Investigating the effect of surface – exosphere interactions

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Résumé

The surface of planetary airless bodies, also called surface bounded exosphere, like our Moon or Mercury, are directly bombarded by solar particles. The most abundant of those particles are solar wind protons. In the case of the Moon, many observations of low energy neutral atoms have shown that a significant portion of these incident protons are backscattered as neutral hydrogen. Measurements of the energy flux distribution of these neutral particles provide a clue regarding the processes occurring in the surface regolith when impacting protons collide with the surface grains. In this work, we developed a model of the fate of protons through the regolith in order to reproduce these measurements. We combined Monte Carlo approach to reconstruct the motion of these particles with molecular dynamics to describe the interaction of an incident proton with a grain and its dependency with incident energy and angle. Using in situ measurements of the solar wind, this detailed modelling allows us to analyze accurately the measurements performed by Chandrayaan-1 CENA instrument and to highlight what could control the flux and energy properties of these backscattered neutral hydrogen particles. Predictions of the intensity and shape of the backscattered neutral hydrogen at Mercury are derived from this calculation.

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