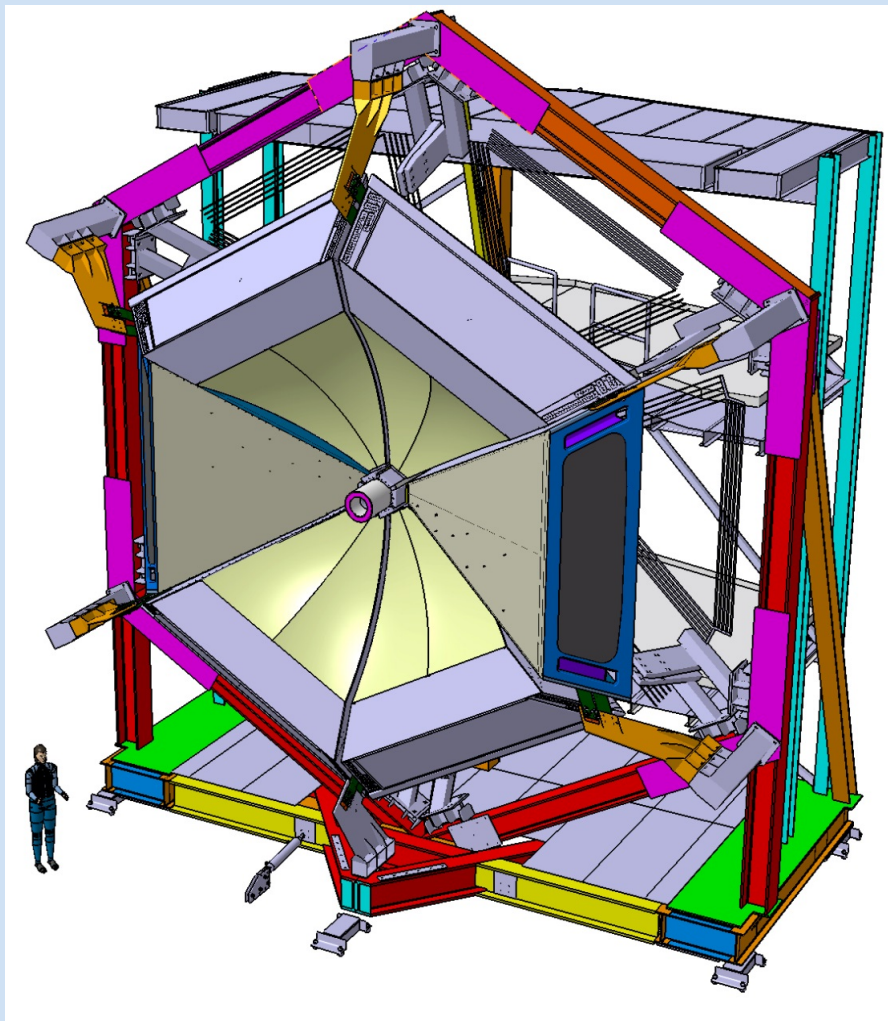




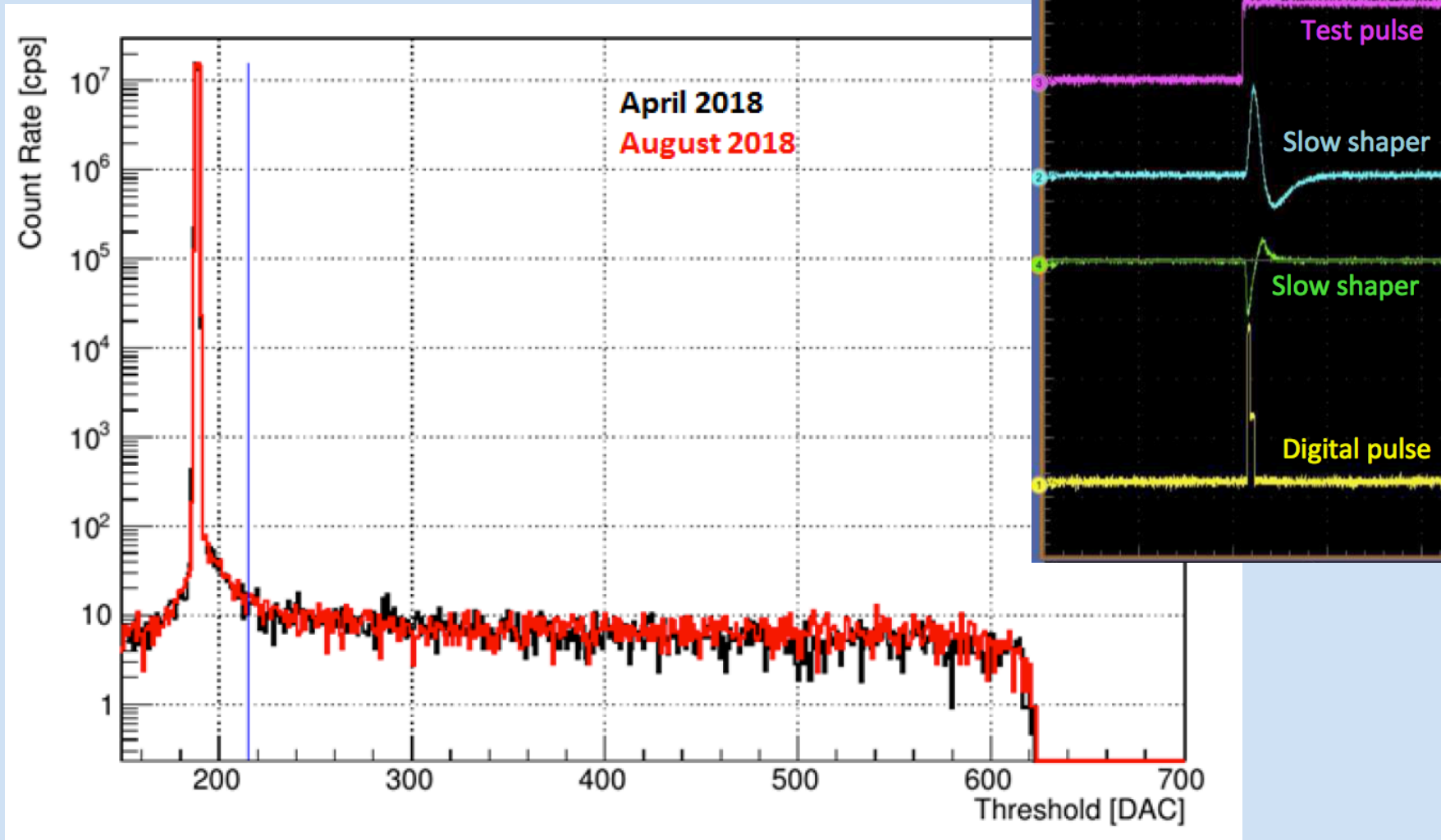
RICH Update

Contalbrigo Marco
INFN Ferrara

CLAS Coll. Meeting, November 13th 2019, JLab

RICH Stability

1 s on-board scalers counting the discriminated MaPMT dark counts

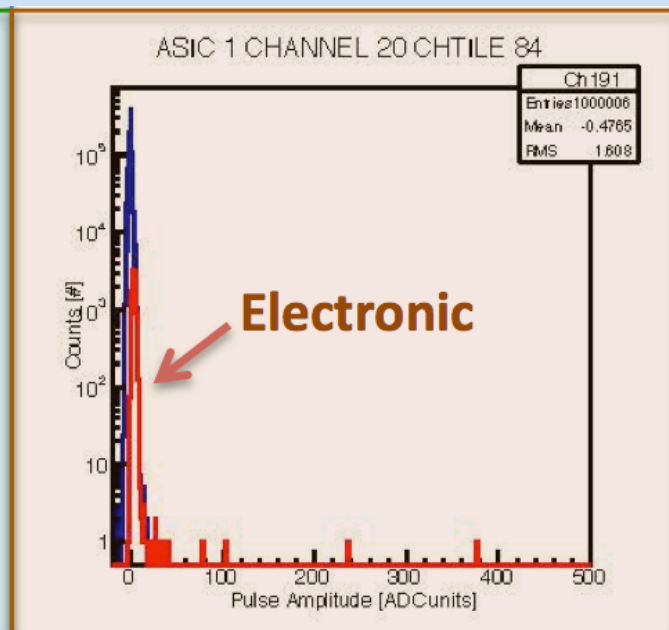
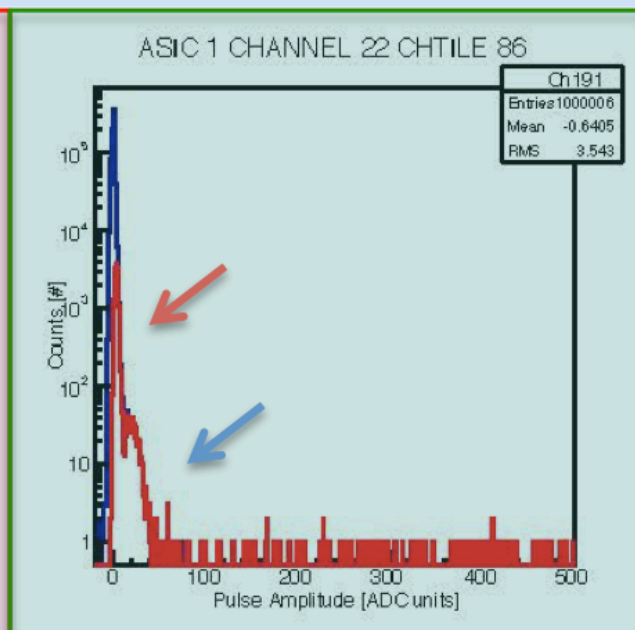
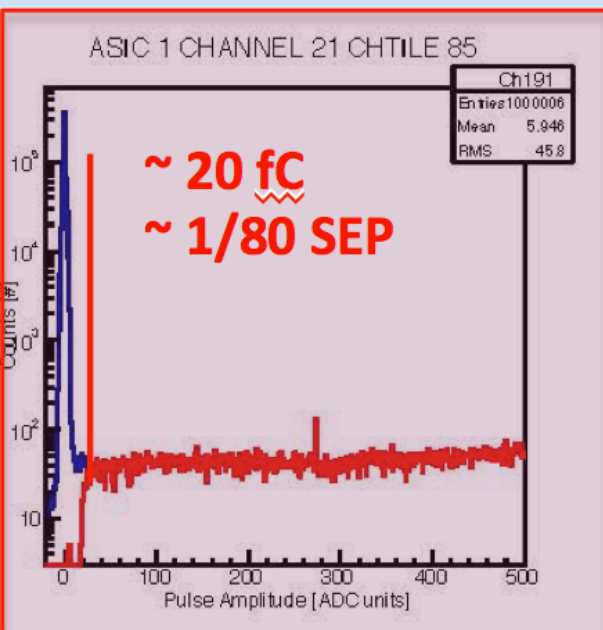


