

Data Validation (DV) Report
for TESS ID 19028197
Sectors 45 - 45
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-2021 13:14:08 Z

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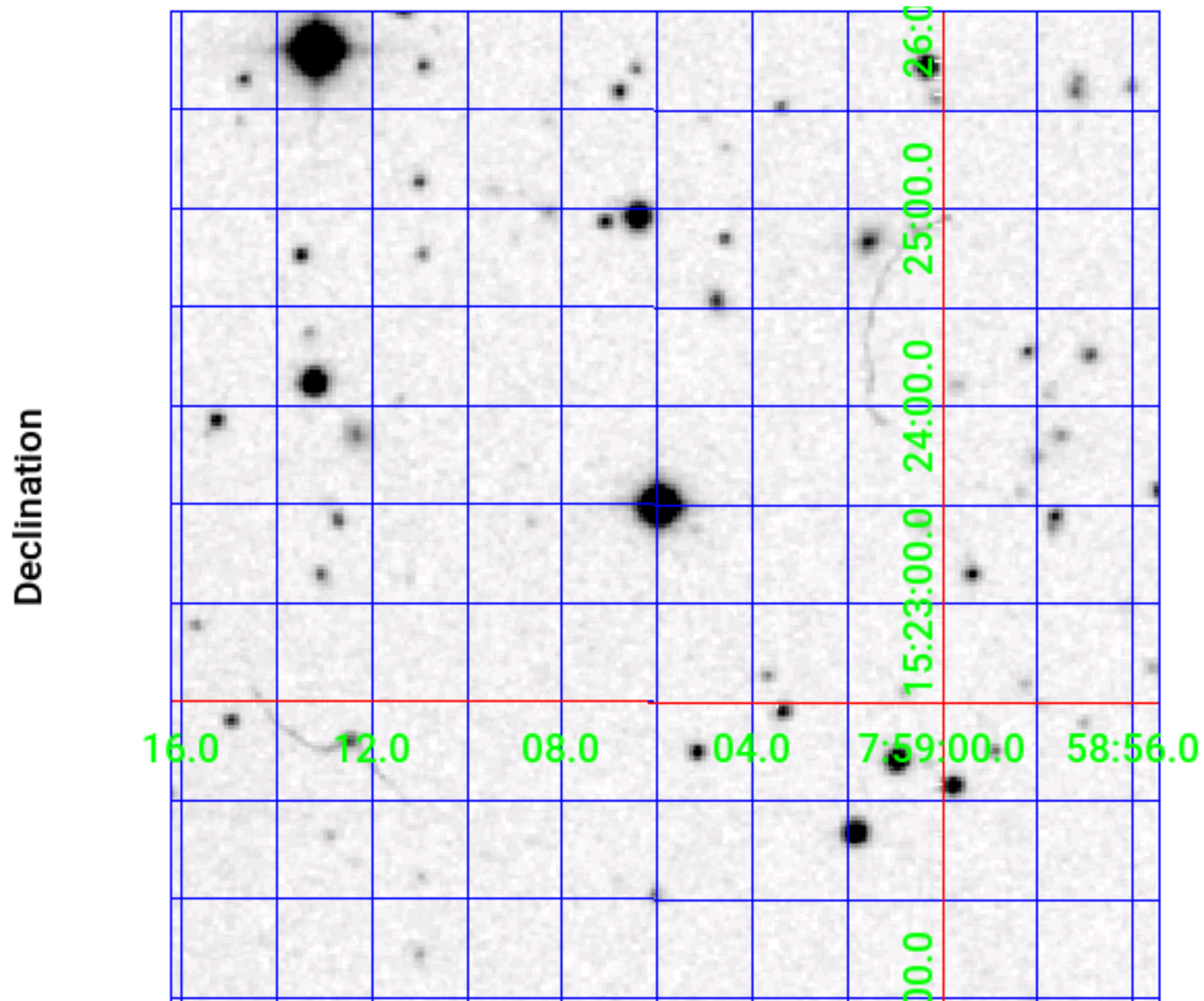
1Summary

Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	19028197			
TOI ID	-			
TESS Name	-			
RA	119.77433151	0	degrees	TIC8.2
Dec	15.39145556	0	degrees	TIC8.2
Magnitude	10.2479	0.0073281		TIC8.2
Radius	0.500	0.015	Solar radii	TIC8.2
Effective Temperature	3552	157	Kelvin	TIC8.2
log(g)	4.738	0.0081941	cm/sec ²	TIC8.2
[M/H]	0.000	0	Solar metallicity	Solar
Stellar Density	3.990	0.141	Solar density	TIC8.2-Derived
Limb Darkening Coefficient 1	0.6821			
Limb Darkening Coefficient 2	0.20269			
Limb Darkening Coefficient 3	-0.13309			
Limb Darkening Coefficient 4	0.013333			
Number of Planet Candidates	1			
TOI Model	csv-file-toi-catalog-12-08-21.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-5.0.54-20211208			
Date Report Generated	09-Dec-2021 13:14:08 Z			

Sector	Target Table	Camera/ CCD	Crowding Metric	Flux Fraction
45	332	2:1	0.9971	0.9011

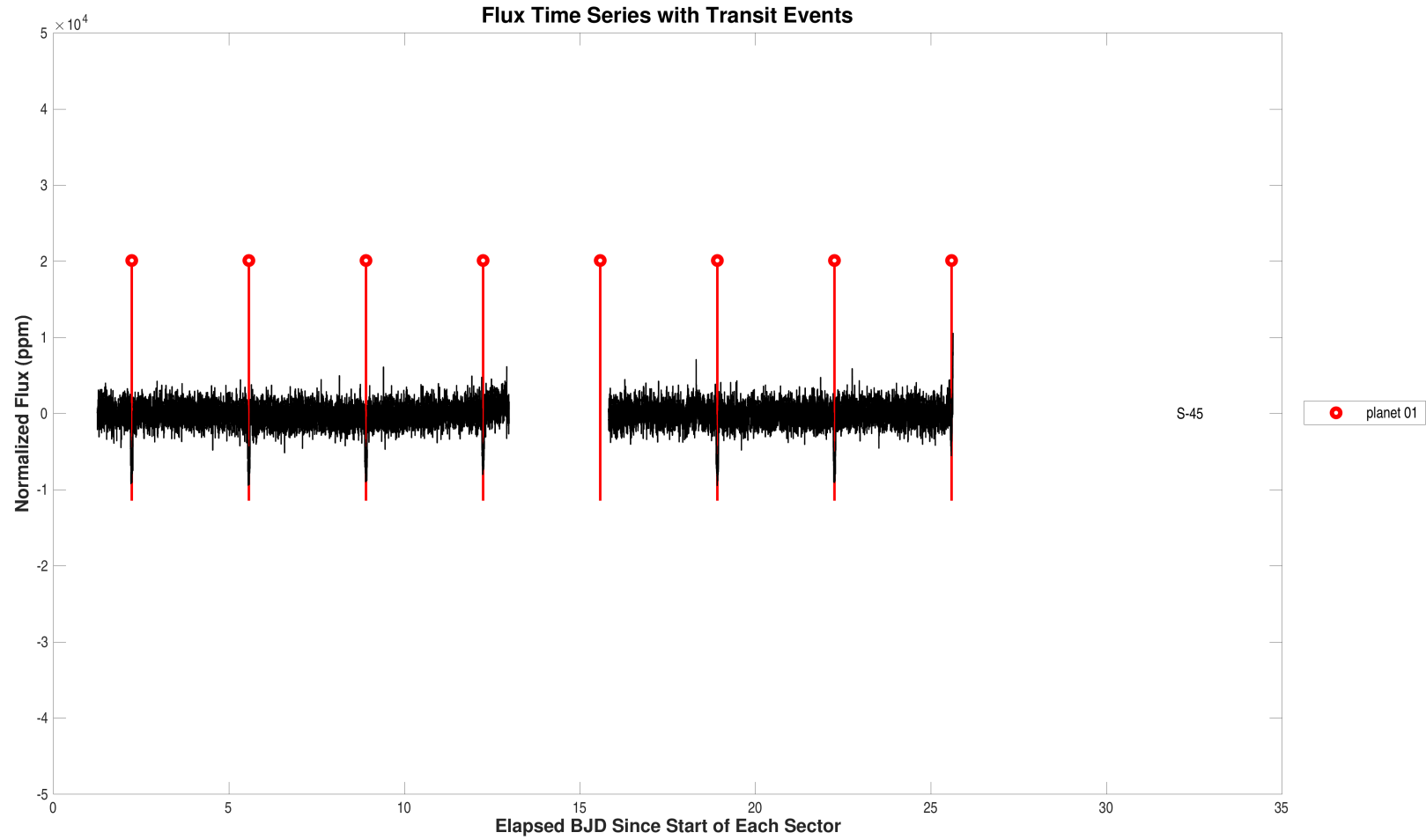
Planet Candidate	TOI ID	TESS Name	TOI Correlation	Period (days)	Period Ratio	Epoch (BTJD)	Semi-major Axis (AU)	Radius (Re)	Seff	Teq (K)	False Alarm	Suspected EB
1	-	-	-	3.336	1.00	2527.229	0.03	4.0	29.7	595	0.00e+00	false

2 Survey Image

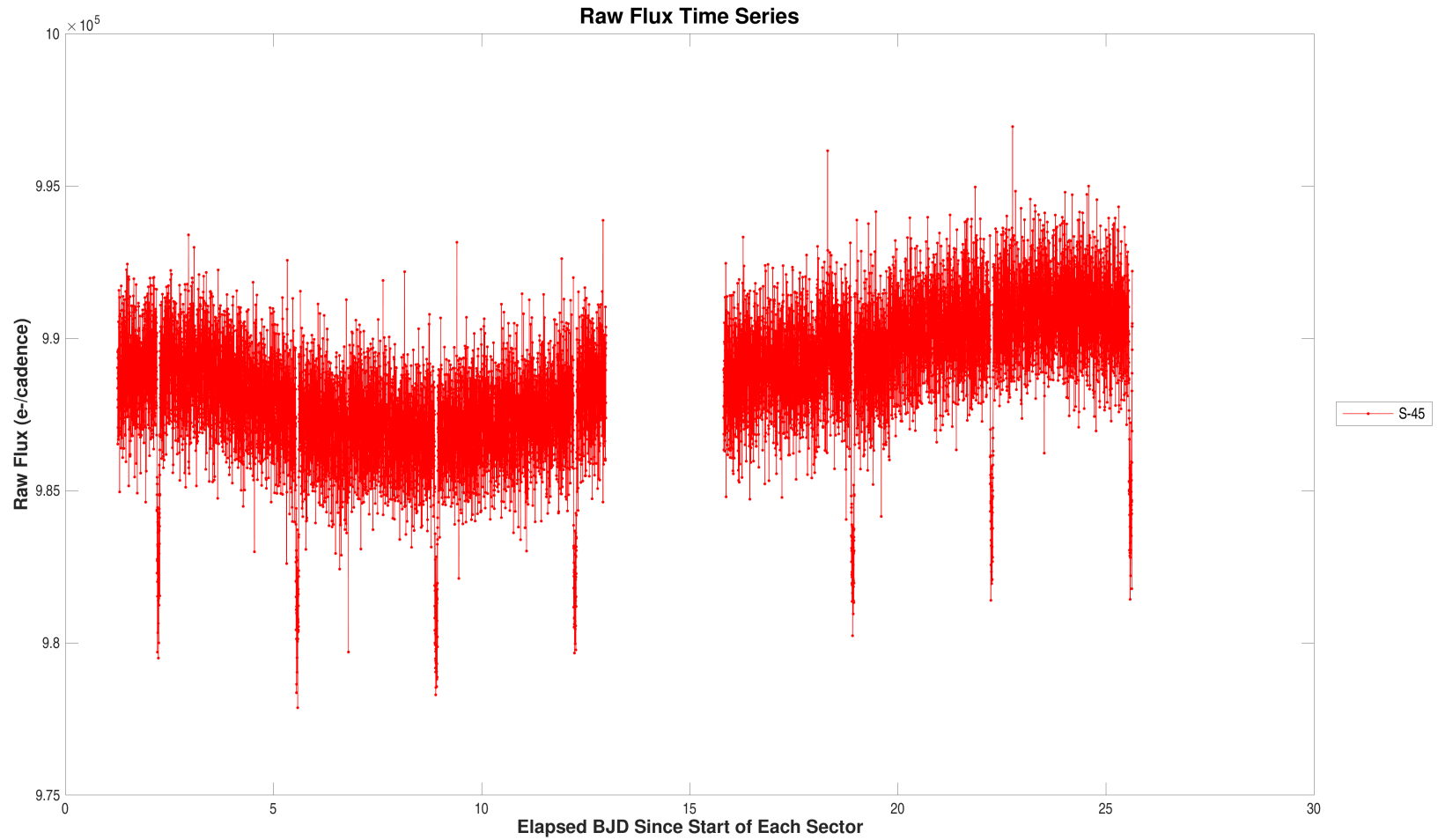


Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (19028197).

