	18.716	344.29	1.27220	2.53692
12	19	3	7	4	5	20.494	298.63	1.31163	2.47514
13	6	3	2	0	1	22.273	86.76	1.34778	1.93832
14	8	3	5	0	0	24.052	107.11	1.38115	2.02984
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 221 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 33.381 Y0 = -57.179

RING WIDTH (ARCMIN) = 2.0

Table 4.4.27. *(a) Ring-Count Data for Galaxy Cluster 27.*

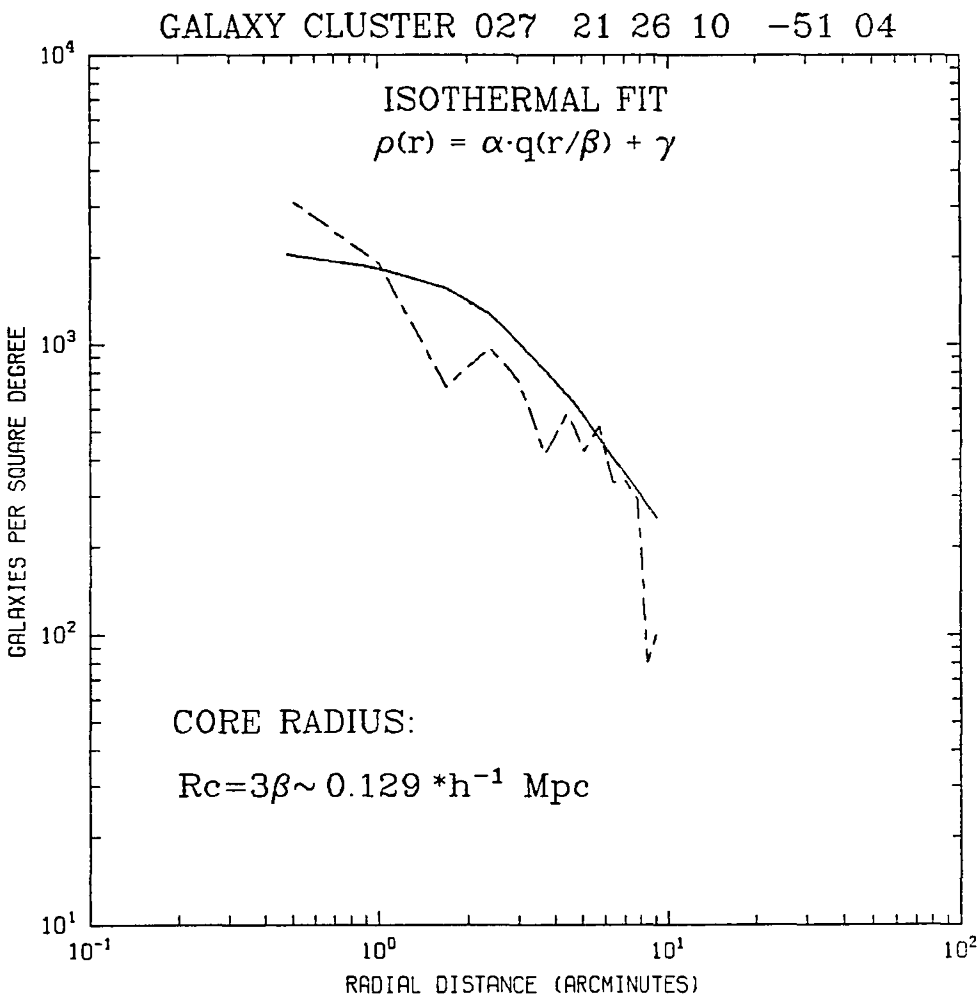


Figure 4.4.27. *(e) Isothermal Fit for Galaxy Cluster 27.*

CLUSTER PARAMETERS GALAXY CLUSTER 027 21 26 10 −51 04
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
$\alpha = 1472.53 \pm 388.72$ $\beta = 1.02 \pm 0.01$ $\gamma = 11.40 \pm 0.40$
$\rho_{\text{BEST FIT}}(r) = 2060.16 \cdot q(r/1.03) + 12.01$
CORE RADIUS: $Rc = 3\beta \sim 0.129 * h^{-1}$ Mpc REDSHIFT: Z = 0.048

Table 4.4.27. *(b) Cluster Parameters for Galaxy Cluster 27.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 221 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This centrally condensed clusters shows a slight depression in the strip count data along the East-West absissa near the center of the cluster whereas the North-South ordinate merely displays a large scatter. The quadrant counts show a general tendency to increase their populations with radial distance from the center of the cluster and this same behavior is seen in the surface density distribution which displays a gradual increase in density radiallly away from the cluster center save for the dip at ring 6.

The high central density of this cluster dominates the ability of the isothermal model to fit the observations well, so as a result we see the fit riding as an envelope over the observed density distribution with better mapping only at the cluster periphery. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 028 21 29 13 −35 23

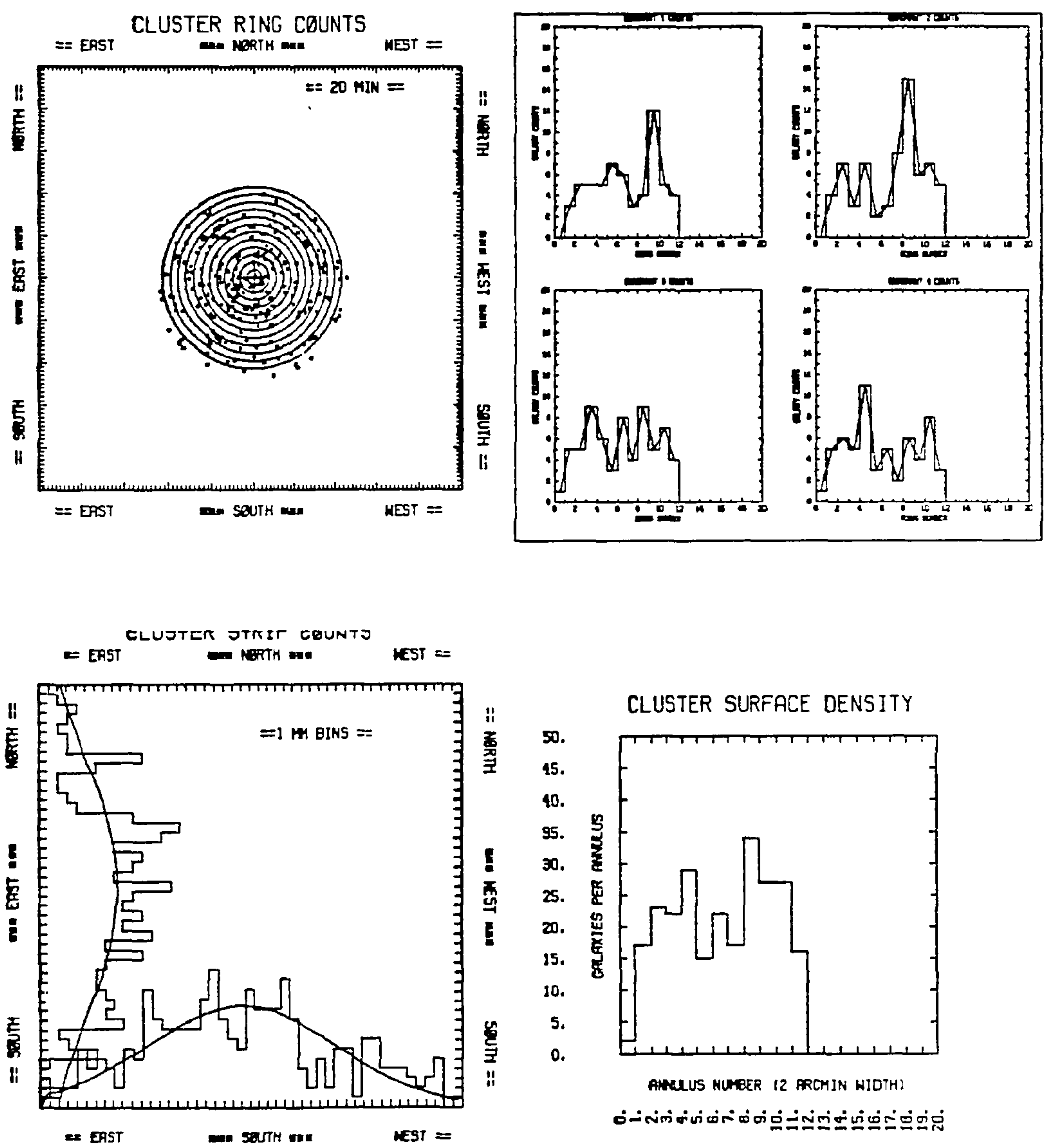


Figure 4.4.28. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 028 21 29 13 -35 23

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	0	1	1	1.259	723.00	0.10001	2.85914
2	17	3	4	5	5	2.815	2048.51	0.44949	3.31144
3	23	5	7	5	6	4.539	1662.91	0.65698	3.22087
4	22	5	3	9	5	6.295	1136.15	0.79898	3.05543
5	28	5	7	5	11	8.061	1124.67	0.90640	3.05103
6	15	7	1	4	3	9.833	492.96	0.99267	2.69281
7	22	5	4	8	5	11.607	611.77	1.06472	2.78659
8	18	4	8	4	2	13.383	433.80	1.12655	2.63729
9	34	4	15	9	6	15.160	723.00	1.18069	2.85914
10	26	11	6	5	4	16.937	494.69	1.22885	2.69433
11	27	6	7	7	7	18.716	464.79	1.27220	2.66725
12	15	3	5	4	3	20.494	235.76	1.31163	2.37247
13	20	7	0	4	9	22.273	289.20	1.34778	2.46120
14	1	1	0	0	0	24.052	13.39	1.38115	1.12675
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 270 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 75.807 Y0 = -19.961

RING WIDTH (ARCMIN) = 2.0

Table 4.4.28. *(a) Ring-Count Data for Galaxy Cluster 28.*

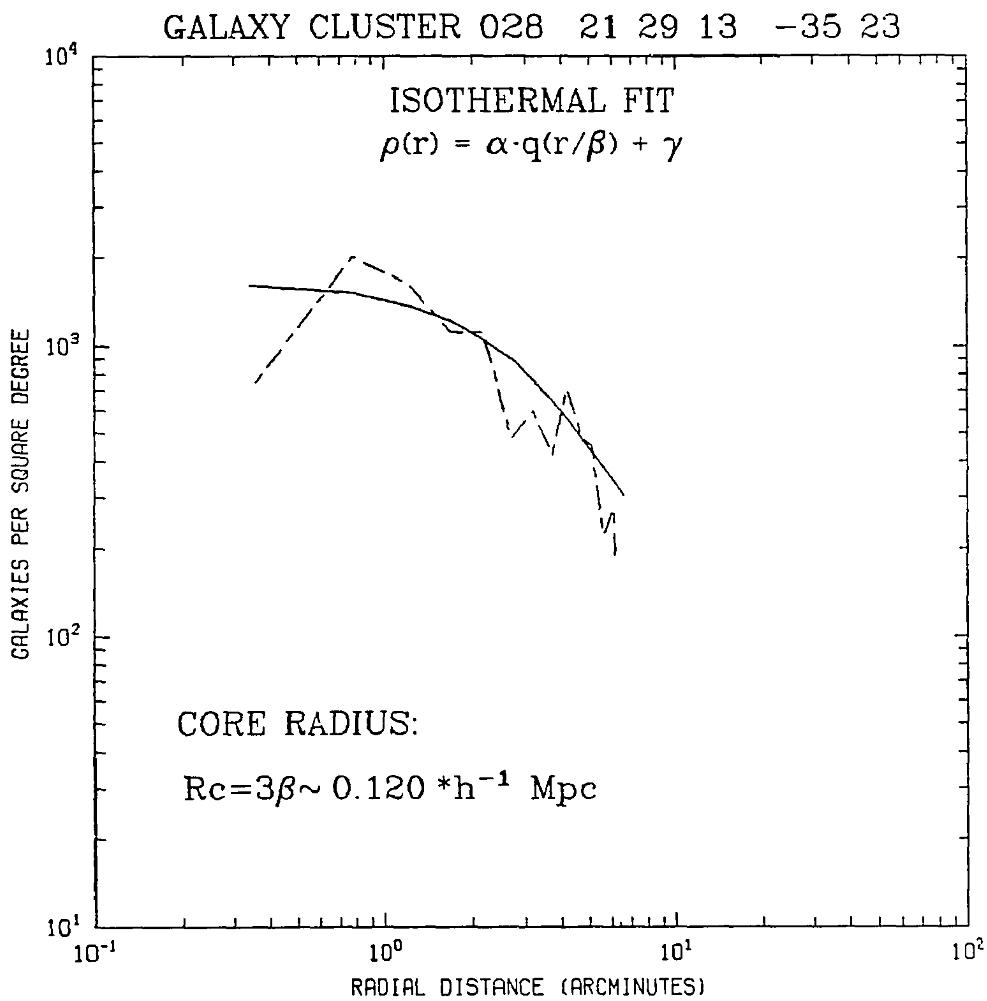


Figure 4.4.28. *(e) Isothermal Fit for Galaxy Cluster 28.*

CLUSTER PARAMETERS
GALAXY CLUSTER 028 21 29 13 −35 23
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
α = 857.47±506.01 β = 1.05±0.16 γ = 11.65±3.19
$\rho_{\text{BEST FIT}}(r) = 1613.81 \cdot q(r/1.04) + 12.21$
CORE RADIUS: $Rc=3\beta\sim$ 0.120 $*h^{-1}$ Mpc — REDSHIFT: Z = 0.044

Table 4.4.28. *(b) Cluster Parameters for Galaxy Cluster 28.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 270 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. In this case we have a fairly centrally condensed cluster; the East-West strip counts along the absissa show a concentration East of center whereas along the North-South ordinate we find a concentration somewhat South of center. We see the same behavior displayed in the quadrant counts with an additional strong peak seen in the first and particularly in the second quadrant at ring 9. The cluster surface density distribution shows a paucity of counts near cluster center and a bifurcated distribution otherwise, with a minimum near ring 7.

The isothermal fit is somewhat effected by the low central projected density, but seems to otherwise approximate the observations, save for the bifurcated region of the distribution near $(10^{0.9} \leq r \leq 10^{1.2})$ where it overrides the data. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 029 21 31 14 −62 15

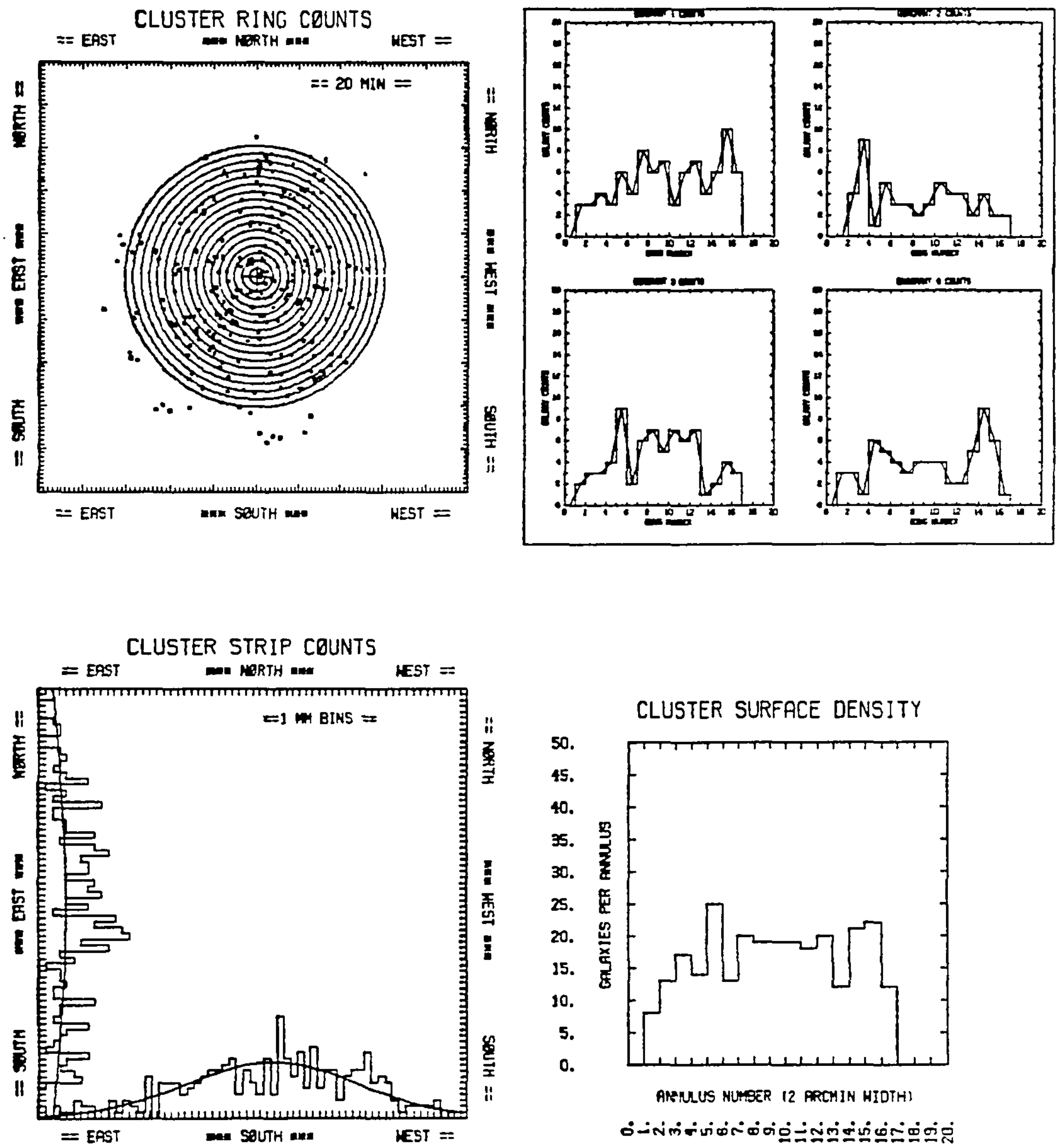


Figure 4.4.29. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 029 21 31 14 -62 15

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	0	0	0	0	0	1.259	0.00	0.10001	0.00000
2	8	3	0	2	3	2.815	964.00	0.44949	2.98408
3	13	3	4	3	3	4.539	939.90	0.65698	2.97308
4	16	3	9	3	1	6.295	826.29	0.79898	2.91713
5	14	3	1	4	6	8.061	562.34	0.90640	2.75000
6	26	7	5	9	5	9.833	854.46	0.99267	2.93169
7	13	4	3	2	4	11.607	361.50	1.06472	2.55811
8	19	8	3	5	3	13.383	457.90	1.12655	2.66077
9	18	5	2	7	4	15.160	382.77	1.18069	2.58293
10	19	8	2	5	4	16.937	361.50	1.22885	2.55811
11	21	3	6	8	4	18.716	361.50	1.27220	2.55811
12	16	6	3	5	2	20.494	251.48	1.31163	2.40050
13	22	7	5	8	2	22.273	318.12	1.34778	2.50259
14	11	4	2	0	5	24.052	147.28	1.38115	2.16814
15	19	6	4	3	6	25.831	236.85	1.41215	2.37447
16	23	8	2	4	9	27.611	268.21	1.44108	2.42848
17	12	7	2	2	1	29.390	131.45	1.46820	2.11878
18	7	2	4	1	0	31.170	72.30	1.49374	1.85914
19	8	3	1	4	0	32.950	78.16	1.51785	1.89300
20	7	1	0	3	3	34.730	64.88	1.54070	1.81214

TØTAL NUMBER ØF GALAXIES CØUNTED = 298 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT XO = 8.471 YO = -118.667

RING WIDTH (ARCMIN) = 2.0

Table 4.4.29. *(a) Ring-Count Data for Galaxy Cluster 29.*

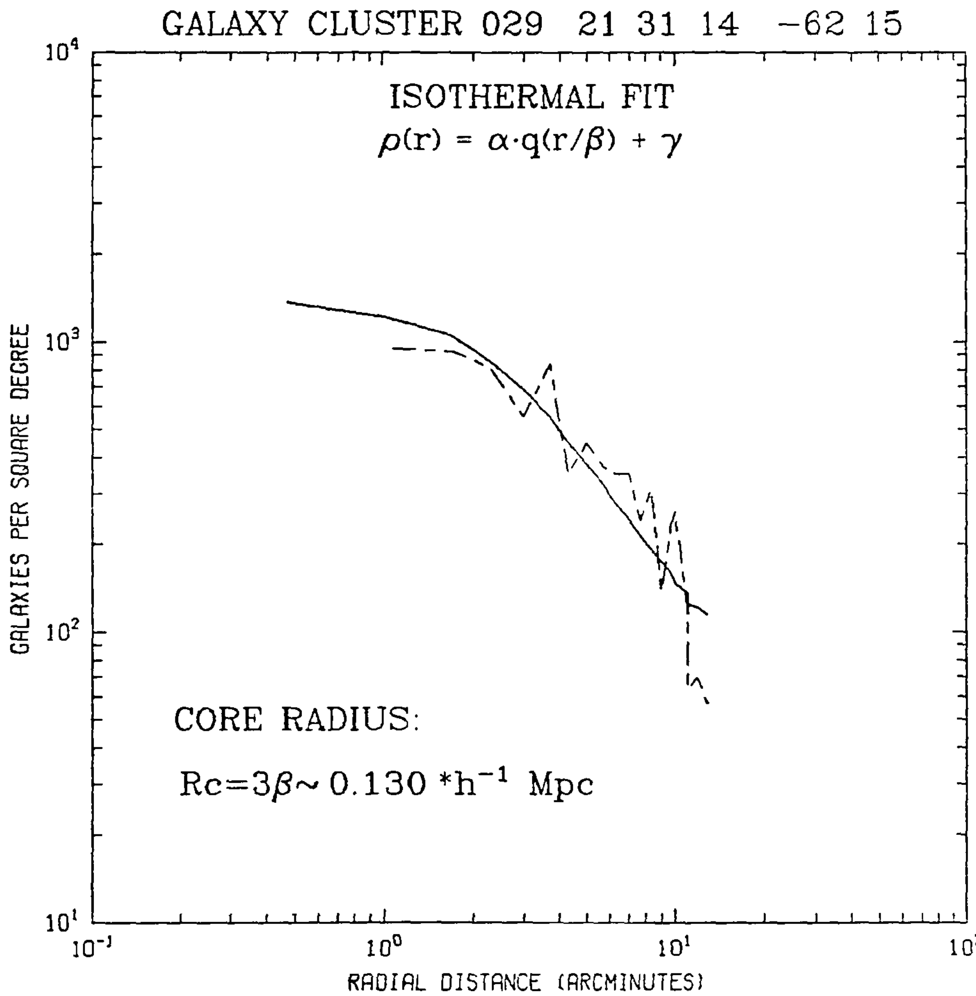


Figure 4.4.29. *(e) Isothermal Fit for Galaxy Cluster 29.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 029 21 31 14 −62 15	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 698.17 ± 474.22 $\beta =$ 1.05 ± 0.18	$\gamma =$ 11.62 ± 3.61
$\rho(r)_{\text{BEST FIT}} =$ 1369.58 $\cdot q(r/1.03) +$ 11.95	
CORE RADIUS:	REDSHIFT:
Rc=3$\beta\sim$ 0.130 $*h^{-1}$ Mpc	Z = 0.048

Table 4.4.29. *(b) Cluster Parameters for Galaxy Cluster 29.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 293 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We find the East-West strip counts somewhat uniformly distributed on the absissa, but more widely scattered and with greater variance along the North-South ordinate. The quadrant count data shows a zone of avoidance at the calculated center of the cluster in all quadrants as well as a generally erratic appearance. The cluster surface density distribution shows a plateau-like shape cut with several minima located at ring 7 and ring 14.

The lack of counts near the center of the cluster forces a deep minima on the isothermal fit, so that point has been ignored in the analysis. The remaining observations are then fairly well modeled by the isothermal distribution with the exception of the tail of the observations that suffer a severe cutoff at the radial distance of $r = 35$ minutes of arc from the center of the cluster. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 030 21 31 06 −53 50

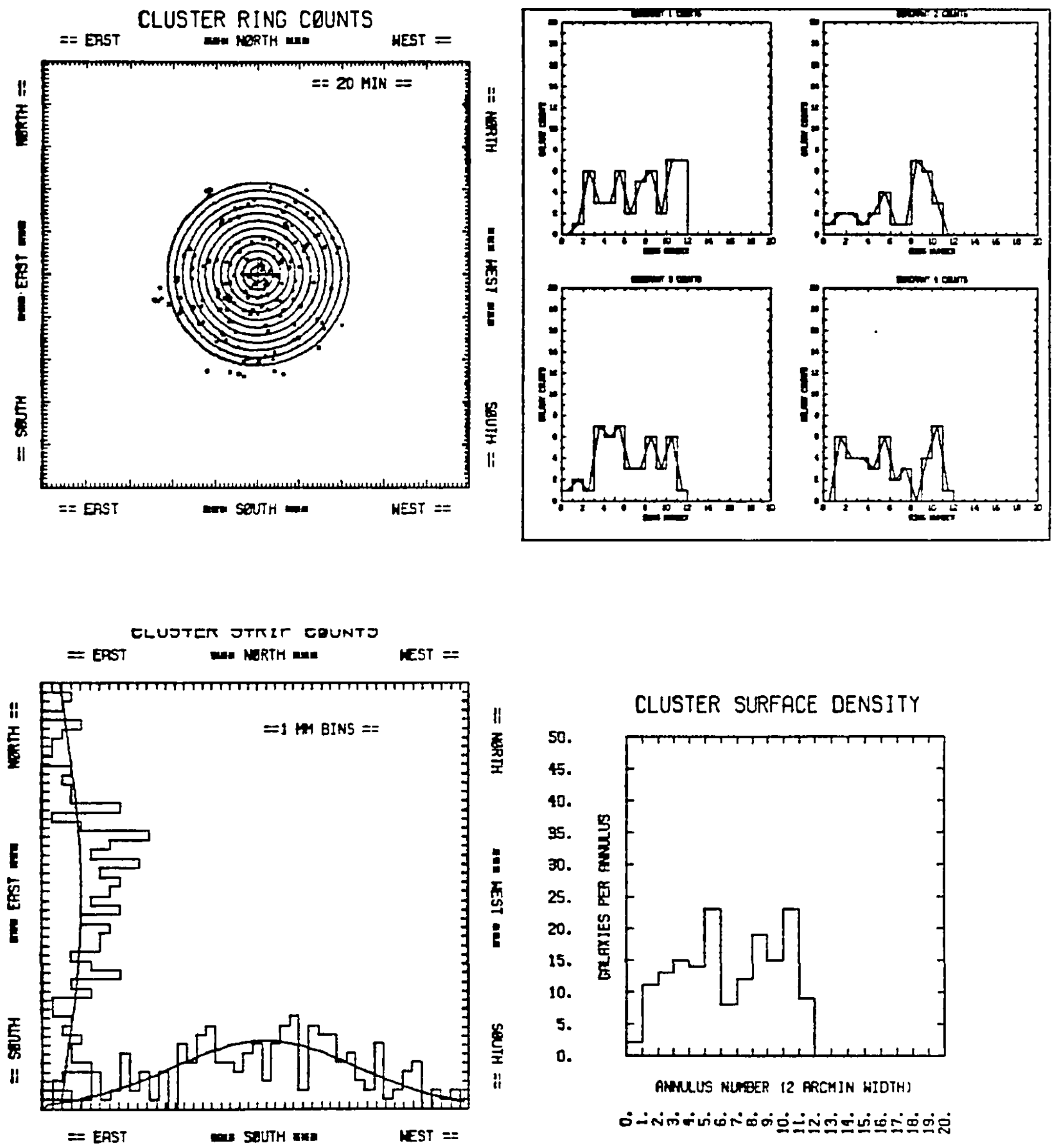


Figure 4.4.30. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 030 21 31 06 -53 50

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	1	1	0	1.259	723.00	0.10001	2.85914
2	11	1	2	2	6	2.815	1325.51	0.44949	3.12238
3	13	6	2	1	4	4.539	939.90	0.65698	2.97308
4	15	3	1	7	4	6.295	774.65	0.79898	2.88910
5	14	3	2	6	3	8.061	562.34	0.90640	2.75000
6	23	6	4	7	6	9.833	755.87	0.99267	2.87845
7	8	2	1	3	2	11.607	222.46	1.06472	2.34726
8	11	5	1	3	2	13.383	265.10	1.12655	2.42341
9	19	5	7	6	1	15.160	404.03	1.18069	2.60641
10	15	3	5	3	4	16.937	285.40	1.22885	2.45545
11	24	7	4	6	7	18.716	413.14	1.27220	2.61610
12	9	7	0	1	1	20.494	141.46	1.31163	2.15063
13	11	2	1	5	3	22.273	159.06	1.34778	2.20156
14	7	1	2	3	1	24.052	93.72	1.38115	1.97184
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 182 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = -28.755 Y0 = 64.519

RING WIDTH (ARCMIN) = 2.0

Table 4.4.30. *(a) Ring-Count Data for Galaxy Cluster 30.*

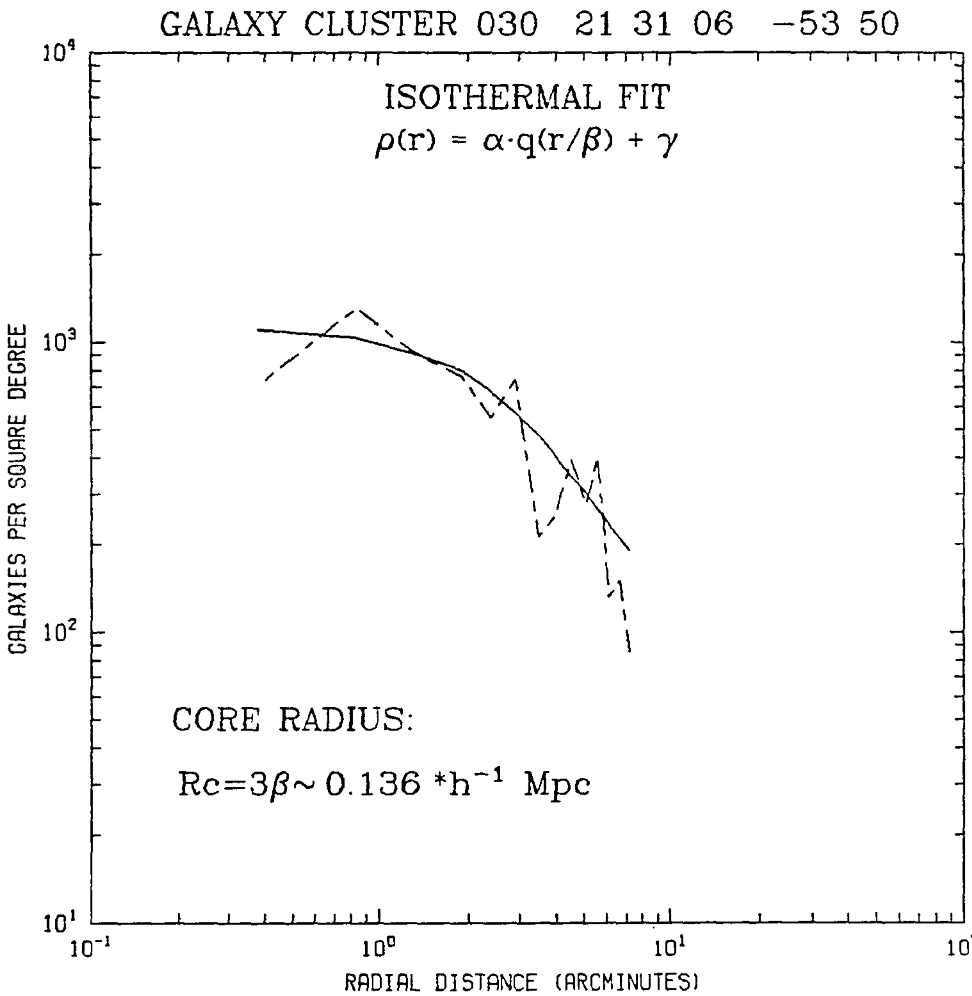


Figure 4.4.30. *(e) Isothermal Fit for Galaxy Cluster 30.*

CLUSTER PARAMETERS
GALAXY CLUSTER 030 21 31 06 −53 50
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
$\alpha =$ 587.05±347.23 $\beta =$ 1.05±0.16 $\gamma =$ 11.61±3.24
$\rho_{\text{BEST FIT}}(r) =$ 1094.55 ·q(r/1.04) + 12.15
CORE RADIUS: $Rc=3\beta\sim$ 0.136 $*h^{-1}$ Mpc — REDSHIFT: Z = 0.050

Table 4.4.30. *(b) Cluster Parameters for Galaxy Cluster 30.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 182 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show a slight enhancement along the East-West absissa to the West and likewise along the North-South ordinate to the North, with the latter distribution showing slightly more variance. The quadrant counts show very few counts near the cluster center with the distribution rising and falling radiallly away from cluster center. The general cluster surface density distribution shows a deep central minimum, a slow rise to a maximum at ring 6, a dramatic fall and then a repeat of the same behavior to the cluster periphery giving a zonal type of population surface density.

The meager central density as well as the depression at $r = 11.6$ arcmin effect the isothermal fitting, yet it appears as if the model accomodates the observed data reasonably with possible exception of the region of sharp cutoff located at the cluster periphery. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 031 21 32 18 −52 44

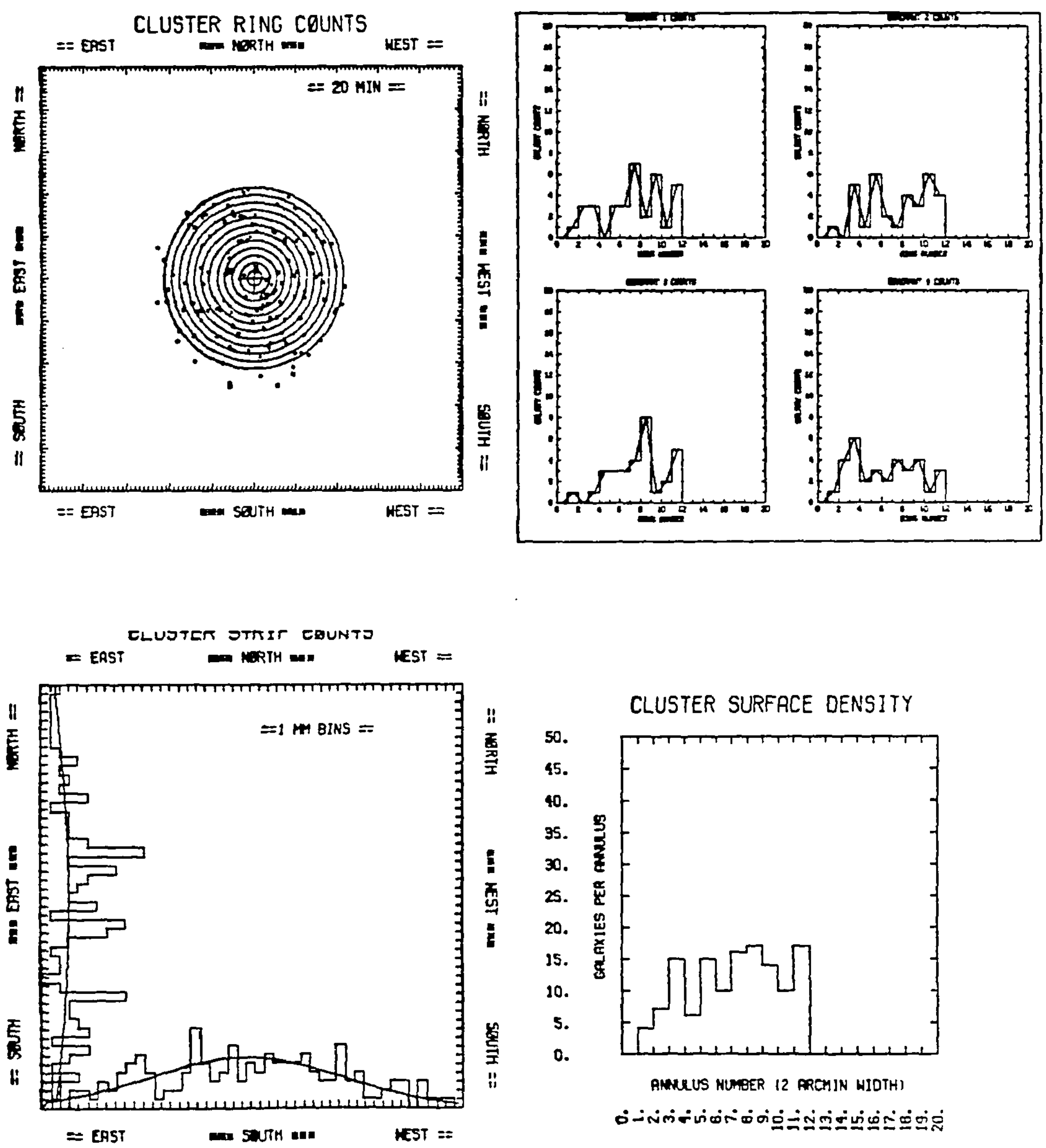


Figure 4.4.31. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 031 21 32 18 -52 44

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	0	0	0	0	0	1.259	0.00	0.10001	0.00000
2	4	1	1	1	1	2.815	482.00	0.44949	2.68305
3	7	3	0	0	4	4.539	506.10	0.65698	2.70424
4	15	3	5	1	6	6.295	774.65	0.79898	2.88910
5	6	0	1	3	2	8.061	241.00	0.90640	2.38202
6	14	3	5	3	3	9.833	460.09	0.99267	2.66285
7	10	2	3	3	2	11.607	278.08	1.06472	2.44417
8	17	8	1	4	4	13.383	409.70	1.12655	2.61247
9	15	2	3	7	3	15.160	318.97	1.18069	2.50375
10	15	6	4	2	3	16.937	285.40	1.22885	2.45545
11	11	1	6	2	2	18.716	189.36	1.27220	2.27728
12	17	5	4	5	3	20.494	267.20	1.31163	2.42683
13	15	2	4	3	6	22.273	216.90	1.34778	2.33626
14	5	0	1	2	2	24.052	66.94	1.38115	1.82572
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000
18	0	0	0	0	0	31.170	0.00	1.49374	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 151 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = -39.266 Y0 = 123.490

RING WIDTH (ARCMIN) = 2.0

Table 4.4.31. *(a) Ring-Count Data for Galaxy Cluster 31.*

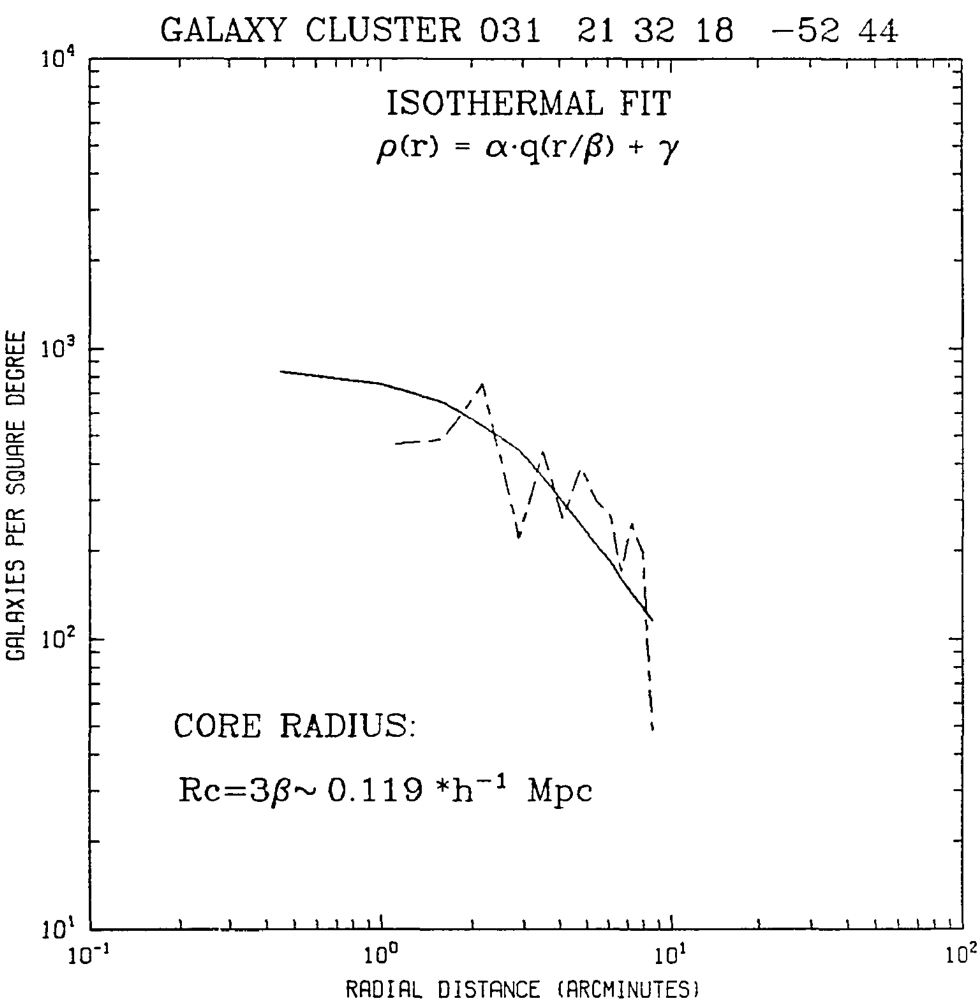


Figure 4.4.31. *(e) Isothermal Fit for Galaxy Cluster 31.*

CLUSTER PARAMETERS
GALAXY CLUSTER 031 21 32 18 −52 44
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
α = 446.80 ±265.69 β = 1.05±0.18 γ = 11.61± 3.55
$\rho_{\text{BEST FIT}}(r)$ = 829.25 ·q(r/1.03) + 11.97
CORE RADIUS: Rc=3β~ 0.119 *h^{-1} Mpc — REDSHIFT: Z = 0.044

Table 4.4.31. *(b) Cluster Parameters for Galaxy Cluster 31.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 151 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. From the cluster strip counts we notice that this scattered,, sparsely populated cluster shows a slight density enhancement West of cluster center along the East-West absissa; the distribution along the North-South ordinate appears erratic and displays a wide variance. The quadrant counts show a zone of avoidance near the cluster center with a generally erratic appearance. Likewise,the cluster surface density distribution displays a seies of peaks and troughs of various widths before a sharp cutoff after ring 12.

