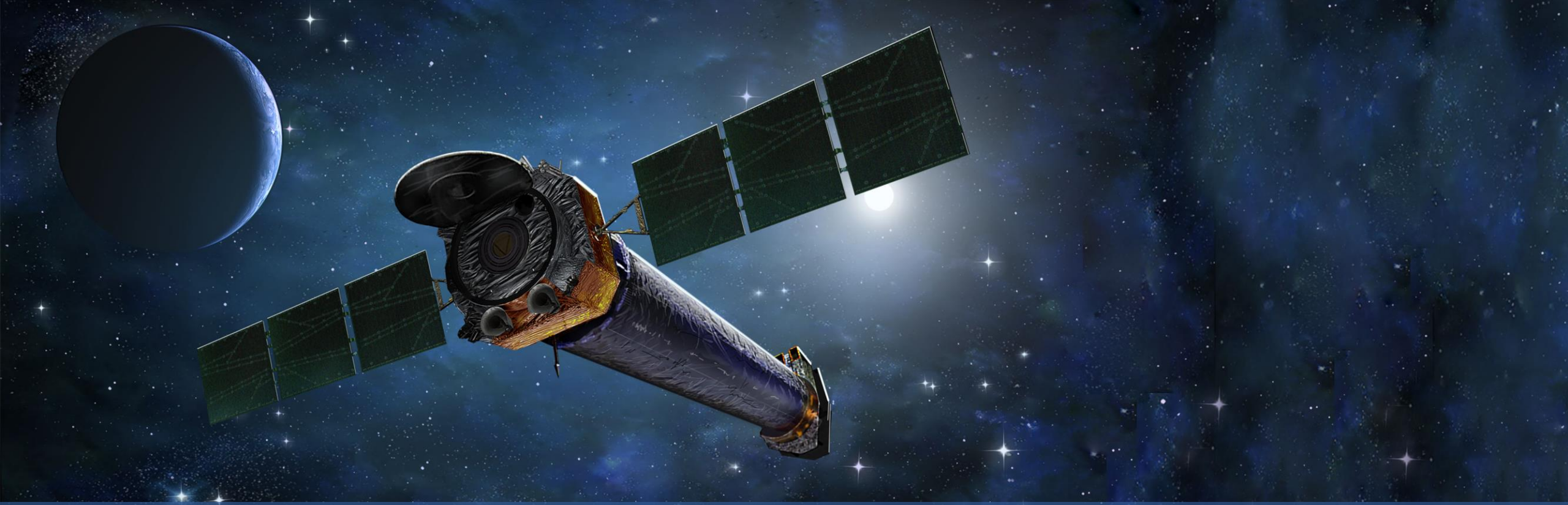


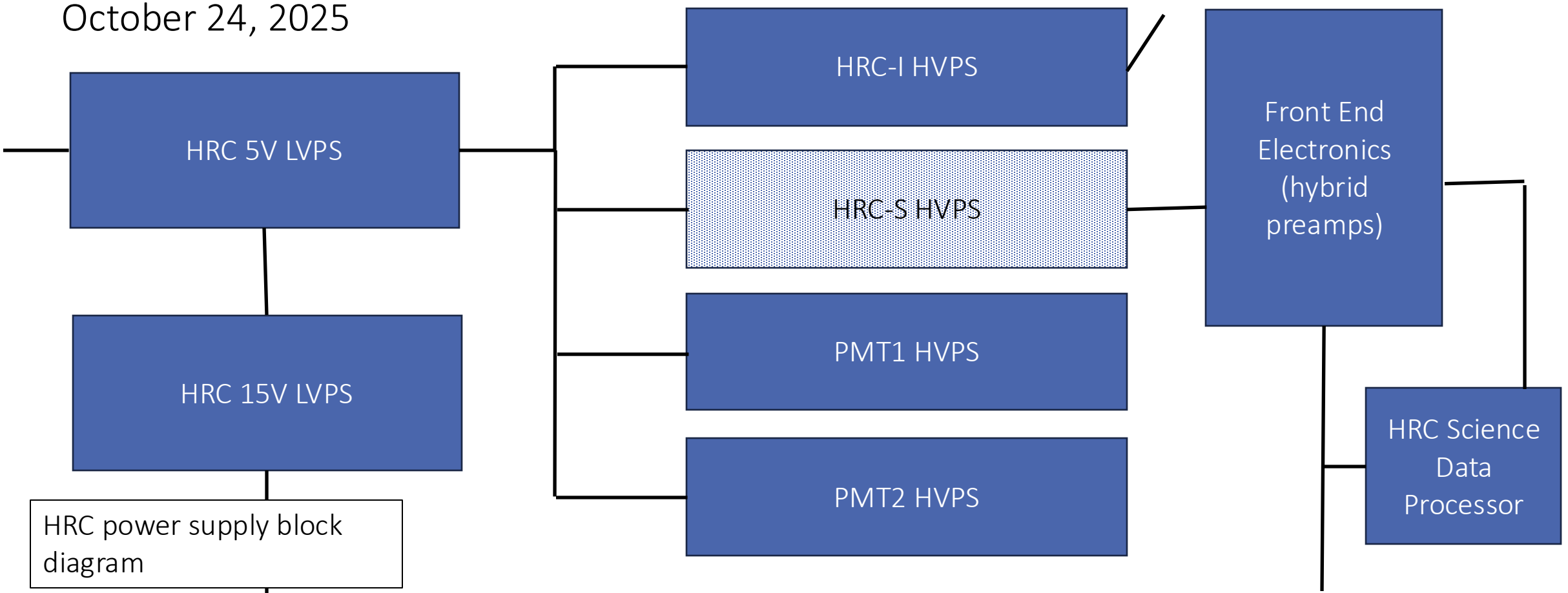
2025 HRC Status – CUC Briefing

Dan Patnaude

11/10/2025

Current Status of Chandra HRC

- HRC observations are currently suspended pending outcome of an engineering investigation into an anomaly with the HRC-S high voltage power supply that occurred on October 24, 2025

