

Chandra X-ray Observatory

HRC Anomaly on 24 August 2020

Preliminary Findings & Recommended Actions

Chandra Community Briefing
26 August 2020

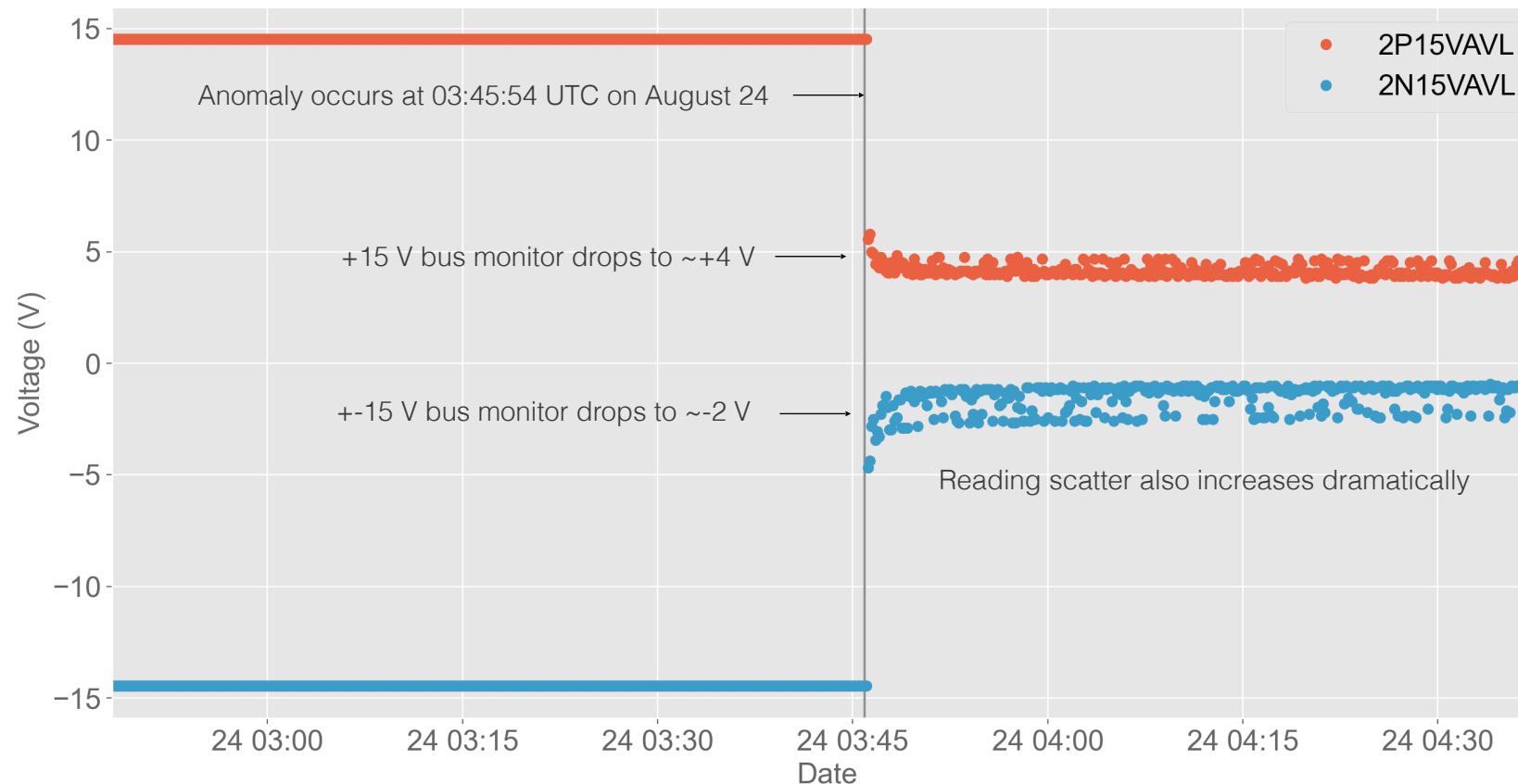
HRC Operations Team

D. Patnaude, R. Kraft, P. Nulsen, G. Tremblay, T. Gauron, A. Kenter, K. Gage, B. Bissell, G. Austin, J. Chappell

CENTER FOR **ASTROPHYSICS**
HARVARD & SMITHSONIAN

Timeline of Events

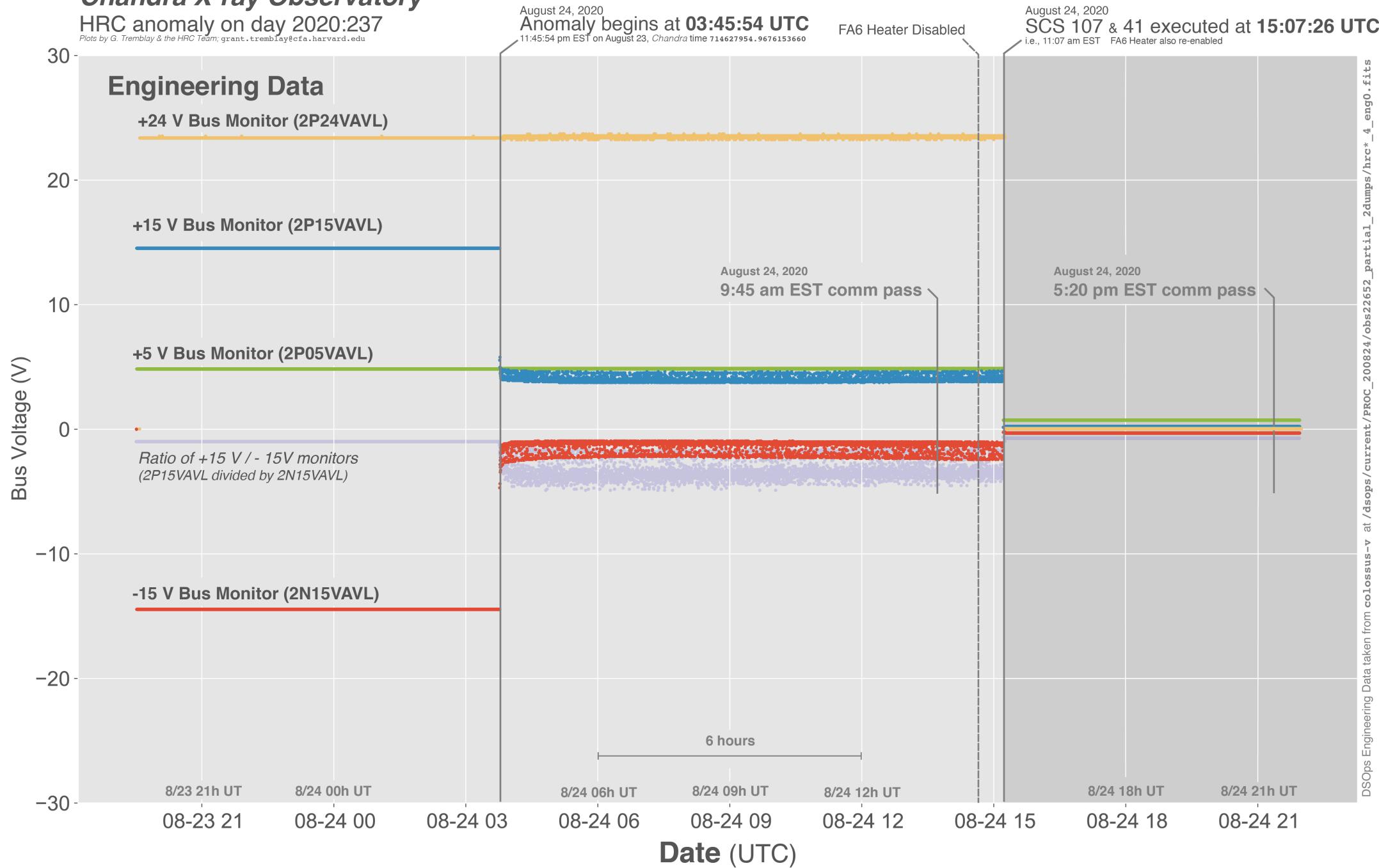
- At the start of Monday morning's comm pass, HRC limit violations were noted in the +15V and -15V bus voltage monitors.
- At the time, the HRC was not observing and was at half voltage (as expected). The selected detector was HRC-I. Shield rates were nominal. The HRC has not observed for the past ~week, and all telemetry prior to the anomaly has been normal.



