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## The First Lunar Far-Side Laser Retroreflector Deployed on Chang'e-6 Lander and Prospect for Chang'e-7 Mission

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The Chang'e-6 (CE-6) mission, part of China's lunar exploration program, marked a significant milestone as the first mission to return samples from the far side of the Moon. One of the highlights of CE-6 mission is that it piggybacked four international payloads, including the INstrument for landing-Roving Laser Retroreflector Investigations (INRRI), developed through a collaboration between the Italian National Institute for Nuclear Physics — Frascati National Labs (INFN-LNF) and the Aerospace Information Research Institute, Chinese Academy of Sciences (AIRCAS).

INRRI is a lightweight, passive optical instrument composed of eight cube corner retroreflectors made from fused silica, offering a wide 120° field of view. This robust and miniaturized design has a high level of maturity and inheritance from previous missions such as NASA's Mars InSight and Perseverance, where similar retroreflectors had been successfully deployed. For CE-6 mission particularly, INRRI was mounted on a specialized bracket to minimize interference from ascender plume effects during liftoff. CE-6 INRRI underwent rigorous qualification tests, including mechanical (acceleration, shock, sinusoidal and random vibrations) and thermal vacuum tests, to validate its structural integrity. After integrated with the lander, CE-6 INRRI underwent the whole spacecraft random and sinusoidal vibration tests and successfully passed all evaluations.

The CE-6 INRRI serves as a high-precision absolute control point, crucial for improving lunar surface mapping especially for the lunar far side. Initial validation of INRRI's operational status has been achieved through observations by the Lunar Orbiter Laser Altimeter (LOLA) onboard NASA's

Lunar Reconnaissance Orbiter (LRO). Future observations by laser ranging from lunar orbiters will refine its position, and will contribute to improving the accuracy of orbit determination for lunar orbiters, advancing studies of lunar geodesy, Earth-Moon dynamics and lunar physics.

Building on this success, the Italian-Chinese collaboration team are working on the piggybacking of Chang'e-7 LAser Retroreflector Arrays (CLARA), including MoonLIGHT (Moon Laser Instrumentation for Geodesy, Geophysics and General relativity High accuracy Tests) and INRRI. Currently INRRI for CE-7 has just completed its mechanical tests and is in the process of arranging the subsequent experiments.