Integrating Compton DAQ and Analysis

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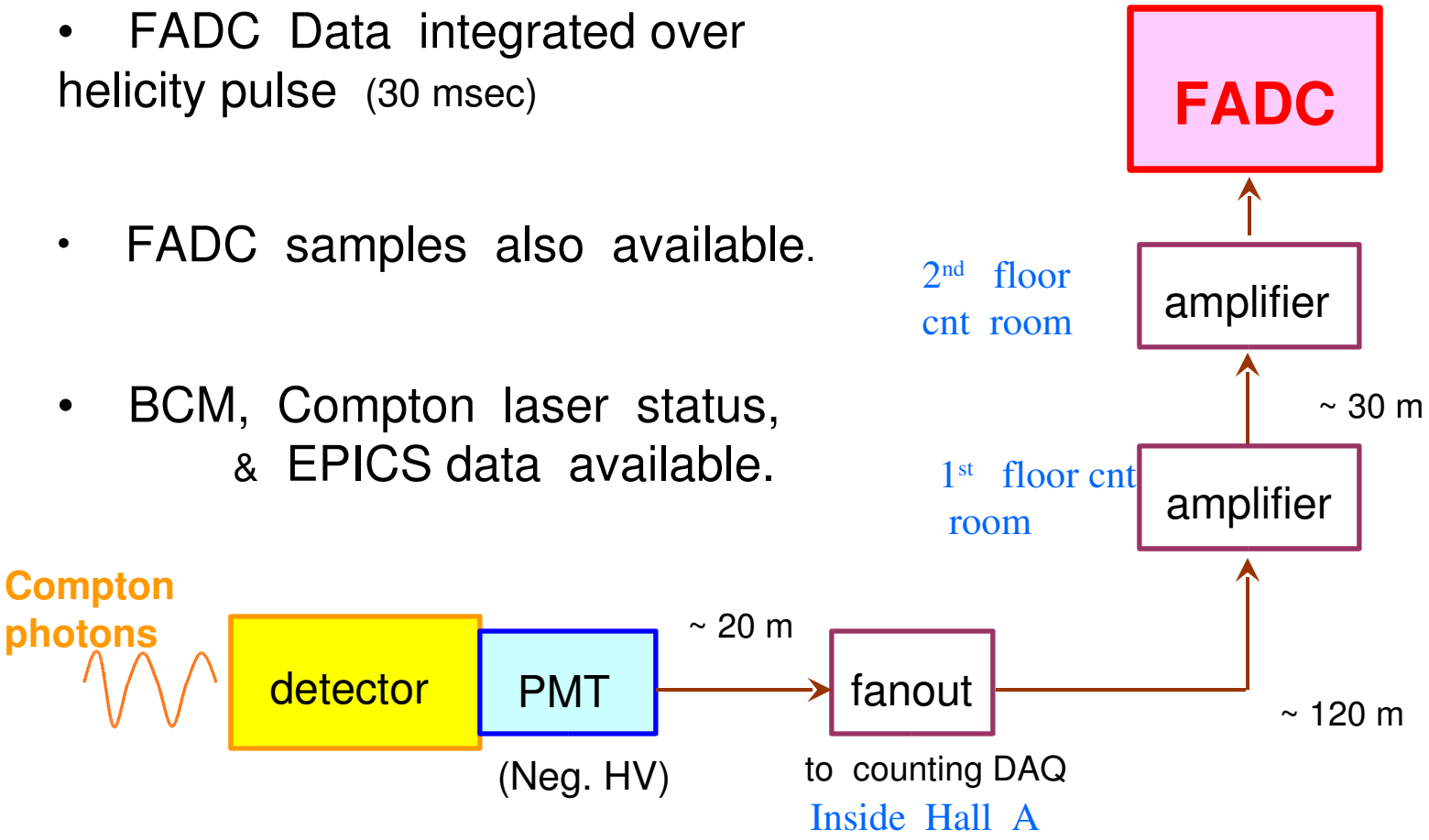
