SciBooNE MRD electronics

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ANNIE Collaboration meeting

April 17, 2015

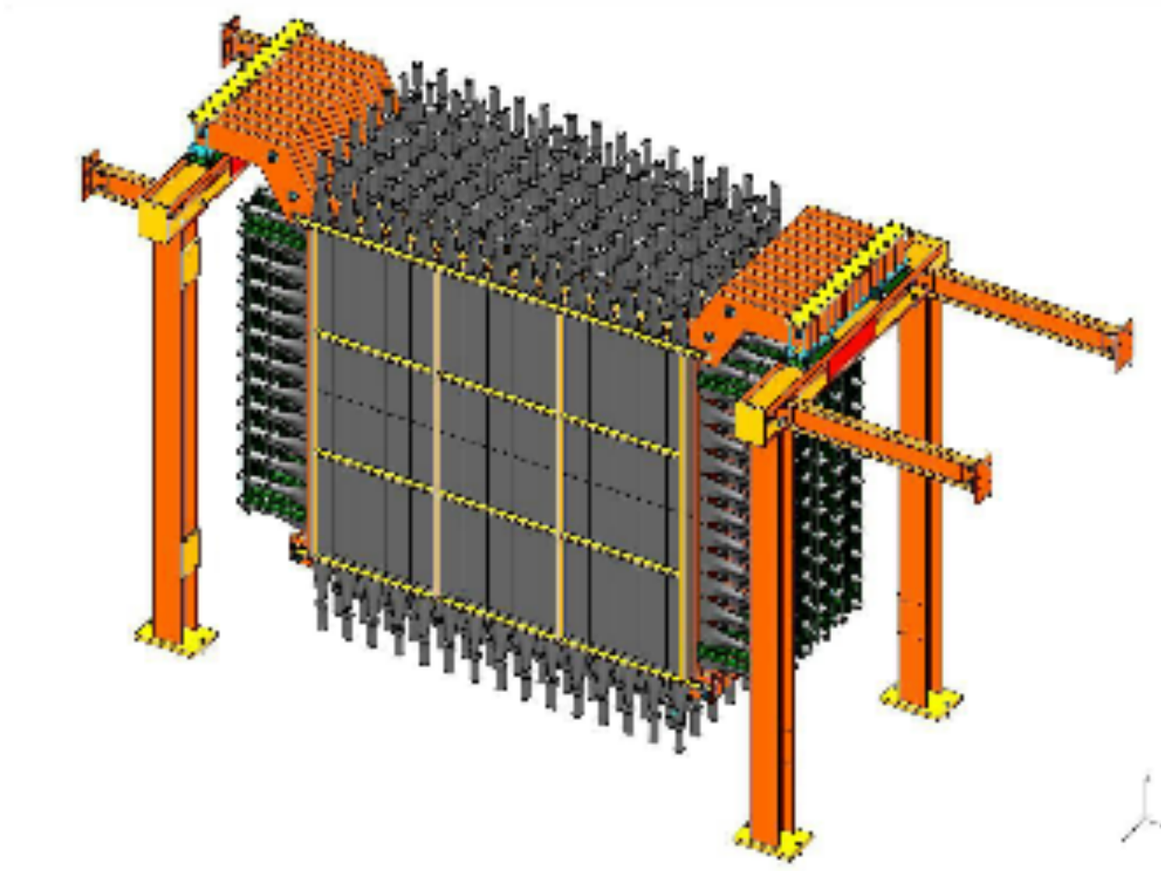
Outline

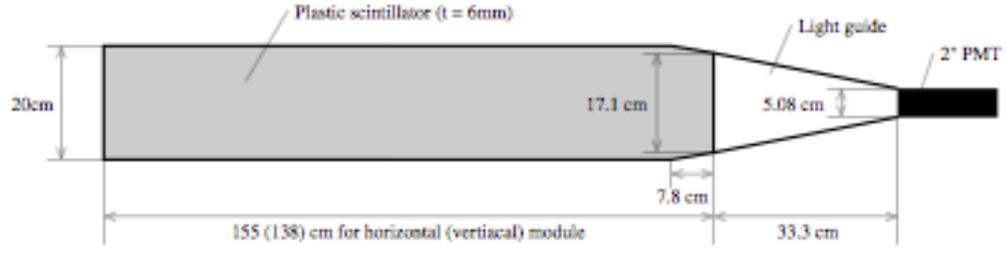
- SciBooNE MRD
- High voltage supply
- Readout electronics
  - Timing readout
  - Charge readout
  - Cosmic trigger
- Performance

