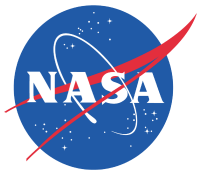

Kepler Data Release 10 Notes

KSCI-19050-001
Data Analysis Working Group (DAWG)
Jessie Christiansen (Editor)

Data Release 10 for Quarter Q7

Q.m		First Cadence MJD midTime	Last Cadence MJD midTime	First Cadence UT midTime	Last Cadence UT midTime	Num CINs	Start CIN	End CIN
7	LC	55462.6725	55552.0491	23-Sep-2010 16:08:24	22-Dec-2010 01:10:42	4375	25509	29883
7.1	SC	55462.6626	55492.7811	23-Sep-2010 15:54:09	23-Oct-2010 18:44:47	44200	753730	797949
7.2	SC	55493.5378	55522.7367	24-Oct-2010 12:54:26	22-Nov-2010 17:40:51	42870	799060	841929
7.3	SC	55523.6161	55552.0590	23-Nov-2010 14:47:11	22-Dec-2010 01:24:58	41760	843220	884979

Prepared by: _____ Date: 4/13/11
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Approved by: Michael R. Haas Date: 4/13/11
Michael R. Haas, Kepler Science Office Director

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Contents

Prefatory Admonition to Users

The corrected light-curve product generated by the PDC (Pre-search Data Conditioning) pipeline module is designed to enable the Kepler planetary transit search. Although significant effort has been expended to preserve the natural variability of targets in the corrected light curves in order to enable astrophysical exploitation of the Kepler data, it is not possible to perfectly preserve general stellar variability on long timescales with amplitudes comparable to or smaller than the instrumental systematics, and PDC currently is known to remove or distort astrophysical features in a subset of the corrected light curves. In those cases where PDC fails, or where the requirements of an astrophysical investigation are in conflict with those for transit planet search, the investigator should use the raw light-curve product, for which basic calibration has been performed but correction for instrumental systematics has not, instead of the PDC (corrected) light-curve product. Where appropriate, the investigator can then use the ancillary engineering data and image motion time series provided in the relevant Data Release Notes Supplement/s for systematic error correction. Investigators are strongly encouraged to study the Data Characteristics Handbook and Data Release Notes for any data sets they intend to use. The Science Office advises against publication of results based on Kepler light curves without careful consideration and due diligence by the end user, and dialog with the Science Office or Guest Observer Office where appropriate.

Users are encouraged to notice and document artifacts, either in the raw or processed data, and report them to the Science Office at kepler-scienceoffice@lists.nasa.gov.

Users who neglect this admonition risk seeing their works crumble into ruin before their time.

1 Introduction

These Data Release Notes provide information specific to the release of Q7 data, processed with SOC Pipeline 6.2. These Notes contain the summary figures and tables for this quarter—the companion text can be found in the Kepler Data Characteristics Handbook (KSCI-19040). The sections are numbered in the same order in these Notes and the Handbook to assist the reader.

1.1 Dates, Cadence Numbers, and Units

No changes from the Data Characteristics Handbook.

Contents of Data Release 10.

Q.m		First Cadence MJD midTime	Last Cadence MJD midTime	First Cadence UT midTime	Last Cadence UT midTime	Num CINs	Start CIN	End CIN
7	LC	55462.6725	55552.0491	23-Sep-2010 16:08:24	22-Dec-2010 01:10:42	4375	25509	29883
7.1	SC	55462.6626	55492.7811	23-Sep-2010 15:54:09	23-Oct-2010 18:44:47	44200	753730	797949
7.2	SC	55493.5378	55522.7367	24-Oct-2010 12:54:26	22-Nov-2010 17:40:51	42870	799060	841929
7.3	SC	55523.6161	55552.0590	23-Nov-2010 14:47:11	22-Dec-2010 01:24:58	41760	843220	884979

2 Release Description

No changes from the Data Characteristics Handbook.

