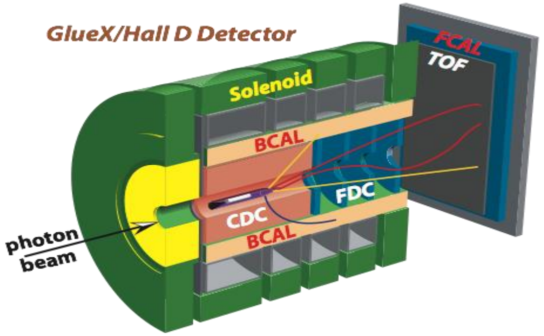

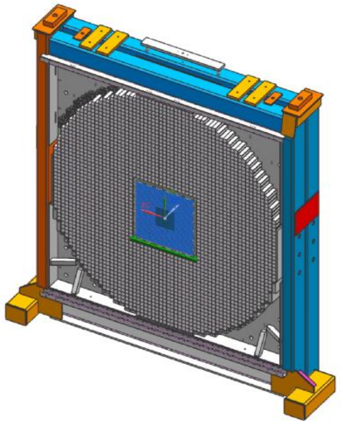

Estimates of the PMT Anode Current of the CCAL (FCAL2) Modules

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Motivation

- Estimate anode current of the FCAL 2 PWO insert

  - decide on the required gain of the active base amplifier

- Measure PMT anode current for CCAL modules. Extrapolate measurements to the FCAL 2

- Perform measurements for two luminosities:

  - use JD70 – 105 (47 um) diamond radiator

  - 350 nA (GlueX II run conditions) and 200 nA electron beam currents

Analysis Overview

- Collect CCAL FADC waveforms using random and PS triggers

  - no data sparsification (no threshold applied)

  - estimate current using waveforms acquired with the random trigger

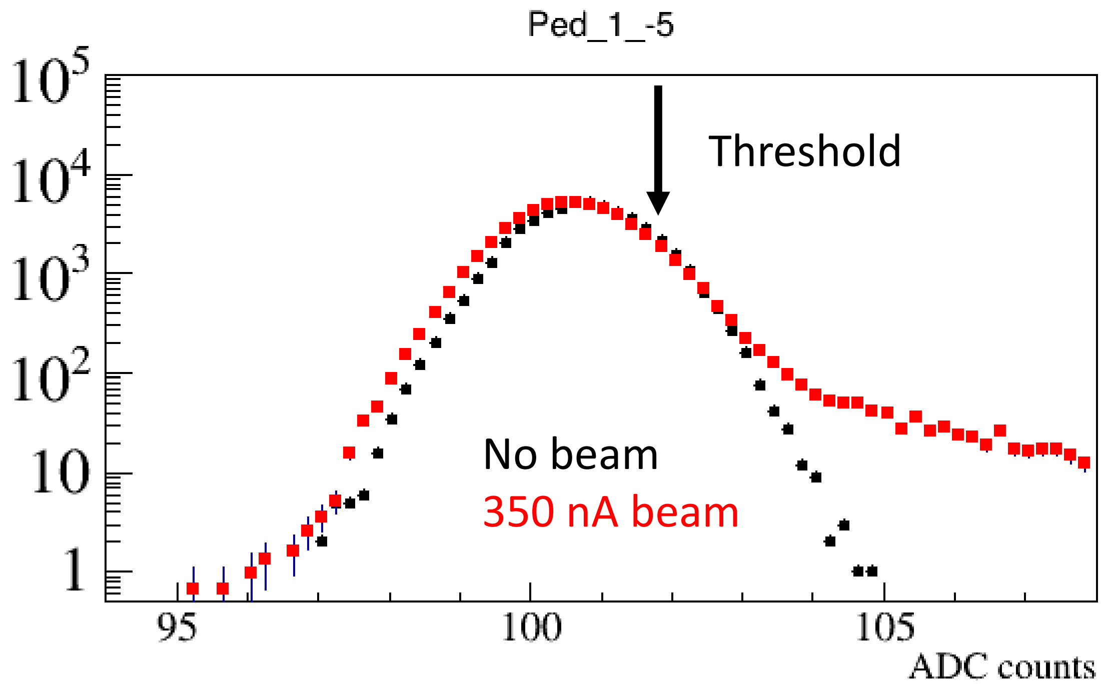
  - Use PS trigger to monitor beam trips (time difference between trigger time stamps)

