FastDRIC update: constructing low-level observables and looking at 2019-11 data

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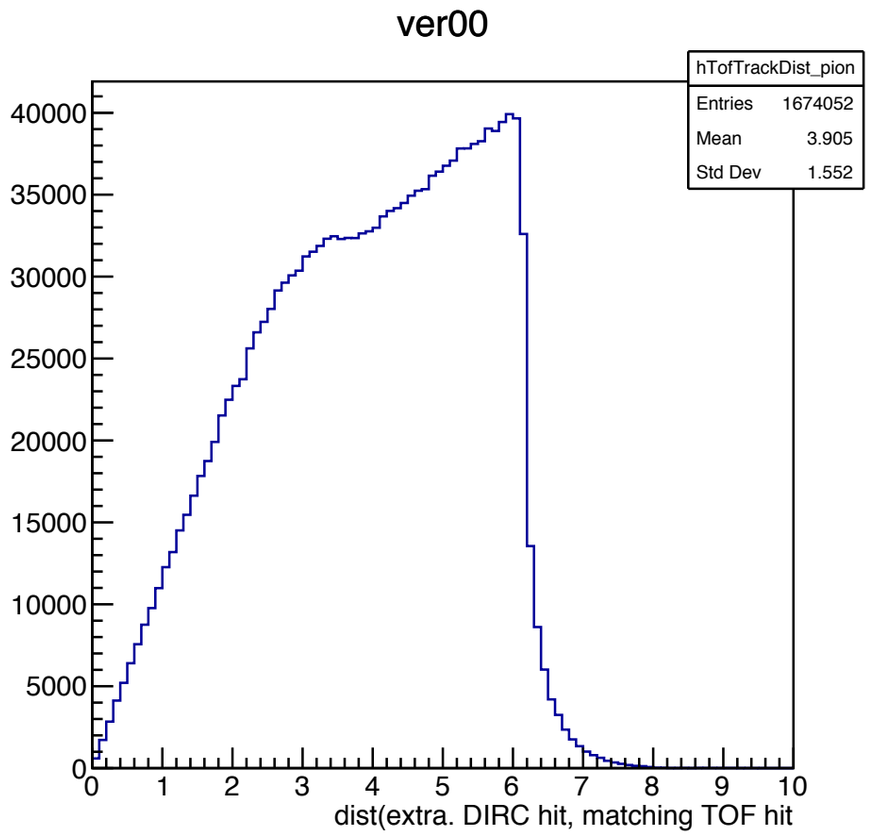
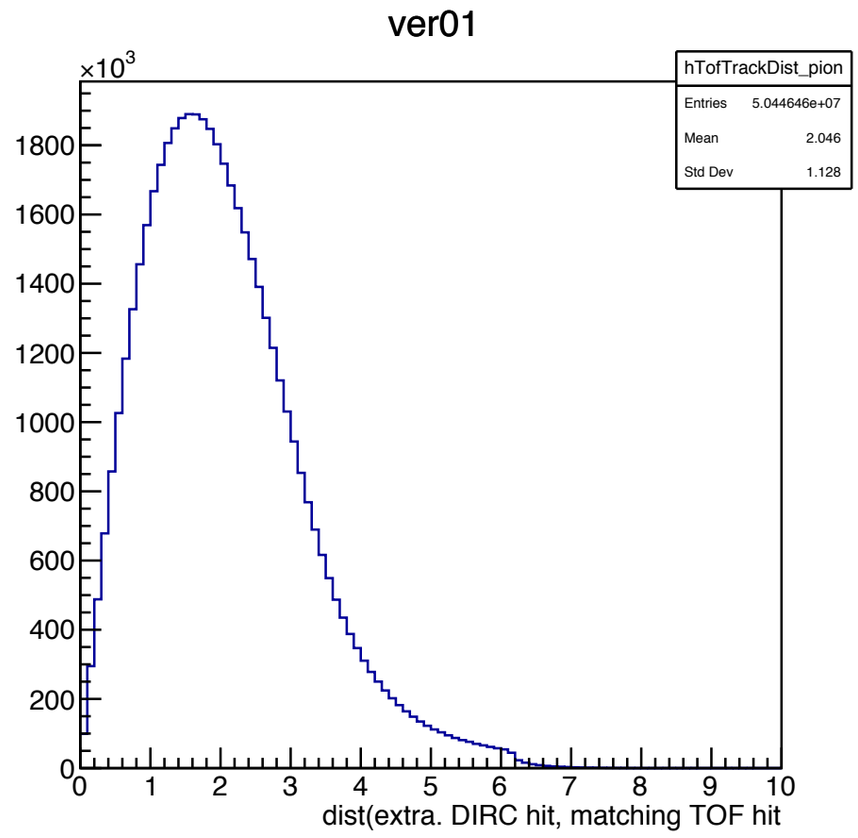
Dataset: ver01

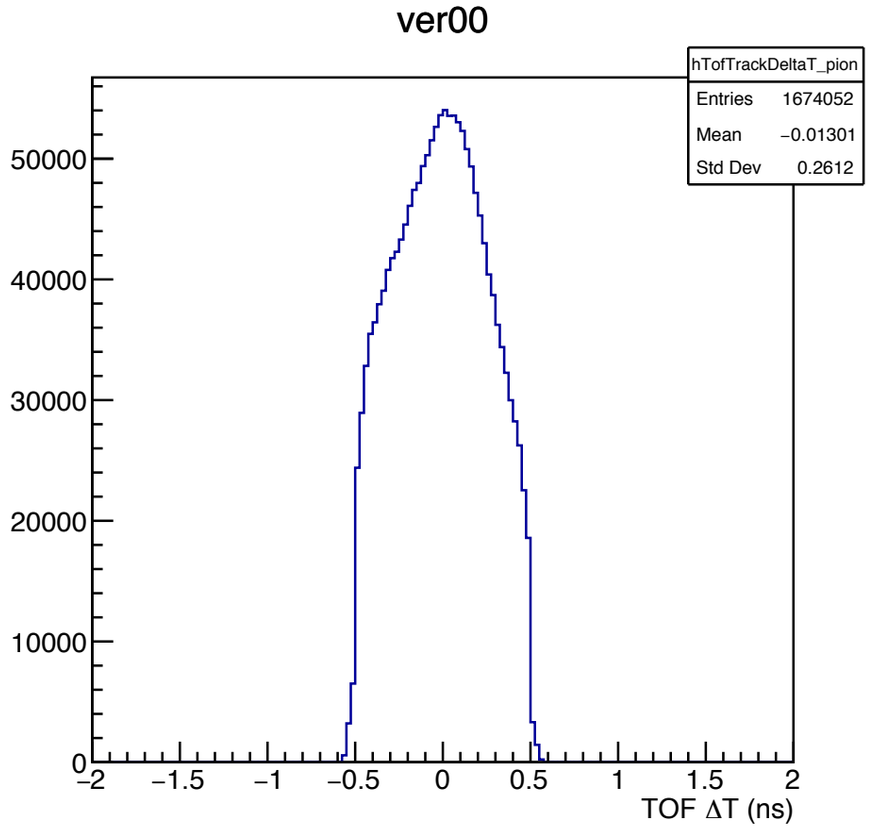
- /volatile/halld/home/gxproj7/RunPeriod-2019-11/dirc_monitoring/ver01/hists/merged/
- Produced with dirc_tree plugin: ρ,ϕ + track selection
- Using partially of runs 71028 — 71228
- Better calibration from both DIRC and other detectors compared to ver00
- Track selection: > 4 GeV (+ ρ,ϕ mass and track quality selection)

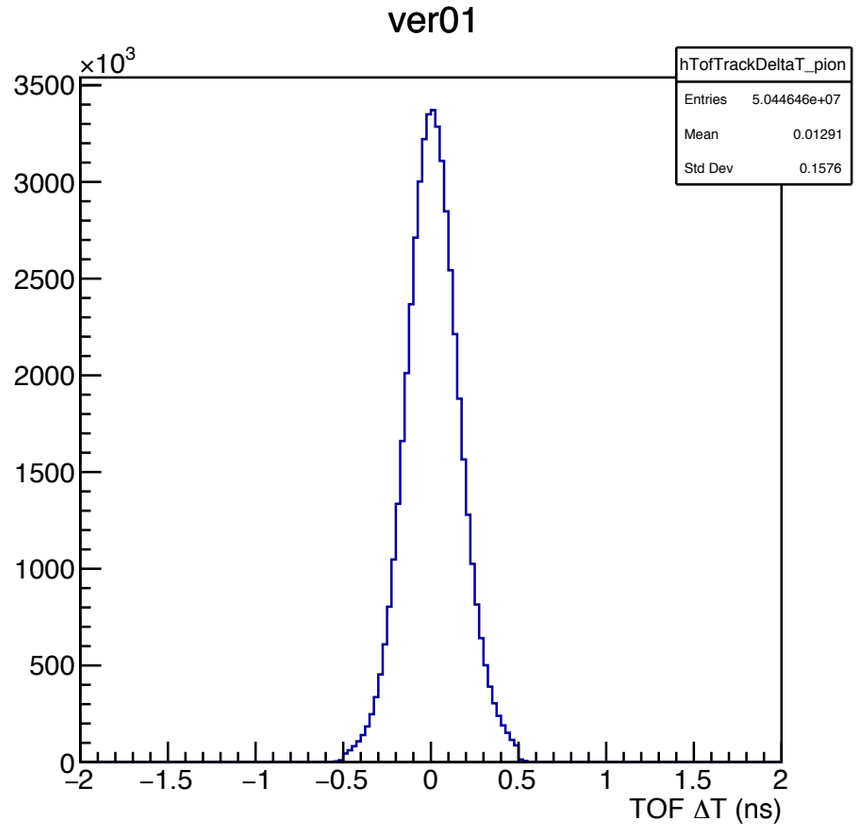
dist(TOF, DIRC)



