CHANDRA
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MEMORANDUM

Date:	October 2, 2025
From:	Jack Steiner
To:	Chandra Operations Team
Subject:	Chandra Commanded Radiation Shutdown on September 01, 2025
Cc:	MSFC Project Science, CXC Director's Office
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1 Abstract

A long-duration M2.7 flare on Aug. 30 produced an Earth-directed CME which impacted on Sep. 1, producing a pronounced spike in the ACE-P3 rates[1] exceeding 3×10^5 just prior to the 4:35pm comm. *txings* hadn't triggered and so a manual shutdown was executed at 5:09pm local time.

The estimated attenuated fluence saved from this shutdown is 4.6×10^9. This memo discusses the event timeline and the unusual timing of this particular event.

2 Introduction

The solar cycle appears to have possibly peaked within the last year which would be consistent with the apparent decline in solar radiation shutdowns in recent months. The CME responsible for this radiation shutdown was not exceptionally powerful (<M3), but its timing and direction meant it was able to have a large impact on Earth and cause a very large increase in particle rates. Notably, ACIS *txings* is the sole radiation monitor for *Chandra*, and so we are reliant on *txings* for autonomous safing. In this particular instance, comm times allowed for a manual radiation shutdown and it is unclear (though appears unlikely) whether a *txings* trip would have occurred autonomously. This was the second radiation-induced shutdown in 2025, and the first manual one.

[1] Standard unit definitions are given in § 6.

3 August 30-September 01 2025 Detailed Timeline

- 2025:242:20:02:00 M2.7 class solar flare was detected.
- 2025:244:20:43:00 CME alert was received.
- 2025:244:20:52:00 Telemetry was obtained *late* during 4:35pm comm following initial DSN-connection difficulties. No *txings* trip was observed and ACE-P3 rates had exceeded 300,000.
- 2025:244:21:00:00 `sot_red_alert` sent calling for a radiation telecon.
- 2025:244:21:09:39 Manual SCS-107 executed.
- 2025:246:00:46:00 Science resumption load began.

4 September 01, 2025 Radiation Increase and Shutdown Discussion

The rapid increase in ACE rates in evidence (see Figs. 2 and 1) was pronounced, and has been attributed to the strong Earth-directed nature of the CME resulting in a narrow shock-front which impacted dramatically and subsequenty passed quickly (in < 24 hrs). ACE-P3 rates first crossed 100,000 at 244:20:15, *less than* an hour before the manual shutdown was commanded. The peak ACE-P3 rate of 321,000 occurred at 244:20:30, less than 40 minutes prior to the manual shutdown. This quick response was only possible given the confluence of the particle-rate increase and a DSN comm at 244:20:35. In fact, here a more rapid shutdown may have been possible had there not been communication problems with DSN over the first 10-15 minutes of comm. By the time the radiation telecon was held, the impressive rates on display led to rapid consensus that a shutdown was necessary. As it was clear that *txings* had not autonomously tripped already, SCS-107 was manually commanded, with the shutdown recorded at 244:21:09:39.

Fig. 3 shows the *txings* rates, and Fig. 4 shows current *txings* proxy rates. GOES proton rates are shown in Fig. 5. The GOES > 10 MeV rates did not even reach threshold for a S1-class Solar Radiation Storm, which is an indirect indicator that *txings* is unlikely to have had a strong response. Based on these plots, with a caveat that the proxy is under calibration and development, it *appears* unlikely that a *txings* trigger would have occurred. We are fortunate for the timing of the comm schedule which allowed such a rapid manual shutdown which was able to prevent appreciable fluence of potentially damaging low-energy protons.

5 Outcome

This event was about as perfectly timed as could be envisioned for an effective manual shutdown to take place. The team's responsiveness to the radiation event, and the quickly-reached mission consensus to enact the shutdown saved 4.6×10^9attenuated fluence, with an accumulation of just 1.3×10^9attenuated fluence for the orbit.

It was noticed during this event that the large jump in ACE-P3 rates resulted in those being incorrectly flagged as spurious and ignored by the ACIS fluence monitor, inhibiting a proper fluence assessment for the orbit at the time of decision-making. A possible software change to the fluence monitor to address this in the future is under exploration.

6 Notes

ACE data were obtained from `ftp://mussel.srl.caltech.edu/pub/ace/browse/`.

ACE fluxes are given in units of particles s^{-1} cm^{-2} MeV^{-1} sr^{-1}, and ACE fluences are in units of particles cm^{-2} MeV^{-1} sr^{-1}.

