

# Search for Dark Matter with 2HDM+a in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

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## Abstract

The existence of dark matter (DM) is carried by a variety of astrophysical measurements, however the nature and properties of the DM are still largely unidentified. The presence of DM is not predicted by the Standard Model (SM), but many theories beyond the Standard Model (BSM) offer the study of DM. Weakly Interacting Massive Particles (WIMPs, denoted as  $\chi$ ) are frequently used as candidates in several of these theoretical models. If Dark Matter interacts weakly with the Standard Model (SM) it could be produced at the Large Hadron Collider (LHC) experiments, escaping the detector and leaving a WIMPs are potentially pair-produced in pp collisions at the Large Hadron Collider (LHC). To identify events with DM, additional SM particle(s) (Z, W and h bosons, jet, quarks...) need to be produced in association with DM in a pp collision. The above-mentioned searches, as well as resonance searches looking for mediators decaying into SM particles, are interpreted in the context of so-called Two-Higgs-Doublet Model (2HDM) with a pseudo-scalar mediator (2HDM+a), which is the simplest UV-complete benchmark with a pseudoscalar mediator. Many interesting results using the LHC Run 2 pp collision data collected at 13 TeV with an integrated luminosity of  $139\text{fb}^{-1}$  have been achieved. Since no significant excess over the expected SM background was found in any of these analyses, the results provide constrains on 2HDM+a benchmark. In addition, a statistical combination is performed of three of the most sensitive analyses:  $E_T^{\text{miss}} + Z(\ell)$ ,  $E_T^{\text{miss}} + h(bb)$ , and  $H^\pm \rightarrow tb$  signatures

**Keywords**— Dark matter, Missing transverse energy, 2HDMa, MonoZ, MonoH,  $H^\pm tb$  .

## References

- [1] ATLAS Collaboration, Combination of ATLAS dark matter searches interpreted in a 2HDM with a pseudo-scalar mediator, using 139-1 of  $\sqrt{s} = 13$  TeV pp collision data ATL-COM-PHYS-2023-252