Kaon LT Status Update

October 4th, 2022

Richard Trotta

Analysis Phases

1. Calibrations ✔
   - Calorimeter, aerogel, HG cer, HMS cer, DC, Quartz plan of hodo
   - Assure we are replaying to optimize our physics settings
2. [~2 months] Efficiencies and offsets ⟵ Current step
   - Luminosity, elastics, Heeps, etc.
3. [3-4 months] First iteration of cross section ⟵ On-deck
   - Extract the kaon electroproduction cross section
4. [~1 months] Fine tune
   - Fine tune values to minimize systematics
5. [~3+ months] Repeat previous two steps
   - Repeat until acceptable cross sections are reached
   - This will highlight any potential complications
6. [~1 month] Possible attempt at form factor extraction
   - The Rosenbluth separation technique** is used to isolate the longitudinal term and thus the form factor can be extracted

2. Efficiencies and offsets

- 10.6 GeV -> Richard
- 8.2 GeV -> Ali
- 6.2 GeV -> Ali/Richard
- ✓ 3.8/4.9 GeV -> Vijay
- Goal: Finish these up as soon as possible

3. First iteration of cross section

- Looking at Bill's code and getting cross-sections
  - Root analysis portion is nearing completion
  - Currently dealing with a few bugs to sort out

Scaler Yield Calculation

$$N_{scaler} = \Sigma(trigscaler) - EDTM_{scaler}$$

$$Y_{scaler} = \frac{N_{scaler}}{Q_{tot}}$$

$$Q_{tot} = (H.BCM.scaler.charge)$$

Yield Calculation

Total elastic events

$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

$$EDTM_{LT} = \frac{numOfNonzeroTDChits}{numOfScalerCounts}$$

$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

$$Q_{tot} = (H.BCM.scaler.charge)$$

Lumi Cuts

- tdcTimeRaw cuts on pTrigs and EDTM
- Evttype cuts (HMS Evttype==2, SHMS Evttype==1)
- abs(current-setcurrent) < 2.5

“+” SHMS (pion)

- P_hgcer_npeSum > 1.5
- P_aero_npeSum > 1.5
- P_cal_etotnorm < 0.9

“+” SHMS (proton)

- P_hgcer_npeSum < 1.5
- P_aero_npeSum < 1.5
- P_cal_etotnorm > 0.0

“-” SHMS (electron)

- P_hgcer_npeSum > 0.5
- P_aero_npeSum > 2.0
- P_cal_etotnorm > 0.8

HMS (electron)

- H_cer_npeSum > 6.0
- H_cal_etotnorm > 0.6

Track Lumi Cuts

- tdcTimeRaw cuts on pTrigs and EDTM
- Evttype cuts (HMS Evttype==2, SHMS Evttype==1)
- abs(current-setcurrent) < 2.5
- (P)H_goodscinhits == 1
- abs(P_gtr_beta-1) > 0.3

“+” SHMS (pion)

- P_hgcer_npeSum > 1.5
- P_aero_npeSum > 1.5
- P_cal_etottracknorm < 0.9

“+” SHMS (proton)

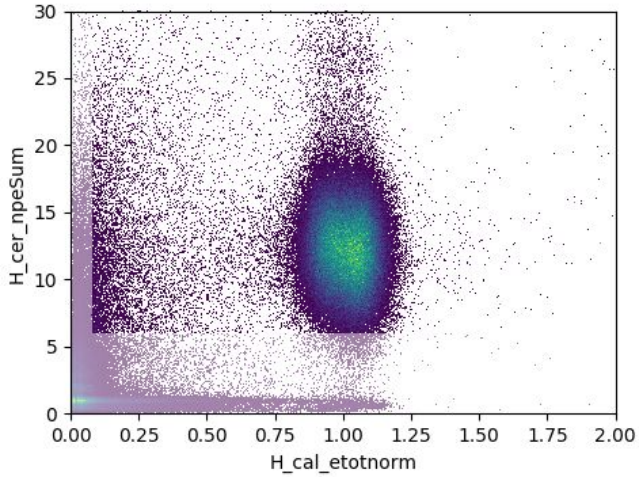
- P_hgcer_npeSum < 1.5
- P_aero_npeSum < 1.5
- P_cal_etottracknorm > 0.0

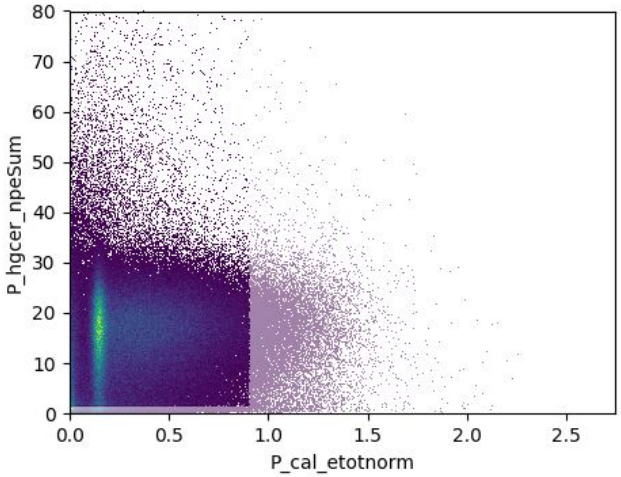
“-” SHMS (electron)

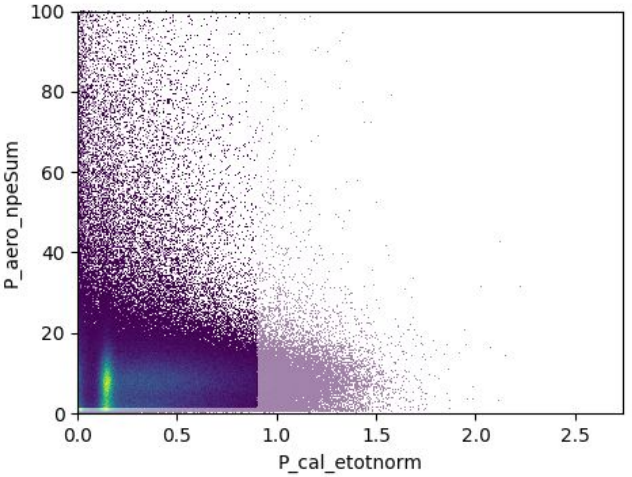
- P_hgcer_npeSum > 0.5
- P_aero_npeSum > 2.0
- P_cal_etottracknorm > 0.8

HMS (electron)

- H_cer_npeSum > 6.0
- H_cal_etottracknorm > 0.6


H_cer_npeSum
H_cal_etotnorm
0
5
10
15
20
25
30
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


