Kaon LT Status Update

August 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

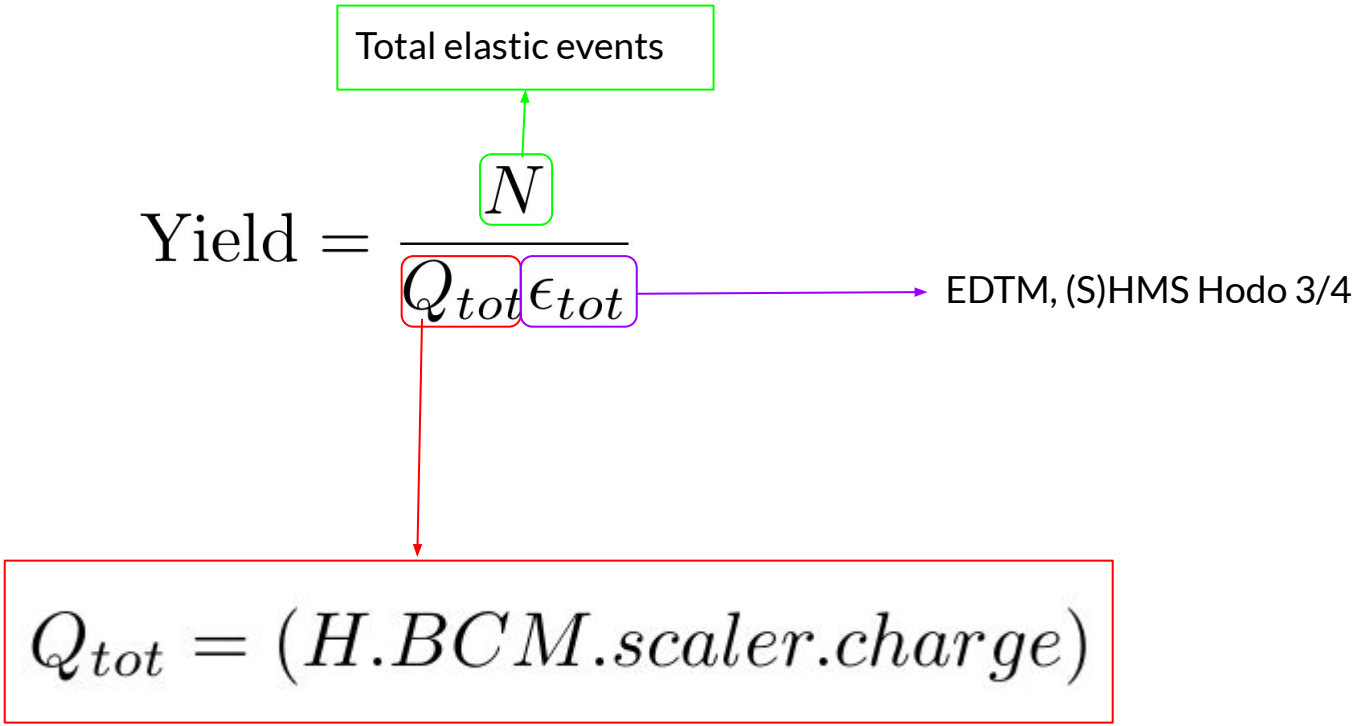
2. Efficiencies and offsets

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



HeeP Cuts

- Cointime peak cut

SHMS

- (evt.P_hod_goodstarttime == 1) & (evt.P_dc_InsideDipoleExit == 1)
- (evt.ssdelta>=-10.0) & (evt.ssdelta<=20.0) & (evt.ssxptar>=-0.06) & (evt.ssxptar<=0.06) & (evt.ssyptar>=-0.04) & (evt.ssyptar<=0.04)

HMS

- (evt.H_hod_goodstarttime == 1) & (evt.H_dc_InsideDipoleExit == 1)
- (evt.hsdelta>=-8.0) & (evt.hsdelta<=8.0) & (evt.hsxptar>=-0.08) & (evt.hsxptar<=0.08) & (evt.hsyptar>=-0.045) & (evt.hsyptar<=0.045)

