Venusian Atmospheric Interplanetary CubeSat Concept (V-ATOMICC)

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PROJECT MISSION

The project goal was to design a CubeSat mission to detect phosphine gas in the atmosphere of Venus in order to prove or disprove the possibility of life in its atmosphere.

This project was created in response to the controversial article published in *Nature Astronomy* which showed a possible detection of the spectral fingerprint of Phosphine by the Atacama Large Millimeter Array(ALMA) and James Clark Maxwell Telescope(JCMT).

This is an example of a 6U CubeSat bus from EnduroSat our mission requires.

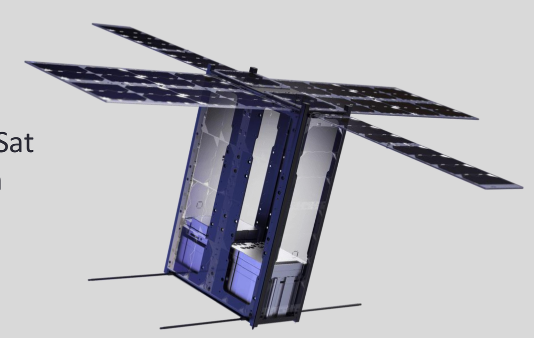


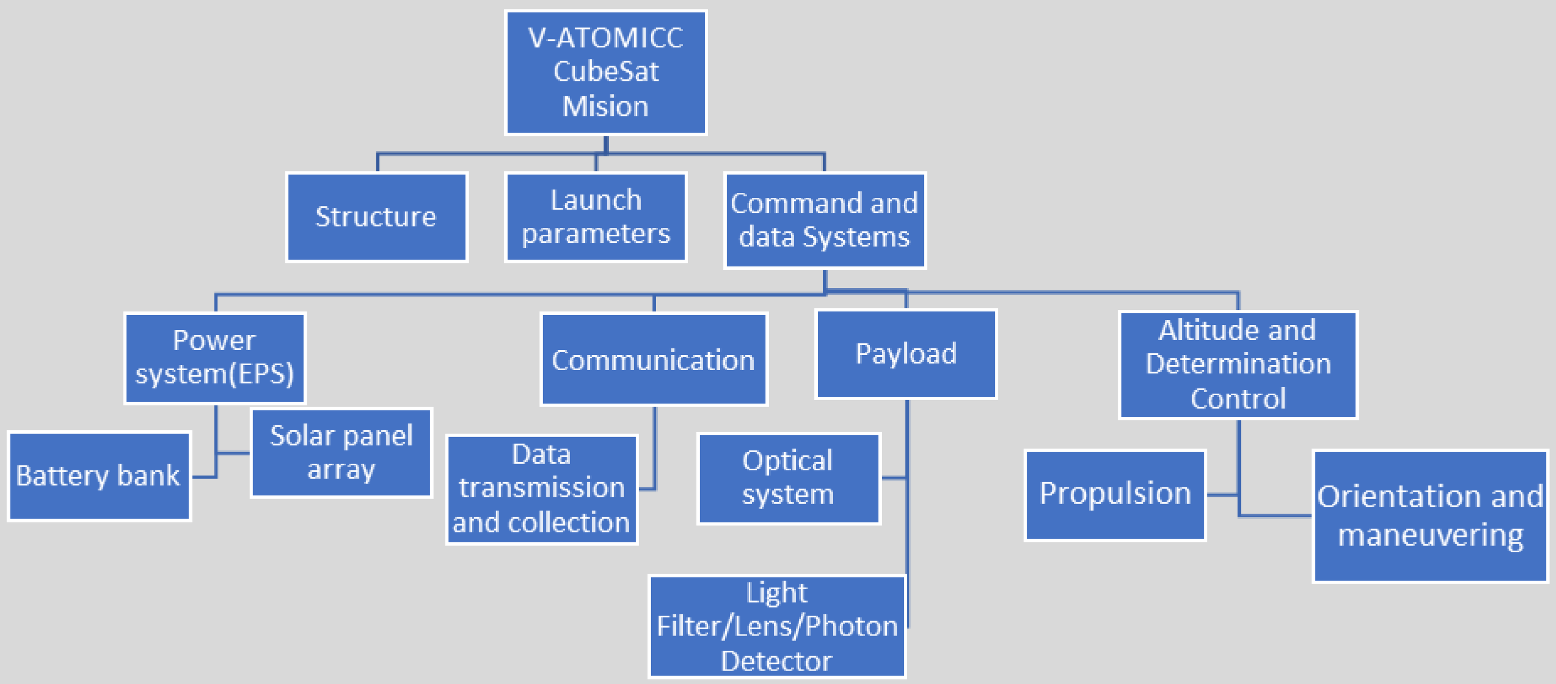
Photo taken by NASA's Mariner 10 spacecraft showing the layers of fast-moving clouds around the planet. Credit: NASA/JPL-Caltech

This is a global view of the surface of Venus created from the first cycle of Magellan mapping and mapped using a computer simulation Credit: NASA/JPL-Caltech