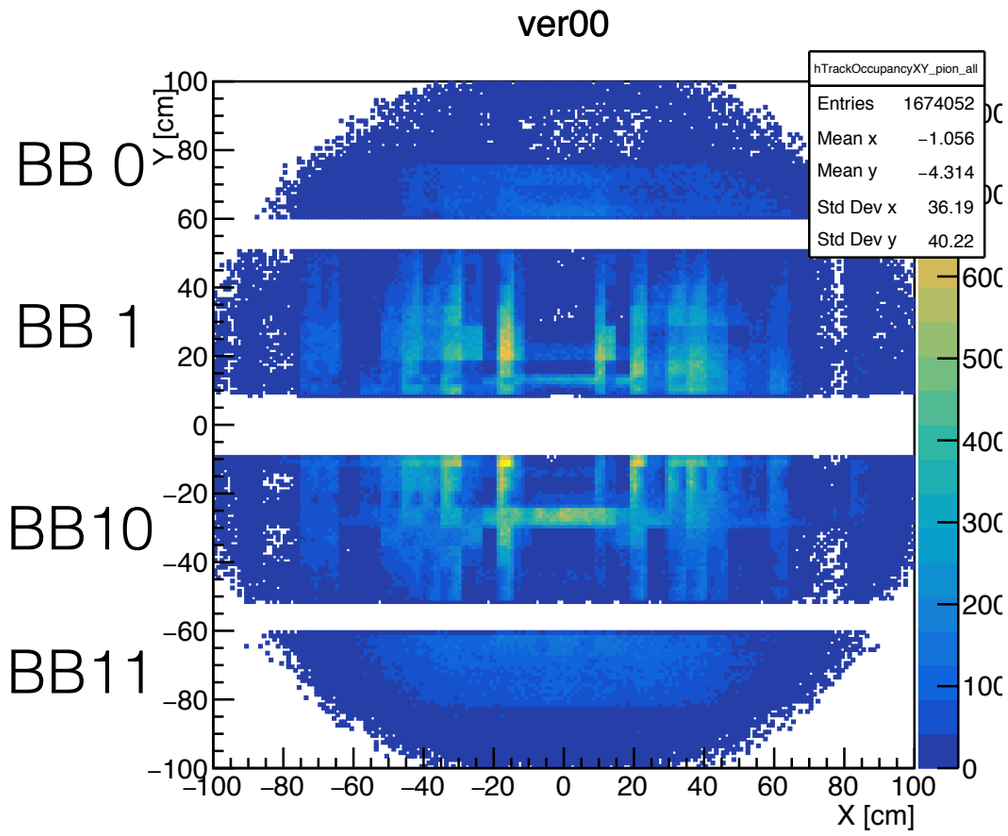


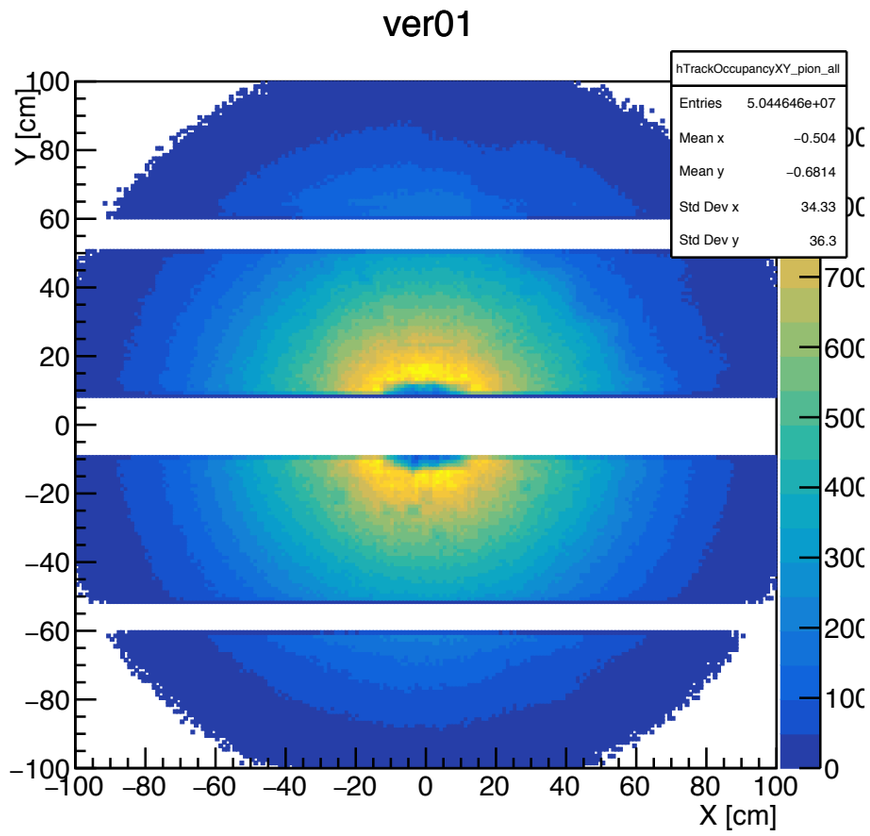
TOF DeltaT



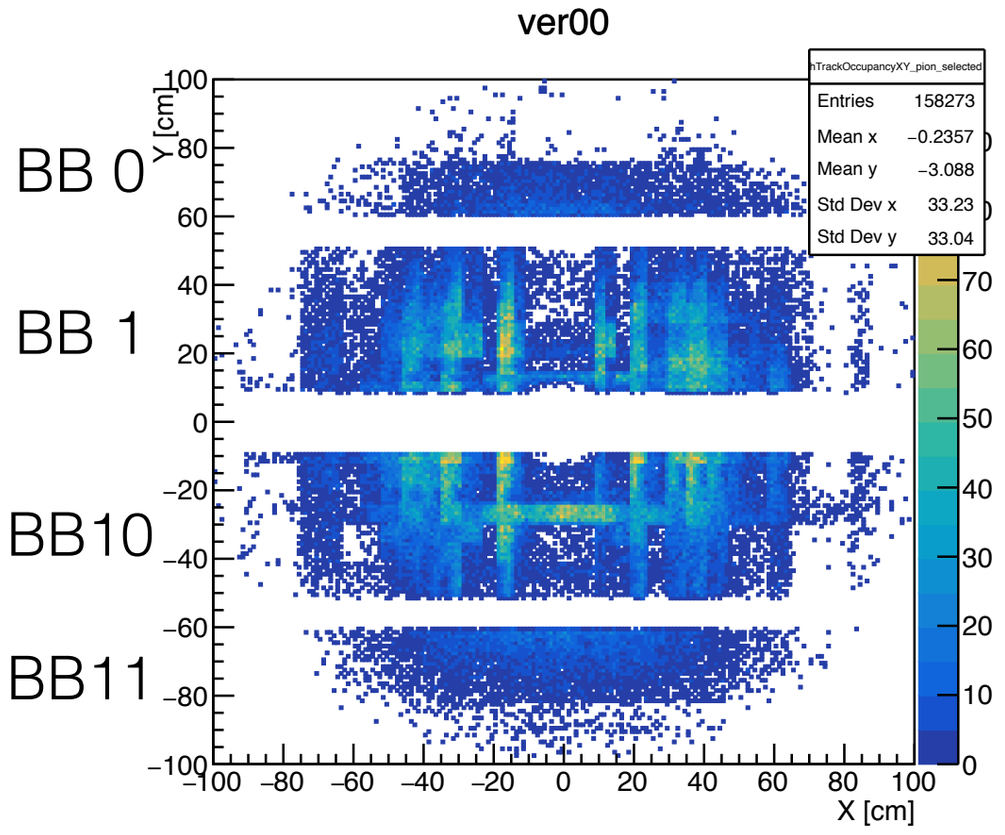


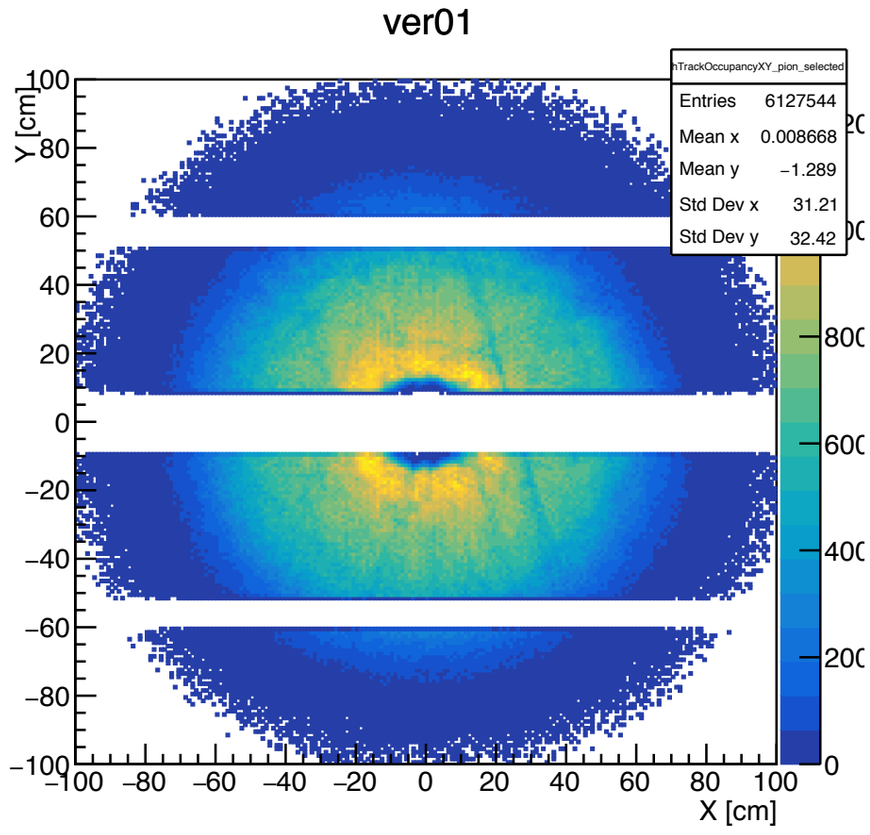
Out of dirc_tree:





After further selection:



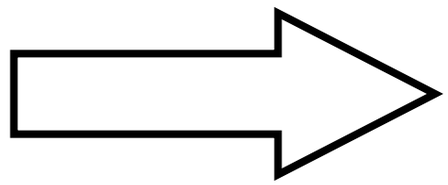


FastDIRC: simulation + reconstruction

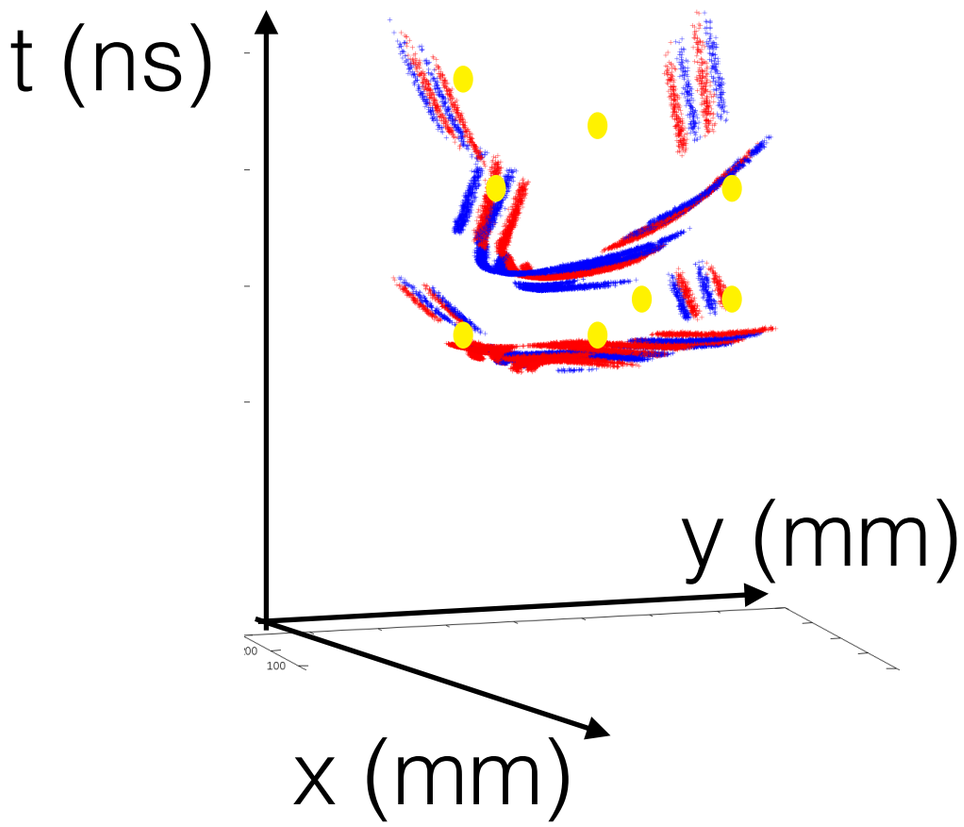
- **Simulation**: given a track (with its kinematics), under a mass hypothesis, it fast simulates a lot of Cherenkov photons that could have come from this track ("support points"). There are *no* "knobs" to turn here, only the geometry&material model.

- **Reconstruction**: compute likelihoods given the observed hits for a given mass hypothesis based on the large amount of simulated photons for this track. This is where the "knobs" are. We'll completely *ignore* this part today.

Input:
track kinematics,
mass hypothesis



O(1M) Cherenkov photons in (x, y, t)



red and blue bands: support points from two mass hypos

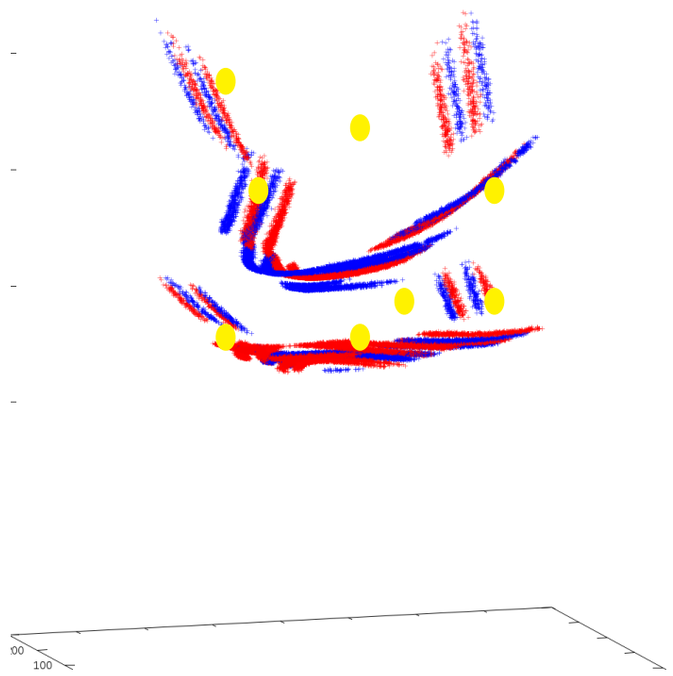
- observed hit

Figure from John Hardin thesis

Goal: given the observed hits and support points, form useful low-level observables (comments and suggestions very welcome!)

