Characteristics of Jupiter's magnetospheric turbulence observed by Galileo

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Jupiter creates the rotation-dominant large magnetosphere due to the fast planetary rotation, the strong magnetic field, and the dominant plasma source from the volcanic moon, Io. Small-scale fluctuation of magnetic field observed in the magnetosphere show turbulent behavior. Previous studies discussed the effect of turbulence on heating the expanding plasma from Io and the relationship with the electric potential drop which accelerates electrons and leads to strong Jovian aurora. Previous analyses of the Jovian magnetosphere disturbances have focused mainly on their power spectra and the corresponding slopes in the low frequency range of [quasi-DC, 10^{-2} Hz], which is limited by low time resolution ($\Delta t \sim 24$ sec.).

In this study, we extend the analysis to higher frequencies of the turbulent spectra using high-time resolution data, which is combined with low-time resolution data of Galileo magnetometer (MAG). Ion characteristic frequencies are obtained using the plasma spectrometer (PLS) data onboard the Galileo spacecraft and an empirical model.

Using both high- and low- time resolution data, we obtain 9 power spectra of magnetic field in the frequency range of [3×10^{-4}, 1] Hz, which are well above the estimated sensitivity floor of the MAG instrument. The frequencies of the evidenced spectral breaks are found to be well correlated with the Taylor-shifted characteristic scales of heavy ion, i.e., ion gyroradius and inertial length. The spectral indices below and above the spectral breaks are found to be broad and cover the ranges of [0.9, 1.7] and [1.9, 2.7], respectively. Furthermore, a statistical survey of the spectral breaks using low-time resolution data suggests a moderate correlation with the local plasma beta. Analysis of higher order statistics (moments >3 of the PDFs of the increments) show an intermittent feature of the turbulence over the analyzed scales. The limitations of the data and assumptions used will be discussed.