

Correlation QDC vs. FlashADC

Runs 219, 228 “up” calorimeter

The problem

- We routinely measured cosmons and electrons with a 12-bit QDC (4096 channels) and all data make sense w.r.t. what is expected
- At BESIII we will sooner or later use an 8-bit Flash ADC; Giulietto's electronics converts integrated charge to a V-signal with a given conversion factor.
- What is this conversion factor? Will we saturate the FADC scale?

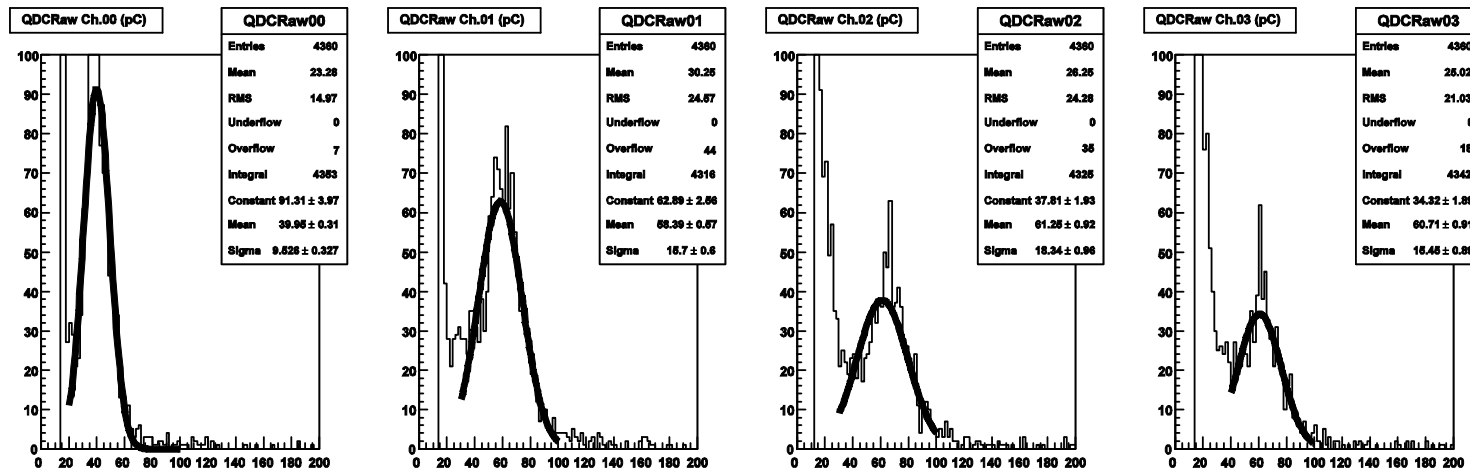
Run 219, cosmics at LNF

- “up” minicalorimeter
- Symmetric external trigger on left and right sides
- HV: “Hamamatsu” 1.4 kV points, gain $\approx 1.2 \cdot 10^6$, Happy Box present
- Chs. 0,1,2,3 to QDC ch.s 0,1,2,3 (gate 200 ns)
- Chs. 4,5,6,7 sent to FADC, analogic sum to ch.3 of FADC

