

## Planetary and Space Simulation Facilities (PSI) Ψ at DLR

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### Abstract

The Planetary and Space Simulation facilities at DLR allow a broad range of tests of physical as well as biological and chemical material individually or integrated into space hardware. The results of these experiments support the design optimization and verification of spacecraft devices and the selection of the most promising biological and chemical material for flight experiments.

In the focus of interest are defined and controlled space and planetary conditions, especially ultra high vacuum, low temperature and extraterrestrial UV or x-ray radiation for the simulation of the ionizing component. In the carefully equipped and monitored simulation facilities dedicated to biological experiments newly developed space hardware is tested and short period or long term effects of the different space parameters on biological, chemical and physical systems is investigated.

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 EXPOSE-R and the completed EXPOSE-E mission on board of the International Space Station ISS. Several experiment verification tests EVT and an experiment sequence test EST have been conducted in the 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 had been attached to the outer balcony of the European Columbus module of the ISS in February 2008 and stayed for 1,5 years in space; EXPOSE-R has been attached to the Russian Svezda module of the ISS in spring 2009 and mission retrieval will be approx. in November 2010.

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.

## References

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