A collider physicist tries to learn neutrino physics

Episode 2: studying fiTQun performance

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Introduction

Everything is still based on feature/prefit branch checked out in June
Benchmarking based on a MacBook M3 Max with 64 GB ram.

Last week we discussed after the group meeting how to proceed with profiling/speeding up the code and Mathieu suggested to just try going for the nearest neighbour instead of interpolating in 6D for the scattered light -- this talk shows the results of doing that

How was the change made?

Modified the existing GetInterpVal function for now

The function was already computing which bin in the scattering table our event belongs to, however when going float (data point) to integer (bin index) it was rounding down instead of calculating the closest bin. I changed this to calculate the closest one.
I also removed a simple interpolation in the 2nd half of this function.

Of course if we decide this approach is useful I will open a merge request on the master branch with a new function.

Flamegraph of fiTQun reminder
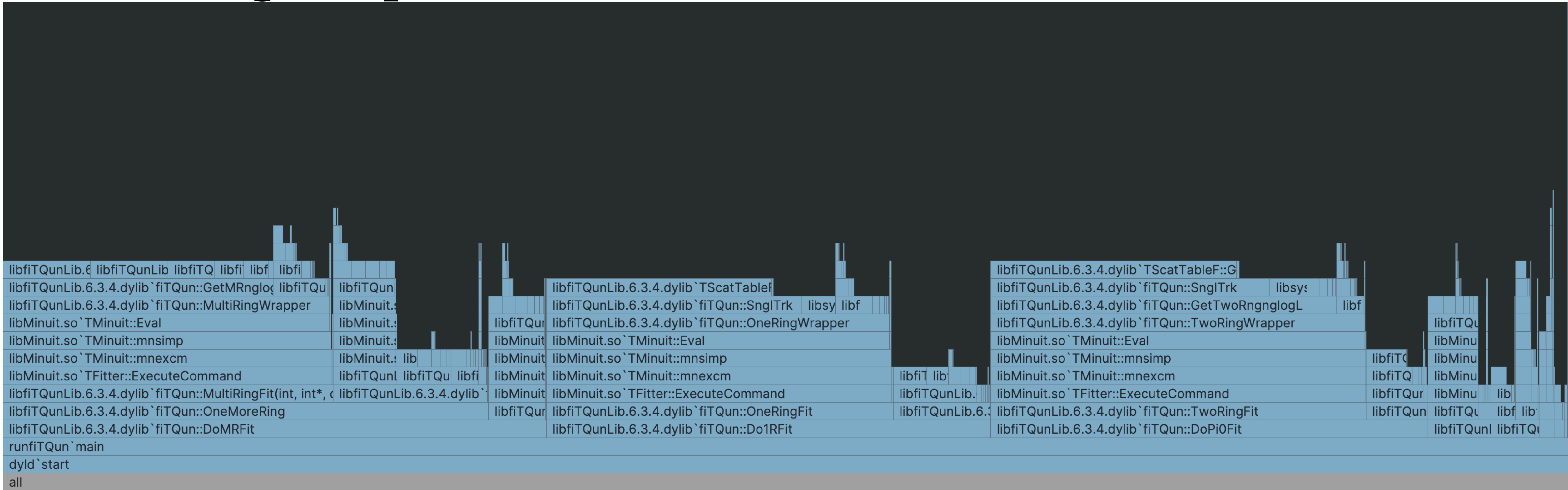
The 6D interpolation used in the scattering table was about 35% of all the function calls in fiTQun and according to the flame graph was consuming a similar amount of computational resources...
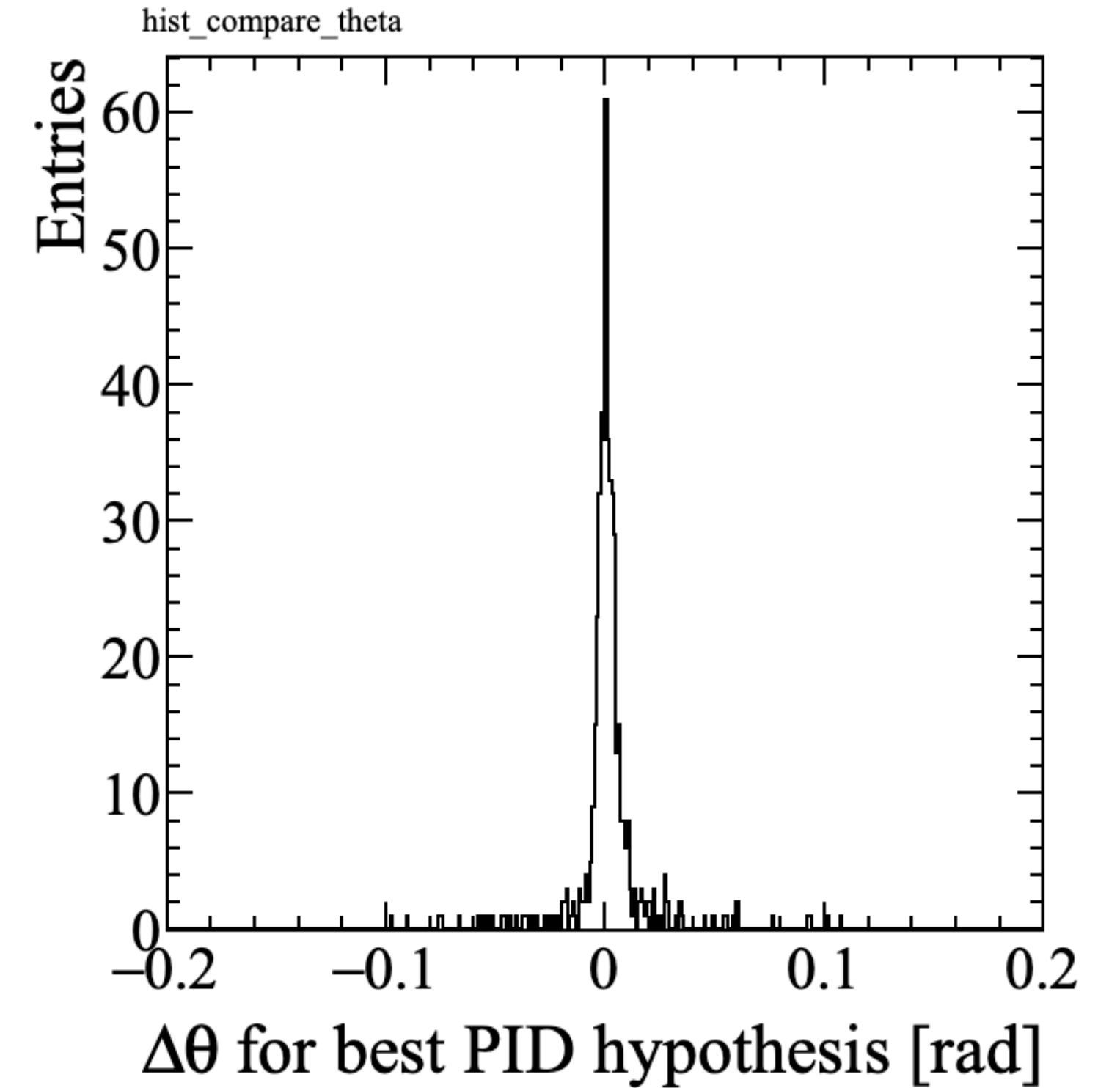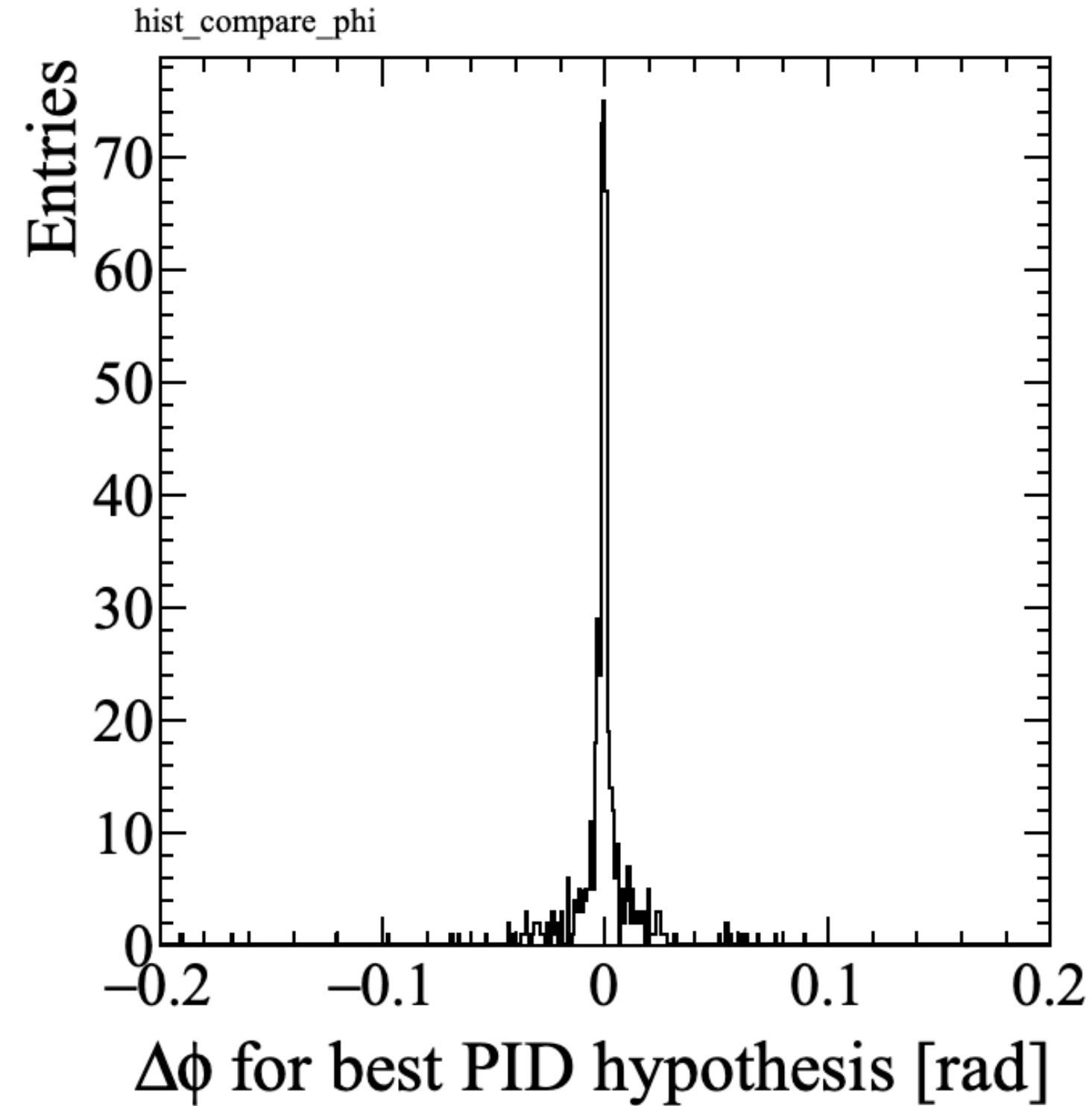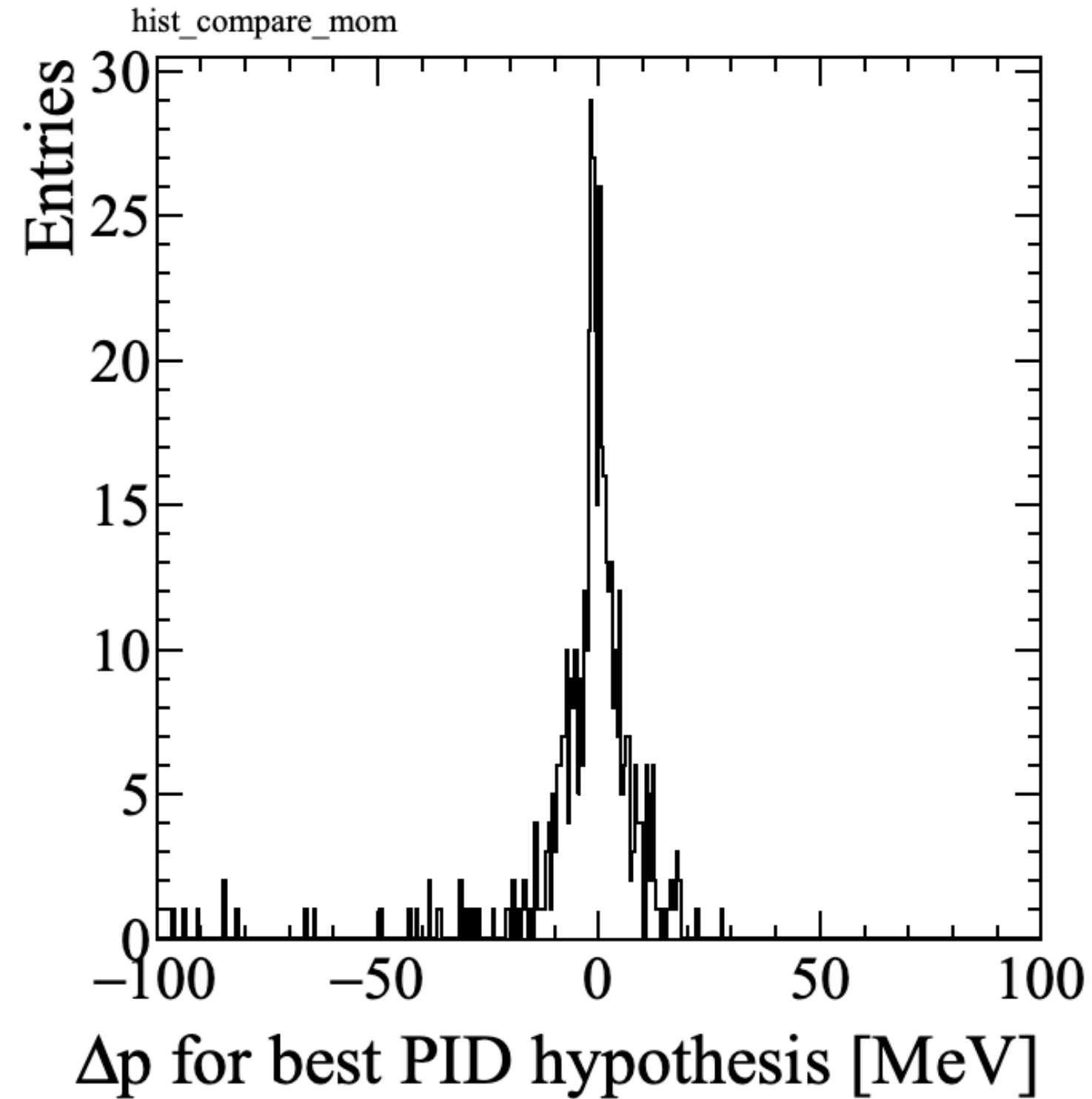
Flamegraph of fiTQun after change
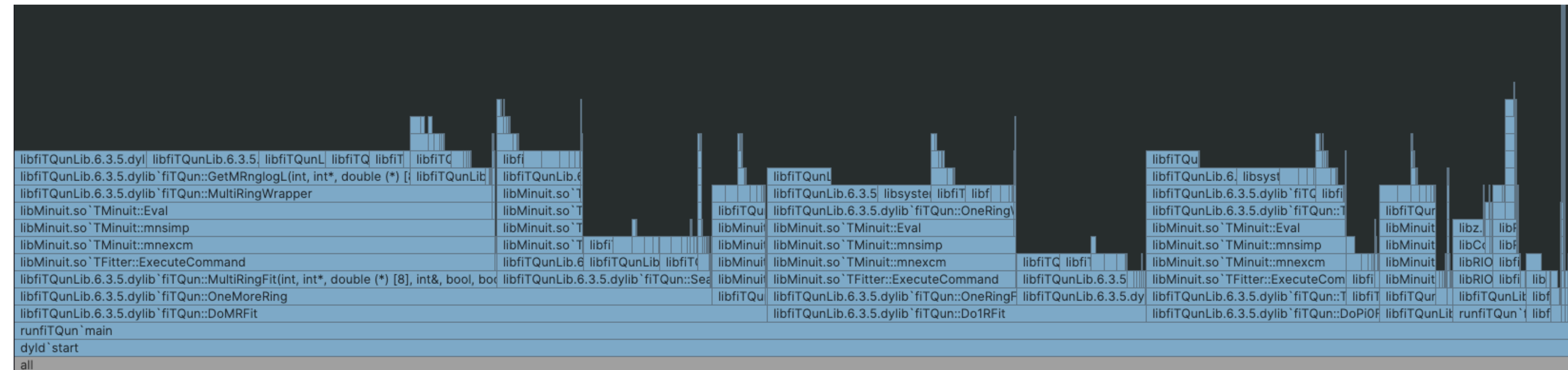
Impact of removing the 6D interpolation clear if you switch between the last and this slide

