

Hit Reconstruction

Pulse Shape Fit Parameters

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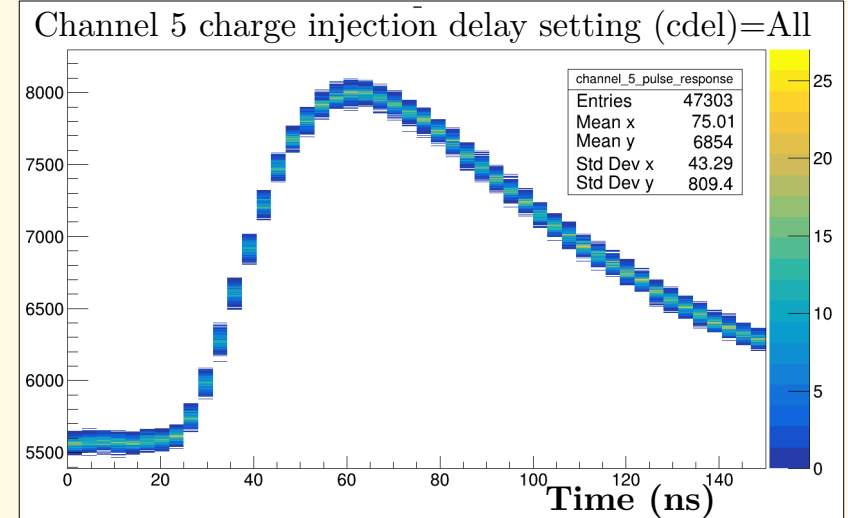
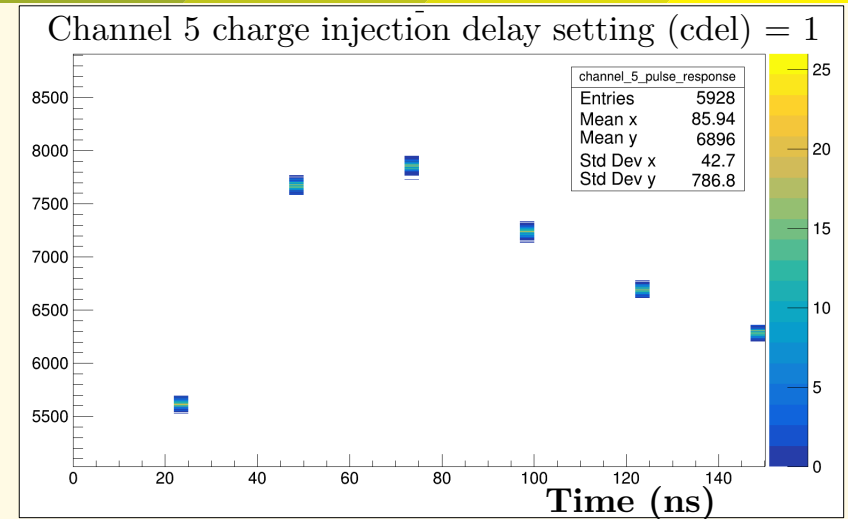


Introduction

- APV25 channel response modeled with Four-Pole Fit Function
- Used UCSC testboard Calibration Pulse Scan data (ADC as function of 48 time bins) to calculate svt shape fit parameters values for 2021 slim sensors
- Parameter values very different from default values in conditions database
 - Default values lead to poor hit fitting, effects track and vertex reconstruction efficiency
 - All 2019 and 2021 analysis thus far use these default fit parameters
- No testboard calibration pulse data available for 2019 sensors, or 2021 “non-slim” sensors
- Calibration pulse run using DAQ taken at Jlab 2021 (run 014393), however error in script lead to only 6 (instead of 48) time bins for a given pulse being filled
 - Similar run taken in 2019 will be analyzed separately in future
- Successfully fit 99% of alive channels, using only 6 time samples
 - Dead channels and failed fits use nearest neighbor fit param values
- Local database updated with correct fit params, will compare reconstruction

