# SCRIT luminosity monitor

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A luminosity monitor has been newly constructed and installed at the SCRIT electron scattering facility[1,2]. This monitor measures the number of bremsstrahlung photons produced by collisions between an electron beam and the target short-lived nuclei trapped in the SCRIT device. Using known a bremsstrahlung cross section, one can determine the collision luminosity on-line.

The monitor consists of a position detector and a calorimeter as shown in Fig. 1. The position detector measures the spatial distribution of the bremsstrahlung photons, and the calorimeter measures their energies. The position detector consists of two identical X- and Y-detectors, each of which has 16 optically isolated scintillating fibers of $3 \times 3$ mm$^2$ cross section. The scintillating fibers are coupled to a $4 \times 4$ multi-anode photomultiplier. The calorimeter consists of seven optically isolated pure-CsI crystals, each of which is 20 cm long with a hexagonal cross section with 4 cm sides.

In order to define the angular acceptance of the detector for the bremsstrahlung process, a large Pb block, 300 (h) x 300 (w) x 50 (t) mm$^3$, with a hole of 50 mm $\phi$ is placed in front of the monitor for collimation of bremsstrahlung photons. Note that the bremsstrahlung photons enters the center crystal of the calorimeter. The luminosity monitor is placed ~670 cm downstream from the center of the SCRIT device.

Figure 2 shows the spatial distributions of bremsstrahlung photons, whose energy is larger than 50 MeV. The stored electron beam energies were 150 and 300 MeV, and typical stored currents were 250 mA for both energies.

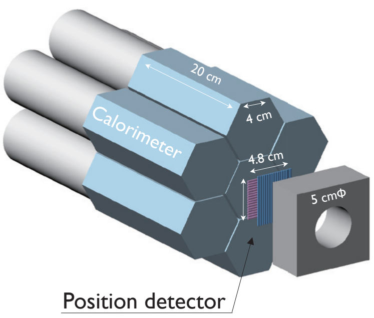


Fig. 1. Bremsstrahlung Luminosity Monitor.

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Non-identical shapes observed for X and Y distributions should be attributed to the asymmetric material distributions of the storage ring along the beam axis, where the bremsstrahlung photons travel through. GEANT4 simulations are performed by taking the material distributions precisely into account as possibly, and the simulation results are found to reproduce the measured spatial distributions reasonably well. In addition, the measured energy distributions of the bremsstrahlung is also well accounted for by the simulation. Assuming that the trapped residual gases are purely oxygen, the collision luminosities are determined as L $= 2.34 \pm 0.09$ cm$^{-2}$s$^{-1}$ and $17.2 \pm 0.69$ cm$^{-2}$s$^{-1}$, respectively[3].

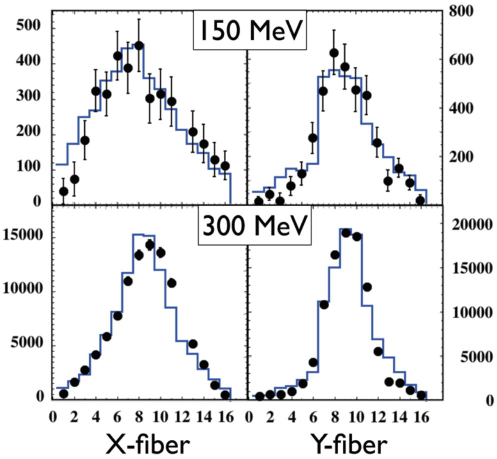


Fig. 2. X and Y distributions for $E_e = 150$ and 300 MeV

During the luminosity measurements mentioned above, elastically scattered electrons from the trapped residual gases were measured simultaneously using a newly installed high-resolution large-acceptance magnetic spectrometer, WiSES (Window-frame Spectrometer for Electron Scattering)[4]. As the elastic scattering cross section for oxygen is also well known, the collision luminosity will be independently determined from the elastic scattering events soon, and the results should be compared with that determined by the luminosity monitor.

References
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3) S. Yoneyama, Master thesis (in Japanese), (2014) Tohoku University.
4) K. Tsukada *et al.*, in this report.