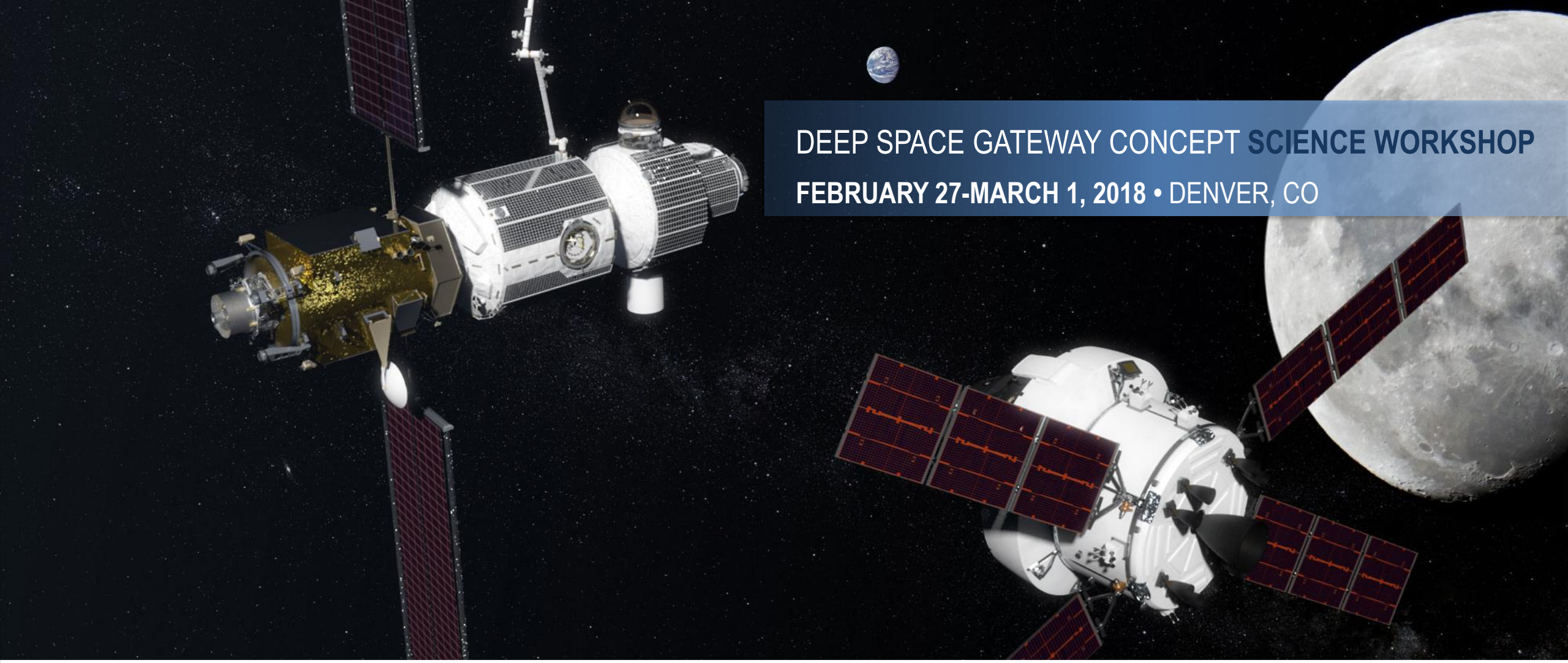


DEEP SPACE GATEWAY CONCEPT **SCIENCE WORKSHOP**

FEBRUARY 27-MARCH 1, 2018 • DENVER, CO

Lunar seismology enabled by a Lunar Orbital Platform - Gateway

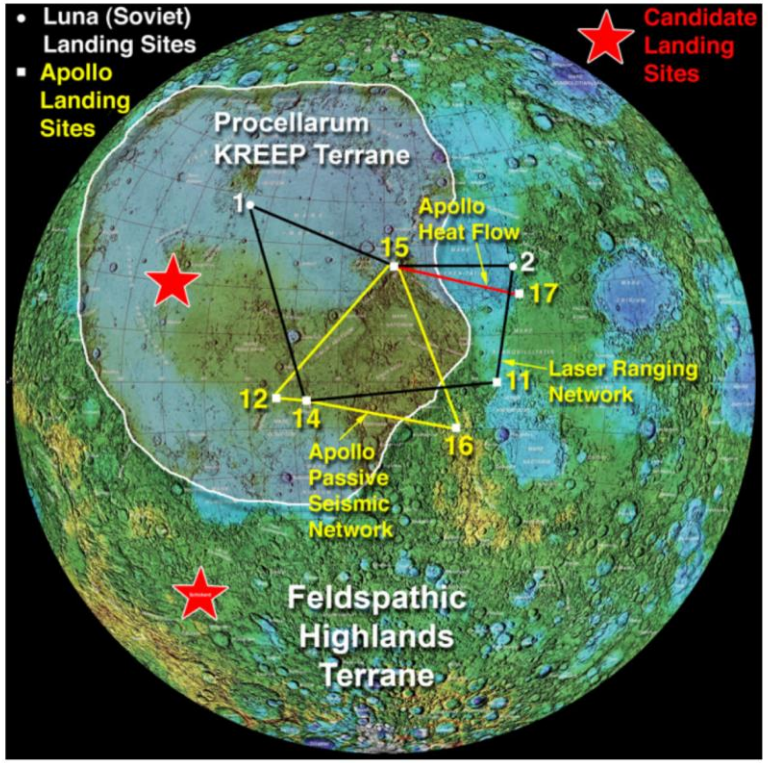
Feb. 28, 2018

Renee Weber, NASA Marshall Space Flight Center

