L.O.V.E. (Life on Venus Exploration) Mission

DSE group 16 - “Could there be life on Venus?”

The Mission

When searching for life we tend to imagine faraway exoplanets, and rarely do we think of our own solar system. Although a lot of focus is put on Mars, Venus, our closest neighbor, could currently host life. Temperatures of 475 ℃ and pressures 95 times what we experience on Earth don’t offer the best conditions for life on the surface. However at high altitudes the temperature and pressure drop until, in the area between 50 and 70 km, they approach those of Earth. Here, amongst a thick deck of sulfuric acid clouds, it is speculated that life could exist, perhaps in the form of bacteria living in suspended water bubbles.
The purpose of our mission is to design a remote sensing platform to perform in-situ measurements on the atmosphere and soil composition of Venus, in an effort to learn more about the planet while looking for specific biomarkers that could be attributed to life.

The design

To achieve this ambitious mission our team has analyzed for weeks the different stakeholders, scientific objectives and requirements involved, along with performing numerous trade-offs to determine the concept of the mission, the number of segments and the concepts for each segment.
Searching for life on a different planet is a matter of trying enough times, hence a mission duration of 200 days was used for the design, to allow enough time for potential biomarkers to be located. This duration called for a design that was remarkably more self-sufficient and reliable than probes previously flown to the planet. Our solution is a pumped hydrogen balloon which will fly along with the 350+ km/h winds of Venus in an equatorial path around the planet. This hybrid “zero-pressure and superpressure” balloon will oscillate between 50 and 62 km altitude while carrying 6 scientific instruments and taking measurements at different altitudes and longitudes. It will also make clever use of zonal winds at different altitudes to ensure it remains close to the equator. The balloon will be taken into the atmosphere inside an entry and descent vehicle and inflated while descending into the atmosphere, held up by the main parachute. These scientific measurements will be supported by two relay satellites orbiting at an inclination of 30.7° around Venus, with their right ascending node 90° apart from each other. The satellites are what allows the balloon to determine its position on the planet and the scientific data to be transmitted back to Earth.
Although the launch and the transfer vehicle fall outside of the detailed design of this project, the currently-selected launcher is the Falcon 9.