Data Validation (DV) Report
for TESS ID 158561566
Sectors 26 - 26

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

24-Jul-2020 23:26:19 Z

Contents

1   Summary

Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	158561566			
TOI ID	1267			
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	csv-file-toi-catalog-07-16-20-edited.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-5.0.3-20200718			
Date Report Generated	24-Jul-2020 23:26:19 Z			

Sector	Target Table	Camera/ CCD	Crowding Metric	Flux Fraction
26	254	2:4	0.9439	0.8190

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	1267.01	-	0.90	6.793	1.00	2011.203	0.11	10.1	477.3	1192	7.28e-37	false

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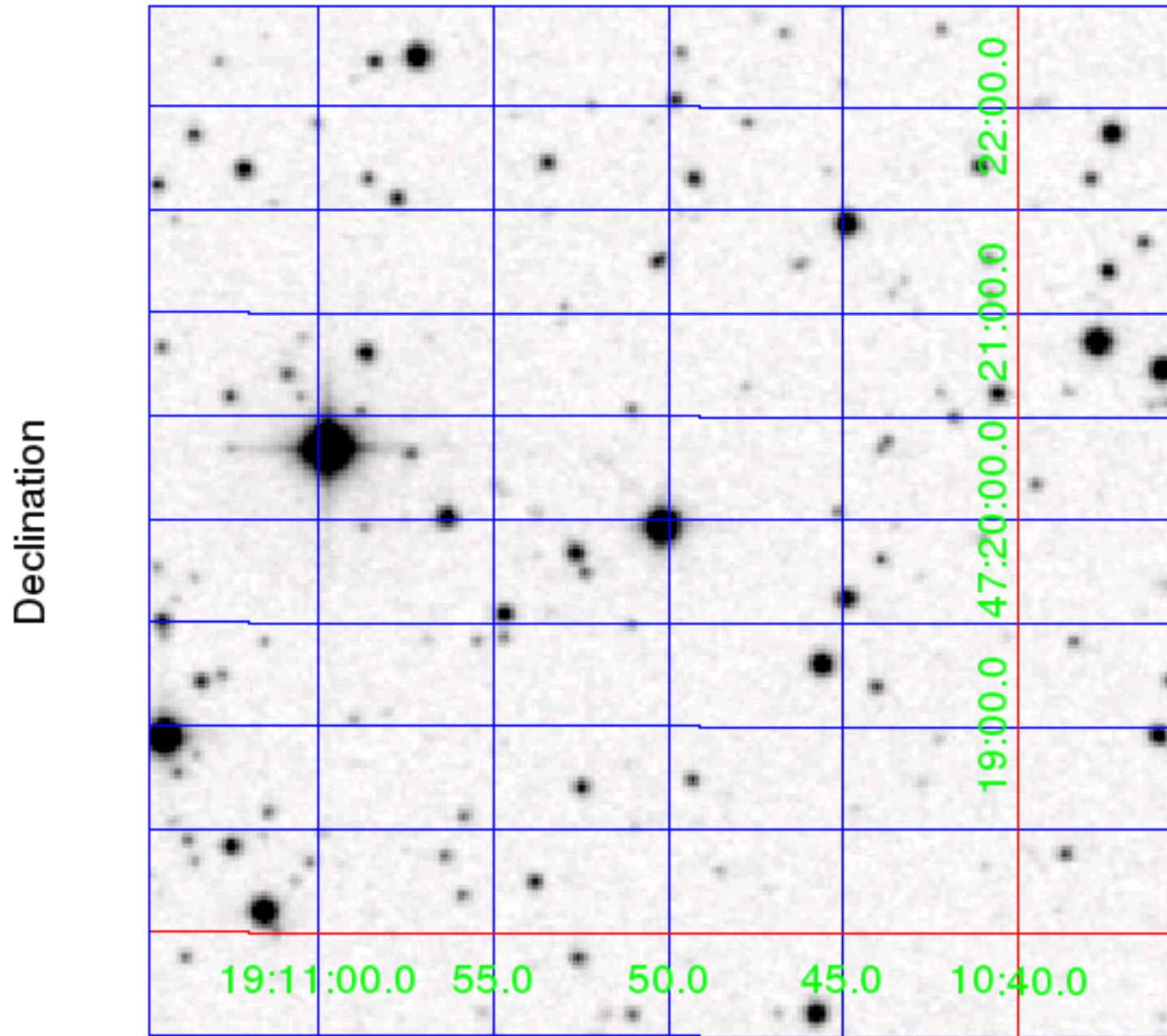
Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (158561566).

3   Flux Time Series
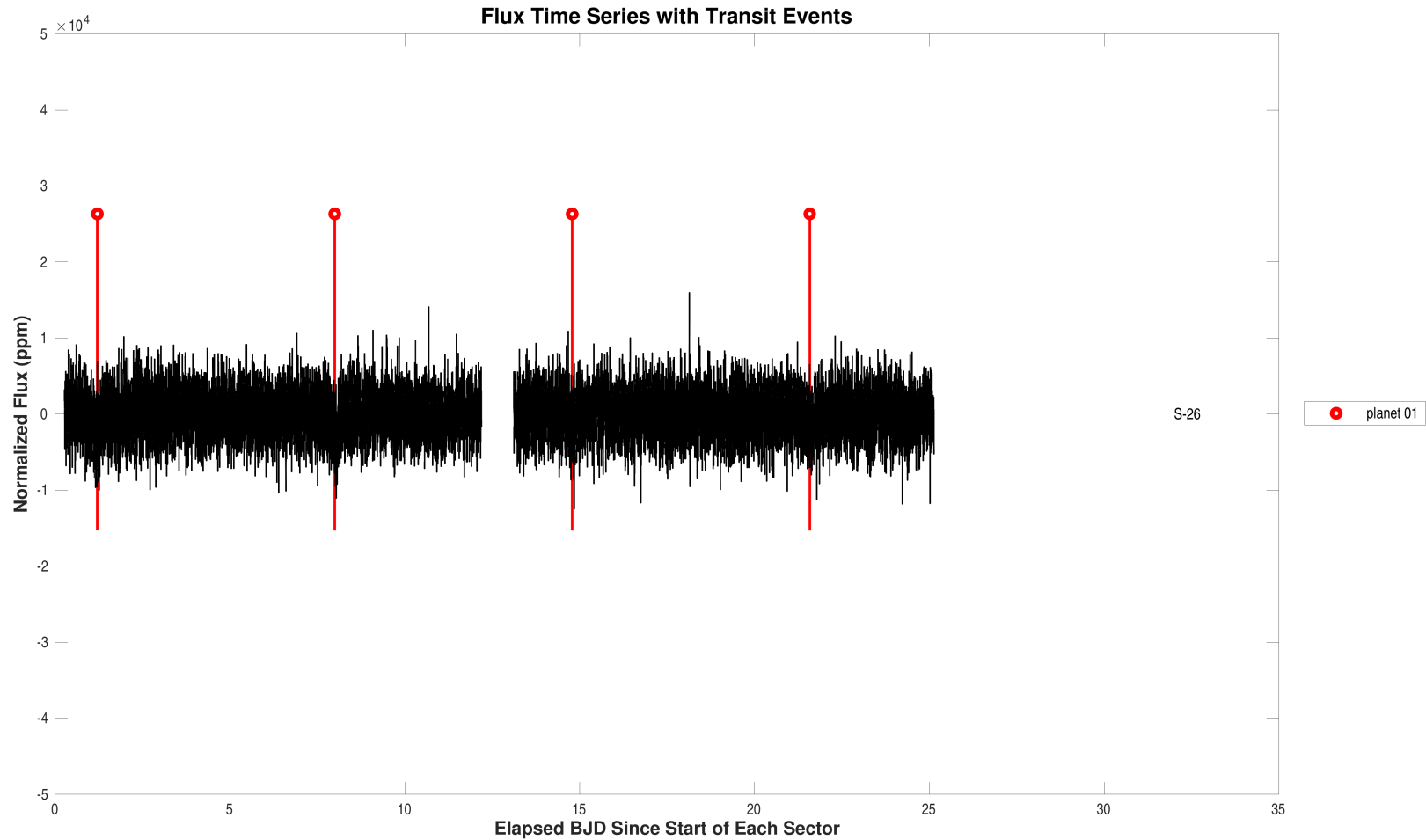
Summary plot of sector-stitched flux time series and transits for target 158561566, marked with DV fitted epoch/period (or TPS epoch/period if fit was not successful). Transits of identified planets are labeled with epoch BTJD and orbital period. For the data of sector 26, target table 254, start BJD is 2459010.
Open `./summary-plots/0000000158561566-00-flux-dv-fit-26-254.fig`
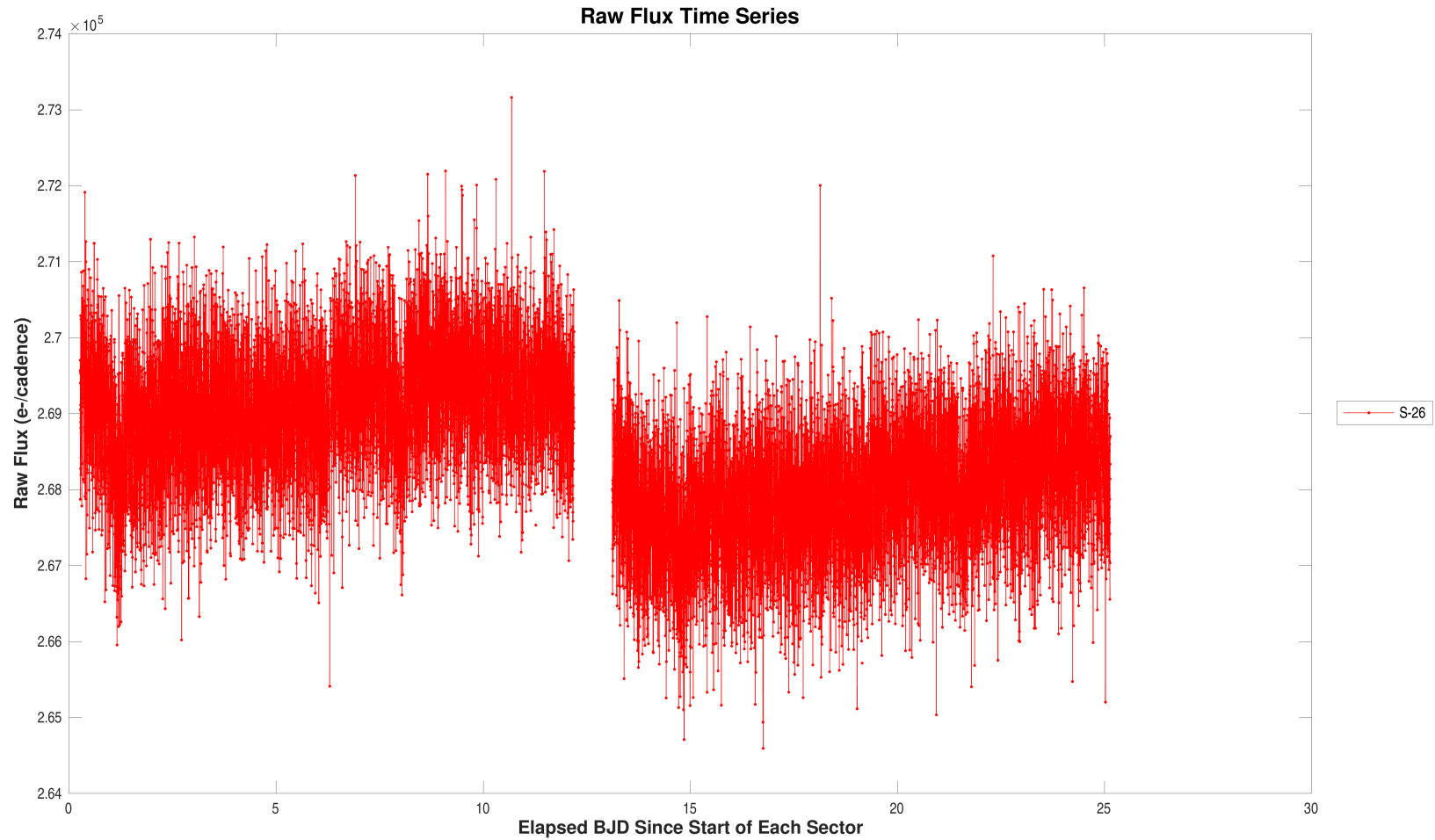
Summary plot of raw flux time series. For the data of sector 26, target table 254, start BJD is 2459010.
Open `./summary-plots/0000000158561566-00-raw-flux-26-254.fig`

4   Dashboards

Planet Candidate 1

Model Fitter	**Stellar Radius** 2.0 ± 0.1 Solar units	**Core Aperture Correlation Statistic** Value = 9.95 Significance = 100.00% **Halo Aperture Correlation Statistic** Value = 2.57 Significance = 99.48% **Core/Halo Ratio** Ratio = 3.88	Ghost Diagnostic Test
	Period = 6.8 ± 0.0 days Depth = 2450 ± 150 ppm Planet Radius = 10.1 ± 1.2 Earth radii Semi-major Axis = 0.1 ± 0.0 AU Effective Stellar Flux = 477.3 ± 18.1 Equilibrium Temperature = 1192 ± 11 Kelvin Chi-squared/DoF = 0.8 SNR = 16.3		

