Far-ultraviolet observations of comet C/2012 S1 (ISON) with a sounding-rocket-borne instrument

P. Feldman[1], S. McCandliss[1], H. Weaver[2], B. Fleming[3], K. Redwine[1], M. Li[4], A. Kutyrev[4], and S. Moseley[4]

[1]Johns Hopkins University
[2]Johns Hopkins Applied Physics Laboratory
[3]University of Colorado
[4]NASA Goddard Space Flight Center

We report on a far-ultraviolet observation of comet C/2012 S1 (ISON) made from a Black Brant IX sounding rocket that was launched on 20 November 2013 at 04:40 MST from the White Sands Missile Range, New Mexico, when the comet was 0.44 au from the Sun, 0.86 au from the Earth, and at a solar elongation of 26.3 degrees pre-perihelion. At the time of launch the comet was 0.1 degrees below ground horizon. The payload reached an apogee of 279 km and the total time pointed at the comet was 353 s. The sounding rocket borne instrument was our wide-field multi-object spectro-telescope called FORTIS (Far-UV Off Rowland-circle Telescope for Imaging and Spectroscopy), which is a Gregorian telescope (concave primary and secondary optics) with a triaxial figured diffractive secondary that provides an on-axis imaging channel and two off-axis spectral channels in a common focal plane. A multi-object spectroscopic capability is provided by an array of microshutters placed at the prime focus of the telescope. Our microshutter array (MSA) is based on prototype devices of the large area arrays developed at Goddard Space Flight Center (GSFC) for use in the Near Infrared Spectrograph (NIRSpec) on the James Webb Space Telescope (JWST). The imaging channel on FORTIS has a field-of-view (FOV) of 0.5 degrees square. The MSA allows selection of up to 43 individual regions, each with a solid angle of 12.4” $\times$ 36.9”, for spectral acquisition over the 800–1950 Ångstroms bandpass at a resolution of 6 Ångstroms. However a problem with addressing the MSA prevented the acquisition of spectra through individual slits. Nonetheless spectrally confused images, dominated by Lyman-alpha emission from the comet, were acquired in both off-axis spectral channels.

The imaging channel uses a CaF_2/MgF_2 cylindrical doublet to correct for astigmatism introduced by the triaxial secondary, which restricts the bandpass to wavelengths longward of 1280 Ångstroms. The corrected imaging resolution is approximately 4”. Broadband images of the comet acquired in the on-axis imaging channel throughout the duration of the flight show a variation in count rate proportional to altitude due to absorption of cometary emissions by terrestrial molecular oxygen located in the lower thermosphere. Molecular oxygen absorption has a strong dependence on wavelength, which will selectively attenuate cometary emissions from different atomic and molecular species and allow us to constrain their production rates relative to hydrogen observed in the spectral channels. Analysis is ongoing and preliminary results will be presented.

Acknowledgements: This work was supported by NASA grant NNX11AG54G to the Johns Hopkins University.