

Report on Calibration of the XGT DAQ after Modification on April 25

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May 8, 2001 (Addition of 2 figures and a paragraph at the end)

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We tested DAQ board for XGT. The purpose of the test is to re-calibration the gain and offset after the last modification on April 25. On April 25, Gary had added a 100ohm resistor at signal input of DAQ as shown in Fig.1, to prevent PMT charge-up. (The anode of the 4 XGT PMTs have open-ended output.)

Summary of the test results

<Test Setup>

We used BNC pulser Model DB-2 to inject a step function pulse with the shortest possible rise time (100ns) and a long fall time (1ms) through a capacitor of 20pF as shown in Fig.2. The waveform of injected charge measure at the output of Fig.2 is given in Fig.3. Here we shorted the output by a 50ohm resistor to represent the effective impedance of the DAQ. We injected pulses of 1.6V to the capacitor of 20pF, so that the charge Q in Figs.1 and 2 is $Q = C \cdot V = 20\text{pF} \cdot 1.6\text{V} = 32\text{pC}$.

This value is in agreement with the charge seen in the waveform in Fig.3:

$$0.5 \cdot 220\text{ns} \cdot (15\text{mV}/50\text{ohm}) = 0.5 \cdot 220\text{ns} \cdot 0.3\text{mA} = 33\text{pC}.$$

<Result of the gain/offset measurements>

We measured relation between "Charge input" and "ADC peak channel". The results are summarized in Fig.4-7. In the figure, we superimposed the results obtained before and after the modification.

We understand most of the results, but two issues remain unexplained.

- A) Saturation of the overall DAQ occurs at ~1.5 times higher input charge. This can be explained by the current drained out by the added 100ohm.
- B) Offsets have not changed significantly. This is in agreement with our expectation.
- C) The ADC channel now saturate at 60% of the old value. This is not understood.
- D) Gain of each channel is about 40% lower now. This is understood as a consequence of A) and C).

E) Ch0 and Ch3 show reasonable linearity except for small charge input. But Ch1 and Ch2 show sizable non-linearity for ADC channels below 200.

<Cosmic-ray spectrum>

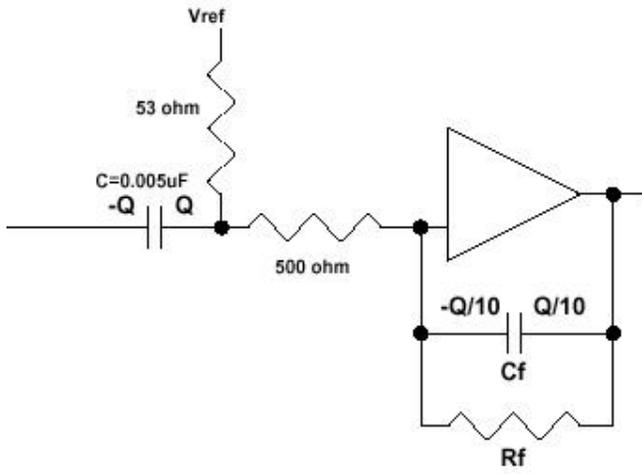
We also took cosmic-ray data for about 1 hour. Trigger condition was the nominal 3-in-a row in Tracker. The obtained spectra of energy deposition in all 4 XGTs are given in Fig.8-11. All four channel showed a clear MIP peak, but the shape of the peak is asymmetric in Ch1 (see Fig.9). This is probably related to the non-linearity seen in Ch.1 in Fig.5.

<Further study of the non-linearity in Ch.1 and Ch.2>

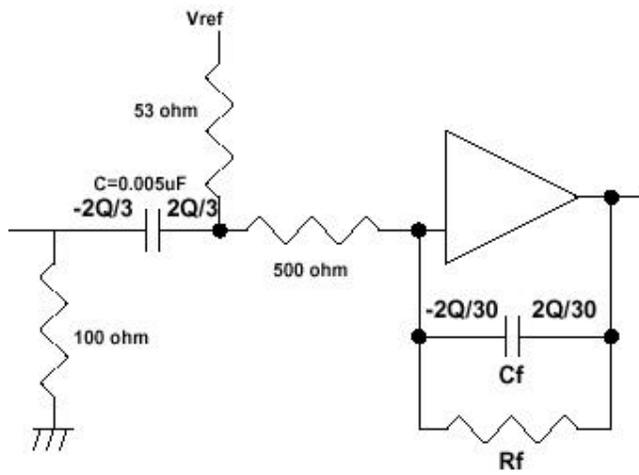
We calibrated response of all XGT DAQ channels with pulsars. Figs.12 and 13 shows the results. We find wiggles for lower input charge values. This may well be symptomatic of cross-talk or alike in the preamplifier, peak-holding circuit, and/or the ADC.

