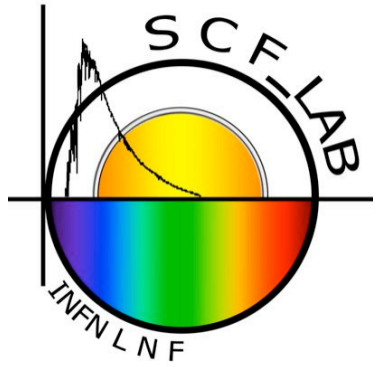


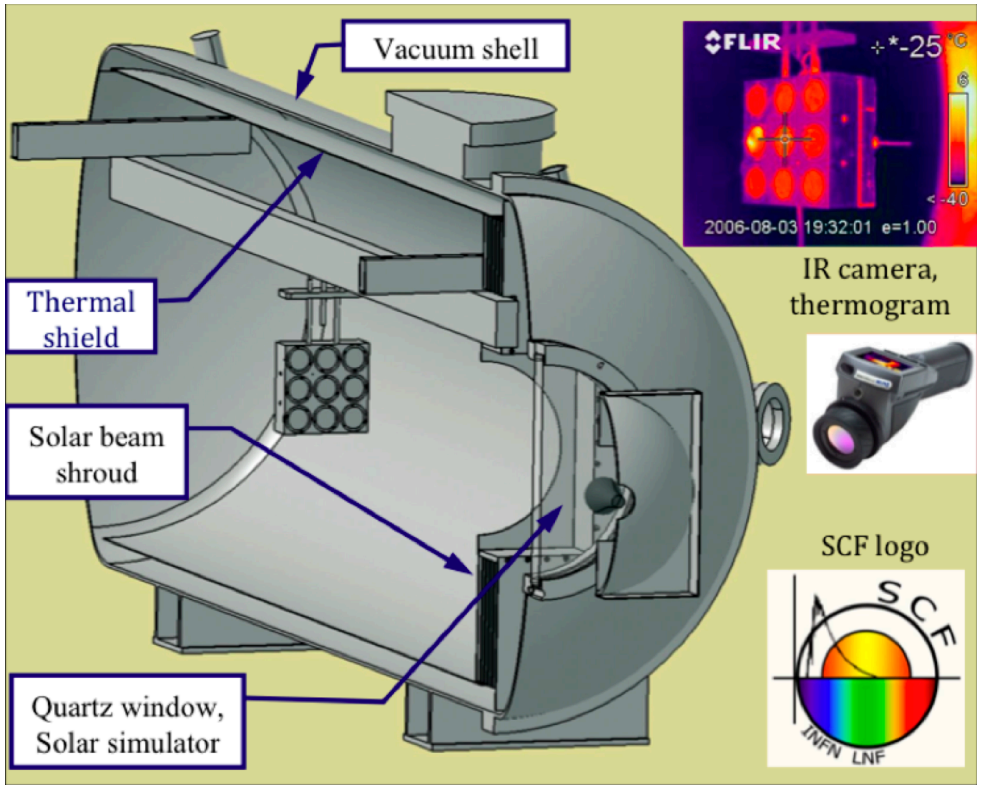
SCF-Test of infrared (1064 nm) laser ranging and altimetry to retroreflectors on moons and planets

Dell'Agnello, S.; Delle Monache, G. O.; Martini, M.; Vittori, R.; Cantone, C.; Boni, A.; Berardi, S.; Patrizi, G.; Tibuzzi, M.; Lops, C.; Maiello, M.; E. Ciocci, E.; Salvatori, L.; Rinaldi, S.

