

# KIC 004770174

## Q1-17 DR25 TCE Parameters

TCE	Run Type	KOI?	Period (Days)	Epoch (BKJD)	Depth (ppm)	Duration (Hours)	MES	SNR	$R_{\star}$ ( $R_{\odot}$ )	$T_{\star}$ (K)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004770174-01	OBS	2971.01	6.095983	134.590304	64.3	6.026	14.3	15.0	1.47	6313	1.58	594.38
004770174-02	OBS	2971.02	31.953341	159.659139	101.3	8.415	8.7	9.6	1.47	6313	1.64	65.28

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004770174-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
004770174-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT

**Notes:** OBS = Observed. INJ = Injected. INV = Inverted. SCR = Scrambled.

N = Not Transit-Like. S = Stellar Eclipse. C = Centroid Offset. E = Ephemeris Match.

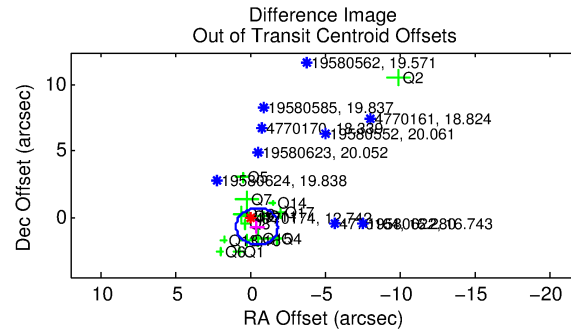
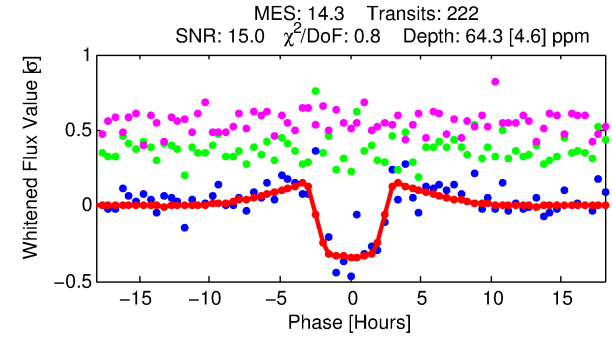
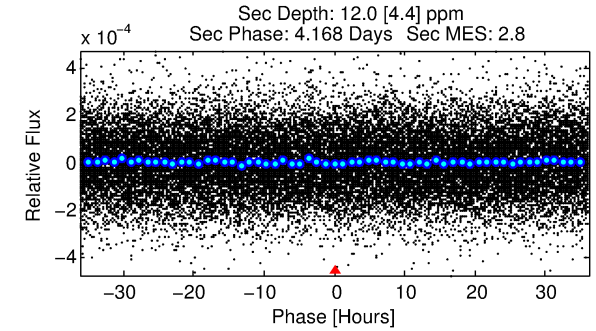
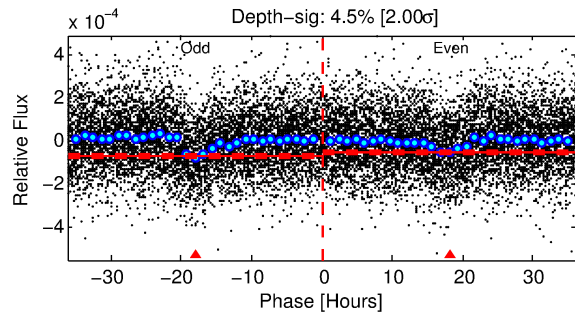
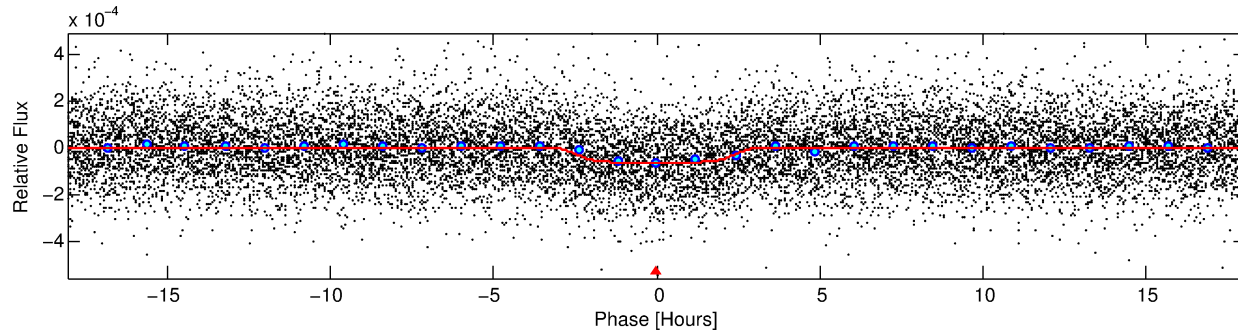
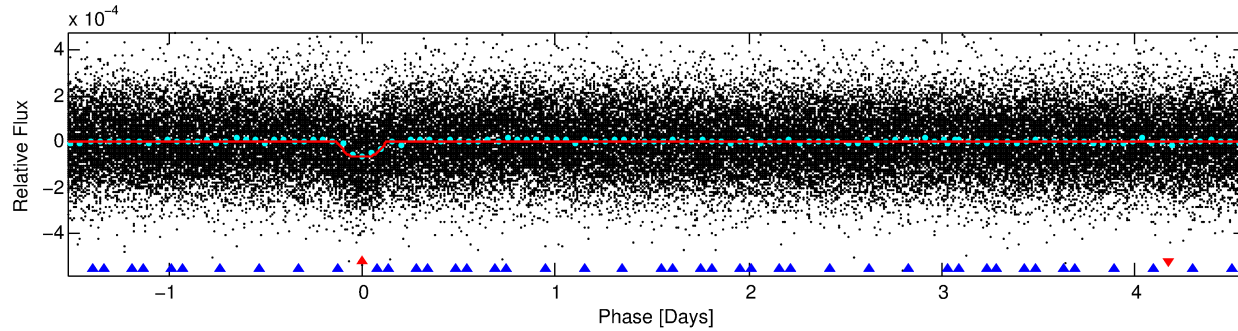
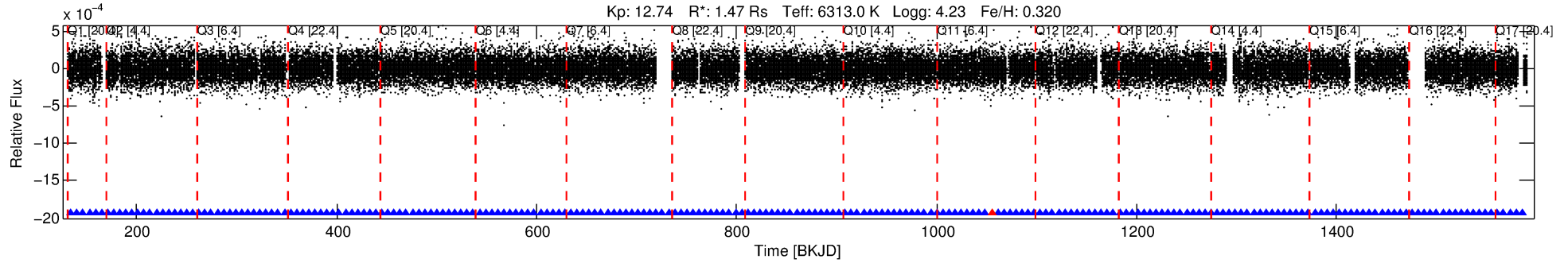
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 004770174-01

No Significant Match Found

# DV One-Page Summary

KIC: 4770174 Candidate: 1 of 2 Period: 6.096 d  
KOI: K02971.01 Corr: 0.931



## DV Fit Results:

Period = 6.09598 [0.00005] d  
Epoch = 134.5903 [0.0061] BKJD  
Rp/R\* = 0.0099 [0.0005]  
a/R\* = 2.14 [0.30]  
b = 0.98 [0.01]  
Seff = 594.38 [144.40]  
Teq = 1259 [76] K  
Rp = 1.58 [0.29] Re  
a = 0.0718 [0.0109] AU  
Ag = 13.54 [5.98] [2.10 $\sigma$ ]  
Teffp = 3734 [363] K [6.67 $\sigma$ ]

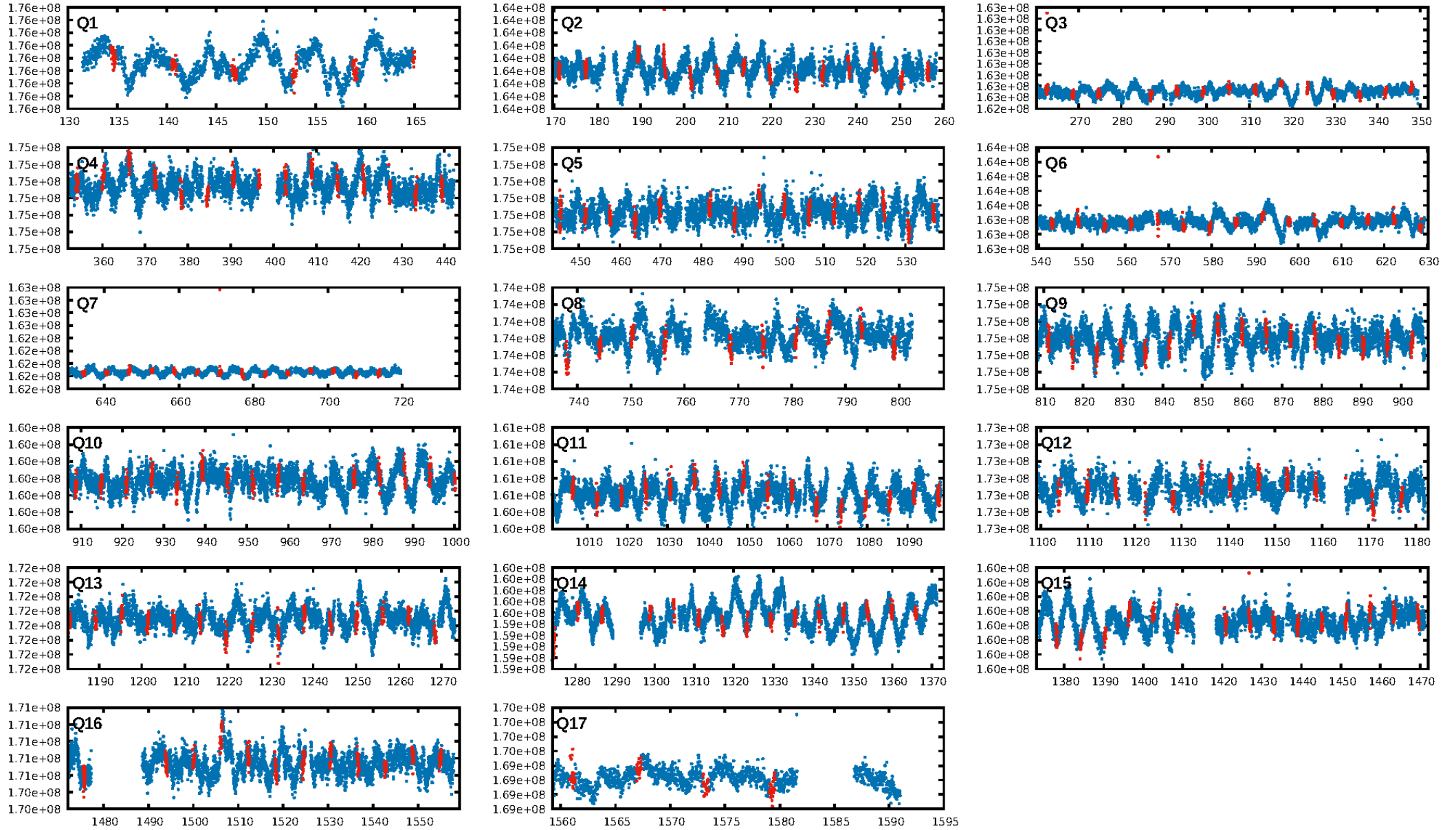
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [59.96 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 2.10e-46  
RollingBand-fgt: 1.00 [211/212]  
GhostDiagnostic-chr: 2.572  
Centroid-sig: 29.4%  
Centroid-so: 0.544 arcsec [0.90 $\sigma$ ]  
OotOffset-rm: 0.828 arcsec [1.77 $\sigma$ ]  
KicOffset-rm: 0.552 arcsec [1.18 $\sigma$ ]  
OotOffset-st: 4/3/3/5 [15]  
KicOffset-st: 4/3/3/5 [15]  
DiffImageQuality-fgm: 0.73 [11/15]  
DiffImageOverlap-fno: 1.00 [17/17]

