

Visualization of Quantum Vortices in Superfluid 3He A Phase

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A phase of superfluid 3He has anisotropic nature, and is characterized by two vectors, \mathbf{l} -vector in momentum space and \mathbf{d} -vector in spin space. The phase of the order parameter is not independent of the phase and direction of \mathbf{l} -vector. As a result, velocity field of Superflow in A phase of superfluid 3He is determined by a gradient of \mathbf{l} -vector. Under rotation the core structure of a vortex in superfluid A phase of 3He is complicated, and depends on magnetic field and angular velocity. In magnetic field more than 200 gauss which is necessary for NMR measurements, its core has about 10 μm size in diameter and two circulation quanta and form vortex lattice depending on its angular velocity. We are now planning to detect A phase vortex lattice using low temperature MRI technique, which has resolution better than 10 μm .

We are now constructing a new rotating Nuclear Demagnetization Cryostat. It has two magnets, one is for demagnetization and the other is a high homogeneous and high field superconducting magnet up to 8 T. Rotating parts are constructed with a magnetic fluid sealing and an air bearing. Using the new cryostat, we are planning MRI experiments for direct measurement of vortices of superfluid A-phase, which needs high homogeneous magnetic field. Also experiments on A1-phase vortices are planned in high magnetic field.