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FROM GROUND-BASED MICROGRAVITY FACILITIES TO SUBORBITAL FLIGHTS

Abstract

The Center of Applied Space Technology and Microgravity (ZARM) founded in 1985 is part of the Department of Production Engineering at the University of Bremen, Germany. ZARM is mainly concentrated on fundamental investigations of gravitational and space-related phenomena under conditions of weightlessness as well as questions and developments related to technologies for space. With a height of 146 m the Bremen Drop Tower is the predominant facility of ZARM and also the only drop tower of its kind in Europe. ZARM's ground-based laboratory offers scientists from all over the globe the opportunity to perform daily short-term experiments under conditions of high-quality weightlessness at a level of 10(-6) g. Scientists may choose up to three times a day between a drop experiment with 4.74 s in simple free fall and an experiment in ZARM's worldwide unique catapult system with 9.3 s in microgravity.

In this paper we demonstrate a simple approach to realize microgravity experiments on suborbital flights by preparing and qualifying the setups at ZARM's ground-based microgravity facilities. It means a full payload integration into the specific suborbital payload module to perform preliminary drop tower experiments under short-term microgravity conditions with the identical suborbital hardware, e.g. testing the overall setup, probing experiment parameters, obtaining first results in microgravity, etc.. A full qualification of the integrated flight module, doing additional shaker or thermal vacuum tests for instance, is also offered with the help of services by ZARM Test Center. In this way a comprehensive preparation and qualification of suborbital flight setups is possible at ZARM.

Furthermore, we report about our experiences of such an approach during a suborbital flight with the New Shepard vehicle of Blue Origin in the USA in 2018, at which we were the first commercial customer to fly research payloads from Europe. Also, the status of experiment preparations utilizing the Bremen Drop Tower for the very first upcoming suborbital payload flight on the new European sounding rocket, MIURA 1, of PLD Space (Spain) is presented.

Finally, we give a status update on the GraviTower Bremen - Prototype (GTB-Pro), a novel ground-based microgravity facility, which is in the final stage of assembling at ZARM. This GTB-Pro represents an actively driven drop tower system that is capable to perform over 100 short-term microgravity experiments per day. It offers a further alternative performing dedicated microgravity research or preparing experiments for suborbital flights or even for space missions.