Title: Quantum turbulence in superfluid helium studied by particle tracking velocimetry visualization technique

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Abstract: The Particle Tracking Velocimetry visualization technique using micrometer size solid deuterium particles as tracers has been applied to study oscillatory flows of He II, which is a quantum fluid with quantized vorticity, as well as flows of He I, which is a classical viscous liquid, focusing on the similarities and differences between the quantum and classical flows. Three experiments are described: the flow past a large-amplitude low-frequency oscillating obstacle in the form of a prism; the steady streaming flow due to a small-amplitude large-frequency oscillating quartz tuning fork - a widely used tool to study quantum turbulence; and the production of *cavitation* in the vicinity of a fast-oscillating tuning fork. The main outcome is the observation that these flows are similar in He I and in He II at large length-scales, whereas at small scales, they exhibit totally different statistical properties. Moreover, in He II, these small scale statistical properties are universal in that they do not depend on the type of the imposed mean flow of the superfluid and normal component and are the same as in thermal counterflow – a pure quantum type of thermal convection with no classical counterpart.

Keywords: Experiment Helium Quantum turbulence Superfluidity Flow visualization Oscillating obstacle Pseudovorticity Length-scale Universality Streaming Quartz tuning fork Cavitation Oscillation wake