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A YEAR SINCE THE LAUNCH OF THE NABEO-1 CUBESAT DRAGSAIL ON ROCKET LAB'S "IT'S BUSINESS TIME" ROCKET: METHODS OF VERIFICATION AND OBSERVATION

Abstract

As on earth, also in space environmental pollution is a manmade problem: meanwhile, thousands of satellites form huge junkyards orbiting this planet for decades to come – and as satellites get smaller and smaller, hundreds of new nano size satellites are being launched each year just to be abandoned at the end of their mission to tumble through space, many of them for more than a decade after just a few months lifetime. Therefore, to ensure safety for future space flight, end-of-life de-orbiting of satellites and upper stages is required by international space debris mitigation standards. For initiation of the de-orbit maneuver a large surface is deployed which multiplies the drag effective surface of the satellite. Thereby the drag force is increased as well causing accelerated decay in orbit altitude. Over the last year, a scaled down version of the small size satellite de-orbiting dragsail ADEO, called NABEO-1 was designed, tested and launched onboard the Rocket Lab rocket "It's Business Time" on the 11th of November 2018 from Rocket Lab's Launch Complex No.1 on the Mahia Peninsula in New Zealand. The NABEO-1 dragsail has an area of 2.5m2; it fits into a 0.8U CubeSat and facilitates a completely passive deployment method. The paper at hand will begin with a summary of the space debris issue especially with respect to nanosatellites leading to the design description of the NABEO-1 dragsail including the challenges and lessons learned by scaling down the 25m2 ADEO small size satellite dragsail to nano sized satellite dimensions. Furthermore, the manufacturing and the qualification test approach will be outlined as well as the launch preparation with the integration of NABEO-1 on the Rocket Lab "It's Business Time" kick-stage. A highlight of the paper is the launch of the dragsail in space on the 11th of November marking the start of the de-orbit mission. As there was an issue detecting the successful deployment of the dragsail on the kick-stage, methods to image the satellite from ground using optical telescopes were used to understand what effects the sail could have on the orbiting kick-stage and verify the sail deployment. Analysis of the photometric magnitude and time-varying light curves are compared against the previous "Still Testing" kick-stage, which launched in January 2018 and did not include a dragsail. Furthermore, a comparison with the de-orbit behavior and decay in semi-major axis of the "Still Testing" kick-stage is presented.