SoLID Tracking

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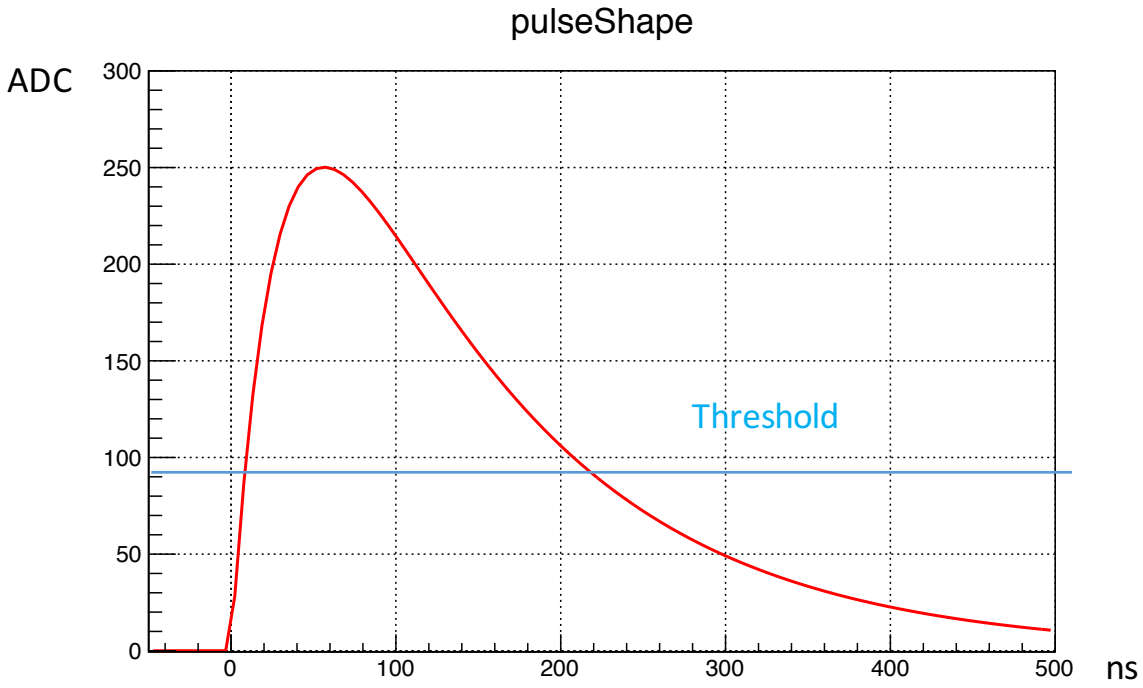
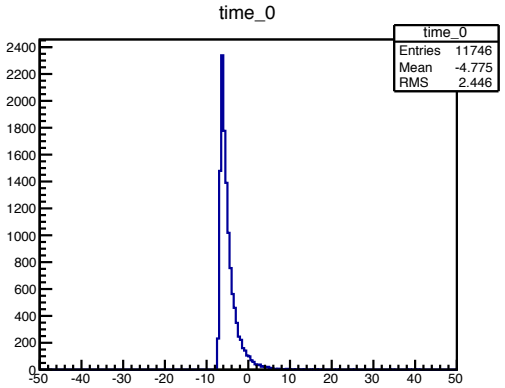
Time Jitter

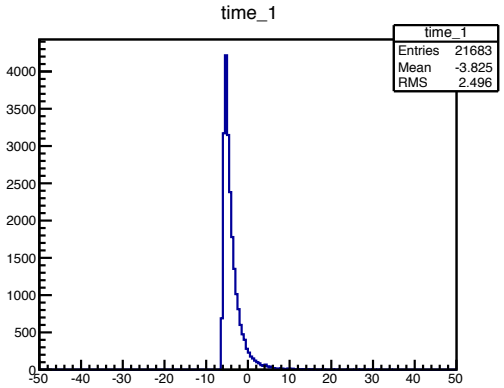
- APV25s have a +/- 12.5 ns time jitter due to the fact that their internal clocks cannot be synchronized for random trigger
- It may at least cause a loss of efficiency
- If APVs cannot be synchronized between each other, then there could be other issues