P_hgcer_npeSum
P_cal_etotnorm
0
10
20
30
40
50
60
70
80
0.0
0.5
1.0
1.5
2.0
2.5


P_aero_npeSum
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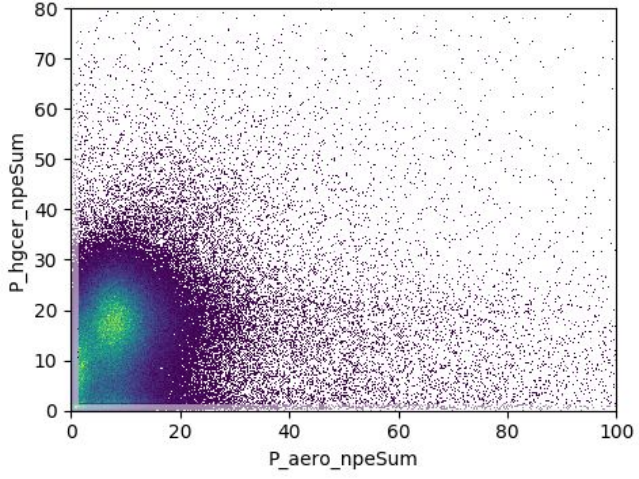
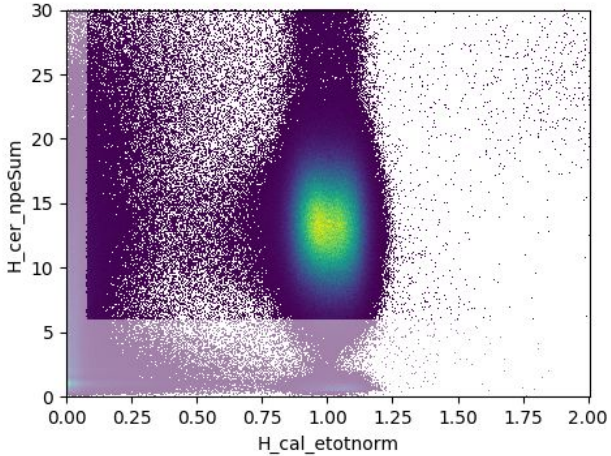
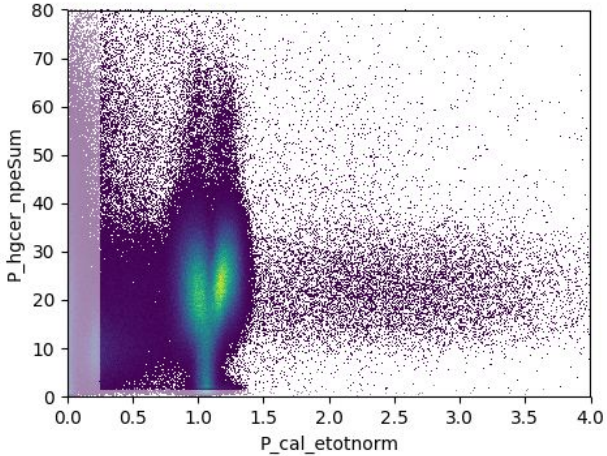
20
40
60
80
100
0.0
0.5
1.0
1.5
2.0
2.5


P_hgcer_npeSum
P_aero_npeSum
0
10
20
30
40
50
60
70
80
0
20
40
60
80
100

Run 7841


H_cer_npeSum
H_cal_etotnorm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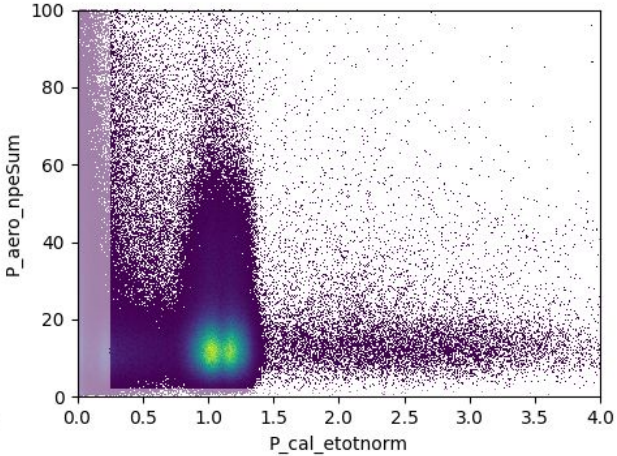
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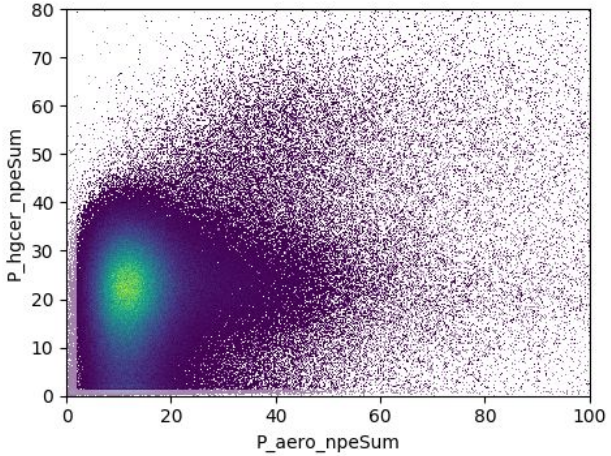
P_cal_etotnorm

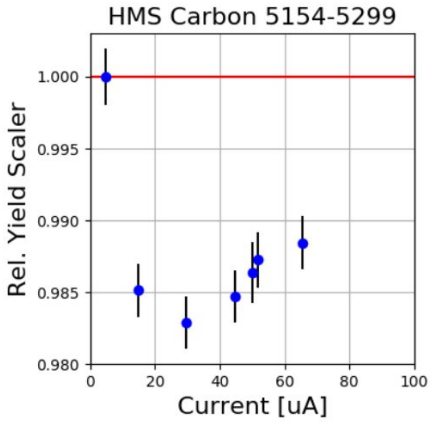

P_hgcer_npeSum
P_aero_npeSum

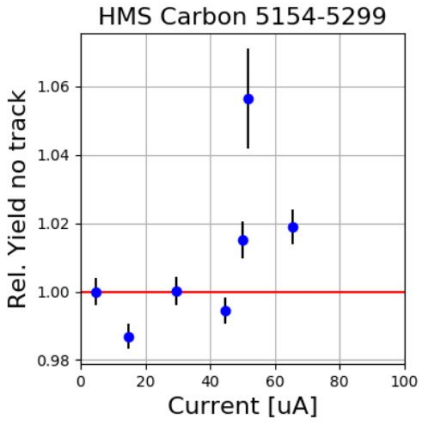
10p6 Carbon #1

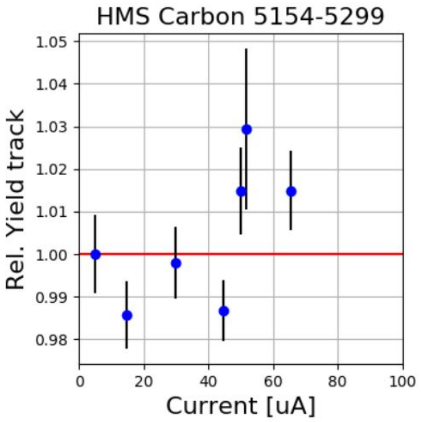
e-pi

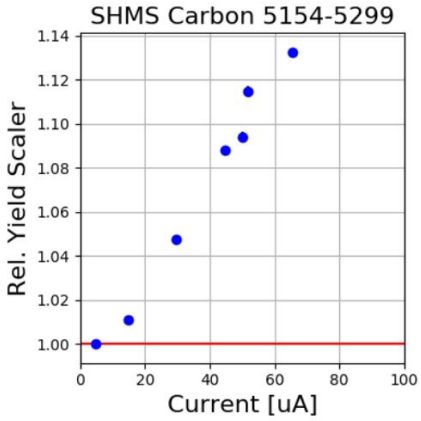
$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

