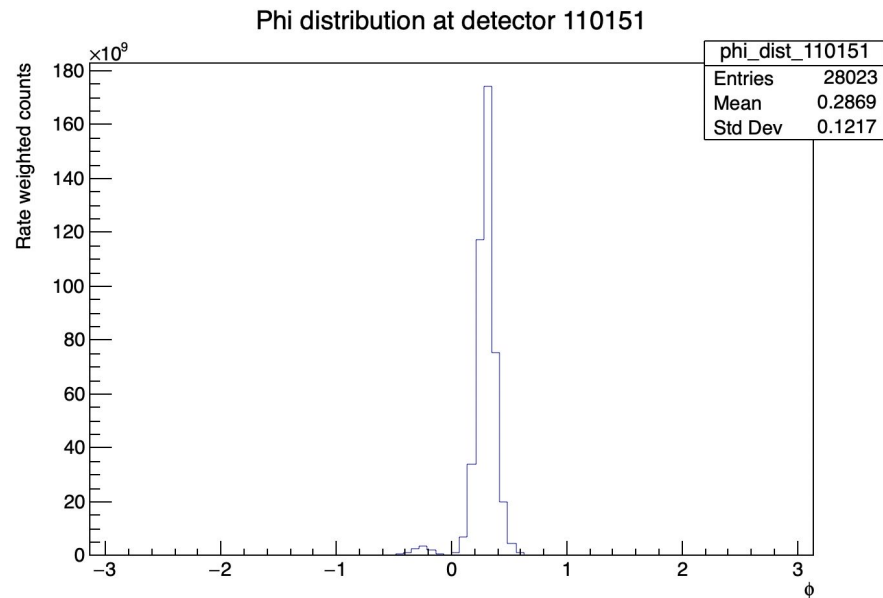


Phi distributions at main detector

James Shirk

- ϕ is the azimuthal angle of the generated particles in either the ep elastic or moller generator
- Get the angle between the x and y momentum of the generated particle
- A_T goes primarily with $\sin(\phi)$

