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1 ESA PROPOSAL-ML100 Pointing Actuator (MPAc)

The MPAc system was designed for the alignment of a retroreflector in azimuth and elevation. Deployment of modern retroreflectors at the lunar surface is a specific target of the Strategy for Science at the Moon. The instrument would address science of both the interior structure and state of the Moon and of relativistic physics.

The retroreflector which will be used is MoonLIGHT 100 (ML 100), a large retroreflector whose structure and dimensions must guarantee an adequate light return from the Moon also avoiding any Lunar Libration issue that dominates the error budget limiting the precision of the experimental tests of gravitational theories.

The final ML100 Pointing Actuator (MPAc) (actuators, structure and retroreflector) shall be integrated on a commercial lunar lander, and must be able to perform two continuous rotations. Azimuth axis actuator (MPAc-A): $\pm 180^o$ around the normal to the (horizontal) lander deck surface on which it is installed. Elevation axis actuator (MPAc-E): $0 - \pm 90^o$ elevation around an axis parallel to the lander deck. The MPAc is similar to dual-axis gimbals used to move/point small communication antennas, but with the following, less restrictive operational requirements: MPAc does not need to do fast movements; MPAc should operate only during the lunar day; MPAc should perform a limited number of pointing operations (while typical antenna gimbals have tested lifetimes of thousands or tens of thousands cycles).

2 Joint Lab KOM-ASI-INFN

The objective of the project is the realization of ASI-INFN joint activities in the field of advanced laser systems for space applications based on laser retro-reflectors and precision laser tracking of satellites and the Moon. This will be achieved through the collaboration between ASI and INFN for the sharing of specialist technical-scientific skills in the field. In particular, these were developed for ASI at the Space Geodesy Center (CGS) of Matera and for INFN by the SCF-Lab (Satellite / lunar laser ranging and altimetry Characterization Facilities Laboratory) team at the National Laboratories of Frascati (LNF).
The programmatic objective of these 5 years of the ASI-INFN project is to capitalize on what was objectively achieved in the 15 years (2004-2018) of life by the INFN-LNF SCF-Lab, the technical-scientific results obtained, the hardware and infrastructure resources built, the experiences and skills acquired, internal and external funding received from various Italian (Agencies, Ministries, Scientific and Technological Commissions), European and non-European sources to consolidate the INFN-ASI partnership as a "twinning" of technical-scientific research between SCF-Lab and MLRO (Matera Laser Ranging Observatory at the CGS). The joint activities are based on the de facto profound synergy between MLRO and SCF-Lab. The first works on the Ground Segment of the SLR/LLR laser tracking as the primary station of ILRS, the second works on the Space Segment as a single laboratory for its ability to supply and qualify advanced laser systems based in particular on laser retro-reflectors (those tracked, precisely, from MLRO). Both represent the state of the art in the two segments of Earth and Space.
In view of concrete mission opportunities and related applications (see the WP of the 3000, WP4000 and WP5000 line), the project requires the continuation of what has already been conducted jointly between ASI and INFN and to extend this collaboration as regards activities, existing, separately available resources, capabilities, HW and SW.
In particular, it will be:

- perfect the development of prototypes and models up to $6 < TRL < 8$;
- qualify LRA for future mission launches;
- support laboratory, analysis (experimental and theoretical) and QA/PA activities;
- guarantee the functioning of the "Internal Special Facilities" of the LNF (SCF-Lab and the new SCF-Lab2).

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