Scanning waveforms

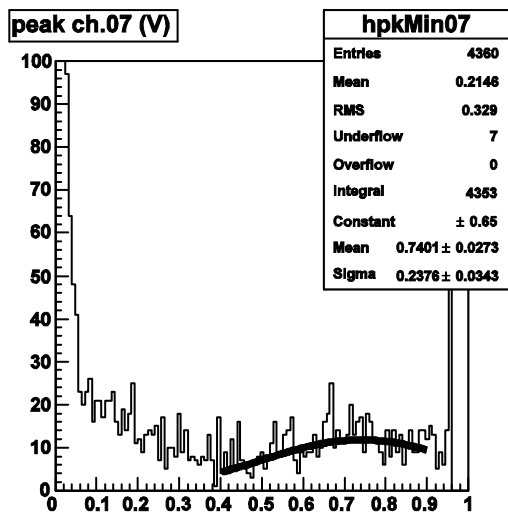
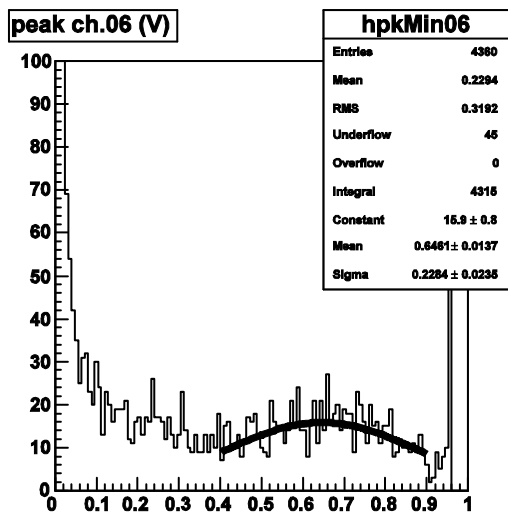
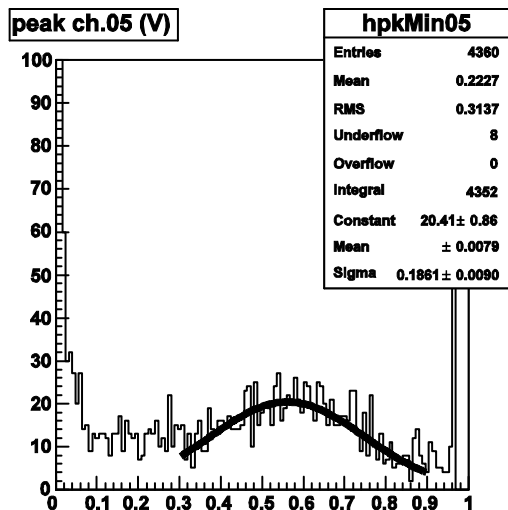
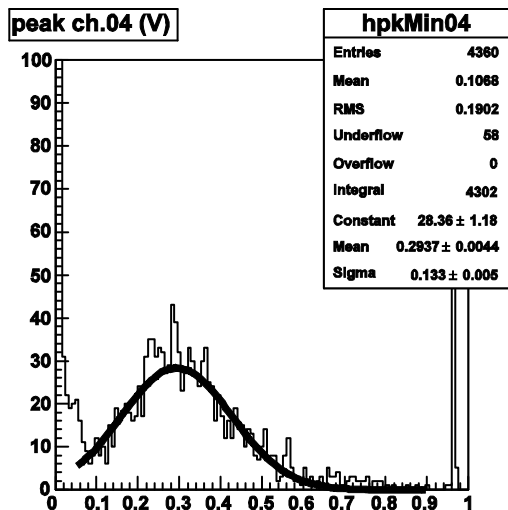
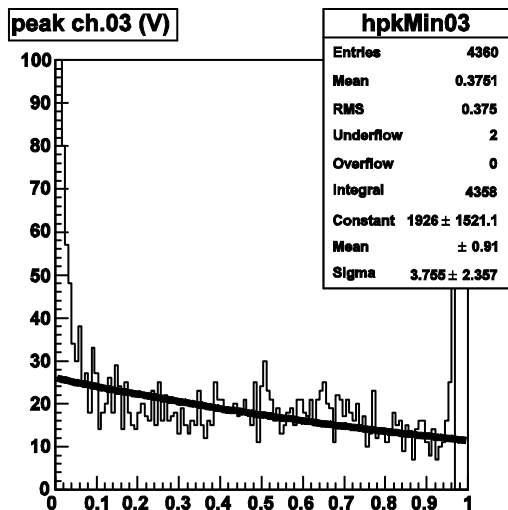
- First 30 ns data (15 samples) used to find the baseline on a per-event basis
- Samples 20 to 50 (40 to 100 ns) used to find the signal peak
- Plot the peak, subtracted from the baseline
- Do the same for channel 3 (analogic sum) and correlate with the sum (0,1,2,3)

