EnVision VenSpec-M - key insights into the surface and surface-atmosphere interaction and volcanic activity of Venus

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Abstract

The VenSpec instrument suite on the EnVision mission consists of three channels: VenSpec-M, VenSpec-H, VenSpec-U, and the Central Control Unit (CCU).

VenSpec-M will provide near-global compositional data on rock types, weathering, and crustal evolution by mapping the Venus surface in five atmospheric windows. VenSpec-M will use the methodology pioneered by VIRTIS on Venus Express but with more and wider spectral bands, the NASA VERITAS VISAR and Envision VenSAR-derived DEMs, and EnVision's lower orbit compared to Venus Express to deliver near-global multichannel spectroscopy with wider spectral coverage and an order of magnitude improvement in sensitivity. It will obtain repeated imagery of surface thermal emission, constraining current rates of volcanic activity following earlier observations from Venus Express [1]. In combination with the observations provided by the identical VEM instrument on the NASA VERITAS mission VenSpec-M will provide more than a decade of monitoring for volcanic activity, as well as search for surface changes.

VenSpec-M is a pushbroom multispectral imaging system using a 14 bands filter array [2]. Those 14 bands fall in four categories depending on where the radiation is originating. The radiation for the six surface bands originates at the surface. Surface bands are used to determine rock types [3, 4] as well as monitor for the thermal signature of active volcanism. The radiation in the two water vapor bands originates in a layer close to the surface and is sensitive to the abundance of water vapor which may see changes due to volcanic exhalations, complementing the H20 and HDO measurements by VenSpec-H in the middle atmosphere [5]. In the three cloud bands, radiation originates at an atmospheric layer above the surface but below the clouds. Because the signal in the cloud bands has no surface or water vapor contributions, the measurements in these bands can be used to remove cloud-induced contrast variability from the other bands. Finally, the three background bands are sensitive in spectral regions where the atmosphere is opaque, thus allowing the removal of background signal on the detector. The high density of cloud particles results in multiple scattering of the radiation, reducing the spatial resolution to 50–100 km.

To correctly interpret VEM/VenSpec-M data and map the Venus surface composition an extensive laboratory calibration campaign is underway [6, 7, 8] as well as a series of field campaigns [8, 9, 10, 11].

[1] Müller et al, this meeting [2] Helbert, J., et al. (2019) 10.1117/12.2529248 [3] Dyar et al, this meeting [4] Helbert, J., et al. (2021), 10.1126/sciadv.aba9428 [5] Vandale et al., this meeting [6] Alemanno et al, this meeting

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