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Orientations of Dark Matter Haloes in CDM and SIDM Latte Galaxies

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The macro-scale properties of dark matter (DM) haloes, such as shape and orientation, rely on the micro-physics of the dark matter particle. Yet the symmetry axes of the Milky Way's dark matter halo are often assumed to be aligned with the symmetry axes of the stellar disc. While this is the likely case for the inner regions of the dark matter halo, there is no physical reason for the outer dark matter halo to have the same alignment. In this work, we explore the evolution of the dark matter halo orientation in the presence or absence of a major merger with a Large Magellanic Cloud (LMC) analog. We restrict our analysis to various simulated Milky Way-mass galaxies (10^{12} $M_{\odot}$) and their DM haloes from the Latte simulation suite. We present orientations of the dark matter axes relative to the stellar disc axes as a function of radius and as a function of time. We conclude that the orientations of the dark matter halo are divergent from the stellar disc axes beyond the stellar disc (>30 kpc), but this trend is not replicated in simulations with self-interacting dark matter (SIDM). In terms of LMC-host perturbations, we find in-falling LMC satellites have differential effects on the alignment of the disc axes depending on their mass scales. Additionally, there is differential alignment of the halo to LMC analog at the stellar disc and out to the virial radius. Our results indicate a dynamic dark matter halo that is responsive to satellite perturbations and anisotropically aligned to the galactic disc.