Hysteresis of Non-Classical Rotational Inertia in 2D ^{4}He Films on Graphite

Y. Shibayama[a], H. Fukuyama[b], and K. Shirahama[a]

[a]Department of Physics, Keio University, Yokohama, Japan
[b]Department of Physics, The University of Tokyo, Tokyo, Japan

A ^{4}He film on graphite is an interesting system in terms of a two-dimensional (2D) correlated Bose system. By torsional oscillator (TO) studies of the ^{4}He bilayers, Crowell and Reppy observed novel mass decoupling in the vicinity of the second layer completion and disappearance of the decoupling just at the second layer completion.[1] They argued the decoupling was caused by non-classical rotational inertia (NCRI) of the bilayers, but the details have not yet been clarified. If 2D solid phase forms at the second layer completion, the NCRI is possibly due to a 2D solid doped with zero-point vacancies. This is interesting in the context of the supersolid state of solid ^{4}He. In order to study the peculiar NCRI, we have studied ^{4}He films on graphite by a TO.[2] In this work, we report the hysteresis of the NCRI with TO velocity sweeps. A 18.39 atoms/nm^2 sample, which exhibited a finite NCRI below 300 mK, was kept at 65 mK after cooling down to 10 mK with no TO driving. And then the velocity sweeps were carried out up to 6000 μm/s. A finite hysteresis in the NCRI was observed below 1000 μm/s. The size was approximately 50% of the total NCRI. We will discuss the hysteresis and possible phase diagrams of the ^{4}He films.

[1]P. A. Crowell and J. D. Reppy, Phys. Rev. B **53**, 2701 (1996).
[2]Y. Shibayama *et al.*, J. Phys.: Conf. Ser. **150**, 032096 (2009).