The European Lunar Lander

human spaceflight and operations

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International Context

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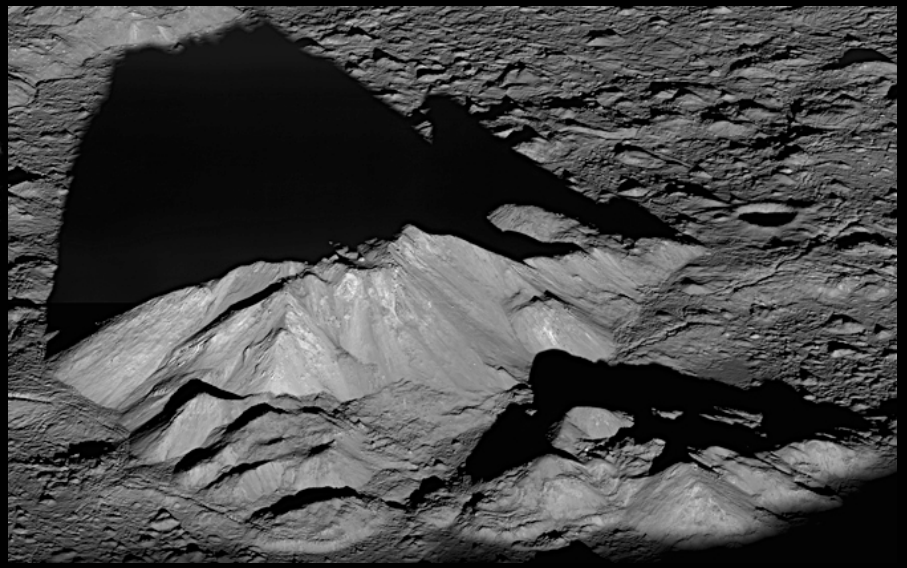
Apollo/Luna Era	1990 - 2006	2007 - 2012	2013 - 2020	Next Decade
	HITEN	KAGUYA	SELENE-2	HUMAN LUNAR EXPLORATION MISSIONS
	CLEMENTINE	L-CROSS	LADEE	
	LUNAR PROSPECTOR	LRO	GOOGLE-X	
	SMART-1	GRAIL	LUNAR LANDER	LUNAR POLAR SAMPLE RETURN
		ARTEMIS	CHANG'E-3	
		CHANG'E-1	CHANG'E-4	
		CHANG'E-2	CHANDRAYAAN-2/ LUNAR-RESOURCE	LUNAR GEOPHYSICAL NETWORK
		CHANDRAYAAN-1	CHANDRAYAAN-3	
			LUNA-GLOB	



ORBITER
IMPACTOR
LANDER
SAMPLE RETURN

European Lunar Lander: Preparing for Future Exploration

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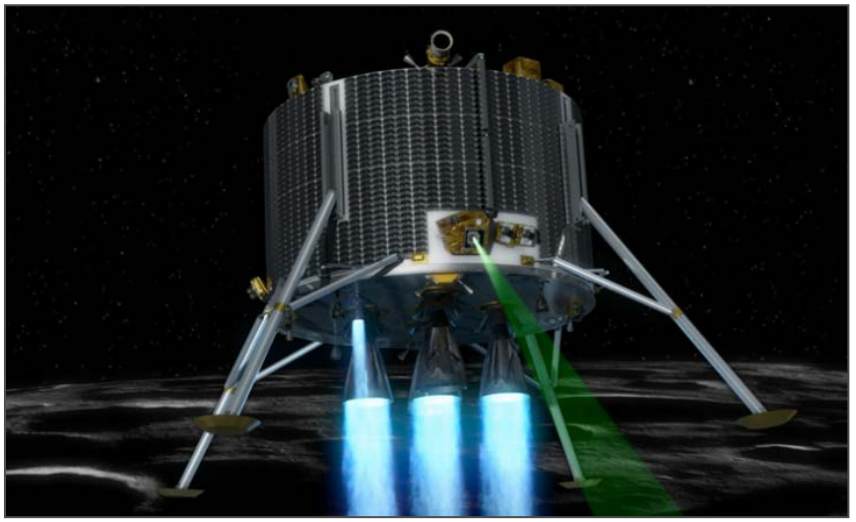
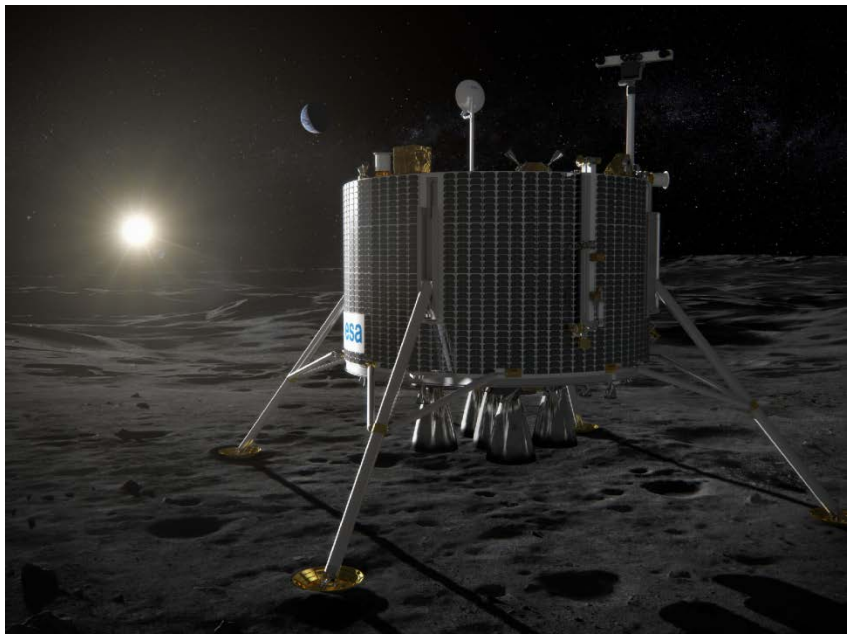
1) Technology

- PRECISE LANDING with advanced Guidance, Navigation and Control
- HAZARD DETECTION AND AVOIDANCE
- OPERATE on the Lunar surface, carry out sampling, support autonomous survival



