The Lunar Water Assessment, Transport, Evolution, and Resource (WATER) Small Satellite Mission Concept

C.A. Hibbitts[1], D. Blewett[1], P. Brandt[1], L. Burke[2], B. Clyde[1], B. Cohen[3], J. Dankanich[4], D. Hurley[1], R. Klima[1], D. Lawrence[1], A. Mirantes[1], D. Moessner[1], W. Patterson[1], J. Plescia[1], J. Sunshine[5], J. Westlake[1]

[1]JHU-APL, [2]NASA GRC, [3]NASA GSFC, [4]NASA MSFC, [5]Univ. of Md.

karl.hibbitts@jhuapl.edu

SMD & HEOMD Priorities

The 2013 – 2022 NRC Decadal Survey:

"Understand the composition of distribution of volatile chemical compounds" and several "Important Questions":

1. "How are volatile elements and compounds distributed, transported, and sequestered in near-surface environments on the surfaces of the Moon and Mercury?"
2. "What fractions of volatiles were outgassed from those planets' interiors, and what fractions represent late meteoritic and cometary infall?"

Lunar Strategic Knowledge Gaps (SKGs) related to Lunar resources

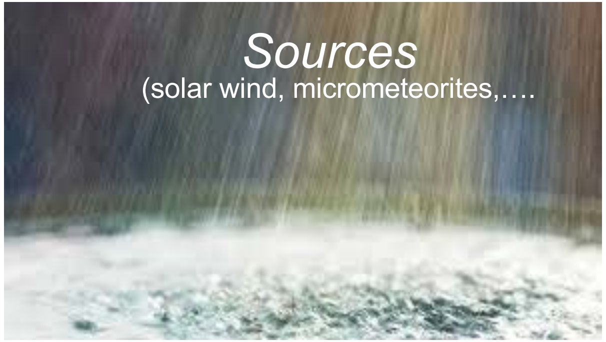
- *1C. Regolith 2: Quality / quantity / distribution / form of H species and other volatiles in nonpolar mare and highlands regolith.*
- *1D. Polar Resources 6: Composition, form and distribution of polar volatiles.*
- *1D. Polar Resources 7: Temporal variability and movement dynamics of surface-correlated OH and H2O deposits towards PSR retention.*
- *1E Composition / volume / distribution / form of pyroclastics / dark mantle deposits and characteristics of associated volatiles.*

Science Objectives

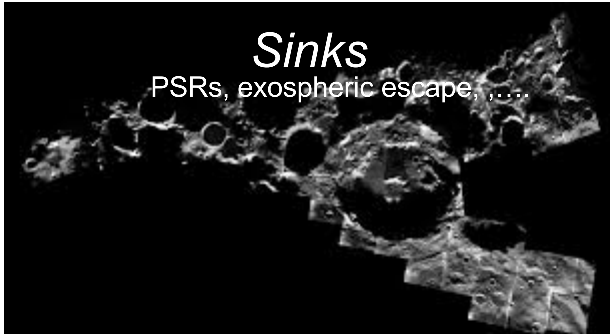
Evaluate mission, payload and CONOPS feasible with a small Lunar orbiter to characterize the water on the Moon.

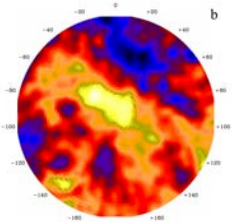
Science Objectives:

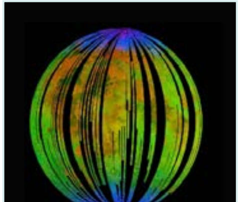
1. What are the chemical form(s) of water on the Moon, including the PSRs, and how are they distributed spatially?
2. How does surficial lunar water evolve over space and time?
3. Is solar wind implantation responsible for the OH on the illuminated Moon?



