

Jupiter's decametric Io-C modulation lanes observed by LWA1

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Frequency-time dynamic spectra of Jupiter's decametric emissions display a complex structure on several different time scales. One of the characteristic spectral patterns on a few seconds time scale is the modulation lanes, which were discovered by Riihimaa in 1968. We have developed a model for the mechanism responsible for their production in which the free parameters have been adjusted to provide a very close fit with the observations [Imai et al., 1992;1997;2002].

In our model, we propose the existence of a grid-like interference screen composed of field-aligned columns of enhanced or depleted plasma density located along the longitudinal direction near satellite Io's orbit. We assume that the radio emitting frequency is very close to the cyclotron frequency at the source, and the shape of the radio beam structure is a thin-walled hollow-cone which has a fixed opening cone half-angle. The line of radio source consisting of the points along the axis of the Io-activated flux tube is also assumed to be located downstream, shifted eastward in the longitudinal direction from the instantaneous Io flux tube, for the case of Io related emissions. As a band of frequency components emitted from near the foot of an excited tube of magnetic flux passes through the screen, interference patterns of slightly different orientations are produced by the radio emissions at the different frequencies. The corotation of this set of interference patterns with Jupiter results in the sloping modulation lanes of the observed dynamic spectrum.

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 first Jupiter radio observation using LWA1 was made by Tracy Clarke (PI) from December, 2011. The observed Io-C dynamic spectrum on March 10, 2012 shows the modulation lanes of both left and right hand polarization components share the same lane structure. It indicates that the both left and right hand Io-C radiations are emitted from the southern hemisphere. And the locations of the radio sources along the Jupiter's magnetic field should be very close. This is very important information to understand the Jupiter's radio emission mechanism.

References

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