

Update on MesonEx trigger efficiency studies

- **MesonEx main trigger**
 - Two charged tracks in CLAS12-FD, in two different sectors
 - “Charged track”: (FTOF*PCU) * (PCAL > 15 MeV) * DC(R3 segment)
- **Trigger efficiency:**
 - Given an *event of interest*, measured by CLAS12 and reconstructed, is it recognized by a certain trigger condition?
 - Requires unbiased set of events to be properly evaluated -> FT-only trigger
- **Trigger purity:**
 - Given events that are measured by CLAS12 due to a certain trigger condition being satisfied, has the reconstructed event the topology of interest (i.e. the topology that was supposed to be selected by the trigger equation)?

This analysis is based on runs 4909,4913,4914,4916,4919(LH₂ target, 45 nA)

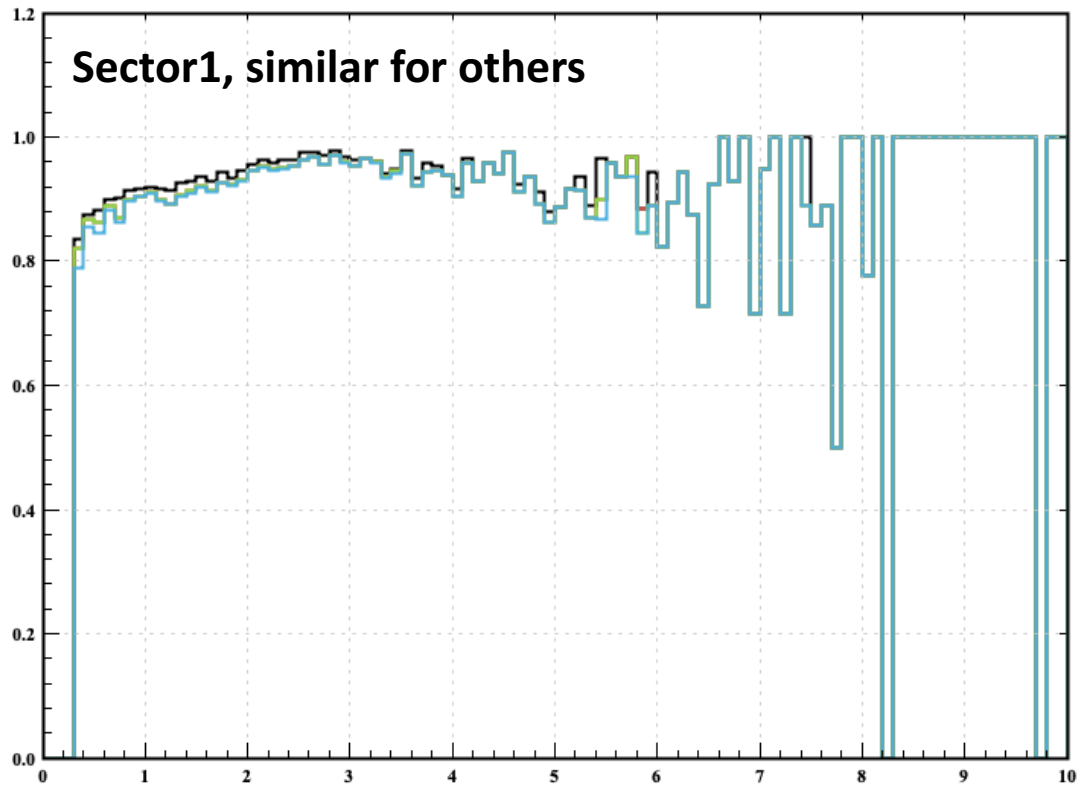
Reconstruction version: 5c.6.8

Analysis procedure (FTOF*PCU):

- Select events with 1 and 1 only TB track reconstructed in a sector, with a matching hit in both PCAL and FTOF1B
 - I rely on REC::Particle, REC::Scintillator, REC::Calorimeter for this
 - Only requirement is that the particle is associated with PCAL hit and FTOF1B hit, no requirements on hit position
 - PCAL $E > 10$ MeV, FTOF $E > 1$ MeV thresholds are used to select events with well defined hits
- Check if the sector-based trigger bit is active
 - FTOF*PCU
 - FTOF*PCU & PCAL>15MeV
 - FTOF*PCU & PCAL>15MeV & DC-OLD (segments, 5 out of 6 layers)
 - FTOF*PCU & PCAL>15MeV & DC-NEW (segments + roads)
- Measure trigger efficiency as a function of particle 3-momentum / hit position in PCAL / hit position in FTOF1B / ...
- Repeat for all sectors

