PRESS RELEASE

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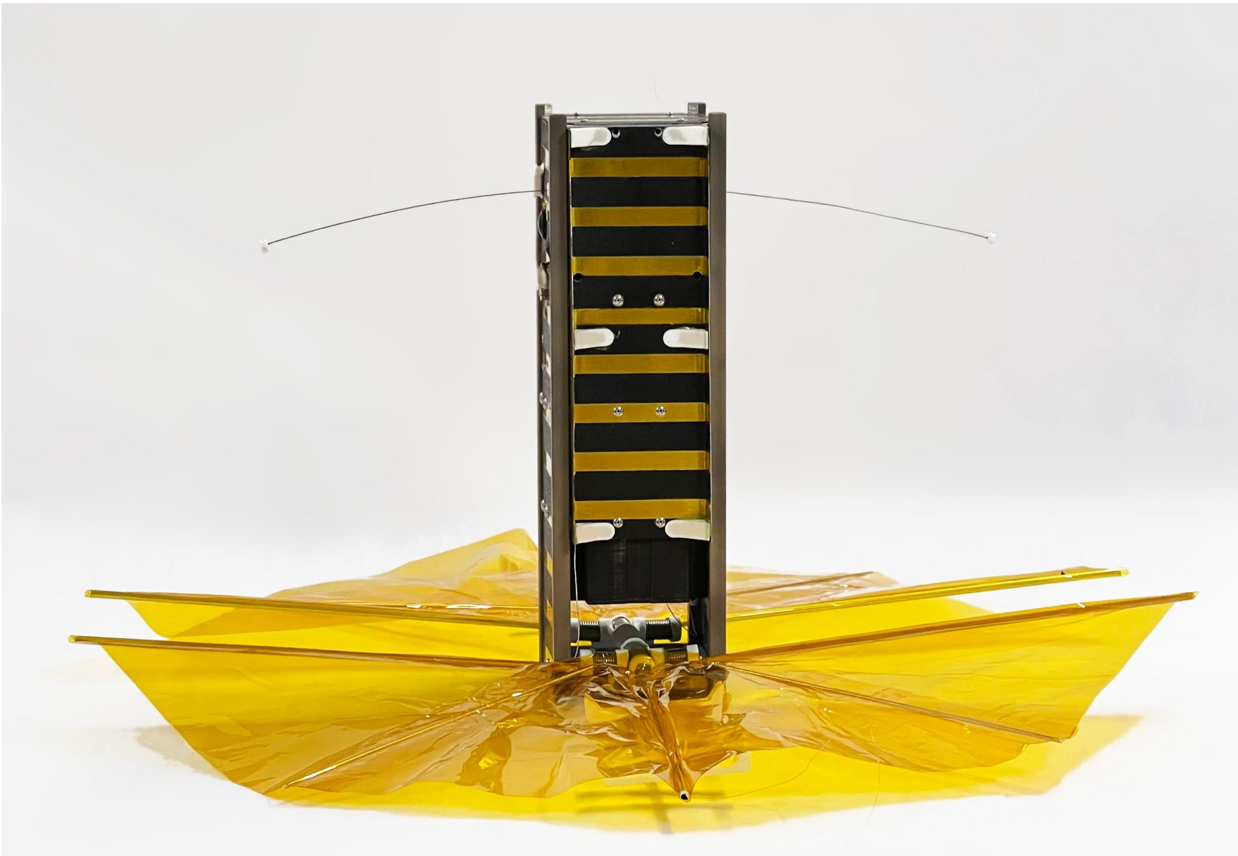
SBUDNIC satellite successfully deploys drag device on orbit

SBUDNIC, a satellite built by Brown University students and launched to a 550 km orbit aboard SpaceX's Transporter 5 mission, successfully deployed its drag device on orbit. Deployment was confirmed via analysis of radar-generated data of orbital altitude over time. SBUDNIC was built using a combination of commercial off-the-shelf parts commonly found in hardware stores and $10 computer processors meant for prototyping, and went from initial design to space in a year. SBUDNIC can be reproduced for less than $7000.

Providence, RI - SBUDNIC, a bread-loaf-sized 6 kilogram satellite built by a student-led team at Brown University, pushed boundaries in space exploration by successfully demonstrating deployment of its novel aerodynamic drag device which will pull the satellite out of orbit approximately three times faster than comparable satellites. SBUDNIC's drag device is an engineering proof of a passive and cost-effective method of drastically reducing the orbital lifetime of small satellites, and is an open-source solution to the emerging existential problem of the accrual of space junk.