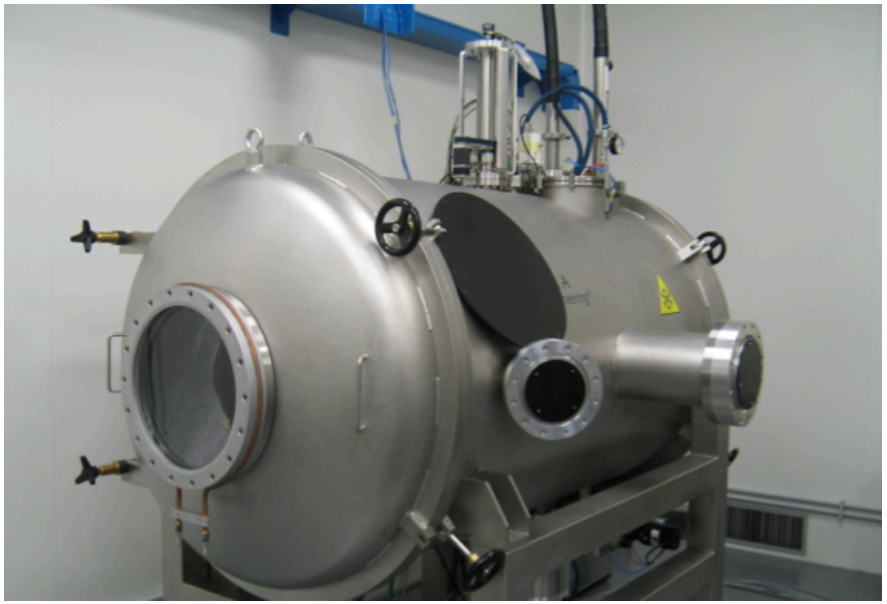
INTRODUCTION

Two unique OGSE (**Optical Ground Support Equipment**) facilities in a clean room to characterize the SLR/LLR/GNSS laser ranging and laser altimetry space segments