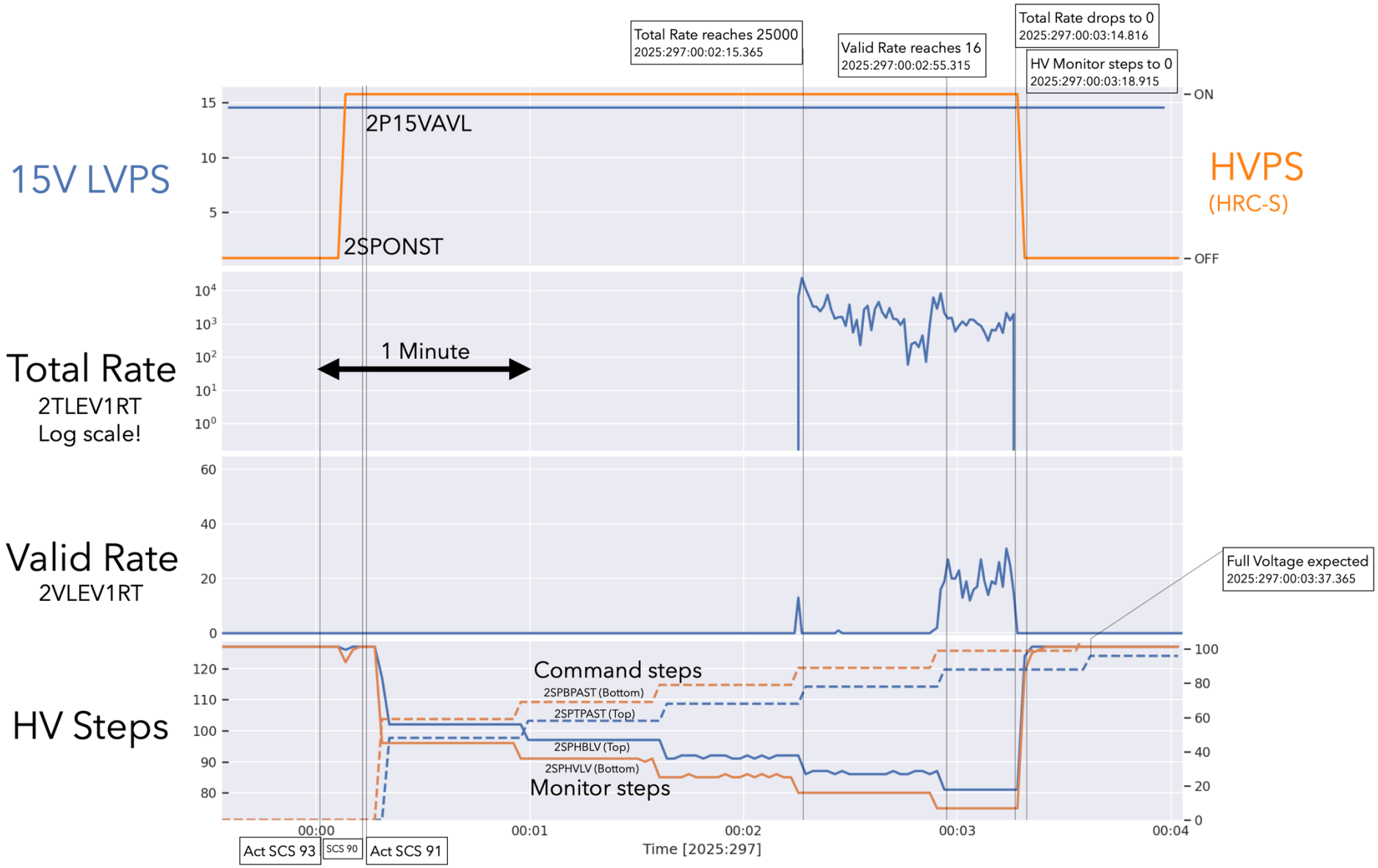


HRC power supply block diagram

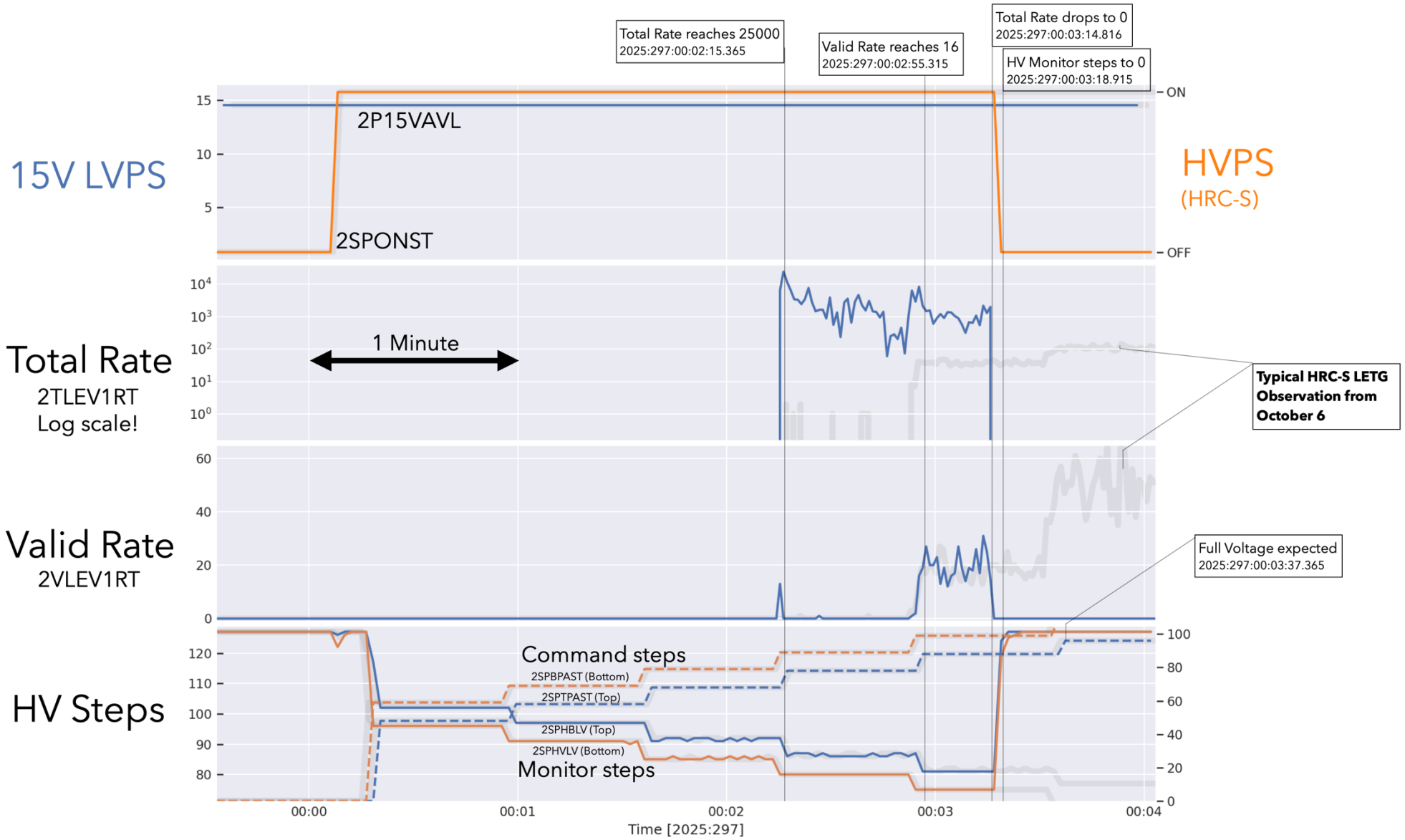
2025:297 HRC-S HVPS Anomaly

- During setup for an HRC-S/LETG observation of V1935 Cen, the HRC-S high voltage power supply (HVPS) shutdown during step 5 (out of 6 steps) of the HVPS ramp-up
  - Preliminary indications are that the HVPS current limiting circuit behaved as expected
- Ongoing analysis of available telemetry show high total event rates (> 10000 c/s average) prior to shutdown
- The shutdown occurred at 2025:297:00:03:15.815 UT
  - The HRC team noted the anomalous state at the start of a comm which overlapped with the observation
- The team, in consultation with the on duty FD and the LSE executed commands to halt the HRC observation and leave the HRC in a safe state
  - All subsequent observations in the schedule were treated as IDLE time (2 GO observations and 2 calibration observations)

2025:297 HRC-S HVPS Anomaly



2025:297 HRC-S HVPS Anomaly



2025:297 HRC-S HVPS Anomaly

- HRC event logic:
  - Events are initially registered via a PHA signal triggered from the MCP glass
    - Events with 8 < PHA < 255 are considered valid, but this comparison is done via the science data processor
  - Electron cloud is read by backend amplifiers connected to a crossed wire grid
    - Shape of charge cloud is compared against a width threshold to discard events induced by charged particles (GCRs tend to produce very narrow charge distributions due to how they penetrate the MCP glass and eject electrons)
  - Anti coincidence is checked with anti-co shields (due to a pre-launch wiring error, anti-co vetoing is disabled for the HRC-S)
- If all are satisfied, the event is considered valid
- Note: As the processing electronics essentially lock up for 8 µs in order to process an event, valid events can be discarded (this is accounted for in the dead time correction)
- During HV ramp up, we expect no valid events until step 5 in the ramp up process

