Quantum transport simulations of graphene non-local spin valves

Marc Vila[1,2]
Christoph W. Groth[3], Aron W. Cummings[1], Stephen R. Power[1,2] Xavier Waintal[3], Stephan Roche[1,4]

[1]Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and The Barcelona Institute of Science and Technology, Campus UAB, Bellaterra, 08193 Barcelona, Spain
[2]Universitat Autònoma de Barcelona, Campus UAB, Bellaterra, 0819 Barcelona, Spain
[3]CEA-INAC/UJF Grenoble 1, SPSMS UMR-E 9001, Grenoble 38054, France
[4]ICREA, Institució Catalana de Recerca i Estudis Avançats, 08070 Barcelona, Spain

marc.vila@icn2.cat

Graphene is a promising platform for transporting spin information due to its high carrier mobility and low intrinsic spin-orbit coupling. State-of-the art devices have already demonstrated room temperature long spin lifetimes of several nanoseconds and spin diffusion lengths up to a few tens of μm [1]. The spin relaxation mechanisms have been founded to be strongly monitored by spin-pseudospin entanglement and dephasing effects [2]. The next challenge is to be able to manipulate and control spin signals to engineer active spintronics and hence envision complex graphene-based, non-charged-based devices [3]. Placing graphene on top of ferromagnetic insulators or transition metal dichalcogenides (TMDC) is a promising route to induce, by proximity effect, magnetism or strong spin-orbit coupling (SOC) in graphene while conserving the excellent electronic properties.

In this work, common experimental devices to measure spin-related properties, such as Hanle non-local spin valves (Figure 1)[4], are simulated in graphene within the Landauer-Büttiker formalism using the Kwant python package [5]. Such software is capable of simulating Hanle setups using fully coherent quantum transport. Comparison and discussion with available experimental data are presented for different graphene systems as well as computing local properties like (spin) currents and local density of states. In this way, a more microscopic picture of the spin-dynamics in graphene is obtained [6].

References

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Figures

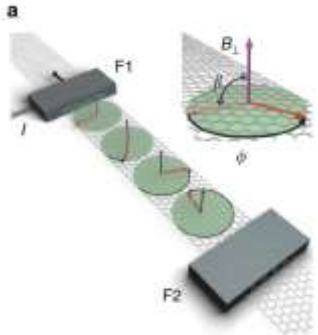

Figure 1: Schematics of the spin precession in a non-local Hanle measurement. Figure extracted from ref. 4.