RICH Cross-talk

Studied with pulsed laser
Set to work at SPE level

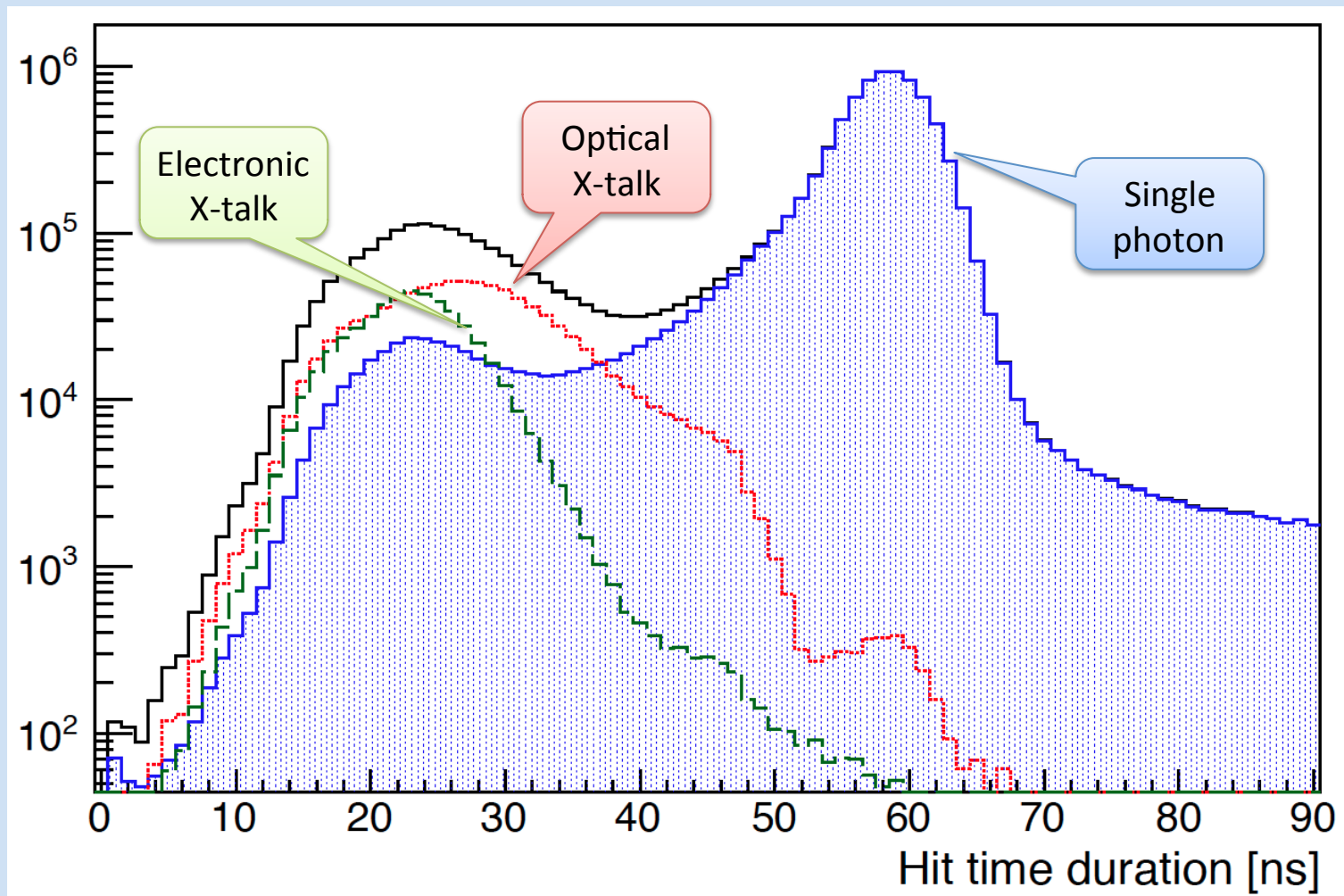
GA0501

95	93	94	92	96	98	97	99
91	89	90	88	100	102	101	103
87	85	86	84	104	106	105	107
83	81	82	80	108	110	109	111
79	77	78	76	112	114	113	115



RICH Cross-talk

As identified by the RICH reconstruction software on CLAS12 DATA



Cherenkov Analysis

Analytic solution for direct photons

“Exact” solution for the Cherenkov Angle

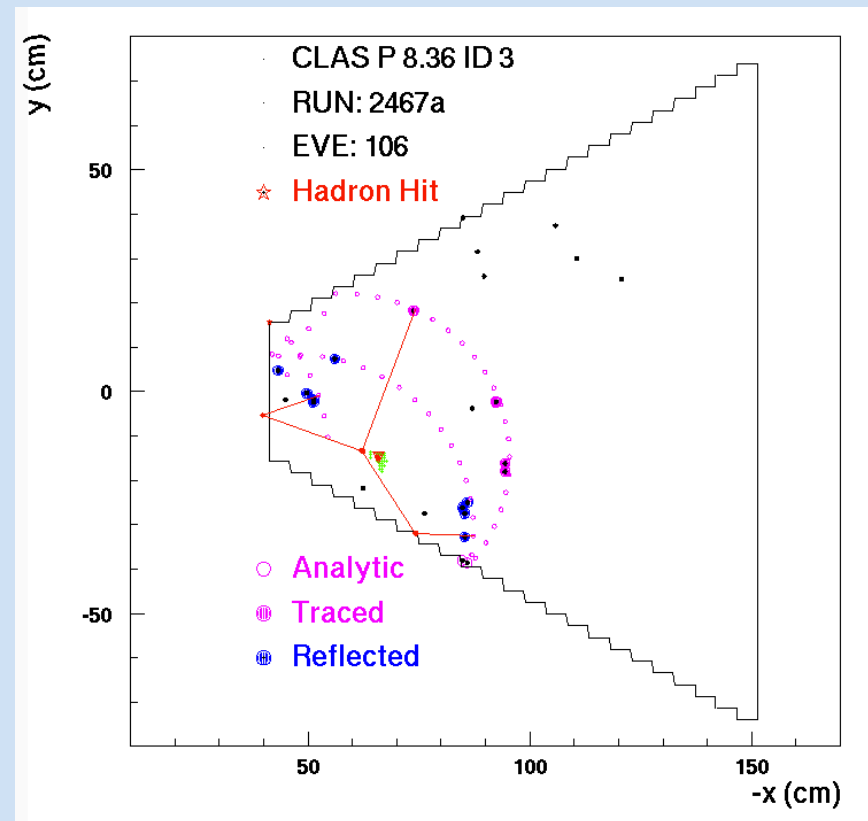
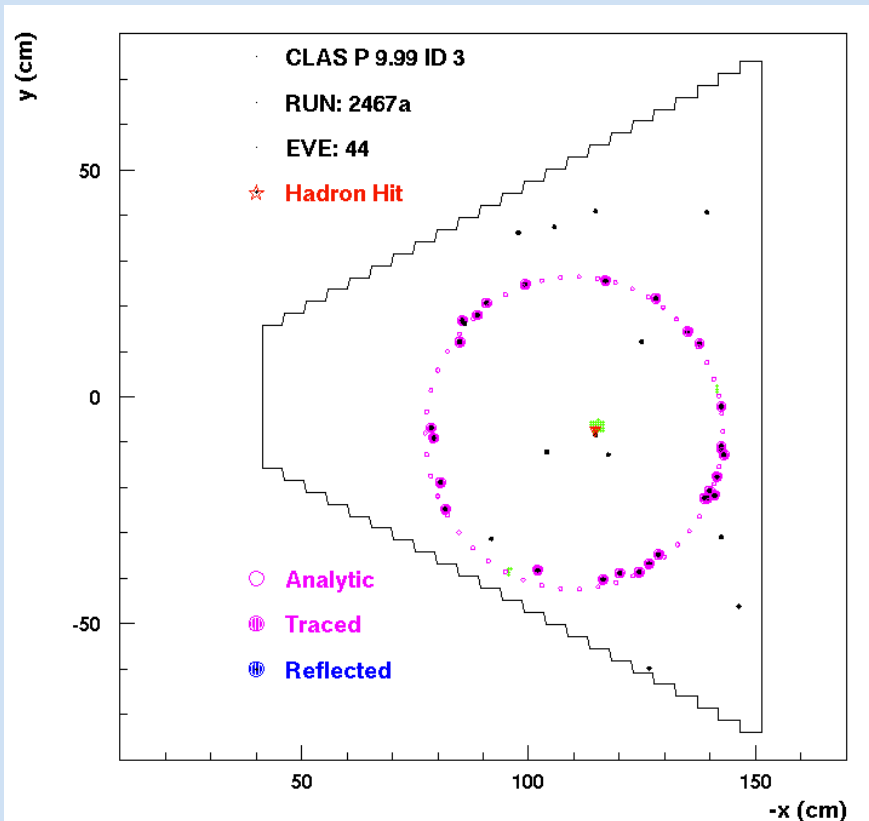
Only direct photons

Ray traced solution for direct photons

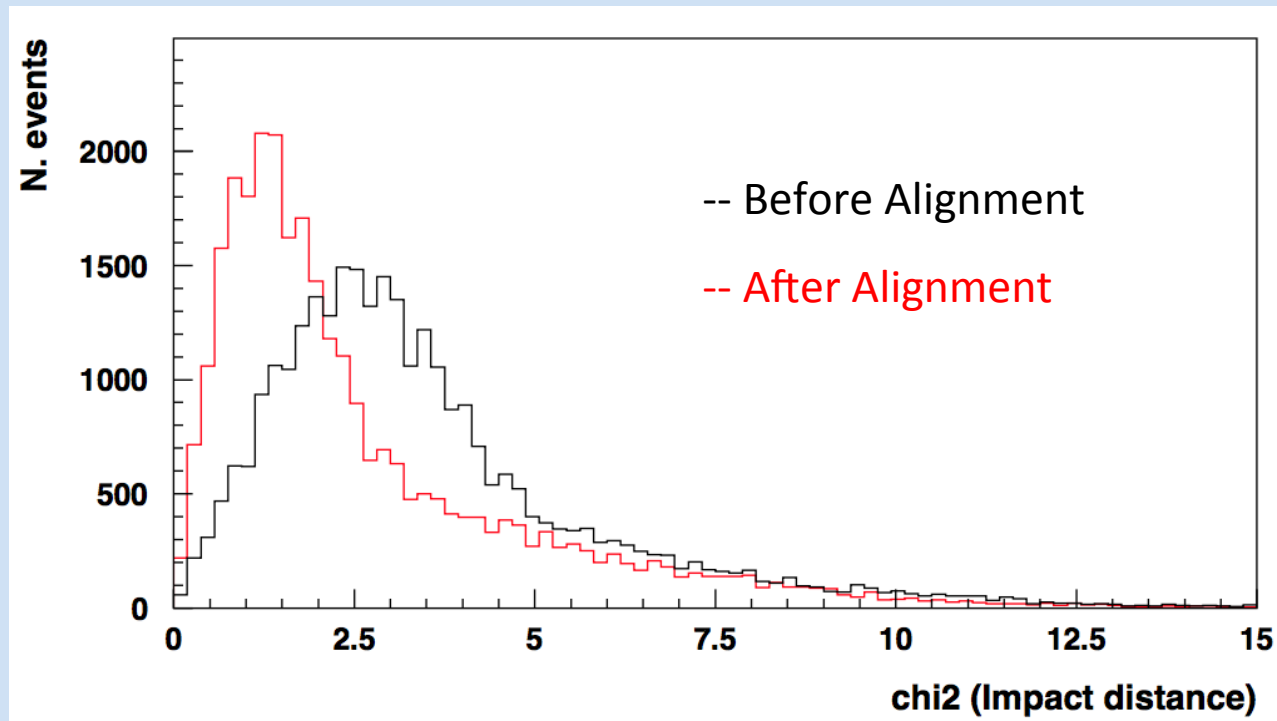
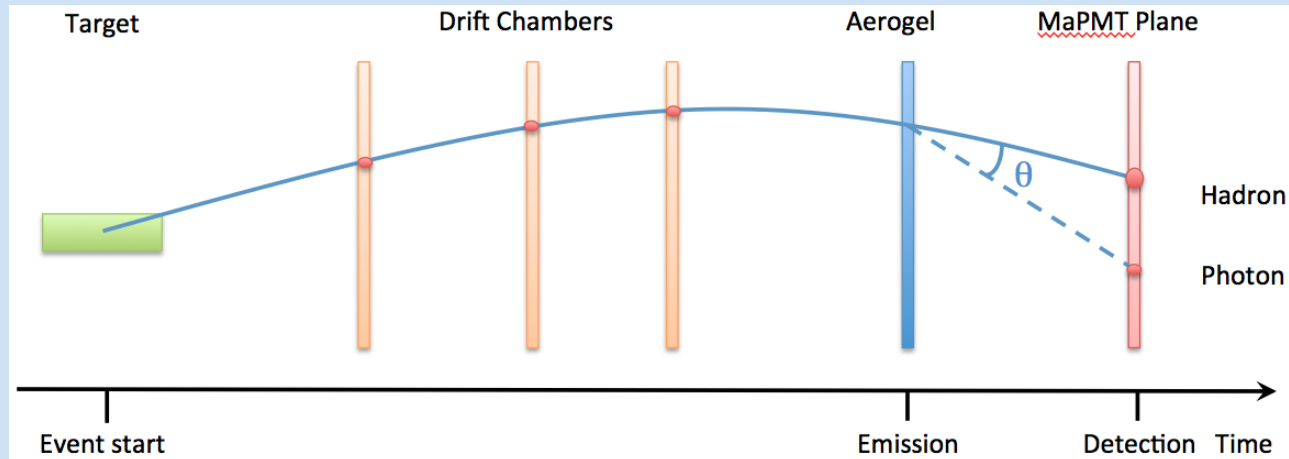
Assume knowledge of aerogel ref index