Eclipsing Binary Discrimination Test	**Odd-Even Depth Comparison Statistic** Value = 6.88e-03 Significance = 93.39%		**Offsets Relative to Out of Transit Centroid** Source RA Offset = -3.36e+00 ± 2.60e+00 arcsec (-1.29 σ) Source Dec Offset = 2.48e+00 ± 2.77e+00 arcsec (0.90 σ) Source Offset Distance = 4.17e+00 ± 2.66e+00 arcsec (1.57 σ) **Offsets Relative to TIC Position** Source RA Offset = -5.77e+00 ± 2.60e+00 arcsec (-2.22 σ) Source Dec Offset = 2.60e+00 ± 2.77e+00 arcsec (0.94 σ) Source Offset Distance = 6.33e+00 ± 2.63e+00 arcsec (2.40 σ)	Difference Image Centroid Offsets
	Shorter Period Comparison Statistic Value = N/A Significance = N/A	**Longer Period Comparison Statistic** Value = N/A Significance = N/A	False Alarm = 7.28e-37 Transit Count = 4 Max Multiple Event Statistic = 12.1	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	$-3.3561 \pm 2.60e+00$	$2.4828 \pm 2.77e+00$	arcseconds
Offset/σ	-1.29	0.90	
Offset Distance	$4.1746 \pm 2.66e+00$		arcseconds
Offset Distance/σ	1.57		
3σ Radius	7.9939		arcseconds

Mean offset from the TIC RA and Dec

|	RA	Dec	Units
Offset	$-5.7691 \pm 2.60e+00$	$2.6022 \pm 2.77e+00$	arcseconds
Offset/σ	-2.22	0.94	
Offset Distance	$6.3288 \pm 2.63e+00$		arcseconds
Offset Distance/σ	2.40		
3σ Radius	7.8993		arcseconds

Planet Candidate 1
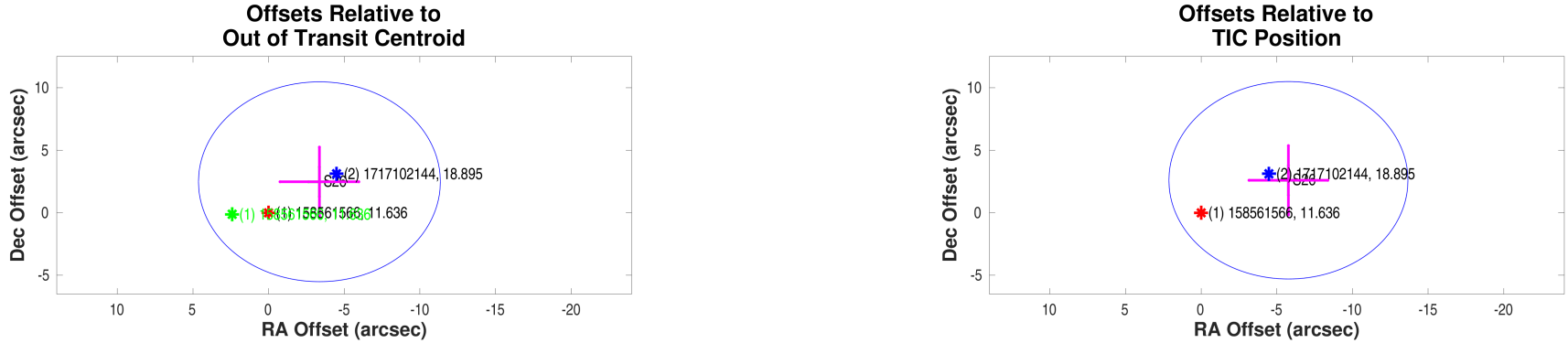
Difference image centroid offsets for target 158561566, planet candidate 1. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in RA and Dec with respect to the TC coordinates 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 (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/0000000158561566-01-difference-image-centroid-offsets.fig`
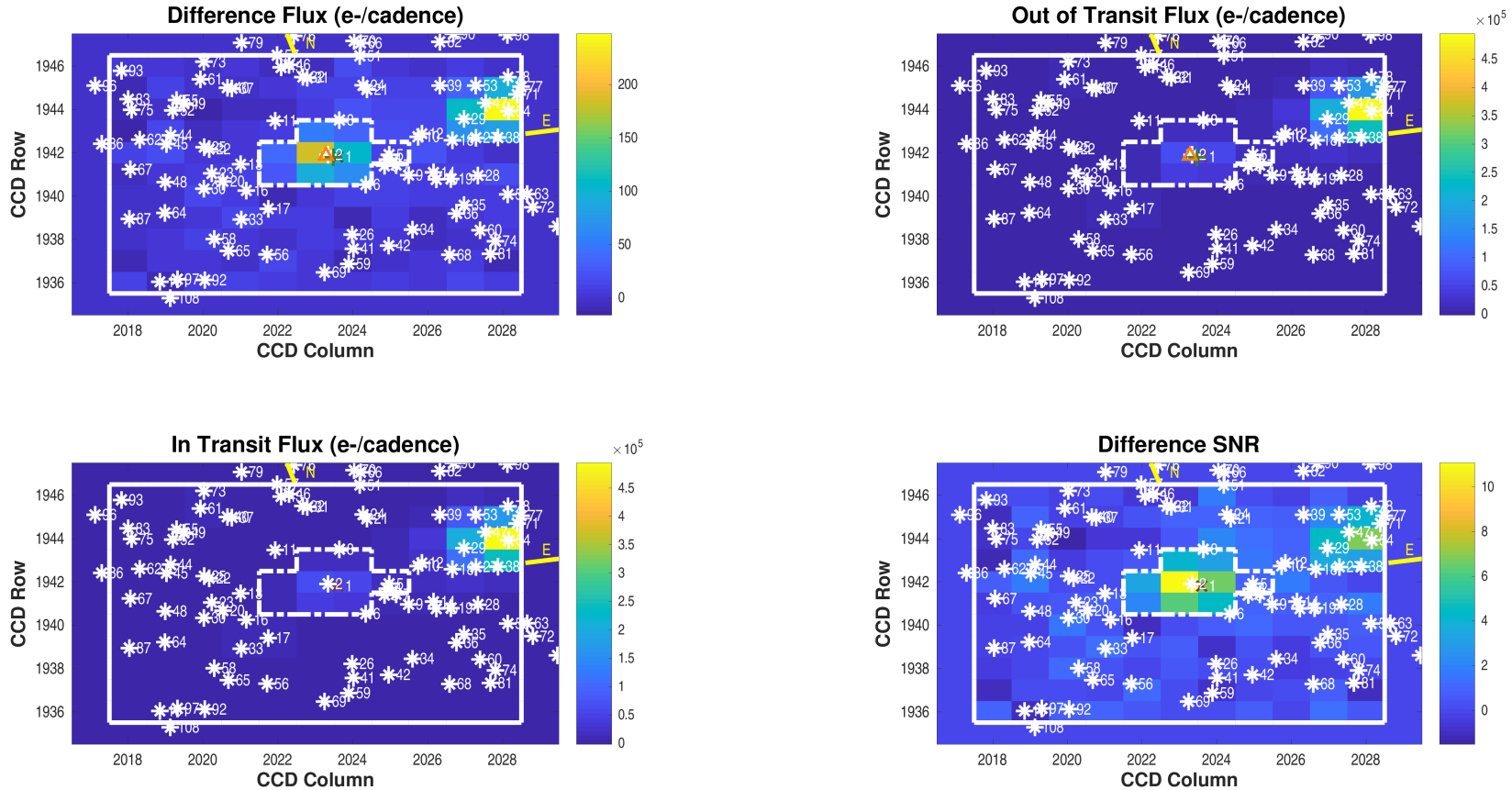
Planet Candidate 1
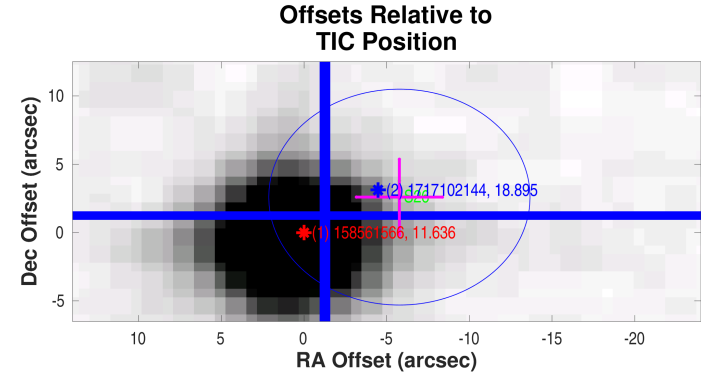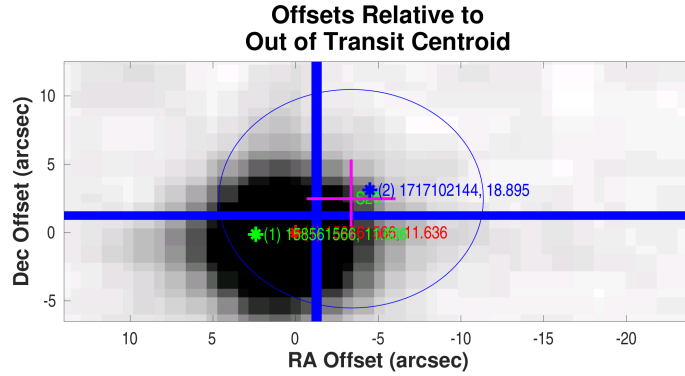
Difference image centroid offsets for target 158561566, planet candidate 1, diplayed on survey image for given target. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in 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/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 26 / Target Pixel Table 254

Difference image for target 158561566, planet candidate 1, sector 26, target pixel table 254. 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 = 639; number of in-transit cadence gaps = 5; number of valid out-of-transit cadences = 1488; number of out-of-transit cadence gaps = 8. Difference image quality metric = 0.58 (not good).
Open ./planet-01/difference-image/0000000158561566-01-difference-image-26-254.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	$1941.79 \pm 7.50e-05$	$2023.47 \pm 6.65e-05$	pixels	$287.70782498 \pm 3.03e-06$	$47.33308317 \pm 2.01e-06$	degrees
Difference Image Centroid	$1941.87 \pm 5.82e-02$	$2023.28 \pm 5.23e-02$	pixels	$287.70644945 \pm 2.99e-04$	$47.33377282 \pm 3.32e-04$	degrees
Offset	$0.0826 \pm 5.82e-02$	$-0.1950 \pm 5.23e-02$	pixels	$-3.3561 \pm 7.29e-01$	$2.4828 \pm 1.20e+00$	arcseconds
Offset/σ	1.42	-3.73		-4.60	2.07	
Offset Distance	$0.2118 \pm 5.38e-02$		pixels	$4.1746 \pm 9.14e-01$		arcseconds
Offset Distance/σ	3.94			4.57		

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

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$1941.81 \pm 3.43e-04$	$2023.60 \pm 5.27e-04$	pixels	$287.70881400 \pm 0.00e+00$	$47.33305000 \pm 0.00e+00$	degrees
Difference Image Centroid	$1941.87 \pm 5.82e-02$	$2023.28 \pm 5.23e-02$	pixels	$287.70644945 \pm 2.99e-04$	$47.33377282 \pm 3.32e-04$	degrees
Offset	$0.0627 \pm 5.82e-02$	$-0.3163 \pm 5.23e-02$	pixels	$-5.7691 \pm 7.29e-01$	$2.6022 \pm 1.20e+00$	arcseconds
Offset/σ	1.08	-6.05		-7.92	2.17	
Offset Distance	$0.3224 \pm 5.28e-02$		pixels	$6.3288 \pm 8.20e-01$		arcseconds
Offset Distance/σ	6.10			7.72		

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	287.70697584	47.33391635	5.46
3	158561563	17.538	287.71782552	47.32925150	25.89
4	158561565	15.490	287.71895924	47.33078134	26.07
5	1717102143	20.233	287.71978680	47.33198663	27.04
6	1717102114	18.540	287.71229428	47.32504901	30.03
7	1717102145	20.592	287.72032892	47.32906562	31.54
8	1717102142	18.003	287.71233834	47.34241461	34.79
9	1717102141	19.940	287.72206305	47.32608761	40.90
10	1717102147	19.759	287.72739047	47.33565344	46.28
11	1717102161	19.476	287.69880356	47.34426364	47.18
12	1717102146	19.345	287.72843268	47.33631557	49.29
13	1717102126	18.157	287.68782127	47.33419304	51.38
14	158561561	15.427	287.72750233	47.32600295	52.18
15	1717102134	18.064	287.72750042	47.32413551	55.75
16	158561562	14.884	287.68673380	47.32728472	57.73
17	158561558	13.974	287.68976329	47.32191838	61.37
18	158561567	14.748	287.73425807	47.33370409	62.12
19	1717102138	18.670	287.73062007	47.32380878	62.75
20	158561564	16.588	287.68262058	47.33034121	64.65
21	1717102148	19.656	287.72075255	47.34941812	65.73
22	158561572	17.429	287.68252868	47.33908895	67.72
23	1717102127	19.934	287.68097289	47.33278322	67.93
24	1717102149	18.983	287.72032222	47.35058214	69.08
25	158561575	16.862	287.68167708	47.33976764	70.49
26	158561548	17.083	287.70510278	47.31265899	73.96
27	1717102139	20.534	287.73942771	47.33358598	74.72
28	1717102132	19.211	287.73656707	47.32382489	75.42
29	158561571	17.495	287.73855950	47.33878736	75.46
30	158489994	18.930	287.67802924	47.32909575	76.45
31	158561589	16.833	287.70929281	47.35429575	76.49
32	1717102164	18.048	287.70843389	47.35464826	77.76
33	158561556	16.981	287.68318426	47.32002441	78.16
34	158561547	16.220	287.71819398	47.31200494	79.14
35	1717102137	20.150	287.73111117	47.31666678	80.24
36	1717102110	20.596	287.72879708	47.31474394	81.98
37	158561588	17.268	287.69257013	47.35395071	85.04
38	1717102140	18.575	287.74406254	47.33292181	86.00