April 23, 2007
SciBooNE MRD installation

SciBooNE MRD

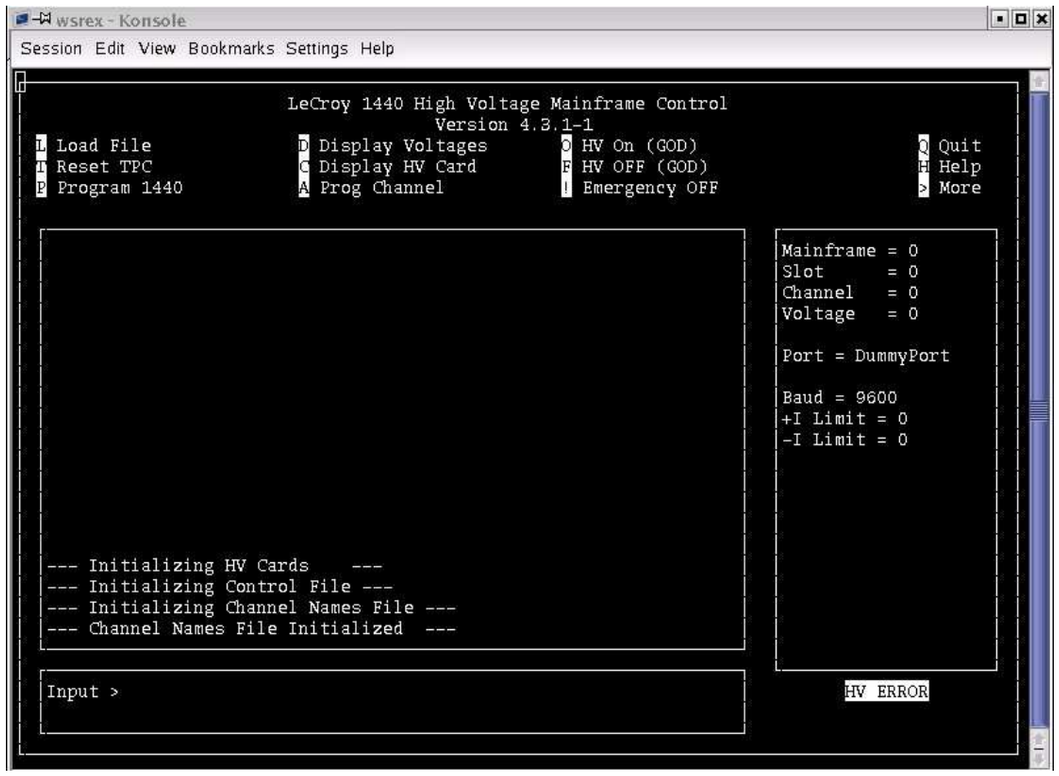
- 12 steel plate + 13-layer of scintillator paddles.
- Horizontal planes (7 planes, 182 channels)
  - Used high-gain (~10^7), long PMTs
  - EMI 9954KB (from KTeV): ~135 channels
  - EMI 9939B (Positive HV): 26 channels
  - EMI 9839B: ~20 channels
- Vertical planes (6 planes, 180 channels)
  - Used low-gain (~10^6), short PMTs
  - Hamamatsu 2154-05 (loaned from Rochester and Kansas state): ~100 channels
  - RCA 6342A: ~80 channels
- All the readout and HV supply modules are from Fermilab PREP.





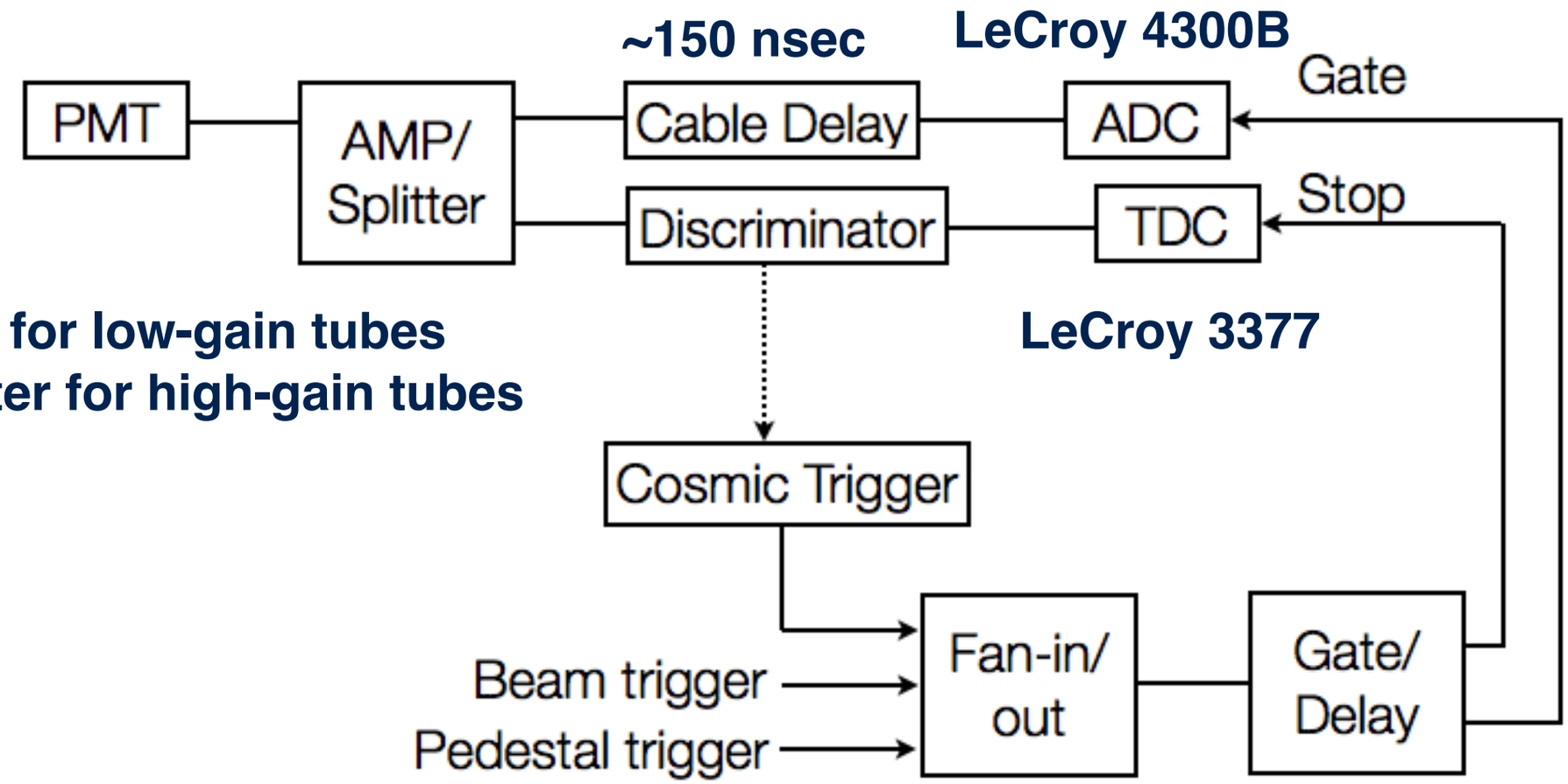
High Voltage supply

- LeCroy 1440 system (from Fermilab PREP)
  - 16 channels/card, up to 16 cards/mainframe
  - Two mainframes used
  - Two cards were for positive HV supply. The rest supplied negative HV.
- Control software from the MIPP experiment
  - Simple terminal interface
  - Controls up to 16 mainframes via serial ports
  - Voltage values loaded from text files
  - Monitoring routine can read HV values from LeCroy units ant write to database (or file).
- Had IP-to-serial converter in the detector hall to send command to the HV mainframes via serial cable.
- More info of the HV control at http://home.fnal.gov/~tayloe/SciBooNE/