Chandra X-ray Observatory

HRC anomaly on day 2020:237

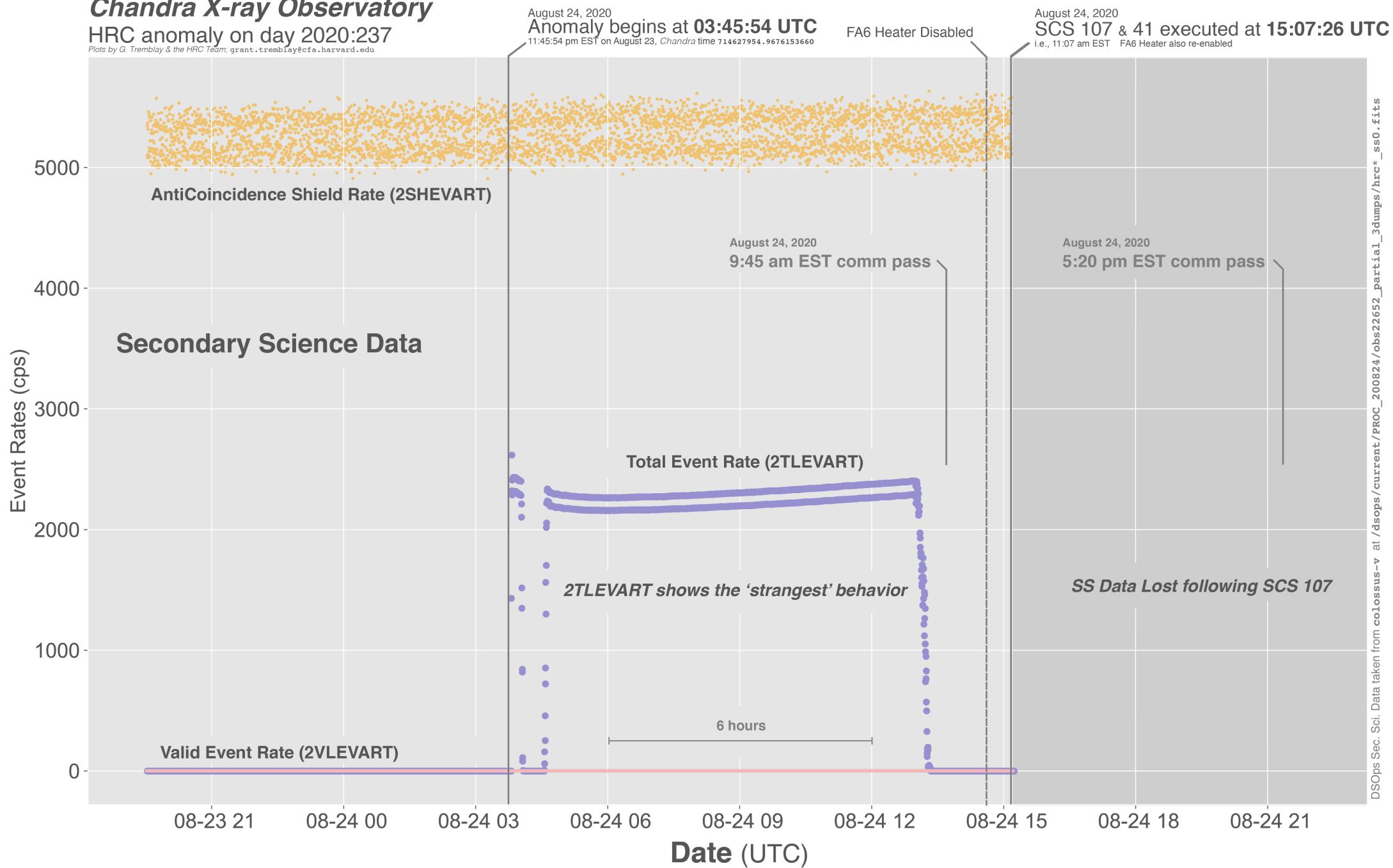
Plots by G. Tremblay & the HRC Team; grant.tremblay@cfa.harvard.edu



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HRC anomaly on day 2020:237

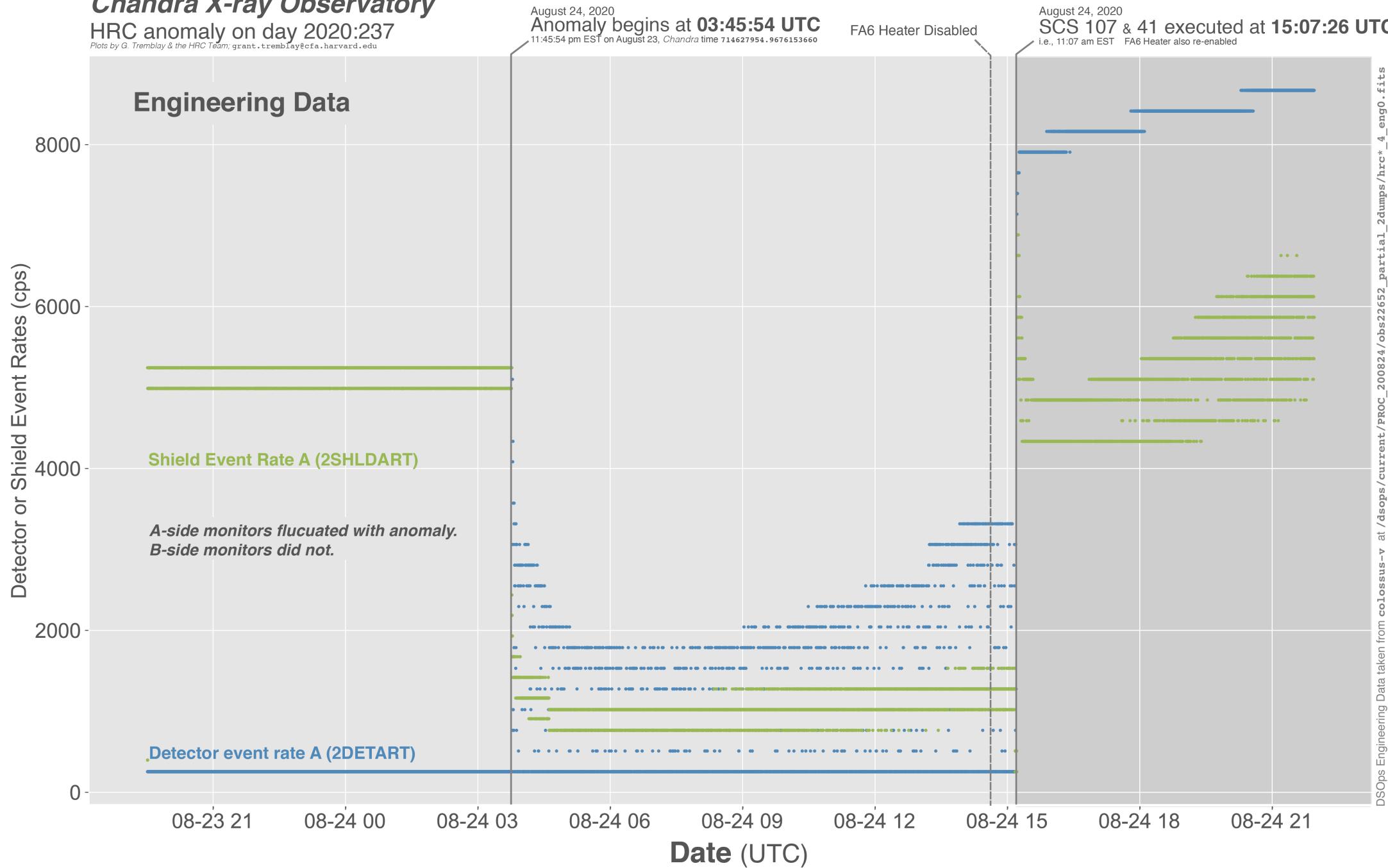
