



Data Validation (DV) Report

for TESS ID 470381900
Sectors 19 - 19

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

17-Jan-2020 14:20:33 Z

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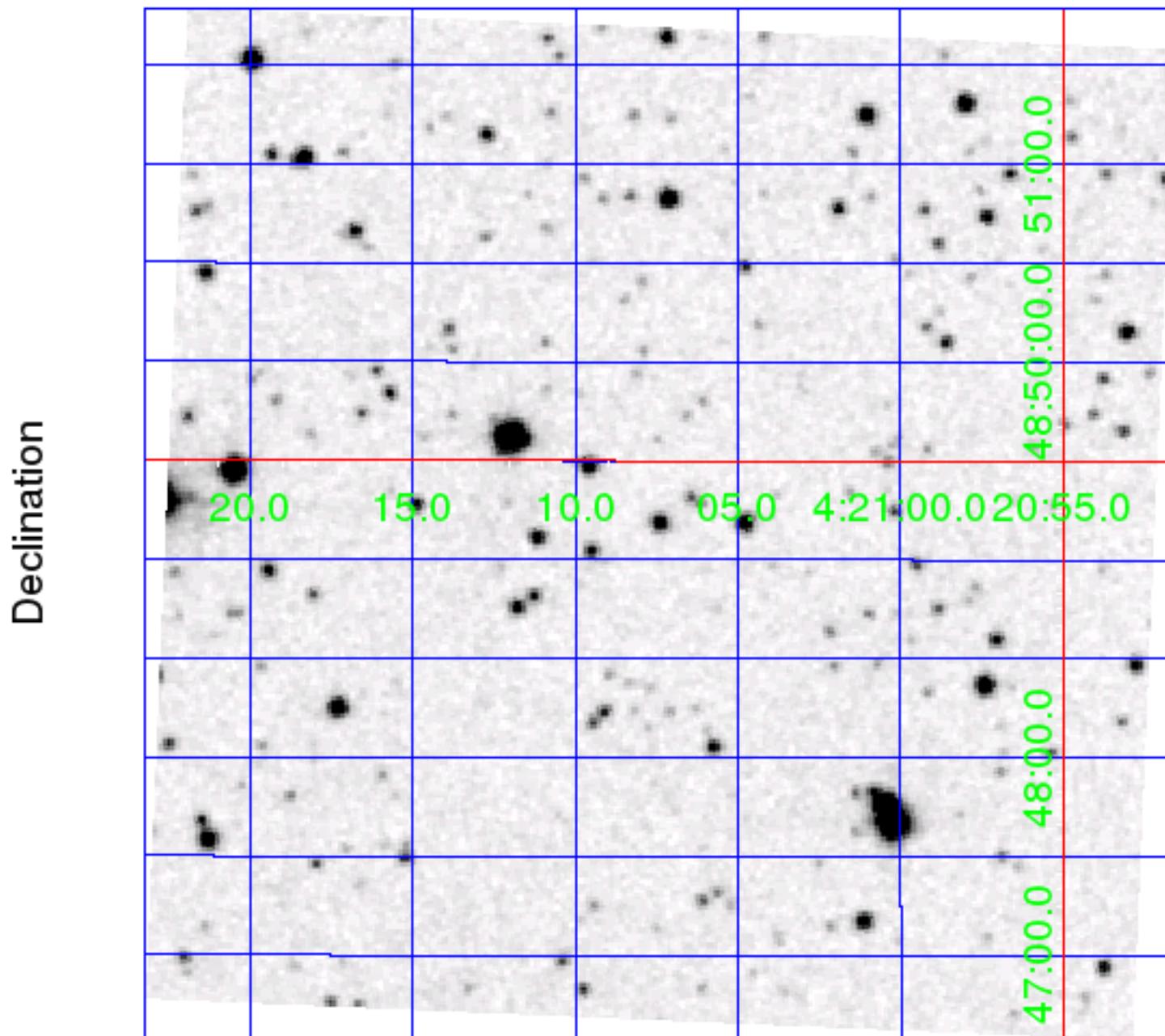
1 Summary

Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	470381900			
TOI ID	-			
TESS Name	-			
RA	65.28056346	0	degrees	TIC8
Dec	48.81991372	0	degrees	TIC8
Magnitude	13.9664	0.0073007		TIC8
Radius	0.280	0.009	Solar radii	TIC8
Effective Temperature	3181	157	Kelvin	TIC8
log(g)	4.948	0.0080613	cm/sec ²	TIC8
[M/H]	0.000	0	Solar metallicity	Solar
Stellar Density	11.537	0.413	Solar density	TIC8-Derived
Limb Darkening Coefficient 1	0.65999			
Limb Darkening Coefficient 2	0.31066			
Limb Darkening Coefficient 3	-0.27116			
Limb Darkening Coefficient 4	0.063552			
Number of Planet Candidates	1			
TOI Model	csv-file-toi-catalog-4_01-10-edited.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-4.0.13-20191205			
Date Report Generated	17-Jan-2020 14:20:33 Z			

Sector	Target Table	Camera/CCD	Crowding Metric	Flux Fraction
19	184	1:2	0.5240	0.6263

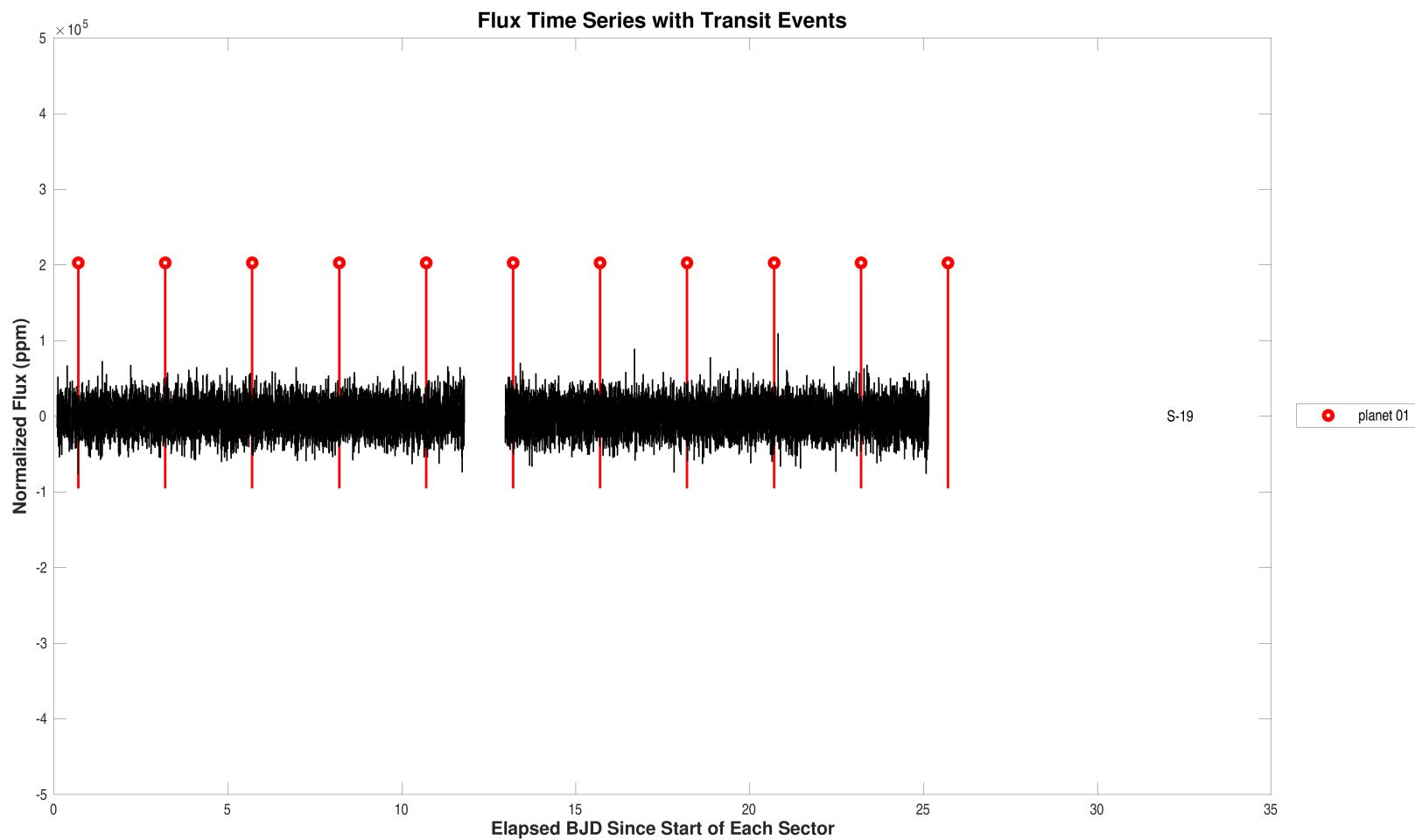
Planet Candidate	TOI ID	TESS Name	TOI Correlation	Period (days)	Period Ratio	Epoch (BTJD)	Semi-major Axis (AU)	Radius (Re)	Seff	Teq (K)	False Alarm	Suspected EB
1	-	-	-	2.501	1.00	1816.698		0.02	3.0	13.8	492	5.59e-14

2 Survey Image

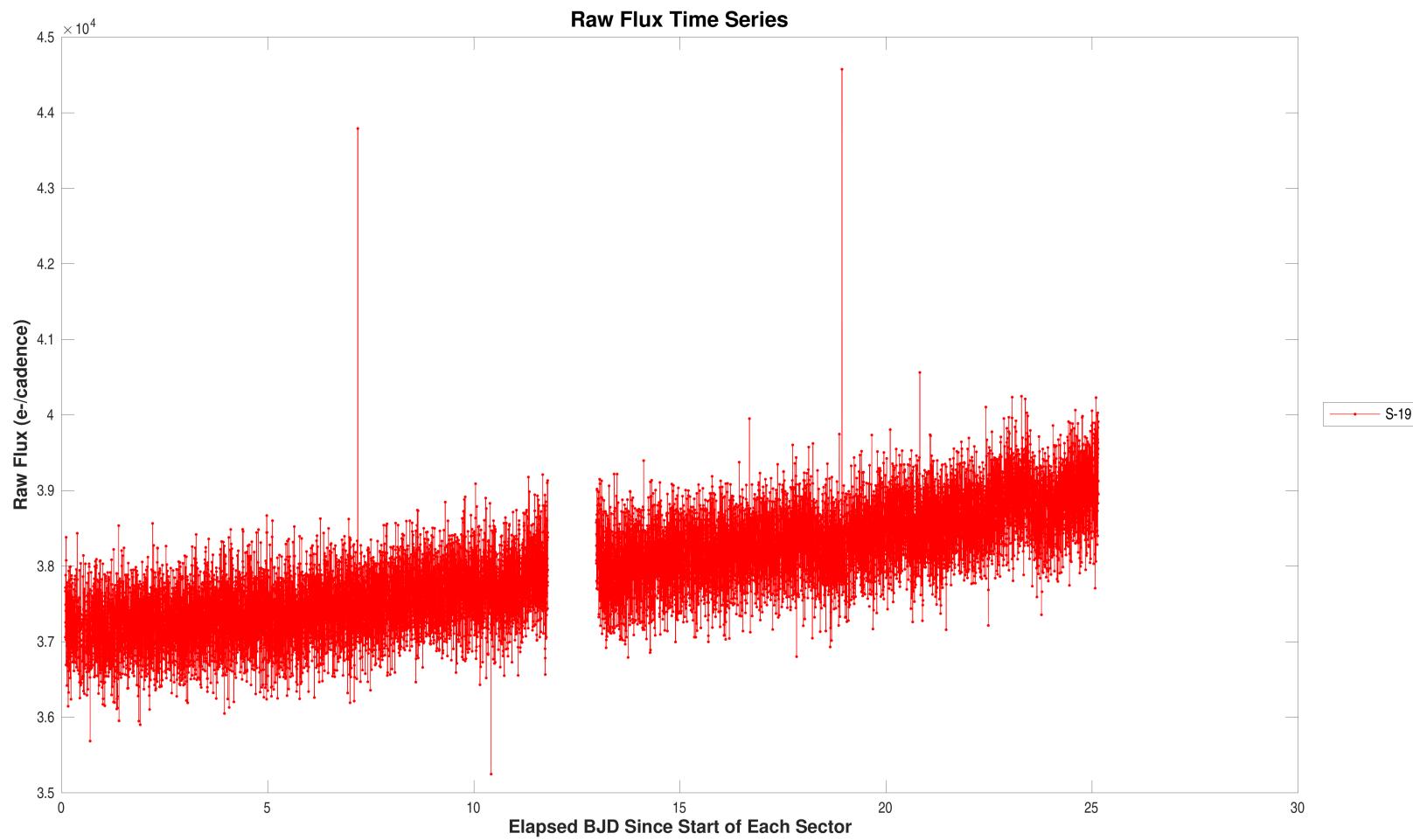


Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (470381900).

