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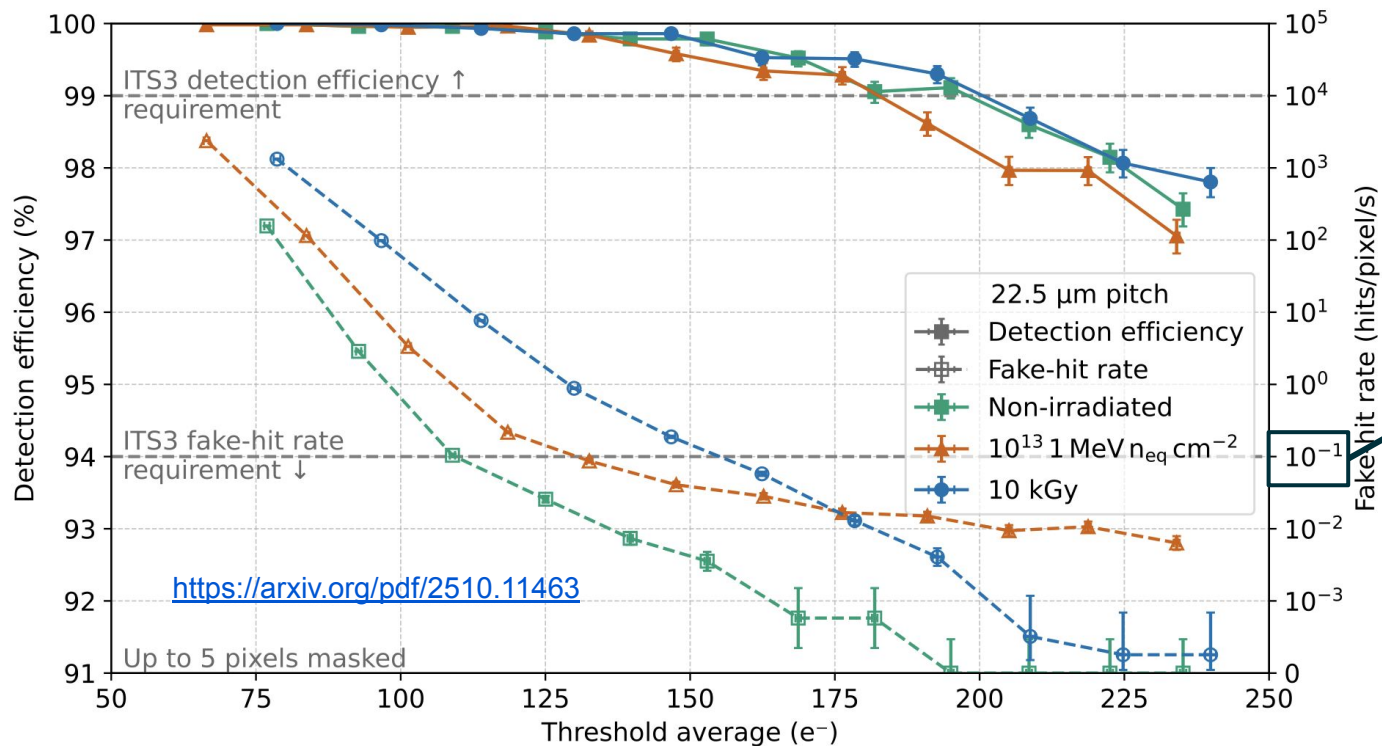
SVT Noise in Track Reconstruction

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SVT Fake Hit Rate



Use the ITS3 upper limit of 0.1/second:

- $2\text{e-}7 \text{ hit/pixel/}2\mu\text{s}$
- Assume randomly distributed on all SVT surfaces

(a) Pixel matrix with pitch 22.5 μm irradiated to different levels.

