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Non-resonant Higgs boson pair production search and photon shower shapes correction via normalizing flows

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The search for non-resonant Higgs boson pair production provides an important probe to the Higgs self-coupling and thus the electroweak symmetry breaking mechanism. The HH $\rightarrow bb\gamma\gamma$ channel is one of the most sensitive channels in the search for di-Higgs bosons. The search performed with Run2 and partial Run3 data collected by the ATLAS experiment with the unprecedented luminosity of about 300 fb^{-1} will be presented. The di-Higgs cross section in the Standard Model (SM) is very small and upper limits on this cross section are derived for the SM and for several beyond the Standard Model scenarios.

Since photons play a central role in this channel, their identification has a direct impact on the sensitivity of the analysis. In particular, shower shape variables in the ATLAS calorimeter are used for electron and photon identification. However, due to the well-known mismodelling of the calorimeter in Geant4-based simulations, shower shape variables show differences between data and MC. To address these differences, a novel correction strategy based on normalizing flows has been proposed. This approach provides an accurate correction of shower shape variables while preserving correlations between them. The performance of this approach will be presented.

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