

# Data Validation (DV) Report

for TESS ID 424865156  
Sectors 15 - 15

This Data Validation Report was produced in the  
TESS Science Processing Operations Center (SPOC) Pipeline  
at NASA Ames Research Center

21-Sep-2019 10:57:06 Z

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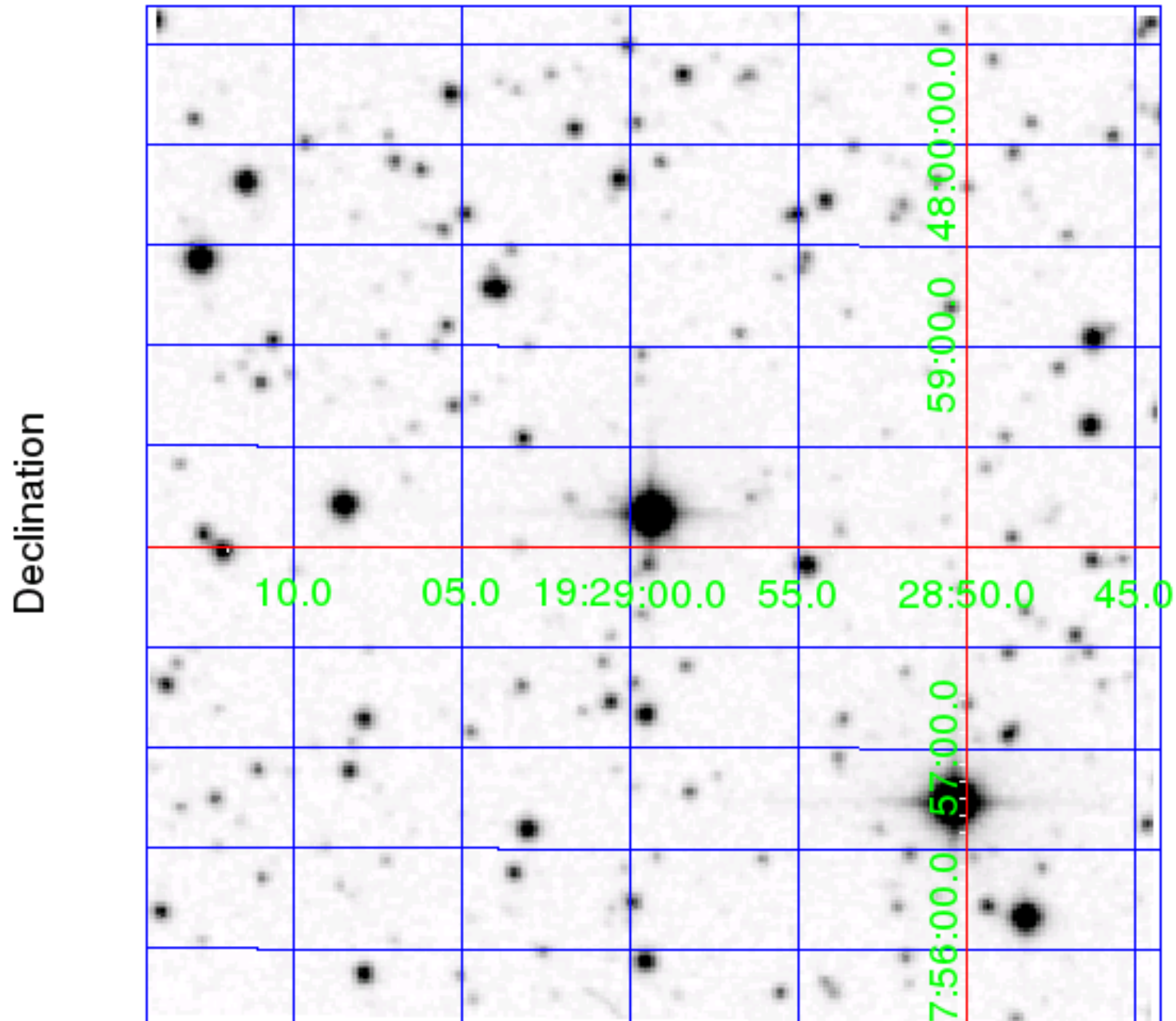
# 1 Summary

Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	424865156			
TOI ID	-			
TESS Name	-			
RA	292.24730755	0	degrees	TIC8
Dec	47.96950451	0	degrees	TIC8
Magnitude	10.0274	0.0061		TIC8
Radius	1.994	0.081	Solar radii	TIC8
Effective Temperature	6532	109	Kelvin	TIC8
log(g)	3.968	0.081665	cm/sec <sup>2</sup>	TIC8
[M/H]	0.233	0.026069	Solar metallicity	TIC8
Stellar Density	0.170	0.033	Solar density	TIC8-Derived
Limb Darkening Coefficient 1	0.49393			
Limb Darkening Coefficient 2	0.41387			
Limb Darkening Coefficient 3	-0.40448			
Limb Darkening Coefficient 4	0.12175			
Number of Planet Candidates	1			
TOI Model	toi-plus-2019-09-20.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-4.0.9-20190919			
Date Report Generated	21-Sep-2019 10:57:06 Z			

Sector	Target Table	Camera/ CCD	Crowding Metric	Flux Fraction
15	169	2:3	0.9852	0.8493

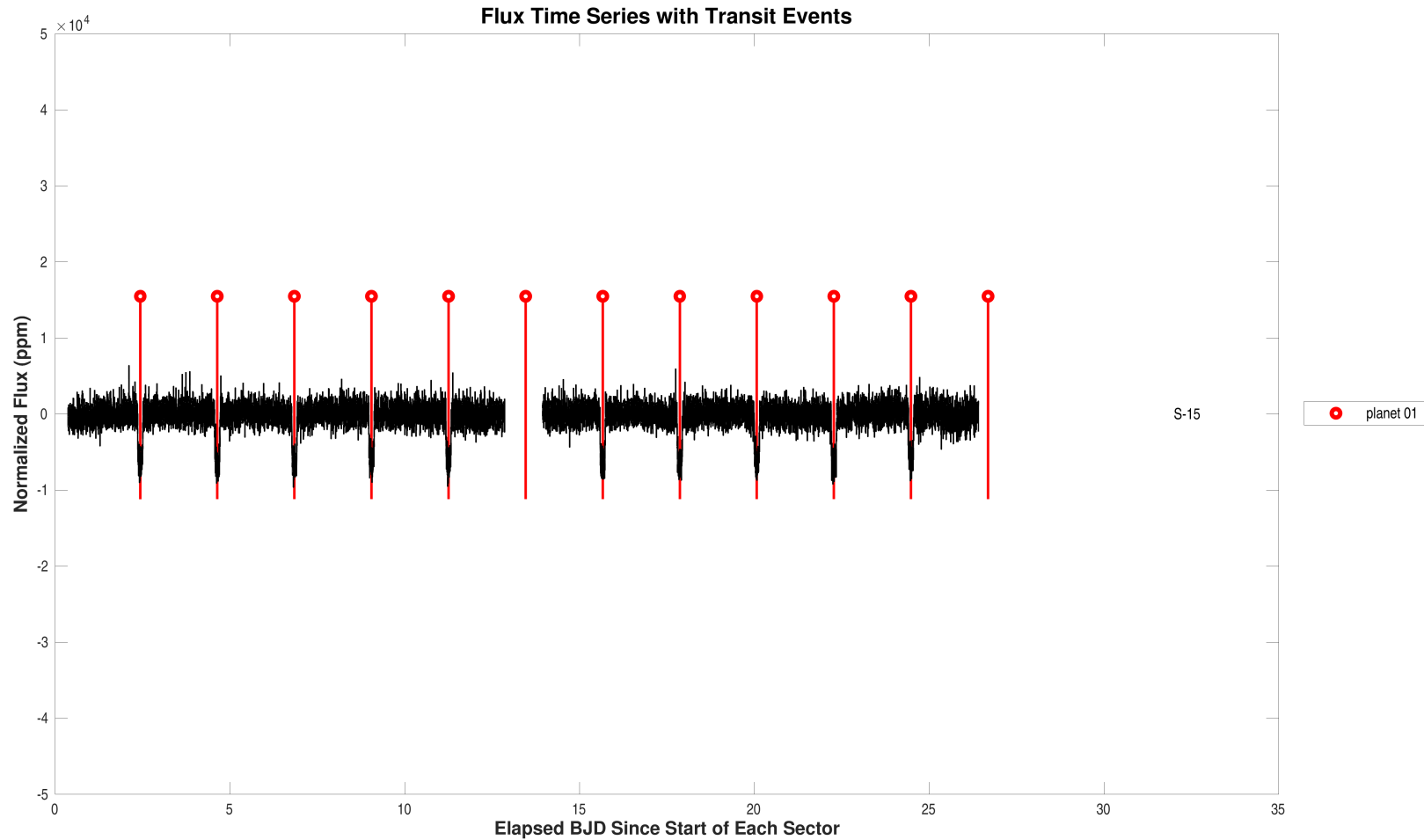
Planet Candidate	TOI ID	TESS Name	TOI Correlation	Period (days)	Period Ratio	Epoch (BTJD)	Semi-major Axis (AU)	Radius (Re)	Seff	Teq (K)	False Alarm	Suspected EB
1	-	-	-	2.205	1.00	1713.434	0.04	16.9	4831.1	2126	0.00e+00	false

## 2 Survey Image

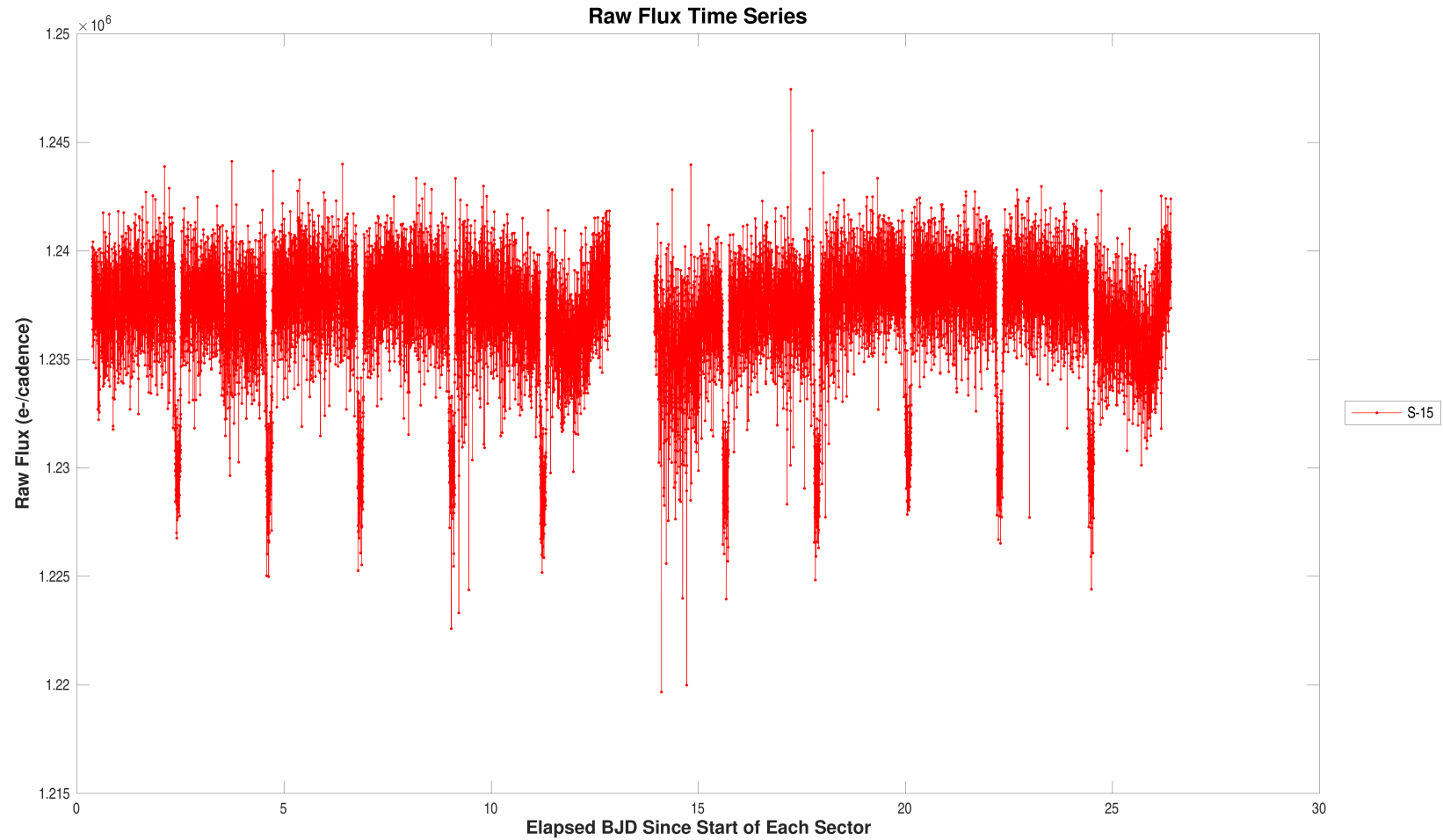


Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (424865156).

