

Data Validation (DV) Report
for TESS ID 169249234
Sectors 72 - 72
Cadence: TARGET (2.0-min)

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

09-Dec-2023 17:33:09 Z

Contents

1	Summary	1
2	Survey Image	2
3	Flux Time Series	3
4	Dashboards	5
5	Pixel Level Diagnostics	6
5.1	Planet Candidate 1	6
5.2	Difference Image TIC Key	10
6	Phased Light Curves	11
7	Planet Candidate 1	14
7.1	Model Fitter: All Transits	14
7.2	Model Fitter: Reduced Parameter Fit Results	17
7.3	Model Fitter: Trapezoidal Fit Results	19
7.4	Validation Tests	21
7.4.1	Weak Secondary Test	21
7.4.2	Eclipsing Binary Discrimination Test	21
7.4.3	Bootstrap Test	22
7.4.4	Ghost Diagnostic Test	22
7.4.5	Validation Test Figures	23
Appendices		27
A	Planet Candidate 1	27
A.1	Model Fitter: All Transits	27
A.2	Model Fitter: Odd & Even Transits	29
A.3	Eclipsing Binary Discrimination Test	34
B	Alerts	35

1Summary

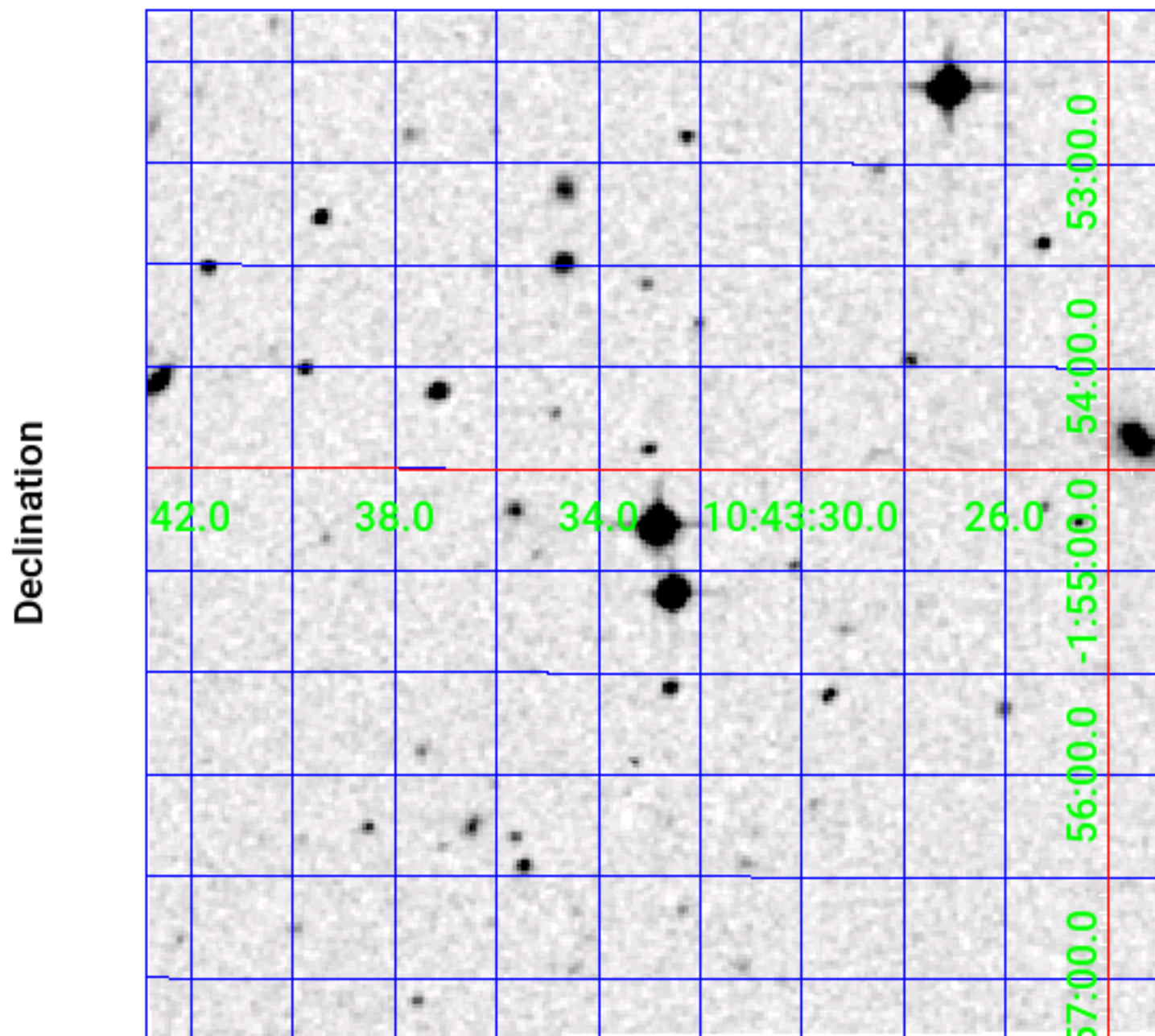
Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	169249234			
TOI ID	2524			
TESS Name	-			
RA	160.88680053	0	degrees	TIC8.2
Dec	-1.91271928	0	degrees	TIC8.2
Magnitude	12.1772	0.007		TIC8.2
Radius	1.187	0.065	Solar radii	TIC8.2
Effective Temperature	5758	136	Kelvin	TIC8.2
log(g)	4.302	0.081278	cm/sec ²	TIC8.2
[M/H]	0.130	0.019	Solar metallicity	TIC8.2
Stellar Density	0.616	0.120	Solar density	TIC8.2-Derived
Limb Darkening Coefficient 1	0.61239			
Limb Darkening Coefficient 2	-0.17744			
Limb Darkening Coefficient 3	0.51323			
Limb Darkening Coefficient 4	-0.2708			
Number of Planet Candidates	1			
TOI Model	csv-file-toi-catalog-12-08-23.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-5.0.103-20231116			
Date Report Generated	09-Dec-2023 17:33:09 Z			

Sector	Target Table	Camera/ CCD	Crowding Metric	Flux Fraction
72	421	4:2	0.7952	0.7457

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	-	-	-	14.372	1.00	3267.570	0.12	12.6	101.6	810	3.92e-207	false

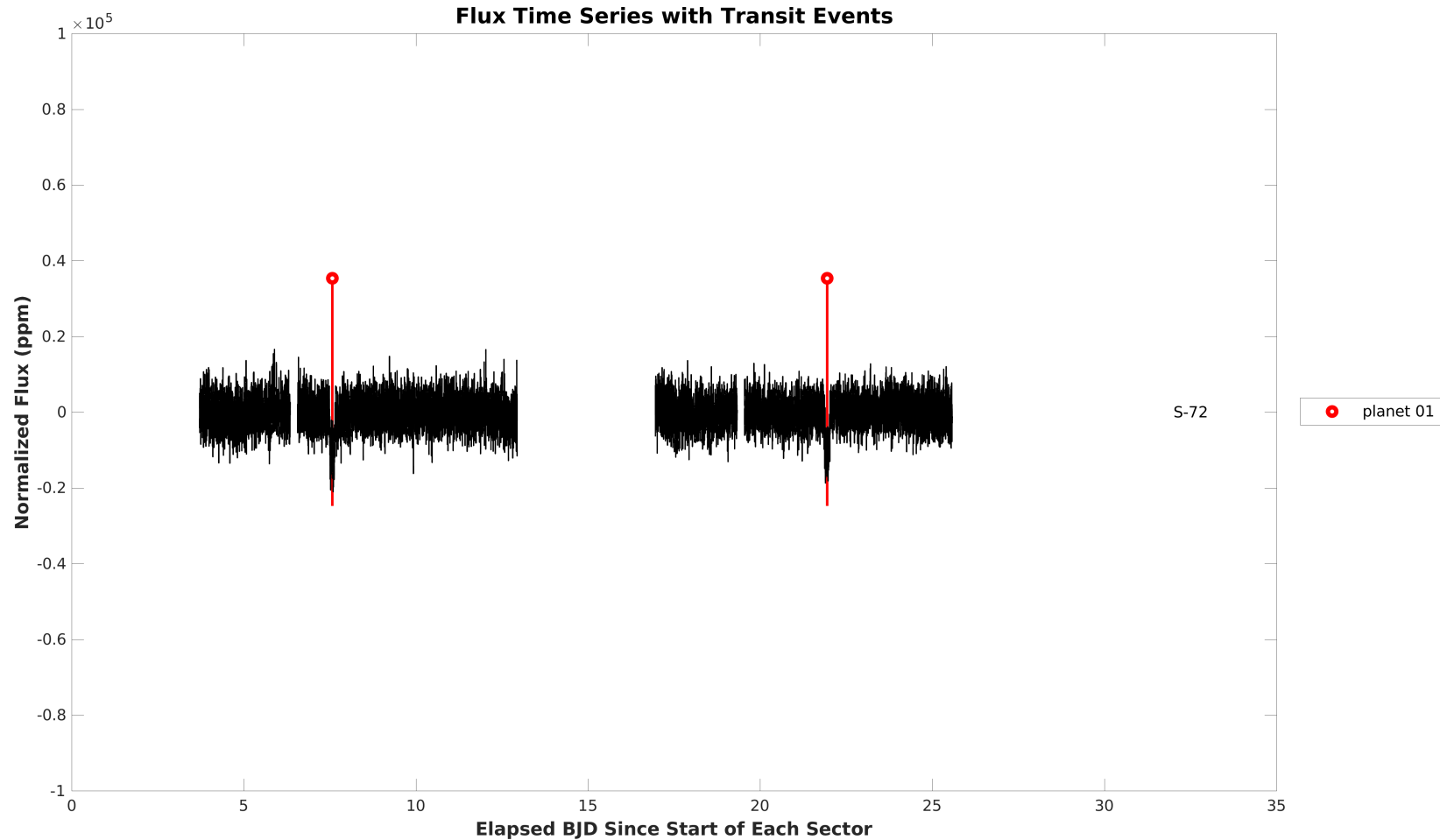
DV did not produce matching results for the following TOI IDs: 2524.01

2 Survey Image

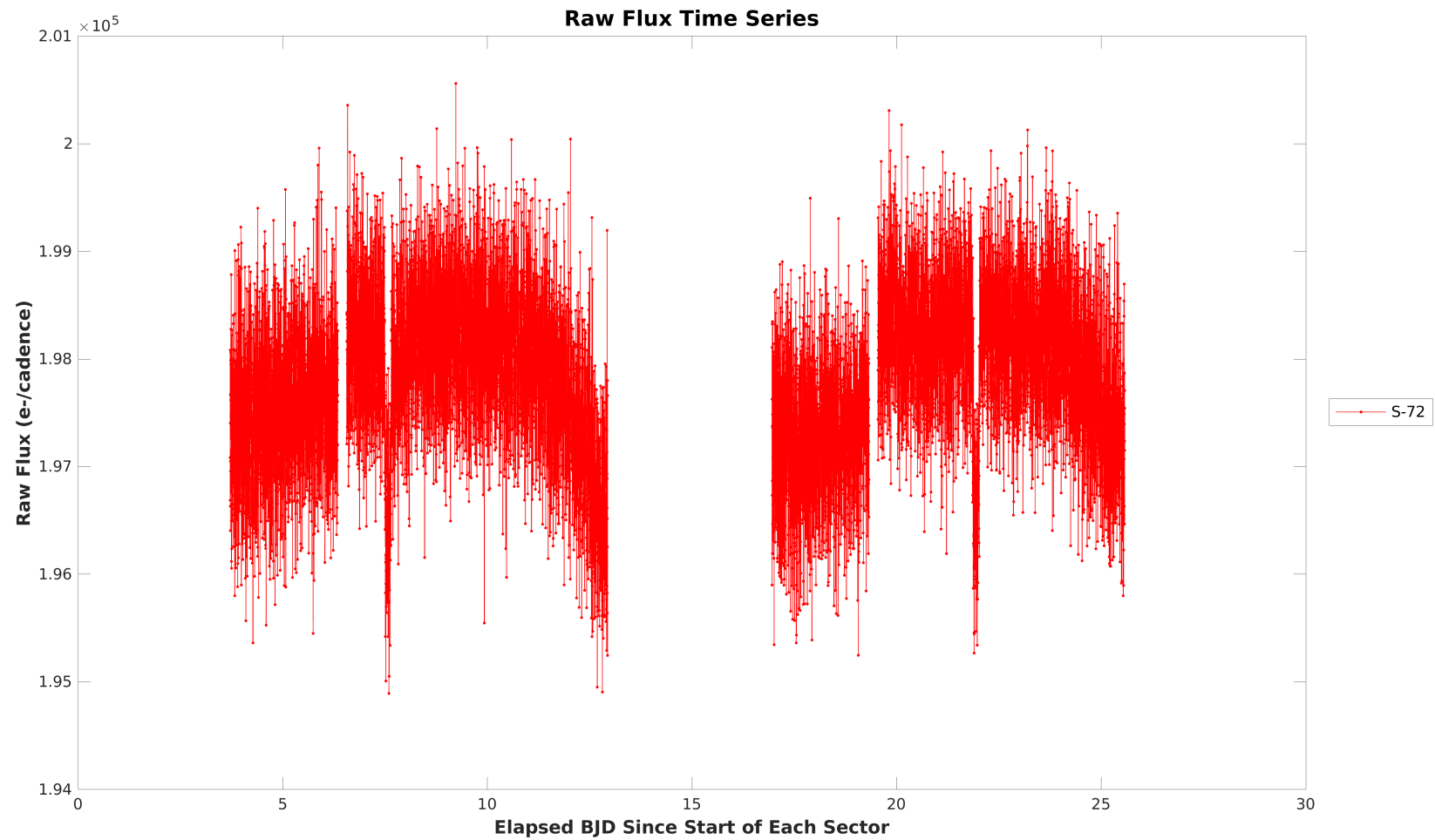


Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (169249234).

