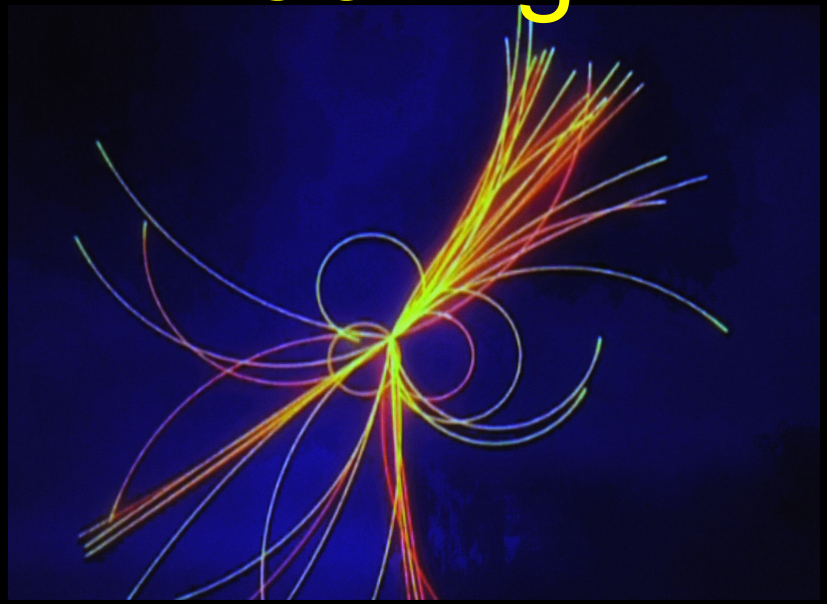
AI Working Group: Tracking



Cristiano Fanelli and Karthik Suresh

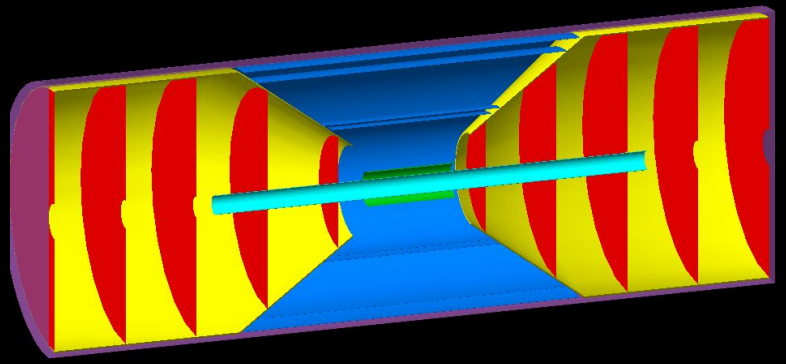
Updates on Tracker

- Ready to launch a global optimization of both barrel and disks
- The idea, for the moment, is to keep the cone geometry that approximates both services and support structure as it is from Rey's design. Later on we can also try to find a better geometry, in such a way that the detector will remain hermetic.
- In all this, having more info about constraints/limits on the barrel staves will be useful.
- In the next presentations we will show a table with the main design parameters, their corresponding ranges and the constraints that have been implemented.
- We have included (i) momentum and angular resolutions, (ii) pointing resolution, (iii) efficiency*.

Kalman Filter - Efficiency

https://github.com/reynier0611/g4lblvtx

Baseline



Frequency of Failed Kalman fit algorithm for pi- tracks (10k events in each bin)

