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Probing Dark Matter Properties Using Dilepton Distributions at the LHC

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We study a family of simplified models in which dark matter (DM) interacts with both quarks and leptons through a renormalizable Yukawa interaction with partner fields. The partners are complex scalar fields if DM is fermionic and Dirac fields if DM is scalar. We study how these type of interactions can reshape the spectra of the lepton pair production at the LHC as a function of the properties of the dark sector (e.g. DM spin, mass, couplings). We found that the dilepton invariant mass allows one to distinguish the spin of DM in the limit in which the mediator and the DM mass are almost degenerate. Furthermore, using the angular distribution in the Collin-Soper frame, it is possible to identify the relative chirality between the Standard Model (SM) fermions that interact with the dark sector. We set bounds on the mass and the coupling of DM with the visible sector, in the cases in which the mediator masses are between 10 and 100 percent above the DM mass. In most of the region of parameter space here explored, dilepton distributions place stronger bounds than the ones from jets+MET searches.

Summary

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