Gain and offset measurement of ACD Electronics Board for External Gamma Target, performed on April 19–20, 2001.

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Following previous examination (XGT_11Apr2001.pdf; "Function Test of ACD Electronics Board for External Gamma Target performed on April 11, 2001."), we conducted detailed measurements of gain and offset of ACD electronics board for External Gamma Target (XGT) at building 33 on April 19 and 20. The test was done by Tsunefumi Mizuno, Sei Ogata and Hirofumi Mizushima, with great help of Dave Lauben.

1 Gain and offset measurement of all four Channel

To check out if all four Channels can collect data simultaneously or not, we first inputted four XGT sensor signals in each Channel simultaneously. However, we failed to collect histogram except for Channel 3; Channel 0–2 showed only pedestals (ADC peak channels of pedestal were ~ 14, ~ 22, and ~ 2 for Channel 0, 1, and 2, respectively). Therefore we decided to use only one channel at one time and measure gain and offset. We utilized "Charge-input method" described in the previous report (XGT_11Apr2001.pdf), and obtained results shown in Figure 1. As already inferred from the previous investigation (see XGT_05Apr2001.pdf and XGT_11Apr2001.pdf), ADC peak channel saturate when the amount of charge inputted exceeds ~ 30 pC. Obtained data (below 30 pC) can be well fitted with a linear function as given below.

- Channel 0: channel $= -54.1 + 36.4 \times$ charge (pC)
- Channel 1: channel $= -20.0 + 37.0 \times$ charge (pC)
- Channel 2: channel $= -130.1 + 38.0 \times$ charge (pC)
- Channel 3: channel $= -49.2 + 37.9 \times$ charge (pC)

Thus, all four Channel show similar gain (within $\sim$5%), whereas offset of Channel 2 is about 100 channel smaller than those of other three Channels. This fact naturally explain why Channel 2 showed ~ 100 smaller peak channel than other three did in the previous measurement (XGT_11Apr2001.pdf).

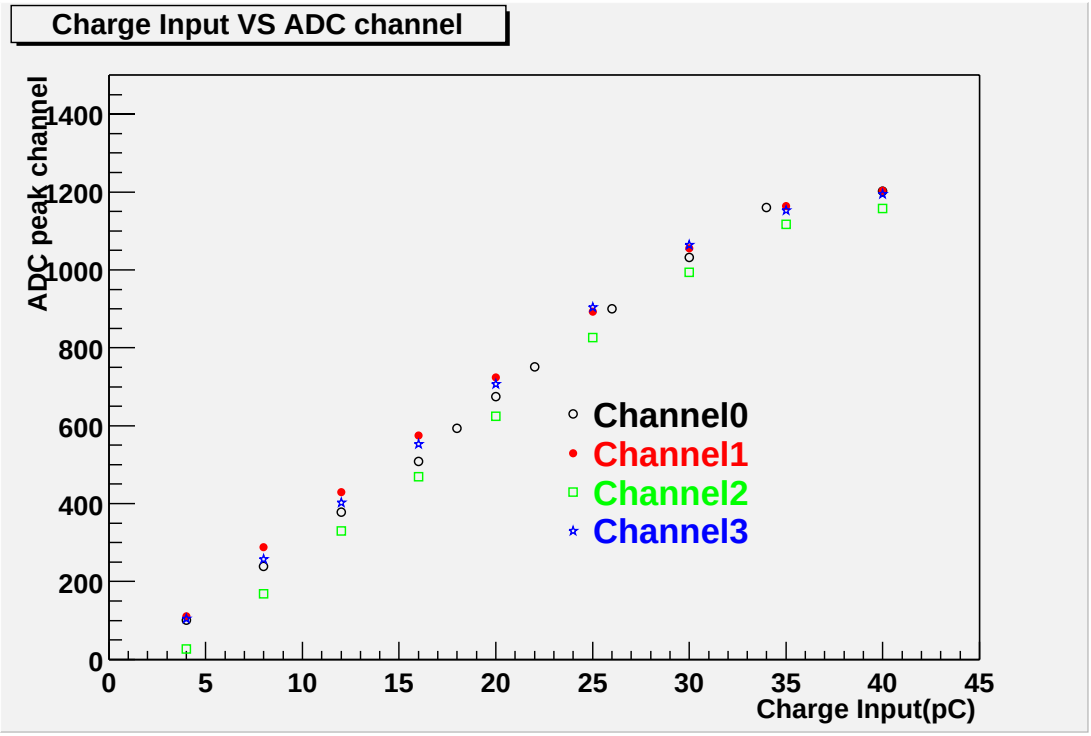

Figure 1: Measurement of gain and offset of XGT board. ADC peak channels are plotted as a function of the amount of injected charge.

2 Response on small charge injection of Channel 0

In the previous section, we found that values of offset of four Channels range from -20 to 130. These values apparently differ from those of pedestals (typically ~ 10). To examine this self-inconsistency, we picked up one Channel (Channel 0) and measured response on small charge injection.

When the amount of charge inputted is below 4 pC, we cannot collect histogram even if we set low-level threshold to the lowest value (type lothr_a(0)). This is probably because preamp output cannot reach to low-level threshold. To collect data for small charge input, we used two pulse generators simultaneously. The setup is shown in Figure 2 and Figure 3. As inferred from Figure 3, signal put into Channel 3 (voltage pulse) first hit the threshold, and DAQ acquires data of both Channel 3 and Channel 0 (charge pulse). In this way, we could collect data of Channel 0 even when input charge was quite low. The obtained results are summarized in Figure 4.

