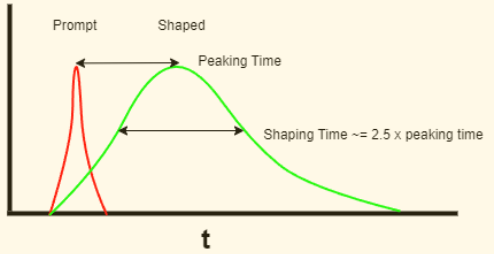
ePIC Digitization Cartoon

Single Channel

Analog Signal

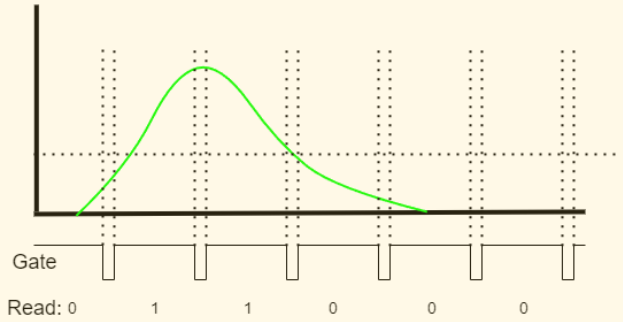


(A) Gated
(ITS-3)

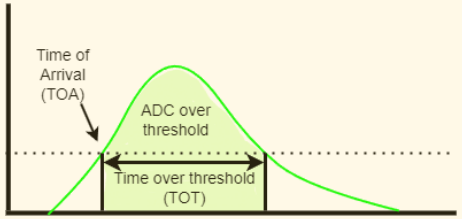
(B) TOA/TOT
(EICROC
HGCROC64
ALCOR)

(C) SAMPLING
(SALSA
FLASH ADC Based)

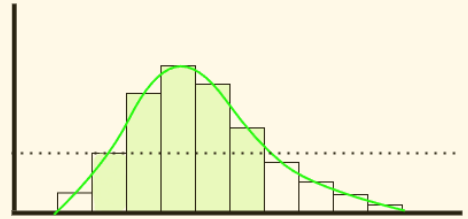
Digitization in ASIC



*Actual Alpide has ~1M channels. Actual readout of chip is the address of all of the hit pixels during each strobe



Readout: [TOA, TOT (or ADC)]



Readout: [T1, ADC1], [T2, ADC2], [T3, ADC3], [T4,ADC4], [T5, ADC5]

DAQ Processing

Convert to T, ADC={1,0} Using Gate Times. Precision O(Gate width) but depends on Gate/Peaking time	No Processing Needed. Time Precision depends upon number of bits and time scale

1-D (average of time bins. Time Precision O(time bin/hit bins)
Result: [T, ADCsum]).

Multiple Channel

DAQ Processing

If Charge Sharing, cluster finding to improve both time and space resolution
Hit output [T, Hit position, ADC/TOT]

In all cases, DAQ will record processed data banks containing information leading to descriptions of 3 numbers: a time, ADC surrogate, and position (in detector coordinates) for each sensed particle.

Type (A) - gated	A hit is recorded if the signal is above threshold any time when the gate signal is high. There is no granularity of the recorded hit, in fact the data recorded is not an ADC value, rather it is the address of the pixel hit. The signals are read out during the period when the gate signal is low. There is no time information recorded, rather the time is implied by the start time of the gate.
Type (B)- TOA/TOT	The readouts are triggered by the signal crossing the threshold. Any variation of the digitization time is included in the time resolution of the chip
Type (C)- sampled	ADC values are registered each sampling cycle. If the ADC values are greater than the threshold the ADC value and corresponding time are written to DAQ. The time/ADC are calculated by averaging or fitting over hit timebins.

Suggested parameters needed to understand time response for each type

ALL	Shaping time (FWHM)
	Analog time resolution - (differences the shaped peak position due to slewing, noise, baseline shifts, etc…)
	Estimated total hit time resolution– (after digitization and DAQ processing)
	Charge sharing (average number of channels hit / particle)
Type (A)	Gated (eg. ITS-3)
	Gate on time (integration time)
	Gate off time (deadtime, at low level, expect shaping time to be greater than gate off time, so no actual hits lost)
Type (B)	TOA/TOT: (eg. EICROC, ALCOR, HGCROC64)
	Time resolution
	Time bits
	ADC/TOT bits
Type (C)	Sampled: (eg. SALSA, FLASH ADC)
	Sample Frequency
	ADC bits