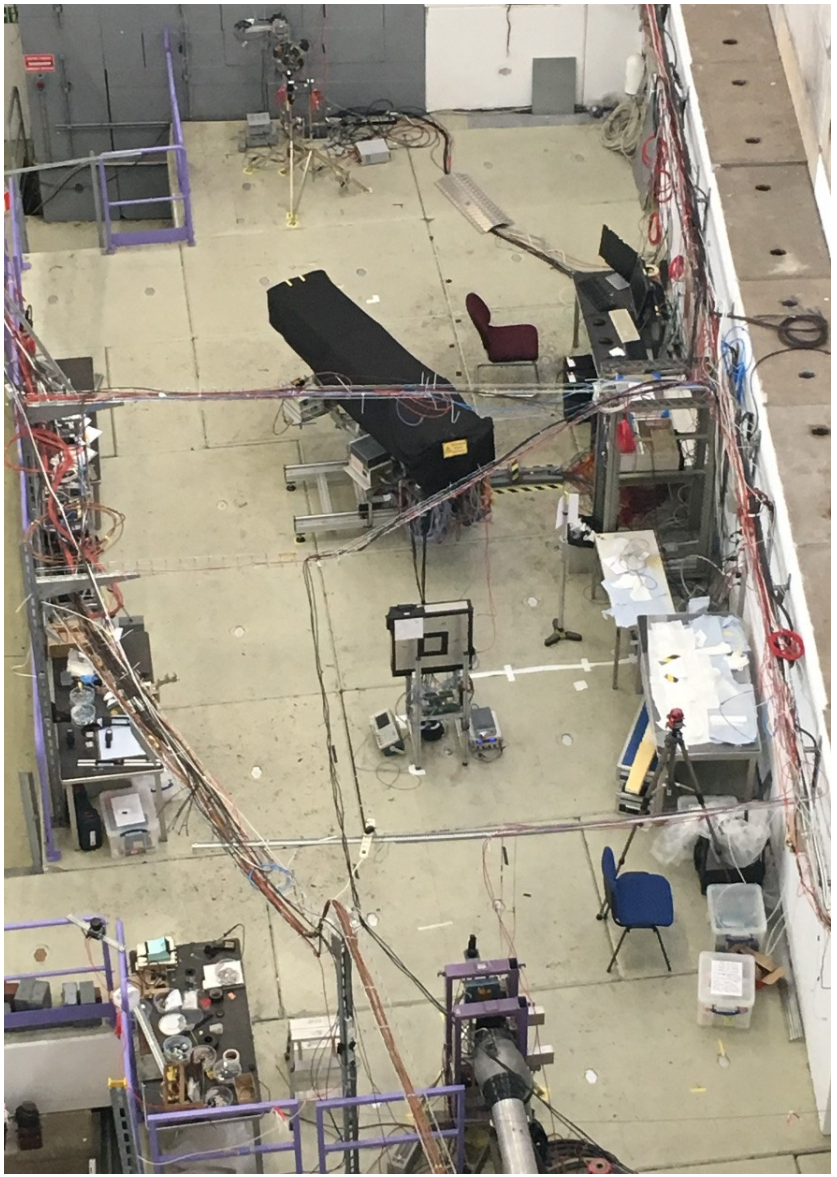
Status of the CERN 2016 Beam Test Analysis

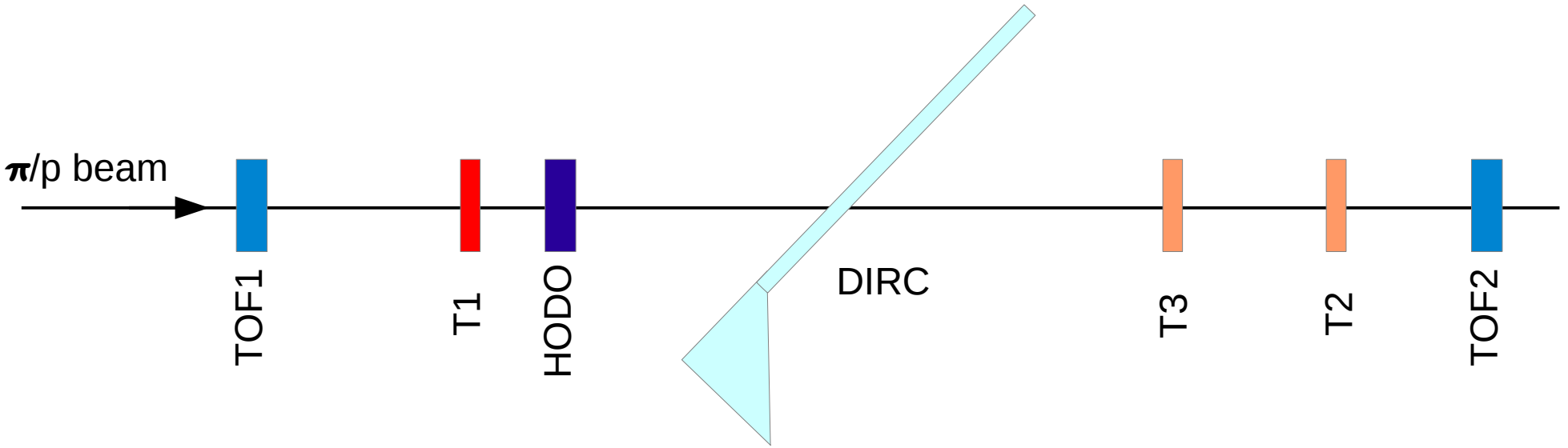


Roman Dzhygadlo,
Panda Cherenkov Group

- prototype test at CERN 2016
- data selection and calibration
- photon yield
- TI reconstruction results
- summary

PANDA meeting
03.17

Cern 2016 Prototype Test

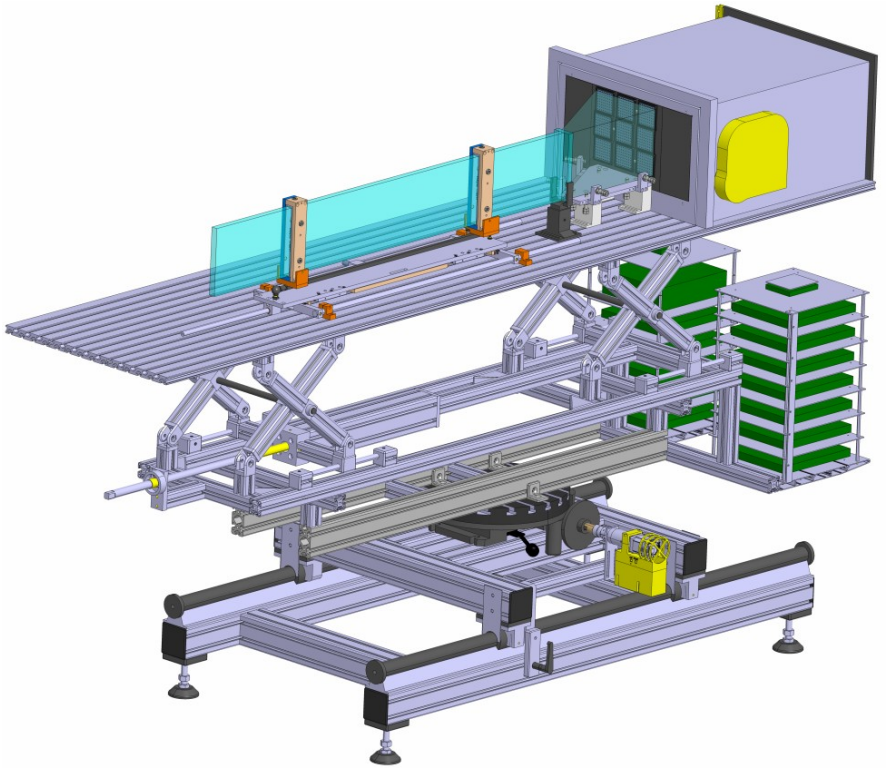


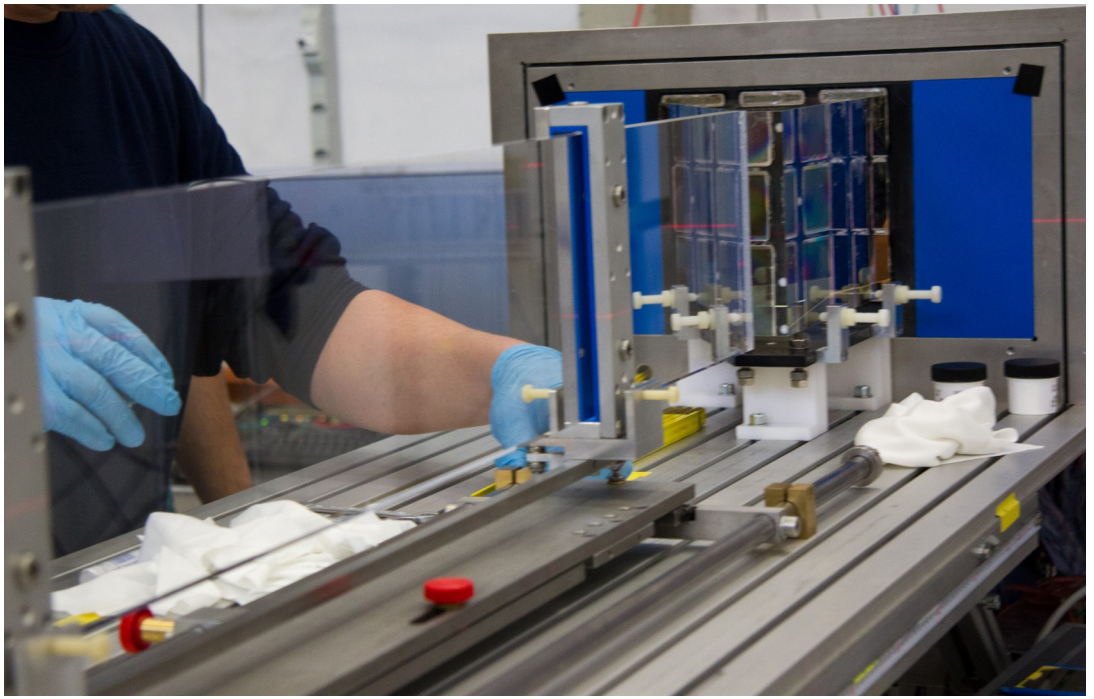
- main goal: validate the PID performance of the plate design

- CERN T9 area
- beam type: protons and pions
- beam momentum: 8, **7**, 6, 5, 4, 3 GeV/c
- TOF PID

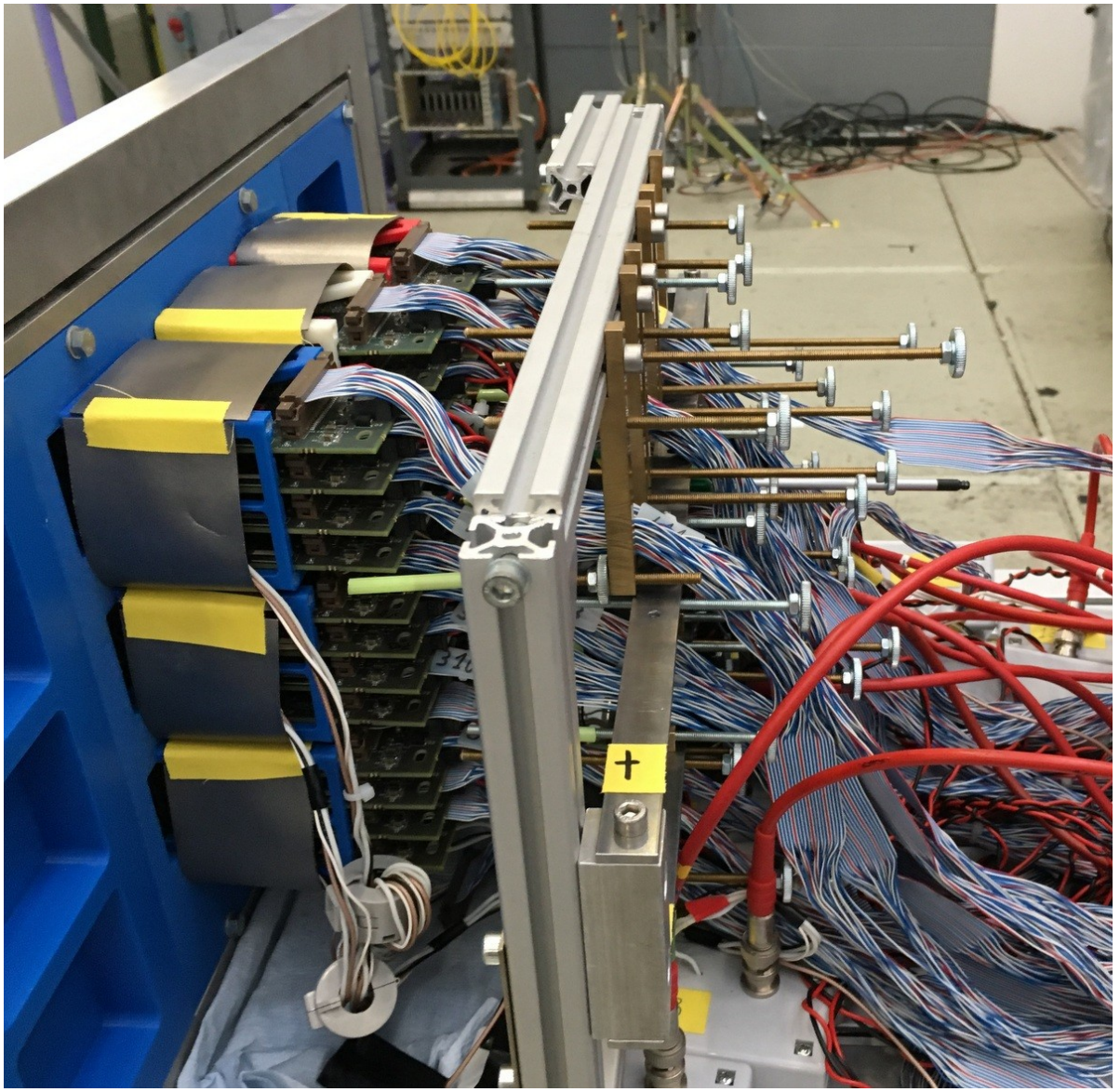
- 30 degree prism as expansion volume => 9 MCP-PMTs (vs 15 last year)
- different configurations of the DIRC prototype (most of the data are with plate)
- different DIRC prototype angles

