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Using a transportable optical clock for chronometric levelling

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With their supreme accuracy and precision, optical clocks and new methods of long distance frequency transfer can be used to determine height differences by measuring the gravitational red shift between two clocks. We are developing transportable optical clocks and optical fibre-based means for clock comparisons that can bridge distances of hundredths of kilometres without accumulation of measurement errors. In this talk, we will focus on the transportable strontium lattice clock we are developing and its first evaluation. Presently, we achieve a fractional frequency instability of 3×10^{-17} after 1000 s averaging time, which is equivalent to a height resolution of 30 cm. The first uncertainty evaluation of the system yielded 9×10^{-17}. We expect rapid improvements to an uncertainty of few parts in 10^{-17}.
This clock will be connected via stabilized optical fibre links with other, stationary frequency standards. The measured red shifts will be compared with the ones calculated from potential differences derived with state of the art geodetic data and models. We will discuss the status of measurements of geodetic relevance with optical clocks and give an outlook on our next steps.
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