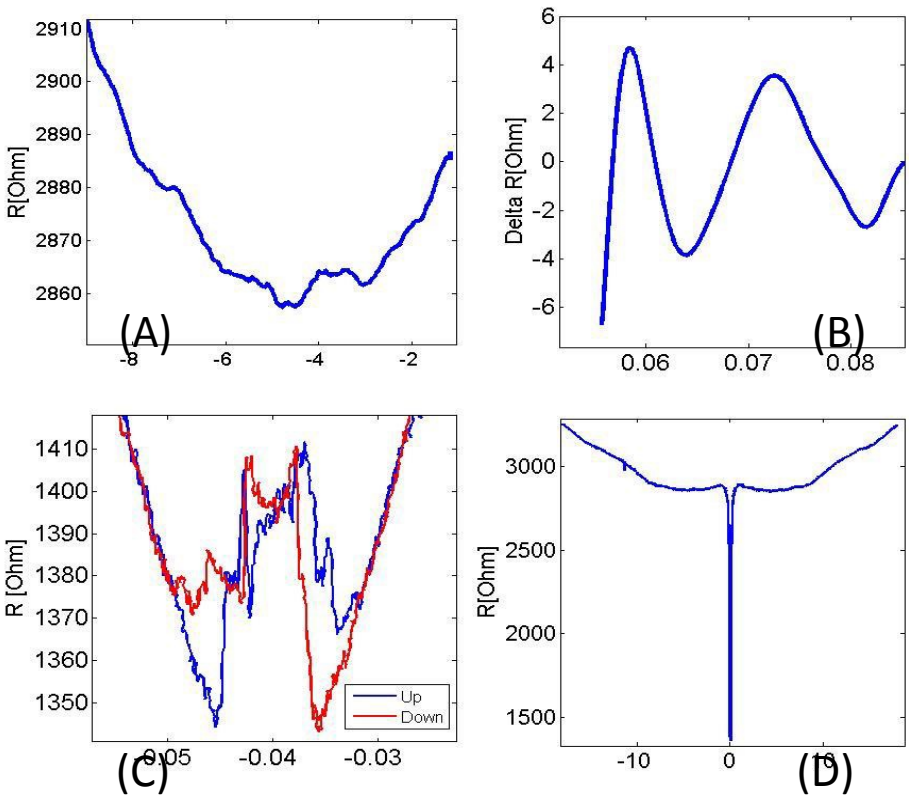
Oxide-Interface-Based Quantum Wires

A. Ron (TAU, Physics); Y. Dagan (TAU, Physics); E. Maniv (TAU, Physics)

Introduction

The interface between $LaAlO_3/SrTiO_3$ unexpectedly exhibits properties of two dimensional electron gas superconductivity, magnetism and tunable spin-orbit interaction. An effort has been made to create narrow bridges and quantum wires from this interfaces that may exhibit helical transport.

Experimental



We measured quantum wires; however a continuous gate sweep was not possible at the required voltage resolution due to software limitations. In addition, we measured narrow channel (50nm) of $SrTiO_3/LaAlO_3$ interfaces as a function of field and gate voltage. Such narrow bridge has never been measured before.

Results and Discussion

Due to the small size of the sample many new features were observed. In figure (A) we show universal conductance fluctuations from which the width of the device was inferred to be 55nm as designed. (B). Shubnikov-de Haas effect from which we found the gate dependence of the carrier concentration. (C). Ferromagnetic hysteresis surprisingly observed within the superconducting transition (D).

Conclusions

We have the ability to fabricate bridges with their width of the order of the Fermi wavelength. Making them shorter is expected to show conductance quantization. From our results we can conclude that superconductivity and magnetism do not spatially coexist.

Acknowledgements

Support from US-Israel Bi-National Science foundation under grant 3-8667 is acknowledged.