Optical lattice clock on bosonic Strontium atoms

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We report on recent realization of an optical lattice clock operating on the $^1S_0$-$^3P_0$ transition in ^{88}Sr, at LENS laboratories. The clock transition is excited with the technique of magnetic field-induced spectroscopy[1]. New experimental techniques has also been developed in order to simplifies the clock spectroscopy in Sr atoms[2]. The first new method helps in the first search of the clock transition without the use of extensive frequency metrology hardware and in particular optical frequency combs. This technique exploits a near coincidence in the atomic wavelengths of the $^1S_0$-$^3P_0$ clock and $^1S_0$-$^3P_1$ second stage cooling transitions in Sr, which are only 5 THz far apart. This coincidence enables the use of an optical (transfer) cavity to reference the frequency of the clock transition relative to that of the much stronger cooling transition. Secondly we reduce the complexity of the experimental setup by using only semiconductor laser sources in the apparatus[3]. With this setup, about 10^4 ^{88}Sr atoms are trapped in a 1D lattice formed by 200 mW of radiation tuned near the magic wavelength at 813 nm.

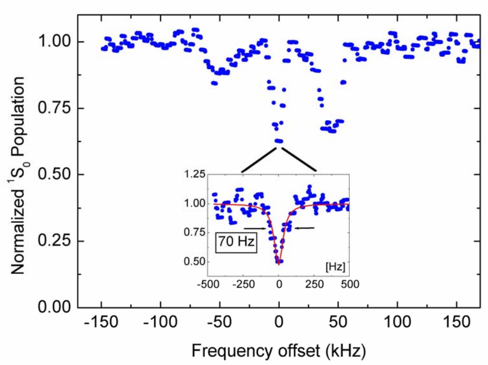

Fig. 1 Spectroscopy of clock transition for ^{88}Sr atoms trapped in 1D lattice at magic wavelength. In the inset is shown the central peak at highest resolution showing a 70 Hz linewidth with S/N of about 7.

We will present a first uncertainty budget for our optical lattice clock based on ^{88}Sr with particular attention to density dependent collisions, which led to an unexpectedly high signal contrast for long interaction times. In view of an absolute frequency measurement of clock transition we'll also present recent experimental results on optimization of an home made Ti:Sa optical frequency comb. Additionally, we anticipate that the simplification of the experimental setup presented will help address a wider range of applications including those requiring transportable devices. Along these lines we will report progress on the realization of the first transportable Sr optical lattice clock[4].

References

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