HIGH-SPECTRAL RESOLUTION mid-UV SPECTROGRAPH FOR VENUS OBSERVING.
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Introduction: Investigating Venus' sulphur-oxide chemical cycle is highlighted as an important science target for Venus exploration because this cycle impacts radiative balance in Venus' atmosphere. In particular, it determines the abundance of S, O, SO, SO_2, and SO_3 in the atmosphere; and it is the abundance of these species along with H_2O that determines the rate of formation of the H_2SO_4 clouds that enshroud the planet. Additionally, the unknown UV absorber, which is expected to be responsible for more than 50% of the energy deposited to Venus mesosphere, is anticipated to be a sulphur-bearing compound [1], and its abundance is also expected to be linked to the sulphur-oxide cycle.

Required Measurement: The two species that most directly map to the mechanisms that drive the sulfur-oxide cycle are the SO_2 and SO gas species. Direct and simultaneous observation of the spatial distribution of these species as a function of local time, latitude and cloud motion in Venus' atmosphere can only be done below the clouds via in-situ observation. However, above the clouds these distributions can be derived from spectroscopic observations obtained in the mid-UV (between 190-240 nm) where the gas signatures of the two gases are isolated from the absorption signatures of other constituents prominent in Venus' atmosphere. Notably, at these wavelengths the absorption signatures of the two gases are strongly but not completely overlapping; to disentangle the bandheads of the 10Ȧ wide gas absorption bands, it is necessary to have both spectral sampling and the resolution of the sampling ≤ 2Ȧ.

Proposed Instrument: We are working to develop a compact & lightweight mid-UV spectrograph that will have sufficient spectral resolution (1.5 Ȧ) to segregate the gas signatures of the two gases and that can obtain reasonable spatial resolution of the planet disk from orbit around Venus as well as from a highly elliptical (perigee ~ 75000 km) Earth orbit. The spectral resolution of the proposed spectrograph will be 10x higher than that achieved by the UVS flown on the Pioneer Venus Orbiter, which was launched in 1978 [2]; and in fact, would be 10x higher than that acquired with any of the spectrographs flown to Venus within the last 40 years [3].The development and use of this type of UV spectrograph for space flight is long overdue, since in the most recent space-mission history the only UV spectrographs that have been flown in interplanetary space with sensitivity to the 190-240 nm wavelength region are the Galileo UVS (15Ȧ spectral resolution) which was developed in the 1980s based on Voyager [4] the SPICAV and SPICAM instruments which aslo obtained 15Ȧ spectral resolution, and were included in the Venus and Mars Express payloads, respectively [3,5]; the MASCS/UVVS (50 Ȧ spectral resolution) included on the Messenger payload [6]; and the IUVS (5Ȧ spectral resolution) included on the MAVEN payload launched November 2013 [7].

References:

[1] Esposito, L. W., (1980), Ultraviolet contrasts and the absorbers near the Venus cloud tops. *J. Geophys. Res.*, ***85***, 8151-8157. [2] Stewart, A. I., et al. (1979) *Science, 203*, 777-779. [3] Bertaux, J. L., et al. (2007) *Planetary and Space Science, 55*, 1673-1700. [4] Hord, C. W., et al. (1992) *Space Science Reviews,60*, 503-530. [5] Bertaux, J. L., et al. (2006) *J. Geophys. Res., 11*, DOI: 10.1029/2006JE002690. [6] McClintock, W. E., et al. (2007) *Space Science Reviews,131*, 481-521. [7] McClintock, W. E., et al. (2013) S*PIE Newsroom.* DOI: 10.1117/2.1201302.004733.