Run 219, cosmics, QDC data

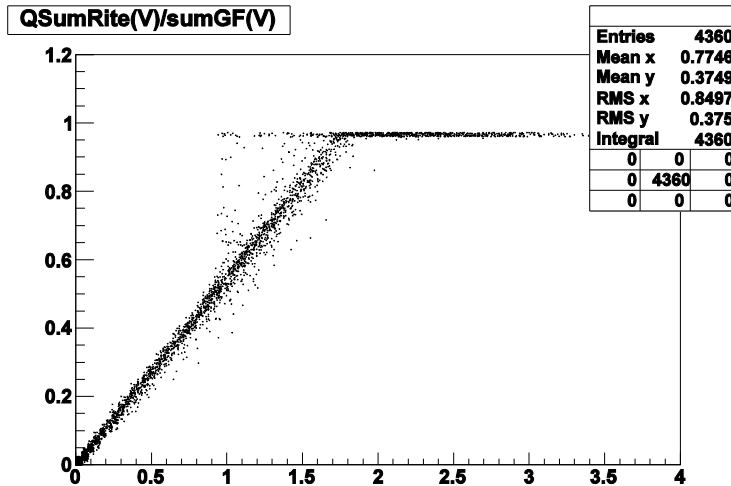


- Ch. 0 in the QDC sees 40 pC, with a sigma of 9.5, over a pedestal of 15.9 → 24 pC. Other channels see 43, 47, 45 pC after pedestal subtraction; in fact they have twice the track length of ch.0.

Run 219, FADC, all triggers



The summing amplifier

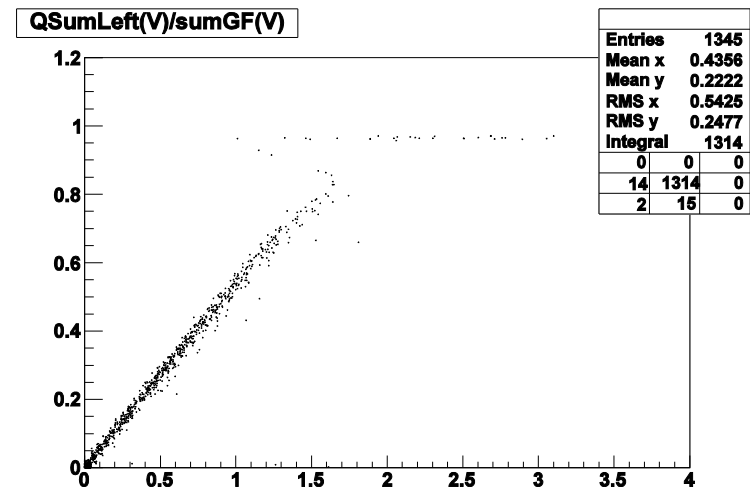


Run 219

There is only a slight effect of bending, or saturation, close to the end of the scale.

The summing amplifier works fine, irrespective of resolution loss.

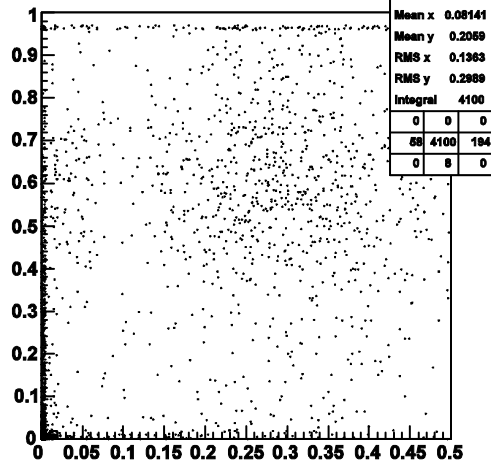
The FADC exits have an extra factor 2 w.r.t. the MON exits, used for the SUM



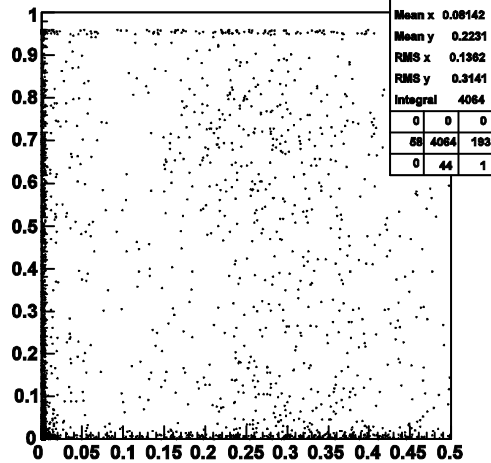
Run 228

Clean up the trigger!

