CATASTROPHIC DISRUPTION ON CORE-MANTLE MIXED ICE-SILICATE TARGETS IN THE LABORATORY

Mark Burchell and Andrew Lightwing

School of Physical Science, Univ. of Kent, Canterbury, Kent CT2 7NH. United Kingdom.

The population of the Kuiper Belt consists of a collection of icy bodies found outside the orbit of Neptune. While the majority of these objects are relatively small, more and more Pluto-sized bodes are being discovered (such as Eris, Sedna and Quaoar; Brown et al., 2006, Brown et al., 2004) which points to a significant population of this category of bodies existing in the Kuiper belt and the Scattered Disk. The collisional disruption rate of these objects is required to model their size distribution and lifetime as well as their collisional evolution, and this requires a knowledge of Q* (the disruption energy) at these size scales.

The measured density of Pluto (2.05 g cm^{-3}) implies a mixed rock:ice content for these bodies. It is also suspected that Pluto possesses a differentiated structure with a thin layer of ice covering an ice-silicate core (McKinnon et al. 1997). If Pluto is taken as typical, then this composition and structure need to be reflected in any detailed modelling of the collisional evolution of these bodies

As a first step to improving our understanding of the disruption of bodies with such a composition and structure, a range of impact experiments have been carried out at the laboratory scale. The impacts were carried out using a two-stage light gas gun at the University of Kent, firing millimetre sized projectiles of varying densities at velocities ranging between 1 and 7 km s^{-1} (Burchell et al., 1999). The targets were spherical, with diameters on the cm scale. A range of target types was used: pure water ice, mixed sand:ice targets and targets with a core (sand:ice) and mantle (ice) structure. From these impacts the critical energy density Q* for each target type has been found, and is compared with previous impact experiments. This comparison allows us to see whether target composition and structure affects the value of Q* on the laboratory scale.

Further work is still required to extrapolate this data to Plutino size scales, where gravity effects may dominate (i.e. for large bodies Q* will be dominated by the need to disperse the shattered bodies against their self gravity). However, the sensitivity of disruption to target structure and composition in the strength dominated regime has been explored in this paper.

References

*Brown et al., 2004; Astron. J.**127 (4)** 2413-2417.*
*Brown et al., 2006; Astrophys. J. **643 (1)**. L61-L63 Part 2.*
*Burchell et al., 1999; Meas. Sci. Technol. **10**, 41 – 50.*
*McKinnon et al 1997; Pluto and Charon. **295** University of Arizona Press.*