3 Flux Time Series



Summary plot of sector-stitched flux time series and transits for target 470381900, 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 19, target table 184, start BJD is 2458816.
Open [./summary-plots/0000000470381900-00-flux-dv-fit-19-184.fig](#)



Summary plot of raw flux time series. For the data of sector 19, target table 184, start BJD is 2458816.
Open [./summary-plots/0000000470381900-00-raw-flux-19-184.fig](#)

4 Dashboards

Planet Candidate 1

Model Fitter	Stellar Radius 0.3 ± 0.0 Solar units	Core Aperture Correlation Statistic Value = 3.66 Significance = 99.99%	Halo Aperture Correlation Statistic Value = 0.06 Significance = 52.57%	Ghost Diagnostic Test
Eclipsing Binary Discrimination Test	Odd-Even Depth Comparison Statistic Value = 2.59e+00 Significance = 10.73%	Offsets Relative to Out of Transit Centroid Source RA Offset = -4.94e+01 ± 3.15e+00 arcsec (-15.68 σ) Source Dec Offset = -2.49e+01 ± 3.97e+00 arcsec (-6.26 σ) Source Offset Distance = 5.53e+01 ± 3.34e+00 arcsec (16.59 σ)	Offsets Relative to TIC Position Source RA Offset = -5.17e+00 ± 3.15e+00 arcsec (-1.64 σ) Source Dec Offset = 4.77e-02 ± 3.97e+00 arcsec (0.01 σ) Source Offset Distance = 5.17e+00 ± 3.15e+00 arcsec (1.64 σ)	Difference Image Centroid Offsets
	Shorter Period Comparison Statistic Value = N/A Significance = N/A	Longer Period Comparison Statistic Value = N/A Significance = N/A	False Alarm = 5.59e-14 Transit Count = 10 Max Multiple Event Statistic = 7.6	Bootstrap Test

Summary of model fitter results and validation test results for target 470381900, 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

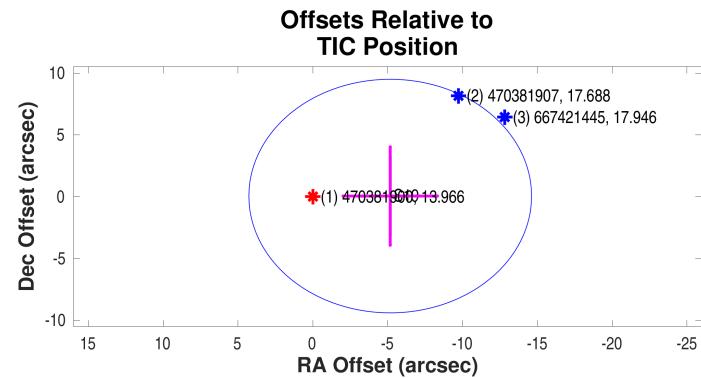
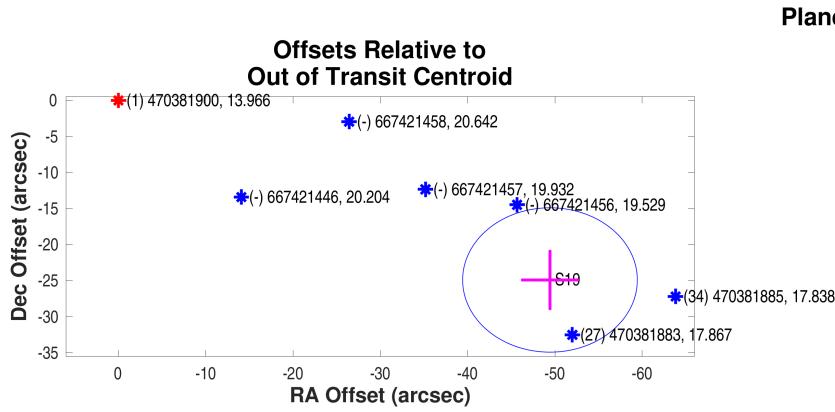
Multi-Sector Average PRF Fit of the Difference Images

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

	RA	Dec	Units
Offset	$-49.4361 \pm 3.15e + 00$	$-24.8931 \pm 3.97e + 00$	arcseconds
Offset/ σ	-15.68	-6.26	
Offset Distance	$55.3498 \pm 3.34e + 00$		arcseconds
Offset Distance/ σ	16.59		
3σ Radius	10.0076		arcseconds

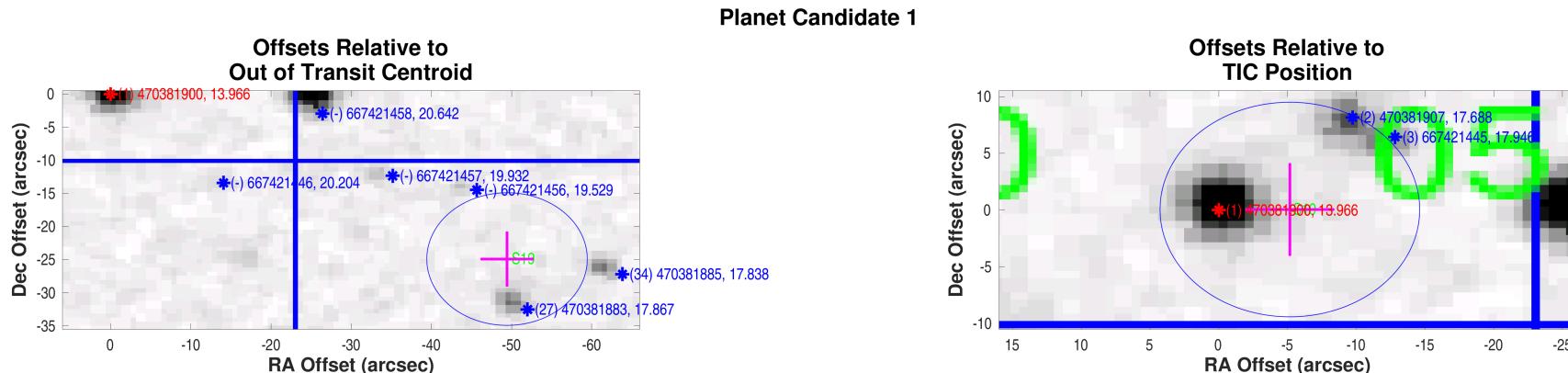
Mean offset from the TIC RA and Dec

	RA	Dec	Units
Offset	$-5.1707 \pm 3.15e + 00$	$0.0477 \pm 3.97e + 00$	arcseconds
Offset/ σ	-1.64	0.01	
Offset Distance	$5.1709 \pm 3.15e + 00$		arcseconds
Offset Distance/ σ	1.64		
3σ Radius	9.4459		arcseconds



Difference image centroid offsets for target 470381900, 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/0000000470381900-01-difference-image-centroid-offsets.fig`



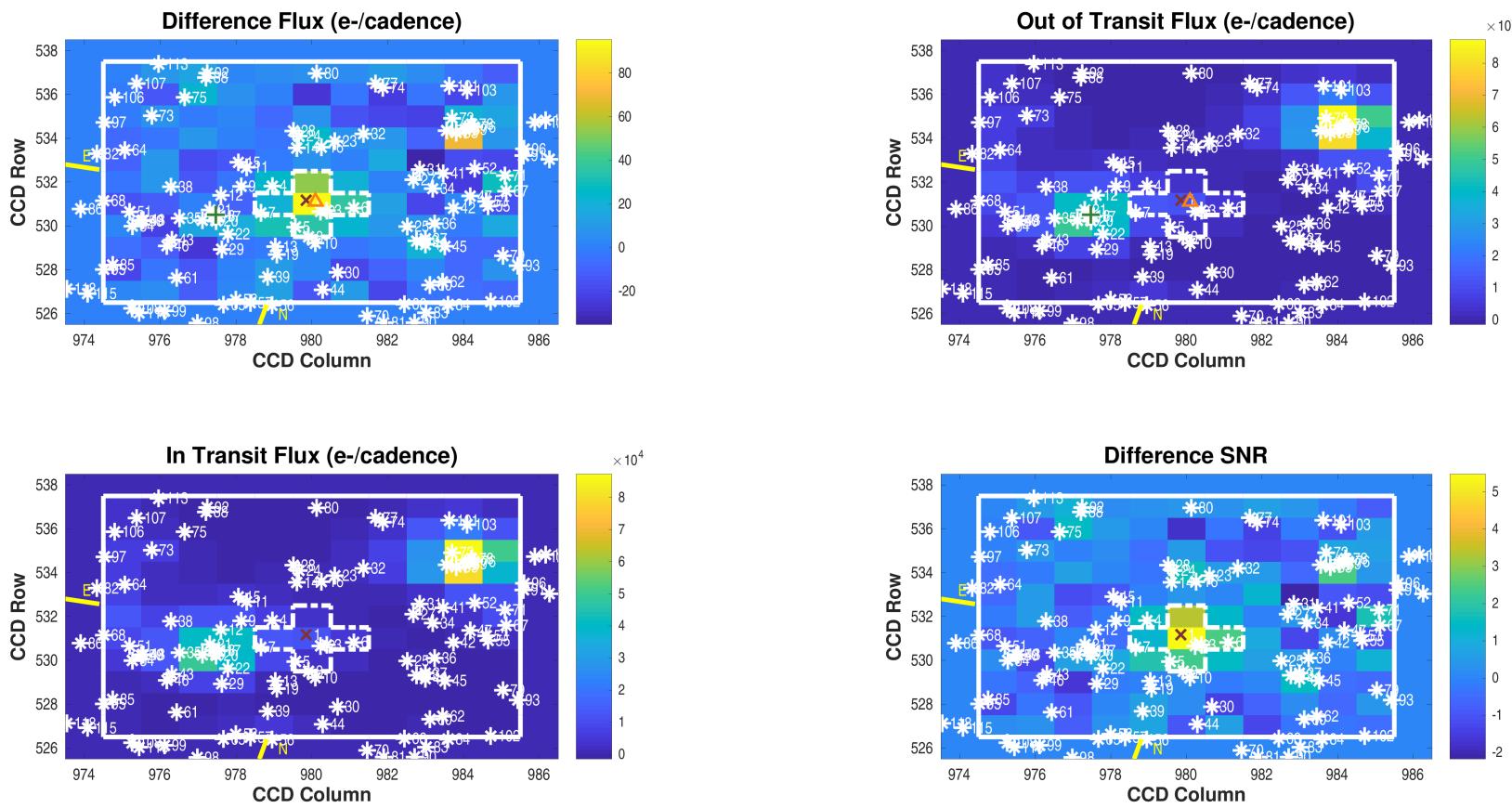
Difference image centroid offsets for target 470381900, planet candidate 1, displayed on survey image for given target. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in RA and Dec with respect to the TIC coordinates of the given target. Symbol key: green cross: per sector centroid offsets with 1-sigma error bars in RA and Dec; magenta cross: robust weighted mean offset over all sectors with 1-sigma error bars in RA and Dec; blue circle: 3-sigma radius of confusion for weighted mean offset; red asterisk: location of target star; blue asterisk: location of other TIC objects in the neighborhood. TIC ID and magnitude are noted in the text associated with each marked 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/0000000470381900-01-difference-image-centroid-offsets-survey.fig](#)

Difference Image Summary Metrics

Number of Difference Images	Number of Metrics	Number of Good Metrics	Fraction of Good Metrics	Quality Threshold
1	1	0	0.0000	0.70

Difference Image
Planet Candidate 1 / Sector 19 / Target Pixel Table 184



Difference image for target 470381900, planet candidate 1, sector 19, target pixel table 184. 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 = 9; number of valid in-transit cadences = 201; number of in-transit cadence gaps = 2; number of valid out-of-transit cadences = 592; number of out-of-transit cadence gaps = 11. Difference image quality metric = 0.64 (not good).

Open [./planet-01/difference-image/000000470381900-01-difference-image-19-184.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	$530.51 \pm 1.17e - 04$	$977.47 \pm 1.30e - 04$	pixels	$65.29934979 \pm 9.47e - 07$	$48.82673552 \pm 8.98e - 07$	degrees
Difference Image Centroid	$531.11 \pm 1.50e - 01$	$980.10 \pm 1.42e - 01$	pixels	$65.27849082 \pm 8.07e - 04$	$48.81982075 \pm 8.58e - 04$	degrees
Offset	$0.5946 \pm 1.50e - 01$	$2.6260 \pm 1.42e - 01$	pixels	$-49.4361 \pm 1.92e + 00$	$-24.8931 \pm 3.09e + 00$	arcseconds
Offset/ σ	3.97	18.51			-25.72	-8.06
Offset Distance	$2.6924 \pm 1.42e - 01$		pixels	$55.3498 \pm 2.21e + 00$		arcseconds
Offset Distance/ σ	18.91			25.04		

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

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$531.17 \pm 1.02e - 04$	$979.85 \pm 1.06e - 04$	pixels	$65.28067224 \pm 0.00e + 00$	$48.81980749 \pm 0.00e + 00$	degrees
Difference Image Centroid	$531.11 \pm 1.50e - 01$	$980.10 \pm 1.42e - 01$	pixels	$65.27849082 \pm 8.07e - 04$	$48.81982075 \pm 8.58e - 04$	degrees
Offset	$-0.0657 \pm 1.50e - 01$	$0.2468 \pm 1.42e - 01$	pixels	$-5.1707 \pm 1.91e + 00$	$0.0477 \pm 3.09e + 00$	arcseconds
Offset/ σ	-0.44	1.74		-2.70		0.02
Offset Distance	$0.2554 \pm 1.42e - 01$		pixels	$5.1709 \pm 1.91e + 00$		arcseconds
Offset Distance/ σ	1.80			2.70		

