Deployment and Burial of Lunar Seismic Sensors using Pneumatically Assisted DIABLO

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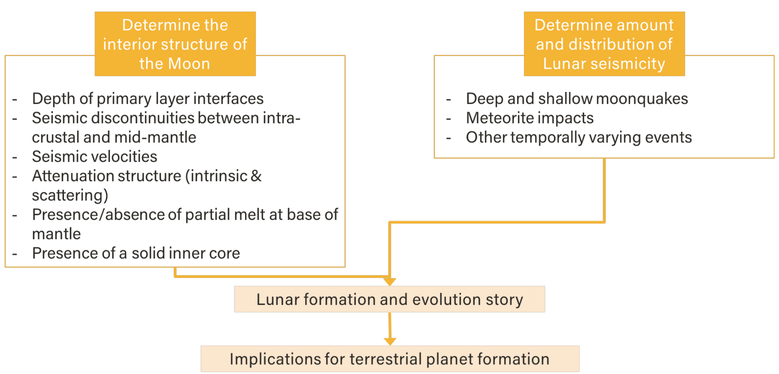
Ten Second Summary

The DALI-funded Seismic instrument is a science instrument designed to bury a sonde, seismic sensor payload, into the surface of the Moon. The burial of the seismic sensors improves the attenuation and decreases the large thermal fluctuations on the payload through a lunar day/night. The pneumatic burial system deploys the sonde with a threshold burial depth requirement of 0.8 meter and can drill up to 1.1 meters (with 0.9 clearance from tip-to-surface) into the lunar regolith.

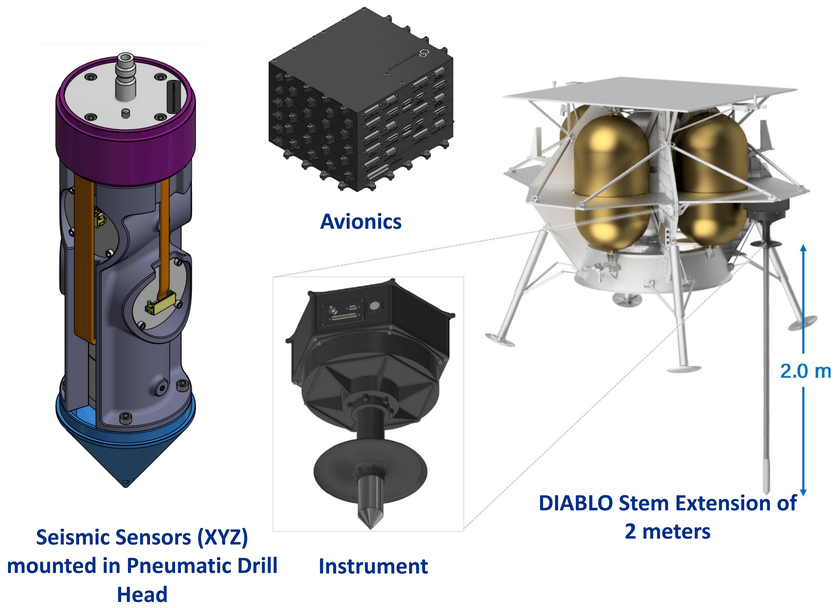
Science



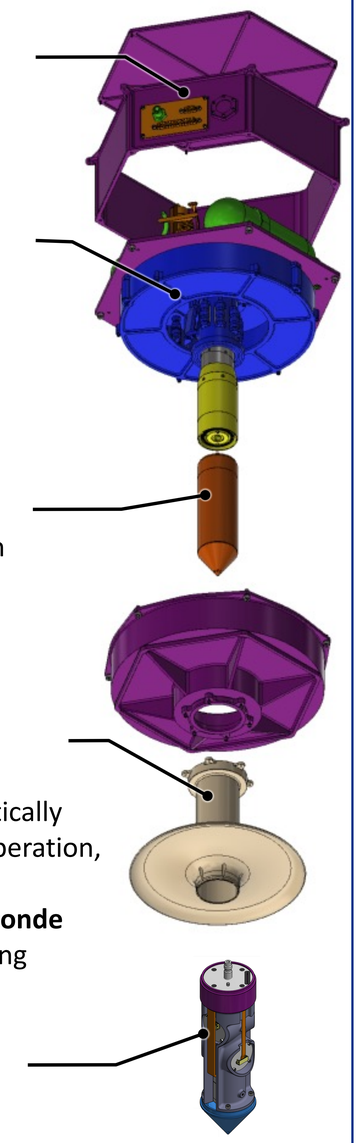
Burying the seismometer past the 0.8m decreases the thermal noise from the lander and the ringing of 'uncompacted surface regolith' while preserving the thermal requirements for the seismic sensors. Collecting short/long term data can further our knowledge on the interior structure and the lunar seismicity on the Moon.

TRL Description

The end-to-end instrument has currently achieved a TRL 5/6 through a series of critical test campaigns. The primary subsystems and ConOps have been demonstrated in a vacuum chamber with BP-1 lunar regolith analog, burying the instrument to the required depth. The DIABLO technology, which deploys/stows the boom of the instrument went through rigorous testing to a TRL 5/6 and is being matured on similar R&D projects. Some of the subsystems on this instruments will achieve TRL 9 on CLPS 19D by 2023.



System Overview



Lander Interface and Housing Structure
Primary structural and thermal interface to the lander

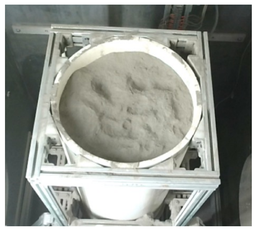
DIABLO Deployment Subsystem (Deployment of Interlocking Actuated Bands for Linear Operations) – deploys helical band drilling structure, **sonde release mechanism** and **sonde** into lunar regolith

Sonde Release Mechanism
Mechanically decouples **sonde** from burial system and deploys service loop to decrease vibration noise

Dust Deflector, Wiper, and Launch Structure
shields burial system from pneumatically transported regolith from drilling operation, wipes helical band structure during retraction, and supports and locks **sonde** and **sonde release mechanism** during launch

Sonde Drilling Nozzle and Sensor Housing
pneumatic drilling nozzle and 3x Seismic sensors to measure lunar seismic activity

Testing



Test conditions

- ❑Vacuum: 4 - 10 Torr
- ❑Regolith Bin with regolith compacted with vibration motor
  - ➢0.3 meter diameter, 2 meter depth

Demonstrated pneumatic drilling meters in vacuum with BP-1 lunar regolith analog.

End to End Instrument Mounted in Vacuum Chamber

Buried Seismometer in Regolith Bin

Future Work

Along with increasing the TRL of the underlying technologies with more testing, the team is also conducting field tests to demonstrate the system with Earthquakes. The seismic sensors and the instrument's subsystems are going to be developed for a flight-like build for a future CLPS mission to the Moon.

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