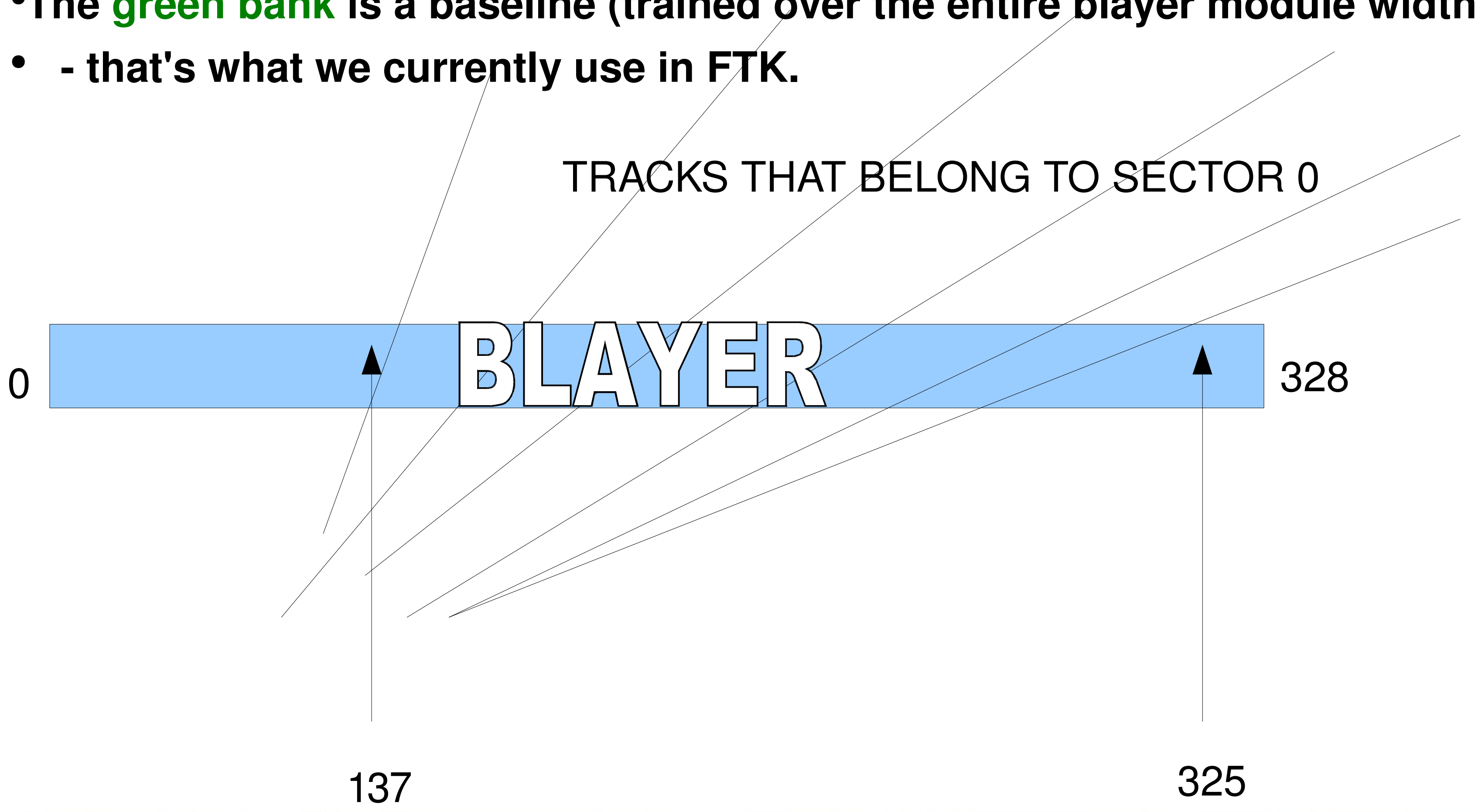
Update on splitting blayer

- We saw a hint that reducing the width of b-layer modules by a factor of 2 improves d0 resolution.
- Below is a summary of what was done, which roughly falls into two categories:
  - Single-sector tests (fast to run)
  - Full-detector tests using split arch (very slow)

