CEA – Saclay, 91191 Gif-sur-Yvette Cedex
Service de Physique de l'Etat Condensé - UMR 3680

SÉMINAIRE

Mercredi 24 octobre 2018 à 11h15

Orme des Merisiers SPEC, Salle Itzykson, Bât.774

Romain LEBRUN - *Johannes Gutenberg University*

TUNABLE LONG-DISTANCE SPIN-TRANSPORT MECHANISMS IN ANTIFERROMAGNETIC INSULATORS

Spintronics has as the long-term goal to use spins, the intrinsic angular momentum of electrons, as an alternative to the electron charge in the development of beyond-Moore, low-dissipation and fast information devices. Despite several big successes, real spintronic devices utilising ferromagnetic materials and spin-polarised charge currents have a number of drawbacks to achieve these objectives. Theoretically, it was predicted that pure spin currents could be generated, transported and employed in antiferromagnetic insulators to enable such new devices1–3. In contrast to ferromagnets, antiferromagnets benefit from unparalleled stability with respect to applied external fields, a lack of long-range dipole-dipole interaction leading to possible high integration densities, and can be operated at terahertz-scale frequencies4.
However, while fundamentally their properties bode well for spin transport, previous indirect observations indicated that spin transmission in antiferromagnets is limited to short distances of a few nanometers5,6. In this talk, I will show that antiferromagnetic magnons can efficiently propagate at room temperature in an easy-axis antiferromagnet with low magnetic damping. In the prototypical insulating antiferromagnet hematite (α-Fe2O3), spin information parallel to the compensated moment n (Néel order) can propagate over distances exceeding tens of micrometers in single crystals7 and in high quality epitaxial thin films. Exploiting the spin Hall effect for spin injection8, one can control the spin current flow through the interfacial spin-bias and by tuning the antiferromagnetic resonance frequency with an external magnetic field. This newly-observed mechanism transports spin as efficiently as the net magnetic moments in the best-suited complex ferromagnets9. Hence, these results pave the way to ultra-fast, low-power antiferromagnet-insulator-based spin-logic devices operating at room temperature and even in the absence of magnetic fields.

1. *Gomonay, E. V. et al. Spintronics of antiferromagnetic systems (Review Article). Low Temp. Phys. 40, 17–35 (2014).*
2. *Jungwirth, T. et al. Antiferromagnetic spintronics. Nat. Nanotechnol. 11, 231–241 (2016).*
3. *MacDonald, A. H. et al. M. Antiferromagnetic metal spintronics. Philos. Trans. R. Soc. Math. Phys. Eng. Sci. 369, 3098–3114 (2011).*
4. *Kimel, A. V. et al. Inertia-driven spin switching in antiferromagnets. Nat. Phys. 5, 727–731 (2009).*
5. *Wang, H. et al. Spin transport in antiferromagnetic insulators mediated by magnetic correlations. Phys. Rev. B 91, 220410 (2015).*
6. *Hahn, C. et al. Conduction of spin currents through insulating antiferromagnetic oxides. EPL Europhys. Lett. 108, 57005 (2014).*
7. *Lebrun, R. et al. Tunable long-distance spin transport in a crystalline antiferromagnetic iron oxide. Nature 561, 222 (2018).*
8. *Bender, S. A. et al. Enhanced Spin Conductance of a Thin-Film Insulating Antiferromagnet. Phys. Rev. Lett. 119, 056804 (2017).*
9. *Cornelissen, L. J. et al. Long-distance transport of magnon spin information in a magnetic insulator at room temperature. Nat. Phys. 11, 1022-1026 (2015).*

A coffee break will be served at 11h00. The seminar will be given in English.

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