"CYTHEREAN SEP MISSION: VENUS EXPLORATION"

A Novel Concept for High Altitude Planetary Atmospheric Exploration.

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Introduction: Cytherean Sep, aims to provide new science data, complementing the studies carried out on prior exploration missions, highlighting a research approach on astrobiological field and enhancing the understanding of evolution led to a hostile environment. Applying, the proposed exploration platforms to complete in-situ research of physicochemical processes in Venus' upper atmosphere, which could catalyze the organic compound formation processes. Landing for a long duration mission and descent safely on the region require a significant advance in engineering development and it's estimated that this kind technology will be ready for the next decade or beyond. On the other hand, the panorama for aerial platform is more promising in the medium term according with "Venus technology plan December 2018" [1].

Image 1 logo mission. Own source.

The present mission concept it's focused on an in-situ observation in the middle and higher Venus' atmosphere approximately 50 or 70 kilometers, implementing a maneuverable long-wingspan deployed platform (AFISV) Atmospheric Flying Investigative Station of Venus, the aid of three attachable drones (AVEV) Aerial Venus Explorer Vehicle and an orbiter. It's a high benefit - high-risk mission for extended periods of observation and requires a significant investment, exhaustive engineering development, due to the hard environment conditions, and the entry atmosphere process. The AFISV equipped with multispectral cameras, sensors, chromatographs, a spectrometer, and a RAMAN to capture relevant data, such as the nature of the ultraviolet spectrum of possible organic compounds and an analysis of samples from the upper atmosphere on the laboratory on board, contributing to the data of the scientific community that helps to solve questions and understand the aspects of thermal, chemical and atmospheric evolution of Venus planet. A Synthetic aperture radar will be used to map the surface, and it will also have sensors on the thermal shield that will reach the surface after being used as a protective shield at the entrance to the high atmosphere of Venus.

According to recent studies by a team of Russian and American-scientists [2], including Limaye, who is a member of the Venera-D scientific team; it was detected in the ultraviolet spectrum certain spots in the clouds of the high atmosphere of Venus, which by the way, has pressure and temperature conditions similar to the Earth at a height between 50 to 60 km, and possibly it is a formation of organic compounds that despite the presence of carbon dioxide, sulfuric acid among other compounds, could develop and survive, considering the existence of complex organic compounds that develop and subsist in extreme environments in the Planet Earth.

Although, the planetary research scientific community has sufficient information to understand the origin and composition of dark traces detected in the ultraviolet spectrum. It is not understood why it has not been mixed with the other particles present in the atmosphere and why it is absorbing ultraviolet light.

The instrument for meteorological and cartographic analysis:

● V28: The V28 camera uses a 24mm lens; that allows ultraviolet photographs.
● IF40: Using 24mm lens infrared photographs, provide a way to penetrate the cloudy part of Venus.
● IF41: Like the IF40, the IF41 features a 24mm lens; but they use a different frequency variation that would provide density and temperature information for cloud formations.
● EV30: For a similar perspective to human vision, visible spectrum (focal strait) photographs with a 1000mm lens are used
● EV31: Allows visible spectrum photography with an 8mm wide-angle lens for larger amplitude shots.
● OSI32: The display of the infrared solar concealment camera allows possessing accurate information about the ambient radiation and temperature of the planet, its design has a lens of 24mm that favors the taking of spectra.

The configurations of scientific cameras give a great contribution to the research, since we can work with the information obtained from the Venusian atmosphere around climate changes (drastic), temperature gradients, topography and images in various color scales with great detail of possible discoveries for the scientific world.

● Gas analysis chamber (RAG): The explorer will be equipped with a gas analysis system, composed of a chromatograph, allowing deep molecular analysis of the various gas particles and aerosols found in the Venus clouds. The gas will be drawn in by a turbine where it will enter a ream with corrosion protection (critical deterioration), the gate has a "diaphragm" mechanism type door that allows he closure and opening efficiently, quickly and airtightly.
● After the entire gas analysis process using the chromatograph, the data will be sent to the analysis facilities attached to Nasa.

● Navigation cameras: The unmanned vehicle has 4 cameras for dynamic navigation in the Venus atmosphere since in the field of research Venus has drastic climate changes which constitute dangers to the vehicle. In its field of view, it has an angle of 60 with the type of wide-angle lens, so you can see greater area than linking it to an artificial vision system, the camera will allows evading the possible risks to the vehicle.
● Cloud mapping and weather radar: The aerial explorer will have weather radar which will allow the mapping of cloud formations; allowing the safe movement of the vehicle; and it will also show us the behavior of the atmosphere for further studies and analysis.
● Radioactivity Meter: The aerial explorer will have the measurement instrument on the highest and lowest peaks in radioactivity, since the planet has critical indices, this radiation is presented even on the planetary surface and thus, with the data provided by this team, may allow to hypotheses or knowledge in the area of radioactivity in the field of Venus.

(SOCSV) Venusian space communication system: In a space exploration mission, communication has a fundamental role for the success of the same; in this case, it is proposed to use three types of ships (Orbiter, AFISV, and AVEV), each one of them with its communication instruments to ensure a data findings and real-time monitoring for the study of Venus. The ships will have dual-band systems. These have an X band transmission and receiver, allowing to send and receive 8 GHz signals, and will also have another S band system that handles 2 GHz frequencies. On the other hand, a redundant system will be implemented for the mothership and the orbiter, so that it works omnidirectionally and links the ships in case of phenomena or problems during the mission.
The orbiter will be the link between the mothership and the (DSN) Deep Space Network. It will perform a triangulation with trajectory, calculated between three points from earth, the orbiter which rotates with Venus, taking advantage of its slow cycle of rotation, and finally the naves on the surface of Venus.

Solar cells for AFISV, assumptions/goals for the air explorer vehicle:

Power	10 kW/h SOP 7,628 kW/h SOP, assuming 33% worst-case degradation
Deployed area (4 wings section)	48 m^2, assuming 7,628 kW/h SOP
Deployed stiffness	> 0,05 Hz
Deployed strength	> 0,1 g
Specific power	> 120 W/kg SOP
Stowed volume	> 40 kW/m^3
Voltage	100 - 160 V
Blanket	Flexible substrate, assuming < 1 kg/m^2 areal density, 0,03" thick
Planar vs concentrator	Assuming planar arrays will be used
Deployment reliability	Goal: "100%" - Deployment is highest perceived project risk

Table 1.

Solar cells for orbiter and protective thermal shield, assumptions/goals for the orbiting vehicle:

Power	5 kW/h BOL 3.8 kW/h EOL, assuming 33% worst-case degradation
Deployed area (4 wings section)	24 m^2, assuming 3.8 kW/h BOL
Deployed stiffness	> 0,05 Hz
Deployed strength	> 0,1 g
Specific power	> 120 W/kg BOL
Stowed volume	> 40 kW/m^3
Voltage	100 - 160 V
Blanket	Flexible substrate, assuming < 1 kg/m^2 areal density, 0,03" thick
Planar vs concentrator	Assuming planar arrays will be used
Deployment reliability	Goal: "100%" - Deployment is highest perceived project risk

Table 2.

References:

[1]Venus technology plan, December 2018 Available: https://www.lpi.usra.edu/vexag/reports/Venus-Technology-Plan-DRAFT-V1.pdf

[2] K. Cooper, «Astrobiology at Nasa LIFE IN THE UNIVERSE, » astrobio.net, 1 February 2017. [En línea].
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