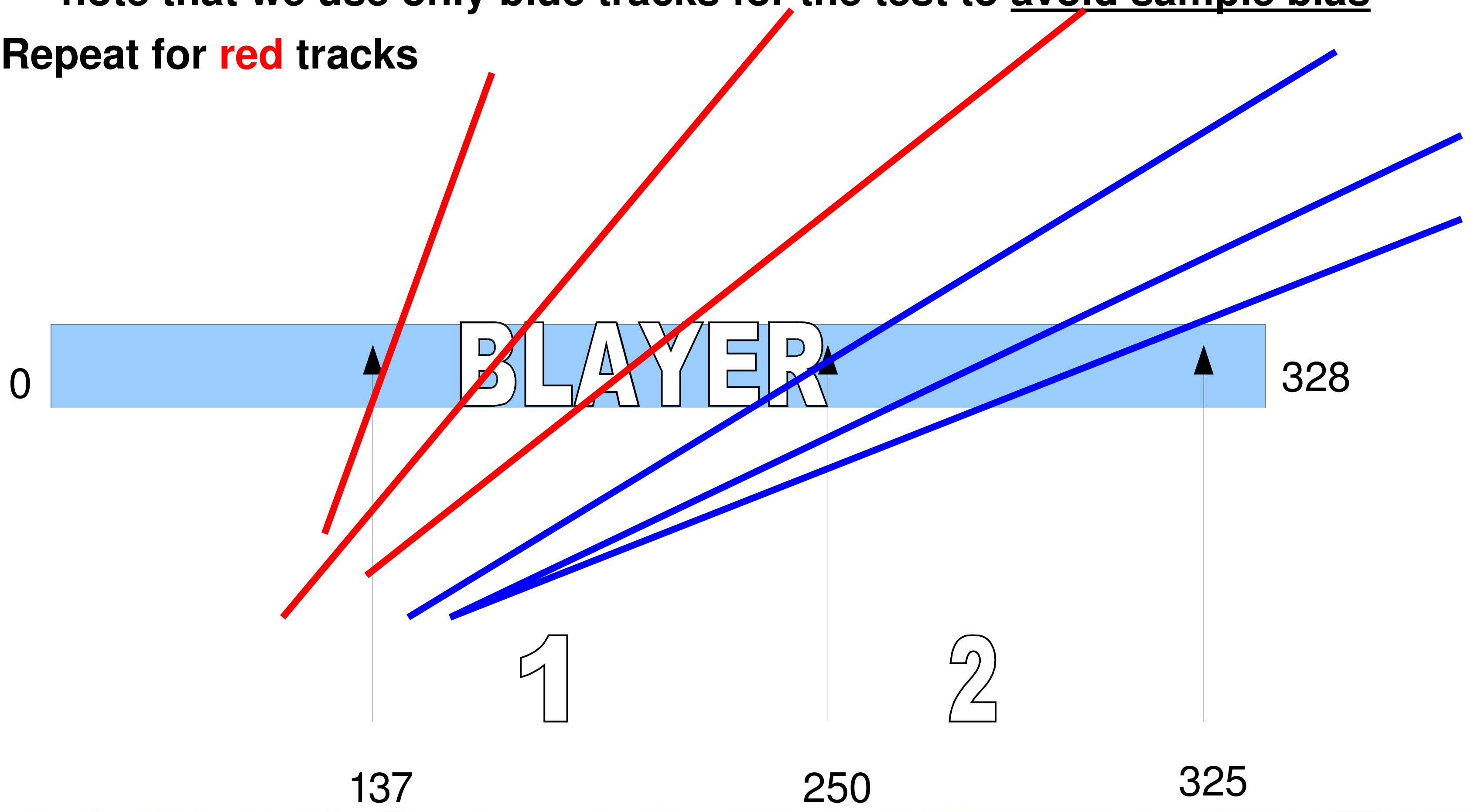
Single sector tests –part 1

- **Choose the most frequent sector in the barrel in 11L architecture.**
- **This sector had 10k training tracks; study their spread in blayer.**
- **Make a bank using 64 of these tracks, keep the rest as an indep sample.**
- **The green bank is a baseline (trained over the entire blayer module width)**
- **- that's what we currently use in FTK.**