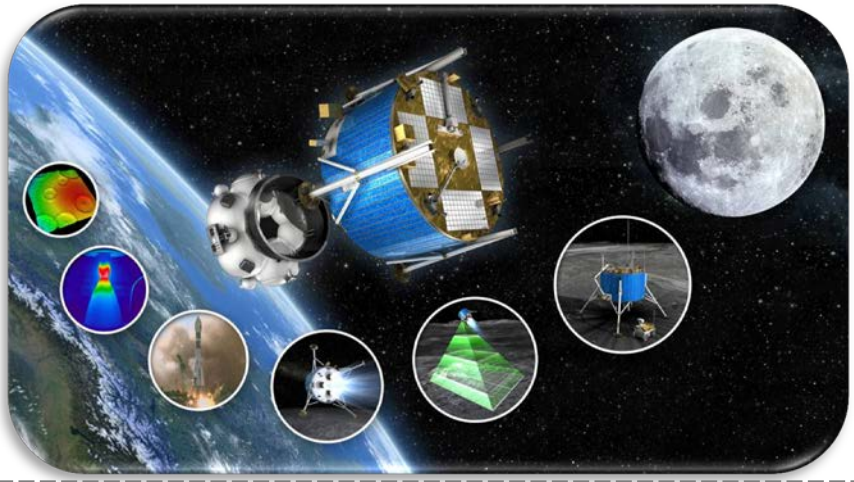
2) Scientific Measurements

- Lunar environment & effects
- Human relevant aspects
- In-situ resources



Phase B1
Contributing Member States

- Several new partners now integrating the original industrial team



2011

ASTRIUM AN EADS COMPANY

deimos ENGENHARIA

DLR

jenaoptronik

KAYSER-THREDE An OHB Technology Company

UNINOVA INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS

VCS A SCISYS COMPANY

neptec

NGC

INO

gmv INNOVATING SOLUTIONS

elecnor deimos

SPACEBEL

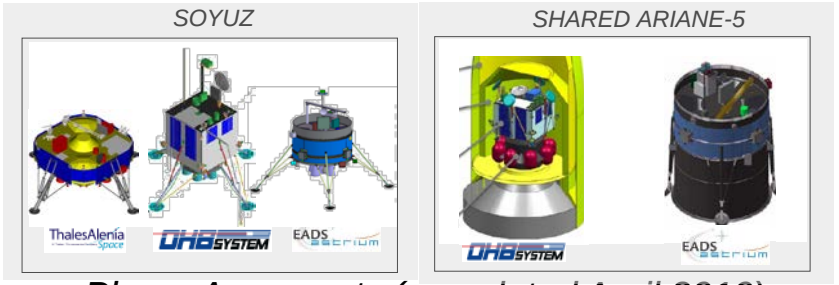
antwerpspace An OHB Company

*Consortium as of 15/05/2012

- After Phase B1, pending approval at MC'12 , the industrial consortium will evolve and adapt to new partners:
  - to broaden the industrial base and reflect the support across Europe
  - to further incorporate expertise necessary for B2/C/D/E

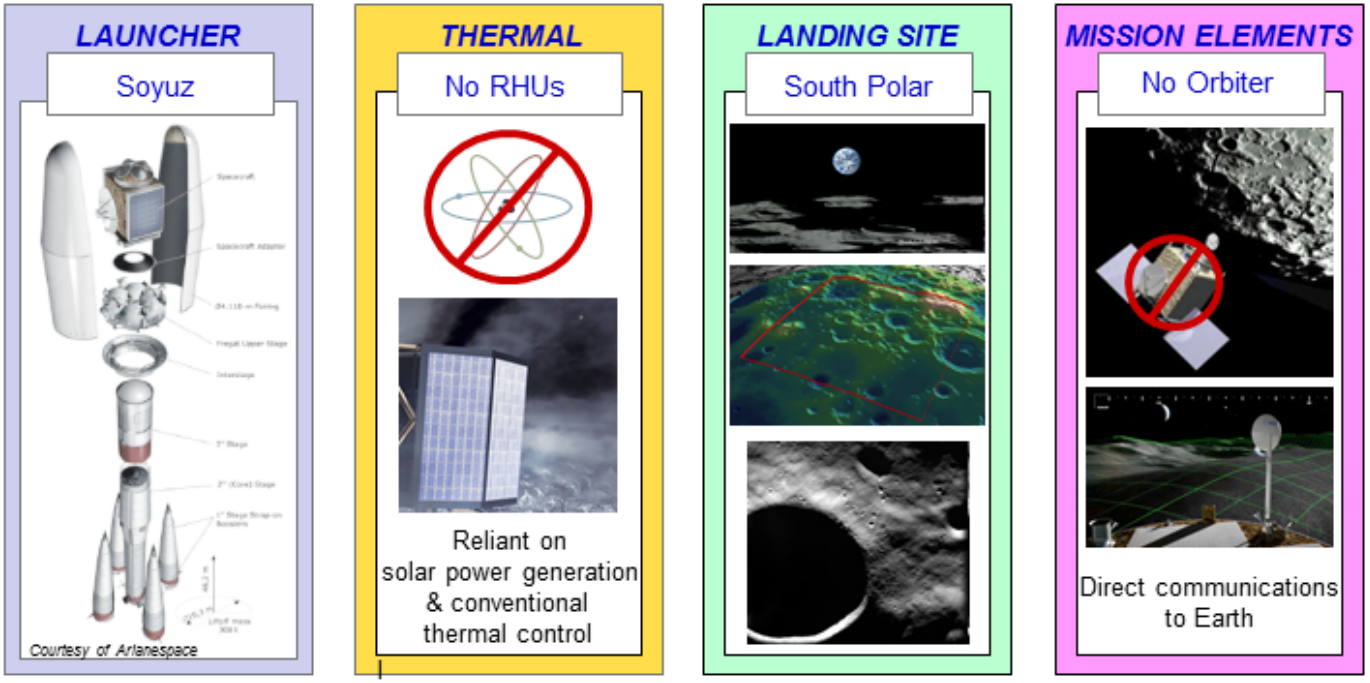
Mission Drivers

- Constraints applying to the Lunar Lander mission
  - Launch: use of European capability
  - Cost: compatible with precursor-type
  - Timeframe: not later than 2018
  - Technology: made-in-Europe