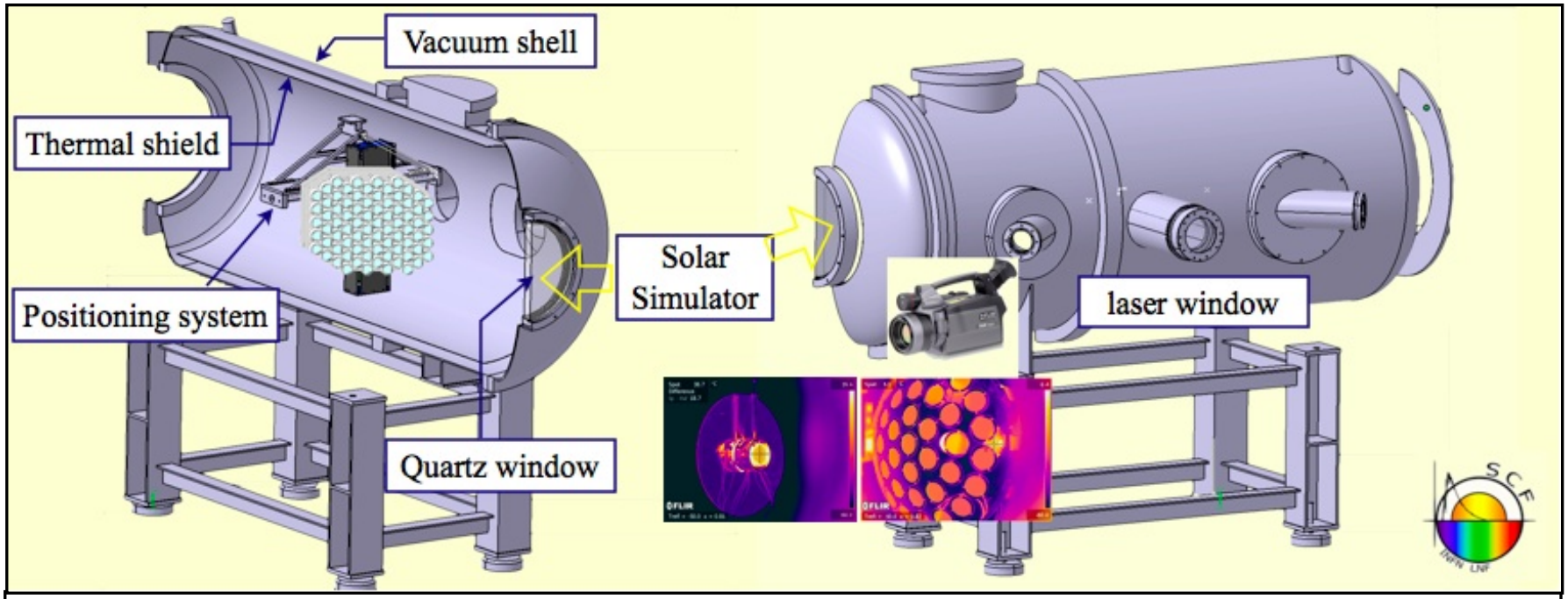
SCF for SLR/LLR/Laser Altimetry



SCF-G for GNSS



INTRODUCTION



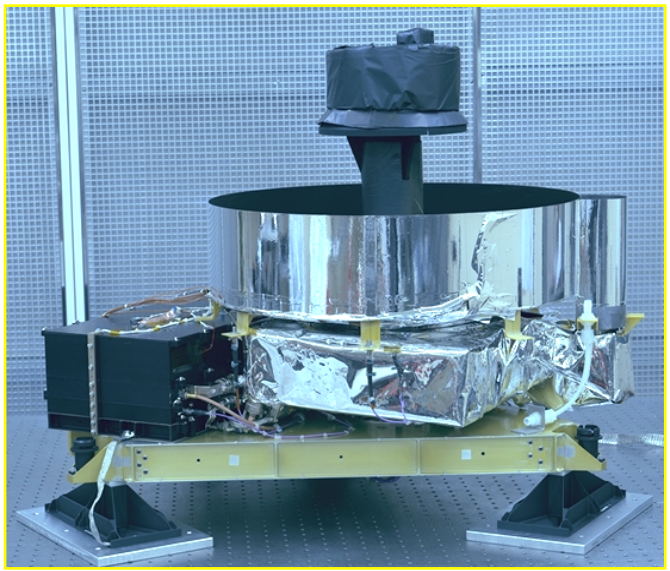
SCF: Satellite/lunar/GNSS laser ranging and laser altimetry Characterization Facility

The SCF modular, versatile and evolutionary design is being upgraded to characterize Infrared (1064 nm) Laser ranging and Altimetry (ILA)

Infrared Laser Altimetry

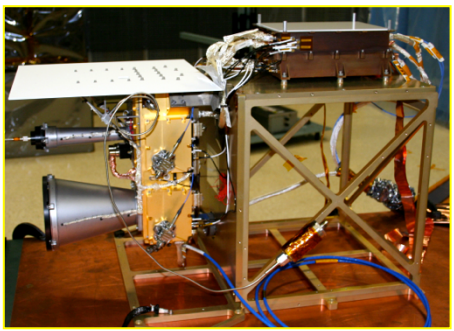
ILA has been, and is an important tool in the exploration and planetary science of Mars (Mars Orbiter Laser Altimeter, MOLA, onboard the Mars Global Surveyor), Mercury (Mercury Laser Altimeter, MLA, onboard MESSENGER) and the Earth's Moon (Lunar Orbiter Laser Altimeter, LOLA, onboard the Lunar Reconnaissance Orbiter).

