RHESSI G6 HV experiment

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This experiment will ramp the high voltage (HV) on RHESSI germanium detector 6 (G6) down to zero volts, then back up to operating voltages, over the course of multiple passes. G6 will be at zero volts for the duration between the first Berkeley pass and the second Berkeley pass. The purpose is to investigate whether there is hysteresis-like behavior that is keeping the noise high on this particular detector. The times in this document assume that this experiment will be performed on 2014 May 19 (2014/139).

The tohban is required to be present at all Berkeley passes and can adjust this procedure in real time. If at all possible, Albert Shih should be connected via phone for all Berkeley passes.

1. **First Wallops pass: 17:25 UT (10:25 AM PDT)**
   1.1. Dump the current HV and threshold settings on G6 for confirmation during or after the pass
      1.1.1.G6 HV: 108 (~2100 V)
      1.1.2.G6 front slow LLD threshold: 0x30
      1.1.3.G6 front fast LLD threshold: 0xFF
      1.1.4.G6 rear slow LLD threshold: 0x30
      1.1.5.G6 rear fast LLD threshold: 0x60
   1.2. Reduce G6 HV by 20 counts (to ~1700 V) **Ended at 1691 V**

```
/IHVDAC DETECTOR=6, VOLTAGE=88 ; was 108
```

   All commands were performed as specified in the instructions.

2. **First Berkeley pass: 18:56 UT (11:56 AM PDT)**
   2.1. Record monitor rates on G6 (do this *quickly*, because this is a short pass)

	G6 front	G6 rear
Fast valid rate	284	15600
Slow valid rate	3328	100
Livetime	83.1	79.6
Reset rate	6650	1382
ULD rate	9	14

   2.2. Reduce G6 HV by 40 counts (to ~900 V)

```
/IHVDAC DETECTOR=6, VOLTAGE=48 ; was 88
```

   2.3. Observe to see if monitor rates return on G6, but move on to the next step once there is less than 90 seconds remaining in the pass
   2.4. Reduce G6 HV by 48 counts (to zero volts)

```
/IHVDAC DETECTOR=6, VOLTAGE=0 ; was 48
```

   All commands were performed as specified in the instructions. Desegmentation happened near the beginning of the second ramp, so somewhere just under 900V.

3. **G6 will be at zero volts for the back orbit**

4. **Second Berkeley pass: 20:34 UT (1:34 PM PDT)**
   4.1. For the next three HV increases, defer any commands to the following pass if necessary. Note the voltage at which segmentation occurs.
   4.2. Raise G6 HV by 10 counts (to ~200 V) and wait for monitor rates to stabilize
   ```
   /IHVDAC DETECTOR=6, VOLTAGE=10 ; was 0
   ```
   4.3. Raise G6 HV by 18 counts (to ~550 V) and wait for monitor rates to stabilize
   ```
   /IHVDAC DETECTOR=6, VOLTAGE=28 ; was 10
   ```
   4.4. Raise G6 HV by 20 counts (to ~900 V)
   ```
   /IHVDAC DETECTOR=6, VOLTAGE=48 ; was 28
   ```

   All commands were performed as specified in the instructions. Segmentation occurred almost immediately, at a few tens of volts! This was a surprise. At the end of these actions the D6 livetimes were 94.5% (front) and 98% (rear). Rear resets were 1150 and rear fasts were 2100.

5. **Third Berkeley pass: 22:14 UT (3:14 PM PDT)**
   5.1. Catch up on any deferred HV increases and wait for monitor rates to stabilize
   5.2. For the next three HV increases, defer any commands to the following pass if necessary. If segmentation has not already occurred, note the voltage at which segmentation occurs.
   5.3. Raise G6 HV by 20 counts (to~1300 V) and wait for monitor rates to stabilize
   ```
   /IHVDAC DETECTOR=6, VOLTAGE=68 ; was 48
   ```
   5.4. Raise G6 HV by 10 counts (to ~1500 V) and wait for monitor rates to stabilize
   ```
   /IHVDAC DETECTOR=6, VOLTAGE=78 ; was 68
   ```
   5.5. Raise G6 HV by 10 counts (to ~1700 V)
   ```
   /IHVDAC DETECTOR=6, VOLTAGE=88 ; was 78
   ```

   All commands were performed as specified in the instructions. At the end of these commands D6 livetime was ~85% for both the front and rear.