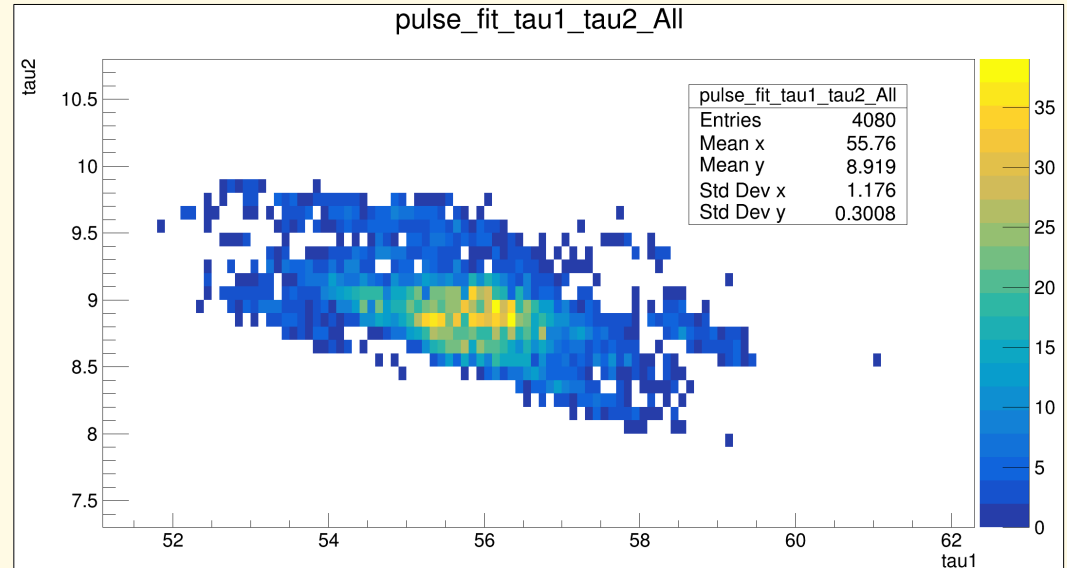
UCSC Calibration Cdel Scan

- Calibration pulse scans taken at UCSC on testboard for 2021 L0/Slim-sensor production
- APV25 internally injects charge into channels, reads out **6 time samples at 25ns intervals (TOP)**
- APV25 “**cdel**” setting (1-8) changes the time delay on readout by $3.125\text{ns} \cdot (8 - \text{cdel})$ to provide more pulse time resolution (BOTTOM)
- **Fit data with pulse shape function** defined in hps-java to get real pulse shape fit parameters
- **This full scan data only exists for 2021 slim sensors...**



