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WAVELENGTH CALIBRATION OF THE FULL-SUN ULTRAVIOLET ROCKET SPECTROGRAPH (FURST)

Abstract

The Sun has a well-known periodicity in sunspot number and magnetic field variation. The underlying cause of this 11-year cycle is not fully understood and has yet to be connected with those processes in other stellar objects. The Full-sun Ultraviolet Rocket SpecTrograph (FURST) is a sounding rocket payload being developed by Montana State University (MSU) alongside the Marshall Space Flight Center (MSFC) solar physics group. Scheduled to launch from White Sands Missle Range (WSMR) in 2022, this instrument is unique in that it will provide the connection between stellar observatories with measurements of our Sun. It will achieve this through extremely high-resolution full-disk spectroscopy in EUV. We aim to obtain a wavelength resolution R $>$ 10,000 in the 115 - 180 nm range, on par with that of the Hubble (HST) Space Telescope Imaging Spectrograph (STIS). The Lyman Alpha line (121 nm) is known to oversaturate CCD electronics and is of particular challenge for this spectral range. In addition, this resolution capability will allow us to study the 3 km/s motion (a Doppler-shift of about 0.01 Angstroms) of the relatively low-temperature plasma in the chromosphere and lower corona.

This paper will present the results of our simulation of the diagnostic lamp signal to be used in this wavelength calibration. To test the viability of this precise of a device, we are building a collimator capable of testing the FURST instrument under strict radiometric requirements. We also simulate the effectiveness of our electronics to be unsaturated at the elusive Lyman Alpha spectral line. Accounting for photon noise, CCD electronic readout noise, and statistical error lead to the development of our pre- and post-launch calibration plan. Future work includes absolute radiometric and wavelength calibration in collaboration with NIST. The FURST instrument will demonstrate the capability of producing the resolution required for atmospheric scientists to understand the extremely small Doppler-shifts of solar system planets. This impact is coupled with the diverse international partnership created by the closely-knit Sounding Rocket teams across the globe. In addition, the capabilities proven by these Sounding Rockets may encourage future satellite missions under the prospect of long-term observations.