Carbon gain $\leftrightarrow$ α gain

special polar. mtg.
16.08.13

<u>dN/dAmp slopes $\Rightarrow$ carbon gain:</u>

- Assume (physics) exponential carbon E distribution:

$$dN/dE \propto e^{-B\cdot E} \qquad B = \text{'slope'}, \ \text{MeV}^{-1}$$

- We measure amplitude (Amp) A in ADC counts:

$$A = g\cdot E \qquad g = \text{carbon gain (ADC counts)/MeV}$$

- Then an amplitude distribution $dN/dA \propto dN/dE$ is:

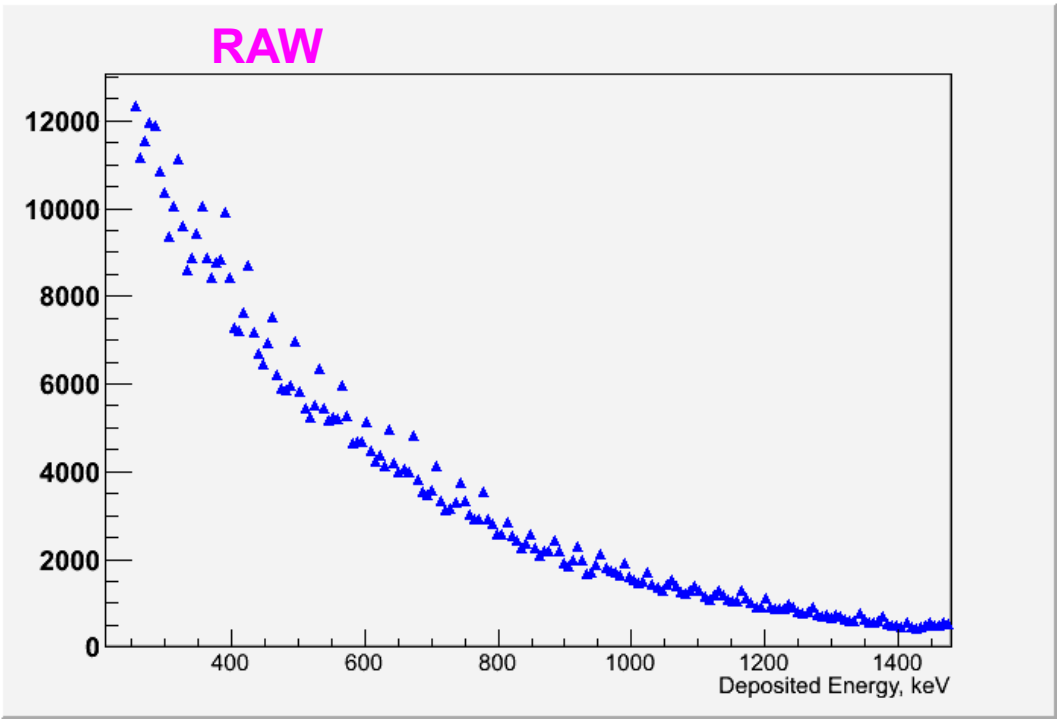
$$dN/dA \propto e^{-B'\cdot A} = e^{-B'\cdot g\cdot E} = e^{-B\cdot E}, \ B' = B/g$$

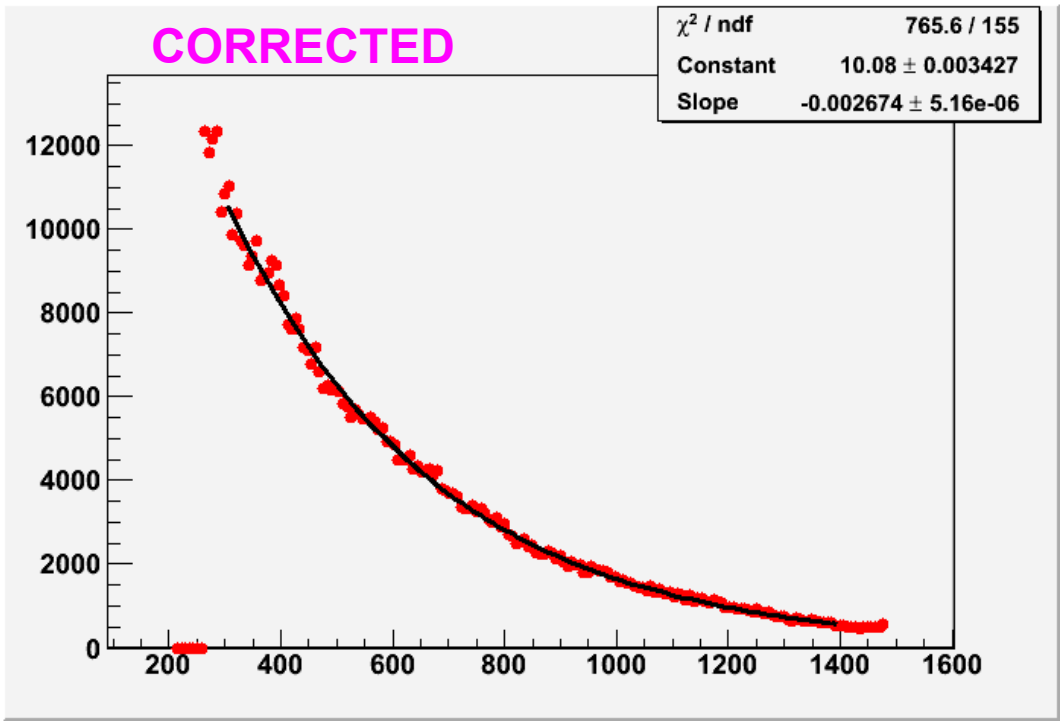
- For fixed (physics) B:
  measure amplitude slope B' $\Rightarrow$ measure carbon gain $g \propto 1/B'$

Amp distributions one chan.

- Use root file 2d histos w/ rough cut: select banana, reject pulser etc.
- Take Amp (ADC) distribution 'calibrated' for α gains:

17485.302
chan. 20





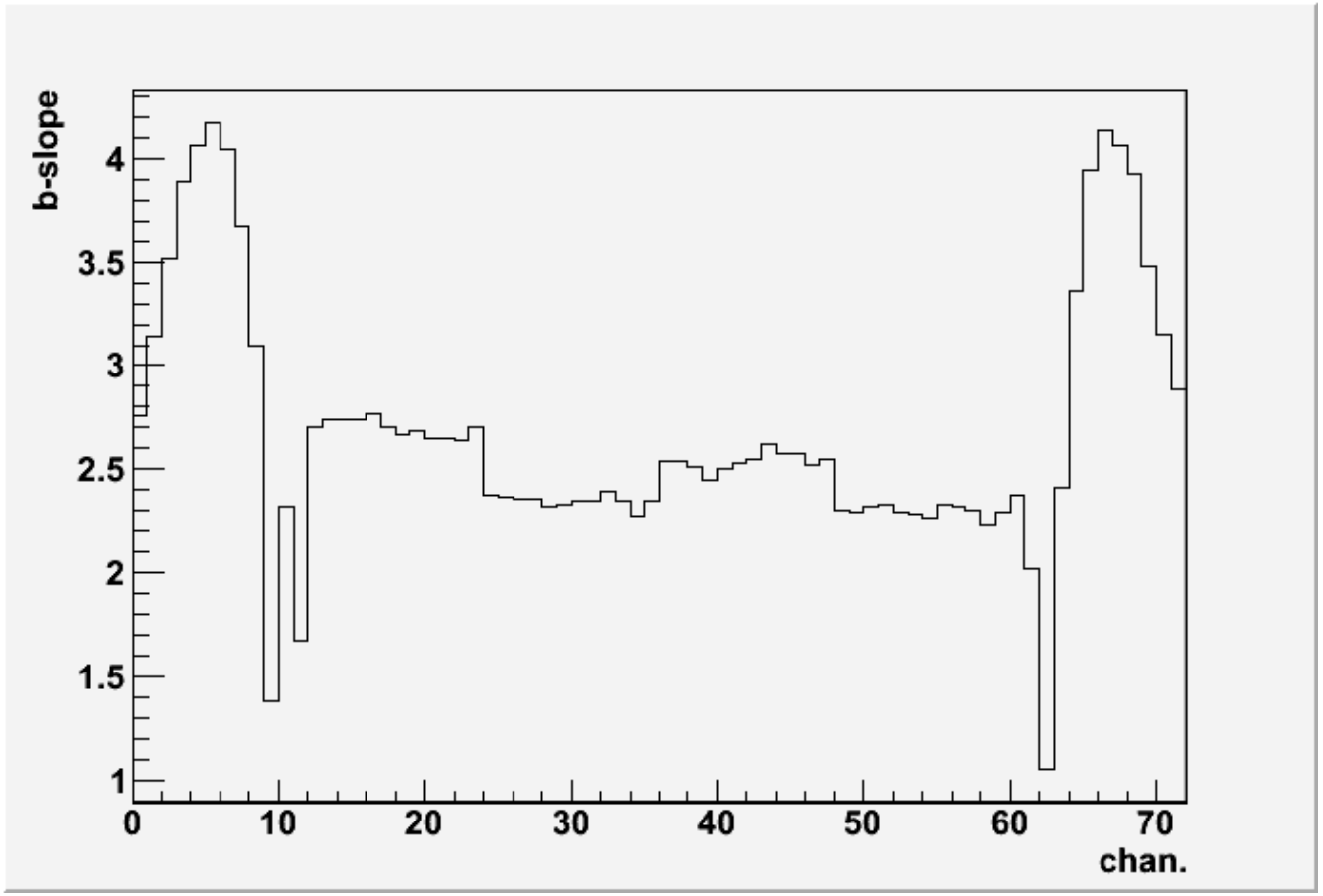
- Systematic effect every 5 bins
- Due to 5/16 ≈ 1/3 in WFD algorithm
- Essentially varying ADC bin width
- Correct: smooth distribution

