Data Validation (DV) Report
for TESS ID 149603524
Sectors 9 - 9

Contents

1 Summary

Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	149603524			
TOI ID	102			
TESS Name	-			
RA	87.13995600	0	degrees	TIC7
Dec	-63.98842700	0	degrees	TIC7
Magnitude	9.716	0.018		TIC7
Radius	1.280	0.000	Solar radii	TIC7
Effective Temperature	6280	0	Kelvin	TIC7
log(g)	4.321	0	cm/sec^2	TIC7
[M/H]	0.240	0.05	Solar metallicity	TIC7
Stellar Density	0.597	0.000	Solar density	TIC7-Derived
Limb Darkening Coefficient 1	0.54364			
Limb Darkening Coefficient 2	0.16949			
Limb Darkening Coefficient 3	-0.020442			
Limb Darkening Coefficient 4	-0.048058			
Number of Planet Candidates	1			
TOI Model	toi-plus-2019-04-23.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-3.3.64-20190423			
Date Report Generated	25-Apr-2019 11:08:32 Z			

Sector	Target Table	Camera/ CCD	Crowding Metric	Flux Fraction
9	152	4:3	0.9887	0.8705

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	102.01	-	0.99	4.412	1.00	1546.676	0.06	15.4	708.8	1316	0.00e+00	false

2   Survey Image
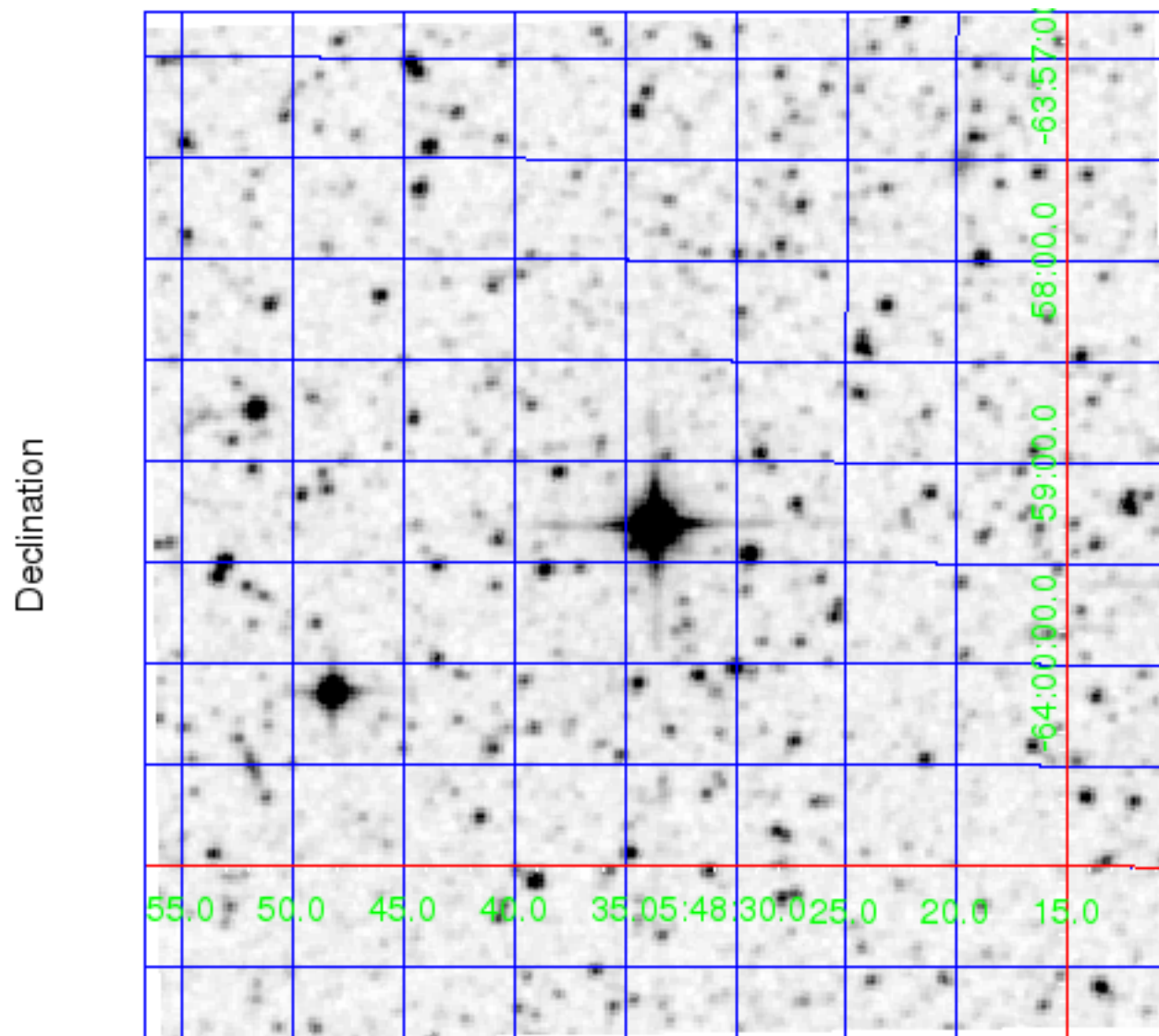
Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (149603524).

3   Flux Time Series
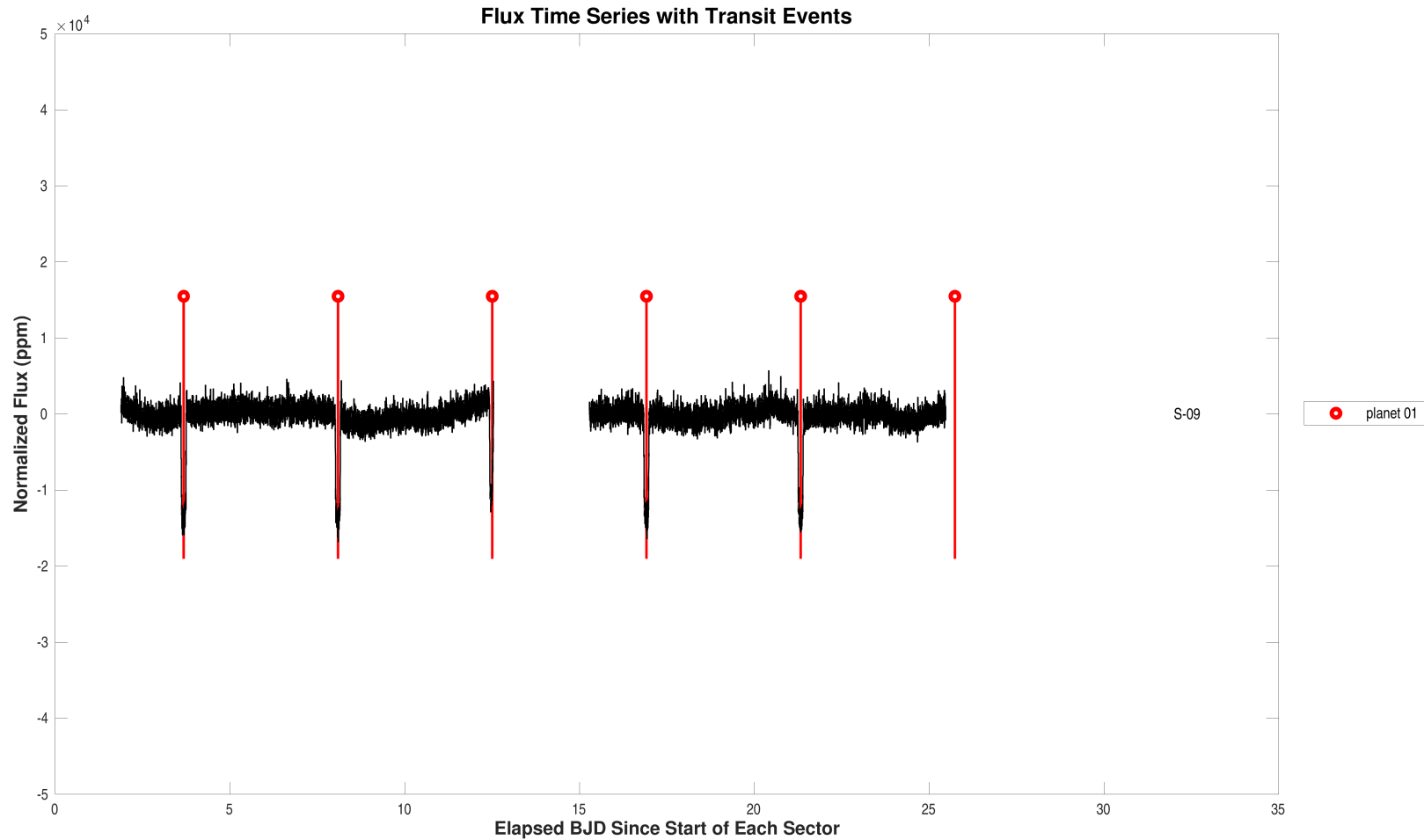
Summary plot of sector-stitched flux time series and transits for target 149603524, marked with DV fitted epoch/period (or TPS epoch/period if fit was not successful). Transits of identified planets are labeled with epoch BTJD and orbital period. For the data of sector 9, target table 152, start BJD is 2458543.
Open `./summary-plots/0000000149603524-00-flux-dv-fit-09-152.fig`
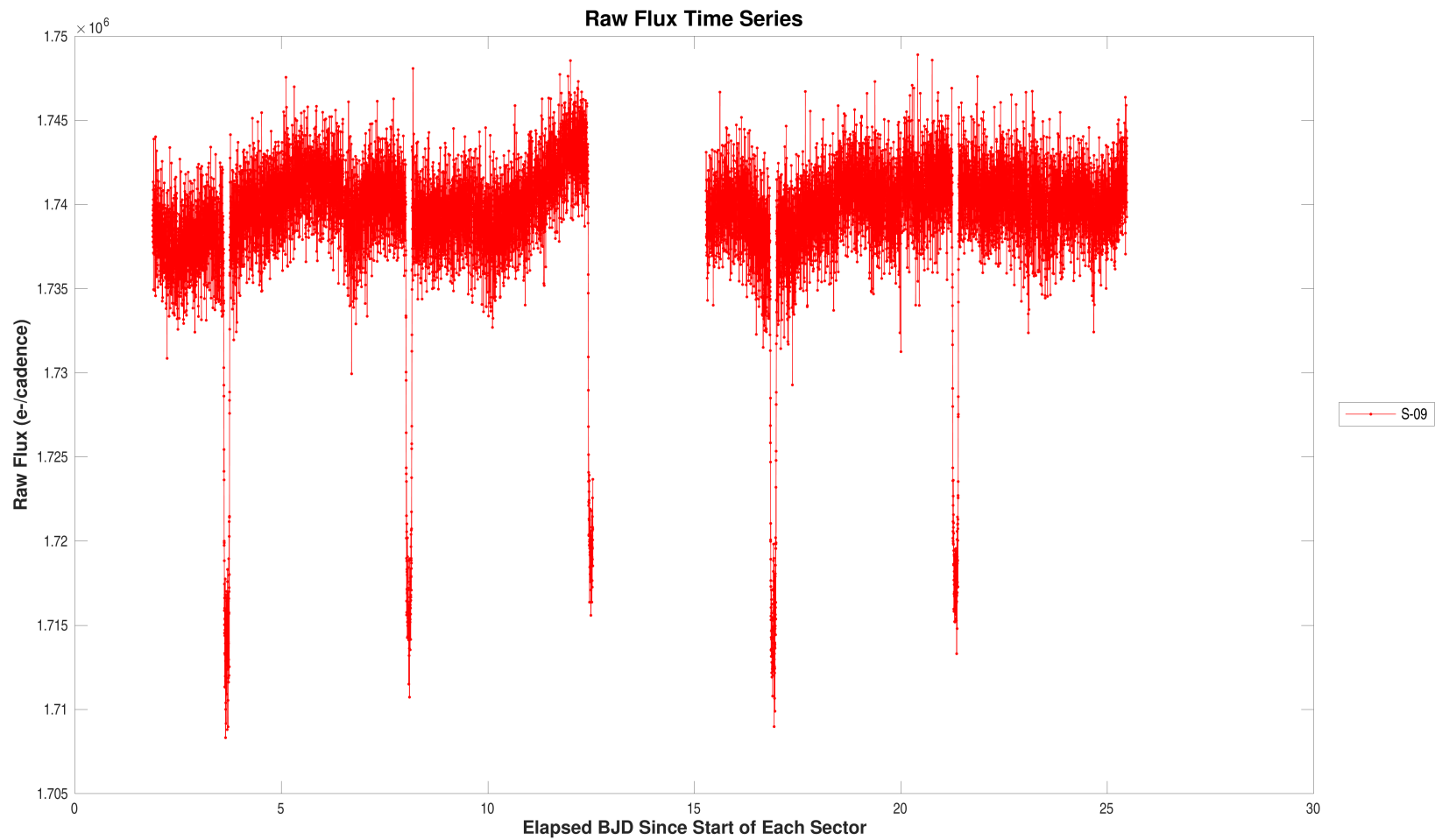
Summary plot of raw flux time series. For the data of sector 9, target table 152, start BJD is 2458543.
Open `./summary-plots/0000000149603524-00-raw-flux-09-152.fig`

