Introduction and Motivations

In this work we describe the search for the Higgs boson pair production where one Higgs boson decays via $h \rightarrow b \bar{b}$ and the other via $h \rightarrow WW^* \rightarrow l^+l^-qq$. The search is performed on full data set 2015 (3.2 fb$^{-1}$) plus 2016 (33.3 fb$^{-1}$) of proton-proton collision data at the center of mass energy of 13 TeV recorded with the ATLAS detector at the LHC.

The SM predicts the interaction of the Higgs boson with itself. This mechanism contributes to the non-resonant Higgs boson pair production through Yukawa type interaction. Fig’s (a) and (b) show the schematic diagram of the non-resonant Higgs boson pair production.

Di Higgs Branching Ratios

1) 6 decay channels are under study by ATLAS
2) 4b has the largest Branching Ratio
3) WWbb is the second largest Branching Ratio
4) The full hadronic decay of the WW pair has higher branching ratio respect to the semi-leptonic, but it is affected by larger QCD background.

Signal Vs Background

1) $t\bar{t}$ is the largest and irreducible background
2) Other backgrounds are $W$+jets, 2+jets and $D$-bosons
3) Nevertheless the decay kinematics can be used to distinguish between signal and background.
4) Largest separation is expected when: $m_{bb} > m_{tt}\approx 350$ GeV
5) The signal topology consists of one charged lepton, four jets two of which are $b$-jets and missing transverse energy

Conclusion

• By adding lepton plus jets trigger, we get a 40% efficiency gain over the single lepton trigger alone.