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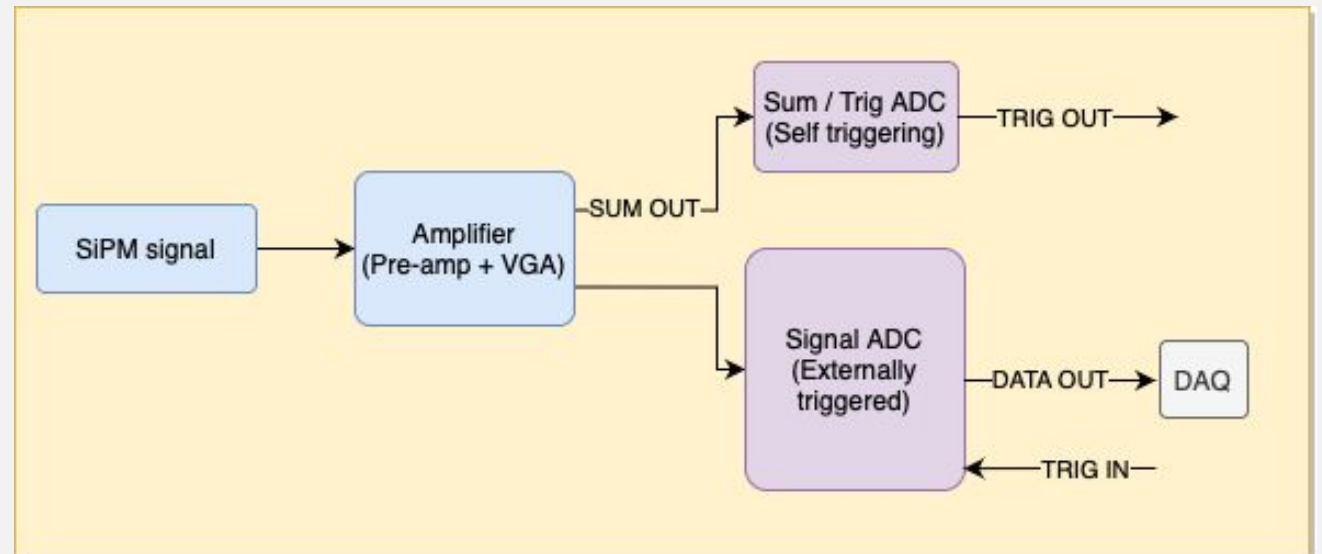
2x2 Trigger

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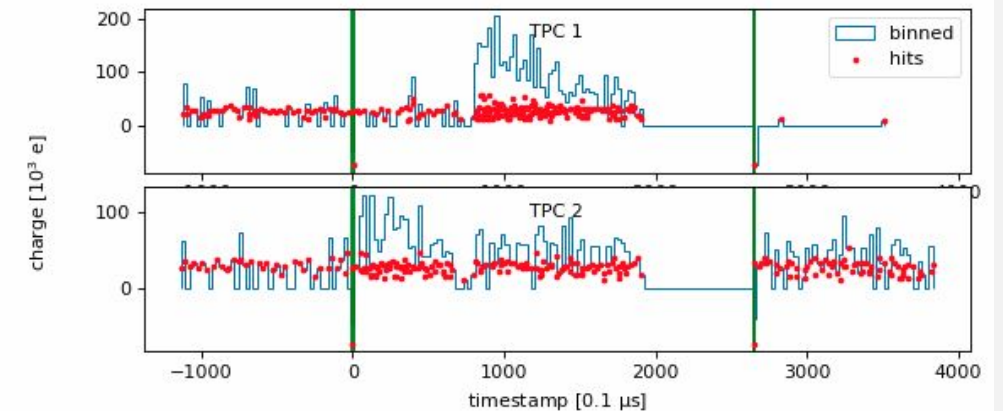
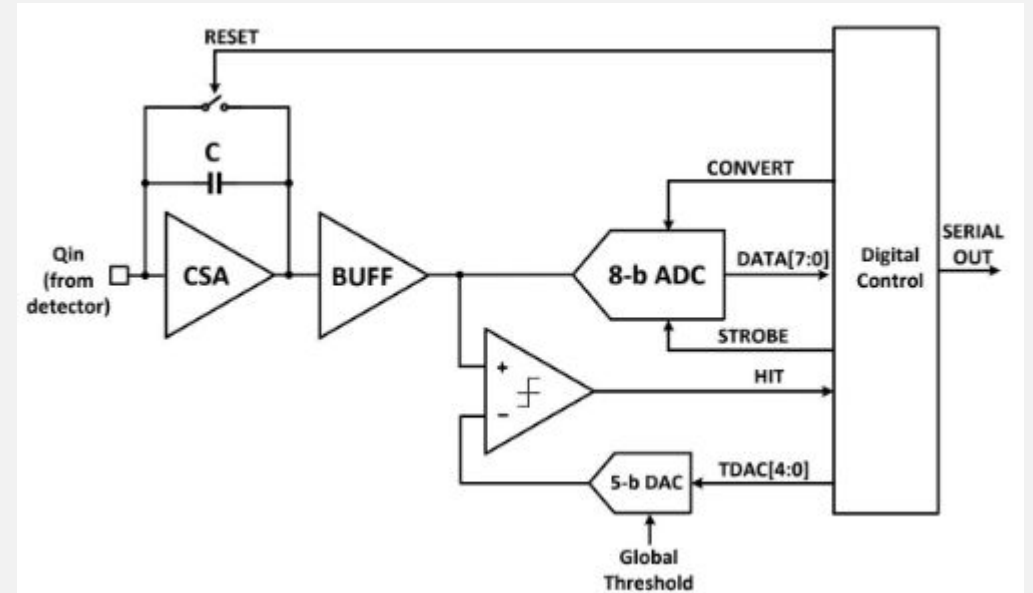
LRS DAQ/trigger

