K2: Extending Kepler's Power to the Ecliptic

Ecliptic Plane Input Catalog

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DOCUMENT CHANGE LOG

CHANGE DATE	PAGES AFFECTED	CHANGES/NOTES
Feb 5, 2014	all	Original Release for Campaign 1 (C1).
Apr 8, 2014	15-18	Added three new columns to the EPIC, provided some provenance information in Figures 3 and 4, and included two new references for Campaigns 2 & 3.
Apr 17, 2014	15, 18-24	Numbered Table 2, added Section 6 for Campaign 0, and included one new reference.
Apr 28, 2014	6, 25, 26	Added Table 0 to log updates to the EPIC; added Section 7 for Campaign 1.
Jul 3, 2014	6	Updated Table 0 to reflect additions to the EPIC for Fields 2, 4, and 5; sorted Table 0 by EPIC ID.
Jul 21, 2014	6	Corrected the EPIC link in first introductory paragraph.
Sep 24, 2014	5, 6, 27	Updated Table 0 to reflect additions to the EPIC for Fields 3, 6, and 7; added Section 8 to describe some regions of incompleteness for C7.
Mar 30, 2015	5, 6, 11, 13, 28	Updated Table 0 for Campaigns 4, 5, 8, 9, and 10; modified Section 3 to describe algorithmic changes when Kepflag = ‘J’ and qualify completeness for Campaign 9; added Section 9 to further describe changes for Campaigns 8, 9, and 10.
Dec 3, 2015	5, 6, 7	Updated Table 0 for the missing targets in Campaigns 6, 7, and 8 and added the comprehensive catalogs for Campaigns 11, 12, and 13. Table 0 expanded onto its own page, so the “pages affected” in the previous log entries are no longer valid.
Jul 7, 2016	7	Updated Table 0 for the missing targets in C9 and C10 and added the comprehensive catalogs for C14, C15, and (backwards-facing) C16.
Sep 26, 2016	5, 7, 15, 19, 30, 31	Updated the table of contents and Section 4 on stellar properties; added the missing targets for C11 and the comprehensive catalog for the forward-facing C16 to Table 0; added Section 10 to describe the changes to the C16 FOV; updated several references (now Section 11).
Jan 10, 2017	15, 31	Updated Section 4 to describe the use of Gaia parallaxes in deriving stellar properties for C10 and later campaigns; added reference to Lindegren et al.

Mar 27, 2017	7-8, 16	Updated Table 0 to include the missing targets for C12, C13, and C14 and the Section 4 text to add stellar properties for C11 and C12.
Jun 27, 2017	8	Updated Table 0 to include the missing targets for C15 and the comprehensive catalogs for C17 and C19.

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1. Introduction

This document describes the Ecliptic Plane Input Catalog (EPIC) for the K2 mission (Howell et al. 2014). The primary purpose of this catalog is to provide positions and *Kepler* magnitudes for target management and aperture photometry. The Ecliptic Plane Input Catalog is hosted at MAST (http://archive.stsci.edu/k2/epic/search.php) and should be used for selecting targets when ever possible.

The EPIC is updated for future K2 campaigns as their fields of view are finalized and the associated target management is completed. Table 0 summarizes the EPIC updates to date and the ID range for each. The main algorithms used to construct the EPIC are described in Sections 2 through 4. The details for individual campaigns are described in the subsequent sections, with the references listed in the last section. Further details can be found in Huber et al. (2016).

Table 0
Log of EPIC IDs assigned by Campaign

Delivery Date	Campaign	Catalog Type	First EPIC ID	Last EPIC ID	Number of Targets
2/5/14	C1	Comprehensive	201000001	202059065	1059065
2/10/14	C0	Proposed Targets	202059066	202154323	95258
4/7/14	C2	Comprehensive	202154324	205871527	3717204
4/7/14	C3	Comprehensive	205871528	206598205	726678
4/18/14	C0	Comprehensive	206598206	210282463	3684258
4/25/14	C1	Missing Targets	210282464	210282491	28
7/3/14	C2	Missing Targets	210282492	210282560	69
7/3/14	C4	Comprehensive	210282561	211233315	950755
7/3/14	C5	Comprehensive	211233316	212235315	1002000
9/9/14	C3	Missing Targets	212235316	212235356	41
9/14/14	C6	Comprehensive	212235357	212886326	650970
9/17/14	C7	Comprehensive	212886327	220115896	7229570
3/30/15	C4	Missing Targets	220115897	220115973	77
3/30/15	C8	Comprehensive	220115974	220769262	653289
3/30/15	C9	Comprehensive[1]	220769263	228682308	7913046
3/30/15	C5	Missing Targets	228682309	228683400	1092

3/30/15	C10	Comprehensive	228683401	229227137	543737
12/3/15	C6	Missing Targets	229227138	229228144	1007
12/3/15	C7	Missing Targets	229228145	229228373	229
12/3/15	C8	Missing Targets	229228374	229228998	625
12/3/15	C11	Comprehensive	229228999	245899083	16670085
12/3/15	C12	Comprehensive	245899084	246541209	642126
12/3/15	C13	Comprehensive	246541210	248368655	1827446
1/19/16	C9	Missing Targets	248368656	248368918	263
4/11/16	C10	Missing Targets	248368919	248370123	1205
7/5/16	C14	Comprehensive	248370124	248959150	589027
7/5/16	C15	Comprehensive	248959151	250261931	1302781
7/5/16	C16 BF[2]	Comprehensive	250261932	251248314	986383
7/7/16	C11	Missing Targets	251248315	251249183	869
9/24/16	C16 FF[2]	Comprehensive	251249184	251455478	206295
10/13/16	C12	Missing Targets	251455479	251456953	1475
1/2/17	C13	Missing Targets	251456954	251457026	73
3/27/17	C14	Missing Targets	251457027	251458114	1088
5/24/17	C17	Comprehensive	251458115	251668138	210024
5/24/17	C18[3]	Comprehensive	N/A	N/A	0
6/2/17	C15	Missing Targets	251668139	251668398	260
6/16/17	C19	Comprehensive	251668399	251809144	140746

[1]The C9 EPIC entries are magnitude limited (see Section 9).
[2]BF is the original ‘backward-facing’ campaign and FF is its ‘forward-facing’ replacement (see Section 10 for details).
[3]The C18 FOV entirely overlaps the C5 FOV, so no new comprehensive EPIC is required.

2. Input Sources and Cross-Matching

Input sources are the Hipparcos catalog (van Leeuwen 2007), the Tycho-2 catalog (Høg et al. 2000), the fourth US Naval Observatory CCD Astrograph Catalog (UCAC4, Zacharias et al. 2013), the Two Micron All Sky Survey (2MASS, Skrutskie et al. 2006), and data release 9 of the Sloan Digital Sky Survey (SDSS DR9, Ahn et al. 2012). Each catalog was downloaded from Vizier (http://webviz.u-strasbg.fr/viz-bin/VizieR) using a search radius of 12 degrees centered on a K2 campaign field. The following quality cuts and transformations were applied to the observables:

(a) Tycho-2: BT and VT photometry were converted into the Johnson BV by interpolating Table 2 in Bessell et al. (2000).

(b) UCAC-4: g'r'i' photometry (which is adopted from the AAVSO Photometric All-Sky Survey, http://www.aavso.org/apass) was transformed to the SDSS gri system (http://www.sdss.org/dr7/algorithms/jpeg_photometric_eq_dr1.html). Uncertainties in the BVgri bands which are set to zero or formal uncertainties set to 0.01 mag were replaced with typical uncertainties calculated from original APASS values as a function of g, r and i magnitude.

(c) 2MASS: All sources brighter than J < 5 mag were discarded due to known saturation problems, and all sources with a J-band quality flag worse than C were removed.