Issues to be resolved

- 1. Why saturation occurs much earlier in the ADC channel.**
- 2. What is causing a large non-linearity for lower input charges._**



a) Before the modification



b) After the modification

Fig.1

The front end of the ACD DAQ before and after the modification on April 25

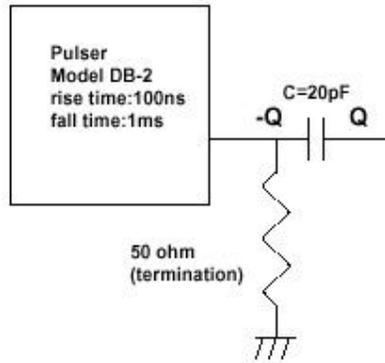


Fig.2 The charge injection scheme used

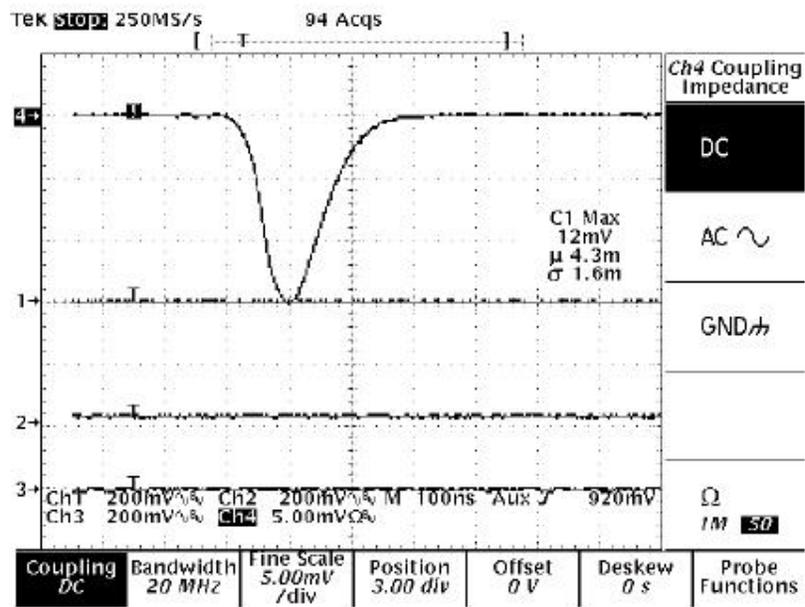


Fig.3 Waveform of the injected charge