Any photon

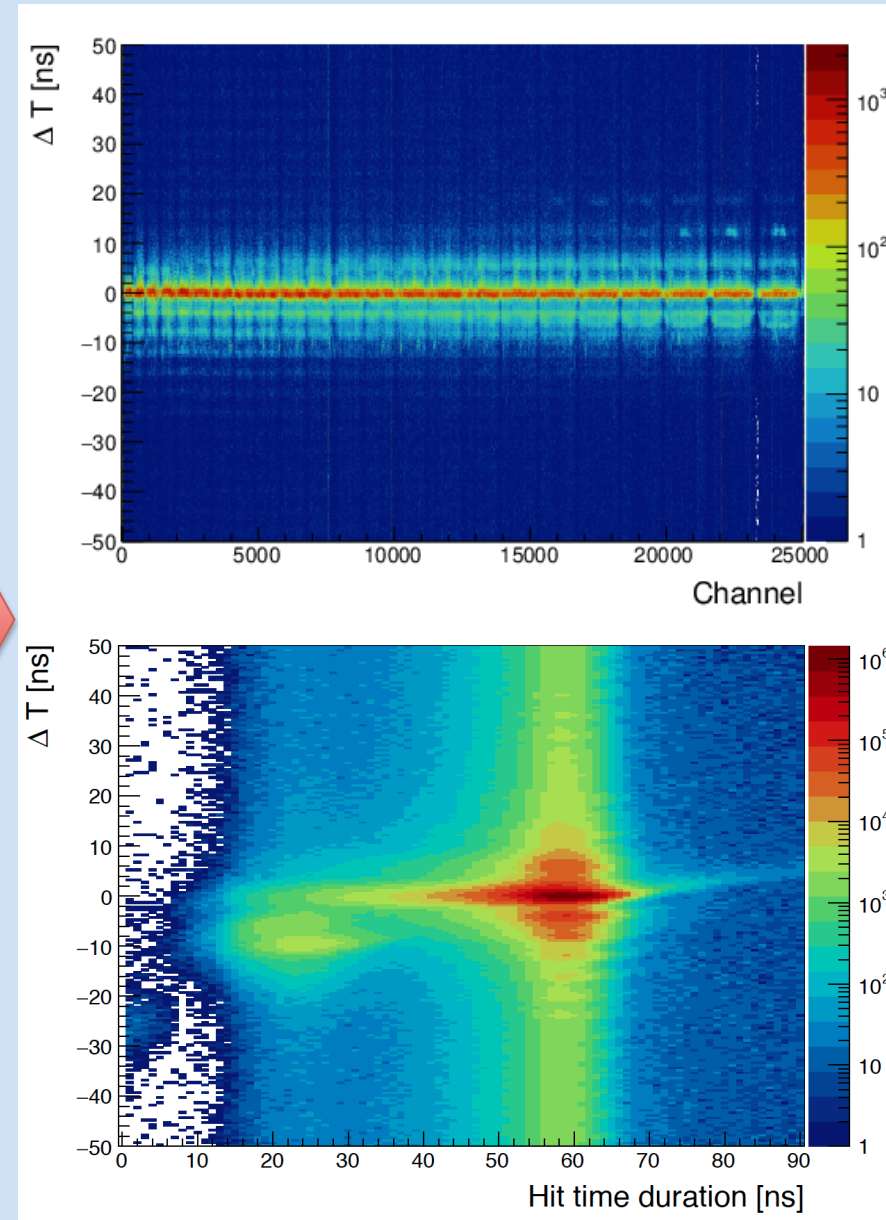
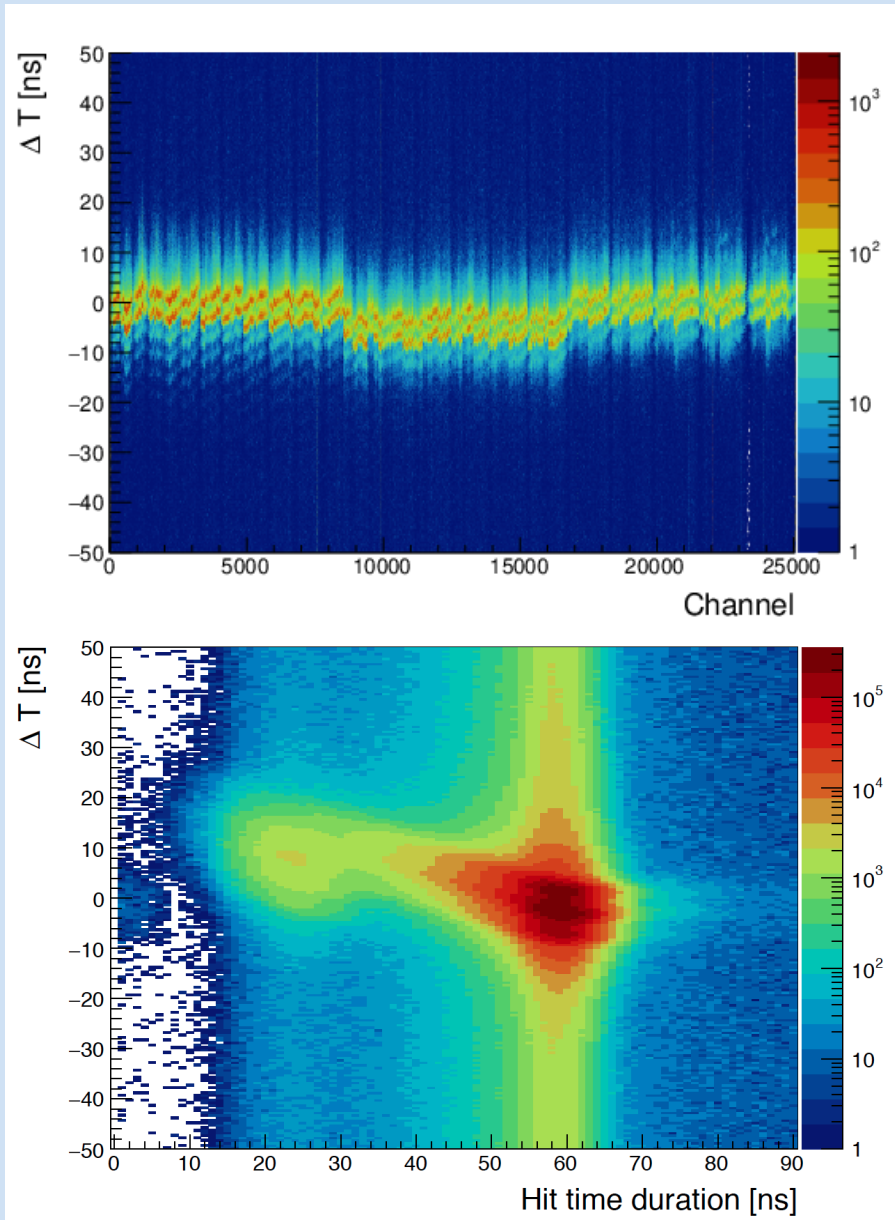
GOAL: get a Cherenkov angle estimate for each photon for detailed PID optimization



