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Probing the Jupiter-Io interaction with synergistic measurements of radio and ultraviolet auroral emissions from Juno, Nançay and HST observatories

Laurent Lamy^{1,2}, Lucas Colombari³, and Philippe Zarka¹

¹Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique, Observatoire de Paris, PSL, CNRS, Meudon, France
(laurent.lamy@obspm.fr)

²Laboratoire d'Astrophysique de Marseille, Pythéas, Univ. Aix-Marseille, CNRS, CNES, Marseille, France

³Laboratoire de Physique et de Chimie de l'Environnement et de l'Espace, Univ. Orléans, CNRS, Orléans, France

The prominent component of Jovian decametric (auroral) emissions is induced by Io. Io decametric emissions (Io-DAM) have thus been monitored on a regular basis by Earth- or Space-based radio observatories for several decades. They display a typical arc-shaped structure in the time-frequency plane which results from the motion of the Io flux tube relative to the observer convolved with the anisotropic radio emission cone. Remote determination of the Io-DAM beaming pattern was used to check the emission conditions at the source (e.g. Queinnec & Zarka, 1998). It has been done at several occasions using various models of magnetic field/lead angles which introduce significant uncertainties. Nevertheless, Io-DAM arcs were shown to be consistent with oblique emissions triggered by the Cyclotron maser Instability from loss-cone electron distributions of a few keVs (Hess et al., 2008). The CMI validity for Jovian DAM and the prominence of loss cone electron distributions has been later confirmed by Juno in situ measurements (e.g. Louarn et al, 2017). In this study, we took advantage of simultaneous radio/UV or bi-point stereoscopic radio measurements provided by Juno/Waves, the Nançay Decameter Array and the Hubble Space Telescope to unambiguously derive the beaming pattern of several Io-DAM arcs and compare it with theoretical expectations. We then assess the energy of CMI-unstable auroral electrons at the source and discuss our results at the light of similar independent studies reaching different conclusions.