- Signal ADC
 - Triggered by external trigger
 - Maximum readout window: **32.8us**
 - Read pre-trigger signal from buffer
 - 8 units in 2x2 (2 per module)
- Trigger / sum ADC
 - Reads analog sum signals from VGA (1 ArCLight / 3 LCMs per sum)
 - Self trigger on threshold (OR logic)
 - Single trigger out for all 4 modules



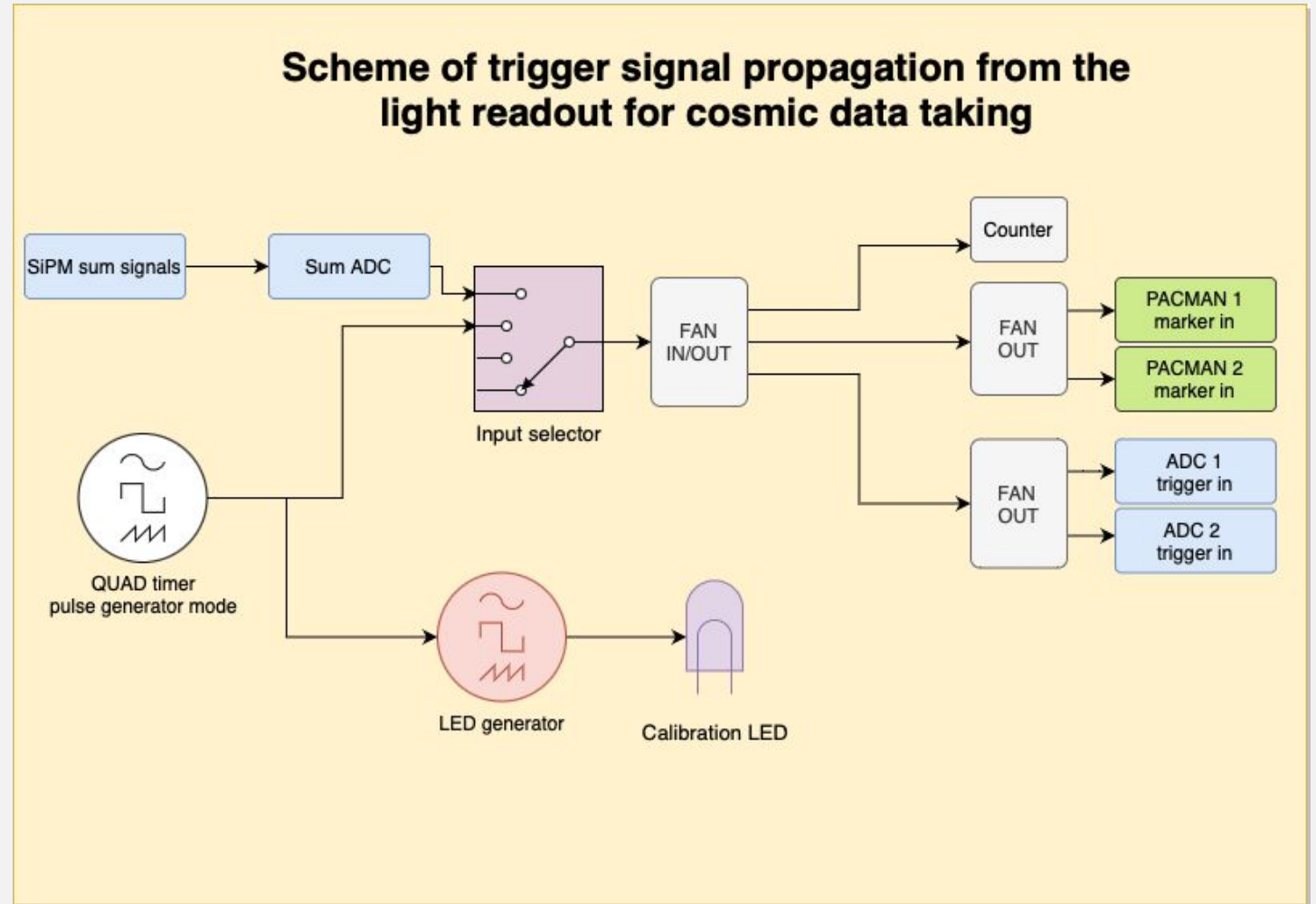
CRS DAQ/trigger

- CRS
 - No external *triggering* used when taking physics data
 - Continuous self-triggering mode (channel by channel)
 - Tunable discriminator voltage per channel
 - External trigger input from LRS used to insert a timestamped *marker* into the packet/data stream



Trigger @ Bern

- Select trigger modes via input selector
- LRS threshold trigger for:
 - LRS DAQ trigger
 - CRS T0 marker
- Calibration pulse for LRS LED calibration



Beam and cosmics

- Beam
 - ~10us Beam spill duration
 - 1.2s Period
 - 6 Batches per beam spill
 - ~0.5 Neutrino interactions per spill (FHC)
 - ~0.2 Neutrino interactions per spill (RHC)
- Cosmic
 - ~5 Hz Expected cosmic rate