CERN 2016 DIRC Prototype Photo

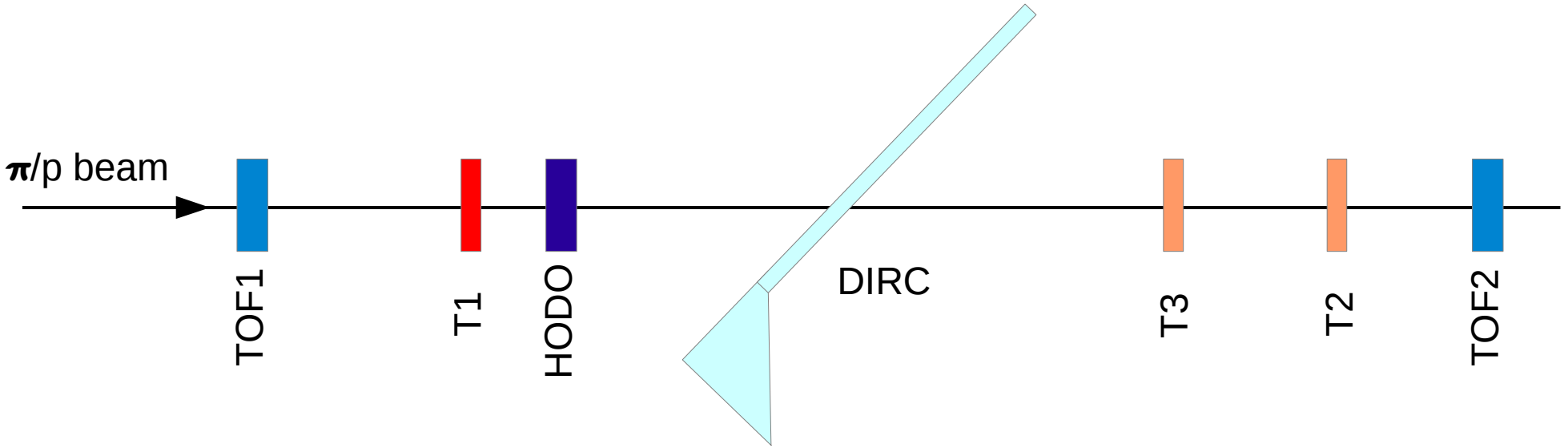




Cern 2016 DIRC Prototype Photo



Event Selection

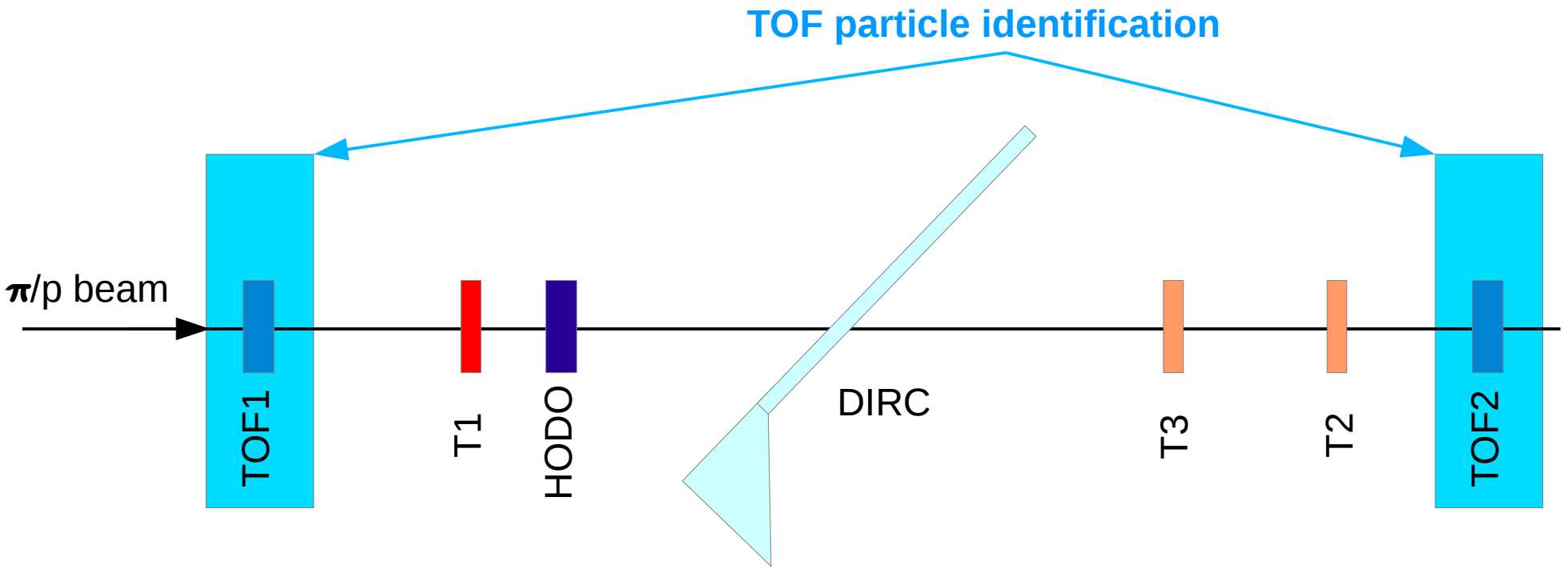


Event selection:

T1	100%
+ TOF1,TOF2	30%
+ T2,T3	10%
+ HODO	<1%

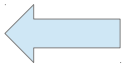
> 0.5B event on T1 level

Event Selection



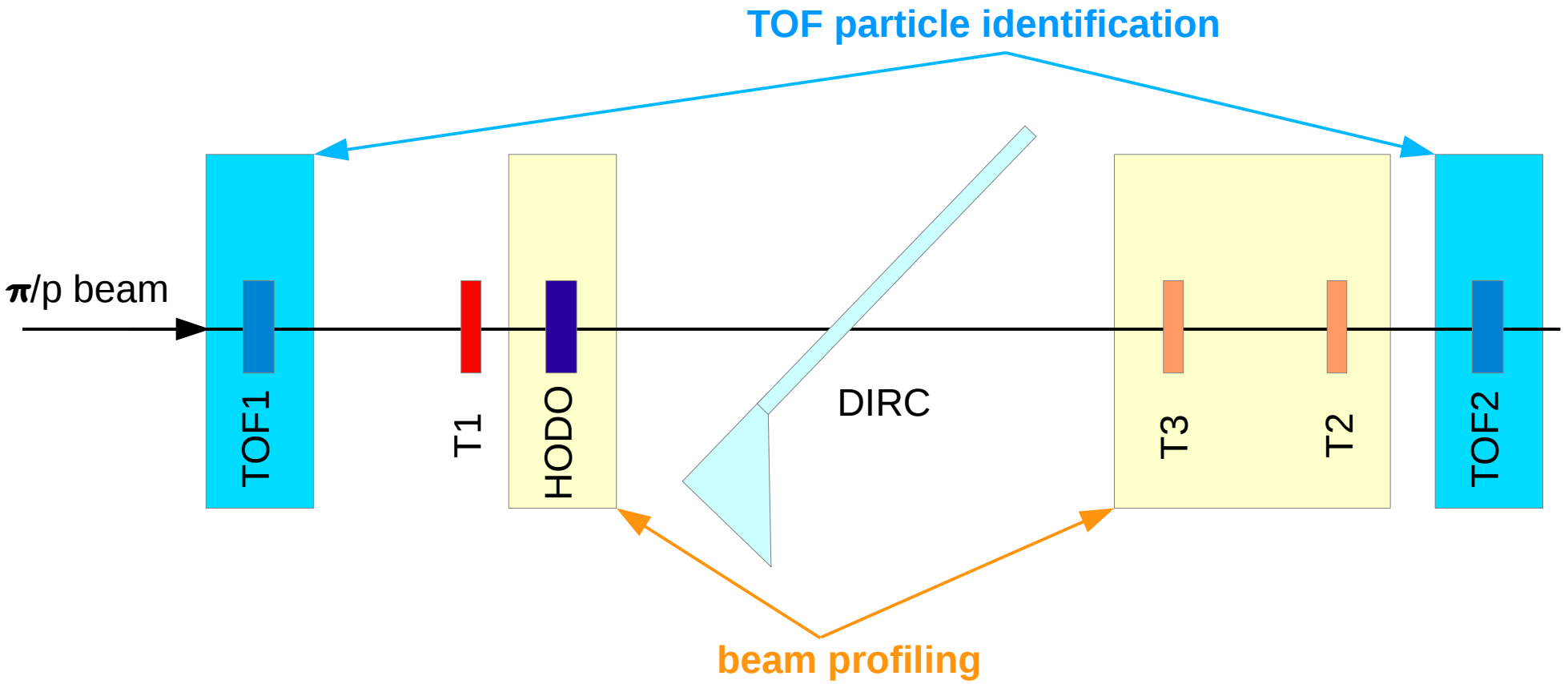
Event selection:

T1	100%
+ TOF1,TOF2	30%
+ T2,T3	10%
+ HODO	<1%



> 0.5B event on T1 level

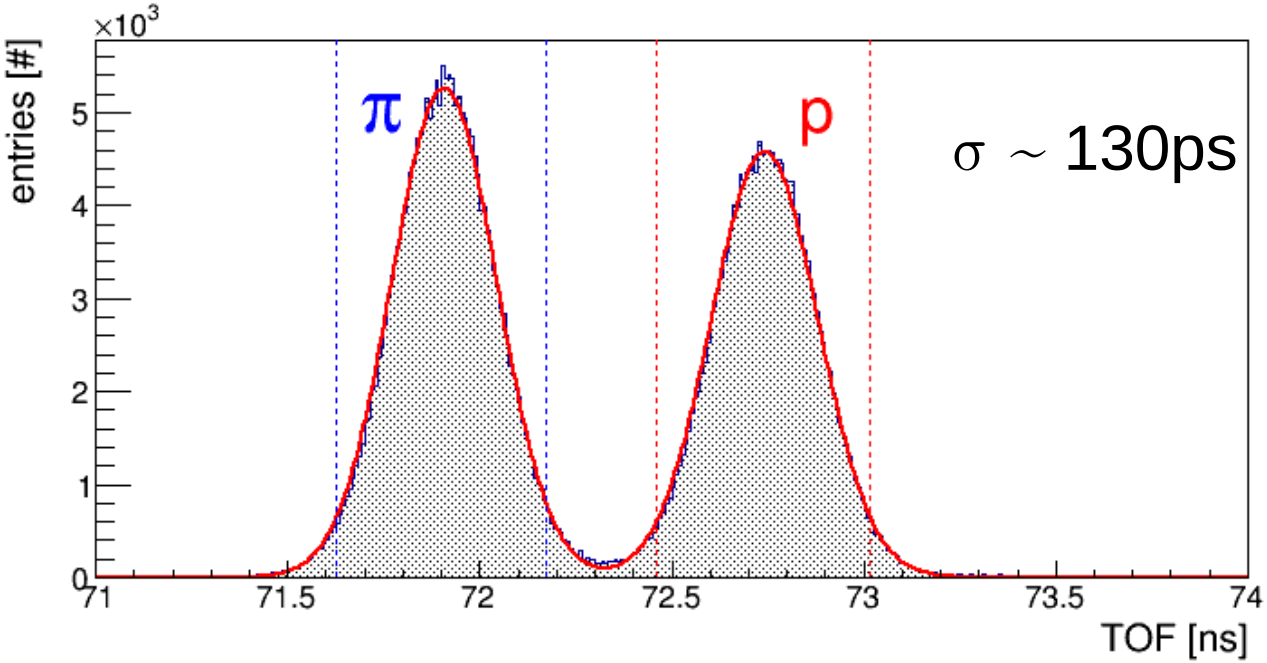
Event Selection



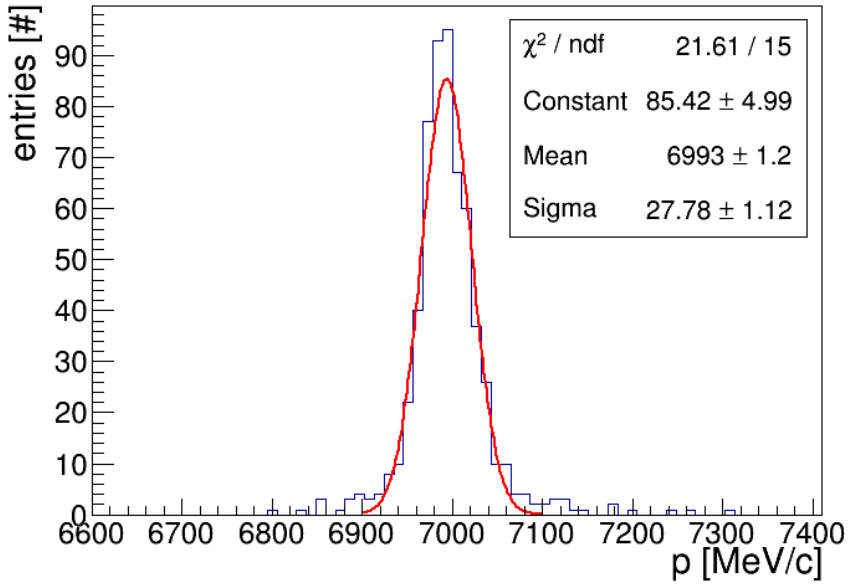
Event selection:

T1	100%	> 0.5B event on T1 level
+ TOF1,TOF2	30%	
+ T2,T3	10%	
+ HODO	<1%	

TOF PID



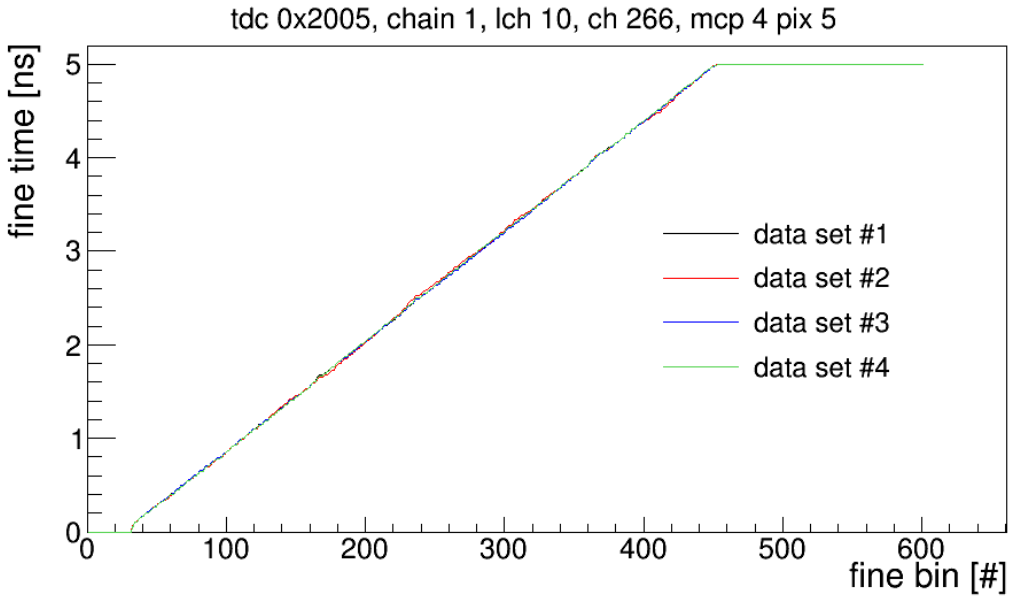
Difference of the MCP-OUT signal of TOF2 and TOF1 counters after walk correction @ 7 GeV/c



Beam momenta from each run

- stable with time
- p = 6990 +/- 20 MeV/c

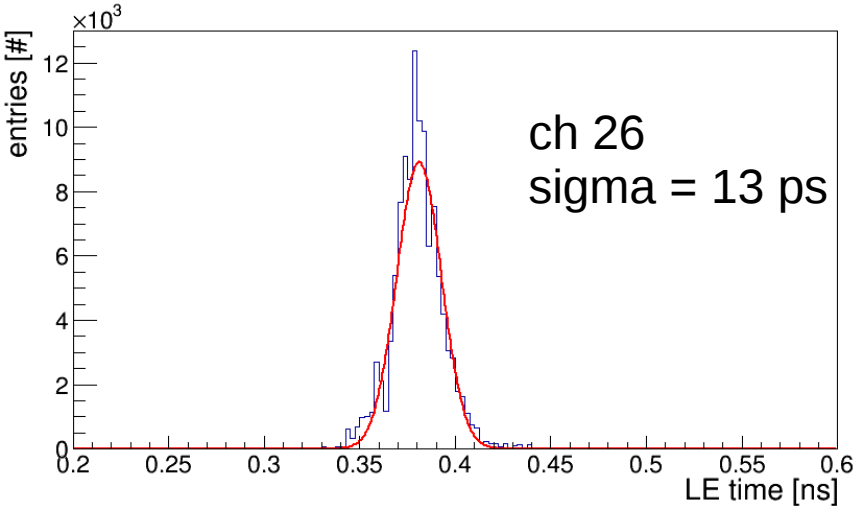
Fine Time Calibration

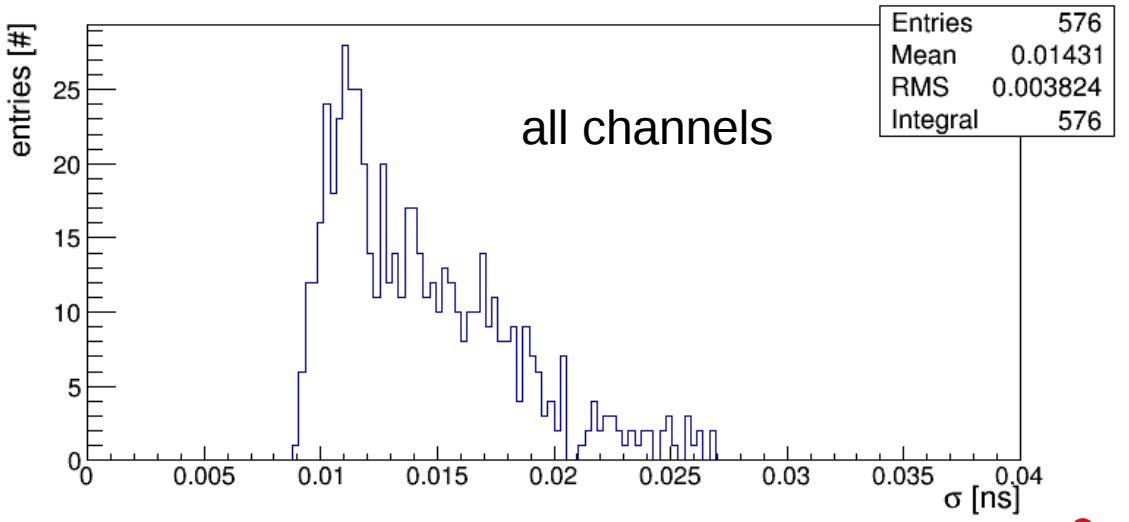


Time = epoch time
+ coarse time
+ fine time

stable with time

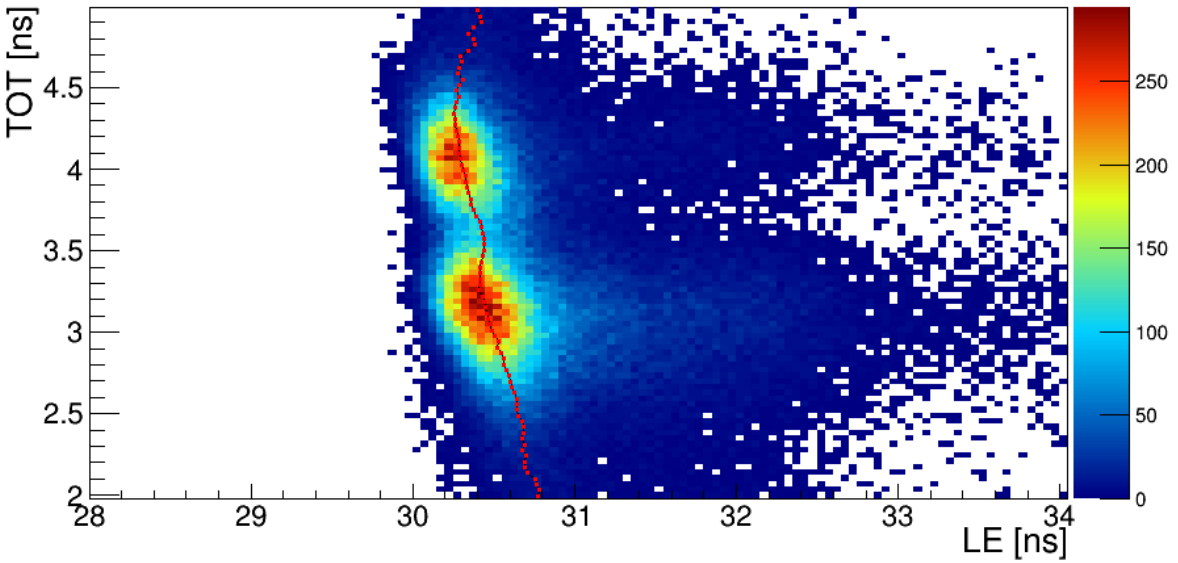
Example of the electronic time resolution:

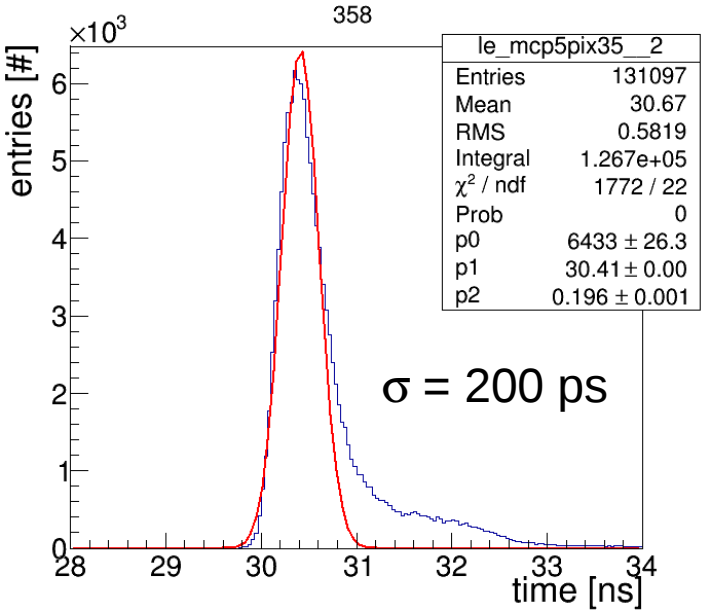




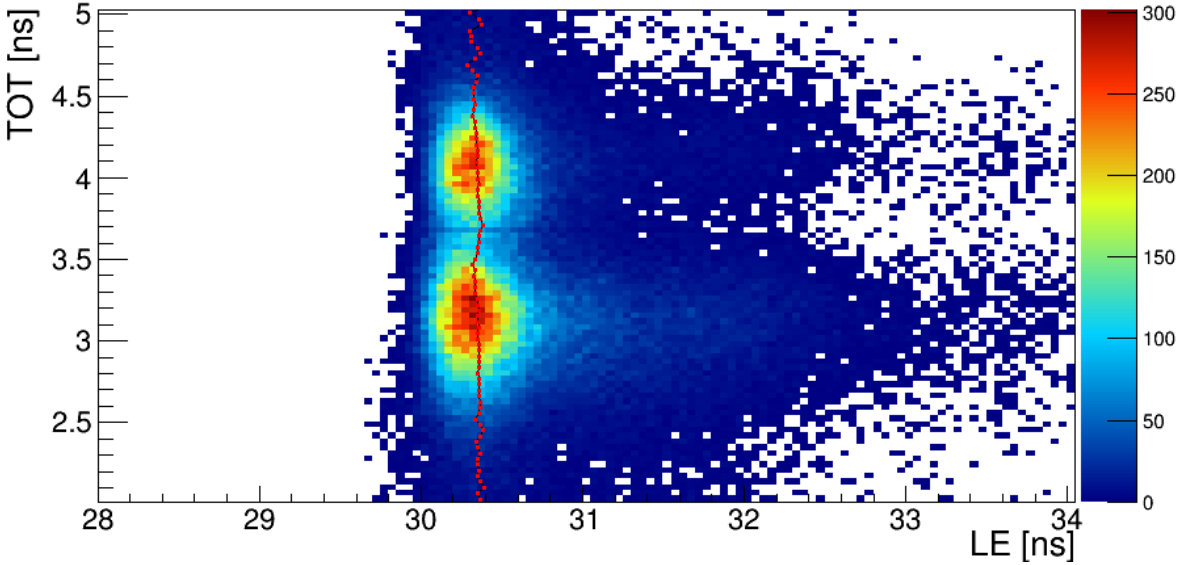
Time Walk Correction of the DIRC ch.

