Search for Higgs in association with top quark pairs at CMS

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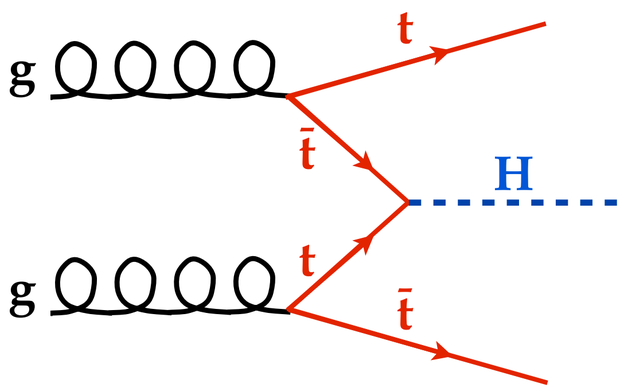
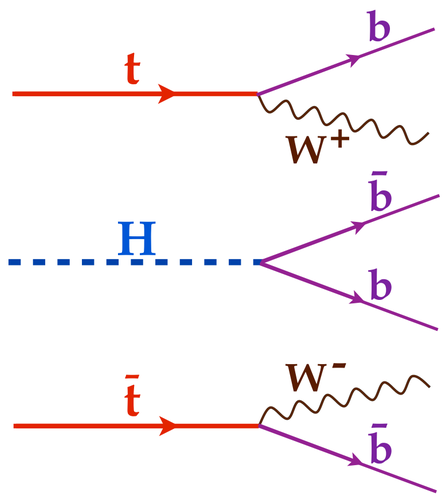
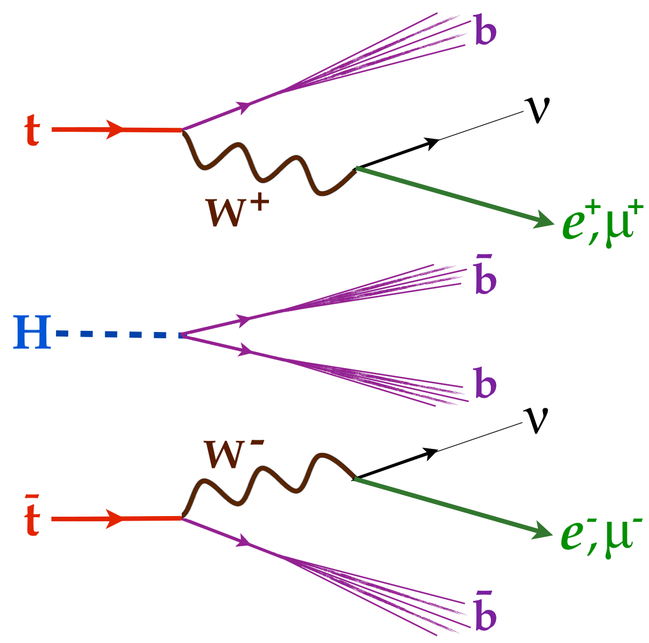


At the LHC, the Higgs can be produced in association with top pairs. This process allows us to directly probe the coupling of the Higgs to top quarks.



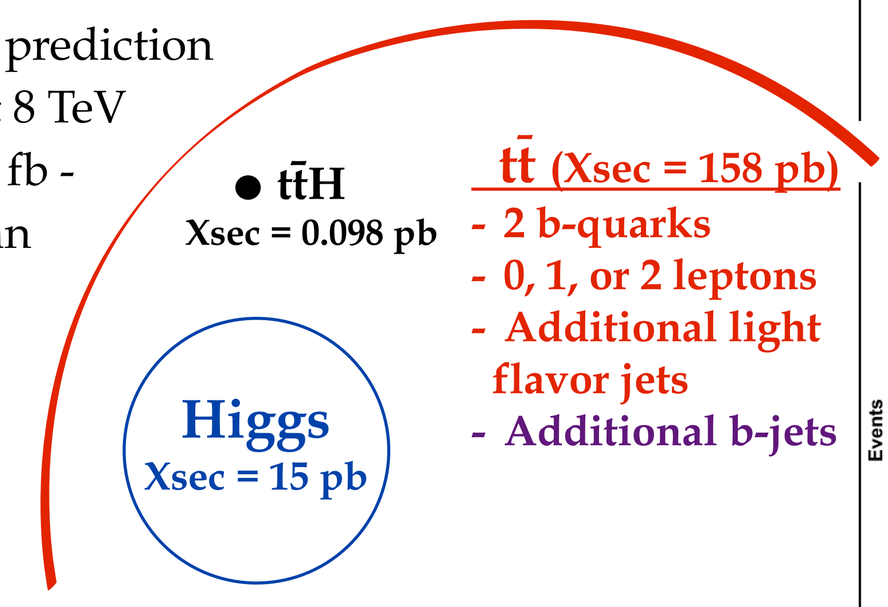
The dominant decay mode allows us to make a significant contribution to the inclusive H→b$\bar{b}$ cross section measurement



