Realistic seeding status

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EIC RNC meeting
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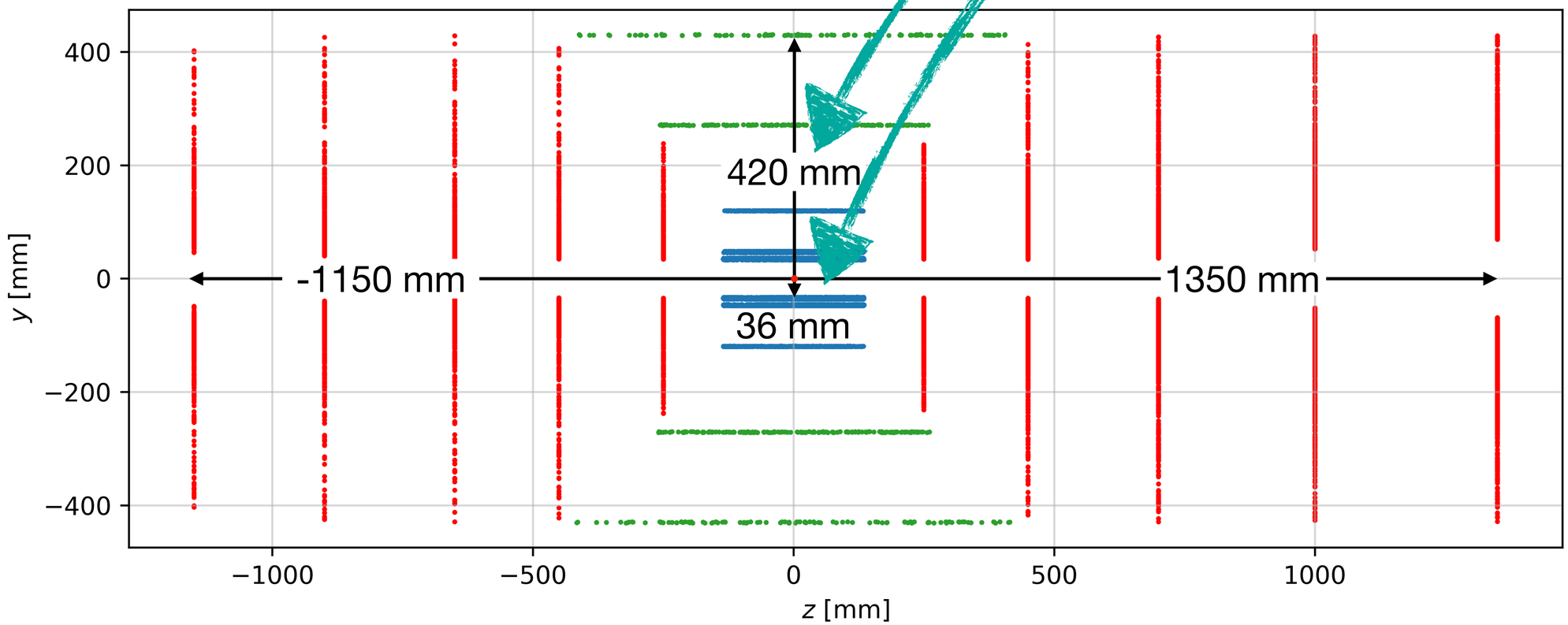
To recap

- Moving realistic-seeder work to EICrecon
  - Y.S. Lai, et al. worked on (**ACTS-based**) seeder in **Juggler** (including some param optimization)
  - J. Osborn ported sPHENIX optimized (**ACTS-based**) seeder to **EICrecon**
  - Need to optimize parameters
  - On 01/20/2023 Y.S. Lai and RCT copied over parameters from **Juggler** to **EICrecon** seeder

ACTS-based meaning that the base code came from ACTS. Both seeders have common variables, etc.