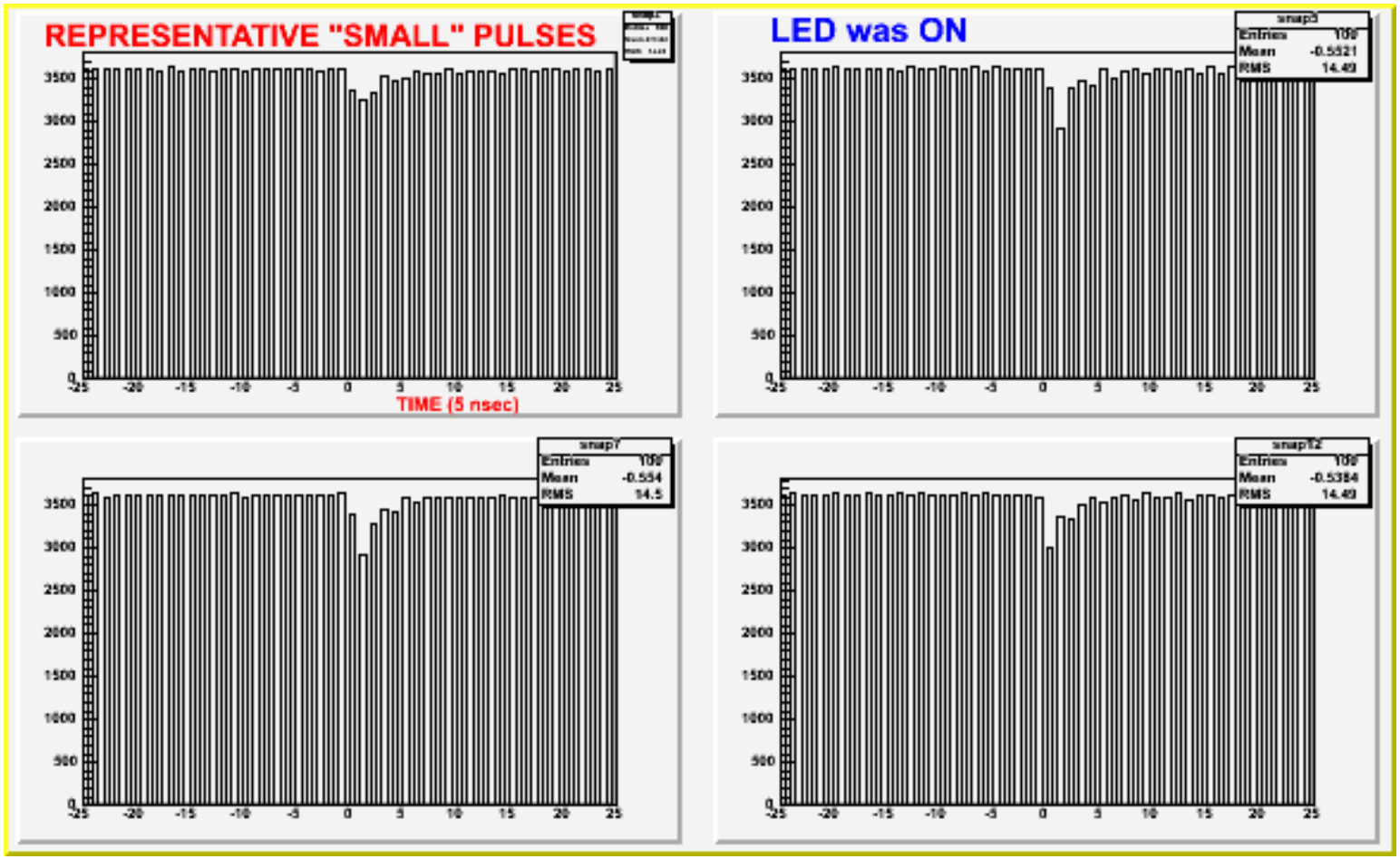
- Reminder about Nov 2006 Results
- Specification of new FADC
- Data Analysis with FADC

