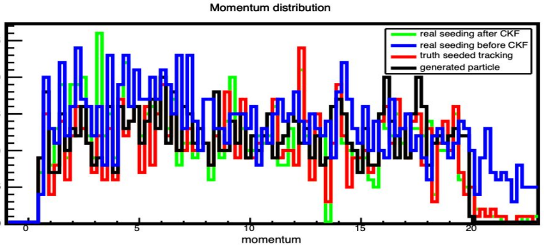
Tracking

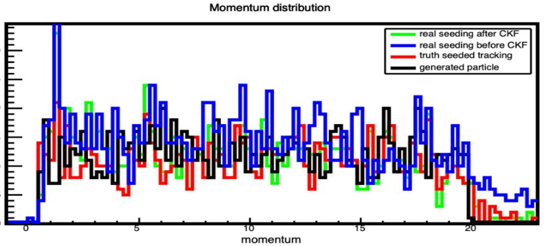
Jeet & Barak

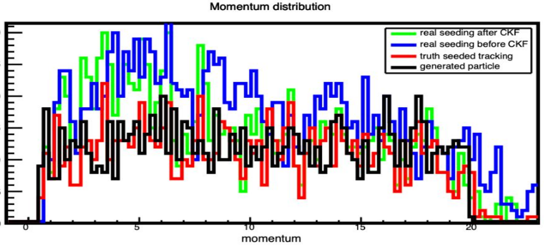
Particle: negative muon
P : 0.5 GeV to 20 GeV
Eta : -4 to 4
Vertex: (0,0,0), (0,0,10), (0,0,-10), (1,0,0), (10,0,0)

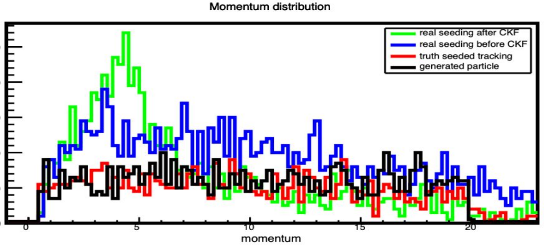
Reconstruction of:
Momentum
Theta
Phi
Charge
Efficiency

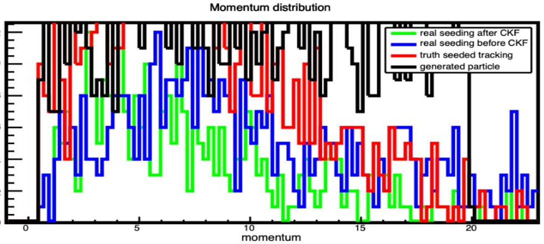
P distribution











Single μ^- generated:

0.5 GeV/c < P < 20 GeV/c

$-4 < \eta < 4$

Generated vertex: ... mm

1) (0,0,0)

2) (0,0,10)

3) (0,0,-10)

4) (1,0,0)

5) (10,0,0)

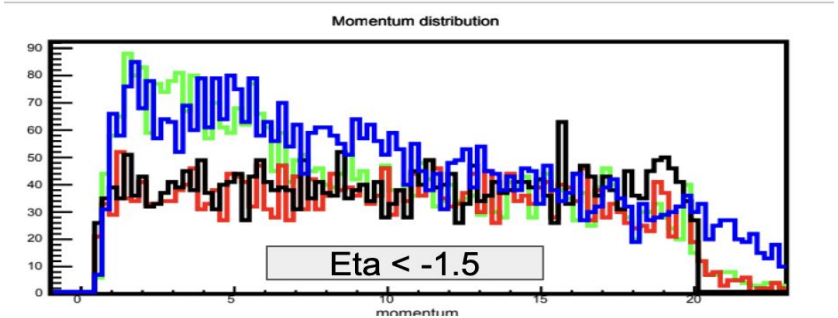
Things to notice:

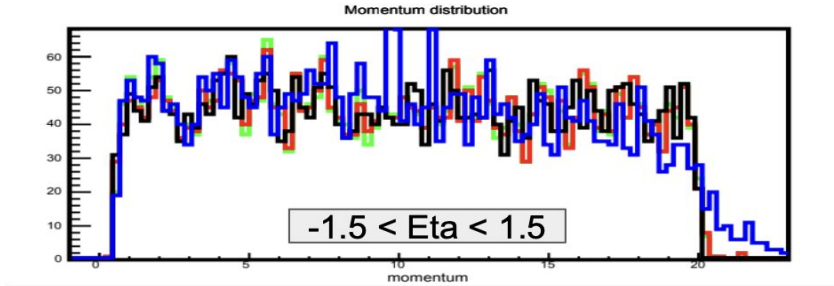
1) P distribution not quite uniform for real seedings
2) P distribution becomes worse as the vertex is further away from beam axis

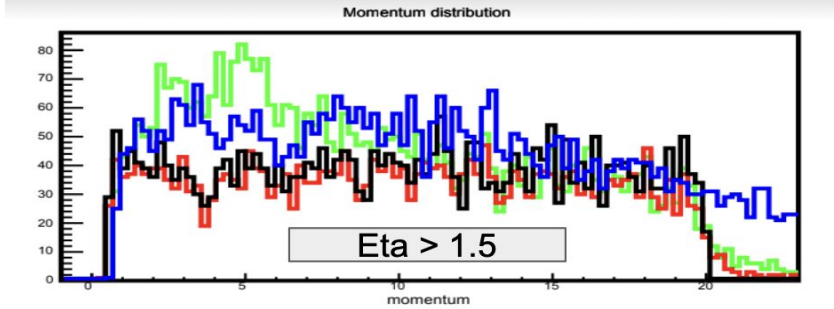
Momentum distribution for unique seeds for various eta ranges; vertex (0,0,0)

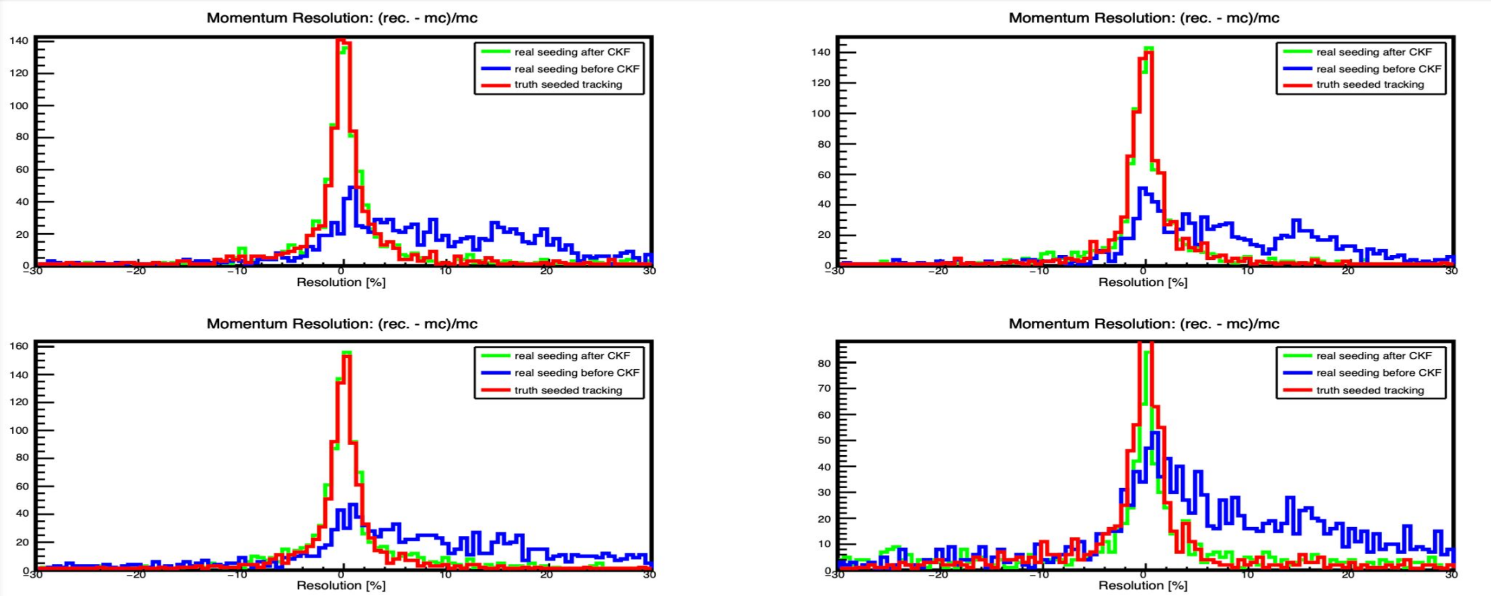
Momentum distribution uniform for -1.5 < eta < 1.5