May expect energy deposits outside of beam spill due to delayed decays

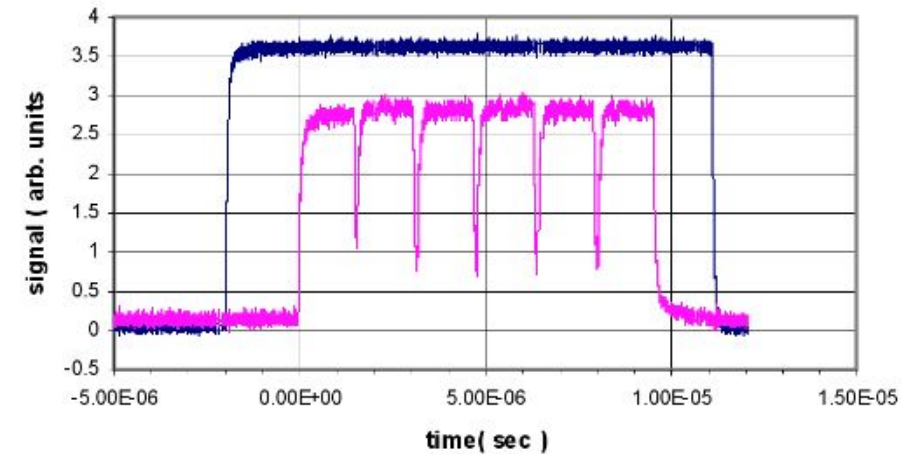
