**Superconductivity and Quantum Transport in Asymmetric and Symmetric SrTiO3 Structures**

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**Introduction**

 The ground state of two-dimensional (2D) electron systems are often functions of disorder, carrier density, strain, and magnetic field. 2D systems involving SrTiO3 (STO) have proven to be a particularly rich playground for the study of unique ground states of matter. We have implemented dual-gated LaAlO3/SrTiO3 (LAO/STO) devices and continuously tunable strained delta-doped STO quantum wells. The dual gated structure allows independent and continuous tuning of disorder and carrier density while strain tuning accesses structural order.

**Experimental**

 The experiments presented here are completed in part in the SCM-1 dilution refrigerator at the NHMFL. Both sets of devices are grown *via* pulsed laser deposition. The dual gate device is fabricated by applying a Au electrode on top of the LAO layer and a Ag electrode from the back of the STO substrate.

**Results and Discussion**

 Strained delta-doped STO: By applying only tiny amount of strain on the substrate, *T*C changes.

Dual-gate LAO/STO: In addition to modulating the superconducting transition temperature, *T*C, strikingly different interface conducting states are accessible in a single device—zero resistance (superconductor), saturating small finite resistance (“metal”), and increasing resistance (insulator), when approaching zero temperature.



**Fig.1** (a) Superconducting transition a function of strain in delta-doped STO. (b) An example of magnetic field induced superconductor to insulator transition in dual-gated LAO/STO interface under a fixed top and back gate voltages.

**Conclusions**

 The dual-gate LAO/STO and strained delta-doped STO devices provide a unique platform for investigating ground state transitions of 2D electron system under various continuously tunable parameters.

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**References**

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