

## Using Boosted Decision Trees based event categorization to target SM and BSM $HH \rightarrow 2b2\gamma$ at ATLAS

In this poster, we present a study of di-Higgs production in the  $HH \rightarrow b\bar{b}\gamma\gamma$  decay channel using data from the ATLAS experiment. This channel is considered one of the “golden channels” for constraining the Higgs self-coupling, benefiting from the high branching ratio of the  $H \rightarrow b\bar{b}$  decay and the excellent ATLAS photon triggers. The analysis employs Boosted Decision Trees (BDTs) to define event categories with varying purities, ensuring that each category contains at least 11  $\gamma\gamma +$  jets events within the diphoton mass range of 110–160 GeV. In this poster, we highlight the benefits and challenges of this strategy, along with its impact on limits, significances, and the trilinear Higgs boson self-coupling modifier under different scenarios.

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