(d) SDSS DR9: Only targets with clean photometry, r magnitudes lower than 20, and photometry errors lower than 0.5 mag were retained.

Note that future deliveries may also include photometry in the WISE bands.

Each catalog was cross-matched for overlapping sources. Published matches (Hipparcos-Tycho, UCAC-Tycho-2MASS) were adopted when available, otherwise sources were matched by finding the closest object within 3 arcseconds of the proper-motion-corrected coordinates provided by Vizier. To eliminate serendipitous matches due to background objects, the V or g band magnitude of the target and matched source were required to agree within 1.5 mag, which is the typical maximum 3σ uncertainty in a given passband. For cross-matches without common passbands (such as Tycho-2MASS, or 2MASS-SDSS), the V and g band magnitudes of the matched source were estimated using Johnson-2MASS-Sloan transformations by Bilir et al. (2005) and Bilir et al. (2008). For transformed magnitudes, the matching criteria were conservatively set to 2 mag for g-band magnitudes estimated from BV, and 4 mag for g-band magnitudes estimated from JHK. While this procedure should eliminate most erroneous cross-matches, it may result in duplicate entries. Visual inspection of sky images from the STScI digitized sky survey (http://archive.stsci.edu/cgi-bin/dss_form) showed that duplicate entries are relatively rare.

For each source, the following observables were cataloged (see Table 1): Right Ascension (RA), Declination (DEC), Johnson BV, 2MASS JHK, Sloan ugriz, proper motion in RA, proper motion in DEC, parallax, and associated uncertainties. For sources with photometry in multiple catalogs, Tycho BV and UCAC gri were prioritized over APASS BV and SDSS gri. Cross-matched identifiers of all catalogs were also recorded. Additionally, extended sources identified in either 2MASS or SDSS were flagged in the "Objtype" identifier.

Table 1

Ecliptic Plane Input Catalog columns*

Column Name	Unit	Description
EPIC	none	K2 Identifier
HIP	none	Hipparcos Identifier
TYC	none	Tycho-2 Identifier
UCAC	none	UCAC-4 Identifier
2MASS	none	2MASS Identifier
SDSS	none	SDSS Identifier
Object type	none	Object Type Flag [STAR, EXTENDED]
Kepflag	none	*Kepler* Magnitude Flag [gri, BV, JHK, J]
RA	degrees	Right Ascension (JD2000)
Dec	degrees	Declination (JD2000)
pmra	milliarcseconds/year	Proper Motion in RA
pmdec	milliarcseconds/year	Proper Motion in DEC
plx	milliarcseconds	Parallax
Bmag	magnitude	Johnson B band magnitude
Vmag	magnitude	Johnson V band magnitude
umag	magnitude	Sloan u band magnitude
gmag	magnitude	Sloan g band magnitude
rmag	magnitude	Sloan r band magnitude
imag	magnitude	Sloan i band magnitude
zmag	magnitude	Sloan z band magnitude
Jmag	magnitude	2MASS J band magnitude
Hmag	magnitude	2MASS H band magnitude
Kmag	magnitude	2MASS K band magnitude
KepMag	magnitude	*Kepler* magnitude (Kp)

*Bracketed items list the possible values for catalog flags (see text for details).

3. *Kepler* Magnitudes

Kepler magnitudes (Kp) were calculated in different ways, depending on the available photometry for a given source. The identifier "Kepflag" keeps track of which photometry was used to calculate the *Kepler* magnitude of each source. The following four schemes were adopted in the priority order listed:

(a) Kepflag = [gri]: Kp was calculated from gri magnitudes using Equations (2)-(5) in Brown et al (2011).

(b) Kepflag = [BV]: Sloan gr was estimated from Johnson BV using the transformations by Bilir et al. (2005):

$$g-r = 1.124\ (B-V) - 0.252, \text{ and} \tag{1}$$

$$g = V + 0.634\ (B-V) - 0.108. \tag{2}$$

Kp was then calculated from gr using Equation (2) in Brown et al. (2011).

(c) Kepflag = [JHK]: Kp was calculated using the polynomial J-K relations by Howell et al. (2012). Given x=J-K these transformations are:

$$Kp = 0.42443603 + 3.7937617\ x - 2.3267277\ x^2 + 1.4602553\ x^3 + K, \tag{3}$$

for all stars with $J-H > 0.75$ and $H-K > 0.1$ (approximate color cut for giants), and

$$\begin{aligned} Kp = 0.314377 &+ 3.85667\ x + 3.176111\ x^2 - 25.3126\ x^3 \\ &+ 40.7221\ x^4 - 19.2112\ x^5 + K, \end{aligned} \tag{4}$$

for all remaining stars. The above relations are calibrated for $-0.2 < J-K < 1.2$ for giants and $-0.2 < J-K < 1.0$ for dwarfs.

(d) Kepflag = [J]: For sources outside the color limits of Equations (3) and (4) or sources which only have a valid J-band magnitude, a rough estimate of Kp was calculated from the J-band magnitude using the relations by Howell et al. (2012):

$$\begin{aligned} Kp = -398.04666 &+ 149.08127\ J - 21.952130\ J^2 + 1.5968619\ J^3 \\ &- 0.057478947\ J^4 + 0.00082033223\ J^5 + J, \end{aligned} \tag{5}$$

for J = 10 – 16.7, and

$$Kp = 0.1918 + 1.08156\ J \tag{6}$$

for $J > 16.7$.

For stars with $J < 10$ that do not meet any of the above criteria, we assigned *Kepler* magnitudes of $Kp = J$ in Campaigns 1 through 7 and $Kp = J + 1.7$ starting with Campaign 8 (see Section 9 for details).

Figure 1 compares *Kepler* magnitudes calculated from UCAC gri, APASS BV, 2MASS JHK, and 2MASS J to original Kp values for a random sample of 5000 stars in the original *Kepler* field. The values show good agreement for the first three methods (panels a-c), with a median offset and scatter of -0.01 ± 0.09 mag for UCAC gri, -0.03 ± 0.13 mag for APASS BV, and 0.01 ± 0.12 mag for 2MASS JHK. Users should be aware that *Kepler* magnitudes based on J (panel d) are very approximate since the transformation is based on the average colors of stars in the *Kepler* field. Deviations of up to 1 mag can be observed for very blue or red sources.