Expert: Teppei Katori

Overview of readout electronics



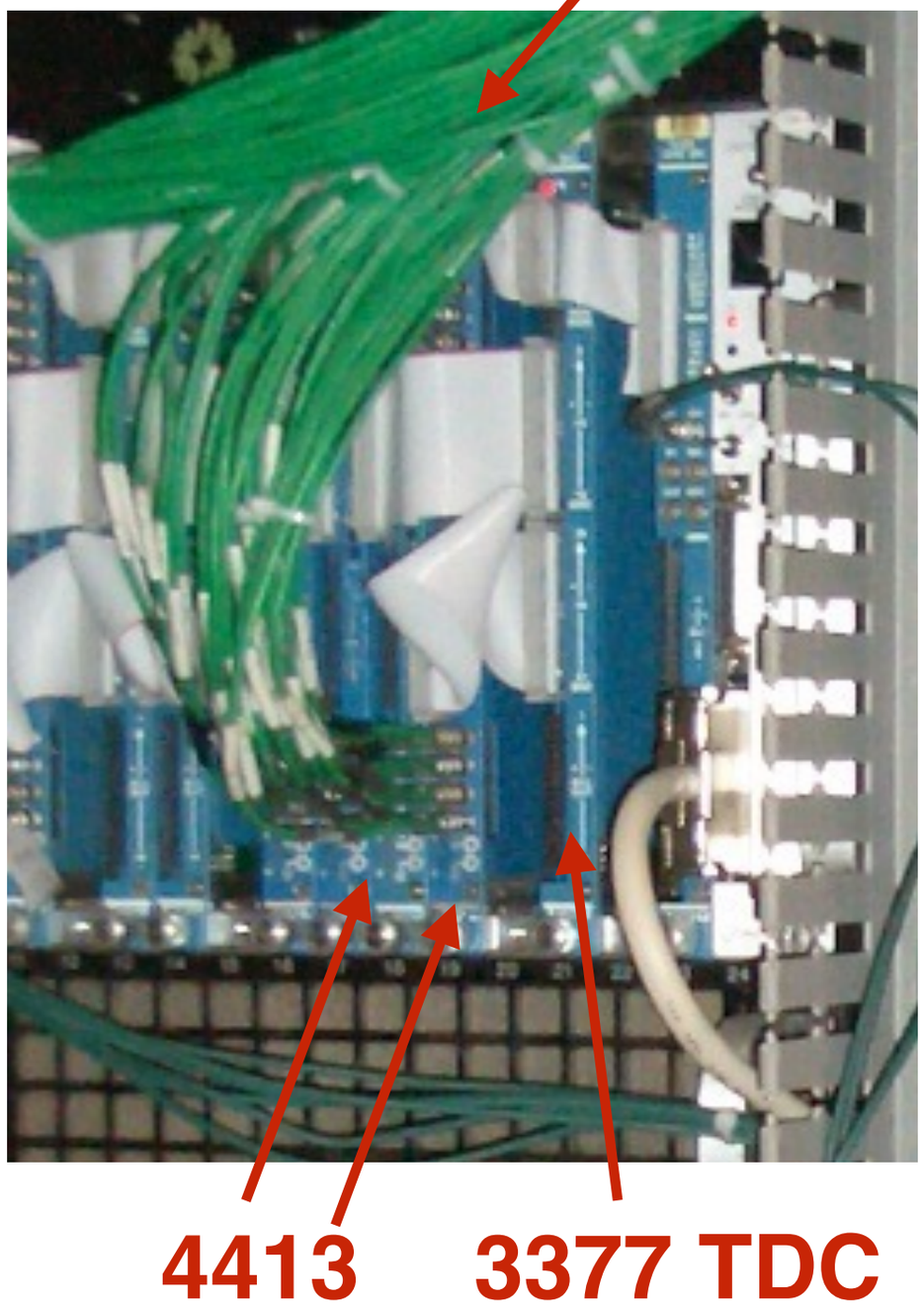
- Read out both charge and timing for each PMT
- CAMAC base, One readout took ~20 msec; Enough
- Cosmic trigger for monitoring detector performance
- Only timing was used for Physics analysis. Used Charge for monitoring detector performance.

