Data Validation (DV) Report
for TESS ID 159742538
Sectors 25 - 25

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

09-Jul-2020 06:22:49 Z

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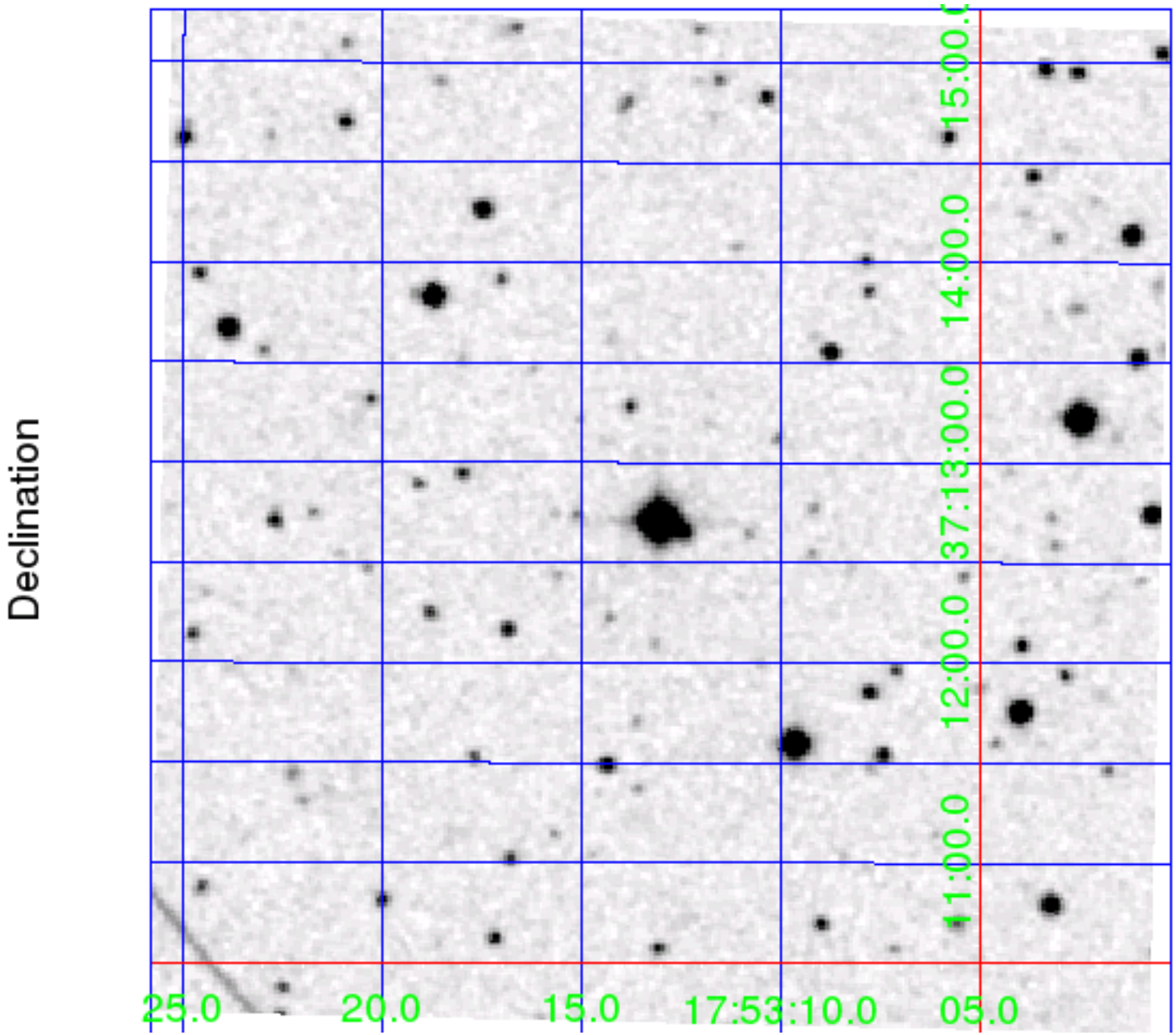
1 Summary

Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	159742538			
TOI ID	-			
TESS Name	-			
RA	268.30437116	0	degrees	TIC8
Dec	37.21182947	0	degrees	TIC8
Magnitude	11.1116	0.0062		TIC8
Radius	2.009	0.105	Solar radii	TIC8
Effective Temperature	6184	138	Kelvin	TIC8
log(g)	3.904	0.087317	cm/sec^2	TIC8
[M/H]	0.260	0.1	Solar metallicity	TIC8
Stellar Density	0.146	0.030	Solar density	TIC8-Derived
Limb Darkening Coefficient 1	0.54859			
Limb Darkening Coefficient 2	0.17594			
Limb Darkening Coefficient 3	-0.032984			
Limb Darkening Coefficient 4	-0.040067			
Number of Planet Candidates	1			
TOI Model	csv-file-toi-catalog-07-07-20-edited.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-4.0.36-20200520			
Date Report Generated	09-Jul-2020 06:22:49 Z			

Sector	Target Table	Camera/ CCD	Crowding Metric	Flux Fraction
25	245	2:4	0.9802	0.8623

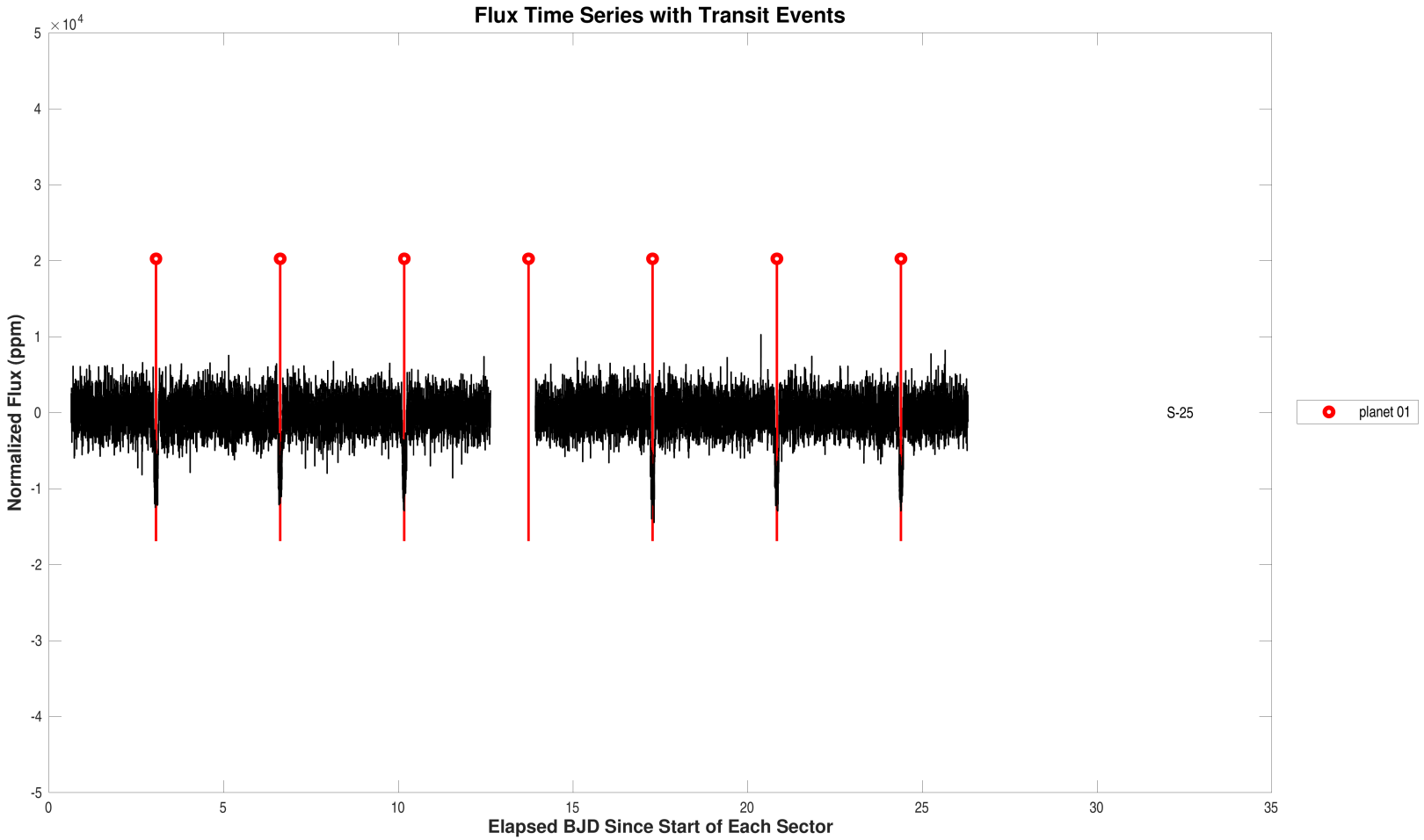
Planet Candidate	TOI ID	TESS Name	TOI Correlation	Period (days)	Period Ratio	Epoch (BTJD)	Semi-major Axis (AU)	Radius (Re)	Seff	Teq (K)	False Alarm	Suspected EB
1	-	-	-	3.554	1.00	1986.063	0.05	21.2	2276.3	1762	0.00e+00	false

2 Survey Image

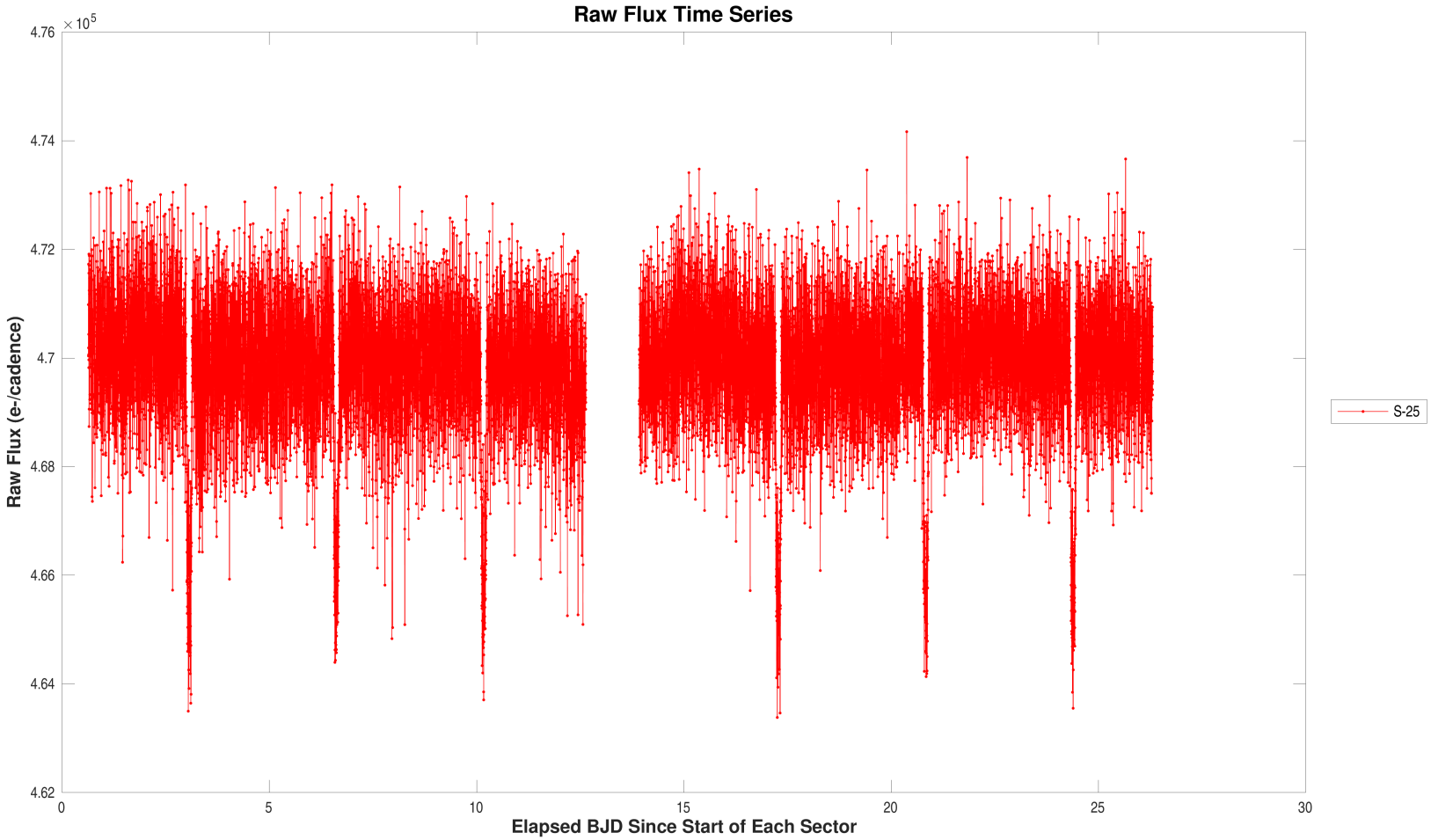


Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (159742538).