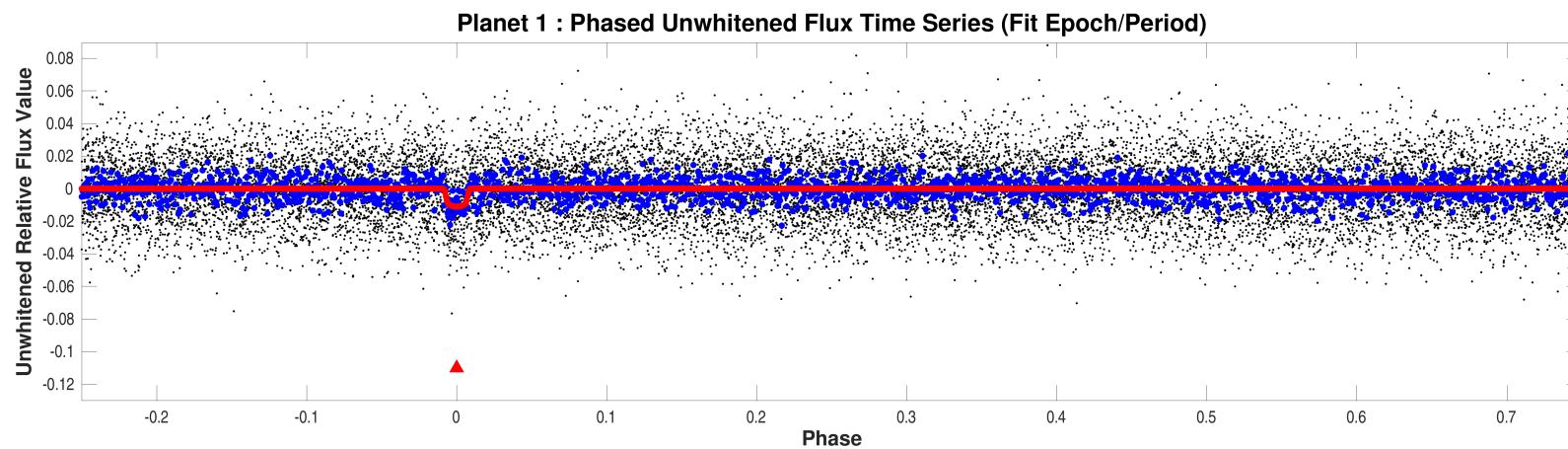
5.2 Difference Image TIC Key

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
1	470381900	13.966	65.28067224	48.81980749	0.00
2	470381907	17.688	65.27656614	48.82207271	12.70
3	667421445	17.946	65.27526072	48.82159399	14.35
4	470381897	15.961	65.28929737	48.81754311	22.01
5	667421460	19.063	65.28080326	48.82689539	25.52
6	470381901	15.272	65.26953542	48.81997561	26.41
7	470381912	14.967	65.28961084	48.82462138	27.37
8	667421453	18.979	65.27711307	48.82883849	33.59
9	470381899	15.249	65.29612097	48.81876651	36.81
10	667421454	18.921	65.27507124	48.83016879	39.59
11	470381889	16.527	65.29652852	48.81381812	43.33
12	470381905	18.248	65.29982922	48.82172073	45.93
13	470381933	18.818	65.28358638	48.83251227	46.26
14	470381877	18.468	65.28705399	48.80715755	47.99
15	470381888	15.863	65.29873979	48.81287840	49.56
16	666709104	19.137	65.28171135	48.80603043	49.66
17	667421452	14.146	65.29856765	48.82705497	49.80
18	470381921	12.094	65.29984466	48.82717957	52.63
19	470381936	18.608	65.28265428	48.83437784	52.66
20	667421450	17.747	65.29874775	48.82832787	52.69
21	667421448	18.637	65.30108340	48.82579224	52.96
22	667421447	18.856	65.29506253	48.83114829	53.20
23	666709105	18.623	65.27924037	48.80405363	56.82
24	470381871	16.839	65.28757930	48.80412074	58.80
25	667421439	18.970	65.25622964	48.82261451	58.81
26	470381922	18.894	65.30188573	48.82863523	59.48
27	470381883	17.867	65.25873540	48.81078208	61.31
28	470381870	17.148	65.28923245	48.80300976	63.79
29	470381938	17.626	65.29518320	48.83514250	65.04
30	470381943	18.346	65.26775973	48.83662923	67.85
31	470381879	18.404	65.25821822	48.80796953	68.18
32	470381868	15.425	65.27356514	48.80117157	69.17
33	470381916	18.549	65.25295999	48.82586731	69.22
34	470381885	17.838	65.25374890	48.81226045	69.36
35	667421597	18.703	65.30710250	48.82898118	70.82
36	470381903	16.624	65.25044730	48.82088849	71.75
37	470381913	17.644	65.25122574	48.82501594	72.27
38	470381904	16.377	65.31158279	48.82146599	73.51

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
39	470381945	18.682	65.28277698	48.84031267	73.99
40	667421467	19.183	65.25073347	48.82640514	74.83
41	470381880	18.454	65.25269661	48.80806447	78.64
42	470381895	17.699	65.24758671	48.81633750	79.41
43	667421596	18.451	65.30700887	48.83459730	82.05
44	470381948	16.875	65.26959642	48.84149263	82.36
45	470381917	18.628	65.24626222	48.82616363	84.71
46	470381941	17.284	65.30756611	48.83630194	87.12
47	470381887	17.501	65.24488373	48.81272766	88.58
48	666709288	17.217	65.31493832	48.83077727	90.31
49	470381930	16.978	65.31521686	48.83092361	91.14
50	666709285	18.072	65.31529825	48.83102003	91.46
51	470381924	17.512	65.31858599	48.82917132	95.98
52	470381873	18.311	65.24615855	48.80570870	96.28
53	470377933	18.950	65.24091281	48.81341620	97.01
54	470381934	17.493	65.31680594	48.83267159	97.37
55	470377931	18.493	65.24007510	48.81454953	98.07
56	470381961	13.703	65.27945076	48.84721454	98.71
57	470381964	17.736	65.28443962	48.84740419	99.75
58	470381960	18.235	65.28793137	48.84718341	100.04
59	470381864	17.794	65.25551630	48.79727208	100.68
60	470381942	17.793	65.24634294	48.83632772	100.79
61	470381952	18.019	65.30278947	48.84390912	101.37
62	470381937	16.427	65.24382675	48.83508785	103.22
63	470381865	16.226	65.25325302	48.79741285	103.56
64	470381890	17.441	65.32480842	48.81399433	106.69
65	470381968	18.301	65.29022848	48.84885803	107.01
66	667421486	18.390	65.25035828	48.84206865	107.64
67	470381882	16.251	65.23738038	48.81013568	108.36
68	666709287	18.919	65.32522873	48.82738889	109.08
69	470381858	12.867	65.25152620	48.79629501	109.26
70	470381959	15.770	65.25762203	48.84639004	110.20
71	470381876	13.898	65.23890982	48.80631241	110.27
72	667421435	19.067	65.25534448	48.79401093	110.58
73	470381872	14.414	65.32169706	48.80442994	111.90
74	470381845	17.938	65.27310655	48.78895892	112.49
75	666709101	18.440	65.31595628	48.79867429	113.06
76	667421433	17.180	65.24979452	48.79537662	114.42

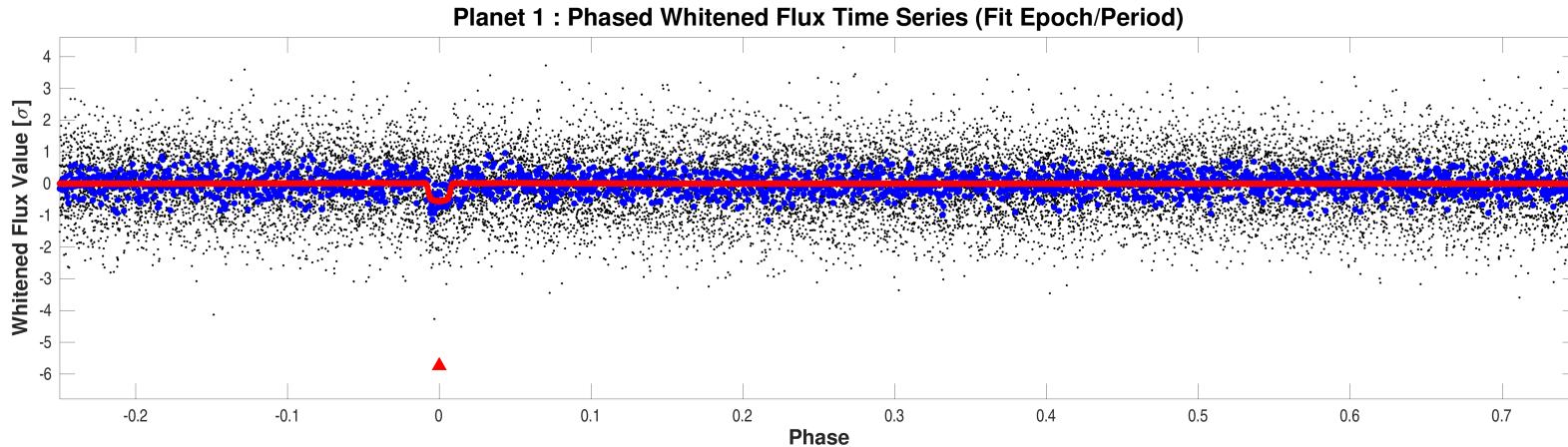
RA, Dec and Distances are corrected for proper motion. This table may not contain all of the objects shown.

6 Phased Light Curves



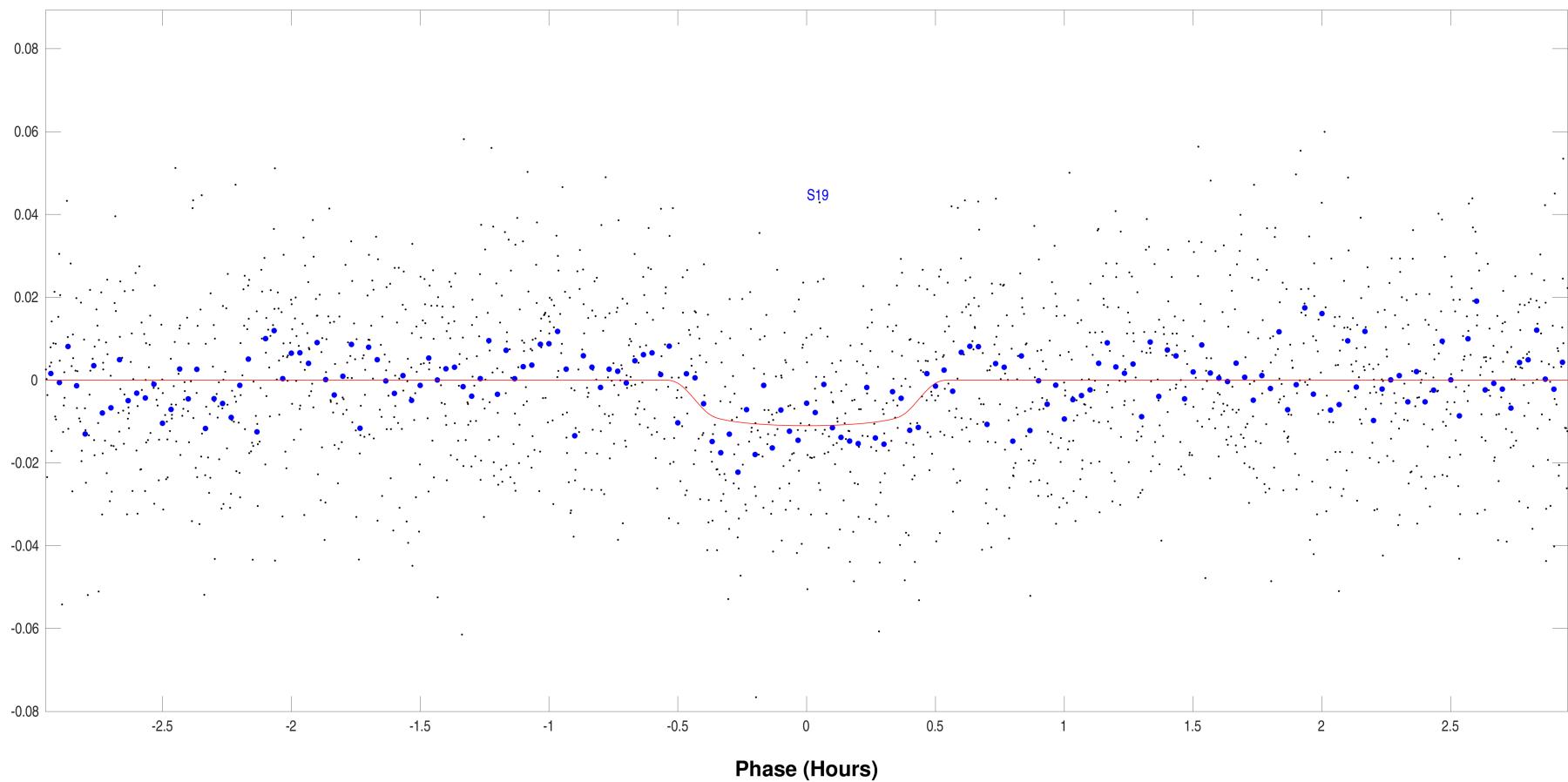
Phased unwhitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased unwhitened flux time series 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 planet candidate #1, red markers for transits of planet candidate #2, etc.

Open [./summary-plots/0000000470381900-01-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 planet candidate #1, red markers for transits of planet candidate #2, etc.