Nov 2006 Compton Integration DAQ

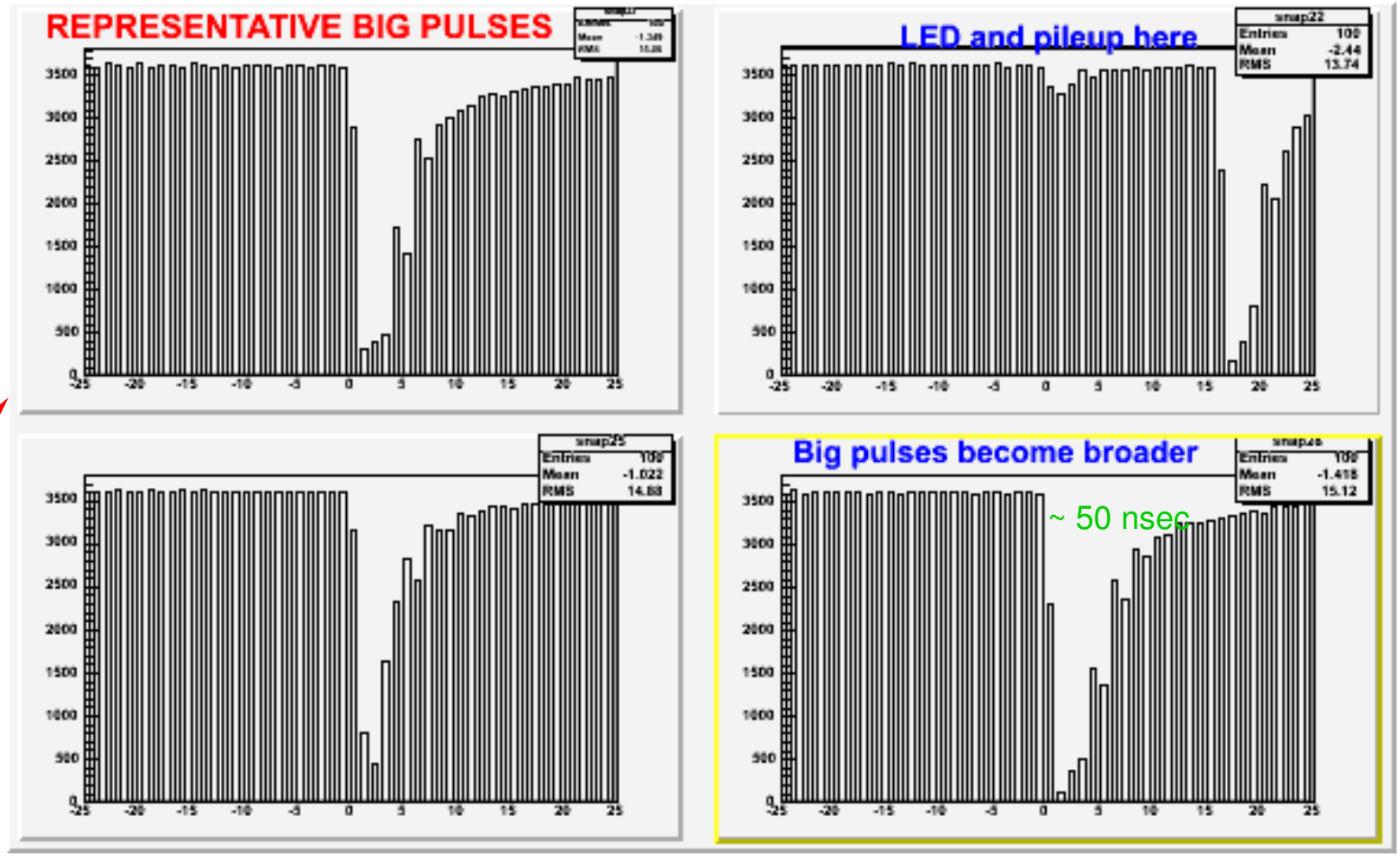
- FADC Data integrated over helicity pulse (30 msec)
- FADC samples also available.
- BCM, Compton laser status, & EPICS data available.



