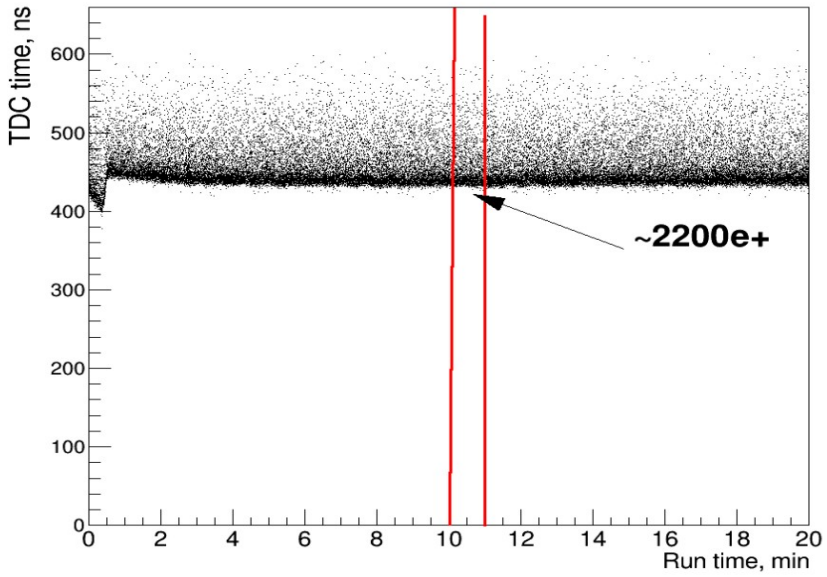
Photon flux monitor operation principle

The algorithm for extraction of the information on the relative photon flux is based on the counting the relative number of positrons produced by photons in the air pair converter and deflected toward the positron detector by pair spectrometer analyzing magnet.

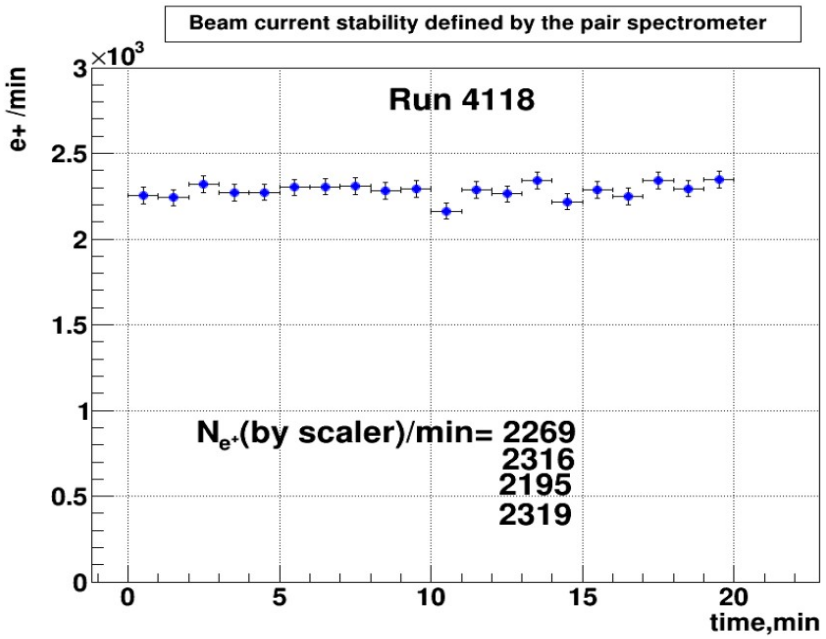
Pair spectrometer detector output signal is supplied to one of the channels of the discriminator to produce a standard square pulse. The discriminator signal is connected to a TDC channel through NIM-to-ECL module.

DAQ writes into the root file the information on the pulse number and the information on the time difference between the start signal and the time when a positron hit the detector (TDC time). If the repetition rate of the accelerator is known, the number of pulses per second can be calculated. For instance, if the rep. rate is 300 Hz, then the number of electron bunches in one second is 300. Plotting the TDC spectrum obtained with the pair spectrometer detector as a function of run time one can obtain the following plot:



Since the software currently writes in the root file only the information on the first event in the puls train, there is an internal limitation on the relative number of positrons that can be correctly detected. If every accelerator pulse produces around one pulse in the pair spectrometer detector (for a given thickness of the pair converter, electron current, and brem. converter thickness) then the relative number of positrons per minute that can be correctly detected. Maximum relative number of positrons that can be detected per minute is 300Hz*60s=18,000 positrons.

During the last run at ISU/HRRL the accelerator repetition rate was 300Hz, pulse width ~ 20 ns, electron current ~ 30 mA, the number of positrons detected per minute according to the visual scaler was ~ $2.2 \cdot 10^3$ positrons/min. Cross calibration showed that the operation of the beam stability monitor based on the information extracted from the root file is adequate (see figure below).



The pair converter thickness should be adjusted such that the number of positrons produced per minute is less than f(Hz)*60(s) for a given electron current and given thickness of the bremsstrahlung converter. In this case it is possible to see the response of the pair spectrometer to the change of the photon flux.