### 3 Flux Time Series



Summary plot of sector-stitched flux time series and transits for target 424865156, marked with DV fitted epoch/period (or TPS epoch/period if fit was not successful). Transits of identified planets are labeled with epoch BTJD and orbital period. For the data of sector 15, target table 169, start BJD is 2458711. Open `./summary-plots/0000000424865156-00-flux-dv-fit-15-169.fig`



Summary plot of raw flux time series. For the data of sector 15, target table 169, start BJD is 2458711.  
Open `./summary-plots/000000424865156-00-raw-flux-15-169.fig`

## 4 Dashboards

## Planet Candidate 1

<b>Model Fitter</b>	<b>Stellar Radius</b> 2.0 ± 0.1 Solar units		<b>Core Aperture Correlation Statistic</b> Value = 58.69 Significance = 100.00%		<b>Ghost Diagnostic Test</b>	
	Period = 2.2 ± 0.0 days Depth = 6601 ± 57 ppm Planet Radius = 16.9 ± 0.7 Earth radii Semi-major Axis = 0.0 ± 0.0 AU Effective Stellar Flux = 4831.1 ± 698.9 Equilibrium Temperature = 2126 ± 77 Kelvin Chi-squared/DoF = 0.8 SNR = 115.7		<b>Halo Aperture Correlation Statistic</b> Value = 14.42 Significance = 100.00%  <b>Core/Halo Ratio</b> Ratio = 4.07			
<b>Eclipsing Binary Discrimination Test</b>	<b>Odd-Even Depth Comparison Statistic</b> Value = 2.92e-02 Significance = 86.44%		<b>Offsets Relative to Out of Transit Centroid</b> Source RA Offset = 4.09e-01 ± 2.50e+00 arcsec (0.16 $\sigma$ ) Source Dec Offset = -1.11e+00 ± 2.50e+00 arcsec (-0.44 $\sigma$ ) Source Offset Distance = 1.18e+00 ± 2.50e+00 arcsec (0.47 $\sigma$ )  <b>Offsets Relative to TIC Position</b> Source RA Offset = 1.15e+00 ± 2.50e+00 arcsec (0.46 $\sigma$ ) Source Dec Offset = 2.76e-01 ± 2.50e+00 arcsec (0.11 $\sigma$ ) Source Offset Distance = 1.18e+00 ± 2.50e+00 arcsec (0.47 $\sigma$ )		<b>Difference Image Centroid Offsets</b>	
	<b>Shorter Period Comparison Statistic</b> Value = <i>N/A</i> Significance = <i>N/A</i>	<b>Longer Period Comparison Statistic</b> Value = <i>N/A</i> Significance = <i>N/A</i>	False Alarm = 0.00e+00 Transit Count = 11 Max Multiple Event Statistic = 101.8		<b>Bootstrap Test</b>	

Summary of model fitter results and validation test results for target 424865156, planet candidate 1. In general, green denotes that the candidate is likely a planet, while red denotes that the candidate is unlikely to be a planet. Cyan denotes that no data is available. The color of the Model Fitter block is: green, when the SNR of the fit is greater than or equal to 10; yellow, if the SNR is greater than or equal to 7.1 but less than 10; red, if the SNR is less than 7.1 or if the fitter failed. The color of the Ghost Diagnostic Test and Eclipsing Binary Discrimination Test blocks are: green, when the significance is within 2-sigma; yellow, when the significance is between 2- and 3-sigma; red when the significance is greater than 3-sigma. The color of the Difference Image Centroid Offsets block is: green, when the max offset distance sigma is less than or equal to 2; yellow, when the max sigma is between 2 and 3; red when the max sigma is greater than 3. The color of the Bootstrap Test block is green whenever the false alarm probability is less than  $10^{-12}$ , low enough to limit the total number of false alarms from a four year mission to less than one. If the false alarm probability is greater than  $10^{-12}$ , the color of the Bootstrap Test block is: green, when the false alarm probability is less than or equal to the CCDF of a Gaussian distribution at the observed maximum multiple event statistic; yellow when the false alarm probability is between 1 and 2 times that of a Gaussian distribution at the max multiple event statistic; and red when the false alarm probability is more than 2 times that of a Gaussian distribution at the max multiple event statistic.

## 5 Pixel Level Diagnostics

To reduce clutter, the catalog IDs in the difference images have been replaced by indices representing distance from the target star. The mapping between the indices and the catalog IDs is found in a table at the end of this section.

### 5.1 Planet Candidate 1

#### Multi-Sector Average PRF Fit of the Difference Images

Mean offset from the PRF fit to the out of transit image

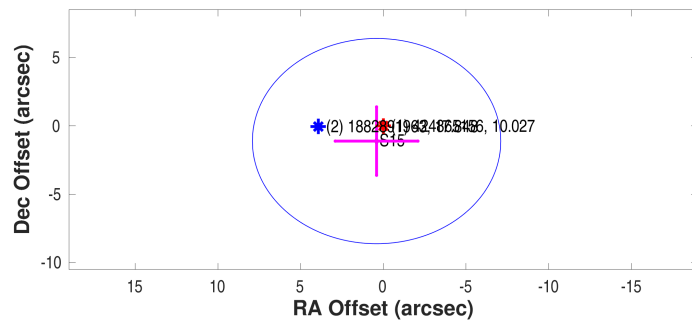
	RA	Dec	Units
Offset	$0.4090 \pm 2.50e + 00$	$-1.1056 \pm 2.50e + 00$	arcseconds
Offset/ $\sigma$	0.16	-0.44	
Offset Distance	$1.1788 \pm 2.50e + 00$		arcseconds
Offset Distance/ $\sigma$	0.47		
$3\sigma$ Radius	7.5096		arcseconds

Mean offset from the TIC RA and Dec

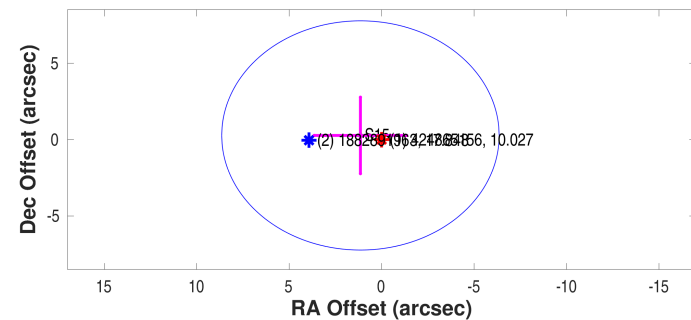
	RA	Dec	Units
Offset	$1.1488 \pm 2.50e + 00$	$0.2761 \pm 2.50e + 00$	arcseconds
Offset/ $\sigma$	0.46	0.11	
Offset Distance	$1.1815 \pm 2.50e + 00$		arcseconds
Offset Distance/ $\sigma$	0.47		
$3\sigma$ Radius	7.5044		arcseconds

#### Planet Candidate 1

Offsets Relative to Out of Transit Centroid



Offsets Relative to TIC Position

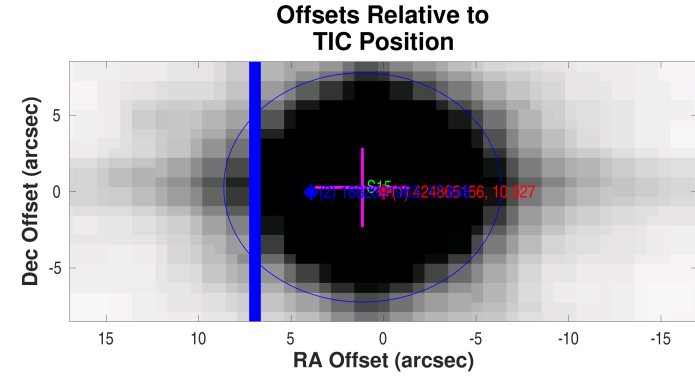
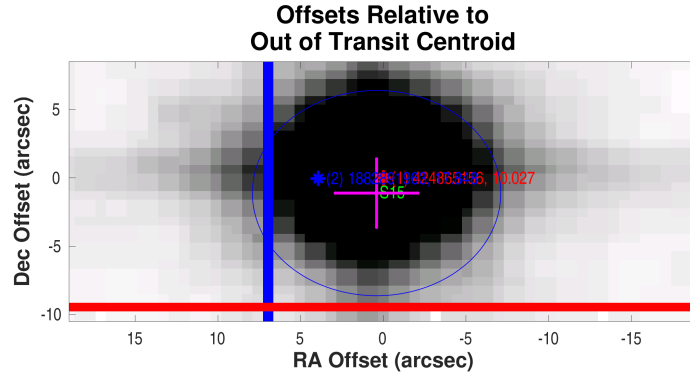


Difference image centroid offsets for target 424865156, planet candidate 1. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in RA and Dec with respect to the TC coordinates of the given target. Symbol key: green cross: per sector centroid offsets with 1-sigma error bars in RA and Dec; magenta cross: robust weighted mean offset over all sectors with 1-sigma error bars in RA and Dec; blue circle: 3-sigma radius of confusion for weighted mean offset; red asterisk: location of target star; blue asterisk: location of other TIC objects in the neighborhood. TIC ID and magnitude are noted in the text associated with each marked object. A constant error term of 2.5000 arcseconds has been added in quadrature to the computed uncertainty in the RA and Dec components of the robust mean offset.

Open `./planet-01/difference-image/0000000424865156-01-difference-image-centroid-offsets.fig`



## Planet Candidate 1



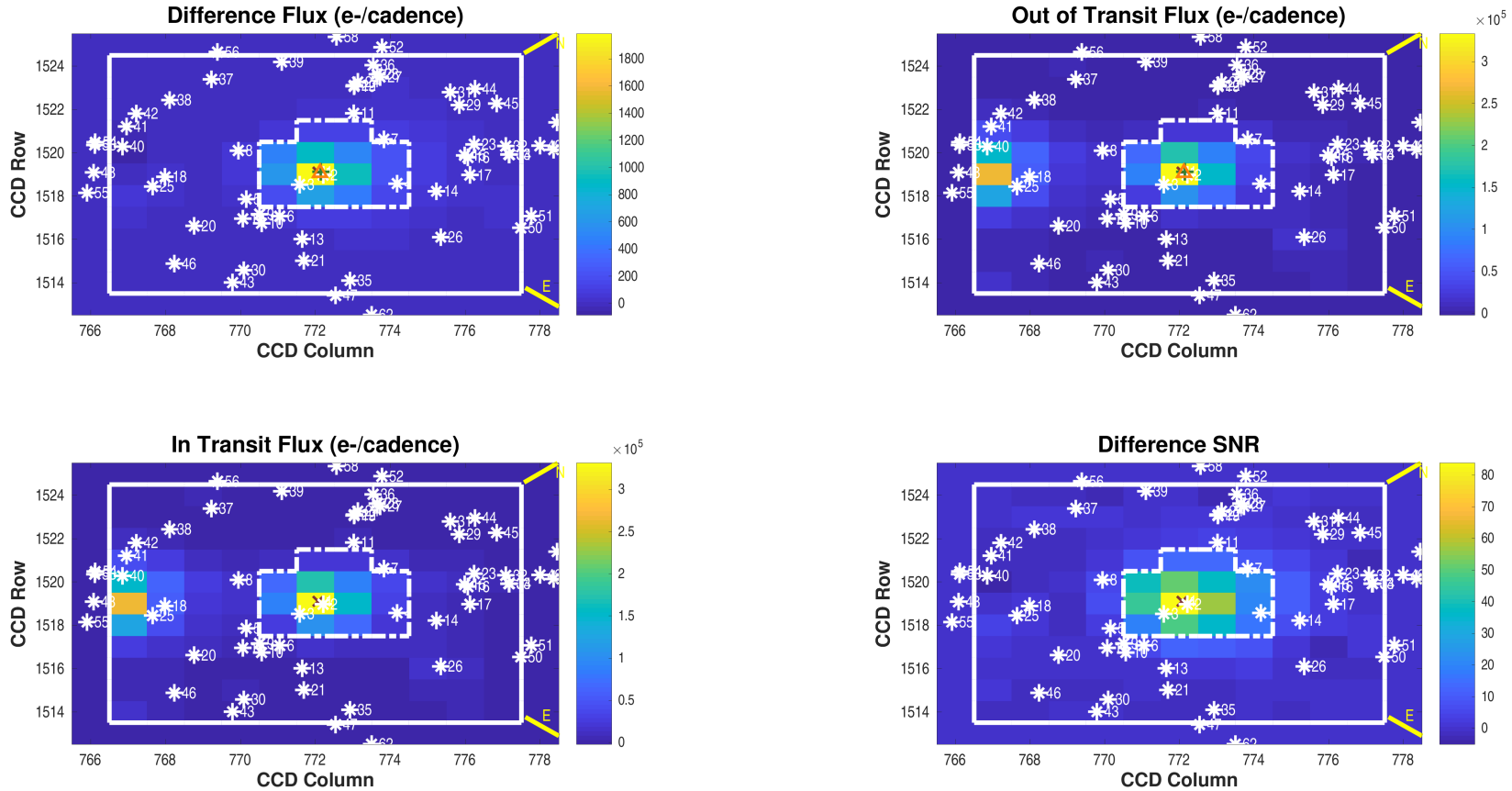
Difference image centroid offsets for target 424865156, planet candidate 1, displayed on survey image for given target. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in RA and Dec with respect to the TIC coordinates of the given target. Symbol key: green cross: per sector centroid offsets with 1-sigma error bars in RA and Dec; magenta cross: robust weighted mean offset over all sectors with 1-sigma error bars in RA and Dec; blue circle: 3-sigma radius of confusion for weighted mean offset; red asterisk: location of target star; blue asterisk: location of other TIC objects in the neighborhood. TIC ID and magnitude are noted in the text associated with each marked object. A constant error term of 2.5000 arcseconds has been added in quadrature to the computed uncertainty in the RA and Dec components of the robust mean offset.

Open `./planet-01/difference-image/0000000424865156-01-difference-image-centroid-offsets-survey.fig`

## Difference Image Summary Metrics

Number of Difference Images	Number of Metrics	Number of Good Metrics	Fraction of Good Metrics	Quality Threshold
1	1	1	1.0000	0.70

**Difference Image**  
Planet Candidate 1 / Sector 15 / Target Pixel Table 169



Difference image for target 424865156, planet candidate 1, sector 15, target pixel table 169. Upper left: difference between mean flux out-of-transit and in-transit; upper right: mean out-of-transit flux; lower left: mean in-transit flux; lower right: difference between mean flux out-of-transit and in-transit after normalizing by the uncertainty in the difference for each pixel. The optimal aperture is outlined with a white dash-dotted line in each panel and the target mask is outlined with a solid white line. Symbol key: x: target position from TIC RA and Dec converted to CCD coordinates via motion polynomials; \*: position of nearby TIC objects converted to CCD coordinates via motion polynomials; +: PRF-fit location of target from out-of-transit image; triangle: PRF-fit location of transit source from the difference image. Number of transits = 10; number of valid in-transit cadences = 957; number of in-transit cadence gaps = 14; number of valid out-of-transit cadences = 2426; number of out-of-transit cadence gaps = 25. Difference image quality metric = 1.00 (good).

