Propagation of a Single Vortex in Superfluid ^{3}He-A and Dynamics of the Orbital state in the order parameter

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We study the propagation of a vortex in superfluid ^{3}He-A in a single narrow cylinder by cw-NMR. In previous work [1], we investigated a quantized vortex in superfluid ^{3}He-A in narrow multi-cylinders and we found that there were some widths on the critical rotation speeds Ω_{c1} (which corresponded to a first critical field H_{c1} in a Type-II superconductor). But in the previous multi-cylinders experiment, only averaged signals of many vortices (there was one vortex in each cylinder) were observed. So it is difficult to study the origin of such the widths on Ω_{c1} and dynamics of vortex.

So we started a simple and clear experiment using a single cylinder sample. In new single cylinder experiment, we also found some widths on the critical rotation speeds Ω_{c1}. This means that the propagation of vortex in the cylinder is stopped by a pinning force or that the critical rotation speeds varies with rotation speeds of container. Because of several reasons we think that the latter interpretation is proper. We will present these reasons in this workshop.

And vortices in superfluid ^{3}He-A are one of the textures of l-vector, which shows the orbital state of the order parameter of superfluid ^{3}He-A. So by measuring dynamics of vortex, it is possible to investigate the dynamics of l-vector, which was governed by magnitude of intrinsic angular momentum and orbital viscosity. We show relation between propagation speeds of vortex and the orbital viscosity.

[1] R. Ishiguro et al., Phys. Rev. Lett. **93**, 125301 (2004).