



Data Validation (DV) Report

for TESS ID 158561566
Sectors 14 - 14

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

13-Sep-2019 10:56:55 Z

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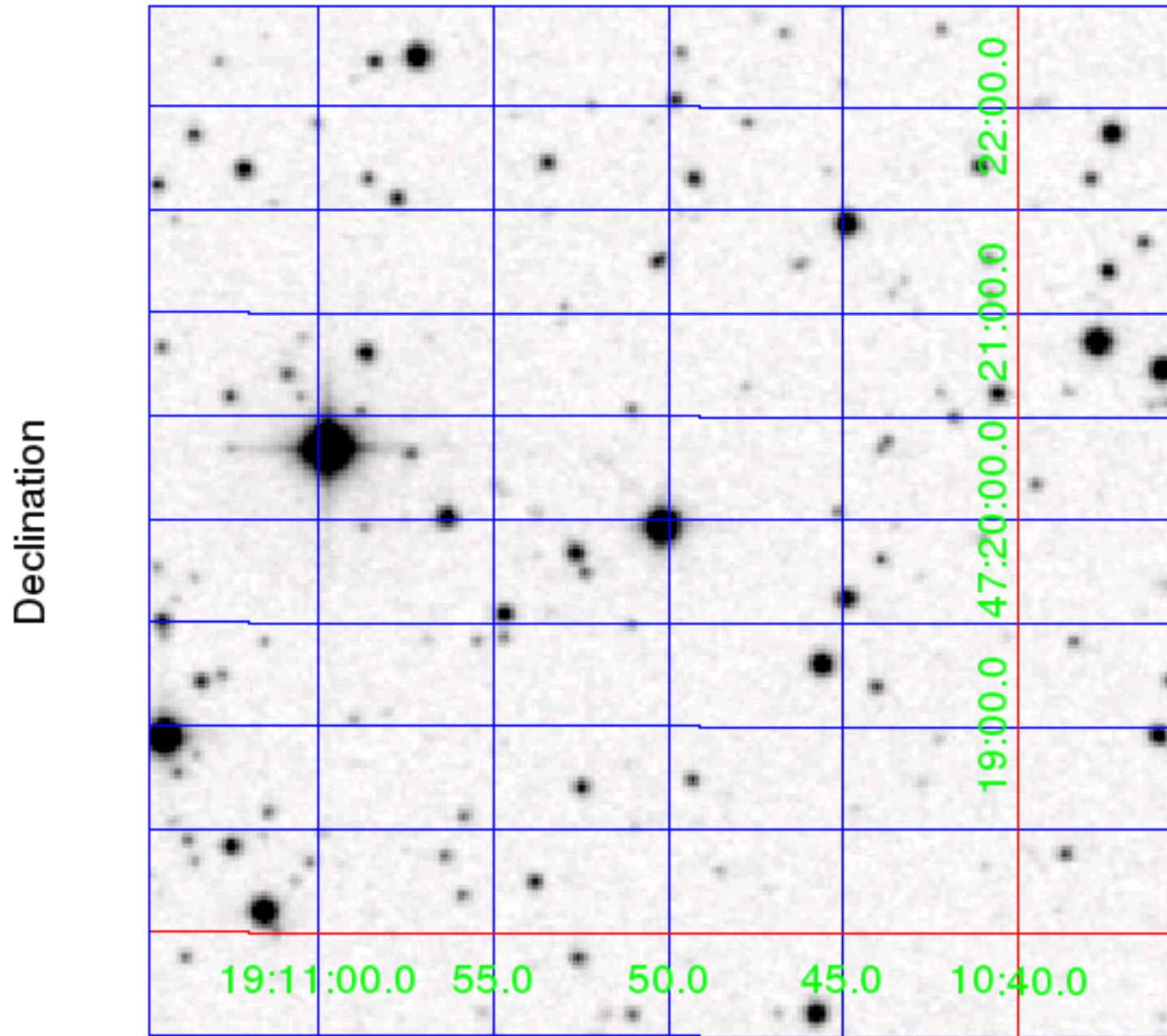
1 Summary

Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	158561566			
TOI ID	-			
TESS Name	-			
RA	287.70881400	0	degrees	TIC8
Dec	47.33305000	0	degrees	TIC8
Magnitude	11.636	0.036		TIC8
Radius	2.001	0.103	Solar radii	TIC8
Effective Temperature	6378	25	Kelvin	TIC8
log(g)	4.438	0	cm/sec ²	Solar
[M/H]	0.070	0.1	Solar metallicity	TIC8
Stellar Density	1.000	0.000	Solar density	Solar
Limb Darkening Coefficient 1	0.47636			
Limb Darkening Coefficient 2	0.34395			
Limb Darkening Coefficient 3	-0.23625			
Limb Darkening Coefficient 4	0.038611			
Number of Planet Candidates	1			
TOI Model	toi-plus-2019-08-29.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-4.0.8-20190912			
Date Report Generated	13-Sep-2019 10:56:55 Z			

Sector	Target Table	Camera/ CCD	Crowding Metric	Flux Fraction
14	167	2:3	0.9553	0.8016

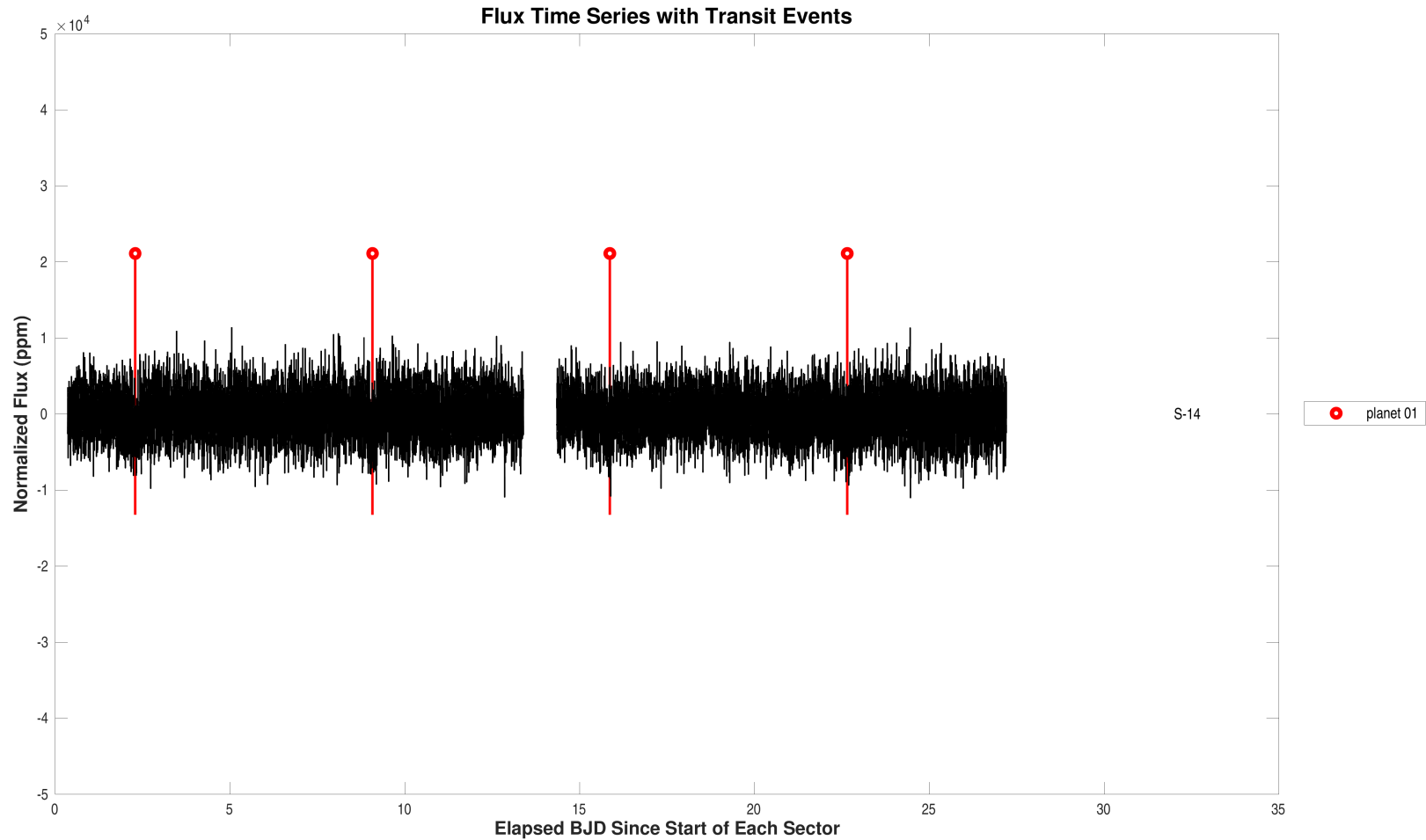
Planet Candidate	TOI ID	TESS Name	TOI Correlation	Period (days)	Period Ratio	Epoch (BTJD)	Semi-major Axis (AU)	Radius (Re)	Seff	Teq (K)	False Alarm	Suspected EB
1	-	-	-	6.789	1.00	1685.288	0.11	9.1	477.6	1192	4.96e-39	false

2 Survey Image

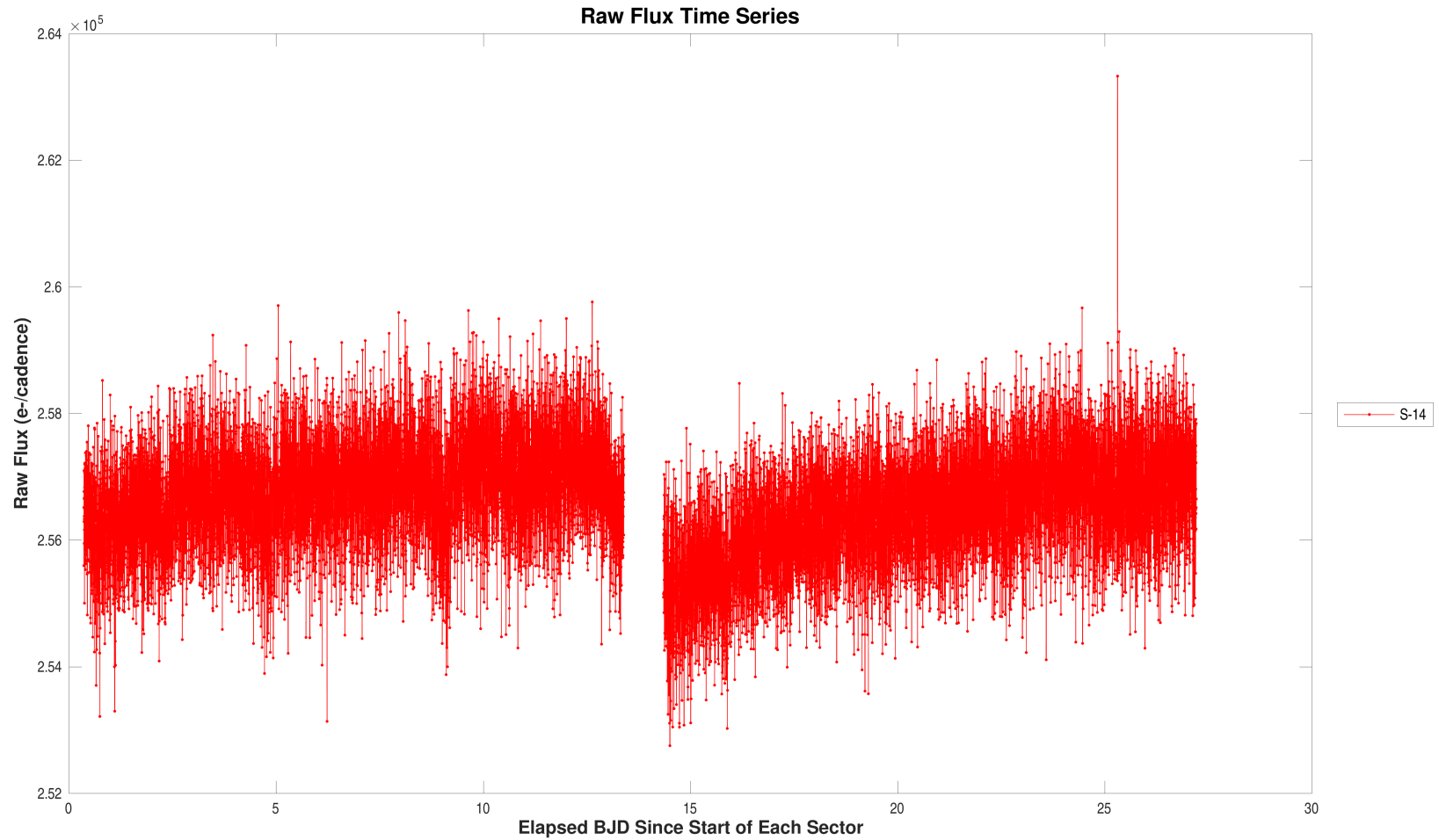


Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (158561566).

