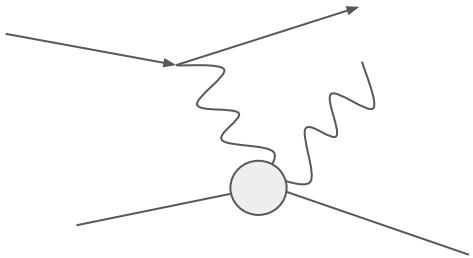
University of Glasgow

DVCS eA Status

G. Penman, R. Montgomery
24/09/21

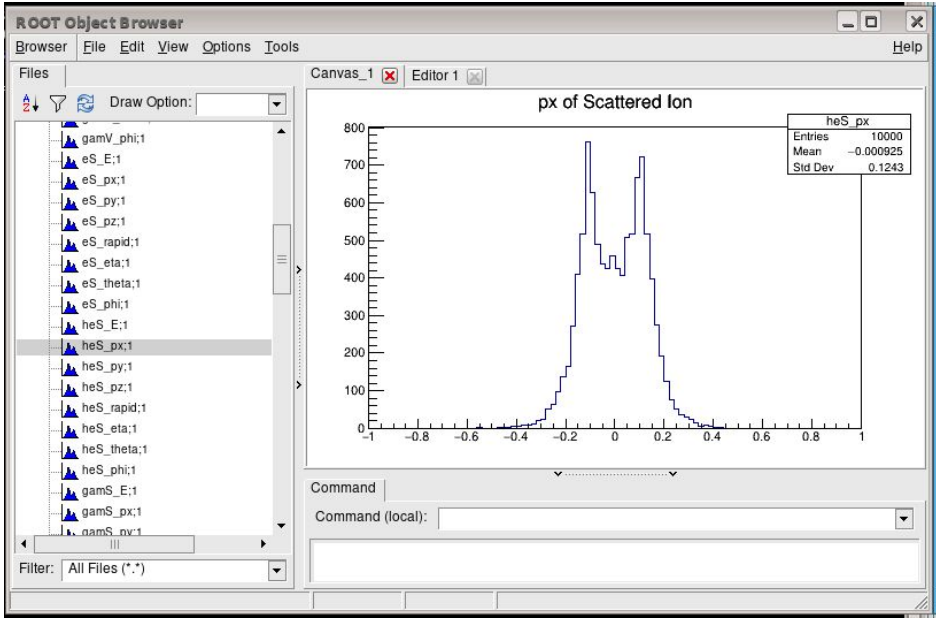
eA->e'A'γ

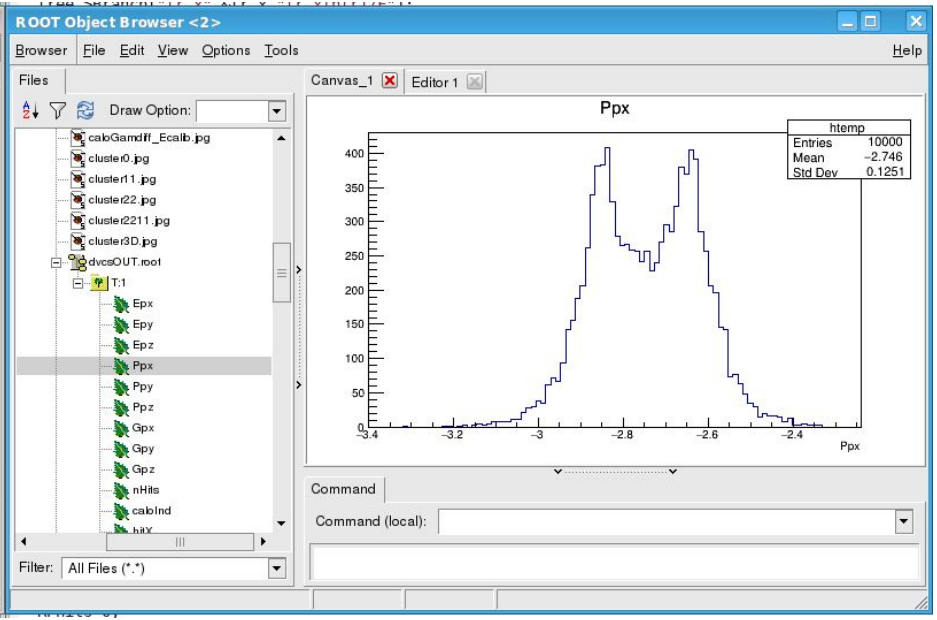


Helium B0/RP Analysis Update

Generator / eicsmear input

Detector “Truth” output





Result: extra component of momentum smears t, nu variables by over factor 100.
What is causing this? Crossing angle consideration - fixed!!