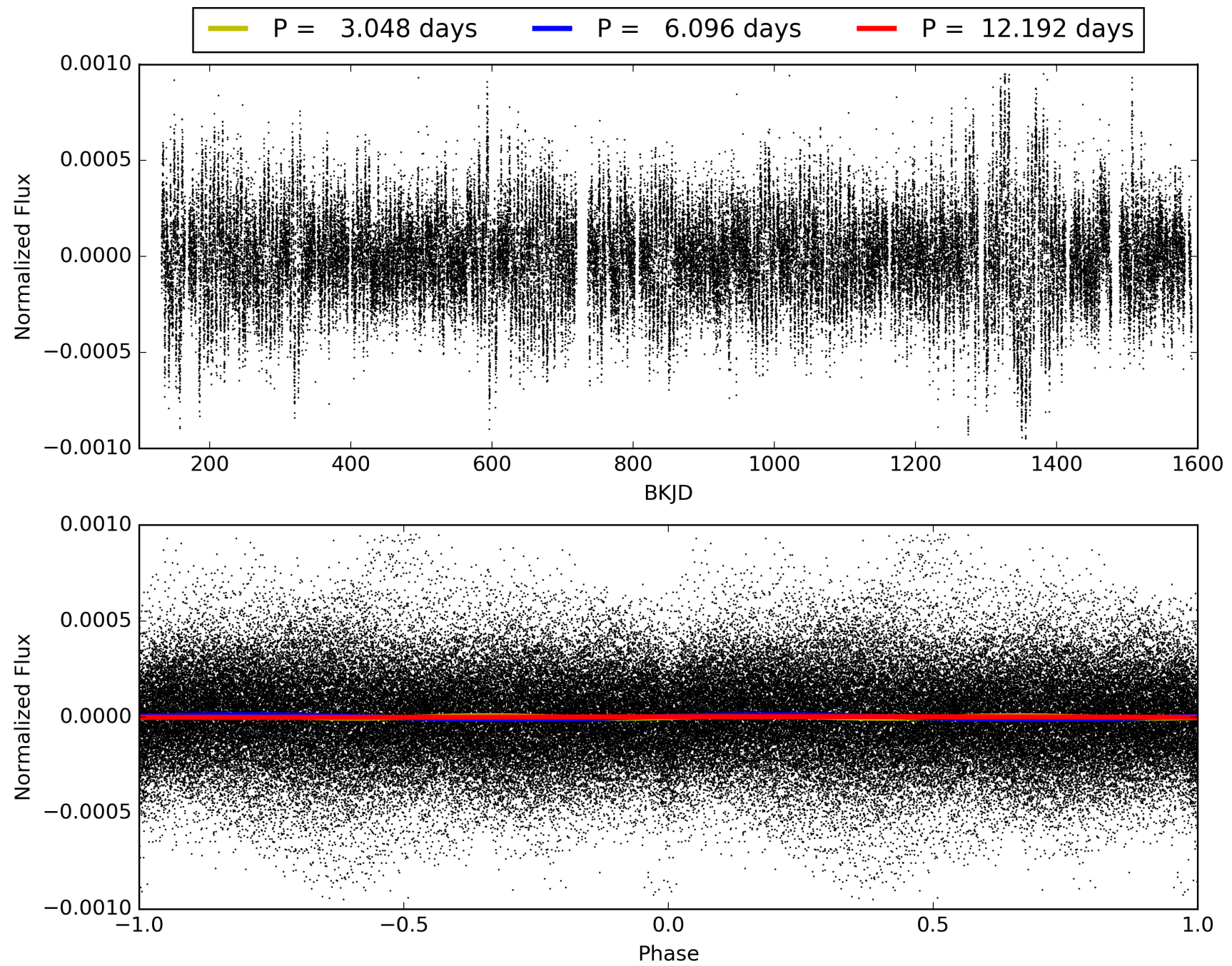
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 11:07:42 Z

This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 004770174-01, PDC Light Curves