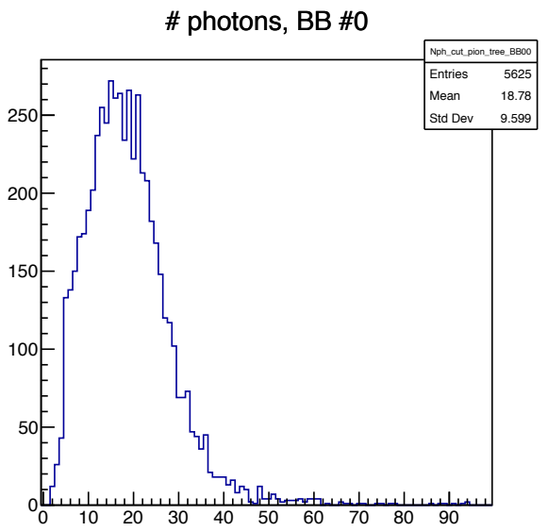
Photon Yield

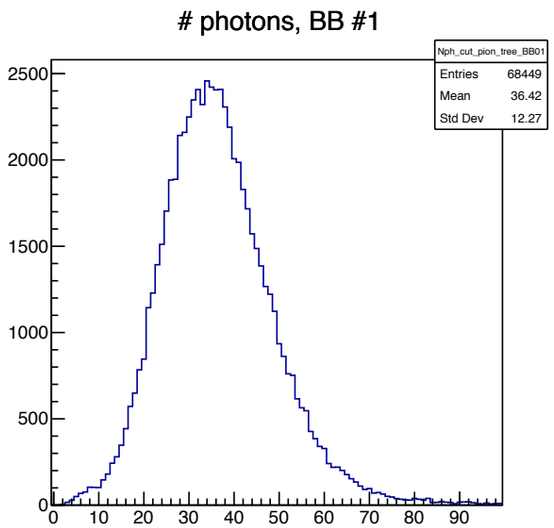
- For a given observed hit, look within:
  - 8.5 mm (6mm*√2)
  - and ± 5 ns (i.e. a “cylinder” in the 3D (x, y, t) space)
- If there’s at least one support point, call it a signal photon