Before: 18x110 - 10K hits in B0, 3.3K hits in RP, even after crossing angle correction.

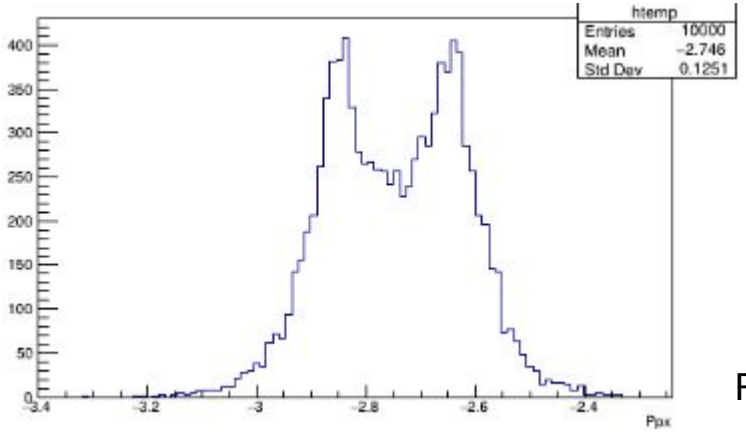
After: 5x41 (5x164) -10K hits in B0, 9756 hits in RP, after crossing angle correction.

*both scenarios before electron + photon exclusivity cuts included

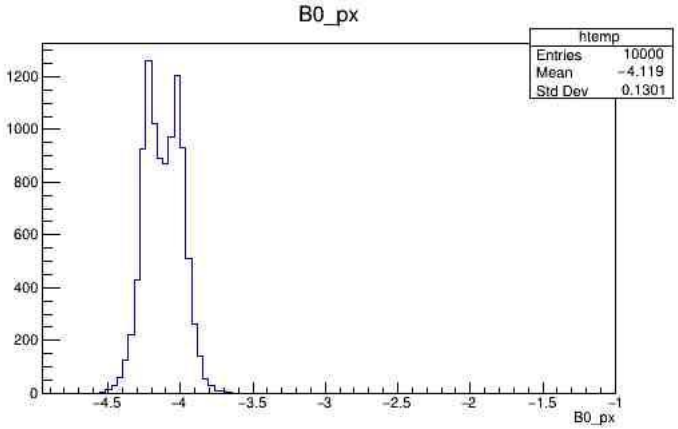
For Both B0 and RP PHG4Hit Container, currently using
hit->get_hit_id() == 1 && truth->get_id() == 100002042
To compare hit momenta and energy to truth momenta and energy