Open `./planet-01/difference-image/0000000424865156-01-difference-image-15-169.fig`

## PRF Fit of the Difference Image

## Offset from the PRF fit to the out of transit image

	Row	Column	Units	RA	Dec	Units
Out of Transit Image Centroid	$1519.13 \pm 2.02e - 05$	$772.15 \pm 1.94e - 05$	pixels	$292.24746539 \pm 7.12e - 07$	$47.96993697 \pm 7.00e - 07$	degrees
Difference Image Centroid	$1519.08 \pm 6.25e - 03$	$772.12 \pm 6.11e - 03$	pixels	$292.24763507 \pm 3.41e - 05$	$47.96962985 \pm 3.64e - 05$	degrees
Offset	$-0.0520 \pm 6.25e - 03$	$-0.0241 \pm 6.11e - 03$	pixels	$0.4090 \pm 8.22e - 02$	$-1.1056 \pm 1.31e - 01$	arcseconds
Offset/ $\sigma$	-8.33	-3.95		4.98	-8.43	
Offset Distance	$0.0573 \pm 6.42e - 03$		pixels	$1.1788 \pm 1.27e - 01$		arcseconds
Offset Distance/ $\sigma$	8.93			9.31		

## Offset from the TIC RA and Dec converted to pixels via motion polynomials

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$1519.10 \pm 1.23e - 04$	$772.07 \pm 1.21e - 04$	pixels	$292.24715847 \pm 0.00e + 00$	$47.96955316 \pm 0.00e + 00$	degrees
Difference Image Centroid	$1519.08 \pm 6.25e - 03$	$772.12 \pm 6.11e - 03$	pixels	$292.24763507 \pm 3.41e - 05$	$47.96962985 \pm 3.64e - 05$	degrees
Offset	$-0.0289 \pm 6.25e - 03$	$0.0493 \pm 6.11e - 03$	pixels	$1.1488 \pm 8.22e - 02$	$0.2761 \pm 1.31e - 01$	arcseconds
Offset/ $\sigma$	-4.63	8.07		13.98	2.11	
Offset Distance	$0.0572 \pm 5.91e - 03$		pixels	$1.1815 \pm 8.52e - 02$		arcseconds
Offset Distance/ $\sigma$	9.68			13.86		

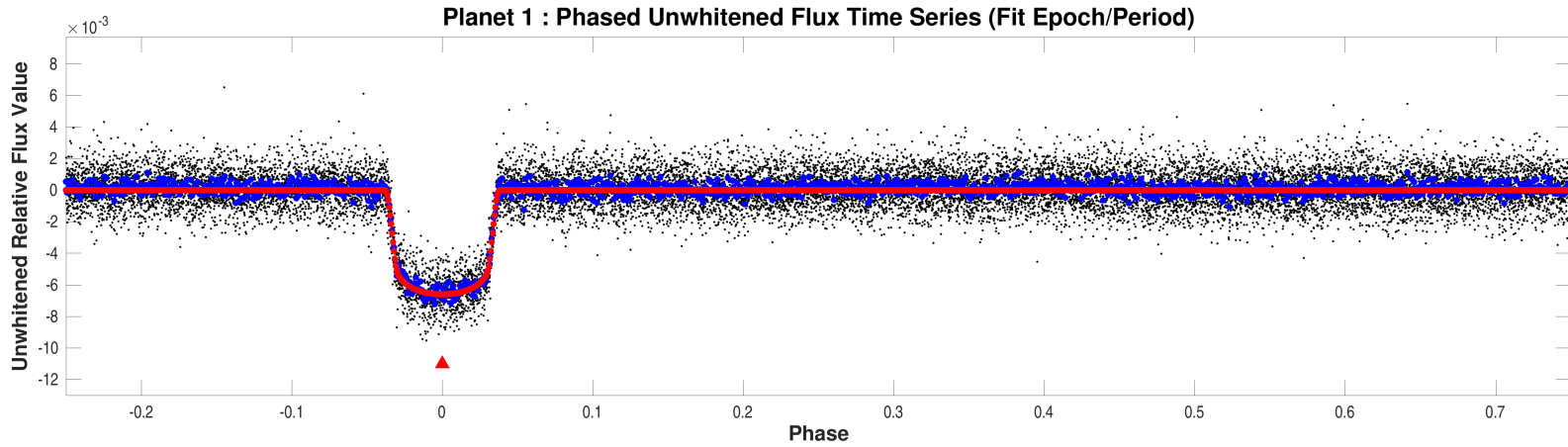
## 5.2 Difference Image TIC Key

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
1	424865156	10.027	292.24715847	47.96955316	0.00
2	1882891963	17.848	292.24879027	47.96954354	3.93
3	424865161	16.155	292.24765087	47.96527117	15.46
4	424865153	15.930	292.26323271	47.97570146	44.62
5	63203906	17.514	292.24305898	47.95690151	46.61
6	1882891960	17.917	292.25330589	47.95720664	46.85
7	1882892012	17.873	292.24859306	47.98264983	47.27
8	424865162	14.481	292.22812210	47.96521013	48.47
9	424865168	17.612	292.24943690	47.95548226	50.95
10	424865170	16.016	292.25235618	47.95395813	57.52
11	424865145	17.686	292.23639849	47.98436400	59.29
12	424865172	14.795	292.24801750	47.95284709	60.18
13	424865169	17.718	292.26339937	47.95524652	64.69
14	424865151	17.024	292.27178338	47.97838809	67.34
15	424865140	14.389	292.26622839	47.98813332	81.16
16	1882892020	15.113	292.26738445	47.98809111	82.65
17	424865144	16.808	292.27266218	47.98497816	82.84
18	424865173	17.365	292.22356561	47.95255740	83.53
19	1882891976	17.829	292.22886250	47.98948897	84.23
20	424865180	16.238	292.24213128	47.94635796	84.38
21	424865176	17.488	292.26971859	47.95136514	85.11
22	424865139	17.529	292.22863200	47.98968500	85.13
23	1882892021	17.805	292.26472395	47.99121028	88.72
24	424865136	17.319	292.22821363	47.99071055	88.81
25	424865177	16.742	292.22424631	47.94943137	91.09
26	424865155	13.037	292.28537912	47.97020684	92.15
27	1882892025	17.793	292.23048894	47.99397902	96.68
28	424865131	16.295	292.22922627	47.99418763	98.66
29	424865125	15.180	292.25126552	47.99702271	99.38
30	424865182	14.621	292.26263042	47.94326148	101.73
31	424865122	17.418	292.24620524	47.99850258	104.24
32	424865130	16.382	292.27036250	47.99419292	104.86
33	424865132	17.359	292.27319708	47.99297238	105.10
34	1882892022	17.801	292.27332559	47.99299141	105.34
35	424865174	15.368	292.28280271	47.95251070	105.57
36	424865128	15.553	292.22597473	47.99548895	106.42
37	1882892388	17.823	292.20370652	47.97581025	107.13
38	63203916	17.215	292.20273156	47.96752081	107.33

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
39	424865143	16.712	292.21026408	47.98645476	107.75
40	424865171	17.387	292.20819450	47.95376259	109.78
41	63203907	17.109	292.20318329	47.95795202	113.92
42	63203912	17.574	292.20112142	47.96144054	114.74
43	424865186	16.353	292.26426577	47.93976343	114.90
44	424865114	17.121	292.24922647	48.00173873	115.98
45	424865116	15.961	292.25688116	48.00127610	116.58
46	424865187	16.654	292.24955274	47.93719008	116.65
47	424865178	15.975	292.28465579	47.94817567	118.71
48	424865181	9.497	292.21079896	47.94585513	122.31
49	424865124	16.839	292.27584674	47.99786501	123.16
50	424865149	16.622	292.29577456	47.98038665	123.50
51	424865147	16.368	292.29415926	47.98371156	124.22
52	1882892442	17.809	292.22235257	47.99980741	124.25
53	63203900	16.152	292.20321861	47.95114546	124.93
54	1882892377	17.641	292.20249579	47.95171258	125.35
55	424865184	17.322	292.21541367	47.94134250	127.16
56	63203923	17.279	292.19700213	47.98155592	128.38
57	424865123	16.828	292.27915891	47.99854676	129.78
58	424865126	17.157	292.21209932	47.99696104	129.91
59	1882892397	17.801	292.20819406	47.99644925	134.89
60	1882891952	17.650	292.21697049	47.93702841	137.86
61	424865111	15.447	292.27204822	48.00406196	137.96
62	63203948	17.217	292.29595873	47.94828659	140.34
63	424865133	17.721	292.19594507	47.99247883	148.49
64	424865119	17.096	292.29020709	48.00019294	151.44
65	424865120	17.178	292.20254771	47.99933072	151.83
66	63203888	16.201	292.20573429	47.93709660	153.69
67	424865127	13.811	292.29768010	47.99694620	156.69
68	1882891744	18.000	292.19904169	47.94016030	156.99
69	1882891927	17.722	292.29535821	47.93926448	159.33
70	424865115	17.439	292.20037005	48.00179833	161.84
71	63203887	12.327	292.20107093	47.93605984	163.95

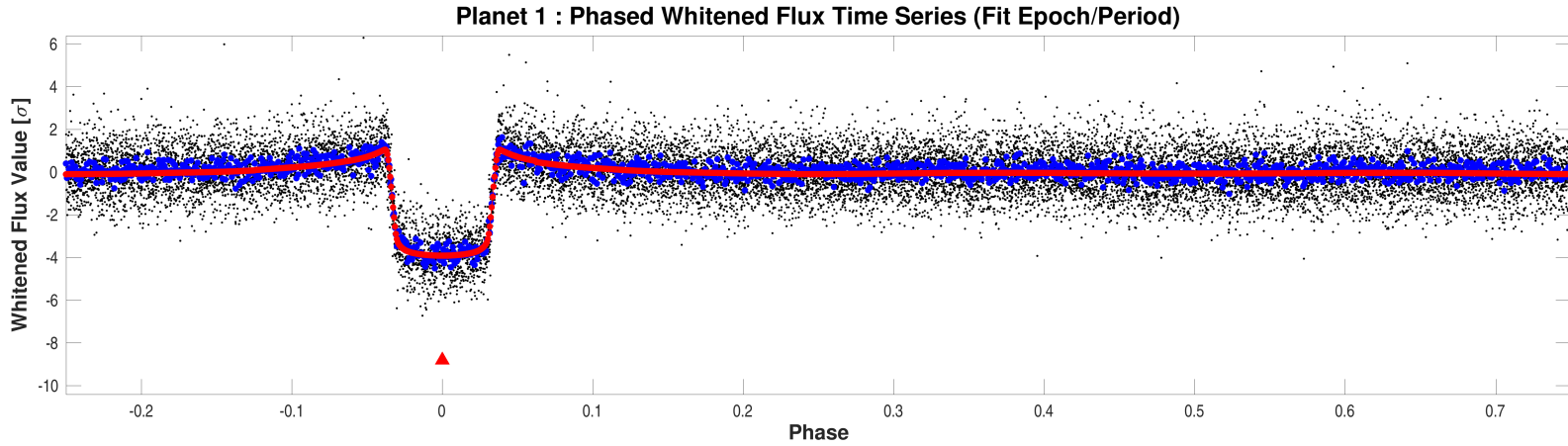
RA, Dec and Distances are corrected for proper motion. This table may not contain all of the objects shown.

## 6 Phased Light Curves



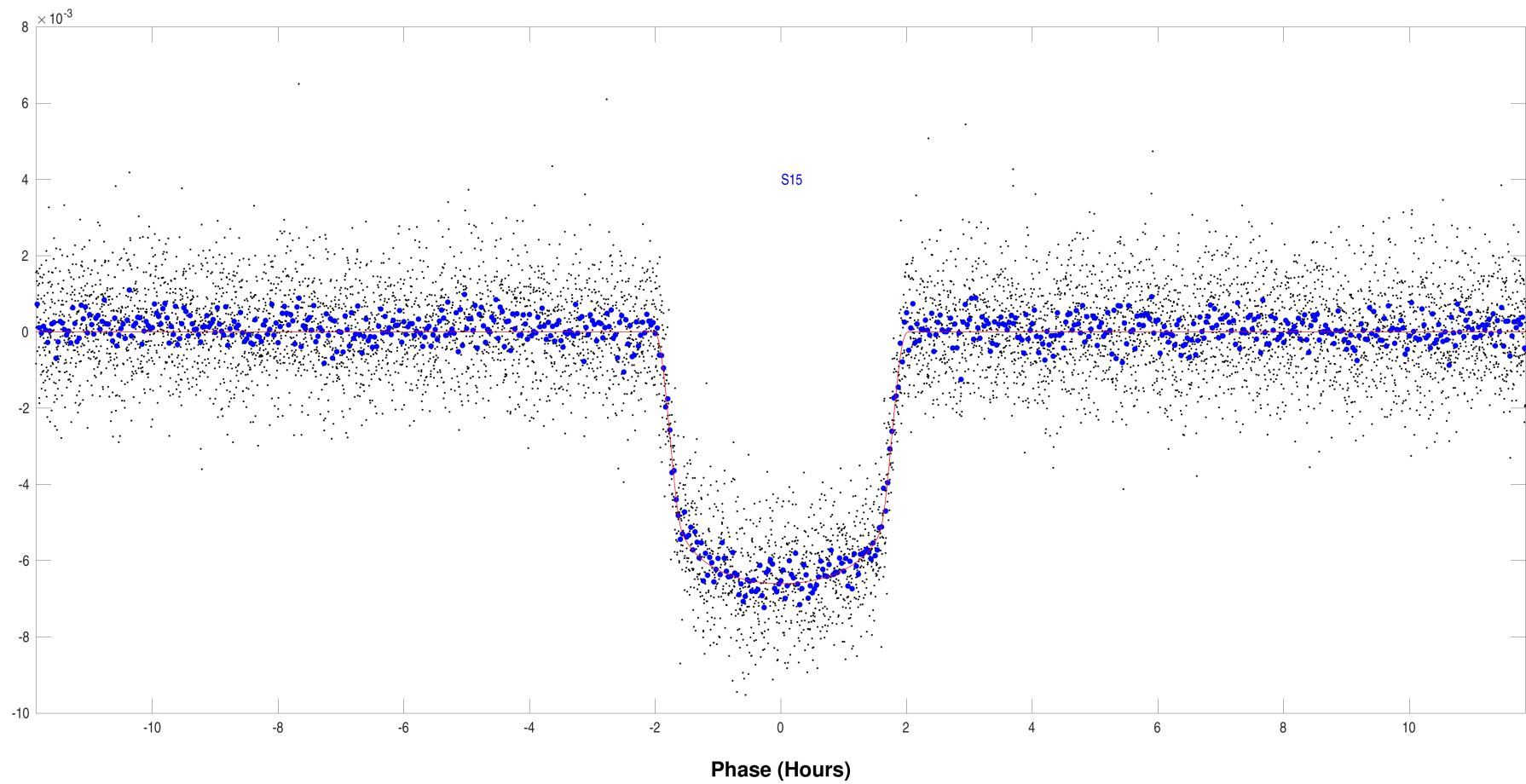
Phased unwhitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased unwhitened flux time series averaged in one cadence wide bins are plotted in bigger blue dots. When all transits fit completes with full or secondary convergence, the averaged values of the phased unwhitened fitted model light curve are plotted in red dots. Transit event markers in different colors indicate the locations of the transits of all planet candidates. The transits of the same planet candidate are labeled with the markers of the same color, for example, blue markers for transits of plane candidate #1, red markers for transits of planet candidate #2, etc.