3 Flux Time Series



Summary plot of sector-stitched flux time series and transits for target 158561566, 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 14, target table 167, start BJD is 2458683. Open `./summary-plots/0000000158561566-00-flux-dv-fit-14-167.fig`



Summary plot of raw flux time series. For the data of sector 14, target table 167, start BJD is 2458683.
Open `./summary-plots/0000000158561566-00-raw-flux-14-167.fig`

4 Dashboards

Planet Candidate 1

Model Fitter	Stellar Radius 2.0 ± 0.1 Solar units		Core Aperture Correlation Statistic Value = 12.18 Significance = 100.00%		Ghost Diagnostic Test	
	Period = 6.8 ± 0.0 days Depth = 1993 ± 160 ppm Planet Radius = 9.1 ± 1.4 Earth radii Semi-major Axis = 0.1 ± 0.0 AU Effective Stellar Flux = 477.6 ± 18.1 Equilibrium Temperature = 1192 ± 11 Kelvin Chi-squared/DoF = 0.8 SNR = 12.4		Halo Aperture Correlation Statistic Value = -0.76 Significance = 22.49% Core/Halo Ratio Ratio = -16.12			
Eclipsing Binary Discrimination Test	Odd-Even Depth Comparison Statistic Value = 2.00e-01 Significance = 65.47%		Offsets Relative to Out of Transit Centroid Source RA Offset = 5.55e+01 ± 2.69e+00 arcsec (20.62 σ) Source Dec Offset = 8.14e+00 ± 3.23e+00 arcsec (2.52 σ) Source Offset Distance = 5.61e+01 ± 2.71e+00 arcsec (20.75 σ) Offsets Relative to TIC Position Source RA Offset = 5.64e+01 ± 2.69e+00 arcsec (20.99 σ) Source Dec Offset = 8.08e+00 ± 3.23e+00 arcsec (2.51 σ) Source Offset Distance = 5.70e+01 ± 2.70e+00 arcsec (21.11 σ)		Difference Image Centroid Offsets	
	Shorter Period Comparison Statistic Value = <i>N/A</i> Significance = <i>N/A</i>	Longer Period Comparison Statistic Value = <i>N/A</i> Significance = <i>N/A</i>	False Alarm = 4.96e-39 Transit Count = 4 Max Multiple Event Statistic = 10.9		Bootstrap Test	

Summary of model fitter results and validation test results for target 158561566, 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

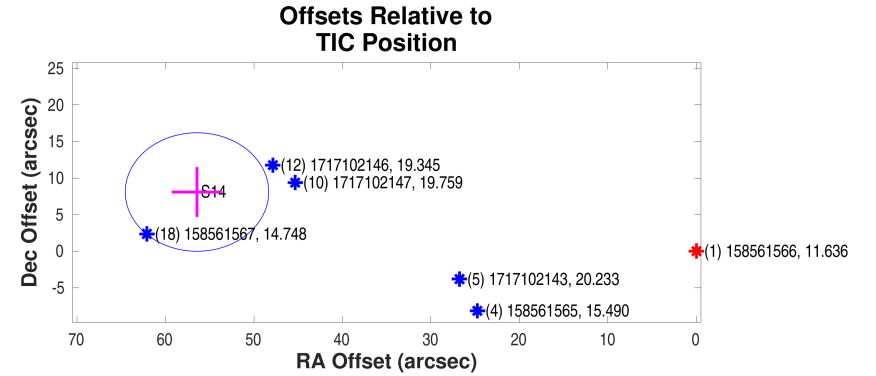
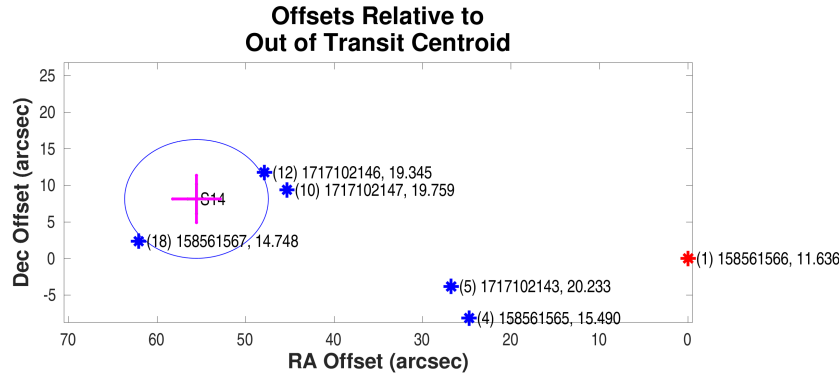
Mean offset from the PRF fit to the out of transit image

	RA	Dec	Units
Offset	$55.5460 \pm 2.69e + 00$	$8.1383 \pm 3.23e + 00$	arcseconds
Offset/ σ	20.62	2.52	
Offset Distance	$56.1390 \pm 2.71e + 00$		arcseconds
Offset Distance/ σ	20.75		
3σ Radius	8.1173		arcseconds

Mean offset from the TIC RA and Dec

	RA	Dec	Units
Offset	$56.4271 \pm 2.69e + 00$	$8.0846 \pm 3.23e + 00$	arcseconds
Offset/ σ	20.99	2.51	
Offset Distance	$57.0033 \pm 2.70e + 00$		arcseconds
Offset Distance/ σ	21.11		
3σ Radius	8.1009		arcseconds

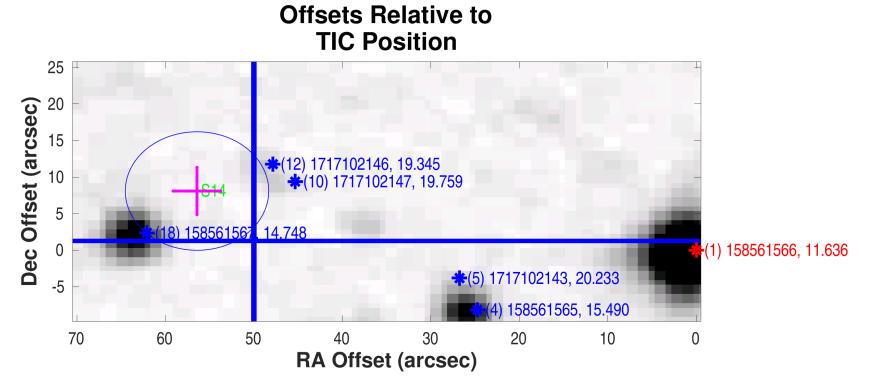
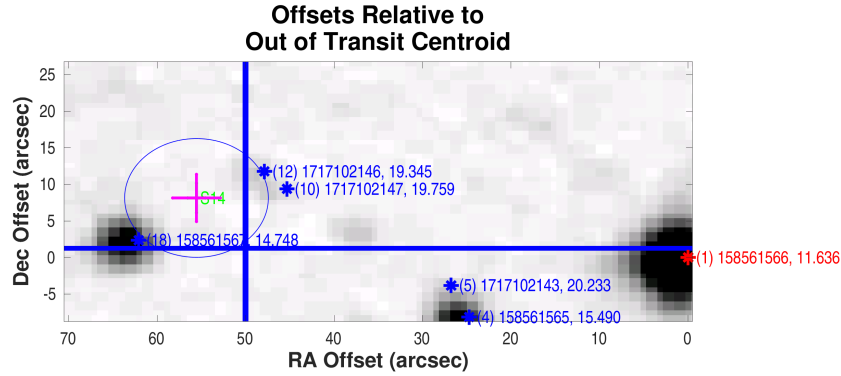
Planet Candidate 1



Difference image centroid offsets for target 158561566, 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/0000000158561566-01-difference-image-centroid-offsets.fig`

Planet Candidate 1



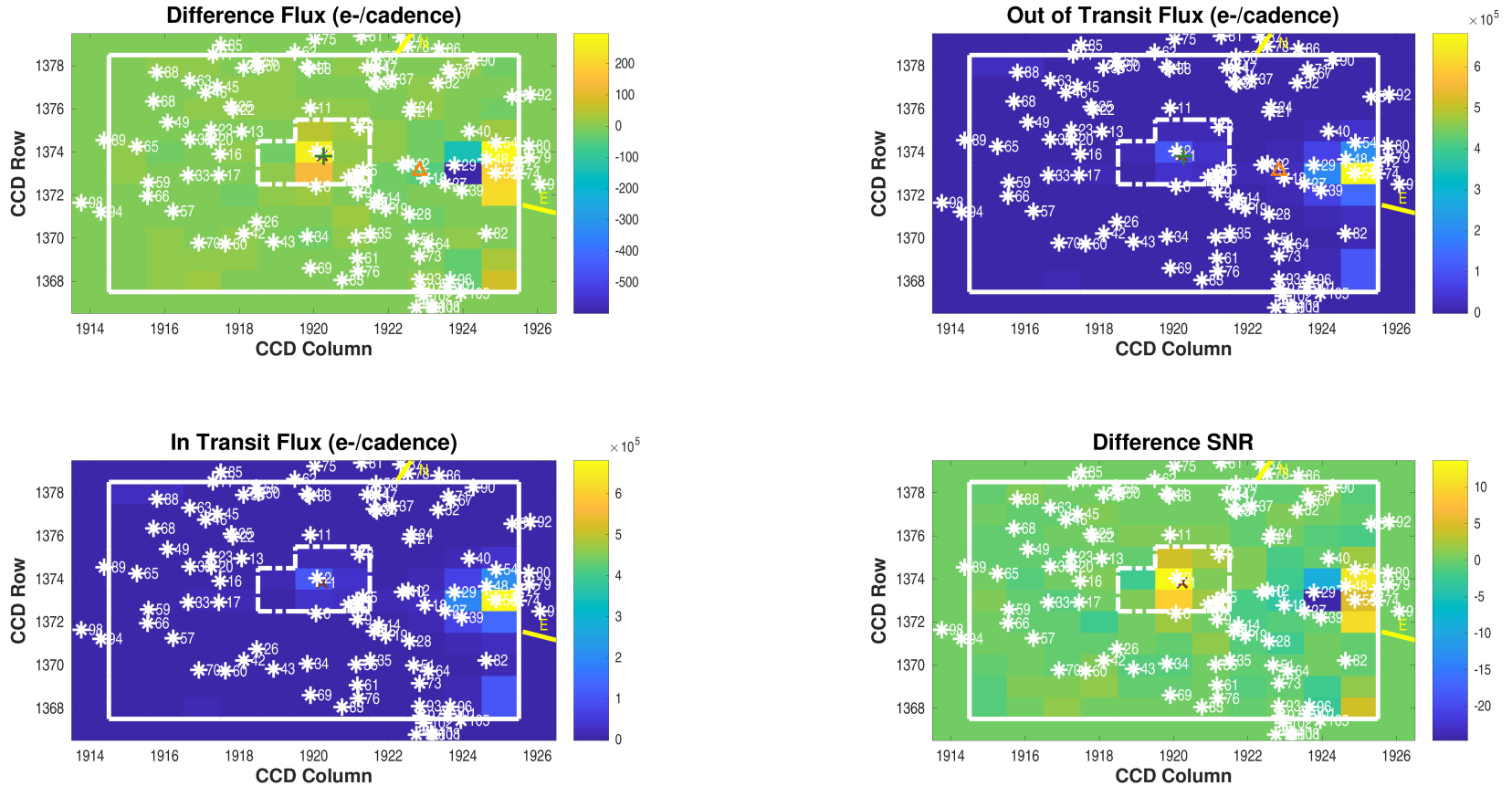
Difference image centroid offsets for target 158561566, planet candidate 1, displayed on survey image for given target. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets 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 offset. 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/0000000158561566-01-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	0	0.0000	0.70

Difference Image
Planet Candidate 1 / Sector 14 / Target Pixel Table 167



Difference image for target 158561566, planet candidate 1, sector 14, target pixel table 167. 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 = 4; number of valid in-transit cadences = 628; number of in-transit cadence gaps = 2; number of valid out-of-transit cadences = 1434; number of out-of-transit cadence gaps = 25. Difference image quality metric = -0.17 (not good).

Open `./planet-01/difference-image/0000000158561566-01-difference-image-14-167.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	$1373.80 \pm 6.61e - 05$	$1920.26 \pm 5.94e - 05$	pixels	$287.70917513 \pm 7.73e - 07$	$47.33303506 \pm 7.62e - 07$	degrees
Difference Image Centroid	$1373.13 \pm 1.02e - 01$	$1922.84 \pm 6.63e - 02$	pixels	$287.73194128 \pm 4.05e - 04$	$47.33529571 \pm 5.66e - 04$	degrees
Offset	$-0.6670 \pm 1.02e - 01$	$2.5758 \pm 6.63e - 02$	pixels	$55.5460 \pm 1.00e + 00$	$8.1383 \pm 2.04e + 00$	arcseconds
Offset/ σ	-6.51	38.83		55.41	3.99	
Offset Distance	$2.6608 \pm 6.59e - 02$		pixels	$56.1390 \pm 9.52e - 01$		arcseconds
Offset Distance/ σ	40.37			58.97		

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

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$1373.82 \pm 1.18e - 04$	$1920.22 \pm 1.19e - 04$	pixels	$287.70881400 \pm 0.00e + 00$	$47.33305000 \pm 0.00e + 00$	degrees
Difference Image Centroid	$1373.13 \pm 1.02e - 01$	$1922.84 \pm 6.63e - 02$	pixels	$287.73194128 \pm 4.05e - 04$	$47.33529571 \pm 5.66e - 04$	degrees
Offset	$-0.6856 \pm 1.02e - 01$	$2.6133 \pm 6.63e - 02$	pixels	$56.4271 \pm 9.89e - 01$	$8.0846 \pm 2.04e + 00$	arcseconds
Offset/ σ	-6.70	39.39		57.07	3.97	
Offset Distance	$2.7017 \pm 6.59e - 02$		pixels	$57.0033 \pm 9.38e - 01$		arcseconds
Offset Distance/ σ	40.97			60.76		