Trigger efficiency (FTOF*PCU) as a function of momentum – FIRST RUN

First run (4909-4913): old FTOF-PCU map, old FTOF thr ($\sqrt{E_L * E_R} > 5$ MeV)



Different colors represent different sector-based trigger bits:

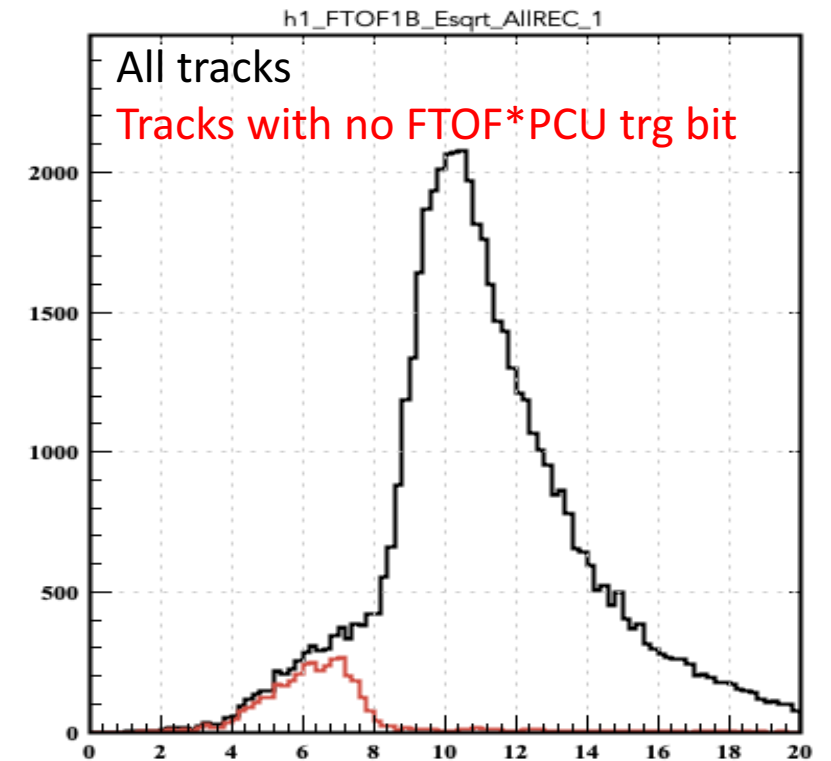
FTOF*PCU

FTOF*PCU & PCAL>15 MeV

FTOF*PCU & PCAL>15 MeV & DC-OLD

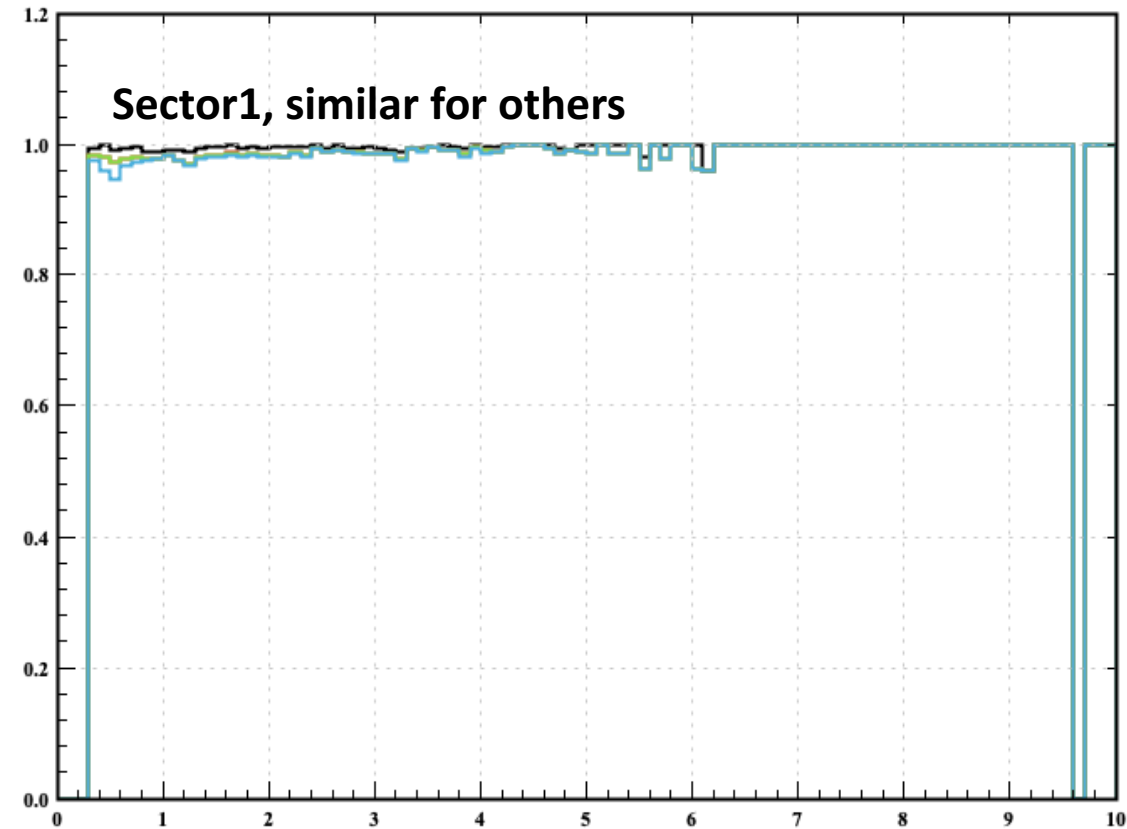
FTOF*PCU & PCAL>15 MeV & DC-NEW

With this configuration, FTOF*PCU is dominating trigger efficiency. As discussed in Spring, effect related mostly to FTOF thr. S-curve clearly visible in data! VTP thr was 5, **but still old gains** (FTOF PMTs gain is dropping)



Trigger efficiency (FTOF*PCU) as a function of momentum – SECOND RUN

First run (4909-4913): old FTOF-PCU map, **new** FTOF thr ($\sqrt{E_L * E_R} > 2$ MeV)



Different colors represent different sector-based trigger bits:

FTOF*PCU

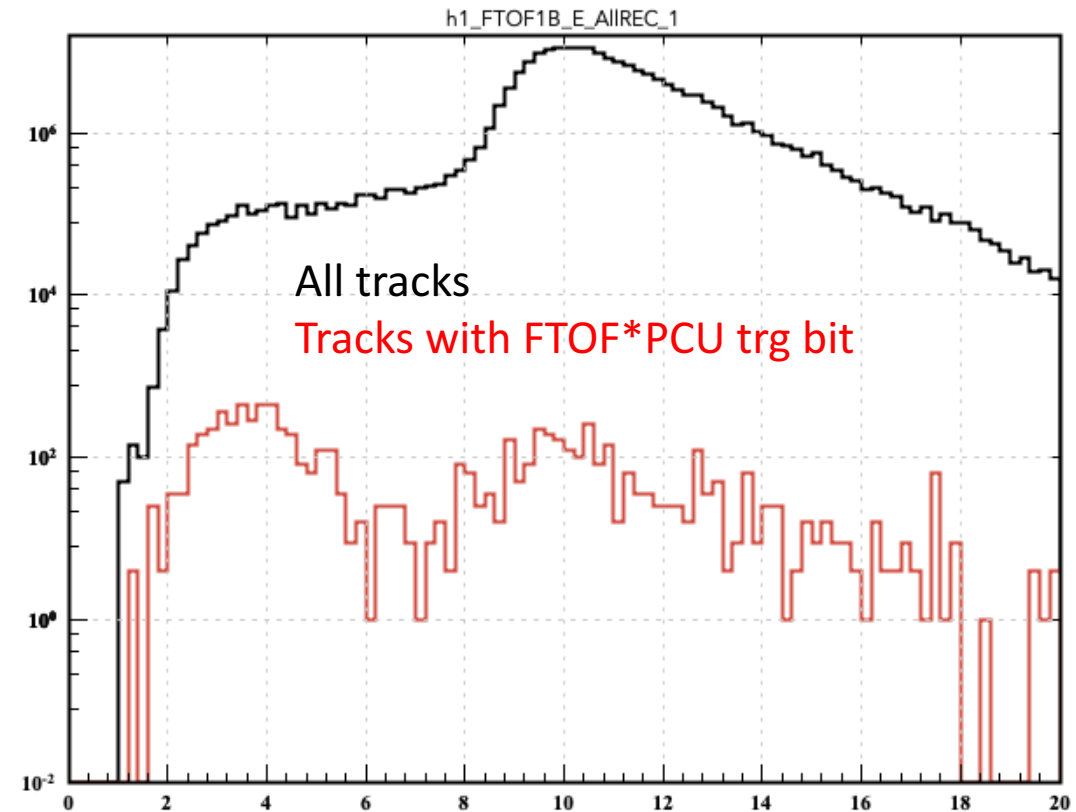
FTOF*PCU & PCAL>15 MeV

FTOF*PCU & PCAL>15 MeV & DC-OLD

FTOF*PCU & PCAL>15 MeV & DC-NEW

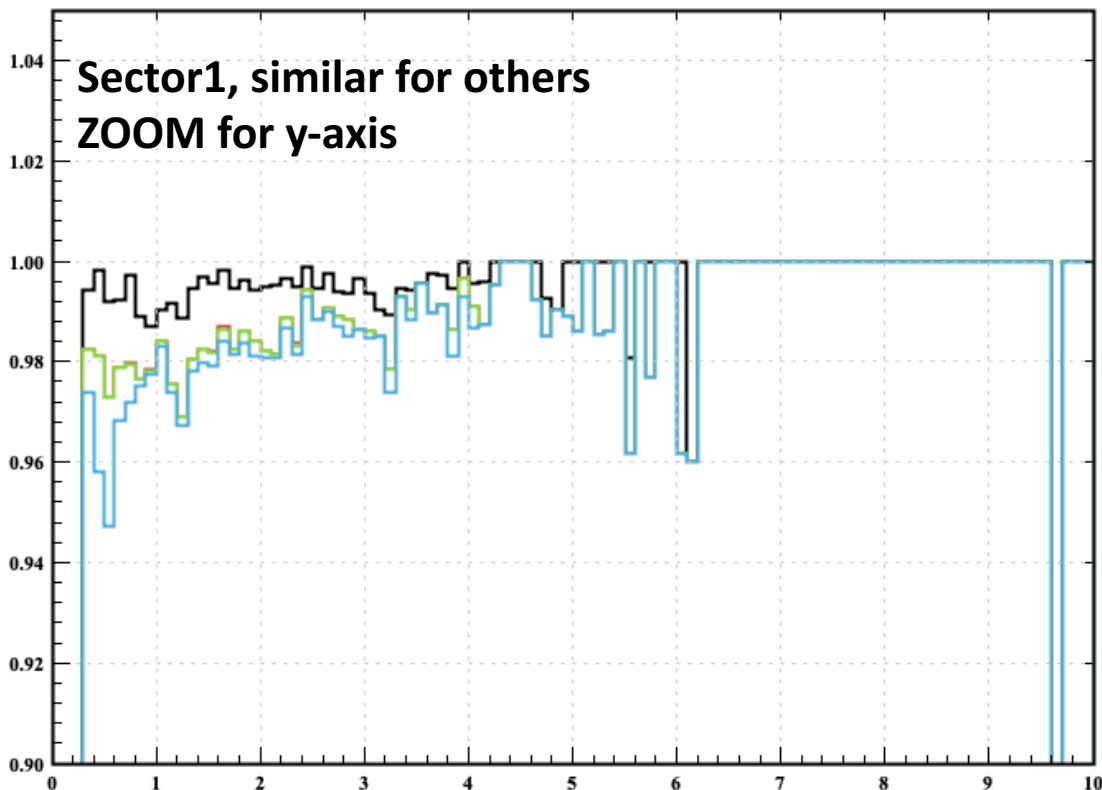
With this configuration, FTOF*PCU efficiency is close to 1 for all momenta. The threshold effect is now (almost) removed.