TDC

- Signal from PMTs discriminated by LeCroy 4413

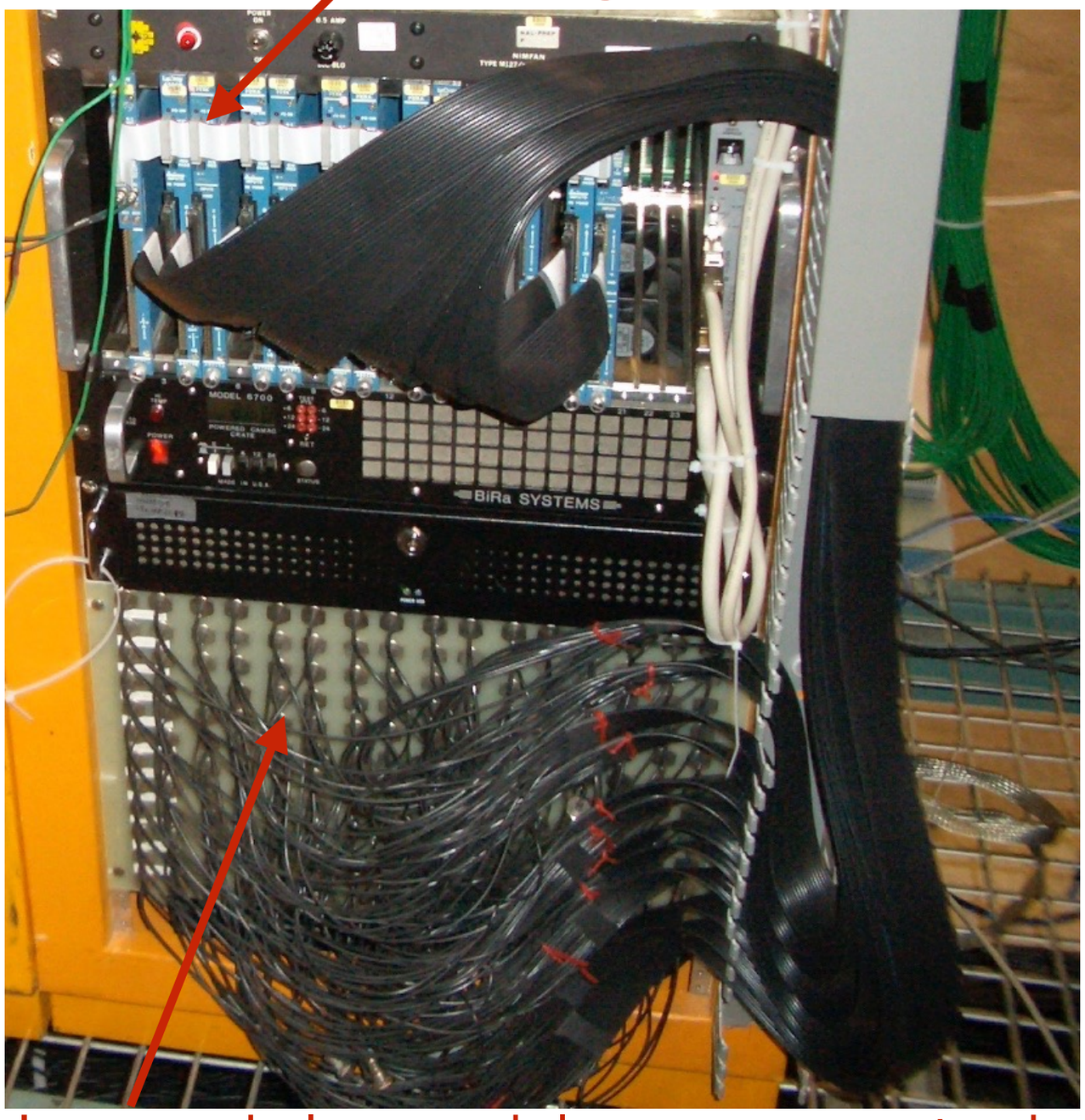
- Output ECL signal from the discriminator sent to LeCroy 3377 32-ch TDC.

- TDC operated with 16-bit, 0.5 nsec/ch mode.