SBUDNIC belongs to an open source size standard known as 3U (3 units) Cubesat, populated by satellites equivalent in size to a standard stack of three 10cm cube units. These all also generally share similar base geometries and mass characteristics. CubeSats are popular in space engineering, as the mass limits and volumetric constraints of the class allow for substantial payload deployment at a relatively affordable cost. CubeSats are often used by governmental science agencies and militaries for remote Earth observation where data captured by the satellite can be deployed for, as examples, climate monitoring or national defense purposes. SBUDNIC is built primarily of low-cost COTS parts, including a $10 Arduino microprocessor commonly used for early stage engineering prototyping, sixty-five AA Energizer lithium batteries no different than those typically found in drugstores, and a variety of 3D printed parts grown on consumer-grade printers extruding hobby-grade filament.

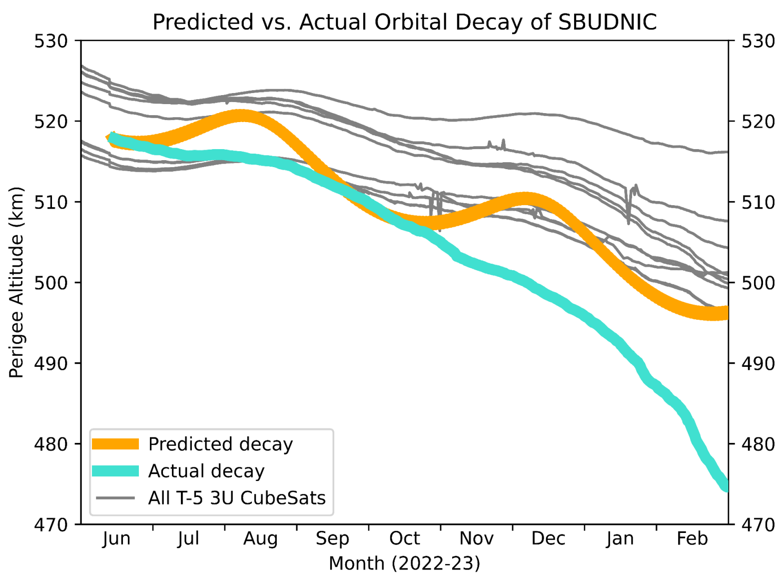


SBUDNIC, prior to launch, with the drag device in deployed configuration.

Analysis of orbital tracking data shows that the drag device, and by extension almost all major subsystems, successfully self-initialized, deployed, and functioned once SBUDNIC was placed into its selected 550km polar orbit by a D-Orbit ION orbital tug. Deployment was then verified from the ground by comparing SBUDNIC's observed orbital decay with predicted orbital decay of the satellite over time, comparing SBUDNIC's altitude to that of the other 3U cubesats deployed at comparable altitudes and orbits as part of SpaceX's Transporter 5 mission, and by radar measurement of the cross-sectional area of the satellite.

SBUDNIC's actual orbit exceeded predicted orbital decay, SBUDNIC's altitude is approximately 30 kilometers below that of the reference grouping of satellites who were around 510km, and the cross-sectional area of SBUDNIC–as measured by the ground-based radar of the United States Space Force 18th Space Defense Squadron (USSF 18 SDS, or 18 SDS)--matches the cross-sectional area of SBUDNIC's main chassis plus deployed drag device.

The drag device, which functions like a parachute to incrementally slow down the satellite over thousands of orbits around the Earth, was designed as a lightweight solution to the emerging problem of the growth of orbital debris. The device weighs approximately 225 grams and consists of two opposing “sails” made of Kapton film, which folded flat along the satellite’s frame prior to deployment. Both sails are arrayed across spring-loaded structural masts made of thin aluminum tubing which extend out from the sides of the satellite upon trigger of the release mechanism. Initial computational predictions completed during the design phase of engineering development suggested that the drag device would decrease the orbital lifetime of SBUDNIC from over 20 years to as few as 6.5 years, depending on fluctuations of atmospheric density as a consequence of solar activity.



The graph shown above displays SBUDNIC’s algorithmically predicted orbital altitude decay in orange, SBUDNIC’s actual orbital decay in teal, and the actual orbital decay of all 3U satellites launched as part of Transporter 5 in black. None of the reference satellites have drag devices or means of boosting their altitude over time. Note the altitude difference between the reference satellites, and that of SBUDNIC which is equipped with a drag device.

