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LASER RETROREFLECTORS AS NEO TRACKING AND GEODETIC TARGETS

**Dell'Agnello S⁽¹⁾, Bianco G⁽¹⁾⁽²⁾, Delle Monache G⁽¹⁾, Ciocci E⁽¹⁾, Contessa S⁽¹⁾,
Maiello M⁽¹⁾, Martini M⁽¹⁾, Mondaini C⁽¹⁾, Porcelli L⁽¹⁾, Salvatori L⁽¹⁾, Tibuzzi M⁽¹⁾,
Vittori R⁽¹⁾⁽²⁾**

⁽¹⁾⁽²⁾ *Istituto Nazionale di Fisica Nucleare – Laboratori Nazionali di Frascati (INFN-
LNF), via E. Fermi 40, Frascati (RM), Italy, +39-0694032730,*

Simone.DellAgnello@lnf.infn.it

⁽²⁾ *Agenzia Spaziale Italiana (ASI) Italy*

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ABSTRACT

Within research activities of the INFN technology research committee “CSN5” and as part of the Affiliation of INFN to NASA-SSERVI (Solar System Exploration Research Virtual Institute, <http://sservi.nasa.gov>), we are developing the laser-based tracking and georeferencing of NEOs by the deployment of Laser Retroreflector Arrays (LRAs) specially designed to support laser tracking of NEOs. This is a contribution to SSA/SST (Space Situational Awareness and Space Surveillance and Tracking). In For planetary science and exploration, these LRAs can also be useful to study the internal NEO geodesy (and deformations), as it is done on a planetary-body scale with Apollo/Lunokhod LRAs on the Moon and as it will be done on Mars with LRAs foreseen onboard of NASA’s Mars 2020 rover and InSight 2018 lander and onboard

ESA's ExoMars missions (Schiaparelli lander and 2020 Rover). We have designed and built NEO LRA markers for:

- 1) Landing missions like ESA's Asteroid Impact Mission (AIM). 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, like NASA's Asteroid Redirect Mission (ARM), 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.

This development inherits from LRAs already developed for the Moon, Mars, airless moons, as well as their evolutions and adaptations to NEOs. Some of LRA models have been characterized at the SCF_Lab (<http://www.lnf.infn.it/esperimenti/etrusco/>), a space test facility entirely 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 satellite laser ranging in general