Replay Offset

```
; Offset in the spectrometer momentum.
  hmomentum_factor = 0.000 ; leave 0 so it will have no effect
                           ; use hpcentral_offset if one needs to offset central
momentum
;
; The hdelta_offset,htheta_offset,hphi_offset effect the
; reconstructed target quantities. Used in h_targ_trans.f
; For transport x is in the dispersive direction with + down
;               y is in the horizontal + towards small angles.
;               z is along the central optics axis.
; In transport coordinates phi = hyptar = dy/dz and theta = hxptar = dx/dz
;    but for unknown reasons the yp offset is named  htheta_offset
;    and  the xp offset is named  hphi_offset
; Do not to change these values, since these are the zero order
;  CMOP matrix elements. If you do change then your hms sieve
;  plots will be screwed up.
  hdelta_offset = 0.       ; (%)   hdelta_tar = hdelta_tar + hdelta_offset
  htheta_offset = 0.  ; (rad) hyp_tar = hyp_tar + htheta_offset
;  hphi_offset   = -4.946337367e-3 ; (rad) hxp_tar = hxp_tar + hphi_offset
hphi_offset = 0.
;

;saturation correction flag
;  hsatcorr = 2000 ;
                           ; a correction to hsdelta event by event
                           ; for a problem in setting Q3 current.
                           ; There was an unknown zero offset in the Q3 current.
                           ; The magnet setting code field00.f partially
                           ; fixes this problem. T. Horn in 2003 determined
                           ; the corrections to delta.
                           ; Data taken with fields set by field99.f or earlier sh
ould set to 1999.
                           ; Data taken with fields set by field00.f or later shou
ld set to 2000.
; These offsets are determined from elastic ep data.
; central_field  correction
  hpcentral_offset = -0.00188 ;
  hthetacentral_offset = .0 ; (rad)
  h_oopcentral_offset = 0.00  ; (rad)
; sets hpcentral = hpcentral * ( 1. + hpcentral_offset / 100. )
;      htheta_lab=htheta_lab + hthetacentral_offset/degree

hcer_debug_adc = 1
```

```
; The pdelta_offset,ptheta_offset,pphi_offset effect the
; reconstructed target quantities.
; For transport x is in the dispersive direction with + down
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; In transport coordinates phi = hyptar = dy/dz and theta = hxptar = dx/dz
;    but for unknown reasons the yp offset is named  htheta_offset
;    and  the xp offset is named  hphi_offset
; Do not to change these values, since these are the zero order
;  CMOP matrix elements. If you do change then your shms sieve
;  plots will be screwed up.

; do not change pdelta_offset from zero, use ppcentral_offset
pdelta_offset = 0.0; (%)   hdelta_tar = hdelta_tar + hdelta_offset
;
ptheta_offset = 0.0 ; (rad) hyp_tar = hyp_tar + htheta_offset
pphi_offset = -8.681269905E-4; (rad) hxp_tar = hxp_tar + hphi_offset

; The following offsets are applied to the central kinematic variables
;      ptheta_lab=htheta_lab + pthetacentral_offset/degree
pthetacentral_offset = 0.0
p_oopcentral_offset = 0.0
;  SHMS central momentum offset determined from carbon elastic data fall 2017
; sets ppcentral = ppcentral * ( 1. + ppcentral_offset / 100. )
ppcentral_offset = -0.250
```
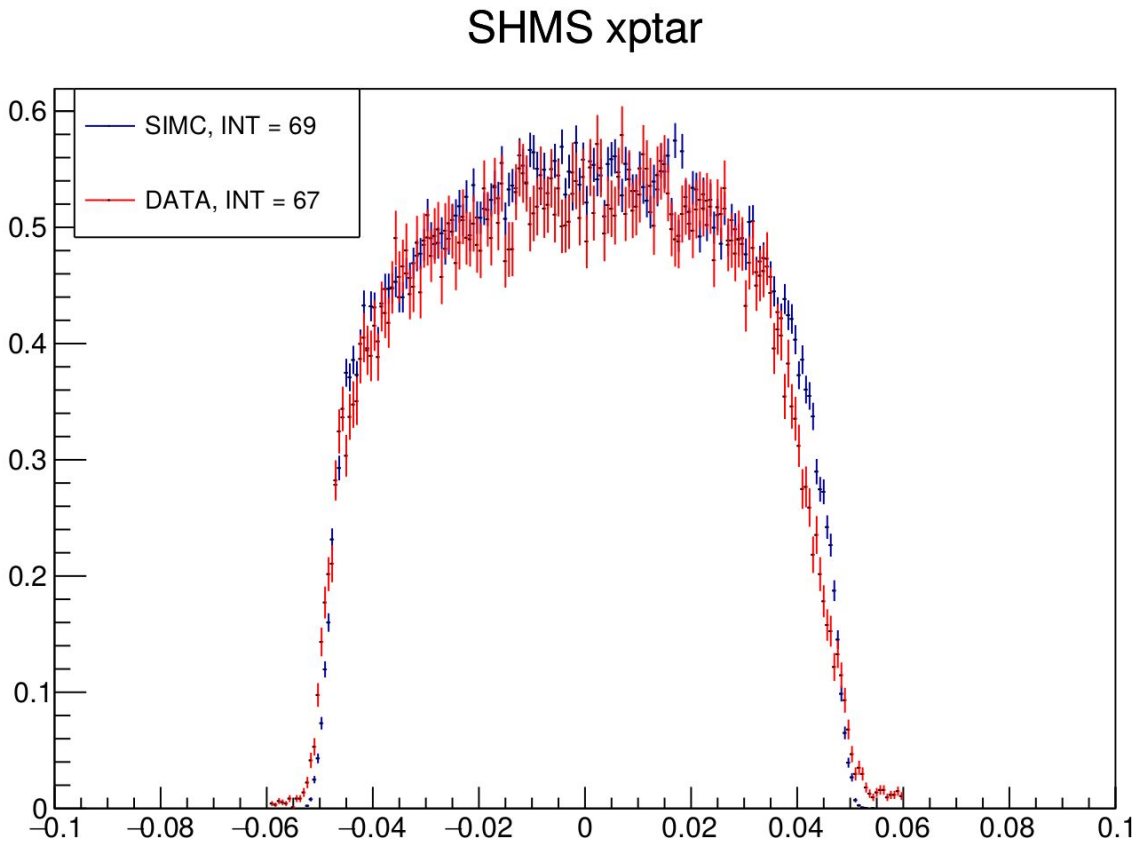