Parameter description

Parameter	Description	ElCrecon default	Y.S. Lai's default
bFieldInZ	z component of magnetic field	1.7 T	1.7 T
rMax	Maximum r value to look for seeds	500 mm	440 mm
rMin	Minimum r value to look for seeds	33 mm	33 mm
zMin	Minimum z value to look for seeds	-800 mm	-1500 mm
zMax	Maximum z value to look for seeds	800 mm	1700 mm
beamPosX	Beam offset in x	0	0
beamPosY	Beam offset in y	0	0



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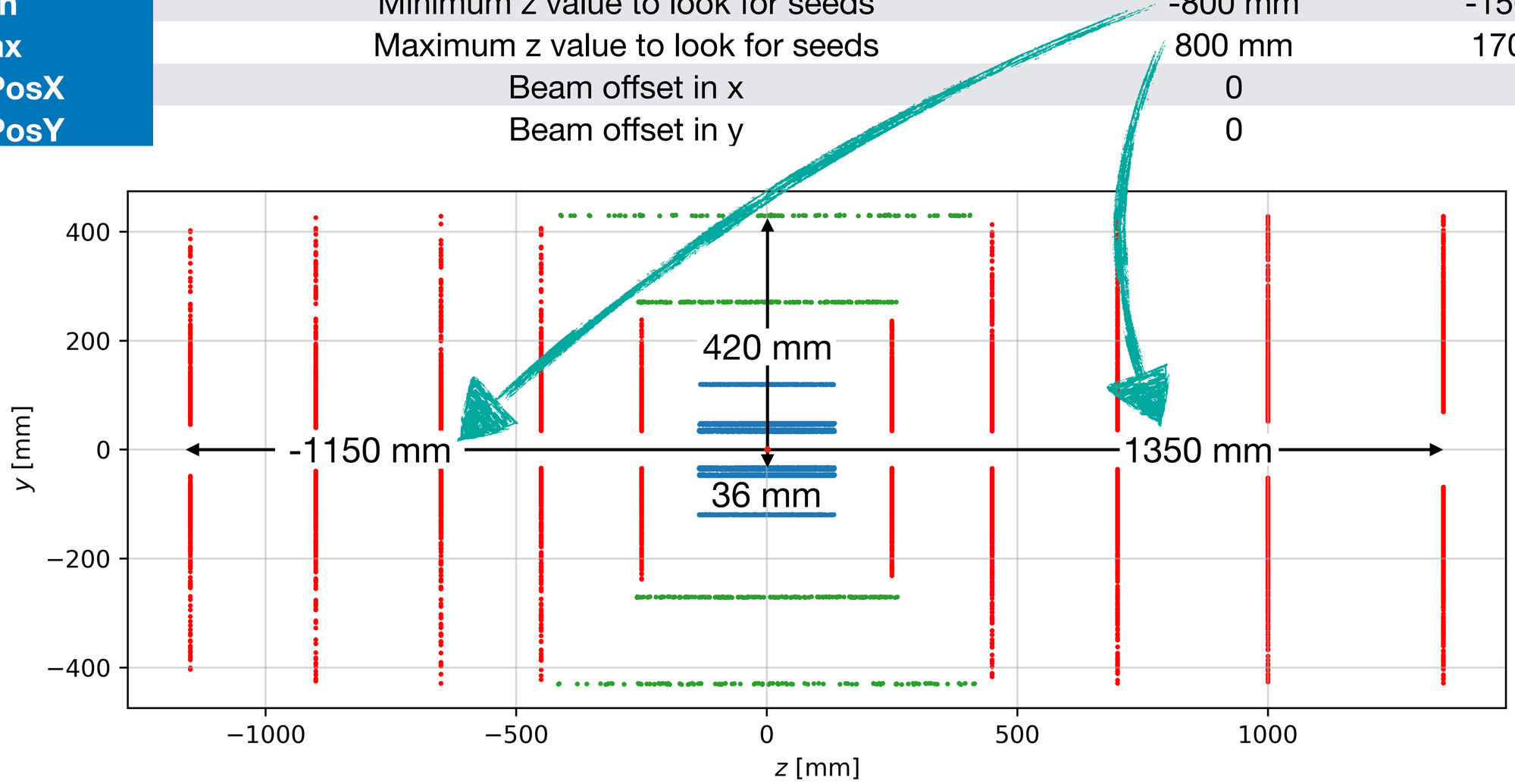