4 Dashboards

Planet Candidate 1

Model Fitter		Ghost Diagnostic Test
Stellar Radius 1.3 ± 0.0 Solar units Period = 4.4 ± 0.0 days Depth = 13982 ± 80 ppm Planet Radius = 15.4 ± 0.1 Earth radii Semi-major Axis = 0.1 ± 0.0 AU Effective Stellar Flux = 708.8 ± 0.0 Equilibrium Temperature = 1316 ± 0 Kelvin Chi-squared/DoF = 0.8 SNR = 174.3	**Core Aperture Correlation Statistic** Value = 111.21 Significance = 100.00% **Halo Aperture Correlation Statistic** Value = 30.52 Significance = 100.00% **Core/Halo Ratio** Ratio = 3.64	

Eclipsing Binary Discrimination Test		Difference Image Centroid Offsets
Odd-Even Depth Comparison Statistic Value = 5.08e+00 Significance = 2.41%	**Offsets Relative to Out of Transit Centroid** Source RA Offset = -1.07e-01 ± 2.50e+00 arcsec (-0.04 σ) Source Dec Offset = -1.41e-01 ± 2.50e+00 arcsec (-0.06 σ) Source Offset Distance = 1.77e-01 ± 2.50e+00 arcsec (0.07 σ) **Offsets Relative to TIC Position** Source RA Offset = -1.01e-04 ± 2.50e+00 arcsec (-0.00 σ) Source Dec Offset = -8.45e-01 ± 2.50e+00 arcsec (-0.34 σ) Source Offset Distance = 8.45e-01 ± 2.50e+00 arcsec (0.34 σ)	

	Shorter Period Comparison Statistic	Longer Period Comparison Statistic	Bootstrap Test
	Value = N/A Significance = N/A	Value = N/A Significance = N/A	False Alarm = 0.00e+00 Transit Count = 5 Max Multiple Event Statistic = 153.2

Summary of model fitter results and validation test results for target 149603524, 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	$-0.1073 \pm 2.50e+00$	$-0.1408 \pm 2.50e+00$	arcseconds
Offset/σ	-0.04	-0.06	
Offset Distance	$0.1770 \pm 2.50e+00$		arcseconds
Offset Distance/σ	0.07		
3σ Radius	7.5011		arcseconds

Mean offset from the TIC RA and Dec

|	RA	Dec	Units
Offset	$-0.0001 \pm 2.50e+00$	$-0.8454 \pm 2.50e+00$	arcseconds
Offset/σ	-0.00	-0.34	
Offset Distance	$0.8454 \pm 2.50e+00$		arcseconds
Offset Distance/σ	0.34		
3σ Radius	7.5014		arcseconds

Planet Candidate 1
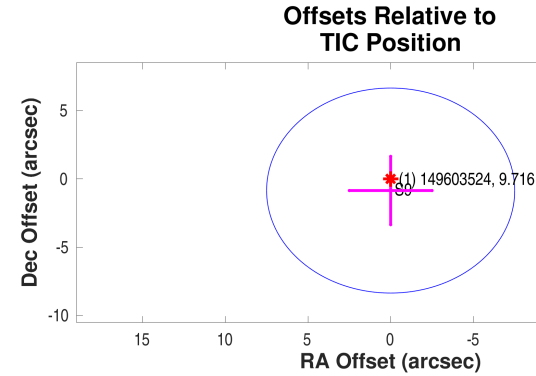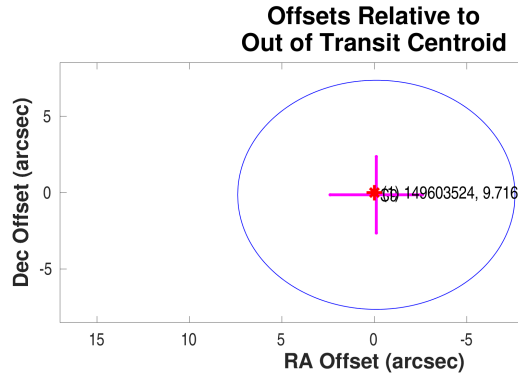
Difference image centroid offsets for target 149603524, planet candidate 1. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in RA and Dec with respect to the TC coordinates 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/0000000149603524-01-difference-image-centroid-offsets.fig
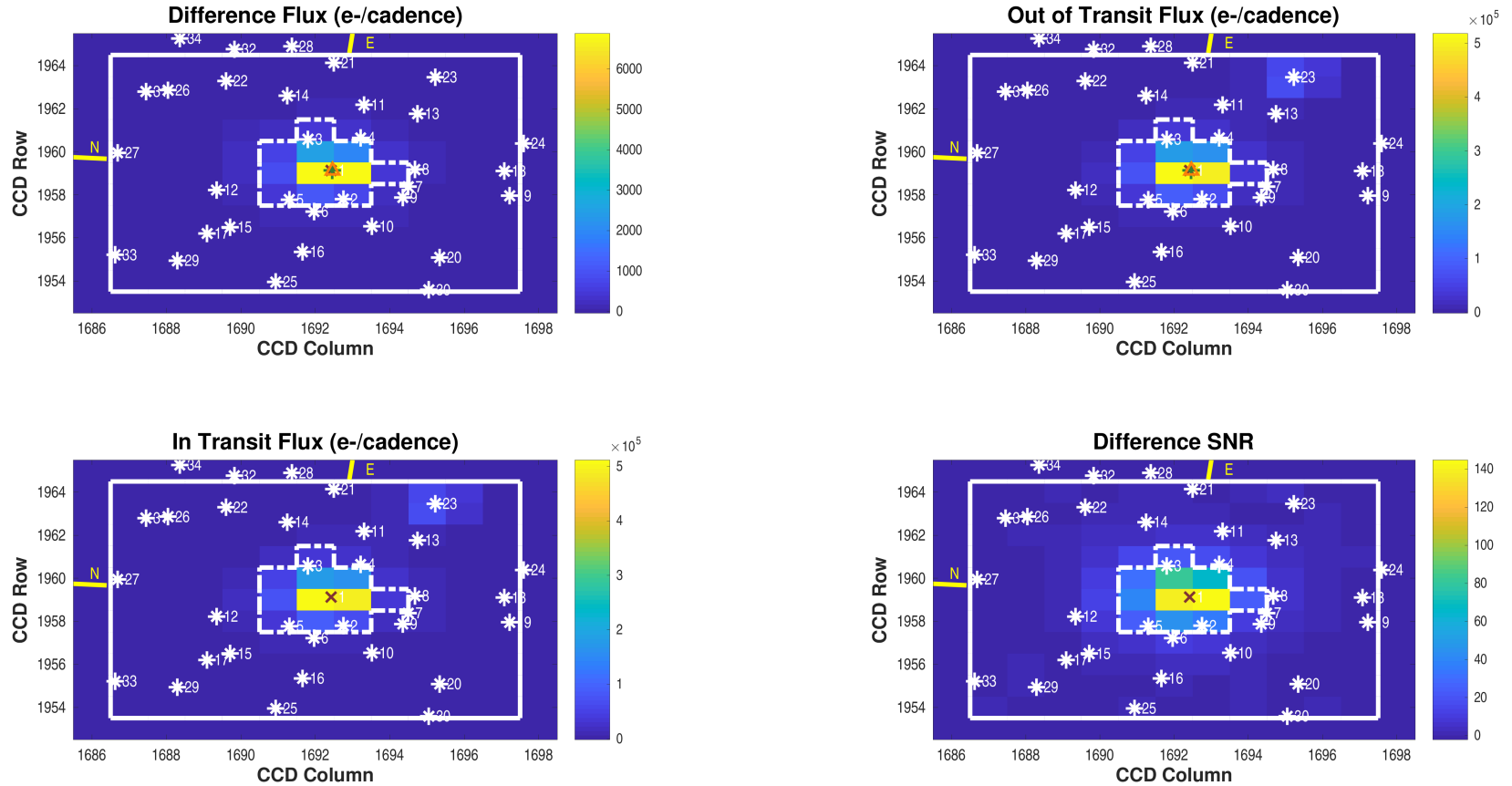
Planet Candidate 1
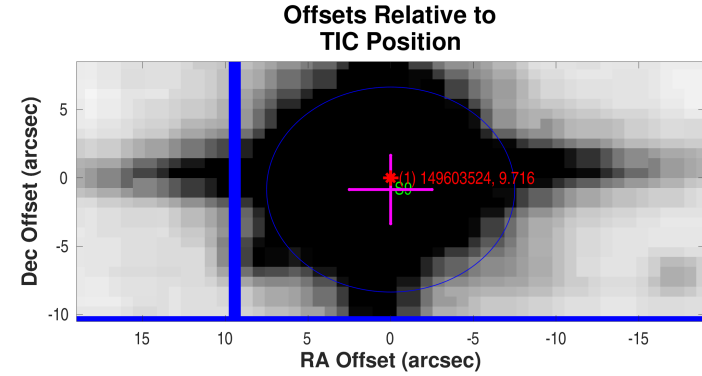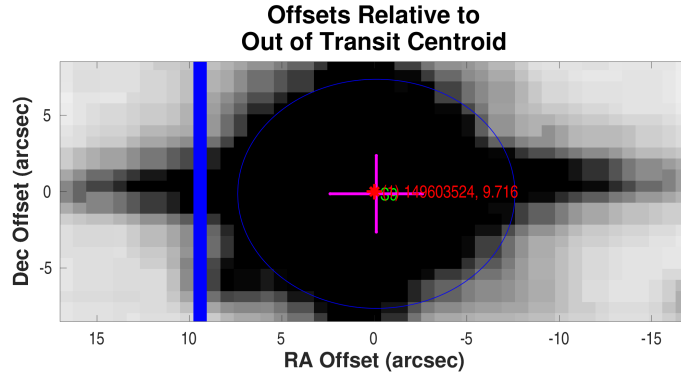
Difference image centroid offsets for target 149603524, planet candidate 1, diplayed on survey image for given target. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in 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; 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/0000000149603524-01-difference-image-centroid-offsets-survey.fig`

Difference Image Summary Metrics

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

Difference Image
Planet Candidate 1 / Sector 9 / Target Pixel Table 152

Difference image for target 149603524, planet candidate 1, sector 9, target pixel table 152. 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 = 353; number of in-transit cadence gaps = 9; number of valid out-of-transit cadences = 940; number of out-of-transit cadence gaps = 0. Difference image quality metric = 1.00 (good).
Open ./planet-01/difference-image/0000000149603524-01-difference-image-09-152.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	$1959.13 \pm 2.25e-05$	$1692.45 \pm 1.68e-05$	pixels	$87.13984400 \pm 1.03e-06$	$-63.98848887 \pm 9.28e-07$	degrees
Difference Image Centroid	$1959.13 \pm 3.25e-03$	$1692.46 \pm 2.39e-03$	pixels	$87.13977607 \pm 1.87e-05$	$-63.98852798 \pm 1.36e-05$	degrees
Offset	$-0.0056 \pm 3.25e-03$	$0.0062 \pm 2.39e-03$	pixels	$-0.1073 \pm 2.95e-02$	$-0.1408 \pm 4.90e-02$	arcseconds
Offset/σ	-1.74	2.59		-3.63	-2.87	
Offset Distance	$0.0084 \pm 2.90e-03$		pixels	$0.1770 \pm 4.34e-02$		arcseconds
Offset Distance/σ	2.89			4.08		

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

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$1959.13 \pm 1.79e-04$	$1692.42 \pm 1.62e-04$	pixels	$87.13977614 \pm 0.00e+00$	$-63.98829313 \pm 0.00e+00$	degrees
Difference Image Centroid	$1959.13 \pm 3.25e-03$	$1692.46 \pm 2.39e-03$	pixels	$87.13977607 \pm 1.87e-05$	$-63.98852798 \pm 1.36e-05$	degrees
Offset	$-0.0036 \pm 3.26e-03$	$0.0399 \pm 2.40e-03$	pixels	$-0.0001 \pm 2.95e-02$	$-0.8454 \pm 4.89e-02$	arcseconds
Offset/σ	-1.09	16.66		-0.00	-17.30	
Offset Distance	$0.0401 \pm 2.42e-03$		pixels	$0.8454 \pm 4.89e-02$		arcseconds
Offset Distance/σ	16.55			17.30		