RICH – DC Matching

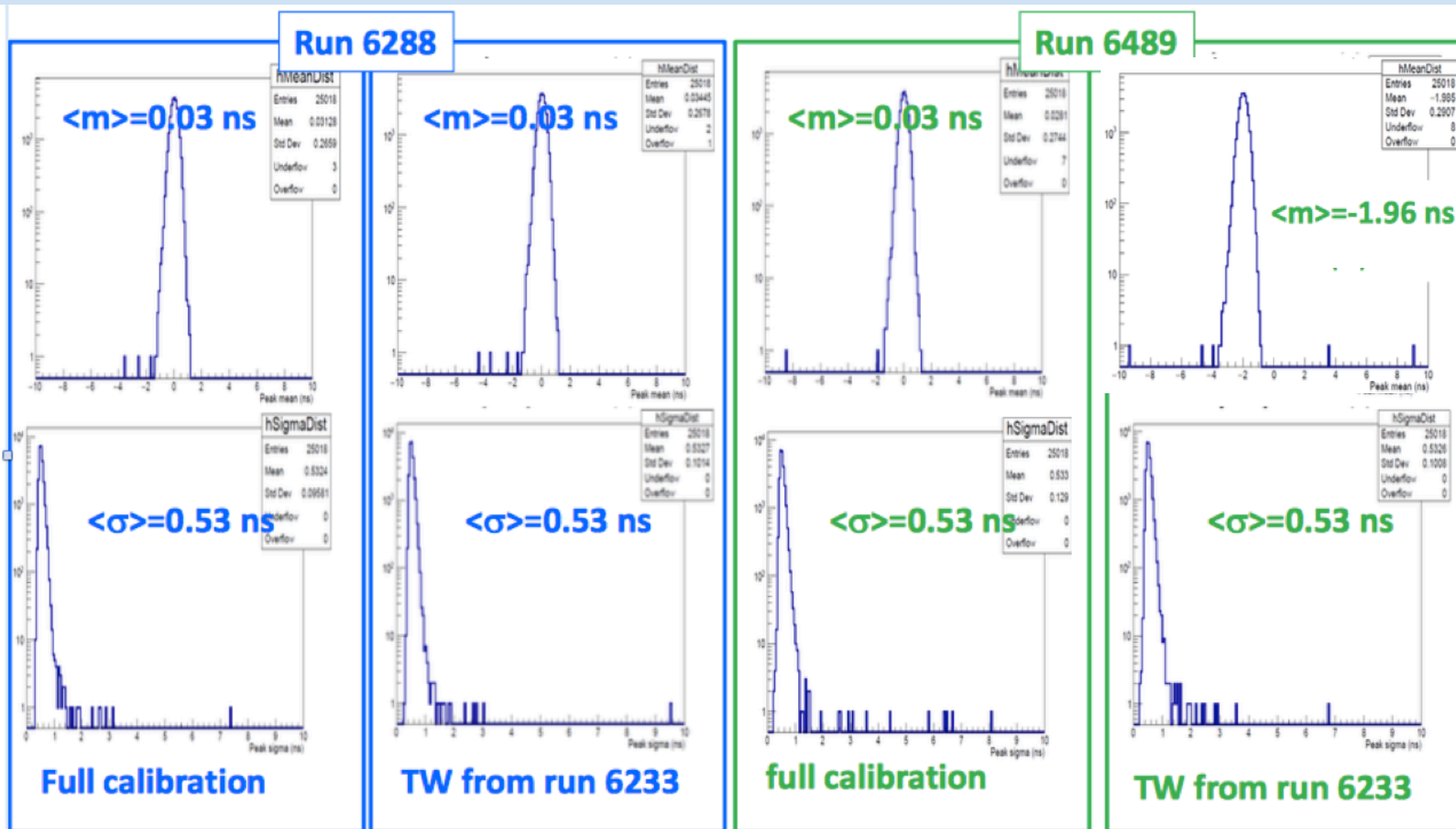


RICH Time Calibration



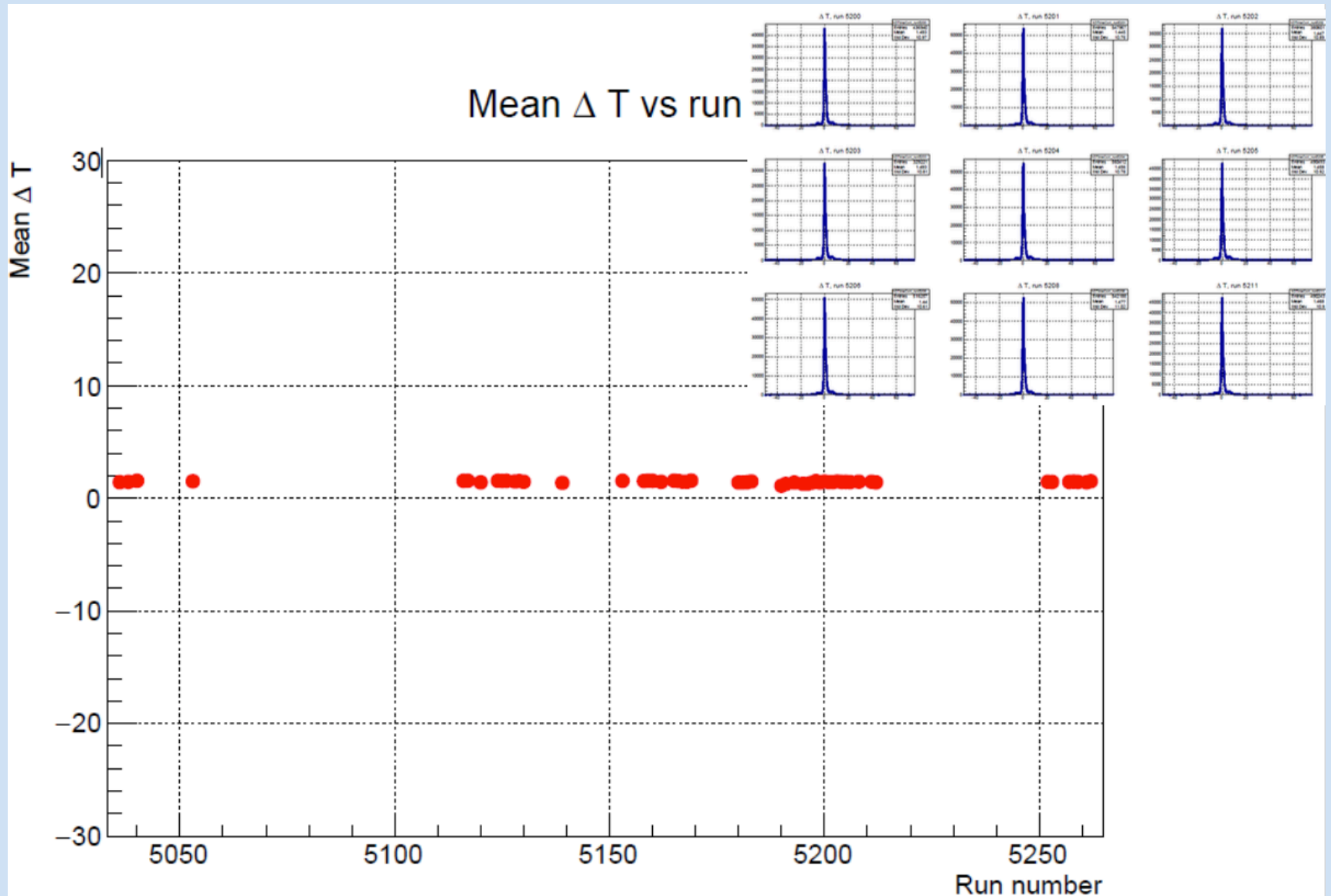
RICH Time Calibration

Calibration is stable in time except for the time offset between RiCH and CLAS12



RICH Time Calibration Monitoring

Mean ΔT vs run



RICH Reconstruction Software

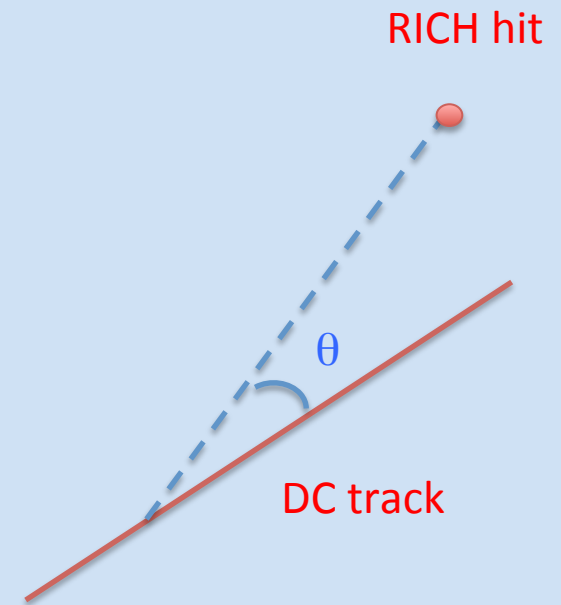
RICH software released in June in time for the DNP data production

Designed as post-process to provides a Cherenkov angle estimate for each single hit in RICH and each hadron in sector 4

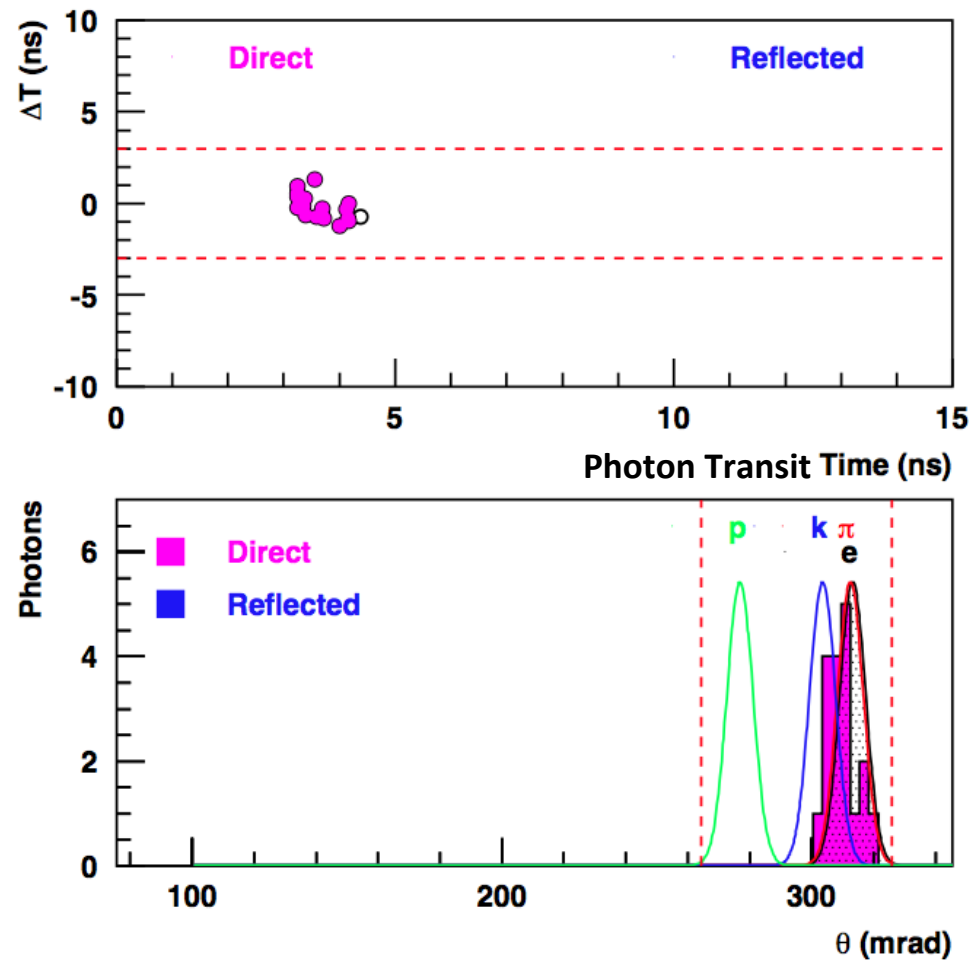
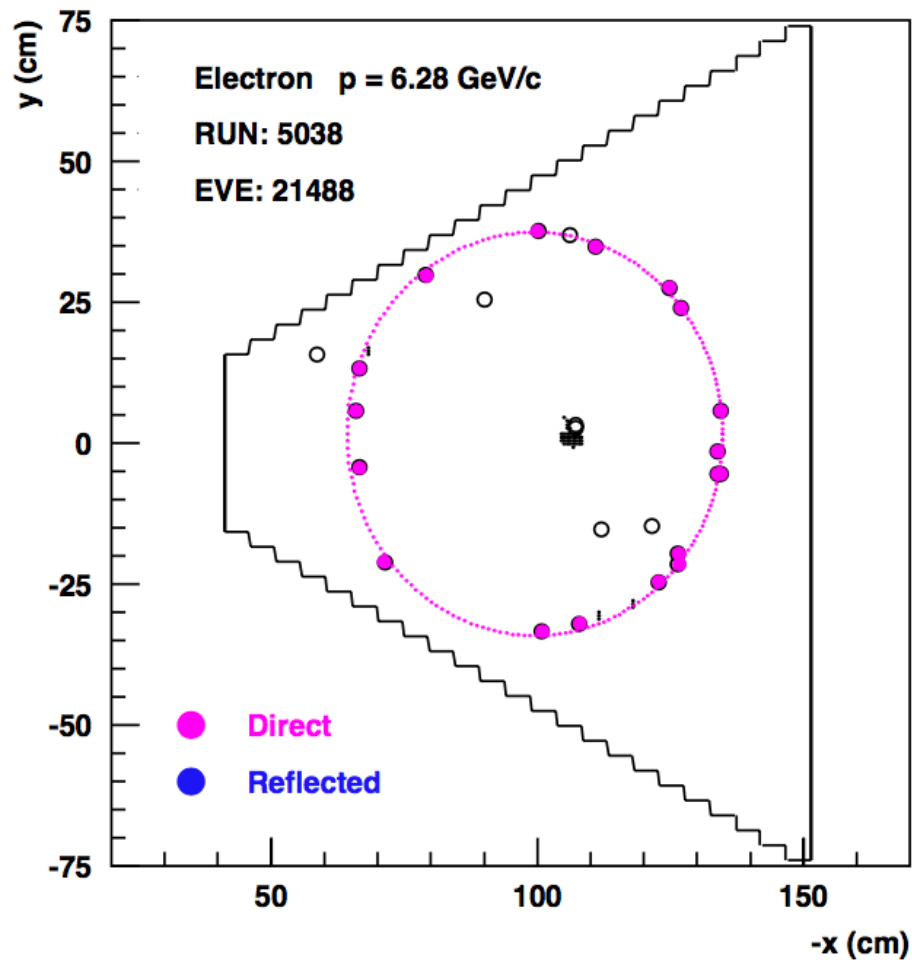
Basic information allowing for independent ID likelihood development

