Observing Jupiter's auroral radio sources and emissions with Juno

Masafumi Imai*[1], William S. Kurth[1], George B. Hospodarsky[1], Yasmina M. Martos[2], Philippe Louarn[3], Scott J. Bolton[4], John E. P. Connerney[2], Corentin K. Louis[3], Laurent Lamy[5], Philippe Zarka[5], Tracy E. Clarke[6], Charles A. Higgins[7], and Baptiste Cecconi[5]

[1] University of Iowa, Iowa City, Iowa, USA
[2] NASA Goddard Space Flight Center, Greenbelt, Maryland, USA
[3] IRAP, Toulouse, France
[4] Southwest Research Institute, San Antonio, Texas, USA
[5] LESIA, CNRS, Observatoire de Paris, Meudon, France
[6] Naval Research Laboratory, Washington, DC, USA
[7] Middle Tennessee State University, Murfreesboro, Tennessee, USA

The fortuitous detection of Jovian auroral radio emissions from a terrestrial observer in 1955 proved the existence of magnetic fields at a planet other than Earth. These non-thermal radio sources are distributed along auroral magnetic field lines at emission frequencies very close to the local gyrofrequencies via the electron cyclotron maser instability. Since their discovery, long-term monitoring from ground-based radio observatories and near-equatorial spacecraft have deepened our understanding of the low-frequency radio emissions consisting of broadband kilometric (bKOM), hectometric (HOM), and decametric (DAM) radio components. Yet these observations were unable to provide information on the latitudinal distribution of the radio emissions and did not provide a physical picture of the wave-particle interactions at their sources. Since 5 July 2016, the Juno spacecraft has toured Jupiter as its first polar explorer in a 53-day eccentric orbit. During each perijove pass, Juno has collected auroral radio data from 50 Hz to 41 MHz using the radio and plasma wave instrument (Waves). Juno has three methods to determine the source locations and beaming properties of the Jovian radio emissions: (1) identification of electron distribution functions associated with emissions at frequencies close to the local gyrofrequency as expected for a source crossing, (2) determination of the direction-of-arrival of incoming waves from the spin-modulated spectral density, and (3) estimation of latitudinal beaming of the radio emissions based on the stereoscopic observations from multiple observers and the statistical characteristics of Jovian radio occurrence. Because the three individual methods are self-consistent and complement each other, Juno observations are useful for determining the Jovian radio beaming parameters and characterizing radio sources. In this talk, we give a brief overview of early radio astronomy results from Juno, providing recent results using these three methods. Our findings as a benchmark of the gas giant planets would yield a better understanding of radio source locations and beaming properties from exoplanets.