

LAXPC10 anomaly on 26 March 2018

9 August 2022

Around 05:36 UT on 26 March 2018 during orbit 13470 ($T = 259738560$ s) the count rate in LAXPC10 showed a strong burst with dead-time corrected peak count rate of about 40000 s^{-1} . After that the counts and spectrum were erratic. Although, the cause of anomaly is not known, as a matter of precaution against possible corona it was decided to reduce the high-voltage by about 200 V and the HV adjustment command was implemented at 9:20 UT on 29 March 2018 during orbit 13517 ($T = 260011200$ s). Since the counts were stable after this adjustment, the HV was increased by about 100 V and the LLD threshold of A6 and A7 were also raised to avoid low channel spikes. These changes were implemented at 08:00 UT on 30 March 2018 during orbit 13531 ($T = 260092800$ s). After reducing the voltage the count rate was not totally stable, there were periods when it showed abnormal counts. These periods can be distinguished by a dip in ULD count rate. The time intervals with ULD count rate below 450 s^{-1} can be treated as bad time interval.

The HV was again reduced by about 100 V at 10:52 UT on 2 April 2018 during orbit 13577 ($T = 260362320$ s). After that no anomaly was observed and the ULD and K-threshold were adjusted at 6:27 UT on 4 April 2018 during orbit 13604 ($T = 260519220$ s). Since then a few abnormal count rate intervals have been observed. These can again be identified by a dip in ULD count rate below 750 s^{-1} . These rejection criterion has been implemented in the software. In order to control these instances some LLD thresholds were raised at 8:55 UT on 6 April 2018 during orbit 13625 ($T = 260700900$ s) but these intermittent bursts continue.

The HV was reduced by another 200 V at 08:20 UT on 27 April 2018 during orbit 13945 ($T = 262513200$ s). After that the detector was stable but the LLD threshold was around 10 keV and the counts from the sources were not clearly seen. The detector was switched off at 08:00 UT on 1 May 2018 during orbit 14004 ($T = 262857600$ s) and was switched on at 10:18 UT on 2 May 2018 during orbit 14020 ($T = 262952280$ s) with HV set to be about 200 V below the nominal operating HV. After that the detector was stable and the HV was increased by about 100 V at 08:47 UT on 7 May 2018 during orbit 14093 ($T = 263378820$ s). The counts were not stable at this HV and hence the HV was reduced by about 100 V back to the old value at 07:20 UT on 8 May 2018 during orbit 14107 ($T = 263460000$ s), but the counts were not stable. As a result the detector was switched off for 2 orbits on 9 May 2018, from 09:27 UT during orbit 14124 ($T = 263554020$ s) to 13:00 UT during orbit 14126 ($T = 263566800$ s). After that also the count rate was not stable. However, on 17 May 2018 from orbit 14241 ($T = 264229000$ s) the counts suddenly became stable without any intervention. Since then the counts were stable in LAXPC10 until about 8:30 UT on 2 June 2018 during orbit 14479. After that the data loss due to intermittent burst is very high.

The detector was switched off around 08:25 UT on 7 June 2018 during orbit 14552 ($T = 266055840$ s). It was switched on around 07:02 UT on 8 June 2018 during orbit 14566 ($T = 266137320$ s). Since the counts were not stable the HV was reduced by about 100 V at around 08:03 UT on 15 June 2018 during orbit 14670 ($T = 266745780$ s). After the HV reduction the counts are stable. With this HV the LLD threshold is about 8 keV and ULD threshold is about 115 keV. As a result the total background counts are higher. On 16 July 2018, the counts again became unstable and there was 80% data loss due to bursts. Hence the HV was reduced by about 100 V at around 11:25 UT on 30 July 2018 during orbit 15340 ($T = 270645900$ s). After this the counts are stable. With this HV the LLD threshold is about 11 keV and ULD threshold is about 190 keV.

