Data acquisition test of External Target performed on April 05, 2001.

Tsunefumi Mizuno
Department of Physics, Hiroshima University
mizuno@hirax6.hepl.hiroshima-u.ac.jp

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This report describes data acquisition test of XGT performed on 05/Apr/2001 at building 33. The test was done by Tsunefumi Mizuno, Patric Valtersson, Dave Lauben, and Scott Williams.

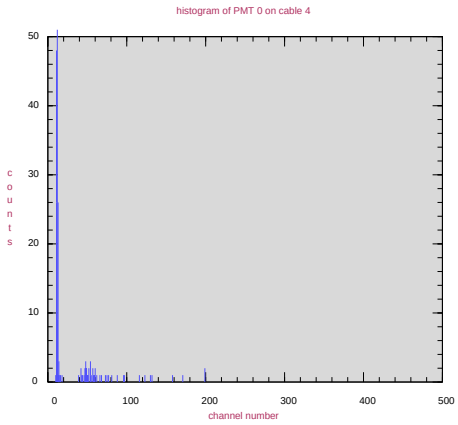
1 Taking PHA histogram with low High-Voltage

On balloon experiment for GLAST, XGTs should select events where π^0 is generated at Target. In such case, energy deposition on scintillator is much larger than ionization energy loss by MIP particle. Hence the applied values of High-Voltage are relatively low. We first started data acquisition with this "low-level voltage"; all four XGTs are set to about 420 V. Both PHA discriminator and Low-level discriminator are set to level 4 (about 4 mV) by typing phthr_a(4) and lothr_a(4), and are not changed during the experiment. Output signal of Target ID 0 is fed up by Channel 0 of XGT data acquisition board (board number 4), that of ID 1 is fed up by Channel 1, that of ID 2 by Channel 2 and ID 3 by Channel 3. We collected (cosmic-ray) events for about 20 minutes and saved obtained histogram for all four Channels in ASCII files [1] and ps files in /export/home/acd/xgt/run1. We showed obtained histograms in Figure 1. It looks like only Channel 0 is functional.

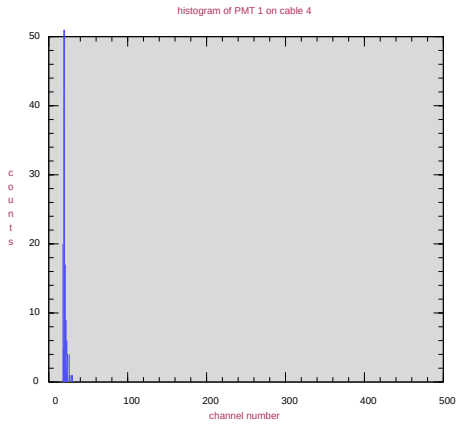
We then input signal from Target ID 0 into Channel 3 and input signal of ID 3 into Channel 0, and obtained the data. As shown in Figure 2, Channel 0 again works and Channel 3 does not. So it seems that not detector of ID 3 but data acquisition system of Channel 3 does not work. We also exchange input to Channel 0 and Channel 2, and Channel 0 and Channel 1 and acquired data. The results were the same; only when the signal is fed-up into Channel 0, we can obtain the PHA histogram.

[1] data of Channel 0 is stored as histogram0.txt, data of Channel 1 is stored as histogram1.txt, and so on. However, after we have finished experiment and started to write-up this report, it turned out that contents of ASCII files for Channel 1, 2, and 3 are the same as that of Channel 0.