Open `./summary-plots/0000000424865156-01-phased-unwhitened-flux-time-series.fig`



Phased whitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased whitened flux time series averaged in one cadence wide bins are plotted in bigger blue dots. When all transits fit completes with full or secondary convergence, the averaged values of the phased whitened fitted model light curve are plotted in red dots. Transit event markers in different colors indicate the locations of the transits of all planet candidates. The transits of the same planet candidate are labeled with the markers of the same color, for example, blue markers for transits of plane candidate #1, red markers for transits of planet candidate #2, etc. Open `./summary-plots/0000000424865156-01-phased-whitened-flux-time-series.fig`

## Planet: 1 Phased Unwhitened Flux Time Series by Sector



Phased unwhitened flux time series by sector for target 424865156, planet candidate 1. Period = 2.2047 days; transit epoch = 1713.434 BTJD.  
Open `./summary-plots/000000424865156-01-phased-unwhitened-flux-time-series-by-sector.fig`



## 7 Planet Candidate 1

### 7.1 Model Fitter: All Transits

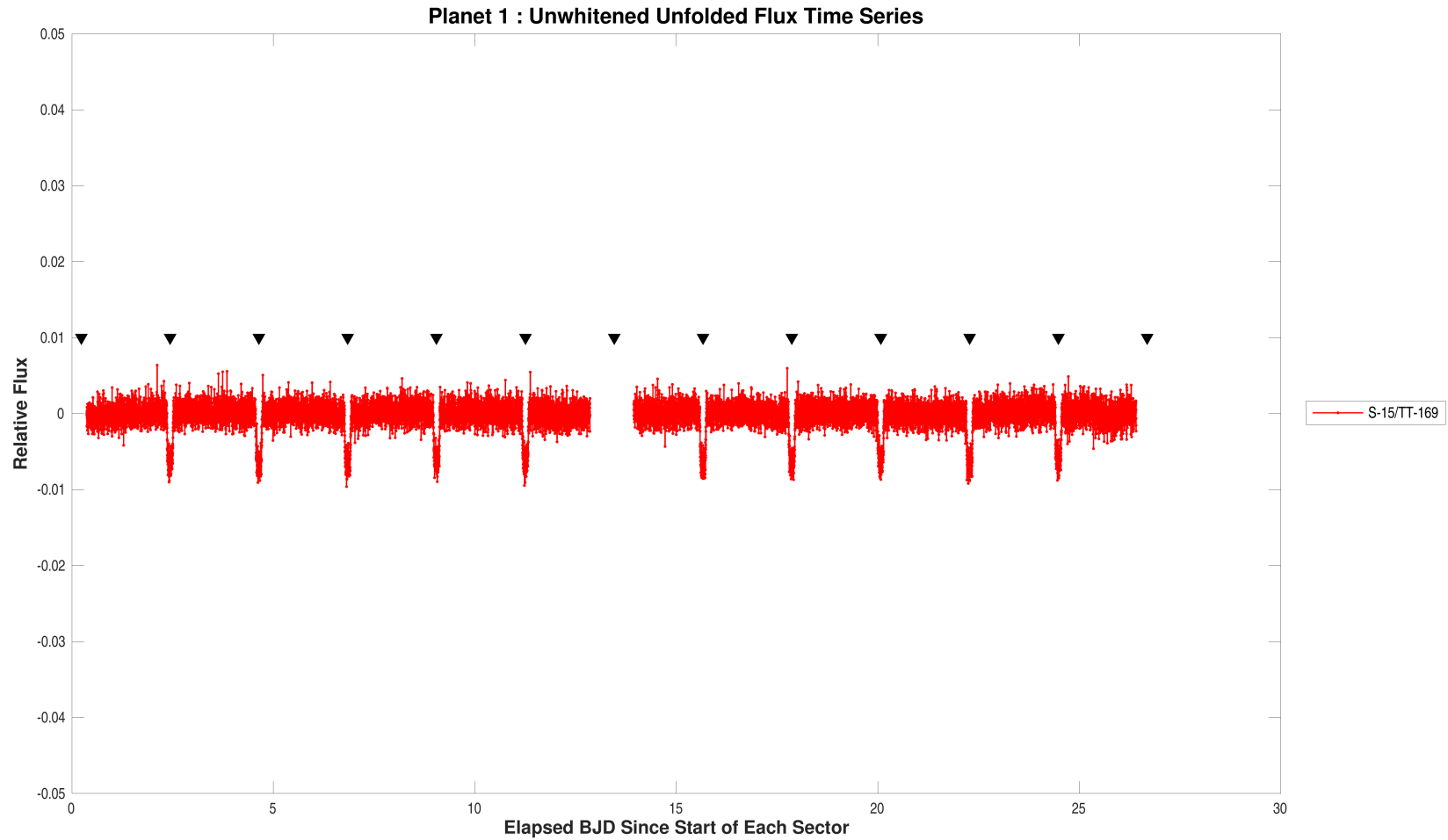
Model Characteristic	Name
Transit Model	mandel-agol_geometric_transit_model
Limb Darkening Model	claret_tess_nonlinear_limb_darkening_model

TCE Parameter	Value	Units
Trial Transit Pulse Duration	3.5	hours
Transit Epoch	1713.4330786	TJD
Orbital Period	2.2041657	days
Maximum SES	36.5	
Maximum MES	101.8	
Robust Statistic	99.5	
Chi Square Goodness of Fit Statistic (DoF)	1675.7 (1019)	
Chi Square2 Statistic (DoF)	625.8 (843.6)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

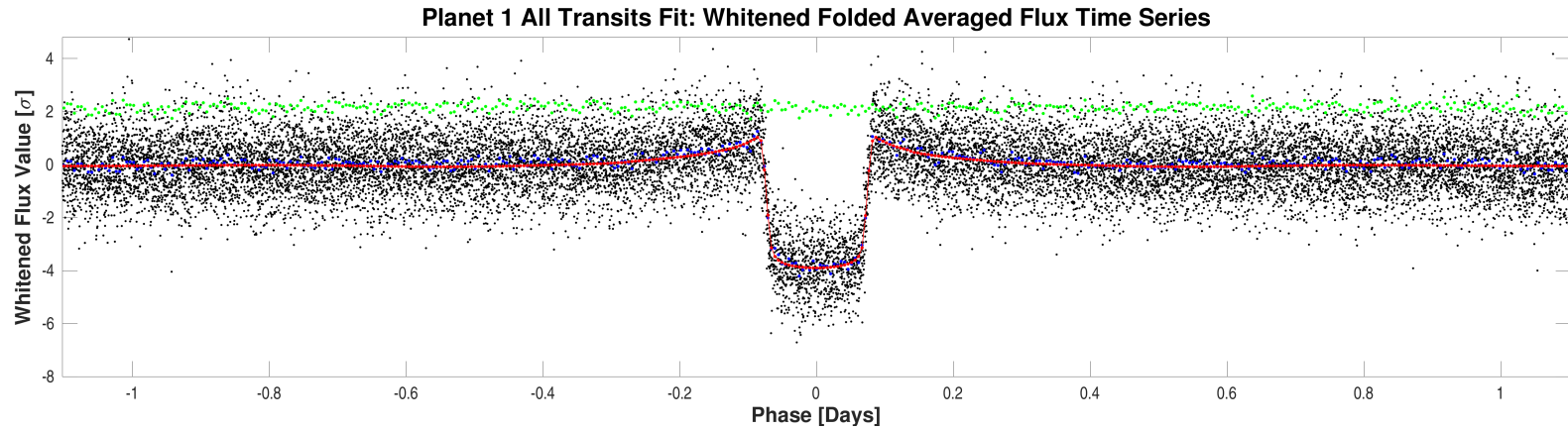
Parameter	Value	Uncertainty	Units
SNR	115.7		
Orbital Period	2.2047412	7.3274e-05	days
Transit Epoch	1713.4339976	4.3403e-04	BTJD
Impact Parameter	0.4824	6.4688e-02	
Planet Radius to Star Radius Ratio	0.0775687	6.1038e-04	
Semi-major Axis to Star Radius Ratio	4.1740	1.5963e-01	
Planet Radius	16.8818	7.0080e-01	Earth radii
Semi-major Axis	0.0366	2.5026e-03	AU
Effective Stellar Flux	4831.1081	6.9886e+02	Goldilocks
Equilibrium Temperature	2126	7.6898e+01	Kelvin
Stellar Density	0.2010	2.3059e-02	Solar density
Transit Depth	6601	5.6883e+01	ppm
Transit Duration	3.9505	3.2610e-02	hours
Transit Ingress Duration	0.3685	3.2571e-02	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	4689.4 (5760.1)		
Model Chi Square Goodness of Fit Statistic (DoF)	694.0 (1217)		
Model Chi Square2 Statistic (DoF)	1.8 (9)		

DoF: Degrees of Freedom



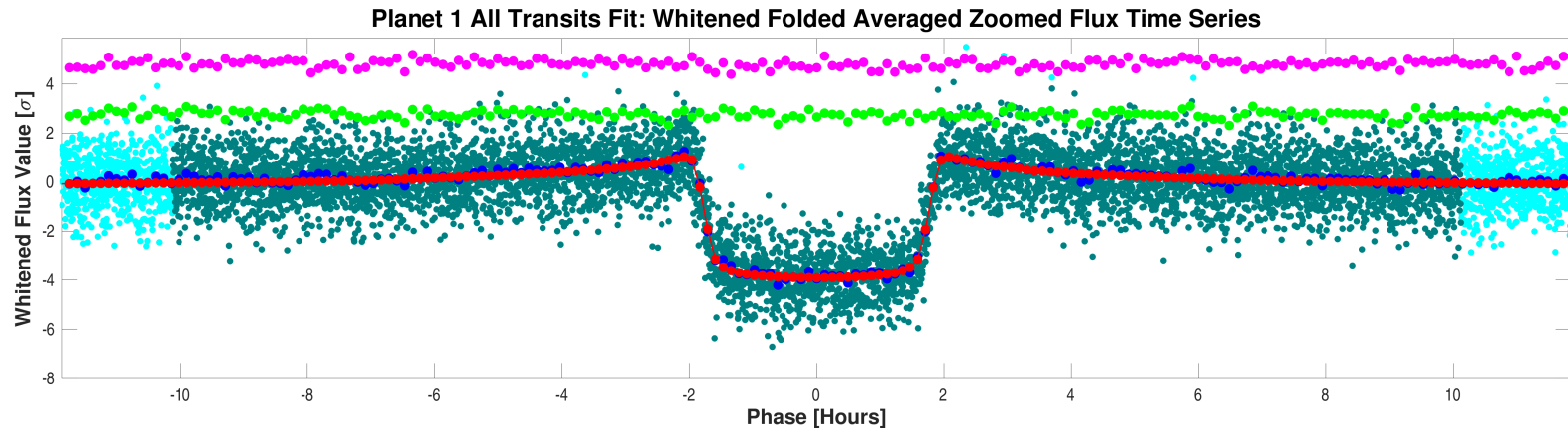
Flux time series for CatId 424865156, Planet candidate 1 in the unwhitened domain. For the data of Sector-15/TargetTableId-169, start BJD is 2458711. Transit event markers indicate the location of transits of the given planet candidate. All transits fit completed with full convergence.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000424865156-01-all-unwhitened-15-169.fig`



Folded flux time series for CatId 424865156, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light curve of the all transits fit; the green dots are the averaged folded fit residuals, vertically offset for clarity. All transits fit completed with full convergence.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000424865156-01-all-whitened.fig`



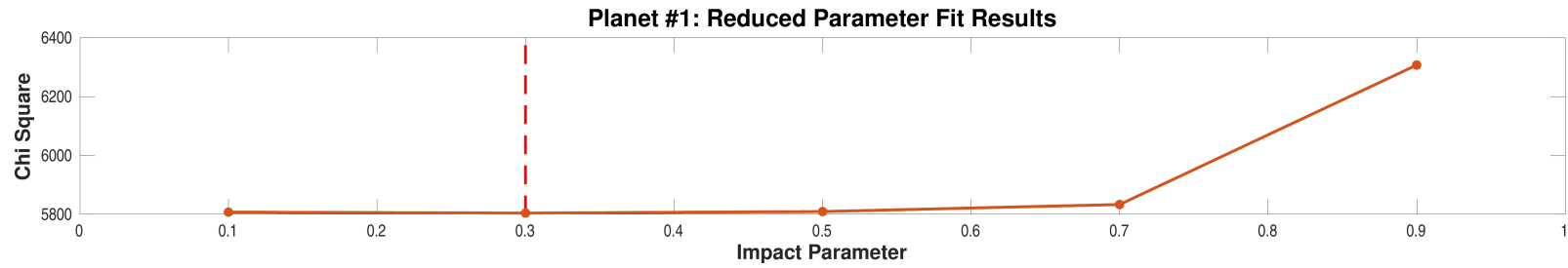
Folded flux time series for CatId 424865156, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the fitted model light curve of the all transits fit; the green dots are the averaged folded fit residuals, vertically offset for clarity. Magenta dots are the averaged values of the folded flux time series, with a phase shift of 0.5 relative to the blue dots, vertically offset for clarity. All transits fit completed with full convergence.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000424865156-01-all-whitened-zoomed.fig`

## 7.2 Model Fitter: Reduced Parameter Fit Results

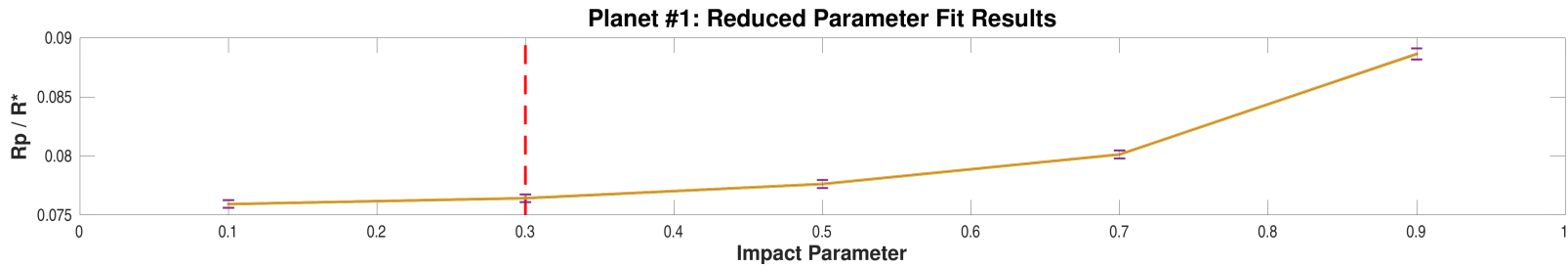
<b>Impact Parameter</b>	<b>SNR</b>	<b>Model Chi Square</b>	<b>Planet Radius to Star Radius</b>	<b>Uncert</b>	<b>Semi-major Axis to Star Radius</b>	<b>Uncert</b>	<b>Transit Depth (ppm)</b>	<b>Uncert</b>	<b>Transit Duration (hours)</b>	<b>Uncert</b>
0.10	119.7	5807.3	0.0759260	3.2471e-04	4.7084	1.3901e-02	6570	5.5887e+01	3.8669	1.1575e-02
0.30	119.9	5804.2	0.0764260	3.2635e-04	4.5234	1.3711e-02	6573	5.5827e+01	3.8923	1.2007e-02
0.50	121.0	5809.3	0.0776289	3.2968e-04	4.1290	1.3350e-02	6589	5.5646e+01	3.9593	1.3158e-02
0.70	120.9	5833.2	0.0801289	3.4447e-04	3.4592	1.3082e-02	6630	5.6629e+01	4.1312	1.6479e-02
0.90	113.2	6307.1	0.0886377	4.6890e-04	2.3496	1.4744e-02	6965	7.1923e+01	4.8187	3.5144e-02

Highlighted row is the best reduced-parameter model fit.