3 Flux Time Series



Summary plot of sector-stitched flux time series and transits for target 169249234, 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 72, target table 421, start BJD is 2460260. Open `./summary-plots/0000000169249234-00-flux-dv-fit-72-421.fig`



Summary plot of raw flux time series. For the data of sector 72, target table 421, start BJD is 2460260.
Open `./summary-plots/0000000169249234-00-raw-flux-72-421.fig`

4 Dashboards

Planet Candidate 1

Model Fitter	Stellar Radius 1.2 ± 0.1 Solar units		Core Aperture Correlation Statistic Value = 15.59 Significance = 100.00%	Ghost Diagnostic Test
	Period = 14.4 ± 0.0 days Depth = 10694 ± 407 ppm Planet Radius = 12.6 ± 0.8 Earth radii Semi-major Axis = 0.1 ± 0.0 AU Effective Stellar Flux = 101.6 ± 16.3 Equilibrium Temperature = 810 ± 32 Kelvin Chi-squared/DoF = 0.8 SNR = 25.8		Halo Aperture Correlation Statistic Value = 3.46 Significance = 99.97% Core/Halo Ratio Ratio = 4.51	
Eclipsing Binary Discrimination Test	Odd-Even Depth Comparison Statistic Value = 2.41e-01 Significance = 62.36%		Offsets Relative to Out of Transit Centroid Source RA Offset = $6.02\text{e-}01 \pm 2.55\text{e+}00$ arcsec (0.24σ) Source Dec Offset = $5.23\text{e+}00 \pm 2.57\text{e+}00$ arcsec (2.04σ) Source Offset Distance = $5.27\text{e+}00 \pm 2.57\text{e+}00$ arcsec (2.05σ) Offsets Relative to TIC Position Source RA Offset = $2.42\text{e-}01 \pm 2.55\text{e+}00$ arcsec (0.10σ) Source Dec Offset = $1.19\text{e+}00 \pm 2.57\text{e+}00$ arcsec (0.46σ) Source Offset Distance = $1.21\text{e+}00 \pm 2.57\text{e+}00$ arcsec (0.47σ)	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 = 3.92e-207 Transit Count = 2 Max Multiple Event Statistic = 22.9	Bootstrap Test

Summary of model fitter results and validation test results for target 169249234, 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

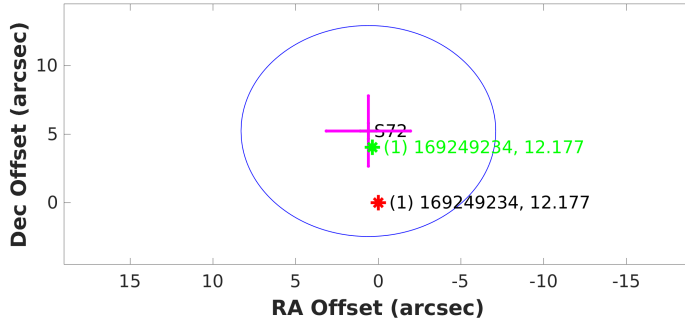
	RA	Dec	Units
Offset	$0.6023 \pm 2.55e+00$	$5.2326 \pm 2.57e+00$	arcseconds
Offset/ σ	0.24	2.04	
Offset Distance	$5.2671 \pm 2.57e+00$		arcseconds
Offset Distance/ σ	2.05		
3σ Radius	7.6999		arcseconds

Mean offset from the TIC RA and Dec

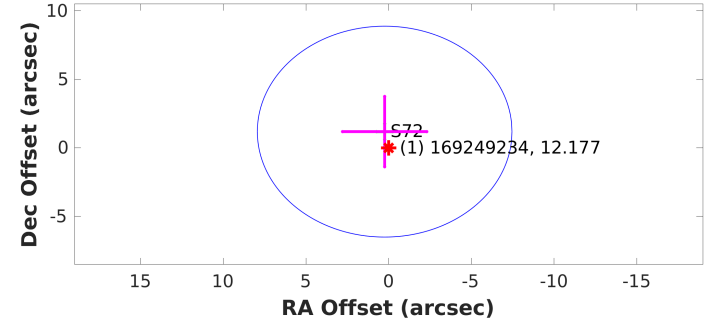
	RA	Dec	Units
Offset	$0.2425 \pm 2.55e+00$	$1.1879 \pm 2.57e+00$	arcseconds
Offset/ σ	0.10	0.46	
Offset Distance	$1.2124 \pm 2.57e+00$		arcseconds
Offset Distance/ σ	0.47		
3σ Radius	7.6983		arcseconds

Planet Candidate 1

Offsets Relative to Out of Transit Centroid



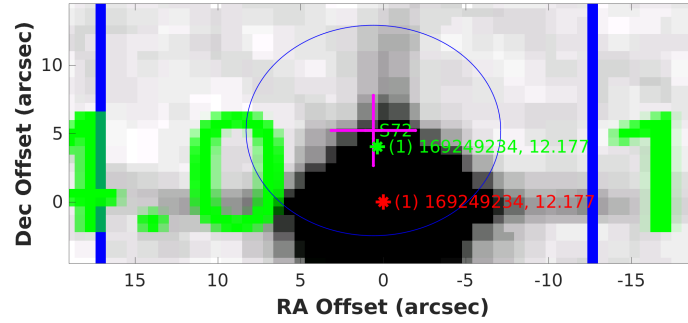
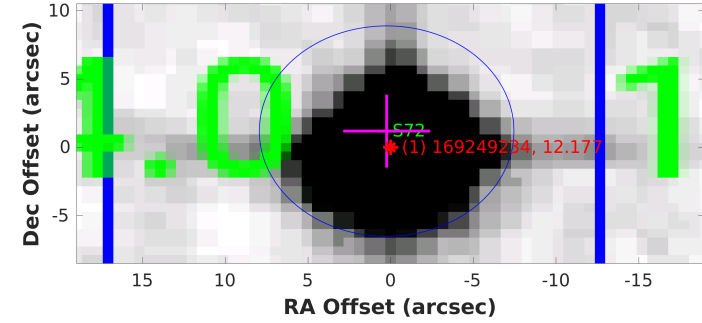
Offsets Relative to TIC Position



Difference image centroid offsets for target 169249234, 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/0000000169249234-01-difference-image-centroid-offsets.fig`

Planet Candidate 1

Offsets Relative to
Out of Transit CentroidOffsets Relative to
TIC Position

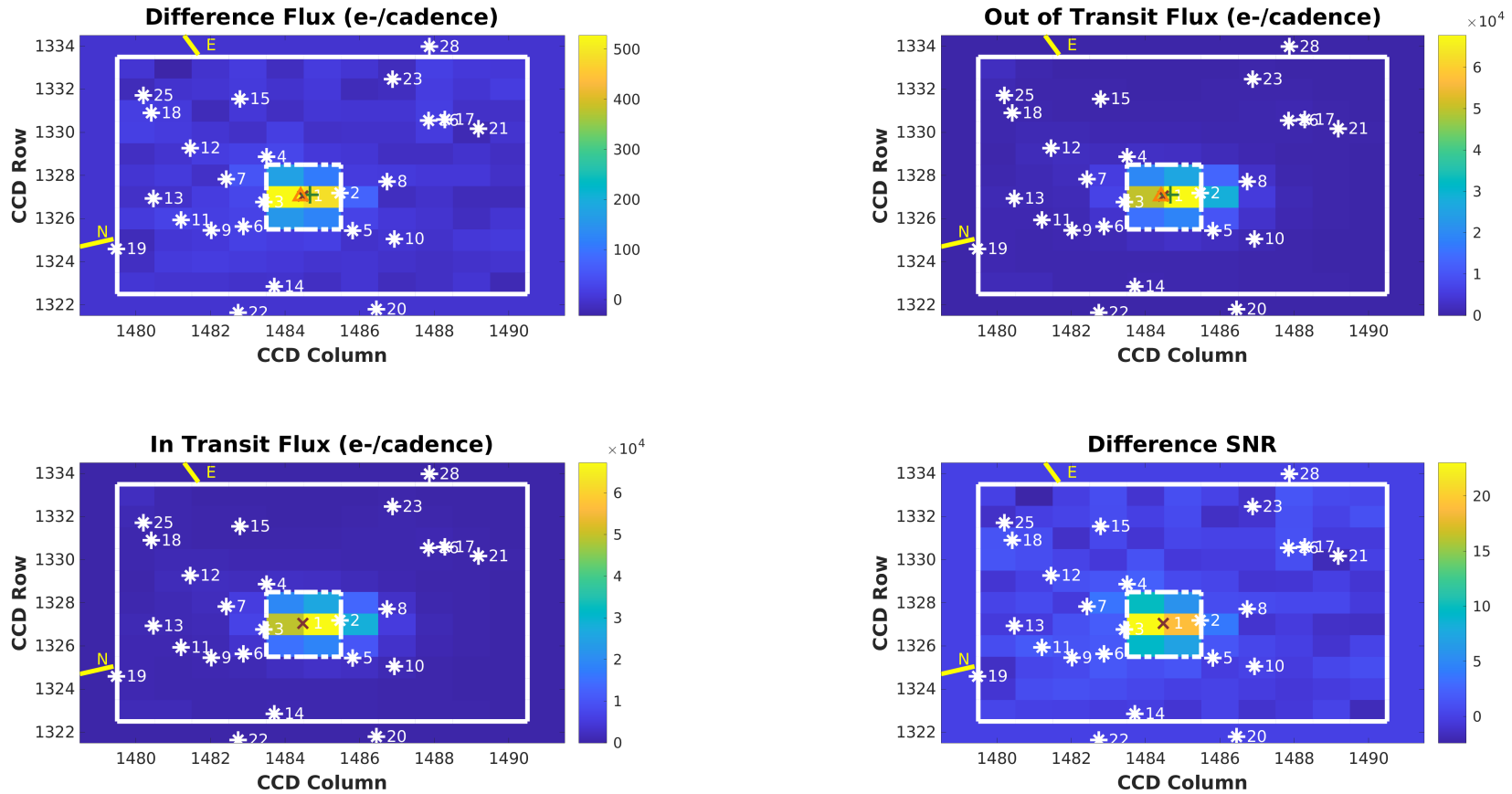
Difference image centroid offsets for target 169249234, planet candidate 1, displayed on survey image for given target. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets 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 (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/0000000169249234-01-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 72 / Target Pixel Table 421



Difference image for target 169249234, planet candidate 1, sector 72, target pixel table 421. 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 = 2; number of valid in-transit cadences = 205; number of in-transit cadence gaps = 0; number of valid out-of-transit cadences = 534; number of out-of-transit cadence gaps = 0. Difference image quality metric = 0.98 (good).

Open `./planet-01/difference-image/0000000169249234-01-difference-image-72-421.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	$1327.10 \pm 1.03e-04$	$1484.67 \pm 1.10e-04$	pixels	$160.88676673 \pm 8.45e-07$	$-1.91381061 \pm 9.04e-07$	degrees
Difference Image Centroid	$1327.04 \pm 2.52e-02$	$1484.42 \pm 2.71e-02$	pixels	$160.88693413 \pm 1.37e-04$	$-1.91235711 \pm 1.62e-04$	degrees
Offset	$-0.0663 \pm 2.52e-02$	$-0.2496 \pm 2.71e-02$	pixels	$0.6023 \pm 4.92e-01$	$5.2326 \pm 5.82e-01$	arcseconds
Offset/ σ	-2.64	-9.20		1.22	8.99	
Offset Distance	$0.2582 \pm 2.79e-02$		pixels	$5.2671 \pm 5.77e-01$		arcseconds
Offset Distance/ σ	9.27			9.12		

