

# Disk Galaxies of the Local Group: Dynamics from HST Proper Motion Studies

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Two disk galaxies, M31 and the Milky Way (MW), dominate the mass and dynamics of the Local Group, so the accurate determination of the relative motion between the two galaxies is of tremendous importance. While the line-of-sight velocity of M31 with respect to the MW is well known, a determination of its proper motion has remained elusive for almost a century. However, we have recently measured the proper motion of M31 *for the first time* using multi-epoch data obtained with the Hubble Space Telescope (HST). The measured proper motion has a final displacement accuracy of only  $12 \mu\text{as/yr}$  thanks to the state-of-the-art technique we developed for this project. In this talk, I will present results of this study and discuss implications including the total mass of the Local Group, and the future orbital evolution and merging of the three disk galaxies M31, M33, and the MW. I will also present new results on the following related topics: structure and shape of the MW halo from proper motion measurements of stars in the distant metal-poor halo and the Sagittarius Stream; and the mass of the MW from proper motion measurements of the distant satellite Leo I. These results are reshaping our understanding of the disk galaxies in the Local Group.