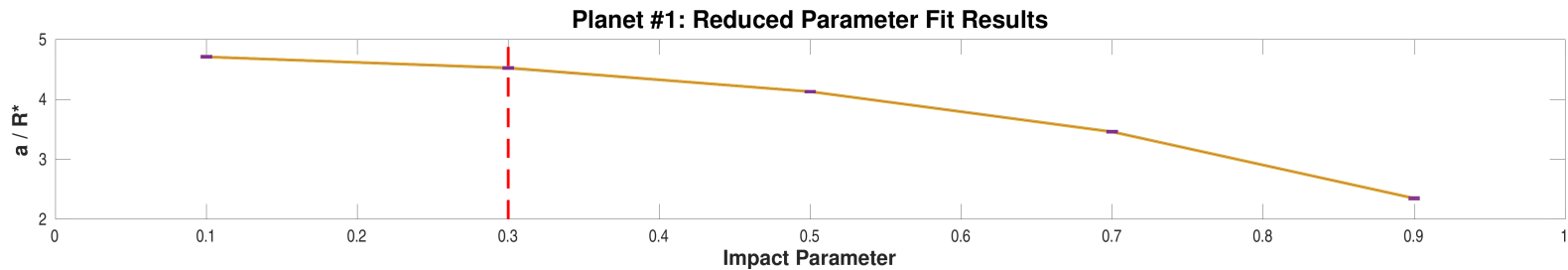
Model chi squares of reduced parameter fits vs. impact parameter for CatId 424865156, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.

Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000424865156-01-reduced-fits-chi-square.fig`



Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 424865156, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.

Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000424865156-01-reduced-fits-rp-over-rstar.fig`



Ratios of semimajor axis to star radius of reduced parameter fits vs. impact parameter for CatId 424865156, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.

Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000424865156-01-reduced-fits-a-over-rstar.fig`

### 7.3 Model Fitter: Trapezoidal Fit Results

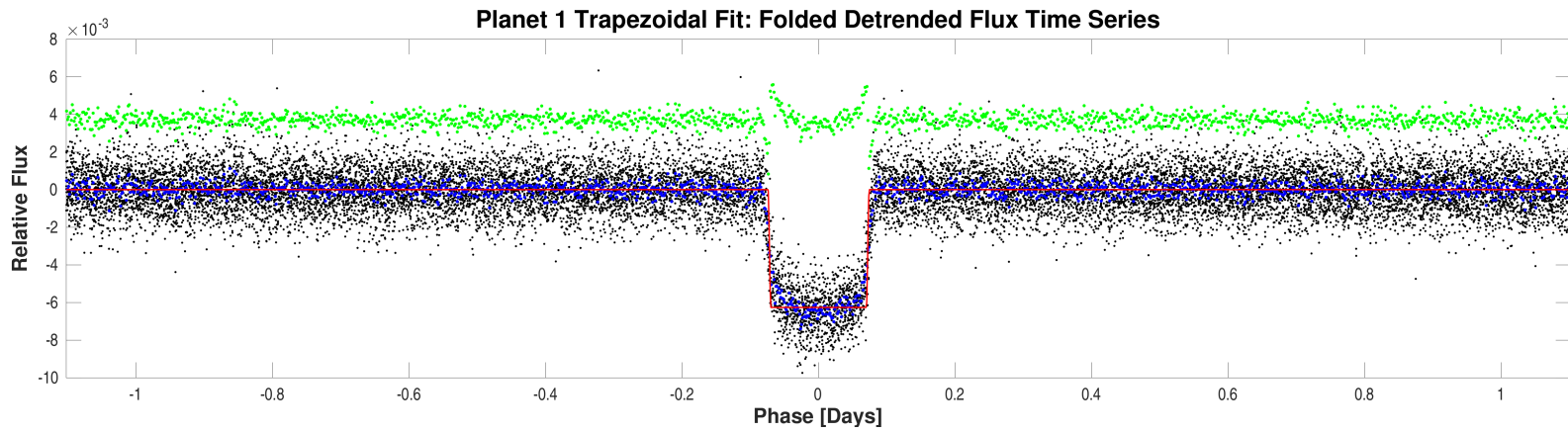
Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

TCE Parameter	Value	Units
Trial Transit Pulse Duration	3.5	hours
Transit Epoch	1713.4330786	TJD
Orbital Period	2.2041657	days
Maximum SES	36.5	
Maximum MES	101.8	
Robust Statistic	99.5	
Chi Square Goodness of Fit Statistic (DoF)	1675.7 (1019)	
Chi Square2 Statistic (DoF)	625.8 (843.6)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

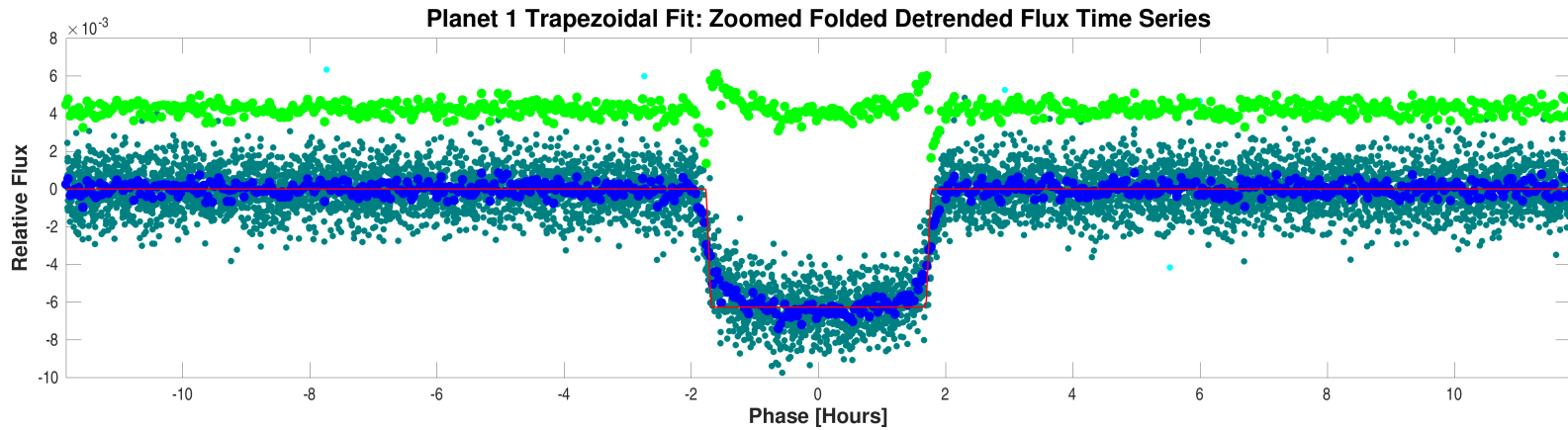
Parameter	Value	Uncertainty	Units
SNR	174.2		
Orbital Period	2.2041657		days
Transit Epoch	1713.4367070		BTJD
Transit Depth	6266		ppm
Transit Duration	3.9435		hours
Transit Ingress Duration	0.4873		hours
Model Chi Square Statistic (DoF)	18982.2 (8386)		

DoF: Degrees of Freedom



Folded detrended flux time series for CatId 424865156, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000424865156-01-all-trapezoidal.fig`



Zoomed folded detrended flux time series for CatId 424865156, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000424865156-01-all-trapezoidal-zoomed.fig`

## 7.4 Validation Tests

The Centroid Test and Eclipsing Binary Discrimination Test are chi-squared hypothesis tests. For these tests, a significance of 100% favors a planet, while 0% indicates an unlikely planet.

### 7.4.1 Weak Secondary Test

Result	Value	Uncertainty	Units	Statistic in Sigmas	Significance (%)
Orbital Period	2.2042		days		
Transit Duration	3.5		hours		
Maximum MES	101.8				
Secondary Phase	1.2069		days		
Secondary MES	1.9				
Minimum Phase	-0.44444		days		
Minimum MES	-2.1				
Median MES	-0.2				
MAD MES	0.63179				
Robust Statistic	4.6				
Secondary Depth	629.2	1.3130e+02	ppm		
Geometric Albedo	1.6	4.0007e-01		1.5743	5.77
Planet Effective Temperature	3715	2.0403e+02	Kelvin	7.2840	0.00

### 7.4.2 Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	2.9168e-02	0.1708	86.44



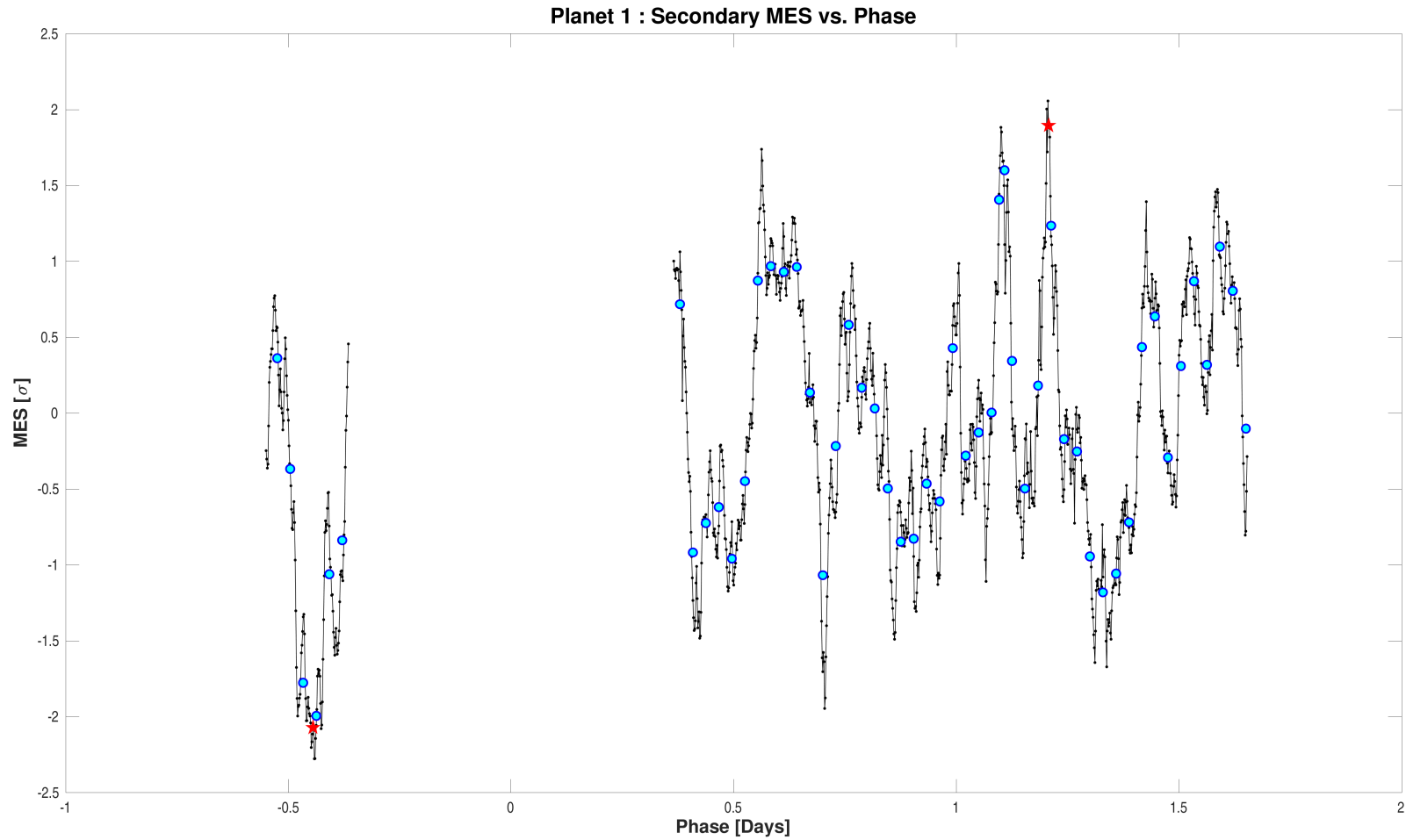
**7.4.3 Bootstrap Test**

<b>Result</b>	<b>Value</b>
False Alarm Probability	0.0000e+00
Bootstrap Threshold for Desired PFA	7.0
MES Mean	0.05
MES Standard Deviation	0.98
Transit Count	11

