SVT readout latency and burst-mode noise

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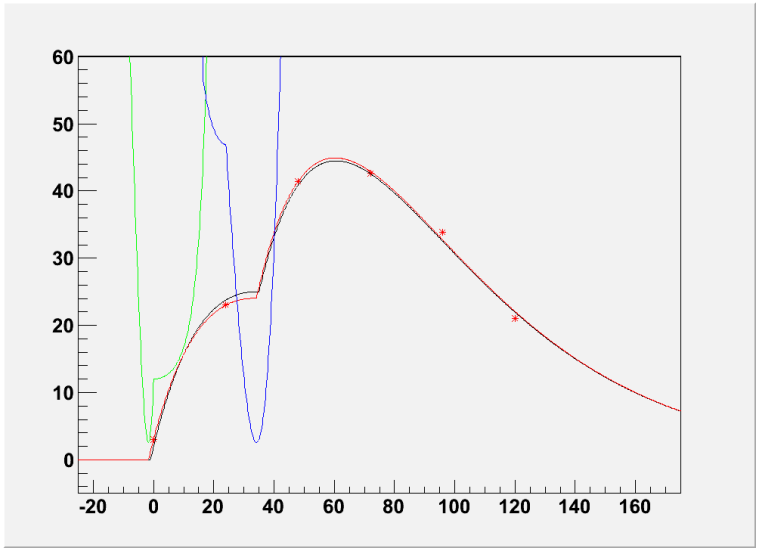
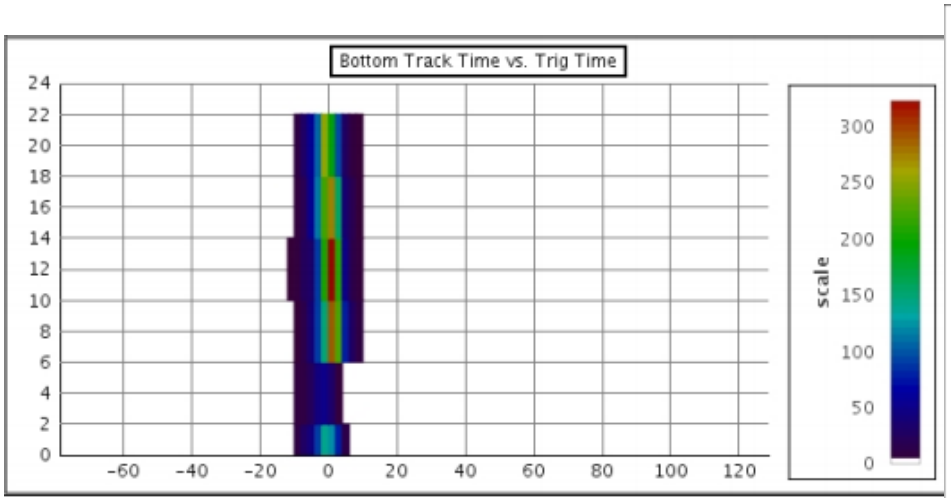
Latency

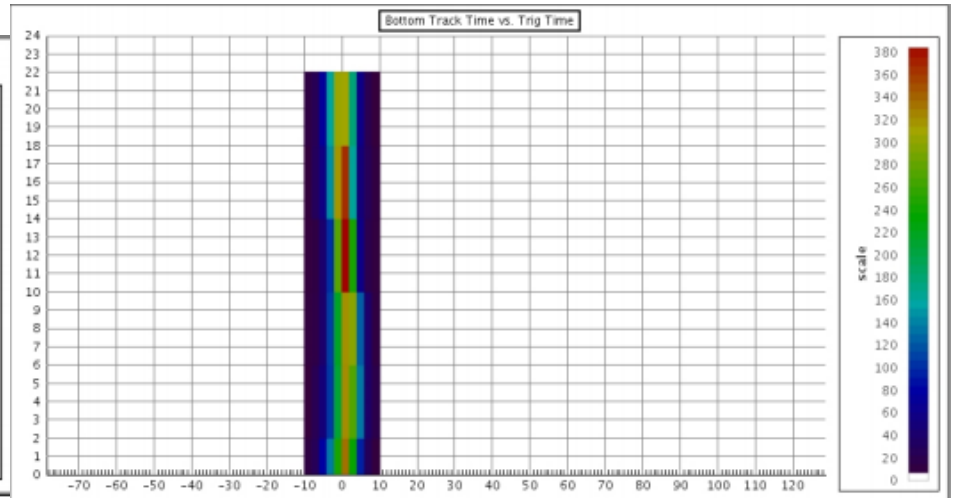
- On trigger, SVT readout chip outputs 6 samples (24 ns apart) from pipeline; readout latency determines which 6 get output
- We are picky about our latency:
  - For pileup fitting, need 2 samples before hits
  - To pass DAQ cuts, need 3 samples above threshold (after hits)
  - 24 ns jitter in hit time relative to readout (trigger comes at random phase relative to SVT clock)