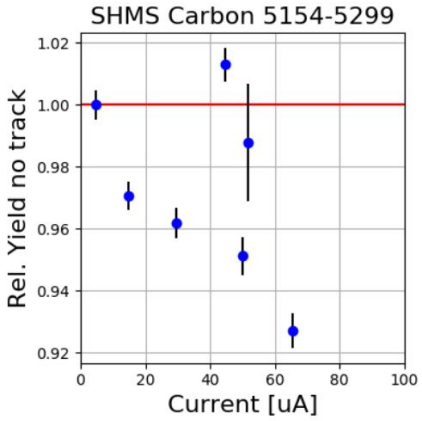
$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

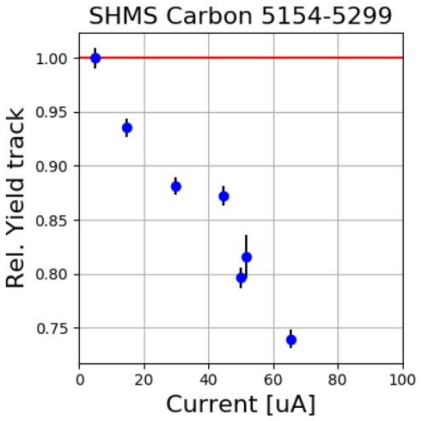










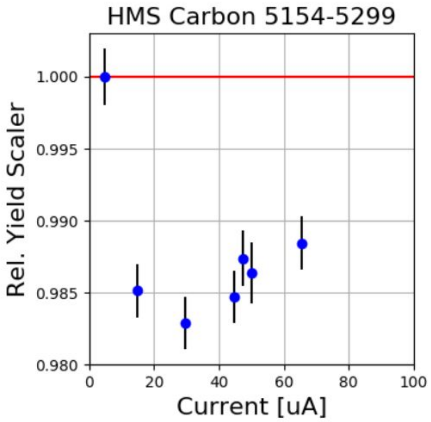


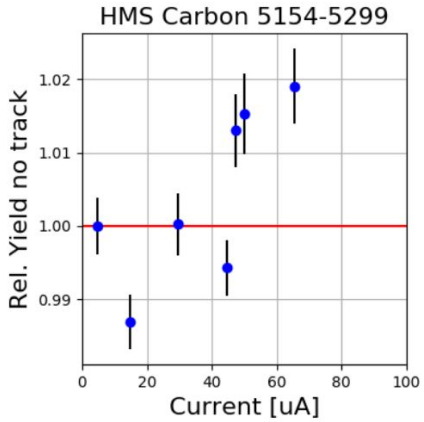
10p6 Carbon #1

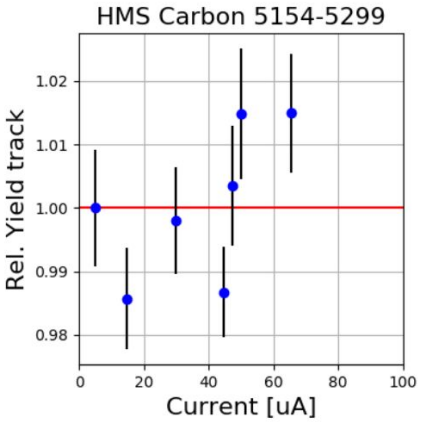
e-p (note: current cut was changed for 5154 so HMS changes a little)

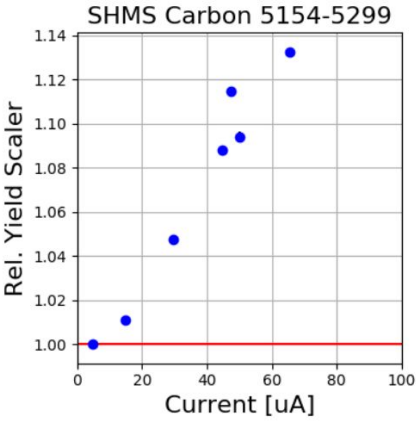
$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

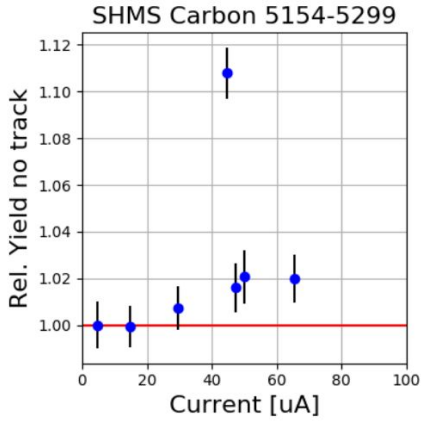
$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

