



# Data Validation (DV) Report

for TESS ID 21744120  
Sectors 25 - 25

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

09-Jul-2020 06:14:51 Z

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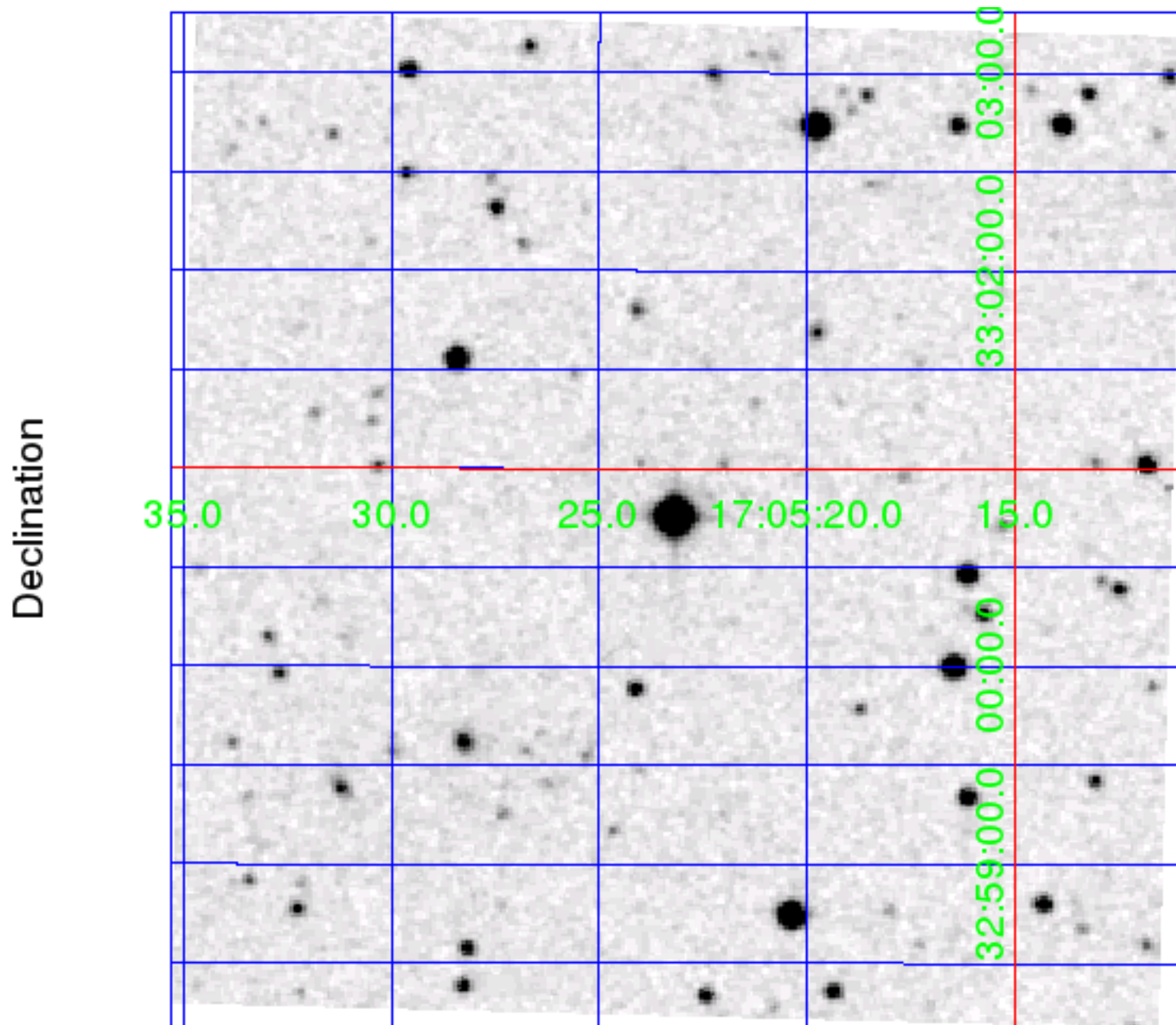
# 1 Summary

Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	21744120			
TOI ID	-			
TESS Name	-			
RA	256.34644827	0	degrees	TIC8
Dec	33.01248310	0	degrees	TIC8
Magnitude	11.733	0.0061		TIC8
Radius	0.740	0.050	Solar radii	TIC8
Effective Temperature	4790	118	Kelvin	TIC8
log(g)	4.588	0.08845	cm/sec <sup>2</sup>	TIC8
[M/H]	0.140	0.08	Solar metallicity	TIC8
Stellar Density	1.907	0.409	Solar density	TIC8-Derived
Limb Darkening Coefficient 1	0.71199			
Limb Darkening Coefficient 2	-0.64061			
Limb Darkening Coefficient 3	1.1483			
Limb Darkening Coefficient 4	-0.47206			
Number of Planet Candidates	1			
TOI Model	csv-file-toi-catalog-07-07-20-edited.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-4.0.36-20200520			
Date Report Generated	09-Jul-2020 06:14:51 Z			

Sector	Target Table	Camera/ CCD	Crowding Metric	Flux Fraction
25	245	1:1	0.9973	0.7783

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	-	-	-	5.508	1.00	1983.745	0.06	10.6	82.2	768	0.00e+00	false

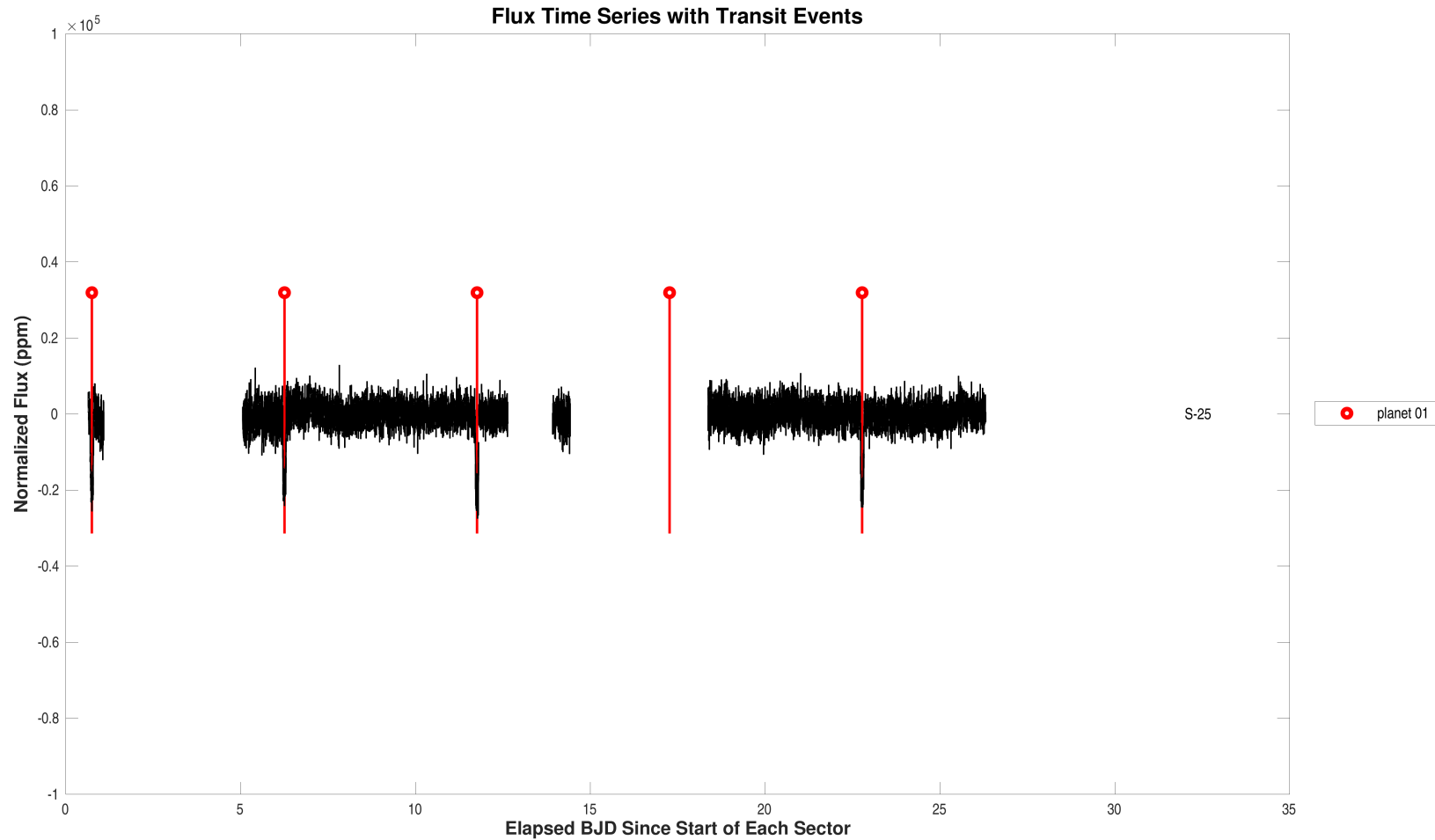
## 2 Survey Image



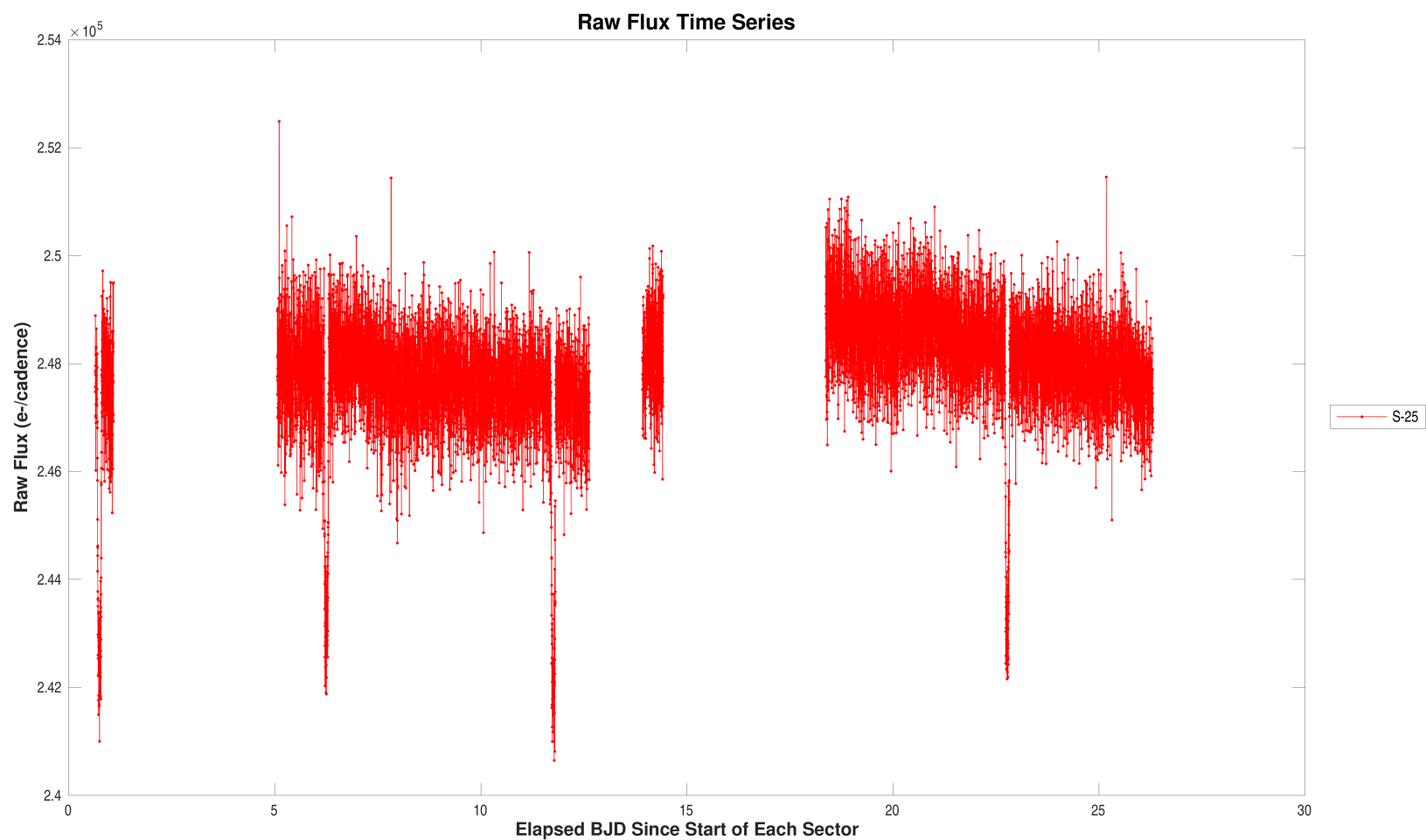
Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (21744120).