6. **Fourth Berkeley pass: 23:55 UT (4:55 PM PDT)**
   6.1. Catch up on any deferred HV increases and wait for monitor rates to stabilize
   6.2. Record monitor rates on G6

	G6 front	G6 rear
Fast valid rate	140	10342
Slow valid rate	2995	162
Livetime	85.1	84.5
Reset rate	5888	1555
ULD rate	20	32

   6.3. The tohban shall decide whether to end the experiment at this point or to continue (requires support on the fifth Berkeley pass!)
   6.4. Raise G6 HV by 20 counts (to ~2100 V)
   ```
   /IHVDAC DETECTOR=6, VOLTAGE=108 ; was 88
   ```

   Here we deviated from the plan, which was intended to take us back up to 2100V for one orbit and then decrease again. We did the step up to ~2100V (though we broke it into two steps). Because conditions seemed slightly (though not hugely) improved from when we started, the decision was made to leave the detector at this voltage until the next day and see how it does. Note that this is the same voltage at which we started. Therefore Step 7 below was not performed.

7. **Fifth Berkeley pass: 01:35 UT (6:35 PM PDT)**

7.1. Reduce G6 HV by 20 counts (to ~1700 V) and wait for monitor rates to stabilize

```
/IHVDAC DETECTOR=6, VOLTAGE=88 ; was 108
```

7.2. Record monitor rates on G6

	G6 front	G6 rear
Fast valid rate		
Slow valid rate		
Livetime		
Reset rate		
ULD rate		

This step was not performed.

8. **End of experiment**

9. **Additional notes on the outcome of the experiment:**

While the improvement at ~1700 V was not particularly dramatic, the apparent improvement at ~2100 V is much more interesting. At the start of the experiment, the front fast valid rate was ~150k, resulting in a livetime of ~15%. After the experiment, the front fast valid rate was ~5k, resulting in a livetime of ~80%.

(The following URLs may be moved later…)