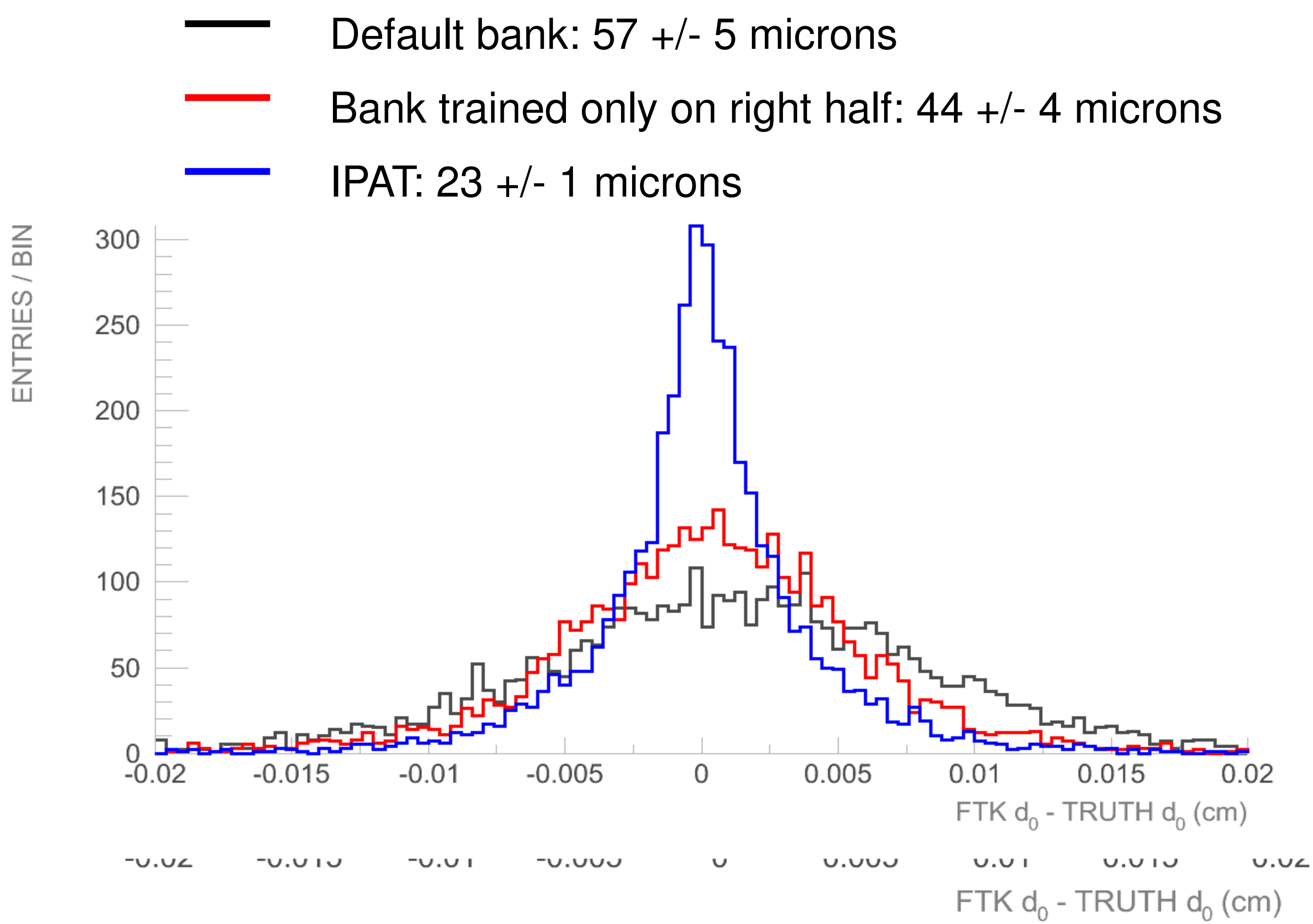


Single sector tests –part 2

- Divide 10k tracks into two populations depending on where they hit blayer.
- Make separate bank using first 64 blue tracks, keep the rest as an indep sample
- Use blue indep tracks with blue vs green (default) bank to compare d0 resolution
- - note that we use only blue tracks for the test to avoid sample bias
- Repeat for red tracks

