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Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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FINAL DESIGN OF THE MAIUS-2/3 PAYLOAD – AN ATOM INTERFEROMETER ON A SOUNDING ROCKET

Abstract

In January 2017 a first sounding rocket mission housing experiments on matter-wave interferometry, MAIUS-1 (Materiewellen-Interferometrie unter Schwerelosigkeit – Matter-Wave Interferometry under Microgravity), has been launched. Following this campaign, two sounding rocket missions, MAIUS-2 and MAIUS-3, are planned to perform sequential and simultaneous dual-species atom interferometry with Bose-Einstein condensates (BEC) of Potassium-41 and Rubidium-87. The scientific payload of the MAIUS missions will be launched on-board a VSB-30 sounding rocket launched from Esrange in Sweden. The flights of these rockets allows for approximately 360 s of microgravity conditions. It therefore offers a microgravity environment for experiments on timescales not accessible in ground based experiments, such as in the drop tower.

During ascent of the rocket, vibrational loads of up to 1.8 g RMS in the frequency range of 20-2000 Hz and accelerations of up to 13 g can occur. Furthermore, static loads, caused by the re-entry and the landing, can be as high as 50 g. Both missions MAIUS-2 and MAIUS-3 fly the same payload, called MAIUS-B. Consequently, the payload needs to be designed to withstand the aforementioned loads.

MAIUS-B is divides into five subsystems:

- Physics Package
- Laser System
- Laser Electronics
- Physics Package Electronics
- Batteries

This paper presents the vibration tests of each subsystem of MAIUS-B performed at the shaker test facility at the center of Applied Space Technology and Microgravity (ZARM) in Bremen. This includes the discussion of the suspension and vibration isolation of the subsystems within the hull segments.

In addition, the overall payload concept, the optimization of budgets (especially mass and size), and the sealing concept will be explained. This is complemented by an overview over the thermal requirements during flight and the heatsink design for the overall payload and each subsystem individually. In addition, the final concept for the electronic and water umbilicals will be introduced.