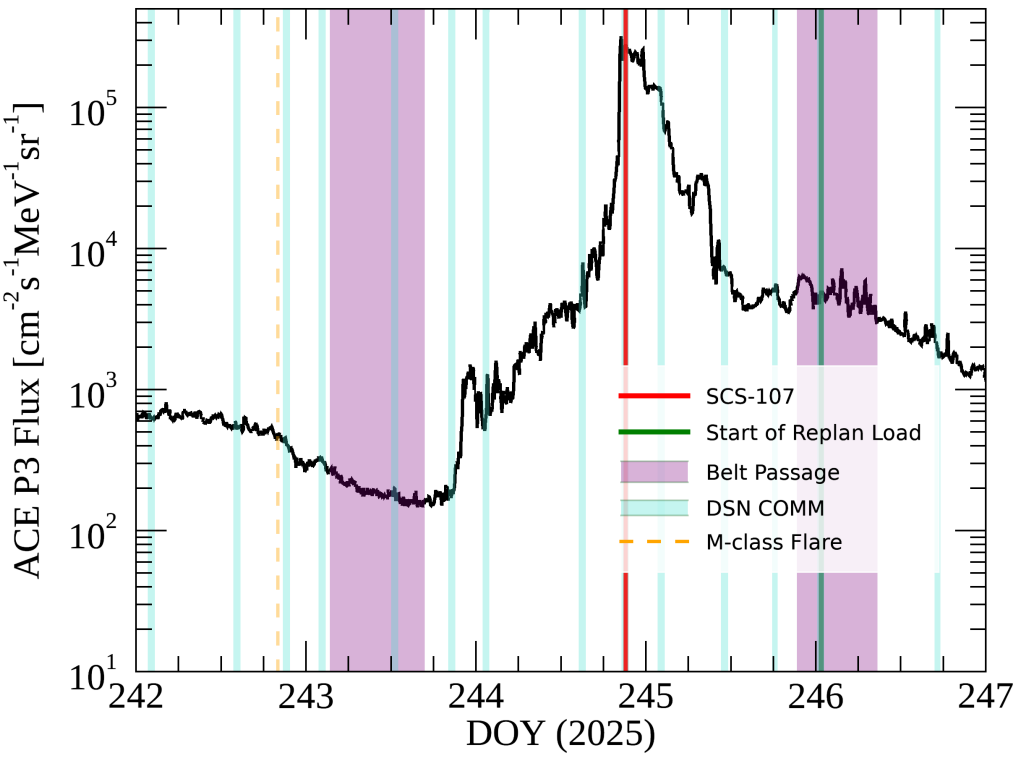

Figure 1: The ACE P3 flux associated with the M2.7 flare and Earth-impacting CME, with time markers indicating the start of the science-resumption load (dark green), the manual SCS-107 (solid red), and the time of the flare (orange). Shaded regions indicate belt passages (purple) and DSN comms (blue). Note the striking confluence of the peak which just preceded the comm which allowed for a rapid shutdown to be initiated.