Ongoing

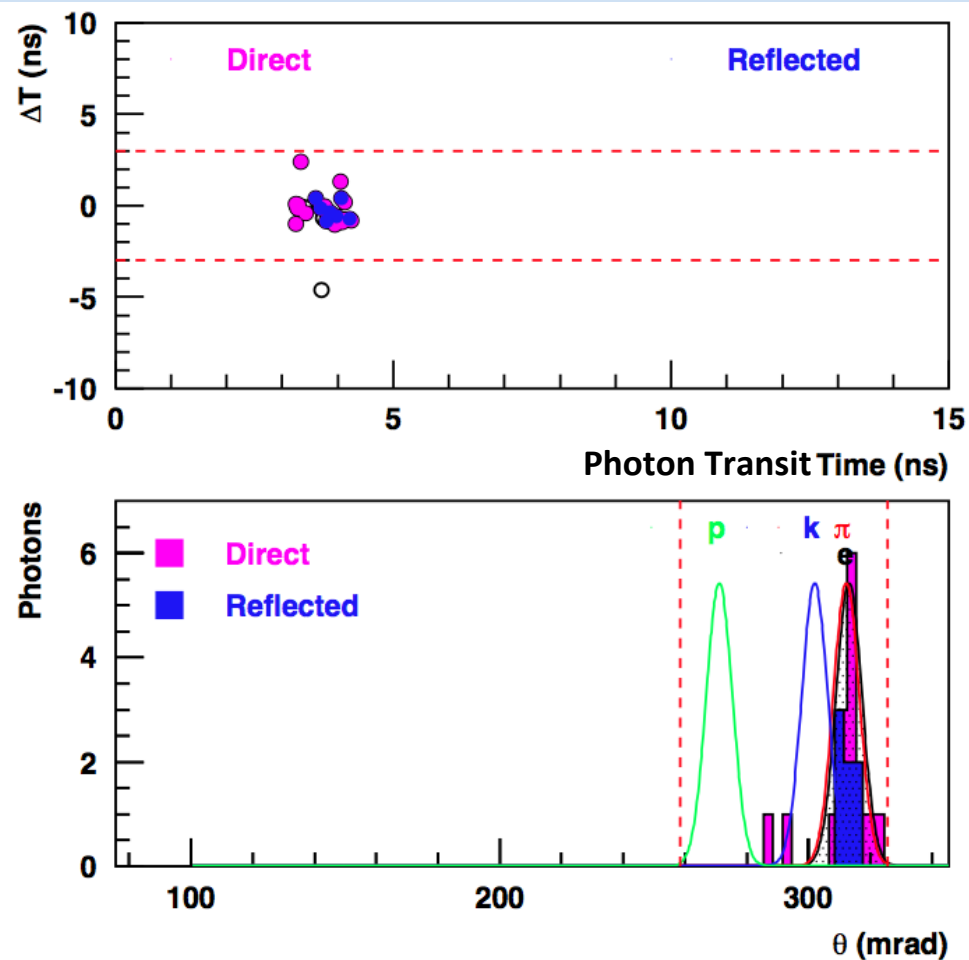
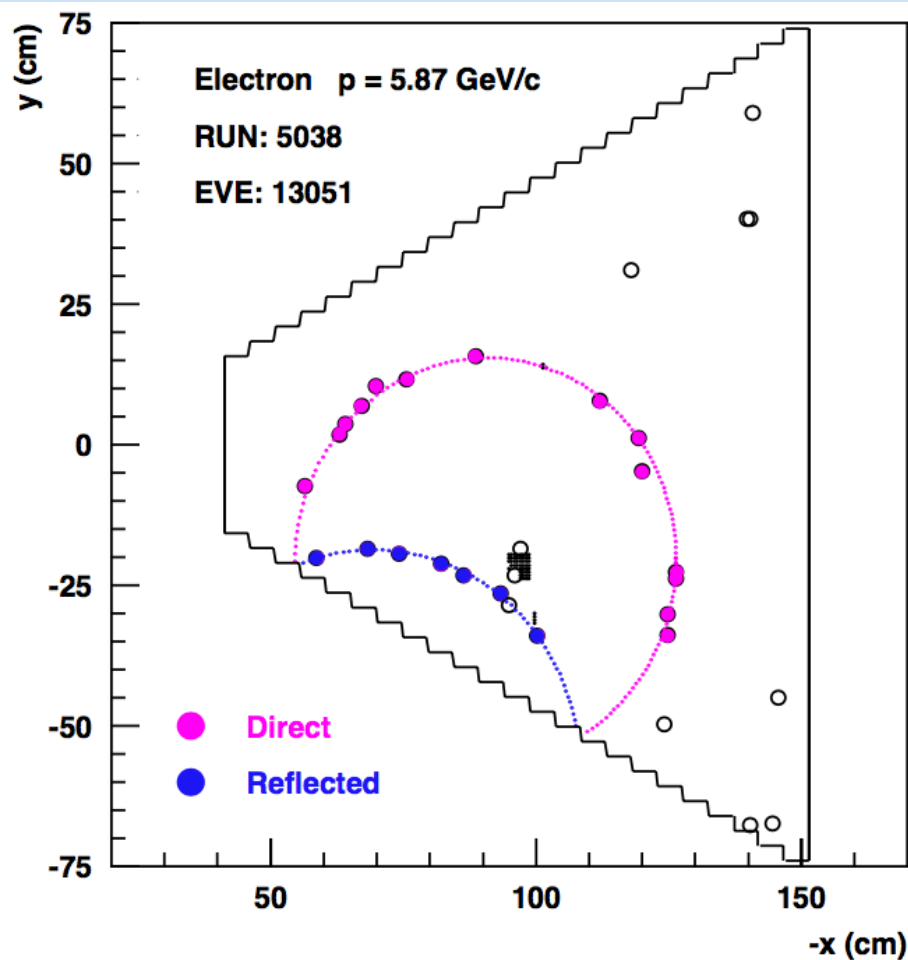
- ✓ Refinements of traced solution
- ✓ Tuning of reconstruction parameters
- ✓ Tune the DST output (photon candidates, variable selection)
- ✓ Hadron Identification Likelihood
- ✓ Aerogel tile by tile characterization
- ✓ Relative misalignment of internal components



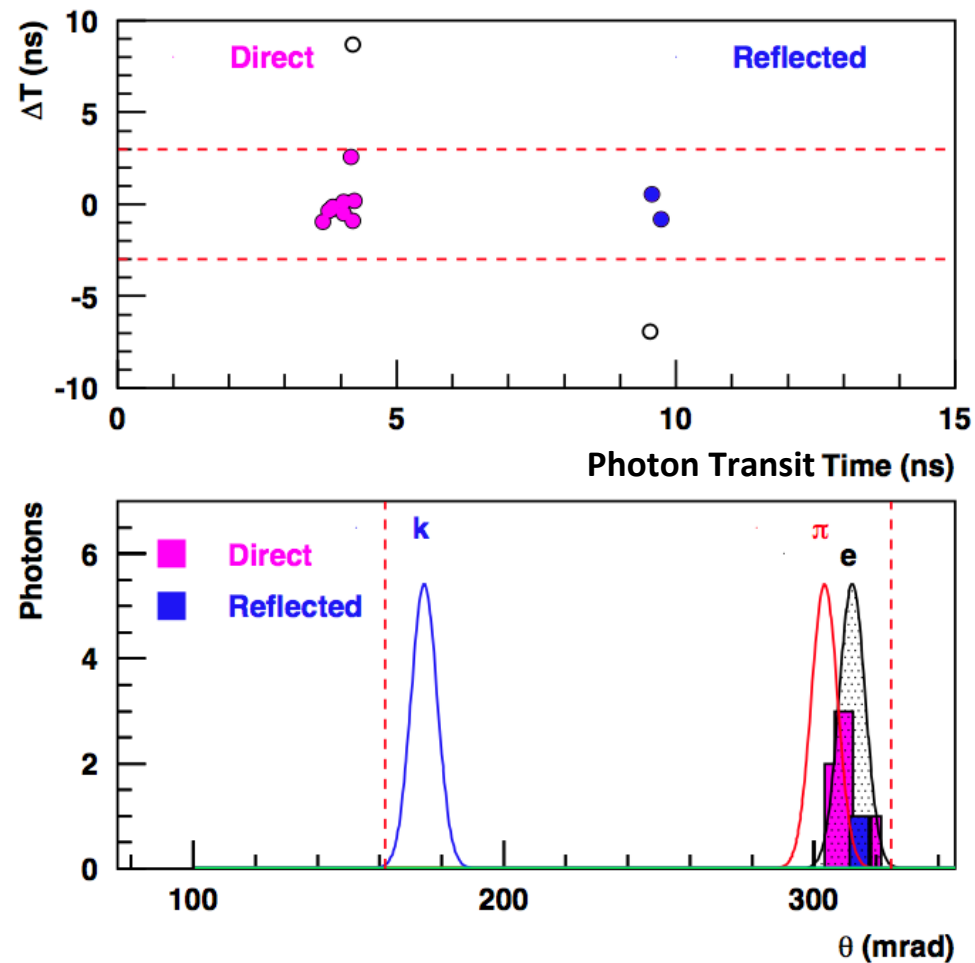
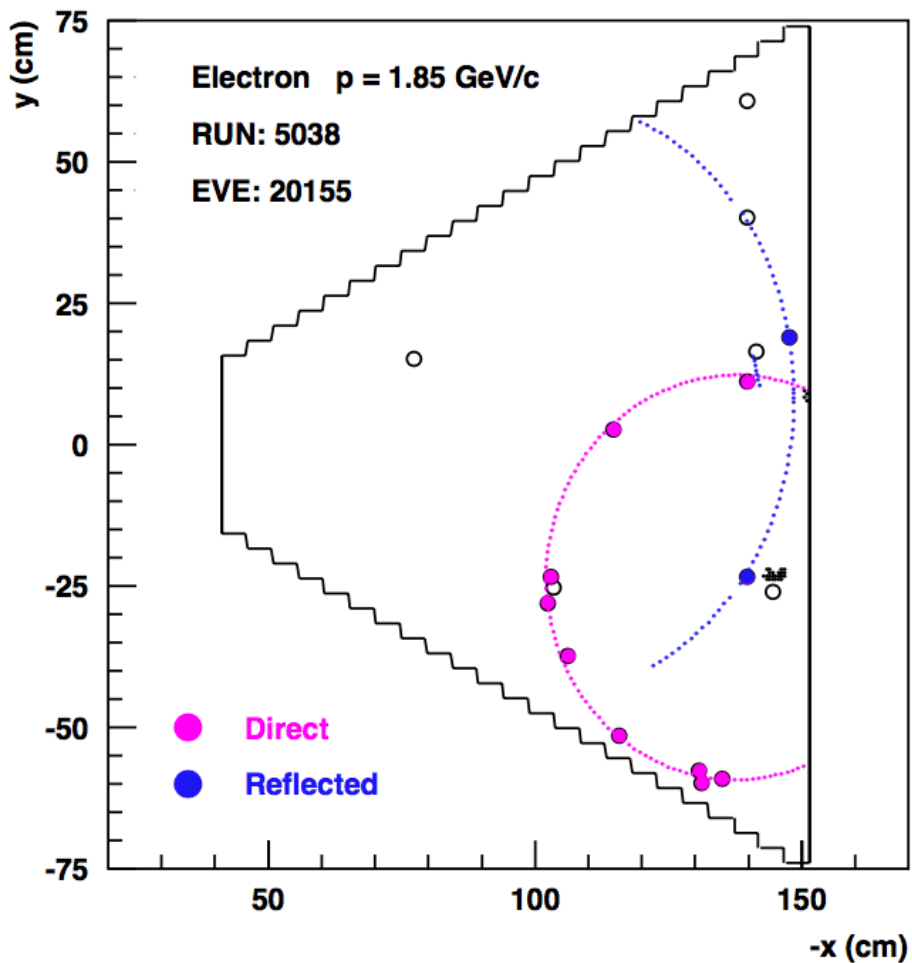
RICH Event Reconstruction



