Cherenkov Analysis Update

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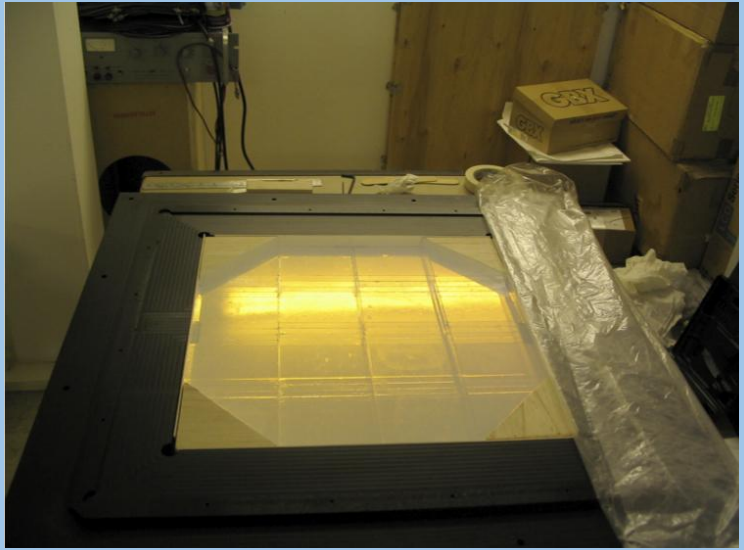
Miles Winter

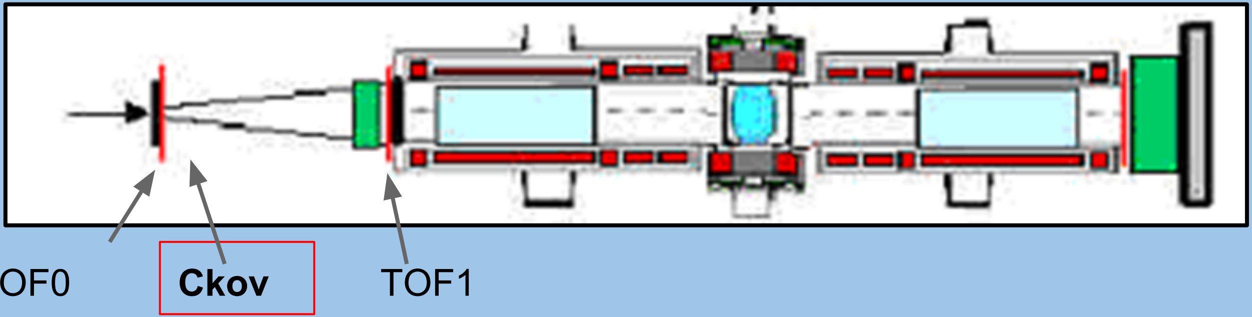


Outline

- Cherenkov properties
- Particle selection
- Pedestal calculation
- Peak fitting
- Stability

Introduction

-MICE uses two threshold Cherenkov detectors each with 4 phototubes for light collection.
-Ckov A is upstream of Ckov B; each is filled with a different density silica aerogel (details on the next slide)
-Cherenkov data is recorded in an 8 bit binary format as each particle passes through the respective aerogels
-The MICE Analysis User Software (MAUS) is responsible for data reconstruction.
-Following reconstruction, calibration and analysis is required to separate background noise from physics events.
- The basic questions: light or no light? Is this expected given the run conditions?



What is reconstructed?
We have access to total charge, arrival times, total npes, etc... All are considered, but the most useful are listed below.

Quantities of Interest:

1. ADC (Pedestal)
2. Electron (or positron) peaks
3. Sub-threshold pions; SPE peaks

More on these in the slides that follow

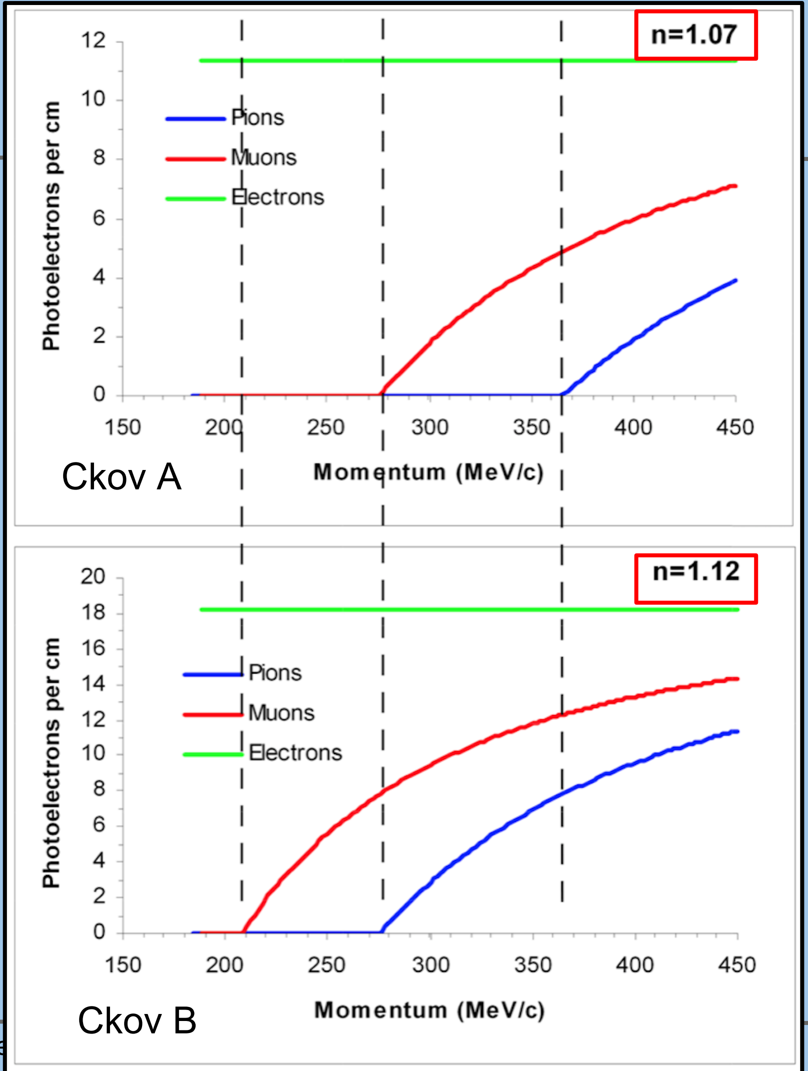
Ckov A & B

Theoretical Threshold Values*

	Ckov A	Ckov B
n	1.07	1.12
β_t	.935	.893
$p_t(\pi)$	366.7 MeV/c	276.8 MeV/c
$p_t(\mu)$	277.7 MeV/c	209.6 MeV/c

$$p_t = \frac{mc}{\sqrt{n^2 - 1}} \qquad \beta_t = \frac{1}{n}$$

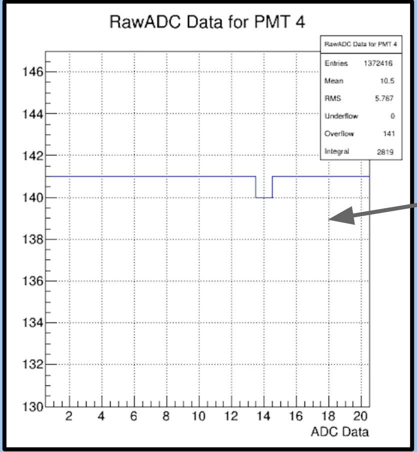
*Electrons always give light

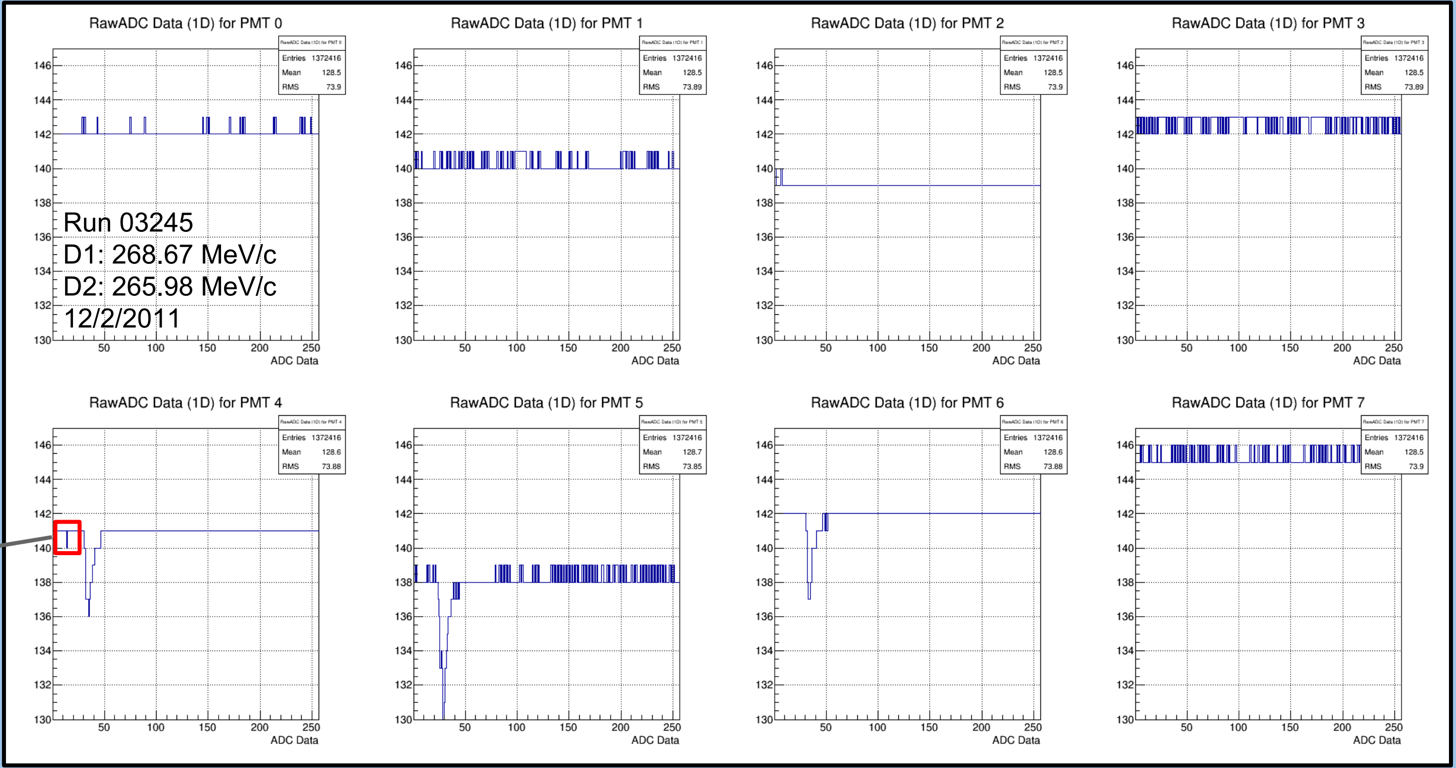


Raw Flash ADC

Pedestal Calculation:
Average of the integral of the first 20 bins.

First 20 bins are found to be pulse free*.