3 Evaluation of Performance

3.1 Overall

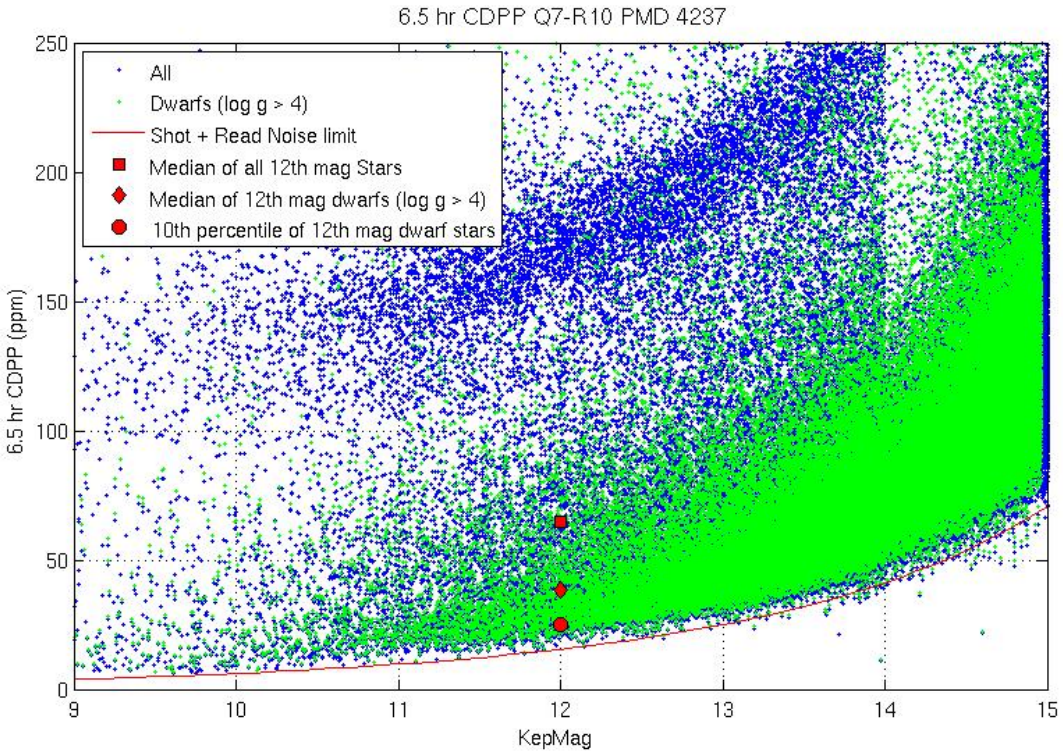

Figure 1: 6.5 hr Temporal Median (TM) of the Q7 CDPP time series calculated by the TPS pipeline module for stars between 9^{th} and 15^{th} magnitude. The 6 hr TMCDPPs have been divided by sqrt(13/12) = 1.041 to approximate 6.5 hr TMCDPPs. Stars on the planetary target list with log g > 4, which are almost certainly dwarf stars, are shown as green + symbols; other stars are marked with blue + symbols.

Table 1: Aggregate statistics for the TMCDPPs plotted in Figure 1. Column Definitions: (1) Kepler Magnitude at the center of the bin. Bins are ± 0.25 mag, for a bin of width 0.5 mag centered on this value. (2) Number of dwarfs (log g > 4) in the bin. (3) 10th percentile TMCDPP for dwarfs in the bin. (4) Median TMCDPP for dwarfs in the bin. (5) Number of all stars in the bin. (6) 10th percentile TMCDPP of all observed stars in the bin. (7) Median TMCDPP for all stars in the bin. (8) Simplified noise model CDPP.

Kp mag	No. dwarfs	10th prctile	Median	No. stars	10th prctile	Median	Noise model
9.0	25	9.6	21.7	180	11.5	76.2	3.8
10.0	161	12.2	35.7	572	14.1	106.0	6.0
11.0	594	18.2	34.7	1704	20.7	97.3	9.5
12.0	2147	24.9	38.2	4265	26.7	65.0	15.2
13.0	6809	36.0	50.0	10038	37.5	58.9	24.4
14.0	0	0.0	0.0	16241	56.6	77.4	40.1
15.0	0	0.0	0.0	27797	96.1	129.9	68.8

4 Historical Events

In this Section, we discuss cadences that may not be useful for high-precision photometry due to planned or unplanned spacecraft events.

