

Simultaneous volumetric measurement of the velocity and temperature field in Rayleigh-Bénard cells with large aspect ratio

The main objective of the project is to determine the influence of the turbulent superstructures on the heat and momentum transfer in Rayleigh-Bénard flows with large aspect ratios, i.e. large lateral dimensions in comparison to height ($\Gamma = 25, 20$ and 10). For these large aspect ratios the typical lateral dimensions of the turbulent superstructures are 2 to 3 times the height. The temporal evolution is very slow, which makes long-time observations necessary. For this reason the flow in a water filled Rayleigh-Bénard cell with transparent cooling plate (see Fig. 1) will be experimentally investigated with optical measurement techniques for Rayleigh numbers in the range of 5×10^5 to 10^8 . To simultaneously measure velocity and temperature in the horizontal plane, thermochromic liquid crystals (TLCs) will be used as tracer particles for stereoscopic particle image velocimetry and volumetric particle tracking velocimetry. The temperature will be determined based in the color appearance of the TLCs. The main benefit of the current experiment is its stability over very long time spans (up to days) which allows for long-time measurements with high spatial resolution and high statistical relevance. Since so far only short time numerical simulations are available the long term evolution of the turbulent superstructures can be investigated for the first time. The project serves as data provider for other projects within the priority programme and benefits from the development of data analysis techniques from other projects.

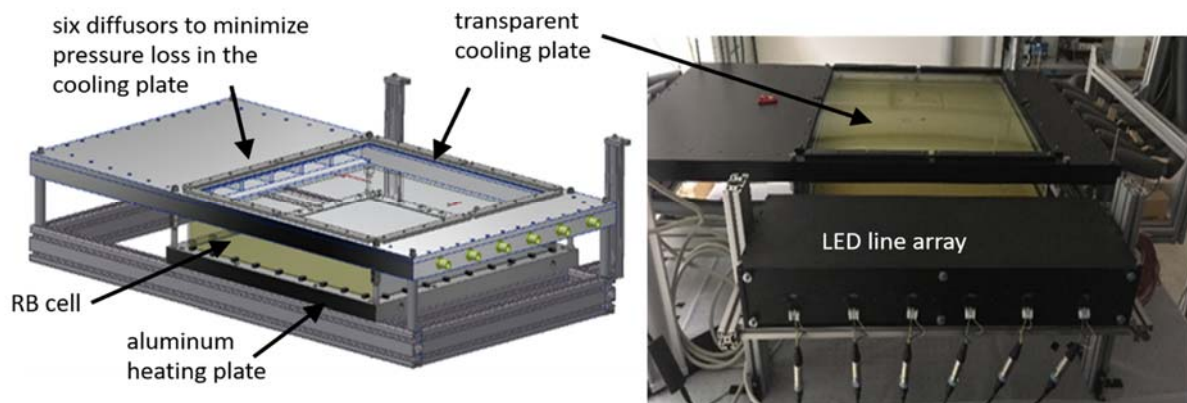


Fig. 1: CAD-model of the setup (left) and the real experimental setup (right) with a light source for the illumination of Thermochromic Liquid Crystals (TLCs). Both pictures show the Rayleigh-Bénard cell with aspect ratio $\Gamma=10$.

References:

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