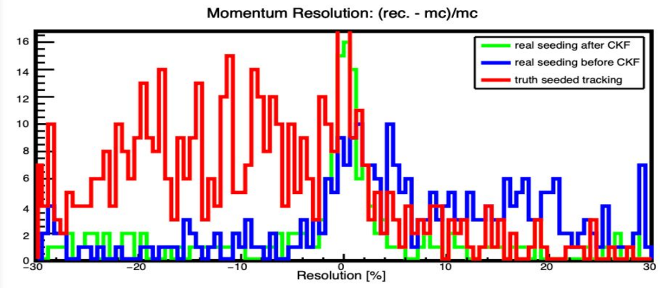
Non uniform for other ranges of eta











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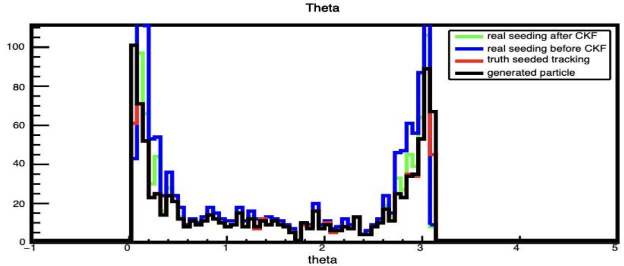
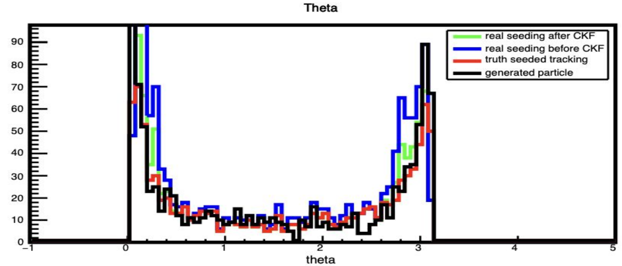
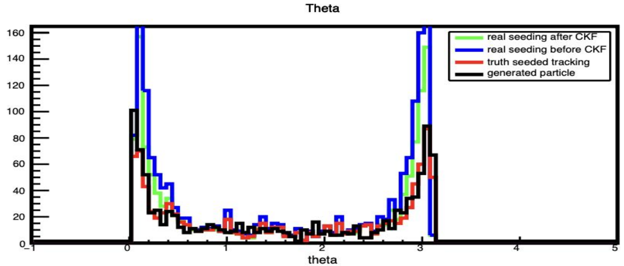
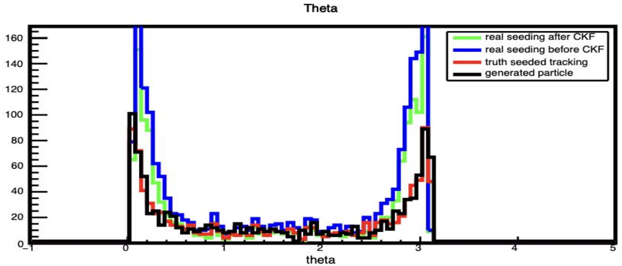
5) (10,0,0)

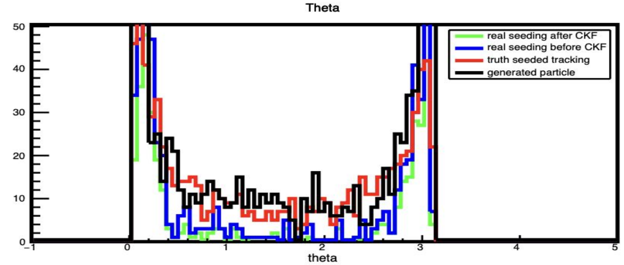
P resolution looks good except for truth seeding at x=10











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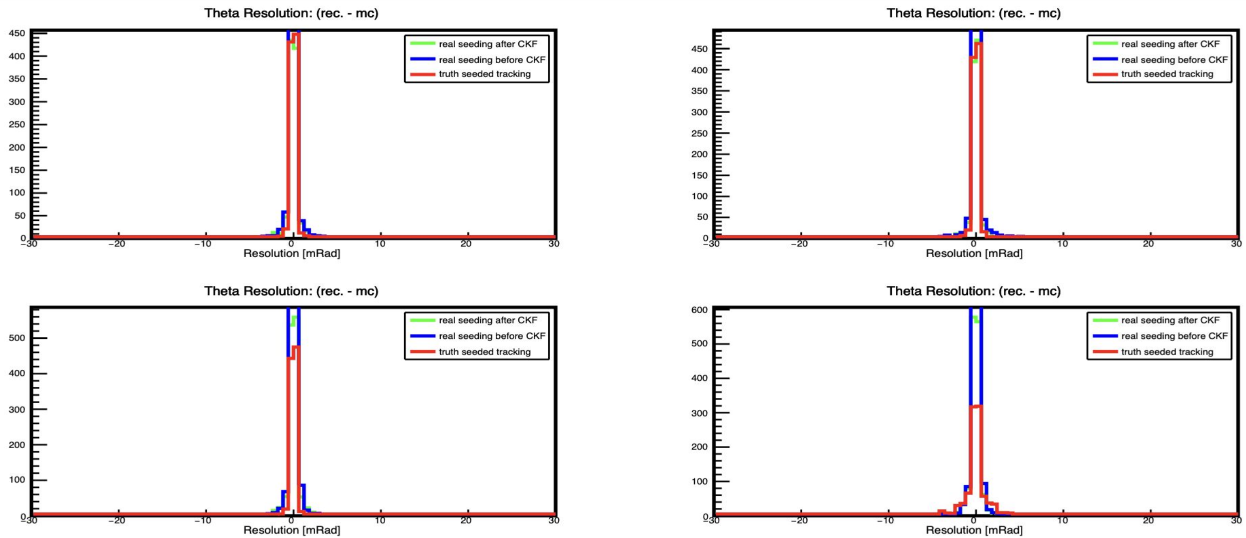
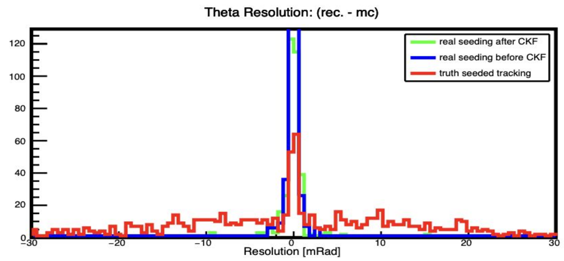
Theta distribution looks good