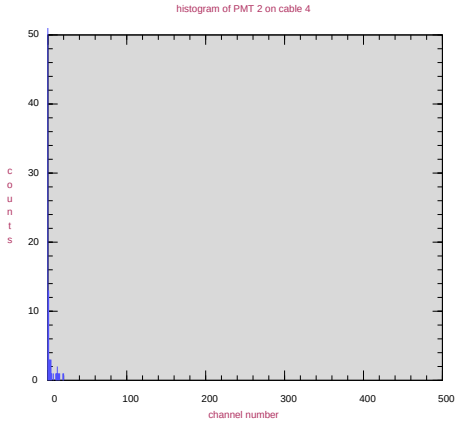
PMT ID 0, Channel 0



PMT ID 1, Channel 1



PMT ID 2, Channel 2



PMT ID 3, Channel 3

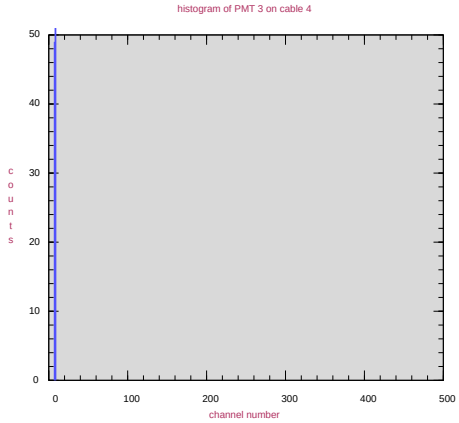
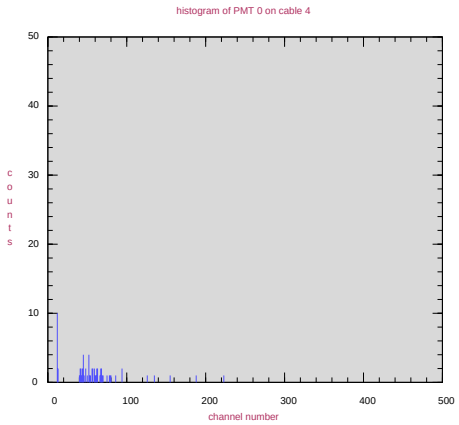


Figure 1: XGT PHA histograms obtained at HV=420 V (for all four PMTs).

PMT ID 3, Channel 0



PMT ID 0, Channel 3

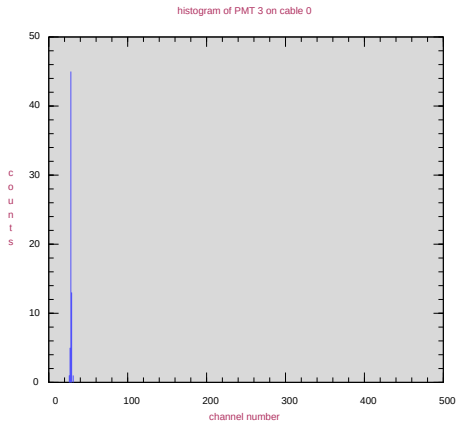


Figure 2: XGT PHA histograms obtained at HV=420 V, and inputs to Channel 0 and 3 are exchanged.

2 Observing PMT output by oscilloscope

In order to examine all four XGT sensors do work or not, we monitored output signals using oscilloscope. We set the value of High Voltage to about 750 V for each XGT and observed PMT output by oscilloscope using 50 Ω termination. Since we do not know how to save waveforms into a floppy disk, we took photographs by digital camera. All four XGTs seemed to work well, as shown in Figure 3.

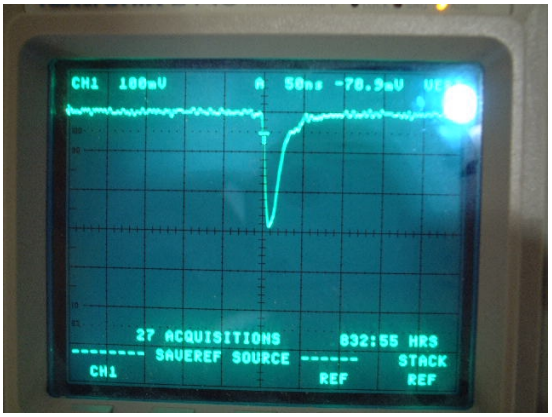
3 Acquiring histogram with higher gain of PMT

In order to calibrate XGT+DAQ at laboratory, we have to use cosmic-ray events. Most of them are MIP particles, and energy deposition is lower than that where π^0 is generated at Target. We plan to set energy threshold at 30–50 MeV, whereas energy deposit by MIP particle passing through scintillator vertically is about 10 MeV (5 cm $\times$ 2 MeV cm^{-1}). Therefore we have to raise the value of high-voltage, or raise the gain of PMT by a factor of ~ 5, to obtain appropriate pulse-height.

