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Beyond the Dark matter effective field theory and a simplified model approach at colliders (20' + 5')

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Direct detection of and LHC search for the singlet fermion dark matter (SFDM) model with Higgs portal interaction are considered in a renormalizable model where the full Standard Model (SM) gauge symmetry is imposed by introducing a singlet scalar messenger. In this model, direct detection is described by an effective operator $m_q \bar{q} q \bar{\chi} \chi$ as usual, but the full amplitude for monojet + $\not{E}_T$ involves two intermediate scalar propagators, which cannot be seen within the effective field theory (EFT) or in the simplified model without the full SM gauge symmetry. We derive the collider bounds from the ATLAS monojet + $\not{E}_T$ as well as the CMS $t\bar{t}$ + $\not{E}_T$ data, finding out that the bounds and the interpretation of the results are completely different from those obtained within the EFT or simplified models. It is pointed out that it is important to respect unitarity, renormalizability and local gauge invariance of the SM.

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