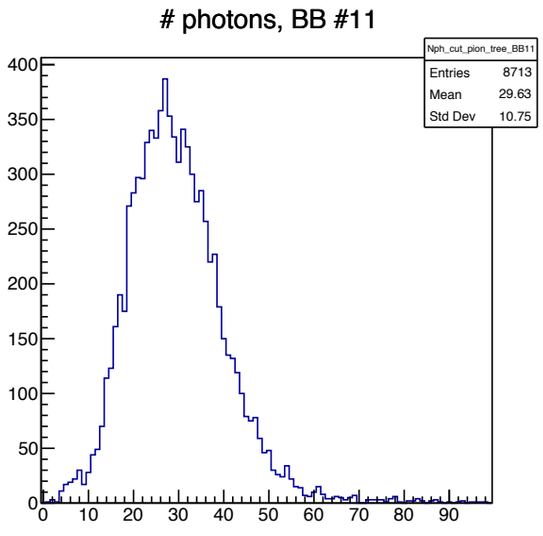


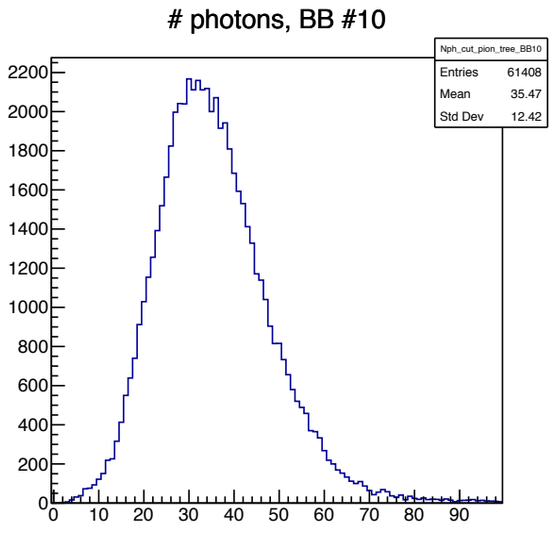
Photon Yield in Bar Box

ver00

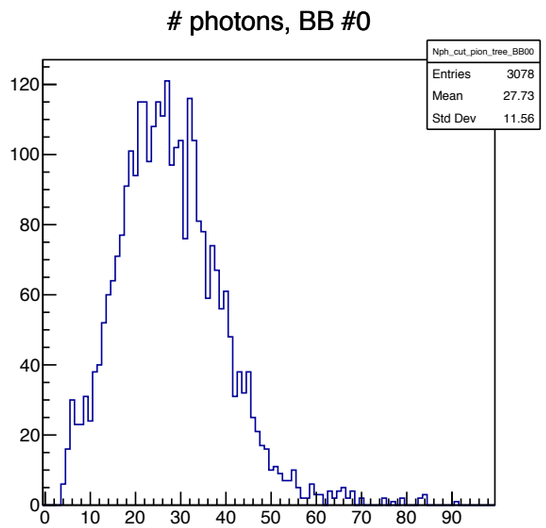


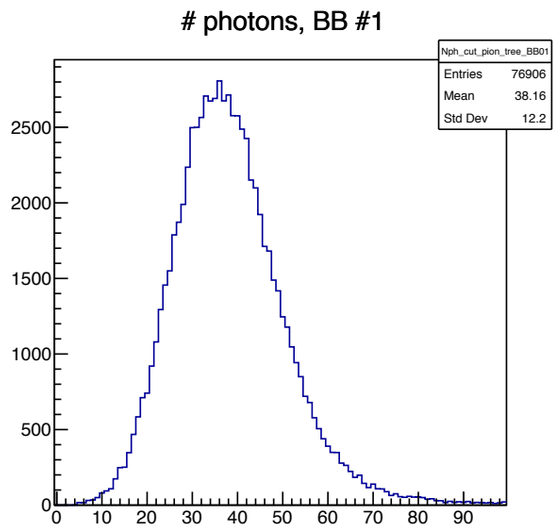


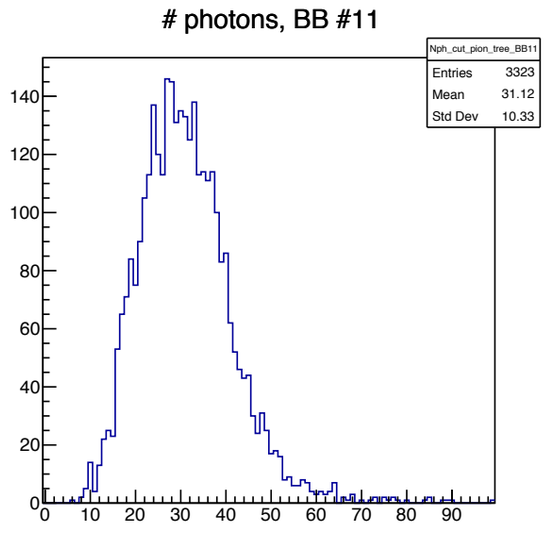


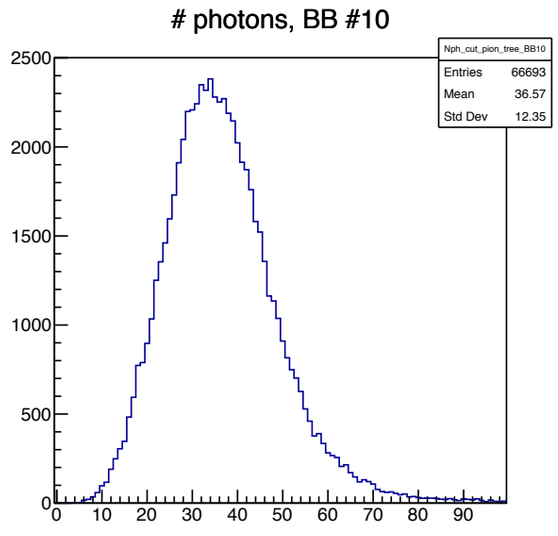


ver01

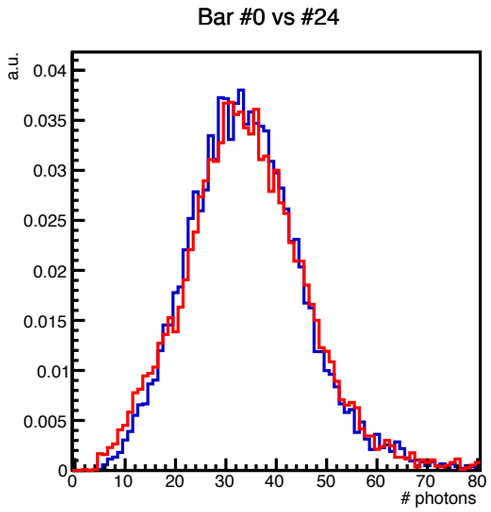


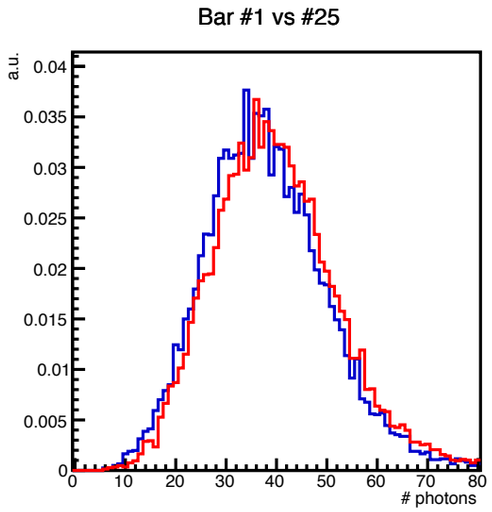


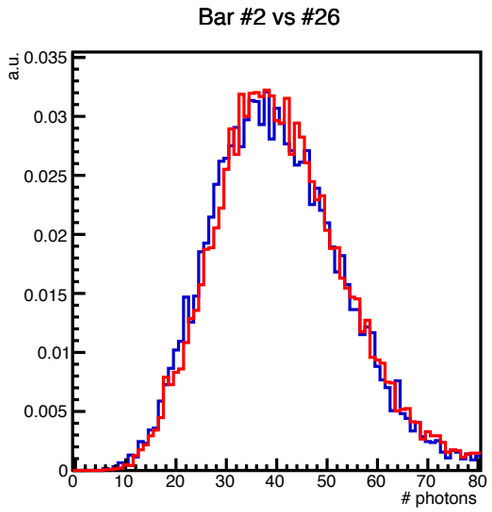


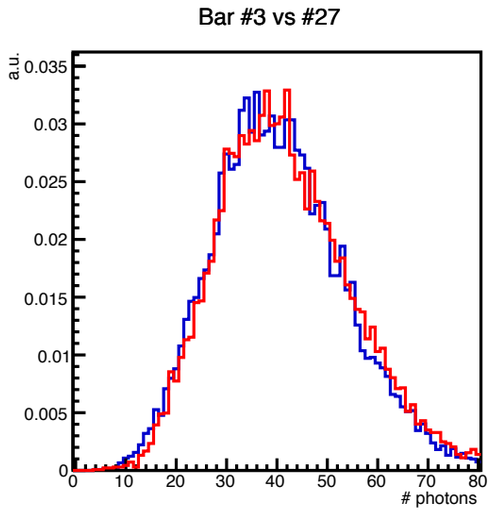


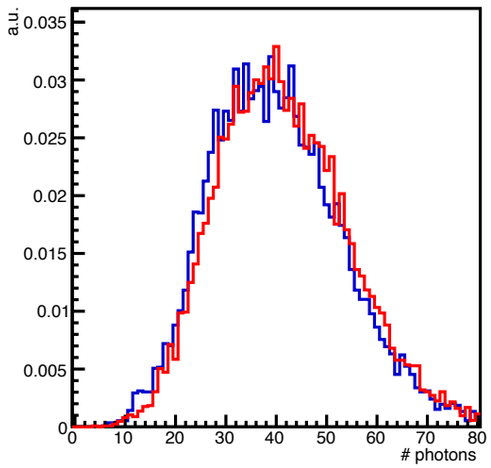
BB10 vs. BB1

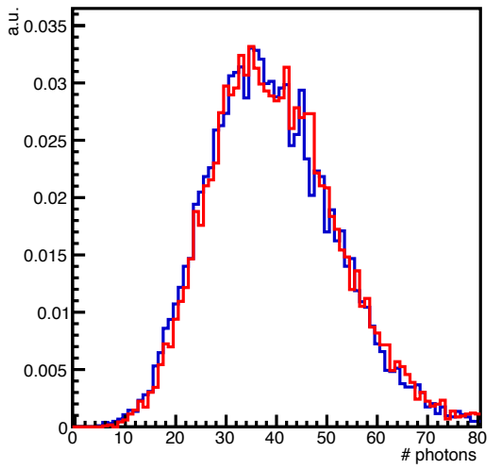

Bar #0 vs #24
a.u.
photons

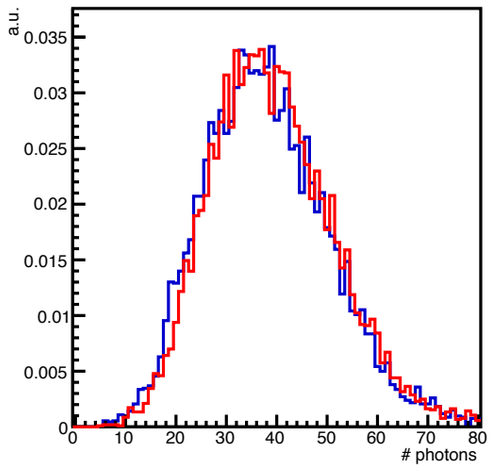

Bar #1 vs #25
a.u.
photons


Bar #2 vs #26
a.u.
photons


Bar #3 vs #27
a.u.
photons


Bar #4 vs #28
a.u.
photons


Bar #5 vs #29
a.u.
photons


Bar #6 vs #30
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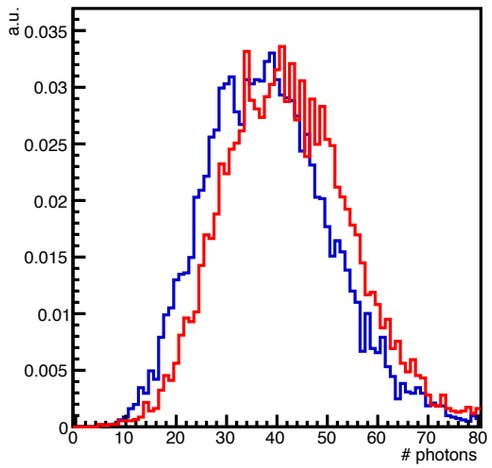
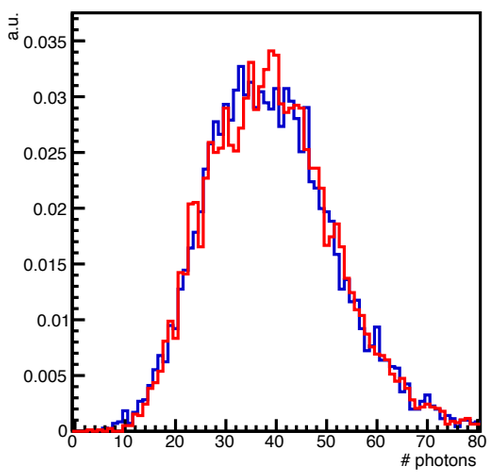
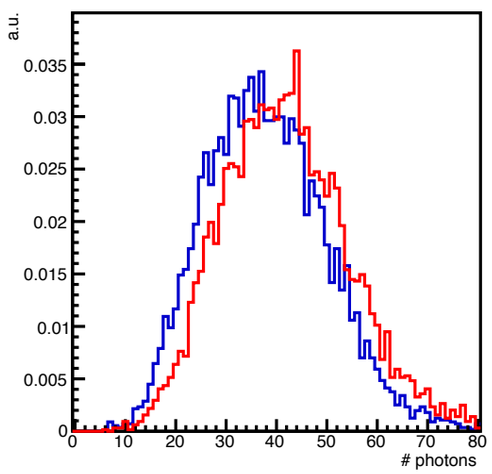
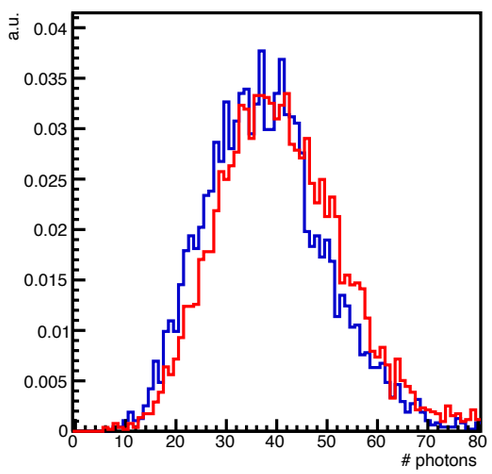
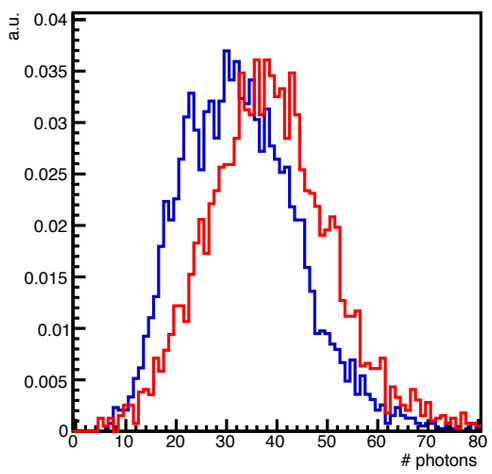
photons