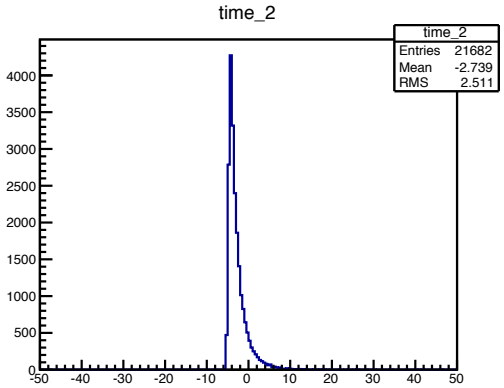


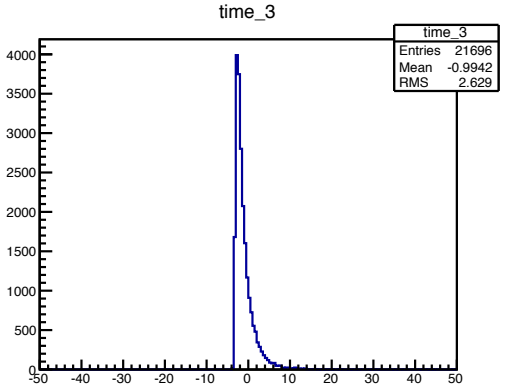
Time Jitter

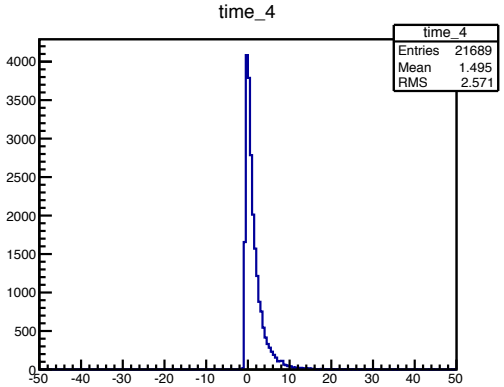
Time when the leading edge of avalanche reach the readout, relative to the trigger start time,
without and smearing