Benchmarking indicates a ~20% speedup in the time taken per event by using the closest point rather than interpolating

Physics performance difference

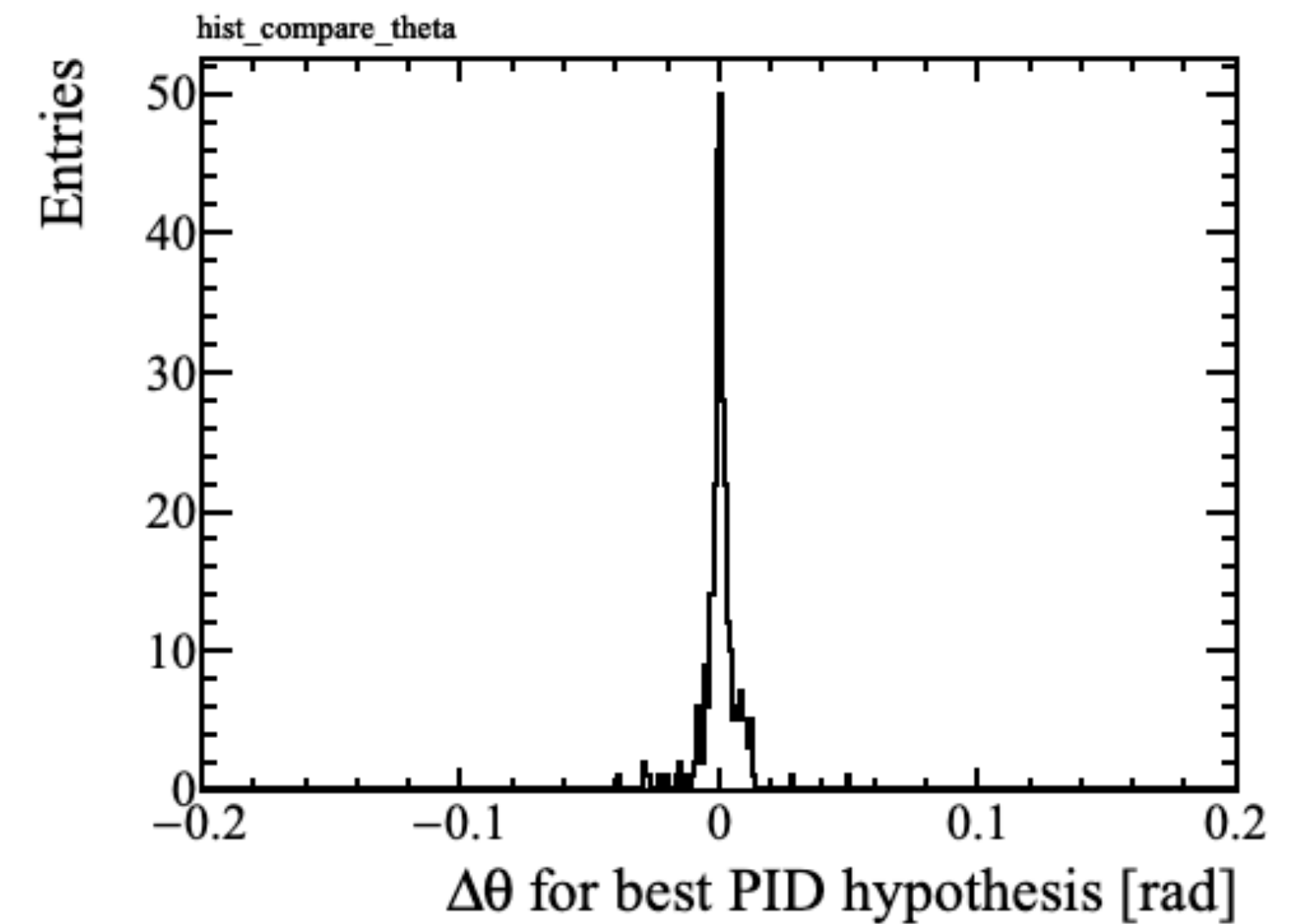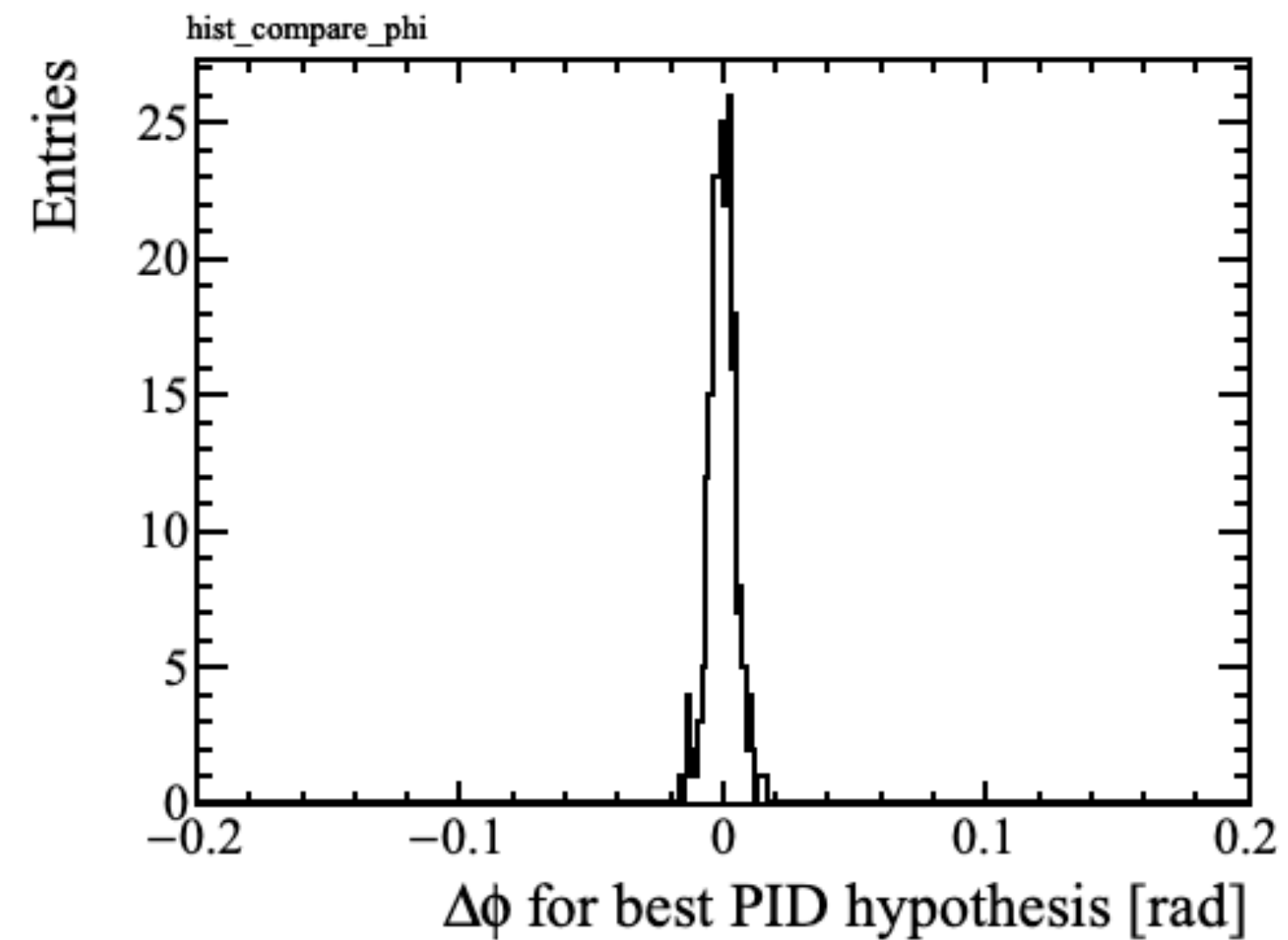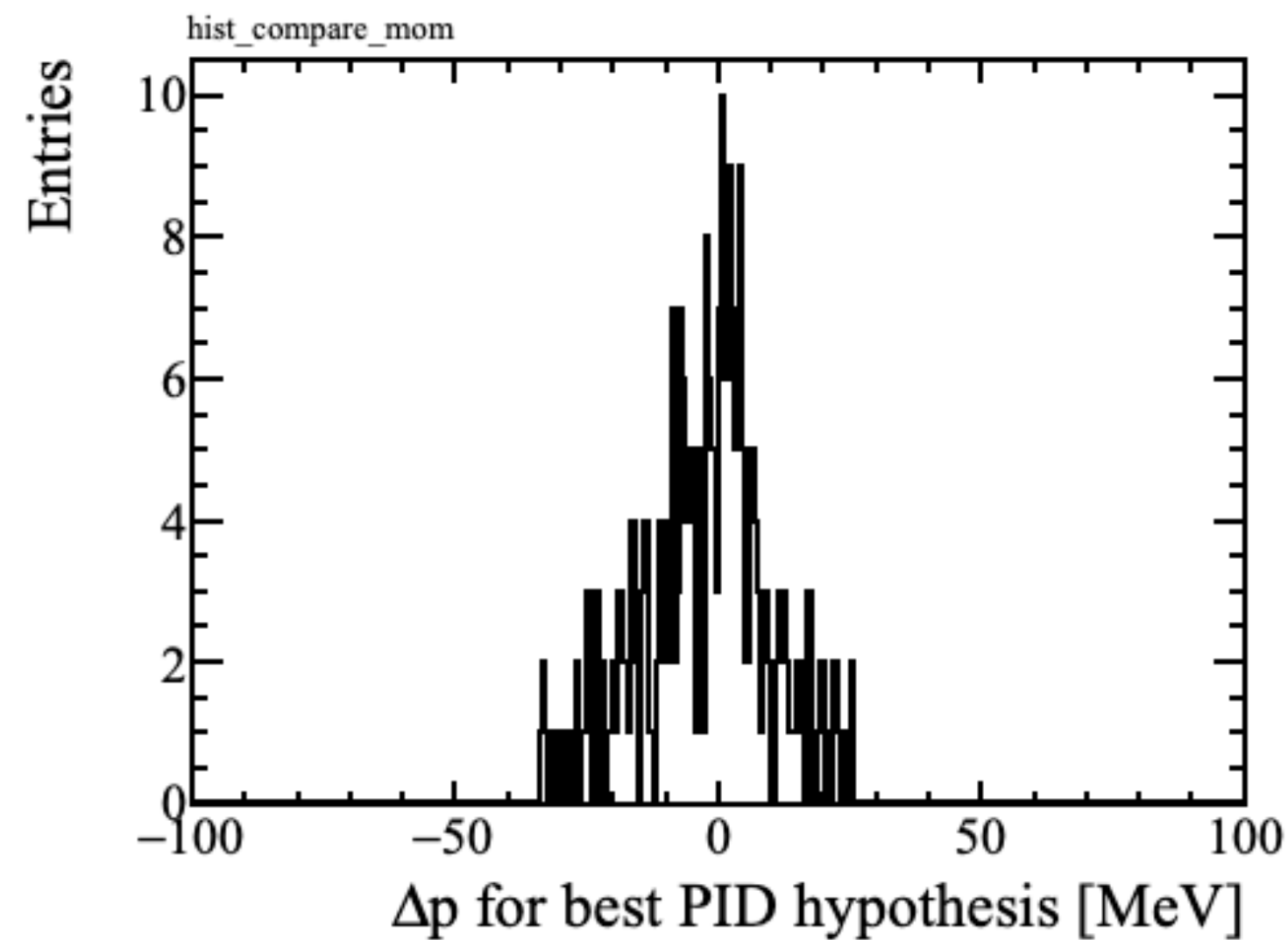Ran over 300 muon events in which the muon decays

