29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Interactive Presentations - 29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (IP)

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THE SPACE MISSIONS LABORATORY AT THE TECHNICAL UNIVERSITY OF MUNICH: RAPID SATELLITE MISSIONS FOR SPACE RESEARCH

Abstract

In Munich, Germany, we recently set out to establish the Space Missions Laboratory (SML), a multidisciplinary and multi-institutional laboratory where engineers and scientists of all universities in Munich collaborate for developing space-science missions. Our research spans a broad range of fields, including astrophysics, astronomy, Earth observation, and planetary science. The overarching objective of the SML is the pooling of resources of the participating institutions to facilitate short mission schedules and the rapid delivery of results. To achieve this, we rely, for example, on common, standardized satellite buses and payload interfaces, as well as on common hardware elements for hosted payloads. The overall integration and qualification of hardware can largely be performed within the SML, saving both time and cost. Furthermore, the proximity of scientific and technical expertise within one governance structure allows to efficiently exchange knowledge and so maximizes both the science return and the reliability of a mission.

We present a selection of current projects to highlight the cooperative approach to our research. These include: a mission to measure the antimatter content of Earth's Van Allen radiation belts aboard a 3U CubeSat to confirm and refine the results of the now-defunct PAMELA instrument; a mission to observe the spectrum and polarization of X-rays emitted by the Cygnus X-1 binary system using the same CubeSat bus; the concept and proof-of-principle tests for a CubeSat-based mission to map Earth's magnetic field in the mesosphere using laser-driven magnetometry; the development of water-electrolysis propulsion for

CubeSat-sized platforms to increase their mission range; and the development of 'intelligent' and versatile propulsion systems. We also give an overview of the joint development of onboard electronics (e.g., high-performance data-handling systems and corresponding processing algorithms), power systems, and interfaces for payloads. These developments are closely tied to our work on instruments for exploration missions, for example the Lunar Volatiles Scout (LVS) and other instruments for the in-situ exploration of the Moon aboard commercial spacecraft and surface vehicles, which we briefly introduce. The integrative development environment of the SML therefore also facilitates the rapid and interdisciplinary adaption of payloads to the requirements of host vehicles, be it our own satellites or commercially operated platforms.