FADC Samples that look like **signal**

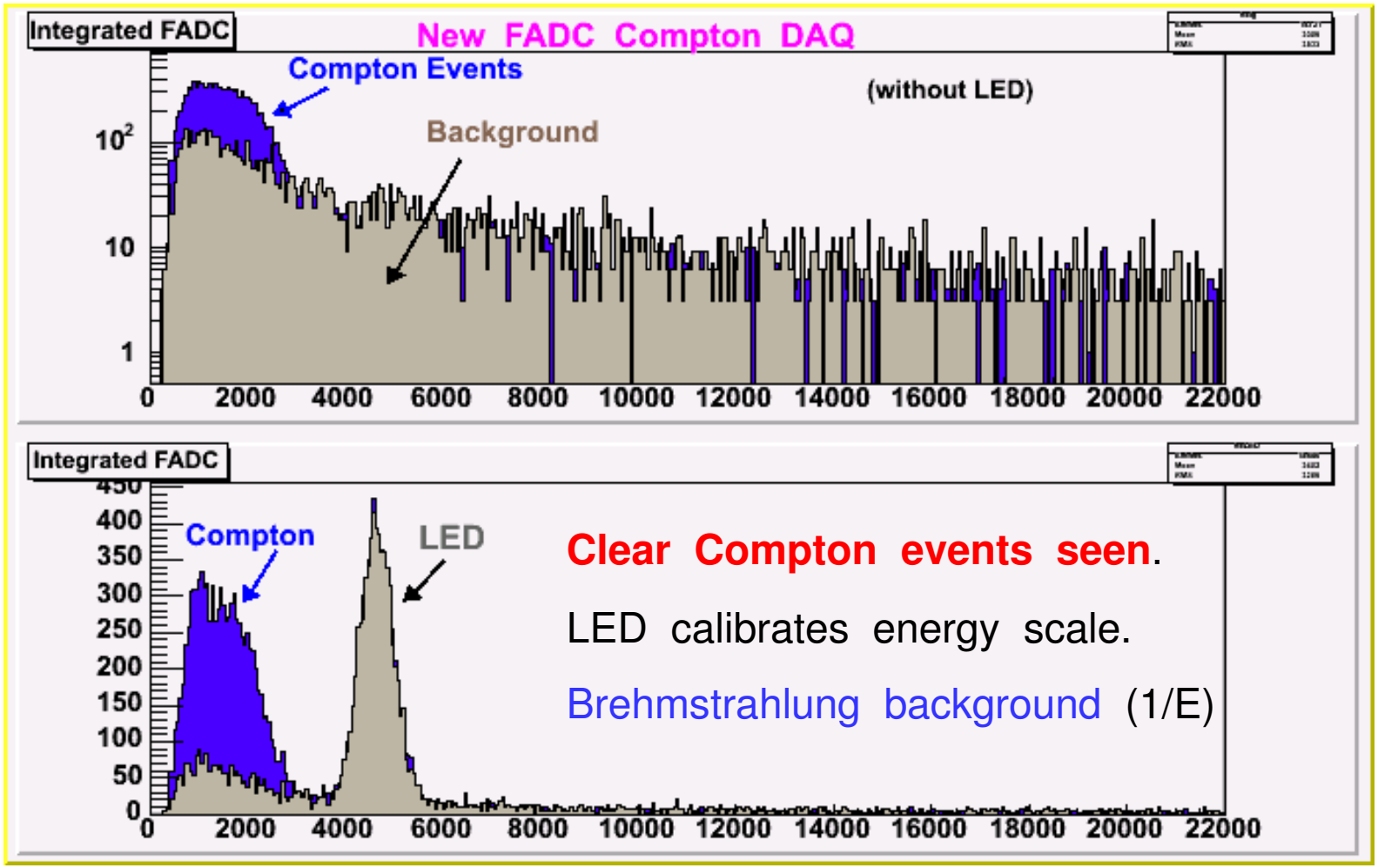


FADC Samples that look like **background**



Integral over the width of individual pulses

It's what the counting DAQ does, too.