Final state with 4 b-jets plus **2 leptons** or **1 lepton + jets**

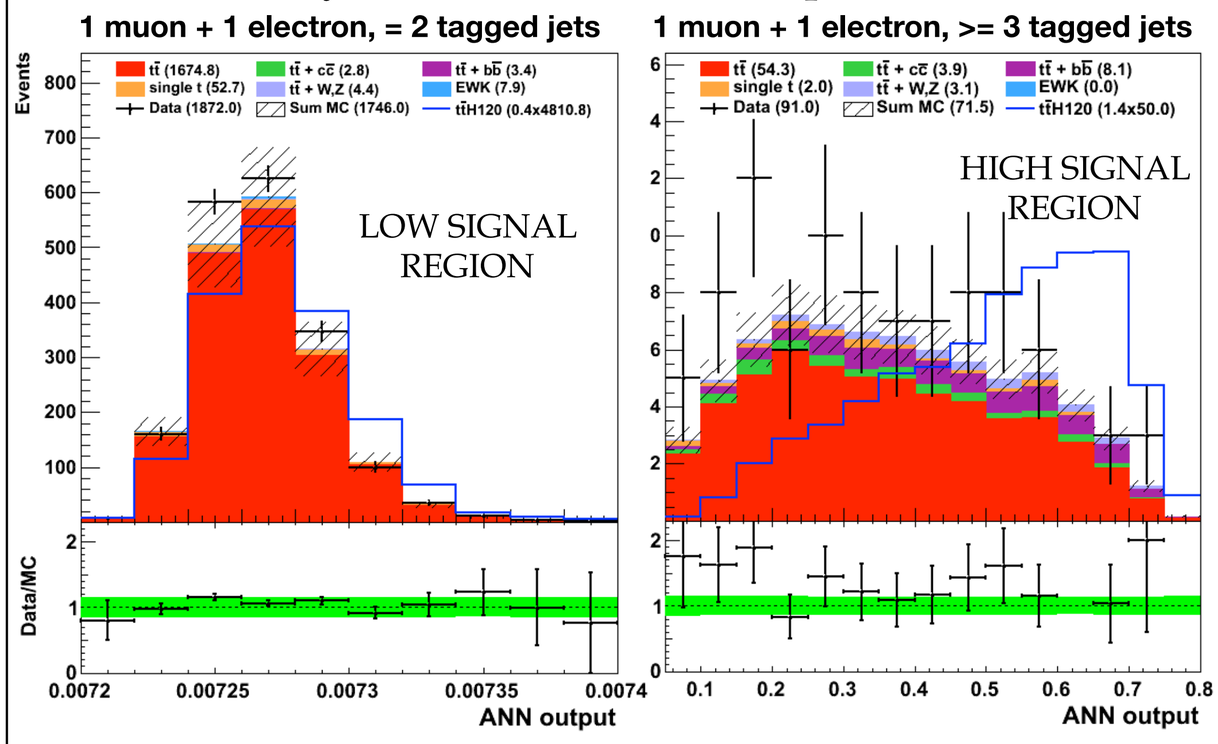
Challenge: small signal, large backgrounds

The Standard Model prediction for t$\bar{t}$H production at 8 TeV (m_H = 125 GeV) is 98 fb - 150 times smaller than the inclusive Higgs cross-section, and 1600 times smaller than the dominant background, t$\bar{t}$.