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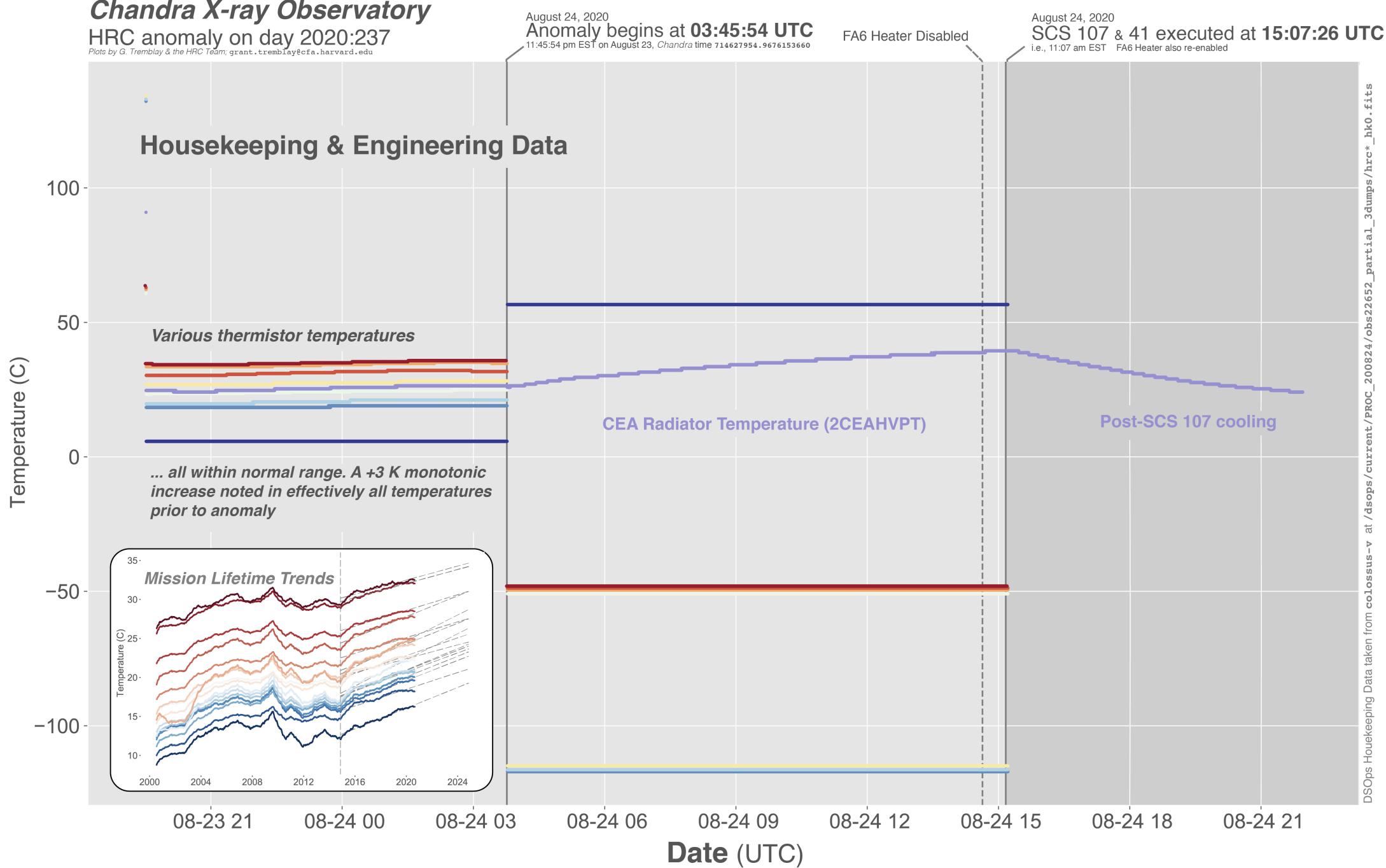
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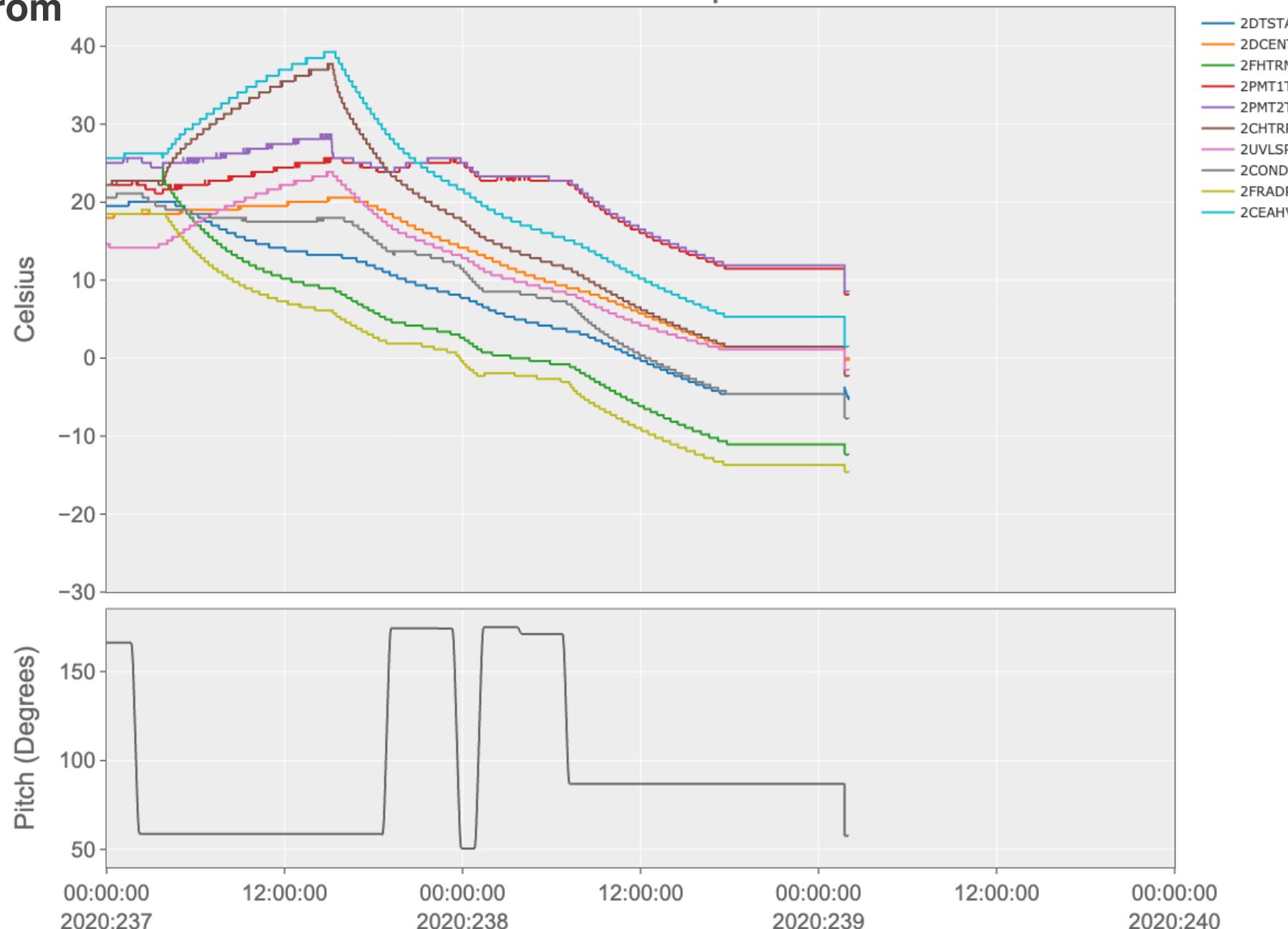
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Recent thermals from M. Dahmer

