

Study of the $H \rightarrow \tau\tau$ decay channel with ATLAS

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After the discovery of the Higgs boson, the precision measurements of its properties and the comparison with the Standard Model (SM) predictions became the crucial part of the Large Hadron Collider (LHC) physics programme. A potential observation of deviations from the SM predictions may lead to the discovery of a new physics. The direct observation of the coupling of the Higgs boson to leptons and its measurements is of particular importance to study the mass generation for leptons. The status of the Higgs boson measurements in the $\tau\tau$ decay mode is presented; the measurements are performed using 36.1 fb^{-1} of data collected by the ATLAS experiment at $\sqrt{s} = 13 \text{ TeV}$.

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1. $H \rightarrow \tau\tau$ measurement

A measurement of total production cross sections of the Higgs boson in proton–proton collisions is presented in the $H \rightarrow \tau\tau$ decay channel. $H \rightarrow \tau\tau$ decay was observed in the combined measurements of the ATLAS [1] and CMS experiments using 2011 and 2012 data [2]. This analysis is performed using 36.1 fb^{-1} of 13 TeV data recorded by the ATLAS experiment at the LHC. The considered Higgs boson production modes are gluon–gluon fusion (ggF), vector-boson fusion (VBF) and associated production with a vector boson (VH). All combinations of leptonic and hadronic τ decays are considered.

The $H \rightarrow \tau\tau$ signal over the expected background from other SM processes is established with an observed (expected) significance of 4.4 (4.1) σ [3]. Using the data taken at 13 TeV the total cross section in the $H \rightarrow \tau\tau$ decay channel is measured to be $3.71 \pm 0.59(\text{stat.})_{-0.74}^{+0.87}(\text{syst.})$ pb for a Higgs boson of mass 125 GeV. The measured values for $\sigma_{H \rightarrow \tau\tau}$ using the data of individual channels and the result from the combined fit are shown on Fig. 1 Left. Total cross-sections are determined separately for VBF production and ggF production to be $\sigma_{H \rightarrow \tau\tau}^{\text{VBF}} = 0.28 \pm 0.09(\text{stat.})_{-0.09}^{+0.11}(\text{syst.})$ pb and $\sigma_{H \rightarrow \tau\tau}^{\text{ggF}} = 3.0 \pm 1.0(\text{stat.})_{-1.2}^{+1.6}(\text{syst.})$ pb, respectively, see Fig. 1 Right. All measurements are in agreement with the SM expectations.

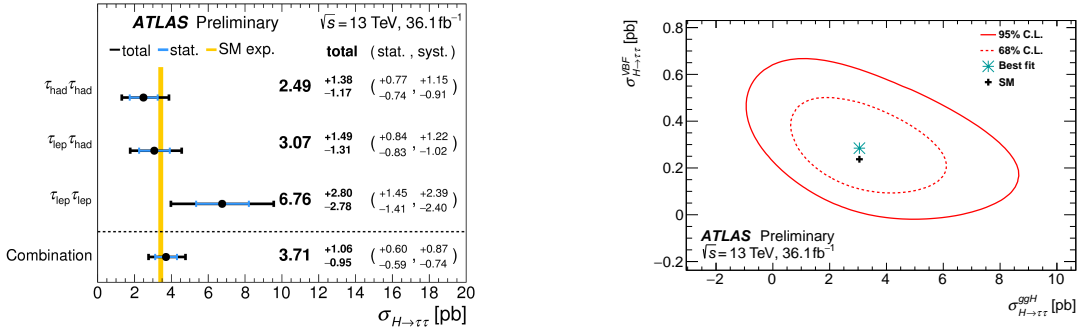


Figure 1: Left: The measured values for $\sigma_{H \rightarrow \tau\tau}$ using the data of individual channels and the result from the combined fit. Right: Likelihood contours for the combination of all channels in the $(\sigma_{H \rightarrow \tau\tau}^{\text{ggF}}, \sigma_{H \rightarrow \tau\tau}^{\text{VBF}})$ plane. Figures are taken from Ref. [3].

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References

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