3 Flux Time Series



Summary plot of sector-stitched flux time series and transits for target 159742538, 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 25, target table 245, start BJD is 2458983.
Open `./summary-plots/0000000159742538-00-flux-dv-fit-25-245.fig`



Summary plot of raw flux time series. For the data of sector 25, target table 245, start BJD is 2458983.
Open `./summary-plots/0000000159742538-00-raw-flux-25-245.fig`

4 Dashboards

Planet Candidate 1

<table>
<tr><td rowspan="2">Model Fitter</td><td colspan="2">Stellar Radius
2.0 ± 0.1 Solar units</td><td rowspan="2">Core Aperture Correlation Statistic
Value = 51.84
Significance = 100.00%
Halo Aperture Correlation Statistic
Value = 3.19
Significance = 99.93%
Core/Halo Ratio
Ratio = 16.24</td><td rowspan="2">Ghost Diagnostic Test</td></tr>
<tr><td colspan="2">Period = 3.6 ± 0.0 days
Depth = 9429 ± 132 ppm
Planet Radius = 21.2 ± 1.1 Earth radii
Semi-major Axis = 0.0 ± 0.0 AU
Effective Stellar Flux = 2276.3 ± 375.3
Equilibrium Temperature = 1762 ± 73 Kelvin
Chi-squared/DoF = 0.8
SNR = 75.0</td></tr>
<tr><td rowspan="2">Eclipsing Binary Discrimination Test</td><td colspan="2">Odd-Even Depth Comparison Statistic
Value = 3.88e-01
Significance = 53.35%</td><td>Offsets Relative to Out of Transit Centroid
Source RA Offset = 3.84e-01 ± 2.51e+00 arcsec (0.15 σ)
Source Dec Offset = -3.39e-01 ± 2.51e+00 arcsec (-0.14 σ)
Source Offset Distance = 5.12e-01 ± 2.51e+00 arcsec (0.20 σ)
Offsets Relative to TIC Position
Source RA Offset = 1.91e-01 ± 2.51e+00 arcsec (0.08 σ)
Source Dec Offset = -1.25e-01 ± 2.51e+00 arcsec (-0.05 σ)
Source Offset Distance = 2.29e-01 ± 2.51e+00 arcsec (0.09 σ)</td><td>Difference Image Centroid Offsets</td></tr>
<tr><td>Shorter Period Comparison Statistic
Value = N/A
Significance = N/A</td><td>Longer Period Comparison Statistic
Value = N/A
Significance = N/A</td><td>False Alarm = 0.00e+00
Transit Count = 7
Max Multiple Event Statistic = 71.9</td><td>Bootstrap Test</td></tr>
</table>

Summary of model fitter results and validation test results for target 159742538, 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

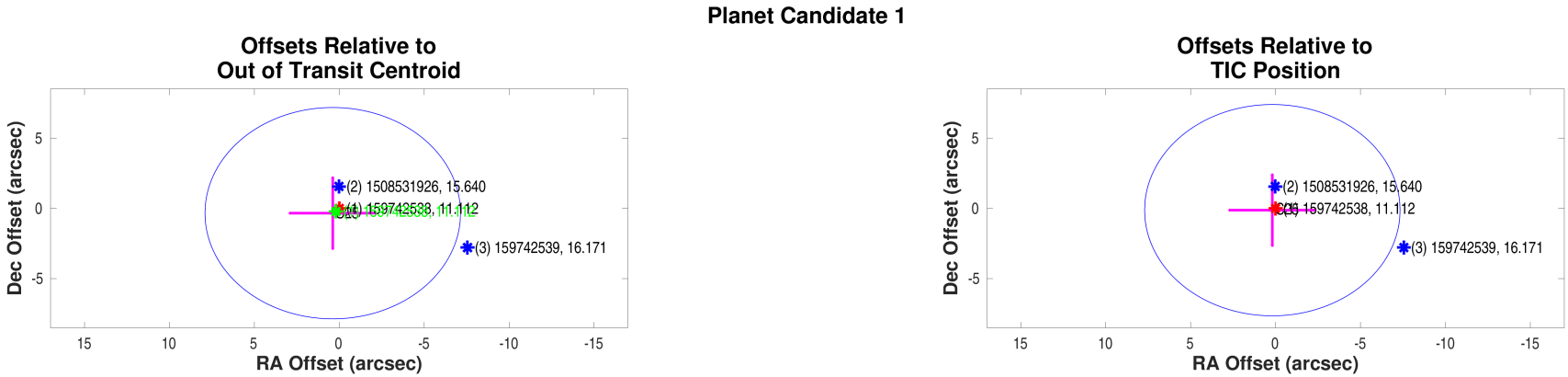
Multi-Sector Average PRF Fit of the Difference Images

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

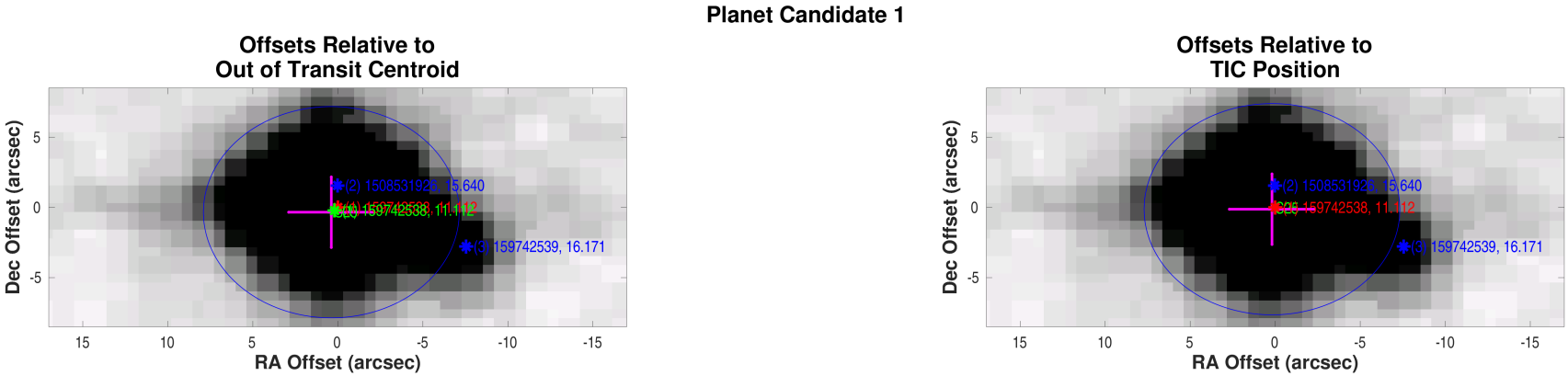
	RA	Dec	Units
Offset	$0.3835 \pm 2.51e+00$	$-0.3394 \pm 2.51e+00$	arcseconds
Offset/σ	0.15	-0.14	
Offset Distance	$0.5122 \pm 2.51e+00$		arcseconds
Offset Distance/σ	0.20		
3σ Radius	7.5249		arcseconds

Mean offset from the TIC RA and Dec

	RA	Dec	Units
Offset	$0.1912 \pm 2.51e+00$	$-0.1252 \pm 2.51e+00$	arcseconds
Offset/σ	0.08	-0.05	
Offset Distance	$0.2285 \pm 2.51e+00$		arcseconds
Offset Distance/σ	0.09		
3σ Radius	7.5233		arcseconds



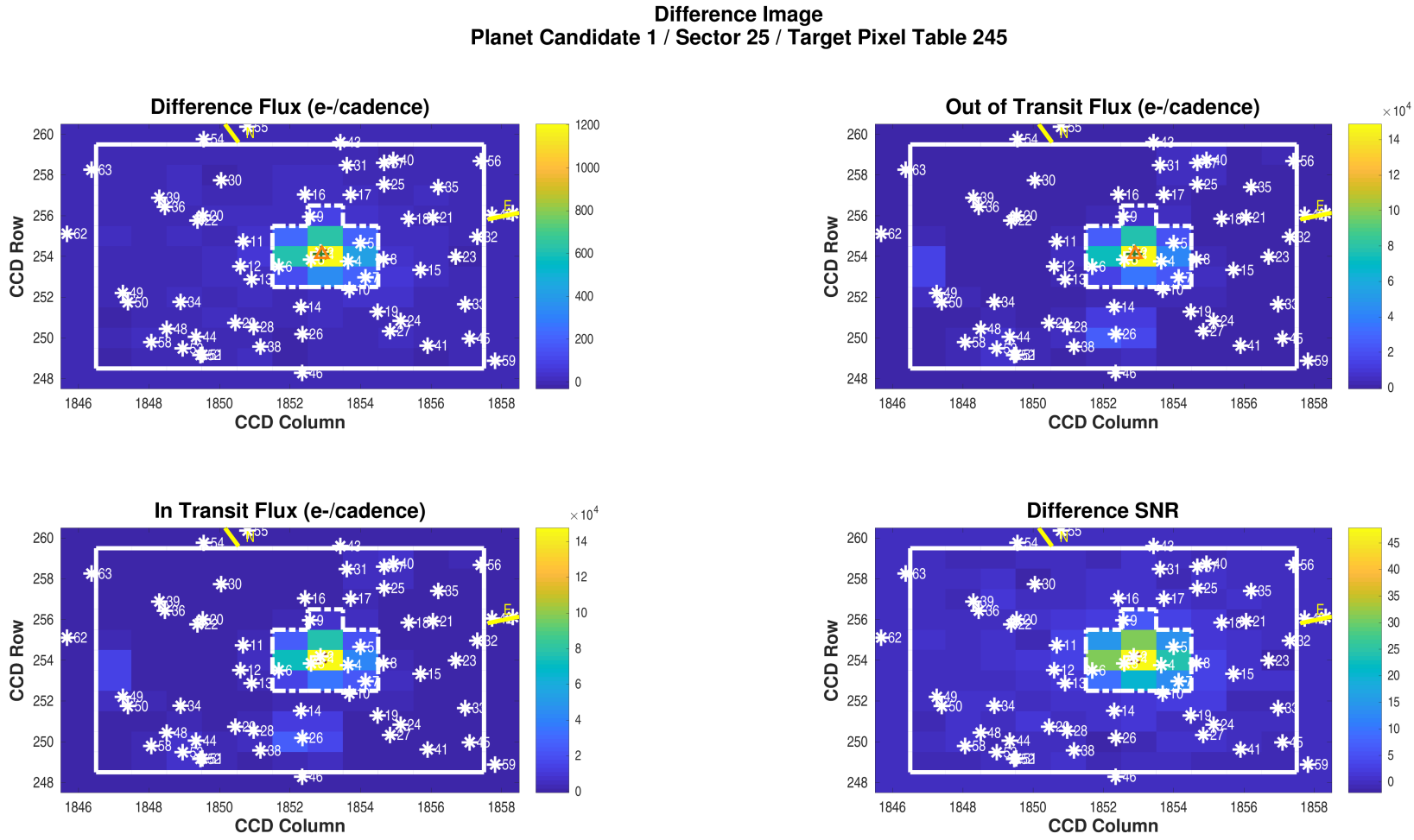
Difference image centroid offsets for target 159742538, planet candidate 1. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in RA and Dec with respect to the TC coordinates 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 (out-of-transit centroid in left panel and TIC position in right panel); green asterisk: TIC location of target star with respect to out-of-transit centroid; 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/0000000159742538-01-difference-image-centroid-offsets.fig`



Difference image centroid offsets for target 159742538, planet candidate 1, diplayed 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 (out-of-transit centroid in left panel and TIC position in right panel); green asterisk: TIC location of target star with respect to out-of-transit centroid; 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/0000000159742538-01-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 for target 159742538, planet candidate 1, sector 25, target pixel table 245. 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 = 6; number of valid in-transit cadences = 437; number of in-transit cadence gaps = 8; number of valid out-of-transit cadences = 1317; number of out-of-transit cadence gaps = 20. Difference image quality metric = 1.00 (good).
Open `./planet-01/difference-image/0000000159742538-01-difference-image-25-245.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	$254.12 \pm 4.69e-05$	$1852.88 \pm 4.61e-05$	pixels	$268.30425794 \pm 8.82e-07$	$37.21177078 \pm 8.62e-07$	degrees
Difference Image Centroid	$254.11 \pm 1.13e-02$	$1852.90 \pm 1.10e-02$	pixels	$268.30439171 \pm 6.36e-05$	$37.21167650 \pm 6.36e-05$	degrees
Offset	$-0.0100 \pm 1.13e-02$	$0.0253 \pm 1.10e-02$	pixels	$0.3835 \pm 1.82e-01$	$-0.3394 \pm 2.29e-01$	arcseconds
Offset/σ	-0.89	2.31		2.10	-1.48	
Offset Distance	$0.0272 \pm 1.10e-02$		pixels	$0.5122 \pm 2.00e-01$		arcseconds
Offset Distance/σ	2.48			2.57		

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

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$254.11 \pm 1.44e-04$	$1852.89 \pm 1.46e-04$	pixels	$268.30432504 \pm 0.00e+00$	$37.21171129 \pm 0.00e+00$	degrees
Difference Image Centroid	$254.11 \pm 1.13e-02$	$1852.90 \pm 1.10e-02$	pixels	$268.30439171 \pm 6.36e-05$	$37.21167650 \pm 6.36e-05$	degrees
Offset	$-0.0028 \pm 1.13e-02$	$0.0117 \pm 1.10e-02$	pixels	$0.1912 \pm 1.82e-01$	$-0.1252 \pm 2.29e-01$	arcseconds
Offset/σ	-0.25	1.07		1.05	-0.55	
Offset Distance	$0.0120 \pm 1.10e-02$		pixels	$0.2285 \pm 1.93e-01$		arcseconds
Offset Distance/σ	1.10			1.18		