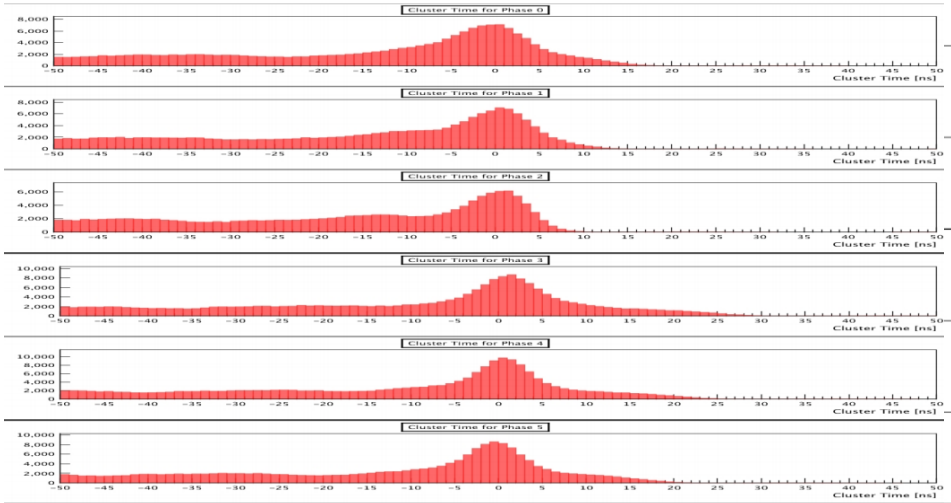


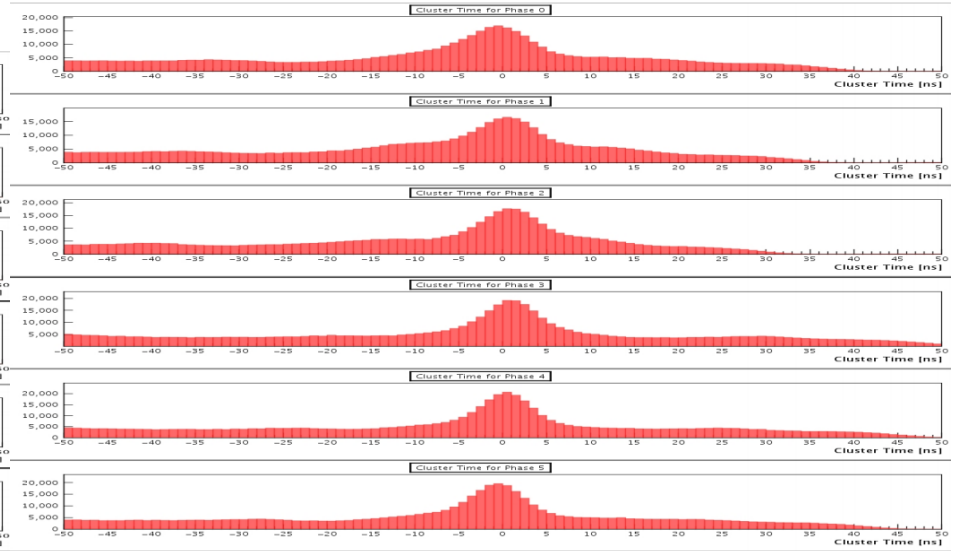
Losing hits (and 1/4 of tracks) to DAQ cuts

