LWA1モジュレーションレーンデータによる木星電波源の位置の測定について

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Source locations of Jupiter's decametric emissions measured by LWA1 modulation lane data

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Jupiter is one of the most powerful radio sources at decametric wavelengths. The radio emitting frequency range is from about 3 to 40 MHz. These emissions originate along magnetic field lines within auroral zones as well as field lines that pass through Io and the Io plasma torus. The radio waves at Jupiter are amplified by particle-field interactions and are generated in both the X-mode and O-mode. Due to the emission source parameters, right-hand (RH) polarized waves are generated from northern hemisphere sources (Io-A and Io-B sources) while left-hand (LH) polarized waves come from the southern hemisphere (Io-C and Io-D sources).

The modulation lanes in the dynamic spectra of Jupiter's decametric emission were discovered by Riihimaa in 1968. We developed a model to explain the production of the modulation lanes [Imai et al., 1992a, 1992b, 1997, 2001, 2002]. By using our model the precise Jupiter's radio source locations and beam parameters can be measured. This new remote sensing tool is called as the modulation lane method.

The Long Wavelength Array (LWA) is a low-frequency radio telescope designed to produce high-sensitivity, high-resolution images in the frequency range of 10-88 MHz. The Long Wavelength Array Station 1 (LWA1) is the first LWA station completed in April 2011, and is located near the VLA site in New Mexico, USA. LWA1 consists of a 256 element array, operating as a single-station telescope. The sensitivity of the LWA1 combined with the low radio frequency interference environment allow us to observe the fine structure of Jupiter's decametric modulation lanes.

Using newly available wide band modulation lane data observed by LWA1, we measured source locations and beam parameters. The LWA1 wideband data provides the opportunity to verify the accuracy of the model in fitting the modulation lane curvature. From this modulation lane curvature fitting method for the wideband data, we can establish that the longitude of the intersection of the active magnetic flux tube with the equatorial plane. The results of LWA1 data analysis indicate that the radio emitting sources are located along the restricted range of longitude. We only receive one of the individual sources which has a very thin beam thickness (probably less than few degrees) at a given time. We show the measured locations of Io-related sources based on the modulation lanes observed by LWA1.