See safe limits table [here](#)

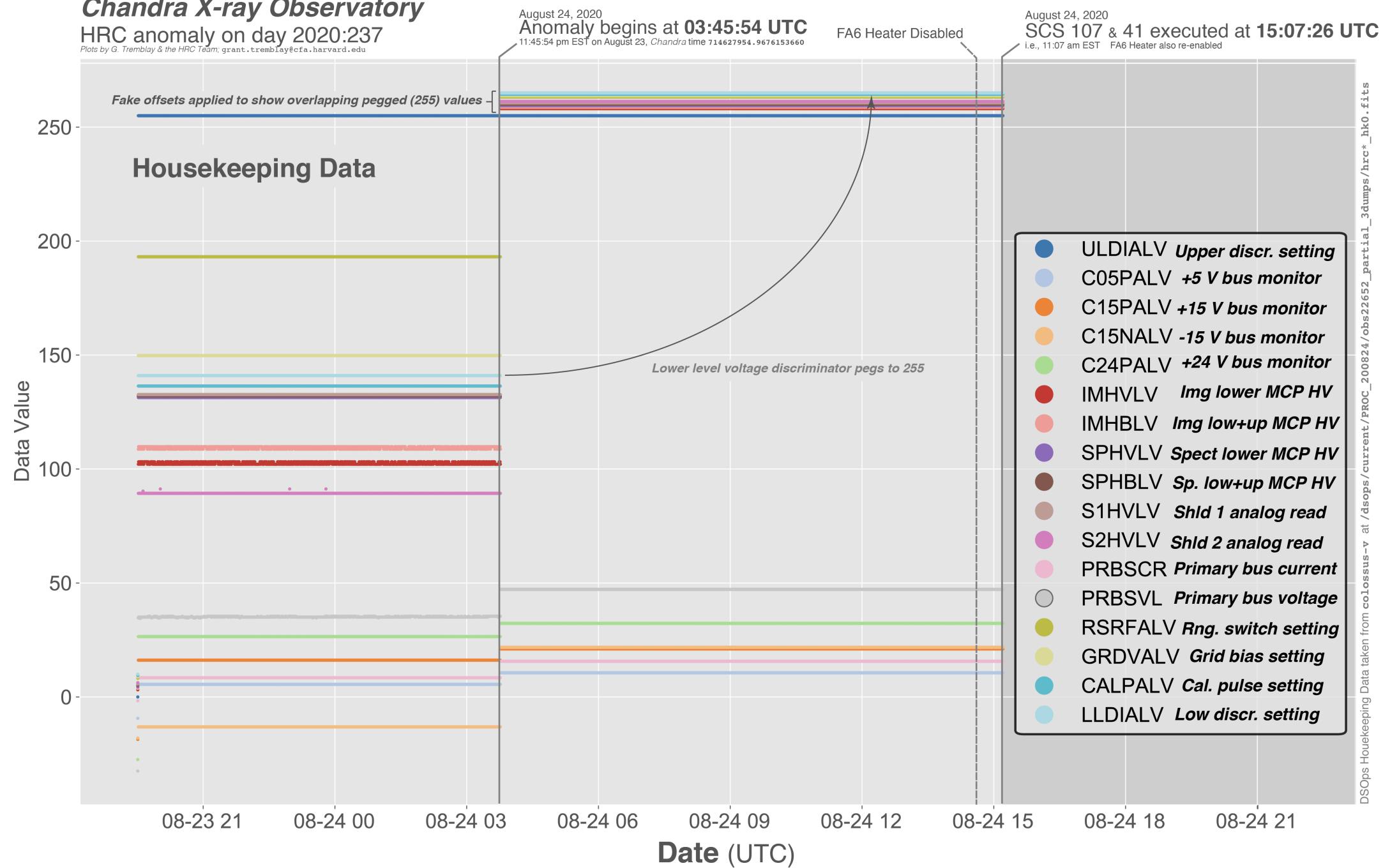
Near Term HRC Temperature Trends



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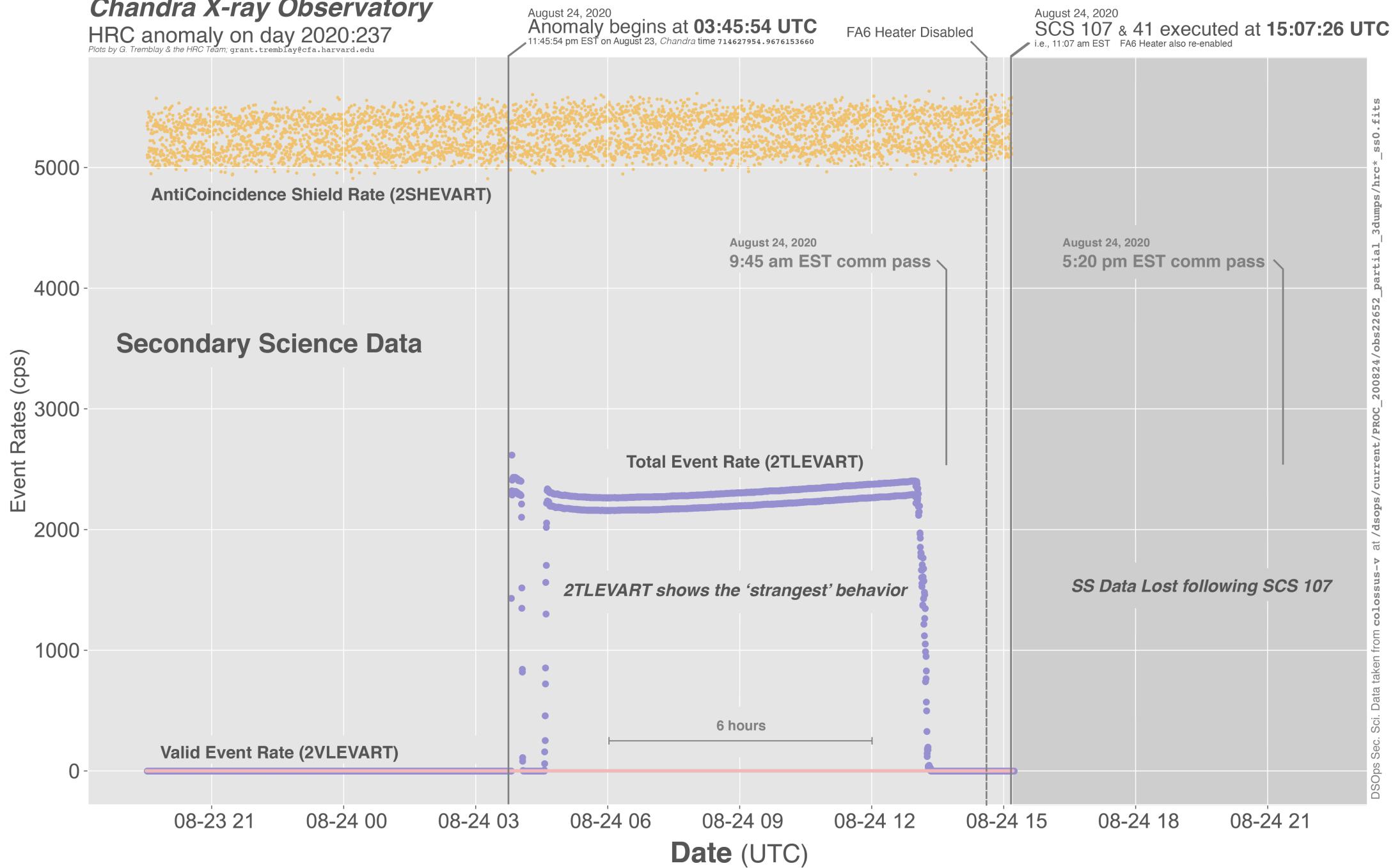
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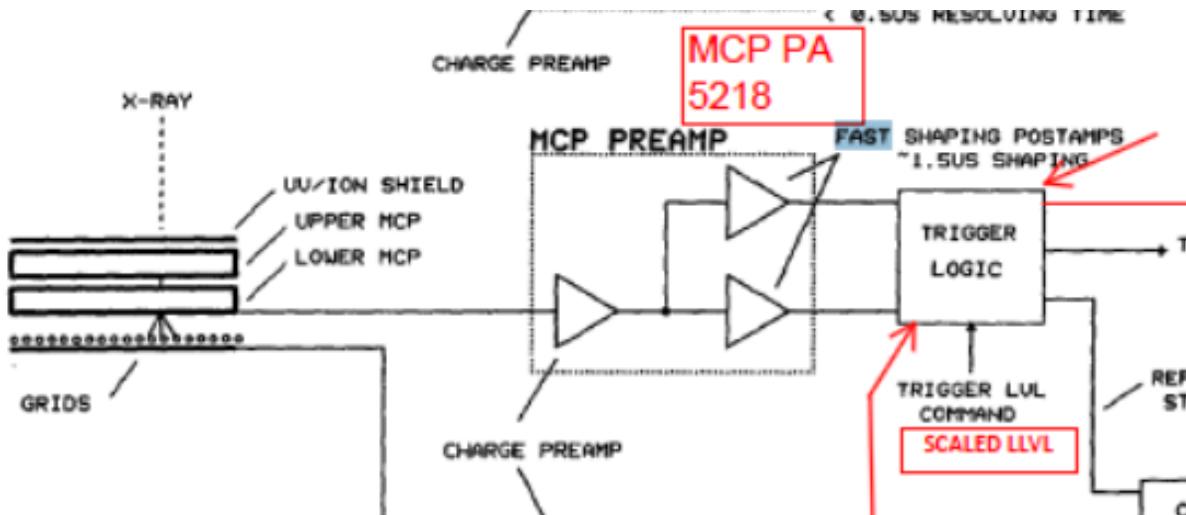
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Explanation of trigger noise

(T. Gauron)

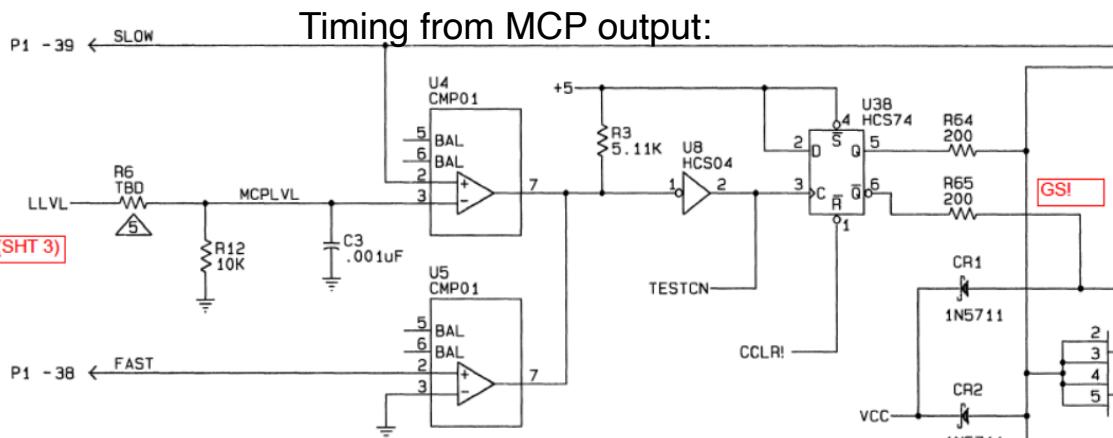
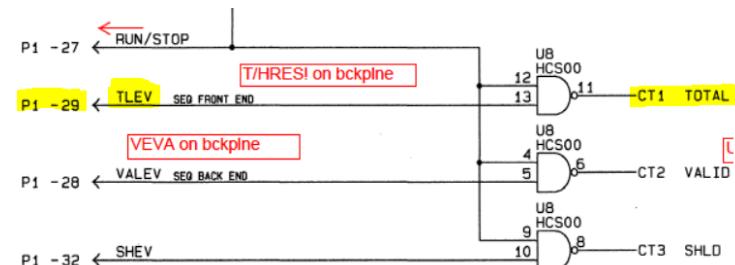
Top Level Trigger from MCP output:



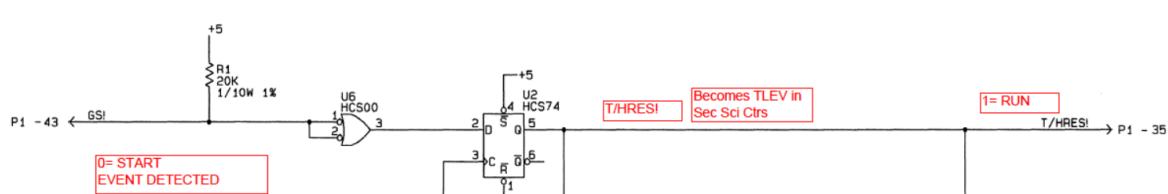
T/HRES! Routes to SEC_SCI_CTR pin 29 on backplane

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5209		
CEJ11	0 1	CE+15A
46	0 2	CEGND
47	0 3	CE-15A
48	0 4	CEGND
49	0 5	CE+5A
50	0 6	CE+5A
51	0 7	
52	0 8	
53	0 9	
54	0 10	
55	0 11	
56	0 12	
57	0 13	
58	0 14	
59	0 15	
60	0 16	
61	0 17	
62	0 18	
63	0 19	
64	0 20	
65	0 21	
66	0 22	
67	0 23	
68	0 24	
69	0 25	
70	0 26	
71	0 27	
72	0 28	
73	0 29	T/HRES! A
74	0 30	SECTIC! A
75	0 31	1.024MHZ2A
76	0 32	

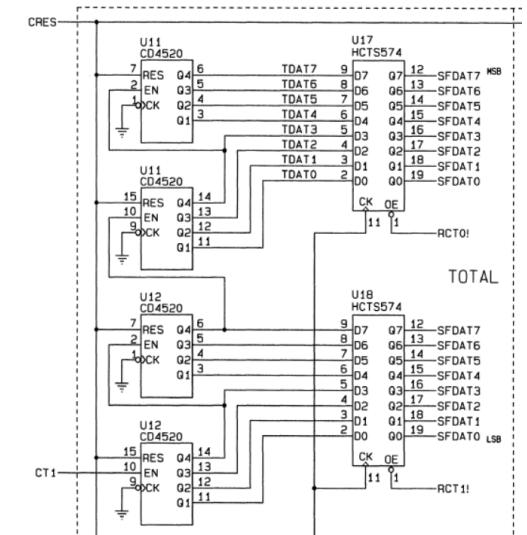
It's called TLEV on the SEC_SCI PWA



GSI! is synced with S/C clock and becomes T/HRES! in SEQUENCER



...and gets counted for TOTAL EVENTS



HRC Team Actions from Monday's Briefing

- **Prioritize developing a CAP to perform a controlled turn-on of the A-side 5V and 15V systems.** This will be informed by the commanding in SCS #69 (turn on HRC) but will likely need review and some modifications.
- **Continue engaging HRC engineering resources to understand the anomaly and evaluate worst case scenarios,** in particular if there is any credible pathway to loss of HRC detectors by turning on the A-side electronics and power supply.
- **Concurrently review the procedure for swapping to the B-side.** This procedure was written in 1999 so may need updates.