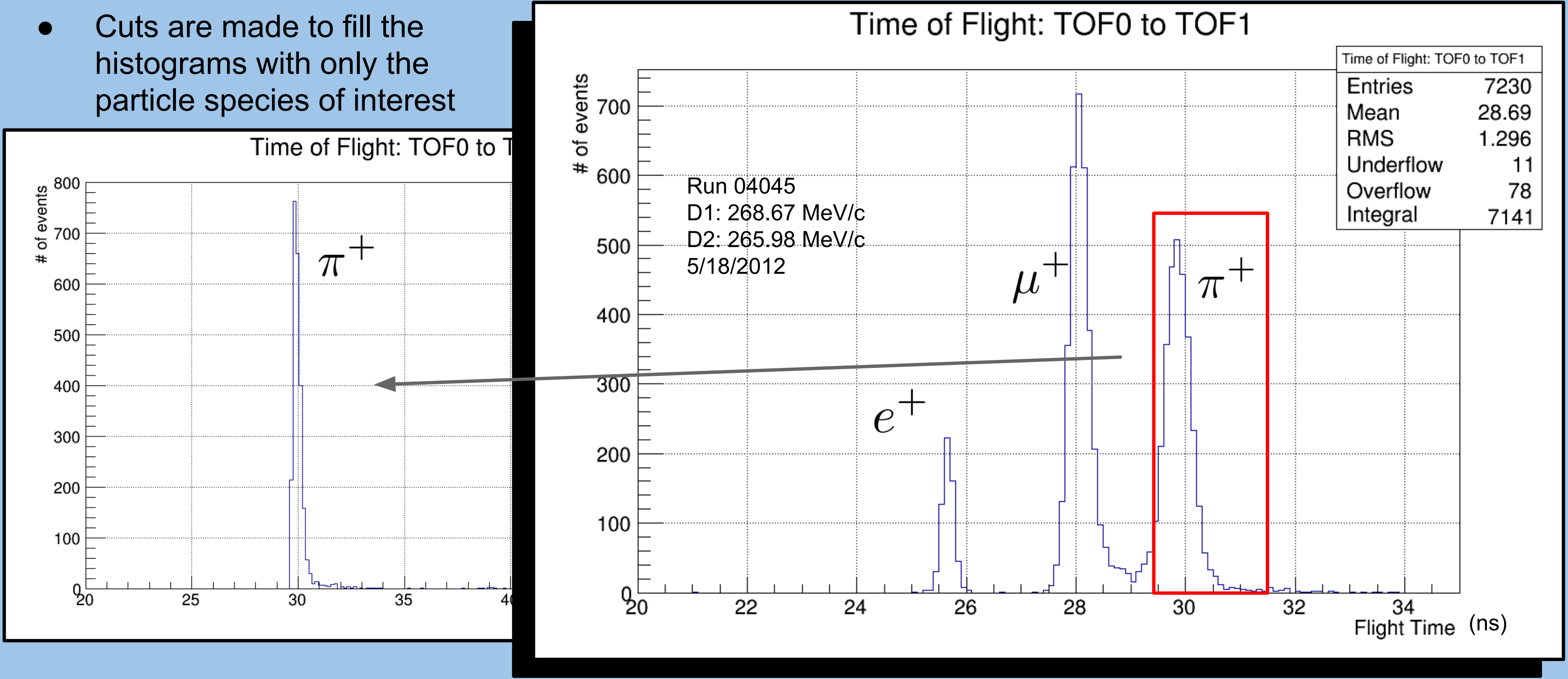




* First 20 bins being pulse free is based on observation.

Particle Selection

- Cuts are made to fill the histograms with only the particle species of interest

