CONTRATOS PREDOCTORALES 2020 SEVERO OCHOA

PROJECT TITLE / JOB POSITION TITLE:

Spintronics based on oxide quantum wells

RESEARCH PROJECT / RESEARCH GROUP DESCRIPTION:
(2.000 characters – including spaces)

Spin-charge conversion paves the way to devices that exploit the spin of carriers instead of their charge. In this regard, $LaAlO_3/SrTiO_3$ quantum wells (QWs) are promising materials for spintronics, where spin-charge conversion can be tuned by electrostatic gating. Over the years, the host laboratory has investigated the properties of these QWs, including 2D superconductivity, Rashba spin-orbit fields and lattice vibrational modes [see selected References 1-5 below]. For instance, we have observed, for a first time, a multi-condensate superconductor tunable by electrostatic gating, published recently in Nature Materials [4]. Importantly for the scope of the present project, the host lab has researched on the gate tunability of the Rashba spin-orbit coupling and of 2D-superconductivity [2], which provides a firm background for the attainment of the objectives of the present project. One of our latest results is related to an unusual photoresponse at the $LaAlO_3/SrTiO_3$ QWs [5], which opens the way to optical control of the generated spin currents by optical means, enhancing the functionality of the spintronic devices (i.e., control by electrostatic gating + optical pumping).

Our project aims at generating spin currents in multifunctional nanodevices, where spin generation is controlled by electrostatic gating and optical pulses. Specific objectives are:

(a) Spin-charge conversion efficiency and its modulation with light.
(b) Unconventional 2D superconductivity with enhanced spin diffusion lengths (superconductive spintronics)

The student will be supervised by Dr. Gervasi Herranz, whose activity can be reached through the Researcher ID: G-2770-2014, https://orcid.org/0000-0003-4633-4367 or Google Scholar.

[1] Pesquera et al., Physical Review Letters 2014.
[2] Herranz et al., Nature Communications 2015.
[3] Gazquez et al., Physical Review Letters 2017.
[4] G. Singh et al., Nature Materials (2019).
[5] Y. Chen et al. Physical Review Letters (2020)

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JOB POSITION DESCRIPTION:
(2.000 characters – including spaces)
Include all the relevant information about the position, role, responsibilities and skills required within the project/group

All required infrastructure and equipment is found at the host Institution and its immediate environment. In particular, the successful candidate will be trained in materials synthesis and nanodevice fabrication. This involves growth of thin films (nanometer scale) by pulsed laser deposition with in-situ RHEED, and access to the ICMAB clean room for device fabrication down to 100 nm and below, using optical and electron-beam lithography. The host group has also an extended experience in measuring electrical transport under magnetic fields, required to measure the Rashba-Edelstein and spin-Hall effects necessary to evaluate the spintronic properties of the devices. Two Quantum Design MPMS-XL systems are available and make possible to characterize the magnetic properties of a certain material under well-controlled conditions of applied magnetic field and temperature. Well-established collaborations (ESPIC-ParisTech, France) will allow measurements at millikelvin temperatures to study superconductivity. The candidate will have full access to our optical lab to perform optical control of the quantum wells. Over the last years, the host group has developed its own infrastructure for optical spectroscopy and imaging. The lab includes a confocal microscope that allows diffraction-limited lateral resolution (a few hundreds of nanometers). Advanced Scanning Transmission Electron Microscopy (STEM) will be also used to study the relationship between atomic and the electronic structure.

The supervisor of the project will provide all the necessary means for the successful candidate to attend schools and relevant international scientific meetings and workshops. Candidates should be fluent in English, with a background in solid state physics. Programming and mathematical skills as well as enthusiasm for Science are more than welcome.

GROUP LEADER:

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RELATED LINKS TO THE POSITION (optional)
URL: https://gervasi-herranz.blog

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