

A systematic effective operator analysis of semi-annihilating dark matter

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Semi-annihilation is a generic feature of dark matter theories stabilized by symmetries larger than Z_2 . It contributes to thermal freeze out and cosmic ray signals, but is irrelevant for direct and collider searches. We use an effective operator approach to make the first model-independent study of the associated phenomenology, enumerating all semi-annihilation operators up to dimension 6, plus leading terms at dimension 7. We find that when the only light states charged under the dark symmetry are dark matter, the model space is highly constrained. If there can be additional light, unstable “dark partner” states the possible phenomenology greatly increases, at the cost of additional model dependence in the new particle decay modes. We find that for semi-annihilation to electrons and light quarks, the thermal relic cross sections can be excluded for dark matter masses up to 100 GeV, but significant model space for semi-annihilating dark matter remains.

Primary author: Dr SPRAY, Andrew (Institute for Basic Science)

Co-author: Dr CAI, Yi (University of Melbourne)

Presenter: Dr SPRAY, Andrew (Institute for Basic Science)

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