

Pre-ship (to Palestine) XGT Electronics Modification/Calibration and Cosmic-run at GSFC.

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– update log of this document –

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July 09, 2001 add rate counter plot taken on July 3rd.

From June 26th to 30th, we modified XGT electronics configuration to improve the performance, performed electronics re-calibration, and took cosmic-ray data at Goddard Space Flight Center. Here we describe the modification and test results. In this report, “Channel” means electronics board Channel, where Ch 0 handles the XGT 0’s signal, Ch 1 the XGT 1’s signal, and so on. On the contrary, “channel” means ADC channel (PHA value).

1 Modification on Electronics and Re-calibration

While BFEM (Balloon Flight Engineering Model) was in SLAC, we used preamplifier mounted inside the electronics board, and 100 Ω resistor is put at signal input to prevent charge-up and to reduce the readout noise. The XGT+Electronics system did work in this configuration, but there remained several problems.

- One of four Channels (Ch 0, that handles the XGT 0’s signal) still seemed to be affected by read-out noise. This Channel showed larger discriminator-hit rate than the other three, as shown in Figure 1.
- Two of four Channels (Ch 1 and Ch 2) showed somewhat large non-linearity for small charge input, as described in the previous report [1][2]. We showed charge-input vs. ADC channel relation in Figure 2 and 3.
- Dynamic range of electronics is somewhat small; each Channel saturates around 900 ADC channel (Figure 2 and 3).

To deal with these issues, we mounted preamplifier near XGT PMTs. In this (new) configuration, preamplifiers are separated from VME Crate, and the length of cable between

PMT and the preamplifier becomes short. These facts are expected to reduce the read-out noise, and we used 10 k Ω resistor at the preamplifier input instead of 100 Ω .

We then re-calibrated gain and offset of XGT electronics in this new (and final, I hope) configuration. The test setup is the same with that described in the previous report [1]; we injected charge pulse using pulse generator and capacitor, and measured the corresponding ADC peak channel. The obtained relation between the “input charge” and the “ADC peak channel” are given in Figure 4–7, with a linear function. The main results are as follows;

- Gain increases by a factor of 2, mainly because of the removal of 100 Ω resistor.
- Ch 1 and 2 still exhibit non-linear relation for ≤ 10 pC input, but the deviation from the linear function seems to be smaller than that of previous configuration (compare Figure 2 and Figure 5, and Figure 3 and Figure 6).
- Saturation level in ADC channel increases from ~ 900 to ~ 1400 .

Thus, the linearity and dynamic range are improved in this new configuration.

2 Cosmic-ray Run

By using external preamplifier (and put 10 k Ω resistor instead of 100 Ω at preamp input), the gain of electronics board increases by a factor of ≥ 2 . We hence adjusted the value of high-voltage in order to reduce the PMT gain. The value of HV is 498.5 V, 469 V, 486 V, and 496 V for XGT 0, 1, 2, and 3, respectively. To checkout the PMT+Electronics gain, we took BFEM cosmic-ray data on June 30th. The obtained data are stored as three ivte format files; gsfc_r000042_20010630_091037_ivte.dat, gsfc_r000043_20010630_101126_ivte.dat, and gsfc_r000044_20010630_171620_ivte.dat in /nfs/farm/g/glast/u02/bfem/data/. From these three files, we extracted XGT histograms. The derived histograms are given in Figure 8–11.

XGT 0, 1, and 3 show clear MIP peak. The PHA distribution of MIP events of XGT 2 seems to be somewhat skew, but the statistics are relatively low. Even for this Channel, the MIP peak position can be well determined within ± 30 channel, i.e., ± 10 % of the peak channel.

The peak channel and corresponding amount of input charge are as follows;

- XGT0: peak is ~ 350 channel, and the input charge is calculated as ~ 6.5 pC
- XGT1: peak is ~ 360 channel, and the input charge is calculated as ~ 6 pC
- XGT2: peak is ~ 340 channel, and the input charge is calculated as ~ 8 pC
- XGT3: peak is ~ 360 channel, and the input charge is calculated as ~ 6.5 pC

All the four channels show linear response up to ~ 30 pC input, so we can securely discriminate events of 4–5 MIP event in flight. If we express the charge-channel relation with second (or higher) polynomial function, ADC channel up to ~ 1400 (this corresponds to ~ 50 pC input) can be utilized, and we can set the threshold level higher.

