

IO-JUPITER ELECTRODYNAMIC INTERACTION, ELECTRON ACCELERATION AND RADIO BURSTS GENERATION

S. Hess*, F. Mottez[†], and P.Zarka[‡]

Abstract

Radio emissions from the Io-Jupiter electrodynamic circuit are structured in discrete bursts, quasi-periodic (5-10 Hz), and with drifting frequency versus time ($df/dt < 0$). High temporal and spectral radio spectrometry, associated to numerical simulations (PIC=Particle-In-Cell) allowed us to study in details the acceleration processes of the electrons responsible for the emissions. We computed the acceleration of ambient electrons within the Io Flux Tube (IFT) by an Alfvén wave excited by Io crossing Jupiter's magnetic field lines. Then we computed the Cyclotron-Maser radio emission generated by the resulting electron populations. The time-frequency structure of these emissions is very similar to those observed. The detailed analysis of the bursts shape in the time-frequency plane (df/dt) allowed us to discover the existence of electric potential drops (= double-layers, ~ 1 kV) aligned with the IFT magnetic field. Such acceleration structures, observed in-situ above the Earth's auroral regions, were unknown at Jupiter. Furthermore, high resolution radio spectroscopy allowed us to study these structures on the long-term (minutes to hours), and we showed that they are moving upwards at the local sound speed. Finally, taking into account these acceleration structures in addition to Alfvén waves in our numerical simulations, we succeeded in reproducing in details the complex time-frequency morphology observed for many radio bursts. We present recent studies on large-scale solar coronal waves (so-called "EIT waves") obtained with the EUVI instruments onboard the twin STEREO spacecraft. EUVI has several advantages for coronal wave studies: a) high cadence full-disk imaging, which allows us to catch the wave evolution and kinematics, b) a large field-of-view, which allows simultaneous observations of the erupting CME, and c) observations from two vantage points, which enable us to get insight into the three-dimensional structure of the wave. The present understanding is basically split into different groups of "wave" versus "non-wave" interpretations of the physical process behind the phenomenon, as well as "flare" versus "CME" for the driving agent. We will present the first observations of the full three-dimensional wave dome in the event of January 17, 2010. The study of the perturbation characteristics and the associated high-frequency radio type II bursts provide evidence for a weakly shocked fast-mode wave as the underlying physical process.

* *Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80303-7814, USA*

[†] *LUTH, Observatoire de Paris, UMR CNRS 8102, 92195 Meudon, France*

[‡] *LESIA, Observatoire de Paris, UMR CNRS 8109, 92195 Meudon, France*

