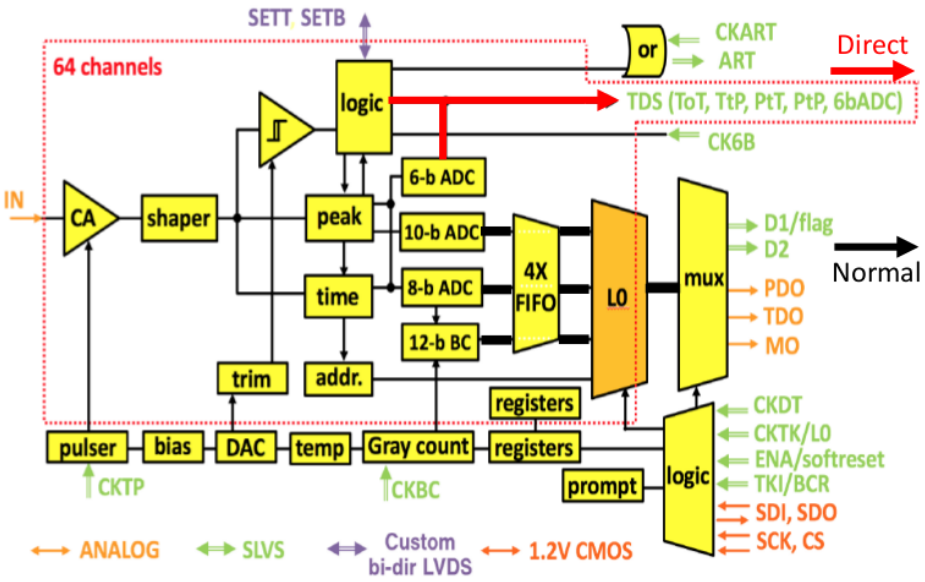
VMM3 chip

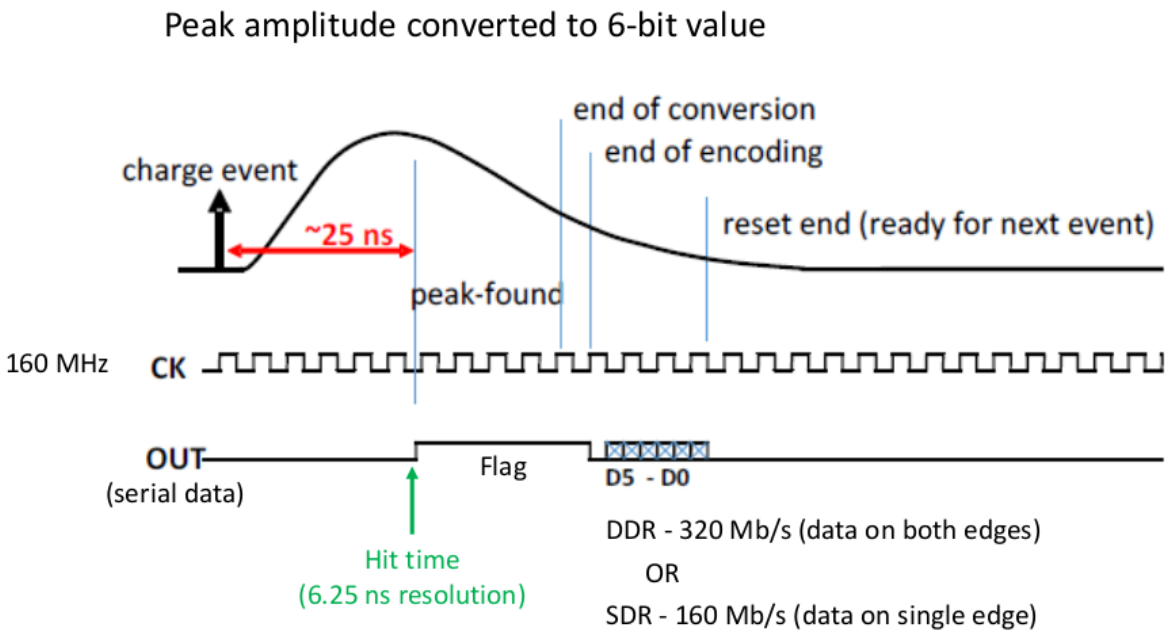
VMM3 block diagram



- ASIC for ATLAS New Small Wheel
- Radiation hard similar to APV25 : > 100 Mrad
- 64 channels
- Low noise over wide range of input capacitance (<1 pF to ~1 nF)
- Shaping times : **25 ns**, 50 ns, 100 ns, 200 ns
- Pulse amplitude proportional to charge at input
- Gains : 0.5, 1, 3, 4.5, 6, 9, 12, 16 mV/fC
- **6 bit ADC (25 ns conversion)** and **10 bit ADC (250 ns conversion)**, 8 bits TDC (1 ns resolution), 12 bits Beam Crossing time stamp
