The gigahertz complex admittance of a quantum R-L circuit in chiral edge channels

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Abstract

We study experimentally the gigahertz complex admittance of a quantum R-L (an inductor L in series with a resistor R) circuit in the presence of magnetic field at 20 mK. Quantized conductance steps are observed on both real and imaginary parts of the admittance when the transmission of quantum point contact is changed. At low magnetic fields, the transmission-independent phase of admittance has been observed which allows us to obtain the transit time of the electrons in quantum coherent conductor directly. We found that the admittance phase depends on the transmission of the quantum point contact when the magnetic fields are relatively high. Here, the Coulomb interaction plays a prominent role in the magnetic field dependence of the admittance phase. Hence, a current and charge conserving scattering theory[1,2] is provided to describe these experimental observation quantitatively. In addition, an admittance phase jumping is observed when the transmitted modes are changed. The theoretical model we proposed considered the effects of gate voltage, which is in good agreement with the experimental observations of admittance phase jumping. This experimental and theoretical investigation provide an ideal system to study quantum transport in gigahertz high frequencies, and it is useful to study quantum coherence effects in the time-dependent situations[3].

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