Mars (MOLA)

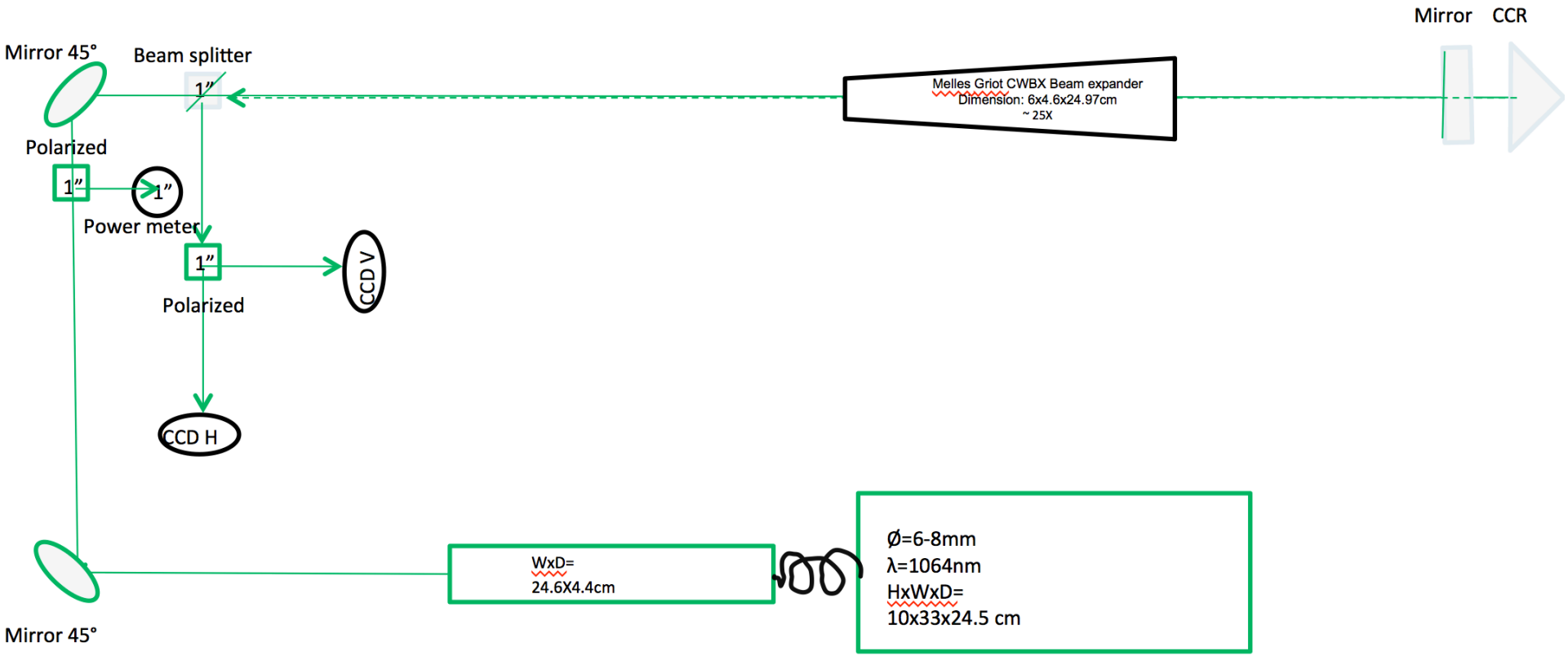


Mercury (MLA)

Moon (LOLA)



