The Great Lunar Expedition for Everyone (GLEE): Distributed Lunar Surface Science

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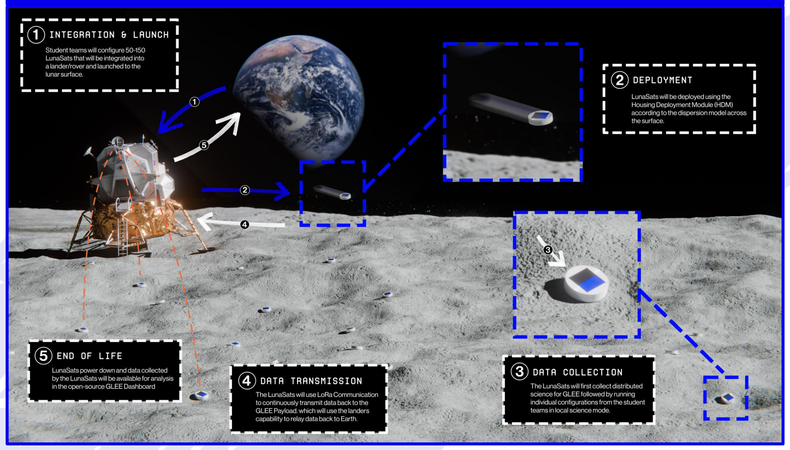
ABSTRACT

The Great Lunar Expedition for Everyone (GLEE) is a distributed lunar surface science mission designed to investigate near-surface thermal, magnetic, mechanical, and regolith properties using a dense network of low-cost sensing platforms. GLEE will deploy a number of solar-powered ChipSats ("LunaSats"), across a localized region of the lunar surface. Each LunaSat autonomously records temperature, acceleration, magnetic field strength, and regolith capacitance data over approximately six lunar hours (~7 Earth days), transmitting time-synchronized measurements through a low-power radio mesh network to a central gateway for downlink.

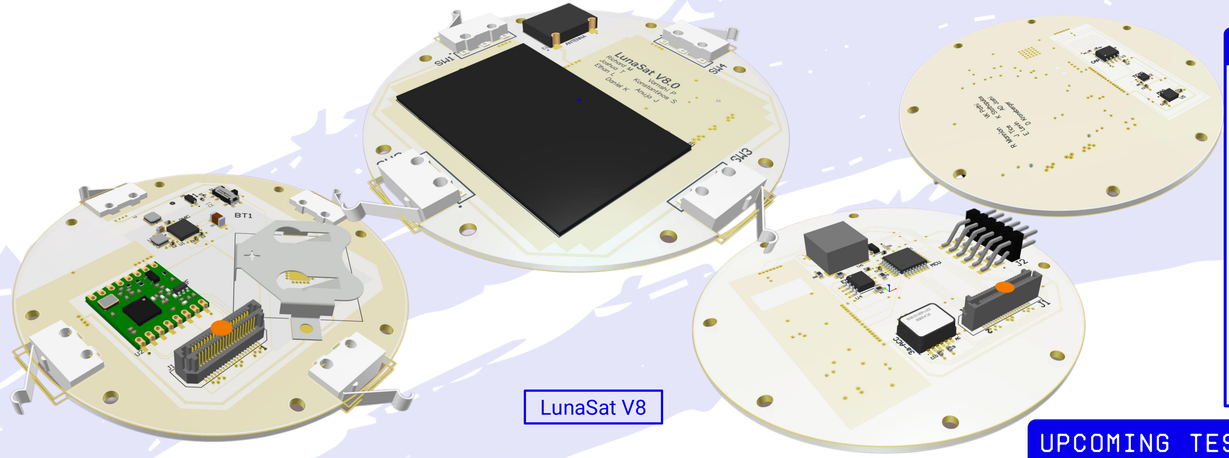
GLEE's science strategy emphasizes spatially distributed measurements to capture meter-scale variability and temporal evolution of lunar surface phenomena that are not observable with traditional single-instrument landers. The accelerometer suite enables detection of high-frequency surface vibrations associated with micrometeoroid impacts and shallow seismic events, while magnetometer measurements constrain local magnetic field variability relevant to crustal remanence studies. Temperature data characterizes diurnal thermal gradients and surface–subsurface heat exchange, and capacitive sensing provides sensitivity to regolith physical properties and dielectric variations.