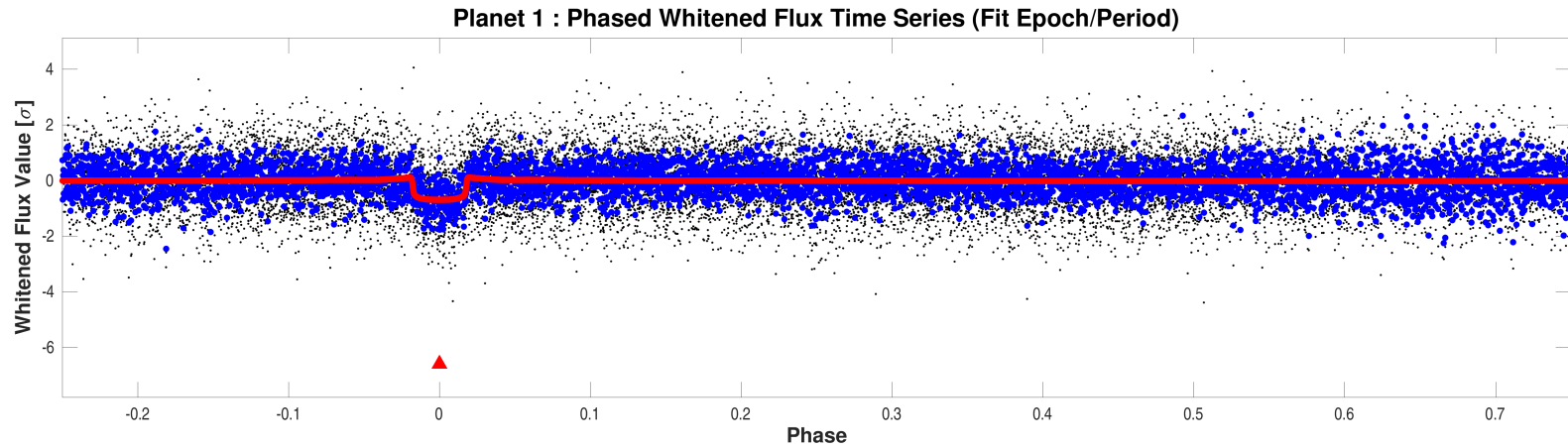| Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
39	1717102152	19.619	287.73642349	47.34808749	86.42
40	1717102162	18.748	287.69167391	47.35427374	87.10
41	1717102113	20.076	287.70411503	47.30896817	87.45
42	1717102112	20.070	287.71180155	47.30864715	88.15
43	1717102163	20.597	287.70468189	47.35778617	89.62
44	1717102130	18.697	287.67564062	47.34382681	89.76
45	158561577	17.498	287.67400576	47.34172127	90.48
46	1717102165	19.499	287.70654852	47.35818678	90.66
47	1717102154	18.141	287.74449788	47.34221219	93.10
48	1717102129	18.818	287.67050163	47.33201810	93.55
49	1717102167	19.077	287.68116313	47.35157331	94.86
50	1717102136	20.086	287.74118756	47.31802855	95.72
51	1717102158	19.924	287.72220192	47.35824380	96.40
52	1717102168	19.676	287.67826002	47.35017263	96.73
53	158561585	15.470	287.74393361	47.34696994	99.26
54	158561573	9.721	287.74857802	47.33936168	99.64
55	158561587	18.397	287.67992907	47.35268633	99.82
56	1717102118	19.013	287.68555991	47.31019597	99.94
57	158561597	16.458	287.70491458	47.36105473	101.26
58	1717102120	19.286	287.67583749	47.31584867	101.53
59	1717102111	18.639	287.70183640	47.30523313	101.58
60	158561543	17.709	287.73224940	47.30970511	101.65
61	158561592	13.913	287.68676625	47.35726684	102.44
62	158561581	15.703	287.66880031	47.34371019	104.90
63	1717102133	18.992	287.74524235	47.31751347	105.01
64	1717102125	19.746	287.66772025	47.32413457	105.27
65	1717102119	19.467	287.67777820	47.31236521	106.20
66	1717102157	20.562	287.72345651	47.36150350	108.48
67	158561568	17.855	287.66427253	47.33637613	109.33
68	158561536	16.547	287.72377354	47.30436593	109.52
69	1717102104	19.906	287.69604133	47.30385085	109.64
70	158561602	16.615	287.72229693	47.36224320	110.12
71	1717102150	18.658	287.75182105	47.34339919	111.35
72	1717102135	19.919	287.74528858	47.31397763	112.40
73	1717102170	18.993	287.68901136	47.36166211	113.77
74	158561538	17.546	287.73451214	47.30644606	114.47
75	1717102131	18.404	287.66966572	47.35159003	116.52
76	1717102172	19.425	287.71007714	47.36548679	116.81

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

6   Phased Light Curves
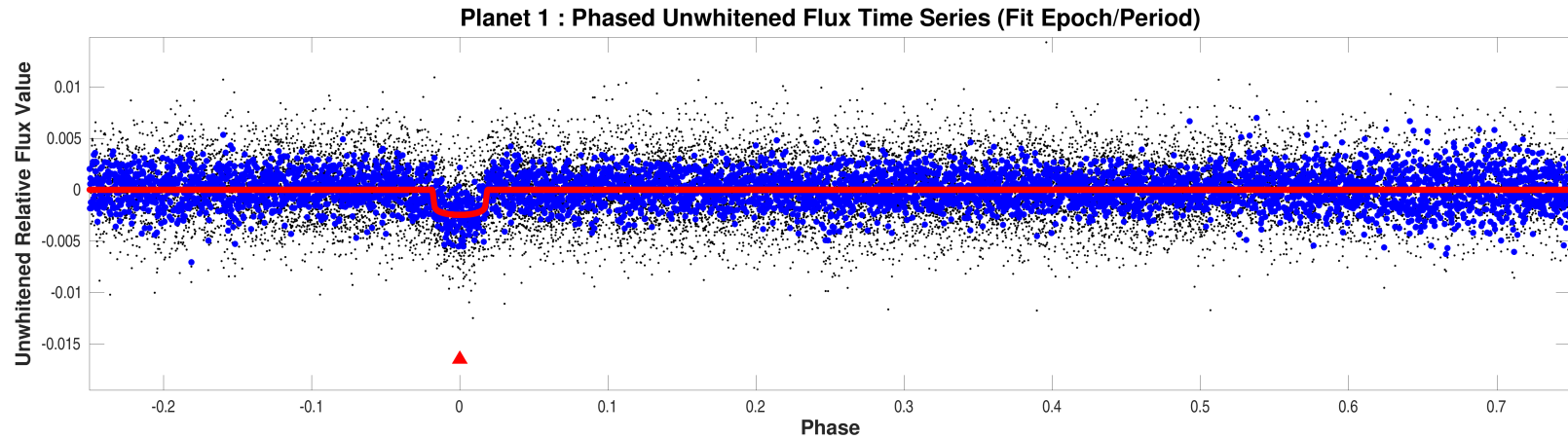
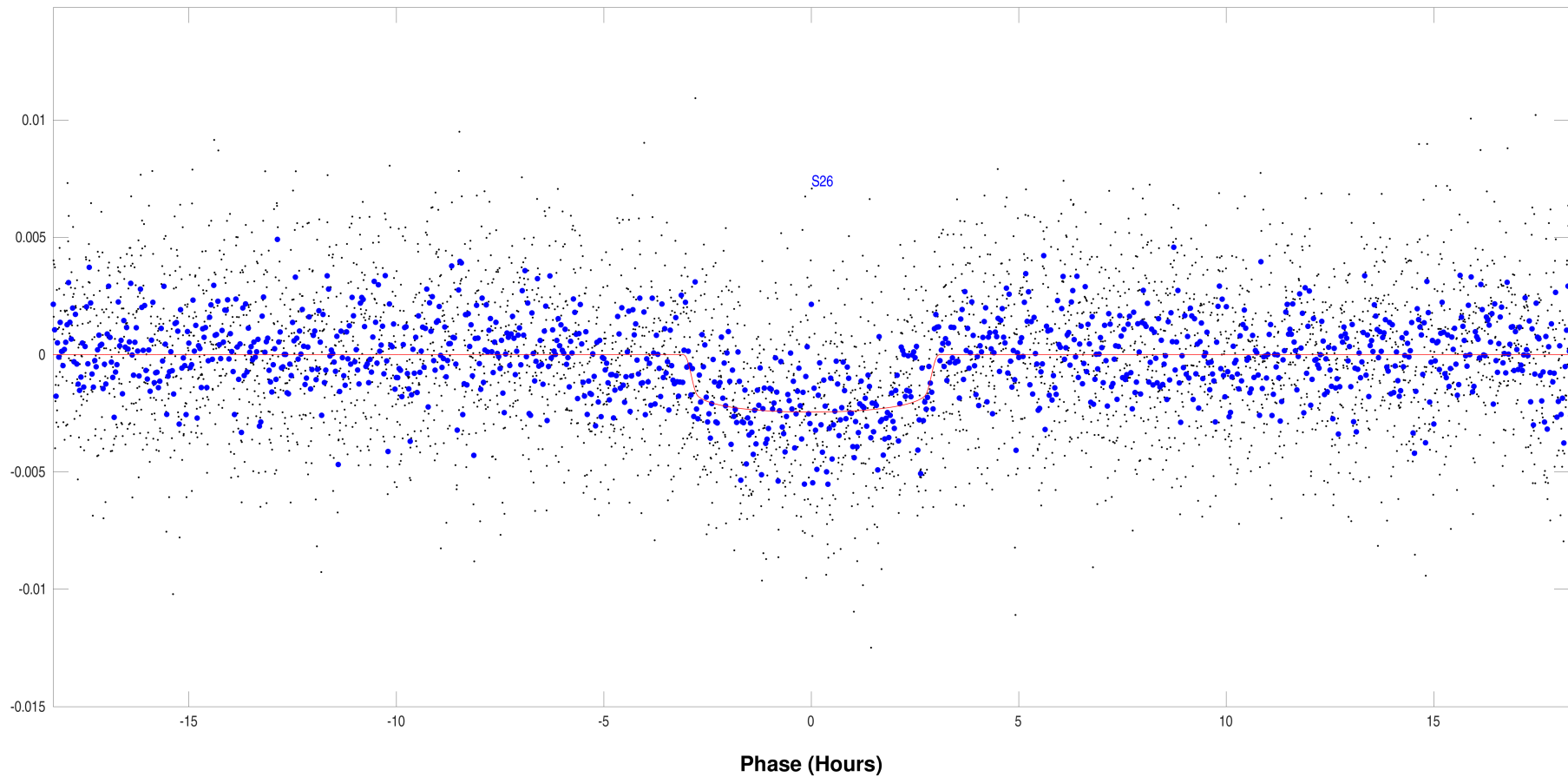**Planet 1 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)**

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`

Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)

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 = 6.7926 days; transit epoch = 2011.2035 BTJD.
Open `./summary-plots/0000000158561566-01-phased-unwhitened-flux-time-series-by-sector.fig`
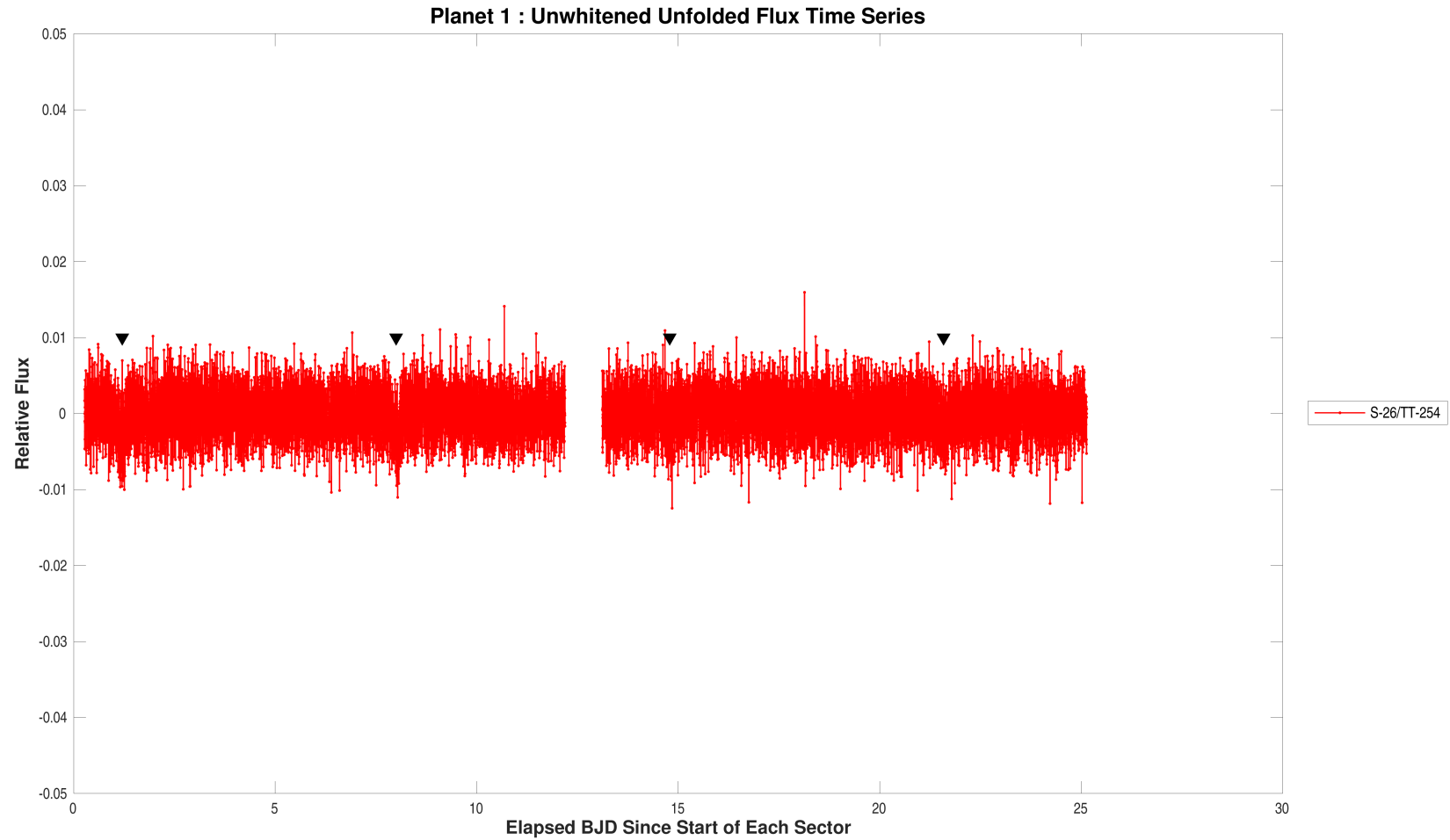
7 Planet Candidate 1

