# Measurement of Radiation Spectra during Electron Beam Injection at the SR center of Ritsumeikan University

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At the SR Center of Ritsumeikan University, radiation doses are always measured using radiation area monitors and survey meters. The bremsstrahlung induced by the stored electron beam on the beamline during synchrotron radiation use is constantly measured. In addition, the energy spectrum of the bremsstrahlung is measured as needed [1]. Activation was also measured. It was confirmed that there was little to no activation [2]. In this study, we measured the radiation energy spectrum inside and outside the radiation-controlled area during the electron beam injection.

A bismuth germanate (BGO) scintillation detector was used for the measurements; the BGO scintillator can measure high energy photons below about 30 MeV. Three measurement locations were set: the microtron room where the injector microtron was installed, the experimental hall where the storage ring was installed, and the assembly room outside the radiation-controlled area which was next to these two rooms. Measurements were performed at a position deviating from the orbital direction of the incident electron beam. The operating conditions of the injector are as follows: energy of 150 MeV, pulse width of 2 microseconds, repetition rate of 10 Hz, and peak current of 1 mA.

In figure 1 (a) and (b) we show the results of subtracting the background from the measured values. Fig. 1 (a) and (b) are the higher and lower energy parts, respectively. In Fig. 1(b), the vertical axis is set to logarithmic scale. Although not shown in figure 1, high energy photons above 10 MeV were almost never detected. The highest radiation dose was observed in the injector room. The assembly room, which is outside the radiation-controlled area, is well shielded and the radiation dose is kept low. The tendencies of the energy spectra are similar in all cases.

From Figure 1(a) it is expected that the detected radiation includes neutron capture gamma rays. It is known that the energies of the neutron capture gamma rays emitted from iron and hydrogen are 7.64 MeV and 2.22 MeV, respectively [3]. In figure 1(b), the peak due to electron-positron pair annihilation can also be seen.

Neutron capture gamma rays may be generated by the following processes.
(1) Bremsstrahlung X-rays are generated when high-energy electron beams of 150 MeV collide with obstacles.
(2) Neutrons are emitted by the photo-neutron reaction caused by high-energy bremsstrahlung X-rays.
(3) Gamma rays are emitted when neutrons are captured by the surrounding material.

The present results suggest that neutron-capture gamma rays are important sources of radiation in directions outside the electron beam orbit direction.

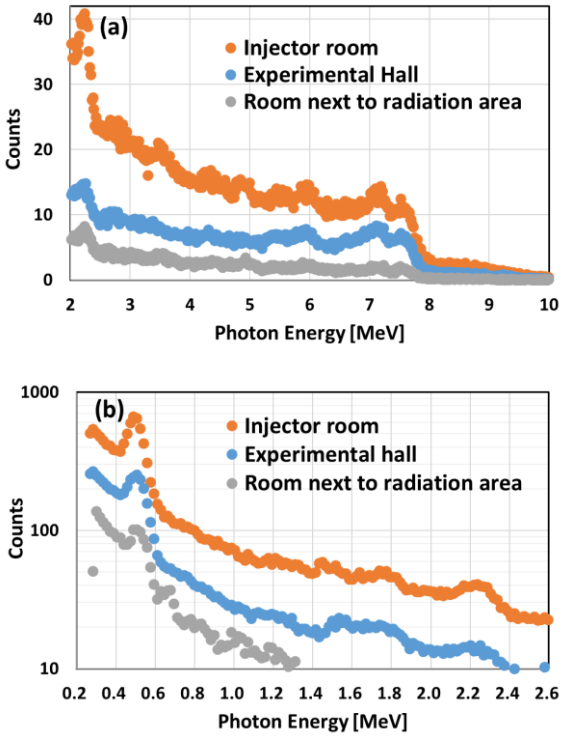


Figure 1 (a) and (b): Energy spectra of radiation during electron beam injection.

## References

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