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deltaRMinBottomSP	Min distance in r between middle and bottom SP in one seed	1 mm	50 mm
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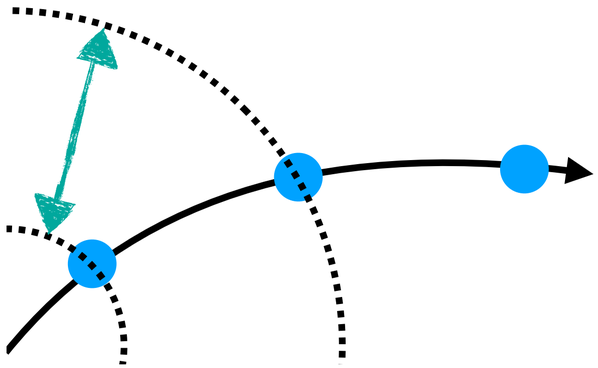

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collisionRegionMin	Min z for primary vertex	-300 mm	-250 mm
collisionRegionMax	Max z for primary vertex	300 mm	250 mm
cotThetaMax	Cotangent of max theta angle	16	16.54
minPt	Min transverse momentum	100	100 MeV/cotThetaMax
maxSeedsPerSpM	Max number of seeds a single middle space point can belong to	1	0
sigmaScattering	How many standard devs of scattering angles to consider	5	5
radLengthPerSeed	Average radiation lengths of material on the length of a seed	0.1	0.1
impactMax	Max transverse PCA allowed	20 mm	3 mm

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impactMax	Max transverse PCA allowed	20 mm	3 mm
rMinMiddle	Min R for middle space point	20 mm	—
rMaxMiddle	Max R for middle space point	400 mm	—
bFieldMin	min B field	—	0.1 T

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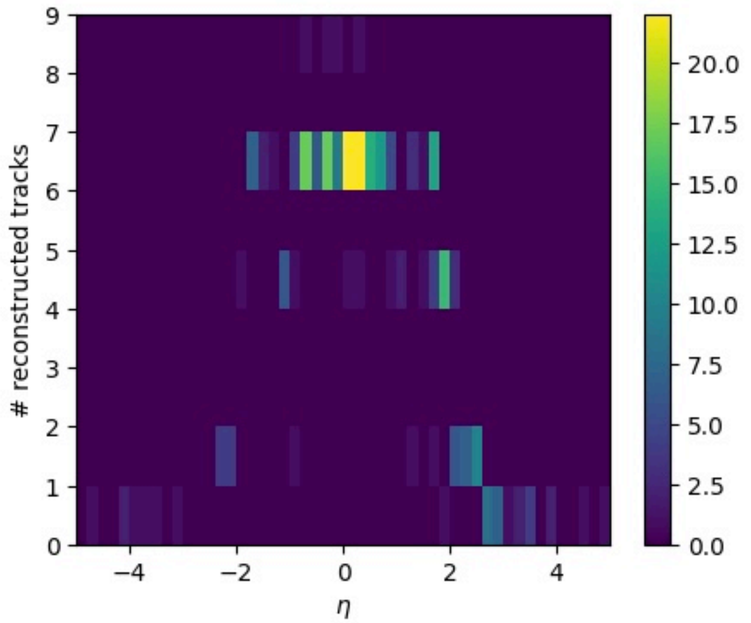
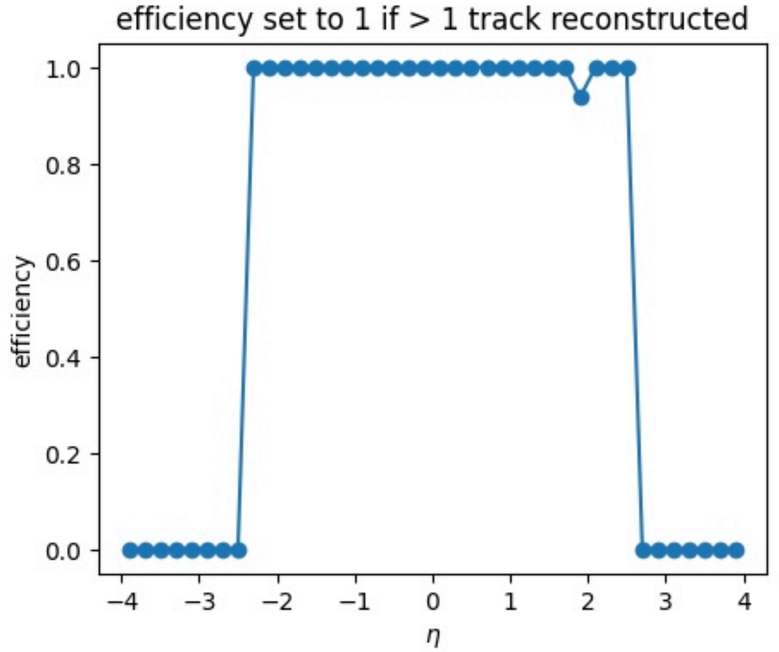
rMinMiddle	Min R for middle space point	20 mm	—
rMaxMiddle	Max R for middle space point	400 mm	—
bFieldMin	min B field	—	0.1 T

