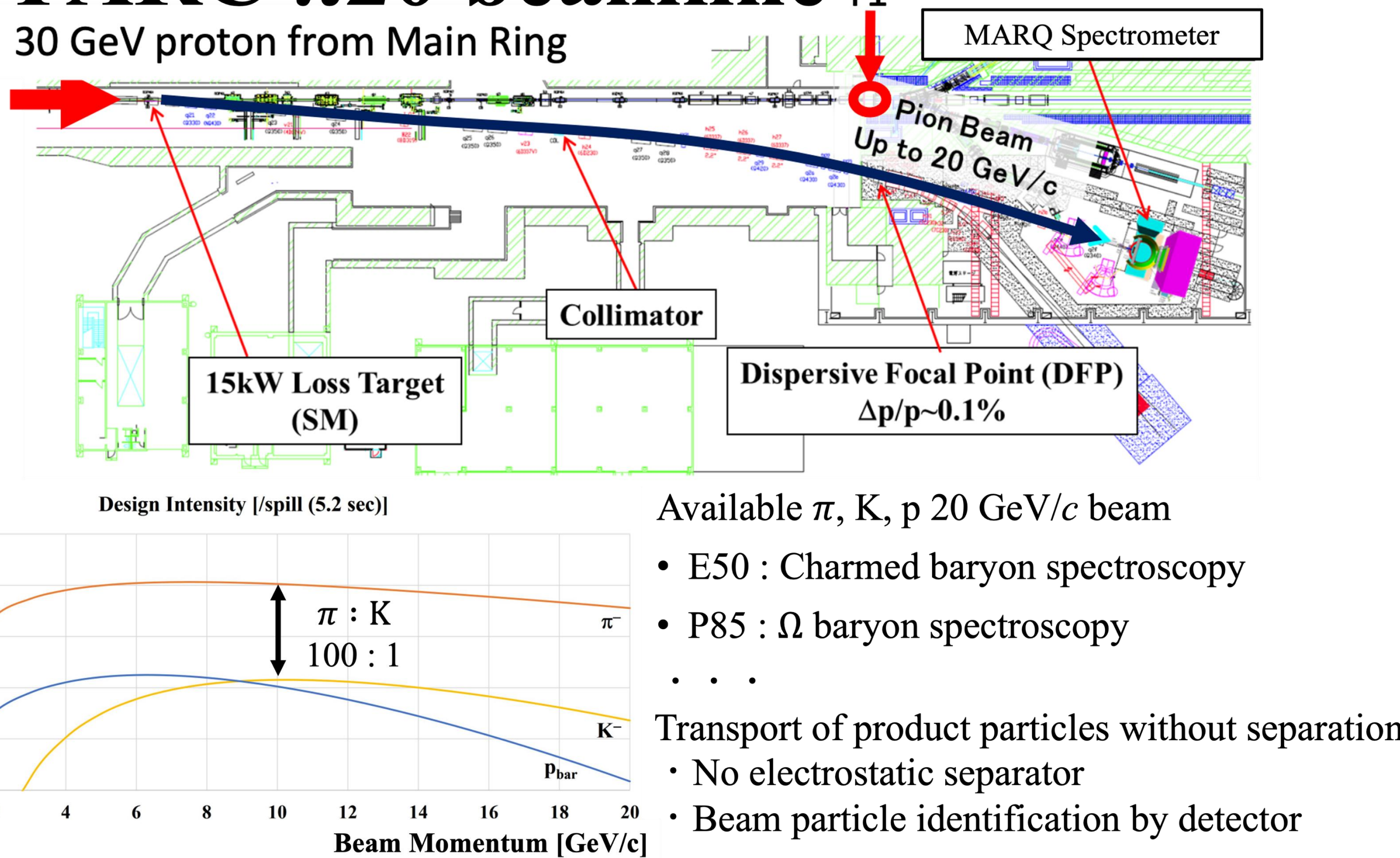


Performance evaluation of ring imaging Cherenkov detector with high momentum hadron beam at J-PARC