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

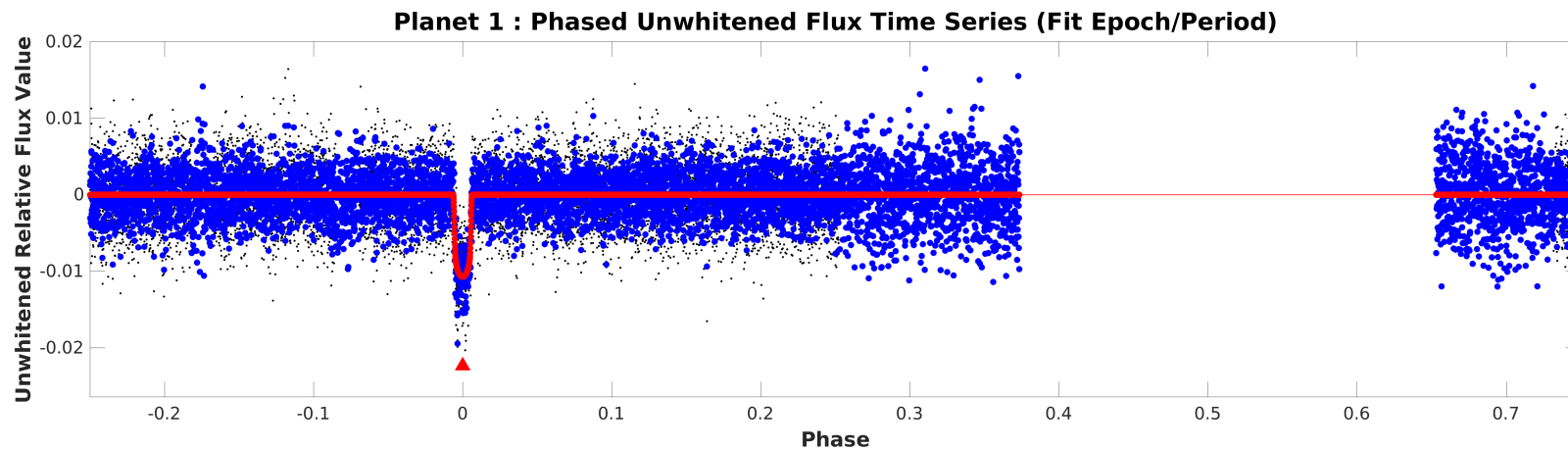
	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$1327.05 \pm 1.08e-04$	$1484.48 \pm 1.12e-04$	pixels	$160.88686674 \pm 0.00e+00$	$-1.91268709 \pm 0.00e+00$	degrees
Difference Image Centroid	$1327.04 \pm 2.52e-02$	$1484.42 \pm 2.71e-02$	pixels	$160.88693413 \pm 1.37e-04$	$-1.91235711 \pm 1.62e-04$	degrees
Offset	$-0.0103 \pm 2.52e-02$	$-0.0587 \pm 2.71e-02$	pixels	$0.2425 \pm 4.92e-01$	$1.1879 \pm 5.82e-01$	arcseconds
Offset/ σ	-0.41	-2.16		0.49	2.04	
Offset Distance	$0.0596 \pm 2.77e-02$		pixels	$1.2124 \pm 5.72e-01$		arcseconds
Offset Distance/ σ	2.15			2.12		

5.2 Difference Image TIC Key

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
1	169249234	12.177	160.88686674	-1.91268709	0.00
2	169249237	12.994	160.88552799	-1.91820065	20.42
3	902975470	18.233	160.88755122	-1.90658965	22.09
4	169249233	17.787	160.89848100	-1.91166800	41.95
5	902975469	19.171	160.87562960	-1.91607702	42.23
6	903007151	20.580	160.88271161	-1.90118651	44.02
7	902975477	19.403	160.89524443	-1.90369448	44.23
8	169249240	17.566	160.88571126	-1.92598710	48.06
9	903007152	19.598	160.88354602	-1.89628576	60.24
10	169249238	18.943	160.87126507	-1.92107004	63.73
11	903007153	19.419	160.88776811	-1.89312080	70.51
12	169249229	16.147	160.90482814	-1.90184734	75.49
13	169249224	17.326	160.89456300	-1.89147100	81.24
14	169249226	18.412	160.86632400	-1.89930300	88.23
15	169249235	18.640	160.91409085	-1.91392154	98.05
16	902975467	19.325	160.89834212	-1.93814342	100.51
17	169249241	17.771	160.89768886	-1.94052145	107.50
18	902975475	17.862	160.91561534	-1.90004513	113.01
19	169249221	17.143	160.88426588	-1.88104317	114.30
20	903007144	18.909	160.85508071	-1.91126038	114.48
21	902975466	20.388	160.89356409	-1.94428783	116.29
22	903007145	20.667	160.86193409	-1.89152252	117.70
23	902975464	18.300	160.91046292	-1.93737864	122.92
24	903007143	19.015	160.85243409	-1.91248251	123.89
25	169249227	16.747	160.92033900	-1.90075300	127.87
26	169249222	17.231	160.91423570	-1.88765067	133.49
27	169249223	16.834	160.85512353	-1.88973215	140.97
28	902975465	20.216	160.91639610	-1.94592498	160.02

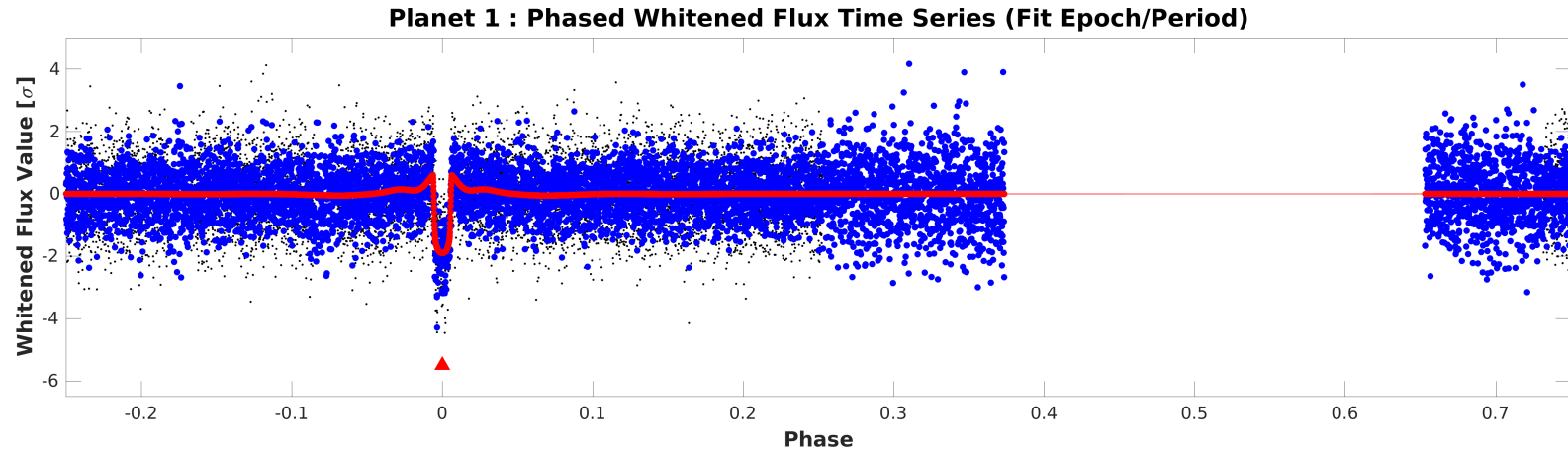
RA, Dec and Distances are corrected for proper motion. This table may not contain all of the objects shown.

6 Phased Light Curves



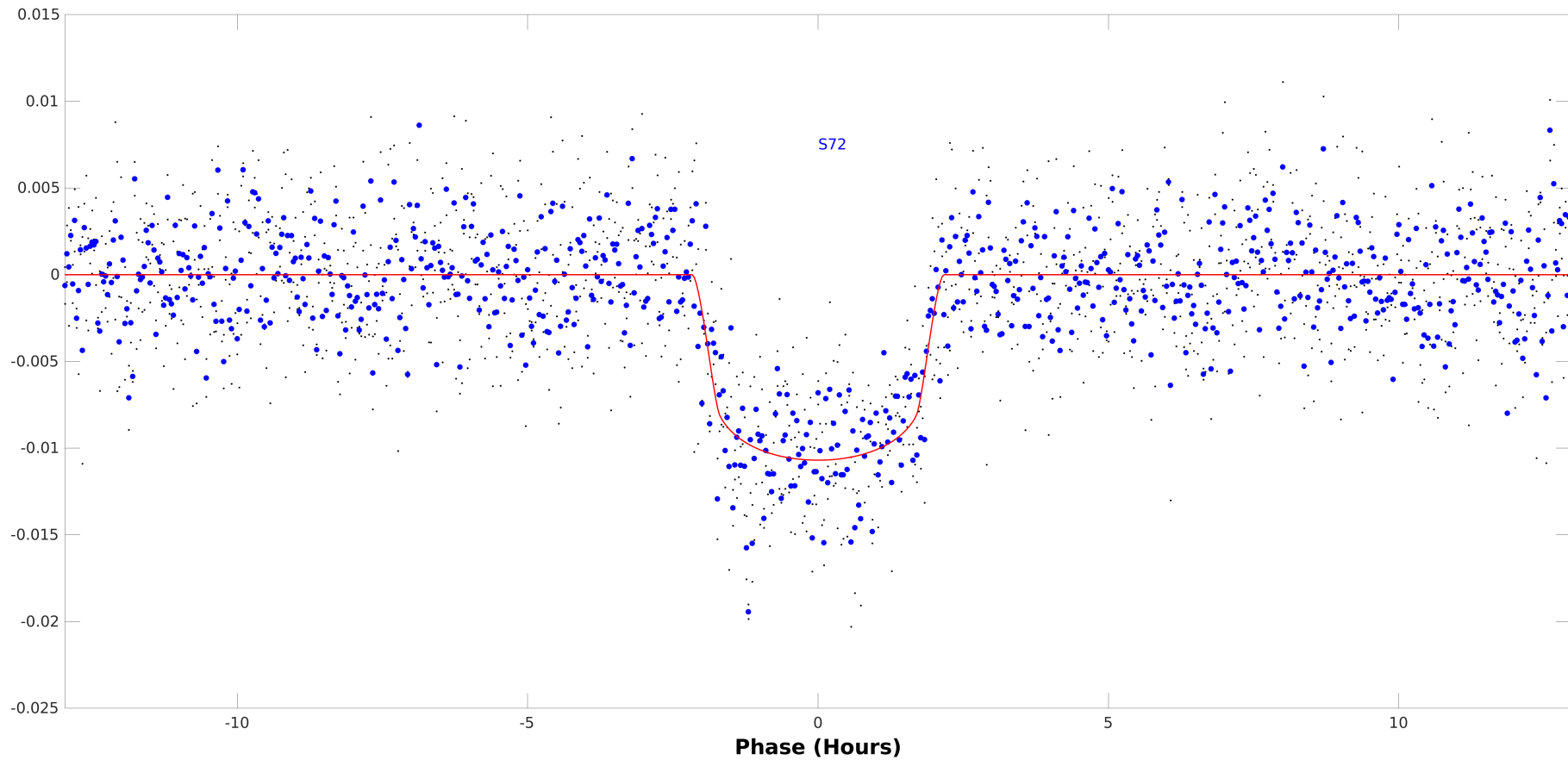
Phased unwhitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased unwhitened flux time series 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/0000000169249234-01-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/0000000169249234-01-phased-whitened-flux-time-series.fig`

Planet: 1 Phased Unwhitened Flux Time Series by Sector

Phased unwhitened flux time series by sector in year 6 for target 169249234, planet candidate 1. Period = 14.3723 days; transit epoch = 3267.5695 BTJD.
 Open `./summary-plots/0000000169249234-01-phased-unwhitened-flux-time-series-by-sector-06.fig`

7 Planet Candidate 1

7.1 Model Fitter: All Transits

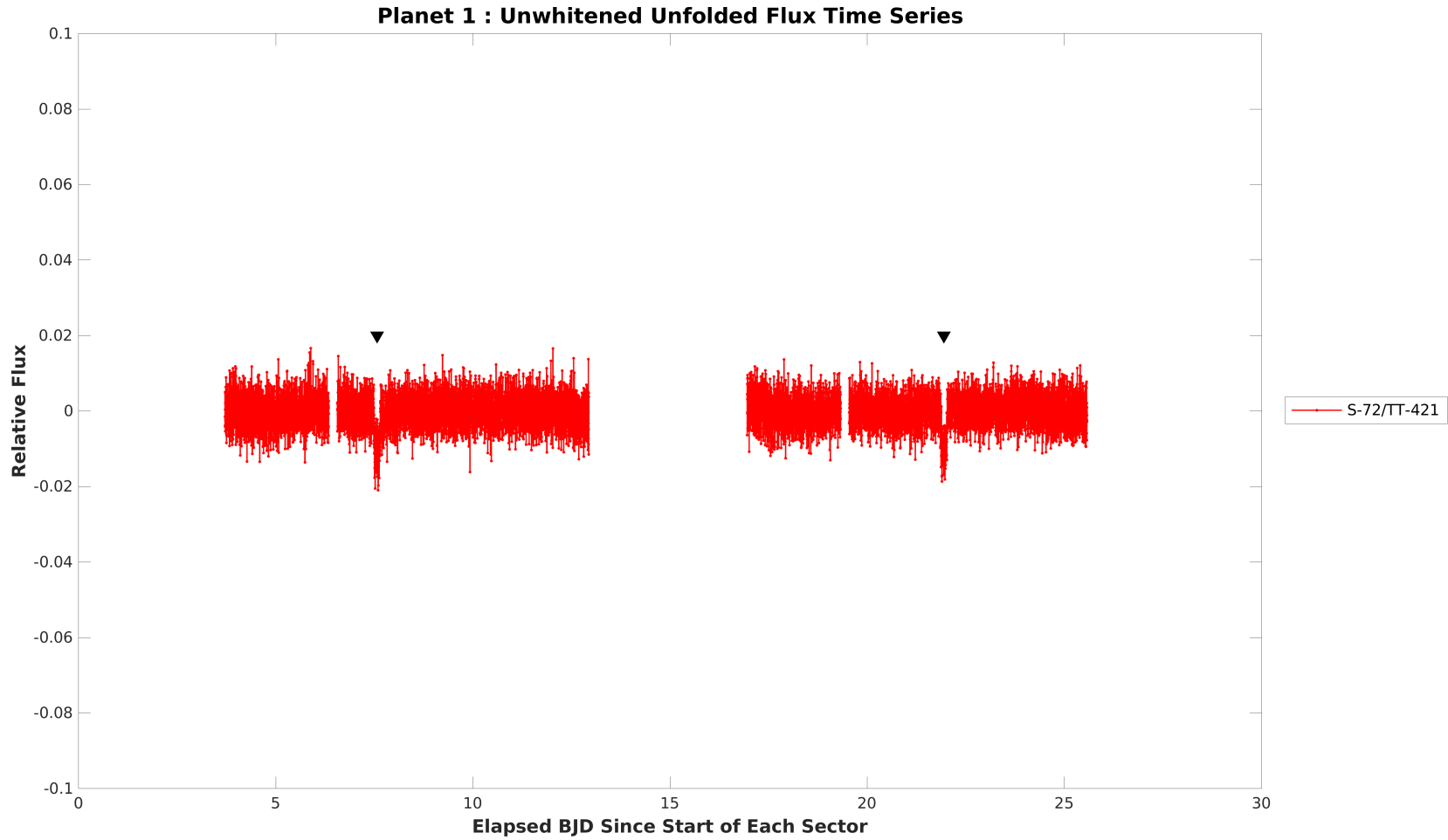
Model Characteristic	Name
Transit Model	mandel-agol_geometric_transit_model
Limb Darkening Model	claret_tess_nonlinear_limb_darkening_model

