# Investigation of Compact Magneto-optical Sources of Slow Atoms for Fountain Standard Based on $^{87}$Rb

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Two rubidium fountain type frequency standards based on cold $^{87}$Rb atoms are developing at VNIIFTRI. As expected, they will be included in ensemble of atomic fountains for time keeping. The first fountain standard is in a development stage. Efficient loading of an $^{87}$Rb atomic trap requires special source. For this purpose, we built the additional MOT system[1], which generates intense beam of slow atoms. The advantages of this approach are very low velocity and divergence of extracted $^{87}$Rb atoms. Also, additional MOT source provides low background of thermal atoms in main vacuum chamber. Two different configurations of the compact magneto-optical sources of slow $^{87}$Rb atoms (LVIS, 2D-MOT)[2] compared in our paper.

The light for the additional MOT is generated by a Toptica TA pro diode laser with a tapered amplifier and a total output power of about 820 mW. The laser frequency is locked by means of frequency modulation spectroscopy (FMS) to the $5S_{1/2}$ (F=2) → $5P_{3/2}$ (F’=3) saturated absorption transition in the $^{87}$Rb vapour. FMS can be provided as by a direct injection-current modulation, and by an external modulation of the laser. Both methods will be tested to estimate a noise level of error signals. The commercial electro-optic modulator (EOM) or acousto-optic modulator (AOM) operating in the Raman-Nath diffraction regime AOM-RN[3] provides the external phase modulation. The repumping light, resonant to the $5S_{1/2}$ (F=1) → $5P_{3/2}$ (F’=2) transition, is generated with a separate external cavity diode laser.

The main characteristics of the additional MOT output atomic beam such as most-probable velocity, longitudinal FWHM velocity width, number of atoms in beam will be presented.

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[3] V.N. Baryshev, V.M. Epikhin, “Compact acousto-optic modulator operating in the pure Raman-Nath diffraction regime as a phase modulator in FM spectroscopy”, Quantum Electron., 40(5), p. 431-436, 2010.