How the rate counter behave in this new configuration is also checked out by Dave Lauben, in the cosmic-ray data taken on July 3rd. As shown in Figure 12, discriminator-hit rate of Ch 0, originally seems to be affected by read-out noise, now becomes to be comparable to that of the other three. Thus, we regard that XGTs are less affected by read-out noise in the new configuration.

References

- [1] “Report on Calibration of the XGT DAQ after Modification on April 25”, can be downloaded as <http://www.slac.stanford.edu/~mizuno/GLAST/XGT/Report1.pdf>
- [2] “BFEM cosmic-run (May 25th) results for XGT and expected threshold level in flight”, can be downloaded as http://www.slac.stanford.edu/~mizuno/GLAST/XGT/XGT_04June2001.pdf

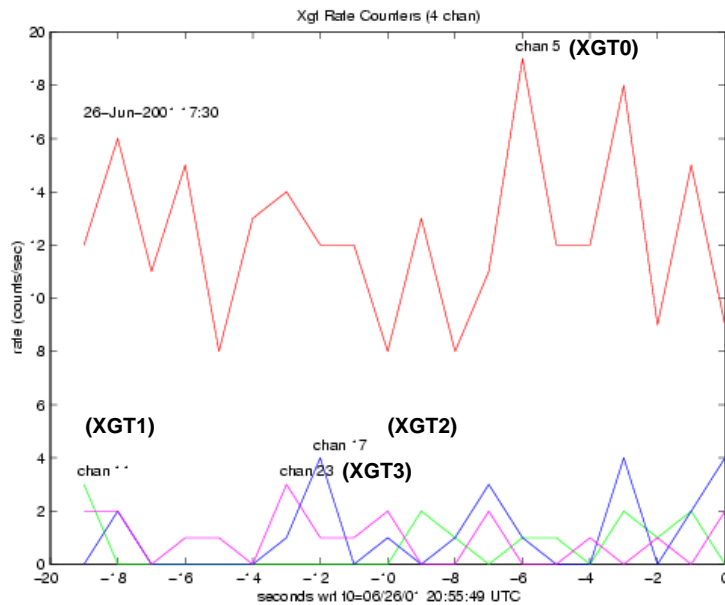


Figure 1: XGT Rate counter plot taken by Dave Lauben on June 26th at GSFC.

