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ACTIVE SPECTROMETER FOR SMALL SATELLITES (ASTROSS)

Abstract

The ARKSAT Cube-Satellite Missions will be the first student-led satellites in the State of Arkansas and have been developed primarily at the University of Arkansas-Fayetteville (UA). The primary goal is the technology development and flight demonstration in pursuit of the Active SpecTROmeter for Small Satellites System (ASTROSS), utilizing formation flights of cooperating light emitters (ARKSAT-3E) and receivers/spectrometers (ARKSAT-3C). ARKSAT-1 is a 1U CubeSat that aims to test critical UA-developed subsystems, including a high-power LED (12,000 lumens) and a novel deorbiting balloon. The follow-on ARKSAT-2, to be launched in 2024, will test flight control subsystems intended for the receiver spacecraft, and the non-pressurized propellent that offers thrust on the order of mNs for attitude and altitude control. The total ASTROSS system is expected to be flight tested in the 2026 timeframe and would demonstrate its feasibility as a low-cost, active spectroscopy platform with the potential for use in future planetary missions. ARKSAT-3 features a 1.5U and 3U CubeSat pair for which ARKSAT-1 and ARKSAT-2 are analogs. It will feature an innovative Calibrated Free-Space Spectroscopy (CFSS) instrument onboard the pair of CubeSats in formation flight. Most in-situ measurements can only represent a limited environment, the sample is taken within the instrument onboard a satellite or rover making it difficult to gather data on a larger scale. ASTROSS aims to address this and other issues by splitting the emitting and receiving ends of a spectrometer onto two satellites, allowing for a scanning-like mechanism where the atmosphere between the two satellites is sampled at a calibrated distance. The system would ensure proper separation distance between the emitting and receiving satellite pair during formation flight by way of a novel onboard Low Temperature Co-fired Ceramics (LTCC) Electric Thruster on ARKSAT-3C. The LTCC manufacturing process involves stacking layers of soft ceramic-polymer thick films and clamping them at high pressures, then co-firing at 850C to fuse all the layers together to produce a monolithically-integrated electric thruster. This allows for the parallel fabrication of all the internal subsystems including the ionization cavity, embedded excitation electrodes and accelerating electrodes. The first electric thruster enabled by LTCC manufacturing technology. The system could continuously sample the atmosphere as the satellites orbit a planetary body to develop a more compressive map of the entire atmosphere of a planetary body, achievable in a fraction of time and budget compared to previous missions. This allows for in-situ measurement capabilities non-existent in current space research.