Current Hypotheses (unchanged since 4:30 EDT 08/24 tagup)

- The anomaly is due to a problem **with the +/- 15 V power supply bus on Side A**
 - **A problem in the +15 V bus would also take out the -15 V power supply due to DC-to-DC design**
 - A problem in the -15 V bus would not cause issues with the +15 V bus
 - **There could be a fault in the electronics on this bus**
 - A load fault that is transient in nature (e.g. an SEL). This should clear with a power cycle.

... or ...
 - A failed component that is dragging down the +15V bus. This would not clear with a power cycle and would require an A/B swap.

... or ...
- A latched-up component downstream of DC-DC converter may clear with power cycle. Otherwise an A / B swap is indicated.

Recommended actions

- The HRC Team recommends that we **attempt a reset of the Side A electronics on the +/- 15 V power supply**
 - **A CAP for this procedure is now written and ready for review.** It is straightforward, and has back-out pathways at several steps.
 - Pending a successful CAP review today, **we are ready to execute it tonight** (pending DSN availability).
 - **The procedure is considered low-risk and reversible.** Chances of causing damage to the instrument are very low.
 - If a Side A reset does not return voltages to nominal values, we will execute SCS 41 to power off the instrument again and **make plans to swap to Side B.**
 - We have already begun preparing an activity for a swap to Side B

Why is a Side A reset preferred?

- Resetting Side A offers *lower risk* than swapping to Side B.
 - The HRC team ***cannot find any plausible scenario*** in which turning on the 5 and 15 V would cause any damage to the single stream components (e.g., MCPs, crossed grid array, etc.)
 - This is a **straightforward procedure** derived from an SCS
 - This addresses the possible “single event latchup” hypothesis
- **Swapping to Side B is more complicated and risky.**
 - It requires switching of latching relays which we haven’t activated in 20 years.
 - It requires shutting the 28 V bus power to the HRC off.
 - B-side electronics have not been used in 20 years
 - It entails significant alteration of all HRC commanding, including protected SCSs, ATSs, and support software
 - It would require a complete calibration of the detectors

Recommended actions

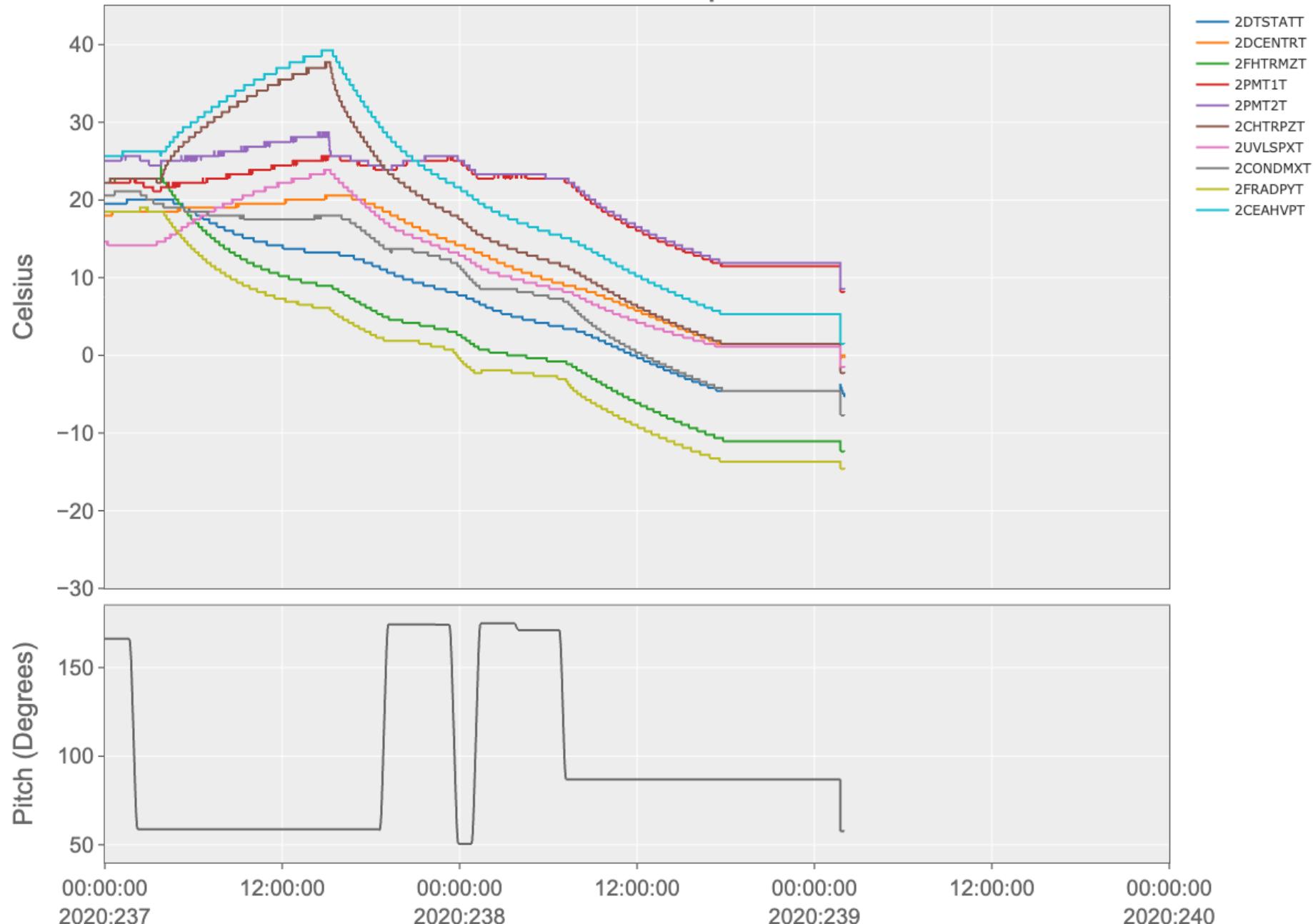
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EXTRA SLIDES