Bar #7 vs #31
a.u.
photons

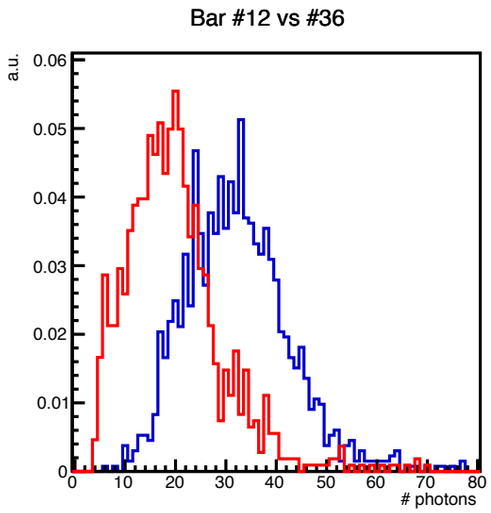

Bar #8 vs #32
a.u.
photons

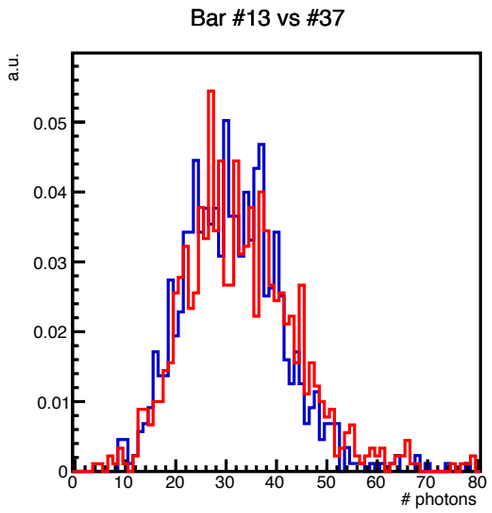

Bar #9 vs #33
a.u.
photons

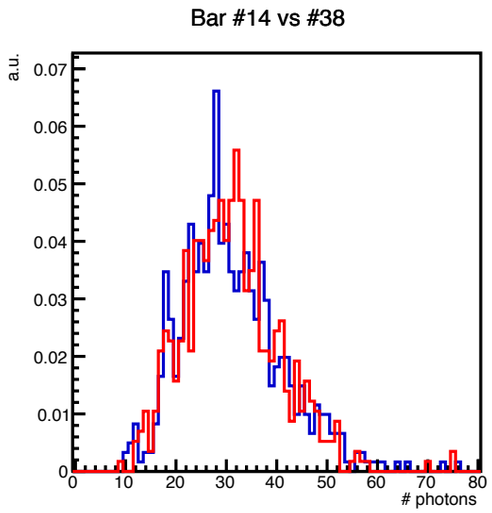

Bar #10 vs #34
a.u.
photons

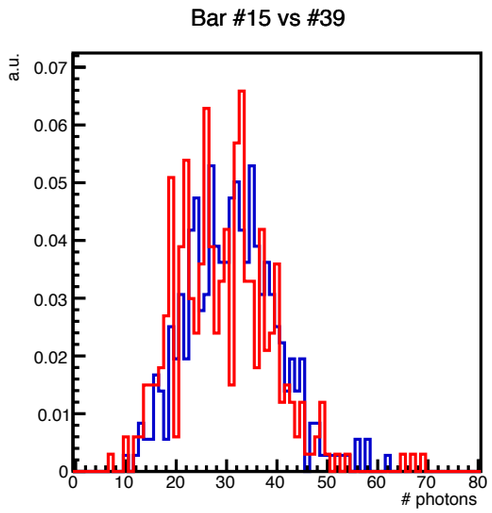

Bar #11 vs #35
a.u.
photons

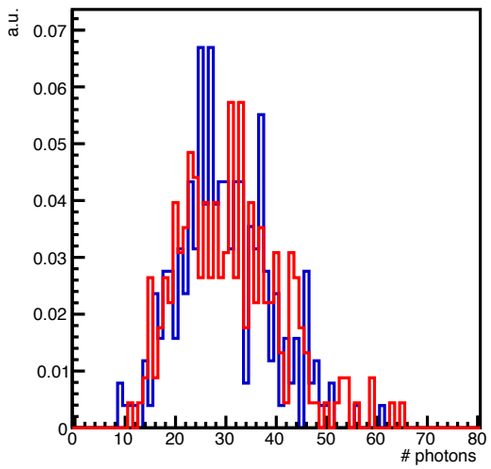
BB11 vs. BB0

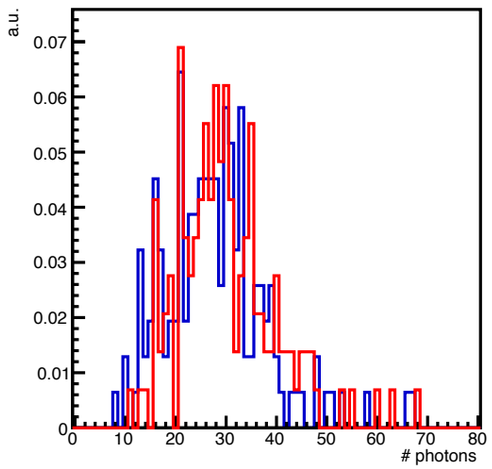

Bar #12 vs #36
a.u.
photons

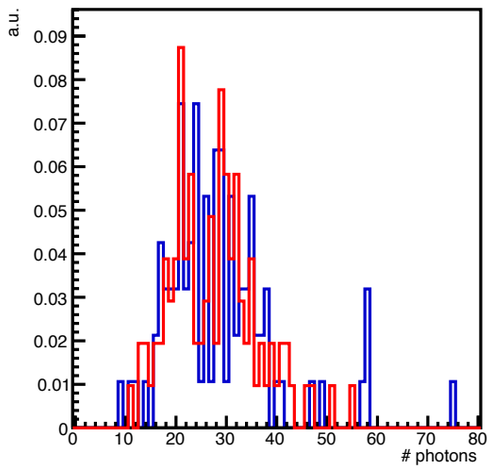

Bar #13 vs #37
a.u.
photons

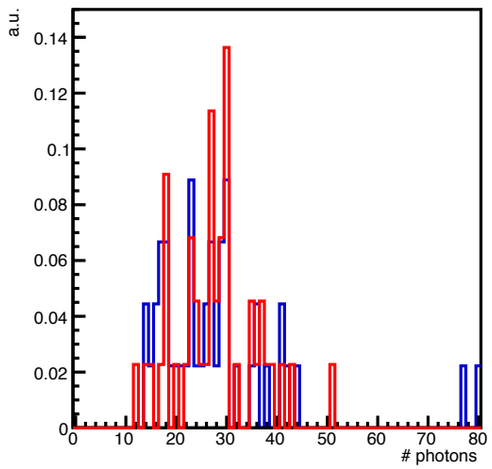

Bar #14 vs #38
a.u.
photons

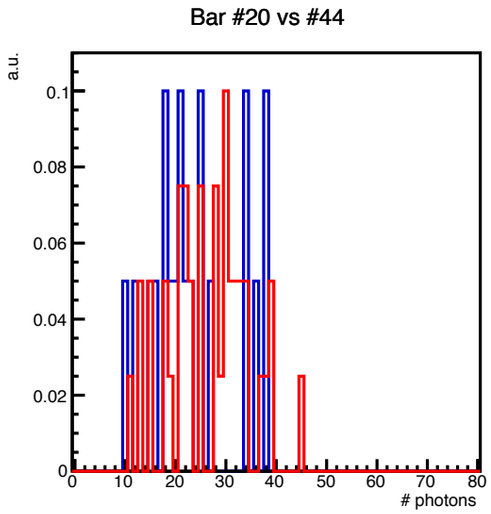

Bar #15 vs #39
a.u.
photons


Bar #16 vs #40
a.u.
photons


Bar #17 vs #41
a.u.
photons


Bar #18 vs #42
a.u.
photons


Bar #19 vs #43
a.u.
photons


Bar #20 vs #44
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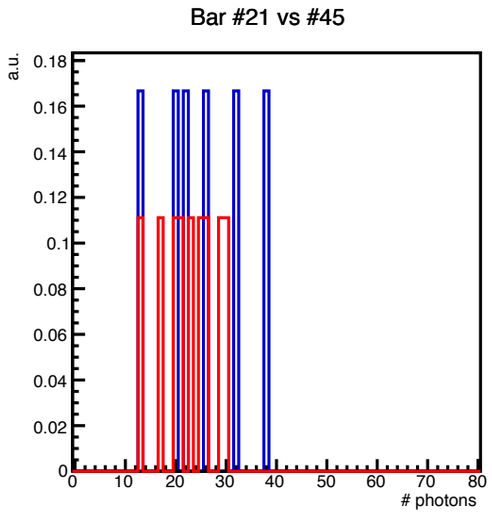
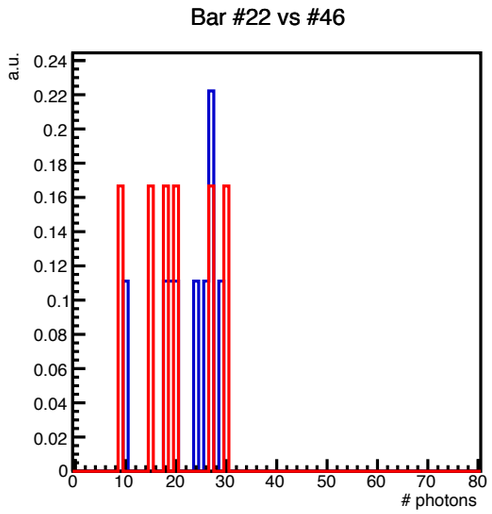
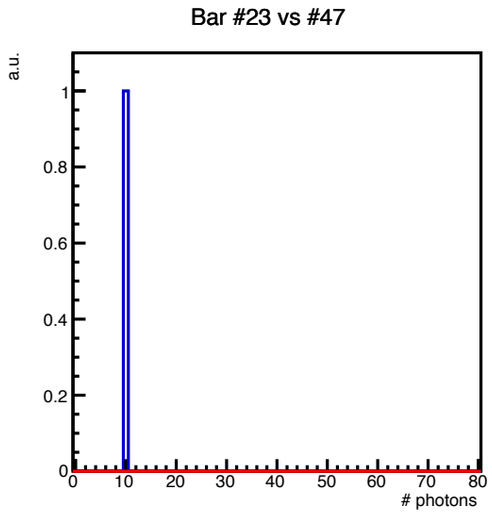
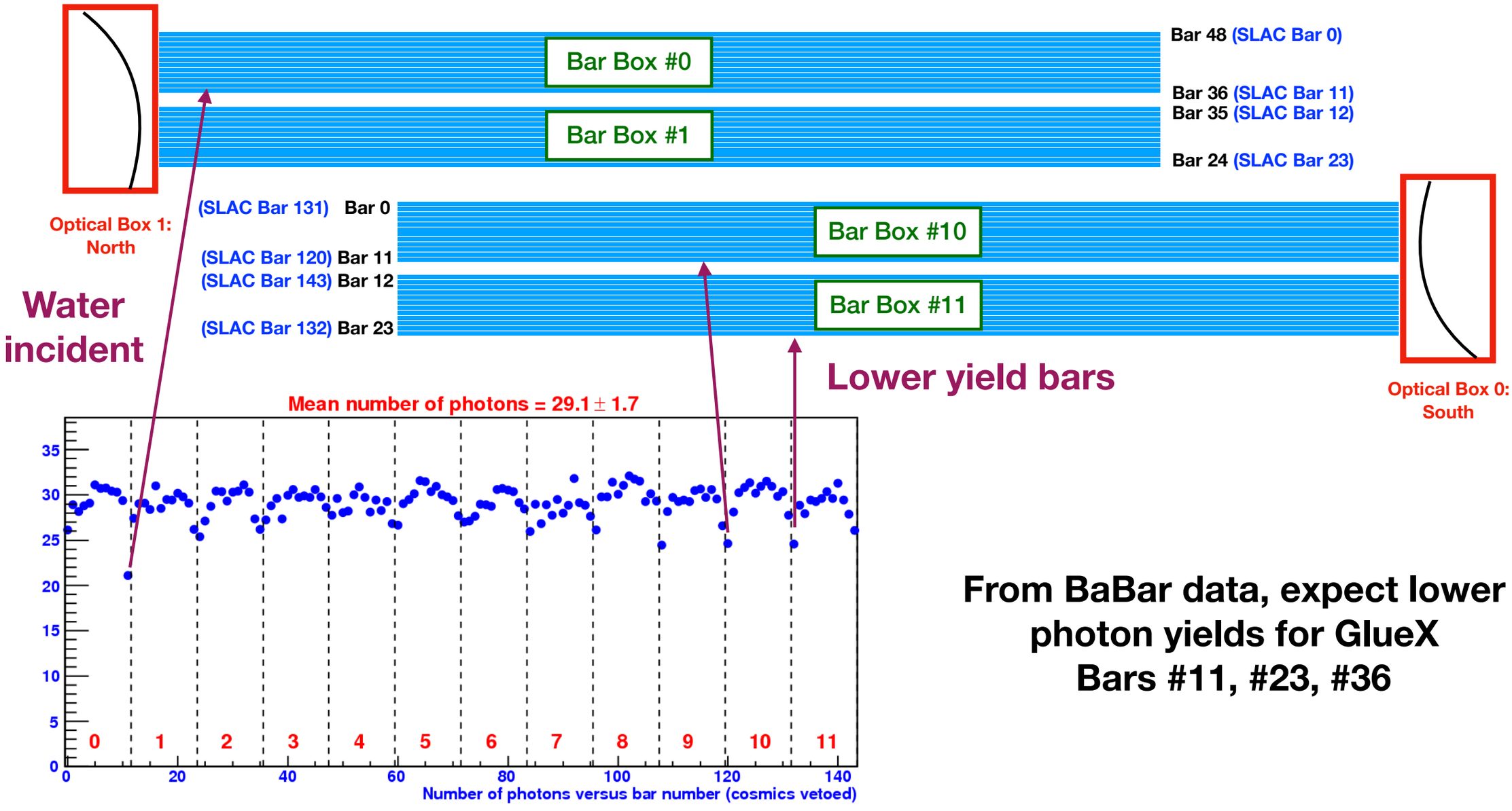
photons


Bar #21 vs #45
a.u.
photons


Bar #22 vs #46
a.u.
photons


Bar #23 vs #47
a.u.
photons

Bar-dependent photon yield



From BaBar data, expect lower photon yields for GlueX Bars #11, #23, #36

Slide courtesy: Justin (https://halldweb.jlab.org/doc-private/DocDB/ShowDocument?docid=3960)

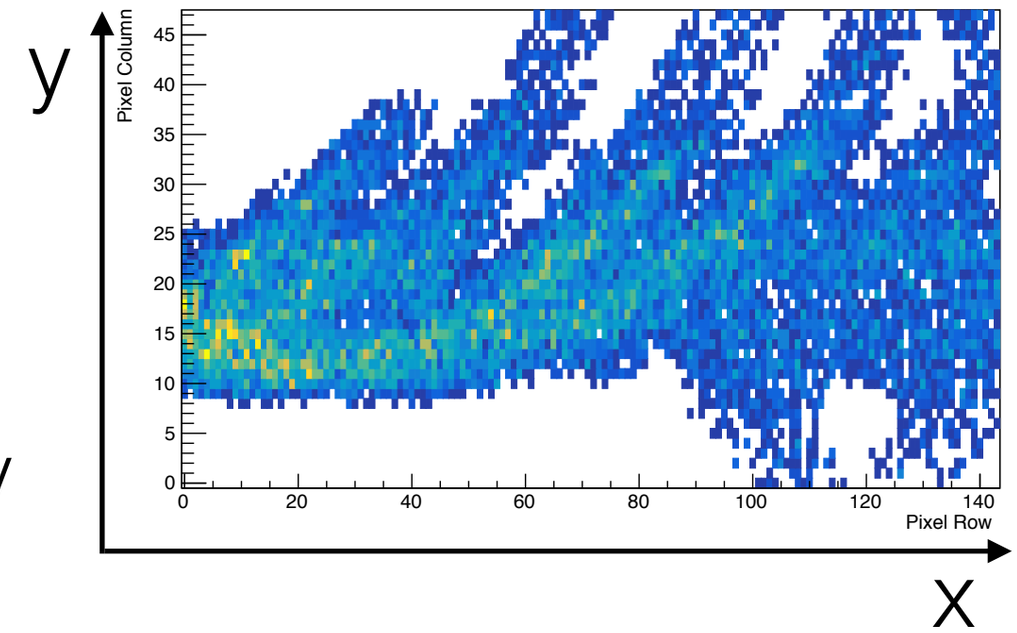
Delta observables

- For each observed hit, look within 20 mm and ±20 ns

- compute Delta observables as O_hit - O_support_i for all the support points within that “3D cylinder”

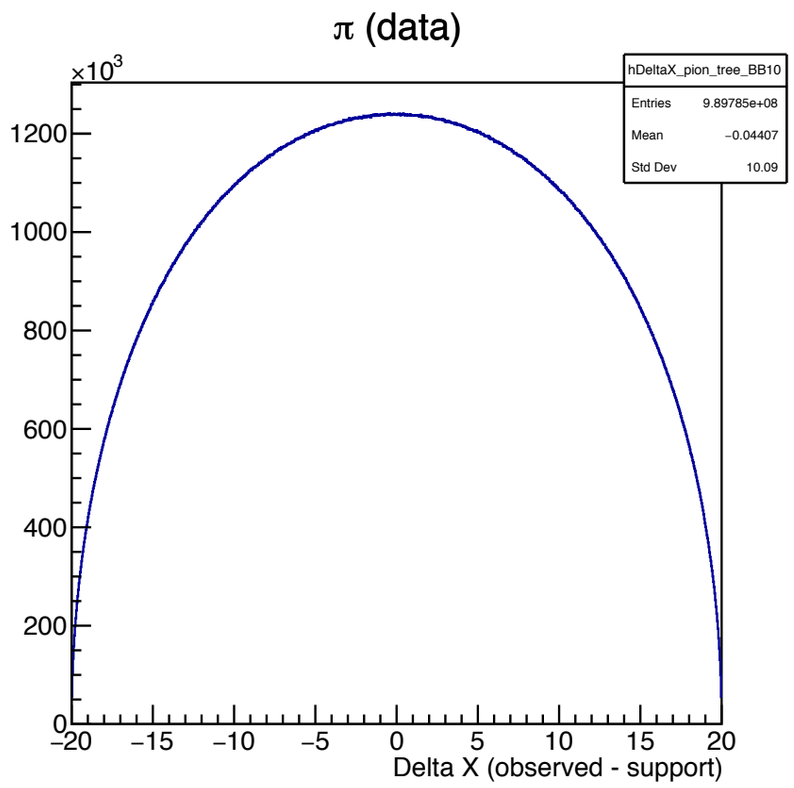
- Considered observables: t, x (along PMT row direction), y (along column), and r_xy

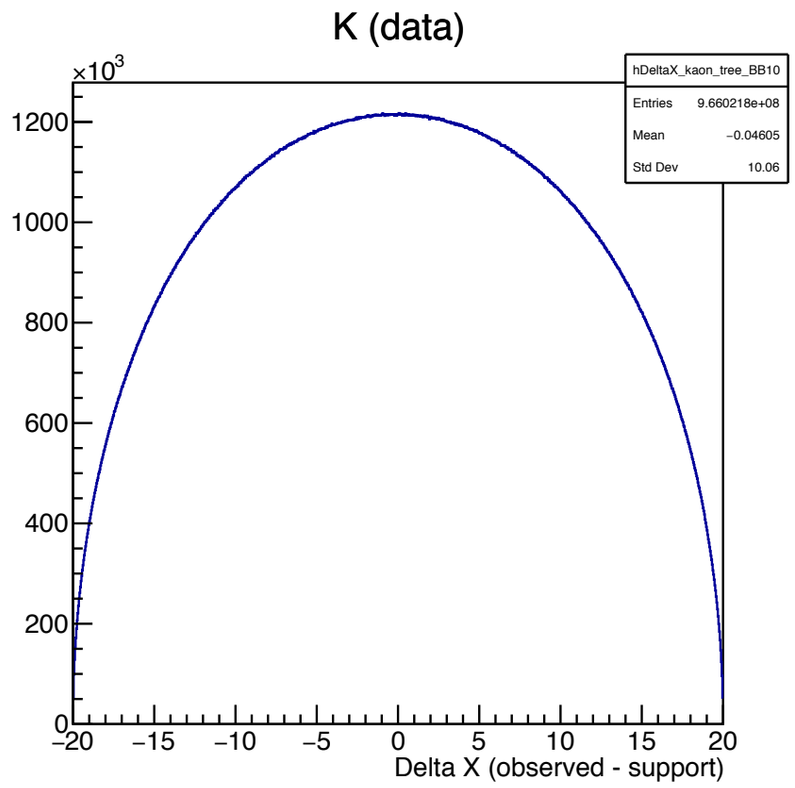
- Usefulness and interpretation are under investigation.