10.6 GeV

COIN (With offsets)

P_{HMS}= -6.590
θ_{HMS}= 18.845
P_{SHMS}= +4.840
θ_{SHMS}= 26.147
PS1=5
PS3=1

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



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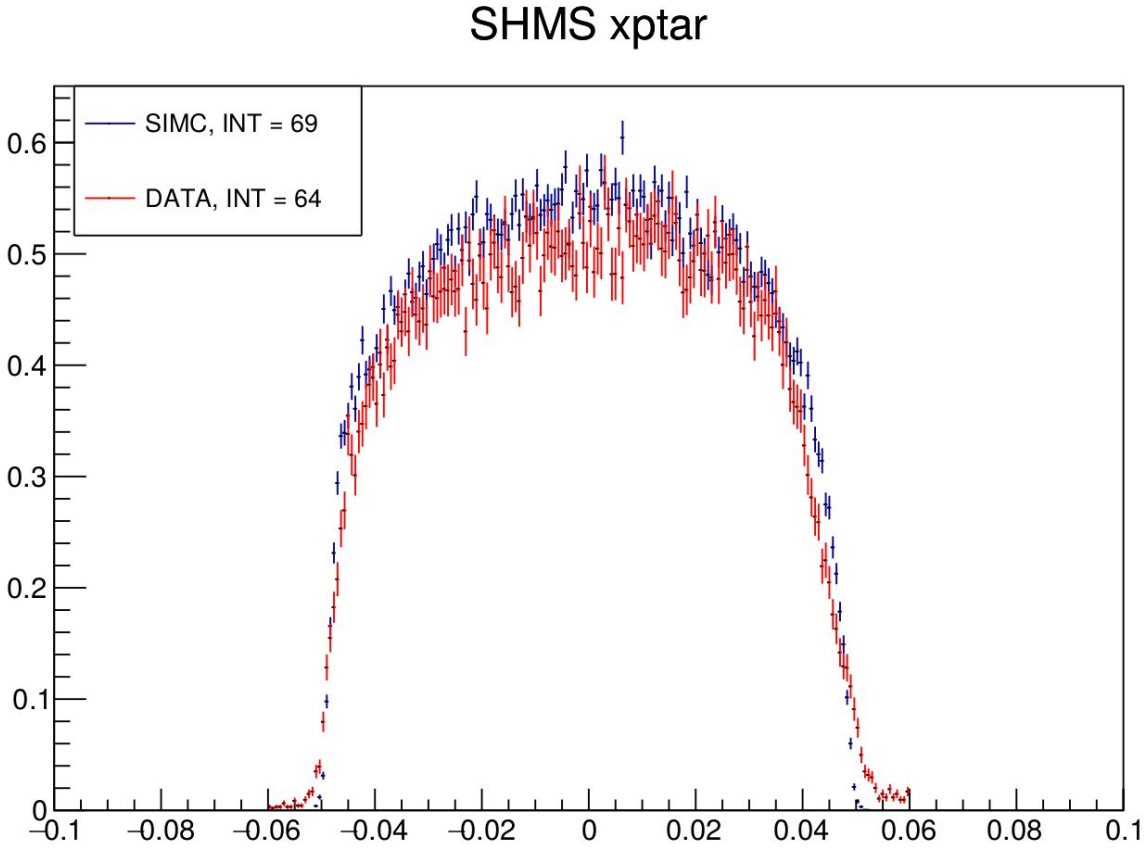

