

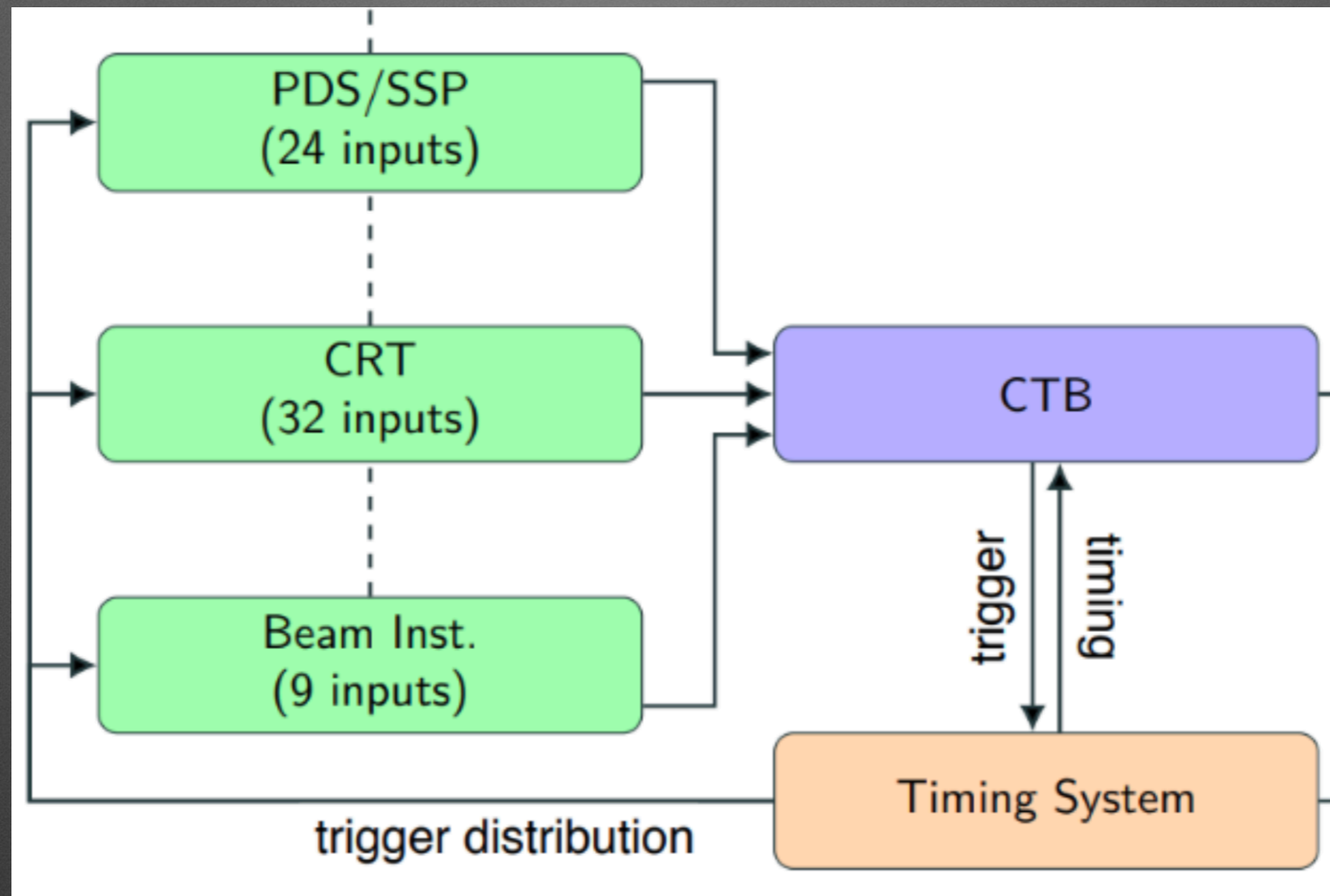
ProtoDUNE CRT+TPC+PDS Cosmic Matching

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ProtoDUNE PDS WG

Introduction

- Technology comparisons underway but sample of cosmics needed for coverage of the entire PDS
- TPC needed for relatively precise position of cosmic information but time resolution 1000x PDS (~20 microseconds)
- CRT has comparable time resolution to PDS (~nanoseconds) but 1.6m uncertainty in pixel size