Fit Function Comparisons

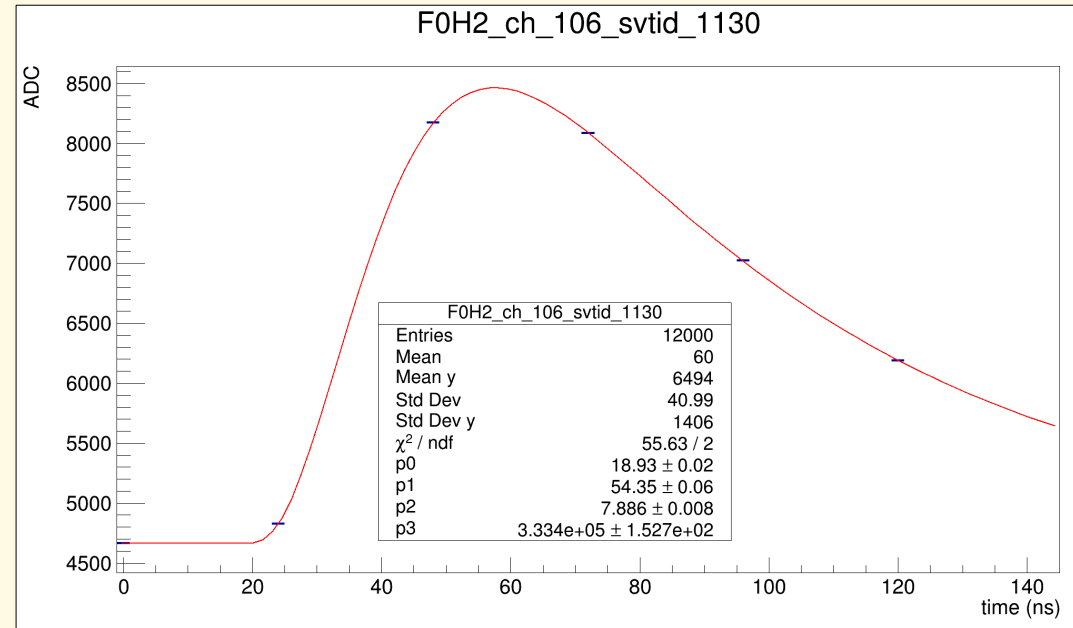
- hps-java conditions database 2019/2021 default values
amp=2500, t0=-10.0, tau1=35.0, tau2=10.0
- **2021 slim sensor fit tau1 mean ~56 significantly different than database**
- **Current fit parameters in hps-java not representative of 2021 slim sensors, rawhit fit quality impacted**
 - Likely true for non-slim sensors
 - Likely true for 2019
- Tested reconstruction using new tau1/2 fit values (applied mean ~56 and ~9 for all channels)
 - Gains in number of Tracks, Particles, and Vertices
- Need to get correct fit params for **all** channels
2019+2021 using DAQ calibration data