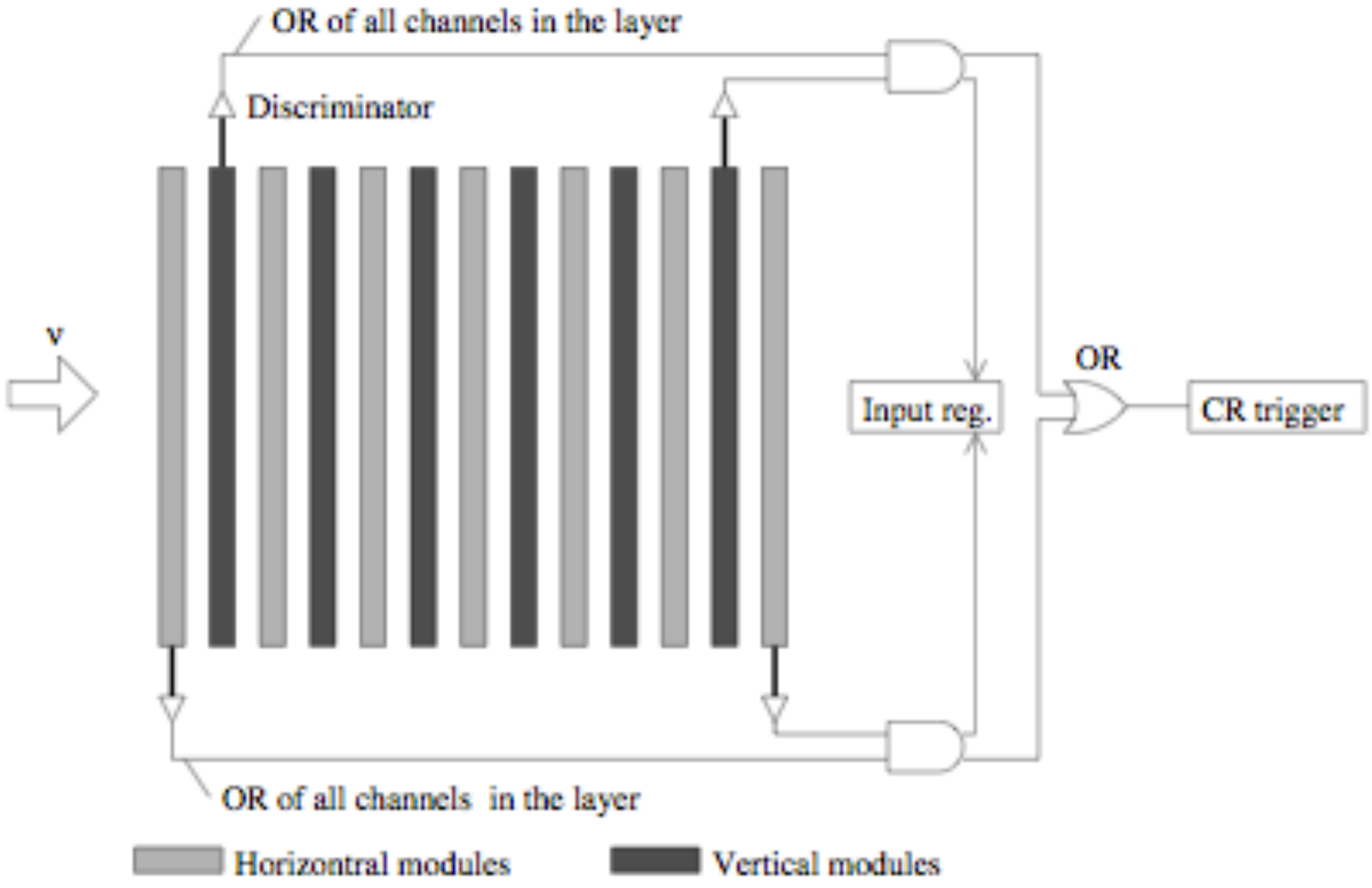


ADC

- LeCroy 4300B ADC
- 11 bit, 0.25 pC/ channel, charge-sensitive ADC
- Integrated charge for 2 μsec gate window (covers one beam spill)



Cosmic trigger



- Simple coincidence of upstream and downstream layers.
- Used for monitoring counter performance and stability.
- ~60 trigger per beam cycle (taken during off-beam period)