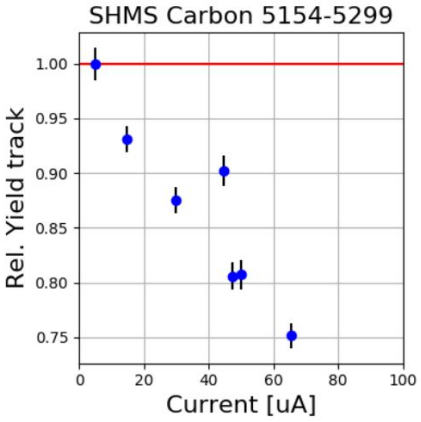








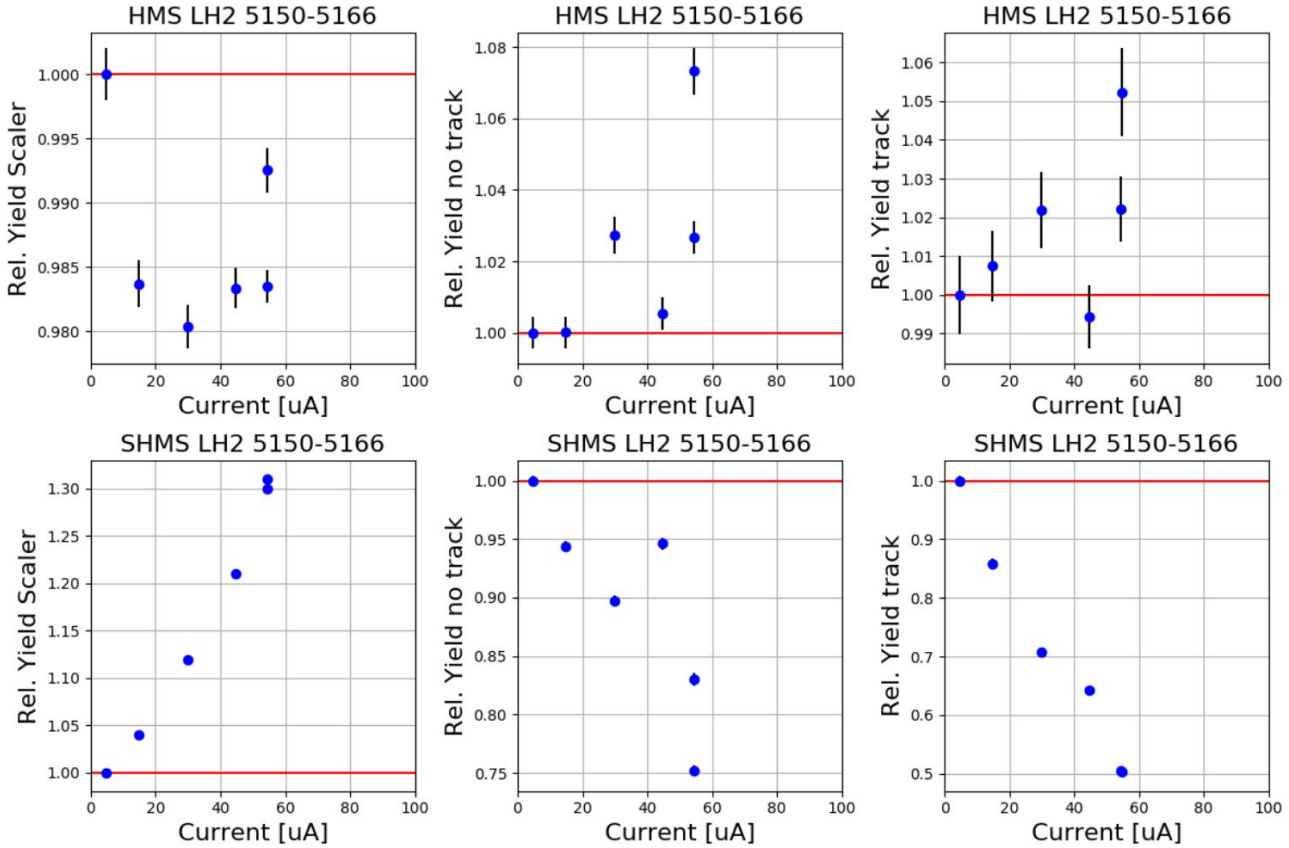




10p6 LH2 #1

$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

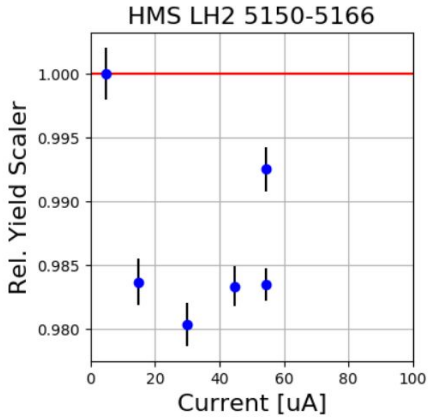


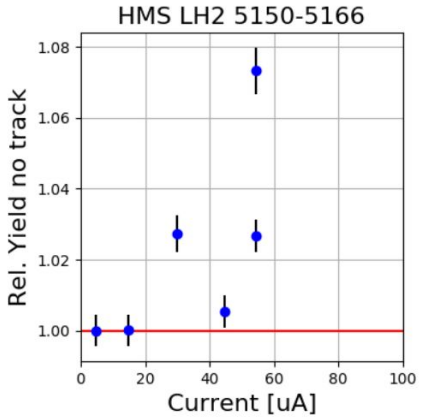
10p6 LH2 #1

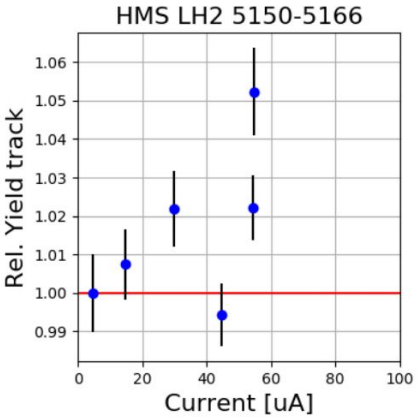
e-p

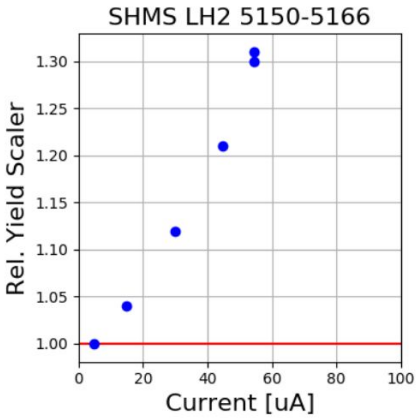
$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

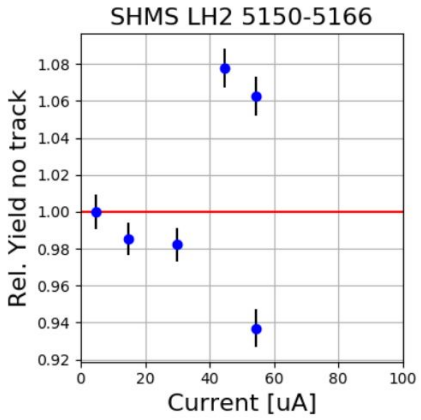
$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

