K2 Data Release Notes 20:
Campaign 14 Original Processing

KSCI-19136-002

K2 Data Analysis Working Group

September 14, 2020

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Moffett Field, CA 94035
These data release notes were originally prepared by members of the Data Analysis Working Group, and made available as webpages in December, 2017, when the data were originally delivered to the Milksulski Archive for Space Telescopes. They are reproduced here for permanent archiving, with edits for clarity and consistency.

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# DOCUMENT CHANGE LOG

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<td>May 29, 2020</td>
<td>001</td>
<td>All</td>
<td>Original release</td>
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<tr>
<td>September 14, 2020</td>
<td>002</td>
<td>Section 3</td>
<td>Removed the section ”Missing CDPP Values for 50% of Non-Custom Targets” as MAST has updated these FITS files to now include the (previously missing) CDPP values. Also, previous release notes erroneously reported CDPP measurements were based on 6.5-hr duration; corrected to 6.0-hr duration CDPP.</td>
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1 At a Glance

1.1 Pointing

- RA: 160.6824762 degrees
- Dec: 6.8509316 degrees
- Roll: 158.7573464 degrees

1.2 Targets with Data at MAST

- 39,024 EPIC IDs in long cadence (LC)
- 147 EPIC IDs in short cadence (SC)
- Many custom targets (see §2.2)

1.3 Full-Frame Images (FFI)

- ktwo2017162122209-c14 ffi cal.fits
- ktwo2017203170143-c14 ffi cal.fits

1.4 First and Last Cadences

- Start Time: 2017-06-01 05:06:29 UTC
  - Long Cadence Number: 145045
  - Short Cadence Number: 4339810
- End Time: 2017-08-19 22:11:02 UTC
  - Long Cadence Number: 148945
  - Short Cadence Number: 4456839

1.5 Pipeline

No features of the pipeline or data files have changed from Data Release 19.

Figure 1: Distribution of the Kepler magnitudes of observed LC targets. The peak at faint magnitudes is due to the large number of faint galaxies.

Figure 2: Left: Schematic of the C14 field-of-view with high-profile objects shown. Right: A full-frame image (FFI) taken during C14, with a flux scaling designed to highlight features of interest.
2 Features and Events

2.1 Pointing and Roll Performance

The C14 pointing and roll behavior are well within the limits of that seen in other K2 campaigns for the majority of the campaign. The pipeline calculated maximum distance between the derived and nominal positions for any target (the “maximum attitude residual”, or MAR) for C14 is less than 2 pixels, well under the 3-pixel limit accommodated by the aperture halos. There were far fewer anomalous thruster firing events in C14 than were seen in recent campaigns.

In order to give the flight system engineers an advanced warning of degradation in the pointing as fuel runs low, the on-board fine point fault logging threshold was lowered from \( \sim 103 \) arcseconds (0.0005 radians) to \( \sim 62 \) arcseconds (0.0003 radians) on 2017-07-14, mid-way through C14. While this change does not affect pointing performance, it did have the unintended effect of flagging more cadences as “Spacecraft is not in fine point” (QUALITY flag bit #16, decimal=32768), which the pipeline then gaps. The result of this threshold change is that there are 129 long cadences gapped as not-in-fine-point in C14 versus 48 in C13, with the majority of these falling in the second half of C14, after the threshold change. The not-in-fine-point cadences have calibrated pixels in the archive TPFs, but no flux values in the light curve files.

The project has identified a workaround for the flagging resulting from this changed threshold and has implemented it for future processing starting with C15.

![Figure 3: The roll-error (left) and maximum distance (right) between the photometrically derived attitude (PAD) and the nominal position plotted against time for C14.](image)

2.2 Targets

The Mikulski Archive for Space Telescopes (MAST) K2 Data Search and Retrieval Page has an option to select data by Object Type, including sections for the custom targets listed below. The corresponding custom EPIC IDs for the masks can also be found in the custom aperture file hosted at MAST.

2.2.1 Galaxies

The C14 field of view sits at 53° N Galactic latitude in the North Galactic cap. There are 14,691 galaxies targeted in the C14 field of view. 47 of the Galaxies with radii > 40 arcseconds were covered with large circular masks. Twelve galaxies were covered with 15x15 pixel square masks. Six galaxies (M95, M96,
M105, NGC3384, NGC3423, NGC3412) were covered by 40x40 pixel square masks consisting of 16 tiles of 10x10 pixel sub-masks.

2.2.2 Other Notable Targets

- Wolf 359: a late M dwarf and 5th nearest star system to the Sun (EPIC 201885041)
- WASP-104: host of a transiting hot Jupiter (EPIC 248662696)
- 7 bright stars observed using custom circular masks, including the 4th-magnitude blue supergiant rho Leo (EPIC 200182931)
- 6 large galaxies observed using custom masks (M95, M96, M105, NGC 3384, NGC 3423, NGC3412) and 14,691 small galaxies observed using standard masks to observe supernovae
- 27 Hilda and Trojan asteroids
- 1 main-belt asteroid: 373 Melusina
3 Data Quality and Processing Notes

3.1 Light Curve Quality

As in previous campaigns, the 6-hour spacecraft roll cycle continues to dominate the systematic errors in C14 simple aperture photometry light curves. The pipeline CDPP 12th magnitude noise benchmark for C14 is the lowest seen since C6. It is comparable to that seen in early campaigns with similar star density (C6, C8, C10), but is well below that seen in C12, also with similar star density. We do not have a definitive cause for the improved precision, but it could be in part due to the relatively low star density and the return to more stable pointing (compared to recent campaigns).

The magnitude dependence of CDPP and its distribution over the focal plane are shown in Figure 4 and Figure 5. CDPP statistics for various magnitude bins are given in an attached file, also printed below.

Attached file: c14_bin1.00_sc1.00_CDPP_Summary_17100214.txt

Kepler Data Analysis Handbook Supplement
6.0 hr CDPP Summary
Generated by MATLAB program cdpp_stats_ismember.m using quasiCdpp
- collected by fovPlottingClass.compile_fov_statistics_from_taskDirs
Bin Width 1 mag, CDPP in ppm, dwarfs identified by logg >=4
File Name: c14_bin1.00_sc1.00_Summary.txt
Star list: /home/jevancle/matfiles/files/k2StellarPropertiesStruct.mat
This file created: 02-Oct-2017 14:10:30
MJD 58028.59063
Column Definitions
1. KepMag bin
2. Number of dwarfs
3. 10th percentile CDPP for dwarfs
4. Median CDPP for dwarfs
5. Number of stars in list in bin
6. 10th percentile CDPP of all stars
7. Median CDPP for all stars
8. Number of giants
9. 10th percentile CDPP for giants
10. Median CDPP for giants
11. Noise model CDPP
12. Fraction of all stars < noise model, percent

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3.2 Targets Missing from the Archive

Pipeline errors during the process of exporting the light curve (LCV) and target pixel (TP) FITS files resulted in two targets (EPIC IDs 248463890 and 248463977) from C14 having no LCV or TPF files at the archive. (These targets were later exported in Data Release 40.)
Figure 4: 6.0-hr CDPP measurements for all targets as a function of Kepler magnitude. Dim targets have poorer overall photometric precision than bright targets, but can look better because the residual sawtooth falls below the noise floor. Saturated targets tend to have lowest CDPP, but often show a residual sawtooth.
Figure 5: 6.0-hr CDPP measured as a function of position on the focal plane, for 12th and 14th magnitude dwarf stars. The photometric precision is generally better near the center of the focal plane where the variations in roll angle produce less pixel motion. All cadences coincident with a definite thruster firing are gapped.