Hypervelocity experiments of impact cratering and catastrophic disruption of minor bodies of the solar system

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A deeper understanding of impact processes is needed to increase our knowledge of the surface evolution of the solid bodies in the Solar System and to allow remote sensing data from forthcoming missions as Smart1, MarsExpress, VenusExpress, Cassini/Huygens, Rosetta to be correctly interpreted. Furthermore impact fragmentation and collisional breakup processes have to be better understood in order to investigate the evolution of the asteroids, comets, Trans Neptunian Objects (TNO) and the small natural satellites and also for developing more complete and accurate theoretical models. New data from ground-based observations and spacecraft encounters are giving us evidence of the low density and significant porosity of the asteroids as well as for the icy satellites of Saturn. Porosity is an important physical characteristic of the minor bodies, affecting their behaviour during cratering and catastrophic disruption. High velocity impacts in porous materials of ice and silicates haven't been performed in sufficient details and the available experimental data sets are limited.

Therefore we focus on the study of impact processes on porous targets in order to complement and extend the available data to ranges of velocity and physical conditions not yet explored. We present an experimental study of catastrophic fragmentation processes onto porous targets by means of high velocity impact experiments using a two-stages light-gas gun located at the impact facility of CISAS "G. Colombo" of the University of Padova. In order to simulate porous bodies of the Solar System, we have produced and used targets of different material, e.g. glass ceramic foam, natural pumices, water ice, and different porosity (with density in the range from 0.35 to 1.07 g/cm3). Impact test campaign have been performed on the different samples varying the impact kinetic energy in order to study the craterization up to catastrophic disruption. The impact and shattering events are observed by high speed shadow photography. The outcomes of the shattering events, all fragments, debris and dust are recovered and weighted in order to derive the fragment mass distributions.

Furthermore, preliminary numerical simulations have been performed by using Smooth Particle hydrodynamics (SPH) technique in order to validate the experimental data. Our simulations are aimed at investigating the propagation of the shock wave into the targets, the variation of the material physical properties and energy partition.