

# Properties of the spin-polarized 2DEG at the LAO/ETO/STO interface

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The multi-orbital character of quasi-two-dimensional electron gases (q2DEGs) at the interface between oxide materials is at the origin of the rich physics of these systems and of the emergence of unconventional quantum phases in them. We will present the two-dimensional electron system (2DES) at the LaAlO<sub>3</sub>/EuTiO<sub>3</sub>/SrTiO<sub>3</sub> interface. It shows tunable superconductivity, spin-orbit coupling and ferromagnetism [1], offering the possibility to study the interaction among ground states that are rarely found combined in the same system, and opening to the possibility to interesting electronic applications. We explore the nature and properties of LAO/ETO/STO interface using a wide range of techniques, from electrical transport to angle-resolved photoemission spectroscopy. We will compare the experimental results with Density functional theory calculations, resolving the mechanism of orbital selective switching of the spin-polarization in this oxide q2DEG [2]. The joint experimental and theoretical approach is becoming essential to gain detailed understanding of novel heterostructures showing exceptional properties, and as a guide for future design of materials for advanced applications [3].

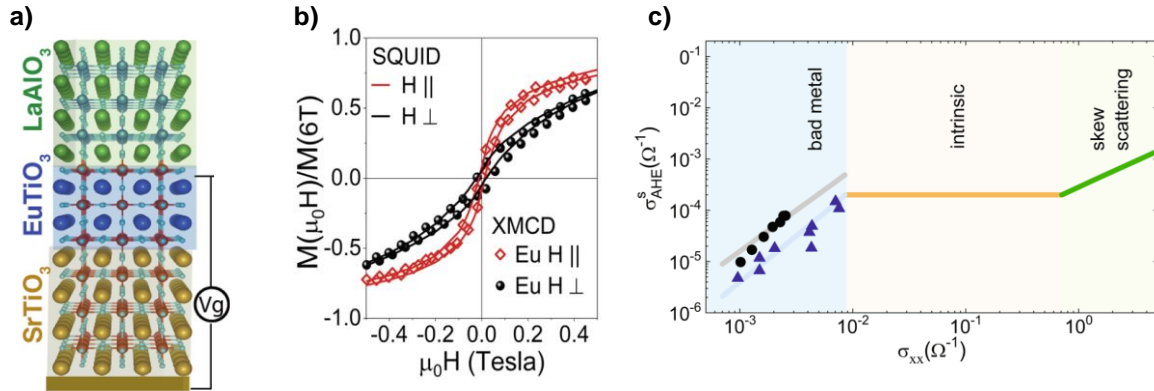


Figure 1: a) Sketch of the LAO/ETO/STO heterostructure. b) Eu- XMCD (scatter data) and SQUID magnetization (continuous lines) as function of the magnetic field parallel (red) and perpendicular (black) to the interface. The data are normalized to the saturation value. c) Anomalous Hall conductivity vs. longitudinal 2D conductivity. Full lines refer to the exponent  $\alpha$  in the relation  $\sigma_{\text{AHE}} \propto (\sigma_{\text{xx}})^\alpha$  with  $\alpha = 1.8$  (light blue, and gray, intrinsic anomalous Hall effect suppressed by disorder),  $\alpha = 0$  (orange, intrinsic anomalous Hall effect),  $\alpha = 1$  (green, skew scattering).

## References

[1] D. Stornaiuolo, et al. Nat. Mater. 15, (2016), 278–284.

[2] R. Di Capua, et al. npj Quantum Mater. 7, (2022), 41

[3] M. D'Antuono, et al., Nanotechnology 33 (2022) 085301

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