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Calibrating Mass Modeling Methods with Numerical Simulations of Galaxies

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Understanding the particle nature of dark matter (DM) based on its distribution in galaxies is impossible without a complete knowledge of the distribution of baryons within those systems. However, the true distribution of baryons in observed galaxies remains highly uncertain, due in part to model degeneracies. We use the NIHAO zoom-in cosmological hydrodynamical simulations, for which the true distributions of baryons and DM particles are known, to investigate the errors associated with typical (disk) galaxy mass models. We find excellent agreement between the observationally inferred and the ‘true’ DM mass profiles at large galactocentric radii. However, in the central parts of galaxies, the mass offset can be as significant as 50%. The discrepancies between modeled and true mass profiles must be accounted for in indirect DM searches based on assumed DM distributions, especially in the central parts of galaxies.

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