The lack of appreciable surface density near the ceneter of the cluster as well as the peripheral cutoff makes the isothermal fit difficult to model, but we approach some level of approximation of the observations near the middle ranges of the cluster. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 032 21 41 46 −51 44

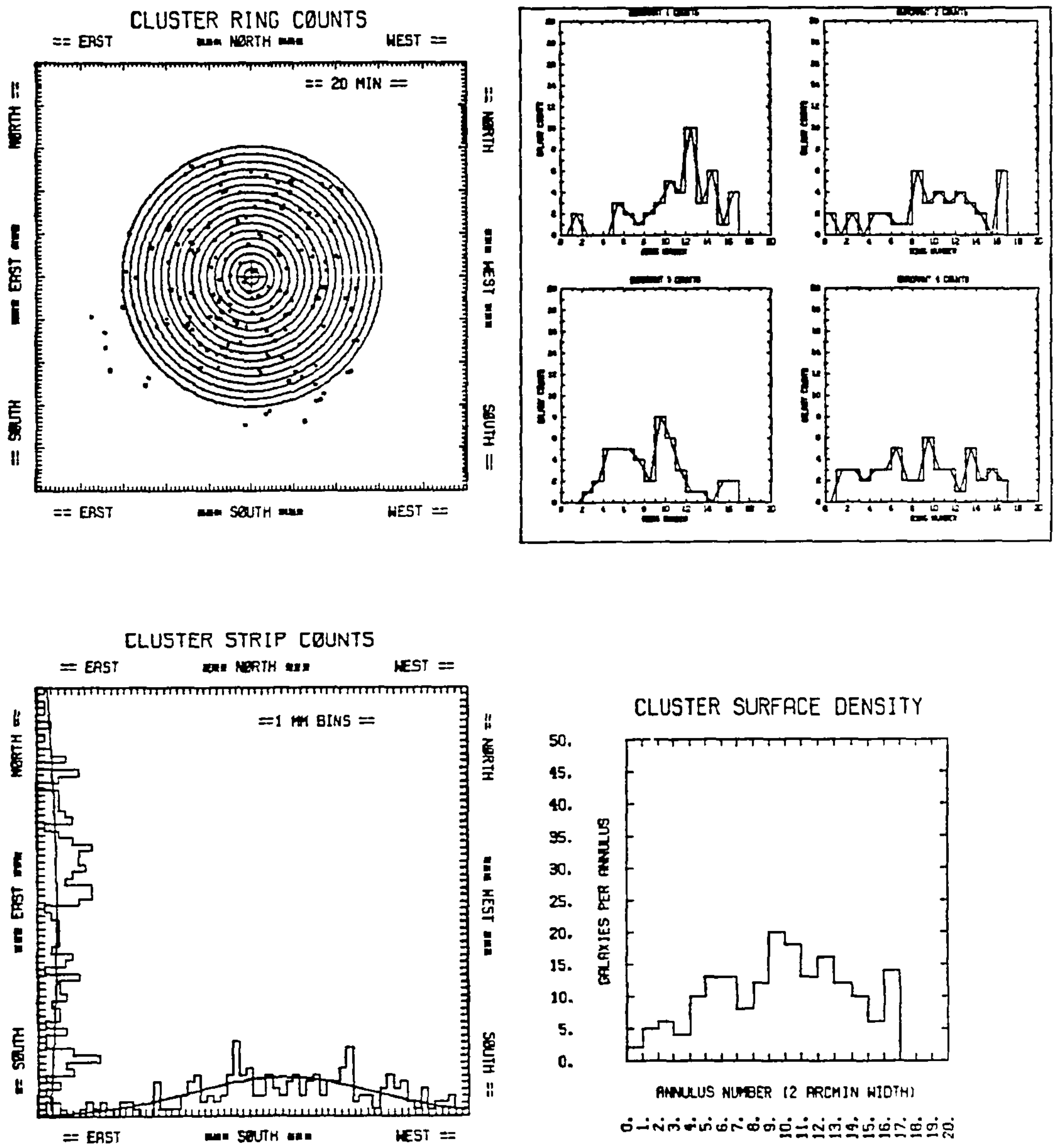


Figure 4.4.32. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 032 21 41 46 -51 44

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	2	0	0	1.259	723.00	0.10001	2.85914
2	5	2	0	0	3	2.815	602.50	0.44949	2.77996
3	6	0	2	1	3	4.539	433.80	0.65698	2.63729
4	4	0	0	2	2	6.295	206.57	0.79898	2.31507
5	10	0	2	5	3	8.061	401.67	0.90640	2.60387
6	13	3	2	5	3	9.833	427.23	0.99267	2.63066
7	13	2	1	5	5	11.607	361.50	1.06472	2.55811
8	8	1	1	4	2	13.383	192.80	1.12655	2.28511
9	12	2	6	2	2	15.160	255.18	1.18069	2.40684
10	18	2	3	8	5	16.937	342.48	1.22885	2.53463
11	20	6	4	6	4	18.716	344.29	1.27220	2.53692
12	12	4	3	2	3	20.494	188.61	1.31163	2.27556
13	16	9	4	2	1	22.273	231.36	1.34778	2.36429
14	12	4	3	1	4	24.052	160.67	1.38115	2.20593
15	11	6	2	0	3	25.831	137.12	1.41215	2.13710
16	5	1	0	2	2	27.611	58.31	1.44108	1.76572
17	13	3	6	2	2	29.390	142.41	1.46820	2.15354
18	8	2	0	0	6	31.170	82.63	1.49374	1.91713
19	3	0	0	2	1	32.950	29.31	1.51785	1.46703
20	2	0	0	1	1	34.730	18.54	1.54070	1.26808

TØTAL NUMBER ØF GALAXIES CØUNTED = 197 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT XO = -96.553 YO = -93.917

RING WIDTH (ARCMIN) = 2.0

Table 4.4.32. *(a) Ring-Count Data for Galaxy Cluster 32.*

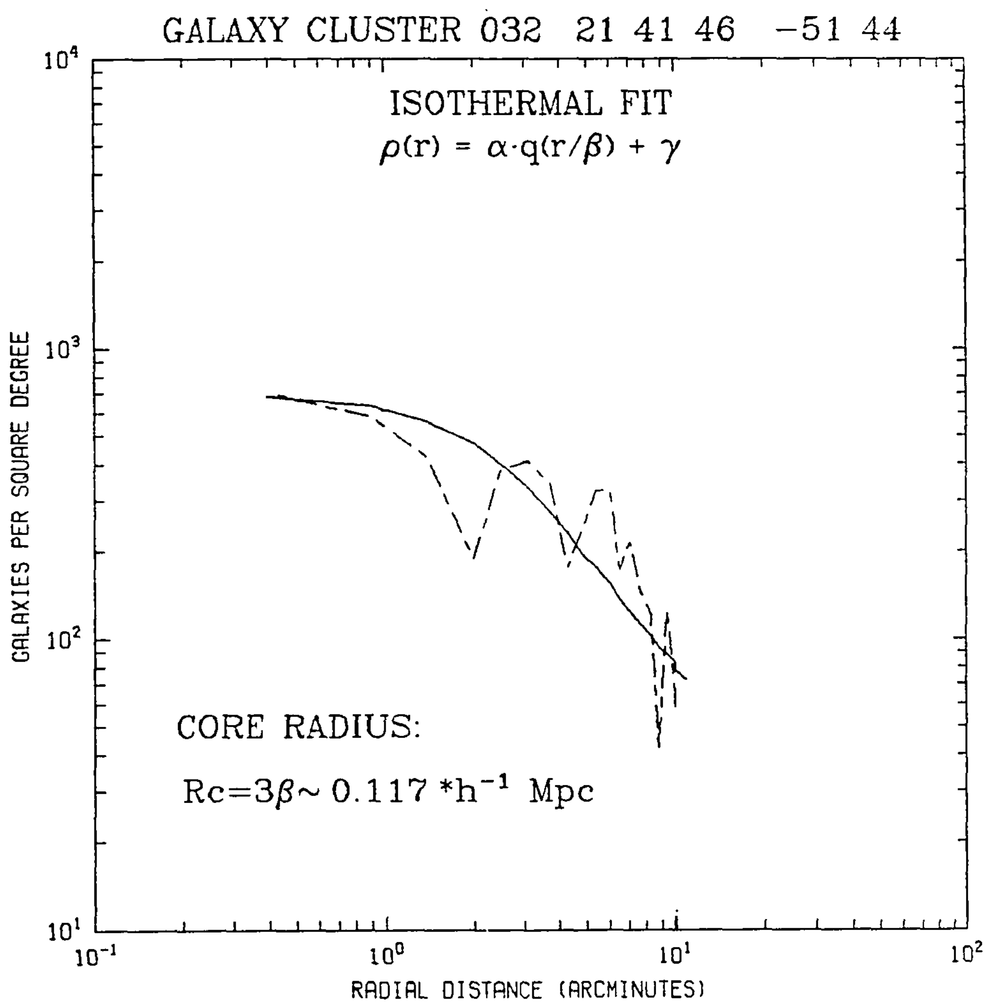


Figure 4.4.32. *(e) Isothermal Fit for Galaxy Cluster 32.*

CLUSTER PARAMETERS GALAXY CLUSTER 032 21 41 46 −51 44	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 380.87±201.58 $\beta =$ 1.05±0.17 $\gamma =$ 11.90±3.34	
$\rho_{\text{BEST FIT}}(r) =$ 671.46 $\cdot q(r/1.04) +$ 12.69	
CORE RADIUS: $Rc = 3\beta \sim$ 0.117 $*h^{-1}$ Mpc	REDSHIFT: Z = 0.043

Table 4.4.32. *(b) Cluster Parameters for Galaxy Cluster 32.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 193 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We find the East-West strip counts slightly enhanced both East and West of the cluster center whereas the North-South ordinate shows an excess North of center as well as a relatively large variance. The quadrant counts show a meager population close to the cluster center but then a rise that is observed in all directions. There is a lagre peak in the distribution at about ring 13 in the first quadrant. The cluster surface density distribution shows an an erratic rise to a maximum at a radial distance of about $r = 18.7$ arcminutes, after which the distribution falls, does a quick rise and falls again.

We find the isothermal fit modeling the observational data fairly well with exceptions at the deep data troughs like that seen at radial distance $r = 13.4$ arcminutes. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 033 21 42 51 −57 29

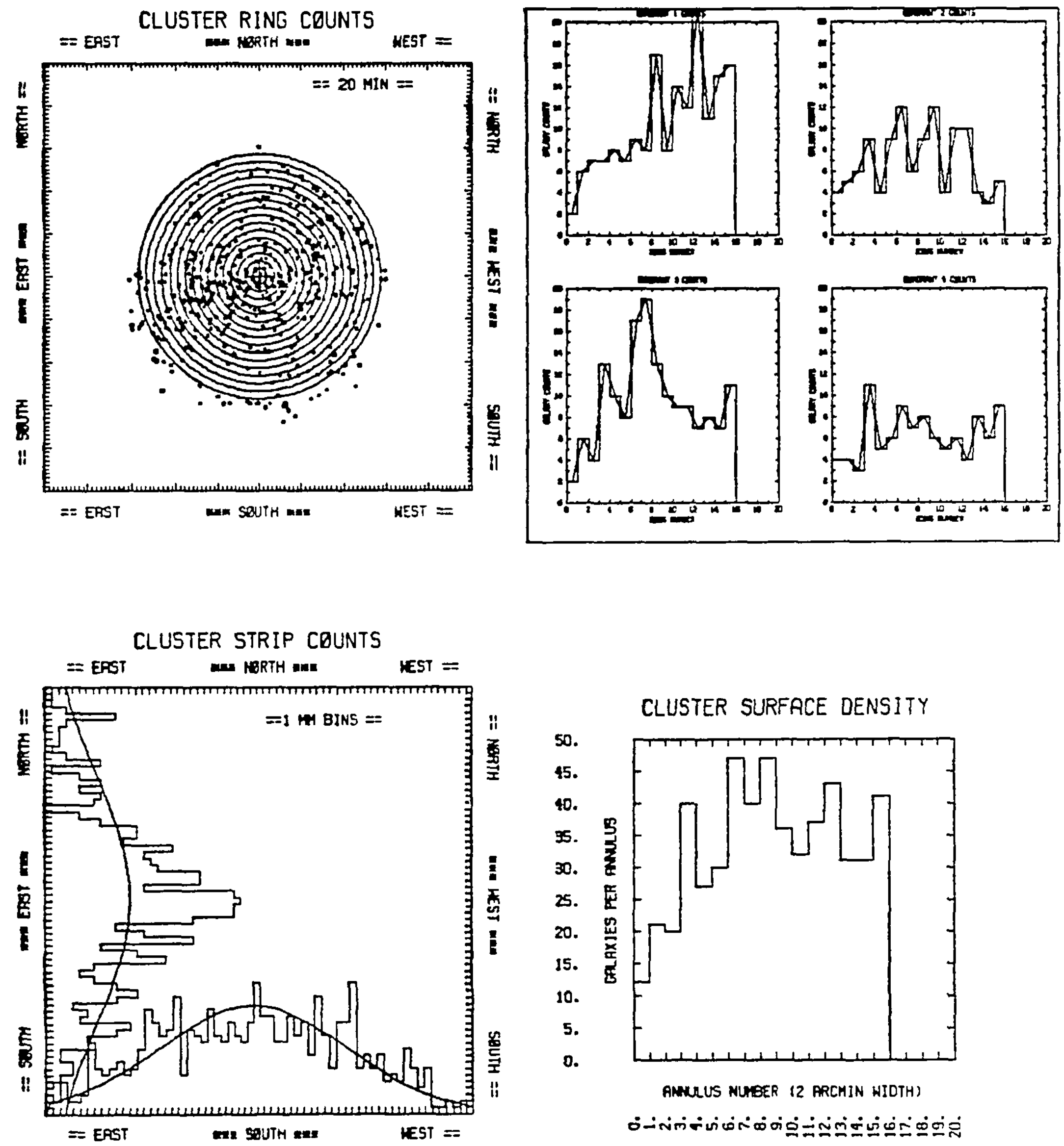


Figure 4.4.33. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 033 21 42 51 -57 29

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	12	2	4	2	4	1.259	4338.02	0.10001	3.63729
2	21	6	5	6	4	2.815	2530.51	0.44949	3.40321
3	19	6	6	4	3	4.539	1373.71	0.65698	3.13789
4	41	8	9	13	11	6.295	2117.37	0.79898	3.32580
5	26	7	4	10	5	8.061	1044.34	0.90640	3.01884
6	30	8	8	8	6	9.833	985.91	0.99267	2.99384
7	48	9	13	17	9	11.607	1334.77	1.06472	3.12541
8	38	8	5	18	7	13.383	915.80	1.12655	2.96180
9	45	15	10	13	7	15.160	956.92	1.18069	2.98087
10	40	10	12	11	7	16.937	761.06	1.22885	2.88142
11	30	14	3	8	5	18.716	516.43	1.27220	2.71301
12	37	12	11	9	5	20.494	581.55	1.31163	2.76458
13	45	22	10	8	5	22.273	650.70	1.34778	2.81338
14	30	11	4	8	7	24.052	401.67	1.38115	2.60387
15	32	15	3	7	7	25.831	398.90	1.41215	2.60086
16	40	16	5	10	9	27.611	466.45	1.44108	2.66881
17	26	4	2	12	8	29.390	284.82	1.46820	2.45457
18	10	3	0	3	4	31.170	103.29	1.49374	2.01404
19	4	0	0	1	3	32.950	39.08	1.51785	1.59197
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 574 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = -74.215 Y0 = 134.600

RING WIDTH (ARCMIN) = 2.0

Table 4.4.33. *(a) Ring-Count Data for Galaxy Cluster 33.*

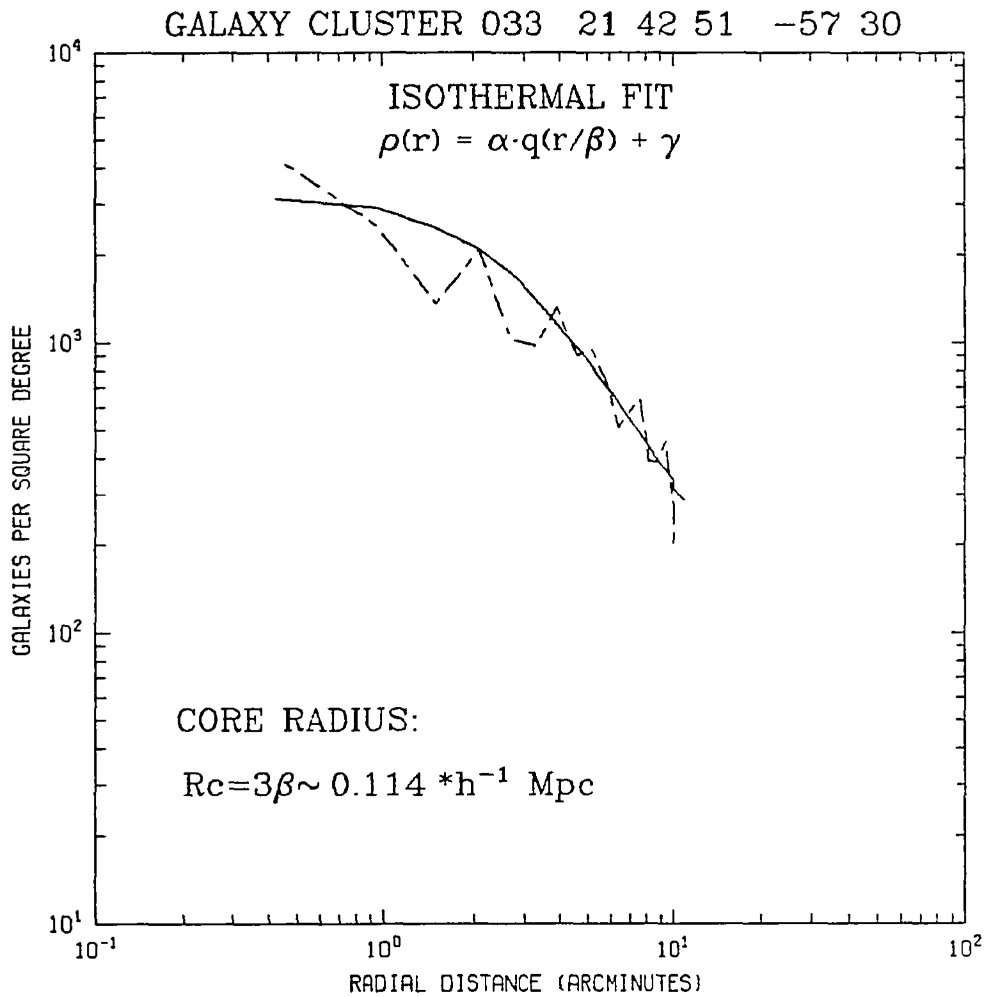


Figure 4.4.33. *(e) Isothermal Fit for Galaxy Cluster 33.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 033 21 42 51 −57 30	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha = 2389.51 \pm 516.81$ $\beta = 1.02 \pm 0.01$ $\gamma = 11.77 \pm 0.40$	
$\rho_{\text{BEST FIT}}(r) = 3157.35 \cdot q(r/1.03) + 12.37$	
CORE RADIUS:	REDSHIFT:
$Rc=3\beta \sim 0.114 \, {}^*h^{-1}$ Mpc	$Z = 0.042$

Table 4.4.33. *(b) Cluster Parameters for Galaxy Cluster 33.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 574 galaxies within 19 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We find the East-West strip count distribution fairly smooth and without any extraordinary maxima or minima; the North-South distribution on ther other hand displays a large excess near the cluster center and a rather large variance. The former suggests a linear feature running East-West along the cluster somewhat South of center. The cluster surface density increases with increasing radial distance to a maximum near ring 8 after which it suffers a slow decline. We see this behavior in the quadrant counts as well.

The isothermal fit to the observed data appears to model the cluster density better in the outerlying regions of the cluster than where we have significant dips in the observations. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 034 21 43 46 −44 06

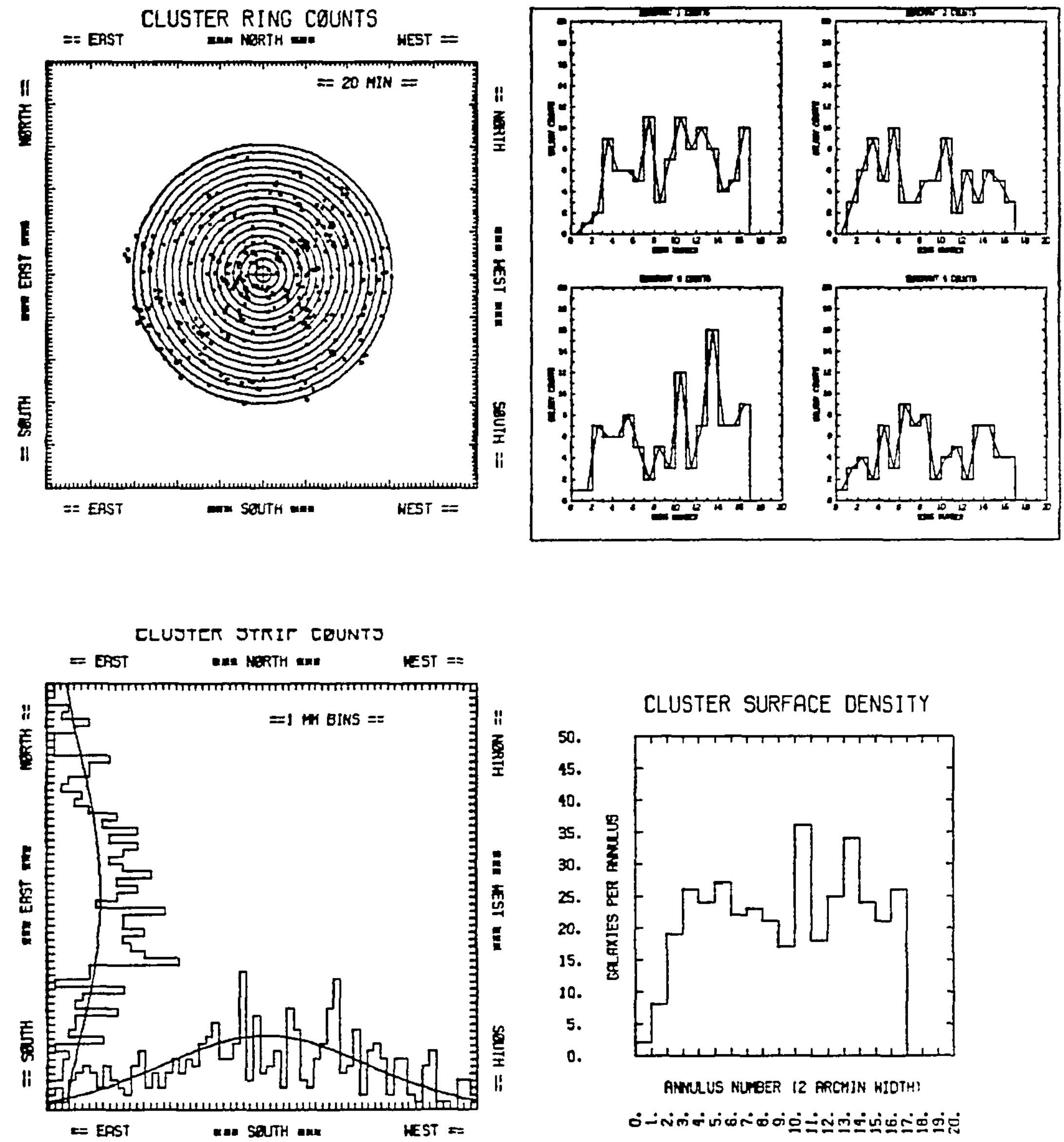


Figure 4.4.34. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 034 21 43 46 -44 06									
RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	0	1	1	1.259	723.00	0.10001	2.85914
2	8	1	3	1	3	2.815	964.00	0.44949	2.98408
3	18	2	5	7	4	4.539	1301.41	0.65698	3.11441
4	26	9	9	6	2	6.295	1342.72	0.79898	3.12799
5	24	5	6	6	7	8.061	964.00	0.90640	2.98408
6	27	7	9	8	3	9.833	887.32	0.99267	2.94808
7	21	5	2	5	9	11.607	583.96	1.06472	2.76639
8	25	11	5	2	7	13.383	602.50	1.12655	2.77996
9	20	3	4	5	8	15.160	425.30	1.18069	2.62869
10	18	7	6	3	2	16.937	342.48	1.22885	2.53463
11	35	10	9	12	4	18.716	602.50	1.27220	2.77996
12	19	9	2	3	5	20.494	298.63	1.31163	2.47514
13	22	10	4	6	2	22.273	318.12	1.34778	2.50259
14	35	7	5	17	6	24.052	468.61	1.38115	2.67081
15	24	5	6	6	7	25.831	299.17	1.41215	2.47592
16	22	5	5	8	4	27.611	256.55	1.44108	2.40917
17	26	10	3	8	5	29.390	284.82	1.46820	2.45457
18	12	2	6	1	3	31.170	123.94	1.49374	2.09322
19	0	0	0	0	0	32.950	0.00	1.51765	0.00000
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 384 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 119.835 Y0 = 51.560

RING WIDTH (ARCMIN) = 2.0

Table 4.4.34. *(a) Ring-Count Data for Galaxy Cluster 34.*

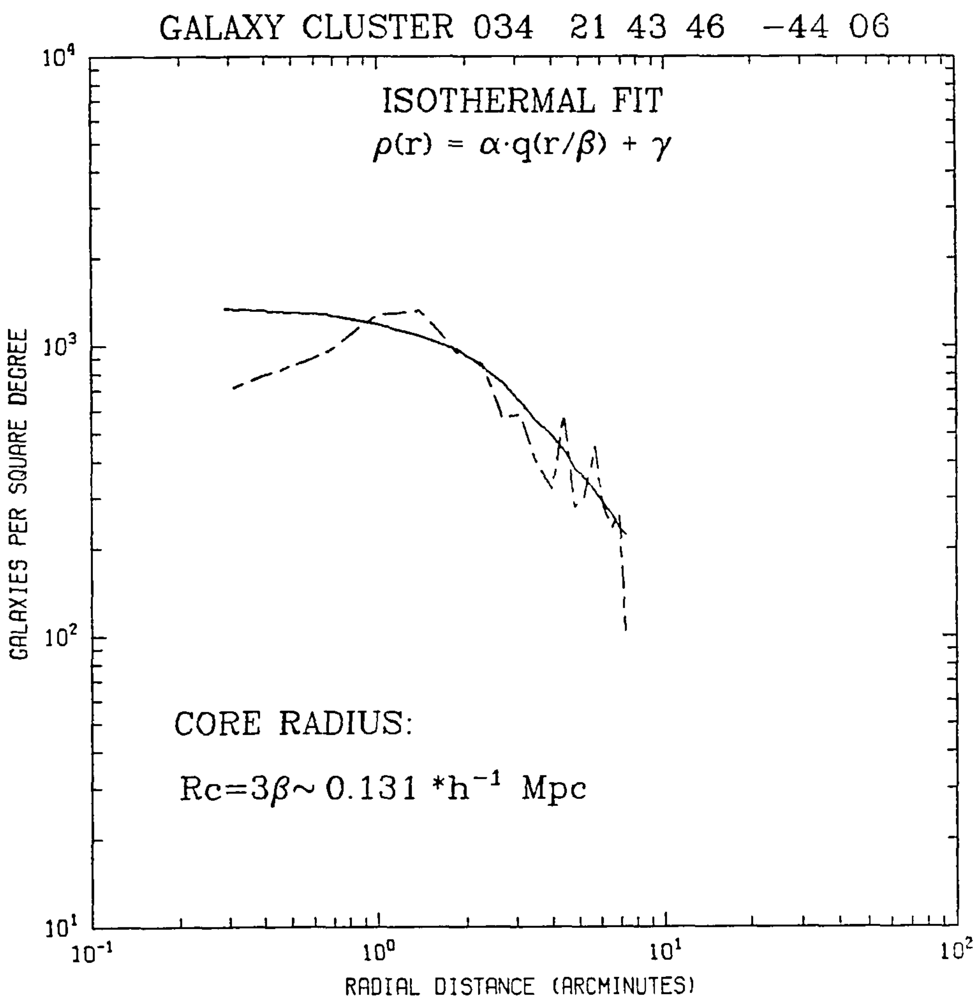


Figure 4.4.34. *(e) Isothermal Fit for Galaxy Cluster 34.*

CLUSTER PARAMETERS GALAXY CLUSTER 034 21 43 46 −44 06		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
$\alpha = 704.08 \pm 416.38$	$\beta = 1.05 \pm 0.16$	$\gamma = 11.90 \pm 3.09$
$\rho(r)_{\text{BEST FIT}} = 1329.19 \cdot q(r/1.04) + 12.84$		
CORE RADIUS: $Rc = 3\beta \sim 0.131 * h^{-1}$ Mpc		REDSHIFT: $Z = 0.048$

Table 4.4.34. *(b) Cluster Parameters for Galaxy Cluster 34.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 384 galaxies within 18 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We find fairly large disperions in both the East-West and North-South components of the strip counts with a slight enhancement South of the cluster center where we see an obvious concentration of galaxies. As shown by the quadrant counts, however, the center of the cluster is nearly devoid of galaxies. We also see that the first quadrant represents the most populous region of the cluster. The cluster surface density rises rapidly as we move from the cluster center to a maximum after which it falls and rises sharply once more through two peaks and then reaches the cluster periphery.

The isothermal fit to this data overshoots near the cluster center but more adequately represents the observations beyond the middle of the cluster. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 035 21 44 41 −46 13

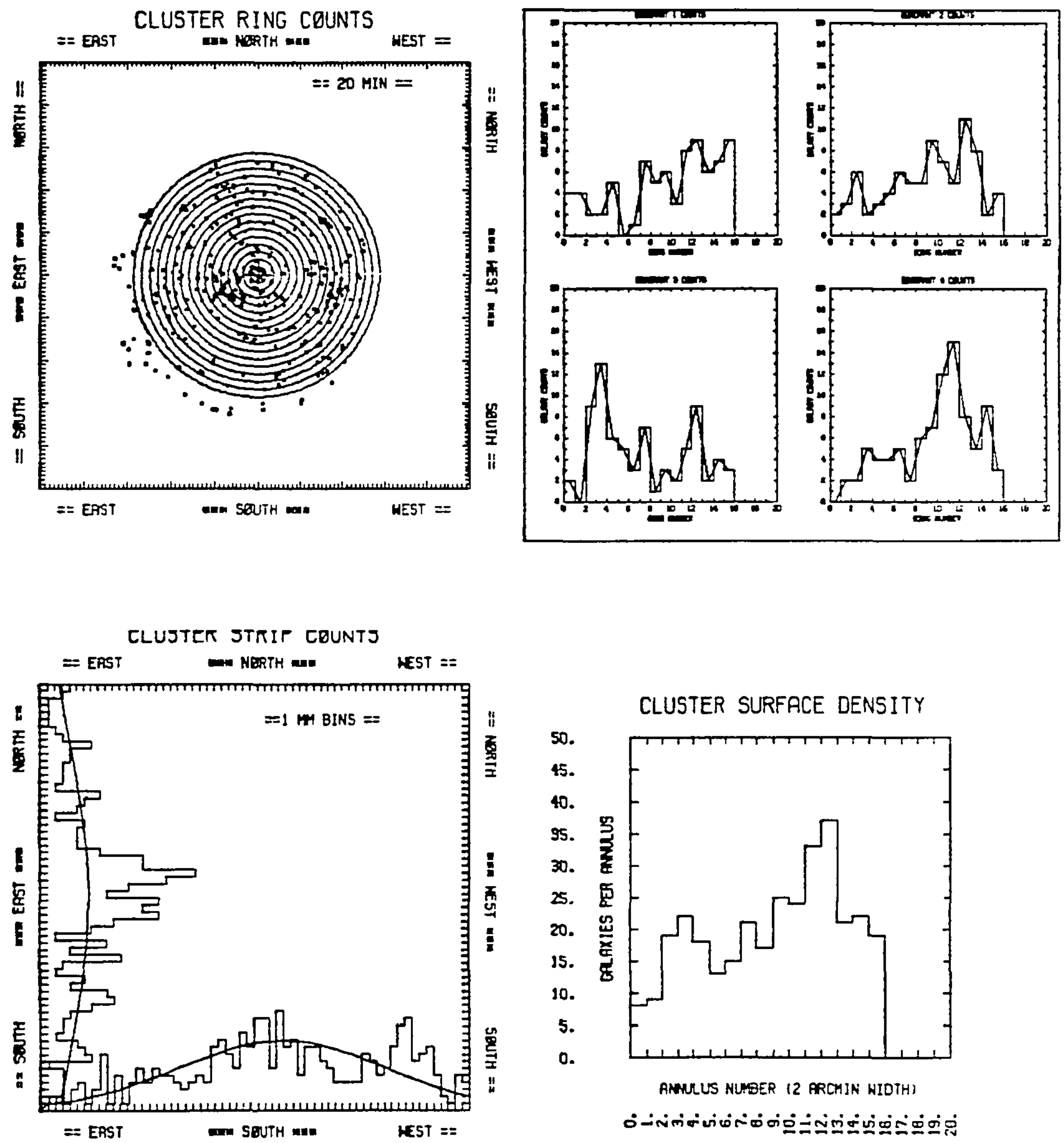


Figure 4.4.35. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 035 21 44 41 -46 13

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	8	4	2	2	0	1.259	2892.01	0.10001	3.46120
2	9	4	3	0	2	2.815	1084.50	0.44949	3.03523
3	19	2	6	9	2	4.539	1373.71	0.65698	3.13789
4	22	2	2	13	5	6.295	1136.15	0.79898	3.05543
5	18	5	3	6	4	8.061	723.00	0.90640	2.85914
6	13	0	4	5	4	9.833	427.23	0.99267	2.63066
7	14	0	6	3	5	11.607	389.31	1.06472	2.59029
8	22	8	5	7	2	13.383	530.20	1.12655	2.72444
9	16	4	5	1	6	15.160	340.24	1.18069	2.53178
10	24	7	9	3	5	16.937	456.63	1.22885	2.65957
11	25	3	7	2	13	18.716	430.36	1.27220	2.63383
12	34	8	5	5	16	20.494	534.39	1.31163	2.72786
13	36	9	11	8	8	22.273	520.56	1.34778	2.71647
14	21	6	8	3	4	24.052	281.17	1.38115	2.44897
15	21	6	1	4	10	25.831	261.78	1.41215	2.41793
16	19	10	4	2	3	27.611	221.57	1.44108	2.34550
17	16	0	8	4	4	29.390	175.27	1.46820	2.24372
18	12	0	2	9	1	31.170	123.94	1.49374	2.09322
19	4	0	2	2	0	32.950	39.08	1.51785	1.59197
20	1	0	0	1	0	34.730	9.27	1.54070	0.96705

TØTAL NUMBER ØF GALAXIES CØUNTED = 354 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT XO = 107.000 YO = -61.752

RING WIDTH (ARCMIN) = 2.0

Table 4.4.35. *(a) Ring-Count Data for Galaxy Cluster 35.*

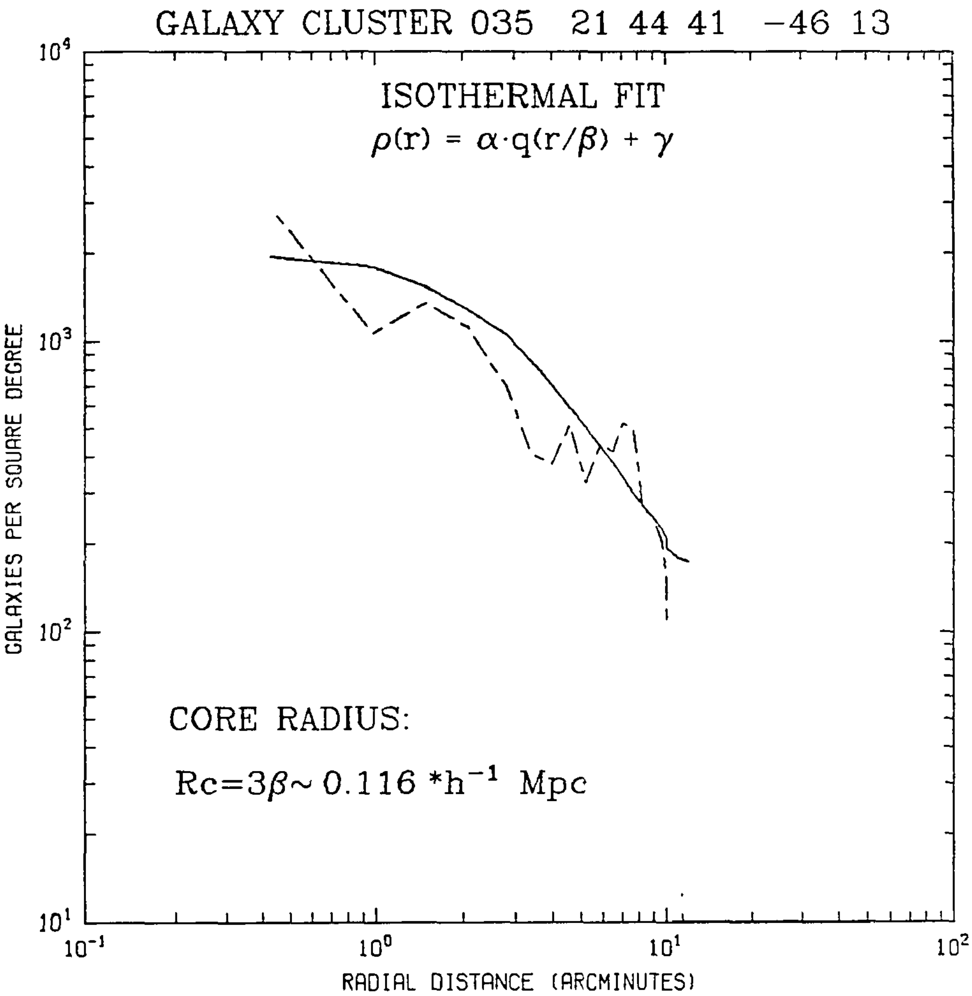


Figure 4.4.35. *(e) Isothermal Fit for Galaxy Cluster 35.*

CLUSTER PARAMETERS		
GALAXY CLUSTER 035 21 44 41 −46 13		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
$\alpha = 976.45 \pm 659.11$	$\beta = 1.05 \pm 0.17$	$\gamma = 11.73 \pm 3.38$
$\rho_{\text{BEST FIT}}(r) = 1951.54 \cdot q(r/1.03\ ) + 12.36$		
CORE RADIUS: $Rc = 3\beta \sim 0.116 * h^{-1}$ Mpc		REDSHIFT: $Z = 0.043$

Table 4.4.35. *(b) Cluster Parameters for Galaxy Cluster 35.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 354 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts reveal a slight enhancement West of center along the East-West absissa as well as another along the North-South ordinate somewhat South of center. Both of these are regions of subclustering in the body of the main cluster. These are also evident in the quadrant counts as peaks in the third and fourth quadrants. The cluster surface density distribution reveals these features as peaks above the general radial rise in density away fron the cluster center.

The isothermal analysis has to contend with the high central density of this cluster as well as the two subclusterings. As a result, it tends to overshoot the observations near the center of the cluster and find a better fit at the cluster periphery. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 036 21 50 32 −58 04

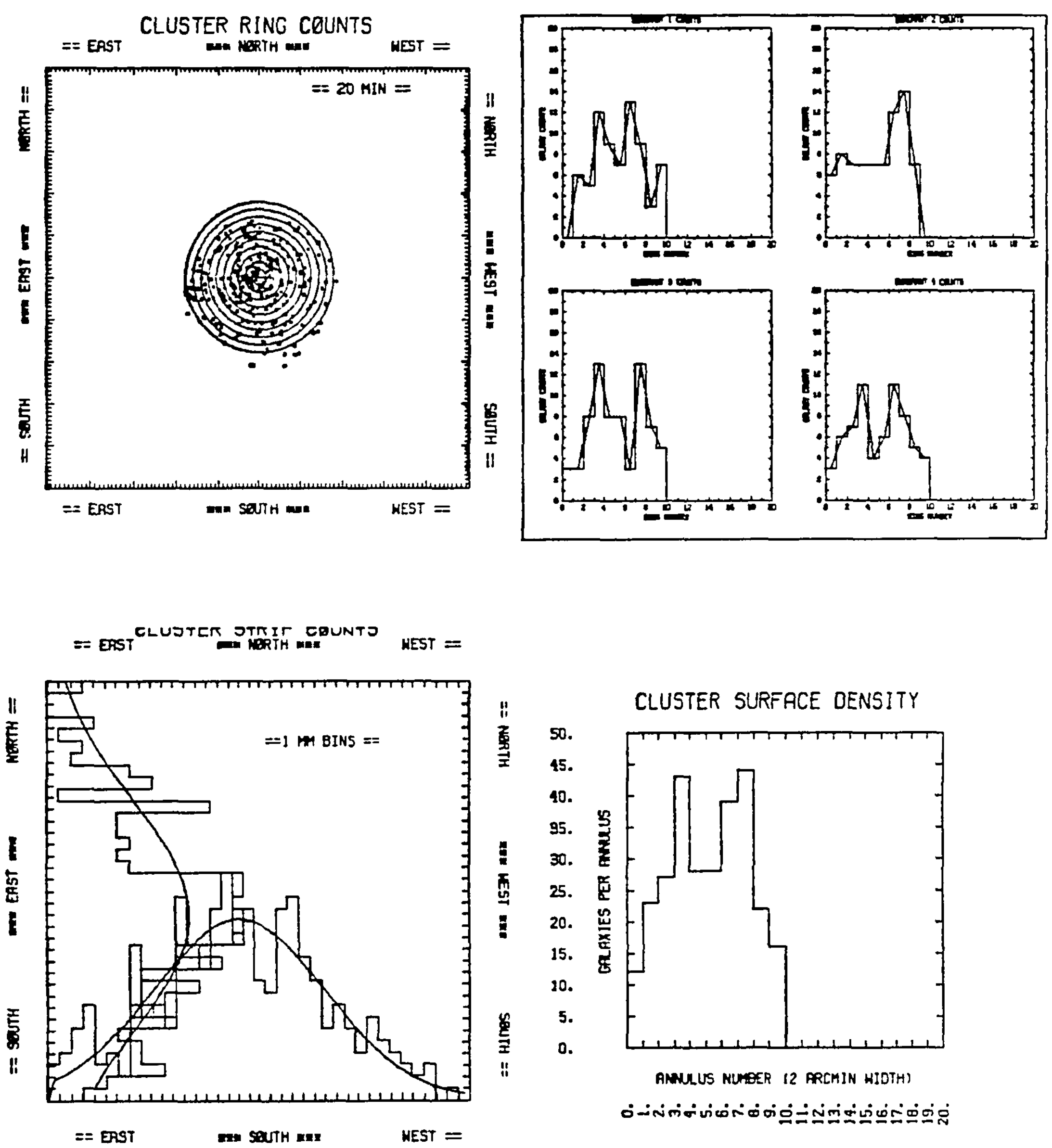


Figure 4.4.36. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 036 21 50 32 -58 04

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	12	0	6	3	3	1.259	4338.02	0.10001	3.63729
2	23	6	8	3	6	2.815	2771.51	0.44949	3.44272
3	27	5	7	8	7	4.539	1952.11	0.65698	3.29050
4	43	12	7	13	11	6.295	2220.65	0.79898	3.34648
5	28	9	7	8	4	8.061	1124.67	0.90640	3.05103
6	26	7	6	7	6	9.833	854.46	0.99267	2.93169
7	40	13	12	4	11	11.607	1112.31	1.06472	3.04623
8	43	9	14	12	8	13.383	1036.30	1.12655	3.01549
9	24	3	8	8	5	15.160	510.35	1.18069	2.70787
10	15	7	0	5	3	16.937	285.40	1.22885	2.45545
11	12	2	0	2	8	18.716	206.57	1.27220	2.31507
12	2	0	0	1	1	20.494	31.43	1.31163	1.49741
13	0	0	0	0	0	22.273	0.00	1.34778	0.00000
14	0	0	0	0	0	24.052	0.00	1.38115	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 295 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT XO = -127.534 YO = 102.014

RING WIDTH (ARCMIN) = 2.0

Table 4.4.36. *(a) Ring-Count Data for Galaxy Cluster 36.*

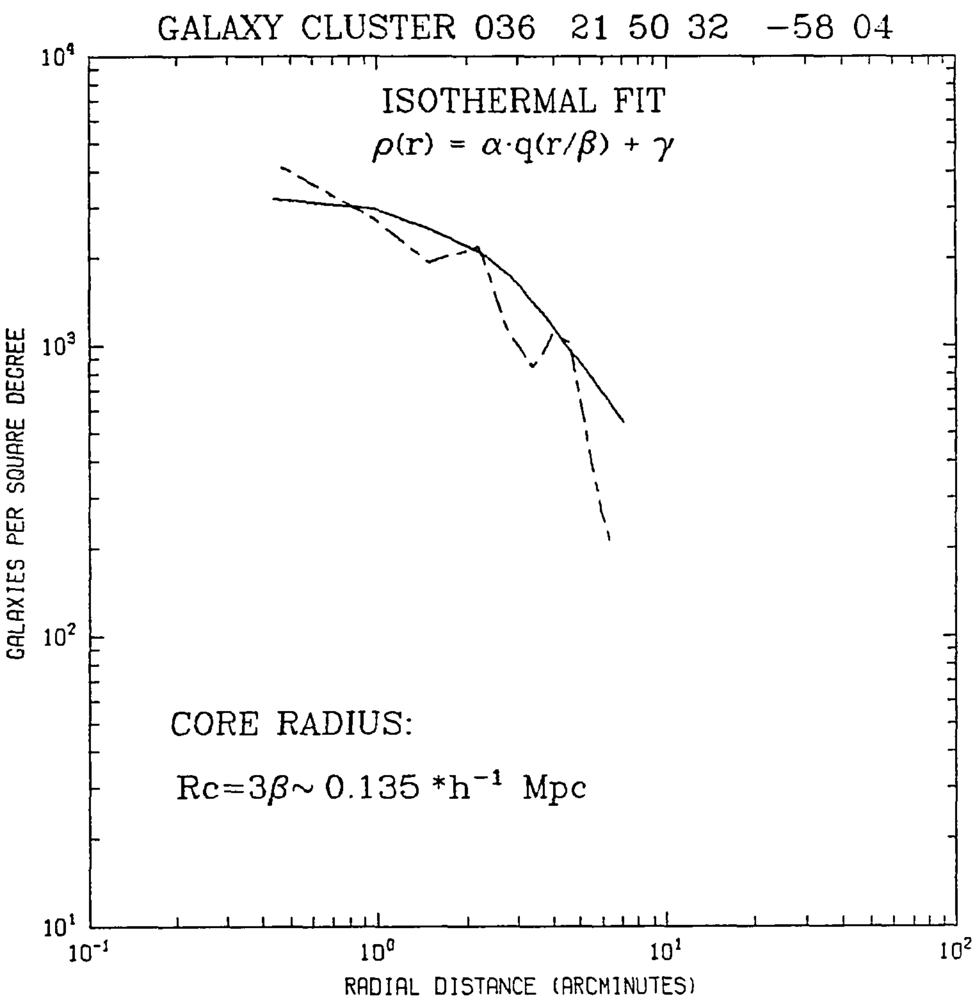


Figure 4.4.36. *(e) Isothermal Fit for Galaxy Cluster 36.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 036 21 50 32 −58 04	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha = 2707.31 \pm 398.52$ $\beta = 1.03 \pm 0.00$ $\gamma = 11.60 \pm 0.24$	
$\rho_{\text{BEST FIT}}(r) = 3244.86 \cdot q(r/1.03) + 11.93$	
CORE RADIUS:	REDSHIFT:
$Rc = 3\beta \sim 0.135 * h^{-1}$ Mpc	$Z = 0.050$

Table 4.4.36. *(b) Cluster Parameters for Galaxy Cluster 36.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 295 galaxies within 12 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The strip counts reveal what the eye beholds as a highly centrally condensed compact cluster. The East-West distribution is fairly symmetric about the center of the cluster, whereas we find a slight concentration South of center along the North-South absissa. The quadrant counts show the main central concentration as coming from the second and fourth quadrants and some effects of subclustering as evidenced by several sharp peaks in the distributions. The cluster surface density map shows a steep rise from center which later rounds off and terminates at the cluster periphery. Two peaks are seen to dominate the distribution.