3 Flux Time Series



Summary plot of sector-stitched flux time series and transits for target 19028197, 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 45, target table 332, start BJD is 2459525. Open `./summary-plots/0000000019028197-00-flux-dv-fit-45-332.fig`



Summary plot of raw flux time series. For the data of sector 45, target table 332, start BJD is 2459525.
Open `./summary-plots/0000000019028197-00-raw-flux-45-332.fig`

4 Dashboards

Planet Candidate 1

Model Fitter	Stellar Radius 0.5 ± 0.0 Solar units		Core Aperture Correlation Statistic Value = 46.45 Significance = 100.00%	Ghost Diagnostic Test
	Period = 3.3 ± 0.0 days Depth = 6342 ± 99 ppm Planet Radius = 4.0 ± 0.2 Earth radii Semi-major Axis = 0.0 ± 0.0 AU Effective Stellar Flux = 29.7 ± 5.3 Equilibrium Temperature = 595 ± 27 Kelvin Chi-squared/DoF = 0.9 SNR = 67.7		Halo Aperture Correlation Statistic Value = 5.90 Significance = 100.00% Core/Halo Ratio Ratio = 7.87	
Eclipsing Binary Discrimination Test	Odd-Even Depth Comparison Statistic Value = 1.36e+01 Significance = 0.02%		Offsets Relative to Out of Transit Centroid Source RA Offset = $-6.14\text{e-}01 \pm 2.51\text{e+}00$ arcsec (-0.24σ) Source Dec Offset = $9.51\text{e-}01 \pm 2.51\text{e+}00$ arcsec (0.38σ) Source Offset Distance = $1.13\text{e+}00 \pm 2.51\text{e+}00$ arcsec (0.45σ) Offsets Relative to TIC Position Source RA Offset = $3.00\text{e-}01 \pm 2.51\text{e+}00$ arcsec (0.12σ) Source Dec Offset = $-1.12\text{e+}00 \pm 2.51\text{e+}00$ arcsec (-0.44σ) Source Offset Distance = $1.16\text{e+}00 \pm 2.51\text{e+}00$ arcsec (0.46σ)	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 = 0.00e+00 Transit Count = 8 Max Multiple Event Statistic = 68.0	Bootstrap Test

Summary of model fitter results and validation test results for target 19028197, 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

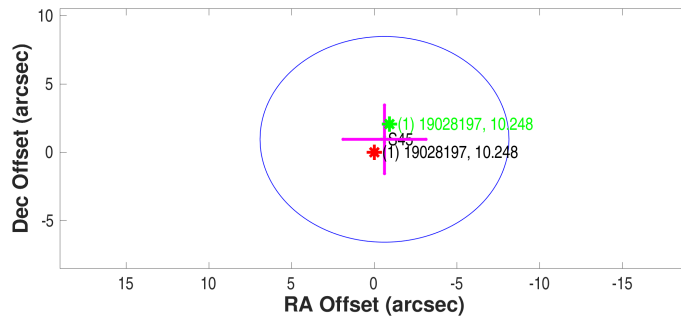
	RA	Dec	Units
Offset	$-0.6144 \pm 2.51e+00$	$0.9508 \pm 2.51e+00$	arcseconds
Offset/ σ	-0.24	0.38	
Offset Distance	$1.1320 \pm 2.51e+00$		arcseconds
Offset Distance/ σ	0.45		
3σ Radius	7.5260		arcseconds

Mean offset from the TIC RA and Dec

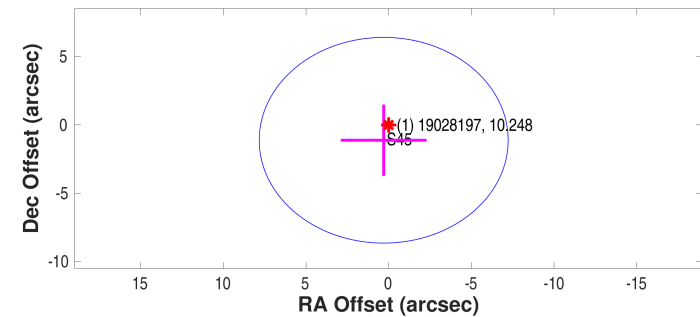
	RA	Dec	Units
Offset	$0.3000 \pm 2.51e+00$	$-1.1161 \pm 2.51e+00$	arcseconds
Offset/ σ	0.12	-0.44	
Offset Distance	$1.1557 \pm 2.51e+00$		arcseconds
Offset Distance/ σ	0.46		
3σ Radius	7.5264		arcseconds

Planet Candidate 1

Offsets Relative to Out of Transit Centroid



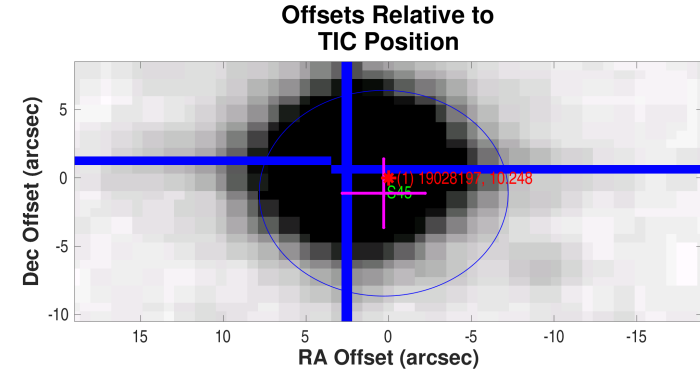
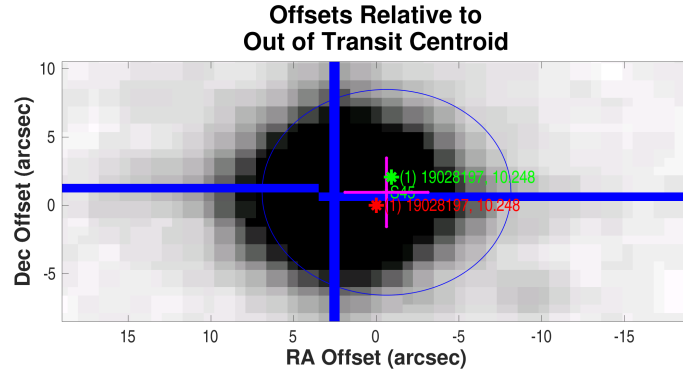
Offsets Relative to TIC Position



Difference image centroid offsets for target 19028197, 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/0000000019028197-01-difference-image-centroid-offsets.fig`

Planet Candidate 1



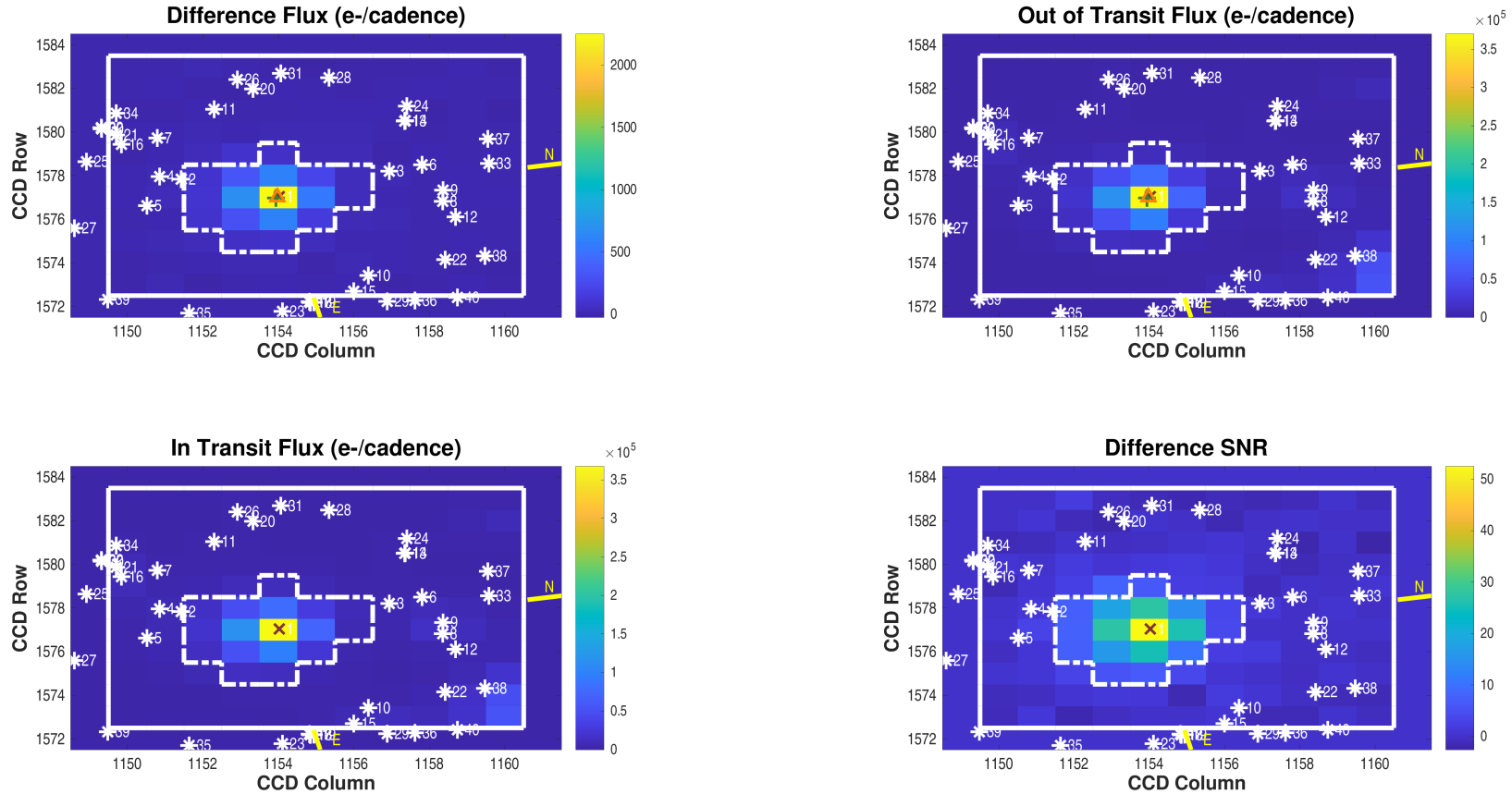
Difference image centroid offsets for target 19028197, planet candidate 1, displayed on survey image for given target. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in 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/0000000019028197-01-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 45 / Target Pixel Table 332



Difference image for target 19028197, planet candidate 1, sector 45, target pixel table 332. 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 = 7; number of valid in-transit cadences = 318; number of in-transit cadence gaps = 0; number of valid out-of-transit cadences = 775; number of out-of-transit cadence gaps = 0. Difference image quality metric = 1.00 (good).

Open `./planet-01/difference-image/0000000019028197-01-difference-image-45-332.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	$1576.98 \pm 3.45e-05$	$1153.94 \pm 3.61e-05$	pixels	$119.77342391 \pm 9.62e-07$	$15.39053334 \pm 9.62e-07$	degrees
Difference Image Centroid	$1577.02 \pm 9.94e-03$	$1153.98 \pm 1.05e-02$	pixels	$119.77324689 \pm 5.83e-05$	$15.39079745 \pm 5.85e-05$	degrees
Offset	$0.0379 \pm 9.94e-03$	$0.0393 \pm 1.05e-02$	pixels	$-0.6144 \pm 2.02e-01$	$0.9508 \pm 2.11e-01$	arcseconds
Offset/ σ	3.81	3.75		-3.04	4.51	
Offset Distance	$0.0546 \pm 9.79e-03$		pixels	$1.1320 \pm 1.97e-01$		arcseconds
Offset Distance/ σ	5.58			5.75		

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

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$1577.04 \pm 1.64e-04$	$1154.03 \pm 1.65e-04$	pixels	$119.77316046 \pm 0.00e+00$	$15.39110747 \pm 0.00e+00$	degrees
Difference Image Centroid	$1577.02 \pm 9.94e-03$	$1153.98 \pm 1.05e-02$	pixels	$119.77324689 \pm 5.83e-05$	$15.39079745 \pm 5.85e-05$	degrees
Offset	$-0.0248 \pm 9.94e-03$	$-0.0500 \pm 1.05e-02$	pixels	$0.3000 \pm 2.02e-01$	$-1.1161 \pm 2.11e-01$	arcseconds
Offset/ σ	-2.49	-4.77		1.48	-5.30	
Offset Distance	$0.0558 \pm 1.00e-02$		pixels	$1.1557 \pm 2.04e-01$		arcseconds
Offset Distance/ σ	5.56			5.66		

