Complementary study of JUNO/MWR investigation of Jupiter's synchrotron emission from ground-based observations at low frequencies

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At frequencies between 50 MHz and several GHz, Jupiter's radio spectrum is dominated by synchrotron radiation emitted by high energy electrons magnetically confined in a region close to the planet (e.g. Jovian radiation belt). For over the past 40 years single dish and interferometric observations have depicted a striking distribution of the electron-belt radio signal around the planet and permitted to establish the occurence of variability over long (years) time periods and sometimes over short (< day) time scales. The origins of these variations are yet to be fully identified.

With the JUNO mission, remote measurements of Jupiter's microwave radiation have been taken at high data rates with the onboard Microwave Radiometer (MWR) instrument. MWR is providing unprecedented measurements of the planet's thermal and synchrotron radiation at 1-50 cm with high resolution for +90 to -90 degrees latitude within 2 planetary radii from inside and outside the electron-belt region [*Janssen et al.*, Space Science Review, 2017]. Our interpretation of JUNO/MWR measurements at six frequencies [*Santos-Costa et al.*, Geophys. Res. Let., 2017] is primarily based on our understanding of the distribution and dynamical behavior of Jupiter's electron belt inferred from physics-based models and tomographic image reconstruction techniques of ground-based observations [e.g. *Santos-Costa and Bolton*, Planet. Space Sci. J., 2008; *Santos-Costa et al.*, J. Geophys. Res., 2011; *Santos-Costa et al.*, A&A J., 2014; *Girard et al.*, A&A J., 2016].

In this paper, we present a short review of JUNO/MWR measurements of Jupiter's radiation-belt emission and lay out the challenge we are currently facing to interpret, from a theoretical and modeling point of view, the many different features observed with a remote sensing instrument. We emphasize how coordinated ground-based observations of Jupiter's synchrotron radiation at low frequencies with JUNO in-situ measurements can enhance our fundamental understanding of the source, loss, energization, and transport mechanisms that shape Jupiter's electron belt distribution within a large region of Jupiter's magnetosphere and help to investigate the control parameters that had been responsible for the variability of Jupiter's radiation zone for the past 55-plus years and the variations that are certainly occurring during the JUNO mission.