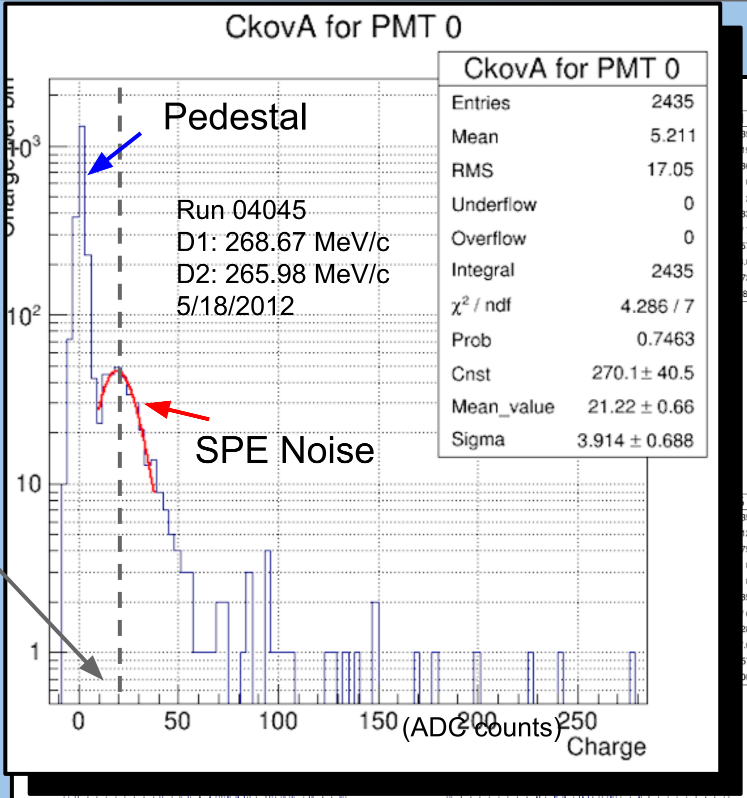


SPE Peak Fitting

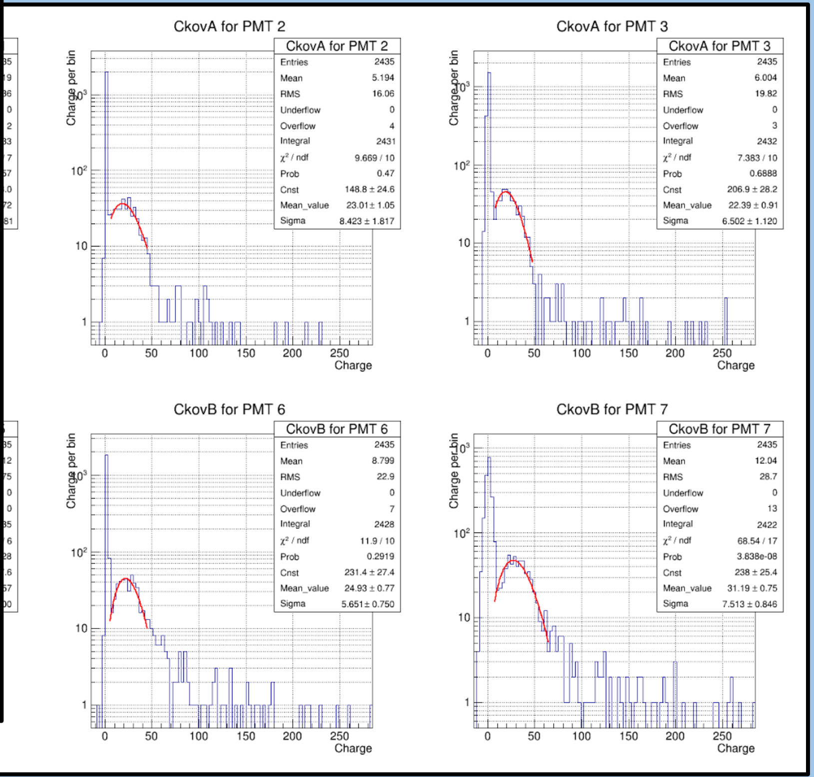
-Pedestal subtracted, sub-threshold pion SPE peak. Fit* shown is of SPE noise

- True number of photoelectrons per pmt is given by: nPE = ADC amp. /SPE constant

- SPE constant is currently set to 23.0 for all 8 PMTs



*Same procedure used for electron peaks



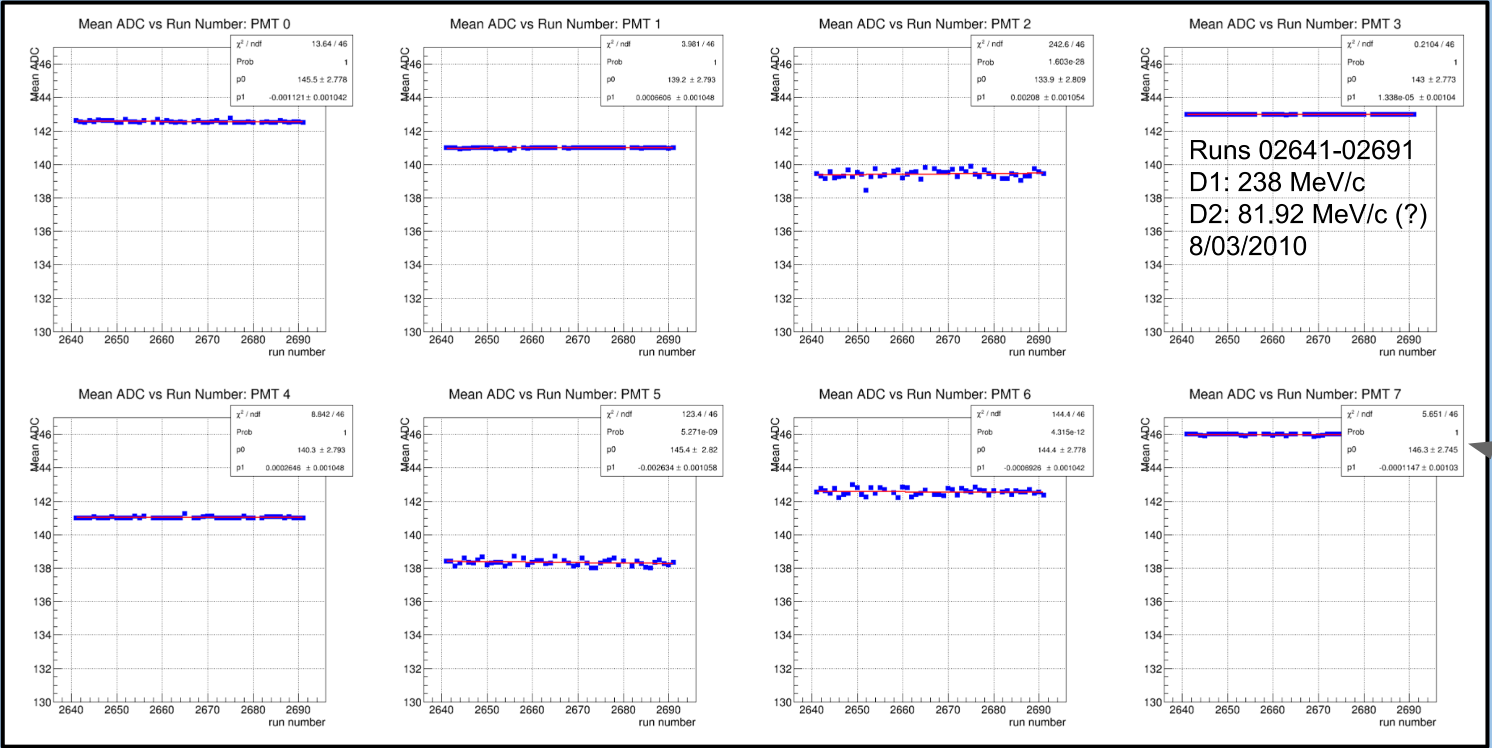
Analysis

Goals:

- Perform reconstruction and analysis on a large number of electron (or positron) and low momentum pion runs.
- Create historical plots of the data. This includes analysis plotted against long term(monthly/yearly) and short term (daily) time frames.
- These plots will provide us with a ckov baseline that can be used to estimate the accuracy of the calibration constant (mean value) of each PMT
- We not only want to determine the proper constants, but also whether or not the constants have any time dependence. This will allow us to more accurately estimate the correct number of photoelectrons per PMT.
- In addition, the results of this analysis will be used to determine whether or not the high and low voltage values of the PMTs at RAL need to be adjusted.

