RF CIRCUIT MODEL OF A QUANTUM POINT CONTACT

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ABSTRACT

The development of nanoscale RF circuit components is important or the development of RF readout circuitry to determine with high temporal resolution[1] the number of electrons on a quantum dot. This has applications in THz spectroscopy at the nanoscale[2] and quantum computing.

In this work, we develop a realistic, physics based, practical RF circuit model for the AC impedance of a quantum point contact that includes the ohmic contacts, the on-chip “lead” resistance and kinetic inductance, and the quantum point contact impedance itself. The kinetic inductance of the electrons in the “leads” in series with the quantum point contact capacitance form a resonant tank circuit whose resonant frequency depends on the width of the quantum point contact channel. These measurements probe devices in a qualitatively new regime: They are in the ballistic limit, and the measurement frequency is higher than the electron scattering frequency.

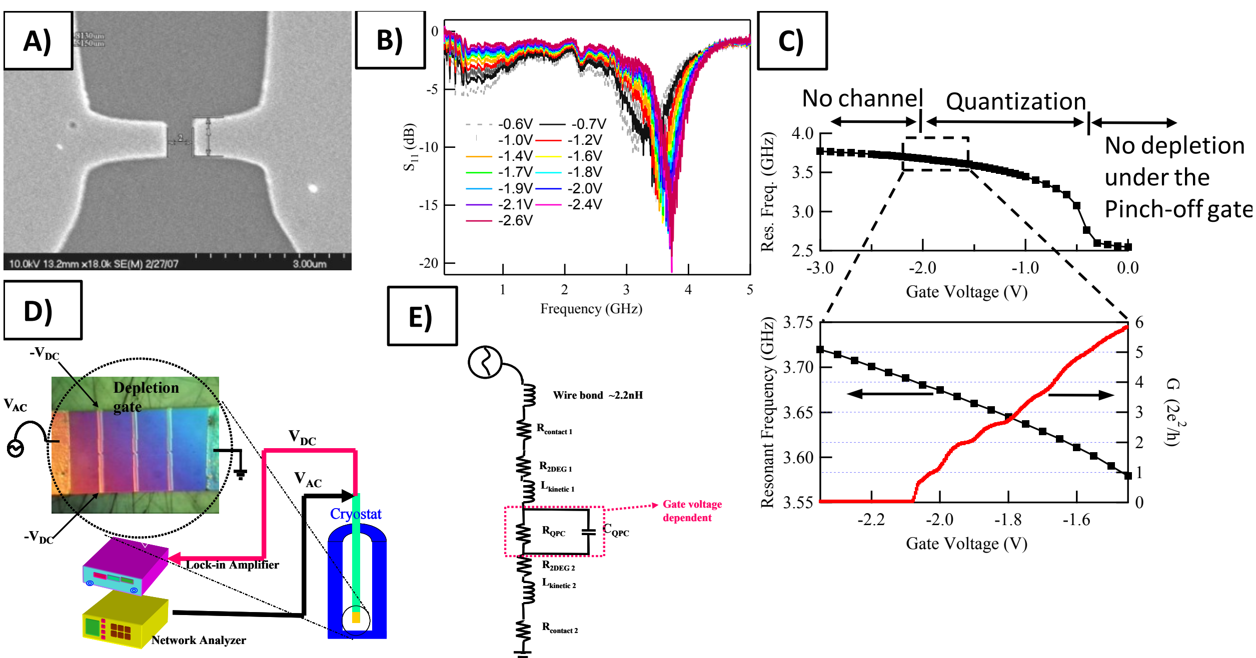

Figure 1. A) SEM of QPC. B) Measured S_{11}. C) Measured resonance frequency vs. pinch-off voltage. D) Measurement setup. E) RF circuit model of QPC including QPC capacitance and kinetic inductance.

REFERENCES

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