Recent observations of binaries

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We will summarize results from recent observations of binary systems in near-Earth asteroids (NEAs), main belt asteroids (MBAs), and trans-Neptunian objects (TNOs).

Arecibo radar observations by Taylor et al. [1] showed that Apollo-type NEA 2004 DC is a binary asteroid. Range-Doppler data from Arecibo and Goldstone reveal a non-circular orbit ($e \sim 0.2$) despite a small orbital separation ($a \sim 0.75$ km, $P \sim 1$ day). This is the only known binary with an eccentric orbit and a semi-major axis only ~ 5 times the primary radius. We will discuss the origin of the eccentricity.

Immediately after the discovery of a satellite to MBA 22 Kalliope [2] it was realized that the primary-to-secondary radius ratio of ~ 5 would allow the detection of mutual events with the potential to improve measurements of component sizes and density of this M-type system. Our orbit solution showed that the best observational circumstances would arise in Feb-Mar 2007 and a campaign of observations was organized [3]. We will report on the event detection [4].

In addition to securing orbital parameters, our characterization of five TNO binaries with the Hubble Space Telescope has revealed two striking results. First, color differences based on the flux measured in HST's F606W and F814W filters show that the primaries and secondaries have very similar color indices (~ 0.1 mag) despite substantial variations in color indices between objects (~ 1 mag). This suggests that components have weathered identically or have similar compositions. Second, all of our 1999 TC36 data are much better fit by three components in a hierarchical configuration than by a binary configuration.

[1] Taylor et al., CBET 535, 2006. [2] Margot and Brown, Science 300, 2003. [3] Margot, Kramer, Warner, Pravec, Hicks, Young, Bauer, in preparation. [4] Warner and Margot, IAUC 861, 2007.