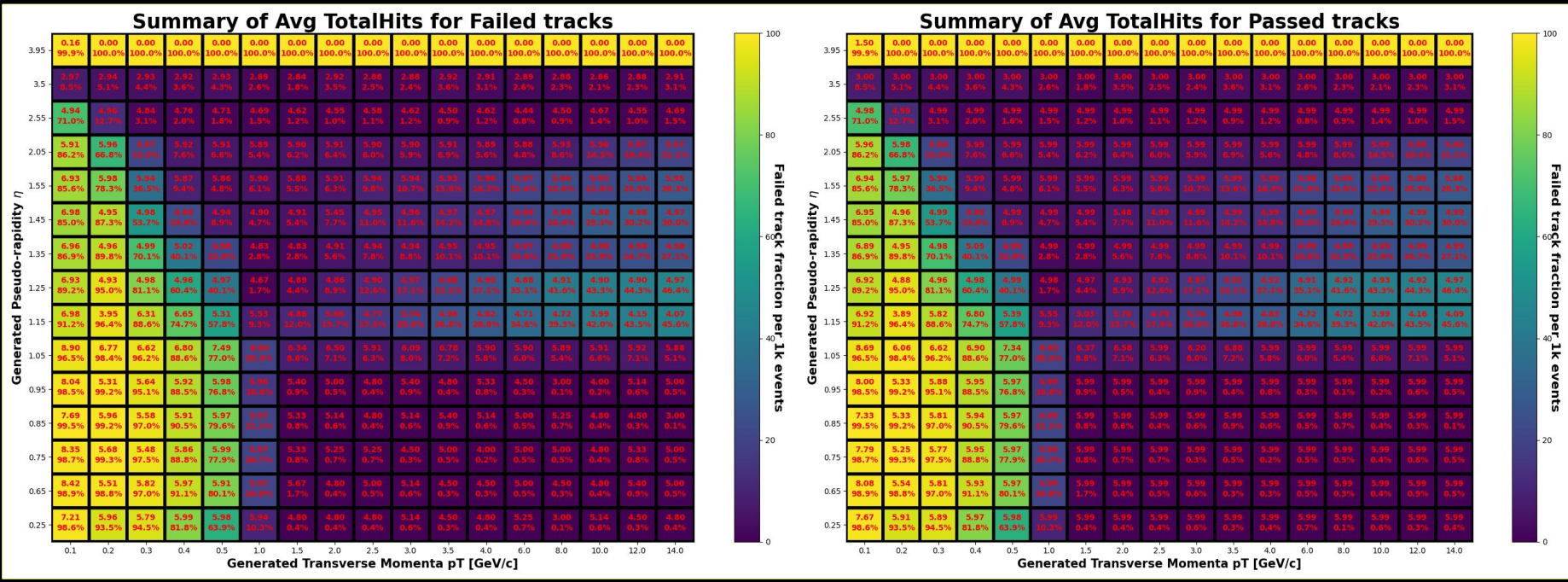
Momenta GeV/c \ Eta	0 - 0.5	1 - 1.5	2.5 - 3	3 - 3.5
0.1 - 2	29% (Failed fraction)	41%	33%	27%
15-16	0.36%	26%	1.5%	2%
29-30	0.25%	32%	1.5%	2%

Frequency of Failed Kalman fit algorithm for pi- tracks with 0. < p < 2GeV/c (10k events in each bin)

RMax \ Eta	0.8-0.9	0.9-1.0	1.0-1.1	1.1-1.2	1.2-1.3
Default RMax with Al Support	50.92%	53.88%	59.24%	49.98%	42.08%
Default RMax Without Al Support	51.25% (Failed fraction)	54.04%	60.4%	51.68%	42.58%
RMax+1cm Without Al Support	51.49%	53.99%	56.57%	47.03%	42.04%

Kalman Filter (for baseline design) Barrel+Fwd

The average N. of hits is calculated considering both Barrel and Forward, and actually corresponds to different tracking stations that have been crossed
(if two hits are in the same station are counted as 1)



First row: average number of hits per track (left: when the track fails KF; right: when pass KF)
Second row: KF inefficiency (same for left and right)

Tracker Configurations and Strategy with AI

It'd be good to come up with a list of different configurations to optimize. At the moment, based on Rey's code https://github.com/reynier0611/g4lblvtx, we can optimize:

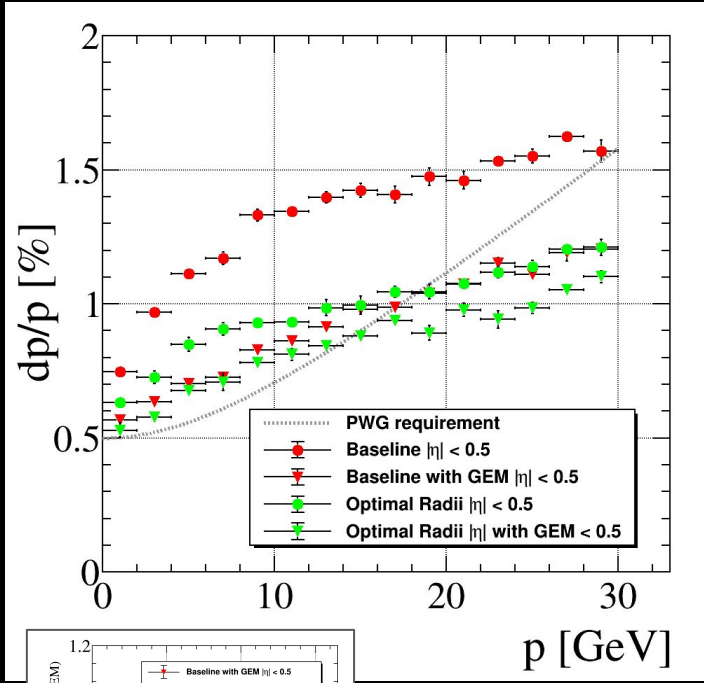
- all Si layers
- all Si with the outermost layer replaced with GEM
- All Si + additional GEM layer

