Geometric Efficiency Correction – Method and implementation with the PRISM framework

November 1st, 2024

Ioana Caracas

First Results: towards implementing the geometric efficiency correction within PRISM

- first results: use all throws (4096) and keep / interested in events that passed the throw (vetoE < 30 MeV) vs Etrim
- all vtx_x position (72) that will be used in the geometric efficiency calculation
- first attempt to apply OA coefficients to Etrim distributions.. (still a lot to do and think of here)

→ Main goal is to take events from the FD and translate them to ND:
what would be the chances that a particular event in the FD (with a given hadronic energy deposit) would be seen in the ND

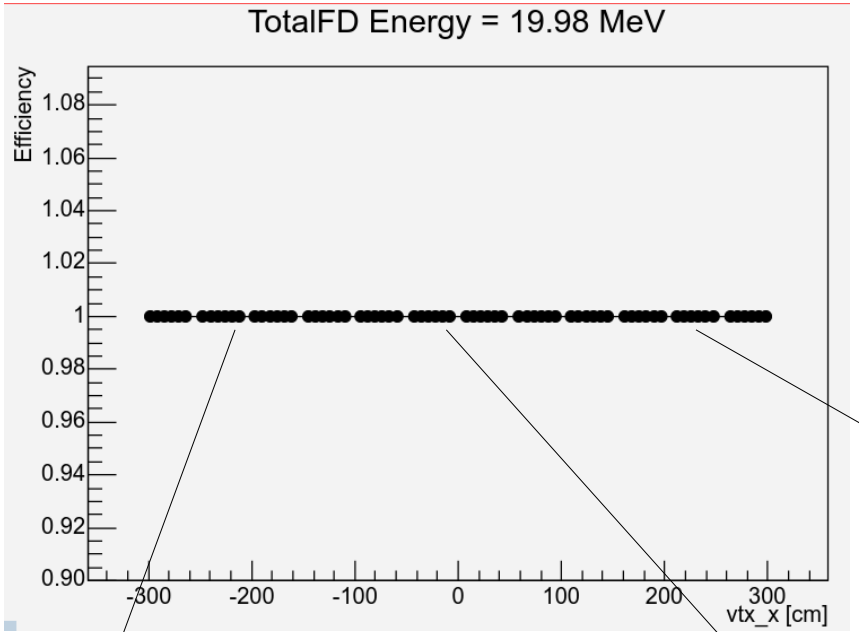
Before I start...

Disclaimer: some small "bug" found in the code: Flynn tried to check the results with pre-trimming events after putting them at a specific vtx_x position, then throwing events at different y, z + rotations

– FD Events are thrown at different y, z + rotations with a lower hadronic energy then they would have eventually → events presented here have a higher efficiency then they would have when the total FD hadronic energy is kept and thrown

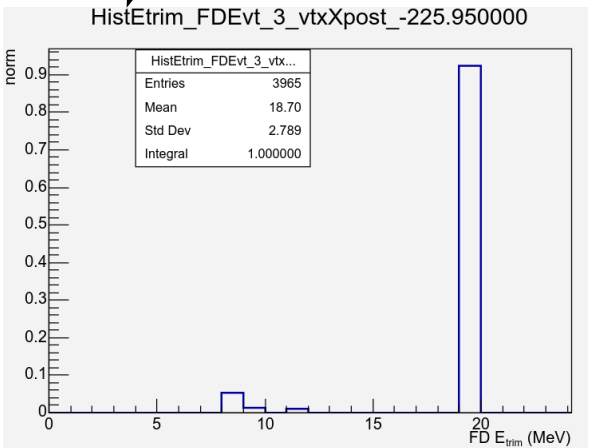
→ solved + updated **plots**

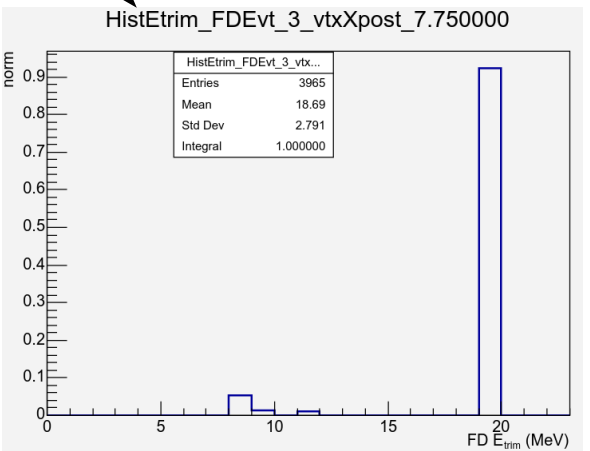
– events with highest energies and spread hadronic signatures most affected by this

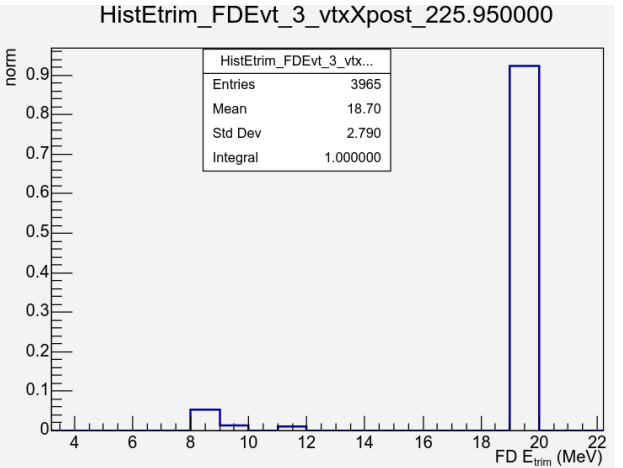


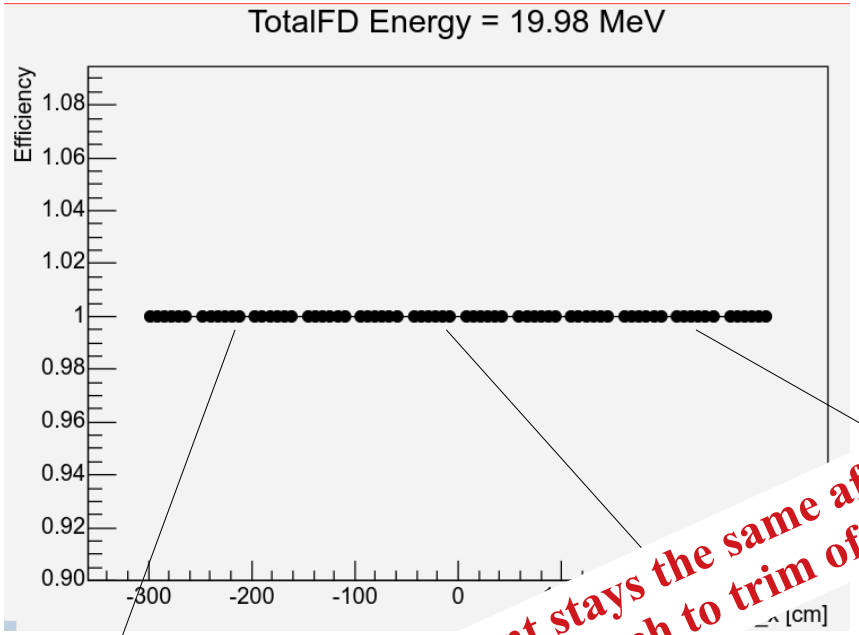
On-axis only : detector at 0 m

- from all throws we only care about throws passing the veto cut :
  Efficiency (vtx_x) = nThrowsPass / AllThrows
- Etrim: energy deposited inside ND active volume (= FD Energy – OutEnergy)
- Integral of each histogram corresponds to the efficiency at the given vtx_x position
- Entries = nThowsPass
  – norm (y-axis) = Entries * Eff / nThrowsPass