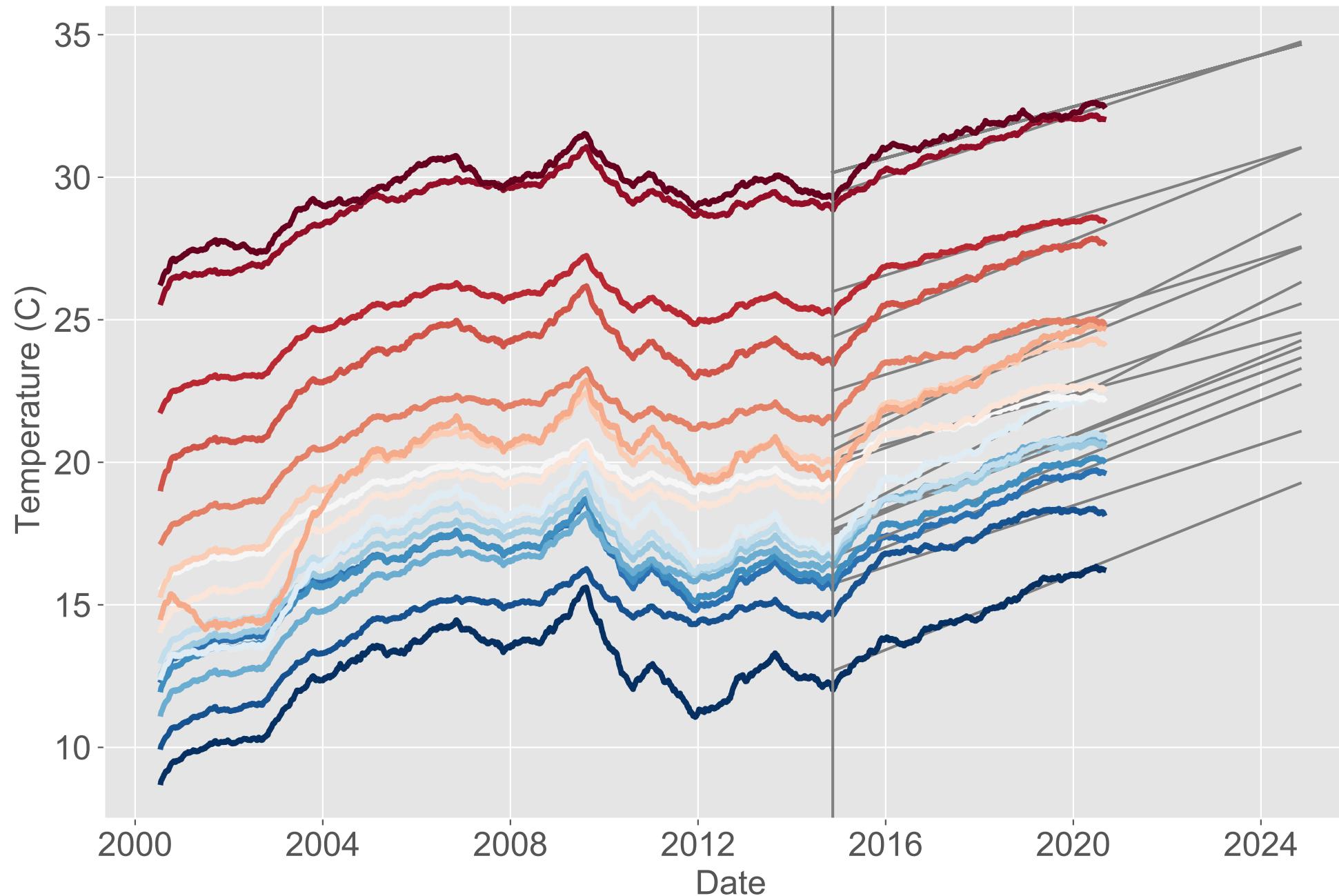
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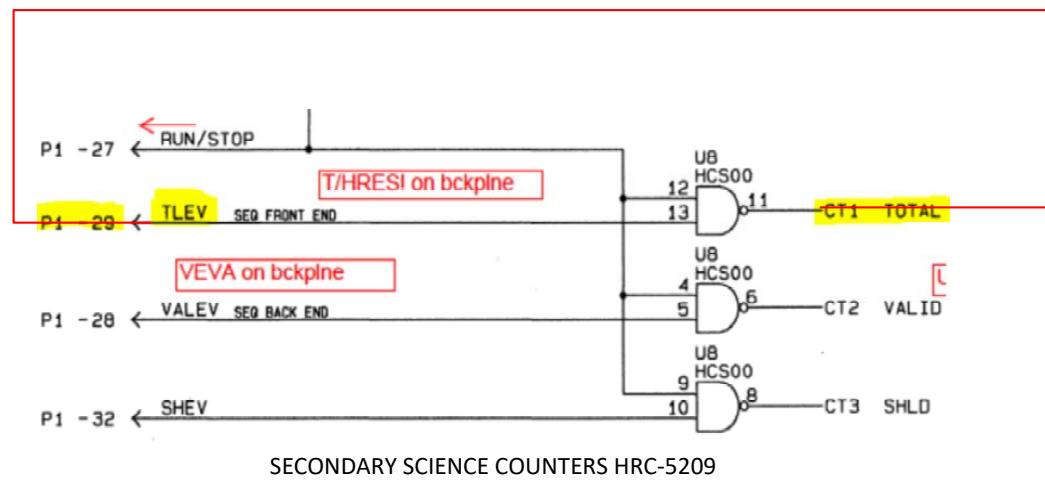
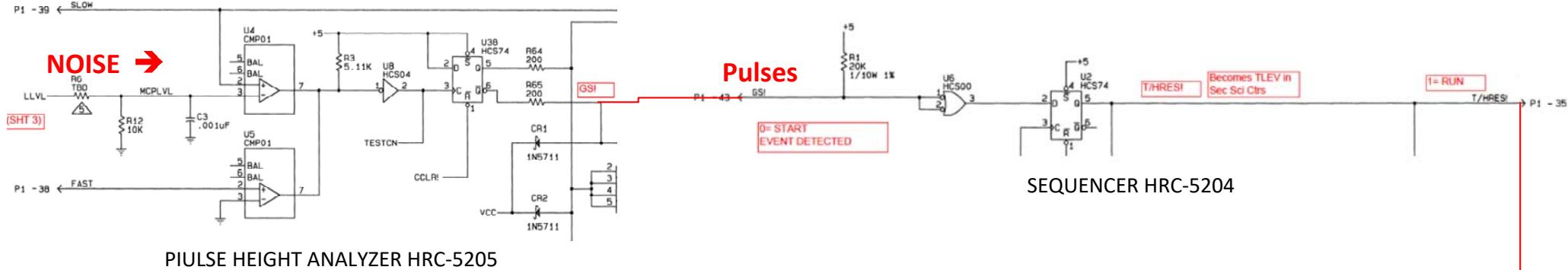
[SAFE LIMITS TABLE HERE](#)

Near Term HRC Temperature Trends

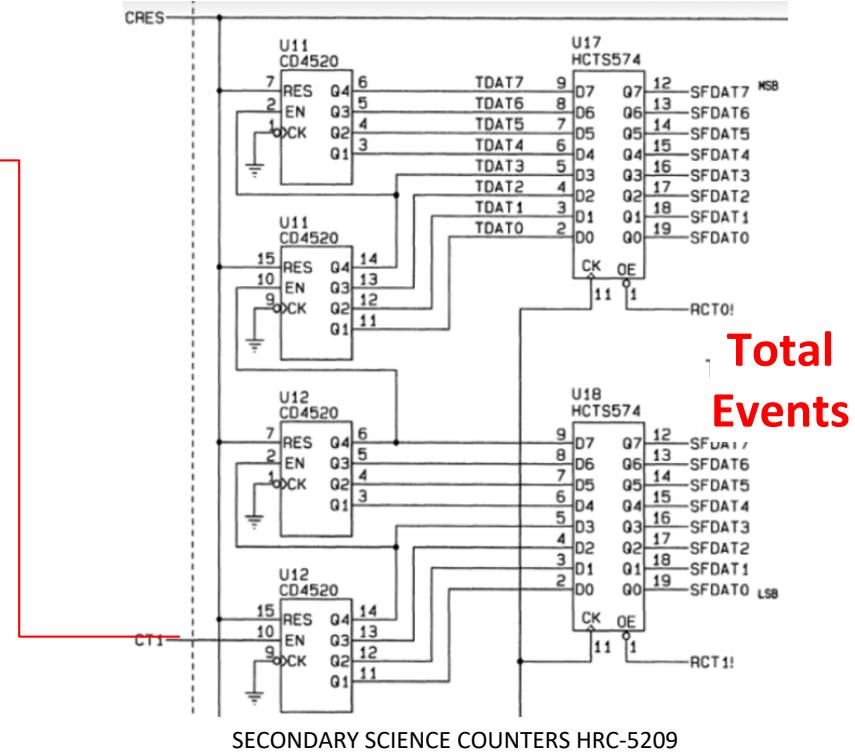


Forecasted HRC Thermistor Temperatures if Current Slopes Hold





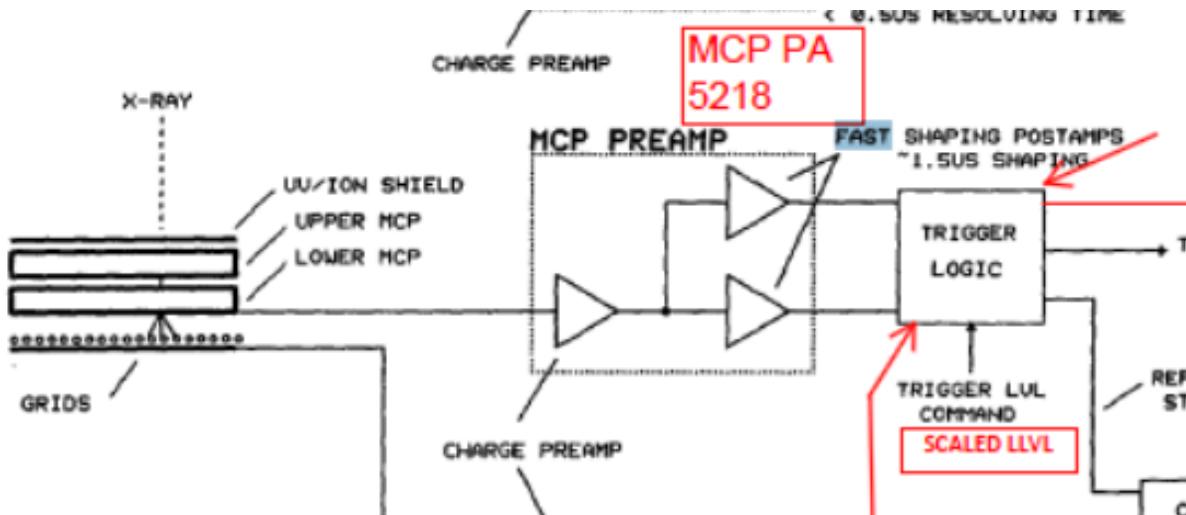
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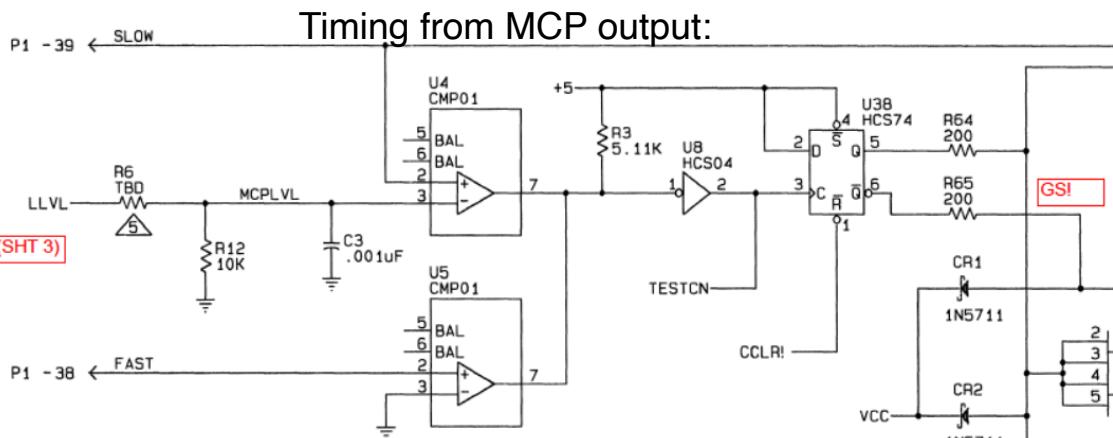
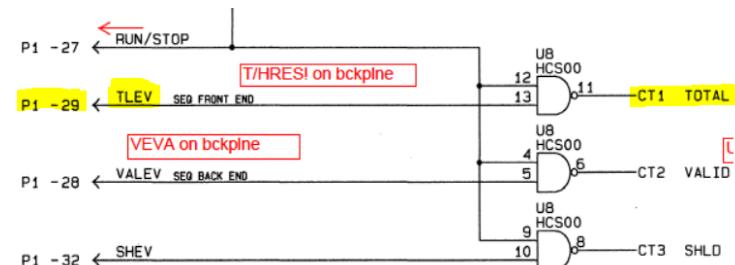
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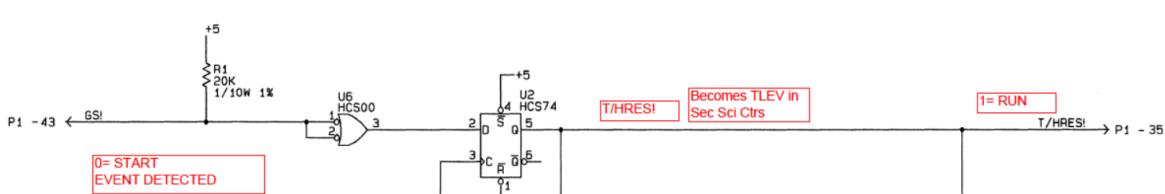
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57	0 12	
58	0 13	
59	0 14	
60	0 15	
61	0 16	
62	0 17	
63	0 18	
64	0 19	SFDAT7A
65	0 20	SFDAT6A
66	0 21	SFDAT5A
67	0 22	SFDAT4A
68	0 23	SFDAT3A
69	0 24	SFDAT2A
70	0 25	SFDAT1A
71	0 26	SFDAT0A
72	0 27	
73	0 28	VEVA
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75	0 30	SECTIC! A
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	0 32	