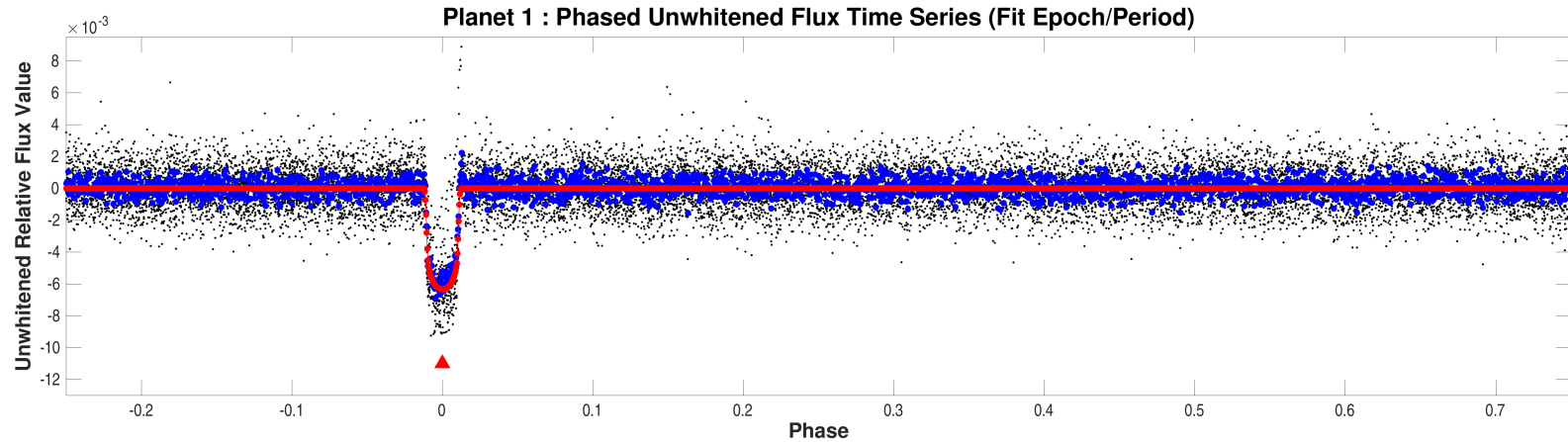
5.2 Difference Image TIC Key

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
1	19028197	10.248	119.77316046	15.39110747	0.00
2	740016752	18.156	119.76531130	15.37730240	56.68
3	19028210	19.097	119.76976640	15.40886732	65.01
4	19028190	16.529	119.76391101	15.37421296	68.77
5	19028188	16.395	119.77141103	15.37083805	73.22
6	19028216	17.704	119.76907476	15.41409864	83.97
7	740016780	18.278	119.75337625	15.37582302	87.99
8	19028219	16.896	119.77966915	15.41532952	90.08
9	19028220	13.506	119.77663499	15.41594889	90.24
10	740016763	19.108	119.79741025	15.40043393	90.62
11	19028193	16.552	119.74738953	15.38578466	91.48
12	19028221	17.914	119.78429700	15.41646000	99.12
13	10000228692	16.781	119.75665300	15.41371300	99.53
14	19028215	18.281	119.75656780	15.41381573	100.00
15	19030543	17.110	119.80122200	15.39744700	100.04
16	19028187	14.403	119.75395160	15.37013076	100.74
17	19028194	16.794	119.80265540	15.39029489	102.42
18	10000228729	16.641	119.80289500	15.39037100	103.24
19	740016758	18.404	119.80295413	15.39091594	103.41
20	740016785	18.729	119.74310916	15.39263760	104.45
21	740016782	18.923	119.75123164	15.36982616	107.99
22	19028214	16.985	119.79555018	15.41274057	110.02
23	740016757	17.680	119.80440253	15.38575601	110.14
24	19028217	18.300	119.75267015	15.41479151	111.03
25	19028184	14.051	119.75754225	15.36401724	111.58
26	19028195	16.327	119.74005713	15.39076676	114.90
27	740016749	18.153	119.77520412	15.35883460	116.40
28	740016790	17.497	119.74248484	15.40458756	117.01
29	19030541	13.258	119.80503696	15.40193962	117.31
30	19028186	15.591	119.74913221	15.36794749	117.93
31	19028202	17.070	119.73976900	15.39759200	118.23
32	740016783	16.813	119.74879173	15.36796955	118.71
33	740016794	19.210	119.77085417	15.42417514	119.31
34	740016779	17.965	119.74534342	15.37092475	120.83
35	740016755	17.704	119.80190167	15.37169628	121.80
36	19028208	18.371	119.80568535	15.40613991	125.19
37	19028224	17.343	119.76415754	15.42525067	126.83
38	19028223	17.614	119.79583626	15.41887943	127.24

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
39	740016744	18.942	119.79560236	15.36020768	135.80
40	19030534	16.882	119.80621727	15.41264960	138.49
41	19030571	18.262	119.80370348	15.36372467	144.76

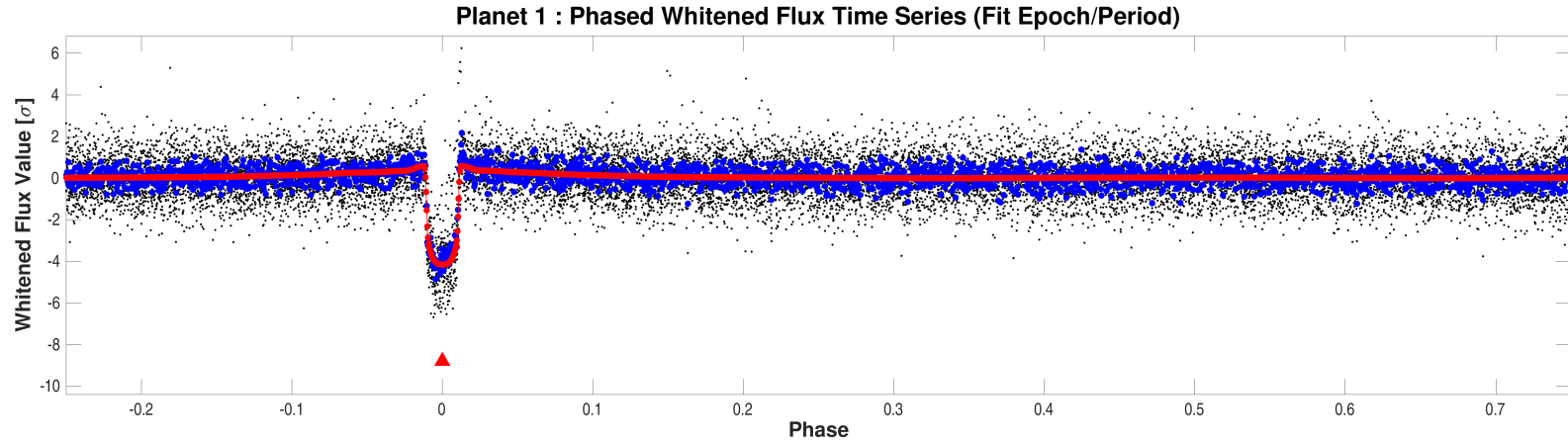
RA, Dec and Distances are corrected for proper motion. This table may not contain all of the objects shown.

6 Phased Light Curves



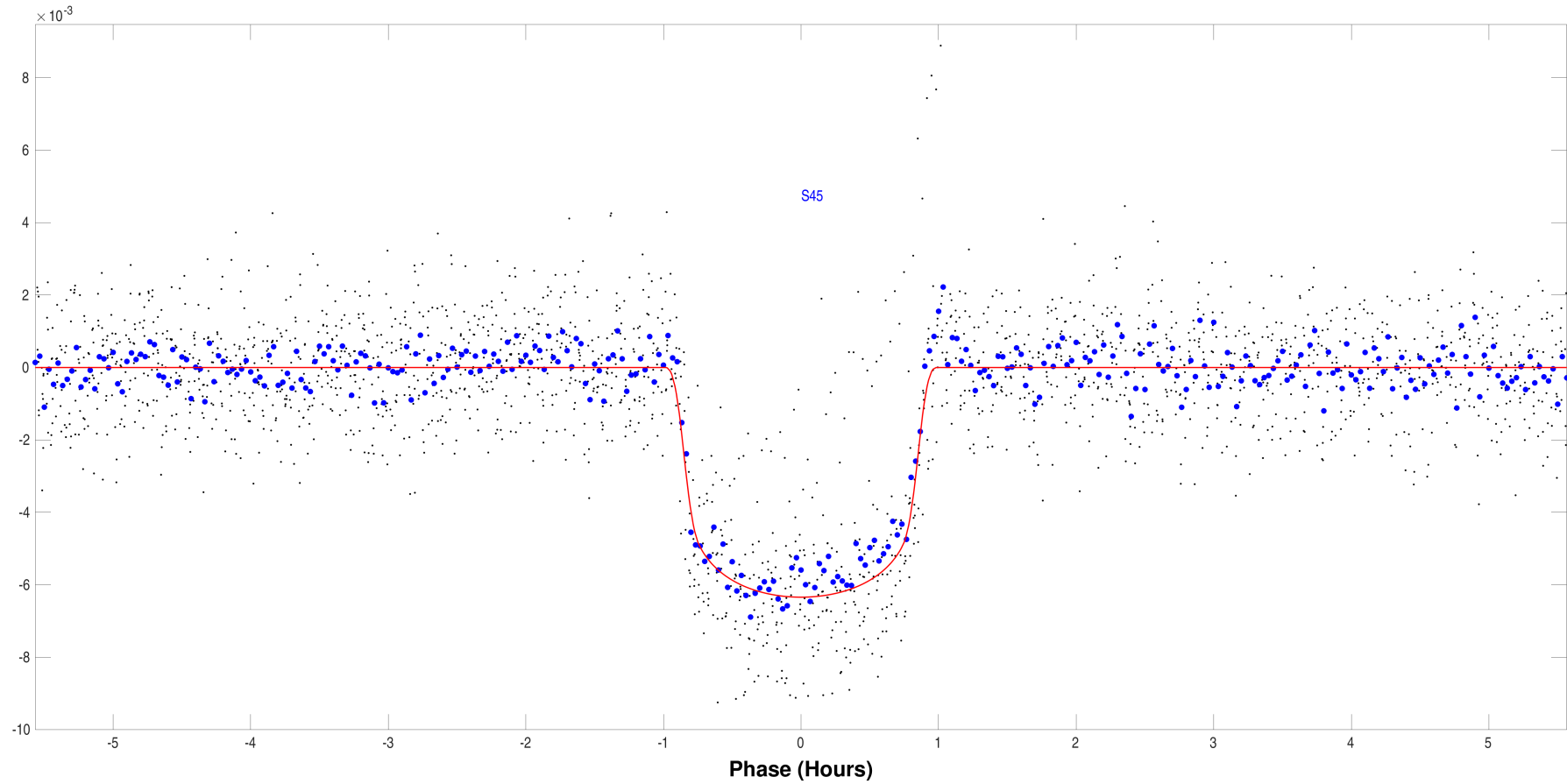
Phased unwhitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased unwhitened flux time series 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/0000000019028197-01-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/0000000019028197-01-phased-whitened-flux-time-series.fig`

Planet: 1 Phased Unwhitened Flux Time Series by Sector

Phased unwhitened flux time series by sector in year 4 for target 19028197, planet candidate 1. Period = 3.3365 days; transit epoch = 2527.2292 BTJD.
 Open `./summary-plots/0000000019028197-01-phased-unwhitened-flux-time-series-by-sector-04.fig`

7 Planet Candidate 1

7.1 Model Fitter: All Transits

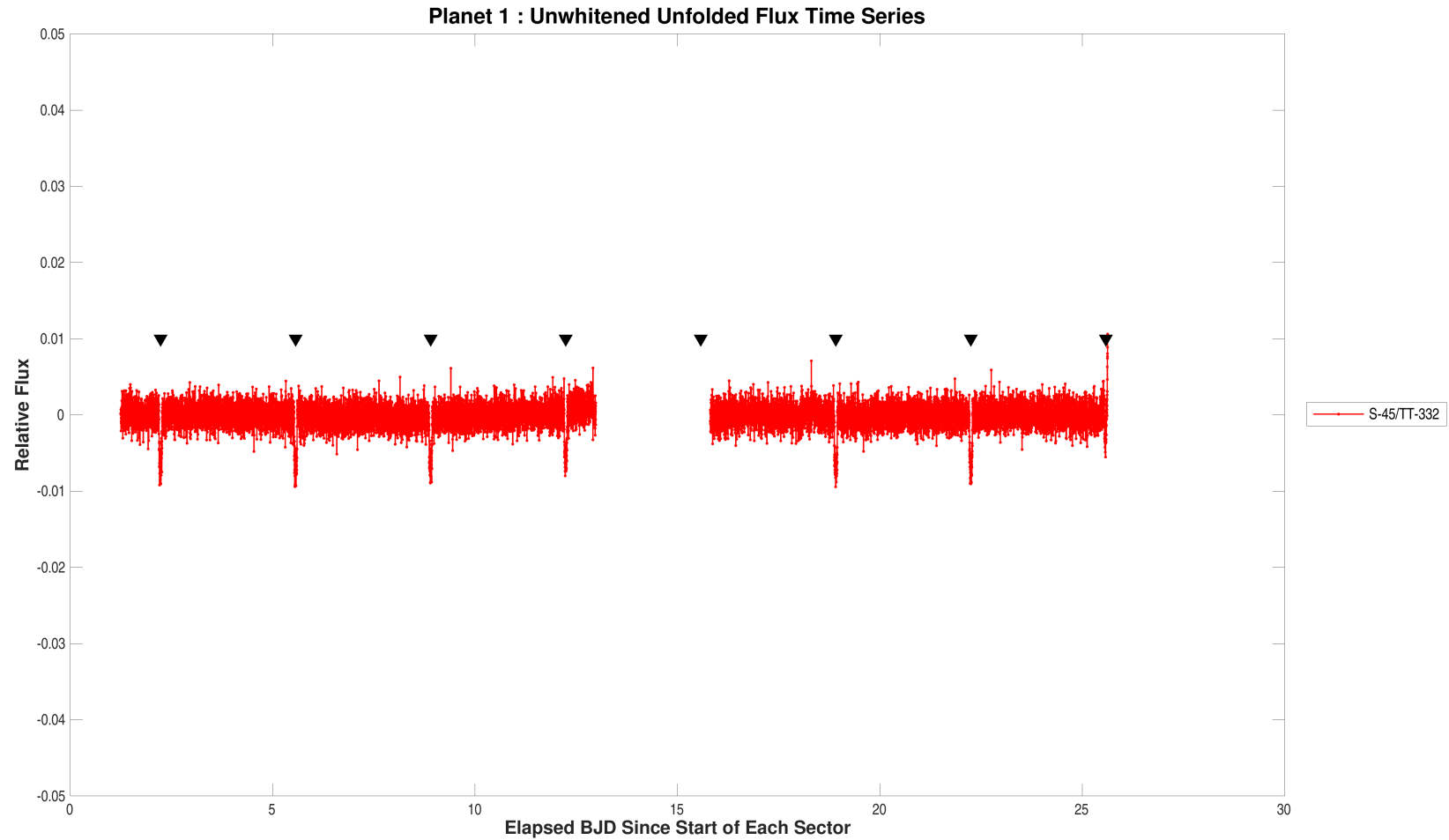
Model Characteristic	Name
Transit Model	mandel-agol-geometric-transit_model
Limb Darkening Model	claret_tess_nonlinear_limb_darkening_model