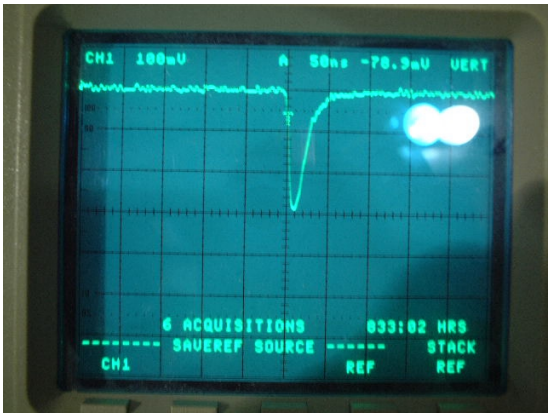
We thus examined XGT+DAQ response on applied high-voltage, by raising the value of voltage and obtaining PHA histogram. We first set high-voltage at about 520 V for all four PMTs, and acquired the data. The results are shown in Figure 4. Again, Channel 1 and 3 look not to work. Channel 2 exhibited events of high PHA values, but there is no clear peak corresponding to MIP event. Channel 0, on the contrary, looks to succeed to acquire MIP event passing through scintillator as a peak around channel 180.

Since only Channel 0 of XGT board (where signal from PMT ID 0 was inputted) did work, we increased the voltage of PMT ID 0 and got the histogram. We set the high voltage at 613 V, 728 V, 825 V, and acquired the data. The obtained histograms are summarized in Figure 5 with that acquired at HV = 520 V. By raising high voltage from 520 V to 613 V, the peak channel increases from $\sim$ 180 to 700, or by a factor of ~ 4