- Losing all tracks for one trigger phase, 50% of tracks for another







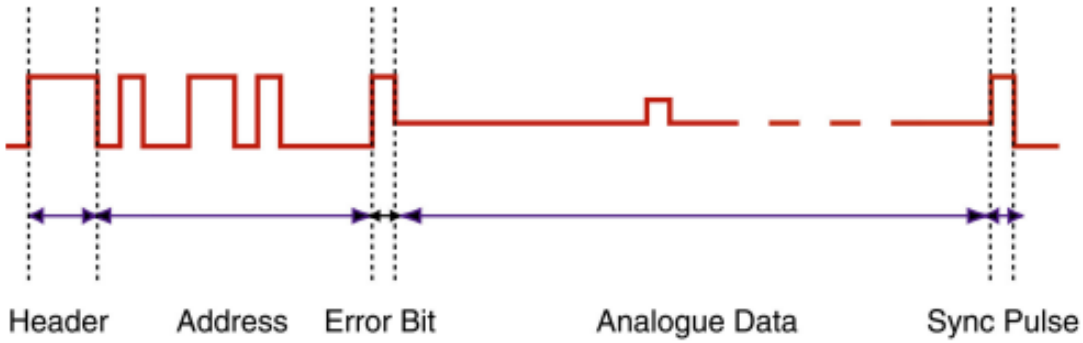


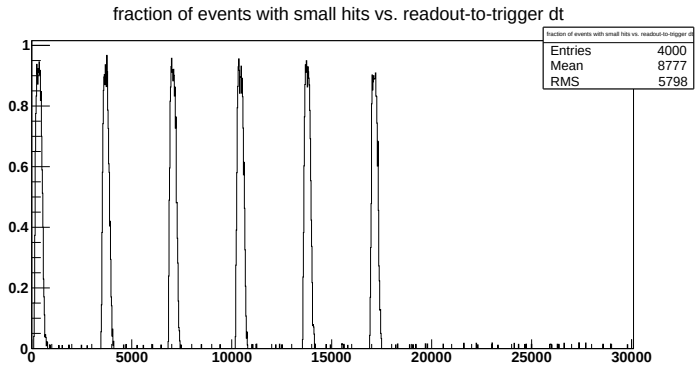
Summary: latency problem

- We “timed in” our latency on April 19
- We realized our latency might not be optimal and we might be losing hits; dropped the ball (travel, shifts)
- Hesitant to move latency by a full 24 ns (would put us in danger of losing pileup rejection)
- Hoped to make DAQ changes to allow 8 ns latency steps; fell through the cracks (other priorities for SLAC SVT group), then didn’t work (May 11 test)
- Didn’t realize until the last week that a small loss in hit efficiency for one trigger phase causes a big loss of track efficiency
- Tested 24 ns shift (May 13), too busy to look closely at data
- Looked at data May 15, realized this was a big deal, changed production config
- Logbook entries: 3340722 (studies) 3341153 (decision to change production config)

Burst mode noise

- APV25 readout chip puts analog and digital signals on the same output line: 128 clocks of analog data, 12 clocks of digital data
- Preamp crosstalk from large currents/voltage swings: events coinciding with digital output will have extra noise
- “Burst mode” (allowing a trigger while the APV25 is still sending data) increases noise in the SVT (only in a subset of events)
  - Noisy events can be identified by looking for noise hits in the SVT (normally 0-2; noisy events have up to 100), and are correlated with time between triggers
  - From TI timestamps, we can identify all events where hits overlapped with digital output
  - Noisy events are 4-6% of data: just discard these





Impact and plans

- Latency:
  - Impact: lost (rough estimate) 25% of events in all runs before 5722; last 2 days of run have better latency setting
  - For next run: get 8 ns latency shift working so we have more control, get 35 ns shaping time so we have more margin for error in setting latency
- Burst-mode noise:
  - Impact: 4-6% of events have extra noise hits, degraded time resolution, low hit efficiency
  - For existing data: may be possible to subtract out noise from noisy events
  - For next run: change hybrid voltages/preamp setpoints to reduce impact of crosstalk