C. R. Neal, University of Notre Dame
S. Kedar, M. Panning, B. Banerdt, NASA Jet Propulsion Laboratory
N. C. Schmerr, University of Maryland, College Park
M. Siegler, Planetary Science Institute, Southern Methodist University

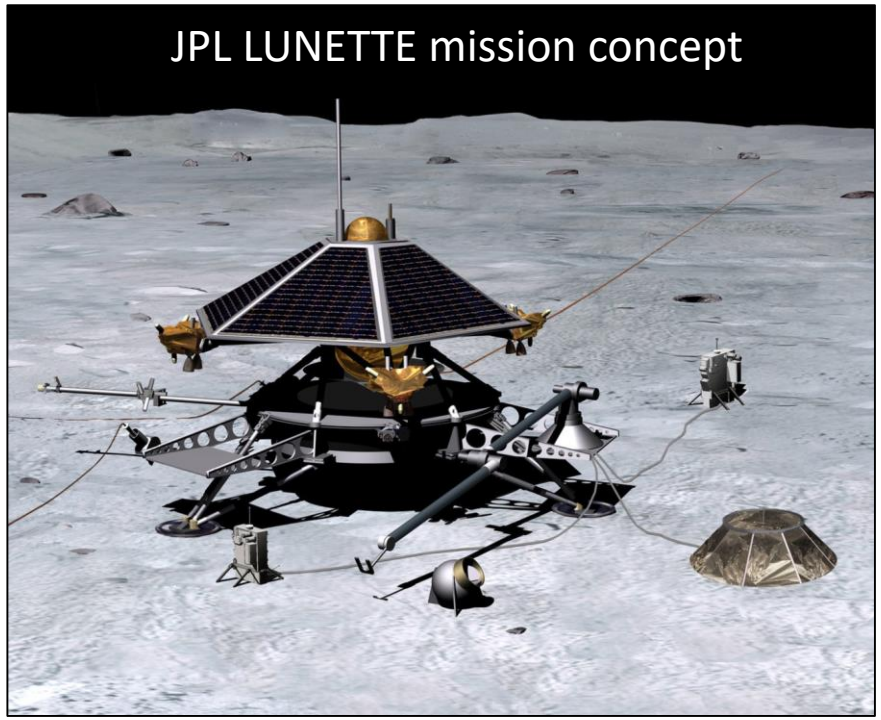
Instrument Function Statement and Gateway Usage

