Interferometric measurements of optical inhomogeneities in an alkali vapor laser active medium

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Abstract—The results of measurements of optical inhomogeneities in a cesium vapor laser active medium by means of a Michelson interferometer are presented.

Keywords—cesium vapor laser; wavefront aberrations; optical inhomogeneities; Michelson interferometer.

The present work is devoted to the study of optical inhomogeneities arising in various operation regimes of cesium vapor laser (CVL) [1-3]. Design features of the investigated CVL, such as pumping, flow of the gaseous medium in a closed cycle, the heating of the laser medium lead to the appearance of optical inhomogeneities in the generation area that can significantly affect the quality of the output radiation beam. A Michelson interferometer was used for measuring of the aberrations in active medium CVL in this paper. Probe laser, operating in a single mode at a wavelength $\lambda=532$ nm served as a light source to produce an interference pattern.

It is reported that «cold» active medium ($T\approx 24^\circ$C) doesn’t introduce noticeable distortion in the wavefront profile of the probe beam. When the cell is heated up to the operating temperature ($T\approx 120^\circ$C) and the flow of the active medium is turned on, the tilt appears in the wavefront of the probe beam. The magnitude of tilt aberration for a single pass through the medium is $9.97\lambda$ that corresponds to the deflection angle of $8.3\times10^{-4}$ rad. The value of this aberration was in part compensated up to $1.58\lambda$ that corresponds to the deflection angle of $6\times10^{-5}$ rad in the experiments. The thermal «lens» in the active medium is formed when pumping. Experimentally measured defocus aberration is $1.85\lambda$ that corresponds to a negative lens with a focal length of 13 m. The experiment was carried out with maintaining the working temperature, pump power and the flow rate in the cell corresponding to [2].

It is proposed to take into account the negative thermal lens occurring in the active medium of CVL when designing the resonator and optical scheme of the laser.

