SIMULATIONS OF THE LCROSS IMPACT USING SMOOTH PARTICLE HYDRODYNAMICS (SPH)

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Introduction We present results of hydrocode calculations of the impact of the Lunar CRater Observation and Sensing Satellite (LCROSS) spacecraft on the moon. This NASA mission is planed for late 2008. The spacecraft with a weight of 2000kg will impact the moon with a velocity of about 2.5 km/s. Using our Smooth Particle Hydrodynamic (SPH) impact code, we investigate the crater formation, crater morphology, velocity distribution of ejecta etc. for different target material (regolith) properties including strength and porosity.

Numerical method Our numerical tool is based on the Smooth Particle Hydrodynamic (SPH) method. In order to simulate solids, standard SPH was extended to include a strength and a fracture model (Benz and Asphaug, 1994). Therefore, our SPH impact code can be used to model impacts and collisions involving solid bodies in the strength- and gravity-dominated regime. This method was already successfully tested at different scales.

Recently, our SPH impact code was extended to include a porosity model. The model is based on the so called P-α model (Herrman 1969) which was adapted for implementation in our SPH code (Jutzi 2004). We are now capable of performing SPH simulations including fracture and porosity.

Impact simulations Using our 3D SPH impact code, we perform several simulations of the LCROSS impact, considering different properties of the target material. For example, we compare simulations of the LCROSS impact in porous and nonporous targets and we also study the influence of the surface topography. For these different types of targets, we investigate the velocity distribution of ejecta, the corresponding maximum height and also the initial depth of the ejected material. We also make estimations of the crater diameter and crater depth. Different models of the impactor are used for this study.

References

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