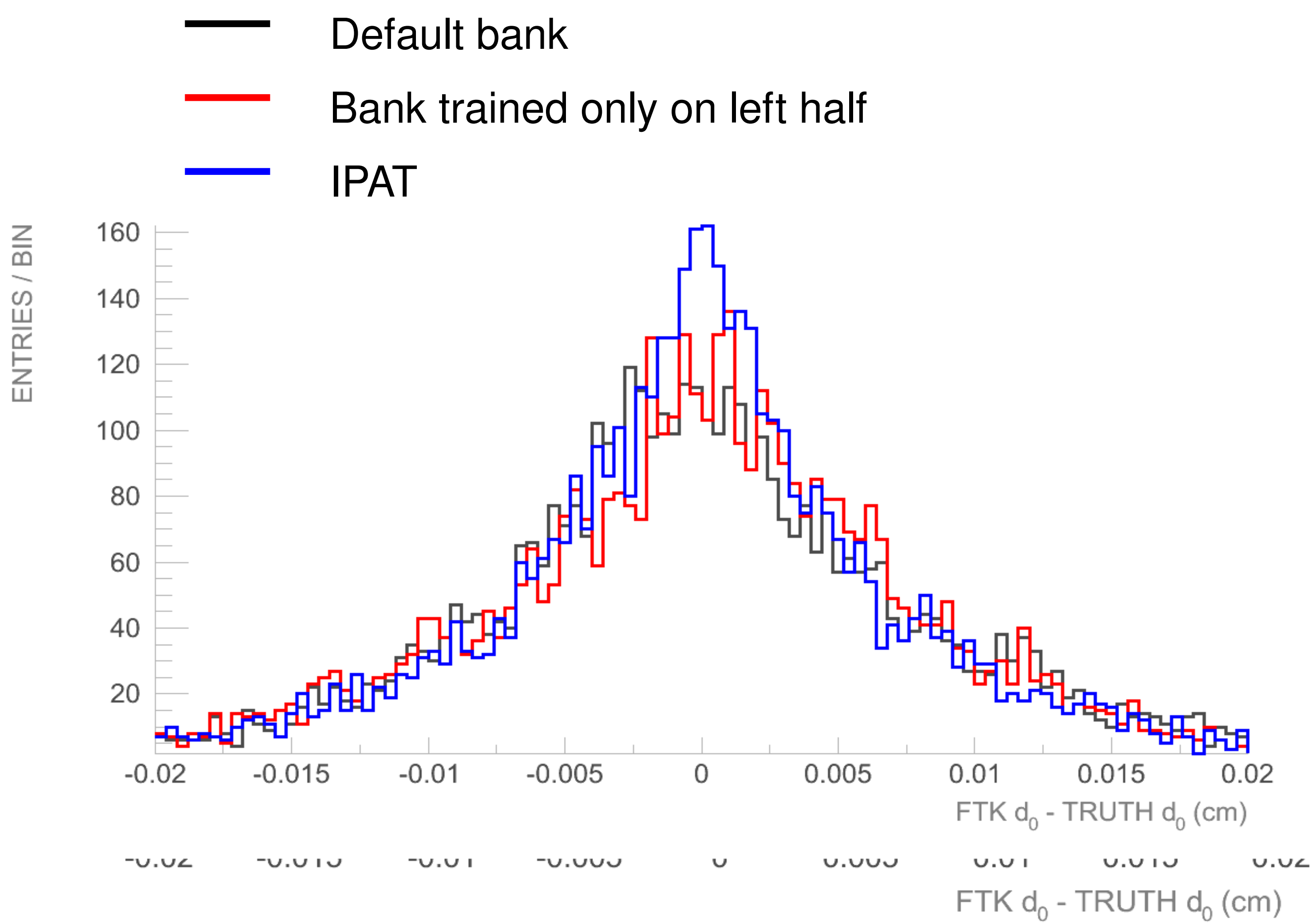


Tracks on the right side



Notice a significant improvement in resolution for bank trained on half-a-module

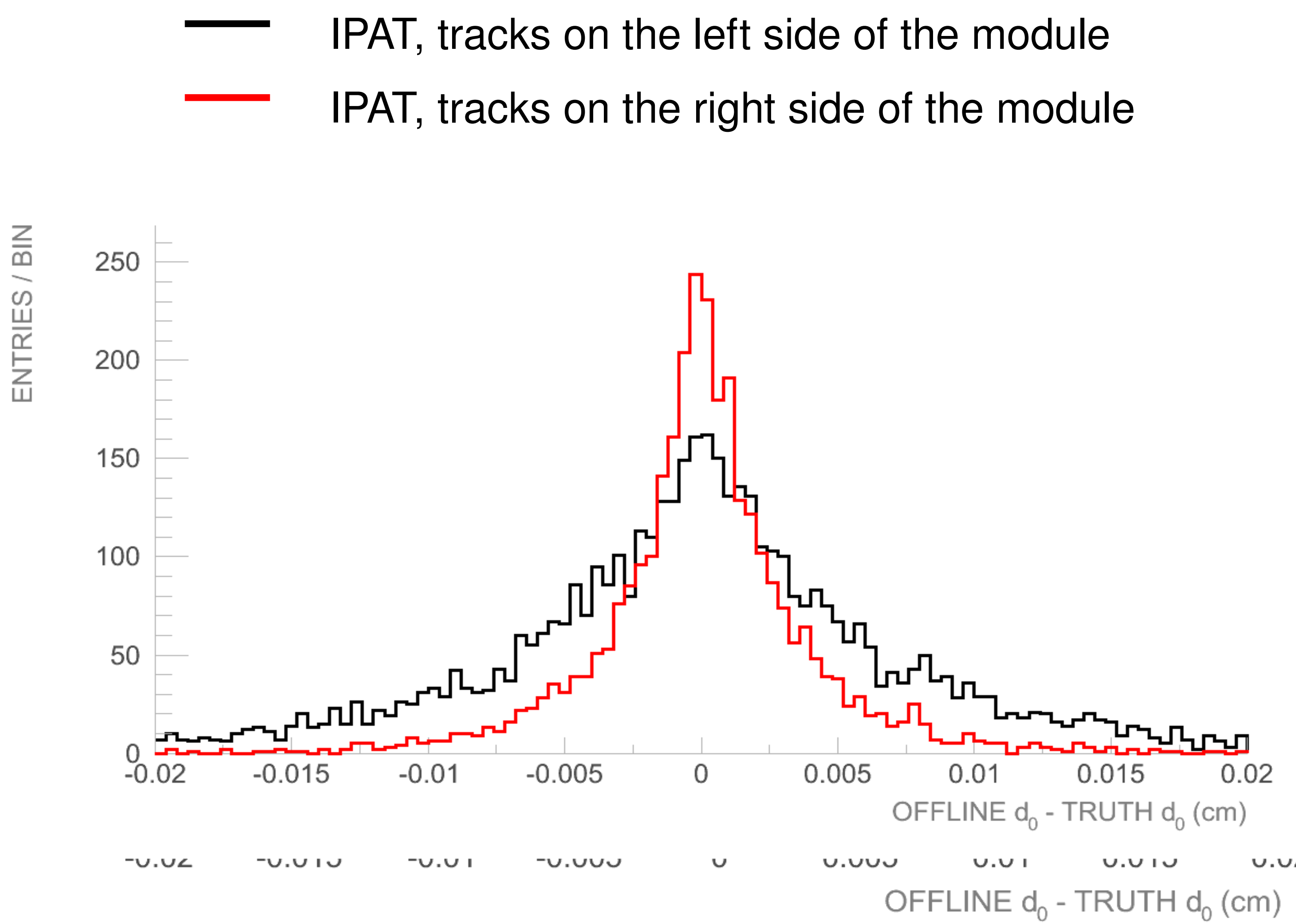
Tracks on the left side



FTK d_0 - TRUTH d_0 (cm)

Note that default bank and bank trained on