Delay cable

Passive splitter

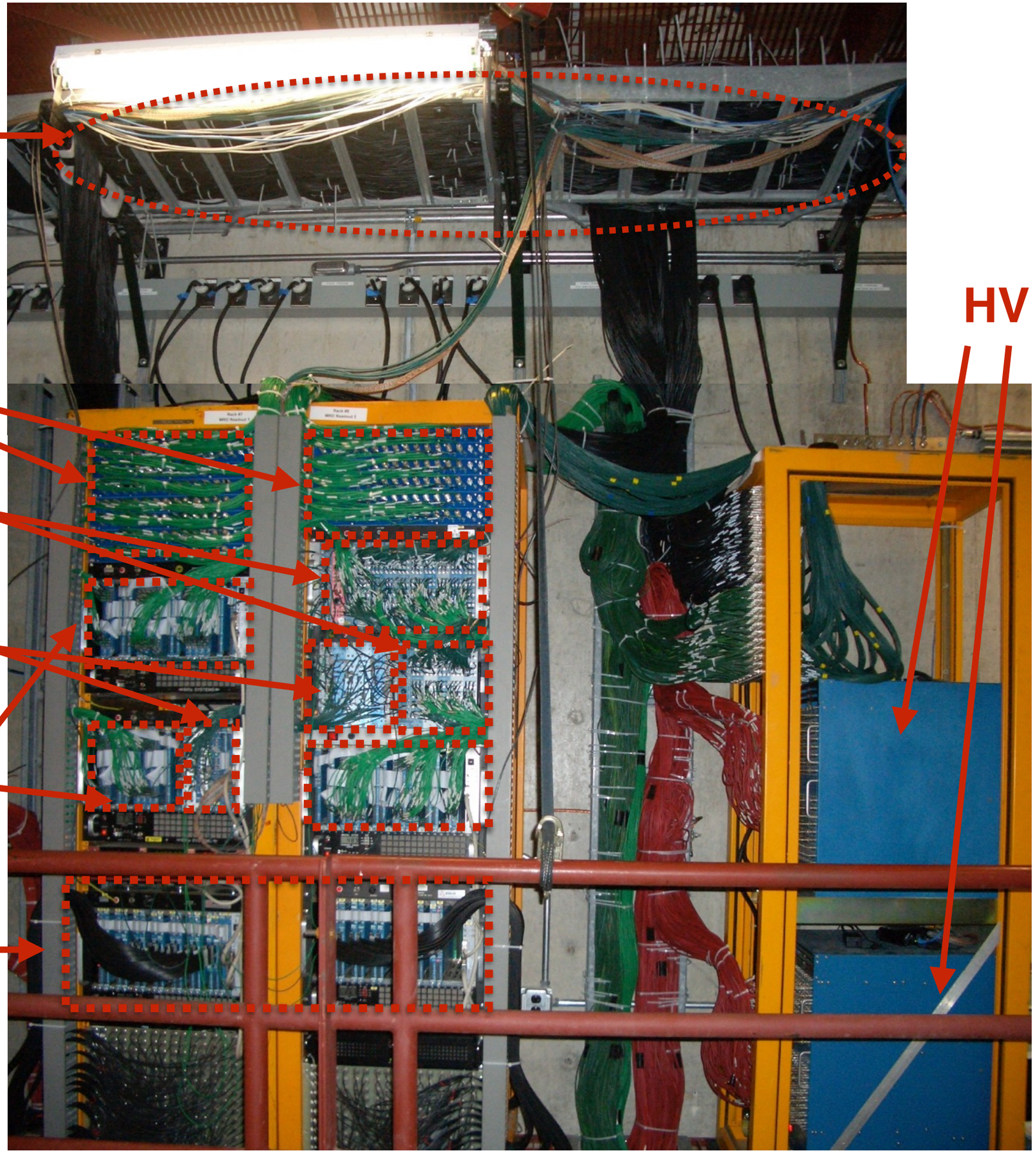
x10 amplifier

Trigger logic

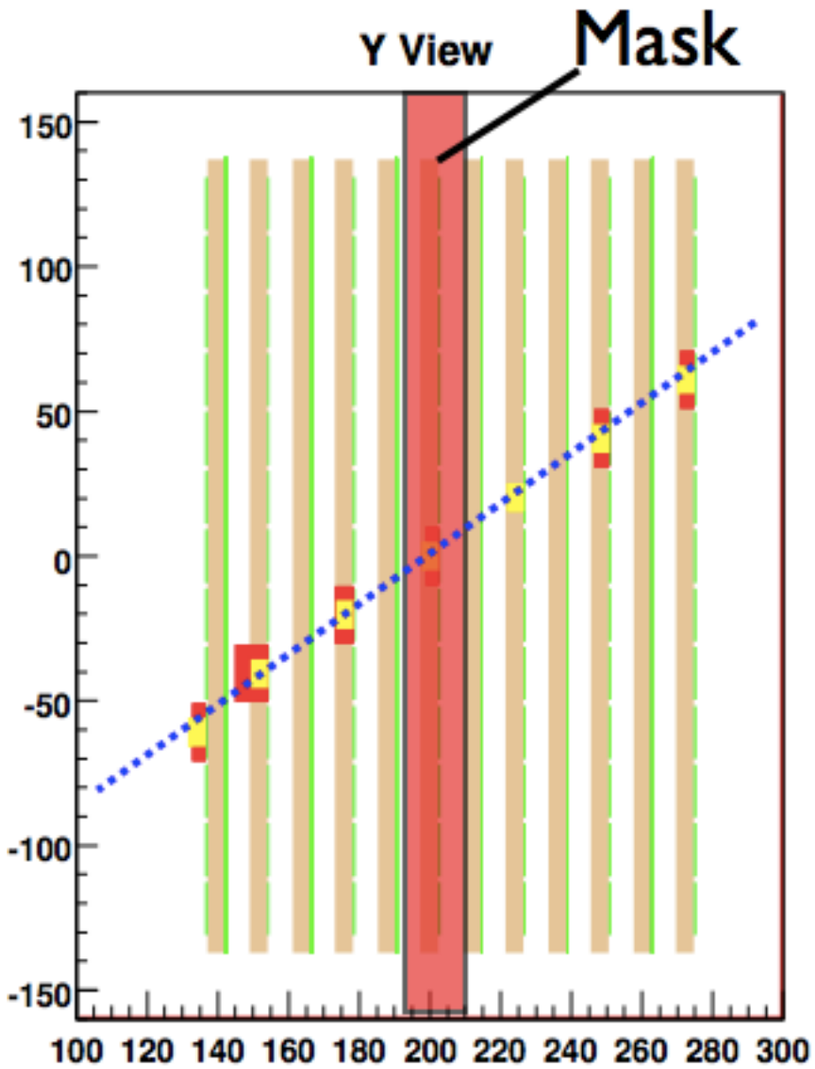
TDC