The isothermal fit envelopes the observational data and is again dominated by the high density peaks. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 037 21 55 17 -60 35

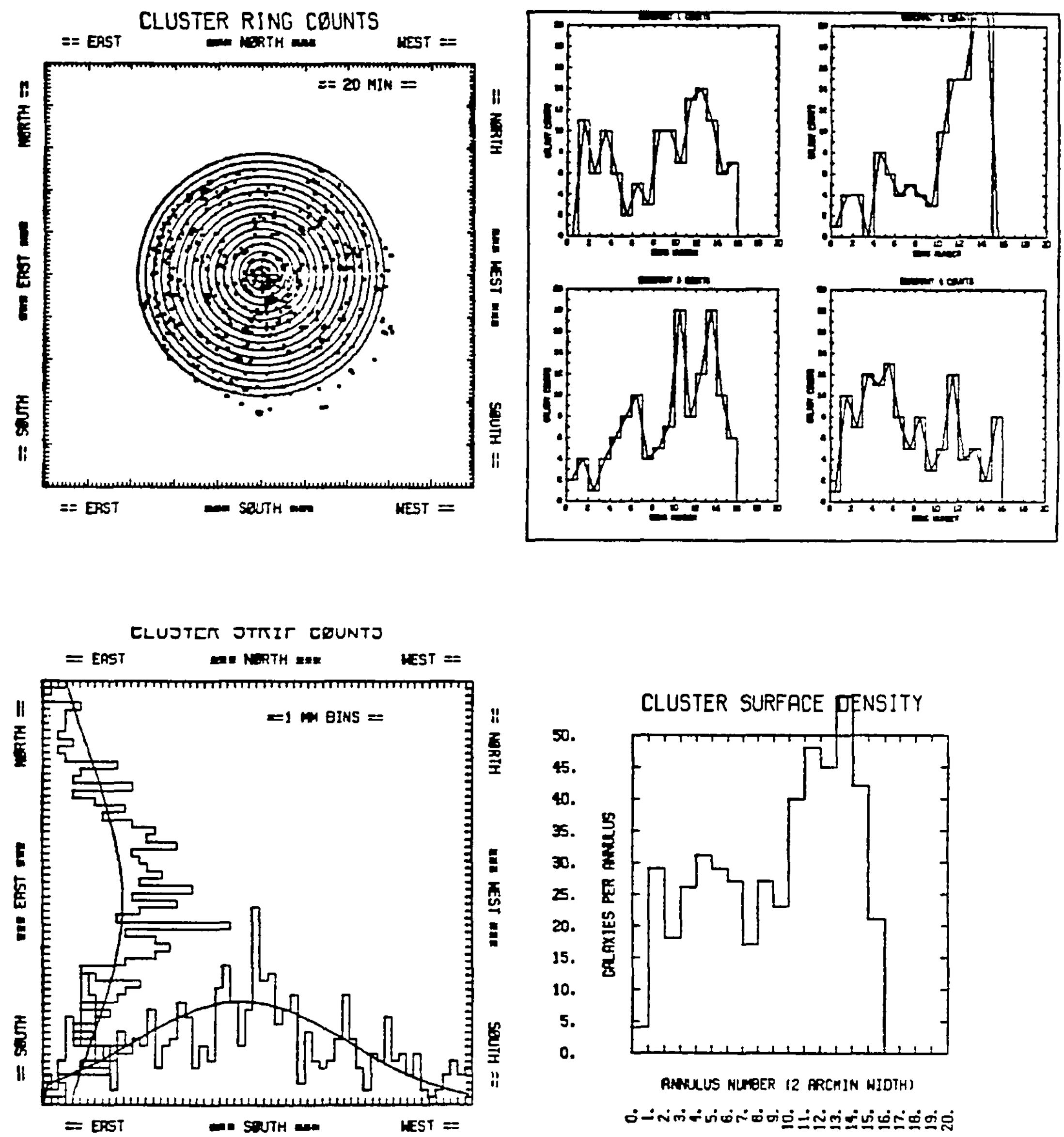


Figure 4.4.37. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 037 21 55 17 -60 35

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	4	0	1	2	1	1.259	1446.01	0.10001	3.16017
2	29	11	4	4	10	2.815	3494.51	0.44949	3.54339
3	18	6	4	1	7	4.539	1301.41	0.65698	3.11441
4	26	10	0	4	12	6.295	1342.72	0.79898	3.12799
5	30	5	8	6	11	8.061	1205.00	0.90640	3.08099
6	30	3	6	8	13	9.833	985.91	0.99267	2.99384
7	26	5	3	10	8	11.607	723.00	1.06472	2.85914
8	16	2	5	4	5	13.383	385.60	1.12655	2.58614
9	28	11	5	5	7	15.160	595.41	1.18069	2.77482
10	23	9	3	7	4	16.937	437.61	1.22885	2.64108
11	39	8	9	18	4	18.716	671.36	1.27220	2.82696
12	48	13	15	8	12	20.494	754.44	1.31163	2.87762
13	47	14	16	12	5	22.273	679.62	1.34778	2.83227
14	54	11	21	18	4	24.052	723.00	1.38115	2.85914
15	44	6	25	10	3	25.831	548.48	1.41215	2.73916
16	20	7	0	6	7	27.611	233.23	1.44108	2.36778
17	10	5	0	1	4	29.390	109.55	1.46820	2.03960
18	13	4	0	0	9	31.170	134.27	1.49374	2.12799
19	7	0	0	0	7	32.950	68.39	1.51785	1.83501
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 512 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 98.536 Y0 = -32.630

RING WIDTH (ARCMIN) = 2.0

Table 4.4.37. *(a) Ring-Count Data for Galaxy Cluster 37.*

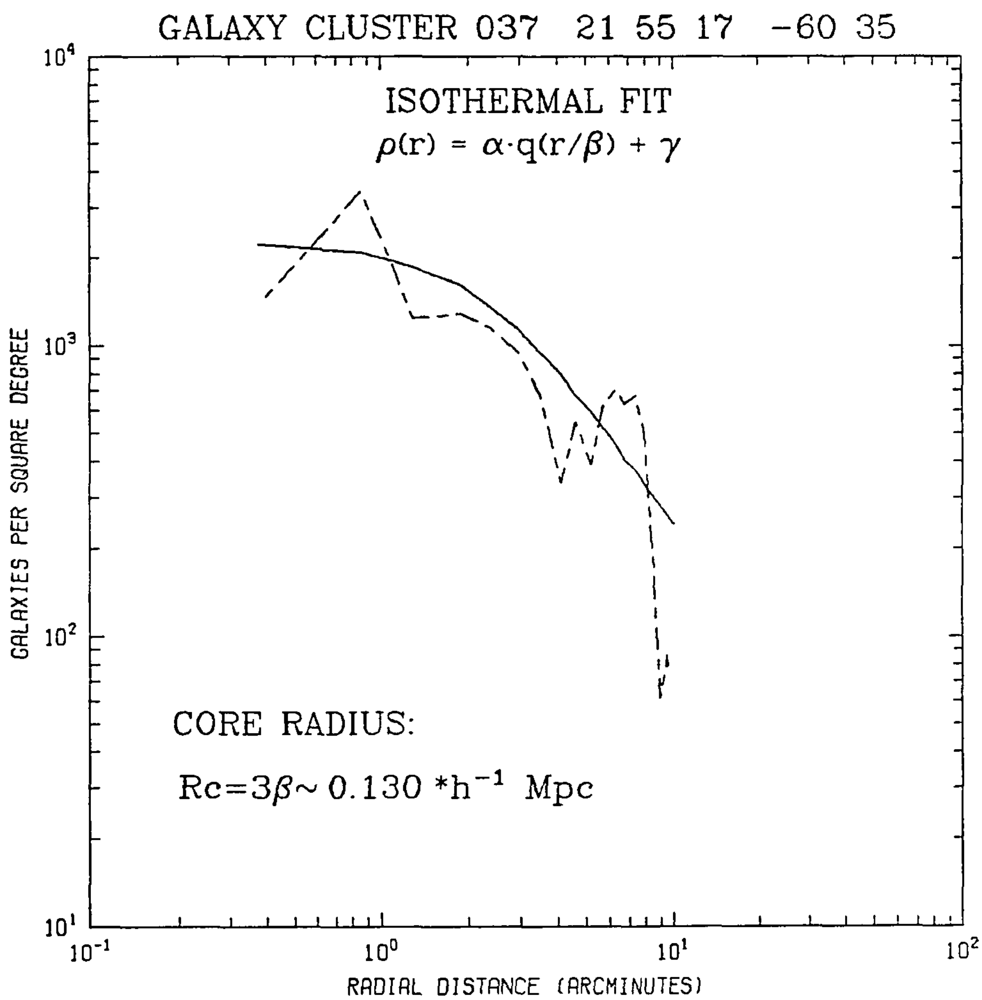


Figure 4.4.37. *(e) Isothermal Fit for Galaxy Cluster 37.*

CLUSTER PARAMETERS
GALAXY CLUSTER 037 21 55 17 −60 35
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
α = 1546.91 ±456.11 β = 1.02±0.01 γ = 11.58± 0.50
$\rho_{\text{BEST FIT}}(r)$ = 2251.82 ·q(r/1.04) + 12.35
CORE RADIUS: Rc=3β~ 0.130 *h^{-1} Mpc — REDSHIFT: Z = 0.048

Table 4.4.37. *(b) Cluster Parameters for Galaxy Cluster 37.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 512 galaxies within 19 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This centrally and peripherally condensed cluster shows a fairly symmetric distribution about the East-West absissa with exception at the Eastward tail of the mapping; likewise along the North-South ordinate we see concentrations both North and South of center. We see the effects of subclustering in the quadrant counts with the more central condensation arising from the fourth quadrant contribution and the unusual arc of galaxies at the periphery of the cluster arising from contributions from the second and third quadrants. This effect is also seen in the cluster surface density distribution with its exaggerated groupings at the extremes of the cluster.

We find the isothermal fit to model the observations poorly mainly because of the consentrations in the data. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 038 21 58 09 −60 11

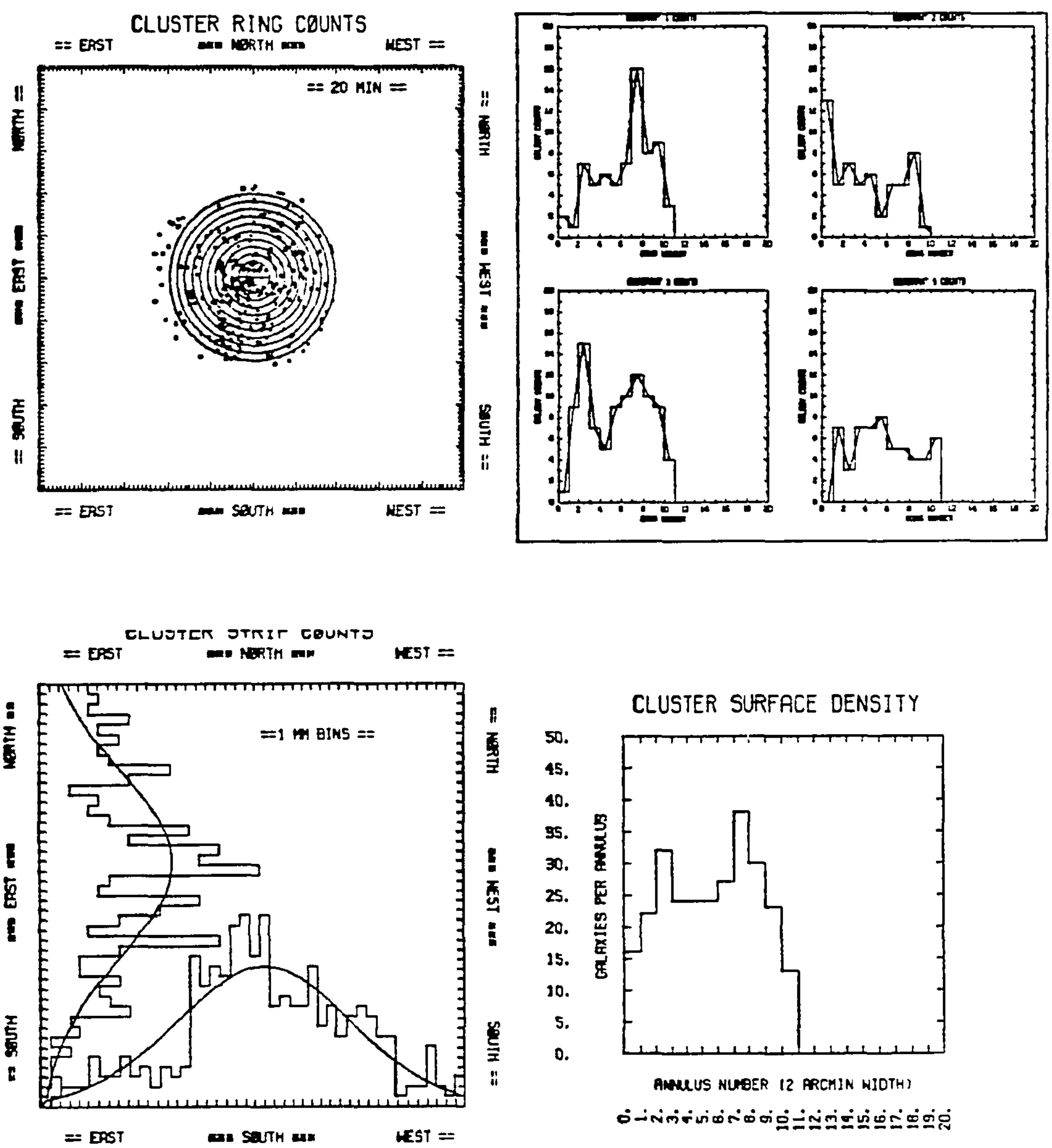


Figure 4.4.38. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 038 21 58 09 -60 11

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	16	2	13	1	0	1.259	5784.02	0.10001	3.76223
2	22	1	5	9	7	2.815	2651.01	0.44949	3.42341
3	32	7	7	15	3	4.539	2313.61	0.65698	3.36429
4	24	5	5	7	7	6.295	1239.43	0.79898	3.09322
5	23	6	6	5	6	8.061	923.84	0.90640	2.96560
6	24	5	2	9	8	9.833	788.73	0.99267	2.89693
7	27	6	5	10	6	11.607	750.81	1.06472	2.87553
8	38	17	5	11	5	13.383	915.80	1.12655	2.96180
9	30	7	8	11	4	15.160	637.94	1.18069	2.80478
10	24	10	1	9	4	16.937	456.63	1.22885	2.65957
11	13	3	0	4	6	18.716	223.79	1.27220	2.34983
12	19	8	2	3	6	20.494	298.63	1.31163	2.47514
13	17	5	9	3	0	22.273	245.82	1.34778	2.39062
14	3	0	3	0	0	24.052	40.17	1.38115	1.60387
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 312 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 80.549 Y0 = -10.760

RING WIDTH (ARCMIN) = 2.0

Table 4.4.38. *(a) Ring-Count Data for Galaxy Cluster 38.*

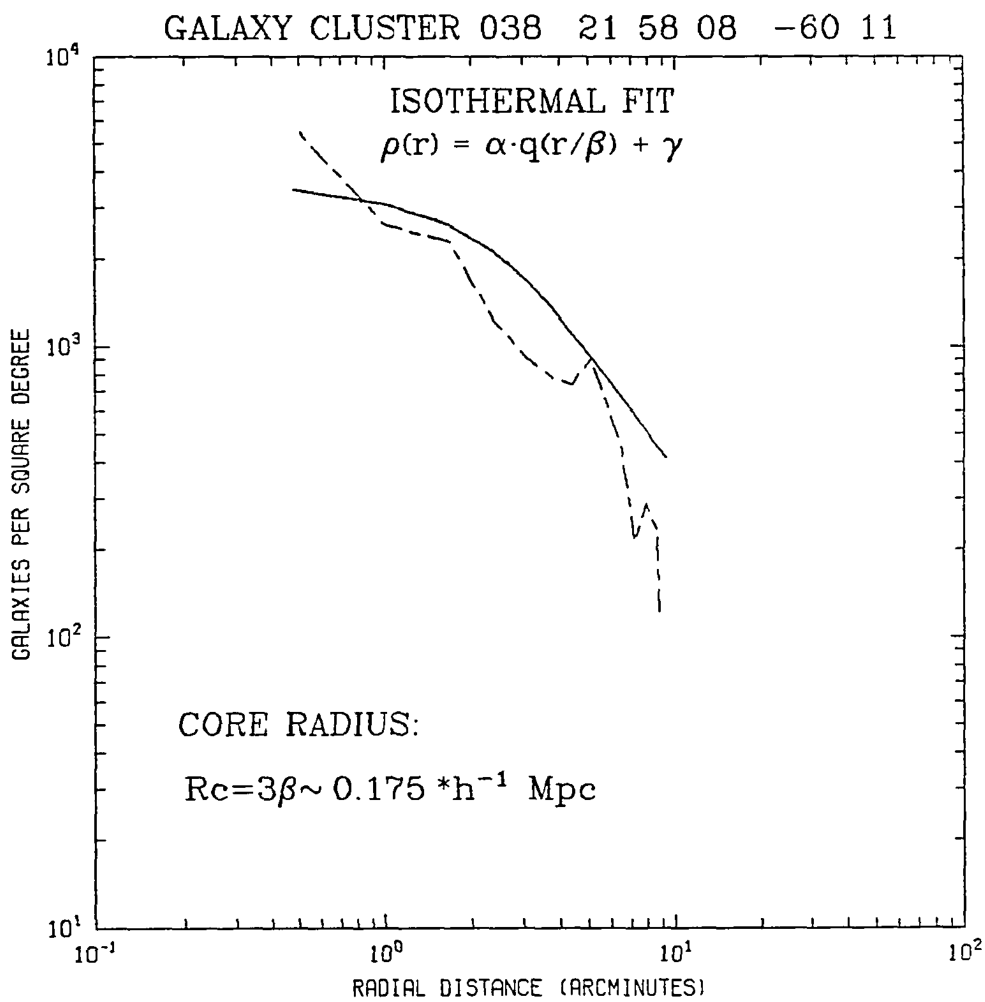


Figure 4.4.38. *(e) Isothermal Fit for Galaxy Cluster 38.*

CLUSTER PARAMETERS GALAXY CLUSTER 038 21 58 08 −60 11	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha = 3173.93 \pm 287.48$ $\beta = 1.02 \pm 0.01$ $\gamma = 11.73 \pm 0.16$	
$\rho(r)_{\text{BEST FIT}} = 3487.59 \cdot q(r/1.03) + 11.90$	
CORE RADIUS: $Rc = 3\beta \sim 0.175 * h^{-1}$ Mpc	REDSHIFT: Z = 0.065

Table 4.4.38. *(b) Cluster Parameters for Galaxy Cluster 38.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 312 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts reveal a strong concentration Eastward of cluster center along the East-West absissa. To the eye this appears as a somewhat linear concentration running North-South from a region just South-East of the cluster center to the cluster periphery. The quadrant counts show the effects of subclustering as evidenced by the extraordinary concentration in the fourth quadrant. The cluster surface density distribution also shows these effects as a gross increase in density near the cluster periphery.

We find the isothermal fit greatly effected by the concentrations noted above so that the fit tends to overide the observations and settle on the peaks of the density distribution. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 039 22 01 11 −58 18

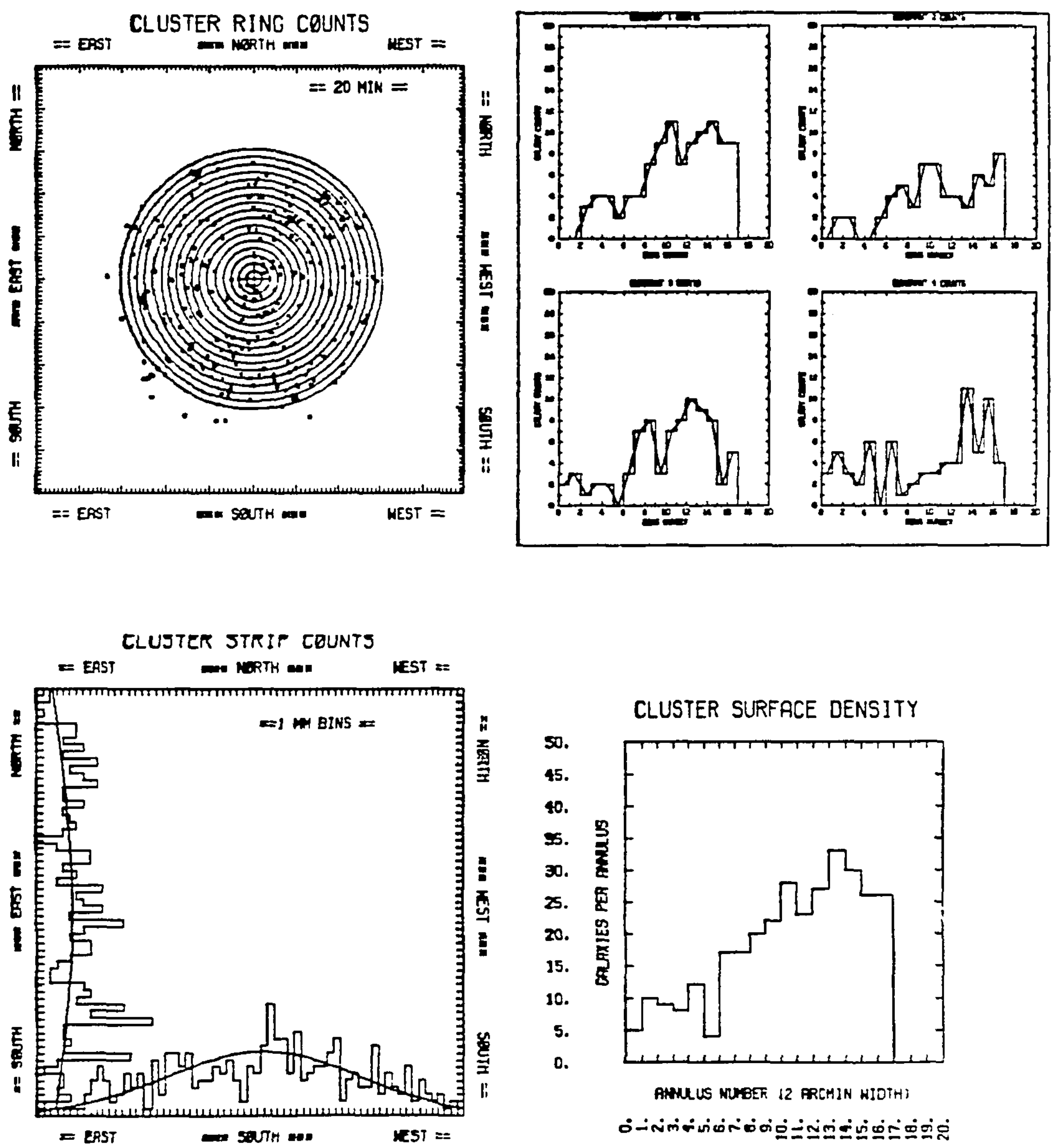


Figure 4.4.39. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 039 22 01 11 -58 18

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	5	0	0	2	3	1.259	1807.51	0.10001	3.25708
2	10	0	2	3	5	2.815	1205.00	0.44949	3.08099
3	9	3	2	1	3	4.539	650.70	0.65698	2.81338
4	8	4	0	2	2	6.295	413.14	0.79898	2.61610
5	12	4	0	2	6	8.061	482.00	0.90640	2.68305
6	3	1	2	0	0	9.833	98.59	0.99267	1.99384
7	17	5	4	2	6	11.607	472.73	1.06472	2.67462
8	18	4	5	8	1	13.383	433.80	1.12655	2.63729
9	16	5	3	6	2	15.160	340.24	1.18069	2.53178
10	26	11	7	5	3	16.937	494.69	1.22885	2.69433
11	25	9	7	6	3	18.716	430.36	1.27220	2.63383
12	25	9	4	9	3	20.494	392.94	1.31163	2.59432
13	27	9	4	9	5	22.273	390.42	1.34778	2.59153
14	32	9	3	9	11	24.052	428.45	1.38115	2.63190
15	32	12	6	9	5	25.831	398.90	1.41215	2.60086
16	25	8	5	2	10	27.611	291.53	1.44108	2.46469
17	27	10	8	5	4	29.390	295.77	1.46820	2.47096
18	6	1	2	3	0	31.170	61.97	1.49374	1.79219
19	6	0	2	3	1	32.950	58.62	1.51785	1.76806
20	2	0	0	2	0	34.730	18.54	1.54070	1.26808

TØTAL NUMBER ØF GALAXIES CØUNTED = 331 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 63.530 Y0 = 90.895

RING WIDTH (ARCMIN) = 2.0

Table 4.4.39. *(a) Ring-Count Data for Galaxy Cluster 39.*

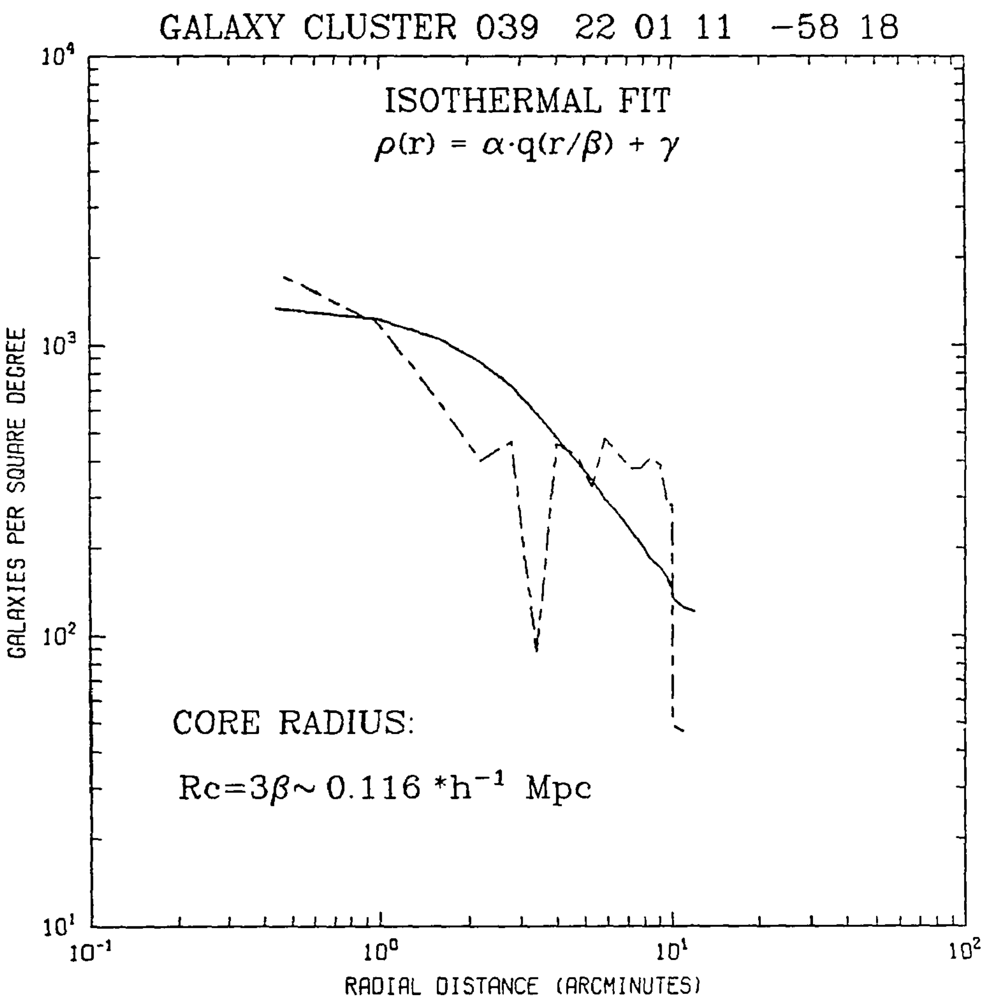


Figure 4.4.39. *(e) Isothermal Fit for Galaxy Cluster 39.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 039 22 01 11 −58 18	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
α = 685.34±437.50 β = 1.05±0.17 γ = 11.89±3.39	
$\rho_{\text{BEST FIT}}(r)$ = 1335.34 ·q(r/1.03) + 12.69	
CORE RADIUS:	REDSHIFT:
Rc=3β~ 0.116 *h^{-1} Mpc	Z = 0.043

Table 4.4.39. *(b) Cluster Parameters for Galaxy Cluster 39.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 331 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. This widely scattered aggregate of galaxies forms a loose cluster with few dense concentrations. The strip counts show considerable scatter especially along the North-South ordinate where we do see slight density enhancements both North and South of cluster center. The quadrant counts reveal concentrations in the third and in particular in the first quadrants. The cluster surface density distribution shows a sharp drop within the slow rise in density directed radially from the cluster center. This radical drop located at ring 6 greatly contributes to the inability of the isothermal model to describe this cluster.

Although the isothermal fit manages to describe some of the observations, it has great difficulty modeling the cluster as a whole. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 040 22 01 07 −50 18

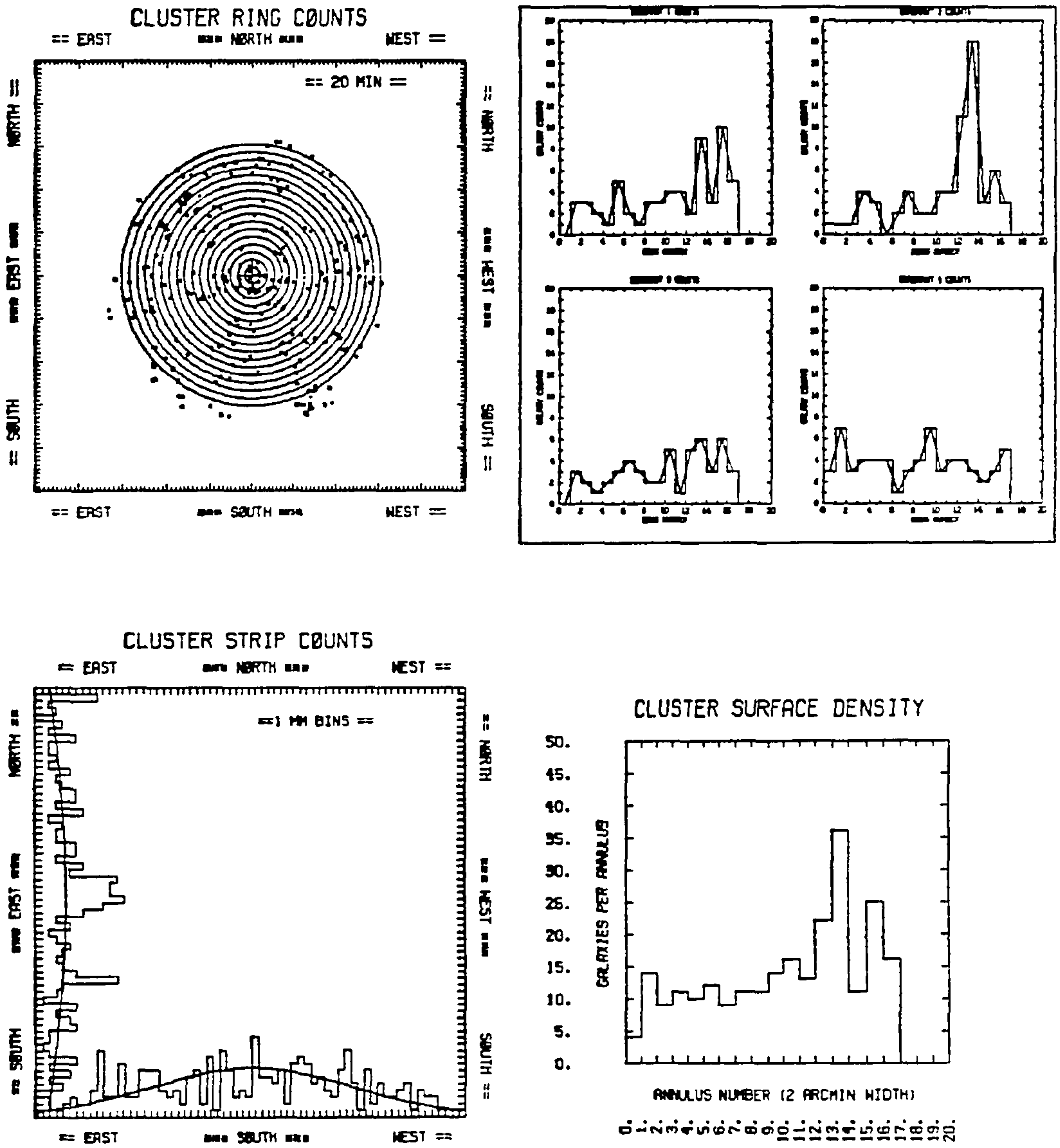


Figure 4.4.40. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 040 22 01 07 -50 18

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	4	0	1	0	3	1.259	1446.01	0.10001	3.16017
2	14	3	1	3	7	2.815	1687.01	0.44949	3.22712
3	9	3	1	2	3	4.539	650.70	0.65698	2.81338
4	11	2	4	1	4	6.295	568.07	0.79898	2.75440
5	9	1	3	1	4	8.061	361.50	0.90640	2.55811
6	13	5	0	4	4	9.833	427.23	0.99267	2.63066
7	9	2	2	4	1	11.607	250.27	1.06472	2.39841
8	10	1	4	3	2	13.383	241.00	1.12655	2.38202
9	12	3	2	2	5	15.160	255.18	1.18069	2.40684
10	13	3	1	2	7	16.937	247.34	1.22885	2.39330
11	16	4	5	4	3	18.716	275.43	1.27220	2.44001
12	12	3	3	2	4	20.494	188.61	1.31163	2.27556
13	19	3	10	3	3	22.273	274.74	1.34778	2.43892
14	41	9	20	8	4	24.052	548.95	1.38115	2.73953
15	10	3	2	3	2	25.831	124.66	1.41215	2.09571
16	24	10	7	4	3	27.611	279.87	1.44108	2.44695
17	18	5	3	5	5	29.390	197.18	1.46820	2.29487
18	23	3	3	8	9	31.170	237.56	1.49374	2.37577
19	14	6	0	3	5	32.950	136.78	1.51785	2.13604
20	3	0	0	0	3	34.730	27.81	1.54070	1.44417

TØTAL NUMBER ØF GALAXIES CØUNTED = 284 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT XO = -8.125 YO = -14.404

RING WIDTH (ARCMIN) = 2.0

Table 4.4.40. *(a) Ring-Count Data for Galaxy Cluster 40.*

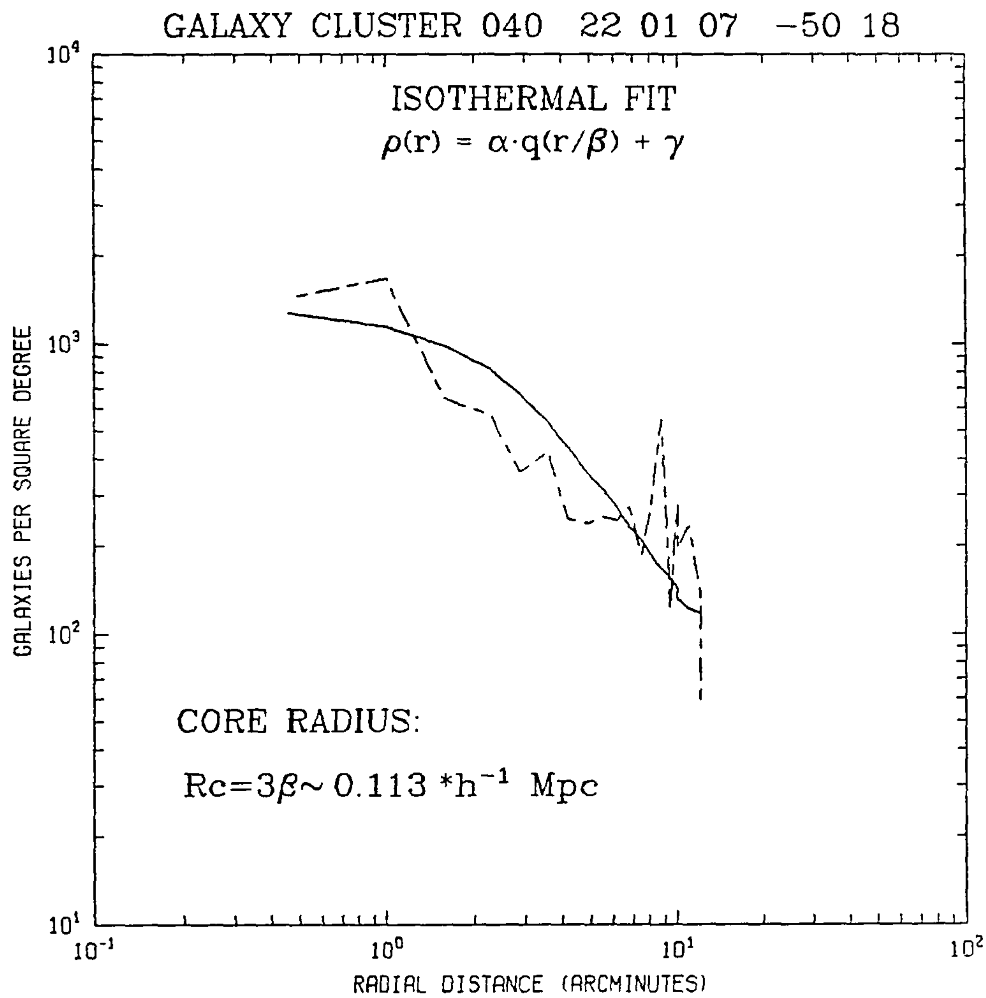


Figure 4.4.40. *(e) Isothermal Fit for Galaxy Cluster 40.*

CLUSTER PARAMETERS
GALAXY CLUSTER 040 22 01 07 −50 18
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
$\alpha =$ 666.48 ± 426.80 $\beta =$ 1.05 ± 0.17 $\gamma =$ 11.72 ± 3.43
$\rho_{\text{BEST FIT}}(r) = 1274.42 \cdot q(r/1.03) + 12.26$
CORE RADIUS: $Rc = 3\beta \sim 0.113 * h^{-1}$ Mpc — REDSHIFT: $Z = 0.042$

Table 4.4.40. *(b) Cluster Parameters for Galaxy Cluster 40.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 284 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show fairly wide dispersion in both directions and display the obvious central concentration located marginally South of the cluster center as well as the slight condensation North-East of center. The quadrant counts confirm the observation in particular in the second quadrant where the dominant peak locates the previously mentioned concentration. Similar behavior is seen in the cluster density distribution which displays a virtual plateau near the cluster center and then departs rapidly near the peripheral concentrations.