SVT Noise v.s. Machine Background

Noise hit: uniform distribution, proportional to SVT surface area (# of pixels)

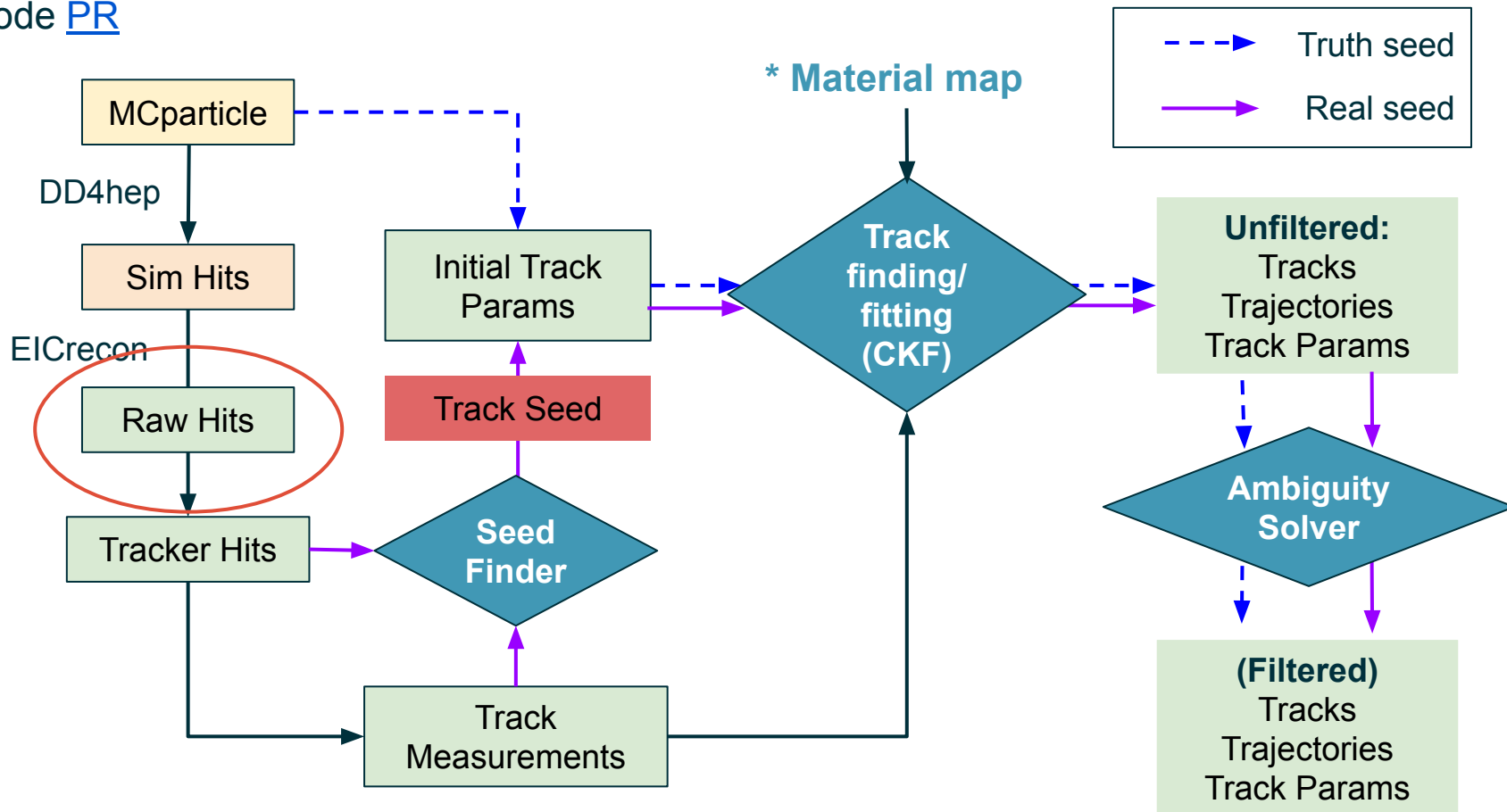
Background: strong geometry dependence and source dependence

Their impact on [track reconstruction](#) varies on each surface, e.g. at larger R: noise hit density unchanged, background hit density drops sharply. See impact on [data rate](#) [here](#)

Snapshot of the data volume summary table		Expected Noise Hit Rate / Readout Element (Hz)	Max Hit Rate (All Sources) (Hz / Readout Element)	Avg Hit Rate / Readout Element (Hz)
Detector	Section			
Inner Barrel (IB)	L0	332,000	18,136,000	10,395,139
	L1	332,000	9,216,000	5,585,813
	L2	332,000	2,416,000	1,620,833
Outer Barrel (OB)	L3	499,000	2,119,000	1,019,991
	L4	416,000	916,000	539,615
Backward Disks (EE)	ED0	416,000	8,621,000	1,779,271
	ED1	416,000	8,621,000	1,113,811
	ED2	416,000	7,096,000	1,089,323
	ED3	416,000	2,266,000	853,269
	ED4	416,000	791,000	513,689
Forward Disks (HE)	HD0	416,000	7,521,000	1,619,604
	HD1	416,000	6,766,000	884,734
	HD2	416,000	1,316,000	528,105
	HD3	416,000	1,266,000	440,620
	HD4	416,000	1,191,000	434,838