  4 param. χ^2 minimization

- Nice smooth distribution
- Good shape fit to $e^{-b \cdot Amp}$
- Note: smoothing doesn't change fit much, but can *see* distributions, sys. effects

Amp b-slopes one run

17485.302

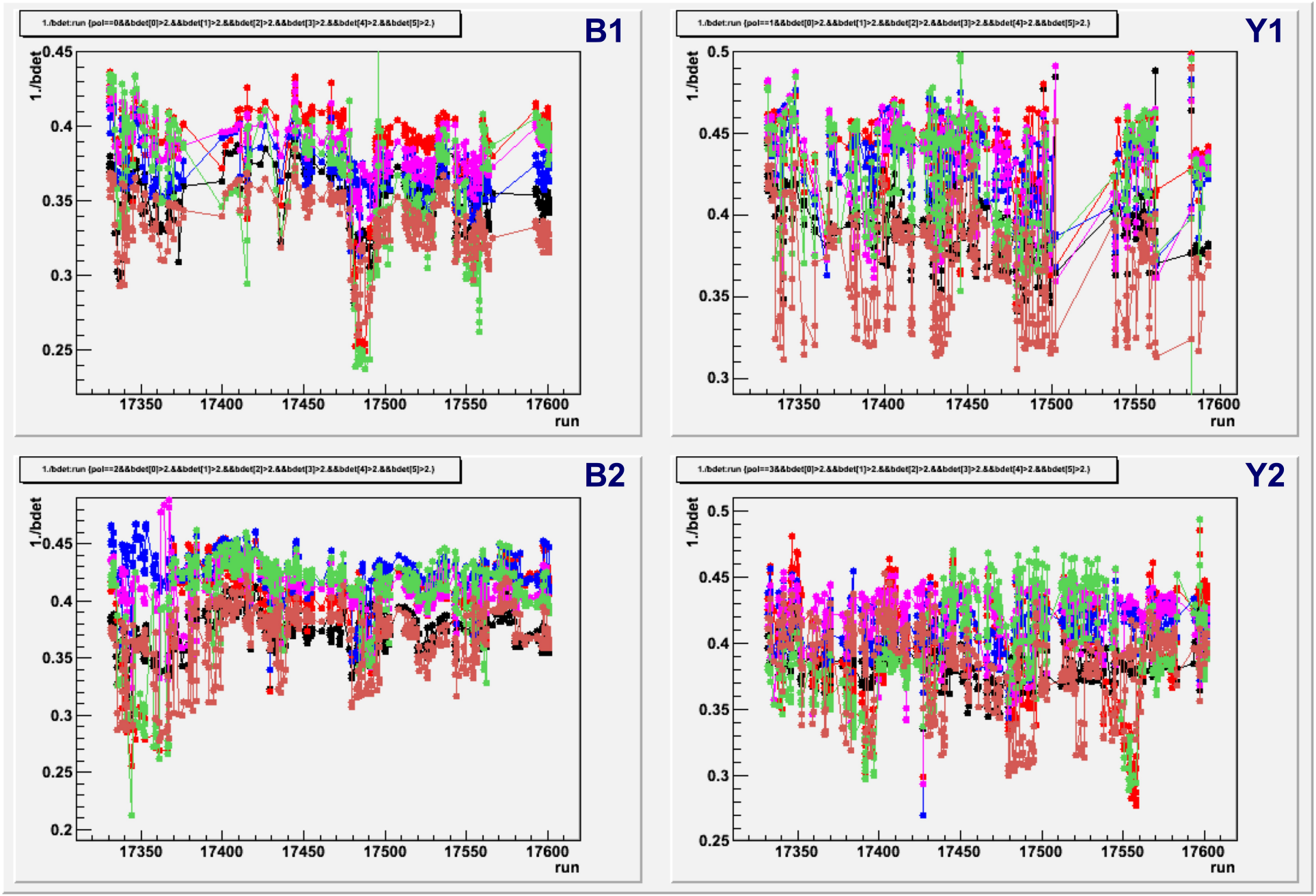


- Clear grouping 12. channels = 1 detector
- Rotated det.: central chan. higher E ⇒ lower B; side chan. vice versa
- For Horizontal targets, 90-deg. detectors (ch. 13-24, 49-60) shadowed
- Take average b per detector, track 1/b ∝ gain over time ↘

1/b (~gain) vs. run

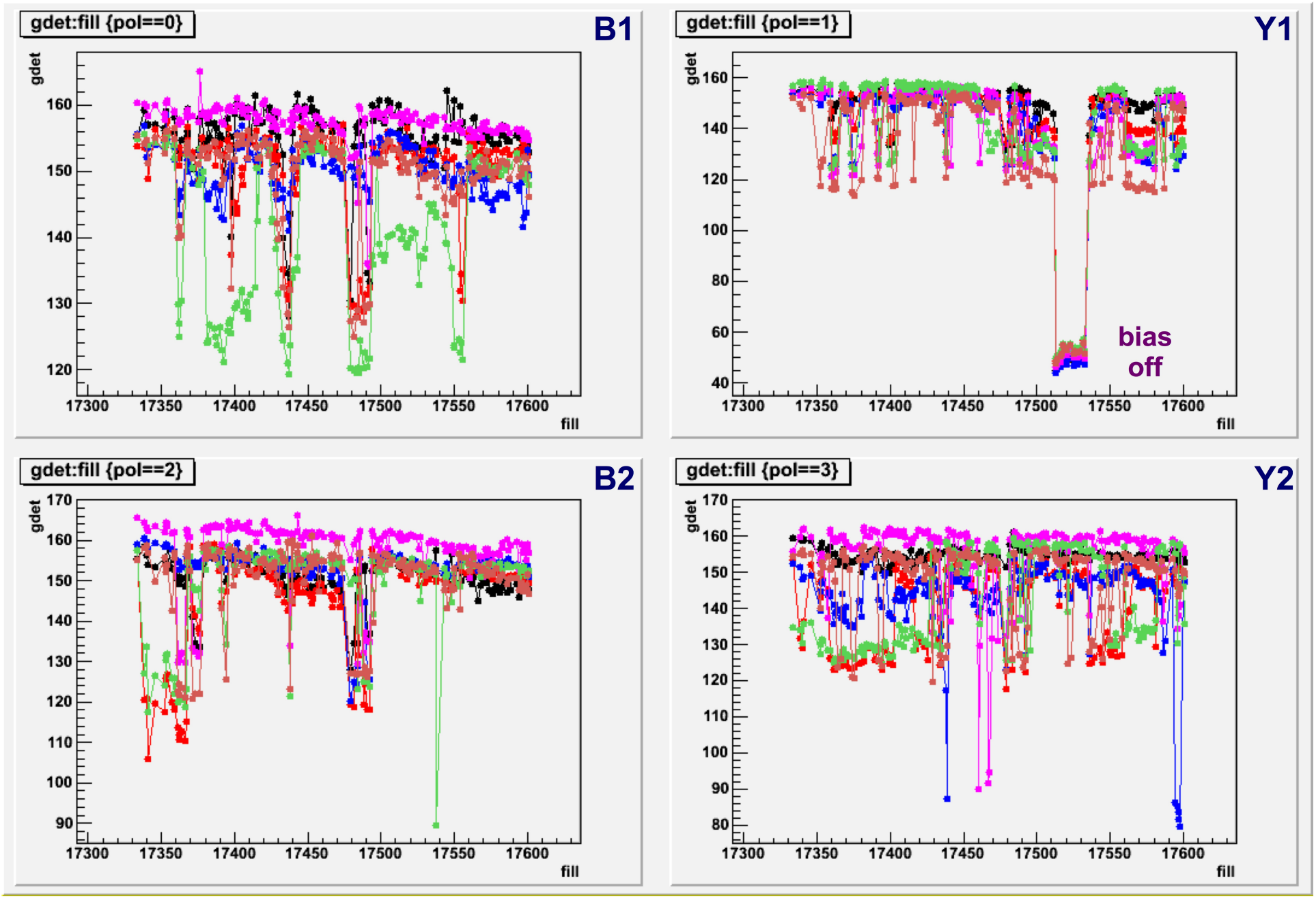
gaps ⇒ pol. not used
targets depleted

- Gains vary over range 25-30%:

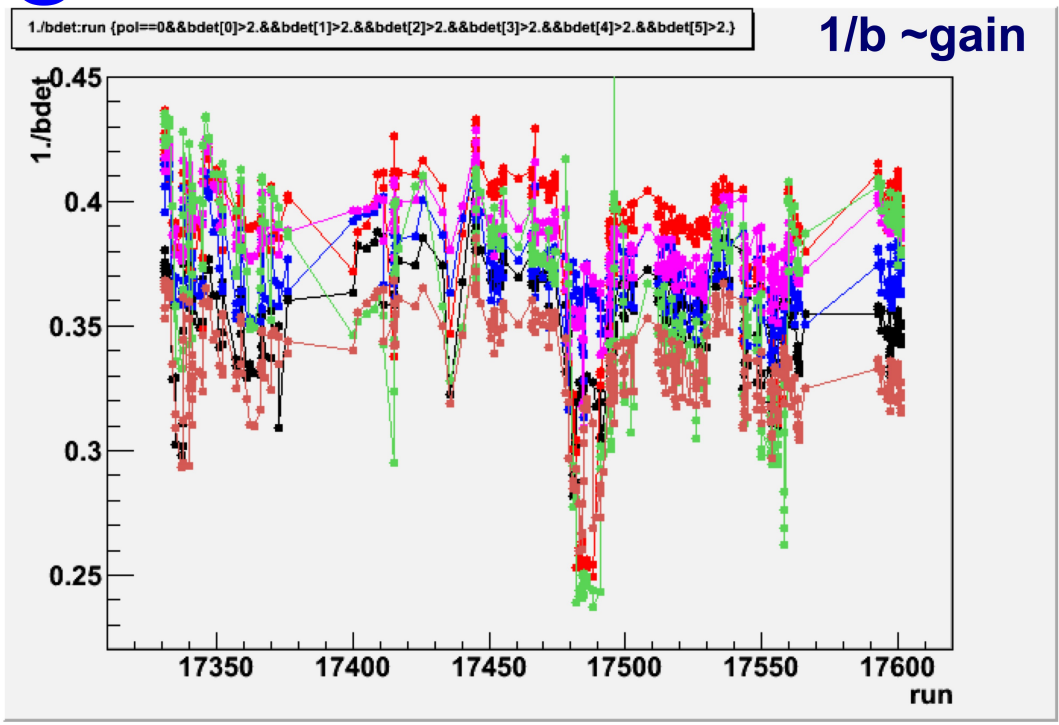


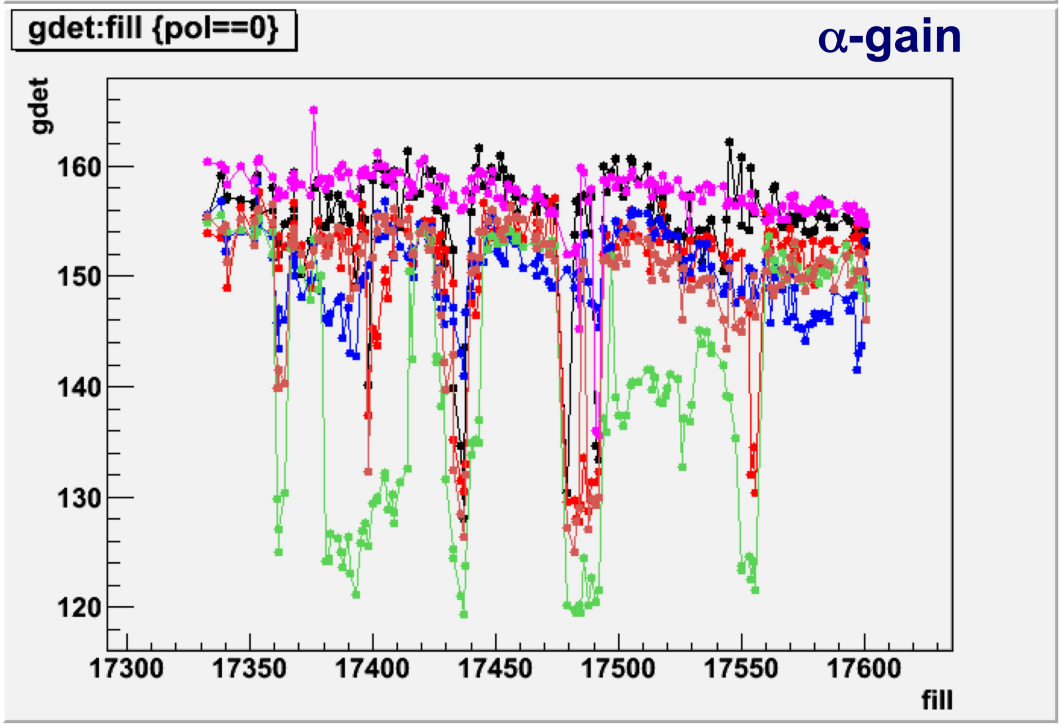
α-gain vs. run

- Gains vary over range 25-30%:



B1: 1/b & α-gain vs. run

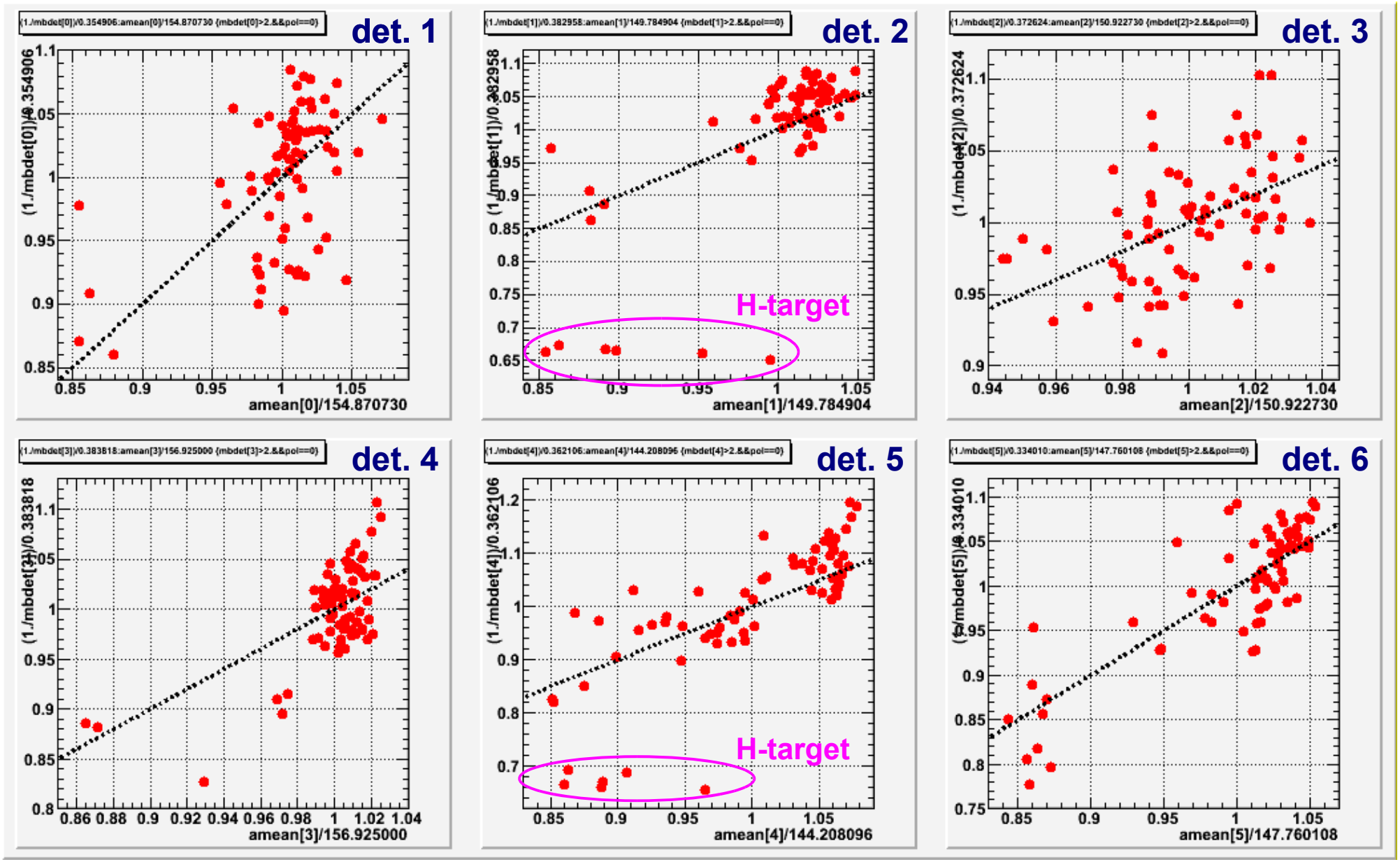




- Some correlation between large downward excursions e.g. det. 5 light green points
- Check 1/b vs. α-gain: use polar. measurement just before end-of-store α run ↘

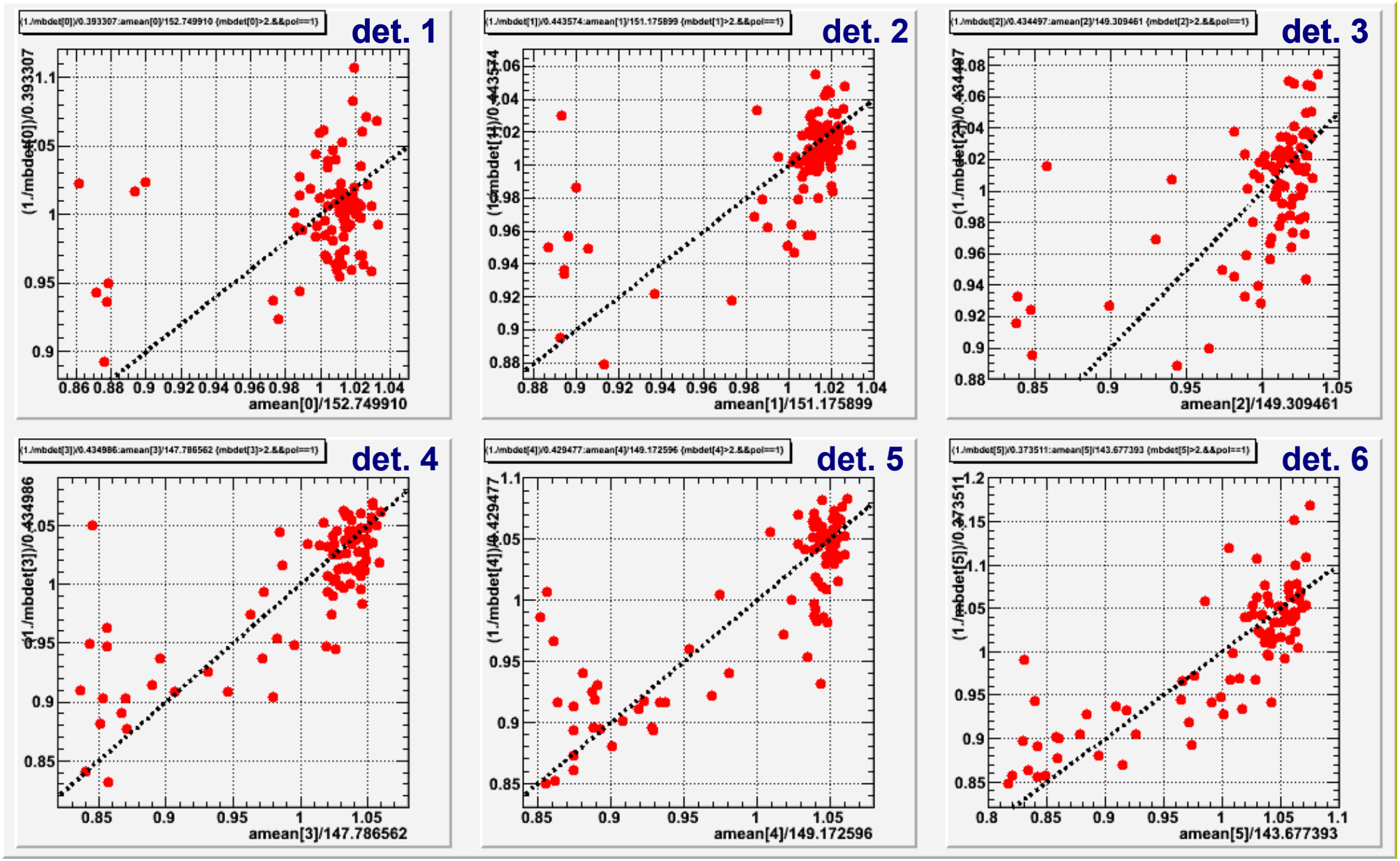
1/b vs. α-gain: B1

- Normalize so values ~1; dotted line y=x:



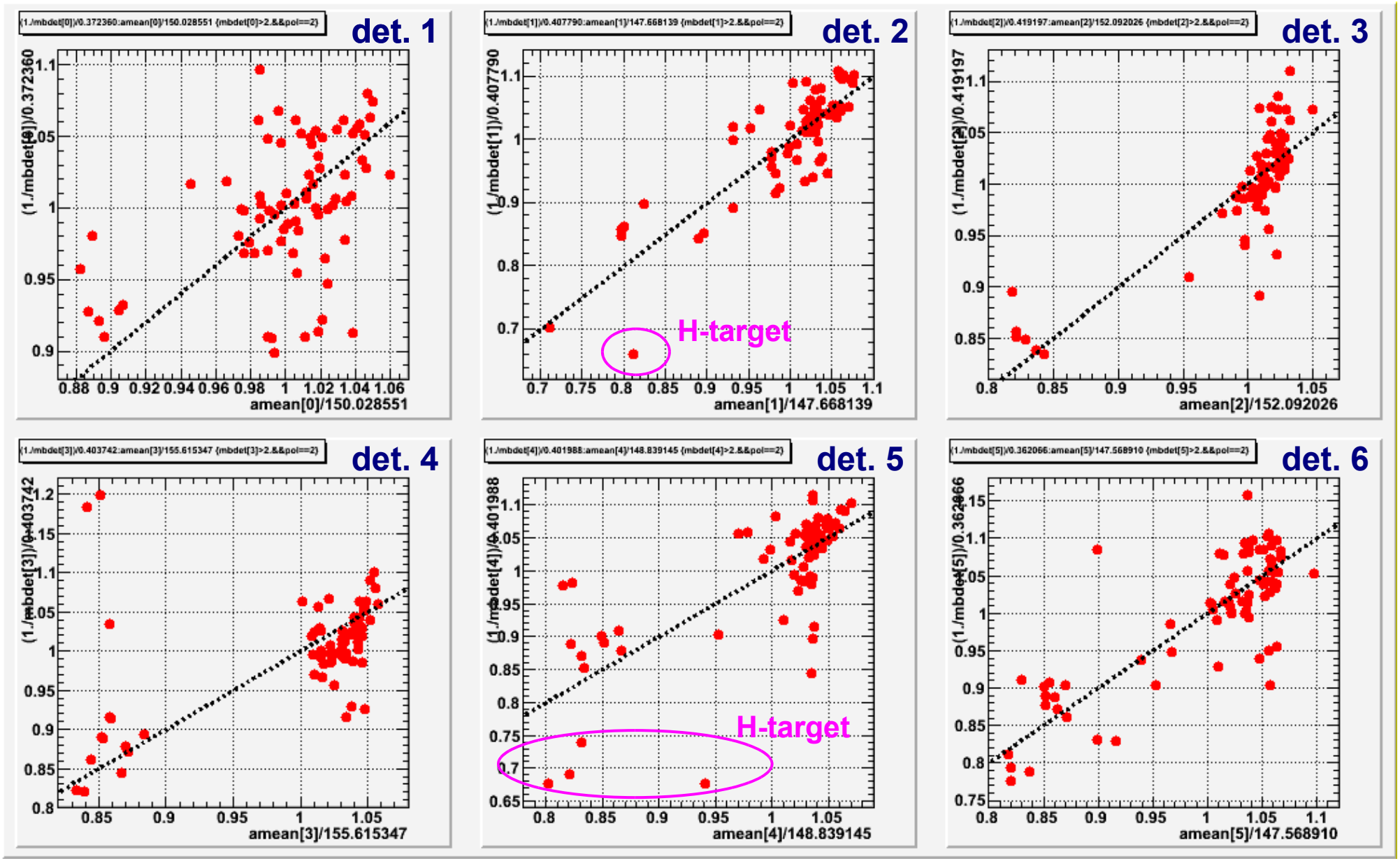
1/b vs. α-gain: Y1

- Normalize so values ~1; dotted line y=x:



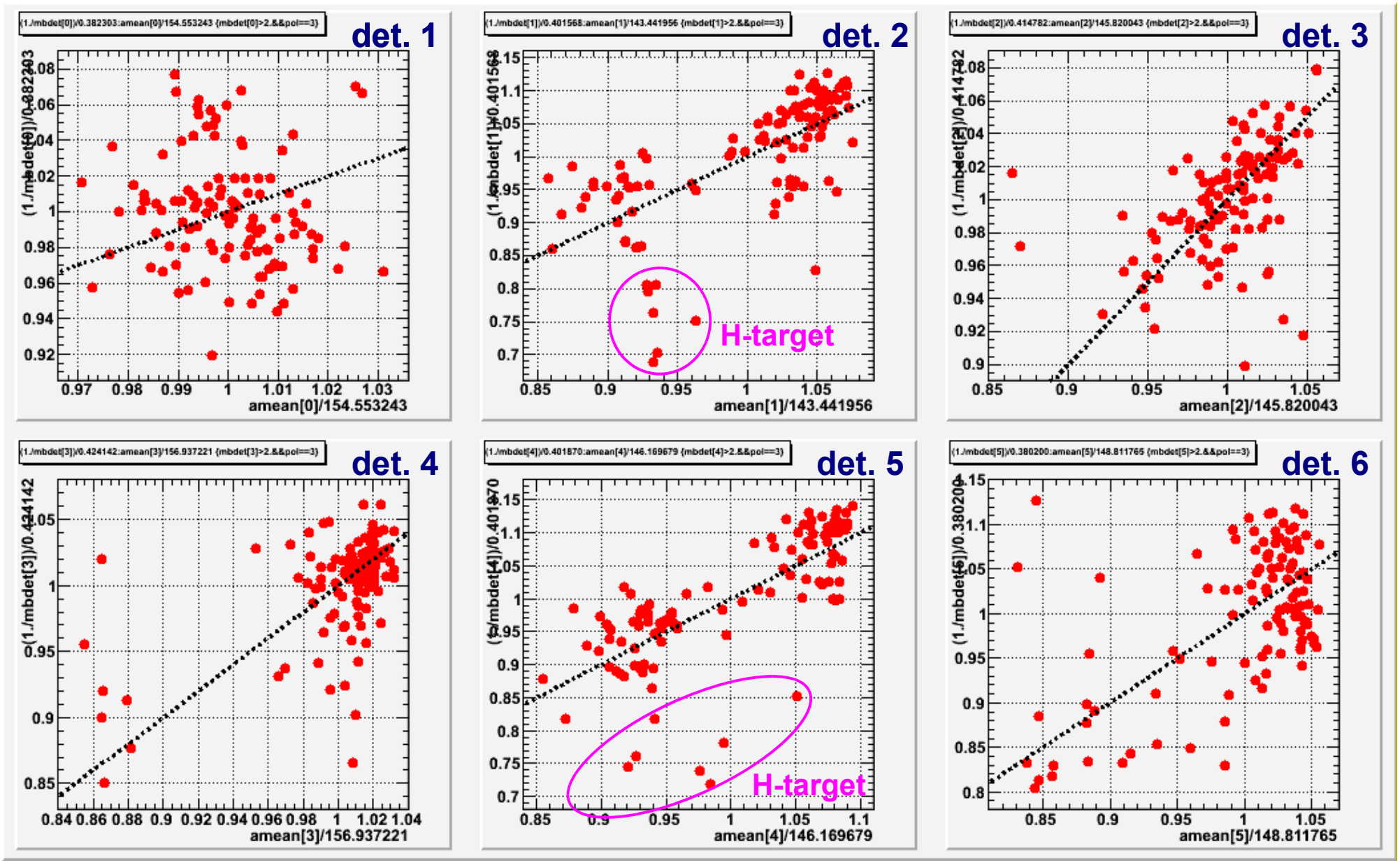
1/b vs. α-gain: B2

- Normalize so values ~1; dotted line y=x:



1/b vs. α-gain: Y2

- Normalize so values ~1; dotted line y=x:



Conclude so far:

- 1/b $\propto$ Carbon-gain
- 1/b follows gross deviations of α-gain
- Carbon-gain $\propto$ α-gain
- We have α-gain measurements every end of store (starting 17333)

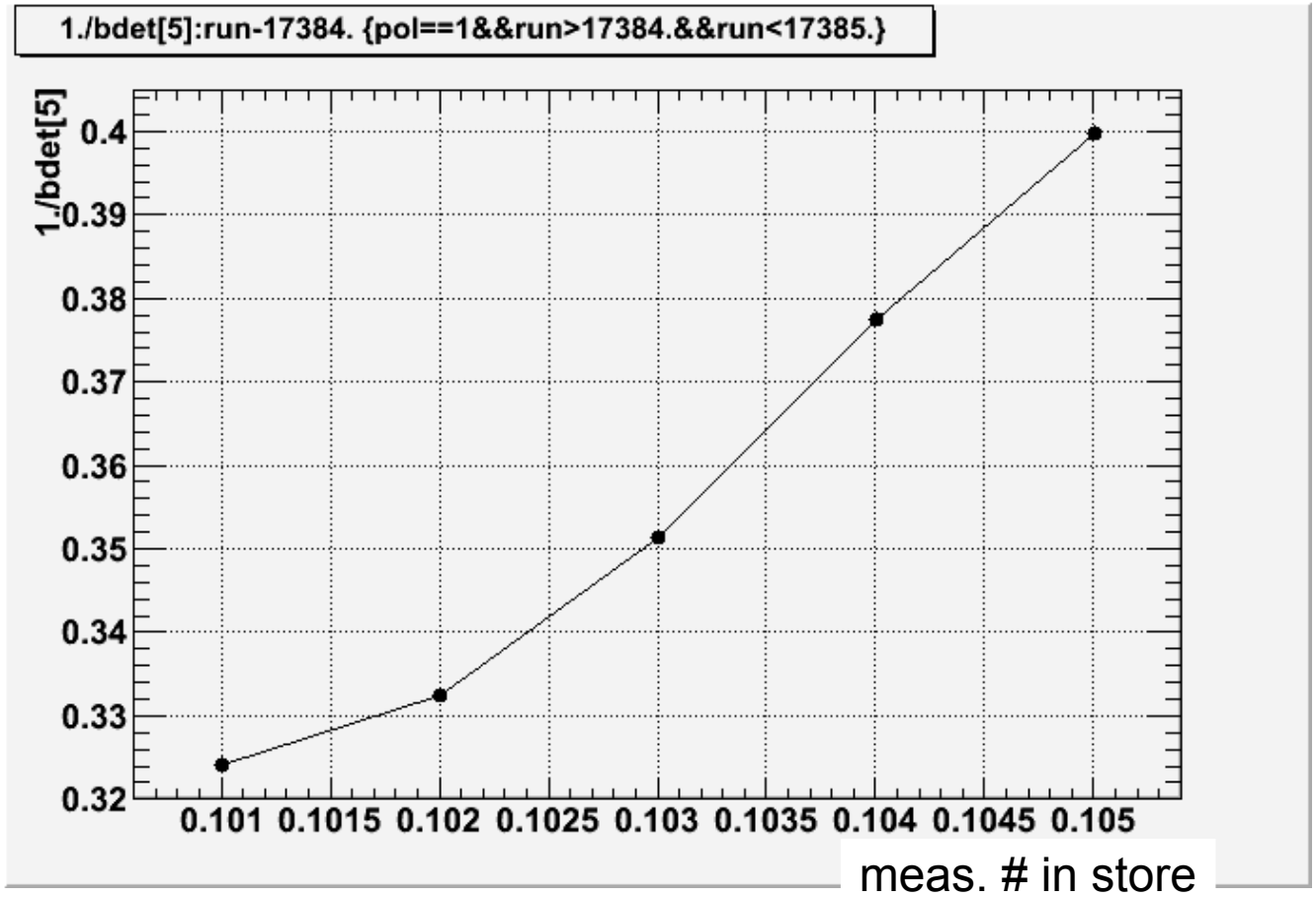
But:

- α-runs only at end-of-store
- Are Carbon-gains stable through a store?

one (hopefully extreme) instance ↘

1/b: store #17384 Y1 det. 6

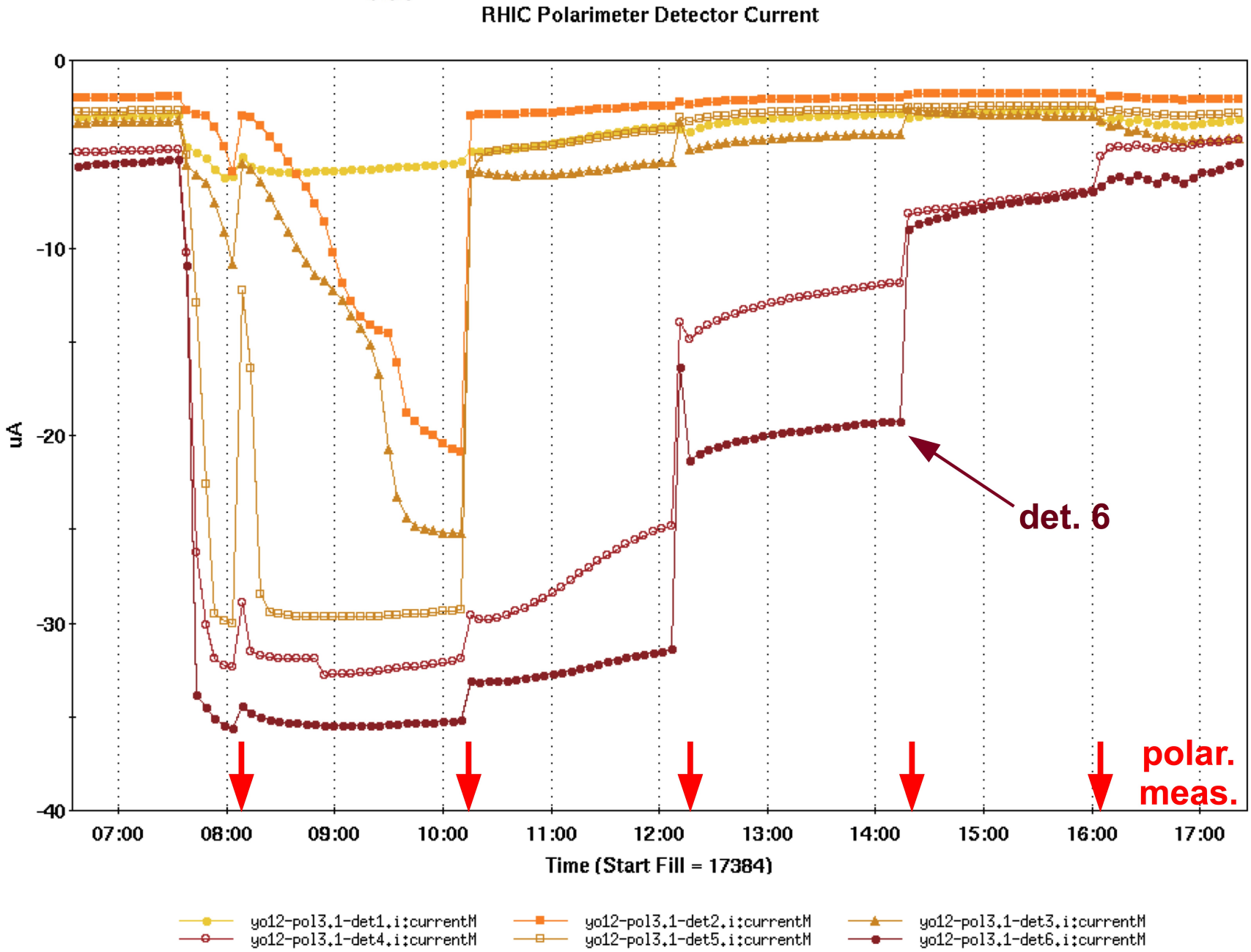
- 5 measurements @ 255 GeV, every ~2 hours
- > 20% Carbon gain change (upwards):



- What was the bias supply current doing during all this?

I_{bias}: store #17384 Y1

- Drops (some big) in I_{bias} each polar. measurement:



Conclude so far:

- 1/b $\propto$ Carbon-gain
- 1/b follows gross deviations of α-gain
- Carbon-gain $\propto$ α-gain
- We have α-gain measurements every end of store (starting 17333)
- But: Carbon gains can and did drift substantially through store

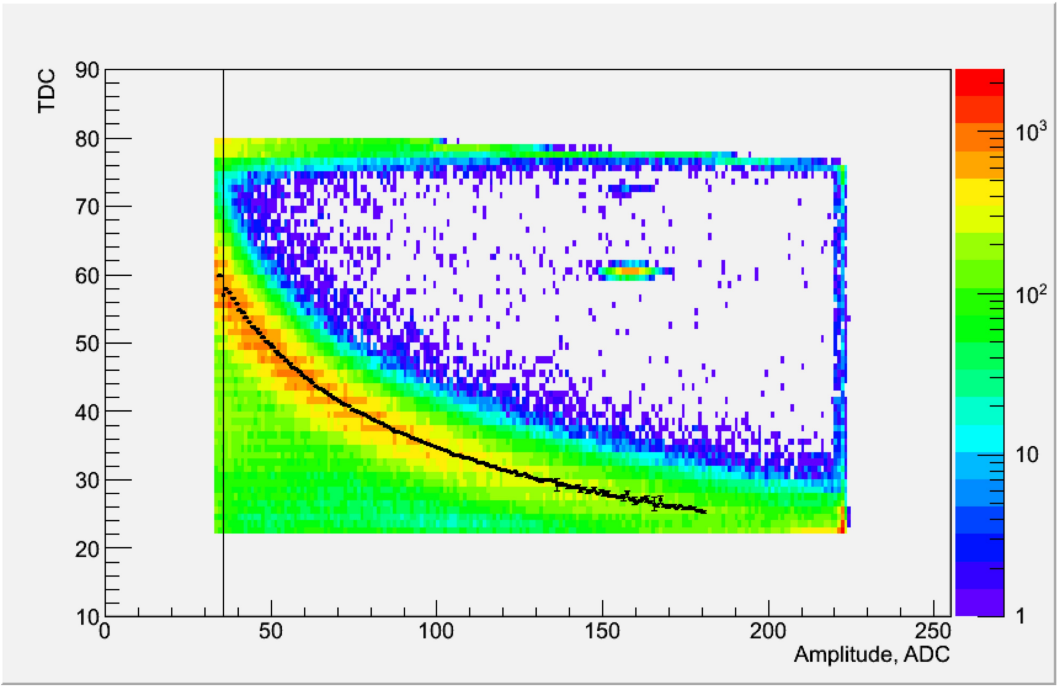
Next?