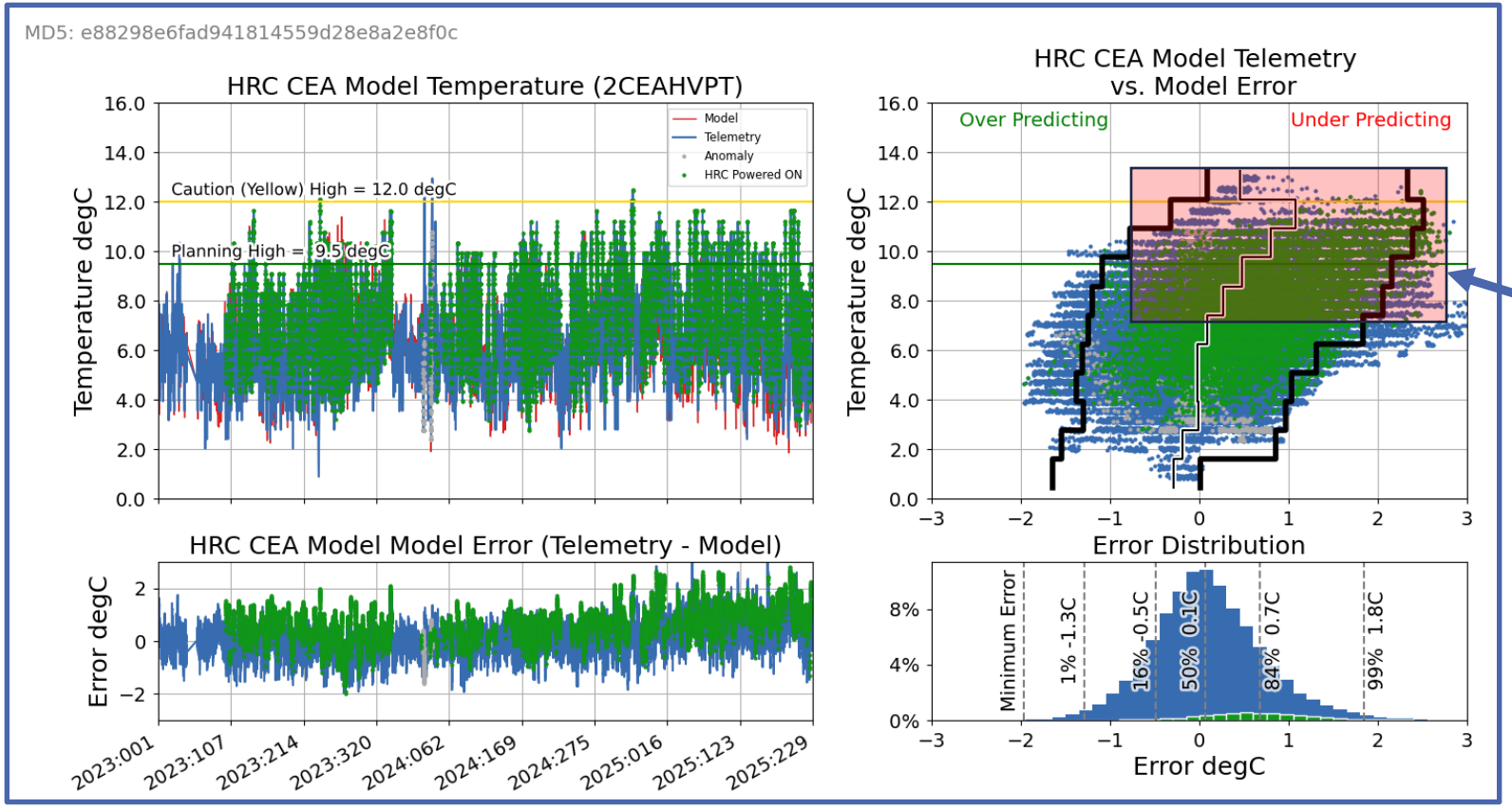
2025:297 HRC-S HVPS Anomaly

- Pathways to turning off the HVPS:
  - Command from the S/C (either via daily loads or via a safing action)
  - Current limit violation
  - Electronics failure (Single Event Upset)
- ➢ It **appears** as if there was an occurrence in the MCPs that created many invalid events and the current monitor was tripped
- Work is ongoing to determine the root cause
- Return to science activities are in the planning stage
  - Activities will be performed during real time contacts and will consist of stepped activities with each one requiring buy in from CXC stakeholders and approval from Chandra Project Science:
    - Verify backend electronics functionality (to be achieved with an HRC-I observation)
    - Verify HRC-S HVPS functionality
    - Verify HRC-S health with observations of cal sources → Vega for the UVIS, and ar Lac for the detector gain
- As noted, the HRC-S HVPS performed as designed. The current limiter logic is a flip flop and after engineering analysis of the lab unit, there is every expectation that the HVPS will power on

HRC LVPS Thermal and Voltage Monitor

- Work continues on the LVPS thermal and voltage monitor
  - Flight software patch was reviewed and approved on October 29, 2025
- Next steps:
  - Code review and approval → requires updates to several existing pieces of flight software
  - Changes to HRC command load definitions to account for new monitor
  - Updates to review software
- FSW patch can be uploaded to the software independent of ongoing HRC HVPS activities, and can reside onboard and remain inactive while work continues on ground segment portion of the patch (updates to HRC command files, load review software)