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1. J-PARC $\pi 20$ beamline



2. Beam-RICH detector

Requirements

PID of π^- , K^- beams in the 5.0-8.5 GeV/c

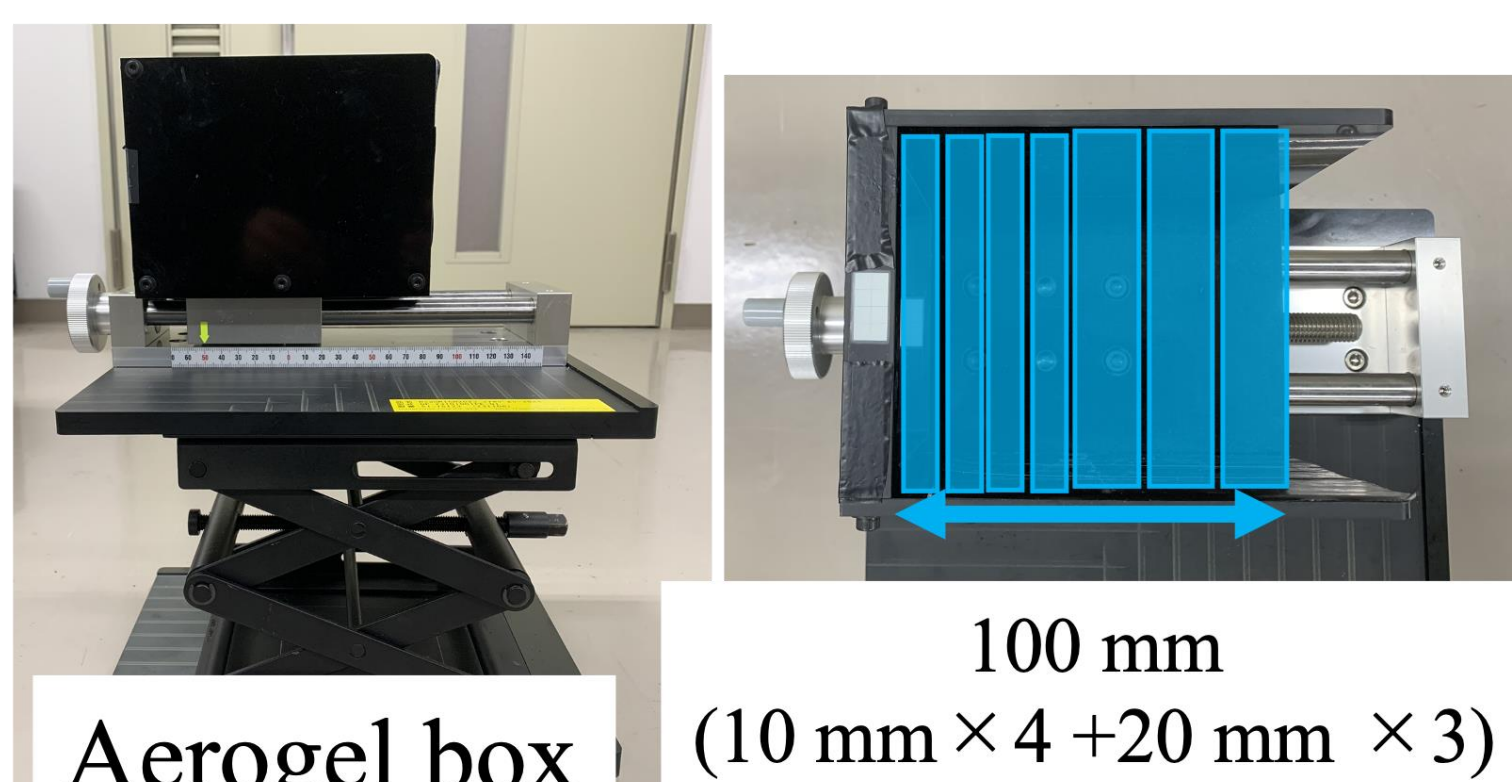
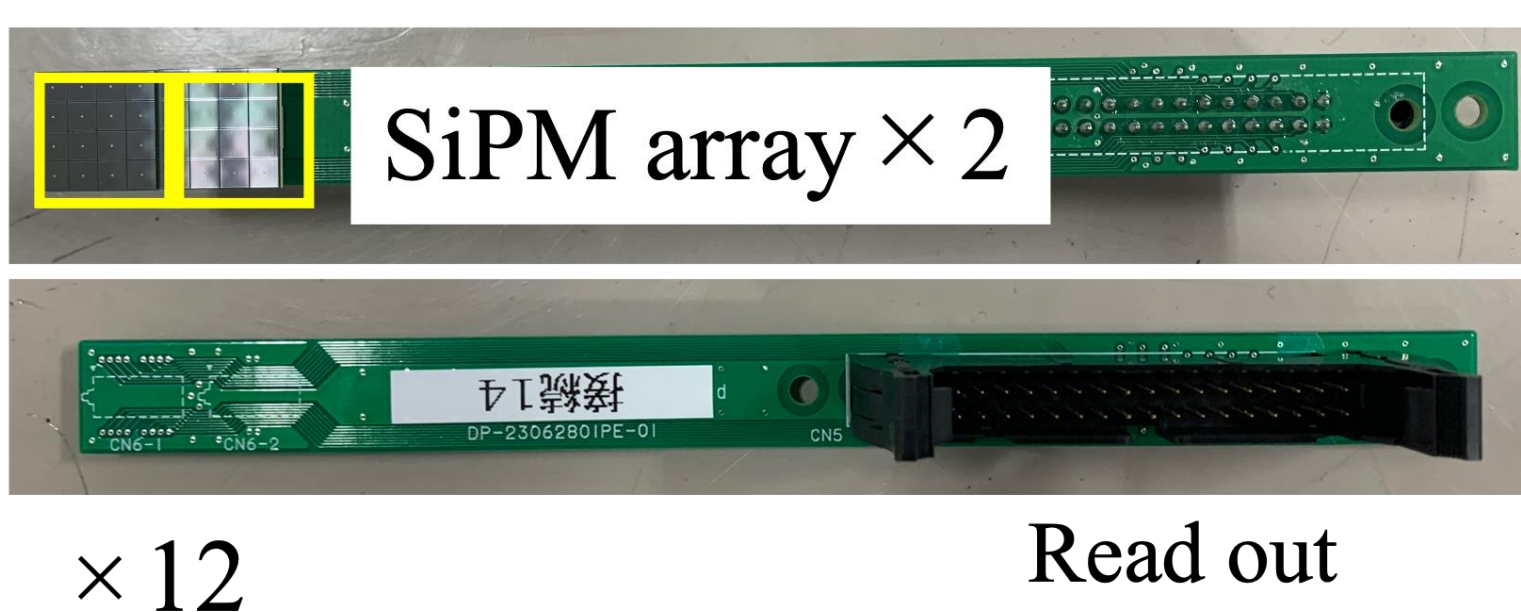
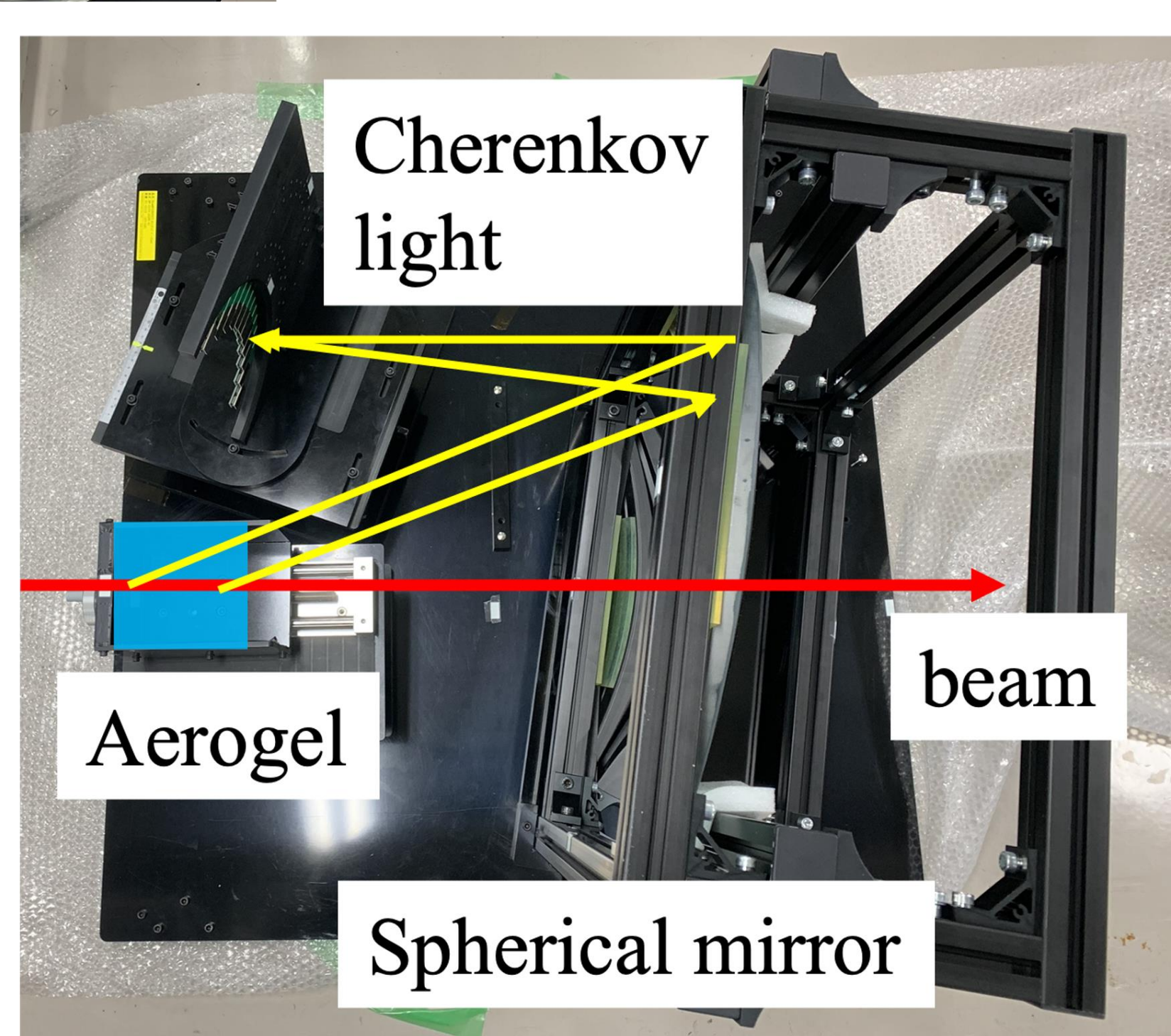
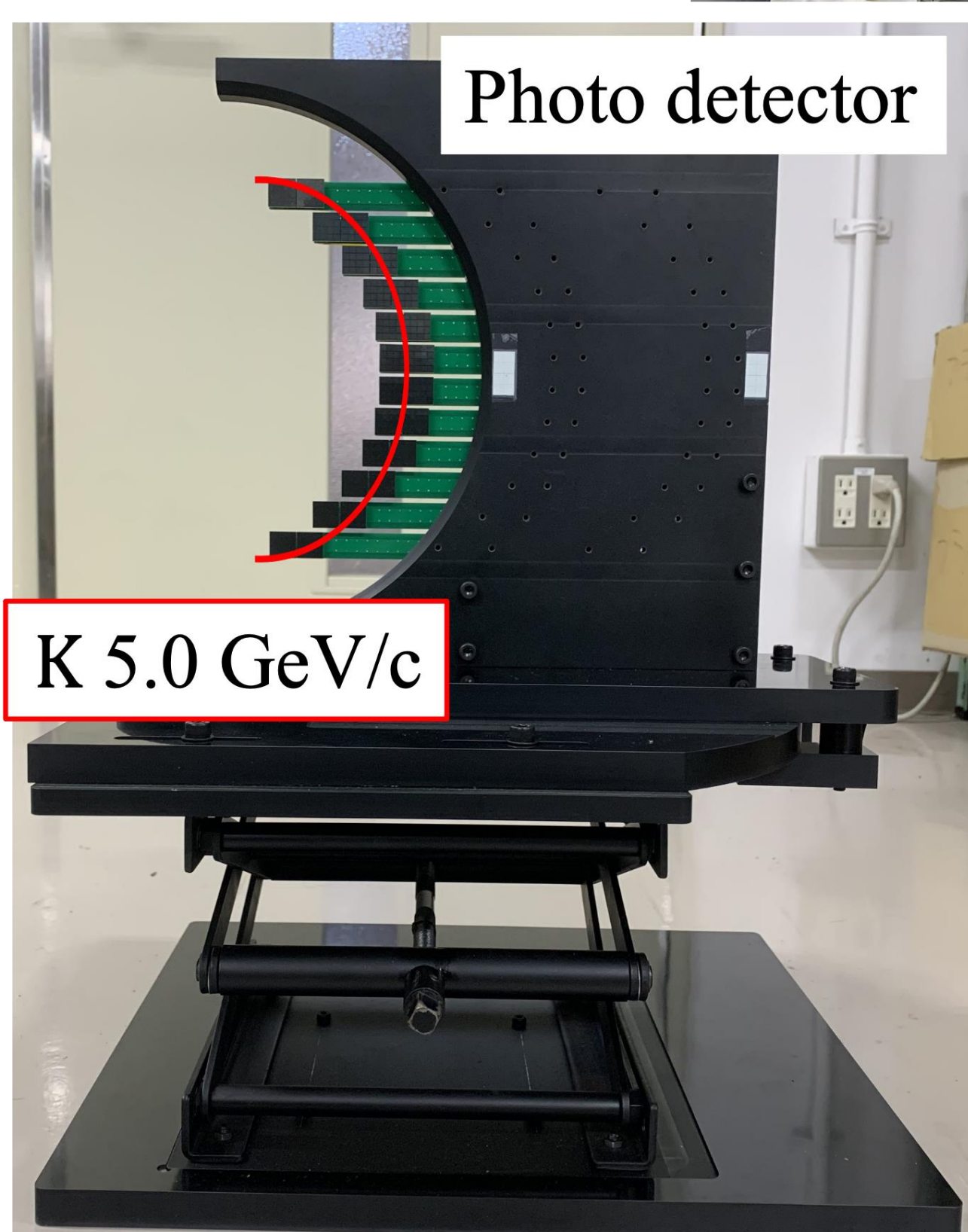
