VIII-O Study on Compact X-Ray Sources

Electron storage rings are useful and practical devices as x-ray sources. However, these synchrotron radiation facilities which can provide intense x-rays usually occupy large area and we need many costs in order to construct and maintain the facilities. So that there have been many works to investigate compact x-ray sources. Laser undulator radiation and backward Compton scattering which are generated by interaction of electron beams from small accelerators with intense laser photons are candidates to produce hard x-rays.

X-ray sources must be shielded for radiation safety. For constructing effective shields, we need to know how many radiations are yielded from our x-ray sources. We will use high energy electrons to produce x-rays. These electrons cause radiations when they interact with beam ducts or beam dumps, so that it is useful to study radiations generated in synchrotron radiation facilities in order to estimate the yields of radiations from our x-ray sources.

VIII-O-1 Study on Radiation Shielding for Small Synchrotron Radiation Facilities

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X-ray sources using high energy electrons usually generate radiations which should be shielded. In order to design effective shields, we need to estimate how many radiations are generated from a storage ring and penetrate radiation shields. Circulating electrons in a storage ring go out of their stable orbit when their energy exceeds the critical energy. These electrons are incident on the beam duct and generate electromagnetic showers around the beam duct.

We measured angular distribution of radiations around a beam duct of the storage ring of UVSOR. Figure 1 shows experimental set up. Two Photodiodes were set in tandem in a copper case and coincident signal from these two photodiodes were counted, so that we detected only charged particles. The area of the photodiodes were 7 × 7 mm^2. We used 12 pairs of photodiodes installed at about 2 m upstream from the inflector. Figure 2 shows an angular distribution of the number of signal from the detectors. We notice that the stray radiations of charged particles counted at inside of the ring are more than that counted at outside, because most electrons which exceed their energy over the bucket height hit on the inside wall of the beam duct.

In order to estimate the amount of the stray radiations around compact x-ray sources, we should investigate the spatial distribution of stray radiations by comparing experimental results and theoretical calculations. We will propose a simple formula to calculate radiation dose around a small accelerator. In order to check the accuracy of the formula, we should measure the radiations at many points around UVSOR storage ring and compare the experimental results with our calculations.

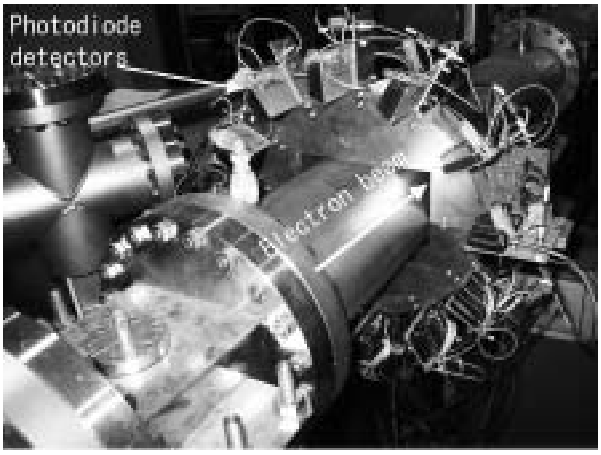

Figure 1. Experimental setup.

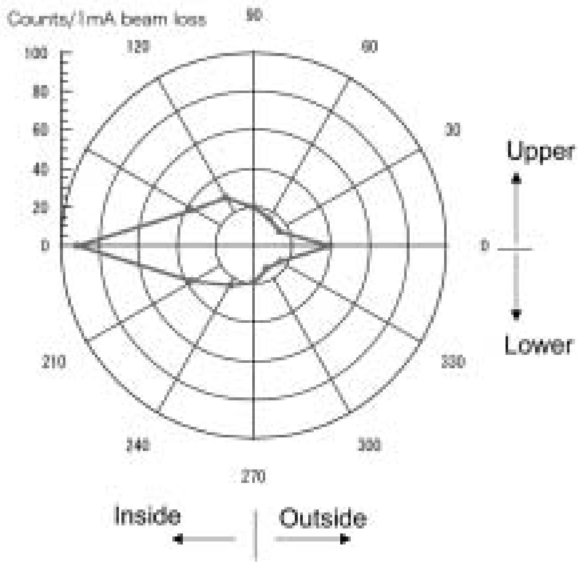

Figure 2. Angular distribution of charged particles around the beam duct of the storage ring of UVSOR.