The scalar sector of the standard model

Martin Flechl on behalf of the ATLAS and CMS collaborations

Abstract
Main results and references to original work.

Presented at Ski2016 LHC Ski 2016 - A first discussion of 13 TeV results
The scalar sector of the standard model

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May 25, 2016

In 2012, the ATLAS [1] and CMS [2] experiments have discovered a Higgs boson [3, 4] and since then started an industry of Higgs boson property measurements. Higgs bosons at the LHC are dominantly produced in gluon-gluon fusion (ggF), vector boson fusion (VBF), and associated production with a W or Z boson (VH), or a top quark pair (ttH) [5].

Higgs boson property measurements are typically the result of global fits combining studies aimed at different production and decay modes. For several measurements, the ATLAS and CMS analyses of the years 2011 and 2012 have been combined.

Higgs boson production in ggF and VBF as well as decays to $\gamma\gamma$, $ZZ$, $WW$ and $\tau\tau$ have been observed at the LHC with a significance of more than 5 Gaussian standard deviations, VH and ttH production with more than 3 [6, 7]. The mass has been measured by ATLAS and CMS as $m_H = 125.09 \pm 0.24$ GeV [8]. 

The global signal strength $\mu$ is measured as $1.09 \pm 0.11$ (ATLAS+CMS) and all results for $\mu$ for different production and decay modes are in good agreement with the standard model (SM) expectation, with only $\mu_{ttH}$ being about two standard deviations higher than 1 [6, 7].

The combined ATLAS+CMS coupling strength modifier $\kappa$ fits [6, 7] are done for different assumptions and free parameters. All results agree with the SM expectation. Examples are universal modifiers for fermions and vector bosons in 2D fits or $\kappa$ ratios for down- and up-type fermions as well as leptons to quarks: All agree with the SM expectation within uncertainties of typically about 15%.

Spin-parity properties have been measured separately by CMS [9] and ATLAS [10]. Among the tested alternatives, the data favor the SM hypothesis but there is still room for a sizable anomalous CP-odd or CP-even admixture.

Both ATLAS and CMS measure fiducial differential cross sections [11, 12, 13]. They agree with the SM expectation within large statistical uncertainties.

While the overall agreement of measurements with the SM is excellent, a few mild anomalies have been observed in the 2011+2012 data, e.g. in $ttH$ [14, 15], $WH \rightarrow e\nu b\bar{b}$ [16], $HH \rightarrow b\bar{b}\gamma\gamma$ [17] and $H \rightarrow \tau\mu$ [18, 19, 20].
A list of most recent ATLAS and CMS Higgs physics results can be found on these TWikis [21, 22]. Prospects are discussed in Refs. [23, 24, 25, 26].

References

[22] CMS Collaboration, https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsHIG.