



## **Plasma waves and turbulence at Saturn: Cassini initial results**

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The Saturn magnetosphere and its interaction with the solar wind creates a plethora of plasma waves and turbulence. The Mach number of the solar wind increases with heliocentric distance and at Saturn produces a very strong bow shock characterized by a large overshoot and intense upstream waves. In part because of the convection of these upstream waves through the shock and against the magnetopause, the boundary of the magnetosphere is continually in motion. In the outer magnetosphere the beta of the plasma is clearly high and the fluctuations in the field appear to be quite random and incoherent. Even during the Titan flybys (at 20 Rs) there was little evidence for coherence wave growth. Well inside of the orbit of Titan into about 6 Rs there is evidence for flux tube interchange. This appears to be the outer edge of the cooler plasma torus associated with the E-ring. The source of the hot plasma beyond 6 Rs may be the ionosphere associated with the attempt of the ionosphere to maintain corotation in the magnetosphere. Inside of 6 Rs there are diamagnetic decreases in the field signaling perhaps isolated hot flux tubes. Throughout much of the cool E-region torus, there are left-handed waves at the ion cyclotron frequency of water group ions. These waves signal the production of water group ions, removing mass from the ring and adding energy to the plasma (from the planet's rotation) when the ions are brought up to corotation. Finally, the engine firing at Saturn Orbit Injection added its own mixture of ions to the magnetosphere triggering the appearance of a set of ion cyclotron waves seen only in the SOI passage.