Open [./summary-plots/0000000470381900-01-phased-whitened-flux-time-series.fig](#)

Planet: 1 Phased Unwhitened Flux Time Series by Sector

Phased unwhitened flux time series by sector for target 470381900, planet candidate 1. Period = 2.5007 days; transit epoch = 1816.6977 BTJD.
Open [./summary-plots/0000000470381900-01-phased-unwhitened-flux-time-series-by-sector.fig](#)

7 Planet Candidate 1

7.1 Model Fitter: All Transits

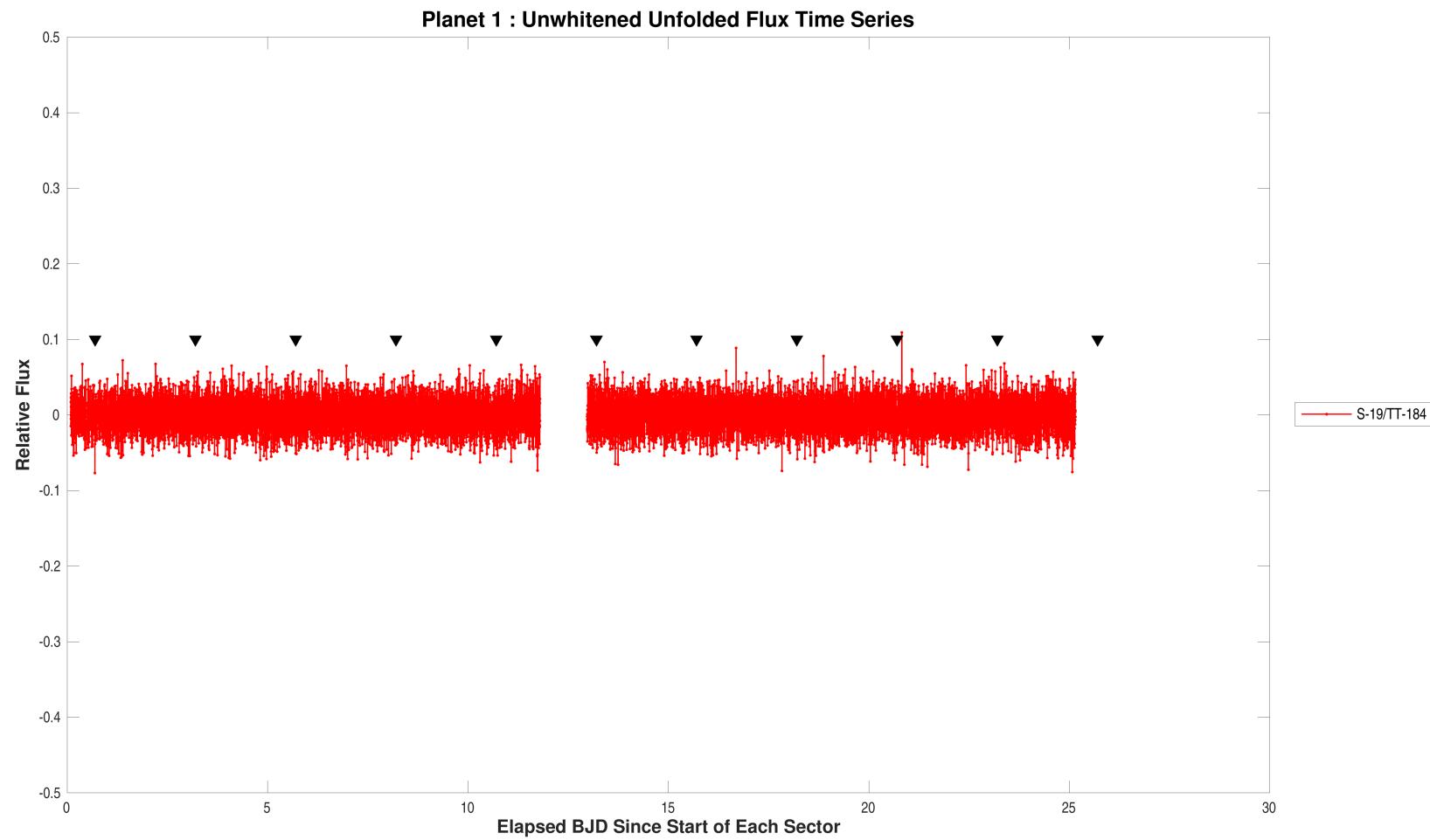
Model Characteristic	Name
Transit Model	mandel-agol_geometric_transit_model
Limb Darkening Model	claret_tess_nonlinear_limb_darkening_model

TCE Parameter	Value	Units
Trial Transit Pulse Duration	1.0	hours
Transit Epoch	1816.6948391	TJD
Orbital Period	2.5004287	days
Maximum SES	4.3	
Maximum MES	7.6	
Robust Statistic	7.2	
Chi Square Goodness of Fit Statistic (DoF)	242.9 (293)	
Chi Square2 Statistic (DoF)	9.6 (14.1)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

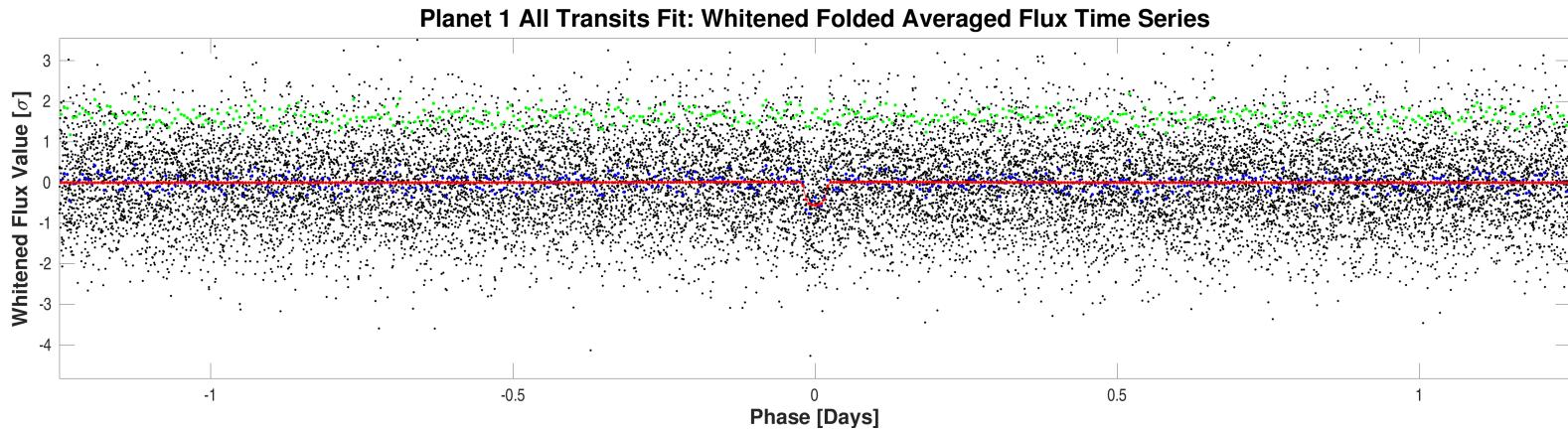
Parameter	Value	Uncertainty	Units
SNR	7.8		
Orbital Period	2.5007147	5.1148e-04	days
Transit Epoch	1816.6977055	2.7523e-03	BTJD
Impact Parameter	0.1426	1.6258e+01	
Planet Radius to Star Radius Ratio	0.0969636	4.3940e-02	
Semi-major Axis to Star Radius Ratio	21.1134	4.9729e+01	
Planet Radius	2.9690	1.3485e+00	Earth radii
Semi-major Axis	0.0229	4.8688e-04	AU
Effective Stellar Flux	13.8067	2.7456e+00	Goldilocks
Equilibrium Temperature	492	2.4441e+01	Kelvin
Stellar Density	20.2202	1.4288e+02	Solar density
Transit Depth	11012	1.5688e+03	ppm
Transit Duration	0.9846	4.4097e-01	hours
Transit Ingress Duration	0.0888	4.6139e-01	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	1284.0 (1516.2)		
Model Chi Square Goodness of Fit Statistic (DoF)	193.7 (328)		
Model Chi Square2 Statistic (DoF)	4.7 (9)		

DoF: Degrees of Freedom



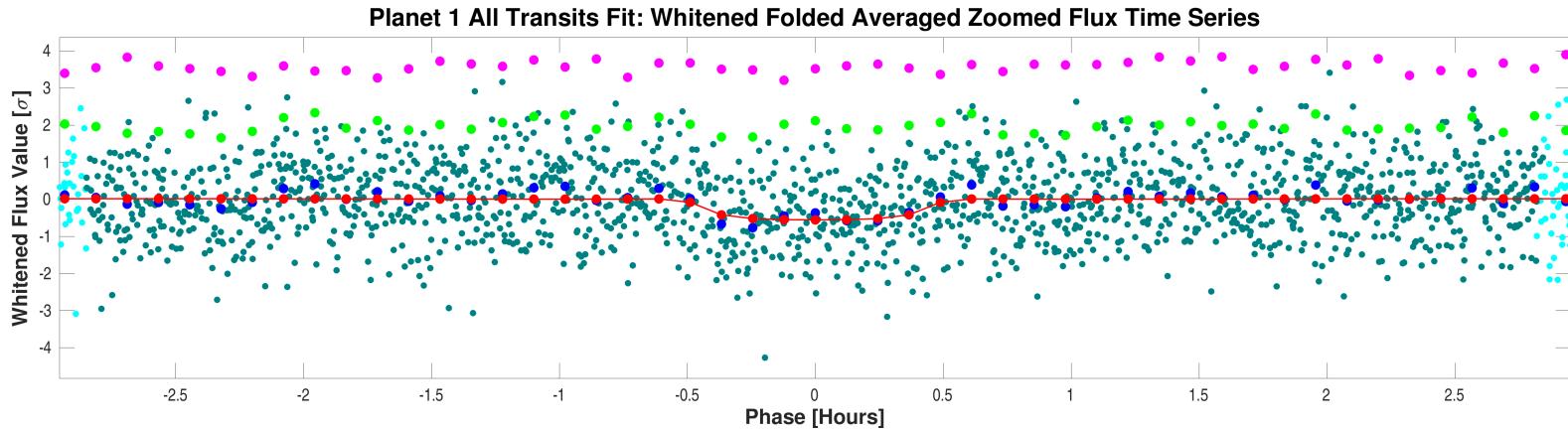
Flux time series for CatId 470381900, Planet candidate 1 in the unwhitened domain. For the data of Sector-19/TargetTableId-184, start BJD is 2458816. Transit event markers indicate the location of transits of the given planet candidate. All transits fit completed with full convergence.

Open [./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000470381900-01-all-unwhitened-19-184.fig](#)



Folded flux time series for CatId 470381900, 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/0000000470381900-01-all-whitened.fig](#)



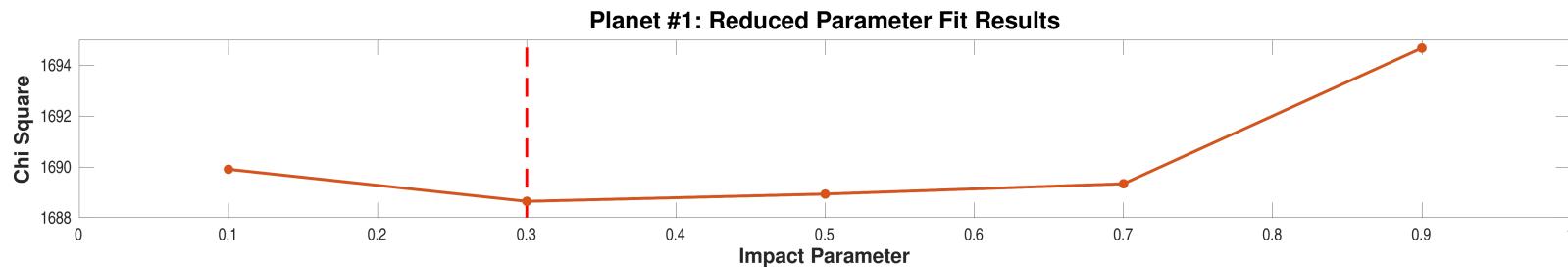
Folded flux time series for CatId 470381900, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000470381900-01-all-whitened-zoomed.fig](#)

7.2 Model Fitter: Reduced Parameter Fit Results

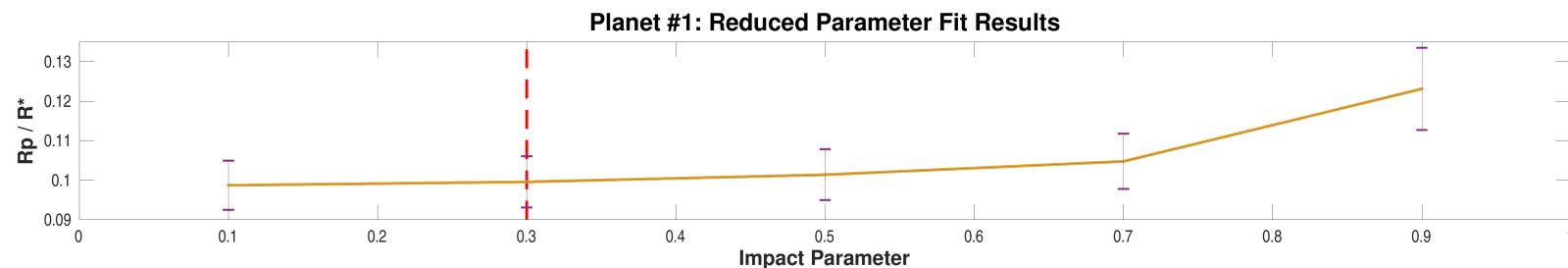
Impact Parameter	SNR	Model Chi Square	Planet Radius to Star Radius	Uncert	Semi-major Axis to Star Radius	Uncert	Transit Depth (ppm)	Uncert	Transit Duration (hours)	Uncert
0.10	8.4	1689.9	0.0987263	6.2476e-03	21.5452	1.7629e+00	11438	1.4384e+03	0.9706	7.7877e-02
0.30	8.4	1688.6	0.0995853	6.4689e-03	20.6555	1.8595e+00	11460	1.4790e+03	0.9790	8.6396e-02
0.50	8.4	1688.9	0.1014014	6.4545e-03	18.7757	1.5986e+00	11467	1.4494e+03	0.9994	8.3062e-02
0.70	8.3	1689.3	0.1047645	6.9976e-03	15.3252	1.5395e+00	11393	1.5078e+03	1.0671	1.0398e-01
0.90	8.1	1694.7	0.1231383	1.0396e-02	10.6361	1.4775e+00	12213	1.7371e+03	1.2120	1.5428e-01

Highlighted row is the best reduced-parameter model fit.



