26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Small/Micro Platforms (6A)

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THE QUEEN MISSION TO DEMONSTRATE AN OPTICAL RB FREQUENCY REFERENCE PAYLOAD AND ADVANCED SMALL SATELLITE PLATFORM TECHNOLOGY

Abstract

Small satellite missions have grown more and more complex over the recent years. State-of-the-art payloads may require pointing accuracy in the range of arcseconds, downlink capacities of up to several hundred Mbps and large amounts of power, even for CubeSat-class spacecraft. To keep up with the ever-increasing requirements, space-proven high-technology components are needed to deliver the desired

performance. In this context the QUEEN mission aims to demonstrate and test components for future complex and demanding missions.

The primary payload of the QUEEN mission consists of a two photon rubidium vapour cell frequency standard that builds on extensive heritage of various drop tower experiments and sounding rocket missions. Compact, robust and space-proven frequency references are important building blocks for future applications and fundamental science missions based on atomic quantum sensors, e.g. for the next generation of global navigation satellite systems or quantum tests of gravity.

Secondary payloads include an optical communications terminal, an X-band transceiver as well as a camera system for medium resolution video applications. The optical communications terminal OSIRIS has already been demonstrated in orbit within several missions. OSIRIS is planned for implementing a high-performance optical downlink for QUEEN, targeting at combining the highest performance with the smallest form factor demonstrated by OSIRIS to date. The X-band transceiver XLink builds on a flexible transceiver platform providing two uplink and two downlink channels. Within the QUEEN mission, high downlink data rates as well as highly reliable transmission modes shall be demonstrated. In addition, uplink in S and X band will be implemented.

The QUEEN satellite builds on the modular TUBiX20 platform of Technische Universität Berlin that already supports two other ongoing missions. TechnoSat, a 20 kg in-orbit technology demonstration mission, is currently in its second year of successful orbit operations. The second mission, TUBIN, will demonstrate wildfire detection based on microbolometer sensors and is presently in production phase. For the QUEEN mission, the platform will be extended to provide more electrical power and a high-speed Ethernet bus for the payloads. Furthermore, the thermal control system needs to be adopted to fulfil the demanding requirements of the quantum technology payload.

This paper summarises the results of the preliminary design phase of the QUEEN mission, while focussing on the platform variant that will support the QUEEN mission. Here, it is highlighted how the modular architecture of the platform allows to scale different parameters towards fulfilling the requirements of the QUEEN mission.