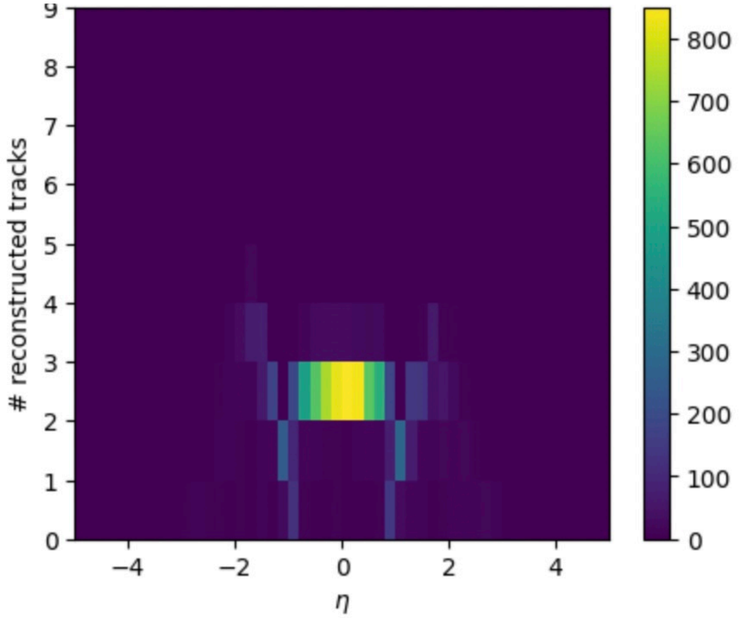
Comparison of both parameter sets

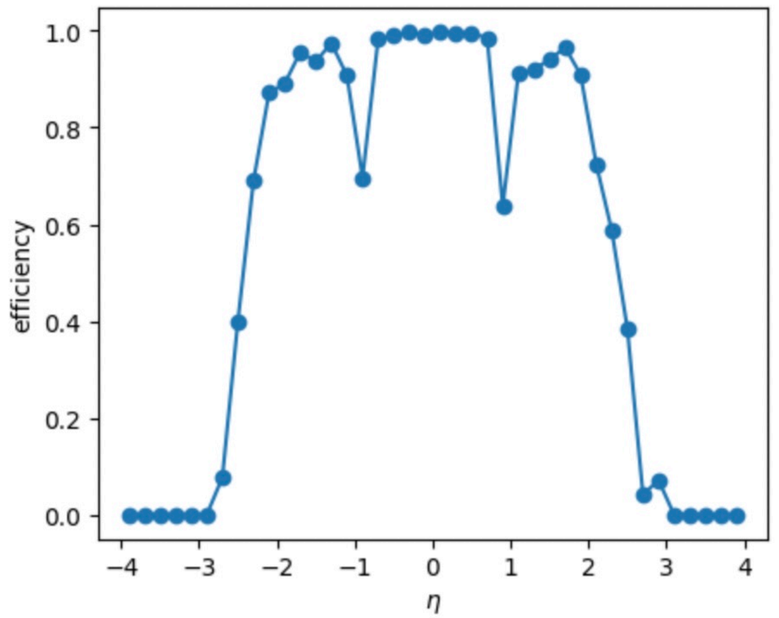
Default (sPHENIX) EICrecon seeder parameters