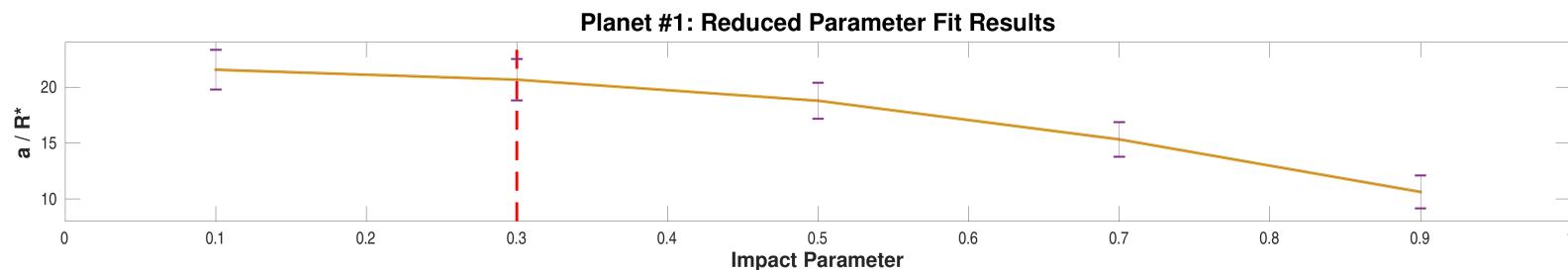
Model chi squares of reduced parameter fits vs. impact parameter for CatId 470381900, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.

Open [./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000470381900-01-reduced-fits-chi-square.fig](#)



Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 470381900, 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/0000000470381900-01-reduced-fits-rp-over-rstar.fig](#)



Ratios of semimajor axis to star radius of reduced parameter fits vs. impact parameter for CatId 470381900, 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/0000000470381900-01-reduced-fits-a-over-rstar.fig](#)

7.3 Model Fitter: Trapezoidal Fit Results

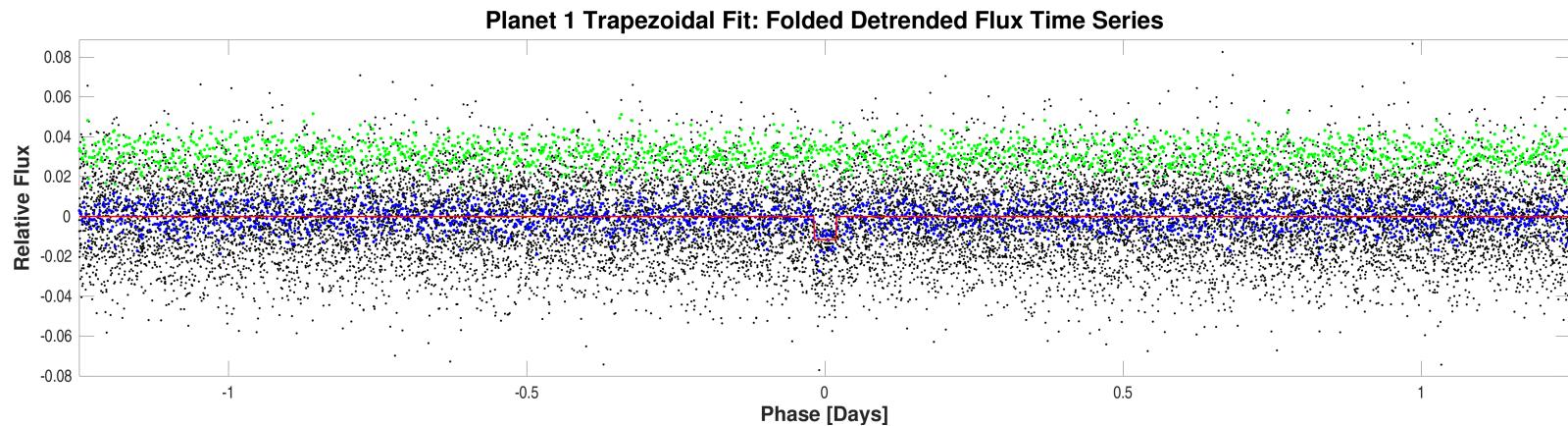
Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

TCE Parameter	Value	Units
Trial Transit Pulse Duration	1.0	hours
Transit Epoch	1816.6948391	TJD
Orbital Period	2.5004287	days
Maximum SES	4.3	
Maximum MES	7.6	
Robust Statistic	7.2	
Chi Square Goodness of Fit Statistic (DoF)	242.9 (293)	
Chi Square2 Statistic (DoF)	9.6 (14.1)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

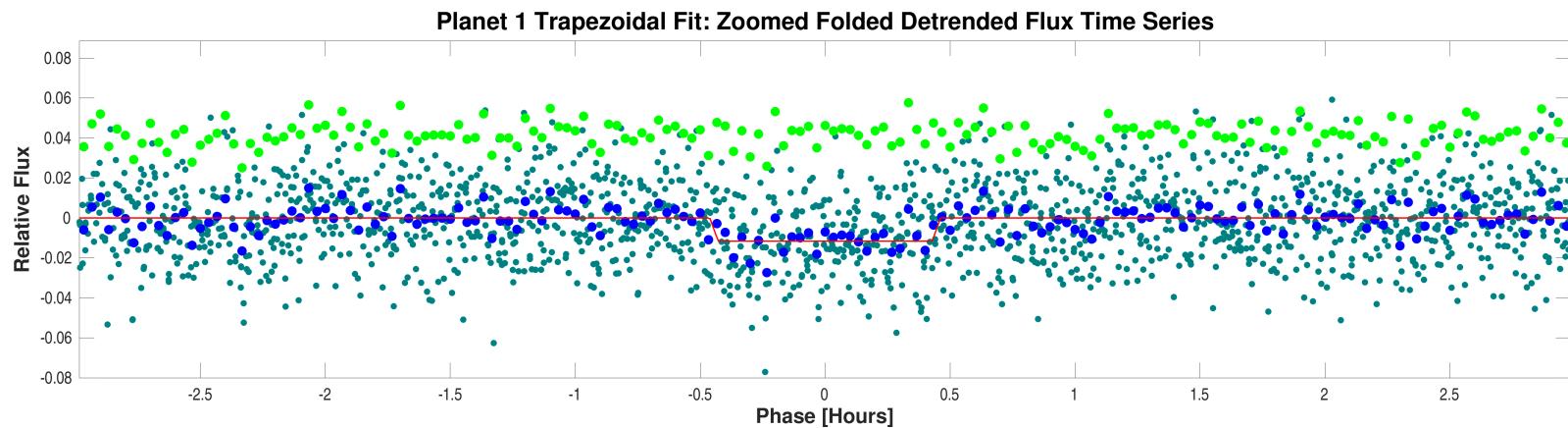
Parameter	Value	Uncertainty	Units
SNR	9.2		
Orbital Period	2.5004287		days
Transit Epoch	1816.6995214		BTJD
Transit Depth	11619		ppm
Transit Duration	0.9949		hours
Transit Ingress Duration	0.1052		hours
Model Chi Square Statistic (DoF)	16681.3 (2325)		

DoF: Degrees of Freedom



Folded detrended flux time series for CatId 470381900, Planet candidate 1 and folded trapezoidal model light curve.

Open [./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000470381900-01-all-trapezoidal.fig](#)



Zoomed folded detrended flux time series for CatId 470381900, Planet candidate 1 and folded trapezoidal model light curve.

Open [./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000470381900-01-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	2.5004		days		
Transit Duration	1		hours		
Maximum MES	7.6				
Secondary Phase	0.1875		days		
Secondary MES	3.2				
Minimum Phase	1.3194		days		
Minimum MES	-2.3				
Median MES	-0.1				
MAD MES	0.68029				
Robust Statistic	2.7				
Secondary Depth	3947.1	1.2699e+03	ppm		
Geometric Albedo	128.8	1.2388e+02		1.0314	15.12
Planet Effective Temperature	2561	6.2847e+02	Kelvin	3.2894	0.05

7.4.2 Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	2.5943e+00	1.6107	10.73

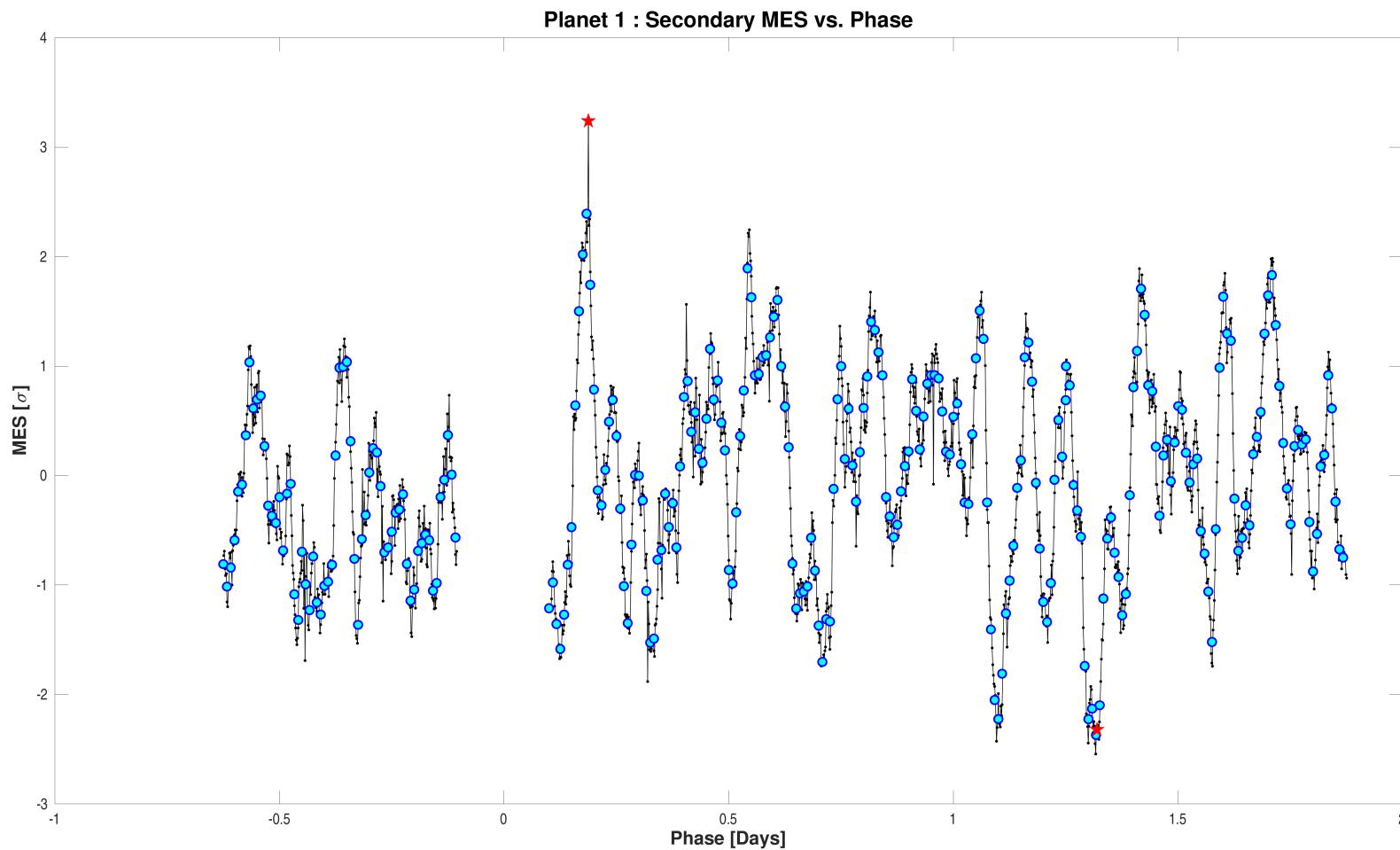
7.4.3 Bootstrap Test

Result	Value
False Alarm Probability	5.5887e-14
Bootstrap Threshold for Desired PFA	7.3
MES Mean	-0.26
MES Standard Deviation	1.06
Transit Count	10