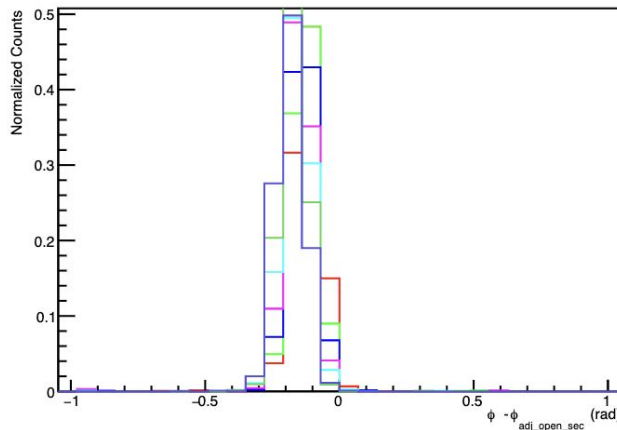


Ring 2 for eP elastic

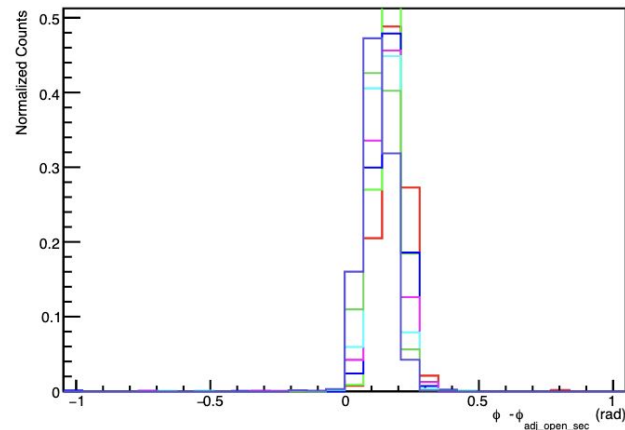
Y axis is
normalized
now

See backups
for legend

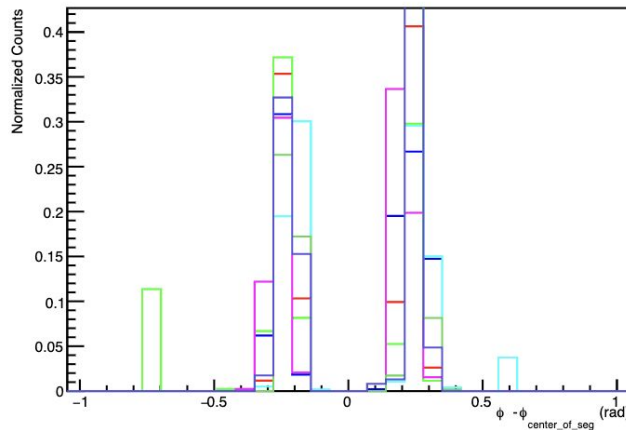
Ring 2, transition left segment



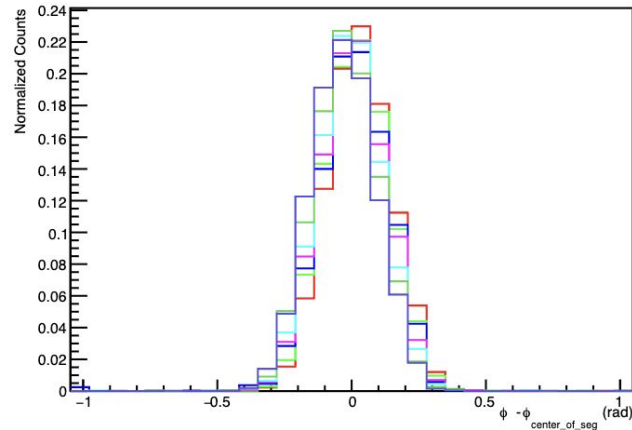
Ring 2, transition right segment



Ring 2, closed segment

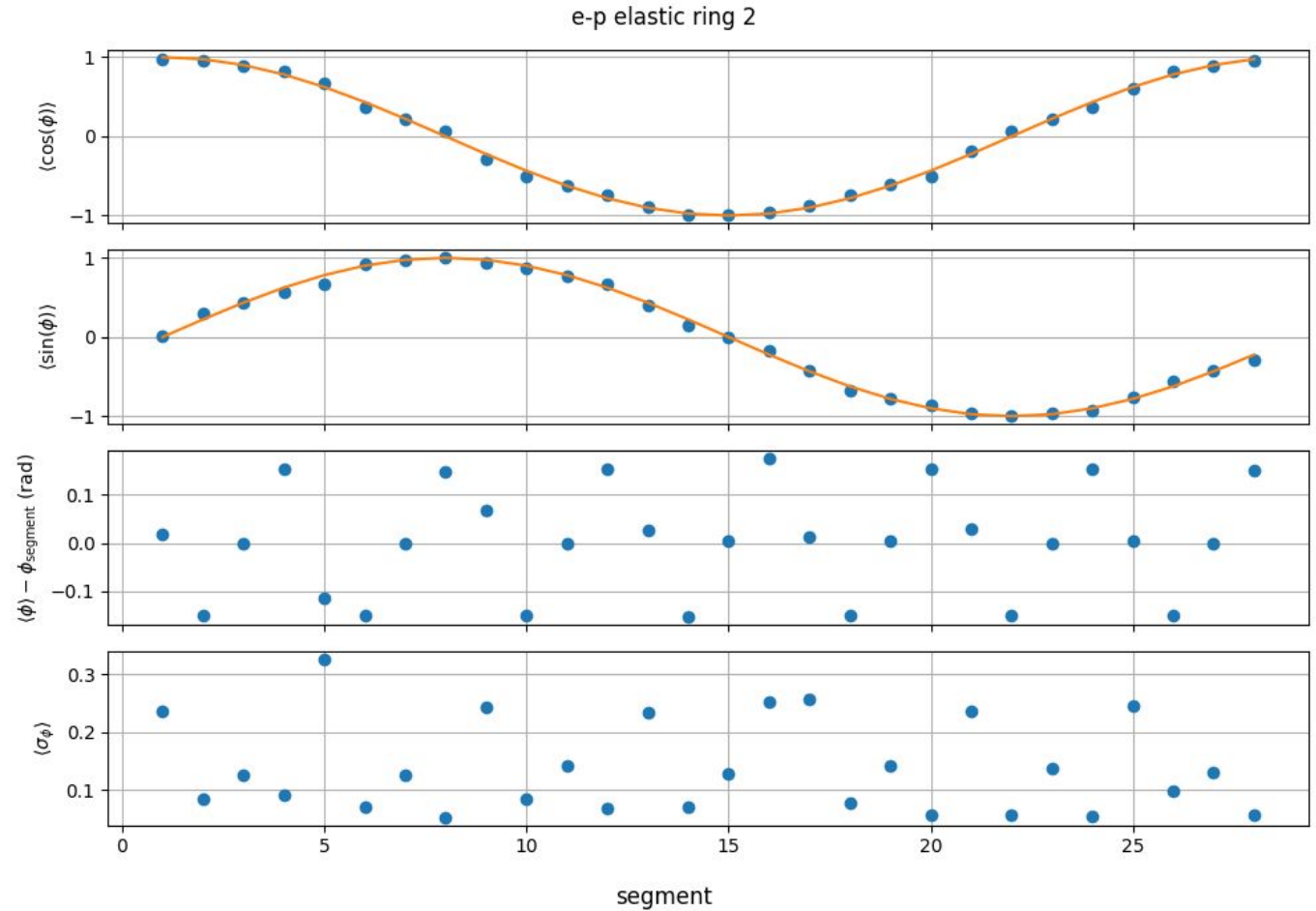