4.1 Kepler Mission Timeline to Date

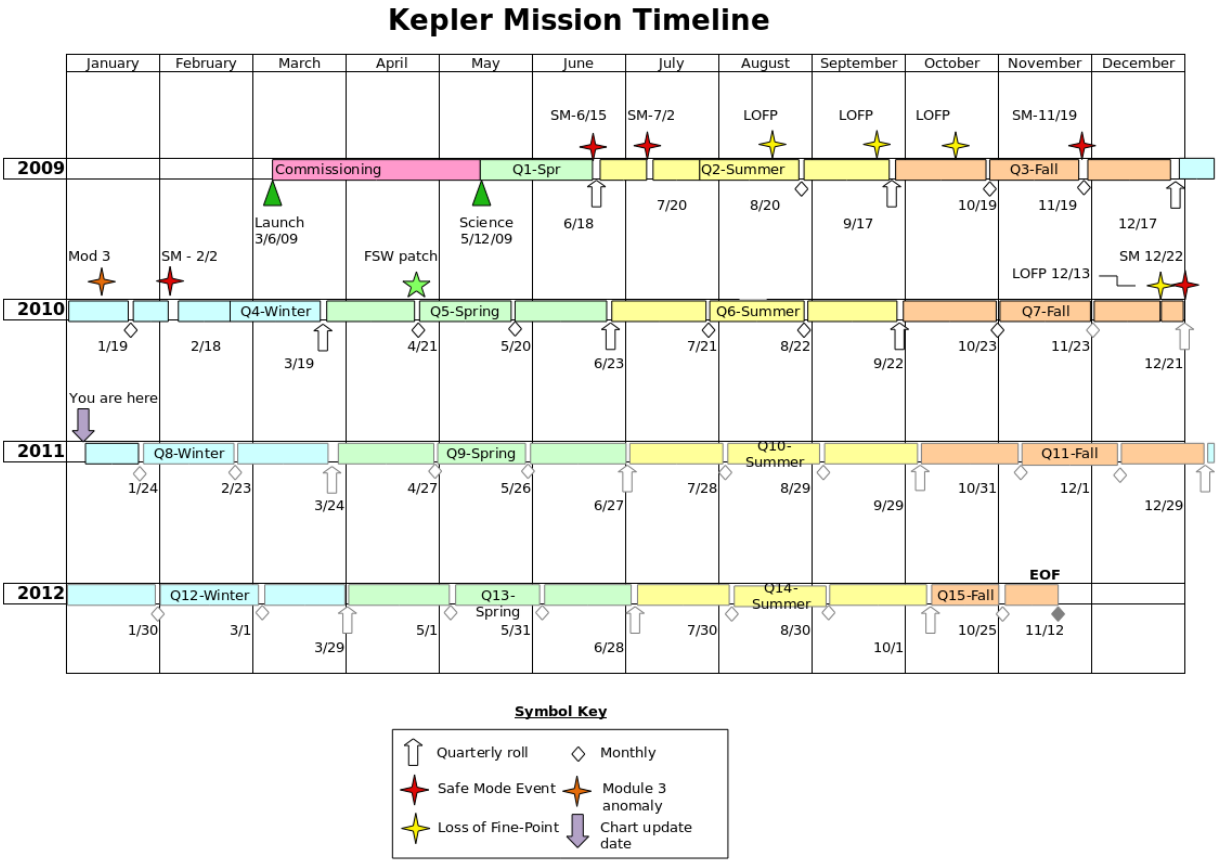

Figure 2: Kepler Mission Timeline as of the end of Q7.

4.2 Safe Mode

There were no Safe Modes in Q7. The Safe Mode shown in Figure 2 on 12/22/10 occurred during the quarterly roll maneuver and has no impact on the Q7 data.

4.3 Loss of Fine Point

The cadences obtained when the spacecraft was not in fine point are listed in Tables 7 and 8, the LC and SC anomaly summary tables respectively.

4.4 Attitude Tweaks

The pointing history is shown in Figure 3; there were no attitude tweaks over the course of Q7.

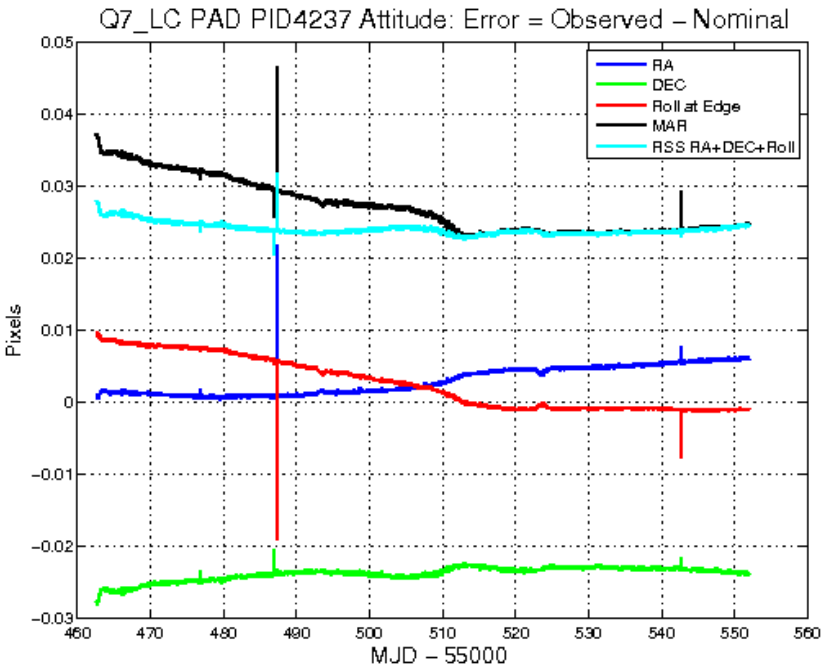

Figure 3: Attitude Error in Q7, calculated by PAD using Long Cadence data. The spikes in the attitude solution are Argabrightening events not marked as bad cadences by the pipeline.

4.5 Variable FGS Guide Stars

No changes from the Data Characteristics Handbook.

4.6 Module 3 Failure

No changes from the Data Characteristics Handbook.

5 Ongoing Phenomena

In this Section, we document the systematic errors arising in nominal on-orbit operations, most of which will be removed from the "corrected" flux time series by the scientific pipeline.

5.1 Image Motion

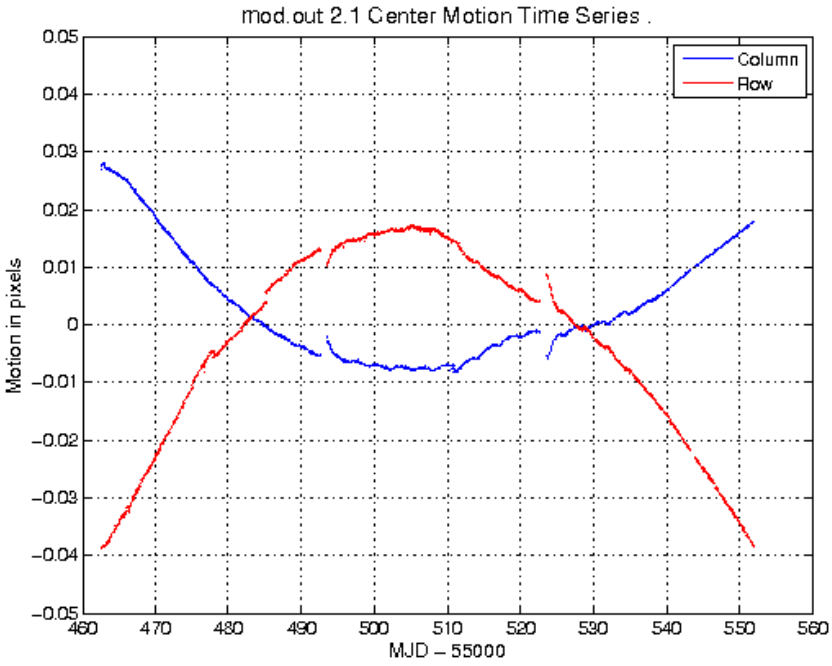

Figure 4: The center motion time series for module 2, output 1. The gaps at MJD-55000 = 493 and 523 are monthly Earth contacts.