Helium B0/RP Analysis Update

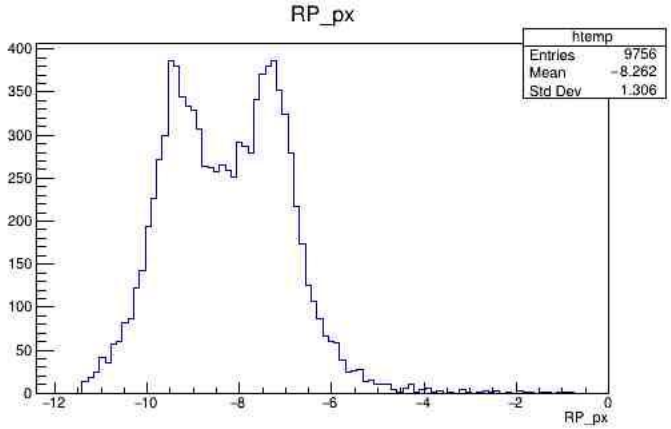
Truth Container

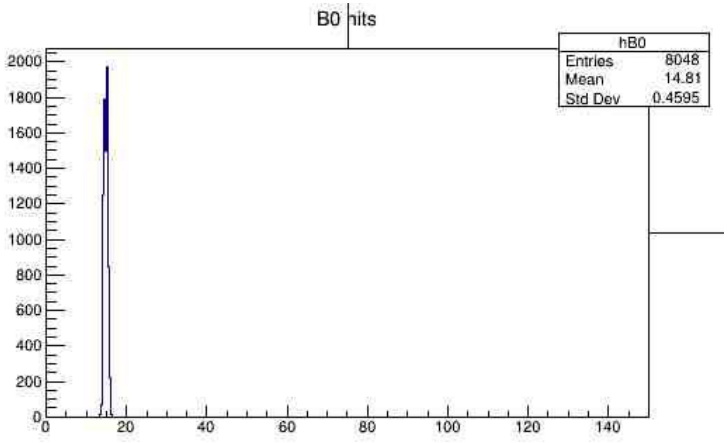


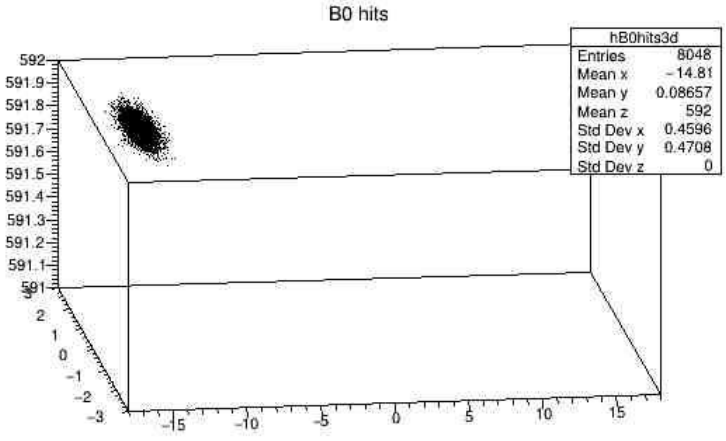
B0 Hit Container

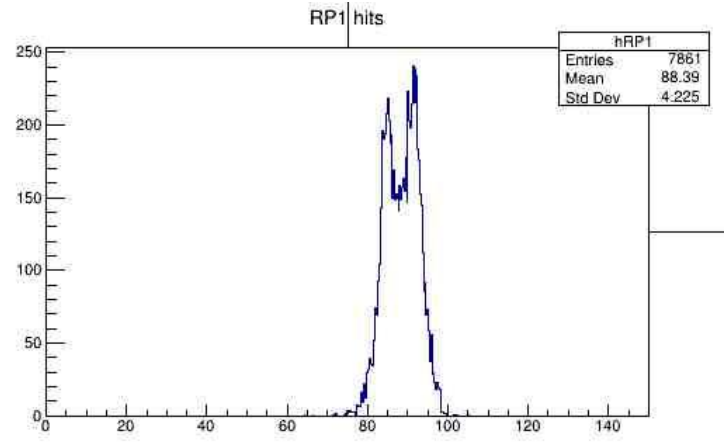


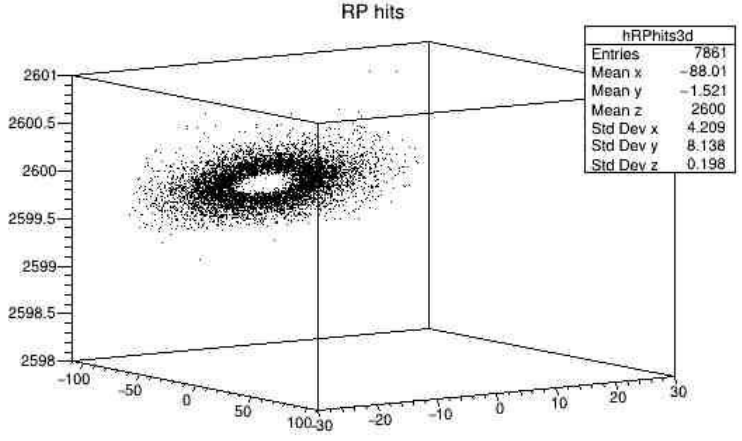
RP Hit Container




B0 hits
hB0
Entries 8048
Mean 14.81
Std Dev 0.4595


B0 hits
hB0hits3d
Entries 8048
Mean x −14.81
Mean y 0.08657
Mean z 592
Std Dev x 0.4596
Std Dev y 0.4708
Std Dev z 0


RP1 hits
hRP1
Entries 7861
Mean 88.39
Std Dev 4.225


RP hits
hRPhits3d
Entries 7861
Mean x −88.01
Mean y −1.521
Mean z 2600
Std Dev x 4.209
Std Dev y 8.138
Std Dev z 0.198

Plots Status Last Week

- DVCS Differential cross-section vs Momentum transfer t. Detector performance: low pT acceptance in far-forward region.
- DVCS Differential cross-section vs Momentum transfer Q2. Detector performance: low pT acceptance in far-forward region.
- DVCS Differential cross-section vs Momentum transfer xB. Detector performance: low pT acceptance in far-forward region.
- Detector efficiency as a function of pseudo rapidity (different colors for different particles, vertical axis is %), detector performance and where the particle are detected
- xb versus Q2 filled with relative counts, detector acceptance
- t versus Q2 filled with relative counts, detector acceptance
- xb versus t filled with relative counts, detector acceptance

What do i need? Finish helium B0 / RP analysis to construct differential cross-section and have detector efficiency. Work for other 2 particles (90%) done.

