FIRST RESULTS OF THE SHREK EXPERIMENT AT ULTRA-HIGH REYNOLDS NUMBER

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The SHREK (SuperFluid von Karman experiment) has been designed to compare properties of superfluid turbulence with ordinary turbulence. The SHREK experiment (Fig. 1) makes particularly use of the phase transition experienced by Helium at 2.2 K, thus allowing to make experiments at very high Reynolds values with normal (above 2.2 K) and superfluid helium (below 2.2 K) [1, 2]. The experimental chamber consists of a cylinder of radius R = 0.4 m and height H = 1.2 m. The fluid is mechanically stirred by a pair of coaxial impellers rotating in opposite direction. The impellers are disks of radius 0.925R, fitted with 8 radial blades of height 0.2R and curvature radius 0.4625R (cf. Figure 1 (b)). The disks inner surfaces are 1.8R apart setting the axial distance between impellers from blades to blades to 1.4R. The impellers rotation rate is between 0.5 Hz to 2 Hz, delivering a total power not exceeding 400 Watt, the cooling capacity of the refrigerator above 1.8 K. The expected range of Reynolds number is 10^7 to 10^8. This experiment benefits from high flexibility of flow conditions, due to the large variation of helium properties over the available temperature range (1.6 K to 5 K). Both superfluid and normal turbulence measurements are possible in the same experiment, with adjustable fraction of the superfluid component (from $\approx 85\%$ at 1.6 K to 0% above 2.2 K). Measurements devices at SHREK include miniature pitot anemometer, second sound probes for superfluid turbulence measurement, miniature pressure sensors, torques and power calorimetric measurement. The torquemeters are SCAIME technology and provide torque measurements over the kHz range.

A first campaign of experiments took place in October 2012. In this talk, we report the first results obtained using torque measurements, obtained for a large range of rotation frequencies f_1 and f_2. The results are compared with results obtained in a scale 1:4 experiment, operated in Saclay with water [3]. We discuss how the results can provide some new insights about the so-called dissipation anomaly, and how they can be used to derive bounds on the effective dissipation provided by quantized vortices in superfluid turbulence.

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References

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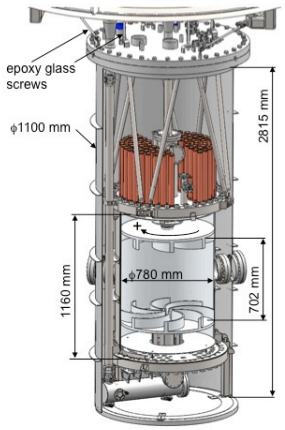

(a) Schematic view of the experimental setup and the impellers blade profile. The arrow on the shaft indicates the studied impeller rotation direction.

(b) Picture of the experiment partially assembled.

Figure 1. The SHREK experiment.