Ring 2, open segment



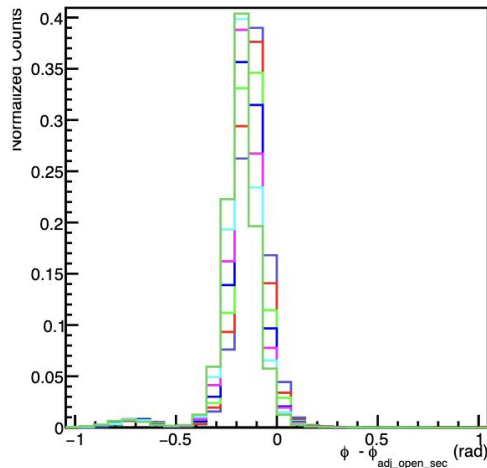
Summary for ring 2

Orange line isn't fit,
it's $\cos(2\pi/28 * (\text{seg} - 1))$

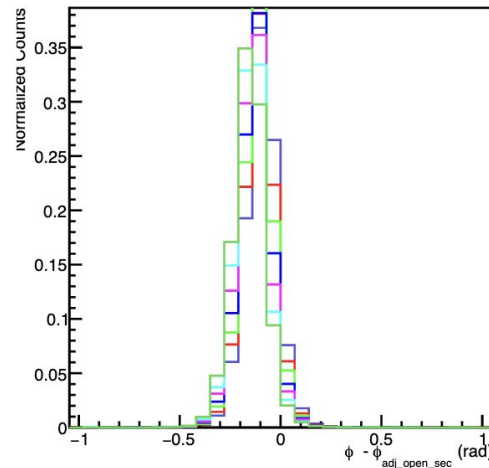


Ring 5 Moller transition tiles

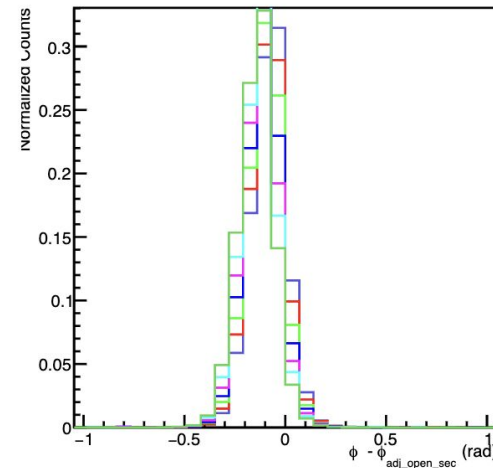
Ring 5, trans left segment, left tile



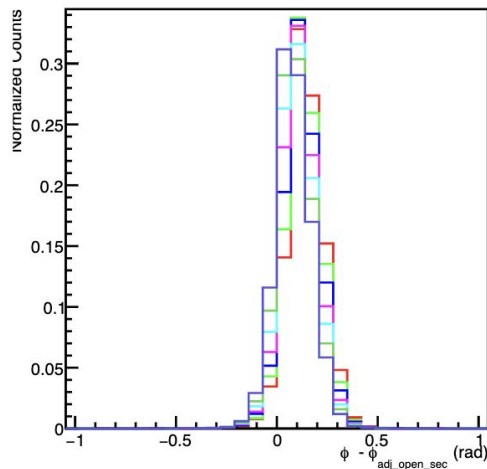