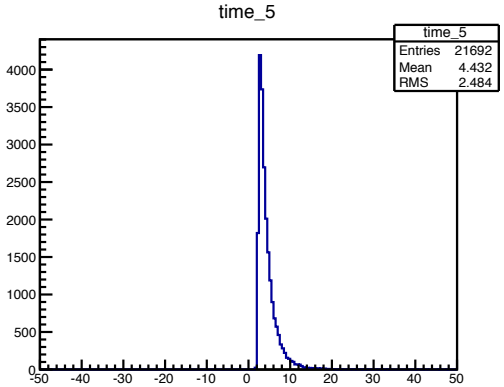








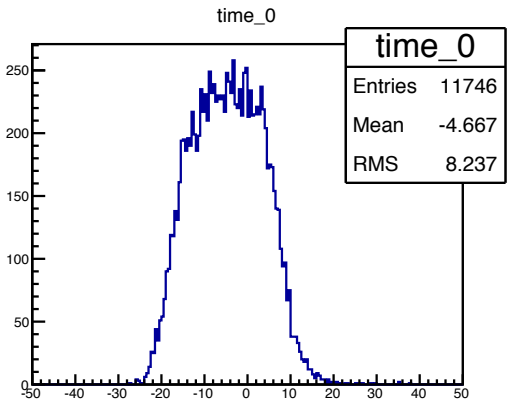


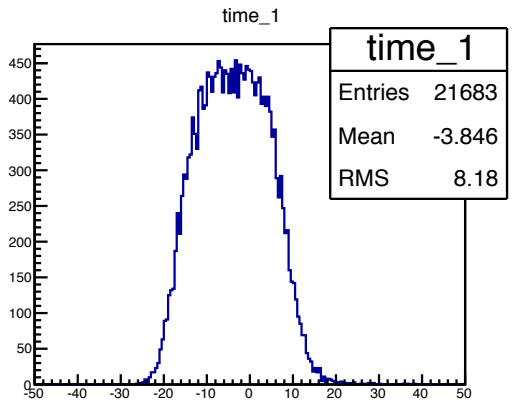


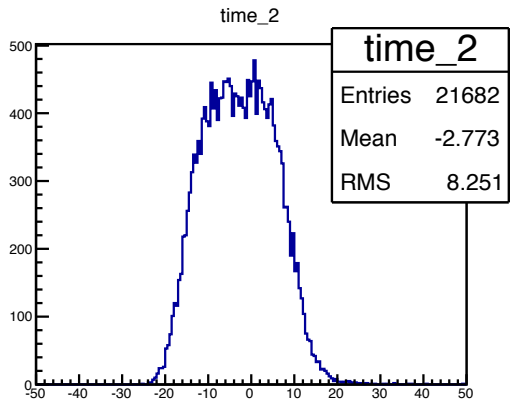
Time Jitter

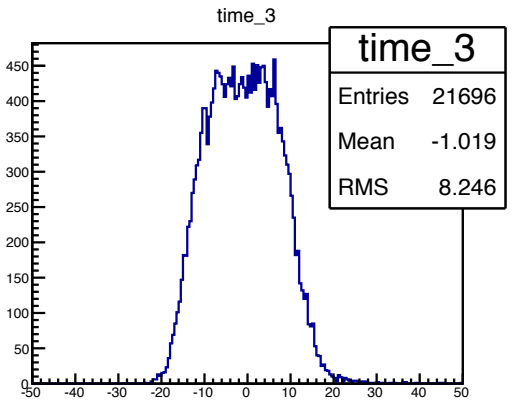
- Assume that the APV jitter is a flat distribution of +/- 12.5 ns
- Assume time jitter from other sources is a Gaussian with width = 3 ns
- Assume all APVs can be synchronized between each other (but not with the trigger)

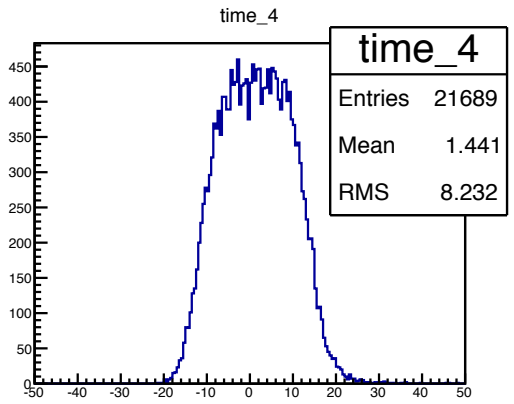
Time Jitter

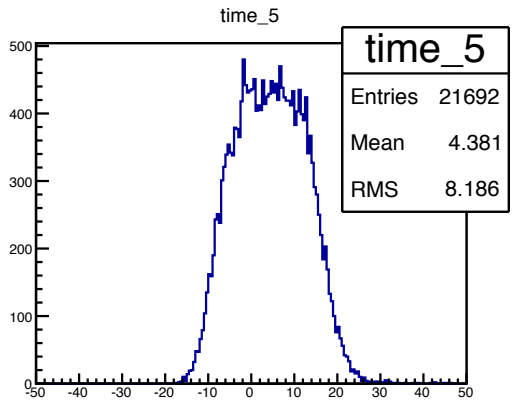

time_0
time_0
Entries 11746
Mean -4.667
RMS 8.237


time_1
time_1
Entries 21683
Mean -3.846
RMS 8.18


time_2
time_2
Entries 21682
Mean -2.773
RMS 8.251


time_3
time_3
Entries 21696
Mean -1.019
RMS 8.246


time_4
time_4
Entries 21689
Mean 1.441
RMS 8.232


time_5
time_5
Entries 21692
Mean 4.381
RMS 8.186

Time Jitter on GEM Efficiency

20k signal electron tracks, ADC threshold cut at 90

	With jitter (%)	Without jitter (%)
Plane 1	94.7	95.0
Plane 2	95.5	95.4
Plane 3	95.0	95.1
Plane 4	94.5	94.7
Plane 5	94.5	94.9
Plane 6	94.5	94.6

Loss of efficiency mainly due to threshold cut. Effect of GEM dead area is not taken into account yet.