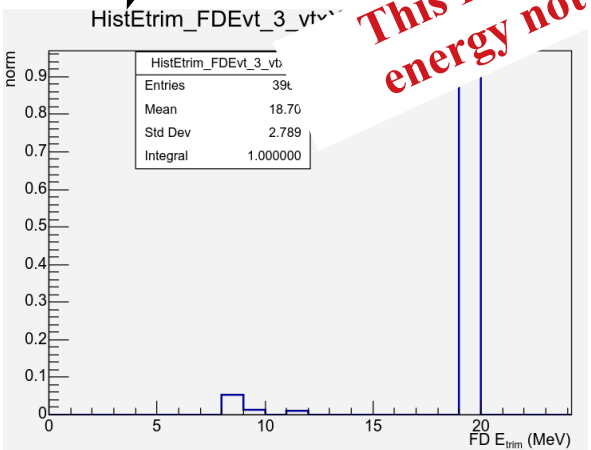
On-axis only : detector at 0 m

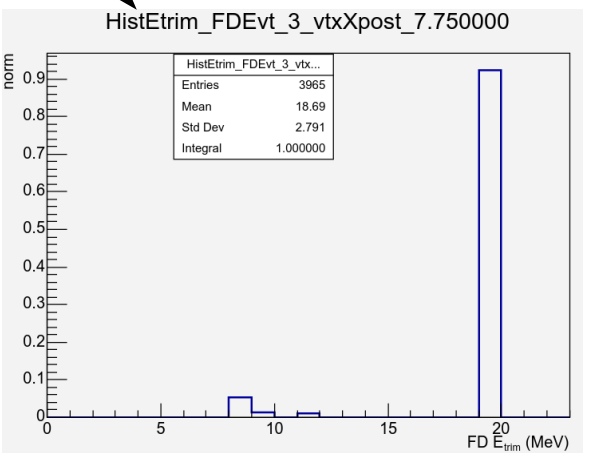
- from all throws we only care about throws passing the veto cut :
  Efficiency (vtx_x) = nThrowsPass / AllThrows
- Etrim: energy deposited inside ND active volume
  (= F… …ergy – OutEnergy)

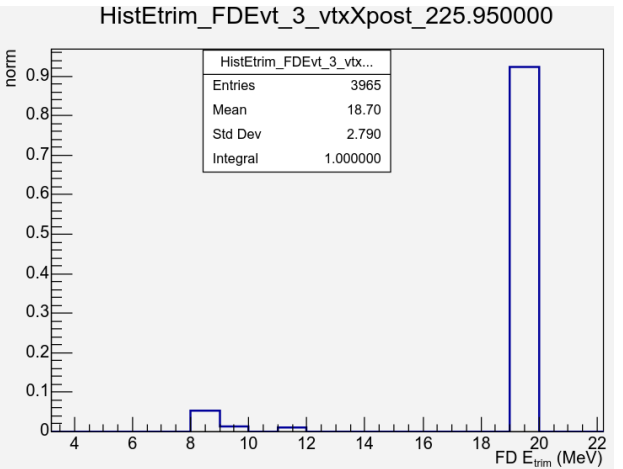
…of each histogram corresponds to the …ficiency at the given vtx_x position

- Entries = nThowsPass
  - **norm (y-axis) = Entries * Eff / nThrowsPass**

This Event stays the same after bug: very low energy not much to trim off to start with

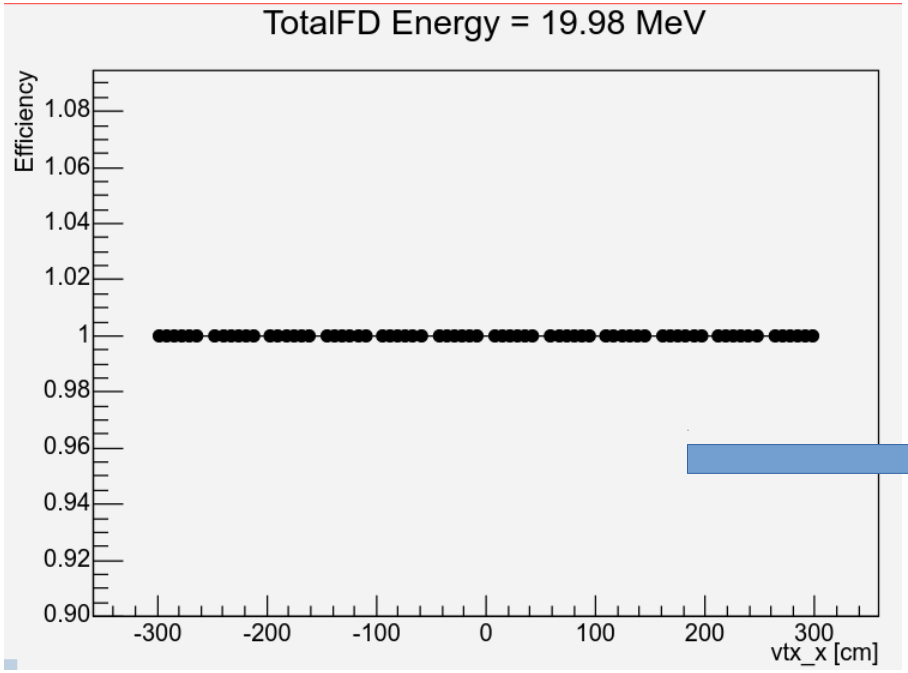


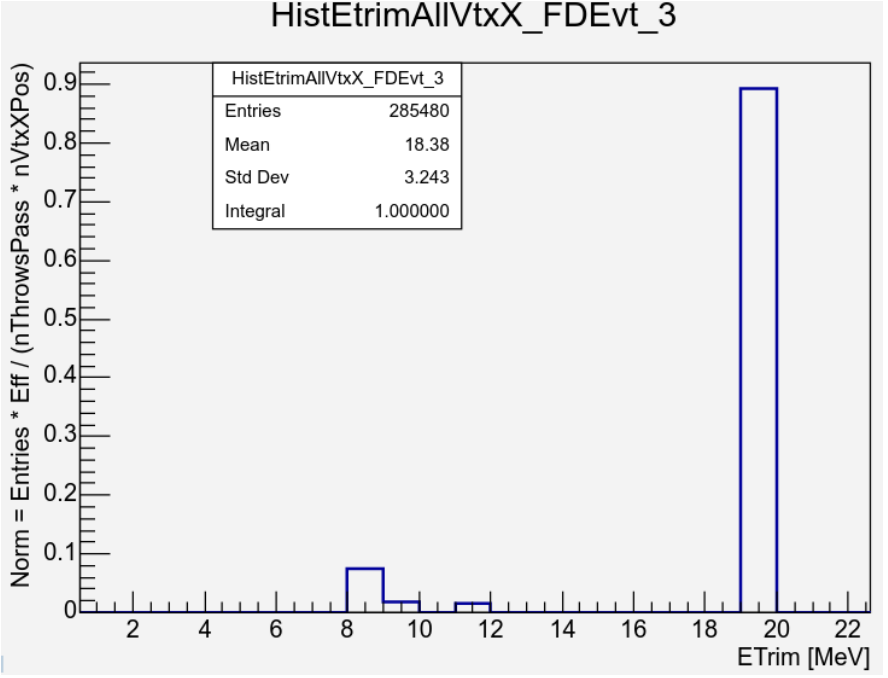




FD Events – efficiency corrected

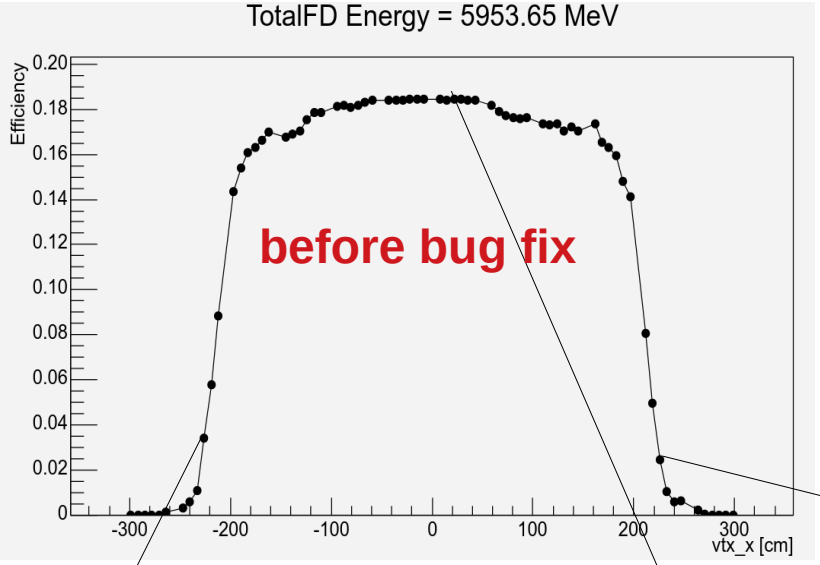
Distribution of FD Event as seen by ND vs Etrim





