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# 10 years of surprises at Saturn: CAPS and INMS highlights

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## Abstract

The Cassini mission at Saturn has provided many surprises on Saturn's rapidly rotating magnetosphere and its interaction with the diverse moons, as well as its interaction with the solar wind. One of the early discoveries was the water-rich composition of the magnetosphere. Its structure and dynamics indicate remarkable injections, periodicities and interchange events. Enceladus, orbiting at 4 $R_S$, was found to have plumes of water vapour and ice which are the dominant source for the inner magnetosphere. Charged water clusters, charged dust and photoelectrons provide key populations in the 'dusty plasma' seen here, as well as chemical complexity in the plume material. Direct pickup is seen near Enceladus and field aligned currents create a spot in Saturn's aurora. At Titan, orbiting at 20 $R_S$, heavy negative and positive ions are seen in the ionosphere, as well as neutrals, all of which have surprising chemical complexity. These provide the source for Titan's haze. Ionospheric plasma is seen in Titan's tail, enabling ion escape to be estimated at 7 tonnes per day. Saturn's ring ionosphere was seen early in the mission, which was oxygen rich and produced photoelectrons; a return will be made in 2017. At Rhea, pickup positive and negative ions indicated weak atmospheres sustained by energetic particle impact, seen in the neutrals also. A weak atmosphere was also seen at Dione. The exosphere production process operates at Jupiter's moons also. Here we review some of the key new results, and discuss the implications for other solar system contexts.