Visualization study of quantum turbulence in superfluid helium-4: progress and future development

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Helium-4 in the superfluid phase (He II) is a two-fluid system that exhibits fascinating quantum hydrodynamics with important scientific and engineering applications. It supports the most efficient heat-transfer mechanism (i.e. thermal counterflow), and it also allows the generation of flows with extremely high Reynolds numbers for turbulence modelling. However, the lack of high-precision flow measurement tools in He II has impeded the progress in understanding and utilizing its hydrodynamics. In recent years, there have been extensive efforts in developing quantitative flow visualization techniques applicable to He II. Two types of techniques based on the use of either particle tracers (i.e. micron-sized frozen particles) or molecular tracers (i.e. He2 excimer molecules) have been developed. We will discuss the advantages and issues associated with these visualization techniques and will highlight some recent progress in our visualization study of counterflow and grid turbulence in He II. We will also briefly introduce our on-going work on developing the next generation flow visualization techniques and our effort on imaging quantized vortices in pure superfluid helium at low temperatures.

Section: VT - Vortices and turbulence

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