Rotational breakup as the origin of small binary asteroids. K. J. Walsh[1,2] and D. C. Richardson[2] and P. Michel[1]. [1]UMR 6202 Cassiopée, University of Nice-Sophia Antipolis, CNRS, Observatoire de la Côte d'Azur, B.P. 4229, 06304 Nice Cedex 4, France [2]University of Maryland, Department of Astronomy, College Park, MD, 20742.

Introduction: We present results of simulations modeling the rotational spinup and disruption of rubble pile asteroids. Our work is motivated by the high fraction (~15%) of binary asteroids among NEAs and small MBAs [1]. Binaries in these populations tend to have oblate, fast-spinning primaries with relatively large, nearby secondaries, suggesting formation by rotational disruption.

Simulations: Our simulations consist of applying a series of small but discrete "spin boosts" to a rubble pile until the body is rotating so rapidly that it undergoes re-shaping, mass loss or disruption. The rubble pile is modeled as a collection of hard spheres whose collisional and gravitational interactions are calculated with the N-body package *pkdgrav*. Different shapes and internal structures were tested for our rubble piles, ranging from fluid-like bodies to those behaving in a manner similar to granular material with internal angle of friction of ~40 degrees. Also tested were rubble piles with large rigid cores surrounded by smaller loose particles. Other parameters varied included the coefficient of restitution and initial body shape (spherical vs. elongated).

Results: We find that gradual spinup (such as via the YORP effect) results in binary formation as long as two requirements are met. First, the asteroid must maintain a low equatorial elongation at critical spin rates. This is only possible if the body has a high angle of friction (~40 degrees), or has a substantial core, both of which help the body resist re-shaping and becoming prolate. By contrast a fluid-like body (angle of friction near 0 degrees) becomes prolate and material that leaves the surface cannot remain in a stable orbit to form a massive satellite. Second, the material must be collisionally dissipative. The particles that escape from the surface of the primary asteroid will not accumulate into large satellites unless the coefficient of restitution governing their collision outcomes is moderately to strongly dissipative, namely with a coefficient below about 0.5 (at least 50% dissipative). In our simulations where these two constraints are met, we find rapid formation of close, sizeable secondaries (semimajor axis a = 2--4 primary radii) with low eccentricities ($e < 0.15$).

References:

[1] Pravec P. et al. (2006) *Icarus*, *181*, 63-93.

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