- 4 MHz of rate per channel thanks to multilevel FIFO
- Continuous or triggered readout on normal data path
- Latency up to 16 µs in triggered mode
- **Fast direct outputs (64 channels) for ATLAS trigger (6b ADC, ToT)**
- Normal data link up to 320 Mb/s

* from Ed Jastrzembski

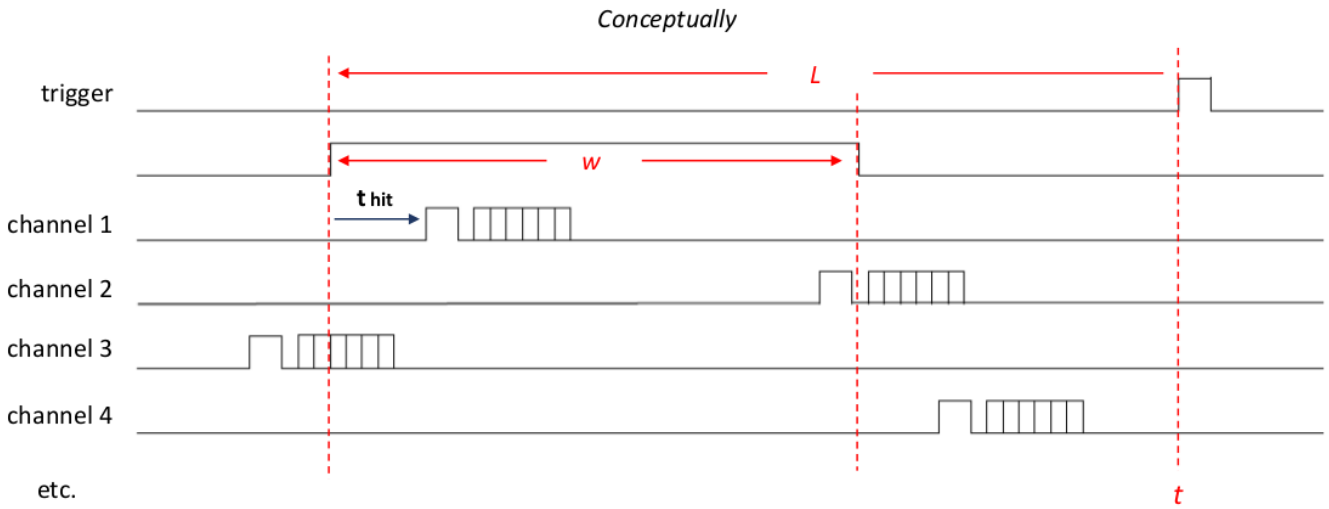
VMM 6-bit Direct Output data format



See 'Time Over Threshold with the VMM1 ASIC', de Geronimo and Polychronakos, ATLAS NOTE, July 19, 2012.