Strategy

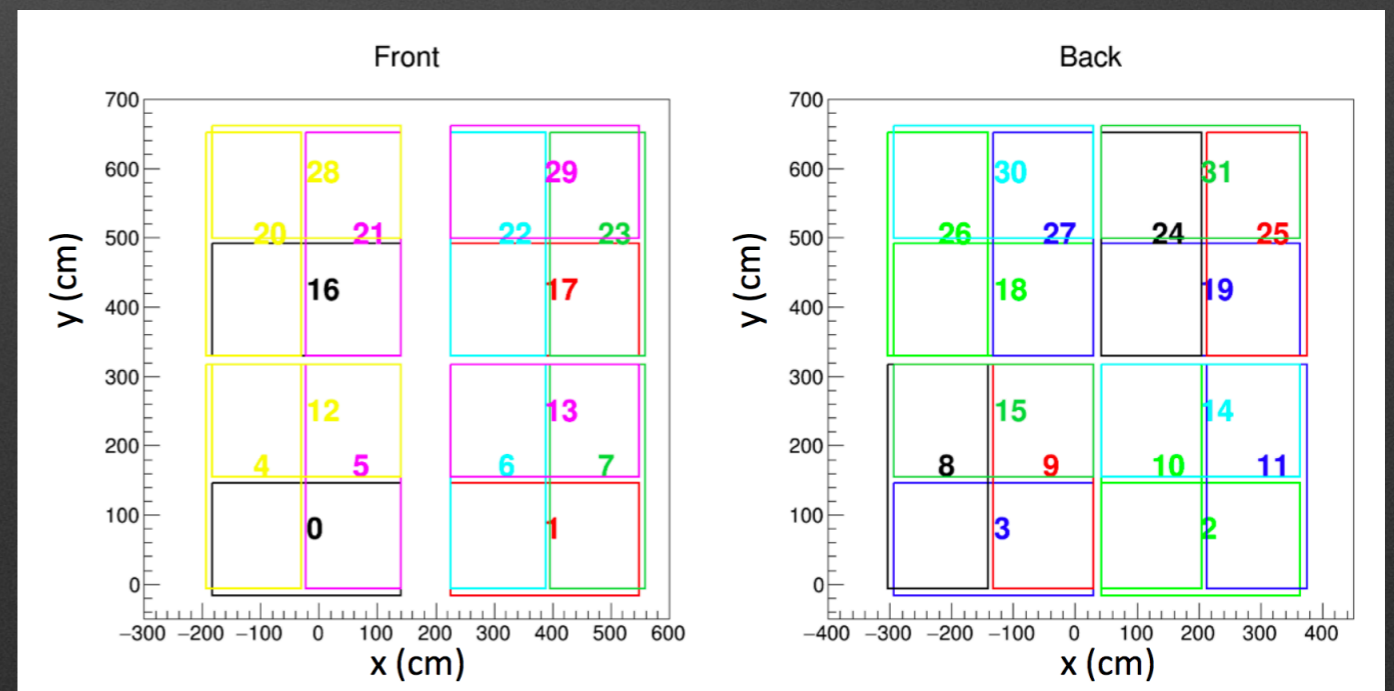
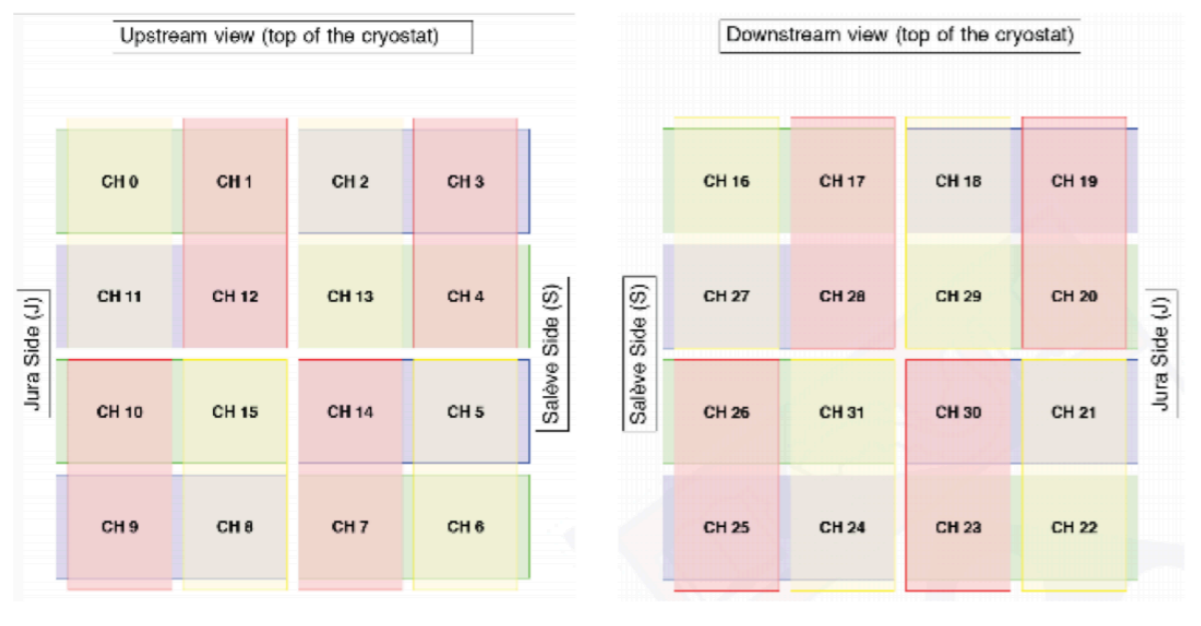


