New ATLAS precision measurements of the Higgs Boson in the 'golden channel'

May 16 2017

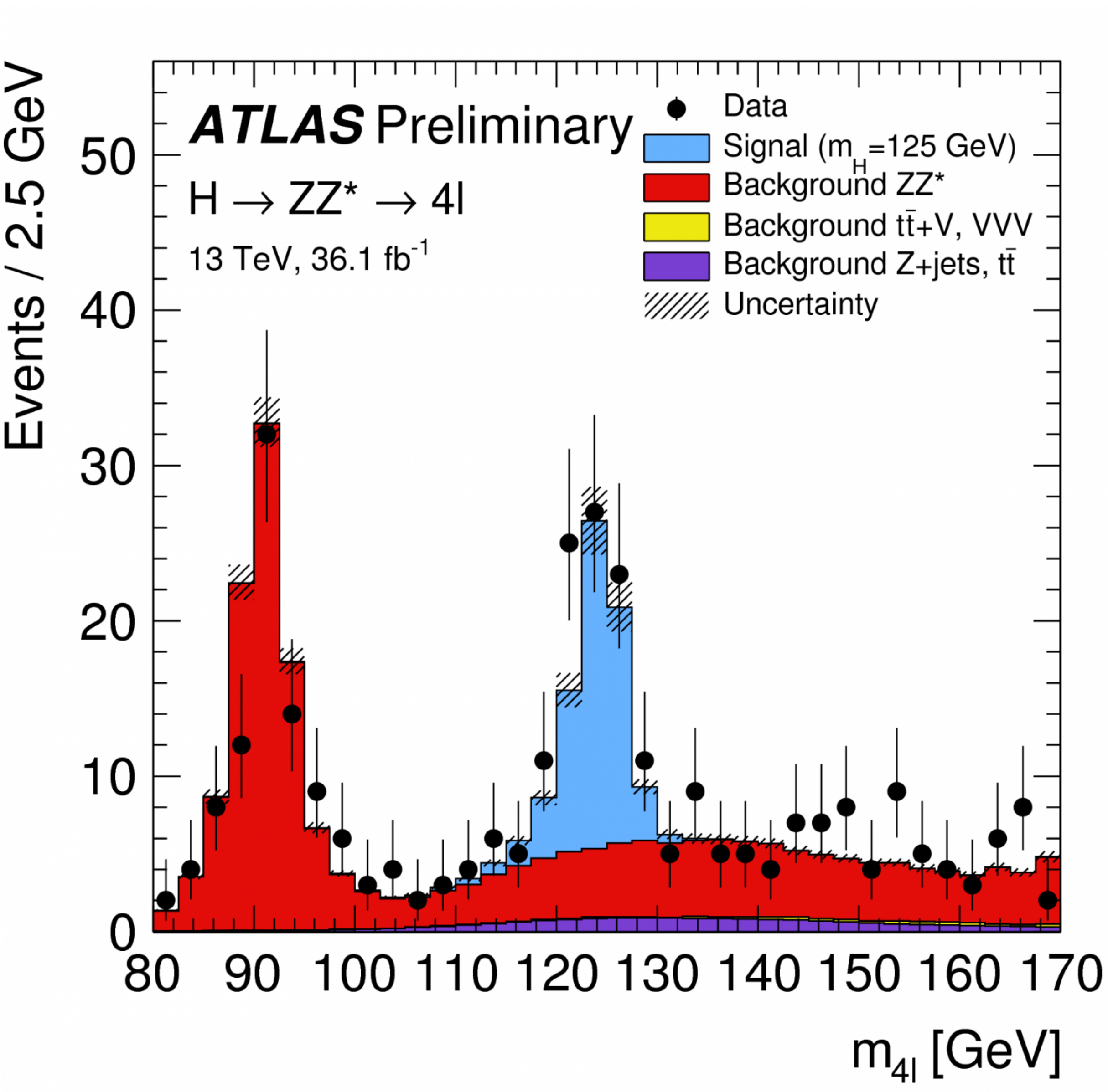

Figure 1: Distribution of the invariant mass of the four leptons selected in the ATLAS measurement of H→ZZ*→4l using the full 2015+2016 data set. The Higgs boson corresponds to the excess of events with respect to the non resonant ZZ* background observed at 125 GeV. Credit: ATLAS Collaboration/CERN

The discovery of a Higgs boson in 2012 by the ATLAS and CMS experiments marked a milestone in the history of particle physics. It confirmed a long-standing prediction of the Standard Model, the theory that comprises our present understanding of elementary particles and their interactions.

With the huge amount of proton–proton collisions delivered by the LHC in 2015 and 2016 at the increased collision energy of 13 TeV, the ATLAS experiment has entered a new era of Higgs boson property measurements. The new data allowed ATLAS to perform measurements of inclusive and differential cross sections using the "golden" H→ZZ*→4ℓ decay.