Cross section normalisation. 10 fb^{-1} ?

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Cross section normalisation. 10 fb^{-1} ?

1. DVCS Differential Cross Section vs t, Q^2, x_B . Low p_T acceptance in FF.

$$\frac{d^4\sigma}{dQ^2 dx_B dt d\phi} - \frac{1}{L\Delta\Omega}(N \pm \sqrt{N})$$

- N is the number of counts in the bin
- L is the integrated luminosity
- $\Delta\Omega$ is the multi-dimensional bin size:

$$\Delta\Omega - \Delta Q^2 \Delta x_B \Delta t \Delta\phi$$

IN PROGRESS
Have t q2 and xb after all exclusivity cuts. Only need to insert equation for cross section and make histograms

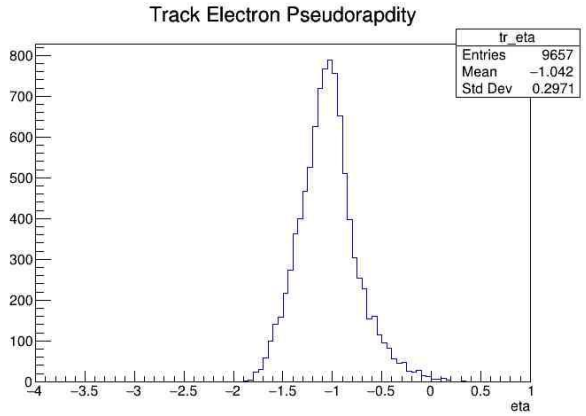
Positive helicity

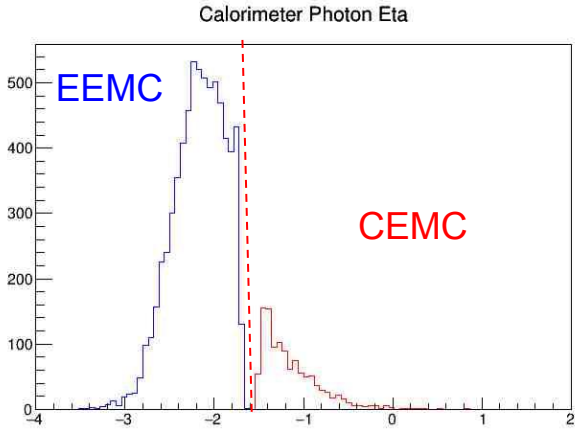
```
Cross section : 17828.933 nb
Precision : 44.246745 nb
Events produced correspond to 0.56088608 nb^-1
```

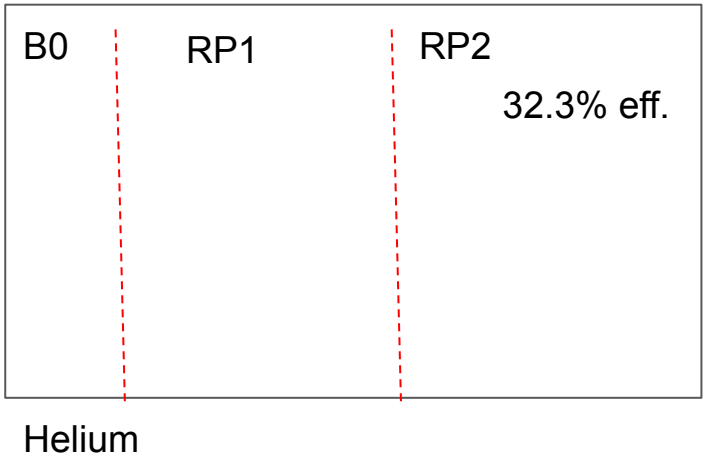
Negative helicity

```
Cross section : 17930.4 nb
Precision : 44.086337 nb
Events produced correspond to 0.55771206 nb^-1
```

