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Plasma in the Water Plume of Enceladus

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The Cassini Ion and Neutral Mass Spectrometer (INMS) in its neutral mode observed a plume atmosphere at Enceladus consisting mostly of water but also containing some carbon dioxide and other species. Other Cassini instruments demonstrated that a strong interaction takes place between Saturn's magnetospheric plasma and the plume, with CAPS spectrometer data from the E2, E3, E5, and E7 encounters showing that the plasma flow near the plume is quite slow. The INMS in its ion mode measured ion composition during E3 and E7, and showed that H3O+ is the main ion species in the plume. The detection of cold H3O+ combined with the almost complete absence of cold H2O+ ions indicates the importance of ion-neutral chemistry in the plume. During E3 the INMS also apparently detected the hydrated ion species, H2O+ (H2O) and H3O+ (H2O) but such species were not detected during E7, when Cassini quickly passed over the southern hemisphere. Some simple interpretations of these ion composition measurements and how they relate to E-ring ion composition will be given. CAPS also observed electrons in the plume during several flybys, indicating the existence of both hot and cold populations. Model calculations of the electron energy distributions will be used to interpret the CAPS observations and to estimate the associated ionization rates.