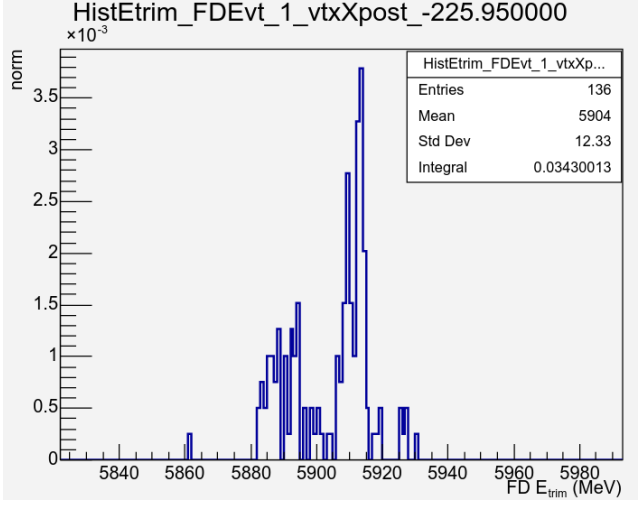
add up all vtx_X Etrim histos (no coefficients applied)

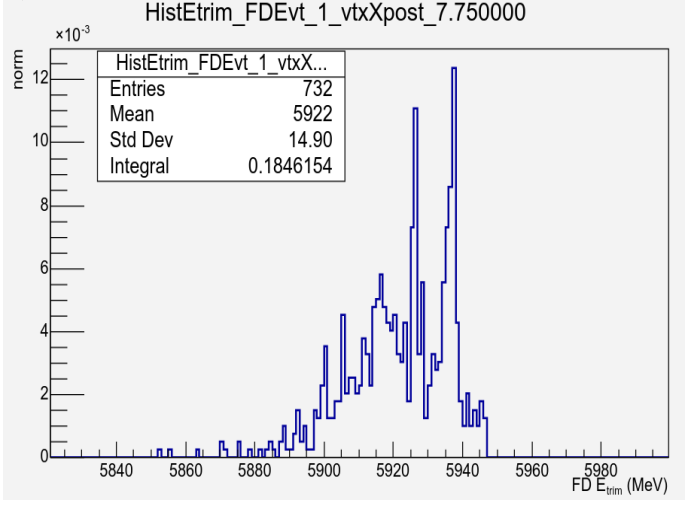
– **average efficiency** (E_{trim}) of FDEvt_3 (FD Energy = 19.98 MeV) at ND is **1**

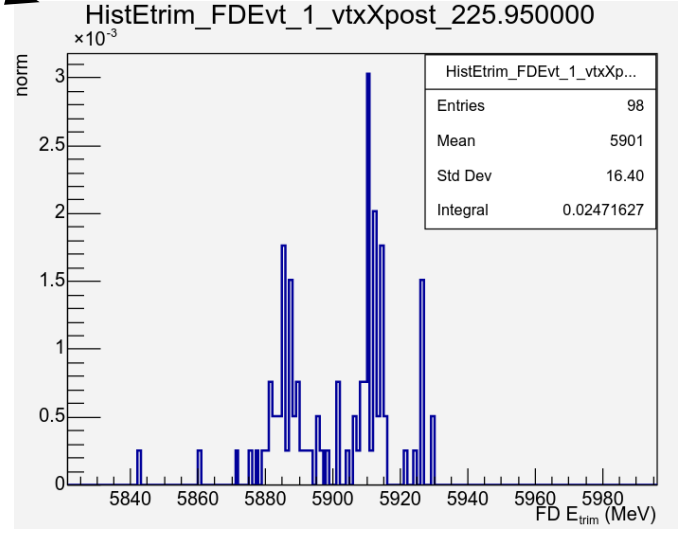


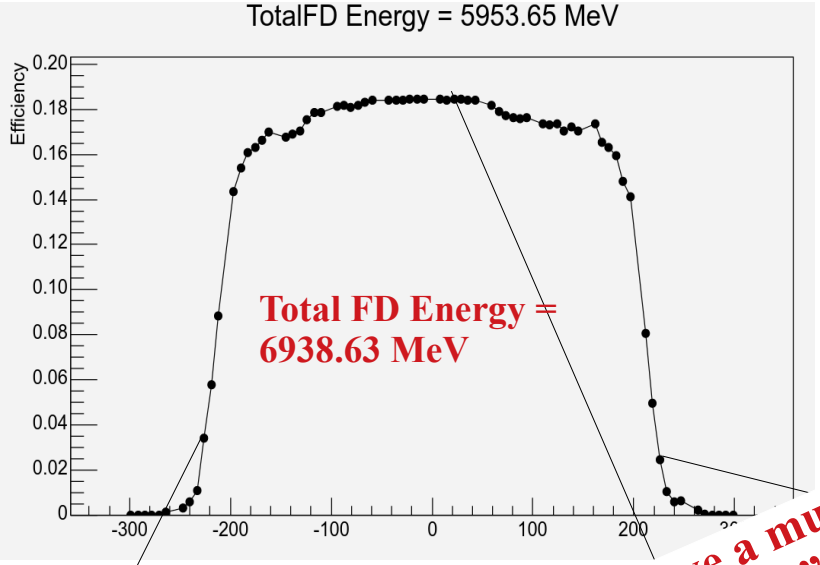
On-axis only : detector at 0 m

- from all throws we only care about throws passing the veto cut :
  Efficiency (vtx_x) = nThrowsPass / AllThrows
- Etrim: energy deposited inside ND active volume (= FD Energy – OutEnergy)
- Integral of each histogram corresponds to the efficiency at the given vtx_x position
- Entries = nThowsPass
  – **norm (y-axis) = Events * Eff / nThrowsPass**









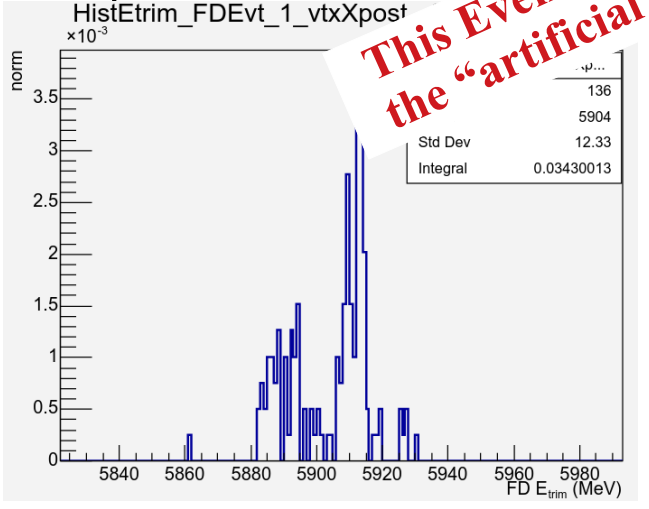
On-axis only : detector at 0 m

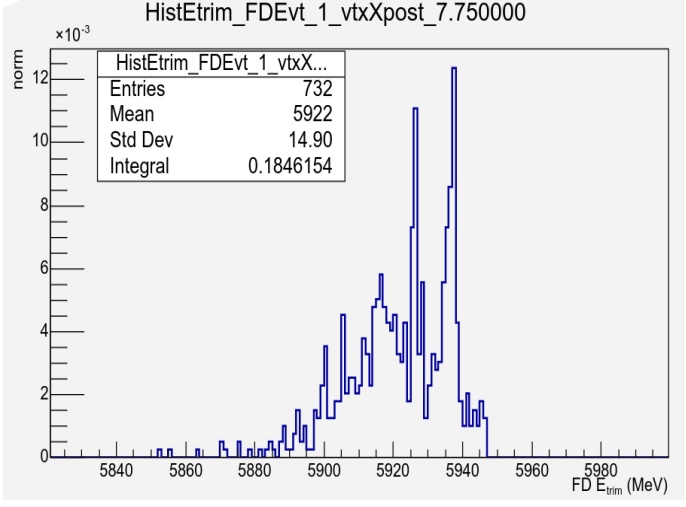
- from all throws we only care about throws passing the veto cut :
  Efficiency (vtx_x) = nThrowsPass / AllThrows
- Etrim: energy deposited inside ND active volume
  (= FD [illegible]gy – OutEnergy)