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

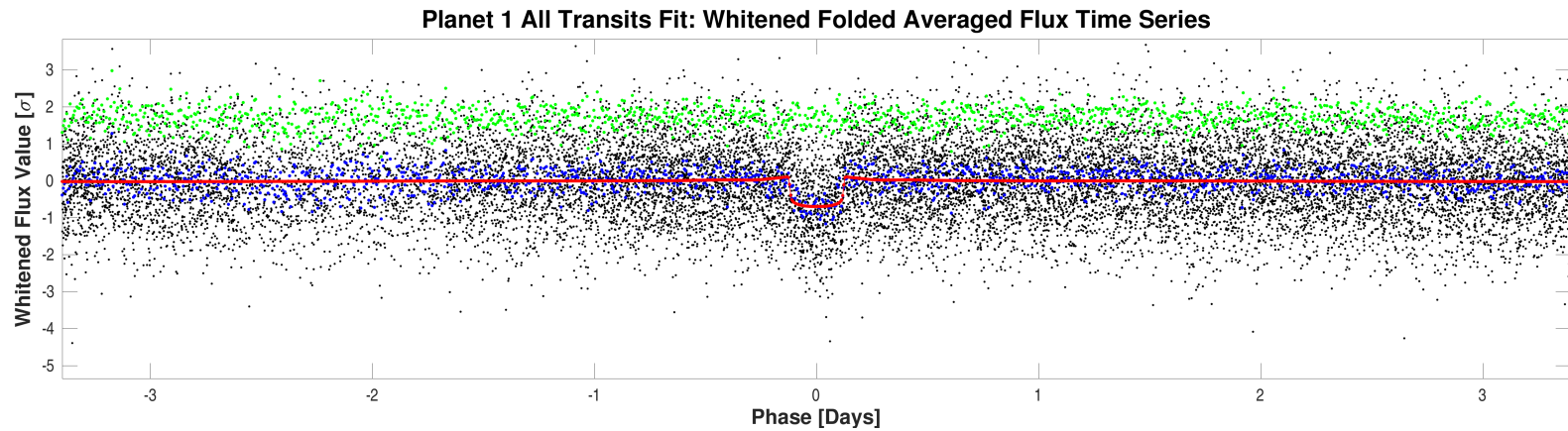| TCE Parameter	Value	Units
Trial Transit Pulse Duration	6.0	hours
Transit Epoch	2011.2086432	TJD
Orbital Period	6.7930527	days
Maximum SES	6.7	
Maximum MES	12.1	
Robust Statistic	16.1	
Chi Square Goodness of Fit Statistic (DoF)	767.8 (714)	
Chi Square2 Statistic (DoF)	1.4 (26.5)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

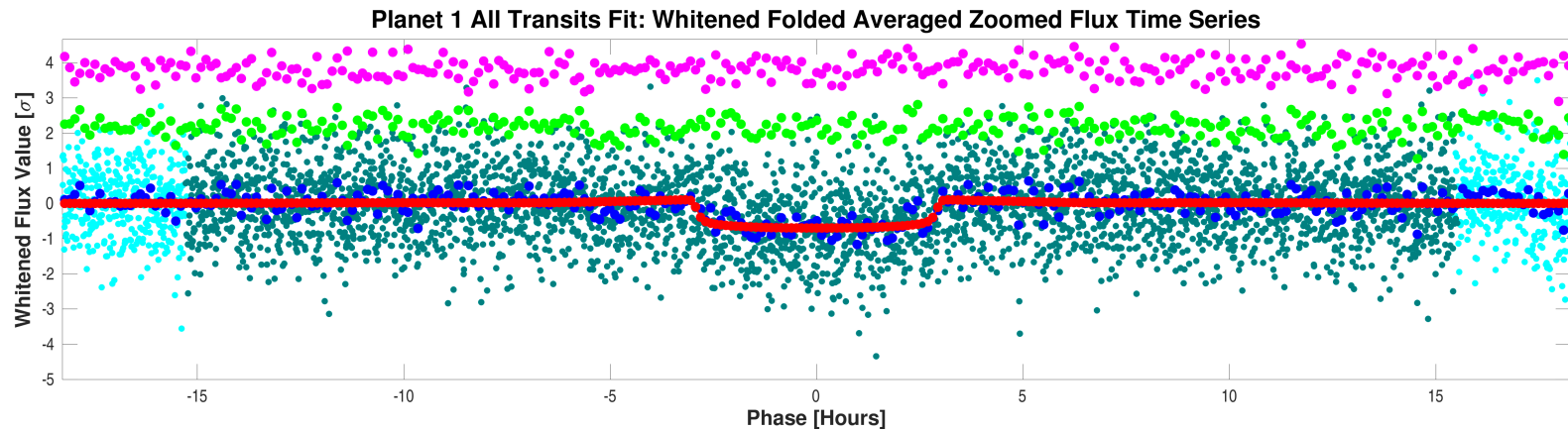| Parameter	Value	Uncertainty	Units
SNR	16.3		
Orbital Period	6.7926035	2.2298e-03	days
Transit Epoch	2011.2034703	4.2249e-03	BTJD
Impact Parameter	0.0175	3.8640e+01	
Planet Radius to Star Radius Ratio	0.0462256	5.0697e-03	
Semi-major Axis to Star Radius Ratio	8.9345	5.9406e+00	
Planet Radius	10.0963	1.2242e+00	Earth radii
Semi-major Axis	0.1115	3.8444e-03	AU
Effective Stellar Flux	477.2942	1.8078e+01	Goldilocks
Equilibrium Temperature	1192	1.1288e+01	Kelvin
Stellar Density	0.2077	4.1424e-01	Solar density
Transit Depth	2450	1.4995e+02	ppm
Transit Duration	6.0896	3.9287e-01	hours
Transit Ingress Duration	0.2702	3.9328e-01	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	2798.7 (3349.0)		
Model Chi Square Goodness of Fit Statistic (DoF)	446.2 (743)		
Model Chi Square2 Statistic (DoF)	0.5 (3)		

DoF: Degrees of Freedom

Flux time series for CatId 158561566, Planet candidate 1 in the unwhitened domain. For the data of Sector-26/TargetTableId-254, start BJD is 2459010. 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-26-254.fig`

Planet 1 All Transits Fit: Whitened Folded Averaged Flux Time Series

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

Planet 1 All Transits Fit: Whitened Folded Averaged Zoomed Flux Time Series

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.
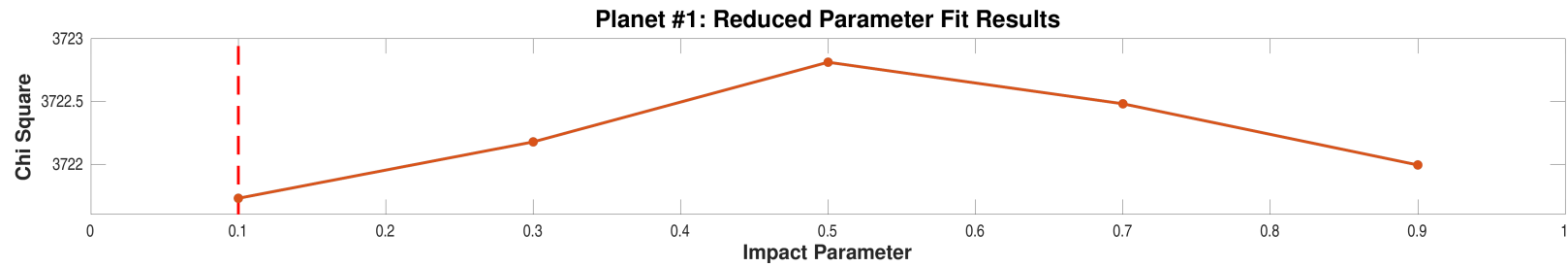Open ./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000158561566-01-all-whitened-zoomed.fig

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	16.4	3721.7	0.0457675	1.4317e-03	9.0359	1.9371e-01	2398	1.4925e+02	5.9908	1.2833e-01
0.30	16.4	3722.2	0.0461312	1.4449e-03	8.7216	1.9101e-01	2405	1.4988e+02	5.9784	1.3100e-01
0.50	16.3	3722.8	0.0468706	1.4720e-03	7.9885	1.8583e-01	2410	1.5060e+02	5.9989	1.4011e-01
0.70	16.4	3722.5	0.0483866	1.5108e-03	6.6249	1.7101e-01	2422	1.5042e+02	6.1608	1.6133e-01
0.90	16.7	3722.0	0.0535583	1.7174e-03	4.3403	1.6424e-01	2557	1.6287e+02	6.7135	2.7176e-01

Highlighted row is the best reduced-parameter model fit.
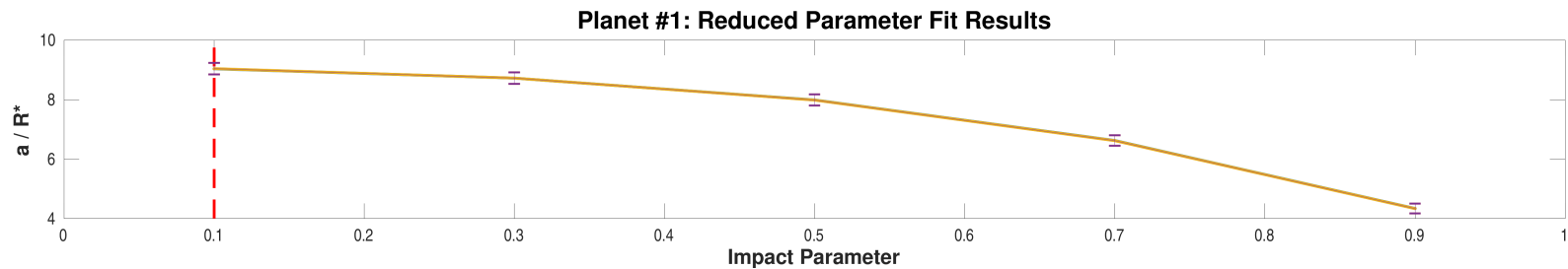
Planet #1: Reduced Parameter Fit Results

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`

Planet #1: Reduced Parameter Fit Results
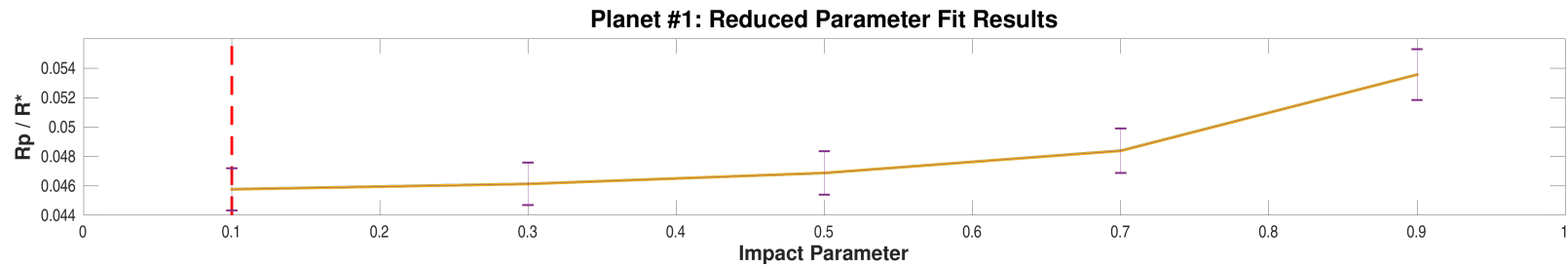
Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 158561566, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.
Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000158561566-01-reduced-fits-rp-over-rstar.fig`

