

## Exospheres from Asteroids to Planets

The study of exospheres can help us understand the long-term loss of volatiles from planetary bodies due to interactions of planets, satellites, and small bodies with the interplanetary medium (solar wind, meteors, and dust), solar radiation, internal forces including diffusion and outgassing, and surface effects like sticking and chemistry. Recent evidence for water and OH on the moon has spurred interest in processes involving chemistry and sequestration of volatile species at the poles and in voids. In recent years, NASA has sent spacecraft to asteroids including Vesta and Ceres, and ESA sent Rosetta to the asteroids Lutetia and Steins. OSIRIS-REX will return a sample from a primitive asteroid, Bennu, to Earth. It is possible that a Phobos-Deimos flyby will be a precursor to a manned mission to Mars. Exospheric particles are derived from the surface and to some extent to interplanetary dust and meteoroids. By comparing the exospheric compositions before and after major meteor shower events it may be possible to determine the extent to which the exosphere reflects the surface composition. Observation of an escaping exosphere, termed a corona, is challenging. We therefore have embarked on a parametrical study of exospheres as a function of basic controlling parameters such as the mass of the primary object, mass of the exospheric species, heliocentric distance, rotation rate of the primary, composition of the body (asteroid type or icy body). These parameters will be useful for mission planning as well as quick look data to determine the size and location of bodies likely to retain their exospheres and observability of exospheric species. We will also consider the sizes of small clusters that may be gravitationally bound to small bodies such as Phobos. In addition, it is of interest to be able to determine the extent of contamination of the pristine exosphere due to the spacecraft sent to make measurements, and the effect on the measurements of outgassing in the instruments. We also investigate the possibility that high velocity cometary impacts produce significant ionized ejecta.