Ring 5, trans left segment, center tile



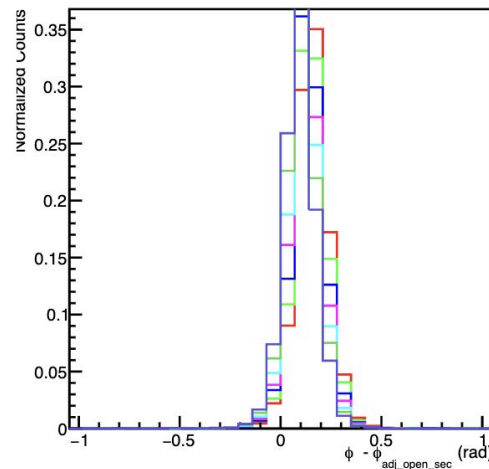
Ring 5, trans left segment, right tile



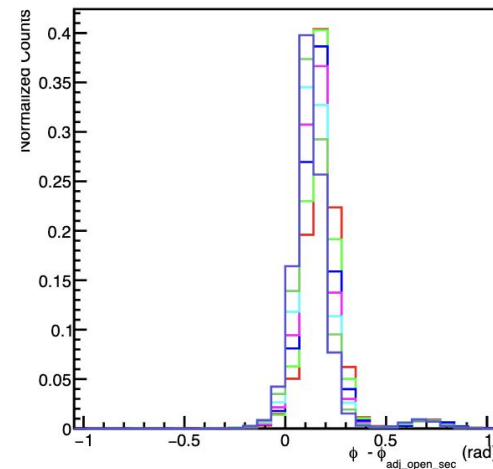
Ring 5, trans right segment, left tile



Ring 5, trans right segment, center tile

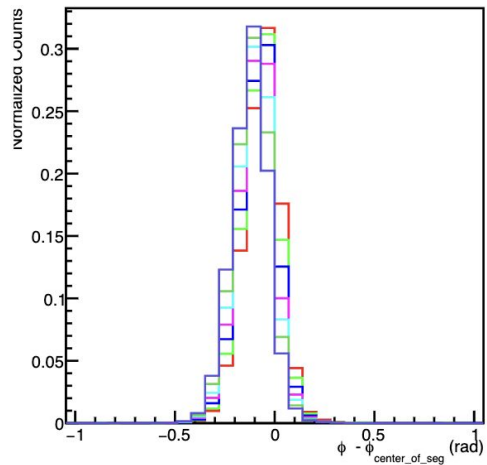


Ring 5, trans right segment, right tile

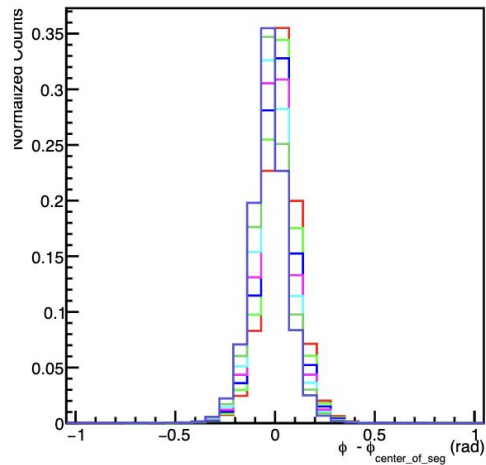