**Current Shape fit results for tau1 and tau2
2021 Slim Sensors Only**

2021 Jlab Pulse Shape Fits

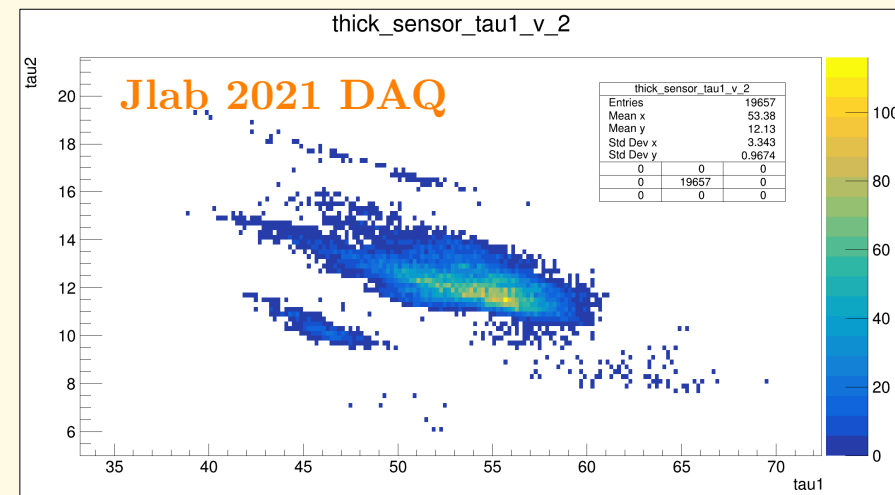
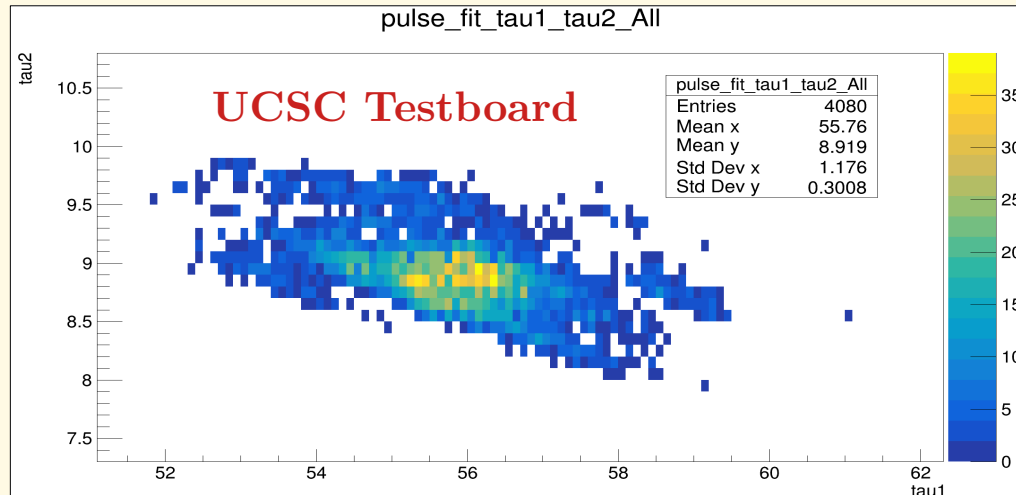
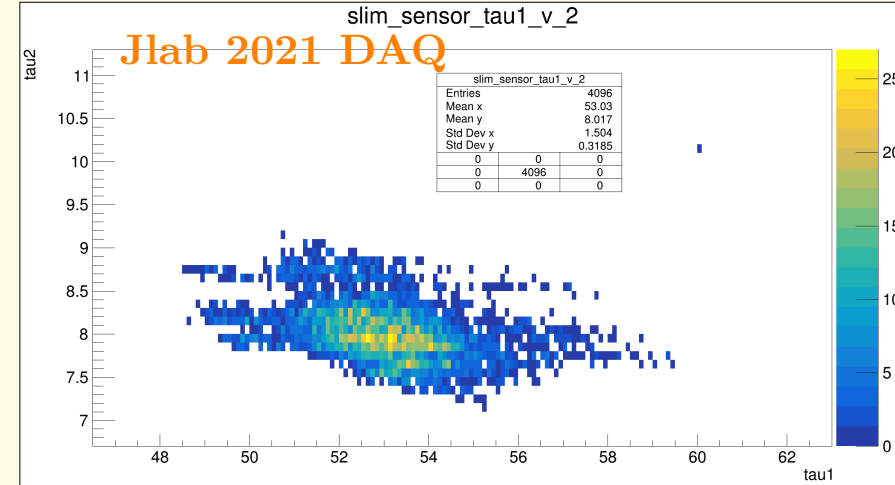
- Calibration pulse scan run taken at Jlab in 2021 (run 14393)
- However, scan script had error, so only 6 time samples available (instead of 48 with full scan)
- Made hpstr processor to read evio events, get all rawsvthits, and build Tprofile of hit amplitude vs time, for all channels
- Fit Tprofile with standard fit function to get shape parameter values amplitude, t0, tau1, tau2
 - Baseline parameter fixed and set equal to Mean of Bin(0)



Tprofile of F0H2 channel 106 with 2000 Calibration Pulse events. Only 6 time bins available. Profile fit with standard shape fit function.

2021 Jlab Pulse Shape Fits

- Cut channels with bad calibration pulses/fits
 - Use nearest neighbor fit parameters
- (TOP RIGHT) Slim sensor fit tau1 v tau2 using 6 time sample DAQ scan data
- (BOTTOM RIGHT) Thick sensor fit tau1 v tau2 using 6 time sample DAQ scan data
- (BOTTOM LEFT) Slim sensor tau1 v tau2 using UCSC Testboard data
- Note difference between slim sensor fit params using 6 time samples vs 48 time samples
 - Any reason to believe differences due to full detector connection?



Summary

- Have calibrated svt pulse shape fit parameter values for 2021 SVT
 - Updated in local copy of database for now
 - Will compare tracking using new vals
 - Are we okay with using nearest neighbors for channels w/o calib pulse?
- **Need to take full calibration pulse scan run at Jlab upon return this year**
- Similar 2019 run exists, but in different format, will require modified eivo processor
 - Will work on getting fit params soon
- Validate 2016 values as sanity check?

