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Effective WIMPs

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Null results from collider and direct detection searches constrain dark matter candidates. We analyze these constraints in the context of minimal extensions to the standard model. The "WIMP miracle" for the relic abundance of thermal dark matter motivates models of weak scale dark matter with renormalizable couplings to standard model particles. We study minimal extensions to the standard model with such thermal relics. These models contain a singlet dark matter particle with cubic renormalizable couplings between standard model particles and "partner" particles with the same gauge
quantum numbers as the standard model particle. We focus on the case of dark matter interactions with quarks or leptons. Within this framework, we consider six models where the dark matter is a scalar boson, fermion, or vector boson, and may or may not be its own antiparticle. We find that collider
and direct detection searches are remarkably complementary for these models. The sensitivity of direct detection experiments varies greatly between models, from no bound to requiring dark matter masses to be in the multi-TeV range, where they are extremely difficult to probe in collider experiments. The limits are strongest in models with direct coupling to quarks and the cases where the dark matter is not its own antiparticle. Direct detection has enhanced sensitivity near the degenerate limit, complimenting the sensitivity of collider searches. Monojet and jets + MET searches at the LHC limit all models, in some cases up to partner masses greater than 1.2 TeV.

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