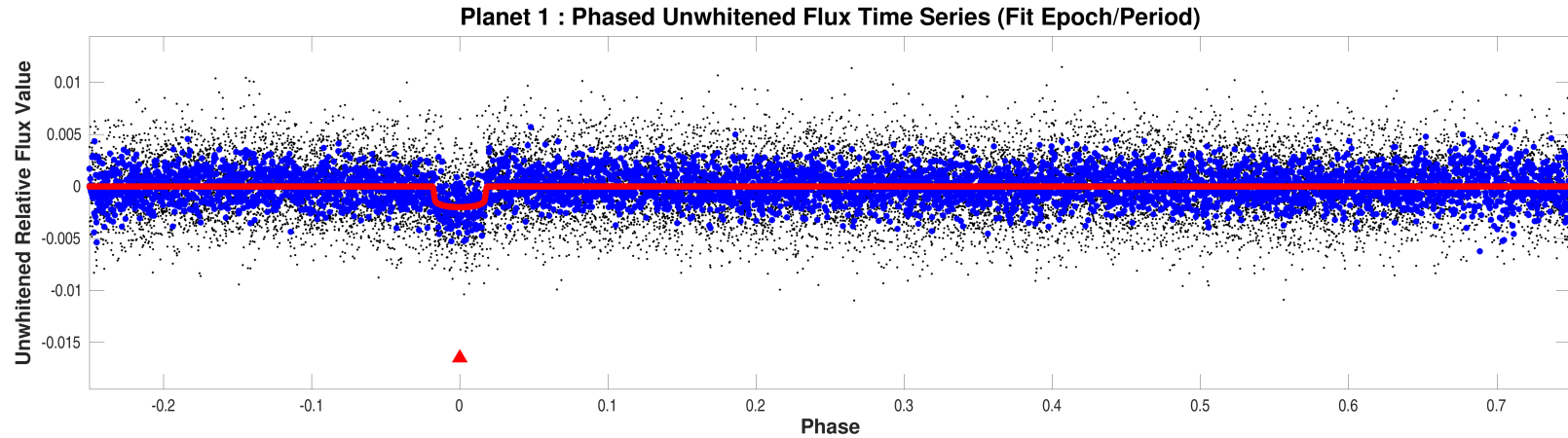
5.2 Difference Image TIC Key

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
1	158561566	11.636	287.70881400	47.33305000	0.00
2	1717102144	18.895	287.70697590	47.33391720	5.46
3	158561563	17.538	287.71782683	47.32925236	25.89
4	158561565	15.490	287.71895788	47.33078377	26.06
5	1717102143	20.233	287.71978687	47.33198829	27.04
6	1717102114	18.540	287.71229524	47.32504945	30.03
7	1717102145	20.592	287.72032892	47.32906562	31.54
8	1717102142	18.003	287.71233982	47.34241614	34.80
9	1717102141	19.940	287.72206320	47.32608945	40.90
10	1717102147	19.759	287.72739188	47.33565477	46.29
11	1717102161	19.476	287.69880334	47.34426280	47.18
12	1717102146	19.345	287.72843348	47.33631728	49.29
13	1717102126	18.157	287.68782176	47.33419408	51.38
14	158561561	15.427	287.72750246	47.32600222	52.18
15	1717102134	18.064	287.72750261	47.32413408	55.76
16	158561562	14.884	287.68673617	47.32728375	57.73
17	158561558	13.974	287.68976267	47.32191973	61.37
18	158561567	14.748	287.73425957	47.33370558	62.13
19	1717102138	18.670	287.73062111	47.32381026	62.75
20	158561564	16.588	287.68262264	47.33034222	64.64
21	1717102148	19.656	287.72075270	47.34941630	65.73
22	158561572	17.429	287.68253603	47.33909280	67.70
23	1717102127	19.934	287.68097277	47.33278837	67.93
24	1717102149	18.983	287.72032233	47.35058257	69.08
25	158561575	16.862	287.68168461	47.33977160	70.48
26	158561548	17.083	287.70510270	47.31265762	73.97
27	1717102139	20.534	287.73942808	47.33358639	74.72
28	1717102132	19.211	287.73656870	47.32382728	75.42
29	158561571	17.495	287.73856104	47.33878918	75.46
30	158489994	18.930	287.67802422	47.32909347	76.46
31	158561589	16.833	287.70929527	47.35429597	76.49
32	1717102164	18.048	287.70843676	47.35465089	77.77
33	158561556	16.981	287.68318450	47.32002714	78.16
34	158561547	16.220	287.71819520	47.31200629	79.14
35	1717102137	20.150	287.73111117	47.31666678	80.24
36	1717102110	20.596	287.72879708	47.31474394	81.98
37	1717102166	20.653	287.71176083	47.35645454	84.56
38	158561588	17.268	287.69257165	47.35395081	85.04

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
39	1717102140	18.575	287.74406329	47.33292305	86.00
40	1717102152	19.619	287.73642315	47.34808916	86.42
41	1717102162	18.748	287.69167471	47.35427583	87.11
42	1717102113	20.076	287.70411764	47.30897095	87.44
43	1717102112	20.070	287.71180793	47.30865238	88.13
44	1717102163	20.597	287.70468189	47.35778617	89.62
45	1717102130	18.697	287.67564166	47.34382729	89.75
46	158561577	17.498	287.67400614	47.34172352	90.48
47	1717102165	19.499	287.70654866	47.35818640	90.66
48	1717102154	18.141	287.74449696	47.34221130	93.10
49	1717102129	18.818	287.67050199	47.33201869	93.55
50	1717102167	19.077	287.68116709	47.35157753	94.86
51	1717102136	20.086	287.74118867	47.31803043	95.72
52	1717102158	19.924	287.72220274	47.35824393	96.40
53	1717102168	19.676	287.67826179	47.35017513	96.73
54	158561585	15.470	287.74393465	47.34697066	99.27
55	158561573	9.721	287.74857617	47.33936033	99.64
56	158561587	18.397	287.67993071	47.35269050	99.83
57	1717102118	19.013	287.68556030	47.31019776	99.93
58	158561597	16.458	287.70491515	47.36105377	101.26
59	1717102120	19.286	287.67583690	47.31584946	101.53
60	1717102111	18.639	287.70183695	47.30523512	101.57
61	158561543	17.709	287.73224954	47.30970569	101.65
62	158561592	13.913	287.68676564	47.35726944	102.45
63	158561581	15.703	287.66880012	47.34371077	104.90
64	1717102133	18.992	287.74524381	47.31751343	105.02
65	1717102125	19.746	287.66771919	47.32413611	105.28
66	1717102119	19.467	287.67777960	47.31236597	106.20
67	1717102157	20.562	287.72345589	47.36150103	108.47
68	158561568	17.855	287.66427334	47.33637735	109.33
69	158561536	16.547	287.72377518	47.30436751	109.52
70	1717102104	19.906	287.69604352	47.30385184	109.63
71	158561602	16.615	287.72229715	47.36224527	110.13
72	1717102150	18.658	287.75182124	47.34340022	111.35
73	1717102135	19.919	287.74528858	47.31397763	112.40
74	1717102153	20.674	287.75355306	47.34052279	112.42
75	1717102170	18.993	287.68901206	47.36166217	113.77
76	158561538	17.546	287.73451175	47.30644733	114.47

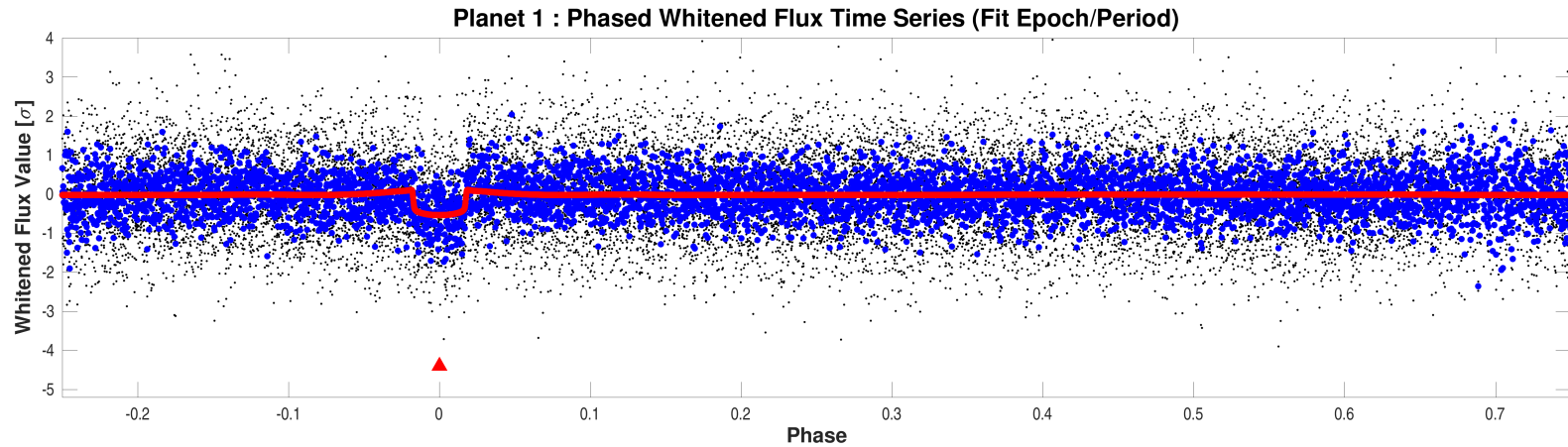
RA, Dec and Distances are corrected for proper motion. This table may not contain all of the objects shown.

6 Phased Light Curves



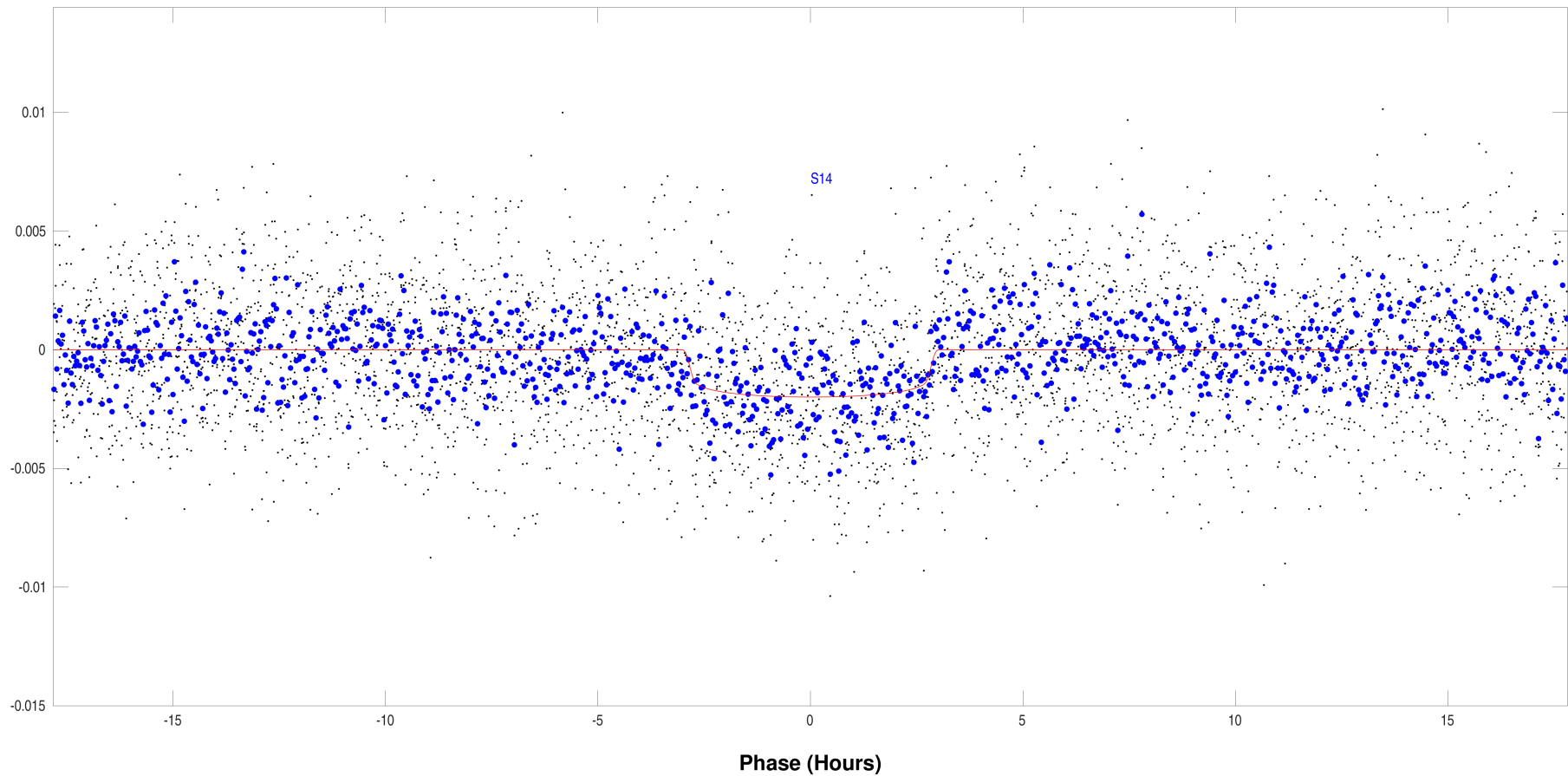
Phased unwhitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased unwhitened flux time series 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/0000000158561566-01-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/0000000158561566-01-phased-whitened-flux-time-series.fig`

Planet: 1 Phased Unwhitened Flux Time Series by Sector

Phased unwhitened flux time series by sector for target 158561566, planet candidate 1. Period = 6.789 days; transit epoch = 1685.2878 BTJD.
Open `./summary-plots/0000000158561566-01-phased-unwhitened-flux-time-series-by-sector.fig`

