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The color distribution of the Plutinos: size and inclination dependent

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Abstract

The color distribution of medium and small trans-Neptunian objects (TNOs) in the outer Solar System is complex, with three major surface types [3], ranging in color from $0.4 \leq g-r \leq 1.1$. The Kuiper belt includes a component of low-inclination and low-eccentricity objects between 40∼48 AU referred to as the cold classicals, which are thought to be primordial and have formed roughly in place. These cold classicals have almost exclusively red in $g-r$ and have unique $r-z$ colors [3]. Are other TNO populations are dynamically excited and thought to have formed elsewhere and been scattered by planetary migration.

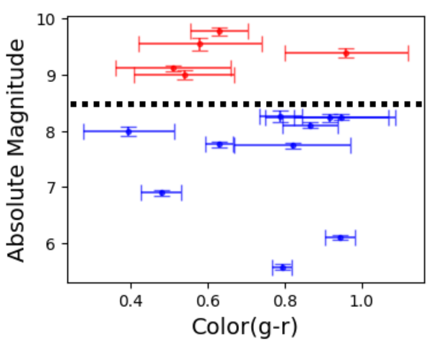

Figure 1: Absolute magnitude H_r versus $g-r$ color for our 15 Plutino sample. The dotted line corresponds to the known transition in the size distribution of this population [1]. Brighter and fainter objects have color distributions that are different at 95% confidence.

The Plutinos, in 3:2 mean motion resonance with Neptune, have a $g-r$ color distribution which depends on both inclination and object size. We have measured $g-r$ colors of 15 Plutinos discovered in the Alexandersen et al. survey [1], measured using the TRIPPy package for photometry of moving targets [2] and calibrated against Pan-STARRS1 photmetric catalogs. Our measurements show that the small (H_r > 8.4) objects have a different color distribution than

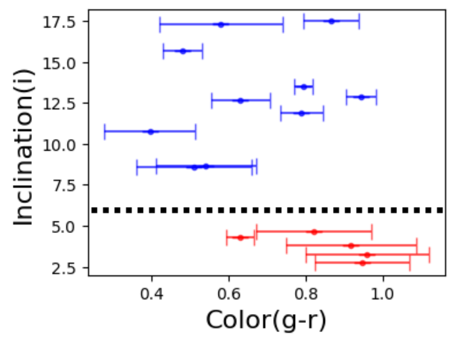

Figure 2: Inclination versus $g-r$ color for our 15 Plutino sample. The dotted line corresponds to the typical division between dynamically 'hot' and 'cold'. The color distribution above and below the dotted line are different at 95% confidence.

the larger Plutinos (5.5 < H_r <8.4) at 95% confidence (see distributions in Figure 1). This suggests that the small objects have a different formation mechanism than the large objects, possibly being primarily collisional fragments. This transition magnitude corresponds to the transition point in the magnitude distribution seen for many populations ([1] for plutinos). Additionally, we find that the low-inclination ($< 6°$) and high-inclination (>6°) Plutinos also show different color distributions at 95% confidence (see distributions in Figure 2). The excess of red surfaces at low inclinations suggests that the Plutino population is contaminated by captured objects of cold classical origin. Of the models we consider, we find that our color distribution model including both an H-dependent color distribution and an additional red low-inclination component produced the highest likelihoods. Based on our measurements, we estimate the true (unbiased) color-ratio of Plutinos of different sizes and inclinations. We propose that the abundance of low-inclination red Plutinos requires that the formation region of the cold classicals extended inward of the 3:2 resonance's current location at 39 AU.

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