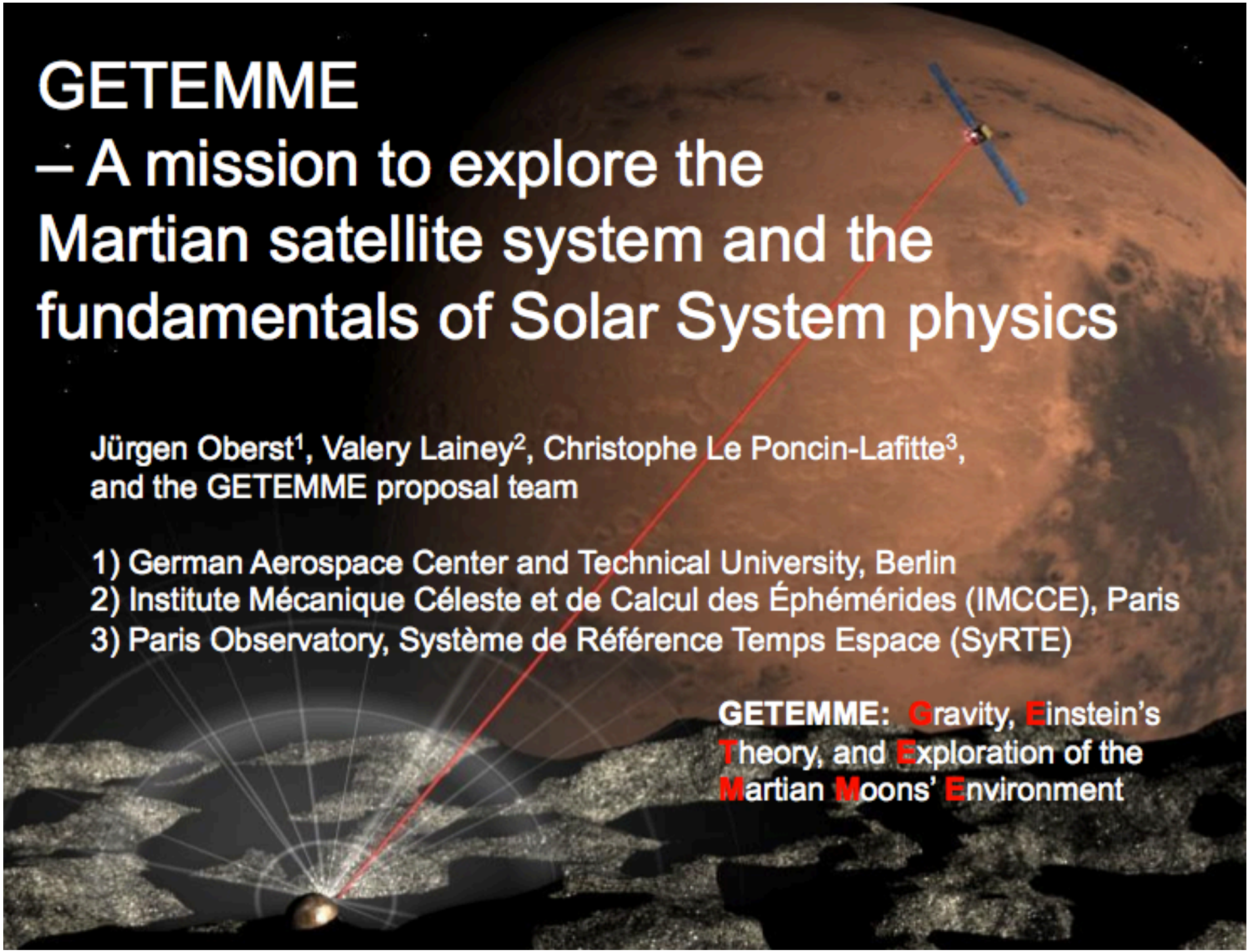
IR LAYOUT @ SCF



THE SCF-TEST

The “SCF-Test” is a new and unprecedented test procedure to characterize and model the detailed thermal behavior and optical performance of LRA in simulated space conditions

Our ILA SCF-Test can be used to validate and optimize reflectors for future missions like GETEMME (Gravity, Einstein’s Theory, and Exploration of the Martian Moons’ Environment), proposed for the Mars-Deimos-Phobos system, and missions to explore the icy and rocky moons of Jupiter, provided that laser retroreflectors can be deployed on the moon or planetary surfaces



GETEMME – A mission to explore the Martian satellite system and the fundamentals of Solar System physics

