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Radio and Plasma Wave Observations at Jupiter by Juno

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The Juno Waves investigation contributes to Juno's objective of exploring Jupiter's polar magnetosphere. The radio and plasma wave observations afforded by Waves provide a multifaceted contribution to this objective. Jupiter's auroral radio emissions in decametric (DAM), hectometric (HOM), and kilometric (KOM) wavelengths have been used for remote sensing of auroral dynamics, starting as early as the 1950's at DAM wavelengths and continuing today with multiple high resolution radio observatories across the globe. The longer wavelengths are accessible only to space-based observatories, above Earth's ionospheric cutoff, most notably by the planetary missions Voyager, Ulysses, Galileo, Cassini, and Juno. The latter provides our first opportunity to sample in situ the source region for these radio emissions and allow the confirmation of the cyclotron maser instability as the generation mechanism.

At lower frequencies, below various characteristic frequencies of the plasma such as the electron cyclotron, plasma frequencies, and their hybrids, are intense plasma waves in the whistler, ion cyclotron, and Alfvén modes as well as electrostatic phase space holes. These play roles in the acceleration of charged particles and/or pitch angle scattering their distributions. A number of these waves also highlight the electromagnetic coupling of Jupiter with the Galilean satellites, particularly Io. Resonances and cutoffs in the plasma wave spectrum provide information on the plasma density. Discrete whistler mode emissions called whistlers and free space mode millisecond pulses called Jupiter dispersed pulses are the result of atmospheric lightning that have greatly increased our base of information on the occurrence of lightning in Jupiter's atmosphere.

This paper will summarize some of the results of the Waves investigation from Juno's prime mission. We will discuss in situ measurements in auroral radio sources and the electron distributions thought to generate them. The relationship between the radio sources and auroral features will also be shown. A summary of the various intense plasma waves found on auroral field lines will be given with some thoughts on their role in the physics of the aurora. We will show the distribution of lightning based on whistler observations and the distinctive favor of mid and high latitudes. Ionospheric electron densities can sometimes be derived from spectral features at the electron plasma frequency near perijove. And, impulsive signals caused by impacts with micron-size dust grains provide the first in situ observations of dust between Jupiter's ring system and Jupiter's atmosphere.