5.2 Difference Image TIC Key

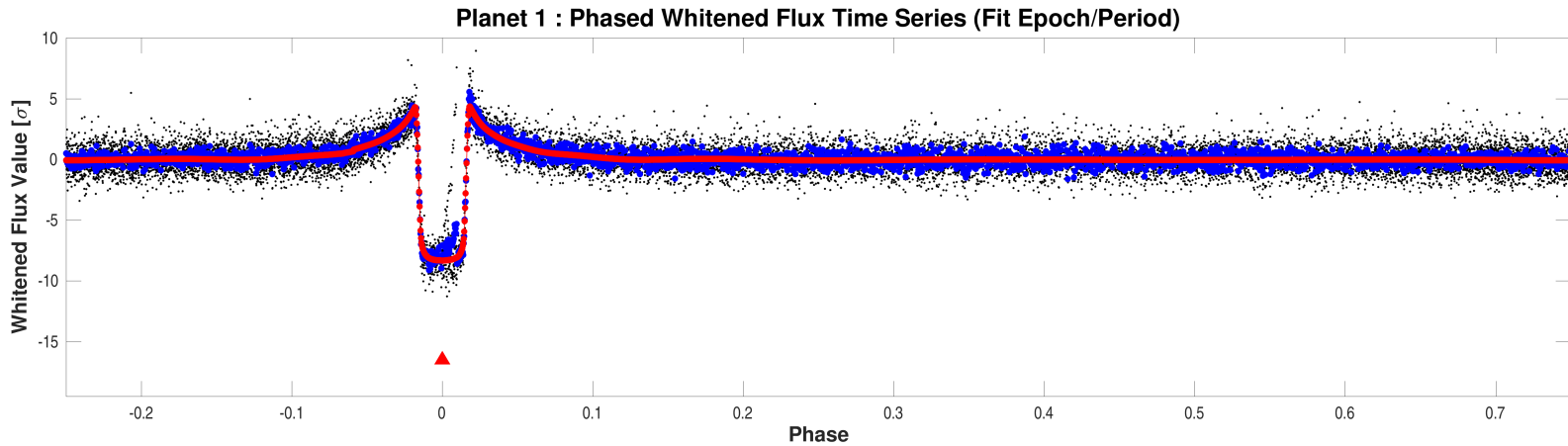| Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
1	149603524	9.716	87.13977614	-63.98829313	0.00
2	149603525	14.992	87.12234500	-63.99093200	29.11
3	149603518	15.820	87.15830784	-63.98390681	33.25
4	149603528	15.894	87.16093642	-63.99213368	36.16
5	149603517	16.575	87.12037769	-63.98247528	37.10
6	149603521	16.940	87.11370874	-63.98663239	41.59
7	149603533	16.610	87.13218962	-64.00079382	46.57
8	149603534	16.790	87.14307323	-64.00140802	47.50
9	149603531	15.354	87.12530673	-64.00020885	48.60
10	149603530	16.942	87.10638181	-63.99609053	59.73
11	149603527	17.068	87.18148318	-63.99183257	67.07
12	149603509	17.521	87.12401158	-63.97081579	67.66
13	149603532	17.805	87.17772438	-64.00046735	74.23
14	149603515	17.096	87.18469871	-63.97958346	77.55
15	149603510	16.195	87.10147800	-63.97385000	79.75
16	149603519	16.848	87.08841726	-63.98581912	81.57
17	149603507	16.254	87.09678245	-63.97039861	93.58
18	149603543	16.057	87.14491788	-64.01550280	98.29
19	149603546	17.150	87.12977437	-64.01693277	104.30
20	149603539	16.895	87.08929200	-64.00748400	105.48
21	149603520	16.975	87.20664439	-63.98606591	105.88
22	149603504	16.591	87.19194769	-63.96962859	106.30
23	149603535	11.775	87.20098472	-64.00233576	109.06
24	149603547	15.712	87.16273700	-64.01783702	112.37
25	149603516	17.371	87.06891848	-63.98234694	113.90
26	149603500	16.390	87.18428476	-63.96074461	121.55
27	149603494	16.631	87.14386667	-63.95439538	122.20
28	149603514	14.099	87.21539586	-63.97907284	123.92
29	149603502	15.988	87.07898222	-63.96640061	124.19
30	149603538	16.757	87.06888503	-64.00655581	129.80
31	149603498	15.548	87.18273741	-63.95733067	130.48
32	149603506	17.006	87.21177300	-63.97013500	131.12
33	149603496	17.227	87.08067688	-63.95650162	147.66
34	149603501	17.789	87.21665027	-63.96131041	155.45

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

6 Phased Light Curves
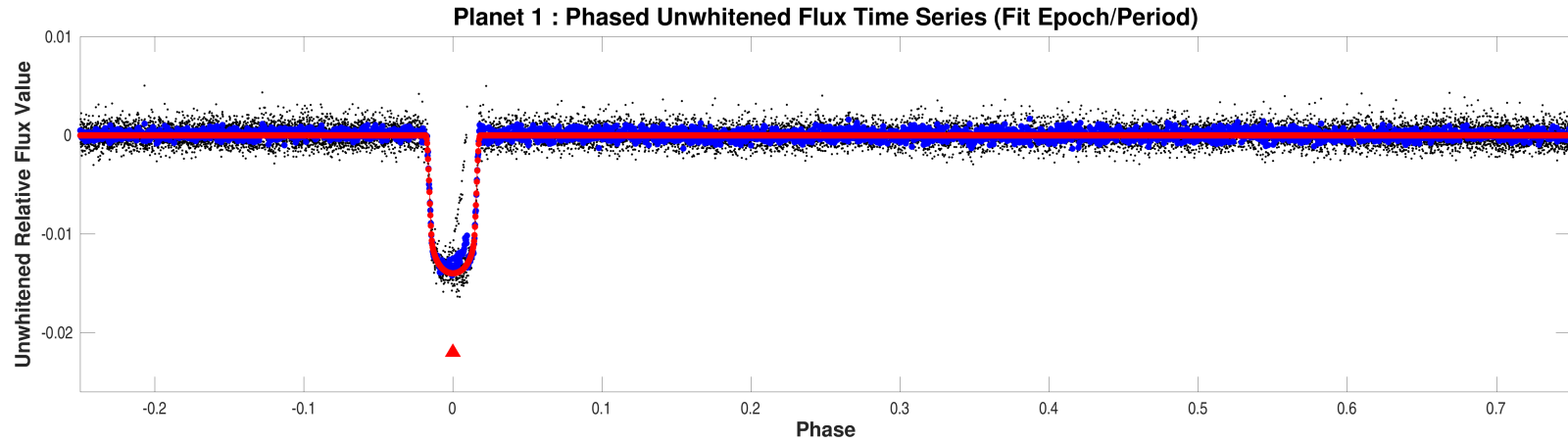
Phased unwhitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased unwhitened flux time series 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/0000000149603524-01-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/0000000149603524-01-phased-whitened-flux-time-series.fig

Planet: 1   Phased Unwhitened Flux Time Series by Sector
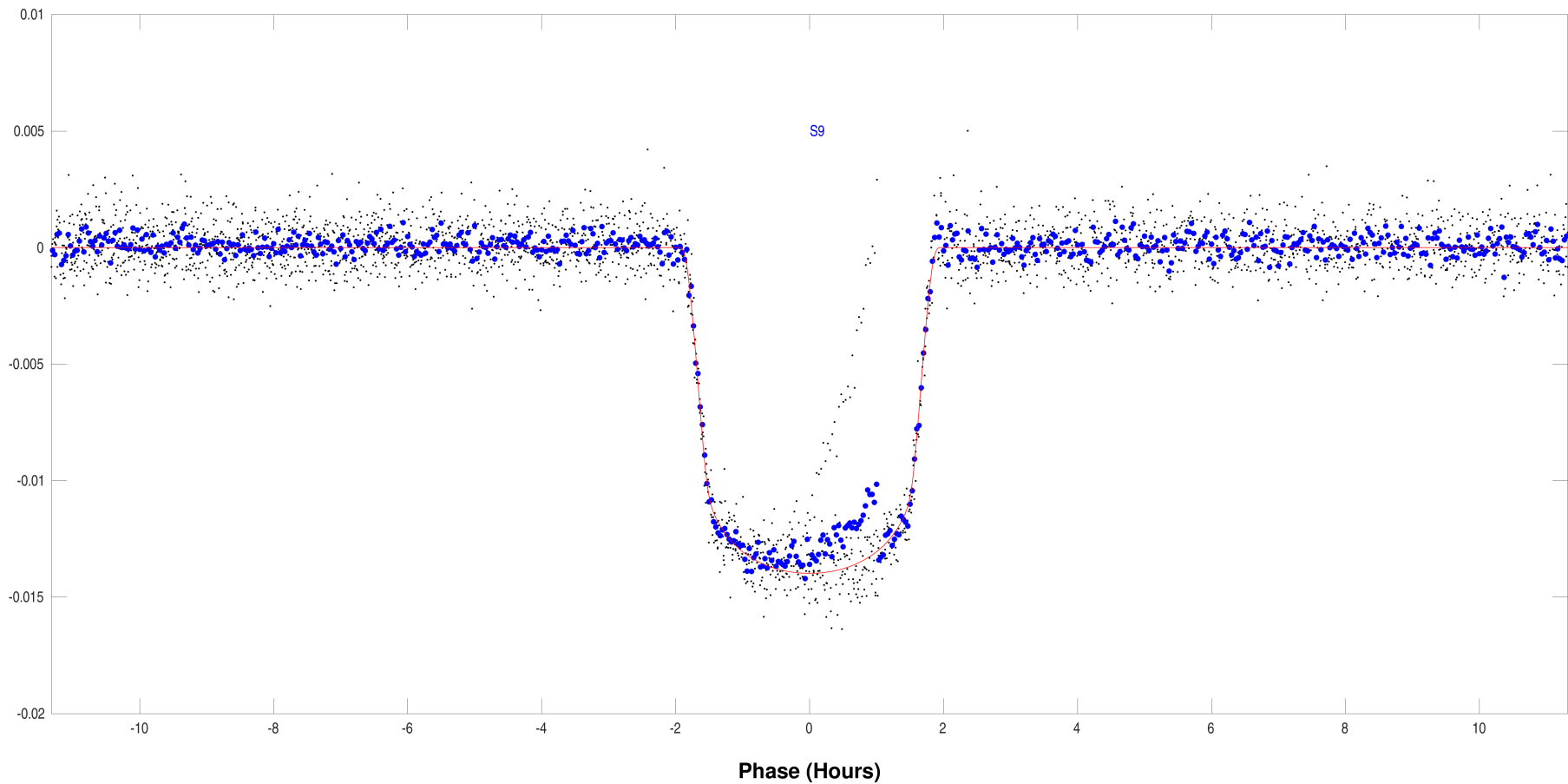
Phased unwhitened flux time series by sector for target 149603524, planet candidate 1. Period = 4.412 days; transit epoch = 1546.6755 BTJD.
Open `./summary-plots/0000000149603524-01-phased-unwhitened-flux-time-series-by-sector.fig`