**7.4.4 Ghost Diagnostic Test**

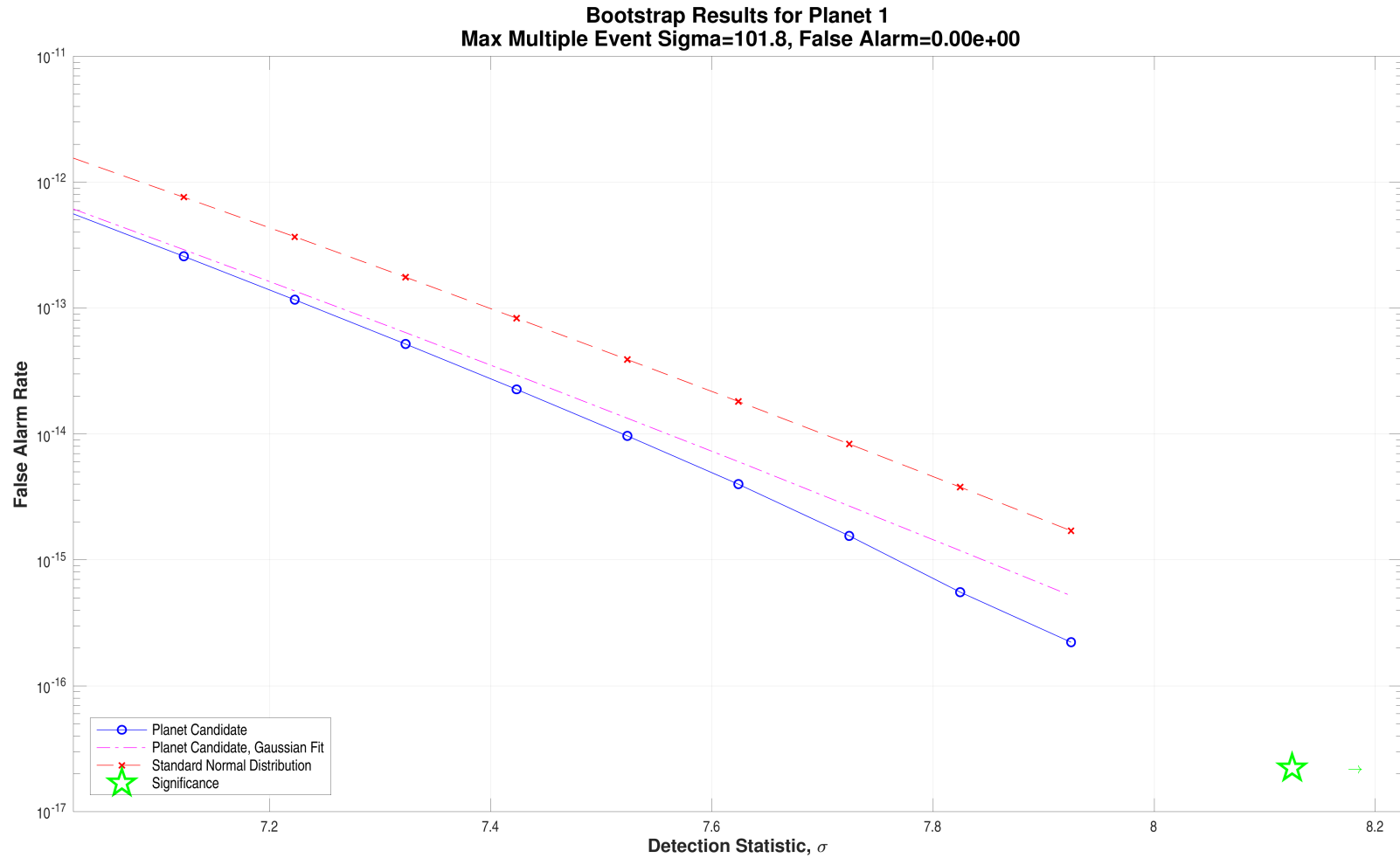
<b>Result</b>	<b>Value</b>	<b>Significance (%)</b>
Maximum MES	101.8	
SNR	115.7	
Core Aperture Statistic	5.8689e+01	100.00
Halo Aperture Statistic	1.4419e+01	100.00
Ratio of Core/Halo Aperture Statistics	4.0702e+00	

## 7.4.5 Validation Test Figures



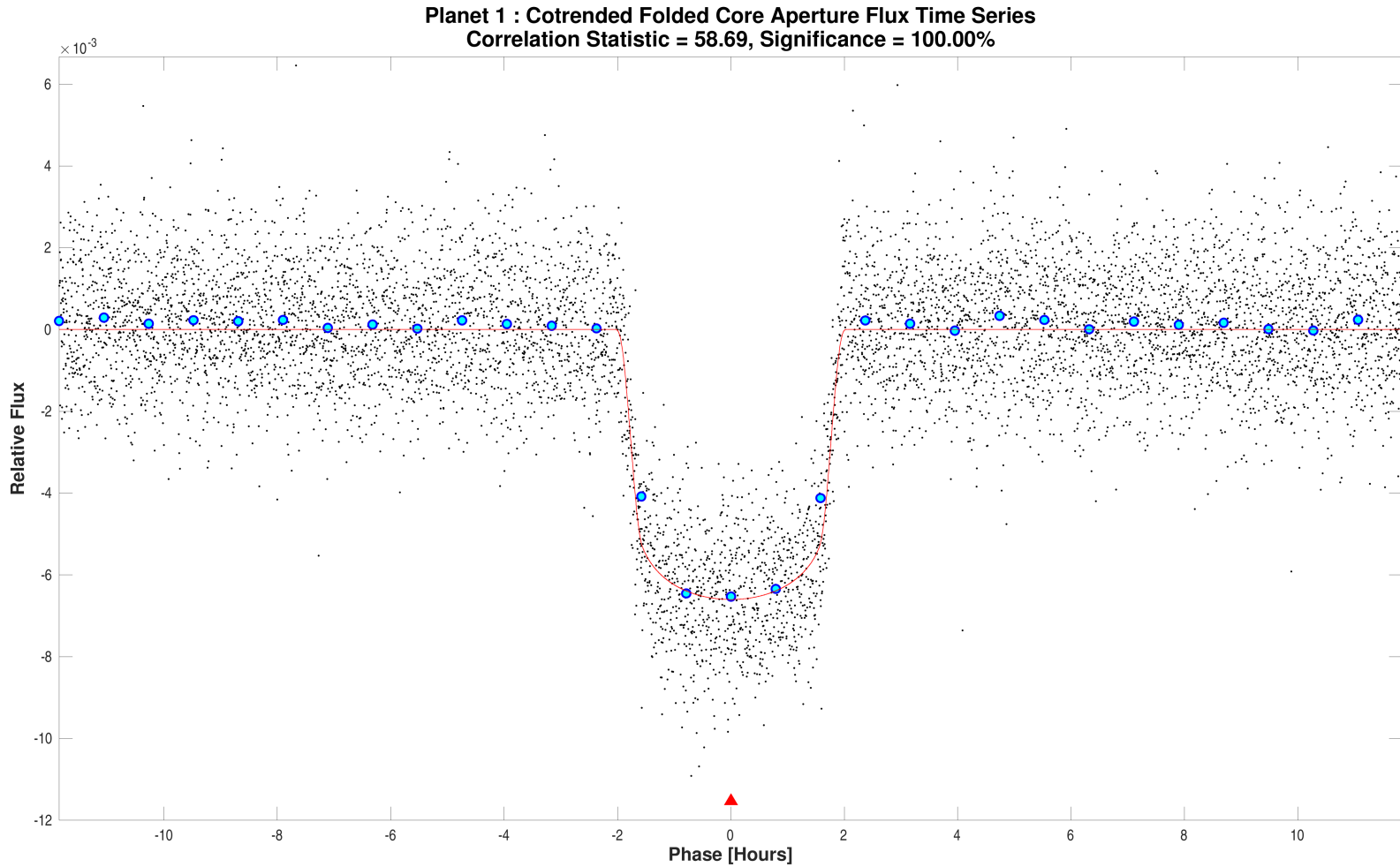
The primary event has been set to zero and both the max and min of the resulting MES vs. Phase are marked with a red star. The best matched pulse duration in hours is 3.5. The maximum secondary MES and corresponding phase are 1.8956 and 1.2069 days respectively. The minimum secondary MES and corresponding phase are -2.0712 and -0.44444 days respectively.

Open `./planet-01/report-summary/0000000424865156-01-weak-secondary-diagnostic.fig`



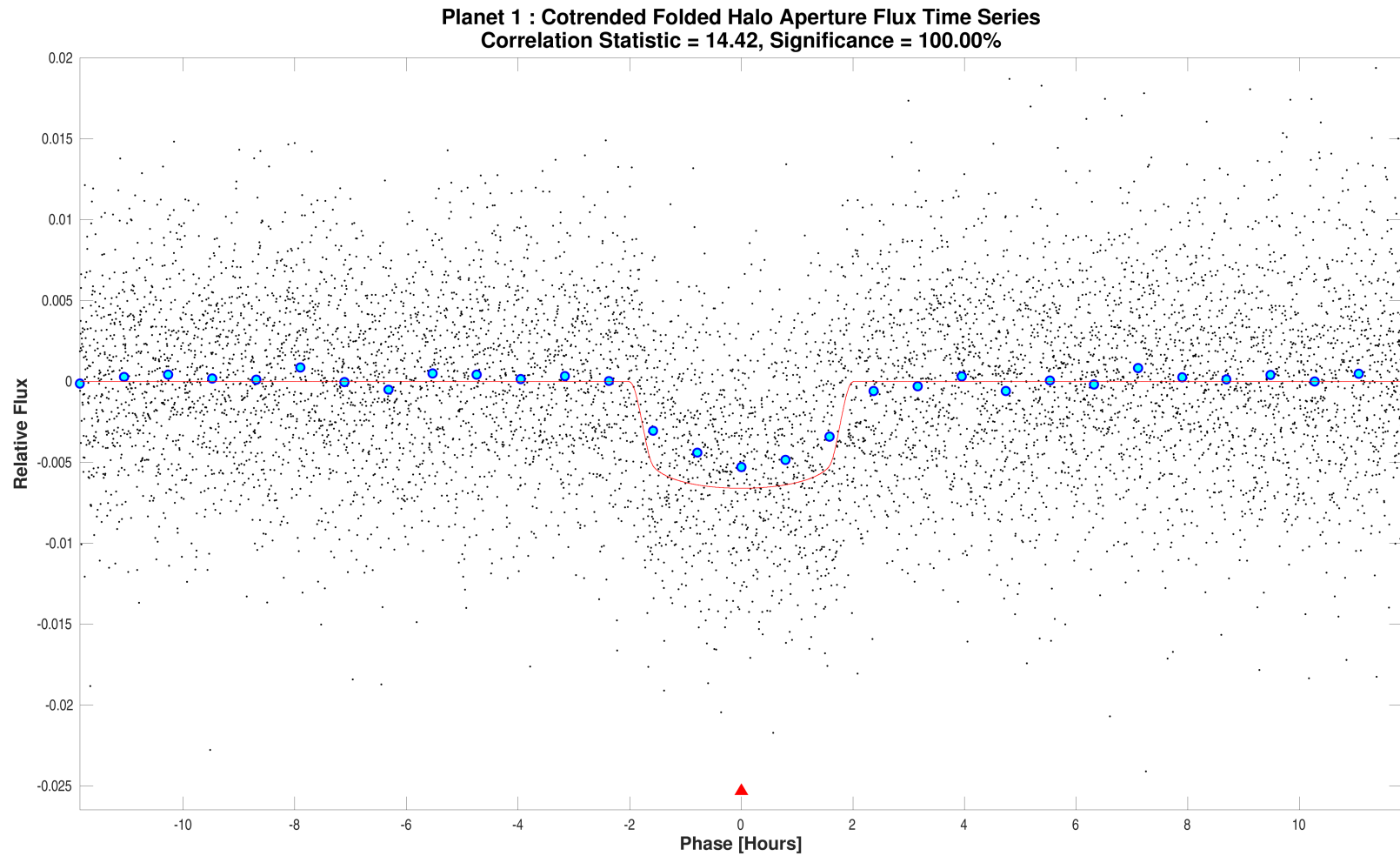
Bootstrap results for target 424865156, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is Inf. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 7.0124.

Open `./planet-01/bootstrap-results/0000000424865156-01-bootstrap-false-alarm.fig`



Optical ghost diagnostic core aperture flux time series for target 424865156, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft engineering data, motion proxies, and/or cotrending basis vectors (CBVs) to remove systematic effects. Flux time series data represent the mean per pixel flux in the core or haloaperture; phase folded data points are shown in the figure with black dots. Binned and averaged phase folded flux values are marked with filled blue circles. The unwhitened transit model light curve is displayed in the figure with a red line. The value and significance of the core aperture correlation statistic are displayed in the figure title if the statistic was successfully computed.

Open `./planet-01/ghost-diagnostic-results/0000000424865156-01-core-unwhitened-cotrended-zoomed-model.fig`

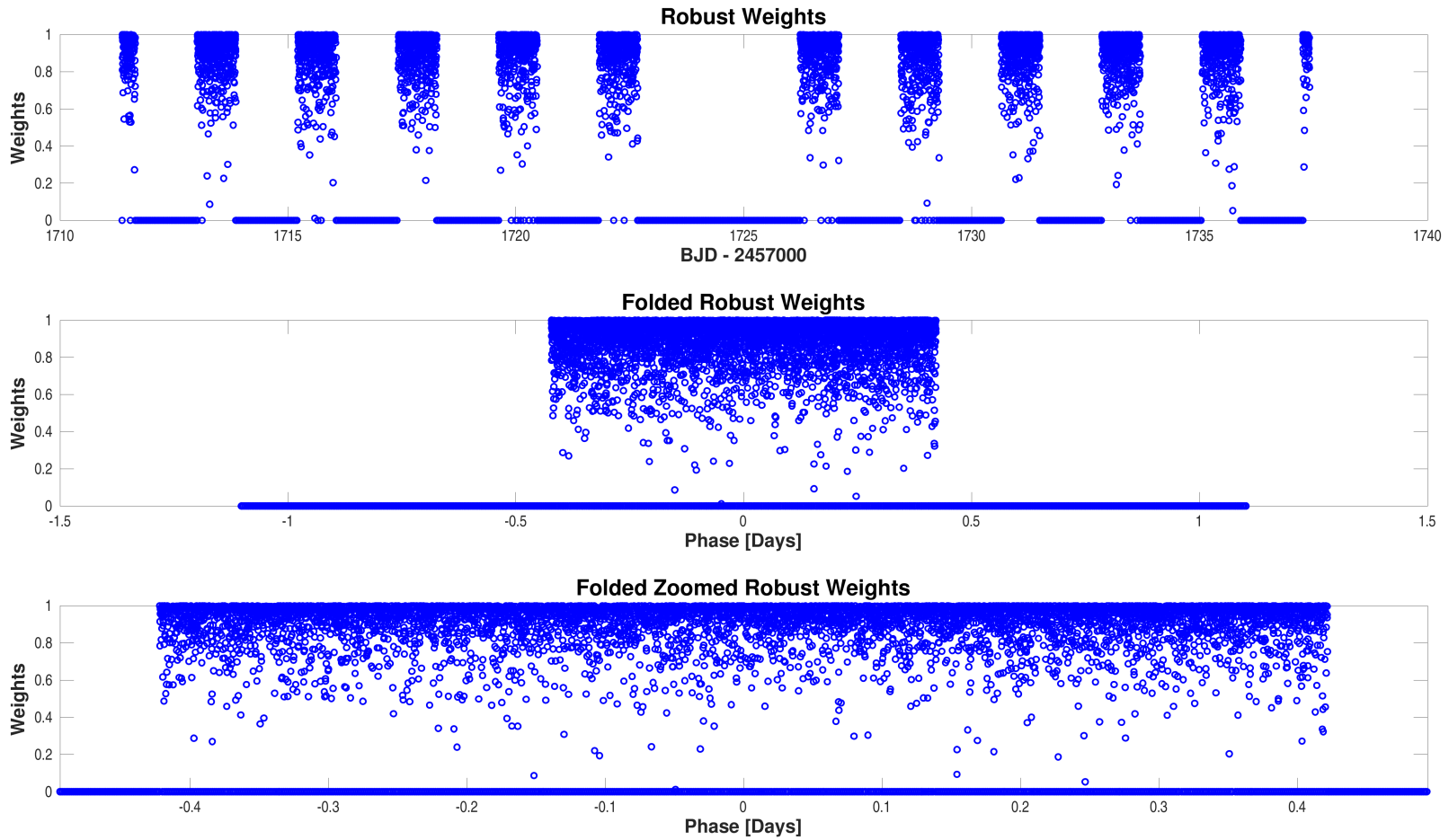


Optical ghost diagnostic halo aperture flux time series for target 424865156, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft engineering data, motion proxies, and/or cotrending basis vectors (CBVs) to remove systematic effects. Flux time series data represent the mean per pixel flux in the core or haloaperture; phase folded data points are shown in the figure with black dots. Binned and averaged phase folded flux values are marked with filled blue circles. The unwhitened transit model light curve is displayed in the figure with a red line. The value and significance of the halo aperture correlation statistic are displayed in the figure title if the statistic was successfully computed.