FPGA function

- Direct output data from the VMM3 chips is continuously written into a circular buffer in the FPGA.
- Let L be the trigger latency ($L < 8$ µs) and w be the data capture window size ($w < 0.8$ µs)
- Upon receipt of a trigger at time t, data corresponding to the time period $[t - L, t - L + w]$ is captured and formatted for transmission off the chip



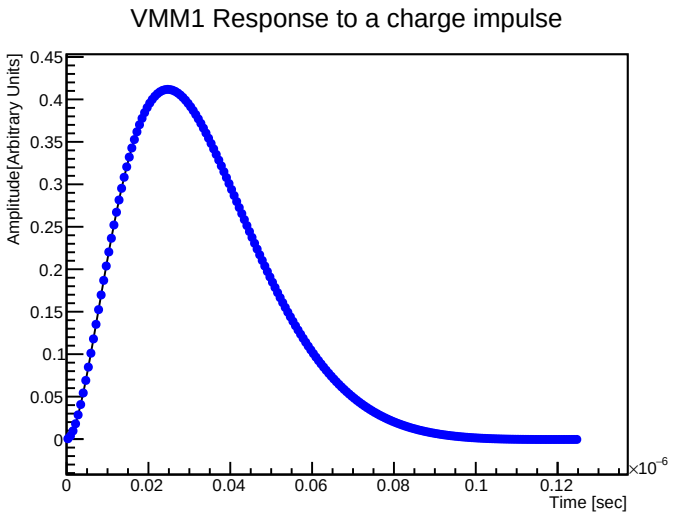
In `uRwell_strip.cc::FindStrip` the time t_{strip} is currently defined as

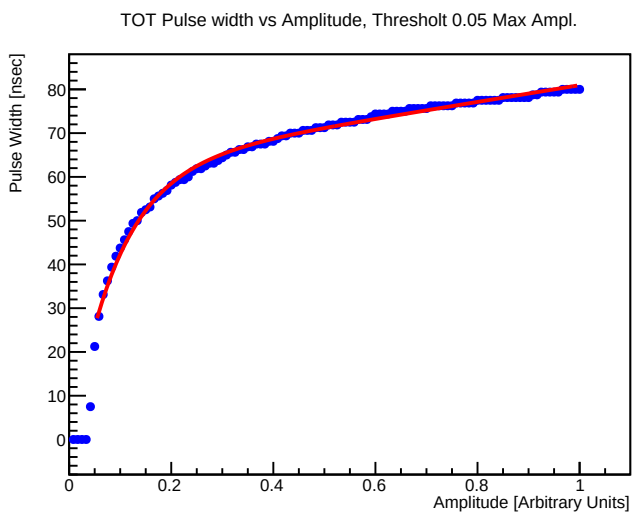
$$t_{strip} = t_{geant} + t_{dz} + t_{readout} + t_{smear}$$

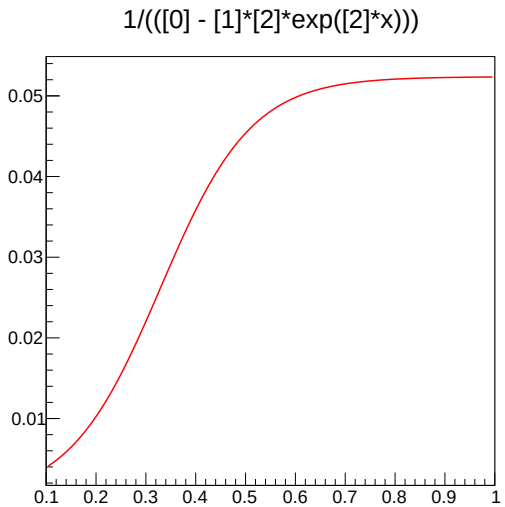
where

- t_{strip} - time signal from a strip.
- t_{geant} - time signal from Geant4 set to be in the middle of the event time window (`aStep->GetPostStepPoint()->GetGlobalTime()`).
- t_{dz} - time for the first ionization electron to drift through the gas gap.
- $t_{readout}$ - time for the signal to travel along the strip to the readout (currently set to zero).
- t_{smear} - a smearing factor to mimic the resolution.

VMM3 shaper waveform*







* 'Time over threshold with the VMM1 ASIC', de Geronimo and Polychronachos, ATLAS NOTE July 19, 2012