7.4.4 Ghost Diagnostic Test

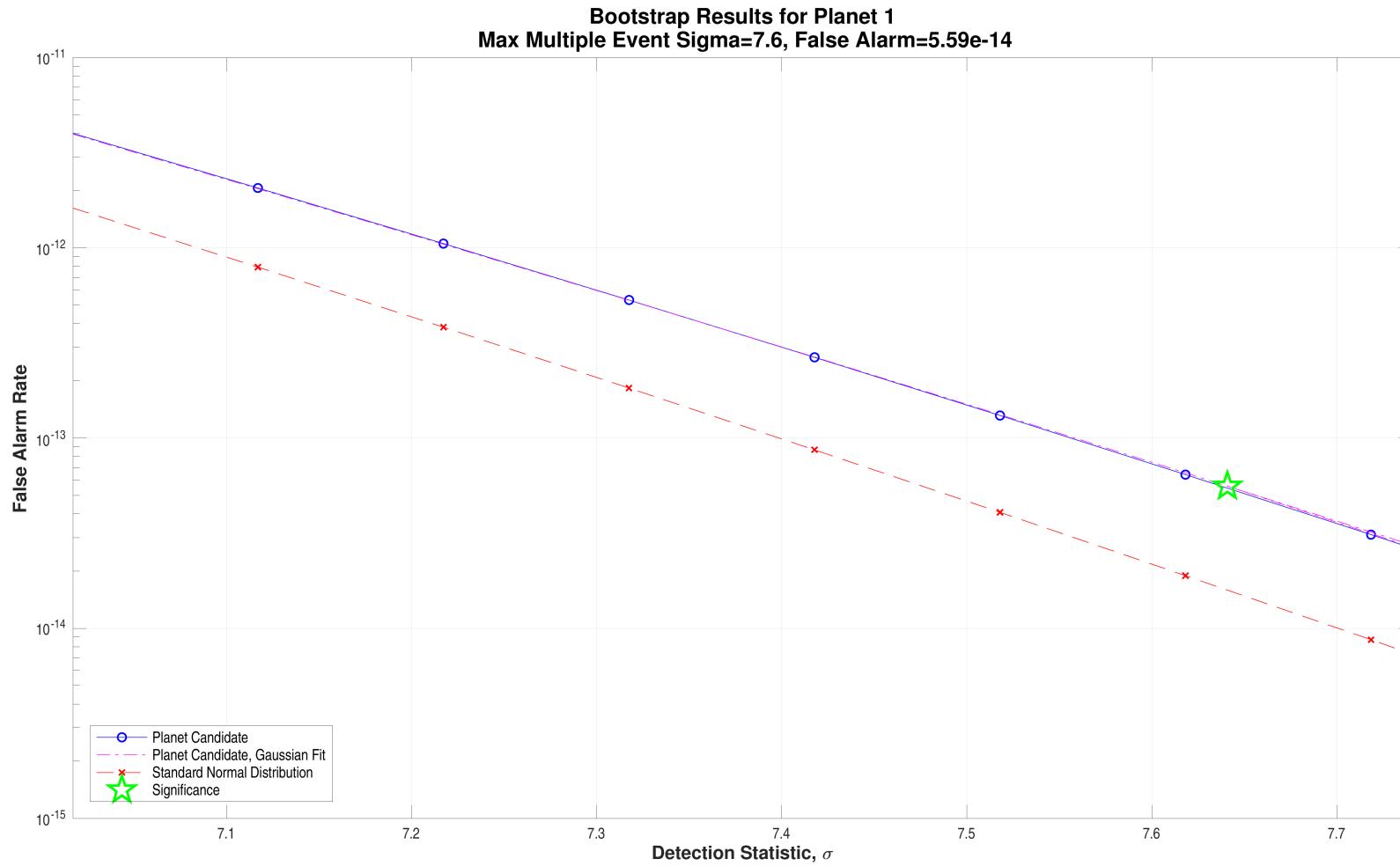
Result	Value	Significance (%)
Maximum MES	7.6	
SNR	7.8	
Core Aperture Statistic	3.6579e+00	99.99
Halo Aperture Statistic	6.4363e-02	52.57
Ratio of Core/Halo Aperture Statistics	5.6833e+01	

7.4.5 Validation Test Figures



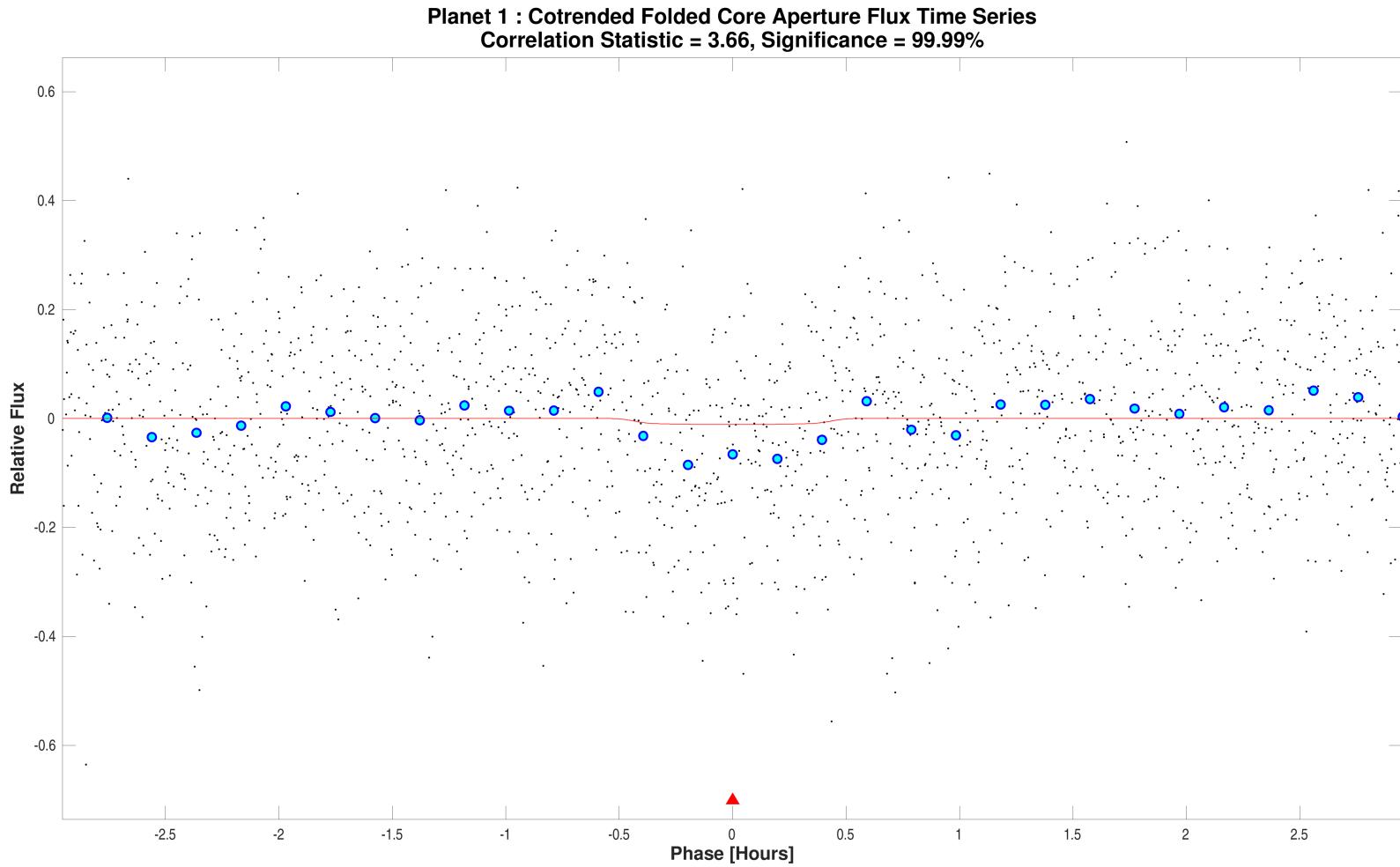
The primary event has been set to zero and both the max and min of the resulting MES vs. Phase are marked with a red star. The best matched pulse duration in hours is 1. The maximum secondary MES and corresponding phase are 3.2388 and 0.1875 days respectively. The minimum secondary MES and corresponding phase are -2.3214 and 1.3194 days respectively.

Open [./planet-01/report-summary/0000000470381900-01-weak-secondary-diagnostic.fig](#)



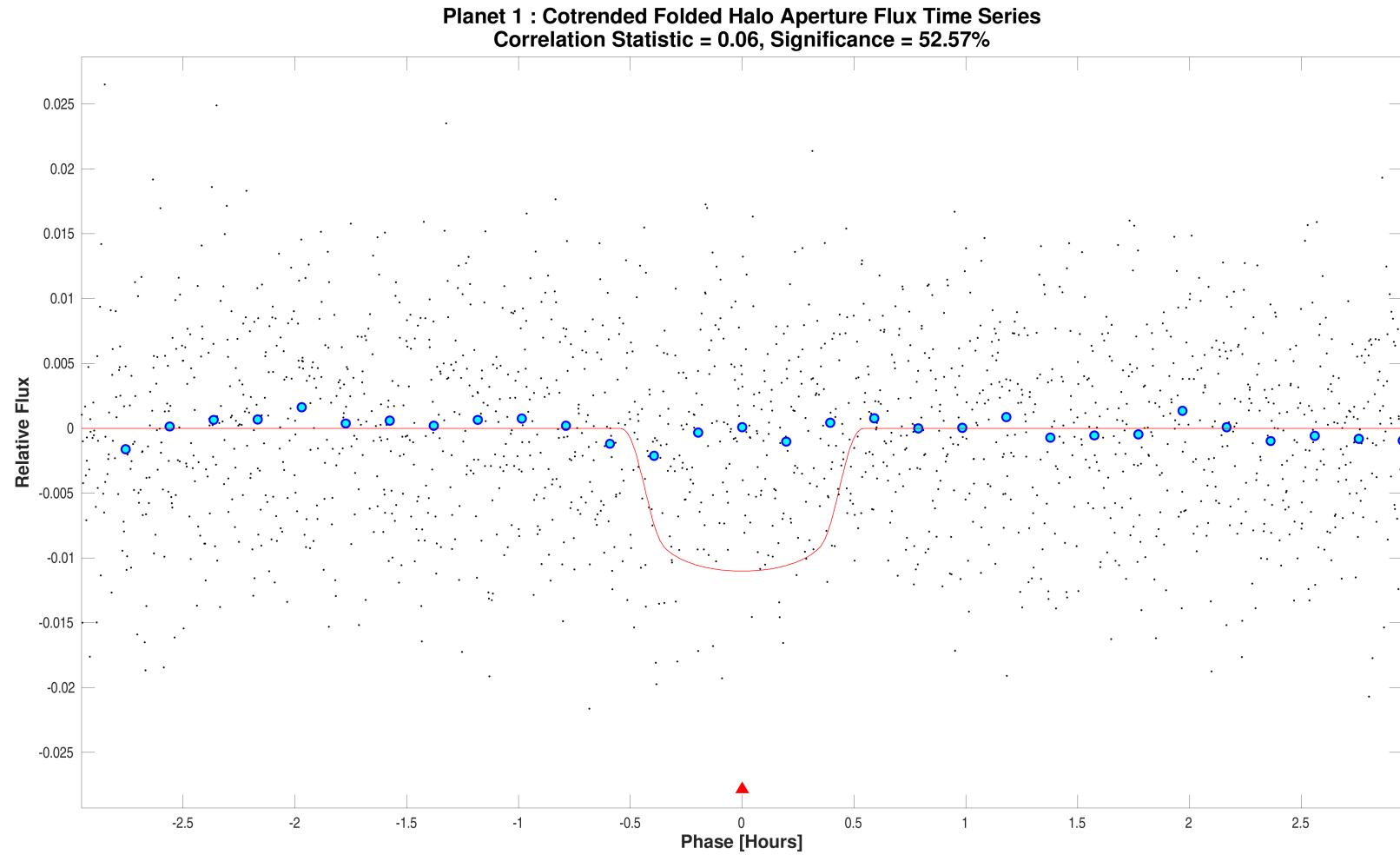
Bootstrap results for target 470381900, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is 7.4262. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 7.2997.

Open [./planet-01/bootstrap-results/000000470381900-01-bootstrap-false-alarm.fig](#)



Optical ghost diagnostic core aperture flux time series for target 470381900, 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/0000000470381900-01-core-unwhitened-cotrended-zoomed-model.fig](#)

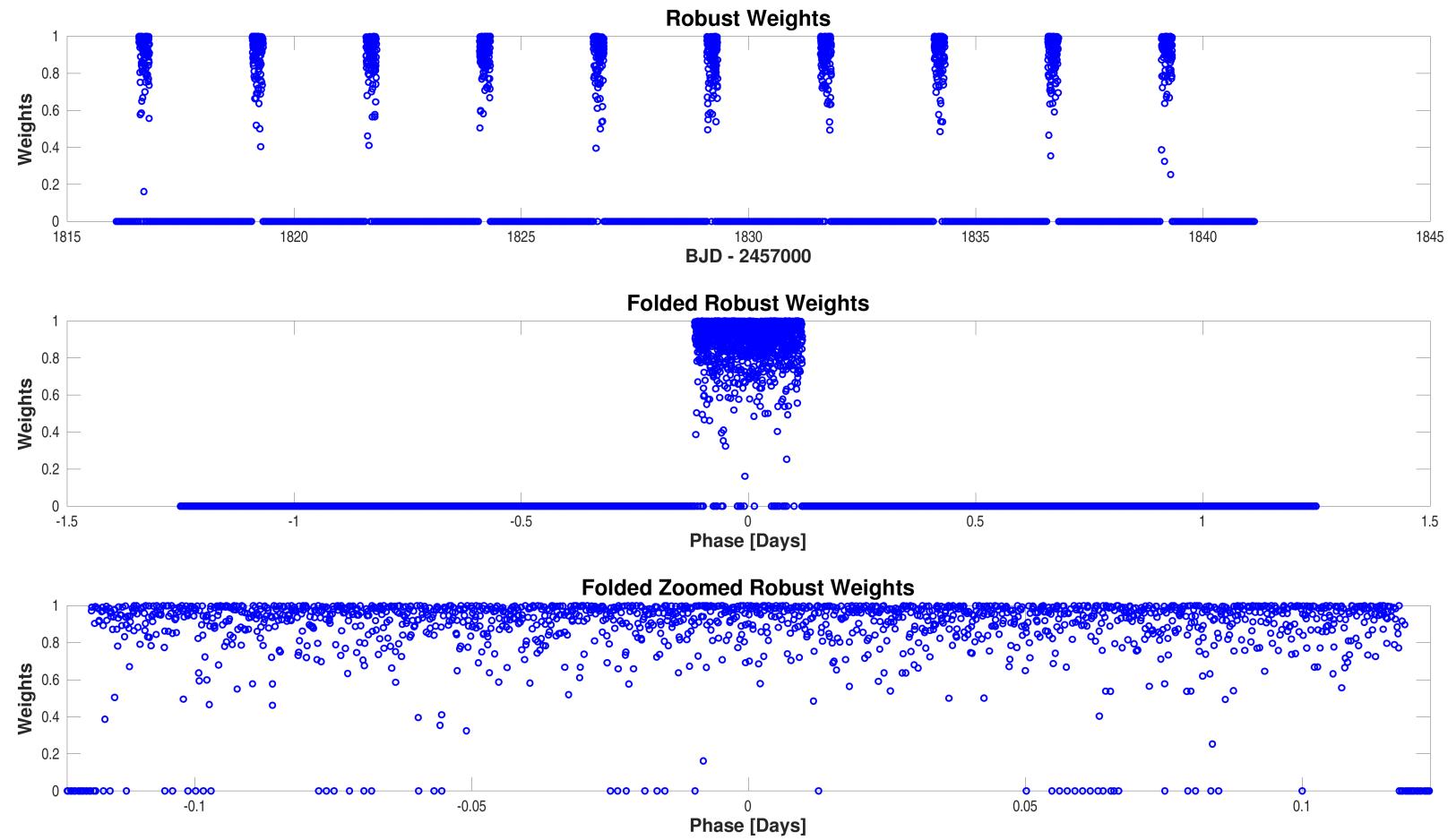


Optical ghost diagnostic halo aperture flux time series for target 470381900, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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/0000000470381900-01-halo-unwhitened-cotrended-zoomed-model.fig](#)