Parameters from juggler

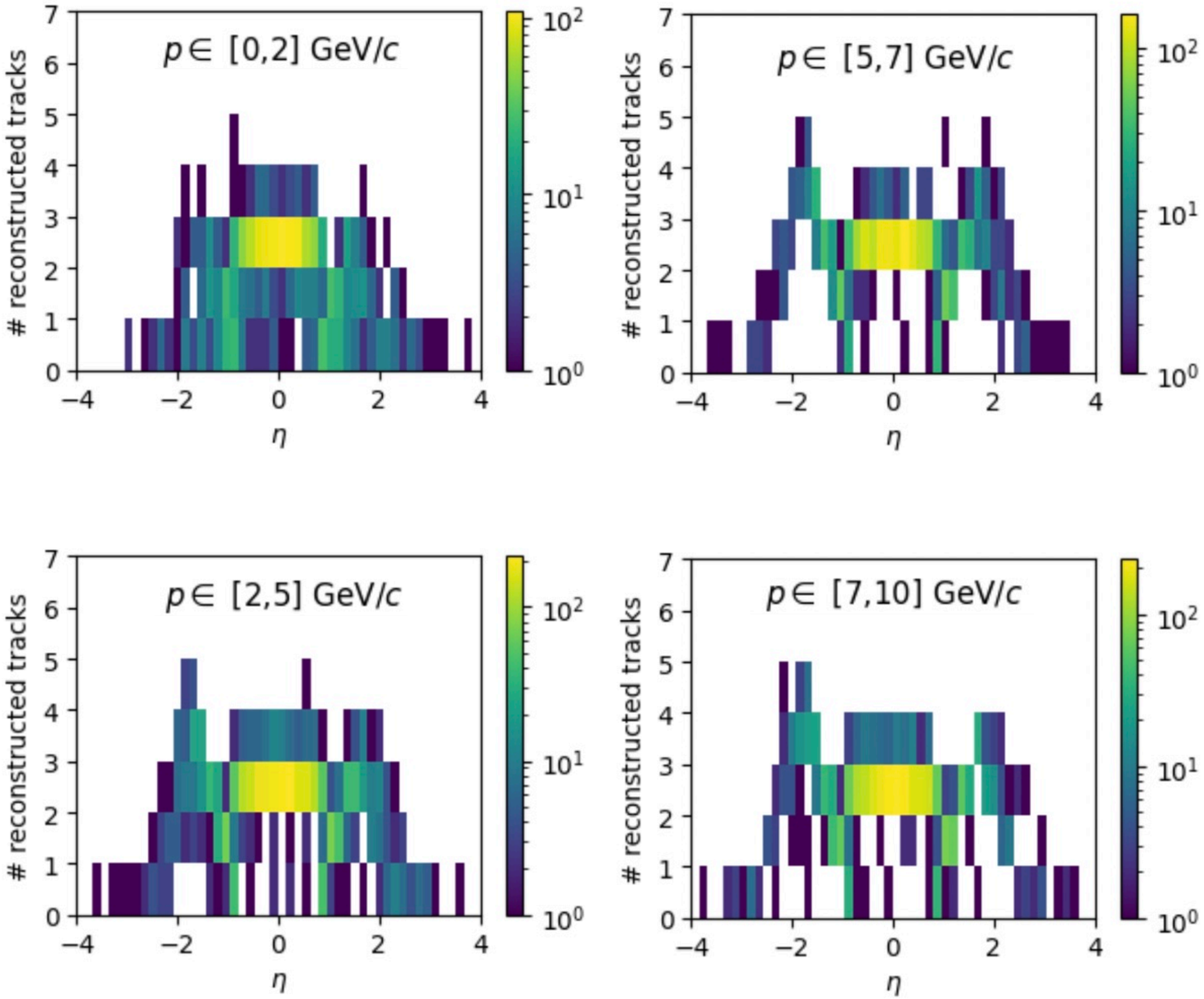




Sample: 10k single pions thrown with $p \in [0,10]$ GeV/c and $\eta \in [-4,4]$

geometry: Brycecanyon

Multiple track reconstruction as a function of momentum



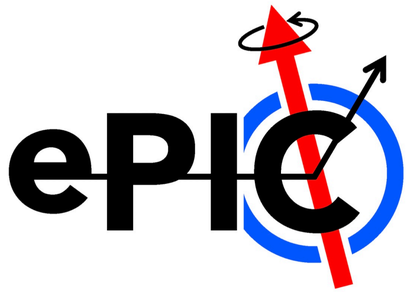
Summary

- Tested functionality of passing multiple seeder parameters at the command-line level
- Copied over and ran seeder with parameters from Y.S. Lai
- Started writing bash scripts to test many parameter sets