### 3 Flux Time Series



Summary plot of sector-stitched flux time series and transits for target 21744120, 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 25, target table 245, start BJD is 2458983. Open `./summary-plots/0000000021744120-00-flux-dv-fit-25-245.fig`



Summary plot of raw flux time series. For the data of sector 25, target table 245, start BJD is 2458983.  
Open `./summary-plots/000000021744120-00-raw-flux-25-245.fig`

## 4 Dashboards

## Planet Candidate 1

<b>Model Fitter</b>	<b>Stellar Radius</b> 0.7 ± 0.0 Solar units		<b>Core Aperture Correlation Statistic</b> Value = 53.65 Significance = 100.00%		<b>Ghost Diagnostic Test</b>	
	Period = 5.5 ± 0.0 days Depth = 21262 ± 316 ppm Planet Radius = 10.6 ± 0.7 Earth radii Semi-major Axis = 0.1 ± 0.0 AU Effective Stellar Flux = 82.2 ± 14.3 Equilibrium Temperature = 768 ± 33 Kelvin Chi-squared/DoF = 0.9 SNR = 70.7		<b>Halo Aperture Correlation Statistic</b> Value = 10.39 Significance = 100.00%  <b>Core/Halo Ratio</b> Ratio = 5.16			
<b>Eclipsing Binary Discrimination Test</b>	<b>Odd-Even Depth Comparison Statistic</b> Value = 3.05e+00 Significance = 8.09%		<b>Offsets Relative to Out of Transit Centroid</b> Source RA Offset = 5.16e-01 ± 2.51e+00 arcsec (0.21 $\sigma$ ) Source Dec Offset = -3.92e-01 ± 2.51e+00 arcsec (-0.16 $\sigma$ ) Source Offset Distance = 6.48e-01 ± 2.51e+00 arcsec (0.26 $\sigma$ )  <b>Offsets Relative to TIC Position</b> Source RA Offset = 3.08e-01 ± 2.51e+00 arcsec (0.12 $\sigma$ ) Source Dec Offset = -5.88e-02 ± 2.51e+00 arcsec (-0.02 $\sigma$ ) Source Offset Distance = 3.13e-01 ± 2.51e+00 arcsec (0.12 $\sigma$ )		<b>Difference Image Centroid Offsets</b>	
	<b>Shorter Period Comparison Statistic</b> Value = <i>N/A</i> Significance = <i>N/A</i>	<b>Longer Period Comparison Statistic</b> Value = <i>N/A</i> Significance = <i>N/A</i>	False Alarm = 0.00e+00 Transit Count = 5 Max Multiple Event Statistic = 61.2		<b>Bootstrap Test</b>	

Summary of model fitter results and validation test results for target 21744120, 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

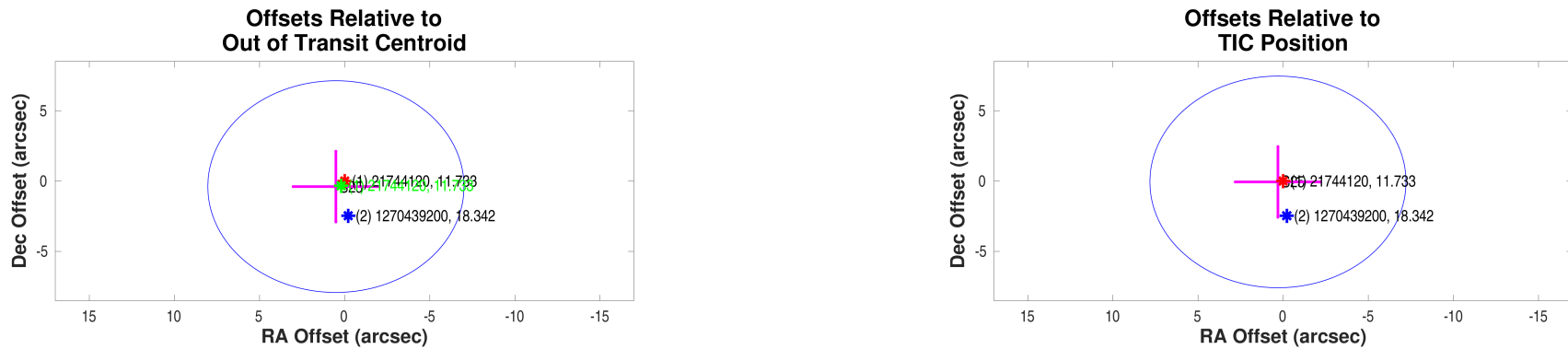
Mean offset from the PRF fit to the out of transit image

	RA	Dec	Units
Offset	$0.5157 \pm 2.51e + 00$	$-0.3920 \pm 2.51e + 00$	arcseconds
Offset/ $\sigma$	0.21	-0.16	
Offset Distance	$0.6478 \pm 2.51e + 00$		arcseconds
Offset Distance/ $\sigma$	0.26		
$3\sigma$ Radius	7.5266		arcseconds

Mean offset from the TIC RA and Dec

	RA	Dec	Units
Offset	$0.3078 \pm 2.51e + 00$	$-0.0588 \pm 2.51e + 00$	arcseconds
Offset/ $\sigma$	0.12	-0.02	
Offset Distance	$0.3134 \pm 2.51e + 00$		arcseconds
Offset Distance/ $\sigma$	0.12		
$3\sigma$ Radius	7.5244		arcseconds

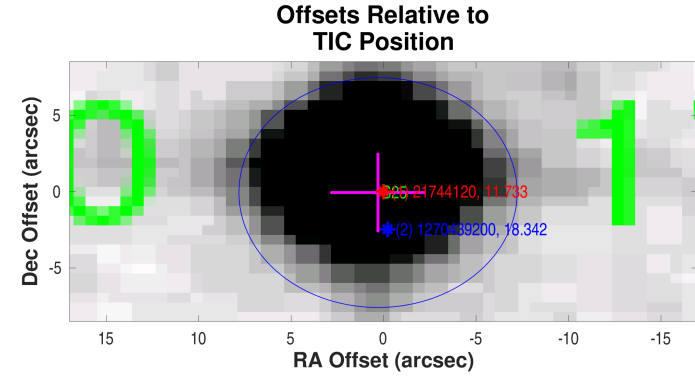
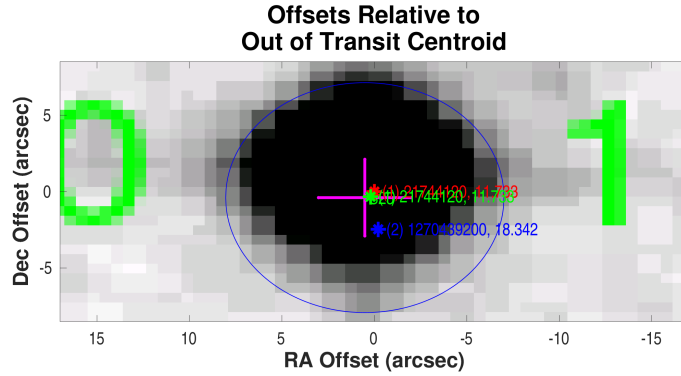
#### Planet Candidate 1



Difference image centroid offsets for target 21744120, 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 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/0000000021744120-01-difference-image-centroid-offsets.fig`

## Planet Candidate 1



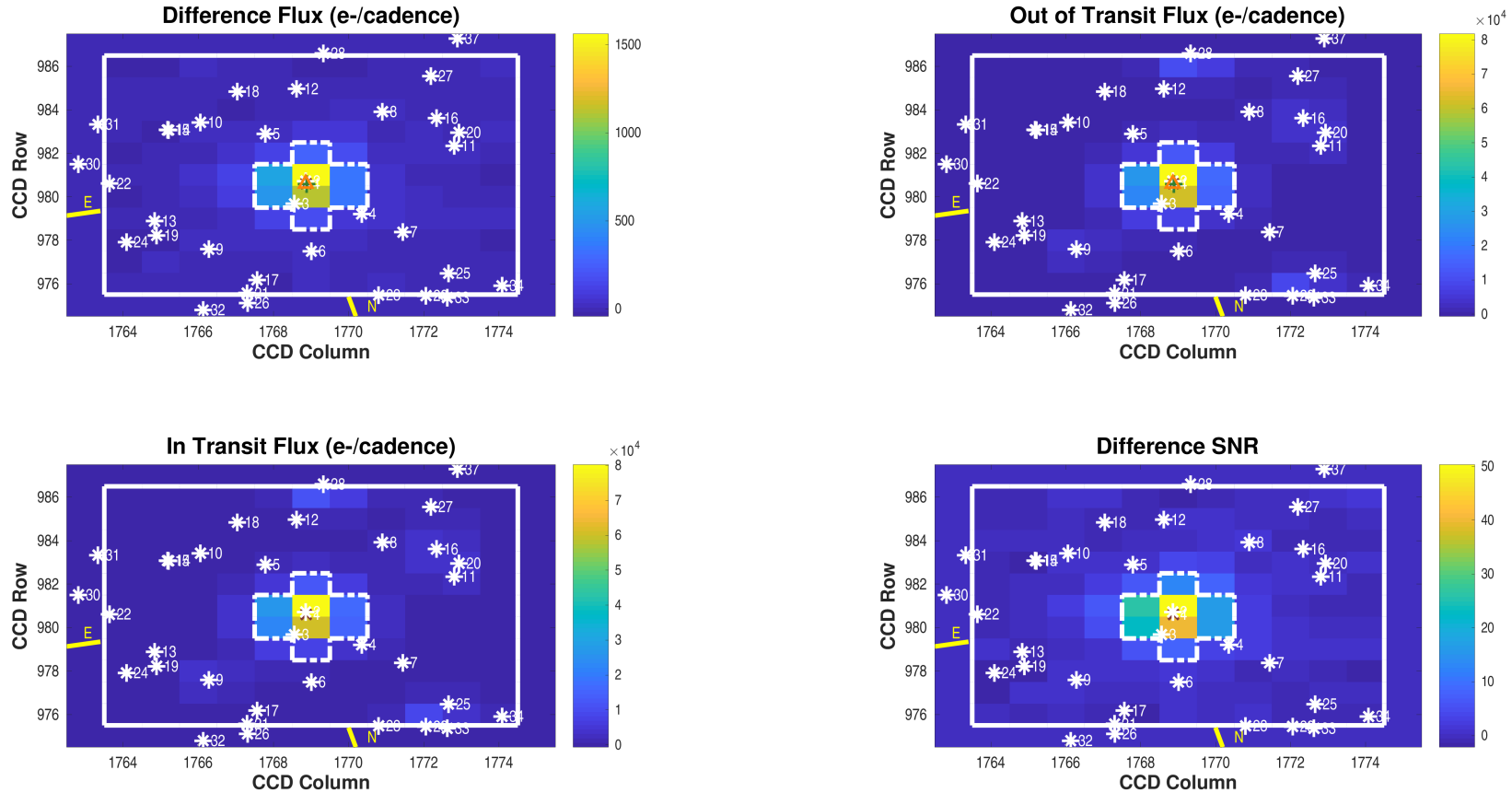
Difference image centroid offsets for target 21744120, planet candidate 1, displayed on survey image for given target. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in 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/0000000021744120-01-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 25 / Target Pixel Table 245



Difference image for target 21744120, planet candidate 1, sector 25, target pixel table 245. 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 = 3; number of valid in-transit cadences = 171; number of in-transit cadence gaps = 1; number of valid out-of-transit cadences = 488; number of out-of-transit cadence gaps = 7. Difference image quality metric = 1.00 (good).

Open `./planet-01/difference-image/0000000021744120-01-difference-image-25-245.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	$980.59 \pm 1.04e - 04$	$1768.88 \pm 1.20e - 04$	pixels	$256.34628428 \pm 9.38e - 07$	$33.01236774 \pm 9.08e - 07$	degrees
Difference Image Centroid	$980.60 \pm 1.06e - 02$	$1768.86 \pm 1.20e - 02$	pixels	$256.34645512 \pm 6.66e - 05$	$33.01225885 \pm 6.30e - 05$	degrees
Offset	$0.0129 \pm 1.06e - 02$	$-0.0281 \pm 1.20e - 02$	pixels	$0.5157 \pm 2.01e - 01$	$-0.3920 \pm 2.27e - 01$	arcseconds
Offset/ $\sigma$	1.22	-2.34		2.56	-1.73	
Offset Distance	$0.0309 \pm 1.20e - 02$		pixels	$0.6478 \pm 2.25e - 01$		arcseconds
Offset Distance/ $\sigma$	2.57			2.88		

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

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$980.60 \pm 1.14e - 04$	$1768.87 \pm 1.17e - 04$	pixels	$256.34635317 \pm 0.00e + 00$	$33.01227518 \pm 0.00e + 00$	degrees
Difference Image Centroid	$980.60 \pm 1.06e - 02$	$1768.86 \pm 1.20e - 02$	pixels	$256.34645512 \pm 6.66e - 05$	$33.01225885 \pm 6.30e - 05$	degrees
Offset	$-0.0005 \pm 1.06e - 02$	$-0.0150 \pm 1.20e - 02$	pixels	$0.3078 \pm 2.01e - 01$	$-0.0588 \pm 2.27e - 01$	arcseconds
Offset/ $\sigma$	-0.05	-1.25		1.53	-0.26	
Offset Distance	$0.0150 \pm 1.19e - 02$		pixels	$0.3134 \pm 2.08e - 01$		arcseconds
Offset Distance/ $\sigma$	1.25			1.51		