5.2 Focus Changes

The change in width of the PRF with time is shown in Figure 5.

5.3 Momentum Desaturation

The Long Cadences affected by momentum desaturations in the reaction wheels are listed in Table 2, and the Short Cadences in Table 3.

Table 2: Momentum desaturations in Q7 and the corresponding Long Cadences. CIN = cadence interval number, RCI = relative cadence index.

LC		
CIN	RCI	Date (MJD)
25610	102	55464.73630
25756	248	55467.71961

Continued on next page

Table 2 – continued from previous page

CIN	RCI	Date (MJD)
25902	394	55470.70291
26048	540	55473.68622
26194	686	55476.66952
26340	832	55479.65283
26486	978	55482.63614
26632	1124	55485.61944
26778	1270	55488.60275
26924	1416	55491.58606
26981	1473	55492.75077
27126	1618	55495.71364
27272	1764	55498.69695
27418	1910	55501.68026
27564	2056	55504.66356
27710	2202	55507.64687
27856	2348	55510.63017
28002	2494	55513.61348
28148	2640	55516.59679
28294	2786	55519.58009
28440	2932	55522.56340
28585	3077	55525.52627
28731	3223	55528.50958
28877	3369	55531.49289
29023	3515	55534.47619
29169	3661	55537.45950
29315	3807	55540.44280
29461	3953	55543.42611
29618	4110	55546.63419
29770	4262	55549.74009
29882	4374	55552.02866

Table 3: Momentum desaturations in Q7 and the corresponding Short Cadences. CIN = cadence interval number, RCI = relative cadence index. The months are separated by horizontal lines.

SC		
CIN	RCI	Date (MJD)
756770	3041	55464.73323
756771	3042	55464.73392
761150	7421	55467.71654
761151	7422	55467.71722
765530	11801	55470.69985
765531	11802	55470.70053
769910	16181	55473.68315
769911	16182	55473.68383
774290	20561	55476.66646
774291	20562	55476.66714
778670	24941	55479.64977

Continued on next page

Table 3 – continued from previous page

CIN	RCI	Date (MJD)
778671	24942	55479.65045
783050	29321	55482.63307
783051	29322	55482.63375
787430	33701	55485.61638
787431	33702	55485.61706
791810	38081	55488.59968
791811	38082	55488.60037
796190	42461	55491.58299
796191	42462	55491.58367
797900	44171	55492.74771
802250	3191	55495.71058
802251	3192	55495.71126
806630	7571	55498.69388
806631	7572	55498.69457
811010	11951	55501.67719
811011	11952	55501.67787
815390	16331	55504.66050
815391	16332	55504.66118
819770	20711	55507.64380
819771	20712	55507.64448
824150	25091	55510.62711
828530	29471	55513.61042
828531	29472	55513.61110
832910	33851	55516.59372
837290	38231	55519.57703
841670	42611	55522.56033
846020	2801	55525.52321
846021	2802	55525.52389
850400	7181	55528.50651
850401	7182	55528.50719
854780	11561	55531.48982
854781	11562	55531.49050
859160	15941	55534.47313
859161	15942	55534.47381
863540	20321	55537.45643
863541	20322	55537.45711
867920	24701	55540.43974
867921	24702	55540.44042
872300	29081	55543.42305
872301	29082	55543.42373
877010	33791	55546.63112
877011	33792	55546.63180
881570	38351	55549.73703
881571	38352	55549.73771
884930	41711	55552.02559

