COUNTING MODE DAQ FOR COMPTON

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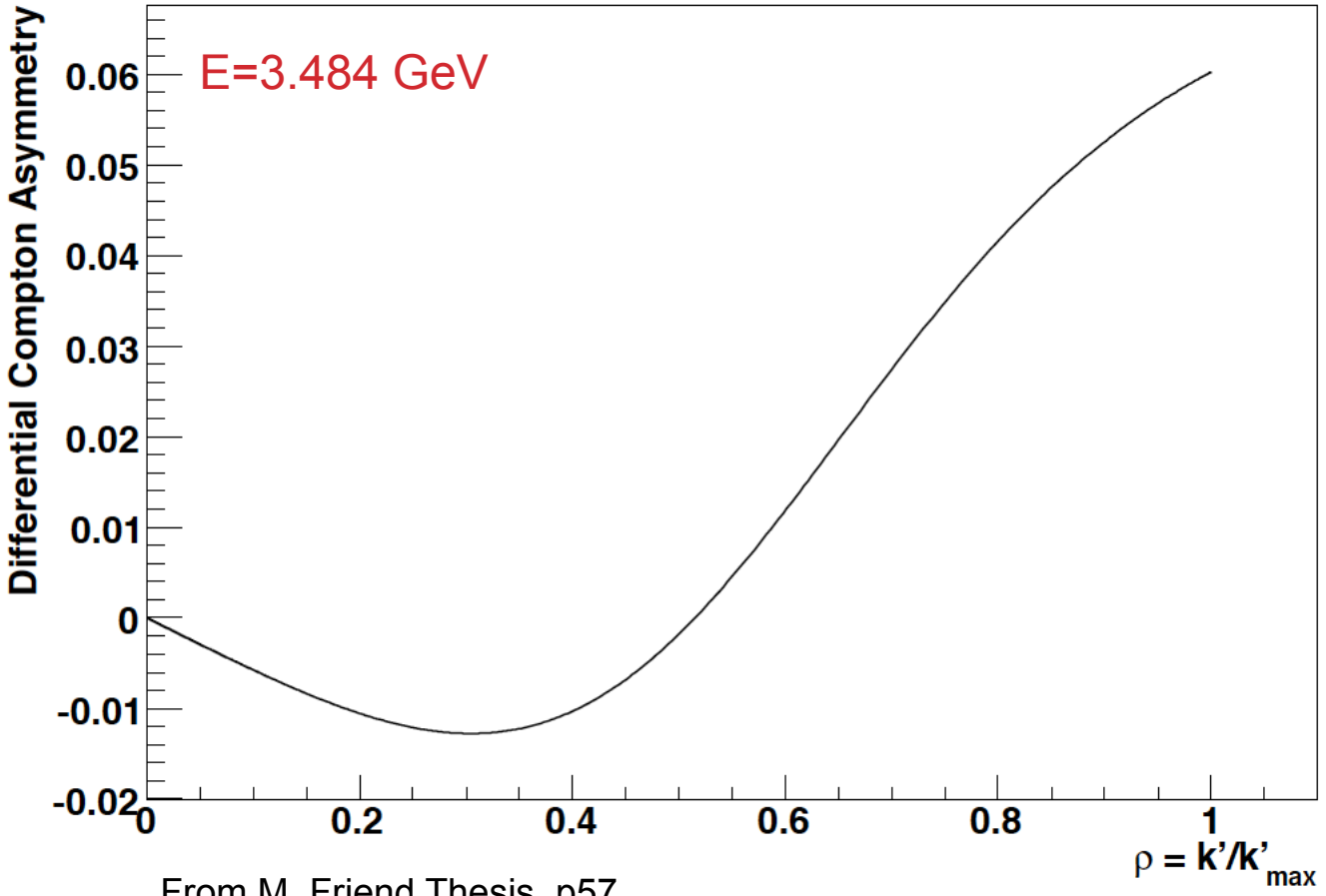
Compton Meeting
Nov 21, 2016

COMPTON ASYMMETRY

$$A_{\exp} = \frac{N^+ - N^-}{N^+ + N^-} = p_e A_{theory}$$



From M. Friend Thesis, p57

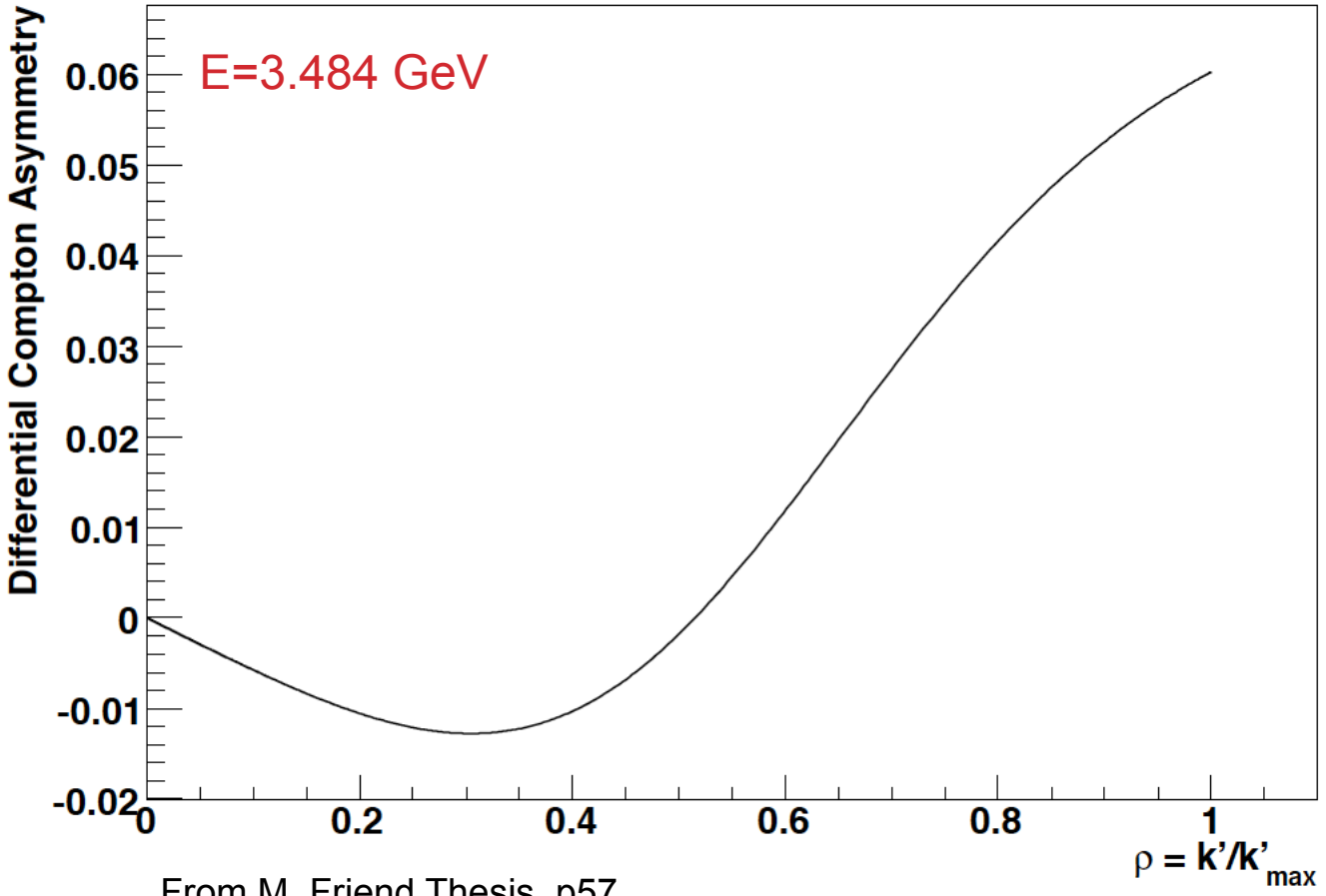
COMPTON ASYMMETRY

$$A_{\exp} = \frac{N^+ - N^-}{N^+ + N^-} = p_e A_{theory}$$

Trigger rates: 10k -100 kHz

Deadtime?

Signals pileup?



