Kaon LT Status Update

August 31st, 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 by the summer time (more iterations will be needed in the future)

3. First iteration of cross section

- Goal: By the start of summer, start looking at Bill's code and getting cross-sections (even if previous step is not quite finished)

Yield Calculation

Total elastic events

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

$$cpuLT = \frac{EvtType}{\frac{TRIG_{accept}}{PS} - edtm}$$

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

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

Note

- Lumi uncertainties are in the process of being updated so take results with this in mind!!!

Lumi Cuts

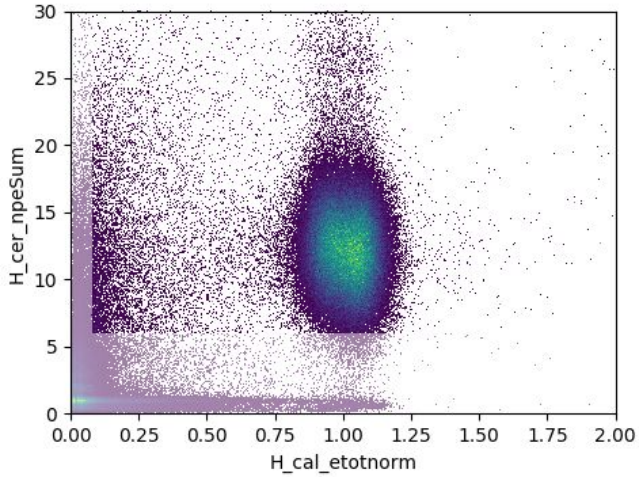
- tdcTimeRaw cuts on pTrigs and EDTM
- Evttype cuts (HMS Evttype==2, SHMS Evttype==1)
- abs(current-setcurrent) < 10.0

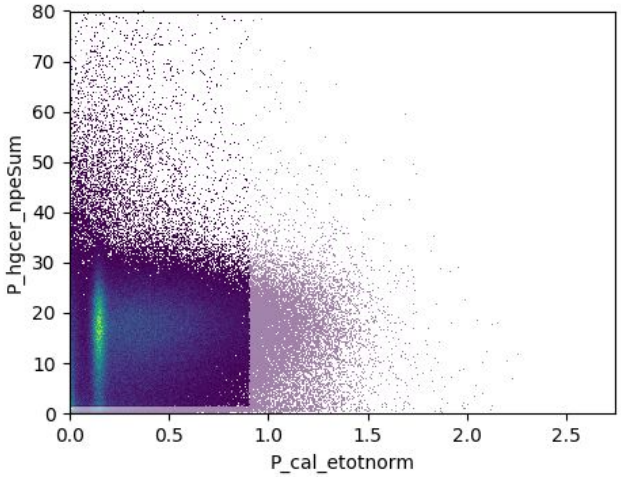
SHMS (pion)

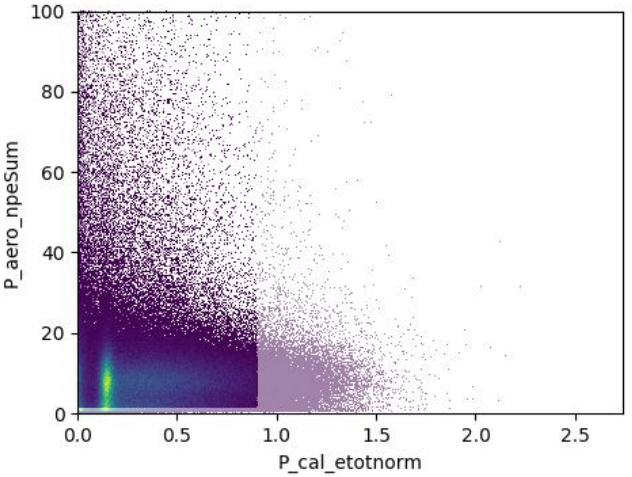
- P_hgcer_npeSum > 1.5
- P_aero_npeSum > 1.5
- P_cal_etotnorm < 0.9

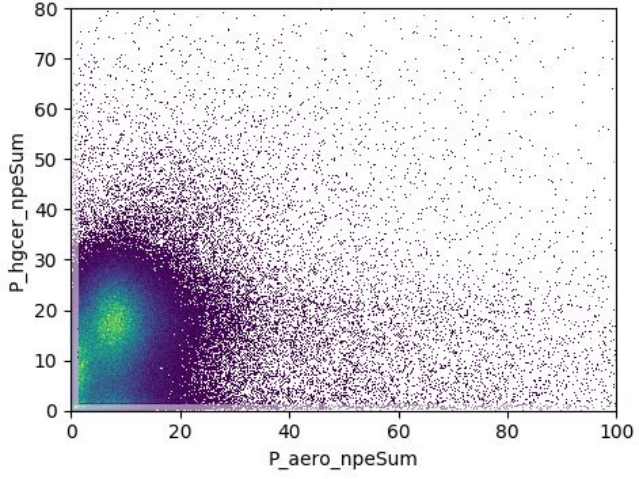
HMS (electron)

- H_cer_npeSum > 6.0
- H_cal_etotnorm > 0.08


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
P_cal_etotnorm
0
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

