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Remote frequency comparison of cryogenic optical lattice clocks

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The accuracy of recent optical lattice clocks reaches to 10⁻¹⁸ level, which allows us to explore cm-level distortion of time and space. The remote comparison of such clocks is of great importance in fundamental physics, such as, gravitational measurement³, geodesy⁴, and dark matter search⁵. Here we report a remote frequency comparison of cryogenic Sr clocks, one of which is located at the University of Tokyo (UTokyo) while the other is located at RIKEN, which is 15 km apart from UTokyo. We connect them by a 30-km-long telecom fiber link with the stability of 1×10⁻¹⁷ at 1s. After 11 measurements carried out over 6 months, frequency difference between the clocks is determined to be 0.7095(24)Hz which translates into a height difference of 15.16 m with an uncertainty of 5 cm. This result is consistent with a height difference independently measured by employing a leveling scheme. Furthermore, we continuously operate these clocks for a period of 3 days and achieved an experimental running time of 73 %. We discuss the future prospect for such precision measurements.

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Author: Dr TAKANO, Tetsushi (The University of Tokyo)

Co-auteurs: Dr YAMAGUCHI, Atsushi (RIKEN); Prof. KATORI, Hidetoshi (The University of Tokyo, RIKEN); Dr USHIJIMA, Ichiro (RIKEN); Dr TAKAMOTO, Masao (RIKEN); Dr NORIAKI, Ohmae (The University of Tokyo); Dr AKATSUKA, Tomoya (RIKEN)

Orateur: Dr TAKANO, Tetsushi (The University of Tokyo)

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