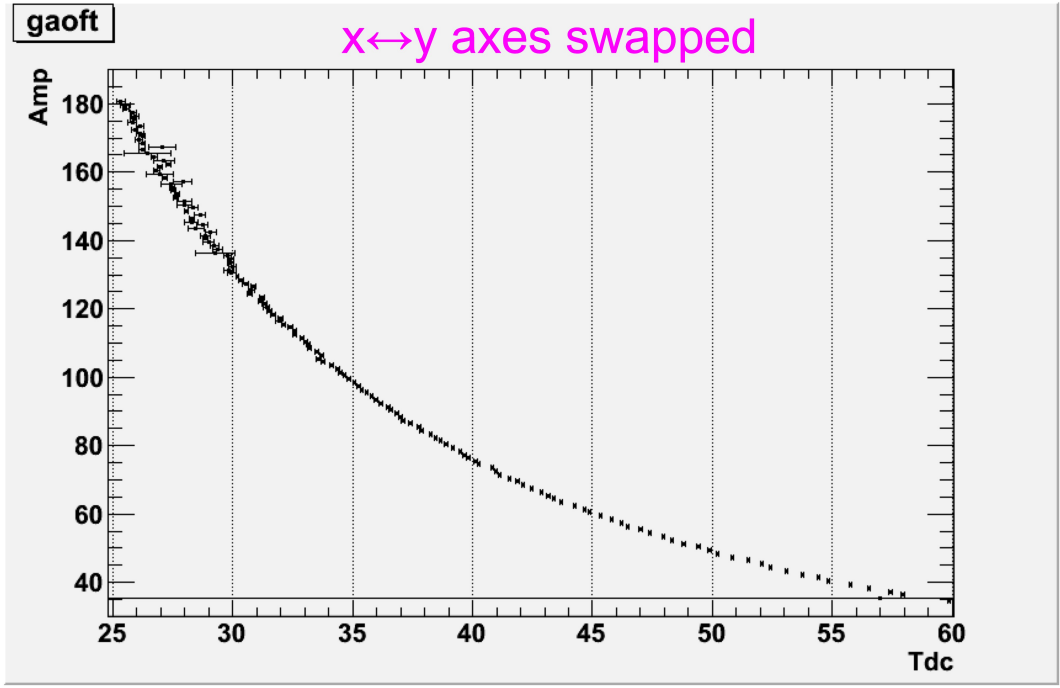
- Dima K. has shown correlation α-gain $\propto$ I_{bias}
- We have continual I_{bias} measurements every 5 min.
- Can we correlate Carbon-gain $\leftrightarrow$ I_{bias}?
- Dima K. ↘

Alternatively... ↘

TOF

- Carbon kinetic energy ↔ Time Of Flight related: $E \propto 1/(T-T_0)^2$
- T = measured TDC value of carbon hits
- T_0 = TDC time of v=∞ prompts (beam ×'ing)





<u>In Amp slices:</u>

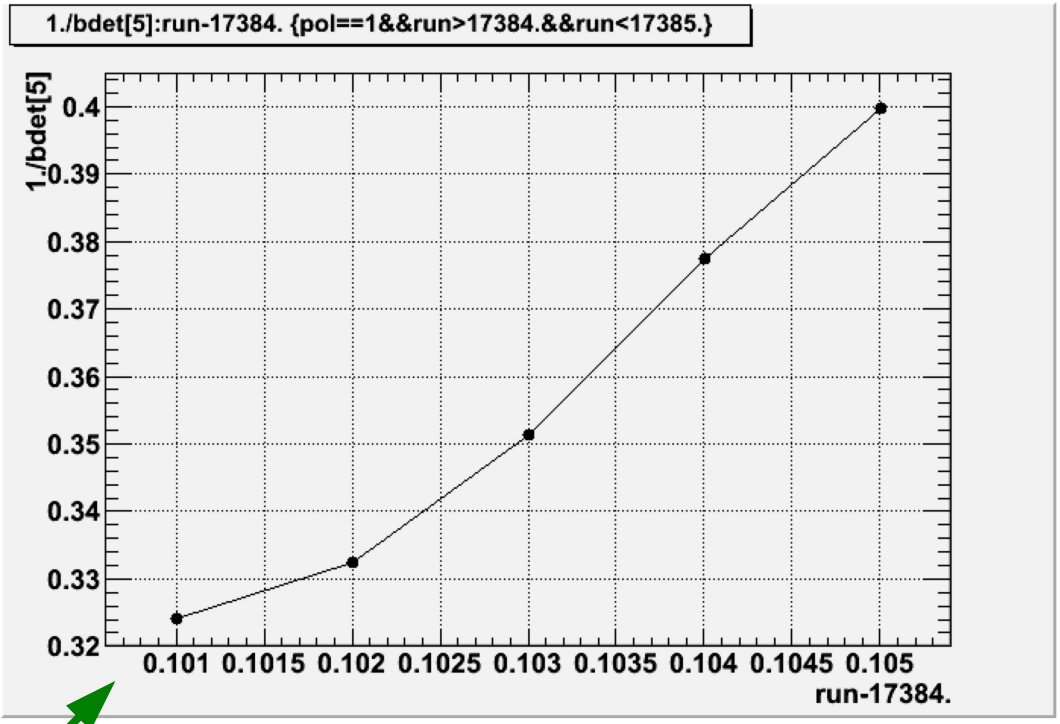
- gaus.+bkg. fit to Tdc distribution
- gaus. mean: Amp↔Tdc relation
- beam T-smearing removed

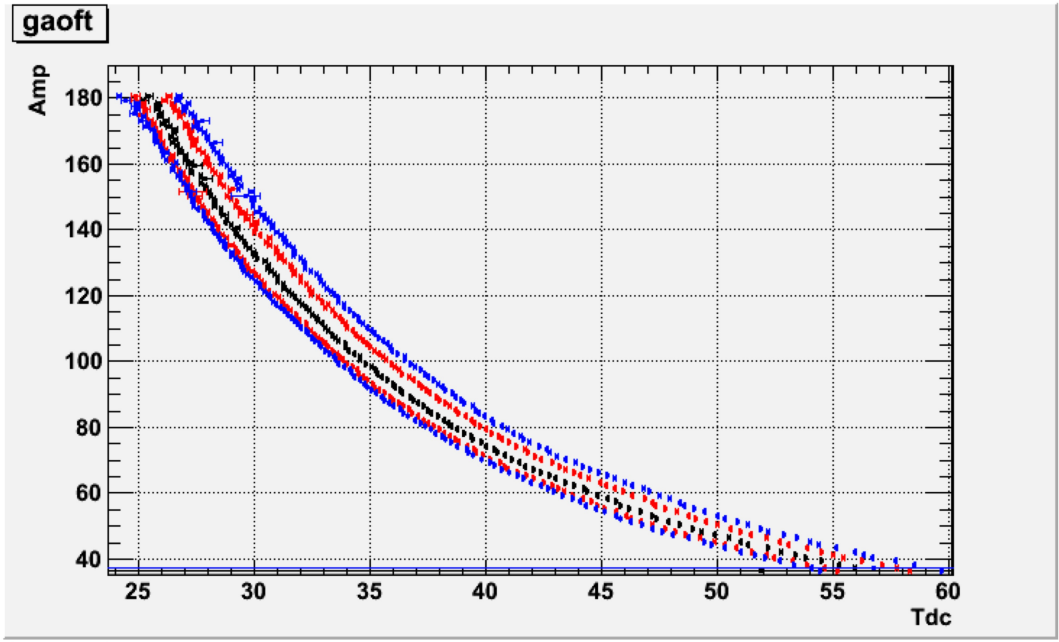
For a fixed T_0

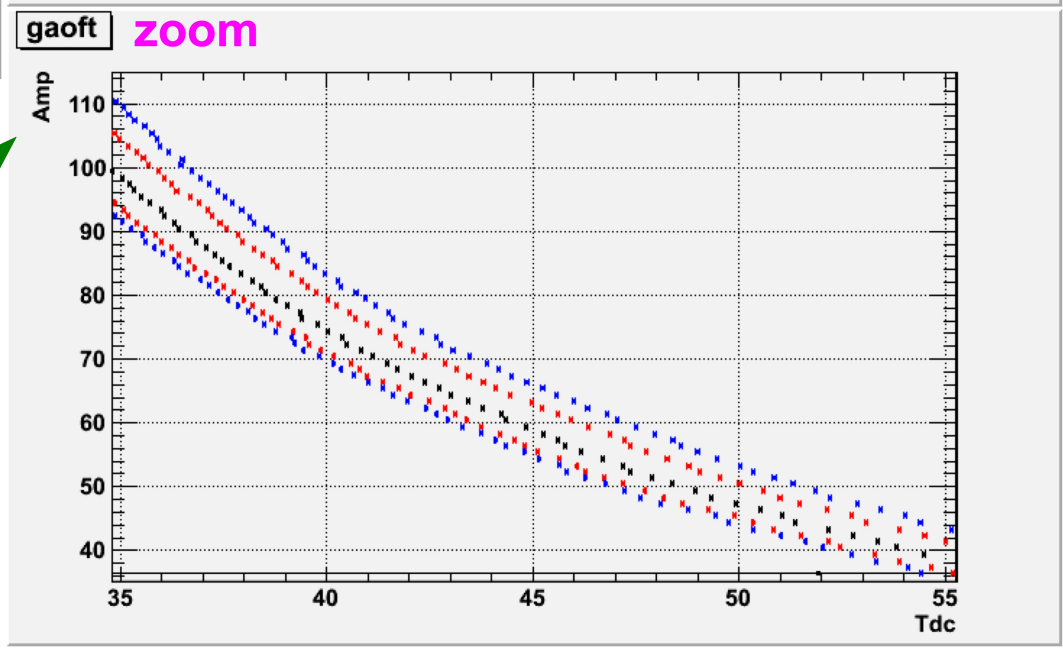
<u>(beam ×'ing time, DAQ timing, …):</u>

