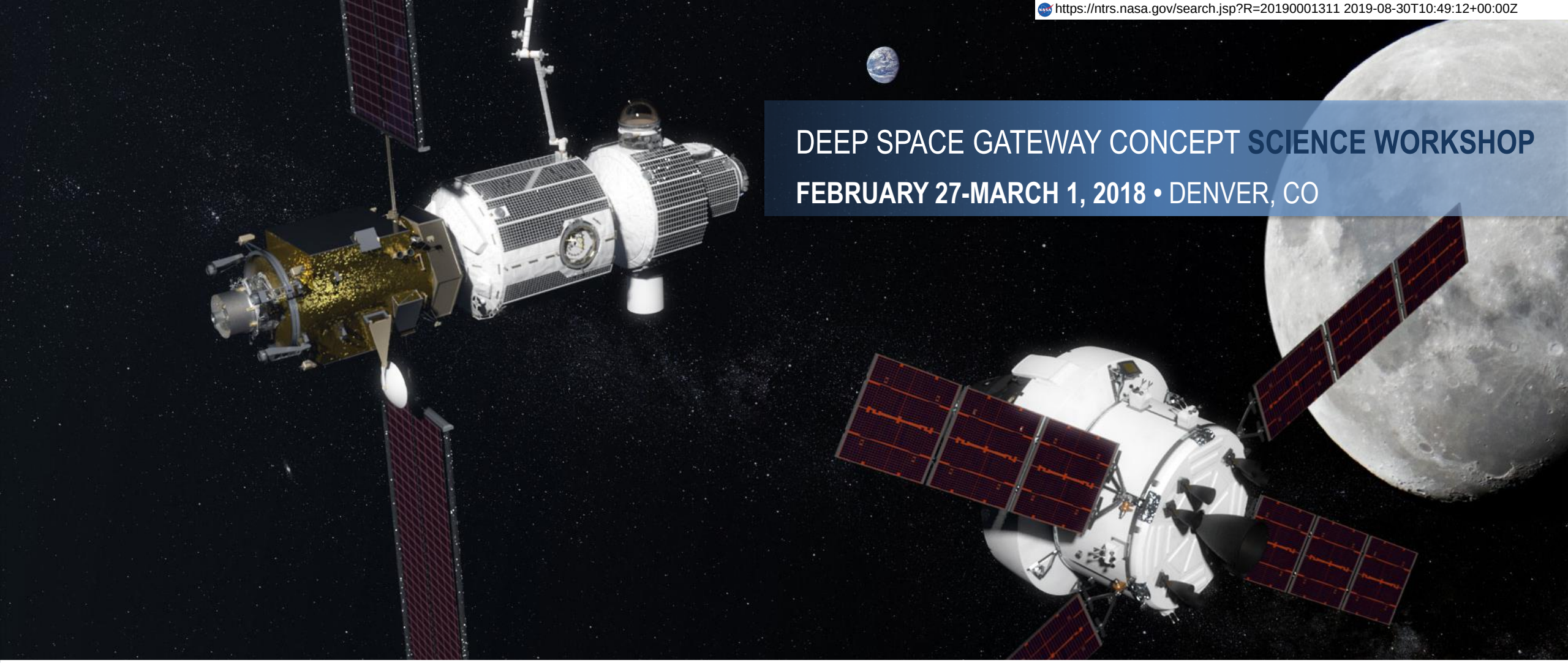

DEEP SPACE GATEWAY CONCEPT SCIENCE WORKSHOP
FEBRUARY 27-MARCH 1, 2018 • DENVER, CO

Lunar seismology enabled by a Lunar Orbital Platform - Gateway