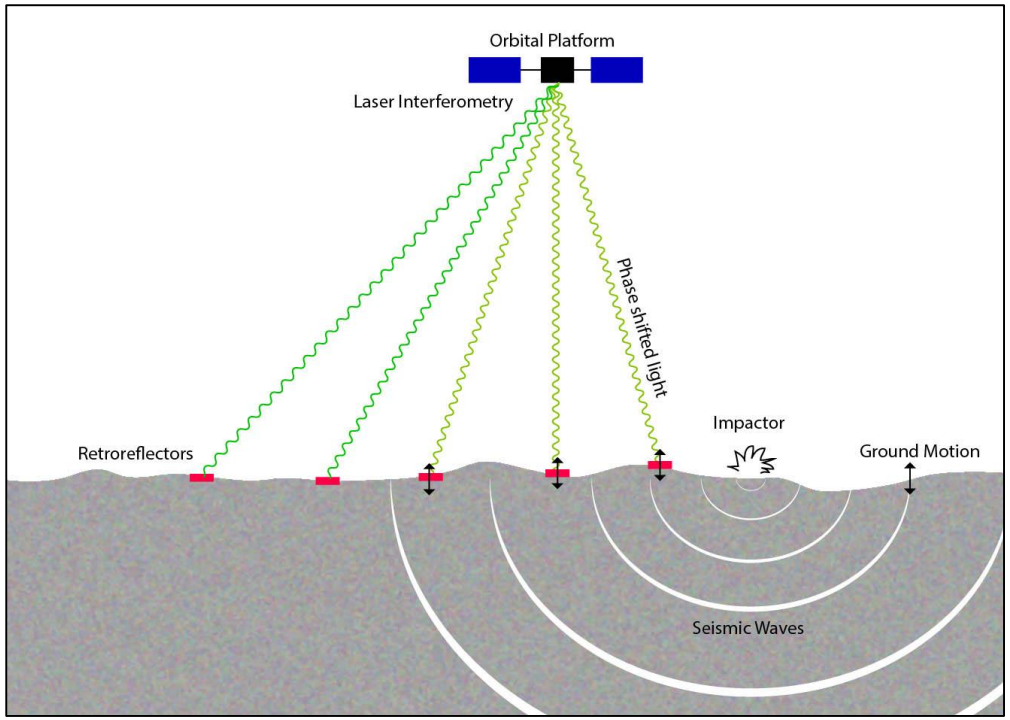
STATEMENT	INSTRUMENT/CONCEPT DETAILS
FUNCTION STATEMENT Deploy a long-lived network of stationary seismometers to the surface to monitor for seismic shaking induced by artificial sources, natural tectonism and meteorite impacts.	Science objectives: • Quantify the amount and distribution of seismicity • Determine the detailed structure of the crust, mantle, and core
WHY IS THE GATEWAY THE OPTIMAL FACILITY FOR THIS INSTRUMENT/RESEARCH? Lunar seismology is optimally enabled by a Gateway architecture that incorporates a reusable lunar lander/ascent vehicle that can deploy identical instrumentation at globally distributed locations	Gateway can enable seismology-enhancing observations: • Penetrators • Active source release • Laser interferometry • Surface monitoring (including high-resolution imaging, impact flashes, SAR, altimetry)



Two basic concepts

Surface geophysical packages vs. Gateway external payloads





“releaseables”

Basic Instrument Parameters – assuming surface geophysical package

PARAMETER	ILN (SOLAR/BATTERY)	ILN (ASRG)	Future
MASS (KG)	25	30	<50kg (commercial?)
VOLUME (M)	-	-	-
POWER (W)	19.5 day / 7.8 night	Up to 74	-
THERMAL REQUIREMENTS	Night survival required (±50°C operating)		
DAILY DATA VOLUME	~hundreds MB/day raw data generated (amount downlinked depends on comm. availability)		
CURRENT TRL	TRL 4-6 for notional payload instruments		
WAG COST & BASIS	2 stations under Discovery / 4 stations under New Frontiers		New Frontiers
DURATION OF EXPERIMENT	6 years	6 years	10 years
OTHER PARAMETERS	-	-	-

