

Sharpening spectral resolution and polarization purity of hard x-rays at the ESRF-EBS

Ralf Röhlsberger

Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg

High-purity polarimetry with hard x-rays based on crossed polarizers has a long history after the pioneering work by Hart and Siddons et al. [1]. The method has a great potential to detect tiny anisotropies in condensed matter via dichroism and birefringence in the vicinity of atomic and nuclear resonances. Its efficiency and sensitivity increases dramatically with decreasing emittance of the x-ray source (for a recent analysis and review see [2]). This is evidenced by an increasing number of applications at modern synchrotron radiation sources [3-7]. For that reason, the ESRF-EBS will provide another boost to further applications of this technique. In this talk I will highlight a few prominent examples in that direction, including the realization of μeV -resolved inelastic x-ray scattering [8,9] and high-resolution studies of spin waves [10].

References

- [1] M. Hart et al., Tunable x-ray polarimeters for synchrotron radiation sources, *Rev. Sci. Instrum* **62**, 2540 (1991); D. P. Siddons et al., X-ray optical activity and the Faraday effect in Cobalt and its compounds, *Phys. Rev. Lett.* **64**, 1967 (1990).
- [2] K. S. Schulze, Fundamental limits of the polarization purity of x rays, *APL Photonics* **3**, 126106 (2018).
- [3] T. S. Toellner, E. E. Alp, W. Sturhahn, T. Mooney, Polarizer/analyzer filter for nuclear resonant scattering of synchrotron radiation, *Appl. Phys. Lett.* **67**, 1993 (1995).
- [4] E. E. Alp, W. Sturhahn, T. S. Toellner, Polarizer-analyzer optics, *Hyperfine Interact.* **125**, 45 (2000)
- [5] B. Marx, K. S. Schulze, I. Uschmann, T. Kämpfer, R. Loetzsch, O. Wehrhan, W. Wagner, C. Detlefs, T. Roth, J. Härtwig, E. Förster, T. Stöhlker, and G. G. Paulus, High-precision x-ray polarimetry, *Phys. Rev. Lett.* **110**, 254801 (2013).
- [6] K. P. Heeg et al., Vacuum-assisted generation and control of atomic coherences at x-ray energies, *Phys. Rev. Lett.* **111**, 073601 (2013).
- [7] J. Haber et al., Collective strong coupling of X-rays and nuclei in a nuclear optical lattice, *Nature Photonics* **10**, 445 (2017).
- [8] R. Röhlsberger, E. Gerdau, R. Ruffer, W. Sturhahn, T. S. Toellner, A. I. Chumakov, E. E. Alp, X-ray optics for μeV -resolved spectroscopy, *Nucl. Instrum. Meth. A* **394**, 251 (1997).
- [9] R. Röhlsberger, E. E. Alp, E. Gerdau, O. Leupold, K. W. Quast, R. Ruffer, W. Sturhahn, T. S. Toellner, E. Burkel, Techniques for inelastic X-ray spectroscopy with μeV -resolution, *Physica B* **263** – **264**, 574 (1999).
- [10] R. Röhlsberger, Photon Polarization Precession Spectroscopy for High-Resolution Studies of Spin Waves, *Phys. Rev. Lett.* **112**, 117205 (2014).