COMPONENT SIZES IN SMALL-BODY MULTIPLES: A CLUE TO FORMATION? K. S. Noll[1] and S. D. Benecchi[2], [1]Space Telescope Science Institute (3700 San Martin Dr., Baltimore MD 21218, noll@stsci.edu), [2]Planetary Science Institute (susank@stsci.edu).

Introduction: Nine multiple systems, eight triples and one quadruple, are now known among the small body populations of the solar system [1]. The relative sizes and separations are known for all of these systems. Patterns in these quanitities may provide constraints on the modes of formation for multiples and binaries in different small body populations.

Observations: In the last decade a number of multiple systems have been discovered among small body populations. Two Near Earth asteroids have been observed to be triple systems by radar observations [2,3]. Four Main Belt asteroids are now observed to be triples [4,5,6,7]. In the Kuiper Belt, the Pluto system is the first known quadruple [8] and (47171) 1996 TC_{36} has recently been confirmed as the second triple [1], after the Haumea system [9].

Semimajor axes and relative sizes are known for all nine multiples and are plotted in Fig. 1. A few patterns are apparent, despite the small number of systems known.

In six of the nine systems, at least one of the components has significantly less than 1% of the total system mass. Two systems, (3749) Balam and (153591) SN_{263} have on component that is close to 1% of the total. (47171) 1999 TC_{36} is an end member in this distribution, having all three components with significant fractions of the system mass, the smallest coming in at just under 10% of the total.

Six of the nine systems follow a remarkably similar pattern in component separation and relative size with the outer satellite being roughly an order of magnitude more massive than the inner satellite and located only roughly a factor of two further from the primary.

Formation Clues?: The dominant pattern suggests a common mechanism of formation, most likely reaccretion from a debris disk formed by either collisional or tidal disruption. This hypothesis can be tested with numerical modeling. Two systems that do not follow this pattern, (47171) 1996 TC_{36} and (3749) Balam may have formed by a different mechanism, possibly dynamical capture. Pluto is, so far, unique.

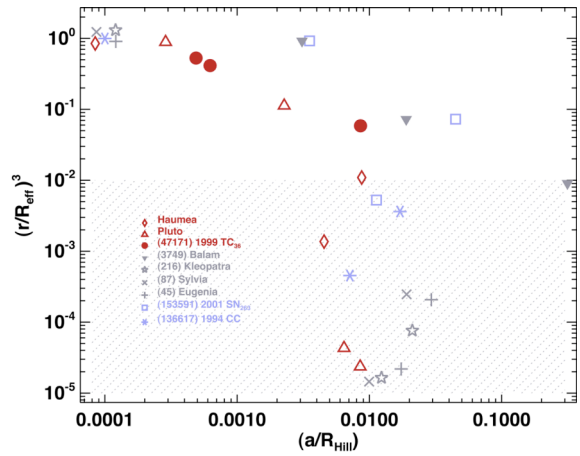

Figure 1. All of the known small-body multiples in the solar system are plotted here. Separations are scaled to the Hill radius. Relative component sizes are inferred from observed brightness ratios assuming common albedo or radar reflectivity (except for the Pluto system).

References:

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