Nonlinear Transports of Electrons on Liquid ^{4}He in a 1.6 μm Channel

H. Ikegami, H. Akimoto, and K. Kono

RIKEN, Hirosawa 2-1, Wako, Saitama 351-0198, Japan

Two-dimensional electrons floating on the surface of liquid ^{4}He form a Wigner crystal at low temperatures accompanied with the commensurate deformation of the surface. The coupling of the Wigner crystal with the surface deformation gives rise to peculiar transport properties. Especially at low frequency transports, the Wigner crystal shows the nonlinear behavior associated with the resonant scattering of surface waves caused by the Bragg-Cherenkov (BC) mechanism[1], and it occurs only when the electrons form the crystal structure with the surface deformation. Here we have investigated the nonlinear properties associated with the BC scattering in the quasi-one-dimensional geometry with a few electrons in the confined direction. Because of the fluctuation due to long-wave thermal phonons, no long-range crystalline order is expected for the quasi-one-dimensional crystal, and therefore it is not clear whether the BC scattering would occur. The quasi-one-dimensional electron system is implemented by confining electrons in a channel 1.6 μm in width. In this channel, only one or two electrons can be present in the confined direction, according to our numerical calculation of the electron distribution in the channel. We observed the clear nonlinear behavior associated with the BC scattering, indicating that the electrons form a crystal-like structure in the channel even though such a small number of electrons are present in the confined direction.

[1] M. I. Dykman and Yu. G. Rubo, Phys. Rev. Lett. **78**, 4813 (1997).