Lagrangian properties of Rayleigh-Bénard convection in large aspect ratio containers

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We report results from Lagrangian Particle Tracking experiments in Rayleigh-Bénard convection (RBC) using water as the working fluid. Experiments were conducted in a RBC cell with a quadratic horizontal cross section of side length $L = 320\,\mathrm{mm}$ and a height of $H = 20\,\mathrm{mm}$ resulting in an aspect ratio of $\Gamma = H/L = 16$. The top plate was cooled using temperature regulated water, while the bottom plate was heated via an ohmic heating element to their desired temperatures T_t and T_b. The mean temperature of the fluid was set to $(T_t + T_b)/2 = 20.0\,^o\mathrm{C}$ resulting in a Prandtl number of $Pr = 7.01$. We varied the temperature difference $\Delta = T_b - T_t$ and in this way covered the Rayleigh number range of $5.3 \times 10^5 < Ra < 2.1 \times 10^6$. For the measurements, we seeded the flow with $50\,\mu\mathrm{m}$ small neutrally buoyant fluorescent polyethylene microspheres (by Cospheric LLC), which were illuminated with UV-LED arrays (by LaVision). Their fluorescence signal was recorded using 6 scientific sCMOS cameras from different angles with a frequency of up to $19\,\mathrm{Hz}$[1]. Using the "Shake-The-Box" (STB) Lagrangian particle tracking algorithm[2], we have determined the position of up to 300,000 particles at a given snapshot, as well as their velocity and acceleration over a time span of up to 30,000 free-fall times. With these data we analysed statistical Lagrangian properties which will be discussed in our presentation, such as spatially resolved probability density functions of the three velocity and acceleration components, statistics of particle displacements and particle pair dispersion.

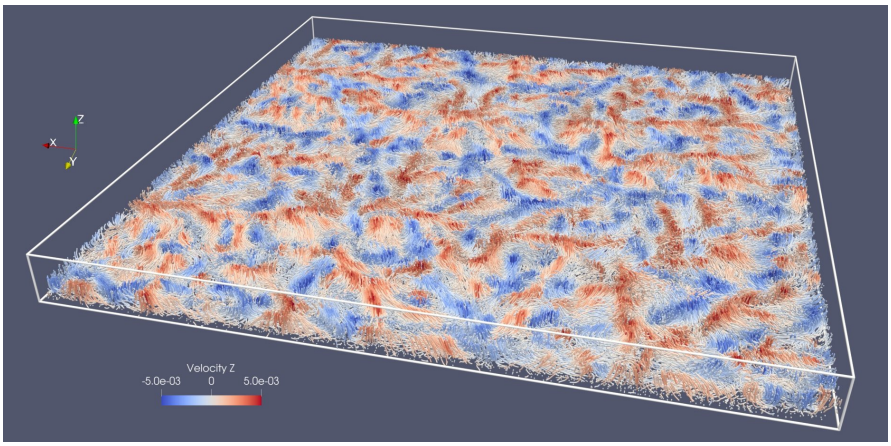

Figure 1: Experimental particle tracks in the lower half of the cell calculated using *Shake-The-Box*. The color represents the vertical velocity. Image created by P. Godbersen.

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[1]Weiss et al., accepted in *Exp. Fluids* (2023)

[2]Schanz et al, *Exp. Fluids* **57**, 70 (2016)