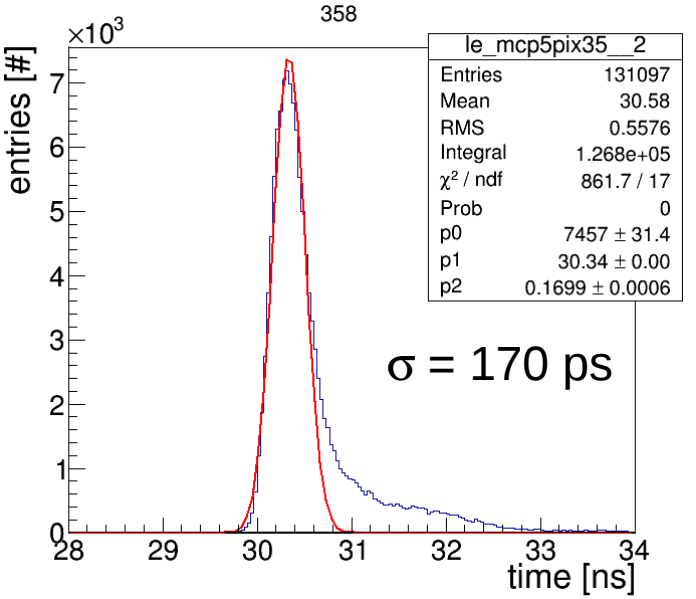
ch 358 before correction:



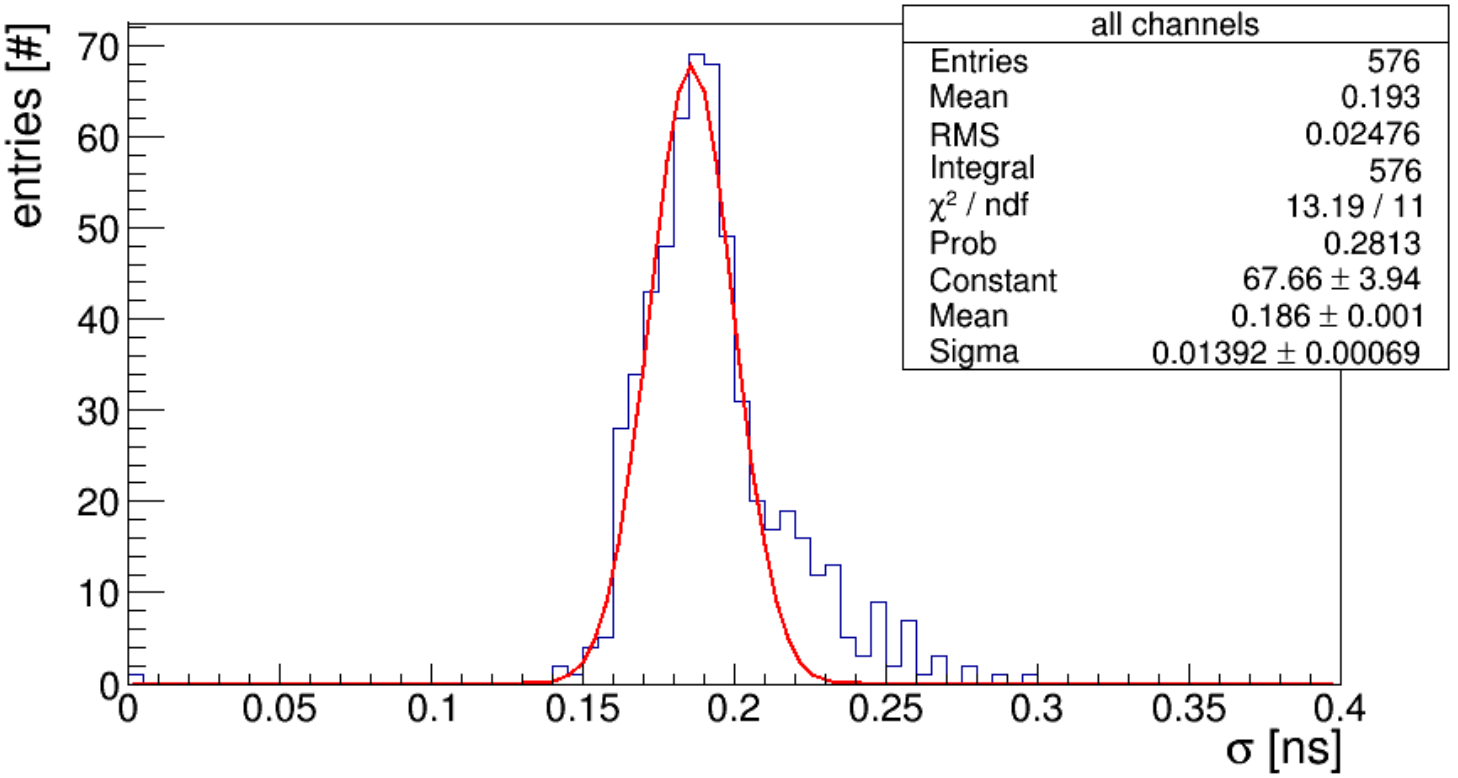


ch 358 after correction:



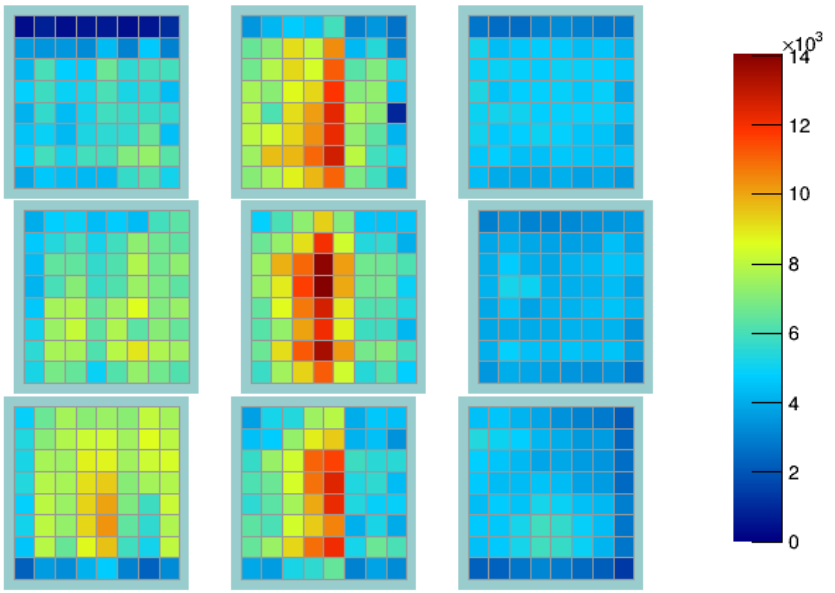


Time Resolution of the PILAS Runs



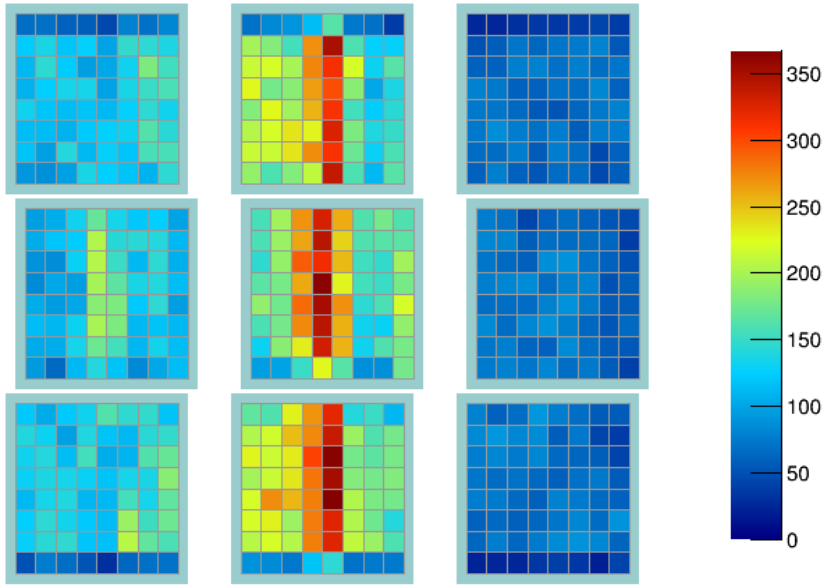
mean = 186 ps

Hit Patterns: Plate with Cyl. Lens



25 degree polar angle
7 GeV/c

Beam data for pion tag

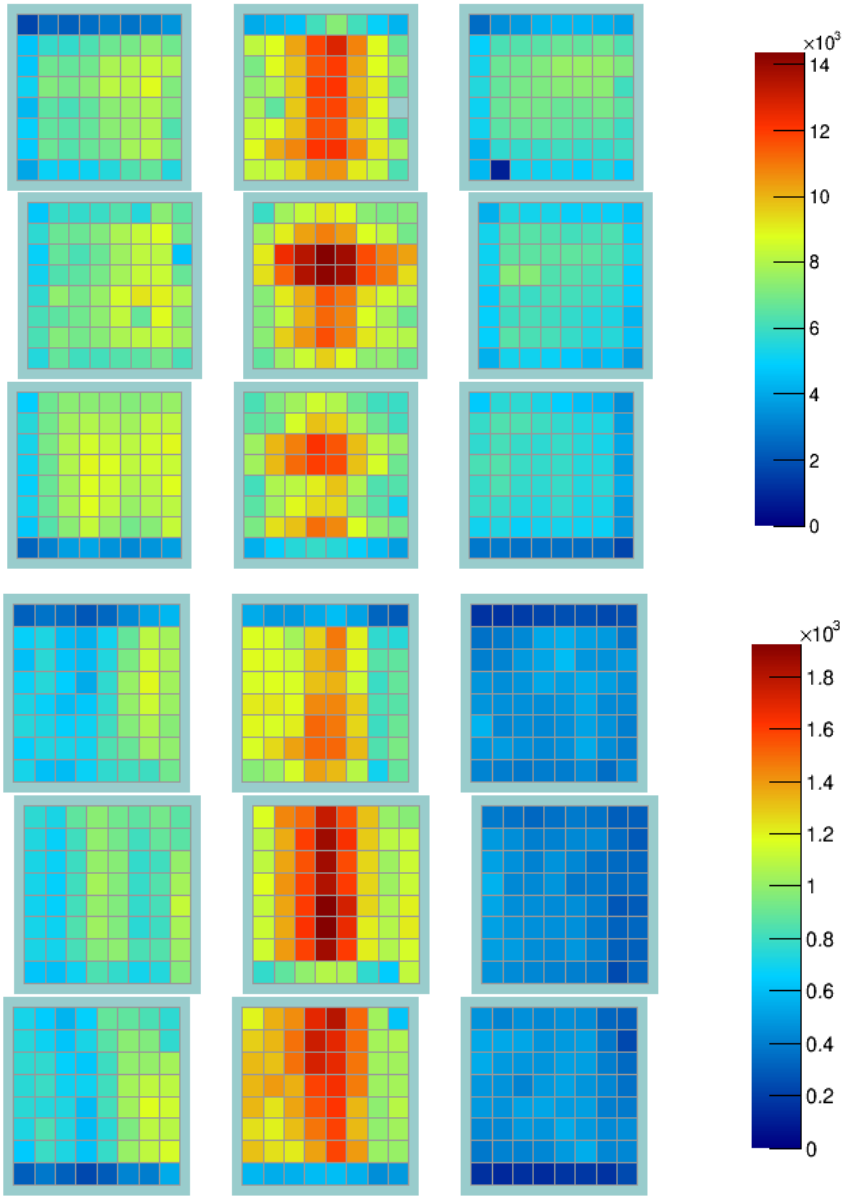


Simulation for pions

Standalone geant4 simulation includes:

- transport efficiency
- quantum/collection efficiency
- charge sharing
- 190 ps time resolution

