

AN ESTIMATION OF THE NUMBER OF EXPECTED RETURNED PHOTONS FOR THE HARTRAO LUNAR LASER RANGER SYSTEM. S. Ndlovu¹, L. Combrinck^{1,3}, P. Exertier², M. Akombelwa³ and N. Chetty³,
¹Hartebeesthoek Radio Astronomy Observatory (sphume@hartrao.ac.za, ludwig@hartrao.ac.za), ²Observatoire de la Côte d'Azur, ³University of KwaZulu-Natal.

Introduction: Development of an integrated model and system to enable optimal efficiency and signal path parameter estimation of a Lunar Laser Ranger, is one of the major requirements for the new Hartebeesthoek Radio Astronomy Observatory's Satellite/Lunar Laser Ranger (S/LLR) system; without optimal efficiency of a lunar laser ranger signal path, the number of returned photons could be zero.

Discussion: The mathematical tool under development will be used to evaluate computed and observed photon return efficiency, using as departure point the existing link equation, with the option to add and estimate parameters in the least squares sense. The existing link equation can be used to predict the laser ranging system efficiency and is based on assumed accuracy of all parameters which influences the returned signal, presented as an estimate of expected number of returned photons. However, it does not make provision for model enhancements and parameter optimisations.

Expected outcome: Optimal efficiency in the S/LLR signal path will yield an improvement in the return-energy of the laser so that ranges to the lunar corner cube retro-reflectors can be measured accurately. This will ensure a high-precision measurement of the Earth-Moon distance, which is highly in demand since determination of the exact Earth-Moon distance is a complex undertaking. The geographic position of the HartRAO station, new state-of-the-art HartRAO S/LLR system under development and the expected number of returned photons will enable HartRAO to play a key role in improving the ranging accuracy to a sub-centimetre level, adding to the current effort to determine highly accurate Earth-Moon distances for various scientific purposes. We estimate the expected photon returns under various scenarios, including variable power levels, lunar distance, atmospheric conditions and system efficiency.