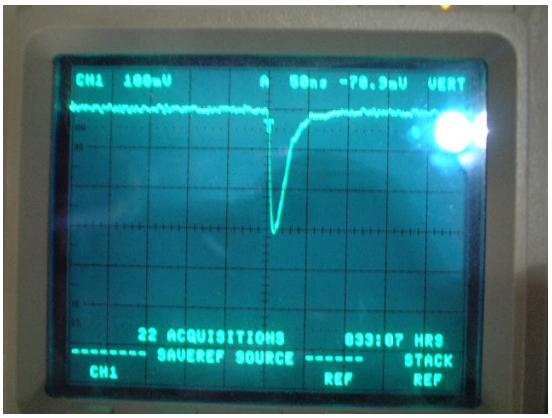
PMT ID 0



PMT ID 1



PMT ID 2



PMT ID 3

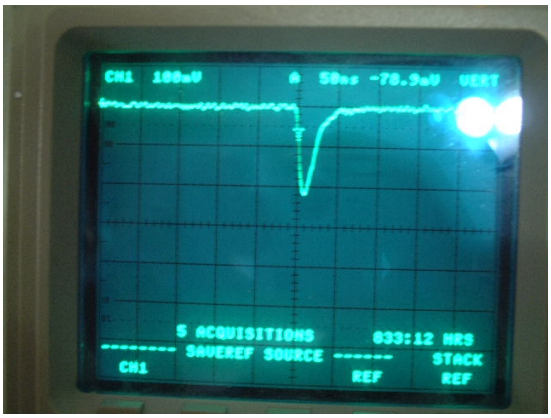
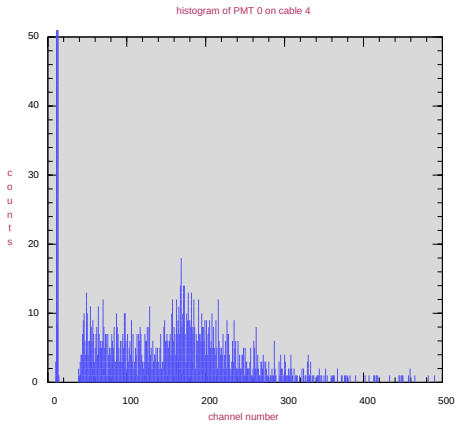
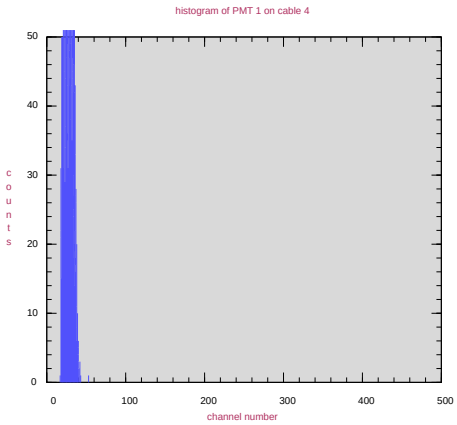


Figure 3: PMT output of four XGTs observed by oscilloscope (cosmic-ray event). The top left panel shows a signal of ID 0 (LA7523), the top right is a signal of ID 1 (LA9725), the bottom left is ID 2 (LA9779), and the bottom right is ID 3 (LA9807), all terminated by 50 Ω and supplied high-voltage of 750 V. The scales are 100 mV/div and 50 ns/div.

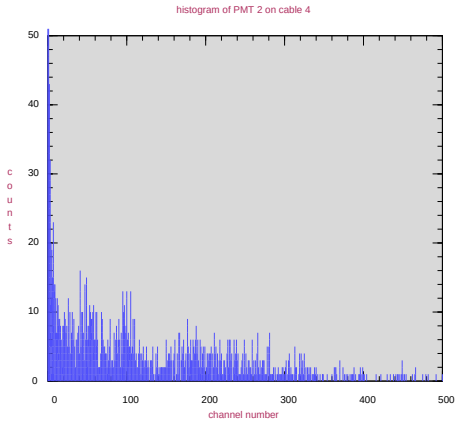
PMT ID 0, Channel 0



PMT ID 1, Channel 1



PMT ID 2, Channel 2



PMT ID 3, Channel 3

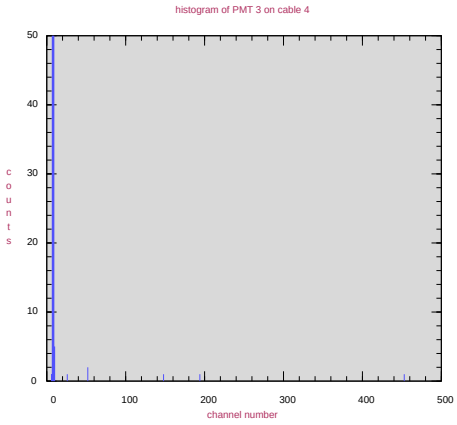
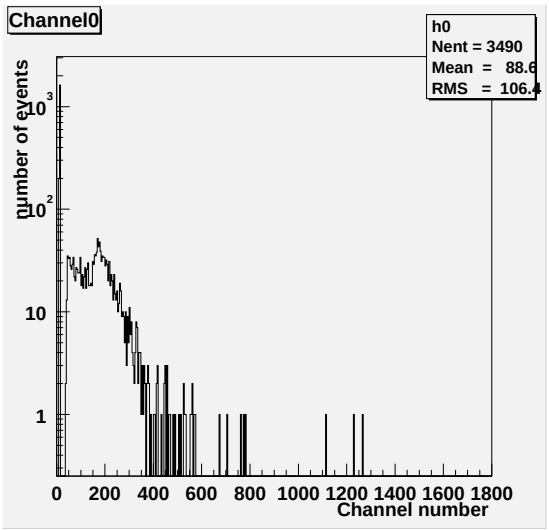


Figure 4: XGT PHA Histograms obtained at HV=520 V (for all four PMTs).

