Understanding Two-Dimensional Electron Gases in Complex Oxides

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The importance of two-dimensional electron gases (2DEG) in today’s world of electronics cannot be understated, given their ubiquitous presence in every transistor in every electronic device. The formation of a two-dimensional electron gas in MOSFETs is fundamentally responsible for its usage as a switch. Hence, the discovery of a two-dimensional electron gas at the interface of complex oxides like SrTiO$_3$/LaAlO$_3$ and SrTiO$_3$/GdTiO$_3$ ushered in a multitude of research activity due to its vast implications, in terms of coupling novel phenomena like superconductivity and ferromagnetism with the properties of the 2DEG. But a complete understanding of the complex transport phenomena in such oxide 2DEGs still remains a challenge.

In this presentation, 2DEGs at oxide interfaces will be introduced along with concepts of quantum tunnelling that we will use to study the properties of the 2DEG. We will also briefly look at how we can produce these oxide materials with atomically sharp interfaces and fabricate tunnel devices to study the electronic structure of the 2DEG.