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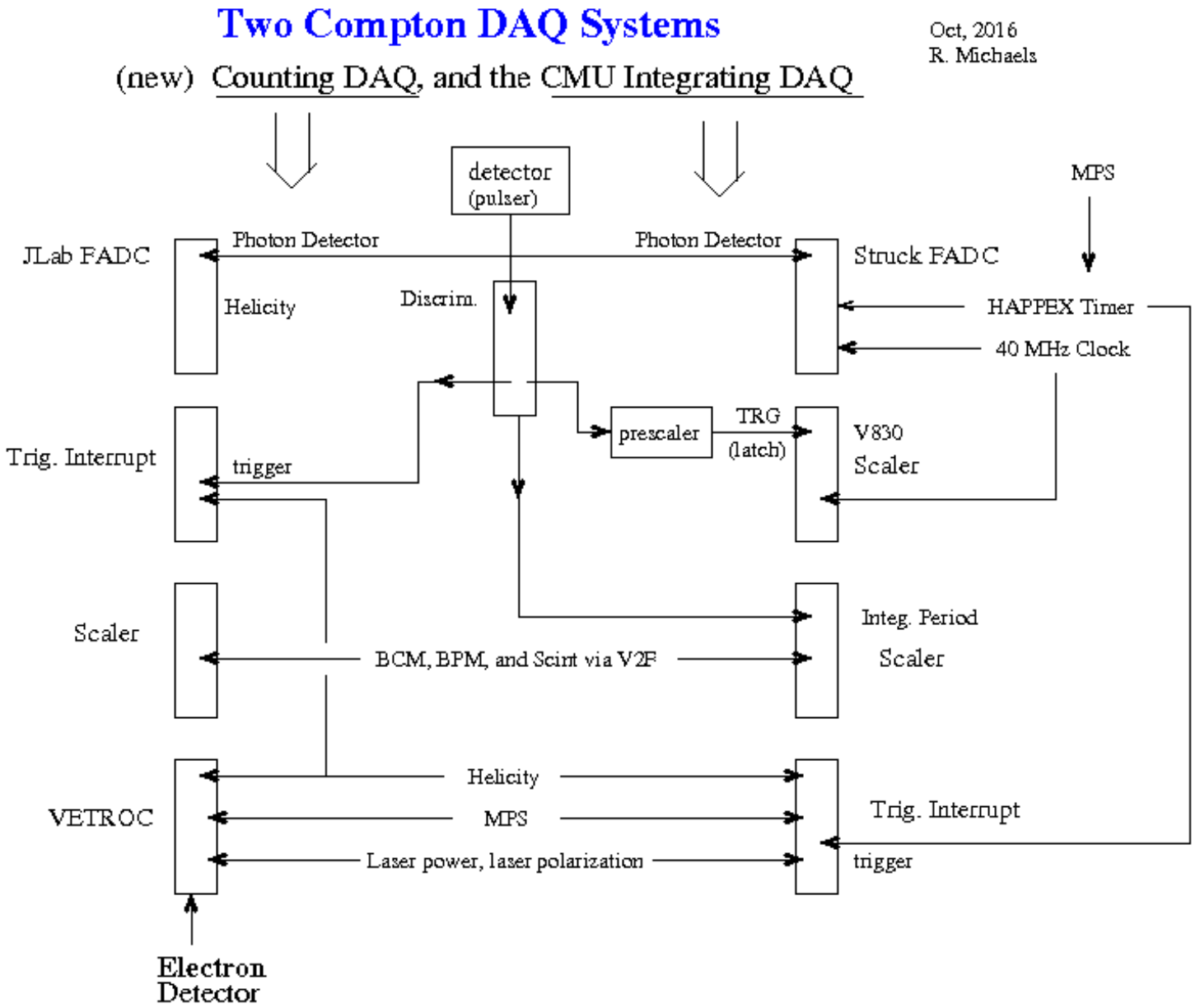
DAQ systems for Compton data:

"new" Counting Mode is based on CODA3 with pipelining electronics and Intel PC

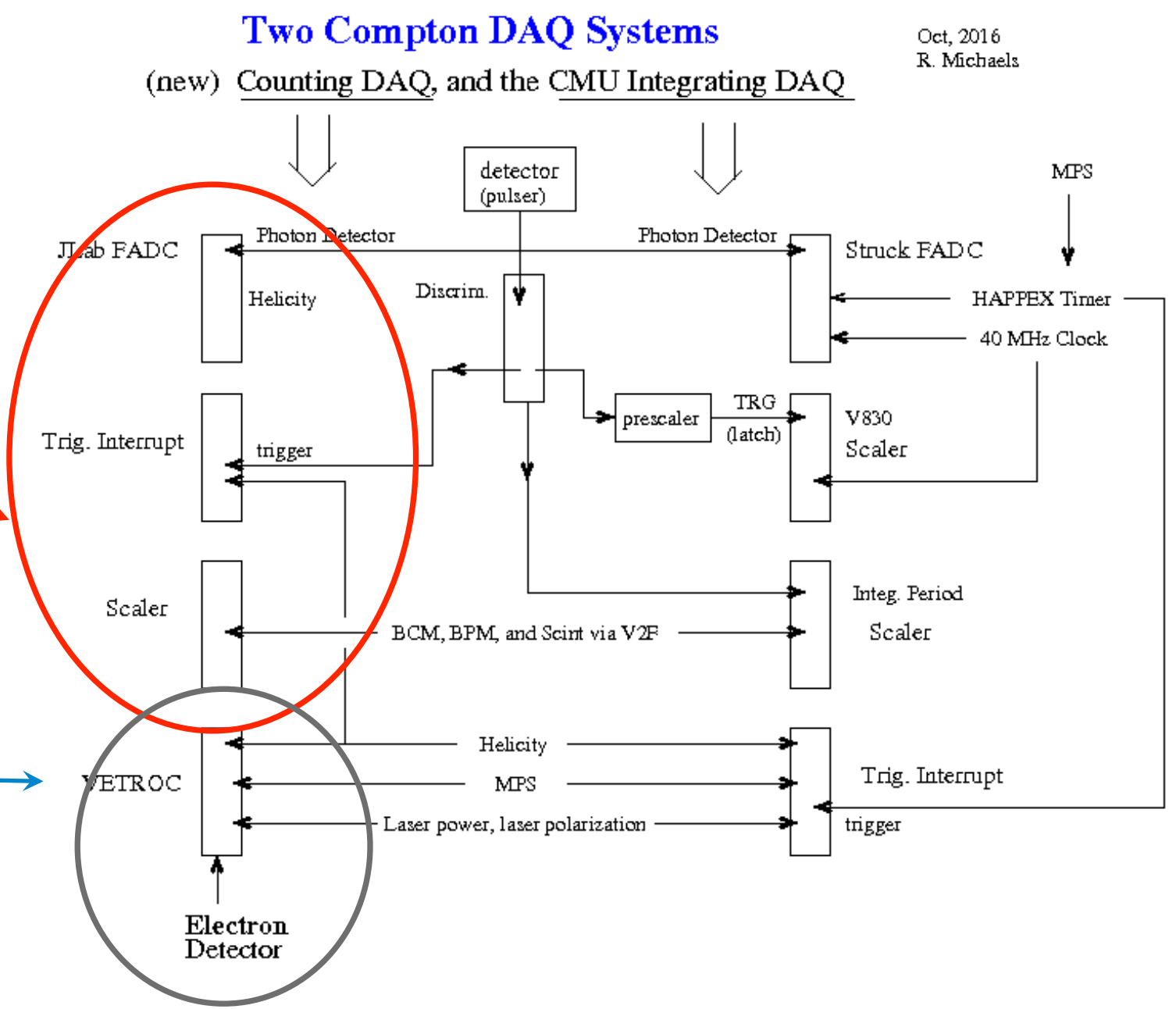
CMU DAQ works well, presently based on vxWorks cpu

Counting vs Integrating has different advantages.