CUBESAT REQUIREMENTS

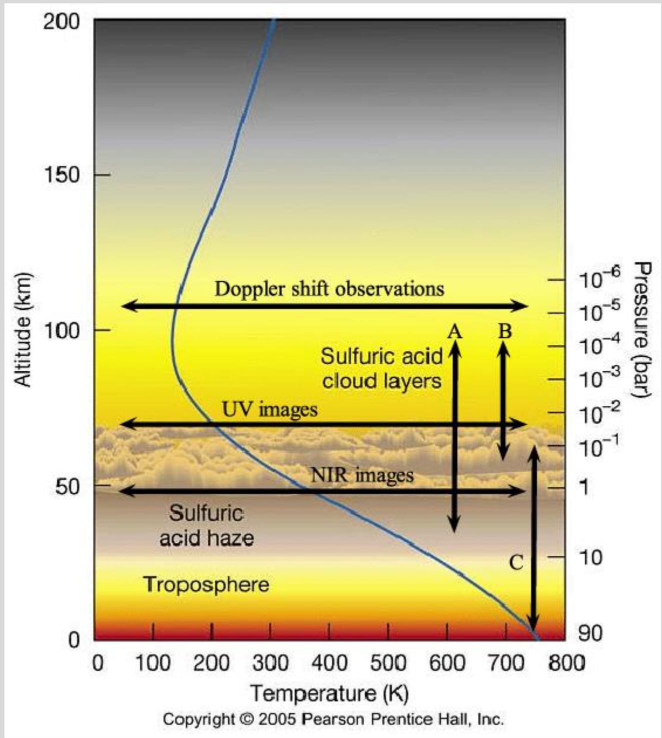
The CubeSat will be traveling in deep space which will require more advanced systems to operate. Deep Space considerations:

-Increased distance from Earth
-High radiation levels
-Extreme temperatures



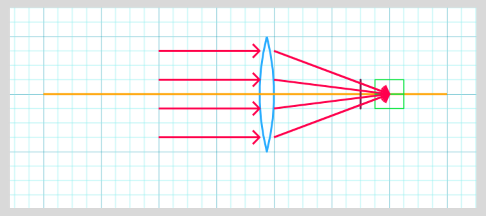
THE ATMOSPHERE OF VENUS

The range of atmosphere we are looking at is between 45 km and 70 km above the surface of Venus. This is the range we expect there could be life. Venus has an incredibly dense and hot atmosphere. Composed mostly of carbon dioxide and sulfuric acid clouds the temperature at the surface is 740 K (872 F) has a pressure of 93 bar (1350 psi). However, the region we have studied is most like the conditions on Earth. The pressure and temperature in this range is close to the same as Earths and it also contains about 20% oxygen and 78% nitrogen making It a possible environment for life.

