Laser Seminar
Wednesday, July 12, 2017

Time 16.45

Location ETH Zurich, Hönggerberg, HPF G6

Speaker Davide Bossini, Institute for Photon Science and Technology, Graduate School of Science, University of Tokyo, Japan

Title Femtosecond quantum spin dynamics at the edges of the Brillouin zone in antiferromagnets

Abstract The investigation of the interaction between femtosecond laser pulses and magnetic materials has already revealed the tremendous potential of this approach for the ultrafast manipulation of spins[1,2]. In particular, the all-optical control of the magnetic order in antiferromagnets has become relevant, given the recent surge of interest in this class of materials for spintronics purposes. The peculiarity of laser pulses, when compared to other stimuli, consists in the possibility to excite, manipulate and detect spin excitations on the femtosecond timescale which meets the requirement for ever-faster approaches to the control of magnets. However, the collective spin excitations photoinduced hitherto in antiferromagnets are limited to low-wavevector magnons, which are the lowest-frequency modes in the dispersion of a typical antiferromagnet[1,3-5]. Recently the highest-frequency modes, which are magnons with wavevector near the edges of the Brillouin zone, have been impulsively photo-excited via a coherent light-scattering approach[6]. Remarkably, a complete manipulation of the phase and amplitude of coherent magnons with frequency equal to 22 THz and 1 nm wavelength (i.e. *femto-nanomagnons*) was achieved[6]. Even more excitingly, further investigation of the femto-nanomagnonics regime demonstrated that it has little in common with the conventional spin dynamics triggered by nearly-zero-wavevector magnons. The classical thermodynamic concepts commonly employed in the description of magnetic dynamics critically do not hold in this newly discovered regime. This observation called for the development of a novel theoretical quantum-mechanical framework, based on magnonic coherent states. A proper equation of motion was derived within our model; in addition some intruiging predictions of our formalism suggest that the photo-generated magnons are intrinsically entangled[7].

References:

[1] D. Bossini et al., ACS Photonics 3, 1385 (2016).
[2] A. Kirilyuk, A. V. Kimel and Th. Rasing, Rev. Mod. Phys. 82, 2731 (2010).
[3] D. Bossini et al. PRB 89, 060405 (R) (2014).
[4] S. Baierl et al. PRL 117, 197201. (2016).
[5] T. Satoh et al. PRL 105, 077402 (2010).
[6] D. Bossini et al. Nat. Commun. 7, 10645 (2016).
[7] D. Bossini et al. *in preparation*.

Host Steve Johnson, Ultrafast Dynamics, IQE

More Info http://www.fastlab.ethz.ch/laser-seminar.html

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