Planet #1: Reduced Parameter Fit Results

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`
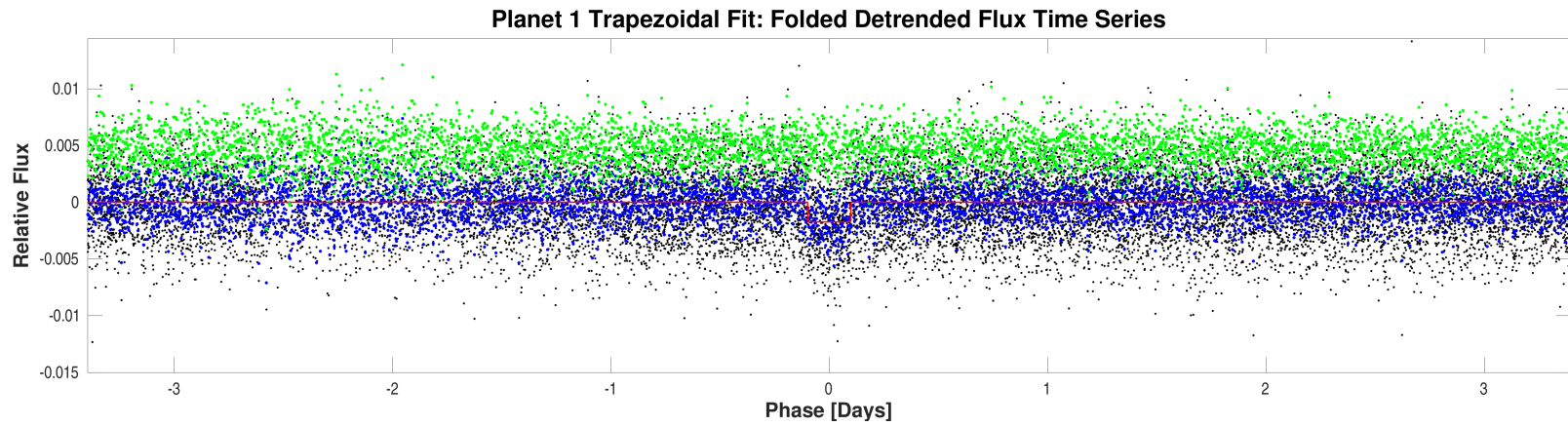
7.3 Model Fitter: Trapezoidal Fit Results

Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

TCE Parameter	Value	Units
Trial Transit Pulse Duration	6.0	hours
Transit Epoch	2011.2086432	TJD
Orbital Period	6.7930527	days
Maximum SES	6.7	
Maximum MES	12.1	
Robust Statistic	16.1	
Chi Square Goodness of Fit Statistic (DoF)	767.8 (714)	
Chi Square2 Statistic (DoF)	1.4 (26.5)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

Parameter	Value	Uncertainty	Units
SNR	14.1		
Orbital Period	6.7930527		days
Transit Epoch	2011.2247163		BTJD
Transit Depth	1732		ppm
Transit Duration	4.9632		hours
Transit Ingress Duration	0.2517		hours
Model Chi Square Statistic (DoF)	17660.4 (5680)		

DoF: Degrees of Freedom

Planet 1 Trapezoidal Fit: Folded Detrended Flux Time Series

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

Planet 1 Trapezoidal Fit: Zoomed Folded Detrended Flux Time Series
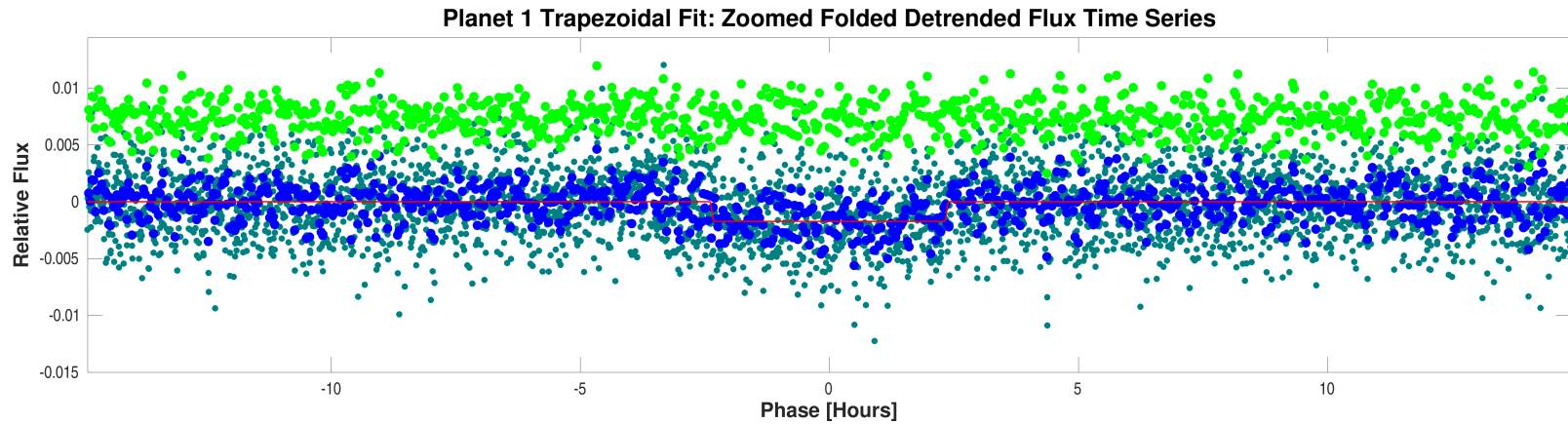
Zoomed folded detrended flux time series for CatId 158561566, Planet candidate 1 and folded trapezoidal model light curve.
Open ./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000158561566-01-all-trapezoidal-zoomed.fig

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	6.7931		days		
Transit Duration	6		hours		
Maximum MES	12.1				
Secondary Phase	1.6764		days		
Secondary MES	1.5				
Minimum Phase	3.5597		days		
Minimum MES	-2.7				
Median MES	-0.1				
MAD MES	0.49969				
Robust Statistic	0.5				
Secondary Depth	99.2	2.1321e+02	ppm		
Geometric Albedo	6.7	1.4383e+01		0.3932	34.71
Planet Effective Temperature	2960	1.5994e+03	Kelvin	1.1056	13.45

7.4.2   Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	6.8780e-03	0.0829	93.39

7.4.3   Bootstrap Test

Result	Value
False Alarm Probability	7.2845e-37
Bootstrap Threshold for Desired PFA	6.4
MES Mean	0.81
MES Standard Deviation	0.89
Transit Count	4

7.4.4   Ghost Diagnostic Test

Result	Value	Significance (%)
Maximum MES	12.1	
SNR	16.3	
Core Aperture Statistic	9.9492e+00	100.00
Halo Aperture Statistic	2.5653e+00	99.48
Ratio of Core/Halo Aperture Statistics	3.8784e+00	

7.4.5 Validation Test Figures

Planet 1 : Secondary MES vs. Phase
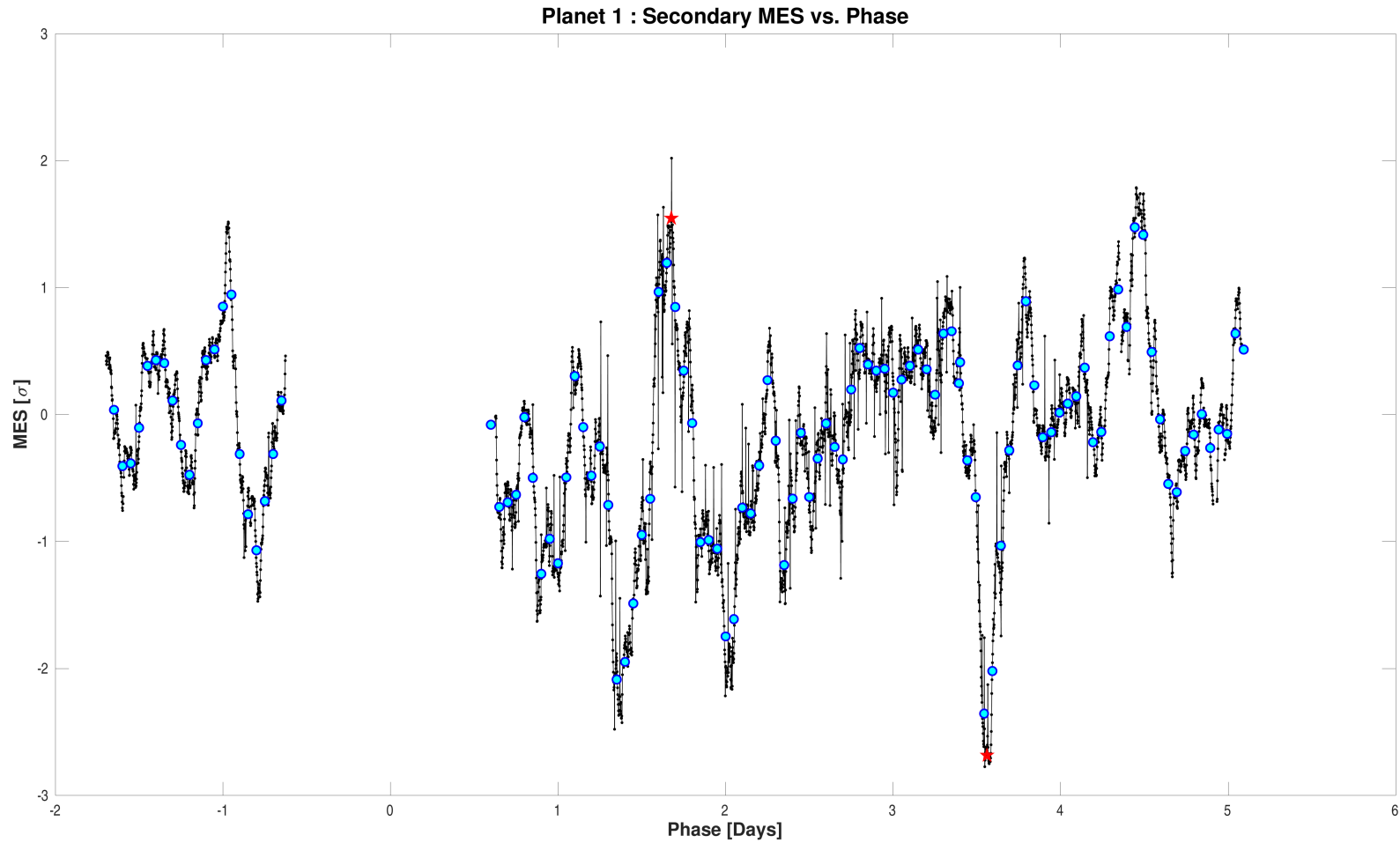
The primary event has been set to zero and both the max and min of the resulting MES vs. Phase are marked with a red star. The best matched pulse duration in hours is 6. The maximum secondary MES and corresponding phase are 1.5484 and 1.6764 days respectively. The minimum secondary MES and corresponding phase are -2.684 and 3.5597 days respectively.

Open `./planet-01/report-summary/0000000158561566-01-weak-secondary-diagnostic.fig`
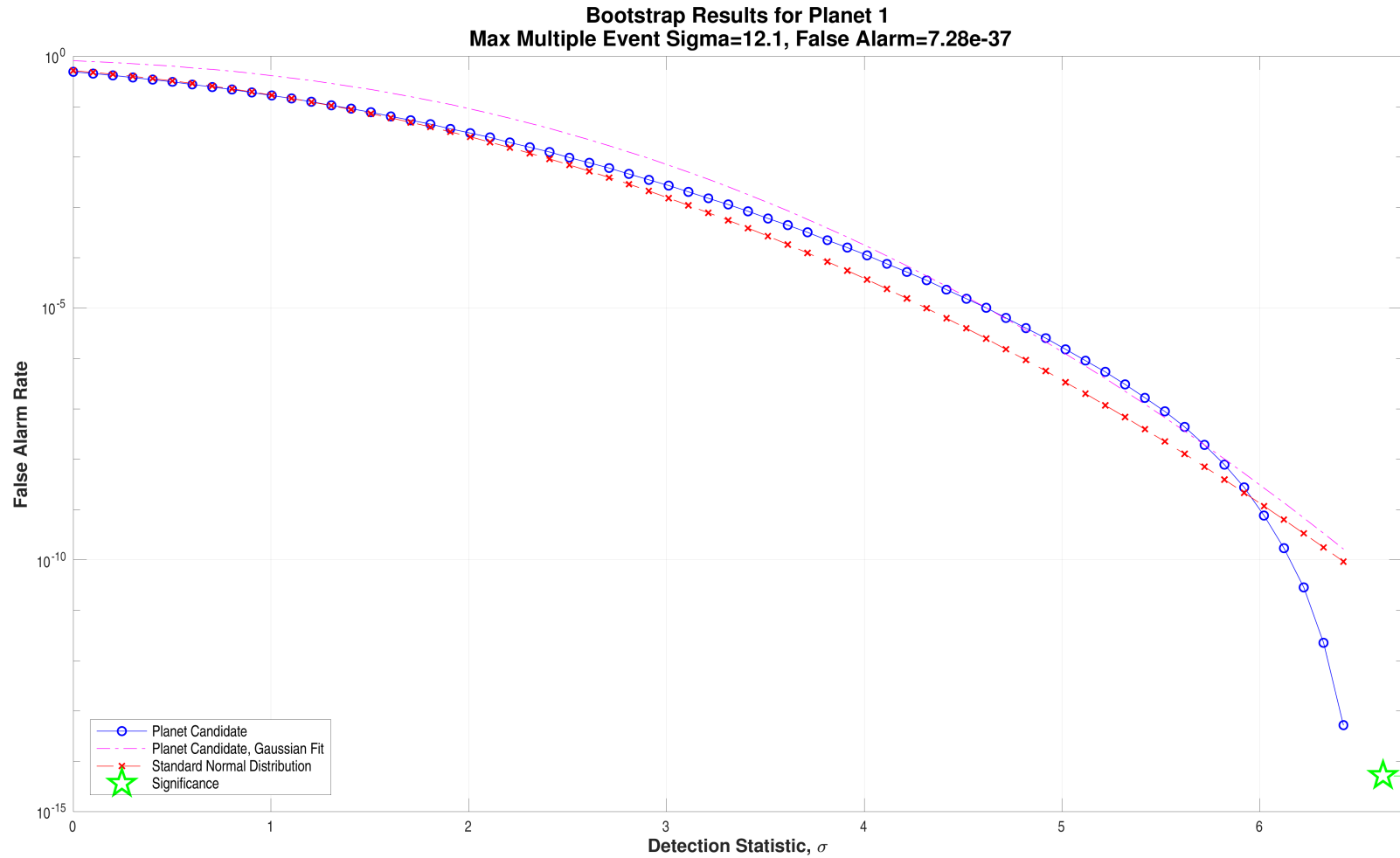
Bootstrap results for target 158561566, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is 12.6292. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 6.3971.
Open `./planet-01/bootstrap-results/0000000158561566-01-bootstrap-false-alarm.fig`

