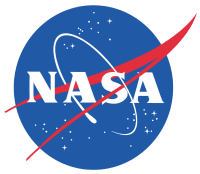

Kepler Data Release 23 Notes

Q17

KSCI-19063-001
Data Analysis Working Group (DAWG)
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Contents

1 Introduction

These Data Release Notes provide information specific to the release of Q17 data, processed with SOC Pipeline 9.1. These Notes contain the summary figures and tables for this quarter. The Kepler Data Characteristics Handbook (Christiansen et al., 2013) discusses most of the known phenomena found in the Kepler data in more detail.

1.1 Dates and Cadence Numbers for Q17

Contents of Data Release 23–Cadence Data

Q.m		First Cadence MJD midTime	Last Cadence MJD midTime	First Cadence UT midTime	Last Cadence UT midTime	Num CINs	Start CIN	End CIN
17	LC	56391.7269	56423.5012	09-Apr-2013 17:26:44	11-May-2013 12:01:39	1556	70976	72531
17.1	SCM1	56391.7170	56414.0911	09-Apr-2013 17:12:31	02-May-2013 02:11:14	32850	2117740	2150589
17.2	SCM2	56419.3024	56423.5110	07-May-2013 07:15:26	11-May-2013 12:15:52	6180	2158240	2164419

Contents of Data Release 23– FFIs
No Full Frame Images are available this quarter.

1.2 The SOC Pipeline for Q17

Data Release 23 was processed with the SOC Pipeline 9.1. For details on how Kepler processes the data through the front-end of the pipeline (modules CAL, PA, PDC), please see the Data Processing Handbook (Fanelli et al., 2011). Notable changes and improvements to the pipeline in 9.1 include the following:

- The algorithm used by the CAL module to propagate the errors on the flux for each pixel and cadence was changed to improve its performance for stars that are highly variable on timescales of less than 12 hours. Under the old approach, undersampling of the error estimates resulted from only calculating the full propagation of uncertainties every ∼24 cadences and interpolating the results beetween these cadences. See §5.1.3 of the Data Characteristics Handbook (Christiansen et al., 2013) for more details. In SOC 9.1 the reported errors for each cadence are a sum of the minimal error calculation (shot noise plus read noise) and an offset term to account for the extra error from the full propagation of errors. This offset is calculated by taking the mean of the difference between the full and the minimal error calculation across all cadences for which both were calculated. See Figure 1 for an example comparing the new and old methods of calculating the error for one pixel of a rapidly variable target.
- PDC now protects known transits from incorrectly being identified as Sudden Pixel Sensitivity Dropouts (SPSDs) or other types of outlier. Cadences containing known transits and eclipses are computed using the known epoch, period and duration of the events. No SPSDs or outliers are flagged during the known transits. This helps preserve transit depths and shapes from corruption by the SPSD and outlier correction algorithms. Note that this only affects known transits. Identification of a transit as an outlier may still occur for transits not identified prior to the data processing.