TCE Parameter	Value	Units
Trial Transit Pulse Duration	3.5	hours
Transit Epoch	3267.5726590	TJD
Orbital Period	14.3722153	days
Maximum SES	17.0	
Maximum MES	22.9	
Robust Statistic	24.0	
Chi Square Goodness of Fit Statistic (DoF)	212.0 (209)	
Chi Square2 Statistic (DoF)	0.9 (54.7)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

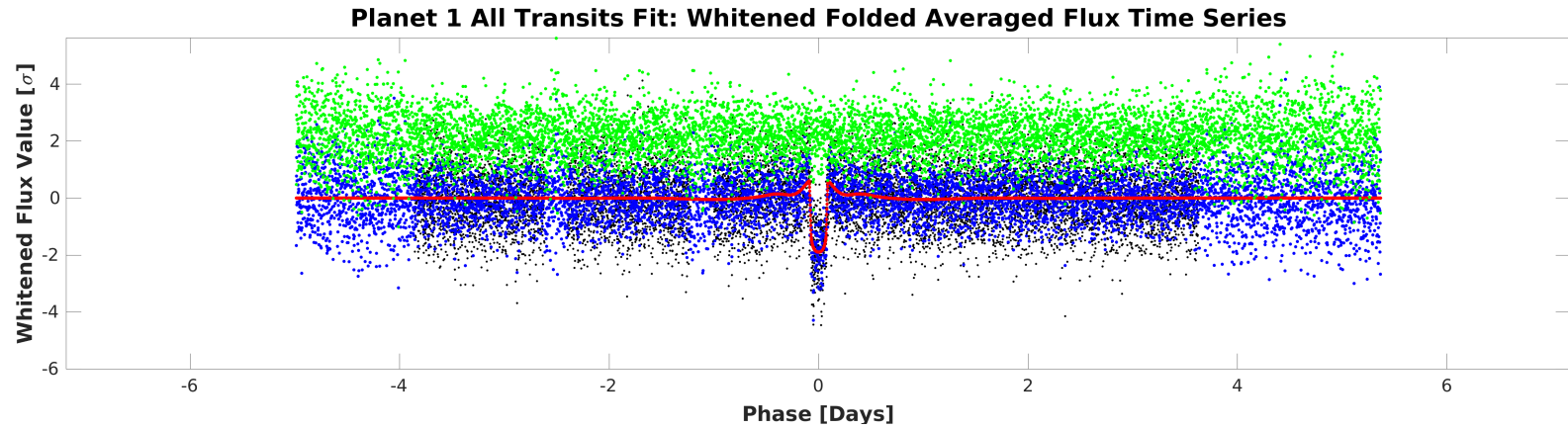
Parameter	Value	Uncertainty	Units
SNR	25.8		
Orbital Period	14.3723192	2.4944e-03	days
Transit Epoch	3267.5695061	1.7665e-03	BTJD
Impact Parameter	0.4269	3.0565e-01	
Planet Radius to Star Radius Ratio	0.0972650	3.6061e-03	
Semi-major Axis to Star Radius Ratio	25.6865	4.0719e+00	
Planet Radius	12.6071	8.3227e-01	Earth radii
Semi-major Axis	0.1169	8.4439e-03	AU
Effective Stellar Flux	101.6185	1.6312e+01	Goldilocks
Equilibrium Temperature	810	3.2497e+01	Kelvin
Stellar Density	1.1023	5.2422e-01	Solar density
Transit Depth	10694	4.0691e+02	ppm
Transit Duration	4.3223	1.6119e-01	hours
Transit Ingress Duration	0.4607	1.6265e-01	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	997.1 (1236.7)		
Model Chi Square Goodness of Fit Statistic (DoF)	158.8 (261)		
Model Chi Square2 Statistic (DoF)	0.8 (1)		

DoF: Degrees of Freedom



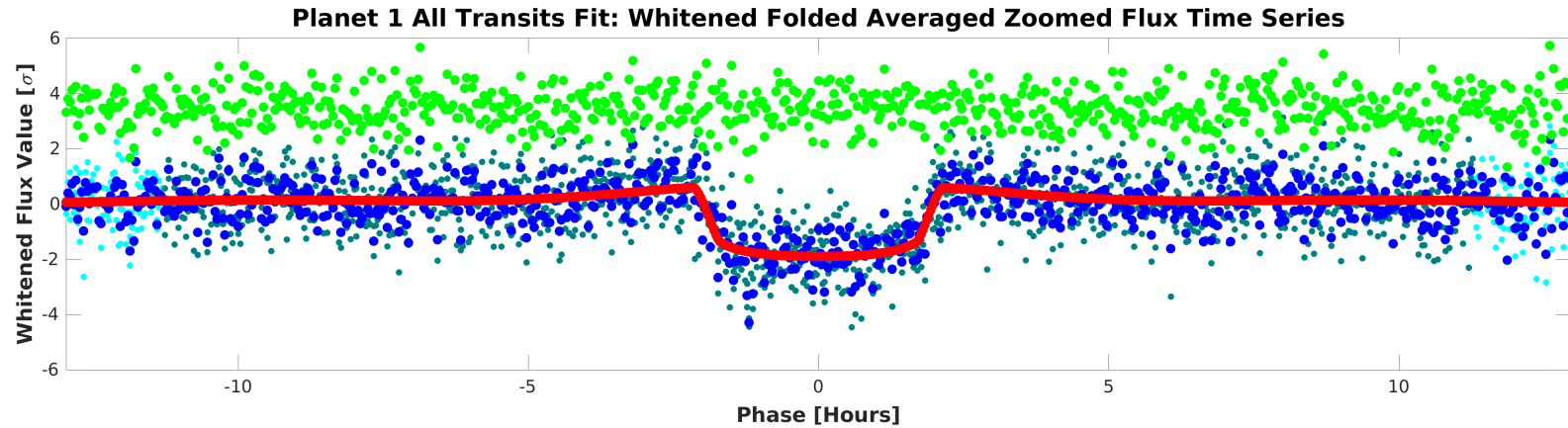
Flux time series for CatId 169249234, Planet candidate 1 in the unwhitened domain. For the data of Sector-72/TargetTableId-421, start BJD is 2460260. Transit event markers indicate the location of transits of the given planet candidate. All transits fit completed with full convergence.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000169249234-01-all-unwhitened-72-421.fig`



Folded flux time series for CatId 169249234, Planet candidate 1 in the whitenened 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/0000000169249234-01-all-whitenened.fig`



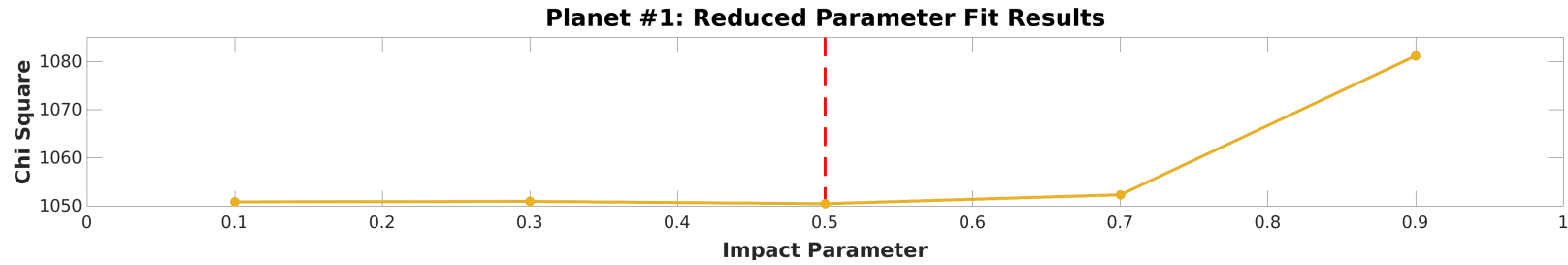
Folded flux time series for CatId 169249234, Planet candidate 1 in the whitenened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the 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/0000000169249234-01-all-whitenened-zoomed.fig`

7.2 Model Fitter: Reduced Parameter Fit Results

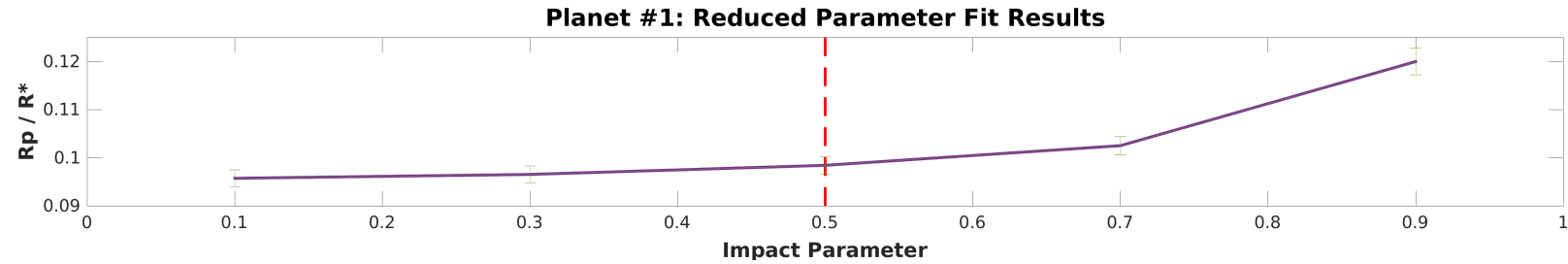
Impact Parameter	SNR	Model Chi Square	Planet Radius to Star Radius	Uncert	Semi-major Axis to Star Radius	Uncert	Transit Depth (ppm)	Uncert	Transit Duration (hours)	Uncert
0.10	27.0	1050.8	0.0957357	1.7534e-03	28.3337	4.1388e-01	10728	3.9067e+02	4.2298	6.1705e-02
0.30	27.1	1050.9	0.0965344	1.7660e-03	27.1412	4.1143e-01	10742	3.9068e+02	4.2682	6.4671e-02
0.50	27.0	1050.5	0.0984270	1.8137e-03	24.5703	4.0592e-01	10777	3.9467e+02	4.3725	7.2403e-02
0.70	27.1	1052.3	0.1025162	1.9086e-03	20.4212	3.9695e-01	10880	4.0208e+02	4.5833	8.9921e-02
0.90	26.6	1081.2	0.1199917	2.7632e-03	13.7182	4.3190e-01	11810	4.9948e+02	5.3477	1.6819e-01

Highlighted row is the best reduced-parameter model fit.



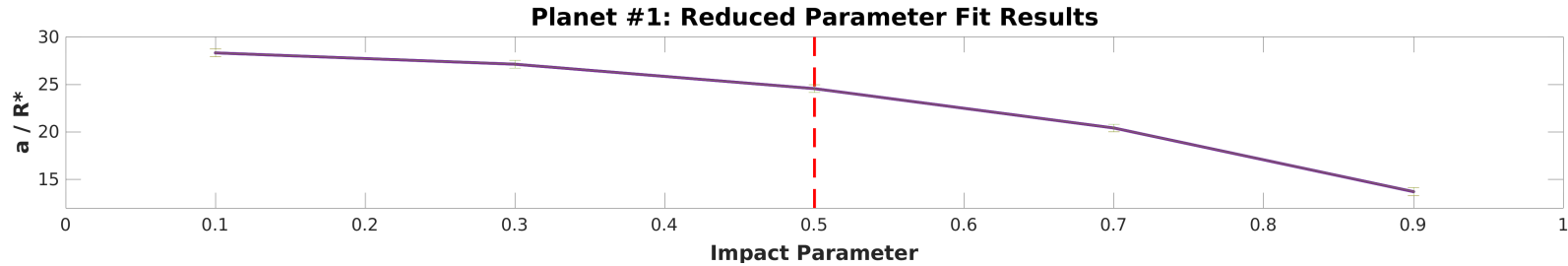
Model chi squares of reduced parameter fits vs. impact parameter for CatId 169249234, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.

Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000169249234-01-reduced-fits-chi-square.fig`



Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 169249234, 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/0000000169249234-01-reduced-fits-rp-over-rstar.fig`



Ratios of semimajor axis to star radius of reduced parameter fits vs. impact parameter for CatId 169249234, 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/0000000169249234-01-reduced-fits-a-over-rstar.fig`

7.3 Model Fitter: Trapezoidal Fit Results

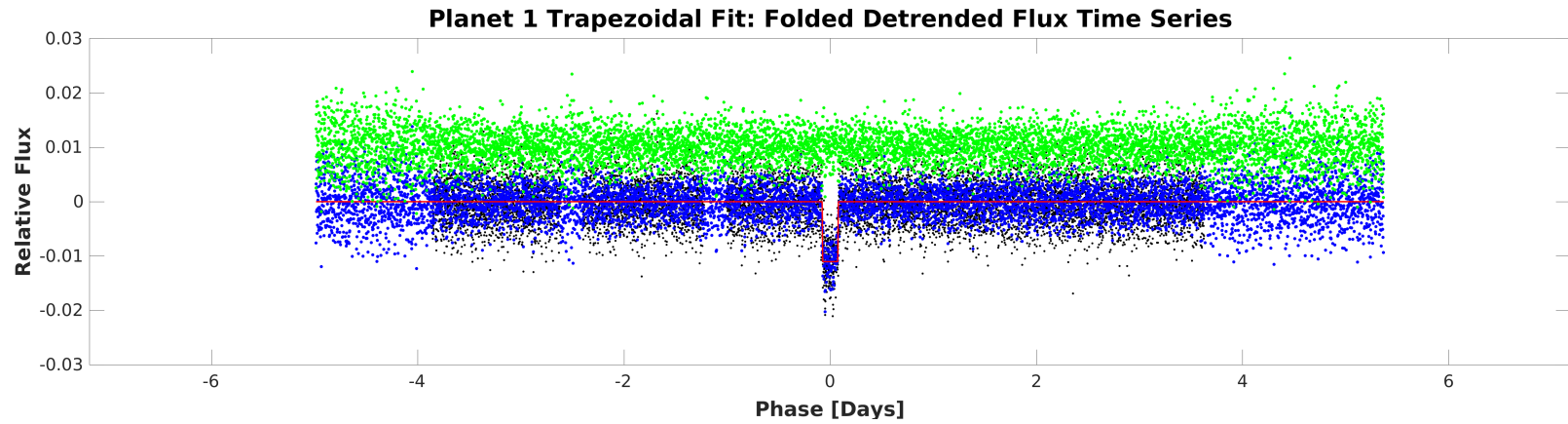
Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

TCE Parameter	Value	Units
Trial Transit Pulse Duration	3.5	hours
Transit Epoch	3267.5726590	TJD
Orbital Period	14.3722153	days
Maximum SES	17.0	
Maximum MES	22.9	
Robust Statistic	24.0	
Chi Square Goodness of Fit Statistic (DoF)	212.0 (209)	
Chi Square2 Statistic (DoF)	0.9 (54.7)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

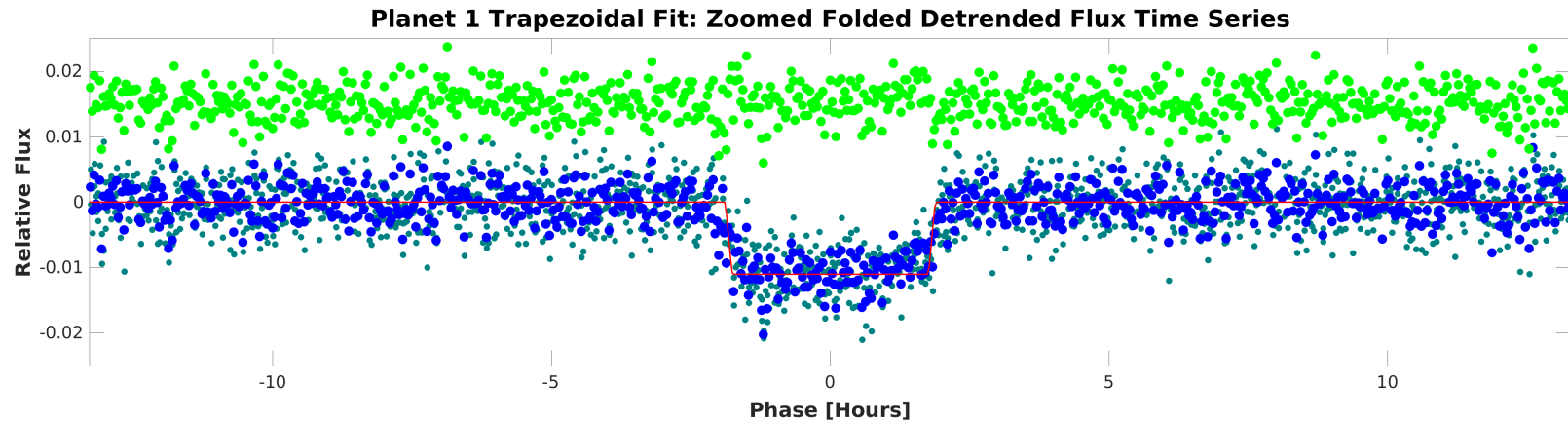
Parameter	Value	Uncertainty	Units
SNR	39.3		
Orbital Period	14.3722153		days
Transit Epoch	3267.5693288		BTJD
Transit Depth	11025		ppm
Transit Duration	4.4288		hours
Transit Ingress Duration	0.7859		hours
Model Chi Square Statistic (DoF)	13106.9 (1674)		

DoF: Degrees of Freedom



Folded detrended flux time series for CatId 169249234, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000169249234-01-all-trapezoidal.fig`



Zoomed folded detrended flux time series for CatId 169249234, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000169249234-01-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	14.3722		days		
Transit Duration	3.5		hours		
Maximum MES	22.9				
Secondary Phase	0.99028		days		
Secondary MES	2.7				
Minimum Phase	-0.41806		days		
Minimum MES	-3.2				
Median MES	-0.1				
MAD MES	0.51668				
Robust Statistic	2.5				
Secondary Depth	1306.7	5.0366e+02	ppm		
Geometric Albedo	61.8	2.5555e+01		2.3795	0.87
Planet Effective Temperature	3510	3.5425e+02	Kelvin	7.5918	0.00

7.4.2 Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	2.4081e-01	0.4907	62.36

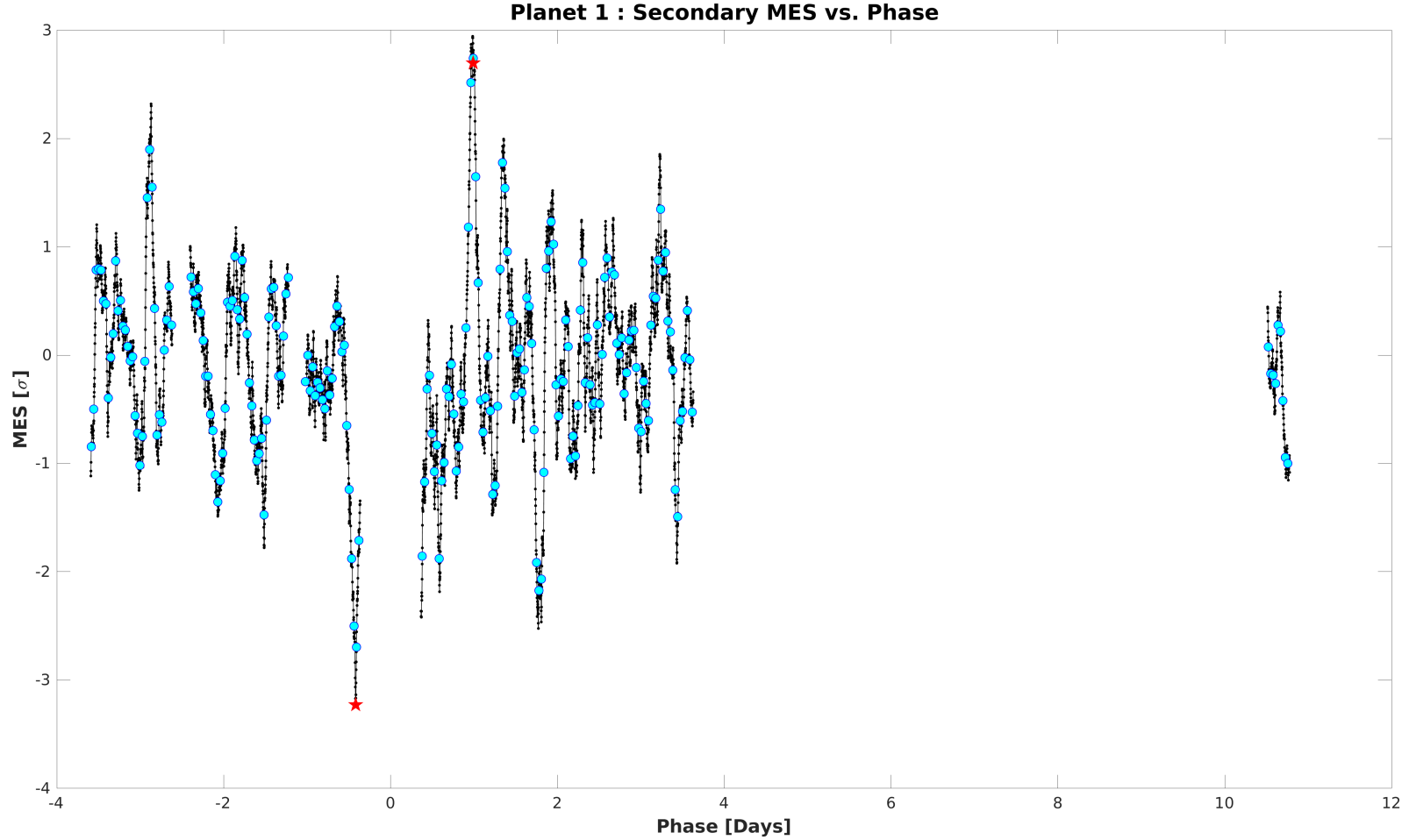
7.4.3 Bootstrap Test

Result	Value
False Alarm Probability	3.9217e-207
Bootstrap Threshold for Desired PFA	4.4
MES Mean	0.63
MES Standard Deviation	0.72
Transit Count	2

7.4.4 Ghost Diagnostic Test

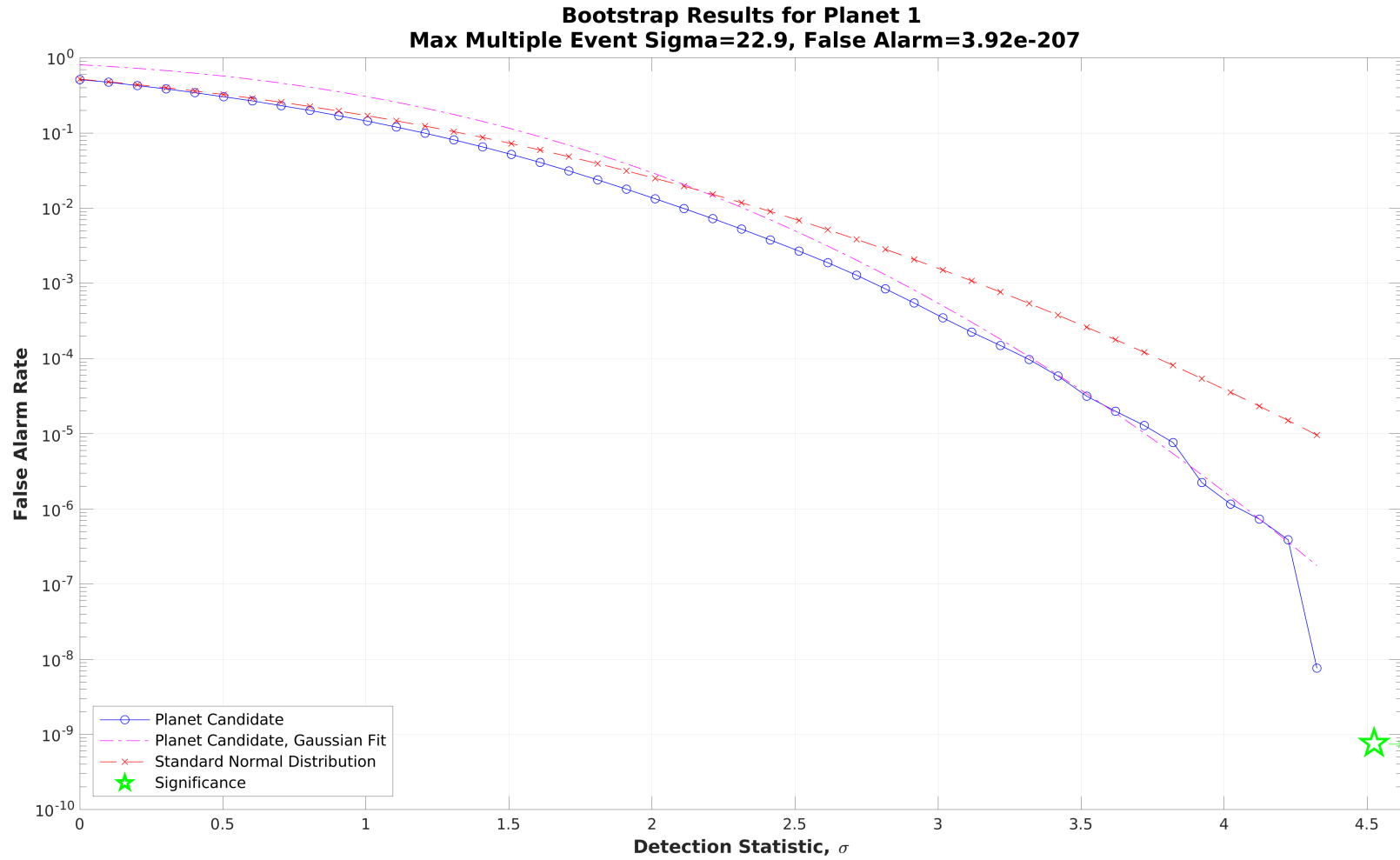
Result	Value	Significance (%)
Maximum MES	22.9	
SNR	25.8	
Core Aperture Statistic	1.5589e+01	100.00
Halo Aperture Statistic	3.4603e+00	99.97
Ratio of Core/Halo Aperture Statistics	4.5051e+00	