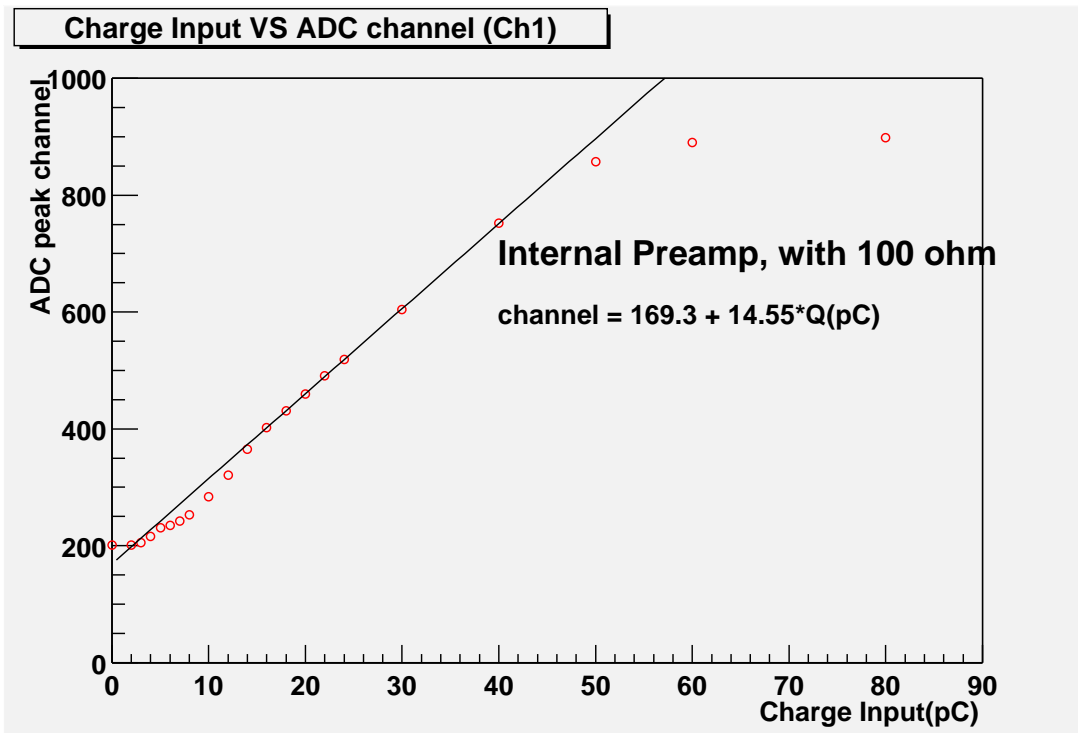


Figure 2: XGT Ch1 charge input and ADC peak channel relation in the previous configuration.

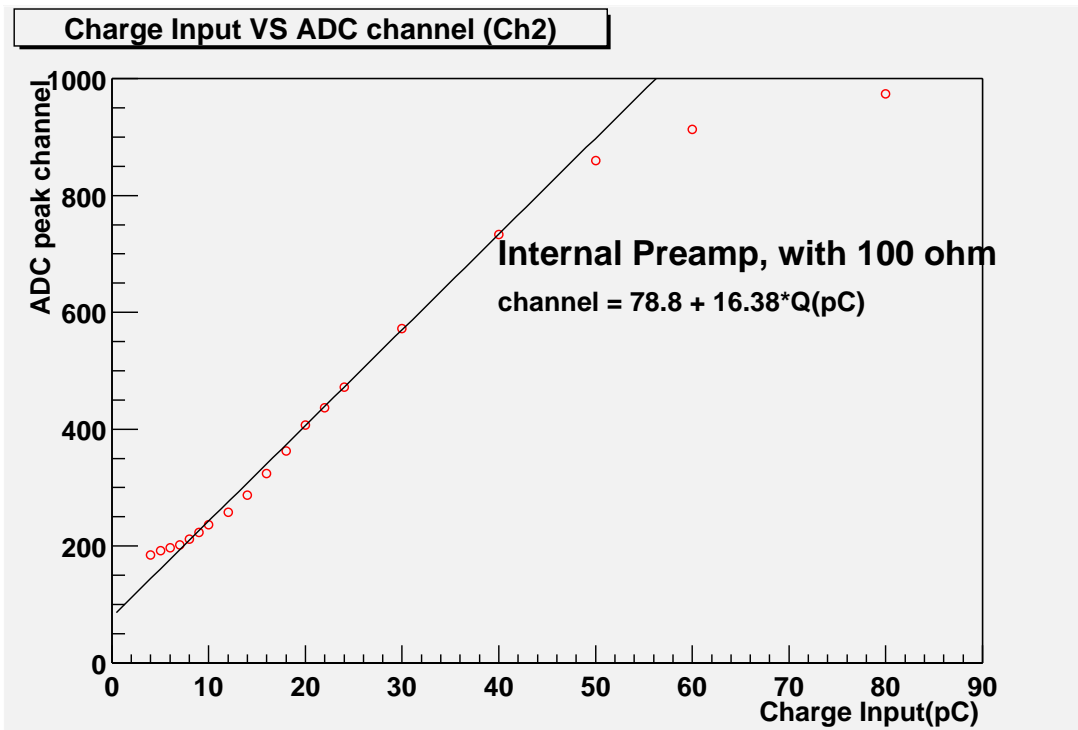


Figure 3: XGT Ch2 charge input and ADC peak channel relation in the previous configuration.