To obtain a **digital integral** with **zero deadtime**:

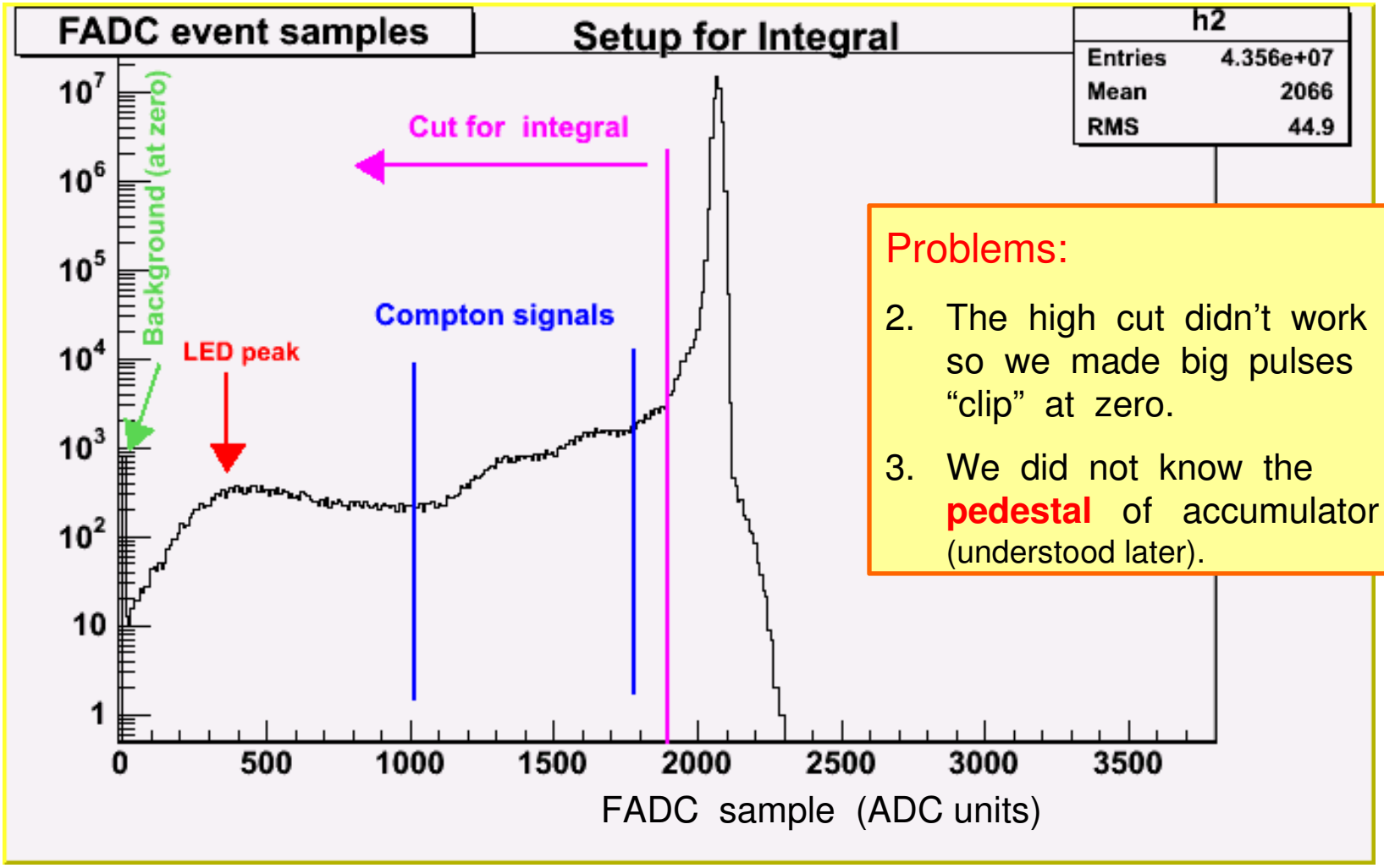
use so-called "Accumulator" = sum of samples over 30 msec helicity window