TCE Parameter	Value	Units
Trial Transit Pulse Duration	2.0	hours
Transit Epoch	2527.2236903	TJD
Orbital Period	3.3374984	days
Maximum SES	31.4	
Maximum MES	68.0	
Robust Statistic	68.6	
Chi Square Goodness of Fit Statistic (DoF)	1287.8 (417)	
Chi Square2 Statistic (DoF)	575.3 (378.4)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

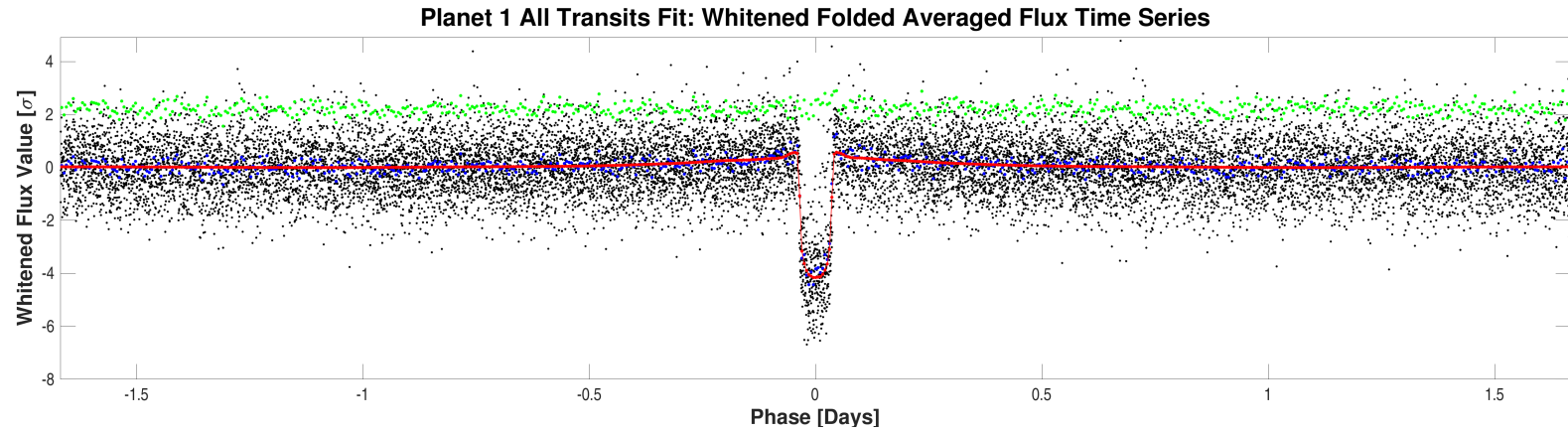
Parameter	Value	Uncertainty	Units
SNR	67.7		
Orbital Period	3.3364723	1.0308e-04	days
Transit Epoch	2527.2291652	4.2434e-04	BTJD
Impact Parameter	0.0100	2.1628e+01	
Planet Radius to Star Radius Ratio	0.0732931	3.1014e-03	
Semi-major Axis to Star Radius Ratio	14.7582	3.1709e+00	
Planet Radius	3.9983	2.0710e-01	Earth radii
Semi-major Axis	0.0347	7.2370e-04	AU
Effective Stellar Flux	29.6605	5.2904e+00	Goldilocks
Equilibrium Temperature	595	2.6541e+01	Kelvin
Stellar Density	3.8794	2.5005e+00	Solar density
Transit Depth	6342	9.9246e+01	ppm
Transit Duration	1.8552	5.8822e-02	hours
Transit Ingress Duration	0.1269	6.0258e-02	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	1663.0 (1828.9)		
Model Chi Square Goodness of Fit Statistic (DoF)	285.9 (412)		
Model Chi Square2 Statistic (DoF)	82.8 (6)		

DoF: Degrees of Freedom



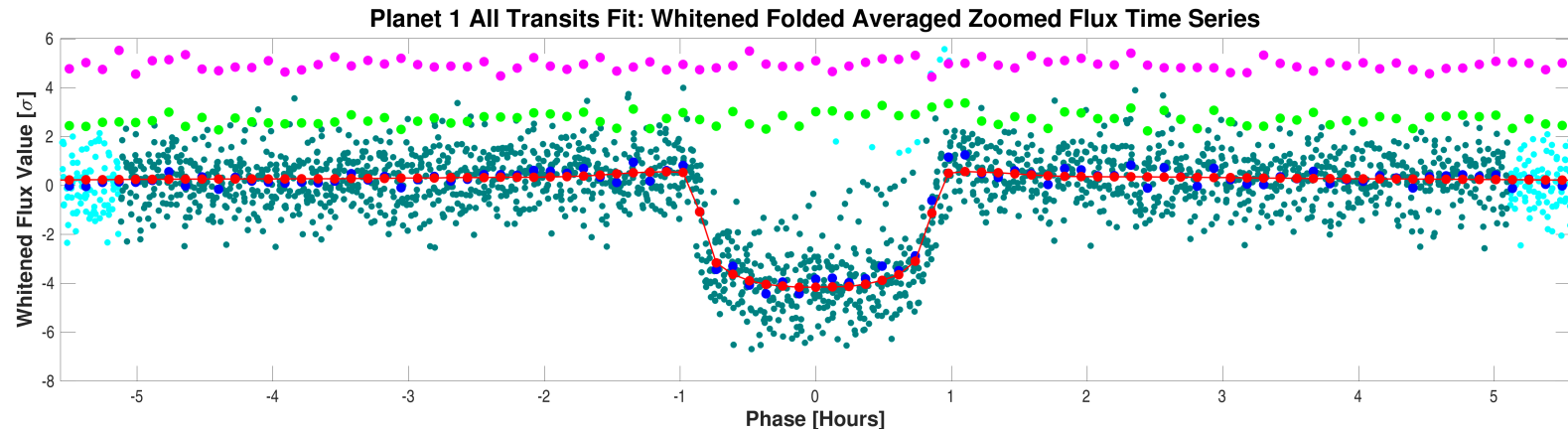
Flux time series for CatId 19028197, Planet candidate 1 in the unwhitened domain. For the data of Sector-45/TargetTableId-332, start BJD is 2459525. Transit event markers indicate the location of transits of the given planet candidate. All transits fit completed with full convergence.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000019028197-01-all-unwhitened-45-332.fig`



Folded flux time series for CatId 19028197, 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/0000000019028197-01-all-whitenened.fig`



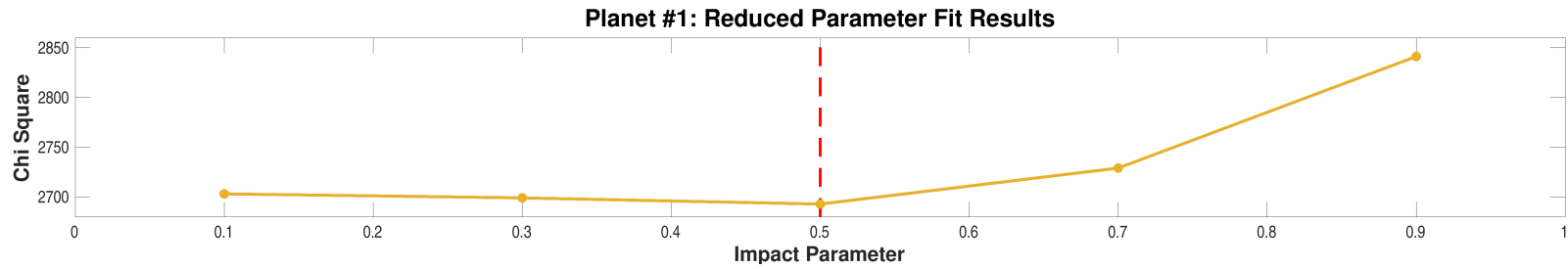
Folded flux time series for CatId 19028197, Planet candidate 1 in the whitenened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000019028197-01-all-whitenened-zoomed.fig`

7.2 Model Fitter: Reduced Parameter Fit Results

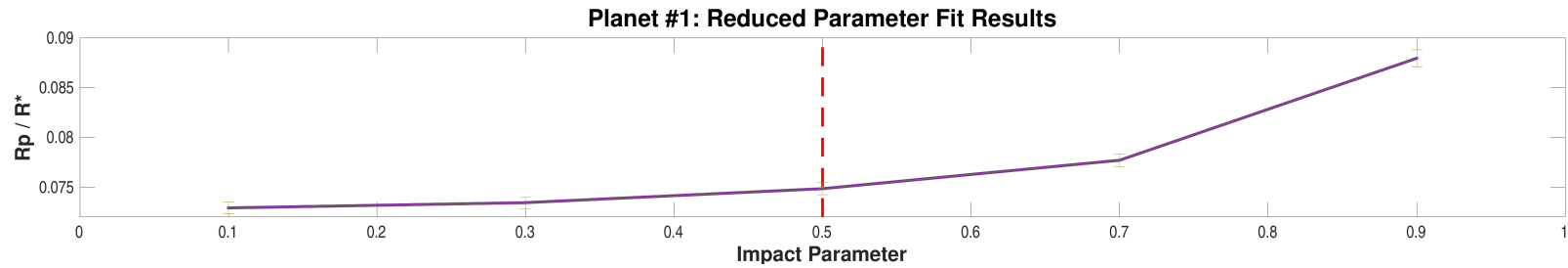
Impact Parameter	SNR	Model Chi Square	Planet Radius to Star Radius	Uncert	Semi-major Axis to Star Radius	Uncert	Transit Depth (ppm)	Uncert	Transit Duration (hours)	Uncert
0.10	71.0	2703.2	0.0729095	5.8681e-04	14.7520	1.1391e-01	6264	1.0027e+02	1.8473	1.4145e-02
0.30	70.9	2699.2	0.0734352	5.9157e-04	14.1483	1.1163e-01	6255	1.0021e+02	1.8588	1.4539e-02
0.50	70.6	2693.0	0.0748417	6.0718e-04	12.8599	1.0632e-01	6266	1.0107e+02	1.8889	1.5468e-02
0.70	70.6	2729.1	0.0777008	6.4148e-04	10.6708	9.9919e-02	6282	1.0299e+02	1.9634	1.8176e-02
0.90	68.7	2841.2	0.0879487	8.4833e-04	6.9424	1.0041e-01	6616	1.2397e+02	2.2659	3.1906e-02

Highlighted row is the best reduced-parameter model fit.



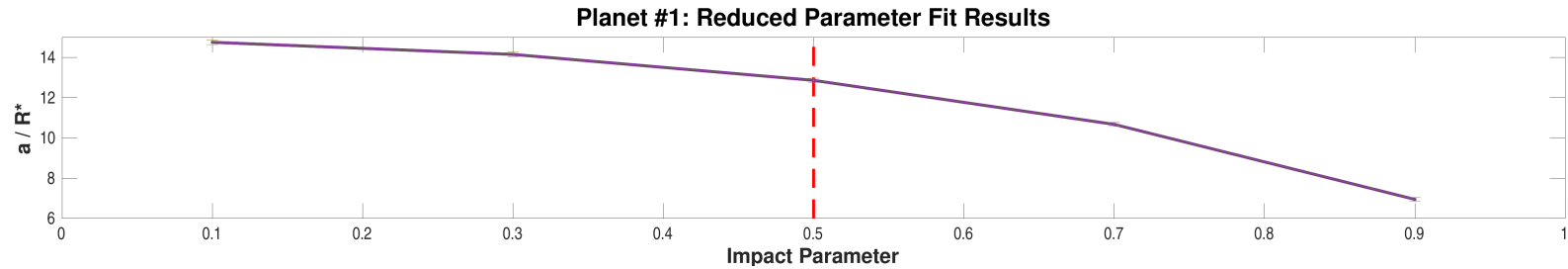
Model chi squares of reduced parameter fits vs. impact parameter for CatId 19028197, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.

Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000019028197-01-reduced-fits-chi-square.fig`



Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 19028197, 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/0000000019028197-01-reduced-fits-rp-over-rstar.fig`



Ratios of semimajor axis to star radius of reduced parameter fits vs. impact parameter for CatId 19028197, 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/0000000019028197-01-reduced-fits-a-over-rstar.fig`

7.3 Model Fitter: Trapezoidal Fit Results

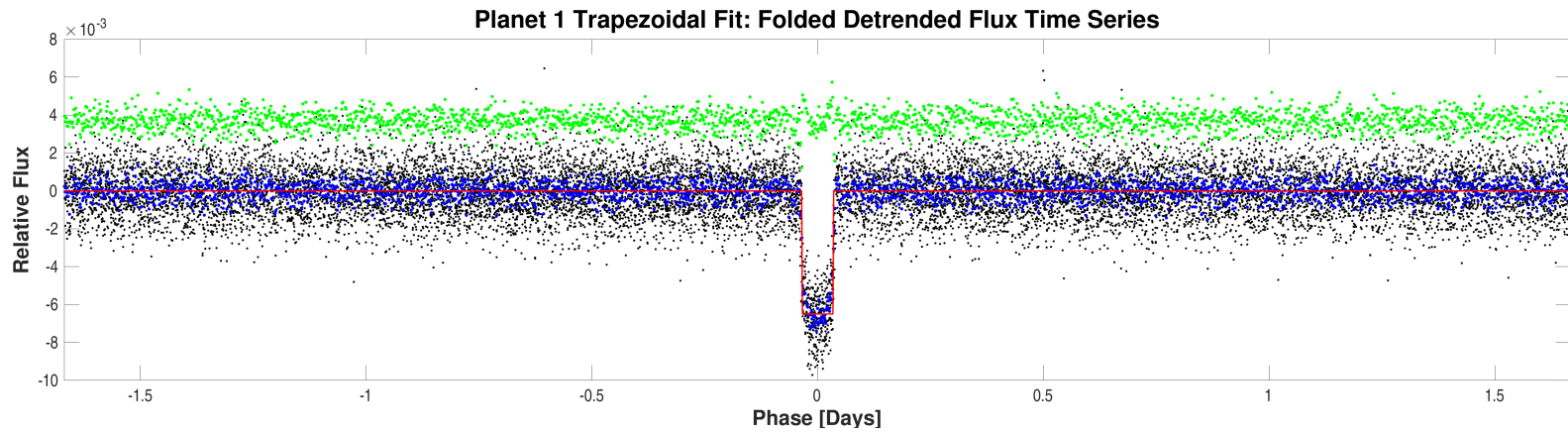
Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

TCE Parameter	Value	Units
Trial Transit Pulse Duration	2.0	hours
Transit Epoch	2527.2236903	TJD
Orbital Period	3.3374984	days
Maximum SES	31.4	
Maximum MES	68.0	
Robust Statistic	68.6	
Chi Square Goodness of Fit Statistic (DoF)	1287.8 (417)	
Chi Square2 Statistic (DoF)	575.3 (378.4)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

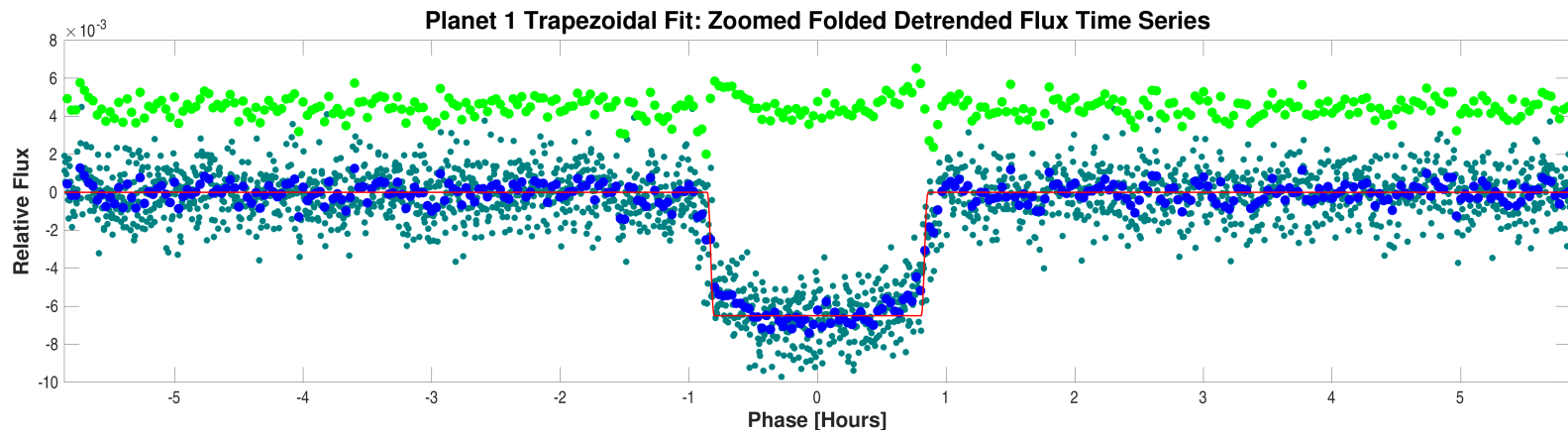
Parameter	Value	Uncertainty	Units
SNR	91.1		
Orbital Period	3.3374984		days
Transit Epoch	2527.2260027		BTJD
Transit Depth	6495		ppm
Transit Duration	1.9525		hours
Transit Ingress Duration	0.2896		hours
Model Chi Square Statistic (DoF)	16166.3 (3216)		

DoF: Degrees of Freedom



Folded detrended flux time series for CatId 19028197, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000019028197-01-all-trapezoidal.fig`



Zoomed folded detrended flux time series for CatId 19028197, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000019028197-01-all-trapezoidal-zoomed.fig`

7.4 Validation Tests

The Centroid Test and Eclipsing Binary Discrimination Test are chi-squared hypothesis tests. For these tests, a significance of 100% favors a planet, while 0% indicates an unlikely planet.

7.4.1 Weak Secondary Test

Result	Value	Uncertainty	Units	Statistic in Sigmas	Significance (%)
Orbital Period	3.3375		days		
Transit Duration	2		hours		
Maximum MES	68.0				
Secondary Phase	0.88889		days		
Secondary MES	3.2				
Minimum Phase	1.7292		days		
Minimum MES	-2.6				
Median MES	-0.1				
MAD MES	0.74644				
Robust Statistic	3.0				
Secondary Depth	302.3	9.8468e+01	ppm		
Geometric Albedo	12.5	4.2139e+00		2.7264	0.32
Planet Effective Temperature	1730	1.6443e+02	Kelvin	6.8129	0.00

7.4.2 Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	1.3583e+01	3.6856	0.02

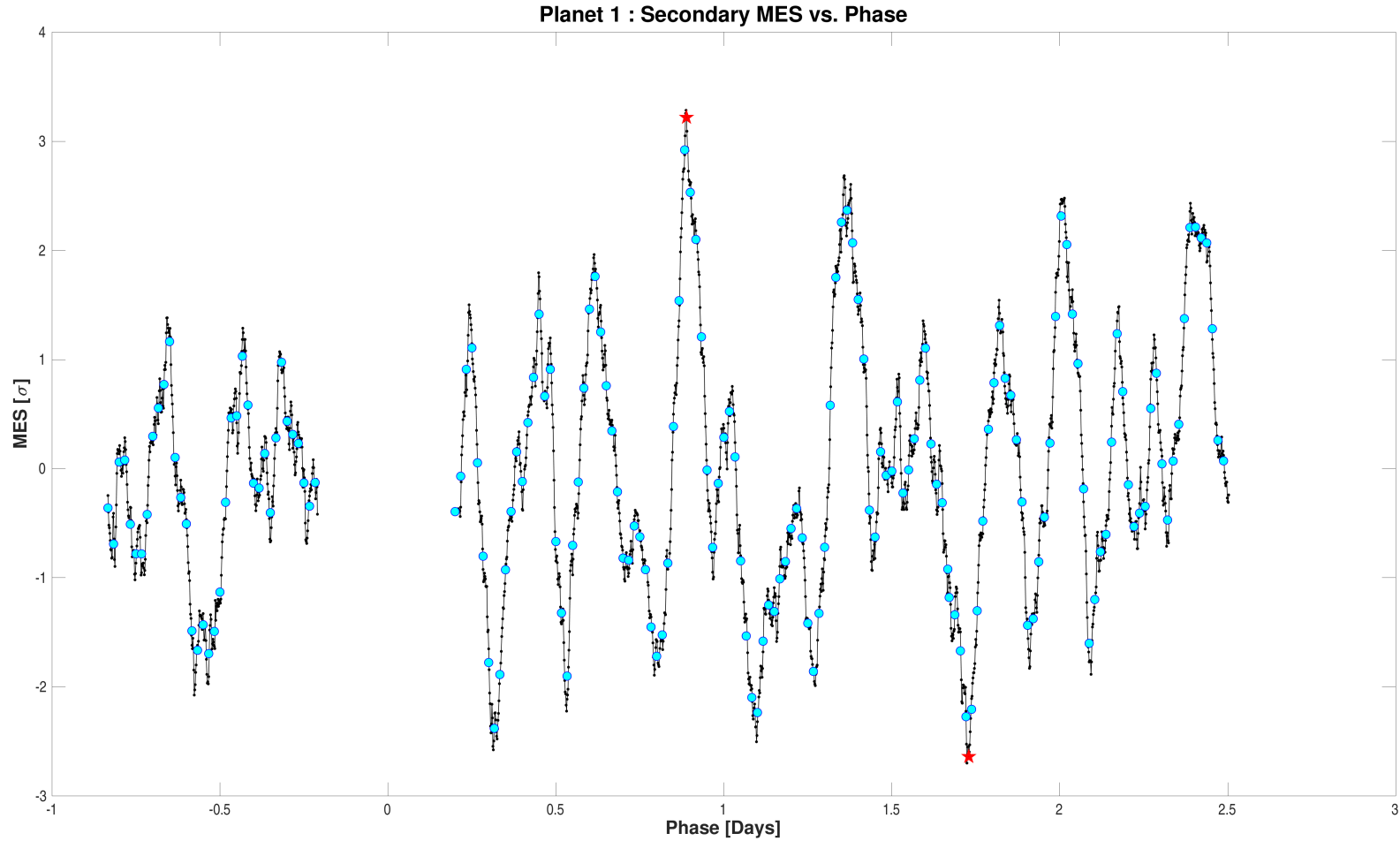
7.4.3 Bootstrap Test

Result	Value
False Alarm Probability	0.0000e+00
Bootstrap Threshold for Desired PFA	8.2
MES Mean	-0.74
MES Standard Deviation	1.26
Transit Count	8

7.4.4 Ghost Diagnostic Test

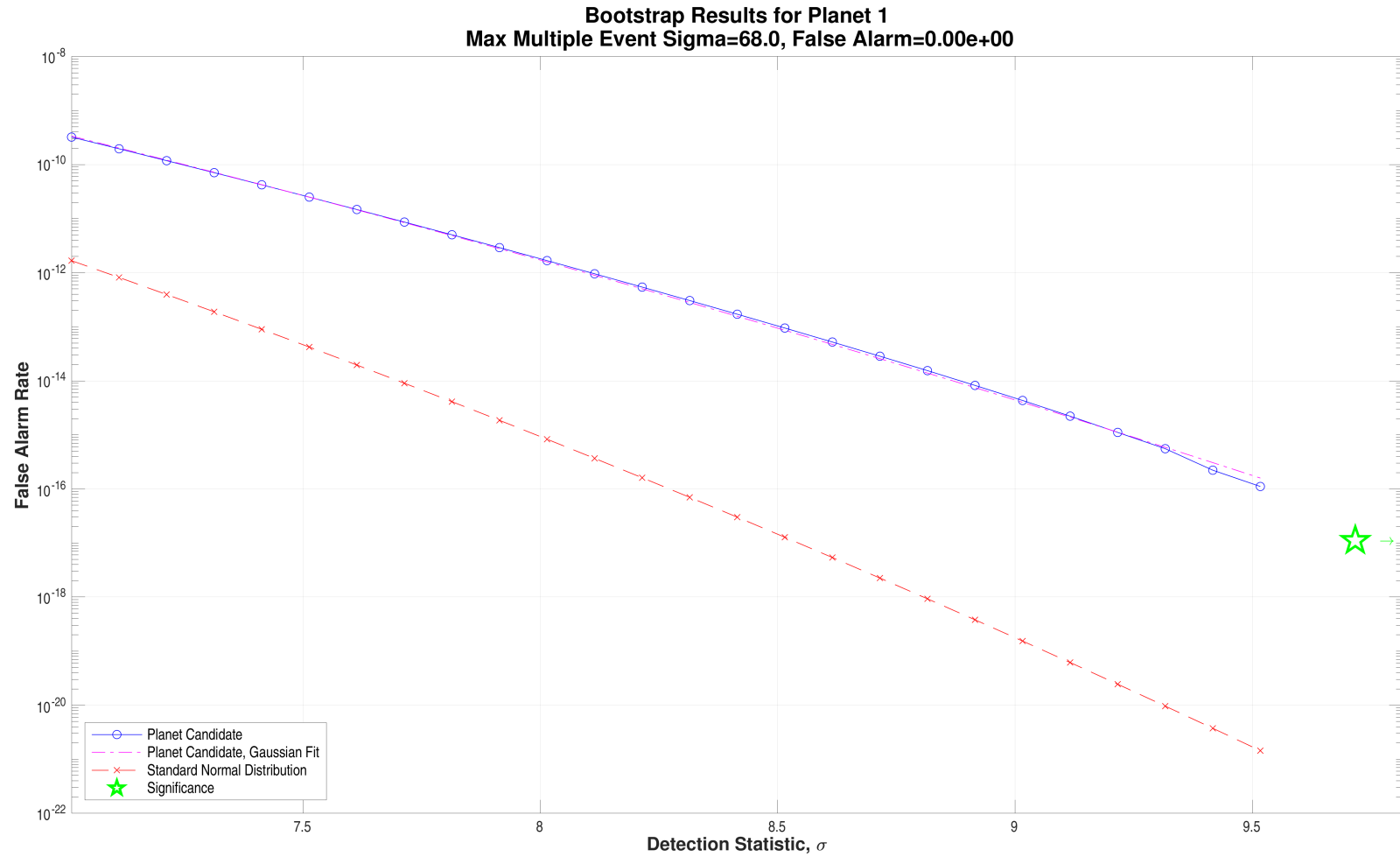
Result	Value	Significance (%)
Maximum MES	68.0	
SNR	67.7	
Core Aperture Statistic	4.6446e+01	100.00
Halo Aperture Statistic	5.8991e+00	100.00
Ratio of Core/Halo Aperture Statistics	7.8734e+00	

