



Acoustic Studies of AC Conductivity Mechanisms in n-GaAs/AlGaAs in the Integer and Fractional Quantum Hall Effect Regime



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We demonstrate a method to determine the complex AC conductivity in an n-GaAs/AlGaAs heterostructure using acoustic techniques.

A major feature of using acoustics is that the conductivity measurements can be made without needing to fabricate contacts. We expect this to be most desirable in evaluating emerging novel material systems where the fabrication technology and surface interactions are less well understood. In our experiments Surface Acoustic Waves (SAW) propagates along a surface of a piezoelectric LiNbO₃. A sample is placed to the surface. An electric field induced by the SAW penetrates into the sample. As a result, damping of the SAW amplitude, as well as shift of its velocity occur. Complex ac conductivity is calculated from the attenuation and speed.

At low fields, $B < 1$ T one can determine the general parameters of the 2D electron gas. At higher fields, the mechanisms of low temperature AC conductivity are analyzed in the IQHE regime, and shown to be a hopping. In the FQHE regime at $\nu=2/3$ the AC conductivity has an activation character. The dependence of the activation energy on field has been determined and shown to follow a similar trend to measurements by other techniques.

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