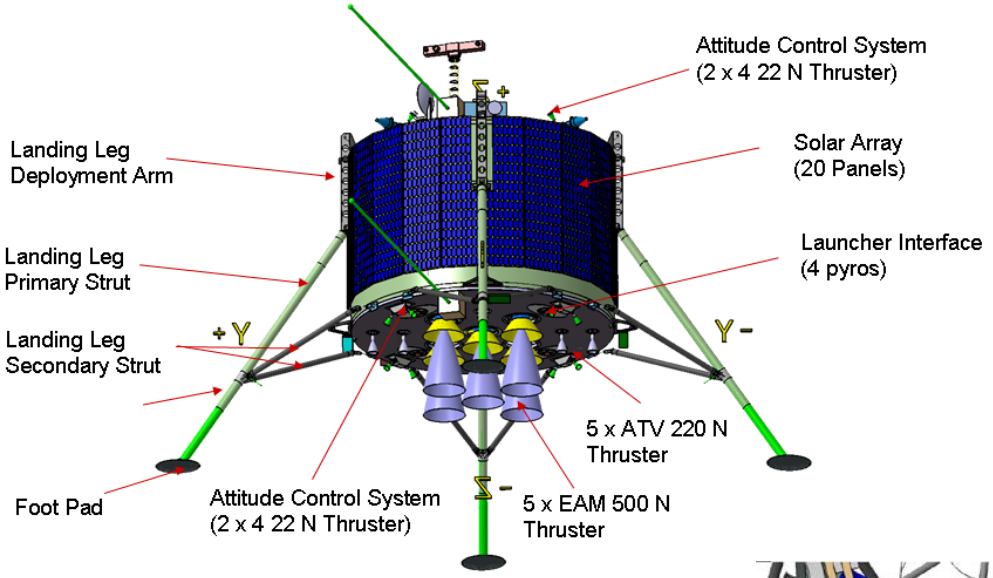


Phase A concepts (completed April 2010)

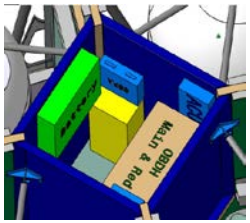
- Key mission baseline choices



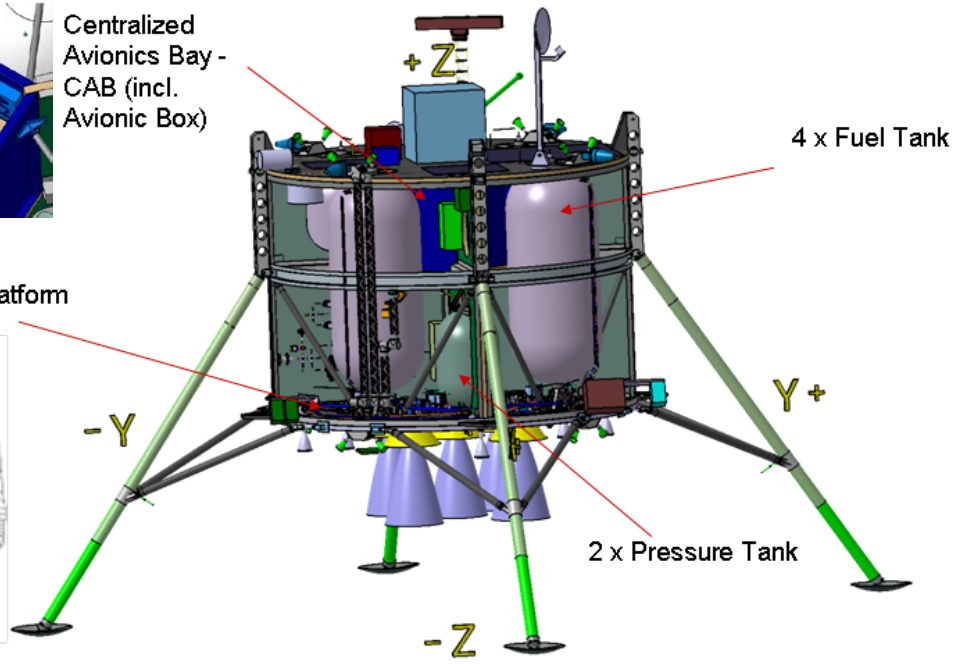
Current Configuration



- Single stage
- Wet mass at launch: 2500 kg (analysed by Arianespace in 2011)
- Mass landed: ~800 kg



Centralized Avionics Bay - CAB (incl. Avionic Box)



Diameter = 2.4 m
Height (incl. legs) ~ 3.4 m
Height (body) = 1.6 m
Footprint radius = 2.8 m

Objectives and Requirements Definition

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- Wide consultation to identify objectives and requirements

Lunar Exploration Definition Team
Topical Teams and workshops: Dust Toxicity (T3LD) Resources (TTELPM) Radiation Biology (TT-IBER) Dusty Plasma Environments (TT-DPESS)
Payload Definition Studies
Landing site characterisation studies

- Workshop “Scientific Preparations for Lunar Exploration” at capacity with 180 participants
- Forthcoming special issue of Planetary and Space Science