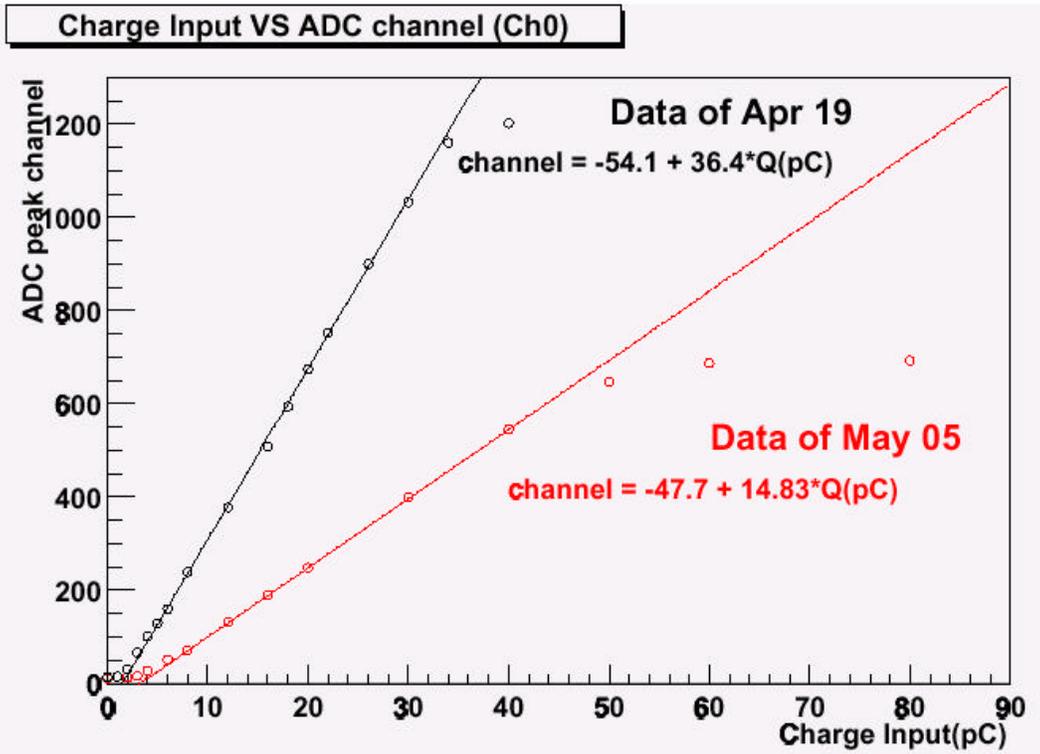


Fig.4 XGT Ch.0: Charge Input VS. ADC Peak Channel

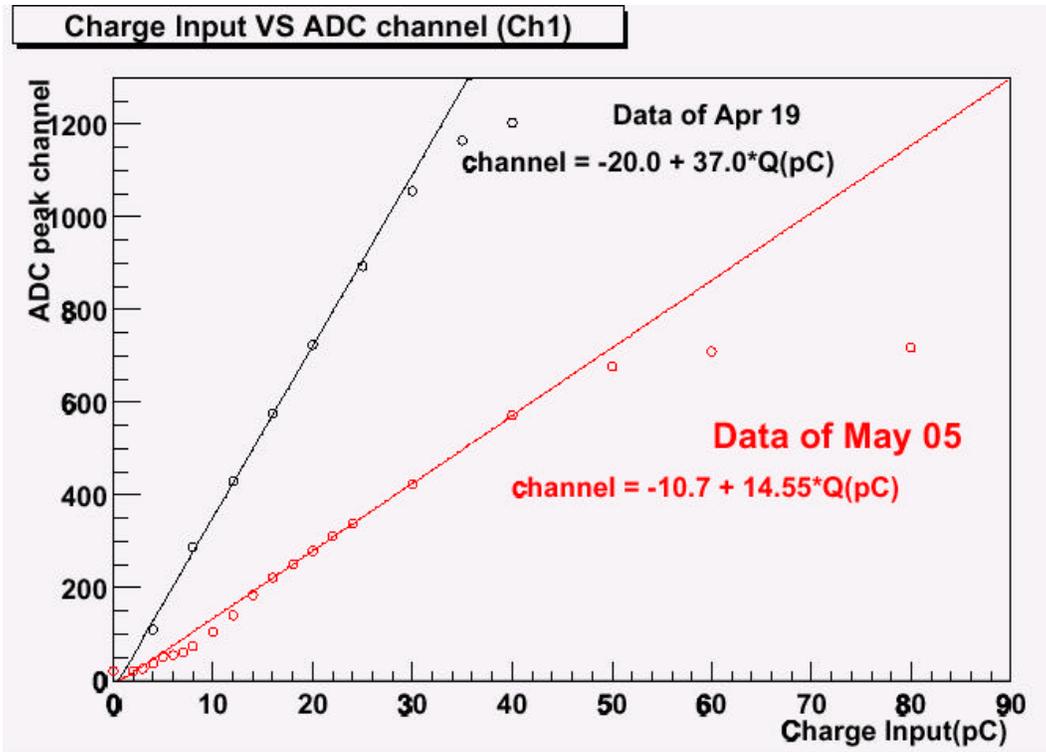


Fig.5 XGT Ch.1: Charge Input VS. ADC Peak Channel

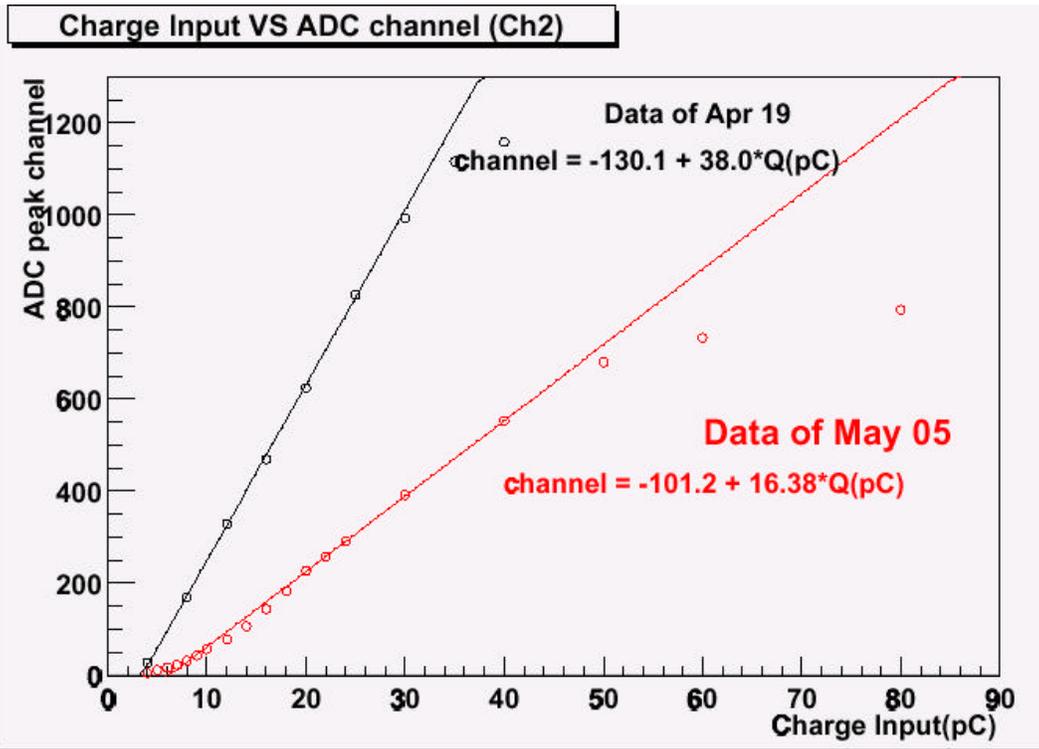