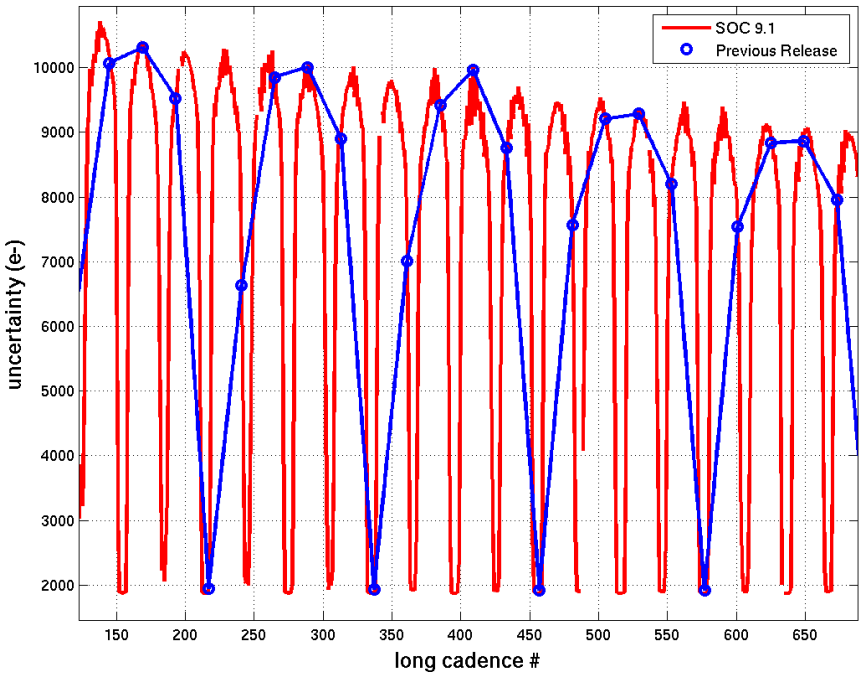

Figure 1: The error on the flux for one pixel plotted against relative, long cadence number for a target that is highly variable on rapid timescales. The error calculated by a previous version of the pipeline is plotted in blue and the error calculated by the current SOC Pipeline 9.1 is plotted in red.

1.3 Kepler Mission Timeline to Date

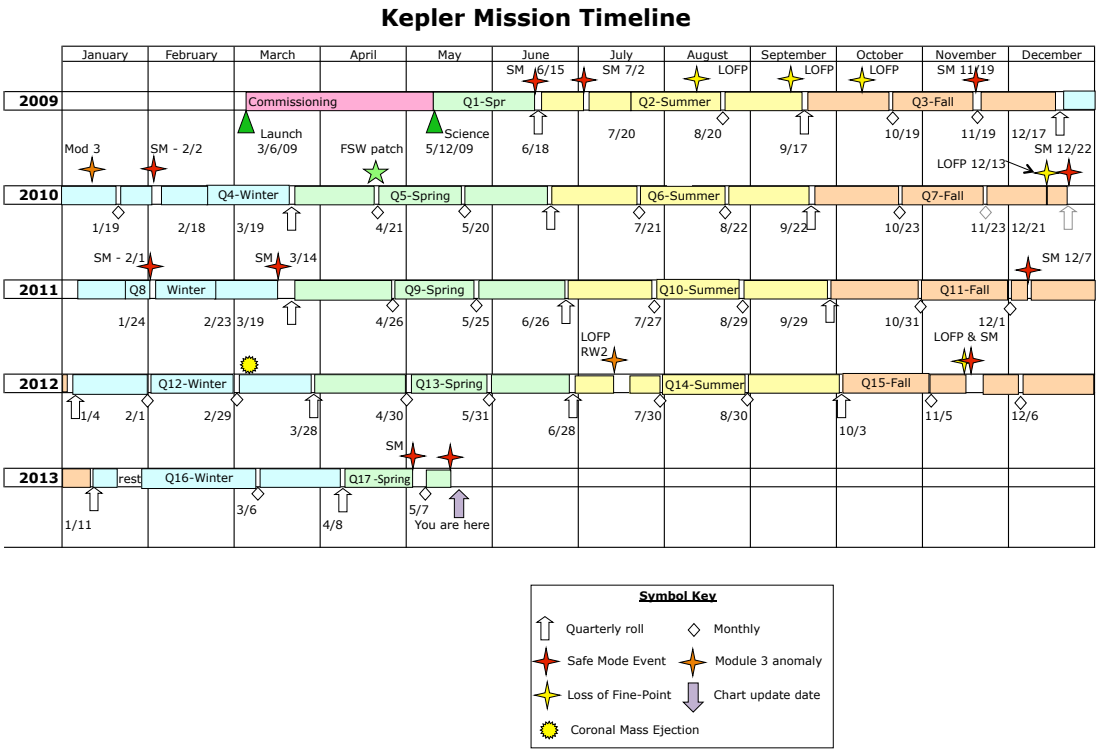

Figure 2: Kepler Mission Timeline as of the end of Q17.

2 Data Quality in Q17

2.1 Evaluation of CDPP

To understand the overall performance of the pipeline, we show the Temporal Median (TM) of the CDPP time series as calculated by the TPS module for different versions of the SOC pipeline (Figure 3). We also provide the CDPP statistics for Q17 binned by magnitude in Table 1.