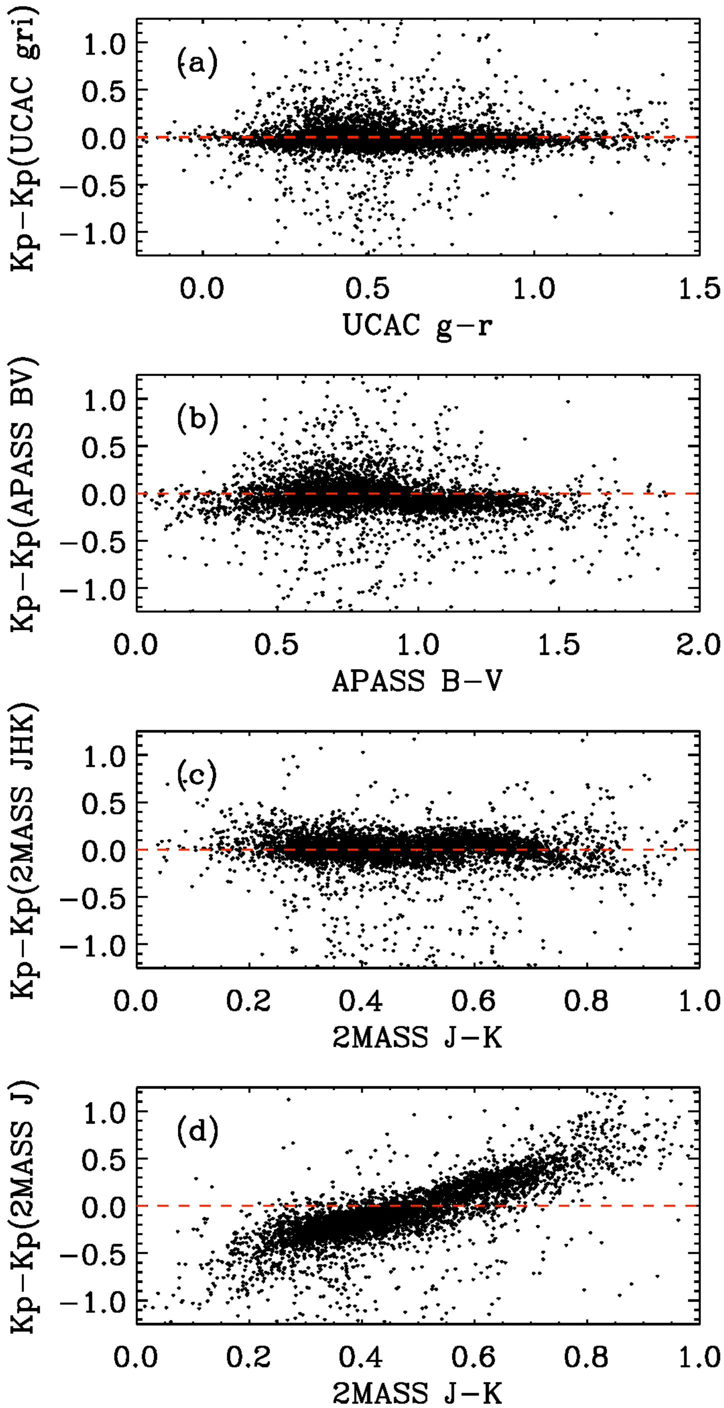

Figure 1: Difference between *Kepler* magnitudes calculated from UCAC gri (panel a), APASS BV (panel b), 2MASS JHK (panel c), and 2MASS J (panel d) as a function of color.

Figure 2 shows the *Kepler* magnitude distribution for sources in a ~80 square degree field in Campaign 1 covered by both 2MASS and SDSS. The steep drop-off at Kp ~ 20 mag is caused by the r < 20 mag cut in SDSS DR9. For coordinates not covered by SDSS the completeness is set by 2MASS sources. The right panel in Figure 2 shows the distribution on a logarithmic scale, illustrating that the catalog includes a small number of objects with Kp > 25. These are predominantly galaxies identified in SDSS.

Visual inspection of field images showed that the catalog should be complete to at least Kp ~ 18 mag for areas covered by SDSS, and Kp ~ 16 mag for areas only covered by 2MASS, except for Campaign 9, where 2MASS was restricted to J < 14 (see Section 9). Completeness for fields only covered by 2MASS may be significantly reduced for sources that are blue and faint. It is emphasized that observers can propose targets that are fainter than the typical completeness limits and/or are not presently included in the Ecliptic Plane Input Catalog. Such targets will be added to the catalog in future deliveries if selected for observation.

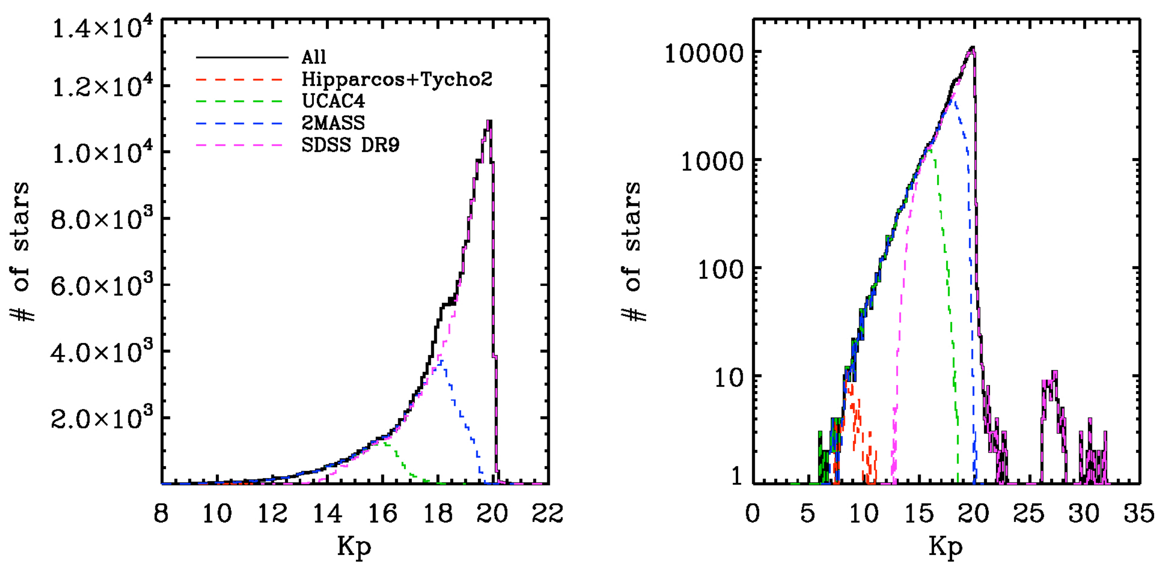

Figure 2: Histogram of *Kepler* magnitudes for sources in a ~80 square degree field in Campaign 1 covered by both SDSS and 2MASS on a linear scale (left panel) and logarithmic scale (right panel). Colors show the individual contributions from different catalogs.

4. Stellar Properties

Stellar properties (i.e., temperatures, surface gravities, metallicities, radii, masses, densities, distances, and extinctions) have been determined for the sources observed during K2 campaigns C1–C8 and C10-C12 using colors, proper motions, spectroscopy, parallaxes, and stellar population models for each field (Huber et al. 2016). These properties have been added to the Ecliptic Plane Input Catalog at the Mikulski Archive for Space Telescopes (MAST). Starting with C10, stellar properties are determined using the same method as in Huber et al. (2016), but including parallaxes from Gaia DR1 (Lindegren et al. 2016).

The code used to perform EPIC stellar classifications is hosted at:

https://github.com/danxhuber/galclassify.

Users are encouraged to employ the EPIC stellar classifications in their efforts to identify interesting sources for study.

5. Changes Implemented for Campaigns 2 & 3

The following changes to the EPIC have been implemented for Campaigns 2 & 3:

(a) Proper motions were supplemented with the NOMAD-1 catalog (Zacharias et al. 2005) to increase completeness for faint high-proper motion stars. NOMAD values were only used for 2MASS cross-matched sources for which no other proper motions were available (i.e., NOMAD does not override Tycho, UCAC, or SDSS).

(b) A small fraction of the bright near-infrared sources (J<10) do not have optical photometry and fall outside the J(HK) calibration range in Howell et al. (2012). Such sources were previously ignored, but are now included with a Kepler magnitude equal to their J-band magnitude. This affects <0.1% of all sources in the EPIC.

(c) Table 2 shows the three new columns added to the EPIC. Details on the 2MASS flags can be found in the 2MASS documentation (Cutri et al. 2003). These new columns are listed after the original columns (see Table 1) defined at MAST.

