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## X-Ray Beams with Orbital Angular Momentum: Resonant Scattering and Coherent Imaging

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The interaction of polarized light beams with magnetic materials defines the rich set of tools in magneto-optics, covering photon energies from infra-red to hard x-rays. Circular polarization imprints a well-defined handedness on the photon beam, associated with a spin angular momentum (SAM)  $\sigma = \pm 1$ . It remains less common to exploit the orbital angular momentum (OAM) of value  $L \in \mathbb{Z}$  carried by light vortices, i.e. by photon beams characterized by a helical wavefront determined by the azimuthal angular dependence of the electric field phase. Nonetheless, the use of OAM beams in the visible range has found important applications over the last three decades [1].

More recently, the generation of OAM beams at shorter wavelengths, from XUV to hard x-rays [2-7], is also finding an increasing number of applications, often based on extrapolations of previous work carried out in the visible range. For instance, as it happened for the SAM, it was shown that the handedness imposed by the OAM can be exploited to perform x-ray spectroscopic studies of magnetic materials [4] and of chiral molecules [5], and a recent ptychography study [6] showed that the attainable spatial resolution in the reconstructed XUV images increases with  $\ell$ .

We will review recent extensions of OAM beams from visible to shorter wavelengths, with focus on potential applications in element-selective x-ray spectroscopy and imaging at synchrotron and free-electron laser sources [7].

### REFERENCES

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