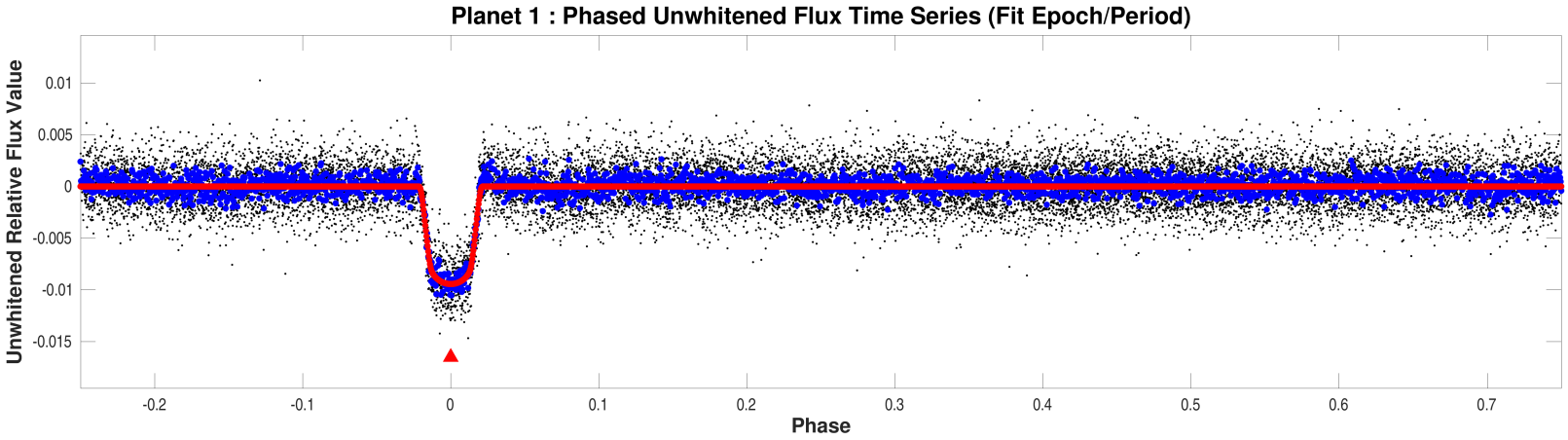
5.2 Difference Image TIC Key

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
1	159742538	11.112	268.30432504	37.21171129	0.00
2	1508531926	15.640	268.30433031	37.21214575	1.56
3	159742539	16.171	268.30169037	37.21093667	8.05
4	1508531919	19.914	268.30815641	37.20863646	15.59
5	1508531920	19.297	268.31283060	37.21240680	24.51
6	1508531924	19.365	268.29492264	37.21084855	27.14
7	159742542	18.218	268.30914683	37.20385889	31.47
8	1508531918	19.705	268.31481779	37.20734603	33.94
9	1508531927	17.905	268.30728561	37.22137559	35.81
10	1508531917	20.053	268.30459257	37.20169779	36.06
11	159742533	18.270	268.29186247	37.21873032	43.76
12	1508531901	19.053	268.28805183	37.21286663	46.84
13	1508531900	19.418	268.28831293	37.20912233	46.84
14	1508531894	19.207	268.29350799	37.19996734	52.43
15	159742543	17.044	268.32007404	37.20286113	55.26
16	1508531928	19.090	268.30932403	37.22693383	56.64
17	1508531922	19.468	268.31755673	37.22456667	59.84
18	1508531923	17.847	268.32479288	37.21583593	60.53
19	159742550	18.343	268.30674400	37.19497231	60.66
20	1508532517	19.799	268.28806183	37.22700111	72.14
21	1508531906	18.489	268.32938634	37.21494842	72.79
22	159742529	15.791	268.28642616	37.22609414	72.90
23	1508531907	17.956	268.32822295	37.20429219	73.54
24	159742554	16.418	268.30967771	37.19164036	73.87
25	1508531930	19.909	268.32498139	37.22538915	77.02
26	159742551	12.962	268.29017394	37.19336891	77.50
27	1508531884	19.468	268.30639205	37.18962931	79.72
28	159742547	16.320	268.28229813	37.19755784	81.14
29	1508531899	17.988	268.27955925	37.19942196	83.66
30	1508532518	18.608	268.29610700	37.23461743	85.76
31	1508531933	18.106	268.32080811	37.23189933	86.69
32	1508531905	19.226	268.33473754	37.20800746	88.21
33	159742553	17.936	268.32353028	37.19234117	88.85
34	1508532493	18.946	268.27246989	37.20725395	92.73
35	1508531929	18.217	268.33437872	37.22202049	93.82
36	1508532515	18.274	268.28234406	37.23102920	93.85
37	159742526	14.340	268.32787156	37.23057367	95.75
38	159742552	17.008	268.28090342	37.19243145	96.57

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
39	1508532516	17.876	268.28260855	37.23353681	100.25
40	1508531931	19.834	268.32993690	37.23083772	100.66
41	1508531885	19.170	268.31123762	37.18425658	100.80
42	159742534	18.200	268.34040050	37.21260801	103.48
43	159742523	15.813	268.32272855	37.23779985	107.73
44	1508531897	19.734	268.27057321	37.19804152	108.56
45	159742559	17.863	268.31977849	37.18385532	109.63
46	1508531892	19.599	268.28494342	37.18397580	114.27
47	159742537	16.967	268.34436548	37.21192176	114.80
48	159742544	16.408	268.26637531	37.20144484	114.91
49	159742536	17.057	268.26322509	37.21234219	117.86
50	1508532491	19.018	268.26288958	37.20985409	118.99
51	1508531895	19.436	268.26936732	37.19342096	119.92
52	1508531896	19.118	268.26894116	37.19343614	120.91
53	159742549	14.167	268.26664074	37.19591791	122.09
54	1508532519	19.353	268.29848855	37.24547393	122.69
55	1508532523	18.894	268.30800269	37.24621989	124.68
56	1508531915	18.845	268.34556420	37.22615552	129.16
57	159742562	17.460	268.28734995	37.17841927	129.36
58	1508532490	17.998	268.26178343	37.19902654	130.24
59	1508531878	17.779	268.32138355	37.17720319	133.51
60	1508531904	18.926	268.34143875	37.18863538	135.00
61	159742560	17.498	268.33307997	37.18043858	139.54
62	1508532498	19.861	268.26105659	37.22949253	139.60
63	159742519	16.758	268.27405623	37.24372374	144.27
64	1508532497	18.878	268.26258655	37.23530647	146.75
65	159742563	18.093	268.27323100	37.17837100	149.51
66	159742518	16.592	268.33706269	37.24520720	152.81
67	159742522	17.403	268.26512632	37.24048422	152.84
68	1508531890	19.847	268.26578620	37.18161034	154.76
69	1508531932	19.801	268.34477149	37.24385877	163.83
70	159742561	15.273	268.26341846	37.17986436	164.01

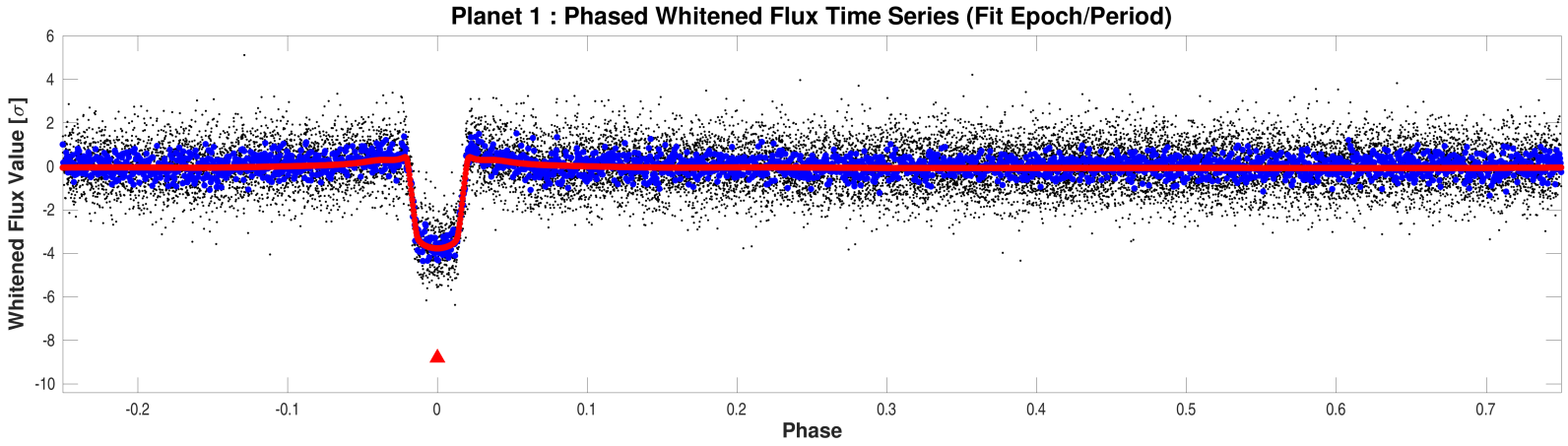
RA, Dec and Distances are corrected for proper motion. This table may not contain all of the objects shown.

6 Phased Light Curves

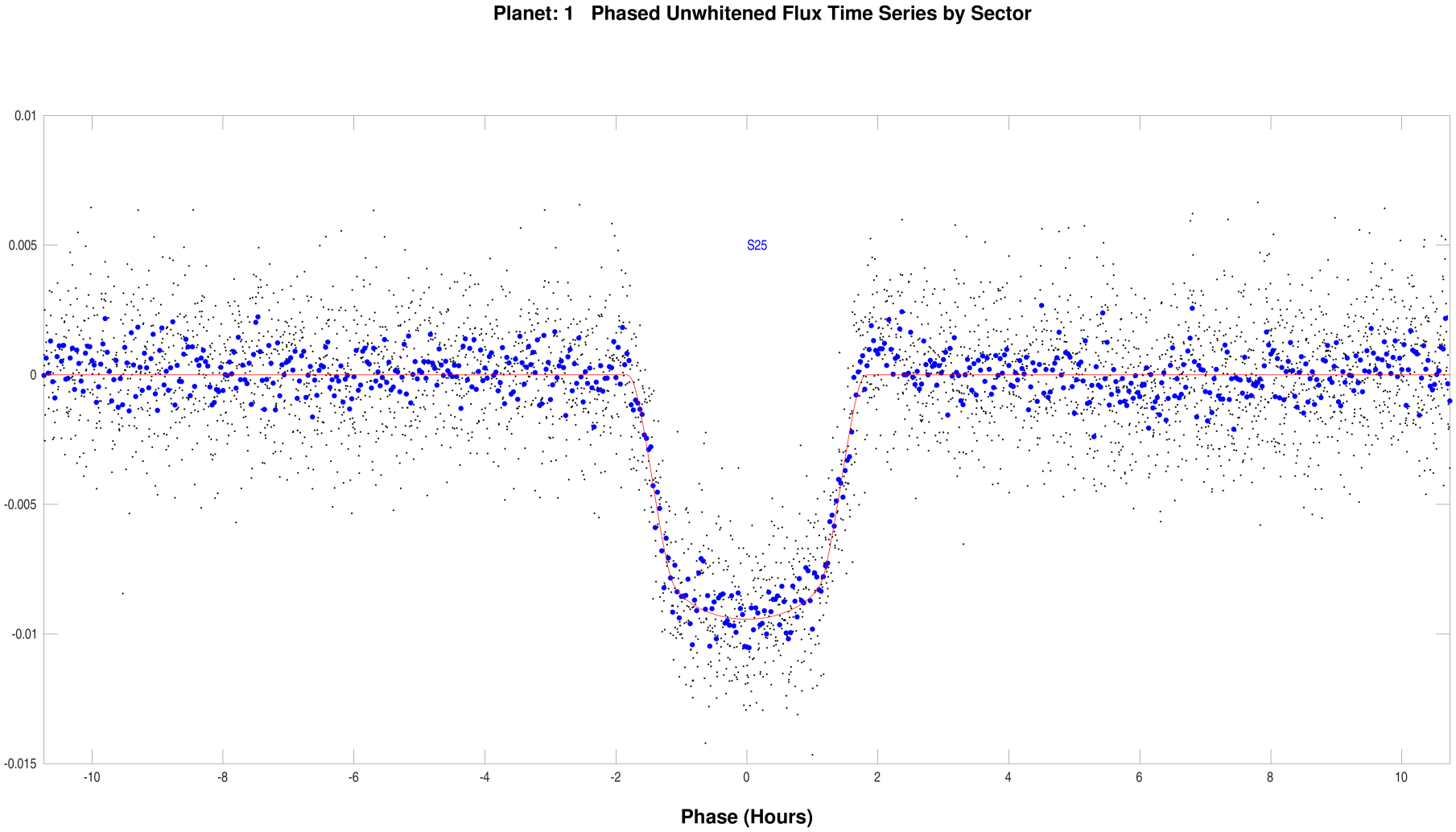


Phased unwhitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased unwhitened flux time series 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/0000000159742538-01-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/0000000159742538-01-phased-whitened-flux-time-series.fig`



Phased unwhitened flux time series by sector for target 159742538, planet candidate 1. Period = 3.5539 days; transit epoch = 1986.063 BTJD.
Open `./summary-plots/0000000159742538-01-phased-unwhitened-flux-time-series-by-sector.fig`