DeltaX

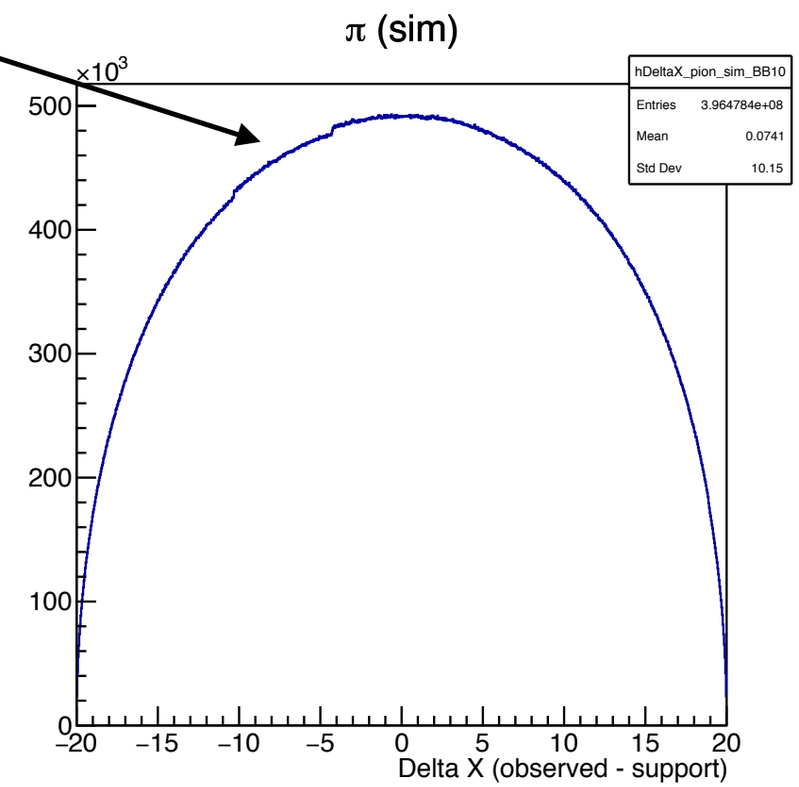
with observed hits

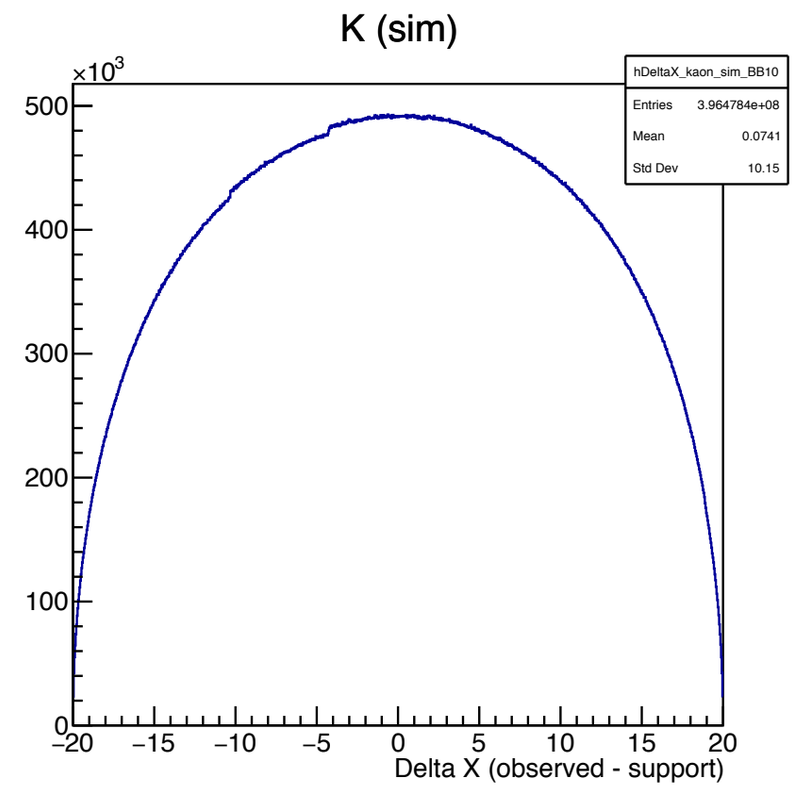




kinks likely due to error in digitization of simulated hits (?)

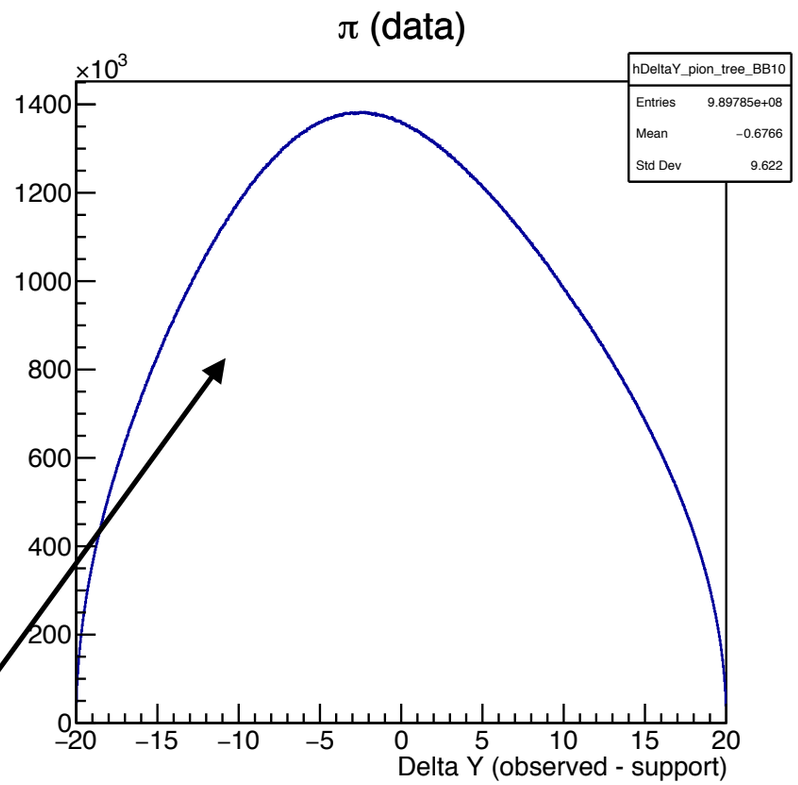
with simulated hits (after digitization)

