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Contribution ID: **1659** Type: **CLOSED - Oral (Non-Student) / orale (non-étudiant)**

Influence of Ferroelectric Quantum Criticality on $SrTiO_3$ Interfaces

Thursday 1 June 2017 08:45 (15 minutes)

It was shown in 2004 that a two-dimensional electron gas may form at the interface between non-polar $SrTiO_3$ and polar cap layers such as $LaAlO_3$. Ongoing interest in these interfaces is sustained by observations of gate-tunable superconductivity, ferromagnetism, and spin-orbit and polaronic effects. This talk will focus on the interfacial electronic structure, which is not well understood even a decade later.

In particular, I will show that the electron distribution at the interface is fundamentally tied to a nearby ferroelectric quantum critical point: energetically, the $SrTiO_3$ lattice favours a ferroelectric transition which, however, is suppressed by quantum fluctuations. Consequently, the $SrTiO_3$ dielectric susceptibility is a strong function of temperature, electric field, and wavevector. As this dielectric susceptibility shapes the confining potential well at the interface, one must expect the electron distribution to also be a strong function of temperature and gate voltage. One of the most striking manifestations of quantum criticality is the prediction that the electron gas becomes deconfined from the interface at low temperatures and densities, opposite to what would be found in conventional semiconductor interfaces.

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Session Classification: R1-1 Solar Cells (DCMMP) | Piles solaires (DPMCM)

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)