half-a-module are basically the same. Moreover, even IPAT is as bad as FTK on the left side. Why?

Tracks on the left vs right side: ipat

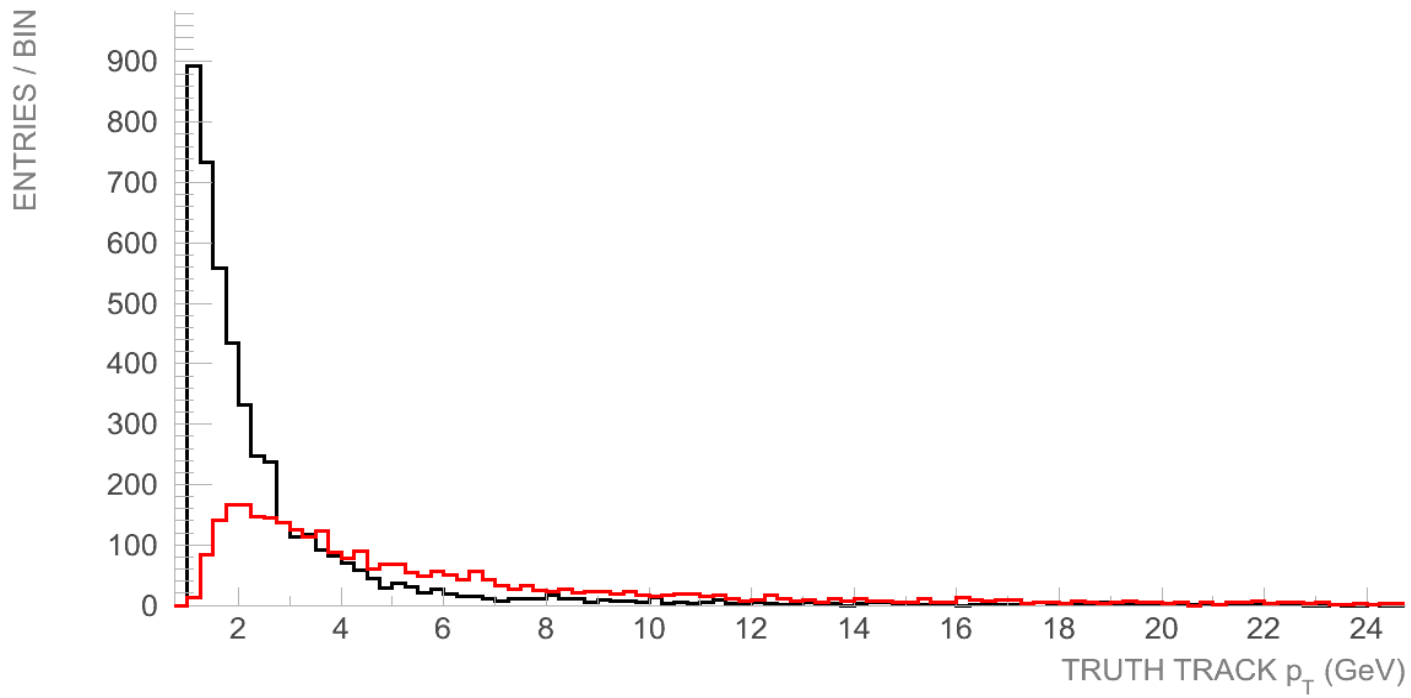


So there is something about the tracks on the left side that makes their reconstruction worse even at IPAT level.