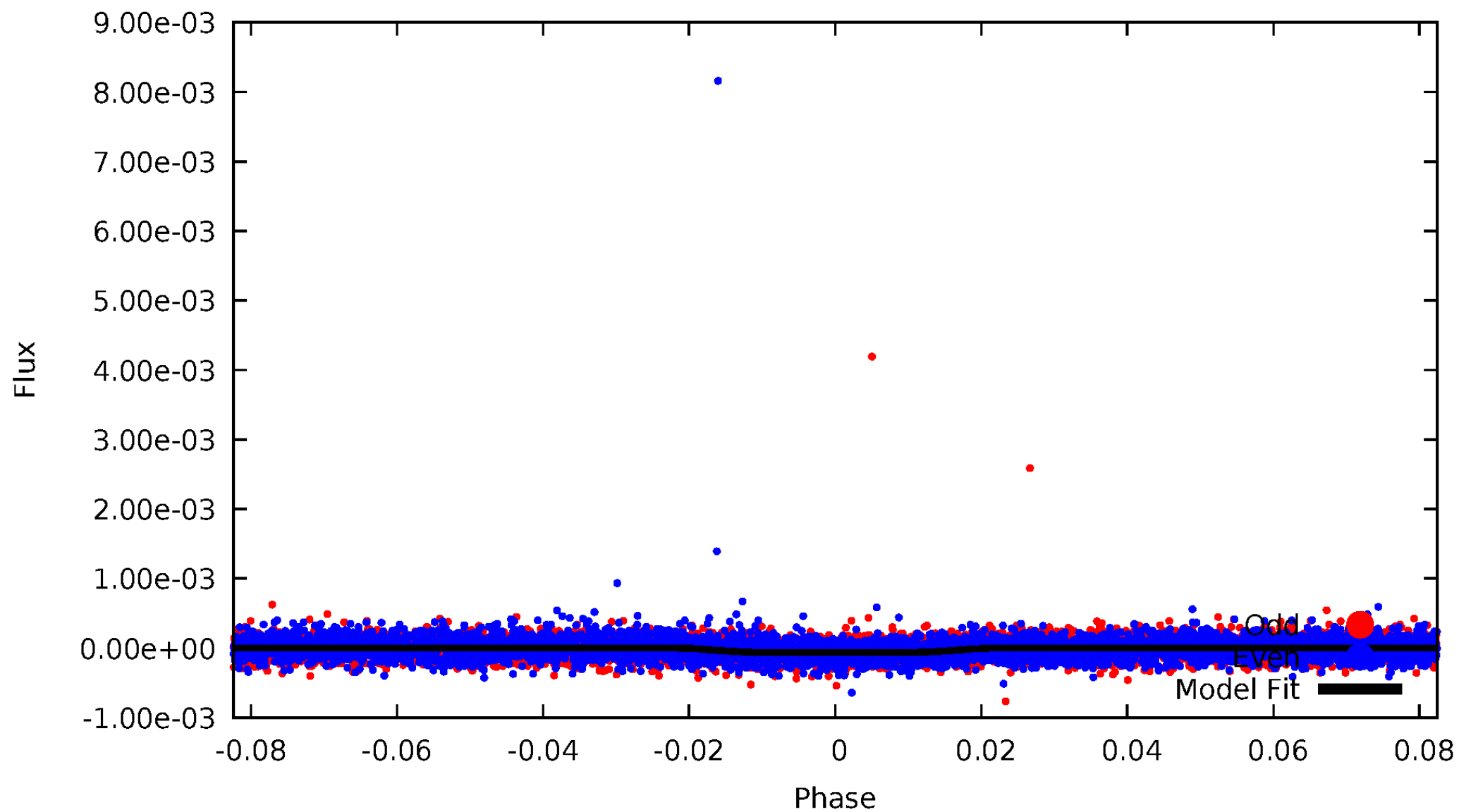


TCE 004770174-01



# DV Odd/Even

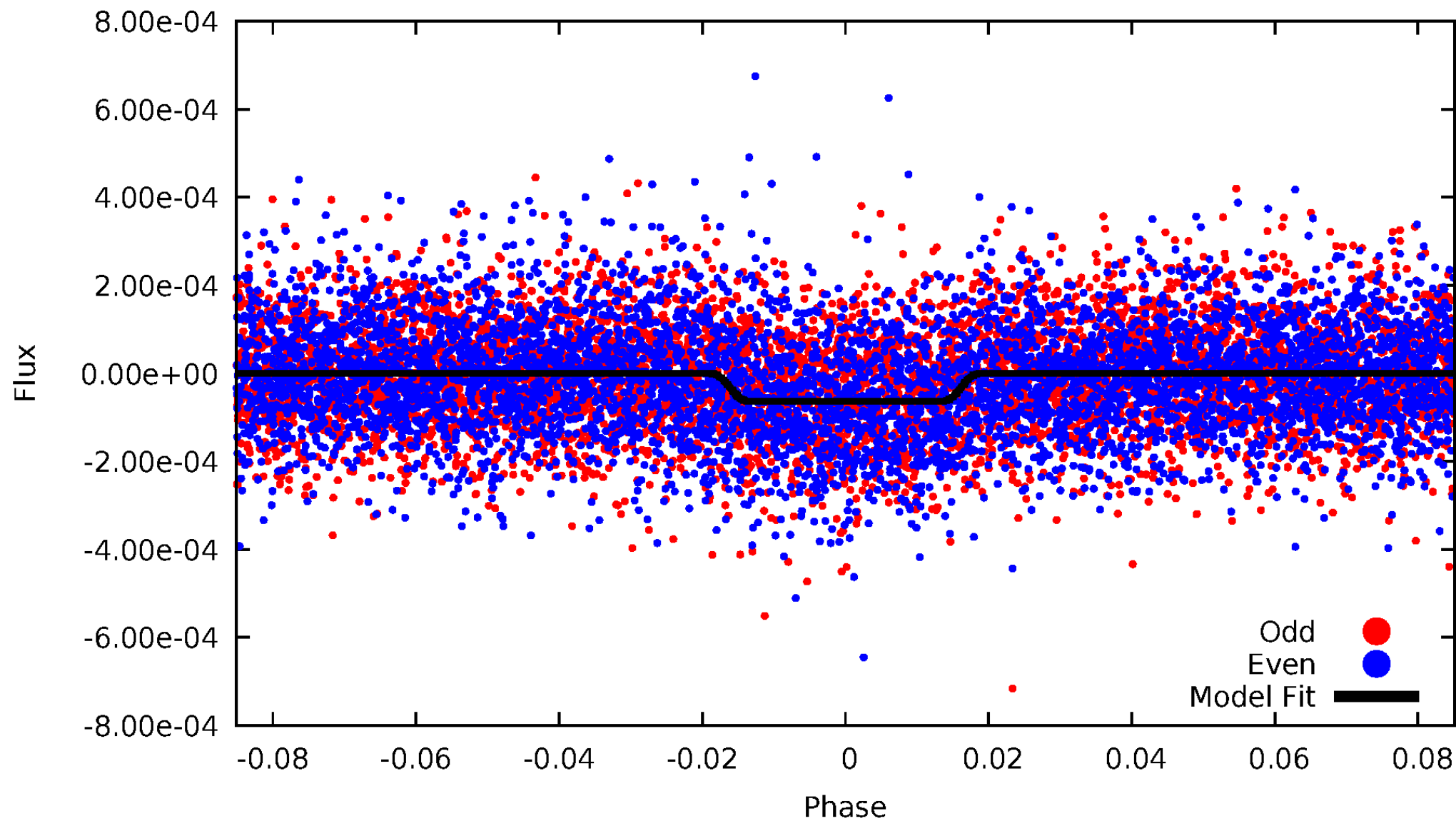
TCE 004770174-01





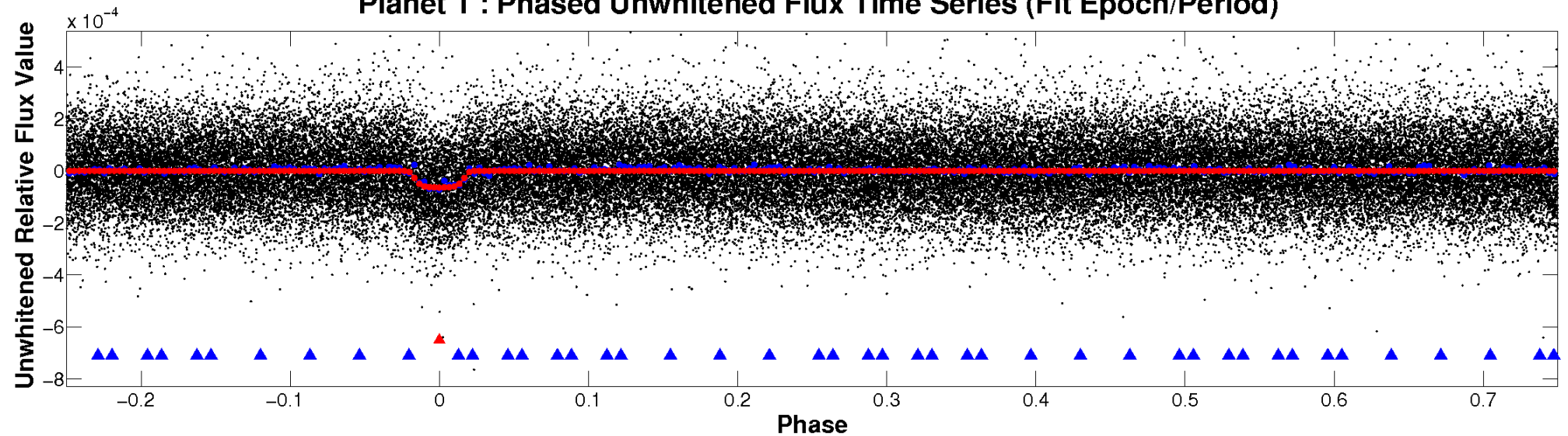
# ALT Odd/Even

TCE 004770174-01

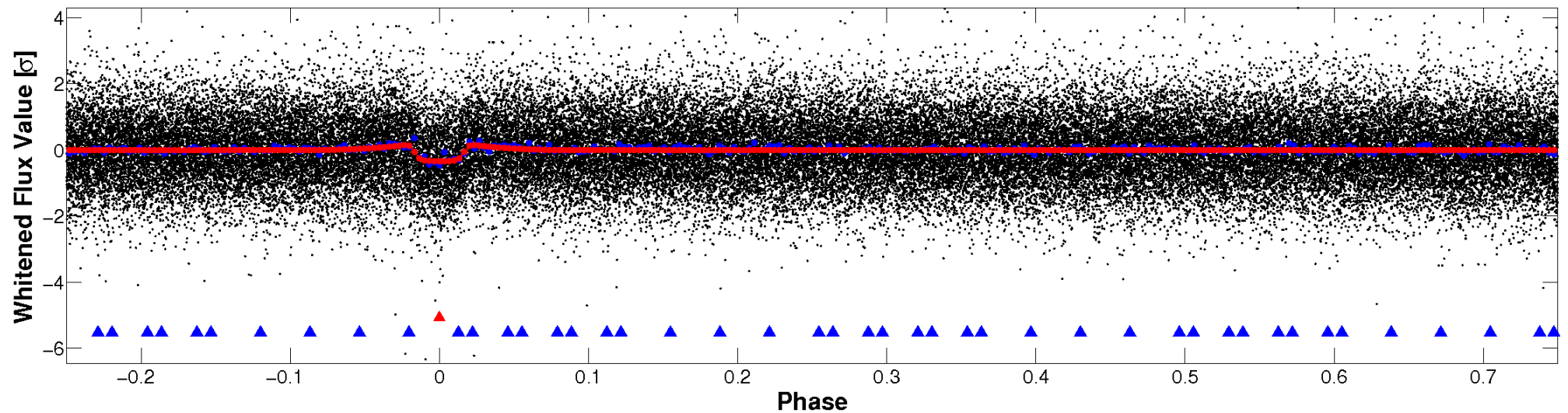


# Non-Whitened Vs. Whitened Light Curve

Planet 1 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

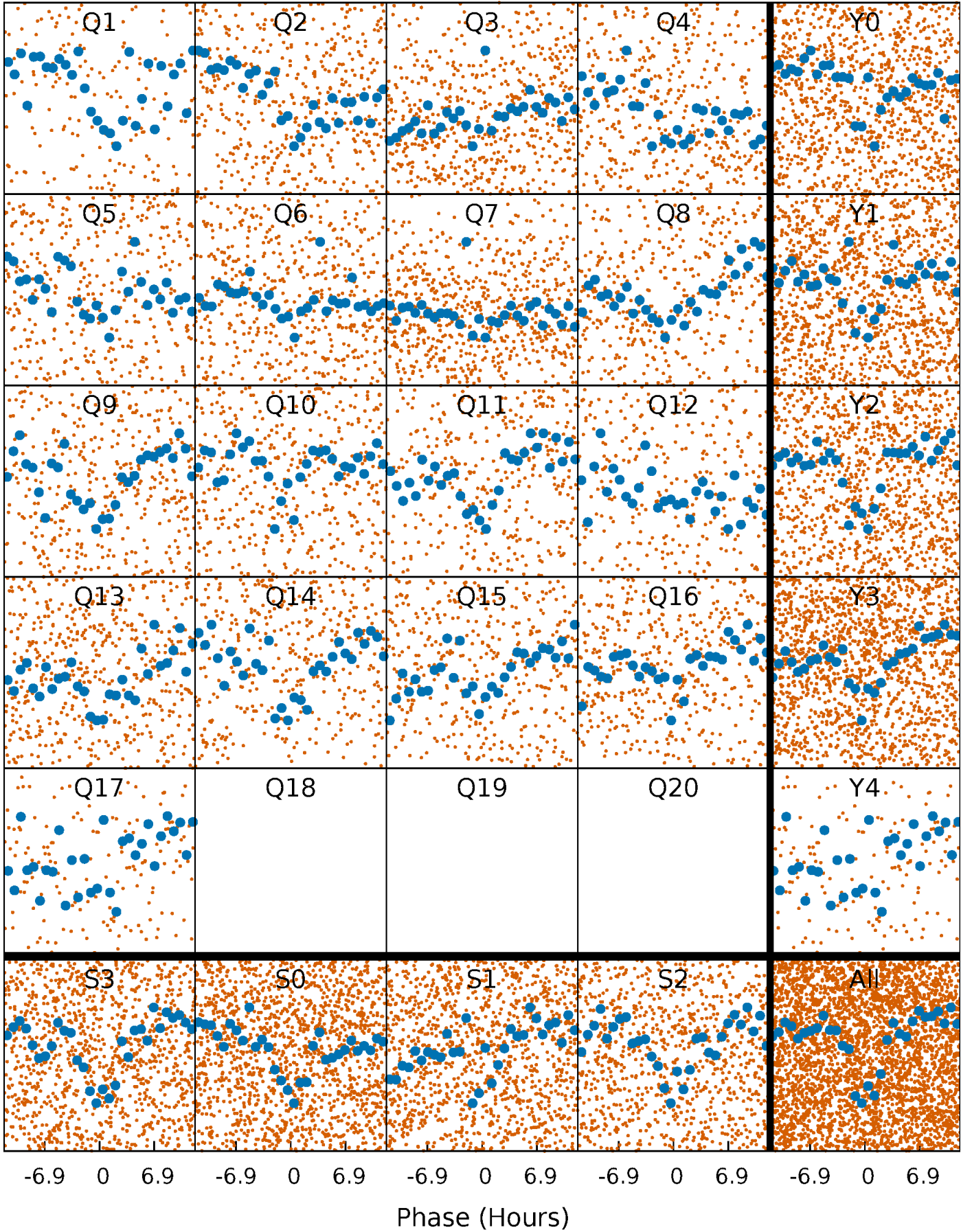


Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

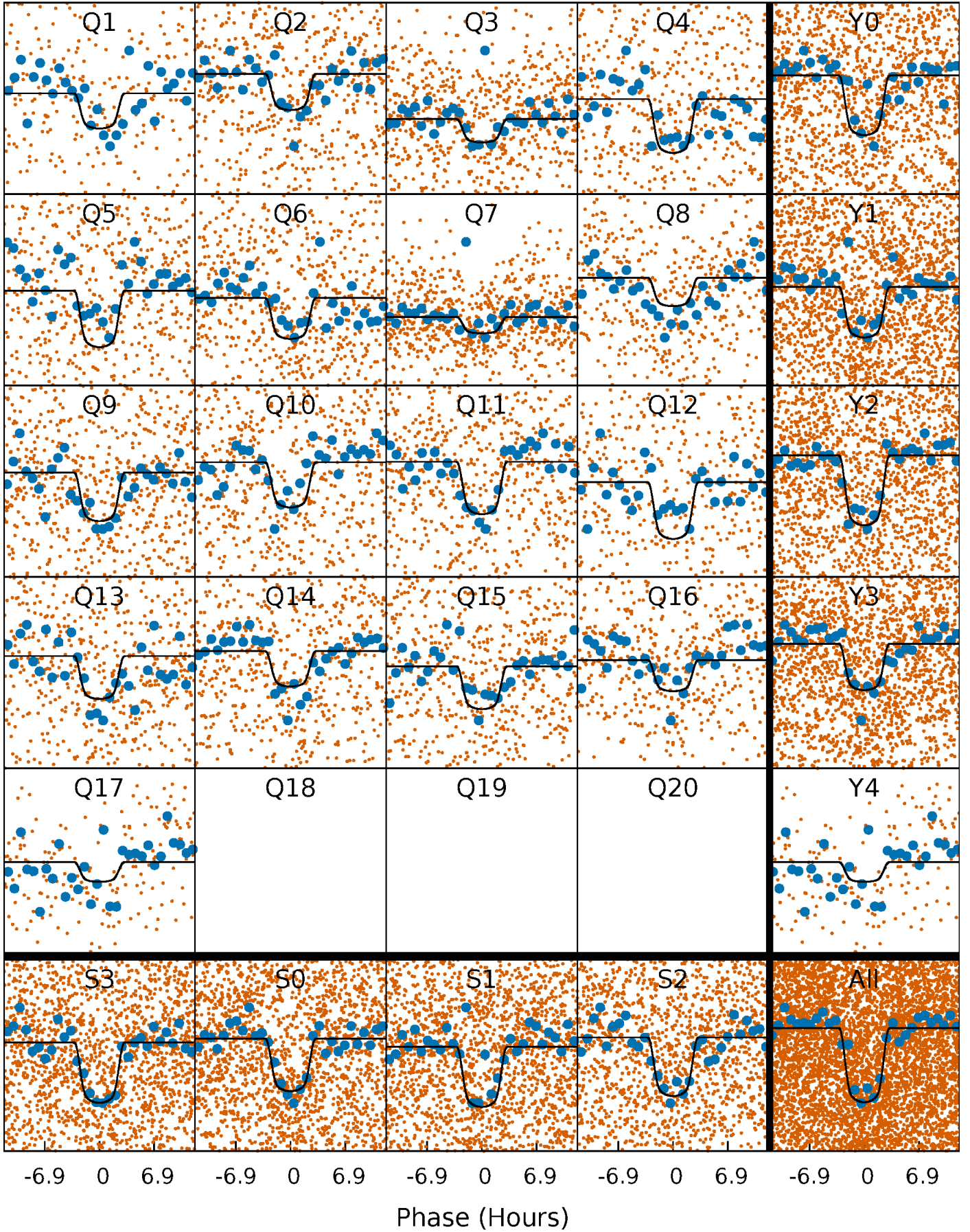
TCE 004770174-01   P= 6.095983 Days    $T_0=134.590305$  (BKJD)