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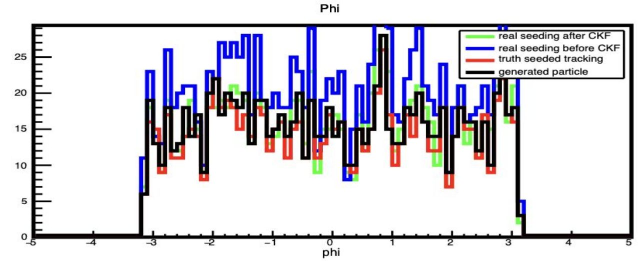
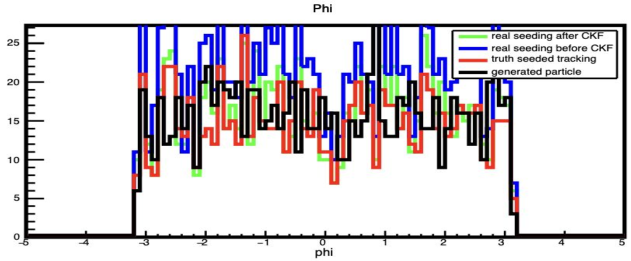
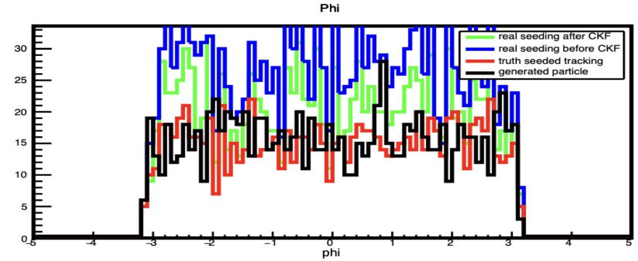
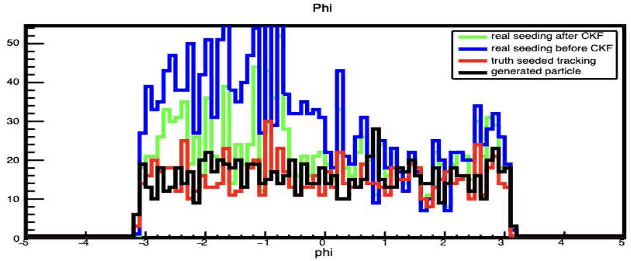
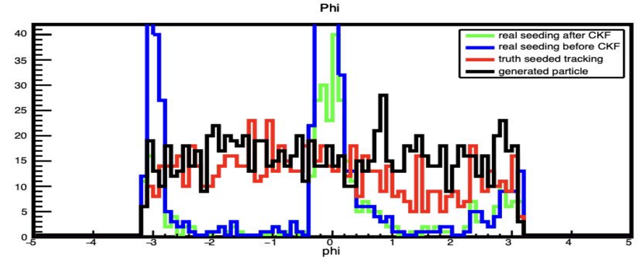
Theta resolution looks good except for truth seeding at x=10











Single μ^- generated:

0.5 GeV/c < P < 20 GeV/c

-4 < η < 4

Generated vertex: ... mm

1) (0,0,0)

2) (0,0,10)

3) (0,0,-10)

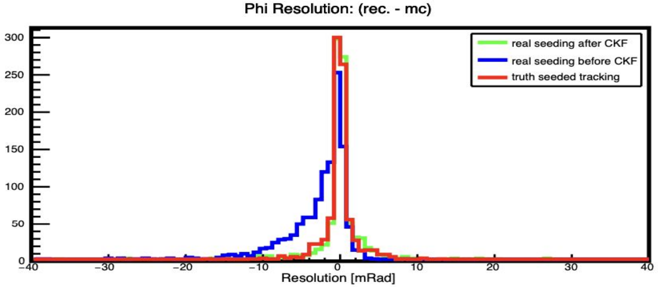
4) (1,0,0)

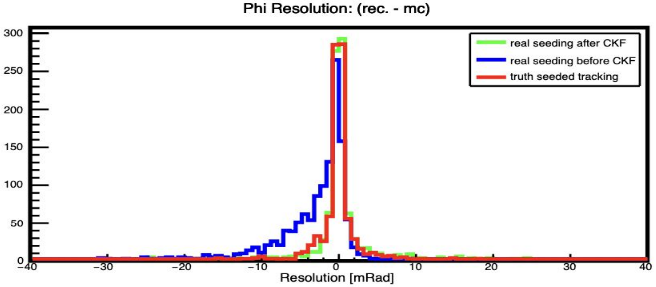
5) (10,0,0)

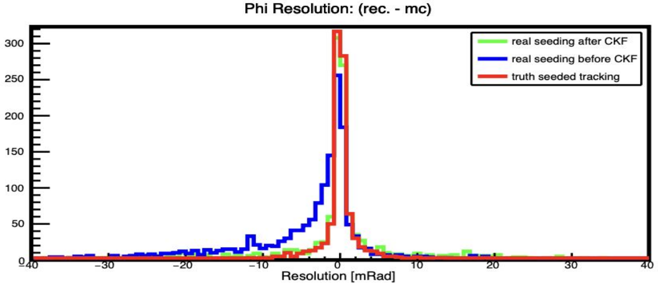
```
auto vxpos = -1.*charge*(ypos-Y0);
auto vypos = charge*(xpos-X0);

auto phi = atan2(vypos,vxpos);
```

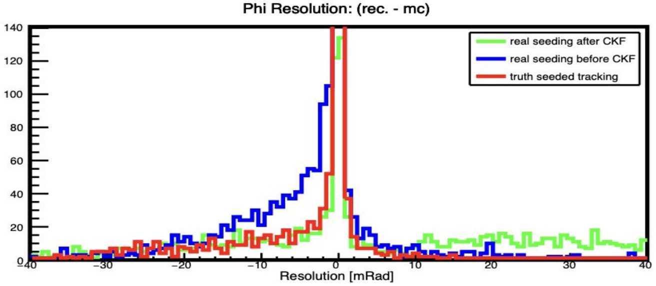
Phi distribution does not look for x=1

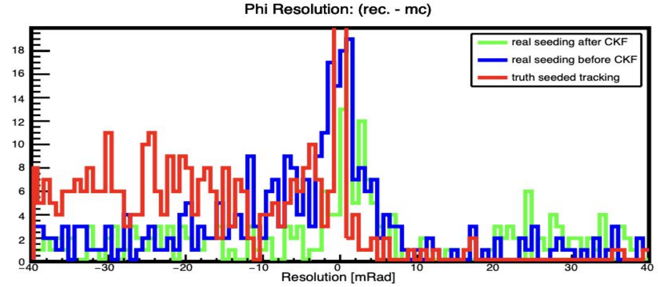
Phi depends on charge; any error in charge creates an error in phi











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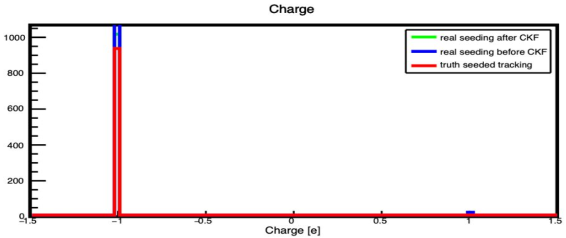
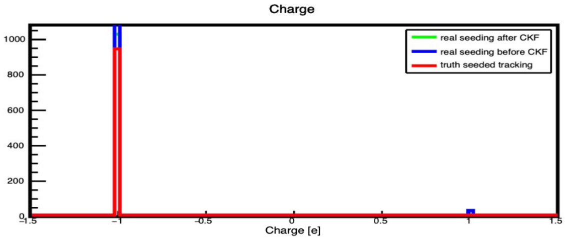
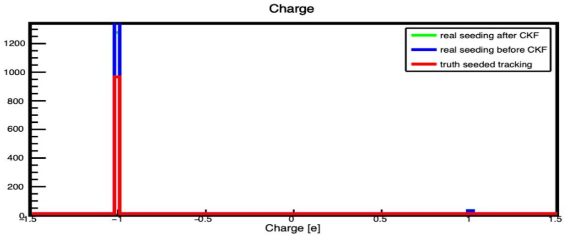
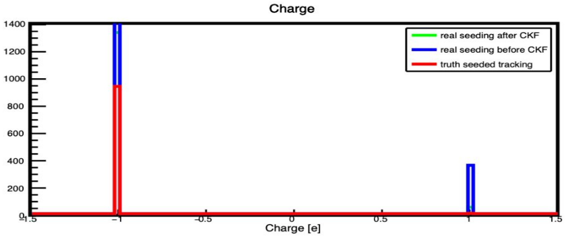
Similar to p res and theta res, Phi resolution is also not good for truth seeding at x=10