7 Planet Candidate 1

7.1 Model Fitter: All Transits

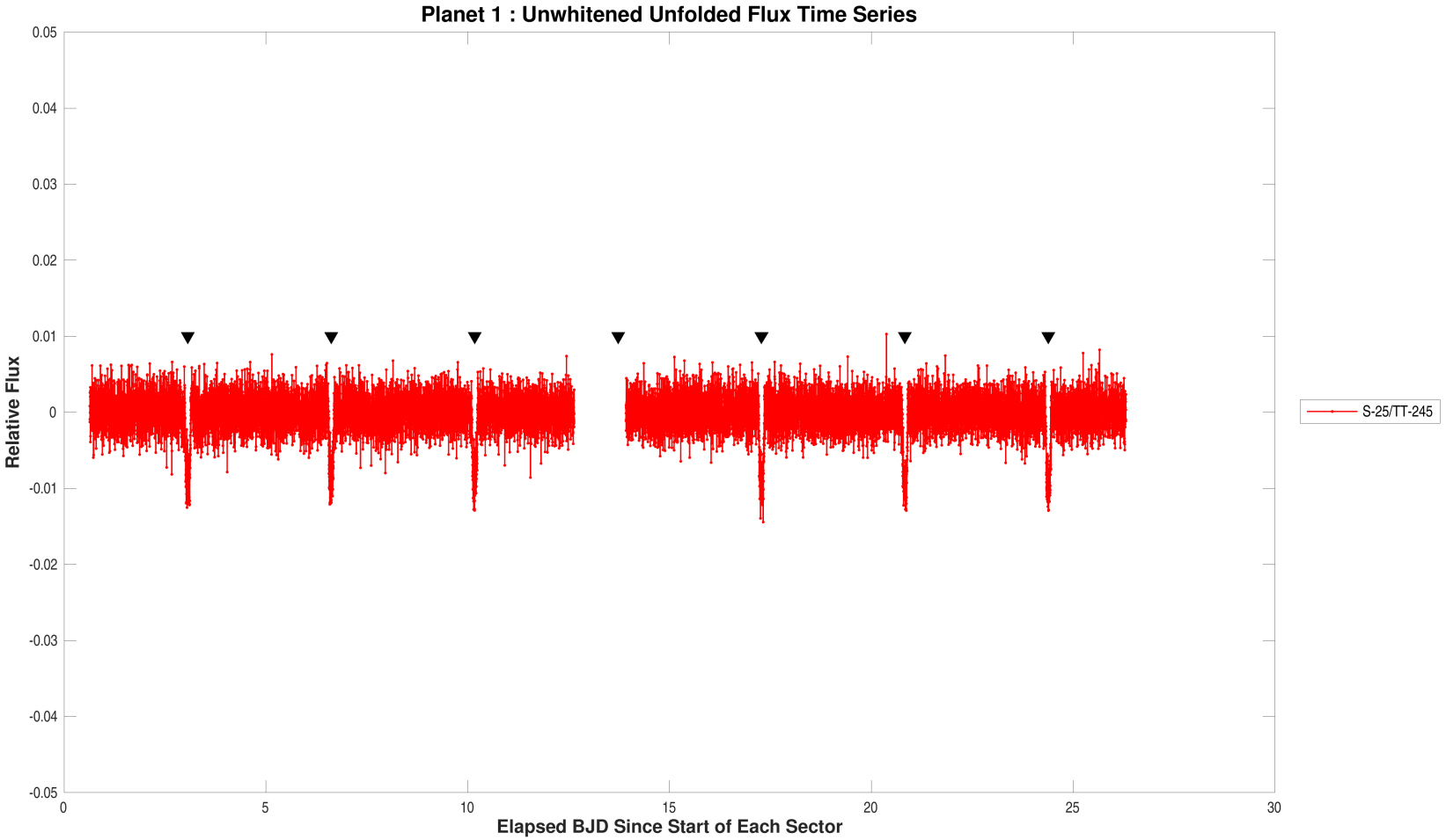
Model Characteristic	Name
Transit Model	mandel-agol_geometric_transit_model
Limb Darkening Model	claret_tess_nonlinear_limb_darkening_model

TCE Parameter	Value	Units
Trial Transit Pulse Duration	3.0	hours
Transit Epoch	1986.0600436	TJD
Orbital Period	3.5541651	days
Maximum SES	30.6	
Maximum MES	71.9	
Robust Statistic	74.7	
Chi Square Goodness of Fit Statistic (DoF)	528.6 (529)	
Chi Square2 Statistic (DoF)	5.2 (507.2)	
Threshold for Desired PFA		

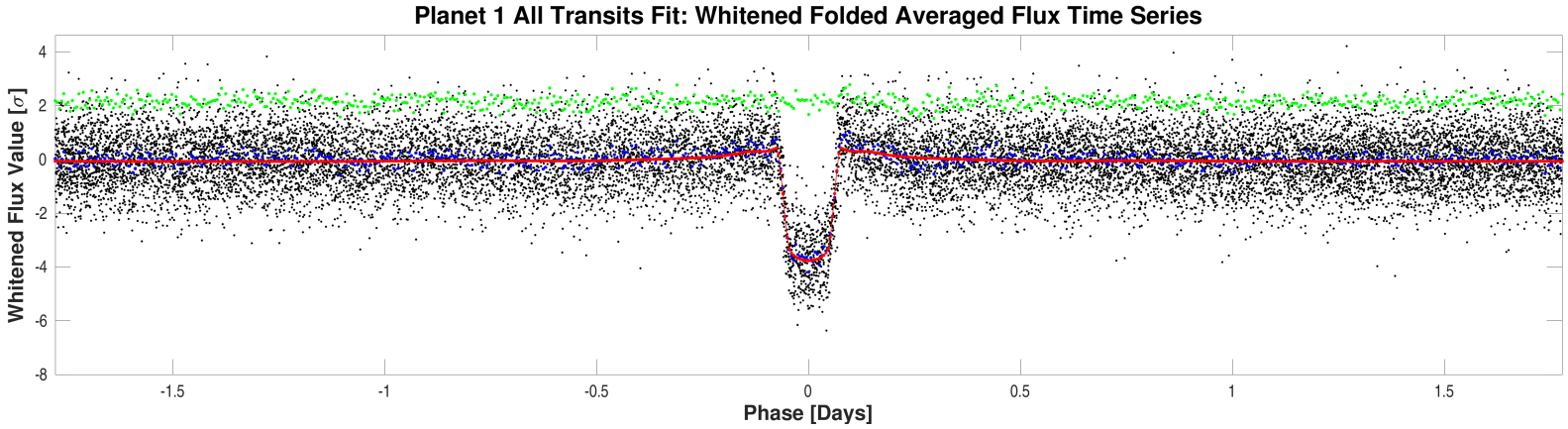
DoF: Degrees of Freedom

Parameter	Value	Uncertainty	Units
SNR	75.0		
Orbital Period	3.5539324	2.1741e-04	days
Transit Epoch	1986.0629861	8.1481e-04	BTJD
Impact Parameter	0.7474	2.5021e-02	
Planet Radius to Star Radius Ratio	0.0966495	1.0509e-03	
Semi-major Axis to Star Radius Ratio	6.1507	2.4907e-01	
Planet Radius	21.1923	1.1268e+00	Earth radii
Semi-major Axis	0.0482	3.6367e-03	AU
Effective Stellar Flux	2276.2915	3.7529e+02	Goldilocks
Equilibrium Temperature	1762	7.2611e+01	Kelvin
Stellar Density	0.2475	3.0069e-02	Solar density
Transit Depth	9429	1.3157e+02	ppm
Transit Duration	3.5792	5.5600e-02	hours
Transit Ingress Duration	0.6601	6.3242e-02	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	2495.3 (3077.5)		
Model Chi Square Goodness of Fit Statistic (DoF)	376.2 (662)		
Model Chi Square2 Statistic (DoF)	4.5 (5)		

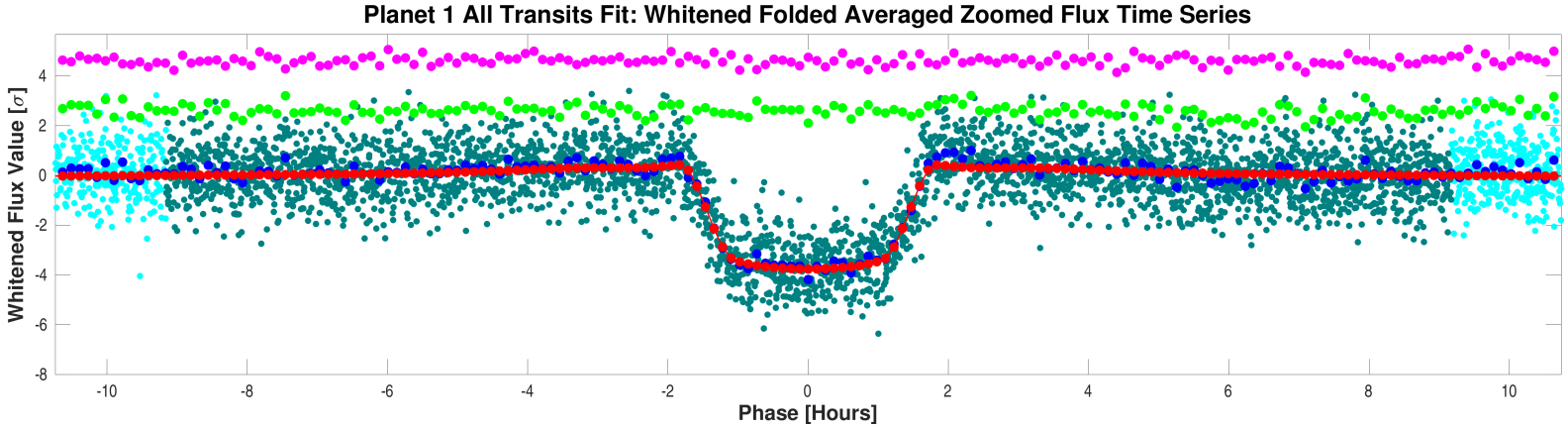
DoF: Degrees of Freedom



Flux time series for CatId 159742538, Planet candidate 1 in the unwhitened domain. For the data of Sector-25/TargetTableId-245, start BJD is 2458983. 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/0000000159742538-01-all-unwhitened-25-245.fig`



Folded flux time series for CatId 159742538, 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/0000000159742538-01-all-whitened.fig`

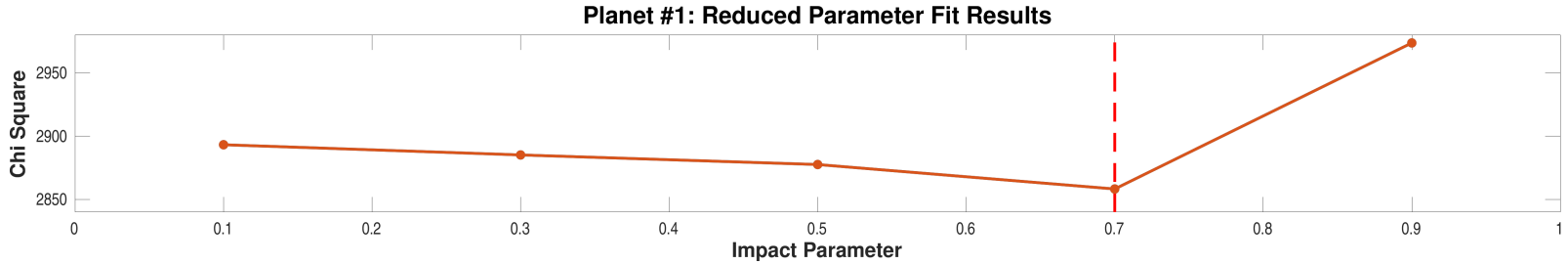


Folded flux time series for CatId 159742538, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000159742538-01-all-whitened-zoomed.fig`

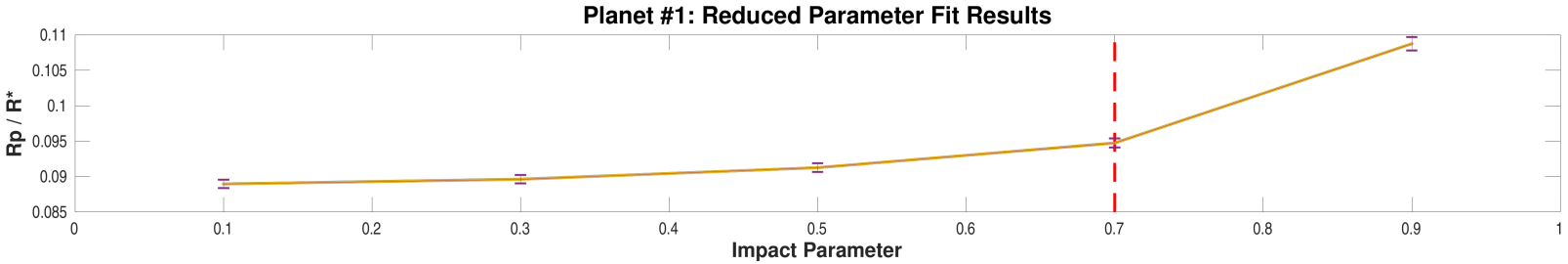
7.2 Model Fitter: Reduced Parameter Fit Results

Impact Parameter	SNR	Model Chi Square	Planet Radius to Star Radius	Uncert	Semi-major Axis to Star Radius	Uncert	Transit Depth (ppm)	Uncert	Transit Duration (hours)	Uncert
0.10	77.4	2893.2	0.0889682	5.9016e-04	9.0794	5.4699e-02	9121	1.2032e+02	3.2506	1.9422e-02
0.30	77.2	2885.1	0.0896374	5.9552e-04	8.6750	5.3230e-02	9133	1.2065e+02	3.2886	2.0025e-02
0.50	77.0	2877.6	0.0912649	6.1001e-04	7.9004	5.1844e-02	9174	1.2188e+02	3.3486	2.1824e-02
0.70	77.2	2858.2	0.0947486	6.3824e-04	6.5706	5.0059e-02	9281	1.2409e+02	3.5077	2.6581e-02
0.90	76.8	2973.6	0.1087509	9.3052e-04	4.4667	5.7112e-02	10127	1.5216e+02	4.0333	5.0218e-02

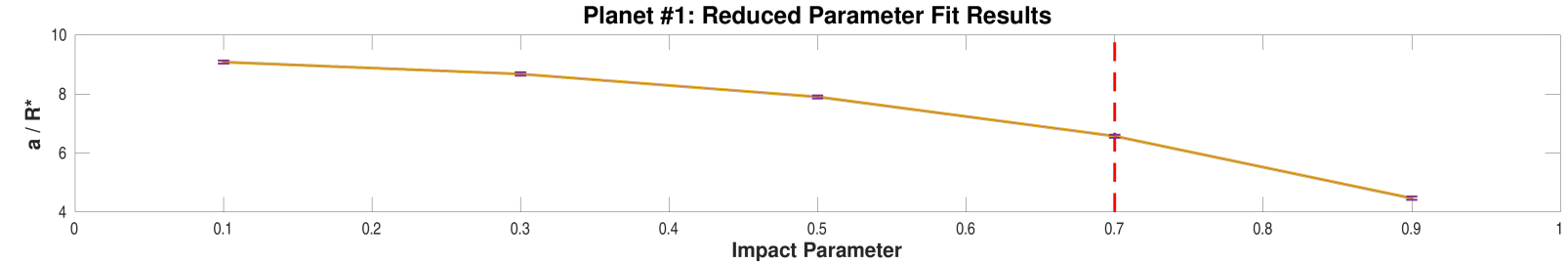
Highlighted row is the best reduced-parameter model fit.