Open `./planet-01/ghost-diagnostic-results/000000424865156-01-halo-unwhitened-cotrended-zoomed-model.fig`

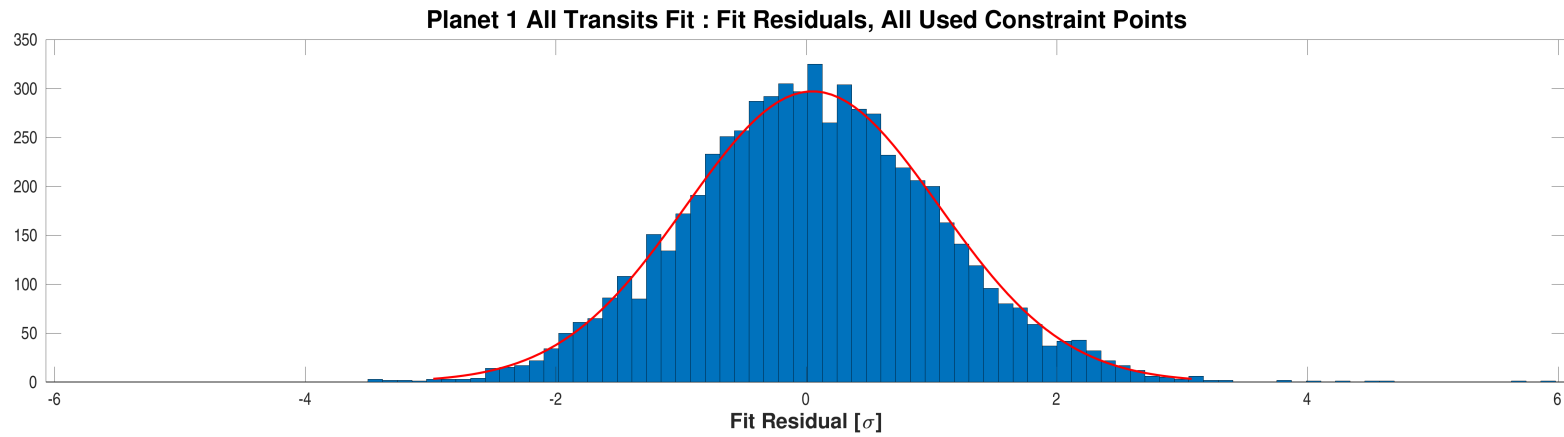
## Appendix A Planet Candidate 1

### A.1 Model Fitter: All Transits



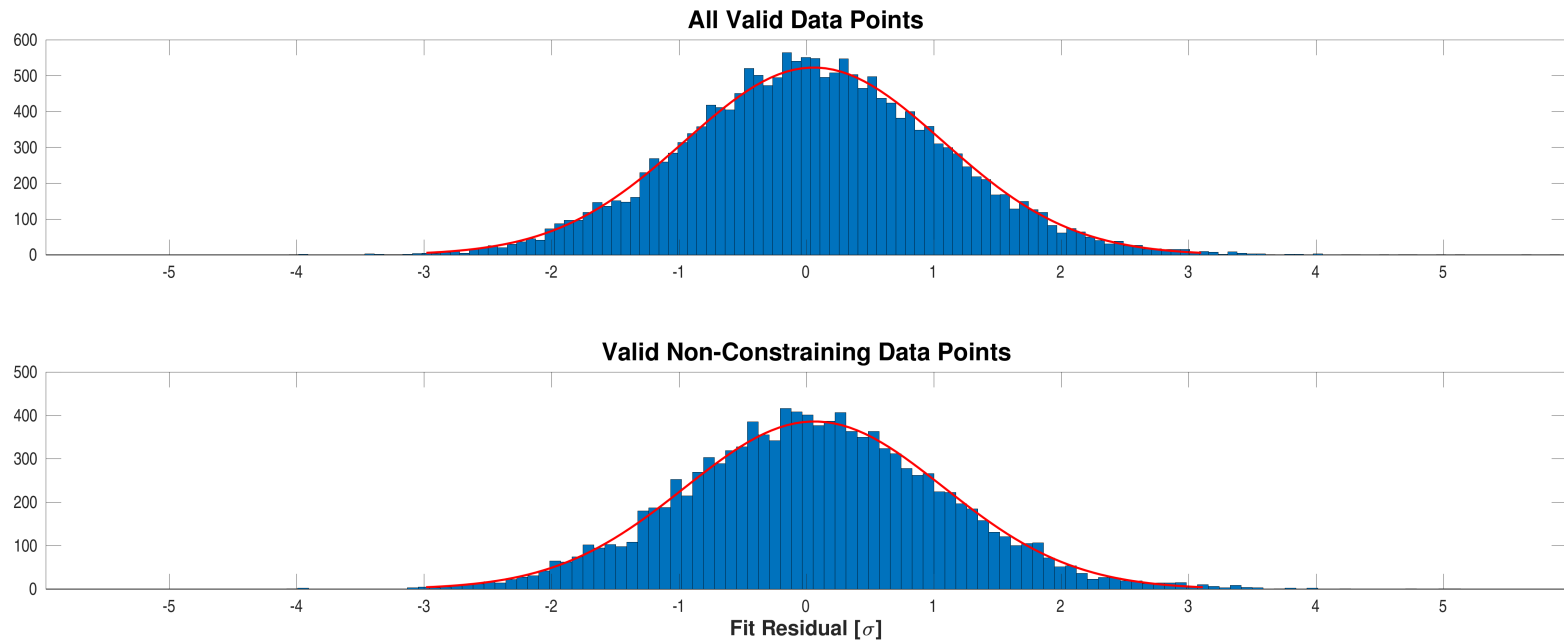
Robust weights distribution for CatId 424865156, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000424865156-01-all-robust-weights.fig`



Fit residuals distribution for CatId 424865156, Planet candidate 1. Only the valid data points used to constrain the fit are shown here. A Gaussian fit to the histogram is shown in red.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/000000424865156-01-all-histo-used.fig`



Fit residuals distribution for CatId 424865156, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.

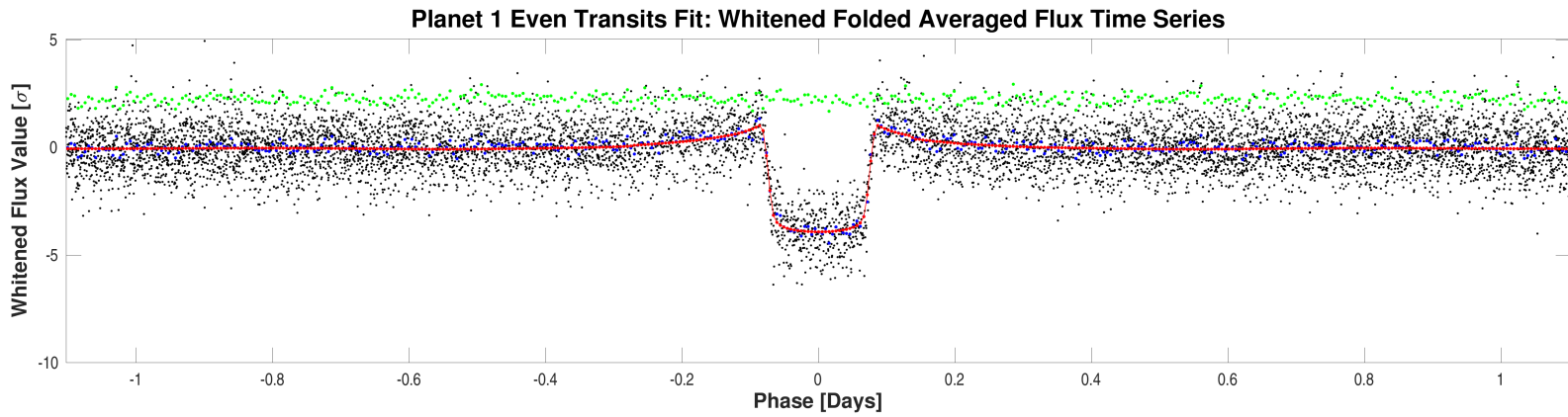
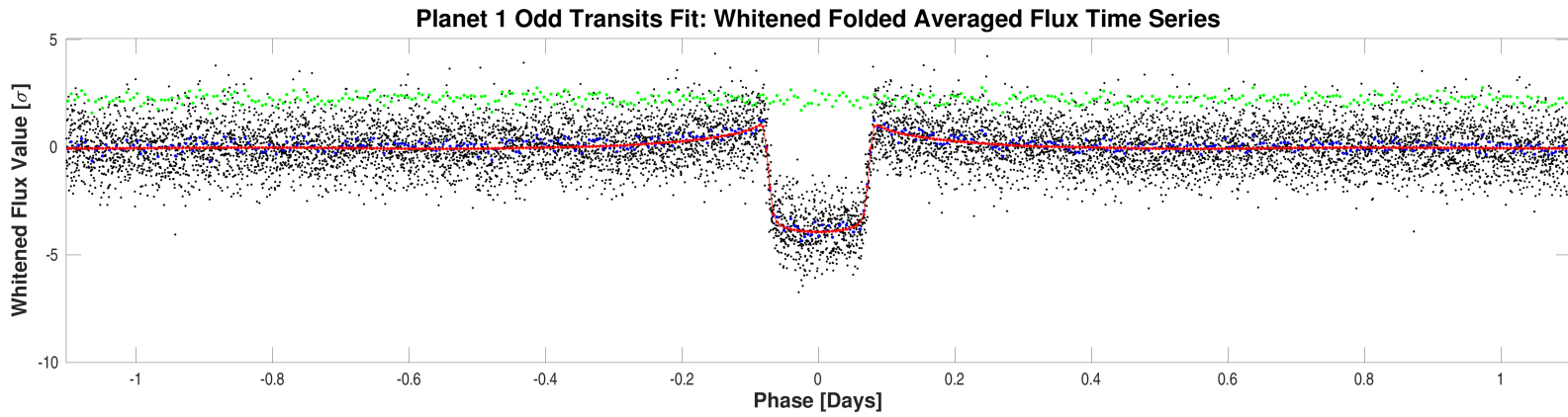
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/000000424865156-01-all-histo-all-and-unused.fig`

## A.2 Model Fitter: Odd &amp; Even Transits

Parameter	Odd Transits Value	Odd Transits Uncertainty	Even Transits Value	Even Transits Uncertainty	Units	$\frac{\text{Difference}}{\ \text{Uncertainty}\ }$
SNR	72.6		90.6			
Orbital Period	2.2046842	9.0360e-05	2.2048341	1.2508e-04	days	9.7149e-01
Transit Epoch	1713.4341150	5.3709e-04	1715.6385440	6.3457e-04	BTJD	3.7561e-01
Impact Parameter	0.4474	9.8229e-02	0.5383	7.8538e-02		7.2272e-01
Planet Radius to Star Radius Ratio	0.0773886	8.0935e-04	0.0779557	9.3392e-04		4.5888e-01
Semi-major Axis to Star Radius Ratio	4.2803	2.2182e-01	3.9902	2.2200e-01		9.2455e-01
Planet Radius	16.8426	7.0873e-01	16.9660	7.2078e-01	Earth radii	1.2210e-01
Semi-major Axis	0.0366	2.5026e-03	0.0366	2.5027e-03	AU	4.6916e-04
Effective Stellar Flux	4831.2747	6.9888e+02	4830.8368	6.9882e+02	Goldilocks	4.4313e-04
Equilibrium Temperature	2126	7.6899e+01	2126	7.6897e+01	Kelvin	4.4313e-04
Stellar Density	0.2168	3.3698e-02	0.1756	2.9304e-02	Solar density	9.2220e-01
Transit Depth	6612	7.3568e+01	6591	9.1803e+01	ppm	1.7079e-01
Transit Duration	3.9130	4.1985e-02	4.0168	5.2247e-02	hours	1.5491e+00
Transit Ingress Duration	0.3505	4.1810e-02	0.4041	5.2382e-02	hours	7.9879e-01
Eccentricity	0.0000	0.0000e+00	0.0000	0.0000e+00		
Peri Longitude	0.0000	0.0000e+00	0.0000	0.0000e+00	degrees	
Model Chi Square Statistic (DoF)	4687.4 (5755.8)		4687.4 (5755.8)			