Lumi Cuts

- tdcTimeRaw cuts on pTrigs and EDTM
- Evttype cuts (HMS Evttype==2, SHMS Evttype==1)
- abs(current-setcurrent) < 10.0

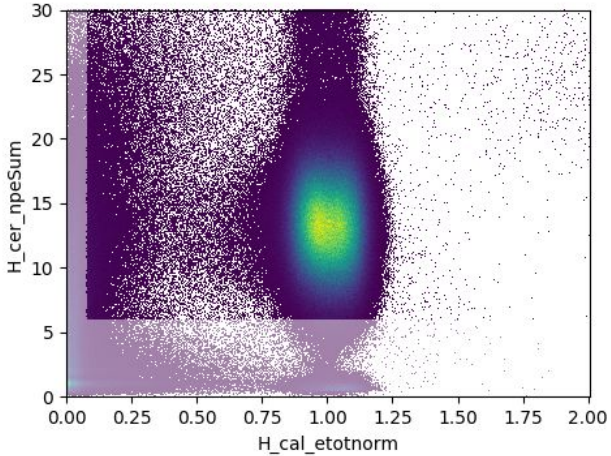
SHMS (electron)

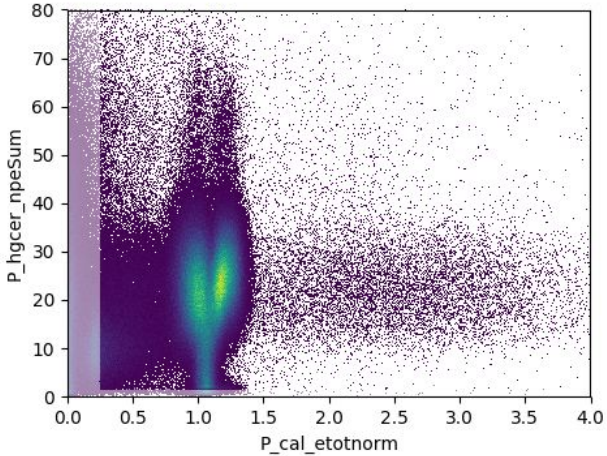
- P_hgcer_npeSum > 1.5
- P_aero_npeSum > 2.0
- P_cal_etotnorm > 0.25

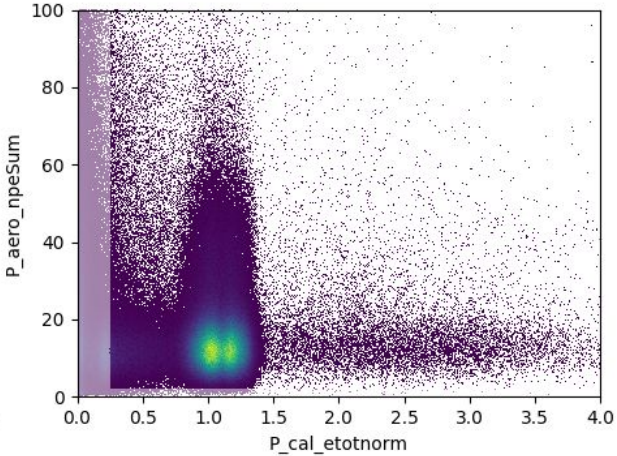
HMS (electron)

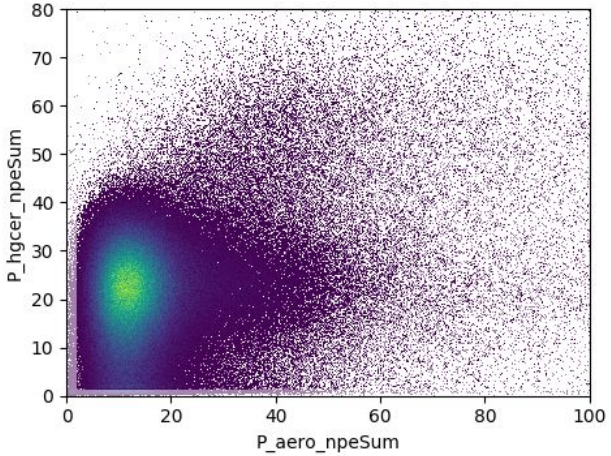
- H_cer_npeSum > 6.0
- H_cal_etotnorm > 0.08