RICH Event Reconstruction

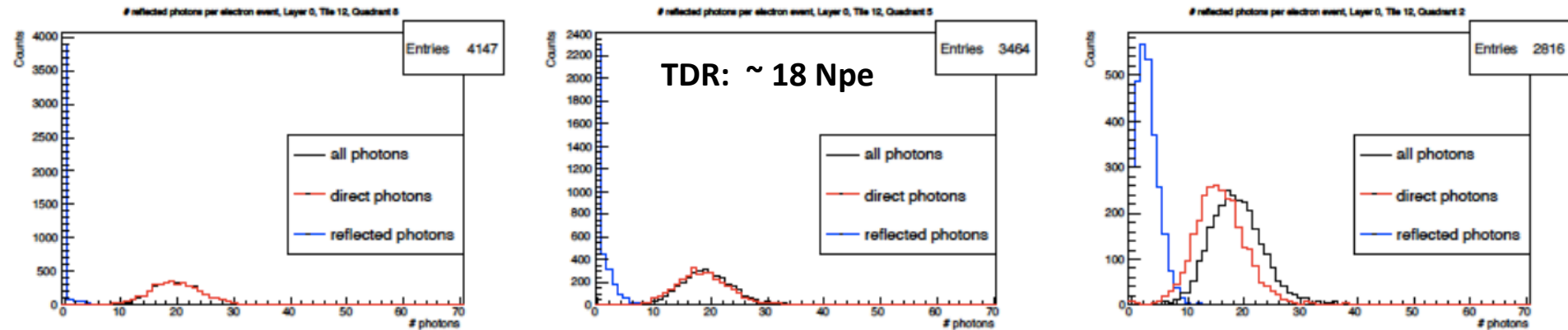


RICH Event Reconstruction

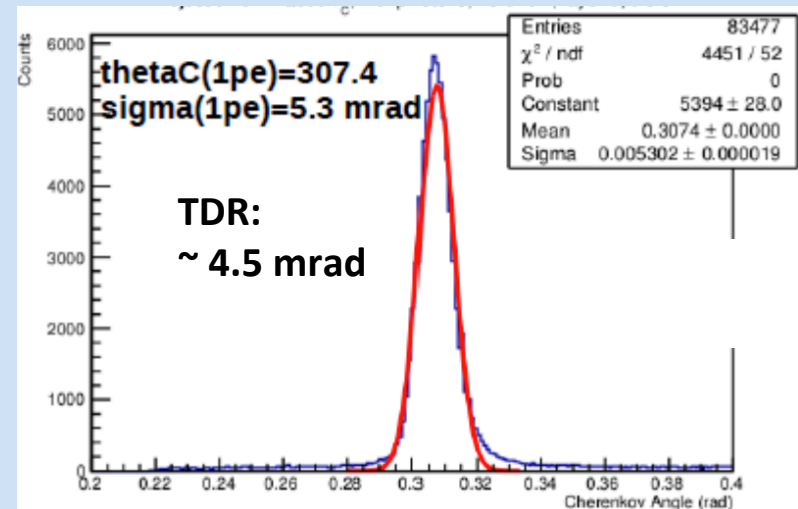
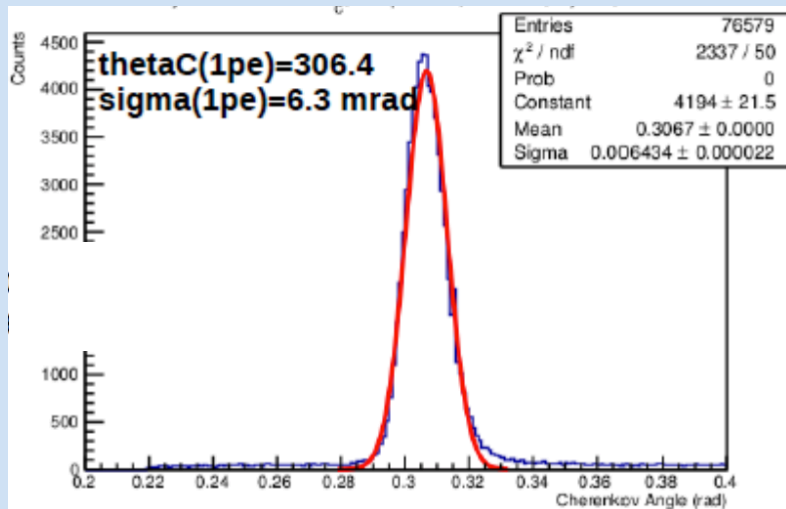


RICH Performance Study

RGA data, direct photons No alignment of internal components
Number of photons and single photon resolution close to TDR



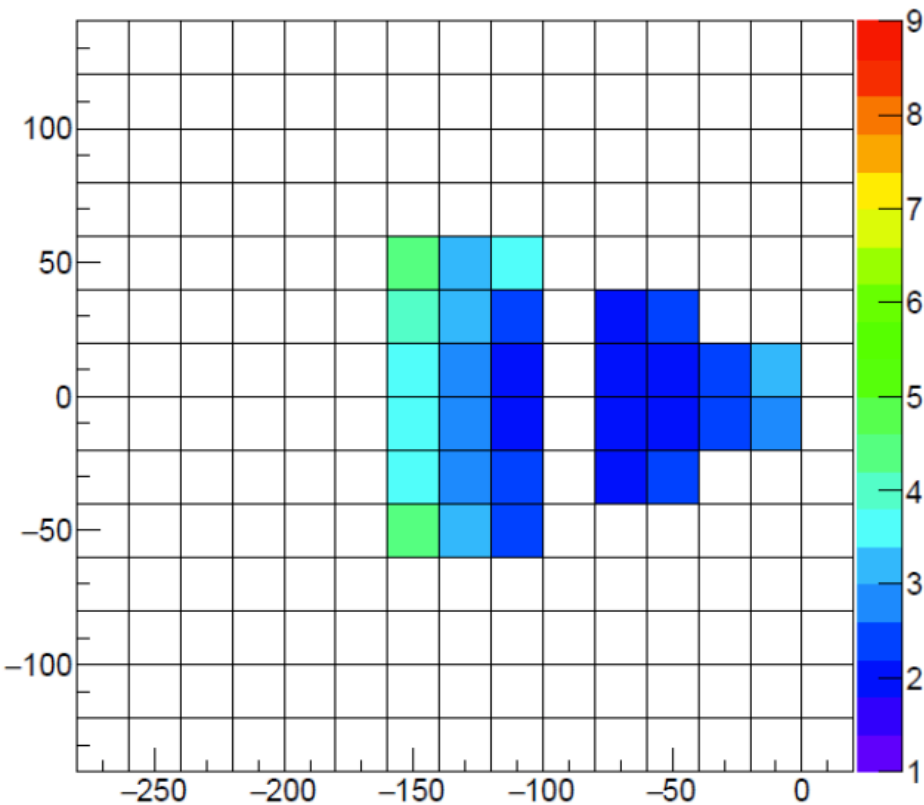
Raw RICH alignment (not for internal components)