&




Lawrence et al., 2006


Pieters et al., 2009

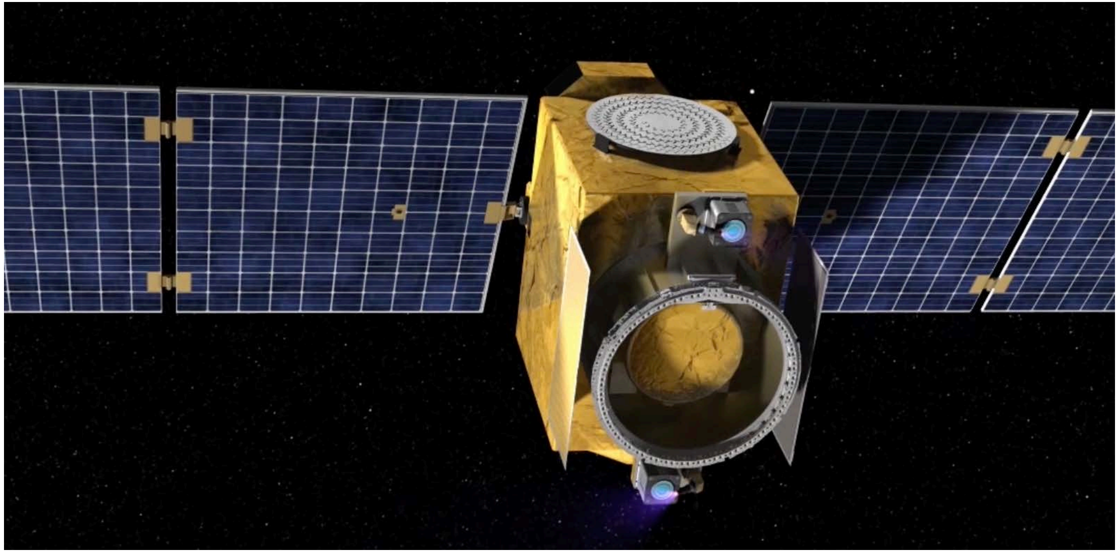
Mission Concept

Component	Mass (kg)	Power (W)
Spacecraft Bus (dry)	100	
Propulsion (Solid Iodine)	55	800
Solar panels (8 m^2), C60	15	960
Instruments	30	50 (peak)
TOTAL	**200kg + reserves**	

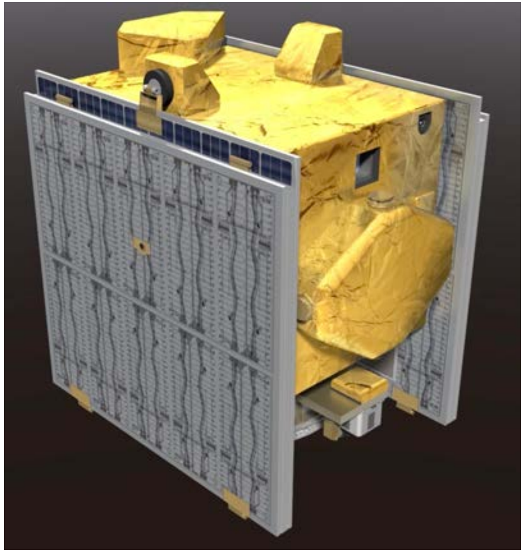
Notional Mission Schedule:

Project Phase A - D: 3 yr
Transit GTO to Lunar Orbit ~ 3 mo
Transition to low periapsis: ~ 2 mo
Science Ops: 6 mo
Phase A – E Duration: 4 yrs