Science Objectives

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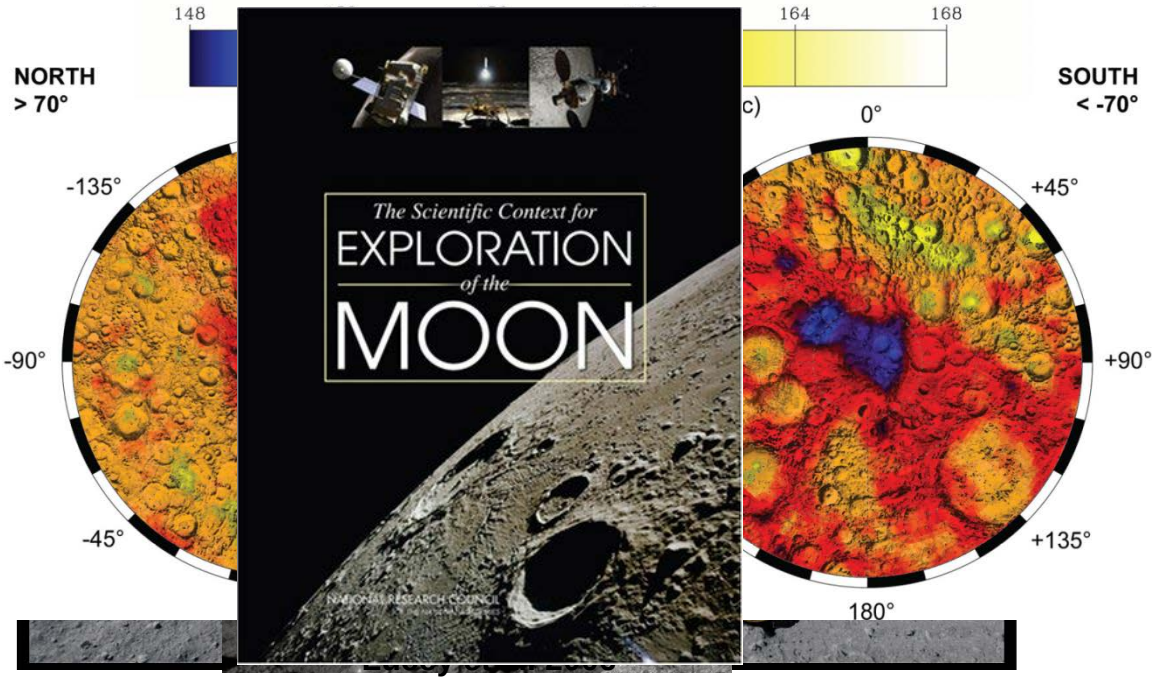
Research Area	Investigation Topic
Human health	Toxicity of lunar dust associated risks to humans
	Radiation environment and likely hazards to humans
Environment and effects	Landing site characterization
	Dust properties and effects on systems
	Dust - Plasma environment and effects
Resources	water, other volatiles and mineralogical species
	Physical properties of potential resources
Preparations for future activities	Characterize the exosphere
	Radio astronomy precursor measurements



Lunar Lander: Model Payload

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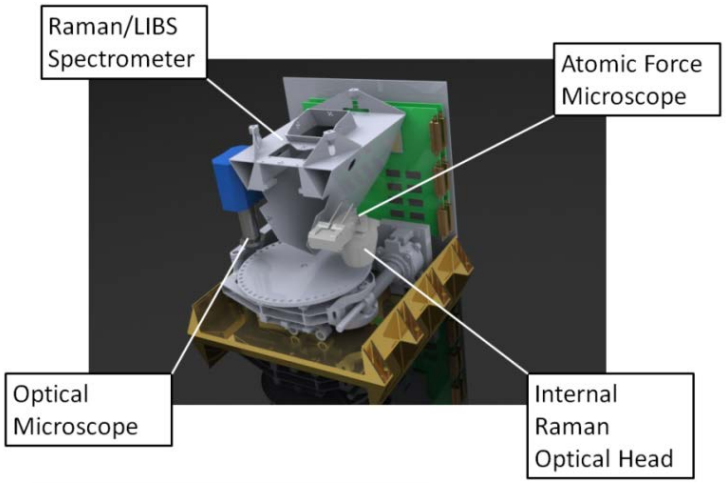
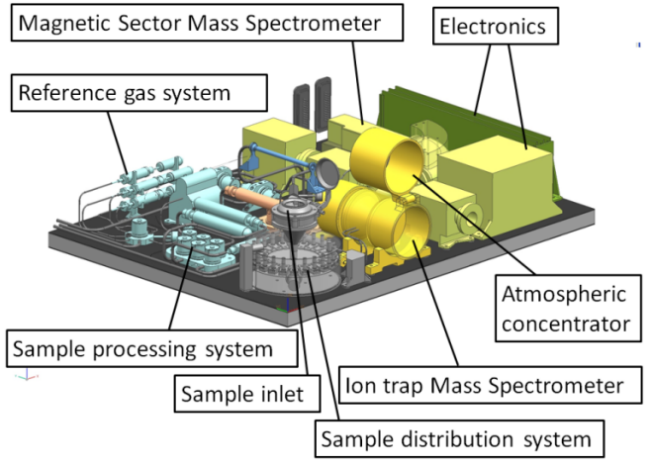
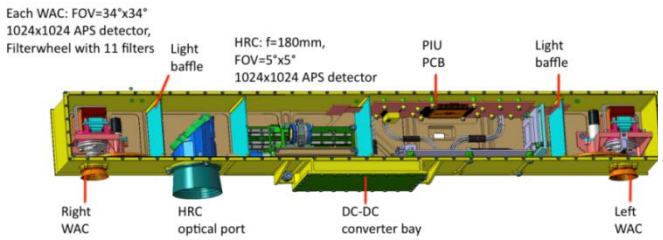
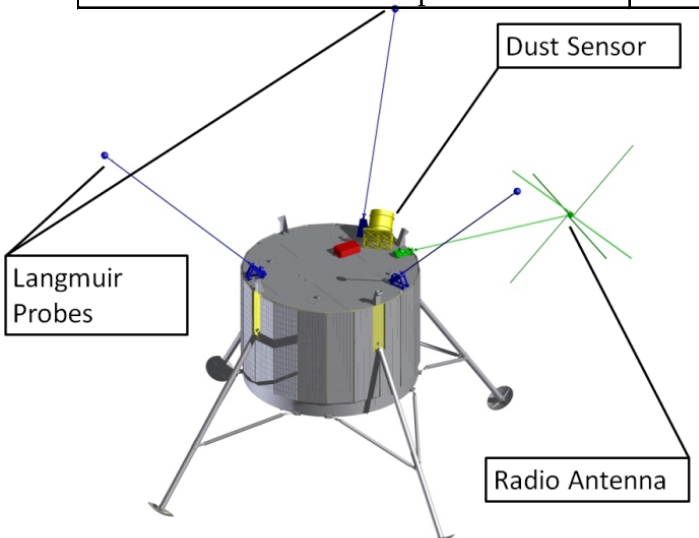
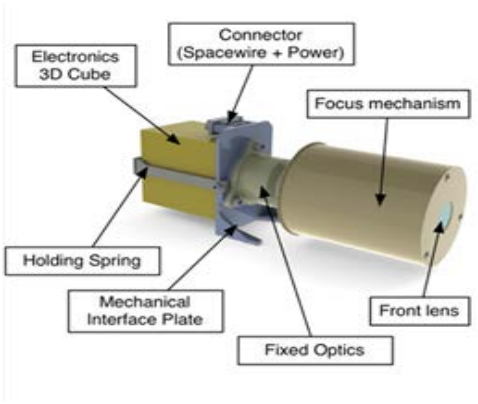






Package	Instrument
Lunar Camera Package (L-CAM)	Stereo Panoramic Camera
	High Resolution Camera
	Robotic Arm Camera
Lunar Dust Analysis Package (L-DAP)	AFM
	Micro Raman-LIBS
	Microscope
	External Raman-LIBS
Lunar Dust Environment and Plasma Package (L-DEPP)	Dust Sensor
	Langmuir Probes
	Radio Antenna
	Ion/Electron Spectrometer
	Magnetometer
Lunar Volatile Resource Analysis Package (L-VRAP)	Mass Sector Mass Spectrometer
	Ion trap mass spectrometer
Radiation and effects experiments	Radiation monitor





Other Experiments?