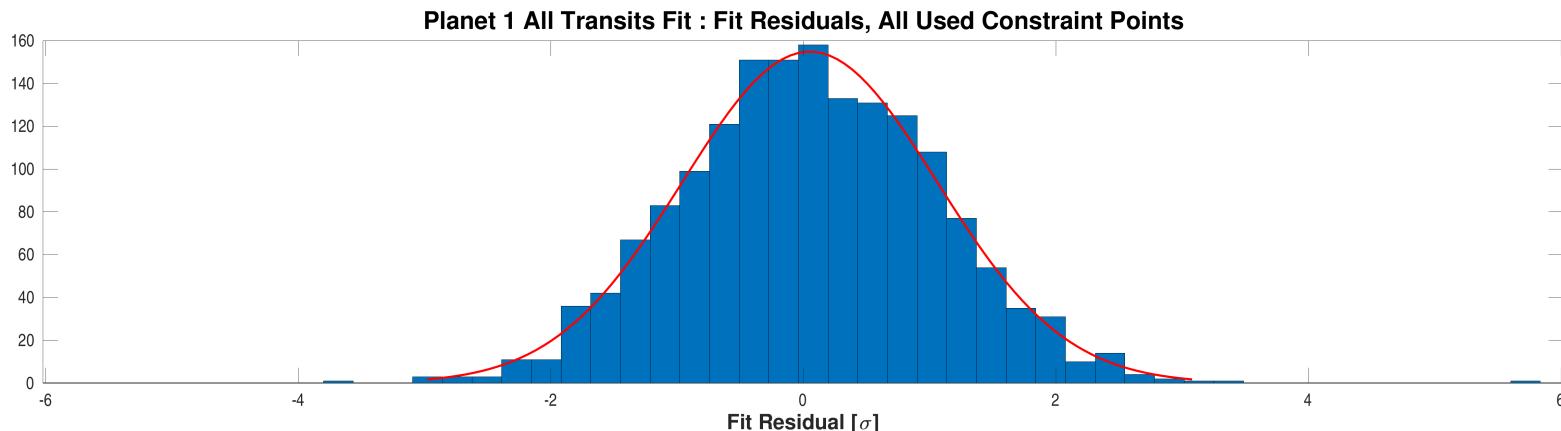
Appendix A Planet Candidate 1

A.1 Model Fitter: All Transits



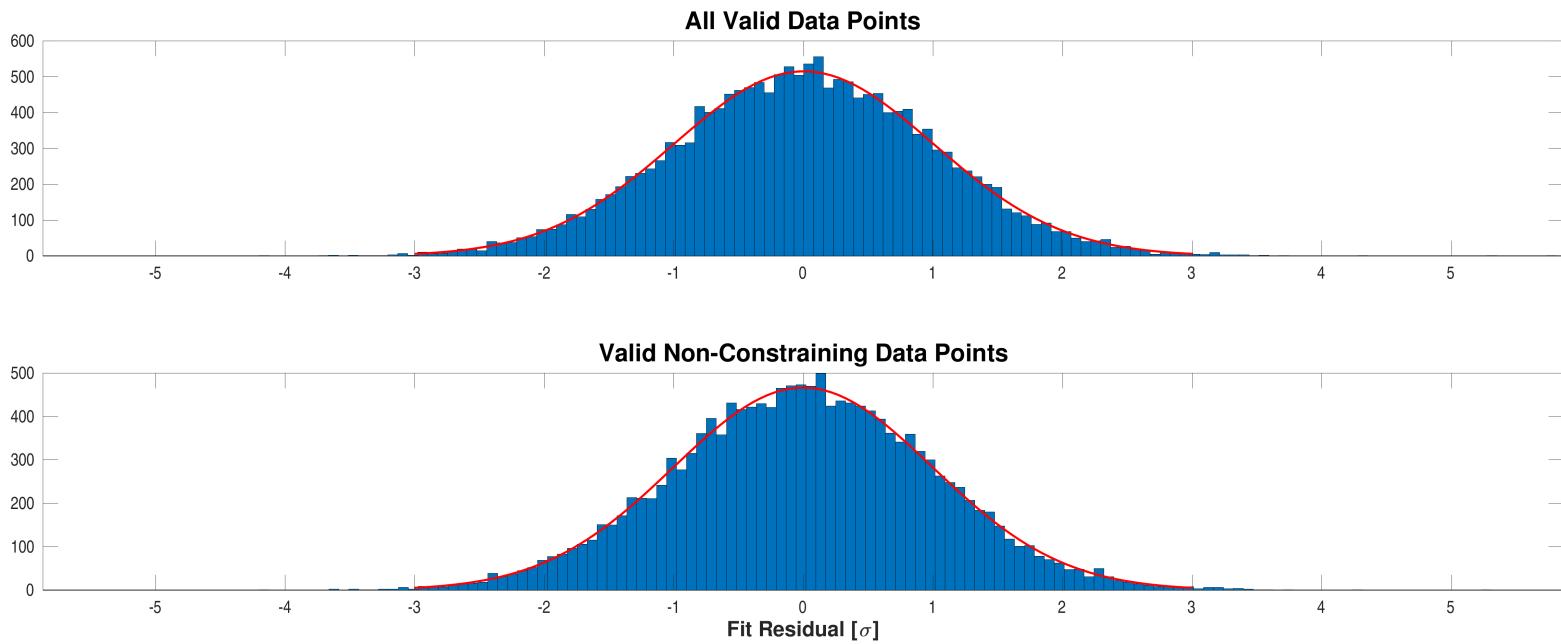
Robust weights distribution for CatId 470381900, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open [./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000470381900-01-all-robust-weights.fig](#)



Fit residuals distribution for CatId 470381900, 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/0000000470381900-01-all-histo-used.fig](#)



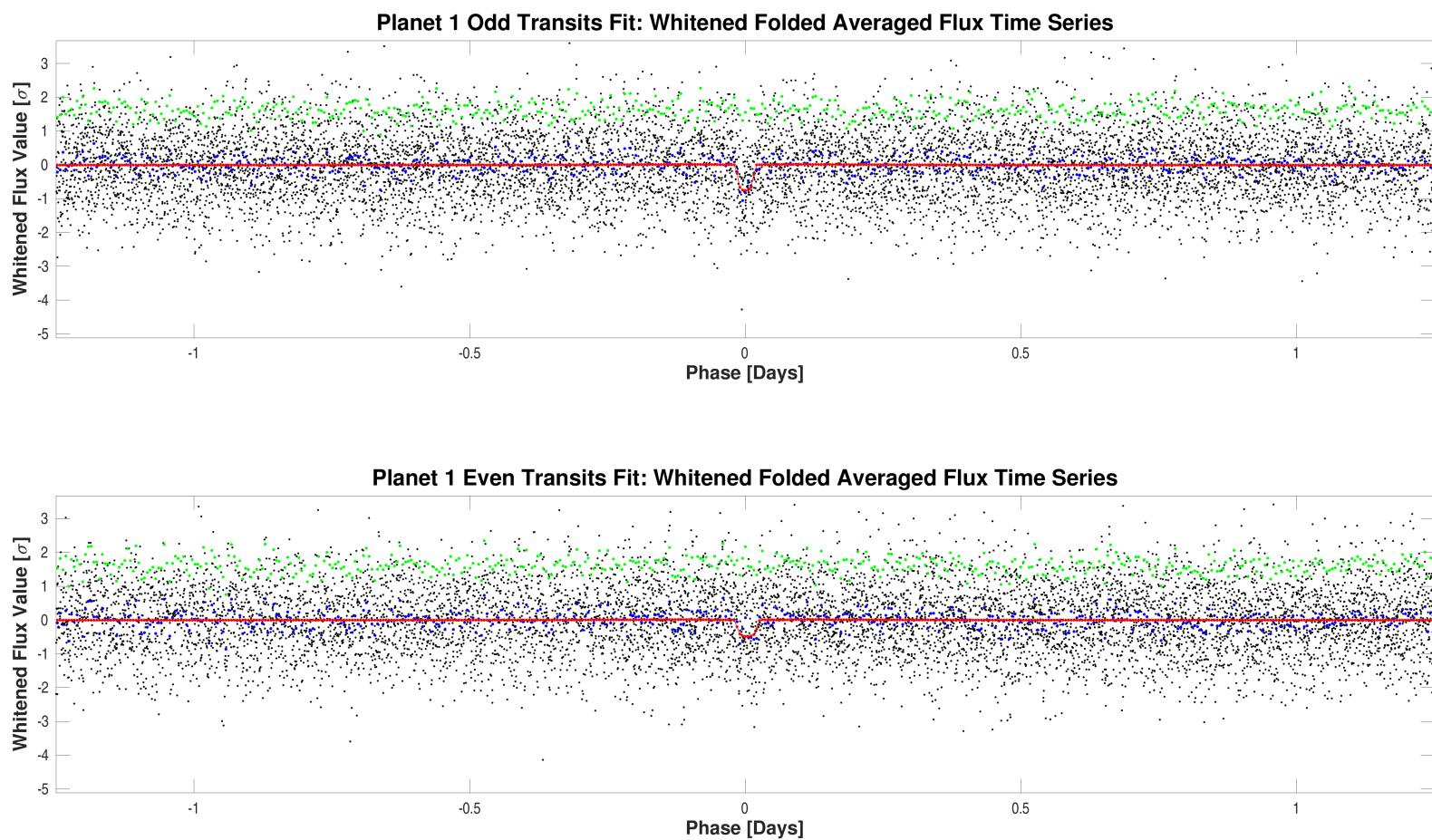
Fit residuals distribution for CatId 470381900, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.

Open [./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000470381900-01-all-histo-all-and-unused.fig](#)

A.2 Model Fitter: Odd & Even Transits

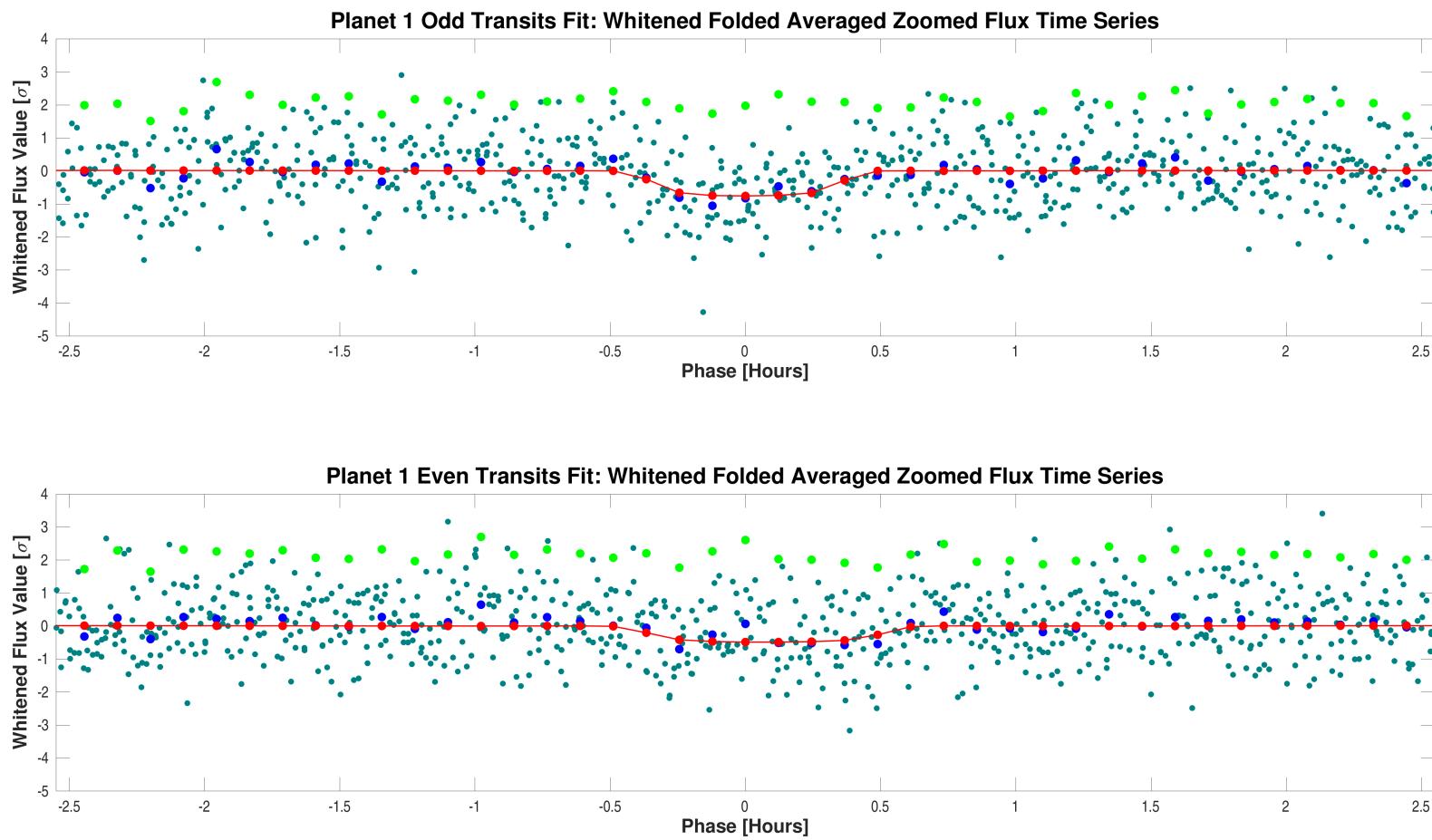
Parameter	Odd Transits Value	Odd Transits Uncertainty	Even Transits Value	Even Transits Uncertainty	Units	Difference $\ \text{Uncertainty}\ $
SNR	6.8		4.9			
Orbital Period	2.5003310	5.7702e-04	2.5008039	8.1396e-04	days	4.7394e-01
Transit Epoch	1816.6960359	2.9828e-03	1819.1975313	3.9788e-03	BTJD	1.5700e-01
Impact Parameter	0.5124	2.2279e+00	0.0181	2.3767e+02		2.0794e-03
Planet Radius to Star Radius Ratio	0.1159835	3.7176e-02	0.0901754	7.3775e-02		3.1240e-01
Semi-major Axis to Star Radius Ratio	22.2994	3.4231e+01	21.2001	9.1036e+01		1.1302e-02
Planet Radius	3.5513	1.1435e+00	2.7611	2.2605e+00	Earth radii	3.1194e-01
Semi-major Axis	0.0229	4.8683e-04	0.0229	4.8690e-04	AU	4.1859e-03
Effective Stellar Flux	13.8095	2.7461e+00	13.8061	2.7454e+00	Goldilocks	8.9657e-04
Equilibrium Temperature	492	2.4442e+01	492	2.4441e+01	Kelvin	8.9657e-04
Stellar Density	23.8299	1.0974e+02	20.4689	2.6369e+02	Solar density	1.1768e-02
Transit Depth	14940	2.5220e+03	9561	2.1894e+03	ppm	1.6107e+00
Transit Duration	0.8497	3.6452e-01	0.9827	7.4142e-01	hours	1.6097e-01
Transit Ingress Duration	0.1162	4.0044e-01	0.0814	7.6973e-01	hours	4.0136e-02
Eccentricity	0.0000	0.0000e+00	0.0000	0.0000e+00		
Peri Longitude	0.0000	0.0000e+00	0.0000	0.0000e+00	degrees	
Model Chi Square Statistic (DoF)	1277.7 (1511.5)		1277.7 (1511.5)			

