

Maximizing Direct Detection with HYPER Dark Matter

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We estimate the maximum direct detection cross section for sub-GeV dark matter scattering off nucleons. For dark matter masses in the range of 10 keV – 100 MeV, cross sections greater than $10^{-36} - 10^{-30} \text{ cm}^2$ seem implausible. We introduce a dark matter candidate which realizes this maximum cross section: Highly interactive Particle Relics (HYPERs). After HYPERs freeze-in, a dark sector phase transition decreases the mass of the mediator which connects HYPERs to the visible sector. This increases the HYPER's direct detection cross section, but in such a way as to leave the HYPER's abundance unaffected and avoid conflict with measurements of Big Bang Nucleosynthesis and the Cosmic Microwave Background. HYPERs present a benchmark for direct detection experiments in a parameter space with few known dark matter models.

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