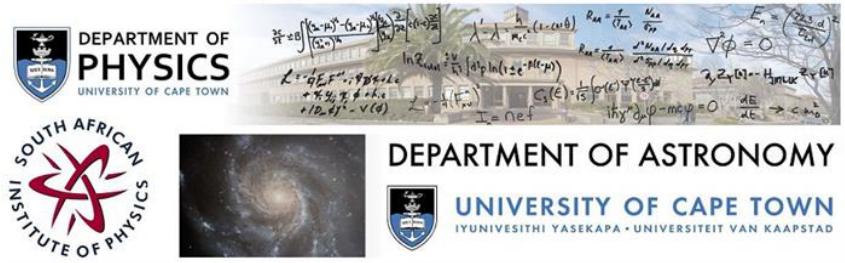

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Development of an integrated model and system to enable optimal efficiency of the HartRAO LLR system

Thursday, 7 July 2016 10:00 (20 minutes)

Abstract content
   (Max 300 words)
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The Lunar Laser Ranger (LLR) system under development at Hartebeesthoek Radio Astronomy Observatory (HartRAO) in South Africa is being built to accurately measure the Earth-Moon distance (at 1 cm level) through the use of short laser pulses, a single photon detection system, an accurate timing system and other sophisticated components. This LLR system is unique in Africa and the entire Southern Hemisphere, and utilizes a 1 m diameter optical telescope, which was donated to the project by the Observatoire de la Côte d'Azur of France. In this work, we discuss the development of an integrated model that will be utilized to obtain optimal efficiency of the HartRAO-LLR system. The model calculates the expected number of returned photons by considering a number of parameters which affects the laser beam pulses as they traverse the atmosphere from the LLR telescope to the Moon and back to the telescope. This is achieved by modelling the effects of thermal and density fluctuations of the atmosphere on the apparent Earth - Moon range, atmospheric extinction, laser beam characteristics, optical path efficiencies and other factors on the number of returned photons. These factors affect the estimated (predicted by software) and actual (measured) number of returned photons for the HartRAO-LLR station. The estimated average signal return rate of the HartRAO LLR ranges between 0 to 12 photons per second, which is in agreement with the available data from five globally distributed LLR stations. Our estimated signal returns are strongly affected by two-way atmospheric extinction (atmospheric and cirrus cloud transmissions), variations in the laser beam incident angle on the retroreflectors located on the Moon as well as the varying Earth - Moon range. Modelling the returned number of photons and comparing these to the actual number received will lead to an understanding of the effects of numerous variables on the total laser path efficiency.

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