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THREE STELLAR YEARS (AND COUNTING) OF PRECISION PHOTOMETRY BY THE BRITE ASTRONOMY CONSTELLATION

Abstract

The mission of the Bright Target Explorer (BRITE) Constellation, comprised of five nearly identical seven-kilogram nanosatellites, is to study the most luminous stars in the Earth's sky. In the push to observe ever fainter objects, these apparently (yet intrinsically) bright stars are not well understood, despite being prominent members of our most familiar constellations. Typically massive and short lived, through their turbulent lives and via their especially violent deaths as supernovae, these stars dominate the ecology of the Universe and are responsible for seeding the interstellar medium with elements critical for the formation of planetary systems and organic life. Using three-centimeter aperture telescopes for photometry, BRITE-Constellation measures stellar brightness variations in two colours, with high cadence over baselines of up to six-months. The milli-magnitude precision it has achieved is at least ten times better than what is currently achievable using ground based observatories. These precise measurements of stellar variability are used to probe the internal and surface (sun spot) structures, ages, and potentially even planetary systems (via transit detection) of these massive luminous stars. BRITE-Constellation, which was launched into orbit in 2013 and 2014, was developed by the Space Flight Laboratory (SFL) in collaboration with astronomers and engineers from Canada, Austria and Poland. Each of the three countries contributed to the financing of the satellites, with member satellites including both the first Austrian spacecraft and the first scientific satellites for Poland. The constellation is believed to be the first satellite constellation dedicated to astronomy and boasts not just the smallest astronomy satellites ever flown, but also the first spacecraft at this scale to achieve arc-second level pointing. Further, due to the low-cost nature of the satellites and the inherent expandability of the mission, at least six other nations have expressed serious interest in contributing additional satellites. As a result, this already uniquely successful mission could become an even greater international phenomenon and commercial outlier in the years to come. The BRITE-Constellation spacecraft are commissioned, fully-operational, and meeting or exceeding all mission requirements including the instrument's limiting visual magnitude, attitude pointing stability, duty cycle, stars per observation field, and up-time. Having now observed in excess of 300 stars, novel scientific returns are being generated from the unique two-colour photometry datasets. This paper describes the goals, key design and operational challenges, on-orbit performance, and highlights the rich scientific returns of this cutting-edge mission.