Ring 5 Moller transition tiles

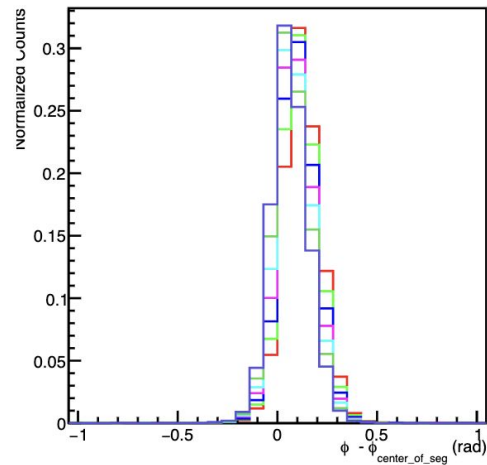
Ring 5, open segment, left tile



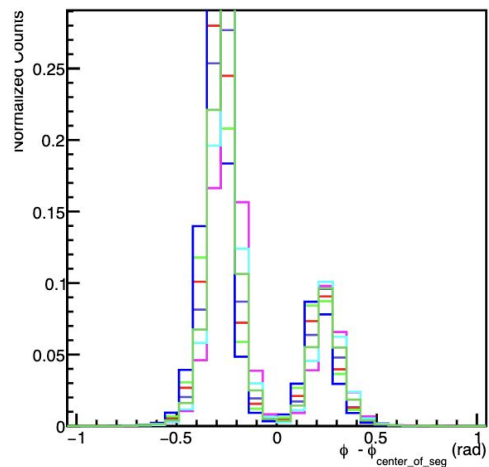
Ring 5, open segment, center tile



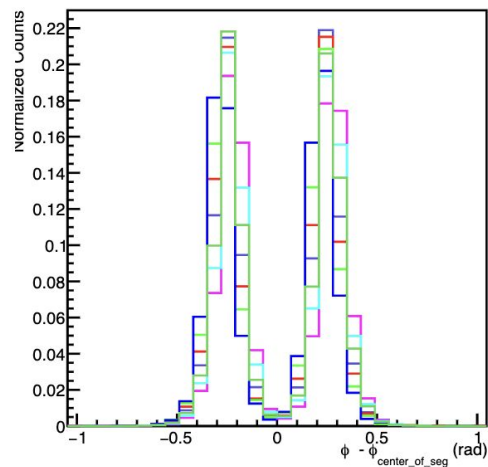
Ring 5, open segment, right tile



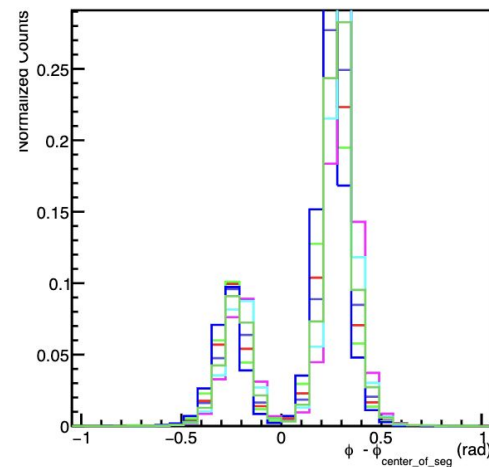
Ring 5, closed segment, left tile