Stability Study:ADC

Linear fit performed. All slopes are within error of zero.



Quantities of Interest:

1. ADC (Pedestal)
2. Low momentum pions (SPE peaks)
3. Electron (or positron) peaks

ADC Data Shown:

- 50 positron runs with identical run conditions taken over the course of a single day.
- Data points are approximately 10-15 minutes apart

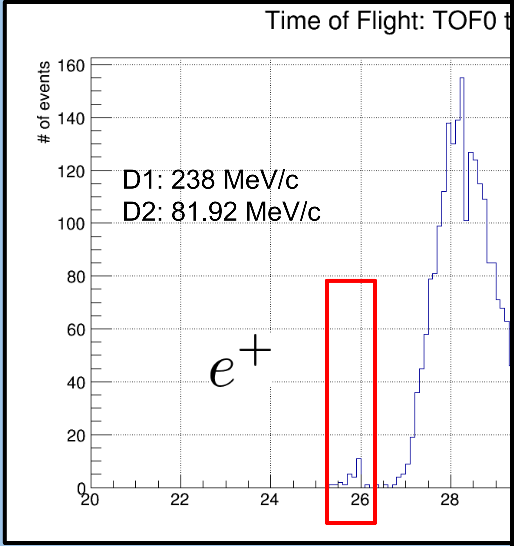
Stability Study: Positron Peaks

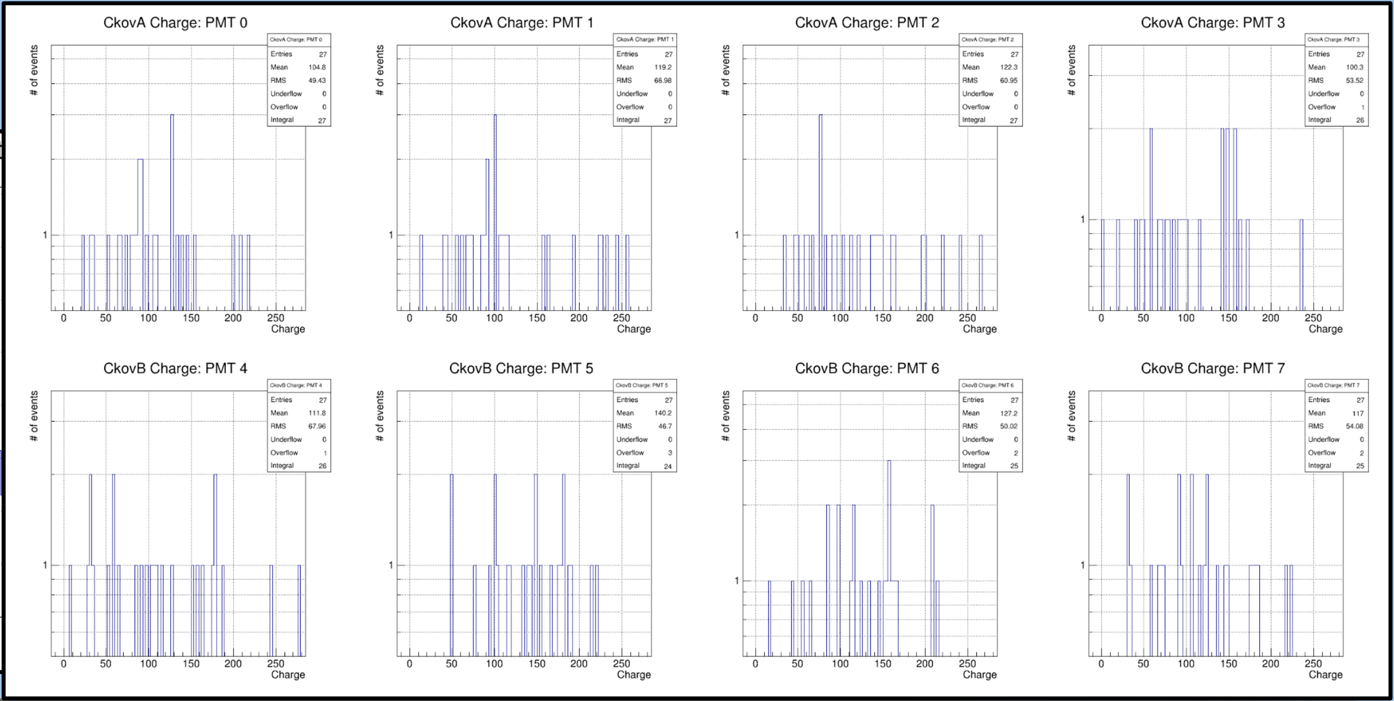
- Positrons are selected using the TOF
- Number of events per run is too low for an accurate fit.
- Combine runs to increase particle number

First run in a sequence of 50

(same group as previous slide)