FTOF*PCU & PCAL>15 MeV is almost as FTOF*PCU & PCAL>15 MeV & DC-OLD. Is PCAL 15 MeV thr important?



Trigger efficiency (FTOF*PCU) as a function of momentum – SECOND RUN

Second run (4919): old FTOF-PCU map, **new** FTOF thr ($\sqrt{E_L * E_R} > 2 \text{ MeV}$)



Different colors represent different sector-based trigger bits:

FTOF*PCU

→ 99%

FTOF*PCU & PCAL>15 MeV

→ 98%

FTOF*PCU & PCAL>15 MeV & DC-OLD

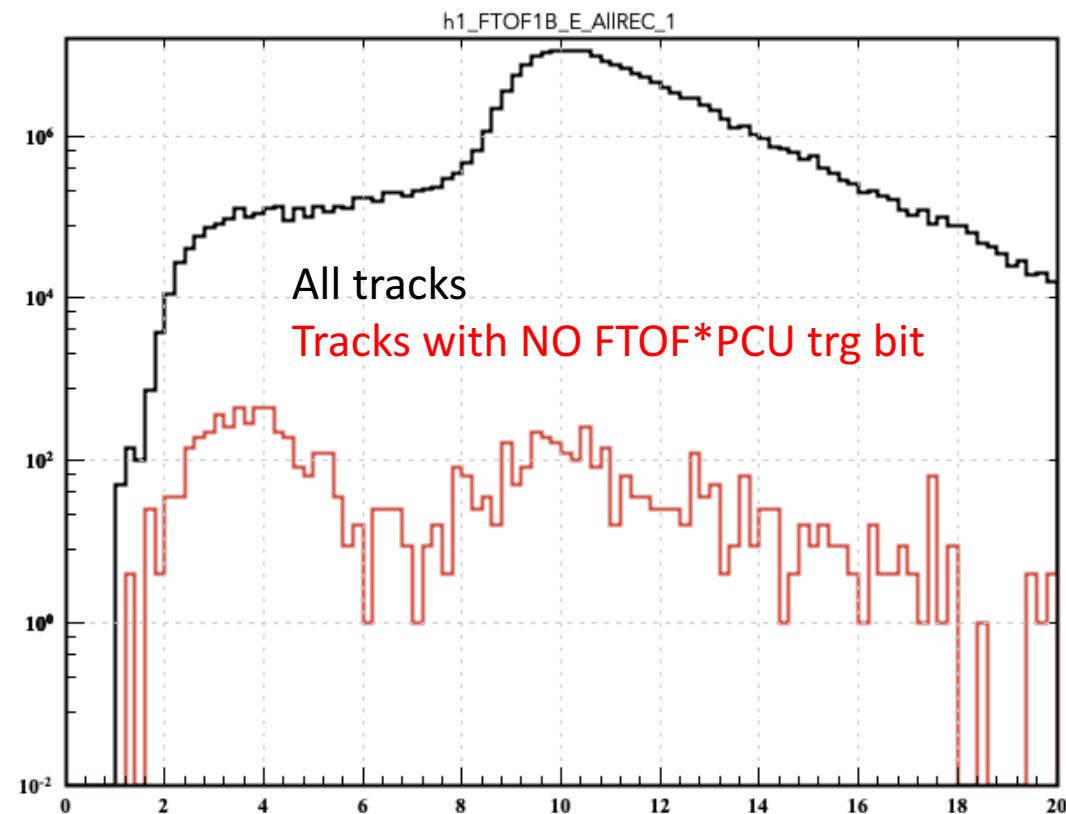
→ 98%

