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Validating Dawn/VIR-MS VIS-IR spectrometer calibration at Vesta

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Abstract

Context: As VIR-MS (VIS and IR Mapping Spectrometer) [1] aboard Dawn mission [2] has started the exploration of Vesta surface, it becomes necessary to validate the data calibration process and to assess the scientific quality of the results. *Aims:* VIR-MS instrument team has realized a calibration pipeline able to ingest Vesta raw data (level 1a) and to generate calibrated hyperspectral cubes (level 1b) both in units of spectral radiance (W m^{-2} μm^{-1} $sterad^{-1}$) and of spectral reflectance. In this paper we describe the methods used to derive the instrumental transfer functions and to verify correctness of the results. *Method:* The instrumental transfer functions of the two VIR-MS instrument channels (VIS: 0.255-1.07 μm; IR: 1.02-5.097 μm) are retrieved using pre-launch calibration measurements which allow us to determine: 1) spectral parameters (spectral range and response); 2) geometric parameters (FOV, IFOV), including scan mirror mechanism characterization; 3) flat field; 4) defective pixels; 5) detector's response linearity; 6) radiometric response. All these measurements were done using the same methods developed for the calibration of VIRTIS-M, a similar spectrometer aboard Rosetta mission [3, 4, 5, 6, 7]. Moreover during the Dawn mission cruise we have improved the calibration accuracy by using a combination of VIR internal calibration sources acquisitions and observations of Vesta taken during the approach phase. *Results:* After having corrected raw data for some instrumental effects (e.g. dark current, instrumental thermal background, VIS channel spectral tilt, IR readout odd-even effect) and having applied the calibration pipeline, Vesta reflectance spectra are obtained. A preliminary analysis and validation of these spectra through comparison with Dawn FC images, ground-based observations, laboratory measurements of HED analog meteorites and models is reported. In general the current VIR data pipeline allow us to recognize the typical red slope at VIS wavelengths, the 0.9 and 2 μm absorption features and the thermal emission in the 4-5 μm region. *Conclusions:* The calibration process of complex imaging spectrometers like VIR-MS is a long time-consuming activity that needs a detailed knowledge of the instrumental behavior. Further improvements are foreseen during the mission.

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