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Global Imaging of Jupiter's Magnetosphere and Torii: Is it possible?

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Abstract

In this presentation we discuss the science that can be revealed by using Energetic Neutral Atom (ENA) imaging in the energy range above about 10 keV, and how/if this can be accomplished given the harsh environmental conditions at Jupiter with particular emphasis on the Jupiter Ganymede Orbiter (JGO) mission scenario.

Past measurements from Jupiter imply that its rotating magnetosphere is an efficient particle accelerator. Energetic ions and electrons are "injected" into the magnetosphere by various processes and form an ocean of an intense and dynamical particle environment. The Jovian Moons are immersed in this environment and are constantly bombarded altering surfaces and atmospheres. The outgassing of Io and Europa mass load the rotating magnetosphere forming the particle torii encircling Jupiter.

Detection of ENAs enables imaging of singly-charged ion plasma in planetary magnetospheres that otherwise would remain invisible. Since 2004, the technique has been in use at Saturn by the Ion Neutral Camera (INCA) on board Cassini revealing how enormous energetic ion clouds are born periodically in the night side magnetosphere and then drift subsequently around Saturn, impacting the Moons instantly characterizing the variability of the particle environment.

First, we use observations and simulations to demonstrate how ENA imaging of the Jovian system would lead to breakthroughs in our understanding of the dynamic magnetosphere, its solar wind control, its interactions with the moons and resulting Io and Europa torii that would far surpass our past knowledge obtained from primarily the Galileo mission. Second, using INCA as a baseline design, we discuss the requirements that the science and environment put on the geometrical factor, design of the charged particle deflection systems, background rejection schemes, radiation shielding, and how this impacts instrument mass. Finally, we apply the analyses results to the current JGO orbit, in order to answer where in the Jovian system ENA imaging could return ground breaking data, while maintaining achievable design requirements.

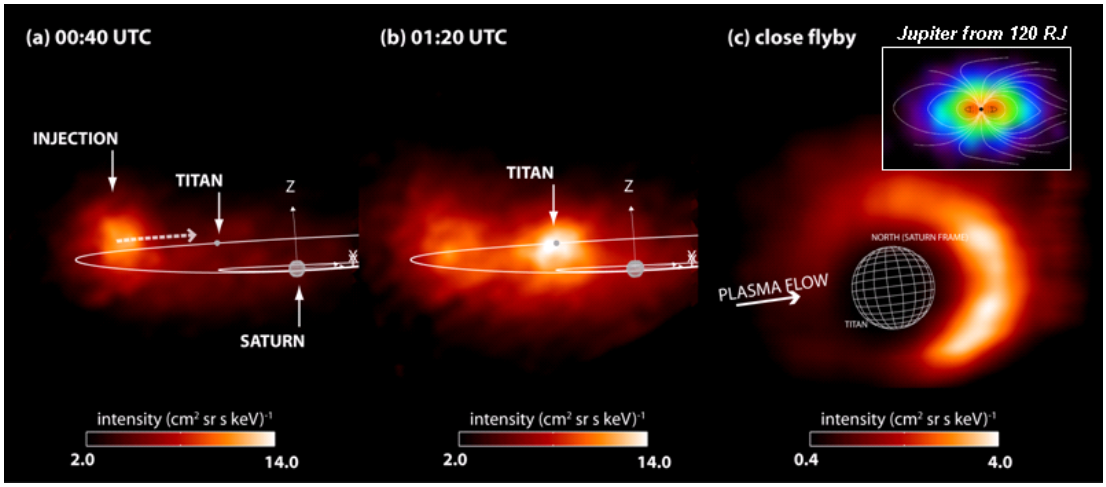

Figure 1. At Saturn, the ENA imaging technique has revealed the dramatic birth and energization of magnetospheric energetic particles and how those impact the Moons. Is this possible at Jupiter?