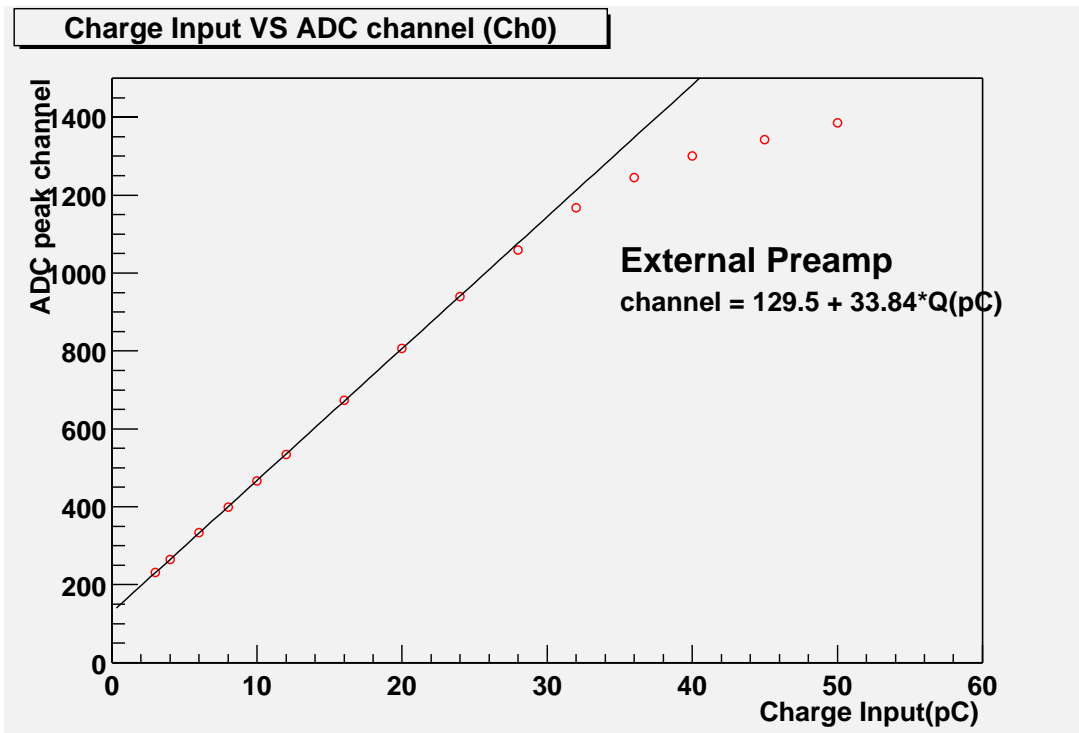


Figure 4: XGT Ch0 charge input and ADC peak channel relation in the current configuration.