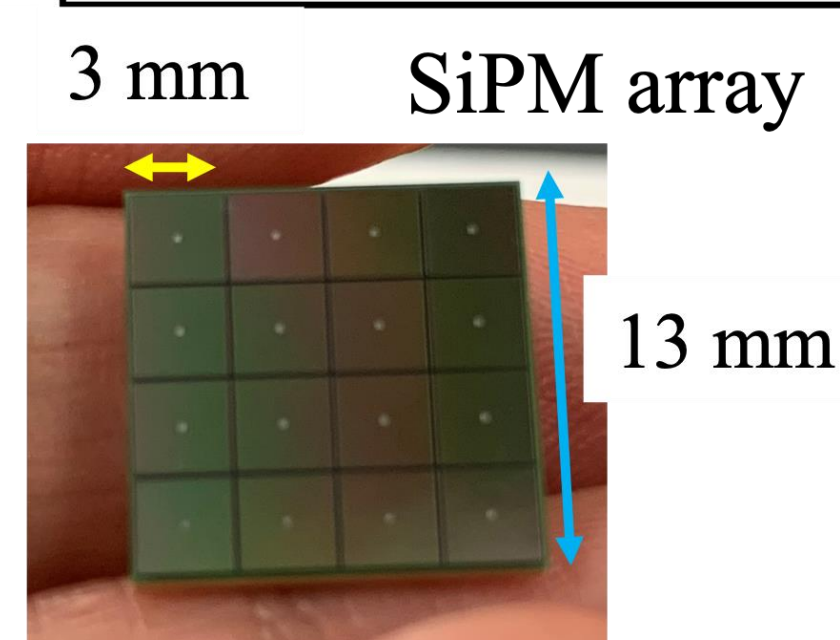
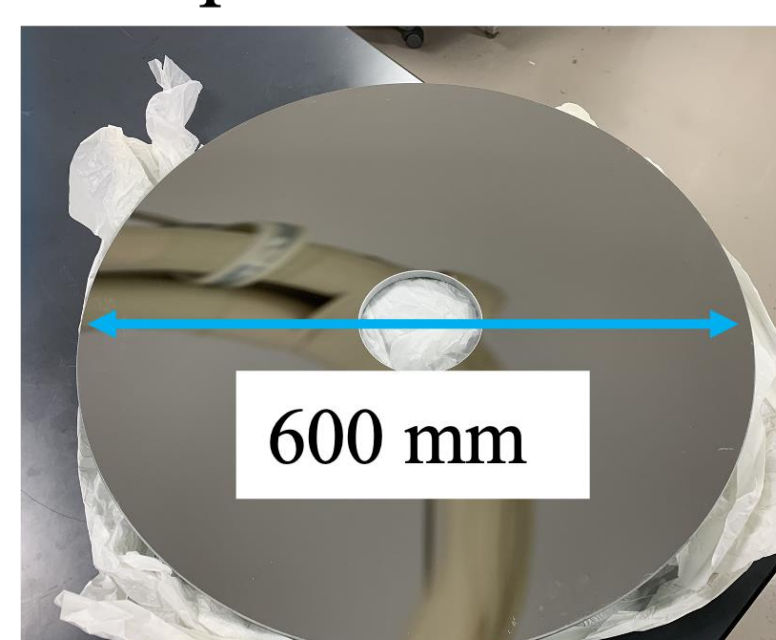
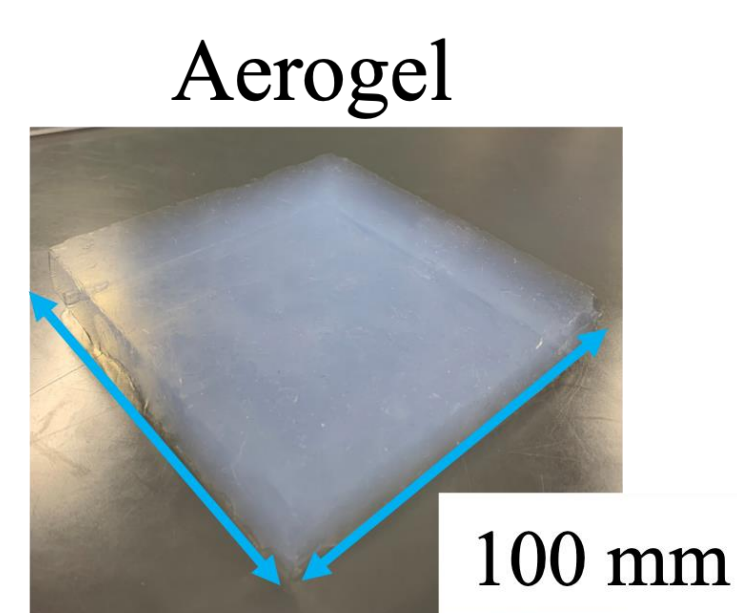
In particular, for K^- beam of 5.0 GeV/c