- While the logic and commanding of the patch is straightforward, this is a major effort with many moving parts and impact to multiple pieces of flight software and protected command sequences → we expect extensive ground testing of new commanding before the new patch is used as a part of the weekly planning process

HRC CEA Thermal Model



Performance of CEA thermal model from 2023:001 to present. Green points/lines indicate times when the HRC 15V is powered on.

- Heat from 15V is modeled as a constant input determined by the ON/OFF state of the power supply MSID
- Captures heating at low temperatures, but underpredicts heat input as the CEA temperature approaches the planning limit
- Work is underway to include a proportional heating component for the 15V LVPS , to better account for the heating at higher temperatures
  - The goal is to better characterize the heating at higher temperatures

Cycle 27 HRC Observations

- Cycle 27 HRC time is highlighted by two programs to observe planets with the HRC-S/LETG
  - 1 Ms of time to observe Jupiter
  - 140ks of time to observe Mars
- Both programs require extensive pre-planning by multiple teams
  - New HRC-S SIMODEs are in development to provide more active area on the detector
- Programs also exist to:
  - Measure the proper motion of neutron stars in SNRs
  - Measure the dust content in Cyg X-2 via a novel use of the HRC-I and HETG
  - Characterize the environments of exoplanets
  - Study the environments of evolved stars

Plans for HRC in FY26

- After a thorough and complete investigation, safely return the HRC-S to operations
- Complete work on updates to CEA thermal model
- Complete adoption of HRC voltage and thermal monitor