subject to cut conditions :

- Cut conditions are optional (can be turned off)
- Sample above a certain threshold. (eliminates noise)
- Sample below another threshold. (eliminates background)

Full-sampling mode used to evaluate systematic errors.

Setting up Accumulator (Nov '06 data)



Problems:

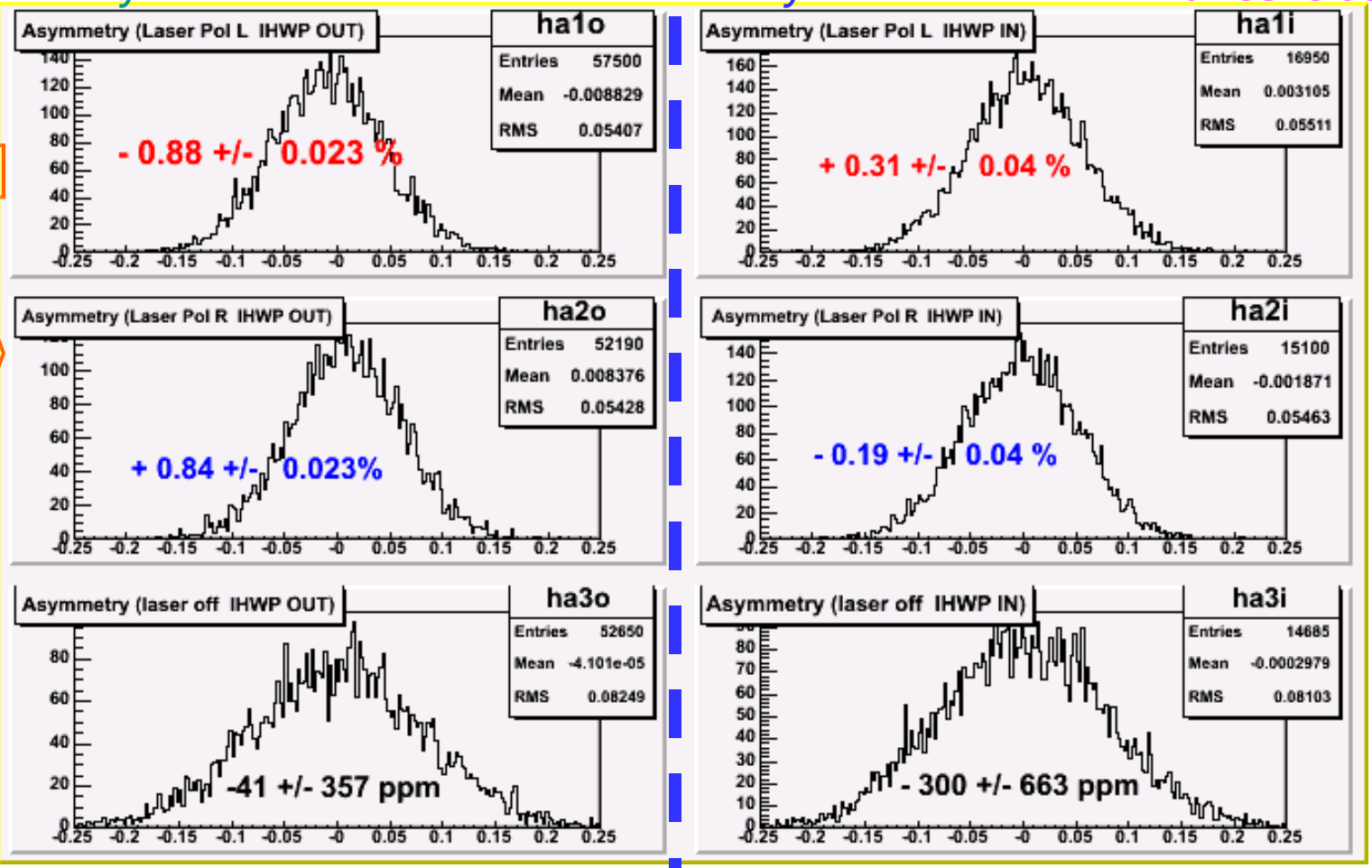
2. The high cut didn't work so we made big pulses "clip" at zero.
3. We did not know the **pedestal** of accumulator (understood later).