- Each subsystem has its own recording buffer and set of timestamps
- Force the CTB to issue a trigger based on coincidence of the upstream and downstream coincidence of CRT pixels
- With knowledge of offsets this more or less guarantees that all systems see the same event

Run Selection and Implementation

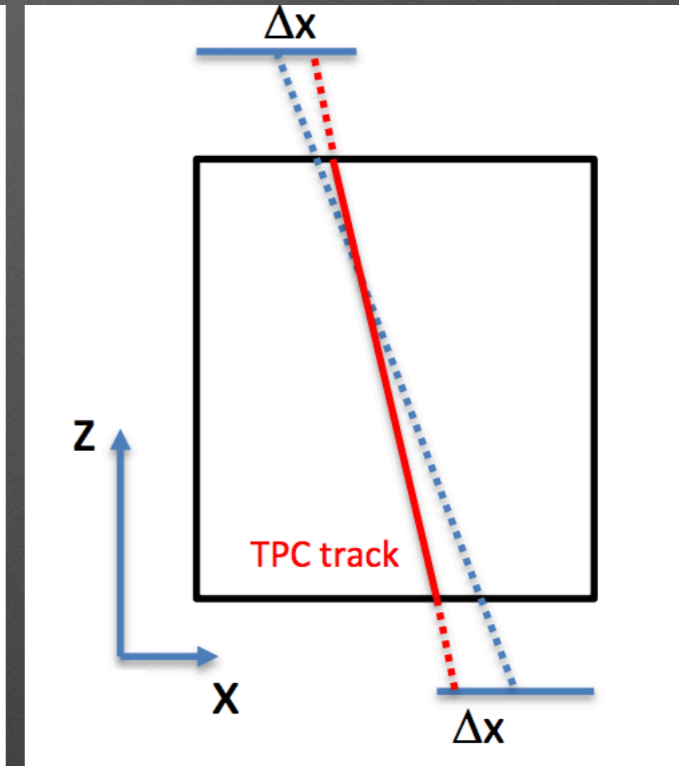
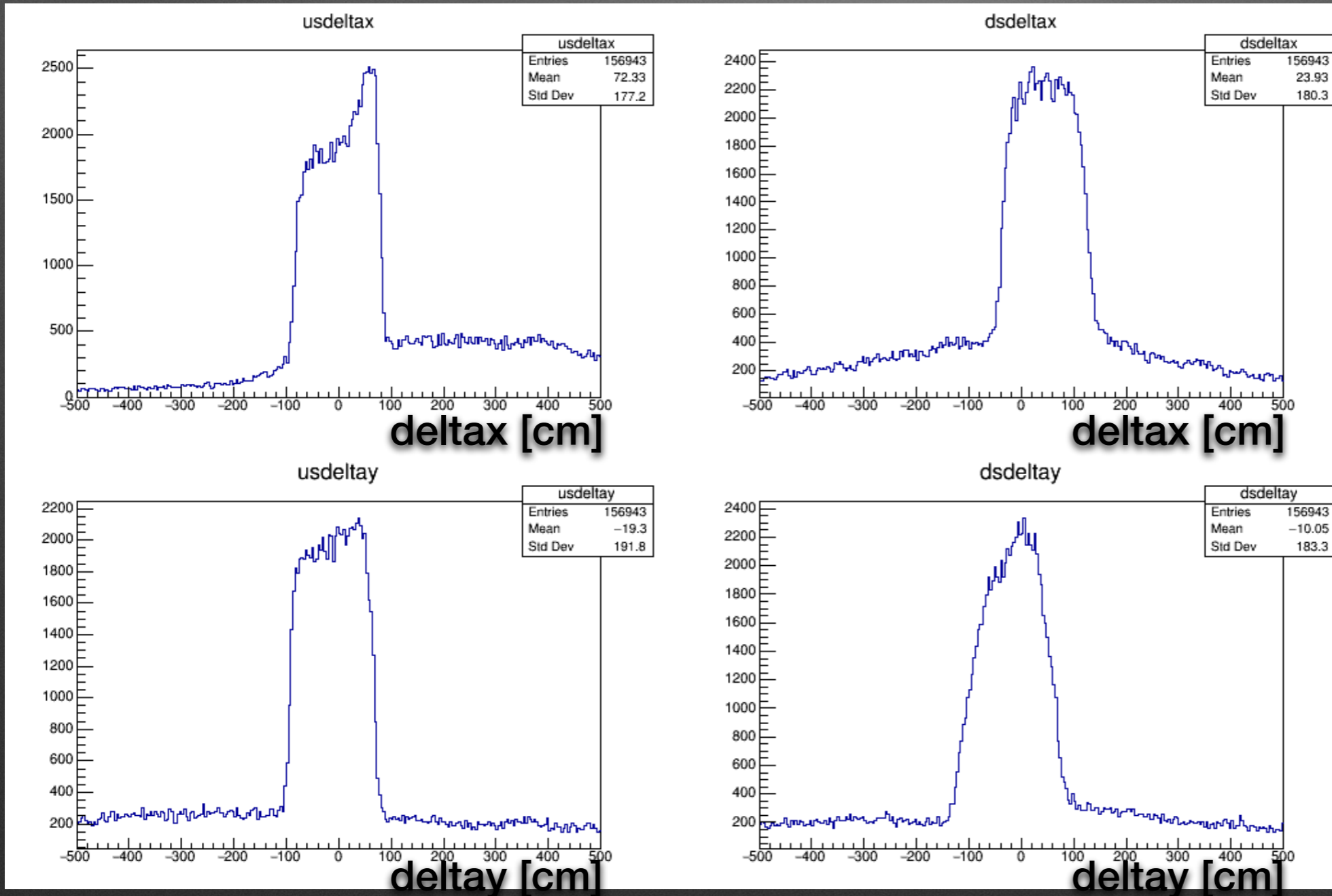
- Used TPC reco'd runs 5785, 5786, 6119, 6120, 6141, 6191, and 6201 ~(5,000 record files)
- Used Pandora TPC tracks primarily. PM tracks used if no Pandora tracks were available or fit the trigger
- CTB Triggers on ~60 nanosecond coincidence between US and DS pixels (0.25 ms TPC window offset factored into TPC deco)
- Pixel centers calculated from CRT module geometry and compared to track projections (Thanks, Tingjun!)

