PCSI
Room Redondo - Session PCSI-TuE

Spin Transport and Spintronics
Moderator: Scott Crooker, Los Alamos National Laboratory

7:30pm **PCSI-TuE-1 Proximitized Materials: From Spintronics to Majorana States*, Igor Zutic,*** University at Buffalo-SUNY **INVITED**

Advances in scaling down heterostructures and atomically-thin two-dimensional (2D) materials suggest a novel approach to systematically design materials as well as to realize exotic states of matter. A given material can be transformed through proximity effects [1] whereby it acquires properties of its neighbors, for example, becoming superconducting, magnetic, topologically nontrivial, or with an enhanced spin-orbit coupling. Such proximity effects not only complement the conventional methods of designing materials by doping or functionalization, but can also overcome their various limitations. In proximitized materials it is possible to realize properties that are not present in any constituent region of the considered heterostructure. Unlike the superconducting proximity, which could exceed mm, other proximity effects extend over only several nm. After some background on proximity effects, we discuss implications of magnetism leaking into initially a non-magnetic region [1-3]. We show that gate-tunable band topology allows helicity reversal of the emitted light [4] and novel paths to spin-lasers [5]. Motivated by the search for elusive spin-triplet topological superconductivity hosting Majorana states, which are considered for fault-tolerant quantum computing, we explain the importance of proximity effects. Instead of epitaxially-defined, topological nanostructures could be designed using magnetic textures and combining magnetic and superconducting proximity effects in 2D systems [6]. Measurements of proximity-induced topological superconductivity in planar Josephson junctions [7] provide novel opportunities for controlling Majorana states [8].

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[3] B. Scharf et al., Phys. Rev. Lett. 119, 127403 (2017).
[4] G. Xu et al., Phys. Rev. Lett. 125, 157402 (2020).
[5] M. Lindemann et al., Nature 568, 212 (2019).
[6] G. L. Fatin et al., Phys. Rev. Lett. 117, 077002 (2016).
[7] M. C. Dartiailh et el., Phys. Rev. Lett. 126, 036802 (2021).

[8] T. Zhou et al., Nat. Commun. 13, 1738 (2022).

8:10pm **PCSI-TuE-9 Spin/Valley Pumping and Long-Distance Spin Transport in Monolayer TMD Semiconductors*, Cedric Robert,*** LPCNO, CNRS INSA Toulouse, France **INVITED**

Monolayers of transition metal dichalcogenides (TMD) are ideal semiconductor materials to control both spin and valley degrees of freedom either electrically or optically. Nevertheless, optical excitation mostly generates excitons species with inherently short lifetime and spin/valley relaxation time. In this presentation we will show that we can strongly polarize (up to 75%) the resident electrons in n-doped WSe_2 and WS_2 monolayers by using a circularly polarized continuous wave laser [1]. Then, using a spatially-resolved optical pump-probe experiment (see Figure 1), we measure the lateral transport of spin/valley polarized electrons over very long distances (tens of micrometers) [2]. These results highlight the key role played by the spin-valley locking effect in TMD monolayers on the pumping efficiency and the polarized electron transport.

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