The European School on Magnetism 2017

<u>Magnetic diffraction with neutrons, non-resonant and resonant X-ray scattering.</u>

Laurent Chapon, Diamond Light Source, United Kingdom.

I will review the scattering techniques that can be used to determine magnetic structures in crystals and thin films (and polycrystalline samples in the case of neutron scattering). I will describe how to derive the elastic neutron scattering cross sections first for non-polarised and then using polarized beams[1][2] and discuss the key findings, such as selection rules, the sensitivity of the technique to spin and orbital momentum. I will then describe the elastic scattering cross sections in the case of non-resonant X-ray scattering [3], [4] and in resonant conditions [5] and compare the information derived to that obtained with neutron scattering . I will show many examples of magnetic structures recently determined by neutron or X-ray scattering, or using the combination of both techniques. Among others, I will show examples of complex non-collinear structures determined using these techniques, experiments under magnetic and electric field and stress and the use of X-ray micro-diffraction to probe a single domain or to perform topographic scans of domains.

[1]   S. W. Lovesey, "Theory of Neutron Scattering from Condensed Matter," *Oxford Univ. Press*, p. Vol. 1 and 2, 1984.

[2]   G. L. Squires, "Nuclear scattering - basic theory," in *Introduction to the Theory of Thermal Neutron Scattering*, Dover Publications (1997).

[3]   M. Blume and D. Gibbs, "Polarization dependence of magnetic x-ray scattering," Phys. Rev. B **37**, 1779 (1988).

[4]   F. de Bergevin, M. Brunel, and IUCr, "Diffraction of X-rays by magnetic materials. I. General formulae and measurements on ferro- and ferrimagnetic compounds," *Acta Crystallogr. Sect. A*, vol. 37, no. 3, pp. 314–324, (1981)

[5]   J. P. Hill and D. F. McMorrow, "X-ray resonant exchange scattering: polarization dependence and correlation functions," *Acta Crystallogr.*, vol. A52, pp. 236–244 (1996).