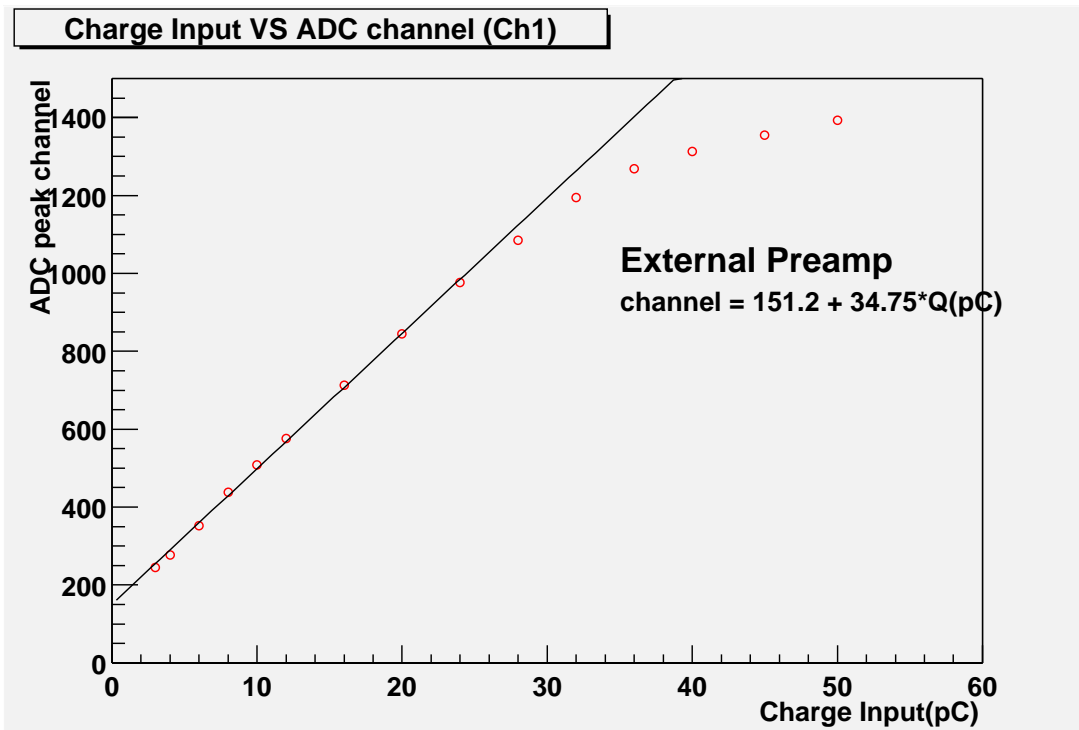


Figure 5: XGT Ch1 charge input and ADC peak channel relation in the current configuration.

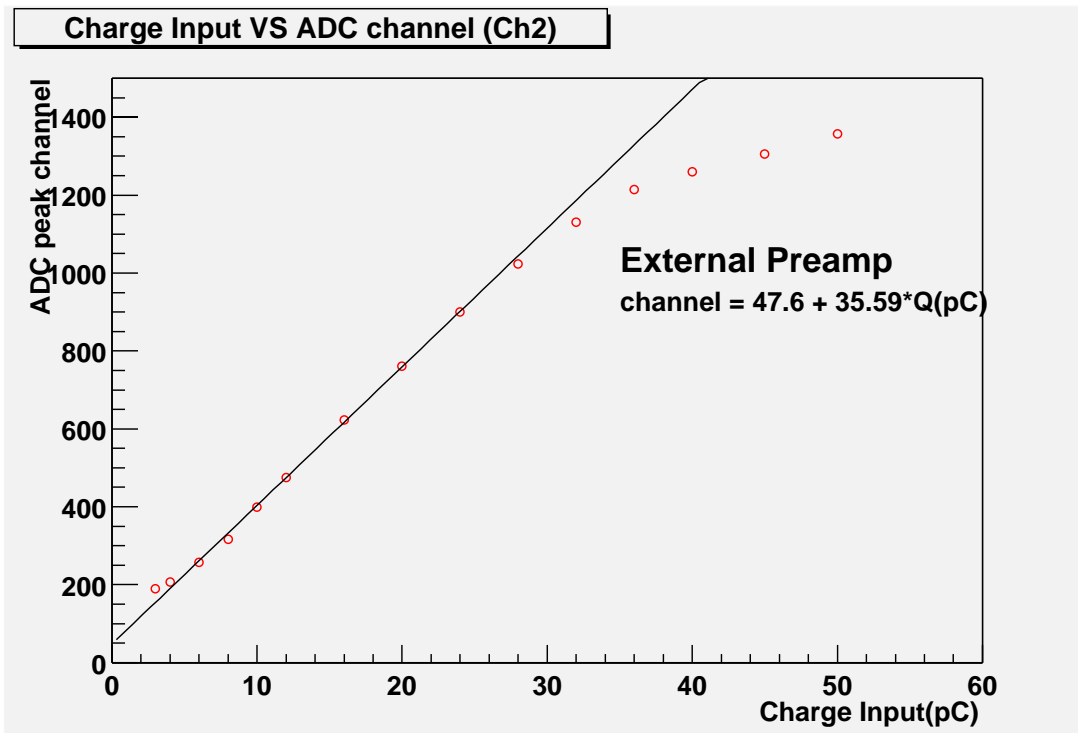


Figure 6: XGT Ch2 charge input and ADC peak channel relation in the current configuration.

