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Lyman Alpha Camera for Io's SO_2 atmosphere and Europa's water plumes

Alfred S. McEwen (1), Bill Sandel (1), and Nick Schneider (2)

(1) University of Arizona, Lunar and Planetary Lab, Planetary Sciences, Tucson, United States (mcewen@lpl.arizona.edu, 001-520-626-8998), (2) LASP, University of Colorado, Colorado, United States

The Student Lyman-Alpha Mapper (SLAM) was conceived for the Io Volcano Observer (IVO) mission proposal (McEwen et al., 2014) to determine the spatial and temporal variations in Io's SO_2 atmosphere by recording the H Ly-α reflection over the disk (Feldman et al., 2000; Feaga et al., 2009). SO_2 absorbs at H Ly-α, thereby modulating the brightness of sunlight reflected by the surface, and measures the density of the SO_2 atmosphere and its variability with volcanic activity and time of day. Recently, enhancements at the Ly-α wavelength (121.57 nm) were seen near the limb of Europa and interpreted as active water plumes $\sim$200 km high (Roth et al., 2014). We have a preliminary design for a very simple camera to image in a single bandpass at Ly-α, analogous to a simplified version of IMAGE EUV (Sandel et al. 2000). Our goal is at least 50 resolution elements across Io and/or Europa ($\sim$75 km/pixel), $\sim$3x better than HST STIS, to be acquired at a range where the radiation noise is below 1E-4 hits/pixel/s. This goal is achieved with a Cassegrain-like telescope with a 10-cm aperture. The wavelength selection is achieved using a simple self-filtering mirror in combination with a solar-blind photocathode. A photon-counting detector based on a sealed image intensifier preserves the poisson statistics of the incoming photon flux. The intensifier window is coated with a solar-blind photocathode material (CsI). The location of each photon event is recorded by a position-sensitive anode based on crossed delay-line or wedge-and-strip technology. The sensitivity is 0.01 counts/pixel/sec/R, sufficient to estimate SO_2 column abundances ranging from 1E15 to 1E17 per cm̂2 in a 5 min (300 sec) exposure. Sensitivity requirements to search for and image Europa plumes may be similar. Io's Ly-α brightness of $\sim$3 kR exceeds the 0.8 kR brightness of Europa's plume reported by Roth et al. (2014), but the plume brightness is a direct measurement rather than inferring column abundance from absorption. Also, the radiation-induced noise is lower at Europa, permitting longer exposure times and imaging at closer range. This is a very simple instrument with no moving parts, a mass of 4 kg (plus 1.7 kg radiation shielding), and it needs 4 W power. It has no special accommodation requirements and would simply collect data in ride-along mode during point-and-stare sequences.

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