Magnetosphere- Ionosphere-Thermosphere coupling studies at Jupiter and Saturn with Juno and Cassini

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Abstract

The magnetodisk of Jupiter is dragged into partial corotation with the planet by an electric current loop that connects the disk to the Jovian upper atmosphere via intense field-aligned currents driving the “main auroral oval” of that planet. Thanks to its unique orbital geometry, NASA’s Juno mission will allow for the first time a quantitative study of the characteristics of the three key segments of this circuit and of their connection: the magnetodisk/plasmasheet, where currents transverse to the magnetic field maintain the disk into partial corotation; auroral field lines, which connect the magnetodisk to the auroral circuit proper and along which current is carried in part by accelerated particles; and the ionospheric closure of the circuit, where Ohmic currents extract momentum from the upper atmosphere and produce Joule heating. To a large extent, the Cassini proximal orbits will provide a similar opportunity at Saturn, as well as the unique opportunity of comparing magnetodisk dynamics and MIT coupling at the two gas giants.

We will describe our detailed plans for a physical study of these three segments and their interconnections, and of the key processes that are at work in the enforcement of magnetospheric corotation and sub-corotation at Jupiter and Saturn, based on the outcome of a workshop on “Magnetosphere-Ionosphere-Thermosphere coupling at Jupiter” organized in Toulouse, France, by IRAP and LESIA on oct. 13 and 14, 2015. All contributions to this workshop can be found on line at:

<http://cdpp.eu/workshops/Jupiter_MIT_coupling/>

Emphasis will be placed first on the models and data analysis tools that are needed to address the scientific challenge of resolving the MIT coupling electrical circuit at these two planets, particularly the on-line tools for handling multi-instruments data sets available at the Centre de Données de la Physique des Plasmas (CDPP), IRAP/CNES, Toulouse, France.

Finally, we will present some of the very first results of the Juno mission acquired in the course of its initial orbits around Jupiter, and will discuss their implications for the continuation of this study over the few years to come.