HMS Luminosity Scan
&
Preliminary Kaon Yield Script

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May 10, 2018

HMS Luminosity Scan

Runs used are 1415 - 1420 taken in the beginning of January 2018

Good Event Selection

Performed two studies, with optional Cherenkov cut

- $|\delta| < 8.0$
- $0.7 < E_{\text{Cal,Norm}} < 1.5$
- BCM4a Current Flag $== 1$
- Number of tracks > 0
- HGC NPE Sum > 2.0

Results – Carbon

With a cut on the Cherenkov

Run	Current	Yield	Counts	Charge	Comp L.T.	Elec L.T.	Tracking	Cher
1415	2	63.35	29467	1022	81.47%	99.99%	99.05%	57.02%
1416	7	67.92	31917	1189	69.75%	99.99%	99.02%	57.20%
1417	10	67.82	66460	1968	88.25%	99.99%	98.89%	57.03%
1418	20	68.59	134478	3969	88.56%	99.99%	98.53%	56.60%
1419	30	69.66	175360	4781	93.76%	99.99%	98.09%	57.24%
1420	40	70.84	258930	6841	96.11%	99.99%	97.81%	56.83%

Without a Cherenkov cut

Run	Current	Yield	Counts	Charge	Comp L.T.	Elec L.T.	Tracking
1415	2	63.55	51837	1022	81.47%	99.99%	99.05%
1416	7	68.11	55959	1189	69.75%	99.99%	99.02%
1417	10	68.02	116848	1968	88.25%	99.99%	98.89%
1418	20	68.78	238242	3969	88.56%	99.99%	98.53%
1419	30	69.85	307185	4781	93.76%	99.99%	98.09%
1420	40	71.06	457029	6841	96.11%	99.99%	97.81%

Cherenkov Efficiency

Low efficiency arises from events giving 0.0 NPE in the HGC. For example, considering Run 1420:

- Out of 209360 events, 151749 give 0.0 NPE in the HGC (72.48%)
- After cuts on slide 2 are applied (electrons are selected, not using HGC information), 50988 events remain of which 21726 give 0.0 NPE in the HGC (42.61%)
- Therefore, only 0.56% of events lie between 0.0 and 2.0

Normalized Yield with Cherenkov Cut

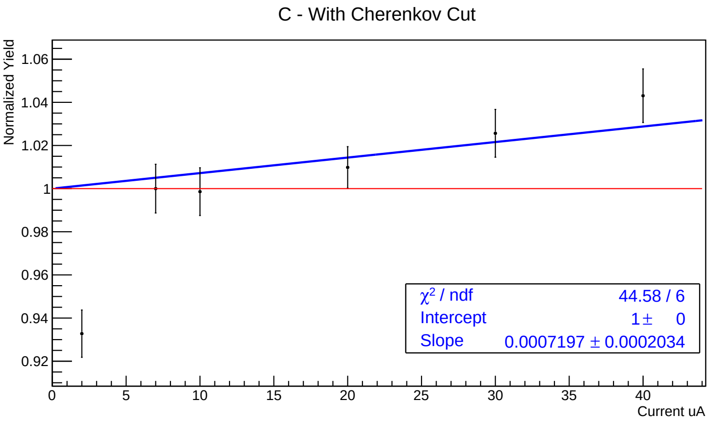

Figure 1 : Normalized Yield for Runs 1415 - 1420 with a cut on the Cherenkov. Normalized to run 1416, current 7 uA.

Normalized Yield without Cherenkov Cut

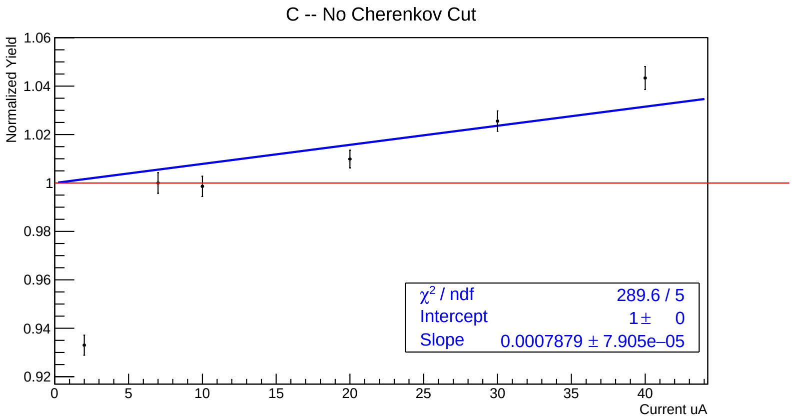

Figure 2 : Normalized Yield for Runs 1415 - 1420 without a cut on the Cherenkov. Normalized to run 1416, current 7 uA.

Scaler Verification

Calculated the efficiencies from scaler information directly to verify their accuracy

Run	REPORT	REPORT	Scaler	Scaler
	Comp L.T.	Elec L.T.	Comp L.T.	Elec L.T.
1415	81.47%	99.99%	80.44% ± 0.33%	99.99% ± 0.07%
1416	69.75%	99.99%	70.64% ± 0.28%	99.99% ± 0.07%
1417	88.25%	99.99%	89.08% ± 0.26%	99.98% ± 0.07%
1418	88.56%	99.99%	88.99% ± 0.18%	99.98% ± 0.07%

Runs 1419 & 1420 did not have the scaler leaves filled.

