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Surface radiation environment of Saturn’s icy moon Mimas

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Abstract

The majority of the large icy satellites that orbit Jupiter and Saturn are embedded within the magnetospheres of their respective parent bodies. The inner regions of these magnetospheric environments are characterized by populations of trapped charged particles, from thermal plasma to high energy energetic ions and electrons. Moons orbiting within these magnetospheres are therefore often subject to continuous bombardment by multiple particle species over a wide range of energies. It is known that such bombardment may induce chemical alterations within icy surfaces through the process of radiolysis, an effect which has the potential to significantly change surface and near-surface composition over typical geological timescales. In order to make quantifiable predictions on the surface composition of these moons, it is therefore critical to have a detailed measure of deposited dose into the surface from the relevant magnetospheric particle species.

Saturn’s innermost large moon Mimas orbits within one of the harshest radiation environments of the Saturnian magnetosphere and remote sensing observations of the moon have revealed a surface that displays strong signs of magnetospheric weathering. It is therefore of great interest to further quantify the interaction of magnetospheric particles with the Mimantean surface, particularly with regards to determining which bombarding species dominate at different moon surface locations and surface depths and to compare this with remote sensing observations. We will present dose-depth profiles for the near-surface which have been computed using a Monte Carlo particle transport code and representative energetic electron and proton spectra derived from measurements made by the MIMI-LEMMS particle instrument on the Cassini spacecraft.