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Velocity distributions of exospheric particles

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Abstract

We apply our Monte Carlo code designed for the calculation of planetary exospheres [1,2] to derive the velocity distributions at a large range of altitudes above the exobase. At the exobase the velocity distributions are very well defined based on the physical process of the energetisation of the exospheric particle (e.g. thermal distribution or atmospheric sputtering). Since the exosphere is collision-free gravitational filtering will alter the distribution as well as loss processes (e.g. photo-ionisation).

Observations of exospheric particles typically probes an ensemble of these particles and derives mean quantities, e.g. densities and mean energies, with the latter often being interpreted as temperatures, since the detailed distributions are often not accessible to a measurement.

To assist the interpretation of the observed data we calculate for any altitude the velocity distributions of the exospheric particles. We will discuss three examples for these distributions. For a thermal exosphere we investigate the hydrogen exosphere of Titan because we can compare with recent HDAC observations from Cassini [3]. For sputtered particles we investigate the oxygen exosphere of the Moon, to compare with recent data from the SARA instrument on Chandrayaan-1 [4]. And finally, the most complicated case is sputtered CaO from Mercury's surface that dissociates in the exosphere into Ca and O fragments, which has been proposed recently based on observations of exospheric Ca [5].

References

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