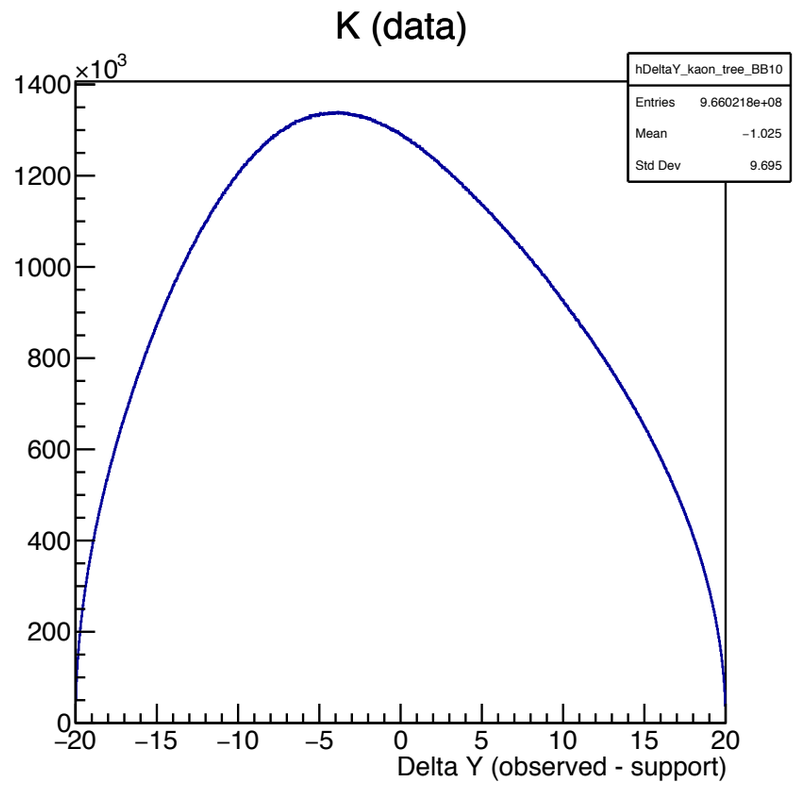


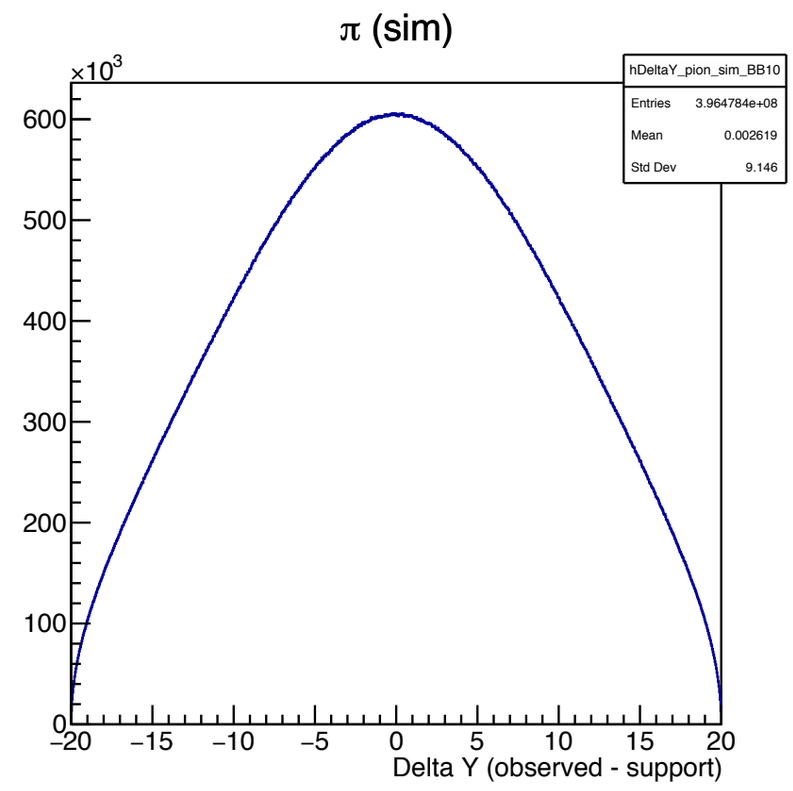


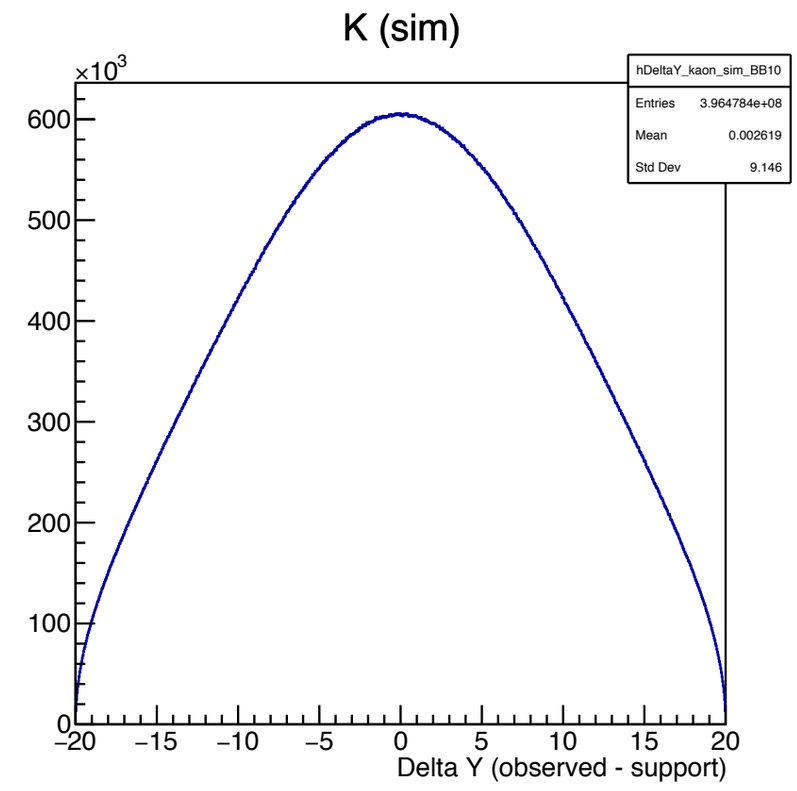
DeltaY

offset from 0 likely due to optics misalignment



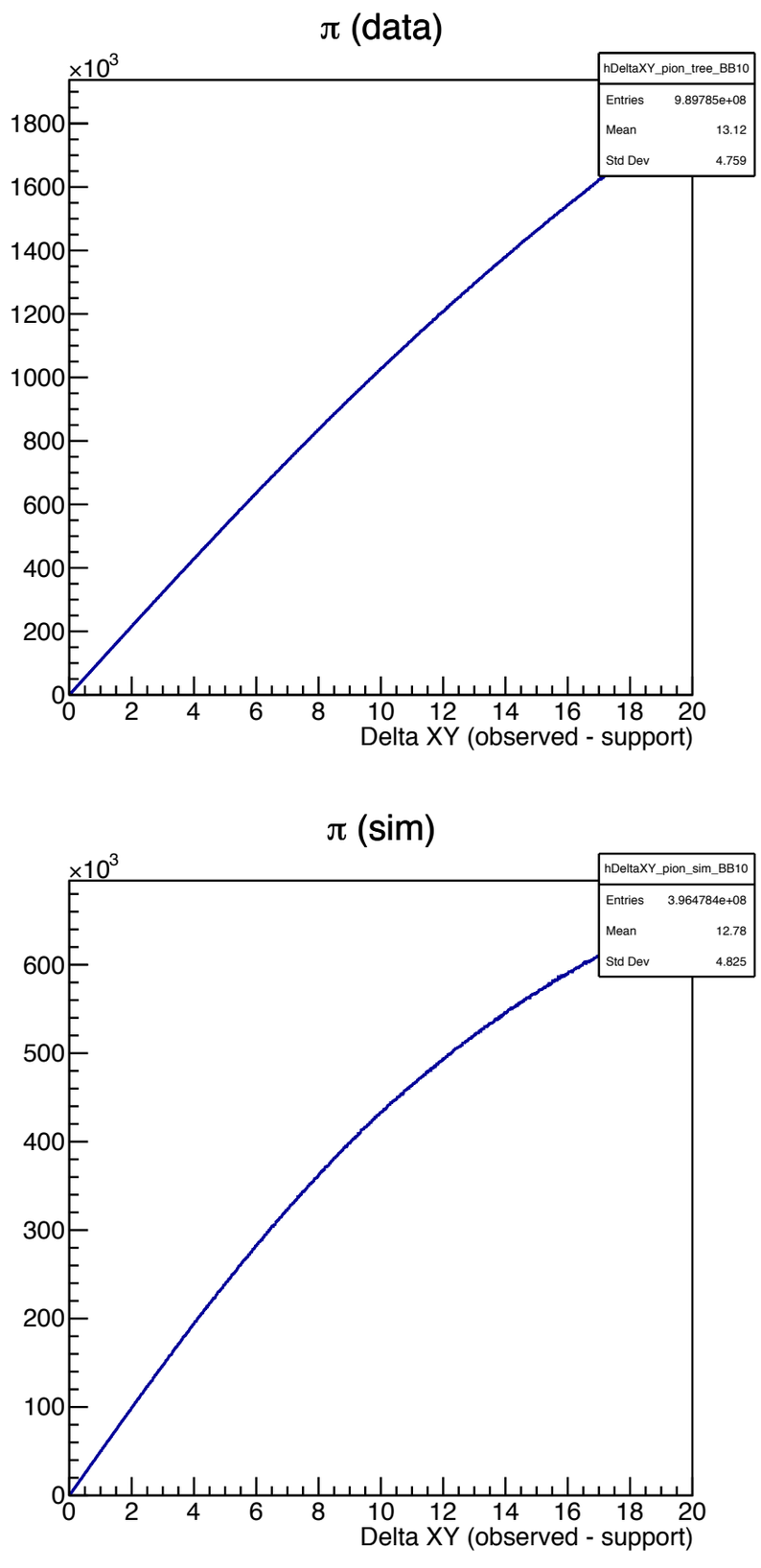


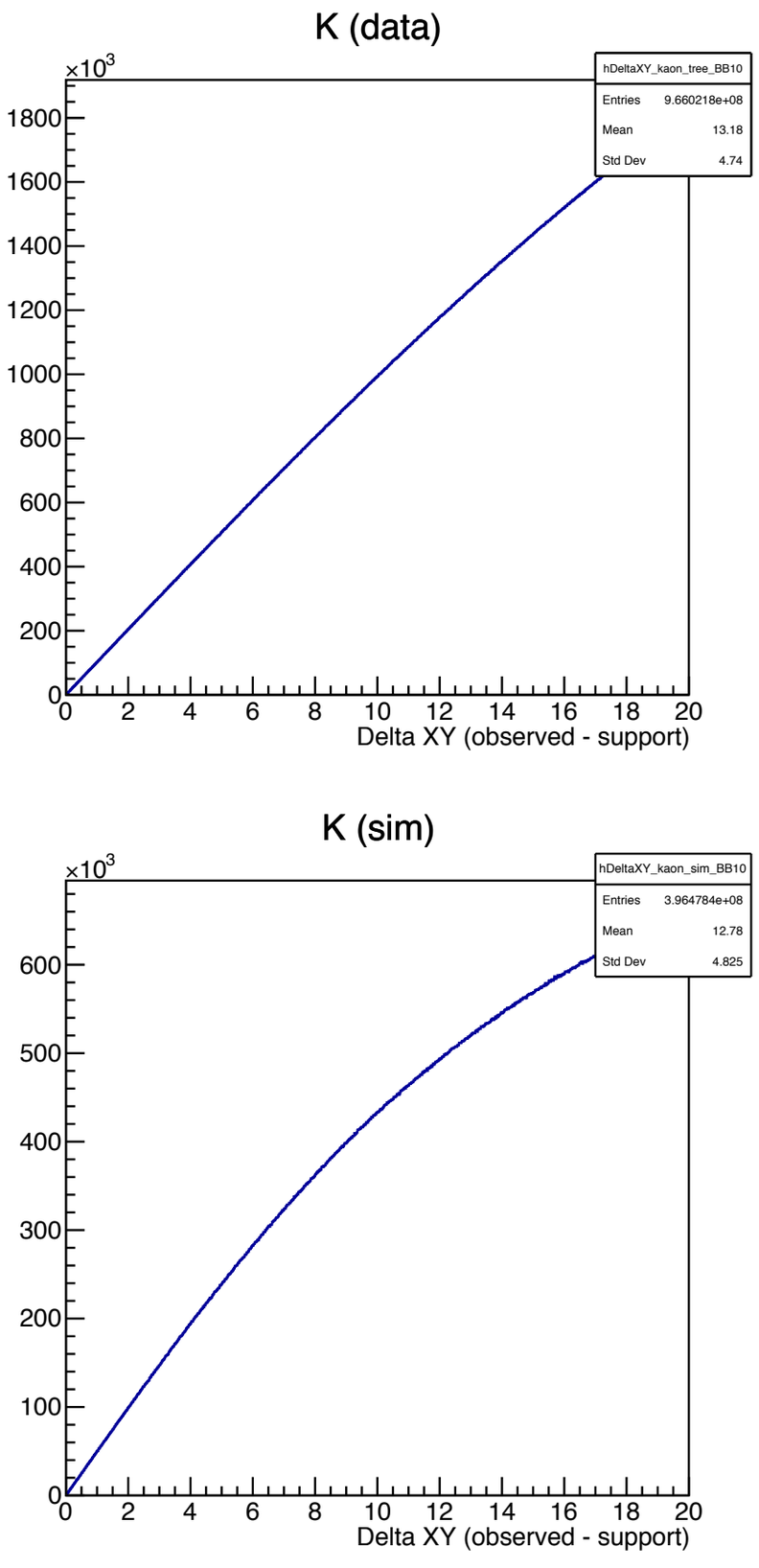




DeltaXY

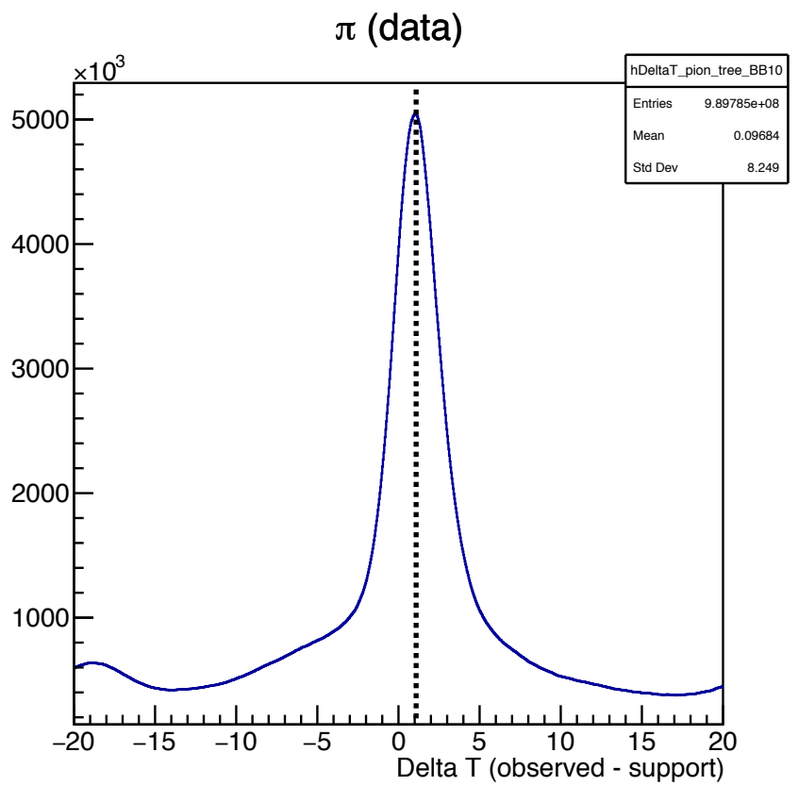
probably not very useful…

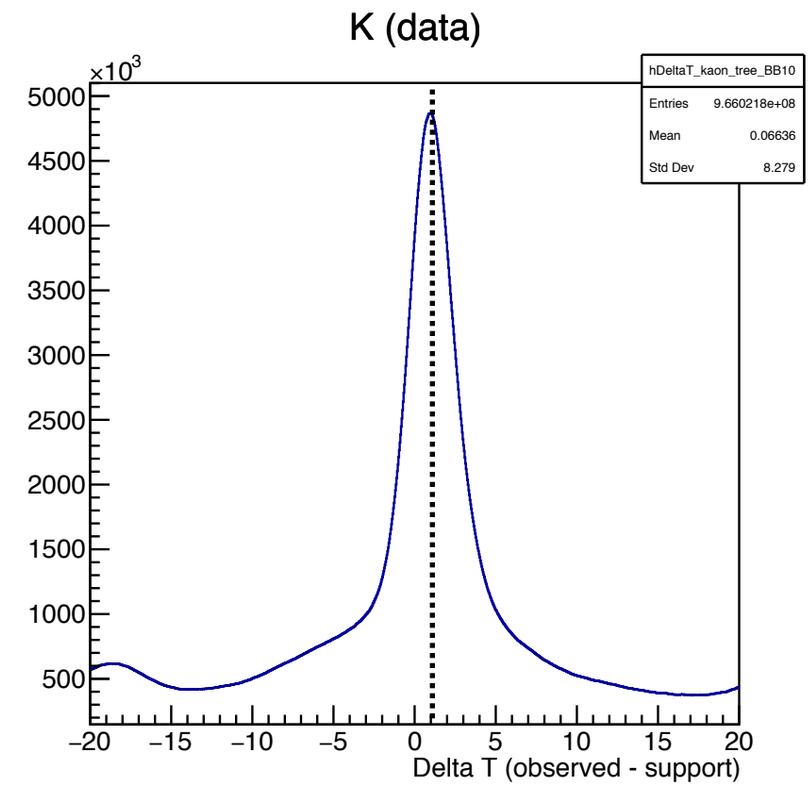


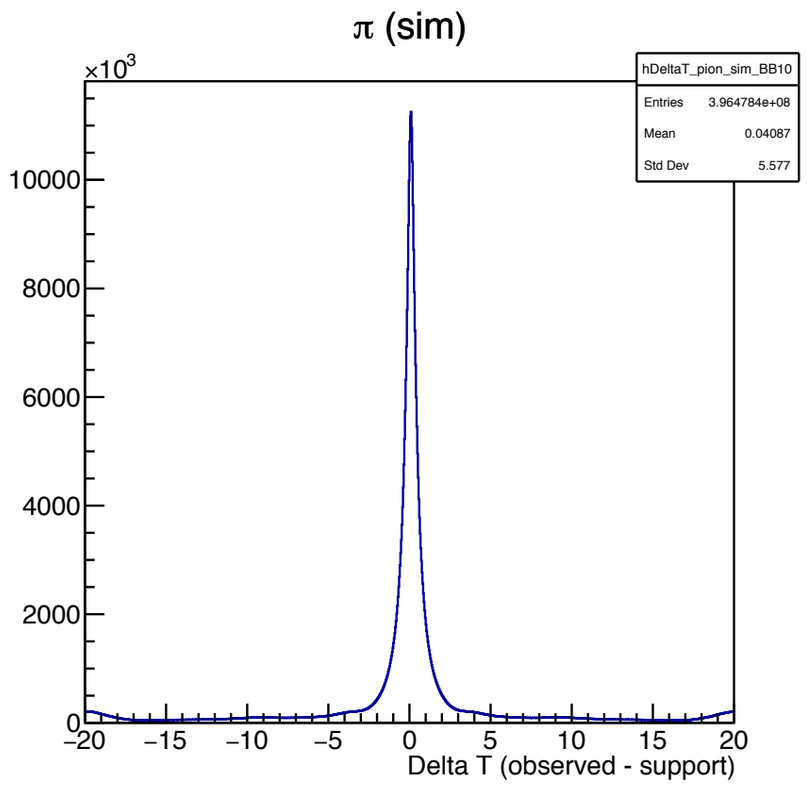


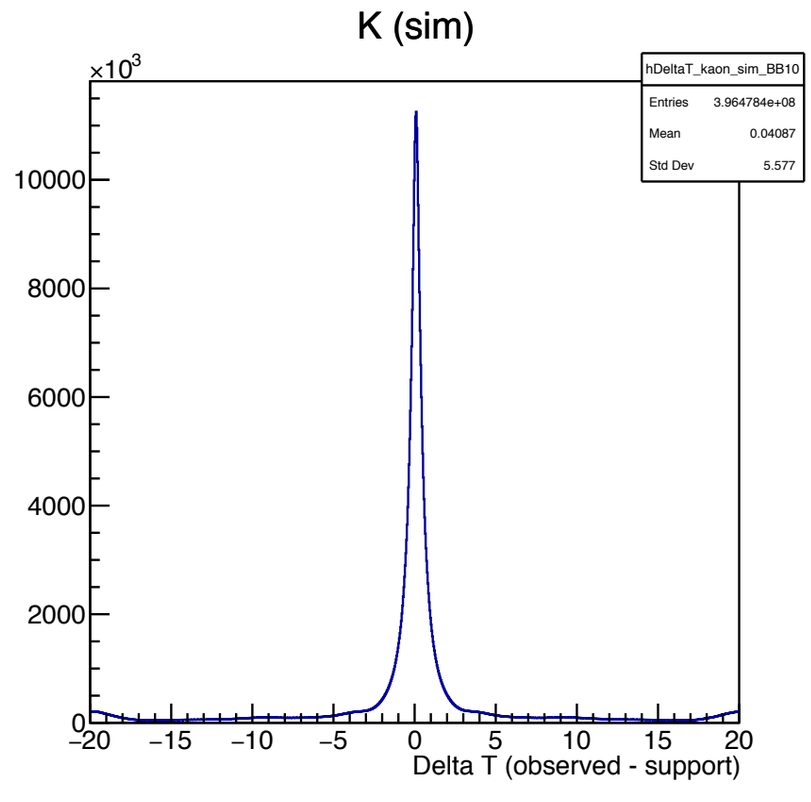
DeltaT

- cause of this offset?