Ring 5, closed segment, center tile

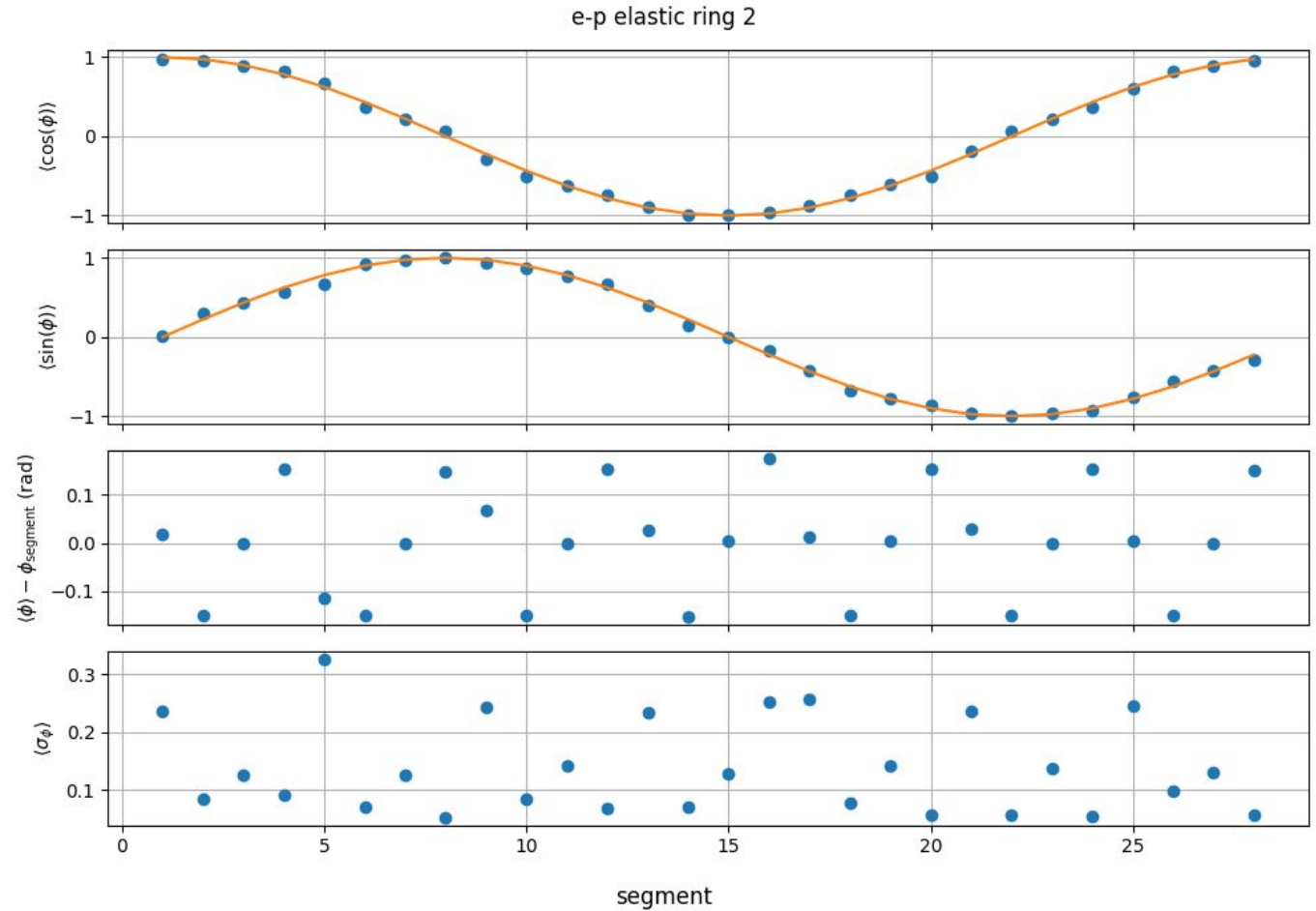


Ring 5, closed segment, right tile

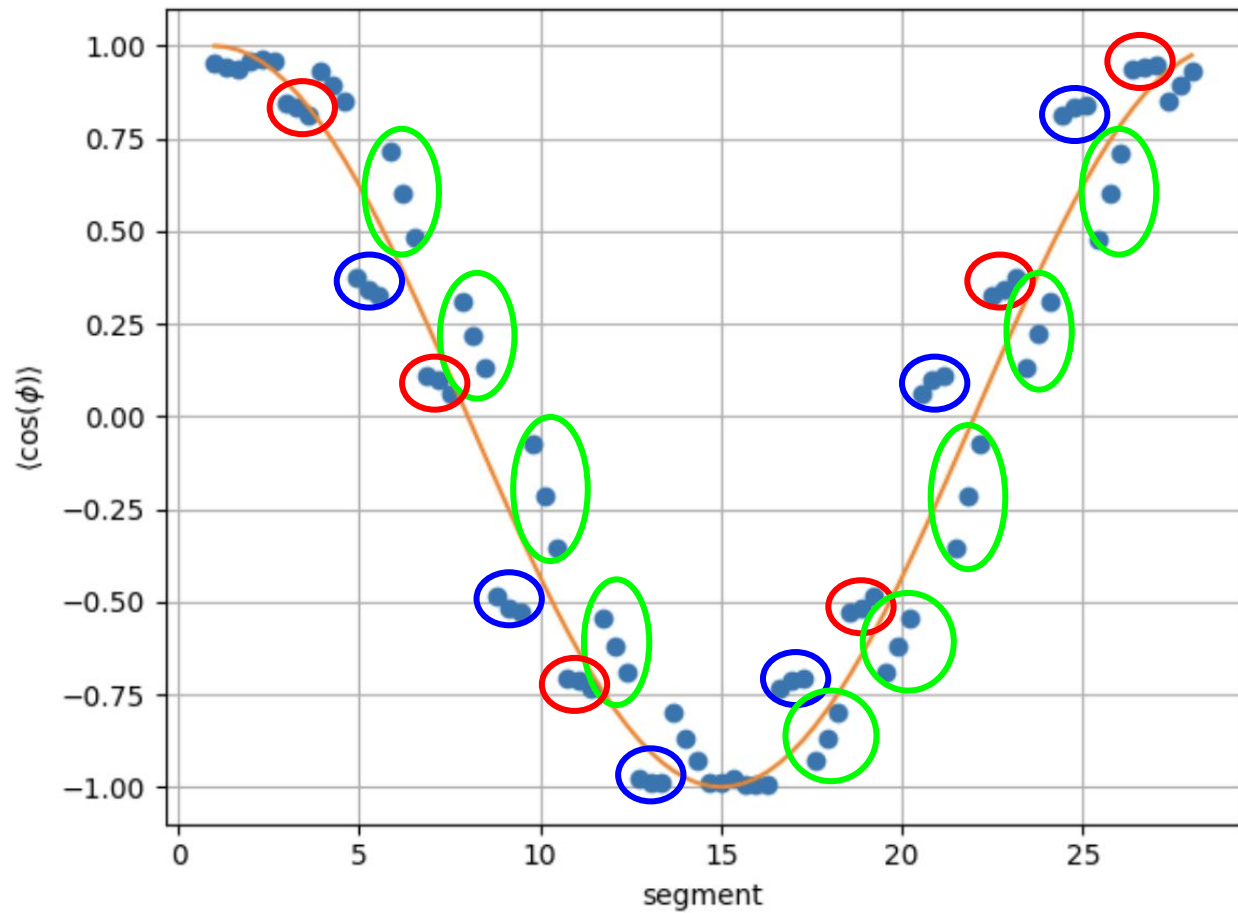


Summary for ring 5

Orange line isn't fit,
it's $\cos(2\pi/28 * (\text{seg} - 1))$



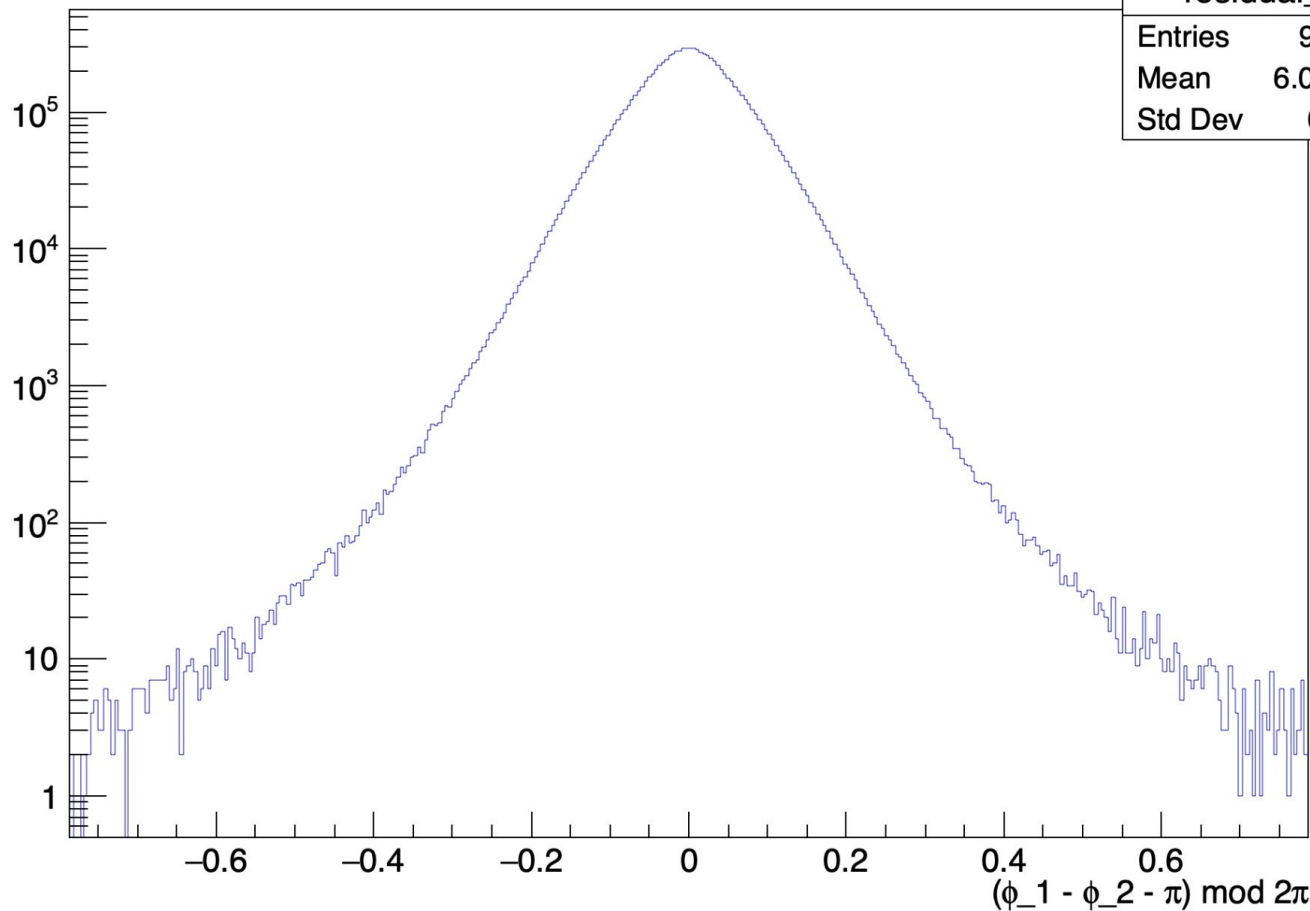
Open
Closed
Transition



Other slides

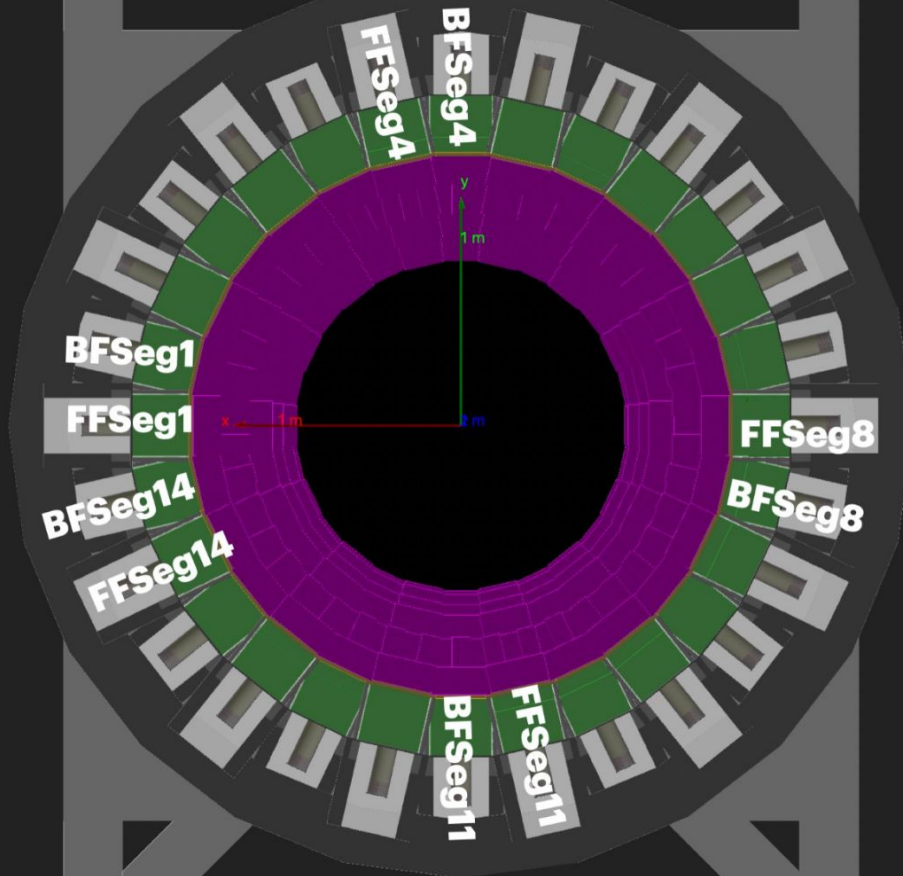