7 Planet Candidate 1

7.1 Model Fitter: All Transits

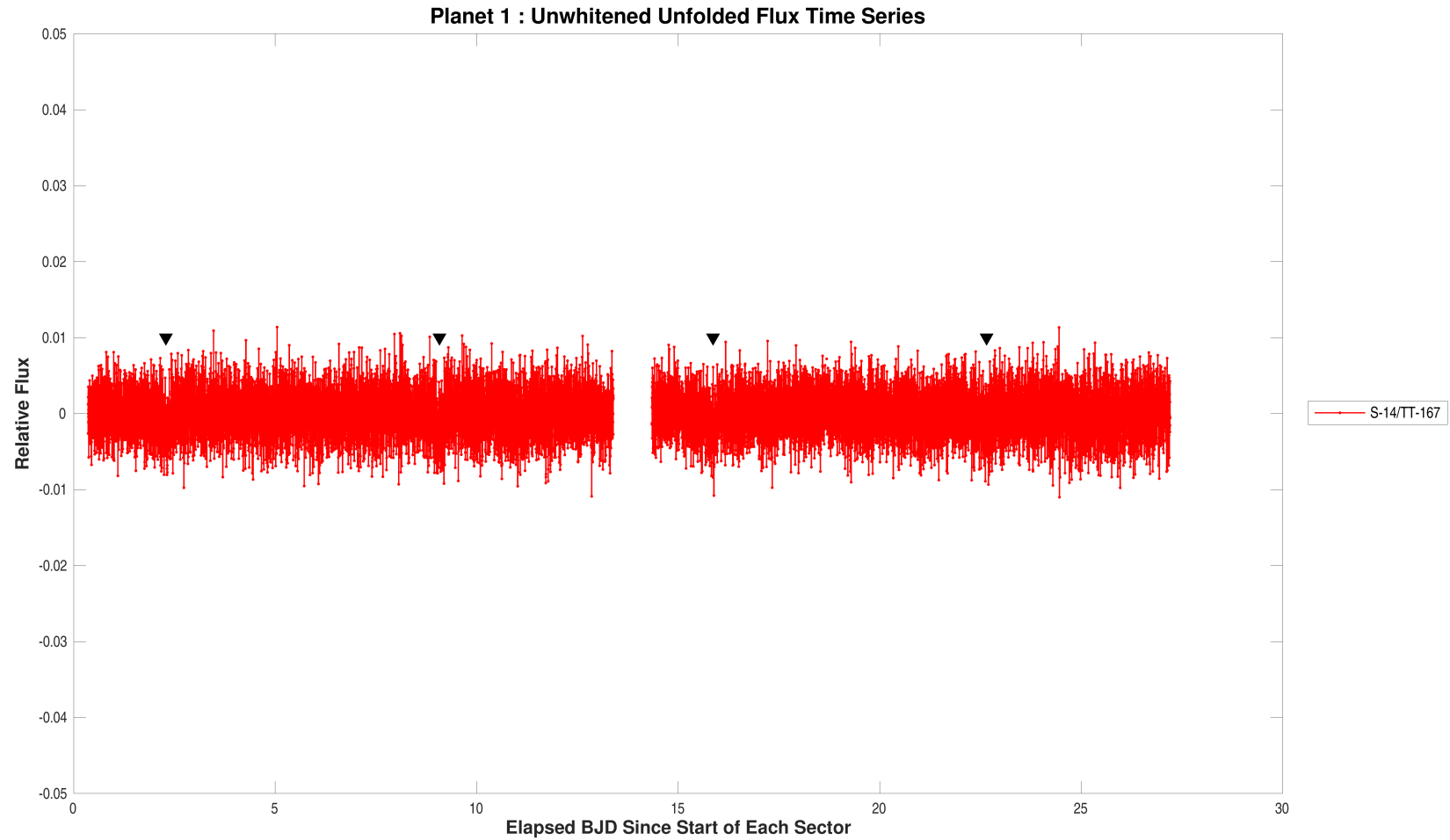
Model Characteristic	Name
Transit Model	mandel-agol_geometric_transit_model
Limb Darkening Model	claret_tess_nonlinear_limb_darkening_model

TCE Parameter	Value	Units
Trial Transit Pulse Duration	6.0	hours
Transit Epoch	1685.2837854	TJD
Orbital Period	6.7902751	days
Maximum SES	6.7	
Maximum MES	10.9	
Robust Statistic	12.4	
Chi Square Goodness of Fit Statistic (DoF)	723.6 (717)	
Chi Square2 Statistic (DoF)	2.0 (16.5)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

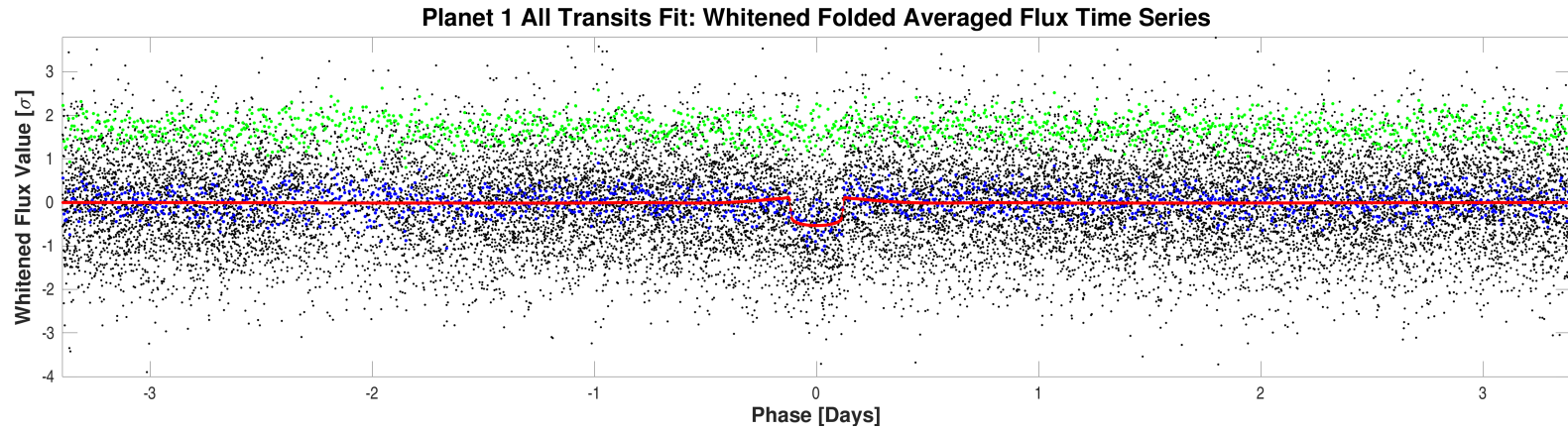
Parameter	Value	Uncertainty	Units
SNR	12.4		
Orbital Period	6.7890224	2.5884e-03	days
Transit Epoch	1685.2877627	4.8695e-03	BTJD
Impact Parameter	0.0100	9.0625e+01	
Planet Radius to Star Radius Ratio	0.0416974	6.1211e-03	
Semi-major Axis to Star Radius Ratio	9.1148	8.1408e+00	
Planet Radius	9.1073	1.4175e+00	Earth radii
Semi-major Axis	0.1115	3.8431e-03	AU
Effective Stellar Flux	477.6299	1.8092e+01	Goldilocks
Equilibrium Temperature	1192	1.1291e+01	Kelvin
Stellar Density	0.2207	5.9143e-01	Solar density
Transit Depth	1993	1.6045e+02	ppm
Transit Duration	5.9401	4.6627e-01	hours
Transit Ingress Duration	0.2387	4.6629e-01	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	2790.2 (3304.4)		
Model Chi Square Goodness of Fit Statistic (DoF)	434.2 (723)		
Model Chi Square2 Statistic (DoF)	1.7 (3)		

DoF: Degrees of Freedom



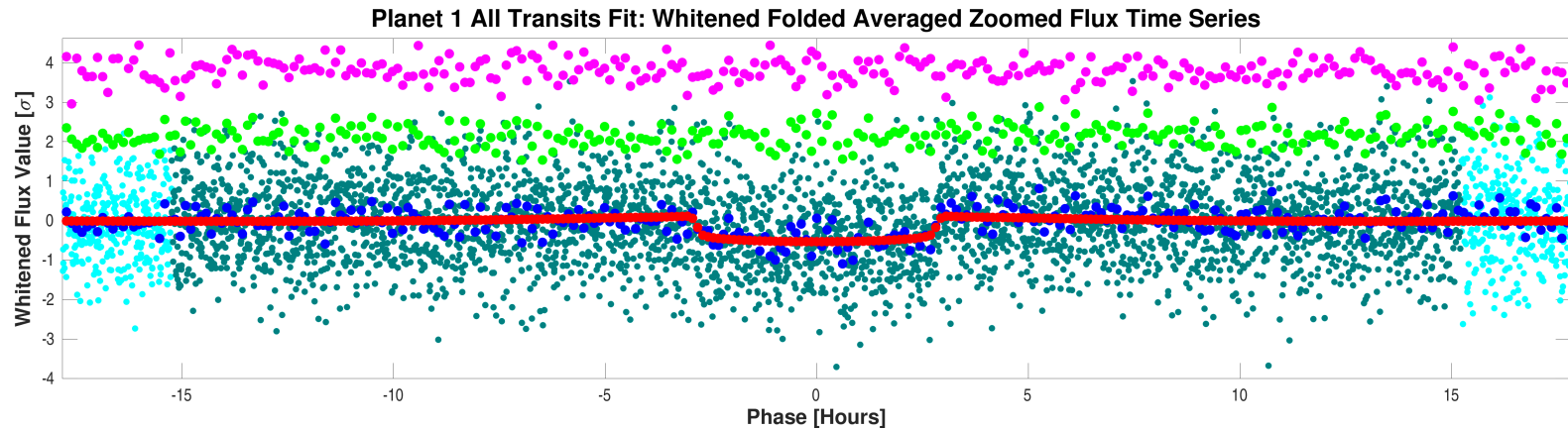
Flux time series for CatId 158561566, Planet candidate 1 in the unwhitened domain. For the data of Sector-14/TargetTableId-167, start BJD is 2458683. Transit event markers indicate the location of transits of the given planet candidate. All transits fit completed with full convergence.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000158561566-01-all-unwhitened-14-167.fig`



Folded flux time series for CatId 158561566, 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/0000000158561566-01-all-whitened.fig`



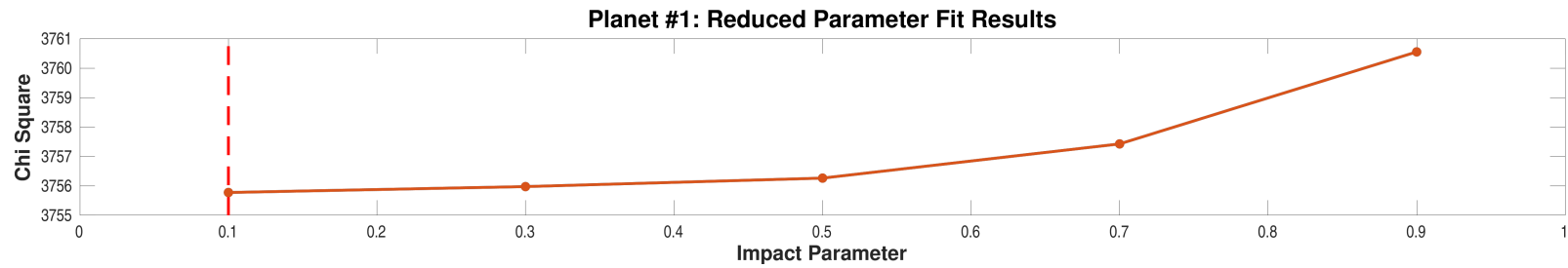
Folded flux time series for CatId 158561566, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000158561566-01-all-whitened-zoomed.fig`

7.2 Model Fitter: Reduced Parameter Fit Results

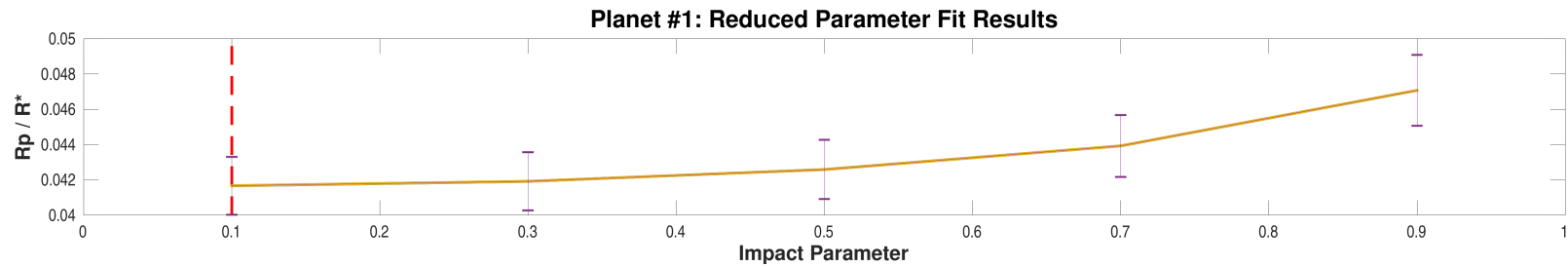
Impact Parameter	SNR	Model Chi Square	Planet Radius to Star Radius	Uncert	Semi-major Axis to Star Radius	Uncert	Transit Depth (ppm)	Uncert	Transit Duration (hours)	Uncert
0.10	12.9	3755.8	0.0416684	1.6421e-03	9.0825	2.1954e-01	1988	1.5586e+02	5.9344	1.4352e-01
0.30	12.9	3756.0	0.0419188	1.6528e-03	8.7059	2.1574e-01	1986	1.5580e+02	5.9608	1.4803e-01
0.50	12.9	3756.3	0.0425900	1.6808e-03	7.9985	2.0833e-01	1990	1.5627e+02	5.9560	1.5610e-01
0.70	12.9	3757.4	0.0439277	1.7507e-03	6.7038	2.0004e-01	1996	1.5827e+02	6.0372	1.8346e-01
0.90	12.7	3760.6	0.0470739	2.0017e-03	3.9239	1.9811e-01	1978	1.6722e+02	7.2906	4.0101e-01

Highlighted row is the best reduced-parameter model fit.



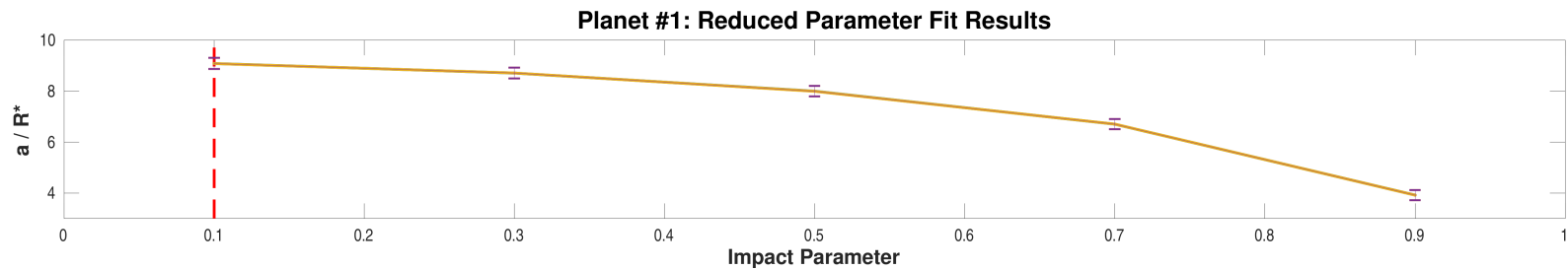
Model chi squares of reduced parameter fits vs. impact parameter for CatId 158561566, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.

Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000158561566-01-reduced-fits-chi-square.fig`



Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 158561566, 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/0000000158561566-01-reduced-fits-rp-over-rstar.fig`



Ratios of semimajor axis to star radius of reduced parameter fits vs. impact parameter for CatId 158561566, 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/0000000158561566-01-reduced-fits-a-over-rstar.fig`

7.3 Model Fitter: Trapezoidal Fit Results

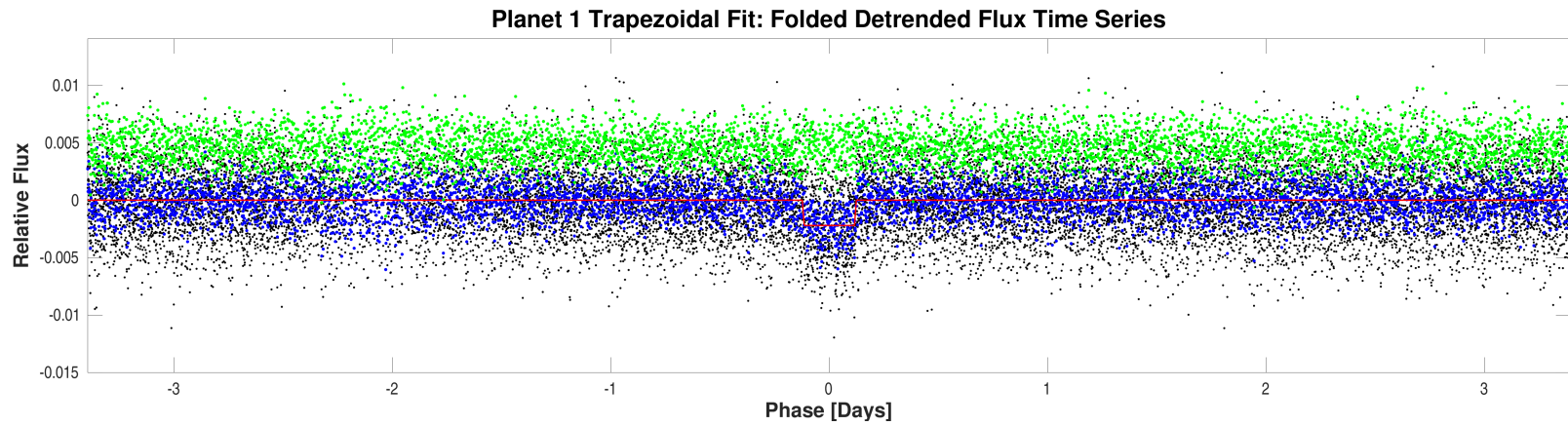
Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

TCE Parameter	Value	Units
Trial Transit Pulse Duration	6.0	hours
Transit Epoch	1685.2837854	TJD
Orbital Period	6.7902751	days
Maximum SES	6.7	
Maximum MES	10.9	
Robust Statistic	12.4	
Chi Square Goodness of Fit Statistic (DoF)	723.6 (717)	
Chi Square2 Statistic (DoF)	2.0 (16.5)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

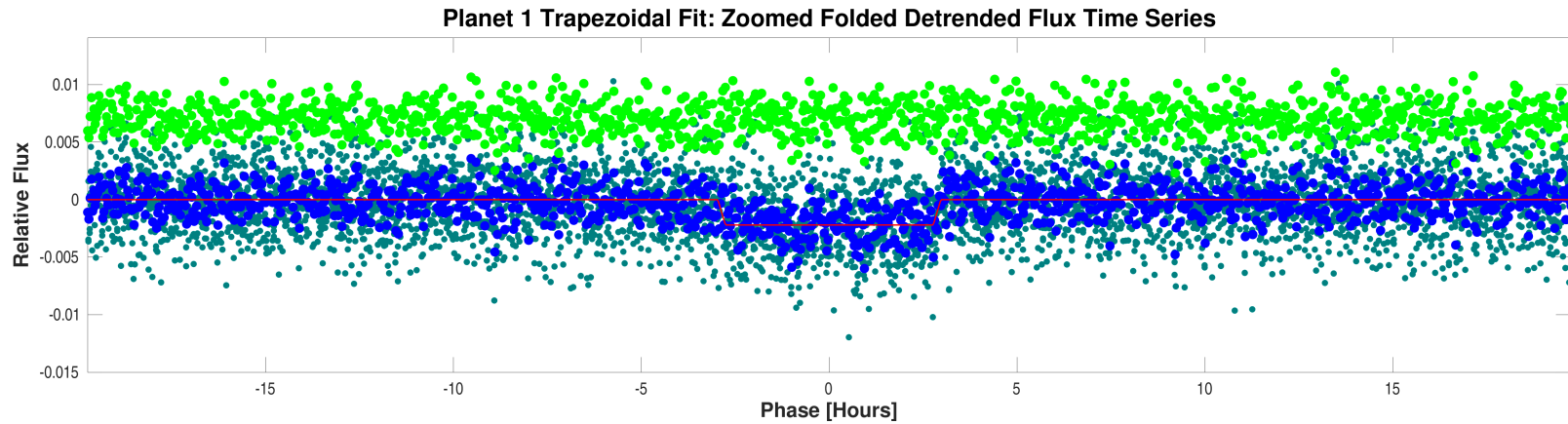
Parameter	Value	Uncertainty	Units
SNR	19.1		
Orbital Period	6.7902751		days
Transit Epoch	1685.2829797		BTJD
Transit Depth	2203		ppm
Transit Duration	6.5786		hours
Transit Ingress Duration	0.8469		hours
Model Chi Square Statistic (DoF)	18867.1 (5704)		

DoF: Degrees of Freedom



Folded detrended flux time series for CatId 158561566, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000158561566-01-all-trapezoidal.fig`



Zoomed folded detrended flux time series for CatId 158561566, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000158561566-01-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	6.7903		days		
Transit Duration	6		hours		
Maximum MES	10.9				
Secondary Phase	-0.65694		days		
Secondary MES	2.1				
Minimum Phase	2.8083		days		
Minimum MES	-2.6				
Median MES	-0.2				
MAD MES	0.55137				
Robust Statistic	1.6				
Secondary Depth	383.4	2.2257e+02	ppm		
Geometric Albedo	31.6	2.0584e+01		1.4865	6.86
Planet Effective Temperature	4371	7.1101e+02	Kelvin	4.4696	0.00

7.4.2 Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	2.0007e-01	0.4473	65.47

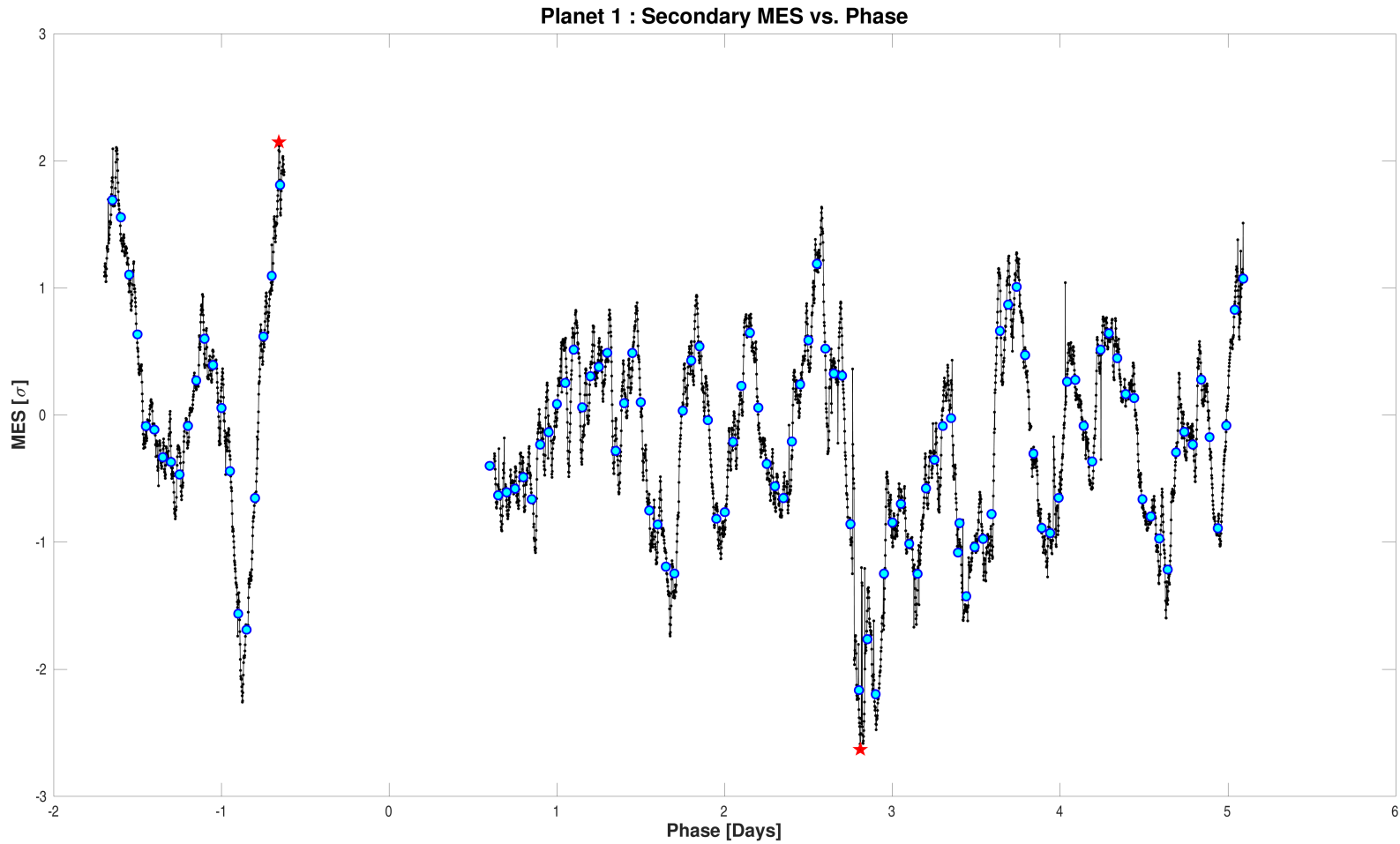
7.4.3 Bootstrap Test

Result	Value
False Alarm Probability	4.9553e-39
Bootstrap Threshold for Desired PFA	6.2
MES Mean	1.09
MES Standard Deviation	0.76
Transit Count	4

7.4.4 Ghost Diagnostic Test

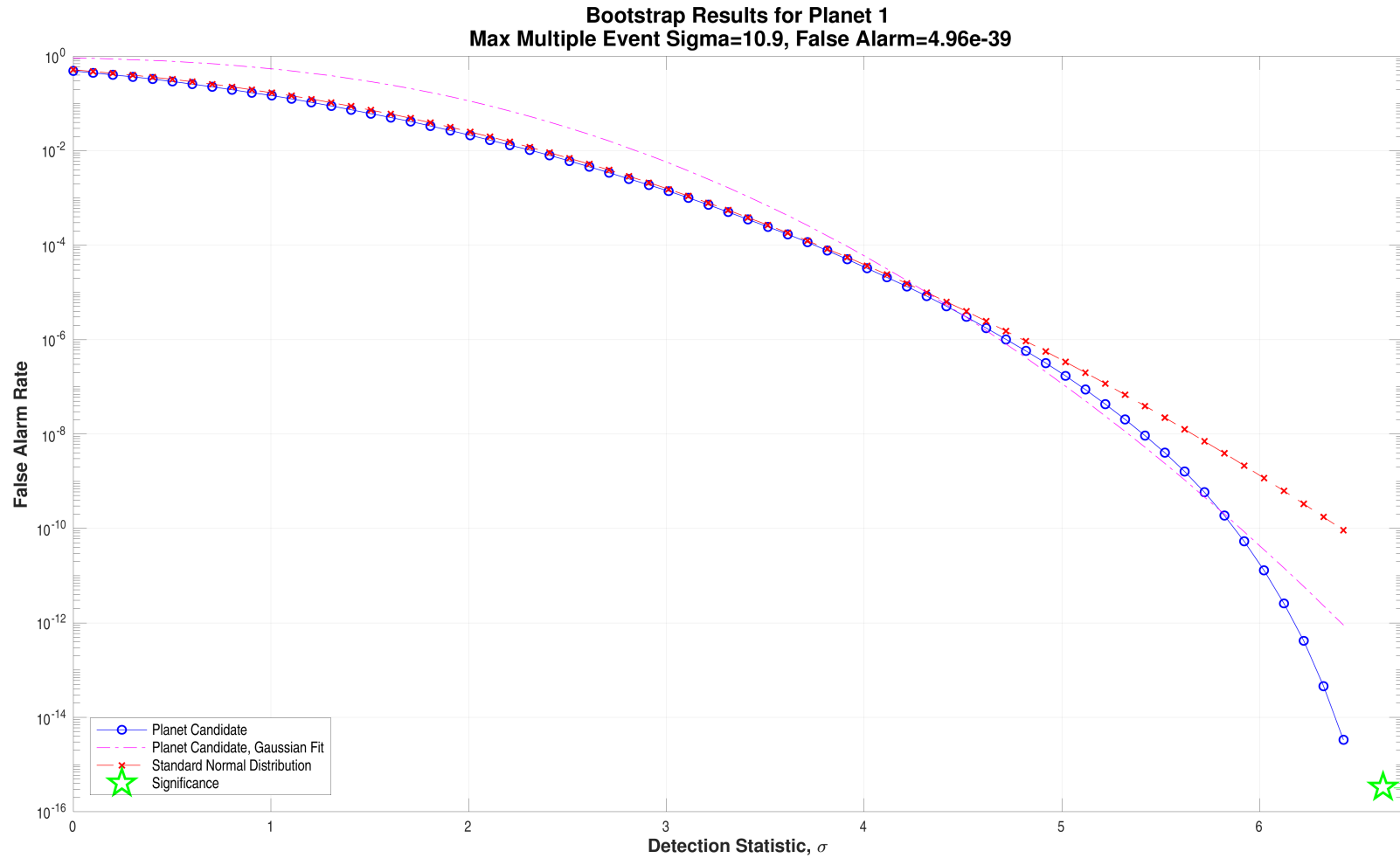
Result	Value	Significance (%)
Maximum MES	10.9	
SNR	12.4	
Core Aperture Statistic	1.2184e+01	100.00
Halo Aperture Statistic	-7.5587e-01	22.49
Ratio of Core/Halo Aperture Statistics	-1.6119e+01	