2. Pseudorapidity vs Normalised Counts (for each 3 particles, split into where detected - where applicable)





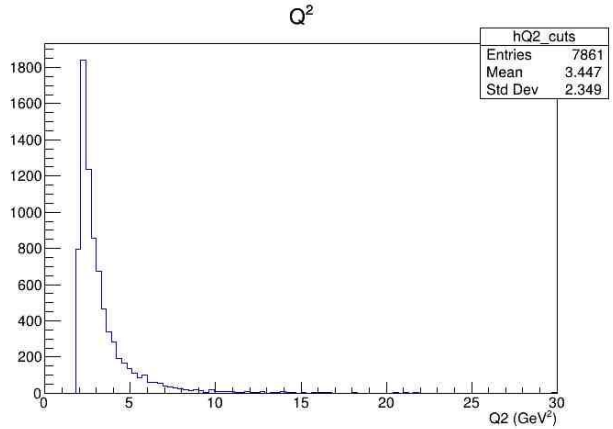


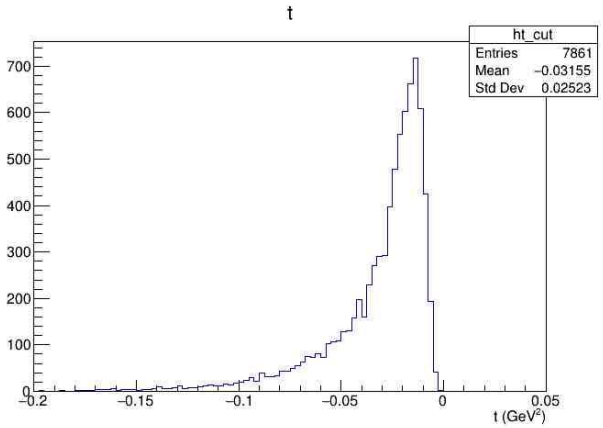
3. Q2, xb, t plots (with relative counts)

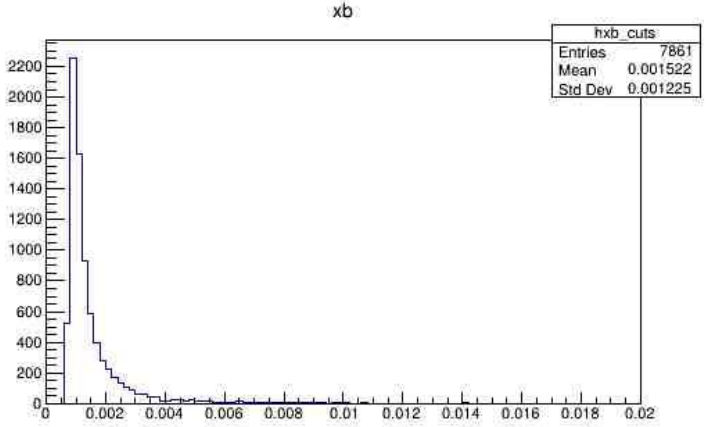
$$Q^2 = -q^2 = \left(k - k'\right)^2$$

$$t = \left(p - p'\right)^2$$

$$x_B = \frac{Q^2}{2M\nu}$$







4. Questions (now with answers!)

- Effect of integer choice in argument of ->get_px : get_px(0) vs get_px(1) vs get_px(2) etc
  - (0) is coordinate entering Geant4 volume, (1) is exiting Geant4 volume, (2) is??
    - -> Use 0
- Plots 3 (q2, t, xb): counts relative to what??
  - Events / total events (per bin?)
- How to convert hit positions to global coord system for B0 and RP radial cuts
  - get_local_x(0), currently not working
-

B0 HitContainer Example:

- Layer 1 ID = 1
- Layer 2 ID = 4294967297
- Layer 3 ID = 8589934593
- Layer 4 ID = 12884901889

Other hits with tiny momenta values are clearly not Helium Hits!