Table 2
New EPIC Columns

Column Name	Unit	Description
NOMAD	none	NOMAD-1 Identifier
Mflg	none	2MASS Flags [Qflg-Rflg-Bflg-Cflg-Xflg-Aflg]
prox	arcseconds	2MASS nearest neighbor distance (i.e., proximity)

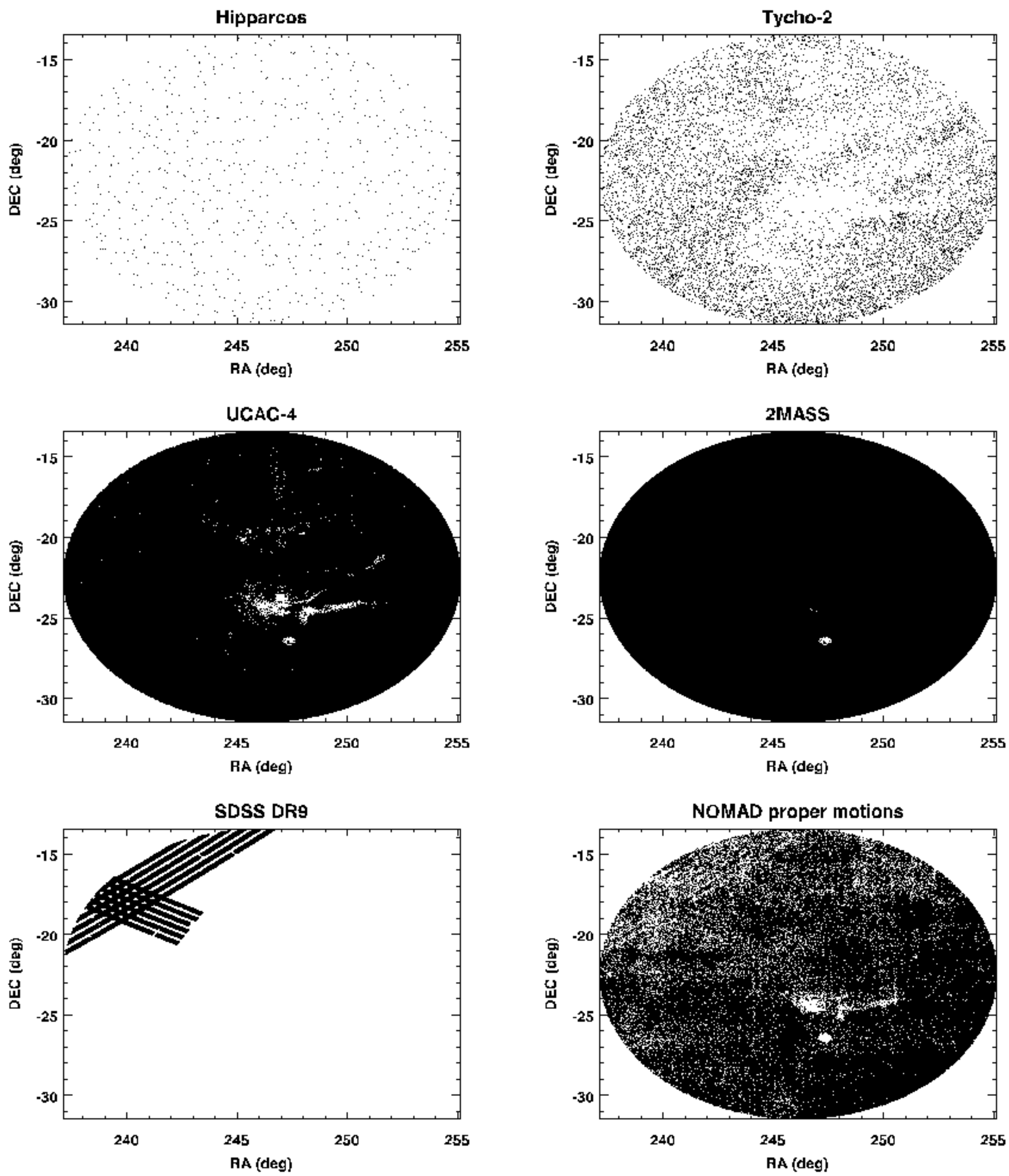

Figure 3: The distribution of sources in the Campaign 2 FOV subdivided into the different input catalogs. Each black point corresponds to a single source in the EPIC. Note that the lack of sources near the field center is due to dust extinction. The hole at RA ~ 247.4 degrees and Dec ~ -26.4 degrees is caused by alpha Sco (V ~ 0.9 mag).

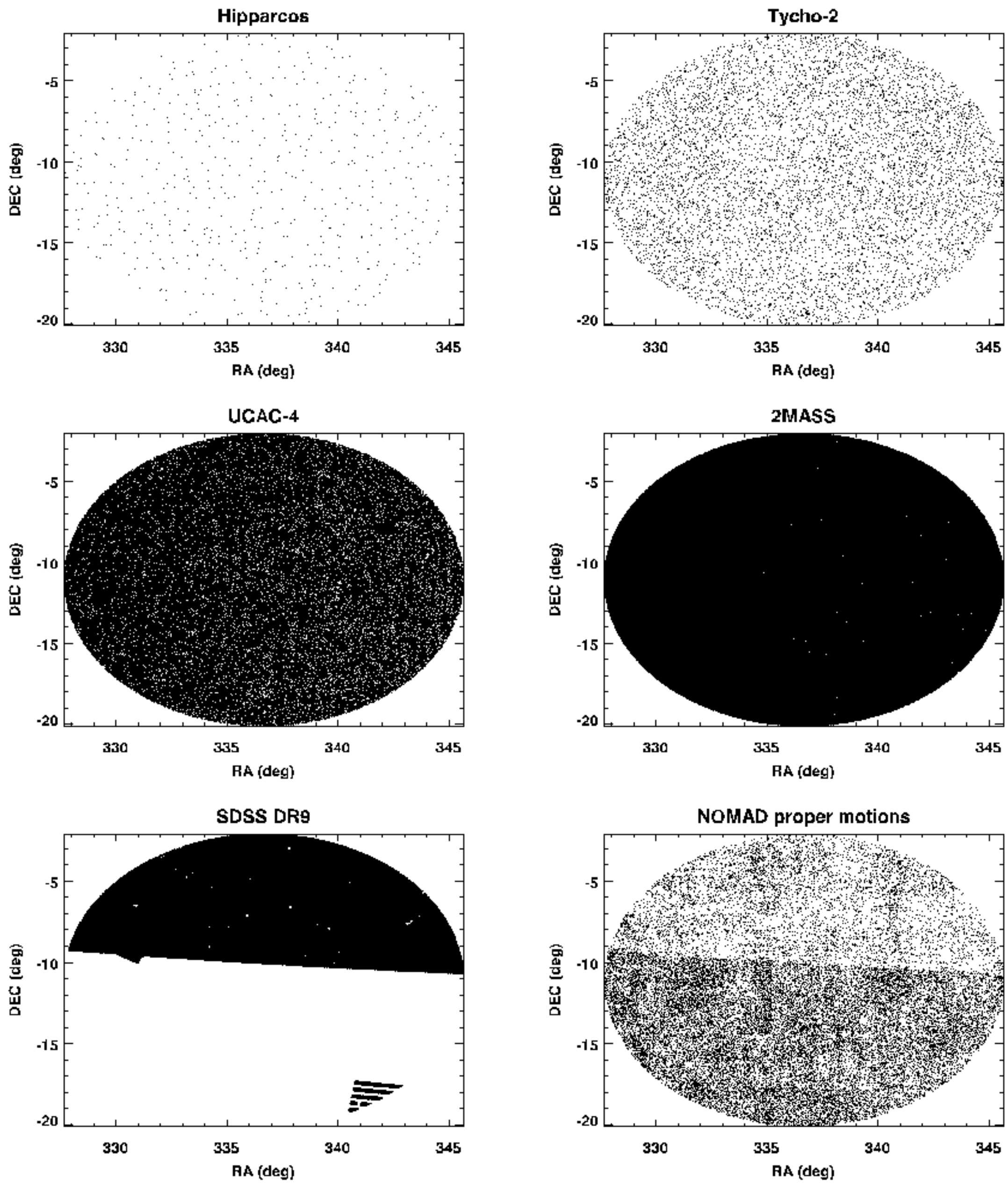

Figure 4: The same as Figure 3, but for Campaign 3. The bimodal distribution in the bottom right panel is caused by the fact that NOMAD proper motions are only used for 2MASS cross-matched sources that do not have proper motions listed in Tycho, UCAC or SSDS.