Measurement data collected by USSF 18 SDS provides further confirmation of the successful deployment of the drag device, as the observed cross-sectional area of SBUDNIC is only possible if the drag device is deployed. USSF 18 SDS classifies the radar cross-sections of man-made Earth-orbiting objects into three ranges: < 0.1 m^2, between 0.1 and 1.0 m^2, and > 1.0 m^2, dubbed “small”, “medium”, and “large”, respectively. As engineered with the drag device deployed, the radar cross-section of SBUDNIC is 0.3187 m^2. In orbit, SBUDNIC’s radar cross-section (RCS) is classified and measured as “medium”. By comparison, the radar cross-section of a typical 3U cubesat is 0.04 m^2 and is thereby classified as “small”. This prediction fits the RCS of the reference satellites shown in the graph—each of those satellites is classified as “small”, with an RCS of less than 0.1 m^2.

While there is a small chance that the drag device deployed independently of the other subsystems also functioning (excluding the radio, which is assumed dead as no signal was ever captured), it is not likely that this occurred. Deployment of SBUDNIC's drag device is dependent on the satellite successfully waking itself up from its low-power launch state, followed by an immediate trigger of a nichrome ablation system which rapidly melts through a monofilament retaining line. This method is well-vetted in other small satellites, and SBUDNIC's deployment trigger and monofilament restraint architecture borrow heavily from preexisting satellites. SBUDNIC also improved on the historical monofilament engineering architecture by protecting the monofilament inside the satellite's aluminum shell to a greater degree than typically found in previously-flown examples of satellites employing the method.

Several of the structural components on SBUDNIC were 3D printed using acrylonitrile butadiene styrene (ABS) plastic filament, which is a common 3D printing material that costs approximately $25 per kilogram when purchased for purposes of consumer-grade 3D printing. ABS is often found in car bumpers, the casings of television remotes, and other consumer electronics and small appliances. The material, when procured at volume from one particular high-cost industrial supplier, is certified as safe for space use by both NASA and the European Space Agency (ESA). SBUDNIC did not use this supplier and instead used low-cost hobby-grade filament by successfully arguing that the industrial product and the hobby-grade filament are functionally chemically identical.

The printer used to grow these parts is the Prusa MK3S+, an affordable, widely-available, and open-source consumer-grade machine. While 3D printed parts are used in space engineering with some regularity, the parts are often printed on expensive specialist machines using expensive aerospace-grade high performance materials like polyether ether ketone (PEEK). As printed and flown, the opposing brackets at the base SBUDNIC's two drag sails together cost approximately $0.70. The same two parts, printed in ABS from the NASA/ESA vetted supplier, would cost approximately $14. Printed in a more typical legacy aerospace material like PEEK on a traditional aerospace-grade printer, the identical parts would cost approximately $43.

One of the core goals of the SBUDNIC program is increasing the accessibility of space. This informed every part of the team's program design, but is most obvious in the everyday off the shelf nature of SBUDNIC's parts, and the use of open source technologies like the family of Arduino microprocessors. SBUDNIC's total program and development budget was a modest thirty thousand dollars; however the satellite itself could be reproduced for *less than $7000*. Other similarly-sized satellites commonly cost more than a million and a half dollars to engineer and build, independent of launch costs.

All of SBUDNIC's design information is available to the public so that other amateur and student groups can emulate and modify its designs to realize their own projects in space. The SBUDNIC team believes that the lightweight, low cost, and highly effective system for accelerating descent from orbit could be adopted by other satellite programs in an effort to cut down on space debris.

The SBUDNIC team is planning a series of presentations in schools throughout Rhode Island, in hopes of inspiring future innovators and making high school students more aware of the opportunities that exist for them in space engineering and design. People, and especially students at the beginning of their scientific and engineering journeys, are fascinated by space but have not yet had the opportunity to participate themselves. SBUDNIC's low-cost approach to spacecraft building demonstrates the missing link between spectating and participating.

The SBUDNIC project received support from Brown University, the National Research Council of Italy (CNR), the NASA Rhode Island Space Grant Consortium, D-Orbit,, AMSAT-Italy, and La Sapienza-University of Rome.

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SBUDNIC is an acronym for Brown University and our main sponsoring organizations, and inspired by the simplicity of the 1957 Sputnik, was launched in May of 2022 from Space Launch Complex 40 at Cape Canaveral, Florida. SBUDNIC's lifecycle is under continuing analysis. SBUDNIC stands for **S**atellite by **B**rown **U**niversity, **D**-orbit, **N**ASA, and the **I**talian National Research **C**ouncil. SBUDNIC was named several years prior to the Russian invasion of Ukraine. Slava Ukraini!