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Electromagnetic waves near the proton cyclotron frequency in the solar wind

Lan Jian (1,2), Robert Alexander (3), Robert Wicks (1,2), Michael Stevens (4), Adolfo Figueroa-Vinas (2), and Christopher Russell (5)

(1) University of Maryland, College Park, MD, USA, (2) NASA Goddard Space Flight Center, Greenbelt, MD, USA, (3) University of Michigan, MI, USA, (4) Harvard Smithsonian Center for Astrophysics, MA, USA, (5) University of California, Los Angeles, CA, USA

Strong narrow-band electromagnetic waves around the proton cyclotron frequency have been found sporadically in the solar wind throughout the inner heliosphere. They are nearly-circularly polarized and propagate close to the magnetic field. Electromagnetic waves near the proton cyclotron frequency can be ion cyclotron waves or magnetosonic waves. They can play an important role in modulating the solar wind ion distribution, and contribute to the heating and acceleration of solar wind. Since the waves are left-hand or right-hand polarized in the spacecraft frame with similar characteristics, they are probably due to Doppler shift of a same type of waves, or there could be a mixture of waves with intrinsically different polarizations. Through the assistance of audification, we have studied the long-lasting low frequency wave events in 2005 using high-cadence magnetic field data from the Wind mission. The Solar Wind Experiment team of the Wind mission has provided the temperature anisotropies for core protons, beam protons, and alpha particles, as well as the beam drift for selected cases. We conduct wave dispersion analysis using these ion moments to examine if these waves can be explained by ion cyclotron anisotropy instability or ion beam instability related to the solar wind inhomogeneities.