

MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Facilities and Operations of Microgravity Experiments (5)

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MAPHEUS - THE MAIDEN FLIGHT OF A NEW VEHICLE FOR MICROGRAVITY EXPERIMENTS

Abstract

There are numerous materials science experiments in microgravity, which can be realized on sounding rockets with reduced diameter and power consumption, e.g. the gelation of aerogels, directional solidification of alloys and diffusion measurements in metallic melts. Such a rocket must offer a period of good microgravity-conditions for more than 120 s. The MAPHEUS (Materialphysikalische Experimente unter Schwerelosigkeit) rocket meets these requirements. The payload is based on modules with 356 mm diameter, which are also used in the REXUS project. MAPHEUS implements the newly developed REXUS service-system. This service-system can control the power supply and handles data communication and time event management of the scientific experiments. An RCS-Module (Rate-Control-System) has been designed and built. This module contains a tank filled with pressurized gas (nitrogen), solenoid valves and nozzles, which are used to reduce the spin during the ballistic flight phase to less than 30/min providing excellent microgravity conditions. During the maiden flight, which is planned for May 2009, the payload will be transported with a double stage solid propellant rocket up to an apogee of about 150 km. The first stage, a Nike motor, burns only for 3.5 s. Approximately 9 s after lift-off the second stage, an Improved Orion motor, ignites. At an altitude of about 70 km a Yo-Yo system decreases the rotation of the vehicle at its longitudinal axis, which is spin-stabilized during the ascent. After the second stage is separated and the rotation rates are reduced by the RCS-System, the experiment phase begins at an altitude above 100 km. The scientific payload of MAPHEUS-1 consists of three DLR internal experiment modules and a battery module from the DLR Institute of Materials Physics in Space, a measurement platform from

the University of Applied Science Aachen and the RB-MUSC of the DLR in Köln. The three material science experiments are AEROGET, an experiment to create frequency doubling aerogels, ATLAS-M, an experiment for diffusion measurements in molten metals and ARTEX-M, an experiment for directional solidification of AlSi-alloys. After the experiment phase, the payload re-enters the atmosphere and is decelerated by the aerodynamic drag. At an altitude of about 4.6 km the parachute system is released and the payload thus decelerated to a terminal velocity of 8 m/s. This paper will give an overview on the MAPHEUS vehicle, the experiments, the maiden flight and the campaign. The paper will also include first flight results. It will also give an outlook on the MAPHEUS program where the DLR Institute of Materials Physics in Space is responsible for the selection and construction of new experiments and the DLR Mobile Rocket Base provides the launcher and is responsible for the operations during campaign.