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Interface effects in oxide heterostructures combining superconductors, ferromagnets and ferroelectrics[1]

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In oxide heterostructures, the interactions at the interfaces often yield novel physical properties, which radically differ from the individual constituents' and provide with new functionalities. Oxide perovskites offer much potential for this, because a variety of isostructural materials exist with very different ground states (superconductors, ferromagnets, ferroelectrics, etc). One interesting possibility is to locally couple one of the heterostructure constituents' sensitivity to an external stimulus (e.g. the electric field for ferroelectrics) to a physical property of the second constituent (e.g. the magnetization in a ferromagnet, or the critical temperature in a superconductor). Such local coupling can be achieved via nanoscale field-effect doping. Through this mechanism, a form of magneto-electric coupling between the local electric polarization in the ferroelectric and the local magnetic induction in the superconductor can be obtained, which allows the electrostatic manipulation of magnetic flux quanta [1]. Another interesting possibility is to intertwine the most distinctive properties from each of the heterostructure constituents. As an example of this, we show how to unite the phase-coherent dissipationless charge transport characteristic of superconductivity and the spin-polarized charge transport characteristic of ferromagnetism [2], which may open the door to novel spintronic devices [3].

[1] A. Crassous, R. Bernard, S. Fusil, K. Bouzehouane, D. Le Bourdais, S. Enouz-Vedrenne, J. Briatico, M. Bibes, A. Barthélémy, and Javier E. Villegas, Phys. Rev. Lett. 107, 247002 (2011).
[2] C. Visani, Z. Sefrioui, J. Tornos, C. León, J. Briatico, M. Bibes, A. Barthélémy, J. Santamaría and Javier E. Villegas, Nature Physics (2012), doi:10.1038/nphys2318.
[3] M. Eschrig, Phys. Today 64, 43 (2011).

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