EXPERIMENTAL INVESTIGATION OF THE LOCAL ANISOTROPY EFFECT IN CONVECTIVE TURBULENCE

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Abstract: Intensity field of the wide laser beam propagated through the cell filled with turbulent water was experimentally investigated. We calculated two-dimensional spatial spectra of light intensity from the distance of 2 meters after the cell and averaged it for many independent realization that shows statistical isotropic of laser intensity field. However, investigation of each single realization shows anisotropy of intensity field. We suggest conception of local anisotropy of density fluctuations in turbulent liquid based on the analysis of experimental data.

EXPERIMENTAL OBSERVATION OF THE LOCAL ANISOTROPY

Experimental design is shown in fig. 1. Photo camera took a picture of the screen was illuminated continuous laser beam with 5 cm diameter. The screen was from the distance of 2 meter after the cell. We controlled temperature regimes in the cell. These regimes are characterized Raleigh (Ra) and Prandtl (Pr) numbers.

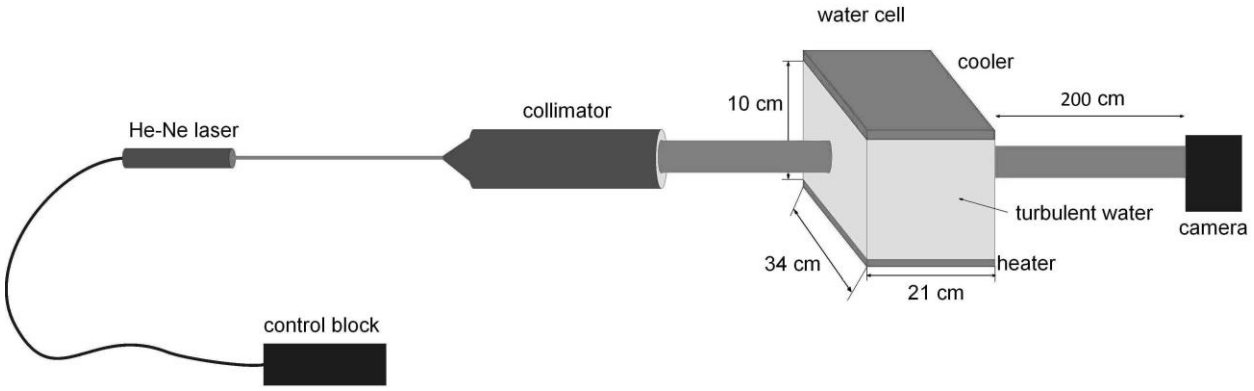

Figure 1. Experimental design

The intensity distributions from the distance of two meters after the cell are shown in fig. 2. Turbulence in the cell is characterized by $Ra=4*10^8$ and Pr=5.2. It is well known that turbulence increases in a rectangular cell in the case heating of the bottom when $Ra \geq 10^6$ and Pr about 7 [1].

We can see significant anisotropy of the intensity inhomogeneity for each realization. Narrow elongate areas of high intensity are present in the intensity distribution on the background of weak intensity. This areas moved (velocity v<1 cm/s) in random directions and slowly changed its shape. The anisotropy disappears after averaging over a large number of the frames. However it is clearly visible in each frame. We named it «local anisotropy» by analogy with local isotropy [2].

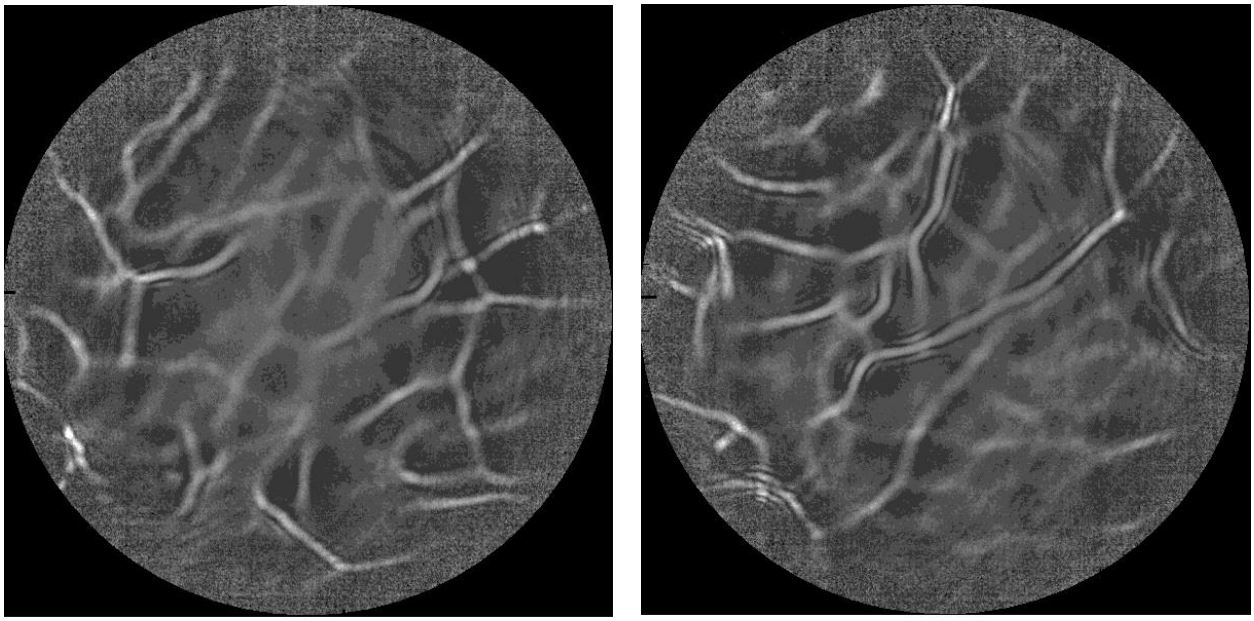

Figure 2. Two random frames of intensity distribution from the distance of 2 meters after the cell is divided by average intensity of the laser beam. Raleigh number was $Ra=4*10^8$. Diameter of laser beam was equal 5 cm.

Observed effect indicates on existence of local anisotropy of turbulence itself. Narrow elongated area is result of focusing of collimated laser beam on refraction index inhomogeneity which appears on boundary of areas with different temperatures/densities. We can see that intensity field contains many such narrow elongated areas. It means that some areas with slowly moving and changing boundaries exist in the cell.

We suggest to allocate the areas with higher intensity and consider its characteristic such as length and width for analysis such fields. Observations show that structure of the inhomogeneities saves up to smearing caused by interference and diffraction [3].

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