K^- detection efficiency of more than 95 %

with π^- miss ID probability of less than 0.03 %

Detector elements

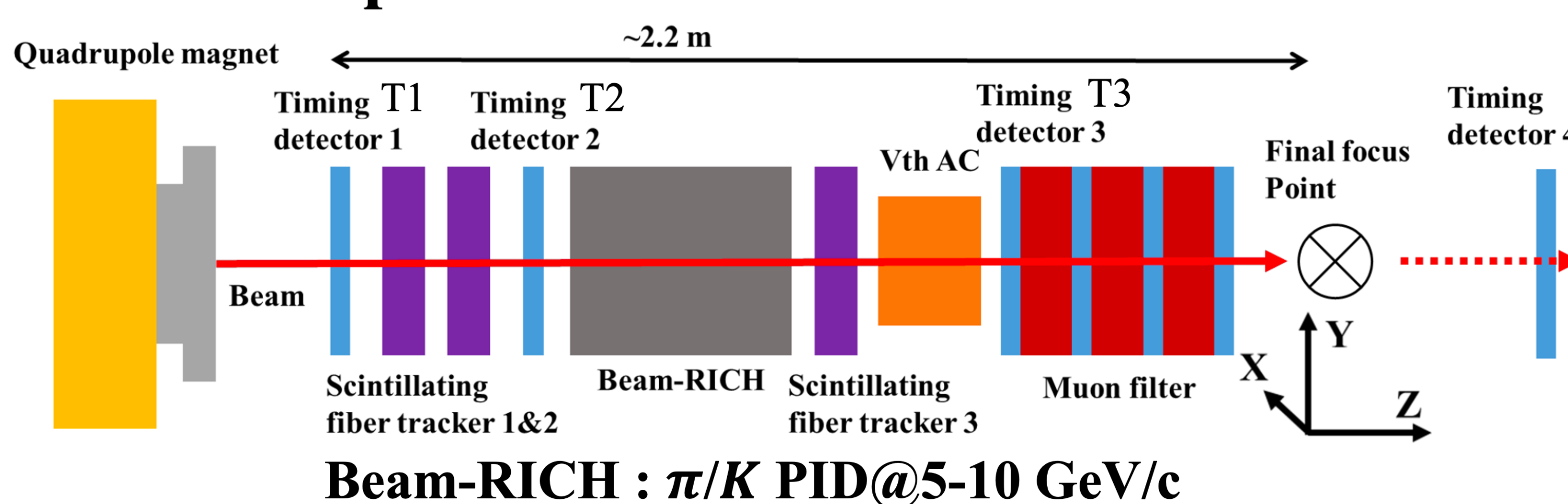
- Aerogel (refractive index $n = 1.021$)
- Spherical mirror (Radius $R = 1005$ mm)
- Multi-Pixel Photon Counter (SiPM) array



3. T106 test experiment

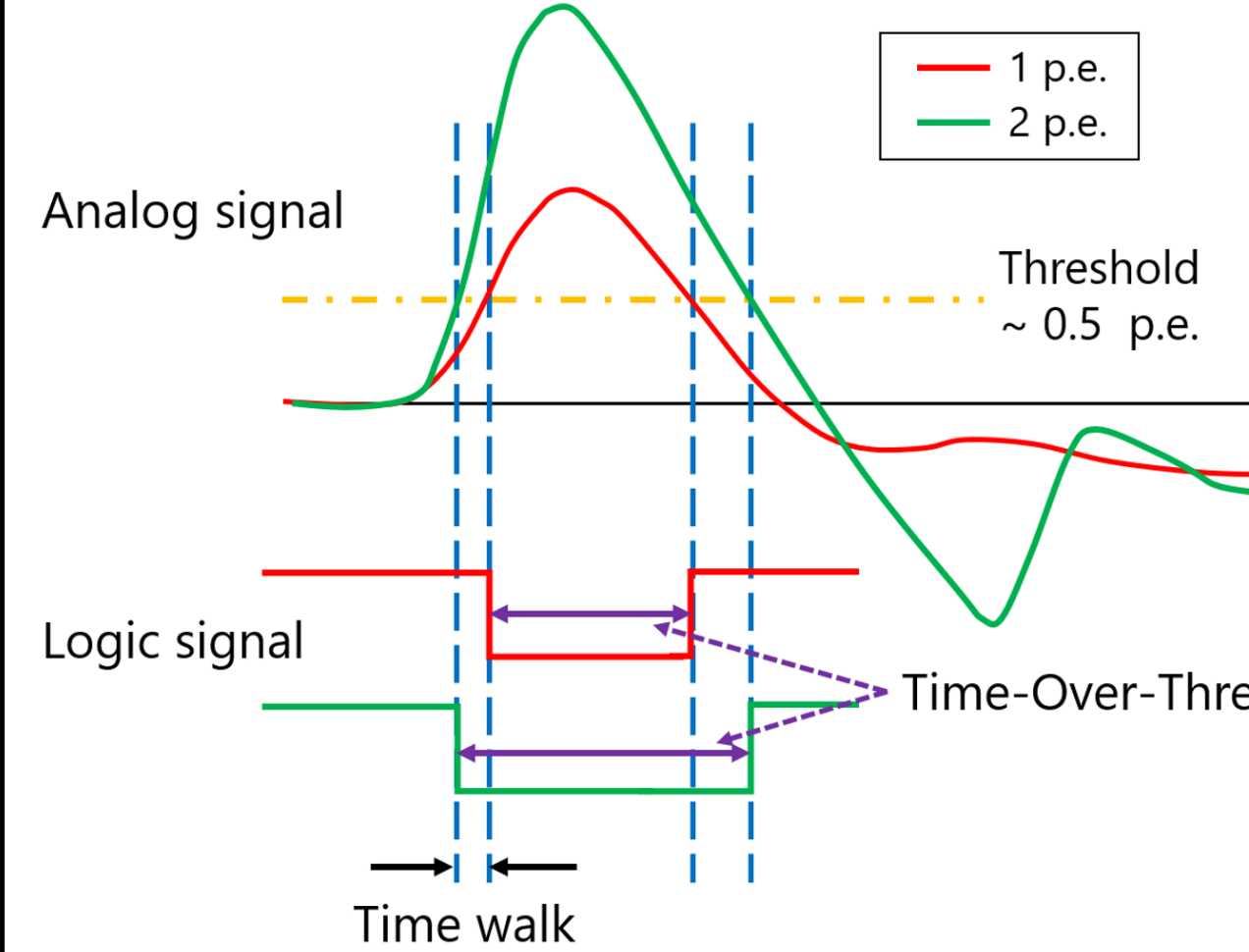
Evaluation of 2ndary beam properties (Only positive beam) @ J-PARC high-p beamline

