Cassini-Huygens, Saturn, Titan and plasma physics

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Cassini-Huygens has orbited Saturn since 1 July 2004. A few days before this Saturn Orbit Insertion (SOI) manoeuvre, instruments on the Cassini orbiter detected the outer regions of Saturn's magnetosphere including the bow shock and magnetopause. Since those early crossings, the detailed exploration of Saturn's magnetosphere has begun. The UK is playing a prime role in several of these observations, including the Cassini Plasma Spectrometer (CAPS) which observes electrons and ions.

Saturn's magnetosphere has similarities and differences to that of the Earth. At Saturn, the solar wind plays a role in controlling the size on the magnetosphere and in aspects of the aurora. However, the rapid rotation of the gas giant planet competes with the solar wind driven processes and dominates the inner region.

Compared to Earth, Saturn's magnetosphere is large at 20-40 times the linear dimension. This changes the timescale for convection within the magnetosphere since although the density of the solar wind is lower at Saturn, its speed is the same. The dusty rings, Titan with its thick atmosphere, and Saturn's 32 known icy satellites, all form additional sources for plasma to the solar wind and the planetary ionosphere.

In this talk we will review the findings about Saturn's plasma environment from Cassini-Huygens so far. We will concentrate on findings within the magnetosphere itself and its interaction with Titan's upper atmosphere. We will look at how the size of the magnetosphere changes, how the aurora is controlled, how plasma boundaries are formed, how dynamic particle injection events form and how dust-plasma interactions are important near the rings. At Titan, we will look at how the magnetosphere is a source of particles for the upper atmosphere of this unique moon and consider effects including ionospheric photoelectrons and the positive and negative ion composition. We will also look at the spacecraft potential and discuss conditions under which this may be positive or negative, and how this affects the on-board particle measurements.