Orbital angular momentum in the x-ray region

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Waves carrying quantized orbital angular momentum have been demonstrated with sound waves, charged particles, and electromagnetic radiation spanning terahertz frequencies to the hard x-ray region. X-ray OAM experiments have yielded intriguing results unique to this part of the spectrum. We have generated x-ray OAM states of high topological charges using both refractive and diffractive optics [1], and are exploring their application to x-ray phase contrast microscopy, coherent diffraction, and magnetic dichroism [2]. Recently, it was found that Laguerre-Gauss modes are present in the harmonics radiated by circularly polarized undulators, opening the door to generation of intense x-ray OAM beams with free-electron lasers [3,4]. This talk discusses new results and some avenues for exploiting x-ray beams carrying OAM.

Calculated intensity for the circularly polarizing undulator at the Advanced Photon Source, at 50 m distance from the source, a magnetic deflection of $K = 2.77$, and 830 eV photon energy (2.5 nm-rad, 0.1% coupling).


