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Jovian decametric radiation seen from Juno, Cassini, STEREO A, WIND, and Earth-based radio observatories

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Abstract

Jupiter's decametric (DAM) radiation is generated very close to the local gyrofrequency by the electron cyclotron maser instability (CMI). This type of planetary auroral radiation is common to the other magnetized planets in our solar system (Earth, Saturn, Neptune, and Uranus). Among planetary auroral radio sources, Jupiter's non-thermal DAM radiation represents the strongest with a flux density of 10^{-21}–10^{-20} W/(m^2Hz) at 1 AU over the broadest frequency range from a few to 40 MHz. Depending upon terrestrial ionospheric conditions and radio frequency interference, the DAM emission above 10 MHz is widely detectable from Earth-based radio observaotries. In contrast, frequencies observed by spacecraft depend upon receiver capability and the ambient solar wind plasma frequency. Observations of DAM from widely separated observers can be used to investigate the geometrical properties of the beam and learn about the generation mechanism. The first two-point common detections of Jovian DAM radiation were made using the Voyager spacecraft and ground-based radio observatories in early 1979, but, due to geometrical constraints and limited flyby duration, a full understanding of the latitudinal beaming of Jovian DAM radiation remains elusive. Juno first detected Jovian DAM emissions on May 5, 2016, on approach to the Jovian system, initiating a new opportunity to perform observations of common DAM radiation with Juno, Cassini, STEREO A, WIND, and Earth-based radio observatories (Long Wavelength Array Station One (LWA1) in New Mexico, USA, and Nançay Decameter Array (NDA) in France). These observers are widely distributed throughout our solar system and span a broad frequency range of 3.5 to 40.5 MHz. Juno resides in orbit at Jupiter, Cassini at Saturn, STEREO A in 1 AU orbit, WIND around Earth, and LWA1 and NDA at Earth. Juno's unique polar trajectory is expected to facilitate extraordinary stereoscopic observations of Jovian DAM radiation, leading to a much improved understanding of the latitudinal beaming and the CMI emission mechanism.