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The structure of a distributed optical atomic clock system for nationwide frequency metrology

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Abstract

This article presents a concept for a nationwide, distributed optical atomic clock system. The proposed architecture is based on the transmission of a reference optical frequency signal via optical fiber to remote laboratories, enabling their local oscillators to be phase-locked to distant optical atomic clocks. This initiative can significantly advance Polish time and frequency metrology by increasing nationwide access to the Polish Optical Atomic Clocks for scientific research, and metrological applications. The paper describes the concept of the distributed frequency standard and discusses its technical requirements. Remote laboratories using commercial optical cavities may achieve short-term stability at the level of $< 2 \times 10^{-15}$, while the long-term instability can reach below 10^{-17} for averaging times of 1000 seconds. The distributed optical signal may be used to stabilize various lasers, via optical frequency comb, which then interrogate cold particles in secondary frequency standards, enabling comparisons and redefinition of the SI second.

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