

# Combined measurements of Higgs boson production and decay and constraints on the Higgs boson self-coupling from the combination of single-Higgs and double-Higgs production analyses performed with the ATLAS experiment

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A combination of measurements of Higgs boson production cross sections and branching fractions is presented. The combination is based on the analyses of the Higgs boson decay modes  $H \rightarrow \gamma\gamma$ ,  $ZZ$ ,  $WW$ ,  $\tau\tau$ ,  $bb$ ,  $\mu\mu$ , and searches for decays into invisible final states. Up to  $139 \text{ fb}^{-1}$  of  $pp$  collision data collected at  $\sqrt{s}=13 \text{ TeV}$  with the ATLAS detector are used. Combined cross section measurements are presented for the  $ggF$ ,  $VBF$ ,  $WH$ ,  $ZH$  and  $ttH$ . The global signal strength, defined as the measured Higgs boson signal yield normalized to its SM prediction, is determined to be  $\mu=1.06 \pm 0.07$ . The combined measurement yields an observed (expected) significance for the  $WH$  of  $6.3\sigma$  ( $5.2\sigma$ ). Measurements in kinematic regions defined within the simplified template cross section framework are also shown. The results are interpreted in terms of modifiers applied to the Standard Model couplings of the Higgs boson to other particles. No significant deviations from SM predictions are observed.

Constraints on the Higgs boson self-coupling are set by combining the single Higgs boson analyses targeting the  $\gamma\gamma$ ,  $ZZ$ ,  $WW$ ,  $\tau\tau$  and  $bb$  decay channels and the double Higgs boson analyses in the  $bbbb$ ,  $bb\tau\tau$  and  $bb\gamma\gamma$  decay channels. The data used in these analyses correspond to an integrated luminosity of up to  $79.8 \text{ fb}^{-1}$  for single Higgs boson analyses and up to  $36.1 \text{ fb}^{-1}$  for the double Higgs boson analyses. With the assumption that new physics affects only the Higgs boson self-coupling ( $\lambda_{HHH}$ ), values outside the interval  $[-2.3, 10.3]$  are excluded at 95% CL. Results with less stringent assumptions are also provided, introducing additional coupling modifiers for the Higgs boson interactions with the other SM particles.

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