Top-gating control of the 2-DEG at the LAO/STO interface

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Transition metal oxides display a great variety of quantum electronic behaviors where correlations often play an important role. The achievement of high quality epitaxial interfaces involving such materials gives a unique opportunity to engineer artificial materials where new electronic orders take place. The recent discovery [1-3] of a superconducting two-dimensional electron gas (2DEG) at the interface of insulating oxides such as $SrTiO_3/LaAlO_3$ or $LaTiO_3/SrTiO_3$ provide a unique system in which superconducting to insulating transition can be continuously controlled using a back gate. In addition, those 2DEG present a field-effect-tunable strong Rashba spin-orbit coupling. Thus they naturally combine all the ingredients to host topological states.

In this presentation, we report the local control of superconducting properties and Rashba spin-orbit coupling with top gates [4,5], in device based on $LaAlO_3/SrTiO_3$ oxides interfaces as shown on figure 1,. Finally, we will discuss the recent results on local control of the metallic 2DEG at even shorter scales with top gates in a quantum point contact geometry. This study paves the way for an accurate control of the 2DEG at oxides interfaces at mesoscopic scales.

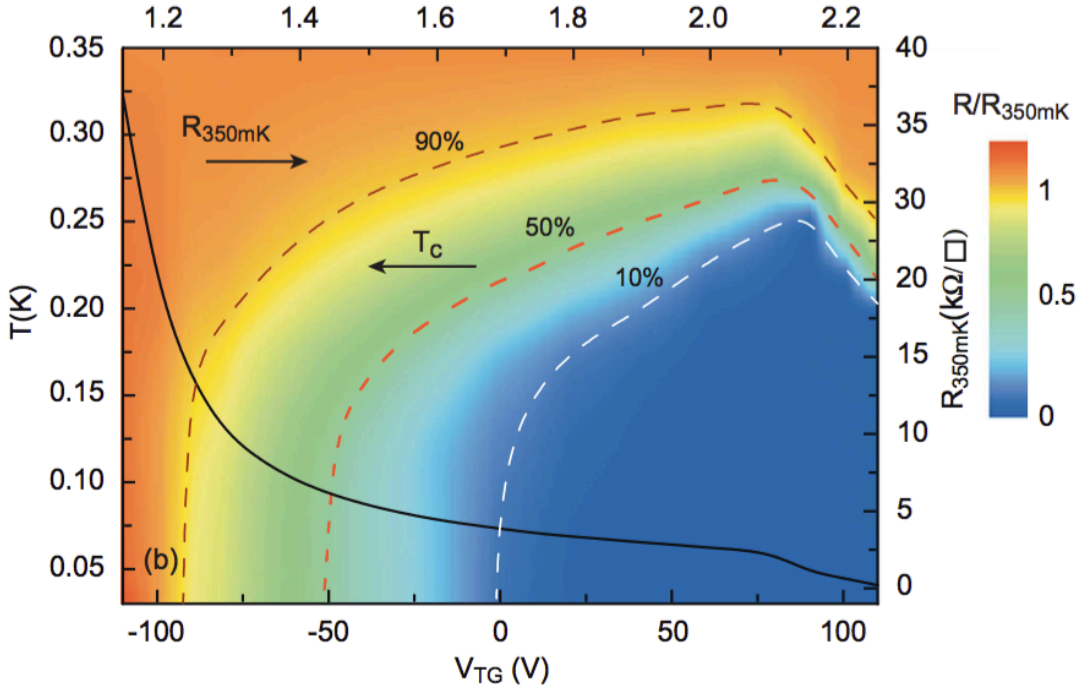

Figure 1 : Sheet resistance normalized by its value at T=350mK plotted with a color scale as a function of temperature (left axis) and top-gate voltage. The carrier densities corresponding to the top-gate voltages have been added in the top axis. The sheet resistance at T = 350 mK is plotted as a function of top-gate voltage on the right axis. e critical temperature T*c* is plotted as function of the top-gate voltage on the le axis for the different criteria: drop of 10%, 50% and 90% of the normal resistance taken at T=350mK, [5].

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