

Planetary and Space Simulation Facilities (PSI) Ψ at DLR

C. Panitz(1,2), E.Rabbow (2) , P.Rettberg (2), M.Kloss (2), G.Reitz (2), G.Horneck (2)

(1) Institute of Aeromedicine, RWTH, Aachen, Germany, cpanitz@ukaachen.de, (2) Institute of Aerospace Medicine, Radiation Biology Section, German Aerospace Center (DLR e.V.), Cologne, Germany (corinna.panitz@dlr.de, ++49 2203 61970)

Abstract

The Planetary and Space Simulation facilities at DLR offer the possibility to expose biological and physical samples individually or integrated into space hardware to defined and controlled space conditions like ultra high vacuum, low temperature and extraterrestrial UV radiation. An x-ray facility stands for the simulation of the ionizing component at the disposal.

All of the simulation facilities are required for the preparation of space experiments:

- for testing of the newly developed space hardware
- for investigating the effect of different space parameters on biological systems as a preparation for the flight experiment
- for performing the “Experiment Verification Tests” (EVT) for the specification of the test parameters
- and “Experiment Sequence Tests” (EST) by simulating sample assemblies, exposure to selected space parameters , and sample disassembly

To test the compatibility of the different biological and chemical systems and their adaptation to the opportunities and constraints of space conditions a profound ground support program has been developed among many others for the ESA facilities of the ongoing missions EXPOSE-R and EXPOSE-E on board of the the International Space Station ISS . Several experiment verification tests EVTs and an experiment sequence test EST have been conducted in the carefully equipped and monitored planetary and space simulation facilities PSI of the Institute of Aerospace Medicine at DLR in Cologne, Germany. These ground based pre-flight studies allowed the investigation of a much wider variety of samples and the selection of the most promising organisms for the flight experiment.

EXPOSE-E has been attached to the outer balcony of the European Columbus module of the ISS in February 2008 and will stay for about 1 year in space; EXPOSE-R has been attached to the Russian Svezda module of the ISS in spring 2009 and mission duration will be approx. 15 months. The missions will give new insights into the survivability of terrestrial organisms in space and will contribute to the understanding of the organic chemistry processes in space, the biological adaptation strategies to extreme conditions, e.g. on early Earth and Mars, and the distribution of life beyond its planet of origin. The results gained during the simulation experiments demonstrated mission preparation as a basic requirement for successful and significant results of every space flight experiment. Hence, the Mission preparation program that was performed in the context of the space missions EXPOSE-E and EXPOSE-R proofed the outstanding importance and accentuated need for ground based experiments before and during a space mission.

The facilities are also necessary for the performance of the ground control experiment during the mission, the so-called Mission Simulation Test (MST) under simulated space conditions, by parallel exposure of samples to simulated space parameters according to flight data received by telemetry.

Finally the facilities also provide the possibility to simulate the surface and climate conditions of the planet Mars. In this way they offer the possibility to investigate under simulated Mars conditions the chances for development of life on Mars and to gain previous knowledge for the search for life on today's Mars and in this context especially the parameters for a manned mission to Mars.



Figure 1: Test chamber used for an EVT with a light source SOL 2000 for the solar UV simulation

[4] de la Torre Noetzel, R.; Sancho, L.G.; Pintado, A.; **Rettberg, Petra**; **Rabbow, Elke**; **Panitz, Corinna**; Deutschmann, U.; Reina, M.; **Horneck, Gerda** (2007): BIOPAN experiment LICHENS on the Foton M2 mission Pre-flight verification tests of the *Rhizocarpon geographicum*-granite ecosystem. COSPAR [Hrsg.]: *Advances in Space Research*, 40, Elsevier, S. 1665 - 1671, DOI 10.1016/j.asr.2007.02.022

References

- [1] **Rabbow E, Rettberg P, Panitz C, Drescher J, Horneck G, Reitz G** (2005) SSIOMUX – Space Simulation for Investigating Organics, Evolution and Exobiology, *Adv. Space Res.* 36 (2) 297-302, doi:10.1016/j.asr.2005.08.040Aman, A. and Bman, B. (1997) *JGR*, 90, 1151–1154.
- [2] Fekete A, Modos K, Hegedüs M, Kovacs G, Ronto Gy, Peter A, Lammer H, **Panitz C** (2005) DNA Damage under simulated extraterrestrial conditions in bacteriophage T7 *Adv. Space Res.* 305-310Aman, A. et al. (1997) *Meteoritics & Planet. Sci.*, 32, A74.
- [3] Cockell Ch, Schuerger AC, Billi D., Friedmann EI, **Panitz C** (2005) Effects of a Simulated Martian UV Flux on the Cyanobacterium, *Chroococcidiopsis* sp. 029, *Astrobiology*, 5/2 127-140Aman, A. (1996) *LPS XXVII*, 1344–1