On 11 October 2018 the count rate again became unstable and there was over 90% data loss due to bursts. Hence the HV was reduced by about 100 V at around 09:43 UT on 15 October 2018 during orbit 16477 ($T = 277292580$ s). After this also the counts were unstable and data loss of about 80% persisted. As a result the detector was switched off for one day at 05:24 UT on 22 October 2018 during orbit 16578 ($T = 277881840$ s). The detector was switched on at 07:34 UT on 23 October 2018 during

Summary of all events in LAXPC10 after 26 March 2018

Time (s)	Orbit	Event	Comments	Background	Response
05:36 259738560	26Mar18 13470	Erratic counts 1988	Data not useful		
09:20 260011200	29Mar18 13517	HV down by ~ 200 V 1990	Counts stable use only single events	earth occult	cshm141SEv1.1
08:00 260092800	30Mar18 13531	HV up by ~ 100 V LLD of A6, A7 raised 1992	Intermittent burst use only single events reject time with ULD < 450 s $^{-1}$	earth occult apr18	cshm81SEv2.0
09:52 260362320	02Apr18 13577	HV down by ~ 100 V 2002	Counts stable use only single events	earth occult	cshm141SEv2.0
06:27 260519220	04Apr18 13604	ULD and K-limits adjusted 2008	Intermittent bursts reject time with ULD < 750 s $^{-1}$	earth occult aps18	cshm141v2.1
08:55 260700900	06Apr18 13625	LLD of A6–A9 adjusted 2018	Intermittent bursts reject time with ULD < 750 s $^{-1}$	earth occult aps18	cshm141v2.2
08:20 262513200	27Apr18 13945	HV down by ~ 200 V 2060	Counts stable	earth occult	cshm193SEv2.2
08:00 262857600	01May18 14004	Switch off 2068	No data	No Data	
10:18 262952280	02May18 14020	Switch on HV up by ~ 200 V 2070	Counts Stable	earth occult aps18	cshm141v2.2
08:47 263378820	07May18 14093	HV up by ~ 100 V 2078	Intermittent burst use only single events reject time with ULD < 450 s $^{-1}$	earth occult apr18	cshm81SEv2.0
07:20 263460000	08May18 14107	HV down by ~ 100 V 2080	Intermittent bursts reject time with ULD < 750 s $^{-1}$	earth occult aps18	cshm141v2.2
09:27 263554020	09May18 14124	detector off 2082	No data		
13:00 263566800	09May18 14126	detector on 2082	Intermittent bursts reject time with ULD < 750 s $^{-1}$	earth occult aps18	cshm141v2.2
08:25 266055840	07Jun18 14552	Switch off 2144	No data	No Data	
07:02 266137320	08Jun18 14566	Switch on 2146	Intermittent bursts reject time with ULD < 750 s $^{-1}$	earth occult jun18	cshm141v2.2
08:03 266745780	15Jun18 14670	HV down by ~ 100 V 2170	Counts stable use only single events reject time with ULD < 450 s $^{-1}$	earth occult jul18	cshm175SEv2.2
11:25 270645900	30Jul18 15340	HV down by ~ 100 V 2260	Counts stable use only single events reject time with ULD < 300 s $^{-1}$	earth occult aug18,sep18	cshm197SEv2.2
09:43 277292580	15Oct18 16477	HV down by ~ 100 V 2438	Intermittent bursts use only single events reject time with ULD < 200 s $^{-1}$	earth occult oct18–mar19	cshm212SEv2.2
05:24 277881840	22Oct18 16578	Switch off 2444	No data	No Data	
07:34 277976040	23Oct18 16594	Switch on 2446	Counts stable use only single events reject time with ULD < 200 s $^{-1}$	earth occult oct18–mar19	cshm212SEv2.2
07:23 293181780	17Apr19 19199	HV down by ~ 100 V 2838	Intermittent bursts use only single events reject time with ULD < 130 s $^{-1}$	earth occult apr19	cshm220SEv2.2
03:00 36901	26Jul22 36901	HV down by ~ 100 V	Intermittent bursts	Data not useful since orbit 36462 on 26Jun22	

orbit 16594 ($T = 277976040$ s). At this HV the LLD threshold is about 15 keV and the ULD threshold is about 310 keV.

