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Cosmological hydrodynamics simulations of the same spiral galaxies: connecting the dark matter distribution of the halo with the subgrid baryonic physics

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Baryonic physics i.e. star formation and stellar feedback are debated topics in galaxy formation and are of paramount importance for dark matter phenomenology. Particularly, the dark matter (DM) distribution features that play the main role in dark matter detection efforts.
In this work, we aim to illustrate the reach of baryonic-physics-related uncertainties on the dark matter distribution features in a Milky-Way (MW) sized halo. To this end, we study the halo morphology, geometry and profile, together with the phase space distribution on the same MW-sized dark matter halo simulated using different combinations of baryonic physics and one case including only DM. In these six high-resolution zoom-in cosmological simulations we found that the modifications of the gravitational potential induced by the central population of baryons induce different dark matter distributions, modifying the mass-density and velocity profiles. The variability and uncertainties on those features can have a direct impact on dark matter direct and indirect detection rates. As a consequence, we highlight the fact that most predictions using cosmological simulations have to be taken with caution as the dark matter distribution will change depending baryonic physics.

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