



NASA's Lunar Discovery and Exploration Program

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Overview of NASA's Current Activities

- Renewed emphasis on lunar science/exploration in NASA research calls
- Community discussion regarding science/exploration opportunities and priorities
- Making existing research data better available to the public
 - Moon DB
 - Updating Lunar Sample Compendium
- Apollo Next Generation Sample Analysis
- Commercial Lunar Payload Services
- Starting the pipeline for lunar payloads

Community Input

SERVI



- LEAG SATs (reports on LEAG website)
 - Advancing Science of the Moon (ASM-SAT)
 - Next Steps on the Moon (NEXT-SAT)
- Lunar Science for Landed Missions Workshop
 - Talks and report archived here:
<https://lunar-landing.arc.nasa.gov/>
- Survive and Operate Through the Night Workshop
 - Fall 2018, prior to LEAG meeting

Commercial Lunar Payload Services (CLPS)

- Draft RFP (SMD/HEOMD/STMD developed) for CLPS posted April 27
- Competition open to U.S. commercial providers of space transportation services, consistent with National Space Transportation Policy and Commercial Space Act
- Multi-vendor catalog, 10-year IDIQ contract, managed through task order competition for specific payload missions
- First vendor selection by Dec 31; future on-ramps as more capabilities are developed
- Structured for NASA as the marginal buyer of a commercial service
- Statement of work permits addition of more complex services as vendor capabilities grow such as providing surface mobility or sample return

Payload Development

- Current Activities to develop payloads
 - CubeSats – SIMPLEx-2 SALMON-3 PEA AO
 - Instrument Development call – DALI
 - STMD technology interests
- What payloads are available now?
 - Received a strong response to RFI; proposal were due June 27
 - Preparing a SALMON-3 PEA AO for payloads that are ready, or nearly ready, to fly
 - GSFC retroreflectors - quick and easy
 - Resource Prospector instruments

Small Innovative Missions for Planetary Exploration (SIMPLEx)

- SIMPLEx-2 AO is released; in addition to soliciting SmallSat proposals for all planetary destination, specific emphasis has been added for SmallSats to conduct lunar science or address exploration SKGs
- Available for potential delivery by commercial lander service provider
 - Ride along under CLPS; providing additional opportunities for commercial companies

DAI (Development and Advancement of Lunar Instrumentation)

- Step 2 proposals were due June 5
 - Received 47 Step 2 proposals
- Lunar instruments that support NASA's broader lunar exploration goals, including human exploration and in situ resource utilization (ISRU), as well as lunar science.
- "Particularly interested" in instruments for small stationary landers, but call is open for any lunar instrumentation, including orbiters/rovers.
- "Most interested in" technologies that will reach at least TRL 6 by end of grant, flight hardware builds for landers with flight opportunities as early as ~2021.

Scope of Science and Technology Payload

SALMON PEA

- Payloads that are ready, or nearly ready, to fly
 - Engineering models
 - + • Flight spares
 - + • Student-built hardware
 - Modified off the shelf
- Cross-division/directorate call
 - Open to Planetary/Heliophysics/Astrophysics/Earth
 - HEOMD SKGs/ISRU
 - STMD goals (“technology”, not just “instruments”)
- Significant international participation will be permitted
 - but not international proposals, they will have to partner with US researchers
- 15 kg limit per instrument, but may combine multiple instruments for a single flight opportunity

2-Stage process

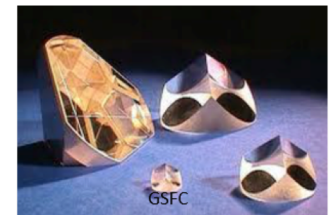
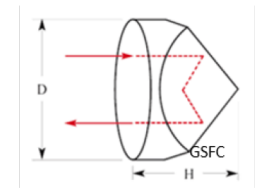
- Different from our usual 2-step downselects
- Phase 1 – “get your instrument ready to fly”
 - No guarantee you will fly
 - Expect to select on order of 8-12 instruments
 - Selections expected ~Summer 2019
- Phase 2 – integrate onto a specific flight opportunity
 - Additional funds for integrating, ops, and science
 - Internal process based on factors such as ease of accommodation, readiness timeline, and appropriateness for landing site for the science or technology proposed

NASA GSFC/MIT Laser Retro-reflector Arrays (LRA) for Lunar Landers



What they are:

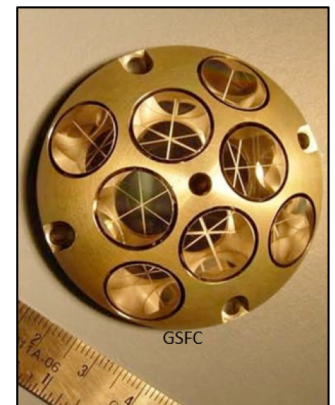
- Custom glass cube corner arrays that retro-reflect incoming laser beams over a wide incident angle.
- Light weight, rad-hard, and long lifetime
- Similar LRAs are carried by Earth-orbiting satellites for precision laser tracking from ground stations



Science applications

- Lander position and movement determination (laser tracking from orbiting or descent LIDAR)
- Permanent fiducial markers on the Moon
 - Location of science measurements by on board instrument, e.g., seismometer
 - Landmarks for precision landing of future lunar craft
- Test of concept of LRA on Mars, asteroids, etc.

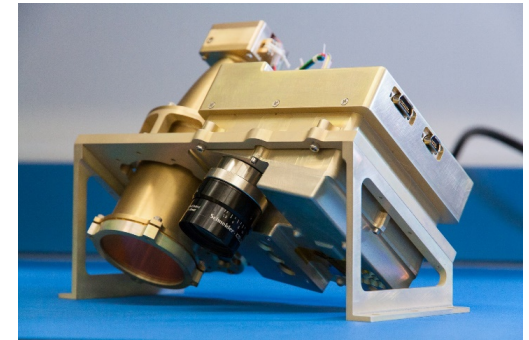
GSFC and MIT LRA team information – Contact Michael Amato, Dave Smith, Xiaoli Sun, for more information.



← 5 cm, 21 g →

Resource Prospector Legacy Instruments

- NASA recently conducted an internal science and engineering assessment of RP instruments.
- Determined that all four RP instruments are at a high enough TRL and have ability to obtain useful science data on the Moon.
- As development continues, plan to integrate instruments into early CLPS missions.



Long-Lived Instruments, Landers and Small Rovers

- Initial landers delivered through the Commercial Lunar Payload Services (CLPS) are expected to last one lunar day (14 Earth days)
- NASA is planning investments to enable operations and mobility for long-lived instruments and small rovers
 - Power supplies, electronics, and mechanisms to survive and/or operate across the extreme temperatures of lunar day and night, despite lunar dust
 - Mobility systems or surface utility stations to enable small, long-lived rovers compatible with delivery to the lunar surface under CLPS capabilities
 - Radioisotopes for heat or power
 - An initial Long Duration Lunar Surface Operations workshop is planned for Fall 2018 co-sponsored by HEOMD, SMD, and STMD

There is excellent science to be done at every step while preparing for human exploration



- Small stationary lander/1-day operations
- CubeSats/SmallSats
- Long-lived landers
- Small rovers
- Large rovers
- Sample return