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Data pipeline architecture and development for VELC onboard Space Solar Mission AdityaL1

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Abstract

ADITYA L-1 is India's first dedicated mission to study Sun and its atmosphere with Visible Emission Line Coronagraph (VELC), a major payload on ADITYA-L1. VELC has provision to make imaging and spectroscopic observations of the corona, simultaneously. Imaging with the Field of View (FOV) from 1.05Ro to 3Ro will be done in continuum at 500 nm. The spectroscopic observations of solar corona in three emission lines, namely 5303 Å [Fe XIV], 7892 Å [Fe XI], 10747 Å [Fe XIII], and Spectro-polarimetry at 10747 Å [Fe XIII] will be performed with FOV of 1.05–1.5Ro. In this work, the end-to-end data pipeline architecture and development of the VELC payload are presented. The VELC proposal submission form, satellite observation parameters, data products, level definitions, data pipeline and analysis software to process the big raw data sets obtained using VELC instruments onboard satellite to science-ready data are discussed.

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Keywords: VELC; Aditya-L1 mission; Coronagraph; Imaging and spectroscopic observations; Data pipeline architecture; Data flow

1. Introduction

To understand the physical and dynamic characteristics of the solar corona, observations were made during the total solar eclipses, where the moon acts as a natural occulter to block the solar disk. In 1930 Lyot invented coronagraph by blocking the solar disk, enabling the observation of the extended coronal atmosphere of the Sun. This invention opened the doors to study solar corona in the times other than a total solar eclipse, with ground base coronagraphs as well as space based instruments. Number of space mission such as SOHO, SDO, STEREO, Trace, Ulysses, Hinode, Solar Orbiter, Parker Solar Probe and many others have made observations of the sun and its

atmosphere in different wavelength domain such as X-rays, EUV and UV mostly. Some are still in operation. ADITYA -L1 is the first Indian solar mission to be launched in the L1 orbit of the Sun earth system to study the sun and solar atmosphere. The Visible Emission Line Coronagraph (VELC) (Singh et al. (2011) and Prasad et al. (2017)) will be one of the major instruments onboard ADITYA-L1. VELC is an internally occulted coronagraph designed to study the solar corona. The coronagraph is capable of recording the solar corona from 1.05Ro to 3Ro in continuum at 5000 Å with an image scale of 2.51 arcsec / pixel and a cadence of 30 s. VELC has the facility of multi-slit spectroscopy at three emission lines 5303 Å [Fe XIV], 7892 Å [Fe XI] and 10747 Å [Fe XIII] with a spectral resolution of 28 mÅ/pixel, 31 mÅ/pixel and 202 mÅ/pixel, respectively in FOV 1.05Ro to 1.5Ro with an image scale of 1.25 arcsec/pixel. VELC also has a dual-beam spectro-

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