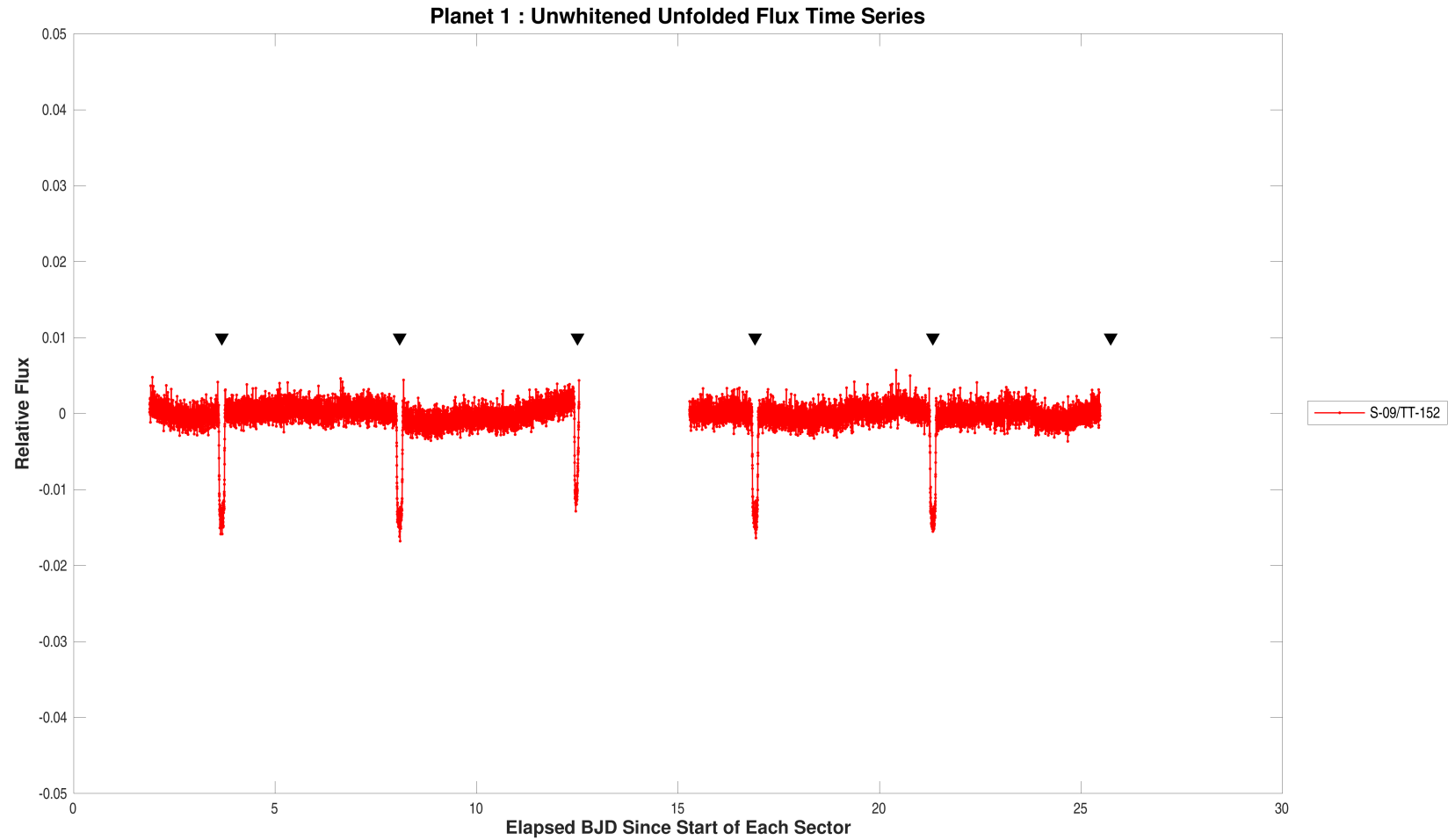# 7 Planet Candidate 1

7.1 Model Fitter: All Transits

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

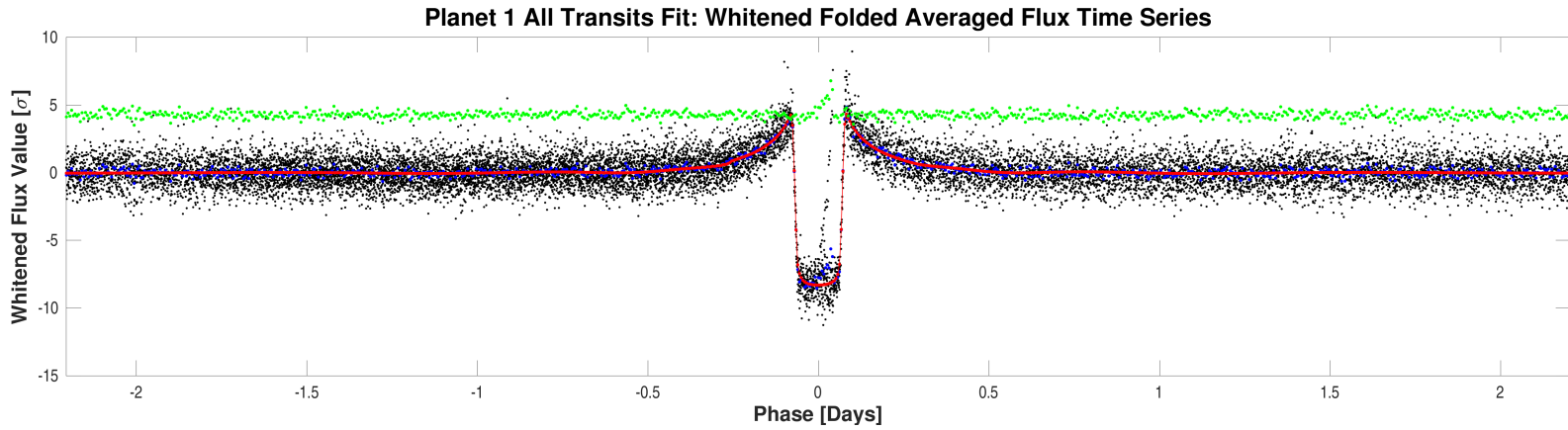| TCE Parameter	Value	Units
Trial Transit Pulse Duration	3.5	hours
Transit Epoch	1546.6775940	TJD
Orbital Period	4.4124980	days
Maximum SES	86.3	
Maximum MES	153.2	
Robust Statistic	140.7	
Chi Square Goodness of Fit Statistic (DoF)	3767.0 (491)	
Chi Square2 Statistic (DoF)	2779.5 (1603.8)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

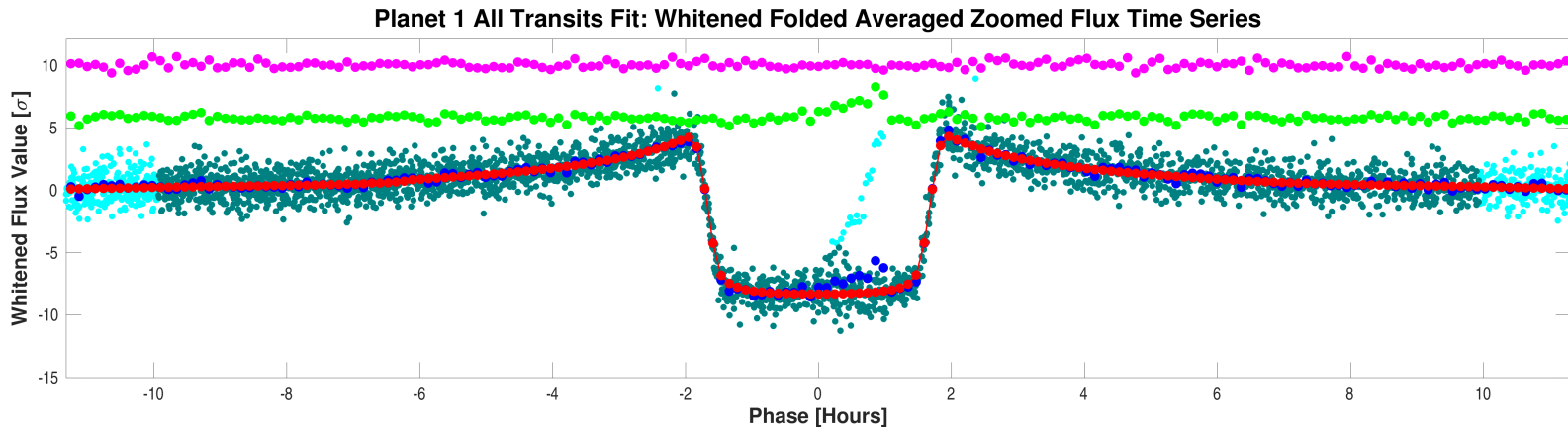| Parameter	Value	Uncertainty	Units
SNR	174.3		
Orbital Period	4.4120004	9.4364e-05	days
Transit Epoch	1546.6755125	2.3481e-04	BTJD
Impact Parameter	0.0100	2.3552e+00	
Planet Radius to Star Radius Ratio	0.1101964	5.5888e-04	
Semi-major Axis to Star Radius Ratio	9.9397	2.3173e-01	
Planet Radius	15.3986	7.8096e-02	Earth radii
Semi-major Axis	0.0568	8.0929e-07	AU
Effective Stellar Flux	708.7547	2.0212e-02	Goldilocks
Equilibrium Temperature	1316	9.3820e-03	Kelvin
Stellar Density	0.6778	4.7404e-02	Solar density
Transit Depth	13982	7.9548e+01	ppm
Transit Duration	3.7723	1.9718e-02	hours
Transit Ingress Duration	0.3756	1.9396e-02	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	2167.2 (2550.0)		
Model Chi Square Goodness of Fit Statistic (DoF)	305.5 (582)		
Model Chi Square2 Statistic (DoF)	2.2 (4)		

DoF: Degrees of Freedom

Flux time series for CatId 149603524, Planet candidate 1 in the unwhitened domain. For the data of Sector-09/TargetTableId-152, start BJD is 2458543. 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/0000000149603524-01-all-unwhitened-09-152.fig`

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

Folded flux time series for CatId 149603524, 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/0000000149603524-01-all-whitened.fig`

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

Folded flux time series for CatId 149603524, 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/0000000149603524-01-all-whitened-zoomed.fig`

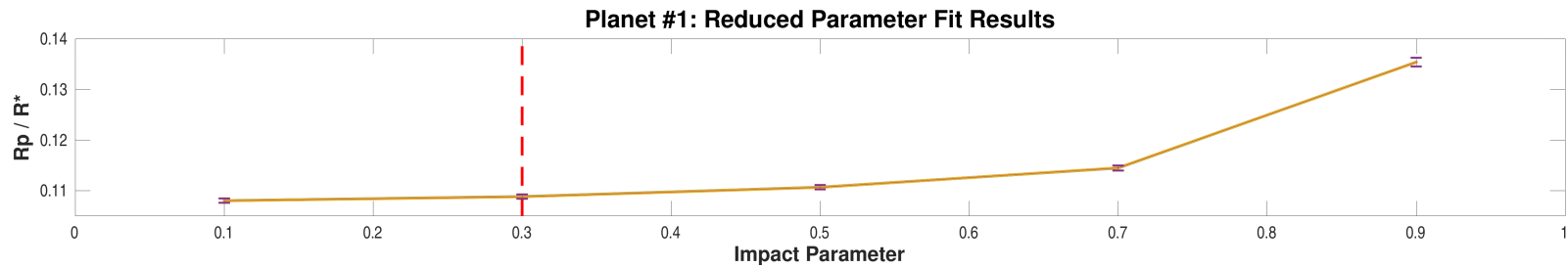## 7.2   Model Fitter: Reduced Parameter Fit Results

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	169.7	4205.4	0.1080353	4.1176e-04	9.8581	2.6329e-02	13419	1.0168e+02	3.7811	1.0227e-02
0.30	170.0	4199.1	0.1088439	4.1436e-04	9.4556	2.6133e-02	13438	1.0169e+02	3.8152	1.0697e-02
0.50	170.0	4288.9	0.1106880	4.2761e-04	8.5956	2.6264e-02	13471	1.0339e+02	3.9043	1.2152e-02
0.70	163.0	4587.5	0.1144872	4.8348e-04	7.1243	2.7723e-02	13531	1.1329e+02	4.1332	1.6548e-02
0.90	156.7	6715.6	0.1354035	8.6077e-04	5.0001	3.8557e-02	14740	1.5763e+02	4.7597	3.7154e-02

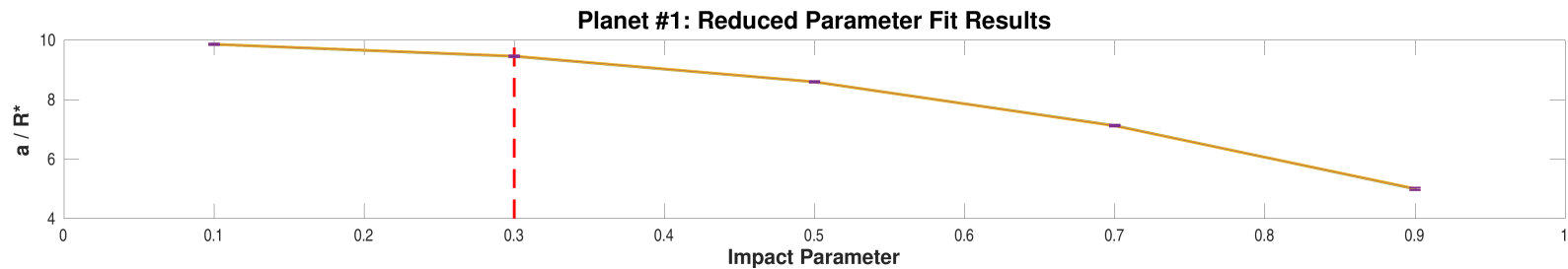Highlighted row is the best reduced-parameter model fit.
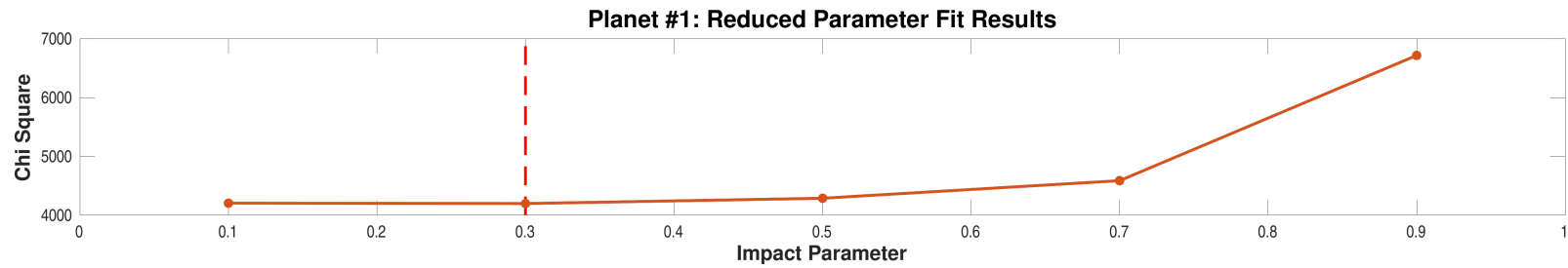
Model chi squares of reduced parameter fits vs. impact parameter for CatId 149603524, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.
Open ./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000149603524-01-reduced-fits-chi-square.fig

Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 149603524, 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/0000000149603524-01-reduced-fits-rp-over-rstar.fig

Ratios of semimajor axis to star radius of reduced parameter fits vs. impact parameter for CatId 149603524, 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/0000000149603524-01-reduced-fits-a-over-rstar.fig
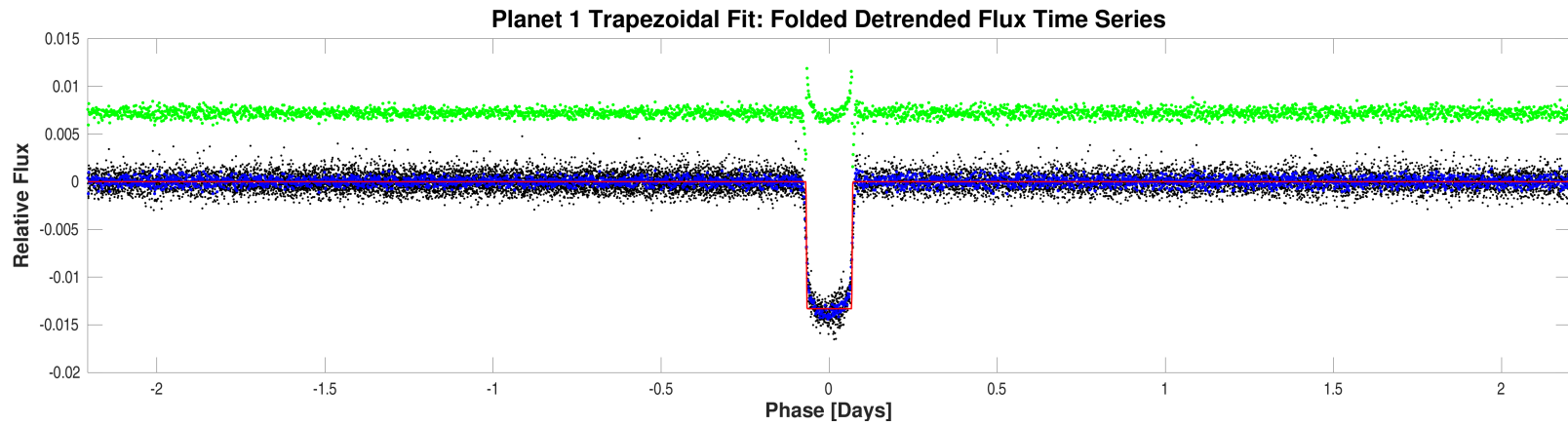
7.3   Model Fitter: Trapezoidal Fit Results

Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

| TCE Parameter	Value	Units
Trial Transit Pulse Duration	3.5	hours
Transit Epoch	1546.6775940	TJD
Orbital Period	4.4124980	days
Maximum SES	86.3	
Maximum MES	153.2	
Robust Statistic	140.7	
Chi Square Goodness of Fit Statistic (DoF)	3767.0 (491)	
Chi Square2 Statistic (DoF)	2779.5 (1603.8)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

Parameter	Value	Uncertainty	Units
SNR	315.7		
Orbital Period	4.4124980		days
Transit Epoch	1546.6744459		BTJD
Transit Depth	13319		ppm
Transit Duration	3.7260		hours
Transit Ingress Duration	0.4572		hours
Model Chi Square Statistic (DoF)	16451.6 (4028)		

DoF: Degrees of Freedom

Planet 1 Trapezoidal Fit: Folded Detrended Flux Time Series

Folded detrended flux time series for CatId 149603524, Planet candidate 1 and folded trapezoidal model light curve.
Open ./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000149603524-01-all-trapezoidal.fig

Planet 1 Trapezoidal Fit: Zoomed Folded Detrended Flux Time Series
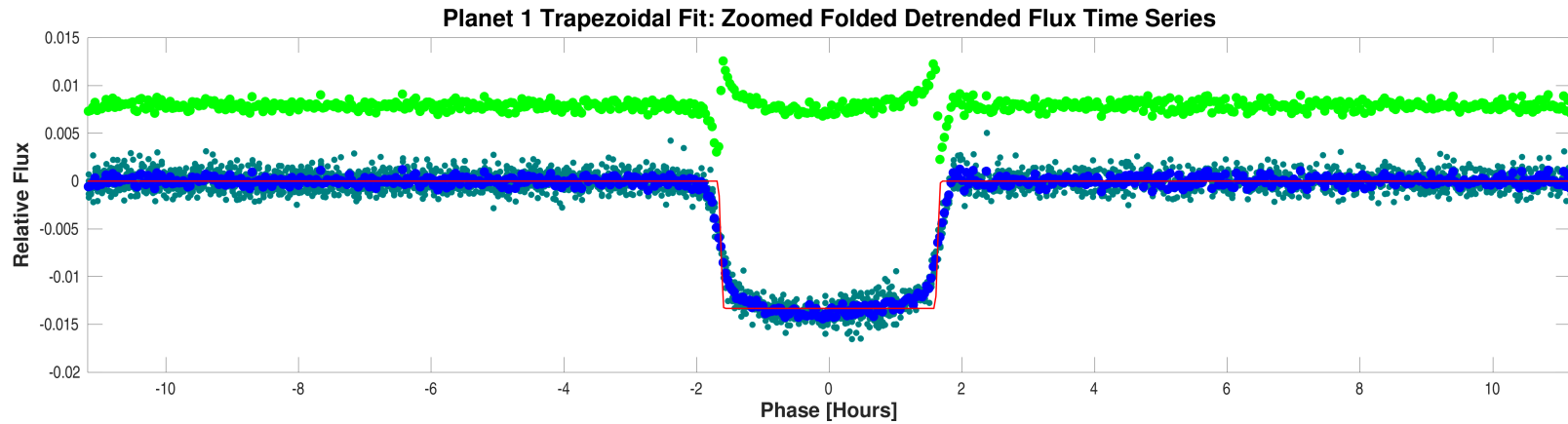
Zoomed folded detrended flux time series for CatId 149603524, Planet candidate 1 and folded trapezoidal model light curve.
Open ./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000149603524-01-all-trapezoidal-zoomed.fig

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	4.4125		days		
Transit Duration	3.5		hours		
Maximum MES	153.2				
Secondary Phase	-0.64028		days		
Secondary MES	3.7				
Minimum Phase	-0.44861		days		
Minimum MES	-3.8				
Median MES	-0.1				
MAD MES	0.58419				
Robust Statistic	3.1				
Secondary Depth	450.1	1.2906e+02	ppm		
Geometric Albedo	3.4	9.6525e-01		2.4495	0.72
Planet Effective Temperature	2756	1.9764e+02	Kelvin	7.2838	0.00

7.4.2   Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	5.0848e+00	2.2550	2.41

7.4.3   Bootstrap Test

Result	Value
False Alarm Probability	0.0000e+00
Bootstrap Threshold for Desired PFA	5.9
MES Mean	1.34
MES Standard Deviation	0.67
Transit Count	5

7.4.4   Ghost Diagnostic Test

Result	Value	Significance (%)
Maximum MES	153.2	
SNR	174.3	
Core Aperture Statistic	1.1121e+02	100.00
Halo Aperture Statistic	3.0521e+01	100.00
Ratio of Core/Halo Aperture Statistics	3.6436e+00	

7.4.5   Validation Test Figures
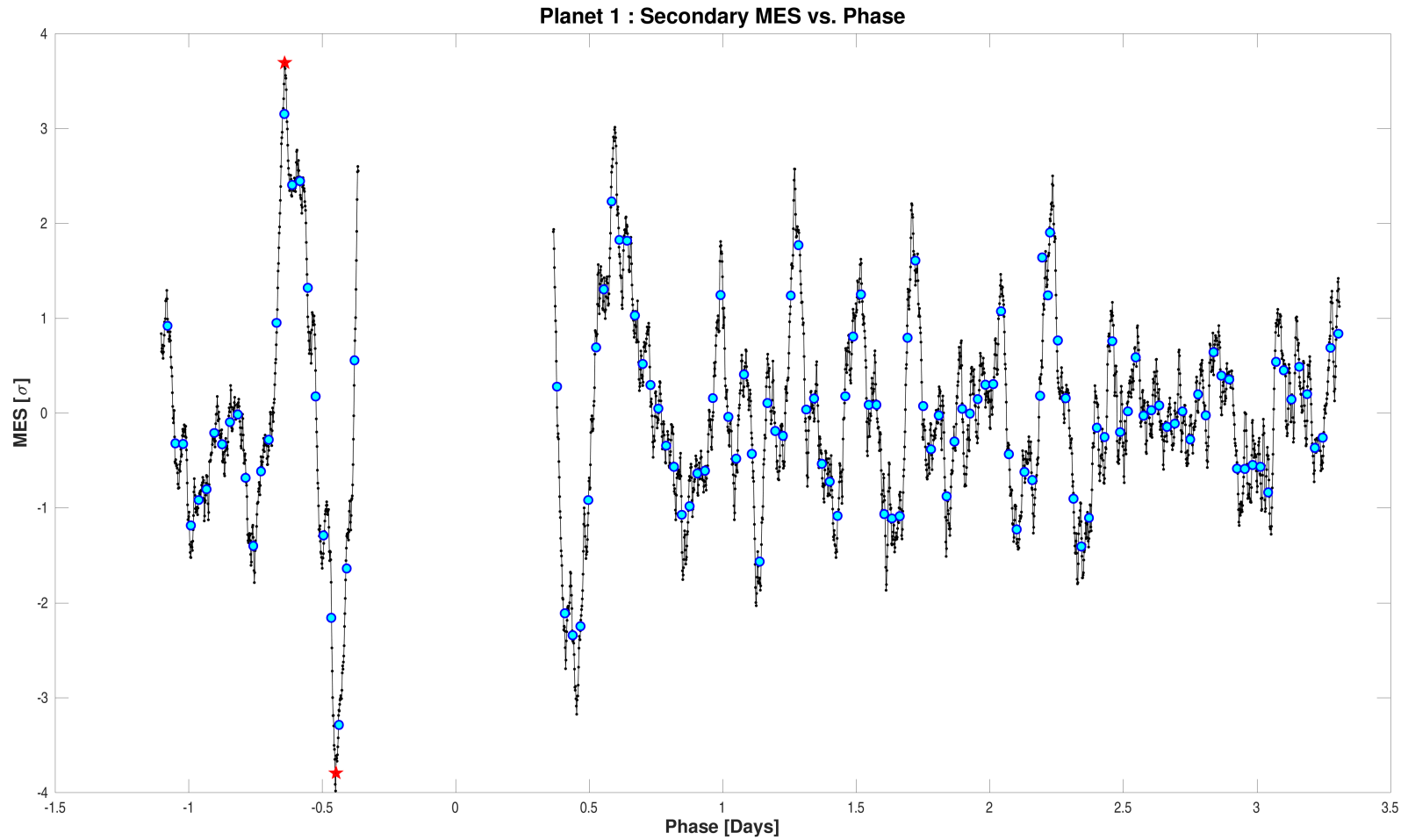
The primary event has been set to zero and both the max and min of the resulting MES vs. Phase are marked with a red star. The best matched pulse duration in hours is 3.5. The maximum secondary MES and corresponding phase are 3.695 and -0.64028 days respectively. The minimum secondary MES and corresponding phase are -3.7933 and -0.44861 days respectively.

Open `./planet-01/report-summary/0000000149603524-01-weak-secondary-diagnostic.fig`
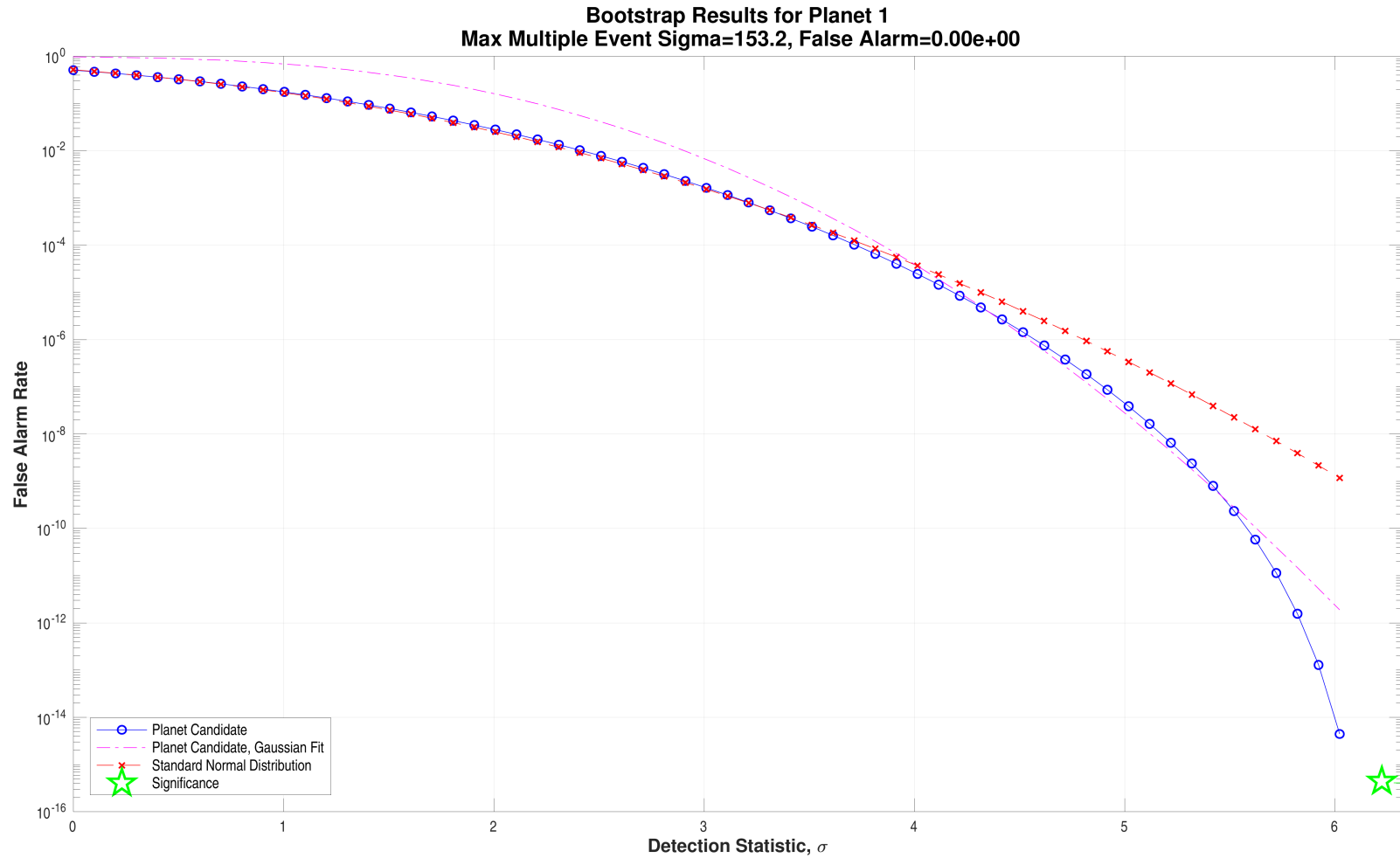
Bootstrap results for target 149603524, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is Inf. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 5.8864.