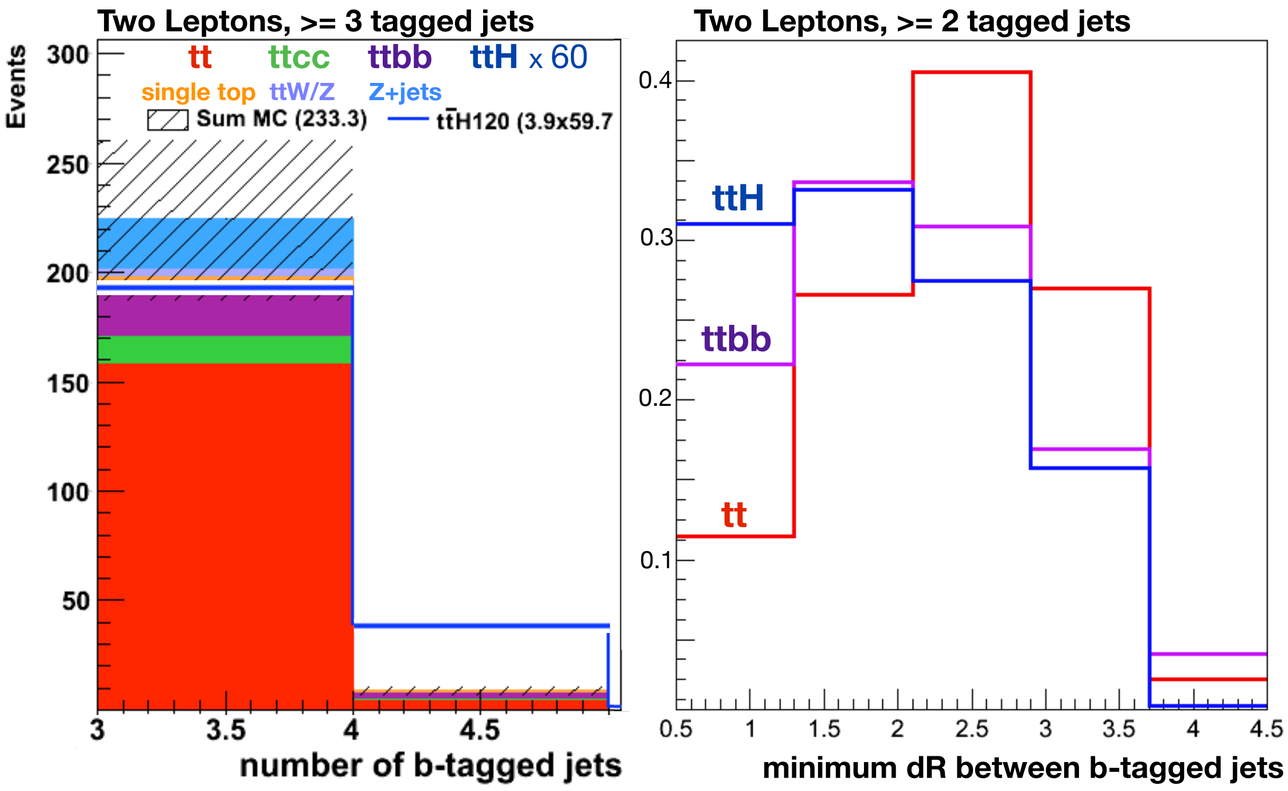
Working smarter: Artificial Neural Networks

Since no single kinematic variable discriminates sufficiently between signal and background, we train a neural network to recognize signal-like events by looking at multiple variables simultaneously. We then use data in low-signal regions to confirm that Monte-Carlo simulation accurately models neural net output.



Discriminating variables: tt̄H vs. tt̄ vs. tt̄b$\bar{b}$

The final state of tt̄H can be distinguished from tt̄ by the number of b-jets. However, since the identification of b-jets is only 70% efficient, we see all 4 b-tags less than 25% of the time. Additionally, rare tt̄b$\bar{b}$ events (with 4 real b-jets) form an irreducible background. Thus we introduce kinematic variable to separate signal from background.



Kinematic discriminants for dilepton channel

1. Scalar sum of the pT for all leptons, jets, and MET
2. Average b-tagginess factor (CSV) for b-tagged jets
3. Highest jet pT
4. Minimum dR between b-tagged jets
5. Minimum dR between the leading lepton and any jet

Setting a limit: current status and 2012 outlook

Combining the dilepton and lepton+jets analyses with 5 fb^{-1} of data at 7 TeV, we set an observed limit of $3.8^{+2.6}_{-0.5}$ times the standard model prediction for tt̄H production (m_H = 125 GeV). With an additional 20-25 fb^{-1} at 8 TeV, we expect to set a limit below 2 times SM, and hope to improve further with better di-bjet mass reconstruction and added channels sensitive to H→W$^+$W$^-$.