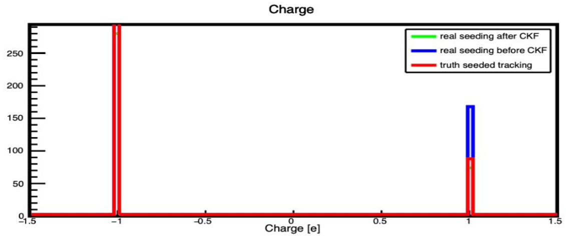
Charge reconstruction











1) (0,0,0)

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# of wrong charges increases as vertex is further away from beam axis

Error is in how charge (bend angle) is determined

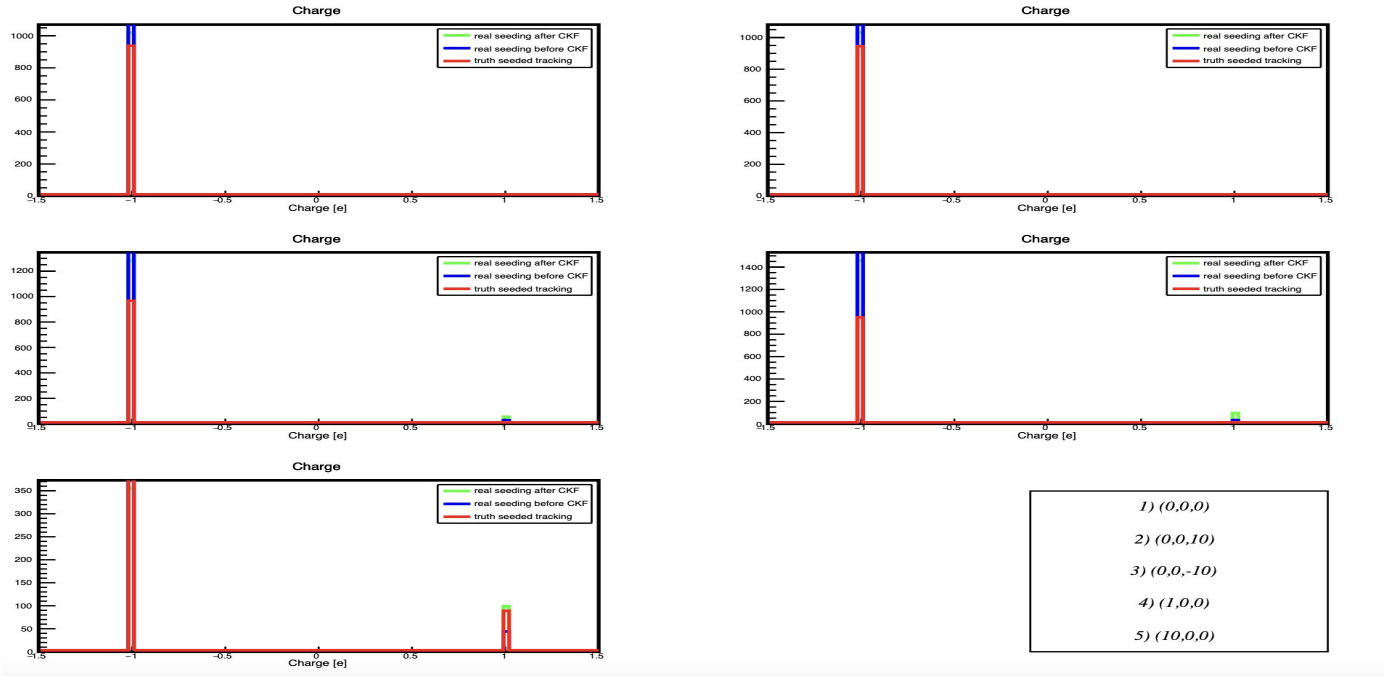
Previously, bend angle measured from origin

```
int eicrecon::TrackSeeding::determineCharge(std::vector<std::pair<float,
{
  // determine the charge by the bend angle of the first two hits
  int charge = 1;
  const auto& firstpos = positions.at(0);
  const auto& secondpos = positions.at(1);

  const auto firstphi = atan2(firstpos.second, firstpos.first);
  const auto secondphi = atan2(secondpos.second, secondpos.first);
  auto dphi = secondphi - firstphi;
  if(dphi > M_PI) dphi = 2.*M_PI - dphi;
  if(dphi < -M_PI) dphi = 2*M_PI + dphi;
  if(dphi < 0) charge = -1;

  return charge;
}
```

Now: measure it from different reference points (PCA, center of circle

const auto firstphi = atan2(firstpos.second-Y0, firstpos.first-X0);
const auto secondphi = atan2(secondpos.second-Y0, secondpos.first-X0);

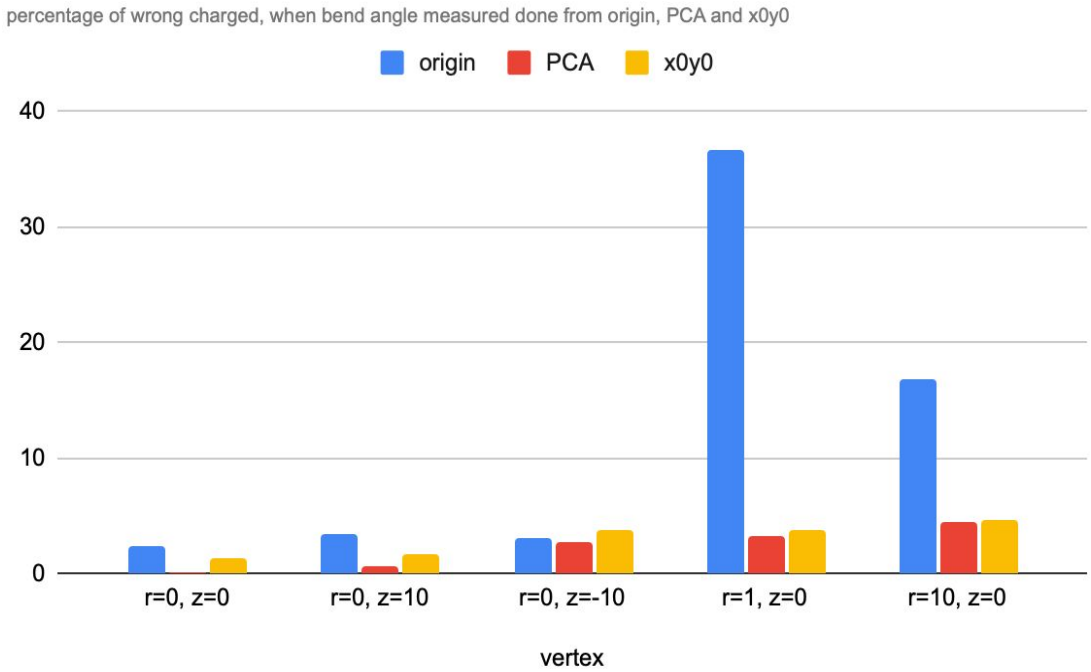
After correction..