Open `./planet-01/bootstrap-results/0000000149603524-01-bootstrap-false-alarm.fig`

Planet 1 : Cotrended Folded Core Aperture Flux Time Series
Correlation Statistic = 111.21, Significance = 100.00%
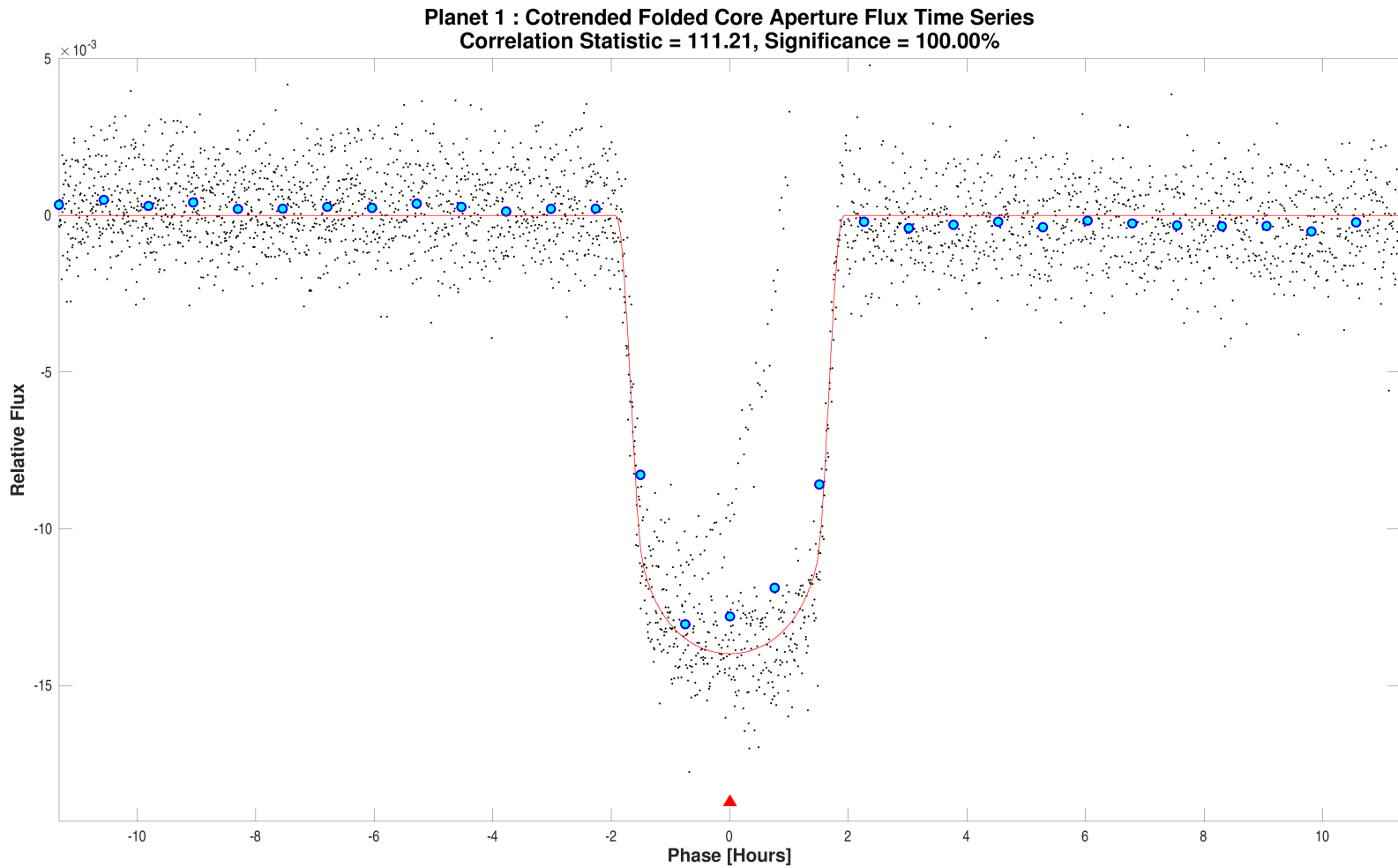
Optical ghost diagnostic core aperture flux time series for target 149603524, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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/0000000149603524-01-core-unwhitened-cotrended-zoomed-model.fig

Planet 1 : Cotrended Folded Halo Aperture Flux Time Series
Correlation Statistic = 30.52, Significance = 100.00%
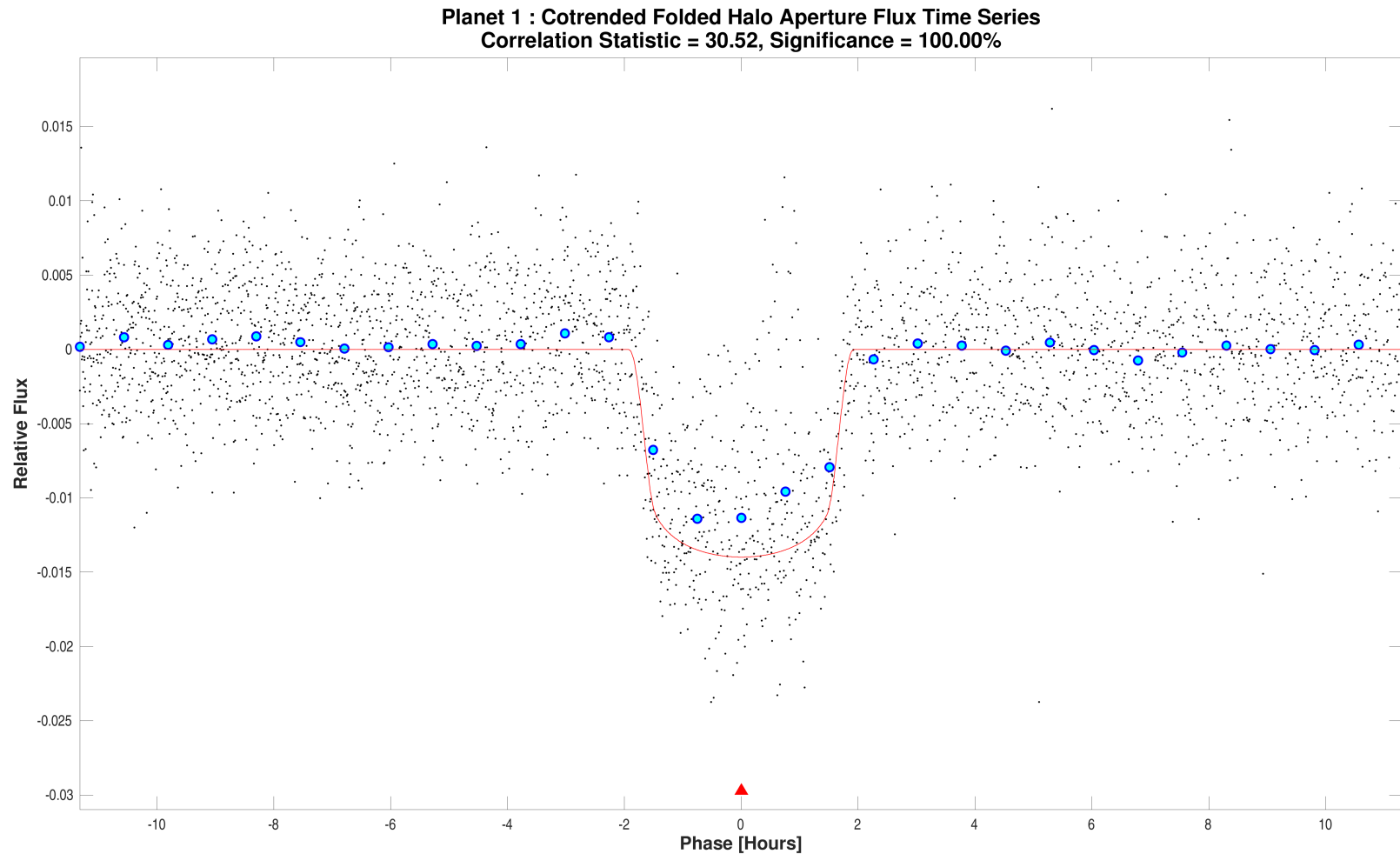
Optical ghost diagnostic halo aperture flux time series for target 149603524, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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/0000000149603524-01-halo-unwhitened-cotrended-zoomed-model.fig`

