LWA1モジュレーションレーンデータにより測定したIo-CとIo-Bの木星デカメートル波電波源のパラメータについて

今井 一雅 [1]; Higgins Charles A.[2]; 今井 雅文 [3]; Clarke Tracy[4]
[1] 高知高専; [2] Middle Tennesee State University; [3] University of Iowa; [4] Naval Research Laboratory

Io-C and Io-B Source parameters of Jupiter's decametric emissions measured from LWA1 modulation lane data

Kazumasa Imai[1]; Charles A. Higgins[2]; Masafumi Imai[3]; Tracy Clarke[4]
[1] NIT, Kochi; [2] Middle Tennesee State University; [3] University of Iowa; [4] Naval Research Laboratory

The modulation lanes in Jupiter's decametric radiation, which were discovered by Riihimaa [1968], are groups of sloping parallel strips of alternately increasing and decreasing intensity in the dynamic spectra. The frequency-time slopes of the lanes can be either positive or negative depending on which of the Jovian sources are being observed. In the Imai et al. [1992a, 1992b, 1997] model for the production of modulation lanes, the lanes are assumed to be a manifestation of regularly spaced plasma density variations that exist in the Io plasma torus. The fringes are produced as a result of the passage of the multi-frequency radiation through an interference grating. By using our model, Jupiter's radio source locations and beam parameters can be measured precisely. This remote sensing tool is called the modulation lane method [Imai et al., 2002, 2006].

The Long Wavelength Array (LWA) is a low-frequency radio telescope designed to produce high-sensitivity, high-resolution spectra 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, allows 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 results of LWA1 data analysis indicate that the radio emitting sources are located along a restricted range of Jupiter's System III longitude. We only receive one of the individual sources at a given time because the source has a very thin beam (probably less than few degrees). We show the measured locations of Io-related sources based on the modulation lanes observed by LWA1. In this analysis we identified the existence of two independent radio sources in the case of Io-C events, one from the northern hemisphere (right hand polarization; we named it as Io-C', Io-C-prime), and one from the southern hemisphere (left hand polarization, Io-C). Previously we considered that both of the right and left hand components were coming from the same hemisphere. However we have investigated four other cases to show that different modulation lane patterns exist between right and left hand components. Thus the right and left hand components are coming from different hemispheres.

We also identified the radio source of the early part of Io-B (we named it as Io-B', Io-B-prime). It is located between 50 to 100 degrees CML of System III longitude and is independent of the main part of Io-B between 100 to 180 degrees CML. The measured center of the source longitude range is about 110 degrees in the case of Io-B' and about 190 degrees in the case of the main part of Io-B. This 110 degrees source longitude corresponds to the brightness peak of the IFP (Io footprint) and when Io is close to the Io plasma torus center [Bonfond et al., 2013]. The 190 degrees source longitude is close to the center of the longitude range of the active magnetic flux tube for non-Io-related radio emissions [M.Imai et al., 2011].