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How to constrain the properties of self-interacting dark matter using observed dark matter halos?

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In this talk, we discuss the relation between the strength of the self-interaction of dark matter (SIDM) particles and the predicted properties of the inner density distributions of dark matter (DM) halos. We present the results of N-body simulations for 28 halos performed for the same initial conditions for cold DM and for SIDM with different cross-sections.
We provide a simple phenomenological description of these results and compare with the semi-analytical typically used in the literature.
Using these results, we then predict how the inner DM surface density should depend on the SIDM cross-section for observed halos. The observed surface densities of DM halos are known to follow a simple scaling law, ranging from dwarf galaxies to galaxy clusters, with a weak dependence on their virial mass. We demonstrate how this scaling law can be used to place constraints on DM self-interactions using large samples of objects. Such constraints can be more robust than constraints derived from individual objects, especially if one uses kinematic observations to directly constrain the DM mass inside a given radius, rather than fitting the data to a pre-selected profile and then reconstructing the mass.

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