Hubble Space Telescope

Cycle 17 GTO/COS Proposal

COS-GTO: Io's Atmospheric Response to Eclipse

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Scientific Category: SOLAR SYSTEM

Scientific Keywords: SURFACES OF PLANETS/MOONS/OTHER, PLANETARY SATELLITES, CHEMICAL ABUNDANCES

Abstract

We will use four HST orbits to study the response of Io's SO2 atmosphere to eclipse egress in the NUV, and two more orbits to study the FUV auroral response in and after eclipse. Io's atmosphere is supported by a poorly-understood combination of direct volcanic emissions, which exist independently of sunlight, and sublimation of surface SO2 frost, which is expected to be drastically reduced as the frost cools at night or in Jupiter eclipse. A sublimation supported atmosphere will thus collapse in Jupiter eclipse, and the degree of atmospheric collapse can be used to determine the relative importance of volcanic and sublimation support. The NUV observations will use the COS G225M grating to obtain disk-integrated observations of four SO2 absorption bands, which can be used to determine SO2 atmospheric density. We cannot observe the SO2 atmosphere in eclipse, but we can observe Io as soon as it re-emerges into sunlight to watch the atmosphere recover. This experiment has been done before with FOS, with inconclusive results, but the improved sensitivity of COS will allow shorter exposures, allowing us to investigate the few minutes after eclipse, when the most diagnostic post-eclipse response is expected. G225M will provide a spectral resolution of about 0.8 A for Io's 1' diameter disk, easily resolving the 10 A wide SO2 bands, and will provide a S/N of 27 in 3 minutes (the time taken for Io to emerge) when binned to 2 A resolution, allowing good sensitivity to any post-eclipse atmospheric changes. We plan to observe two eclipse reappearances, using two orbits for each, in order to look for long-term (2-hour) as well as short-term (few minute) changes, and to check the reproducibility of any effects seen.

We will also observe the response of Io's FUV auroral emissions to Io eclipse, exploiting the high sensitivity of COS to obtain higher time resolution than has previously been possible. Though the bulk SO2 atmosphere cannot be observed in eclipse, FUV auroral emissions from neutral O and S can be observed, and their brightness can be modeled to give bulk atmospheric density (Saur and Strobel 2004). We will observe two eclipse egresses with the G130M grating at 1300 A, to look for the brightness variation of the 1304 and 1356 A OI and 1389 and 1429 A SI lines for comparison with models. Observations will be done at different Jupiter magnetic longitudes to separate eclipse-related effects from effects due to Io's varying position in the Io torus, which also affects emission brightness.

Investigators:

	Investigator	Institution	Country
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Number of investigators: 2

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Target Summary:

Target	RA	Dec	Magnitude
IO			V = 9.0 +/- 1.0, F(2900) = 50 kR

Observing Summary:

Target	Config Mode and Spectral Elements	Flags	Orbits
IO	COS/NUV Spectroscopic G225M		2
IO	COS/NUV Spectroscopic G225M		2
IO	COS/FUV Spectroscopic G130M		1
IO	COS/FUV Spectroscopic G130M		1

Total prime orbits: 6

This is a COS GTO project, no scientific justification is needed.