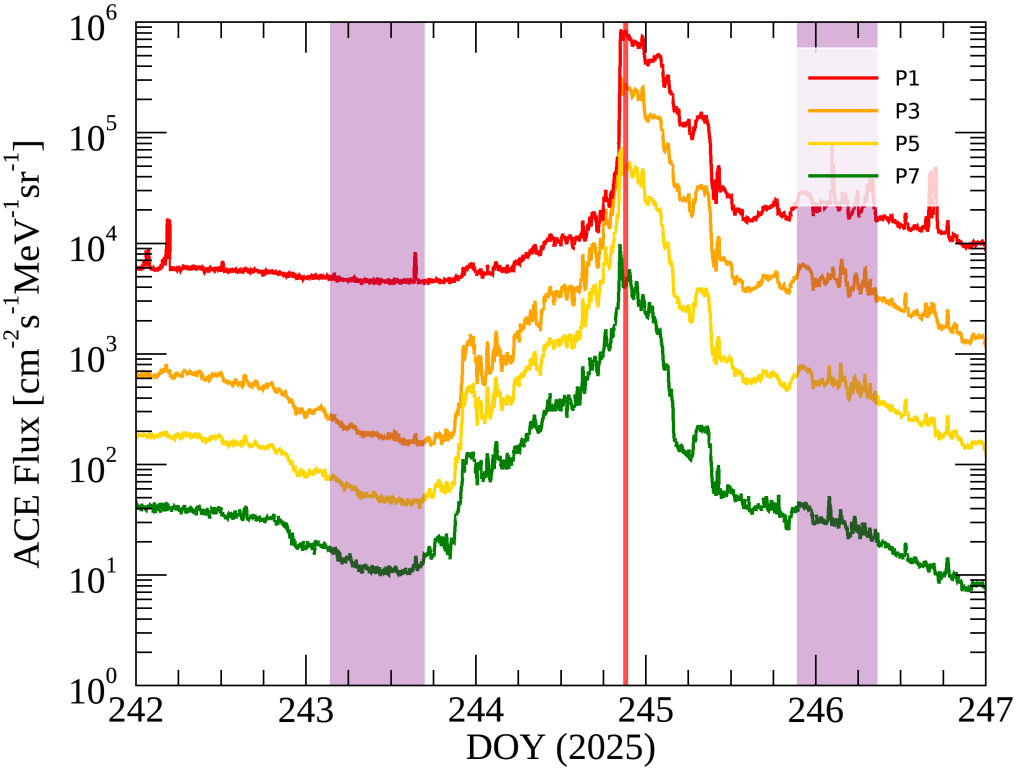

Figure 2: ACE proton bands associated with the M2.7's CME. The red vertical line marks the time of shutdown and purple shaded regions depict the belt passages.

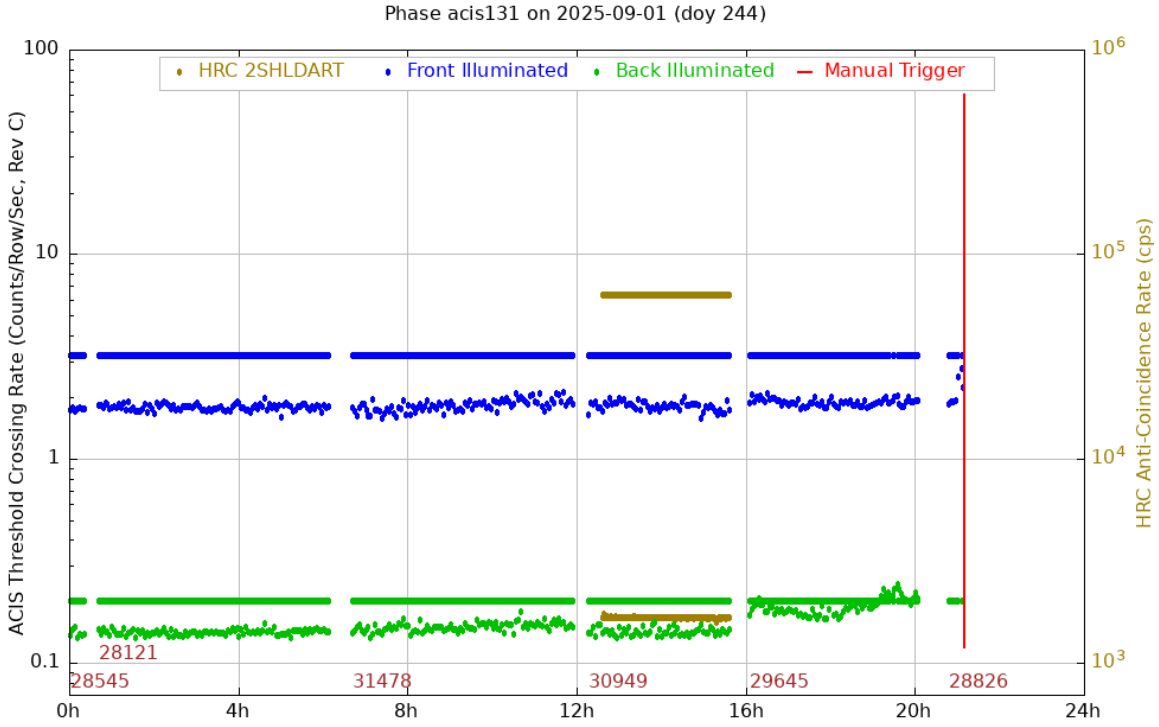

Figure 3: *txings* data taken on 2025 September 01 which shows rising *txings* rates leading up to the manual SCS-107 (obtained courtesy P. Ford).