Pixel numbers



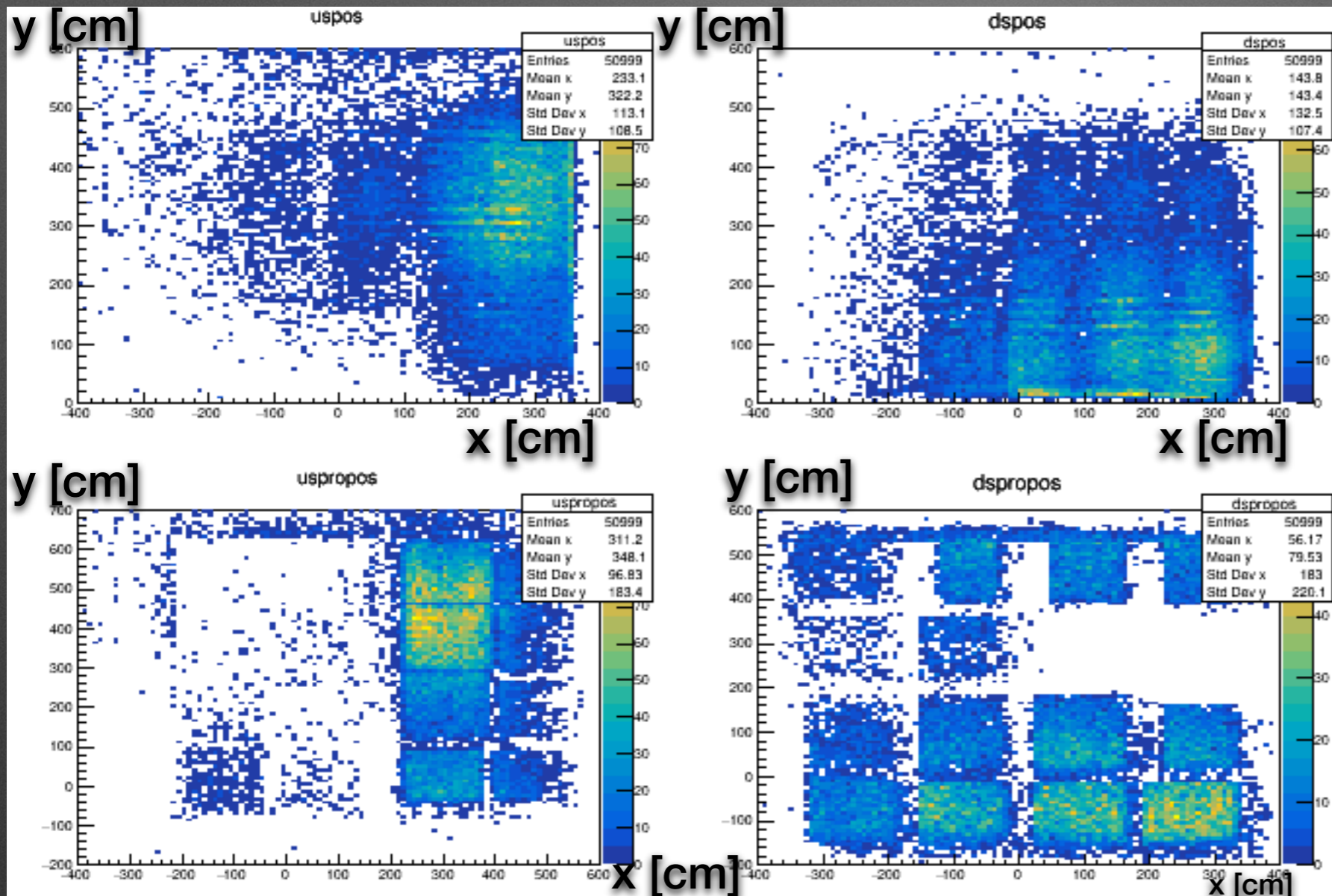
TPC+CRT

First step is to reproduce Tingjun's analysis:



- Note: This includes geometric shifts in both the upstream and downstream CRT module positions