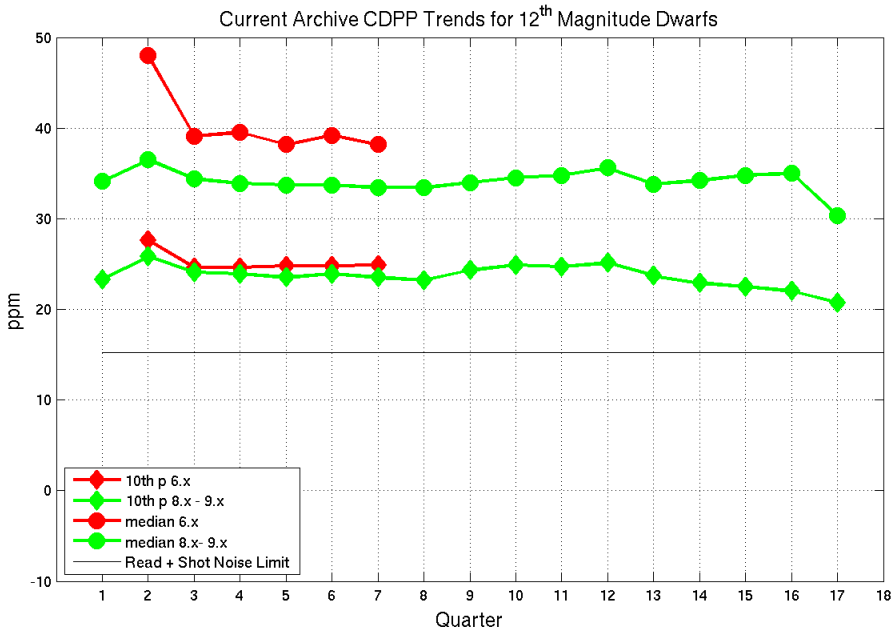

Figure 3: 6.5-h Temporal Median of the CDPP time series. The median (circles) and 10th percentile value (diamonds) for all dwarf stars between Kp=11.75–12.25 are given. The 6-h TMCDPPs have been divided by sqrt(13/12) = 1.041 to approximate 6.5-h TMCDPPs. A detailed discussion of the CDPP values is given in the Kepler Data Characteristics Handbook. The 6.x, 8.x and 9.x labels given in the legend refer to the version of the SOC pipeline used. The reduction in CDPP starting in Q14 may be related to the new method used to calculate CDPP in Q14 (see DRN 19, §1.2.)

Table 1: Aggregate statistics for the TMCDPPs by magnitude. 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	52	7.9	20.6	185	8.4	44.3	3.8
10.0	161	10.4	27.0	592	11.5	55.9	6.0
11.0	636	14.8	25.7	1680	16.3	57.6	9.5
12.0	2229	20.7	30.4	3929	21.7	43.4	15.2
13.0	7009	30.6	40.3	9518	31.3	44.9	24.4
14.0	14489	48.4	61.5	16625	48.9	63.0	40.1
15.0	28863	85.9	109.7	28867	85.9	109.7	68.8
16.0	15020	156.7	196.5	15020	156.7	196.5	127.8

2.2 Summary of Data Anomalies

Certain cadences are flagged to indicate a possible reduction of quality. See the QUALITY and SAP_QUALITY columns of the target pixel and light curve files, respectively. Cadences with data anomalies that affect the entire focal plane are shown in Figure 4. The meaning of the flags are explained in the Data Characteristics Handbook (Christiansen et al., 2013) and Archive Manual (Thompson & Fraquelli, 2012).

Two Safe Modes occurred during Q17. The first, spanning CIN 72071–72325, marks the end of the first month of data. The second, at CIN 72532, marks the end of month 2 and the end of data collection for Kepler (see §3.4). With no further data to report, the cadences of the second safe mode are not included as part of the archived data set.

