

COUNTING MODE DAQ FOR COMPTON

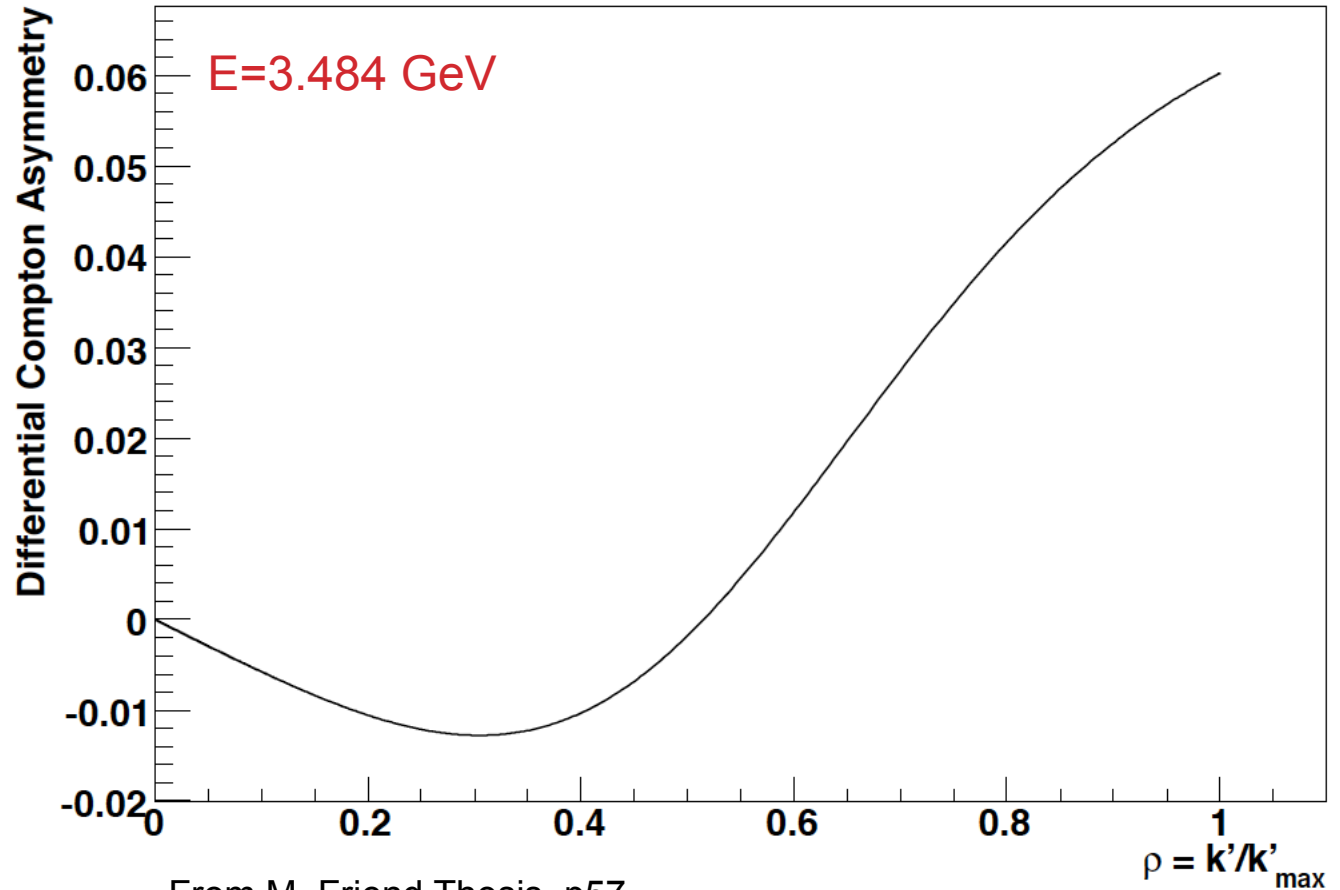
SHUJIE LI (PRESENTING)

**BOB MICHAELS, ALEXANDRE CAMSONNE
HANJIE LIU, SCOTT BARCUS (VETROC)**

Polarimetry Meeting
Nov 21, 2016

COMPTON ASYMMETRY

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



From M. Friend Thesis, p57

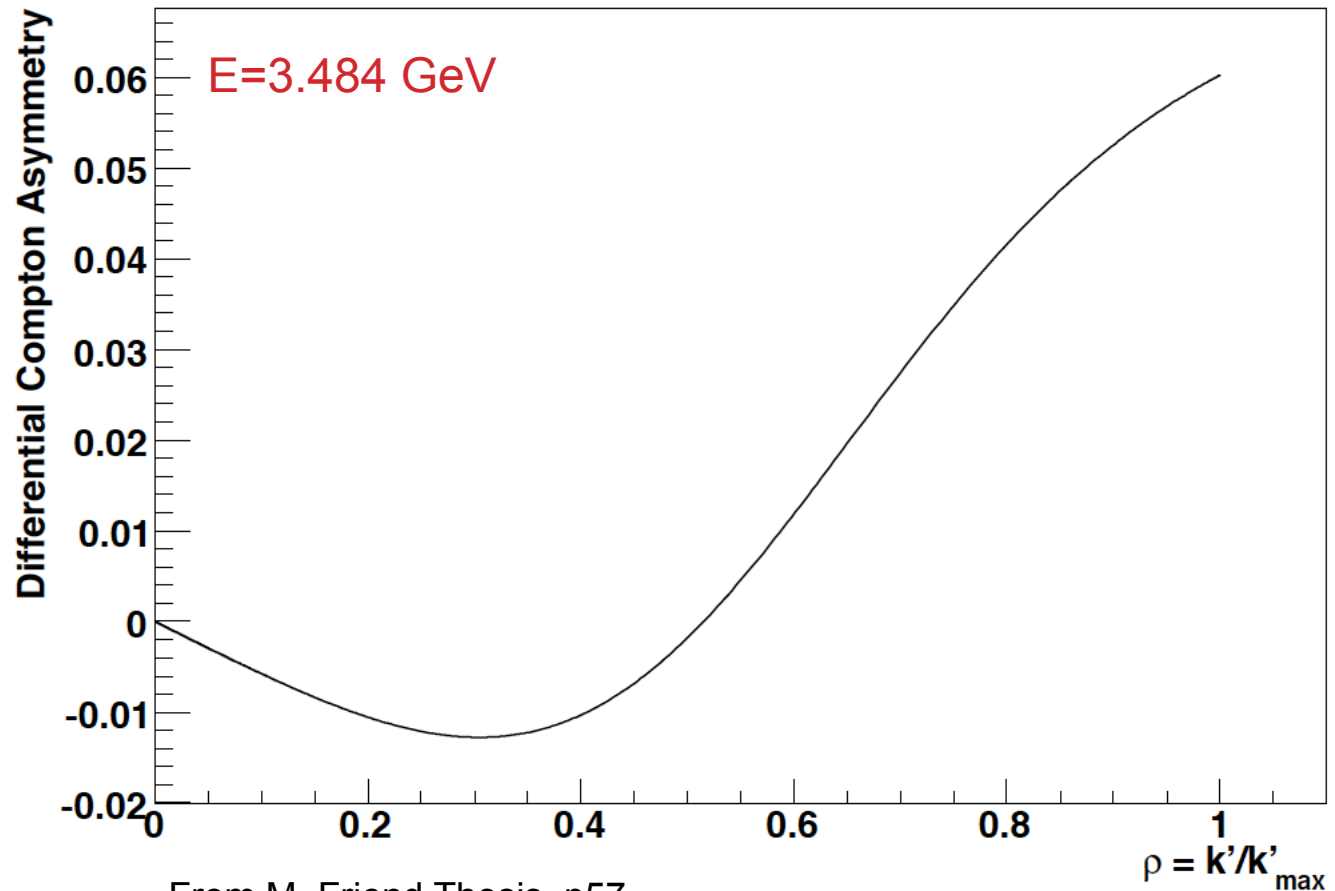
COMPTON ASYMMETRY

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

Trigger rates: 10k -100 kHz

Deadtime?