## 5.2 Difference Image TIC Key

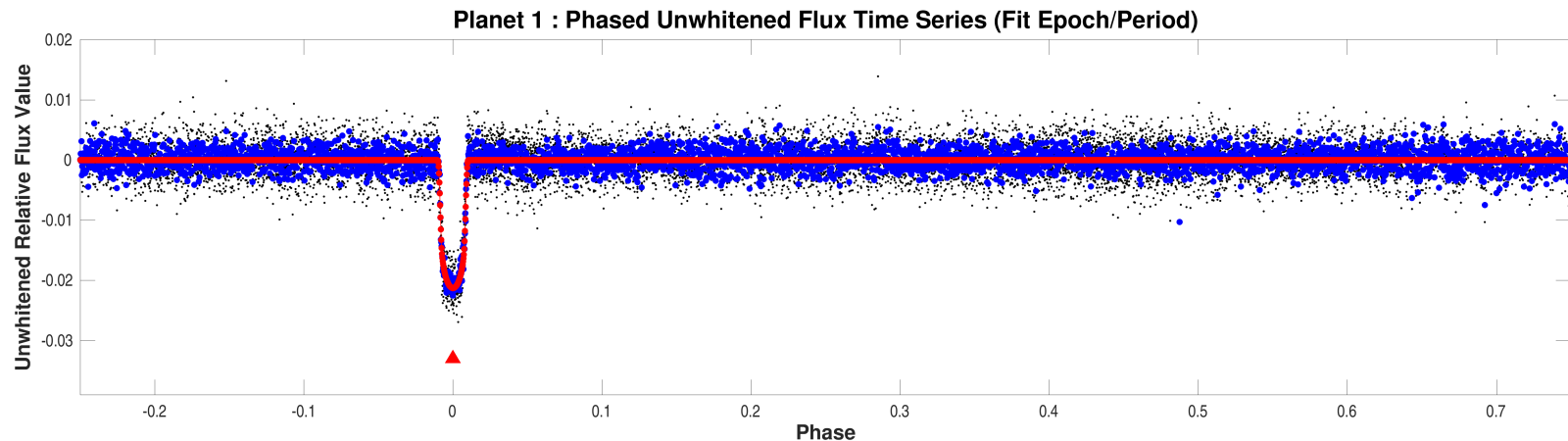
Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
1	21744120	11.733	256.34635317	33.01227518	0.00
2	1270439200	18.342	256.34628351	33.01158921	2.48
3	1270439199	19.850	256.34985126	33.01705813	20.20
4	21744119	19.206	256.33841006	33.02201305	42.47
5	21744132	17.451	256.35034047	32.99797152	52.88
6	21741342	18.629	256.34999000	33.02993000	64.50
7	21741341	18.265	256.33223700	33.02810300	71.15
8	1270439188	18.849	256.32779344	32.99627322	80.36
9	21744116	14.895	256.36828886	33.02584782	82.29
10	1270439191	20.468	256.36126134	32.99280662	83.29
11	21741333	15.558	256.31719803	33.00759350	89.61
12	1270439187	19.950	256.34171531	32.98744457	90.48
13	1270439192	18.813	256.37615147	33.01672139	91.37
14	10000546159	17.368	256.36749300	32.99369000	92.46
15	21744133	18.454	256.36768700	32.99358700	93.13
16	21741330	14.772	256.31852365	32.99982895	95.21
17	1270439204	19.462	256.36168607	33.03543593	95.37
18	1270439183	19.194	256.35255443	32.98610687	96.05
19	1270439201	19.498	256.37675485	33.02049575	96.43
20	21741331	17.327	256.31542112	33.00429961	97.69
21	21744113	16.855	256.36435377	33.03852071	109.00
22	1270439193	20.017	256.38173728	33.00546856	109.59
23	1270439292	20.632	256.34083169	33.04356609	113.87
24	1270439197	19.801	256.38262544	33.02118811	114.10
25	1270439293	20.364	256.32679057	33.04035207	117.06
26	21744112	18.417	256.36494484	33.04107367	117.89
27	21741324	15.973	256.31667314	32.98873861	123.32
28	21741318	13.520	256.33448155	32.97917479	124.43
29	21741347	13.910	256.33235814	33.04532841	126.27
30	1270439190	18.586	256.38601739	32.99937052	128.43
31	21744134	18.286	256.37983400	32.98978400	129.50
32	21744111	18.023	256.37339775	33.04136333	132.78
33	1270439294	19.893	256.32864325	33.04654500	134.46
34	21741346	16.995	256.31798672	33.04535870	146.69
35	1270439202	18.973	256.38065629	33.04464343	155.89
36	1270439173	19.946	256.38379935	32.98164523	157.92
37	21741319	16.819	256.30937440	32.97991823	161.34
38	21744137	17.074	256.38441270	32.97944552	164.83



<b>Index</b>	<b>Catalog ID</b>	<b>Mag</b>	<b>RA</b> <b>(degrees)</b>	<b>Dec</b> <b>(degrees)</b>	<b>Distance</b> <b>(arcsec)</b>
39	21741348	15.725	256.30755539	33.04547916	167.35
40	1270439203	19.986	256.38767226	33.04560250	173.07

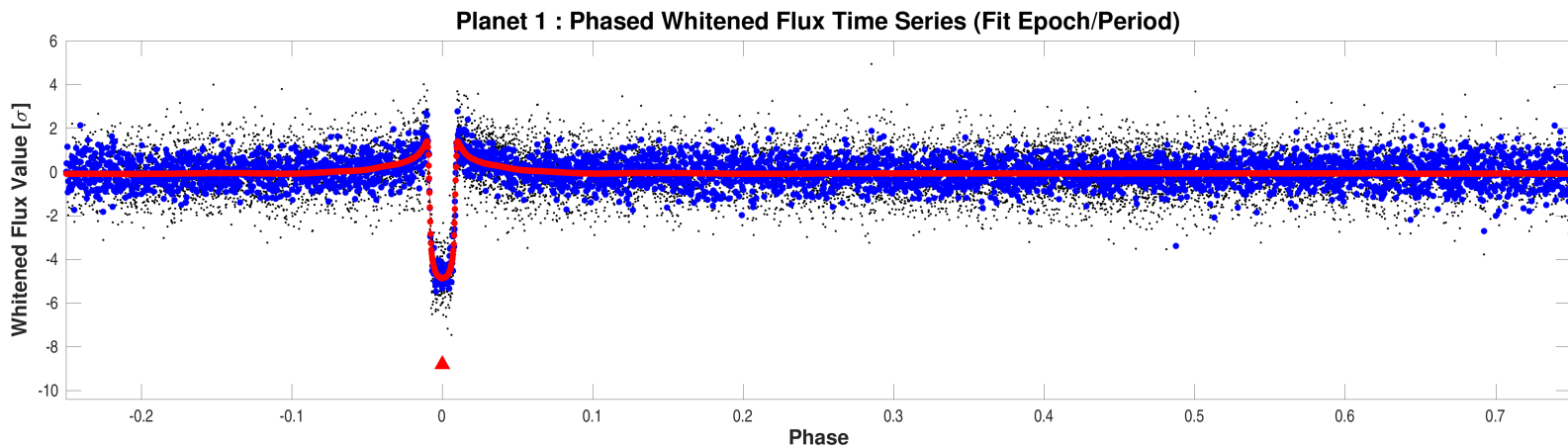
RA, Dec and Distances are corrected for proper motion. This table may not contain all of the objects shown.

## 6 Phased Light Curves



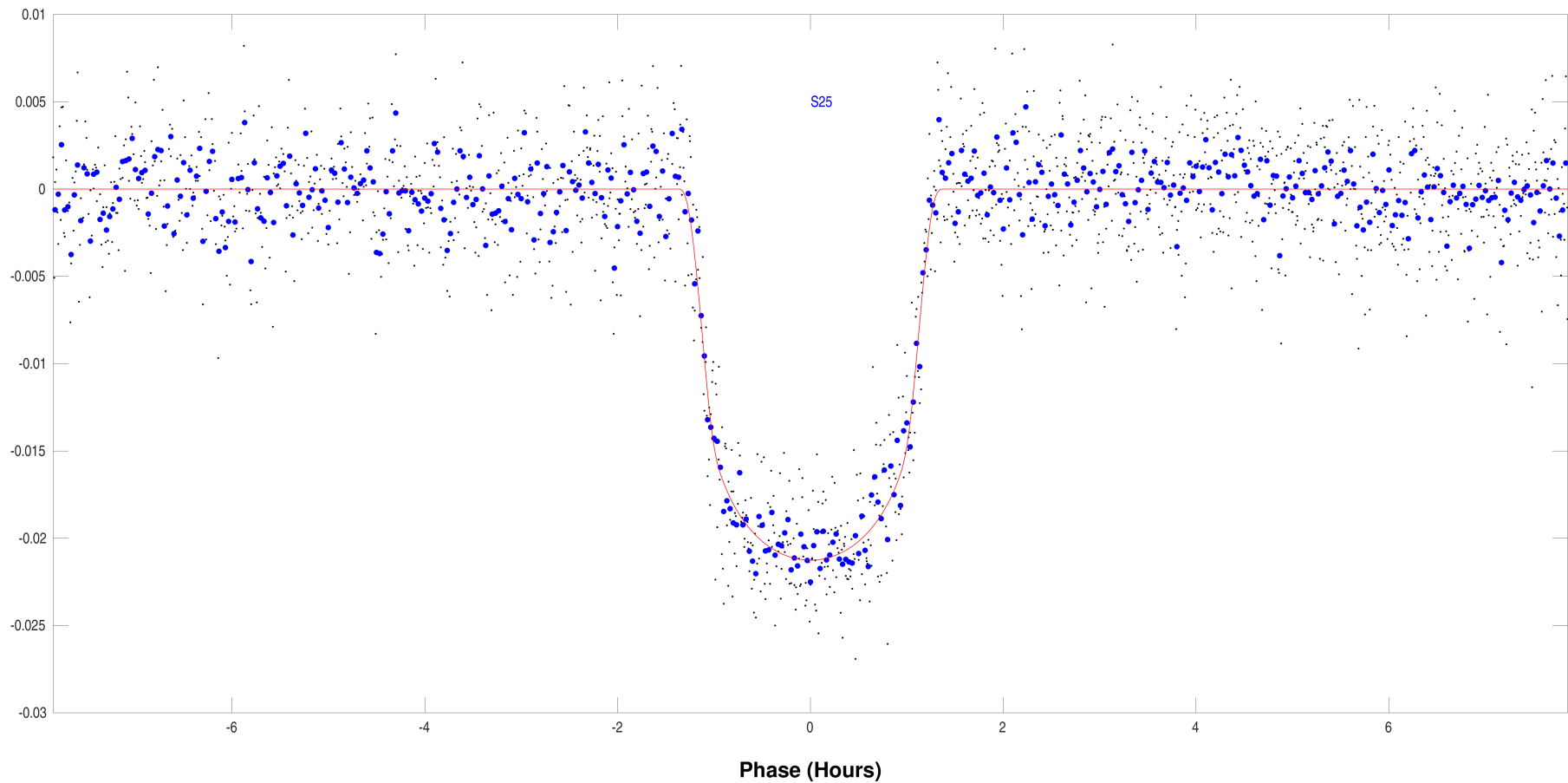
Phased unwhitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased unwhitened flux time series 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/0000000021744120-01-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/000000021744120-01-phased-whitened-flux-time-series.fig`

**Planet: 1 Phased Unwhitened Flux Time Series by Sector**

Phased unwhitened flux time series by sector for target 21744120, planet candidate 1. Period = 5.508 days; transit epoch = 1983.7451 BTJD.  
Open `./summary-plots/000000021744120-01-phased-unwhitened-flux-time-series-by-sector.fig`

## 7 Planet Candidate 1

### 7.1 Model Fitter: All Transits

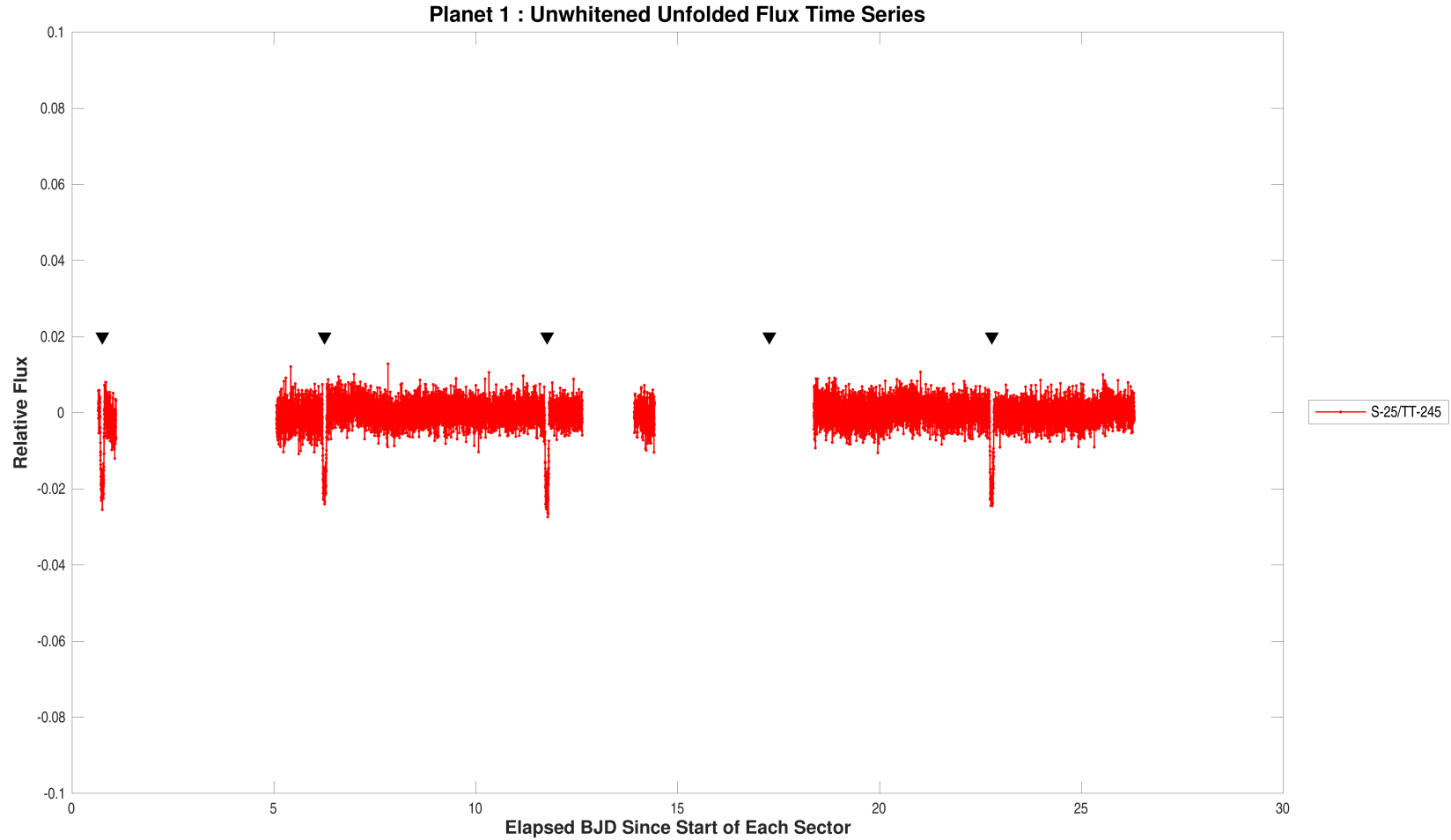
Model Characteristic	Name
Transit Model	mandel-agol_geometric_transit_model
Limb Darkening Model	claret_tess_nonlinear_limb_darkening_model