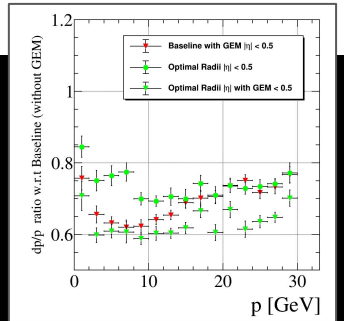
Karthik has been also working in including as another option the FTS design from G4_FST_EIC.C

Since we want to include the efficiency in the optimization process, an analysis has been done starting with the baseline design to analyse the tracks that passed the KF. Inefficiency observed in the transition region… work ongoing. .

Pattern recognition and fake tracks studies will be done comparing a baseline and optimized designs.

Results and Summary



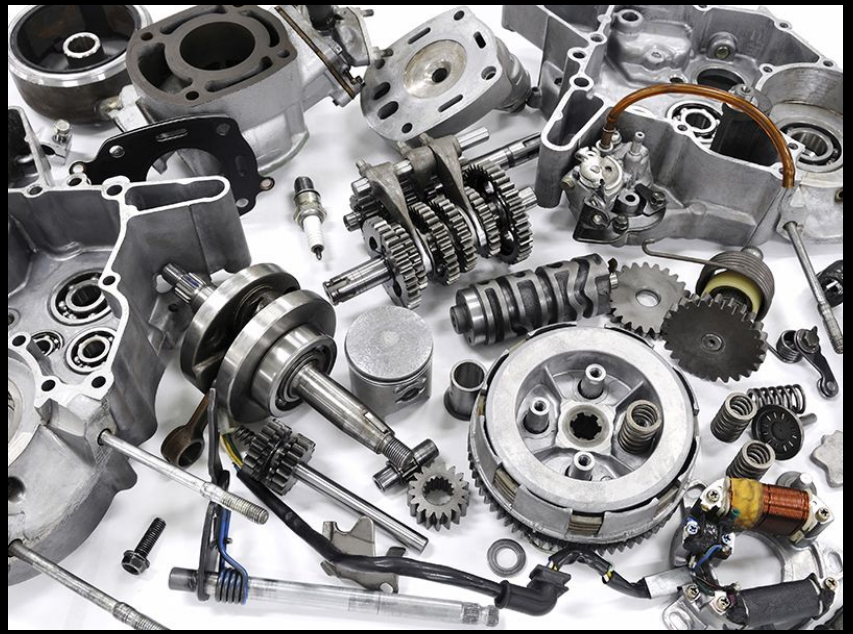


- Preliminary results from AI optimizing simultaneously momentum, polar and azimuthal angles resolutions, suggest to push the outermost two layers at large radii and close to each other (see https://indico.bnl.gov/event/12052/contributions/50502/attachments/34967/56877/AI_Supported_Detector_Design.pdf). This provided a substantial improvement in momentum resolution as compared to the baseline design.

- We received a comment to leave like 5 cm between these two layers. We checked this “manually” and showed (left figure) that the effect on resolution is almost negligible.