The 6D Interpolation and the closest bin method agree on the best PID for 500/502 sub-events

    One electron (6D) identified as a pi+ (closest)

    One muon (6D) identified as an electron (closest)

Differences in recoed momentum and directions are rather small?
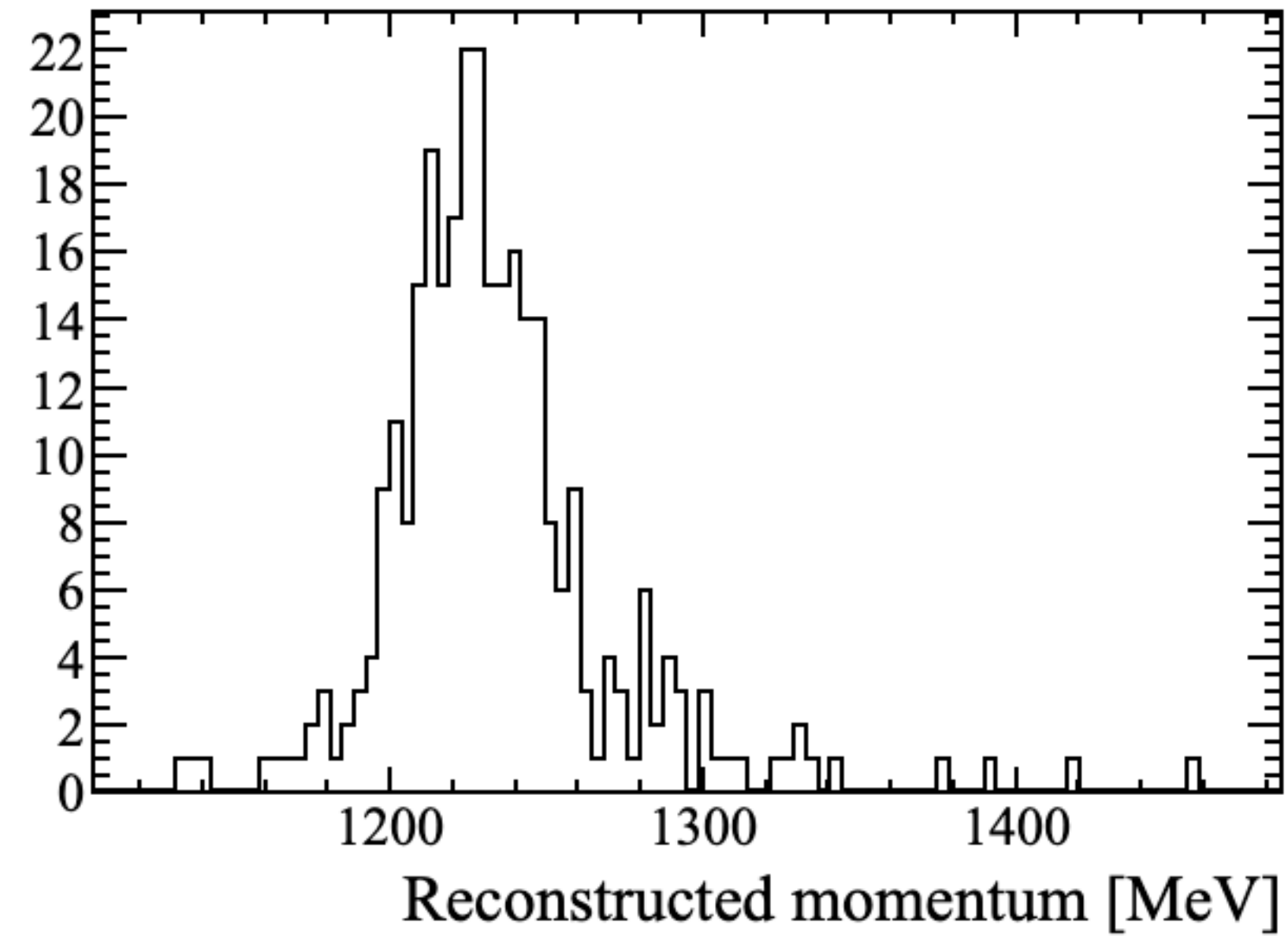
Physics performance difference (2)

