Disentangling the dark matter halo from the stellar halo

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The outer haloes of the Milky Way and Andromeda galaxies contain as much important information on their assembly and formation history as the properties of the discs resident in their centres. In this paper we have used the Constrained Local UniversE Simulation project to disentangle the stellar and DM component of three galaxies that resemble the MW, M31 and M33 using both DM only and DM + gas-dynamical simulations. Stars that are accreted in substructures and then stripped follow a completely different radial distribution than the stripped DM: the stellar halo is much more centrally concentrated than DM. In order to understand how the same physical process can lead to different z=0 radial profiles, we examined the potential at accretion of each stripped particle. We found that star particles sit at systematically higher potentials than DM, making them harder to strip. We then searched for a threshold in the potential of accreted particles \phi_[th], above which DM particles behave as star particles. We found such a threshold at >16 \phi_{subhalo}, where \phi_{subhalo} is the potential at a subhaloes edge at the time of accretion. Thus a rule as simple as selecting particles according to their potential at accretion is able to reproduce the effect that the complicated physics of star formation has on the stellar distribution. This niversal result reproduces the stellar halo to an accuracy of within ~2%. Studies which make use of DM particles as a proxy for stars will undoubtedly miscalculate their proper radial distribution and structure unless particles are selected according to their potential at accretion. Furthermore, we have examined the time it takes to strip a given star or DM particle after accretion. We find that, owing to their higher binding energies, stars take longer to be stripped than DM. The stripped DM halo is thus considerably older than the stripped stellar halo.

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