TCE Parameter	Value	Units
Trial Transit Pulse Duration	2.5	hours
Transit Epoch	1983.7454613	TJD
Orbital Period	5.5069418	days
Maximum SES	38.8	
Maximum MES	61.2	
Robust Statistic	57.1	
Chi Square Goodness of Fit Statistic (DoF)	915.7 (295)	
Chi Square2 Statistic (DoF)	457.1 (266.2)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

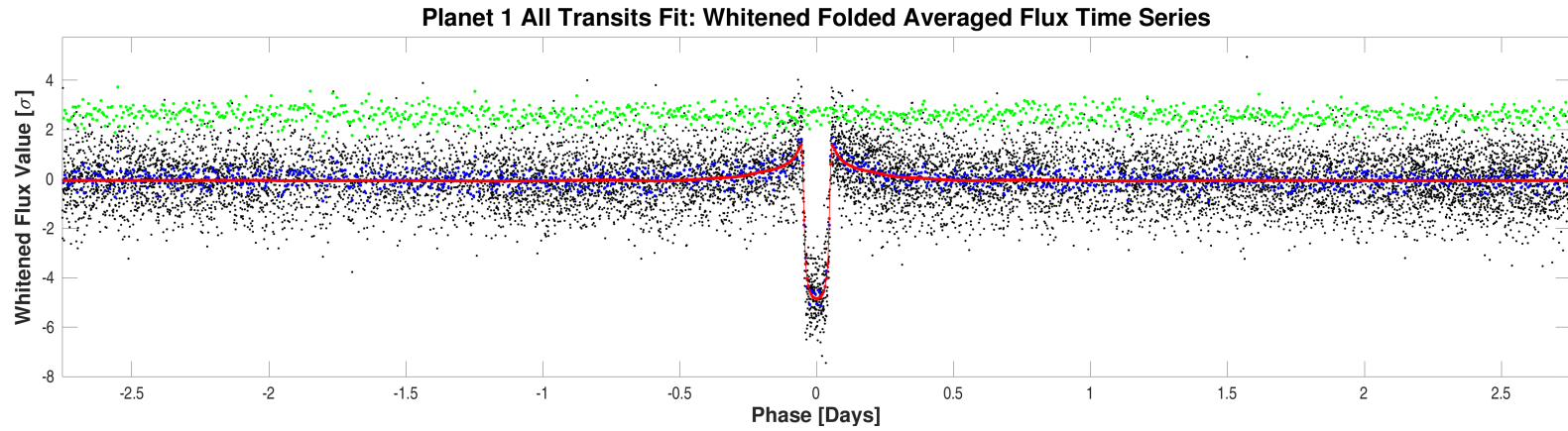
Parameter	Value	Uncertainty	Units
SNR	70.7		
Orbital Period	5.5080431	2.0744e-04	days
Transit Epoch	1983.7451334	4.9113e-04	BTJD
Impact Parameter	0.0106	6.7929e+00	
Planet Radius to Star Radius Ratio	0.1317979	2.7173e-03	
Semi-major Axis to Star Radius Ratio	18.2039	1.2973e+00	
Planet Radius	10.6490	7.4761e-01	Earth radii
Semi-major Axis	0.0560	4.5570e-03	AU
Effective Stellar Flux	82.2412	1.4265e+01	Goldilocks
Equilibrium Temperature	768	3.3305e+01	Kelvin
Stellar Density	2.6714	5.7113e-01	Solar density
Transit Depth	21262	3.1557e+02	ppm
Transit Duration	2.6177	4.8113e-02	hours
Transit Ingress Duration	0.3051	5.0104e-02	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	1215.5 (1370.6)		
Model Chi Square Goodness of Fit Statistic (DoF)	212.1 (326)		
Model Chi Square2 Statistic (DoF)	11.2 (3)		

DoF: Degrees of Freedom



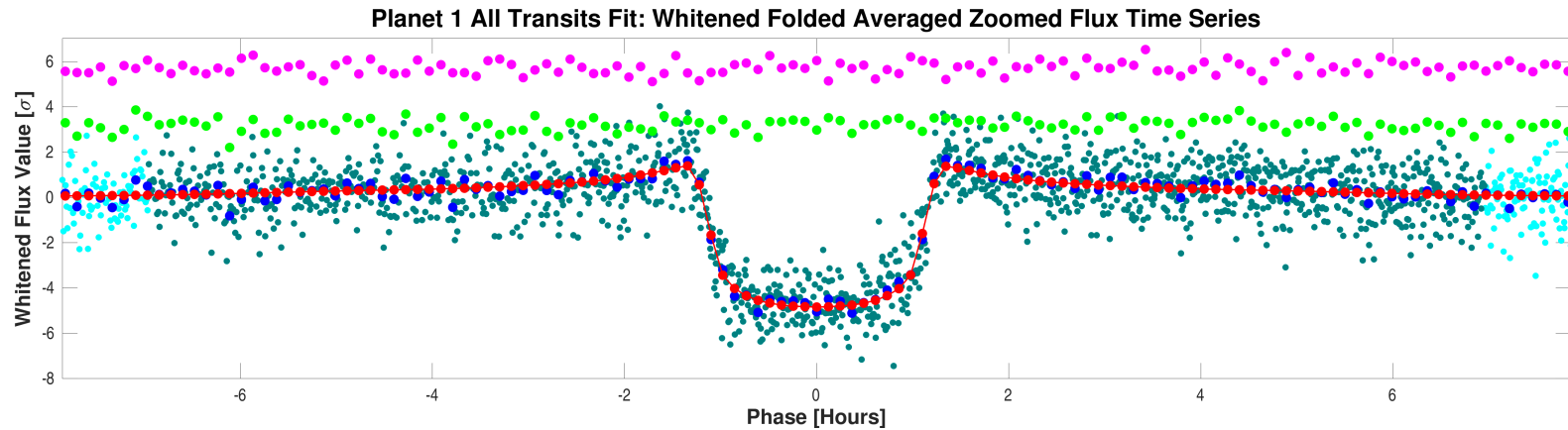
Flux time series for CatId 21744120, Planet candidate 1 in the unwhitened domain. For the data of Sector-25/TargetTableId-245, start BJD is 2458983. Transit event markers indicate the location of transits of the given planet candidate. All transits fit completed with full convergence.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/000000021744120-01-all-unwhitened-25-245.fig`



Folded flux time series for CatId 21744120, 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/000000021744120-01-all-whitened.fig`



Folded flux time series for CatId 21744120, 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.

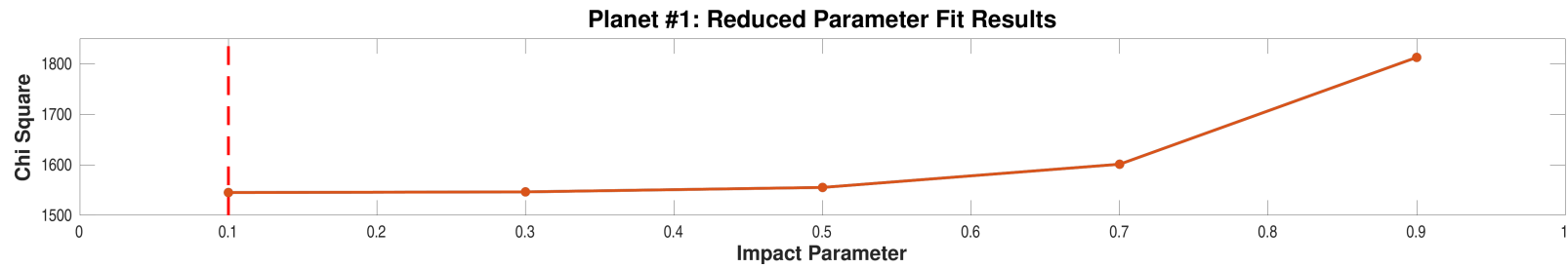
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/000000021744120-01-all-whitened-zoomed.fig`

## 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	74.0	1545.0	0.1319898	9.4131e-04	18.1000	1.2405e-01	21270	3.0121e+02	2.6231	1.7889e-02
0.30	73.6	1546.3	0.1334882	9.5845e-04	17.3808	1.2325e-01	21299	3.0354e+02	2.6484	1.8684e-02
0.50	73.6	1555.2	0.1370296	9.9378e-04	15.8555	1.2206e-01	21375	3.0731e+02	2.7133	2.0766e-02
0.70	73.3	1601.1	0.1444612	1.0906e-03	13.2679	1.2328e-01	21554	3.2114e+02	2.8776	2.6543e-02
0.90	70.9	1812.9	0.1843872	1.7786e-03	10.0773	1.4867e-01	23441	3.8553e+02	3.2307	4.4869e-02

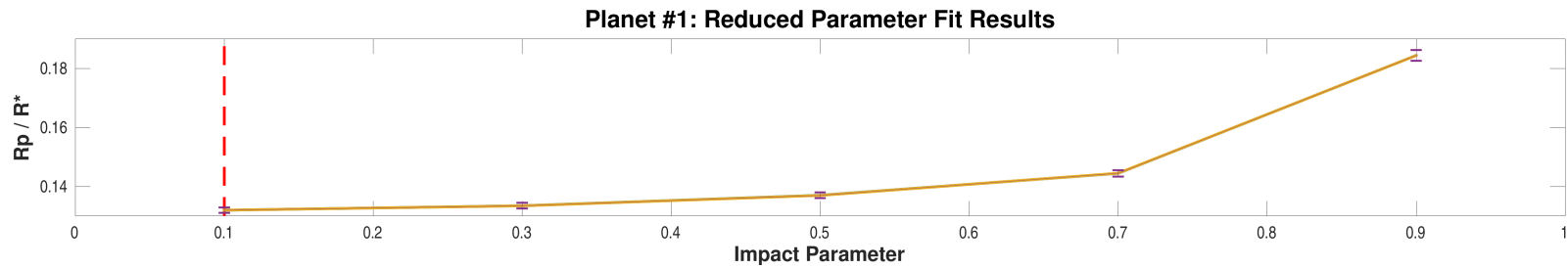
Highlighted row is the best reduced-parameter model fit.





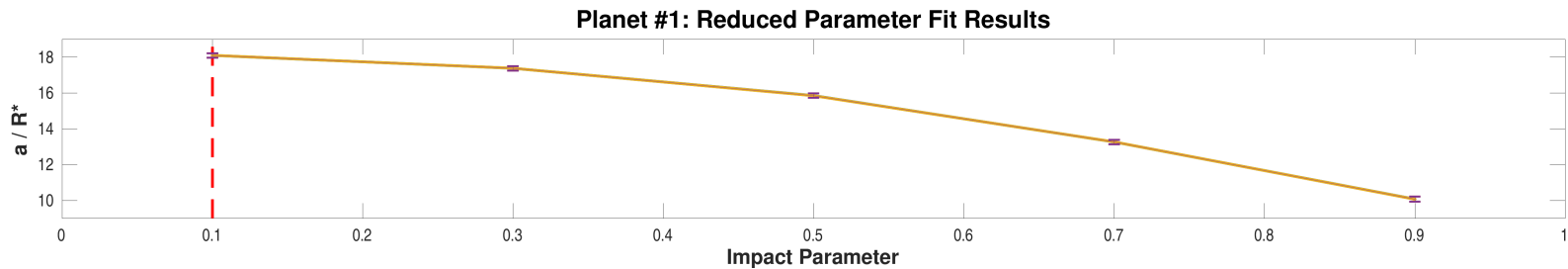
Model chi squares of reduced parameter fits vs. impact parameter for CatId 21744120, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.

Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000021744120-01-reduced-fits-chi-square.fig`



Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 21744120, 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/0000000021744120-01-reduced-fits-rp-over-rstar.fig`



Ratios of semimajor axis to star radius of reduced parameter fits vs. impact parameter for CatId 21744120, 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/0000000021744120-01-reduced-fits-a-over-rstar.fig`

### 7.3 Model Fitter: Trapezoidal Fit Results

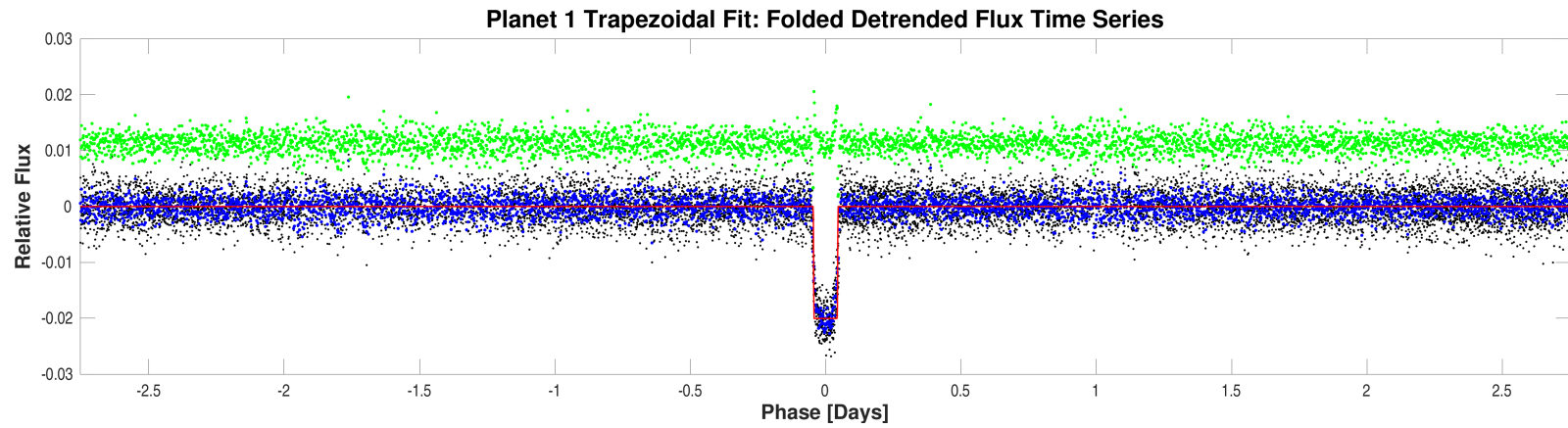
Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

TCE Parameter	Value	Units
Trial Transit Pulse Duration	2.5	hours
Transit Epoch	1983.7454613	TJD
Orbital Period	5.5069418	days
Maximum SES	38.8	
Maximum MES	61.2	
Robust Statistic	57.1	
Chi Square Goodness of Fit Statistic (DoF)	915.7 (295)	
Chi Square2 Statistic (DoF)	457.1 (266.2)	
Threshold for Desired PFA		

DoF: Degrees of Freedom

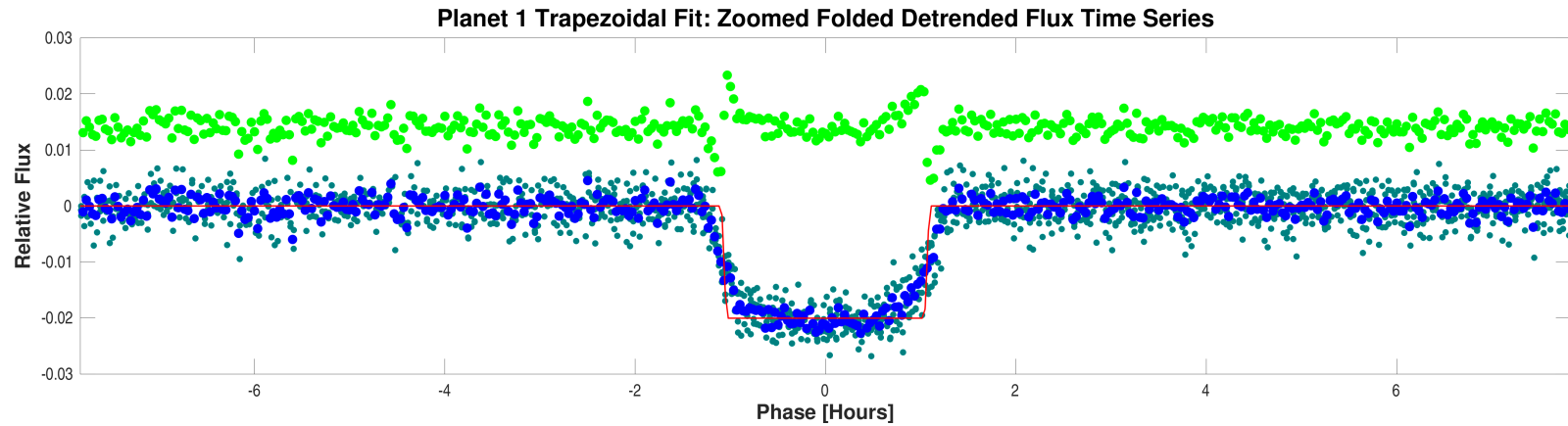
Parameter	Value	Uncertainty	Units
SNR	105.7		
Orbital Period	5.5069418		days
Transit Epoch	1983.7468084		BTJD
Transit Depth	20038		ppm
Transit Duration	2.6103		hours
Transit Ingress Duration	0.4768		hours
Model Chi Square Statistic (DoF)	12032.2 (2076)		

DoF: Degrees of Freedom



Folded detrended flux time series for CatId 21744120, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/000000021744120-01-all-trapezoidal.fig`



Zoomed folded detrended flux time series for CatId 21744120, Planet candidate 1 and folded trapezoidal model light curve.

Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/000000021744120-01-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	5.5069		days		
Transit Duration	2.5		hours		
Maximum MES	61.2				
Secondary Phase	2.4028		days		
Secondary MES	2.0				
Minimum Phase	0.76111		days		
Minimum MES	-2.4				
Median MES	0.0				
MAD MES	0.49624				
Robust Statistic	2.1				
Secondary Depth	719.5	2.8370e+02	ppm		
Geometric Albedo	11.0	4.6213e+00		2.1564	1.55
Planet Effective Temperature	2161	2.2066e+02	Kelvin	6.2416	0.00

### 7.4.2 Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	3.0473e+00	1.7456	8.09

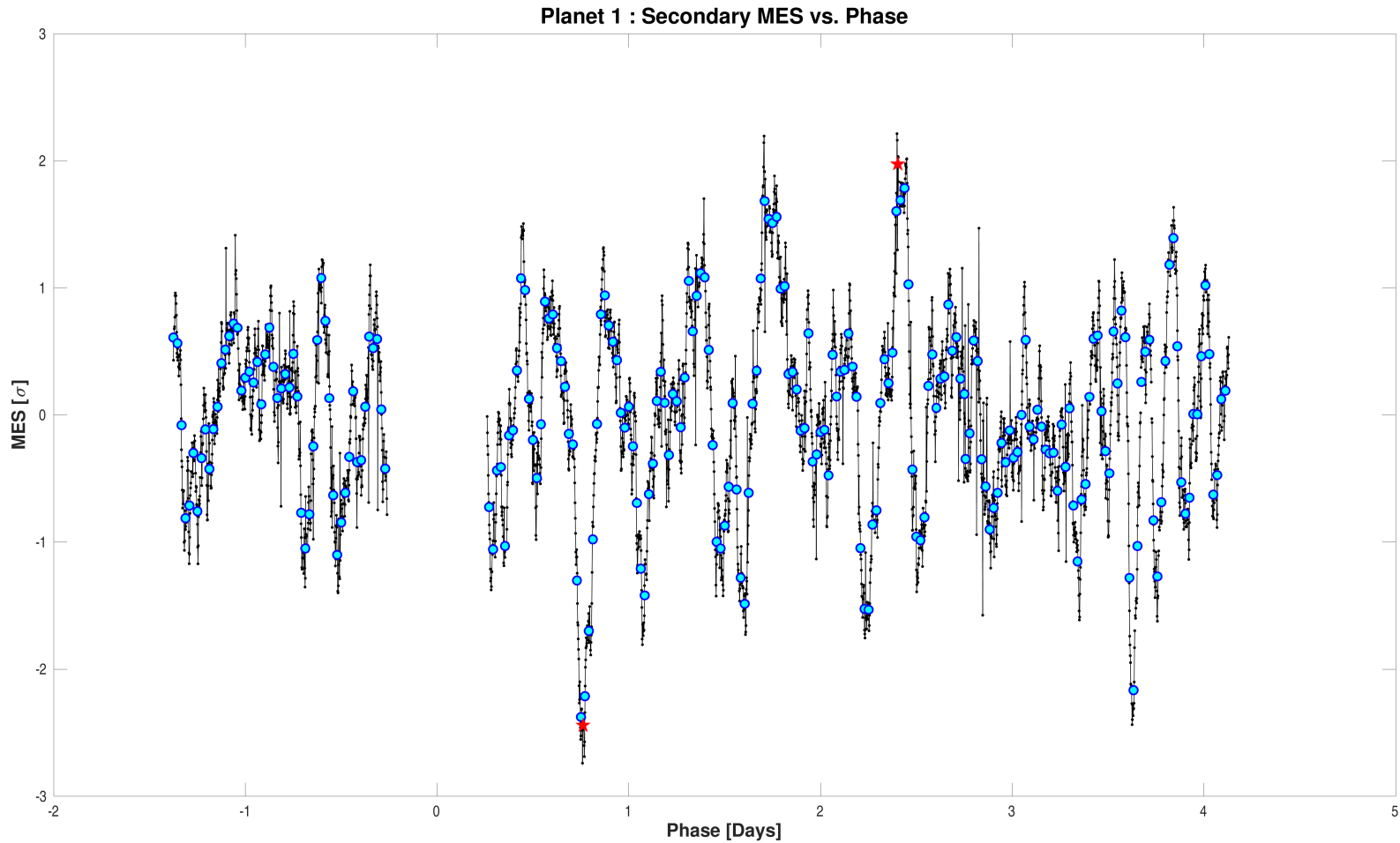
**7.4.3 Bootstrap Test**

<b>Result</b>	<b>Value</b>
False Alarm Probability	0.0000e+00
Bootstrap Threshold for Desired PFA	5.6
MES Mean	0.88
MES Standard Deviation	0.67
Transit Count	5

**7.4.4 Ghost Diagnostic Test**

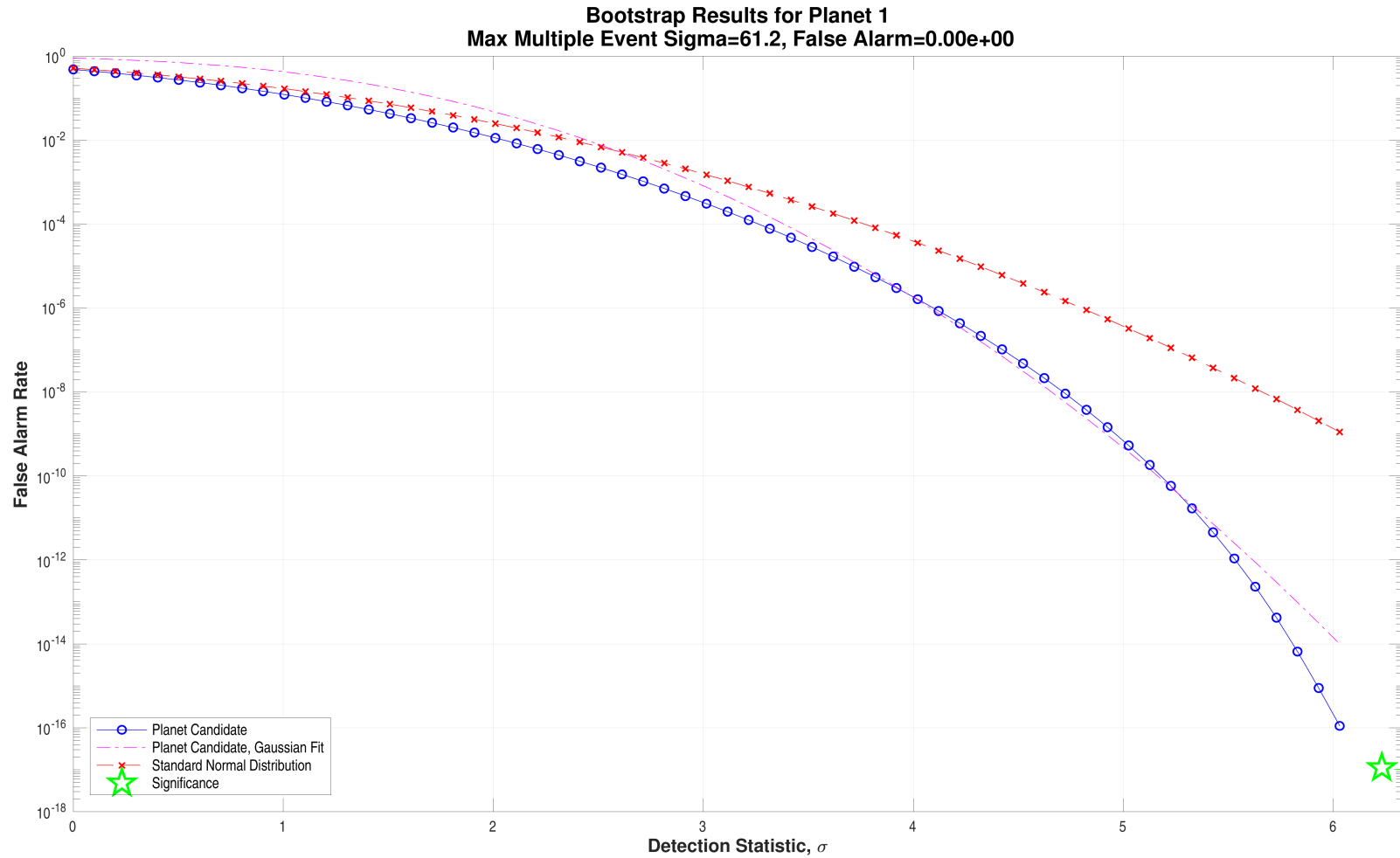
<b>Result</b>	<b>Value</b>	<b>Significance (%)</b>
Maximum MES	61.2	
SNR	70.7	
Core Aperture Statistic	5.3655e+01	100.00
Halo Aperture Statistic	1.0393e+01	100.00
Ratio of Core/Halo Aperture Statistics	5.1628e+00	