Signals pileup?



From M. Friend Thesis, p57

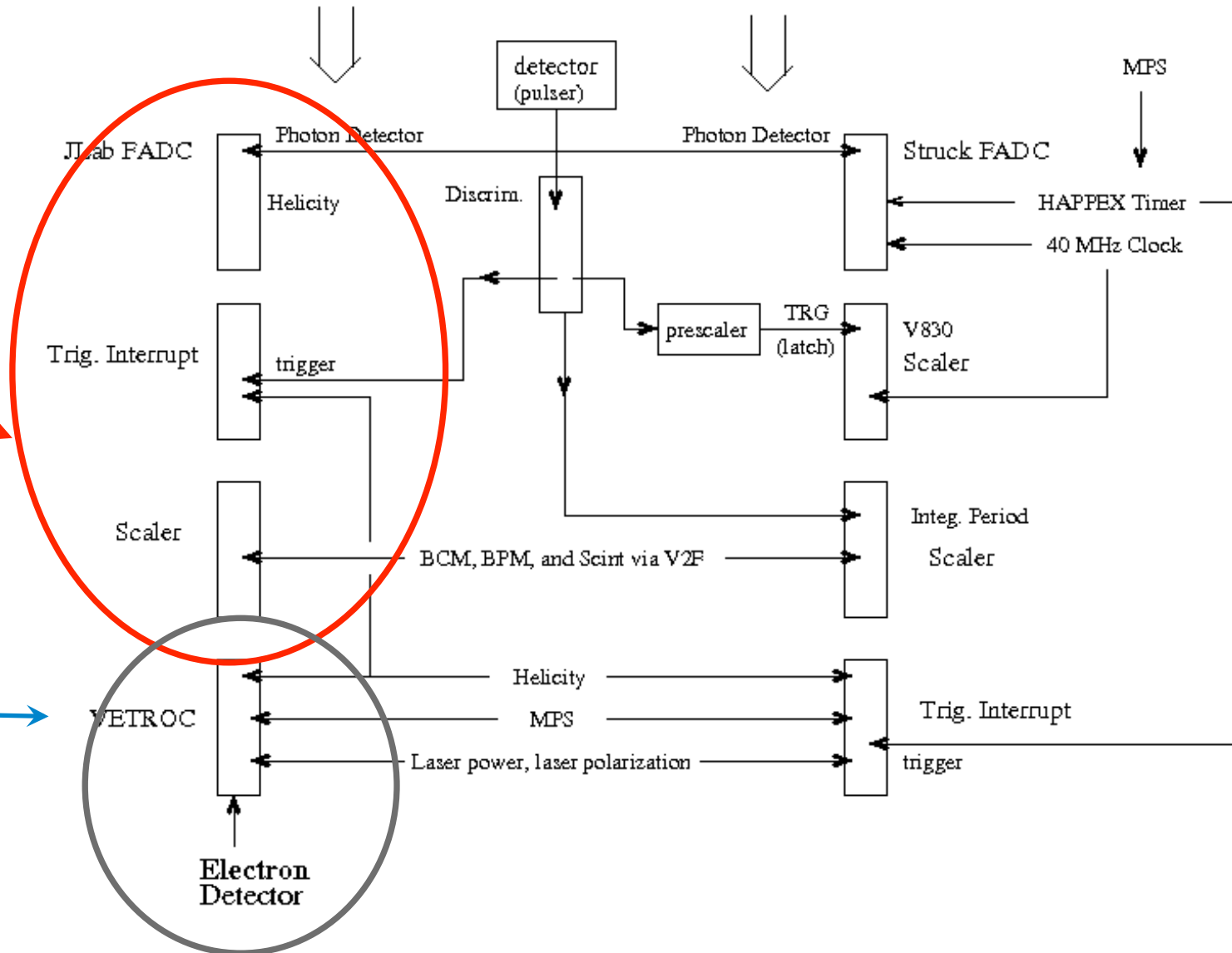
Two Compton DAQ Systems

(new) Counting DAQ, and the CMU Integrating DAQ

Oct, 2016
R. Michaels

Exists, being
tested in Hall A
with photon
detector

Exists, under
development in
the GRINCH
chrenkov detector
test stand

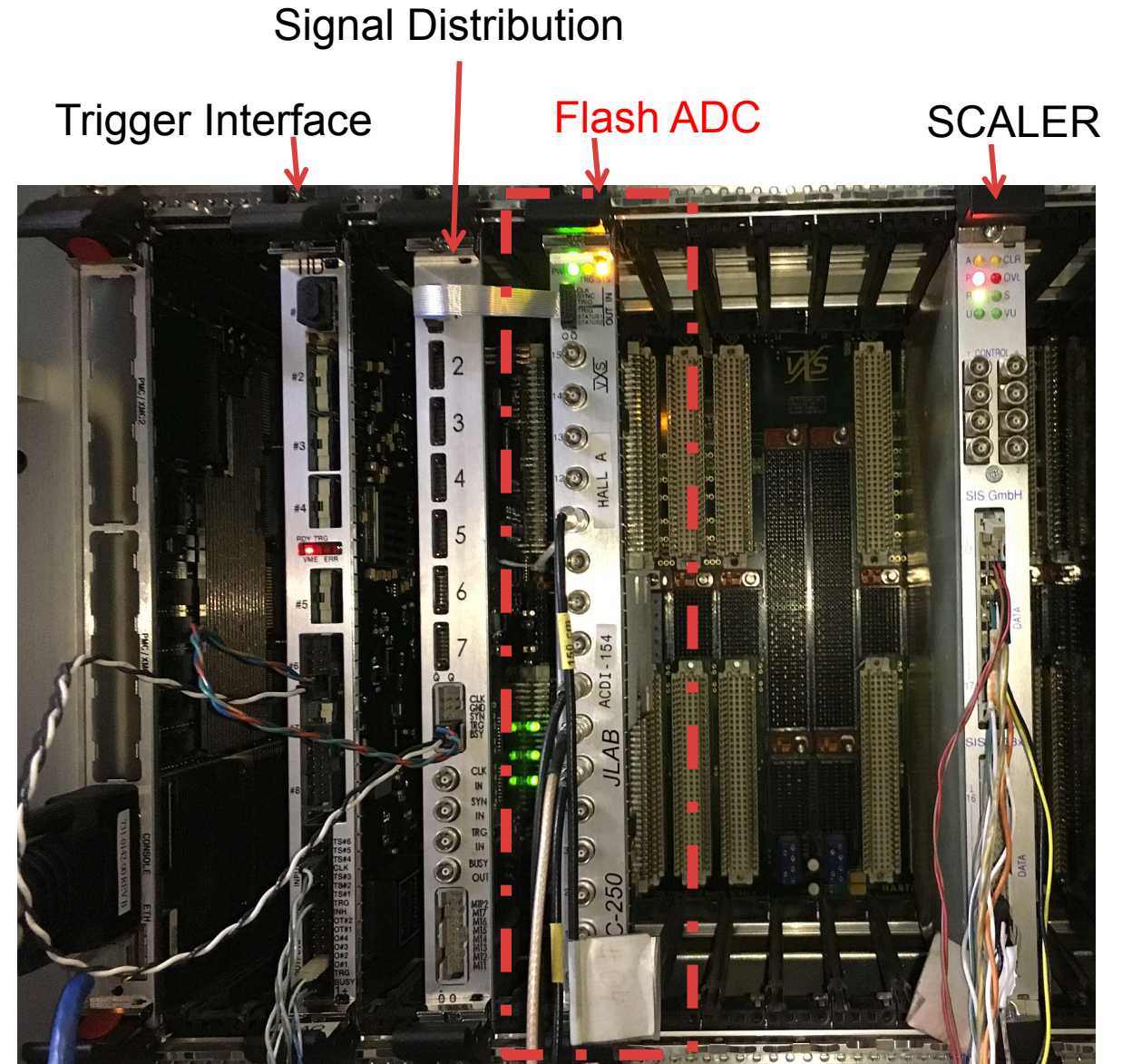