During orbit 19080 on 9 April 2019, LAXPC10 again started showing erratic counts. During the six months since the last HV adjustment the gain had increased by about 1/3 of the reduction on 15 October 2018. During the last one year since the problem started the HV has been reduced by five steps of about 100 V, while gain shift during this period has compensated for about one of this step. Since the spectrum continued to be erratic the HV was lowered by about 100 V at 07:23 UT on 17 April 2019 during orbit 19199 ($T = 293181780$ s). After this some intermittent burst in ULD counts continued, but since 20 April 2019 the counts are stable. At this HV the LLD threshold is about 30 keV and ULD threshold is about 400 keV. With this gain it is difficult to estimate the position of peaks in A8 as it is close to the LLD threshold of A8 and hence is difficult to get any reliable measure of the gain shift. As a result the data may not be useful.

During orbit 24705 on 23 April 2020, LAXPC10 again started showing erratic counts and the spectrum was erratic, though the total count rates were close to normal. On 27 April 2020 the burst in SGR 1935+2154 was still detected in LAXPC10. We are keeping watch on its performance. On 3 May 2020 during orbit 24870, the erratic counts stopped and LAXPC10 counts and spectrum were at the state before 23 April 2020.

During orbit 29830 on 4 April 2021, LAXPC10 again started showing erratic counts and the spectrum was erratic, though the total count rates were close to normal. On 14 April 2021 during orbit 29979, the erratic counts stopped and LAXPC10 counts and spectrum were at the state before 4 April 2021. The data obtained during this period should be rejected. With the drift in gain, the LLD threshold of LAXPC10 as on 16 April 2021 is about 20 keV, while the ULD is around 230 keV.

During orbit 33863 on 1 January 2022, LAXPC10 again started showing erratic counts and the spectrum was erratic, though the total count rates were close to normal. On 12 January 2022 during orbit 34018, the erratic counts stopped and LAXPC10 counts and spectrum were at the state before 1 January 2022. During this time LAXPC10 did detect GRB 220107A. The data obtained during this period should be rejected. With the drift in gain, the LLD threshold of LAXPC10 as on 13 January 2022 is about 16 keV, while the ULD is around 190 keV.

During orbit 36462 on 26 June 2022, LAXPC10 again started showing erratic counts and the spectrum was erratic, though the total count rate was close to normal. Since this erratic behaviour continued the HV was reduced by around 100 V during orbit 36901 around 03:00 UT on 26 July 2022 ($T \approx 396501000$). After this there is some improvement in the behaviour, but erratic counts and spectrum continue to some extent. Further, it is not possible to have any estimate of the gain of the detector as no peak is seen in the veto Anode A8. As a result, the data are not usable.

Table 1 lists all events and adjustments made Table 1 lists all events and adjustments made and recommendation for background and response files. The comments apply to time interval starting from the event time till the next event.

Rejection of events based on ULD threshold is implemented in the software. However, this may not be perfect, so some adjustment may be needed in gti file after looking at the light curve. During the time when adjustments were being made it is best to use background spectrum and counts from observation during Earth Occultation. Some background observation is available for all values of HV, but there could be some variations.

Before the K-thresholds were adjusted on 4 April 2018, it is necessary to use only single events as the logic for double events will not be correctly implemented. This option is available in new version of software ($iev = -1$ or 1). Considering the unpredictable nature of detector no adjustment of ULD and K-threshold is planned at the HV values used after 15 June 2018, and hence it is advisable to use only single events.

The responses listed are indicative, neighbouring responses may also be tried, if available. The program backshifv3.f may not work for the time covered by this table as appropriate background may not be available. For the times where the response file v2.2 is recommended the latest version of backshifv3 may be able to calculate the shift and recommend appropriate response. During these

period the peak channel at 30 keV has shifted at a rate that is comparable to that before April 2018.

The LLD threshold was around 10 keV during the period before 15 October 2018. As a result, the count rates for the source is reduced. This has reduced even further after reduction in HV. Latest version of the software would be required for analysing these data.