Spacecraft



Solar-electric propulsion

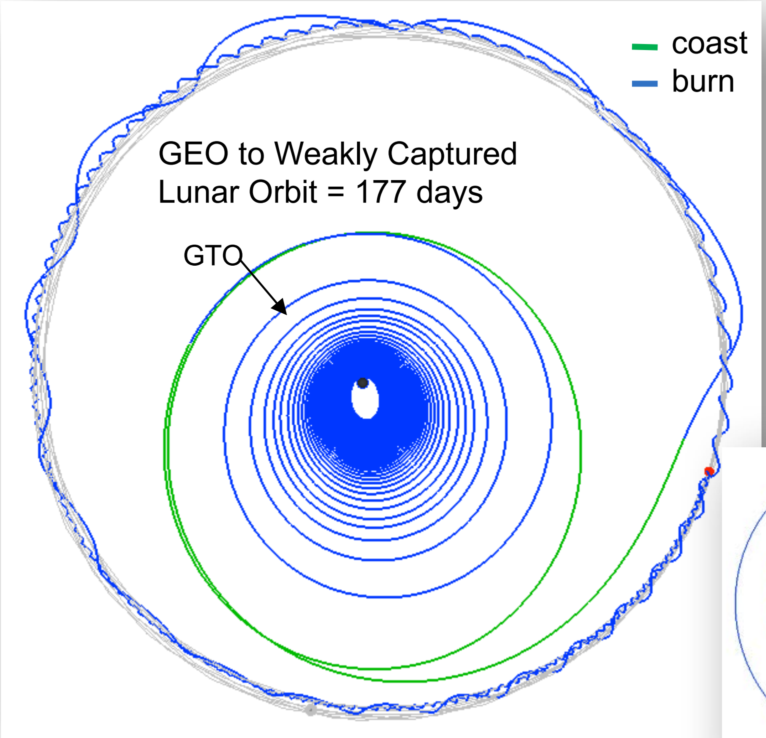


3-axis stabilized with instruments on nadir facing deck

Mission Trajectory

15 km x 1000 km Polar LLO (Perilune over S. Pole)

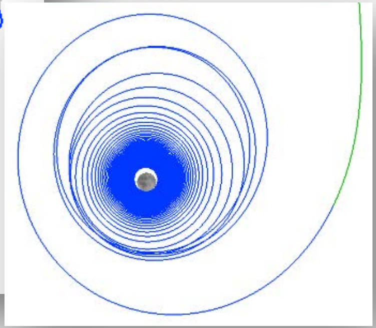
Orbit Phase	ΔV (m/s)
GTO to weakly captured lunar orbit	3251
Lunar spiral-in	1161
Altitude maintenance	8
Argument of perilune maintenance	247
Total	**4667**