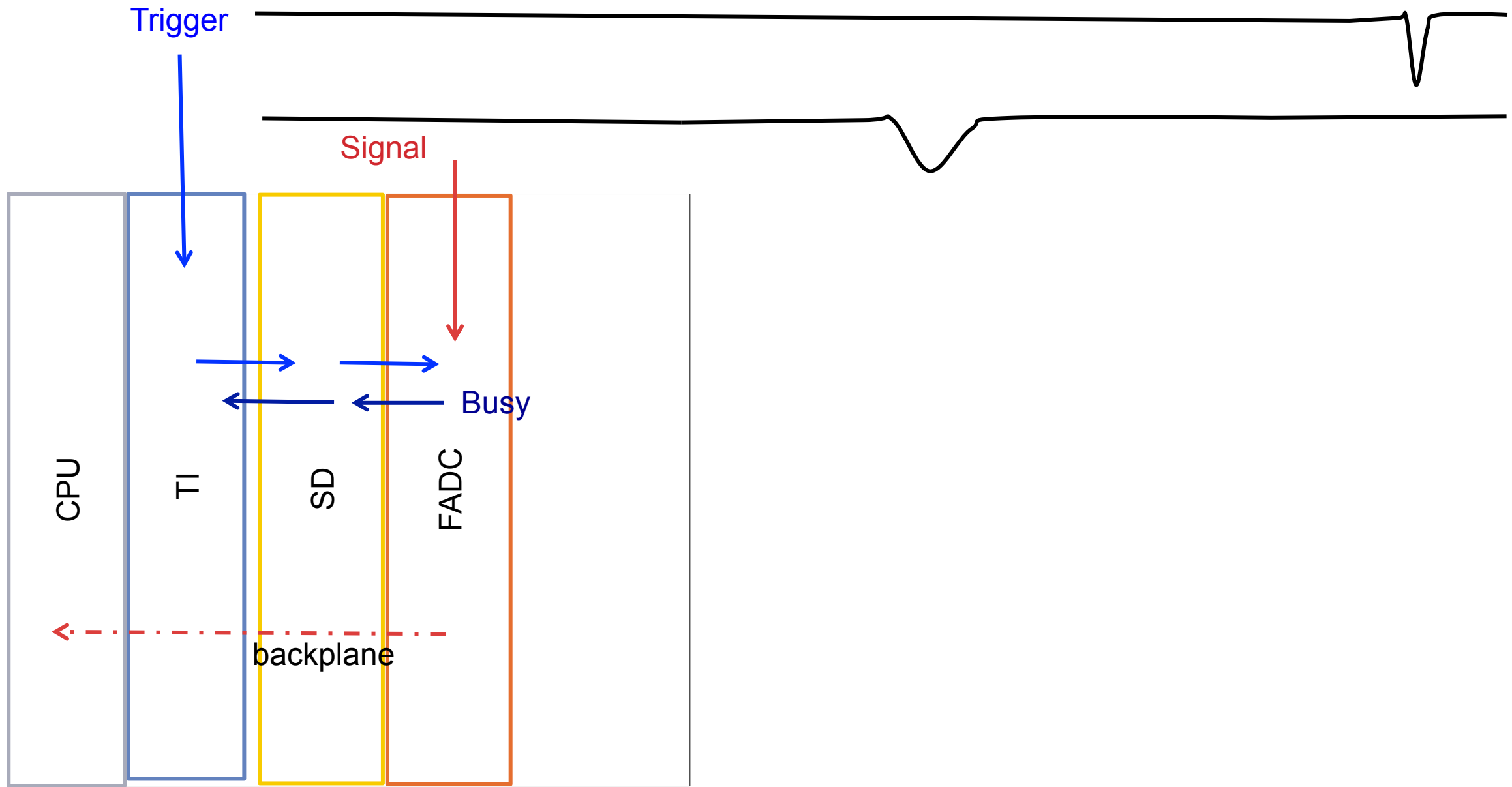
COUNTING MODE DAQ

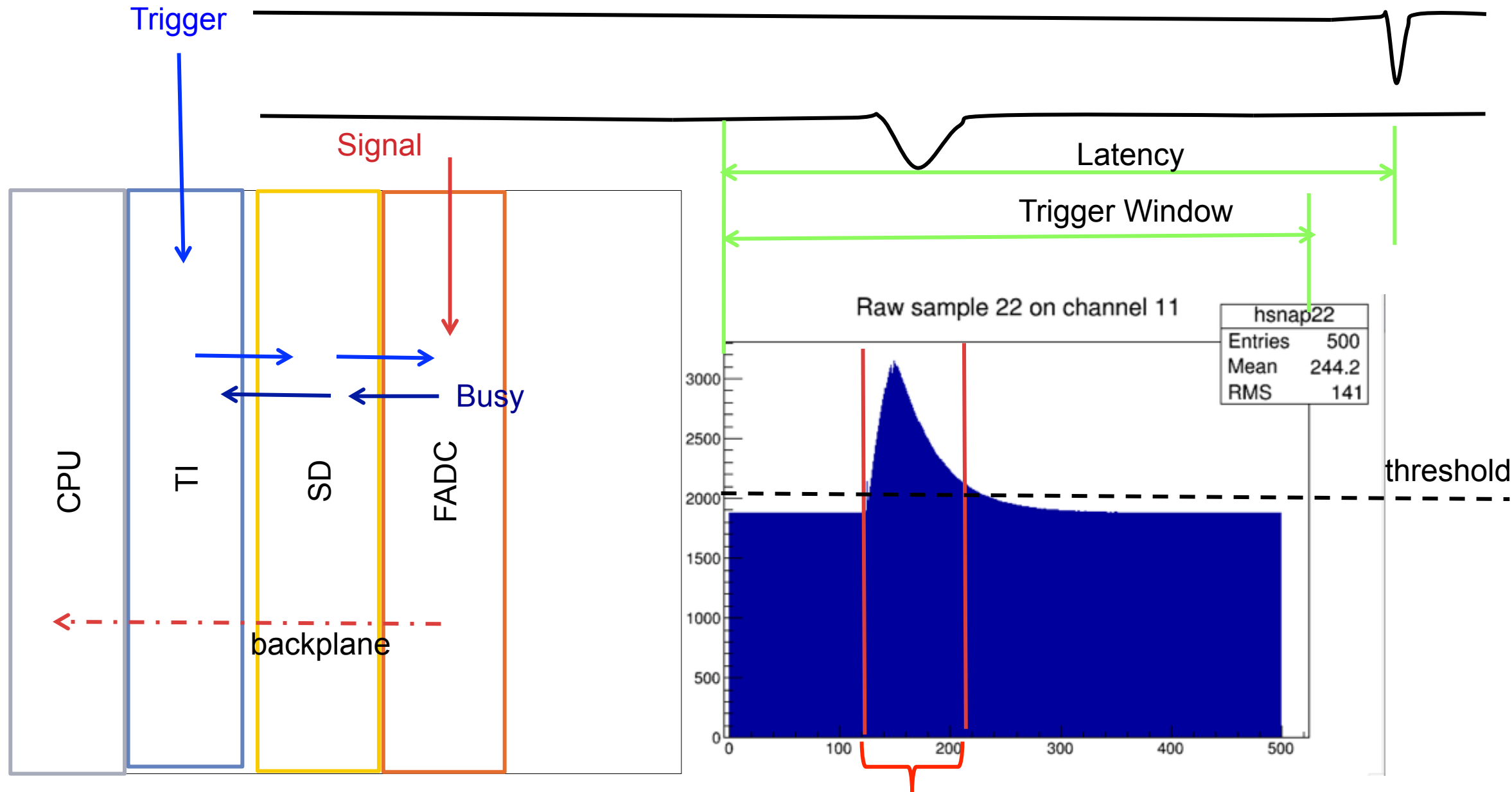
Flash ADC 250 MHz:

- Made by JLab
- 4,000 dollars
- 16 channels
- Ring buffer with up to 8 μ s latency
- Double buffer allows taking and processing data at the same time
- Send data by block (1-256 triggers)

deadtime-free?