# of wrong charges for real seeding decreases drastically

% of wrong charged, when bend angle measured from different reference points

	neg muon		
vertex	origin	PCA	x0y0
r=0, z=0	2.4	0.2	1.3
r=0, z=10	3.5	0.6	1.6
r=0, z=-10	3.1	2.8	3.7
r=1, z=0	36.7	3.2	3.8
r=10, z=0	16.8	4.4	4.6

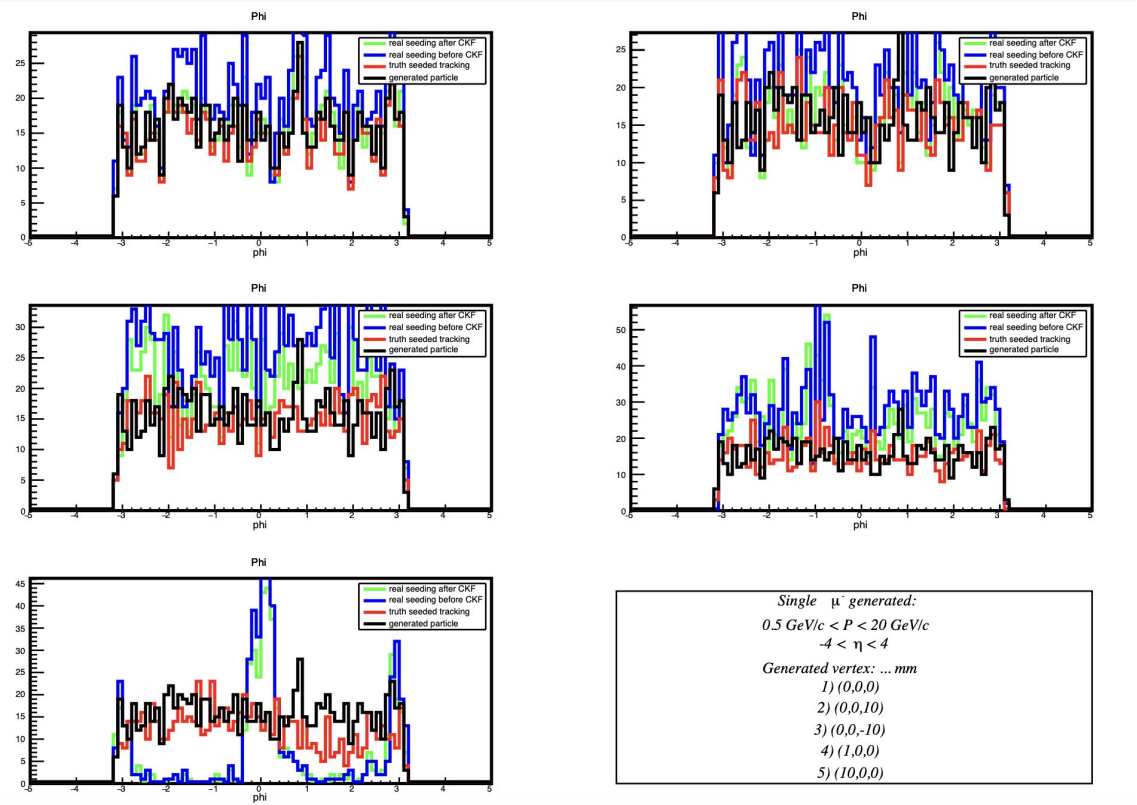


PCA and center of radius (X0,Y0) provides better charge reconstruction

Consquence

After charge correction:

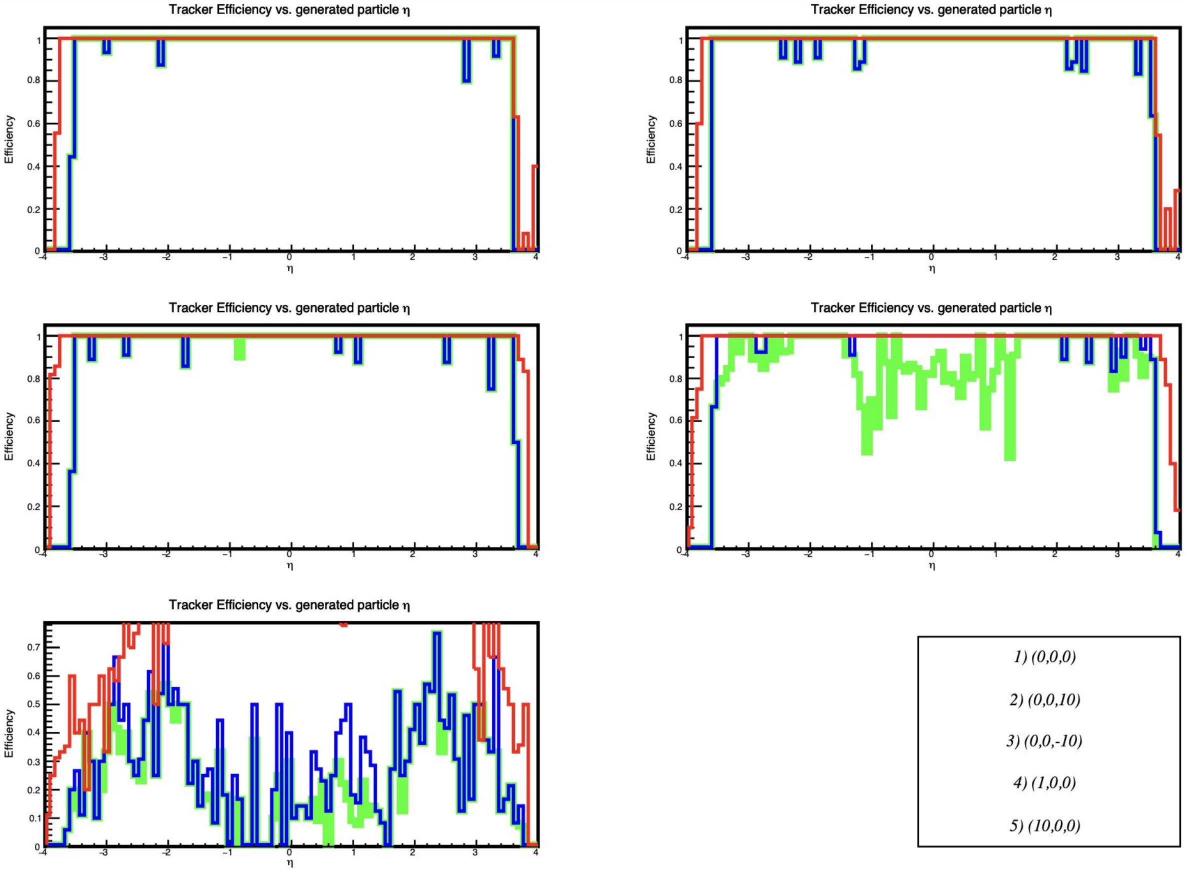
At x=1, phi distribution improves



Consequences

Before charge correction:

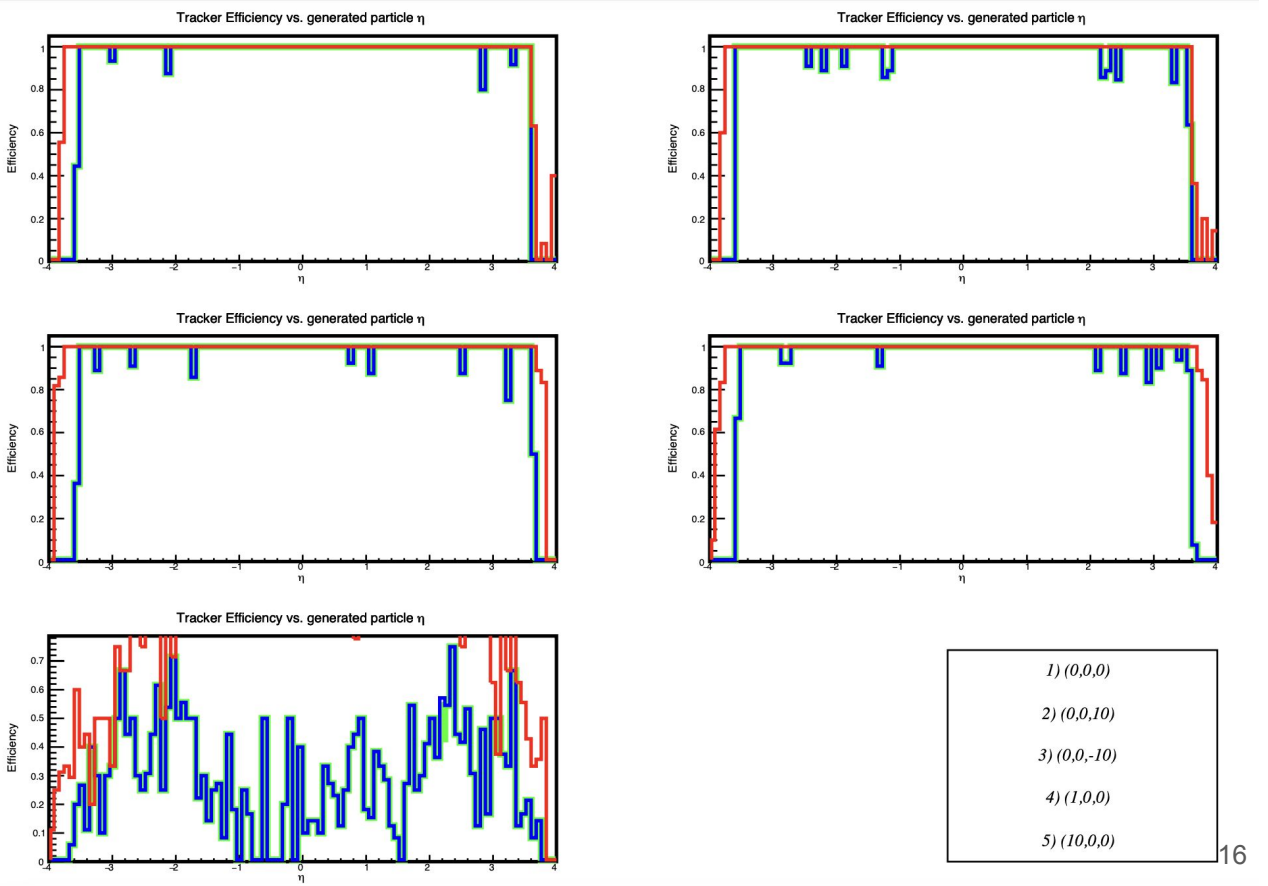
Error in tracker efficiency vs eta for real seeding after CKF at x=1



Consequence:

After charge correction:

At x=1, tracker efficiency vs eta for real seeding after CKF becomes better



Consequences

Before charge correction:

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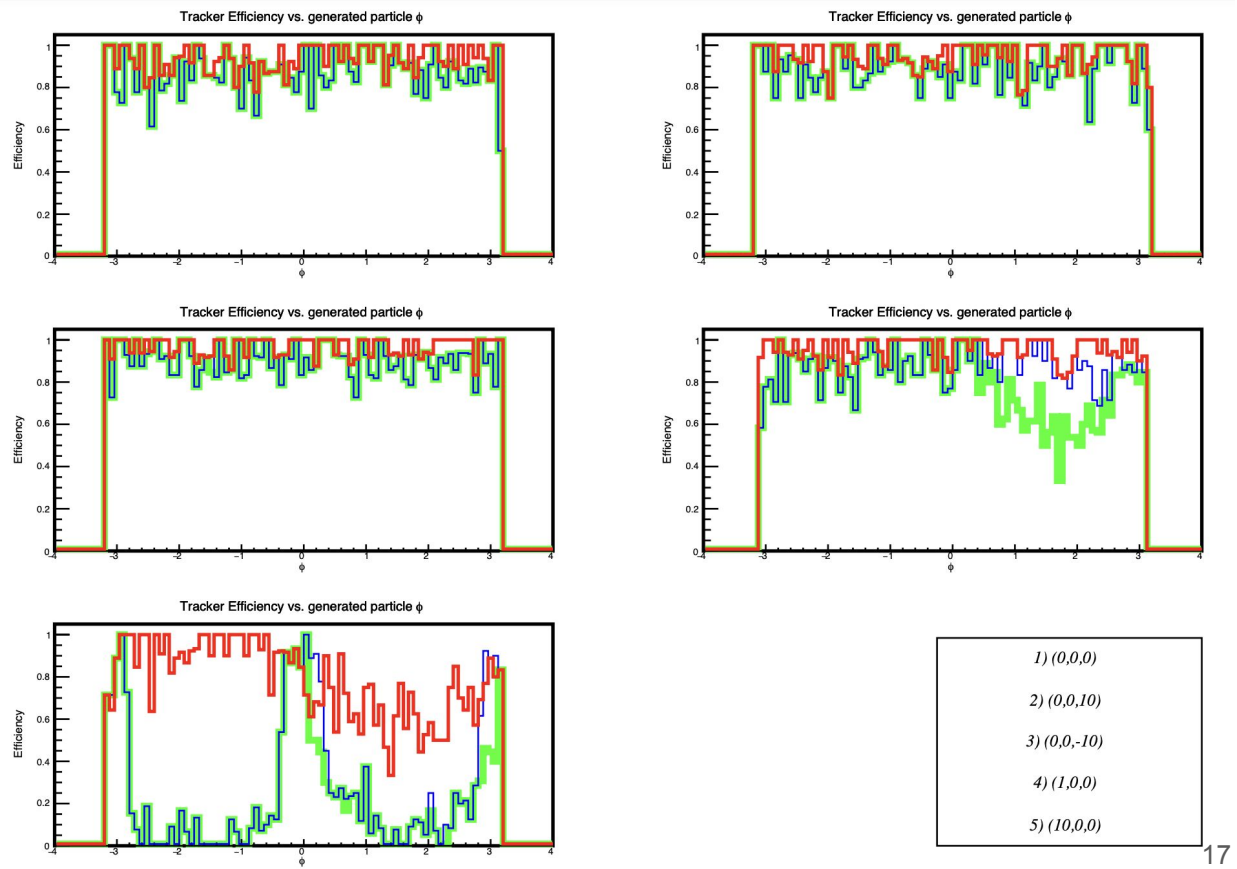