No significant loss of efficiency is observed from time jitter

GEM Efficiency

20k signal electron tracks, include time jitter
Unit in %

	Threshold = 80	Threshold = 90	Threshold = 100	Threshold = 110	Threshold = 120
Plane 1	96.0	94.7	93.3	91.5	89.5
Plane 2	96.7	95.5	93.8	92.0	90
Plane 3	96.2	95.0	93.4	91.4	89.3
Plane 4	96.0	94.5	92.9	91.0	88.8
Plane 5	96.0	94.5	92.9	90.7	88.4
Plane 6	96.0	94.5	92.7	90.7	88.3

Loss of efficiency mainly due to threshold cut. Effect of GEM dead area is not taken into account yet.

Update on Occupancy and Efficiency

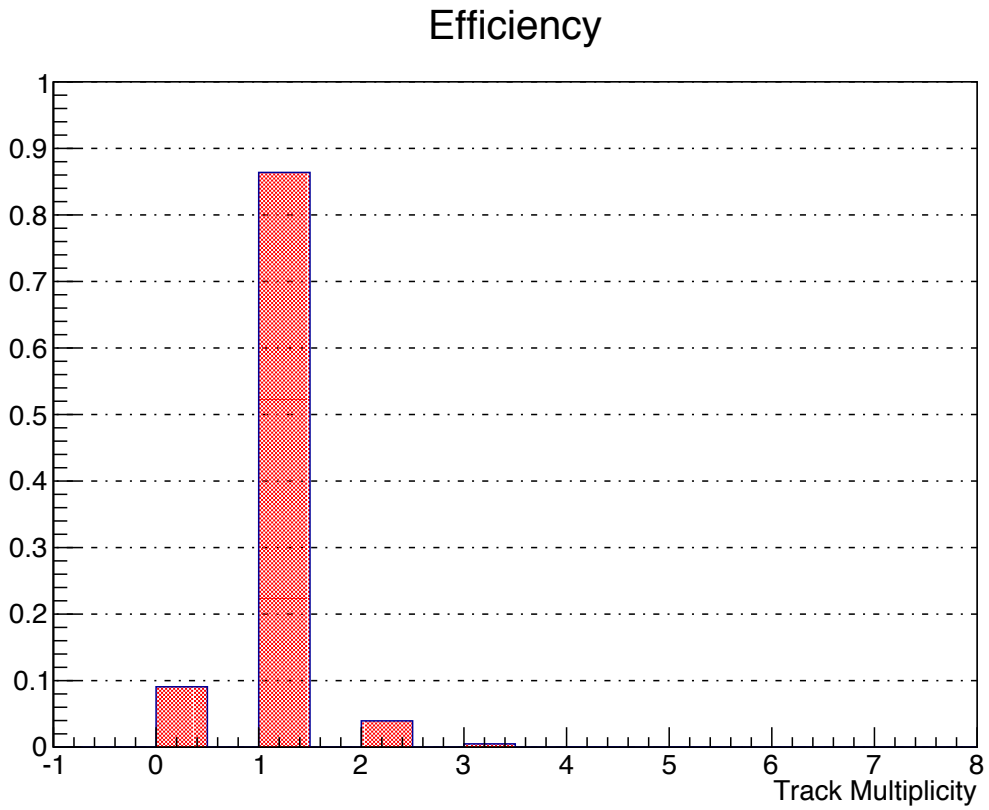
- Condition:
  - Lorentzian avalanche model
  - Include effect of cross talk
  - 100% background (15 uA current)
  - Background event time randomized for 450ns before and 25 ns after the sampling time
  - Include time jitter
  - Pedestal noise sigma = 20.7 ADC
  - Assume 30 sectors per tracker, each cover 12 deg in phi
  - Number of strips on each readout (there are two readouts for each chamber):
    - 453, 510, 583, 702, 520, 640
  - ~6800 events in total

Update on Occupancy

Unit in %

	Threshold = 80	Threshold = 90	Threshold = 100	Threshold = 110	Threshold = 120
Plane 1	3.89	3.42	3.05	2.73	2.48
Plane 2	15.34	13.87	12.56	11.39	10.35
Plane 3	6.02	5.27	4.66	4.15	3.72
Plane 4	3.73	3.29	2.93	2.64	2.39
Plane 5	3.35	2.92	2.58	2.3	2.07
Plane 6	2.47	2.15	1.90	1.70	1.53

Tracking Efficiency at 100% background



Vertex Resolution at 100% background

Single track event only