- Sum up FADC ampilitudes above the threshold (1 count above the baseline) in a 400 ns window (100 fadc samples)

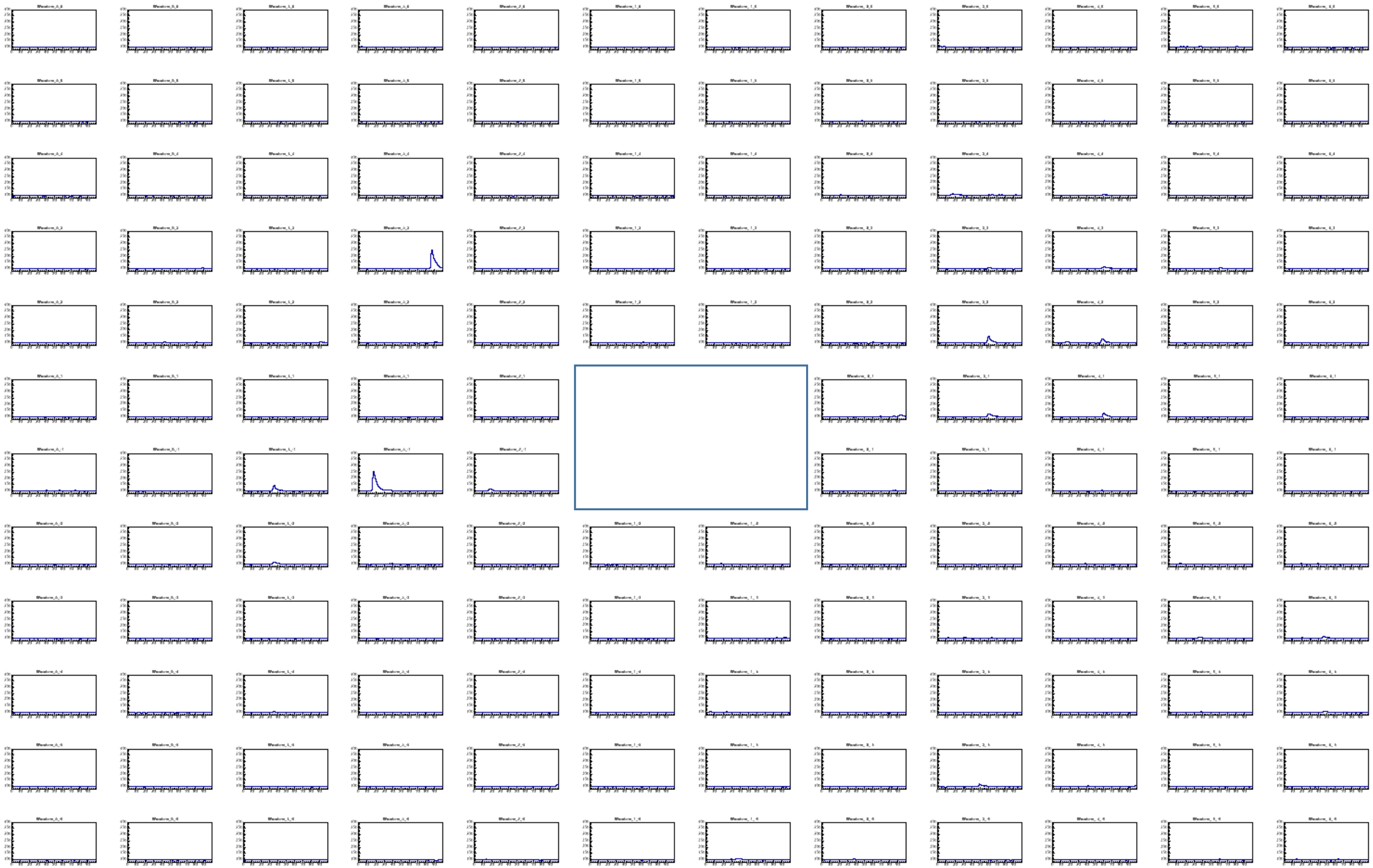
- Estimate anode current as follows:

$$A = \frac{5 \cdot 10^{-4}\ V}{50\ Om} \cdot \frac{<A(FADC)>}{100\ samples} \cdot \frac{1}{Gain(Amplifier)}$$