6. Changes Implemented for Campaign 0

The EPIC did not exist when Campaign 0 target selection began, so EPIC IDs were assigned to the 7748 targets approved for flight during the proposal review and target management process. This set of observed targets is referred to below as the "Target Catalog." The only columns populated in this catalog are those provided by the proposers: Kepler magnitude, Right Ascension, and Declination. Subsequently, a Comprehensive Catalog was created for Campaign 0 as described in Sections 2 and 3 above in order to compute source crowding, flux fraction, and optimal apertures (see Thompson et al. 2016).

The fields of view for these two catalogs are shown in Figure 5. They were merged into a Combined Catalog for use in SOC pipeline processing and archival at MAST. To accomplish this merger, sources were considered matched between the two catalogs if their positions agreed to < 10 arcseconds and their Kepler magnitudes agreed to < 4 magnitudes. For matched sources, the Target Catalog was given precedence over the Comprehensive Catalog – essentially trusting the positions and magnitudes provided by successful proposers (see http://keplerscience.arc.nasa.gov/K2/GuestInvestigations.shtml) over those computed internally.

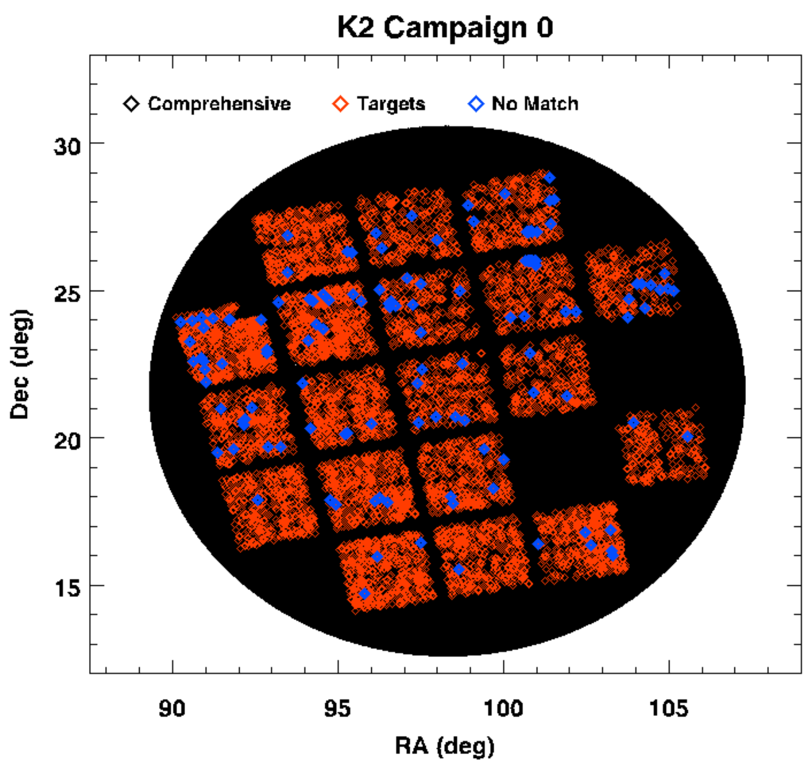

Figure 5: This field of view for Campaign 0 shows the source distribution for the Comprehensive Catalog (black), the Target Catalog (red), and the 137 sources in the Target Catalog that have no match in the Comprehensive Catalog (blue).

As shown in Figure 5, there were 137 sources in the Target Catalog that had no match in the Comprehensive Catalog. For these unmatched sources, the following procedure was adopted to create the Combined Catalog:

1) If Kepmag > 14 (80 targets), unmatched Target Catalog sources were included with no change because the Comprehensive Catalog is significantly incomplete at faint magnitudes.

2) If Kepmag < 14 (11 targets) and the Target Catalog had a duplicate source, then the source that best agreed with the Comprehensive Catalog was included and the nearby duplicate was forced to Kepmag = 30, thereby declaring it to be an artifact. An example of this situation is shown in Figure 6. In such cases, the pipeline is expected to produce valid photometry for the first source, but will only export calibrated pixel-level data for the second. Consequently, proposers who submitted poor source coordinates might find more completely processed data under an alternate EPIC ID.

3) If Kepmag < 14, the Target Catalog has no duplicate source, and:

a) Kepmag > 12 (23 targets), then the magnitude of the source was forced to Kepmag = 30. Several examples are shown in Figure 7. The rationale is that the Comprehensive Catalog is expected to be complete at these magnitudes, so unmatched sources are likely to be artifacts.

b) Kepmag < 12 (2 targets), and a corresponding source was found in the Comprehensive Catalog within a distance < 30", then the Target Catalog source was replaced by its match in the Comprehensive Catalog. An example is shown in Figure 8. The rationale is that for these bright sources uniqueness is less of an issue, so the search space was expanded to obtain matches that led to more reliable parameters. Since the C0 aperture masks include a halo of 10 pixels (i.e., 40 arcseconds) in all directions, the requisite pixels were likely collected and valid photometry may ensue.

c) Kepmag < 12 (14 targets), and no corresponding source was found in the Comprehensive Catalog within a distance < 30", then the magnitude of the source was forced to Kepmag = 30. The rationale is that larger offsets probably push the proposed targets outside their aperture masks even if the intended sources could be correctly identified in the Comprehensive Catalog.

4) The remaining (7) targets were included because they were judged to be plausible omissions or magnitude mismatches in the Comprehensive Catalog.