Hit Patterns: Plate w/o Focusing

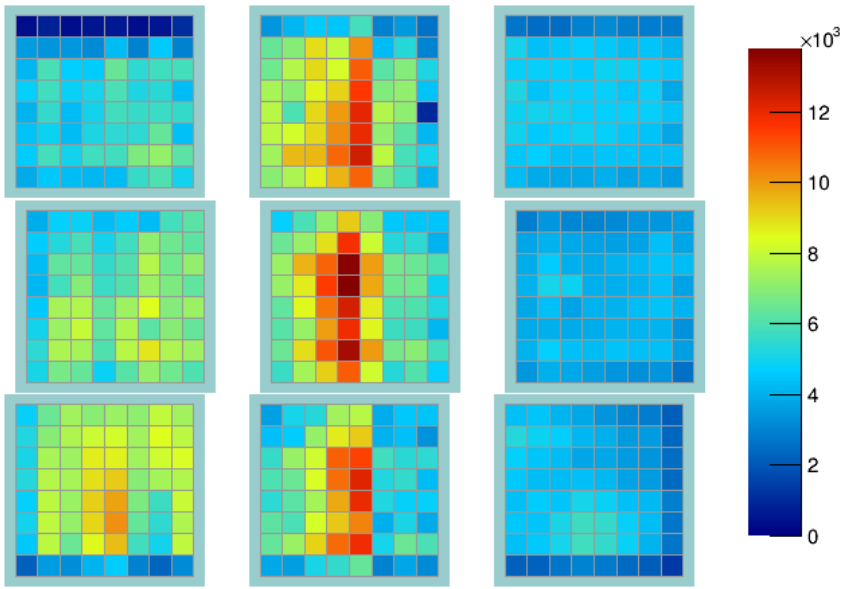


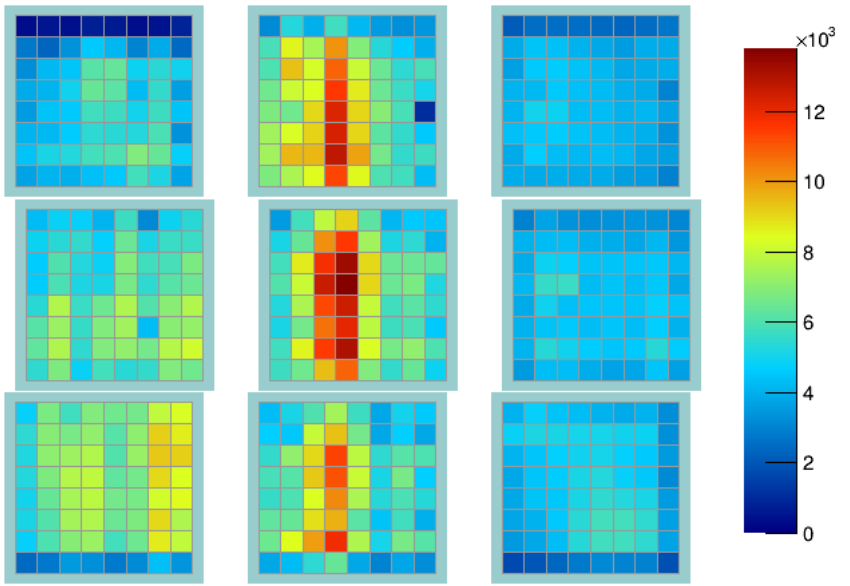
25 degree polar angle
7 GeV/c

Beam data for pion tag

Simulation for pions

Pions vs Protons



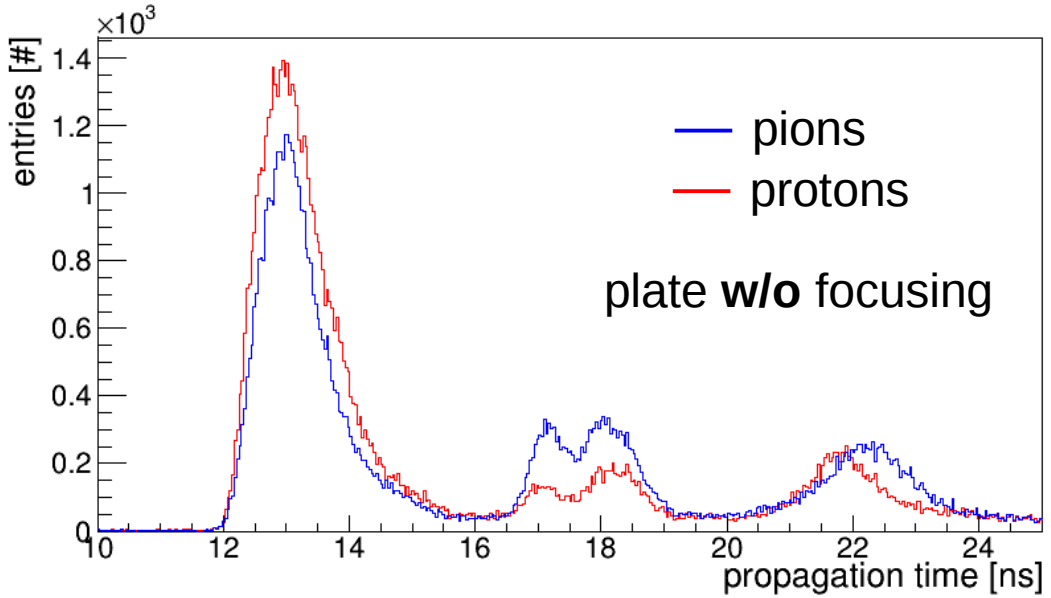


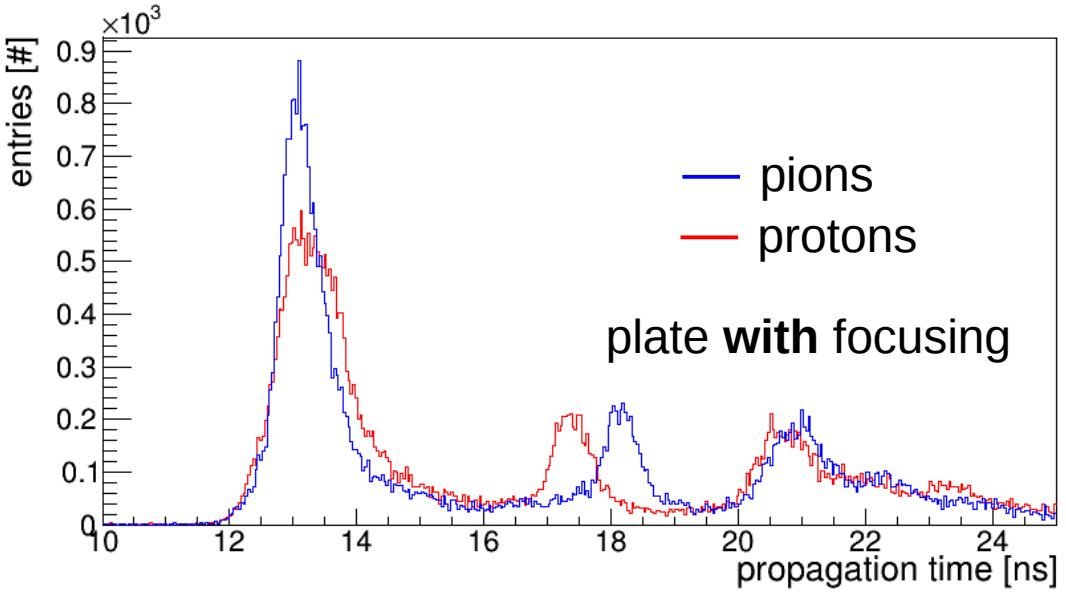
25 degree polar angle
7 GeV/c
plate with cylindrical lens

pions (beam data)

protons (beam data)

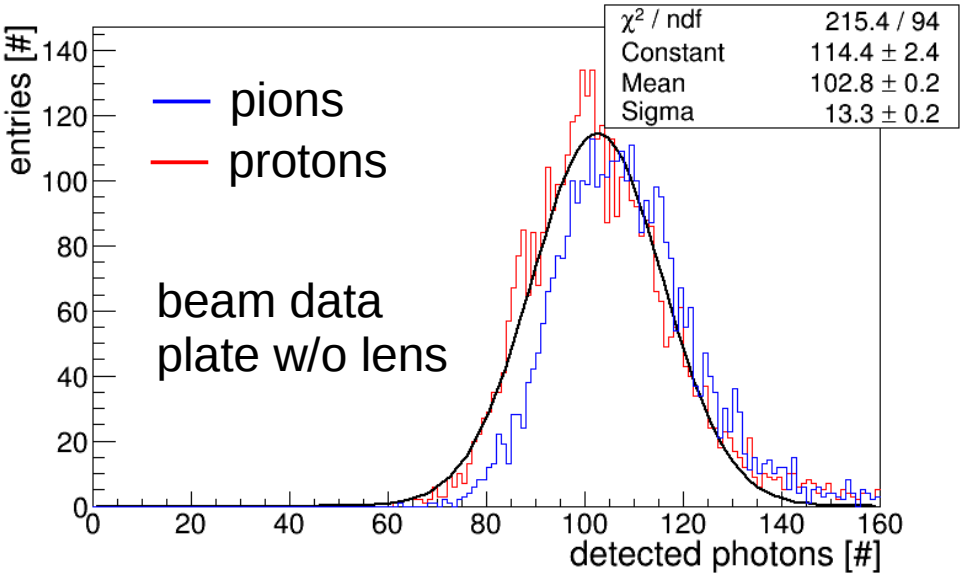
Propagation Time of the Cherenkov Ph.