Track Selection

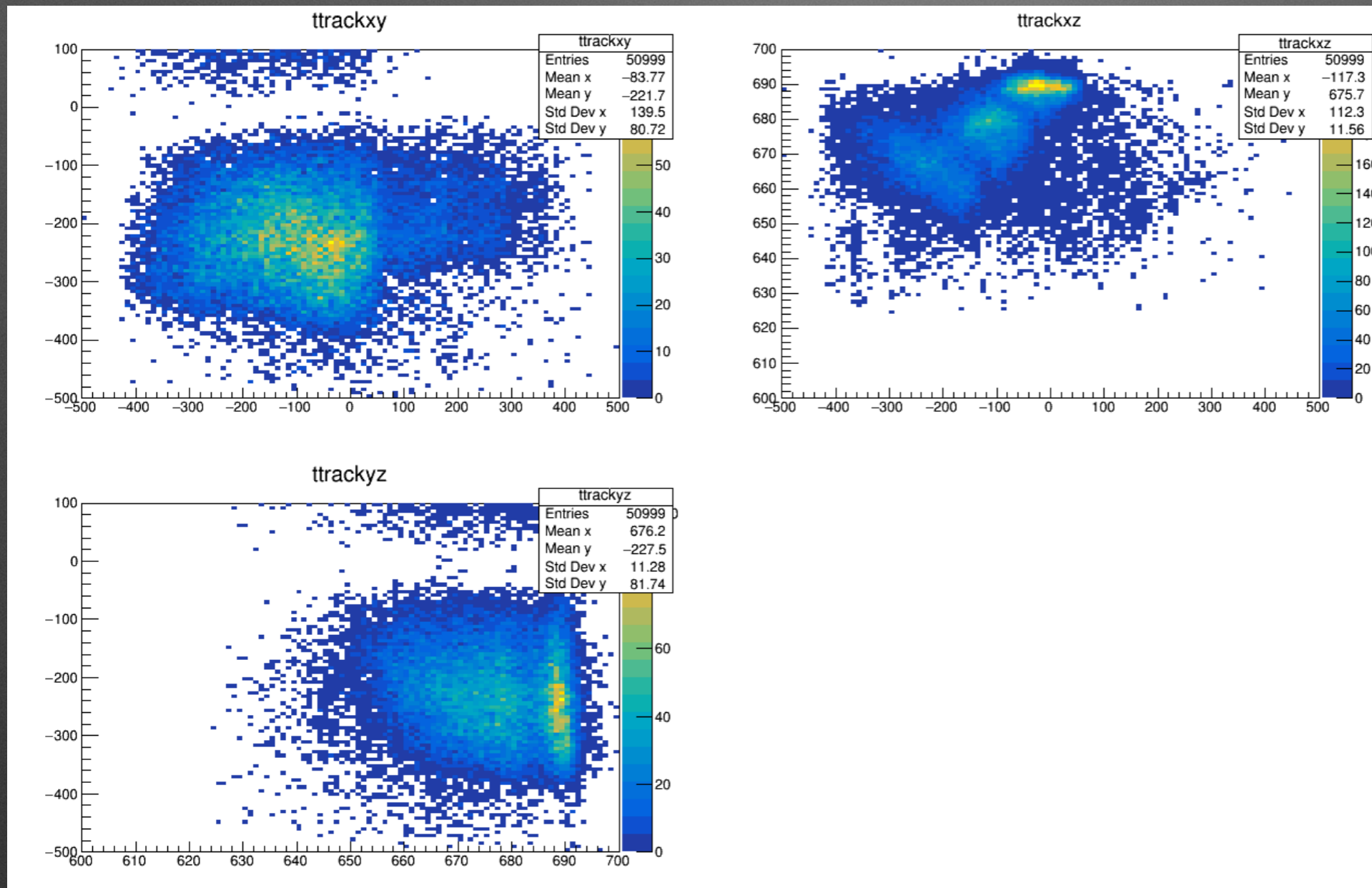


- With cuts on properly projected tracks we can pick out externally timed and throughgoing TPC tracks

- Beam side is favored due to 7-8m difference in z location of US CRT modules (1 in 25 beamleft to beamright)
- Also CRT module 19 is *dead* but tracks can be recovered