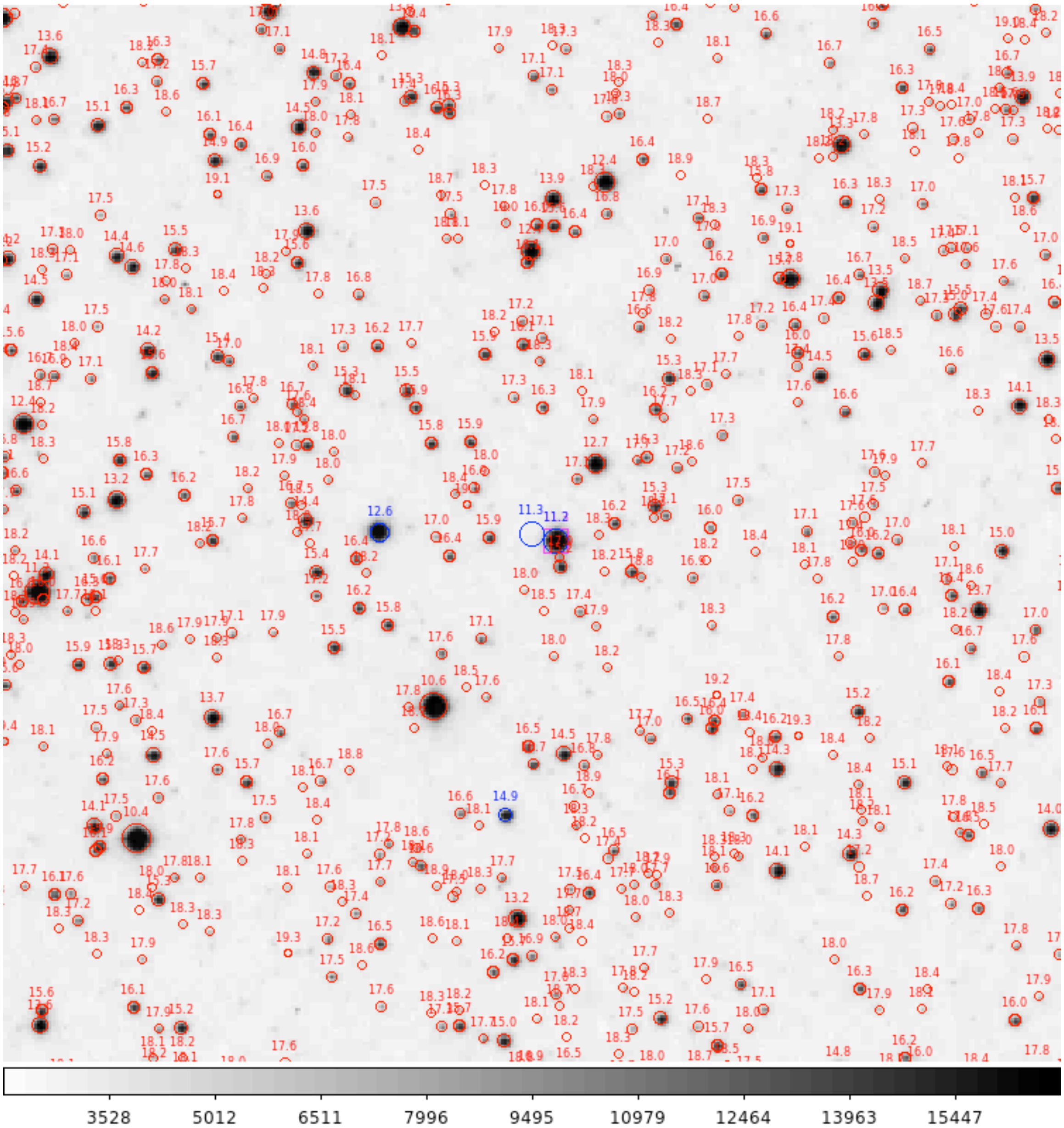

Figure 6: POSS2 images from the Digitized Sky Survey in the Campaign 0 field showing sources in the Comprehensive Catalog (red) and the Target Catalog (blue). Each image spans 10 by 10 arcminutes. Circle sizes scale with Kepler magnitude, which is given next to each source. There are two proposed 11.3 magnitude targets (i.e., blue circles) near the center of the image; one corresponds to a visible star of the correct magnitude (i.e., the magenta square) and the other lies nearby on empty sky. The correctly associated target was retained and the nearby duplicate was declared an artifact by setting its Kepmag = 30.

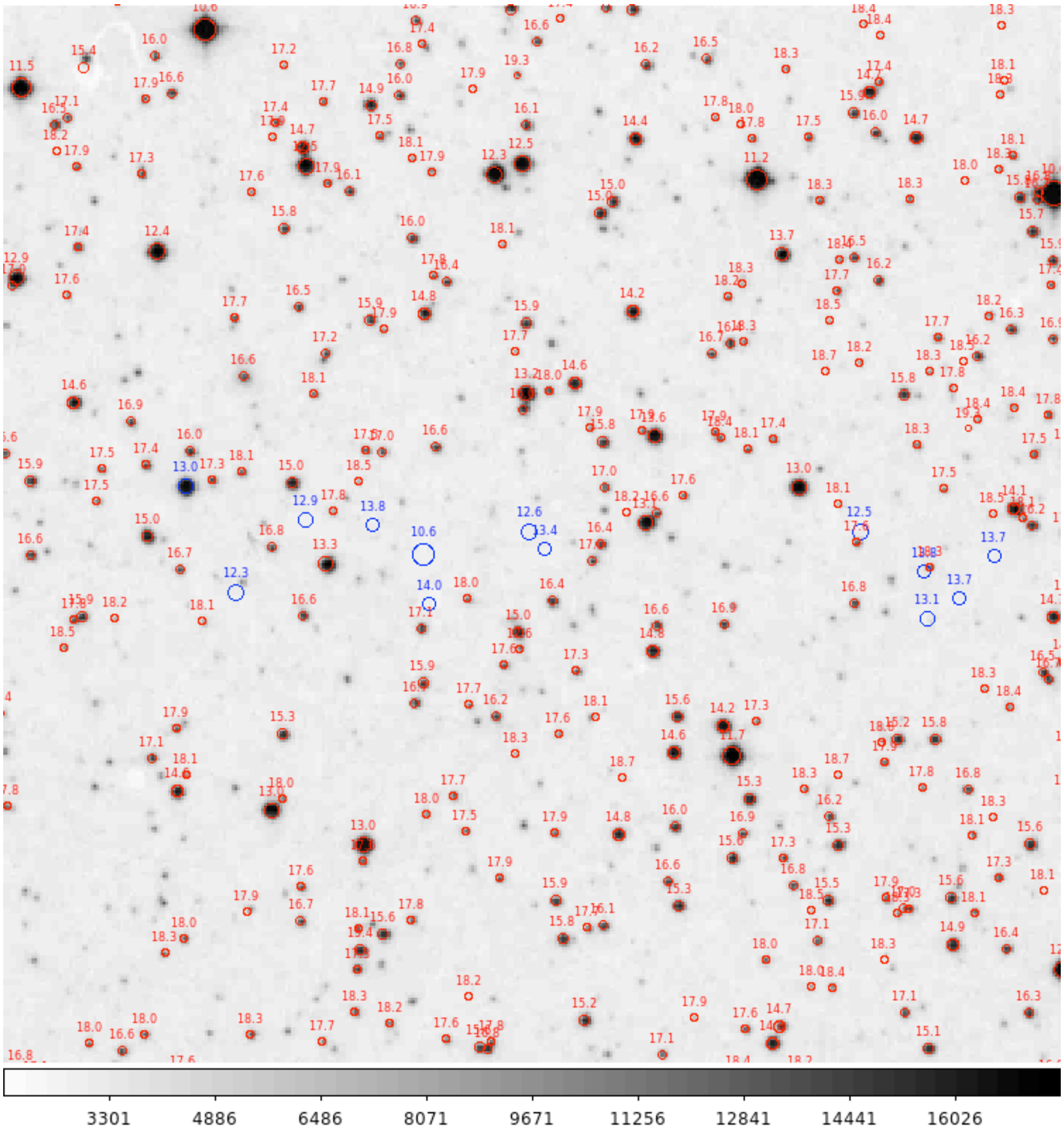

Figure 7: Same style image as shown in Figure 6. Note that there are several proposed targets (i.e., blue circles) that contain no obvious star of the expected magnitude. These have been declared artifacts by setting their Kepmag = 30. Only target pixel files will be generated for these EPIC IDs.

