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# Intercontinental Optical Clock Comparison using Broadband VLBI

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We performed for the first time an intercontinental comparison of two optical clocks using very long baseline interferometry (VLBI). Optical clocks are atomic clocks based on optical transitions and have now surpassed the performances of the best traditional microwave clocks. International comparisons of optical clocks are interesting for fundamental metrology (e.g., redefinition of the second on an optical transition), geodesy (e.g., chronometric determination of gravitational potential) and fundamental physics (e.g., search for variations of constants).

VLBI routinely exploits atomic clocks to synchronize distant antennas for astronomy and geodetic measurements. Choosing signals from well-known radio-frequency sources enables to reverse this principle and measure the clock difference. We show that this is an attractive technique for comparing optical clocks.

Two transportable antennas with 2.4 m diameter were installed at NICT Koganei headquarters in Japan and INAF Medicina Radio Observatory in Italy, realizing a baseline of 8800 km. The VLBI stations for this experiment implement broadband VLBI observations as a large bandwidth is critical for high-resolution frequency transfer. The reduced sensitivity due to the small antenna diameter can be compensated including in the network the large-aperture 34 m antenna in Kashima, Japan. The VLBI link was used to measure the optical frequency ratio between the Sr optical clock at NICT and the Yb optical clock at INRIM in Italy, which is connected to the Medicina Radio Observatory with an optical fibre link. Our measurement is in agreement with comparison using satellite techniques as well as previous measurements of the Yb/Sr optical frequency ratio.