EPSC Abstracts
Vol. 6, EPSC-DPS2011-1688, 2011
EPSC-DPS Joint Meeting 2011

Discovery of an Unidentified Electronic Emission Band in Io's Eclipse Spectrum

L. M. Trafton, C. H. Moore, D. B. Goldstein, and P. L. Varghese
University of Texas at Austin (lmt@astro.as.utexas.edu)

Abstract

Spectra of Io taken during early umbral eclipse by HST/STIS during the 1999 Io-Galileo Campaign were reanalyzed to improve the S/N of Io's extracted spectrum. This has revealed a spectral emission band extending from 4100 Å to at least 5700 Å that was previously unreported. The integrated intensity appears consistent with Galileo and Cassini images taken through filters that include this wavelength range

1. Introduction

As part of the 1999 Io-Galileo Campaign [1], Io was observed in eclipse on three dates using HST/STIS shortly after entering the umbra of Jupiter's shadow. Different gratings having different wavelength ranges were used on the different dates. The results reported here were obtained from the Aug 7, 1999 eclipse using the CCD detector with grating G430L, which has a spectral range of 2900–5700 Å. Each eclipse was observed using two consecutive exposures summing to ∼25 min.. The Aug 7 eclipse began late, not starting until 13 min into the umbra. The 2x2 square aperture included all of Io's disk and scattered light from Jupiter. Io was detected in eclipse primarily due to electron impact excitation of SO_2, SO, S_2, Na D, and O I 6300. On this night, only SO_2 and S_2 were within the spectral range, which peak in the laboratory near 3100 Å.

2. Observations and Results

The spectra were reprocessed to improve the subtraction of Jupiter's light scattered into the STIS aperture, which was the biggest source of error. The small size of the aperture severely limited sky-averaging. Emission was detected in both CCD exposures. The G430L grating has a dispersion 2.73 Å/pixel with 0."05 pixels. The effective spectral resolution was 44 Å, assuming uniform emission over Io's disk. The spectrum was smoothed this much to reduce random noise. It was noticed that regular spectral features occurred above 4100 Å, where the SO_2 emission should be dying out. This spectrum persists when extracted from each half of Io's disk separately; and when extracted from each of the two tandem eclipse exposures. The spectrum is not present in Jupiter's scattered background; and fringing in the detector image was excluded as a source.

This longer-wavelength emission does not agree with Monte Carlo simulations of Io's electron-excited SO_2 and S_2 emission. However, the wavelength-integrated intensity appears to be consistent with Galileo and Cassini images of Io's night side taken through filters that span this wavelength range [2],[3]. These images show evidence of widespread emission that is not associated with the volcanic plumes, and so cannot arise simply from SO_2.

3. Conclusions

The regular emission features appear to be spread too far apart to be rotational transitions. This excludes such diatomic molecules as NaK in the ground electronic state as the source. The regular features are more likely to be vibrational transitions, indicating an unidentified electronically excited species.

References

[1] Bagenal, F., HST-Galileo Io Campaign, Bull. Amer. Astron. Soc. 31, 1164–1165, 1999.

[2] Geissler, P. E., et al. Galileo Imaging of Atmospheric Emissions from Io, Science 285, 870–874, 1999.

[3] Geissler, P. E., et al., Cassini observations of Io's visible aurorae, Icarus 172, 127–140, 2004.