Development of beam RICH for J-PARC high-p beamline

Existing secondary beamline
- Low momentum
  : ~2 GeV/c

J-PARC high momentum (high-p) beamline
- High momentum
  : 5-20 GeV/c
- High intensity
 : 30×10^6 /sec

Experiments @ high-p beamline
- J-PARC E50 experiment (Charmed-baryon spectroscopy)
- Ξ^* spectroscopy
- High-statistics Λp scattering experiment

Features of high-p beamline
- Unseparated secondary beam
  ➔ PID is necessary
- Wide momentum range
  ➔ Not possible with threshold type Cherenkov detector

Beam RICH for particle ID

E50 spectrometer

Beam detector

Beam RICH

$\pi^-,\ K^-,\ \bar{p}$

π^-

K^+
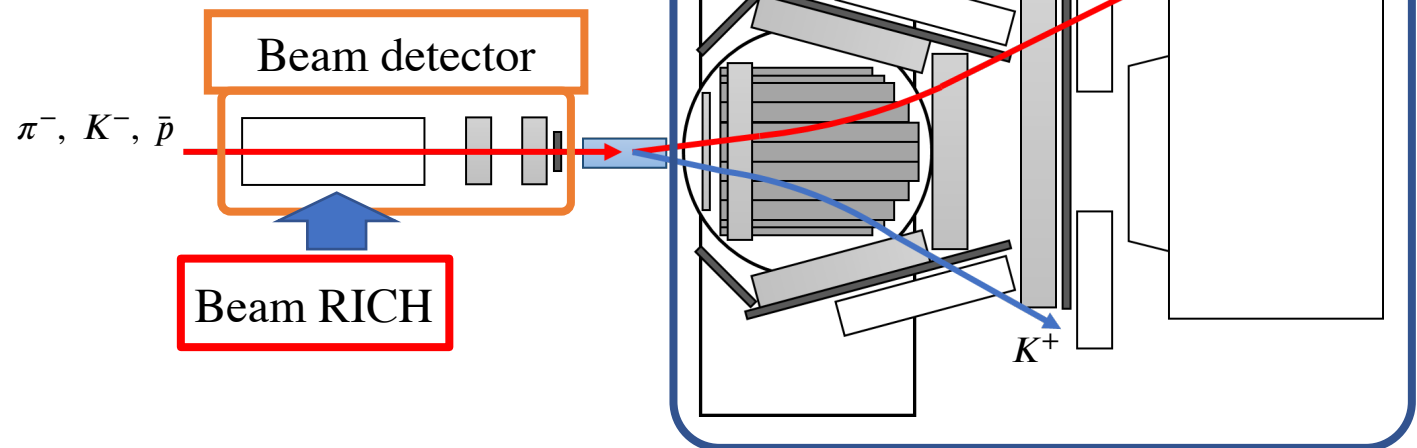
Development status of beam RICH

Scheme of detection plane

Beam RICH with aerogel

Required performance :

