Optical lattice atomic clocks as a reference for spectroscopy

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We report a system of two independent strontium optical lattice standards probed with a single shared ultra-narrow laser [1,2]. The two optical frequency standards (Sr1 and Sr2) are based on the $^1S_0$ – $^3P_0$ transition in neutral strontium atoms. The Sr1 can operate with bosonic isotope ^{88}Sr while Sr2 can operate with either bosonic ^{88}Sr or fermionic ^{87}Sr isotope. Two clouds of atoms in Sr1 and Sr2 are independently probed by an ultra-stable laser with spectral width below 1 Hz. An Er:fiber optical frequency comb, with one tooth phase-locked to the ultra-stable laser allows performing spectroscopic measurements with accuracy of optical atomic clock. The absolute frequency of the clocks can be calibrated by a long distance stabilized fiber optic link with the UTC(AOS) and UTC(PL) via the OPTIME network [3].

As a demonstration of the accuracy of the system we plan to determine ratios of molecular oxygen B-band transition frequencies to the strontium optical atomic clock frequency. This will be realized by making optical heterodyne beat-notes of the clock laser and the CRDS spectrometer [4] probe laser with the same optical frequency comb at wavelengths of 698 nm and 690 nm, respectively. By referencing all measured frequencies to the same reference frequency, we will obtain frequency ratios free from uncertainties of the reference frequency. Such a technique allows for determination of frequency ratios with extreme accuracy and precision [5]. We also demonstrate the sub-Hz precision of measurements of relative positions of the optical cavity modes using novel CMDS technique [6].

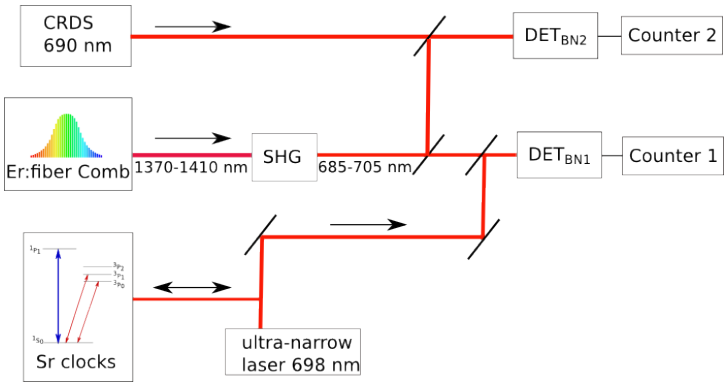

Figure 1: *A simplified set-up of the measurement of ratios of molecular oxygen B-band transition frequencies in reference to the strontium optical atomic clock frequency.*

References

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