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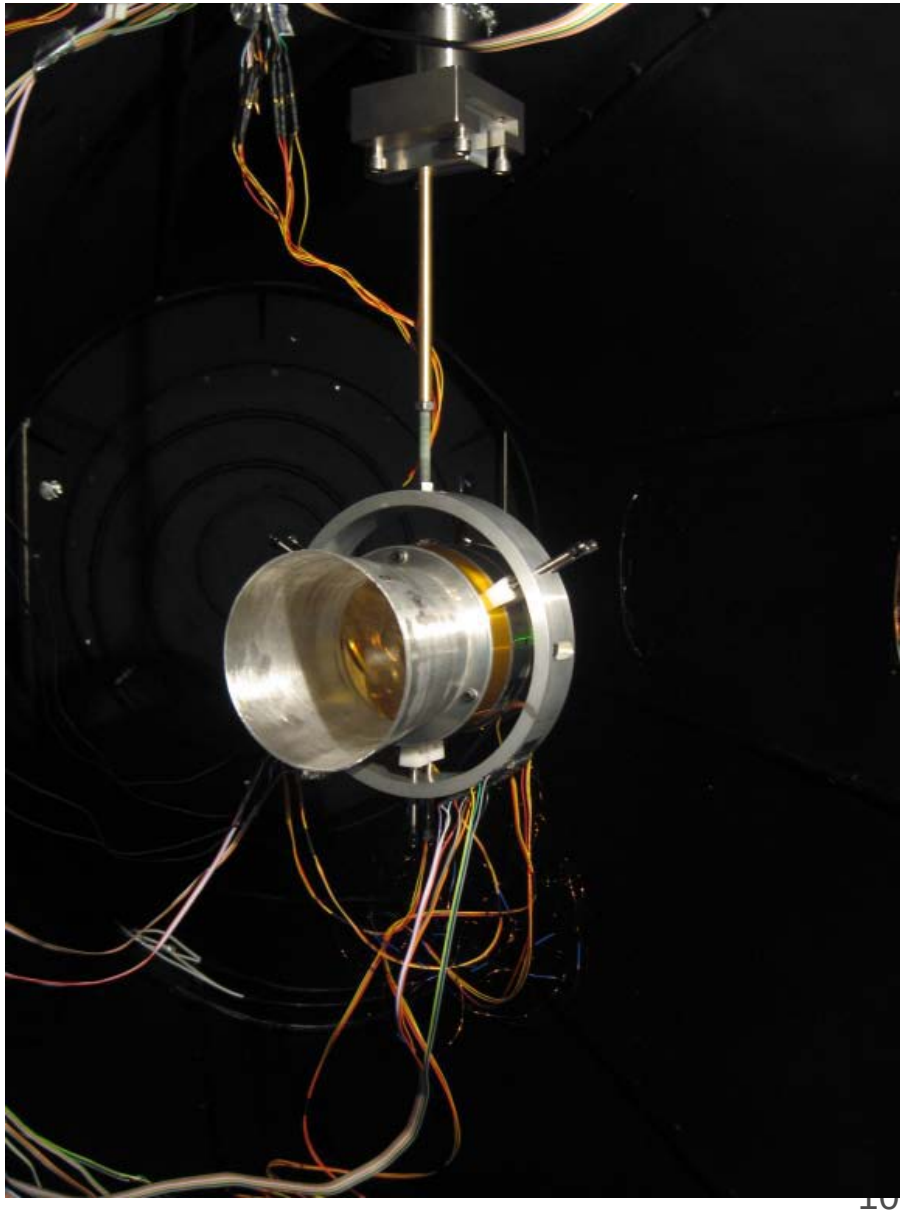
- ESA led Model Payload is not a selected payload
- Alternative experiments can be considered
- Address exploration relevant questions
- Provide fundamental scientific return
- E.g. Laser reflector
  - Verify landing precision
  - Absolute reference for coordinate systems
  - Lunar interior and fundamental physics



