MONITORING THE HIGH-ENERGY RADIATION ENVIRONMENT OF EXOPLANETS AROUND LOW-MASS STARS WITH SPARCS (STAR-PLANET ACTIVITY REASEARCH CUBESAT)

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A full **twenty-five percent** of M stars (0.1 – 0.6 M_{sun}) host a small planet in the habitable zone (HZ), implying that **most of the HZ planets in our galaxy orbit M stars**. M dwarf systems are also the most amenable to observations of the planetary atmospheres due to the large planet-to-star contrast ratio and the short orbital periods of HZ planets. However, M-Dwarfs are known to flare much more frequently than Sun-like stars, each flare producing strong UV emission.

A planet's habitability, including atmospheric retention, is strongly dependent on the star's UV emission, which chemically modifies, ionizes, and even erodes the atmosphere over time including the photodissociation of important diagnostic molecules. The slope of an M star's UV spectrum can affect atmospheric lifetimes and **increase the detectability** of biologically generated gases, but may also lead to the formation of abiotic oxygen and ozone producing a **false-positive biosignature**. There has yet to be a dedicated monitoring effort of M-Dwarf flares.

We aim to monitor the high-energy radiation environment of exoplanets orbiting low-mass stars with a dedicated 6U CubeSat called SPARCS (Star-Planet Activity Research CubeSat). Over a mission lifetime of approximately 15 months, we will monitor ~20 M stars in two UV photometric bands using high quantum efficiency, UV-optimized detectors. These delta-doped detectors with custom antireflection coatings will revolutionize UV astronomy with their significantly increased sensitivity of silicon arrays in the ultraviolet. This technology has been flown successfully on suborbital platforms, demonstrating greater than **five times the sensitivity** of the most recent dedicated UV mission, GALEX. SPARCS is the mission to bring this innovation to orbit.

The targets will range in spectral type and age including young stars (20 Myr), which are likely forming terrestrial planets, to old stars with known rocky planets, such as Proxima Centauri, to map the evolution of the UV emission and flare rates. These data will guide a grid of brand-new upper-atmosphere M star models as a function of stellar mass and age since current "photosphere-only" models severely underpredict UV fluxes at all wavelengths. The determined intensity, spectral slope, variability and evolution of such a host star's high-energy radiation will provide realistic input stellar fluxes to photochemical planet atmospheric models to better understand the evolution and habitability of a planet and in interpreting its transmission and emission spectrum.

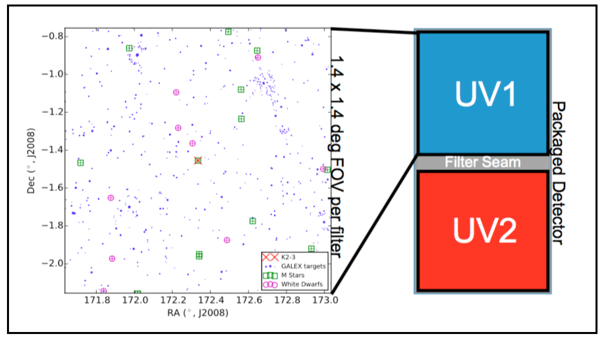

Figure 1: Left: The field of view (FOV) per SPARCS filter showing all sources brighter than 20th mag in the GALEX NUV band. Right: A schematic of the 1k x 2k detector with the two mounted UV filters. As with most FOVs for our targets, the FOV for the planet host K2-3 contains other M dwarfs for UV monitoring.