DoF: Degrees of Freedom



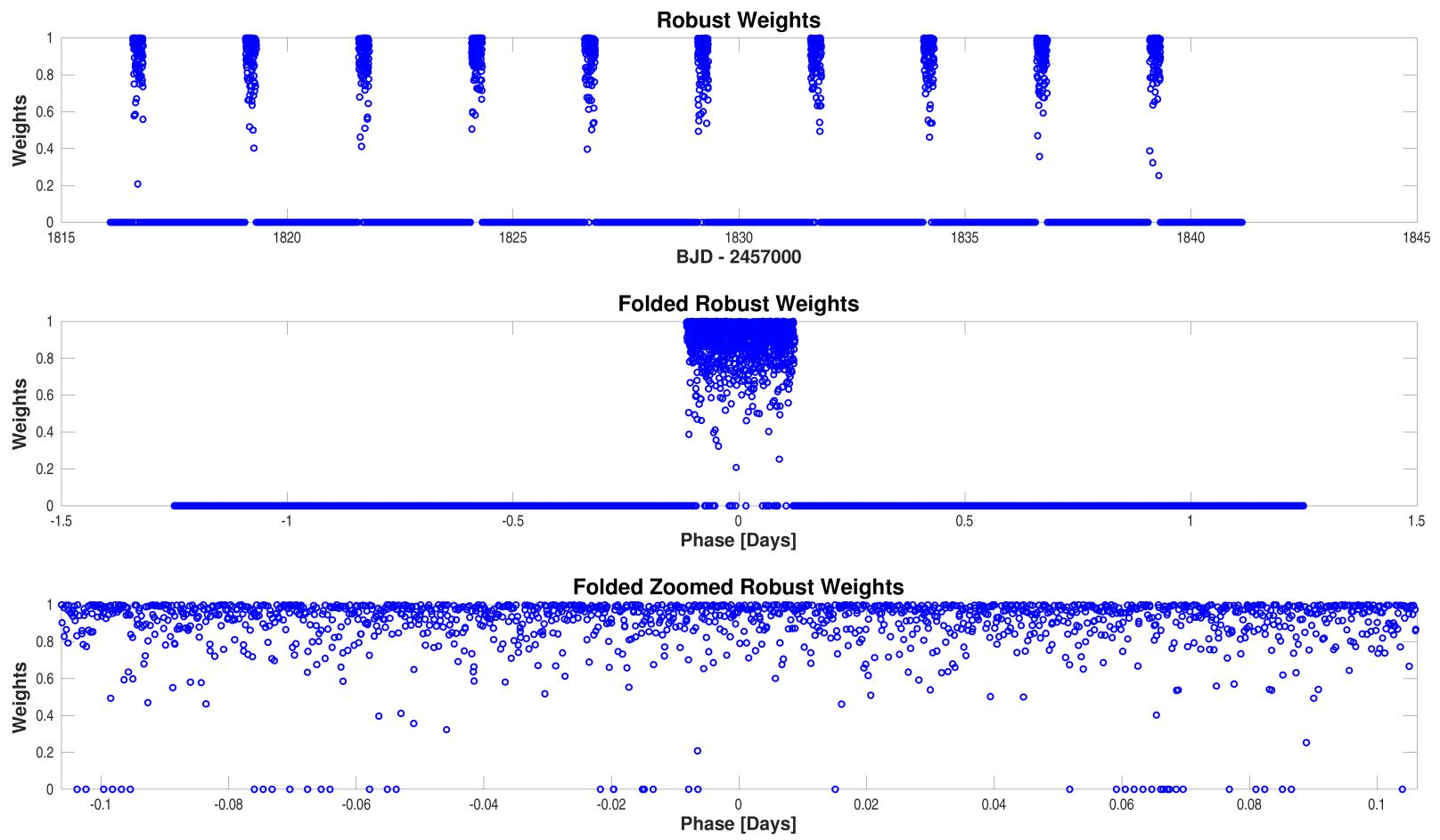
Folded flux time series for CatId 470381900, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light 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/0000000470381900-01-odd-even-whitened.fig](#)



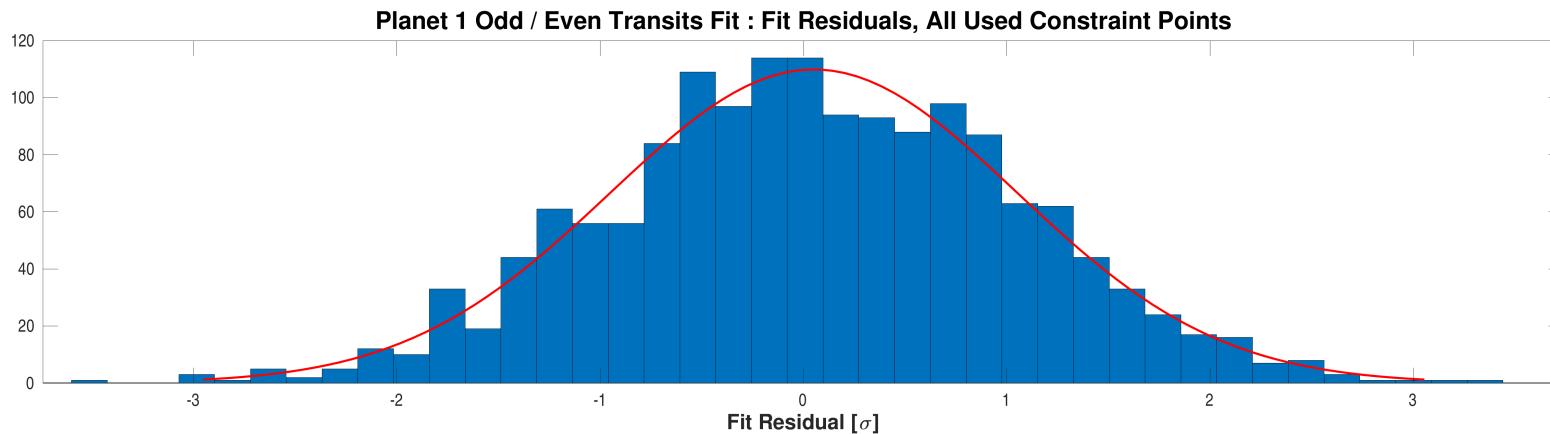
Folded flux time series for CatId 470381900, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000470381900-01-odd-even-whitened-zoomed.fig](#)



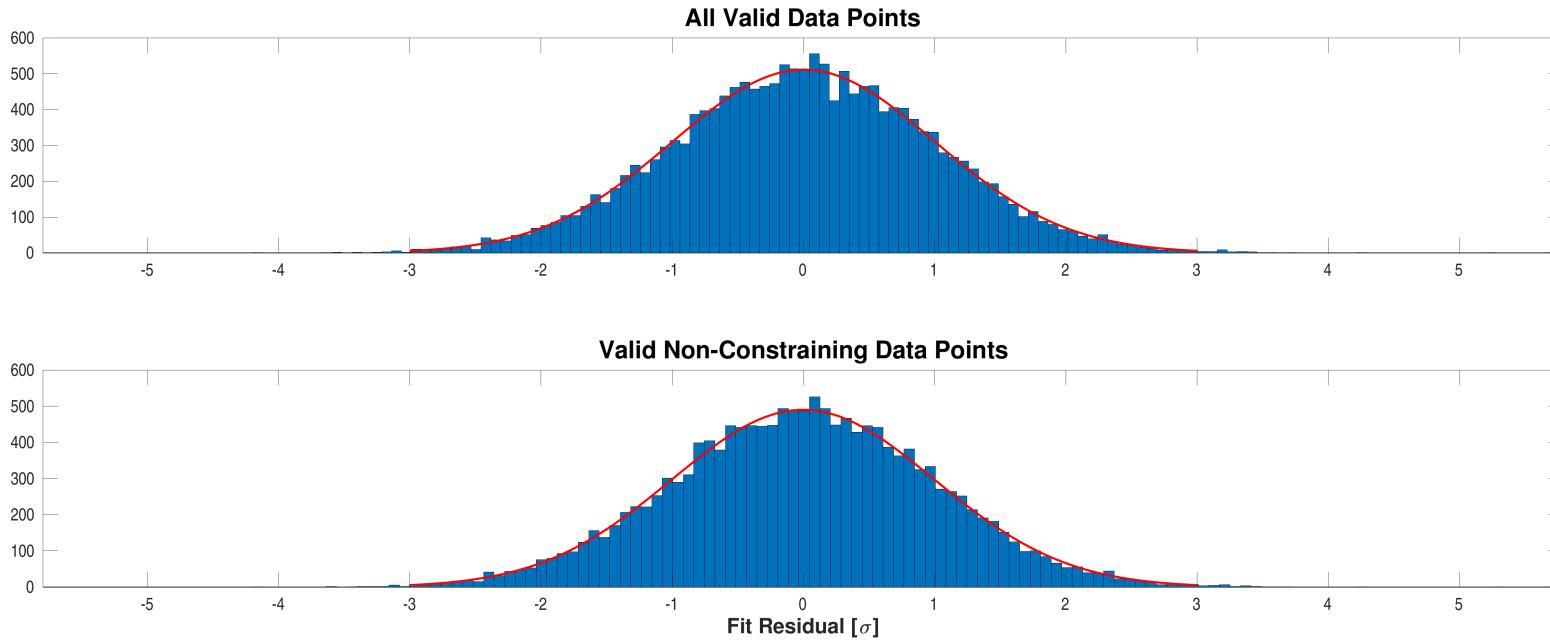
Robust weights distribution for CatId 470381900, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open [./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000470381900-01-odd-even-robust-weights.fig](#)



Fit residuals distribution for CatId 470381900, 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.

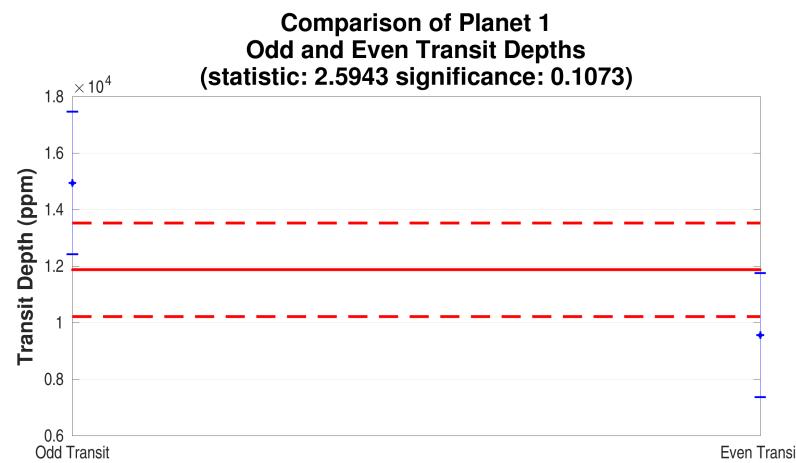
Open [./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000470381900-01-odd-even-histo-used.fig](#)



Fit residuals distribution for CatId 470381900, 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/0000000470381900-01-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 470381900, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary.
Open [./planet-01/binary-discrimination-test-results/000000470381900-01-eclipsing-binary-discrimination-tests.fig](#)

Appendix B Alerts

This target did not trigger any alerts.