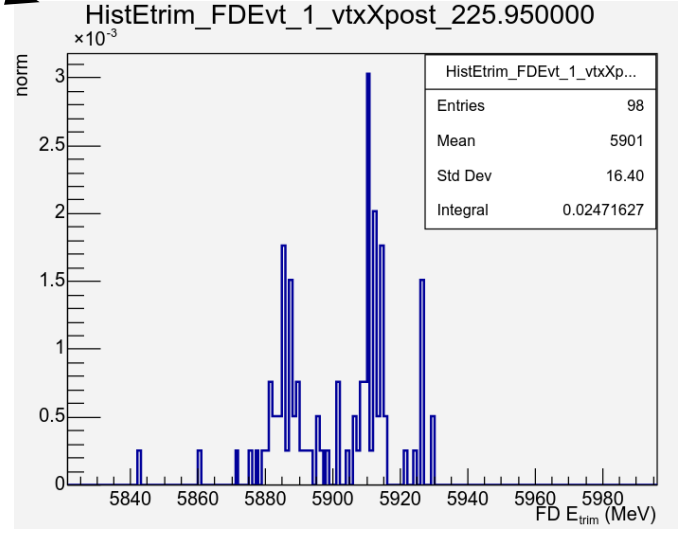
. each histogram corresponds to the
[illegible]iency at the given vtx_x position
Entries = nThowsPass

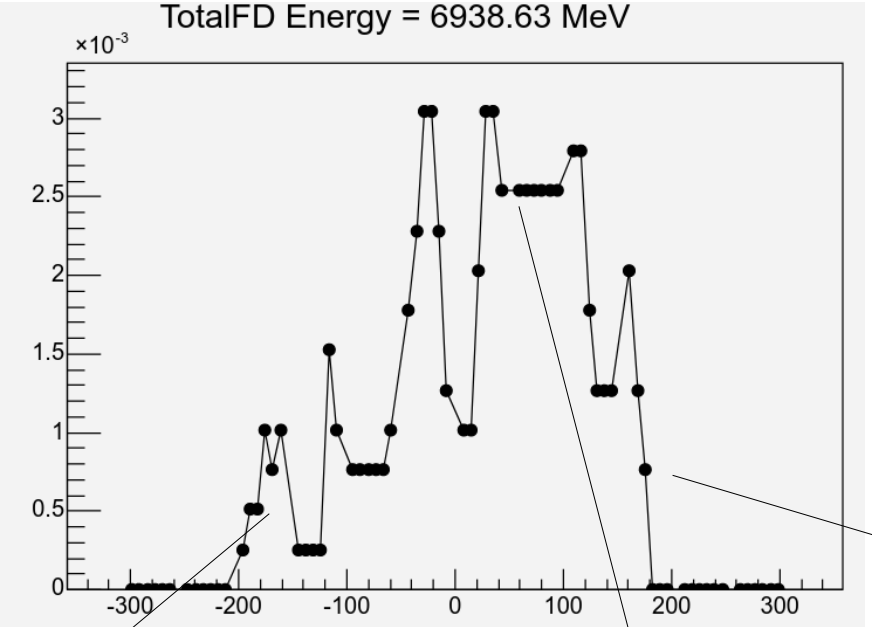
– **norm (y-axis) = Events * Eff / nThrowsPass**

This Event will have a much lower efficiency once the "artificial trimming" is fixed

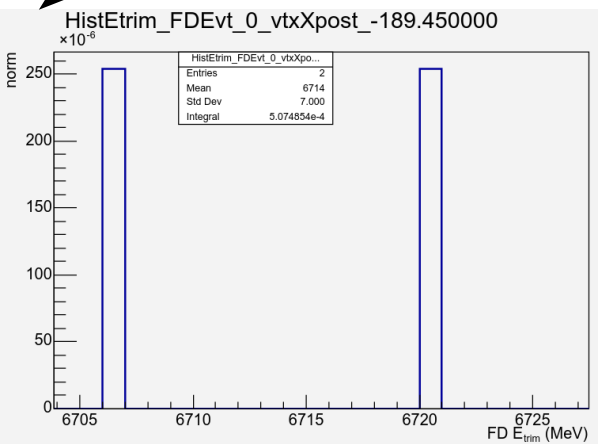


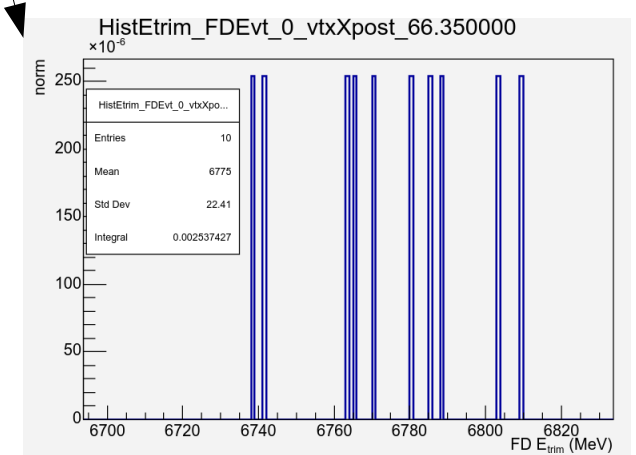


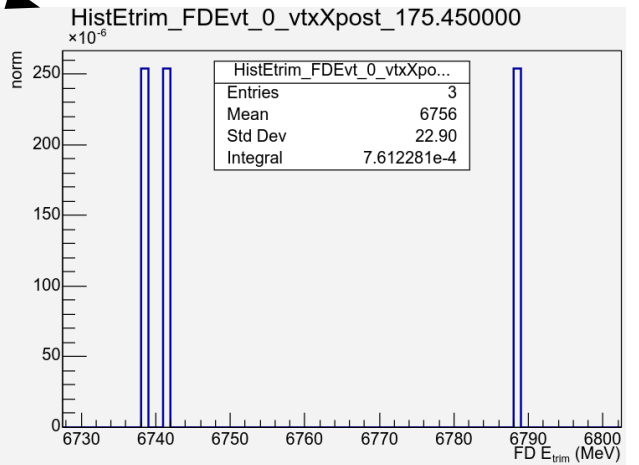




Same Event after bug fix: don't trim the energy out, keep the total FD energy and re-throw the events in y, z + rotations

