Laboratoire des Solides Irradiés, UMR 7642

Séminaire Invité

Nicholas KIOUSSIS

W. M. Keck Computational Materials Theory Center, California State Univ. Northridge,USA

Mercredi 18 janvier - 11H00

Salle 2034 – Bâtiment 83

10h30

Electric Field and Strain Control of Magnetism: Towards Ultralow Energy Memory Devices

Electric field induced switching of magnetism, as opposed to current-driven spin transfer torque magnetization switching, can lead to a new paradigm enabling ultra-low power, highly scalable, and nonvolatile magnetoelectric random access memory (MeRAM). To date the realization of MeRAM relies primarily on ferromagnetic (FM) based heterostructures. On the other hand, antiferromagnetic (AFM) materials, with staggered magnetic order accompanied by a zero net magnetic moment, have been revisited as potential candidates for active elements in spintronic devices. Recent experiments on FeRh thin films grown epitaxially on MgO and $BaTiO_3$ substrates demonstrated spin reorientation across the AFM-FM phase transition and isothermal electric field control of the magnetic phase transition driven via tetragonal piezoelectric strain, respectively. These results raise the intriguing question of the effect of tetragonal strain on tuning the interplay between FM and AFM spin correlations and hence the stability of the FeRh phases. In the first part of my talk I will show that tetragonal distortion has a dramatic effect on the relative stability of the various magnetic structures of FeRh giving rise to a wide range of novel stable/metastable structures and magnetic phase transitions. The novel magnetic phase transitions open interesting prospects for exploiting strain engineering for the next-generation memory devices. In the second part of my talk I will present results of manipulation of the magnetization direction of ultrathin FeRh/insulator bilayers in the AFM or FM phase by purely electric field means (rather than E-field induced strain). I will show an E-field *magnetization switching* with *giant* voltage controlled magnetic anisotropy efficiency and a spin reorientation across the metamagnetic transition.