The 5:1 Neptune resonance: Dynamics and population

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Based on 4 objects detected with semi-major axes near the 5:1 external resonance with Neptune, we estimate a substantial, and previously unrecognized, population of objects, perhaps more populated than the 3:2 resonance. The resonances external to the 'Classical' Kuiper belt are largely unexplored in both observations and dynamical simulations. However, these resonances are significant Kuiper Belt Object (KBO) reservoirs; merely undiscovered due to their greater distances and other biases against detection. These 4 objects were detected by the Canada-France Ecliptic Plane Survey (CFEPS), and our dynamical simulations find that 3 of them are resonant. Because the CFEPS survey is well characterized, we can use these detections to constrain the orbital distribution and population size of the 5:1 resonant objects. We further constrain our model population by requiring the KBOs to come to pericenter only within our detection limits, to avoid overestimation. Our population estimate for the 5:1 resonance is $\sim 3000^{+5000}_{-2000}$ objects with $H_g < 8$ (diameter ~ 170 km). This is at least as large as the Plutinos (3:2 resonance) at 90 % confidence. The small number of detected objects results in a such large population estimate due to the numerous biases against detecting objects with semimajor axes at ∼88 au.

The trapping mechanism for the 5:1 resonance is not obvious. The resonance stability lifetimes of the known objects constrain the size of the source population. Determining the trapping efficiency and dynamical lifetimes of these resonant objects will provide cosmogonic insight. These object may represent a transient population of scattering objects or could be a population of objects trapped during the early formation of the bulk structure of the trans-neptunian region. The 5:1 resonant population is a cosmogonic lever which provides insight into the evolutionary history of the Solar System.

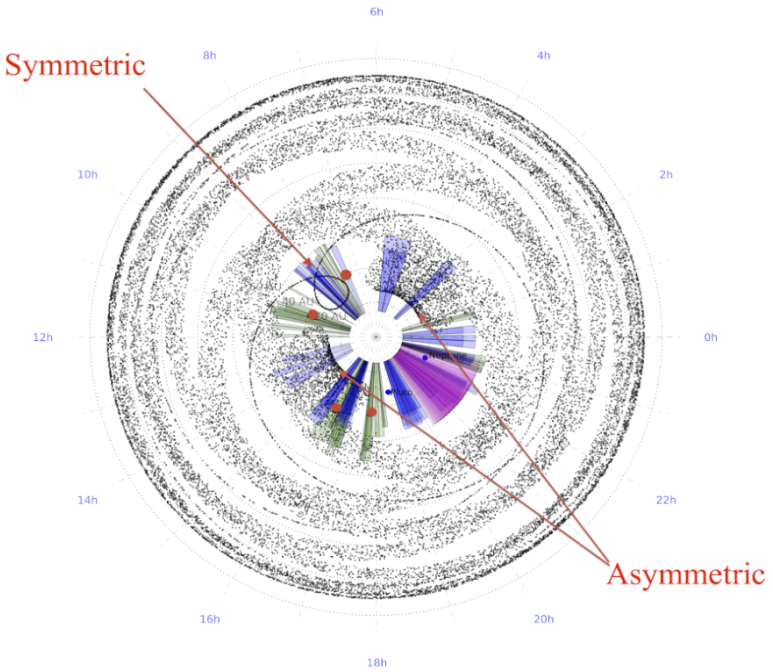

Figure: 5:1 Resonant Population Model: This is a top-down view of the Solar System, showing toy model of the 5:1 Neptune resonance. The black dots are instantaneous positions of model objects in the 5:1 resonance. The eccentricity range and libration amplitude have been restricted in order to make the resonance structure more clear. The symmetric resonators come to pericenter opposite Neptune, while the asymmetric resonant objects come to pericenter at 70 and 290 degrees from Neptune. The CFEPS survey blocks are superimposed in shaded wedges. This shows the survey coverage, but also illustrates the discovery biases inherent in a survey, which are particularly severe for resonant objects with restricted pericenters. The detected objects are shown in red circles.