



VIVA (Venus' Interior, Volcanism and Atmosphere): a Venus mission to reveal unknown interior structure, thermosphere dynamics and meteoroid flux from atmospheric response to seismic waves, volcanic events and external forcings

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Despite being often described as Earth's sister planet due to a similar distance to the Sun and comparable size, Venus's internal structure and geodynamic regime, together with its upper atmosphere dynamics and asteroid entry rates, are poorly constrained. Whereas Venus is a prime candidate for being a tectonically active planet and presents a very dynamic atmosphere, future missions will not constrain high frequency phenomena such as seismic waves, meteoroid impacts, and high frequency gravity waves. These short duration events can be used to infer Venus' seismicity, internal structure, upper atmosphere dynamics and the small Solar System bodies population [1].

We present a mission concept that targets high rate observations of upper atmosphere airglow emissions on both the day and night side of Venus, as well as thermal imaging in the visible. These observations will allow us to image the propagation of acoustic waves generated by seismic waves, enabling us to investigate quake locations and magnitudes, as well as to determine the structure of the crust and upper mantle. Volcanic events will also be studied through the associated increase in surface and atmosphere temperature. In addition, variations in airglow emissions will constrain the transfer of mechanical energy from the lower atmosphere to the thermosphere, as well as atmosphere dynamics (winds) and composition, and its response to solar forcing. Finally, the observation of fireballs produced by asteroid entries will constrain the asteroid population that crosses Venus's orbit.

The instruments required to perform these high rate observations are presented. They are based on a strong heritage relying on previous implementations in planetary missions.

The mission concept and spacecraft demand new capabilities in terms of on-board attitude determination and data processing capabilities. In particular, a dedicated on-board data processing unit capable of autonomously detecting different event types with advanced algorithms, including

machine learning methods, has been identified as a key component of the mission. This unit will also be used to average out phenomena over different temporal and spatial scales. To maximise science return, the mission will adopt an operational concept involving the capability to download high rate event data from a first quicklook information, similar to the one implemented on InSight NASA mission.

The feasibility of the mission, already partly demonstrated by VAMOS JPL/NASA mission concept study [2,3], is validated through a dedicated mission analysis study.

References

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