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# Superconductivity, Magnetism, Anisotropy and Memory: The Remarkable Properties of the Conducting Gas at the (111) LaAlO<sub>3</sub>/SrTiO<sub>3</sub> Interface

Venkat Chandrasekhar<sup>\*1</sup>, Samuel Davis<sup>1</sup>, Zhen Huang<sup>2</sup>, Kun Han<sup>2</sup>, A Ariando<sup>2</sup>, and Thirumalai Venkatesan<sup>2</sup>

<sup>1</sup>Northwestern University – United States

<sup>2</sup>National University of Singapore – Singapore

## Abstract

The 2D conducting gas that forms at the interface between the two insulators LaAlO<sub>3</sub> (LAO) and SrTiO<sub>3</sub> (STO) has garnered a lot of attention due to wide variety of physical phenomena that it exhibits, including strong spin-orbit coupling, superconductivity, magnetism, and localization effects, among others. Most of the experimental and theoretical work so far has been on LAO/STO interfaces grown in the (001) crystal orientation, in which the system has rectangular symmetry at the interface. More recently, interest has focused on LAO/STO interface grown in the (111) crystal orientation, in which the interface has hexagonal symmetry, similar to graphene and transition-metal-dichalcogenides, raising the possibility of topological effects. As with the (001) interface structures, we find that the system exhibits both superconductivity and magnetism coexisting at the same interface. Unlike the (001) interface, the (111) interface is highly anisotropic, showing different characteristics along different crystal directions in all its properties, including longitudinal resistivity, Hall effect, quantum capacitance, superconductivity and magnetism. In addition, we observe an unusual memory effect in the superconducting state: the system remembers the gate voltage at which it is cooled through the superconducting transition.

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<sup>\*</sup>Speaker