Department of Physics
Condensed Matter Physics
Clarendon Laboratory, Parks Road, Oxford OX1 3PU

UNIVERSITY OF OXFORD

CONDENSED MATTER SEMINAR

Thursday 8th of June at 2.15pm

"Soft x-ray (coherent) scattering for magnetic studies"

Dr. Nicolas Jaouen
SEXTANTS beamline, Synchrotron SOLEIL, France

Many current forthcoming applications of magnetic materials involve heterostructures or alloys containing magnetic and non-magnetic elements. X-ray Resonant (Coherent) Scattering is the technique of choice to probe such phenomena thanks to its element-selectivity and spatial sensitivity.

In this presentation I will introduce the experimental set-up that we developed at SOLEIL and illustrate their capabilities. SEXTANTS [1] is a beamline of the SOLEIL synchrotron, covering the 50-1700eV energy range dedicated to soft x-ray scattering. The resolving power exceeds 10^4 and maximum flux on the sample ranges from 1×10^{14} (100 eV) to 2×10^{13} (1000 eV) ph./s/0.1% bw. The beamline main objective is the investigation of the electronic and magnetic properties of solids using three scattering techniques: resonant inelastic x-ray scattering (RIXS), x-ray resonant magnetic scattering (XRMS) and coherent x-ray scattering (CXS), the last one including also imaging via Fourier transform holography (FTH) [2]. Several recent results obtained at SEXTANTS beamline will be presented illustrating its capability to probe and image magnetic materials with element selectivity and few tens of nanometer spatial resolution using soft x-ray scattering.

In the second part of my presentation I will report on recent result [3] we obtained a time resolved XRMR (X-ray Magnetic Reflectivity) experiment on a prototype ferromagnetic Ni thin film at the FEMTOSPEX beamline at BESSY II. I will show how we can extract simultaneously sub picosecond in-depth spatially resolved magnetization profile and the film thickness using the formalism described in [4]. Extending our simulations to larger incidence angles and better energy resolution we show that time resolved XRMR, thanks to its in depth sensitivity, can be employed to discriminate experimentally between currently discussed models describing the ultrafast demagnetization phenomenon. Our study thus paves the way for future time resolved XRMR experiments at X-ray Free Electron Laser facilities, which provide the photon flux and energy resolution necessary to access the required X-ray incidence angles.

[1] M. Sacchi et al., Journal of Physics: Conference Series 425 (2013) 072018
[2] S. Eisebitt et al., Nature, 432, 885 (2004).
[3] E. Jal et al., Phys Rev B. 2017, 95: art.n° 184422
[4] M. Elzo, et al., Journal of Magnetism and Magnetic Materials 324, 105 (2012).

Host: Prof Thorsten Hesjedal
Audrey Wood Seminar Room, Clarendon Laboratory