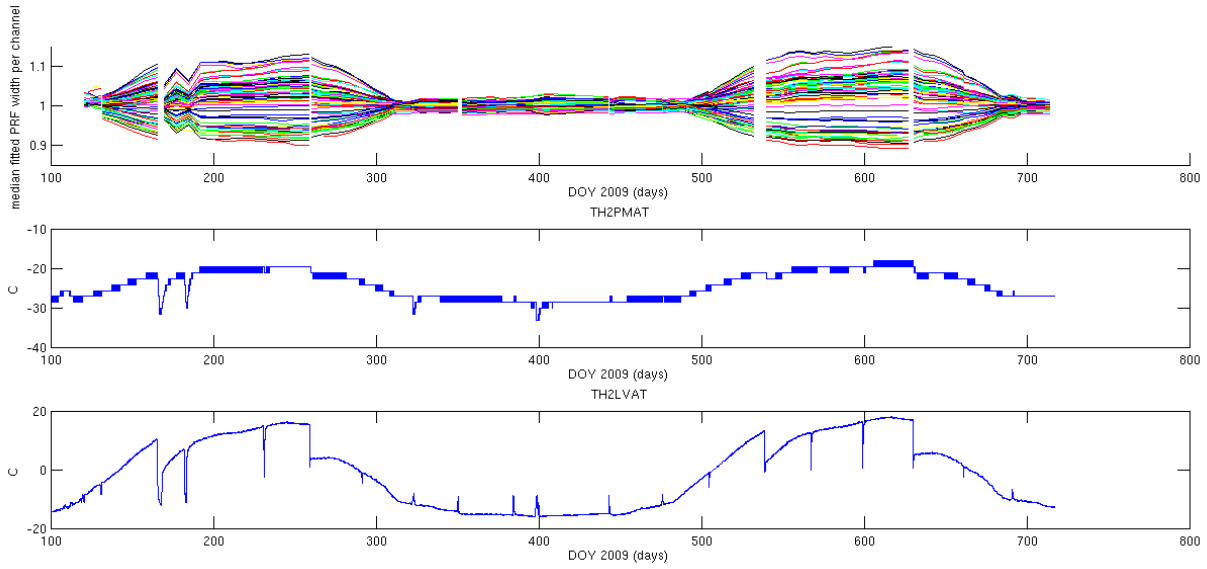

Figure 5: The correlation of the variation in PRF width with various spacecraft temperatures, demonstrating the seasonal nature of the focus and PRF changes.

5.4 Reaction Wheel Zero Crossings

The cadences occurring during reaction wheel zero crossings are listed in Table 4.

Table 4: Zero crossing events in Q7, defined as the time from first to last zero crossing in the event, rounded to the nearest cadence. The corresponding Short Cadence numbers can be found in the Data Release 10 Supplement. CIN = cadence interval number, RCI = relative cadence index.

Event no.	MJD start	MJD end	CIN start	CIN end	RCI start	RCI end
1	55465.084	55465.186	25627	25632	119	124
2	55465.227	55467.086	25634	25725	126	217
3	55467.209	55467.720	25731	25756	223	248
4	55476.670	55476.956	26194	26208	686	700
5	55479.653	55479.673	26340	26341	832	833
6	55488.603	55488.623	26778	26779	1270	1271
7	55491.586	55491.668	26924	26928	1416	1420
8	55495.714	55495.836	27126	27132	1618	1624
9	55498.697	55498.758	27272	27275	1764	1767
10	55501.660	55501.721	27417	27420	1909	1912
11	55507.647	55507.688	27710	27712	2202	2204

5.5 Downlink Earth Point

The cadences occurring during spacecraft Earth Point are listed in Tables 7 and 8.

5.6 Manually Excluded Cadences

No changes from the Data Characteristics Handbook.

5.7 Incomplete Apertures Give Flux and Feature Discontinuities at Quarter Boundaries

No changes from the Data Characteristics Handbook.

5.8 Argabrightening

The cadences affected by Argabrightening events are listed in Tables 5 and 6 for LC and SC respectively.

Table 5: Q7 LC Argabrightening Events with amplitude $T_{\rm MAD} > 10$, and occurring on a number of channels $T_{\rm MCE} > 10$. The columns are (1) Cadence interval number (CIN) for Argabrightening cadences, (2) Relative cadence index (RCI) for Argabrightening cadences, (3) Argabrightening cadence mid-times (MJD), (4) Mean Argabrightening statistic over channels included in the Argabrightening event $< S_{\rm Arg} >_{\rm FPA}$, (5) Number of channels exceeding threshold for this cadence ($\rm N_{chan}$), (6) Number of channels exceeding the default pipeline threshold for this cadence ($\rm N_{pipe}$).

CIN	RCI	Mid-Times (MJD)	$< S_{\rm Arg} >_{\rm FPA}$	$\rm N_{chan}$	$\rm N_{pipe}$
25925	417	55471.17288	7.8	18	0
26051	543	55473.74752	9.9	36	0
26350	842	55479.85717	11.9	52	0
26698	1190	55486.96806	50.8	80	3
26724	1216	55487.49933	186.4	80	72
26789	1281	55488.82752	5.5	18	0
26976	1468	55492.64860	7.3	22	0
27466	1958	55502.66107	9.2	31	0
27636	2128	55506.13478	29.0	78	0
27777	2269	55509.01592	7.0	17	0
27807	2299	55509.62893	6.8	28	0
28885	3377	55531.65635	15.4	65	0
29427	3919	55542.73137	130.1	80	65
29438	3930	55542.95614	6.8	14	0
29877	4369	55551.92649	28.5	77	0

5.9 Background Time Series

The background flux time series for Q7 is shown in Figure 6.

5.10 Pixel Sensitivity Droputs

No changes from the Data Characteristics Handbook.

5.11 Short Cadence Requantization Gaps

No changes from the Data Characteristics Handbook.

Table 6: Q7 SC Argabrightening Events with amplitude $T_{\rm MAD} > 10$, and occurring on a number of channels $T_{\rm MCE} > 10$. The columns have the same meanings as Table 5. Note consecutive detections of the largest events. A horizontal line separates the three months of the quarter; the relative cadence index (RCI) is reset at the start of each month.

CIN	RCI	Mid-Times (MJD)	$< S_{\rm Arg} >$	$N_{\rm chan}$	$N_{\rm pipe}$
766232	12503	55471.17799	8.2	20	0
770015	16286	55473.75467	11.6	40	0
778976	25247	55479.85819	10.8	43	0
789405	35676	55486.96159	56.0	80	28
790205	36476	55487.50649	81.5	80	63
790206	36477	55487.50717	120.0	80	71
790207	36478	55487.50785	10.7	37	0
792146	38417	55488.82854	3.8	14	0
797754	44025	55492.64826	6.8	12	0
817552	18493	55506.13308	31.4	79	3
871277	28058	55542.72626	107.5	80	78
871278	28059	55542.72694	37.3	80	7
884793	41574	55551.93228	32.1	79	3

5.12 Spurious Frequencies in SC Data

Please see the Erratum on the final page for a correction from the Data Characteristics Handbook.