- However CRT introduces geometric trigger bias

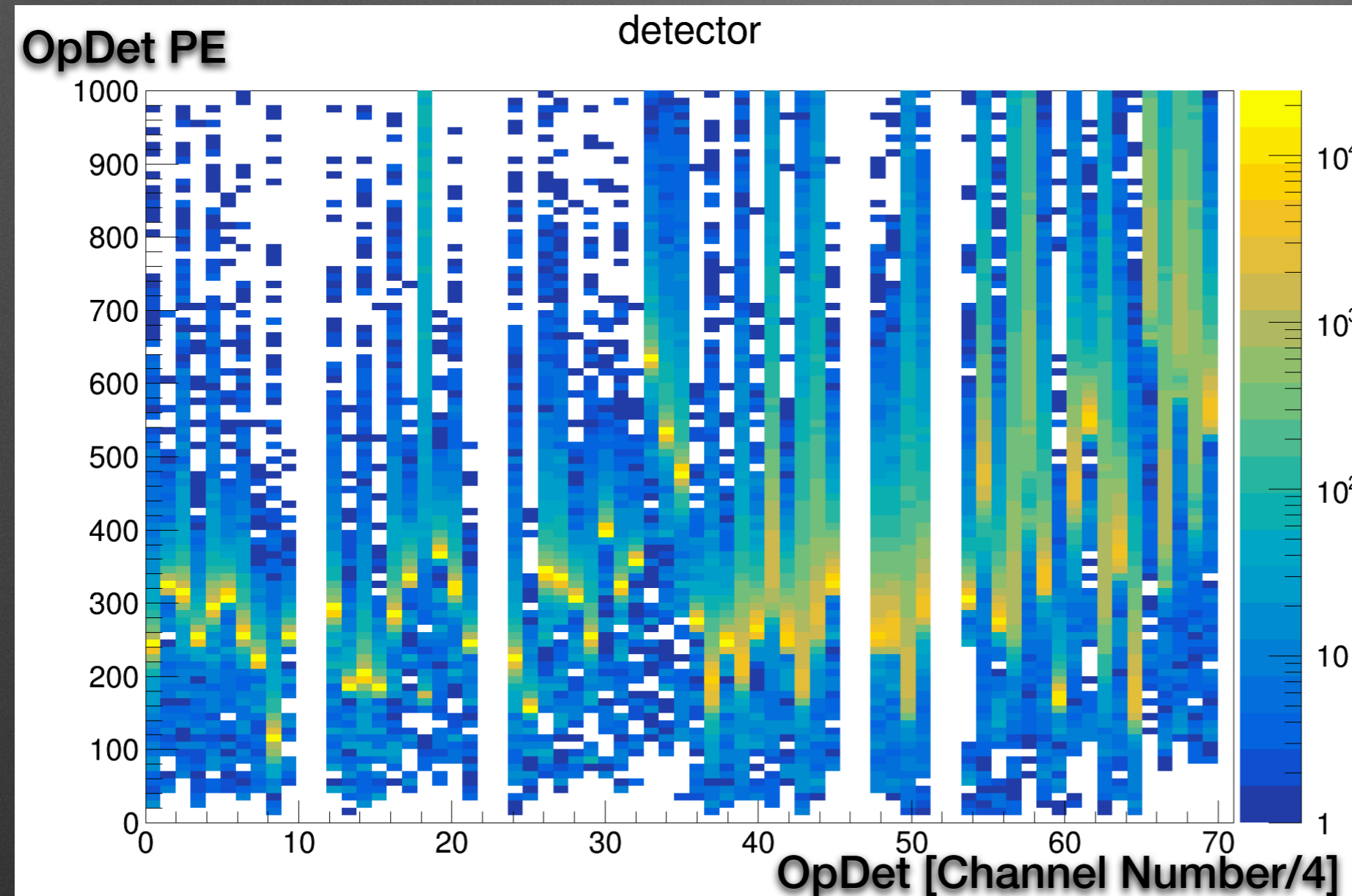
Track Characteristics



- Most tracks angled down and to left if viewing (US->DS)
- Downstream module is lower and more to the left of the upstream module

Bulk track characteristics necessary for MC!

