

Towards the observation of the dimuon decay of the Higgs boson with the ATLAS detector

The discovery of the Higgs boson in 2012 confirmed the mechanism responsible for electroweak symmetry breaking and the generation of mass. While the Higgs boson's couplings to the third generation of fermions (top, bottom, and tau) are now well established, its interactions with the second generation remain largely unexplored. This presentation discusses the search for the rare decay of the Higgs boson into a pair of muons ($H \rightarrow \mu\mu$), which serves as a unique probe to test the Standard Model prediction that Yukawa couplings are proportional to fermion mass.

Following an introduction to the Higgs mechanism and the theoretical framework of Yukawa couplings, an overview of the ATLAS experiment at the LHC will be presented, with a focus on the muon spectrometer capabilities essential for this measurement. Finally, the talk will detail the latest results combining the full Run 2 dataset with the new Run 3 data collected at $\sqrt{s} = 13.6$ TeV. These measurements provide evidence for the Higgs boson decay to muons, marking a fundamental step in characterizing the Higgs sector and its coupling to second-generation fermions.