7.4.5 Validation Test Figures



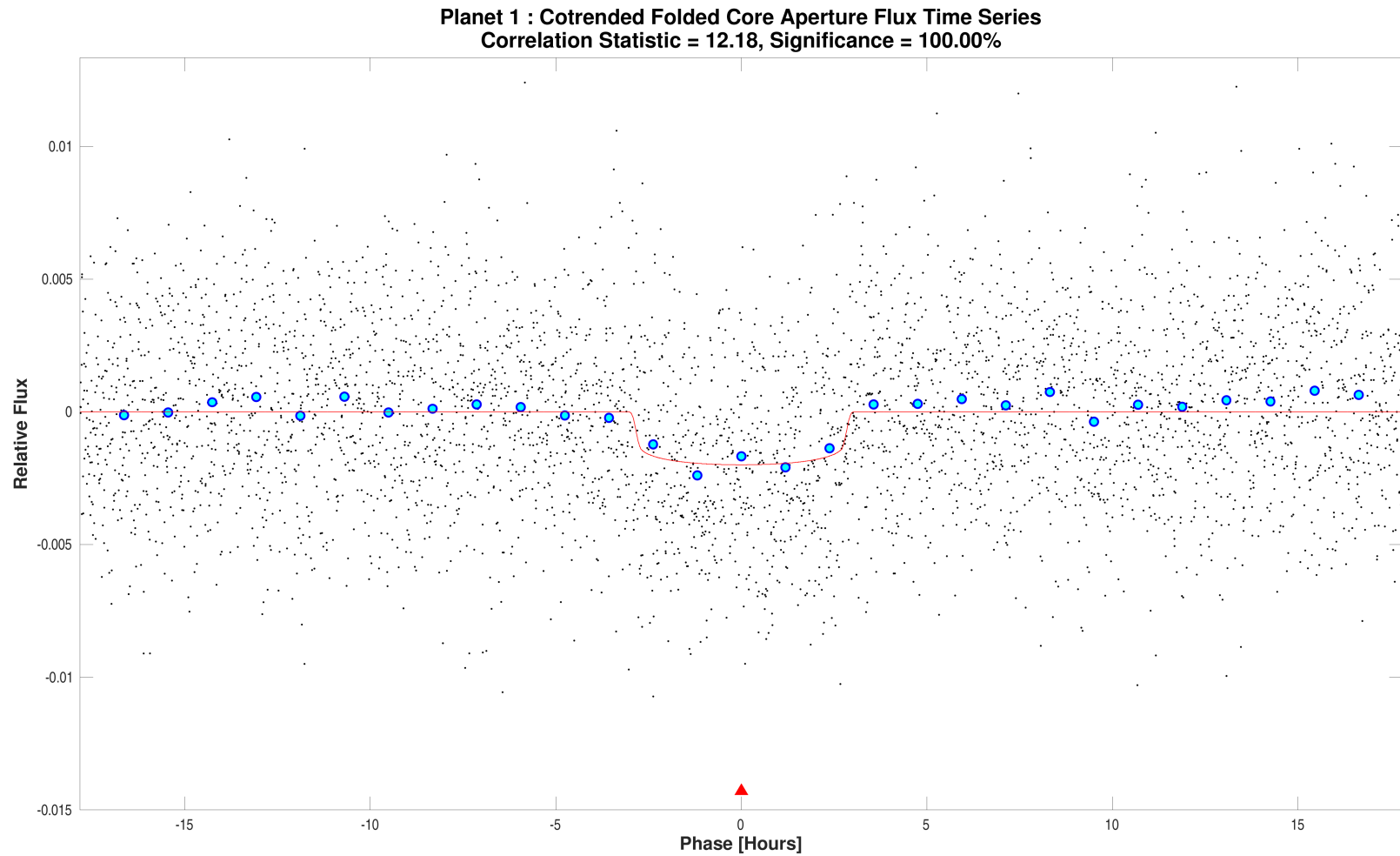
The primary event has been set to zero and both the max and min of the resulting MES vs. Phase are marked with a red star. The best matched pulse duration in hours is 6. The maximum secondary MES and corresponding phase are 2.1499 and -0.65694 days respectively. The minimum secondary MES and corresponding phase are -2.6307 and 2.8083 days respectively.

Open `./planet-01/report-summary/0000000158561566-01-weak-secondary-diagnostic.fig`



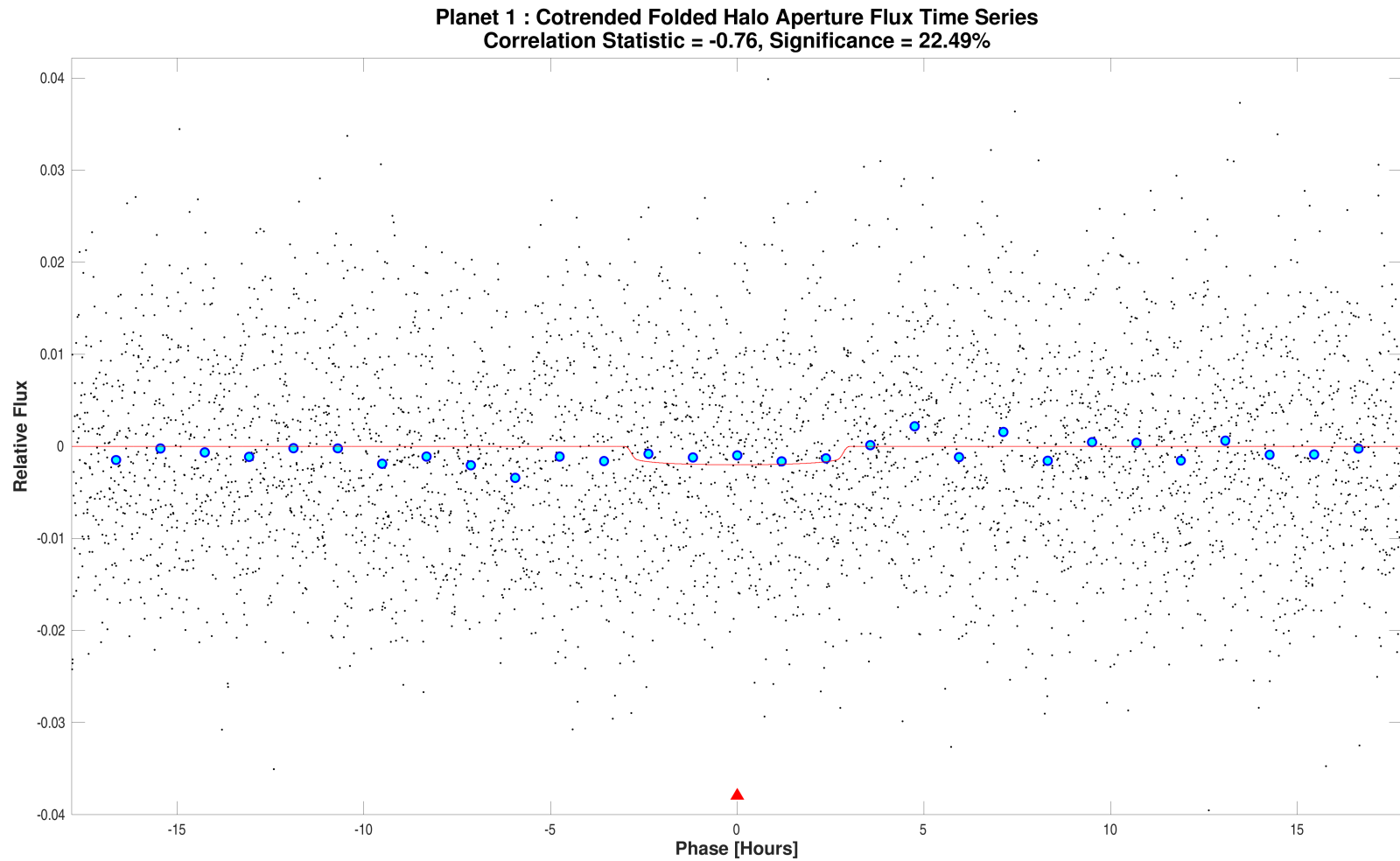
Bootstrap results for target 158561566, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is 13.0161. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 6.2144.

Open `./planet-01/bootstrap-results/0000000158561566-01-bootstrap-false-alarm.fig`



Optical ghost diagnostic core aperture flux time series for target 158561566, 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/0000000158561566-01-core-unwhitened-cotrended-zoomed-model.fig`

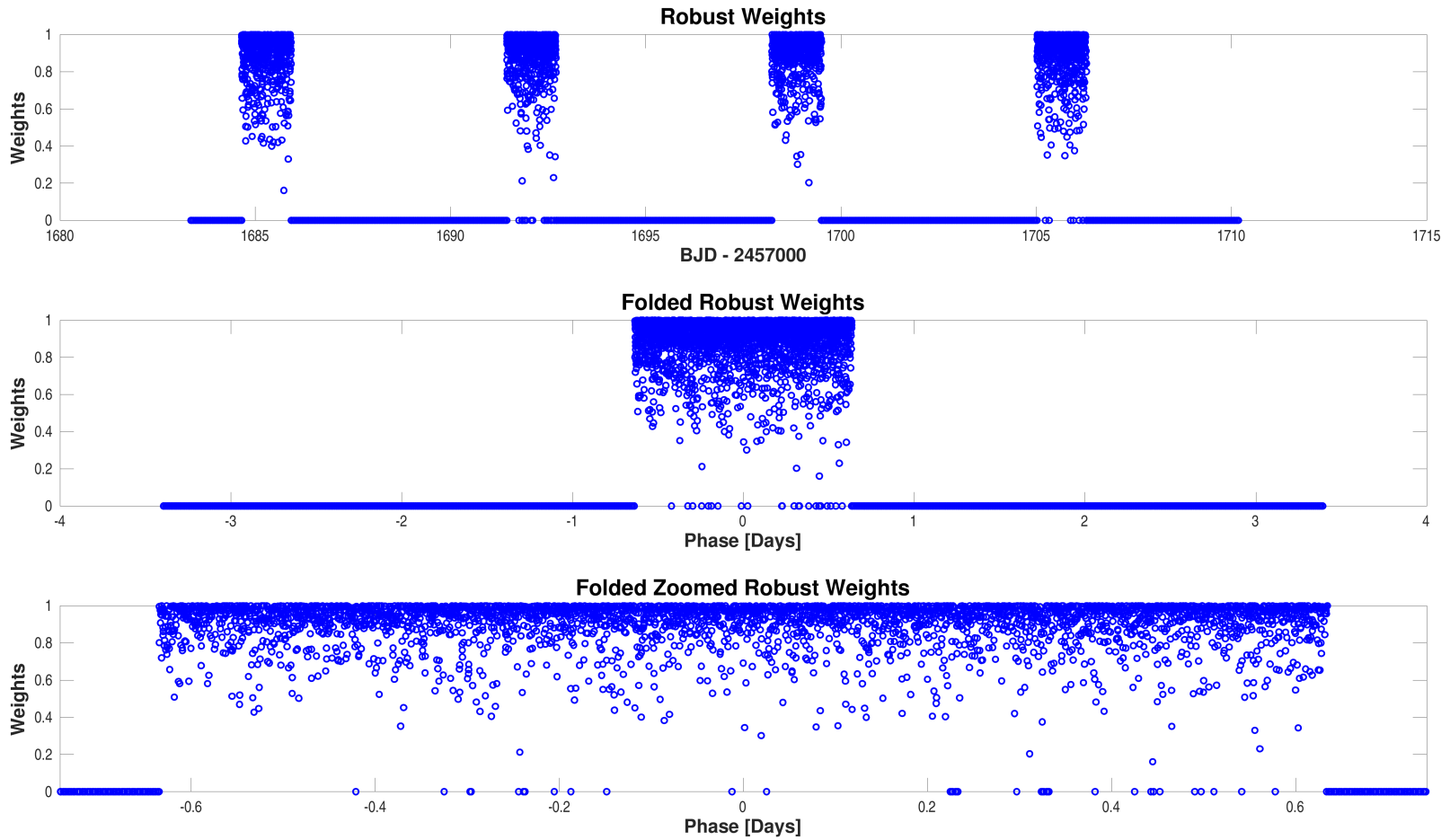


Optical ghost diagnostic halo aperture flux time series for target 158561566, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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/000000158561566-01-halo-unwhitened-cotrended-zoomed-model.fig`