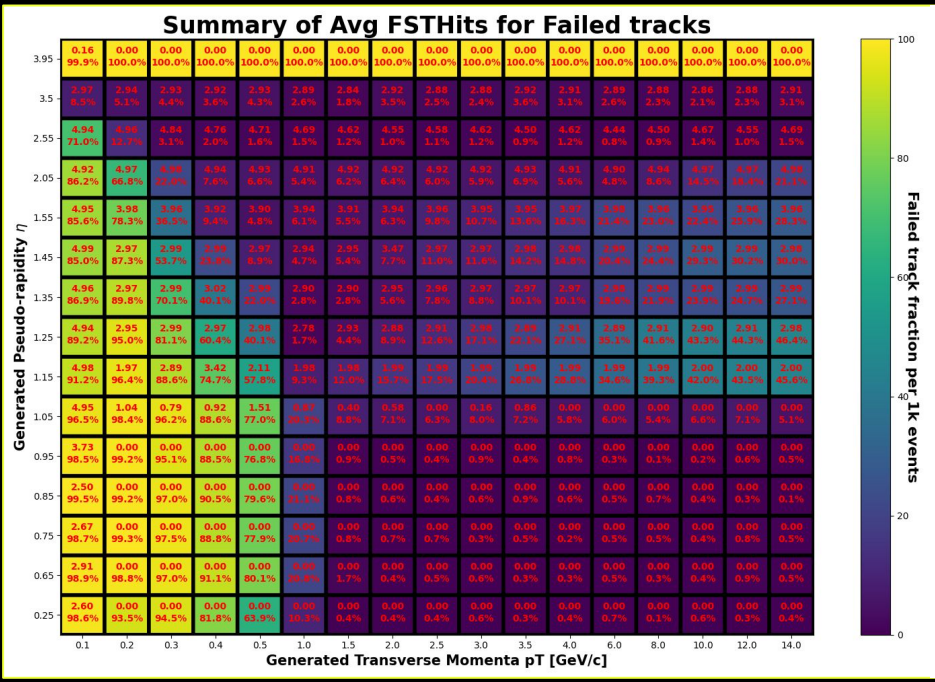
- The obtained resolution is also close to what one would obtain with an extra GEM layer outside the DIRC

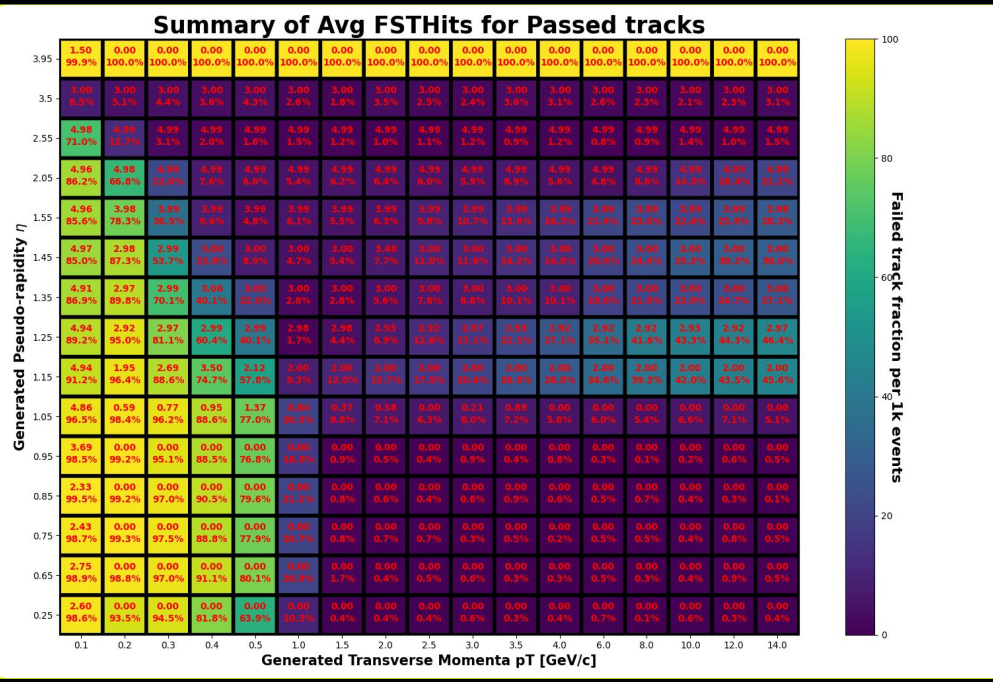
SPARES



Kalman Filter (for baseline design) Fwd

The average N. of hits is calculated considering Forward, and actually corresponds to different tracking stations that have been crossed (if two hits are in the same station are counted as 1)