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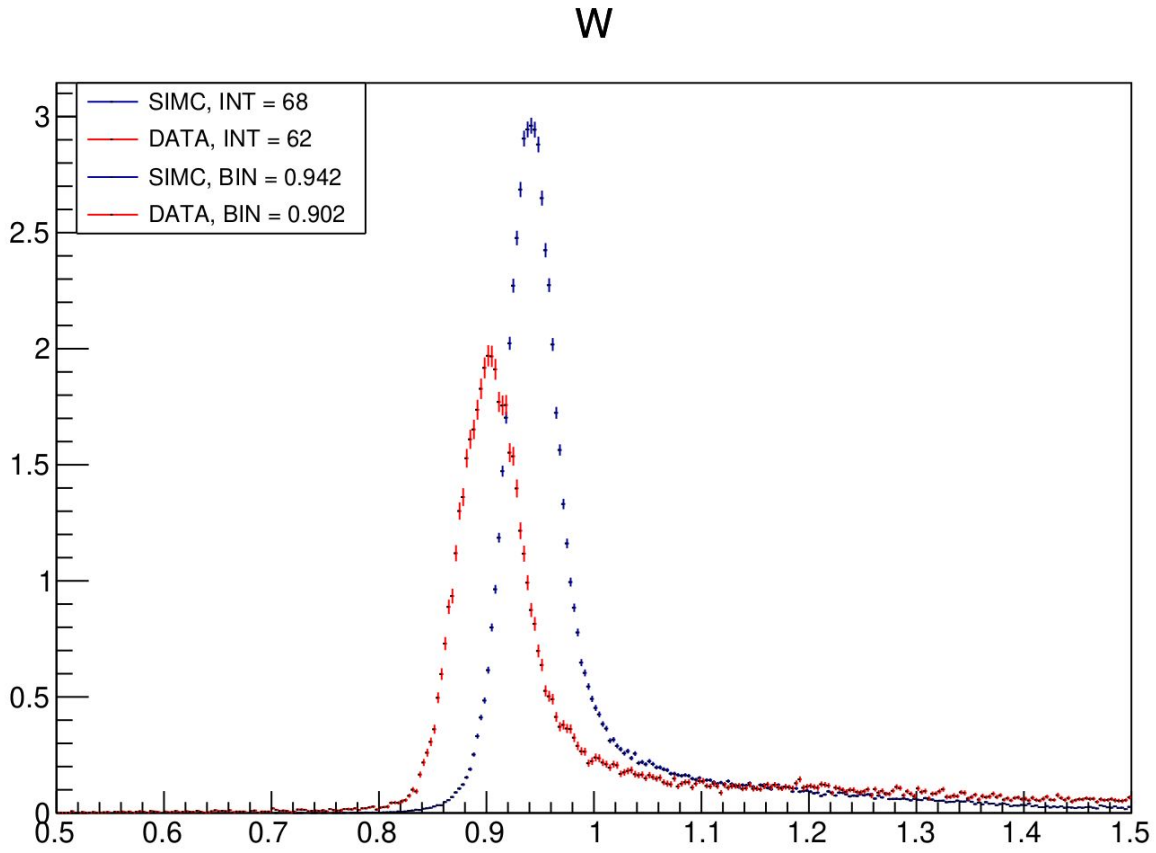

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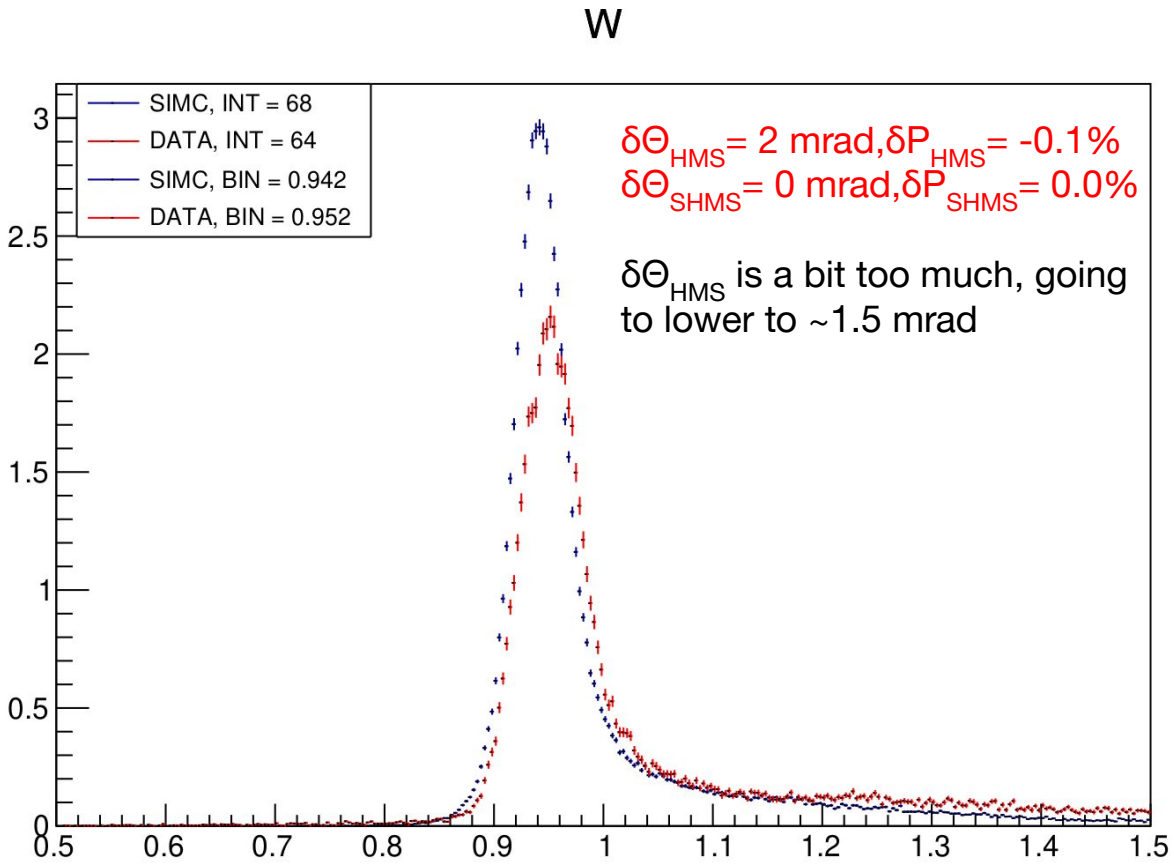

