Overarching Principles:

1. Must be better than Apollo (coverage, duration, instrument performance).
2. Learn from the Apollo experience.

Why LGN?

Planetary Science:
- Moon represents an end-member in planetary evolution (large small body, small rocky planet).
- Primary planetary differentiation preserved.
- Key to understanding terrestrial planet initial differentiation.

Lunar Science:
- Heat flow probes yield crustal heat budget estimates.
- Combined with EMS, the temperature profile of the deep interior can be modeled along with mineralogy.
- Seismic and LLR data also yield structure and compositional information of the lunar interior.
- Heat flow at A-15 and A-17 close to PKT boundary.

Human Exploration:
- LGN must be established prior to renewed human lunar activity; we do not know the exact locations or causes of the shallow moonquakes (SMQs) – the largest magnitude seismic events recorded by Apollo (1 event/year of magnitude ≥5; [4,5]).
- Establishing surface infrastructure near SMQ epicenters must be avoided.
- Seismometers: ≥4 sensors; ≥1 order of magnitude better sensitivity than Apollo; broader frequency range (0.1 to >10 Hz).
- Apollo Passive Seismometer - three long period sensors (X, Y, Z, at with detection limits of 0.3m at 0.002 Hz and one short period sensor (2 with a detection limit of 0.3m at 1 Hz).

Seismometer: 
- Heat Flow: measure temperature every 20 cm to a depth ≥3 m (relative accuracy = 0.01K). Measurements every hour. Thermal conductivity determined at several intervals (e.g., every 50 cm).
- Apollo Heat Flow Experiment - 2 probes ~11 m apart. Absolute temperature to ±0.5K. Thermal conductivity (0.009-0.014 WmK) determined for 2 depth intervals with ~15% accuracy.

Electromagnetic Sounding (EMS): Measurement of electric and magnetic fields at each station yields an independent determination of conductivity structure (magnetotellurics) without requiring an orbital asset. Comparison of magnetic data between different stations (geomagnetic depth sounding) provides a complementary result.

Electromagnetic Sounding (EMS):
- Long-lived (e.g., ~10 years) power supply for each station.
- Miniaturization, ruggedization, & cold electronics.
- Autonomous operations, data based decision making, and networking.

Technology Development:

Underway:
- Seismometer [6,7,8]
- Heat Flow Probes [9,10]

Needed:
- Reliable landers. Leverage the MSFC International Lunar Network [1] experience, MoonRise, etc.
- EMS deployment mechanisms.
- Long-lived (≥10 years) power supply for each station.
- Miniaturation, ruggedization, & cold electronics.
- Autonomous operations, data based decision making, and networking.

Lunar Geophysical Network (LGN) New Frontiers (NF)-class mission [2], as part of the NF-5 call. This mission consists of several identical landers distributed across the lunar surface, each carrying geophysical instrumentation. The primary science objectives are to characterize the Moon's internal structure, seismic activity, global heat flow budget, bulk composition, & magnetic field.

Seismometers only deployed at A-12, A-15, and A-16 sites, away from magnetic anomalies.
- Heat flow at A-15 and A-17 close to PKT boundary.

Seismic and LLR data also yield structure and composition of the lunar interior.

Narrow aperture of seismic network.
- Seismic and LLR data also yield structure and composition of the lunar interior.

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