residual phis

N



Particles are
generated
roughly back to
back

Looking at DS



detector type front flush = 0xFF = decimal 15 x 10000

detector type back flush = 0xBF = decimal 11 x 10000

then segment number x 100

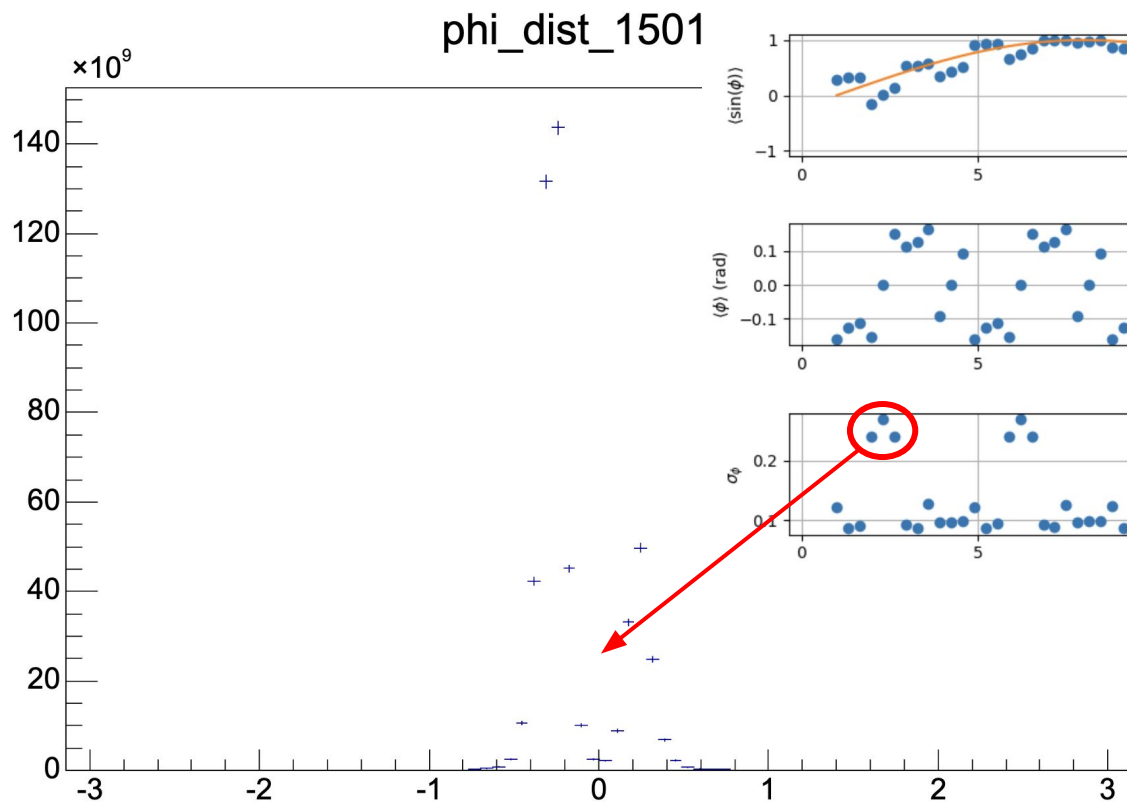
then ring number x 10

and then for ring 5: 1 = left, 2 = center, 3 = right as you look in beam direction.

