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Abstract. The description of the pair spectrometer of the GlueX detector at Jefferson Lab and its performance during the first beam commissioning runs are presented. We measured the amount of light collected from each channel of the pair spectrometer hodoscopes and the time resolution of the pair spectrometer counters.

1. The pair spectrometer of the GlueX experiment

GlueX is the new experiment in the experimental Hall D at Thomas Jefferson Accelerator Facility [1]. The main goal of GlueX is to search for hybrid mesons with exotic quantum numbers using a beam of linearly polarized photons incident on a liquid hydrogen target. Beam photons are produced in a radiator by 12 GeV electrons via the coherent bremsstrahlung process [2]. One of the key components of the Hall D photon beam line is the magnetic pair spectrometer [3], which is used to monitor the beam flux to measure the spectrum of the collimated photon beam. The pair spectrometer reconstructs the energy of a beam photon by measuring the momentum of the $e^{\pm}$ pair produced in a thin converter. The pair spectrometer consists of a thin converter, a dipole magnet with the magnetic field of 1.8 T and two layers of scintillator detectors: 16 coarse counters and the high-granularity hodoscope. Detectors are organized in two arms, each arm covers the $e^{\pm}$-energy range between 3 GeV and 6.25 GeV. The hodoscope is an array of thin scintillator tiles with the thickness of 1 mm and 2 mm. The light from each tile is collected by means of wavelength shifting fibers and is detected by a Hamamatsu silicon photomultiplier (SiPM) with a sensitive area of 3×3 mm^2. SiPM pulses are digitized using a flash ADC. The hodoscope energy resolution varies between 12 MeV and 20 MeV for 6 GeV and 12 GeV reconstructed photons, respectively. The coarse scintillator counters are used to produce a trigger by requiring a coincidence of hits in the two detector arms. They should also provide time measurements with a resolution better than 250 ps, which is required to identify the electron beam bunch where the beam photon is emitted. The counters are instrumented with Hamamatsu R6427-01 PMTs.

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2. Beam line performance of the pair spectrometer

The distribution of the maximum flash ADC amplitude measured for each hodoscope scintillator tile is presented in figure 1. The amount of light collected from a tile corresponds to about 60 – 90 SiPM pixels.

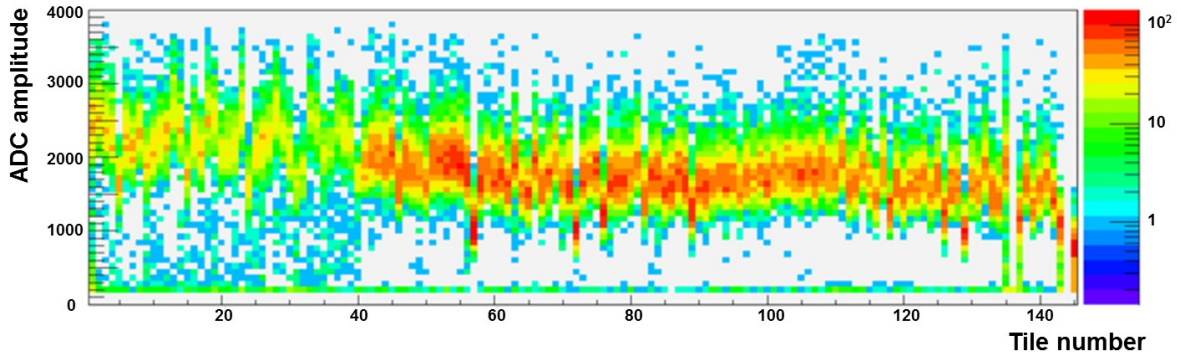

Figure 1. Maximum flash ADC amplitude measured for hodoscope scintillator tiles.

Energy spectrum of beam photons measured with the pair spectrometer during the first Hall-D commissioning run is presented in figure 2. Peaks in the energy spectrum (regions enhanced with linearly polarized photons) correspond to photons produced in coherent bremsstrahlung process from the diamond crystal. During the commissioning phase the Jefferson Lab accelerator provided a 5 GeV electron beam, which energy was about a factor of two smaller than the nominal beam energy of 12 GeV. The time resolution measured with the coarse counters was found to be better than 150 ps. The light yield corresponds to more than 900 photo electrons detected with the PMT.

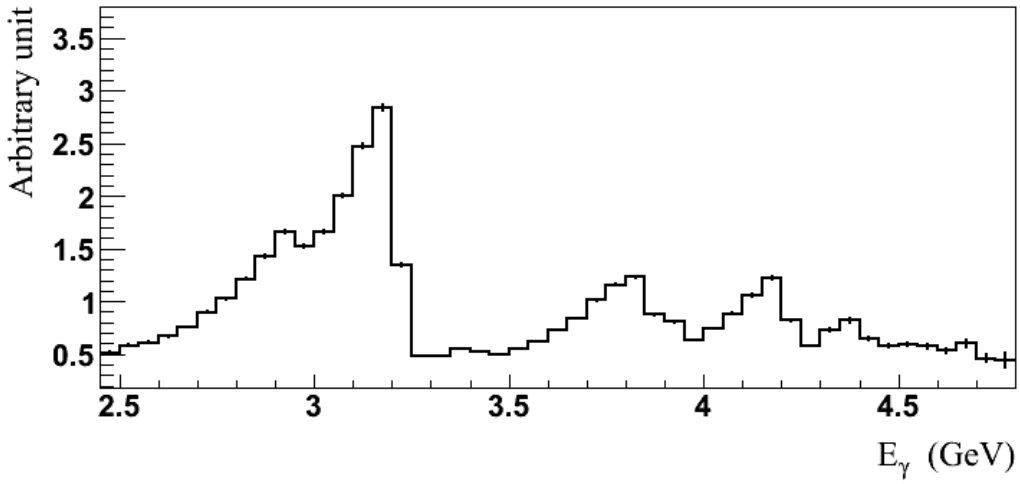

Figure 2. Photon energy spectrum measured with the PS hodoscope during the first commissioning run with a diamond radiator.

3. Conclusion

We have presented the performance of the pair spectrometer for GlueX experiment during the first commissioning beam. The energy spectrum of the photon beam, measured by pair spectrometer, produced in coherent bremsstrahlung process from the diamond crystal. The amount of light collected from each channel of the pair spectrometer hodoscopes corresponds to about 60 – 90 SiPM pixels. The time resolution measured with the pair spectrometer counters was better than 150 ps.

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