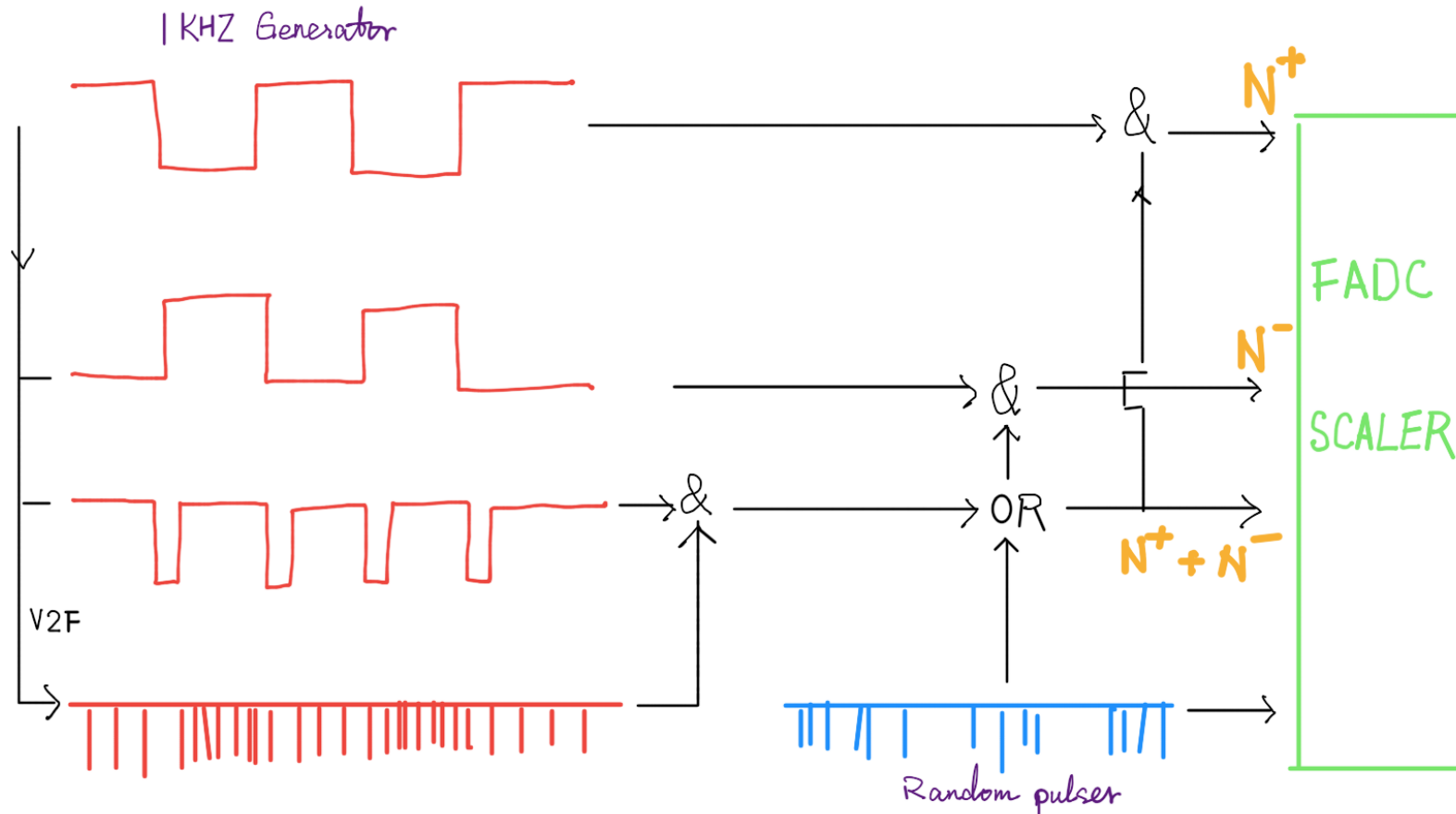






Only the integral is recorded

TEST MODE



Helicity from pulse generator

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

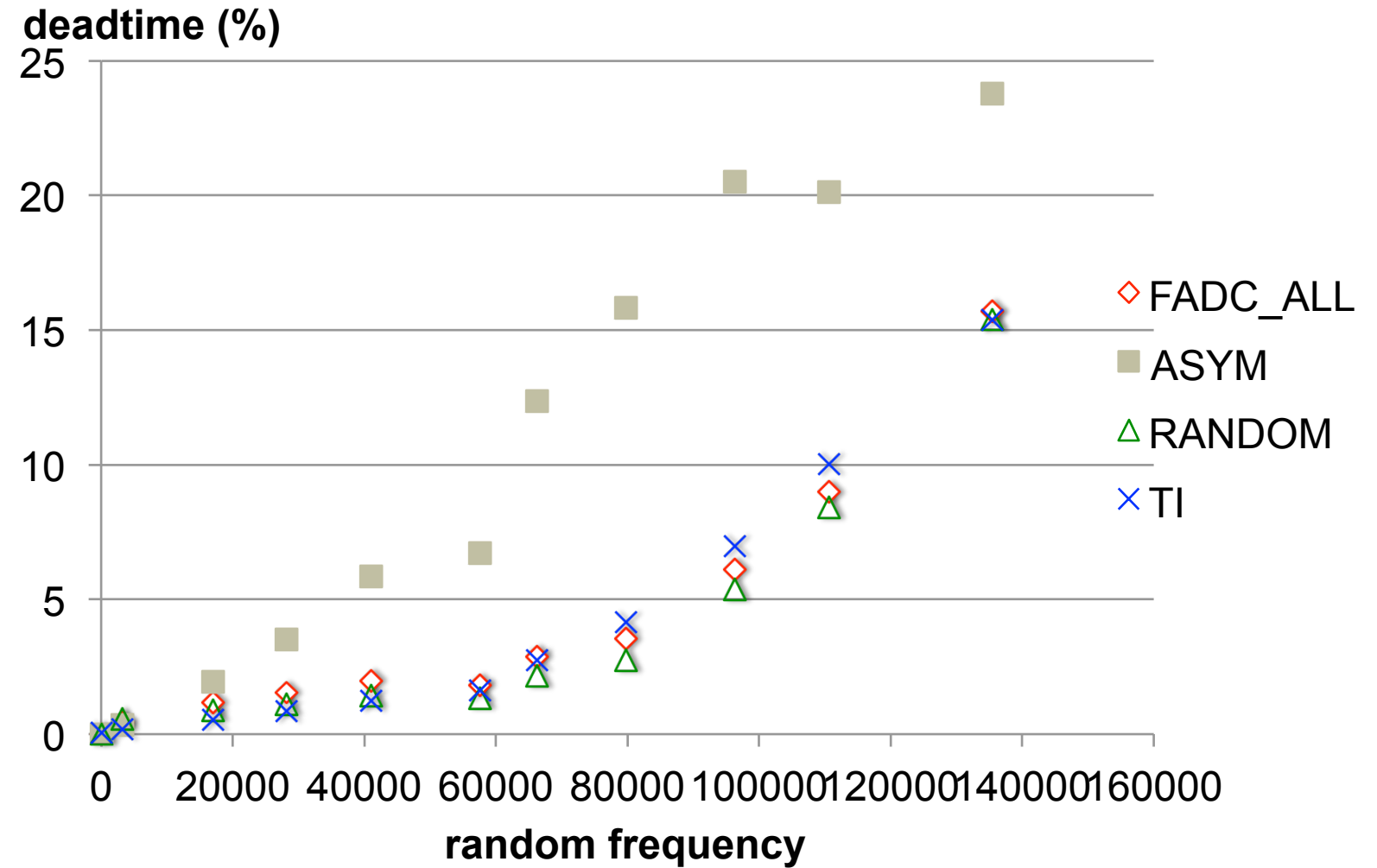
Random pulser (up to 100 kHz) to push system to the limit