## 7.4.5 Validation Test Figures



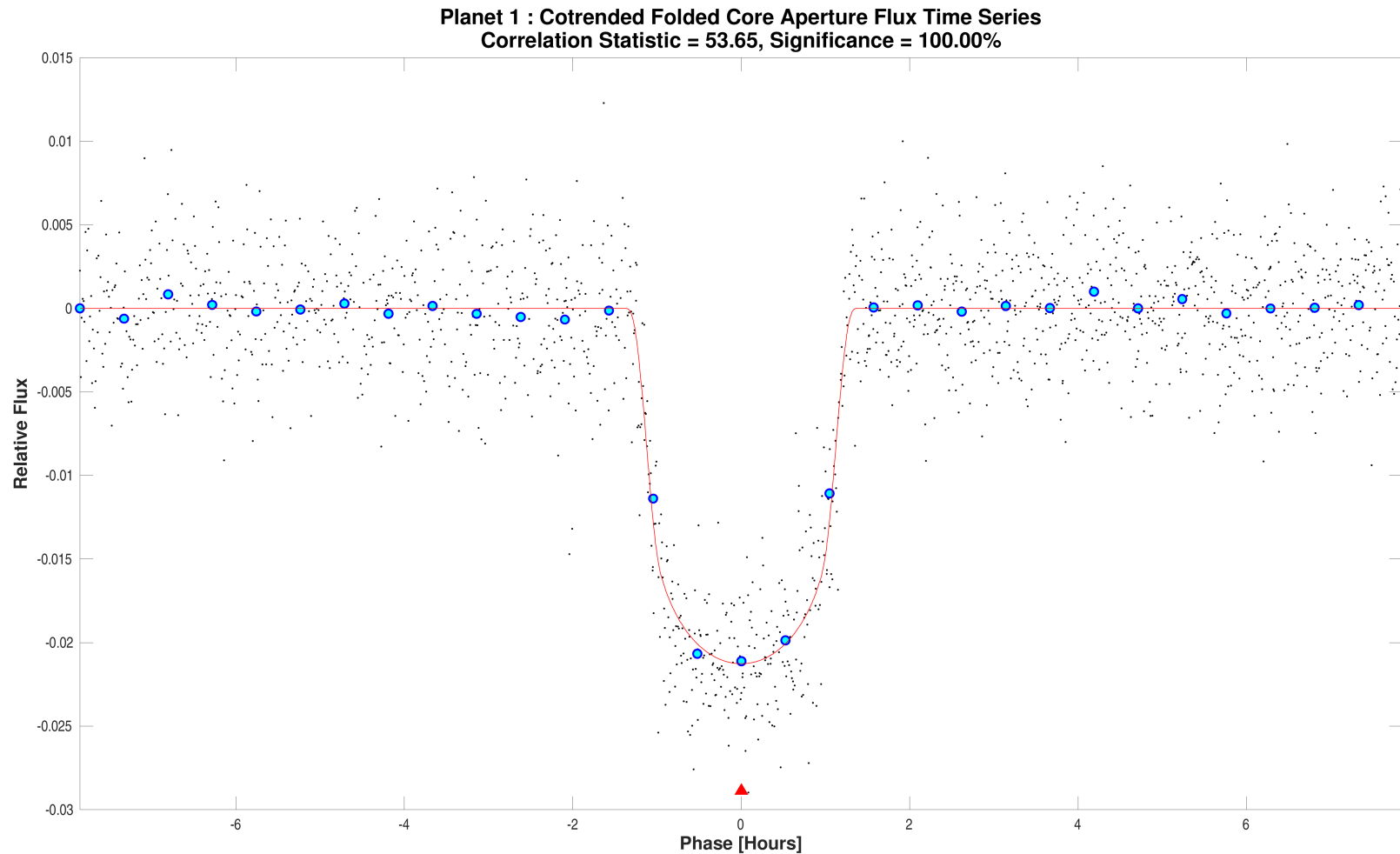
The primary event has been set to zero and both the max and min of the resulting MES vs. Phase are marked with a red star. The best matched pulse duration in hours is 2.5. The maximum secondary MES and corresponding phase are 1.9764 and 2.4028 days respectively. The minimum secondary MES and corresponding phase are -2.4414 and 0.76111 days respectively.

Open `./planet-01/report-summary/0000000021744120-01-weak-secondary-diagnostic.fig`



Bootstrap results for target 21744120, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is Inf. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 5.5819.

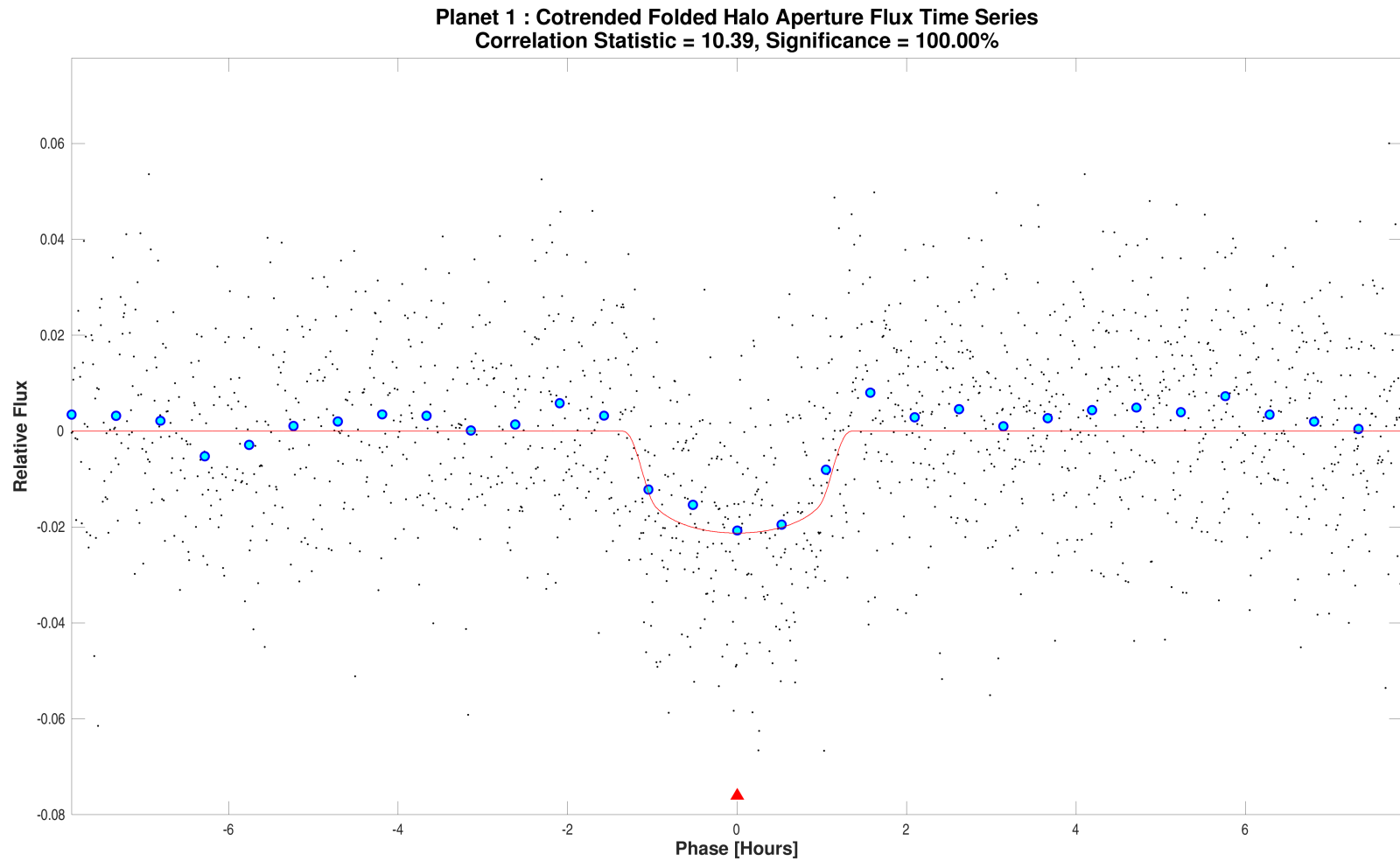
Open `./planet-01/bootstrap-results/0000000021744120-01-bootstrap-false-alarm.fig`



Optical ghost diagnostic core aperture flux time series for target 21744120, 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/0000000021744120-01-core-unwhitened-cotrended-zoomed-model.fig`



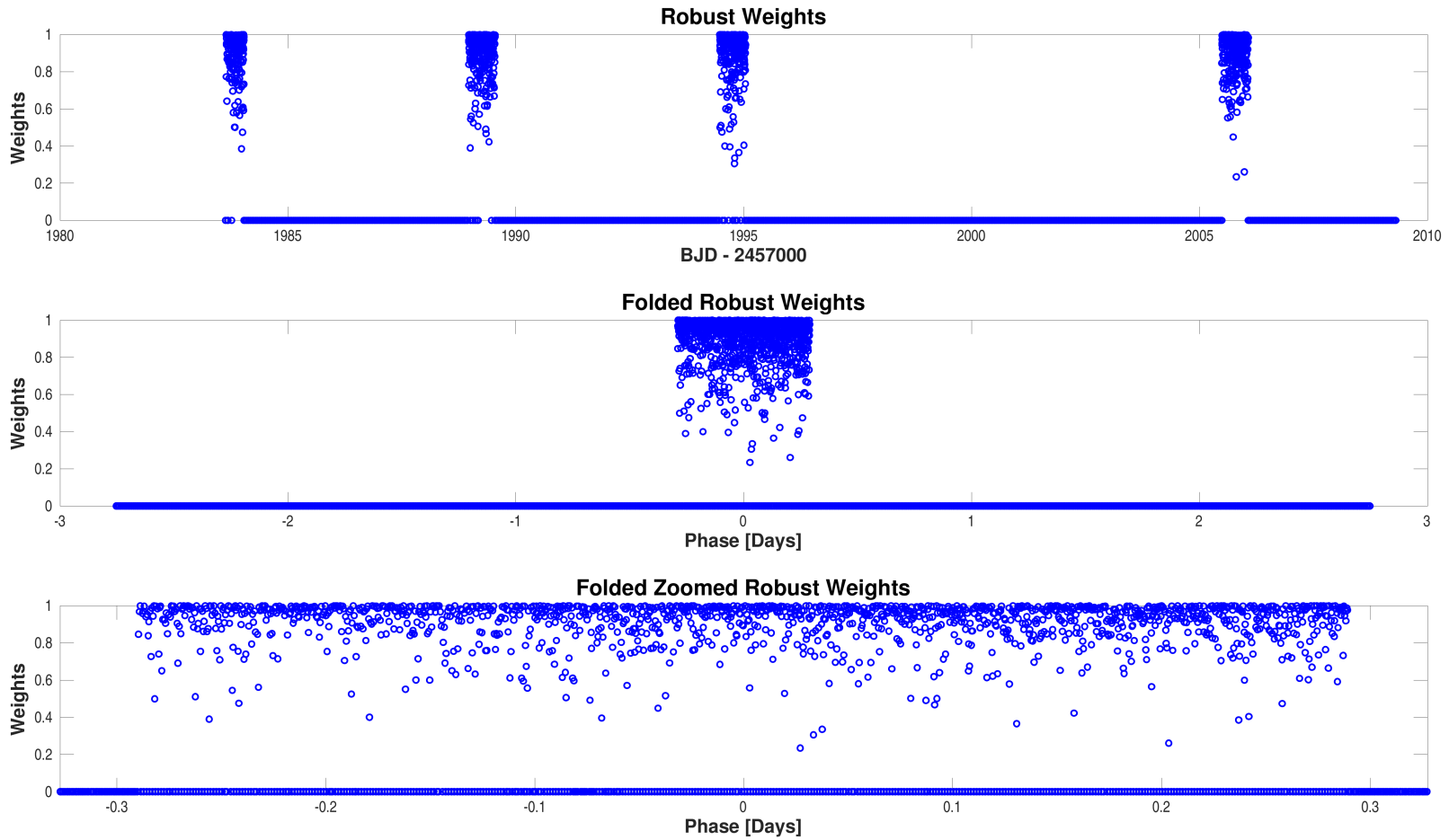


Optical ghost diagnostic halo aperture flux time series for target 21744120, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft 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/0000000021744120-01-halo-unwhitened-cotrended-zoomed-model.fig`