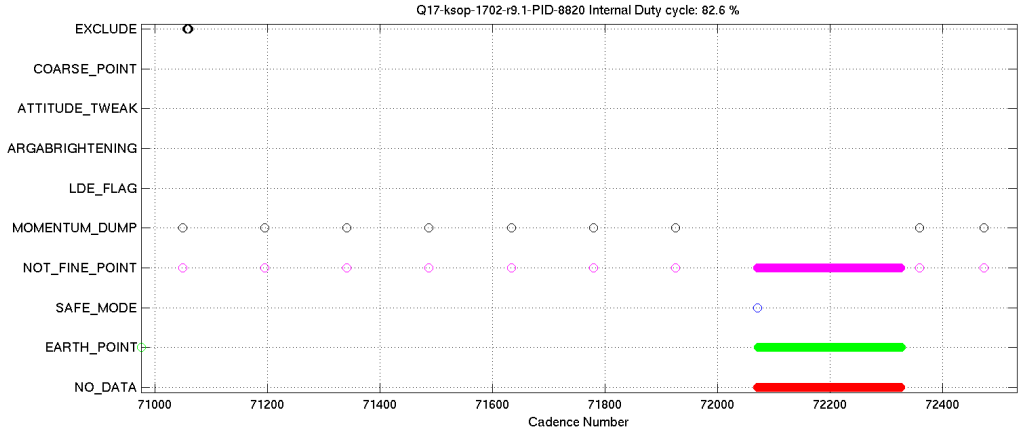

Figure 4: An overview of the location of the data anomalies flagged in Q17. "NO_DATA" indicates those cadences with no data collected (e.g. during Earth-point or Safe Mode events).

Clarifications on select flags in Figure 4 are listed here:

- ARGABRIGHTENING refers to cadences where the multiple-channel Argabrightening flag (flag 0x07, decimal value 64) was set. The single channel Argabrightening flag (0x0D, decimal value 4096) is not represented on this plot.
- COARSE_POINT refers to cadences where the pointing of the telescope drifted by more than 0.5 millipixels from the nominal value (flag 0x16, decimal 32768). NOT_FINE_POINT refers to cadences where the telescope's fine guidance sensor reported that the telescope was not in fine point mode (flag 0x03, decimal value 4).
- LDE_FLAG refers to flags set by the Spacecraft when a error was detected in the Local Detector Electronics (LDE) or the on-board memory (flag 0x15, decimal value 16385). The pipeline does not process these cadences and only raw pixels are available.

3 Notable Features of the Q17 Data

In this section we discuss features of the data that occurred during collection or processing that are either new to Q17, significantly different than previous quarters, or not discussed in the Data Characteristics Handbook (Christiansen et al., 2013). A more complete listing of events that are known to affect the data are discussed in the Data Characteristics Handbook.

3.1 Solar Flare

The sun emitted a series of X-ray flares on and around CIN 71058 in month 1 of Q17. Cadences 71056 to 71060 were gapped with the EXCLUDE flag to indicate that this data is of bad quality. However, the dark current remained elevated for several hours after the peak of the event, and users may notice degraded quality, especially for fainter stars.

3.2 PDC Uses Regular MAP for All Targets

Because of the short duration of this quarter, the PDC (Pre-Search Data Conditioning) module of the pipeline did not perform the multi-scale MAP algorithm. As a result all PDC light curves were co-trended without band splitting, using the regular MAP algorithm. This information has also been reported in the headers of the light curve FITS files available at MAST, see the keyword PDCMTHD.

3.3 PDC Corrected Short Cadence Data

As discussed in §5.15 of the Data Characteristics Handbook (Christiansen et al., 2013) (and §3.6 of DRN 19), PDC attenuates signals with timescales longer than approximately one third the quarter duration. For Q17, this timescale is shorter, ∼7-10 days, instead of the typical ∼20 days of other quarters.

In short cadence, MAP is applied on a monthly basis. Since Q17M2 is only a week long, signals with timescales longer than a few days are removed. Short cadence data for this month should not be used to examine phenomena with timescales of days or longer.

3.4 Final Data Set Collected

The second month of Q17 was interrupted by a safe mode event. After the spacecraft was commanded to return to science attitude, reaction wheel 4 failed and the spacecraft returned to safe mode. Extensive analysis concluded that neither of the two failed wheels could be recovered. With only two wheels, it is not possible to point at the Kepler field for the purpose of collecting high precision photometry. No futher data will be collected for the original Kepler Mission; however there are still plans to reprocess the entire Q0–Q17 data set with an improved SOC pipeline.

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