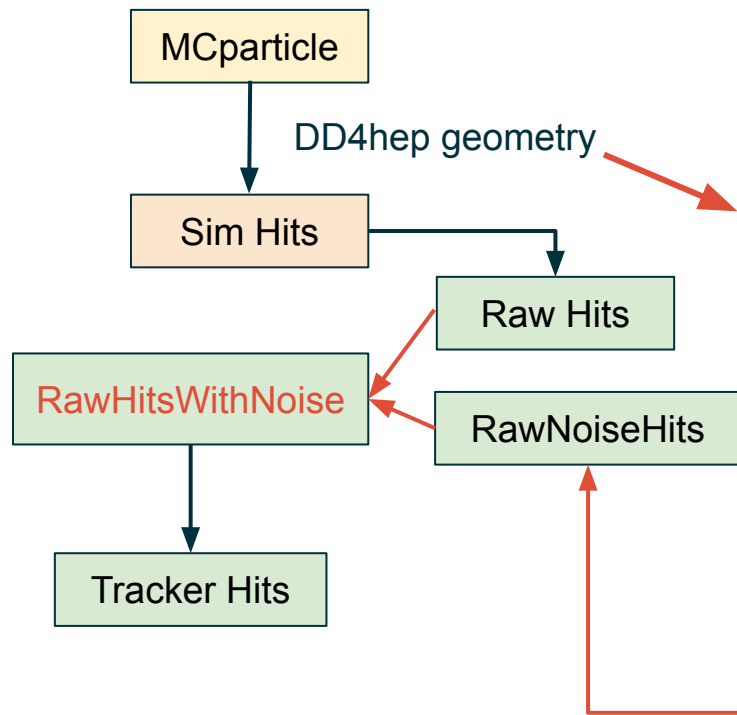
Noise Injection in EICrecon

Code [PR](#)



Noise Injection in EICrecon

Code [PR](#)



Noise Injection Algorithm

```
-PSVT:noise_rate_per_pixel_per_event="{noise_rate}"  
-PBVTX:SiBarrelVertexNoiseRawHits:addNoise=true  
-PBTRK:SiBarrelNoiseRawHits:addNoise=true  
-PECTRK:SiEndcapTrackerNoiseRawHits:addNoise=true
```

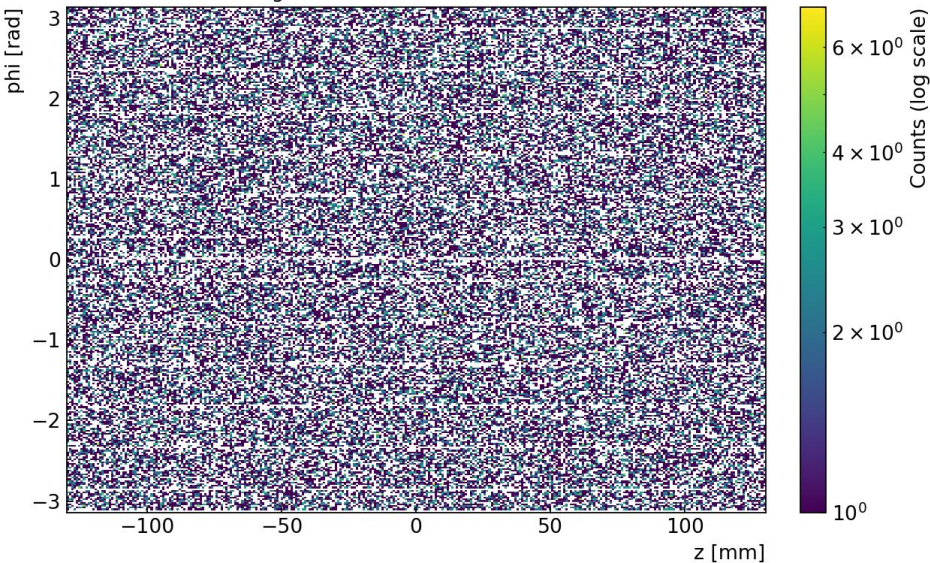
For a given SVT layer:

- **Event header:**
 - cache a list of sensitive components:
 - area/pitch size → range of pixels → # of expected noise hits
 - calculate total expected noise hits N_{layer} and weight per component w_i
- **per-event:**
 - # of noise hits per layer $M_{\text{layer}} \sim \text{Poisson}(N_{\text{layer}})$
 - Loop over M_{layer} :
 - Select a component with prob. $\sim w_i$
 - Select a pixel on that component
 - Create a noise hit

Noise Distribution Check

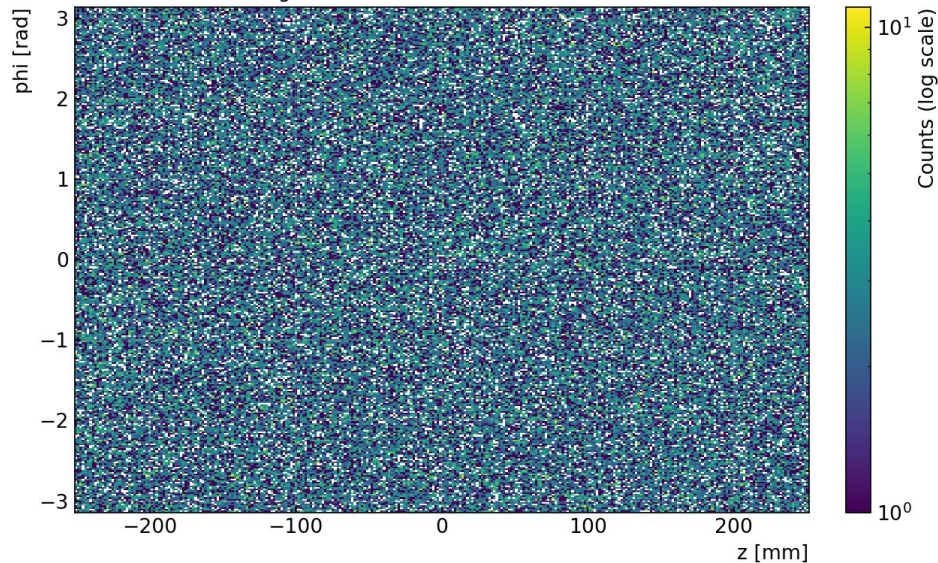
Curved IB with RSU structure

BVTX: VertexBarrel (L0)
events=1000, avg/event=76.90, configured noise mean=76
r range=30-42 mm, mean r=38.0 mm



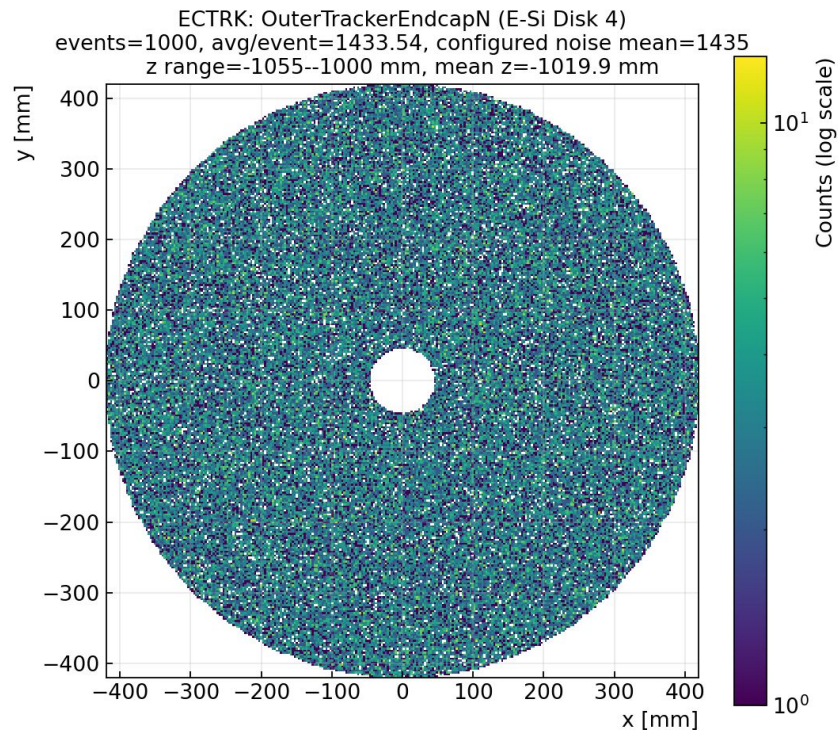
Flat OB constellation staves

BTRK: SagittaSiBarrel (L3)
events=1000, avg/event=1145.40, configured noise mean=1145
r range=250-290 mm, mean r=266.3 mm



Noise Distribution Check

Disks with trapezoids.