Model chi squares of reduced parameter fits vs. impact parameter for CatId 159742538, 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/0000000159742538-01-reduced-fits-chi-square.fig`



Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 159742538, 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/0000000159742538-01-reduced-fits-rp-over-rstar.fig`



Ratios of semimajor axis to star radius of reduced parameter fits vs. impact parameter for CatId 159742538, 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/0000000159742538-01-reduced-fits-a-over-rstar.fig`

7.3 Model Fitter: Trapezoidal Fit Results

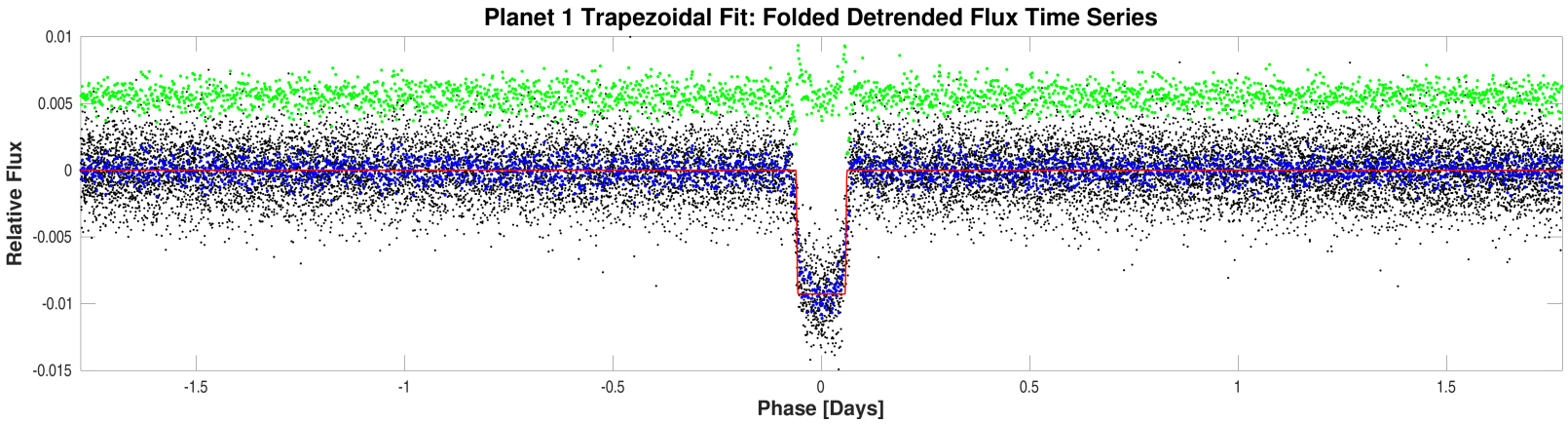
Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

TCE Parameter	Value	Units
Trial Transit Pulse Duration	3.0	hours
Transit Epoch	1986.0600436	TJD
Orbital Period	3.5541651	days
Maximum SES	30.6	
Maximum MES	71.9	
Robust Statistic	74.7	
Chi Square Goodness of Fit Statistic (DoF)	528.6 (529)	
Chi Square2 Statistic (DoF)	5.2 (507.2)	
Threshold for Desired PFA		

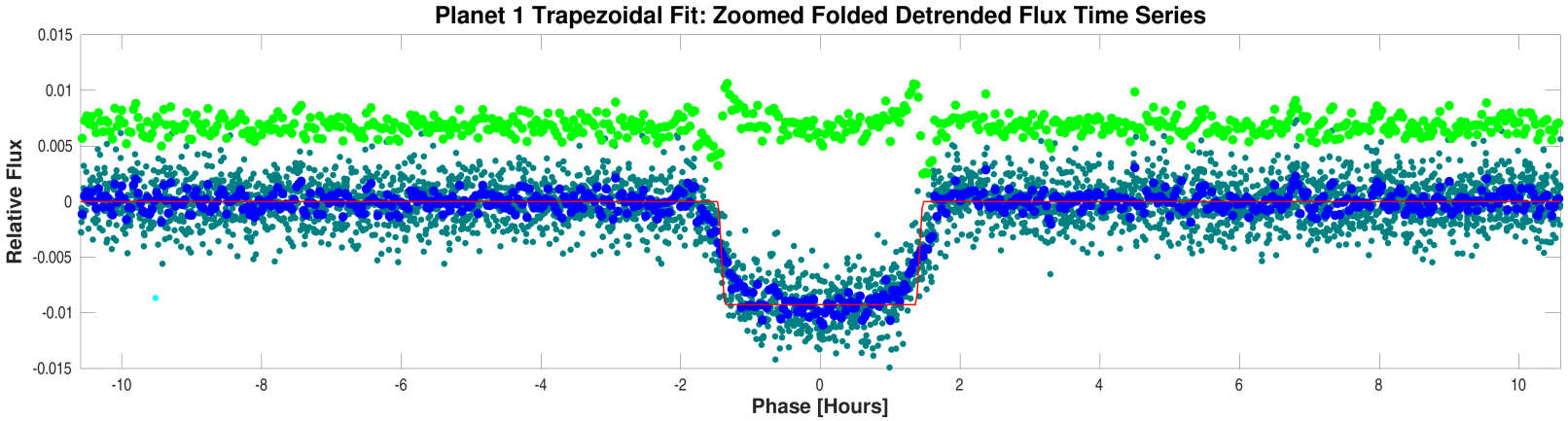
DoF: Degrees of Freedom

Parameter	Value	Uncertainty	Units
SNR	95.2		
Orbital Period	3.5541651		days
Transit Epoch	1986.0625358		BTJD
Transit Depth	9271		ppm
Transit Duration	3.5301		hours
Transit Ingress Duration	0.6959		hours
Model Chi Square Statistic (DoF)	17718.5 (4457)		

DoF: Degrees of Freedom



Folded detrended flux time series for CatId 159742538, Planet candidate 1 and folded trapezoidal model light curve.
Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000159742538-01-all-trapezoidal.fig`



Zoomed folded detrended flux time series for CatId 159742538, Planet candidate 1 and folded trapezoidal model light curve.
Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000159742538-01-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	3.5542		days		
Transit Duration	3		hours		
Maximum MES	71.9				
Secondary Phase	2.4903		days		
Secondary MES	2.4				
Minimum Phase	-0.44306		days		
Minimum MES	-3.1				
Median MES	-0.1				
MAD MES	0.94706				
Robust Statistic	1.9				
Secondary Depth	217.7	1.1492e+02	ppm		
Geometric Albedo	0.6	3.3822e-01		-1.1260	86.99
Planet Effective Temperature	2416	3.2372e+02	Kelvin	1.9727	2.43

7.4.2 Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	3.8772e-01	0.6227	53.35

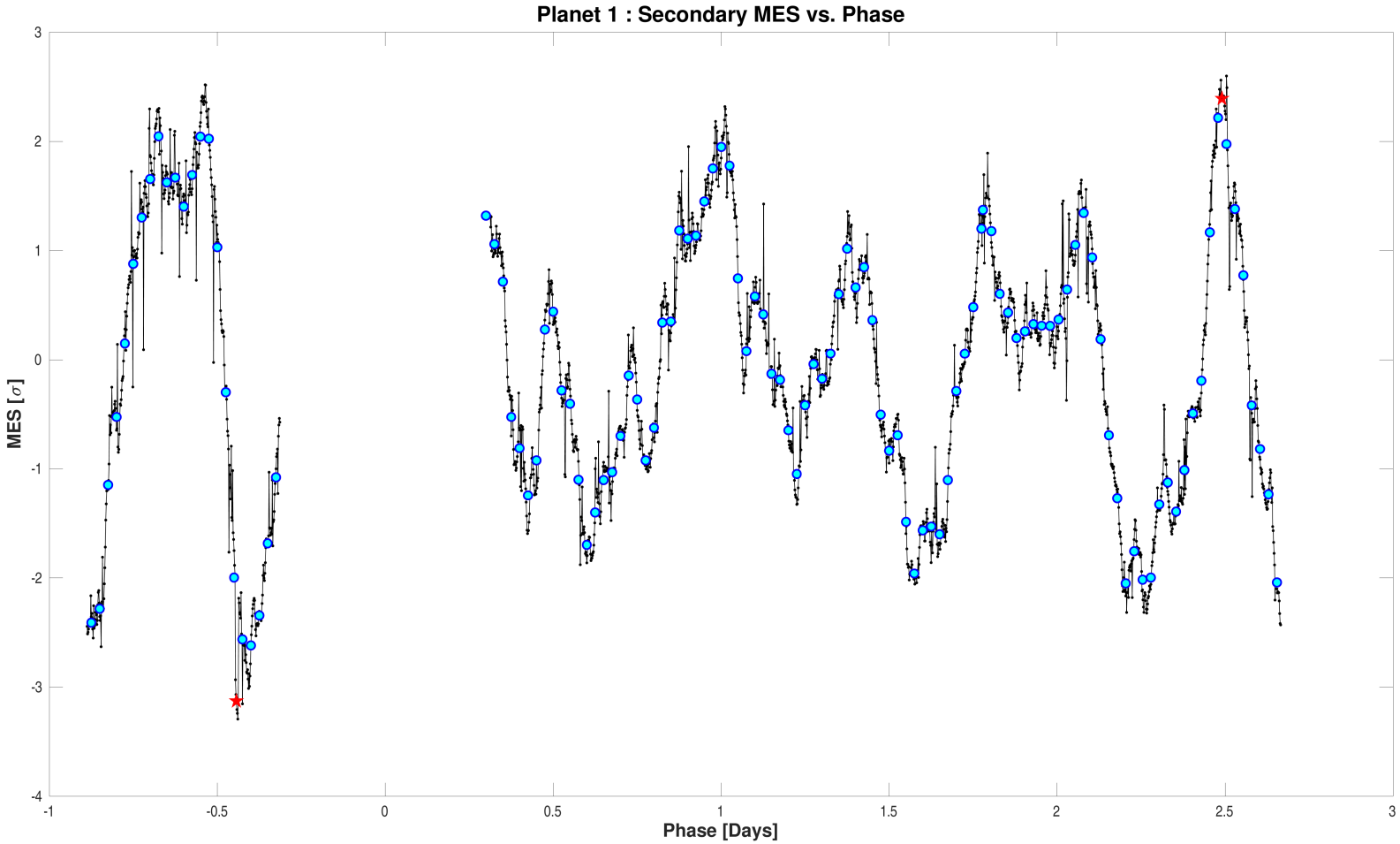
7.4.3 Bootstrap Test

Result	Value
False Alarm Probability	0.0000e+00
Bootstrap Threshold for Desired PFA	9.1
MES Mean	-1.00
MES Standard Deviation	1.43
Transit Count	7

