Séminaire – Vendredi 4 Juillet 2014 (11h)

Prof. Carsten Ullrich
Université de Missouri-Columbia, USA

Salle de Réunion – Bâtiment 411

Giant collective spin-orbit field in quantum wells: fine structure of spin plasmons

Spin-orbit (SO) coupling is a relativistic quantum mechanical effect which contributes to the fine structure splitting of atomic spectral lines. In extended solids, SO coupling causes many important phenomena which can be quite different from the atomic case. For instance, itinerant electrons in doped semiconductors have a distribution of momenta, and each electronic spin precesses in its own momentum-dependent SO field (leading to the D'yakonov-Perel' dephasing of nonequilibrium spin distributions). However, many-body effects can lead to a striking collective reorganization of the SO fields, causing an electronic behavior like in a macroscopic quantum object. Intersubband spin plasmons in quantum wells are subject to a giant collective SO field that splits the spin-plasmon spectrum into a triplet. This theoretically predicted effect [1] is experimentally verified [2] using inelastic light scattering in the presence of magnetic fields for an asymmetrically doped GaAs quantum well. We also demonstrate the same effect for spin waves in a CdMnTe quantum well [3]. These results provide a powerful indication that these constructive phenomena are universal to collective spin excitations of conducting systems. We also demonstrate that an important contribution to spin plasmon damping is given by the spin Coulomb drag effect [4]. This work is supported by DOE grant DE-FG02-05ER46213.

[1] C. A. Ullrich and M. E. Flatte, Phys. Rev. B 66, 205305 (2002); ibid. 68, 235310 (2003)
[2] F. Baboux, F. Perez, C. A. Ullrich, I. D'Amico, J. Gomez, and M. Bernard, Phys. Rev. Lett. 109, 166401 (2012)
[3] F. Baboux, F. Perez, C. A. Ullrich, I. D'Amico, G. Karczewski, and T. Wojtowicz, Phys. Rev. B 87, 121303(R) (2013)
[4] I. D'Amico and C. A. Ullrich, Phys. Rev. B 88, 155324 (2013)