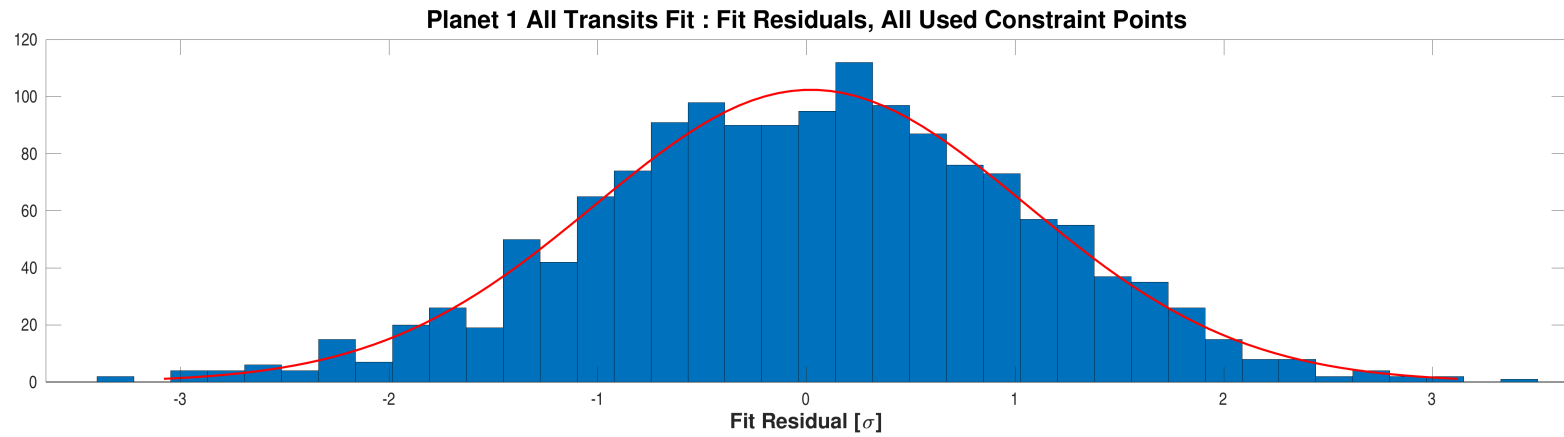
## Appendix A Planet Candidate 1

### A.1 Model Fitter: All Transits



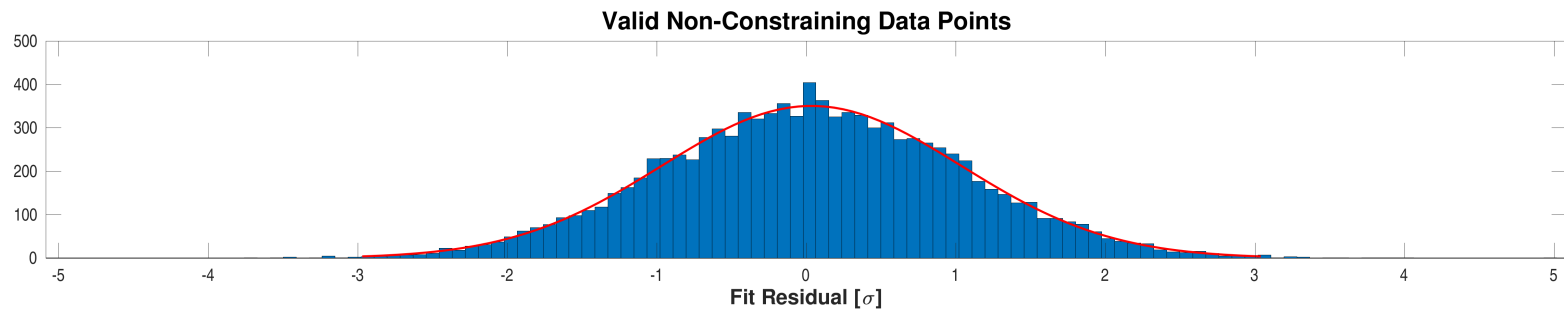
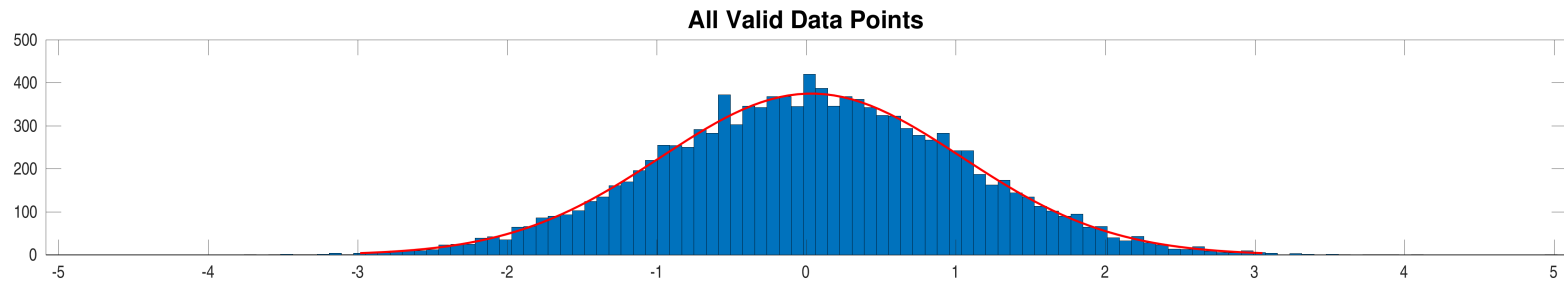
Robust weights distribution for CatId 21744120, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000021744120-01-all-robust-weights.fig`



Fit residuals distribution for CatId 21744120, 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/000000021744120-01-all-histo-used.fig`



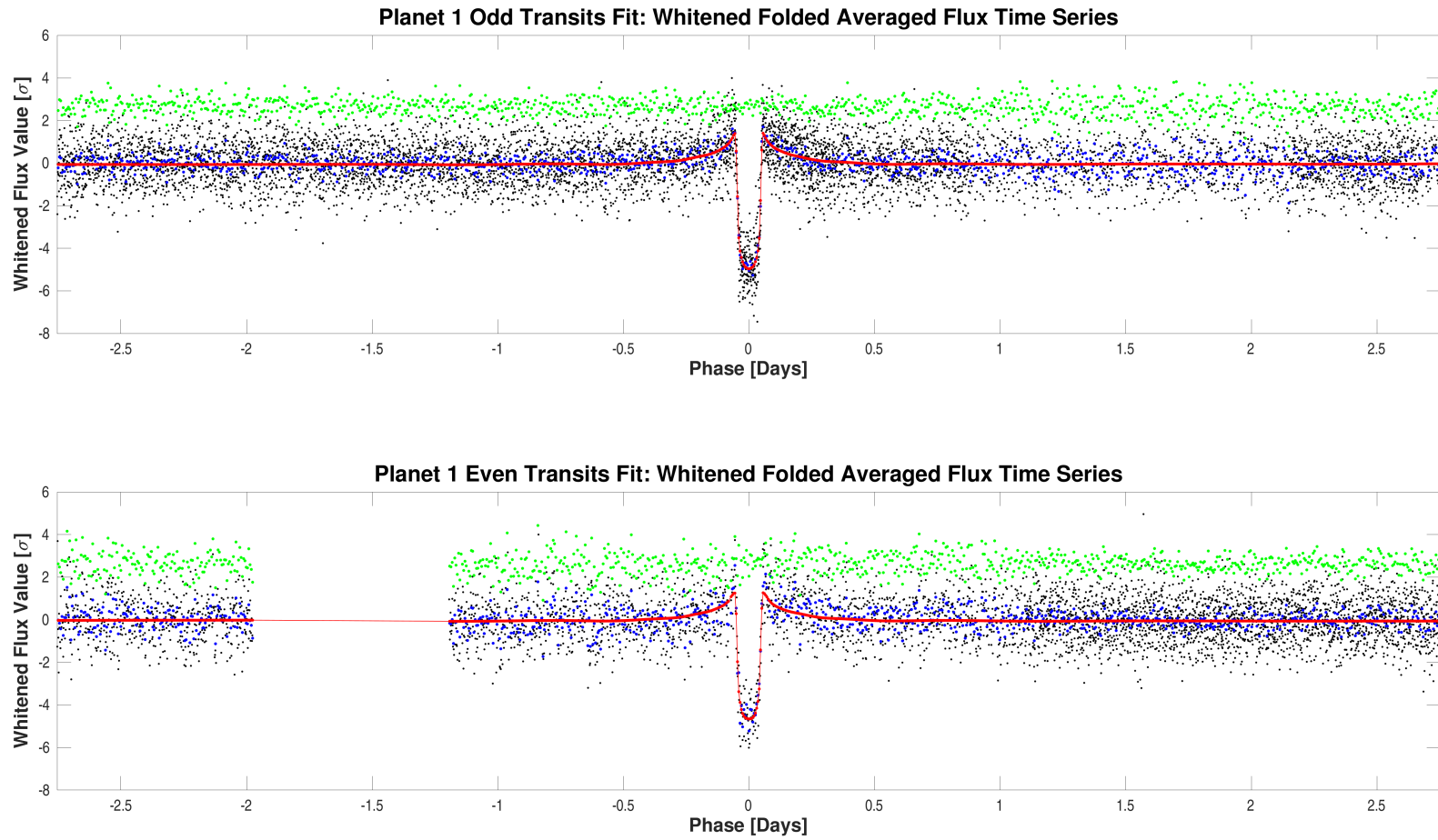
Fit residuals distribution for CatId 21744120, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.

Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/000000021744120-01-all-histo-all-and-unused.fig`

## A.2 Model Fitter: Odd &amp; Even Transits

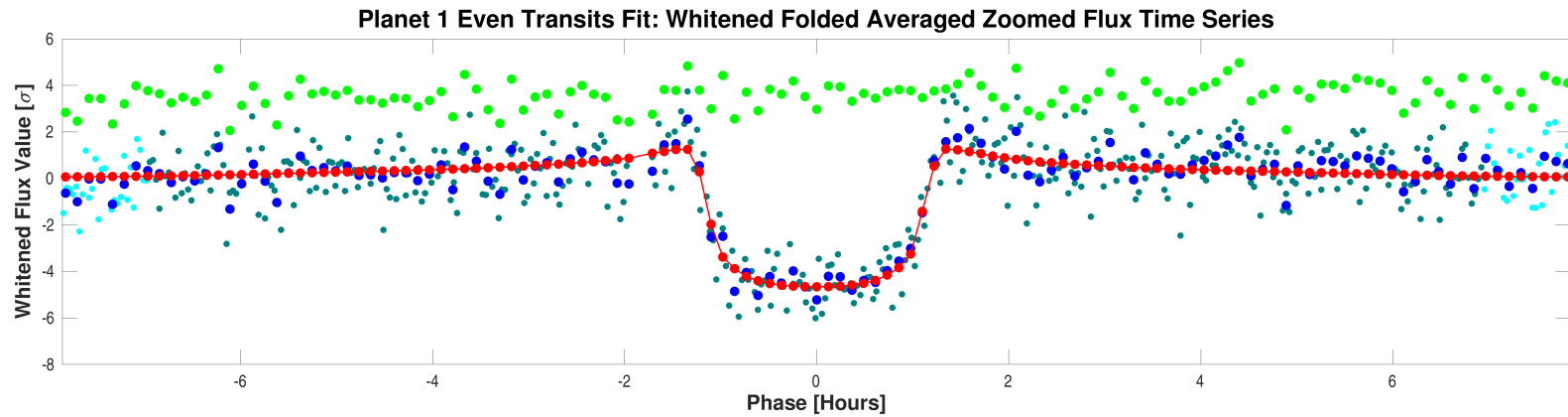
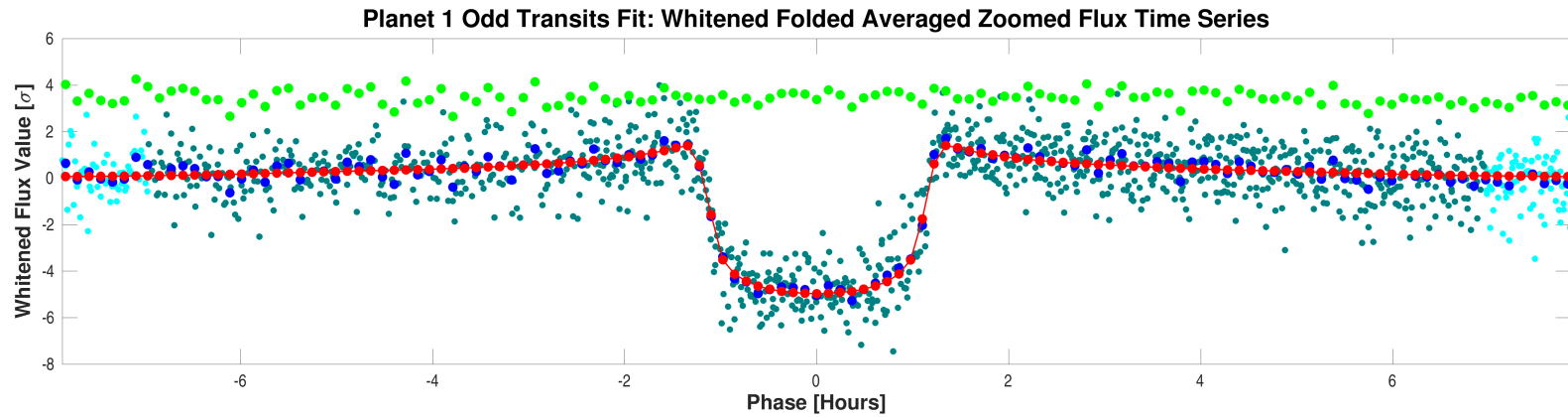
Parameter	Odd Transits Value	Odd Transits Uncertainty	Even Transits Value	Even Transits Uncertainty	Units	$\frac{\text{Difference}}{\ \text{Uncertainty}\ }$
SNR	62.4		34.5			
Orbital Period	5.5080378	2.1456e-04	5.5080357	0.0000e+00	days	9.7148e-03
Transit Epoch	1983.7453163	5.7015e-04	1989.2528772	6.6628e-04	BTJD	5.4986e-01
Impact Parameter	0.0477	1.6626e+00	0.0100	1.6578e+01		2.2639e-03
Planet Radius to Star Radius Ratio	0.1329898	3.0312e-03	0.1290090	6.0018e-03		5.9205e-01
Semi-major Axis to Star Radius Ratio	18.2007	1.4287e+00	18.0788	2.9487e+00		3.7187e-02
Planet Radius	10.7453	7.6156e-01	10.4237	8.5117e-01	Earth radii	2.8162e-01
Semi-major Axis	0.0560	4.5570e-03	0.0560	4.5570e-03	AU	2.1942e-06
Effective Stellar Flux	82.2413	1.4265e+01	82.2413	1.4265e+01	Goldilocks	2.0570e-06
Equilibrium Temperature	768	3.3305e+01	768	3.3305e+01	Kelvin	2.0570e-06
Stellar Density	2.6700	6.2876e-01	2.6167	1.2804e+00	Solar density	3.7340e-02
Transit Depth	21635	3.6292e+02	20373	6.2524e+02	ppm	1.7456e+00
Transit Duration	2.6187	5.3761e-02	2.6294	1.0704e-01	hours	8.8669e-02
Transit Ingress Duration	0.3083	5.5752e-02	0.3007	1.1310e-01	hours	5.9801e-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)	1208.1 (1366.0)		1208.1 (1366.0)			

