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The structure of the magnetodisk of Saturn near 20 R_S

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The magnetodisk is a complex plasma structure, it rotates around Saturn with decreasing angular velocity as we move outward (co-rotation lag), and it exhibit a vertical, flapping motion perpendicular to the equatorial plane of Saturn, with a period near to the SKR periodicity. The central line of the magnetodisk is surrounded by a structured plasma sheet, a smooth, broad ion layer composed of light ions, and a heavy ion layer displaying narrow substructures. The central line is identified with the position where the radial component of the magnetic field changes sign in KRTP-system (these are spherical polar Saturn centered coordinates, R is radial away from Saturn, P is azimuthal, and T is meridional). The plasma sheet is denser and wider on the dayside of Saturn. Outside the plasma sheet, in the lobes, the plasma density is lower.

We explore the magnetodisk structure using ion moments derived from the data of the Cassini Plasma Spectrometer (CAPS), for the time period of the prime mission near Titan encounters till the end of May 2008. Recently Thomsen et al. [J. Geophys. Res., 115, A10220, doi: 10.1029/2010JA015267, 2010] published a survey of the properties of the ion plasma in the magnetosphere of Saturn based on the moments derived from the data measured by the CAPS instrument onboard Cassini. We complement that survey with case studies. Previously we reported results on proton, heavy ion, and m/q=2 ion densities in the plasma sheet and in the lobes along those segments of Cassini orbits which are near the Titan encounters. We found that close to B_R=0 the heavy ion density was higher than the proton density; while the m/q=2 ions had the lowest density.

Here we report results on ion temperatures and velocities around 20 RS along the same orbits. The denser heavy ion component near B_R=0 is cooler, at the same locations a cooler component dominates the electron spectra. The pattern of ion temperatures in the lobes and in the plasma sheet is investigated. The analysis of the velocities requires much care due to the viewing limitation of the CAPS instruments, and the technique inherent in moment computation. In the equatorial plane of Saturn the velocity components are pointing dominantly in the co-rotation direction, we also found outward-moving plasma structures. Inward-moving plasma has not yet been detected. The velocity components perpendicular to the equatorial plane are also investigated. These results lead to a coherent picture of the magnetodisk around the orbit of Titan.