Study of strongly correlated electron systems by X-ray magnetic scattering with polarization control

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The advent of synchrotron radiation and optical elements for polarization control has opened the way to the full use of X-ray magnetic scattering techniques. Intrinsic properties of synchrotron radiation like the energy tunability and the high degree of polarization of X-rays are fundamental for studying charge, orbital and magnetic properties of materials. Since microscopic magnetism arises from the unpairing of electrons on their electronic band structure, X-rays as an electronic probe is also a probe to magnetic properties, especially in a microscopic scale with small samples and high Q resolution and with chemical and electronic site specificity. Polarisation effects are difficult to observe in the X-ray range because the complex refractive index is close to unity. Nevertheless they could be observed close to the absorption edges where they are enhanced by resonant effects [1]. These enhanced effects could be observed in scattering and absorption experiments giving rise to new techniques as X-ray resonant magnetic scattering [2] and X-ray magnetic dichroism. The resonant exchange scattering technique gives spectroscopic information with the unique feature of being a coherent elastic-scattering process with no complicated final-state effects. In this presentation we are going to revise the application of this recent and powerful technique to explore the intricate connection between charge, orbital and magnetic ordering in magnetic materials. In particular we investigated the magnetic structure of Sm_2IrIn_8 by X-ray magnetic scattering with polarization analysis [3]. The experiments were performed on the 4-ID-D at the Advanced Photon Source (APS), and ID-20 beamline at the European Synchrotron Radiation Facility (ESRF). Below T_N = 14.2 K, additional ((2n+1)/2, k, l) reflections were observed (with n, k, l integers). Such peaks were dramatically enhanced at the Sm L_{II} and L_{III} edges, at E= 7313 and 6716 eV respectively, due to resonant effects. All these properties of the superstructure reflections are consistent with an antiferromagnetic (AFM) structure with a wave vector $\tau = (1/2,0,0)$. The direction of the magnetic moment was determined as lying in the ab plane and rotated by about 18 degrees by performing an azimuthal dependence at the dipolar resonant peak. Results of the effect of a 10 T field on the magnetic structure will be also described.

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