The four-lepton channel, albeit rare (0.012% branching fraction into final states with electrons or muons), has the clearest and cleanest signature of all the possible Higgs boson decay modes. This is due to the channel's small background contamination. Figure 1 shows a narrow resonant peak at 125 GeV in the reconstructed invariant mass on top of a locally relatively flat background distribution dominated by (non-resonant) qq→ZZ* production.

The Higgs boson's transverse momentum can be used to probe different Higgs production mechanisms and possible deviations from the Standard Model interactions. Figure 2 shows the measured differential cross section of the four-lepton transverse momentum (p_T4l) compared to various Standard Model predictions.

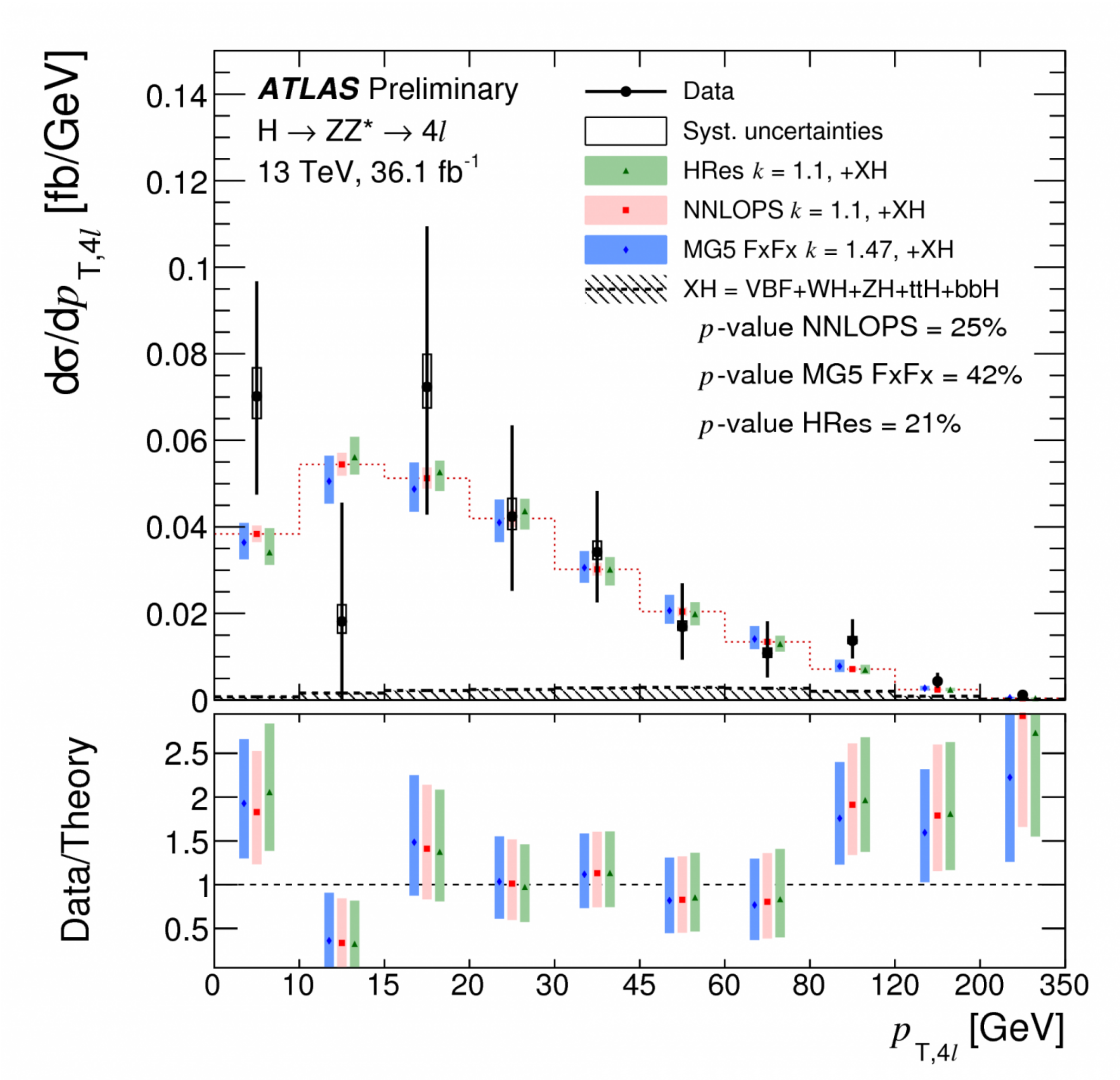

Figure 2: Differential cross section for the transverse momentum (pT4l) of the Higgs boson. The measured cross section is compared to different ggF SM predictions. The error bars on the data points show the total uncertainties, while the systematic uncertainties are indicated by the boxes. Credit: ATLAS Collaboration/CERN

By studying the number of jets produced in these events, as well as the transverse momentum of the leading jet, ATLAS can probe and help improve the theoretical modelling of Higgs boson production via gluon fusion. The measured and predicted differential cross sections as a function of the jet multiplicity are shown in Figure 3.

