Haosen Shang - Transportable optical atomic clock based on thermal atomic ensembles

Rapport sur les contributions

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The optical atomic clock is the most ever signal generator to provide extraordinary frequency stability and accuracy. These characteristics open the door for its huge applications not only in scientific research, such as searching for dark matter and gravitational wave detection but also in advanced technological developments, such as the redefinition of SI second and geodesy measurements. However, most of the optical atomic clocks are still restricted to be operated under laboratory circumstances, because of their huge size and complicated structures. Therefore, a transportable optical clock system attracts more and more research interests. In this talk, I will present the transportable optical atomic clock we realized based on the thermal calcium beam [1], which considers the balance between clock performance and transportability. To further mitigate the perturbation of the environmental factors on the optical local oscillator which is locked on a high finesse optical cavity, we also put forward and developed two promising approaches to acquire a compact narrow linewidth laser system that is aimed as the transportable optical local oscillator, including narrowing laser linewidth using high signal-to-noise ratio modulation transfer spectroscopy [2] and realization of microscale continuous-wave superadditive laser [3]. Finally, to solve the common problems of low atoms utilization efficiency faced byalmost all thermal atomic ensembles, we proposed a velocity-grating spectroscopy scheme that can improve the signal-to-noise ratio by 22 times at least [4], thus further reducing the quantum projection noise and frequency instability for the transportable calcium beam optical atomic clock.

[1] H. Shang, et al., Optics Express 25(24), 30459-30467 (2017).
[2] H. Shang, et al., Optics Express 28(5), 6868-6880 (2020).
[3] H. Shang, et al., In Joint Conference of the IEEE IFCS-ISAF (IEEE, 2020), pp. 1-4.
[4] H. Shang, et al., arXiv:2012.03430 (2020).

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