Exists, being tested in Hall A with photon detector

Exists, under development in the GRINCH chrenkov detector test stand



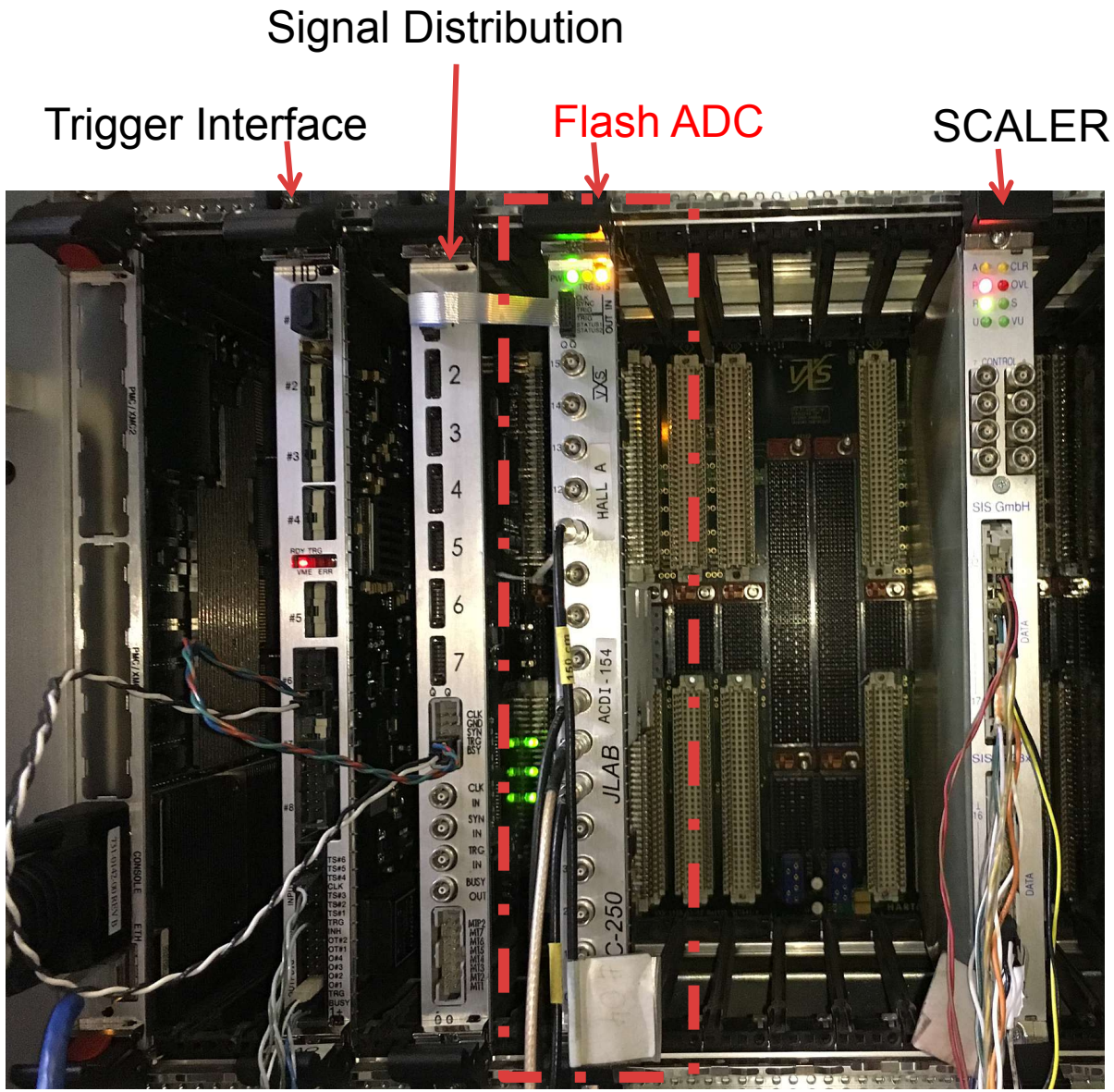
COUNTING MODE DAQ

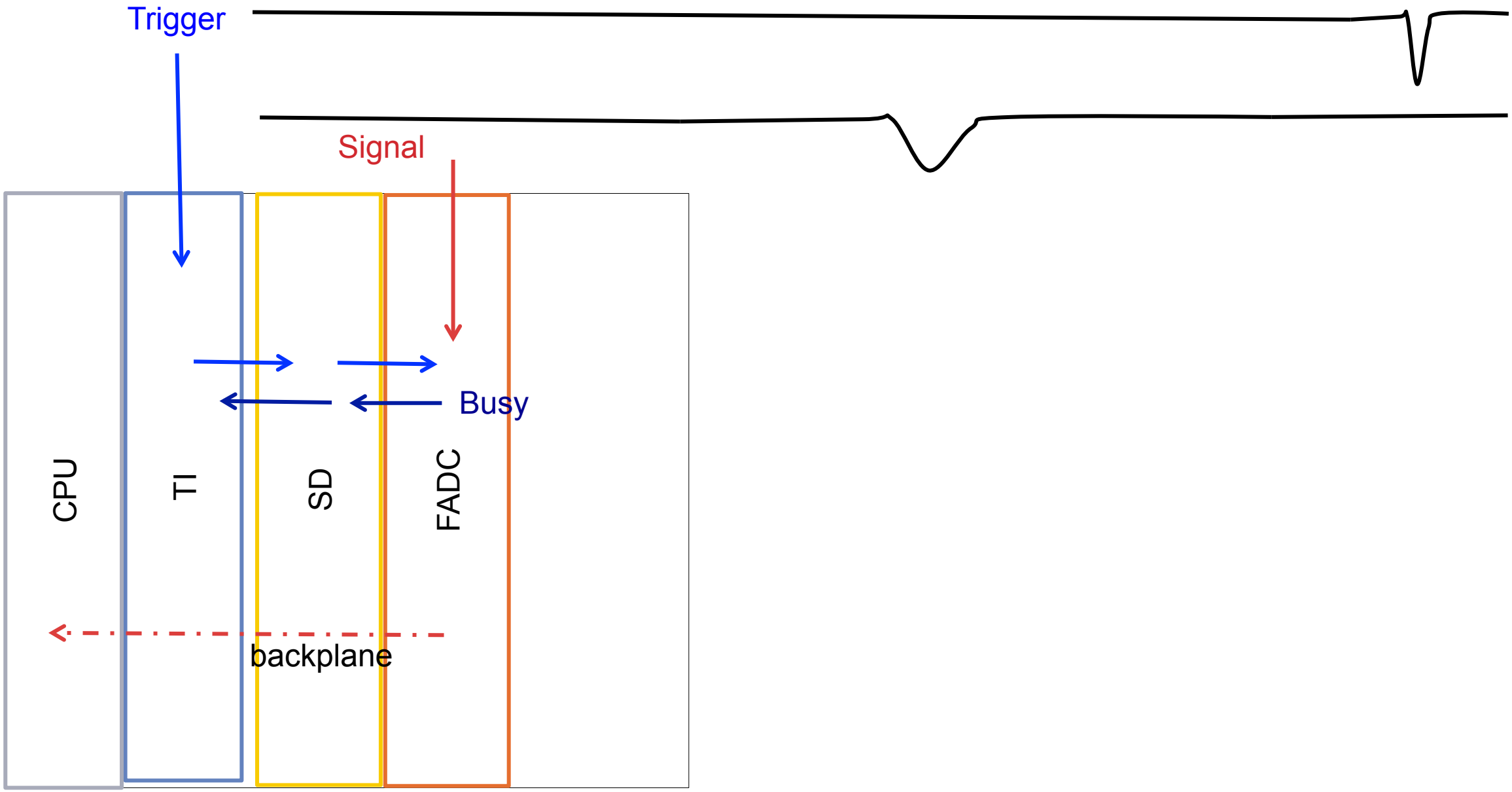
Flash ADC 250 MHz:

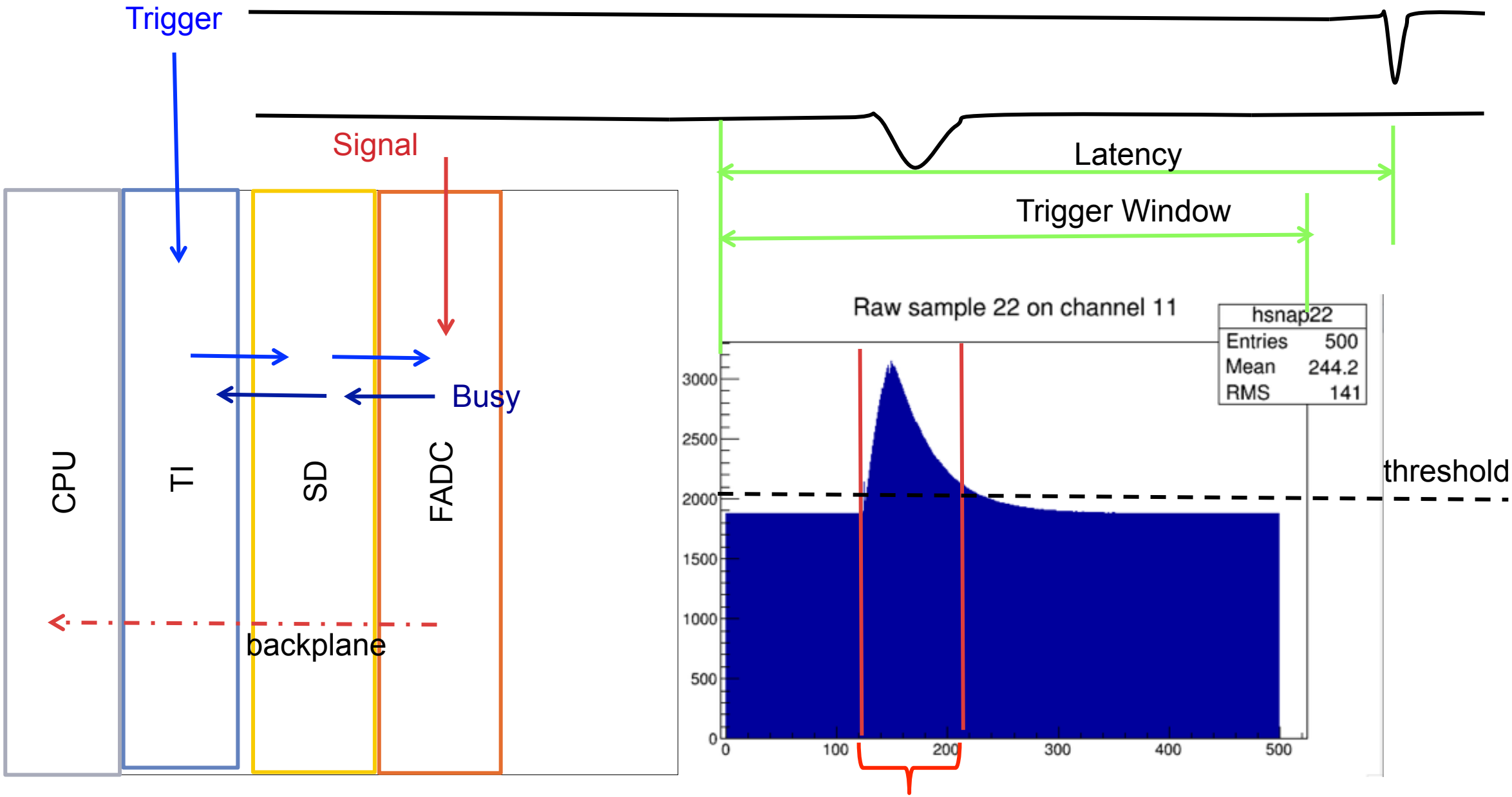
- Made by JLab
- 4,000 dollars
- 16 channels

- Ring buffer with up to 8 μs latency
- Double buffer allows taking and processing data at the same time
- Send data by block (1-256 triggers)

deadtime-free?

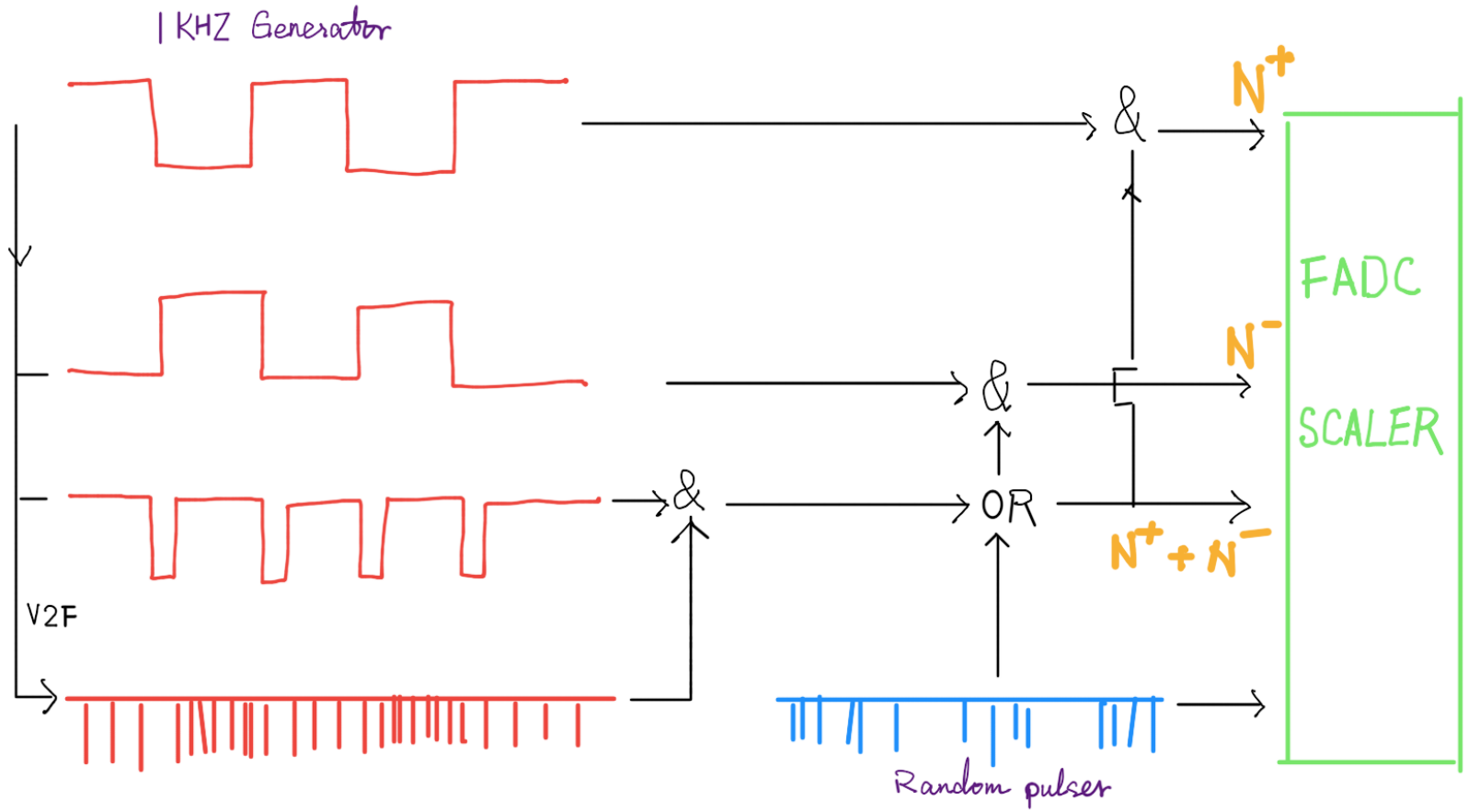



Trigger
Signal
Busy
CPU
TI
SD
FADC
backplane



Only the integral is recorded

TEST MODE



Helicity from pulse generator

Asymmetry from V2F box (250 kHz, 1.1% asymmetry)

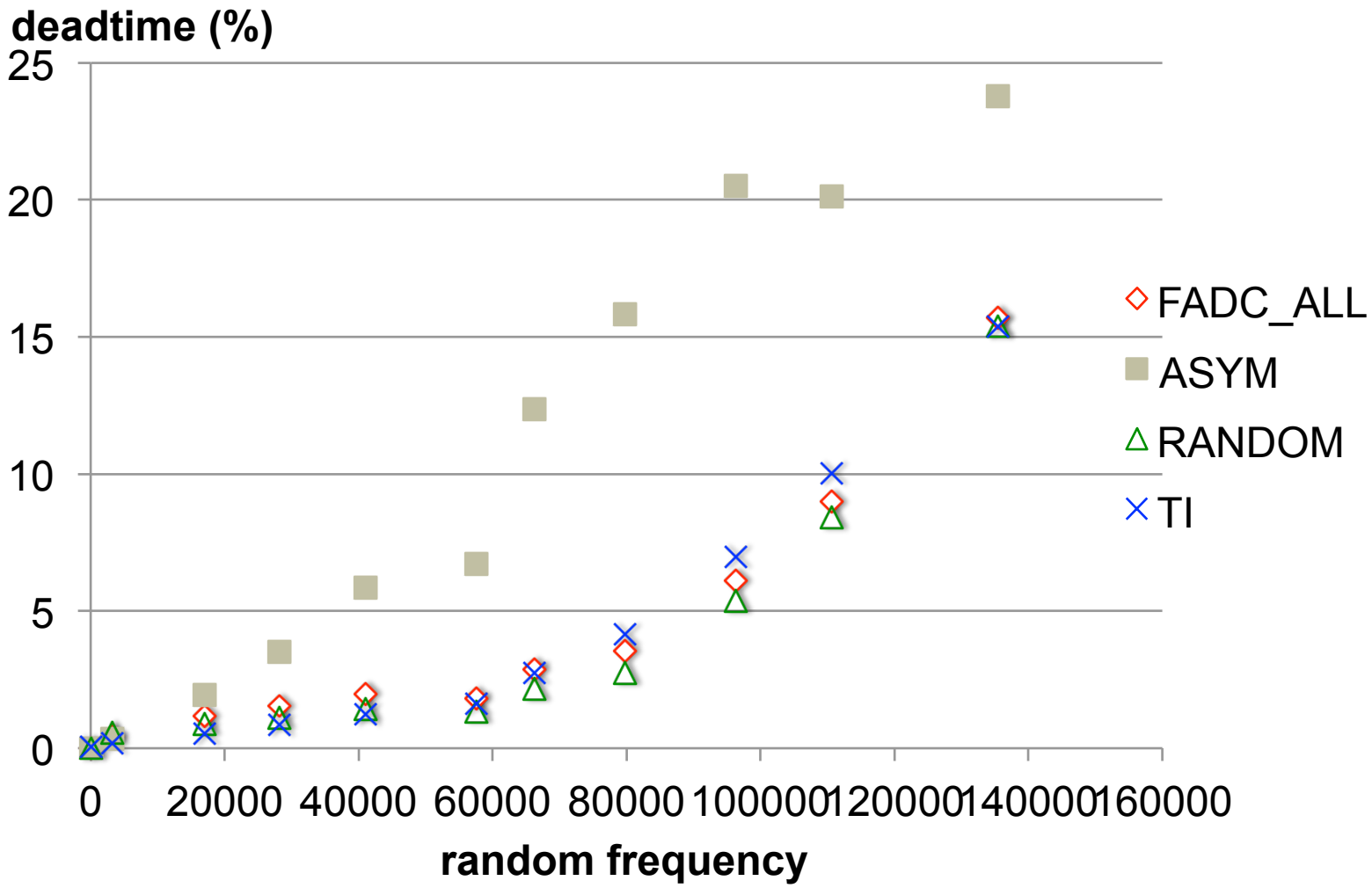
Random pulser (up to 100 kHz) to push system to the limit