+Discriminator

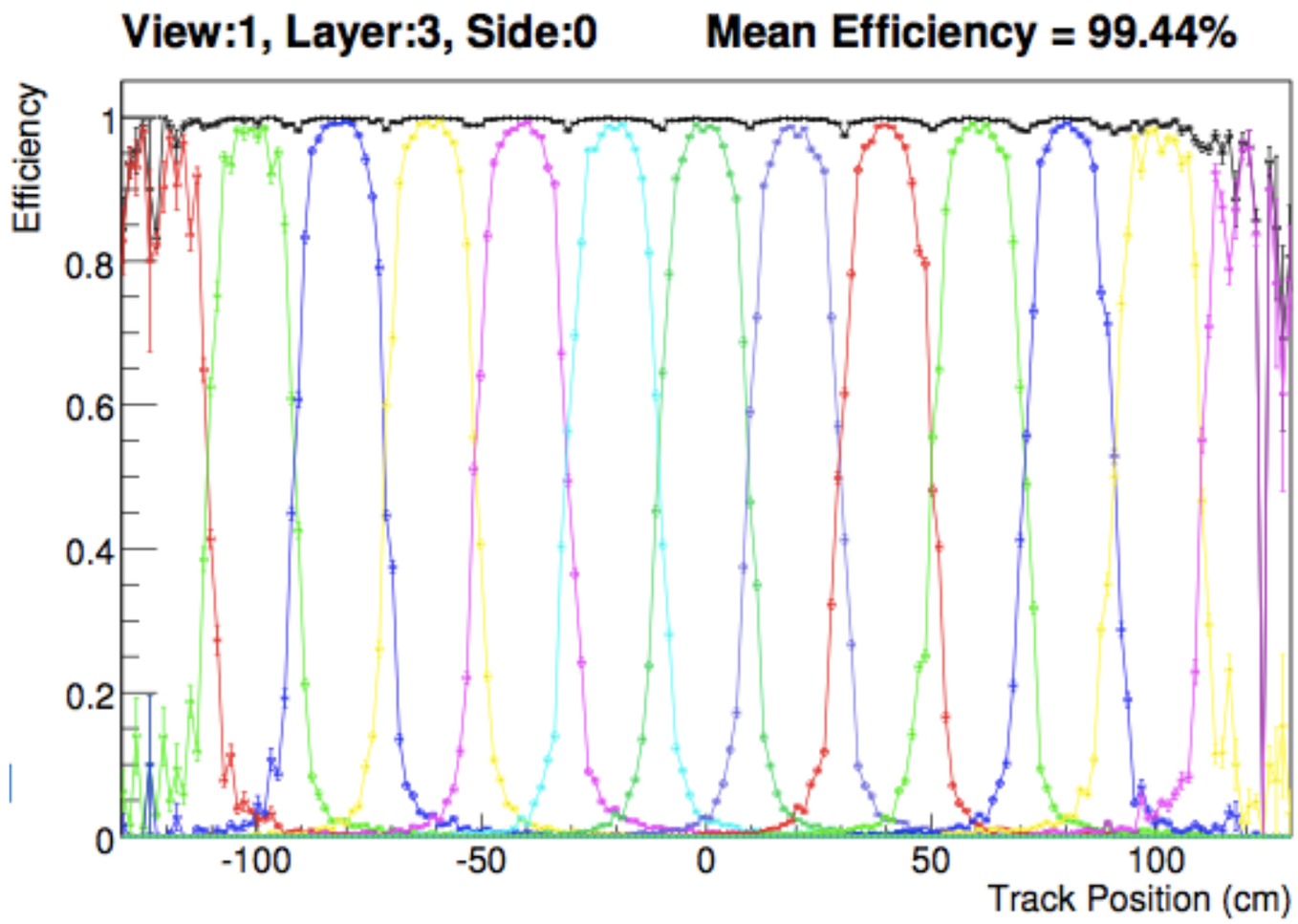
ADC

HV supply



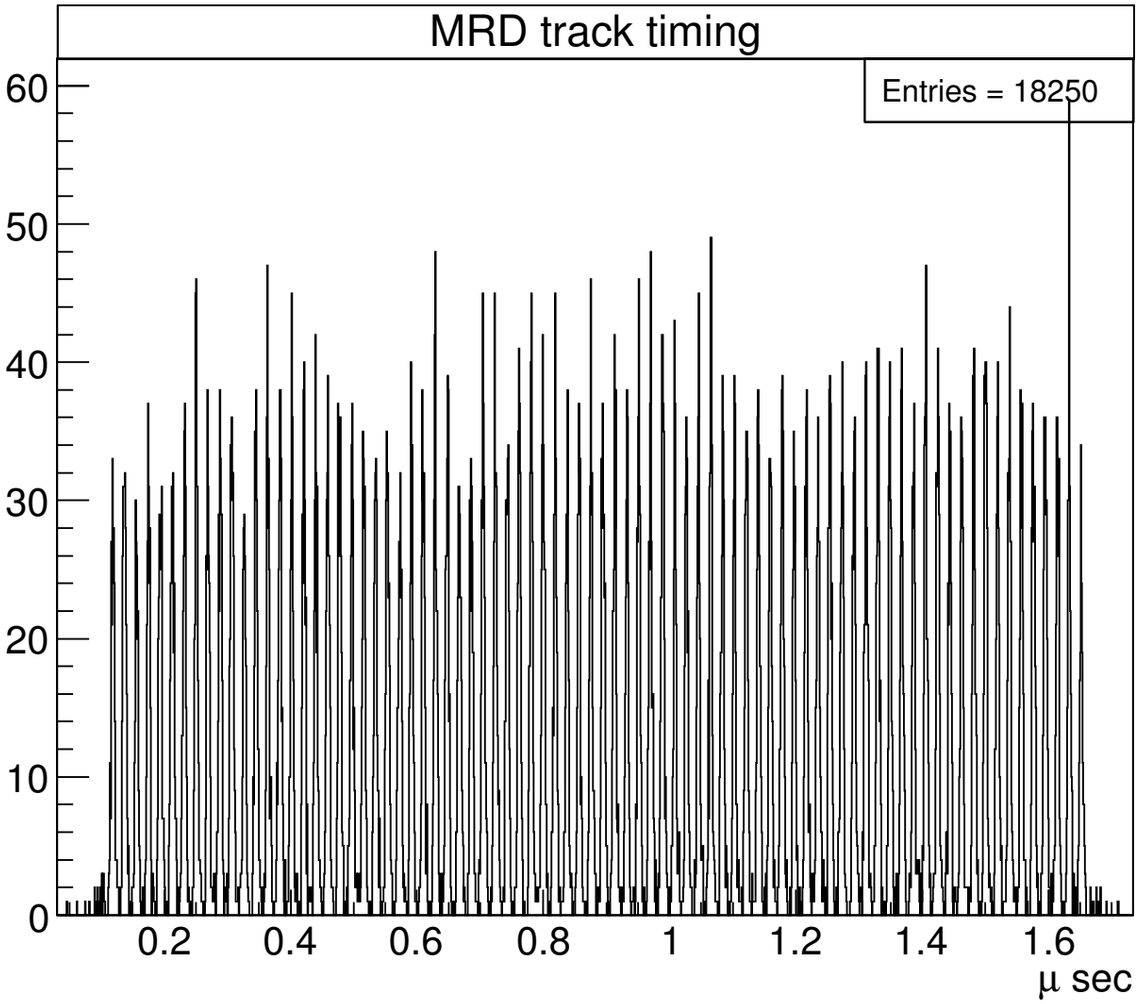
Detector performance (1)
Counter efficiency