Several differential cross sections have been measured for observables sensitive to Higgs boson production and decay, including kinematic distributions of the jets produced in association with the Higgs boson. Good agreement is found between the data and Standard Model predictions. The measurements are used to constrain anomalous Higgs boson interactions (see Figure 4).

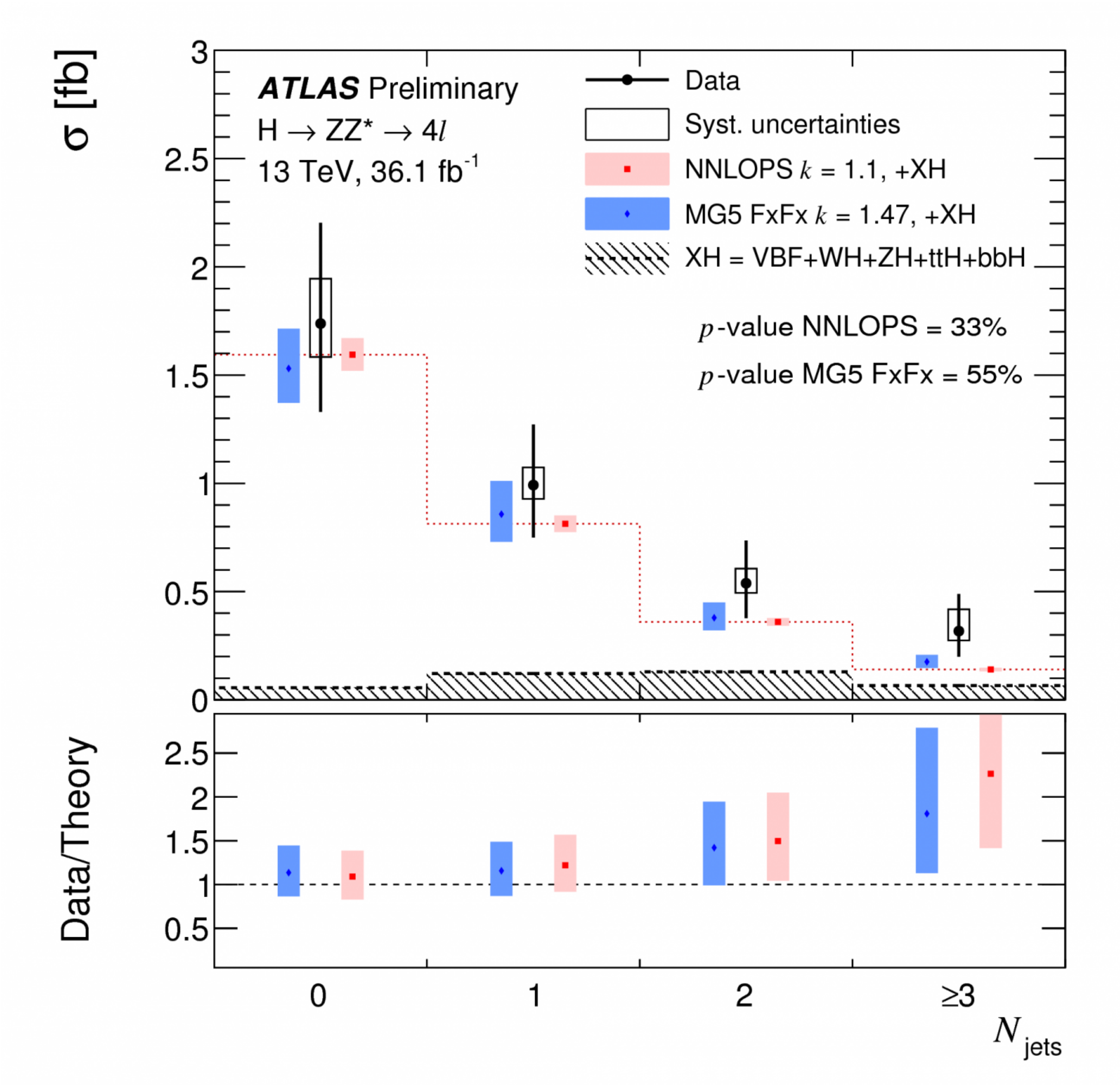

Figure 3: Distribution of the invariant mass of the four leptons selected in the ATLAS measurement of H→ZZ*→4l using the full 2015+2016 data set. The Higgs boson corresponds to the excess of events with respect to the non resonant ZZ* background observed at 125 GeV. Credit: ATLAS Collaboration/CERN