7.4.5 Validation Test Figures



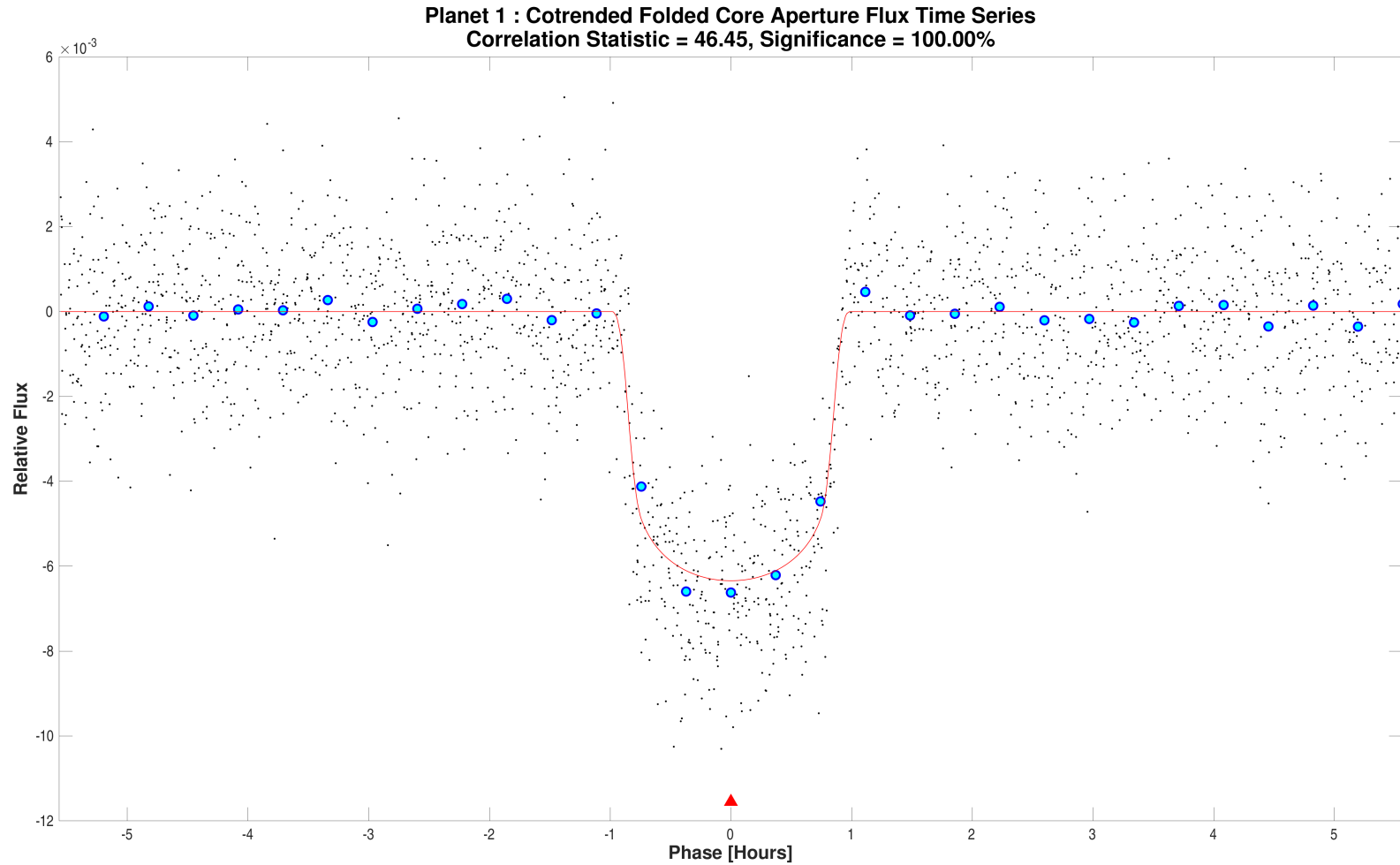
The primary event has been set to zero and both the max and min of the resulting MES vs. Phase are marked with a red star. The best matched pulse duration in hours is 2. The maximum secondary MES and corresponding phase are 3.2191 and 0.88889 days respectively. The minimum secondary MES and corresponding phase are -2.6393 and 1.7292 days respectively.

Open `./planet-01/report-summary/0000000019028197-01-weak-secondary-diagnostic.fig`



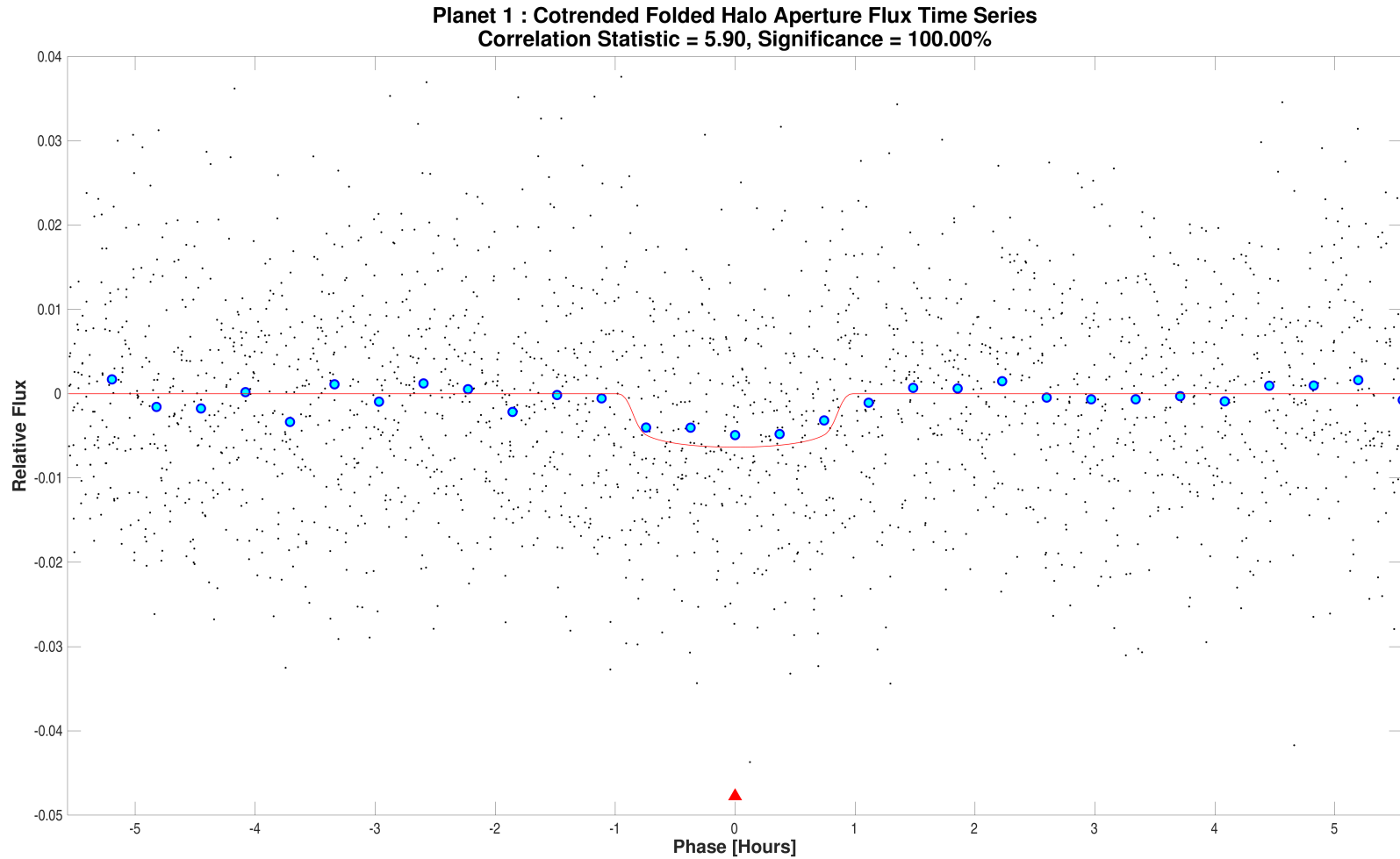
Bootstrap results for target 19028197, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is Inf. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 8.1948.

Open `./planet-01/bootstrap-results/0000000019028197-01-bootstrap-false-alarm.fig`



Optical ghost diagnostic core aperture flux time series for target 19028197, 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/0000000019028197-01-core-unwhitened-cotrended-zoomed-model.fig`

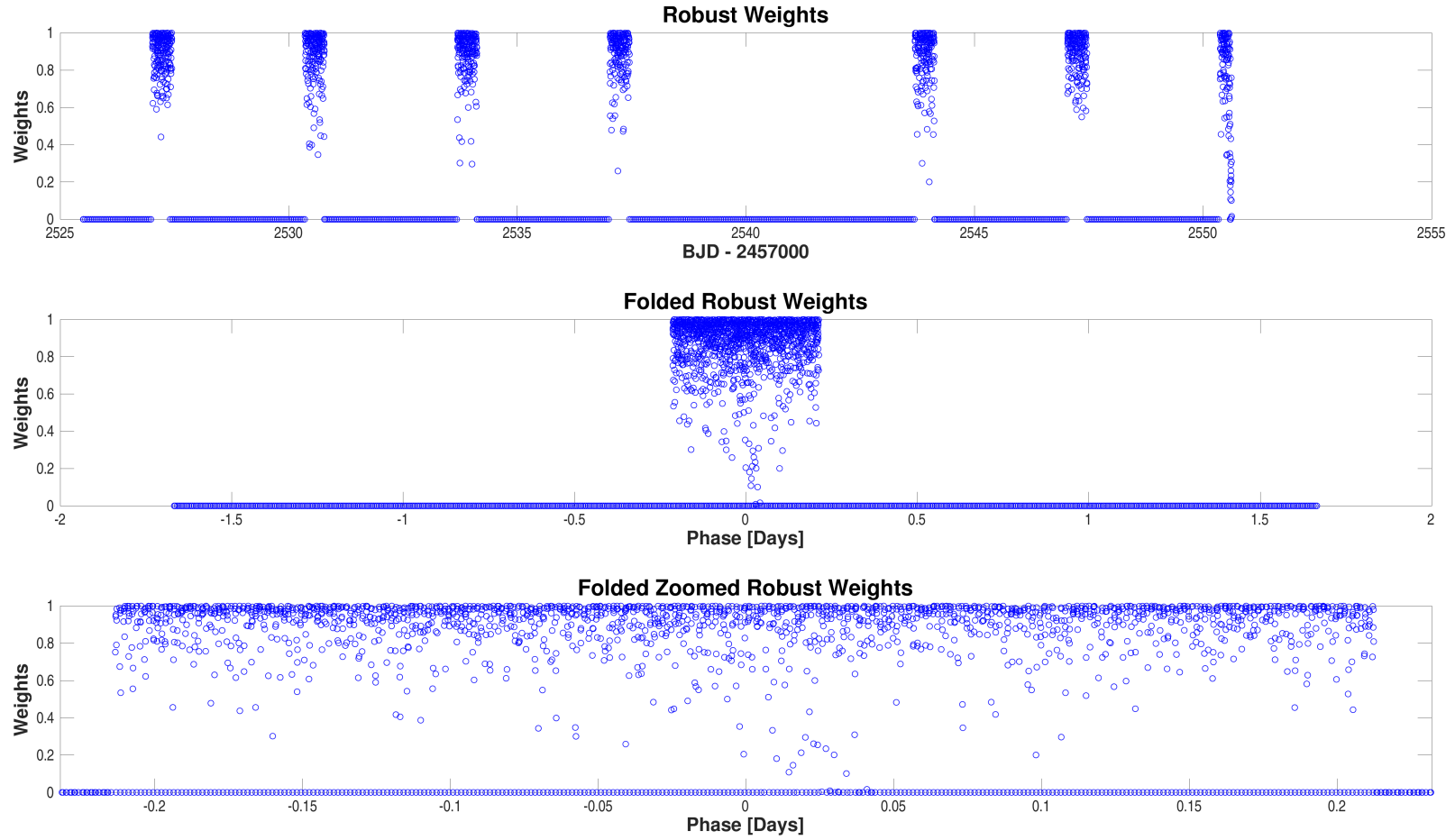


Optical ghost diagnostic halo aperture flux time series for target 19028197, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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/0000000019028197-01-halo-unwhitened-cotrended-zoomed-model.fig`

