STUDY OF PLANETARY IMPACT CRATERS AND THEIR EJECTION MATERIAL BASED ON LOW IMPACT SPEED LABORATORY MODELS. Suárez-Cortés Álvaro D[1], Alberto Flandes[2], Héctor J. Durand-Materola[2]. [1]Posgrado en Ciencias de la Tierra, Universidad Nacional Autónoma de México, Coyoacán 04510, México City, México. [2]Ciencias Espaciales, Instituto de Geofísica, Universidad Nacional Autónoma de México, Coyoacán 04510, México City, México.

Introduction: Impact craters are the dominant morphological features of the solid surfaces of most of the bodies in the solar system. A consensus has been reached regarding the various morphological characteristics of impact craters, but many questions remain open on the processes generated at the time of their formation, in particular, due to the large number of variables involved. Because they are extremely complex phenomena, which involve not only mechanical, but thermodynamic and geochemical processes, therefore, it is impossible to make an accurate analysis of impact craters simply through satellite images of the craters, since, in the least, a detailed study of the surface is required.

Laboratory experiments that simulate the physical characteristics of planetary-scale impacts may provide valuable tools to help determine the processes and phenomena triggered at the time of an impact and afterwards. The challenge is to derive consistent scaling relations in order to extrapolate laboratory results to planetary scales.

Detailed studies of the dynamics of the impact ejecta properties from laboratory experiments have been done through dimensional analysis in order to find the mass-velocity relations for the ejecta from impact craters onto various media that could actually help understand the processes involved in large-scale planetary cratering events. [1] developed scaling laws for hypervelocity (at ≈3 km/s) impact cratering. [2] studied the ejecta velocities of impacts on coarse-grained at speeds between 0.80 and 1.92 km/s. [3] report impact experiments based on the scaling laws at ≈200 m/s. This latter study derives the main scaling parameters of their experiments through the dimensionless π-Theorem and makes a comparison with the Crater excavation flow model or Z-model [4, 5].

In contrast, in this work, we introduce impact experiments at much lower impact speeds (10 m/s$\geq v_p \leq$70 m/s) with a low-cost experimental setup and apply a similar analysis used by the above authors. One of our hypotheses is that from the dynamics of the ejecta from laboratory low-speed impacts, it is also possible to obtain valuable information as in the case of laboratory impact experiments at much larger speeds based on similar scaling relations. Our analysis is mainly focused on the morphology and dynamics of the ejecta produced as the projectile collides with the target.

Even at these low speeds, the final morphologies of the laboratory craters obtained may be compared to the morphologies of some impact craters on planetary bodies in the Solar system. We test our low-impact speed approximation with estimations of the theoretical diameters of four known impact craters (Wolfe Creek in Australia, Barringer in the United States, Lonar Lake in India and Chícxulub in Mexico).

Acknowledgments: This work has been supported by DGAPA/PAPIIT IN104721. We are grateful for the invaluable support by D. Porta Zepeda and C. Echeverría Arjonilla and the Hydrodynamics and Turbulence Workshop at the Sciences Faculty of UNAM, where the experiments of this work were performed.

References: [1] Housen, K. et al. (1983) JGR, 88 (B3), 2485–2499. [2] Cintala, M. J. et al. (1999). MaPS, 34 (4), 605–623. [3] Tsujido, S. et al. (2015) Icarus 262, 79–92. [4] Maxwell, D. E. (1977) Impact and Explosion Cratering: Planetary and Terrestrial Implications, 1003–1008. [5] Croft, S. K. (1980) LPSC Proceedings, 3, 2347–2378

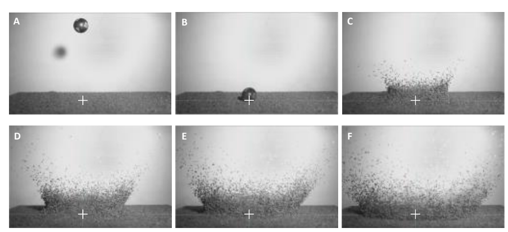

Figure 1: Impact example of a steel sphere (r=1.27 mm) on coarse-grained sand at 18.25 m/s.

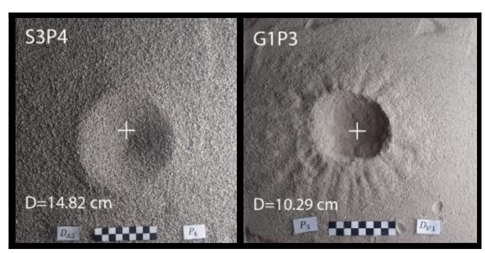

Figure 2: Examples of impact craters. Left: Steel sphere (radius 7.90 mm) on coarse-grained sand at 31.34 m/s. Right: Glass sphere (r=12.10 mm) on fine-grained sand at 41.57 m/s.