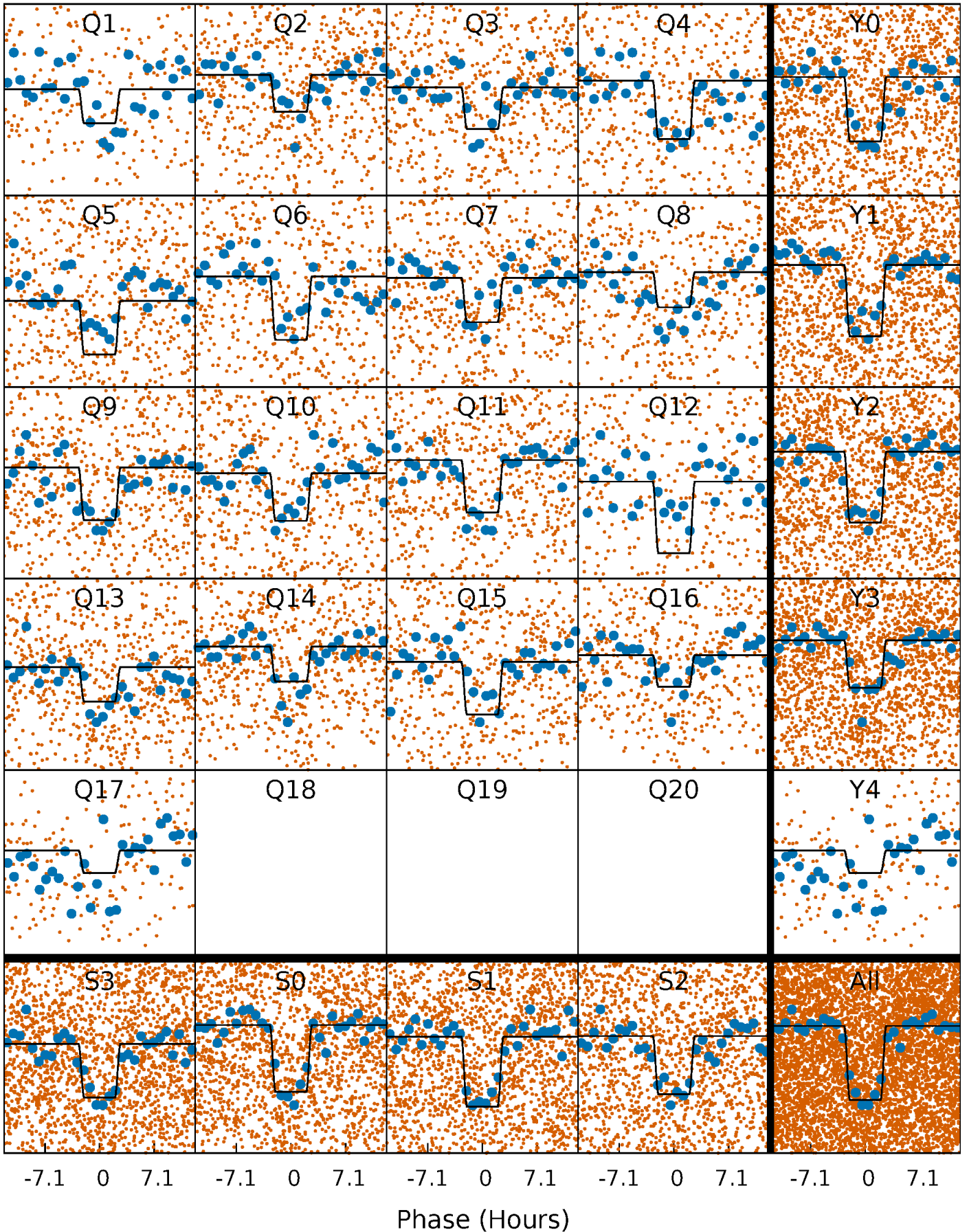
# DV Quarter-Phased Transit Curves

TCE 004770174-01 P= 6.095983 Days  $T_0=134.590305$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

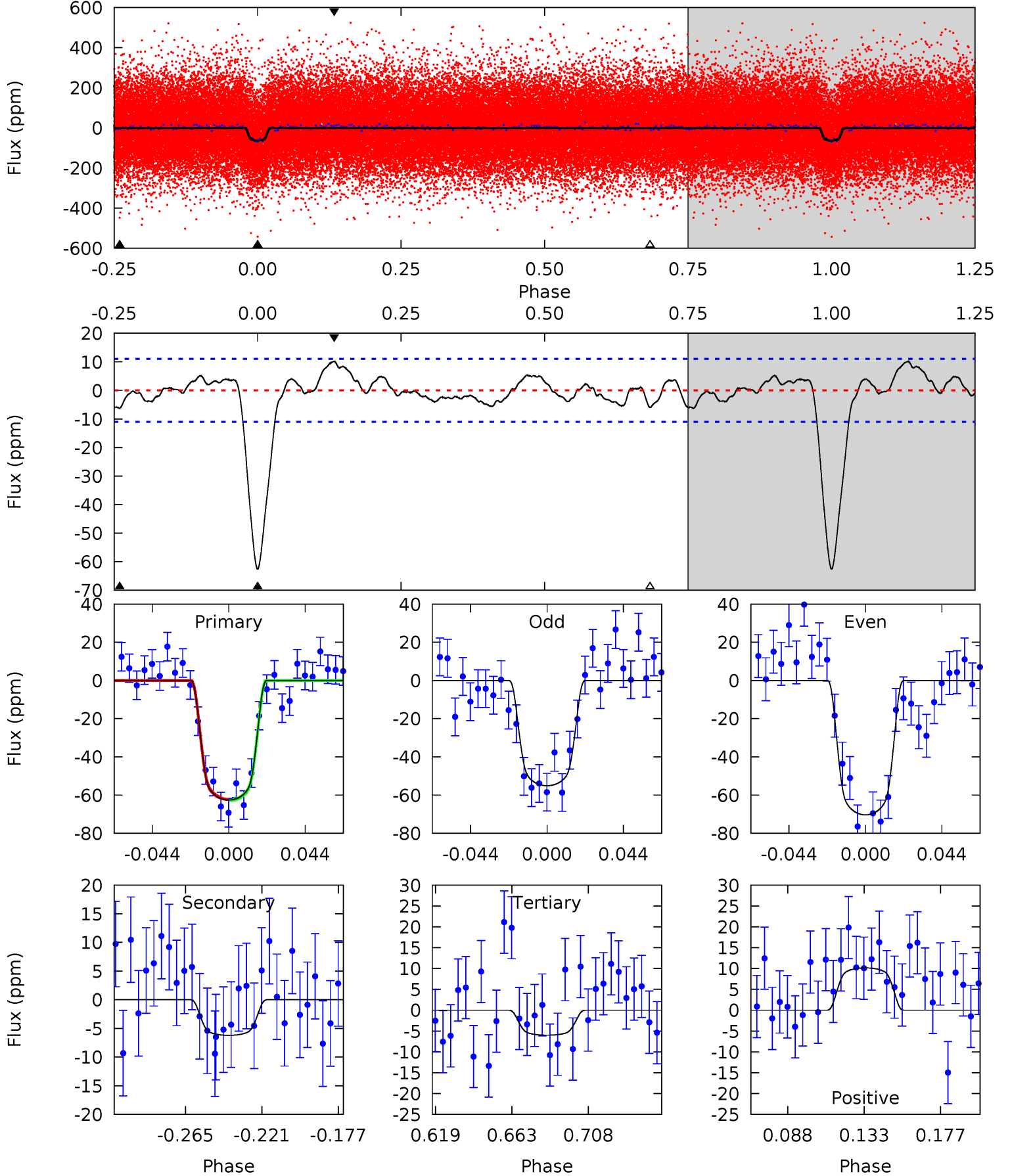
TCE 004770174-01 P= 6.095973 Days  $T_0=134.590508$  (BKJD)



# DV Model-Shift Uniqueness Test

004770174-01, P = 6.095983 Days, E = 128.494322 Days

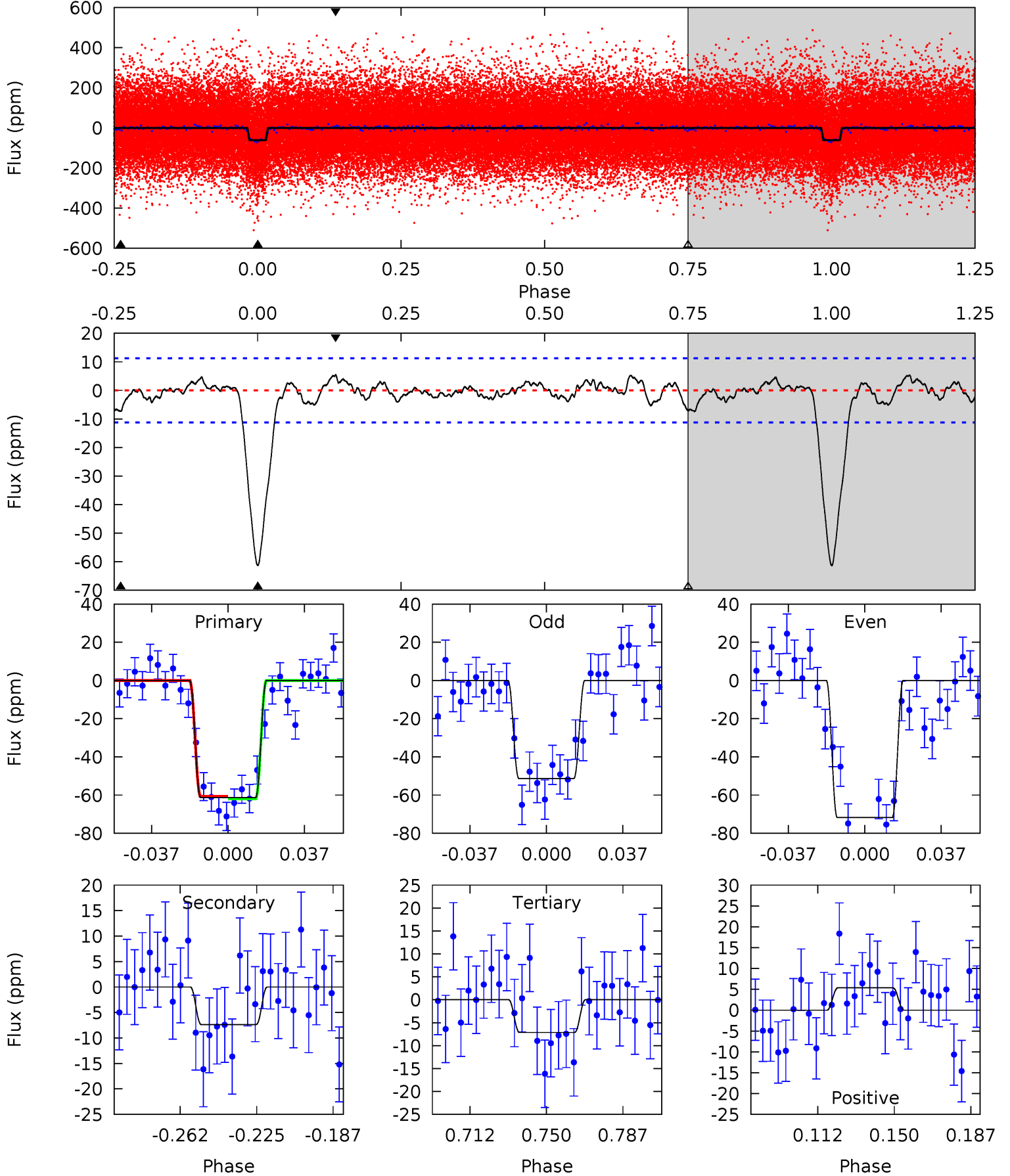
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
26.8	2.66	2.57	4.35	4.73	2.01	1.51	24.3	22.5	0.09	-1.69	3.28	0.82	0.14	0.12



# Alt Model-Shift Uniqueness Test

004770174-01, P = 6.095973 Days, E = 128.494535 Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
26.1	3.13	3.03	2.28	4.77	2.08	0.99	23.0	23.8	0.09	0.85	4.36	0.99	0.08	0.30





### Stellar Parameters For KIC 004770174

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$6313^{+113}_{-139}$	$4.228^{+0.084}_{-0.126}$	$0.320^{+0.100}_{-0.150}$	$1.467^{+0.259}_{-0.188}$	$1.325^{+0.101}_{-0.092}$	$0.591^{+0.239}_{-0.215}$
	+2%/-2%	+2%/-3%	+31%/-47%	+18%/-13%	+8%/-7%	+41%/-36%
Source	SPE59	SPE59	SPE59	DSEP		

KIC = Kepler Input Catalog; PHO = Photometry; SPE = Spectroscopy; AST = Asteroseismology  
 TRA = Transits; DESP = Dartmouth Models; MULT = Multiple Models

### Secondary Eclipse Parameters for KIC 004770174-01 / KOI 2971.01

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-6 \pm 2$	$1.59^{+0.16}_{-0.14}$	$1765^{+71}_{-69}$	$3586^{+214}_{-301}$	$6.834^{+3.037}_{-2.780}$
Alt.	$-7 \pm 2$	$1.30^{+0.16}_{-0.13}$	$1769^{+85}_{-71}$	$3979^{+246}_{-285}$	$12^{+5}_{-4}$

$T_{max}$  = Theoretical Maximum Planetary Temperature

$T_{obs}$  = Observed Planetary Temperature (Assuming  $A=0.3$ )

$A_{obs}$  = Observed Albedo (Assuming  $T=0$ )

If a secondary eclipse is present, the system is likely an EB if  $T_{obs} \gg T_{max}$  AND  $A_{obs} \gg 1.0$