Single particle + noise FHR scan

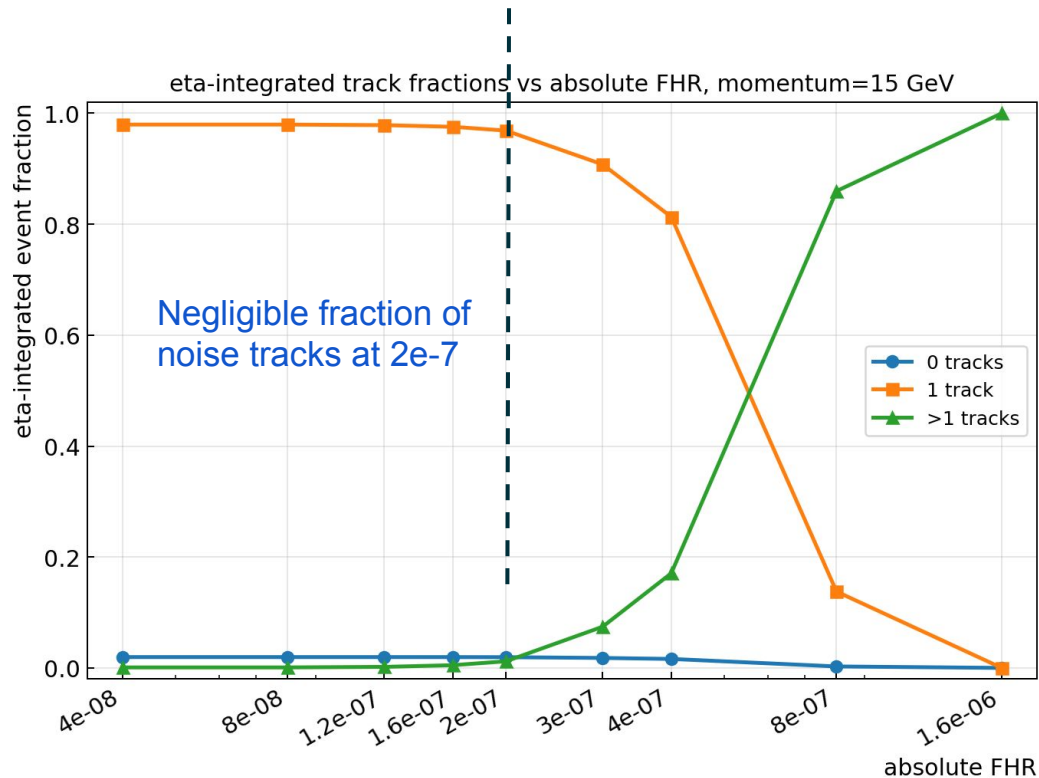
Configuration:

- eic-shell 26.05
- 1000 pi+ events per setting:
 - eta: -3.5 to 3.5
 - Momentum: 0.5, 1, 2, 5, 10, 15 GeV/c
 - FHR = $4\text{e-}8$ to $16\text{e-}7$ /pixel/event

Check number of reconstructed tracks:

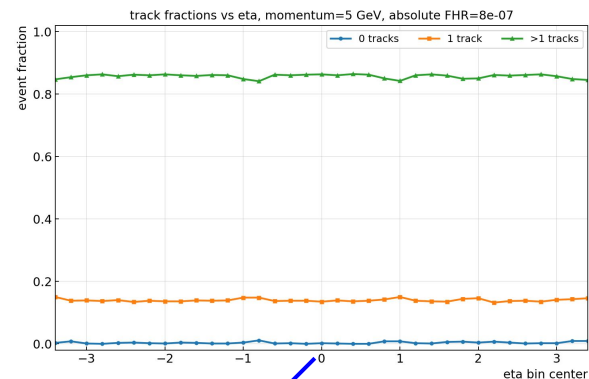
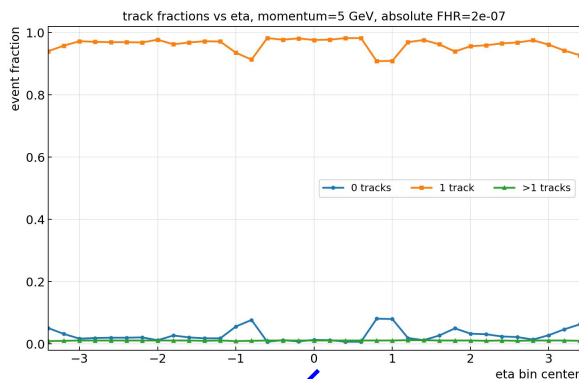
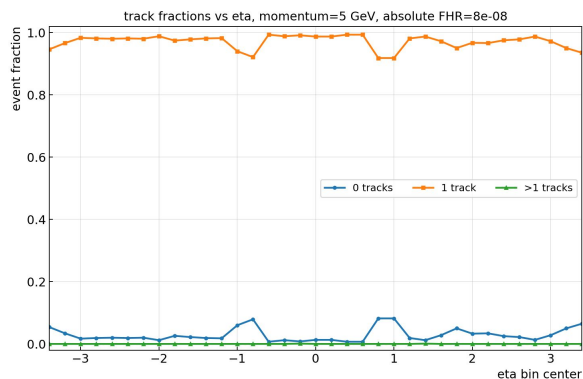
- No purity cut.
- Fraction of 0, 1, >1 track events wrt FHR at fixed mom, integrated eta → to map out the performance pressure from noise
- Fraction of >1 track events at each FHR, mom v.s. eta → check geometry dependency

Fraction of Noise Tracks vs. FHR

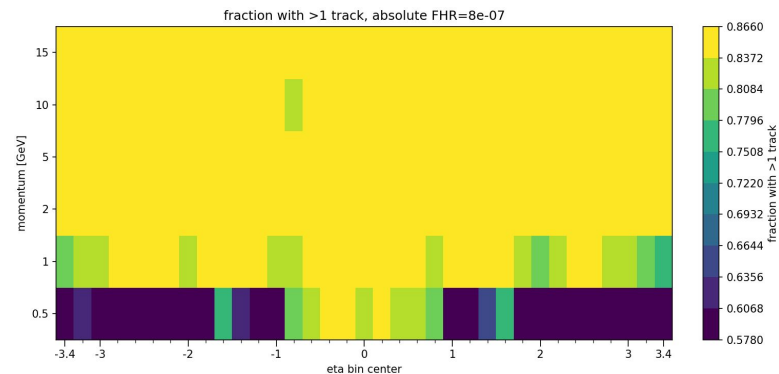
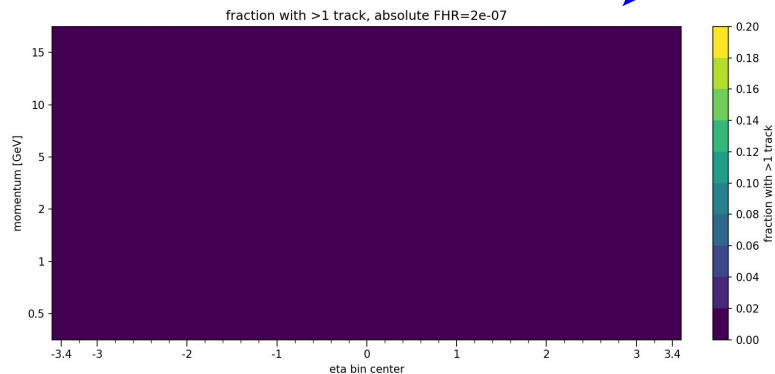


Fraction of Noise Tracks vs. eta

- Fixed momentum, FHR=8e-8, 2e-7, 8e-7



- Momentum vs eta, FHR=2e-7, 8e-7



Summary

- We developed a mechanism to inject SVT random noise in EICrecon
 - Compatible with various geometry shapes
 - Default is off, can turn on each SVT parts for dedicated studies
- With single track scan, noise track is not an issue up to the ITS3 design limit of $2e-7/\text{pixel}/2\mu\text{s}$
- Next step: full set of tracking study with machine background + SVT noise