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New insights on low-mass dark matter subhalo tidal tracks via numerical simulations

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A number of studies assert that dark matter (DM) subhaloes without a baryonic counterpart and with an inner cusp always survive no matter the strength of the tidal force they undergo.
In this work, we perform a suite of numerical simulations specifically designed to analyse the evolution of the circular velocity peaks ($V_{\max}$, and its radial value $r_{\max}$) and concentration of low-mass DM subhaloes due to tidal stripping. We employ the improved version of the DASH code, introduced in our previous work AAS+23 to investigate subhalo survival.
We follow the tidal evolution of a single DM subhalo orbiting a Milky Way (MW)-size halo, the latter modeled with a baryonic disc and a bulge replicating the actual mass distribution of the MW. We also consider the effect of the time-evolving gravitational potential of the MW itself. We simulate subhaloes with unprecedented accuracy, varying their initial concentration, orbital parameters, and inner slope (both NFW and prompt cusps are considered).
Unlike much of the previous literature, we examine the evolution of subhalo structural parameters –*tidal tracks*– not only at orbit apocentres but also at pericentres, finding in the former case both similarities and differences – particularly pronounced in the case of prompt cusps.
Overall, $r_{\max}$ shrinks more than $V_{\max}$, leading to a continuous rise of subhalo concentration with time. The *velocity concentration* at present is found to be around two orders of magnitude higher than the one at infall – about an order of magnitude more compared to the increase found for field haloes – being comparatively larger for pericentre tidal tracks versus apocentres.
These findings highlight the dominant role of tidal effects in reshaping low-mass DM subhaloes, providing valuable insights for future research via simulations and observations, such as correctly interpreting data from galaxy satellite populations, subhalo searches with gravitational lensing or stellar stream analyses, and indirect DM searches.

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