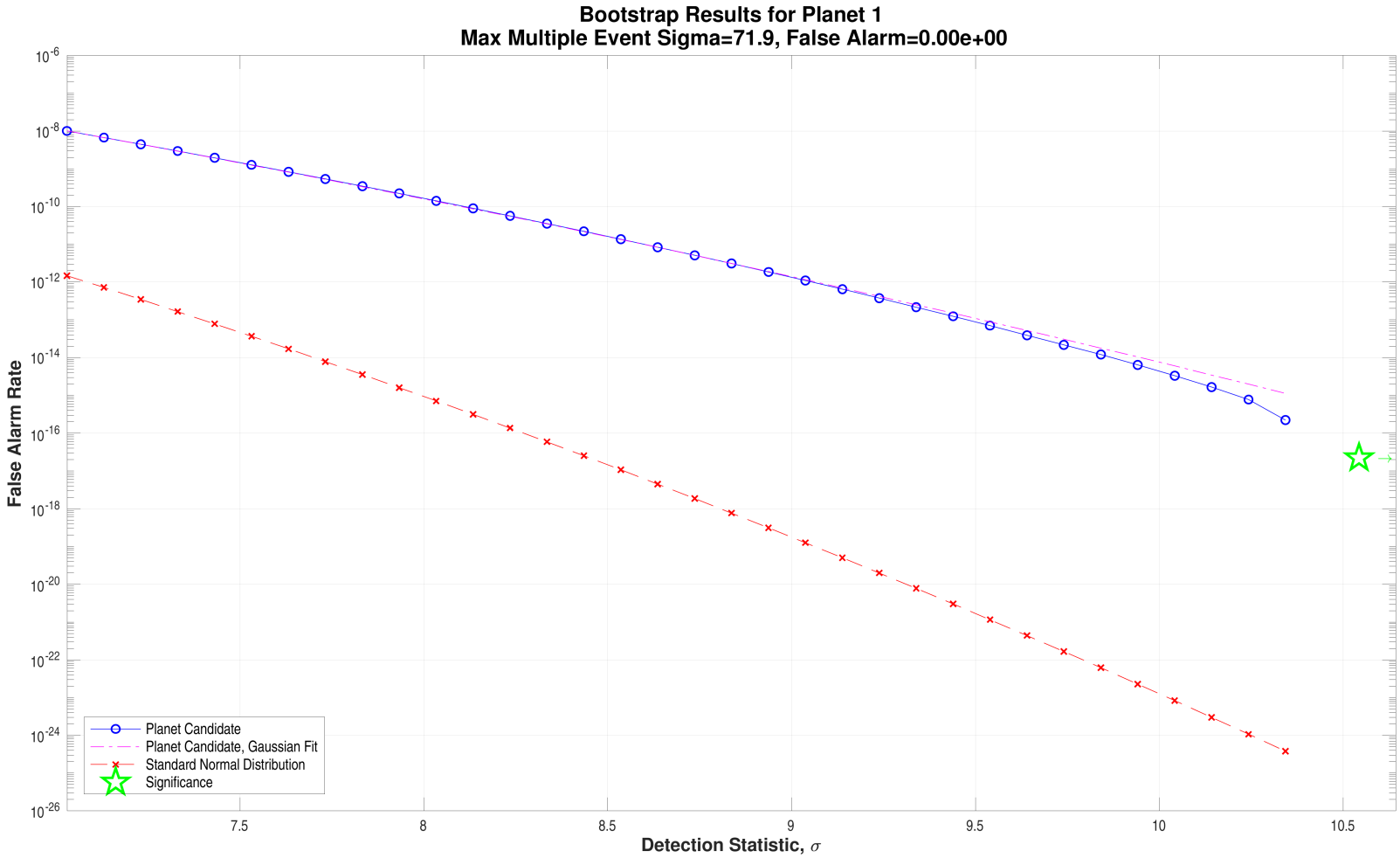
7.4.4 Ghost Diagnostic Test

Result	Value	Significance (%)
Maximum MES	71.9	
SNR	75.0	
Core Aperture Statistic	5.1841e+01	100.00
Halo Aperture Statistic	3.1923e+00	99.93
Ratio of Core/Halo Aperture Statistics	1.6240e+01	

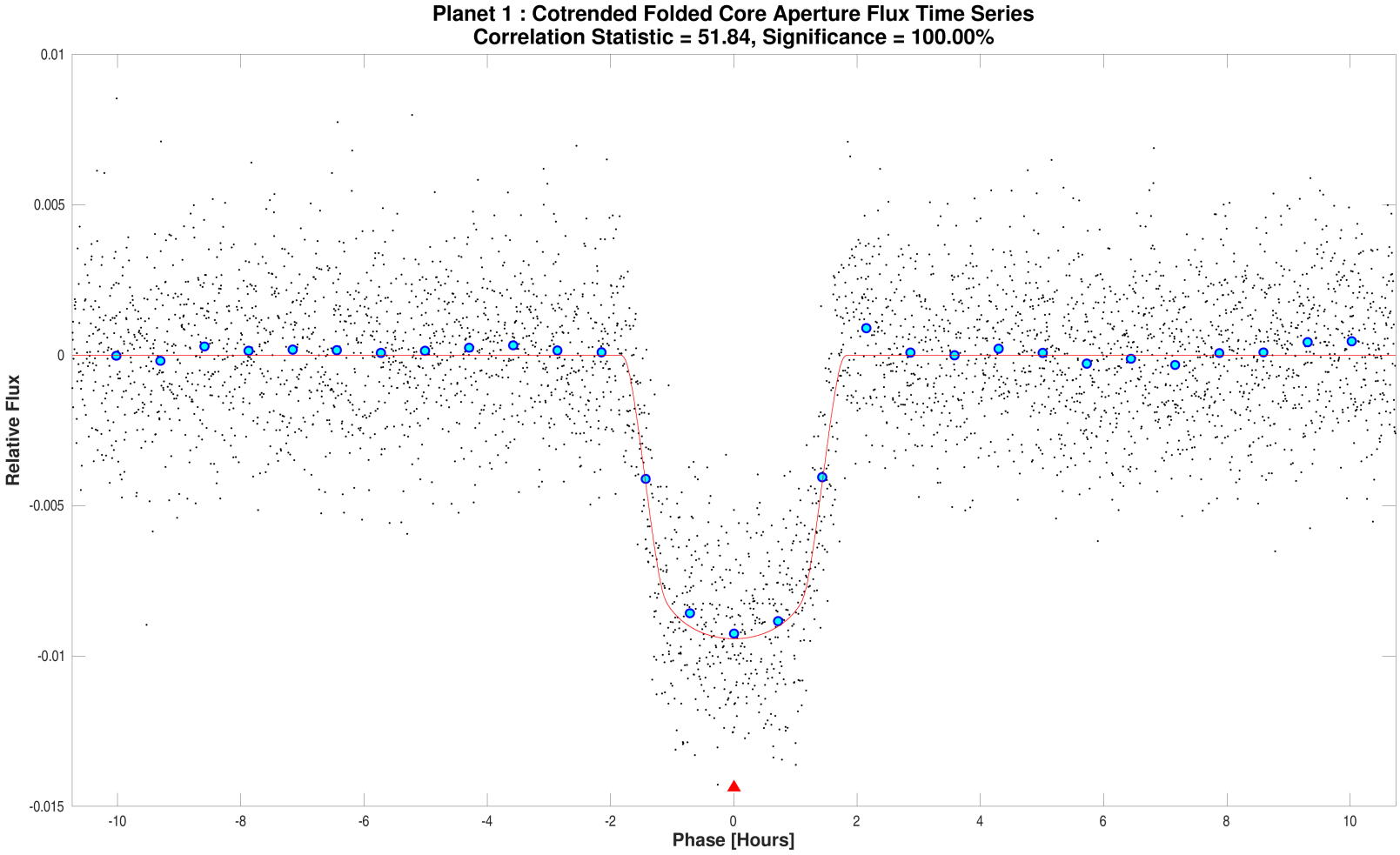
7.4.5 Validation Test Figures



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. The maximum secondary MES and corresponding phase are 2.3926 and 2.4903 days respectively. The minimum secondary MES and corresponding phase are -3.1273 and -0.44306 days respectively.
Open `./planet-01/report-summary/0000000159742538-01-weak-secondary-diagnostic.fig`

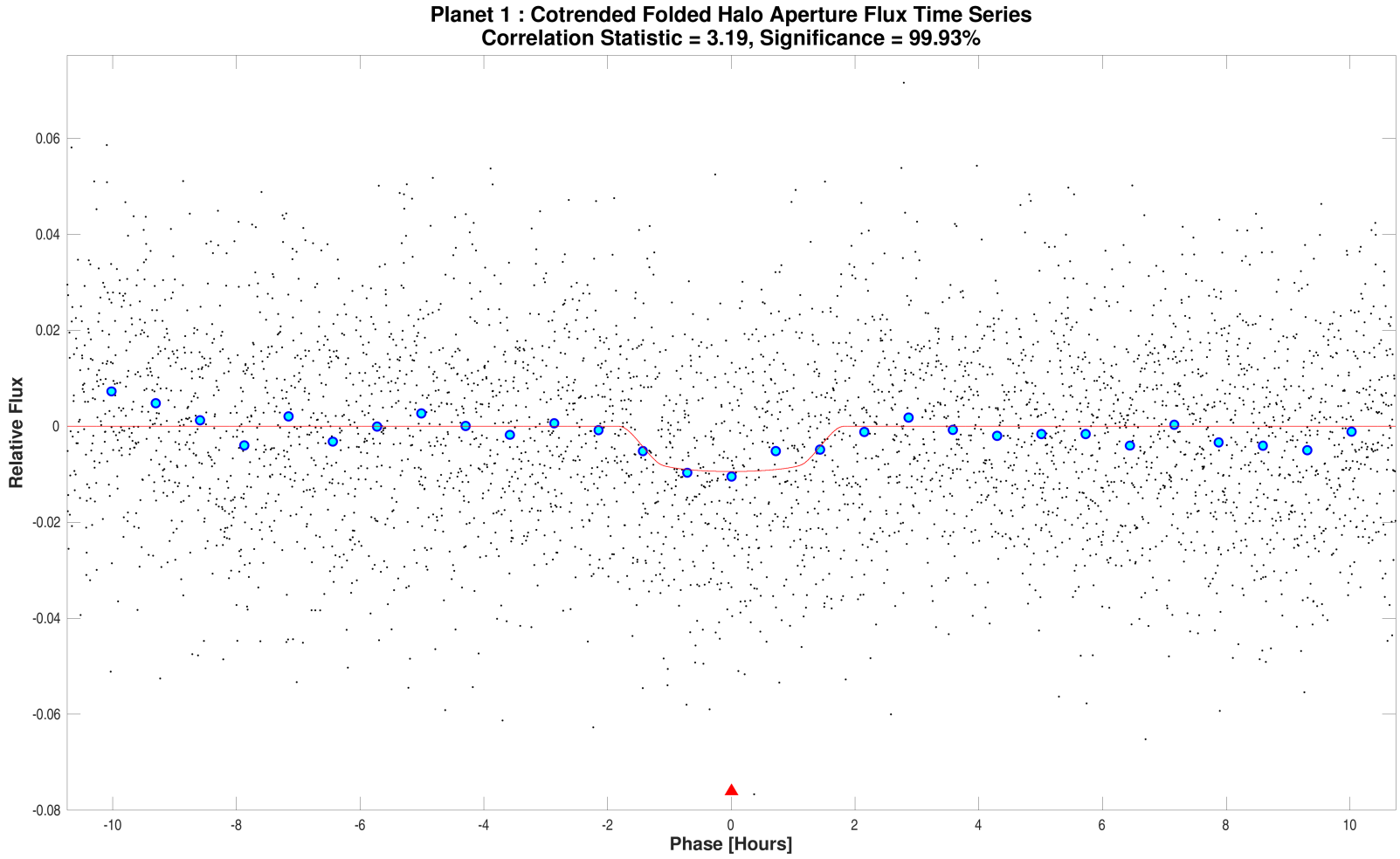


Bootstrap results for target 159742538, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is Inf. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 9.1485.
Open `./planet-01/bootstrap-results/0000000159742538-01-bootstrap-false-alarm.fig`



Optical ghost diagnostic core aperture flux time series for target 159742538, 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/0000000159742538-01-core-unwhitened-cotrended-zoomed-model.fig`

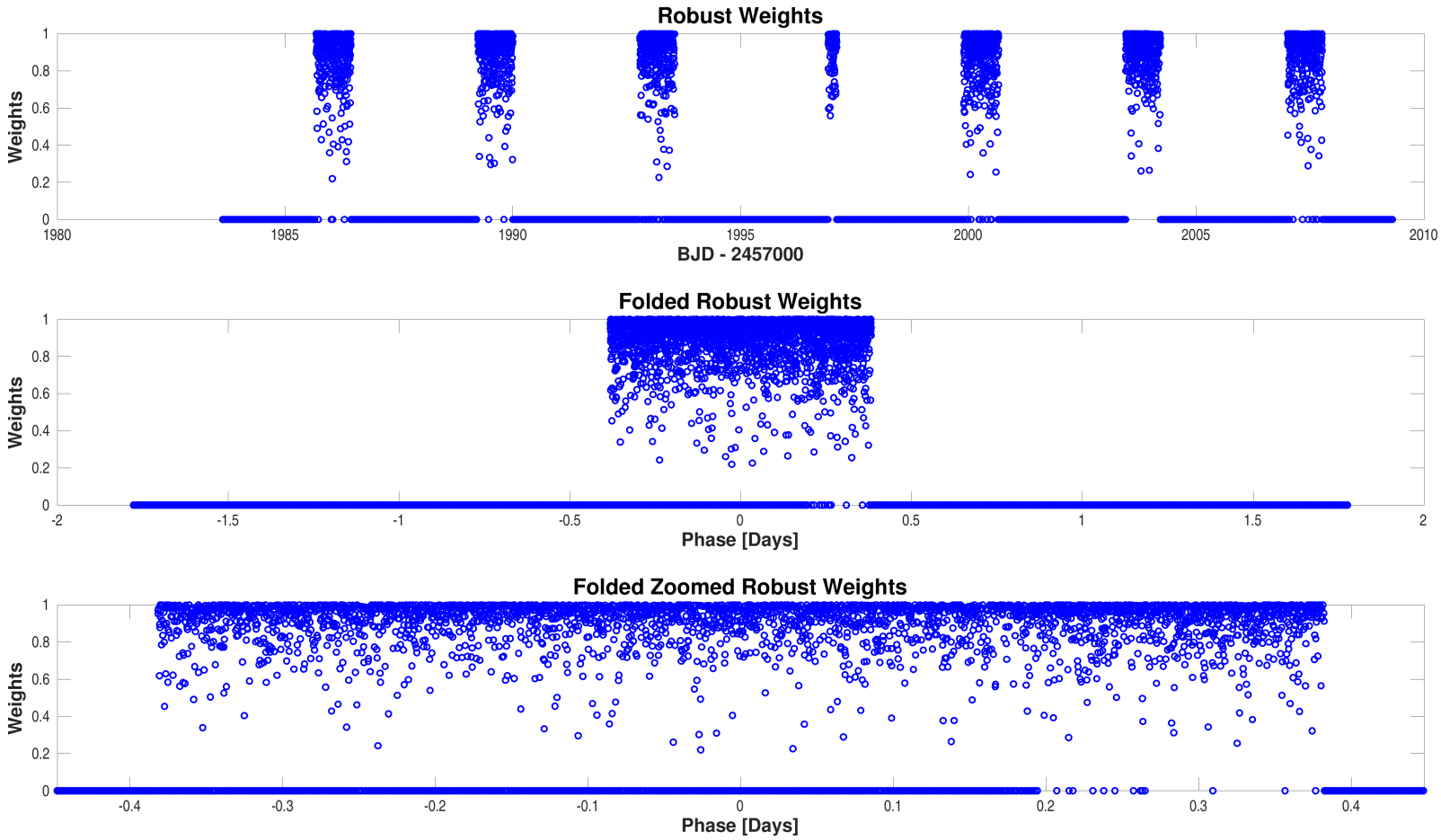


Optical ghost diagnostic halo aperture flux time series for target 159742538, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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.