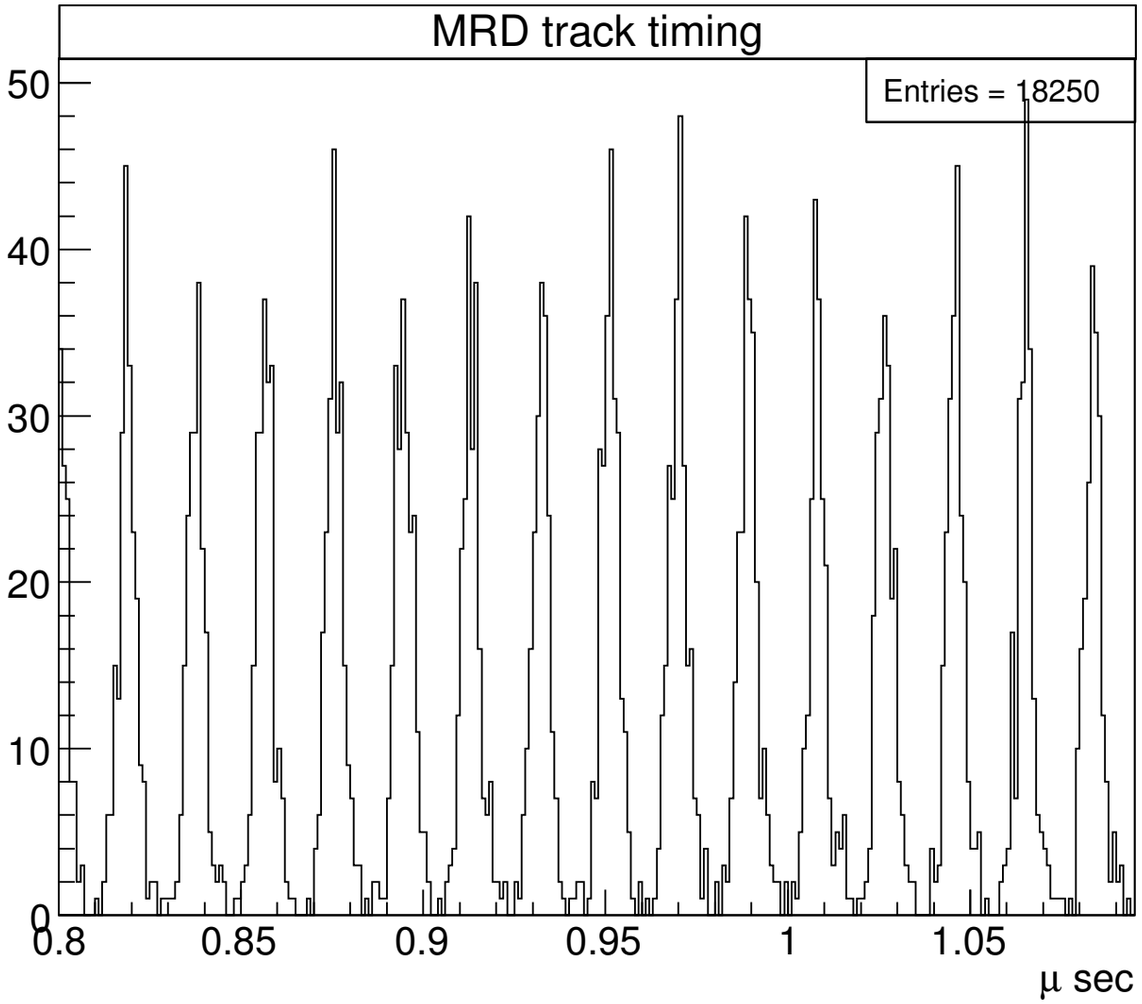




- Evaluated efficiency with cosmic muons
- ~99% efficiency on average
- Inefficiency dominated by the gap between counters (a few mm)

Detector performance (2)
Event timing



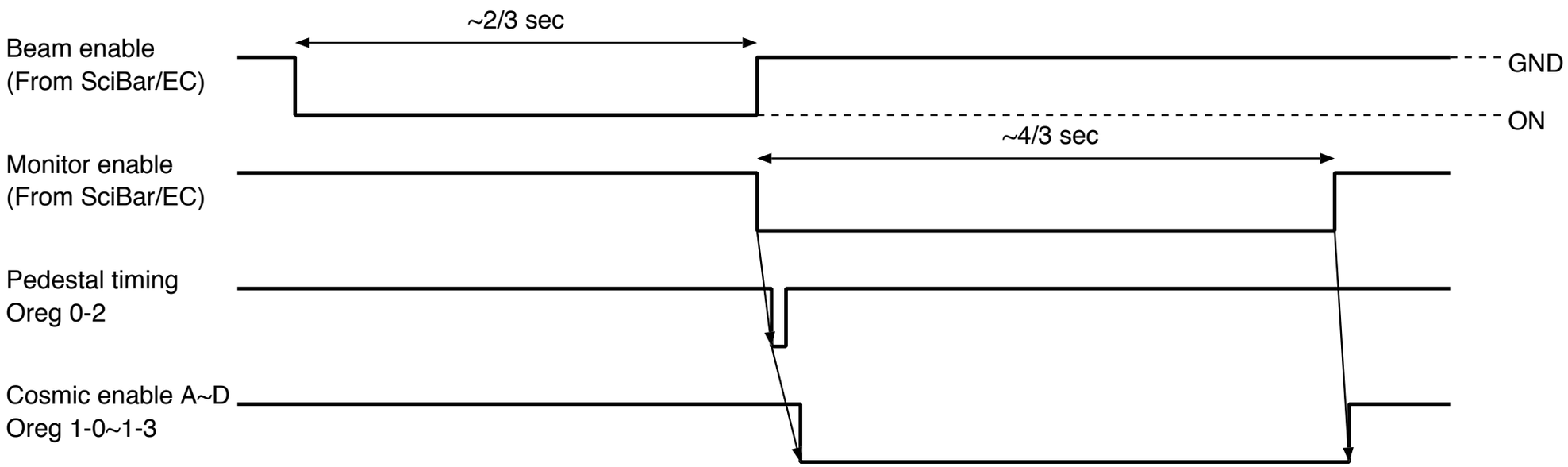


- Timing of reconstructed tracks in MRD within one beam spill
- Able to detect 53 MHz Booster RF structure.

Summary

- SciBooNE MRD: Steel+Plastic scintillator sandwich
- 362 PMTs used to detect scintillation paddles between the plates.
- HV supply via LeCroy 1440 system
- CAMAC-based readout system
  - Read out charge and timing from each PMT for each beam spill
  - Self cosmic trigger for monitoring detector performance
- Worked quite well for detecting muon tracks

Timing chart for one accelerator cycle



Timing chart for one event (normal run)