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Impact of Gravitational Slingshot of Dark Matter on Galactic Halo Profiles

We study the impact of gravitational slingshot on the distribution of cold dark matter in early and modern era galaxies. Multiple gravitational encounters of a lower mass dark matter particle with massive baryonic astrophysical bodies would lead to an average energy gain for the dark matter, similar to second order Fermi acceleration. We calculate the average energy gain and model the integrated effect on the dark matter profile. We find that such slingshot effect was most effective in the early history of galaxies where first generation stars were massive, which smeared the dark matter distribution at the galactic center and flattened it from an initial cusp profile. On the other hand, slingshot is less effective after the high mass first generation stars and stellar remnants are no longer present. Our finding may help to alleviate the cusp-core problem, and we discuss implications for the existing observation-simulation discrepancies and phenomena related to galaxy mergers.

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