Schedule and Next Steps

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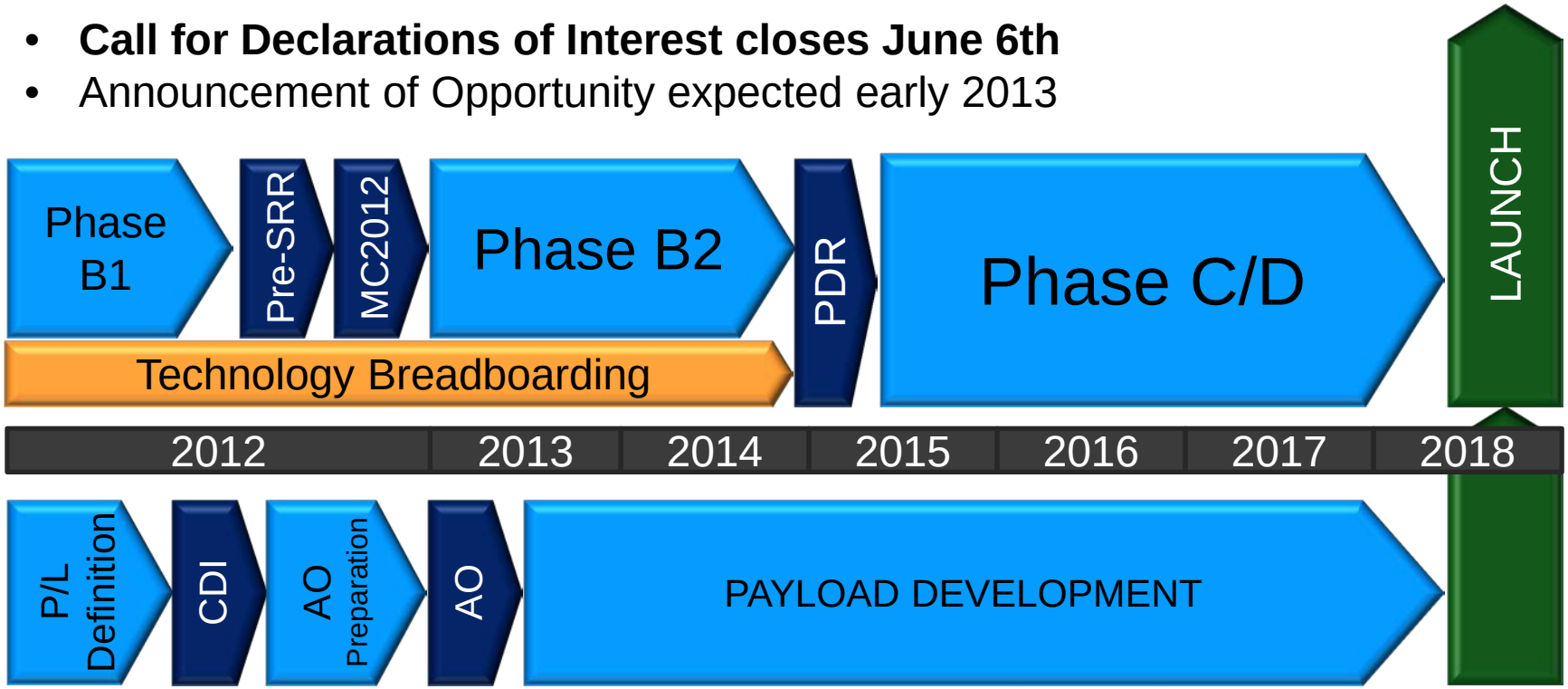
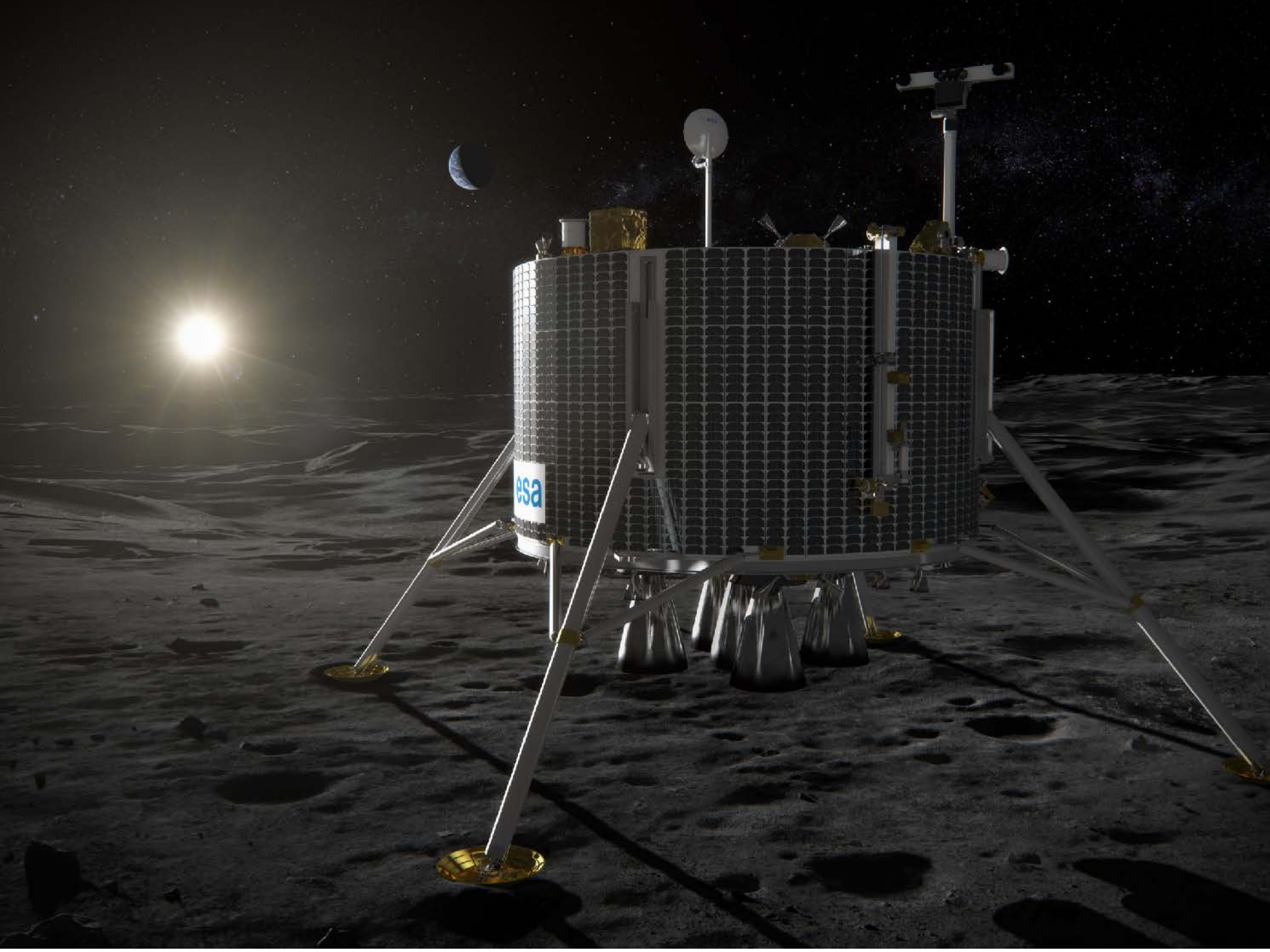
- Pre-SRR in October 2012
- Ministerial Council in November 2012 (MC2012)
- S-PDR planned early 2015
- Breadboarding activities running continuously up to PDR (TRL 5)

- **Call for Declarations of Interest closes June 6th**
- Announcement of Opportunity expected early 2013