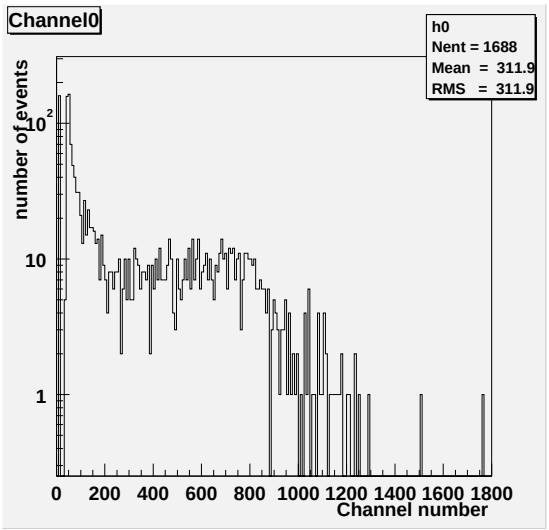
(see top two panels in Figure 5). This can be explained by the fact that HV index of XGT PMT is typically 7.9; $\left(\frac{620\ \mathrm{V}}{520\ \mathrm{V}}\right)^{7.9} \sim 4$. As we further raise the HV value, events of higher channels (1400–1500) seem to be cut-off, as can be seen in Figure 5. We have to understand this phenomena (cut-off at ~ 1400 channel), and then determined the applied high-voltage.

Finally, we tried to take histogram with another HV setting. We set the value of high-voltage at 663 V, and started data acquisition program. This time, however, Channel 0 was also out of function. This problem should be fixed.

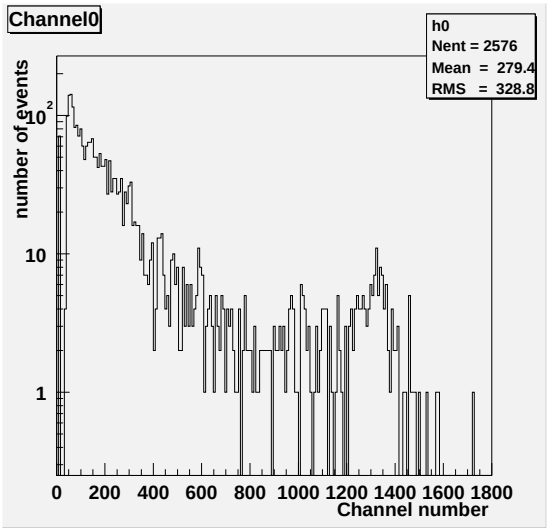
PMT ID 0, Channel 0, HV=520 V



PMT ID 0, Channel 0, HV=613 V



PMT ID 0, Channel 0, HV=728 V



PMT ID 2, Channel 2, HV=835 V

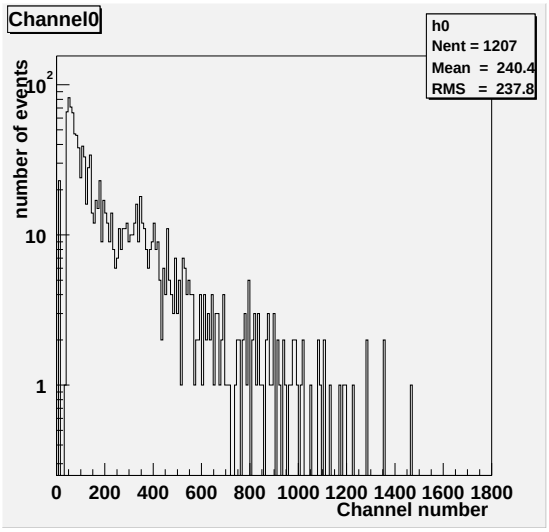


Figure 5: XGT PHA Histograms of Channel 0 obtained at HV=520 V (top left), 613 V (top right), 728 V (bottom left), and 835 V (bottom right).