Run 7841


H_cer_npeSum
H_cal_etotnorm

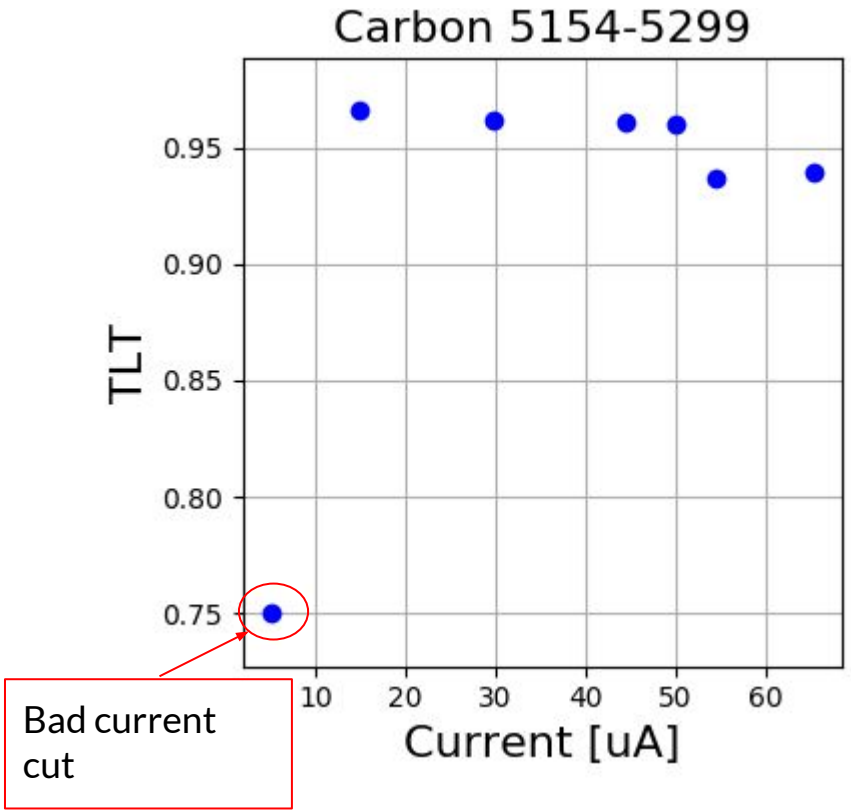

P_hgcer_npeSum
P_cal_etotnorm


P_aero_npeSum
P_cal_etotnorm


P_hgcer_npeSum
P_aero_npeSum

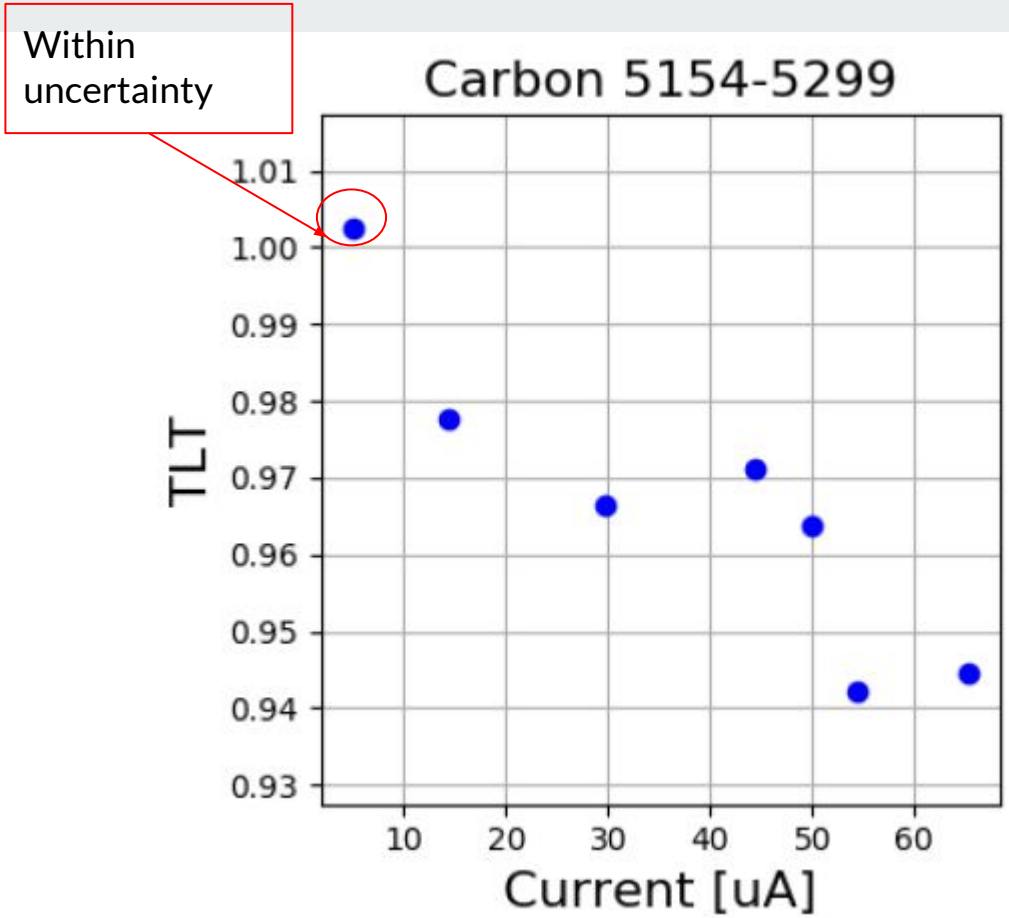
Lumi

Before cut adjustments



Lumi

Current cuts fixed

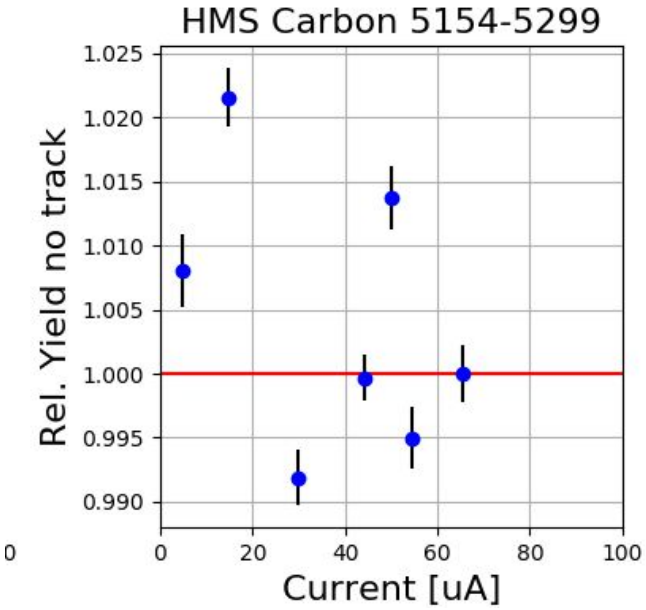


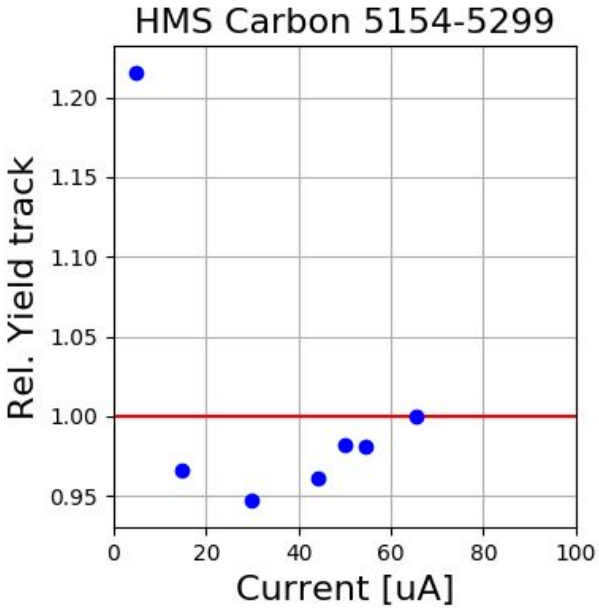
Lumi

Before cut adjustments

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

