Quick-look results for the surface/regolith mechanical properties of Ryugu based on MASCOT bouncing analyses

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We present quick-look results and constraints on the mechanical properties of the regolith on asteroid 162173 Ryugu, based on expected data regarding the mechanical interactions by the lander MASCOT as well as data from MINERVA nano-landers and possibly from the first sampling touchdown by Hayabusa2.

MASCOT is going to be deployed from an altitude of ~55 m and has a touch-down velocity of ~0.2 m/s. It is expected to bounce several times before coming to rest [3]. The descent trajectory and the larger bouncing arcs can be captured by optical imaging from the spacecraft (ONC [5]) giving constraints on MASCOT in-flight trajectories. Moreover, direct images of footprints as well as data from MASCOT's magnetometer MASMAG [4] on bounce times (and possibly rotation rates or changes thereof), images by MASCOT's camera MASCAM [2] during bouncing and their fusion with ONC images projected to the shape, and finally MASCAM images after rest offer a rich database that allows us to constrain Ryugu's surface mechanical properties, with implications on the asteroid's surface history. Variations of the radio-frequency signal all along MASCOT's trajectory and day/night detection by MASCOT's photoelectric cell sensors can also contribute to the analysis.

The measured total linear energetic coefficient of restitution (CoR), i.e. the fraction of energy dissipated at each bounce, can be compared to the CoR values measured for the MASCOT structure bouncing against a hard wall [6] and soft-sphere DEM simulations of MASCOT landing on a bed of granular material [7,8]. Footprint images of the bounce imprints in loose granular material also constrain the granular frictional properties and the regolith depth.

Preliminary conclusions on the mechanical properties of Ryugu's surface material will be drawn.

References

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