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The Milky Way and M31 Orbital History - Did the Local Group evolve in Isolation?

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We use new proper motion measurements of M31 to examine the orbit and angular momentum between the Milky Way (MW) and M31. Assuming a Local Group (LG) mass consistent with measured values and that the system evolves in isolation, we show that a variety of orbits is possible. We compare to a sample of LG-like systems in the Illustris-TNG simulation and find that $\sim 13\%$ of these pairs have already experienced a pericentric passage. Using the simulated sample, we examine how accurately an isolated, two-body model describes the MW-M31 orbit, showing that $\sim 10\%$ of the analogues in the simulation are well-modeled by such an orbit. Systems that evolve in isolation, by this definition, exhibit a lower rate of major mergers and, in particular, have not experienced any major mergers since $z \approx 0.3$. Given the likely quiet recent major merger history of the MW, it is plausible that the isolated two-body model appropriately describes the orbit, though recent evidence for a major merger in M31 may complicate this interpretation.

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