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Hunting the dark-Higgs: A search for a dark-Higgs boson in the 4b+MET final state at $\sqrt(s) = 13$ TeV with the ATLAS detector

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The Standard Model of particle physics, while remarkably successful in describing most phenomena related to the fundamental interactions and particles, notably lacks a mechanism to account for dark matter, prompting a wealth of beyond the Standard Model (BSM) theories that propose various candidates and interactions. One such theory is the dark Higgs boson model. This model introduces three additional states: the dark matter candidate; a dark Higgs boson responsible for giving mass to the dark matter candidate; and a heavy spin-1 mediator (Z'). It is able to reproduce the observed relic density naturally. A search for a di-Higgs resonance will be presented, with each Higgs decaying to two b-jets, paired with significant missing transverse momentum (MET), in 140/fb of pp collision data recorded by the ATLAS experiment at $\sqrt(s) = 13$ TeV. This signature provides the first sensitivity for the process where the Z' radiates a dark Higgs, the Z' decays to two dark matter particles, and the dark Higgs into two Higgs bosons, likely for a sufficient dark Higgs mass. A specialised neural network approach is used, decorrelated with the di-Higgs mass (a proxy for the dark Higgs mass), to enhance the sensitivity of our search, enabling the analysis to probe the previously unexplored parameter space of high Z' and dark-Higgs masses.

Author: SPEAKER, ATLAS

Presenters: SPEAKER, ATLAS; MEONI, Evelin (Universita della Calabria e INFN (IT))

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