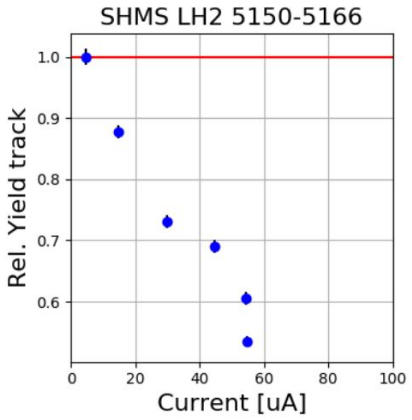










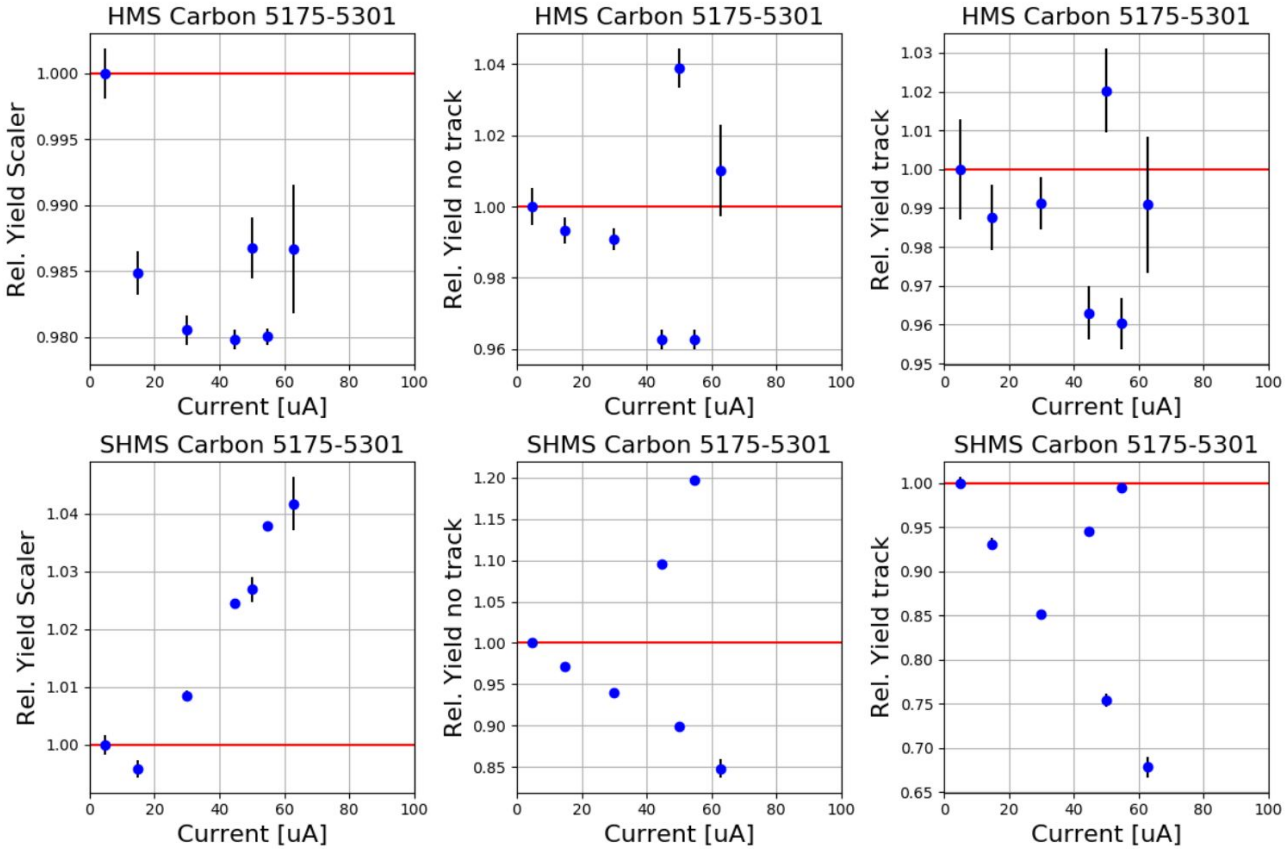


10p6 Carbon #2

e-pi

$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

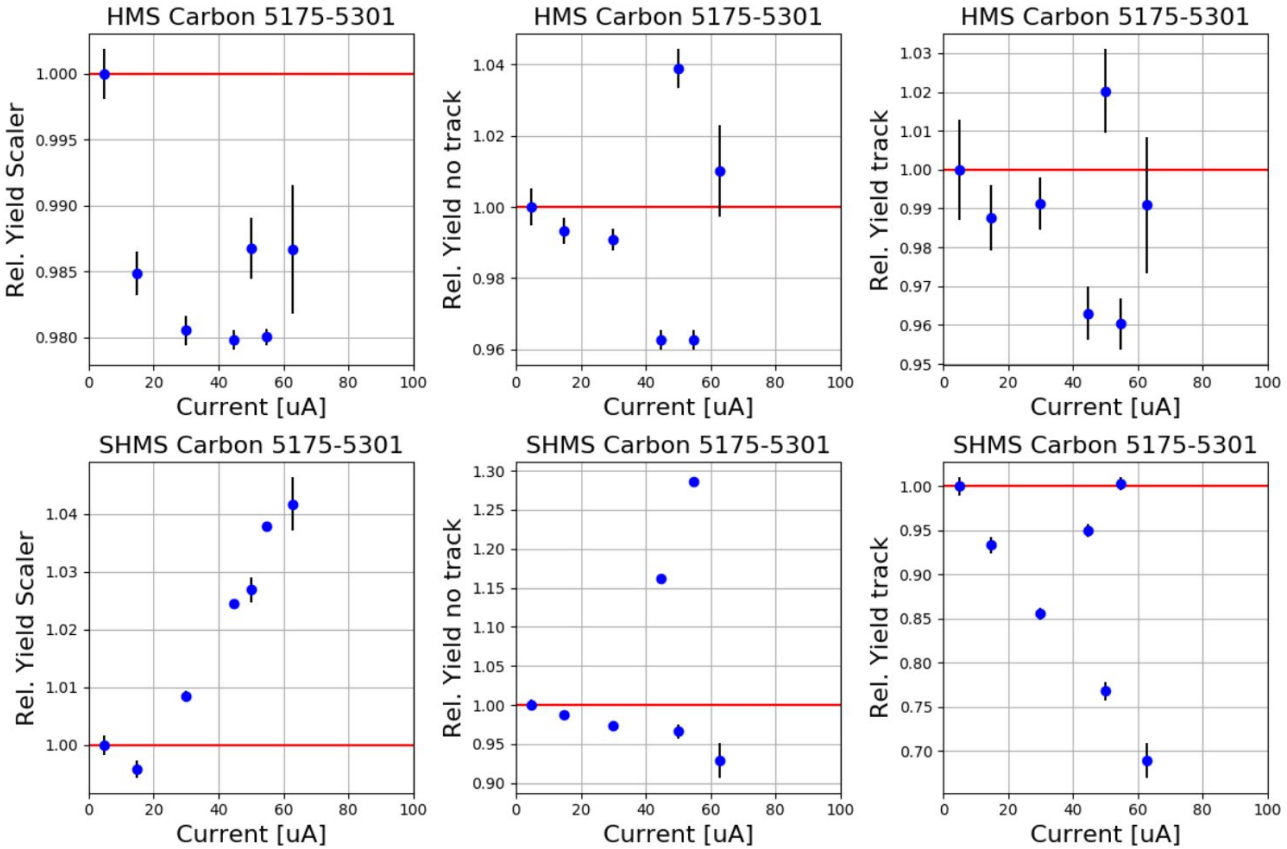


10p6 Carbon #2

e-p

$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

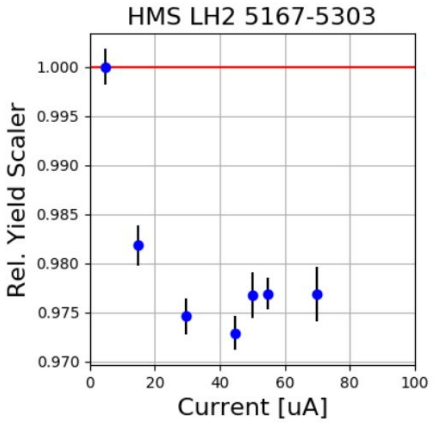


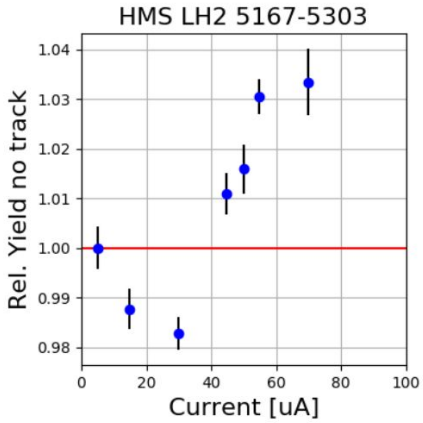
10p6 LH2 #2

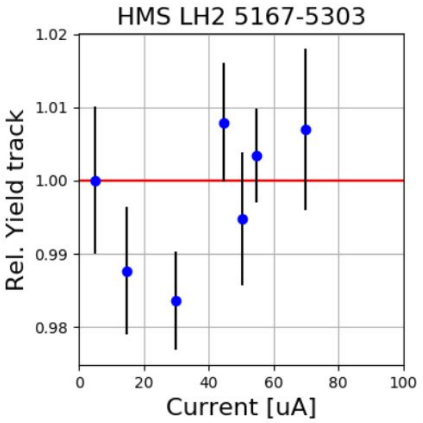
e-pi

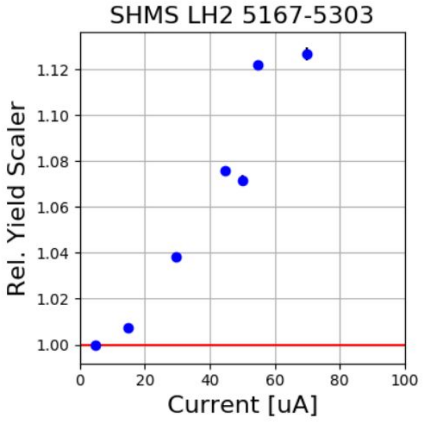
$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

