# Radar observations of binary asteroids

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Since the discovery of the binary nature of 2001 DP 107 (Margot et al) we have observed about 20 near-Earth binary asteroids with the Arecibo and Goldstone radars. The radar observations give independent estimates of the sizes of both primary and secondary components. Usually, the primary rotation is near the breakup limit and the secondary's rotation is tidally locked to the orbital period. The exceptions to this rule are Hermes, which is a symmetric system, 1998 ST27, which has a small distant, more rapidly rotating secondary, and 2003 YT1, which may have a more rapidly rotating secondary. The statistics of this outcome may shed light on the lifetimes of these objects if we can estimate the tidal evolution timescale.

The secondaries are typically 20-40% the diameter of the primaries. The orbits are largely consistent with close alignment of the orbit and spin axes, but only a few have been examined in detail.

The uncertainty in density determined is dominated by the uncertainty in the volume of the primary. In the best determined case (1999 KW4) with a detailed shape model, this uncertainty is of order 10%. The uncertainties in densities reported from low-resolution imaging (both NEA and MB) need to be carefully considered.

Obtaining vis/IR spectra of NEAs is often serendipitous, as the radar opportunities are independent of lunar phase, weather, and time of day. Thus most radar-observed binaries have unknown spectral types. We have seen at least S and C group objects, including a range of S group mineralogies from pyroxene-rich to olivine-rich.