Compare FADC and SCALER counts to get deadtime

TEST MODE

$$D_{FADC} = 1 - \frac{N_{FADC}}{N_{SCAL}}$$

$$D_{TI} = \frac{deadtime}{deadtime + livetime}$$

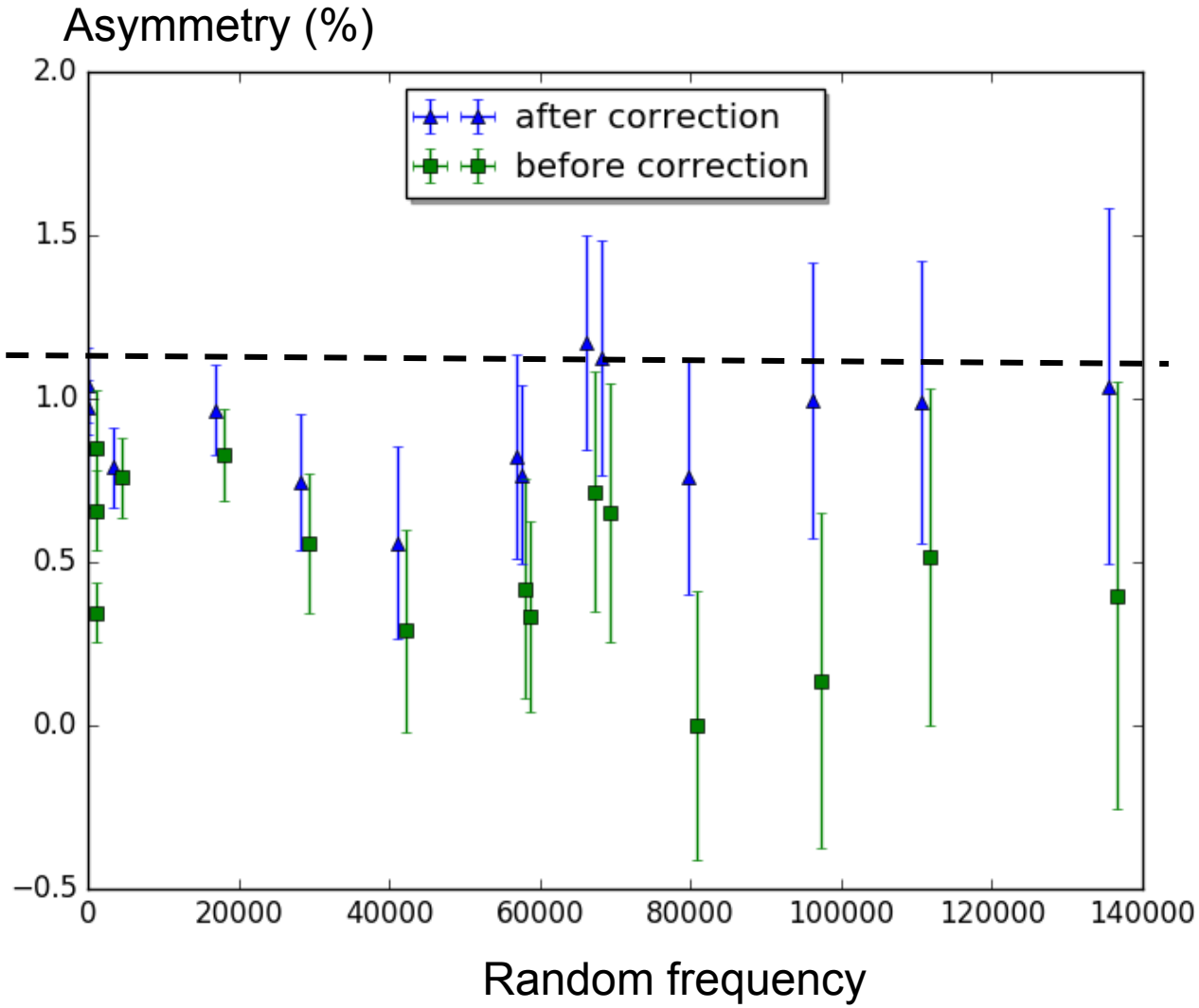


TEST MODE

$$A_{FADC} = \frac{N^{+}_{FADC} - N^{-}_{FADC}}{N^{+}_{FADC} + N^{-}_{FADC} - N^{rdm}_{FADC}}$$

$$N_{corrected} = N_{FADC} / (1 - D_{FADC})$$

$$A_{corrected} = \frac{N^{+}_{corrected} - N^{-}_{corrected}}{N^{+}_{corrected} + N^{-}_{corrected} - N^{rdm}_{corrected}}$$