Tracks on the left vs right side: pt

Truth pT, tracks on the left side of the module

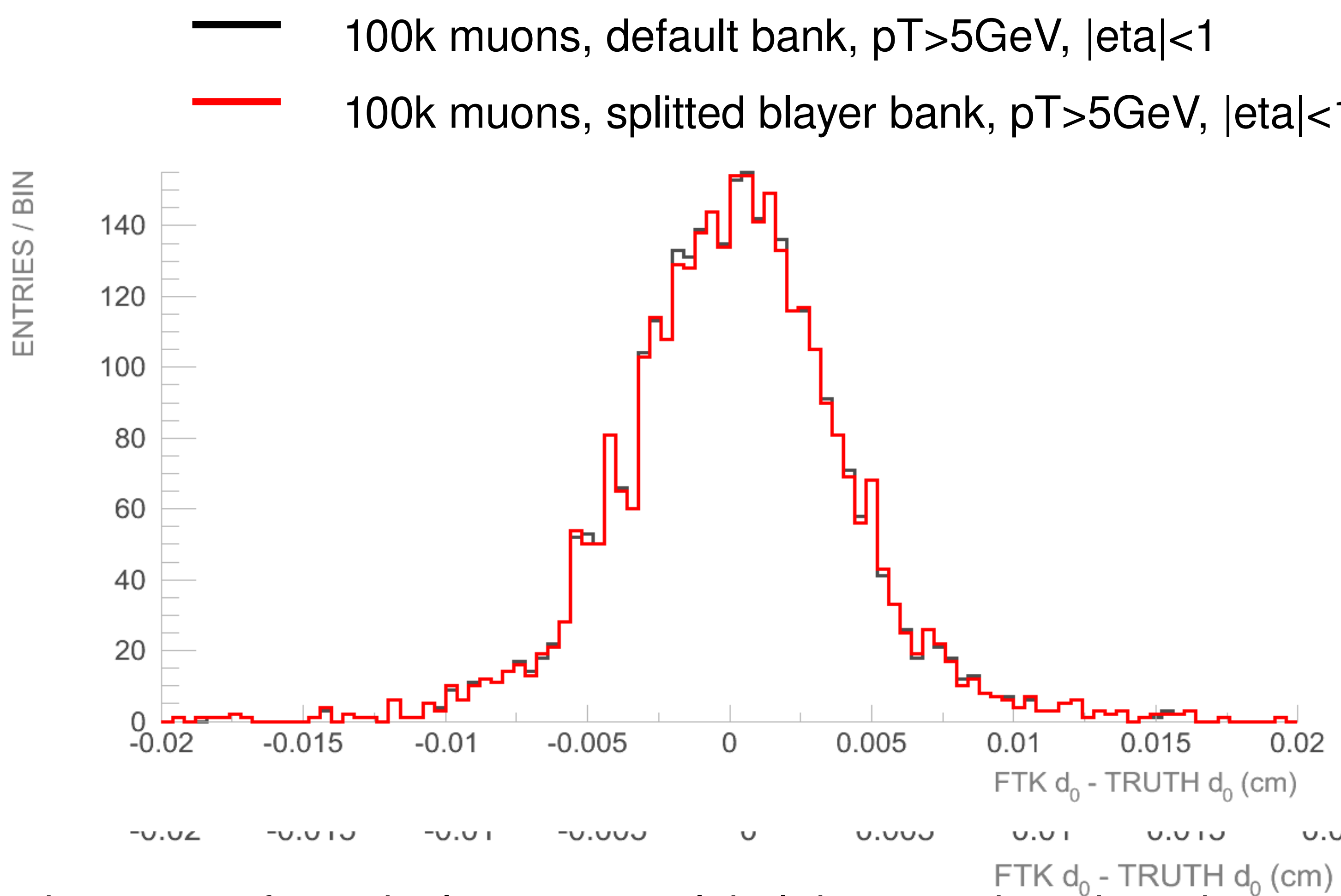
Truth pT, tracks on the right side of the module



So, tracks on the left side are low pT! They are reconstructed badly by FTK and IPAT, and reducing blayer module width does not help at all.

Tracks on the right, however, are higher pT, and that's where FTK can improve by using a more narrow blayer module width.

Using split blayer global bank



But when we go from single sector to global detector, there is no improvement:-(
In fact, the banks have virtually identical bin-by-bin performance! Note that here, the blayer modules are split in the middle, and not in the midpoint of track spread! But what else is going on here? Shouldn't we see at least marginal improvement?