Run 02641
D1: 238 MeV/c
D2: 81.92 MeV/c (?)
8/03/2010

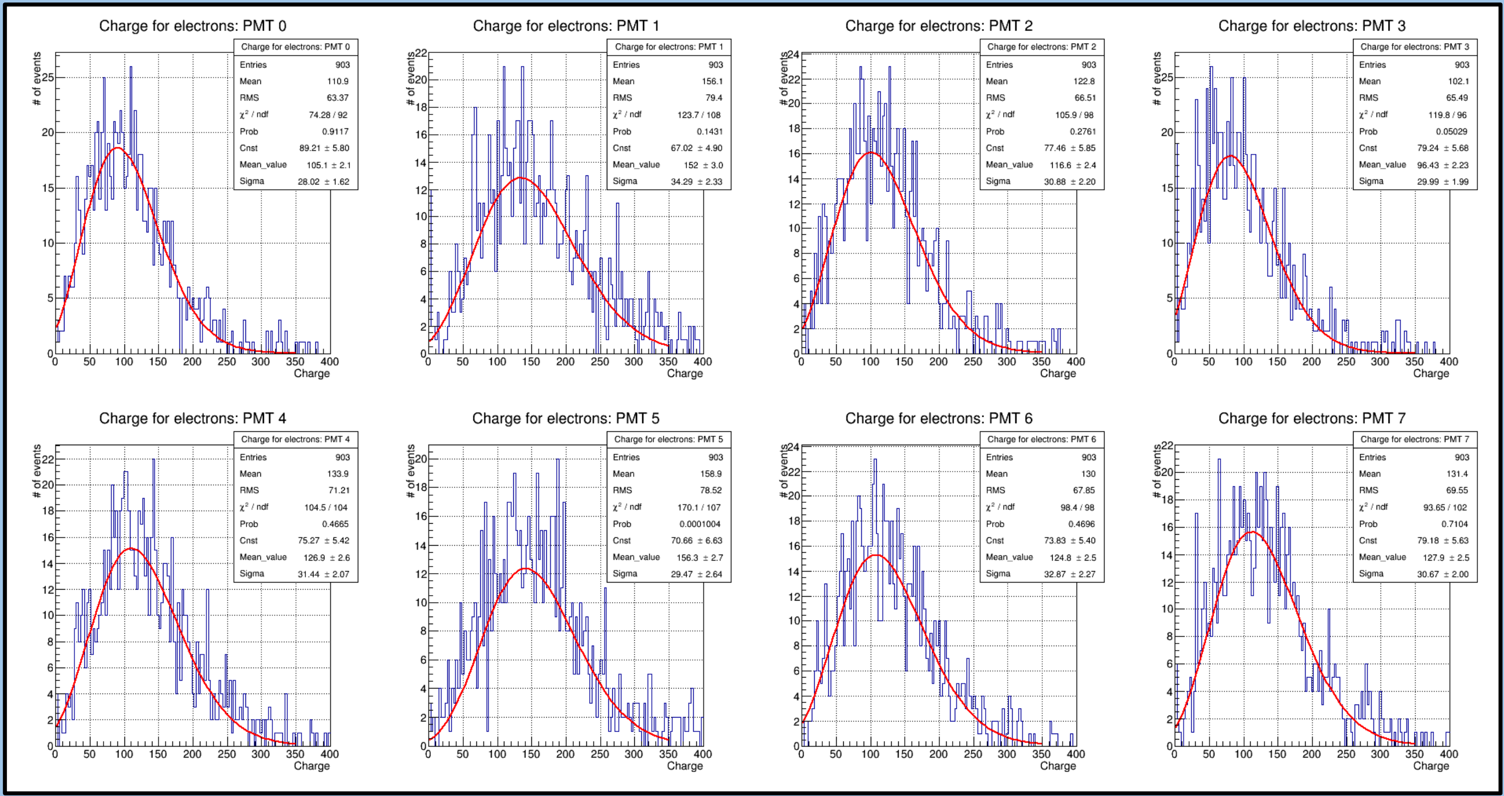




Stability Study: Positron Peaks

Runs 02641-02691
D1: 238 MeV/c
D2: 81.92 MeV/c
8/03/2012

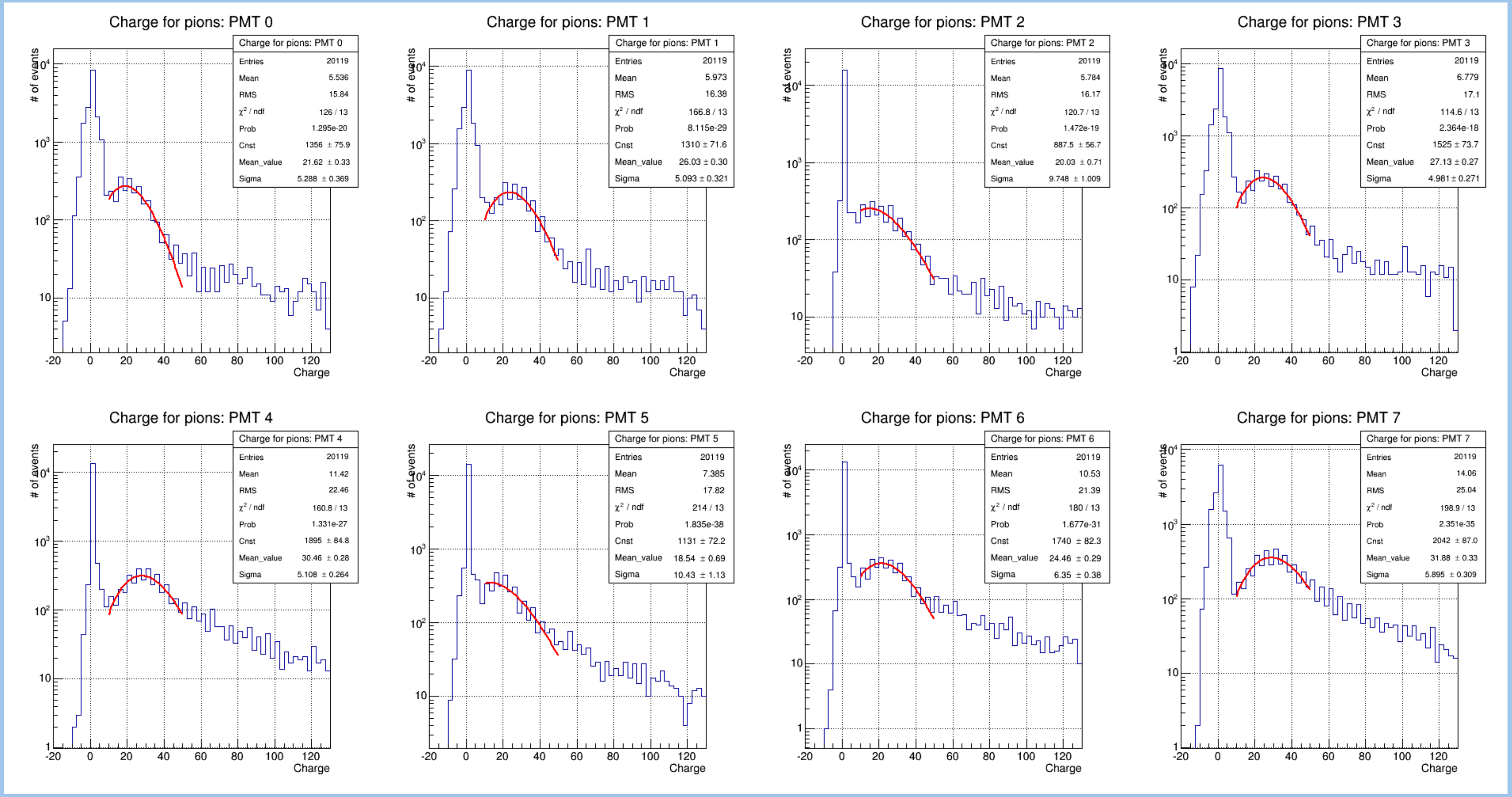
PMT	Mean	Uncertainty
0	105.1	2.1
1	152.0	3.0
2	116.6	2.4
3	96.4	2.2
4	126.9	2.6
5	156.3	2.7
6	124.8	2.5
7	127.9	2.5



Stability Study: SPE Peaks

May 2012 pion runs*
D1: 268.67 MeV/c
D2: 265.98 MeV/c

PMT	Mean	Uncertainty
0	21.4	0.3
1	25.5	0.3
2	19.3	0.8
3	26.8	0.3
4	29.7	0.3
5	18.4	0.5
6	23.8	0.3
7	30.7	0.3



