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THE STAR-PLANET ACTIVITY RESEARCH CUBESAT (SPARCS): DETERMINING INPUTS TO PLANETARY HABITABILITY

Abstract

Seventy-five billion low-mass stars in our galaxy host at least one small planet in their habitable zone (HZ). The stellar ultraviolet (UV) radiation received by the planets is strong and highly variable and impacts atmospheric loss, composition, and habitability. These effects are amplified by the extreme proximity of the stellar HZs (0.1–0.4 AU) in low-mass stars.

SPARCS is a NASA-funded mission to characterize the quiescent and flare UV emission from low-mass stars. SPARCS will observe 20 low-mass stars, over timescales of days, simultaneously in two UV bands: 153–171 nm and 260–300 nm. SPARCS Sun-synchronous terminator orbit, allows for long periods of uninterrupted observations, reaching 10s of days for some targets.

SPARCS payload consists of a 10 cm telescope, a dichroic element, UV detectors and associated electronics, a thermal control system, and an on-board processor. It is hosted on a Blue Canyon Technologies 6U CubeSat.

SPARCS' is host to a number of technology innovations that have broad applicability to other missions. SPARCS demonstrates the use of "2D-doped" (i.e., delta- and superlattice-doped) detectors and detector-integrated metal dielectric filters in space. This detector technology provides 5x larger quantum efficiency than NASA's GALEX. In addition, SPARCS' payload processor provides dynamic exposure control, automatically adjusting the exposure time to avoid flare saturation and to time-resolve the strongest stellar flares. A simple passive cooling system maintains the detector temperature under 238K to minimize dark current. The spacecraft bus provides pointing jitter smaller than 6", minimizing the impact of flat-field errors, dark current, and read-noise. All these elements enable competitive astrophysics science within a CubeSat platform.

SPARCS passed Critical Design Review and it is currently in the final design and fabrication phase ("Phase C" in the NASA context). It will be launched in late 2023, for a primary mission of one year.