

Velocity dependence of dark matter annihilation for indirect detection.

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The p-wave annihilation of the dark matter particle has recently gained wider interest. Generically, the expected annihilation cross section estimated from the required relic density is considerably smaller than the value of $\langle \sigma v \rangle \approx 3.0 \cdot 10^{-26} \text{cm}^3 \text{s}^{-1}$ for a pure s-wave annihilation channel scenario. In this work, we provide expected annihilation rates from the dynamics of dSphs galaxies and galaxy clusters using the N-dimension Particle Swarm Optimization (PSO) scanning method. We introduce and calculate a velocity-dependent J-factor, which in turn allows us to find the effective annihilation cross section for different interactions. The result demonstrates that a family of WIMP-type dark matter models exist, which can not be detected in indirect searches. In specific cases however, Sommerfeld enhancement could boost the annihilation by a sufficiently large factor to become observable again. We finally consider additional and recent constraints from direct dark matter search experiments.

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