*runs used: 03999, 04000, 04018, 04045, & 04046

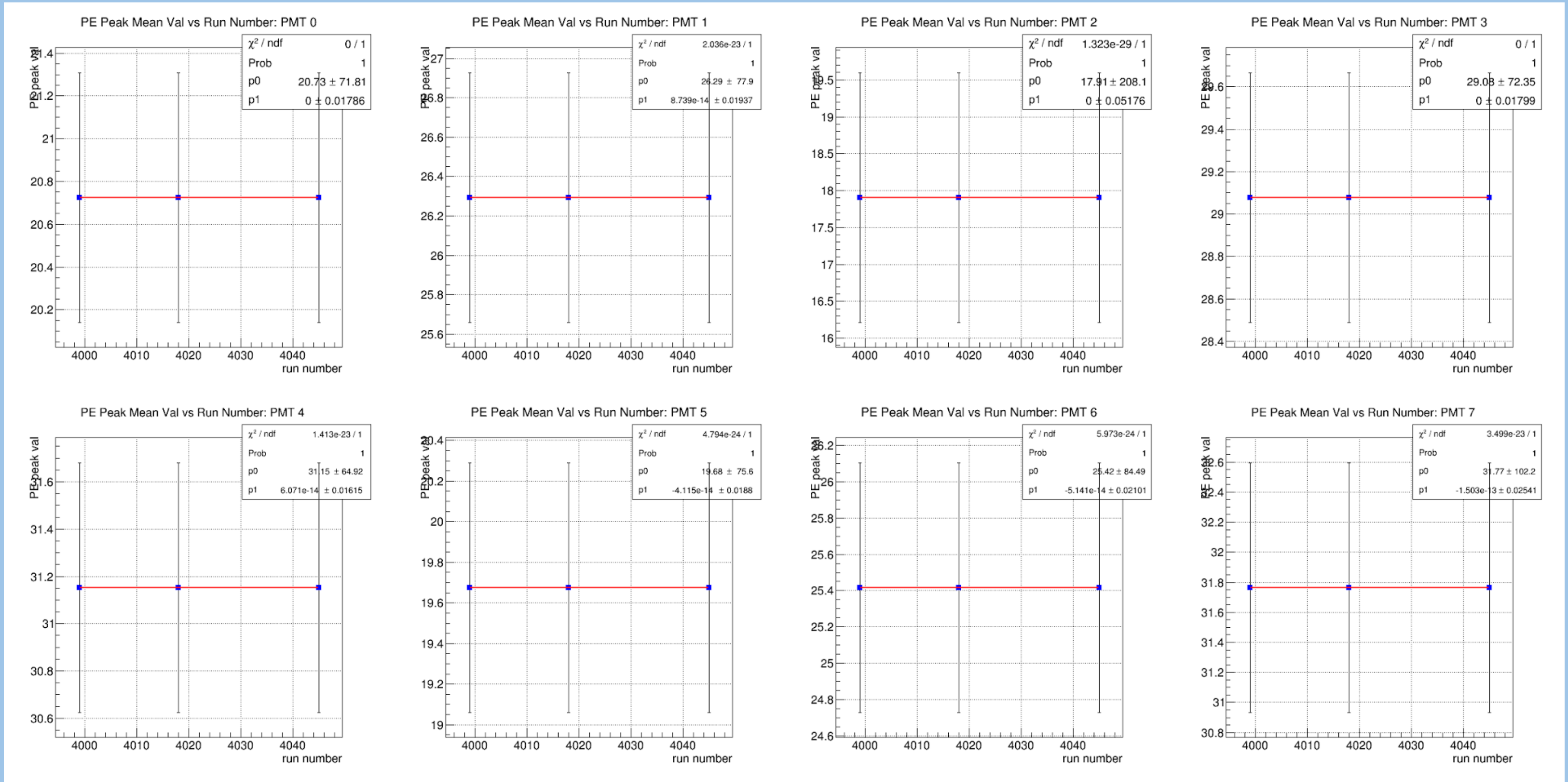
Stability Study: SPE Peaks

May 2012 pion runs*
D1: 268.67 MeV/c
D2: 265.98 MeV/c

SPE calibration constant stability over a three day period

Runs are stacked in groups corresponding to the date on which they occurred

Runs are labeled with the first run number that occurred that day.



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Stability Study: SPE Peaks

May 2012 pion runs*
D1: 268.67 MeV/c
D2: 265.98 MeV/c

SPE peak width stability over a three day period