7.4.5 Validation Test Figures



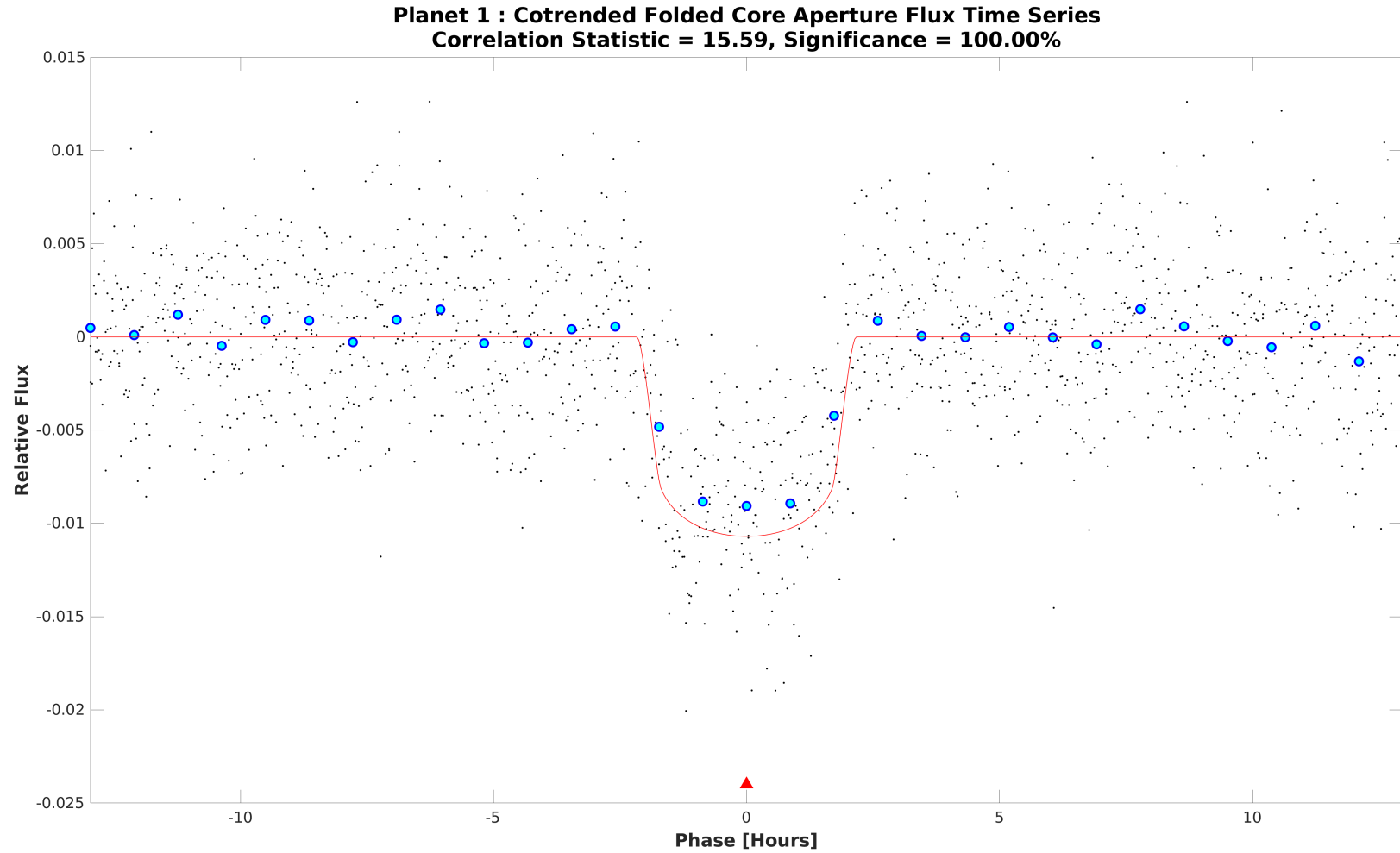
The primary event has been set to zero and both the max and min of the resulting MES vs. Phase are marked with a red star. The best matched pulse duration in hours is 3.5. The maximum secondary MES and corresponding phase are 2.6973 and 0.99028 days respectively. The minimum secondary MES and corresponding phase are -3.2291 and -0.41806 days respectively.

Open `./planet-01/report-summary/0000000169249234-01-weak-secondary-diagnostic.fig`



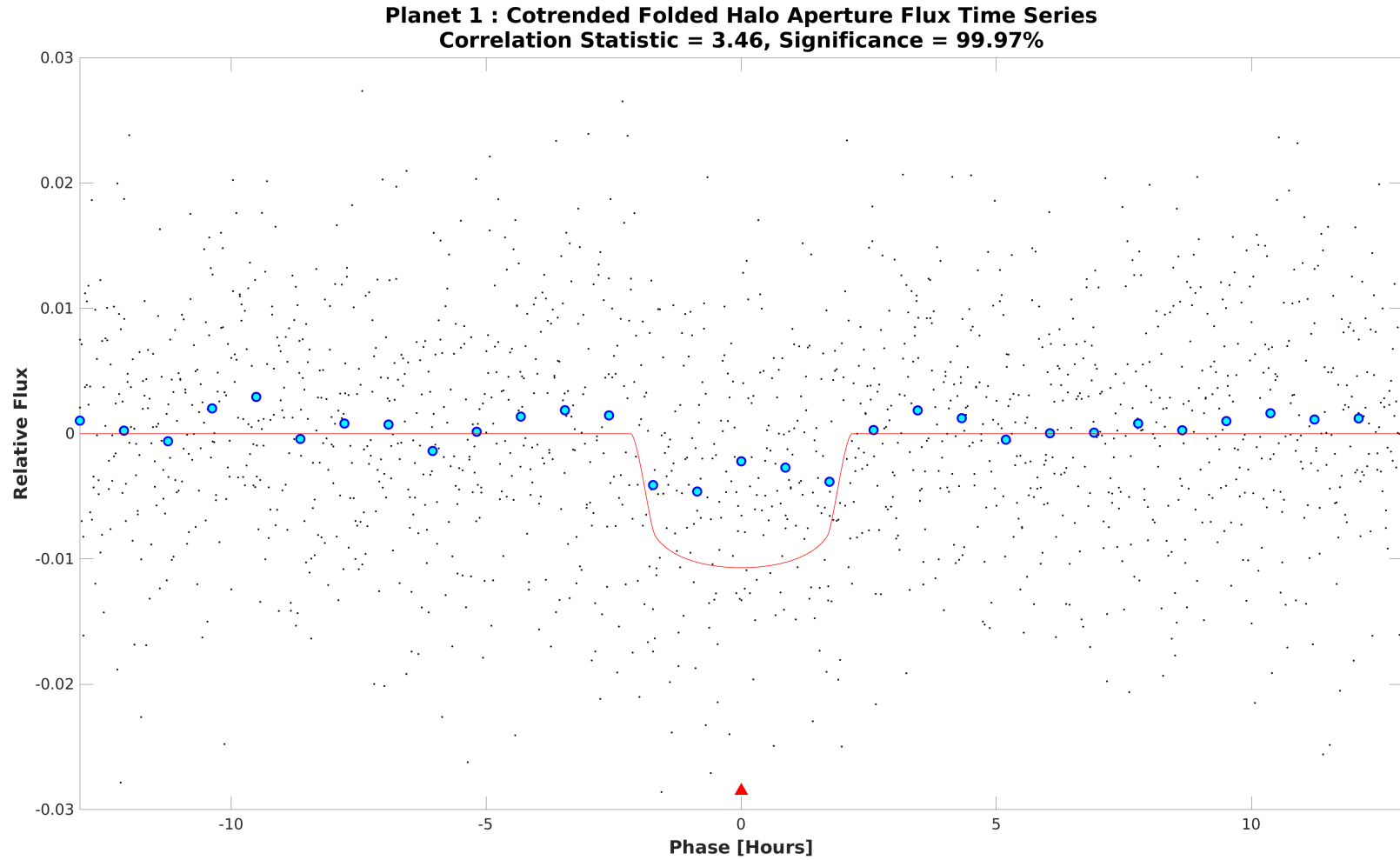
Bootstrap results for target 169249234, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is 30.6896. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 4.4246.

Open `./planet-01/bootstrap-results/0000000169249234-01-bootstrap-false-alarm.fig`



Optical ghost diagnostic core aperture flux time series for target 169249234, 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/0000000169249234-01-core-unwhitened-cotrended-zoomed-model.fig`

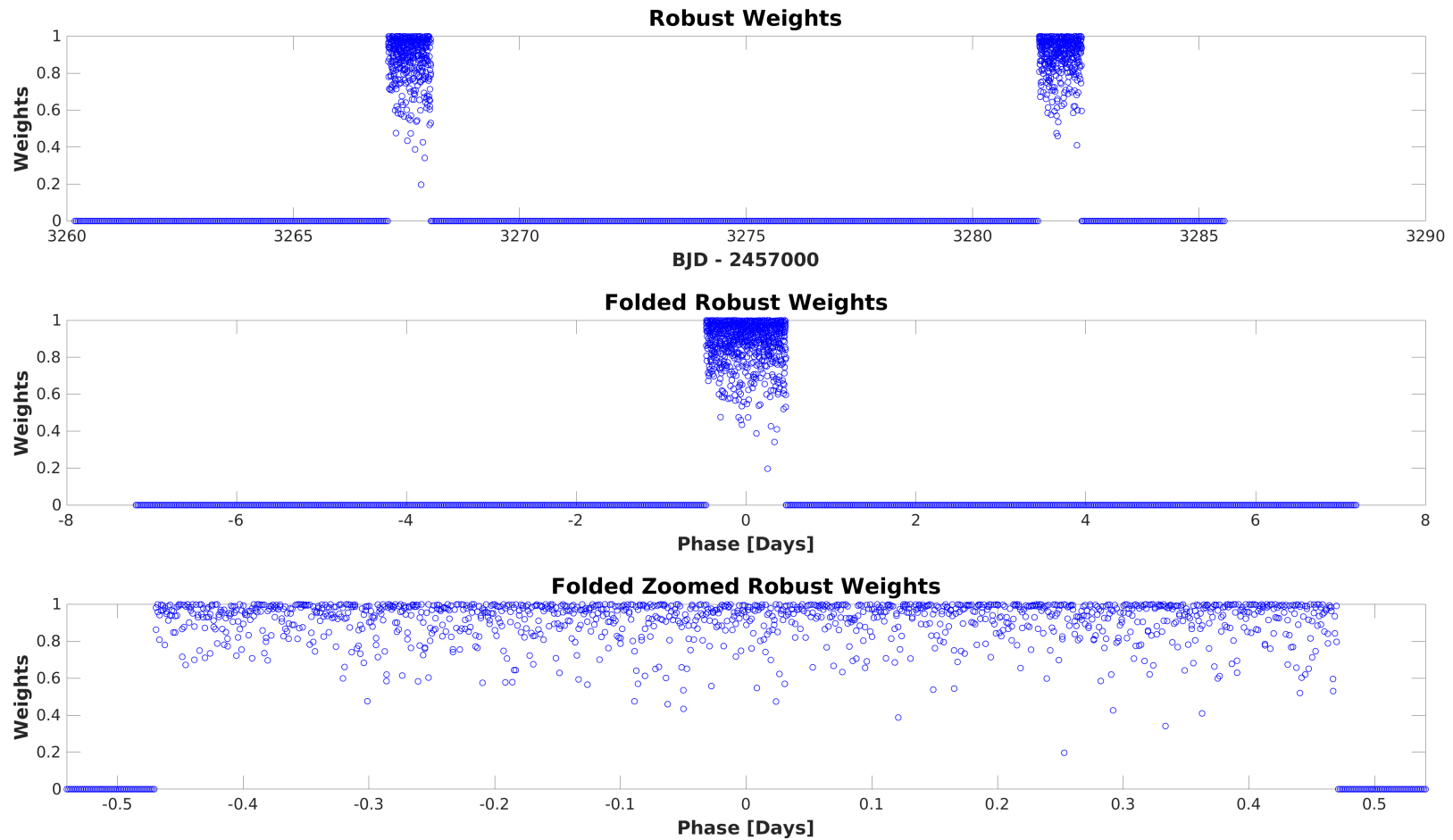


Optical ghost diagnostic halo aperture flux time series for target 169249234, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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/0000000169249234-01-halo-unwhitened-cotrended-zoomed-model.fig`