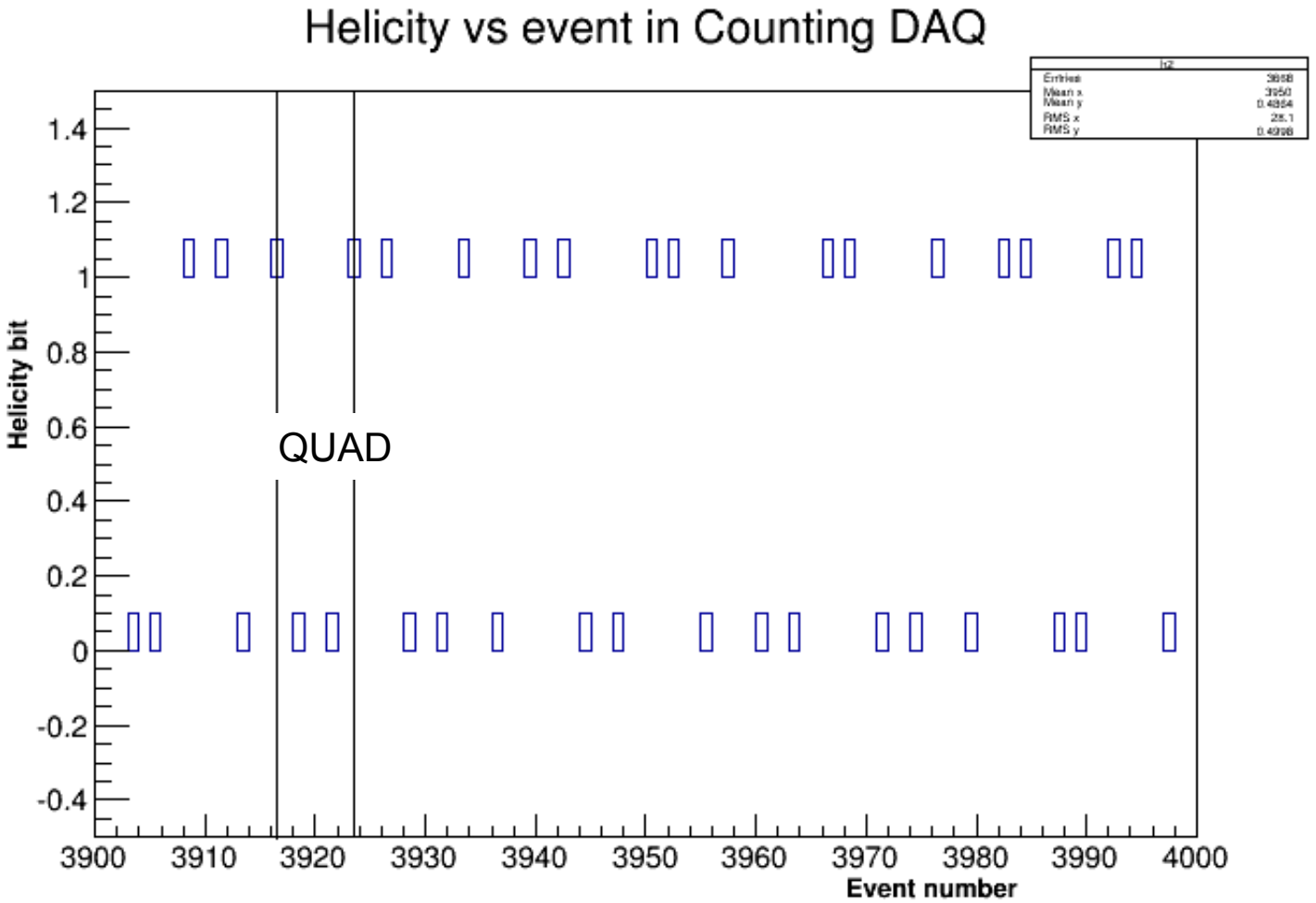


PRODUCTION MODE

Send BCM, CAVITY, HELICITY, MPS to FADC and scaler

RUN 5609:

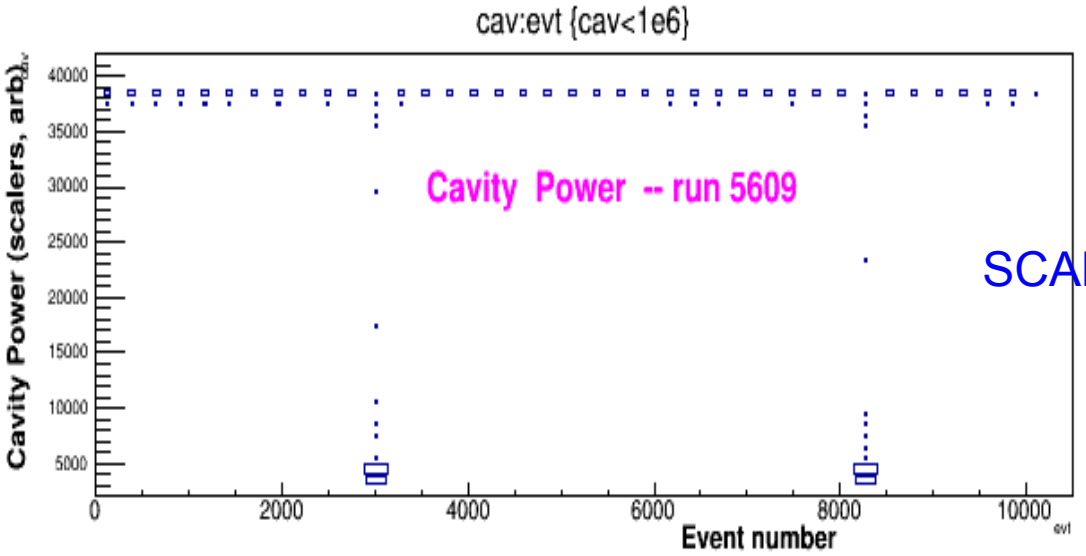
Date: Nov 07
Beam energy: 8518 GeV
Beam current: 10 us
Signal rates: ~7.5 kHz
Deadtime: ~ 0