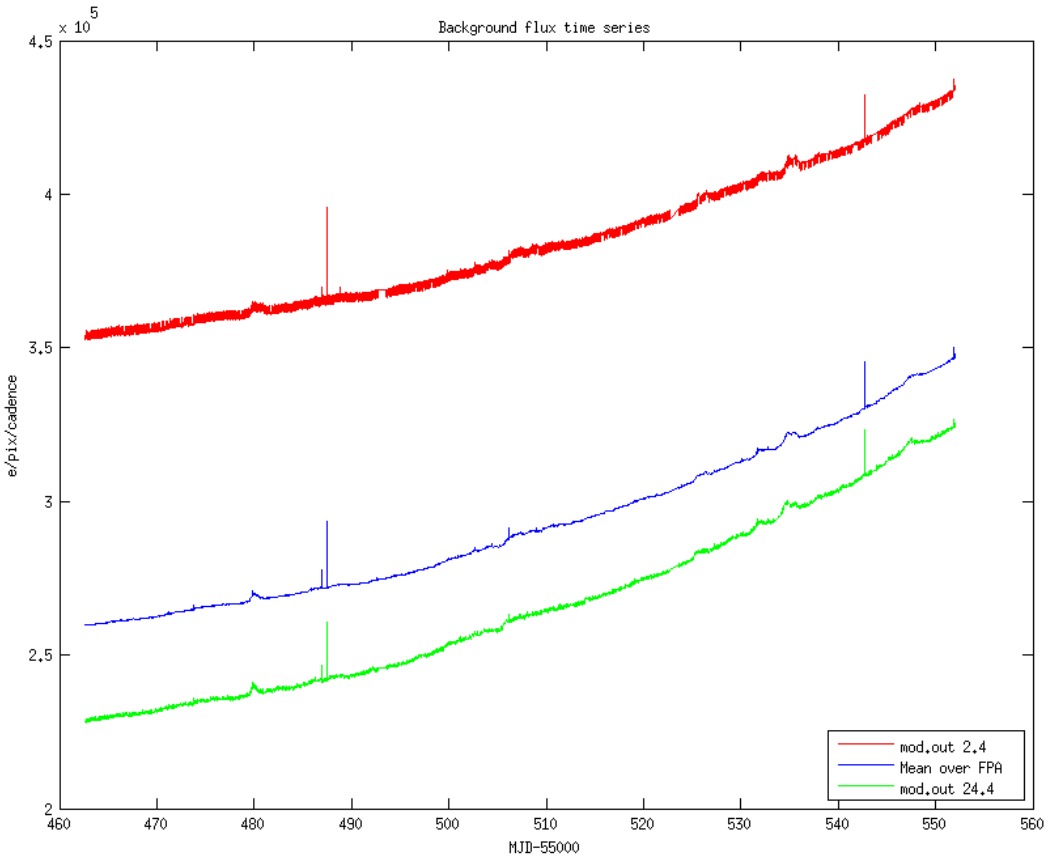

Figure 6: The background flux time series for Q7 showing the average over all the modules, and two individual modules. The narrow spikes are Argabrightening events not marked as bad cadences by the Pipeline.

5.13 Anomaly Summary Tables

The full lists of affected cadence interval numbers (CINs) for Tables 7 and 8 below are included in the Data Release 10 Supplement.

Table 7: Q7 LC Anomaly Summary Table

LC CIN start	LC CIN end	Anomaly Type	Note
25509	25509	EARTH POINT	Monthly data downlink
26724	26724	ARGABRIGHTENING	See Section 5.8
26983	27019	EARTH POINT	Monthly data downlink
28449	28491	EARTH POINT	Monthly data downlink
29427	29427	ARGABRIGHTENING	
29461	29485	COARSE POINT	See Section 4.3
29618	29620	COARSE POINT	

Table 8: Q7 SC Anomaly Summary Table

SC CIN start	SC CIN end	Anomaly Type	Note
25509	25509	EARTH POINT	Monthly data downlink
26724	26724	ARGABRIGHTENING	See Section 5.8
26983	27019	EARTH POINT	Monthly data downlink
28449	28491	EARTH POINT	Monthly data downlink
29427	29427	ARGABRIGHTENING	
29461	29485	COARSE POINT	See Section 4.3
29618	29620	COARSE POINT	
802249	802260	COARSE POINT	
806629	806640	COARSE POINT	
811009	811020	COARSE POINT	
815389	815400	COARSE POINT	
819550	819579	COARSE POINT	
819700	819729	COARSE POINT	
819769	819780	COARSE POINT	
819850	819879	COARSE POINT	
824149	824160	ARGABRIGHTENING	
828529	828540	ARGABRIGHTENING	
832909	832920	COARSE POINT	
837289	837300	COARSE POINT	
841669	841680	COARSE POINT	
846019	846031	COARSE POINT	
850399	850410	COARSE POINT	
854779	854790	COARSE POINT	
859159	859170	COARSE POINT	
863539	863550	COARSE POINT	
867919	867930	COARSE POINT	
871277	871278	ARGABRIGHTENING	
872299	873024	COARSE POINT	
877009	877079	COARSE POINT	

Continued on next page

Table 8 – continued from previous page

SC CIN start	SC CIN end	Anomaly Type	Note
881569	881580	COARSE POINT	
884929	884940	COARSE POINT	

6 Time and Time Stamps

No changes from the Data Characteristics Handbook. Please see Appendix A for additional information regarding the change in the LC duration with time.