The non-uniform cluster surface density lessens the ability of the isothermal fit to model the observational data. This is particularly evident in the plateau regions of the distribution. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 041 22 19 59 −55 23

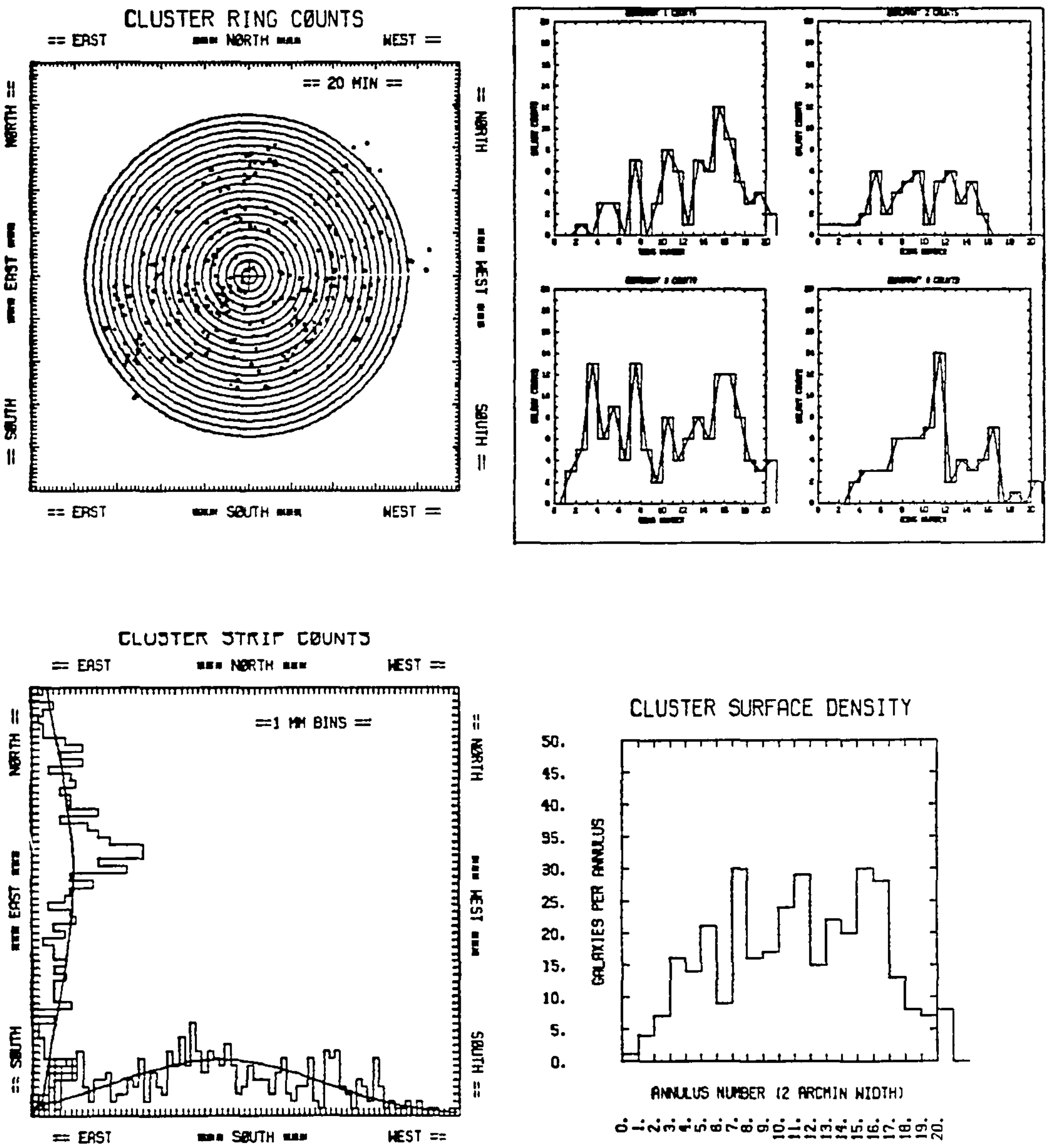


Figure 4.4.41. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 041 22 19 59 -55 23

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	1	0	1	0	0	1.259	361.50	0.10001	2.55811
2	4	0	1	3	0	2.815	482.00	0.44949	2.68305
3	6	1	1	4	0	4.539	433.80	0.65698	2.63729
4	17	0	1	14	2	6.295	877.93	0.79898	2.94346
5	14	3	2	6	3	8.061	562.34	0.90640	2.75000
6	20	3	6	8	3	9.833	657.28	0.99267	2.81775
7	10	0	2	5	3	11.607	278.08	1.06472	2.44417
8	30	7	4	13	6	13.383	723.00	1.12655	2.85914
9	16	0	5	5	6	15.160	340.24	1.18069	2.53178
10	17	3	6	2	6	16.937	323.45	1.22885	2.50981
11	24	8	1	8	7	18.716	413.14	1.27220	2.61610
12	29	6	5	4	14	20.494	455.81	1.31163	2.65878
13	14	1	6	5	2	22.273	202.44	1.34778	2.30630
14	22	7	2	9	4	24.052	294.56	1.38115	2.46917
15	20	5	6	6	3	25.831	249.31	1.41215	2.39674
16	30	13	2	11	4	27.611	349.84	1.44108	2.54387
17	29	9	0	13	7	29.390	317.68	1.46820	2.50199
18	13	5	0	8	0	31.170	134.27	1.49374	2.12799
19	7	3	0	3	1	32.950	68.39	1.51785	1.83501
20	8	4	0	4	0	34.730	74.15	1.54070	1.87014

TØTAL NUMBER ØF GALAXIES CØUNTED = 348 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT XO = 101.125 YO = -22.117

RING WIDTH (ARCMIN) = 2.0

Table 4.4.41. *(a) Ring-Count Data for Galaxy Cluster 41.*

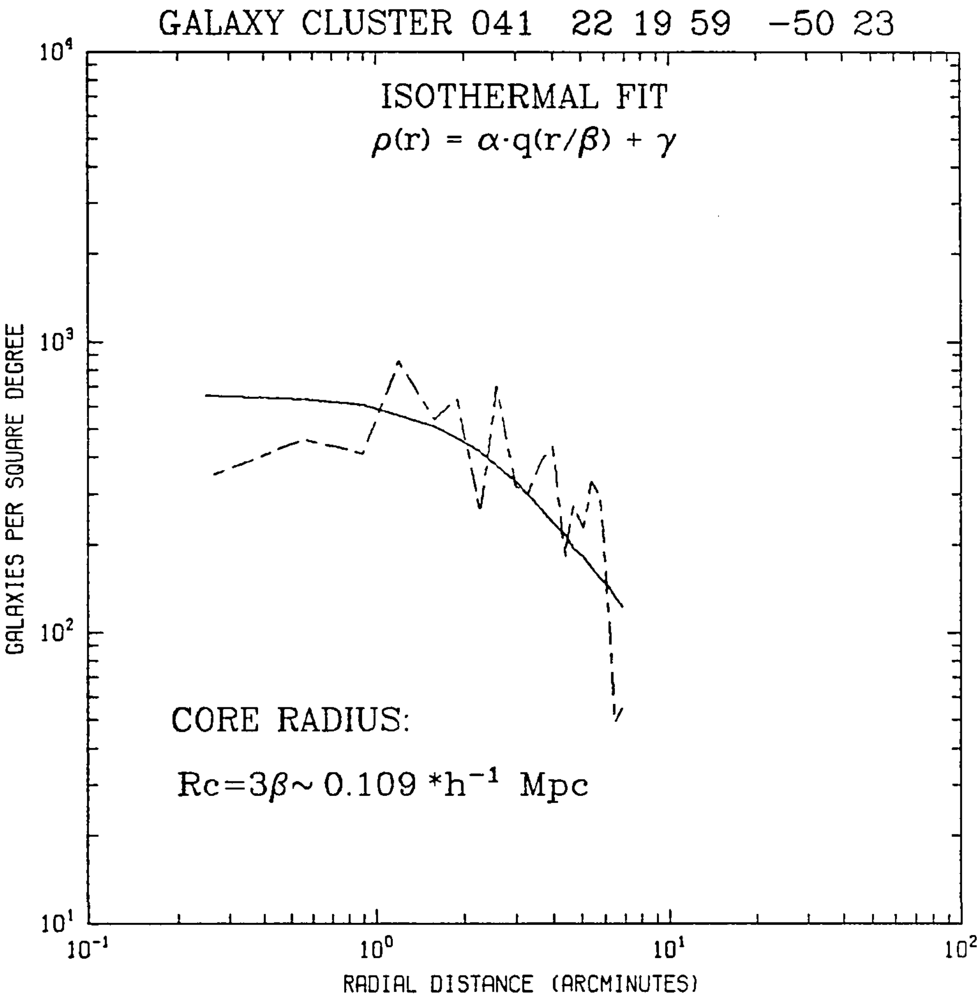


Figure 4.4.41. *(e) Isothermal Fit for Galaxy Cluster 41.*

CLUSTER PARAMETERS		
GALAXY CLUSTER 041 22 19 59 −50 23		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
α = 430.40±219.66	β = 1.05±0.15	γ = 12.35±3.03
$\rho_{\text{BEST FIT}}(r)$ = 642.22·q(r/1.04) + 13.12		
CORE RADIUS:		REDSHIFT:
Rc=3β~ 0.109 *h^{-1} Mpc		Z = 0.040

Table 4.4.41. *(b) Cluster Parameters for Galaxy Cluster 41.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 348 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts reveal a slight concentration East of center along the East-West absissa and likewise another somewhat South of center along the North-South ordinate. This corresponds to what is seen as a small group of galaxies South-East of cluster center. The quadrant counts reveal a paucity of galaxies at or near the cluster center noticed in all quadrants, and several peaks which correspoond to the aforementioned group and other enhancements near the cluster periphery. The surface density distribution shows several peaks and valleys and in particular the lack of membership near the center of the cluster.

The isothermal fit seems to model the middle portions of the cluster adequately but runs into difficulty at the cluster center, as we might have anticipated, and at the cluster periphery. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 042 22 21 26 −56 38

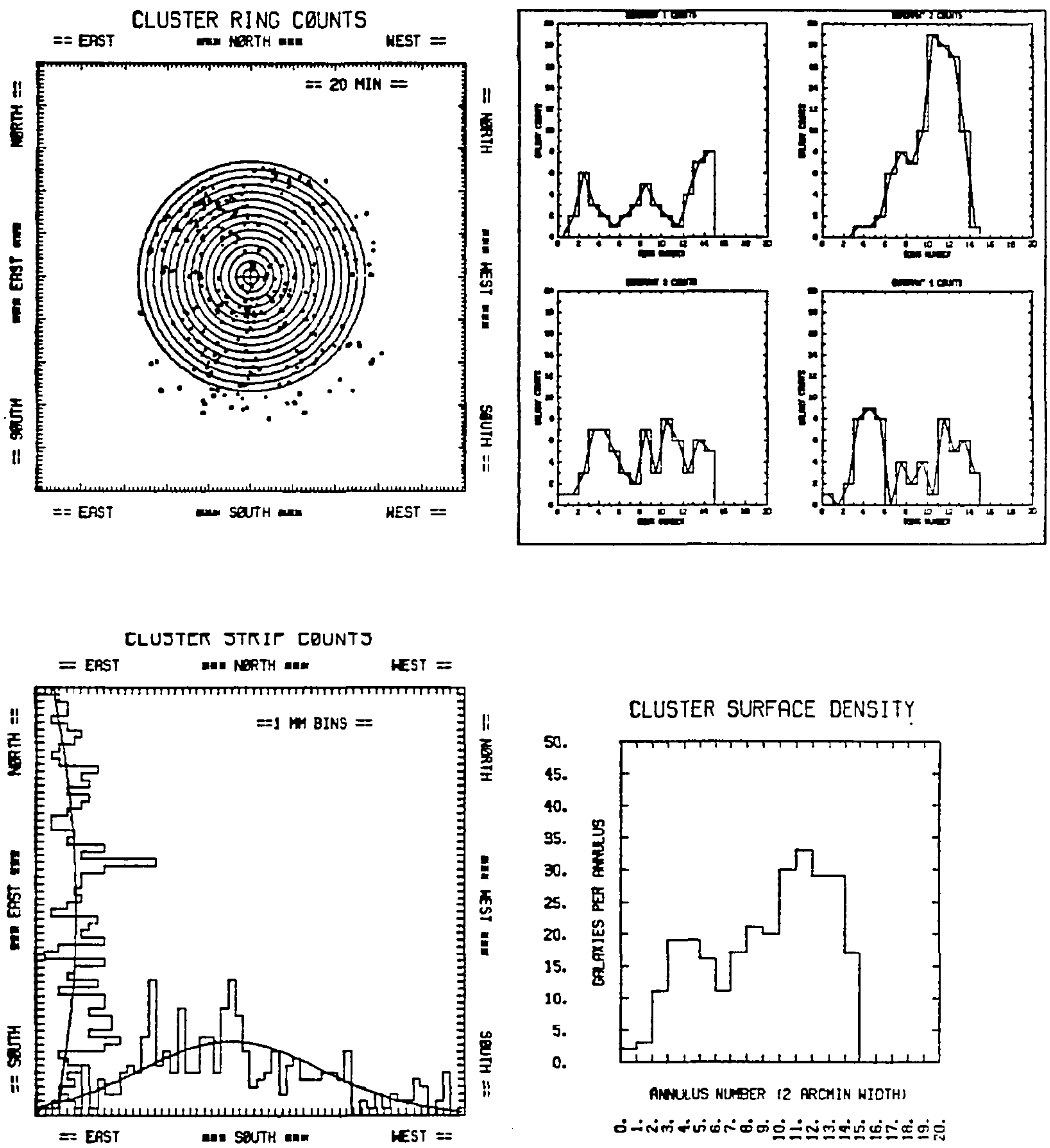


Figure 4.4.42. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 042 22 21 26 -56 38

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	0	1	1	1.259	723.00	0.10001	2.85914
2	3	2	0	1	0	2.815	361.50	0.44949	2.55811
3	11	6	0	3	2	4.539	795.30	0.65698	2.90053
4	19	3	1	7	8	6.295	981.22	0.79898	2.99177
5	19	2	1	7	9	8.061	763.17	0.90640	2.88262
6	16	1	2	5	8	9.833	525.82	0.99267	2.72084
7	11	2	6	3	0	11.607	305.89	1.06472	2.48556
8	17	3	8	2	4	13.383	409.70	1.12655	2.61247
9	20	5	7	6	2	15.160	425.30	1.18069	2.62869
10	20	3	9	4	4	16.937	380.53	1.22885	2.58039
11	29	2	18	8	1	18.716	499.22	1.27220	2.69829
12	35	1	20	6	8	20.494	550.11	1.31163	2.74045
13	28	4	16	3	5	22.273	404.88	1.34778	2.60733
14	29	6	11	6	6	24.052	388.28	1.38115	2.58914
15	18	9	1	5	3	25.831	224.38	1.41215	2.35098
16	16	10	0	3	3	27.611	186.58	1.44108	2.27087
17	21	6	0	10	5	29.390	230.05	1.46820	2.36182
18	4	1	0	0	3	31.170	41.31	1.49374	1.61610
19	5	1	0	2	2	32.950	48.85	1.51785	1.68888
20	4	0	0	0	4	34.730	37.08	1.54070	1.56911

TØTAL NUMBER ØF GALAXIES CØUNTED = 327 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 87.461 Y0 = -88.514

RING WIDTH (ARCMIN) = 2.0

Table 4.4.42. *(a) Ring-Count Data for Galaxy Cluster 42.*

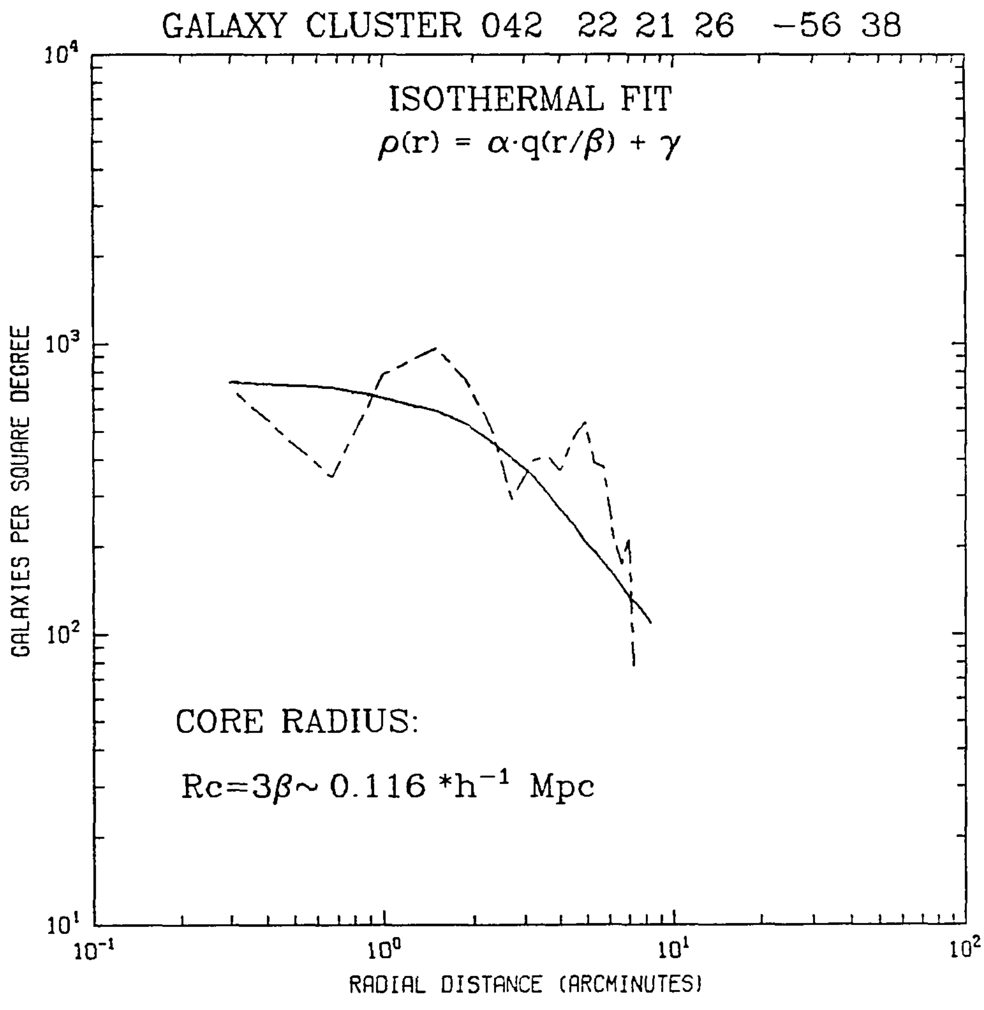


Figure 4.4.42. *(e) Isothermal Fit for Galaxy Cluster 42.*

CLUSTER PARAMETERS GALAXY CLUSTER 042 22 21 26 −56 38	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 519.80 ± 286.90 $\beta =$ 1.05 ± 0.16 $\gamma =$ 12.11 ± 3.10	
$\rho_{\text{BEST FIT}}(r) =$ 728.31 $\cdot q(r/1.03) +$ 12.42	
CORE RADIUS: $Rc = 3\beta \sim$ 0.116 $*h^{-1}$ Mpc	REDSHIFT: Z = 0.043

Table 4.4.42. *(b) Cluster Parameters for Galaxy Cluster 42.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 327 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The strip counts quantify what is apparent to the eye: a concentration East of the cluster center along the East-West absissa locates an apparent subcluster North-East of the center of the cluster; likewise, an enhancement to the South of center along the North-South ordinate reveals another concentration just South of center. The quadrant counts show much the same, especially with the dramatic peak seen in the second quadrant between rings 10 and 12 that corresponds to the subclustering found North-East of the cluster center. The cluster surface density distribution is enhanced by the subclusters to give significantly large and wide peaks in the mapping.

The peaks and valleys of the observed surface density distribution do not allow the isothermal fit to model the data very well. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 043 22 22 36 −56 06

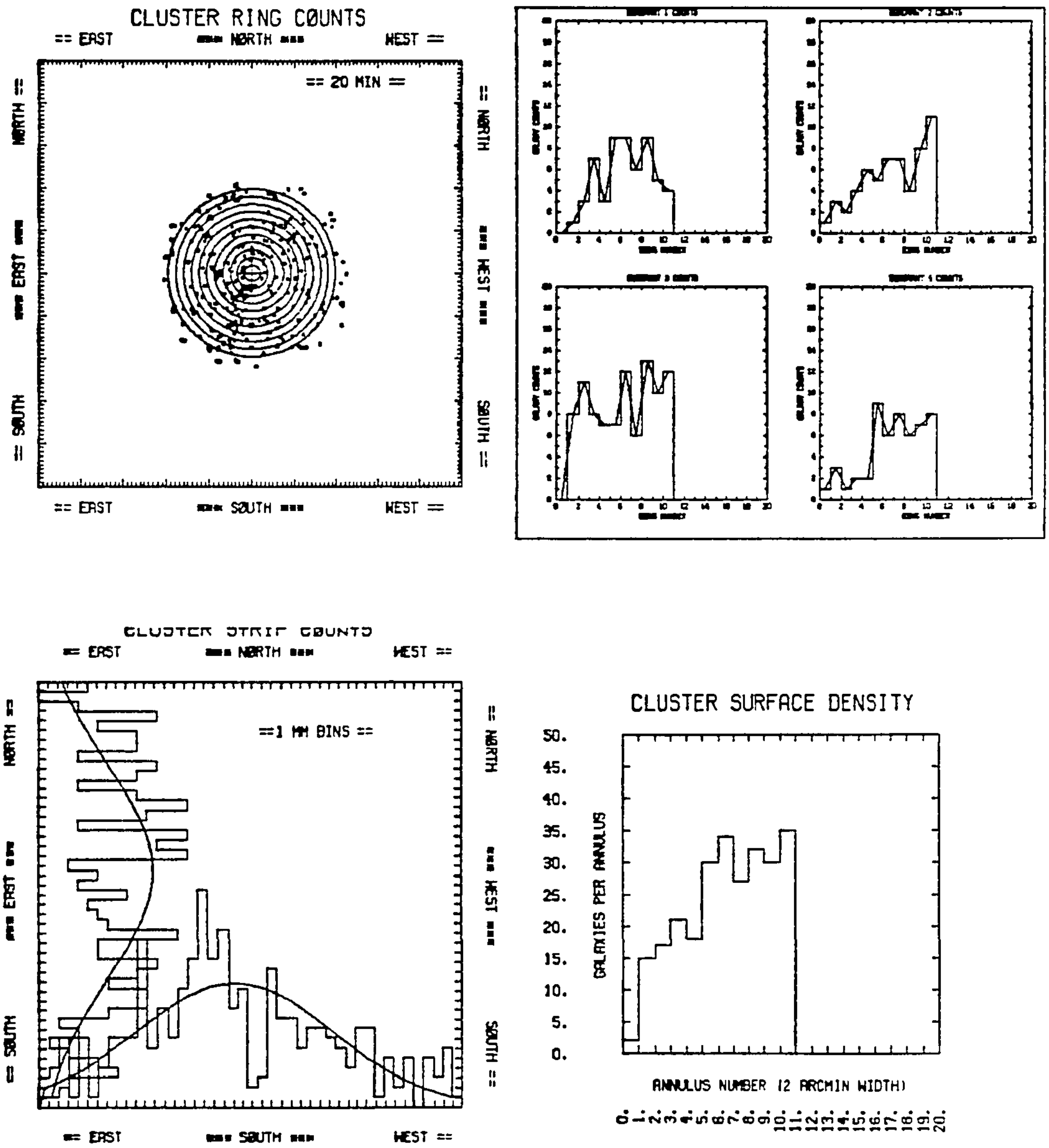


Figure 4.4.43. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 043 22 22 36 -56 06

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	1	0	1	1.259	723.00	0.10001	2.85914
2	15	1	3	8	3	2.815	1807.51	0.44949	3.25708
3	17	3	2	11	1	4.539	1229.10	0.65698	3.08959
4	20	7	3	8	2	6.295	1032.86	0.79898	3.01404
5	19	3	7	7	2	8.061	763.17	0.90640	2.88262
6	30	9	5	7	9	9.833	985.91	0.99267	2.99384
7	33	8	7	12	6	11.607	917.66	1.06472	2.96268
8	28	7	7	6	8	13.383	674.80	1.12655	2.82918
9	32	9	4	13	6	15.160	680.47	1.18069	2.83281
10	30	5	8	10	7	16.937	570.79	1.22885	2.75648
11	34	4	11	12	7	18.716	585.29	1.27220	2.76737
12	30	4	13	7	6	20.494	471.52	1.31163	2.67350
13	17	8	4	0	5	22.273	245.82	1.34778	2.39062
14	6	5	0	0	1	24.052	80.33	1.38115	1.90490
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 313 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 79.768 Y0 = -59.436

RING WIDTH (ARCMIN) = 2.0

Table 4.4.43. *(a) Ring-Count Data for Galaxy Cluster 43.*

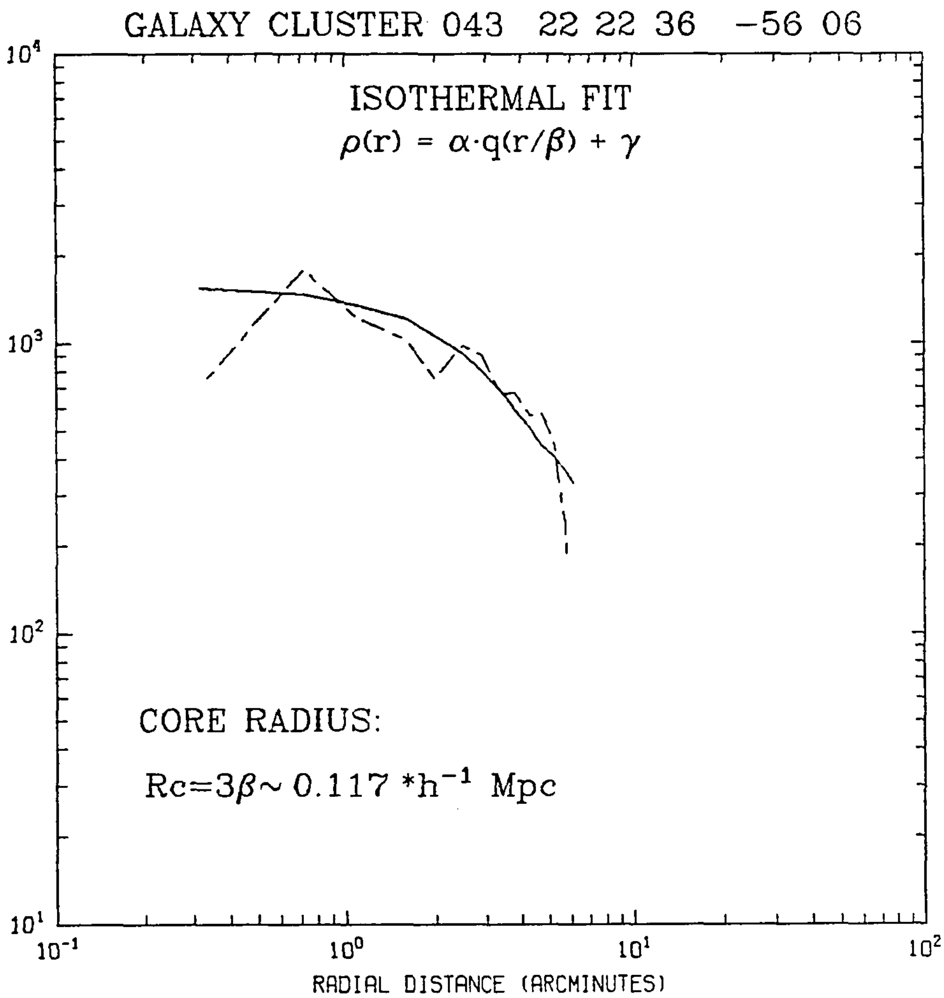


Figure 4.4.43. *(e) Isothermal Fit for Galaxy Cluster 43.*

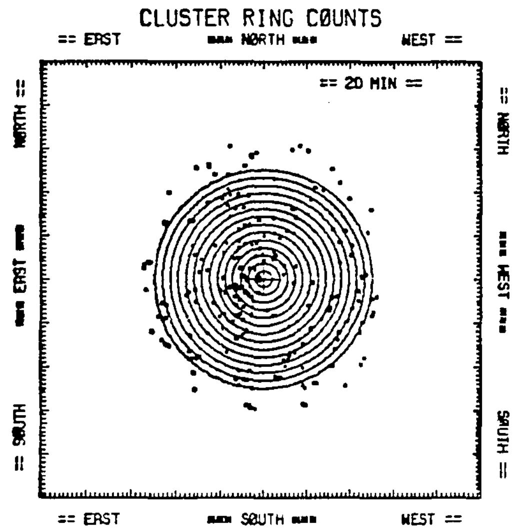
CLUSTER PARAMETERS GALAXY CLUSTER 043 22 22 36 −56 06	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 806.33 ± 492.59 $\beta =$ 1.05 ± 0.16 $\gamma =$ 11.77 ± 3.12	
$\rho(r)_{\text{BEST FIT}} =$ 1541.59 $\cdot$ q(r/1.04) + 12.56	
CORE RADIUS: Rc=3β~ 0.117 *h^{-1} Mpc	REDSHIFT: Z = 0.043

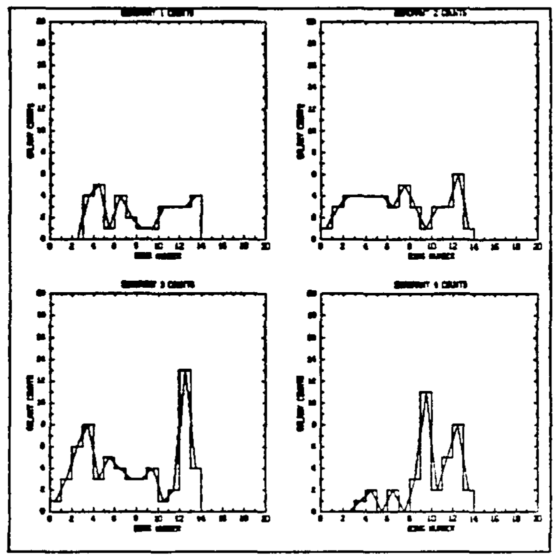
Table 4.4.43. *(b) Cluster Parameters for Galaxy Cluster 43.*

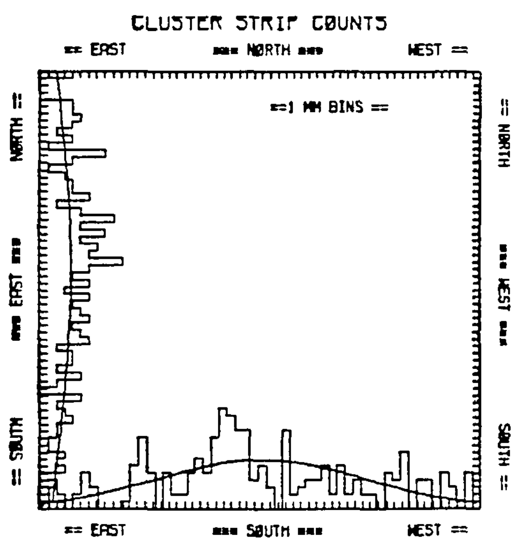
Using the cluster center as determined by the dispersion ellipse analysis, we count 313 galaxies within 14 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts reveal several instances of subclustering: The East-West absissa shows a concentration East of center while the North-South ordinate decribes one South of center. These correspond to what we see as a farly strong condensation South South-East of center. The quadrant counts show similar behavior as well as a paucity of cluster members at the center. In addition, the cluster surface density distribution reflects all of the above findings and shows the presence of two wide peaks in the general rise of density radially from the cluster center.

The isothermal fit appears to model the data well with the exception of the lack of contribution to the general density near the cluster center. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 044 22 24 46 −30 51







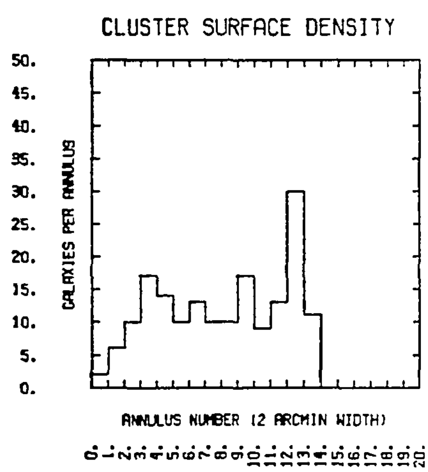


Figure 4.4.44. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 044 22 24 46 -30 51									
RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	1	1	0	1.259	723.00	0.10001	2.85914
2	6	0	3	3	0	2.815	723.00	0.44949	2.85914
3	10	0	4	6	0	4.539	723.00	0.65698	2.85914
4	15	4	4	6	1	6.295	774.65	0.79898	2.88910
5	14	5	3	4	2	8.061	562.34	0.90640	2.75000
6	11	1	5	5	0	9.833	361.50	0.99267	2.55811
7	14	4	3	5	2	11.607	389.31	1.06472	2.59029
8	7	1	3	3	0	13.383	168.70	1.12655	2.22712
9	12	2	5	3	2	15.160	255.18	1.18069	2.40684
10	17	1	1	4	11	16.937	323.45	1.22885	2.50981
11	9	3	3	0	3	18.716	154.93	1.27220	2.19013
12	13	3	2	3	5	20.494	204.33	1.31163	2.31033
13	31	3	7	13	8	22.273	448.26	1.34778	2.65153
14	10	4	1	3	2	24.052	133.89	1.38115	2.12675
15	22	2	6	6	8	25.831	274.24	1.41215	2.43813
16	13	1	4	6	2	27.611	151.60	1.44108	2.18069
17	11	2	4	0	5	29.390	120.50	1.46820	2.08099
18	6	3	3	0	0	31.170	61.97	1.49374	1.79219
19	3	2	1	0	0	32.950	29.31	1.51785	1.46703
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 226 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 143.511 Y0 = -45.125

RING WIDTH (ARCMIN) = 2.0

Table 4.4.44. *(a) Ring-Count Data for Galaxy Cluster 44.*

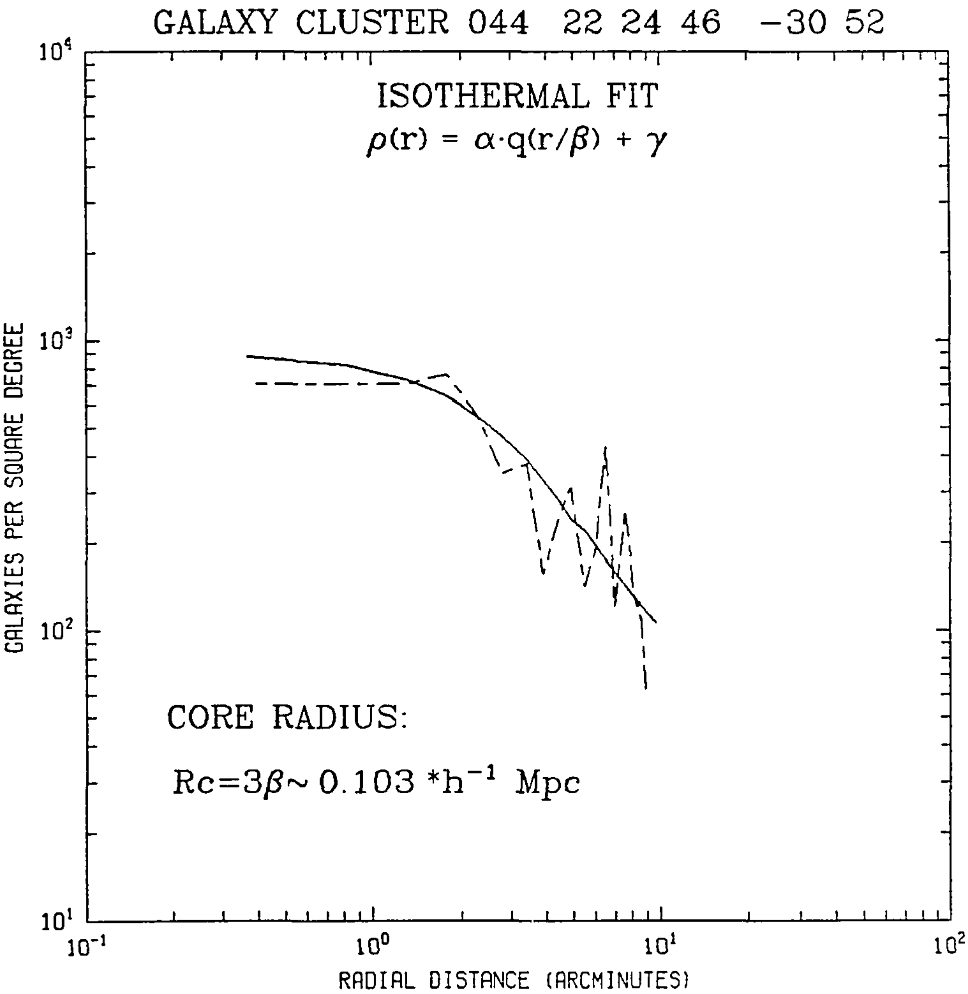


Figure 4.4.44. *(e) Isothermal Fit for Galaxy Cluster 44.*

CLUSTER PARAMETERS		
GALAXY CLUSTER 044 22 24 46 −30 52		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
$\alpha =$ 476.80 ±266.70	$\beta =$ 1.05±0.16	$\gamma =$ 11.79± 3.24
$\rho_{\text{BEST FIT}}(r) =$ 867.02 ·q(r/1.04) + 12.52		
CORE RADIUS:		REDSHIFT:
Rc=3β~ 0.103 *h^{-1} Mpc		Z = 0.038

Table 4.4.44. *(b) Cluster Parameters for Galaxy Cluster 44.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 226 galaxies within 19 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We notice a slight enhancement along the East-West absissa slightly East of the cluster center and a general large variance along the North-South ordinate. The quadrant counts suggest a paucity of galaxies near the cluster center in particular in the first and fourth quadrants, to the West, and a relatively large contribution to the South-East mostly from the third quadrant. The cluster surface density distribution shows a ragged plateau with a large peak located at the cluster periphery near ring 13.