Layer 1 Hit

Layer 2 Hit

Layer 3 Hit

Layer 4 Hit

Hit, Px, Py, Pz, x, y, z

```
 Event filled, next
 event = 3947
B0 hit id: 1 -4.24336 -4.24336 163.572 -15.2652 -0.0784237 591.95
B0 hit id: 2 -0.000779096 -0.000779096 0.000613575 -15.2667 -0.07843 592.008
B0 hit id: 4294967297 -4.29247 -4.29247 163.568 -15.8913 -0.0808451 615.95
B0 hit id: 8589934593 -4.34099 -4.34099 163.566 -16.5245 -0.0832892 639.95
B0 hit id: 8589934594 -0.000653522 -0.000653522 0.00223425 -16.5259 -0.0832945 640.002
B0 hit id: 8589934595 0.000658633 0.000658633 -0.000891056 -14.8743 3.06838 640.05
B0 hit id: 8589934596 -0.000226966 -0.000226966 0.000655253 -16.0391 3.51019 639.95
B0 hit id: 12884901889 -4.39428 -4.39428 163.561 -17.1656 -0.0860088 663.95
```

```
 Event filled, next
 event = 732
RP hit id: 1 -9.32408 -9.32408 163.538 -91.4013 -9.56724 2599.6
RP hit id: 4294967297 -9.32297 -9.32297 163.538 -102.796 -11.1838 2799.49
B0 hit id: 1 -4.0197 -4.0197 163.769 -14.4696 0.541708 591.95
B0 hit id: 4294967297 -4.06626 -4.06626 163.767 -15.0618 0.564478 615.95
B0 hit id: 4294967298 -0.00167493 -0.00167493 0.00364915 -15.0634 0.564537 616.012
B0 hit id: 4294967299 -0.00149147 -0.00149147 -0.00365565 -8.17303 2.89261 616.05
B0 hit id: 4294967300 -0.00153424 -0.00153424 0.00297768 -13.842 6.0263 615.95
B0 hit id: 4294967301 -0.000855791 -0.000855791 -0.00237583 -9.40611 13.5765 616.05
B0 hit id: 4294967302 -0.0024611 -0.0024611 2.89107e-05 -9.58317 13.6389 615.95
B0 hit id: 4294967303 -0.00218567 -0.00218567 0.000215854 -10.0347 13.4311 615.95
B0 hit id: 4294967304 -0.00155181 -0.00155181 0.00169415 -13.267 12.7537 615.95
B0 hit id: 4294967305 0.000860113 0.000860113 0.000782696 -14.9067 11.3931 615.95
B0 hit id: 8589934593 -4.11735 -4.11735 163.76 -15.6615 0.587314 639.95
B0 hit id: 12884901889 -4.16809 -4.16809 163.758 -16.2687 0.609898 663.95
```

Real hits occur on same hit ids! 1, 4294967297, 8589934593, 12884901889

Notice RP1 and RP2 hit: ID == 1, 4294967297

RP HitContainer Example

- RP1 ID = 1
- RP2 ID = 4294967297

RP1 Hit

RP2 Hit

Hit ID, Px, Py, Pz, x, y, z

```
Event filled, next
event = 712
RP hit id: 1 -8.82288 -8.82288 162.885 -89.9058 4.48585 2599.67
RP hit id: 4294967297 -8.82314 -8.82314 162.885 -100.735 5.24334 2799.58
RP hit id: 4294967298 -0.000658168 -0.000658168 0.000776217 -100.736 5.24344 2799.61
```

HOWEVER: Now Momentum Values very Skewed. Accounting for crossing angle makes truth container and B0 momenta look normal, but RP still looks off.

Momenta Money? Momenta Problems!

```
Truth: 3-vector before rotation -4.12313 0.244043 163.767
Truth 3-vector after rotation: -0.0275567 0.244043 163.806
B0 3-vector before rotation: -4.14658 0.272987 163.766
B0 3-vector after rotation: -0.0510223 0.272987 163.805
B0 3-vector after rotation2: 4.04486 0.272987 163.793
B0 3-vector before rotation: -4.19664 0.272557 163.764
B0 3-vector after rotation: -0.101126 0.272557 163.803
B0 3-vector after rotation2: 3.9947 0.272557 163.792
B0 3-vector before rotation: -4.24666 0.269219 163.761
B0 3-vector after rotation: -0.151209 0.269219 163.801
B0 3-vector after rotation2: 3.94457 0.269219 163.79
B0 3-vector before rotation: -4.29906 0.271946 163.758
B0 3-vector after rotation: -0.203651 0.271946 163.799
B0 3-vector after rotation2: 3.89208 0.271946 163.789
RP 3-vector before rotation: -8.14985 -2.35679 163.594
RP 3-vector after rotation: -4.05652 -2.35679 163.683
RP 3-vector after rotation2: 0.0371244 -2.35679 163.721
RP 3-vector before rotation: -8.15053 -2.35559 163.593
RP 3-vector after rotation: -4.05721 -2.35559 163.682
RP 3-vector after rotation2: 0.0364283 -2.35559 163.72
```

- Truth
- B0 Layer 1
- B0 Layer 2
- B0 Layer 3
- B0 Layer 4
- RP1
- RP2