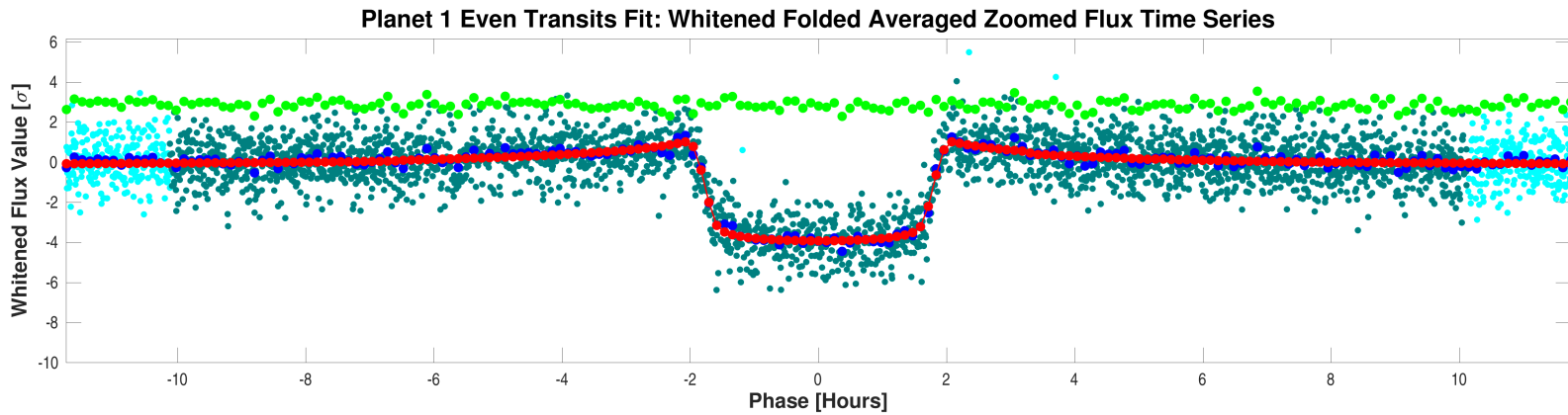
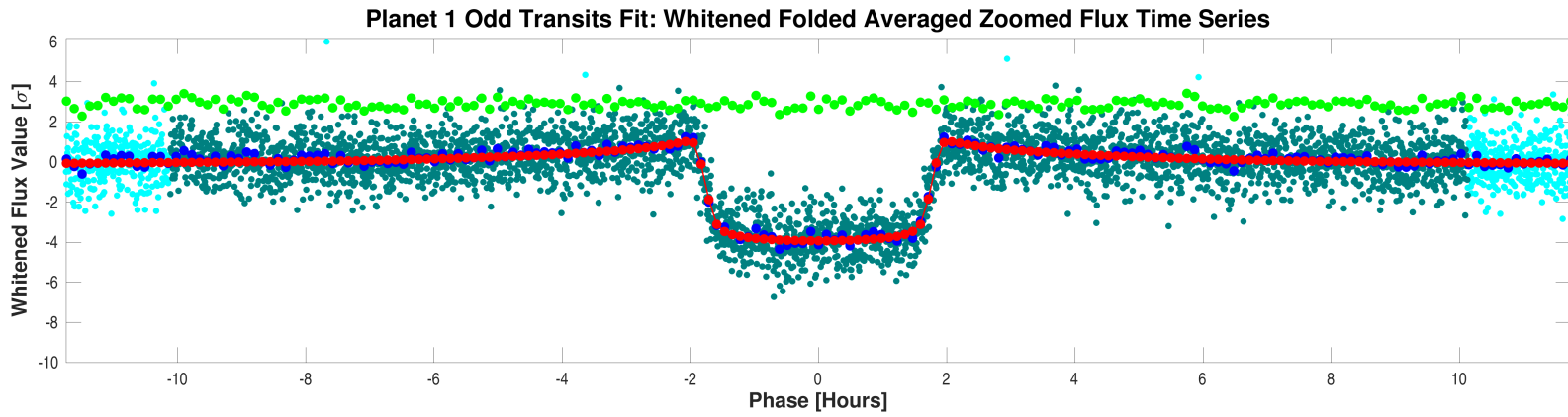
DoF: Degrees of Freedom





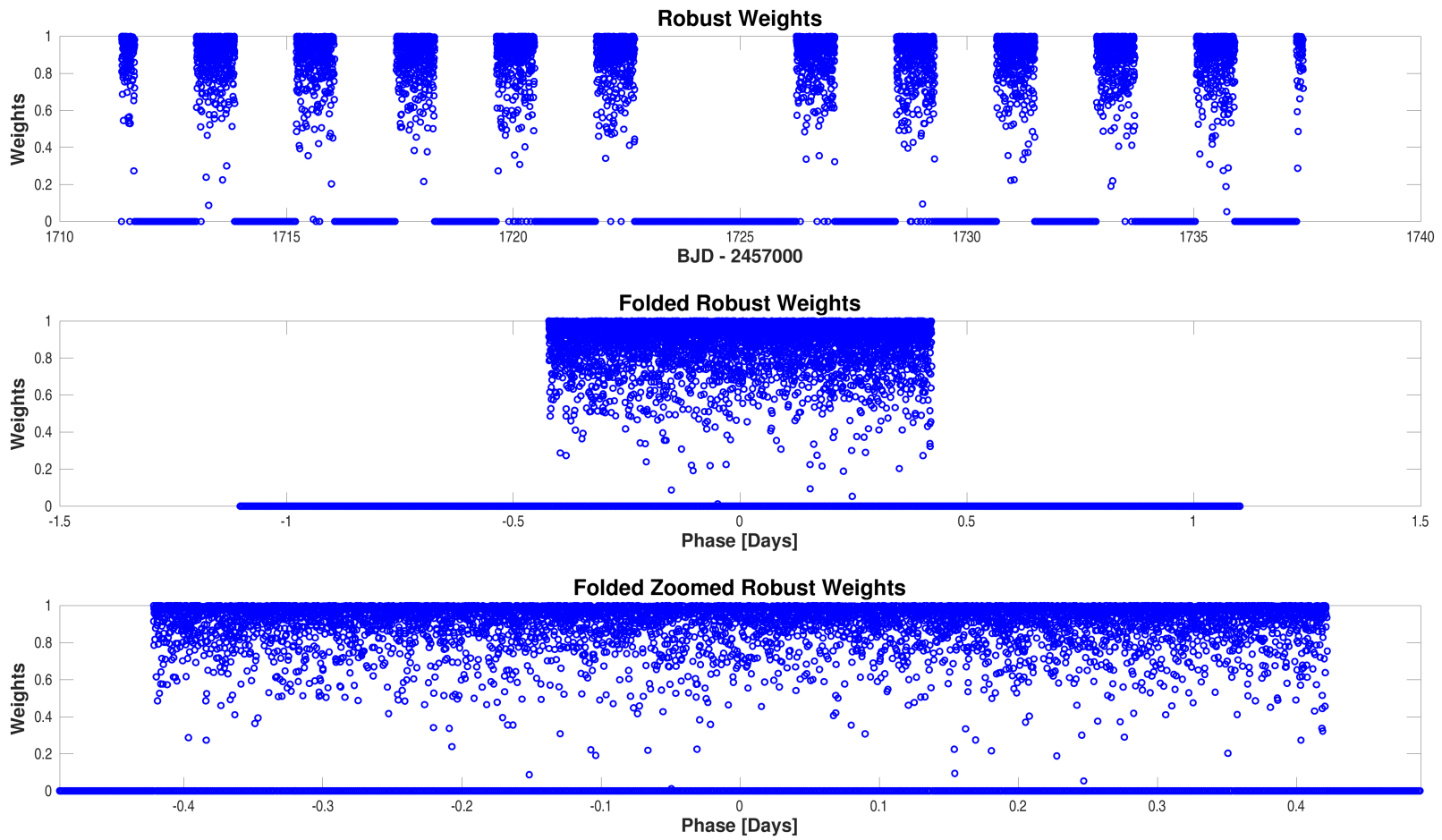
Folded flux time series for CatId 424865156, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light curve of the odd/even transits fit; the green dots are the averaged folded fit residuals, vertically offset for clarity. Odd-even transits fit completed with full convergence.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/000000424865156-01-odd-even-whitened.fig`



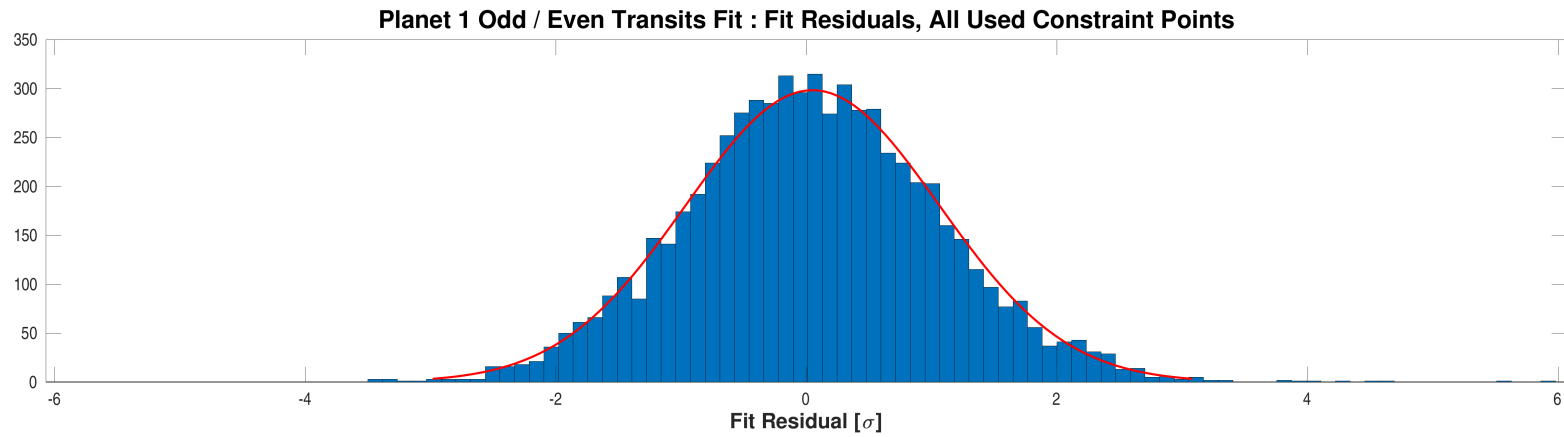
Folded flux time series for CatId 424865156, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the fitted model light curve of the odd/even transits fit; the green dots are the averaged folded fit residuals, vertically offset for clarity. Magenta dots are the averaged values of the folded flux time series, with a phase shift of 0.5 relative to the blue dots, vertically offset for clarity. Odd-even transits fit completed with full convergence.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000424865156-01-odd-even-whitened-zoomed.fig`



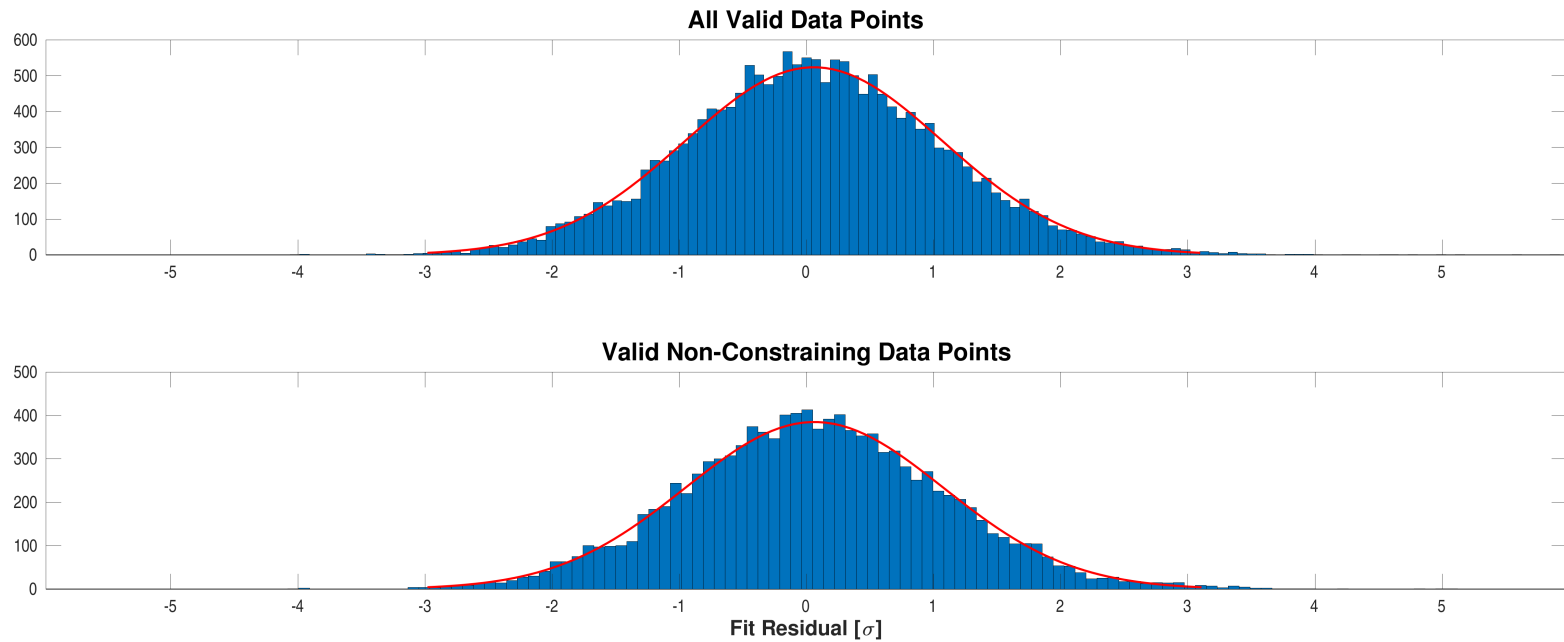
Robust weights distribution for CatId 424865156, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000424865156-01-odd-even-robust-weights.fig`



Fit residuals distribution for CatId 424865156, Planet candidate 1. Only the valid data points used to constrain the fit are shown here. A Gaussian fit to the histogram is shown in red.

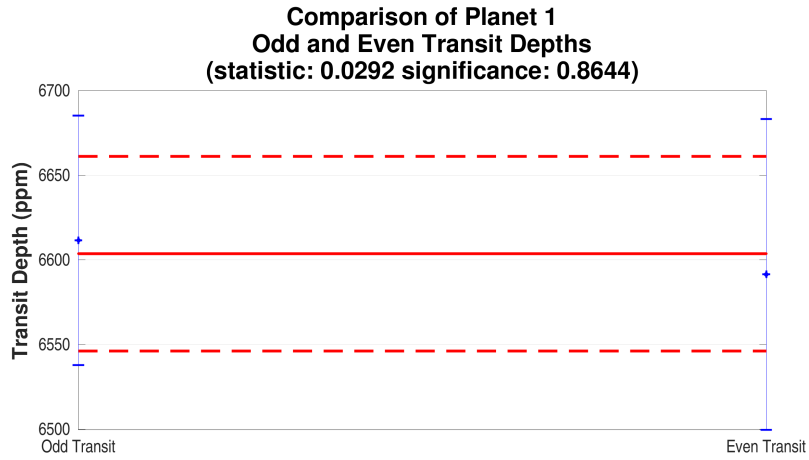
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000424865156-01-odd-even-histo-used.fig`



Fit residuals distribution for CatId 424865156, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000424865156-01-odd-even-histo-all-and-unused.fig`

### A.3 Eclipsing Binary Discrimination Test



Top-left: Diagnostic plot of Odd/Even Transit Depth Test for catId 424865156, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary. Open `./planet-01/binary-discrimination-test-results/0000000424865156-01-eclipsing-binary-discrimination-tests.fig`

## Appendix B Alerts

This target did not trigger any alerts.