IL NUOVO CIMENTO **38 C** (2015) 46
DOI 10.1393/ncc/i2015-15046-9

Colloquia: IFAE 2014

Measurement of the Higgs boson properties with the ATLAS detector

A. Gabrielli on behalf of the ATLAS Collaboration

Dipartimento di Fisica, Università di Roma "Sapienza", Roma, Italy
INFN, Sezione di Roma 1, Piazzale Aldo Moro 2, 00185, Roma, Italy

received 7 January 2015

Summary. — In this paper, a brief overview of the results, based on proton-proton collision data recorded at a centre-of-mass energy of 7 TeV in 2011 and 8 TeV in 2012, for the properties of a new Higgs-like particle at 125.5 GeV are presented.

PACS 14.80.Bn – Standard Model Higgs bosons.

1. – Mass and signal strength

The mass of the newly discovered boson can be measured precisely in the high mass resolution channels $H \to \gamma\gamma$ and $H \to ZZ^{(*)} \to 4l$. Figure 1 shows the profile likelihood ratio as a function of m_H for $H \to \gamma\gamma$ and $H \to ZZ^{(*)} \to 4l$ channels and their combination. The combined mass is measured to be $m_H = 125.5 \pm 0.2(stat)^{+0.5}_{-0.6}(sys)$ GeV [1].

2. – Couplings

The signal strength scale factors $\mu_{i,f}$ for either the Higgs production or decay modes were determined. However, for a consistent measurement of Higgs boson couplings, production and decay modes cannot be treated independently. The framework and benchmarks as recommended in ref. [2], measurements of coupling scale factors are implemented using a LO tree level motivated framework ref. [3]. For these measurements the following channels are used: $\gamma\gamma$, ZZ^*, WW^*, $b\bar{b}$ and $\tau\tau$.

Fermion versus vector (gauge) couplings. – This benchmark is an extension of the single parameter fit, where different strengths for the fermion and vector couplings are probed. It assumes that only SM particles contribute to the $H \to \gamma\gamma$ and $gg \to H$ vertex loops, but any modification of the coupling strength factors for fermions and vector bosons are propagated through the loop calculations. In fig. 2 (left) there is a plot with the best-fit of κ_V and κ_F with 68% CL contours.

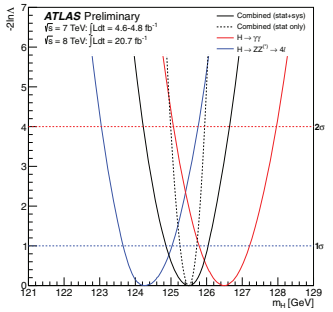

Fig. 1. – The profile likelihood ratio $-2\ln\Lambda(m_H)$ as a function of m_H for the $H \to \gamma\gamma$ and $H \to ZZ^{(*)} \to 4l$ channels and their combination, obtained by allowing the signal strengths $\mu_{\gamma\gamma}$ and μ_{4l} to vary independently.

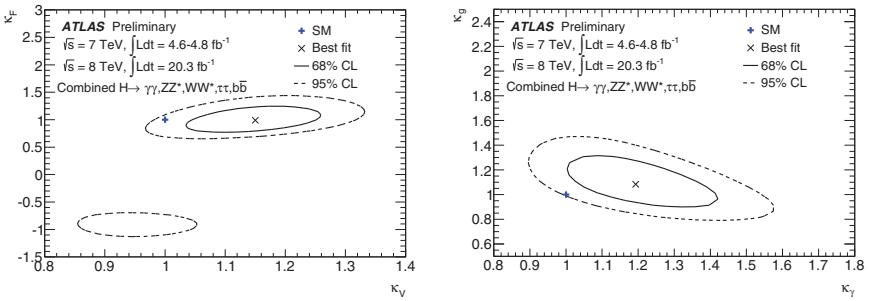

Fig. 2. – Correlation of the coupling scale factors κ_F–κ_V (left) and κ_g–κ_γ (right) with 68% CL contours.

Loop structure. – Many BSM physics scenarios predict the existence of new heavy particles, which can contribute to loop induced processes such as $gg \to H$ production and $H \to \gamma\gamma$ decay. Effective scale factors κ_g and κ_γ are introduced to parameterise the $gg \to H$ and $H \to \gamma\gamma$ loops to probe for contributions from non-SM particles in these precesses. In fig. 2 (right) there is a plot with the best-fit of κ_g and κ_γ with 68% CL counturs.

3. – Conclusions

Using data taken in 2011 and 2012, at centre-of-mass energies of respectively 7 TeV and 8 TeV, the ATLAS collaboration has reported the observation of a new particle with a mass of $m_H = 125.5\,\text{GeV}$, in the search for the Standard Model Higgs boson. Within the current statistical uncertainties and assumptions, no significant deviations from the Standard Model couplings are observed.

REFERENCES

[1] ATLAS Collaboration, "Combined measurements of the mass and signal strength of the Higgs-like boson with the ATLAS detector using up to 25 fb-1 of proton-proton collision data," AATLAS-CONF-2013-014.
[2] LHC Higgs Cross Section Working Group,"LHC HXSWG interim recommendations to explore the coupling structure of a Higgs-like particle", arXiv:1209.0040[hep-ph].
[3] ATLAS Collaboration, "Higgs couplings combination". ATLAS-CONF-2014-009.