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An experiment of determining the geopotential difference using two hydrogen atomic clocks

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According to general relativity theory, one may determine the geopotential difference between two arbitrary stations by comparing there-located clocks' running rates. In this study, we provide experimental results of the geopotential determination based on the time elapse comparison between two hydrogen atomic clocks, one fixed clock and one portable clock, using the common view satellite time transfer (CVSTT) technique. We compared the portable clock located at Jiugongshan Time Frequency Station (JTFS) with the fixed clock located at Luojiashan Time Frequency Station (LTFS) for 30 days. The two stations are separated by a geographic distance of around 240 km with height difference around 1230 m. Then the clock was transported (without stopping its running status) to LTFS and compared with clock for zero-baseline calibration for 15 days. The clock-comparison-determined geopotential difference between JTFS and LTFS is determined. Results show that the clock-comparison-determined result deviates from the EGM20080-determined result by about $2322 \pm 1609 \text{ m}^2\text{s}^{-2}$, equivalent to $237 \pm 164 \text{ m}$ in height, in consistence with the stability of the hydrogen atomic clocks applied in the experiments (at the level of $10^{-15}/\text{day}$).

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