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Unravelling complex ordering phenomena with polarised x-rays

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A key feature of the synchrotron light that helps us to unravel the properties of the materials is the ability to generate, control and analyse the polarisation of the photons in a wide energy range [1,2,3]
This feature of the synchrotron beam offers the opportunity to enhance different element of the light-matter cross section and to apply it to a variety of synchrotron-based techniques exploring materials at different lengths and energy scales.

The dominant term in the x-ray diffraction cross section do not modify the polarization of the scattered photons, however in resonant condition or when a more comprehensive model of the scattering process is used, the light-matter cross section can modify in a well-defined manner the polarisation state of the diffracted photon and an analysis of the final polarisation state of the diffracted photons can be used to distinguish different scattering processes, and to access different physical properties of the system under investigation [4].

For this reason, the x-ray polarisation is often used to investigate ordering phenomena, to solve magnetic structures [5,6], to establish their chirality [6], and, when combined with the spatial resolution capability of the synchrotron beam, to map different types of domains [7,8], the same approach can be readily transferred to the study of excitations, where energy and momentum are transferred [9].

In the same manner the photoelectron emitted using polarised light can be used to investigate topological magnetic textures and domain patterns in few nanometres of quantum materials[8] complementing the spatial resolution achievable with diffraction.
In this seminar I will introduce the polarisation of the light in relation to the investigation of chirality and non-collinearity and I will discuss the opportunities offered by this property.

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