Appendix A   Planet Candidate 1

A.1   Model Fitter: All Transits
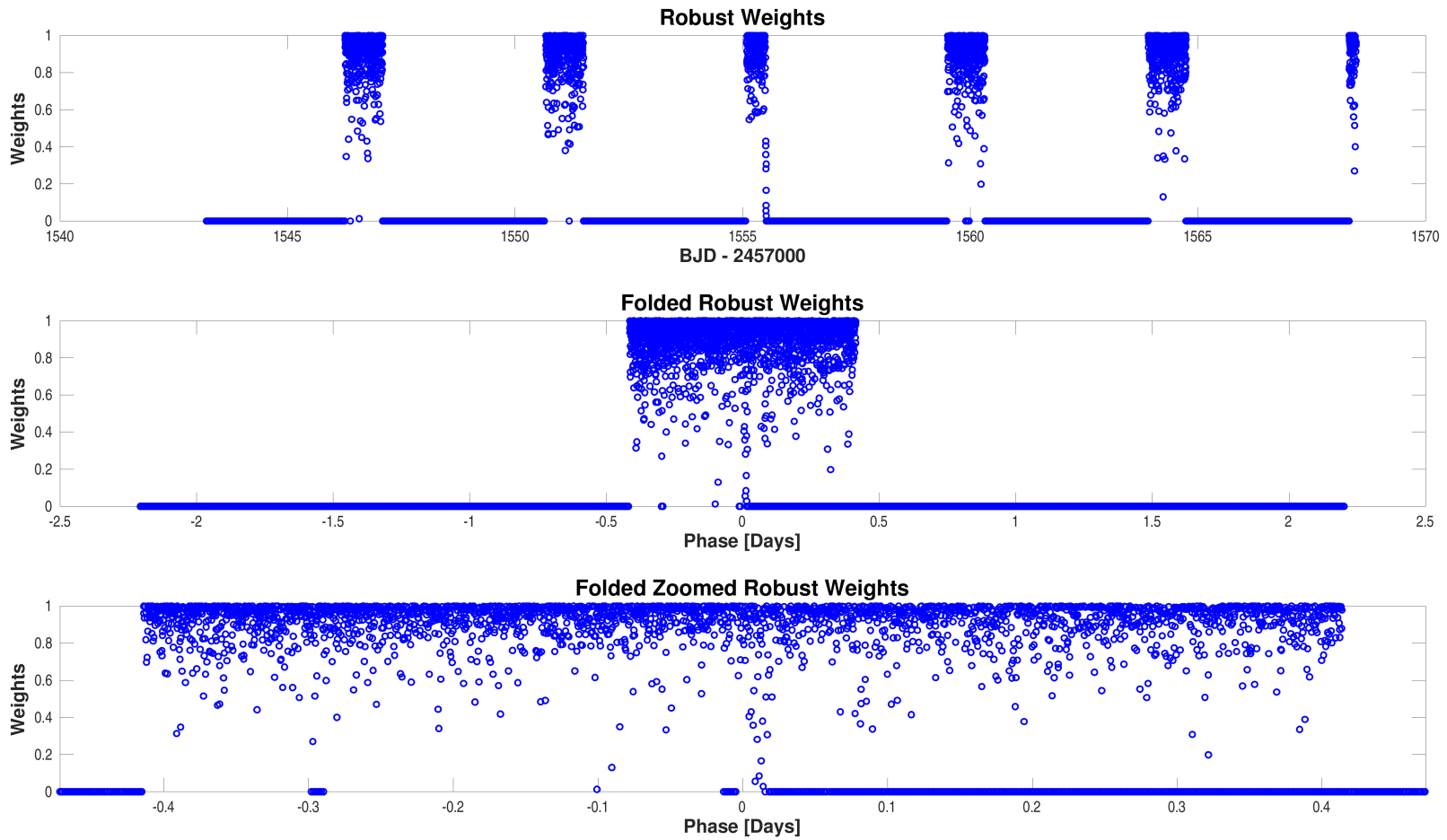
Robust weights distribution for CatId 149603524, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000149603524-01-all-robust-weights.fig`
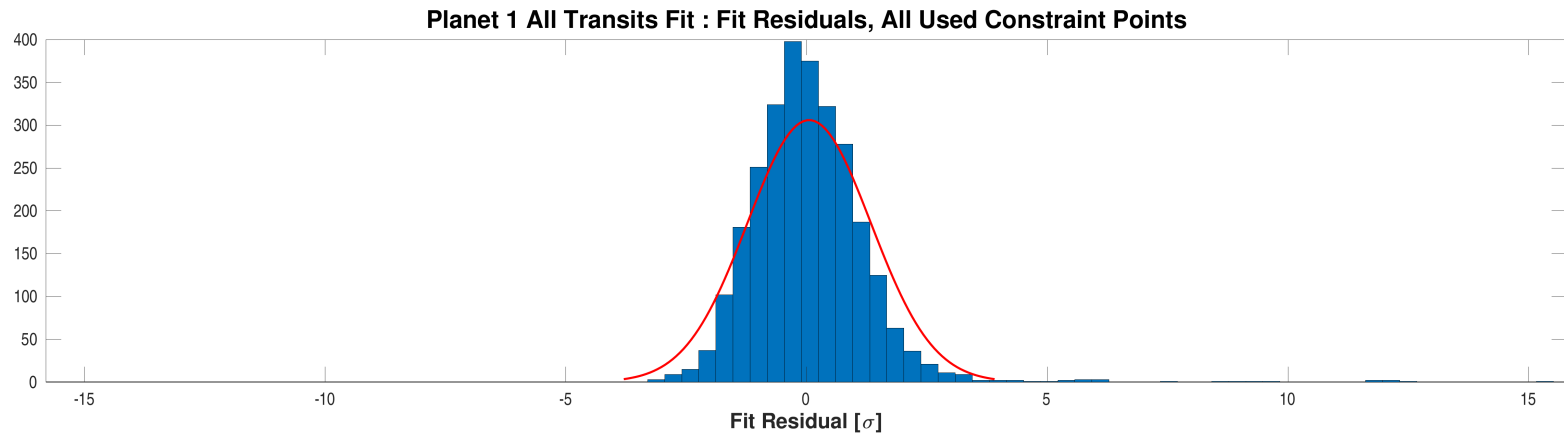
Fit residuals distribution for CatId 149603524, Planet candidate 1. Only the valid data points used to constrain the fit are shown here. A Gaussian fit to the histogram is shown in red.
Open ./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000149603524-01-all-histo-used.fig
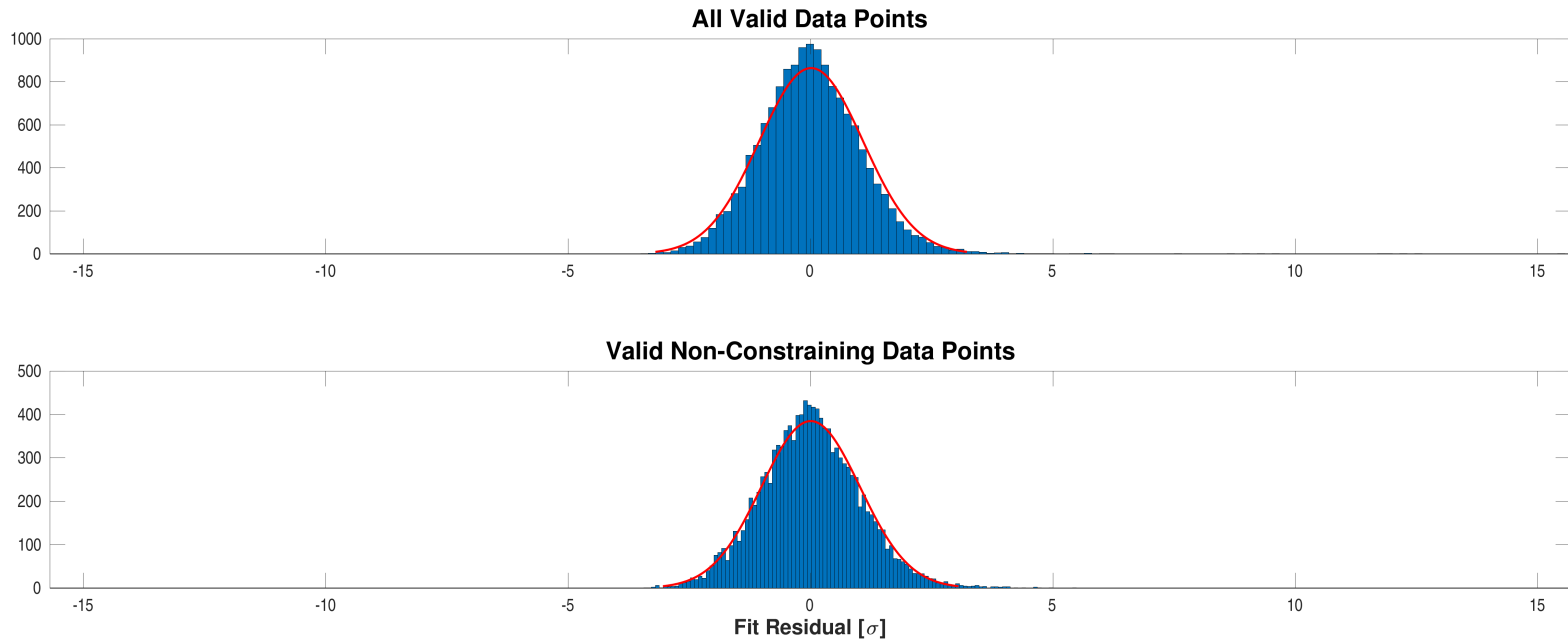

Fit residuals distribution for CatId 149603524, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.
Open ./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000149603524-01-all-histo-all-and-unused.fig
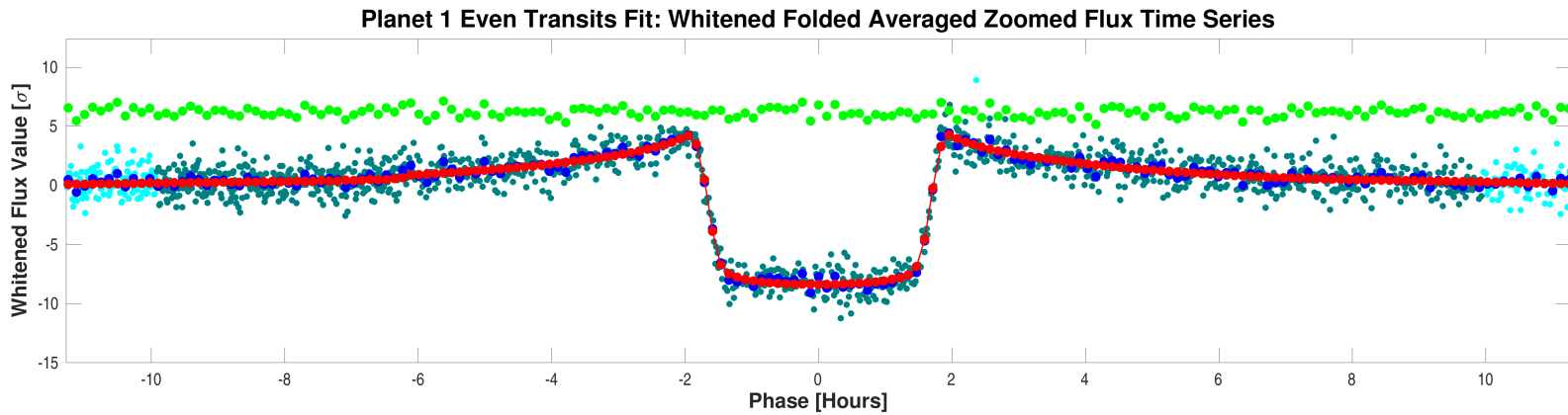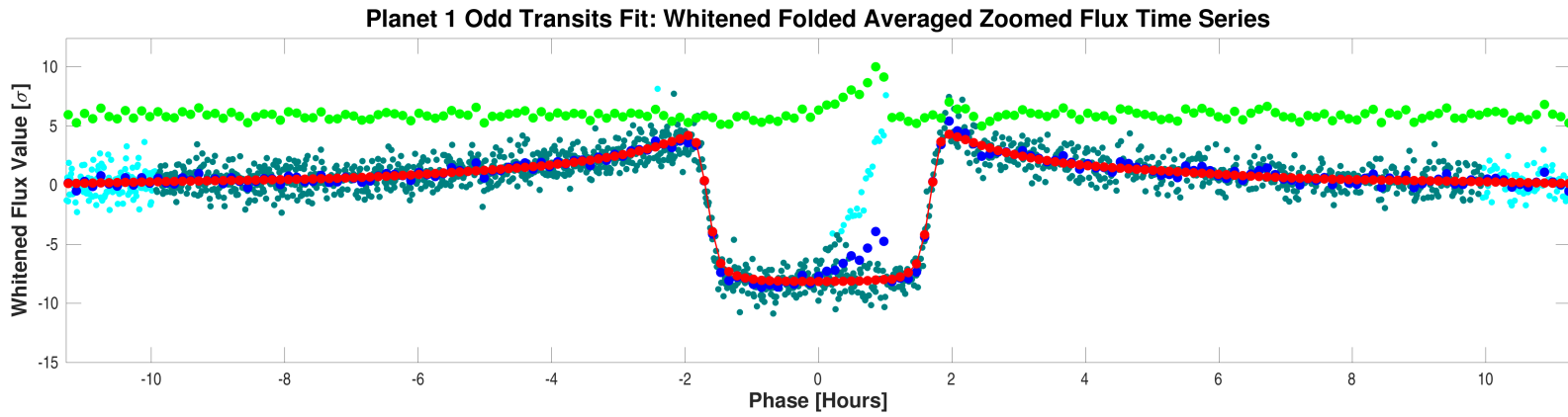
A.2   Model Fitter: Odd & Even Transits

Parameter	Odd Transits Value	Odd Transits Uncertainty	Even Transits Value	Even Transits Uncertainty	Units	Difference ‖Uncertainty‖
SNR	129.7		114.4			
Orbital Period	4.4120177	1.0765e-04	4.4119888	2.1744e-04	days	1.1884e-01
Transit Epoch	1546.6753378	2.9311e-04	1551.0876721	2.9799e-04	BTJD	7.9869e-01
Impact Parameter	0.0100	3.2743e+00	0.1871	1.7597e-01		5.4001e-02
Planet Radius to Star Radius Ratio	0.1092256	7.5555e-04	0.1110003	8.4783e-04		1.5628e+00
Semi-major Axis to Star Radius Ratio	9.9666	3.2308e-01	9.7657	3.2948e-01		4.3535e-01
Planet Radius	15.2629	1.0558e-01	15.5109	1.1847e-01	Earth radii	1.5628e+00
Semi-major Axis	0.0568	9.2321e-07	0.0568	1.8648e-06	AU	1.1884e-01
Effective Stellar Flux	708.7510	2.3057e-02	708.7572	4.6574e-02	Goldilocks	1.1884e-01
Equilibrium Temperature	1316	1.0703e-02	1316	2.1619e-02	Kelvin	1.1884e-01
Stellar Density	0.6833	6.6448e-02	0.6428	6.5063e-02	Solar density	4.3531e-01
Transit Depth	13737	1.0388e+02	14107	1.2674e+02	ppm	2.2550e+00
Transit Duration	3.7588	2.7112e-02	3.7884	2.9754e-02	hours	7.3405e-01
Transit Ingress Duration	0.3713	2.6632e-02	0.3921	2.9389e-02	hours	5.2613e-01
Eccentricity	0.0000	0.0000e+00	0.0000	0.0000e+00		
Peri Longitude	0.0000	0.0000e+00	0.0000	0.0000e+00	degrees	
Model Chi Square Statistic (DoF)	2178.4 (2548.3)		2178.4 (2548.3)			

DoF: Degrees of Freedom
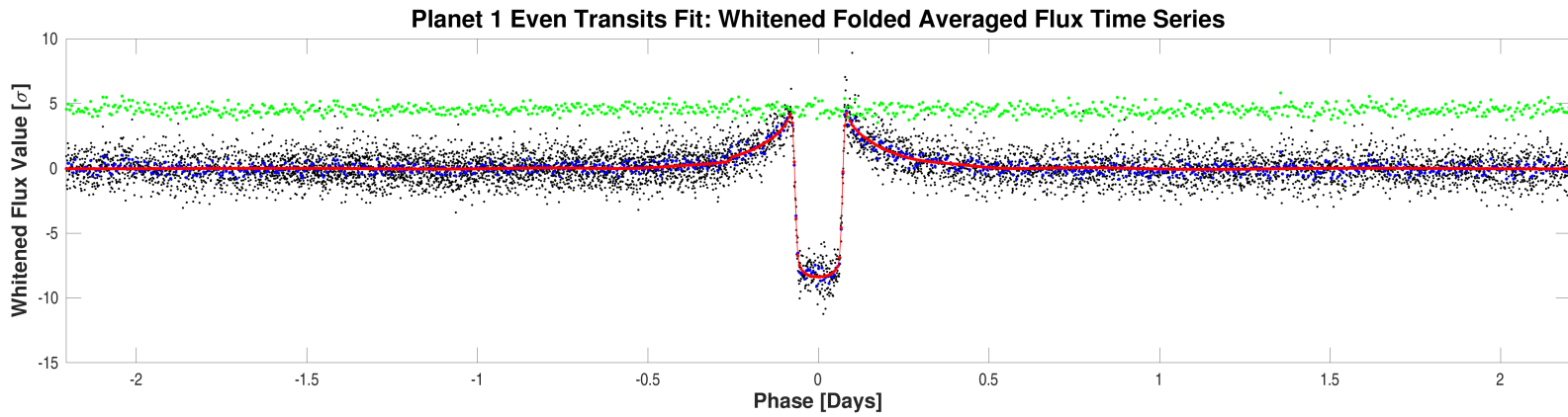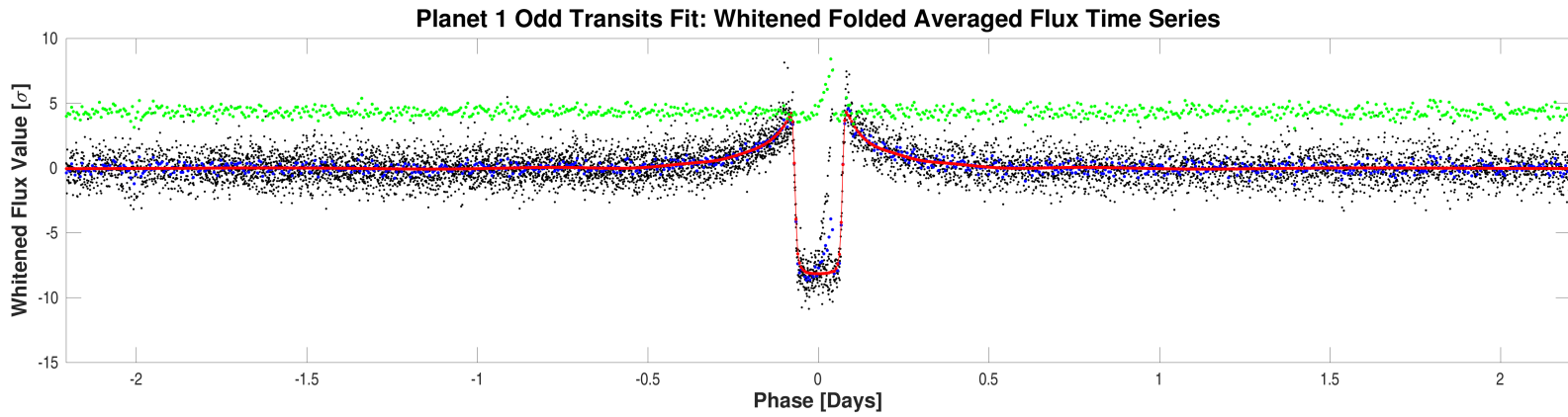
Planet 1 Odd Transits Fit: Whitened Folded Averaged Flux Time Series