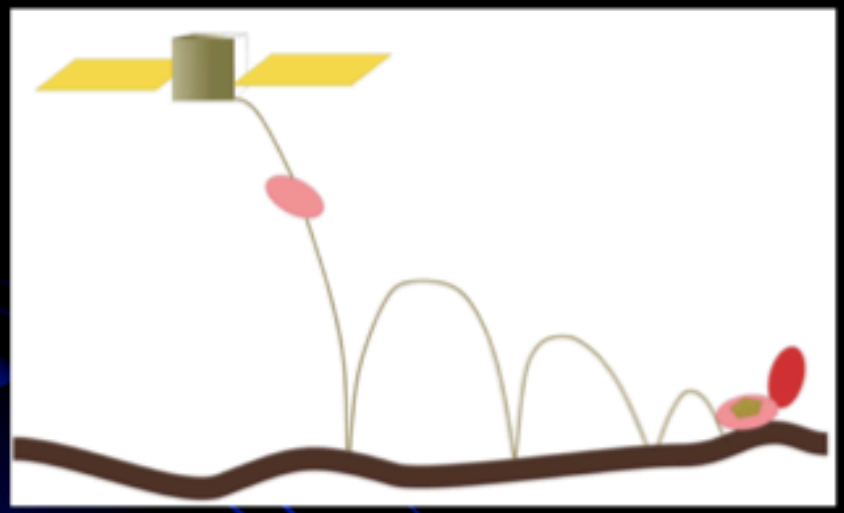
Jürgen Oberst[1], Valery Lainey[2], Christophe Le Poncin-Lafitte[3], and the GETEMME proposal team

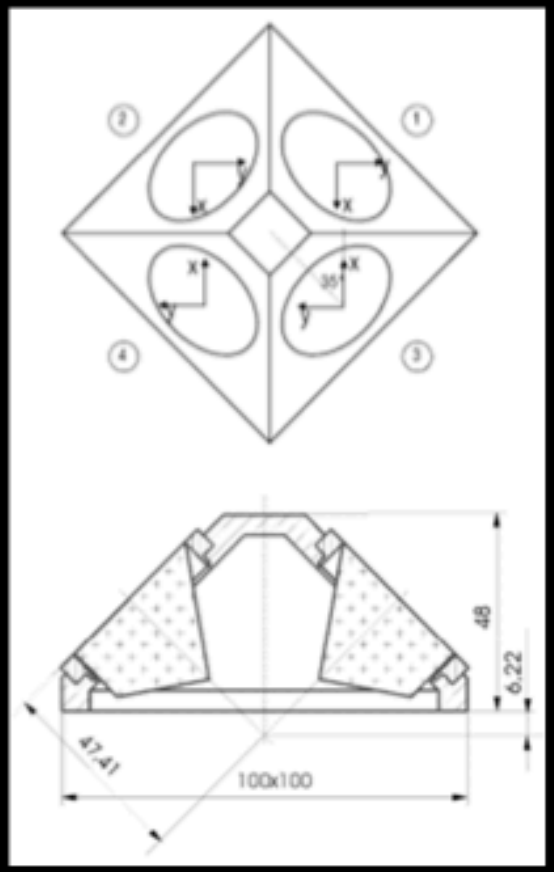
1) German Aerospace Center and Technical University, Berlin
2) Institute Mécanique Céleste et de Calcul des Éphémérides (IMCCE), Paris
3) Paris Observatory, Système de Référence Temps Espace (SyRTE)

GETEMME: Gravity, Einstein's Theory, and Exploration of the Martian Moons' Environment

GETEMME Reflector Stations

- 4 landers, 2 on each satellite near side (to allow measurements of librations
  - low touch-down velocity: < 10 m/s
  - open cover after deployment
  - battery power for few hrs after landing
  - stay passively on the satellite surfaces for years …