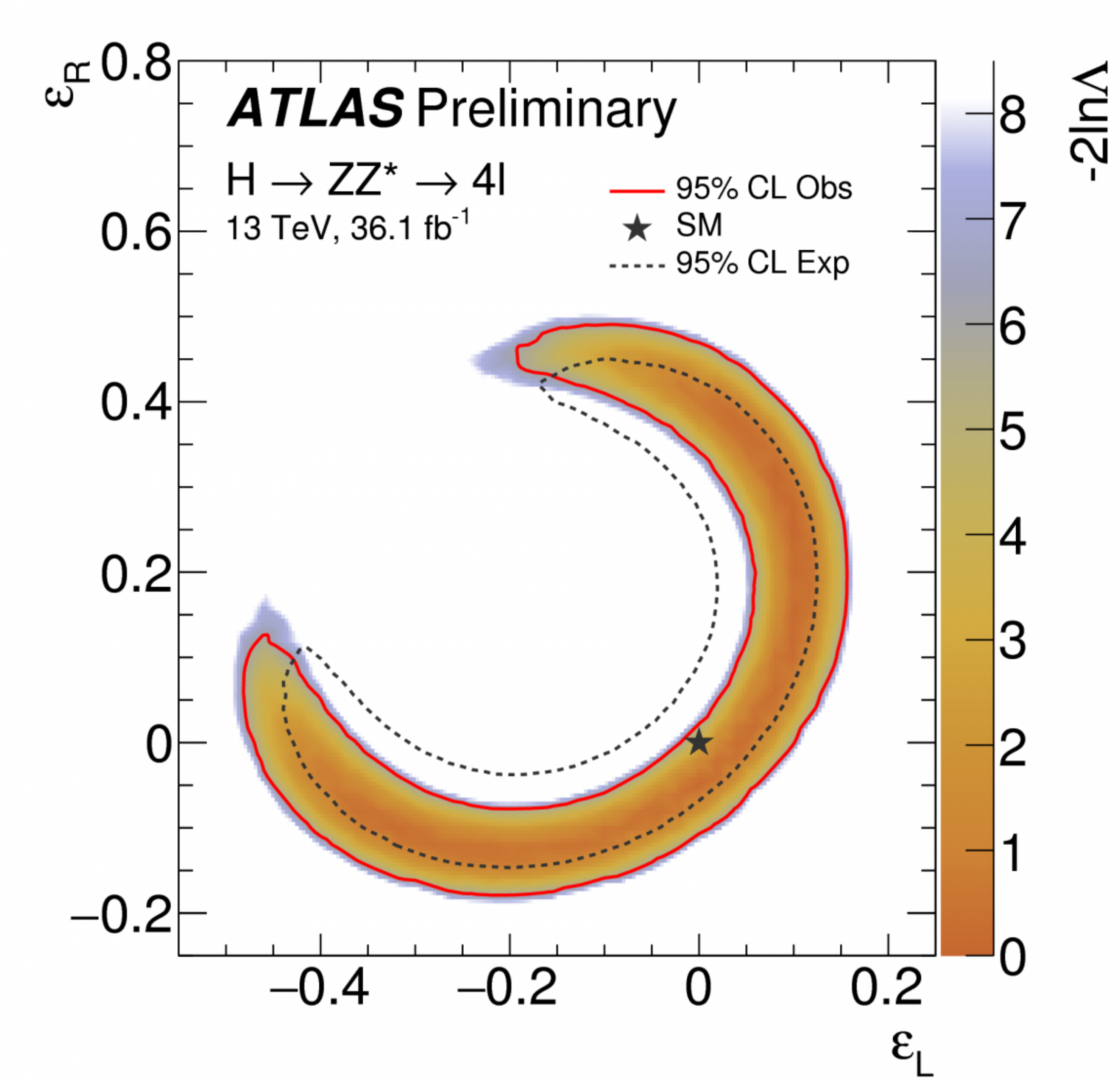

Figure 4: Limits on modified Higgs-boson decays within the framework of pseudo-observables. The limits are extracted in the plane of εL and εR, which modify the contact terms between the Higgs boson and left- and right-handed leptons, assuming lepton-flavour universality. Credit: ATLAS Collaboration/CERN

More information: Presentation at LHCP conference by Eleni Mountricha: Higgs measurements in high resolution channels with ATLAS: indico.cern.ch/event/517784/co … 28/lhcp_17_05_15.pdf

Provided by ATLAS Experiment