Joint CQSE and CASTS Seminar

Weekly Seminar
May 6, 2016 (Friday)

TIME May 6, 2016, 14:30 ~ 15:30
TITLE The Rise of the Spin Current in Graphene
SPEAKER Prof. Miguel A. Cazalilla
Department of Physics, National Tsing Hua University
PLACE Rm716, CCMS & New Physics Building, NTU

Abstract

Graphene is a wonder material that is one carbon-atom thick and has attracted much attention in recent years due to its excellent electrical and mechanical properties. In recent years, it has been also the focus of much research in the field of spintronics. Due to the lightness of carbon, spin orbit coupling (SOC) in this material is believed to be rather weak, which translates into rather long spin diffusion lengths, as it has been observed experimentally. Therefore, this material has been proposed as a good candidate material for passive spintronics, which requires the spin currents to be generated by a different material.

In this colloquium, I shall review the recent theoretical and experimental progress in the field of active graphene spintronics. I will describe how this material, when decorated with various kinds of adatoms, is found to exhibit a sizable spin Hall effect (SHE). The physical mechanisms for the enhancement of the SOC and SHE will be discussed, as well as the effects of the application of finite frequency and wave vector electric fields. Finally, we shall discuss a theory that fully accounts for the quantum spin coherence of the carriers and therefore can describe the various spin relaxation mechanisms due to scattering with impurities. In addition, our theory describes a new contribution to the current-induced spin polarization (also known as inverse galvanic effect), which results from the quantum mechanical interference of the spin flip and the skew scattering mechanisms. The new mechanism leads to a direct coupling between the charge current and the spin polarization, which can have also important applications for all graphene spintronic devices and can be also present in other anisotropic and/or low-dimensional materials.