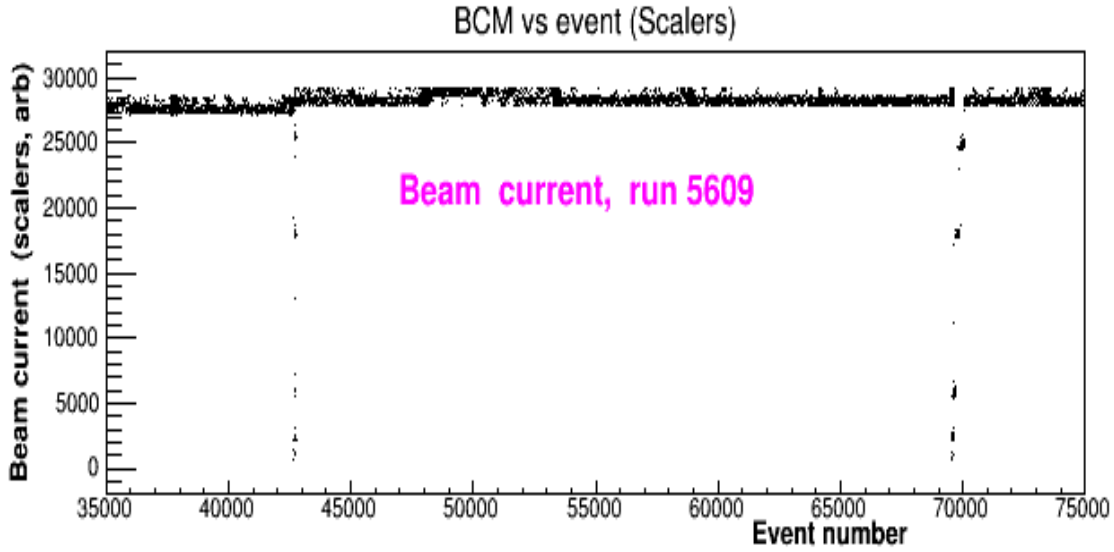
From R. Michael

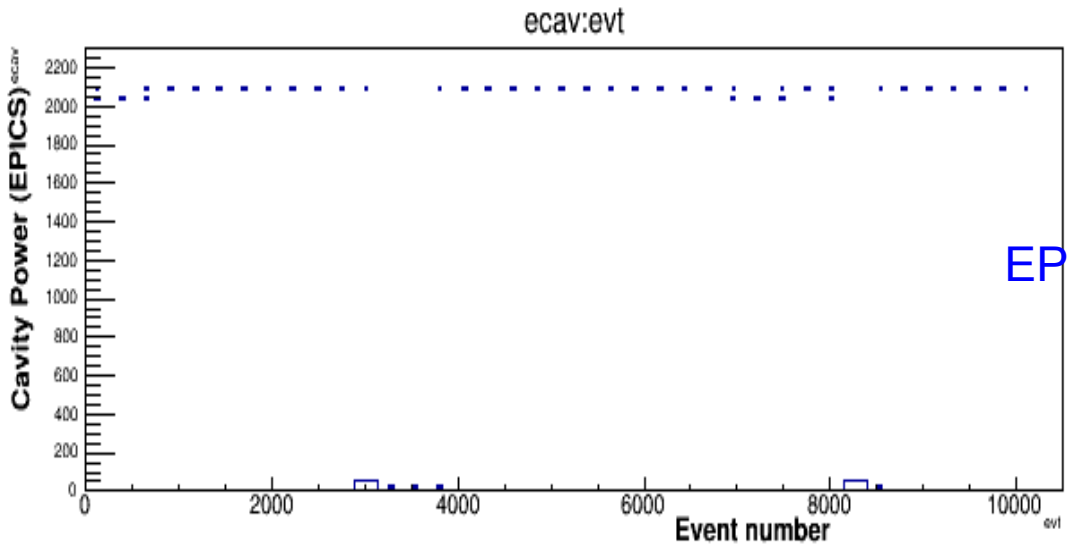
PRODUCTION MODE

Send BCM, CAVITY, HELICITY, MPS to FADC and scaler

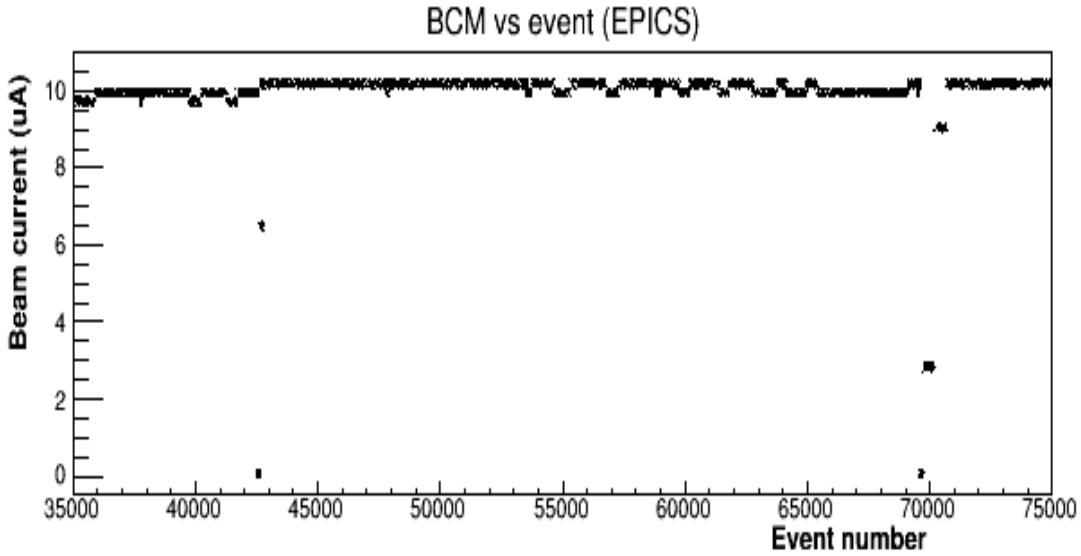


SCALER





EPICS



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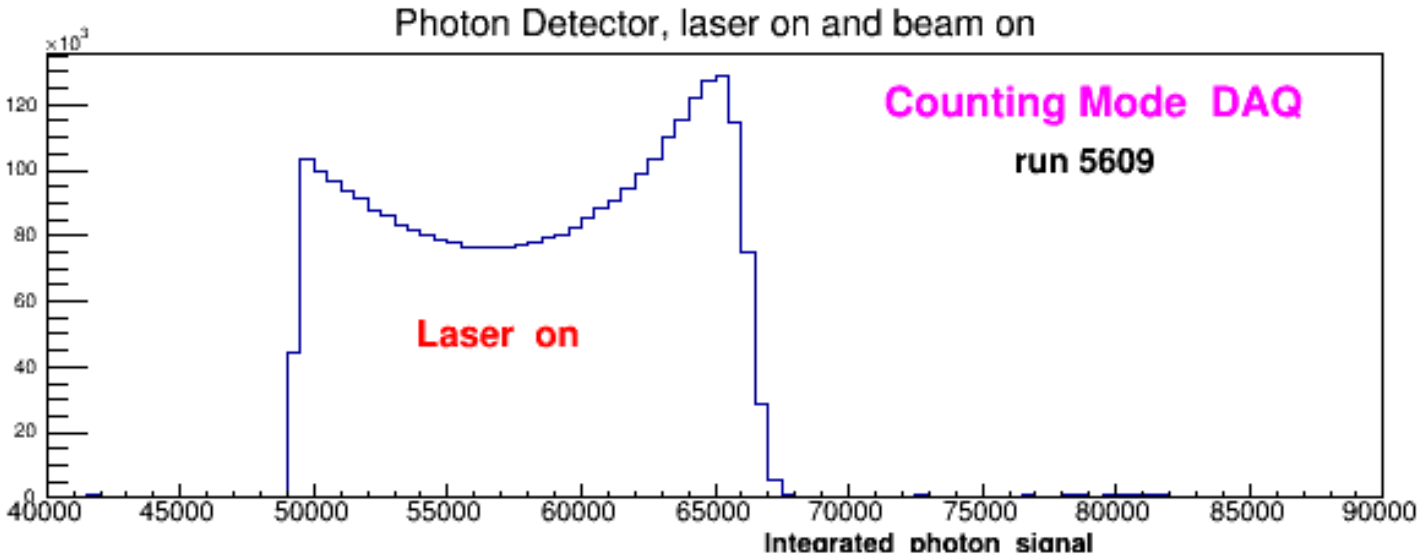
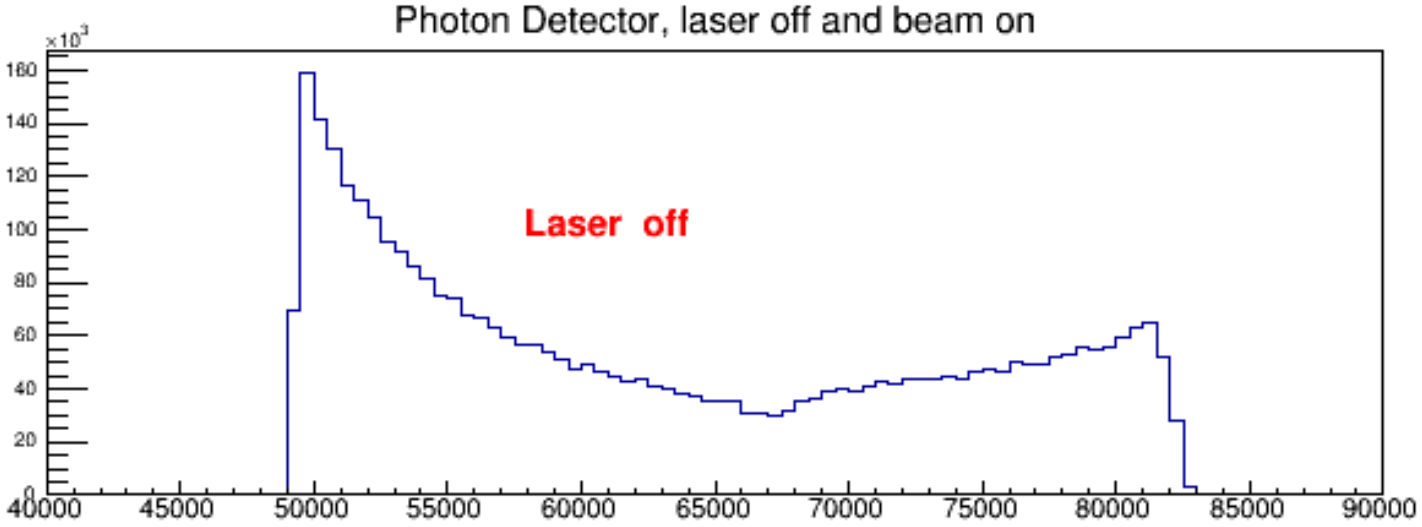
PRODUCTION MODE

Send BCM, CAVITY, HELICITY, MPS to FADC and SCALER





From R. Michael

Use BCM, cavity information to select events

Need to assign helicity to every signal

More study on deadtime

What is a VETROC ? (Vxs – based Electron Trigger and ReadOut Controller)

VETROC

A module built by the JLab DAQ group

Like a TDC

Pipelining -- zero (very little) deadtime

Feeds data to a GTP across backplane. (GTP also built at JLab)

GTP = Global Trigger Processor

GTP has FPGA programmed to form a trigger based on pattern of hits in VETROC

GTP

VETROC Specs

VETROC

Resolution : 1 nsec (our board)
can be 20 psec

128 channels per board, 17 boards fit in crate

Bandwidth: 4 Gbit/sec

Can accept front-panel trigger, or can feed its data to GTP to form a trigger at 30 MHz

