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Search for Dark Higgs and Triple Higgs at ATLAS

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Ref. Phys. Rev. Lett. 134 (2025) 121801
A search is performed for dark matter particles produced in association with a resonantly produced pair of b-quarks with $30 < m_{bb} < 150$ GeV using 140 fb^{-1} of proton-proton collisions at a center-of-mass energy of 13 TeV recorded by the ATLAS detector at the LHC. This signature is expected in extensions of the Standard Model predicting the production of dark matter particles, in particular those containing a dark Higgs boson s that decays into $b\bar{b}$. The highly boosted s$\rightarrow b\bar{b}$ topology is reconstructed using jet reclustering and a new identification algorithm. This search places stringent constraints across regions of the dark Higgs model parameter space that satisfy the observed relic density, excluding dark Higgs bosons with masses between 30 and 150 GeV in benchmark scenarios with Z′ mediator masses up to 4.8 TeV at 95% confidence level. The result leads to the 1^{st} ever cosmological coherent dark Higgs search at LHC.

Ref. Phys. Rev. D 111 (2025) 032006
The 1^{st} ever search for the production of three Higgs bosons (□□□) at LHC has been performed in the $b\bar{b}b\bar{b}b\bar{b}$ final state is presented. The search uses 126 fb^{-1} of proton-proton collision data at √□ =13 TeV collected with the ATLAS detector at the Large Hadron Collider. The analysis targets both non-resonant and resonant production of □□□. The resonant interpretations primarily consider a cascade decay topology of □→□□→□□□ with masses of the new scalars □ and □ up to 1.5 and 1 TeV, respectively. In addition to scenarios where □ is off-shell, the nonresonant interpretation includes a search for Standard Model □□□ production, with limits on the trilinear and quartic Higgs self-coupling set. No evidence for □□□ production is observed. An upper limit of 59 fb is set, at the 95% confidence level, on the cross section for Standard Model □□□ production.

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