# Simoultaneous velocity and thermal field measurment using Thermochromic Liquid Crystal

E. Bernard*, A. Barret *, F. Chilla * and J. Salort*

The Rayleigh-Bénard cell is a useful model system to understand the physics of turbulent thermal convection, because the boundary conditions are well defined. This allows to compare experiments and numerical simulations over a wide range of parameters [1].
While the velocity field has been studied using several experimental technique such as PIV or PTV [2], the thermal field, which is the engine of thermal convection, remains difficult to access experimentally. Historically, the main technique to obtain temperature statistics was the use of local temperature sensors but they only allow for point measurement [3]. However, the recent development of technics such as Laser Induced Fluorescence (LIF) [4] or the use of Thermochromic Liquid Crystal (TLC) [5] allow to extend the thermal field measurements to two dimensions, which would help to have a better understanding of its role in thermal convection.
In order to study plume statistical characteristics, we have performed PIV measurement in the bulk of a square Rayleigh Benard cell at Ra=$10^{10}$, enhancing the turbulence with the help of rough bottom plate and using TLC as tracers. Illuminated with white laser source, these encapsulated liquid crystal of $10\mu m$ change color with the temperature [6], so we are able to measure particles's temperature. From those data, we are able to reconstruct a 2D thermal field and the velocity field simoutaneously and then compute statistics and correlation between those 2 fields.

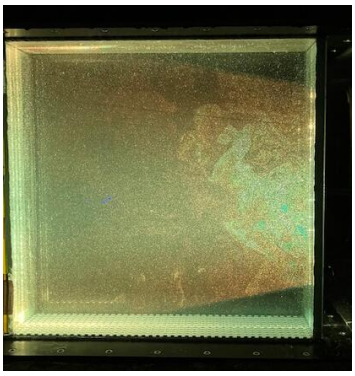

Figure 1: Rayleigh Benard cell seeded with TLC.

*ENSL, CNRS, Laboratoire de physique, F-69342 Lyon, France

[1]F. Chillà J. Schumacher, *The European Physical Journal E.* **35**, 1 (2012).
[2]Rui Ni et al., *Phys. Fluids* **692**, (2012).
[3]J. Salort et al., *Physics of Fluids*, **26**, 015112 (2014).
[4]J. Sakakibara, *Experiments in fluid* **37** (2004)
[5]Y.-B. Du and P. Tong, *Physical Review Letter* **81** (1998)
[6]S. Moller et al., '19th International Symposium on the Application of Laser and Imaging Techniques to Fluid Mechanics (2019)