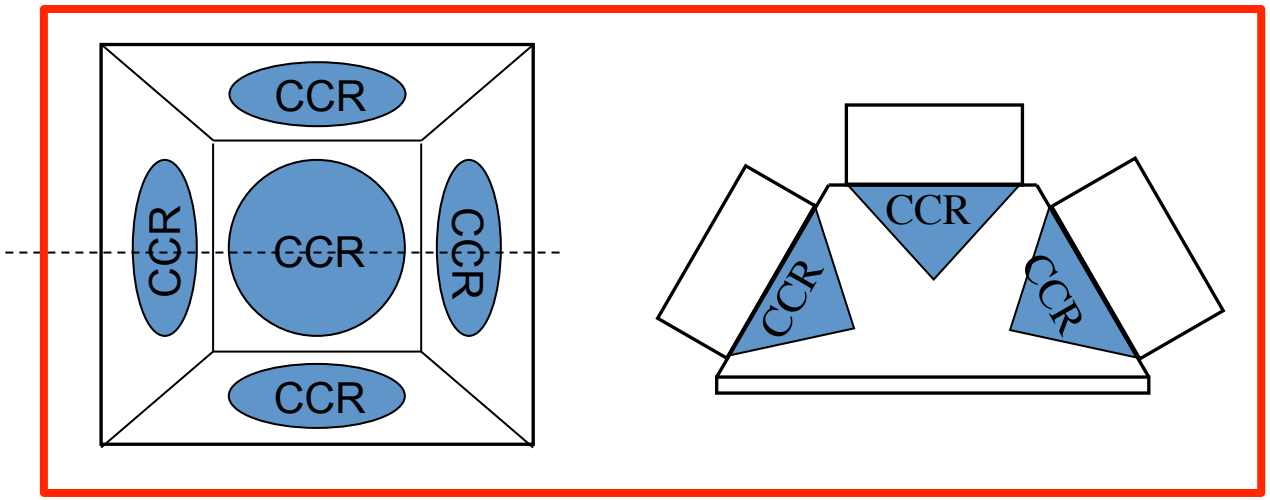
Retroreflectors /
Heritage: Champ

OTHER PROSPECTS

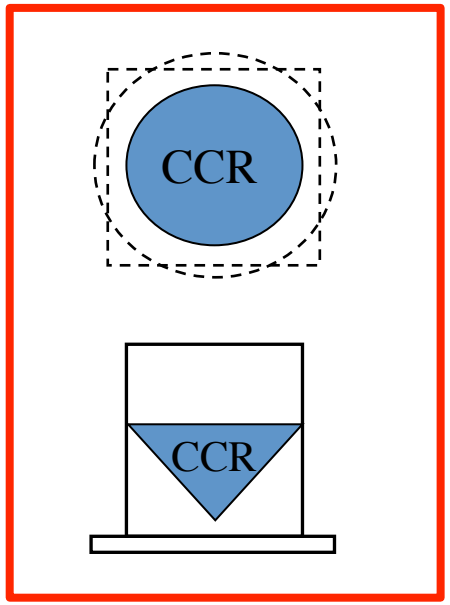
- INFN-LNF conceived a new, simple, very lightweight, very compact retroreflector payload
- **INstrument for landing-Roving laser Retroreflector Investigations (INRRI)**
  - **INRRI to be deployed on landers and/or rovers on the surface of the Moon, Mars and/or Phobos and Deimos, asteroids and the icy moons of Jupiter and Saturn.**
  - INRRI to be laser-ranged not directly by Earth, but by the orbiters with laser altimetry and/or with laser ranging capabilities
- In the case of the Earth's Moon:
  - Proposed (Mini)Rovers
  - To be laser-ranged by
    - Possibly NASA's Lunar Reconnaissance Orbiter, LRO (in orbit) – special 1-CCR design, customized (with D. Smith et al) to produce an acceptable signal in LOLA receivers. Optimization will be base also on results of IR SCF-Test
    - Future orbiter missions with lunar laser altimetry and/or laser ranging capabilities