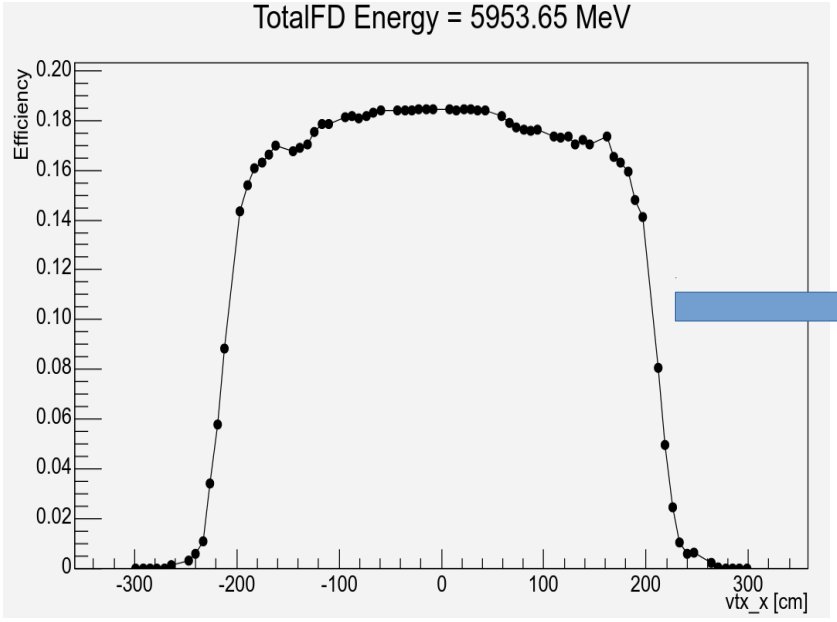






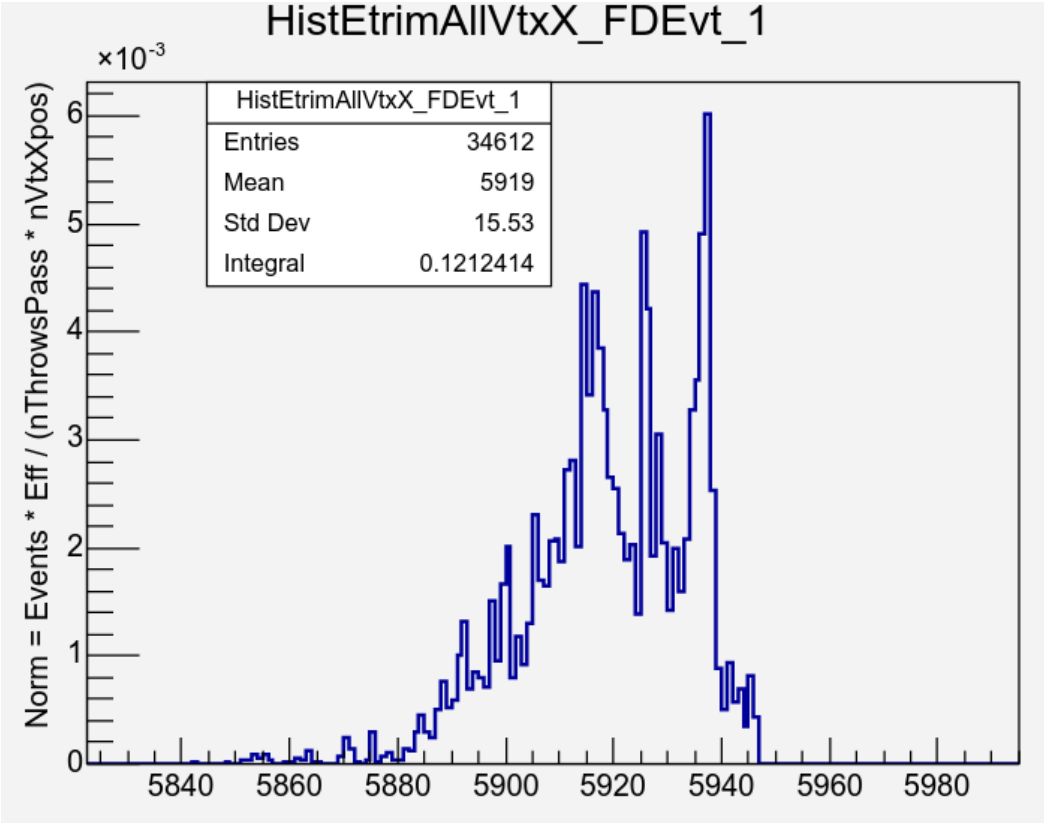
FD Events – efficiency corrected

before bug fix



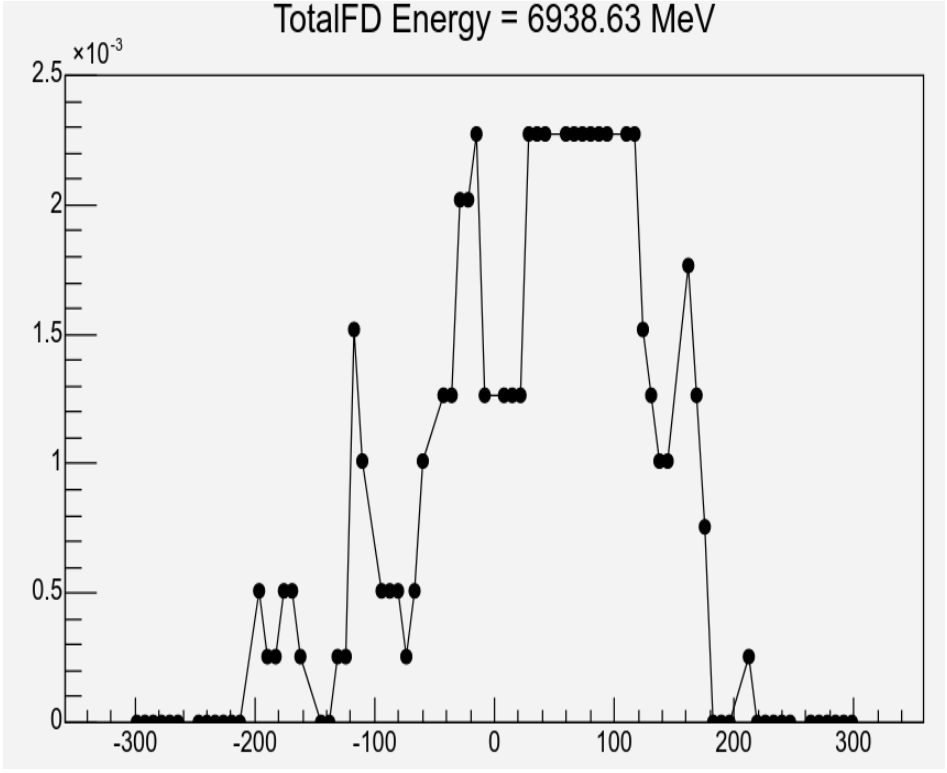
add up all vtx_X Etrim histos (no coefficients applied)

Distribution of FD Event as seen by ND vs Etrim



– **average efficiency** (E_{trim}) of FDEvt_1 (FD Energy = 5953.65 MeV) at ND is **0.12**