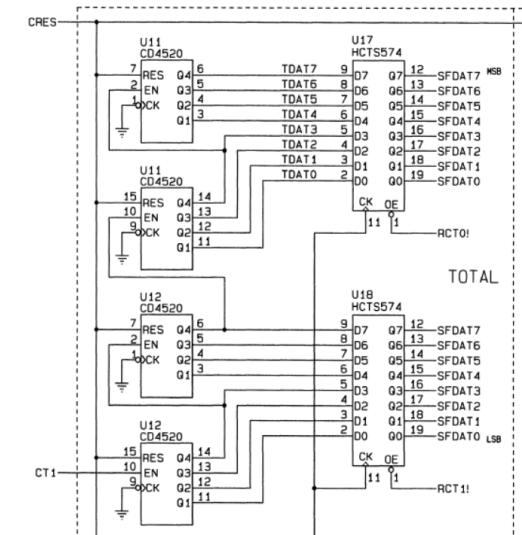
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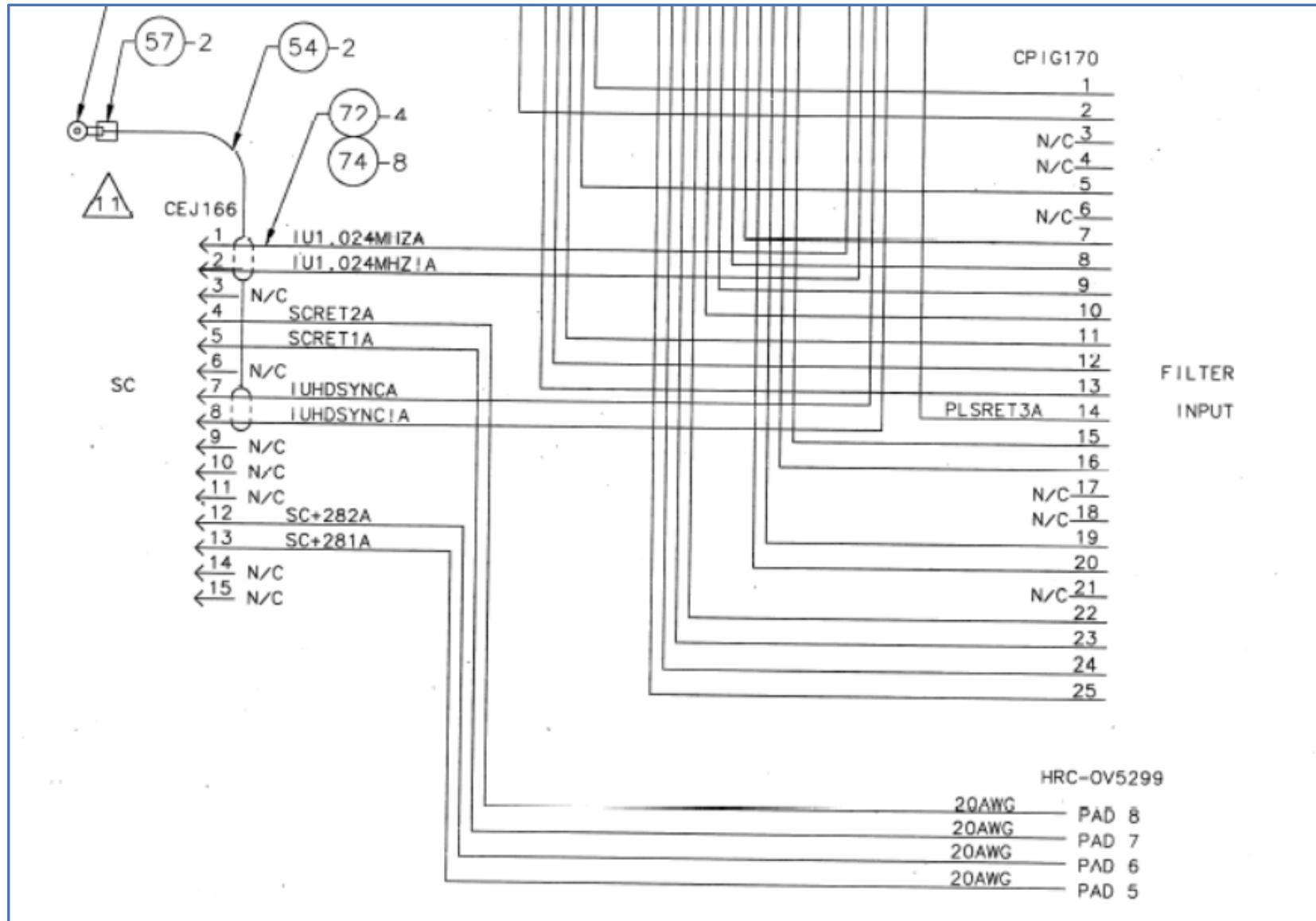


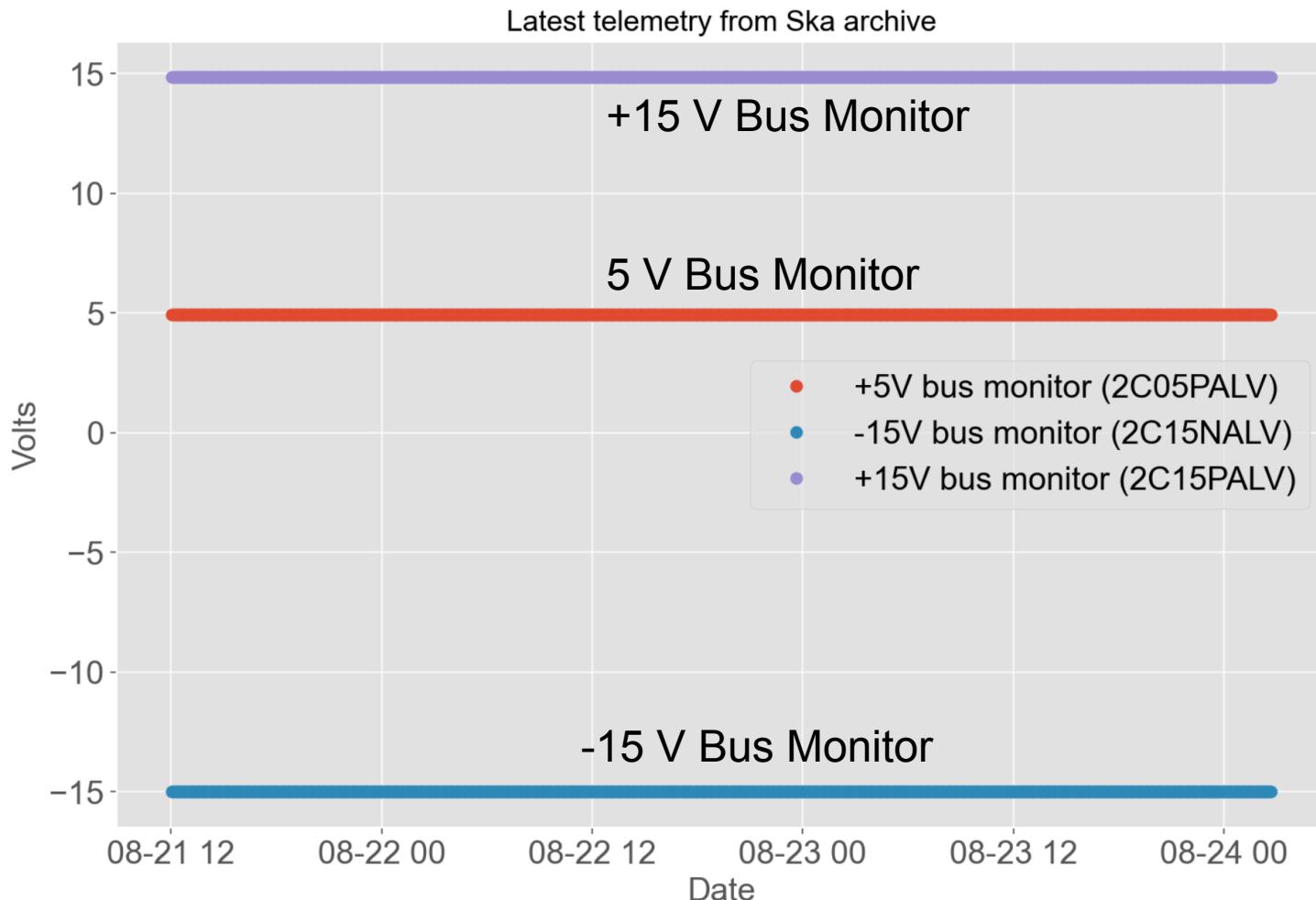
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Prime and redundant side wiring

