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An Overview of Cassini Plasma Spectrometer (CAPS) Measurements Taken During the First Two Years in Orbit

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In this paper we will give a brief summary of the very exciting results obtained by the CAPS team during the first two years of the Cassini mission. In that period CAPS has made comprehensive measurements of Saturn's magnetosphere and its boundaries as well as the plasma environments of Titan, the main ring system, the extended E-ring, and the intriguing moon Enceladus. Not unexpectedly, we have found a wide variety of dynamic interactions between the rapidly rotating Saturnian plasma and the atmospheres, ionospheres, and ice grains embedded within the magnetosphere. There is convincing evidence for the centrifugally driven flux tube interchange instability playing a leading role in plasma transport within the middle magnetosphere. We have found several features of plasma composition that are of considerable interest: The magnetosphere is everywhere dominated by water group ions (O+, OH+, H2O+, and H3O+). These appear to originate from neutral gas emanating from Enceladus at a rate that we estimate to be ∼100 kg/s. Our detection of H3O+ indicates that ion-molecule reactions are important in this region. Surrounding the main rings, however, the plasma is primarily O+ and O2+ derived from O2, which makes up the neutral ring atmosphere as a result of water ice decomposition. Charge exchange between neutrals and plasma in the inner magnetosphere and over the main rings redistributes water products and molecular oxygen to the outer magnetosphere. There they become a source for oxygen ions that we find impinging on Titan's upper atmosphere at a rate of ∼5 x 1023 ions/s. CH4+ has also been found in the co-rotating flow at Titan in smaller amounts. Surprisingly we observe N+ produced locally, deep in the magnetosphere, possibly from primordial nitrogen emitted by Enceladus—but definitely not from Titan. Clearly, although this is Saturn's magnetosphere, our composition results show convincingly that most of the plasma has been scavenged and transported from the surfaces and atmospheres of solid bodies orbiting within it and not, for example, from the solar wind or Saturn's ionosphere. Papers on these subjects can be downloaded from the CAPS website: http://caps. space. swri. edu/.