MacroBB - Macro-visualisation Bas Bruit

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LABORATORIES: NEEL, INAC

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Visualization techniques at cryogenic temperature are important for many activities carried out within the alliance «New Frontiers of Cryogenics», from the study of cryogenic hydrodynamics to that of phase transitions of cryogenic fluids in porous media, through the use of cryogenic fluids to study bubble collapse, or the production of solid hydrogen ribbon as a source of proton beams. To increase the spatial resolution and the detection sensitivity in these experiments, LANEF funded a shared visualization equipment, portable, complete and versatile. This equipment consists of two complementary long-focal microscopes, and a Scientific-CMOS camera. Over the past four years, this equipment has been used in INAC and NEEL on different setups and has contributed to reinforce the existing links between these two laboratories.

In F. Sy's PhD work, we combined the long focal microscopes and fast cameras to compare the isothermal turbulence in Helium I (classical fluid) and in Helium II (which has one inviscid component) through a Lagrangian analysis. Using an oscillating grid turbulence generation, we showed using that turbulence in Helium I behaves in agreement with previous results obtained in similar flows using classical fluids. Interestingly, the same turbulence properties stand also in superfluid conditions.

The CMOS camera has been used during V. Doebele's PhD work to characterize, through speckle correlation, the evolution of the microscopic spatial distribution of liquid helium confined in a silica aerogel during condensation-evaporation cycles at 5 K (Fig. 2). The high sensitivity of the CCD translates to a 1% stability of the correlation function between two images acquired in identical conditions. This allowed us to show the so-called microscopic return point memory effect along minor hysteresis loops. While this effect was theoretically expected at the microscopic scale for systems in the Random Field Ising Model class, this is its first experimental demonstration.

MacroBB equipment has also been used to study the dynamics of quantum vortices in superfluid He4 (ongoing PhD of E. Durozoy), to develop solid hydrogen ribbon as a source of proton beams (PhD of S. Garcia), perform tests on the thermal stability of high Tc supraconductive wires (A. Badel), and made it possible to obtain new contracts and collaborations between NEEL and INAC-SBT (ANR ECOUTURB).

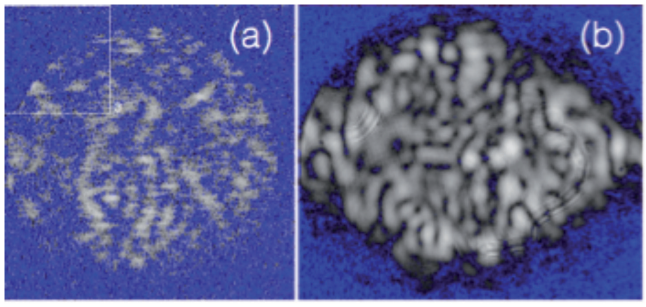

Fig. 2: Speckle images with standard CCD and CMOS cameras.

OUTCOMES

[1] Oscillating grid high Reynolds experiments in superfluid. Proc. 15th European Turbulence Conference Paper no. 318. Delft University of Technology.

PhD "Turbulence de Grille Oscillante à Basse Température" F. Sy, co-supervised by B. Rousset and M. Gibert, defended October 2016.

PhD of V. Doebele, co-supervised by P. Spathis and P. E. Wolf, defense Fall 2018, and paper in preparation

Leverage: ANR ECOUTURB (2016), ANR CAVCONF (2017)

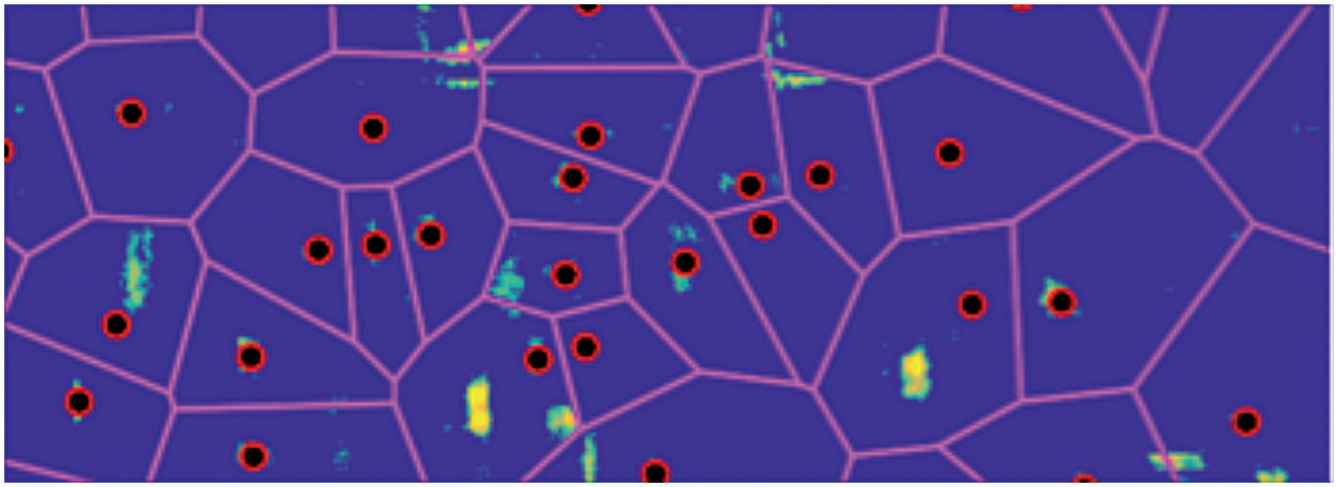

Fig. 1: Particle tracking in the Glass Cryostat at INAC