## DV Centroid Data

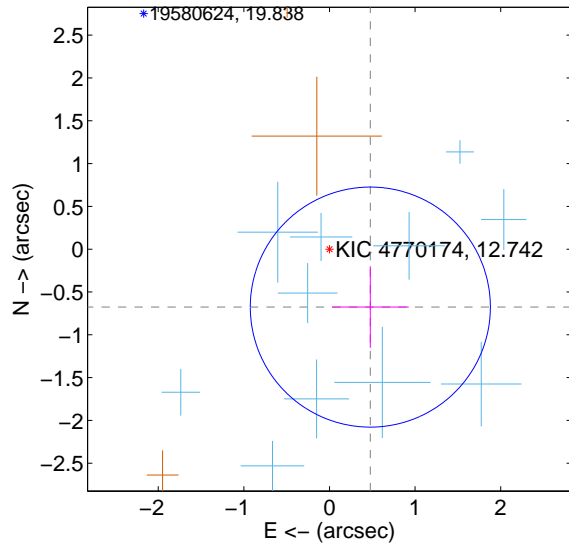
Supplemental centroid analysis for 004770174-01. Kepler magnitude: 12.74. Transit SNR 14.99

There are 11 quarters with good PRF difference image offsets

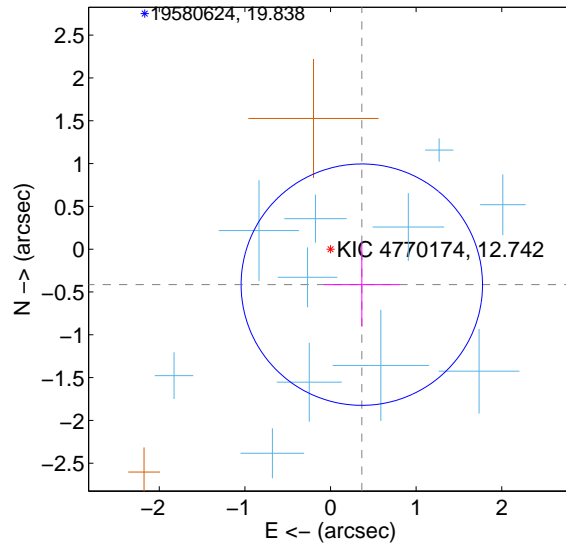
The direct PRF centroid is offset from the target star catalog position by about 0.17 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.828 \pm 0.467$	1.77	$-0.477 \pm 0.449$	$-0.676 \pm 0.476$
PRF-fit source offset from KIC position	$0.552 \pm 0.470$	1.18	$-0.365 \pm 0.444$	$-0.414 \pm 0.489$
photometric centroid source offset	$0.54 \pm 0.60$	0.90	$-0.33 \pm 0.64$	$-0.43 \pm 0.58$

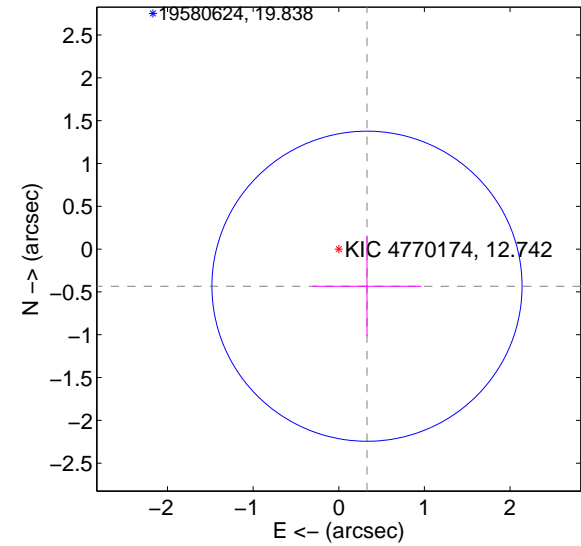
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

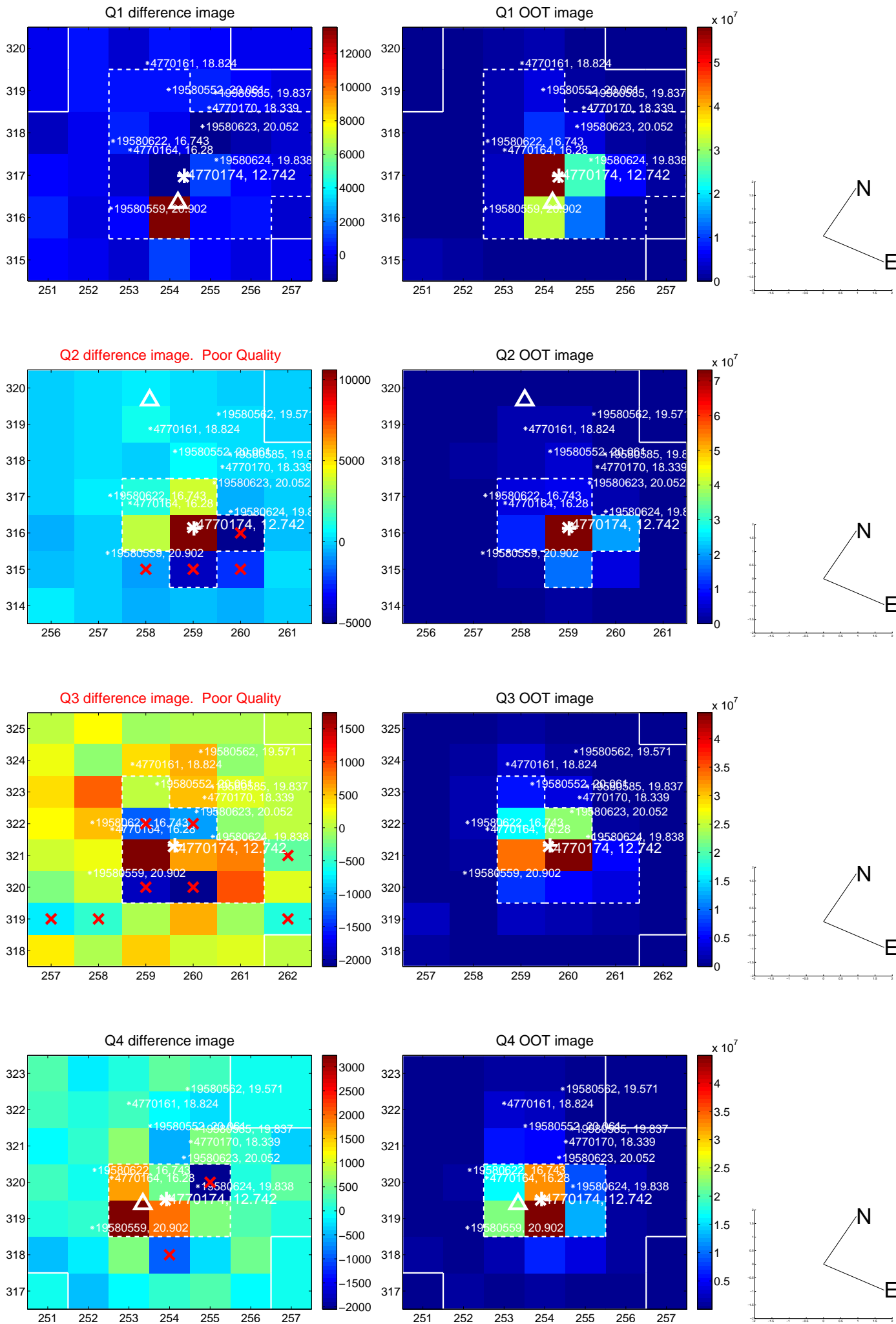


offset from photometric centroids

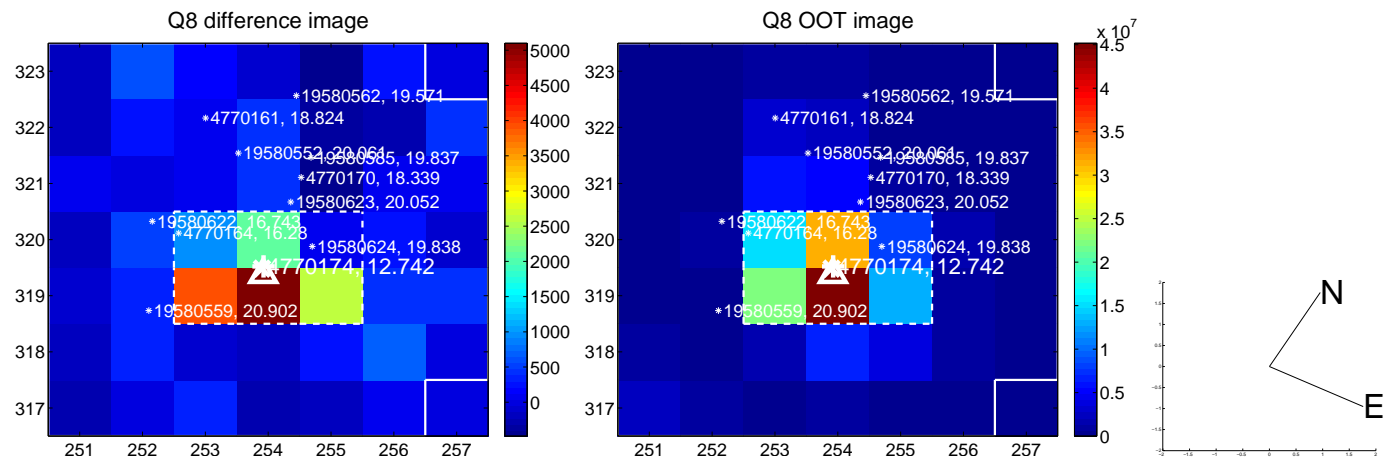
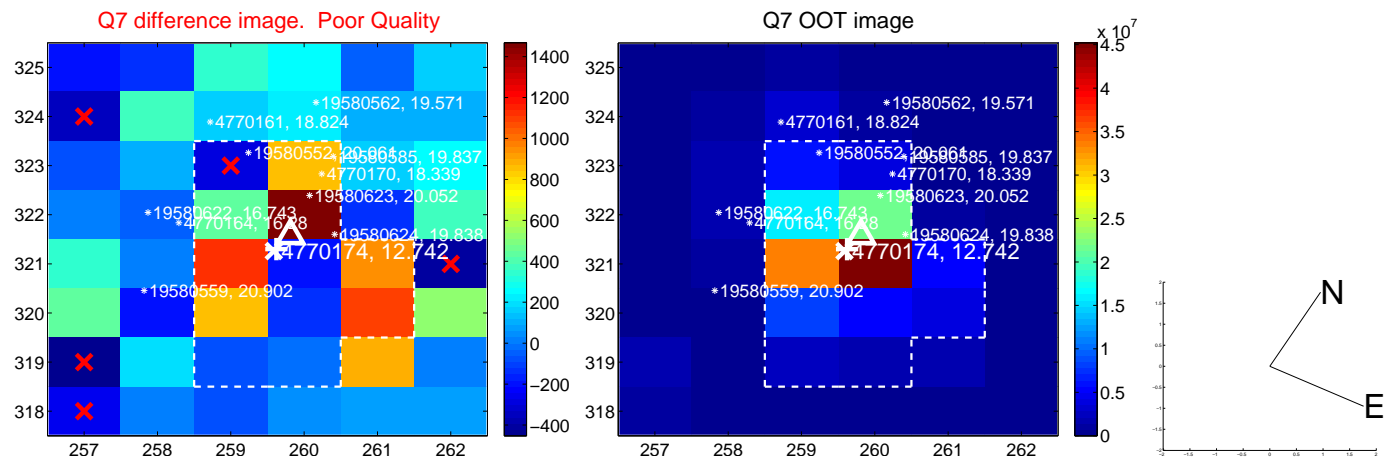
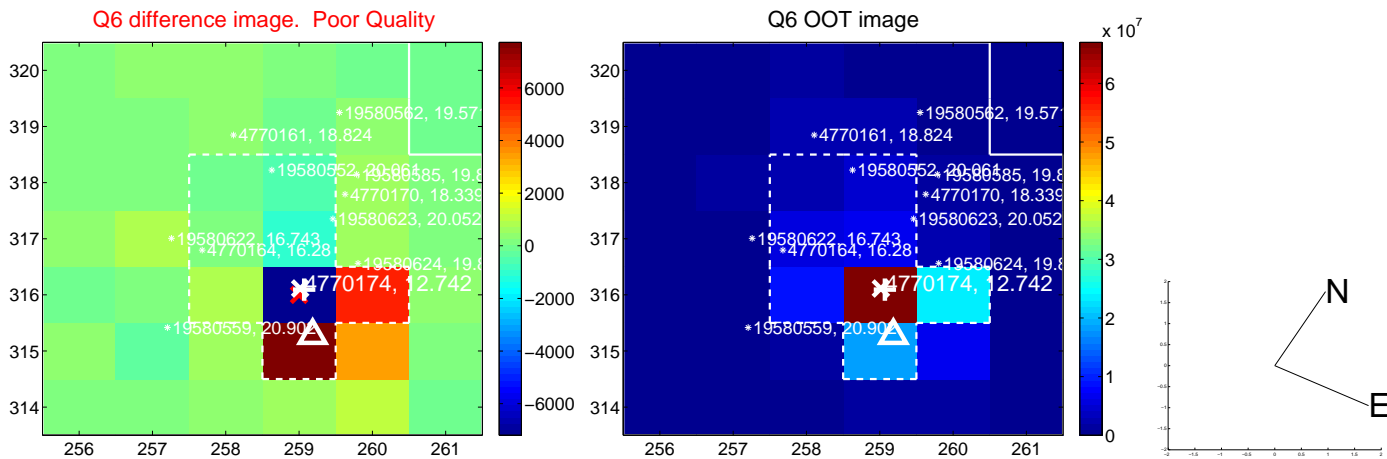
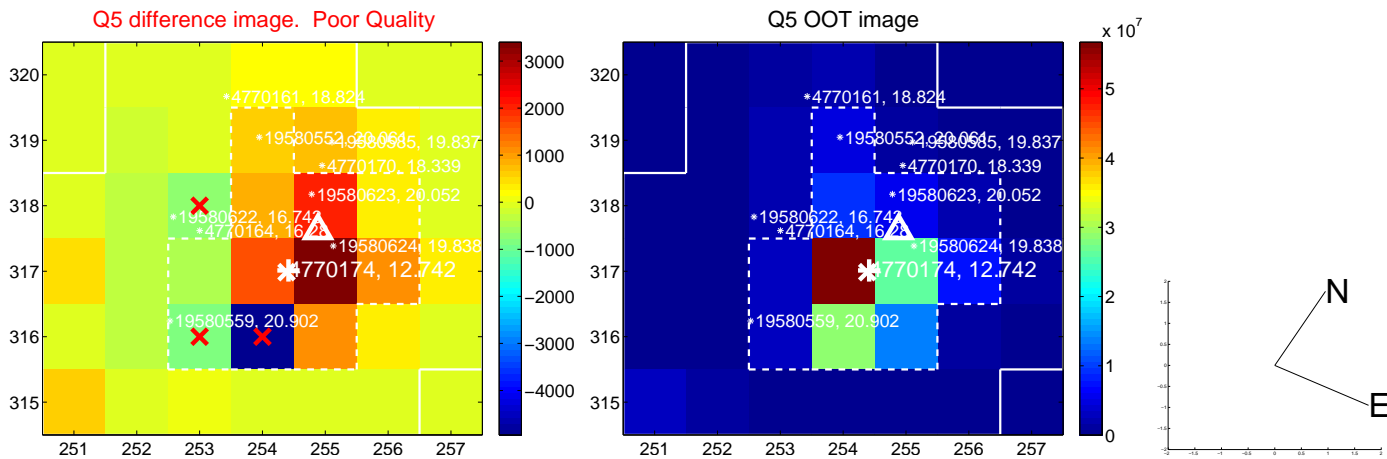


