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Investigating the Geophysics of Venus: Result of the post-Alpbach Summer School 2014

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Venus has been investigated by only five dedicated mission programs since the beginning of space flight. This relatively low level of interest is remarkable when considering that mass and radius of Venus are very similar to Earth's, while at the same time characteristics such as spin rate, atmospheric composition, pressure and temperature, make Venus a very different, inhabitable world. The underlying causes of these differences are not well understood. Apprehending Venus' tectonics and internal structure would not only shed light on the question why those two planets evolved so differently, but also help refining current models of planetary systems formation. In order to answer the question about reasons for differences in evolution of those two planets a group of 15 young scientists and engineers designed a mission to Venus during a follow-up of the Alpbach Summer School 2014.
The primary objective of this mission is to learn whether Venus is tectonically active and on what time scale. In order to accomplish this goal the mission will determine the crustal structure of Venus, the current activity and distribution of active volcanoes and the movement of continental plates. The secondary objective is to further constrain the models of Venus' internal structure and composition. To achieve this, the mission will investigate the size, state and composition of the core as well as the state and composition of the mantle.
The proposed mission consists of an orbiter in a near-polar circular orbit around Venus and a balloon for in-situ measurements operating during the initial phase of the mission. The balloon carries a nephelometer, a magnetometer, a mass spectrometer and stereo microphones and meteorological package. The orbiter carries a gradiometer for determining the gravity field, a synthetic aperture radar for investigating small changes in surface topography and mapping microwave signals from the surface and an IR and UV spectrometer and IR camera for monitoring heat signatures from volcanoes. By using the previous landers as reference points it will also be possible to accurately determine the spin rate with the radar.
The nominal mission duration is planned to be five years starting from the release of the balloon. The balloon will operate for 25 days during which it oscillates vertically in the atmosphere between an altitude of 40 and 60 kilometres in a period of about six hours. At the same time, due to prevailing wind directions on Venus, it will gradually spiral from the equator towards higher latitudes. During the balloon science phase the orbiter will be in an elliptical orbit to maximise the time of visibility of the balloon with the orbiter. After this phase, the orbiter will be brought into a circular orbit at an altitude of 250 kilometres. To save fuel, apoapsis lowering will be achieved by aerobreaking in Venus' atmosphere.
In the presentation further details about the mission timeline will be given. Particular engineering problems such as thermal control and data communication and the proposed solutions will be presented.