

Payload design for the Lunar Flashlight mission: Illuminating the Moon's South Pole

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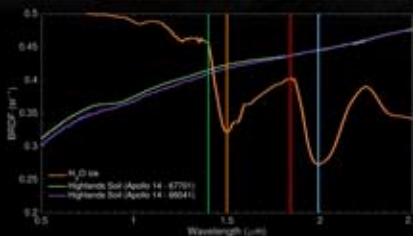
Paul Hayne, Jose Camacho, Chris Paine, Glenn Sellar, Quentin Vinckler (Jet Propulsion Laboratory); Ben Greenhagen (JHU Applied Physics Laboratory), David Paige (UCLA), Karillon Crabtree (Photon Engineering)

Water at the Lunar Poles?

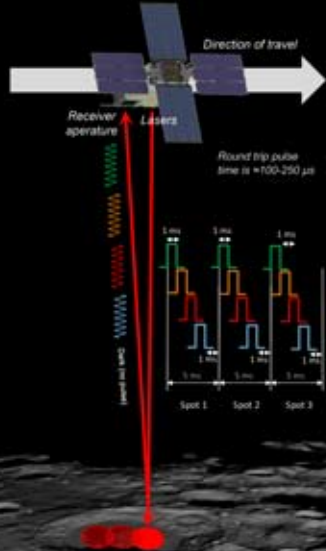
Recent reflectance data from LRO instruments suggest water ice and other volatiles may be present on the surface in lunar permanently shadowed regions, though the detection is not yet definitive [Gladstone et al. 2012, Zuber et al. 2012, Hayne et al. 2015]. Understanding the composition, quantity, distribution, and form of water and other volatiles associated with lunar permanently shadowed regions (PSRs) is identified as a NASA Strategic Knowledge Gap (SKG) for Human Exploration. These polar volatile deposits are also scientifically interesting, having the potential to reveal important information about the delivery of water to the Earth-Moon system.

Measurement Approach

Lunar Flashlight's four-channel laser projector will illuminate permanently shadowed regions, measuring surface reflectance at wavelengths where water ice absorbs. Water ice will be distinguished from dry regolith in two ways: 1) spatial variations in albedo, and 2) reflectance ratios between absorption and continuum channels. Water ice band depths will be mapped in order to distinguish the composition of the PSRs from that of the sunlit terrain. These data will be highly complementary to other lunar datasets, including LRO.



DILAS lasers
Continuum (CO2S):
 • 1.264 ± 0.0007 / ± 0.230 µm
 • 1.889 ± 0.0007 / ± 0.080 µm
 Absorption bands (water):
 • 1.495 ± 0.015 / ± 0.015 µm
 • 1.990 ± 0.005 / ± 0.005 µm



The Lunar Flashlight Mission

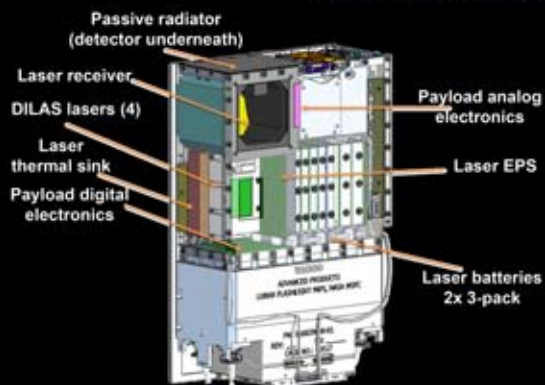
The Lunar Flashlight (LF) mission is a 6U CubeSat, to be launched as a secondary payload on the first test flight (EM-1) of the Space Launch System (SLS), currently scheduled for 2018. The goal of LF is to determine the presence or absence of exposed water ice and map its concentration at the 1-2 kilometer scale. After being ejected in cislunar space by SLS, Lunar Flashlight maneuvers into a low-energy polar orbit with a perigee of 10-30 km above the lunar south pole.



The Lunar Flashlight Payload

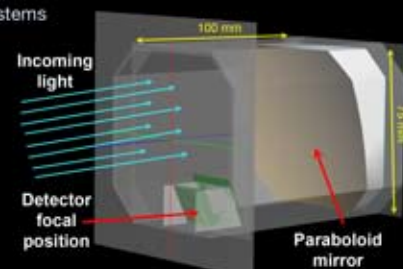
Lunar Flashlight will be the first planetary mission to use an active multi-band reflectometer

- Observe permanently shadowed and eclipsed ground within 80°S
- 1ms time pulsing of 4 lasers, plus one dark ms
- Independent laser power subsystem and power monitoring
- 1-single pixel detector reflectometer sensitive over 1-2µm
- Raw data collection and transfer from SC to ground systems

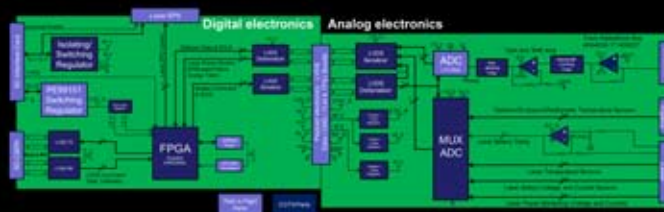


Receiver:
 • Field-of-view: 14 mrad
 • Volume 88.9 x 99.06 x 88.9 mm
 • Passively cooled by external radiator

Detector
 • 1mm diameter Teledyne Judson InGaAs detector
 • 2.2µm cutoff
 • 1.1A/W responsivity
 • Detector operational T: 206 K



Mirror Surface:
 • AR-coated aluminum bare mirror for 1-2 µm
 • Radius of curvature: 140mm
 • Conic constants: -1
 • Figure 2λ @ 632.8 nm
 • RMS roughness: $\lt; 3\text{\AA}$



Lunar Flashlight ConOps