(T. Gauron)



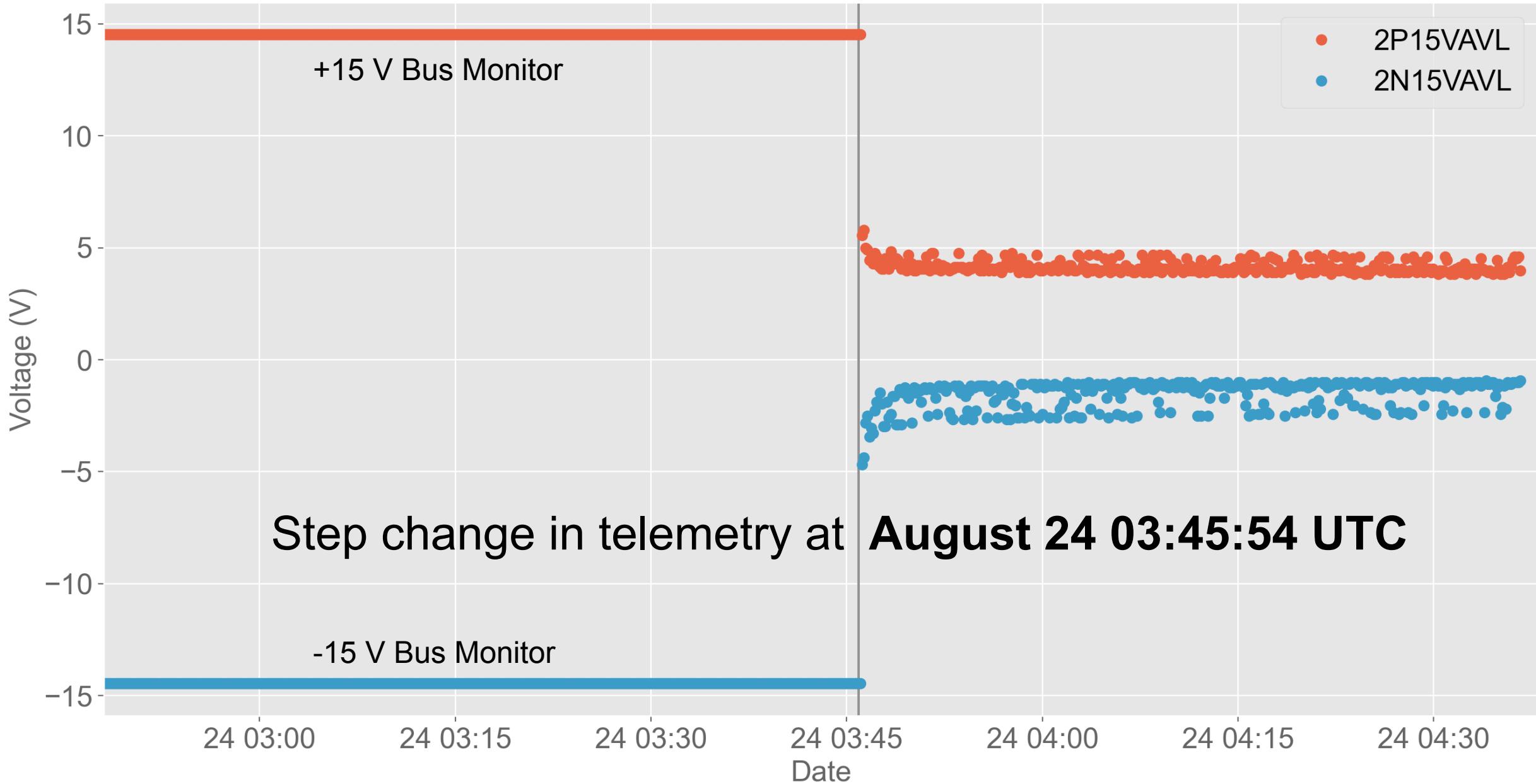


HRC
telemetry
prior to event
has been
normal.

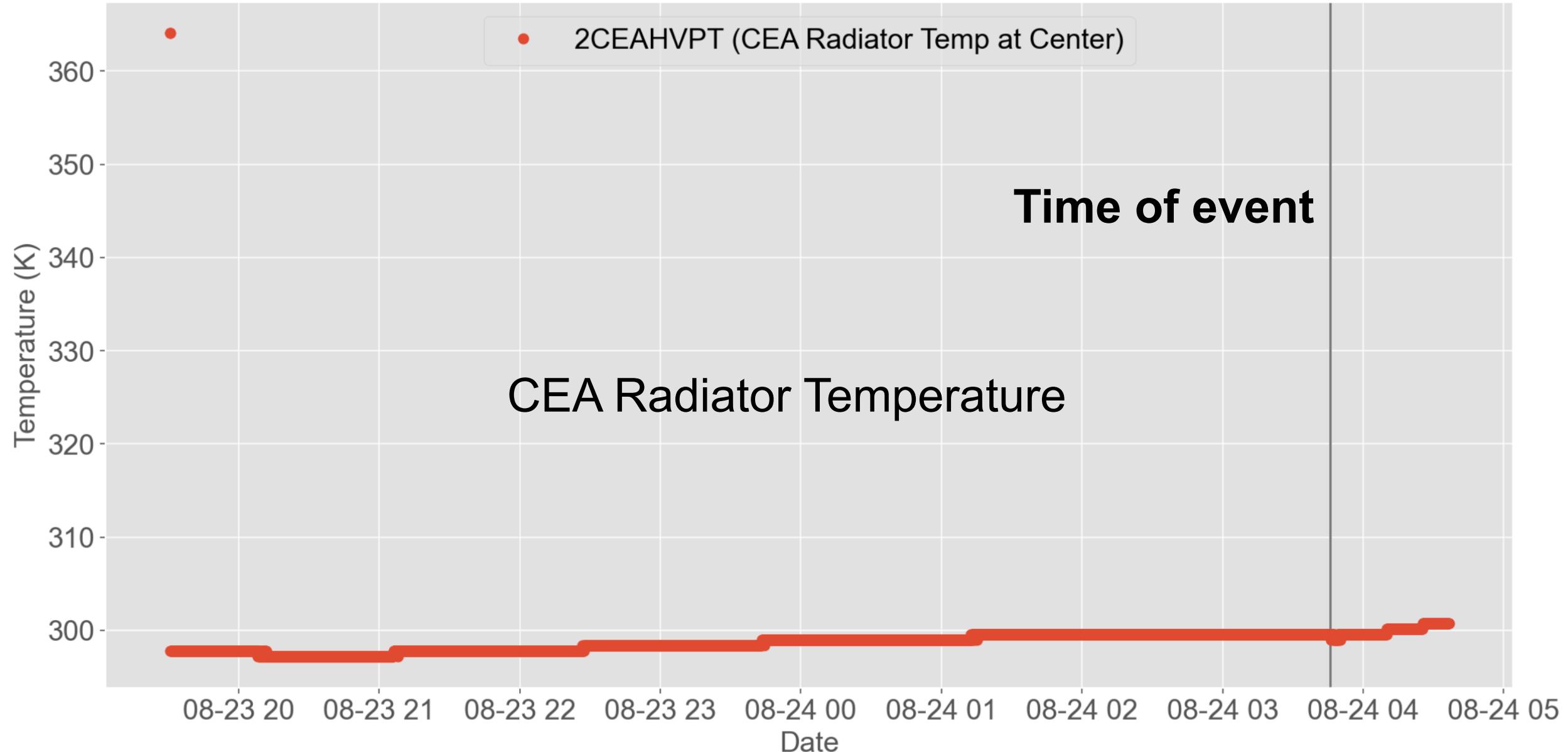
HRC has not observed in
the past week.

Full-resolution Ska data from August 21-24

dsops/current/PROC_200824/obs22652_partial_2dumps/run/hrcf714598238N001_4_eng0.fits



dsops/current/PROC_200824/obs22652_partial_2dumps/run/hrcf714598238N001_4_eng0.fits



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