Superconducting and spintronic properties of 2D electrons in oxide heterostructures

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The peculiar `taillish' resistance of the $LaAlO_3/SrTiO_3$ or $LaTiO_3/SrTiO_3$ (LXO/STO) heterostructures near the superconducting transition is due to the occurrence of a low-dimensional (nearly filamentary) structure of the superconducting cluster with small long-distance connectivity embedded in the two-dimensional system [1,2]. An electronic phase separation can account for the systematic occurrence of such nanoscopic inhomogeneity and we have proposed two, possibly cooperative, mechanisms for the instability of the electron gas [2,3]. Under some conditions, the inhomogeneous state of LXO/STO can give rise to multiple quantum criticality [4] and a quantum Griffith's phase [5].

More recently, experiments have demonstrated the presence of a strong spin galvanic effect (SGE) describing an efficient conversion of a non-equilibrium spin polarization into a transverse charge current in LAO/STO. We have analyzed [6] the SGE for oxide interfaces within a three-band model for the Ti t_{2g} orbitals, which displays an interesting variety of effective spin-orbit couplings in the individual bands that contribute differently to the spin-charge conversion. We also investigate the influence of disorder and temperature, which turns out to be crucial to provide an appropriate description of the experimental data.

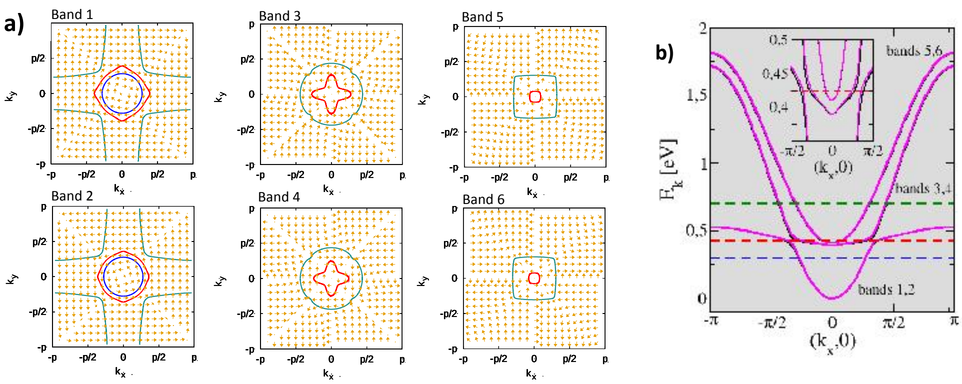

Figure. a) Chiral spin structure for the 6 t_{2g} bands of LAO/STO interface together with the Fermi surface. b) Structure of the t_{2g} interface bands. The inset enlarges the region around the Lifshitz point where the spin-orbit splitting is large. The horizontal dashed lines in the main panel refer to the chemical potentials $\mu = 0.3$ eV (blue), $\mu = 0.425$eV (red) and $\mu = 0.7$eV (green).

References

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