DEPARTAMENTO DE FÍSICA FUNDAMENTAL

Spin-orbit and spin-heat coupling effects in graphene

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Two-dimensional spintronics is frequently associated to new paradigms for data storage and computing. However, its progress is heavily dependent on functional materials exhibiting properties such as high spin polarization, spin filtering, spin coherence and large spin-orbit coupling [1]. A prime example is graphene, where spins can flow snugly through its crystal lattice due to low intrinsic spin-orbit coupling but at the same time making difficult to manipulate spins, which is the major drawback for successfully implementing spin devices based on graphene. Recent technical advances have promoted the fabrication of complex 2D systems. Van der Waals heterostructures are new class of artificial materials in which materials assembled on top of each other interact through proximity effects generating new functionalities. In this talk I will first present a series of experiments where we study spin dynamics in graphene/transition metal dichalcogenides (TMDC) van der Waals heterostructures [2]. I will show how modification of the graphene spin-valley coupling via proximity effect with the TMDC results in anisotropic spin dynamics. In addition, I will show how proximity-induced SOC in these heterostructures results in for spin-to charge conversion through the spin Hall effect and the (inverse) spin galvanic effect with unprecedented tunability at room temperature. Finally, I will discuss the interaction of spin and heat currents in pristine graphene and how spin propagation can be reinforced by the presence of thermal gradients arising from hot carriers [4, 5].

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