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

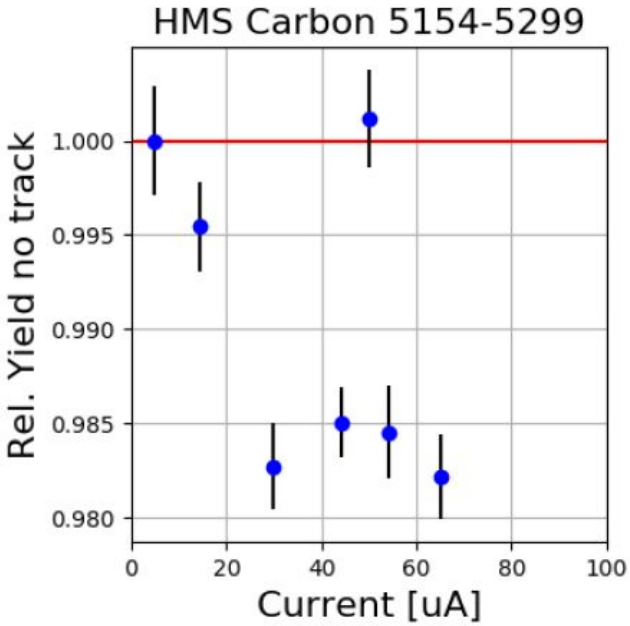


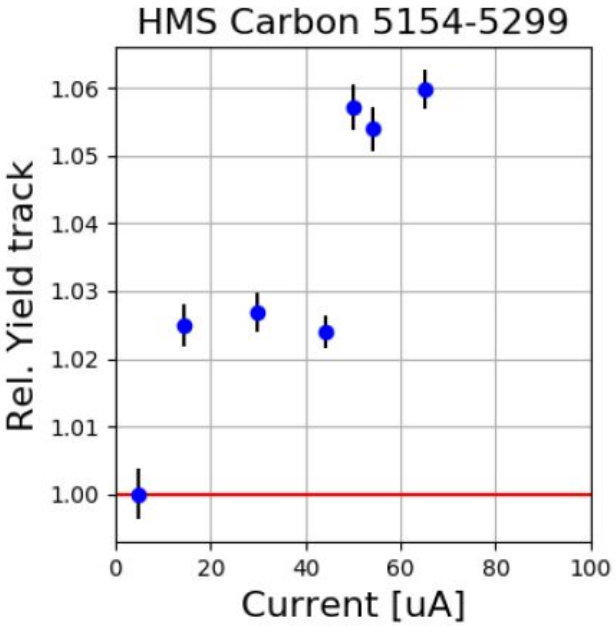


Lumi

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

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



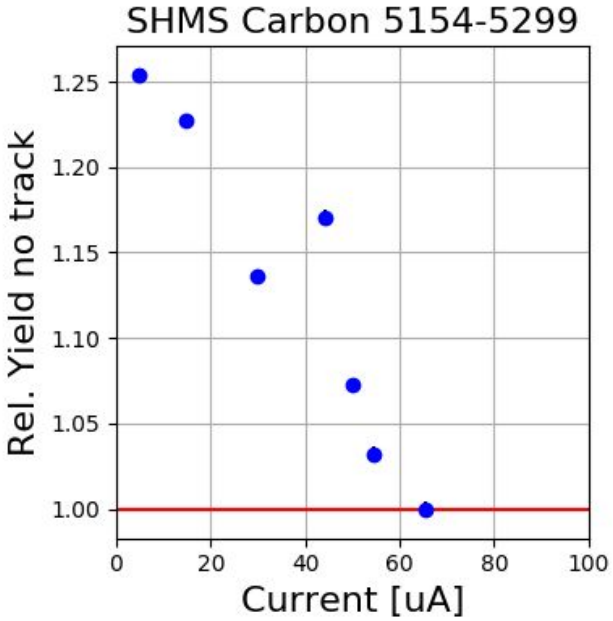


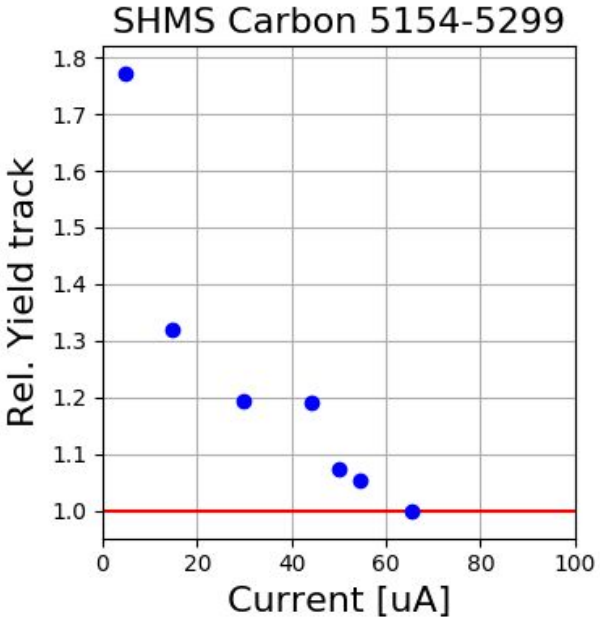
Lumi

Before cut adjustments

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