Results for Scaler Efficiencies

Run	Current	Yield	REPORT Yield
1415	2	63.4502	63.3506
1416	7	67.0733	67.9171
1417	10	67.2033	67.8214
1418	20	68.2704	68.5851
1419	30	69.6587	69.6587
1420	40	70.842	70.8420

Normalized Yield with Cherenkov Cut, Scaler Efficiencies

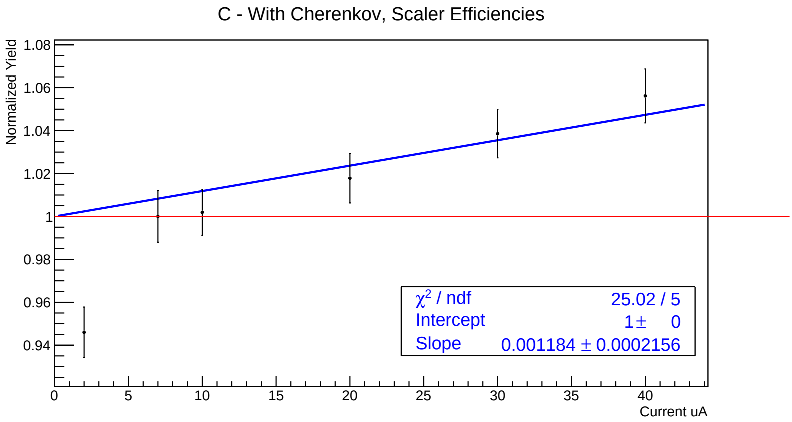

Figure 3 : Normalized Yield for Runs 1415 - 1420 with a cut on the Cherenkov and efficiencies calculated from scalers. Normalized to run 1416, current 7 uA.

Preliminary Kaon Yield

Run used is 3424 taken near the start of the SIDIS experiment

Good Event Selection

Choosing electrons in HMS, kaons in SHMS:

- $E_{\text{HMS Cal,Norm}} > 0.8$
- $E_{\text{SHMS Cal,Norm}} < 0.7$
- Aerogel NPE $>$ 1.5 AND HGC NPE $<$ 1.5
- $|\delta_{\text{HMS}}| < 8.0$
- $|\delta_{\text{SHMS}}| < 8.0$
- (e,K coincident time - 10.0) $<$ 1.0
- $|\beta_{\text{SHMS}} - 1.0| < 0.1$

e,K coincident time is given in leaf CTime.eKCoinTime_ROC1, the 10.0 is subtracted to center the distribution on 0.0.

Results

To begin, only two cuts are applied: coincident time, and beta

Kinetic Cut Results

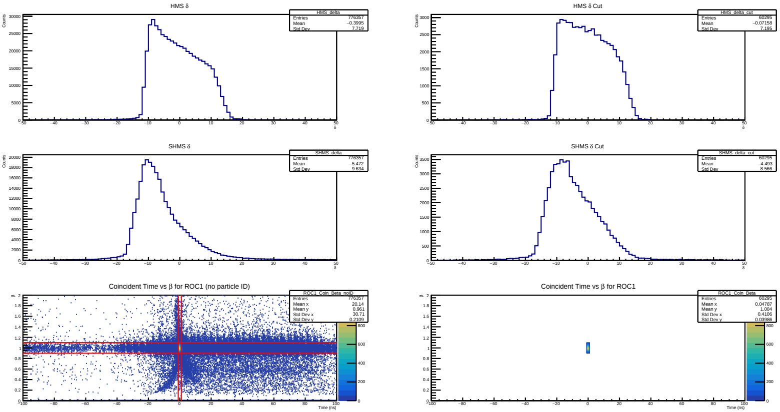

Figure 4 : Summary of δ, timing and β distibutions after cuts.

Particle Cut Results

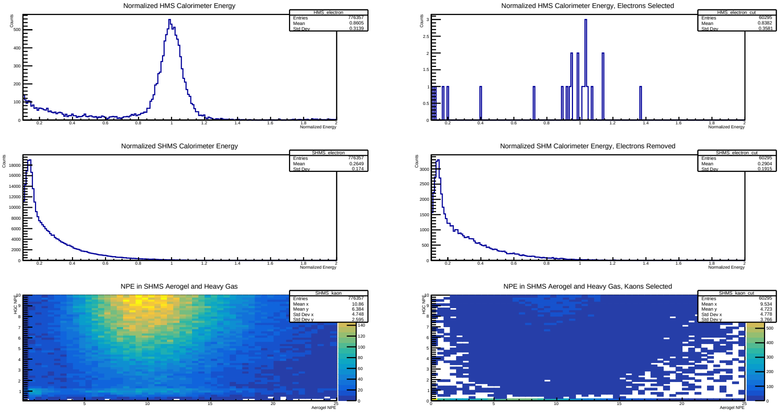

Figure 5 : Summary of calorimeter and Cherenkov distributions after cuts.

Results

Good News: selecting the coincident time gives a definite kaon signal from the SHMS Cherenkovs (large signal at 0 NPE in HGC, 7.0 NPE in aerogel)!
Bad News: selecting the coincident time gives almost no electrons in the HMS calorimeter!

Possibly due to poor calorimeter calibrations. Will require further investigations.

Scaler Efficiencies

After talking to Mark Jones, the efficiencies for coincident running is easily extrapolated from HMS singles

- Both scaler trees, TSH and TSP, should be identical
- Computer livetime is taken from the leaf P.pTRIG6.scaler
- Electronic livetime is the product of each spectrometers livetime. Both can be found in TSP tree where P.pPRE150.scaler is SHMS and P.hPRE150.scaler is HMS

Script Procedure

Currently, the script will generate all the preceding figures for shift workers to examine and verify are accurate. However, it requires a .root file that has BCM information (flags, etc.) to calculate the efficiencies. This requires at least two replays of the data. Therefore we could have a shell script that would:

Scaler replay $\rightarrow$ BCM Calibration $\rightarrow$ Full Replay $\rightarrow$ Run Yield Script

If it is necessary to have a new BCM calibration for each run.