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Plasma Parameters in Io's Torus: Measurements from Apache Point Observatory

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Abstract

We report observations from nine nights of observations of the Io plasma torus made in conjunction with JAXA's Hisaki mission torus observations and the Hubble Space telescope auroral campaign. Groundbased remote sensing of forbidden line emissions yield measures of plasma density which cannot be made at UV wavelengths.

1. Introduction

The Io plasma torus is an astrophysical nebula wrapped around Jupiter, originating from the intense volcanic activity of Jupiter's moon Io. The torus varies both spatially and temporally, driven by changes in volcanism and asymmetries in the Jovian magnetosphere. We report results from 9 nights of observation spanning November 2013 to February 2014 with the Dual Imaging Spectrograph on the ARC 3.5m telescope at Apache Point Observatory in New Mexico. Emissions in these data include the [SII] doublets at 6716/6731A and 4069/4076A, [OII] at 3726/3729A, [SIII] at 3722A and 6312A, as well as resonantly scattered neutral [NaI] at 5890/5896A. Constraints on electron density, temperature and ion mixing rations can be obtained. Observations of both ansa during a 5 hour period characterize the complete longitudinal structure. Specifically, the intensity ratio of the collisionally excited [SII] doublet at 6716/6731A is a diagnostic for local electron density sampled at ~20 minute cadence. Absolute intensity can be derived directly from the reflectance of Jupiter's disc and standard calibrations are performed on the data such as bias subtraction, wavelength calibration and rectification. A unique background subtraction procedure is developed to disentangle scattered Jovian reflection and the torus. These observations were made in conjunction with JAXA's Hisaki mission, the HST auroral campaign and infrared monitoring of volcanism to better understand how mass and energy are transported throughout the system.

2. Figures

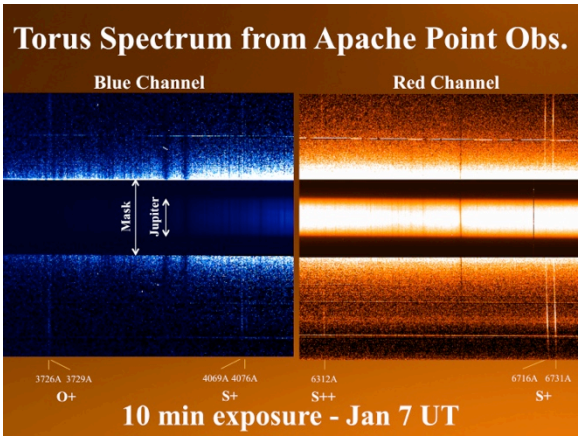

Figure 1: Visible wavelength spatially-resolved spectrum of the Io plasma torus, showing emissions from S^{+}, S^{++} and O^{+}. Sky subtraction and image rectification have not yet been performed on this dataset. The slit spans both sides of the plasma torus (shown vertically); Jupiter's spectral image lies across the image center. It was obtained through a neutral density filter to reduce stray light within the instrument. The Jupiter spectral image provides spatial registration and intensity calibration. Multiple images were obtained during one observing sessions, allowing plasma properties of the torus to be derived as a function of longitude around Jupiter and independently on the east (dawn) and west (dusk) sides of Jupiter.