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A Long-Lived Global Lunar Geophysical and Geodetic Network

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During the Apollo missions, the US astronauts deployed a small 4-station geophysical instrument network that operated successfully until 1977. The Apollo experience suggests that there is enormous science potential in such network data to further our understanding of the Moon's internal structure and in the dynamics of the Earth-Moon system. Therefore, we propose to deploy a next-generation instrument network on the Moon, involving 10-15 stations, equipped with RTG power sources, for the survival over a period of 5 - 10 years. The stations, to be deployed in areas including the far hemisphere and the poles (which require an orbiter for data relay and which therefore could not be covered by the Apollo network) shall collect gravity, heat flow, magnetic field, and new broadband seismic data using state-of-the-art instrumentation. Cameras pointed at the sky near the polar sequence shall be used to track lunar librations. In addition, nearside landers shall carry picosecond laser transponders, to be used for Earth-Moon ranging at mm-accuracy. Laser shots (50 mJ) originating on the Moon and pointed at Earth could be received by all of the existing Satellite Laser Ranging Stations. From the raw range measurements, parameters of Lunar interior structure and of Earth-Moon dynamics can be modeled with greatly improved accuracy. For example, tidal deformation and surface gravity measurements combined will constraint both tidal Love numbers (h2 and k2), a first in planetary geophysics. New seismic data from a truly global network will elucidate the intricate mechanisms of seismic sources, and the interior structure of the Moon, notably global variations in thickness of the crust, and the size and properties of the Lunar core. It is conceivable that data packages from the Moon can be received by small meter-size receiving antennas, within a time window of 2-3 hours per day. Owing to the proximity of the Moon, a mission could return data very rapidly after launch. A network mission offers great potential for international cooperation –especially in the light of a major US initiative promoting a return to the Moon – and could be a test bed for future global geophysical/geodetic networks on planets beyond. The concept of this global lunar network was introduced as a contribution to the ESA Call for Visions in 2005.