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Single top channel analysis in association with higgs production at ATLAS: a feasibility study

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Abstract content
   (Max 300 words)
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The Standard Model (SM) is our best current understanding of the nature of matter and energy. It explains almost every fundamental physical phenomenon, but not all. This motivated the construction of The Large Hadron Collider (LHC), the world's highest energy particle collider, at
the European Centre for Nuclear Research (CERN) in Geneva, Switzerland. ATLAS and CMS are two large general-purpose detectors at the LHC. One of their most important goals was the discovery of the elusive Higgs boson, the missing particle predicted by the Standard Model. This was concurrently achieved and announced in July 2012. What has now become a priority is the measurement of the Higgs boson properties to find possible deviations from what is predicted by the Standard model.

The most massive of all observed elementary particles is the top quark. High energies are thus needed to create it. The high energy proton-proton collisions at the LHC have for the first time lead to a large production of top quarks, allowing analyses of its properties. Its presence at high energies means it is also a good probe for physics beyond the Standard Model.
The top Yukawa coupling is a Higgs property of which the measurement, although consistent with SM so far, is not yet precise enough to exclude non-SM values [ATLAS-CONF-2013-034, CMS-HIG-12-028]. The single top production in association with a Higgs boson affords a unique opportunity to study the relative sign of the top Yukawa coupling constant: There exists an almost completely destructive interference between the Higgs-to-W and the Higgs-to-top coupling. This leads to an enhancement in the cross-section in the Wb → tH process if the couplings to the W boson and the top are opposite in sign [JHEP, 1305:022, 2013].
The dominant Higgs decay is the bbbar channel. Looking at the tHj → Wb + bb +j and W → lv process, gives a signature of 1 lepton + 3 b-jets + 1 forward jet + missing transverse energy. Monte Carlo samples where the vector boson and fermion coupling scale factors are set, respectively, to cV=1 and cF = 1 (SM value) or cF= -1 (non-SM value with a cross-section that is a magnitude greater compared to SM) are compared to background. It is investigated whether the signal could reach a high enough significance value to be feasibly detected in real data from the ˜21fb-1 integrated luminosity of the LHC 8 TeV run.

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