- Slice in Tdc ⇒ fixed carbon energy
- Amp at this Tdc is ∝ carbon gain

Gain drift 17384 Y1 det. 6

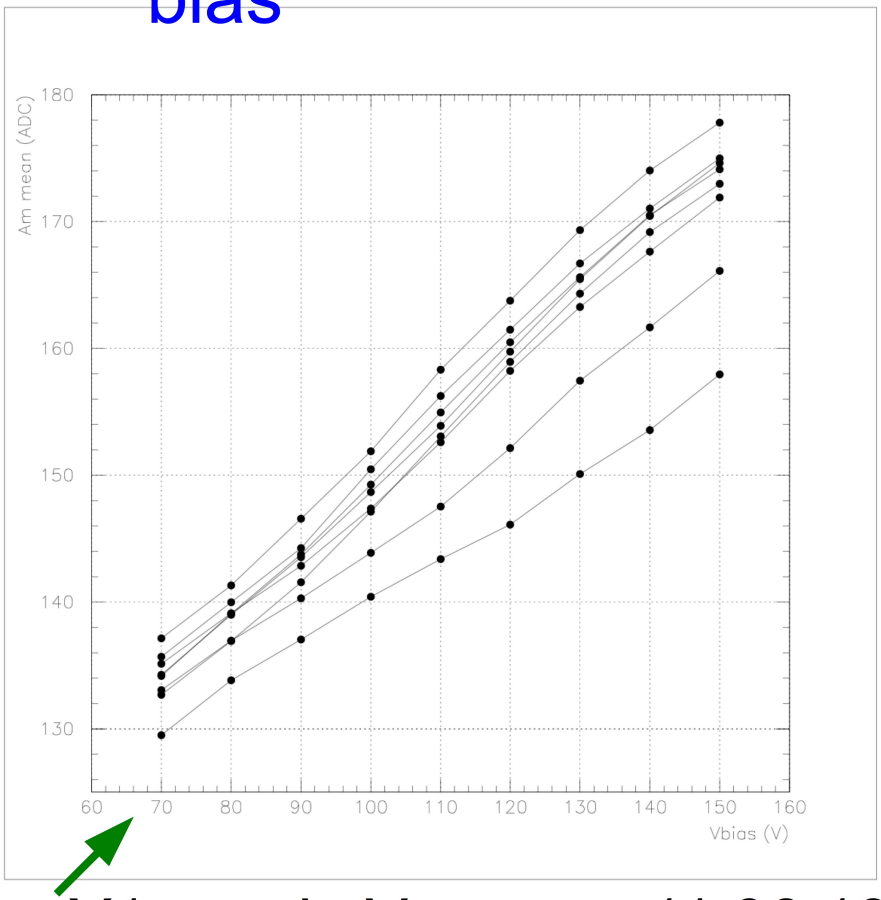


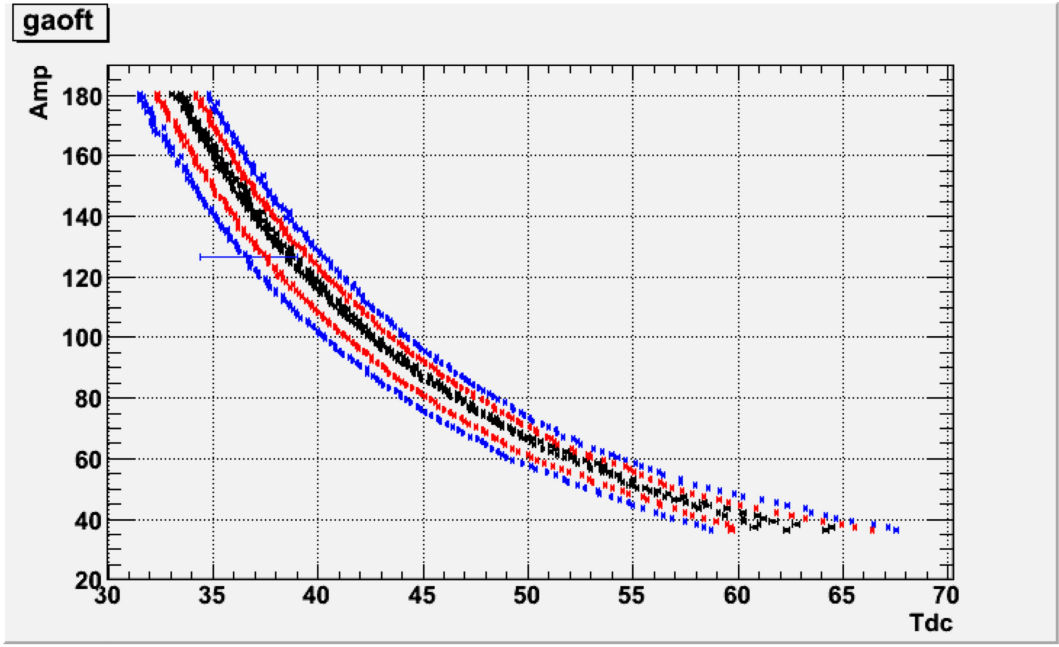


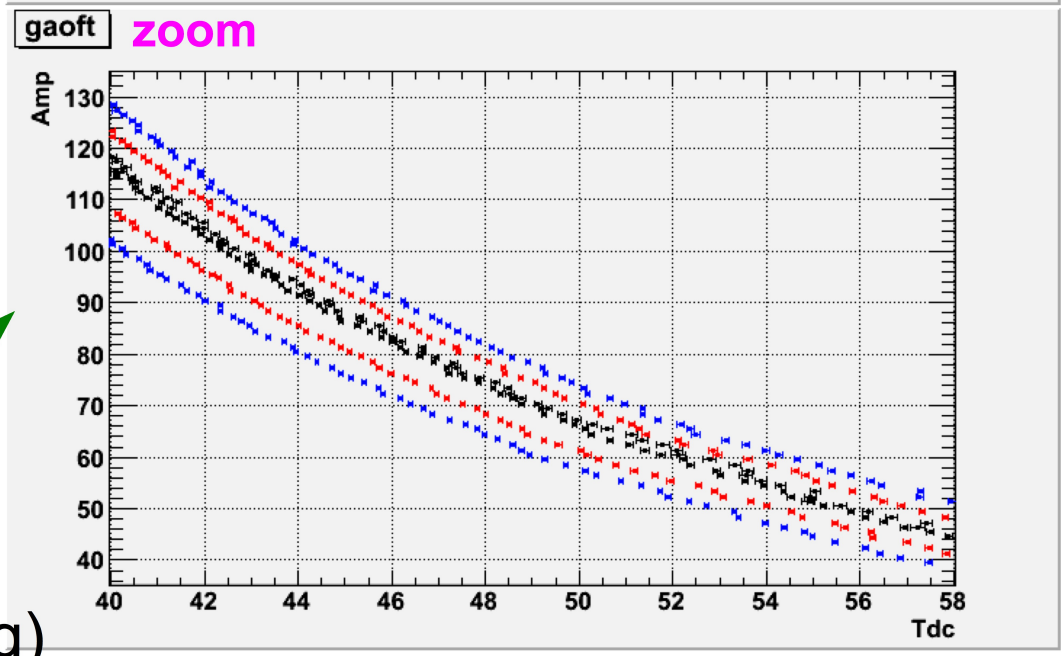


- Already saw gain drift via b-slopes
- Amp vs. Tdc points for meas.
  .101 , .102 , .103 , .104 , .105
  show ~same magnitude Amp jumps
- Measure of carbon-gain

V_{bias} scan Y2 store 17597 (Haixin)







- Y1 α-gain V_{bias} scan 11.06.13
  70→150 V , α-gain→+20-30%
- Y2 scan Amp vs. Tdc points
  70 , 90 , 110(2×) , 130 , 150 V
  carbon gain → +25% (I_{bias} varying)
- Measure of carbon-gain

TOF: summary & outlook

So far:

- These two examples over short period: T_0 stable
- If T_0 stable, Amp vs. Tdc data tracks carbon-gain

Going further:

- Track T_0 over time $\Rightarrow$ track carbon-gain over time
- Absolute T_0 $\Rightarrow$ absolute carbon energy scale

Work proceeding with this program...

- dN/dE $\Rightarrow$ dN/dT ?