High field transport properties of high mobility 2DEG at the $LaAlO_3/SrTiO_3$ interface

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The formation of a two-dimensional electron gas (2DEG) at the interface between two insulators $SrTiO_3$ (STO) and $LaAlO_3$ (LAO) is among the most intriguing findings in oxide electronics. While the gate tunable superconductivity [1] and spin orbit coupling [2] at this interface are well studied, no clear consensus is reached on the quantum oscillations due to the limitation of applied magnetic field. We have investigated the quantum transport of a high mobility 2DEG at LAO/STO interface under high magnetic field (55T). The Shubnikov-de Haas (SdH) oscillations in longitudinal resistance (R_{xx}) show a clear monotonic dependence with varying the gate voltage/carrier density (see Fig. 1), despite a one order of magnitude discrepancy between the carrier concentrations estimated from the Hall resistance and the SdH oscillation's frequency [3]. Interestingly, the Landau fan diagram is non-linear implying the presence of many sub-bands derived from the Ti:3d orbitals (d_{xy}, d_{xz} and d_{yz}) of STO and/or sub-band spin-spitting at the Fermi energy in the band structure. The substantial shift in the amplitude and frequency of the oscillations observed with varying back-gate voltage allows investigating the complex band structure of this 2DEG.

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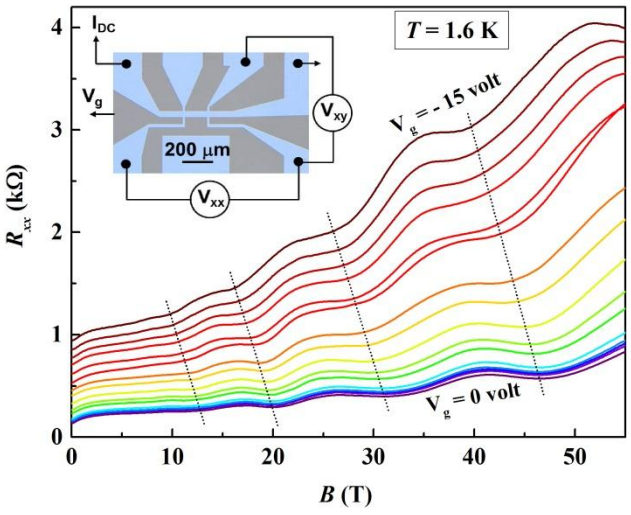

Figure 1. The magnetic field dependence of longitudinal resistance (R_{xx}) with varying back-gate voltage. The dot lines are guides for the eye. The inset shows an optical micrograph of LAO/STO device.