10.6 GeV

HMS SING

P_{HMS}= -5.322
θ_{HMS}= 22.60
P_{SHMS}= -6.300
θ_{SHMS}= 20.00

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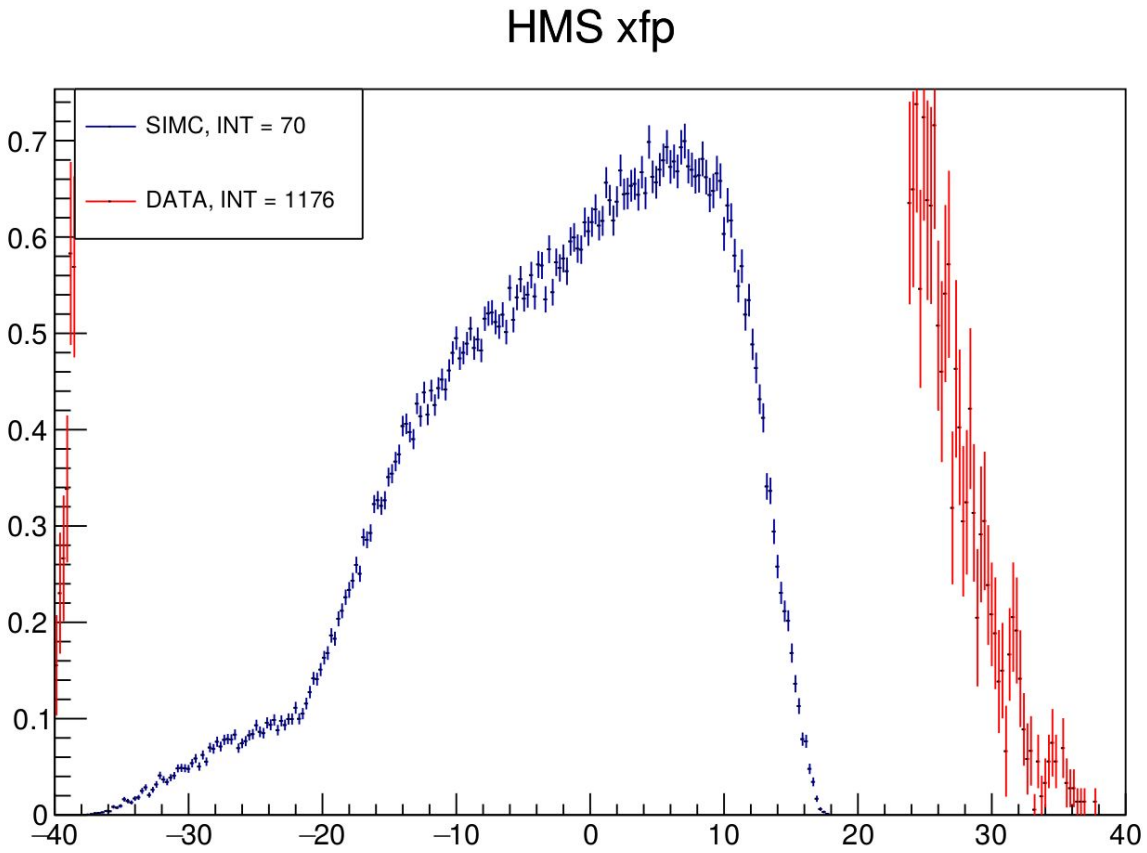