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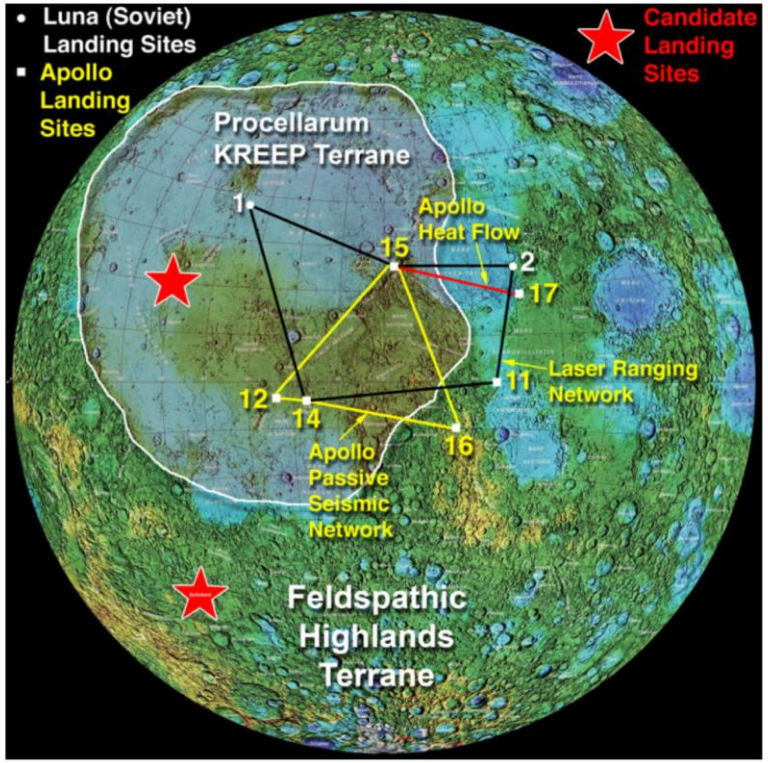
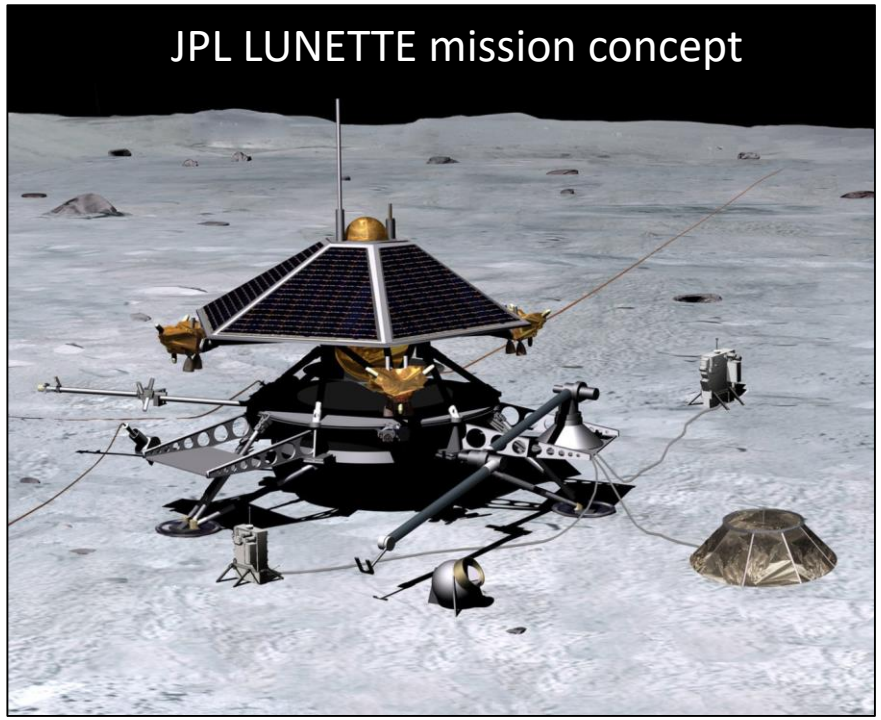
Instrument Function Statement and Gateway Usage