Asymmtries from Accumulator

Day 1 : IHWP **out** | *Day 2 : IHWP* **in** | *and different thresholds !*

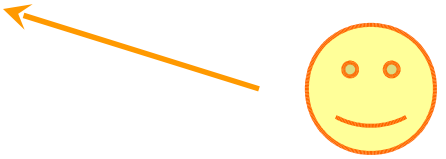
FLIP laser pol.

Laser off.



Summary of Nov `06 Experience

- Saw Compton events, good signal-to-background



- Too much electronic noise
  - → Need shorter cable runs.
  - → Want no amplifiers
  - → Get more gain with 12-stage PMT ?
- Accumulators worked well, but ...
  - → Asymmetries made no sense until we realized …
  - → Pedestal subtraction wrong and threshold dependent.
  - → Need more info. to subtract pedestals.

Specification of new FADC

with fancier accumulators

by Bob Michaels and Gregg Franklin

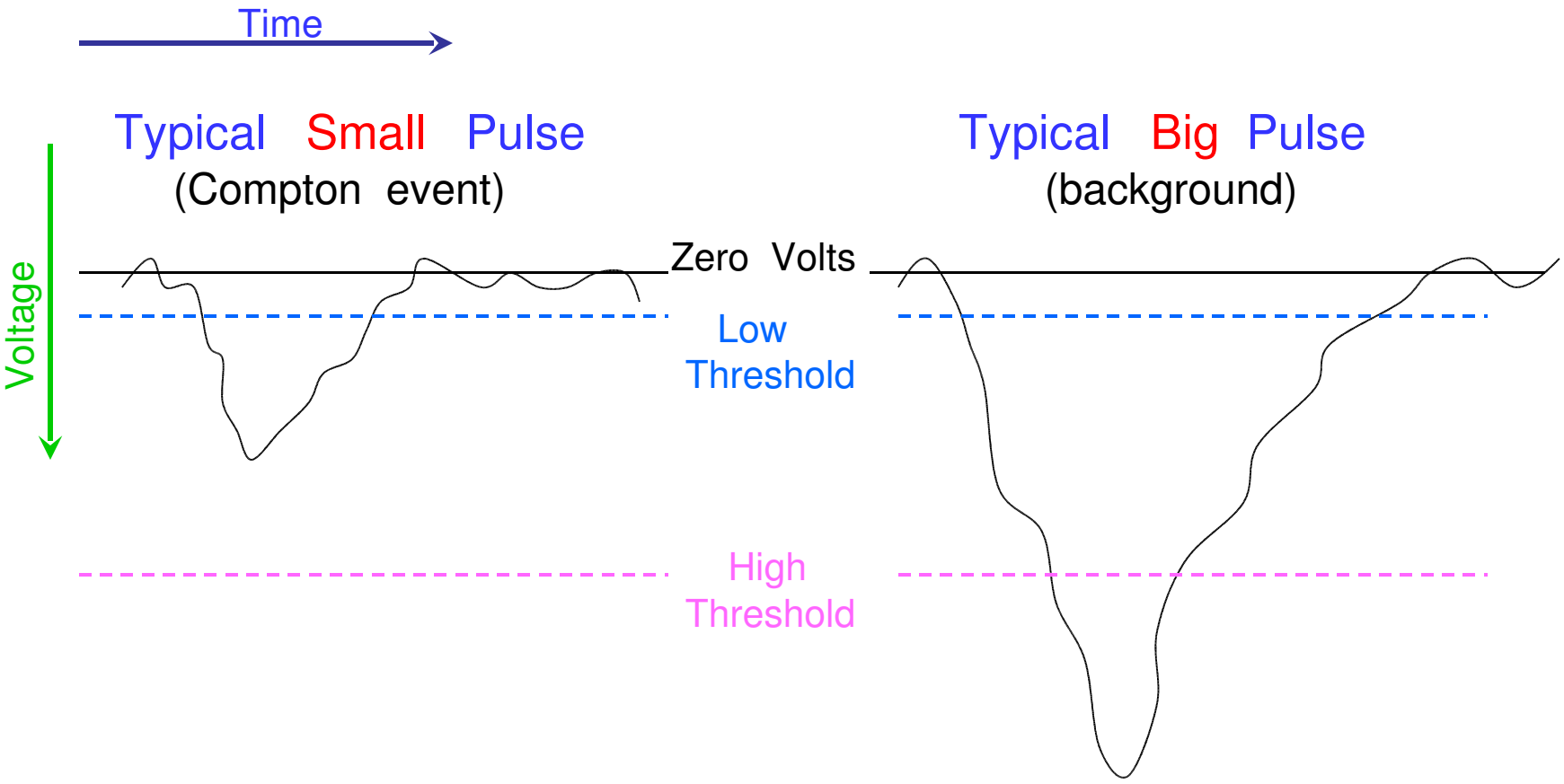
http://www.jlab.org/~rom/fadcspec.pdf

- Spec has been sent to two vendors:
  SISGmbH and CAEN.
- Expect boards from each vendor in ~August.
- Old SISGmbH boards can be updated (new firmware)
- Boards have other uses in Hall A.

Custom FADC based on SIS3320 / CAEN1720.

Resolution	12 bits
Sampling Rate	250 MHz (or 200) CAEN SIS
Range	$\pm 5\ V$ bipolar
Buffer	8.25×10^6 Samples (33 msec)
Accumulator	See next slides

How Thresholds Work



Accumulator Feature → *See the spec for details.*

- Samples added between Tstart and Tstop

- Subject to cut conditions (optional).

  Ex #1 Data above a threshold, or data between a low & high threshold.

  Ex #2 Data "N" pulses before & after a threshold (more linear response).

- Number of samples available N_{sample}

  Necessary for pedestal subtraction

Example : How to Analyze Data

thanks, Gregg !

FADC measurements $V = C\,(\,P - A\,)$

V Voltage ; C Conversion ; P Pedestal ; A ADC value

Integrated Signal

(C cancels in Asy.)

$$S = (P \times N_{samples}) - \sum_i A_i$$

missing in Nov '06

Deadtime Correction

(high threshold ``robs'' signal)

$$= \left(\sum A\right)_{high\ thresh.} \div \left(\sum A\right)_{all\ data}$$

Physical Signal to use in Asymmetry.

$$S_{physics} = S \times \frac{1}{1 - } \times \left(1 - \right) B \;;\; where\ B = \left(\sum A\right)_{high\ thresh.}$$

B = background : empirical correction

Conclusions – Integrating Compton DAQ

- ``Data Analysis on a Chip" looks promising, may have widespread applications
- but yet to be proven.
- FADC with new accumulators ready this summer. ~ August