7 Contents of Supplement

The Supplement is available as a full package (DataReleaseNotes10SupplementFull.tar), which contains the files described below.

Pipeline Instance Detail Reports

```
q7_lc_pa+pdc_mpe_true_r6.2_ksop-752_as-run_pipeline_instance_detail_110222.txt
q7m1_sc_cal+pa+pdc_mpe_true_r6.2_ksop-752_as-run_pipeline_instance-detail_110228.txt
q7m2_sc_cal+pa+pdc_mpe_true_r6.2_ksop-752_as-run_pipeline_instance-detail_110228.txt
q7m3_sc_cal+pa+pdc_mpe_true_r6.2_ksop-752_as-run_pipeline_instance-detail_110228.txt
```

Data Anomaly Types

```
DataAnomalyTypes_Q7_LC_PID4158_Summary.txt
DataAnomalyTypes_Q7_SCM1_PID4177_Summary.txt
DataAnomalyTypes_Q7_SCM2_PID4197_Summary.txt
DataAnomalyTypes_Q7_SCM3_PID4217_Summary.txt
```

Mod.out central motion

```
Q7_LC_central_column_motion.txt
Q7_LC_central_row_motion.txt
```

Thermal Telemetry

```
Q7_LDE_averageBoardTemp.txt
Q7_TH12LVAT_MJD_gap.txt
Q7_TH1RW34T_MJD_gap.txt
```

Background Flux Time Series

```
Q7_LC_background.txt
Q7_SCM1_background.txt
Q7_SCM2_background.txt
Q7_SCM3_background.txt
```

Argabrightening Detections

```
ArgAgg_Q7_LC_PID4158_MADT010_MCT10_Summary.txt
ArgAgg_Q7_SCM1_SC_PID4177_MADT010_MCT10_Summary.txt
ArgAgg_Q7_SCM2_SC_PID4197_MADT010_MCT10_Summary.txt
ArgAgg_Q7_SCM3_SC_PID4217_MADT010_MCT10_Summary.txt
```

Out of Fine Point Cadence Lists

```
Q6_LC_isNotFinePoint.txt
Q6_SCM1_isNotFinePoint.txt
Q6_SCM2_isNotFinePoint.txt
Q6_SCM3_isNotFinePoint.txt
```

Zero Crossing Events

```
Q7_LC_ZeroCrossings.txt
Q7_SCM1_ZeroCrossings.txt
Q7_SCM2_ZeroCrossings.txt
```

There were no zero crossing events in the third month of the quarter, hence the absence of a `Q7_SCM3_ZeroCrossings.txt` file.

7.1 Short Supplement Package

The Supplement also contains a short package suitable for emailing (DataReleaseNotes10SupplementShort.tar). The small package does not contain the following files:

```
Q7_LC_background.txt
Q7_SCM1_background.txt
Q7_SCM2_background.txt
Q7_SCM3_background.txt

Q7_LC_central_column_motion.txt
Q7_LC_central_row_motion.txt

Q7_TH12LVAT_MJD_gap.txt
Q7_TH1RW34T_MJD_gap.txt
```

8 References

No changes from the Data Characteristics Handbook.