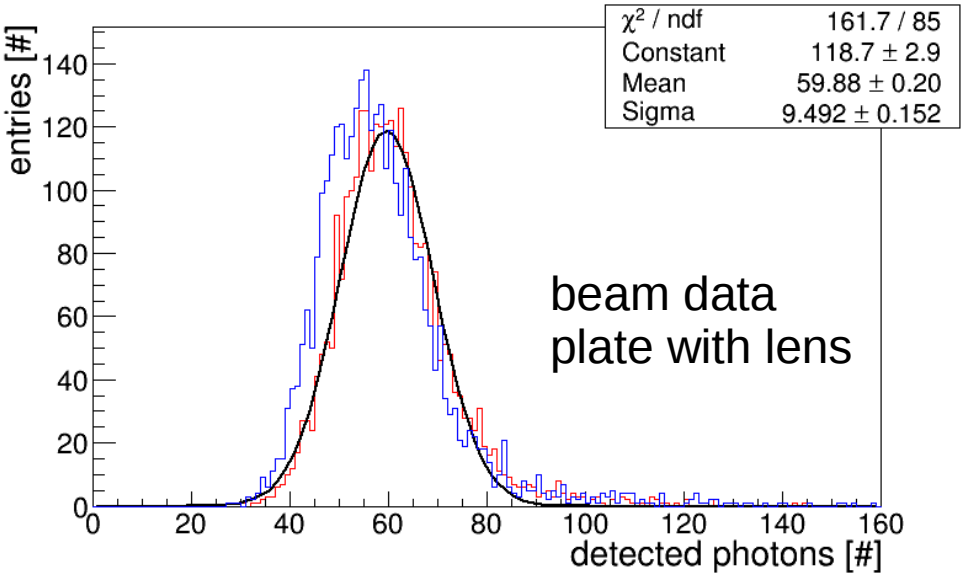


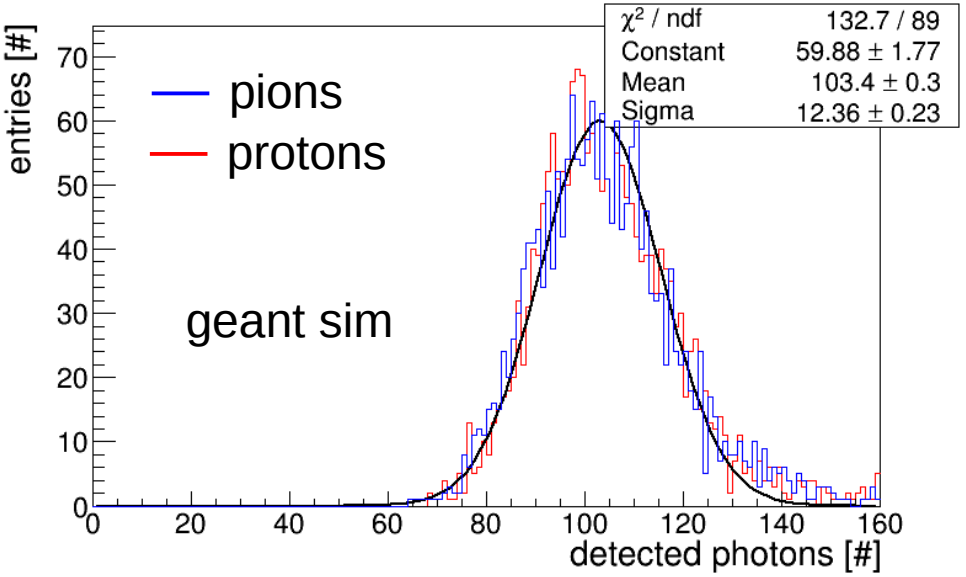


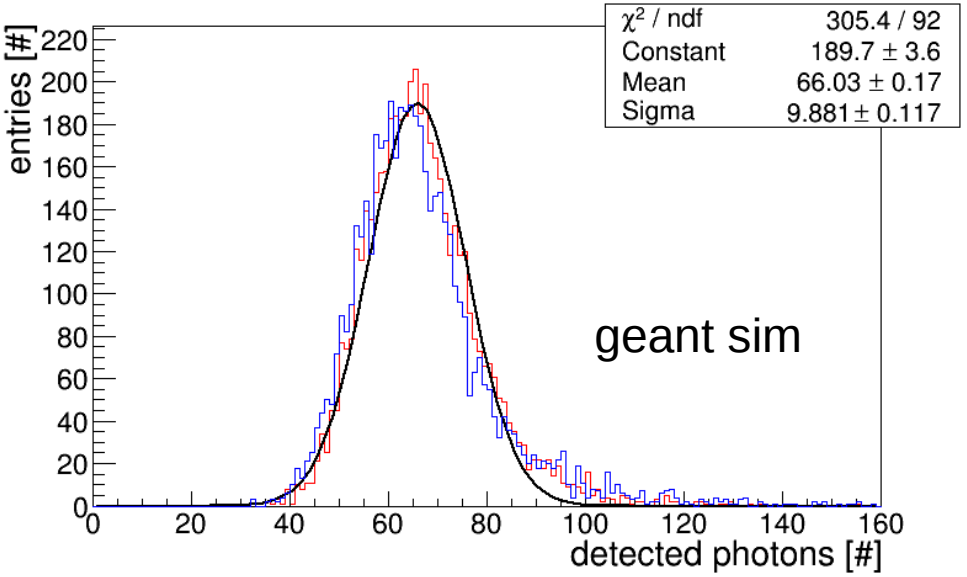
beam data
@ 7 GeV/c
@ 25 degree
ch 363

Detected Photon Yield @ 25 degree



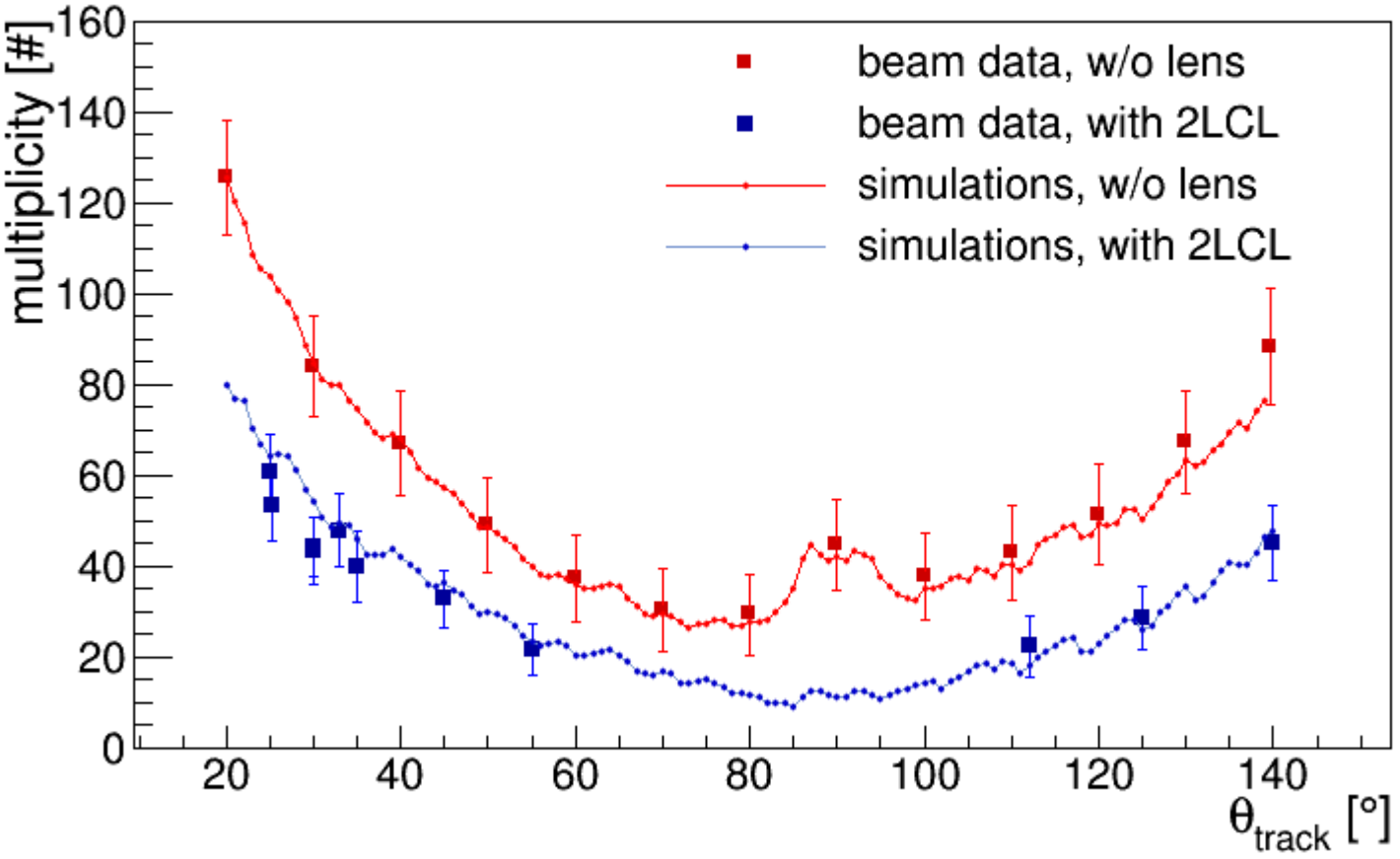






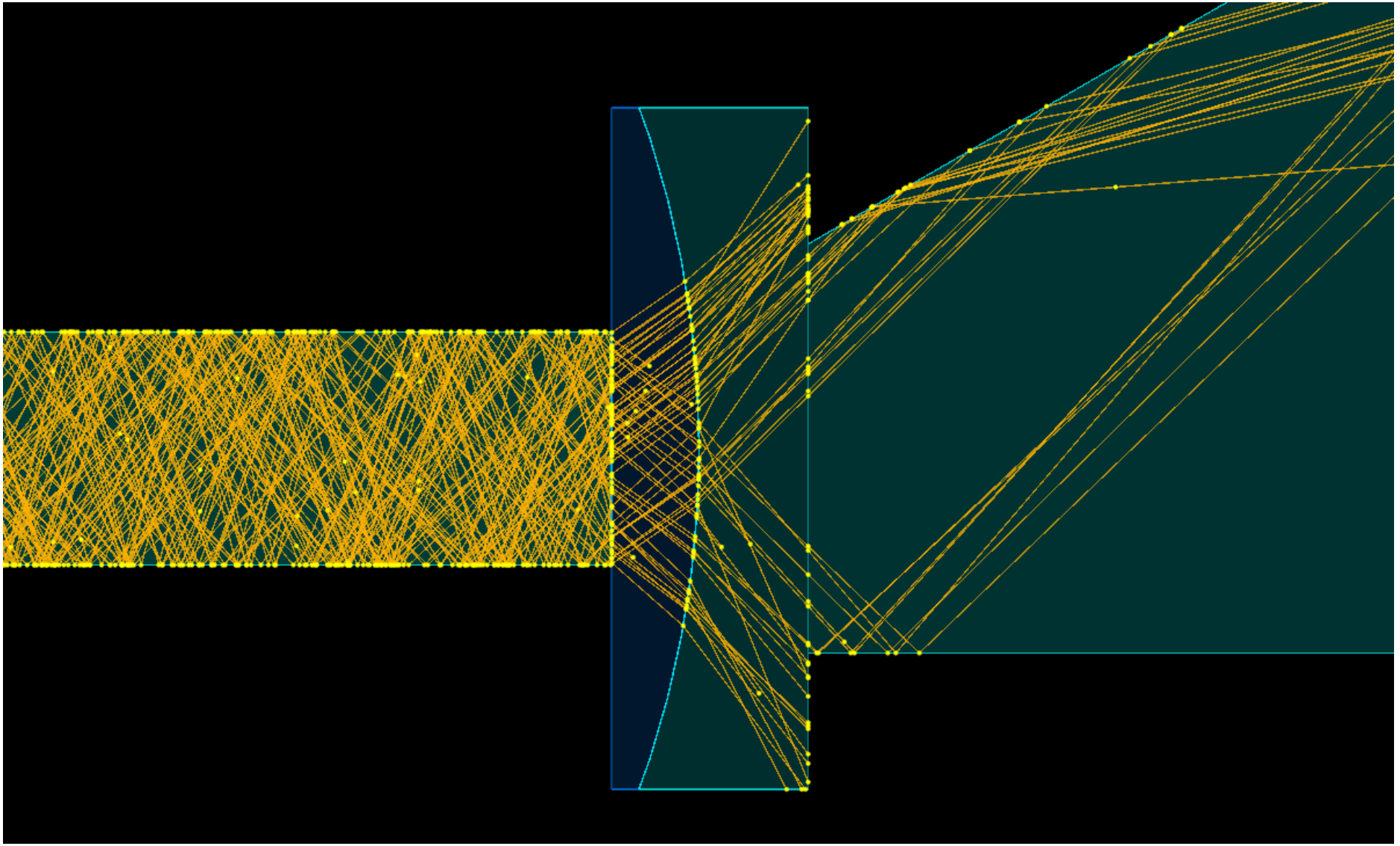
Detected Photon Yield

Plate radiator. Protons @ 7GeV/c and 25° incident angle



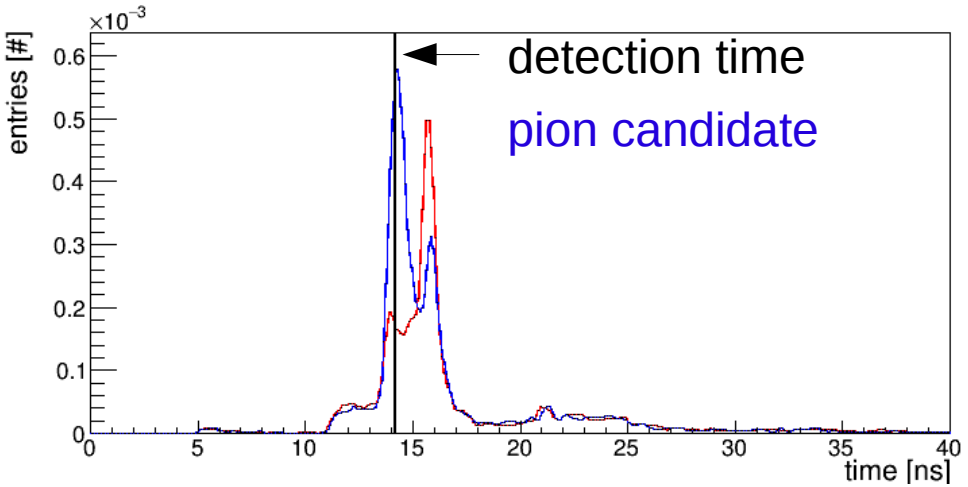
Detected Photon Yield. Geant4 sim

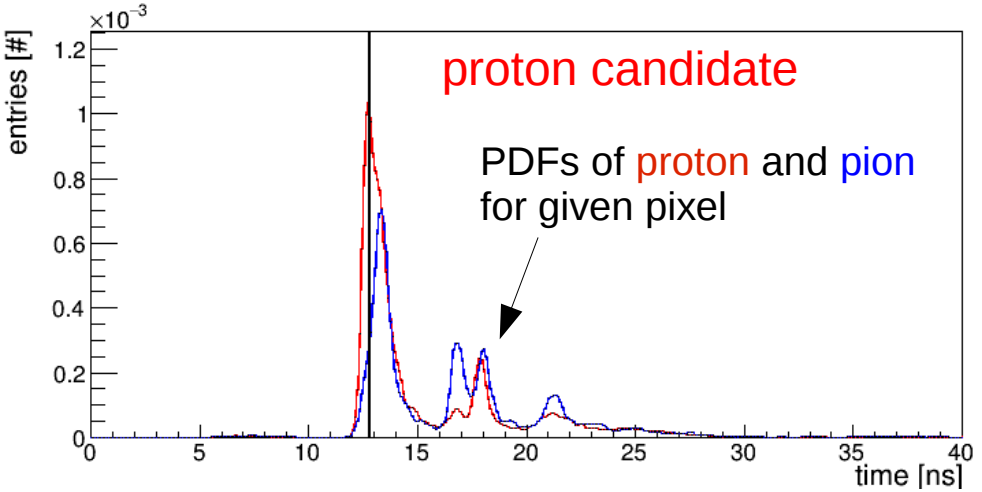
Loss of the photons in the lens:

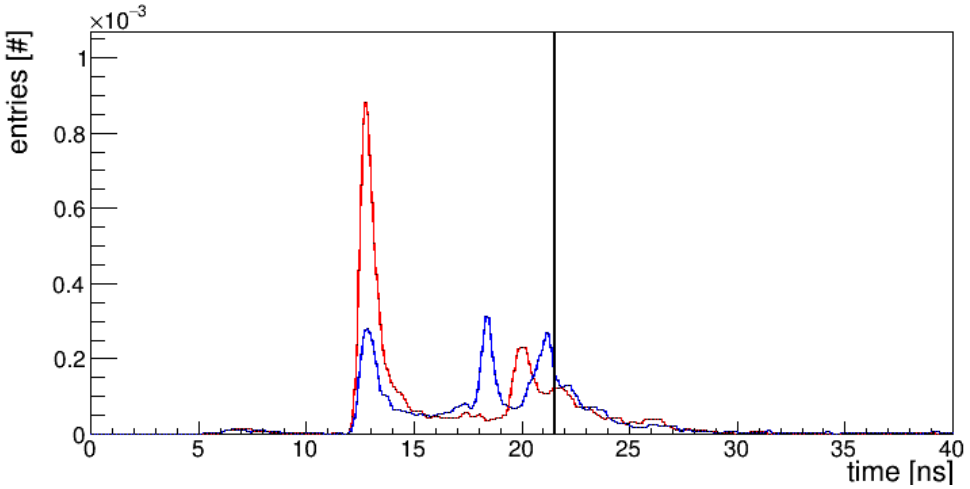


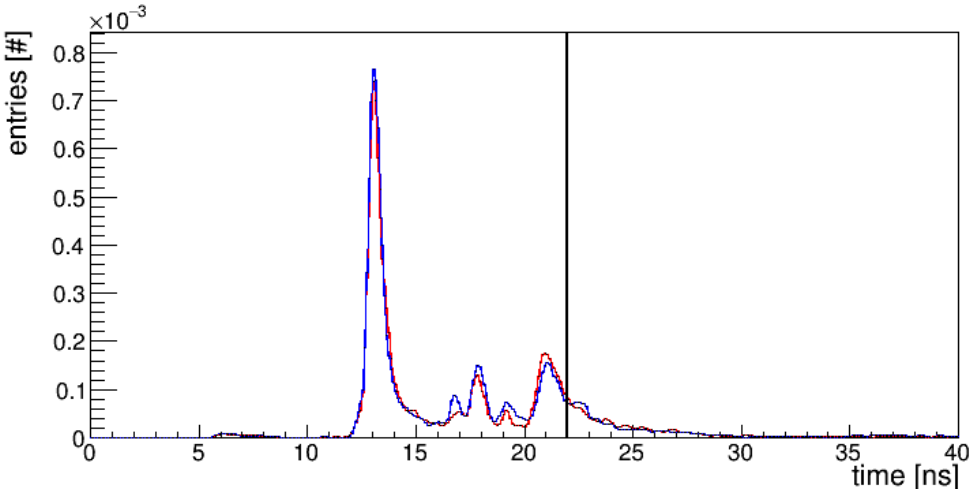
Time Imaging Reconstruction. PDFs

beam data with plate @ 7 GeV/c @ 25 degree





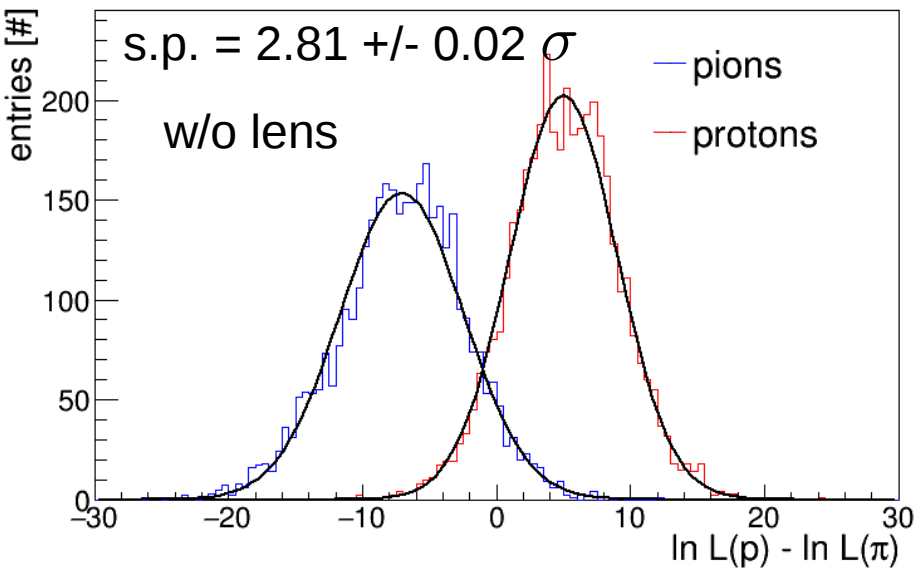


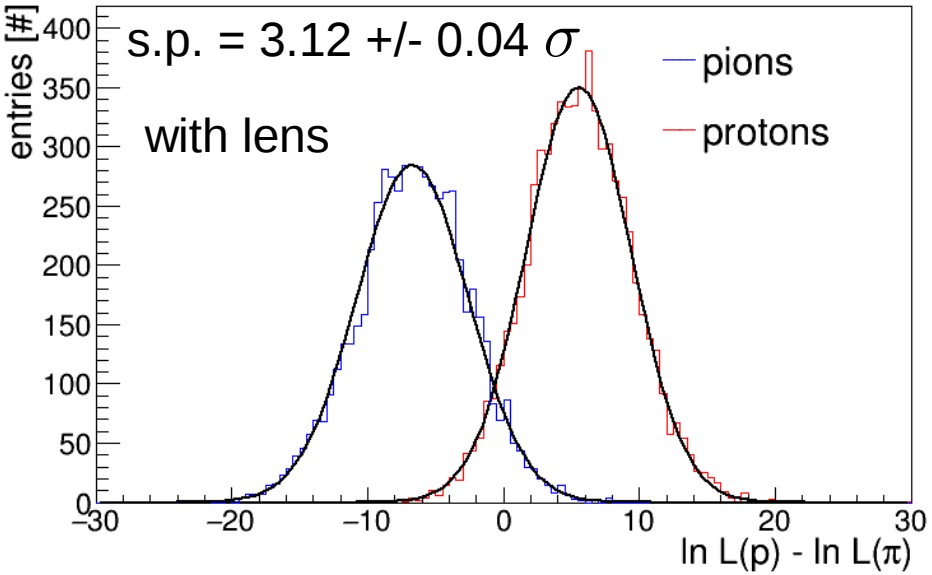


Time Imaging Reconstruction

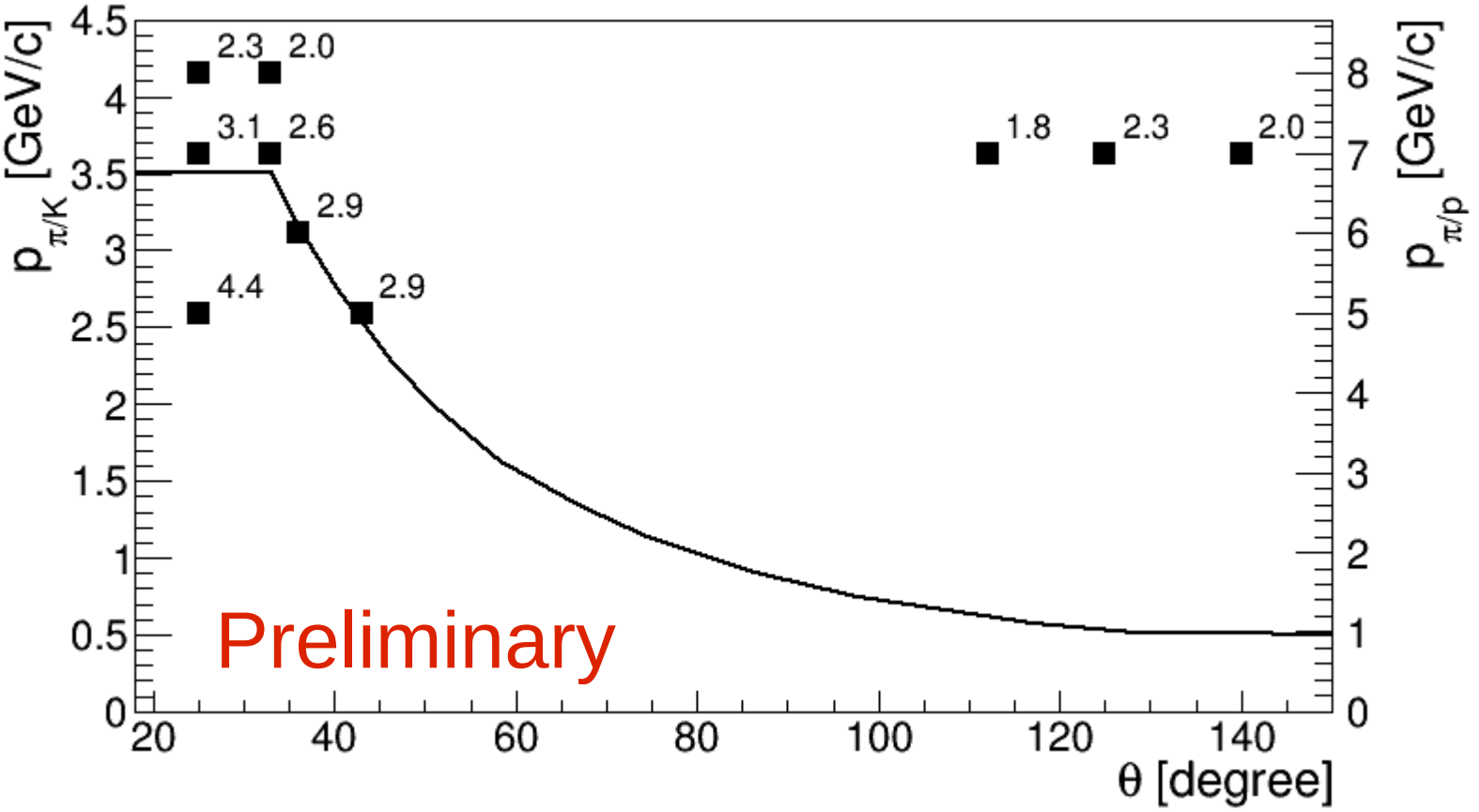
beam data with plate @ 7 GeV/c @ 25 degree