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

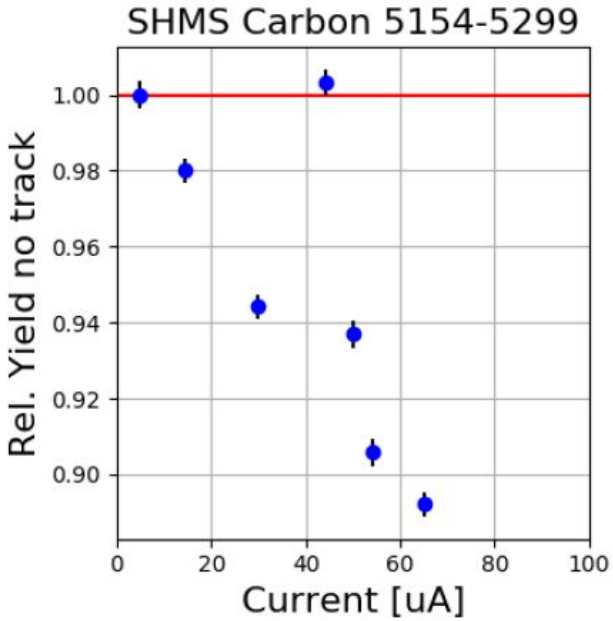


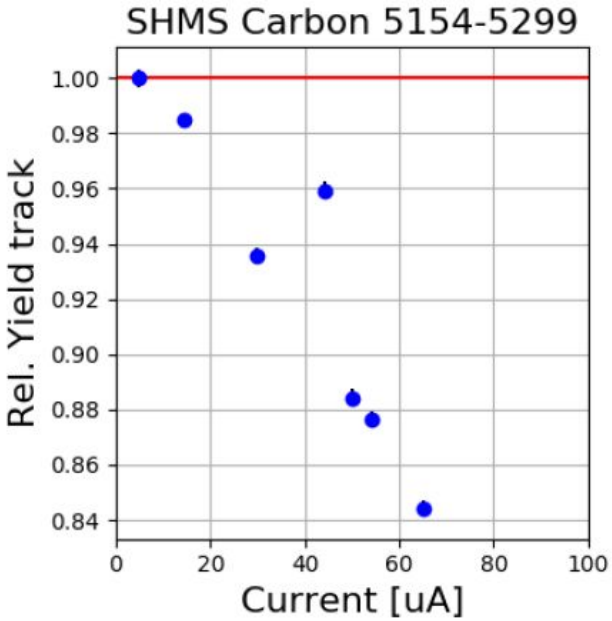


Lumi

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

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



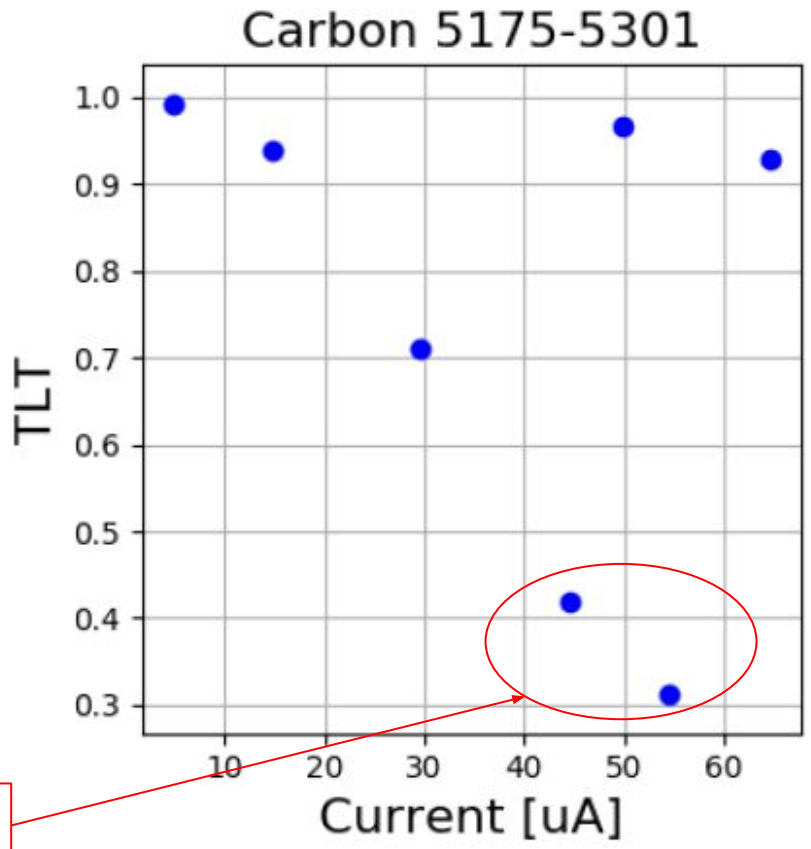


Tracking makes things a bit worse but seeing the heavy trend in no track there are still some dependencies leaking into the cuts