We find the isothermal analysis to adequately model the observations fairly well with perhaps the exception of the region near the center of the cluster and the trough near ring 11. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 045 23 16 35 −42 22

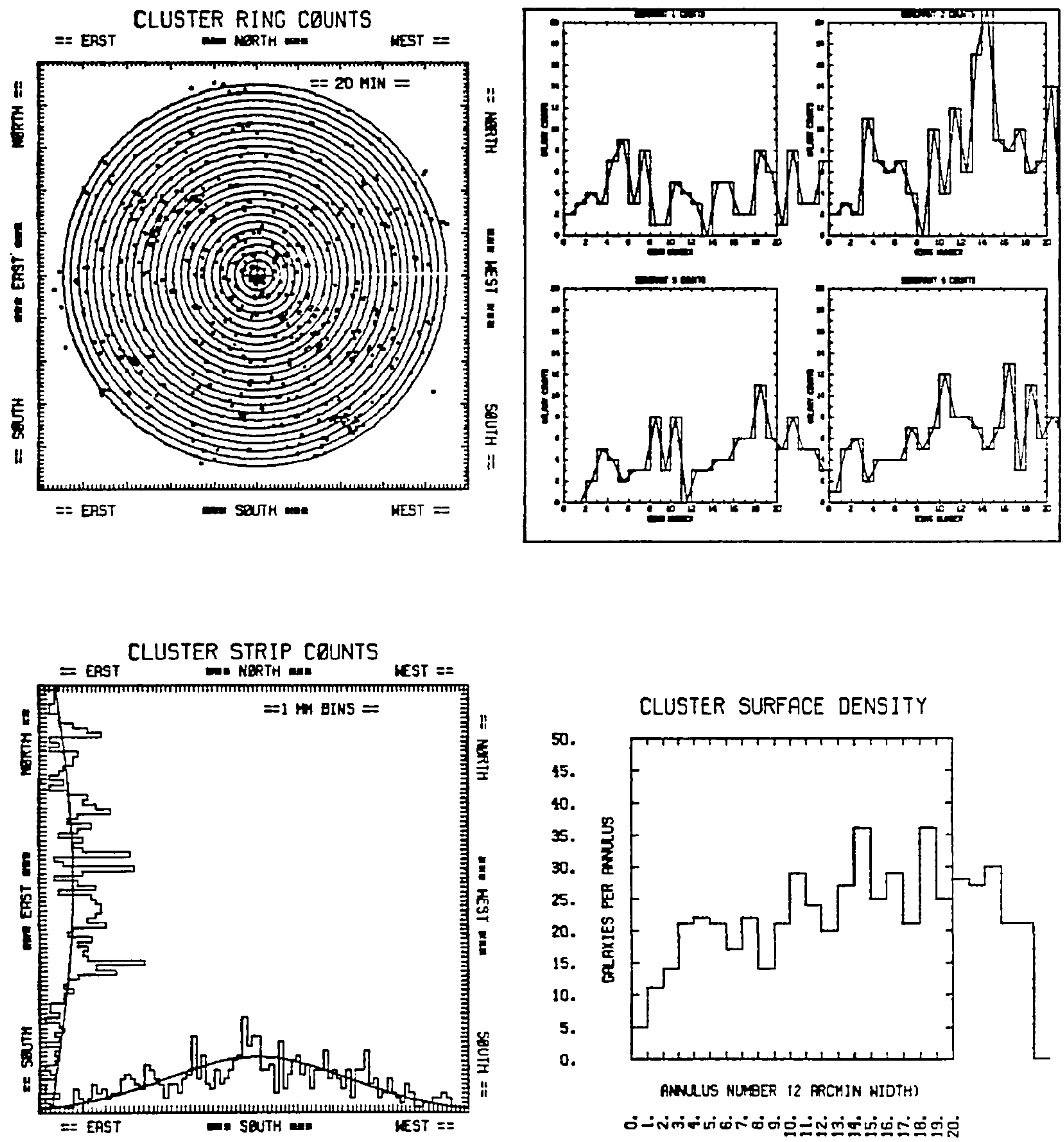


Figure 4.4.45. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 045 23 16 35 -42 22

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	5	2	2	0	1	1.259	1807.51	0.10001	3.25708
2	11	3	3	0	5	2.815	1325.51	0.44949	3.12238
3	14	4	2	2	6	4.539	1012.20	0.65698	3.00527
4	21	3	11	5	2	6.295	1084.50	0.79898	3.03523
5	22	7	7	4	4	8.061	883.67	0.90640	2.94629
6	20	9	5	2	4	9.833	657.28	0.99267	2.81775
7	17	3	7	3	4	11.607	472.73	1.06472	2.67462
8	23	8	5	3	7	13.383	554.30	1.12655	2.74375
9	13	1	0	7	5	15.160	276.44	1.18069	2.44160
10	22	1	10	4	7	16.937	418.58	1.22885	2.62178
11	29	5	4	8	12	18.716	499.22	1.27220	2.69829
12	24	4	12	0	8	20.494	377.22	1.31163	2.57659
13	19	3	6	3	7	22.273	274.74	1.34778	2.43892
14	25	0	14	3	8	24.052	334.72	1.38115	2.52469
15	37	5	24	3	5	25.831	461.23	1.41215	2.66391
16	27	5	10	5	7	27.611	314.86	1.44108	2.49811
17	29	2	8	6	13	29.390	317.68	1.46820	2.50193
18	19	2	8	6	3	31.170	196.24	1.49374	2.29280
19	33	5	8	10	10	32.950	322.42	1.51785	2.50842
20	30	9	7	7	7	34.730	278.08	1.54070	2.44417

TØTAL NUMBER ØF GALAXIES CØUNTED = 585 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 75.547 Y0 = -126.152

RING WIDTH (ARCMIN) = 2.0

Table 4.4.45. *(a) Ring-Count Data for Galaxy Cluster 45.*

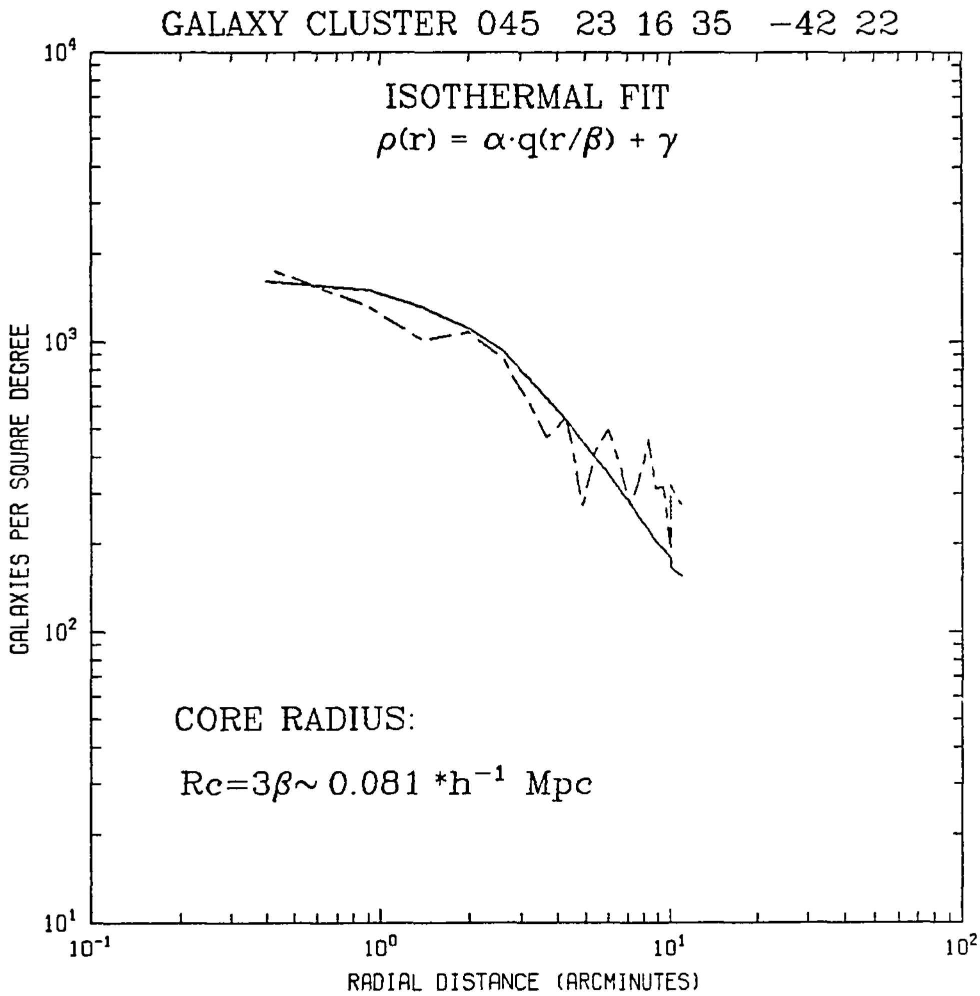


Figure 4.4.45. *(e) Isothermal Fit for Galaxy Cluster 45.*

CLUSTER PARAMETERS
GALAXY CLUSTER 045 23 16 35 −42 22
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
$\alpha =$ 830.83±538.15 $\beta =$ 1.05±0.17 $\gamma =$ 11.85±3.33
$\rho_{\text{BEST FIT}}(r) =$ 1612.29·q(r/1.03) + 12.60
CORE RADIUS: Rc=3β~ 0.081 *h^{-1} Mpc — REDSHIFT: Z = 0.030

Table 4.4.45. *(b) Cluster Parameters for Galaxy Cluster 45.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 401 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show several concentrations: we note one East of the cluster center along the East-West absissa and another to the far West of center corresponding to a subgroup of galaxies located at the South-West periphery of the cluster; likewise, we see several concentrations along the North-South ordinate. These features are also found in the quadrant counts in particular, for example, at the large peak seen in the second quadrant. The cluster surface density shows a gradual, albeit ragged, rise in density radially outward from the cluster center.

The isothermal fit appears to model the observational data rather well with the possible exception of the region near the cluster periphery where some of the more concentrated subclustering is found. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 046 23 27 36 −39 36

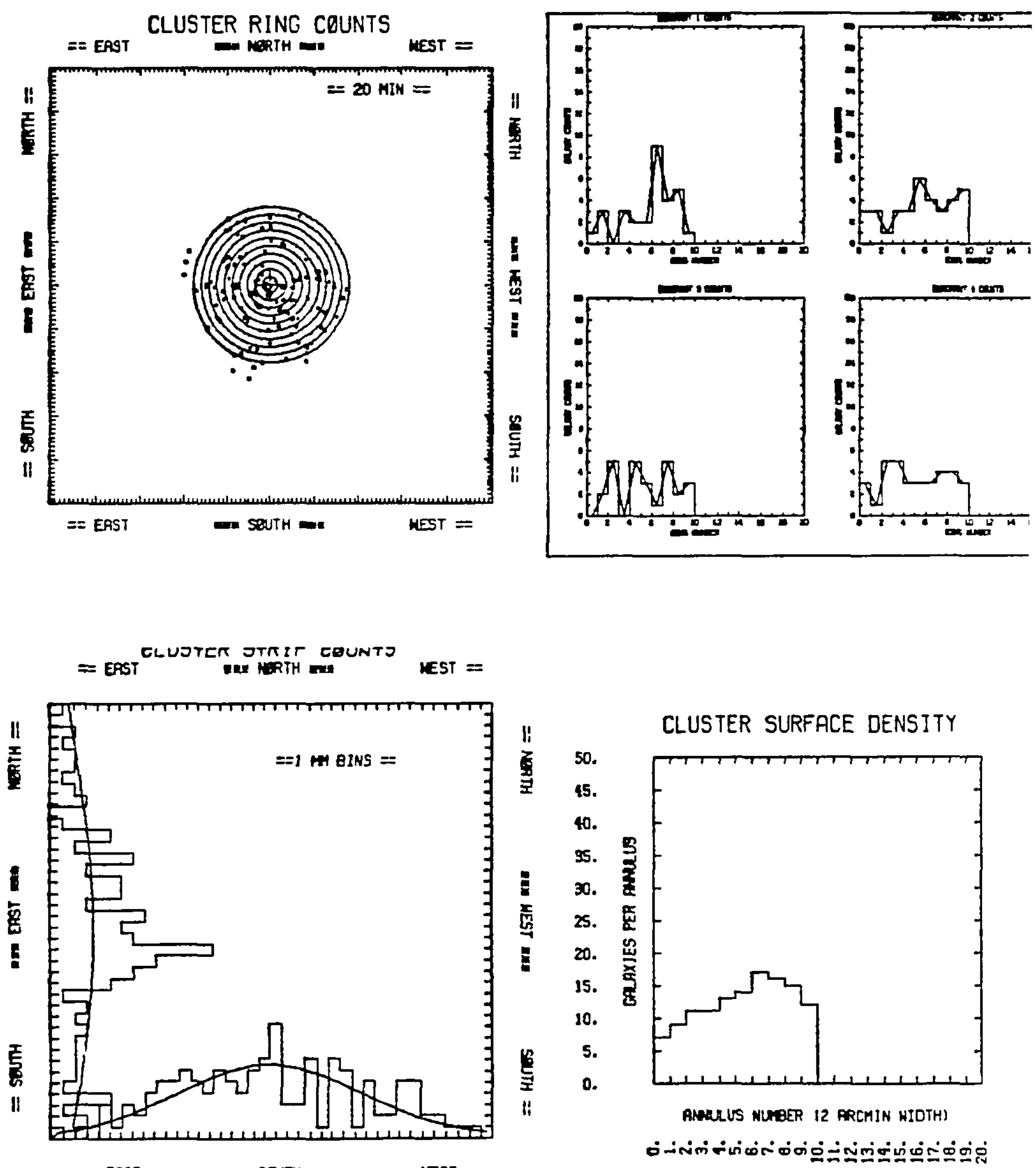


Figure 4.4.46. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 046 23 27 36 -39 36

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	7	1	3	0	3	1.259	2530.51	0.10001	3.40321
2	8	3	2	2	1	2.815	964.00	0.44949	2.98408
3	12	0	2	5	5	4.539	867.60	0.65698	2.93832
4	10	3	2	0	5	6.295	516.43	0.79898	2.71301
5	14	2	4	5	3	8.061	562.34	0.90640	2.75000
6	14	2	6	3	3	9.833	460.09	0.99267	2.66285
7	17	9	4	1	3	11.607	472.73	1.06472	2.67462
8	15	4	3	5	3	13.383	361.50	1.12655	2.55811
9	16	5	4	2	5	15.160	340.24	1.18069	2.53178
10	12	1	5	3	3	16.937	228.32	1.22885	2.35854
11	4	2	1	0	1	18.716	68.86	1.27220	1.83795
12	5	0	3	2	0	20.494	78.59	1.31163	1.89535
13	0	0	0	0	0	22.273	0.00	1.34778	0.00000
14	0	0	0	0	0	24.052	0.00	1.38115	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 134 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT XO = -34.358 YO = 24.253

RING WIDTH (ARCMIN) = 2.0

Table 4.4.46. *(a) Ring-Count Data for Galaxy Cluster 46.*

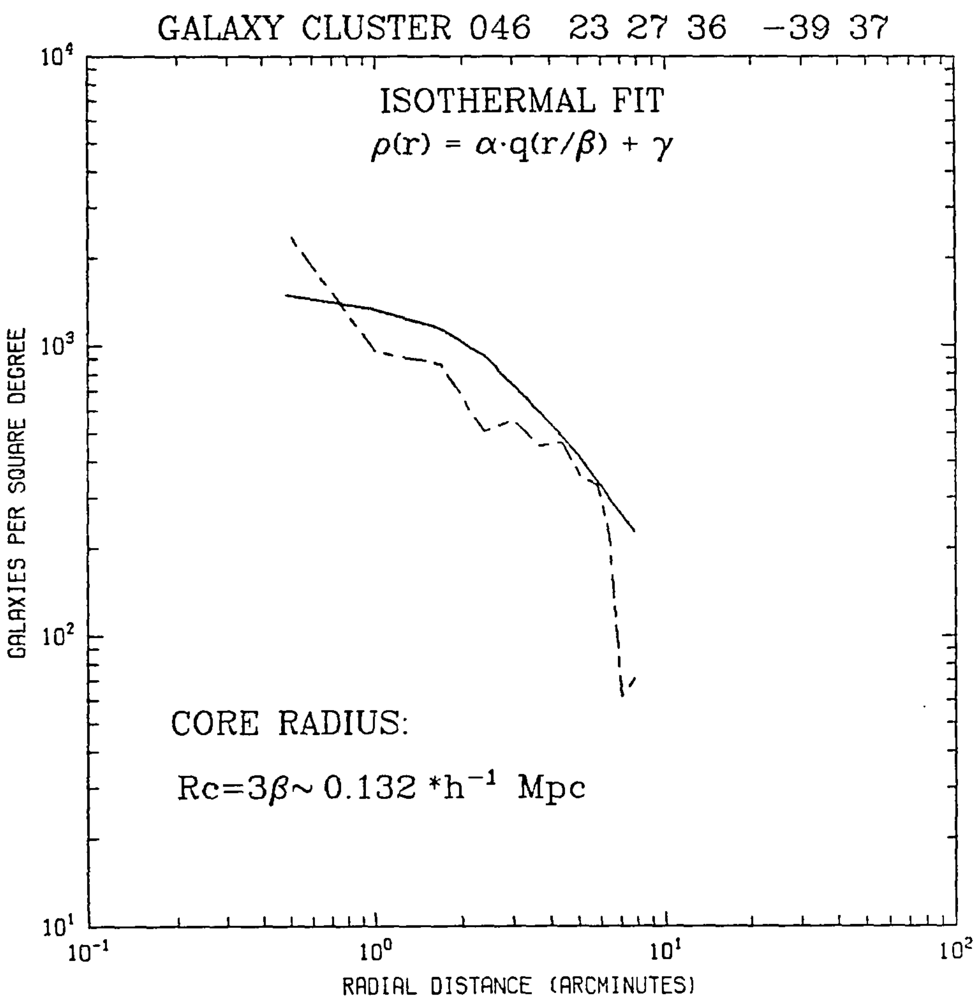


Figure 4.4.46. *(e) Isothermal Fit for Galaxy Cluster 46.*

CLUSTER PARAMETERS GALAXY CLUSTER 046 23 27 36 −39 37		
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$		
$\alpha =$ 779.97±492.73	$\beta =$ 1.05±0.18	$\gamma =$ 11.63±3.54
$\rho_{\text{BEST FIT}}(r) =$ 1494.86 $\cdot q(r/1.03) +$ 11.96		
CORE RADIUS: $Rc = 3\beta \sim$ 0.132 $*h^{-1}$ Mpc		REDSHIFT: Z = 0.049

Table 4.4.46. *(b) Cluster Parameters for Galaxy Cluster 46.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 134 galaxies within 12 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. We find the strip counts somewhat concentrated East of cluster center along the East-West absissa as well as South of center along the North-South ordinate where we appear to have several concentrations of galaxies. Likewise the quadrant counts tend to have their peaks at locations where there is a local excess of galaxies. Finally, the cluster surface density shows a gradual rise in population with increasing radial distance away from center reaching a maximum near ring 7 after which it tapers off.

The isothermal fit is severely effected by the high central density calculated for this cluster which is well over twice as great as that in the adjacent annulus. As a result the fit rides higher above the observations then one might want in order to provide an acceptable model. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 047 23 34 24 −69 34

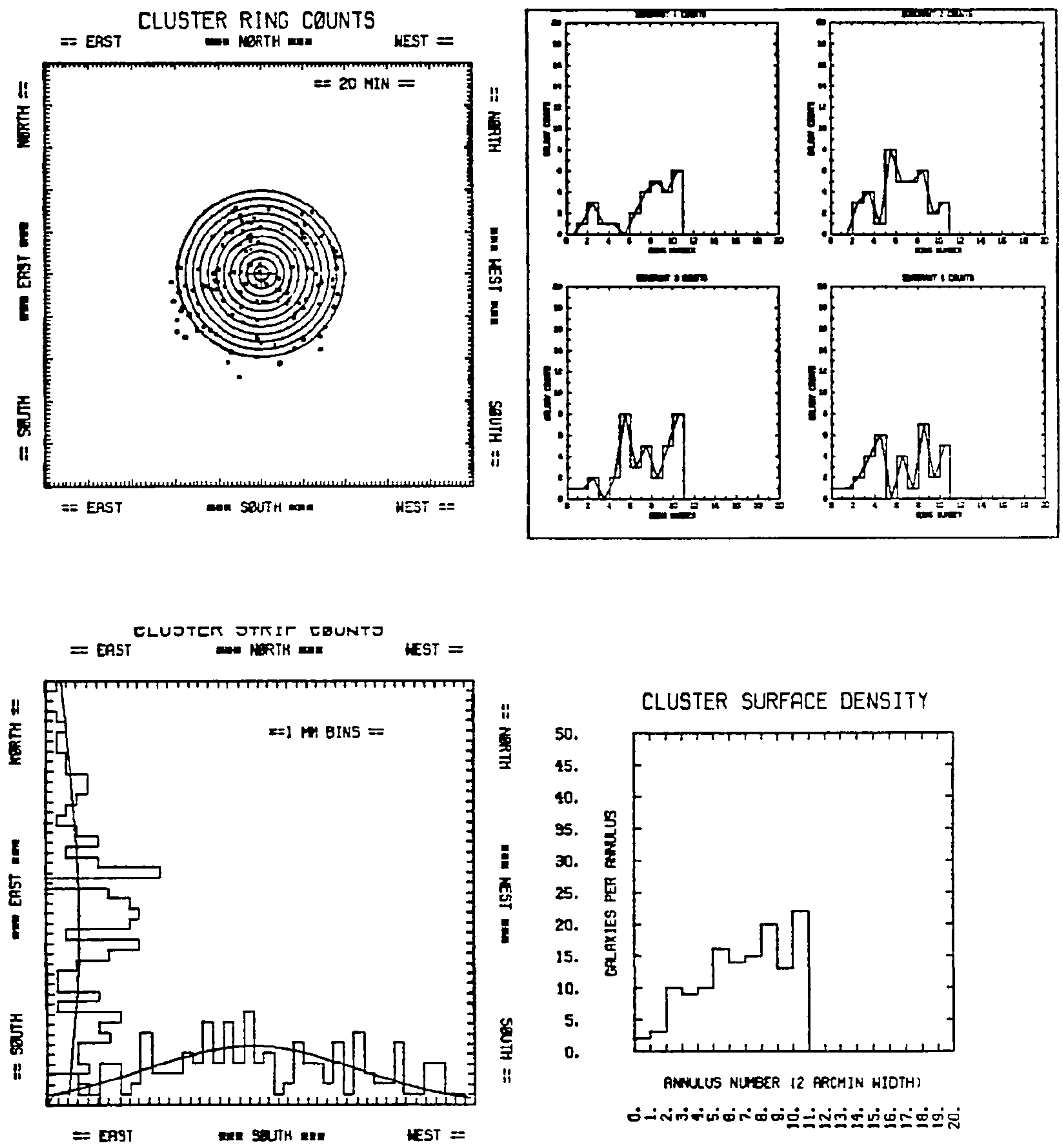


Figure 4.4.47. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 047 23 34 24 -69 34

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	0	1	1	1.259	723.00	0.10001	2.85914
2	3	1	0	1	1	2.815	361.50	0.44949	2.55811
3	10	3	3	2	2	4.539	723.00	0.65698	2.85914
4	8	1	3	0	4	6.295	413.14	0.79898	2.61610
5	10	1	2	2	5	8.061	401.67	0.90640	2.60387
6	16	0	7	8	1	9.833	525.82	0.99267	2.72084
7	15	2	6	3	4	11.607	417.12	1.06472	2.62026
8	15	4	5	5	1	13.383	361.50	1.12655	2.55811
9	19	4	6	2	7	15.160	404.03	1.18069	2.60641
10	14	5	2	5	2	16.937	266.37	1.22885	2.42548
11	22	6	3	8	5	18.716	378.72	1.27220	2.57831
12	11	4	0	4	3	20.494	172.89	1.31163	2.23778
13	3	0	0	2	1	22.273	43.38	1.34778	1.63729
14	1	0	0	1	0	24.052	13.39	1.38115	1.12675
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 149 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = -38.221 Y0 = 25.705

RING WIDTH (ARCMIN) = 2.0

Table 4.4.47. *(a) Ring-Count Data for Galaxy Cluster 47.*

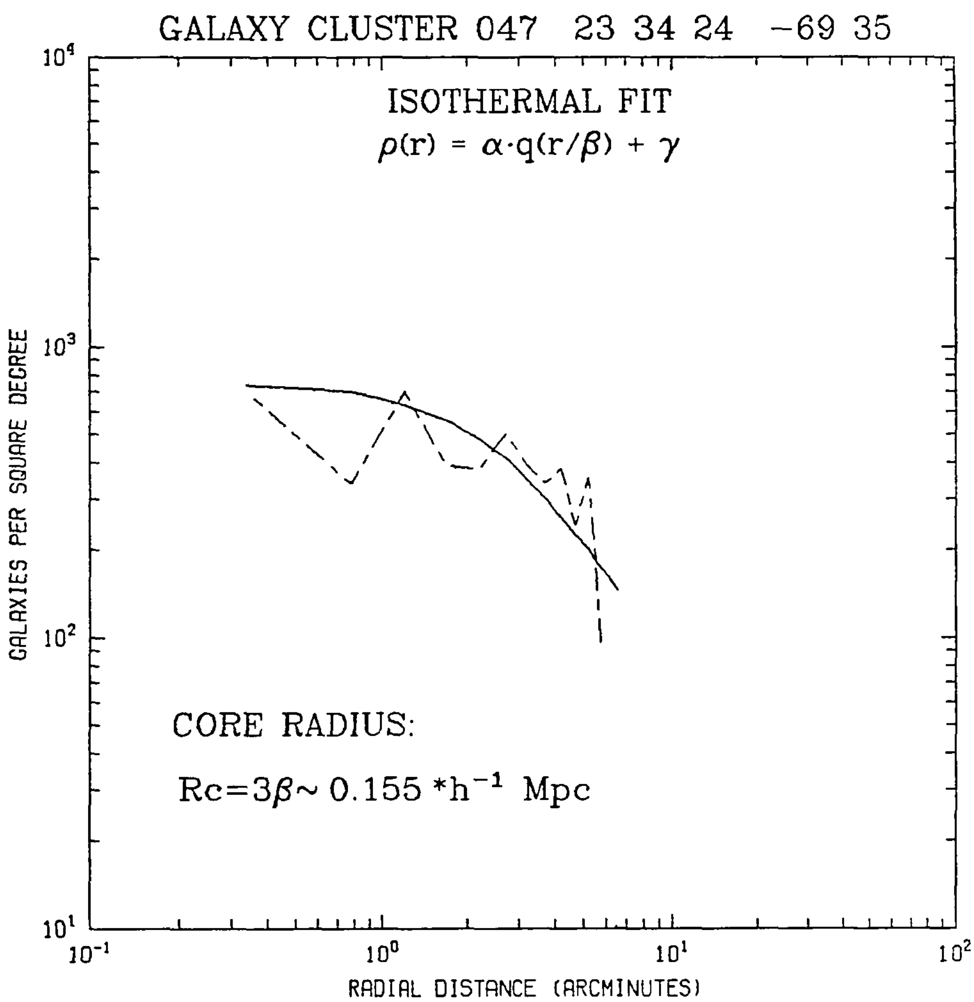


Figure 4.4.47. *(e) Isothermal Fit for Galaxy Cluster 47.*

CLUSTER PARAMETERS GALAXY CLUSTER 047 23 34 24 −69 35	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha = 408.53 \pm 214.93$ $\beta = 1.05 \pm 0.16$ $\gamma = 11.80 \pm 3.20$	
$\rho_{\text{BEST FIT}}(r) = 730.16 \cdot q(r/1.04) + 12.59$	
CORE RADIUS: $Rc = 3\beta \sim 0.155 * h^{-1}$ Mpc	REDSHIFT: Z = 0.057

Table 4.4.47. *(b) Cluster Parameters for Galaxy Cluster 47.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 149 galaxies within 13 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts display a slight enhancement of numbers of galaxies to the East of cluster center along the East-West absissa. The North-South ordinate shows a large variance and a high centrally located concentration. The quadrant counts reveal a relatively low central density and several regions of higher density indicating a low level of subclustering. The cluster surface density shows a steady growth radially from cluster center but with several peaks and troughs in the data.

The isothermal fit appears pulled down by the low surface density and as a result fails to model well the tail of the distribution. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 048 23 38 42 −30 30

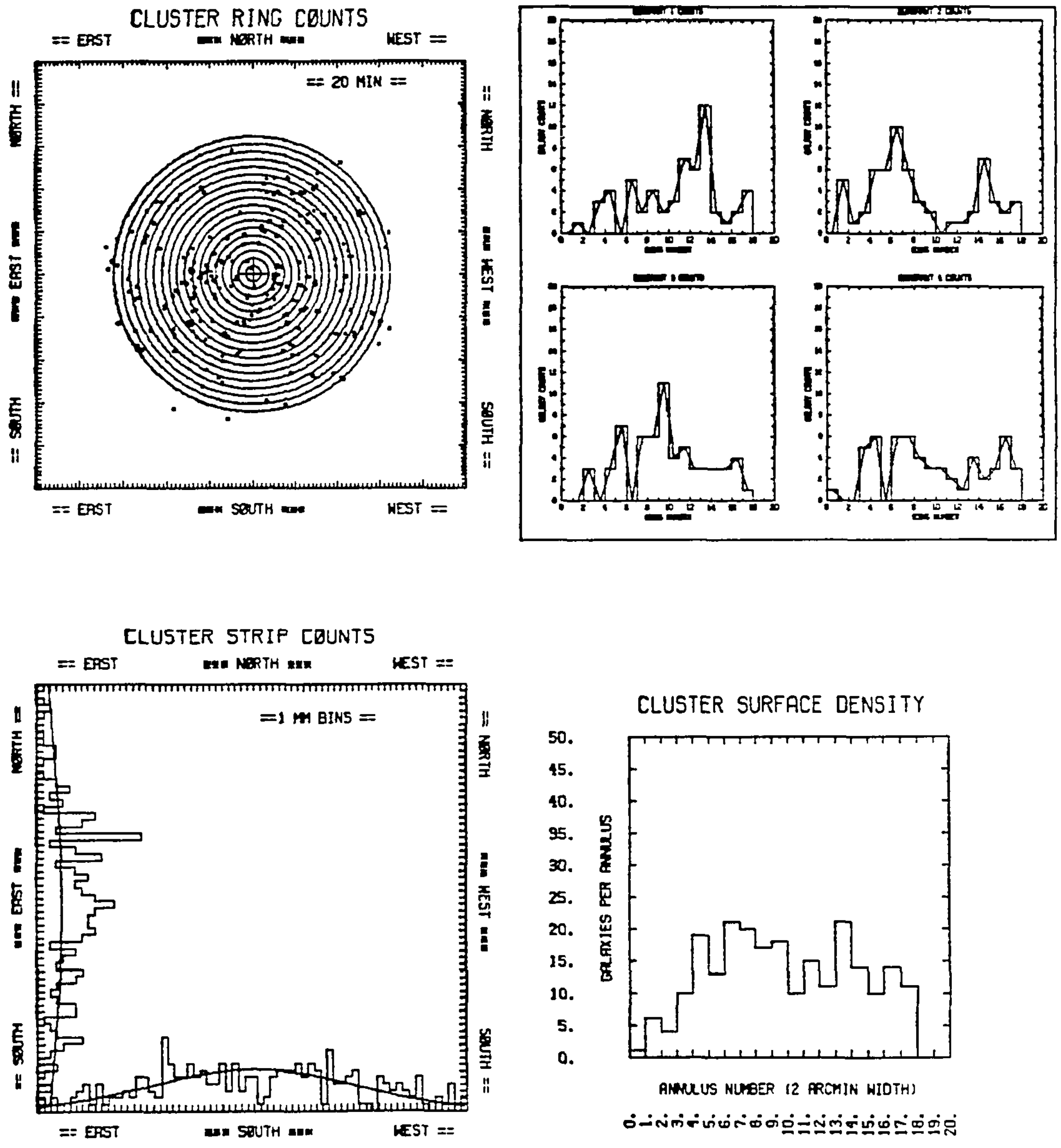


Figure 4.4.48. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 048 23 38 42 -30 30

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	1	0	0	0	1	1.259	361.50	0.10001	2.55811
2	6	1	5	0	0	2.815	723.00	0.44949	2.85914
3	4	0	1	3	0	4.539	289.20	0.65698	2.46120
4	10	3	2	0	5	6.295	516.43	0.79898	2.71301
5	19	4	6	3	6	8.061	763.17	0.90640	2.88262
6	13	0	6	7	0	9.833	427.23	0.99267	2.63066
7	21	5	10	0	6	11.607	583.96	1.06472	2.76639
8	19	2	6	6	5	13.383	457.90	1.12655	2.66077
9	17	4	3	5	5	15.160	361.50	1.18069	2.55811
10	18	2	2	11	3	16.937	342.48	1.22885	2.53463
11	11	3	0	5	3	18.716	189.36	1.27220	2.27728
12	15	7	1	5	2	20.494	235.76	1.31163	2.37247
13	10	6	1	2	1	22.273	144.60	1.34778	2.16017
14	22	12	2	4	4	24.052	294.56	1.38115	2.46917
15	13	2	7	3	1	25.831	162.05	1.41215	2.20966
16	11	1	3	3	4	27.611	128.27	1.44108	2.10814
17	12	2	2	3	5	29.390	131.45	1.46820	2.11878
18	12	4	3	2	3	31.170	123.94	1.49374	2.09322
19	9	1	2	1	5	32.950	87.93	1.51785	1.94415
20	6	3	1	1	1	34.730	55.62	1.54070	1.74520

TØTAL NUMBER ØF GALAXIES CØUNTED = 249 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT XO = 86.526 YO = -26.689

RING WIDTH (ARCMIN) = 2.0

Table 4.4.48. *(a) Ring-Count Data for Galaxy Cluster 48.*

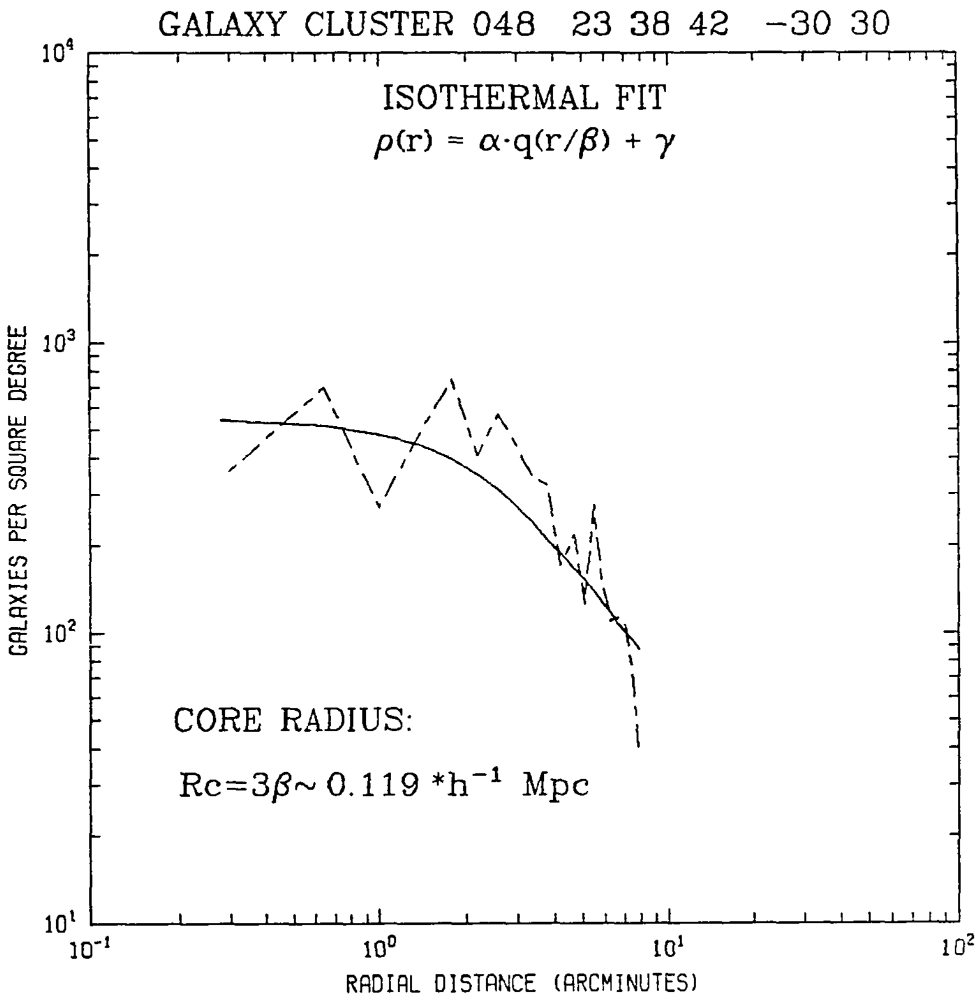


Figure 4.4.48. *(e) Isothermal Fit for Galaxy Cluster 48.*

CLUSTER PARAMETERS
GALAXY CLUSTER 048 23 38 42 −30 30
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
$\alpha =$ 408.86 ± 207.68 $\beta =$ 1.05 ± 0.15 $\gamma =$ 12.12 ± 3.07
$\rho_{\text{BEST FIT}}(r) = 529.94 \cdot q(r/1.03) + 12.29$
CORE RADIUS: $R_c = 3\beta \sim 0.119 \, {}^*h^{-1}$ Mpc — REDSHIFT: Z = 0.044

Table 4.4.48. *(b) Cluster Parameters for Galaxy Cluster 48.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 249 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts display several concentrations: along the East-West absissa we see and Eastward enchancement of galaxy counts; likewise several significant peaks are present in the North-South counts along the ordinate where we find a central concentration dominating the distribution. It is in these locations where we find instances of subclustering. The quadrant counts show a very low central density and several peaks confirming the presence and location of small groups of galaxies. The cluster surface density rises and falls raggedly with increasing distance from the center of the cluster.

The isothermal fit appears somewhat dragged down due to the paucity of galaxies in ring 3 and hence poorly models the observed surface density distribution. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 049 23 44 55 -28 24

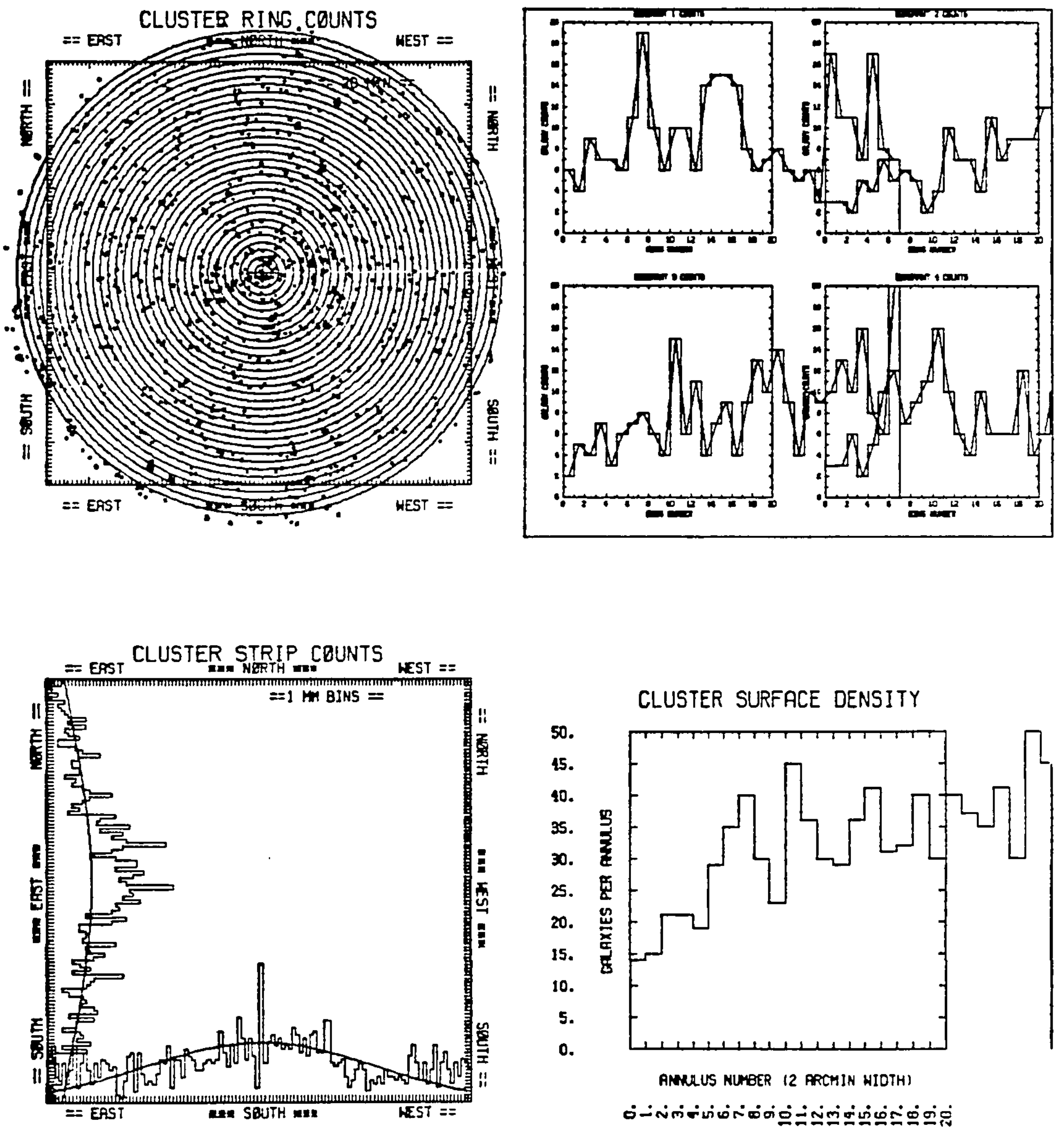


Figure 4.4.49. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 049 23 44 55 -28 24

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	14	6	3	2	3	1.259	5061.02	0.10001	3.70424
2	15	4	3	5	3	2.815	1807.51	0.44949	3.25708
3	19	8	2	4	5	4.539	1373.71	0.65698	3.13789
4	23	8	5	7	3	6.295	1187.79	0.79898	3.07474
5	19	7	4	3	5	8.061	763.17	0.90640	2.88262
6	29	6	7	6	10	9.833	953.05	0.99267	2.97912
7	32	9	5	7	11	11.607	889.85	1.06472	2.94932
8	42	21	6	7	8	13.383	1012.20	1.12655	3.00527
9	30	10	5	7	8	15.160	637.94	1.18069	2.80478
10	23	6	2	4	11	16.937	437.61	1.22885	2.64108
11	46	10	4	15	17	18.716	791.86	1.27220	2.89865
12	34	9	9	6	10	20.494	534.39	1.31163	2.72786
13	30	6	7	11	6	22.273	433.80	1.34778	2.63729
14	29	13	8	4	4	24.052	388.28	1.38115	2.58914
15	32	16	2	6	8	25.831	398.90	1.41215	2.60086
16	45	15	13	10	7	27.611	524.76	1.44108	2.71996
17	33	15	7	4	7	29.390	361.50	1.46820	2.55811
18	28	8	6	8	6	31.170	289.20	1.49374	2.46120
19	43	6	12	14	11	32.950	420.12	1.51785	2.62338
20	29	7	8	9	5	34.730	268.81	1.54070	2.42944

TØTAL NUMBER ØF GALAXIES CØUNTED = 1140 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 15.479 Y0 = 85.995

RING WIDTH (ARCMIN) = 2.0

Table 4.4.49. *(a) Ring-Count Data for Galaxy Cluster 49.*

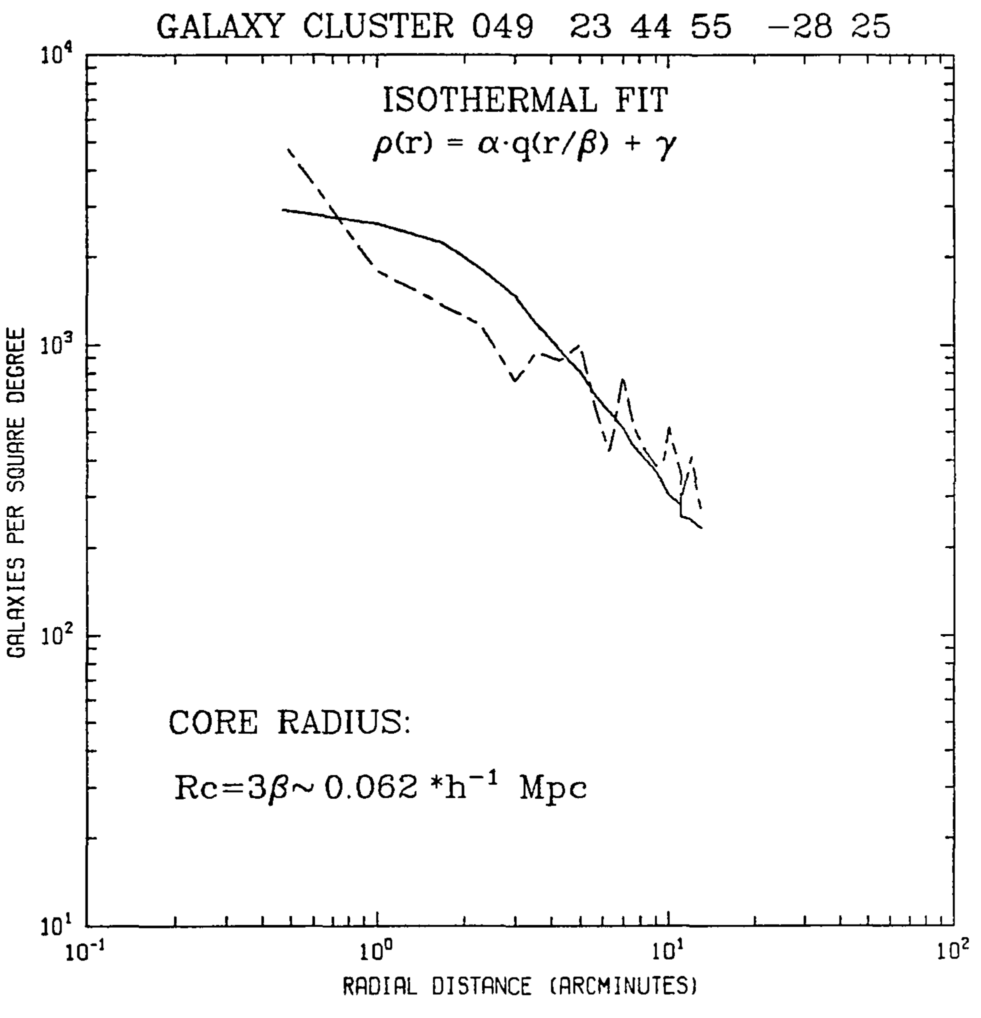


Figure 4.4.49. *(e) Isothermal Fit for Galaxy Cluster 49.*

CLUSTER PARAMETERS GALAXY CLUSTER 049 23 44 55 −28 25	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha = 2283.79 \pm 442.64$ $\beta = 1.02 \pm 0.00$ $\gamma = 11.89 \pm 0.38$	
$\rho_{\text{BEST FIT}}(r) = 2928.43 \cdot q(r/1.03) + 12.44$	
CORE RADIUS: $R_c = 3\beta \sim 0.062 * h^{-1}$ Mpc	REDSHIFT: Z = 0.023

Table 4.4.49. *(b) Cluster Parameters for Galaxy Cluster 49.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 595 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The strip counts for this large and diverse cluster display central concentrations both along the East-West absissa and North-South ordinate as well. This feature is also displayed in the quadrant counts which show a high central density in addition to the presence and location of several instances of subclustering. The general cluster surface density distribution increases slowly with increasing radial distance and shows numberous peaks and troughs in the observational data.