Fig.6 XGT Ch.2: Charge Input VS. ADC Peak Channel

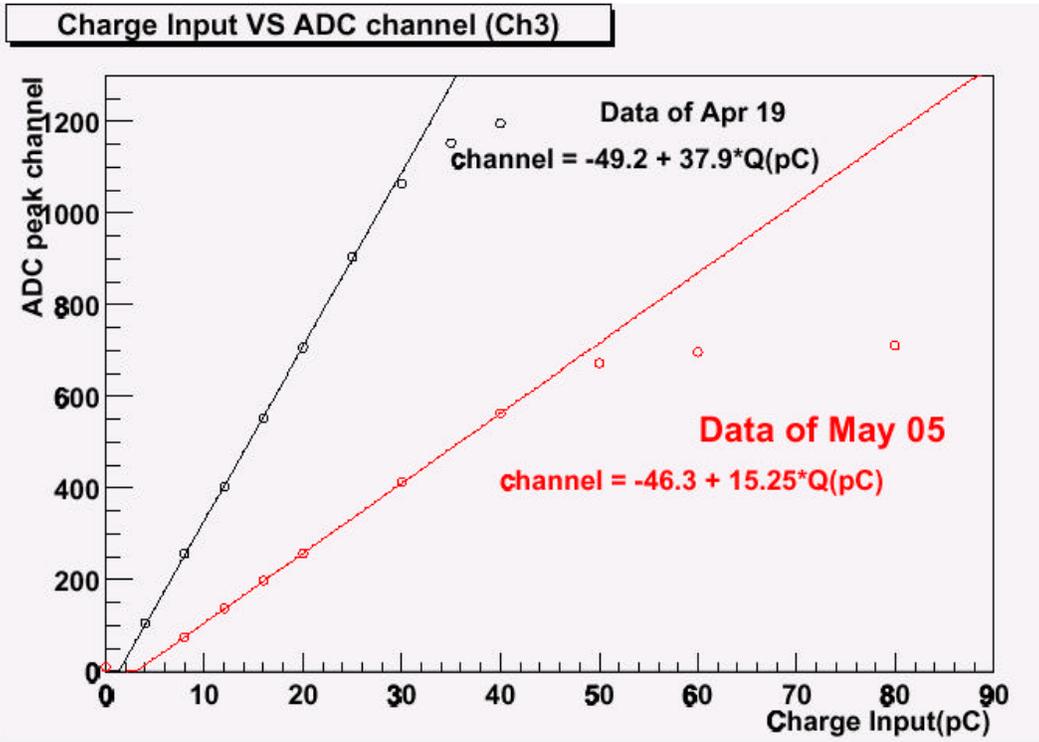


Fig.7 XGT Ch.3: Charge Input VS. ADC Peak Channel

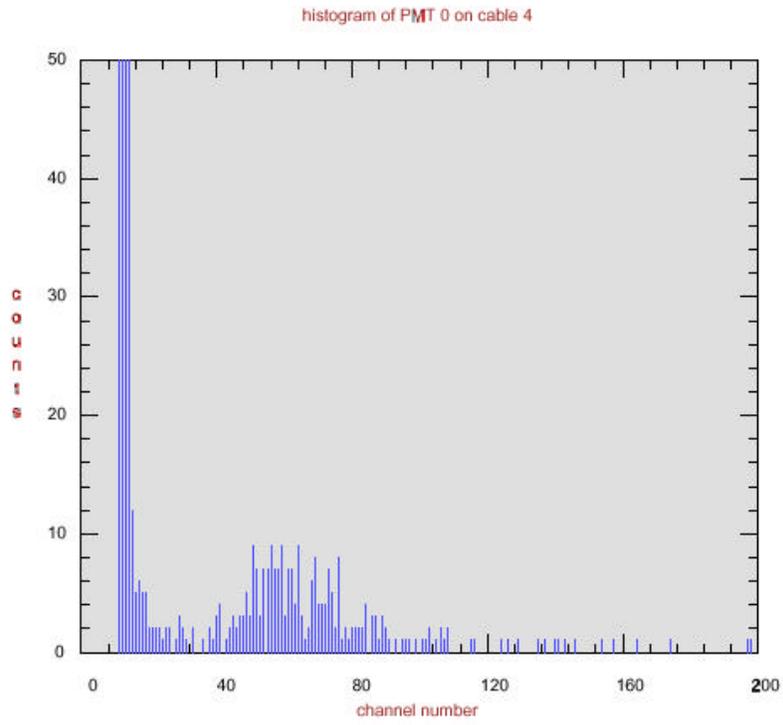


Fig. 8 CR Spectrum for XGT Ch.0