Lumi

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

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

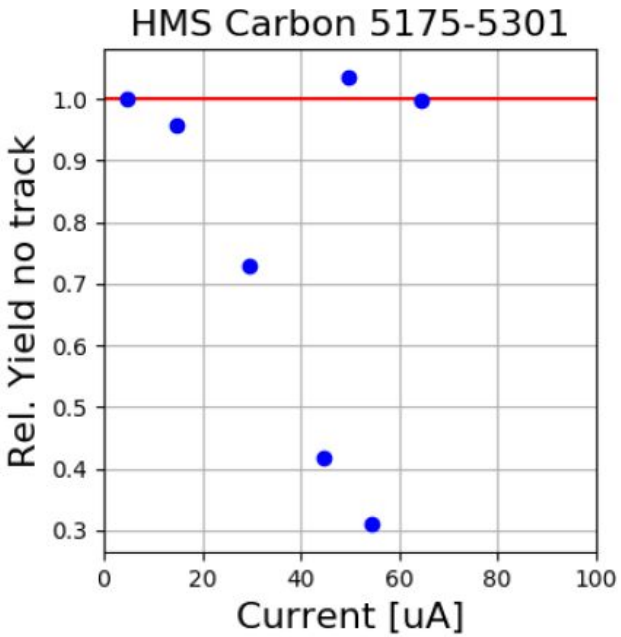


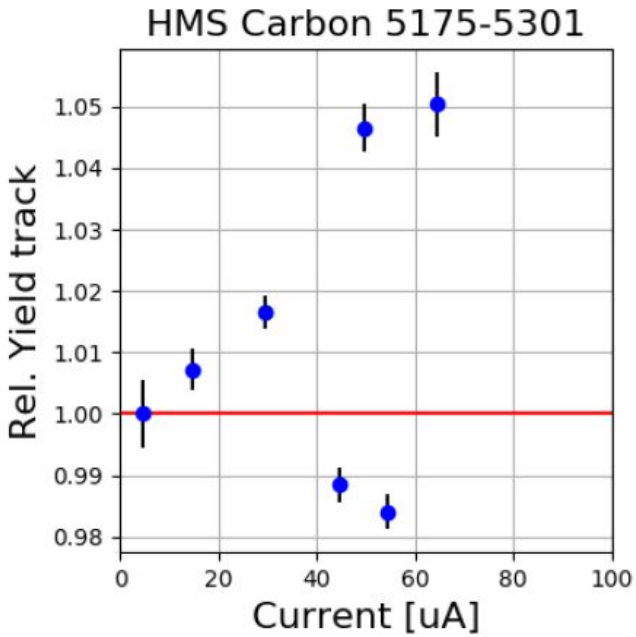
Really low TLT

Lumi

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

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



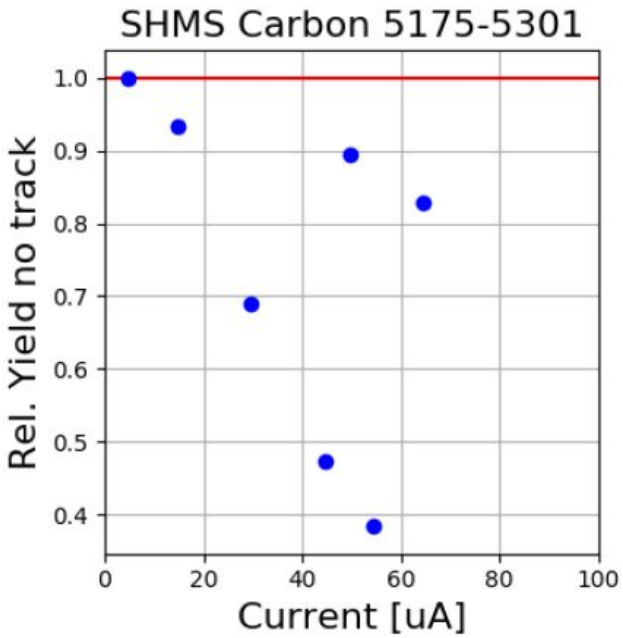


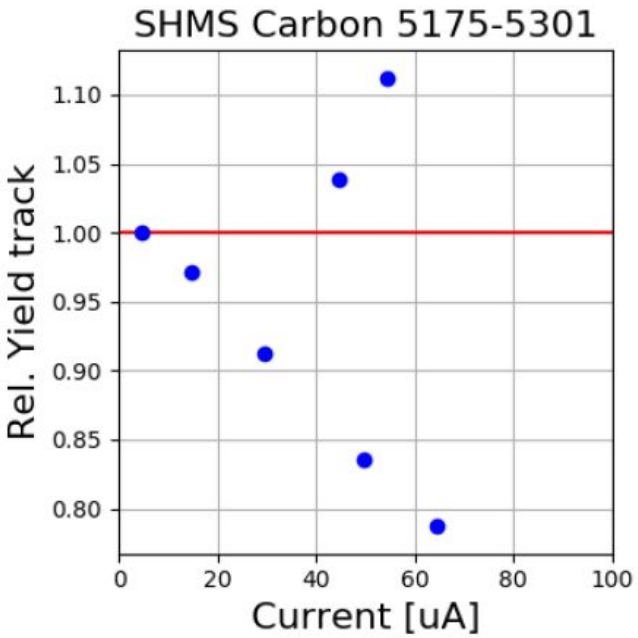
For some reason tracking fixes TLT issue…still investigating

