EPSC Abstracts,
Vol. 2, EPSC2007-A-00491, 2007
European Planetary Science Congress 2007

On the concept of material strength and first simulations of asteroid disruption with explicit formation of spinning aggregates in the gravity regime

P. Michel (1) and D.C. Richardson (2)

(1) Côte d'Azur Observatory, UMR 6202 Cassiopée, Nice, France, (2) University of Maryland, College Park, USA

During their evolutions, the small bodies of our Solar System are affected by several mechanisms which can modify their properties. While dynamical mechanisms are at the origin of their orbital variations, there are other mechanisms which can change their shape, spin, and even their size when their strength threshold is reached, resulting in their disruption. Such mechanisms have been identified and studied, both by analytical and numerical tools. The main mechanisms that can result in the disruption of a small body are collisional events, tidal perturbations, and spin-ups. However, the efficiency of these mechanisms depends on the strength of the material constituing the small body, which also plays a role in its possible equilibrium shape. We will present several important aspects of material strength that are believed to be adapted to Solar System small bodies and briefly review the most recent studies of the different mechanisms that can be at the origin of the disruption of these bodies.

In particular, we have recently made a major improvement in the simulations of asteroid disruption by computing explicitly the formation of aggregates during the gravitational reaccumulation of small fragments, allowing us to obtain information on their spin, the number of boulders composing them or lying on their surface, and their shape. We will present the first and preliminary results of this process taking as examples some asteroid families that we reproduced successfully with our previous simulations (Michel et al. 2001, 2002, 2003, 2004a,b), and their possible implications on the properties of asteroids generated by a disruption. Such information can for instance be compared with data provided by the Japanese space mission Hayabusa of the asteroid

Itokawa, a body now understood to be a fragment of a larger parent body. It is also clear that future space missions to small bodies devoted to precise in-situ analysis and sample return will allow us to improve our understanding on the physical properties of these objects, and to check whether our theoretical and numerical works are valid.

References

Michel P., Benz W., Tanga P., Richardson D.C. 2001. Collisions and gravitational reaccumulation: forming asteroid families and satellites. Science 294 1696-1700 (+cover of the journal).

Michel P., Benz W., Tanga P., Richardson D.C. 2002. Formation of asteroid families by catastrophic disruption: simulations with fragmentation and gravitational reaccumulation. Icarus 160, 10-23.

Michel P., Benz W., Richardson D.C. 2003. Fragmented parent bodies as the origin of asteroid families. Nature 421, 608-611 (+cover of the journal).

Michel P., Benz W., Richardson D.C. 2004a. Disruption of pre-shattered parent bodies. Icarus 168, 420-432.

Michel P., Benz W., Richardson D.C. 2004b. Catastrophic disruptions and family formation: a review of numerical simulations including both fragmentation and gravitational reaccumulations. Planet. Space. Sci. 52, 1109-1117.