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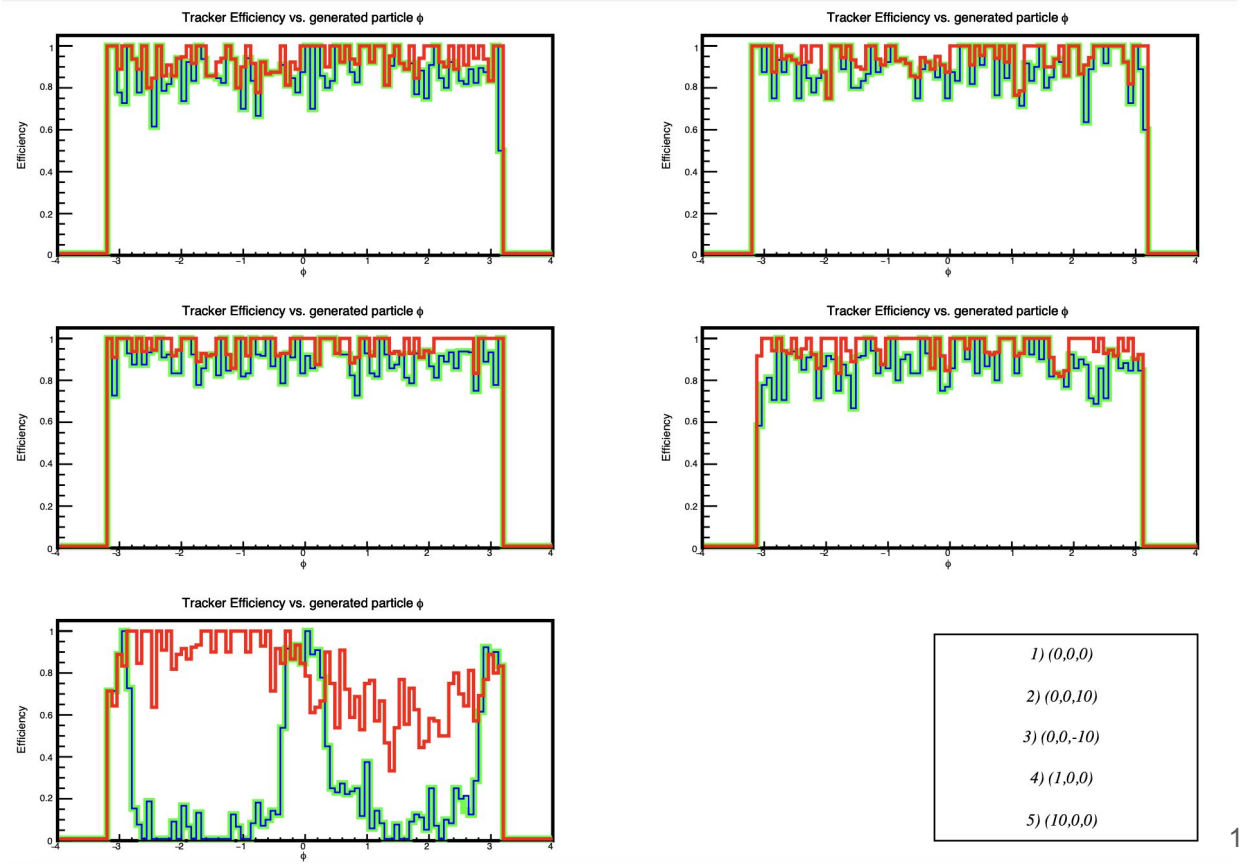
After charge correction:

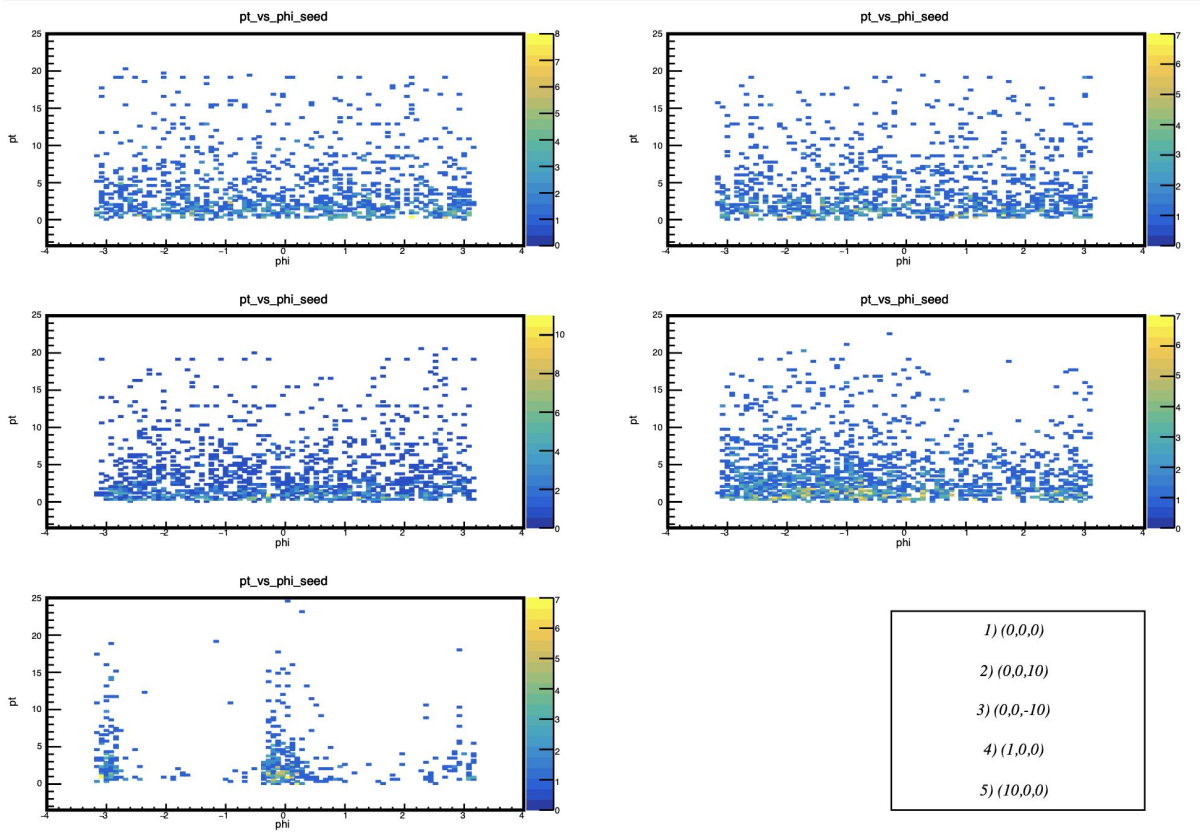
At x=1, tracker efficiency vs phi for real seeding after CKF becomes better



Consequence

Before charge correction:

Pt vs phi for real seeding after CKF is not symmetric at x=1



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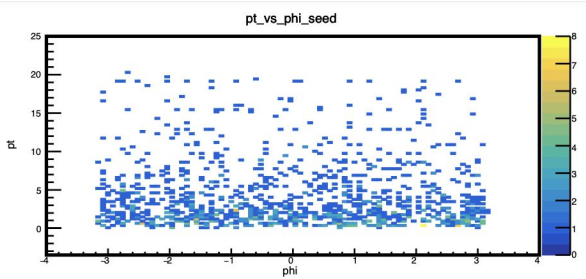