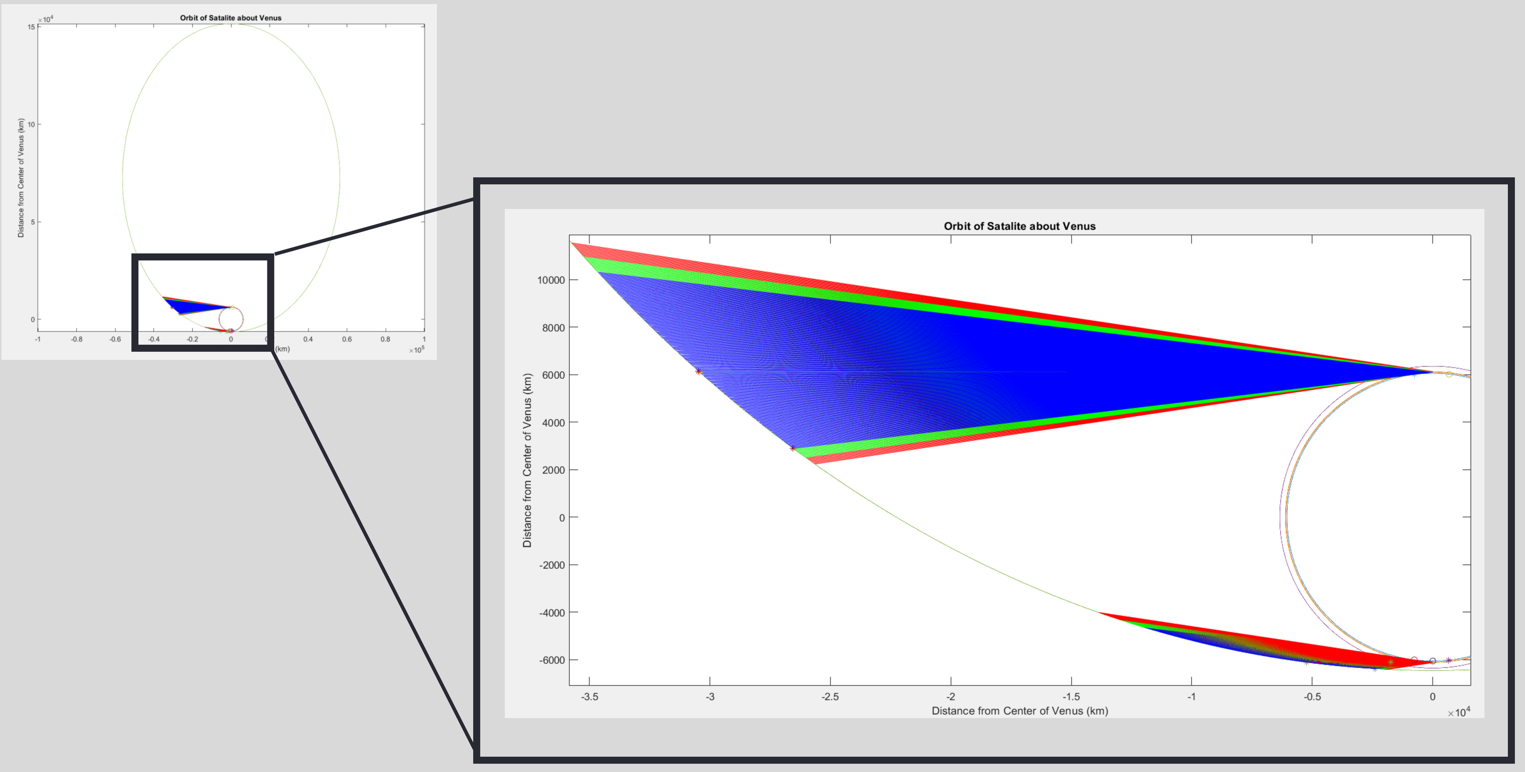


OUR DESIGN

Our design consists of the optical system on the CubeSat which will collect light emitted from the atmosphere of Venus. The system consists of a 0.435mm radius of aperture, a lens with a focal length of 8cm, a 10µm filter, and a detector which must be sensitive in the 10µm wavelength range, and can detect an wattage of 0.03374µW. In addition, there will be a similar device but will have a 11µm filter which will allow us to compare the difference between a high absorption band and a low absorption band to act as a base line for the measurements.



This is a model of the optical system with the satellite. It shows the incident light interacting with the convex lens then being reflected through the filter and entering the detector.

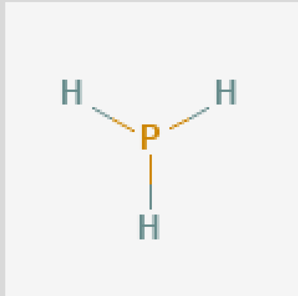


This figure shows the satellite orbit and its two potential data collection regions.

PHOSPHINE AS A BIOSIGNATURE

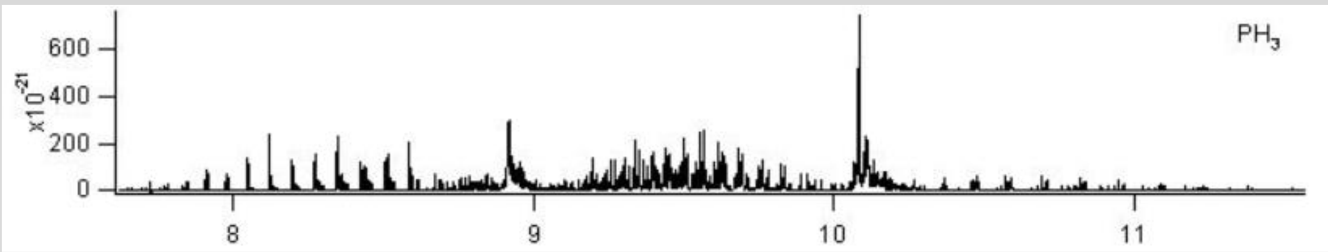
Due to Venus having a hospitable zone in its atmosphere to house life, many believe that microscopic life forms could exist in the cloud layers. Discovering phosphine could further prove this hypothesis. On Earth phosphine production is found in anerobic ecosystems, such as those found around deep hydrothermal vents in the ocean. A discovery of life on Venus would revolutionize the way we explore the solar systems for habitable planets.

The exact reason that phosphine is produced during anaerobic activity is still unknown , however researches suspect that It is produced chemically by turning other compounds into phosphine. Phosphine can also be produced from lightning or volcanic activity but not in enough quantities for it to be a compelling explanation for phosphine on Venus.



Compound Summary:

- Formula: PH3
- Molecular Weight: 33.998
- Description: Colorless toxic gas, flammable and explosive at room temperature



DATA CALCULATIONS

Irradiance Calculations

- We needed to know how much light we expect to collect in the specific excitation bandwidth and an unexcited bandwidth to compare
- If we can compare and find a significant difference in the signal strengths, we can detect the existence of phosphine

Applying the effects of the 100nm wide bandwidth filter, centered at 10µm, our calculations brought us to an expected Irradiance of: 0.0568 W/m^2 at closest approach in the orbit given a 20 ppb distribution.