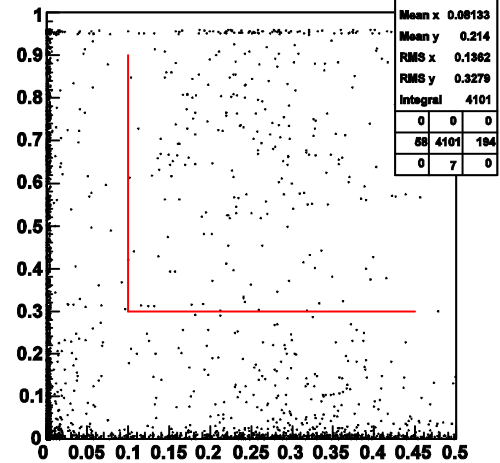
correlation ch.5 vs. ch. 4



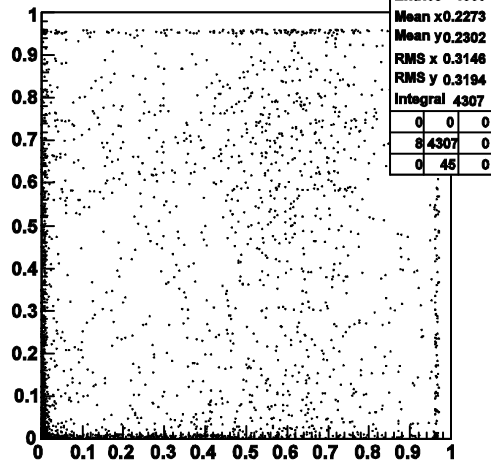
correlation ch.6 vs. ch. 4



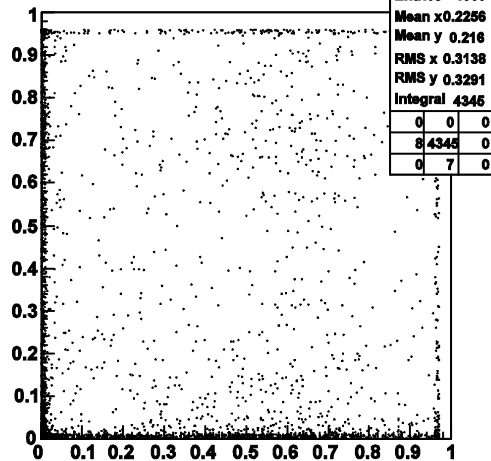
correlation ch.7 vs. ch. 4



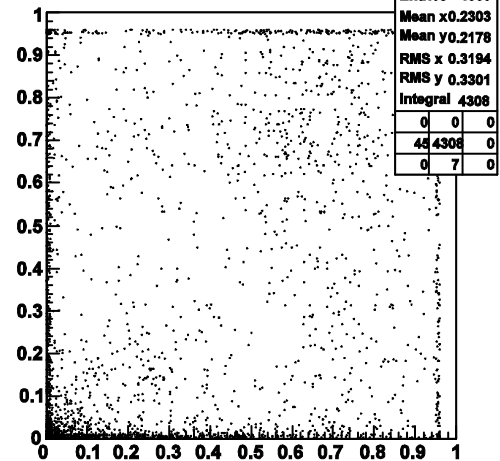
correlation ch.6 vs. ch. 5



correlation ch.7 vs. ch. 5

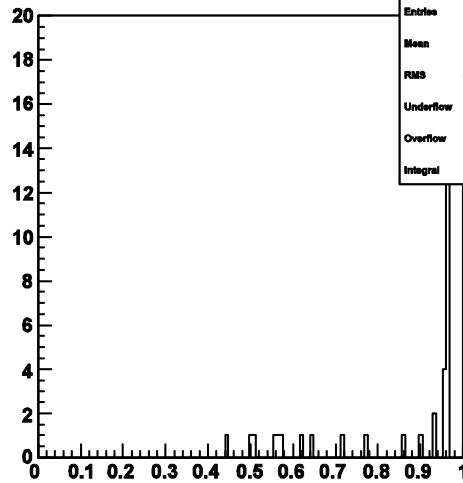


correlation ch.7 vs. ch. 6

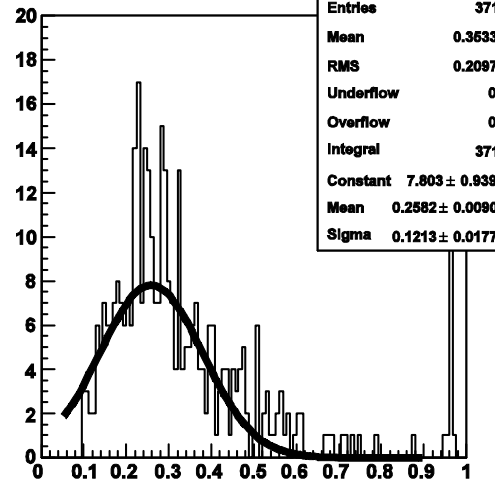


Run 219, FADC, trigger cleanup

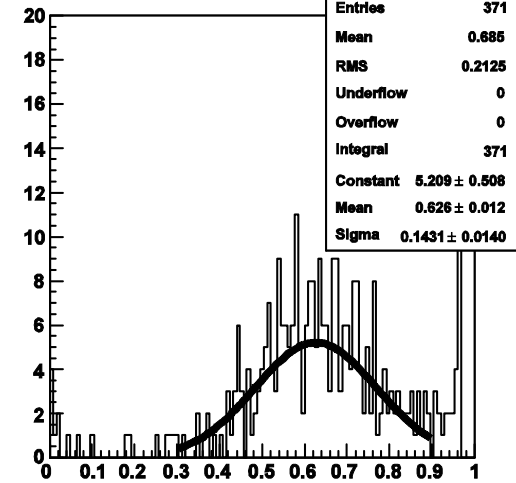
peak ch.03 (V)



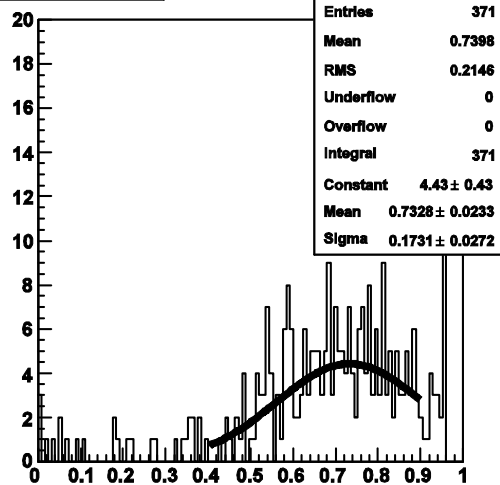
peak ch.04 (V)



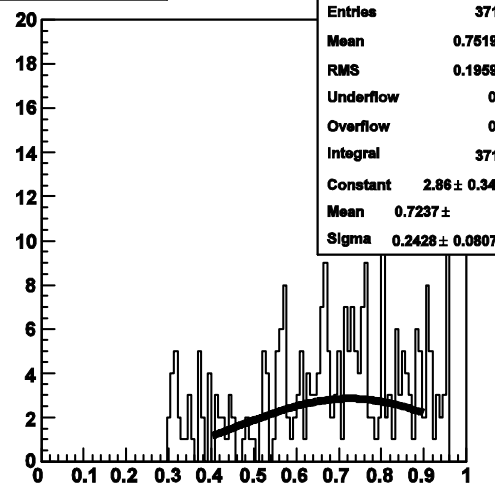
peak ch.05 (V)



peak ch.06 (V)



peak ch.07 (V)



Peak in channels 5,6,7 is a factor 2 higher than in channel 4, just as expected. This is a good thing!

Summary of facts

- Ch. 3 is the SUM out of “far” NIM modules
- Ch. 4 is, by construction, identical to ch. 0 and, by trigger configuration, should see exactly the same charge as ch. 0 (in QDC **and** FADC)
- Fitting the FADC ch. 4 peak we see an average of 0.26 V with a sigma of 0.12 V (pedestal subtracted)
- Conversion factor is $(260/24 \approx 11)$ mV/pC

Is this OK?

- In cosmics, we see 16 MeV, divided 2.29:4.57:4.57:4.57 in the 4 channels 0(4),1(5),2(6),3(7)
- FADC ch. 4 (4 mV/count, 256 counts) sees 300 mV/2.29 MeV, that is 33 cts/MeV: ch.4 will saturate at 7 MeV of deposited energy. Even before, considering peak widths.
-it's really not OK! The gain is way too high

