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Deep Laser Cooling and Trapping of Sr at VNIIFTRI

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Today strontium optical lattice clock is one of the most stable source of frequencies approaching eighteenth digit in fractional stability [1]. Such impressive performance makes strontium optical clock a strong candidate for re-definition of second and open new perspectives for fundamental tests and applications. Our group at VNIIFTRI works on development of Sr-87 lattice clock targeting fractional inaccuracy of frequency at 10^{-16} level.

In this talk the current progress of past few years will be discussed: efficient first stage laser cooling at 461 nm, second stage laser cooling at 689 nm, development of stabilized lasers for the second stage cooling and clock transition spectroscopy, trapping atoms into the dipole trap. Using highly stabilized laser at 689 nm [2] we demonstrated deep second stage laser cooling at the "broadband" and "single mode" regimes for Sr-88 isotope. Achieved temperatures of 2-3 μK are sufficient for efficient loading into an optical dipole trap at the magic wavelength of 813 nm (see fig. 1). After test experiments with Sr-88 we plan to switch to less abundant Sr-87 isotope for spectroscopy of the clock transition at 698 nm.

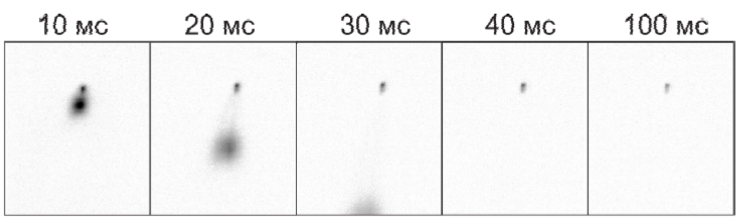

Figure. 1: Retrapping from the MOT to the optical dipole trap of Sr-88 cloud. Images are captured after 10, 20, 30, 40 and 100 ms after switching off the MOT.

References

1. B.J. Bloom et al., Nature **506**, 71 (2014)
2. K. Khabarova et al., Quantum Electronics **42**, 1021 (2012)