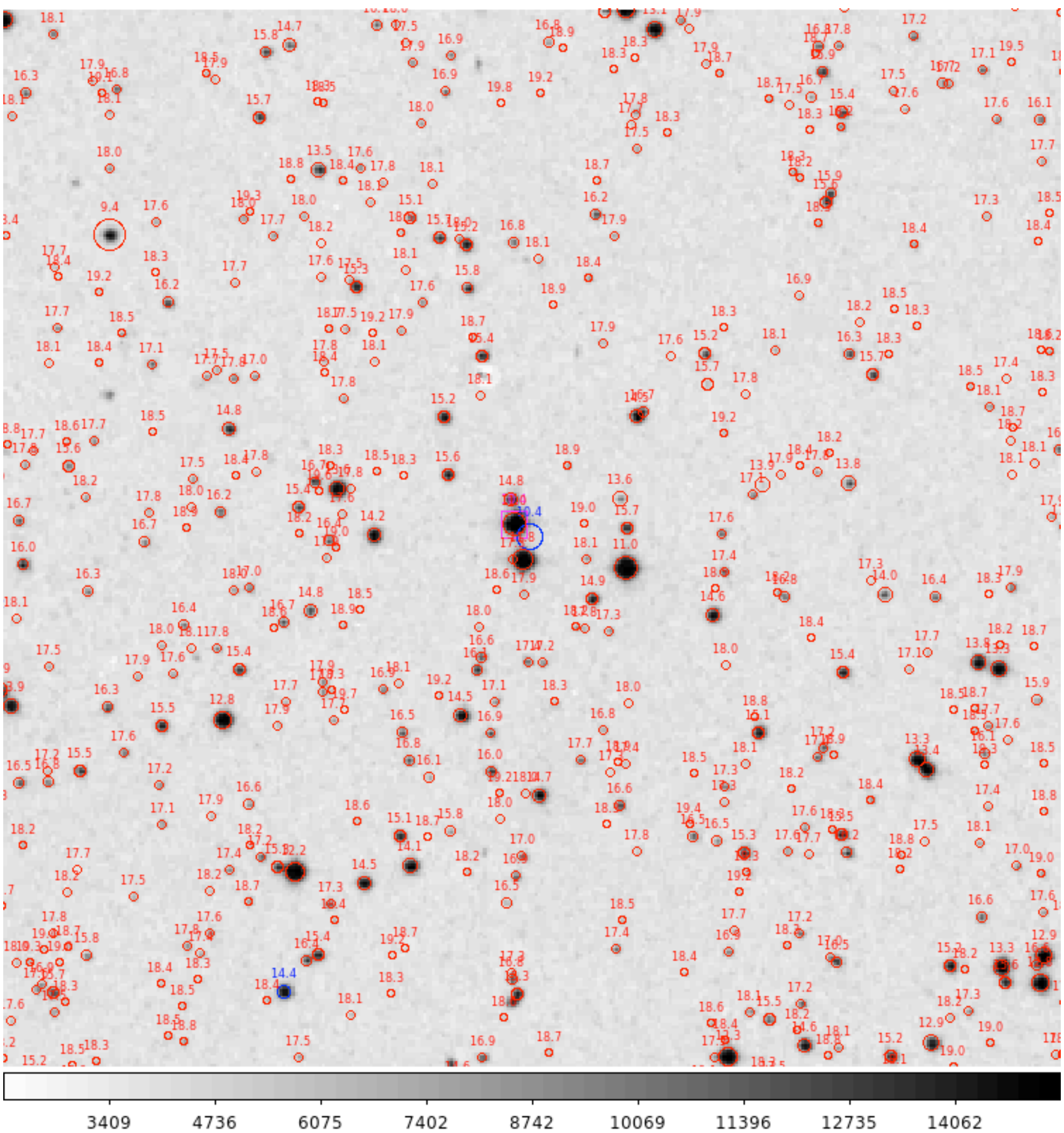

Figure 8: Same style image as shown in Figure 6. The proposed target (i.e., empty blue circle) has been assigned the coordinates of the nearest star of the same magnitude (i.e., the magenta square).

Table 3 lists the 50 proposed targets where the C0 Target Catalog information was replaced by the presumably more reliable Comprehensive Catalog values. As is apparent in the Table, some Right Ascensions and Declinations were clearly truncated. The values in the "Use Case" column refer to the logic described on page 20.

Table 3
Original information in the Campaign 0 Target Catalog that has been overridden by values in the Comprehensive Catalog

EPIC ID	RA (J2000) [deg]	Dec (J2000) [deg]	Kepmag	Use Case
202072959	96.25958	17.97139	11.3	2
202072962	100.90669	21.52123	10.1	2
202072982	100.2087	24.07166	10.5	2
202073036	103.93625	20.50028	12.1	2
202073099	98.83213	20.59304	10.8	2
202073125	99.4	19.605	13.4	2
202073136	98.64625	15.55139	11.9	2
202073152	101.0625	16.4	10.2	2
202073360	90.25138	23.93893	11.2	2
202073364	96.00625	20.46667	10.1	2
202073377	93.46126	25.6249	12.2	2
202060164	103.275	16.15	9.1	3c
202060210	91.20417	24.065	11.6	3c
202060421	91.4625	20.985	9.5	3c
202060813	90.975	22.33333	11.6	3c
202065115	100.83463	26.00889	10.6	3c
202065116	101.00775	27.00051	11.8	3c
202065117	100.66158	26.00254	12	3a
202065118	100.86758	26.00239	12.3	3a
202065119	100.75829	26.01358	12.5	3a
202065120	100.81625	26.01269	12.6	3a
202065121	100.85546	26.01389	12.9	3a
202065122	100.73379	27.01307	13.1	3a
202065123	100.74613	26.00006	13.1	3a
202065124	100.74658	27.00643	13.3	3a
202065125	100.66408	26.00734	13.3	3a
202065126	100.81333	26.00997	13.4	3a

202065127	100.83846	27.01582	13.5	3a
202065128	100.86404	27.00734	13.7	3a
202065129	100.73471	26.01016	13.7	3a
202065130	100.78521	27.00316	13.7	3a
202065131	100.74071	26.00325	13.7	3a
202065132	100.98225	26.00257	13.7	3a
202065133	100.95683	26.00356	13.7	3a
202065134	100.74683	26.0074	13.8	3a
202065135	100.7005	27.01023	13.8	3a
202065136	100.84375	26.01331	13.8	3a
202071440	98.53688	20.7	10.004	3c
202071443	98.69914	25	10.032	3c
202071445	91.00042	21.9	10.054	3c
202071446	103.79575	24.7	10.053	3c
202071448	97.94332	20.7	10.066	3c
202071450	91.47688	22.5	10.075	3c
202072947	96.54995	24.43277	11.7	3c
202073290	102.20162	24.28817	12.1	3a
202073323	100.0125	19.27333	13	3a
202073354	100.61958	24.11056	13.4	3a
202073415	105.55184	20.02898	11.4	3c
202073186	94.11483	23.312	10.4	3b
202073345	104.44608	25.19915	10.8	3b

7. Changes Implemented for Campaign 1

For Campaign 1, there were 44 targets on silicon that were submitted without EPIC IDs. Of these, one required a custom aperture, 15 were readily associated with EPIC stars, and 28 were assigned new EPIC IDs. The latter set is tabulated in Table 4 with proposer-supplied RA, Dec, and Kepmag. The alternate IDs are listed for convenience, but are not populated at MAST. The other columns in Tables 1 and 2 are generally not populated for these objects, except for eight targets that have proposer-supplied proper motions.