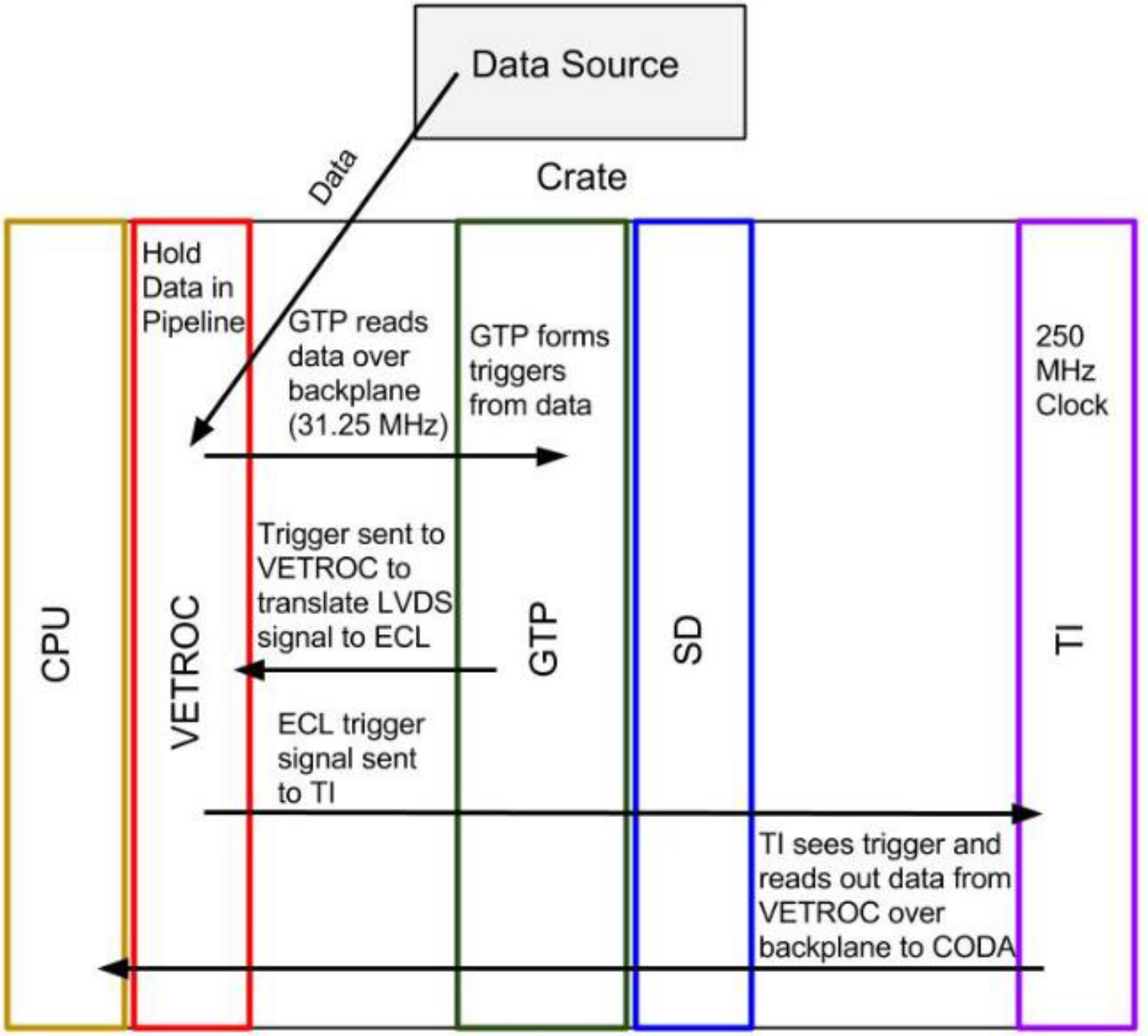
Readout speed – observations:
0 deadtime for 160 kHz with 5 hits
250 kHz with 1 hit

GTP

GRINCH Test Stand

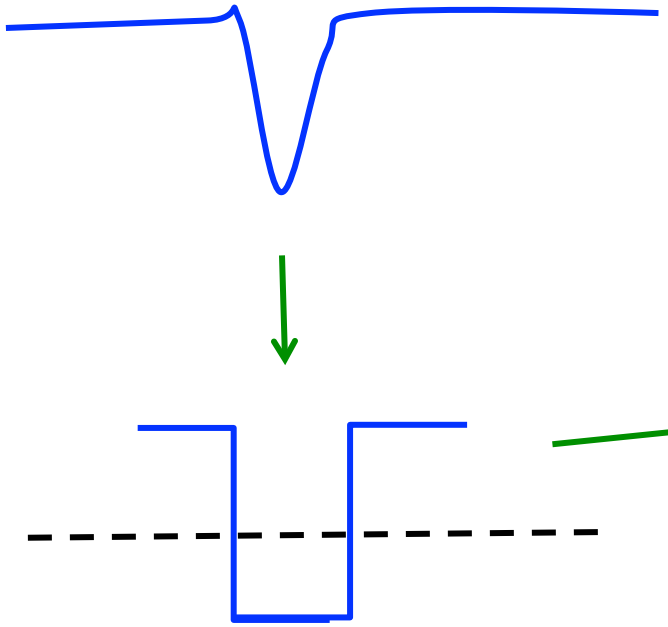
Uses VETROC Similarly to how Compton Edet would

Scott Barcus
Carlos Gayoso
Ben Raydo
Evan McClellan

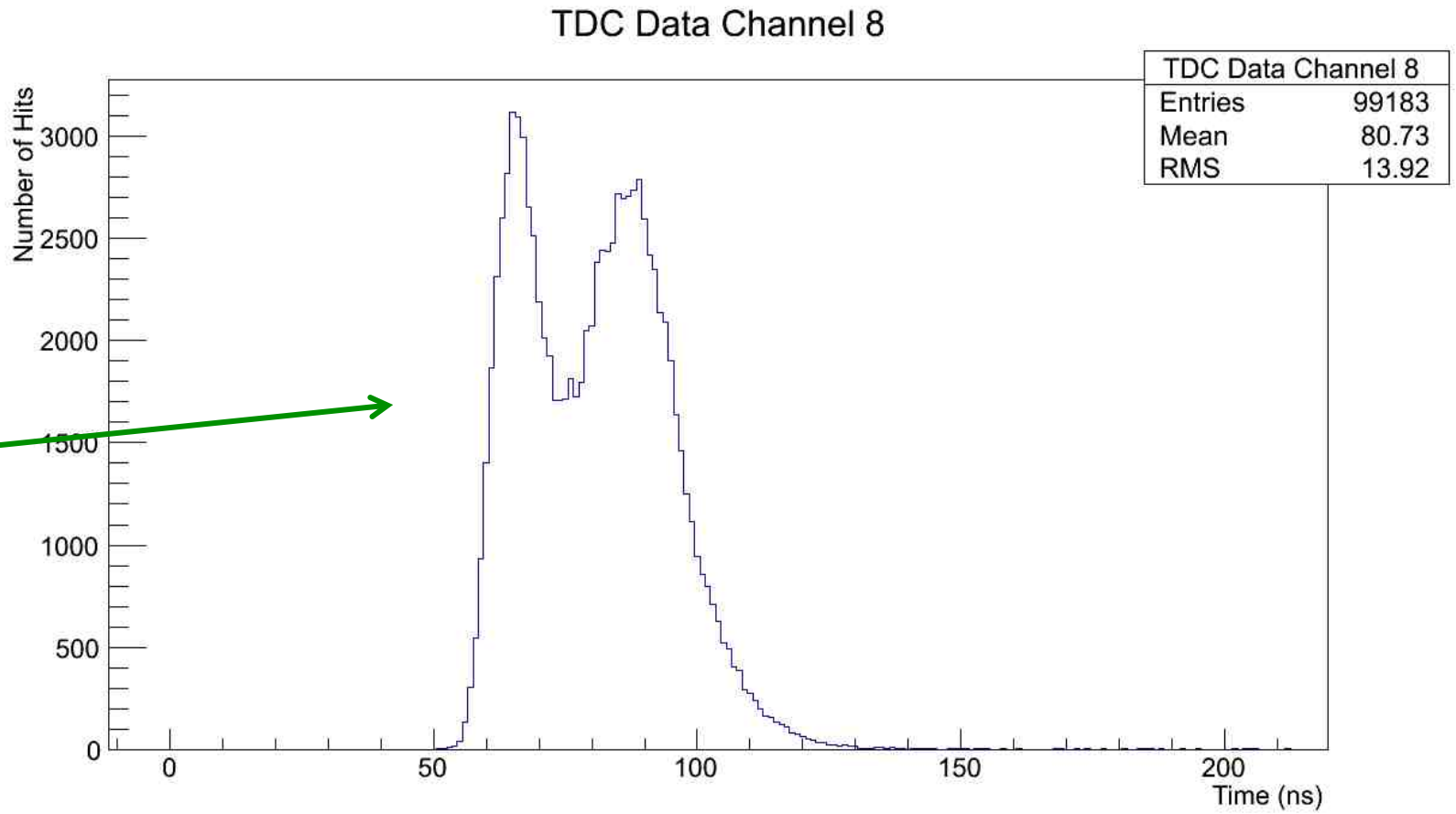


VETROC data from GRINCH Setup -- an example

PMT data processed by NINO cards. Light from LED. Two peaks are leading and trailing edges. Trailing edge wider as expected.



Trigger on edges



CONCLUSIONS -- COUNTING MODE DAQ

- Counting mode FADC DAQ for photons is being deployed
- VETROC for electrons being used in a GRINCH test stand
- Next year we'll merge the above two, in a test stand

Future direction:

Can have a JLab FADC with accumulators alongside the counting FADC

Can have broad general use, e.g. SBS or SOLID.

THANK YOU

GRINCH Test Stand

Uses VETROC
Similarly to how
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