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three- $\sigma$ . Red \*: target star. Blue \*: Other stars. Text next to a star gives its KIC ID and kepmag. KIC IDs > 15,000,000 are from the UKIRT catalog.

white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

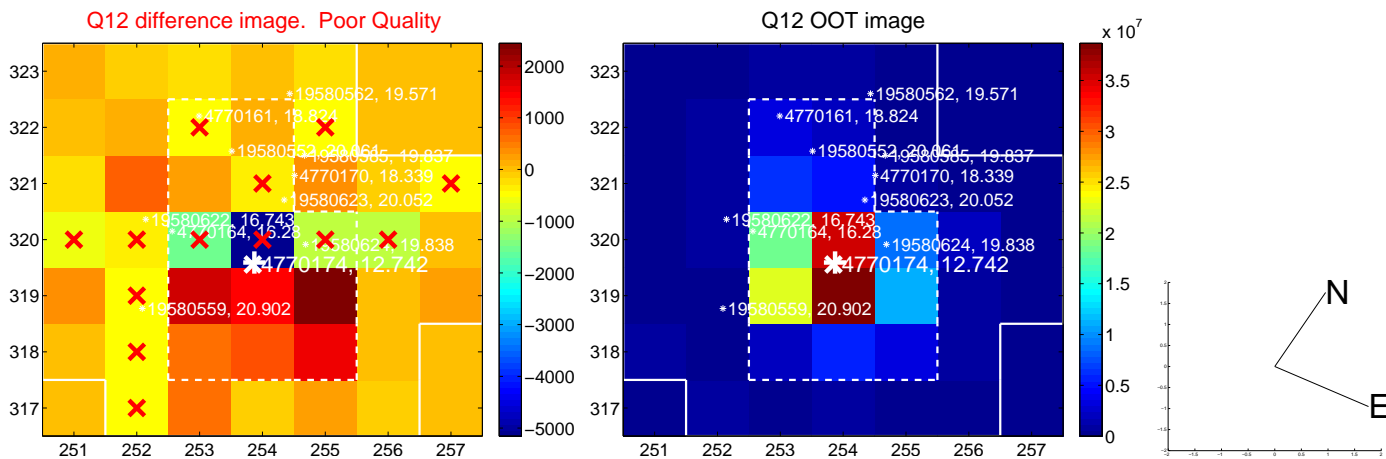
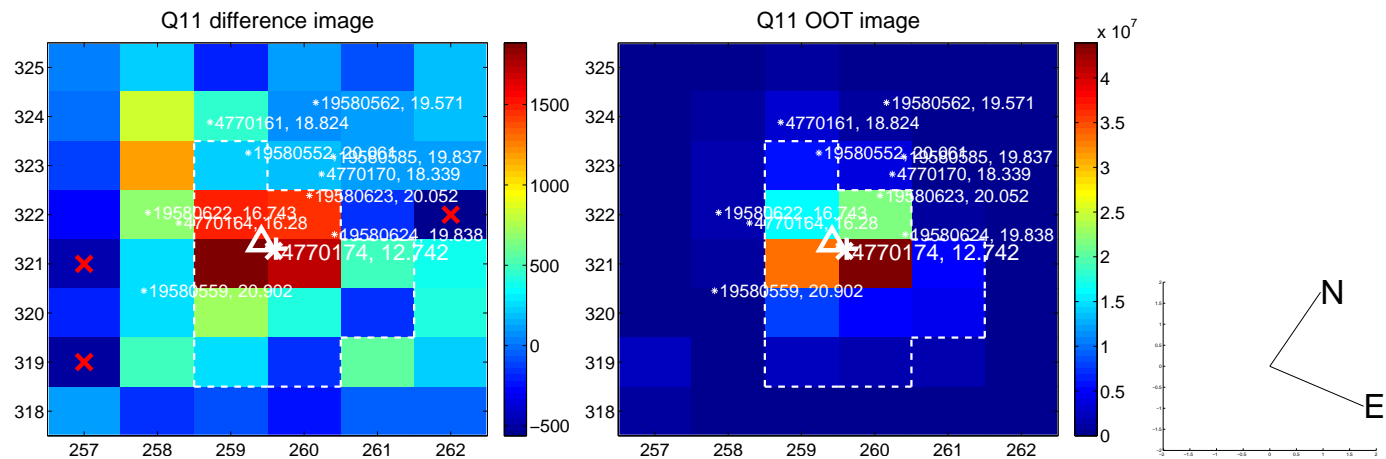
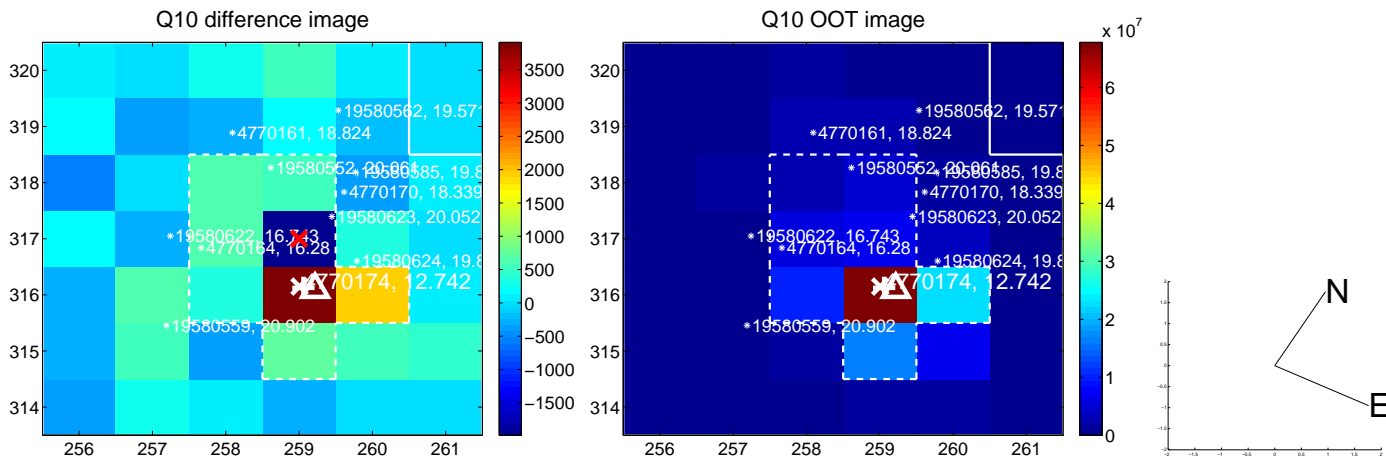
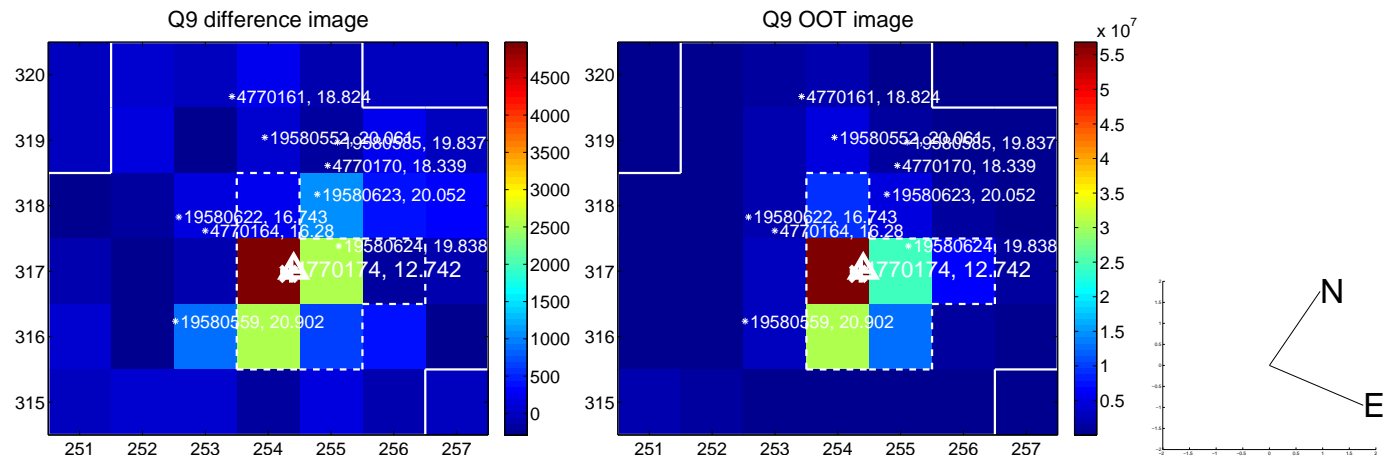


white ×: KIC target position; +: OOT centroid; △: difference centroid. red ✕: large negative pixel value.