201 days thrusting

24 days coasting

Spiral-In: 48 days

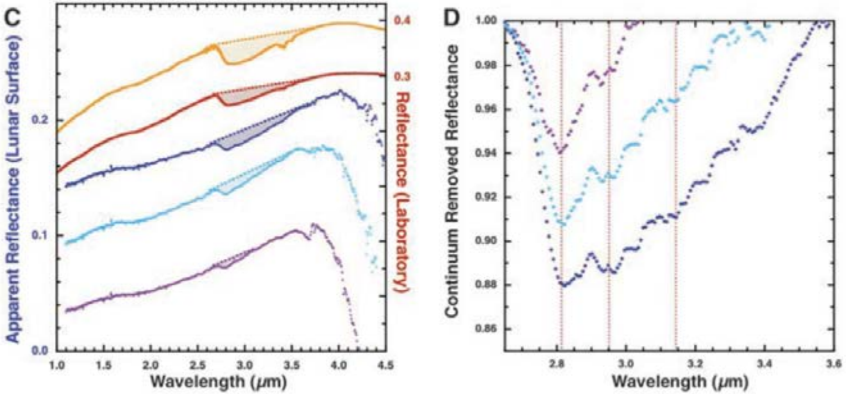


Instruments

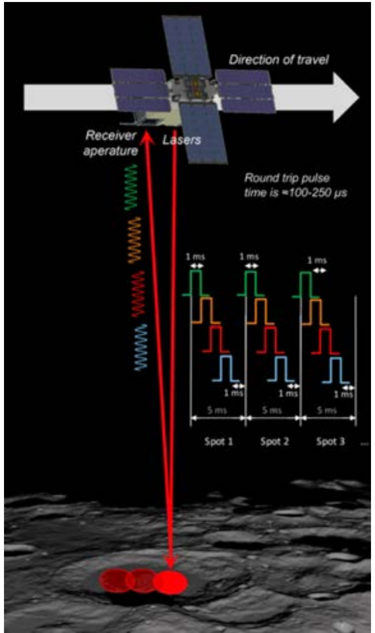
Mapping Surficial Water and Hydroxyl

Mapping Near-Surface Polar Hydrogen

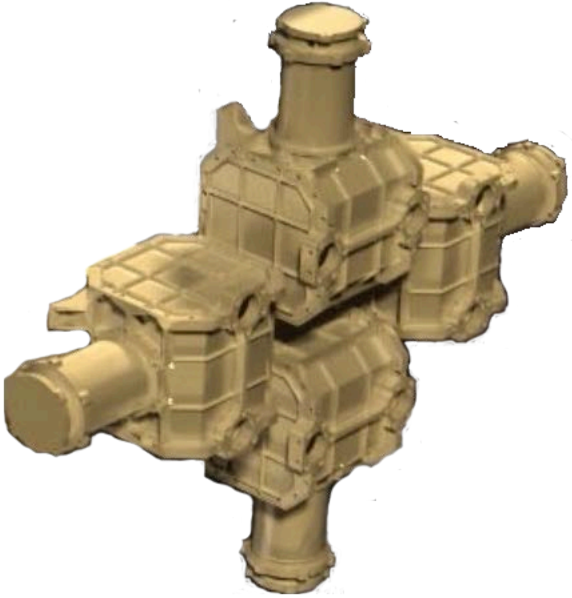
MIMSI
Mid-Infrared Multi-Spectral Imager



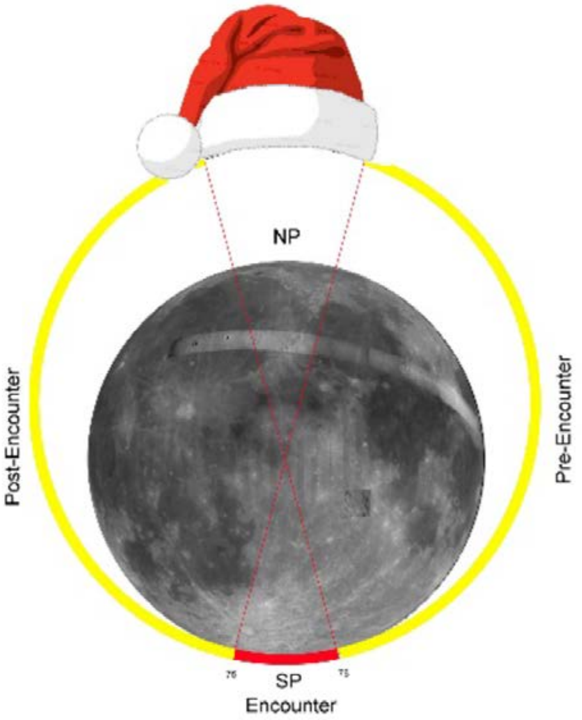
WattIR
Active Multiband IR Reflectometer



NS
Neutron Spectrometer



Concept of Operations



Orbit:

2.65 hours period

1000km apoapsis over NP

~ 15 km periapsis over SP

90º inclination, with an argument of periapsis within 5º of SP

Eclipse: Lunar < 50 min. Earth&Lunar combo: < 3.75 hours

Science Operations:

~ 1Gbit/orbit

NS: polar science within 15º of SP, which is < 25 km altitude.

Always on for background measurements

WattIR: operates within 5º of SP

MIMSI: operates over illuminated terrain when nadir facing.