Reconstruction of the electron oscillations on the surface of liquid helium.

Hala Siddiq[1,2], Kostyantyn Nasyedkin[3,4], Kimitoshi Kono[3,5], Dmitry Zmeev[1], Peter V. E. McClintock[1], Yuri A. Pashkin[1], and Aneta Stefanovska[1]

[1]*Department of Physics, Lancaster University, Lancaster LA1 4YB, United Kingdom*
[2]*Jazan University, Faculty of Science, Department of Physics, Jazan, Saudi Arabia*
[3]*Quantum Condensed Phases Research Team, RIKEN CEMS, Wako, Saitama 351 0198, Japan*
[4]*Neutron Scattering Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA*
[5]*International College of Semiconductor Technology, National Yang Ming Chiao Tung University, Hsinchu 300, Taiwan*

In recent years, system of electrons on the liquid helium surface is considered as hot topic because the electrons encounter very little physical resistance and liquid helium is actually a very clean medium. Indeed, such a system has been widely used as an experimental model for investigating two dimensional (2D) quantum and nonequilibrium phenomena. At 0.3 K, we have recorded currents induced in five Corbino electrodes by spontaneous oscillations of surface electrons on liquid helium, with a perpendicular magnetic field and microwave radiation. Approaches of time-resolved multi-scale analysis were used to distinguish stochastic from frequency-modulated deterministic dynamics and visualize the electrons' underlying oscillatory dynamics from these recorded data. We have revealed oscillations with a variable frequency which is dependent on changing the pressing voltage and electron densities. The main frequency of the oscillations was confirmed to be generated by the inter-edge magneto-plasmons and modulated by interactions with gravity waves of the surface of liquid helium. The corresponding patterns of electron motion will be shown for different electron densities and pressing voltages.