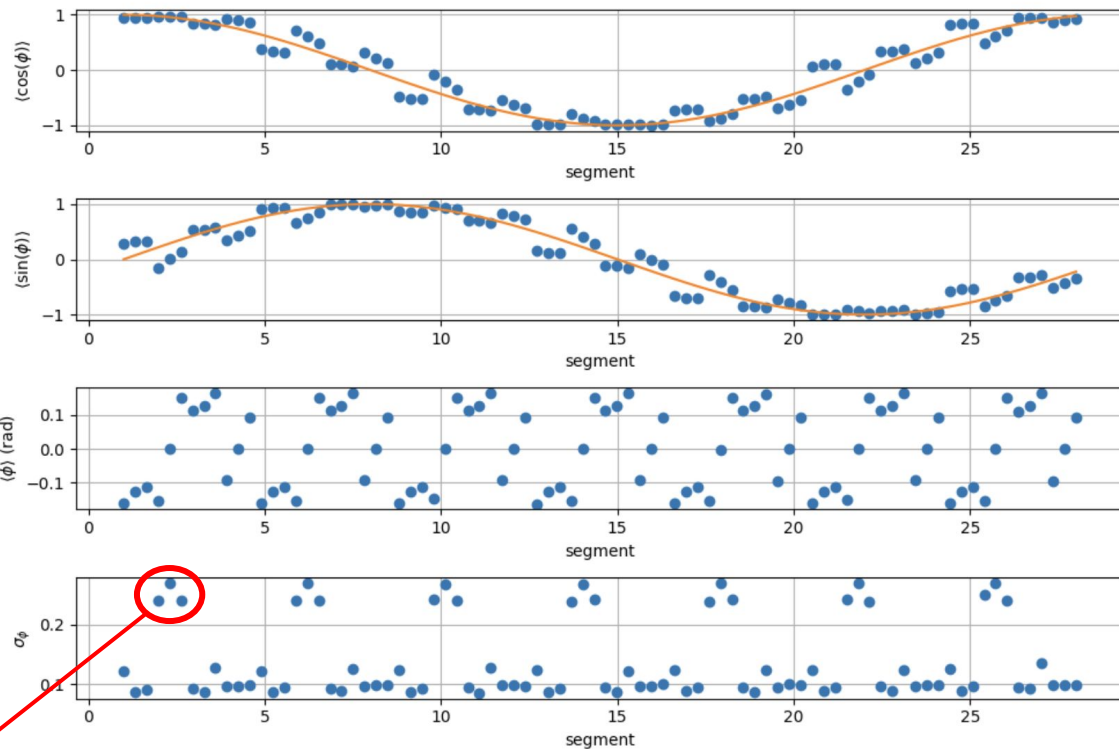
For example;

151152 is FF, segment 11, ring 5, center

110430 is BF, segment 4, ring 3 (the last 0 means there is no left, right, or center)



Moller electrons ring 5



Distributions in the closed
septants are bimodal
-> higher stddev

Colors

Color (root number)	Septant
Red (2)	1
Green (3)	2
Blue (4)	3
Magenta (6)	4
Cyan (7)	5
Muted green (8)	6
Periwinkle (9)	7

Event selection: Moller

```
for(int npart = 0; npart < part->size(); npart++){  
    if (part->at(npart).trid == 1) phis[0] = TMath::ATan2(part->at(npart).py, part->at(npart).px);  
    if (part->at(npart).trid == 2) phis[1] = TMath::ATan2(part->at(npart).py, part->at(npart).px);  
}
```



Phis[0] always has trid==1 particle

```
for(int nhit = 0; nhit < hit->size(); nhit++){  
    // loop over the main detectors by detector id  
    if(hit->at(nhit).mtrid == 0 && TMath::Abs(hit->at(nhit).pid) == 11){  
        for(int ndet = 0; ndet < n_dets; ndet++){  
            if(hit->at(nhit).det == main_det_ids[ndet]){  
                if(hit->at(nhit).trid == 1) phi_dist_moller[ndet]->Fill(phis[0], rate);  
                if(hit->at(nhit).trid == 2) phi_dist_moller[ndet]->Fill(phis[1], rate);  
            }  
        }  
    }  
}
```

Event selection: eP elastic

I require `part->size() == 1` so this only ever loops once



```
double phi;
for(int npart = 0; npart < part->size(); npart++){
    phi = TMath::ATan2(part->at(npart).py, part->at(npart).px);
}

for(int nhit = 0; nhit < hit->size(); nhit++){
    // loop over the main detectors by detector id
    if(hit->at(nhit).mtrid == 0 && TMath::Abs(hit->at(nhit).pid) == 11){
        for(int ndet = 0; ndet < n_dets; ndet++){
            if(hit->at(nhit).det == main_det_ids[ndet] && (hit->at(nhit).trid == 1)){
                phi_dist_moller[ndet]->Fill(phi, rate);
            }
        }
    }
}
```

$$m_1 = \frac{1}{N} \sum_{n=1}^N e^{i\phi_n}$$

“Sample moment”

$$\langle \phi \rangle = \text{Arg}(m_1)$$

Mean of phi

$$\langle \cos(\phi) \rangle = \text{Real}(m_1)$$

(and $\langle \sin(\phi) \rangle$ is the imaginary part)

In general you need to put weights in too, these are the unweighted formulae

$$\begin{aligned}
m_1 &= \frac{1}{N} \sum_{n=1}^N e^{i\phi_n} = \frac{1}{N} \sum_{n=1}^N \cos \phi_n + i \sin \phi_n \\
&= \frac{1}{N} \left(\sum_{n=1}^N \cos \phi_n + \sum_{n=1}^N i \sin \phi_n \right) \\
&= \frac{1}{N} \left(\sum_{n=1}^N \cos \phi_n \right) + \frac{1}{N} \left(\sum_{n=1}^N i \sin \phi_n \right) \\
&= \langle \cos(\phi) \rangle + i \langle \sin(\phi) \rangle
\end{aligned}$$