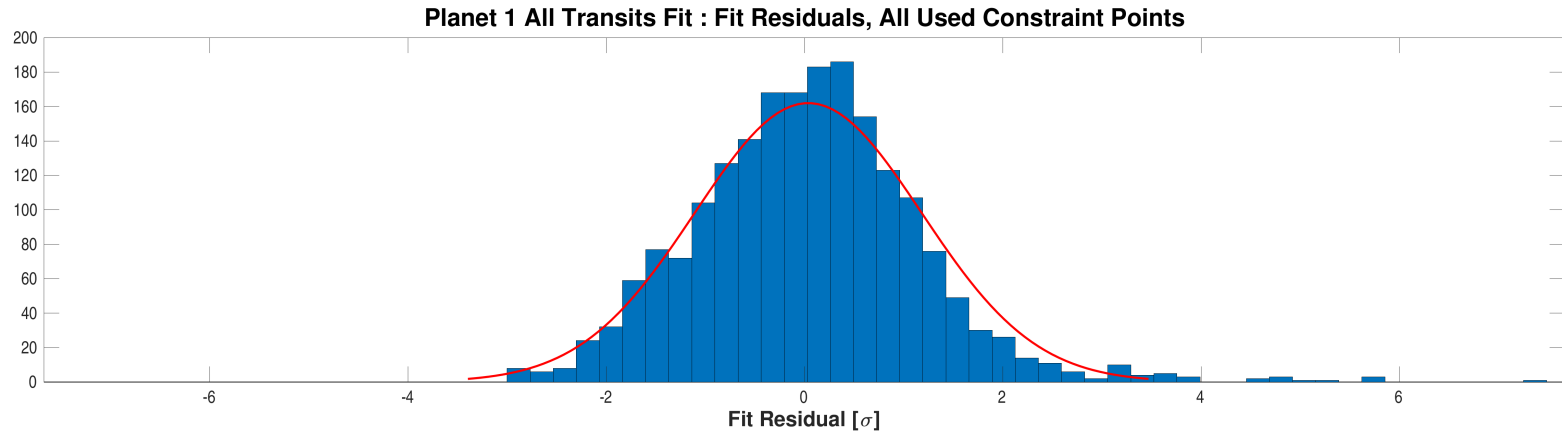
Appendix A Planet Candidate 1

A.1 Model Fitter: All Transits



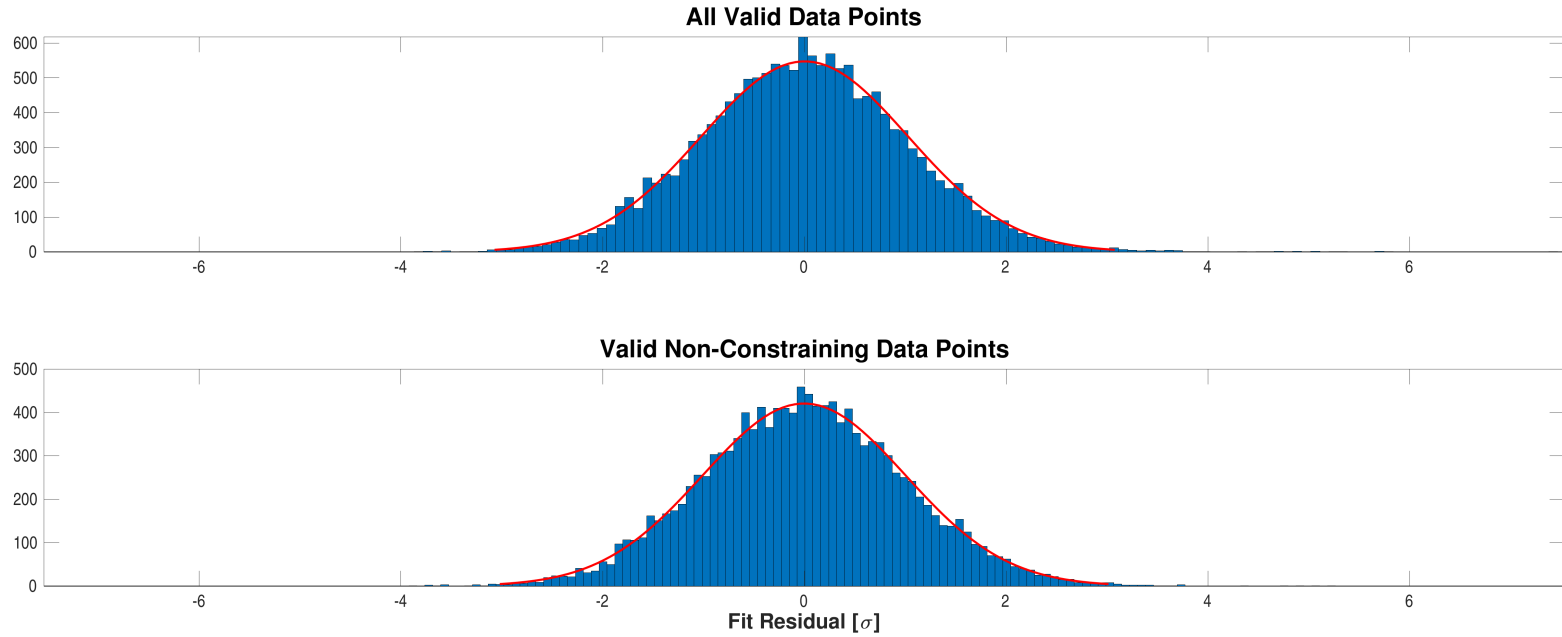
Robust weights distribution for CatId 19028197, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000019028197-01-all-robust-weights.fig`



Fit residuals distribution for CatId 19028197, 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/0000000019028197-01-all-histo-used.fig`



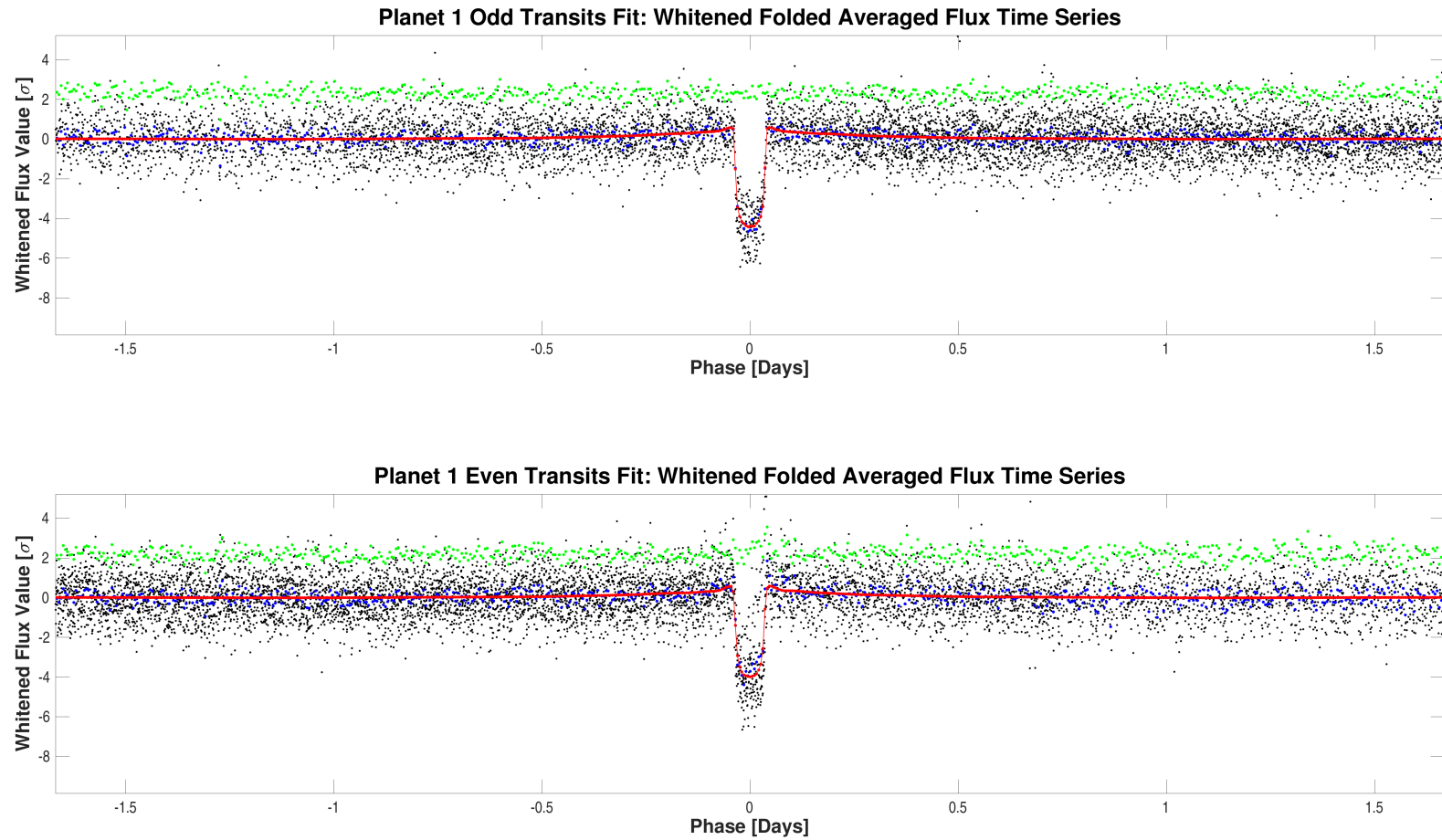
Fit residuals distribution for CatId 19028197, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000019028197-01-all-histo-all-and-unused.fig`

A.2 Model Fitter: Odd & Even Transits

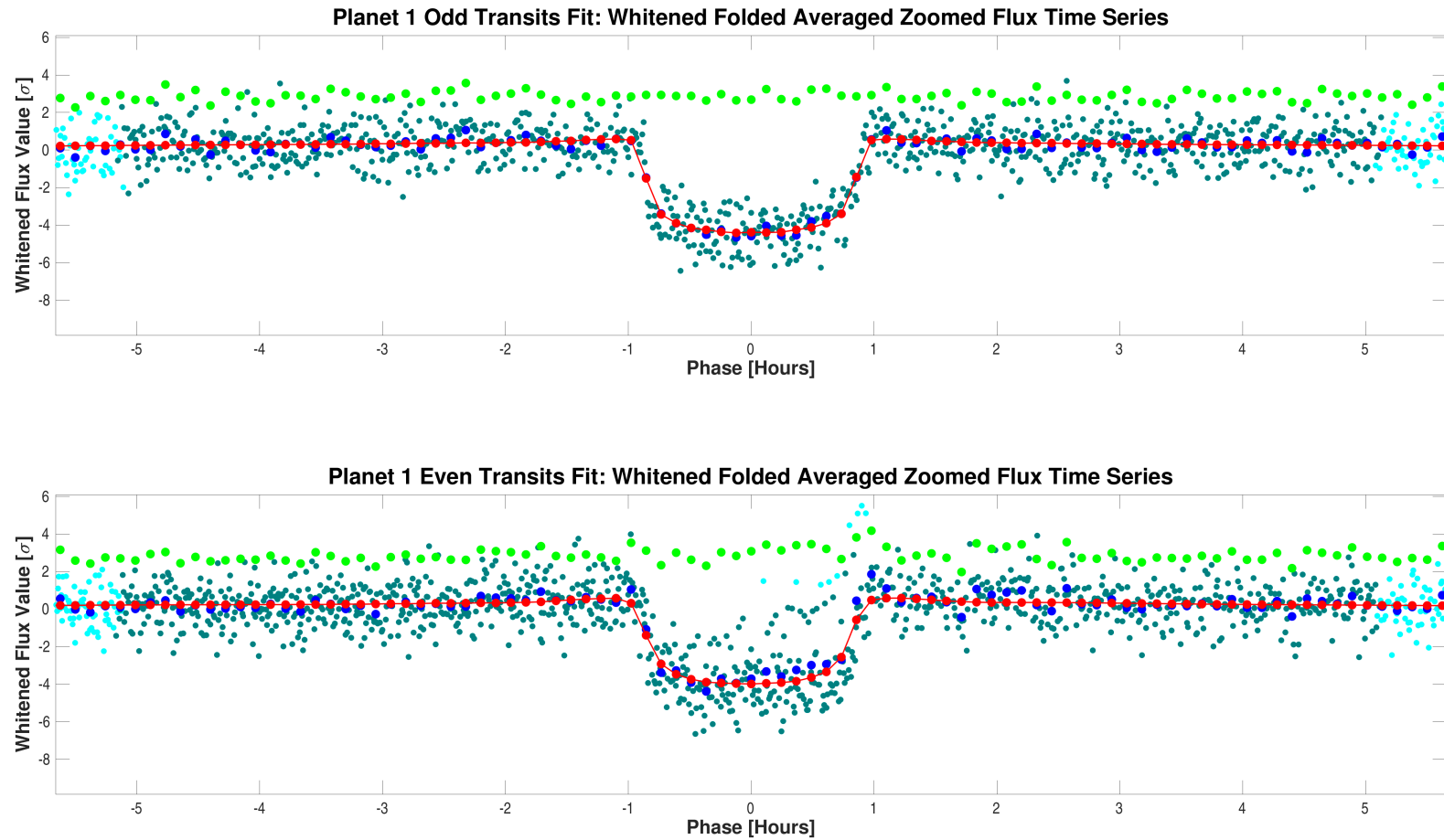
Parameter	Odd Transits Value	Odd Transits Uncertainty	Even Transits Value	Even Transits Uncertainty	Units	Difference Uncertainty
SNR	48.5		47.9			
Orbital Period	3.3369454	1.4690e-04	3.3360107	1.5630e-04	days	4.3578e+00
Transit Epoch	2527.2279148	5.2247e-04	2530.5666714	5.7101e-04	BTJD	2.9513e+00
Impact Parameter	0.1538	1.7296e+00	0.0100	3.2331e+01		4.4415e-03
Planet Radius to Star Radius Ratio	0.0758897	4.0843e-03	0.0714620	4.5017e-03		7.2844e-01
Semi-major Axis to Star Radius Ratio	14.4019	3.8978e+00	14.8937	4.7828e+00		7.9695e-02
Planet Radius	4.1399	2.5483e-01	3.8984	2.7179e-01	Earth radii	6.4831e-01
Semi-major Axis	0.0347	7.2377e-04	0.0346	7.2364e-04	AU	6.3235e-03
Effective Stellar Flux	29.6549	5.2894e+00	29.6660	5.2913e+00	Goldilocks	1.4809e-03
Equilibrium Temperature	595	2.6539e+01	595	2.6542e+01	Kelvin	1.4809e-03
Stellar Density	3.6041	2.9263e+00	3.9883	3.8422e+00	Solar density	7.9537e-02
Transit Depth	6769	1.5130e+02	6029	1.3190e+02	ppm	3.6856e+00
Transit Duration	1.8867	7.9795e-02	1.8349	8.4674e-02	hours	4.4461e-01
Transit Ingress Duration	0.1363	8.1607e-02	0.1226	8.6976e-02	hours	1.1505e-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)	1659.8 (1826.6)		1659.8 (1826.6)			

