Characteristics of Jupiter's decametric Riddle arcs observed by LWA and Juno

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The Riddle arcs were found in the dynamic spectrum of Jupiter's decametric radio emissions observed by the Voyager spacecraft [Riddle, 1983]. The Riddle arcs have the same slope at the same frequency and System III longitude on a frequency time plot. An isolated Riddle arc can be easily recognized inside of the Io-A arc structures. The emission of the Riddle arcs was determined to be from the instantaneous Io flux tube.

The modulation lane method [Imai et al., 2018] is based on the slope measurements of modulation lanes on the dynamic spectrum of Jupiter's decametric radio emissions. We usually measure the slope with a 1 MHz bandwidth and determine the most probable value of the lead angle between activated flux tubes to fit the value of the slope. We use this lead angle to calculate the longitudinal location of the magnetic field line of the radio emitting sources.

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 [Clarke et al., 2014]. Using LWA data we analyzed the modulation lanes and the Riddle arcs and found that almost all of the Riddle arcs correspond to a zero-degree lead angle. This means that the radio sources related to the Riddle arcs are located along the instantaneous Io flux tube. This result is consistent with Riddle's conclusion.

With the advantage of Juno's unique polar orbit, the Waves instrument [Kurth et al., 2017] observed for the first time the polar beaming patterns and geometry of Jupiter's decametric radio emission sources. The dynamic spectra recorded by the Waves instrument from PJ1 (Aug. 27, 2016) to PJ16 (Oct. 29, 2018) show the Riddle arcs very clearly. The characteristics of these Riddle arcs are almost the same. The Riddle arcs occur during the time of positive jovigraphic latitude, and their existence implies sharp beaming from the northern hemisphere radio source. We consider this finding of Riddle arcs recorded by the Juno Waves instrument to be very important because it provides details of Jupiter's decametric radio emission around the instantaneous Io flux tube.

References:

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