THE RELATIVE SIZES OF TRANSNEPTUNIAN BINARIES: DIFFERENCES BETWEEN DYNAMICAL CLASSES?

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Introduction: More than fifty transneptunian binaries (TNBs) have been discovered in the last seven years [1]. The presence of such a large number of binaries has been an unexpected boon to physical studies of the Kuiper Belt. Here we describe the relative sizes of the components found in these systems including an unexpected correlation with dynamical class.

Relative Sizes: The discovery of a TNB immediately yields the relative brightness of the two detected components. With an assumption about the albedos of the components (usually assumed to be the same) relative brightness can be converted to size using $d_1/d_2 = 10^{-0.2(m1-m2)}$. The magnitudes of both components of known TNBs are shown graphically in Figure 1.

Observational Limits: The detectability of a secondary depends both on the attributes of the instrument (angular resolution, sensitivity, exposure time) and on the relative separations of the components (i.e. whether the background is determined by the sky or by the PSF of the primary). The discovery of TNBs has mostly been carried out with HST, but with four different instruments, so that the detection limits for the full data set are heterogeneous.

The best limits for faint, wide secondaries come from a subset of the detections made with the ACS/HRC camera [1-3] which reach V~27. Only a few faint companions were found in these data, suggesting that shallower surveys are not missing many such systems.

Relative Sizes: In Figure 1 we have separated objects according to their dynamical class [4]. We have further distinguished Classicals by their mean inclination with "Cold" Classicals having $i \leq 5.5°$.

When plotted in this way, a striking pattern is evident. Cold Classicals are clustered at $\Delta_{mag} < 1.5$, with secondaries no smaller than half the size of the primary and many nearly equal-sized systems. By contrast, other dynamical classes show a much broader range of secondary/primary size.

It is also interesting to note that the three plutino binaries all have $\Delta_{mag} > 2$ while the TNBs in the outer resonances are mostly (5 of 7) comparable-sized systems like the Cold Classicals.

Interpretation: Dynamical capture can be shown to be the only plausible formation mechanism for at least some TNBs, based on their system angular momentum [1]. Dynamical capture tends to favor the formation of systems with similar-sized components [5], and thus may explain the preference for such systems in the Cold Classical population. Collisions may also play a role in the formation of binaries, particularly among the largest objects [6].

References: [1] Noll K. S. et al. (2008) *The Solar System Beyond Neptune* 345-363; astro-ph/0703134 [2] Noll K. S. et al. (2006) *DPS 38,* Abstract #34.03 [3] Barker E. A. and Noll K. S. (2007) *DPS 39,* Abstract #52.09 [4] Gladman B. et al. (2008) *The Solar System Beyond Neptune* 43-57. [5] Astakhov S. A. et al. (2005) *MNRAS, 360*, 401-415. [6] Brown M. E. et al. (2006) *ApJ, 639*, L43-L46.

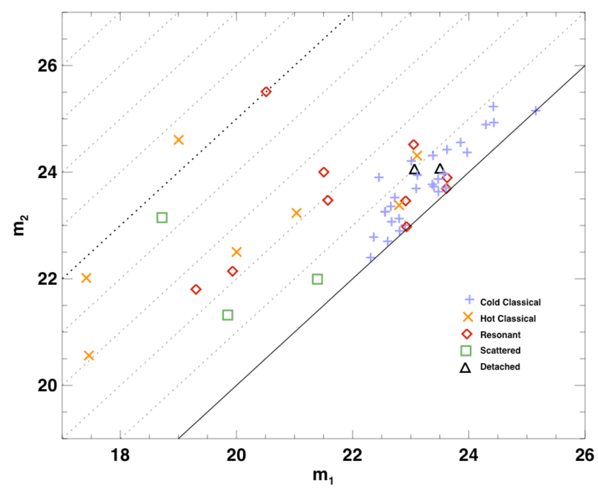

Figure 1. The measured magnitudes of both components of transneptunian binaries are shown, separately labeled by dynamical class[4] as indicated. The solid diagonal line marks the locus of equal-sized binary components. Dotted diagonal lines to the upper left are increments of 1 magnitude difference between components. The Cold Classicals cluster at $\Delta_{mag} < 1.5$ while other dynamical classes show a broader range of relative component sizes.