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Oblate beaming cone of Jovian decameter radiation derived from occurrence probability

P. H. M. Galopeau (1) and M. Y. Boudjada (2)
(1) LATMOS-CNRS, Université Versailles Saint-Quentin-en-Yvelines, Guyancourt, France, (2) Space Research Institute, Austrian Academy of Sciences, Graz, Austria (patrick.galopeau@latmos.ipsl.fr)

Abstract

The CML-Io phase diagram, where the occurrence of the jovian decameter radiation is plotted versus the central meridian longitude (CML) and the phase of the satellite Io, reveals four zones of enhanced probability: the so-called Io-controlled sources Io-A, Io-B (emitted from the northern hemisphere), and Io-C, Io-D (emitted from the south). Supposing that the radio emission is generated near the local gyrofrequency (by the cyclotron maser instability) along a magnetic field line carried away by Io during its revolution around Jupiter (with a lead angle δ), we study the occurence probability in a polar diagram defined by the local magnetic field. More precisely we examine the location of the four Io-controlled sources (Io-A, Io-B, Io-C and Io-D) as a function of the colatitude angle θ relative to the gradient of the magnetic field (playing the role of an optical axis for the wave propagation) and an azimuth angle ψ linked to the direction of magnetic field vector. The angular distribution of the sources clearly shows that the angle θ is not constant and that the jovian decameter emission controlled by Io is radiated in a hollow cone which is not axi-symmetrical around the magnetic field gradient but flattened in the direction of the magnetic field vector. The use of elliptic coordinates allows us to compute with precision an oblate beaming cone for each Jovian hemisphere. This new result is compatible with the existence of a sector of active longitude favouring the radiation in regions of the CML-Io phase diagram in good agreement with the observations.