

Moon and space plasma, A natural laboratory, where space weather meets space weathering

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Non-atmospheric bodies







Magnetic anomaly



Richmond and Hood, 2008



Mini-magnetosphere



Harnett and Winglee, 2002



Marius E

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Reiner N (NASA / LRO_LROC_TEAM)

Reiner Gamma

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Reiner A



Weathering effects?





ENA generation from surface

Sputtered ENAs



Mostly small energy (<100 eV) Planetary Space Weather meeting, Europlanet, IRAP, Toulouse.



We provide plasma at surface by ENA

ENA provides information at the surface
Plasma at spacecraft







Scattering from lunar regolith



Extreme event for Moon



Lue et al., 2014

Scattered hydrogen ENA





Shielding = Mini-magnetosphere size



Vorburger et al., 2014



Space weather impact weathering





ENA, magnetosphere, water

Water / hydroxyl features





Water production by solar wind?

$\mathbf{H^{+} + e^{-} + Fe = O \rightarrow Fe - OH}$

$2 \ Fe\text{-}OH \rightarrow Fe\text{=}O + Fe + H_2O$

$2 \ Fe\text{-}OH \rightarrow Fe\text{-}O\text{-}Fe + H_2O$



IRF

Lunar environment



Space weather influences space weathering



SELMA (M5): Science overview



How do airless bodies interact with space environment: The Moon as an accessible laboratory

What is the origin of water on the Moon?

How does the volatile cycles on the Moon work?

How do the lunar mini-magnetospheres work?

What is the influence of dust on the lunar environment and surface?

SELMA is a mission in the frame of the Cosmic Vision themes 1 and 2

- 1. What are the conditions for planet formation and the emergence of life?
- 2. How does the Solar System work?



SELMA (M5): Mission overview



- Mass 1302 kg (at launch); Dry mass 627 kg; Payload 111 kg
- Four elements
 - SELMA orbiter
 - SIP-MA (42 kg)
 - Impactor (10 kg) and RCS (6U) for impact experiment
- 15 instruments
 - · 4 remote sensing
 - 7 in situ
 - 4 in situ (SIP-MA)
- Launch January 1, 2029 (flexible)
 - Soyuz-Fregat or Ariane 62
 - Lifetime for 15 months
- · Epochs
 - · SIP-MA after 6 months
 - Impact experiment after 15 months



SIP-MA

- Deep inside mini-magnetosphere
 - Low altitude (down to electron scale; Debye length~0.1 km) is important
 - Shallow impact angle (1–2°) indicates 1– 3 seconds for 0.1 km descent
 - Measurement of electron and ion's 3-D distribution functions with 0.5 s resolution is required





SELMA: summary

How do airless bodies interact with space environment: The Moon as an accessible laboratory

Water		How does the Solar
Exosphere		System works?
Mini-magnetosphere	Mission	What are the conditions for planet formation and
Dust		the emergence of life?
SELMA science	To investigate the lunar environment and surface interactions $m_{\rm e}$	Cosmic Vision
SELIVIA IVIISSION		SELMA characteristics
Launch in 2029		SELIVIA Characteristics
Lifetime for 15 months		Coordinated measure-
		ments of in-situ and
1302 kg (wet)		remote sensing
627 kg (drv)		Terriete certeirig
with 111 kg (payload)		Impact probe for mini-
with the kg (payload)		
		magnelosphere
15 sensors (4 remote	Lead proposition	
sensing, 7 in situ, and 4	Statis Conducasti Tosmillumi r rutadha Swadali histlak Gopac Physics, Swadali histlak Gopac Physics, Box 812, S5-66128, Kiruna, Stac66128, Kiruna, Swadah Box 812, S5-66128, Kiruna, Swadah +64902/7012 (clina) +46902/7012 (clina)	Water detection by
on impact probe)	446/70/237 85 86 (mobile) 446/70/237 73 09 (mobile) base(gridse	impactor
	Call for a Medium-size Mission Opportunity in ESA's Science Programme (M5)	



Support SELMA today!

Open <u>http://tinyurl.com/support-selma</u>

2 Put your name, institution, and country



4 Send the link to your friends

SELMA supporter registration

In response to ESA's medium-class mission opportunity call (<u>http://www.cosmos.esa.int/web/callfor-m5-missions</u>) a mission to the Moon to investigate its environment was proposed in Octorber 2016: SELMA.

Thank you very much for you who already expressed the support of SELMA

Even after the close of the call itself, we decided to continue gathering supporters. We really appreciate that you could support this mission by registering the following form.

Any questions regarding SELMA mission and the suporters can be sent to Dr Yoshifumi Futaana (Science Lead of SELMA).

*Obligatorisk



Message (optional)

Ditt svar

Please click the "submit" button. Your information will be sent to the SELMA proposal team. Thank you for your support!