FD Events – efficiency corrected



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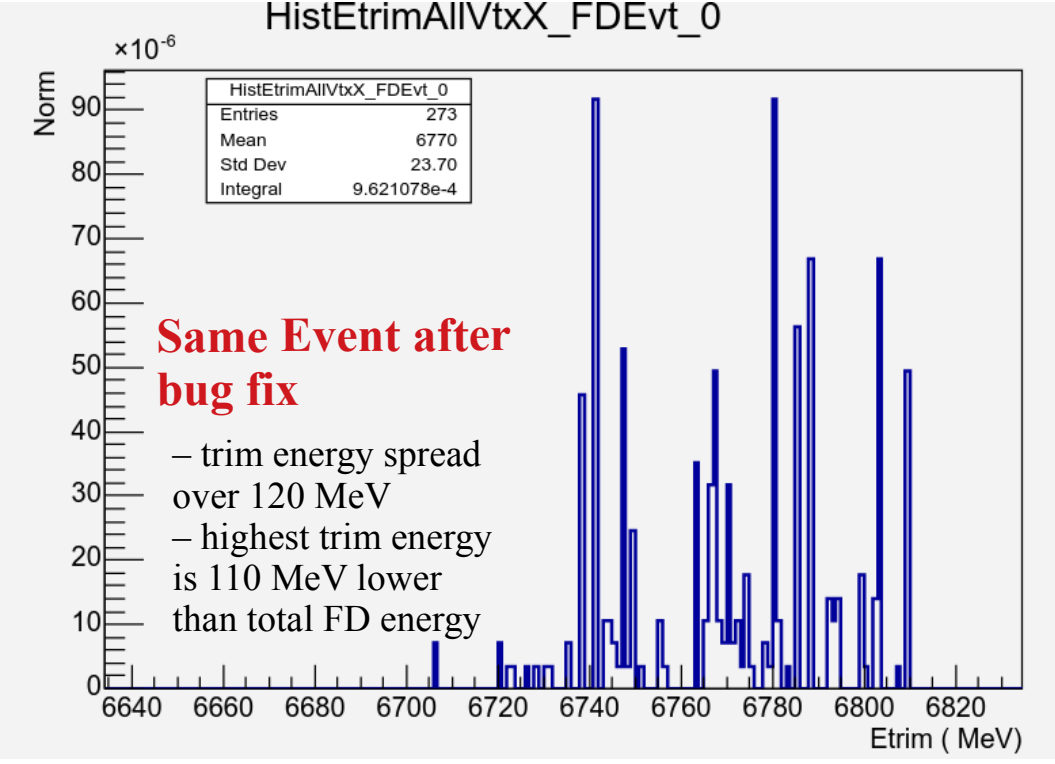
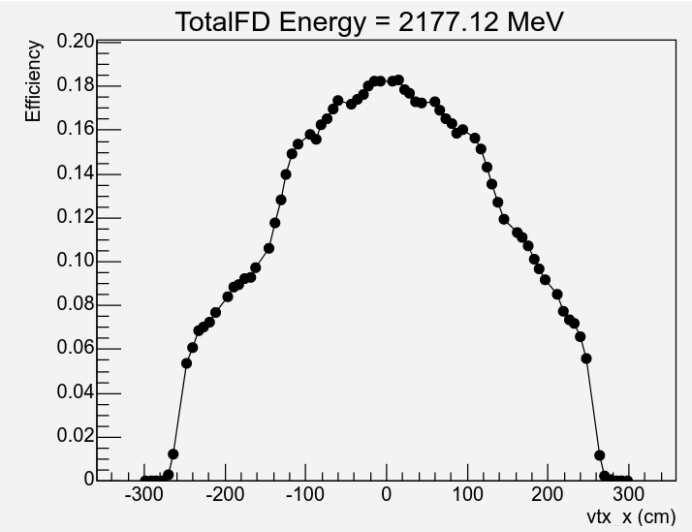
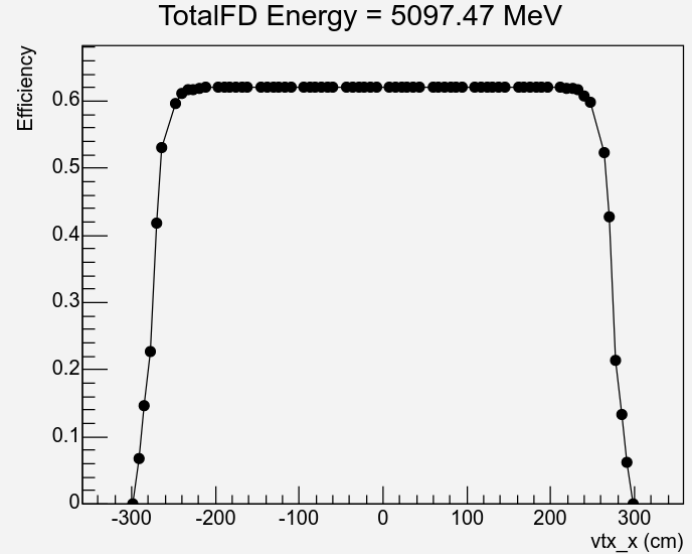
Distribution of FD Event as seen by ND vs Etrim

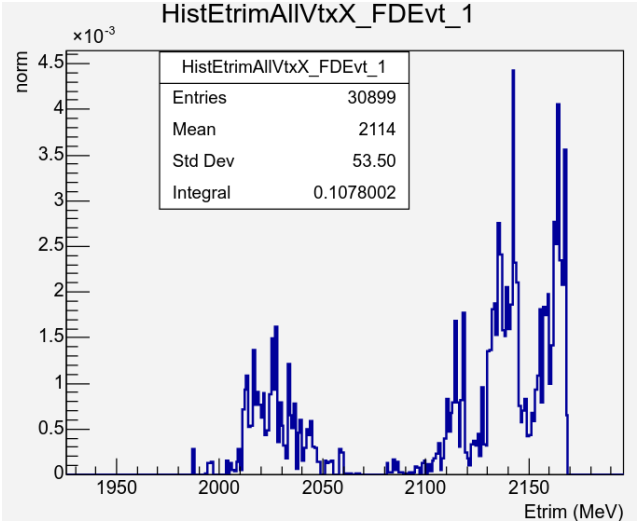


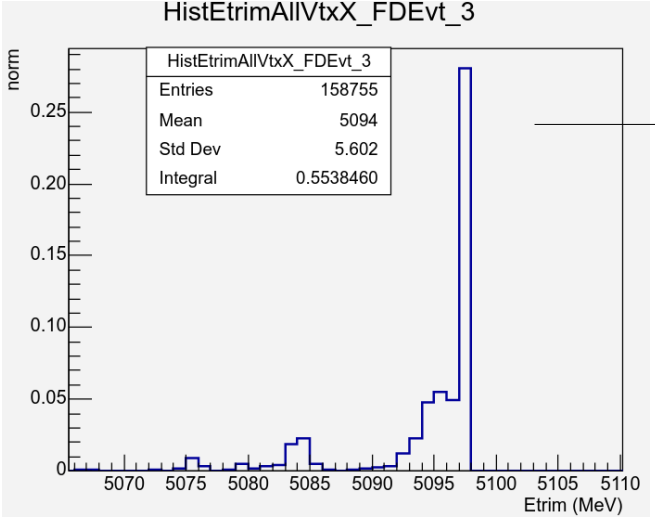
– **average efficiency** (E_{trim}) of FDEvt_1 (FD Energy = 5953.65 MeV) at ND is **9.62 e-4**