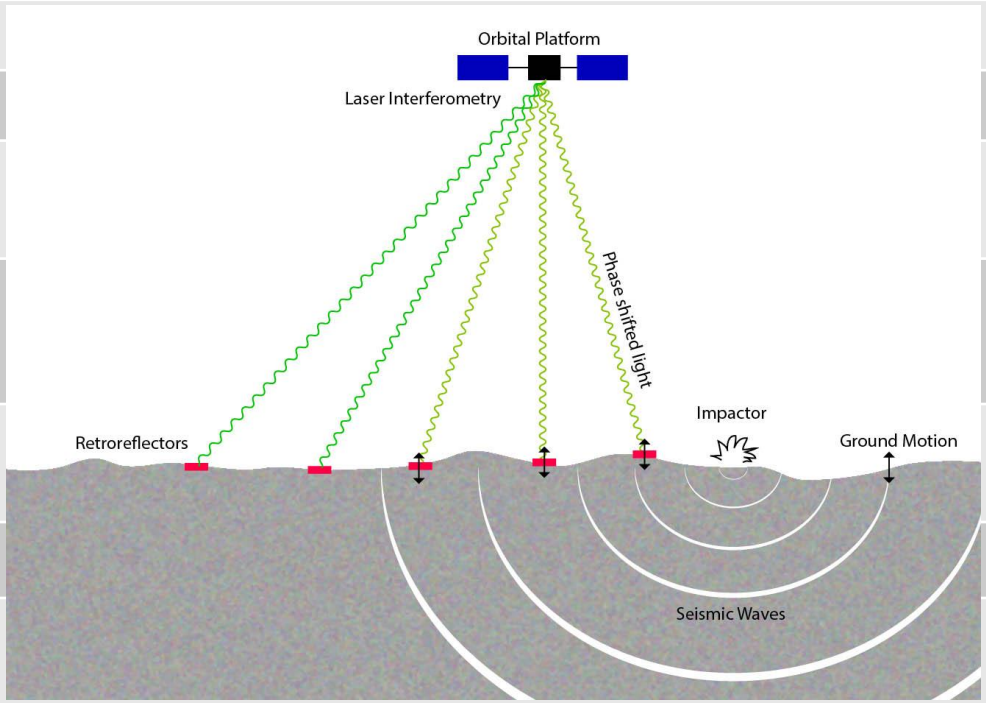
Instrument Gateway Usage – “releaseables” (landers, penetrators, etc.)

USAGE	INSTRUMENT REQUIREMENTS & COMMENTS
ORBIT CONSIDERATIONS	Appropriate for release of autonomous assets to lunar surface
FIELD OF VIEW REQUIREMENTS	N/A
REQUIRES USE OF AIRLOCK	N/A
CREW INTERACTION REQUIRED?	N/A
WILL ASTRONAUT PRESENCE BE DISRUPTIVE?	N/A
DOES THE INSTRUMENT PRESENT A RISK TO THE CREW	N/A
OTHER CONSUMABLES REQUIRED	N/A
SPECIAL SAMPLE HANDLING REQUIREMENTS	N/A
NEED FOR TELEROBOTICS?	Possible use of arm or other deployment mech. for asset release
OTHER REQUIREMNTS OF THE GATEWAY?	Far-side stations would require comm. relay.

JPL LUNETTE mission concept

Instrument Gateway Usage – external payloads (imagers, lasers, etc.)

USAGE	INSTRUMENT REQUIREMENTS & COMMENTS
ORBIT CONSIDERATIONS	Stable LLO (lasers/LROC); L2 halo for far-side impact flash monitoring
FIELD OF VIEW REQUIREMENTS	N/A
REQUIRES USE OF AIRLOCK	N/A
CREW INTERACTION REQUIRED?	N/A
WILL ASTRONAUT PRESENCE BE DISRUPTIVE?	possibly
DOES THE INSTRUMENT PRESENT A RISK TO THE CREW	N/A
OTHER CONSUMABLES REQUIRED	N/A
SPECIAL SAMPLE HANDLING REQUIREMENTS	N/A
NEED FOR TELEROBOTICS?	Possible for instrument pointing and stability
OTHER REQUIREMNTS OF THE GATEWAY?	N/A



References and Status of Work in this Field

Background information and science drivers:

1) International Lunar Network Final Report https://sservi.nasa.gov/wp-content/uploads/drupal/ILN_Final_Report.pdf
2) LUNETTE: A Discovery-class Lunar Geophysical Network concept: https://www.lpi.usra.edu/meetings/lpsc2010/pdf/2710.pdf
3) Enabling technologies: https://www.hou.usra.edu/meetings/V2050/pdf/8143.pdf

Status of current development efforts:

4) Penetrator concept (LUNAR-A heritage): https://www.sciencedirect.com/science/article/pii/S0032063308004170
5) Impact flash monitoring: https://www.hou.usra.edu/meetings/deepspace2018/pdf/3031.pdf
6) Laser retroreflectors: https://www.hou.usra.edu/meetings/leag2017/pdf/5070.pdf
7) Planetary Broadband Seismometer: https://agu.confex.com/agu/fm17/meetingapp.cgi/Paper/263006
8) Seismometer to investigate ice and ocean structure: https://agu.confex.com/agu/fm17/meetingapp.cgi/Paper/259995
9) Magnetometer: https://www.hou.usra.edu/meetings/deepspace2018/pdf/3173.pdf
10) Heat flow probe: https://www.hou.usra.edu/meetings/deepspace2018/pdf/3009.pdf

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