$$N_{\mathrm{sep}} = \frac{|\mu_1 - \mu_2|}{0.5(\sigma_1 + \sigma_2)}$$

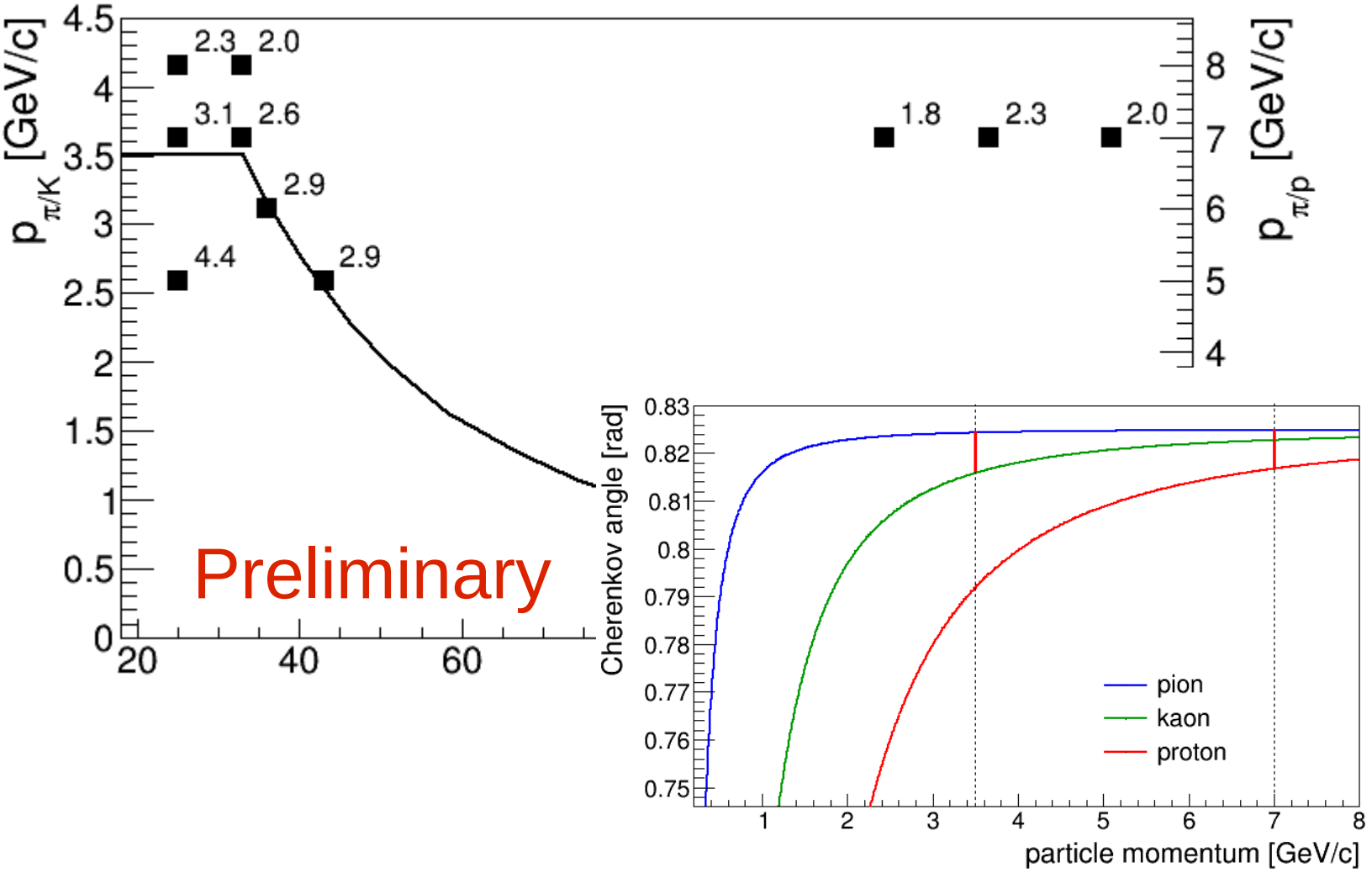




Separation Power Map



Separation Power Map



Separation Power Table

for 7 GeV/c momentum

angle [^{o}]	π/p sep. beam data [s.d]	π/p sep. simulation [s.d]	π/K sep. PANDA sim [s.d]
25	3.1	3.1	9.8
33	2.6	2.7	6.9
112	1.8	1.4	5.4
125	2.3	1.9	6.0
140	2.0	2.3	7.2

Preliminary

Separation Power Table

for 7 GeV/c momentum

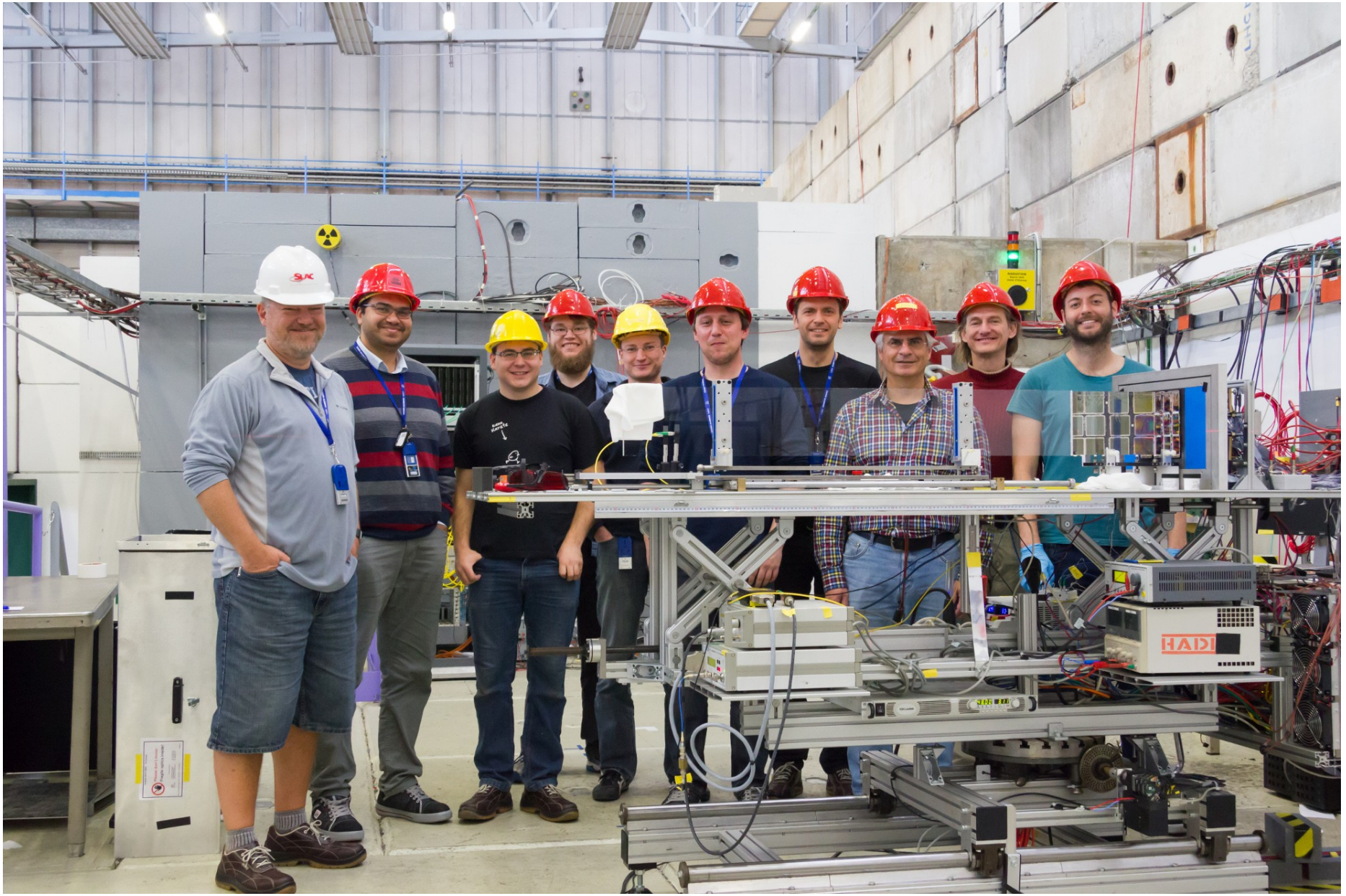
angle [°]	π/p sep. beam data [s.d]	π/p sep. simulation [s.d]	π/K sep. PANDA sim [s.d]
25	3.1	3.1	9.8
33	2.6	2.7	6.9
112	1.8	1.4	5.4
125	2.3	1.9	6.0
140	2.0	2.3	7.2

Preliminary

	vs.	
9 MCP-PMTs		11 MCP-PMTs
2-layer cylindrical lens		3-layer cyl. Lens
190 ps time resolution		100 ps
2 mrad track resolution		1-2 mrad

Summary and Outlook

- Test beam was successful (recorded >0.5B triggers for different prototype config.)
- Achieved time resolution of about 190 ps is better than last year but still significantly worse than 100 ps goal
- Improved pi/p separation compared to 2015
- The design with cylindrical lens performs better (despite the lens was not matching prism)
- Good agreement between data and simulations indicates that the plate radiator with the 3-layer cylindrical lens will reach PANDA PID goal if the time resolution < 150ps



Thank you for the attention

Separation Power Table

for 7 GeV/c momentum

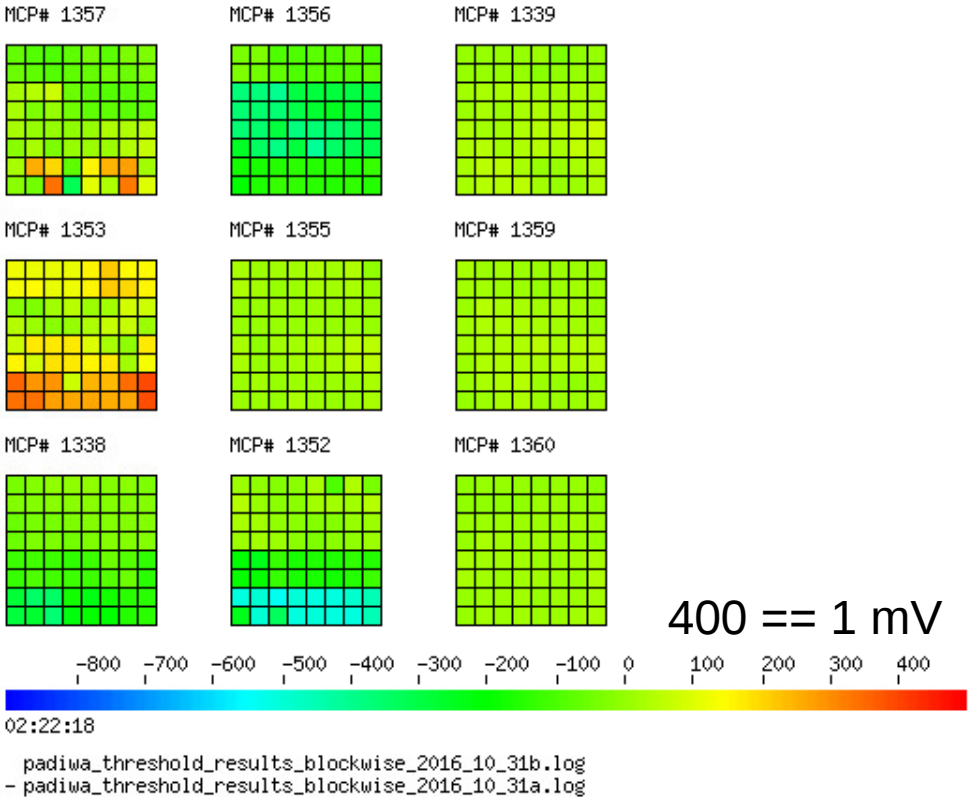
angle [^{o}]	π/p sep. beam data [s.d]	π/p sep. simulation [s.d]	π/p sep. PANDA design sim	π/K sep. PANDA sim [s.d]
25	3.1	3.1	4.4	9.8
33	2.6	2.7	3.8	6.9
112	1.8	1.4	2.7	5.4
125	2.3	1.9	3.2	6.0
140	2.0	2.3	3.7	7.2

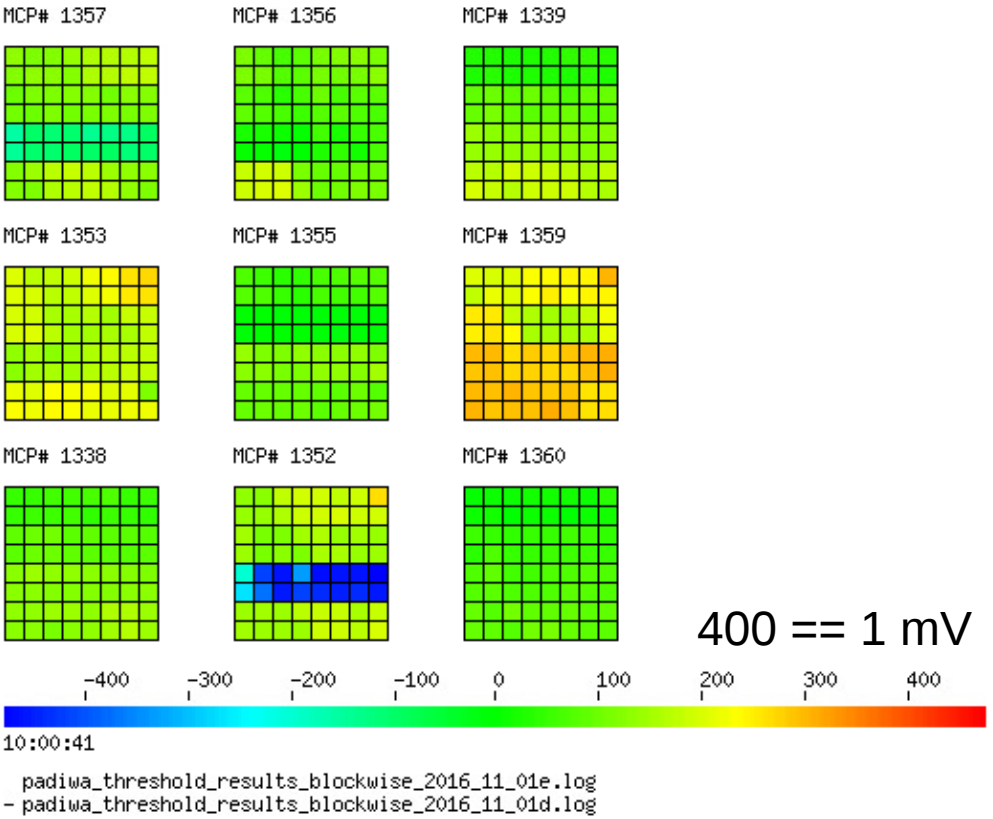
Preliminary

150 ps vs. 100 ps
2 mrad vs. 1-2 mrad

Threshold Floating

Threshold difference after few hours of data taking:





- floating in the range of [-1,+1] mV
- the data were taken with 0.5-2 mV offset to the threshold value due to low amplitude signals

Significant impact on recorded hit multiplicity