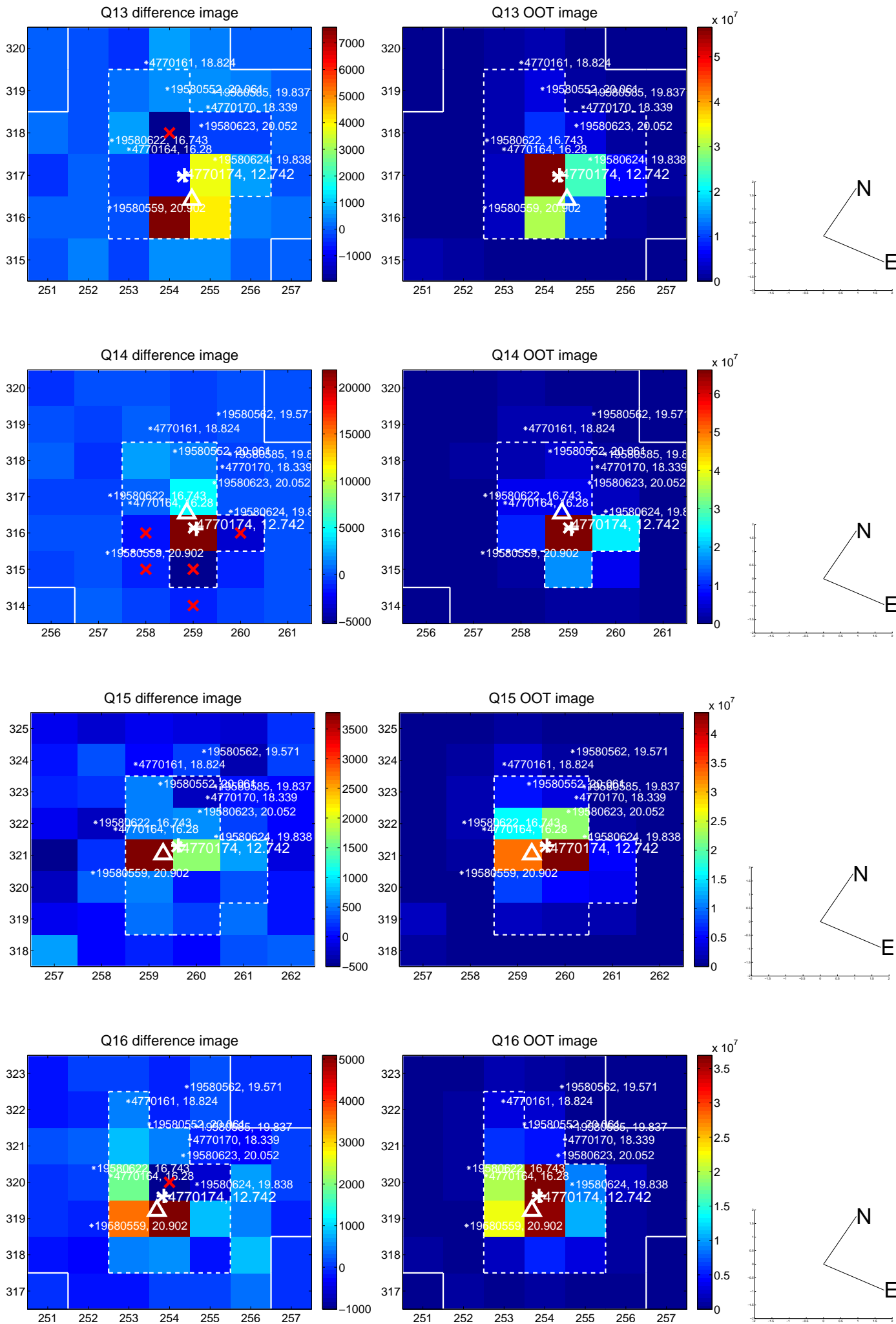




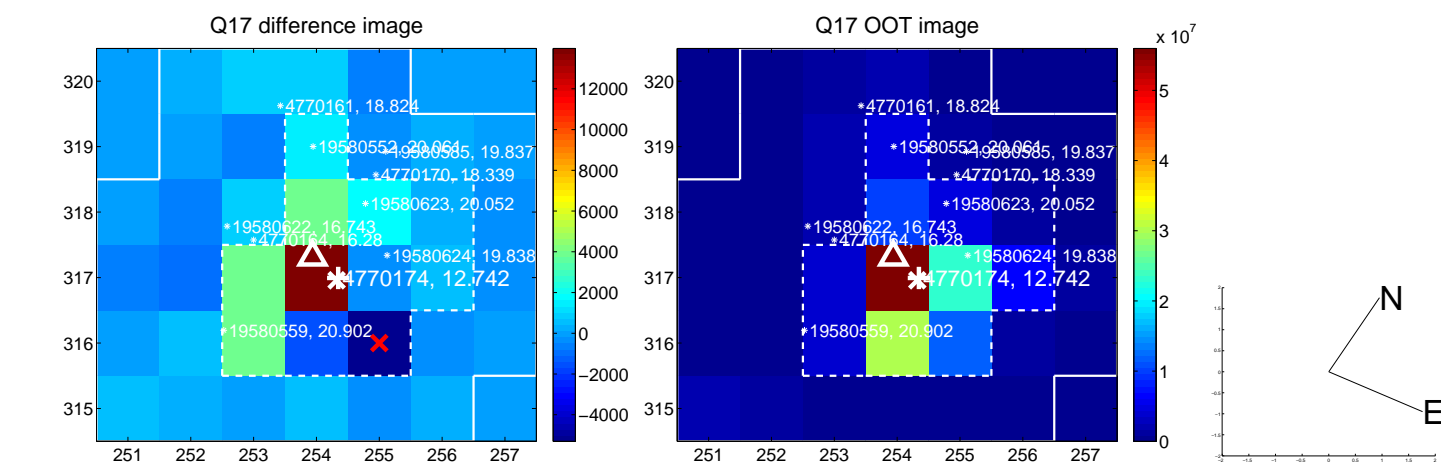
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



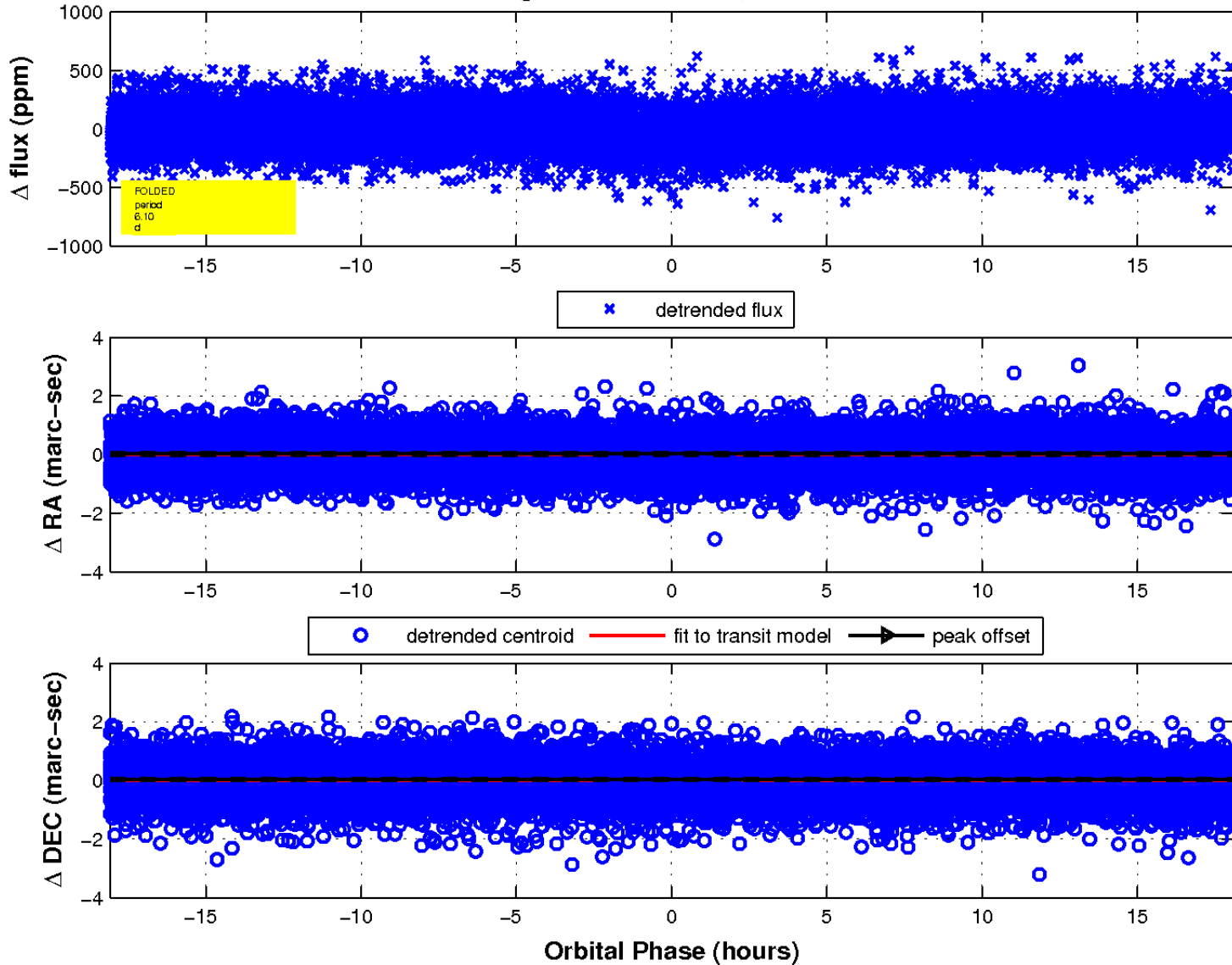
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

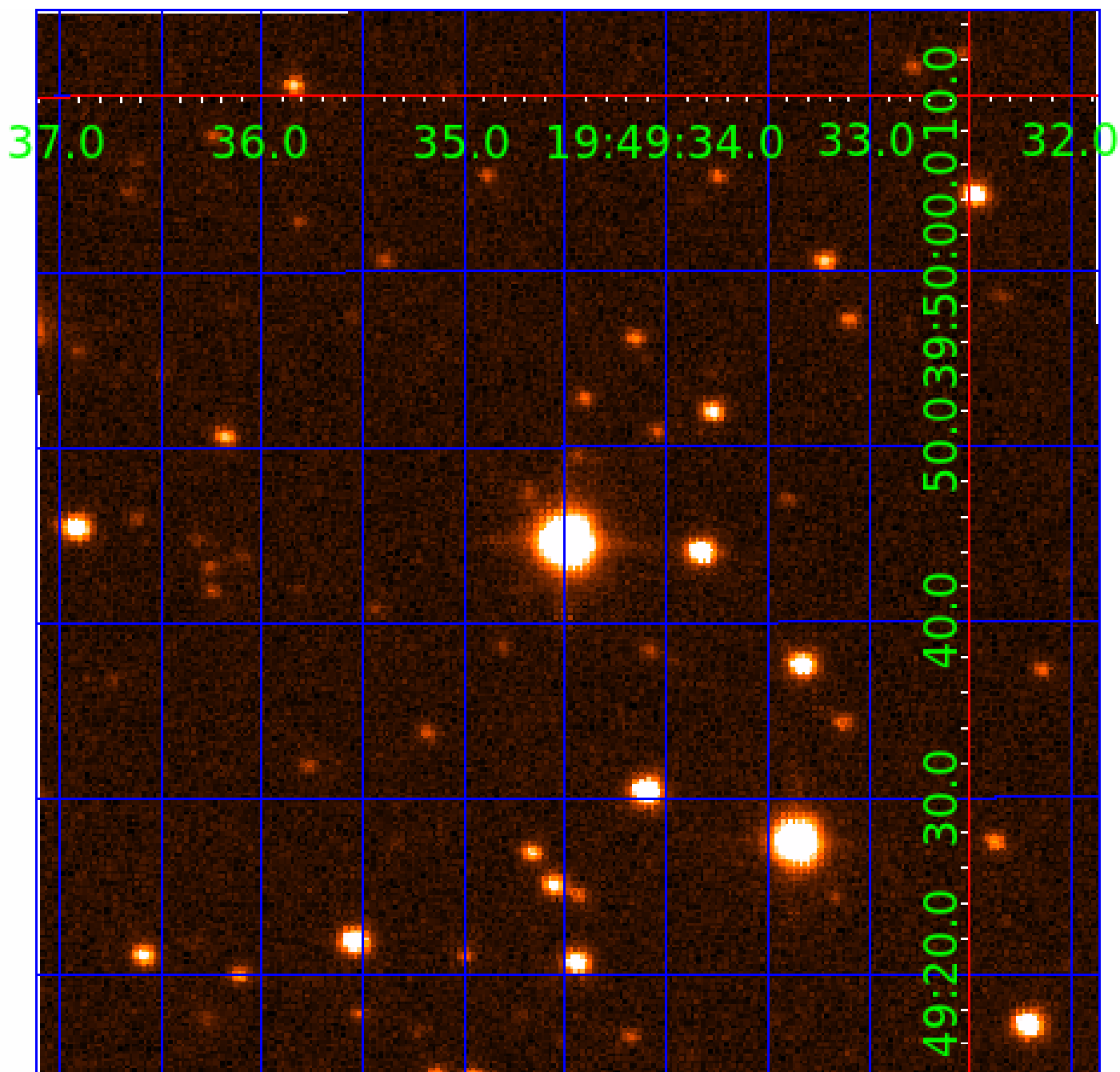


fluxWeightedCentroids, Planet 1 of 2



UKIRT Image

Declination





# KIC 004770174

## Q1-17 DR25 TCE Parameters

TCE	Run Type	KOI?	Period (Days)	Epoch (BKJD)	Depth (ppm)	Duration (Hours)	MES	SNR	$R_{\star}$ ( $R_{\odot}$ )	$T_{\star}$ (K)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004770174-01	OBS	2971.01	6.095983	134.590304	64.3	6.026	14.3	15.0	1.47	6313	1.58	594.38
004770174-02	OBS	2971.02	31.953341	159.659139	101.3	8.415	8.7	9.6	1.47	6313	1.64	65.28

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004770174-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
004770174-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT

**Notes:** OBS = Observed. INJ = Injected. INV = Inverted. SCR = Scrambled.

N = Not Transit-Like. S = Stellar Eclipse. C = Centroid Offset. E = Ephemeris Match.