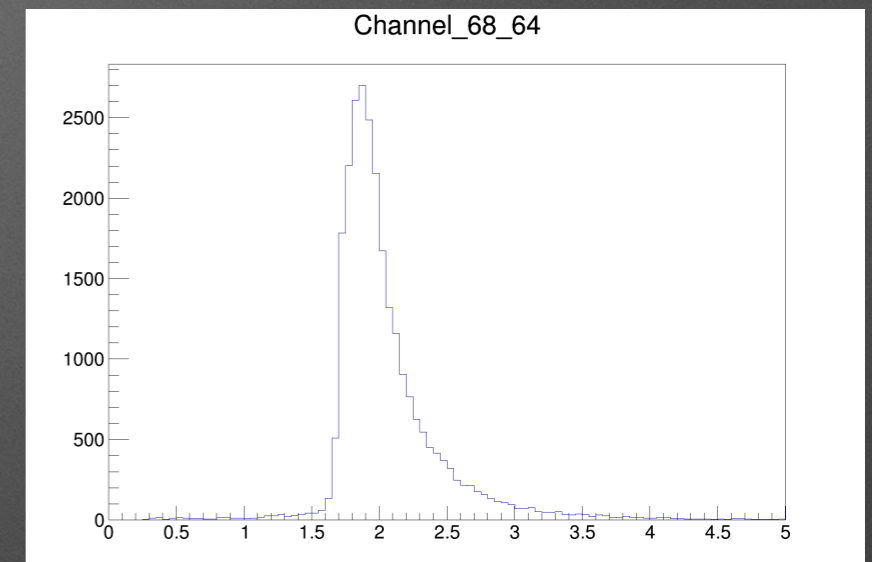
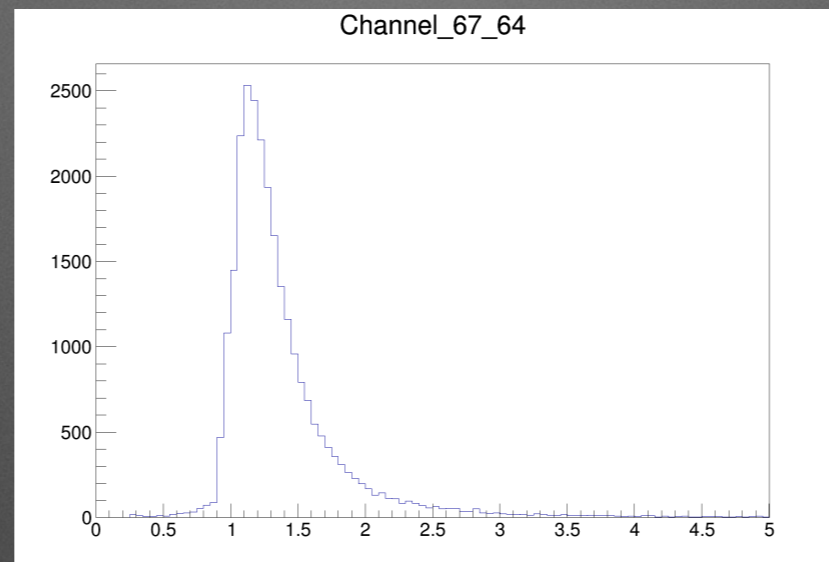
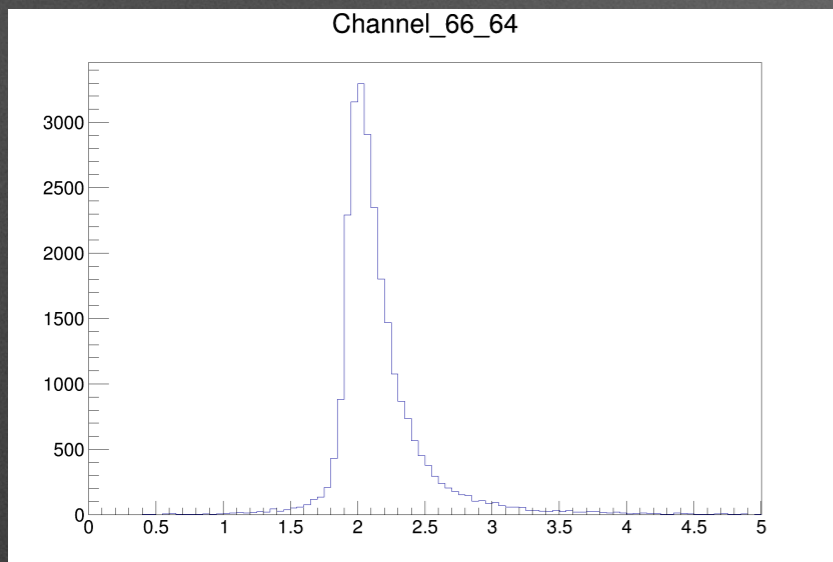
Photon Detector Response



• Curious photon detector response: strong peaks at particular values indicate a contamination or reco issue (possibly both)?

Comparison Update

- Comparison machinery in place and functioning correctly, but likely require tweaks to OpHitFinder.



Far Side ARAPUCA vs Nearby Above and Below

