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Analysis of ion cyclotron wave properties at Enceladus: comparison of flyby data with 1D simulation results

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Abstract

Saturn's moon, Enceladus, releases about 200 kilograms per second of water group ions into the Saturnian magnetosphere. It is the primary mass-loading source for the neutral cloud in the inner magnetosphere. The generation of ion cyclotron waves (ICWs) associated with the pickup of these neutrals, with amplitudes proportional to the ionization rate of the newly added ions. Thus they can be studied to determine the characteristics of the mass-loading process. Figure 1 is an example of the observed wave phenomena during an Enceladus pass, E19, on May 2, 2012. Here, data from the Cassini magnetometer is displayed in KRTP coordinate components along with the total field magnitude for the Enceladus flyby. The K in KRTP is for 'Krono' which identifies that the system is centered on Saturn. The RTP in the acronym are radial, theta, and phi directions, respectively. The observed waves have frequencies near the gyro frequency of water group ions as seen in Figure 2. Figure 2 is an example of the power spectrum of ICWs observed near Enceladus and it shows the transverse and compressional components of the waves. It is presumed that in the inner magnetosphere, near the mass-loading region, one would identify ICWs as the dominant wave contributing to greater transverse wave power. Farther away, mirror-mode waves dominate and these waves contribute to greater compressional wave power. Figure 2 shows that near the water group gyro frequency, the transverse wave power is greater than that of the compressional wave power.

1. Figures

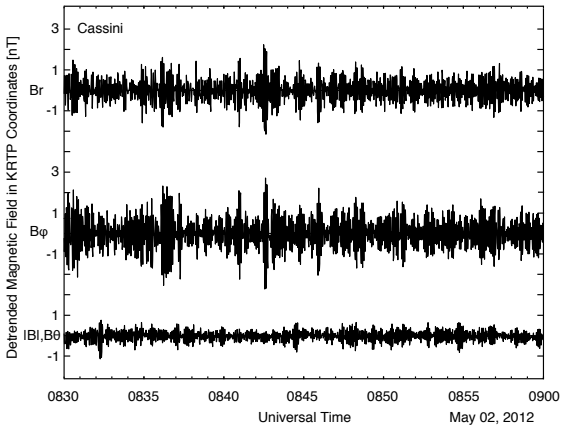

Figure 1: Figure 1: Three KRTP components of the magnetic field and total field are shown for the interval 0830-0900 UT on May 2, 2012. The data, from the Cassini magnetometer, is one-second resolution and has been quadratically detrended and the average removed.

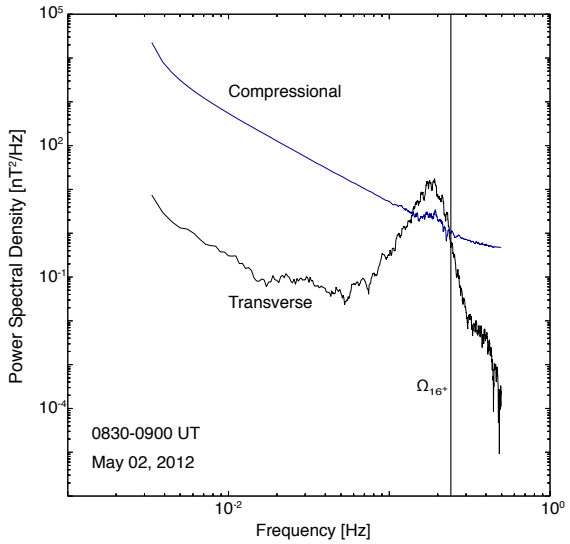

Figure 2: Figure 2: Power spectrum showing both the compressional power and transverse power of the waves seen near Enceladus on May 2, 2012.

2. Summary and Conclusions

For this study, 1D hybrid simulations are performed to examine the self-consistent growth of ICWs from pickup ions near Enceladus. They are conducted for varying pickup and background plasma parameters such as pickup density, velocity, composition, background plasma density, temperature and composition, for comparison with the ICW observations near Enceladus.