Runs are stacked in groups corresponding to the date on which they occurred

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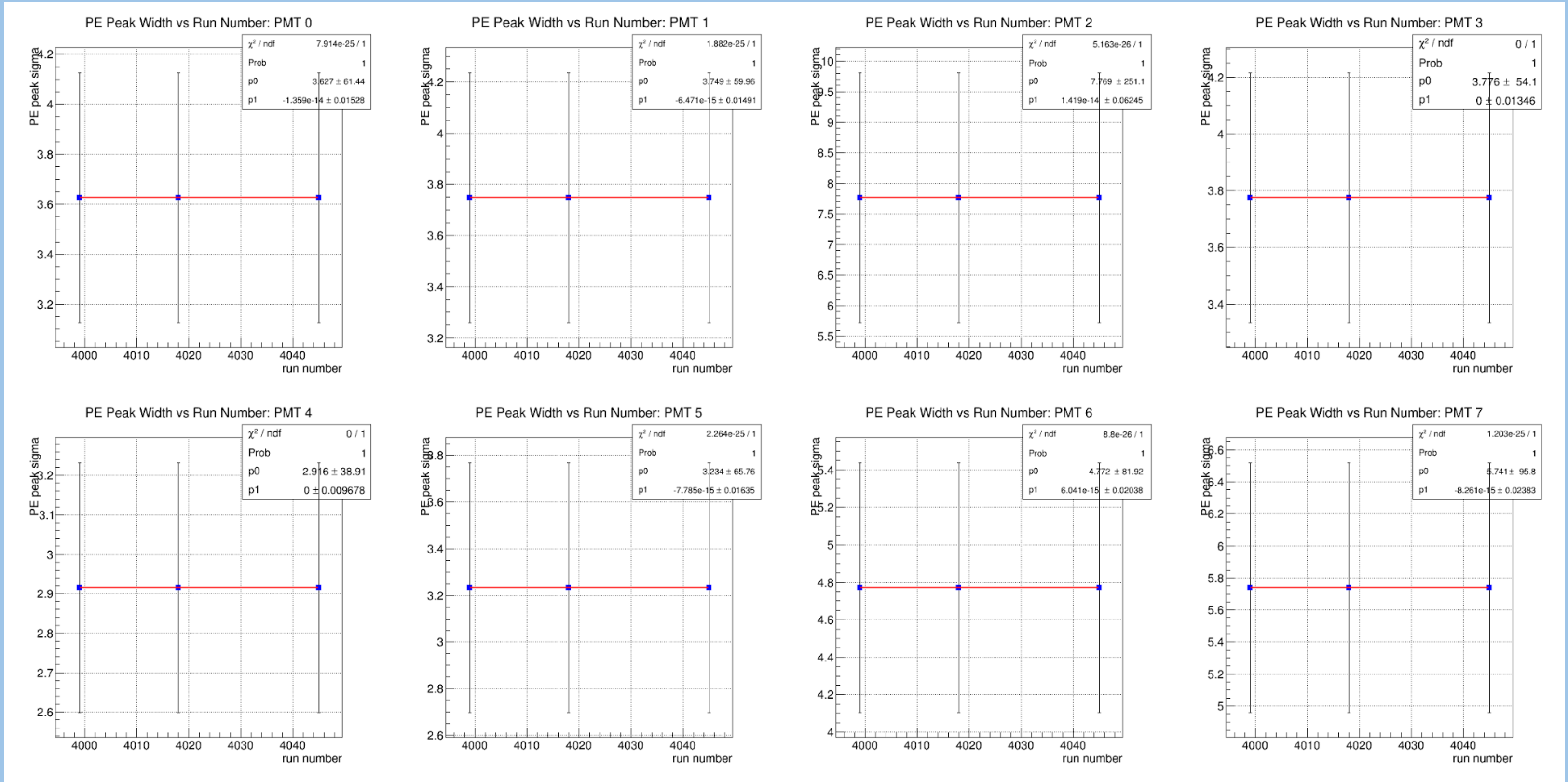

*runs used: 03999, 04000, 04018, 04045, & 04046

Conclusions

- Promising progress thus far
- What’s next:
  - More event scanning to find possible anomalies in fADC
  - Look for trends and time dependence in all quantities
  - Determine correct calibration constant for each PMT
  - Determine correct pedestal value for each PMT
  - Provide reliable information for upcoming pion contamination study
  - Be ready to take data in early 2015