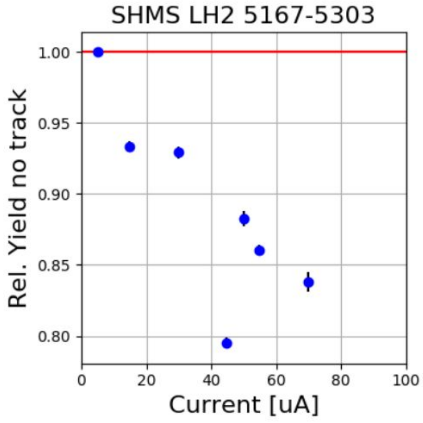
$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

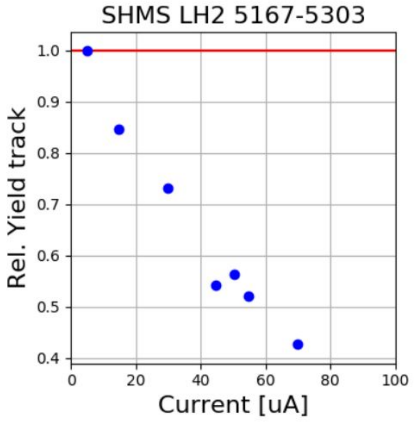










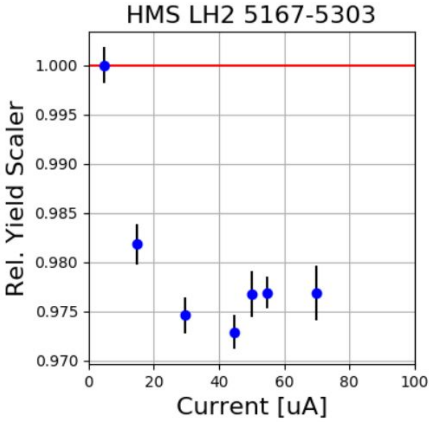


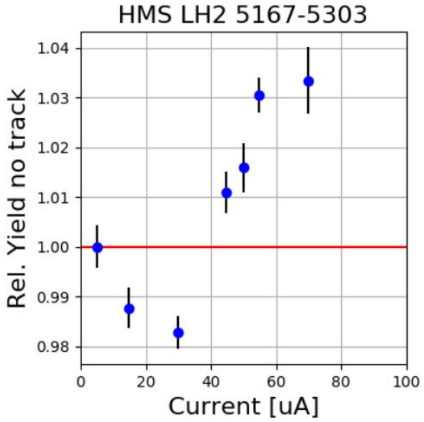
10p6 LH2 #2

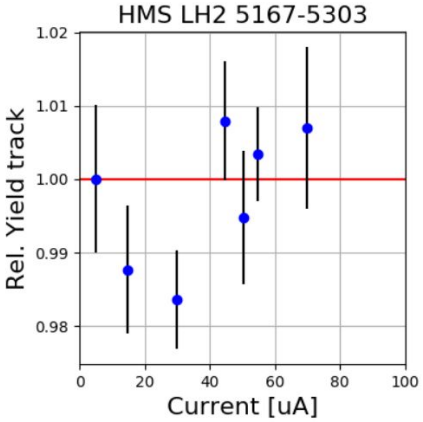
e-p

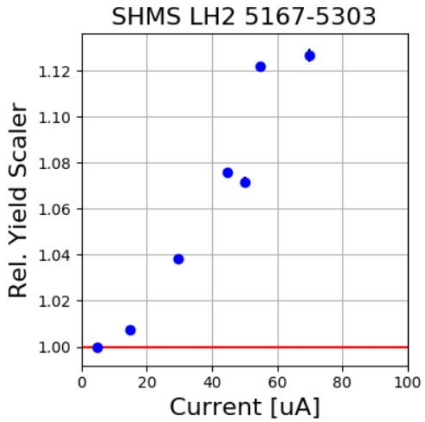
$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

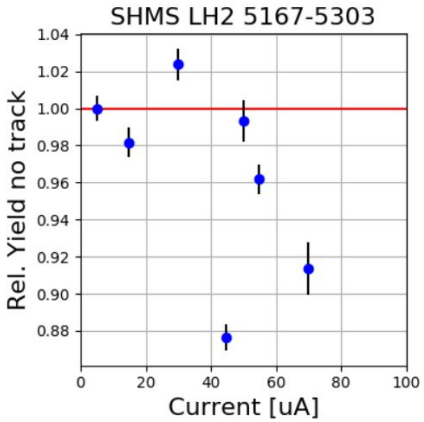
$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

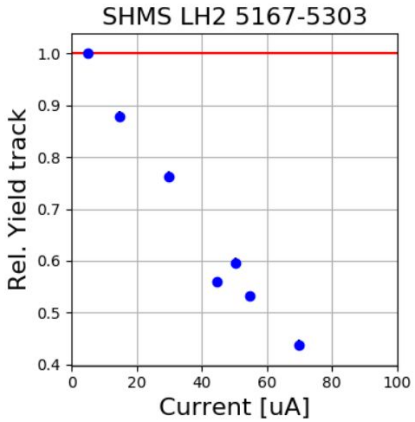










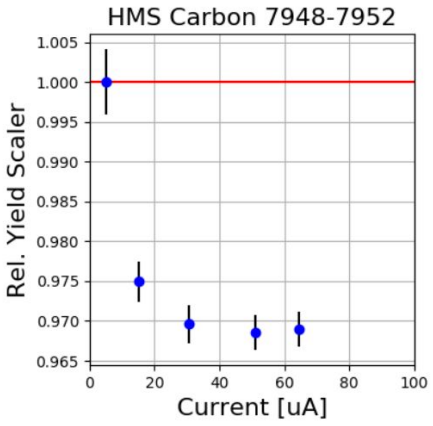


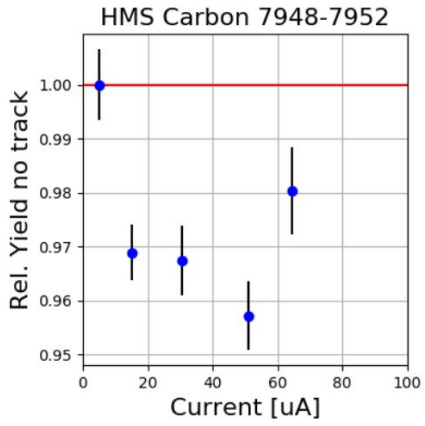
8p2 Carbon #1

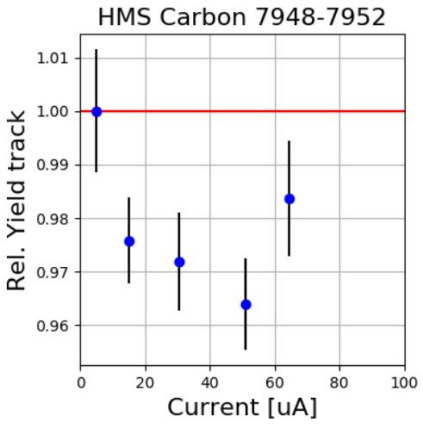
e-e

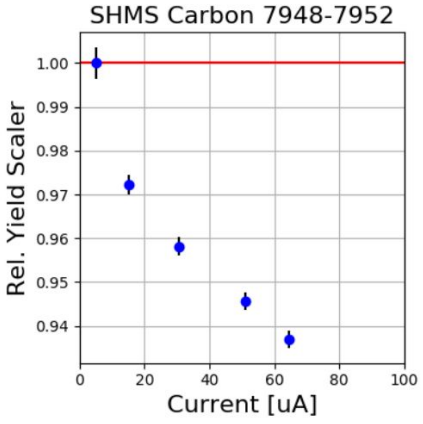
$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

