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Self-interacting dark matter with a stable vector mediator

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Light vector mediators can naturally induce velocity-dependent dark matter self-interactions while at the same time allowing for the correct dark matter relic abundance via thermal freeze-out. If these mediators subsequently decay into Standard Model states such as electrons or photons however, this is robustly excluded by constraints from the Cosmic Microwave Background. We study to what extent this conclusion can be circumvented if the vector mediator is stable and hence contributes to the dark matter density while annihilating into lighter degrees of freedom. We find viable parts of parameter space which lead to the desired self-interaction cross section of dark matter to address the small-scale problems of the collisionless cold dark matter paradigm while being compatible with bounds from the Cosmic Microwave Background and Big Bang Nucleosynthesis observations.

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