Jupiter's radio 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]. On a frequency time plot these Riddle arcs have the same slope at the same frequency and System III longitude. (The typical System III longitude is about 260 degrees at 20 MHz.) An isolated Riddle arc can be easily recognized inside of the Io-A arc structures. This emission of Riddle arcs was concluded to be from the instantaneous Io flux tube.

The modulation lane method [Imai et al., 1992,1997,2002] is based on the measurements of the slope 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. The lead angle is the longitudinal angle between the instantaneous Io flux tube and the previously energized flux tube (real emitting region). The longitudinal location of the magnetic field line of the radio emitting sources can be calculated by this lead angle.

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 sensitivity of the LWA, combined with the low radio frequency interference environment, allows us to observe wide band modulation lanes of Jupiter's decametric radio emissions [Clarke et al., 2014]. We have analyzed the modulation lane data including the Riddle arcs observed by LWA. We found 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.

The Juno spacecraft [Bolton et al., 2017] was inserted into polar orbit around Jupiter on 04 July 2016. Juno's highly eccentric orbits have a period of about 53 days with apojove near 113 Jovian radii and perijove near 1.06 Jovian radii. With the advantage of this unique orbit, Juno's Waves instrument [Kurth et al., 2017] is observing 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 show the Riddle arcs very clearly. We are continuing to analyze the Waves data to find the Riddle arcs in each Juno orbit. The Riddle arcs can be used as a reference point to understand the latitudinal beaming patterns of Jupiter's decametric radio emissions and the location of radio sources. We present the preliminary results of this study.

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