Planet 1 : Cotrended Folded Core Aperture Flux Time Series
Correlation Statistic = 9.95, Significance = 100.00%
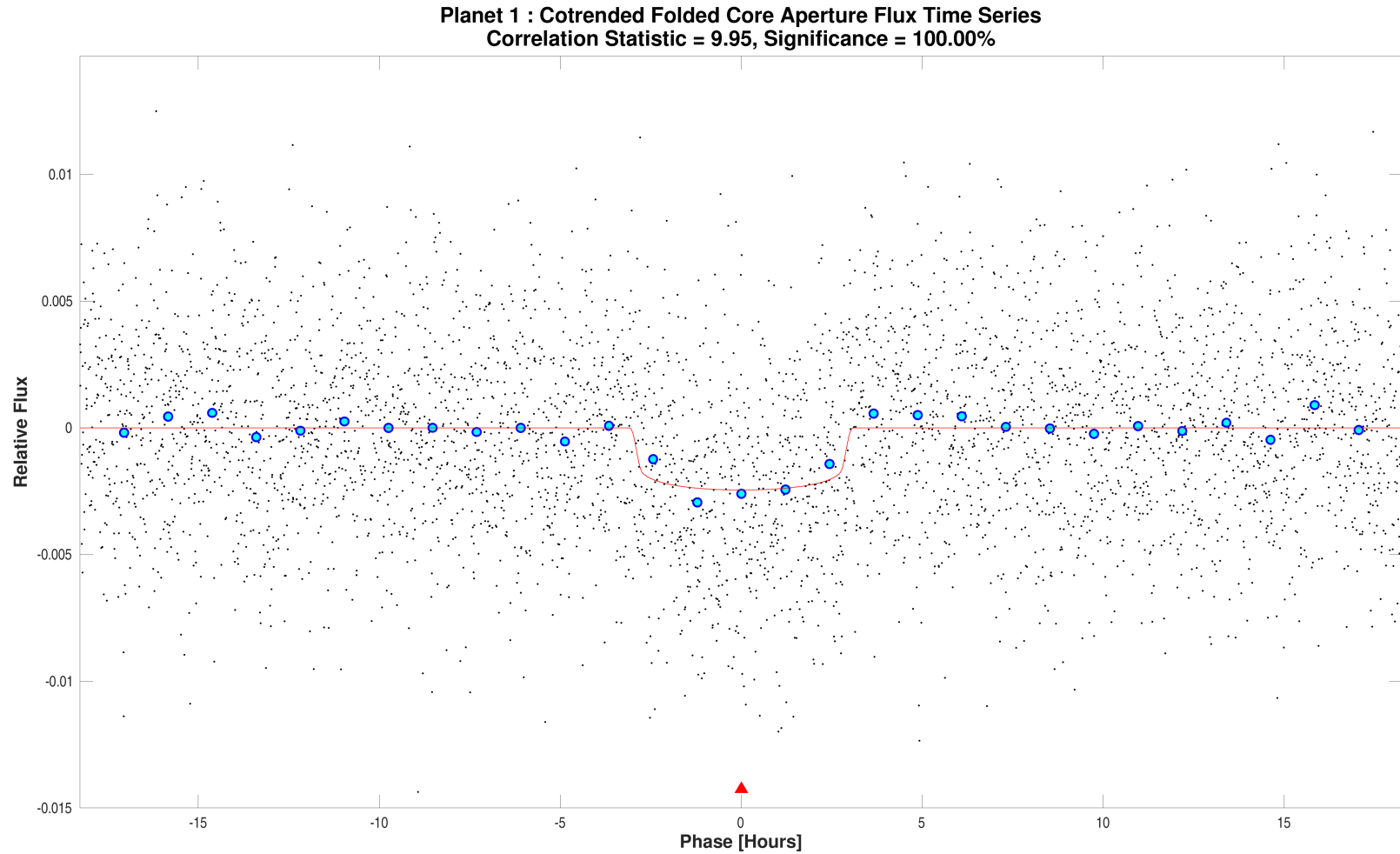
Optical ghost diagnostic core aperture flux time series for target 158561566, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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

Planet 1 : Cotrended Folded Halo Aperture Flux Time Series
Correlation Statistic = 2.57, Significance = 99.48%
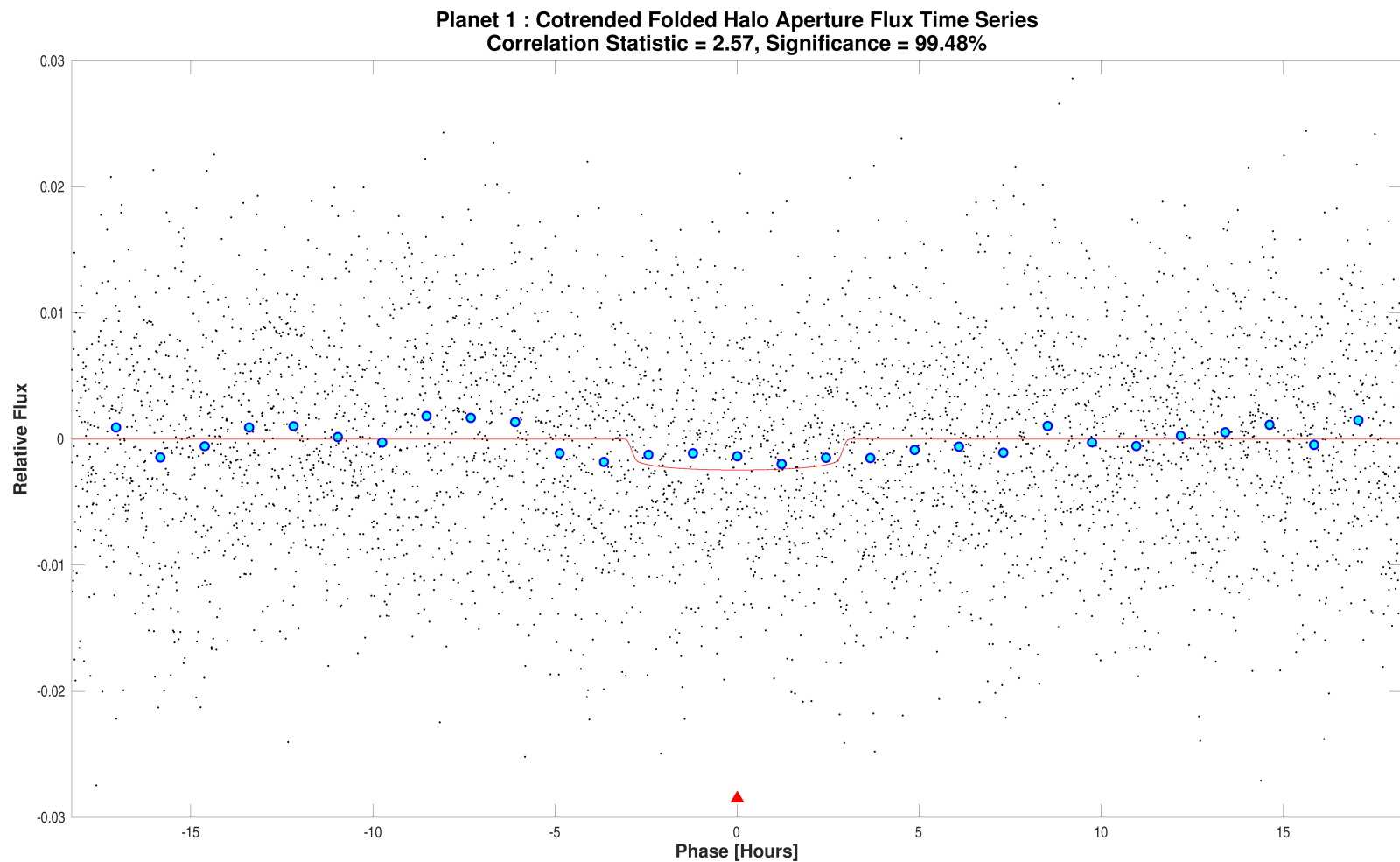
Optical ghost diagnostic halo aperture flux time series for target 158561566, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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/0000000158561566-01-halo-unwhitened-cotrended-zoomed-model.fig

Appendix A   Planet Candidate 1

A.1   Model Fitter: All Transits
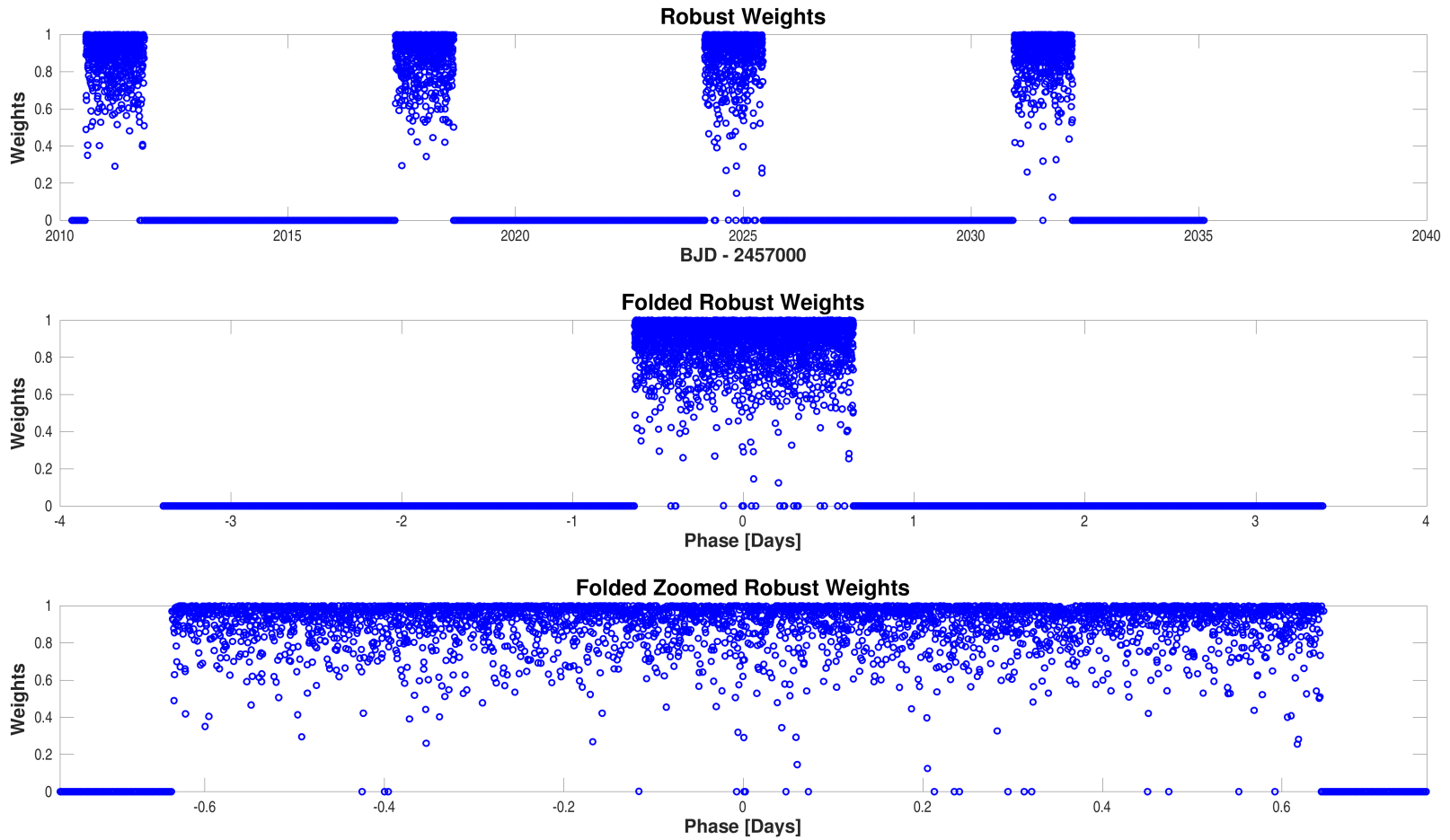
Robust weights distribution for CatId 158561566, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000158561566-01-all-robust-weights.fig`
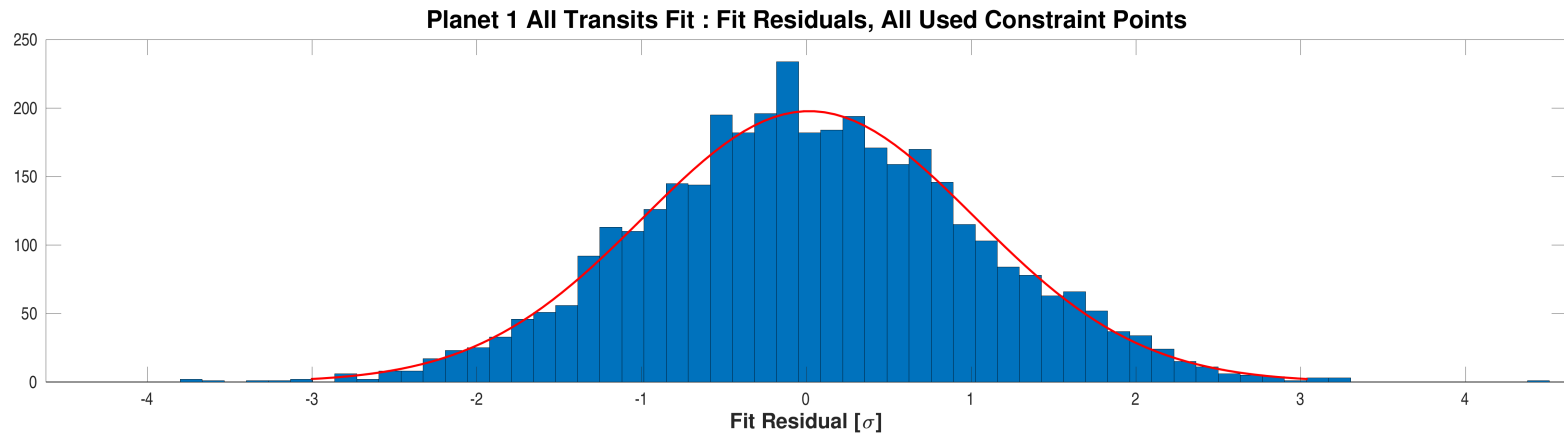
Planet 1 All Transits Fit : Fit Residuals, All Used Constraint Points