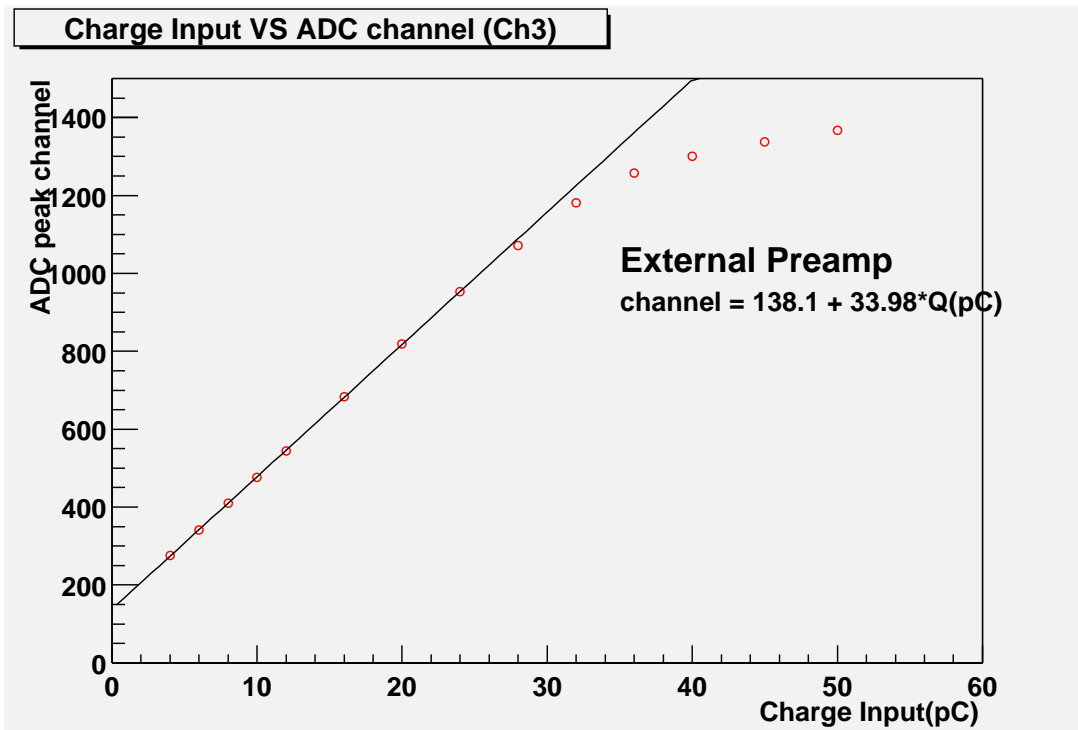


Figure 7: XGT Ch3 charge input and ADC peak channel relation in the current configuration.

BFEM Cosmic (June 30 98.7k events, XGT0)

