OBSERVATIONAL PROPERTIES OF WEAKLY COUPLED DARK MATTER

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Can dark matter properties be constrained if dark matter particles do not interact with the Standard Model fields? The answer is yes. By studying both cosmological and astrophysical constraints, we show that stringent constraints on dark matter particle mass and coupling values can be derived even if the dark matter sector is uncoupled from the Standard Model sector.

By taking the Higgs portal model as a representative example, we compute the total dark matter abundance from decay of a primordial dark matter condensate [1] and nonthermal production from the Standard Model sector [2]. We then use the Planck limit on isocurvature perturbations and different astrophysical constraints on dark matter self-interaction to derive a novel constraint connecting dark matter mass and self-interaction coupling with the scale of cosmic inflation [2,3].

[1] S. Nurmi, T. Tenkanen and K. Tuominen, arXiv:1506.04048, JCAP 11 (2015) 001.
[2] K. Kainulainen, S. Nurmi, T. Tenkanen, K. Tuominen and V. Vaskonen, arXiv:1601.07733, submitted to JCAP.
[3] M. Heikinheimo, T. Tenkanen, K. Tuominen and V. Vaskonen, in progress.