Critical magnetic fluctuations measured in the time domain with coherent x-rays

Jeroen Goedkoop[1], Christian Schüßler-Langeheine[2], Holger Ott[2], Eugen Weschke[3], Enrico Schierle[3], ***Stan Konings***[1]
[1]University of Amsterdam, [2]University of Cologne, [3]Free University Berlin

In recent experiments the magnetic structures of thin holmium films of various thicknesses have been characterized with x-ray resonant magnetic scattering at the holmium M_{45} resonance. Over a 15-20 K wide temperature interval around the magnetic phase transition, the magnetic superstructure peak was found to display critical broadening, with signs of a crossover from three to two-dimensional behavior. In experiments performed at the Berlin synchrotron BESSY we directly measured the magnetic fluctuations that arise at this phase transition by applying x-ray photon correlation spectroscopy (XPCS). By filming the speckle pattern with a CCD detector, we can directly observe this magnetic phase transition, as a change from static at low temperature to dynamic speckle at higher temperature. The observation of a static speckle pattern on top of the dynamic speckle shows that the system is non-ergodic and pinned to the defect structure of the film. With this study we proof the feasibility of resonant XPCS to address the low-frequency dynamics of sub-micron magnetic correlations.