Geophysical Research Abstracts
Vol. 12, EGU2010-14212, 2010
EGU General Assembly 2010

Velocity Distributions in Planetary Exospheres: Implications for Titan and Mercury

Audrey Schaufelberger (1), Peter Wurz (1), Helmut Lammer (2), and Yuri Kulikov (3)

(1) Physikalisches Institut, University of Bern, Bern, Switzerland (schaufelberger@space.unibe.ch), (2) Space Research Institute, Austrian Academy of Sciences, Graz, Austria, (3) Polar Geophysical Institute, Russian Academy of Sciences, Murmansk, Russian Federation

At the exobase the velocity distributions are very well defined based on the physical process of the energetisation of the exospheric particles. Above the exobase, though, where the number of collisions between particles is negligible and the particles can be assumed to move along ballistic and hyperbolic trajectories, gravitational filtering and photo-ionisation will influence the velocity distributions.

We apply a Monte Carlo code which traces each particle along its ballistic trajectory to determine the particles' velocity distributions at a large range of altitudes above the exobase at Titan and Mercury. At Titan, we investigate the thermal hydrogen, nitrogen and methane population and compare our results to observation data from the Hydrogen Deuterium Absorption Cell (HDAC) instrument on board the Cassini spacecraft. At Mercury, we model two different sources for calcium, i.e., surface sputtered calcium and calcium originating from photo-dissociated calcium-dioxide, and compare them to the High Resolution Echelle Spectrograph (HIRES) data from the W.M. Keck I telescope.

Our studies show that about 45 % of the hydrogen atoms have high enough velocities to be able to escape Titan's exosphere. Thermal molecular nitrogen and methane, on the other hand, can only reach an altitude of about 300 km and 500 km above the exobase, respectively. No nitrogen or methane particle is fast enough to escape Titan's exosphere. These results are in good agreement with the observational data but disagree with recent hydrodynamic outflow hypotheses. When comparing the two different sources for the calcium population in the Hermian exosphere, we discovered that the densities and velocities of the dissociated calcium agree better with the HIRES data. We therefore conclude that calcium fragments, originating from dissociated calcium-oxide, are the most likely source for the observed calcium atoms.