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Lunar Camera Package

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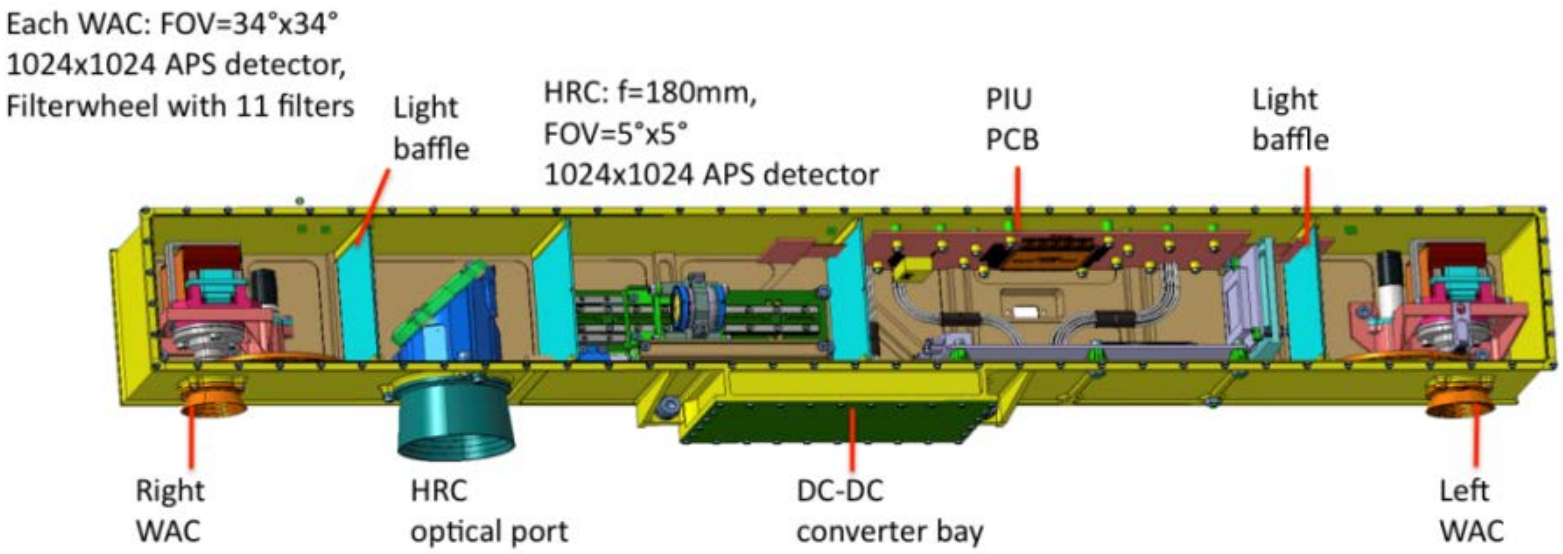
Provide scientific context

Determine illumination profile

Monitor operations

Stereo panoramic cameras

Robotic arm camera



Exomars Pancam – Credit MSSL

Lunar Dust Environment and Plasma Package

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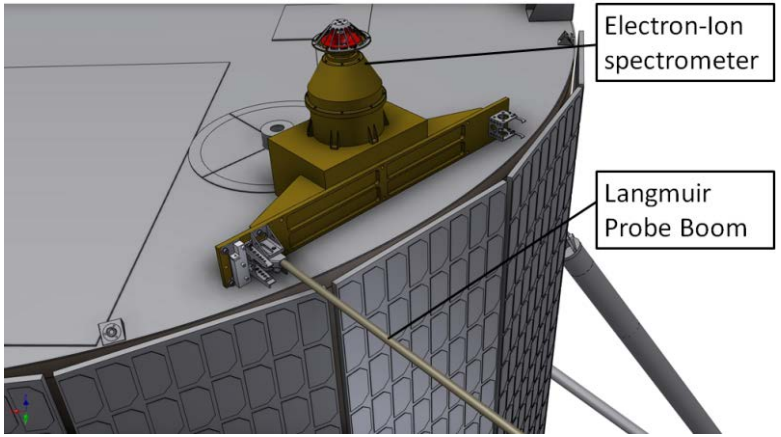
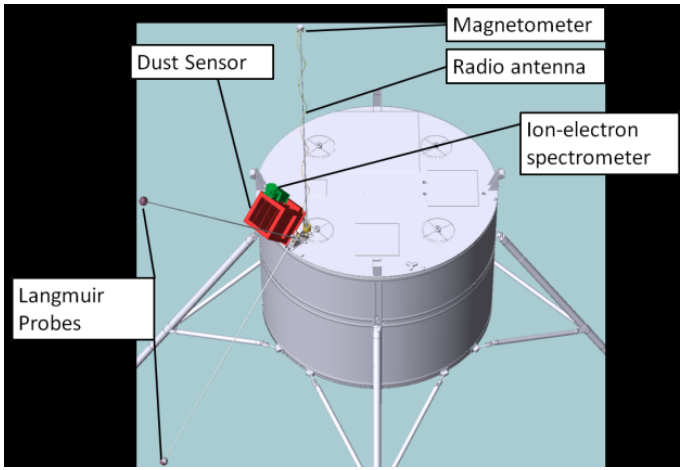
Measurements

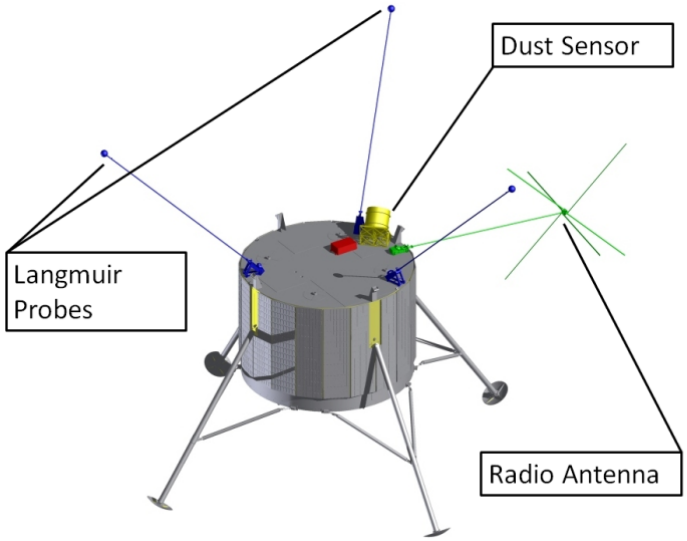
- Dust motion, charge, size distribution, trajectory
- Electric fields
- Plasma properties
- Medium - Long wavelength radio background