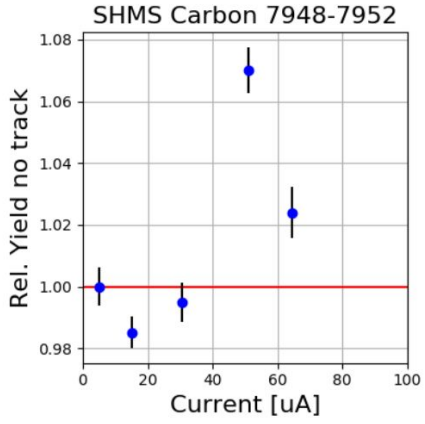
$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

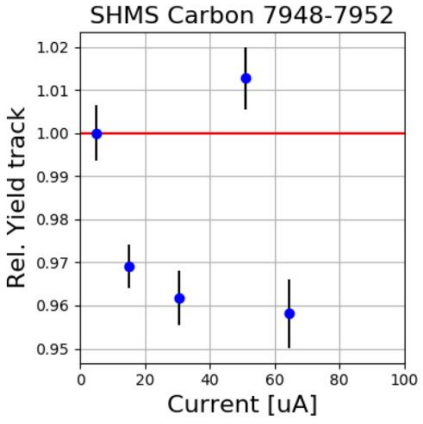










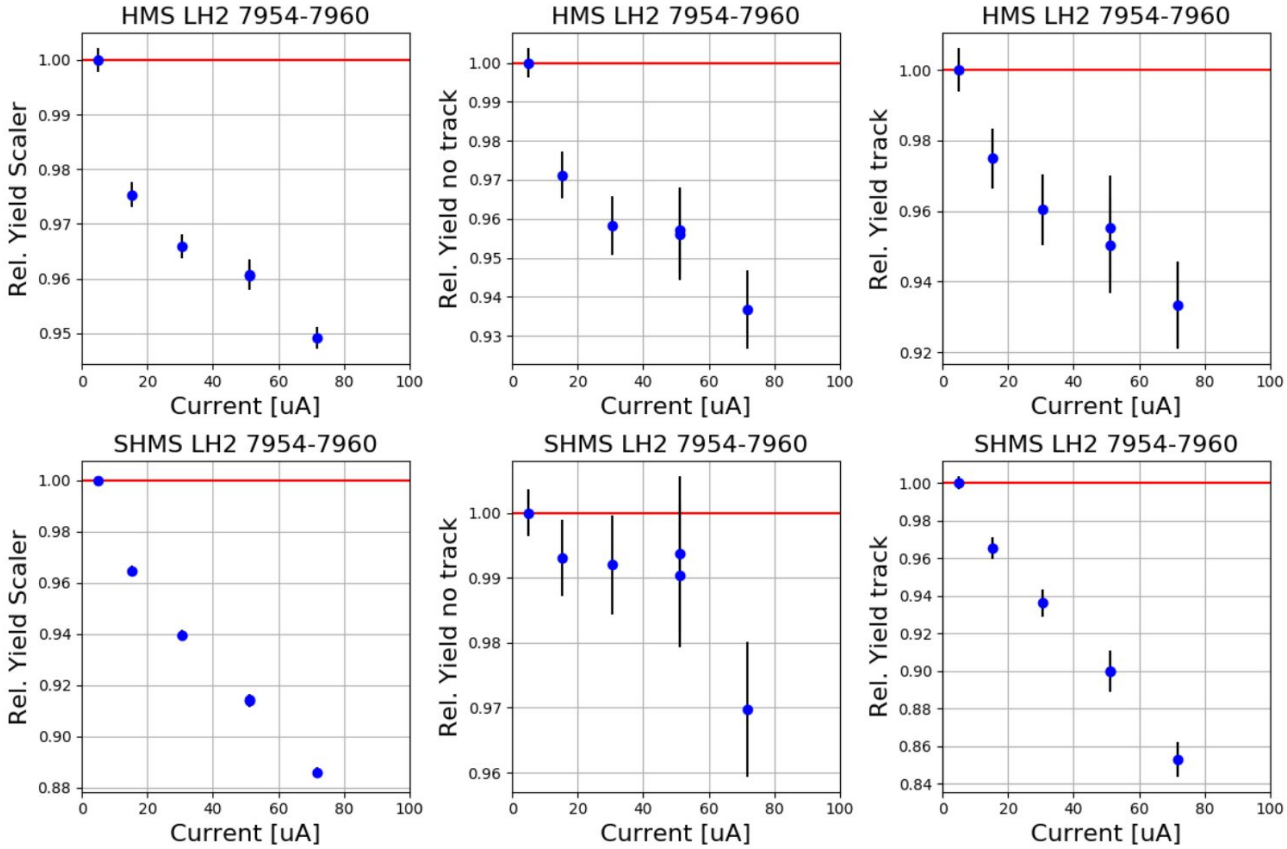


8p2 LH2 #1

e-e

$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

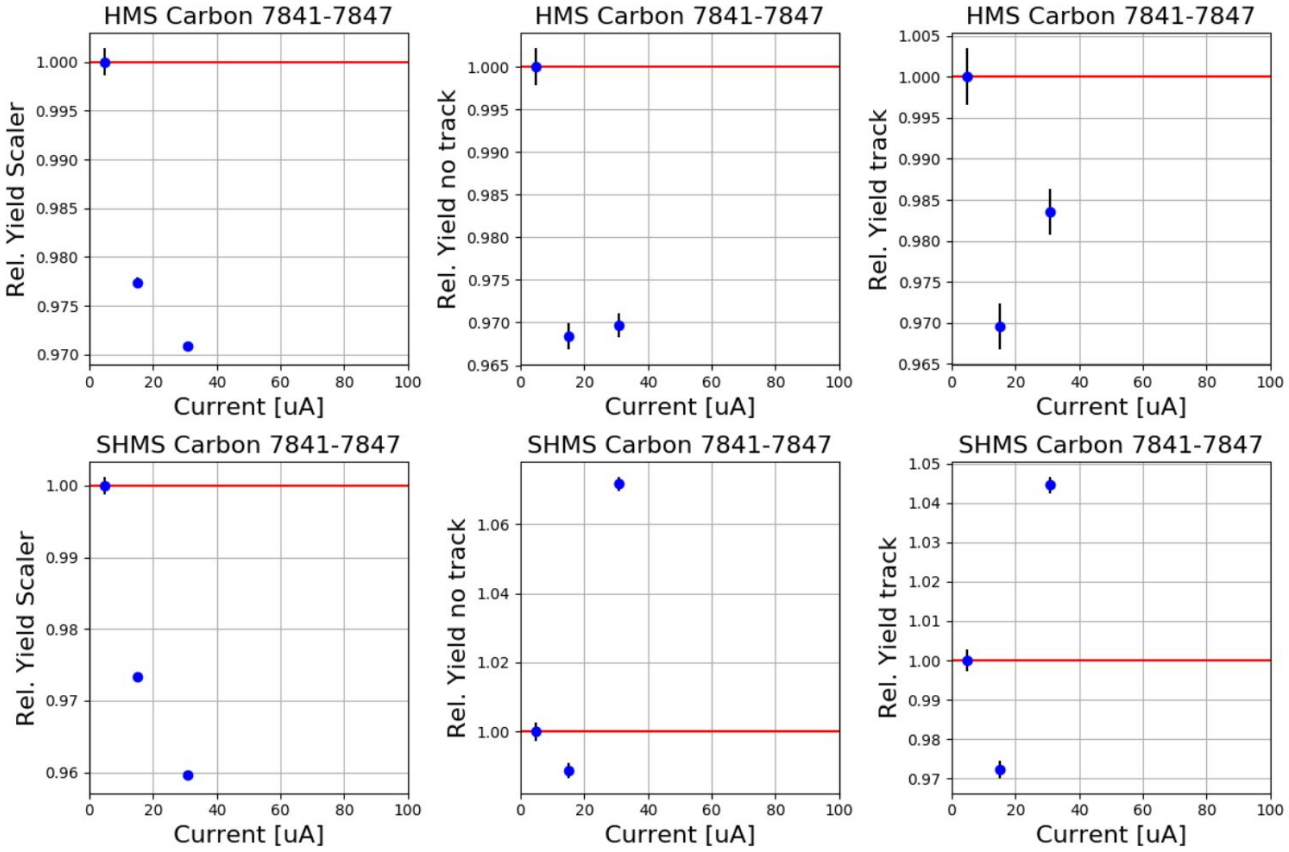


6p2 Carbon #1

e-e

$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

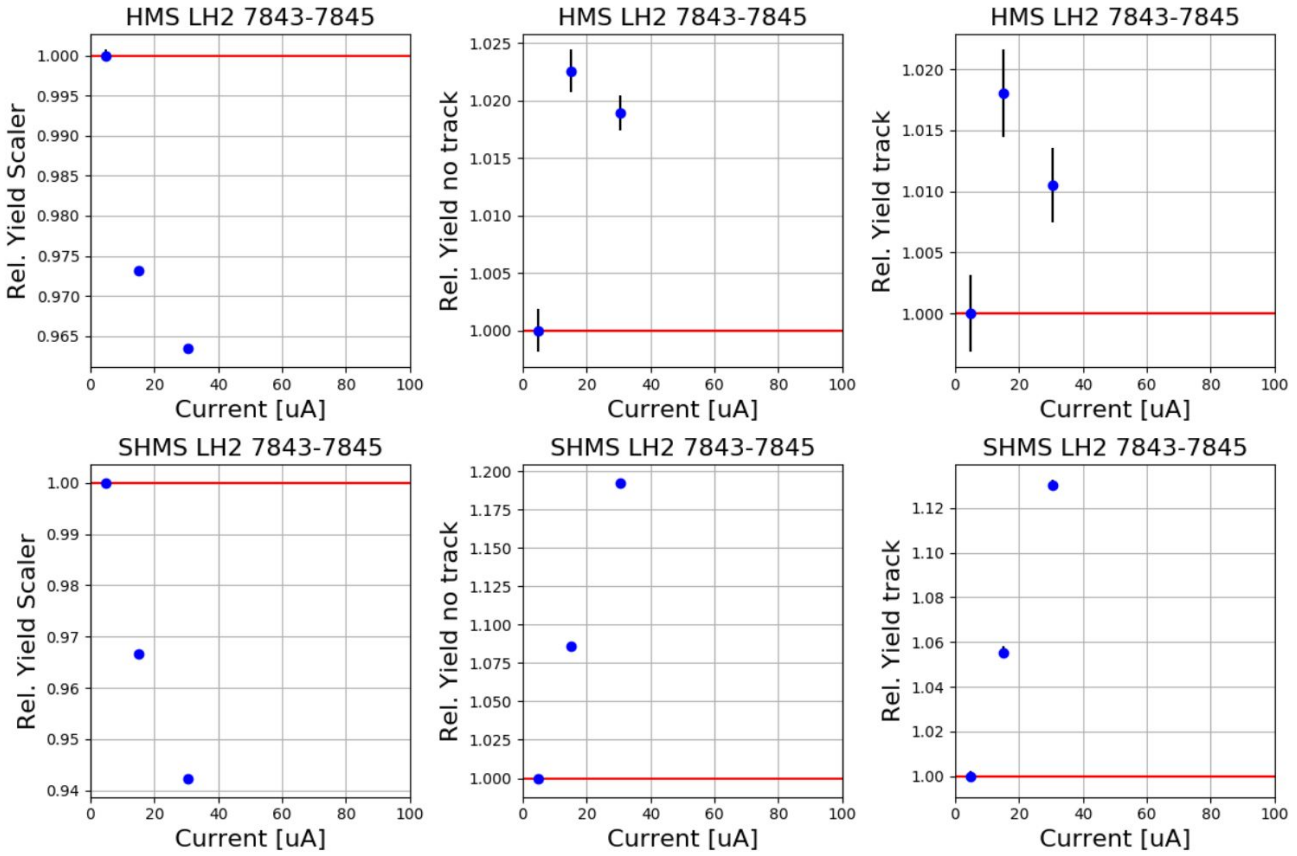
$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$



6p2 LH2 #1

$$\text{Yield} = \frac{N}{Q_{tot}\epsilon_{tot}}$$

$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$



Heep Uncertainty

- Efficiency Uncertainty Per Run

$$\frac{\Delta\epsilon_{TOTAL,run}}{\epsilon_{TOTAL}} = \sqrt{(\frac{\Delta\epsilon_{CER,e}}{\epsilon_{CER,e}})^2 + (\frac{\Delta\epsilon_{h_t rack,e}}{\epsilon_{h_t rack,e}})^2 + (\frac{\Delta\epsilon_{p_t rack,p}}{\epsilon_{p_t rack,p}})^2 + (\frac{\Delta\epsilon_{EDTM}}{\epsilon_{EDTM}})^2}$$

- Total Efficiency Uncertianty

$$\delta\epsilon_{TOTAL} = \sum_{run} \Delta\epsilon_{TOTAL,run}$$

To Do…

- Key topics
  1. Bill's cross section code is coming along
     - root_ana portion had a hiccup that I am debugging
     - Need to apply dynamic way to call for cross section plotting code
  2. Luminosity analysis, continue iterating on cuts
  3. Fast Raster Correction
- Other topics
  1. Verify the beam and target positions
  2. Calorimeter calibrations
  3. HGCer efficiency calculation (Ali has a write up I need to code)
     - Aerogel efficiency once this is done
     - These are just for physics