Momentum range : 5-10 GeV/c

Mixing π into K : < 3 %

Beam spread : ±5 cm, ± 10 mrad

➔ Estimate parameters of beam RICH to obtain required performance

Scheme of beam RICH

R/2

←Detection plane

R=1.0m

↑ aerogel

Spherical mirror →
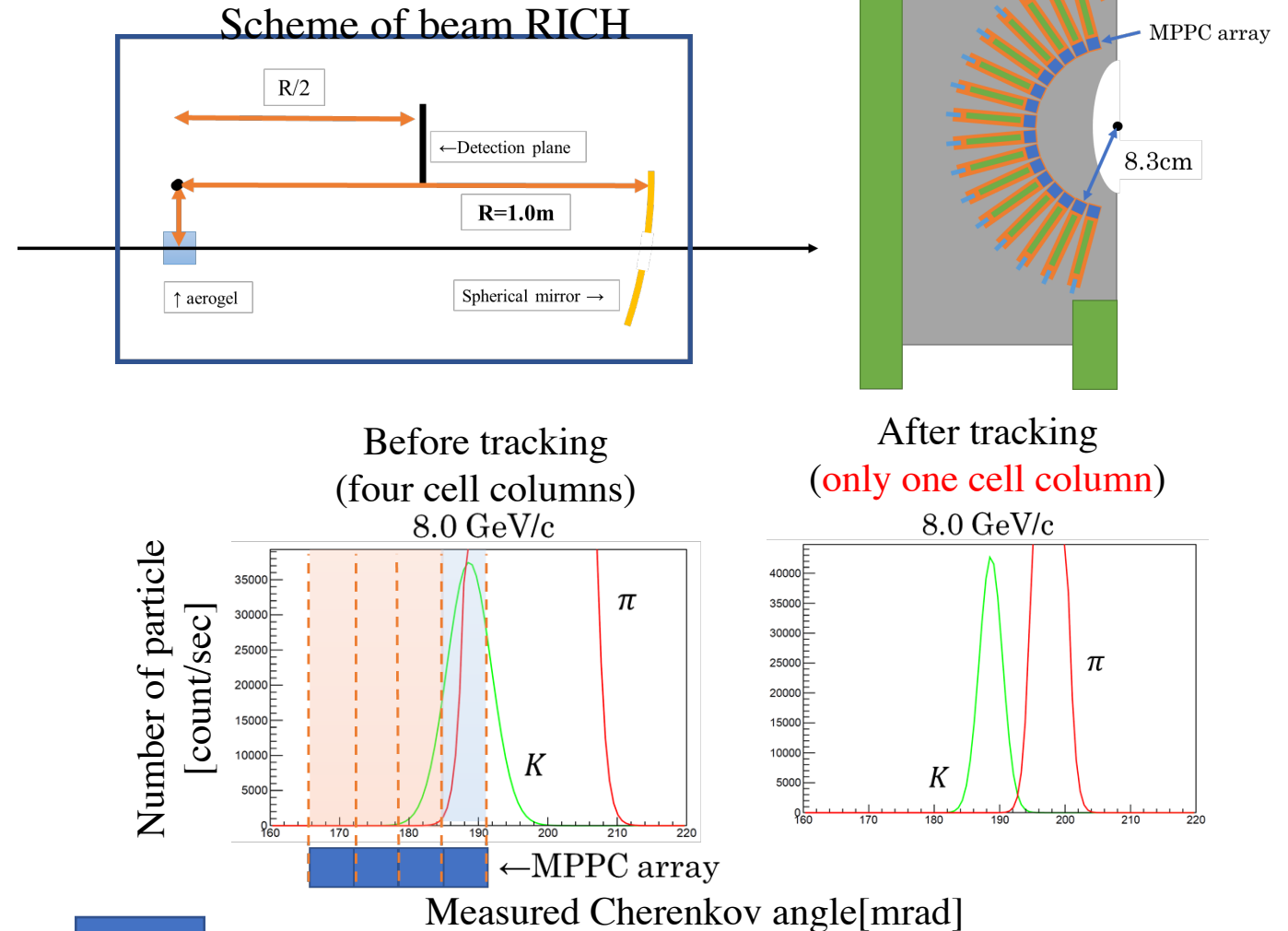
MPPC bias

Read-out

MPPC array

8.3cm

Expected performance :

Angular resolution of 1 p.e. : $\sigma_\theta = 4.5$ mrad

Number of p.e. : $N_{p.e.} \sim 10\ p.e.$
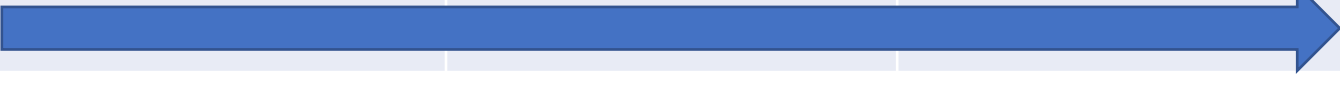
➔ Good PID @ 5-8 GeV/c with tracking
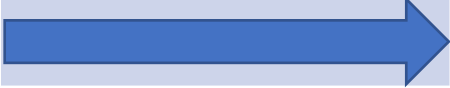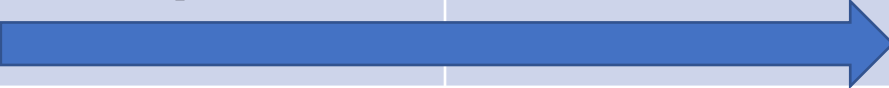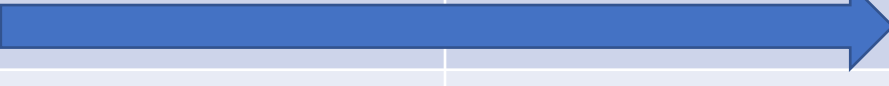
➔ Enough number of p.e. for noise separation

Before tracking
(four cell columns)
8.0 GeV/c

Number of particle [count/sec]

π

K

←MPPC array

Measured Cherenkov angle[mrad]

After tracking
(only one cell column)
8.0 GeV/c

π

K

Test experiment at LEPS for evaluation of beam RICH

Research schedule

	M2	D1	D2	D3
Beam RICH	Development of prototype →	Development of actual beam RICH detector →		
CITIROC streaming DAQ	Development for prototype beam RIHC →			
CDS		Development of streaming DAQ for CDS →		
K1.8BR		Study CDS and join K1.8BR experiment →		

Cylindrical Detector System (CDS) : Scattered particle detectors at J-PARC K1.8BR beamline. We plan to use this detectors as scattered particle detectors for high-p beamline.

Research in abroad

EMPHATIC experiment
 : hadron scattering experiment@Fermilab

- Use detectors developed by J-PARC high-p group
- We can measure the background of J-PARC E50 experiment with EMPHATIC setup
- Experiment will be conducted in the fall of 2021

I have two plan to join this experiment

Plan 1 : Go Fermilab and join run in the fall of 2021

Plan 2 : Join run in the fall of 2021 by remote shift

Fallback plan

- Discussion with EMPHATIC group
- Join international seminars