MISSION CONCEPT OF OPERATIONS (CONOPS):



TECHNOLOGY VERIFICATION

To test this technology in a space-like environment, LunaSat V7.0 flew on the HASP (High Altitude Student Platform) mission in September of 2024. This test was focused on ensuring that the LunaSats can operate in a hostile space-like environment while relying on their own solar power and antennas to transmit data. This verified the mission readiness level for TRL 5.

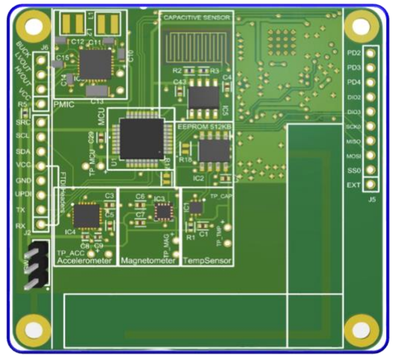


LunaSat V8

LUNASAT SPECIFICATIONS

	V7	V8
Dimensions:	60 x 60 x 1.7 mm	75 x 75 x 16 mm
Accelerometer:	3-Axis: MPU600	3-Axis: SCA3300 1-Axis: 540A
3-Axis Magnetometer:	MMC5983MA	MMC5983MA
Temperature Sensor:	TMP117	TMP117
Capacitive Sensor:	In-House Regolith Sensor	In-House Regolith Sensor
Microcontroller:	AVR128DB32	AVR128DB32
Solar Panel:	SM141K08TFV	SM141K08TFV

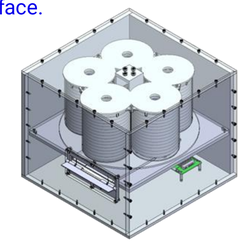
HASP LunaSat V7 Testing in LEO



LunaSat V7

LUNASAT DEPLOYMENT

The Housing Deployment Module (HDM) deploys the LunaSats to form a distributed network on the lunar surface.



THE NEW V8

The new edition of the LunaSat, the V8, had drastic changes to its geometry. Instead of one singular square PCB like the V7, the V8 features two separate circular modules. This is to make deployment with the Housing Deployment Module much easier, allowing it to throw protected, symmetric disks rather than a wider and bulkier square shape. With the addition of a second PCB to be stacked on top of one another, it allows for a much larger area to work with for the mission. This also allows greater protection for more sensitive components that do not need to be facing outwards.

UPCOMING TESTS

1. Data collection test with LunaSats launched from the HDM
2. LunaSat range performance assessment
3. Deployment pattern testing
4. Summer RockSat testing
5. Accelerometer shake table testing
6. High Temp Oven Testing

FUTURE DEVELOPMENT PLANS

The future of the LunaSat is focused on improvement and testing. Our current focus is on testing/verifying the functionality of the new V8 and evaluating power consumption

1. V8 is currently undergoing testing and verification to ensure reliable operation and accurate data collection
2. V8 will be tested on a RockSat mission this summer to raise the TRL level of the LunatSat from 5 to 7. This should also increase the TRL level of the HDM to 5
3. Improve testability and make development easier by streamlining the process of programming a LunaSat
4. Re-evaluate power management circuitry and microprocessor utilization to maximize efficiency in less-than-ideal conditions
5. The next iteration should be smaller and easier to manufacture by reducing bulky components specific to testing and RockSat

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Scan the QR code to sign up for our LEAP (Lunar Exploration Aerospace Project) Workshop today!

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