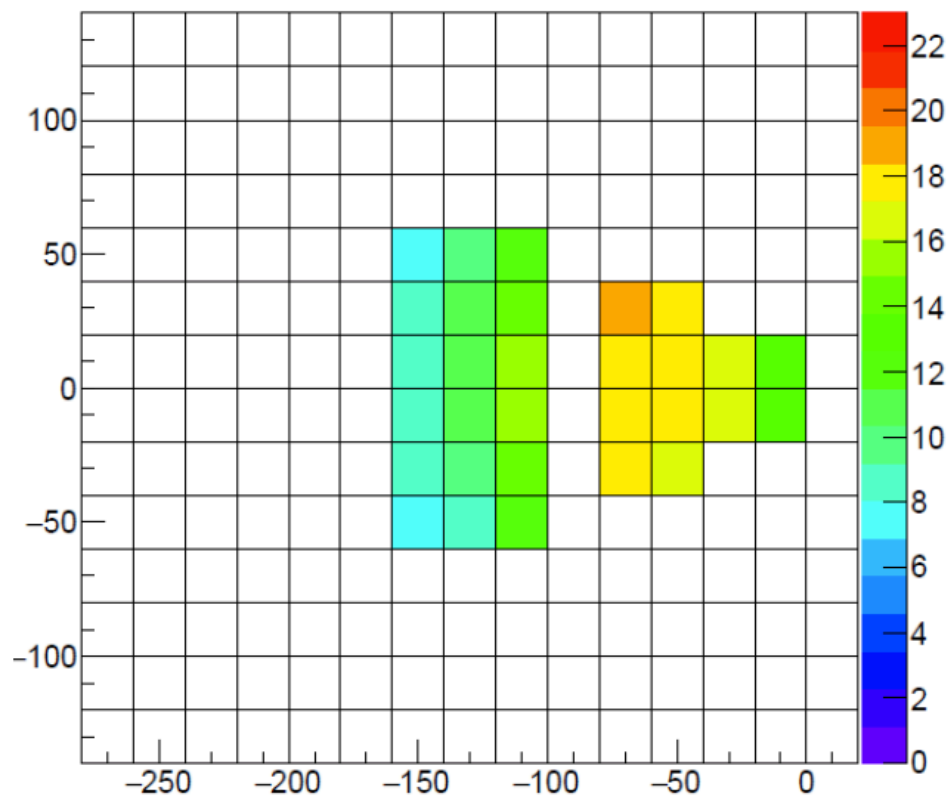
Moving to Tile by Tile Study

Study done with direct photons only

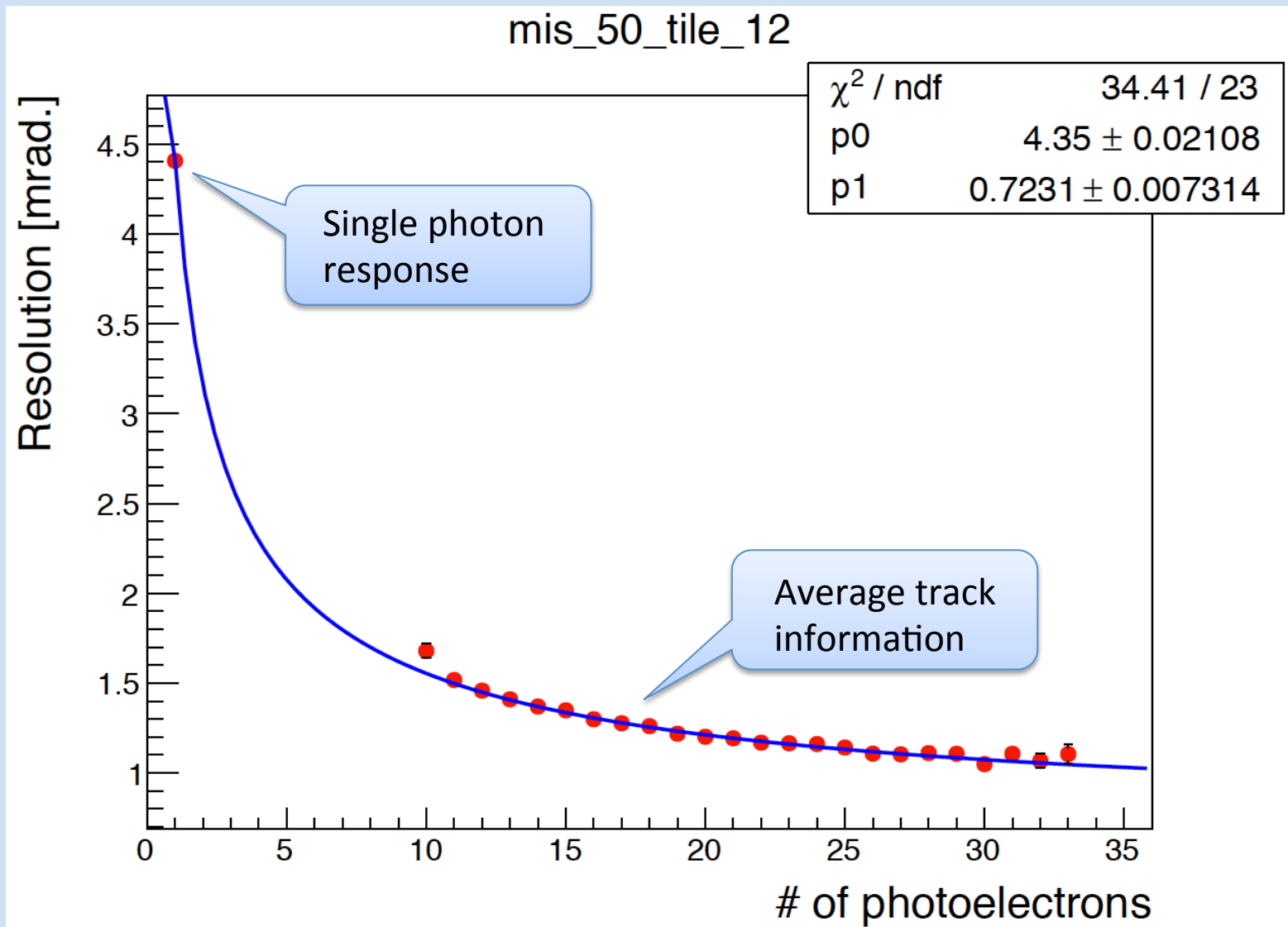
θ_C Sigma Map per tile



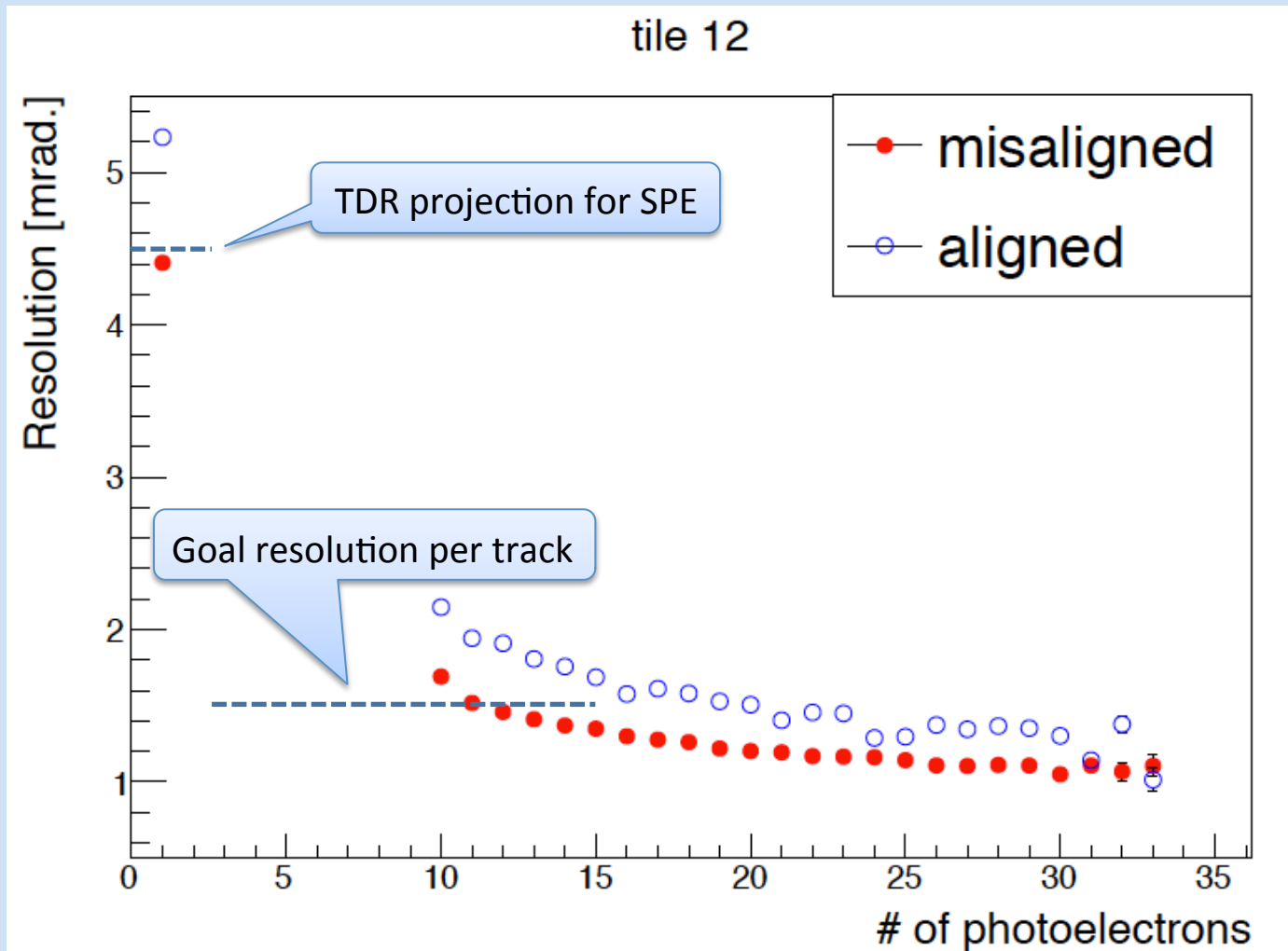
N. photons per track, Map per tile



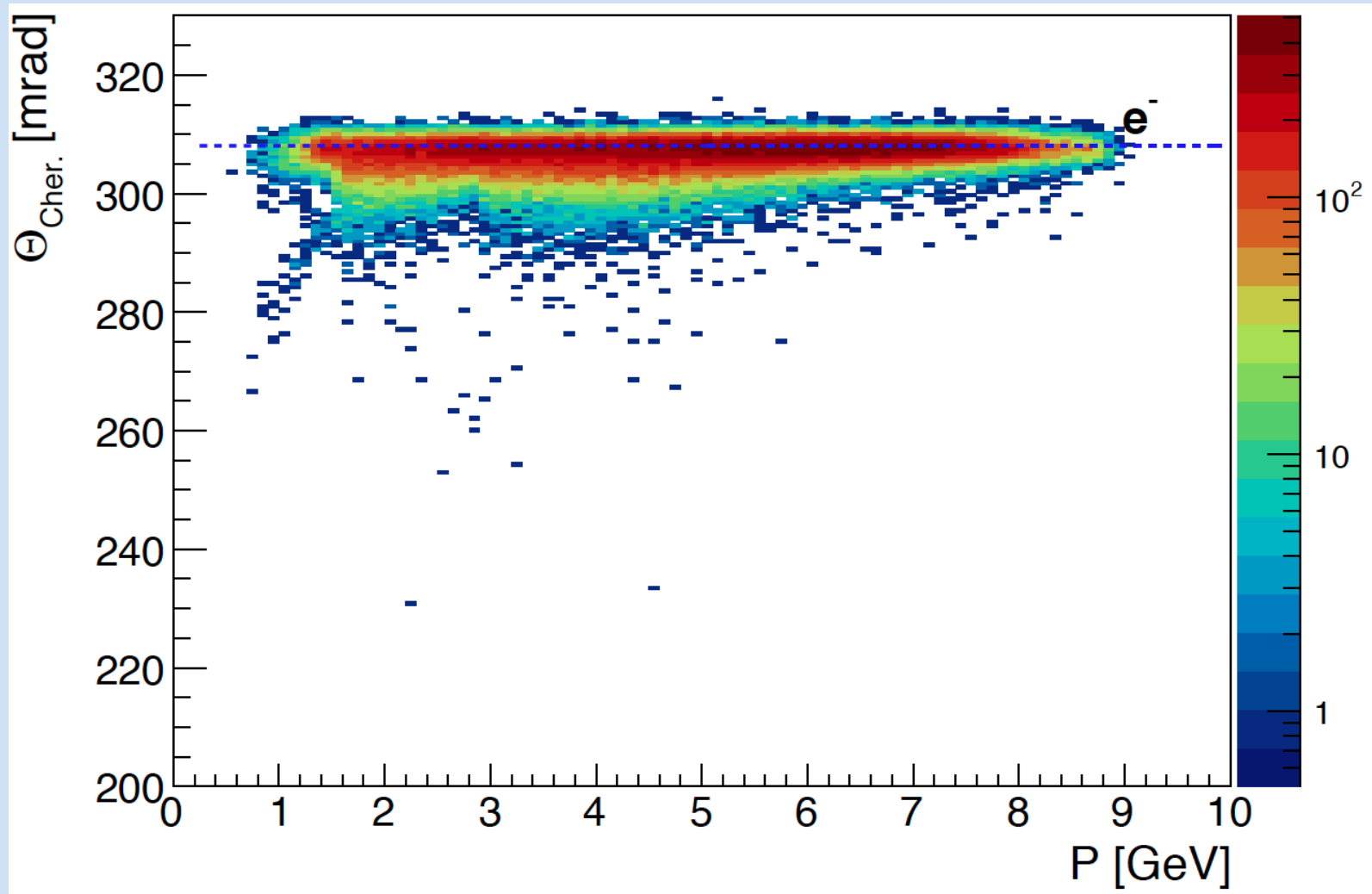
Cherenkov Angle Resolution



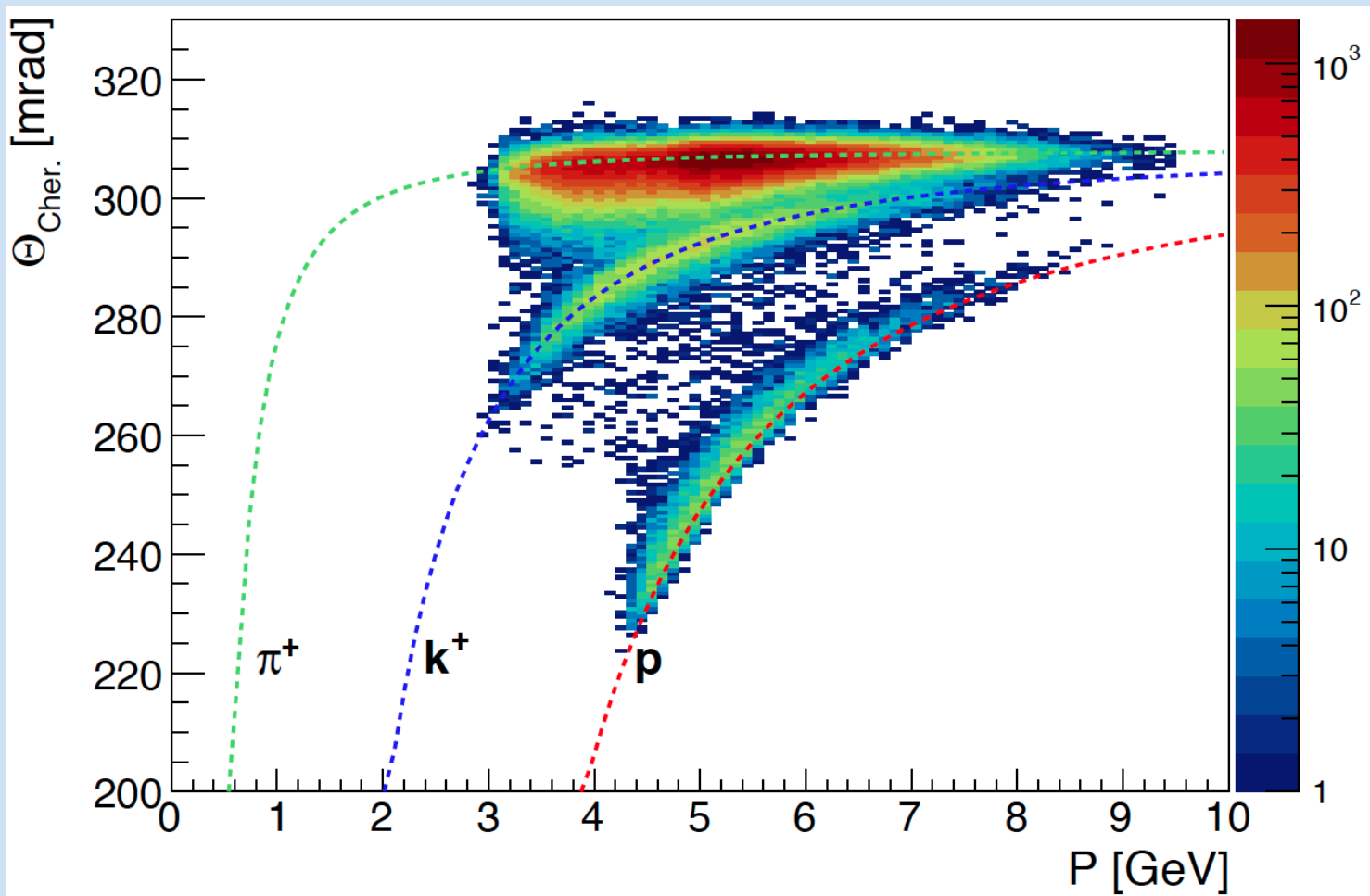
RICH Alignment Impact



RICH Response to Electrons

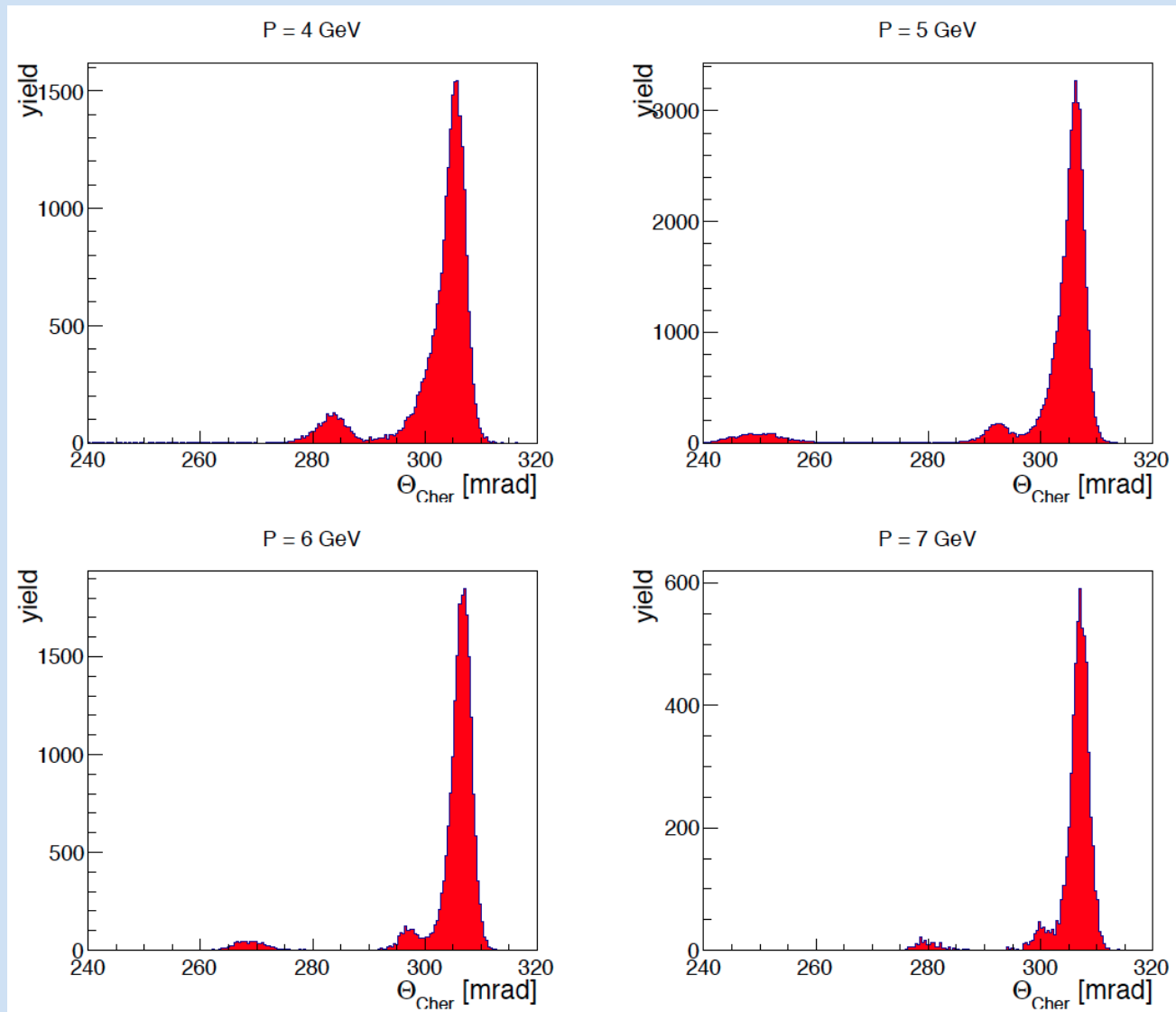


RICH Hadron Separation



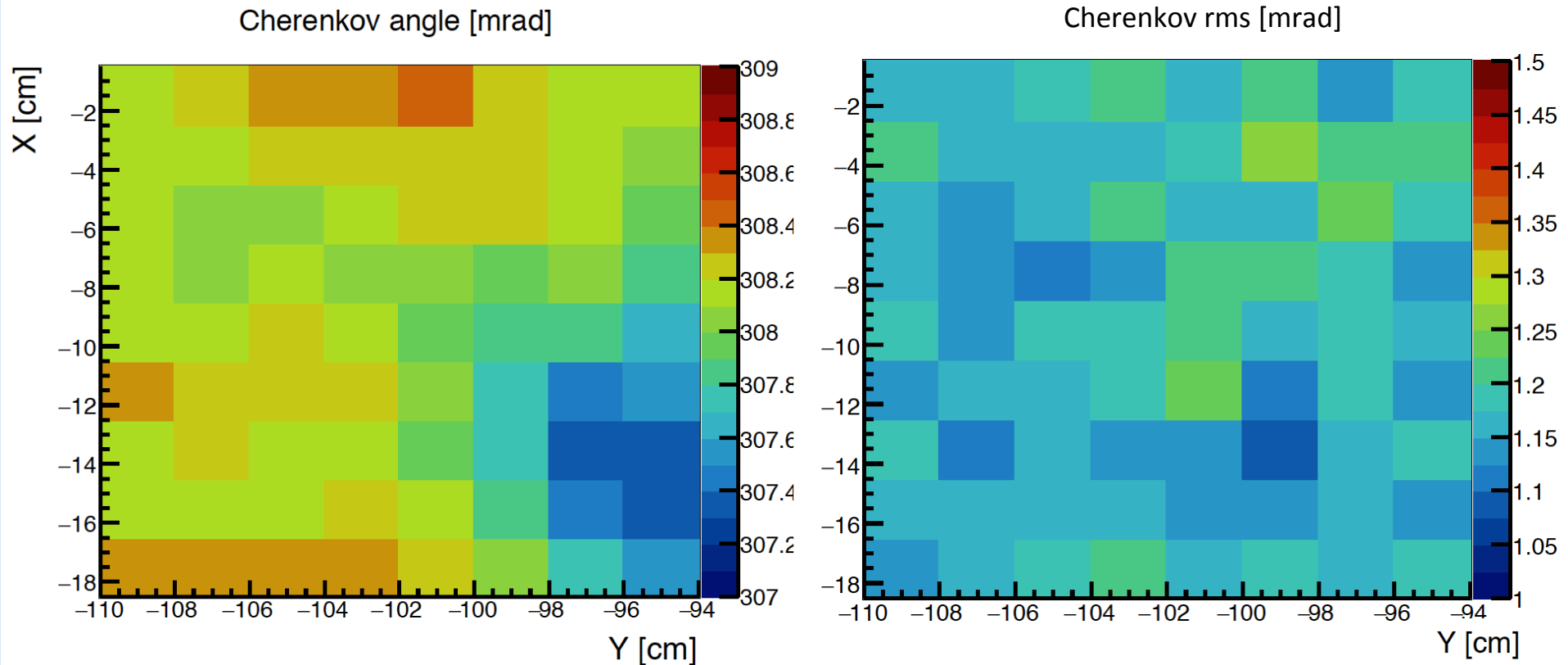
RICH Hadron Separation

In slices of momentum



Aerogel Performance Mapping

Study aerogel performance on electron control sample as a function of the track position



Second RICH Module

- ✓ 90 % Mechanical structure
- ✓ 100 % Planar mirrors
- ✓ 69 % MaPMTs
- ✓ 100 % MAROC3 chips
- ✓ 90 % Aerogel
- ✓ 10 % Services
- ✓ Spherical mirror



Second Module Plan (FY)	19-1	19-2	19-3	19-4	20-1	20-2	20-3	20-4	21-1	21-2	21-3	21-4
Mechanics												
Aerogel												
Mirrors												
Electronics												
MAPMTS												
Services in Hall												
Assembling + Installation												



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Shared

Conclusions & Outlook

RICH reconstruction software is ready for mass production

- ✓ Stress tests

Reconstruction and calibration of a large data set

- ✓ Study misalignment:

A preliminary study has been done, need to be refined and extended to the spherical mirror

- ✓ Refine code structure and output

eu.mihosoft.vrl.v3d → org.jlab.geom.prim

- ✓ Refine optical surfaces

Aerogel non-planarity

Mirror efficiency / MaPMT efficiency

- ✓ Perform PID

Basic calculations are already available, no outputs (on purpose)