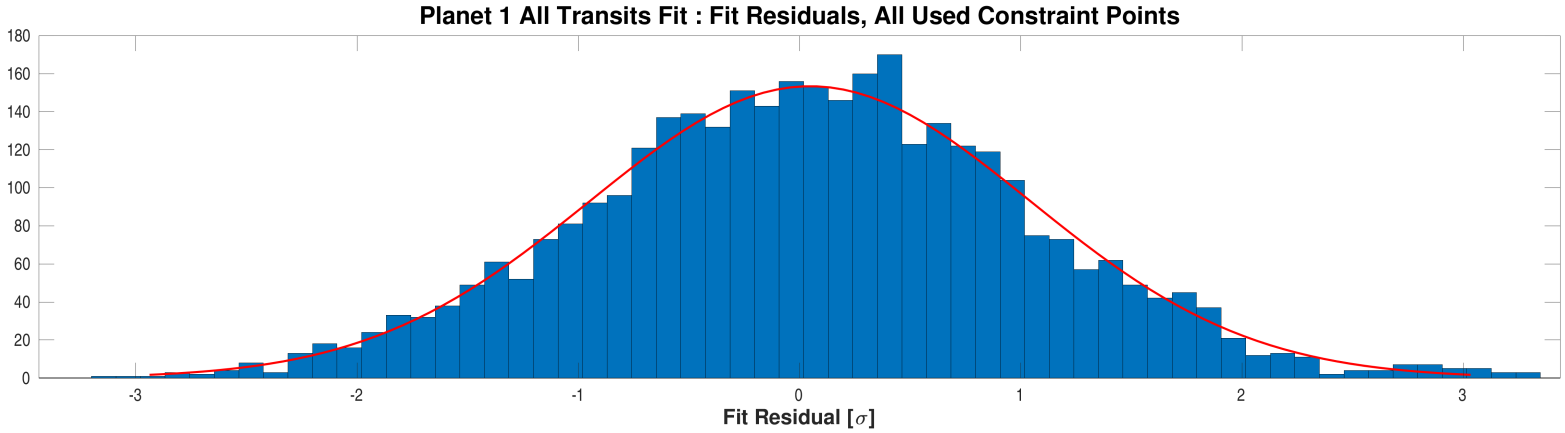
Open `./planet-01/ghost-diagnostic-results/0000000159742538-01-halo-unwhitened-cotrended-zoomed-model.fig`

Appendix A Planet Candidate 1

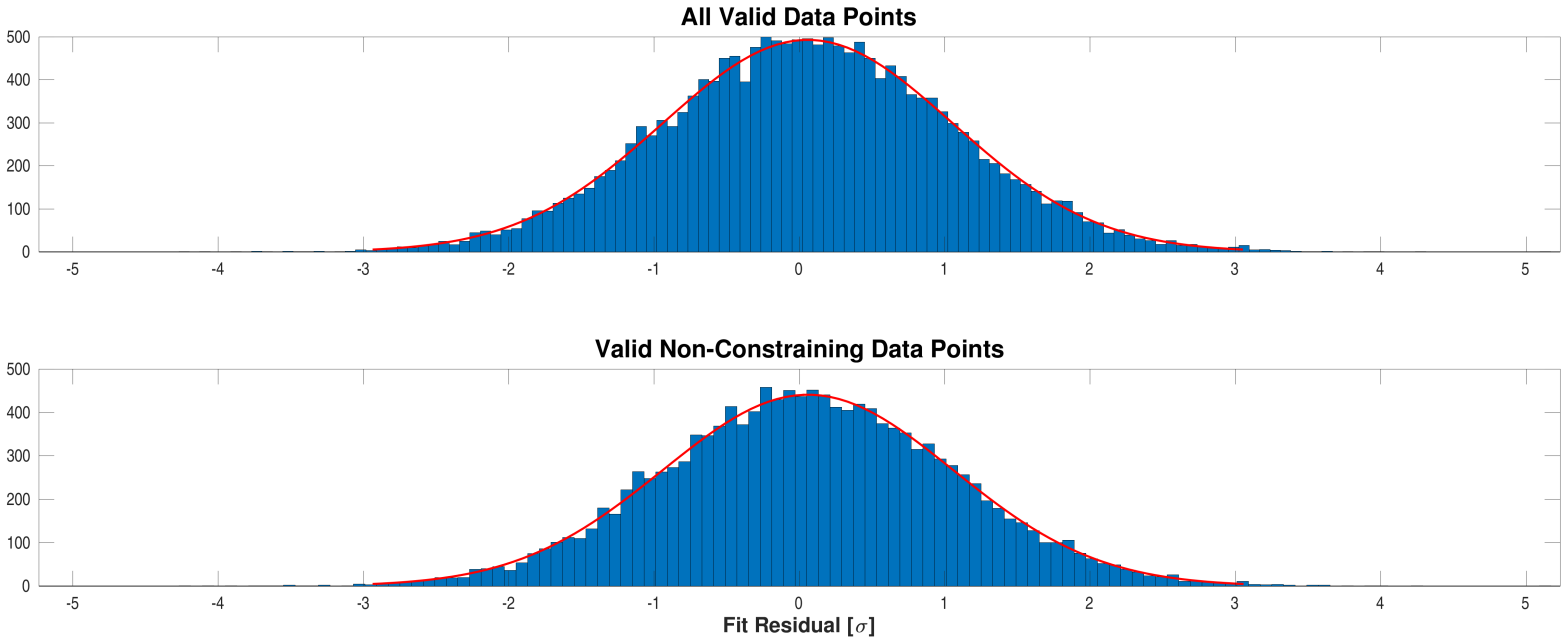
A.1 Model Fitter: All Transits



Robust weights distribution for CatId 159742538, 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/0000000159742538-01-all-robust-weights.fig`



Fit residuals distribution for CatId 159742538, 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/0000000159742538-01-all-histo-used.fig`

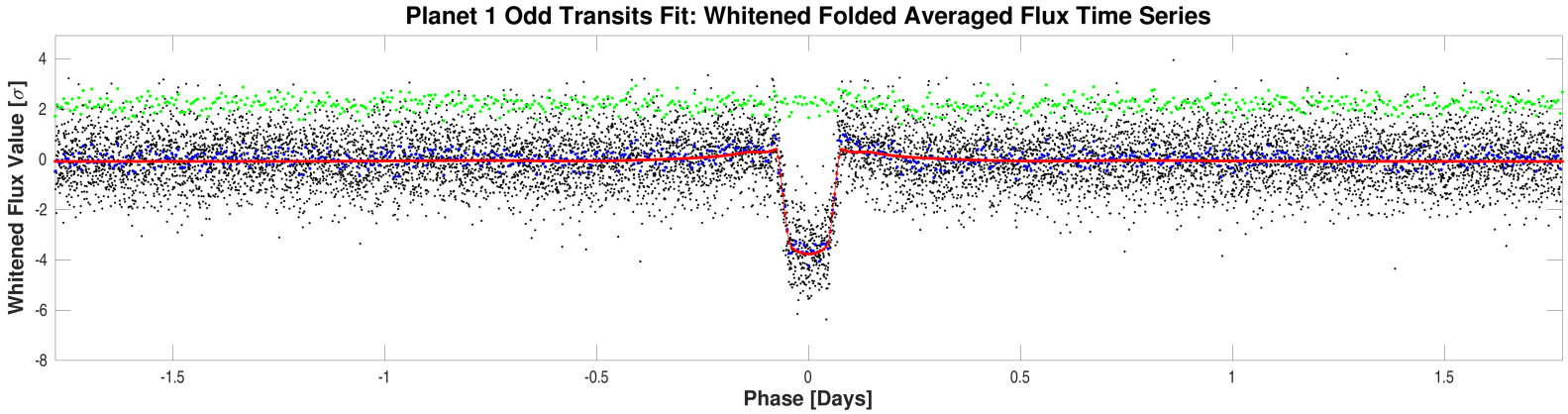


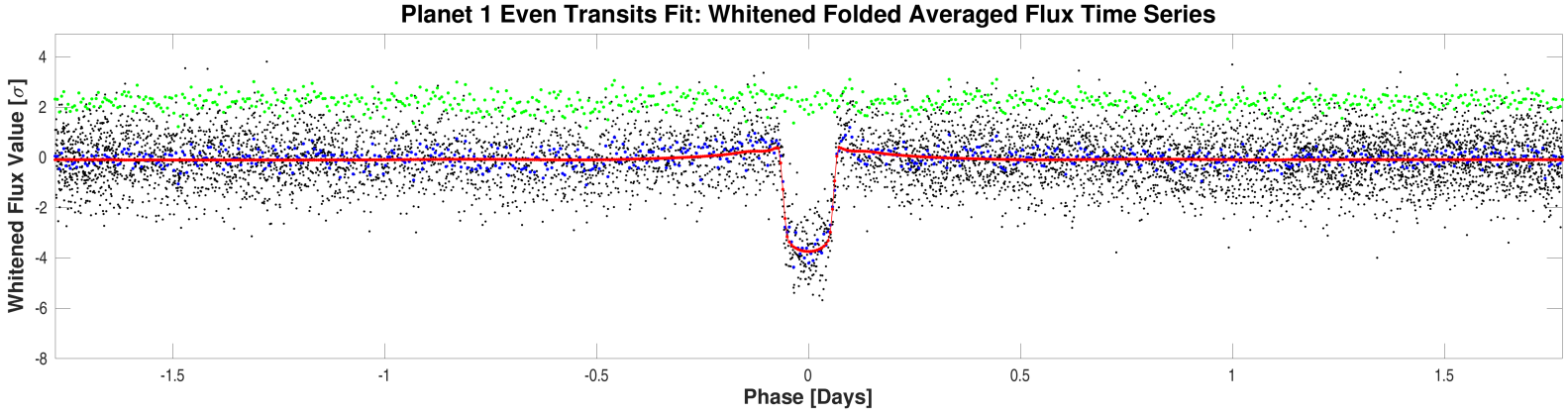
Fit residuals distribution for CatId 159742538, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000159742538-01-all-histo-all-and-unused.fig`

A.2 Model Fitter: Odd & Even Transits

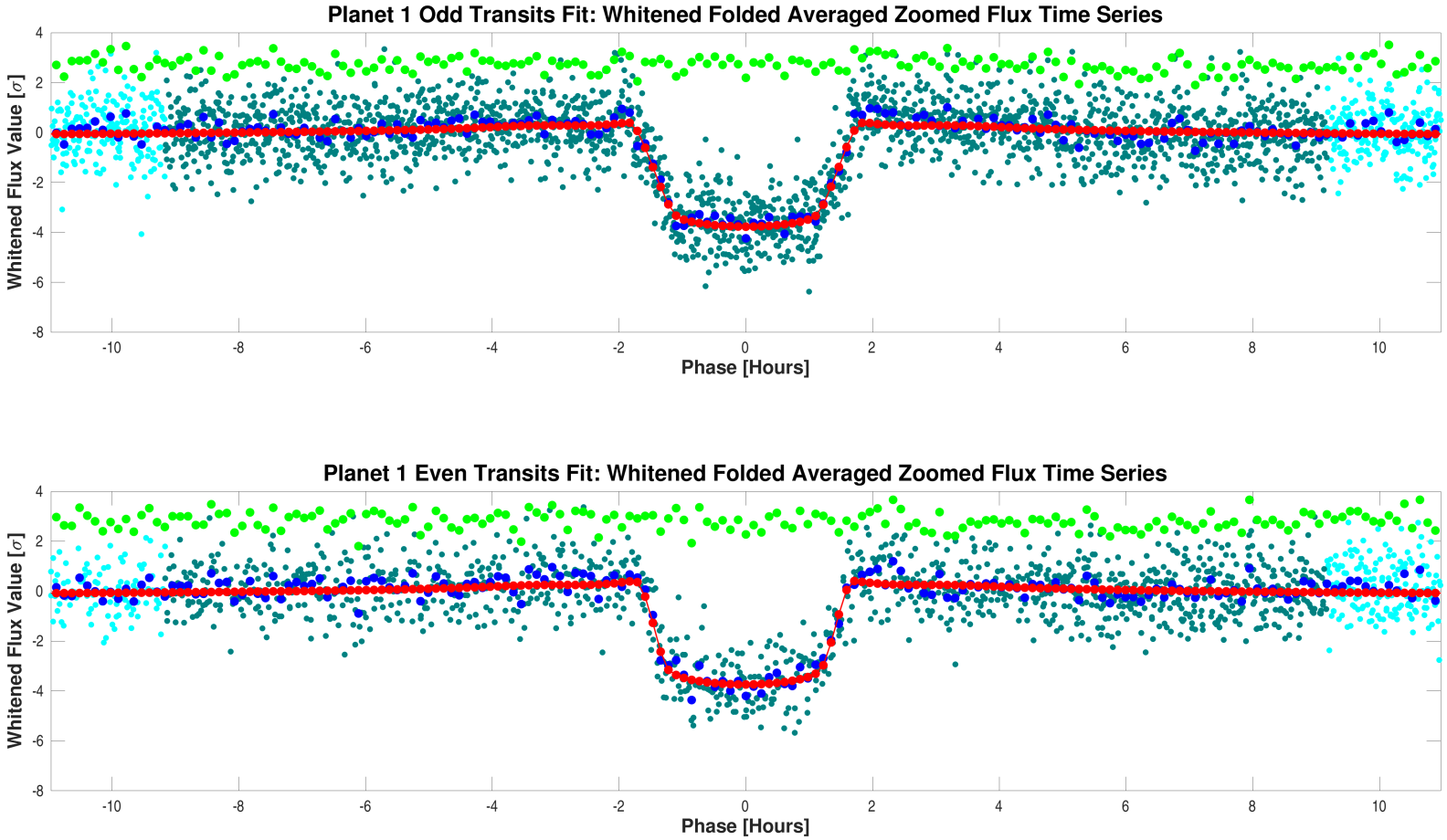
Parameter	Odd Transits Value	Odd Transits Uncertainty	Even Transits Value	Even Transits Uncertainty	Units	Difference / Uncertainty
SNR	61.0		43.6			
Orbital Period	3.5539028	2.6788e-04	3.5541292	3.5756e-04	days	5.0681e-01
Transit Epoch	1986.0632367	1.0180e-03	1989.6158554	1.0231e-03	BTJD	9.1025e-01
Impact Parameter	0.7663	2.6576e-02	0.6308	9.2356e-02		1.4102e+00
Planet Radius to Star Radius Ratio	0.0973119	1.2856e-03	0.0934643	1.9951e-03		1.6211e+00
Semi-major Axis to Star Radius Ratio	5.9034	2.7638e-01	7.2268	6.8083e-01		1.8012e+00
Planet Radius	21.3376	1.1457e+00	20.4939	1.1528e+00	Earth radii	5.1907e-01
Semi-major Axis	0.0482	3.6367e-03	0.0482	3.6368e-03	AU	3.9797e-04
Effective Stellar Flux	2276.3169	3.7529e+02	2276.1235	3.7526e+02	Goldilocks	3.6433e-04
Equilibrium Temperature	1762	7.2612e+01	1762	7.2610e+01	Kelvin	3.6433e-04
Stellar Density	0.2188	3.0736e-02	0.4014	1.1345e-01	Solar density	1.5534e+00
Transit Depth	9452	1.6455e+02	9281	2.2088e+02	ppm	6.2267e-01
Transit Duration	3.6539	6.9364e-02	3.3773	9.3078e-02	hours	2.3835e+00
Transit Ingress Duration	0.7193	8.0871e-02	0.4592	9.8229e-02	hours	2.0444e+00
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)	2485.2 (3069.5)		2485.2 (3069.5)			