DoF: Degrees of Freedom



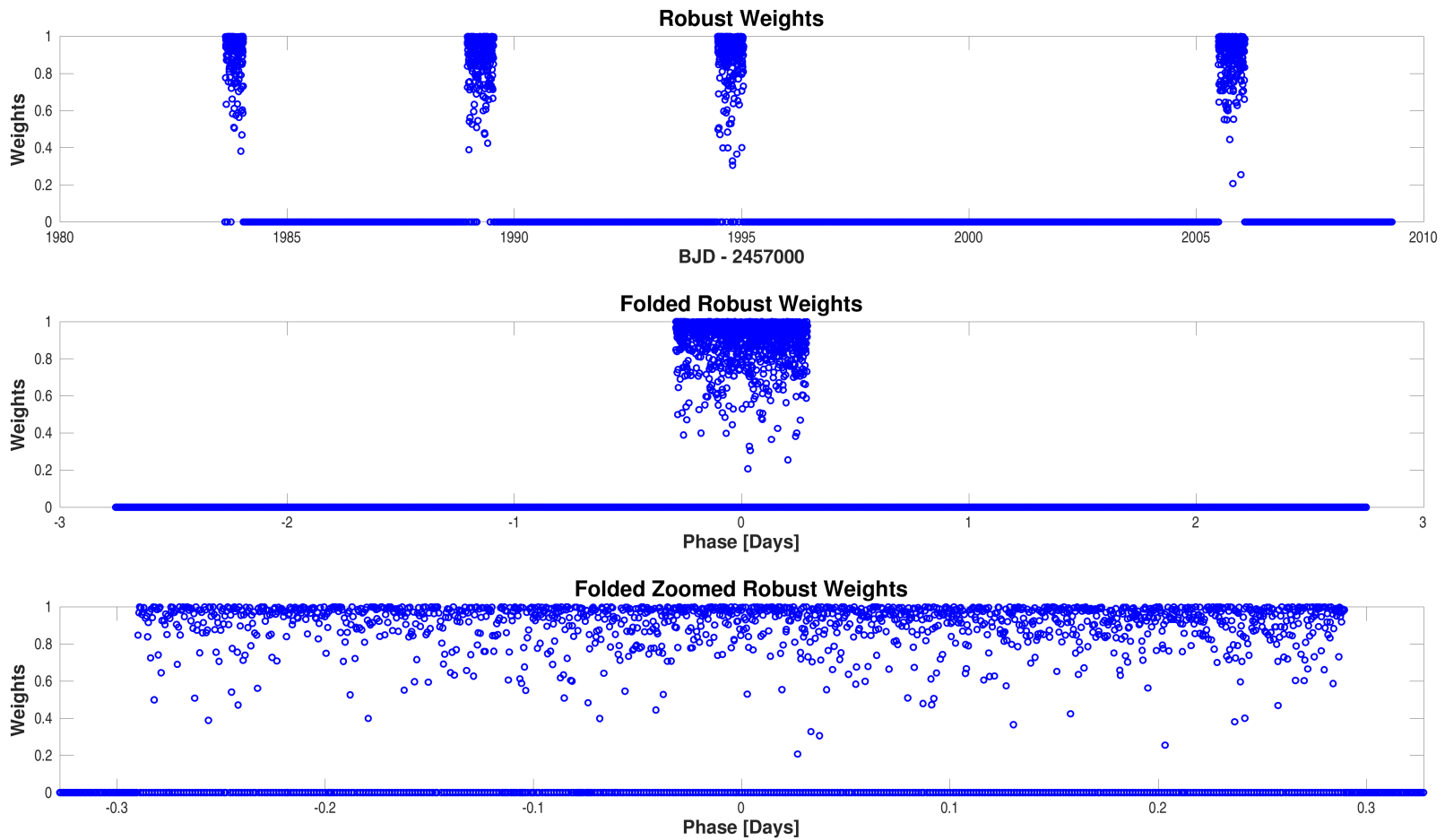
Folded flux time series for CatId 21744120, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light 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/0000000021744120-01-odd-even-whitened.fig`



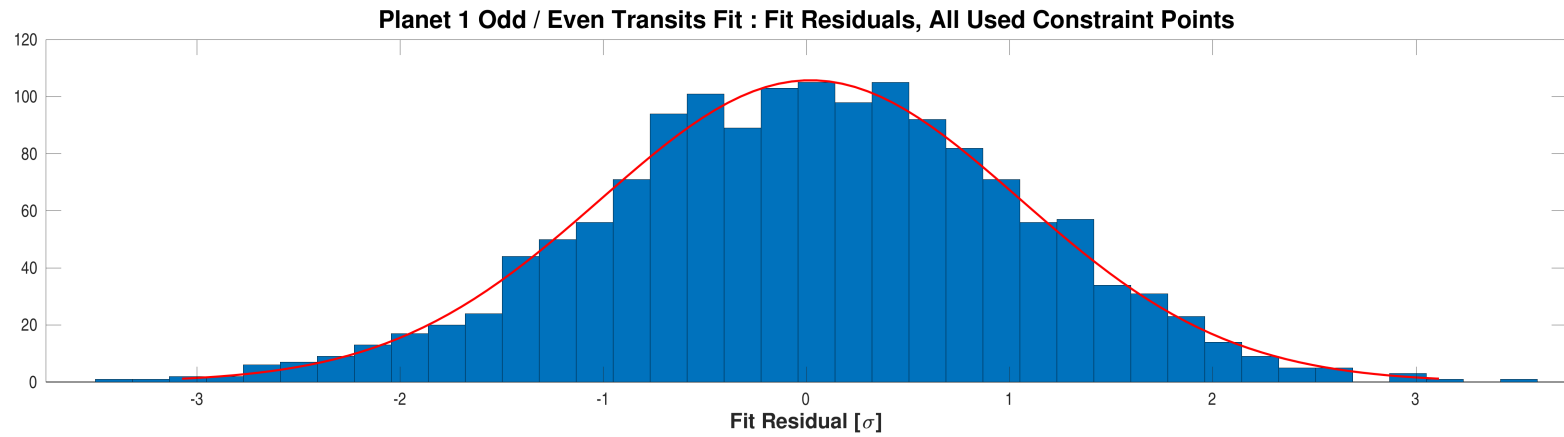
Folded flux time series for CatId 21744120, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged 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/0000000021744120-01-odd-even-whitened-zoomed.fig`



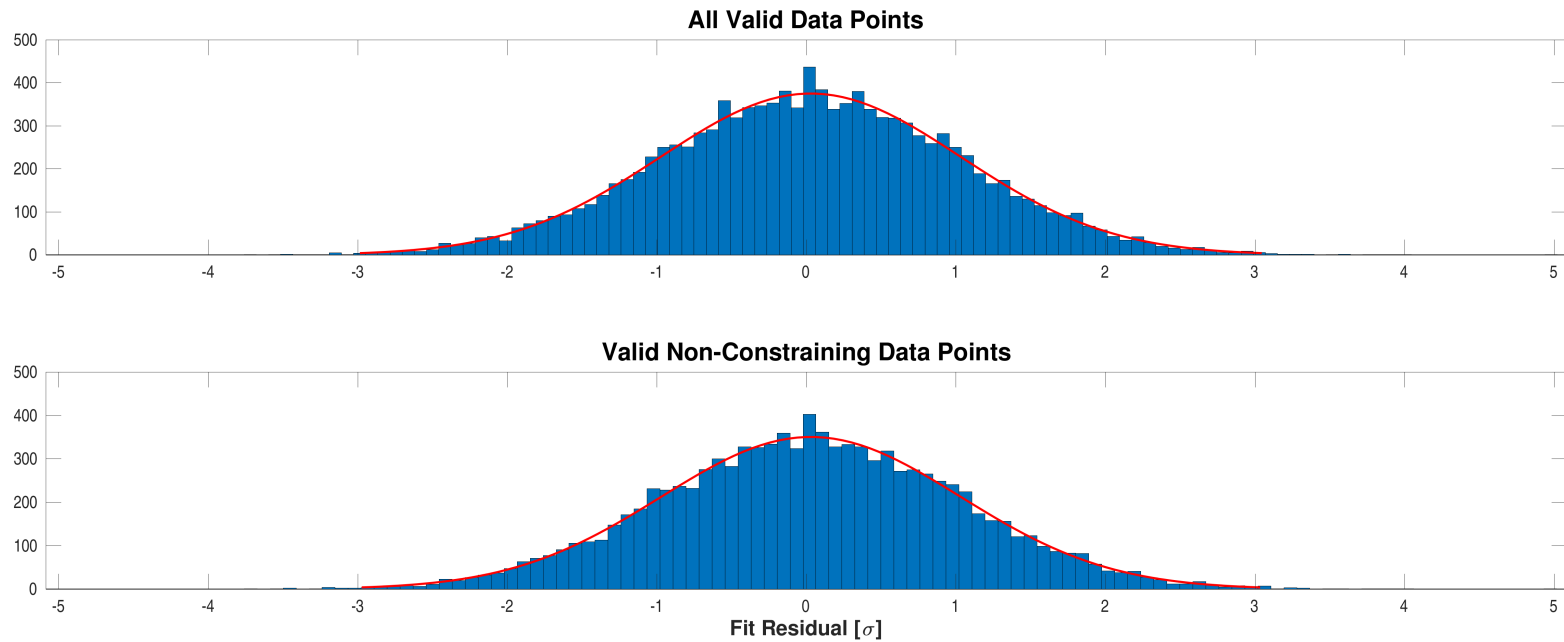
Robust weights distribution for CatId 21744120, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000021744120-01-odd-even-robust-weights.fig`



Fit residuals distribution for CatId 21744120, 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/0000000021744120-01-odd-even-histo-used.fig`

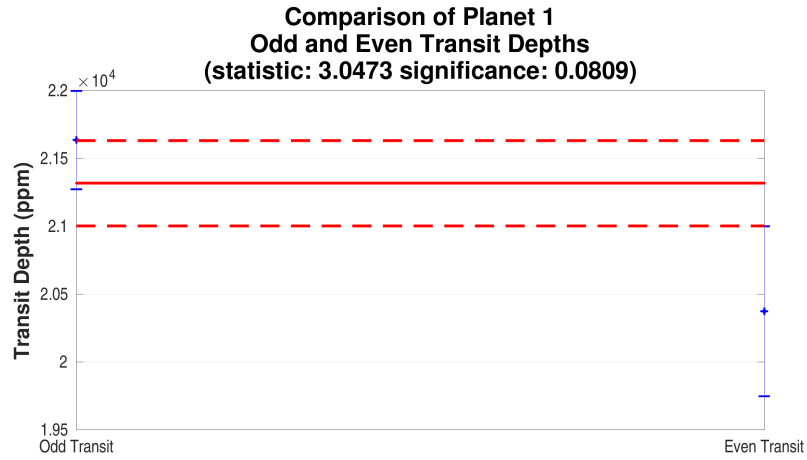


Fit residuals distribution for CatId 21744120, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.

Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000021744120-01-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 21744120, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary. Open `./planet-01/binary-discrimination-test-results/0000000021744120-01-eclipsing-binary-discrimination-tests.fig`

## Appendix B Alerts

This target did not trigger any alerts.