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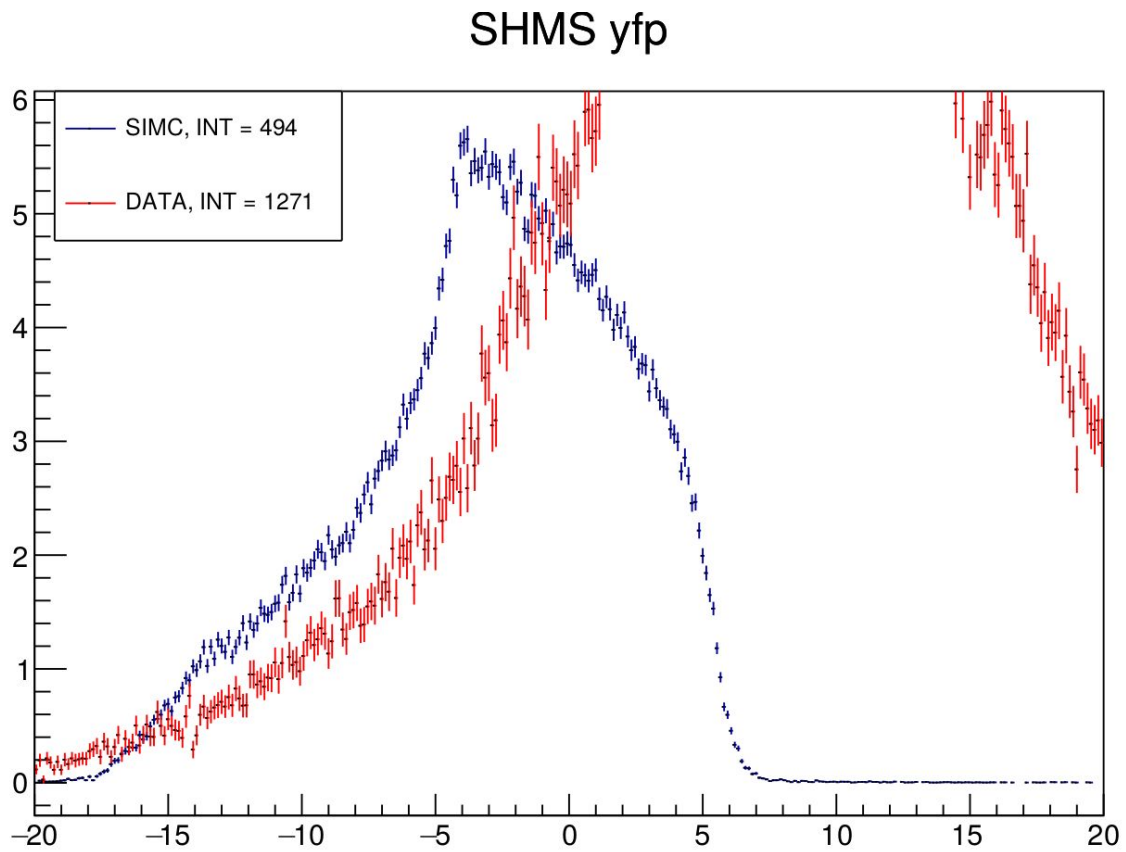


Yield Calculation

Total elastic events

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

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

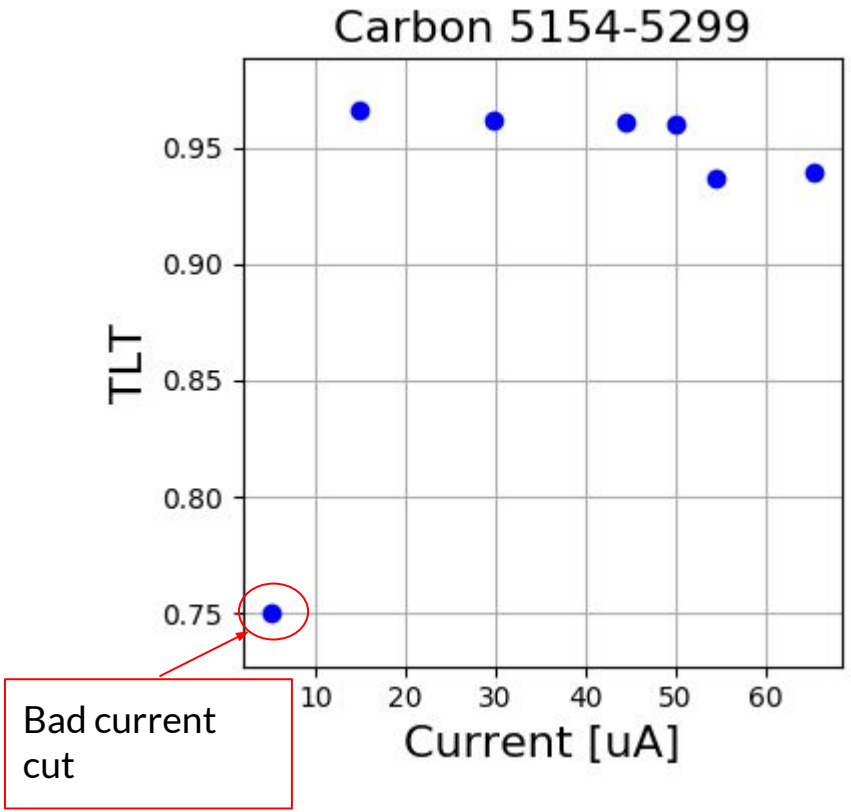
$$track = \frac{\Sigma track_{nontrack}}{\Sigma track_{ntrack}}$$

