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BEESAT-3 COMMISSIONING - BETTER LATE THAN NEVER

Abstract

BEESAT-3 is a single-unit CubeSat developed by Technische Universität Berlin. Its primary mission objective is to provide hands-on education for aerospace students of the university, the secondary objective is the in-orbit demonstration of an S band transmitter.

Together with BEESAT-2 and SOMP, a single-unit CubeSat developed by Dresden University in Germany, BEESAT-3 was launched on the 19th of April 2013 attached to the Bion-M No. 1 spacecraft with a Soyuz rocket from Baikonur Cosmodrome. After successful separation on the 21st of April, radio contact to the satellite could not be established. Thereupon, a comprehensive failure analysis was performed. But, although potential for improvement of the spacecraft design could be revealed, all scenarios that led to the immediate loss of the mission were classified as unlikely.

In the following years sporadic attempts to receive a signal of BEESAT-3 failed. In 2017, a second evaluation of possible failure modes was conducted. After a comprehensive review of the electronics design, as well as the software of the satellite, a new scenario to explain the unresponsiveness of the spacecraft was found. Yet again, first contact attempts based on this scenario failed. On January the 7th, 2018, four years, eight months and 20 days after launch, an experiment was conducted in which BEESAT-3 was commanded using the ground station in Berlin, while radio amateurs from the Netherlands listened to the satellite using the 25 m parabolic antenna of the Dwingeloo Radio Observatory. Shortly after the experiment they reported that strong signals from BEESAT-3 were received. Knowing for the first time, that the spacecraft was alive and operating, the BEESAT-3 team was able to establish contact and retrieve data from the satellite using the ground station of Technische Universität Berlin. Since then BEESAT-3 is operated regularly.

This paper presents the design of the BEESAT-3 satellite and recapitulates the events that ultimately lead to establishing contact to BEESAT-3 after more than four years on orbit. Furthermore, it discusses the impact of the spacecraft's weak radio signal on mission operations and presents initial orbit data of the BEESAT-3 mission.