Ultrafast magnetic X-ray scattering

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The structure and dynamics of magnetic nanosystems is of both, fundamental and technological interest. Ideally, one would like to probe magnetisation dynamics on a time scale of 100 femtoseconds (fs), with nanometre spatial resolution, while being able to do the measurements element-specifically in order to account for the complex composition of actual magnetic media. Storage ring sources provide us with the necessary structural information while ultrafast magnetic scattering experiments require flashes of resonantly tuned soft X-rays that can be anticipated given the current construction of X-ray free-electron lasers (FEL) in Stanford, CA, Hyogo, Japan and Hamburg, Germany. The FLASH facility in Hamburg already provides uniquely intense coherent short pulses in the EUV energy range with the shortest fundamental wavelength λ=6.1 nm. Using the fundamental wavelength λ=7.97 nm it was possible to detect the fifth harmonic at 1.59 nm with an average energy of 3.5 nJ. This wavelength corresponds to the Co L_3 absorption edge and enabled us to perform the first resonant magnetic scattering experiment using FEL pulses of about 20 fs duration.