Detector setup



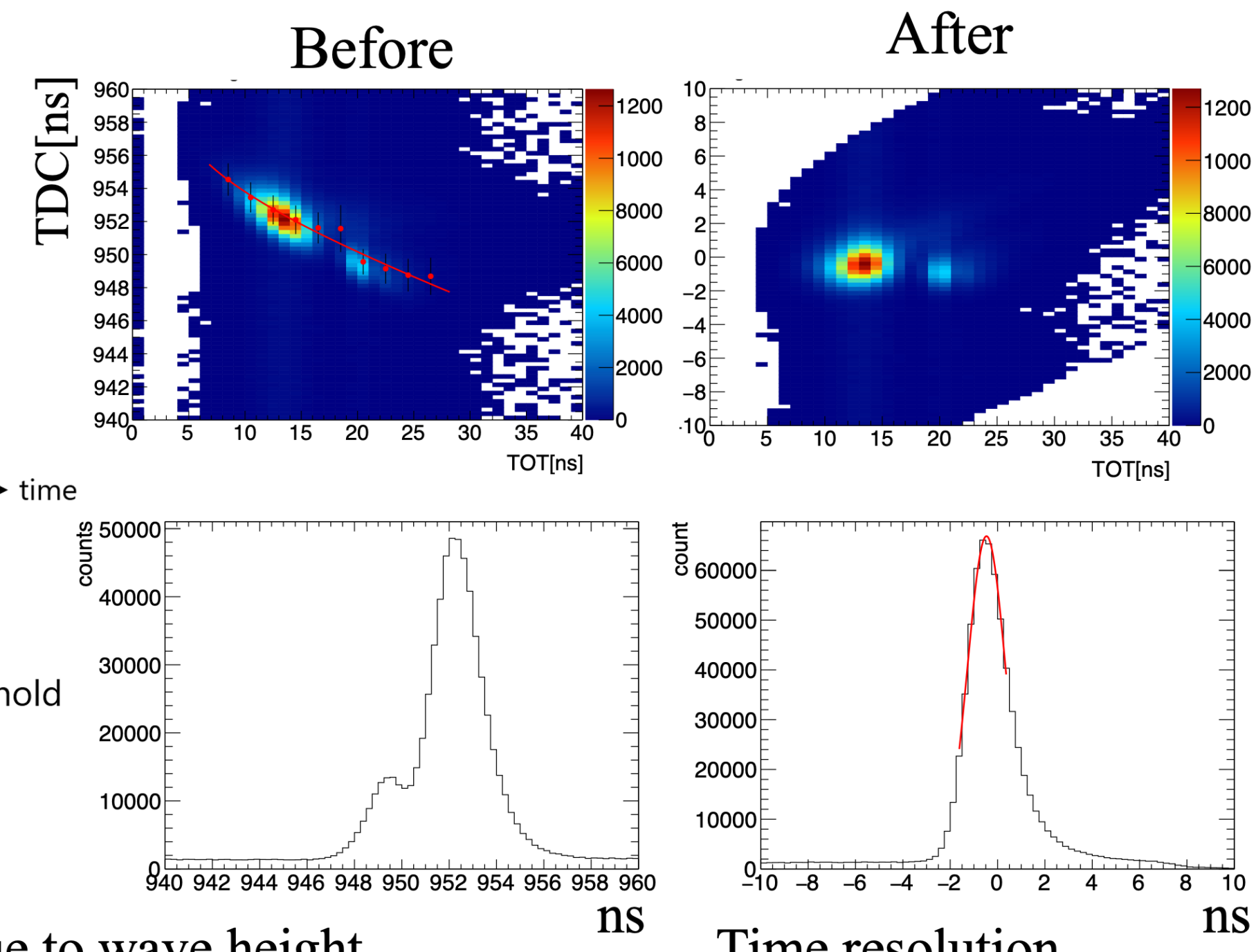
4. Analysis

Time walk correction



Correction for differences in rise time due to wave height

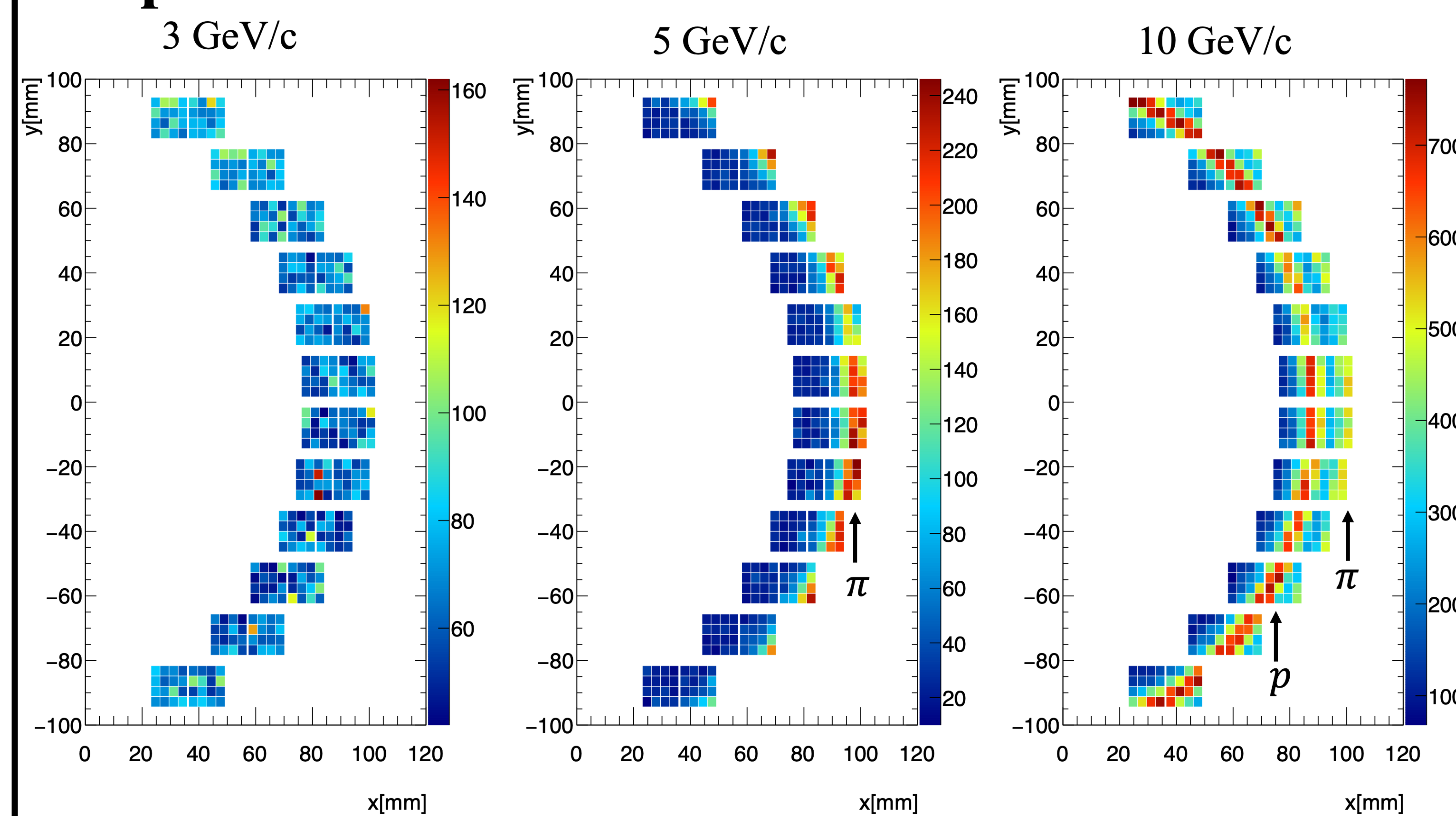
- Correction performed based on the correlation between SiPM's TDC (time difference from T1) and TOT
- Correction performed for each of the 384 channels