DoF: Degrees of Freedom



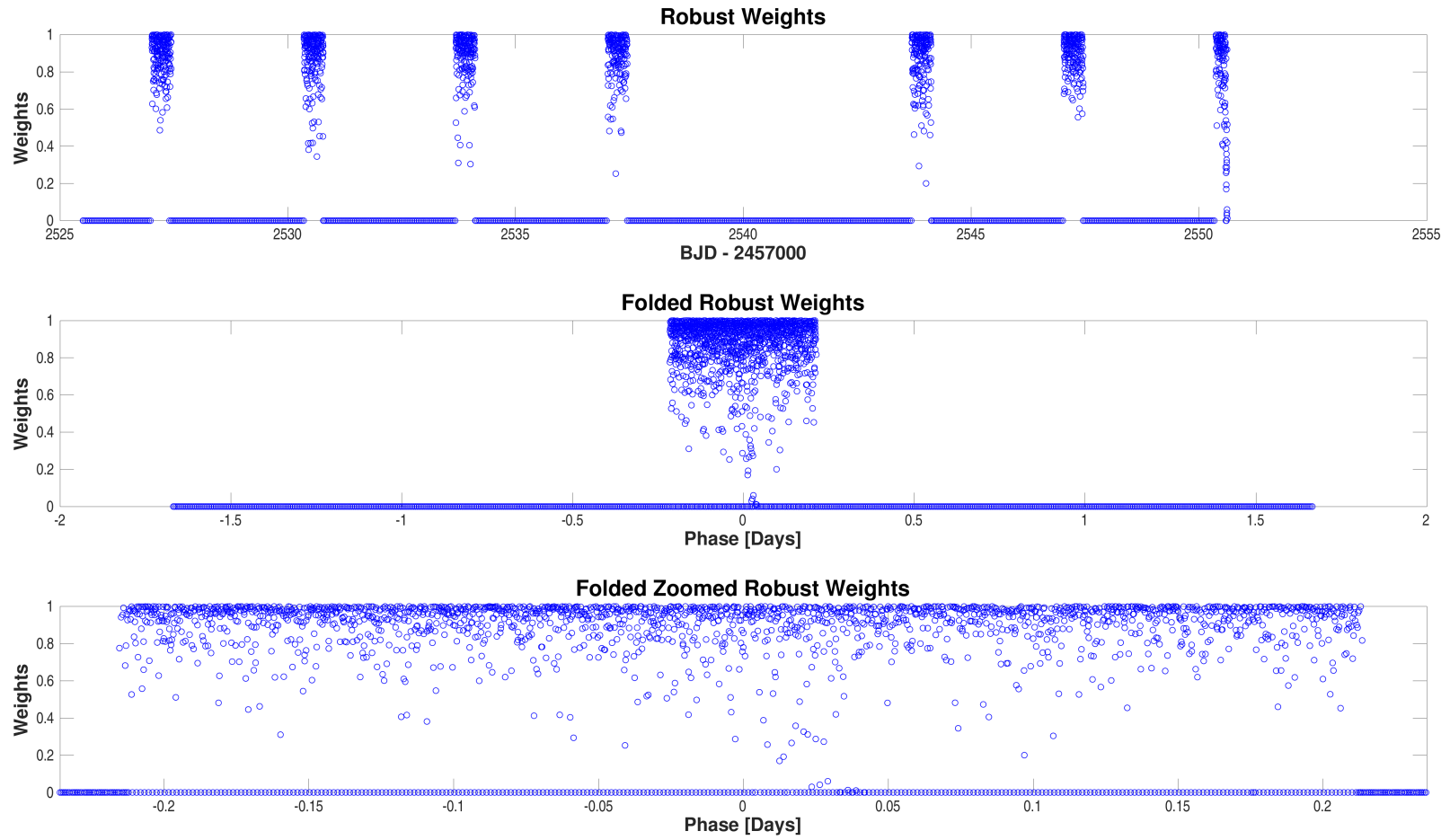
Folded flux time series for CatId 19028197, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light 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/0000000019028197-01-odd-even-whitened.fig`



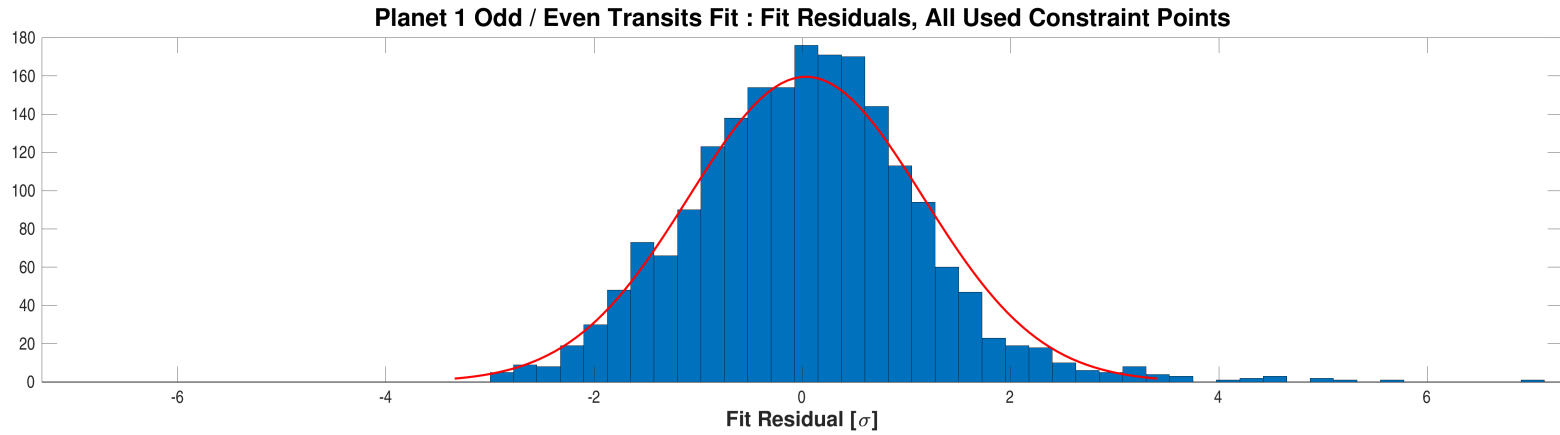
Folded flux time series for CatId 19028197, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000019028197-01-odd-even-whitened-zoomed.fig`



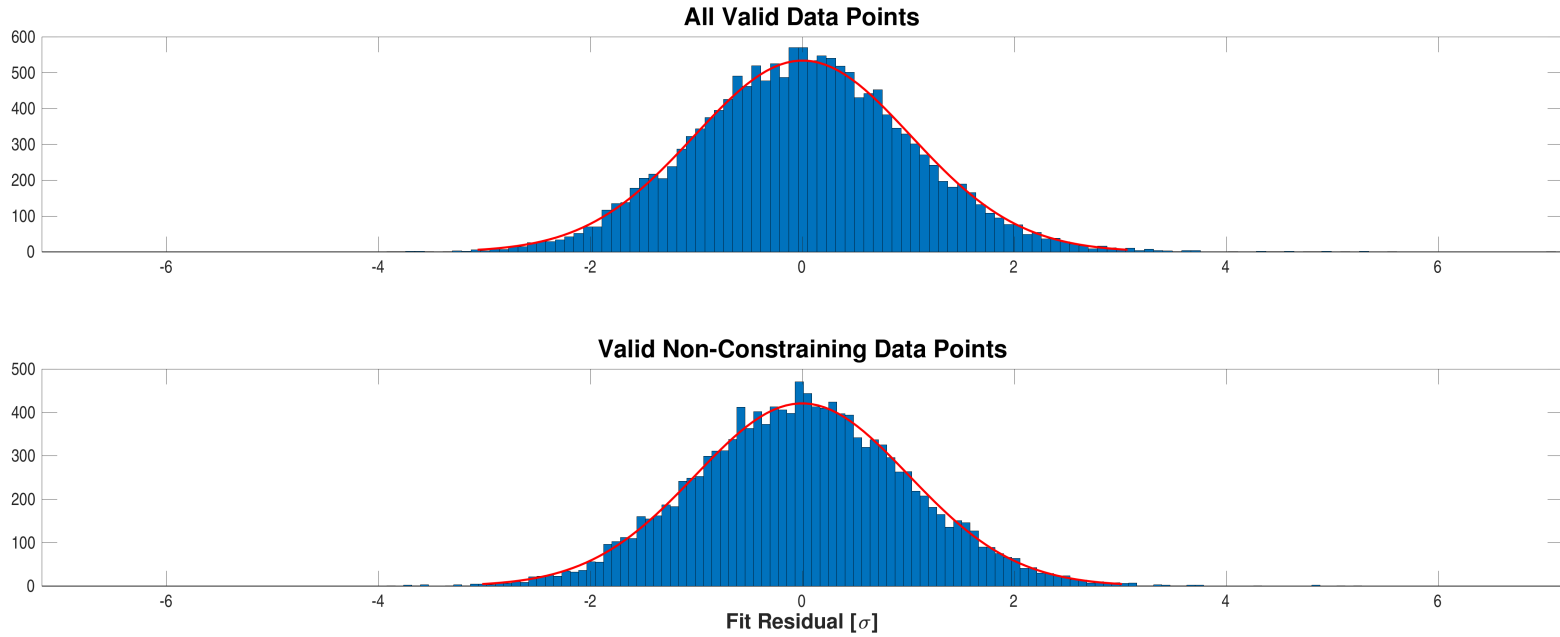
Robust weights distribution for CatId 19028197, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000019028197-01-odd-even-robust-weights.fig`



Fit residuals distribution for CatId 19028197, 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.

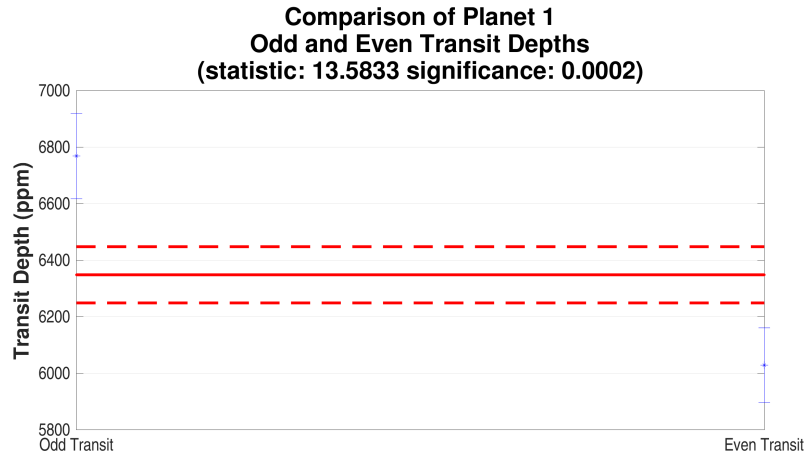
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000019028197-01-odd-even-histo-used.fig`



Fit residuals distribution for CatId 19028197, 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/0000000019028197-01-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 19028197, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary. Open `./planet-01/binary-discrimination-test-results/0000000019028197-01-eclipsing-binary-discrimination-tests.fig`

Appendix B Alerts

This target did not trigger any alerts.