Compare FADC and SCALER counts to get deadtime

TEST MODE

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

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



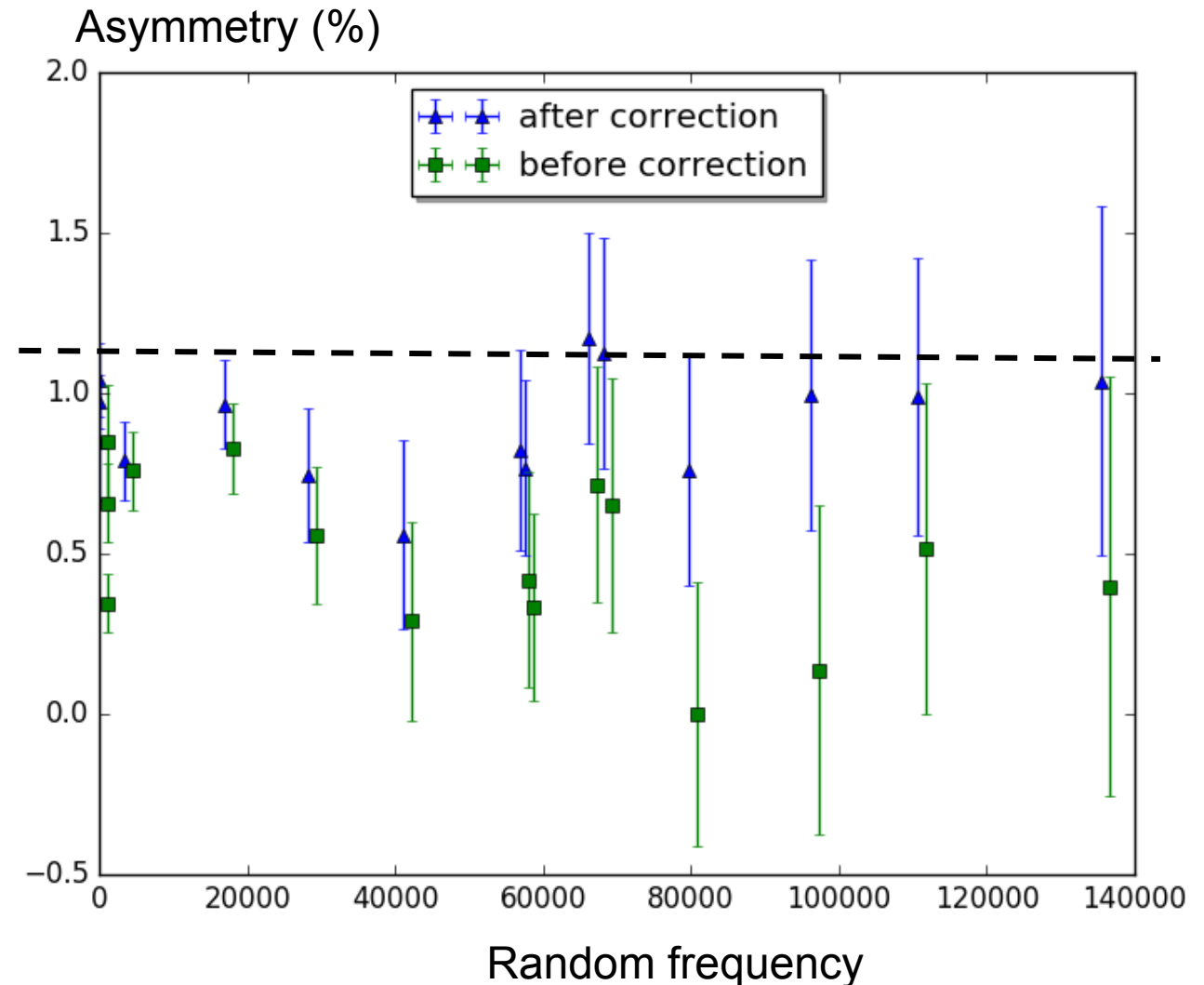
TEST MODE

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

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



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



PRODUCTION MODE

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

RUN 5609:

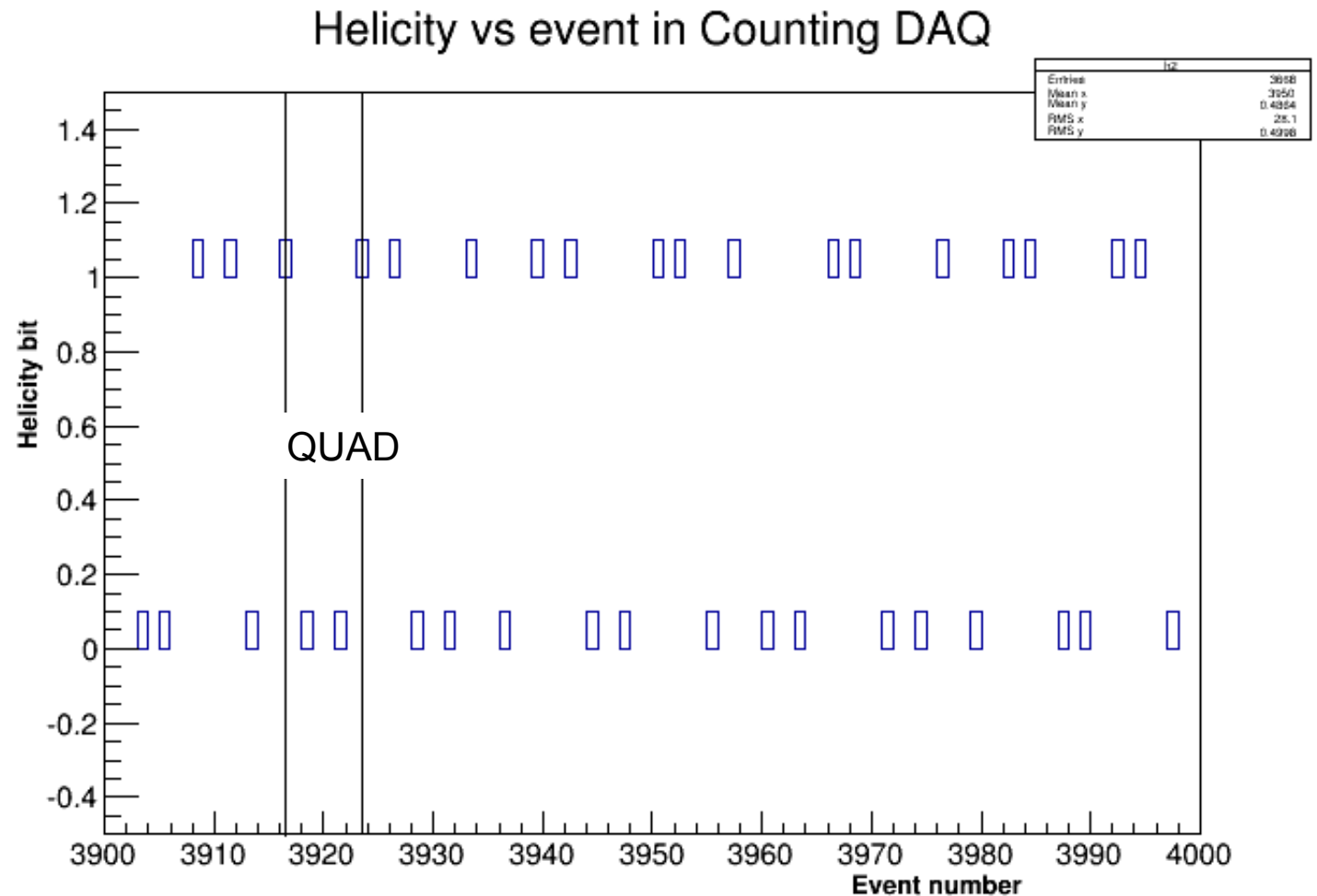
Date: Nov 07

Beam energy: 8518 GeV

Beam current: 10 us

Signal rates: ~7.5 kHz

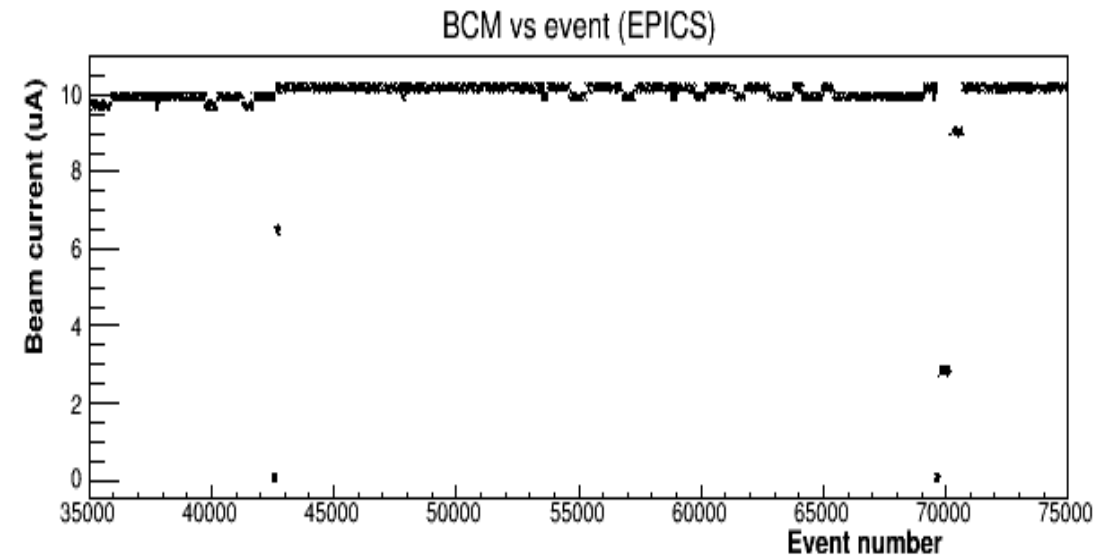
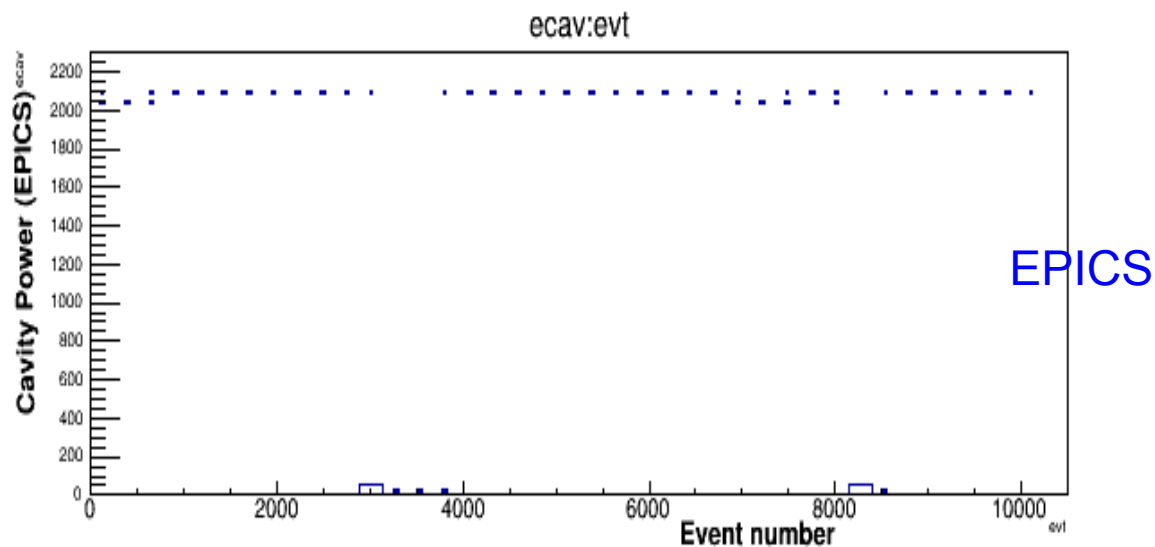
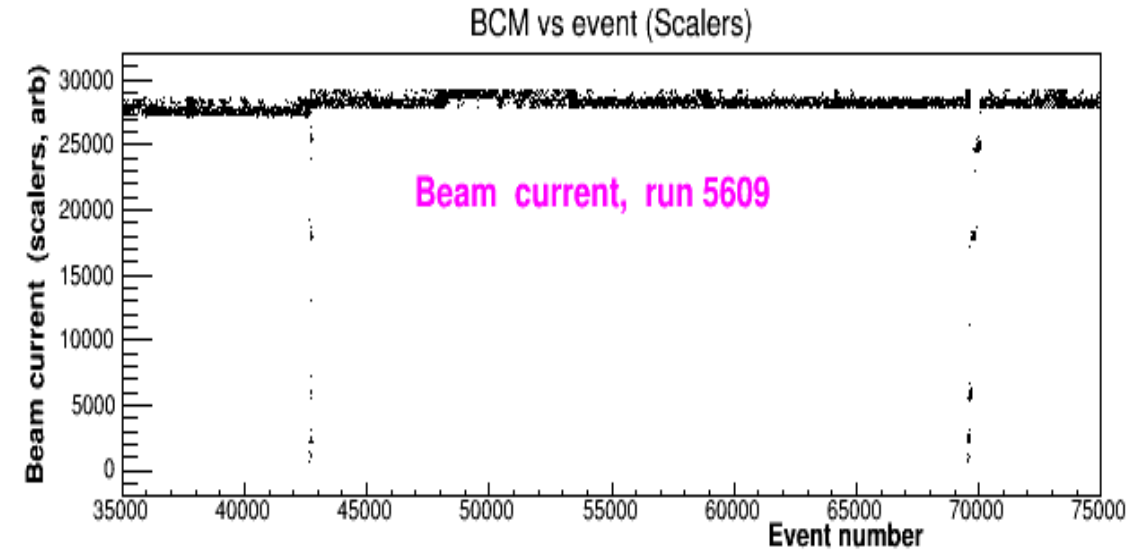
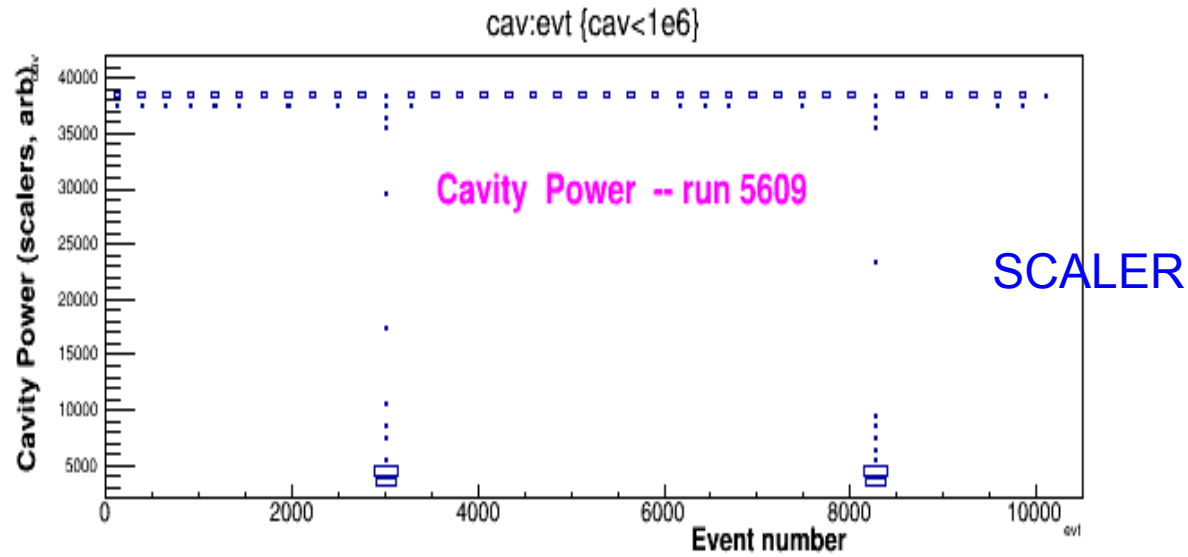
Deadtime: ~ 0