Next steps

- Perform a one-by-one parameter scan to assess sensitivity and understand parameter effect
- Perform a grid search to optimize parameters

Thanks for your attention



Backup

Source (Y.S. Lai's params)

https://eicweb.phy.anl.gov/EIC/juggler/-/blob/acts-seeding-21/JugTrack/src/components/TrackParamACTSSeeding.cpp

```
float bFieldInZ = 1.7 * Acts::UnitConstants::T;
float cotThetaMax = std::sinh(3.5);
float minPt = 100 * Acts::UnitConstants::MeV / cotThetaMax;
float rMax = 440 * Acts::UnitConstants::mm;
float zMin = -1500 * Acts::UnitConstants::mm;
float zMax = 1700 * Acts::UnitConstants::mm;
float deltaRMin = 50 * Acts::UnitConstants::mm;
float deltaRMax = 220 * Acts::UnitConstants::mm;
//
float collisionRegionMin = -250 * Acts::UnitConstants::mm;
float collisionRegionMax = 250 * Acts::UnitConstants::mm;
float maxSeedsPerSpM = 0;
float sigmaScattering = 5;
float radLengthPerSeed = 0.1;
float beamPosX = 0 * Acts::UnitConstants::mm;
float beamPosY = 0 * Acts::UnitConstants::mm;
float impactMax = 3 * Acts::UnitConstants::mm;
```

```
/// The minimum magnetic field to trigger the track
/// parameters estimation
double bFieldMin = 0.1 * Acts::UnitConstants::T;

/// Constant term of the loc0 resolution.
double sigmaLoc0 = 25 * Acts::UnitConstants::um;
/// Constant term of the loc1 resolution.
double sigmaLoc1 = 100 * Acts::UnitConstants::um;
/// Phi angular resolution.
double sigmaPhi = 0.02 * Acts::UnitConstants::degree;
/// Theta angular resolution.
double sigmaTheta = 0.02 * Acts::UnitConstants::degree;
/// q/p resolution.
double sigmaQOverP = 0.1 / Acts::UnitConstants::GeV;
/// Time resolution.
double sigmaT0 = 1400 * Acts::UnitConstants::s;

int numPhiNeighbors = 3;

float deltaRMiddleMinSPRange = 10. * Acts::UnitConstants::mm;
float deltaRMiddleMaxSPRange = 10. * Acts::UnitConstants::mm;
```

Source (J. Osborn's params)

https://github.com/eic/EICrecon/blob/main/src/algorithms/tracking/OrthogonalTrackSeedingConfig.h

```
float m_rMax = 500. * Acts::UnitConstants::mm;
float m_rMin = 33. * Acts::UnitConstants::mm;
float m_deltaRMinTopSP = 1. * Acts::UnitConstants::mm;
float m_deltaRMaxTopSP = 400. * Acts::UnitConstants::mm;
float m_deltaRMinBottomSP = 1. * Acts::UnitConstants::mm;
float m_deltaRMaxBottomSP = 400. * Acts::UnitConstants::mm;
float m_collisionRegionMin = -300 * Acts::UnitConstants::mm;
float m_collisionRegionMax = 300 * Acts::UnitConstants::mm;
float m_zMin = -800. * Acts::UnitConstants::mm;
float m_zMax = 800. * Acts::UnitConstants::mm;
```

```
float m_maxSeedsPerSpM = 1;
float m_cotThetaMax = 16;
float m_sigmaScattering = 5;
float m_radLengthPerSeed = 0.1;
float m_minPt = 100.; // MeV
float m_bFieldInZ = 0.0017; //kTesla
float m_beamPosX = 0;
float m_beamPosY = 0;

/// Maximum transverse PCA allowed
float m_impactMax = 20. * Acts::UnitConstants::mm;

/// Middle spacepoint must fall between these two radii
float m_rMinMiddle = 20. * Acts::UnitConstants::mm;
float m_rMaxMiddle = 400. * Acts::UnitConstants::mm;
```