

# Recent ATLAS results of Dark Matter and Dark Photon combinations, and Dark Higgs searches

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Ref: <https://arxiv.org/abs/2306.00641>

Results from a wide range of searches targeting different experimental signatures with and without missing transverse momentum ( $\cancel{E}_T$ ) are used to constrain a Two-Higgs-Doublet Model (2HDM) with an additional pseudo-scalar mediating the interaction between ordinary and dark matter (2HDM+a). The analyses use up to  $139 \text{ fb}^{-1}$  of proton-proton collision data at a centre-of-mass energy  $\sqrt{s} = 13 \text{ TeV}$  recorded with the ATLAS detector at the Large Hadron Collider between 2015-2018. The results from three of the most sensitive searches are combined statistically. These searches target signatures with large  $E_{\text{miss}}$  and a leptonically decaying Z boson; large  $\cancel{E}_T$  and a Higgs boson decaying to bottom quarks; and production of charged Higgs bosons in final states with top and bottom quarks, respectively. Constraints are derived for several common as well as new benchmark scenarios within the 2HDM+a.

Ref. <https://arxiv.org/abs/2406.01656>

A combination of searches for Higgs boson decaying into a visible photon and a massless dark photon ( $H \rightarrow \gamma d$ ) is presented using  $139 \text{ fb}^{-1}$  of proton-proton collision data at a centre-of-mass energy of  $\sqrt{s} = 13 \text{ TeV}$  recorded by the ATLAS detector at the Large Hadron Collider. The observed (expected) 95% confidence level upper limit on the Standard Model Higgs boson decay branching ratio is determined to be  $\text{Br}(H \rightarrow \gamma d) < 1.3\%$  (1.5%). The search is also sensitive to higher-mass Higgs bosons decaying into the same final state. The observed (expected) 95% CL limit on the cross section times branching ratio ranges from  $16 \text{ fb}$  ( $26 \text{ fb}$ ) for  $m_H = 400 \text{ GeV}$  and  $1.0 \text{ fb}$  ( $1.5 \text{ fb}$ ) for  $m_H = 3 \text{ TeV}$ . Results are also interpreted in the context of a minimal simplified model.

Ref. <https://arxiv.org/abs/2407.10549> & ATLAS-CONF-2024-004

A first dedicated search is performed for dark matter particles produced in association with a resonantly produced pair of b-quarks with  $m(\text{bb}) < 150 \text{ GeV}$  using  $140 \text{ fb}^{-1}$  of proton-proton collisions recorded by the ATLAS detector at a center-of-mass energy of  $13 \text{ TeV}$ . This signature is expected in extensions of the Standard Model predicting the production of dark matter particles, in particular those containing dark Higgs bosons. This search uses a novel experimental method to extend the experimental reach to lower bb-pair invariant masses, considers a wider range of dark Higgs boson interpretations and excludes new regions of parameter space for this model. For dark Higgs boson masses between  $30$  and  $150 \text{ GeV}$ ,  $Z'$  mediator masses up to  $3.4 \text{ TeV}$  and  $4.8 \text{ TeV}$  are excluded for benchmark scenarios.

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**Session Classification:** Parallel talks (2)