Ran over 300 electron events (newer sim version)
The 6D Interpolation and the closest bin method agree on the best PID for all sub-events
Differences in recoed momentum and directions are again rather small?
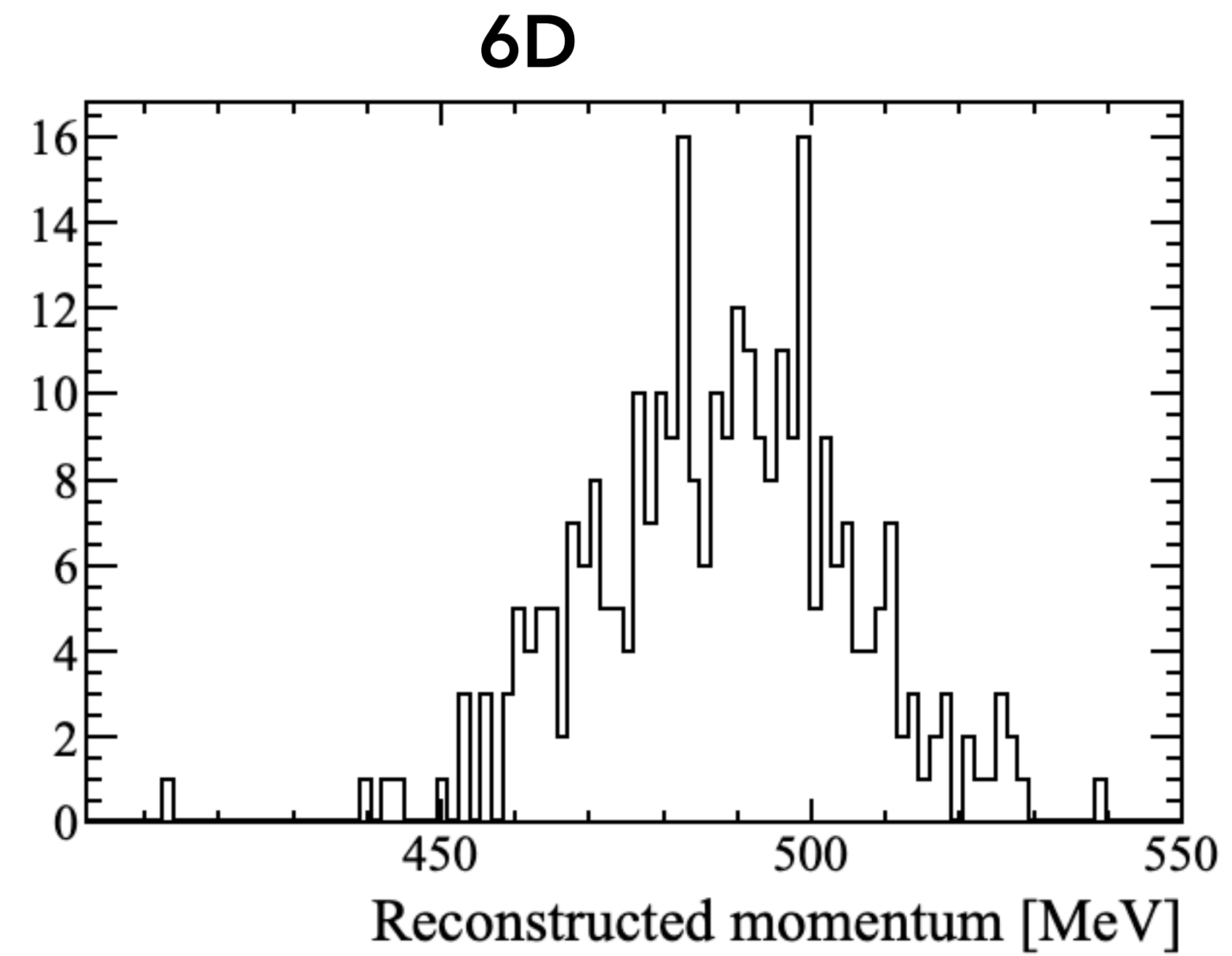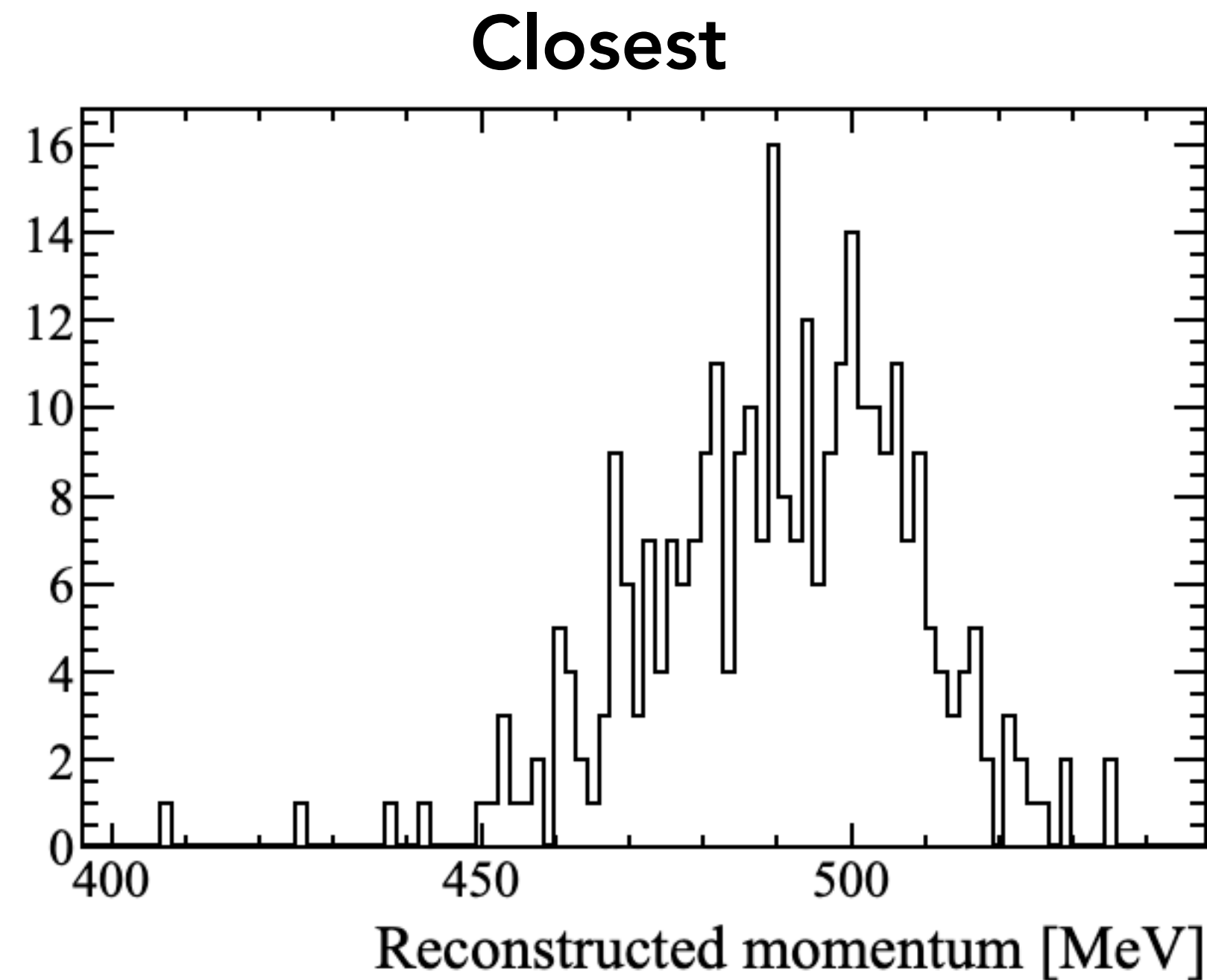   Maybe a bit bigger tails in the momentum difference than for muons?

Reconstructed momenta for muons

On the muon events, the reconstructed momentum is not the expected 500 MeV?

Reconstructed momenta for electrons

Closest

6D

On the electron events, the reconstructed momentum is peaking as expected around 500 MeV!

If I perform a naive single gaussian fit, the mean and width of the "closest" approach are actually better -- 493 vs 487 MeV and 17.7 vs 18.3 MeV respectively. Need more statistics to conclude anything however...

Conclusions and next steps

Replacing the 6D interpolation with a simple lookup of the nearest element in the scattering table saves ~20% of time in fiTQun

Impact on physics performance seems small/negligible

Have written a very simple script to compare two output ntuples from the reconstruction, is it worth committing for validation purposes?

Profiling after this change indicates no single algorithm is dominant, will focus on SingleTrk and EvalIn functions next