Lumi

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

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



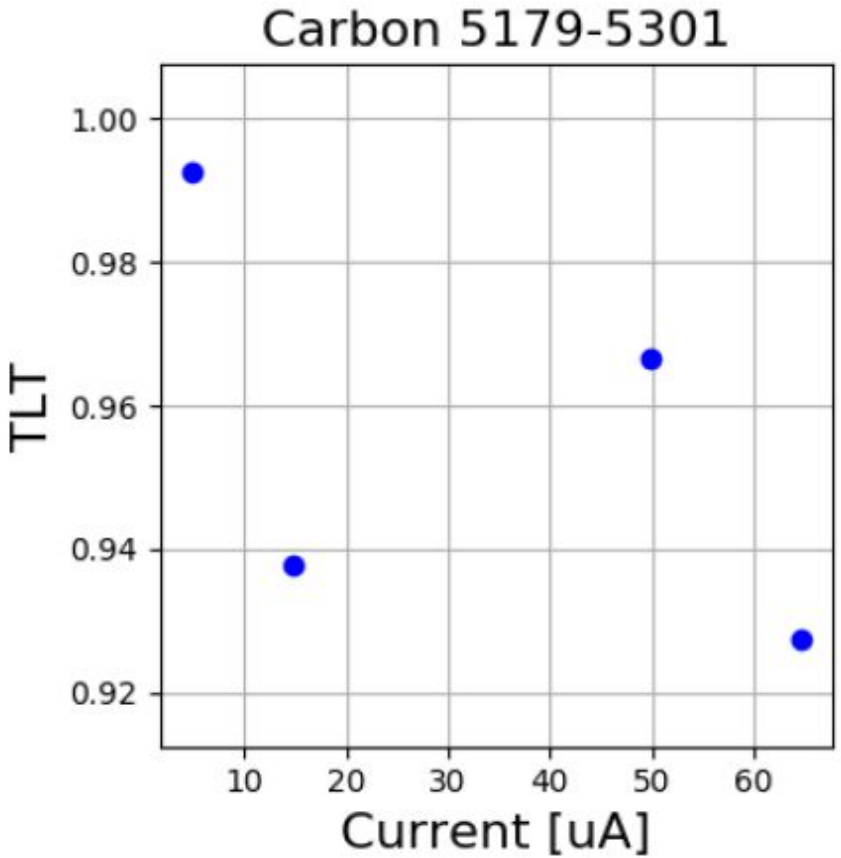


For some reason tracking fixes TLT issue…still investigating

Lumi

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

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

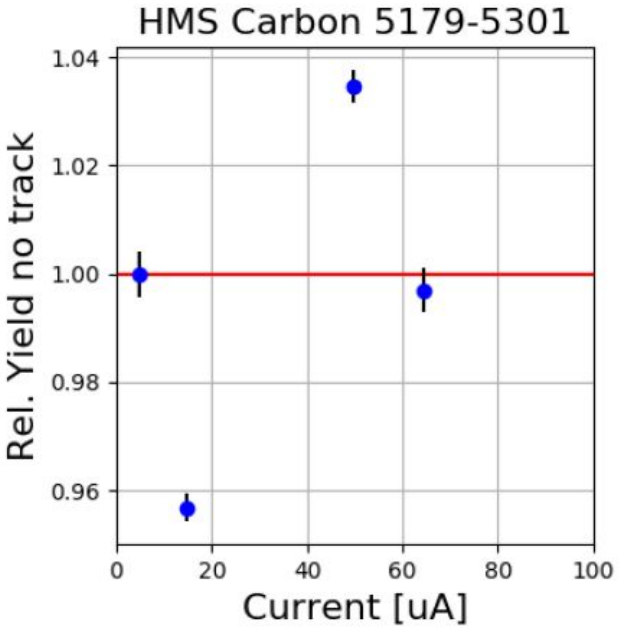


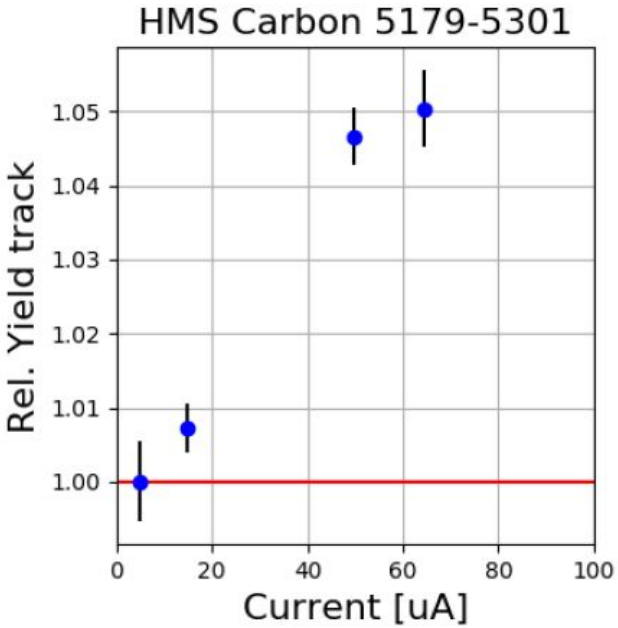
Really low TLT runs removed

Lumi

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

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



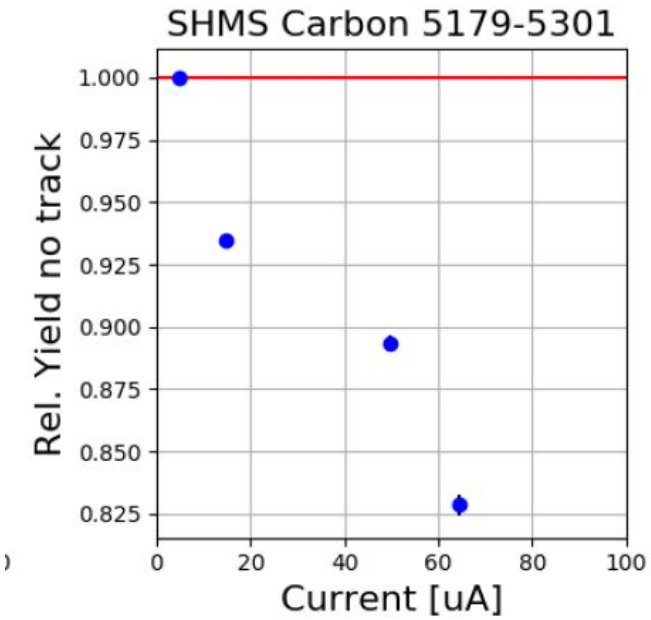


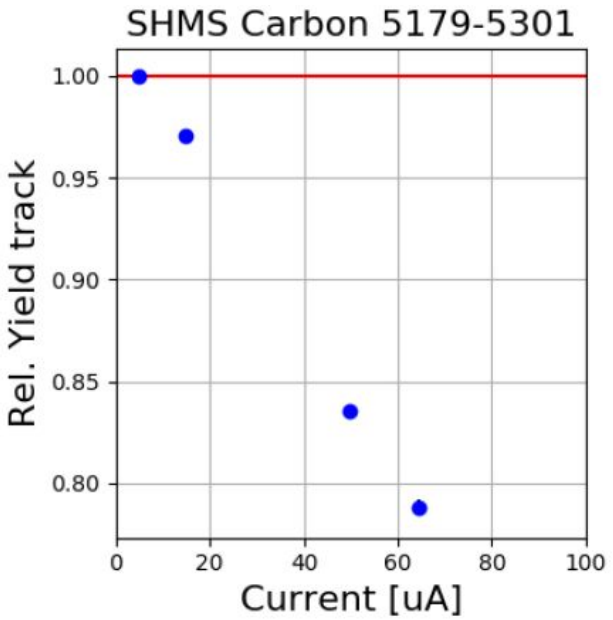
Tracking makes things a bit worse. No real trend in no track but tracking shows heavy dependence leaking into the cuts

Lumi

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

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





Tracking makes things a bit worse but seeing the heavy trend in no track there are still some dependencies leaking into the cuts

To Do…

- Key topics
  1. Looking at offsets now that all issues are resolved (the discrepancies in momentum calculations between simc and hcana may need to become a priority)
  2. Luminosity analysis, continue iterating on cuts
  3. Heep and luminosity uncertainty calculations
  4. Continue looking at Bill's cross section code (lots of hard coded info to adjust and move)
- Other topics
  1. Figure out Heep singles/efficiencies singles issue
  2. Calorimeter calibrations
  3. HGCer efficiency calculation (Ali has a write up for me)