

Chapter 1

Summary and Conclusion

In literature, there are numerous studies done on Higgs production through several channels. Though Higgs decaying into b jets carry the highest branching ratio, this channel was not interested due to high QCD backgrounds and $b\bar{b}\tau^-\tau^+$ was the next promising channel to consider towards future targets like measuring Higgs self couplings. In this study we evaluated some important crosssections towards measuring trilinear Higgs couplings at LHC. The processes we considered here were $pp \rightarrow hh \rightarrow b\bar{b}b\bar{b} + X$ and $pp \rightarrow hh \rightarrow b\bar{b}\tau^+\tau^- \rightarrow b\bar{b}lj_\tau + \cancel{E}_T$ for both SM and MSSM via gluon fusion as well as for b quark fusion. Using new method of mass cut on the $b\bar{b}b\bar{b}$ final state, we could reduce 90% of background while saving 80% of the signal. For SM this improved the ratio of signal vs background significantly which could lead to measure the trilinear Higgs couplings at LHC in future, probably at $\sqrt{s} = 14 \text{ TeV}$.

In MSSM, b quark fusion is especially interested because the couplings and hence the signal can be greatly enhanced with large values of $\tan \beta$. Neutral Higgs production via b quark fusion was studied and with the updated mass cut for the 4b final state we could get $N_{ss} = 2.87(9.0)$ for luminosity $=300(3000)fb^{-1}$, at $\sqrt{s} = 14 \text{ TeV}$ for the pseudoscalar mass of 200 GeV . We also evaluate $b\bar{b}\tau^+\tau^-$ final state followed by $\tau^+\tau^- \rightarrow lj_\tau + \cancel{E}_T$ both via gluon fusion and b quark fusion. With the selection cuts applied to reconstructed mass of Higgs fom $\tau^+\tau^-$, the cross section rates were improved and hence the significance.

The results presented in this study conclude that gluon fusion with $(b\bar{b})(b\bar{b})$ final state has a high constraint on measuring trilinear Higgs couplings in SM at LHC running at $14\ TeV$. Results also shows that $b\bar{b}\tau^+\tau^-$ final state too provides a possibility towards the target through gluon fusion. Even in enhanced models like MSSM, both $(b\bar{b}b\bar{b})$ final state and $(b\bar{b}\tau^+\tau^-)$ are quite promising channels to consider towards trilinear Higgs self coupling, specially through b quark fusion with high $\tan\beta$ values as well as through gluon fusion. For a precise measurement of couplings we also initiated the possible processes for measuring it at proposed electron positron collider at ILC, in future.

References