From R. Michael

PRODUCTION MODE

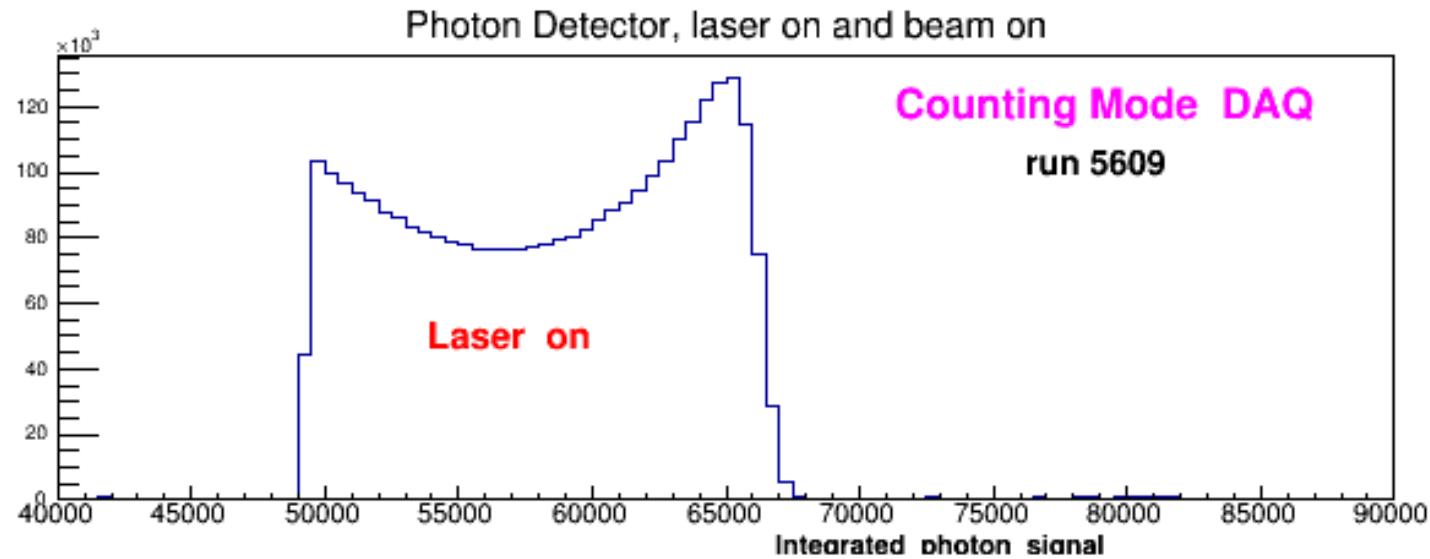
Send BCM, CAVITY, HELICITY, MPS to FADC and scaler



From R. Michael

PRODUCTION MODE

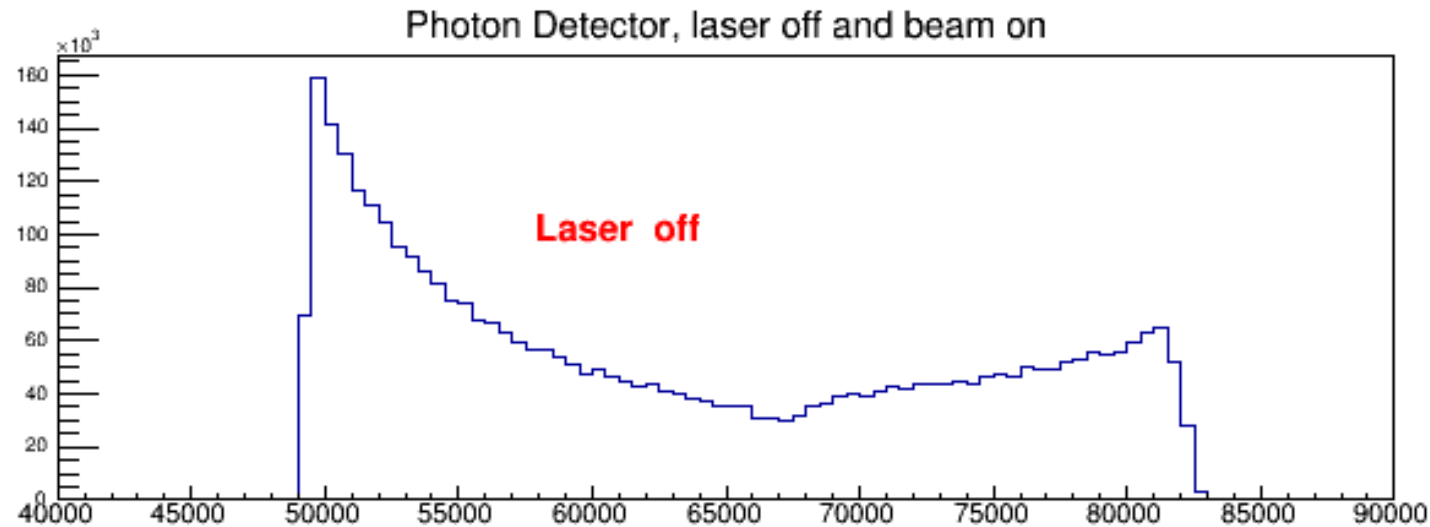
Send BCM, CAVITY, HELICITY, MPS to FADC and SCALER



Use BCM, cavity information to select events

Need to assign helicity to every signal

More study on deadtime



From R. Michael

What is a **VETROC** ? (**V**xs – based **E**lectron **T**rigger and **R**ead**O**ut **C**ontroller)