DoF: Degrees of Freedom

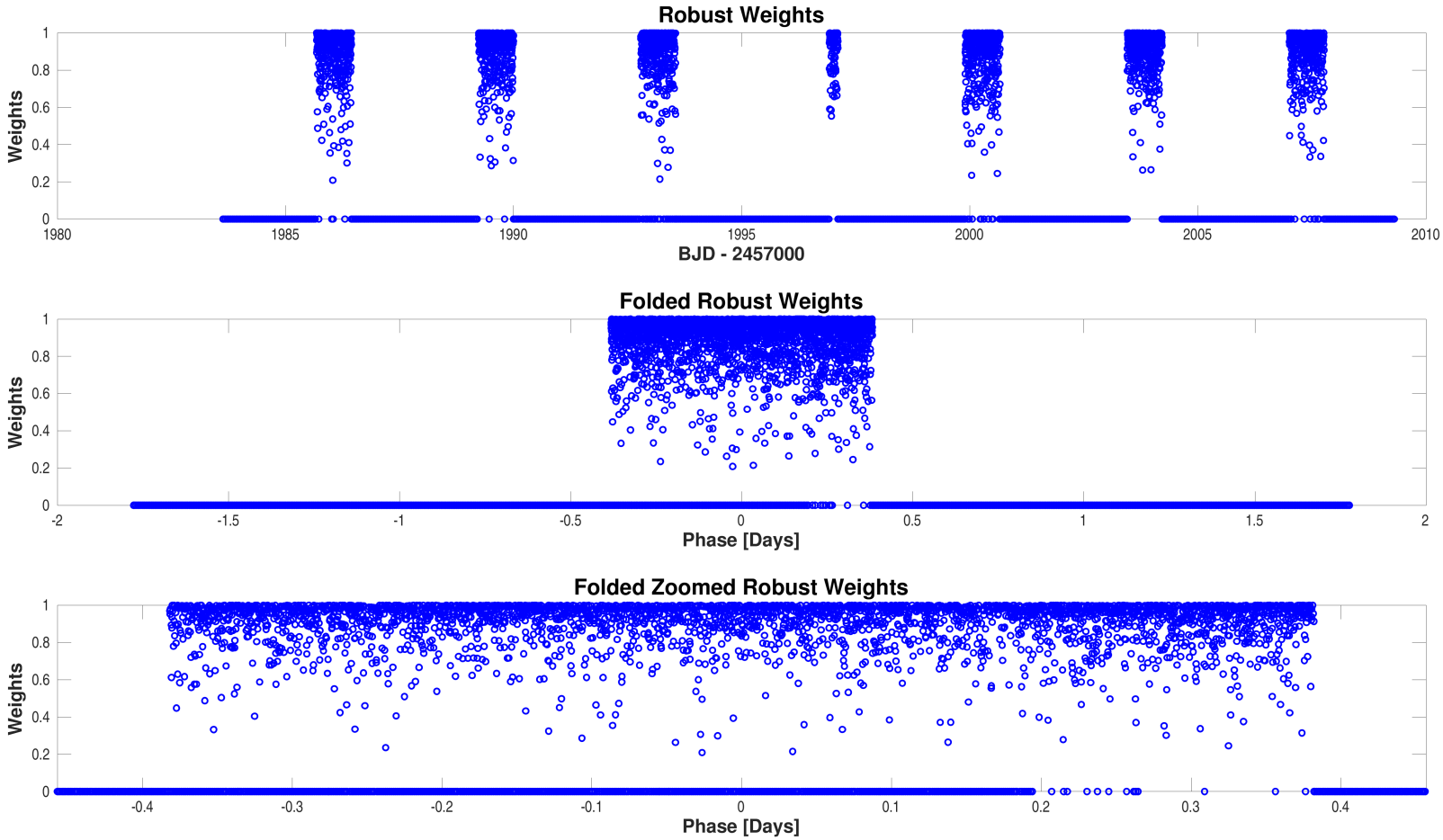




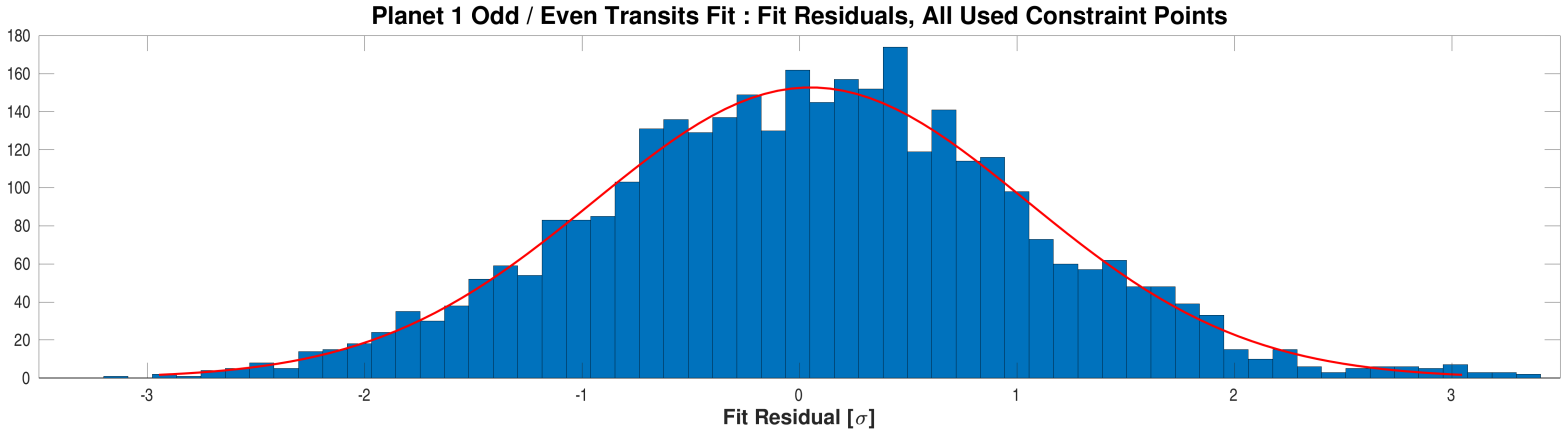
Folded flux time series for CatId 159742538, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light 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/0000000159742538-01-odd-even-whitened.fig`



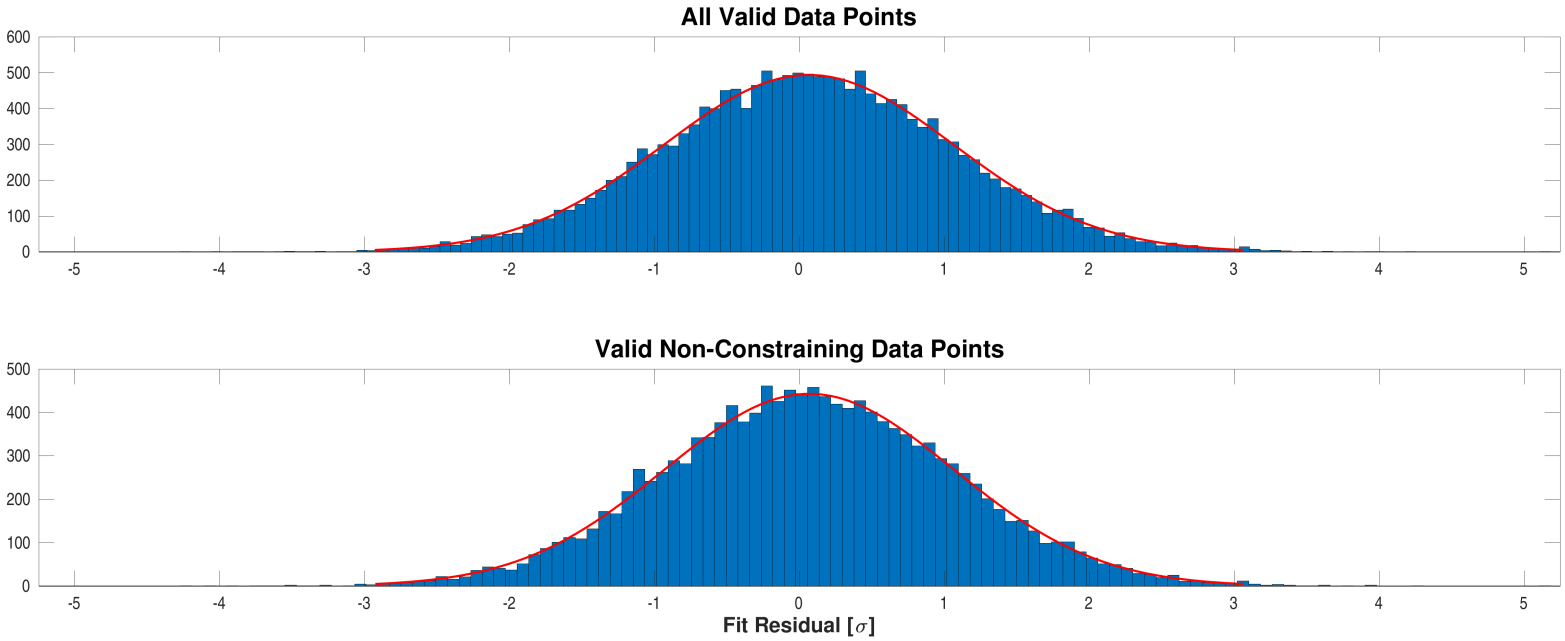
Folded flux time series for CatId 159742538, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000159742538-01-odd-even-whitened-zoomed.fig`



Robust weights distribution for CatId 159742538, 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/0000000159742538-01-odd-even-robust-weights.fig`

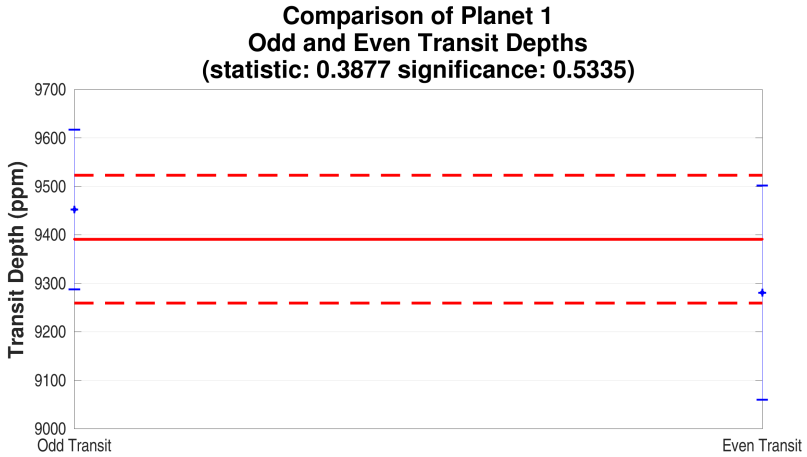


Fit residuals distribution for CatId 159742538, Planet candidate 1. Only the valid data points used to constrain the fit are shown here. A Gaussian fit to the histogram is shown in red.
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000159742538-01-odd-even-histo-used.fig`



Fit residuals distribution for CatId 159742538, 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/0000000159742538-01-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 159742538, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary. Open `./planet-01/binary-discrimination-test-results/0000000159742538-01-eclipsing-binary-discrimination-tests.fig`

Appendix B Alerts

This target did not trigger any alerts.