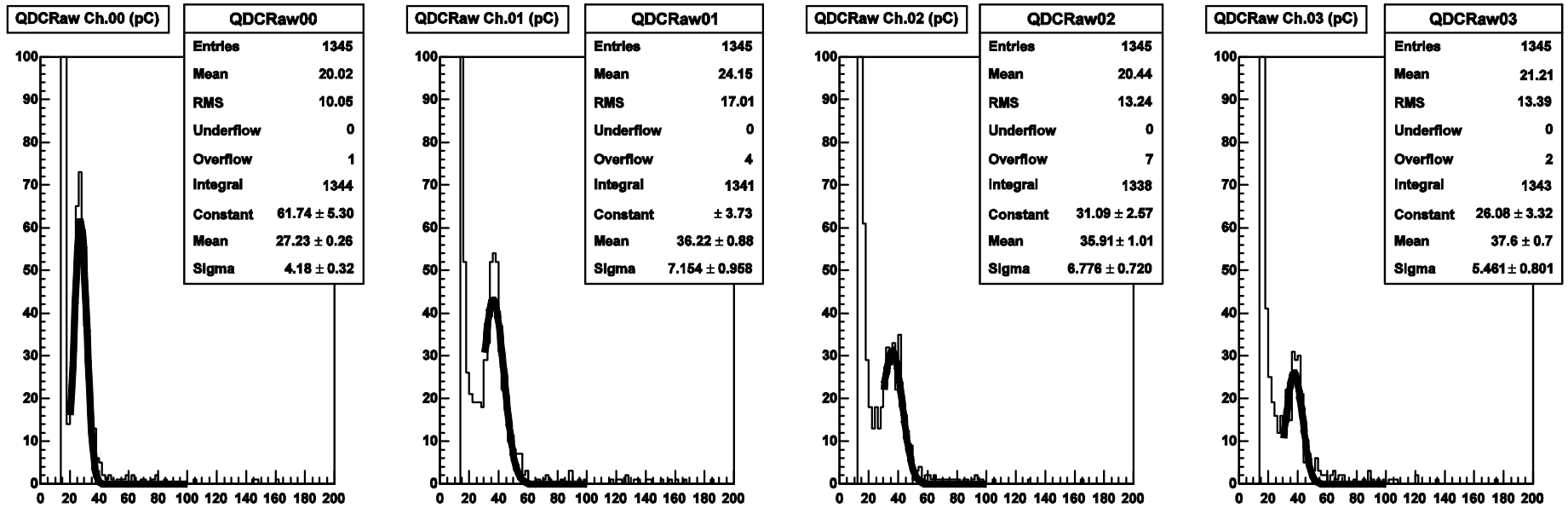
What about 450 MeV electrons?

- We see in the scintillating fibers 12% of the electron energy, that is 50 MeV
- Shower profile ratios are, from BTF data, 0.1:0.5:0.3:0.1: **5, 25, 15, 5 MeV in chs. 4 to 7**
- All channels would saturate, ch. 5 first
- This is more than an order of magnitude too much
- We must reduce gain by at least one order of magnitude, reducing HV and using the “MON” exit of the yellow NIM modules (factor 2 less than “FADC” exits).

