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Title : Calibration of the electromagnetic calorimeter of the ATLAS experiment and application to the measurement of (BE)H boson couplings in the diphoton channel

Keywords : ATLAS, Higgs, couplings, calorimeter, calibration

Abstract : The discovery of the Higgs boson was a major success of the run 1 of the LHC. The era of precision measurements began as any deviation from the expected Standard Model (SM) value would be an indirect hint of new physics Beyond the Standard Model (BSM). This is important since no direct evidence was found.

This thesis has a first focus on the calibration of the electromagnetic calorimeter of the ATLAS experiment. The final step of this calibration uses the knowledge of the lineshape of the Z boson in order to correct the measured energy of electrons and photons. Recommendations for the beginning of run 2 have been given to provide calibration constants for early analyses. Run 2 calibration constants have been computed and the performances of run 1 have been reached and improved : the systematic uncertainty on the resolution constant term of the electromagnetic calorimeter, which was dominant for the Higgs boson couplings measurement at run 1, has been divided by a factor 3.

The measurement of the H boson couplings consists in measuring the shape of the resonant signal over a smooth decreasing background in categories optimized for various processes, by tagging the objects produced in association with the Higgs boson. The results are based on 36 fb^{-1} of data recorded in 2015 and 2016 at $\sqrt{s}$=13 TeV. The ratio of the measured production cross-sections of the Higgs boson over the SM expected value (μ) has been measured. No significant deviation with respect to the SM has been observed :

$$\mu = 0.99 \pm 0.14$$

The ratios of the main production processes have also been measured:

$$\mu_{ggH} = 0.80 \pm 0.18$$

$$\mu_{VBF} = 2.1 \pm 0.66$$

$$\mu_{VH} = 0.7 \pm 0.85$$

$$\mu_{ttH+tH} = 0.5 \pm 0.6$$

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