A Drift in LC Duration With Time

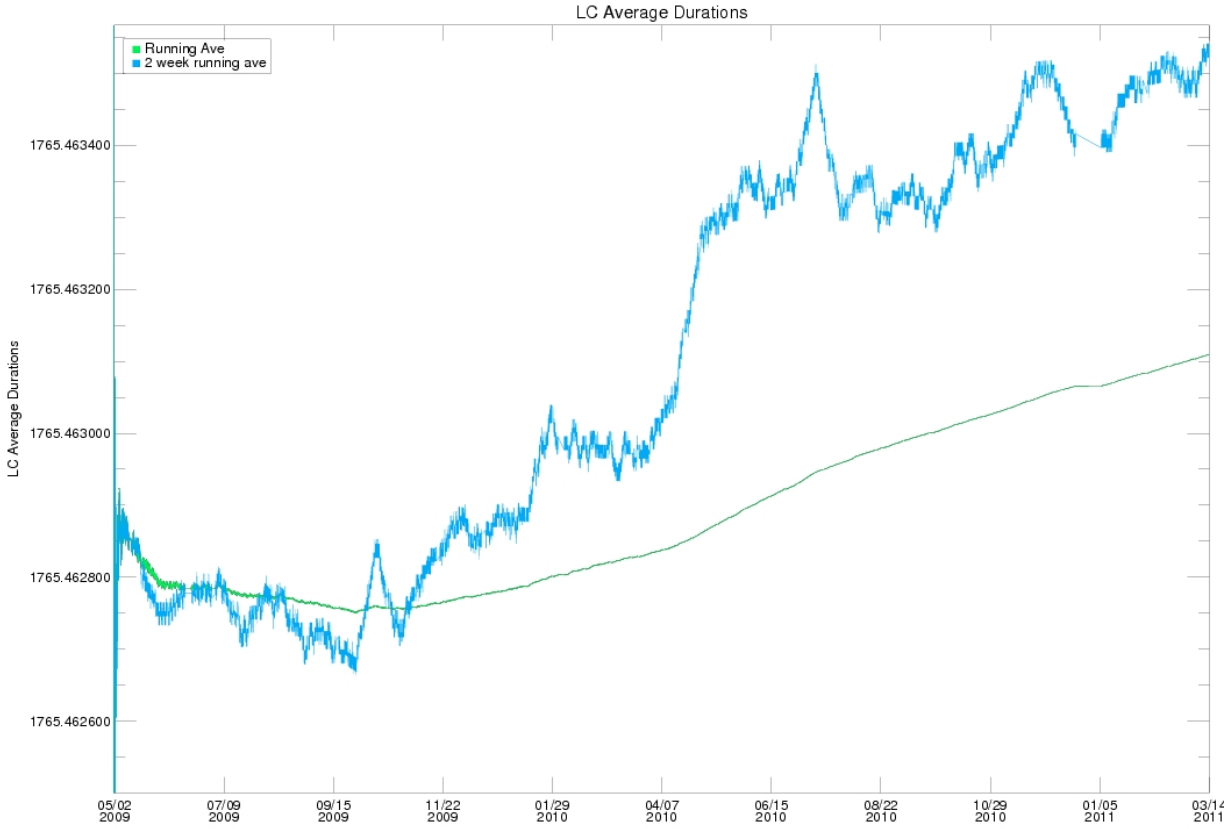

Figure 7: The change in the LC duration, given in seconds, with time, due to the drift in the onboard spacecraft clock. The two week running average is plotted in blue, and the cumulative average with time is plotted in green. Each point on the green line is the median of all blue points from earlier epochs. The overall change is at the sub-millisecond level and therefore should not be of concern to the user.

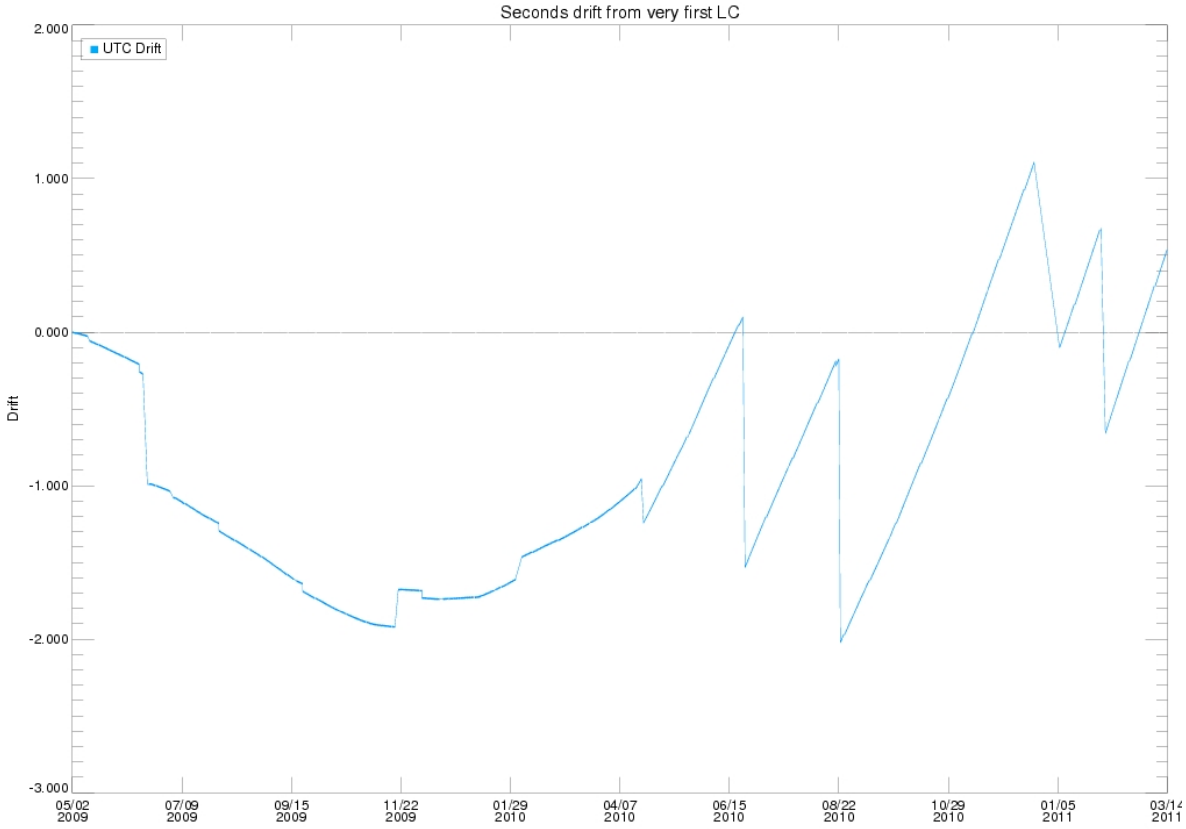

Figure 8: The drift in the onboard spacecraft clock, given in seconds, is plotted with respect to UTC. Since the sudden rate change in the drift near 2010-04-07 the clock has run consistently slow relative to UTC. To compensate, we have performed more frequent and larger clock resets, causing the saw-tooth discontinuities. The times given in the FITS headers are corrected for this drift.

B Erratum

There is an error in Table 6 of the Data Characteristics Handbook (KSCI-19040-001): List of Possible Spurious Frequencies in SC data. On the first line of the table, 8.9 μHz should read 3.9 μHz.