The isothermal fit appears to model the periphery of the cluster adequately, but fails somewhat in the near-central regions. This may be due to the high central density compared to the surrounding values. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER 050 23 59 06 −44 07

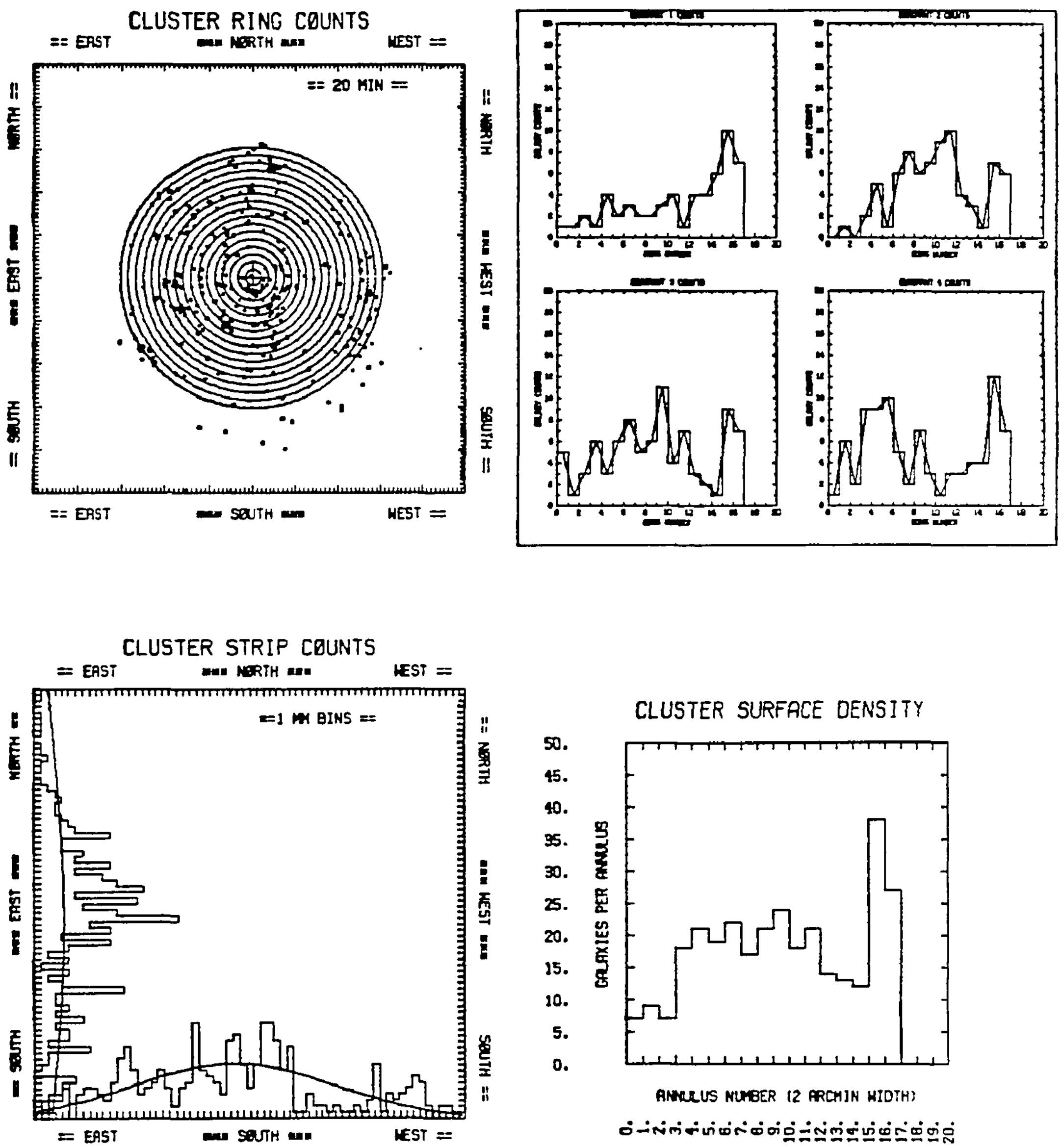


Figure 4.4.50. *(a) Cluster Ring Counts. (b) Quadrant Counts. (c) Cluster Strip-Counts and (d) Cluster Surface Density.*

GALAXY CLUSTER 050 23 59 06 -44 07

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	7	1	0	5	1	1.259	2530.51	0.10001	3.40321
2	9	1	1	1	6	2.815	1084.50	0.44949	3.03523
3	7	2	0	3	2	4.539	506.10	0.65698	2.70424
4	18	1	2	6	9	6.295	929.57	0.79898	2.96828
5	21	4	5	3	9	8.061	843.50	0.90640	2.92609
6	19	2	1	6	10	9.833	624.41	0.99267	2.79547
7	22	3	6	8	5	11.607	611.77	1.06472	2.78659
8	17	2	8	5	2	13.383	409.70	1.12655	2.61247
9	19	1	5	6	7	15.160	404.03	1.18069	2.60641
10	26	4	8	11	3	16.937	494.69	1.22885	2.69433
11	18	4	9	4	1	18.716	309.86	1.27220	2.49116
12	19	1	8	7	3	20.494	298.63	1.31163	2.47514
13	16	4	6	3	3	22.273	231.36	1.34778	2.36429
14	11	3	3	2	3	24.052	147.28	1.38115	2.16814
15	14	7	1	1	5	25.831	174.52	1.41215	2.24184
16	36	10	6	8	12	27.611	419.81	1.44108	2.62305
17	28	7	7	7	7	29.390	306.73	1.46820	2.48675
18	8	2	1	1	4	31.170	82.63	1.49374	1.91713
19	10	6	0	1	3	32.950	97.70	1.51785	1.98991
20	5	0	0	2	3	34.730	46.35	1.54070	1.66602

TØTAL NUMBER ØF GALAXIES CØUNTED = 334 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = -104.794 Y0 = 47.058

RING WIDTH (ARCMIN) = 2.0

Table 4.4.50. *(a) Ring-Count Data for Galaxy Cluster 50.*

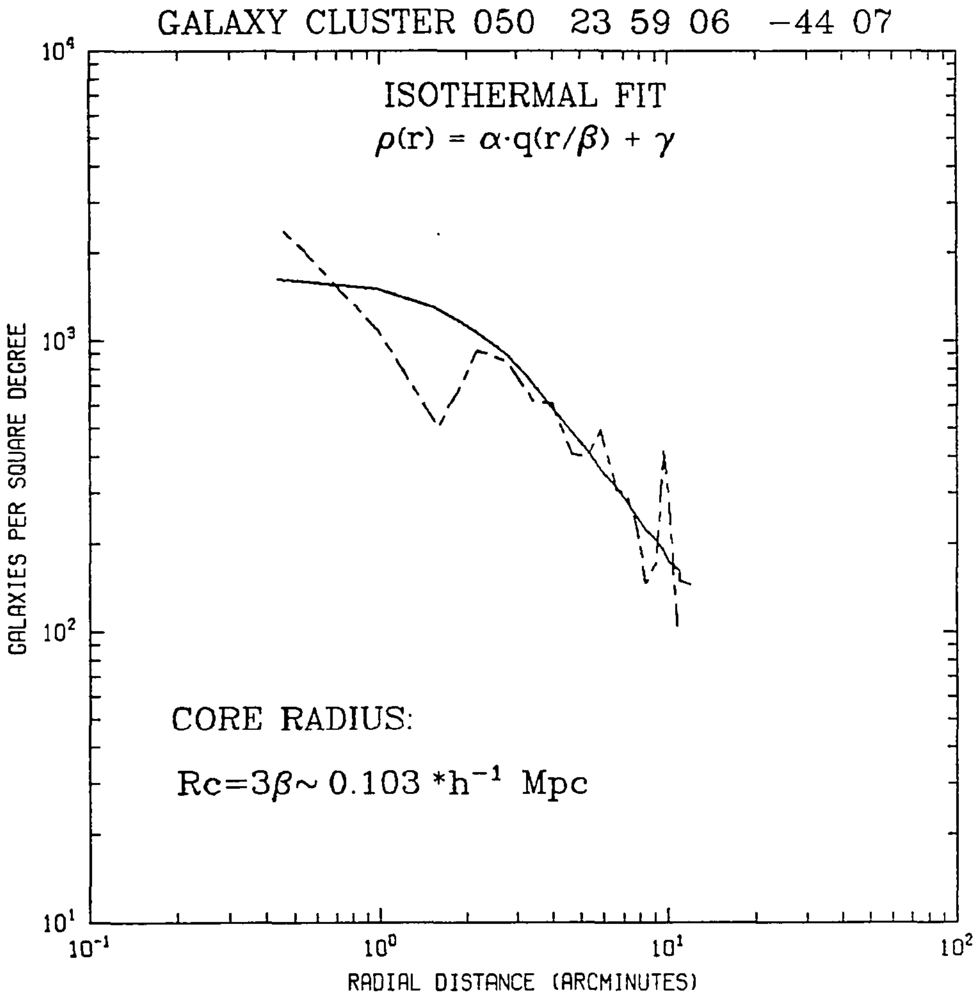


Figure 4.4.50. *(e) Isothermal Fit for Galaxy Cluster 50.*

CLUSTER PARAMETERS	
GALAXY CLUSTER 050 23 59 06 −44 07	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 831.68 ±553.84 $\beta =$ 1.05±0.17 $\gamma =$ 11.82±3.43	
$\rho_{\text{BEST FIT}}(r) =$ 1631.48 $\cdot q(r/1.03) +$ 12.47	
CORE RADIUS:	REDSHIFT:
$Rc=3\beta\sim$ 0.103 $*h^{-1}$ Mpc	Z = 0.038

Table 4.4.50. *(b) Cluster Parameters for Galaxy Cluster 50.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 330 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show several instances of subclustering as is evidenced by the wide peaks seen along the East-West absissa, both East and West of center as well as by similar concentrations along the North-South ordinate, in particular South of center. The quadrant counts reveal a low central condensation but a number of concentrations particularly in quadrants two and three that correspond to small groups of galaxies. The cluster surface density rises quickly radially away from the center to a rough plateau, sinks and then peaks at the cluster periphery.

The resulting isothermal fit appears to model the observations well with the exception of the trough near ring 3 and the peripheral peak. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit"" determined from the χ^2 minimization procedure.

CHAPTER V

THE ABELL CLUSTERS

But as each revolution of thought
has contained some kernel
of surviving truth,
so we may hope that our present
representation of the universe
contains something that will last,
notwithstanding
its faulty expression.
– Arthur Stanley Eddington, 1914

In this chapter we provide a condensed version of cluster descriptions and subsequent isothermal analysis of several *Abell Clusters* found by Abell (1957) in his survery of the distribution of rich clusters of galaxies. The present description serves as an interface between our current work and that which has gone before, not only to restudy previous efforts but to compare and extend the expanding body of information with earlier studies. We trust that these first steps will continue the work of Abell and eventually lead to the large Southern effort that he planned and organized as an all-sky completion of his work carried out in the Northern hemisphere.

5.1 Description and Isothermal Analysis of 5 Abell Clusters

In this section we present a uniform Description and Isothermal Analysis of five Abell clusters of galaxies. Rather than publish the data in numerical form, we choose a graphical and tabular format for ease of comparison between cluster and cluster. The sample is magnitude-limited and uniform to $m_v = 19.0$. As in the previous cases, we provide a general description of the individual clusters, with relevant commentary, as well as the results of an isothermal analysis performed on each.

GALAXY CLUSTER ABELL 0428 03 13 53 −19 17

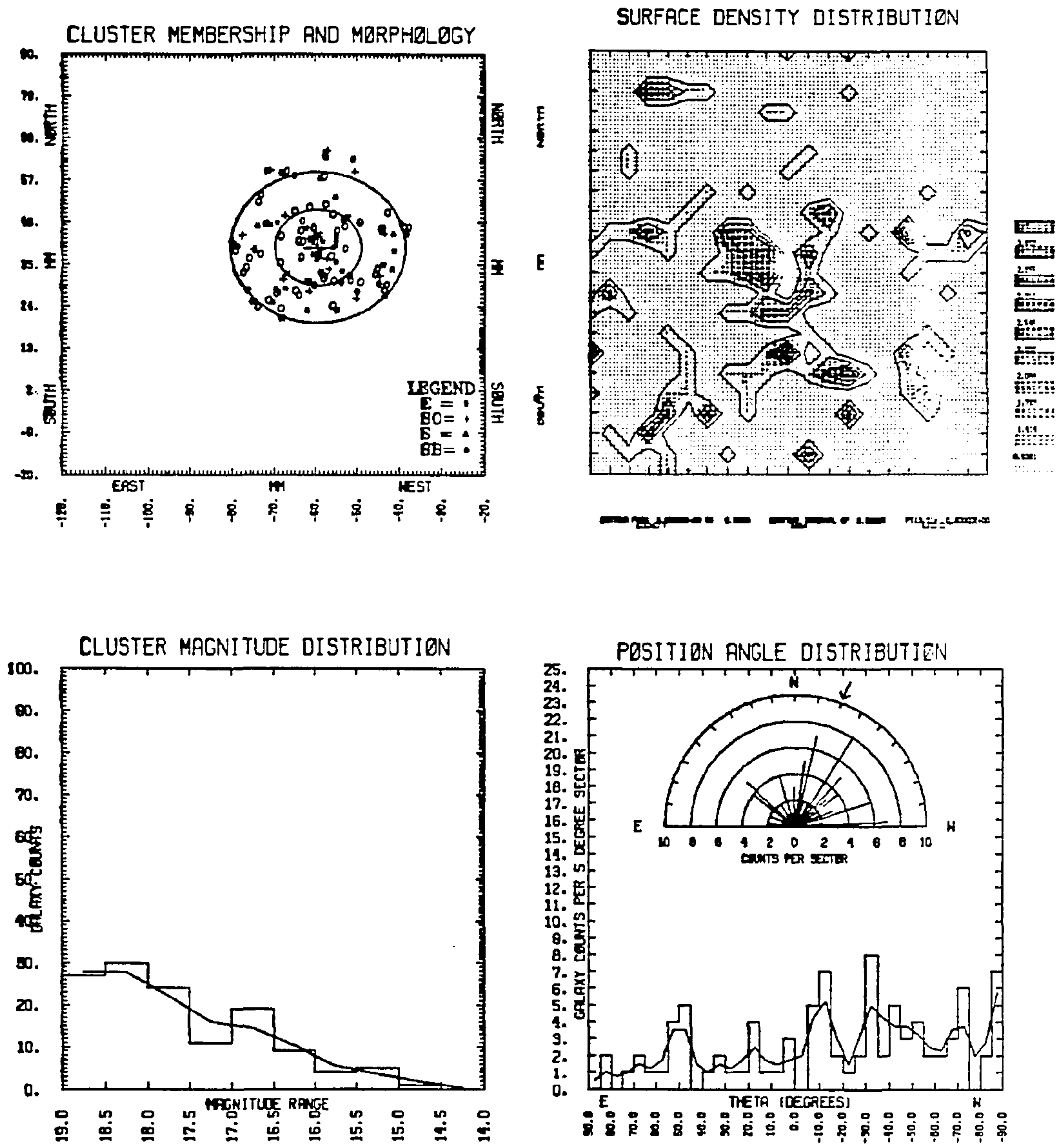
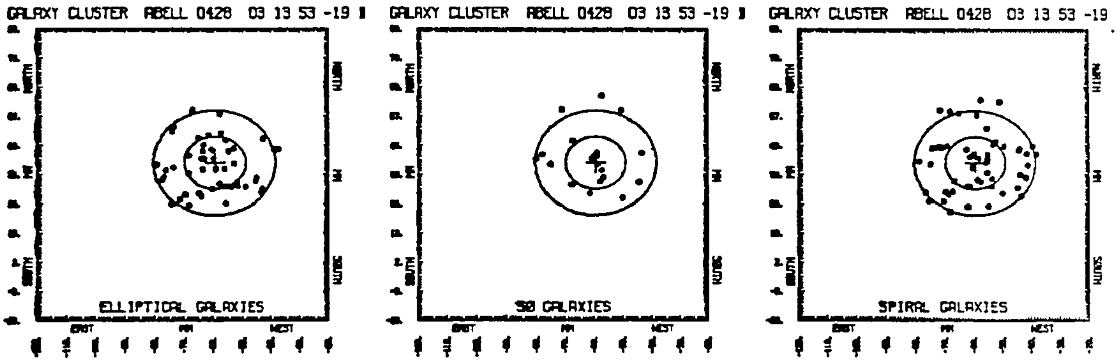


Figure 5.1.01 *(a) Cluster Morphology. (b) Surface Density Distribution. (c) Magnitude Distribution and (d) Position Angle Distribution.*



GALAXY CLUSTER ABELL 0428 03 13 53 −19 17

FIELD 547 ESØ/SERC PLATE J6385

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
059.504	039.261	3 13 53.4	-19 17 44.3	003 42 13.2	-55 54 0.7	0.061

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	50	MAJØR AXIS	10.44	SAMPLE PØPULATIØN	130
SØ	20	MINØR AXIS	9.84	CØRE PØPULATIØN	46
S	56	ECCENTRICITY	0.33	LIMITING MAGNITUDE	19.0
SB	3	PØSN. ANGLE	-0.17		
P	1				

Figure 5.1.01 *(e,f,g) Cluster Morphological Population Distributions.*
Table 5.1.01 *(a) Cluster Population Description.*

Galaxy Cluster Abell 0428: 03 13 53 -19 17. The cluster is located in the North-East quadrant of ESO/SERC Field 547. Within a diameter of 45mm as determined by m_{10} we count 207 galaxies in this cluster and 130 to a limiting magnitude of m_{lim} = 19.0. The cluster is classified Abell type *RI* because of its near lack of spherical symmetry and presence of several concentrations indicating subclustering.

We count 38 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 0. We suggest a $B-M$ type III classification for the cluster which has no dominant galaxies in the field. For m_1,m_3, and m_{10} we give 14.9, 15.4 and 15.9, respectively. The value of m_{10} implies a redshift of 0.061.

The cluster appears somewhat elongated and has several noticable concentrations, notably that immediately North of center and that South-West of center, which are the densest and a number of less dense groups scattered throughout mainly the second and third quadrants of the cluster.

The cluster magnitude distribution appears somewhat bifurcated rising slowly from the brightest galaxies to a small peak near $m_v = 17.0$ then falling to a trough a magnitude later only to rise again to another peak near $m_v = 18.5$ after which it falls rapidly to the magnitude limit. The position angle distribution is scattered, but suggests an excess in the numbers of bright galaxies oriented West of North.

The elliptical galaxies in the cluster appear to be somewhat more concentrated towards the center of the cluster. The spirals appear to be loosely scattered throughout the cluster, but also somewhat concentrated in the central regions. We find the $(E : SO : S)$ ratio to be $(1.0 : 0.4 : 1.2)$ indicating nearly twenty percent more spirals in this cluster than ellipticals. The core population comprises nearly 35% of the sample enclosed in 0.11 square degrees. This gives a core surface density of 407 galaxies per square degree on the sky.

We note several pairs of close or superposed pairs of galaxies in this cluster such as the early and late pair of ellipticals at $x = 51.9, y = 31.8$; and the superposed pair of lenticulars at $x = 74.1, y = 44.8$. We also point out the presence of an peculiar galaxy with the appearance of an amorphous mass with multiple concentrations located at $x = 59.5, y = 36.8$.

GALAXY CLUSTER ABELL 0428 03 13 53 −19 17

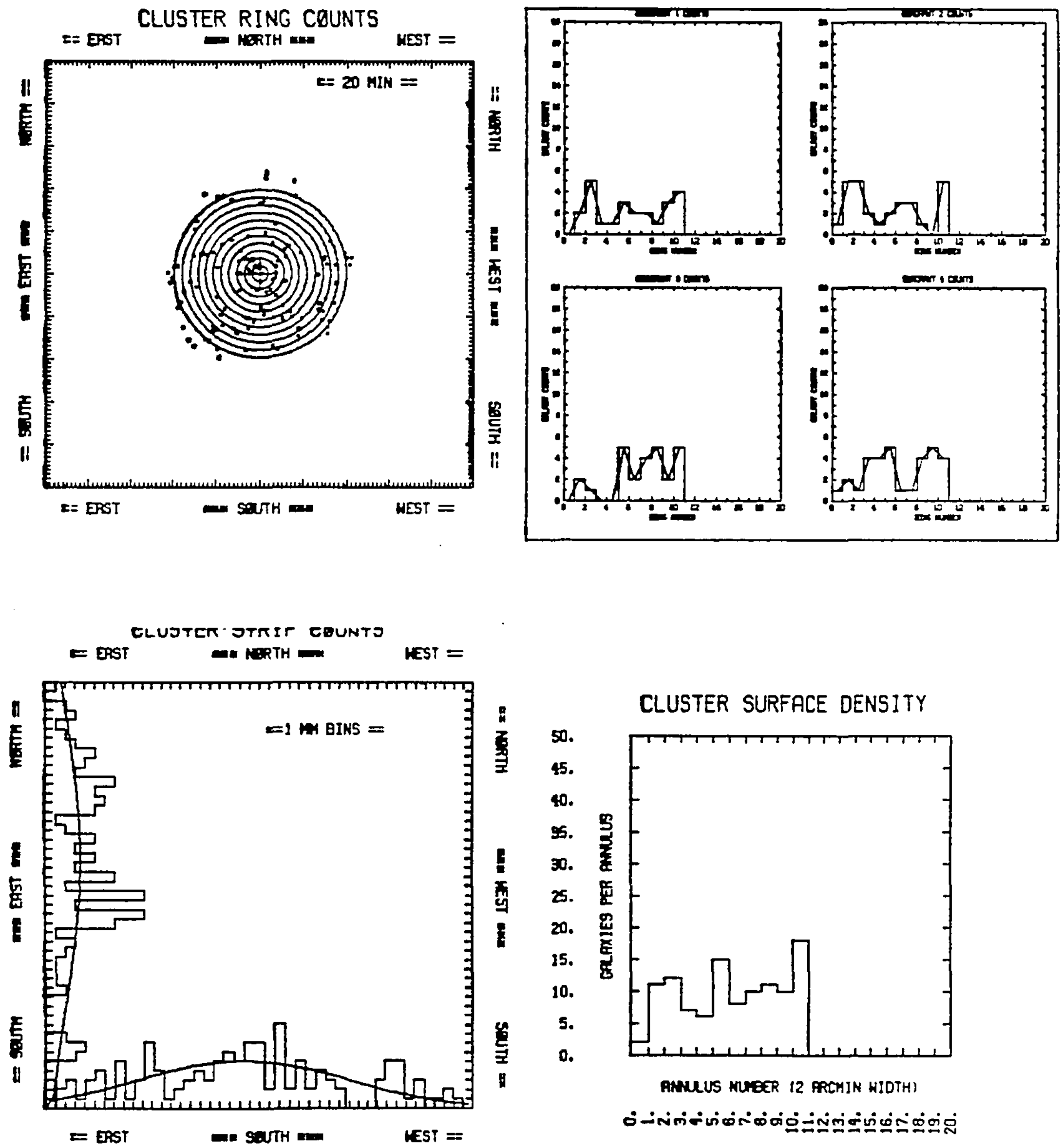


Figure 5.1.01. *(h) Cluster Ring Counts. (i) Quadrant Counts. (j) Cluster Strip-Counts and (k) Cluster Surface Density.*

GALAXY CLUSTER ABELL 0428 03 13 53 -19 17

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	2	0	1	0	1	1.259	723.00	0.10001	2.85914
2	11	2	5	2	2	2.815	1325.51	0.44949	3.12239
3	11	4	5	1	1	4.539	795.30	0.65698	2.90053
4	8	2	2	0	4	6.295	413.14	0.79898	2.61610
5	6	1	1	0	4	8.061	241.00	0.90640	2.38202
6	13	2	2	5	4	9.833	427.23	0.99267	2.63066
7	10	3	3	2	2	11.607	278.08	1.06472	2.44417
8	10	2	3	4	1	13.383	241.00	1.12655	2.38202
9	11	1	1	5	4	15.160	233.91	1.18069	2.36905
10	10	3	0	2	5	16.937	190.26	1.22885	2.27936
11	17	4	4	5	4	18.716	292.64	1.27220	2.46634
12	13	2	5	5	1	20.494	204.33	1.31163	2.31033
13	3	3	0	0	0	22.273	43.38	1.34778	1.63729
14	4	2	2	0	0	24.052	53.56	1.38115	1.72881
15	1	1	0	0	0	25.831	12.47	1.41215	1.09571
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000
17	0	0	0	0	0	29.390	0.00	1.46820	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 130 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = -59.504 Y0 = 39.262

RING WIDTH (ARCMIN) = 2.0

Table 5.1.01. *(b) Ring-Count Data for Abel Cluster 0428.*

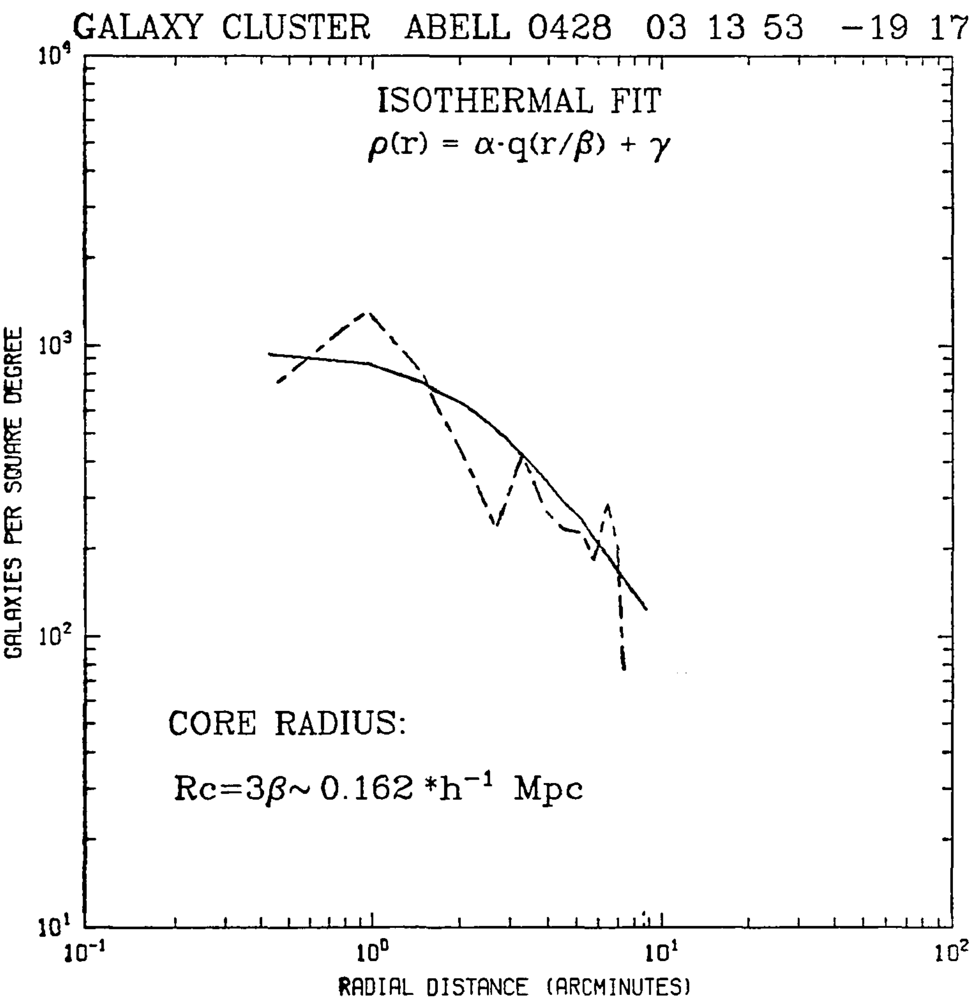


Figure 5.1.01. *(l) Isothermal Fit for Abell Cluster 0428.*

CLUSTER PARAMETERS	
GALAXY CLUSTER ABELL 0428 03 13 53 −19 17	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 499.15±289.99 $\beta =$ 1.05±0.17 $\gamma =$ 11.53±3.33	
$\rho_{\text{BEST FIT}}(r) =$ 928.14 $\cdot q(r/1.03) +$ 11.94	
CORE RADIUS:	REDSHIFT:
$Rc = 3\beta \sim 0.162 * h^{-1}$ Mpc	Z = 0.060

Table 5.1.01. *(c) Cluster Parameters for Abell Cluster 0428.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 130 galaxies within 15 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show several instances of subclustering as is evidenced by the slight enhancement Eastward of center along the East-West absissa as well as North of center along the North-South ordinate. The quadrant counts show the lack of central condensation except in the second and fourth quadrants where we see slight galaxy concentrations. The cluster surface density distribution shows an erratic rise and fall of density radially away from the center of the cluster; two peaks are seen, one at ring 6 and the other at ring 11.

The resulting isothermal fit appears to model the observations fairly with the exception of the peak near ring 3. This surface density enhancement seems to bias the fit to higher values along the ordinate. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER ABELL 0514 04 45 54 -20 33

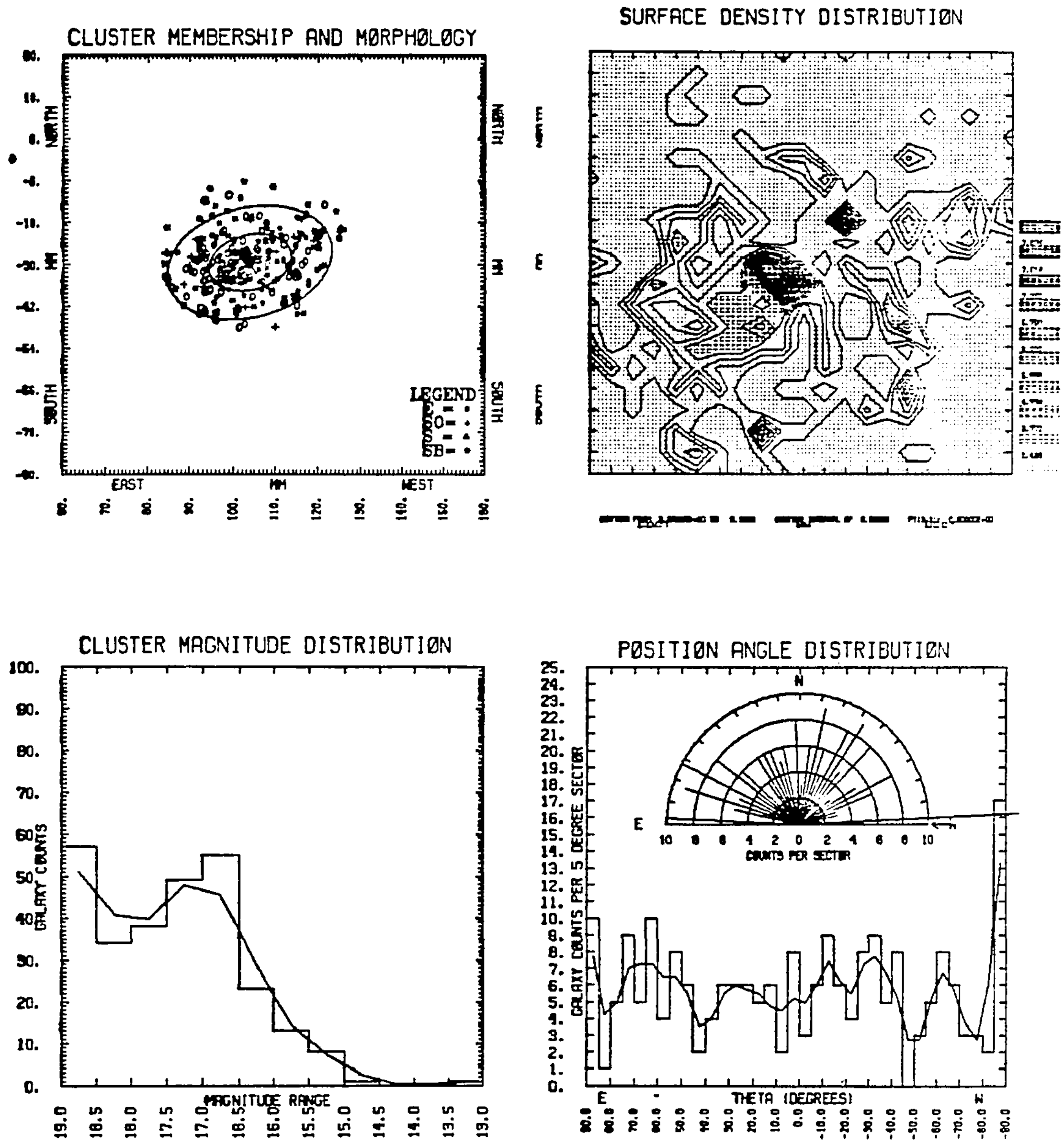
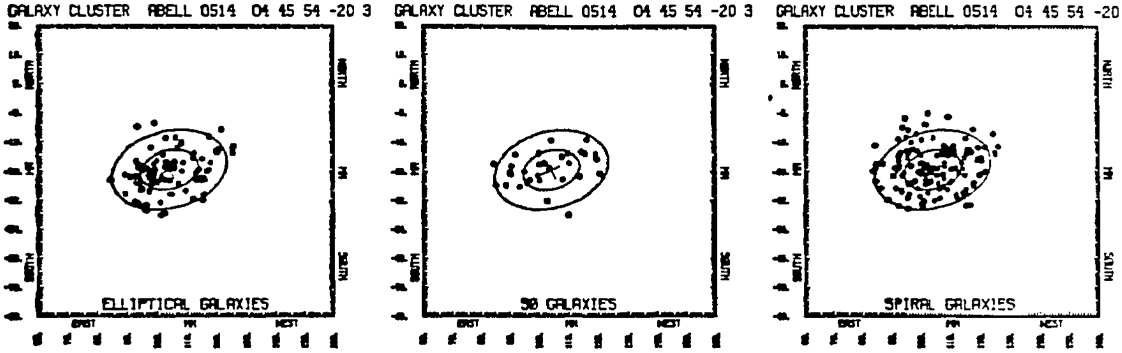


Figure 5.1.02 *(a) Cluster Morphology. (b) Surface Density Distribution. (c) Magnitude Distribution and (d) Position Angle Distribution.*



GALAXY CLUSTER ABELL 0514 04 45 54 −20 33						
FIELD 552						ESØ/SERC PLATE J5605
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
103.854	-029.613	4 45 54.7	-20 33 40.5	219 28 43.9	-35 56 19.1	0.051
MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS		
E	101	MAJØR AXIS	10.02	SAMPLE PØPULATIØN	279	
SØ	32	MINØR AXIS	7.64	CØRE PØPULATIØN	102	
S	141	ECCENTRICITY	0.65	LIMITING MAGNITUDE	19.0	
SB	4	PØSN. ANGLE	25.76			
P	1					

Figure 5.1.02 *(e,f,g) Cluster Morphological Population Distributions.*
Table 5.1.02 *(a) Cluster Population Description.*

Galaxy Cluster Abell 0514: 04 45 55 -20 34. The cluster is located in the South-East quadrant of ESO/SERC Field 552. Within a diameter of 45mm as determined by m_{10} we count 329 galaxies in this cluster and 279 to a limiting magnitude of m_{lim} = 19.0. The cluster is classified Abell type *RI* because of its lack of spherical symmetry and presence of several concentrations indicating subclustering.

We count 120 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B - M$ type II-III classification for the cluster which has as its brightest galaxies those intermediate in appearance between giant ellipticals and merely normal bright ellipticals. For m_1,m_3, and m_{10} we give 13.5, 15.3 and 15.5, respectively. The value of m_{10} implies a redshift of 0.051.

The cluster appears quite elongated and has several noticable concentrations, notably that immediately North of center and that South-East of center, which are the densest and a number of less dense groups scattered throughout mainly the third and first quadrants of the cluster, the former being the most dominant. The cluster magnitude distribution appears somewhat bifurcated rising with an almost exponential rise from the brightest galaxies to a large peak near $m_v = 16.5$ then falling to a trough a magnitude and a half later only to rise rapidly to another peak between $m_v = 18.5$ and the magnitude limit. This phenomenon may be interpreted as the possible superposition of two clusters. The position angle distribution is scattered, but suggests an excess in the numbers of bright galaxies oriented West of North in particular at the Western pole somewhat aligned with the major axis of the dispersion ellipse.

We note the condensation of elliptical galaxies in the South-East portion of the cluster, near the center. The spirals appear to be loosely scattered throughout the cluster but there appears to be a major concentration of them near the center. We find the $(E : SO : S)$ ratio to be $(1.0 : 0.3 : 1.4)$ indicating nearly forty percent more spirals in this cluster than ellipticals. The core population comprises nearly 37% of the sample enclosed in 0.08 square degrees. This gives a core surface density of 1210 galaxies per square degree on the sky.

We notice several interesting superpositions in the cluster; even the brightest galaxy in the cluster, located at $x = -108.2, y = -26.7$, appears to be superposed with a lenticular galaxy to the North-East. Another pair is seen at $x = -124.8, y =$

-22.7 consisting of a lenticular and an elliptical and a pair with an early and late elliptical at $x = -99.2, y = -29.8$. Several barred spiral galaxies are seen with ring-like structures and "s-shaped" features such as seen at $x = -113.6, y = -34.9$.

GALAXY CLUSTER ABELL 0514 04 45 54 -20 33

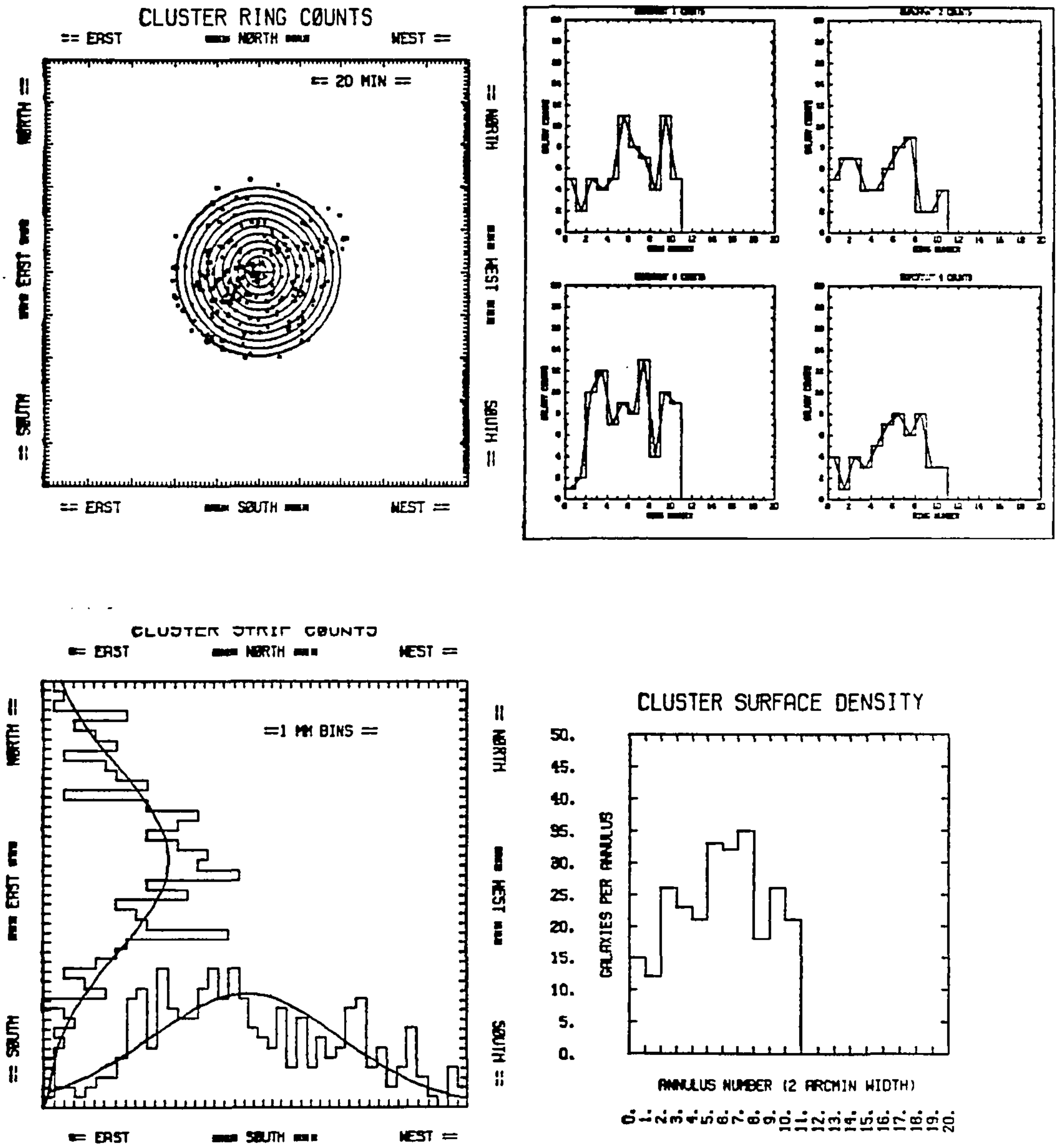


Figure 5.1.02. *(h) Cluster Ring Counts. (i) Quadrant Counts. (j) Cluster Strip-Counts and (k) Cluster Surface Density.*

GALAXY CLUSTER ABELL 0514 04 45 54 -20 33

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	15	5	5	1	4	1.259	5422.52	0.10001	3.73420
2	12	2	7	2	1	2.815	1446.01	0.44949	3.16017
3	26	5	7	10	4	4.539	1879.81	0.65698	3.27411
4	23	4	4	12	3	6.295	1187.79	0.79898	3.07474
5	20	4	4	7	5	8.061	803.34	0.90640	2.90490
6	33	12	5	9	7	9.833	1084.50	0.99267	3.03523
7	33	8	9	8	8	11.607	917.66	1.06472	2.96268
8	34	7	9	13	5	13.383	819.40	1.12655	2.91350
9	19	4	2	4	9	15.160	404.03	1.18069	2.60641
10	23	10	2	8	3	16.937	437.61	1.22885	2.64108
11	22	5	3	11	3	18.716	378.72	1.27220	2.57831
12	7	1	4	2	0	20.494	110.02	1.31163	2.04148
13	7	5	2	0	0	22.273	101.22	1.34778	2.00527
14	4	3	1	0	0	24.052	53.56	1.38115	1.72881
15	1	1	0	0	0	25.831	12.47	1.41215	1.09571
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 279 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 103.854 Y0 = -29.613

RING WIDTH (ARCMIN) = 2.0

Table 5.1.02. *(b) Ring-Count Data for Abel Cluster 0514.*

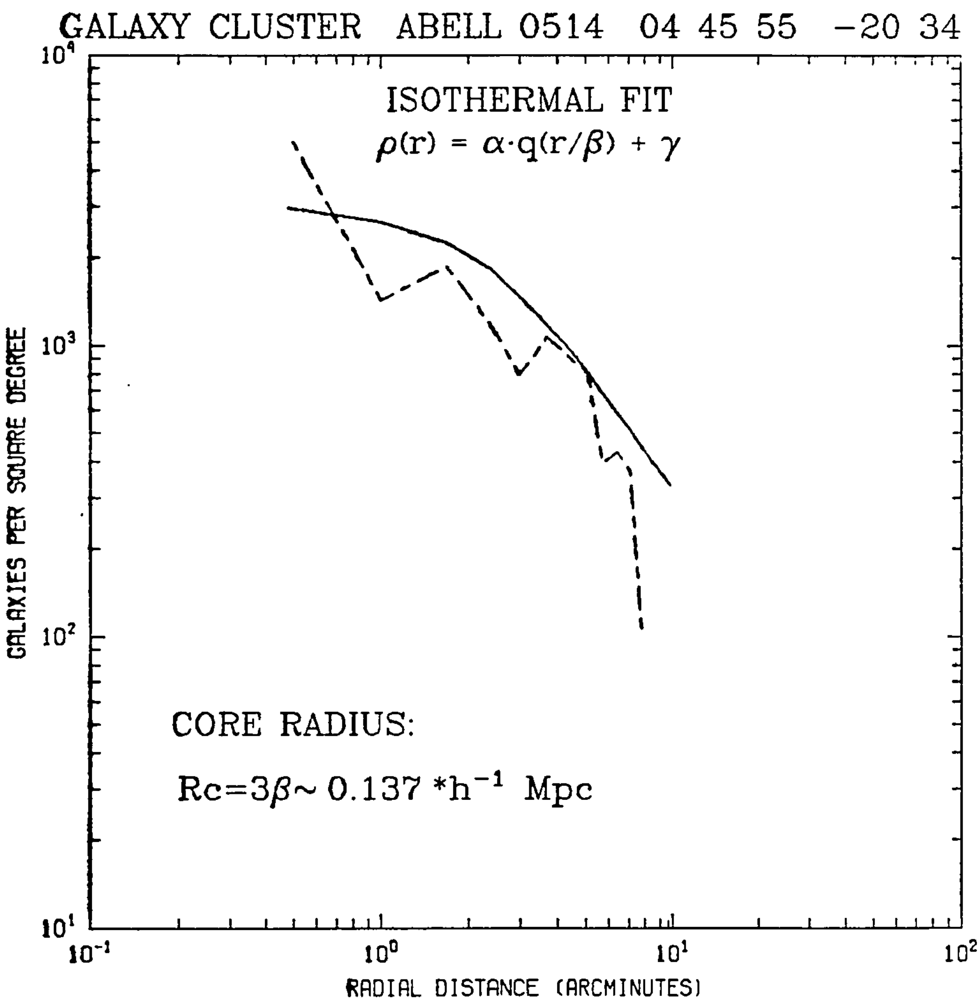


Figure 5.1.02. *(l) Isothermal Fit for Abell Cluster 0514.*

CLUSTER PARAMETERS
GALAXY CLUSTER ABELL 0514 04 45 55 −20 34
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
α = 2677.51 ±277.30 β = 1.03±0.00 γ = 11.79± 0.19
$\rho_{\text{BEST FIT}}(r) = 2999.70 \cdot q(r/1.03) + 12.01$
CORE RADIUS: $Rc=3\beta\sim$ 0.137 $*h^{-1}$ Mpc — REDSHIFT: Z = 0.051

Table 5.1.02. *(c) Cluster Parameters for Abell Cluster 0514.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 279 galaxies within 15 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show several instances of subclustering as is evidenced by the great enhancement Eastward of center along the East-West absissa as well as South of center along the North-South ordinate. The quadrant counts show a strong contribution from the rhird quadrant at the location of the densest concentration of galaxies in the cluster. As a result, the cluster surafce density rises quickly as we move radially away from the cluster center. The distibution reaches a peak at Ring 8 and then drops away.