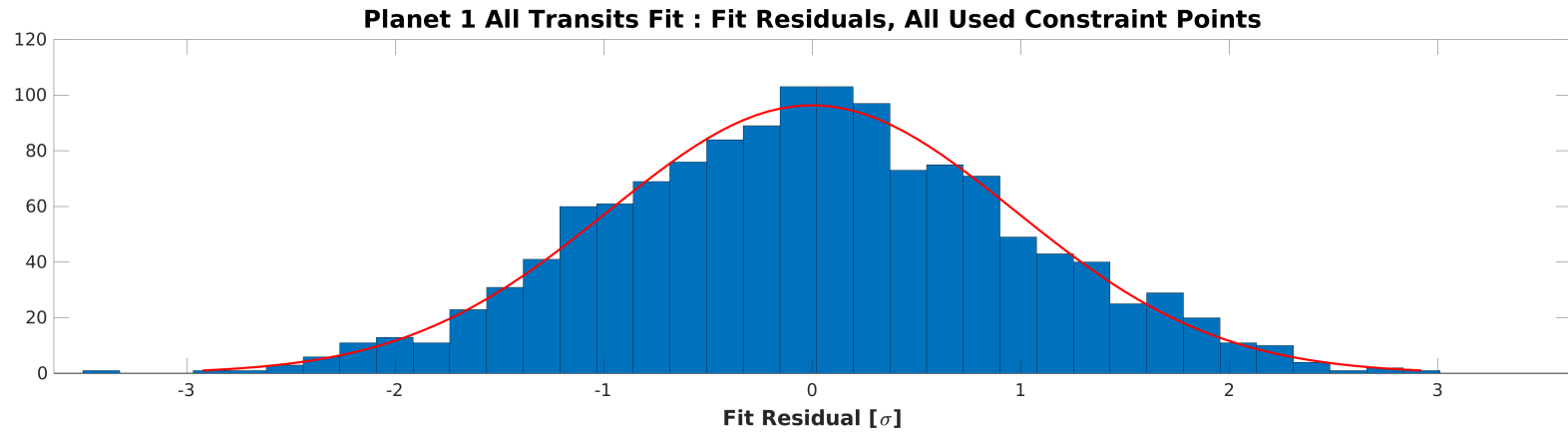
Appendix A Planet Candidate 1

A.1 Model Fitter: All Transits



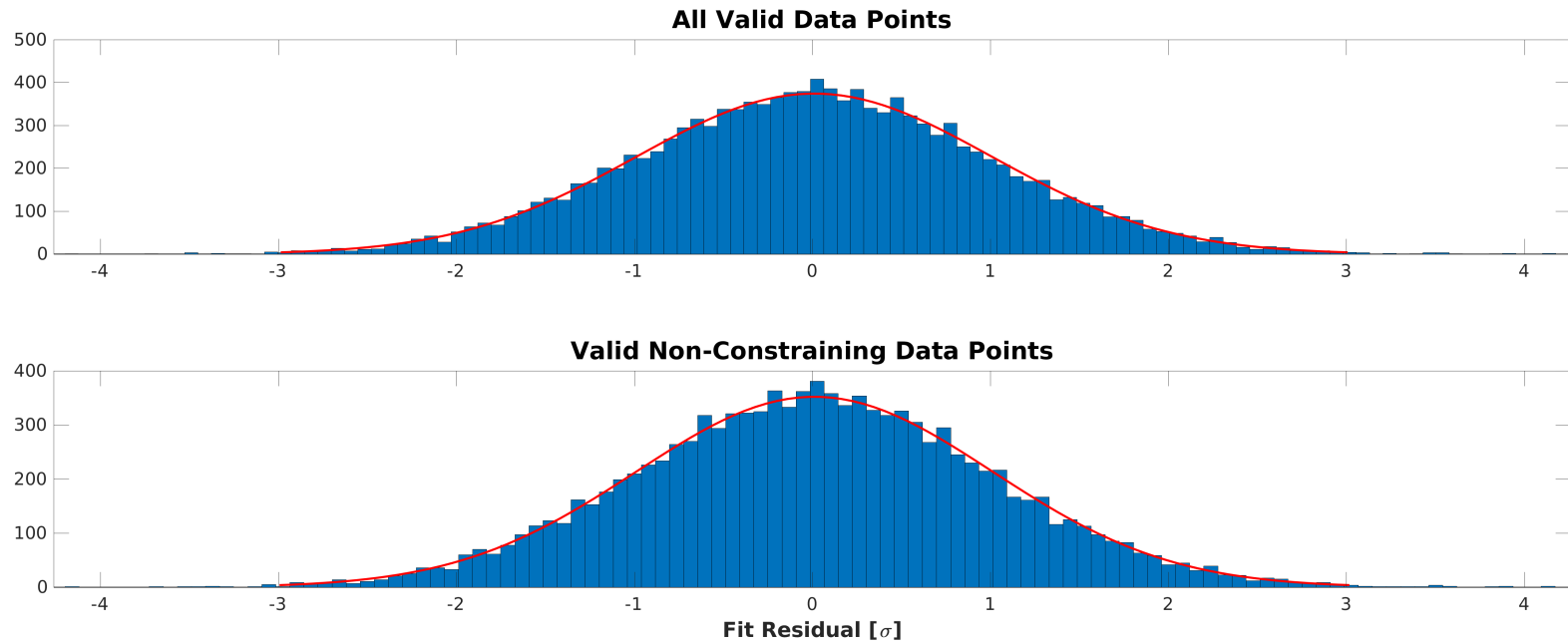
Robust weights distribution for CatId 169249234, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000169249234-01-all-robust-weights.fig`



Fit residuals distribution for CatId 169249234, 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/0000000169249234-01-all-histo-used.fig`



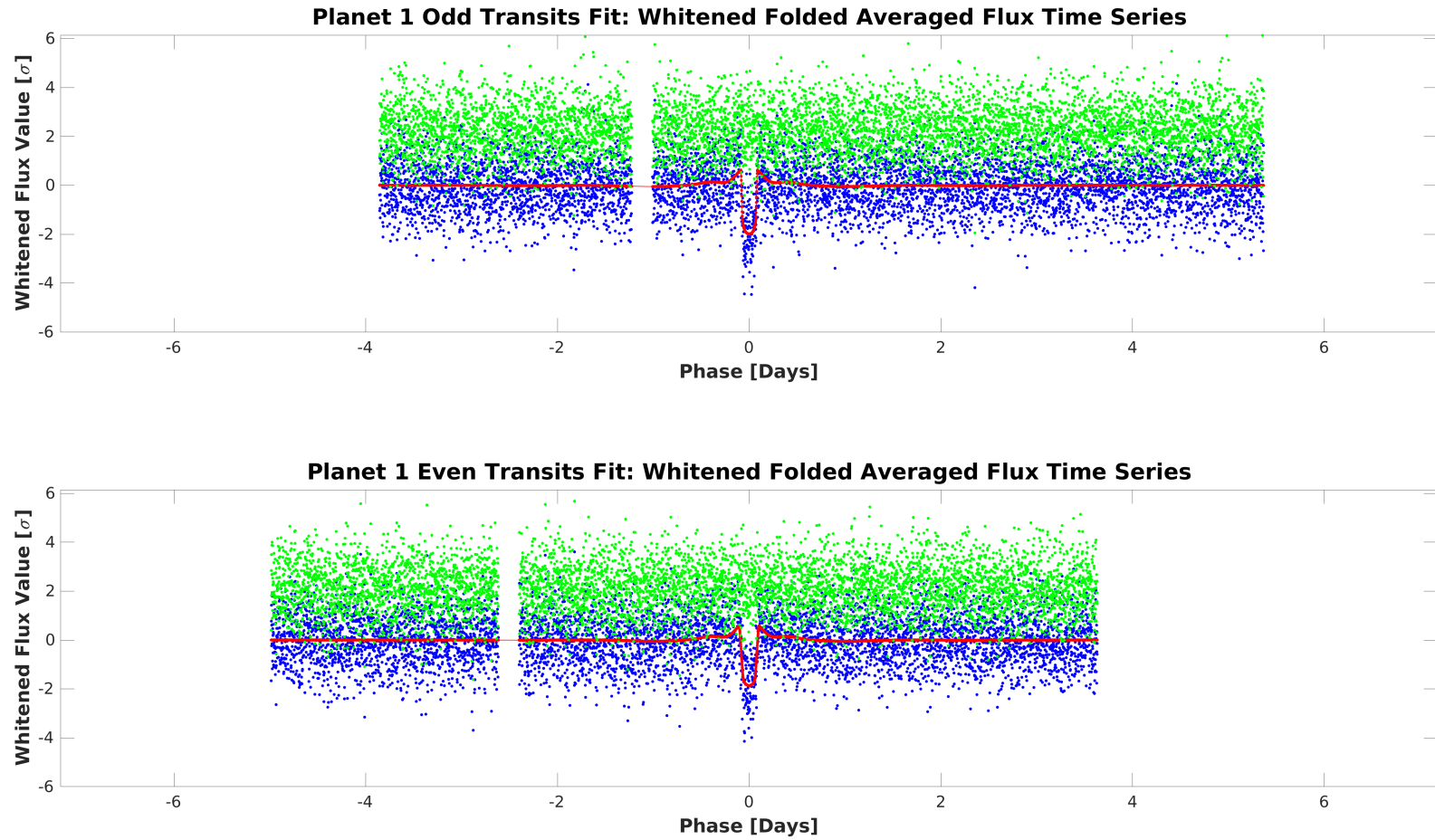
Fit residuals distribution for CatId 169249234, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000169249234-01-all-histo-all-and-unused.fig`

A.2 Model Fitter: Odd & Even Transits

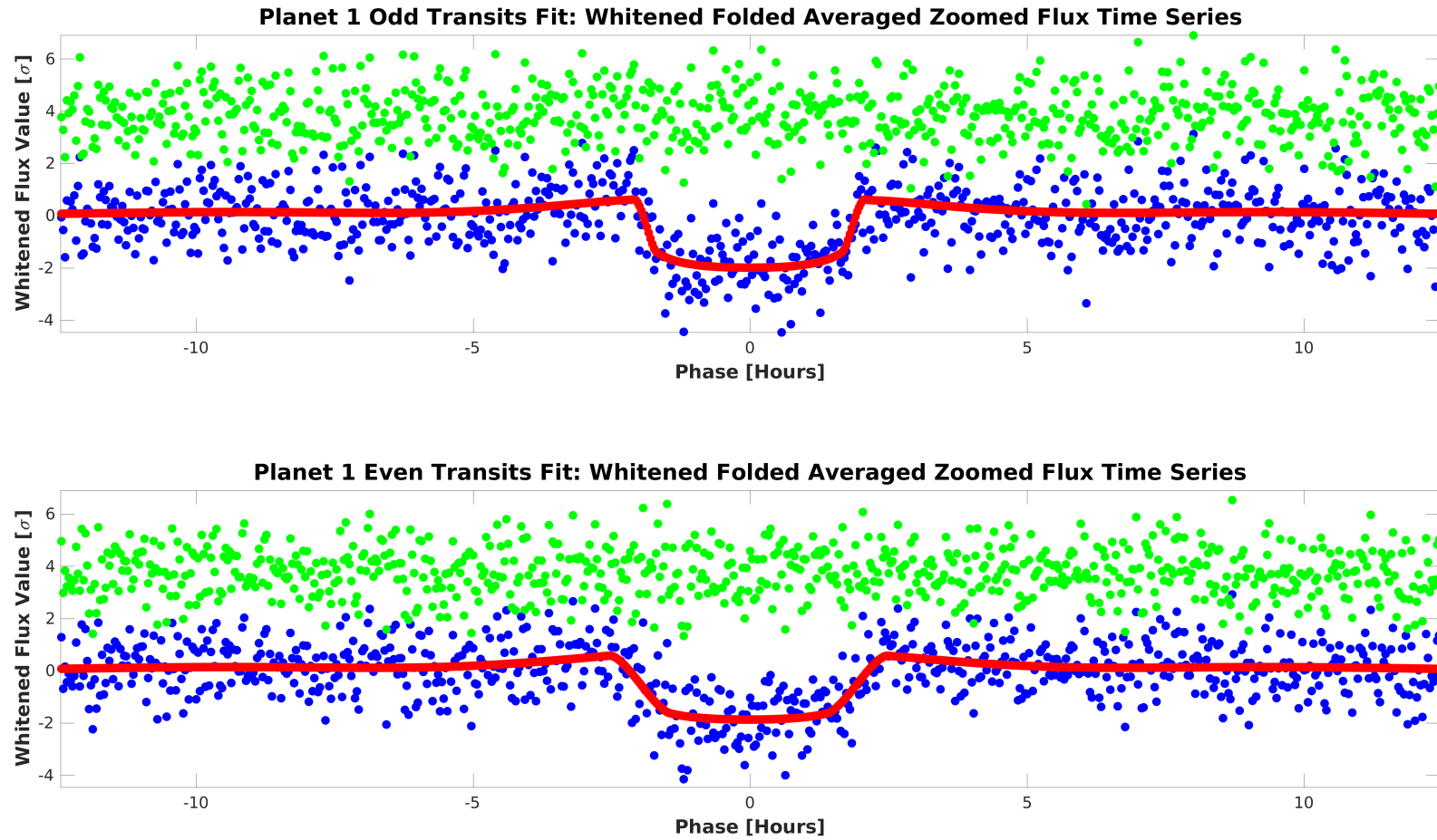
Parameter	Odd Transits Value	Odd Transits Uncertainty	Even Transits Value	Even Transits Uncertainty	Units	$\frac{\text{Difference}}{\ \text{Uncertainty}\ }$
SNR	18.8		17.9			
Orbital Period	14.3721719	0.0000e+00	14.3721719	0.0000e+00	days	
Transit Epoch	3267.5691260	1.5785e-03	3281.9408017	2.4169e-03	BTJD	2.2293e-01
Impact Parameter	0.1767	1.3396e+00	0.7711	7.1320e-02		4.4307e-01
Planet Radius to Star Radius Ratio	0.0974155	5.2773e-03	0.1036556	4.3886e-03		9.0916e-01
Semi-major Axis to Star Radius Ratio	28.6681	6.9737e+00	17.3506	2.2911e+00		1.5418e+00
Planet Radius	12.6266	9.7137e-01	13.4354	9.2851e-01	Earth radii	6.0191e-01
Semi-major Axis	0.1169	8.4439e-03	0.1169	8.4439e-03	AU	0.0000e+00
Effective Stellar Flux	101.6199	1.6313e+01	101.6199	1.6313e+01	Goldilocks	0.0000e+00
Equilibrium Temperature	810	3.2497e+01	810	3.2497e+01	Kelvin	0.0000e+00
Stellar Density	1.5325	1.1183e+00	0.3397	1.3458e-01	Solar density	1.0589e+00
Transit Depth	11064	5.7410e+02	10654	6.0608e+02	ppm	4.9073e-01
Transit Duration	4.1492	2.0702e-01	5.0033	2.7966e-01	hours	2.4549e+00
Transit Ingress Duration	0.3793	2.0415e-01	1.0541	3.3426e-01	hours	1.7227e+00
Eccentricity	0.0000	0.0000e+00	0.0000	0.0000e+00		
Peri Longitude	0.0000	0.0000e+00	0.0000	0.0000e+00	degrees	
Model Chi Square Statistic (DoF)	985.2 (1231.5)		985.2 (1231.5)			