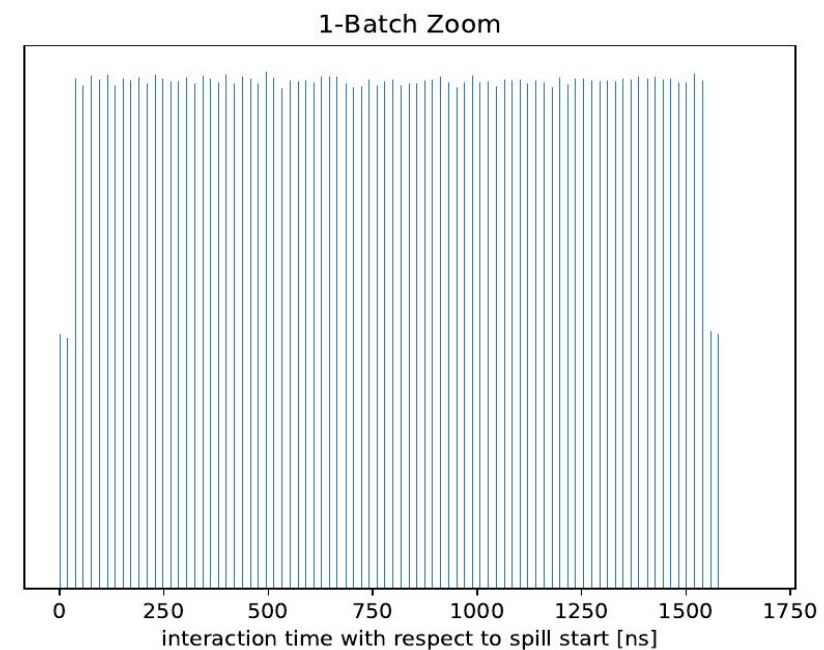
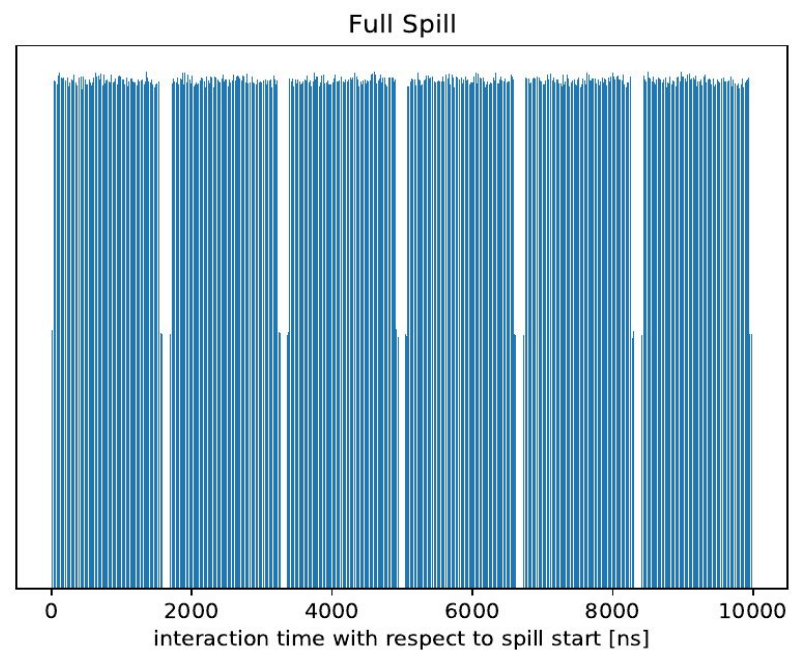
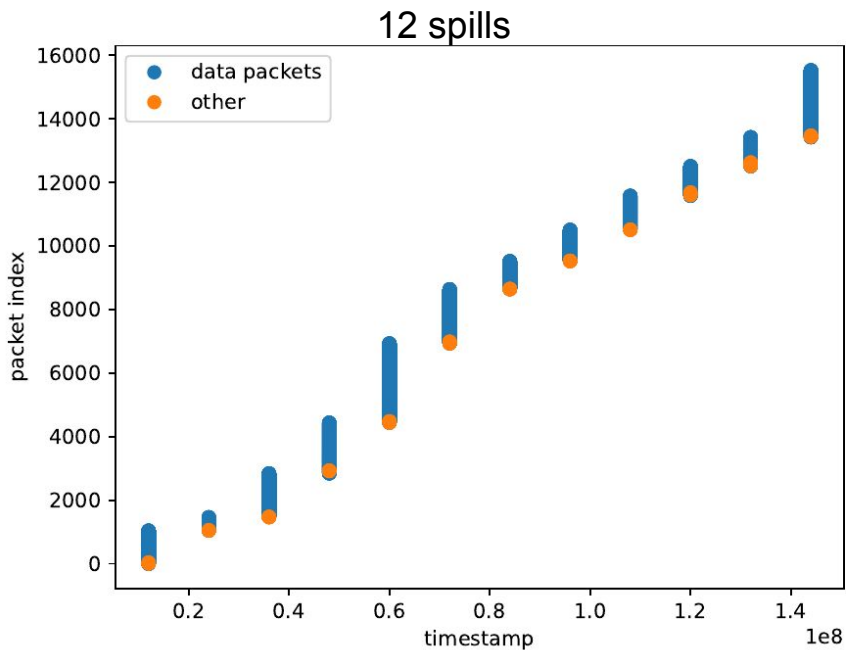