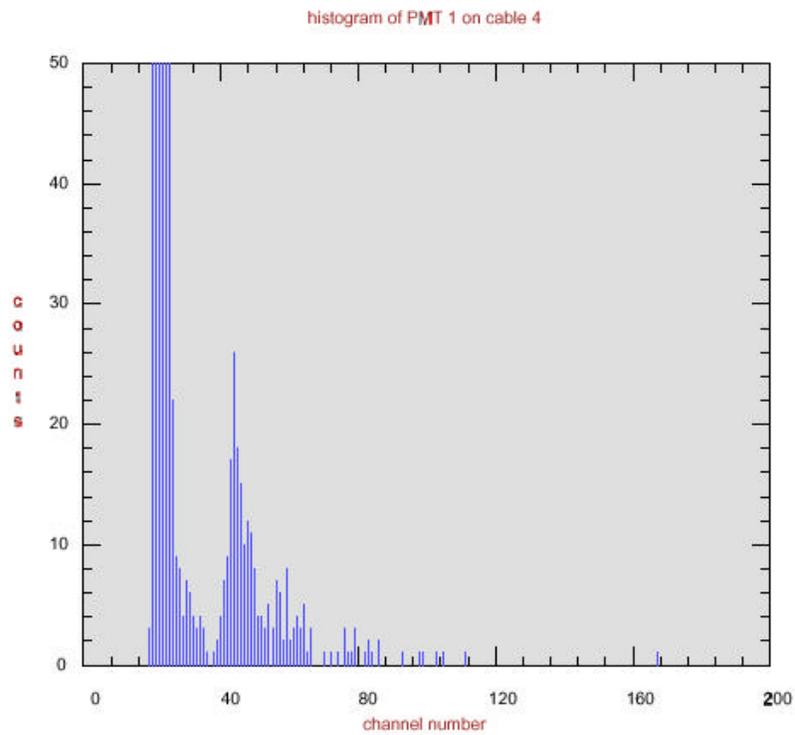


Fig. 9 CR Spectrum for XGT Ch.1

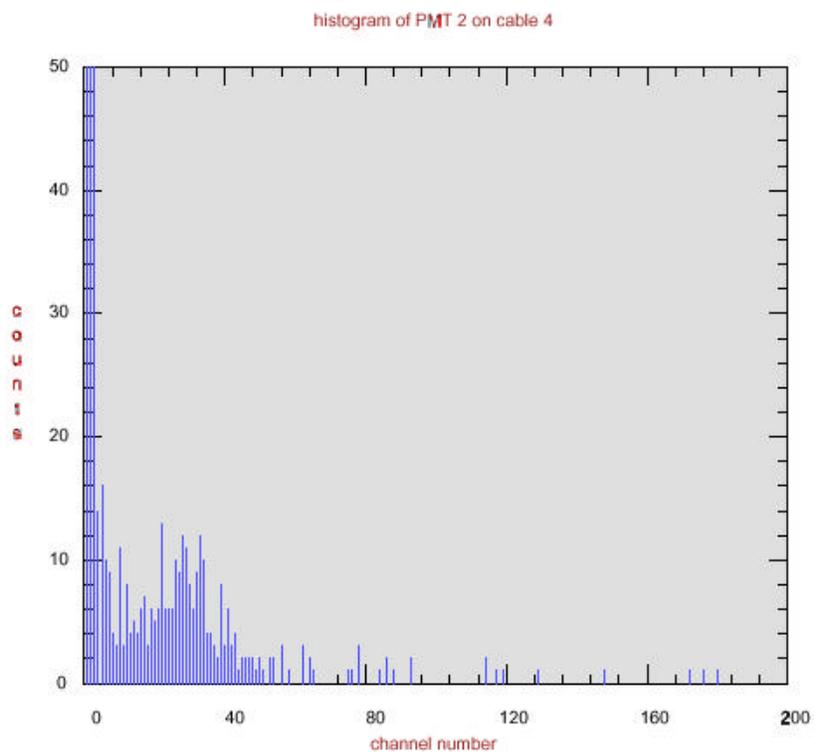


Fig. 10 CR Spectrum for XGT Ch.2

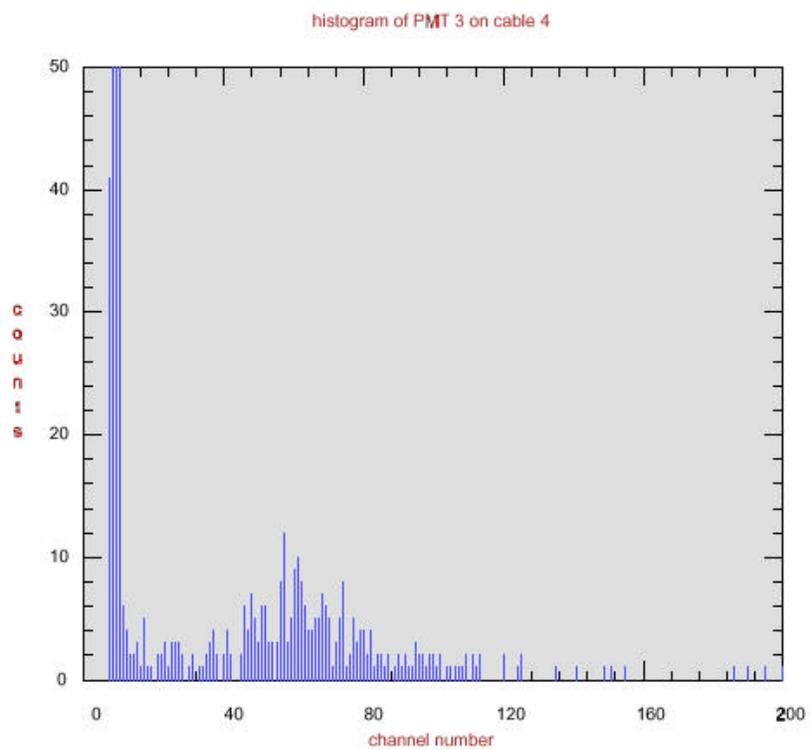


Fig. 11 CR Spectrum for XGT Ch.3

