Diffraction of Optical Vortex from Undulator

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It has been theoretically shown that radiation from an electron in circular motion with a relativistic speed has vortex property. Electron motion in a helical undulator radiation may be regarded as combination of mildly relativistic circular motion and ultra-relativistic drift motion along the rotation axis which is identical with the undulator axis. Therefore, helical undulator radiation has vortex property such that the fundamental component is circularly polarized plane wave and the higher harmonics are circularly polarized but optical vortex with helical wavefront. When we apply undulator vortex radiation to some experiments, it is desirable to observe the helicity and the topological charge of the vortex beam at various position in the beam-line. It is well known that optical vortex shows interesting diffraction patterns for various apertures. We can get information on the vortex property from the diffraction patterns. Among these, diffraction from triangular aperture seemed most feasible for our purpose.

To make a systematic study on the triangular diffraction, we have prepared triangular aperture of several size. The experiment was carried out at BL1U of UVSOR-III storage ring. This beam-line equipped with APPLE-II type undulator. By setting it in the helical mode with the fundamental wavelength at 710nm, the second harmonic radiation at 355 nm was extracted to the air. By using conventional CCD Camera, we made observation on the diffraction pattern. Some of the results are shown in Figure 1. We succeeded in observing the characteristic pattern which shows the helicity and the topological charge. Some more details on the experimental results will be presented in the symposium.

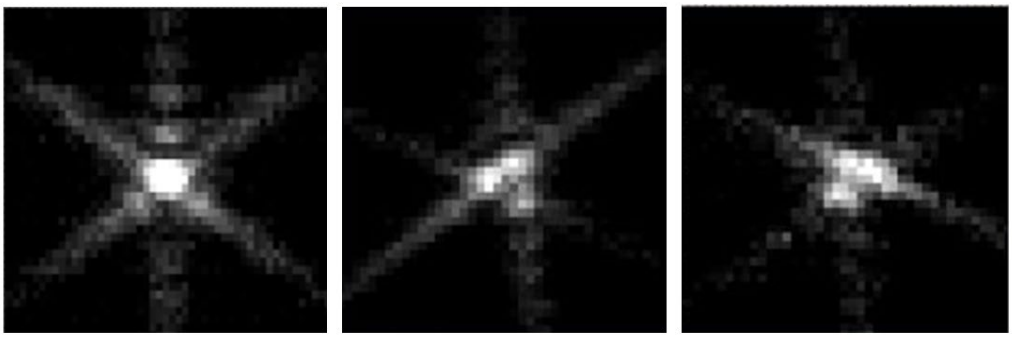

FIGURE 1. Diffraction by triangular aperture of helical undulator radiation observed at UVSOR BL1U, for 1st harmonic (left) and 2nd harmonic radiation (center and right, the helicity is reversed). The wavelength is centered at 355nm.