Interesting / Not intuitive events





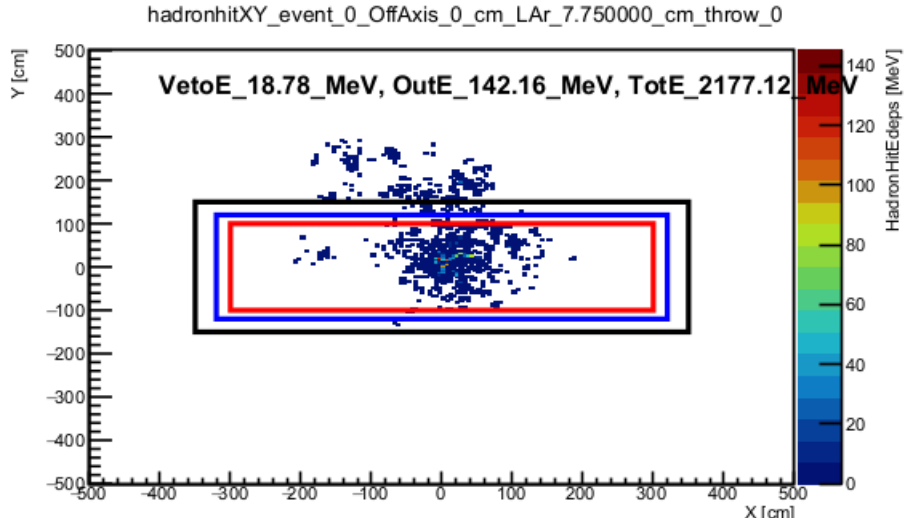


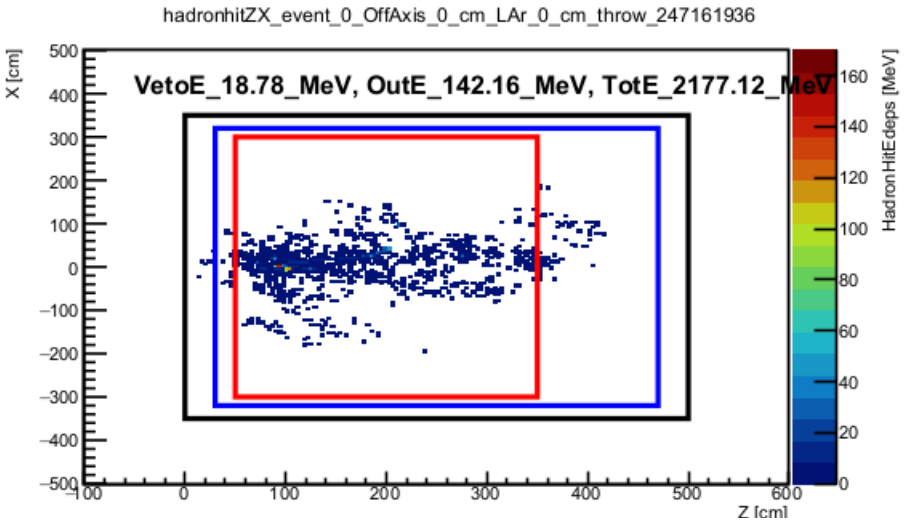


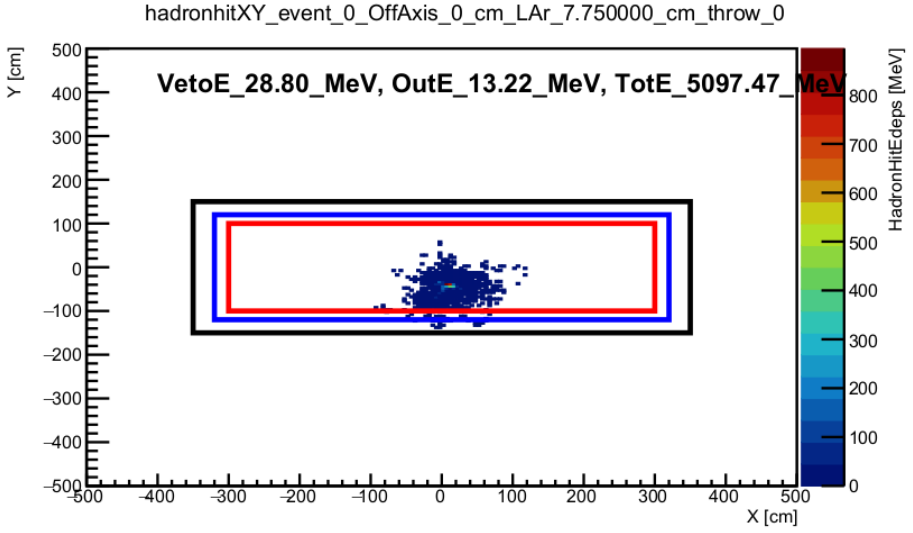
- why is there a lower efficiency for an event with 2.1 GeV at the FD than for an event with 5 GeV?

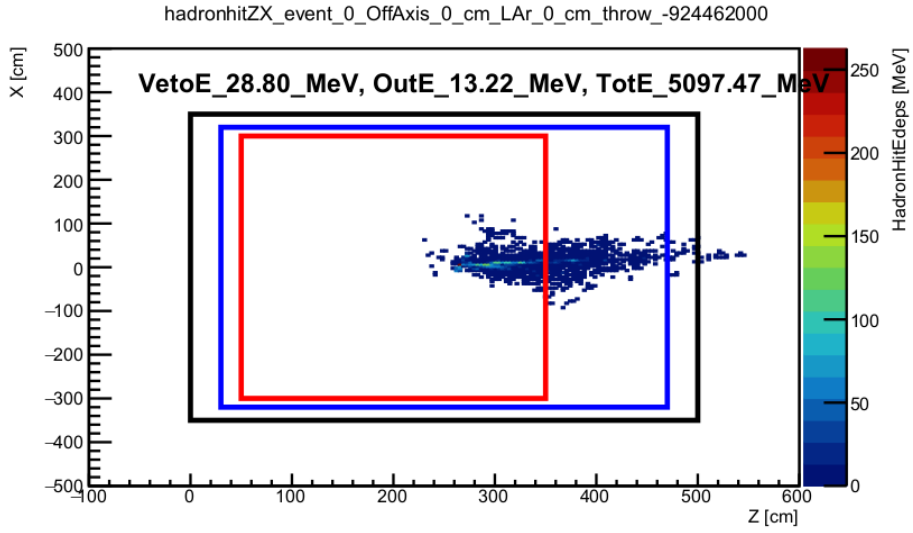
seems like this event is barely trimmed at all..

