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Characteristic signatures of energetic ions upstream from the Kronian magnetosphere

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The Magnetospheric Imaging Instrument (MIMI) on the Cassini spacecraft performed comprehensive measurements of the spatial distribution, composition and charge state

of the energetic ion population in the environment upstream from the post-noon and dawn side of the Kronian magnetosphere during the approach phase and subsequent several orbits of the Cassini spacecraft around the planet. High sensitivity observations of energetic ion directional intensities, energy spectra, and ion composition were obtained by the Ion and Neutral Camera (INCA) of the MIMI instrument complement with a geometry factor of $\sim$2.5 cm^2 sr and some capability of separating light (H, He) and heavier (C, N, O) ion groups (henceforth referred to as "hydrogen" and "oxygen" respectively). Charge state information was provided by the Charge-Energy-Mass-Spectrometer (CHEMS) over the range $\sim$3 to 220 kev per charge. The observations have revealed the presence of a series of distinct upstream bursts of energetic hydrogen and oxygen ions up to distances of 126 Rs, which exhibit the following characteristics: (1) The hydrogen ion bursts are observed in the energy range $\sim$3 to $\sim$220 keV (and occasionally to E $>$ 220 keV) and the oxygen ion bursts in the energy range $\sim$32 to $\sim$300 keV. (2) The duration of the ion bursts is several minutes up to 4 hrs. (3) The events are of varying composition, with some exhibiting significant fluxes of oxygen and other magnetospheric species. (4) The bursts have a filamentary structure with some exhibiting distinct signatures of "velocity-filtering effects" at the edges of convecting IMF filaments. (5) Some ion bursts are accompanied by distinct diamagnetic field depressions and exhibit wave structures consistent with ion cyclotron waves

for both hydrogen and oxygen. Given that energetic ions trapped within the magnetosphere of Saturn are mostly H^+ and O^+ (Krimigis et al, 2005), we conclude that O^+-rich upstream events must be particles leaking from Saturn's magnetosphere under favorable IMF conditions. The observations will be presented and compared to theoretical models.

Reference:

Krimigis et al, Dynamics of Saturn's magnetosphere from MIMI during Cassini's orbital insertion, Science, 307, 1270-1273, 2005.