IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Astrobiology and Exploration (6)

Author: Dr. Andreas Elsaesser
Free University of Berlin, Germany, a.elsaesser@fu-berlin.de

Dr. Amedea Perfumo
Geoforschungszentrum Potsdam, Germany, aperfumo@gfz-potsdam.de
Dr. Andrew Mattioda
National Aeronautics and Space Administration (NASA), Ames Research Center, United States, Andrew.L.Mattioda@nasa.gov
Dr. Antonio J Ricco
National Aeronautics and Space Administration (NASA), United States, ajricco@stanford.edu
Prof. Christophe Danelon
Delft University of Technology (TU Delft), The Netherlands, c.j.a.danelon@tudelft.nl
Prof. Dirk Wagner
Geoforschungszentrum Potsdam, Germany, dirk.wagner@gfz-potsdam.de
Dr. Farid Salama
National Aeronautics and Space Administration (NASA), Ames Research Center, United States, Farid.Salama@nasa.gov
Prof. Francesco Canganella
Università degli Studi dellaTuscia, Italy, canganella@unitus.it
Prof. Hans-Gerd Löhmannsröben
Potsdam University, Germany, loeh@chem.uni-potsdam.de
Prof. Harold Linnartz
University of Leiden, The Netherlands, linnartz@strw.leidenuniv.nl
Prof. Renato Fani
Università degli Studi diFirenze (UniFI), Italy, renato.fani@unifi.it
Dr. Richard Quinn
National Aeronautics and Space Administration (NASA), Ames Research Center, United States, rquinn@mail.arc.nasa.gov
Dr. Victor Parro
Centro de Astrobiologia (INTA-CSIC), Spain, parrogv@cab.inta-csic.es
Dr. Wayne Nicholson
University of Florida, United States, WLN@ufl.edu
Dr. Zita Martins
Instituto Superior Técnico, Portugal, zita.martins@tecnico.ulisboa.pt

EXOCUBE: A MINIATURISED IN-SITU SPACE LABORATORY FOR ASTROBIOLOGICAL EXPOSURE EXPERIMENTS ON THE INTERNATIONAL SPACE STATION.

Abstract

The influence of space and planetary conditions on organic molecules, biological supramolecular structures, and living organisms is of prime interest in the field of astrobiology. Experimentally, space and

planetary conditions are not easily accessible in ground-based laboratories. This especially holds true for space radiation and microgravity. Therefore, performing experiments directly in space allows exposure to real microgravity and overcomes the technical challenge of trying to simulate solar and cosmic radiation on Earth. The Exocube space exposure platform is currently being developed by the European Space Agency as part of a new European Space Exposure Platform for the International Space Station. Exocube will be equipped with a miniaturized Fourier transform infrared spectrometer and a system of LEDs and photodiodes for colorimetric and fluorescent spectrophotometry. One of the main questions Exocube will address is how life at different stages of complexity responds to, and evolves in space and planetary conditions and what biomolecular mechanisms come into play at the interface between biology and physics. Exocube is aiming to address these questions with far reaching implications for the interpretation of the results of past and upcoming planetary exploration missions.

Exocube is part of a new generation of space exposure experiments able to monitor experimental parameters *in-situ* via spectroscopic instrumentation. While leveraging existing cubesat technology from the O/OREOS satellite, Exocube is pushing forward the design and development of *in-situ* experiments for astrobiology in space. On Exocube, it will be possible to expose living organisms not only to cosmic but also to solar radiation whereas photochemical reactions of organic molecules can be interrogated via infrared spectroscopy. Experiments on Exocube range from exposure of biogenic molecules and protocellular structures to living prokaryotic and eukaryotic microorganisms. Well-characterised samples will be exposed to radiation levels in low Earth orbit and microgravity in order to measure *in-situ* molecular stability via vibrational spectroscopy and biological response via reporter dyes. This will allow us to study in detail the bio-molecular pathways triggered by radiation events and microgravity, and will help to identify key molecules and components, which are involved in the adaptation of these organisms to space conditions.

Outcomes from the Exocube project will support current and upcoming ESA/NASA planetary and space exploration missions (e.g. ExoMars, Mars2020, JUICE) addressing key questions in the area of radiation biology, planetary protection, biomarker stability, life-detection on other planets and biotechnologies for life-support systems.