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### **Timing system for the lunar laser ranging station at HartRAO, South Africa: preliminary results**

HartRAO is currently developing a Lunar Laser Ranging (LLR) station that will range to the five retro-reflectors located on the surface of the Moon. The LLR technique requires an accurate timing system to ensure precise measurements of the two-way time-of-flight of the laser pulses. Improvements in frequency stability of clocks within space geodetic techniques imply direct improvements of data products derived from the techniques. In this regard, the Microsemi 4380A rubidium reference timing system was selected based on its highly stable frequency, sub-picosecond short-term stability and low phase noise. To achieve optimal frequency stability from the 4380A, a thermally controlled environment is required to maintain the environmental temperature to within desired levels. This will minimize thermally induced instabilities in frequency. In this contribution, the installation progress and preliminary test results of the frequency stability of the 4380A timing system in comparison to the HartRAO hydrogen maser clock are presented. Preliminary results indicate that the 4380A timing system can achieve sub-picosecond Allan deviation in a  $10^3$  second period, and that the LLR control room exhibit temperature variations of  $\sim 3^\circ\text{C}$  per day. Since the frequency stability of the 4380A is  $3 \times 10^{-10}$  between  $0^\circ\text{C}$  and  $50^\circ\text{C}$ , the current LLR thermal control system seems to be adequate to minimize thermally induced frequency errors during ranging. Due to the timing reference system, we therefore anticipate the accuracy of our normal data point to be a centimetre or less.