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
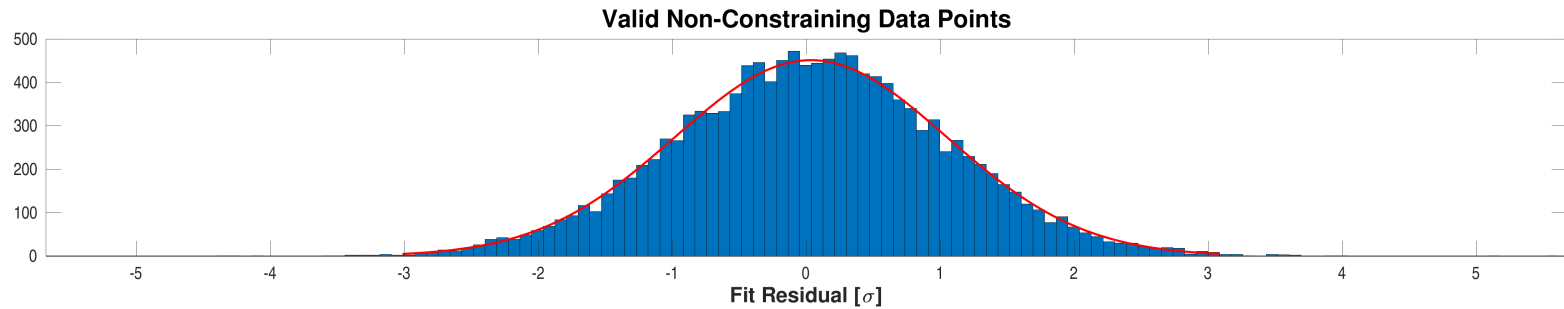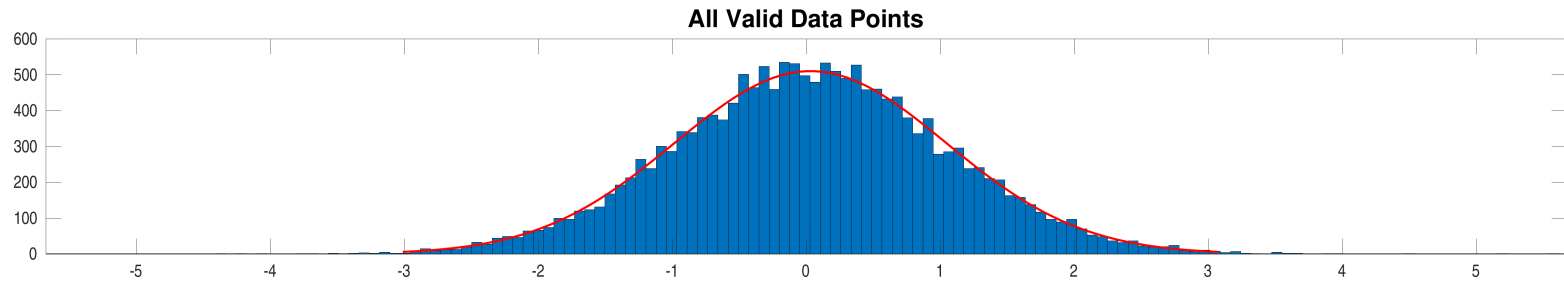
All Valid Data Points

Valid Non-Constraining Data Points

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	Difference ‖Uncertainty‖
SNR	11.5		12.0			
Orbital Period	6.7922317	3.5435e-03	6.7958304	3.3915e-03	days	7.3368e-01
Transit Epoch	2011.2124104	5.1567e-03	2017.9897293	4.8085e-03	BTJD	2.1678e+00
Impact Parameter	0.3951	1.7323e+00	0.0100	9.0555e+01		4.2515e-03
Planet Radius to Star Radius Ratio	0.0471048	6.3269e-03	0.0467289	6.8774e-03		4.0227e-02
Semi-major Axis to Star Radius Ratio	8.8015	7.0216e+00	8.9877	8.0171e+00		1.7472e-02
Planet Radius	10.2883	1.4808e+00	10.2062	1.5922e+00	Earth radii	3.7762e-02
Semi-major Axis	0.1115	3.8444e-03	0.1115	3.8457e-03	AU	7.2421e-03
Effective Stellar Flux	477.3290	1.8082e+01	476.9920	1.8069e+01	Goldilocks	1.3183e-02
Equilibrium Temperature	1192	1.1290e+01	1192	1.1288e+01	Kelvin	1.3183e-02
Stellar Density	0.1986	4.7520e-01	0.2112	5.6518e-01	Solar density	1.7126e-02
Transit Depth	2479	2.1346e+02	2504	2.0789e+02	ppm	8.2934e-02
Transit Duration	5.7343	5.3004e-01	6.0598	5.3099e-01	hours	4.3375e-01
Transit Ingress Duration	0.3043	5.3244e-01	0.2716	5.3025e-01	hours	4.3538e-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)	2800.3 (3346.2)		2800.3 (3346.2)			

DoF: Degrees of Freedom
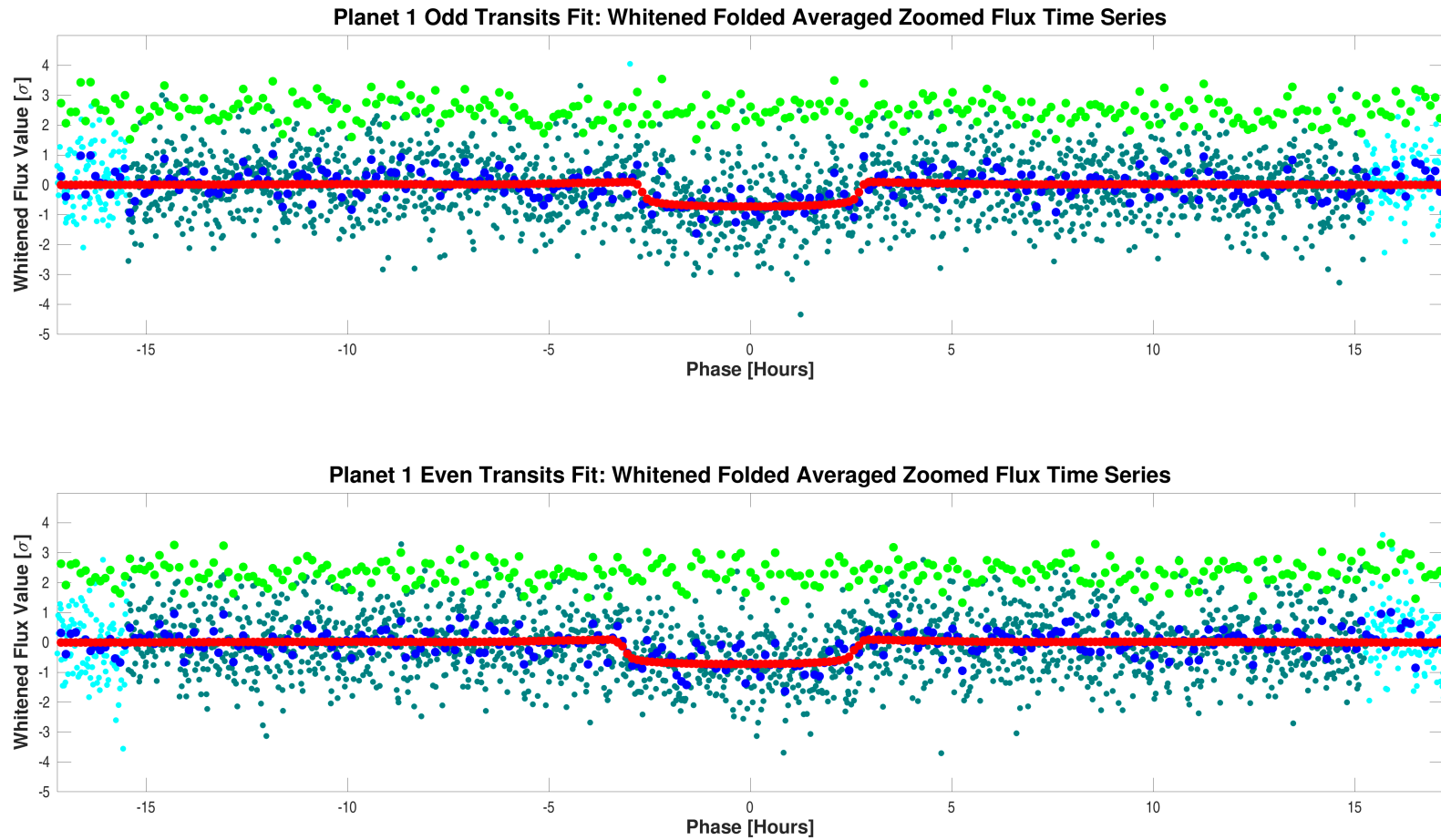
Odd Transits Fit: Whitened Folded Averaged Flux
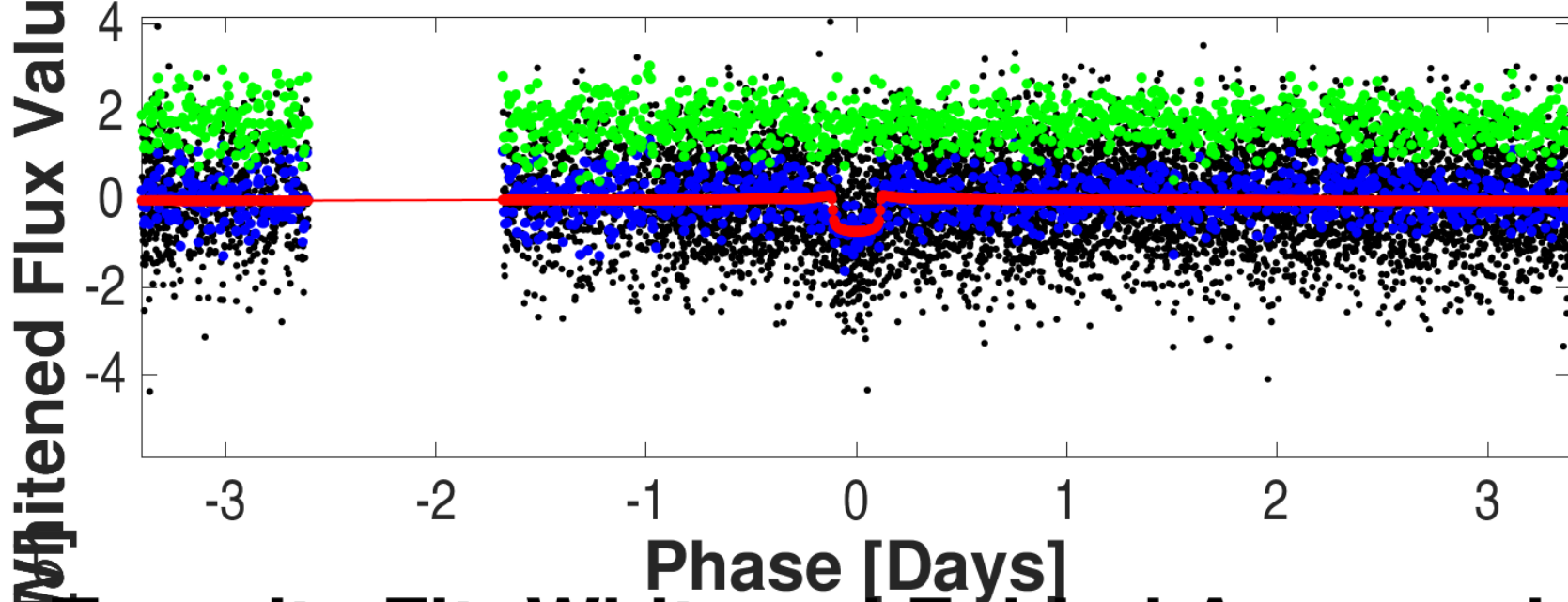
Even Transits Fit: Whitened Folded Averaged Flux
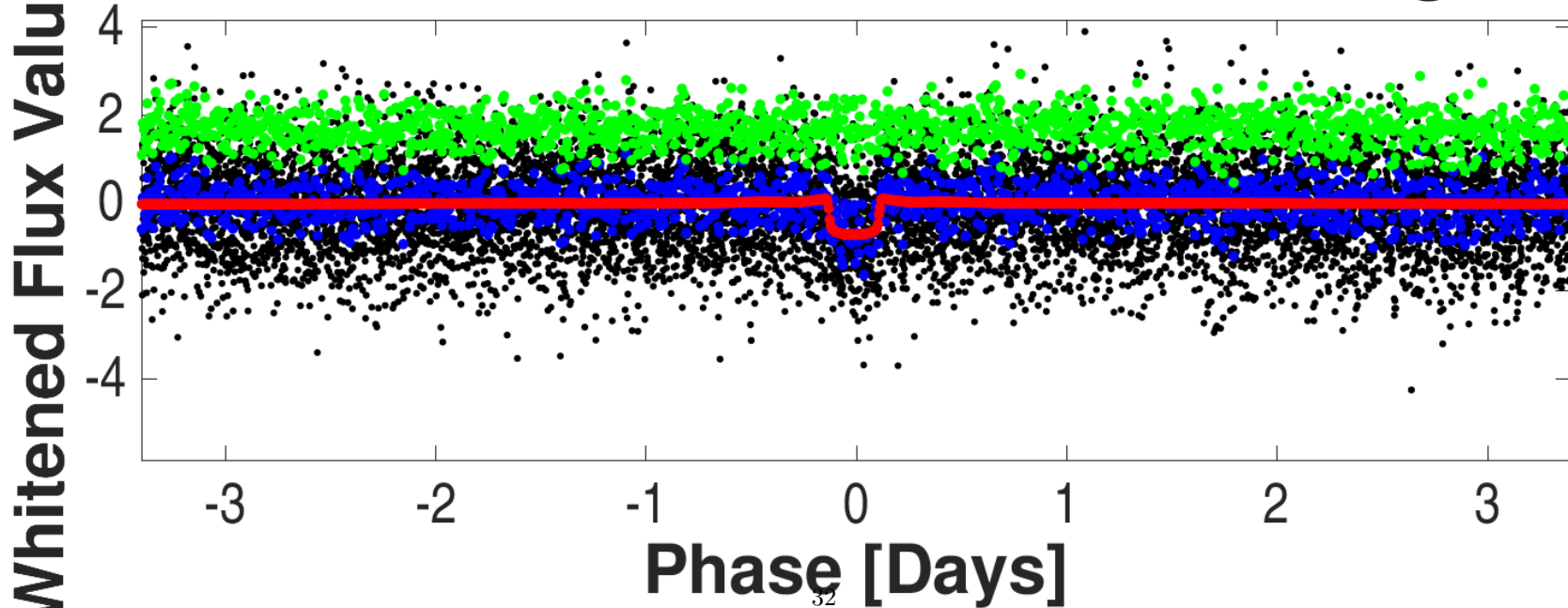
Folded flux time series for CatId 158561566, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light 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.
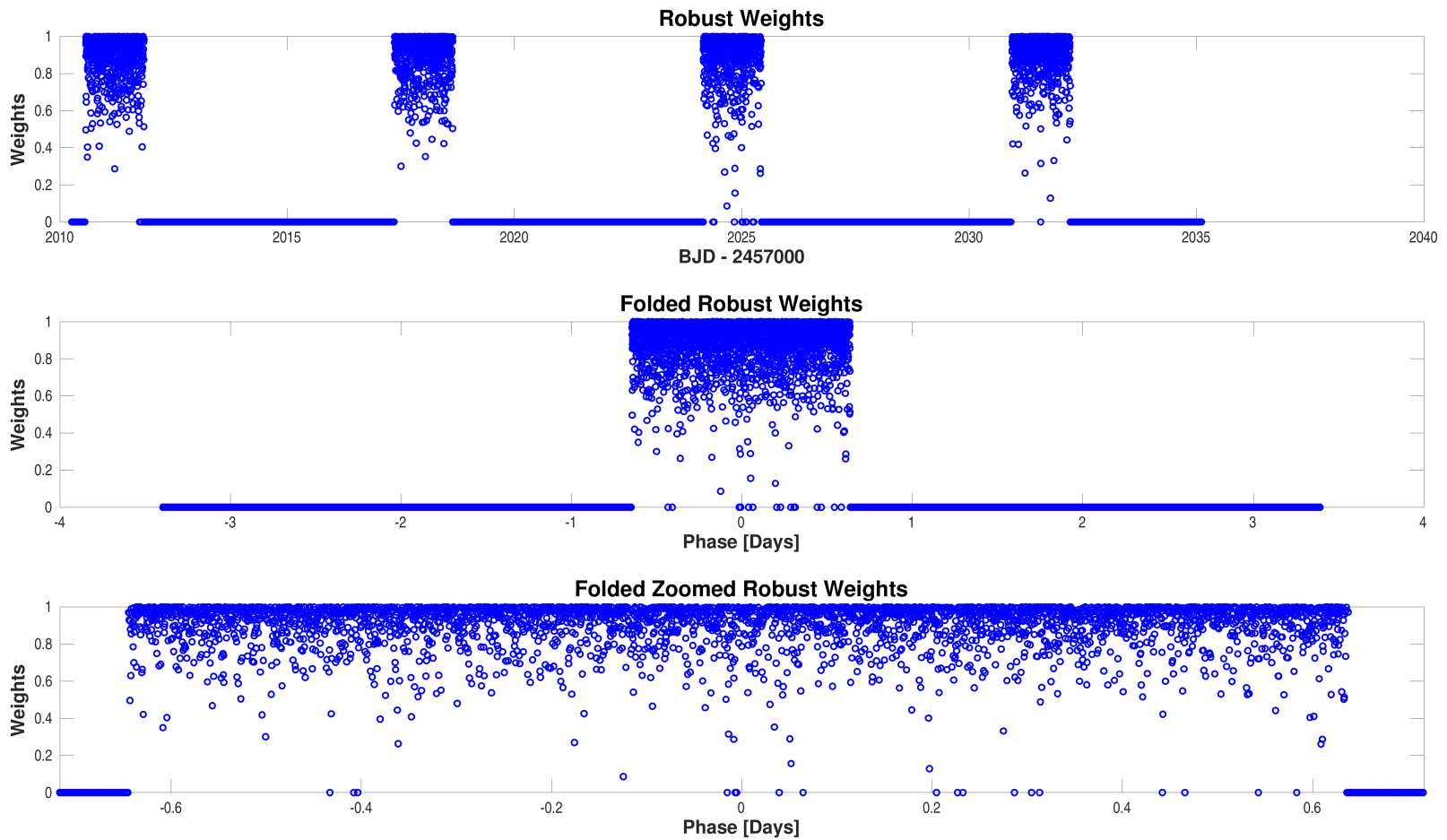
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000158561566-01-odd-even-whitened.fig`