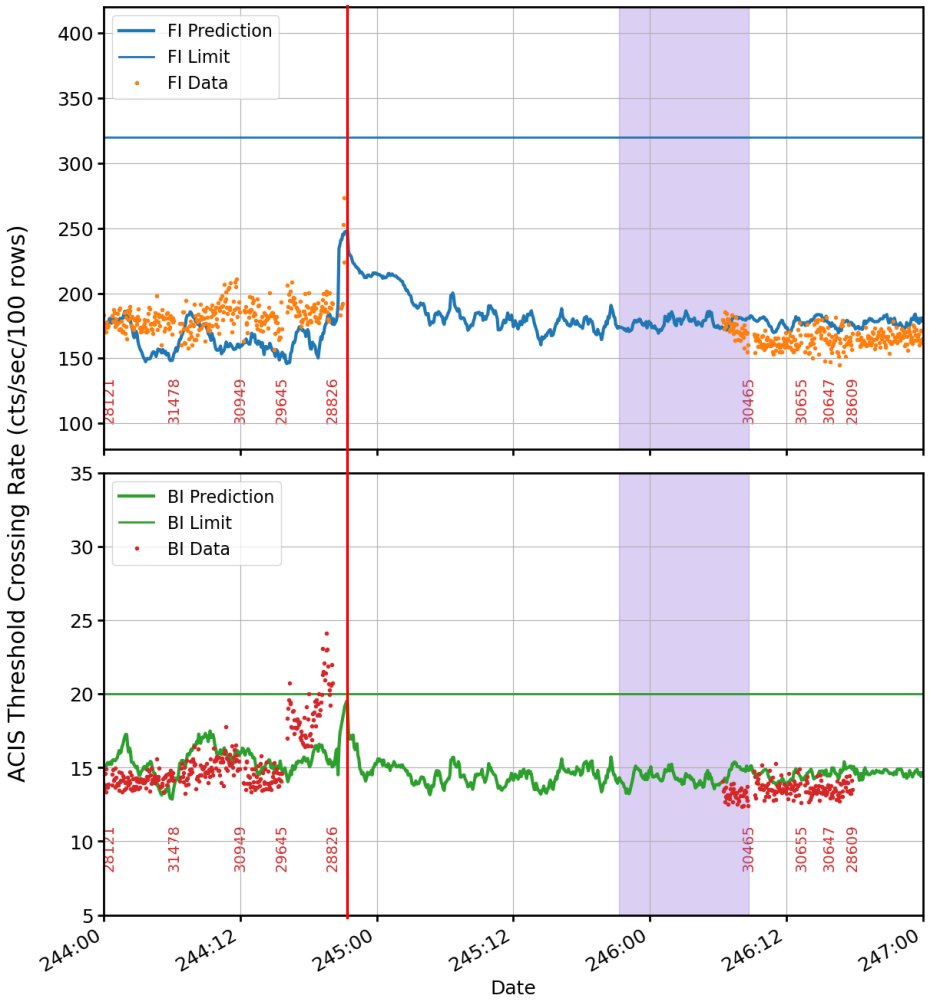

Figure 4: *txings* proxy for the radiation environment on 2025 September 01. The approximate time of manual shutdown is marked in red. The proxy doesn't indicate an autonomous trigger would have occurred (proxy data courtesy J. ZuHone).

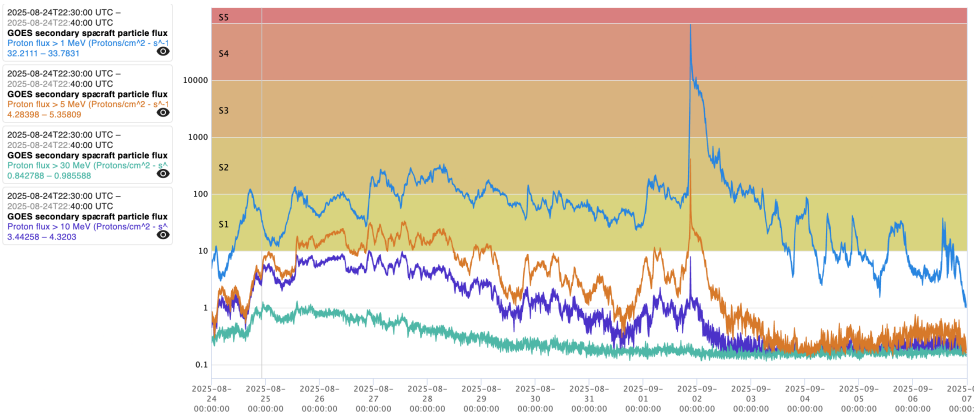

Figure 5: GOES proton rates in particles cm^{-2} s^{-1} sr^{-1} MeV^{-1} for protons > 1 MeV, > 5 MeV, > 10 MeV and > 30 MeV in energy in blue, orange, purple, and teal, respectively. Plot generated via the LASP Space-Weather Portal (`https://lasp.colorado.edu/space-weather-portal`). The NOAA Solar Radiation Storm Scale marked in color bands corresponds to the > 10 MeV proton rates (purple line). Notably, at no point did the particle rates associated with the CME reach even a S1-scale storm.