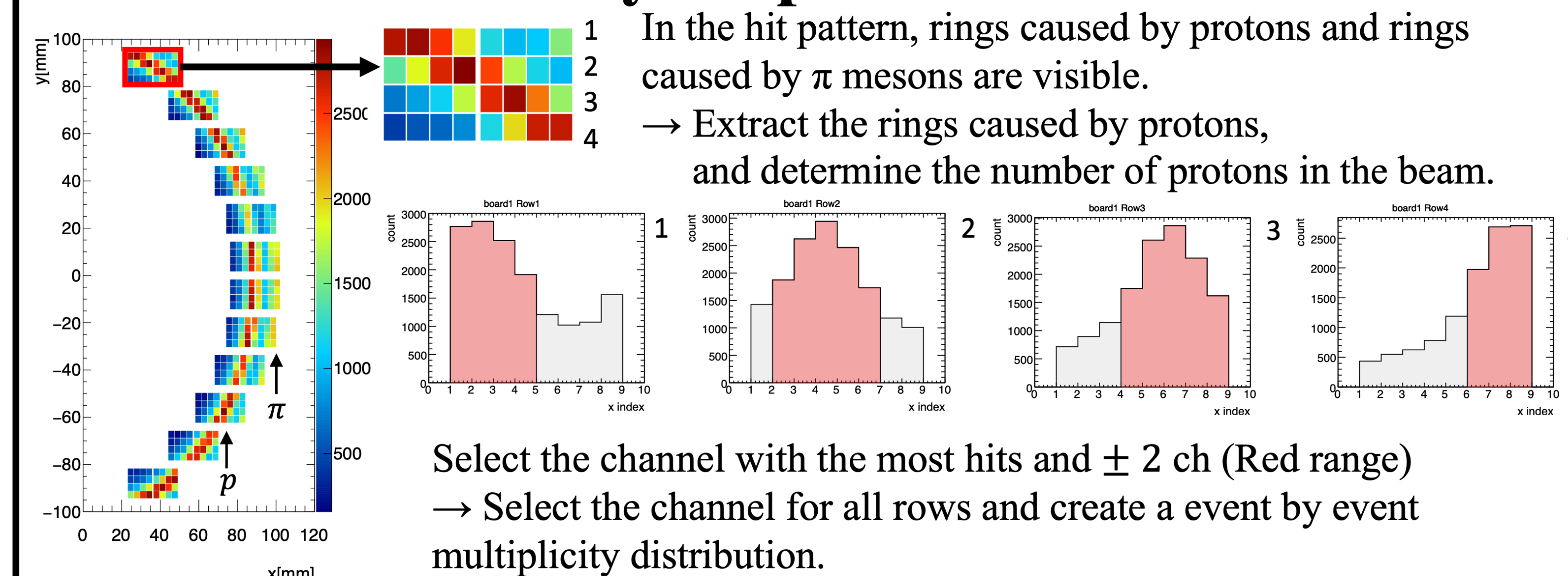
Time resolution

- $\sigma_t \sim 0.850$ ns
- TDC cut range
- 4 ns (-2 ns \sim 2 ns)