credit FMI/IRF



credit ASI



credit Kayser-Threde

Lunar Dust Analysis Package

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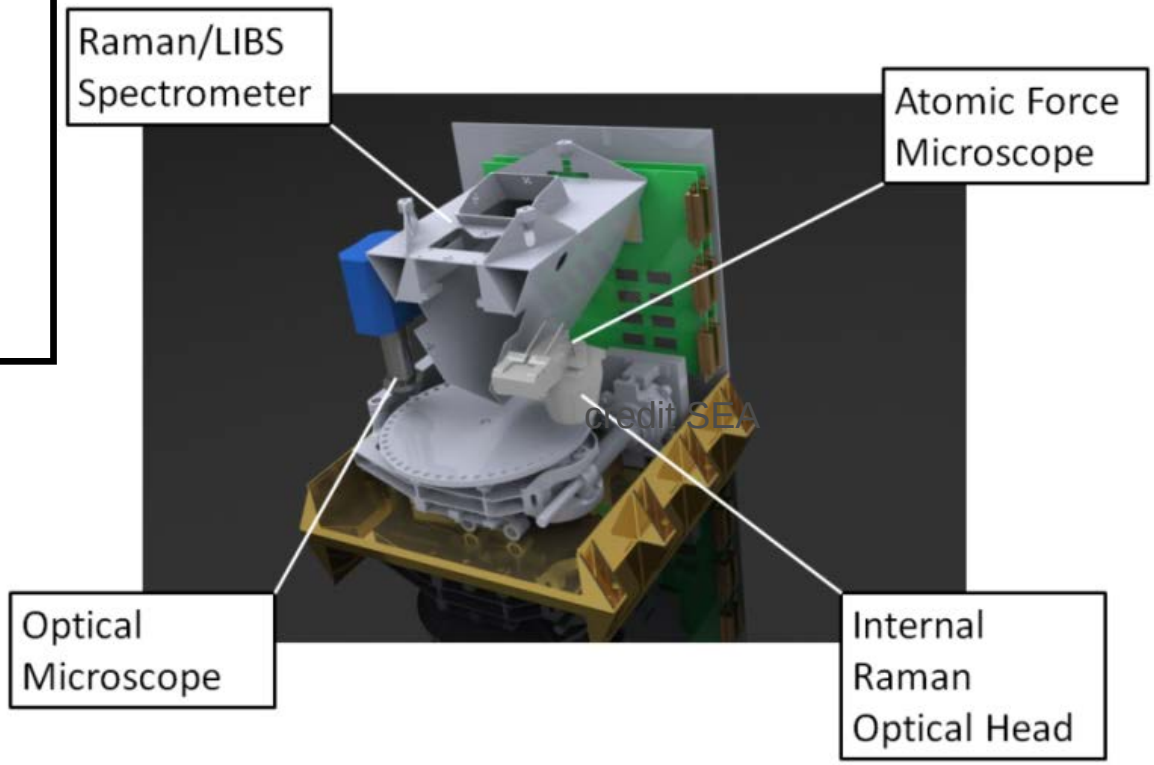
Lunar Dust Analysis Package

- Size distribution of dust ~10nm - 100µm
- Structure and morphology of grains
- Dust/regolith chemistry/mineralogy
- Dust/regolith elemental composition?
- OH group, H_2O



Lunar Volatile Resource Analysis Package

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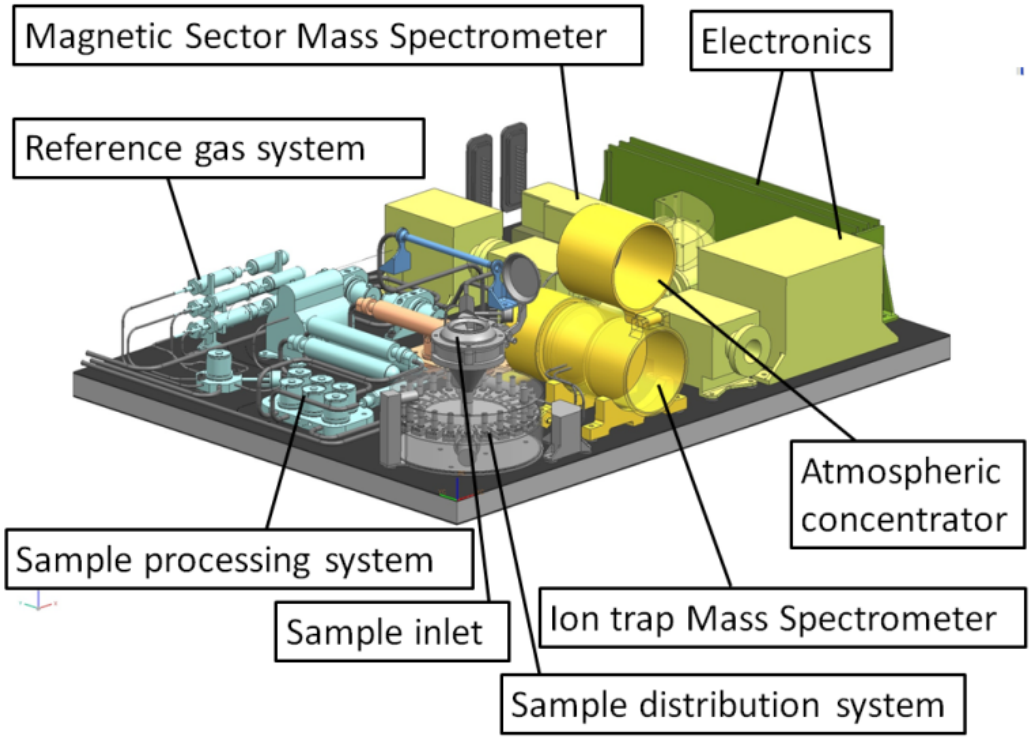
Measurements

Identify water and solar wind implanted volatiles in the lunar regolith

Extract volatiles from the lunar regolith

Observe exosphere species



credit OU