

Ion cyclotron waves at Saturn: Latitude structure and implications for the vertical extent of the neutral cloud

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Abstract

We present an analysis of ion cyclotron waves in Saturn's magnetosphere. Following earlier work by Leisner et al., 2011, who examined data from 11 Cassini in 2005-2006, we consider the amplitude and frequency distribution of ion cyclotron waves. We used the spacecraft's 111 inclined orbits between 2004 and 2015. Based on the vertical distribution of these waves, we infer the vertical distribution of fresh ion production and therefore the vertical distribution of Saturn's neutral cloud.

1. Introduction

Ion cyclotron waves are left-circularly polarized electromagnetic waves at or slightly below the ion cyclotron frequency. They are generated by freshly ionized particles in an unstable ring distribution. As such, they offer a tracer for the production of plasma and the distribution of neutrals in a planet's magnetosphere.

Analysis of early Cassini observations [Leisner et al., 2011] obtained on 11 orbits in 2005-2006, showed that ion cyclotron wave amplitudes peak off the equator and that the peak frequency was higher as the spacecraft approached the equator than after crossing the equator. This was interpreted as ion production confined to the equator, advective growth of the waves as they propagated away from the equator, and a Doppler shift in frequency due to the vertical component of the spacecraft's velocity.

2. Current analysis

Here, we expand these observations to include the 111 equator crossings between 2004 and 2015 with an inclination greater than 50 and a radius less than 10 Saturn radii. This will verify the Doppler shift interpretation and provide a statistical map of wave amplitude versus latitude and radius. These results when combined with theory and modeling of advective growth constrain the vertical extent of the source region. This will be compared with theoretical

calculations of ion production based on models of the neutral cloud and its vertical extent.

References

[1] Leisner, J., S., C. T. Russell, H. Y. Wei, and M. K. Dougherty, Probing Saturn's ion cyclotron waves on high-inclination orbits: Lessons for wave generation, *J. Geophys Res.*, 116, A09235, 2011.