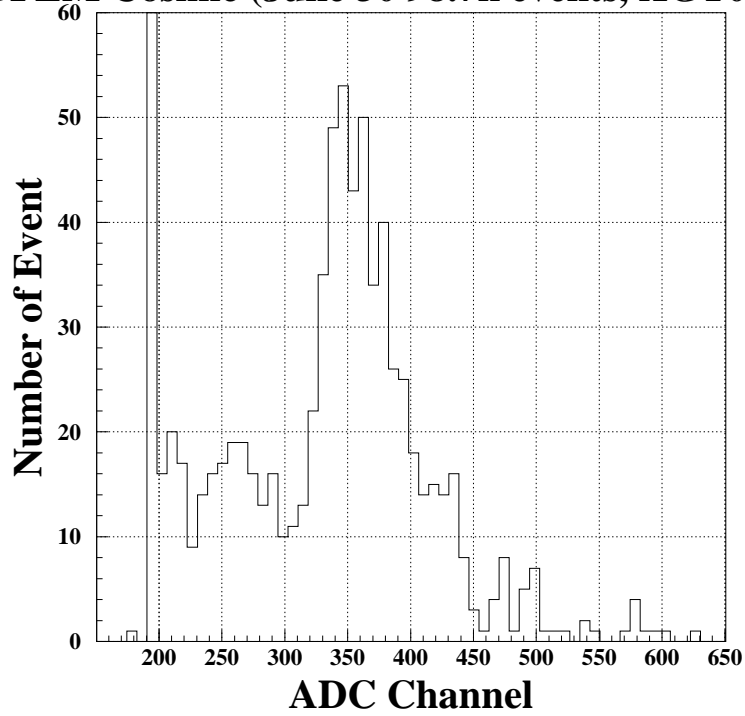


Figure 8: XGT 0 cosmic-run histogram taken on June 30th. HV=498.5 V.

BFEM Cosmic (June 30 98.7k events, XGT1)

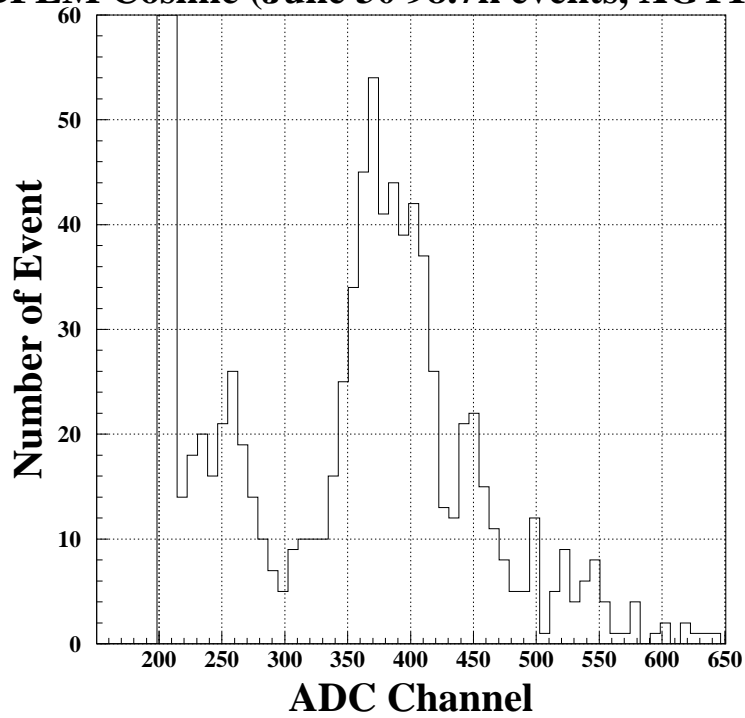


Figure 9: XGT 1 cosmic-run histogram taken on June 30th. HV=469 V.

BFEM Cosmic (June 30 98.7k events, XGT2)

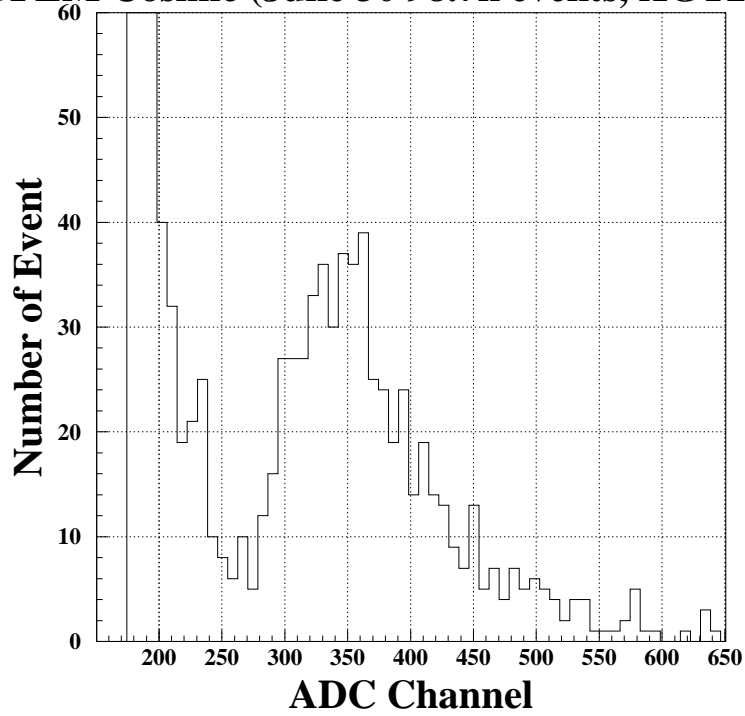


Figure 10: XGT 2 cosmic-run histogram taken on June 30th. HV=486 V.