Run 228, cosmics at LNF

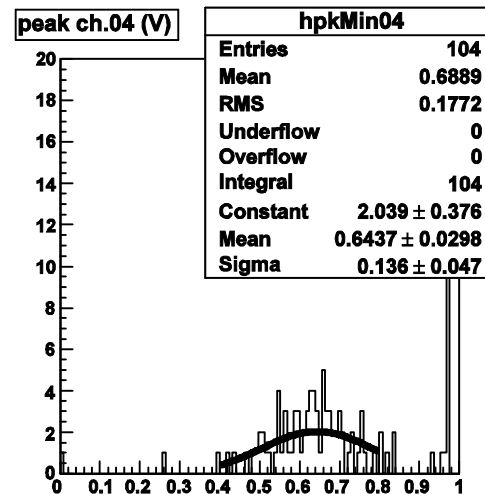
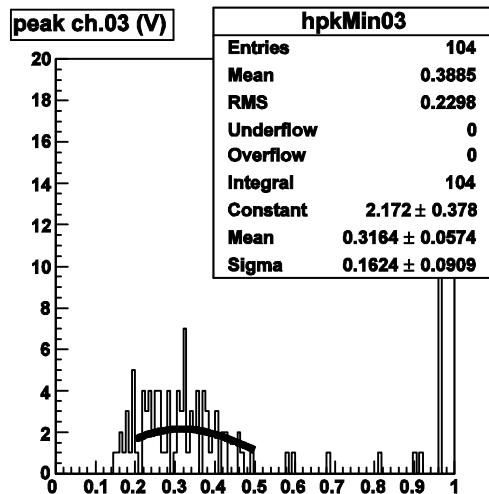
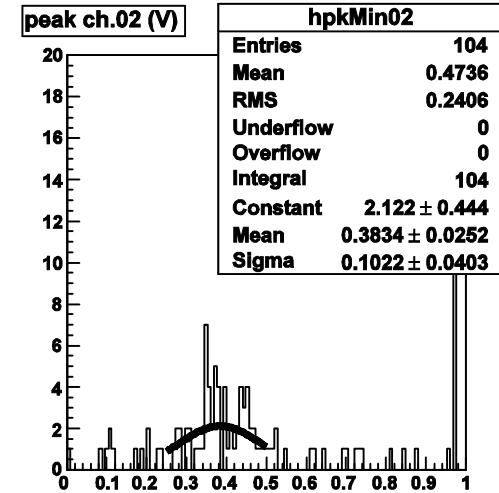
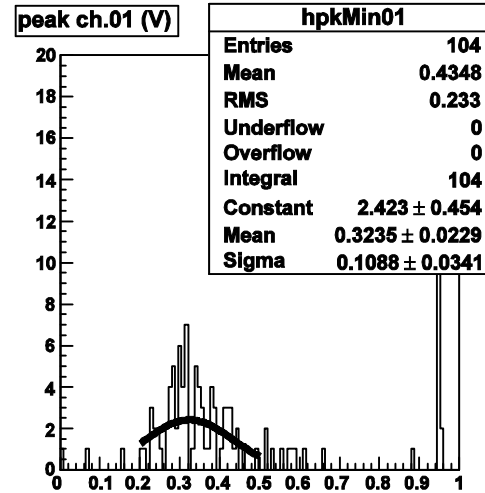
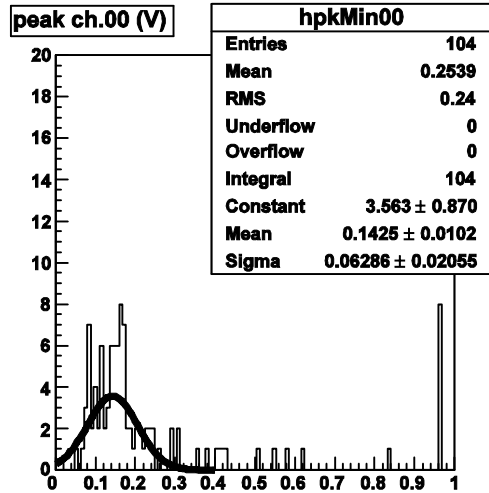
- “up” minicalorimeter
- HV: “corrected” 1.4 kV points, gain $\approx 1.2 \cdot 10^6$, Happy Box not present
- Ch. 0,1,2,3 sent to QDC (gate 200 ns)
- Ch. 4,5,6,7 sent to FADC chs. 0,1,2,3, analogic sum to ch. 4 of FADC

Run 228, cosmics, QDC data



Ch	Ped (pC)	Peak (pC)	Gain (pC)	σ (pC)	$\sigma / E(\%)$
0	16.1	(27.2 ± 0.3)	11.1	(4.2 ± 0.3)	38%
1	15.7	(36.2 ± 0.9)	20.5	(7.2 ± 1.0)	35%
2	14.1	(35.9 ± 1.0)	21.9	(6.8 ± 0.7)	31%
3	15.6	(37.6 ± 0.7)	22.0	(5.5 ± 0.8)	25%

Run 228, FADC, trigger cleanup



Peak in channels 1,2,3 is a factor 2 higher than in channel 0, just as expected. This is a good thing!

Run 228, FADC, trigger cleanup

Ch	Peak (mV)	σ (mV)	σ/E (%)
0	(142±10)	(63±20)	44
1	(323±23)	(109±34)	38
2	(383±25)	(102±40)	27
3	(316±57)	(162±91)	51
SUM	(644±30)	(136±47)	21

- Unfortunately, a small sample (1 day only)
- σ/E seems **bigger** in the FADC chain than in the QDC one, but need more stat
- Channel values now in range (cfr. slide 7) at least for cosmics

Summary

- The maximum gain for cosmics running is about $6 \cdot 10^5$
- This can be achieved running without Happy Box, and/or using the “MON” exit of the yellow SELF modules
- Maximum gain for BESIII running hard to predict, probably $\approx 10^5$ or less
- This is required also because of high rates