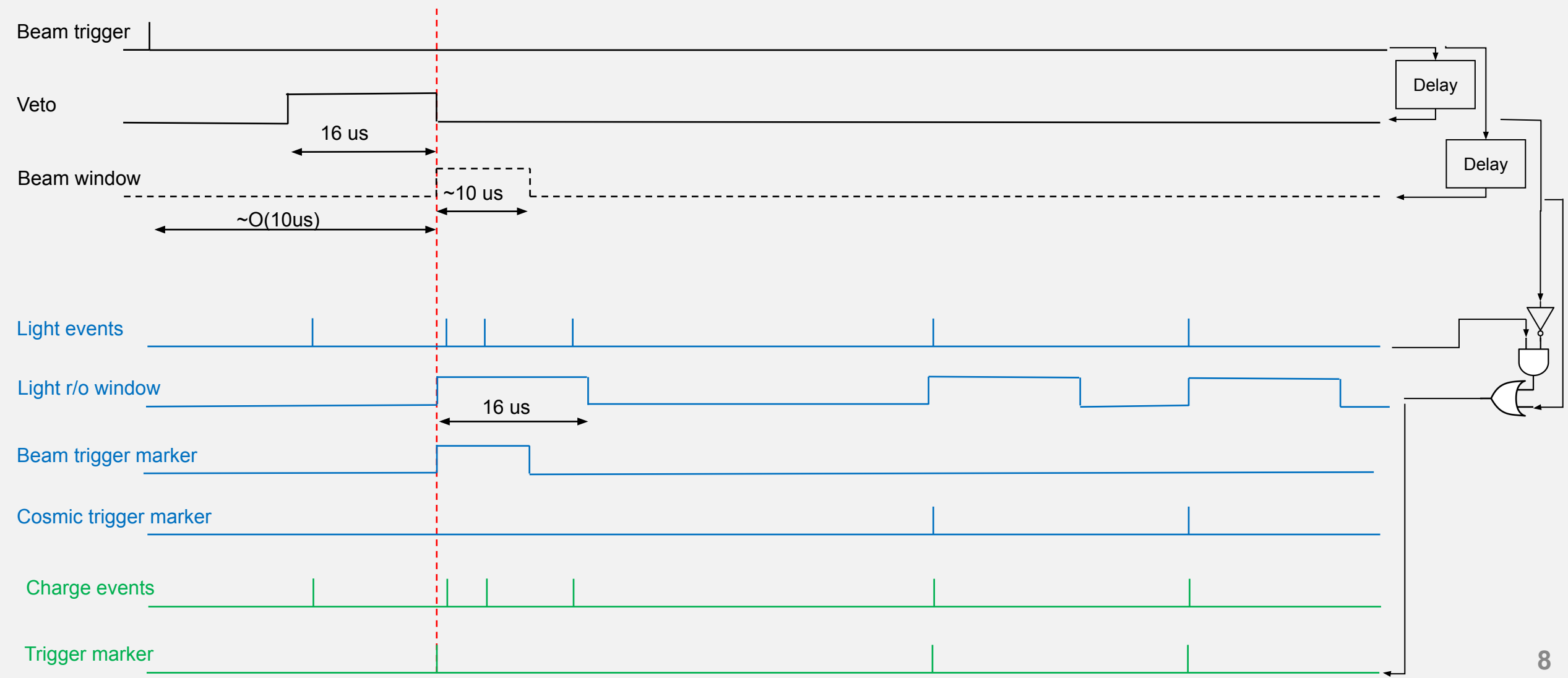
Figure 32: An Oscilloscope Trace of the Proton Current as Seen by the NuMI Toroid in NuMI-Only Mode. This is shown as a pink line, and the dark blue line corresponds to the beam trigger window. The Booster batch structure is clearly visible. The first batch is usually sent to the anti-proton source and is then lost to the NuMI beam. The remaining 5 batches are extracted and sent to NuMI.

Current Spill Timing in Simulation



- Define different selectable options for global trigger
- Based on
 - LRS (cosmic or in-spill events)
 - Beam trigger
 - Minerva ?
 - Calibration LED pulse
- Needs for non-beam physics?
- Trigger markers can be recorded in LRS data stream
- Send global trigger as marker to CRS
 - No more online T0 information (compared to Bern runs)
 - Could be used as improved time sync between CRS and LRS (additional to PPS)

Trigger scheme 1



Trigger scheme 2