DoF: Degrees of Freedom



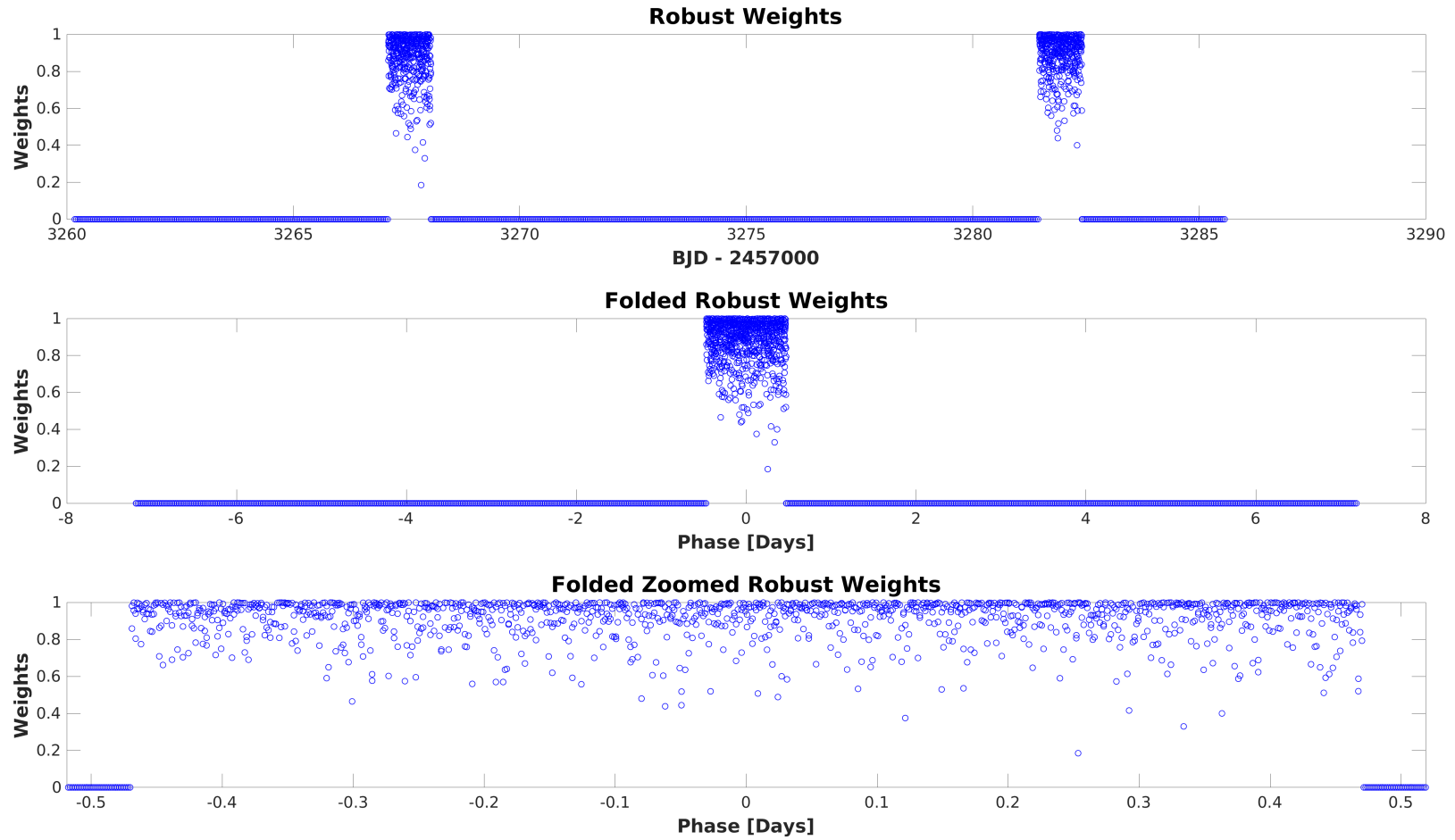
Folded flux time series for CatId 169249234, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light 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/0000000169249234-01-odd-even-whitened.fig`



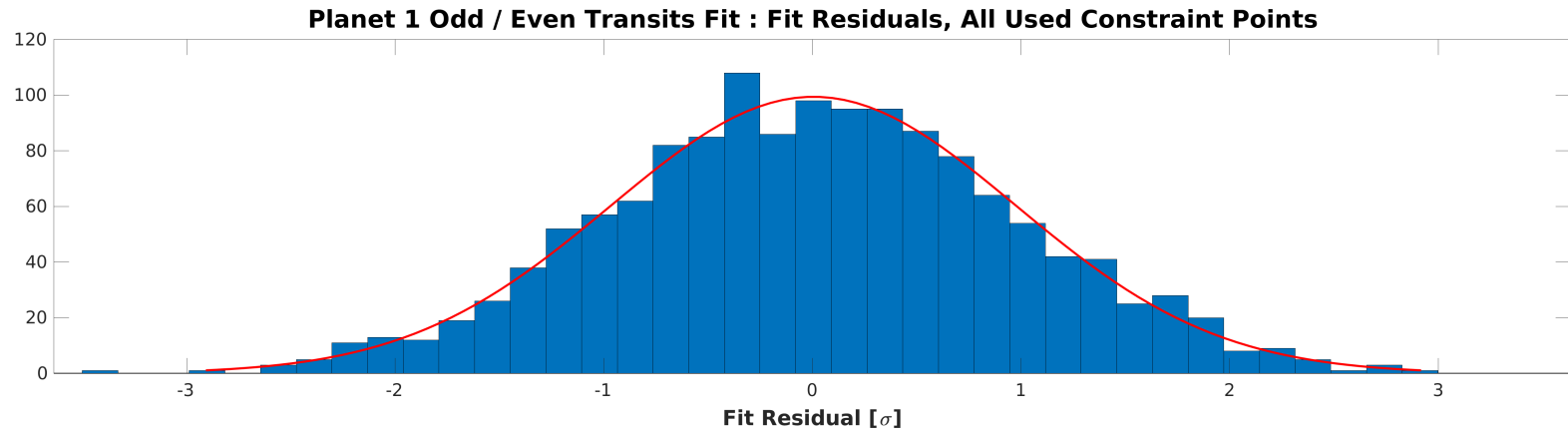
Folded flux time series for CatId 169249234, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000169249234-01-odd-even-whitened-zoomed.fig`



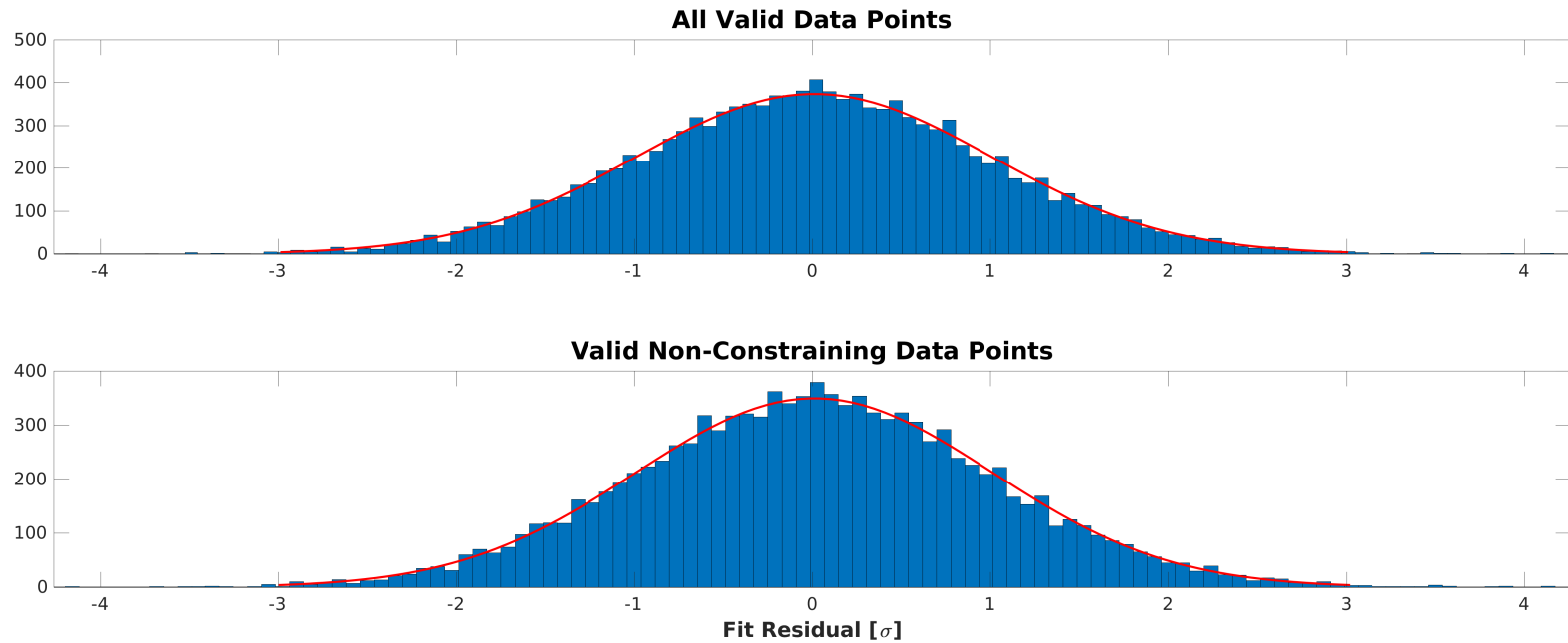
Robust weights distribution for CatId 169249234, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000169249234-01-odd-even-robust-weights.fig`



Fit residuals distribution for CatId 169249234, 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.

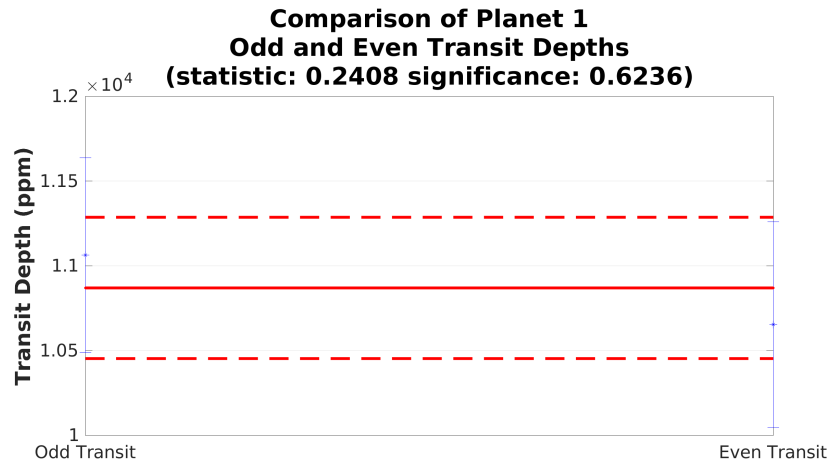
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000169249234-01-odd-even-histo-used.fig`



Fit residuals distribution for CatId 169249234, 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/0000000169249234-01-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 169249234, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary. Open `./planet-01/binary-discrimination-test-results/0000000169249234-01-eclipsing-binary-discrimination-tests.fig`

Appendix B Alerts

This target did not trigger any alerts.