COLLISION AND IMPACT SIMULATIONS INCLUDING POROSITY

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The Smooth Particle Hydrodynamic (SPH) method has been used extensively over the years to simulate impacts and collisions involving brittle solids. This approach has been tested at different scales. At the small ones, laboratory impact experiments have been used to validate the method. At larger scales, asteroid families have served as laboratory to test the approach in the gravitational regime. In all cases, the results of carefully carried out simulations have been shown to agree quite well with the experiments.

However, spacecraft missions and ground-based observations are providing increasing evidence that many or even most asteroids are porous. Porosity may also play an important role in the formation of planets as the dissipative properties of porous media will enhance the collisional sticking mechanism required to build planetesimals. Furthermore, the simulations of collisional asteroid family formation have also shown that the internal structure of the parent bodies involved plays a major role in defining the collisional outcome (fragment size distribution, fragment velocities, amount of material ejected, etc.). While large scale cracks and/or boulders can be modeled explicitly, small scale (smaller than the numerical resolution) porosity has to be modeled implicitly within a suitable model.

In order to account for these important effects related to material properties, we have extended the SPH method to render it suitable for the calculation of shock dynamics and fracture in porous media. Our approach is based on the so called P-alpha model which was adapted for implementation in our SPH impact code. We shall report some test results of this new approach and point out some generic difficulties facing these simulations.