An investigation of whistler-mode auroral hiss at Jupiter using the Juno spacecraft

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The Juno spacecraft is currently in polar orbit around Jupiter, as of July 5, 2016. As the spacecraft passed over the poles of Jupiter for the first time on August 27, 2016, the radio and plasma wave instrument detected whistler mode radio emissions similar to auroral hiss previously studied at Earth. Auroral hiss is a very intense electromagnetic emission that covers a wide range of frequencies below the electron cyclotron frequency or the electron plasma frequency, whichever one is smaller. This study will analyze auroral hiss emissions that have a characteristic “funnel-shape” on a frequency vs. time spectrogram. The funnel-shape shows that the waves are propagating upward from a source below the spacecraft. From previous terrestrial studies of auroral hiss, it is known that these emissions are produced by upward propagating electron beams, and a similar association is expected at Jupiter. The energetic-particle detector instrument on Juno (JEDI) has observed these up-going electron beams correlated with the auroral hiss. This study will compare such observations on JEDI to the auroral hiss observations on the Juno plasma wave instrument (Waves). Ray tracing techniques will be used to determine the location of the magnetic field lines where the auroral hiss is generated. This study will also investigate whether the E/cB (Electric to Magnetic) ratio of the auroral hiss gives us an estimate of the electron density. A numerical program will be developed to simulate the index of refraction as a function of frequency and angle. Realistic values of the B field from Juno observations will be used in the simulation in order to compare the results to the measured E/cB ratio on Juno, which will help determine if this ratio gives us an estimate of the electron density. This study will provide direct comparisons of the Jovian auroral hiss with previous terrestrial studies.