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

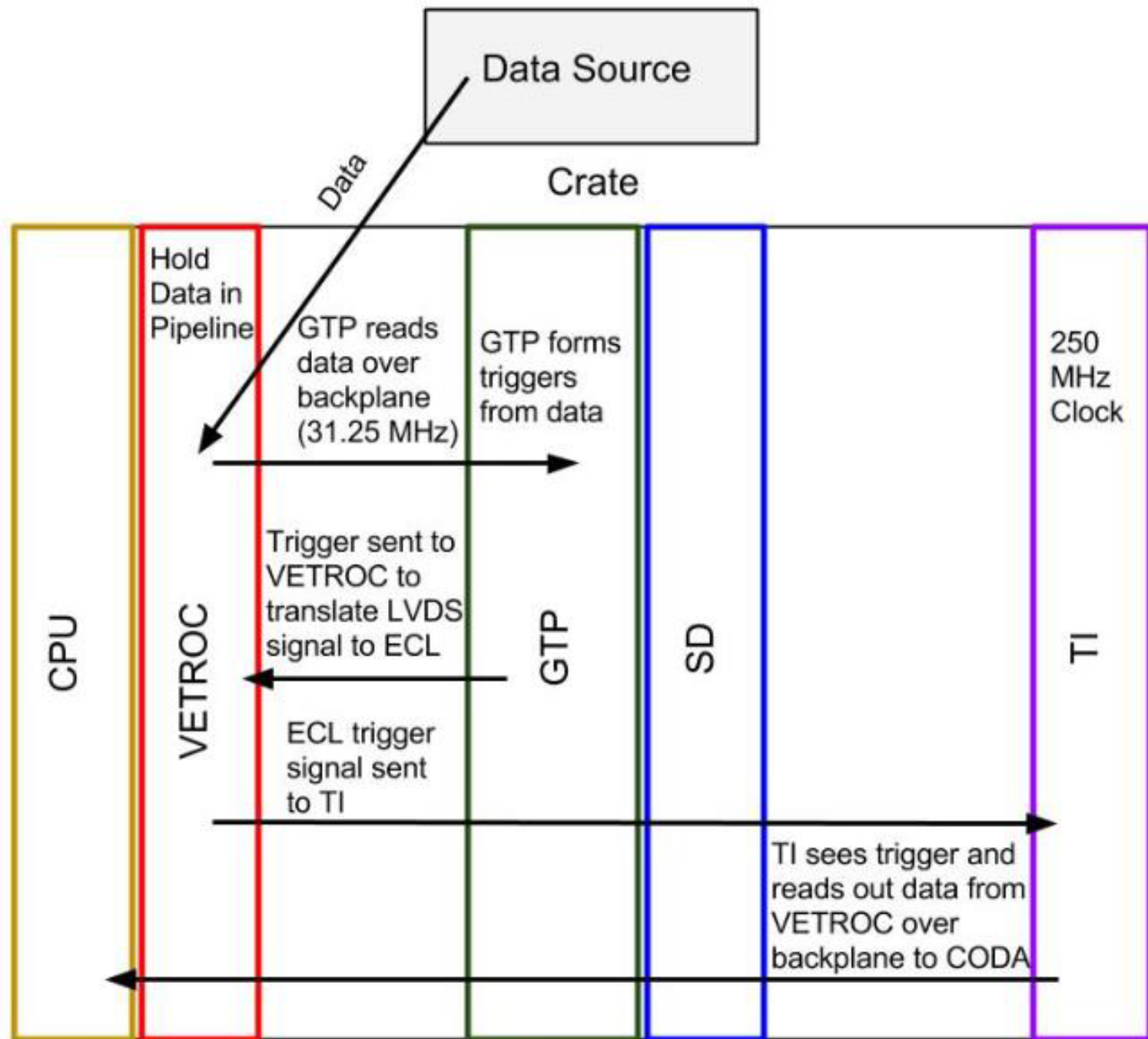


GTP

GRINCH Test Stand

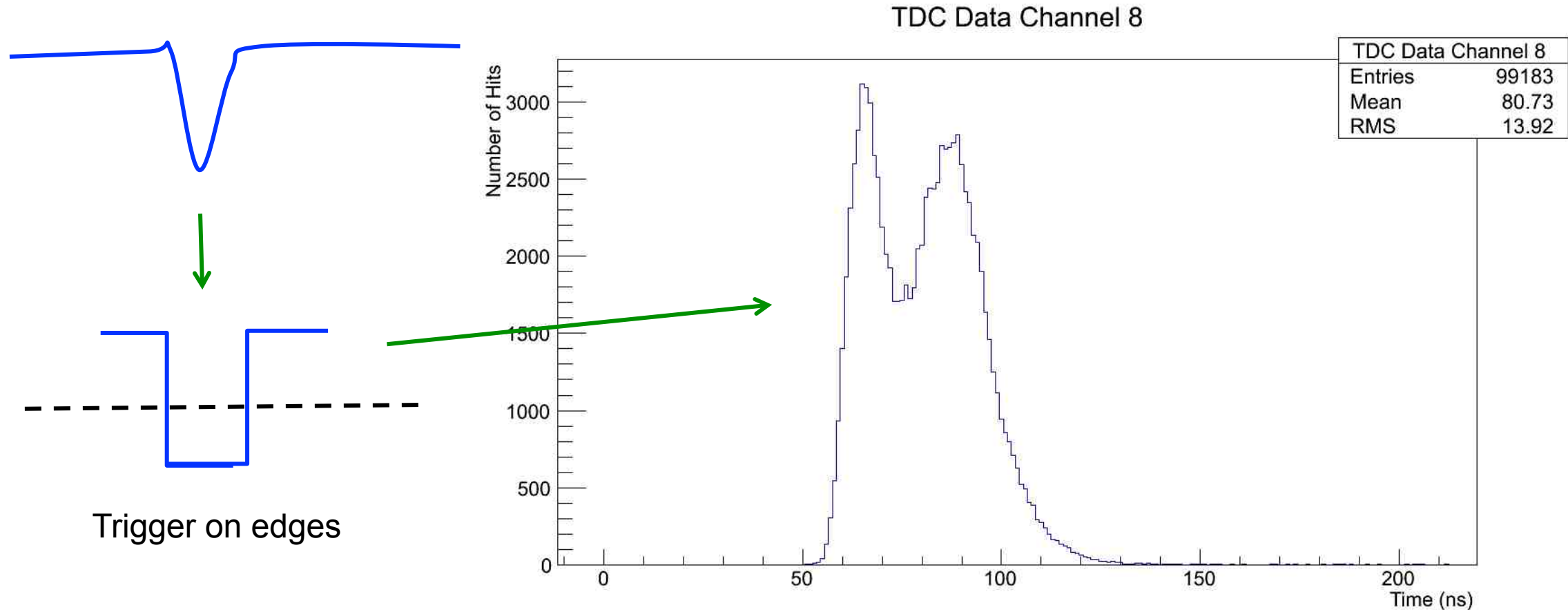
Uses VETROC
Similarly to how
Compton Edet
would

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.



CONCLUSIONS -- COUNTING MODE DAQ

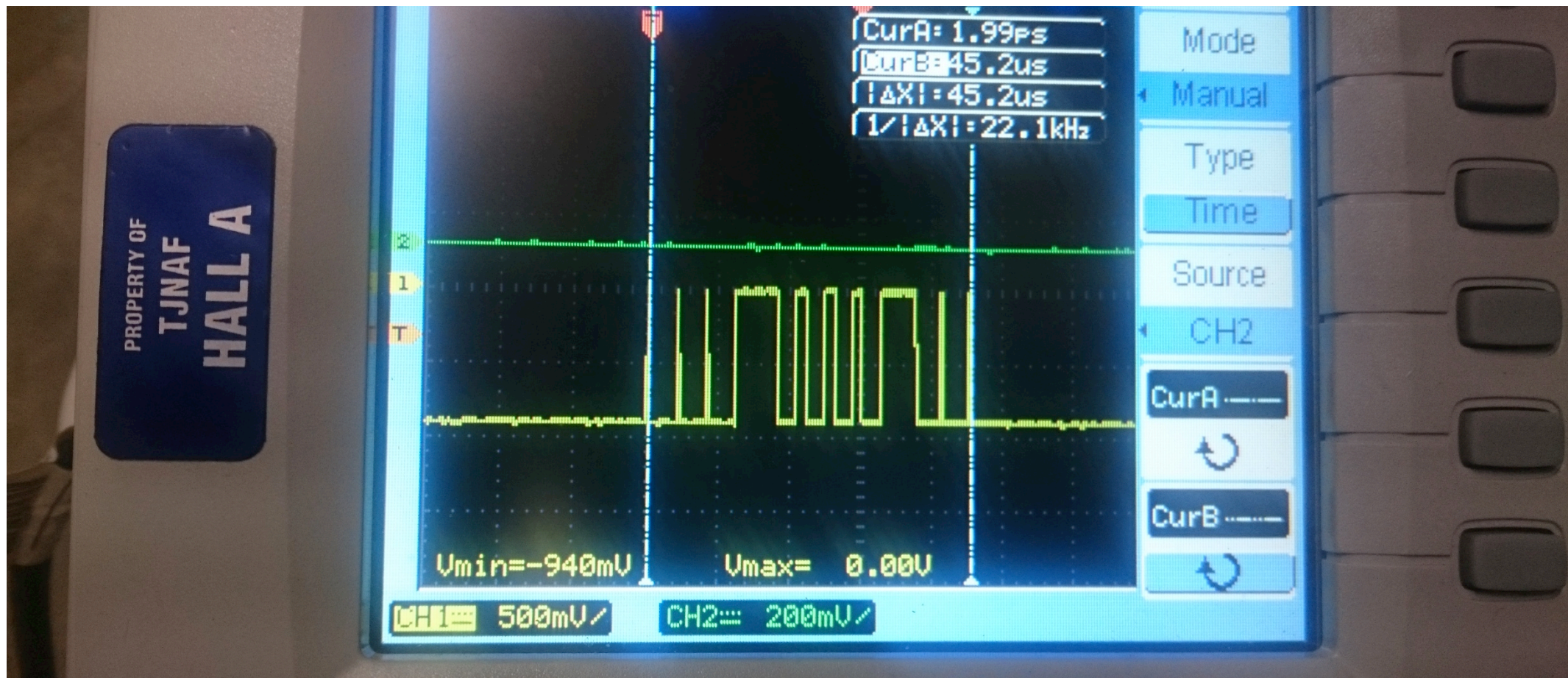
- Counting mode FADC DAQ for photons is being deployed
- VETROC for electrons being used in a GRINCH test stand
- Next year we'll merge the above two, in a test stand

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



Deadtime with 250 kHz asym box signal

GRINCH Test Stand

Uses VETROC
Similarly to how
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