Aachen
Graphene &
2D-Materials
Center

Aachen-Graphene Flagship-Seminar

January 21, 2020

at the Physikzentrum Melaten

12:00 in 28A301

Spin-orbit proximity phenomena and tunable spin-to-charge conversion in graphene

Sergio O. Valenzuela

Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona Spain

Graphene has emerged as a centrepiece for future spintronics, owing to its tunable electronic properties and ability to transport spin information over very long distances [1]. For active devices, however, spin manipulation remains an open challenge. Such a challenge can be resolved with spin-orbit coupling (SOC) induced by proximity effects. Here, I will present our recent results regarding spin dynamics in graphene-based van der Waals heterostructures. In the first part, I will review the microscopic mechanisms that influence the spin propagation in pristine graphene, including the presence of hot carriers [2]. In the second part, I will discuss our recent experiments on proximity-induced SOC and spin-to-charge conversion in stacks of graphene and transition metal dichalcogenides (TMDC) and in graphene in contact with metals such as Pt [3,4]. I will show that key information can be obtained from the spin-lifetime anisotropy, as it is determined by the preferential direction of the spin-orbit fields that cause the spin relaxation. Even though the spin-lifetime in graphene on SiO_x is isotropic, it becomes strongly anisotropic in bilayers comprising graphene and a TMDC, even at room temperature [3]. Indeed, it varies over one order of magnitude depending on the spin orientation and is largest for spins point out of the graphene plane. This suggests that the strong spin-valley coupling in the TMDC is imprinted in graphene and felt by propagating spins, a phenomenon that also lead to an enhanced spin-to-charge interconversion efficiency [4,5].

[1] M. Drögeler et al., Nano Lett. 16 (2016) 3533; Z. M. Gebeyehu et al., 2D Mater. 6 (2019) 034003.
[2] J. F. Sierra et al., Nature Nanotech. 13 (2018) 107.
[3] L. A. Benítez et al., Nature Phys. 14 (2018) 303; A. W. Cummings et al., Phys. Rev Lett. 119 (2017) 206601.
[4] W. Savero Torres et al, 2D Mater. 4 (2017) 041008.
[5] L. A. Benítez, W. Savero Torres et al., Nature Mater. (2020) doi:10.1038/s41563-019-0575-1

AMO

RWTH AACHEN UNIVERSITY