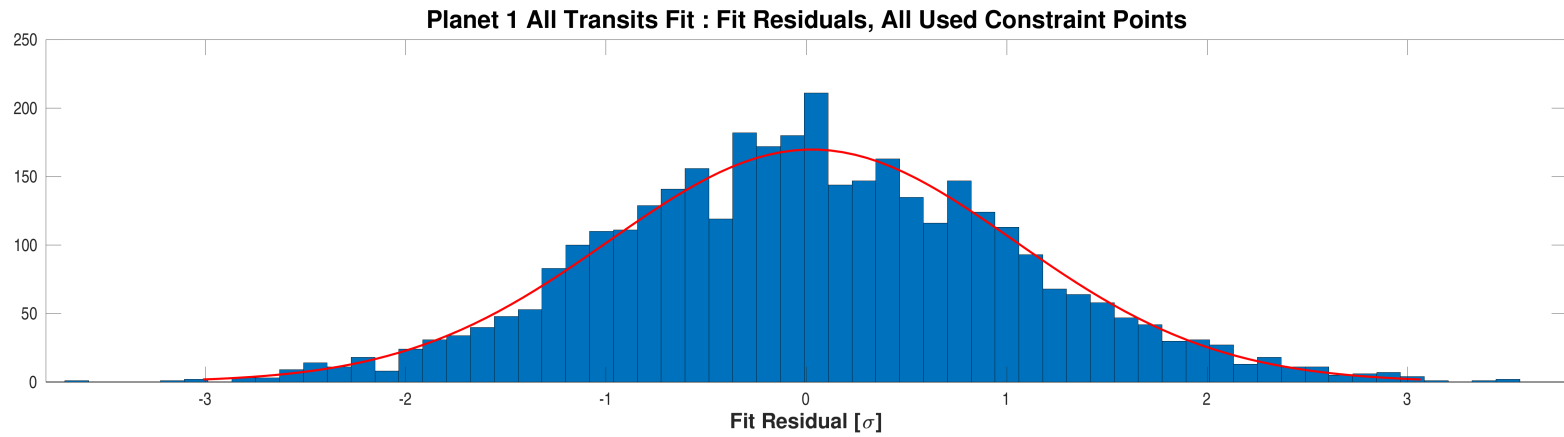
Appendix A Planet Candidate 1

A.1 Model Fitter: All Transits



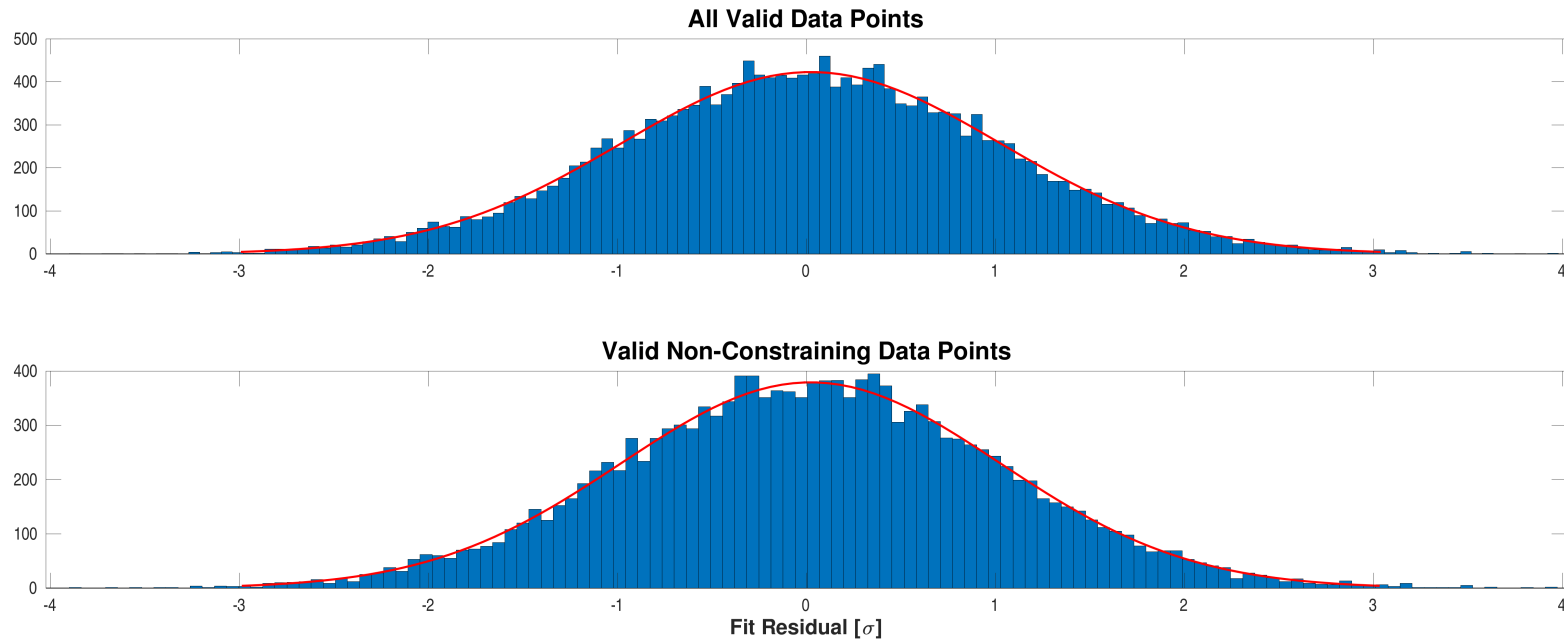
Robust weights distribution for CatId 158561566, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000158561566-01-all-robust-weights.fig`



Fit residuals distribution for CatId 158561566, 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/0000000158561566-01-all-histo-used.fig`



Fit residuals distribution for CatId 158561566, 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.

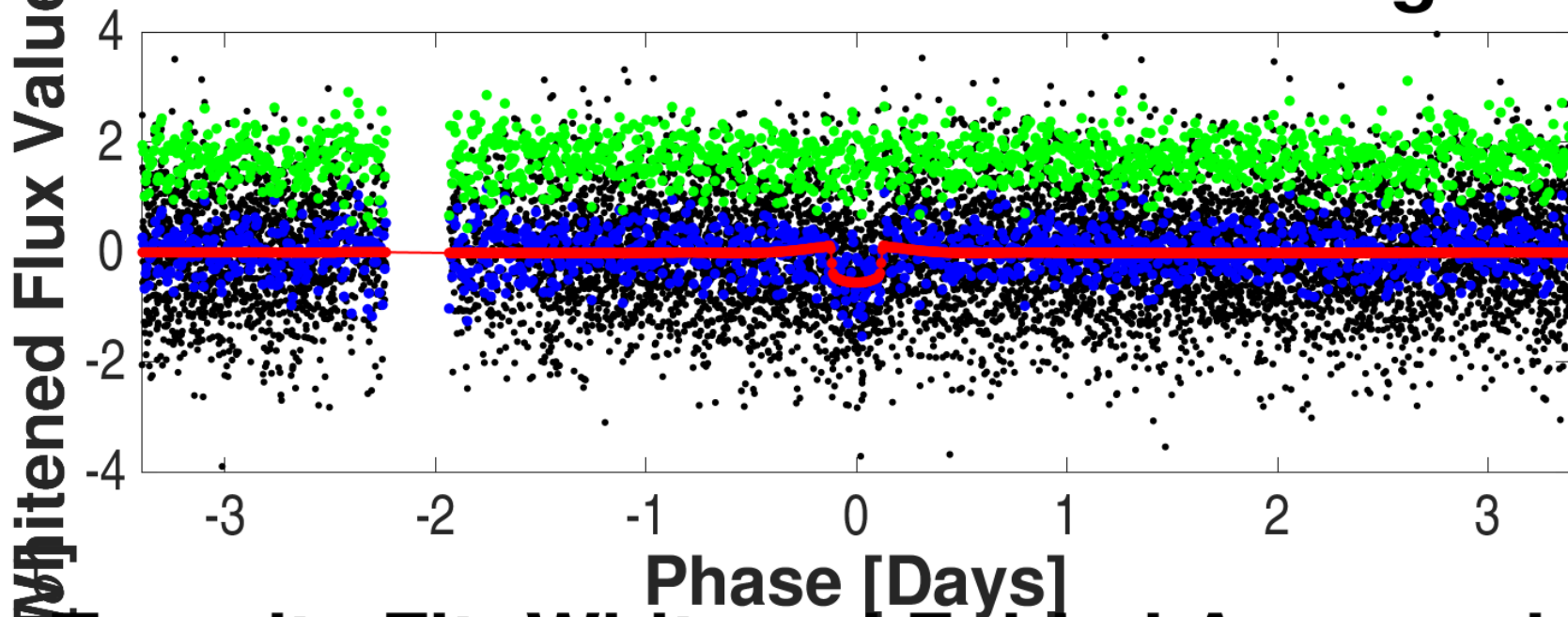
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000158561566-01-all-histo-all-and-unused.fig`

A.2 Model Fitter: Odd & Even Transits

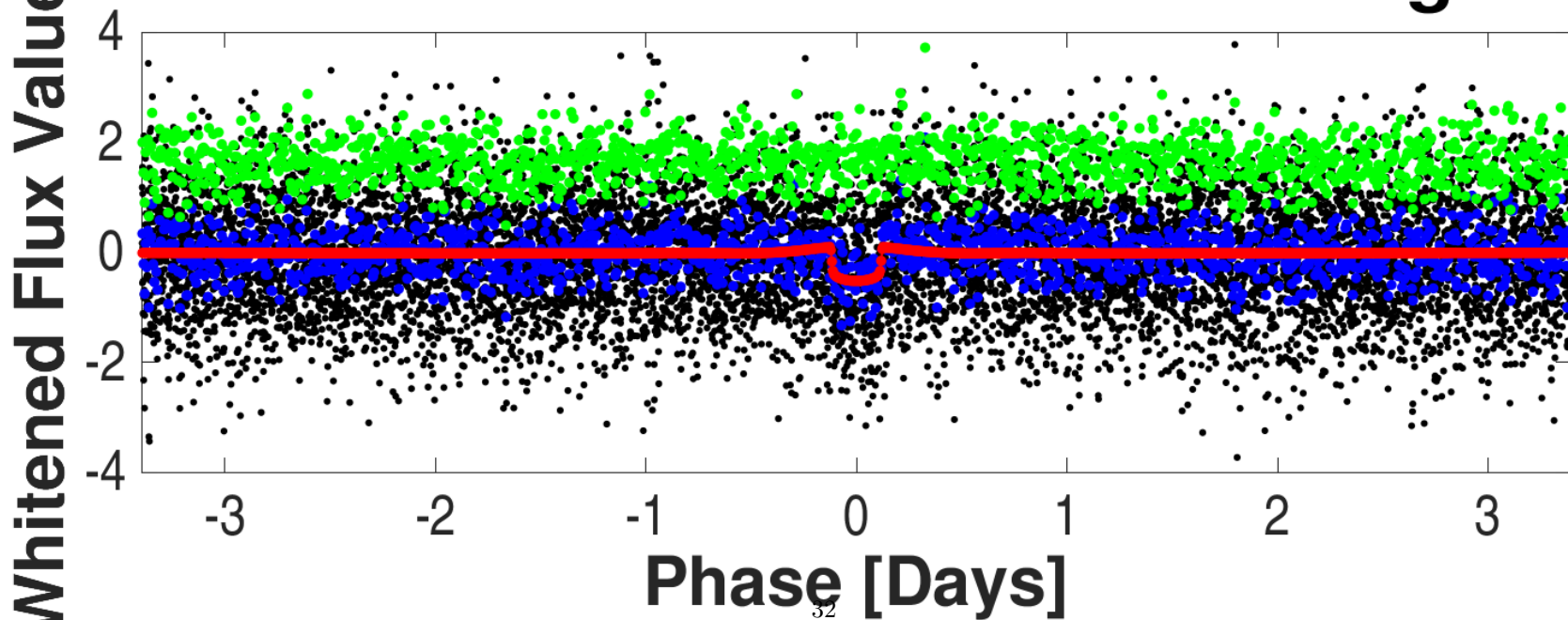
Parameter	Odd Transits Value	Odd Transits Uncertainty	Even Transits Value	Even Transits Uncertainty	Units	$\frac{\text{Difference}}{\ \text{Uncertainty}\ }$
SNR	9.1		8.4			
Orbital Period	6.7880544	3.9130e-03	6.7895343	4.2708e-03	days	2.5550e-01
Transit Epoch	1685.2892995	5.6322e-03	1692.0757221	6.1129e-03	BTJD	3.1277e-01
Impact Parameter	0.0449	2.6019e+01	0.0100	1.4121e+02		2.4326e-04
Planet Radius to Star Radius Ratio	0.0424667	8.0995e-03	0.0409559	9.3222e-03		1.2234e-01
Semi-major Axis to Star Radius Ratio	9.0868	1.0489e+01	9.1581	1.2744e+01		4.3249e-03
Planet Radius	9.2753	1.8329e+00	8.9453	2.0880e+00	Earth radii	1.1877e-01
Semi-major Axis	0.1115	3.8429e-03	0.1115	3.8435e-03	AU	2.9806e-03
Effective Stellar Flux	477.7207	1.8097e+01	477.5819	1.8093e+01	Goldilocks	5.4255e-03
Equilibrium Temperature	1192	1.1292e+01	1192	1.1292e+01	Kelvin	5.4255e-03
Stellar Density	0.2188	7.5756e-01	0.2239	9.3457e-01	Solar density	4.2382e-03
Transit Depth	2067	2.2646e+02	1923	2.2844e+02	ppm	4.4729e-01
Transit Duration	5.9569	6.1833e-01	5.9081	7.0705e-01	hours	5.1933e-02
Transit Ingress Duration	0.2441	6.1628e-01	0.2334	7.1013e-01	hours	1.1395e-02
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)	2802.0 (3303.8)		2802.0 (3303.8)			