FTOF*PCU & PCAL>15 MeV & DC-NEW

→ 96-97%

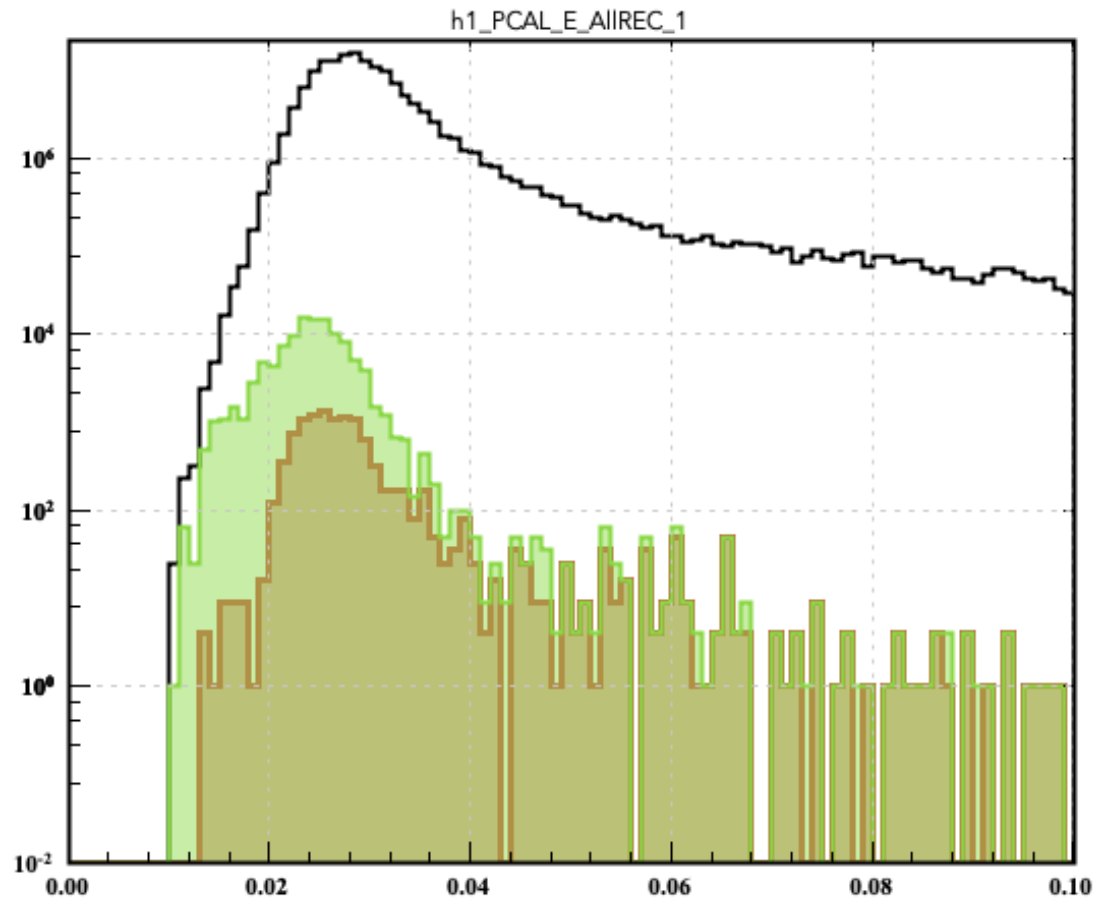
With this configuration, FTOF*PCU efficiency is close to 1 for all momenta. The threshold effect is now (almost) removed.

FTOF*PCU & PCAL>15 MeV is almost as FTOF*PCU & PCAL>15 MeV & DC-OLD. Is PCAL 15 MeV thr important?



Trigger efficiency (FTOF*PCU) as a function of momentum – SECOND RUN

First run (4909-4913): old FTOF-PCU map, **new** FTOF thr ($\sqrt{E_L * E_R} > 2 \text{ MeV}$)