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

Lumi

Lumi looks pretty good

Main issue is just cut related now



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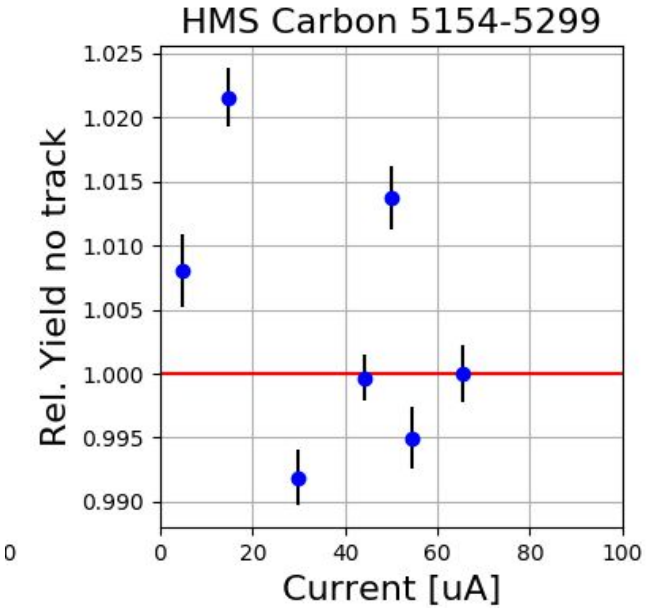

