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Investigating the Unexplored H→4g Decay Mode With Machine Learning Analysis Techniques in *pp* Collisions at $\sqrt{s}$ = 13 TeV With the ATLAS Detector MURTAZA SAFDARI, Stanford Univ, ATLAS COLLABORATION — ATLAS is investigating a previously unexplored final state of the Higgs boson (H) decaying to four gluons (g). Several Beyond Standard Model (BSM) physics models propose a coupling of the Standard Model (SM) Higgs to new scalars or pseudoscalars (a), which in turn can decay to gluons via BSM-SM physics interactions. Previous analyses have searched for other decay modes of the BSM scalars, but none have looked for the 4g final state due to its experimental challenges. With the full 139 fb^{-1} of data ATLAS collected over the 2015-2018 run, sensitivity to the H→aa→4g decay can be reached with innovative Machine Learning (ML) analysis techniques. The mass range of the scalar being targeted in this analysis is 1 - 15 GeV/c^2, wherein the a→gg decay is contained within the same jet in the ATLAS detector. This leads to a unique substructure in the jets which can be harnessed using ML classifiers designed to learn the distinct features of a di-gluon jet arising from the decay of a scalar. The analysis also employs cutting edge background estimation techniques to decorrelate the outputs of the ML classifiers with the axes used for the estimation. The analysis provides complementary sensitivity with indirect constraints.

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