INRRI models

INRRI-5

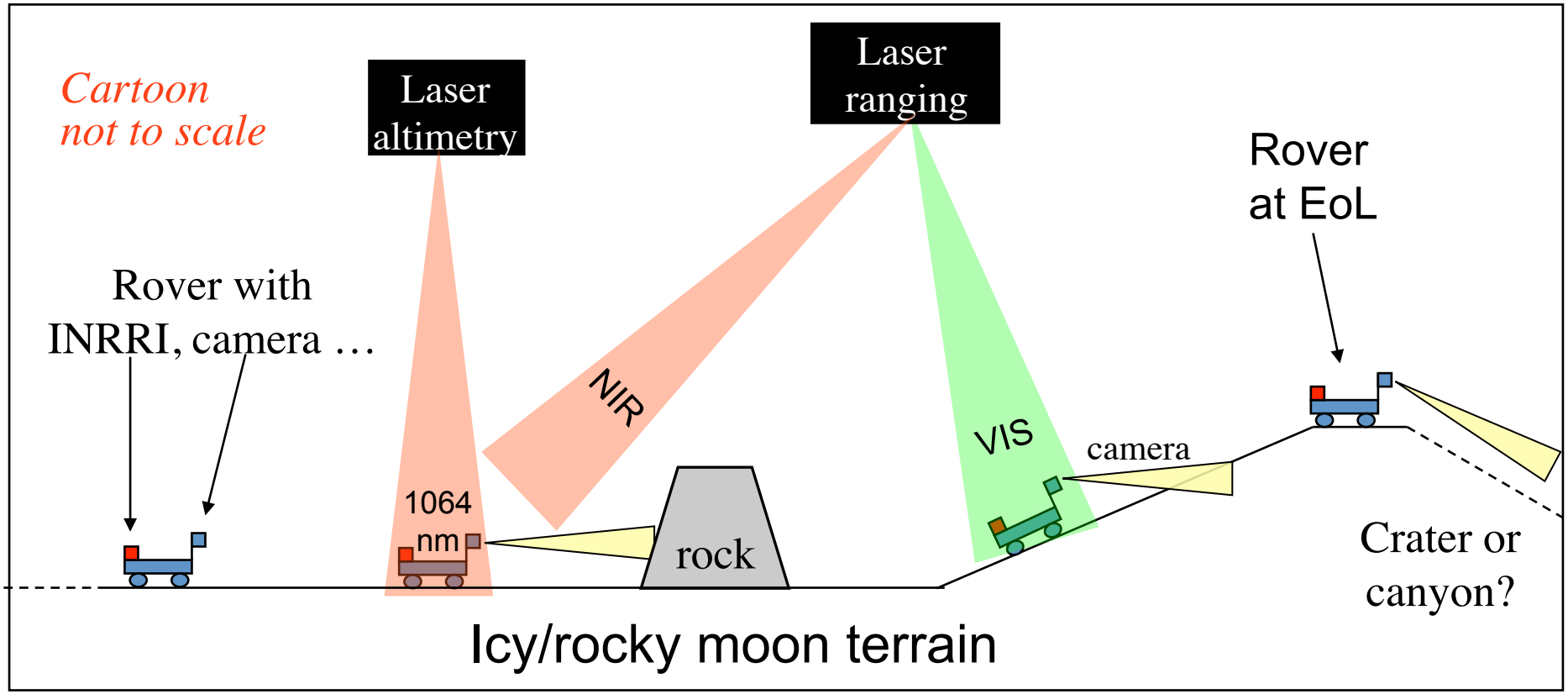


INRRI-1



INRRI-1 will be used also to SCF-Test the effect of lunar dust (for ex. for Apollo reflectors) in collaboration with T. Murphy and D. Currie

SELENO-LOCATION w/INRRI



CONCLUSIONS

The SCF allows the characterization of ILA investigations (@1064 nm) to cube corner retroreflectors.

A prototype, very compact, very lightweight INRRI-1 CCR payload has been designed and built for lunar laser altimetry to CCRs deployed close to the lunar poles.

Our ILA SCF-Test (@1064 nm) can be used to validate and optimize reflectors for future missions like GETEMME@Mars and INRRI@moon(s).

THANK YOU
FOR YOUR ATTENTION

ANY COMMENTS/QUESTIONS?