- sim. hits used 1 ns Gaus. smearing (checked with LED data by Ahmed), wider widths likely come from track extrapolation

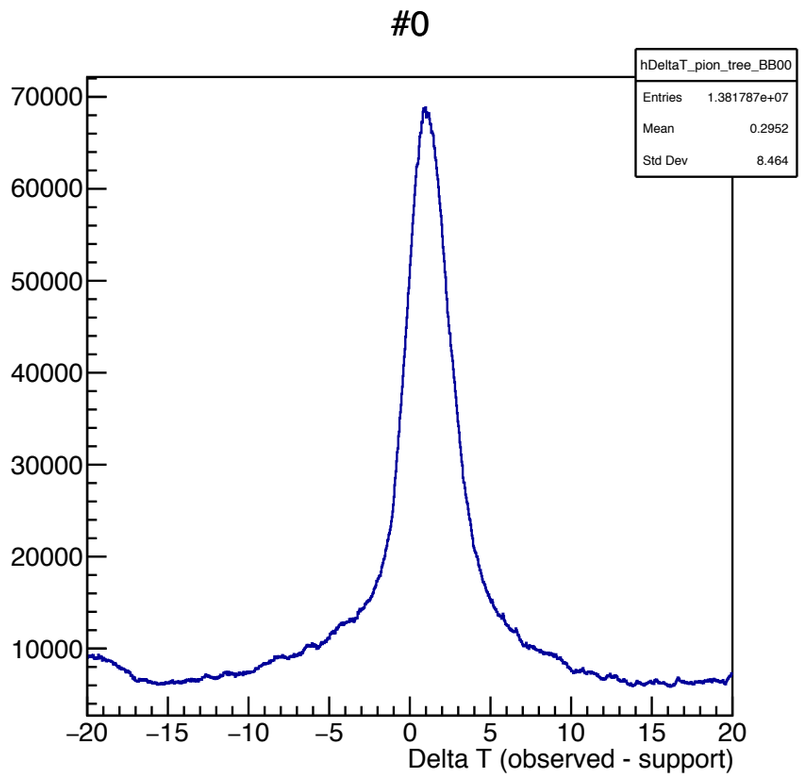


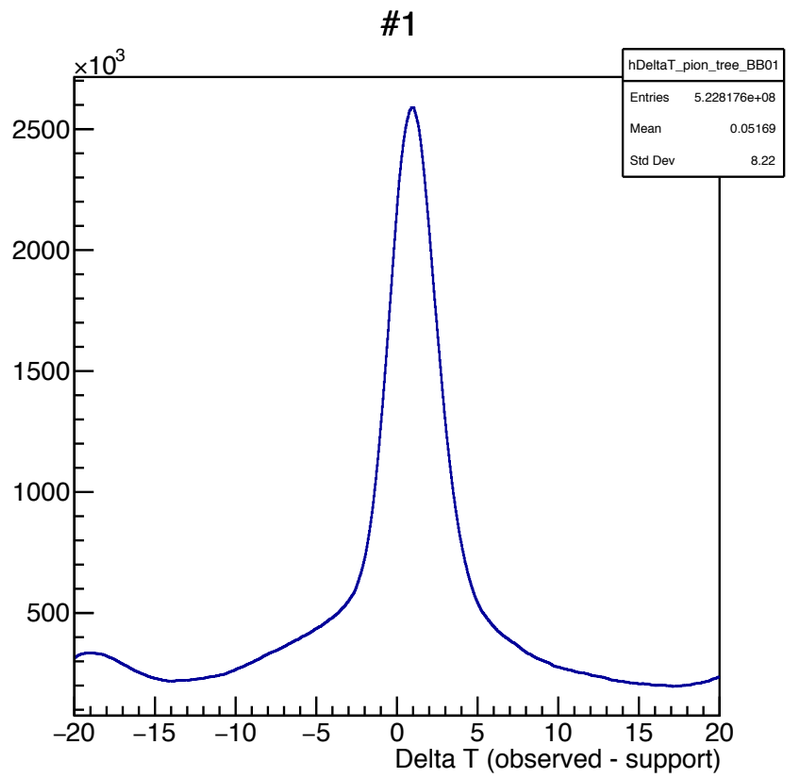


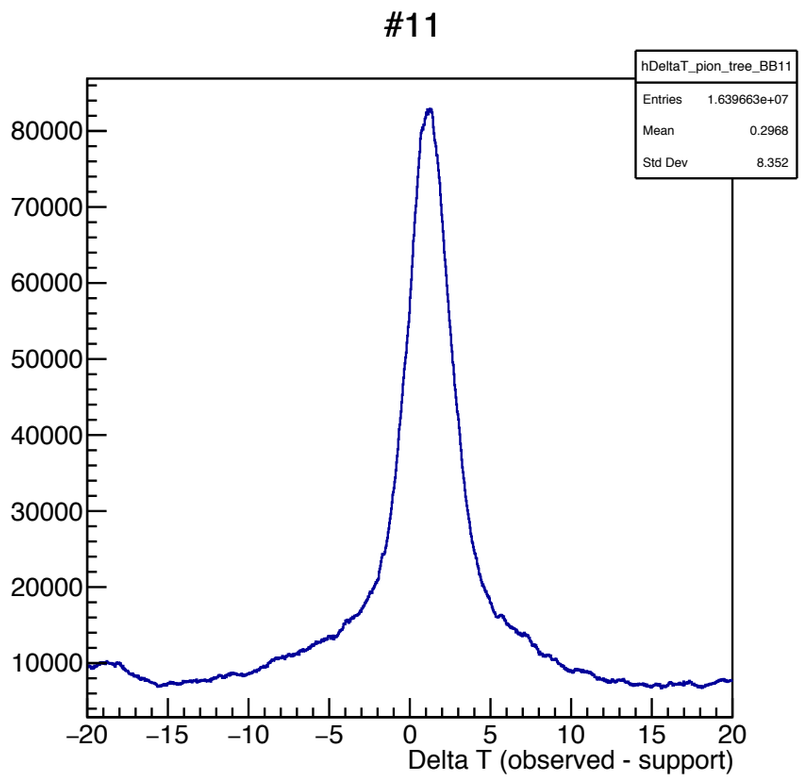


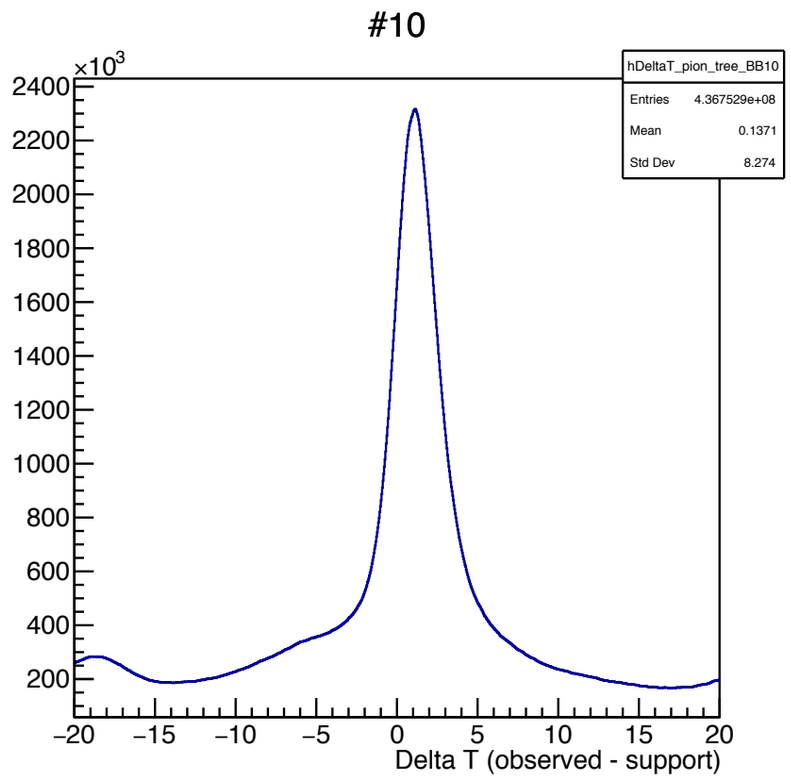


DeltaT: comparing among bar boxes









- Much more reasonable performance from BB#0 with better calibration from other systems

- Efforts are being made to take better advantage of those fast-simulated per-track Cherenkov photons

- Comments and ideas are more than welcome!