**Planet 1 Even Transits Fit: Whitened Folded Averaged Flux Time Series**

Folded flux time series for CatId 149603524, 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/0000000149603524-01-odd-even-whitened.fig`

Folded flux time series for CatId 149603524, 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/0000000149603524-01-odd-even-whitened-zoomed.fig
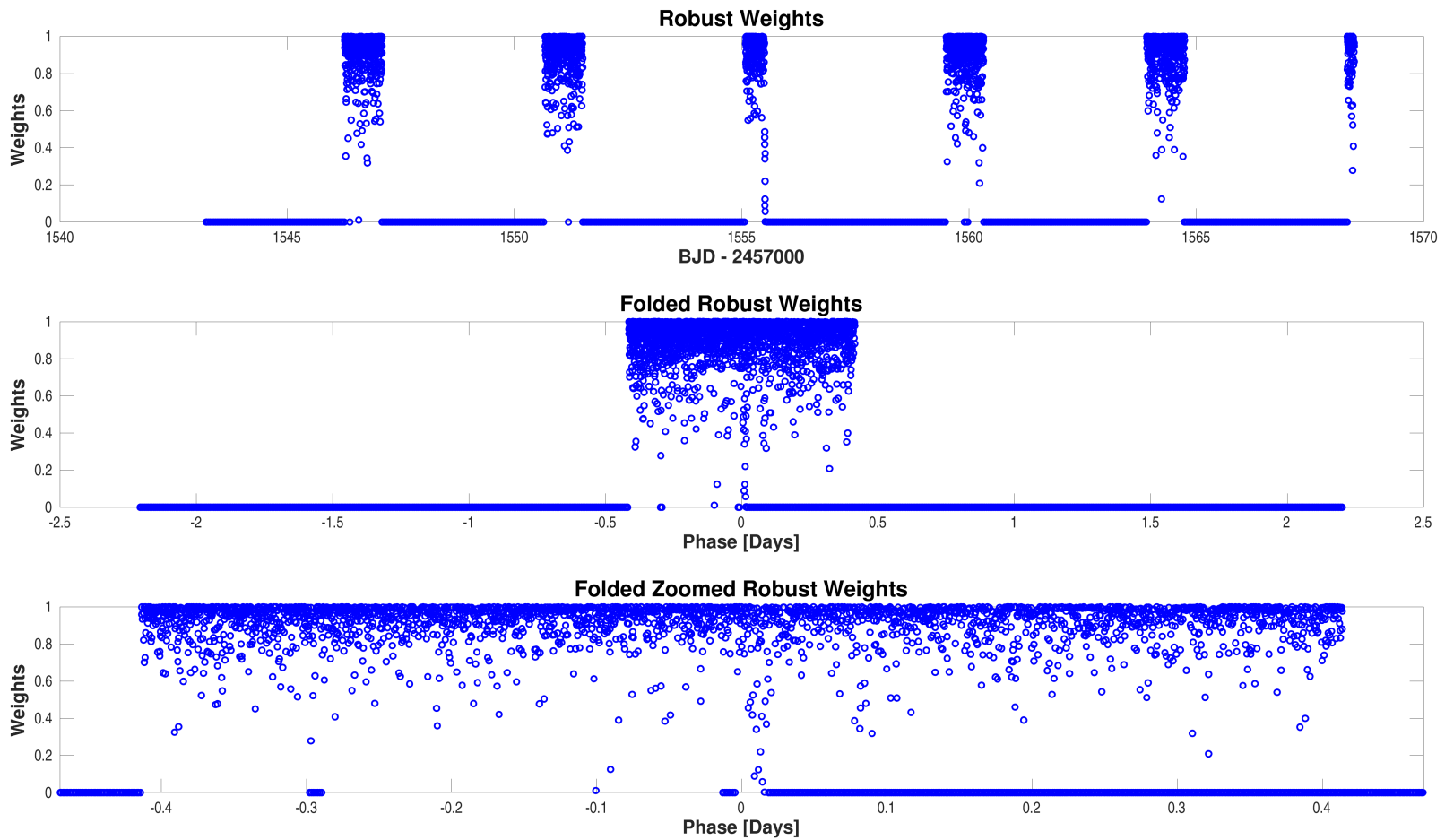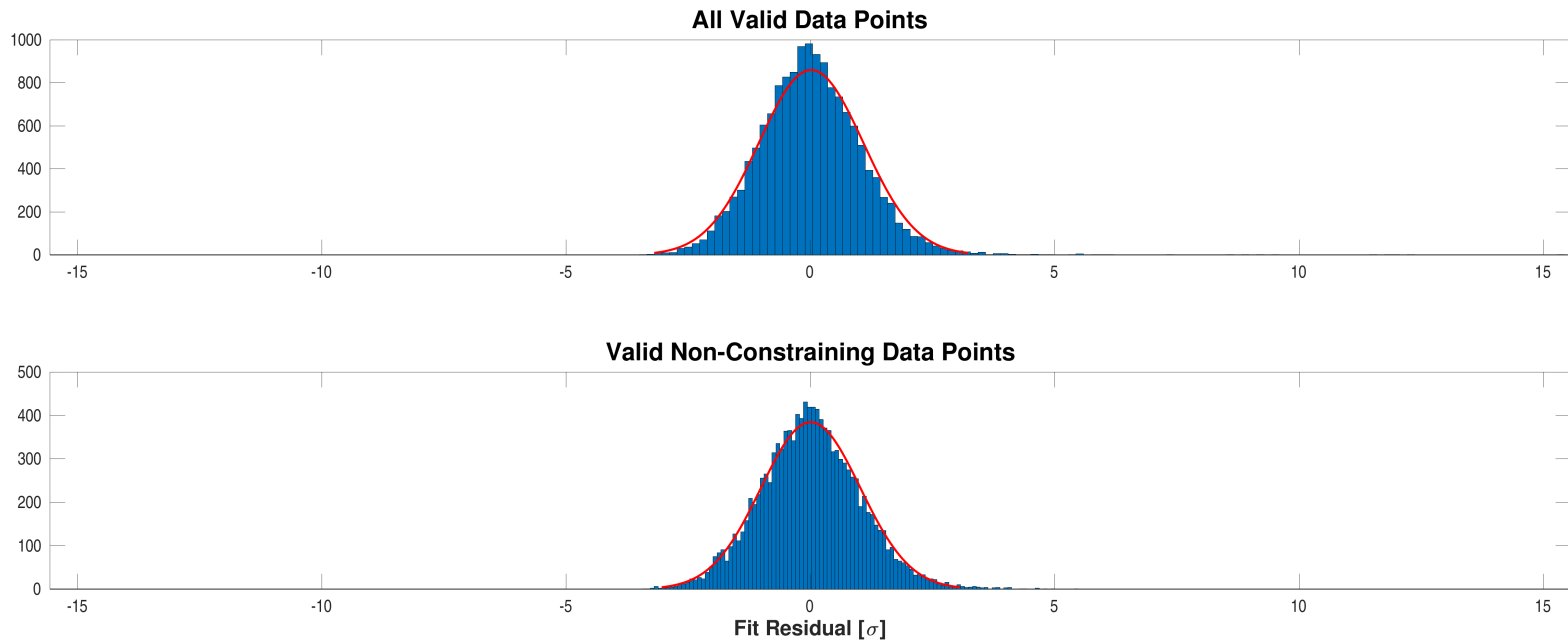
Robust weights distribution for CatId 149603524, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000149603524-01-odd-even-robust-weights.fig`
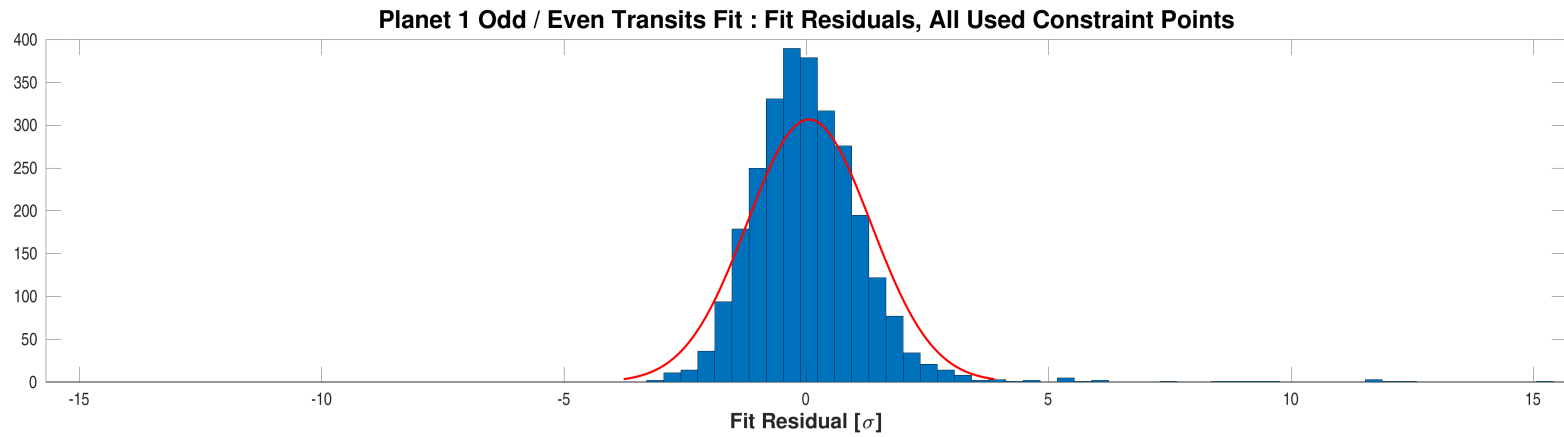
Fit residuals distribution for CatId 149603524, Planet candidate 1. Only the valid data points used to constrain the fit are shown here. A Gaussian fit to the histogram is shown in red.
Open ./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000149603524-01-odd-even-histo-used.fig

Fit residuals distribution for CatId 149603524, 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/0000000149603524-01-odd-even-histo-all-and-unused.fig

A.3 Eclipsing Binary Discrimination Test
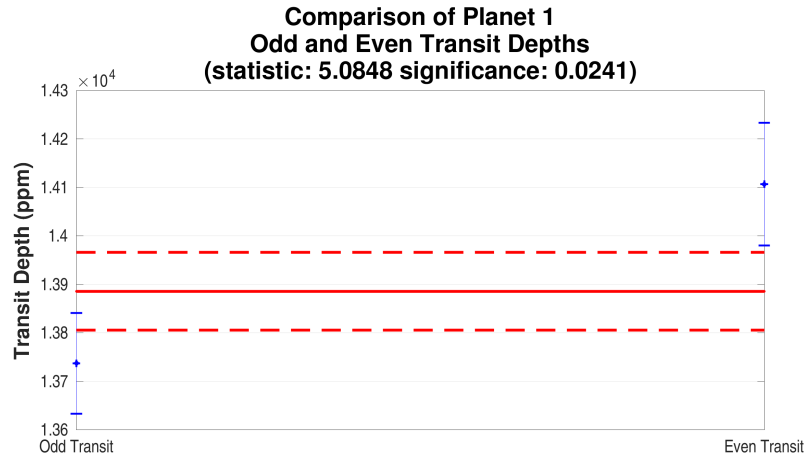
Top-left: Diagnostic plot of Odd/Even Transit Depth Test for catId 149603524, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary.
Open `./planet-01/binary-discrimination-test-results/0000000149603524-01-eclipsing-binary-discrimination-tests.fig`

Appendix B Alerts

This target did not trigger any alerts.