Contribution ID: **10** Type: **not specified**

Higgs coupling combination measurement at ATLAS ten years after the discovery

The standard model of particle physics describes the known fundamental particles and forces that make up our universe, with the exception of gravity. One of the central features of the standard model is a field that permeates all of space and interacts with fundamental particles. The quantum excitation of this field, known as the Higgs field, manifests itself as the Higgs boson, the only fundamental particle with no spin. In 2012, a particle with properties consistent with the Higgs boson of the Standard Model was observed by the ATLAS and Compact Muon Solenoid (CMS) experiments at the Large Hadron Collider at CERN. Since then, more than 30 times as many Higgs bosons have been recorded by the ATLAS experiment, enabling much more precise measurements and new tests of the theory. Here, on the basis of this larger dataset, we combine an unprecedented number of production and decay processes of the Higgs boson to scrutinize its interactions with elementary particles. Interactions with gluons, photons, and W and Z bosons—the carriers of the strong, electromagnetic and weak forces—are studied in detail. Interactions with three third-generation matter particles (bottom (b) and top (t) quarks, and tauons (tau)) are well measured and indications of interactions with a second-generation particle (muons, mu) are emerging. These tests reveal that the Higgs boson discovered ten years ago is remarkably consistent with the predictions of the theory and provide stringent constraints on many models of new phenomena beyond the standard model.

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