DoF: Degrees of Freedom

Odd Transits Fit: Whitenened Folded Averaged Flux

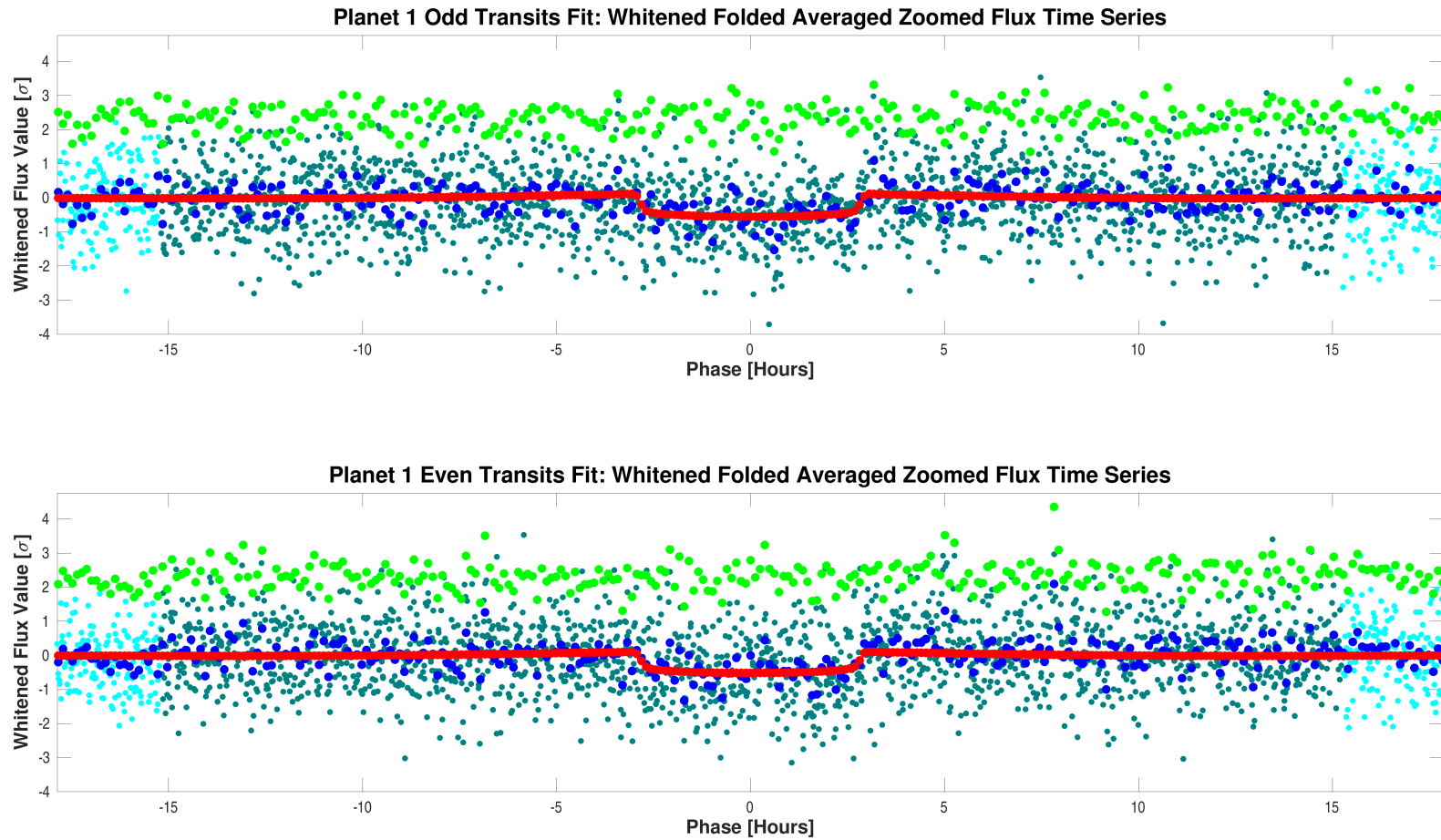


Even Transits Fit: Whitenened Folded Averaged Flux



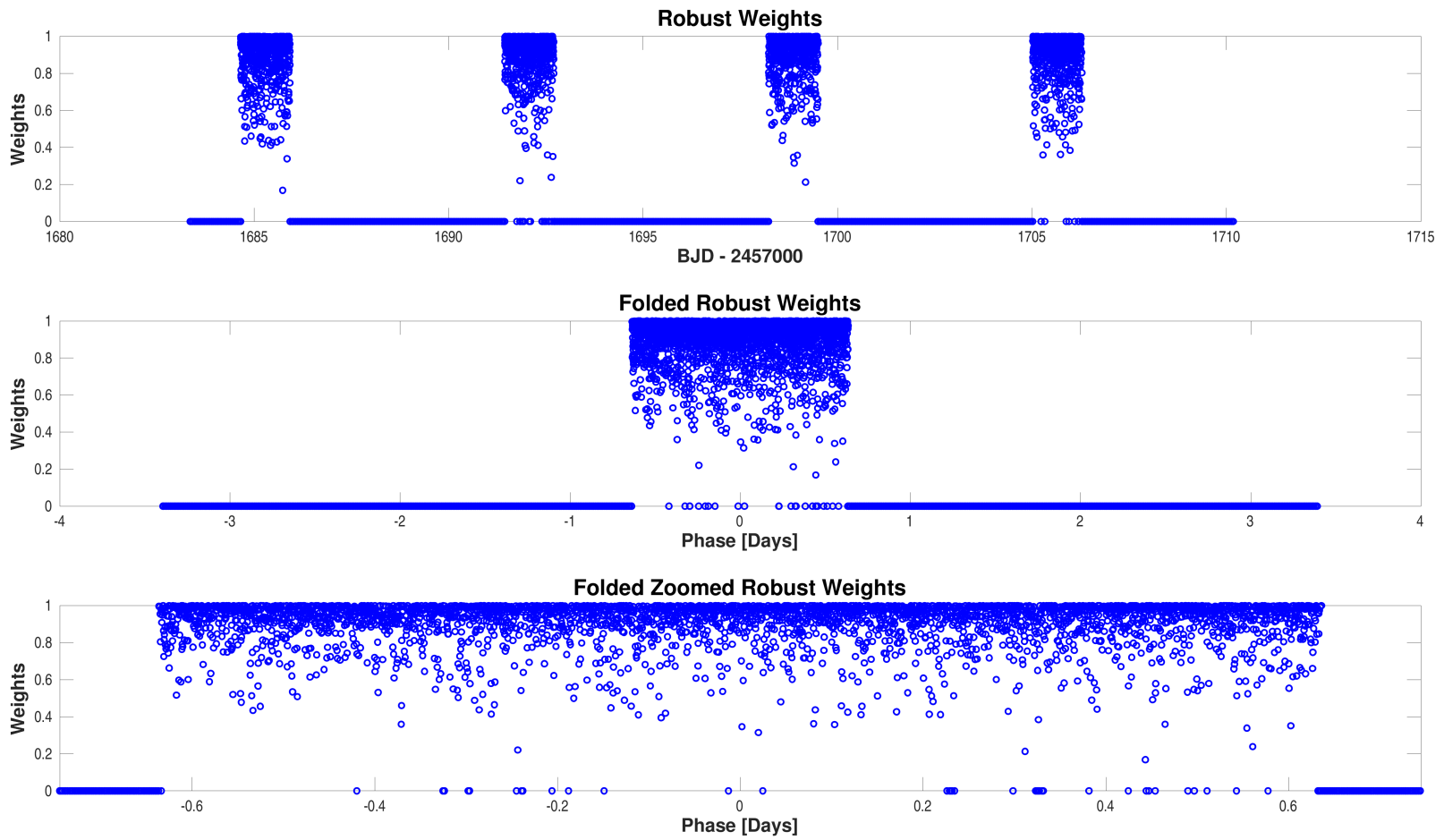
Folded flux time series for CatId 158561566, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light 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/0000000158561566-01-odd-even-whitened.fig`



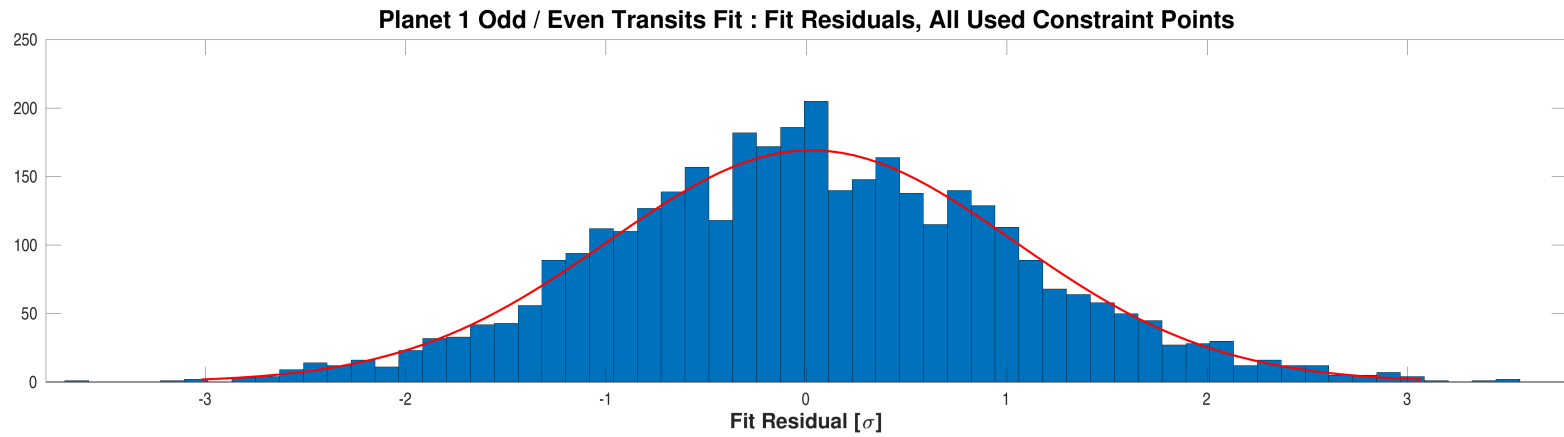
Folded flux time series for CatId 158561566, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000158561566-01-odd-even-whitened-zoomed.fig`



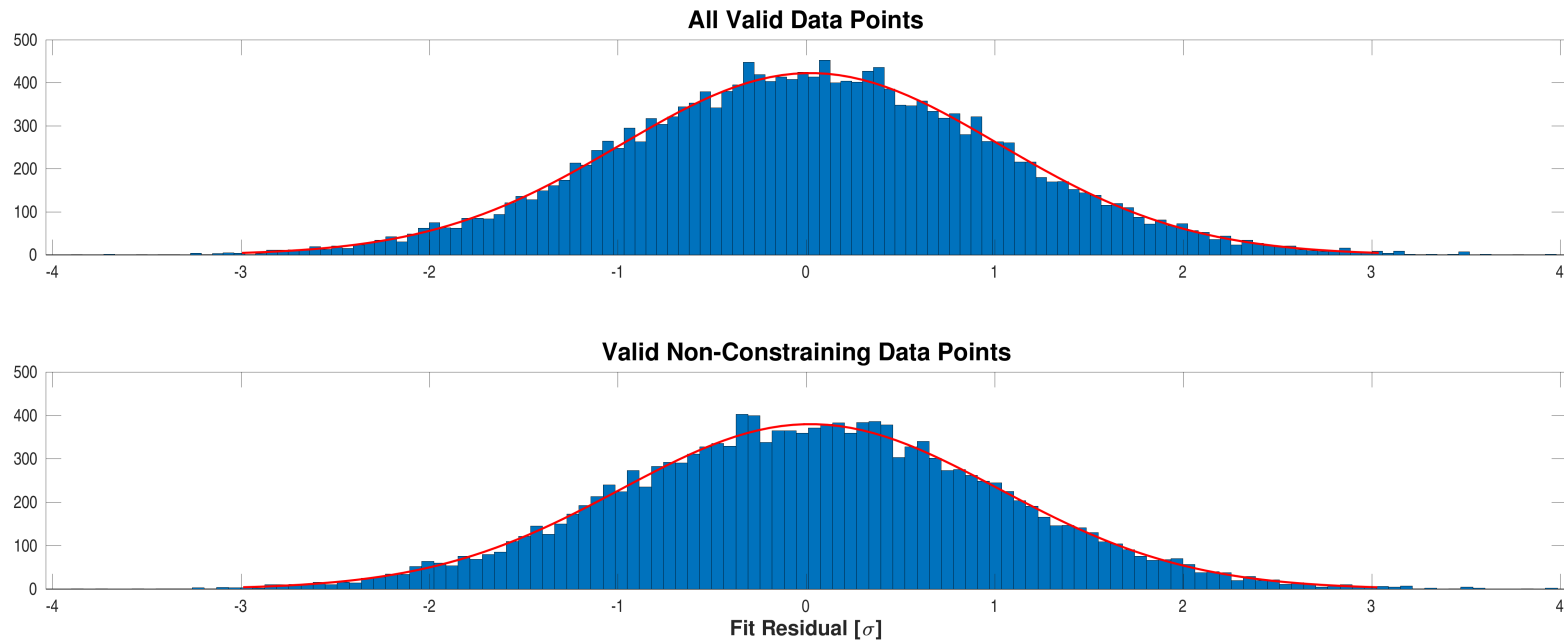
Robust weights distribution for CatId 158561566, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000158561566-01-odd-even-robust-weights.fig`



Fit residuals distribution for CatId 158561566, 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.

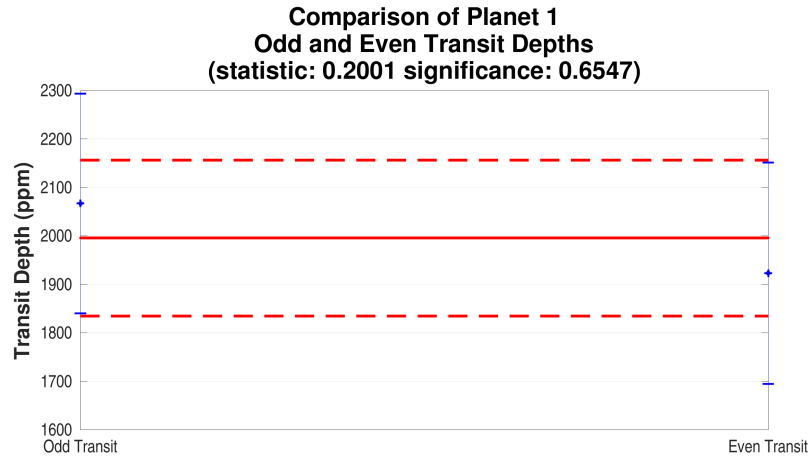
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000158561566-01-odd-even-histo-used.fig`



Fit residuals distribution for CatId 158561566, 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/0000000158561566-01-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 158561566, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary. Open `./planet-01/binary-discrimination-test-results/0000000158561566-01-eclipsing-binary-discrimination-tests.fig`

Appendix B Alerts

This target did not trigger any alerts.