National Aeronautics and Space Administration

FY23 Strategic University Research Partnership (SURP)

Provenance of the Plutinos

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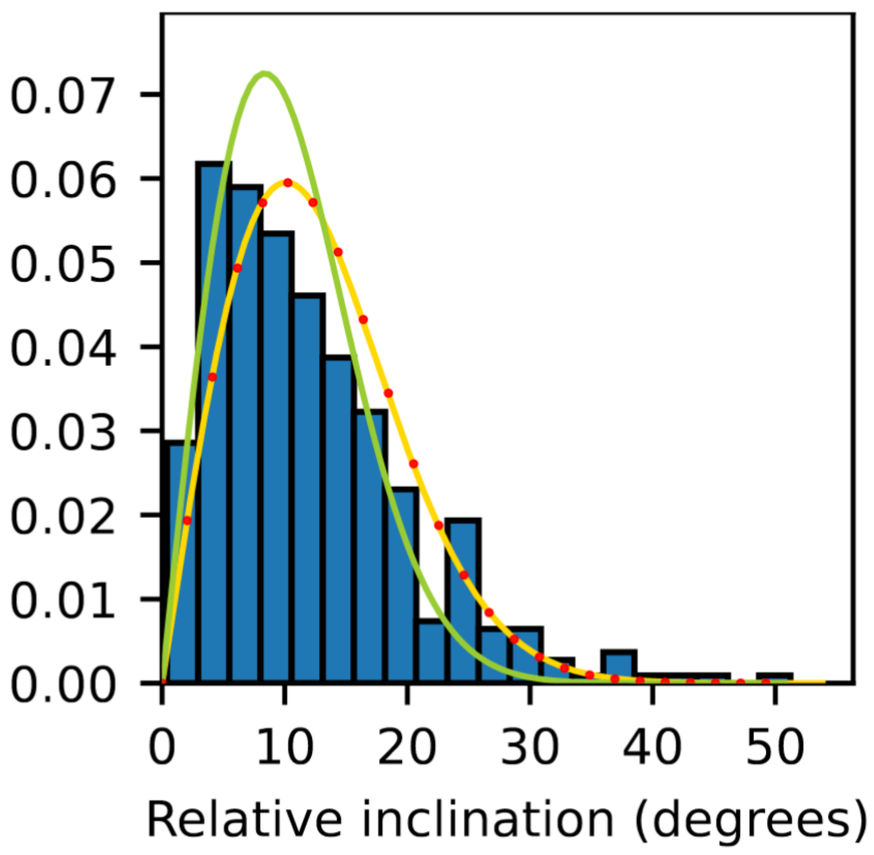
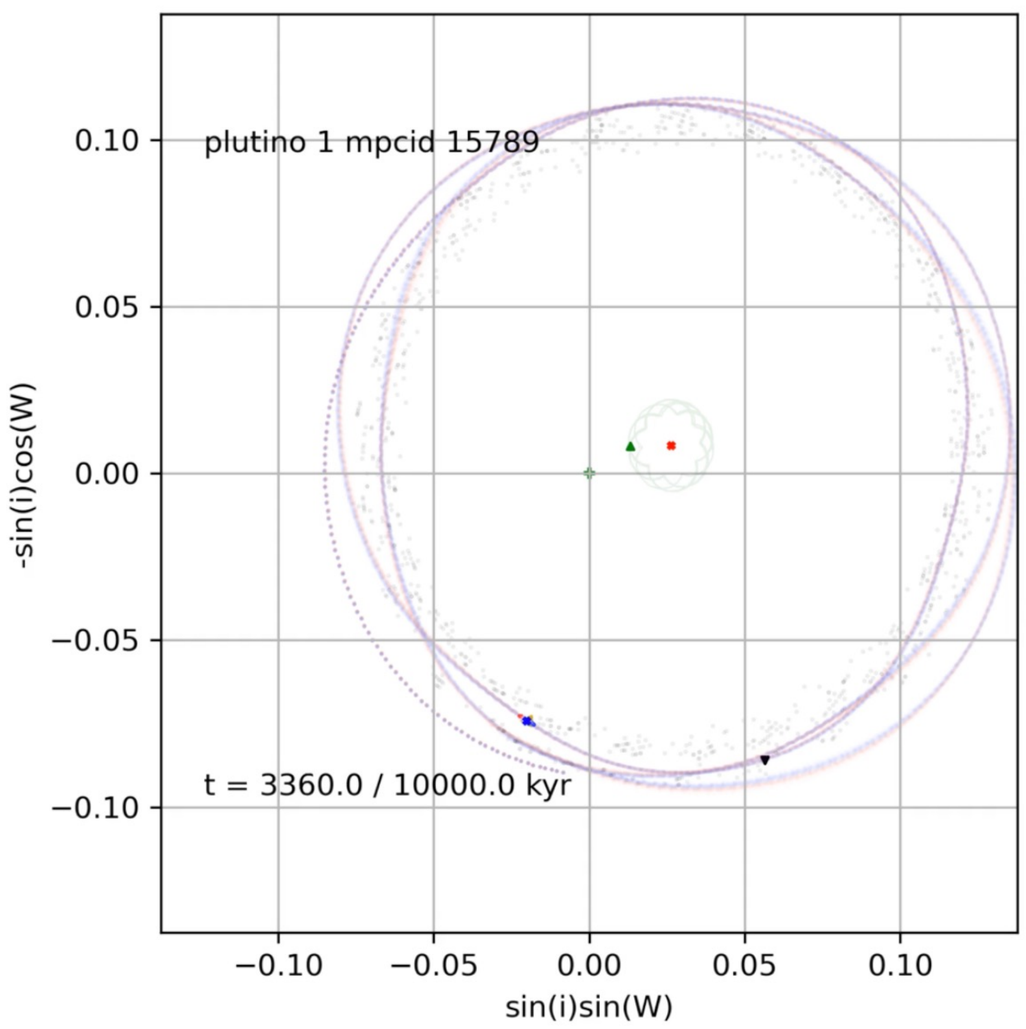
Objectives: The “Plutinos” are a prominent dynamical subgroup of the Kuiper belt, locked in the 3/2 mean motion resonance (MMR) with Neptune. Plutinos are thought to have been captured by a migratory Neptune in the early history of the Solar system. In this project, we investigate the peculiarities of the Plutinos’ distribution within the resonance zone. In particular, we sought to understand the distribution of orbit poles of the Plutinos. The results of the investigation will lead to insights on the Plutinos’ origins within the Sun’s protoplanetary disk, will test theoretical predictions and identify unmodelled effects, and will inform models of the solar system's origin and dynamical evolution.

Approach and Results: We have developed a new theoretical framework for modeling the distribution of spin poles of Kuiper belt objects (left figure) and are currently investigating the orbital dynamics of resonant Kuiper belt objects (right figure).

Significance/Benefits to JPL and NASA: This research will expand the expertise of the JPL small bodies research group to the study of the dynamics of the Kuiper belt. This work also extends JPL leadership in the study of the outer Solar system, which is a field that will soon experience rapid growth in the era of LSST/Vera Rubin Observatory and other upcoming large astronomical surveys. KBOs are a foundational destination for potential future JPL missions, and the University Arizona has extensive experience with spaceflight missions making this partnership both natural and strategic for capturing future Discovery and New Frontiers proposals. The University of Arizona is a longstanding strategic partner for JPL.





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- Matheson, I. C., R. Malhotra, and J. T. Keane. 2023. A von Mises-Fisher distribution for the orbital poles of the plutinos. Monthly Notices of the Royal Astronomical Society 522: 3298-3307. DOI: 10.1093/mnras/stad1208.
- Matheson, I. and R. Malhotra. 2023. A Measurement of the Kuiper Belt's Mean Plane From Objects Classified By Machine Learning. The Astronomical Journal 165: 241. DOI: 10.3847/1538-3881/accffd.

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