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Using Exact Velocity Distributions for Galactic Dark Matter Halos in Gamma-Ray Luminosity Calculations[1] DANIEL HUNTER, FRANCESC FERRER, Washington University in St Louis — Gamma-ray observation is a possible way to measure the spacial distribution of dark matter in galactic halos, but some particle models require knowledge of the velocity distribution to make predictions of the luminosity from self-annihilation. For many halo models, this cannot be found analytically. Even in cases where it can be derived, a Maxwell-Boltzmann distribution is often used for the particle velocity in lieu of the correct distribution. A Maxwell-Boltzmann distribution is only correct, however, for a singular isothermal sphere. Furthermore, the velocity distribution does not have a trivial dependence on position, as is usually assumed when calculating line-of-sight integrals in luminosity formulae. In principle, the interaction rate $\langle \sigma v \rangle$ must be included in this integral (commonly called the 'J-factor'). We numerically compute the correct velocity distribution for several halo models and compare luminosity predictions with those found using a Maxwell-Boltzmann distribution. In many cases, the Maxwell-Boltzmann distribution is reasonable, but in others, especially when observing the galactic center, it significantly underestimates the luminosity, implying that the true constraints on dark matter models may be more strict than previously thought.

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Daniel Hunter
Washington University in St Louis

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