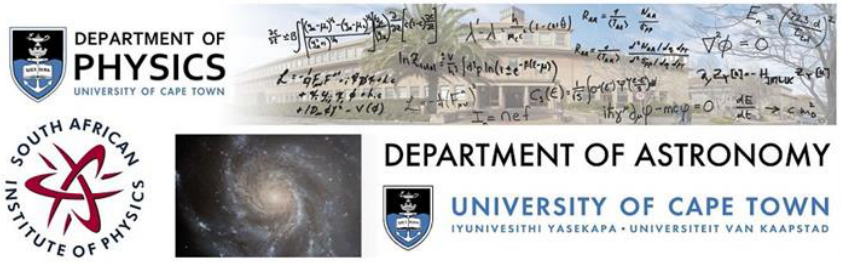

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Tube assembly experiments for optimal temperature sensor placement on the HartRAO Lunar Laser Ranger telescope

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Abstract content
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Accurate measurements of temperature gradients are important for the operational performance of optical laser telescopes, particularly the Lunar Laser Ranging (LLR) telescope. This is more so on the LLR one-meter aperture telescope that is under development at the Hartebeesthoek Radio Astronomy Observatory (HartRAO) which is expected to achieve sub-centimeter range precision to the Moon, for enhanced tests of Earth-Moon system dynamics. This paper presents results of experiments that were conducted to determine the optimal placement of sensors in order to measure the temperature gradients across the entire surface area of the tube assembly. Ideally installation of a large number of sensors is needed to accurately measure the gradients across the whole tube system, notwithstanding the potential issues of cluttering of sensors and wires and the accompanying measurement noise. However, the choice on the quantity of sensors including placement, mainly depends on the opto-structural design, size, thermal properties and/ or prior thermal simulations of the tube assembly components coupled with performance requirements of the telescope. Thus in this study, the minimum number of sensors were placed at strategic locations on the tube in order to interpolate temperatures between the sensors and determine the temperature gradients as well as the induced structural deformations due to the varying ambient air temperature. This information is instrumental in the phases of a mathematical model under development at HartRAO for monitoring and mitigating thermal variations of the LLR telescope tube assembly to <= 1℃. Such model is expected to contribute toward the achievement of the stringent pointing accuracy requirement of about 0.5" to the corner cube retroreflectors mounted on the lunar surface.

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