Impact Summary: Discovery of a Novel Dynamically-Stabilized Low Lunar Orbit

Summary:

This work presents a first-of-its-kind class of stable low lunar orbits that require negligible control thrust (<1 m/s delta-V) over multi-day simulations. The system operates in an Earth-centric rotating frame, employing a full 3D feedback loop on the angular velocity vector to conserve total angular momentum across the Earth-Moon-satellite system. The resulting configuration suppresses drift and maintains orbit stability for over 30 days. This orbit family offers new possibilities for fuel-efficient lunar operations, space station deployment, and stationkeeping without active propulsion. The results are validated through theoretical modeling and full numerical simulation.

Interest:

The research addresses a long-standing challenge in astrodynamics: how to maintain stable low lunar orbits near perilune over extended durations without frequent course corrections. It has direct implications for lunar gateway architectures, autonomous satellite design, and dark-thrust orbital strategies.

Availability:

All simulation code, delta-V logs, and visualizations are embedded in the preprint to ensure full reproducibility and open validation.