The resulting isothermal fit appears to model the observations poorly due to the excessively large value of the central density. This strongly motivates the fit to higher values along the ordinate forcing it to envelope the observations rather than pass through them. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER ABELL 0533 04 58 57 −22 38

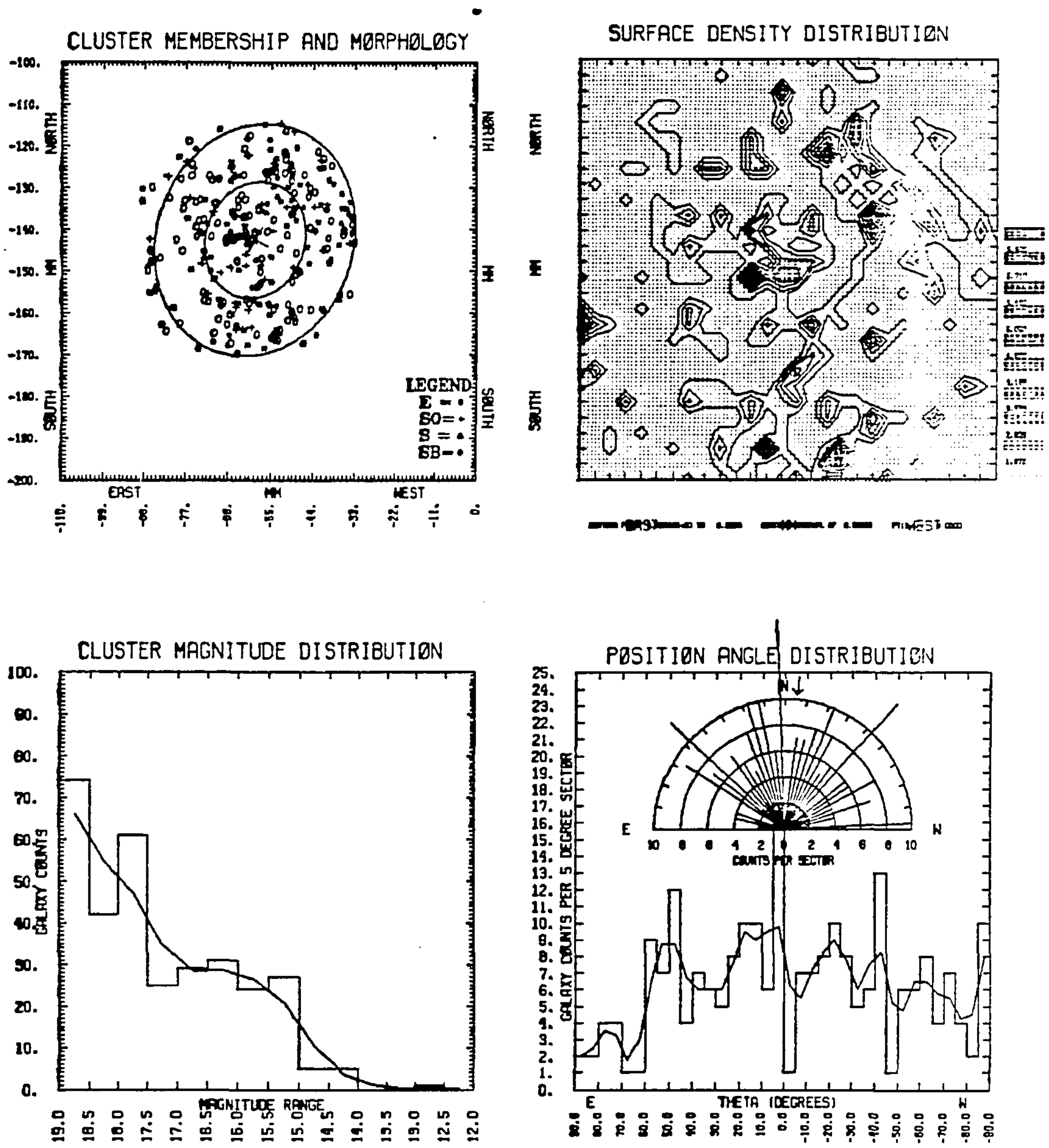
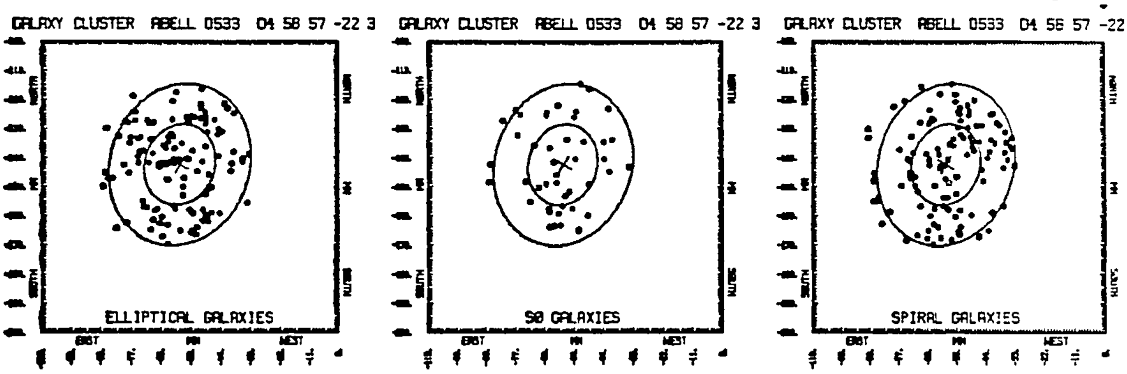


Figure 5.1.03 *(a) Cluster Morphology. (b) Surface Density Distribution. (c) Magnitude Distribution and (d) Position Angle Distribution.*



GALAXY CLUSTER ABELL 0533 04 58 57 −22 38						
FIELD 552					ESØ/SERC PLATE J5635	
X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-058.668	-141.297	4 58 57.5	-22 36 55.6	223 5 35.7	-33 45 27.2	0.042
MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS		
E	133	MAJØR AXIS	14.32	SAMPLE PØPULATIØN		324
SØ	48	MINØR AXIS	12.61	CØRE PØPULATIØN		90
S	133	ECCENTRICITY	0.47	LIMITING MAGNITUDE		19.0
SB	7	PØSN. ANGLE	59.72			
P	3					

Figure 5.1.03 *(e,f,g) Cluster Morphological Population Distributions.*

Table 5.1.03 *(a) Cluster Population Description.*

Galaxy Cluster Abell 0533: 04 58 57 -22 38. The cluster is located in the South-East quadrant of ESO/SERC Field 552. Within a diameter of 60mm as determined by m_{10} we count 430 galaxies in this cluster and 324 to a limiting magnitude of m_{lim} = 19.0. The cluster is classified Abell type *RI* because of its lack of spherical symmetry and presence of several concentrations indicating subclustering.

We count 120 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B - M$ type III classification for the cluster which has no dominant galaxies that could be considered giant ellipticals or larger. For m_1,m_3, and m_{10} we give 14.3, 14.4 and 15.1, respectively. The value of m_{10} implies a redshift of 0.042.

The cluster appears somewhat elongated and has several noticable concentrations, notably that immediately East of center and that North-West of center, which are the densest and a number of less dense groups scattered throughout mainly the first and fourth quadrants of the cluster, the former being the most dominant. The cluster magnitude distribution rises gently from the brightest galaxies to a plateau centered at $m_v = 16.0$ then rises sharply to a set of peaks spanning one and a half magnitudes to the sample limit with a large dip occurring at $m_v = 18.0$. The position angle distribution is scattered, but with several peaks, the largest running North-South and another two, almost symmetric to the latter, running East of North and West of North, respectively.

We note the relatively scattered appearance of the distribution of elliptical galaxies, but with concentrations on the first and fouth quadrants. The spirals are likewise distributed, but with the heaviest concentration located in the first quadrant. We find the $(E : SO : S)$ ratio to be $(1.0 : 0.4 : 1.1)$ indicating nearly ten percent more spirals in this cluster than ellipticals. The core population comprises nearly 28% of the sample enclosed in 0.20 square degrees. This gives a core surface density of 453 galaxies per square degree on the sky.

We notice several interesting superpositions in the cluster: for instance a bright pair of ellipticals composed of an early and late member are seen at $x = 49.8, y = -136.4$; and a pair of bright superposed spirals are located at $x = 40.7, y = -135.2$. This cluster also seems fairly rich in spiral-type galaxies possessing ring-like structures such as the ones seen at $x = 78.7, y = -122.7$ and $x = 52.4, y = -147.6$. We also make note of an unusual object, seen edge-on, with what appear to be broken ansae located at $x = 74.0, y = -164.1$. Several very extended low surface brightness objects are also noticed in the field at $x = 39.9, y = -147.9$ and $x = 37.2, y = -156.0$ and are likely to be foreground galaxies superposed on the cluster.

GALAXY CLUSTER ABELL 0533 04 58 57 -22 38

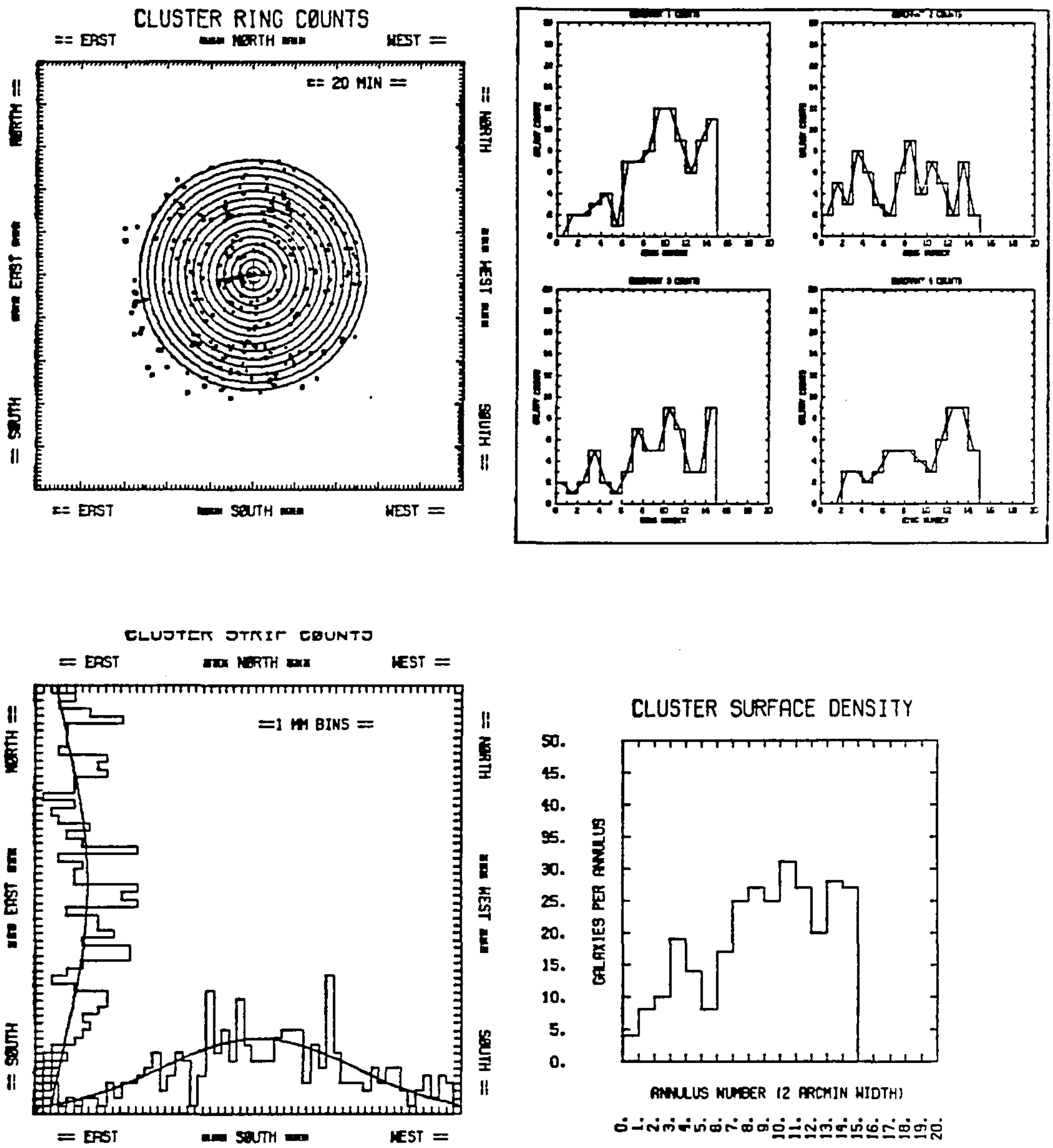


Figure 5.1.03. *(h) Cluster Ring Counts. (i) Quadrant Counts. (j) Cluster Strip-Counts and (k) Cluster Surface Density.*

GALAXY CLUSTER ABELL 0533 04 58 57 -22 38

RING NUMBER	TOTAL COUNT	QUADRANT COUNTS NW	NE	SE	SW	COUNTING RADIUS (ARCMIN)	OBSERVED DENSITY (GAL/SQDEG)	LOG(RAD)	LOG(DEN)
1	4	0	2	2	0	1.259	1446.01	0.10001	3.16017
2	8	2	5	1	0	2.815	964.00	0.44949	2.98408
3	10	2	3	2	3	4.539	723.00	0.65698	2.85914
4	18	2	8	5	3	6.295	929.57	0.79898	2.96828
5	15	5	6	2	2	8.061	602.50	0.90640	2.77996
6	8	1	3	1	3	9.833	262.91	0.99267	2.41981
7	17	7	2	3	5	11.607	472.73	1.06472	2.67462
8	24	7	6	6	5	13.383	578.40	1.12655	2.76223
9	26	7	8	6	5	15.160	552.88	1.18069	2.74263
10	26	13	5	5	3	16.937	494.69	1.22885	2.69433
11	30	12	6	9	3	18.716	516.43	1.27220	2.71301
12	28	9	6	6	7	20.494	440.09	1.31163	2.64354
13	21	6	2	4	9	22.273	303.66	1.34778	2.48239
14	27	9	6	3	9	24.052	361.50	1.38115	2.55811
15	25	10	2	8	5	25.831	311.64	1.41215	2.49365
16	25	4	5	12	4	27.611	291.53	1.44108	2.46469
17	7	1	2	4	0	29.390	76.68	1.46820	1.88459
18	5	0	3	2	0	31.170	51.64	1.49374	1.71301
19	0	0	0	0	0	32.950	0.00	1.51785	0.00000
20	0	0	0	0	0	34.730	0.00	1.54070	0.00000

TOTAL NUMBER OF GALAXIES COUNTED = 324 MAGNITUDE CUTOFF. MV = 19.0

CLUSTER CENTER AT X0 = -59.211 Y0 = -142.605

RING WIDTH (ARCMIN) = 2.0

Table 5.1.03. *(b) Ring-Count Data for Abel Cluster 0533.*

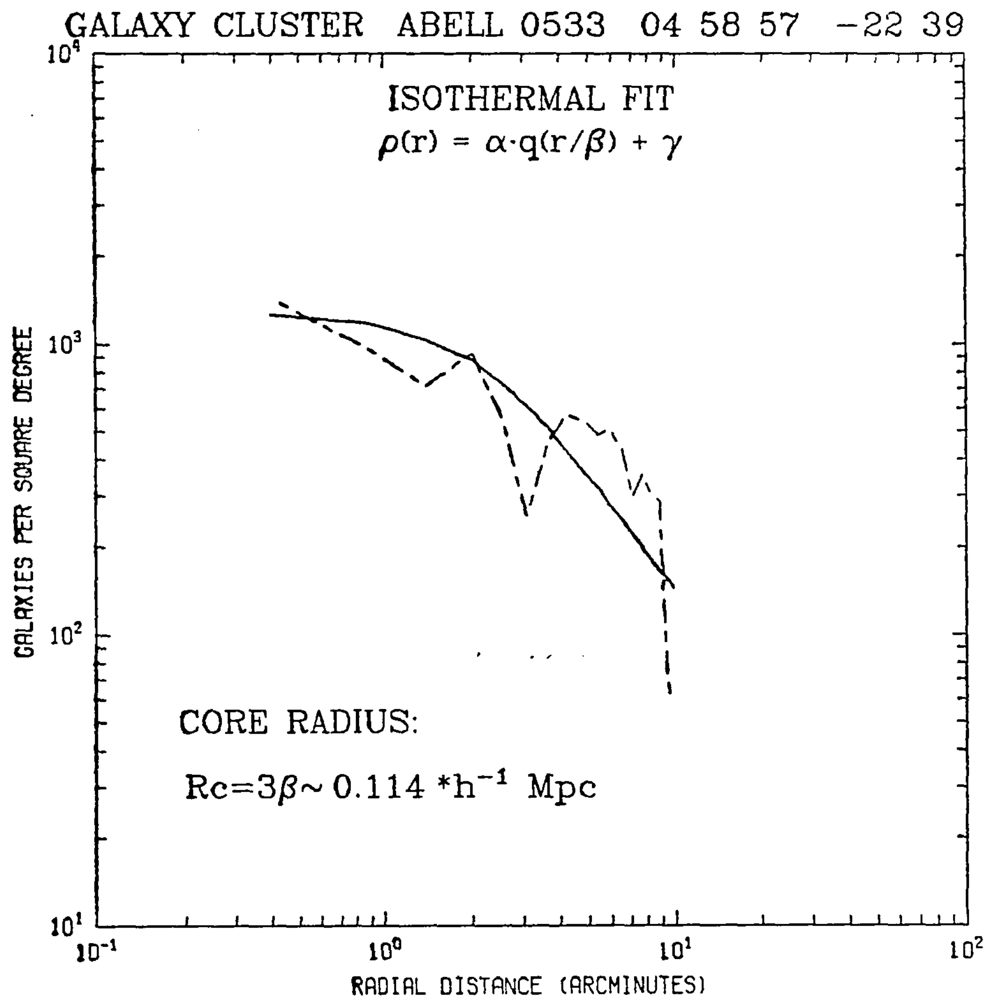


Figure 5.1.03. *(l) Isothermal Fit for Abell Cluster 0533.*

CLUSTER PARAMETERS	
GALAXY CLUSTER ABELL 0533 04 58 57 −22 39	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha =$ 663.69±413.02 $\beta =$ 1.05±0.17 $\gamma =$ 11.88±3.34	
$\rho_{\text{BEST FIT}}(r) =$ 1259.85 $\cdot q(r/1.04) +$ 12.65	
CORE RADIUS:	REDSHIFT:
$Rc = 3\beta \sim$ 0.114 $*h^{-1}$ Mpc	Z = 0.042

Table 5.1.03. *(c) Cluster Parameters for Abell Cluster 0533.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 324 galaxies within 18 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show several instances of subclustering as is evidenced by the peaks found both East and West of center along the East-West absissa as well as those found, particularly South of center, along the North-South ordinant. The quadrant counts show these effects, especially in the first quadrant near Ring 10. The cluster surface density shows a ramp-like rise radially away from center with two troughs in the distribution at Rings 6 and 13.

The resulting isothermal fit appears to model the observations fairly due to the continually high values of the peripheral density. Since the latter appears to be caused by subclustering one might expect a better fit if those concentrations were absent from the distribution. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER ABELL 1736 13 24 41 −26 57

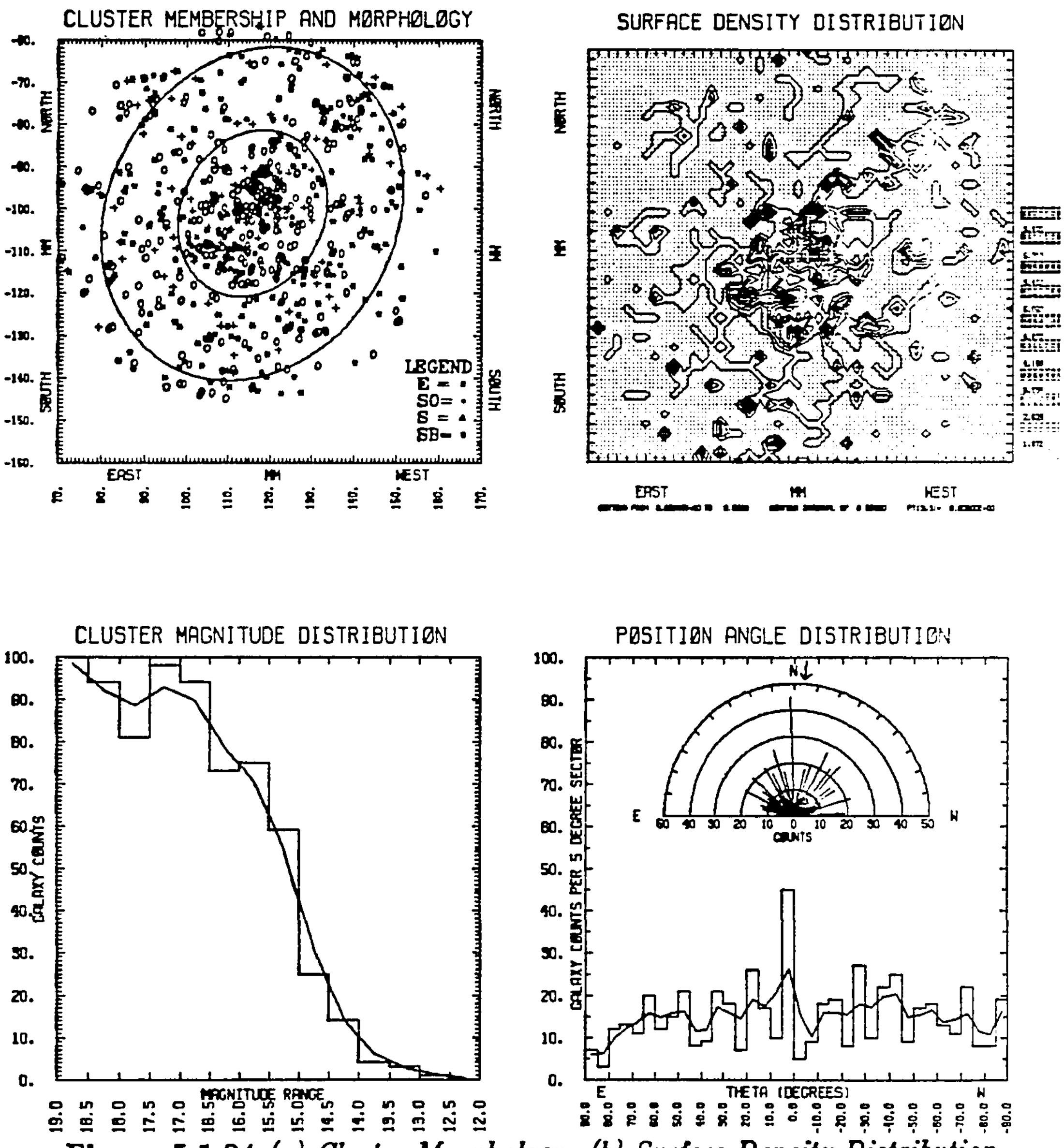
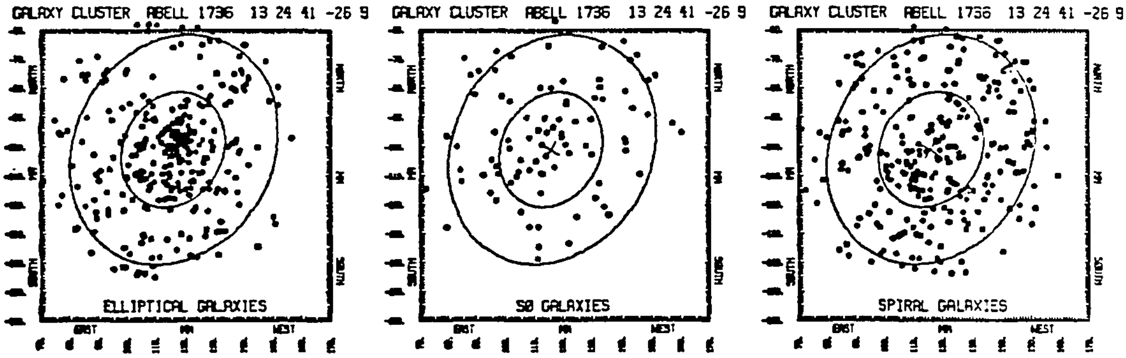


Figure 5.1.04 *(a) Cluster Morphology. (b) Surface Density Distribution. (c) Magnitude Distribution and (d) Position Angle Distribution.*



GALAXY CLUSTER ABELL 1736 13 24 41 −26 57

FIELD 509 — ESO/SERC PLATE J2357

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
-113.207	-103.482	13 24 40.7	-26 57 22.2	312 42 35.0	34 58 18.9	0.028

MORPHOLOGY		DISPERSION ELLIPSE		CLUSTER MEMBERS	
E	308	MAJOR AXIS	20.47	SAMPLE POPULATION	726
S0	90	MINOR AXIS	17.03	CORE POPULATION	297
S	287	ECCENTRICITY	0.55	LIMITING MAGNITUDE	19.0
SB	27	POSN. ANGLE	61.23		
P	14				

Figure 5.1.04 *(e,f,g) Cluster Morphological Population Distributions.*

Table 5.1.04 *(a) Cluster Population Description.*

Galaxy Cluster Abell 1736: 13 24 41 -26 57. The cluster is located in the South-West quadrant of ESO/SERC Field 509. Within a diameter of 90mm as determined by m_{10} we count 886 galaxies in this cluster and 726 to a limiting magnitude of $m_{lim} = 19.0$. The cluster is classified Abell type *I* because of its lack of spherical symmetry and presence of several concentrations indicating subclustering. We do note, however, its high central density of galaxies.

We count 92 galaxies brighter than $m_3 + 2$ and thus classify the cluster as

having an Abell richness of 2. We suggest a $B - M$ type III classification for the cluster which has no dominant galaxies that could be considered giant ellipticals or larger, although the brightest galaxy in the field is seen to possess a corona. For m_1,m_3, and m_{10} we give 13.2, 13.5 and 14.3, respectively. The value of m_{10} implies a redshift of 0.028.

The cluster appears somewhat elongated and has several noticable concentrations, notably that immediately North North-West of center and that South-East of center, which are the densest and a number of less dense groups scattered throughout mainly the first quadrant of the cluster. The most dominant subgroup shows a complicated structure filled with dense groups of galaxies.

The cluster magnitude distribution tends to be somewhat serpentine, rising quickly from the brightest galaxies to about $m_v = 17.0$ where it tapers off. The bulk of the population can be found in this region. The position angle distribution is scattered and jagged appearing, but with several peaks, the largest seen running North-South.

We note the relatively scattered appearance of the distribution of elliptical galaxies, and their central concentration with an apparent condensation in the first quadrant. The spirals appear to be more loosely scattered with a slight concentration in the third quadrant, South-East of center. We find the $(E : SO : S)$ ratio to be $(1.0 : 0.3 : 1.1)$ indicating nearly ten percent more spirals in this cluster than ellipticals. The core population comprises nearly 41% of the sample enclosed in 0.38 square degrees. This gives a core surface density of 774 galaxies per square degree on the sky.

This rich and diverse cluster contains many noteworthy species of galaxies: several are noticed to possess coronae as the object located at $x = -103.3, y =$

−144.1; we notice superposed pairs of galaxies, either ellipticals such as those found at $x = -106.6, y = -97.3$ or spirals like are seen at $x = -115.7, y = -142.3$; and we see a very close pair of barred-spiral galaxies at $x = -156.257, y = -99.2$ and, remarkably, another located at $x = -88.4, y = -123.5$.

A curious superposed triplet of elliptical galaxies are seen at $x = -131.1, y = -75.1$. Finally, the peculiars can be typified by the unusual object seen at $x = -93.3, y = -94.3$.

GALAXY CLUSTER ABELL 1736 13 24 41 -26 57

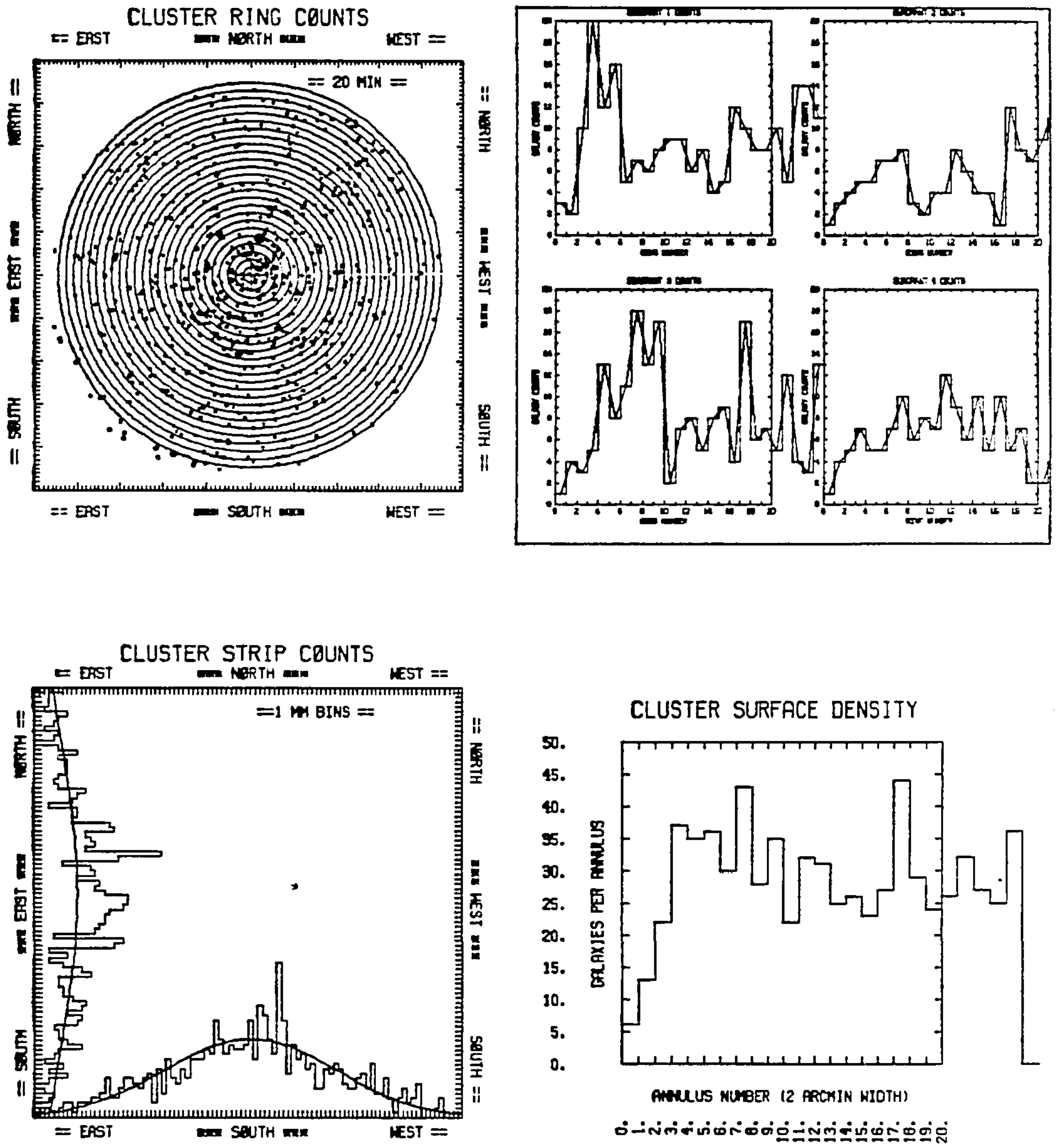


Figure 5.1.04. *(h) Cluster Ring Counts. (i) Quadrant Counts. (j) Cluster Strip-Counts and (k) Cluster Surface Density.*

GALAXY CLUSTER ABELL 1736 13 24 41 -26 57

RING NUMBER	TØTAL CØUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	6	3	1	1	1	1.259	2169.01	0.10001	3.33626
2	13	2	3	4	4	2.815	1566.51	0.44949	3.19493
3	22	10	4	3	5	4.539	1590.61	0.65698	3.20156
4	37	20	5	5	7	6.295	1910.79	0.79898	3.28121
5	34	11	5	13	5	8.061	1365.67	0.90640	3.13535
6	36	16	7	8	5	9.833	1183.10	0.99267	3.07302
7	31	6	7	11	7	11.607	862.04	1.06472	2.93553
8	39	7	7	16	9	13.383	939.90	1.12655	2.97308
9	32	6	4	15	7	15.160	680.47	1.18069	2.83281
10	35	8	2	17	8	16.937	665.92	1.22885	2.82342
11	22	9	4	2	7	18.716	378.72	1.27220	2.57831
12	30	8	4	6	12	20.494	471.52	1.31163	2.67350
13	32	7	8	9	8	22.273	462.72	1.34778	2.66532
14	24	8	5	4	7	24.052	321.33	1.38115	2.50696
15	28	4	5	9	10	25.831	349.04	1.41215	2.54287
16	22	5	4	9	4	27.611	256.55	1.44108	2.40917
17	26	10	1	4	11	29.390	284.82	1.46820	2.45457
18	43	10	12	17	4	31.170	444.13	1.49374	2.64751
19	31	10	7	6	8	32.950	302.88	1.51785	2.48127
20	23	8	7	7	1	34.730	213.19	1.54070	2.32877

TØTAL NUMBER ØF GALAXIES CØUNTED = 726 MAGNITUDE CUTØFF. MV = 19.0

CLUSTER CENTER AT X0 = 115.661 Y0 = -101.238

RING WIDTH (ARCMIN) = 2.0

Table 5.1.04. *(b) Ring-Count Data for Abell Cluster 1736.*

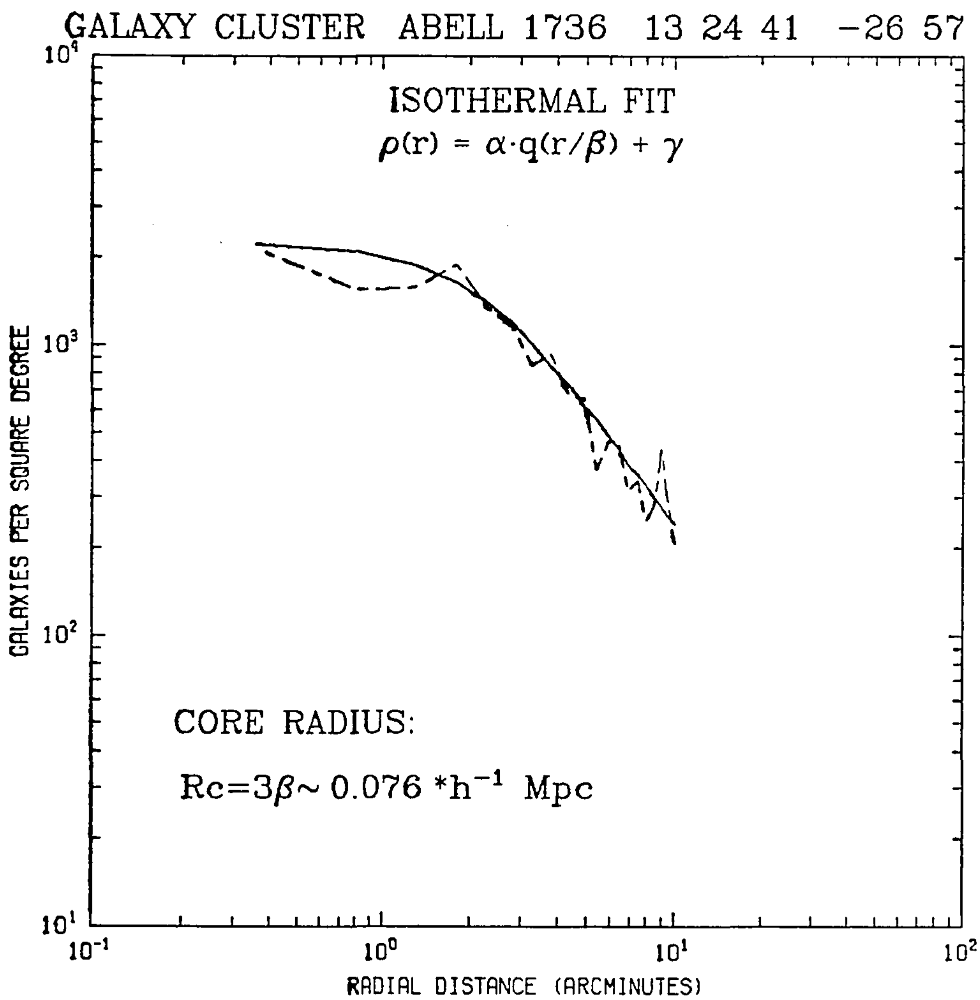


Figure 5.1.04. *(l) Isothermal Fit for Abell Cluster 1736.*

CLUSTER PARAMETERS
GALAXY CLUSTER ABELL 1736 13 24 41 −26 57
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$
$\alpha = 1548.58 \pm 456.65$ $\beta = 1.03 \pm 0.01$ $\gamma = 11.77 \pm 0.56$
$\rho_{\text{BEST FIT}}(r) = 2239.85 \cdot q(r/1.04) + 12.62$
CORE RADIUS: $Rc = 3\beta \sim 0.076 *h^{-1}$ Mpc — REDSHIFT: $Z = 0.028$

Table 5.1.04. *(c) Cluster Parameters for Abell Cluster 1736.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 566 galaxies within 20 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show the high central condensation of this cluster as a slight enhancement somewhat North of center along the North-South ordinate. The quadrant counts display the latter with significant peaks in the first and third quadrants. We also find a general rise in counts towards the periphery of the cluster. Thsi is corroborated by the cluster surface density plot which shows a rapid increase in density from cluster center to some maximum region afetr which it gradually tapers off to an irregular plateau having an exceptional peak at Ring 18.

The resulting isothermal fit appears to model the observations quite well except for the slight dip near the cluster center at radii $2.8 \leq r \leq 4.5$ minutes of arc.

