

PDC2015
Frascati, Roma, Italy

- Planetary Defense – Recent Progress & Plans
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IAA-PDC-15-P-72

LASER RETROREFLECTORS AS NEO POSITIONING AND GEODETIC TARGETS

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Keywords: *Cube Corner Retroreflectors (CCR), Lasercomm, Lunar Laser Ranging (LLR), Satellite Laser Ranging (SLR)*

ABSTRACT

In the framework of research activities of the INFN Astroparticle Physics Committee (CSN2) and as part of the Affiliation of INFN to NASA-SSERVI (Solar System Exploration Research Virtual Institute, <http://sservi.nasa.gov>), we are studying the feasibility of laser-marking NEOs by the deployment of Laser Retroreflector Arrays (LRAs) specially designed to support laser tracking of NEOs and contribute to SSA/SST (Space Situational Awareness and Space Surveillance and Tracking). For large enough NEOs, LRAs can also be useful to study the internal NEO geodesy (and deformations), as it is done, for example, on a planetary-body scale with Apollo/Lunokhod LRAs on the Moon.

As a conceptual exercise, we are designing NEO LRA markers for:

- 1) Landing missions of the type of ROSETTA, HAYABUSA-2 and OSIRIS-REX. These reflectors would support laser tracking by Moon, Mars, Jupiter, Saturn orbiters equipped with lasercomm payloads that can also perform time-of-flight laser ranging, as recently demonstrated by NASA’s LADEE mission. This lasercomm infrastructure for the whole solar system is one of the primary

goals of the newly created “Optical Communications Division” inside the NASA Space Communications and Navigation (SCaN) program within HEOMD.

- 2) Asteroid retrieval/redirect missions, which might deliver asteroids in cislunar, and/or Earth-Moon Lagrangian points. These would exploit local laser ranging from orbit, *à la* LADEE, and by LLR-capable stations of the International Laser Ranging Service (ILRS). The latter stations include: APOLLO (Apache Point Observatory Lunar Laser ranging Operation) in the USA, GRASSE in France, ASI-MLRO (Matera Laser Ranging Observatory) in Italy.

The study includes LRA models already developed for other destinations (Moon, Mars, airless moons), as well as their evolutions and adaptations to NEOs. Some of LRA models have been (or will soon be) characterized at the SCF_Lab (<http://www.lnf.infn.it/esperimenti/etrusco/>), a space test facility dedicated to laser retroreflectors, located at INFN-LNF, Frascati, Italy (across the street from ESA-ESRIN). Modeling of LRA optical specifications, deployment and tracking parameters must be done ad-hoc for NEOs, and is a new realm of application of the geodetic techniques of LLR and SLR.
