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A study on the influence of Io's volcanic activity at the plasma torus variability

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Abstract

Io is the innermost and smallest of the four Galilean moons (Io radii orbital distance, R_{Io} = 1815 km). Its active and high temperature volcanism is very variable. The release of lava flows and plumes produces a patchy atmosphere, mainly composed by SO_2, SO, S, O [1]. Io's tenuous atmosphere allows a significant fraction of neutral atoms and molecules to escape. The material which escapes from the gravitational pull of Io forms a neutral cloud that extends for several Jupiter's radii (R_J = 71,492 km). The neutrals follow Io in its orbit about Jupiter and once the neutrals are ionized the ions are accelerated to the nearly corotational flow of the plasma to form the so called Io Plasma Torus (IPT) [2]. The main constituents of the plasma torus are sulfur and oxygen ions. Io volcanism is responsible for the supply of ions to the whole magnetosphere of Jupiter and is animportant driver of the magnetospheric physics.

Considering this scenario, it is reasonable to expect that the IPT should be affected by changes in Io's volcanic activity. Therefore, the aim of this work is to study this coupling using measurements at different wavelengths during simultaneous observations of Galileo and Cassini missions. Cassini mission crossed Jupiter magnetosphere at the end of 2000 in its route to Saturn. On the other hand, Galileo was an orbiter of Jupiter for 8 years. The period studied in this work is a six-month period, from October of 2000 to March of 2001. The instruments analyzed from the Cassini mission were the Ultraviolet Imaging Spectrograph (UVIS) and the Radio and Plasma Wave Science (RPWS). While the instrument from Galileo used in our analysis was the Plasma Wave Subsystem (PWS). The Lomb-Scargle periodogram method was applied to the torus data, with the goal to identify the main periodicities observed at the IPT in timescales ranging from hours to days.

A second part of the analysis is to identify possible variations and enhancements of the IPT after the period of the energetic eruption at the volcano Surt. The eruption observation was obtained at the Keck II telescope on February 21, 2001. Understanding the time of influence of an energetic and intense eruption (also called outburst) at the IPT is an important step to unveil part of this complex system. Besides the interaction between the volcanic activity and the enhancements of the IPT, we also aim to obtain information related to system III and system IV.

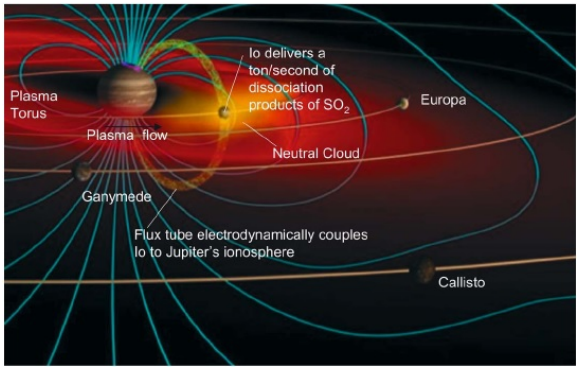

Figure 1: Main components of Jupiter-Io coupled system. Image shows the four Galilean satellites (Io, Europa, Ganymede and Callisto), Io's plasma torus, the neutral cloud and the flux tube connecting Io to Jupiter's ionosphere. The torus lies in the centrifugal equator [3].

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