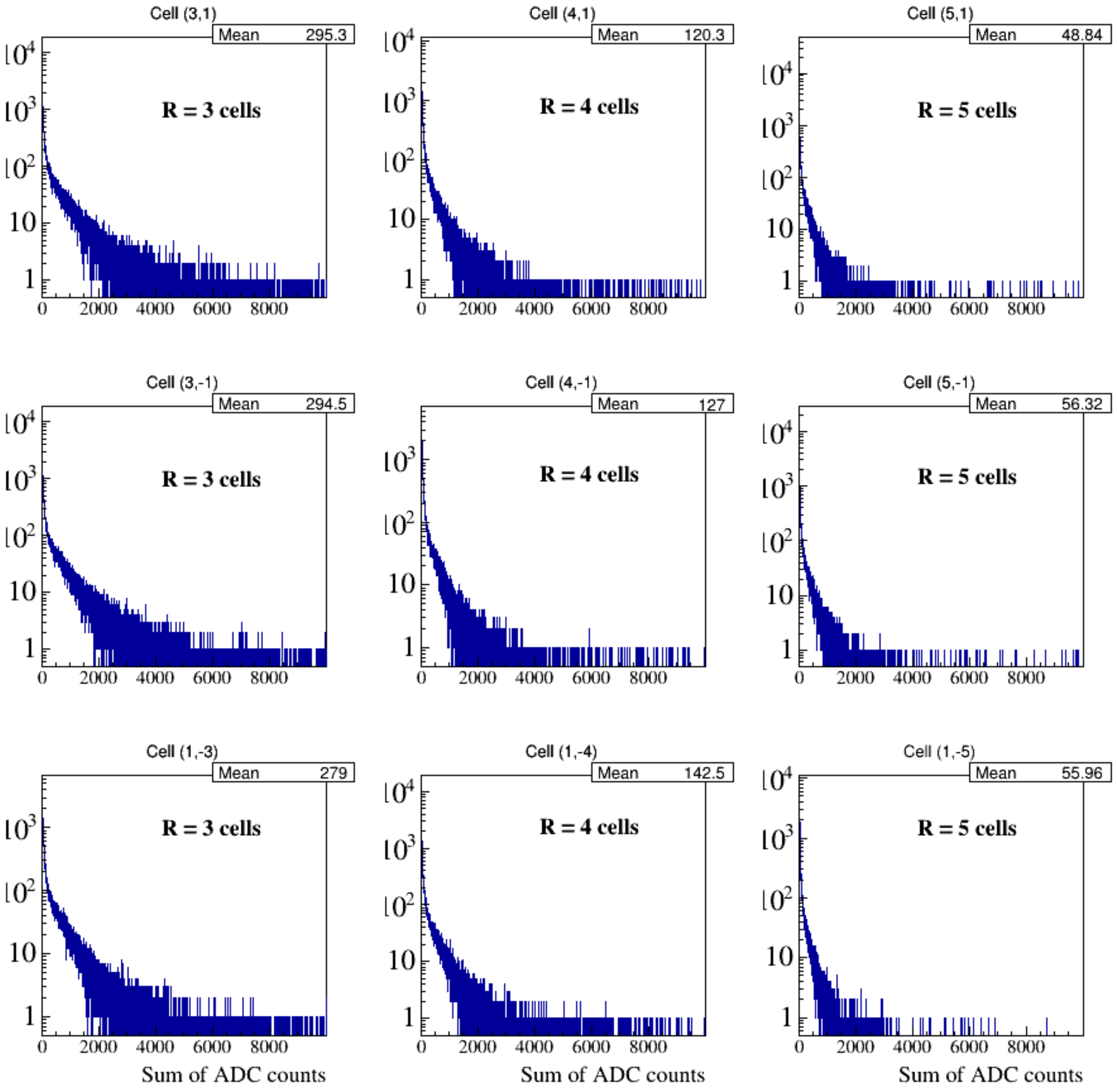
FADC Pedestals



CCAL FADC Waveforms

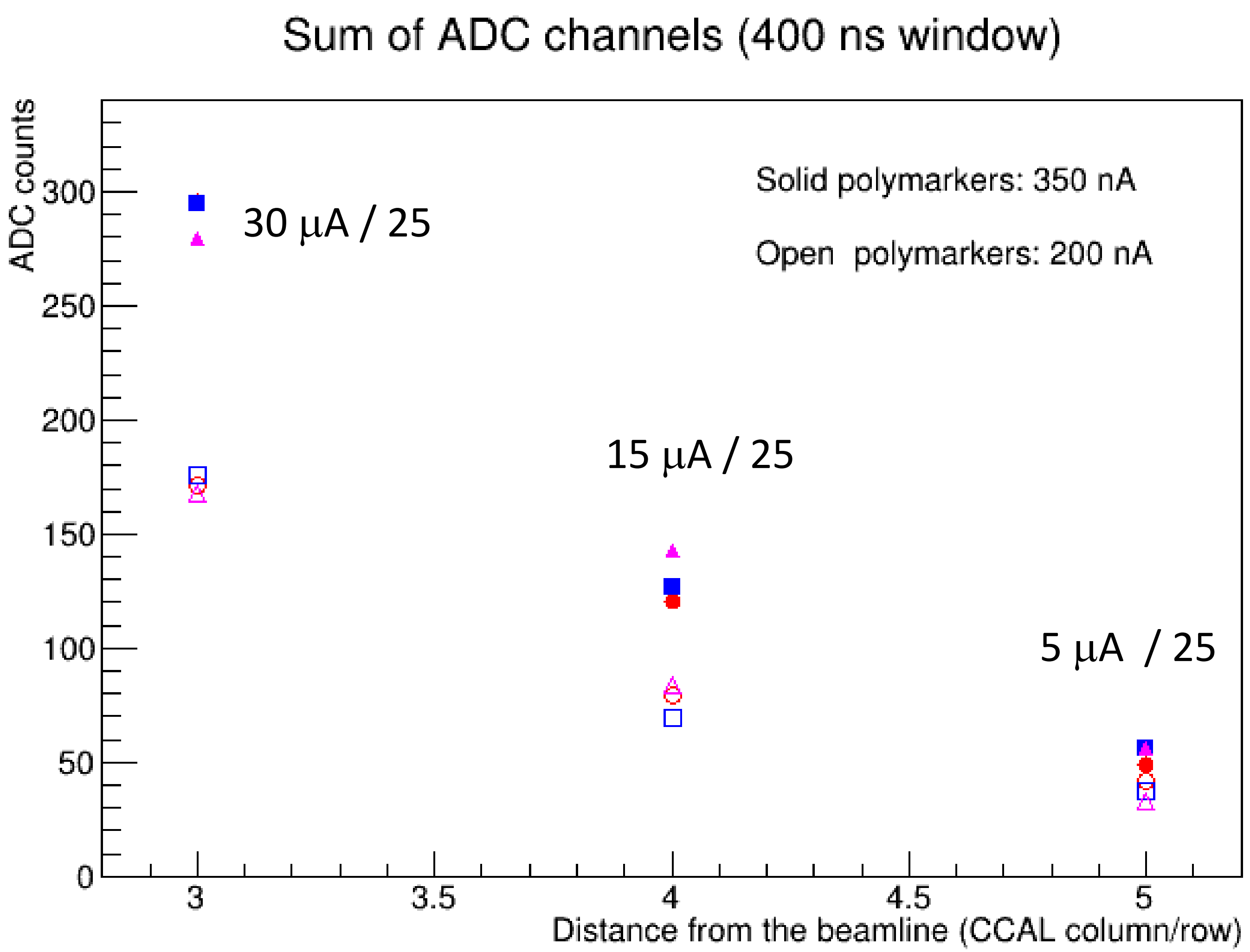


Sum of FADC Amplitudes in 400 ns Time Window



- FADC amplitude sums for modules in different CCAL layers

Sum of FADC Amplitudes in 400 ns Time Window



Current seen by FADC in the 3rd row: 30 μA

Current through the divider: 30 μA / 25 = 1.2 μA

Current estimates for FCAL:

- beam hole in the FCAL insert: 2x2 modules
- 1st layer covered by an absorber
- CCAL is positioned at $Z_{CCAL} = 2 \cdot Z_{FCAL}$ ($Z_{CCAL} \sim$ 12 m)

  aperture: 4th CCAL layer corresponds to the 2nd FCAL layer

  solid angle: factor 4

- FCAL current in the 3rd layer (1st after an absorber) if no amplifier used:

  5 x 4 = 20 μA

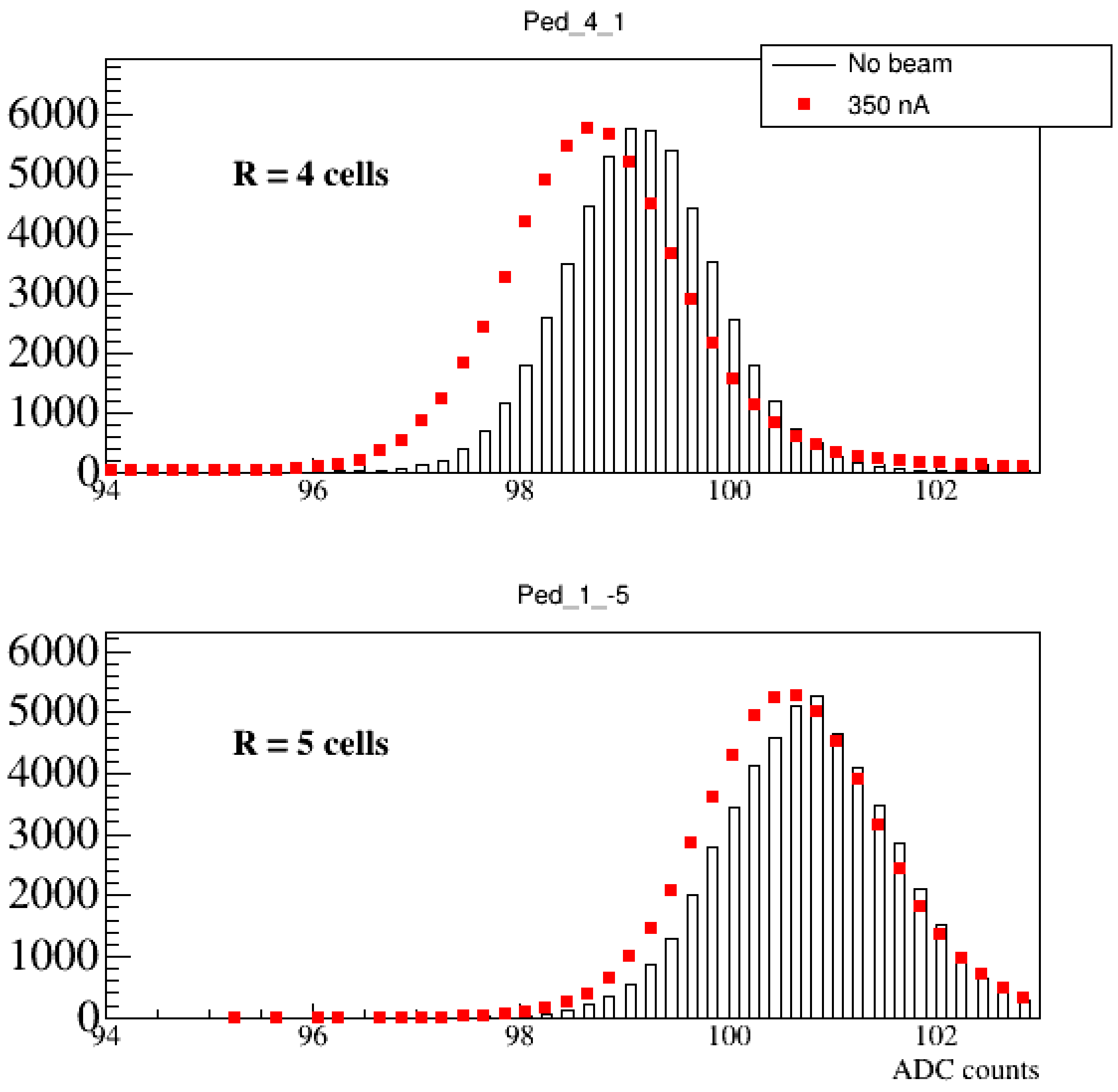
Discussion

- Can (probably) use active bases without dividers in all FCAL 2 insert modules except the 3 – 4 layers after the absorber. The amplification factor of 3 or 6 can be used for these modules

- 28 active bases were taken from the CCAL (all bases from layer 3 and 8 modules from layer 4). Gain of these dividers will be modified (coordinated with Fernando):
  - 14 bases – gain 3
  - 14 bases – gain 6

  Modified bases will be reinstalled on CCAL and testes in March / April

FADC Baseline Shift as a Function of Rate



- Amplifier in the active base is AC coupled
  - expect some FADC baseline shift at high rate
  - The shift depends on the rate

Note, if the amplifier is bypassed, the PMT Is DC coupled

- Checked the baseline shift at CCAL (350 µA at the diamond radiator JD70-105)
  - The shift is about 0.5 fadc counts in the 4^{th} layer (0.1 count in the 5^{th} layer)