Table 4
User-supplied information used to define missing EPIC IDs for C1

EPIC ID	RA (J2000) [deg]	Dec (J2000) [deg]	Kepmag	Alternate ID
210282464	166.08348	-0.60784	18.7	J110420.03-003628.2
210282465	166.76577	4.09537	17.1	J110703.78+040543.3
210282466	169.44333	2.1654	18.6	J111746.40+020955.4
210282467	173.4968	9.41172	18.3	J113359.23+092442.1
210282468	177.72253	6.34708	18.7	J115053.43+062049.5
210282469	177.77431	-0.1933	18.9	J115105.83-001135.8
210282470	177.8837	6.39682	18.1	J115132.08+062348.5
210282471	181.80835	0.90494	18.9	J120713.95+005418.3
210282472	173.2325	-0.55817	21	
210282473	173.24667	-0.56767	21	
210282474	173.4025	-0.64536	21.1	
210282475	173.20875	-0.44461	20.4	
210282476	173.21083	-0.51886	20.7	
210282477	173.23708	-0.57211	20.7	
210282478	173.25583	-0.53408	21.1	
210282479	173.22333	-0.54886	21.2	
210282480	173.2175	-0.53811	21.2	
210282481	173.21042	-0.49781	21.6	
210282482	173.25417	-0.54258	21.8	
210282483	173.2375	-0.58375	21.9	
210282484	173.22292	-0.51392	22	
210282485	173.21167	-0.60094	22.1	
210282486	173.265	-0.54158	22.2	
210282487	168.1493	0.47051	17.6	CSS1112+00
210282488	168.90471	5.16714	16.7	MLS1115+05
210282489	174.46234	0.70497	19.4	MLS1137+00
210282490	179.96583	0.13144	15.9	PG1157+004
210282491	171.64938	-2.2605	20.9	TXS1124-019A

8. Regions of Incompleteness for Campaign 7

For the Campaign 7 field of view, there was no 2MASS data available for a rectangular region about 0.1 degrees in RA by 0.3 degrees in Dec that is centered near RA = 287.9, Dec = -17.7 (see Figure 9a) and for a circular region about 0.07 degrees in diameter that is centered near RA = 285.3 degrees, Dec -22.7 degrees (see Figure 9b). While the latter is almost certainly due to masking associated with the 8.2 magnitude star at the center of the region, the former is not understood. The result is that the EPIC is much less complete in these two regions than in the remainder of the C7 field of view. These regions are relatively small compared to that caused by alpha Sco in the Campaign 2 field of view (see Figure 3).

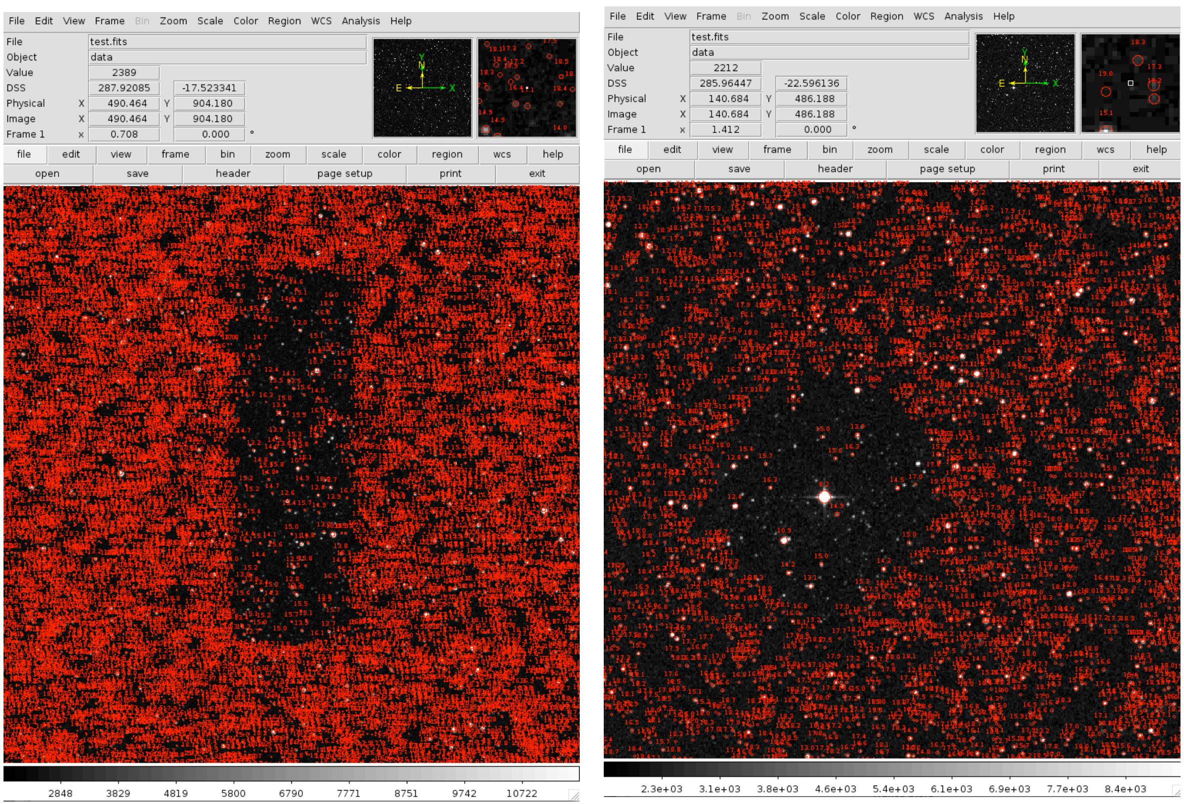

Figure 9: These two images show the lack of completeness in small (a) rectangular and (b) circular regions within the bounds of the C7 field of view.

9. Changes and Caveats for Campaigns 8, 9, and 10

Since Campaign 9 is near the Galactic plane and includes portions of the Galactic Bulge, the stellar density is at least a factor of ten higher than for any previous field of view. Consequently, the 2MASS query was truncated at J < 14 in order to limit the number of catalog entries for Campaign 9 to 7.9 million (*cf* Table 0). Since UCAC is typically complete to Kp ~ 15, the EPIC is likely complete to about this magnitude, but the resulting magnitude estimates are less accurate as reddening is large in this field. Additionally, due to strong differential reddening between optical and infrared magnitudes, Kp magnitudes derived from JHK will be underestimated (too bright) compared to Kp magnitudes derived from optical bands. Fortunately, these issues are expected to have little impact on the aperture sizes used for data collection, particularly since the majority of the pixels collected during Campaign 9 will reside in large super apertures to facilitate a microlensing experiment.

As outlined in Section 3, Kepmag (Kp) is calculated in different ways depending on the available photometry. For Campaigns 1 through 7 when only a J-band magnitude was available (i.e., Kepflag = 'J'), Equations (5) and (6) were used to calculate Kp for J > 10 and Kp was assumed equal to the J-band magnitude for J < 10. This results in a discontinuity at J = 10 where Equation (5) gives Kp = J + 1.659, while brighter stars have Kp = J. For Campaigns 1 through 7, this discontinuity was negligible due to the small number of infrared bright stars without optical counterparts for which Kepflag='J' and J < 10. However, for Campaign 9 a significant number of distant giant stars (~2% of the total EPIC sample) lack optical photometry and fall outside the calibration range for Equations (5) and (6) due to strong reddening. These stars all fall into the Kepflag='J' and J < 10 category. Therefore, the algorithm has been modified to assign Kp = J + 1.7 for J ≤ 10 and Kepmag = 'J' beginning with Campaign 8. While this condition only applies to four stars in Campaign 8 and eight stars in Campaign 10, it changes the magnitudes of 150, 965 stars in Campaign 9.

10. Changes in Campaign 16

The field of view for C16 was originally centered at RA = 320.4927498°, dec = -16.6083745°, and roll = -161.8683708° with the spacecraft flying backwards through space (see Figure 2 of Howell et al. 2014) and EPIC IDs 250261932 through 251248314 were defined to support target selection (see Table 0). More recently, C16 was redefined as a forward-facing campaign to facilitate science programs that benefit from simultaneous Earth-based observations before K2 runs out of fuel. The new C16 field of view, centered at RA = 133.7099689°, dec = 18.5253931°, and roll = -15.0205959°, has a 30% overlap with the C5 field of view. Hence, the redelivered C16 catalog for the forward-facing campaign only includes targets (i.e., EPIC IDs 251249184 to 251455478) that lie in the C16 FOV and are not already included in the C5 catalog (i.e., EPIC IDs 211233316 to 212235315 and 228682309 to 228683400). Note that the original C16 entries remain in the catalog as well, but may never be observed by K2. The Guest Observer tool for performing FOV checks (https://github.com/KeplerGO/K2fov) has been updated accordingly.

11. References

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