Two-photon interferometry

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Characterization of x-ray coherence is very important for performing a number of applications based on coherence, as well as for diagnosing high-quality synchrotron sources. Two-photon interferometry originally introduced by Hanbury-Brown and Twiss [1] has a potential to determine spatial and temporal coherence (first-order coherence) and the photon statistics (higher-order coherence) with a very fast resolution. For present synchrotron sources, two-photon interference can be measured as an enhancement of coincidence probability of photoelectric pulses from a single bunch. A high-resolution monochromator must be used in order to get a reasonable enhancement of the coincidence probability [2].

We have developed a system for two-photon interferometry at SPring-8. As a key optics a high-resolution monochromator (HRM) based on 4-bounced asymmetric diffractions has been developed. The device enables to produce monochromatic x-rays with an extremely small bandwidth ΔE = 120 μeV at E = 14.41 keV [3]. First we have measured a spatial coherence profile, particularly along the vertical direction, at the 27-m undulator beamline (19LXU) of SPring-8. Enhancement of coincidence probability was measured as a function of vertical slit width. The large enhancement (~ 30 % max.) allowed us to determine spatial coherence profile with high accuracy [4]. Recently we have performed a similar experiment at the beamline 29XU of SPring-8, equipped with a 4.5-m undulator called a *SPring-8 standard* undulator. From the coherence length and the betatron function, we have determined a vertical source size and emittance, which are in good agreement with estimation by the accelerator group. We have also proved that the method can be applied to diagnose coherence propagation by optical elements.

For temporal domain, we have succeeded in determination of pulse width (32 ps in FWHM) from measurement of the coincidence probability as a function of energy bandwidth [5]. The method will provide an essential information for ultrafast synchrotron sources which are currently developed.

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