Could statistics be a problem?

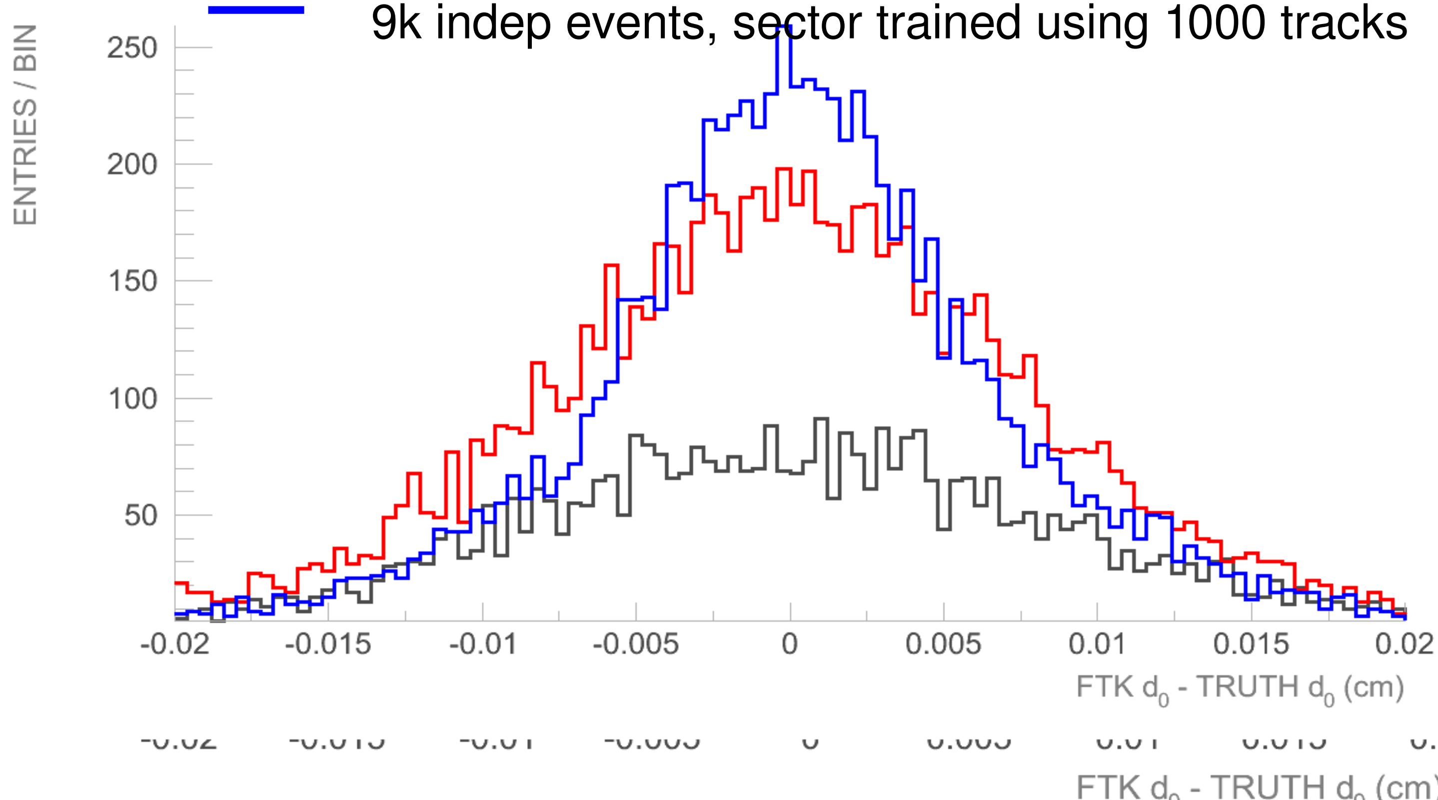
- If a sector covers a narrow part of a blayer module (due to alignment), having a small number of training is enough for good consts
- But if a sector covers a large part of blayer module (0..328), we need many more tracks
- Reducing the blayer modules in half will also halve the statistics → worse resolution
- Below is an explicit check on a single sector

Using split blayer global bank

9k indep events, sector trained using 16 tracks

9k indep events, sector trained using 64 tracks (<u>default</u>)

