

# Abstract

Superfluid  $^4\text{He}$  (He II) is a quantum liquid whose flow is strongly affected by quantum mechanical effects. This thesis presents experimental and numerical studies of turbulent flows in He II – *quantum turbulence*. Experimentally, quantum turbulence is investigated in thermal counterflow, pure superflow and coflow using second sound attenuation, precision local thermometry and by visualisation of helium excimer molecules. The steady state and decay of the vortex line density in pure superflow and counterflow is studied and the universal quasi classical decay is characterised by measurements of the effective kinematic viscosity. General dynamical behaviour is studied in detail in unsteady thermal counterflow, with various theoretical models tested. A new model where the mean tangle curvature is dependent on the vortex line density is proposed. Temperature dependence and enhancement of intermittency in quasi-classical flow in the wake of a moving grid is found using visualisation. Numerically, the interaction of the tangle of quantized vortices with solid tracers is investigated, where a back reaction of the seeding particles on the tangle is identified and its relevance to visualisation experiments is discussed. Additionally, an interesting and as-yet overlooked spherical counterflow is studied, where a possible critical temperature for the creation of turbulence was found. The findings are explained in terms of a transparent physical model.