Two-photon correlation measurement of synchrotron radiation

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Introduction

The two-photon correlation measurement gives the information about the photon statistics of light[1]. We performed the two-photon correlation measurement of the undulator radiation with an intensity interferometer[2]. Until now, we observed an explicit bunching effect of the two-photon correlation signal, which implies that the synchrotron radiation has a chaotic nature. In addition, we estimated the electron-beam emittance of the stored beam. The two-photon correlation measurement gives the instantaneous emittance whereas the one-photon correlation measurement gives the averaged emittance.

Experimental

We have performed the two-photon correlation measurement in VUV region at an undulator beamline BL-16B. The experimental setup is shown in figure 1. The incident beam was diffracted through the diffraction slit and was divided into two beams which were detected by two photomultiplier-tubes respectively. The output signals were multiplied together in a correlator. We measured the correlation output as a function of the width of the diffraction slit.

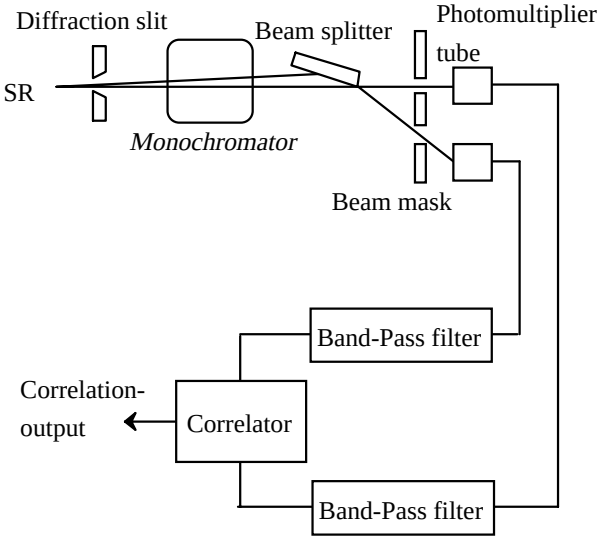

Fig. 1: Experimental setup of the two-photon correlation measurement

Results and Discussion

Figure 2 shows the experimental results. It was found that the correlation signal was gradually increased with decreasing the width of the diffraction slit, which indicates that the photon statistics of the synchrotron radiation has a chaotic nature. The electron-beam emittance was estimated as shown in Table 2. The estimated electron-beam emittances were smaller than the designed value, which is consistent with our intention that the instantaneous emittance is smaller than the averaged one (designed value).

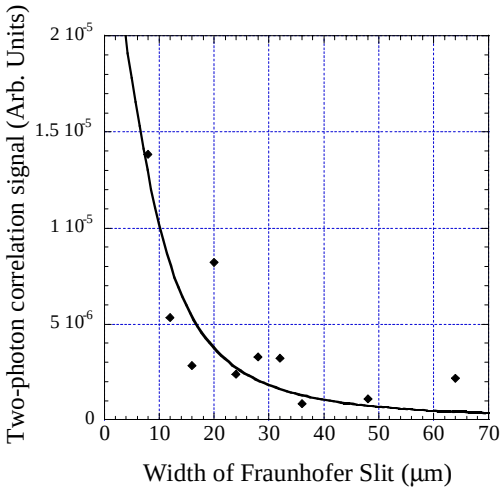

Fig. 2: Two-photon correlation signal

Table 1: Estimated electron-beam emittance

Modulation frequency (Hz)	Electron-beam emittance (nmrad)
2.766	11.5
5.192	17.4
Designed value	36.0

References

[1] R. Hanbury Brown, R. Q. Twiss, Nature 177, 27 (1956a).
[2] R. Z. Tai et al., Phys. Rev. A 60, 3262 (1999).

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