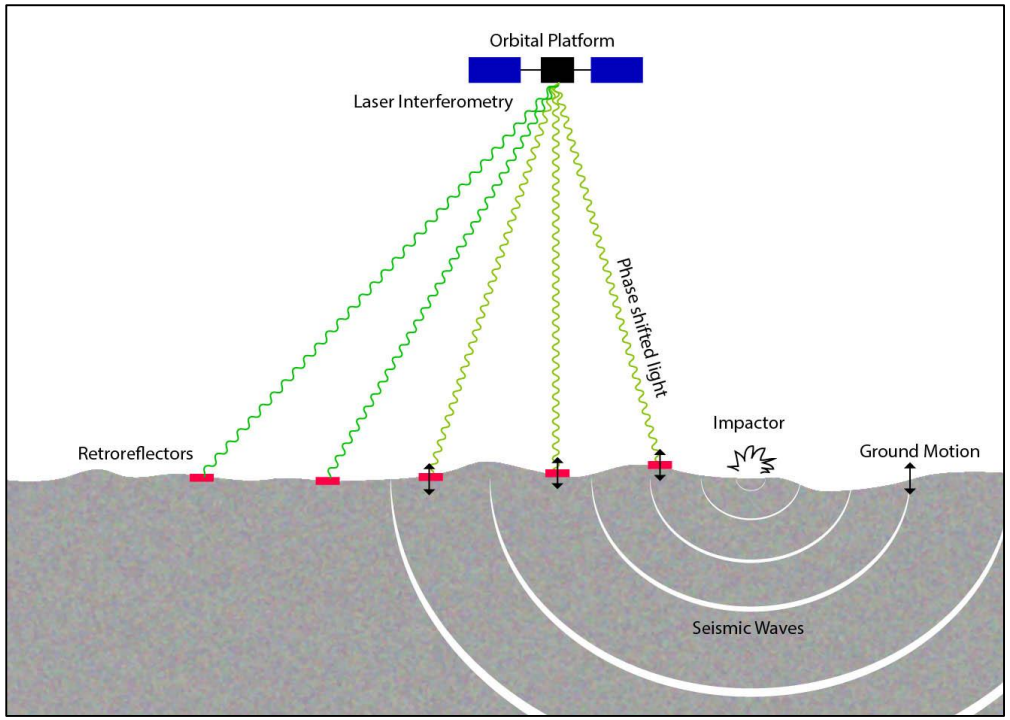
STATEMENT	INSTRUMENT/CONCEPT DETAILS
FUNCTION STATEMENT Deploy a long-lived network of stationary seismometers to the surface to monitor for seismic shaking induced by artificial sources, natural tectonism and meteorite impacts.	Science objectives: • Quantify the amount and distribution of seismicity • 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	-	-	-

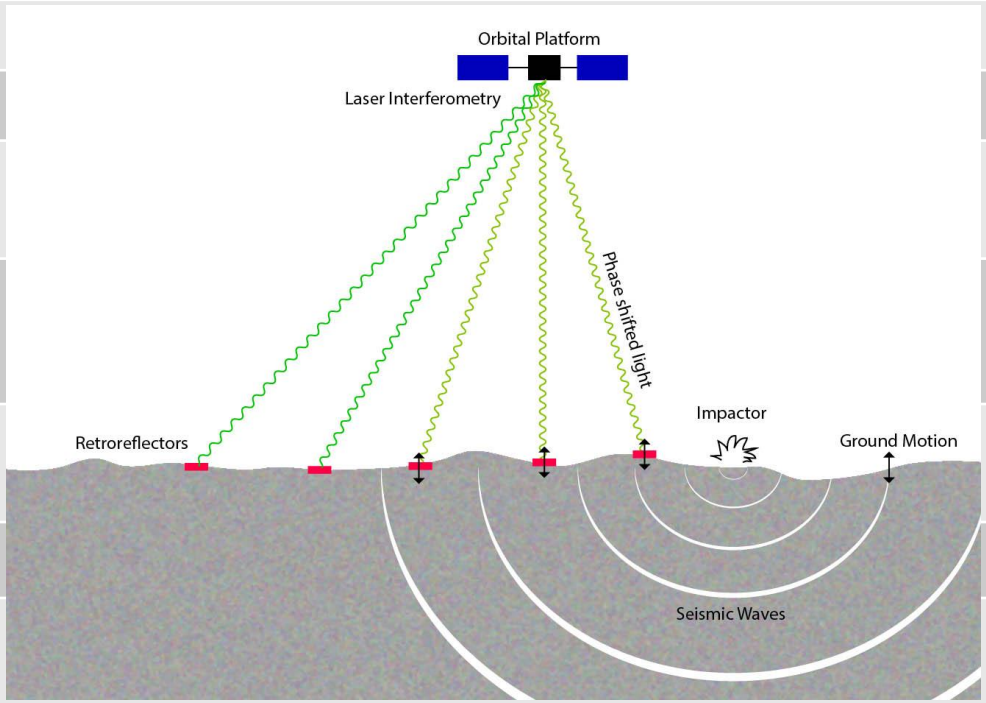
Instrument Gateway Usage – “releaseables” (landers, penetrators, etc.)

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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