SEARCH FOR THE STANDARD MODEL HIGGS BOSON DECAYING TO FOUR LEPTON FINAL STATES AT THE ATLAS EXPERIMENT*

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The search for the Standard Model Higgs boson in the four lepton (electron and muon) final state with the ATLAS detector at the Large Hadron Collider is reviewed.

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ATLAS is a general purpose particle physics experiment at the Large Hadron Collider (LHC) with its major goal the discovery of the Standard Model (SM) Higgs boson [1]. The first proton–proton LHC collisions at 14 TeV center of mass energy are expected in 2008. The experimentally cleanest signature for the discovery of the Higgs is its "golden" decay to four leptons (electrons and muons): Higgs $\rightarrow ZZ \rightarrow 4l$.

The excellent energy resolution and linearity of the reconstructed electrons and muons leads to a narrow 4-lepton invariant mass peak on top of a smooth background. The major component of the background consists of the irreducible $pp \rightarrow ZZ \rightarrow 4l$ decays. The most challenging mass region is between 120–150 GeV where one of the Z bosons is off-shell giving low transverse momentum leptons.

In the analysis presented here, the electrons are identified by performing a set of cuts on electromagnetic and hadronic calorimeter observables. The muons are reconstructed by combining inner detector tracks with muon spectrometer tracks. The single electron and muon identification efficiency is given in Fig. 1.

Interesting events are selected by requiring four isolated leptons coming from the main vertex that satisfy kinematic and acceptance criteria (four leptons in the range $|\eta| < 2.5$ with p_{T} greater than 7 GeV, two of them having with p_{T} greater than 20 GeV). Further cuts on lepton isolation in the

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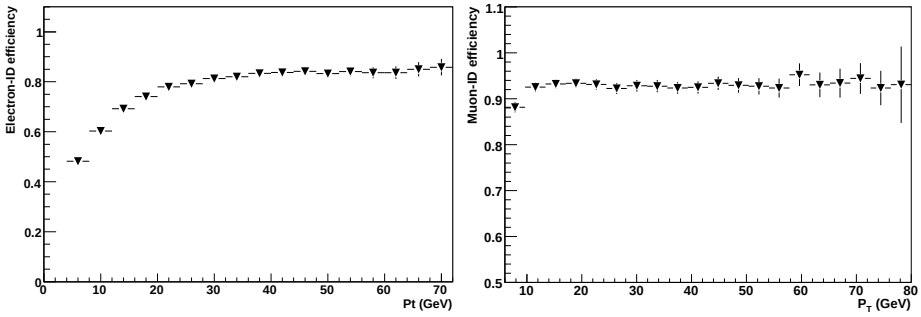

Fig. 1. Preliminary electron (left) and muon (right) efficiency as a function of p_{T}.

calorimeter and the tracker reduces the $Zb\bar{b} \to 4l$ background by a factor of 100 and the $t\bar{t} \to WbW\bar{b} \to 4l$ by a factor of 1000. This allows the $Zb\bar{b}$ background to be reduced to the level of 10–20% of the irreducible ZZ background at the low Higgs mass region.

Fig. 2 summarizes the ATLAS combined sensitivity for the discovery of a light SM Higgs boson with an integrated luminosity of 30 fb^{-1} [2].

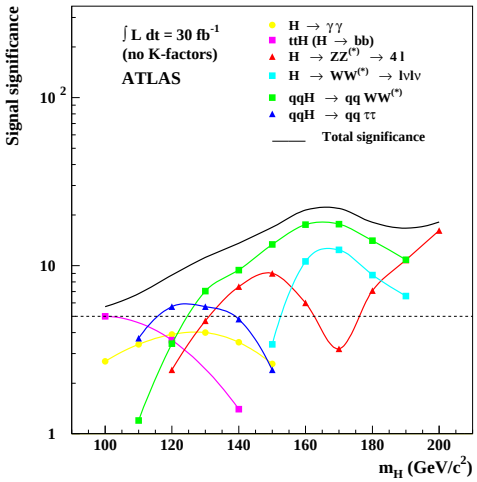

Fig. 2. Combined ATLAS sensitivity for discovering a light SM Higgs.

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REFERENCES

[1] ATLAS Collaboration 1999, Technical Design Report, Volumes I and II, CERN/LHCC 99-14, 99-15.

[2] S. Asai *et al.*, *Eur. Phys. J.* **C32S2**, 19 (2004).