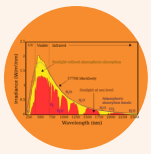
National Aeronautics and Space Administration

ARCSTONE

Calibration of Lunar Spectral Reflectance from Space

One of the most challenging tasks in remote sensing from space is achieving required instrument calibration accuracy on-orbit. The Moon is known to be an excellent exoatmospheric calibration source. However, the current accuracy of the Moon as an absolute reference is limited and requires factor of 10 improvement to meet the challenging objective of Earth Science observations. ARCSTONE is a mission concept and technology demonstration that provides a solution to this challenge – providing lunar measurements from space and avoiding interference from Earth atmosphere. An orbiting spectrometer flying on a small satellite in low Earth orbit will provide lunar spectral reflectance with accuracy sufficient to establish an SI-traceable absolute lunar calibration standard for past, current, and future Earth weather and climate sensors, and future constellation observing systems.

Sunlight, reflected from Earth, carries a vast amount of information into space about the planet's climate, weather, surface, atmosphere and its composition.



Instrument calibration in space and uncertainties of measurements have direct impact on the quality of science products.

The Moon is an excellent exoatmospheric calibration source. Photometric properties of the Moon are extremely stable, and therefore potentially knowable to high accuracy.

ARCSTONE will measure spectral reflectance of the entire lunar disk from UV (350nm) to SWIR (2300nm) wavelengths with combined uncertainty < 0.5% over most of its spectral range.

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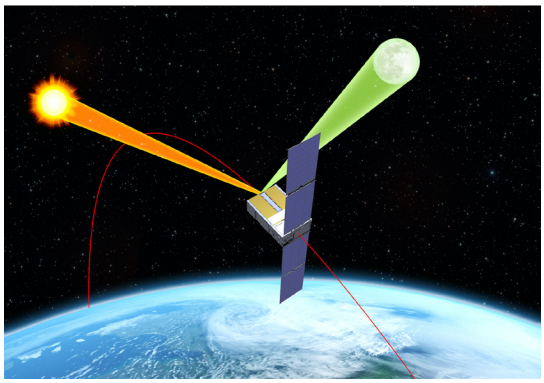
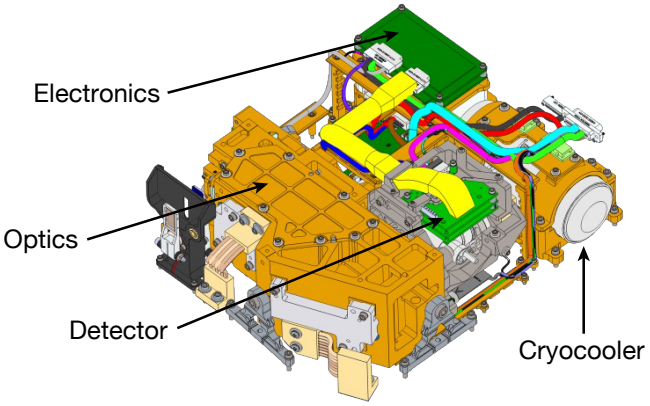
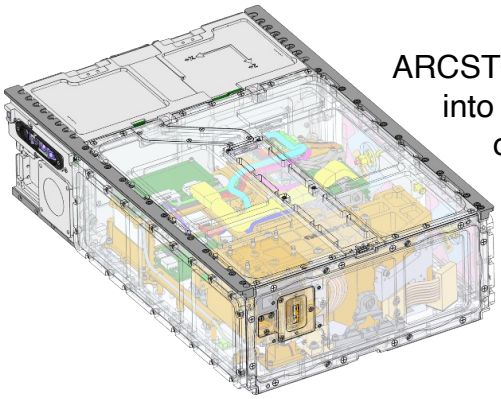
ARCSTONE Architecture

ARCSTONE in low-Earth orbit



ARCSTONE Payload





ARCSTONE is a spectrometer with a single field-of-view, integrated into 6U CubeSat, to be deployed to low-Earth Sun-synchronous orbit at 500 km altitude. The payload includes the following key components: optics, detector, cryocooler to operate the detector at 140K temperature, electronics, and calibration system with dark and spectral filters. The spacecraft has all standard components, such a power, GN&C, radio, data, etc., except propulsion system.

ARCSTONE Operations in Space

ARCSTONE operations in space include observations of Moon and Sun to derive lunar spectral reflectance, and cold-space measurements for thermal background characterization. These measurements achieved using the same optical path, but varying integration times when viewing the Sun and the Moon. The pointing and tracking of Moon and Sun is performed by an agile 6U CubeSat.

ARCSTONE Concept and Design:
Swanson, R., C. Lukashin, M. Kehoe, M. Stebbins, H. Courrier, T. Jackson, M. Cooney, G. Kopp, P. Smith, C. Buleri, T. Stone, “The ARCSTONE Project to Calibrate Lunar Reflectance,” IEEE Aerospace Proceedings, 2020. Available online: https://ieeexplore.ieee.org/abstract/document/9172629

ARCSTONE **For more information explore: https://science.larc.nasa.gov/ARCSTONE/**