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Cuspy to cored galaxy profiles from late-time dark matter oscillations

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The reason why dwarf spheroidal and other galaxies appear to have a lower central density than predicted from N-body simulations based on LCDM cosmology is still an open question.

Apart from the possibility that baryonic physics could play a leading role in shaping the inner density profile of galaxies, the most popular new-physics explanation is to assume heat transfer caused by dark matter (DM) self-interactions.

Here, we present a novel mechanism of solving the core-cusp problem through reactivation of DM annihilation in galaxies at late times. This can happen in asymmetric DM models when there is a very small DM-number violating mass term that causes oscillations between DM and its antiparticle.

Using analytical methods as well as N-body galactic simulations, we show that this mechanism can convert cuspy DM profiles into cored ones for light fermionic DM with mass in the range (0.1 – 1) GeV and a lighter mediator into which the DM can annihilate.

We identify regions of parameter space where annihilation of DM particles is more efficient than elastic scattering at reducing the inner density of the DM profile. Dark matter annihilation is therefore a qualitatively distinct alternative to the mechanism of elastic self-interacting dark matter for addressing the cusp-core problem.

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