Soft x-ray coherent magnetic scattering experiments

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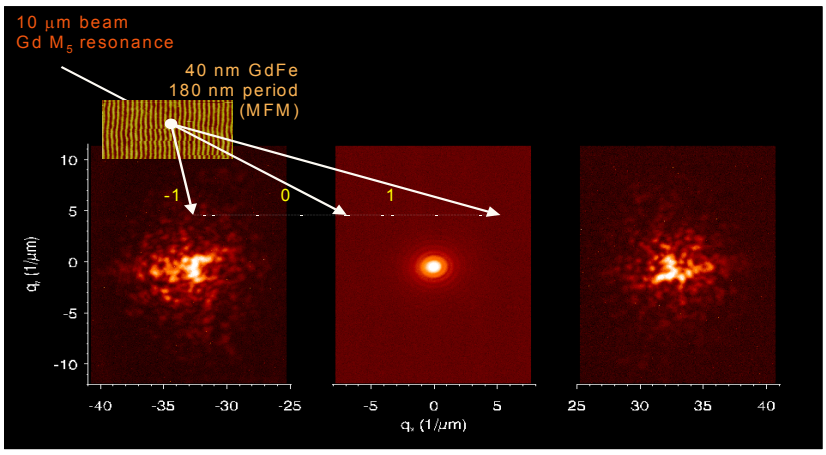
The increased coherence of third generation synchrotron sources allows us to port laser techniques such as holography and dynamical light scattering from the visible to the x-ray spectral range. In addition to the obvious improvement in resolution, the x-ray range may allow for new variants that are not possible in the visible, as exemplified by techniques that use the strong magnetic contrast at soft x-ray resonances.
In this talk I will report on soft x-ray coherent magnetic scattering experiments performed on stripe magnetic domain systems as occurring in amorphous GdFe thin films with perpendicular anisotropy. This system was chosen in order to have maximum magnetic contrast, negligible charge scattering and minor multiple scattering.
These experiments were performed at the ESRF on a spectroscopy beam line using a phosphor screen + visible CCD detector. A careful Kramers Kronig analysis of the magnetic cross section was made at both the Gd M_5 and the Fe L_3 resonances, which matches experimentally observed scattering cross sections remarkably well and is in agreement with atomic calculations.
Despite non-ideal conditions we were able to obtain very high resolution speckle patterns both of ordered and disordered stripe systems from which the local magnetic correlation function can be obtained straightforwardly. Attempts at speckle inversion of these data have been foiled by lack of q-range.



We will discuss the field and energy dependence of the speckle patterns. We show that the scattered intensity in our experiment do not show energy-dependent anomalous interference between the magnetic and charge scattering contributions.
Finally, first attempts at critical scattering at the Gd M_5 edge of epitaxial Gd (0001) layers on W are reported. Despite mK temperature resolution and stability no such scattering could be observed, explainable by sample imperfections, lack of sufficient flux and detector insensitivity.