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Hot O+ ion presence and directional flows in the magnetosheath of Saturn

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Two successive, equatorial Cassini orbits (days 303 to 359 of 2005) of almost identical geometry, are examined in detail using plasma, energetic particle and magnetic field data from three instruments onboard the Cassini orbiter, the Magnetospheric Imaging Instrument (MIMI), the Casini Plasma Spectrometer (CAPS) and the Cassini Magnetometer (MAG). Both the energetic particle and the plasma sensor packages have the capability of directional particle intensity measurements and extensive pitch angle sampling, thus providing direct detection of the prevailing thermal and suprathermal particle flow. Additionally, the MIMI/CHEMS sensor also offers compositional ion measurements and in particular separates O+ ions for energies above $\sim$9 keV. In this study, we focus on the relatively less explored region of the Saturnian magnetosheath, in an attempt to address questions such as: (a) What is the hot plasma composition and pitch angle distribution in the magnetosheath? (b) How do the plasma and energetic particle properties (spectrum, anisotropy) compare to those assumed or predicted by models? (c) What is the range of the dynamical variability as seen along a nearly identical spacecraft pass $\sim$2 weeks later? (d) Are the periodicities observed in the magnetospheric plasma properties also identified in the magnetosheath? Furthermore, the observed directional flows of hot ion plasma is discussed in the context of the existing theories and the plasmoid-release and dipolarization activity observed in the dawn local time sector of Saturn, and the evolution of H+ and O+ the energy spectra along the spacecraft trajectory is also shown. Initial results indicate that energetic (>9 keV) O+ ions are present in the Saturnian magnetosheath, however, their contribution to the total suprathermal number density (<20%) is significantly reduced compared to the magnetosphere (>60%). Typical values for the total suprathermal (>3 keV) number density and pressure in the magnetosheath are 0.025 cm$\hat{}$-3 and 0.015 nPa respectively.