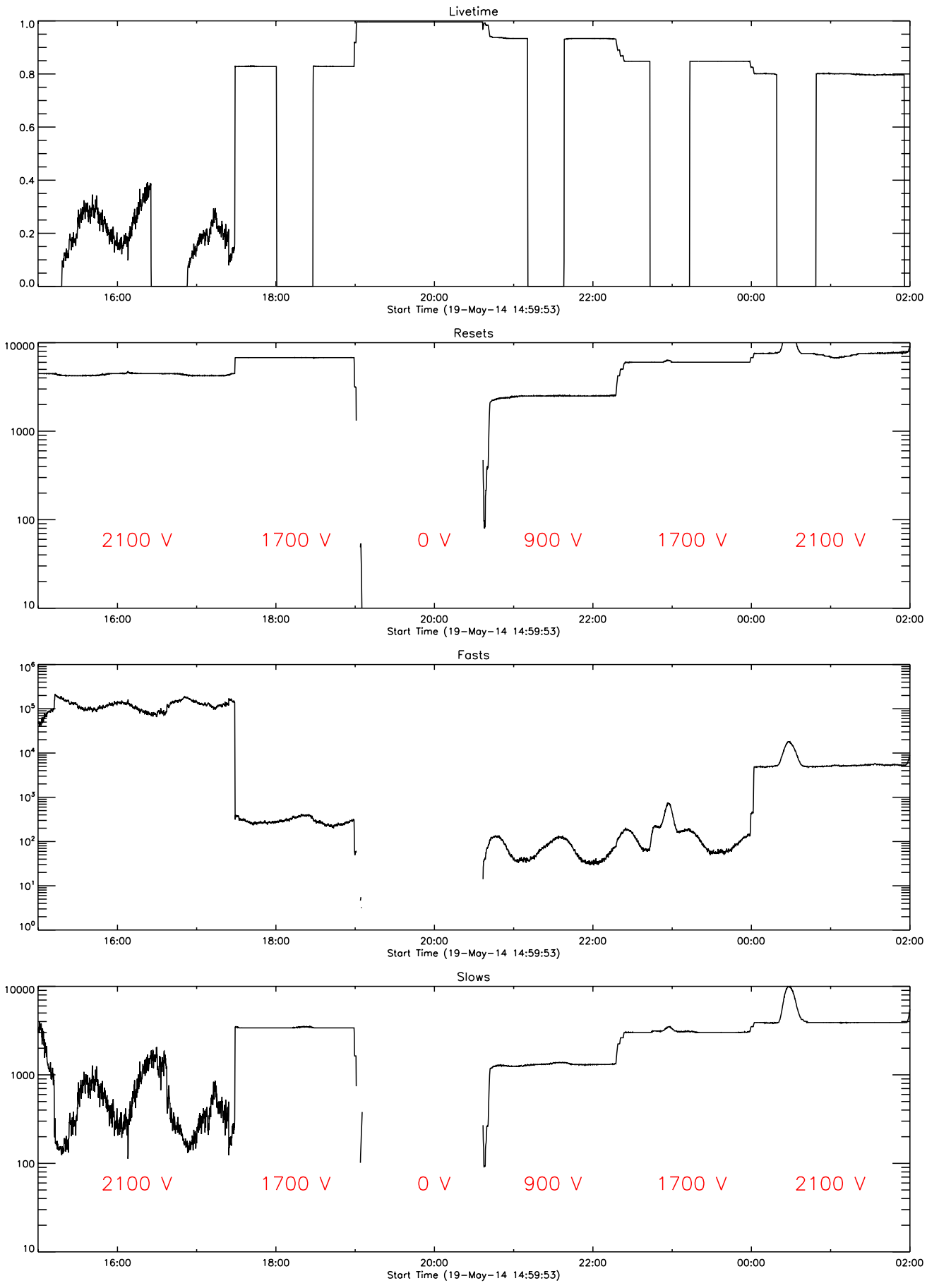
http://sprg.ssl.berkeley.edu/~ayshih/vc/20140519/vc1_20140519172532_fronts.png
(look before 17:29 UT)
http://sprg.ssl.berkeley.edu/~ayshih/vc/20140520/vc3_20140520013538_fronts.png
(look after 00:01 UT)

We shall see whether this reduction in fast-channel noise is stable.

Regarding the comments on segmentation, I suspect that (true) desegmentation did not actually occur at an HV just below 900 V. Looking at the monitor rates for the HV decrease from 1700 V to 900 V (18:59:20 UT), the slow valids drop out temporarily until the detector stabilizes at the new HV (it's more apparent by looking at the reset rate). I think that if we had stopped the HV decrease anywhere between 900 V and 200 V, the detector would have re-segmented.

http://sprg.ssl.berkeley.edu/~ayshih/vc/20140519/vc1_20140519185615_rears.png

Although it's somewhat surprising that the detector now segments at 200 V (or possibly even 25 V), we've seen this before on significantly damaged detectors. The active volume starts forming from the inside out, so we can get electronically separate segments very easily.


Livetime
1.0
0.8
0.6
0.4
0.2
0.0
16:00
18:00
20:00
22:00
00:00
02:00
Start Time (19-May-14 14:59:53)
Resets
10000
1000
100
10
2100 V
1700 V
0 V
900 V
1700 V
2100 V
16:00
18:00
20:00
22:00
00:00
02:00
Start Time (19-May-14 14:59:53)
Fasts
10^6
10^5
10^4
10^3
10^2
10^1
10^0
16:00
18:00
20:00
22:00
00:00
02:00
Start Time (19-May-14 14:59:53)
Slows
10000
1000
100
10
2100 V
1700 V
0 V
900 V
1700 V
2100 V
16:00
18:00
20:00
22:00
00:00
02:00
Start Time (19-May-14 14:59:53)