BFEM Cosmic (June 30 98.7k events, XGT3)

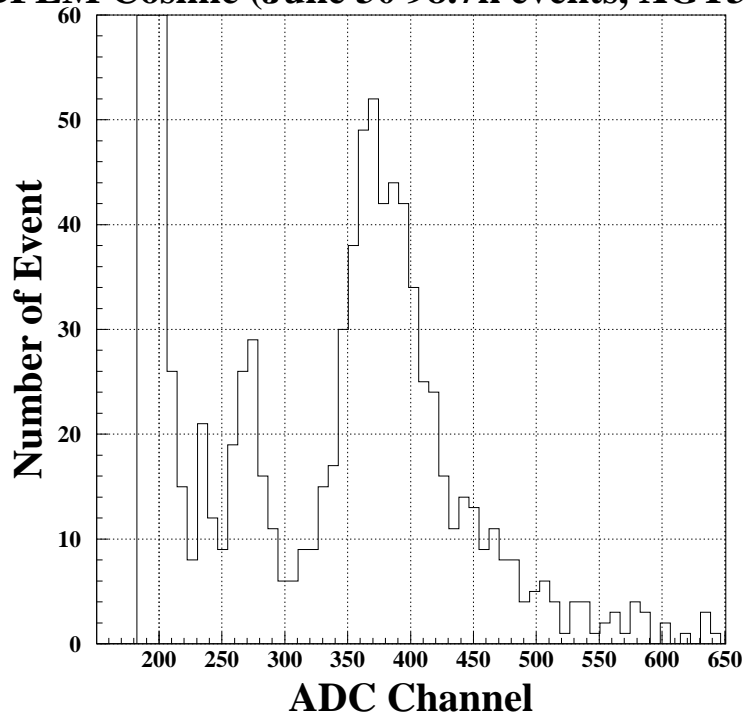


Figure 11: XGT 3 cosmic-run histogram taken on June 30th. HV=496 V.

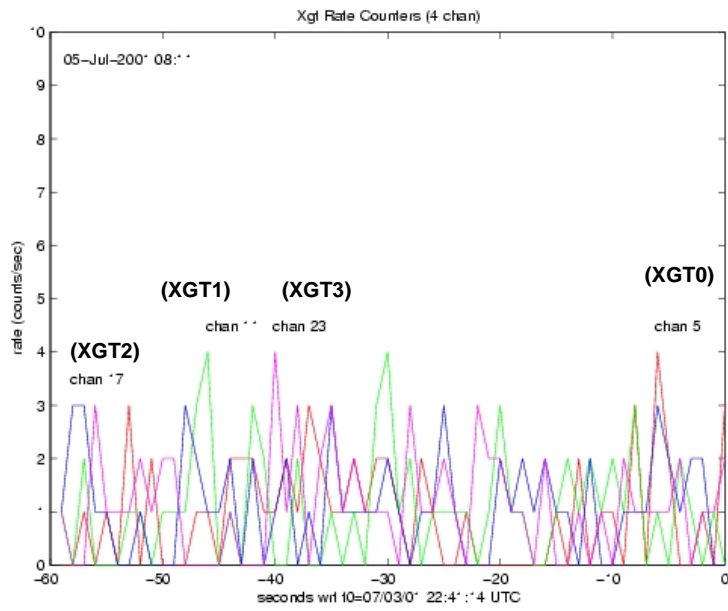


Figure 12: XGT Rate counter plot taken by Dave Lauben on July 3rd at GSFC.