

LUNAR TRAILBLAZER: A PIONEERING SMALLSAT FOR MAPPING LUNAR WATER AND LUNAR GEOLOGY AND A KEY COMPONENT FOR LUNAR RESOURCE EVALUATION CAMPAIGNS.

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Lunar Trailblazer is a NASA SIMPLEX small satellite orbiter mission for understanding the Moon’s water and water cycle, managed by PSD and funded by ES-SIO [3]. Confirmed in November 2020, Lunar Trailblazer passed its System Integration Review in May 2022, and the Lunar Trailblazer spacecraft will be delivered for launch in 2023 as an ESPA Grande rideshare. NASA has moved forward Lunar Trailblazer’s rideshare baseline launch date to 2023.

Figure 1. Illustrations of the Lunar Trailblazer spacecraft and its launch configuration.



Lunar Trailblazer simultaneously measures composition, temperature, and thermophysical properties at high spatial and spectral resolution with pushbroom imaging from the High-resolution Volatiles and Minerals Moon Mapper (HVM³) [2] and the Lunar Thermal Mapper (LTM) [3] (Table 1; Fig. 1-2). The mission is optimized to (1) detect and map water on the lunar surface at key targets to determine its form (OH, H₂O, or ice), abundance, and distribution as a function of latitude, soil maturity, and

lithology; (2) assess possible time-variation in lunar water on sunlit surfaces; and (3) map the form, abundance, and distribution of water ice in permanently shadowed regions (PSRs). In all cases, Lunar Trailblazer simultaneously (4) measures surface temperature to quantify local gradients and search for small cold traps. While achieving its objectives, Trailblazer will also provide the best-available spatial and spectral resolution data for mapping of lunar rock type, mineralogy, and thermo-physical properties.

Table 1. Current best estimate Lunar Trailblazer observing parameters from 100±30 km orbit

HVM ³	
Spatial Sampl.	50-90 m/pixel
Swath Width	30-55 km
Spectral Range	0.6 – 3.6 μm
Spectral Sampl.	10 nm
SNR	>100 at reference
Uniformity	>90% cross track
# Data Cubes*	≥1000
LTM	
Spatial Sampl.	40-70 m/pixel
Spatial Width	14-27 km
Thermal	4 broad bands, 6-100 μm, for 110-400K (±2 K)
Composition	11 channels, 7-10 μm w/ <0.5 μm resolution
# Data Cubes*	≥1000

Over Trailblazer’s ≥1-year primary science mission, each instrument will acquire ≥1000 targeted >100 km² images of at the Moon, selected by the science team to meet the 4 objectives above. In October 2021, we held a workshop soliciting community targets and welcome new targets (to signup: t.co/H4OBIzcbuY).

The sub-100-m/pixel data will be the state-of-the art for determining the surface distribution, composition, and abundance of water ice and any impurities. Paired with information on neutron data (for water at depth), temperature, and lighting, Lunar Trailblazer data provide essential information on accessibility and extractability of lunar ice.

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References: [1] Ehlmann et al., IEEE Aerospace Conf. Proceedings, 2022, 14p [2] Thompson et al., LPSC 2020, abs. #2052 [3] Bowles et al., LPSC 2020, abs. #1380

Figure 2. Schematic Lunar Trailblazer data cube and data types

