CUVE - CUBESAT UV EXPERIMENT: UNVEIL VENUS' UV ABSORBER WITH CUBESAT UV MAPPING SPECTROMETER.
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Abstract: Our Venus mission concept Cubesat UV Experiment (CUVE) was one of the proposals selected for funding by the NASA Planetary Science Deep Space SmallSat Studies (PSDS3) Program in 2017. Our. CUVE concept is to insert a CubeSat spacecraft into a Venusian orbit and perform remote sensing (Fig. 1) of the UV spectral region using a high spectral resolution point spectrometer to resolve UV absorbers bands and also characterize the still unidentified main absorber present in the UV region. The UV spectrometer is complemented by an imaging UV camera with multiple bands in the UV absorber main band range for contextual imaging. CUVE would complement past, current and future Venus missions with conventional spacecraft, and address critical science questions cost effectively.

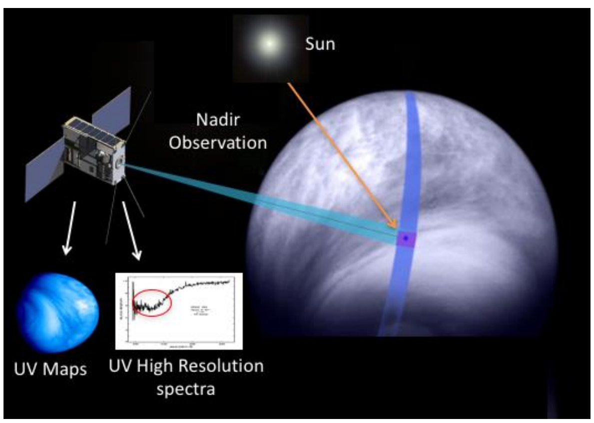

Figure 1: CUVE – Cubesat UV Experiment – in orbit around Venus will observe dayside and night side.

Introduction: The Venusian upper cloud deck, situated at an altitude range 60-70 km, is formed of small droplets comprising a mix of ~80% sulfuric acid (H_2SO_4) and water. These clouds are the reason for Venus' high albedo in the visible, where 70-80% of the incoming solar radiation is backscattered to space. For this reason, despite Venus being closer to the Sun than Earth, it absorbs a similar quantity of energy to that absorbed on our home planet. The maximum absorption of solar energy by Venus occurs in the UV where we observe spectral contrast features that originate from the non-uniform distribution of unknown absorbers within its clouds. This opacity source affects the energy balance in the Venusian atmosphere. The efficient absorbing power of the unknown UV absorbers in the clouds controls Venus' atmospheric engine. Determining the nature, concentration and distribution of these absorbers will increase the understanding of the overall radiative and thermal balance of the planet, in particular the atmospheric dynamics and the chemistry of the upper clouds. Sulfur dioxide SO_2 and the later discovered sulfur monoxide SO are strong UV absorbers present in Venus' spectrum between 200 and 340 nm; however, these species do not explain the strong absorption at longer wavelengths, around 365 nm which signifies a different substance (in gas or aerosol form) distributed non-uniformly in the cloud top and absorbing in the UV (for overview see [1]). Some candidate species have been proposed to explain the spectral contrast features in the UV: SO_2, $FeCl_3$, Cl_2, Sn, SCl_2, S_2O (e.g., [2], [3], [4], [5], [6]), elemental sulfur (S_8 o S_x in general) o polymeric sulfur ([7] and the recently hypothesized S_2O_2 (OSSO) ([8]). Spectroscopic measurements that reveal spatial and temporal variability will constrain contributions from these species. Previous missions and studies did not successfully detect the origin of the absorbers.

Concept: CUVE is a targeted mission, with a dedicated science payload and a compact spacecraft bus capable of interplanetary flight independently or as a ride-share with another mission to Venus or to a different target. CUVE Science Objectives are: 1) Nature of the "Unknown" UV-absorber; 2) Abundances and distributions of SO_2 and SO at and above Venus's cloud tops and their correlation with the UV absorber; 3) Atmospheric dynamics at the cloud tops, structure of upper clouds and wind measurements from cloud-tracking; CUVE has a high spectral resolution spectrometer capable of resolving SO and SO_2 lines. The payload measures a broad spectral range spanning all relevant UV absorbers, and also includes a UV imager.

Summary and Conclusions: CUVE will produce high spectral resolution UV spectra of Venus and broad spectral range imaging maps. These maps will characterize the nature of the components in its atmosphere that absorb in the UV. This mission will be an excellent platform to study Venus' cloud top atmospheric properties where the UV absorption drives the planet's energy balance.

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