Enhanced Superconducting Fluctuations in Two-Dimensional Oxide Superconductor

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Strong spin-orbit coupling, and low crystal symmetry are key ingredients for the search of non-conventional superconducting systems [1,2]. The recent discovery of superconductivity at the (111) surface of $KTaO_3$ sparked a renewed interest in the investigation of interfacial superconductivity in oxides. The surface of $KTaO_3$(111) has been shown to host non-coplanar spin textures and strong spin-orbit coupling [4,5], crucial factors to attain non-standard superconducting states or nontrivial band topology[1-3].
Although early observations yield a promising outlook for this material platform [4-7], the thermodynamics of the superconducting state of $KTaO_3$ (111) remains undetermined.
We study the increase in conductivity above the transition temperature in superconducting field effect devices at the surface of $KTaO_3$(111). The conductivity's enhancement in these devices is considerably underestimated by the standard Aslamazov-Larkin contribution. The discrepancy is resolved by considering a comprehensive model including other fluctuation mechanisms such as the phase coherent Maki-Thompson (MT) correction. The theoretical model accounts also for dynamical and short-wavelength fluctuations, which makes it applicable over a broad range of temperatures.
This analysis allows to capture an enhancement in conductivity that extends up to 4 times the critical temperature and highlight MT corrections as the leading contribution to the conductivity's enhancement.

References

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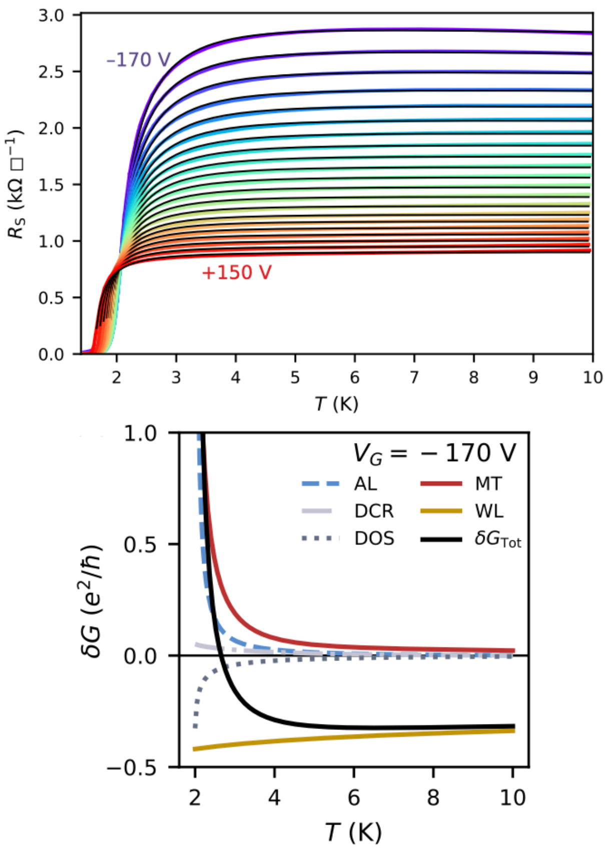

Figures

Figure 1: Top panel: electrostatically tunable superconducting transition with overlaid fits. Bottom panel: separate contributions at fixed gate voltage (170V) shows MT contributions dominating over the entire temperature range.