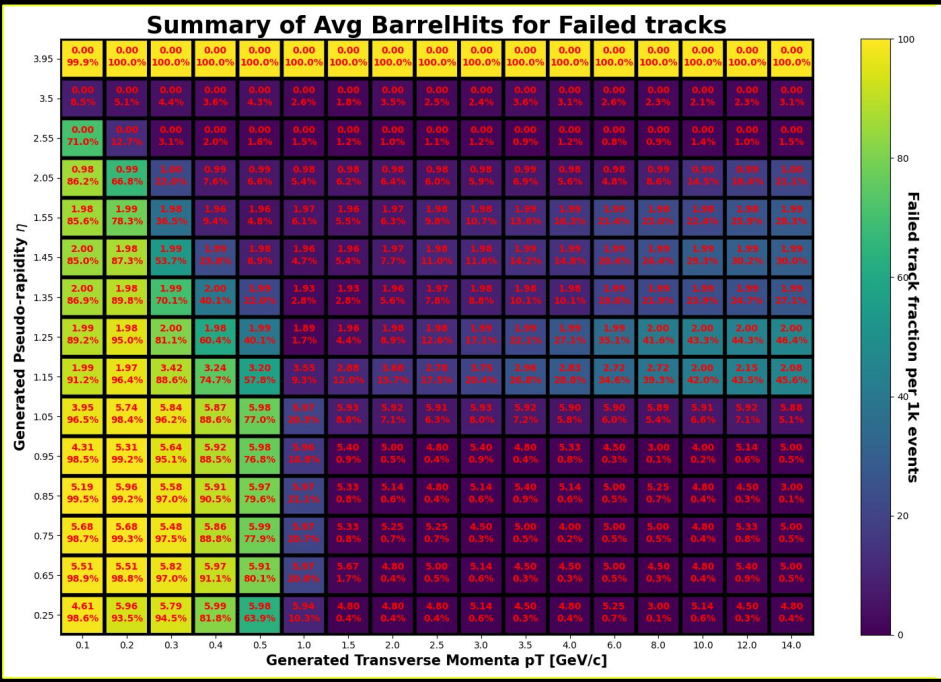


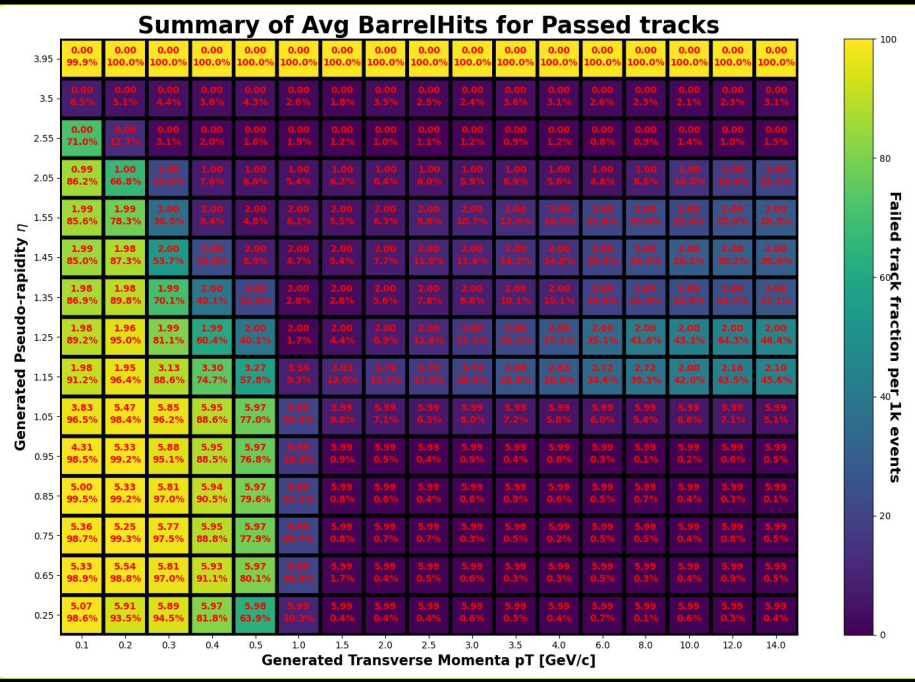


First row: average number of hits per track (left: when the track fails KF; right: when pass KF)
Second row: KF inefficiency (same for left and right)

Kalman Filter (for baseline design) Barrel

The average N. of hits is calculated considering the Barrel, and actually corresponds to different tracking stations that have been crossed (if two hits are in the same station are counted as 1)





First row: average number of hits per track (left: when the track fails KF; right: when pass KF)
Second row: KF inefficiency (same for left and right)