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IMPLEMENTATION OF THE MILLER UREY EXPERIMENT IN SPACE

Abstract

More than 50 years ago, Stanley Miller and Harold C.Urey carried out their landmark experiment, demonstrating that amino acids can be created from simple gases, then assumed to be present in the early earth atmosphere. Under a contract by ESA Joanneum Research, Graz University of Technolgy (Austria) and Verhaert Space (Belgium) develop the Miller-Urey Experiment in space. The industrial team is supported by the Science Team, Prof.P.Ehrenfreund (University of Leiden), Dr.Rainer Schräpler (University of Braunschweig) and Dr.Oliver Botta (ISSI, Bern). The experiment, which will be conducted on board of ISS, is aimed at the investigation of prebiotic chemical pathways for the synthesis of organic compounds in the accretionary disk environment. Solid silicate particles serve as surfaces for water ice to form thin mantles around the grains. The repeated movement of the grain/ice mantles through a spark discharge region stimulates chemical reactions similar to the original Miller-Urey-Experiment. At the temperatures below -5 deg. a distribution of intermediates and products will be formed, which will provide information about the reaction pathways. The chemical reactions are carried out in three pairs of gas-tight spherical vials made of stainless steel. One vial contains hydrogen, methane, ammoniac and water ice on silicate grain particles, the other vial has a different gas mixture composed of hydrogen, carbon monoxide, nitrogen and water ice on silicate grain particles. Each vial provides a high-voltage electric discharge field, through which the ice-covered particles will float in microgravity and where the reactions will take place. Piezo-electric shakers mounted on the vials avoid sticking of particles to the walls of the vial. During the experimental phase of about 200 hours the temperature is kept below -5C

by Peltier elements. After the experiment is completed, the astronaut dismantles the vials and puts them into the MELFI freezer on board of the ISS for storage. Passive cooling is used during download of the vials to earth by the Space Shuttle. The gas mixtures and solid residues inside the vials will be analyzed after return to ground. The experiment is currently in CDR phase and planned to be delivered to ESA by the end of 2009. The upload to ISS is foreseen for 2010. The paper describes the requirements, the set-up of the experiment and the technology involved. Initial test results obtained during parabolic flight campaigns and drop tower and laboratory tests to optimize operational parameters are also presented.