As seen from Figure 4, our DAQ board show non-linear response on change input when the amount of charge is below 2–3 pC; as we reduce the amount of charge, the decrease of peak channel is gradually suppressed and the peak channel reaches to pedestal (~ 14 for Channel 0, see § 1). We regard this is the reason why the values of offset calculated by fitting the data are lower than pedestals (§ 1).

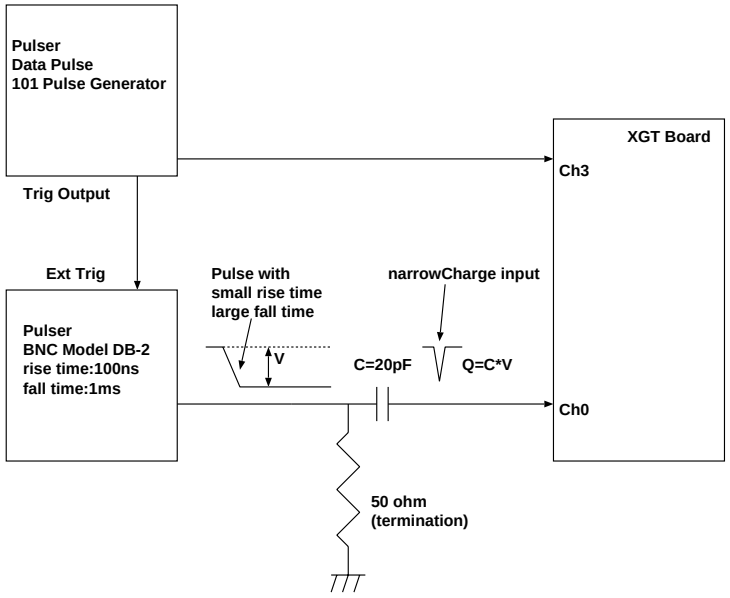

Figure 2: Setup to collect data for small charge input.

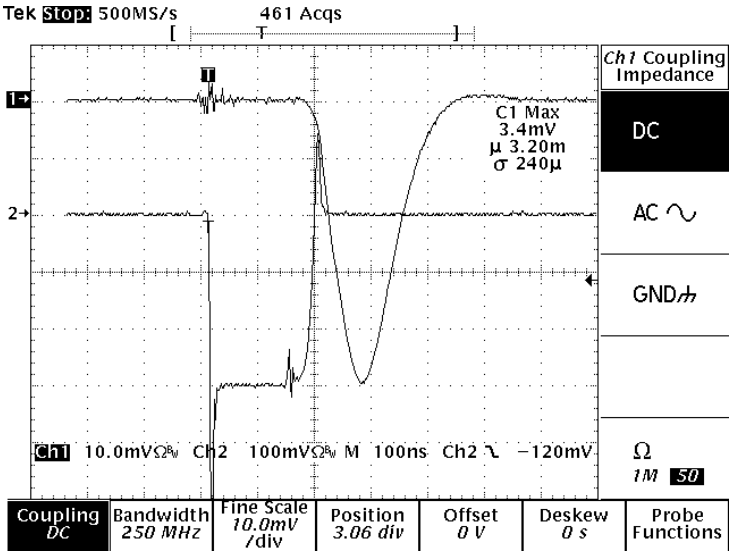

Figure 3: Voltage pulse put into Channel 3 (trace 2) and charge pulse put into Channel 0 (trace 1), both in 100 ns/div. The former hit the low-level discriminator, and starts DAQ system. Since the latter signal comes into XGT board almost at the same time, we can collect histogram of this signal simultaneously.

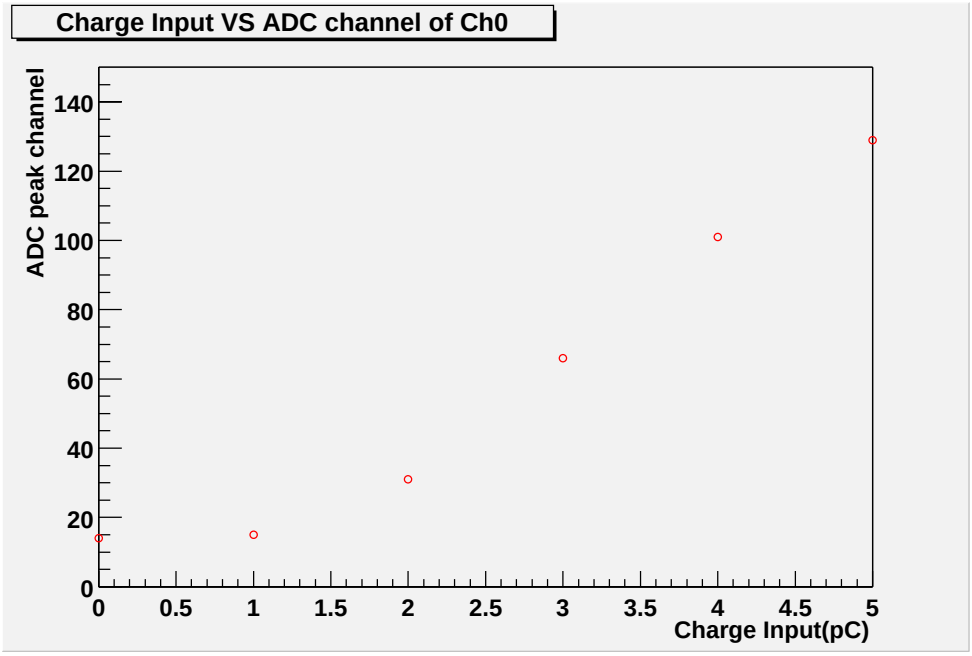

Figure 4: Relation between ADC peak channel and inputted charge of Channel 0, when the amount of charge is quite low.