Interesting / Not intuitive events – hadron hits

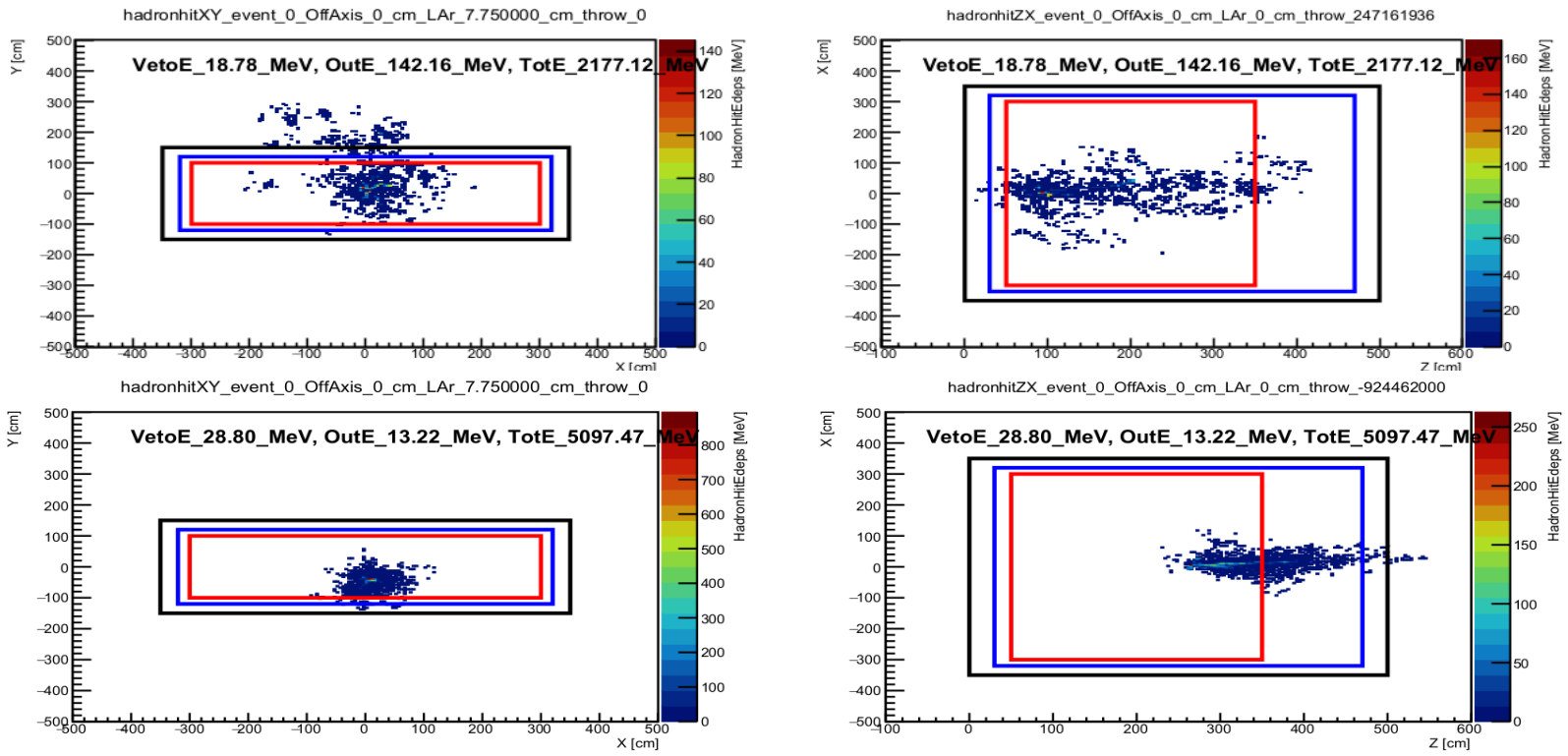






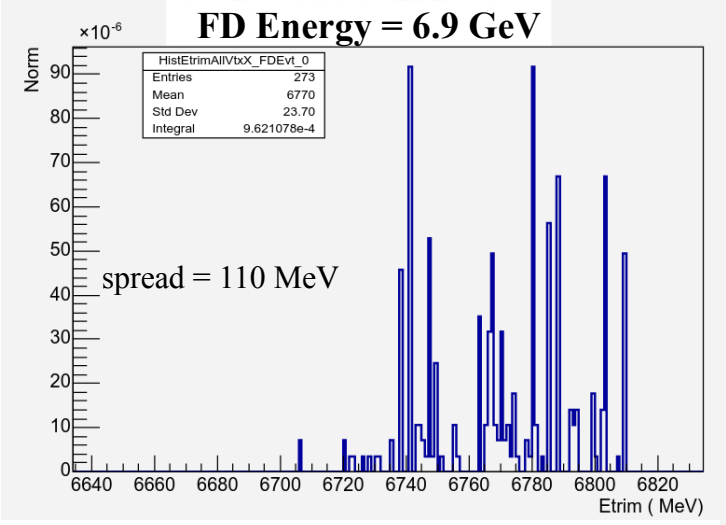


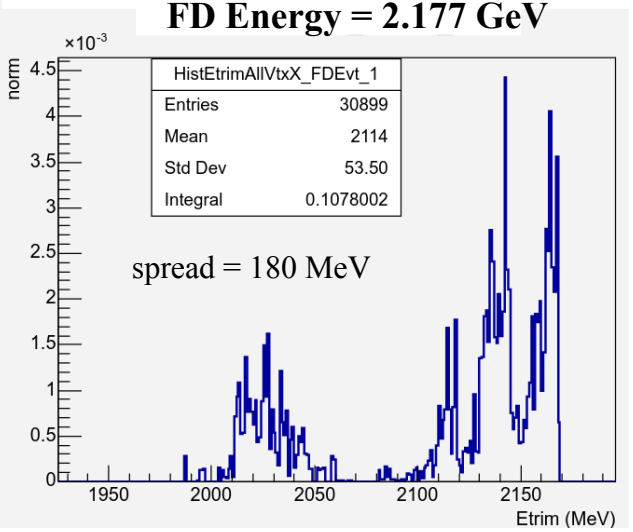
Interesting / Not intuitive events – hadron hits

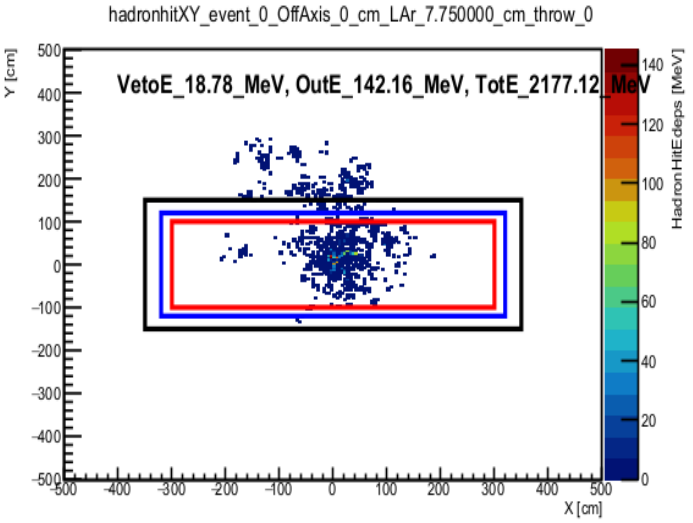


- lower energy event (2.1 GeV) has a more "spread" hadronic signature, while the 5 GeV event is pretty well contained / narrow
  - different primaries inducing the shower: – 2.1 GeV: 2 protons, 1pi0, 4 pi+/-
    – 5 GeV: 11 protons, 3 pi0, 0 pi+/-

Interesting / Not intuitive events





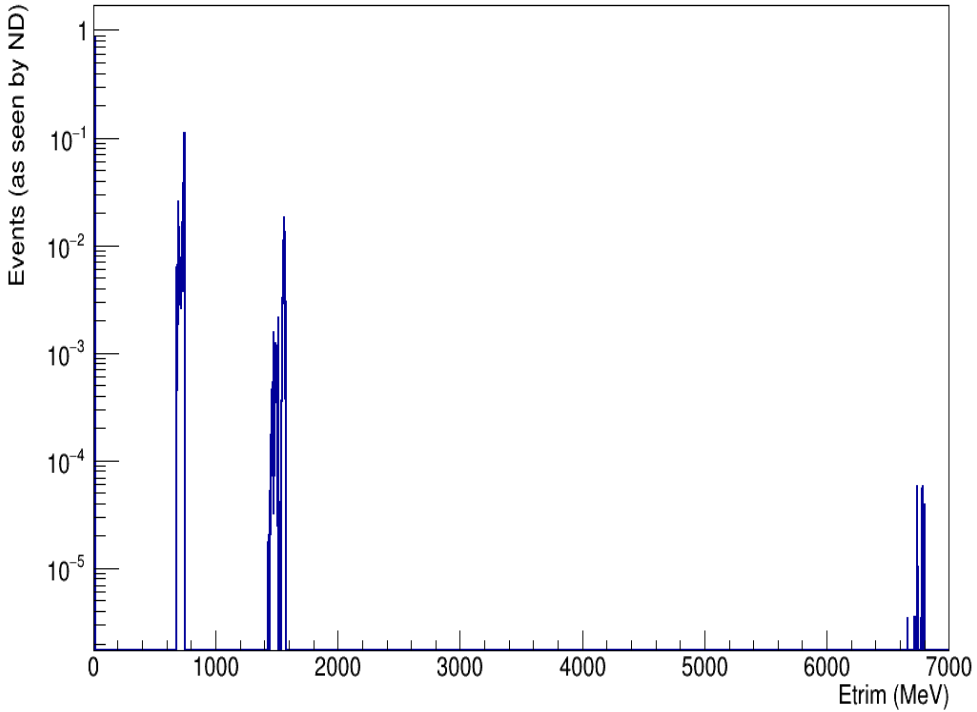


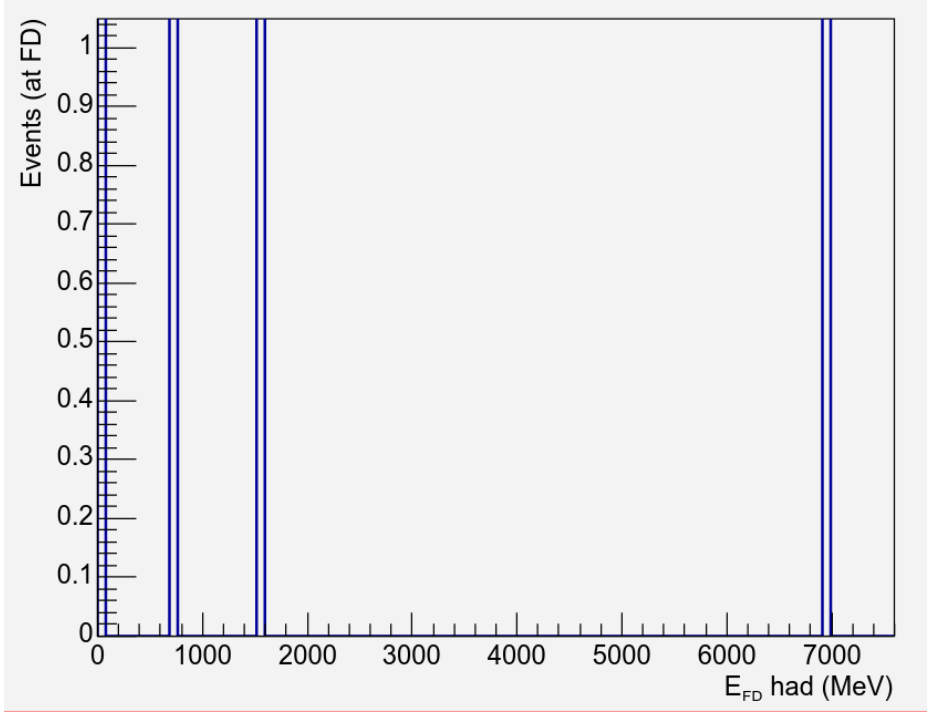
- looking not only for high FD energy events, but also for events with a spread hadronic energy deposit (more pi+/- and not so many p in the primaries) in order to see a very "split" Etrim distribution

  → best type of event to show the usefulness of Etrim would be a high energy event with a very wide hadronic signature… (however those are not very likely to pass the throws) → need to start working with more events – soon :)

Events distribution in the FD vs Seen by ND

- on-axis only + no coefficients applied (very very first attempt of such a plot)





– again need more statistics for such a plot .. but still maybe useful for a visualization.