The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

GALAXY CLUSTER ABELL 2538 23 06 01 −20 11

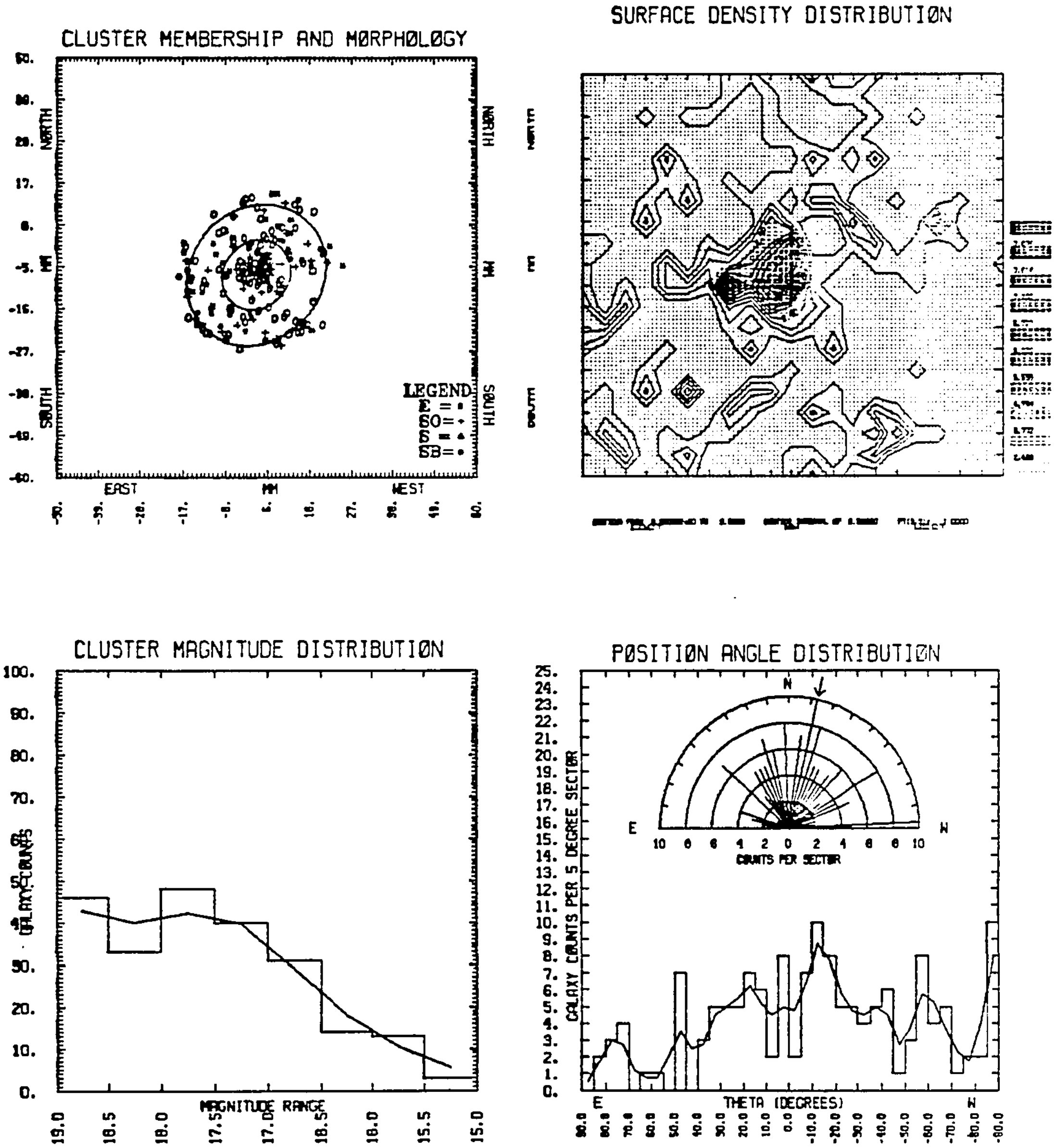
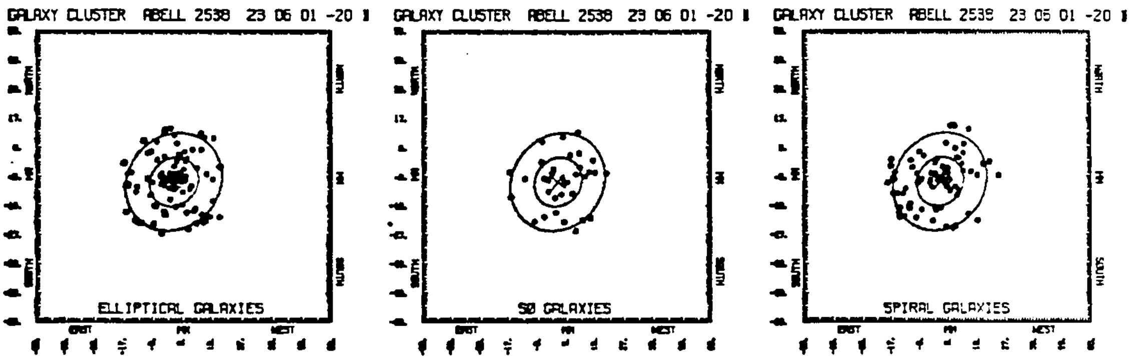


Figure 5.1.05 *(a) Cluster Morphology. (b) Surface Density Distribution. (c) Magnitude Distribution and (d) Position Angle Distribution.*



GALAXY CLUSTER ABELL 2538 23 06 01 −20 11

FIELD 604 ESØ/SERC PLATE J3654

X	Y	RA (1950)	DEC (1950)	L (1950)	B (1950)	Z
001.925	-007.189	23 6 1.6	-20 10 47.3	345 42 35.0	-65 25 2.8	0.060

MØRPHØLØGY		DISPERSIØN ELLIPSE		CLUSTER MEMBERS	
E	107	MAJØR AXIS	9.66	SAMPLE PØPULATIØN	228
SØ	36	MINØR AXIS	8.54	CØRE PØPULATIØN	91
S	82	ECCENTRICITY	0.47	LIMITING MAGNITUDE	19.0
SB	3	PØSN. ANGLE	50.78		
P	0				

Figure 5.1.05 *(e,f,g) Cluster Morphological Population Distributions.*
Table 5.1.05 *(a) Cluster Population Description.*

Galaxy Cluster Abell 2528: 23 06 01 -20 11. The cluster is located in the South-East quadrant of ESO/SERC Field 604. Within a diameter of 45mm as determined by m_{10} we count 291 galaxies in this cluster and 228 to a limiting magnitude of $m_{lim} = 19.0$. The cluster is classified Abell type R because of its spherical symmetry and high central condensation.

We count 112 galaxies brighter than $m_3 + 2$ and thus classify the cluster as having an Abell richness of 2. We suggest a $B-M$ type II-III classification for the cluster which has as its brightest galaxies those intermediate in appearance between the giant ellipticals and normal bright galaxies.. For m_1,m_3, and m_{10} we give 15.3, 15.5 and 15.8, respectively. The value of m_{10} implies a redshift of 0.060.

The cluster appears highly centrally condensed, with a dense group of galaxies lying just East of the center of the cluster. Another slightly concentrated region is found right at the geometric center of the cluster. Finally, a few subgroups are noticed to the South at the periphery of the cluster.

The cluster magnitude distribution rises gently from the brightest galaxies to a plateau beginning at about $m_v = 17.0$ and ending at the magnitude limit. The position angle distribution appears skewed in favor of orientations tending West of North with a higher number of measured angles in that region.

We note the central condensation of elliptical galaxies and their paucity in the Southernmost regions of the cluster. The spirals appear to be somewhat centrally condensed with a zone of avoidance in the fourth quadrant. We find the $(E : SO : S)$ ratio to be $(1.0 : 0.3 : 0.8)$ indicating nearly twenty percent more ellipticals in this cluster than spirals. The core population comprises nearly 40% of the sample enclosed in 0.09 square degrees. This gives a core surface density of 1001 galaxies per square degree on the sky.

We find several pairs of galaxies in this cluster: a typical pair consisting of an early and a late elliptical galaxy is seen at $x = 2.6, y = -26.6$; and a pair of spirals at $x = -3.6, y = -5.6$. A curious small group of ellipticals, looking much like a chain, is seen at $x = -2.9, y = -6.2$.

GALAXY CLUSTER ABELL 2538 23 06 01 −20 11

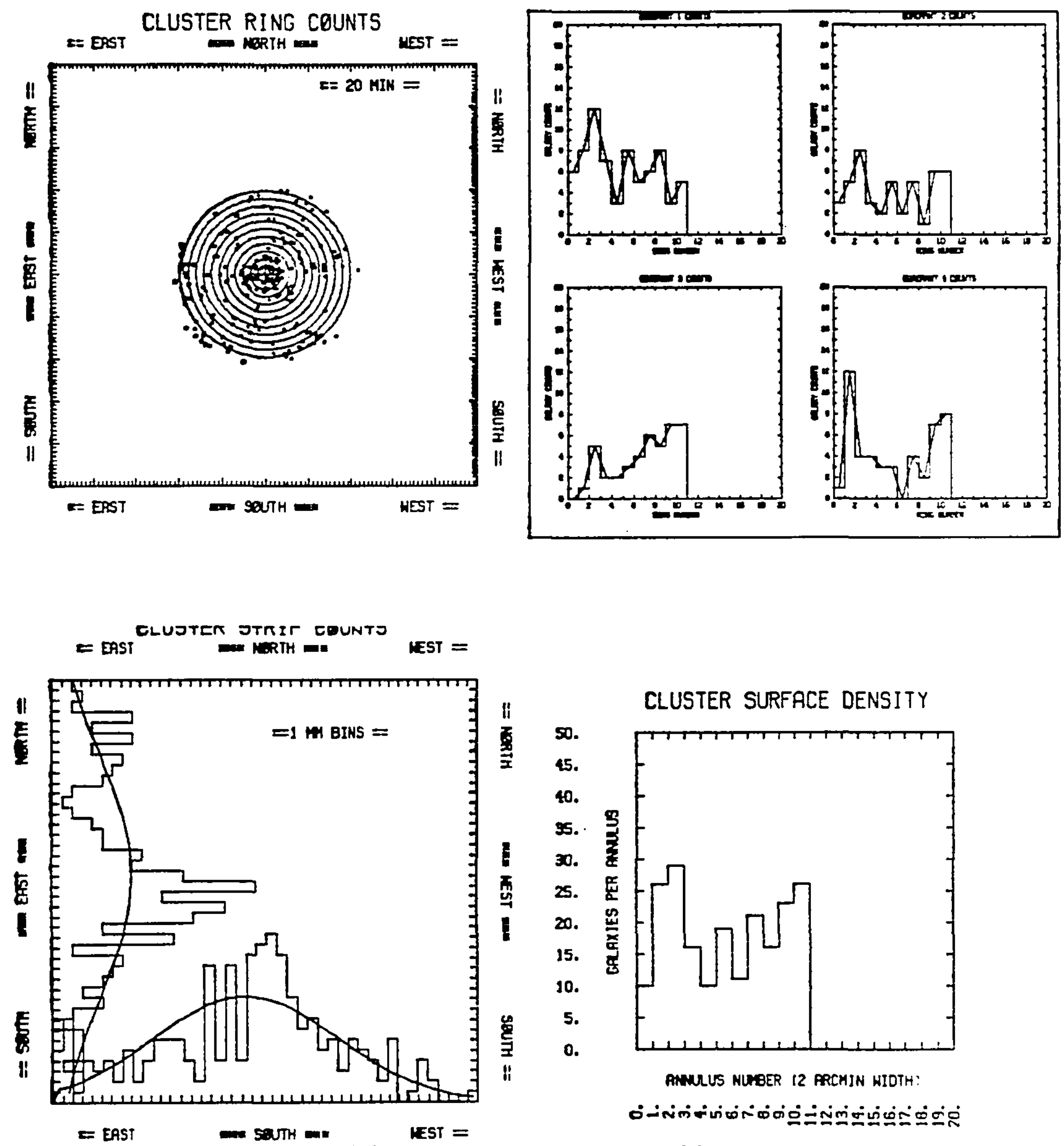


Figure 5.1.05. *(h) Cluster Ring Counts. (i) Quadrant Counts. (j) Cluster Strip-Counts and (k) Cluster Surface Density.*

GALAXY CLUSTER ABELL 2538 23 06 01 -20 11

RING NUMBER	TØTAL COUNT	QUADRANT CØUNTS NW	NE	SE	SW	CØUNTING RADIUS (ARCMIN)	ØBSERVED DENSITY (GAL/SQDEG)	LØG(RAD)	LØG(DEN)
1	10	6	3	0	1	1.259	3615.01	0.10001	3.55811
2	26	8	5	1	12	2.815	3133.01	0.44949	3.49596
3	28	12	7	5	4	4.539	2024.41	0.65698	3.30630
4	15	7	3	2	3	6.295	774.65	0.79898	2.88910
5	11	2	3	2	4	8.061	441.84	0.90640	2.64526
6	18	8	5	2	3	9.833	591.55	0.99267	2.77199
7	12	5	2	5	0	11.607	333.69	1.06472	2.52335
8	21	7	4	6	4	13.383	506.10	1.12655	2.70424
9	17	8	2	5	2	15.160	361.50	1.18069	2.55811
10	21	3	5	7	6	16.937	399.55	1.22885	2.60158
11	26	5	5	7	9	18.716	447.57	1.27220	2.65086
12	17	4	5	7	1	20.494	267.20	1.31163	2.42663
13	6	5	0	0	1	22.273	86.76	1.34778	1.93832
14	0	0	0	0	0	24.052	0.00	1.38115	0.00000
15	0	0	0	0	0	25.831	0.00	1.41215	0.00000
16	0	0	0	0	0	27.611	0.00	1.44108	0.00000

TØTAL NUMBER ØF GALAXIES CØUNTED = 228 MAGNITUDE CUTØFF, MV = 19.0

CLUSTER CENTER AT X0 = 1.925 Y0 = -7.190

RING WIDTH (ARCMIN) = 2.0

Table 5.1.05. *(b) Ring-Count Data for Abel Cluster 2538.*

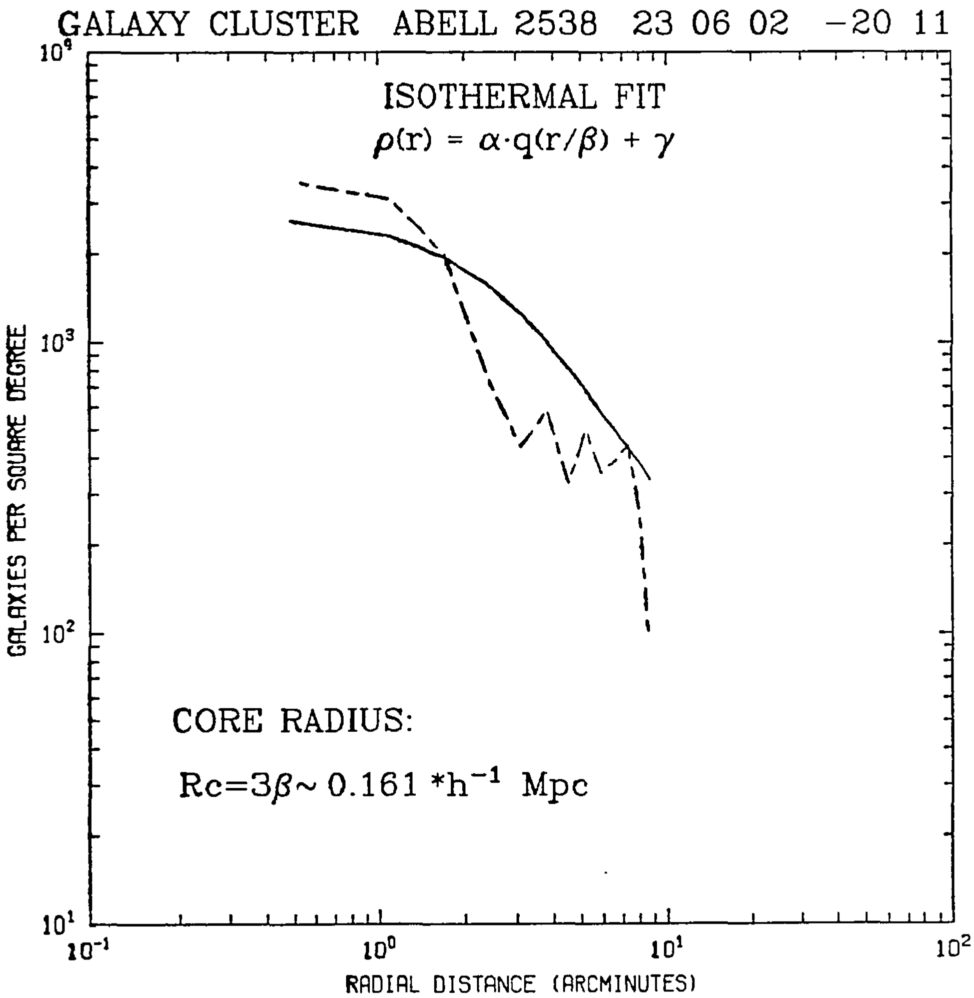


Figure 5.1.05. *(l) Isothermal Fit for Abell Cluster 2538.*

CLUSTER PARAMETERS	
GALAXY CLUSTER ABELL 2538 23 06 02 −20 11	
$\rho(r) = \alpha \cdot q(r/\beta) + \gamma$	
$\alpha = 2115.07 \pm 364.82$ $\beta = 1.02 \pm 0.00$ $\gamma = 11.39 \pm 0.25$	
$\rho_{\text{BEST FIT}}(r) = 2629.08 \cdot q(r/1.03) + 11.74$	
CORE RADIUS:	REDSHIFT:
$Rc = 3\beta \sim 0.161 * h^{-1}$ Mpc	$Z = 0.060$

Table 5.1.05. *(c) Cluster Parameters for Abell Cluster 2538.*

Using the cluster center as determined by the dispersion ellipse analysis, we count 228 galaxies within 13 rings of width 2.0 arcminutes and to the limiting magnitude $m_v = 19.0$. The cluster strip counts show the high central condensation of this cluster as high peaks in both counting distributions. We notice a peak West of center along the East-West absissa as well as a density enhancement North of center at the periphery of the cluster along the North-South ordinate. The quadrant counts indicate the great contribution to the central density by all quadrants save the third; a majority of counts are found in the first. The cluster surface density is low near the center of trhe cluster and bounds rapidly towards a maximum by Ring 3 after which it drops through a ragged u-shaped trough to rise again at the cluster periphery.

The extreme high surface density of the central portions of the cluster seem to overwhelm the ability of the isothermal fit to model the observations and we see the fit as an envelope above the middle and peripheral portions of the cluster. The results of the analysis are seen in the table above which gives the calculated value of the cluster parameters and their variance as well as the "best fit" determined from the χ^2 minimization procedure.

CHAPTER VI

CONCLUSION

But as for certain truth,
no man has known it,
nor will he know it;
neither of the gods,
nor yet of all the things
of which I speak.
And if by chance he were to utter
the final truth, he would himself
not know it;
For all is but a woven web
of guesses.
– Xenophanes

Among the few secure conclusions one may draw from the analysis of the past legs of this journey is that the less one knows about the universe the easier it is to explain. In this respect, the study of the large scale structure of the universe does not differ from any other scientific subject matter of lesser extent. Still, to the study of the ever-expanding universe, and in particular the study of these aggregates we call clusters of galaxies, we may apply with special appropriateness the saying, "The greater the sphere of our knowledge, the larger is the surface of its contact with the infinity of our ignorance." The principal reason why this is so is amply documented in the successive phases of our penetration into the study of the structure of the universe and received its most timely expression at the dedication ceremonies of the Hale telescope in the words of Vannevar Bush: " It is a great truth of science that every ending is a beginning, that each question answered leads to new problems to solve, that each opportunity grasped and utilized engenders fresh and greater opportunities."

Indeed, the fresh and greater opportunities offered by our current study afford an embarrassment of riches. Any single aspect or area of concentration of the study of our data poses new problems when scrutinized in detail. Thus, this effort of data acquision and preliminary analysis can only serve as a beginning. In this light we present a catalogue of galaxy clusters and their parameters gleaned from our study.

In **Table 6.0.1** we present the pertinent data from the measurement of 50 Bright Southern Clusters of Galaxies. The table includes a cluster identification number, Rectangular Coordinates on the ESO/SERC J plate for the cluster center, the ESO/SERC Field Number, Right Ascension and Declination for the epoch 1950 of the cluster center, redshift, Abell Richness and Type, Bautz-Morgan Classification, the number of cluster members to $m_v = 19.0$ in the sample population and and estimate of the cluster core radius in Mpc with $h = 0.5$. **Figure 6.0.1** gives the epoch 1950 locations of the clusters on the celestial sphere using a Mollweide projection.

In succeeding sections we will point out particulars of our sample, paying close attention to similarities and differences between the clusters themselves, as well as making general comments on what can be said of clusters of galaxies in general. The latter we do with caution since the very acquistion of our sample is a consequence of the effects of selection.

BRIGHT SØUTHERN CLUSTERS ØF GALAXIES AND THEIR PARAMETERS

N	X	Y	FIELD	RA (1950)	DEC (1950)	Z	ABELL R	ABELL TY	B-M TYPE	PØP	R
01	005.543	-070.735	349	00 00 45.6	-36 19 39.4	0.042	1	R	I-II	330	0.228
02	035.621	-003.767	349	00 03 13.9	-35 4 01.6	0.072	2	R	II	265	0.390
03	071.702	-039.543	349	00 06 49.1	-35 43 49.9	0.057	2	IR	II-III	265	0.308
04	051.069	-119.610	149	00 07 28.7	-57 14 52.8	0.044	1	IR	III	153	0.238
05	-107.031	024.617	194	00 18 08.3	-49 32 34.3	0.050	1	R	II	214	0.262
06	-015.272	094.597	350	00 22 49.7	-33 17 33.7	0.038	2	RI	II	335	0.206
07	-005.774	-082.259	196	01 29 33.8	-51 32 55.7	0.040	0	RI	III	289	0.216
08	-043.427	-127.677	297	01 39 50.0	-42 23 49.0	0.050	1	RI	I-II	214	0.272
09	087.306	109.669	154	02 55 44.0	-52 56 09.1	0.049	2	I	II	356	0.264
10	-103.679	-070.538	302	03 44 04.7	-41 21 11.8	0.050	2	R	I	224	0.268
11	101.219	054.375	302	04 04 04.0	-39 00 28.8	0.042	1	IR	II	107	0.226
12	-115.824	-001.271	253	05 24 00.3	-45 01 46.1	0.061	0	I	III	115	0.328
13	-083.921	004.016	087	06 21 39.4	-64 56 34.9	0.038	0	R	II-III	163	0.206
14	-088.653	070.926	161	06 25 02.5	-53 39 26.8	0.049	2	R	I	232	0.264
15	-076.713	032.793	161	06 26 25.1	-54 22 29.4	0.048	2	R	II	235	0.260
16	146.553	065.348	442	12 51 41.2	-28 44 33.4	0.048	2	RI	II	348	0.258
17	-095.233	-121.728	382	13 03 25.3	-37 17 59.6	0.049	0	R	II	181	0.264
18	005.223	069.735	384	14 00 40.6	-33 44 13.9	0.020	0	RI	I	444	0.108
19	102.148	117.241	384	14 09 17.9	-32 50 02.6	0.044	1	I	III	238	0.238
20	102.819	053.059	384	14 09 28.3	-34 01 38.5	0.038	1	RI	II	219	0.204
21	-043.965	-081.811	447	14 30 26.3	-31 32 40.5	0.054	0	RI	II-III	150	0.292
22	003.581	080.348	339	19 56 35.4	-38 32 47.9	0.026	2	I	I-II	458	0.142
23	-105.191	-022.456	401	20 38 34.4	-35 23 58.1	0.065	1	R	III	334	0.356
24	-095.831	-115.415	235	20 48 40.7	-52 08 45.6	0.037	1	I	III	179	0.200
25	-131.705	018.574	145	21 13 10.0	-59 36 24.2	0.042	2	I	II	271	0.230

Table 6.0.1 *(a.) Catalogue of Southern Galaxy Clusters*

BRIGHT SØUTHERN CLUSTERS ØF GALAXIES AND THEIR PARAMETERS											
N	X	Y	FIELD	RA	DEC	Z	ABELL		B-M	PØP	R
				(1950)	(1950)		R	TY	TYPE		
26	-144.719	-001.784	403	21 22 58.0	-35 00 38.8	0.052	2	RI	III	323	0.286
27	-033.381	-057.179	236	21 26 09.6	-51 04 18.4	0.048	0	I	III	221	0.258
28	-075.807	-019.961	403	21 29 13.5	-35 22 50.6	0.044	1	I	II	270	0.240
29	-008.471	-118.667	145	21 31 14.2	-62 15 40.3	0.048	2	R	I	298	0.260
30	028.755	064.519	188	21 31 05.9	-53 50 08.2	0.050	1	I	II	182	0.272
31	039.266	123.490	188	21 32 18.2	-52 44 02.1	0.044	1	I	III	151	0.238
32	096.553	-093.917	236	21 41 46.5	-51 43 57.4	0.043	2	I	I-II	197	0.234
33	074.215	134.600	145	21 42 50.8	-57 29 48.5	0.042	2	R	II	574	0.228
34	-119.835	051.560	288	21 43 46.1	-44 06 15.9	0.048	2	I	II	384	0.262
35	-107.000	-061.752	288	21 44 40.6	-46 13 32.3	0.043	2	R	II-III	354	0.232
36	127.534	102.014	145	21 50 32.0	-58 03 48.4	0.050	2	R	II-III	295	0.270
37	-098.536	-032.630	146	21 55 17.4	-60 35 13.4	0.048	2	R	III	512	0.260
38	-080.549	-010.760	146	21 58 08.7	-60 11 45.0	0.065	2	R	I	312	0.350
39	-063.530	090.895	146	22 01 11.1	-58 18 36.8	0.043	1	I	I-II	331	0.232
40	008.125	-014.404	237	22 01 06.9	-50 18 11.9	0.042	0	R	I-II	284	0.226
41	-101.125	-022.117	190	22 19 59.2	-50 23 08.1	0.040	2	R	II-III	348	0.218
42	-087.461	-088.514	190	22 21 25.9	-56 38 22.8	0.043	2	I	II-III	327	0.232
43	-079.768	-059.436	190	22 22 36.0	-56 05 57.1	0.043	1	I	III	313	0.234
44	-143.511	-045.125	468	22 24 46.3	-30 51 42.7	0.038	1	RI	II	226	0.206
45	-075.547	-126.152	347	23 16 35.3	-42 22 36.6	0.030	2	I	III	585	0.162
46	036.794	021.784	347	23 27 57.5	-39 37 06.8	0.049	1	I	I	134	0.264
47	038.221	025.705	077	23 34 24.3	-69 34 43.5	0.057	0	I	III	149	0.310
48	-086.526	-026.689	471	23 38 44.8	-30 30 04.2	0.044	1	I	I	249	0.238
49	-015.479	085.995	471	23 44 55.4	-28 24 42.6	0.023	1	R	I-II	1140	0.124
50	104.794	047.058	292	23 59 05.8	-44 06 46.5	0.038	0	I	II	334	0.206

Table 6.0.1 *(b.) Catalogue of Southern Galaxy Clusters*

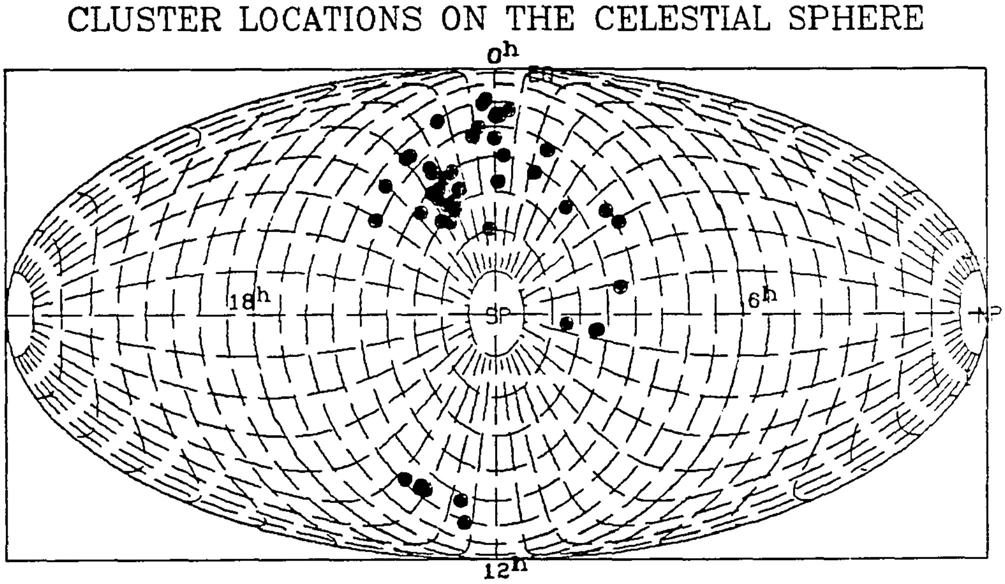


Figure 6.0.1 *Galaxy Cluster Locations on the Celestial Sphere*

6.1 Observational Features of Bright Southern Clusters of Galaxies

Of the galaxy clusters in our sample only a third of them can be considered *Regular* in the Abell sense; that is, having spherical symmetry and being highly centrally condensed. The remainder are either intermediate in class or are designated irregular. It would appear that, if this sample is typical of galaxy clusters, irregularity is the rule rather than the exception. However, of the 7 galaxy clusters that are unambiguously **cD** clusters we find 5 to be classed *Regular* so that, as far as our sample is concerned, the **cD** phenomenon is related to the symmetry of the cluster.

We note the suggestion of Peach (1969) that the brightest cluster member is formed in a special manner before the formation of the other cluster members. In addition, Tremaine and Richstone (1976) have cited that the statistical variation $\sigma(m_1 - m_2)$ as compared to $\sigma(m_1)$ is evidence for the first-ranked cluster member's being a special object. Further, Ostriker and Tremaine (1976) have advanced the idea that the first ranked cluster galaxy grows in luminosity by accretion of other bright cluster members. Now, whether the **cD** galaxies in these clusters are objects of formation or evolution, the case is clear that these galaxies are remarkable.

From the magnitude distributions of this group we find that the chance of the **cD** galaxies being a mere statistical fluctuation is negligible. On the other hand, if the giant **cD** galaxies have grown at the expense of other members of their parent clusters, then indeed they can be considered quite special. A more careful examination of the luminosity functions and morphological distributions may be able to distinguish between these two cases, but for the moment the inescapable conclusion is that the **cD** galaxies in our sample are "special objects."

The uniqueness of the **cD** phenomenon has implications beyond formation or evolution. The use of **cD** galaxies as a standard candle has been put forth by several authors. For instance, Peebles (1968) has suggested that the apparently small dispersion of M_1 in his sample is solely due to the steep slope of the luminosity function. Without the construction of either Abell-type or Schechter-type Luminosity Functions, though, it would be difficult to derive a set of corrections to M_1 based on M_*, the bright-end turnover, as a standard candle, especially when one considers the unreliability of M_* as pointed out by Dressler (1976). In our sample, for those few clusters with **cD** galaxies the redshift spread ranges from 0.02 to 0.06 while the m_v of the **cD** galaxies ranges from 11.2 to 15.2. It must be left to future observations and computation of cluster luminosity functions to resolve the matter.

There are other "special" phenomena noticed in our sample. Throughout the clusters we have measured there appear to be galaxies in close proximity, that is, within two galaxy diameters of each other or actually superposed. The curious feature observed is that many of these are observed as pairs or binary systems with a typical combination consisting of an early and a late elliptical galaxy. Often, the earlier companion is seen to be the brighter member of the pair. The usual numbers of these pairs seen in any particular cluster are few but we call attention to the remarkable case of 39 pairs seen in *Cluster 49* which represents some 7% of the cluster members. Likewise, *Cluster 28* has 15 pairs, or 11% of the sample; and *Cluster 23* has 16 pairs, or 9.5% of the cluster members being binary.

In addition, there are several cases of bright elliptical galaxies observed with halos in virtually every cluster. However, some of these are truely unusual in the sense that they are surrounded by a population of many faint attendants as if they were micro-clusters in their own right. Whether we are seeing super massive globular cluster type objects or very small elliptical galaxies imbedded in a giant elliptical galaxy's halo remains to be seen. A prototypical example of this unusual phenomenon is seen in *Cluster 21*.

6.2 Cluster Parameters

Abell's Richness Parameter: The criterion for estimating the *Richness* of a cluster of galaxies as developed by Abell (1957) was based on the number of galaxies within a two magnitude interval of the third brightest cluster member. Richness, as defined by Abell, is a parameter that is used quite often as an indication of mass: $M_{virial} \propto Richness$, or, better, of luminosity $M/L \propto R_{vir}^2 V_{vir}^2 / Richness$.

The tacit assumption contained in this definition is that there exists a universal *Luminosity Function.* Now a change in the slope of the bright end of the luminosity function from cluster to cluster could add or detract from a cluster's richness even though its total population would be unchanged. This and the lack of precise photometric measurements to establish such a magnitude interval yield richness determinations that are by-and-large consistent, but occasionally give a poor estimation of the total cluster population. These limitations notwithstanding, we cannot overestimate the value of Abell's method.

A natural richness criterion could be based on the total number of galaxies counted and complete to some faint limiting magnitude $m_{\rm lim}$. In practice, however, this would be a difficult number to estimate. Nevertheless, the dispersion analysis can yield a useful approach. The *Core* population may be able to be used to evaluate a reliable estimate of richness provided the cluster in question is centrally condensed and symmetric. In this case we would be sampling a known fraction of the population ($\sim 40\%$) as shown in **Figure 6.2.1.**

A method that appears to be more in keeping with the variations of cluster luminosity functions is an estimate of the total or core luminosity. This could be converted to mass by virtue of M/L ratios, but due to the many uncertainties in this type of analysis, in particular because of recent observations in the X-ray

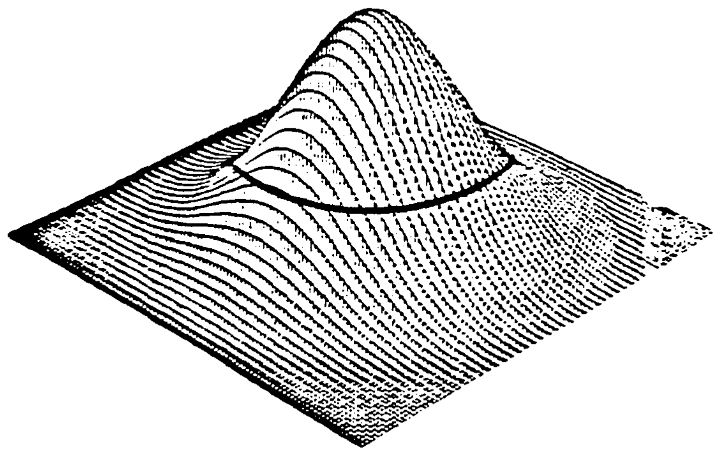


Figure 6.2.1 *Core Population from Dispersion Ellipse Calculations.*

regions of the spectrum which yield masses of clusters in excess of that determined by estimates using luminous matter because of intracluster gas, no attempt has been made to do so.

Equipartition: Due to the lack of sufficient time, it is generally believed that the process of equipartition is incomplete in clusters of galaxies. As the process continues, one would expect that the most massive galaxies in a cluster lose energy to the less massive ones, and consequently fall towards the center of the cluster. It would be reasonable to expect, therefore, that the effects of equipartition would be observed by a segregation of mass, or more directly, by luminosity. Oemler (1974) suggested that equipartition has proceeded to the point where it was evidenced by the brightest cluster members. He found that for the average of his data, the brightest two magnitudes of the cluster population were systematically closer to the cluster center than the fainter members.

In order to estimate the degree of equipartition in our sample we applied a zeroth-order approximation by considering the position of the three brightest cluster members from the center of the cluster as determined by the dispersion analysis. We simply determine the mean distance from center of these bright galaxies and for the

55 clusters of our sample their positions are generally less than 5.25 arcminutes from the cluster with $\sigma = 3.08$. We take this as preliminary evidence for equipartitioning in galaxy clusters in agreement with Oemler's contention. In the future, it may be more meaningful to compute the cluster radius in terms of brightness intervals since in this case statistically significant results could be derived for each cluster. A curious result that comes from this basic analysis is that *Cluster 10*, a **cD** cluster, has a very high dispersion of bright member galaxies which would imply a lack of evidence for relaxation in this particular cluster of galaxies. Other **cD** clusters in the sample show this effect marginally and if Oemler's point of view that **cD** clusters are the most evolved distributions of galaxies, we would expect the segregation of cluster members to be most pronounced. In only one of the **cD** galaxies of our admittedly small sample, *Cluster 18*, is there evidence of the brightest galaxies being more concentrated with the mean distance from cluster center of 1.44 arcminutes with $\sigma = 0.99$. These results are meaningful if we interpret them in terms of the loss of bright galaxies in the core of the cluster to the massive **cD** galaxy.

Core Radii: From **Table 6.0.1** we find the collected results of our *Isothermal Analysis*. These results ought to be viewed with caution due to the illness of fit for most of the cluster core radii and their large dispersion. The effects of subclustering and large dips and peaks in the surface density distributions virtually forefit our attempts to model the observed surface densities with a smooth Isothermal model. The core radii so determined are small and are reasonable only inasmuch as we are able to model the very cores of clusters and not their extremities. There are, of course, portions of our surface density distributions that do agree, but since none of the cases fit the Isothermal model within statistical uncertainties, any conclusions drawn must be viewed with suspicion.

We do point out, however, the importance of such an analysis. The *structural length*, which is one of the parameters determined in the isothermal fitting, has been invoked as a *standard candle*. Bahcall (1975) measured a sample of 15 rich clusters with $z \leq 0.14$ and concluded that the core radii determined by isothermal fitting have similar linear values. The mean for the sample was 0.25 Mpc with a dispersion of 0.04 Mpc. This very small dispersion was very encouraging from the cosmological point of view and was the stimulus for determining the core radii for other clusters of galaxies. However, investigations of other authors have brought distrust in the applicability of the core radius as a standard measure. The core radii obtained by Austin and Peach (1974) and Dressler (1973) for some of the clusters in Bahcall's sample were generally greater than those of Bahcall. The results of Chincarini and Materne (1980) are also at variance with Bahcall's measures; they find that although the core radius seems to be fairly constant from cluster to cluster, it is doubtful when using the data presently available that we can determine it to an accuracy higher than 0.15 Mpc. Nevertheless, the core radius is a fair standard size for clusters of galaxies. Whether, however, the core radius as determined for a single cluster is an accurate parameter to be used with X-ray observations is uncertain, since the X-ray studies appear to give a more accurate determination of cluster masses. Combined with galaxy counts in a cluster they may allow a better modelling of the cluster potential. We may have to take into account asymmetries as are seen in the surface density distributions in our sample and perhaps find parameters that are less sensitive to the observational uncertainties or better at reflecting the true nature of a cluster of galaxies.

Luminosity Function: The concept of a *Universal Luminosity Function* is summarized by Schechter (1975) and has found its way into many extragalactic problems. Abell (1963) proposed that luminosity functions of clusters of galaxies followed a universal form and postulated that all clusters show the same characteristic absolute magnitude M_* where the luminosity function changes slope. He later suggested (Bautz and Abell, 1973)that this absolute magnitude can be used as a *standard candle* for cosmological investigations.

As we have found with the distribution of magnitudes in our survey, other investigators have attempted to derive means to describe the distribution of cluster members as a function of their brightness along the lines of Gaussian or similarly peaked functions (Hubble, 1936). In later studies, though, it became obvious that the luminosity function was more probably a monitonically increasing sequence down to as faint a limiting magnitude that could be observed (Zwicky, 1957).

It was then that Abell introduced the idea of an integrated luminosity function, that is, an analytic expression for the number of galaxies found with absolute magnitudes between M and $M + \delta M$. He proposed the form

$$n(< M) = A dex(\alpha M); \quad \alpha = 0.75 \quad M < M_*$$

$$n(< M) = B dex(\beta M); \quad \beta = 0.25 \quad M > M_*$$

where $n(< M)$ is the number of galaxies per unit volume which are brighter than the absolute magnitude M and the constants A and B must satisfy the continuity condition

$$A dex(\alpha M_*) = B dex(\beta M_*).$$

This expression maps as a pair of straight lines on the *logN* vs. *AbsoluteMagnitude* diagram. The "break," or M_*, is defined as the the point where the function suffers a change in slope.

The accumulated luminosity function for our sample is given in **Figure 6.2.2.** and includes all clusters where the limiting absolute magnitude corresponding to $M = 17.5$ is fainter or equal to $M = -19.0$. In this case, we find $M_* = -21.3$.

From this sample it is reasonable to conclude that the luminosity function can serve as a standard candle if it relies on the magnitudes of many galaxies.

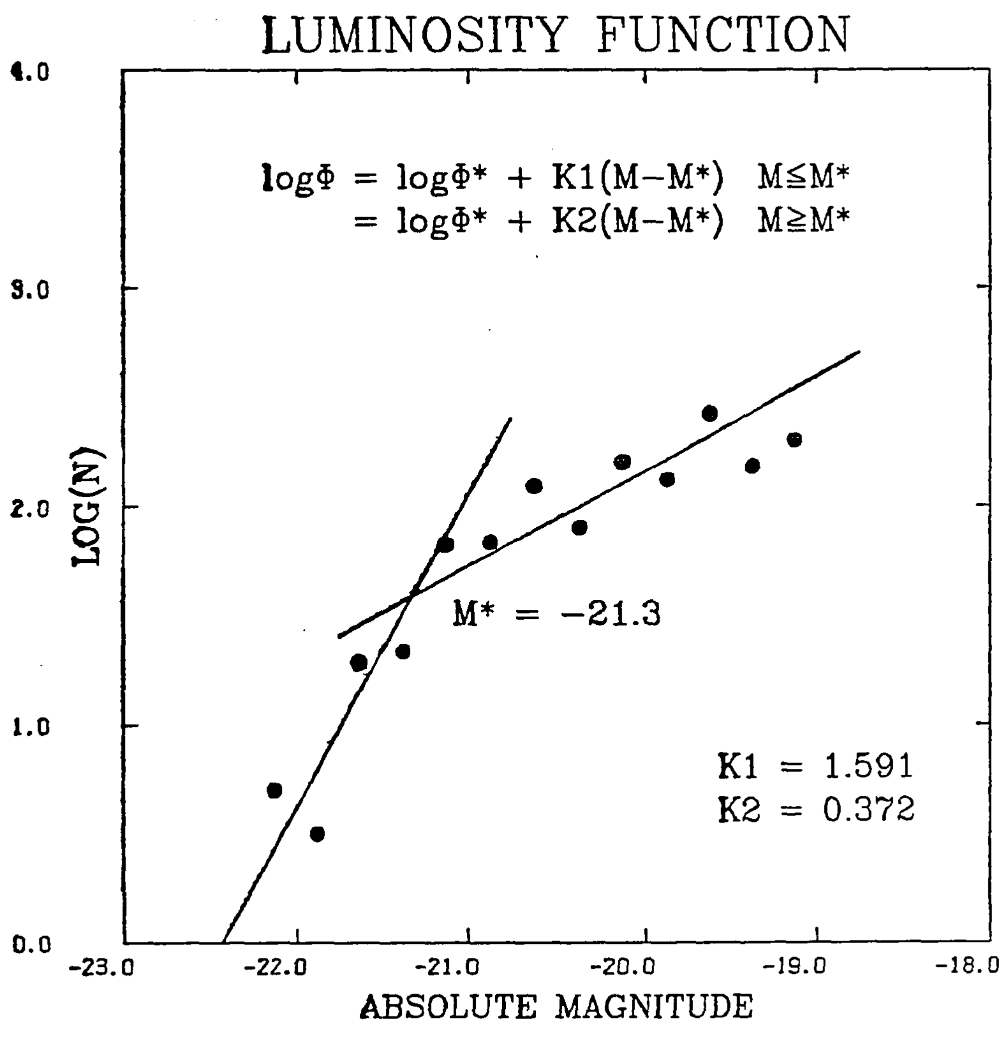


Figure 6.2.2. *Luminosity Function for 55 Bright Southern Clusters of Galaxies.*

In conclusion we are reminded of a sobering fact to be kept in mind. After more than three hundred years of spectacular advances, the evaluation of the scientific cosmology formulated by Salviati, Galileo's spokesman in the *Dialogue*, is still valid. Astronomy, Salviati admitted, has not yet arrived " at such a state that there are not many things still remaining undecided, and perhaps still more which remain unknown."

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... And if it serves
no other purpose, at least
that long catalogue of authors
will be useful to lend authority
to your book at the outset.
– Miguel de Cervantes

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