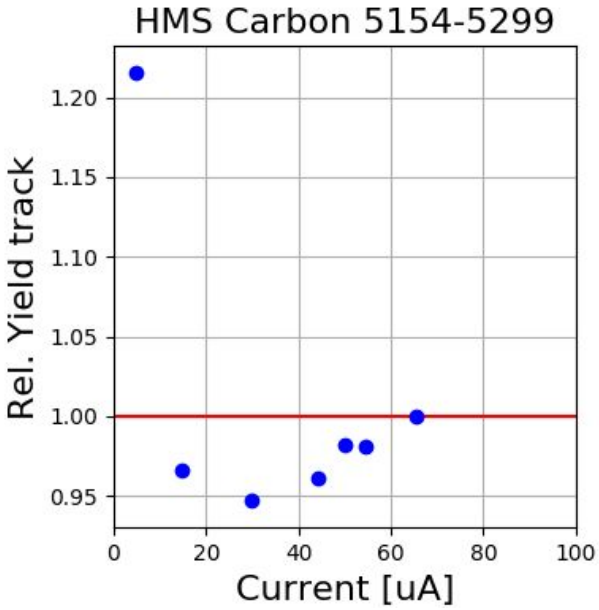

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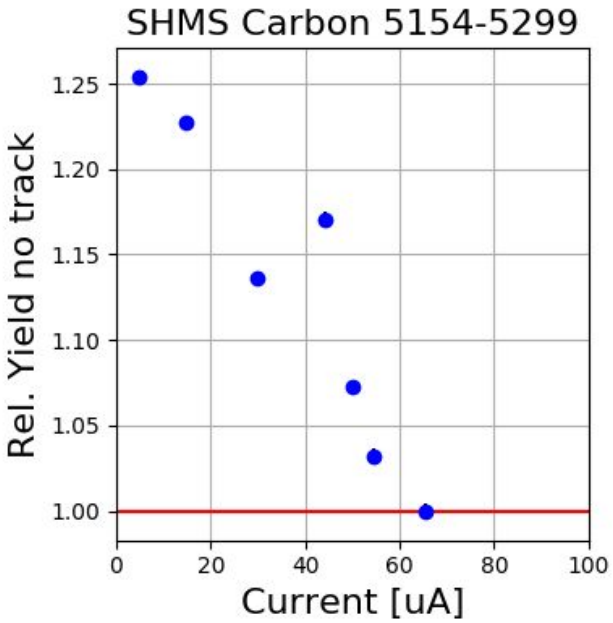
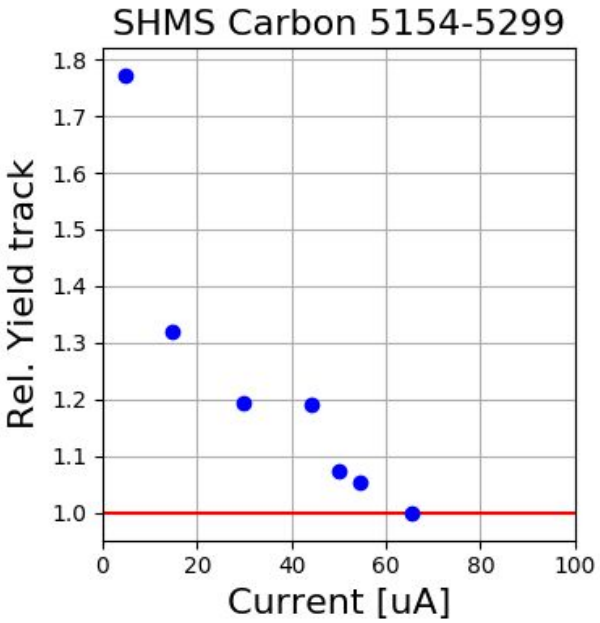
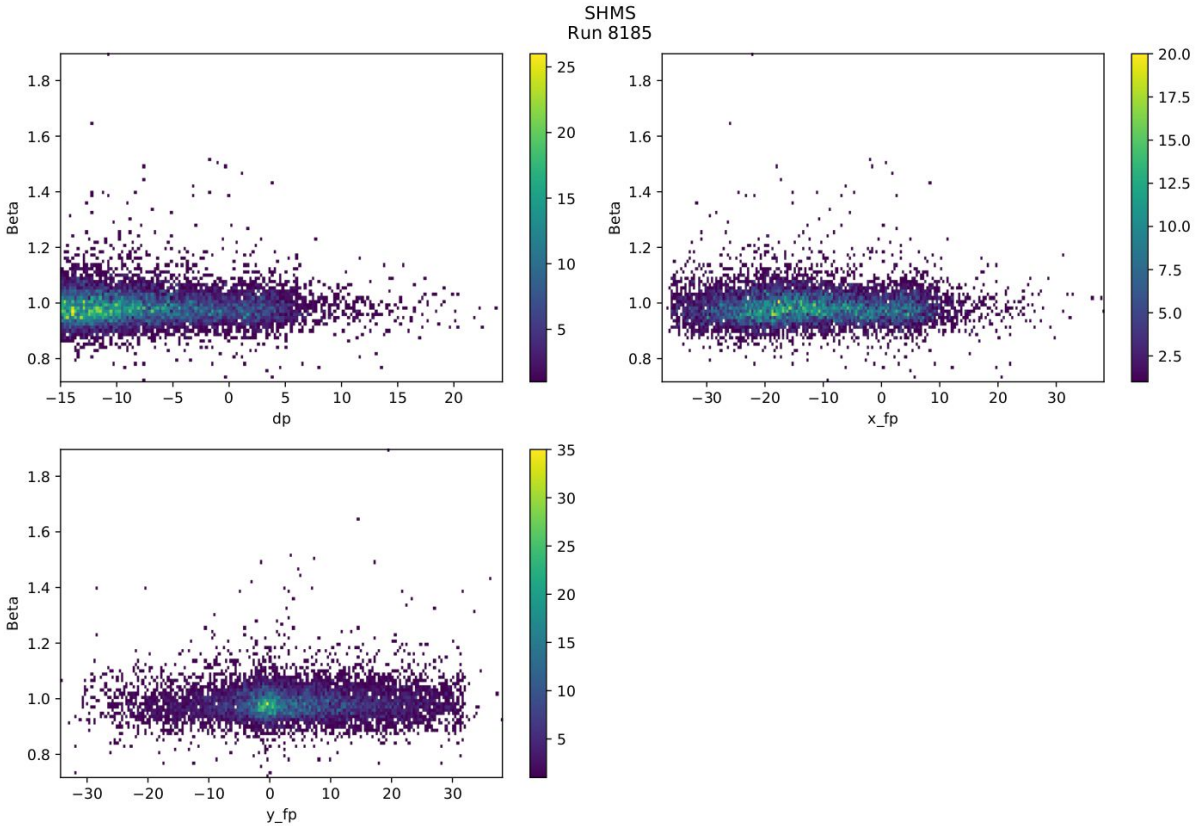




8.2 GeV Hodo Calibration

Calibrations look good for all energies except 6.2 GeV

Still need to mess around with this one a bit



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. Figure out Heep singles/efficiencies singles issue
  3. Luminosity analysis (adjust cuts)
  4. Continue looking at Bill's cross section code (lots of hard coded info to adjust and move)
- Other topics
  1. Test out aerogel SIMC cuts
  2. Calorimeter calibrations
  3. HGCer efficiency calculation (Ali has a write up for me)