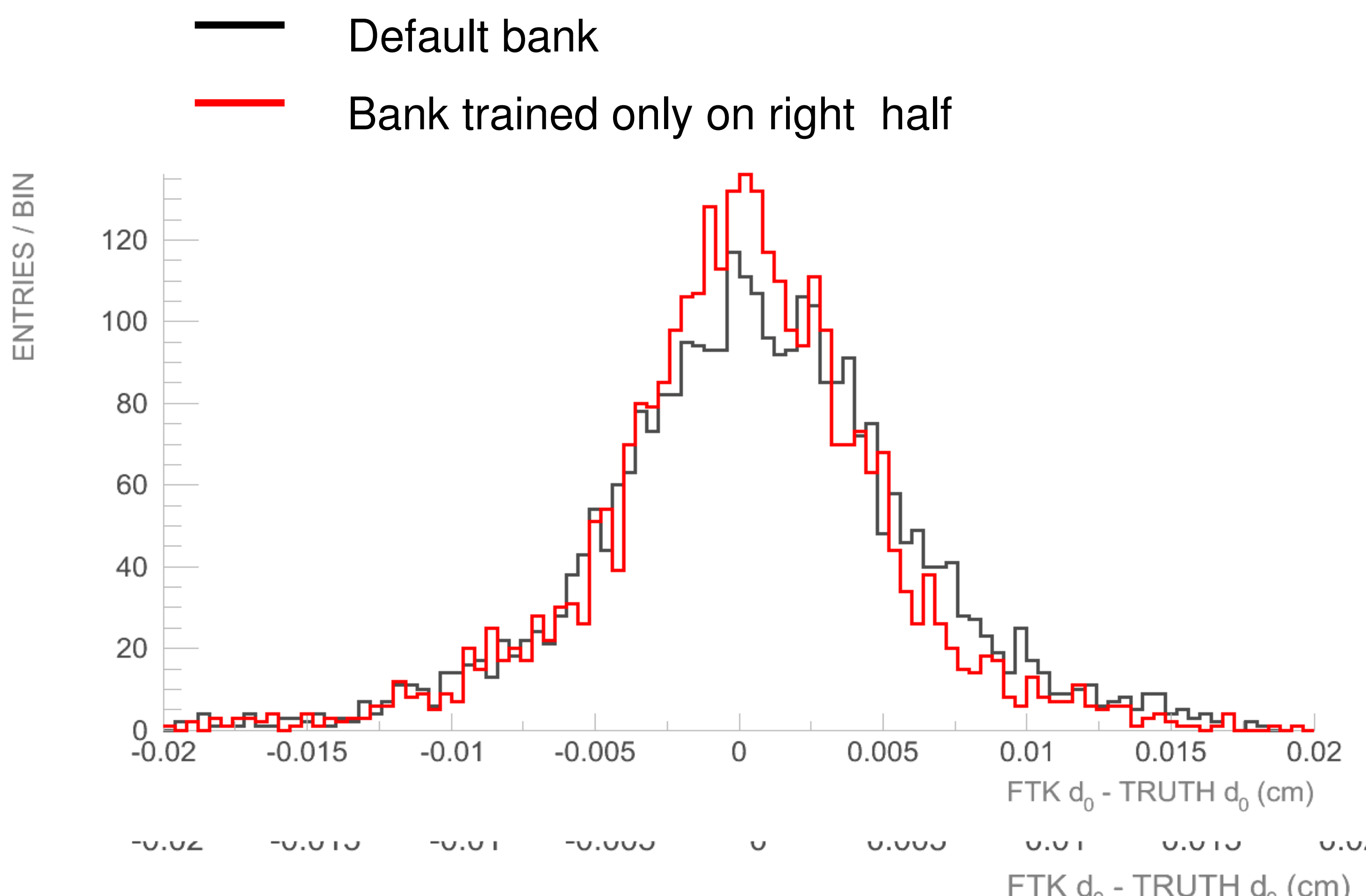
9k indep events, sector trained using 1000 tracks



For this sector, the spread of hits in blayer is ~190, and even larger in other pixel layers. So it is very sensitive to the amount of training tracks that go in.

So recall the original test showing d0 resolution improvement in the right side. Is it still there if we train all banks using 1000 tracks, rather than 64? - next page

Right half: using 1k training



So the significant improvement in d0 resolution due to narrow blayer modules is almost completely washed out if we use a lot of training events in the sector.

Conclusions (for now)

- It appears that using narrow blayer modules benefits ONLY in these conditions:
  - High pT tracks
  - Sectors with low training statistics for consts
  - Sectors with large track spread in blayer
- A general detector-wide test shows no improvement at all. Perhaps that's because sectors with >100 training tracks already have coverage of 80%, while those at the bottom don't have large spreads. So a very small # of tracks is reconstructed using the sectors that actually benefit from blayer splitting.

Things to try...

- Splitting first two pixel layers
- Splitting into 4 segments, rather than 2
- We still need to understand why FTK resolution for higher pT tracks is worse than IPAT/NewTracking.
  - Single-sector setup is a very quick way to do these studies!