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.
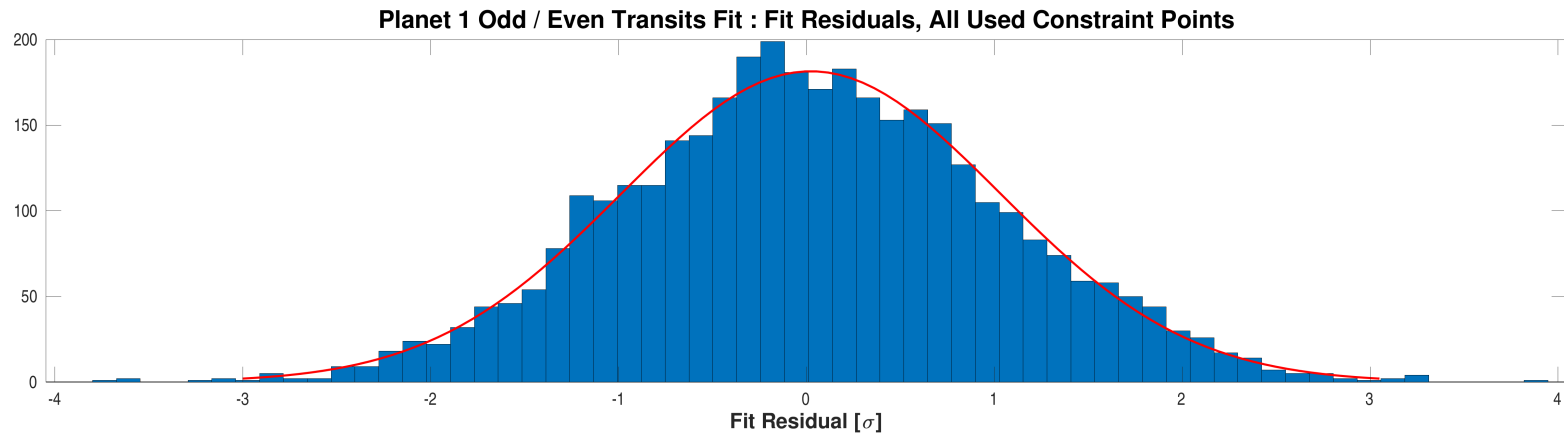
Open ./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000158561566-01-odd-even-whitened-zoomed.fig
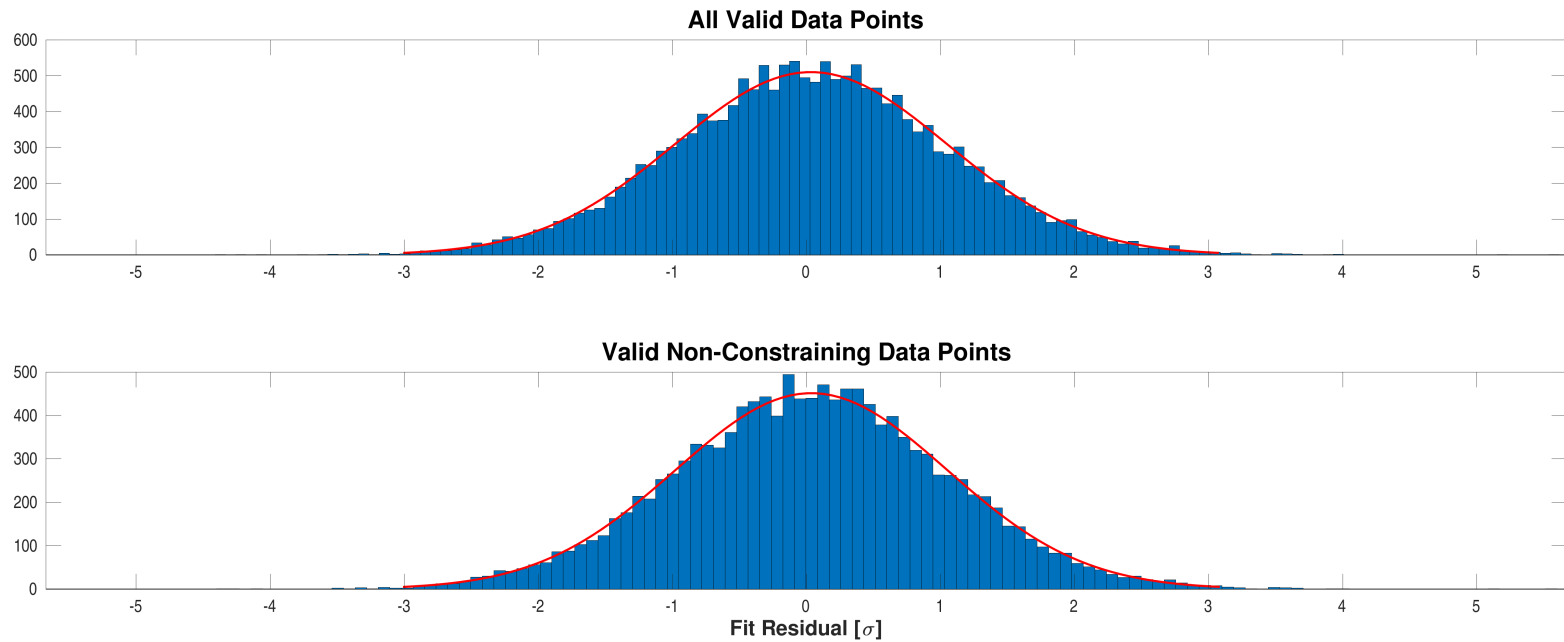
Robust weights distribution for CatId 158561566, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

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

Planet 1 Odd / Even Transits Fit : Fit Residuals, All Used Constraint Points

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
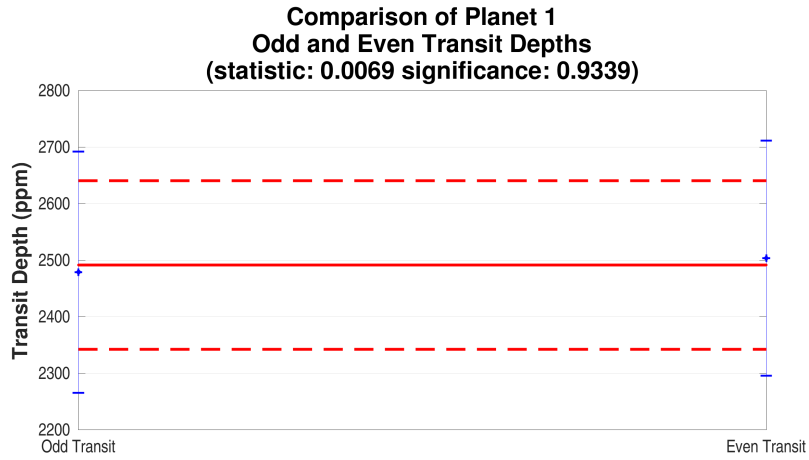
Top-left: Diagnostic plot of Odd/Even Transit Depth Test for catId 158561566, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary.
Open `./planet-01/binary-discrimination-test-results/0000000158561566-01-eclipsing-binary-discrimination-tests.fig`

Appendix B   Alerts

This target did not trigger any alerts.