All tracks

Tracks with NO FTOF*PCU trg bit

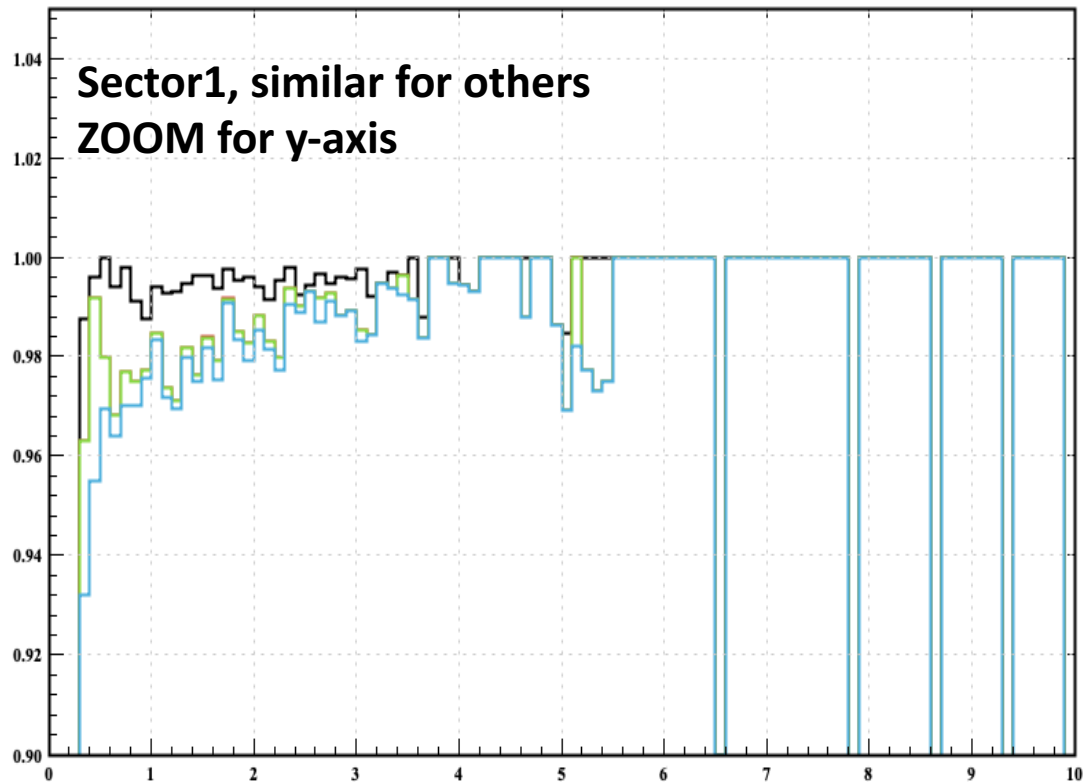
Tracks with NO FTOF*PCU*PCAL>15 MeV trg bit

There is some residual threshold effect at low energy.

Do we want / can we lower the PCAL thr to 10 MeV (or less?)

Trigger efficiency (FTOF*PCU) as a function of momentum – THIRD RUN

Third run (4914-4916): **new** FTOF-PCU map, **new** FTOF thr ($\sqrt{E_L * E_R} > 2 \text{ MeV}$)



Different colors represent different sector-based trigger bits:

FTOF*PCU

→ 99%

FTOF*PCU & PCAL>15 MeV
then growing from 96% to 99%

→ 99% very low P,

FTOF*PCU & PCAL>15 MeV & DC-OLD

→ AS ABOVE

FTOF*PCU & PCAL>15 MeV & DC-NEW

→ 96-97%

With this configuration, FTOF*PCU efficiency is almost as before, but FTOF*PCU & (PCAL>15MeV) changes: increases at very low P, then decreases, then grows to 99%. To be investigated, probably the trigger requirement PCAL>15MeV cleans the sample of tracks.

Trigger efficiency – TODO

- Data for this study was acquired using FT-only trigger (no bias on CLAS12), resulting in larger number of good tracks for same number of triggers. Need to estimate minimum triggers number to repeat at periodic times in the future.
- Data for this study can be used to evaluate trigger efficiency on specific (exclusive) event topology, as ω photoproduction – need to coordinate with Derek for this.
- Further investigate the “Roads” condition.
- Proposal for next runs: old FTOF-PCU map, new FTOF threshold
 - Current DAQ setting is this one.

Backup

- Comparing old FTOF thr (left) and new FTOF thr (right) efficiency selecting "good" tracks as those having PCAL hit with energy > 5 MeV (previously was 10 MeV)
 - FTOF*PCU efficiency with new THR still $\sim 99\%$ (ok)
 - FTOF*PCU*(PCAL >15 MeV) efficiency with new THR still $\sim 98\%$