Hit pattern

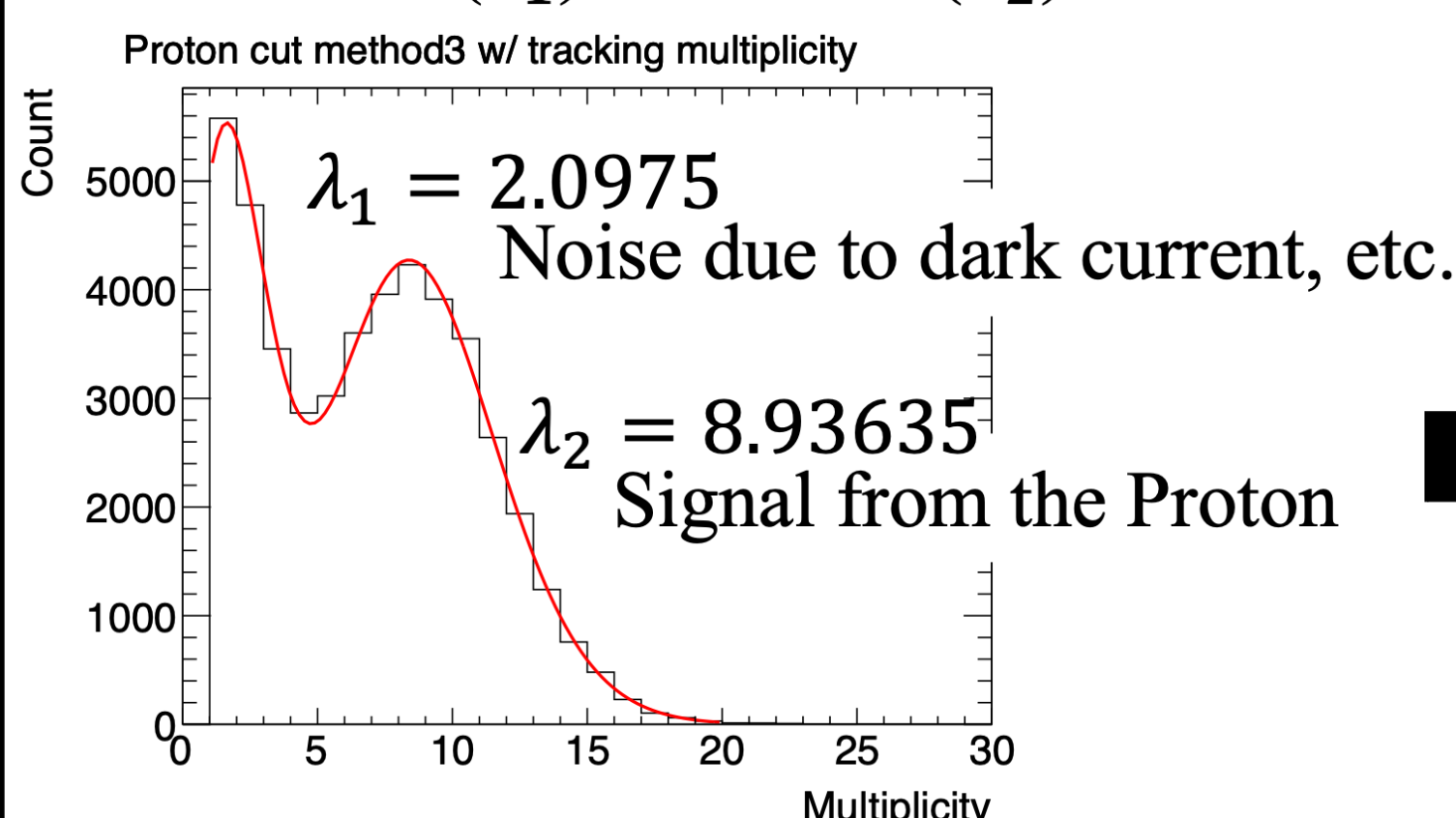


Channel selection by hit pattern



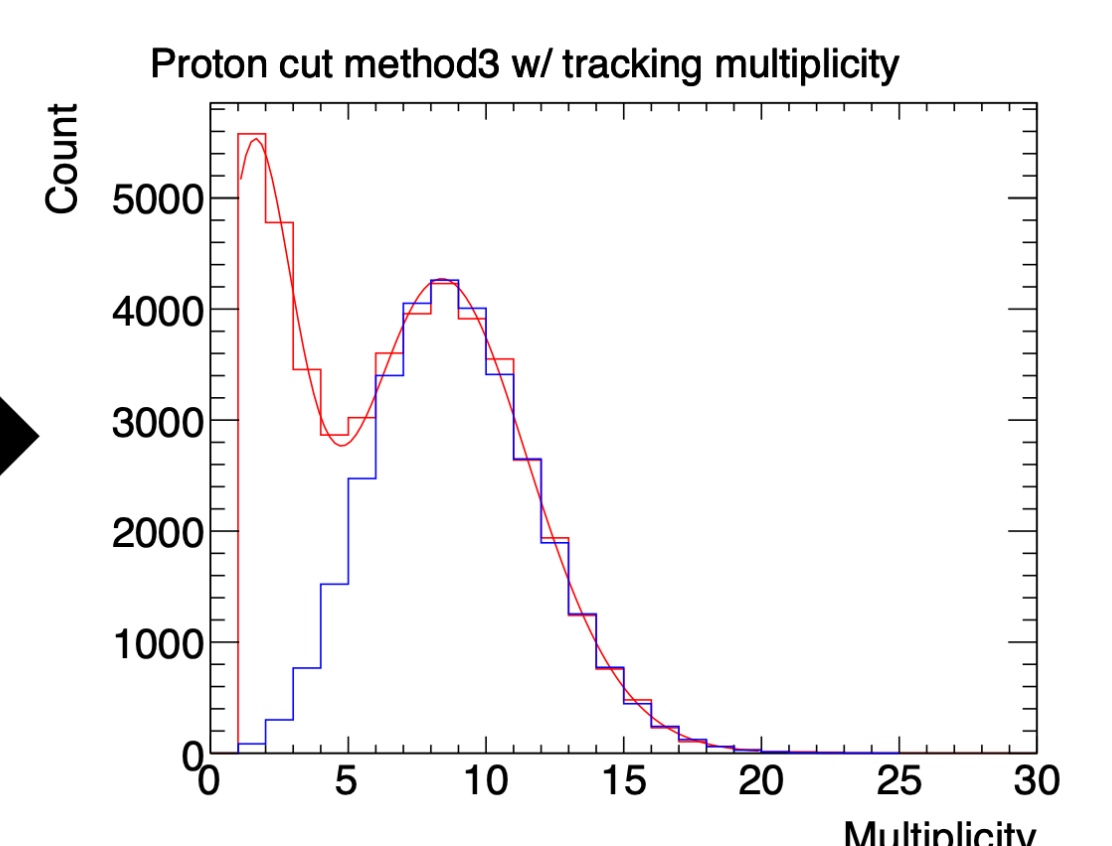
Proton ratio in the 10 GeV/c beam

Fitting the multiplicity distribution with Poisson(λ_1) + Poisson(λ_2)



Red : Multiplicity distribution

Blue : Poisson distribution at λ_2



Integrated value of the Poisson distribution at λ_2 : $\frac{31767}{50172}$ = Proportion of protons in the beam particles : **63.4%**

5. Summary and Prospects

- Evaluation tests conducted on secondary particle beams in the high-momentum beamline
 - Performance evaluation data acquired for Beam-RICH using secondary particle beams at 3, 5, and 10 GeV/c
 - Ring-like patterns observed in the hit patterns, likely corresponding to π^+ at 5 GeV/c and p, π^+ at 10 GeV/c
 - For the 10 GeV/c data, the proportion of beam particles was determined using hit pattern-based channel selection and Poisson fitting of the multiplicity distribution. (Proton ratio: 63.4%)
- For the 3 and 5 GeV data, no rings from K particles were observed due to the low proportion of K particles in the beam (3 GeV/c $\sim 1/1000$, 5 GeV/c $\sim 1/100$).
 - Therefore, it is difficult to determine the proportion of K in the beam in this preliminary analysis.
 - We plan to analyze using the "global approach."
 - Global approach assumes several particle hypotheses and calculates the expected number of detected photons for each. Particle identification is performed based on the differences in the log-likelihood values derived from these expectations.