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Self-interacting Dark Matter in the Light of Non-Standard Cosmology

The cold, collisionless dark matter (DM) postulated in the ΛCDM model leads to several small scale anomalies such as the cusp-core problem, the missing satellites problem and the too big to fail problem. Self-interacting dark matter (SIDM), a promising alternative type of dark matter, not only alleviates the small scale anomalies, but also matches with highly accurate large scale predictions of the ΛCDM model. However, in the standard cosmology, the thermal relic of SIDM is below the observed DM relic density due to large annihilation cross-section. Therefore, we make an attempt to realise the correct thermal relic of SIDM by assuming a non-standard cosmological history. This is achieved by introducing an additional scalar field to the standard scenario. The SIDM is assumed to be a Dirac fermion, while the mediator needed to facilitate the self-interaction can be either a light scalar or boson. We study the phenomenological consequences in the SIDM sector in non-standard cosmology, including relic density, direct and indirect searches. We find out the viable parameter space for the model after confronting with relevant phenomenological and experimental constraints.

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