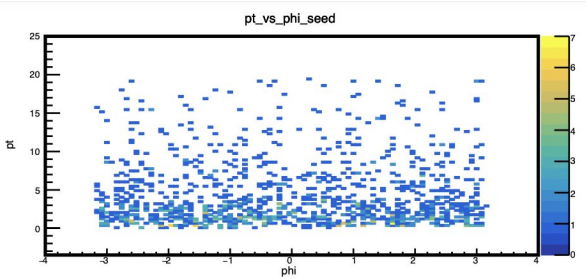

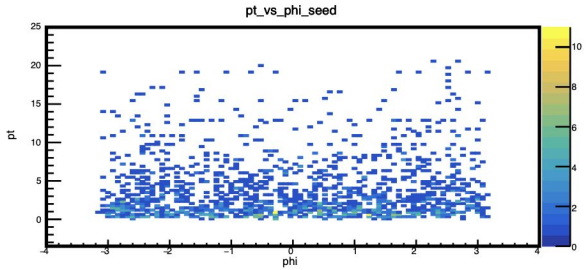

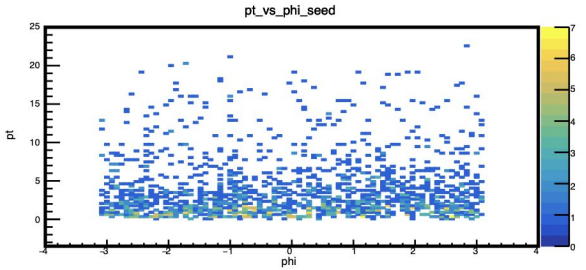

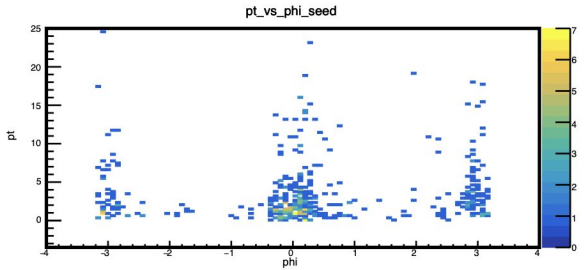

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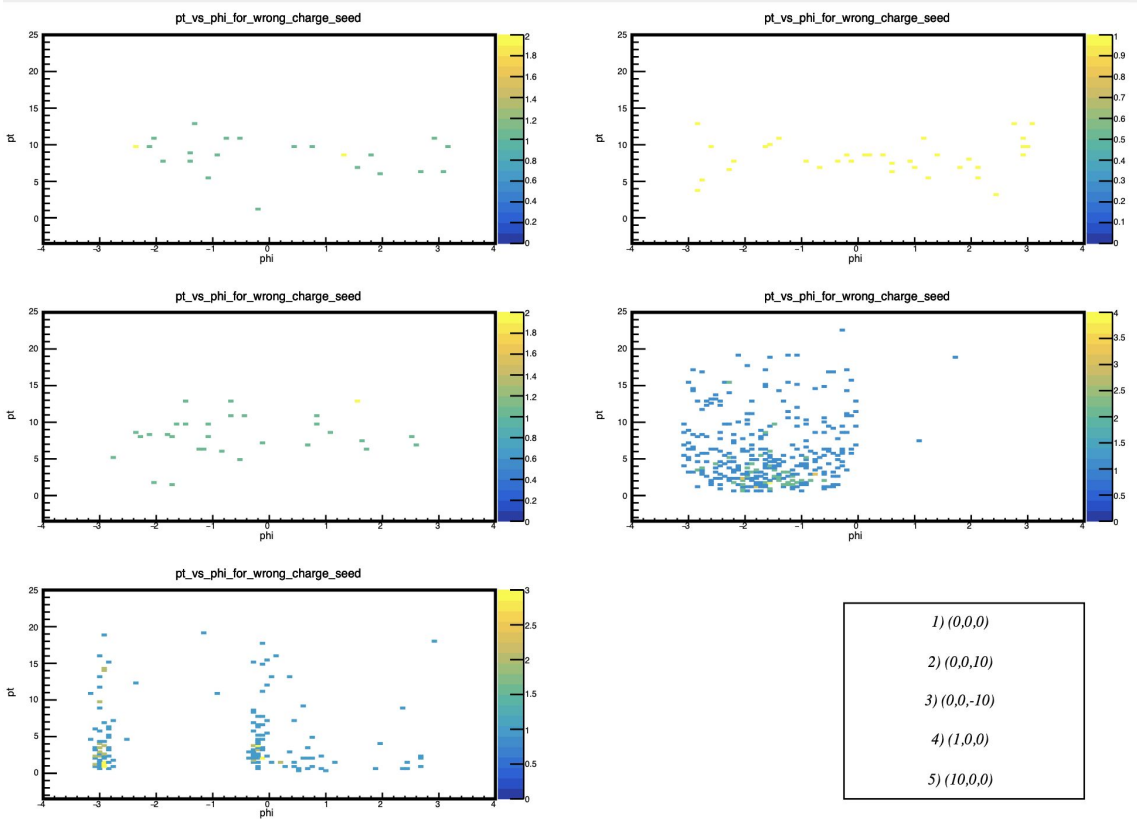
Consequence

Before charge correction:

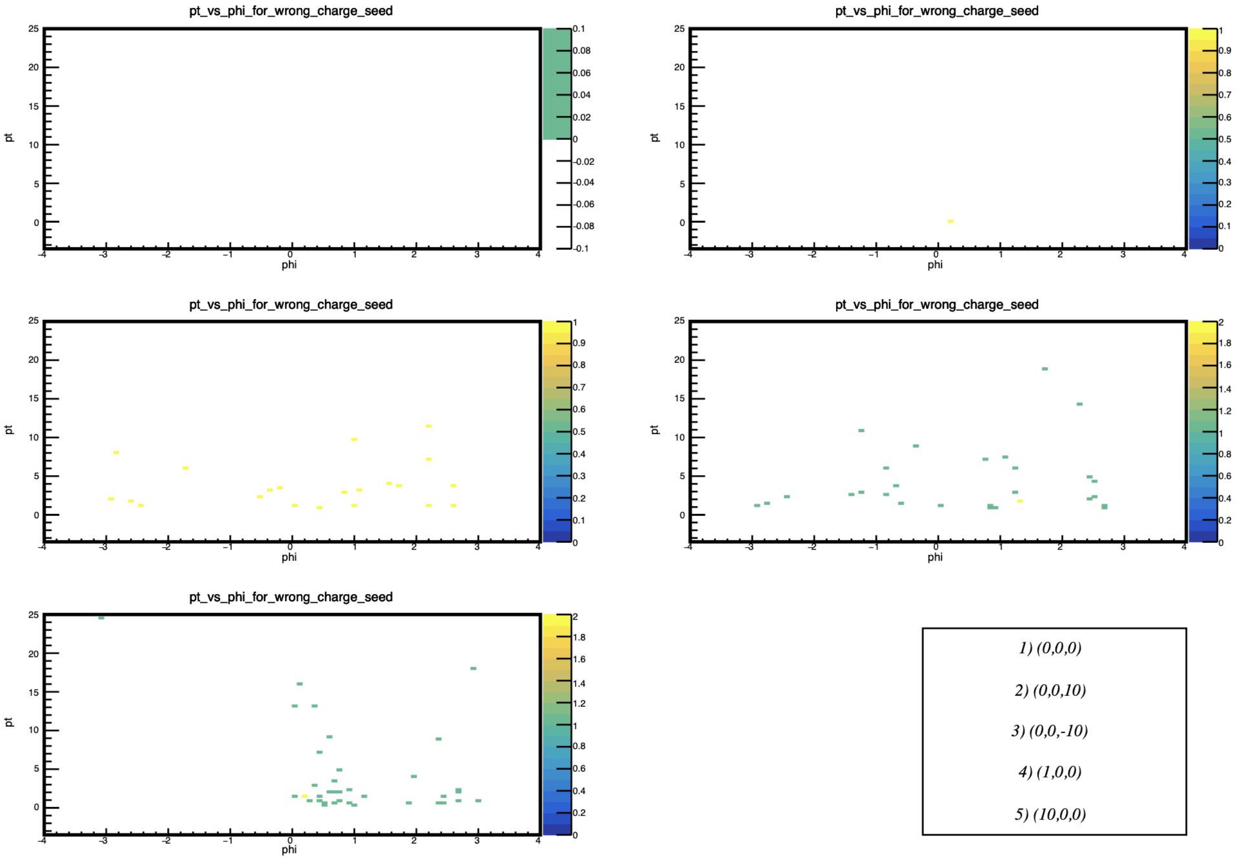
Error in Pt vs phi for wrong charged seeds



Consequence

After charge correction:

Improvement in Pt vs phi for wrong charged seeds



Summary and future plans

Charge correction is needed!

Error observed for truth seeding at x=10

Future plans:

Redefine phi, so that error in charge does not create error in phi

Study the covariance matrix (initial errors) involved with seeding