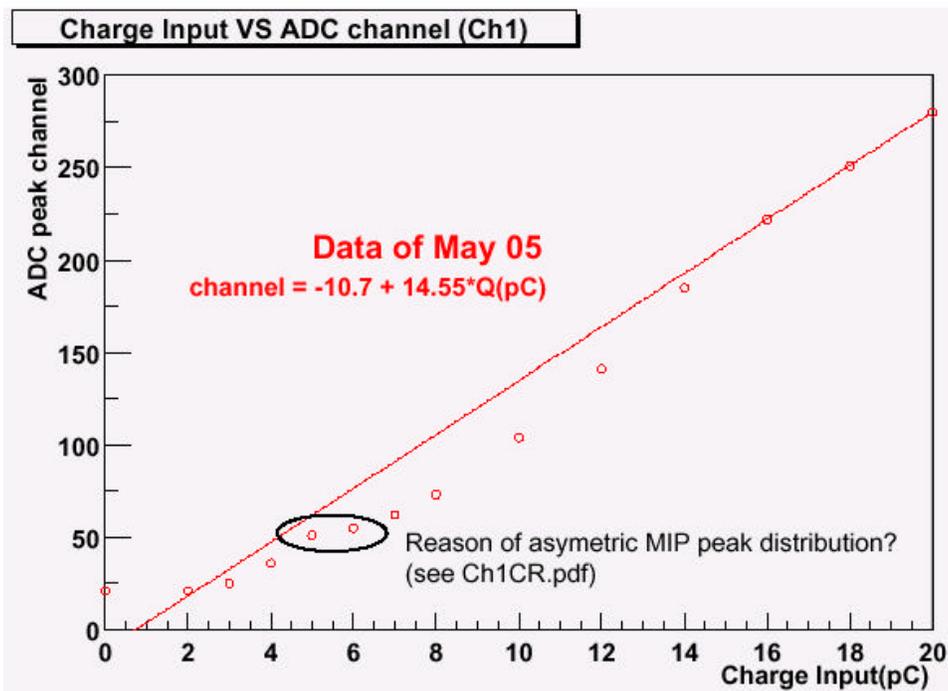


Fig. 12: Blowup of Fig.5, XGT Ch.1: Charge Input VS. ADC Peak Channel

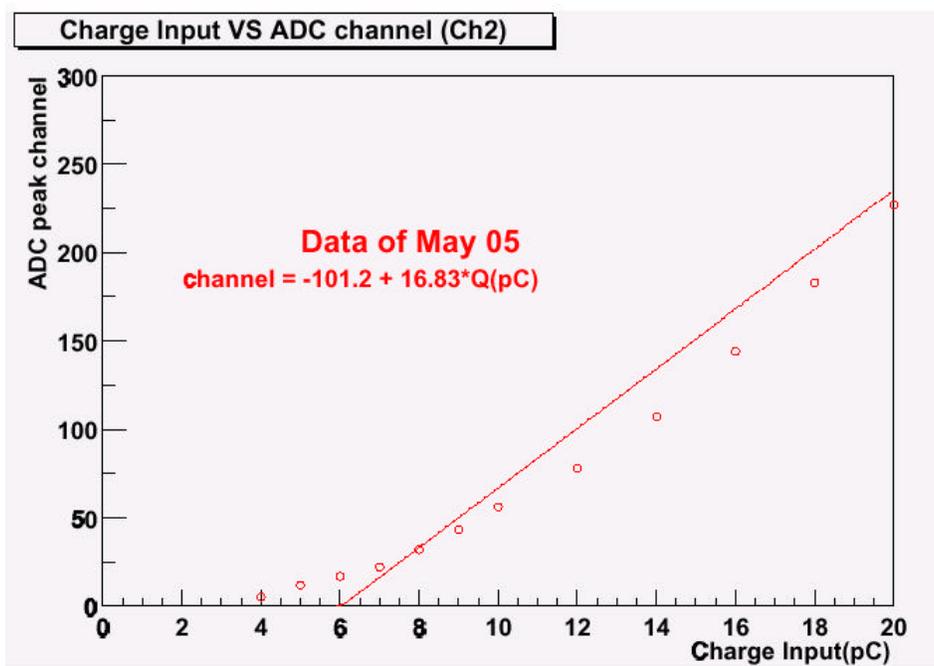


Fig. 13: Blowup of Fig.6, XGT Ch.2: Charge Input VS. ADC Peak Channel