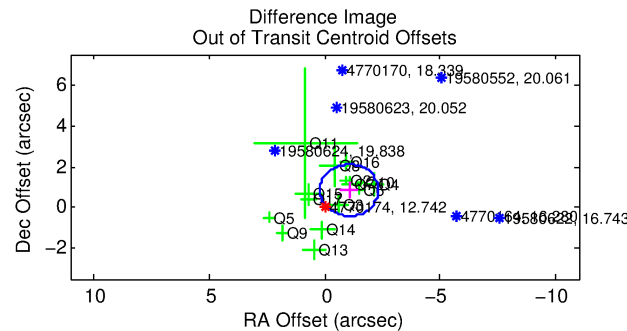
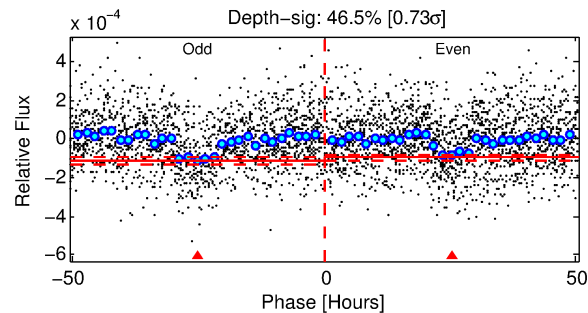
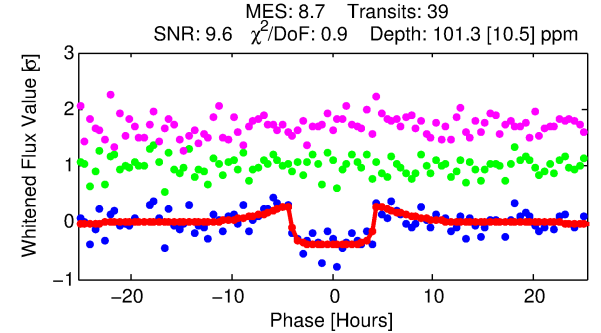
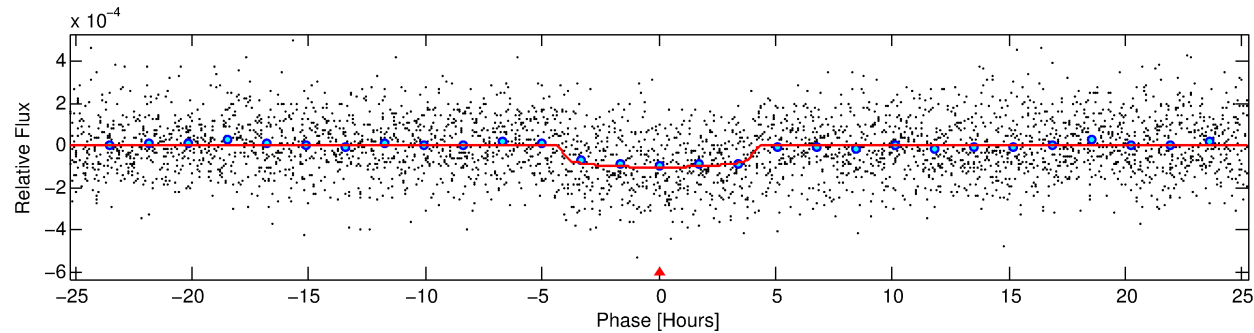
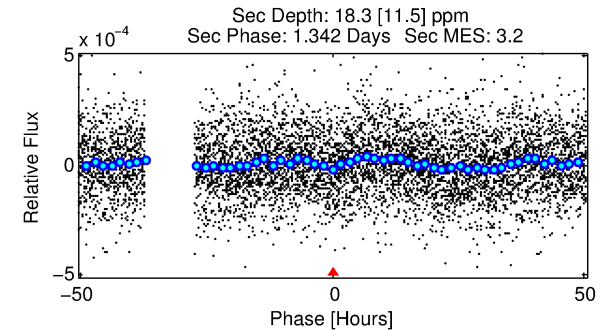
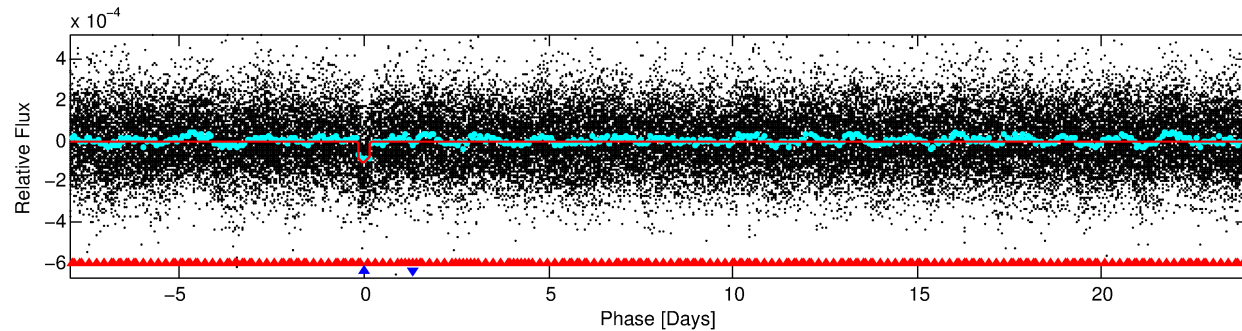
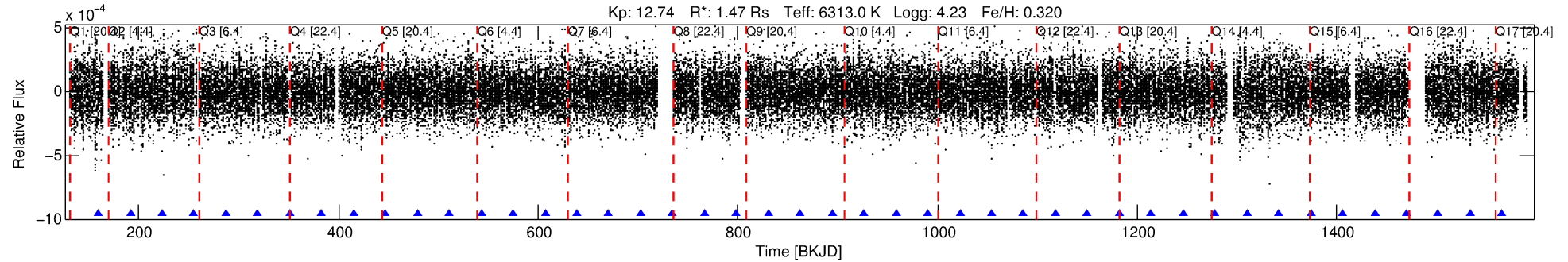
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 004770174-02

No Significant Match Found

# DV One-Page Summary

KIC: 4770174 Candidate: 2 of 2 Period: 31.953 d  
KOI: K02971.02 Corr: 0.980



## DV Fit Results:

Period = 31.95334 [0.00036] d  
Epoch = 159.6591 [0.0095] BKJD  
Rp/R\* = 0.0102 [0.0028]  
a/R\* = 17.69 [23.99]  
b = 0.81 [0.60]  
Seff = 65.28 [15.86]  
Teq = 725 [44] K  
Rp = 1.64 [0.54] Re  
a = 0.2166 [0.0330] AU  
Ag = 175.72 [152.80] [1.14σ]  
Teffp = 4080 [861] K [3.89σ]

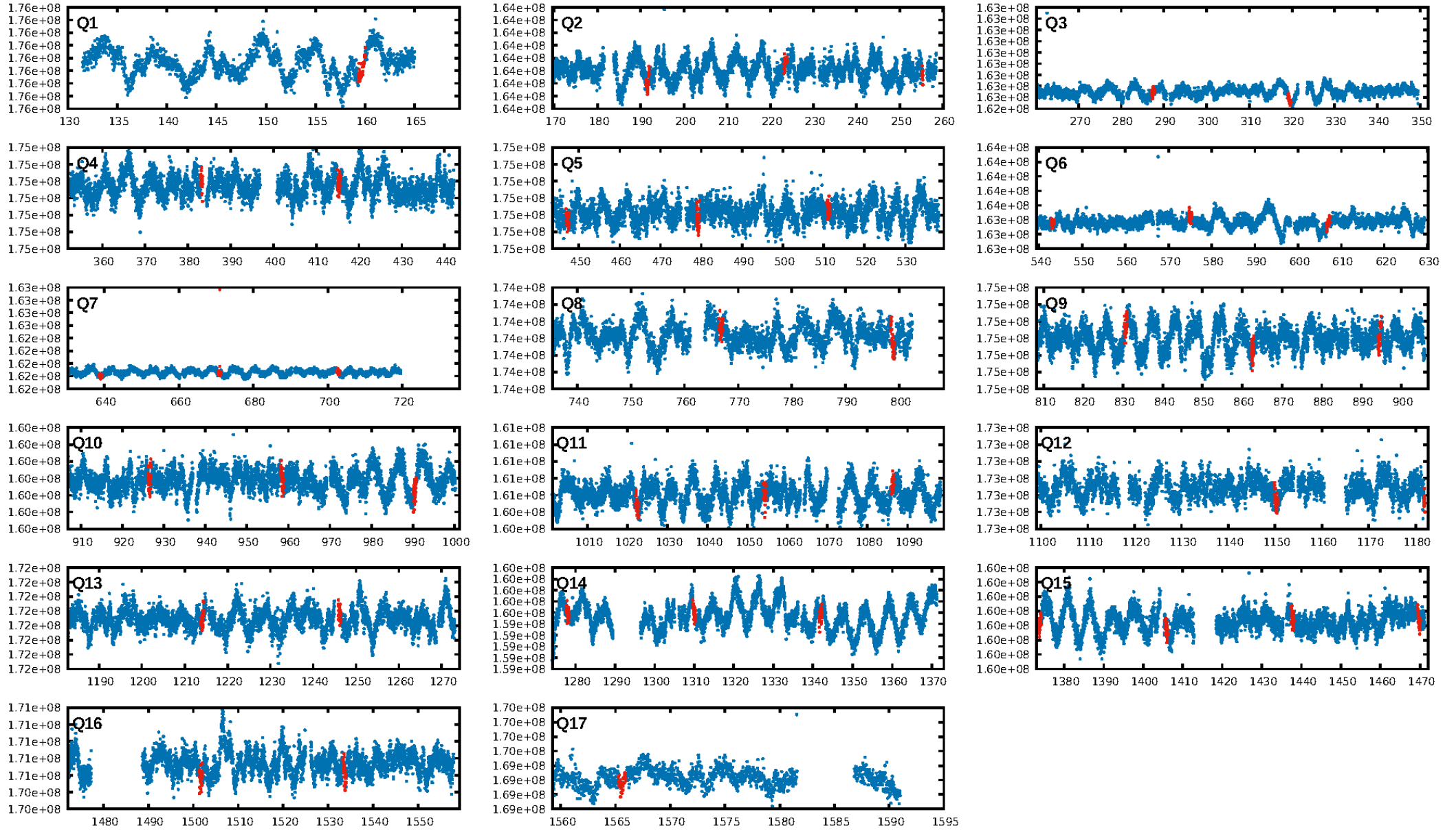
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [59.96σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 95.8%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 9.89e-18  
RollingBand-fgt: 1.00 [37/37]  
GhostDiagnostic-chr: 3.633  
Centroid-sig: 21.0%  
Centroid-so: 0.818 arcsec [1.08σ]  
OotOffset-rm: 1.350 arcsec [3.19σ]  
KicOffset-rm: 1.303 arcsec [3.12σ]  
OotOffset-st: 4/4/3/4 [15]  
KicOffset-st: 4/4/3/4 [15]  
DiffImageQuality-fgm: 0.80 [12/15]  
DiffImageOverlap-fno: 0.76 [13/17]

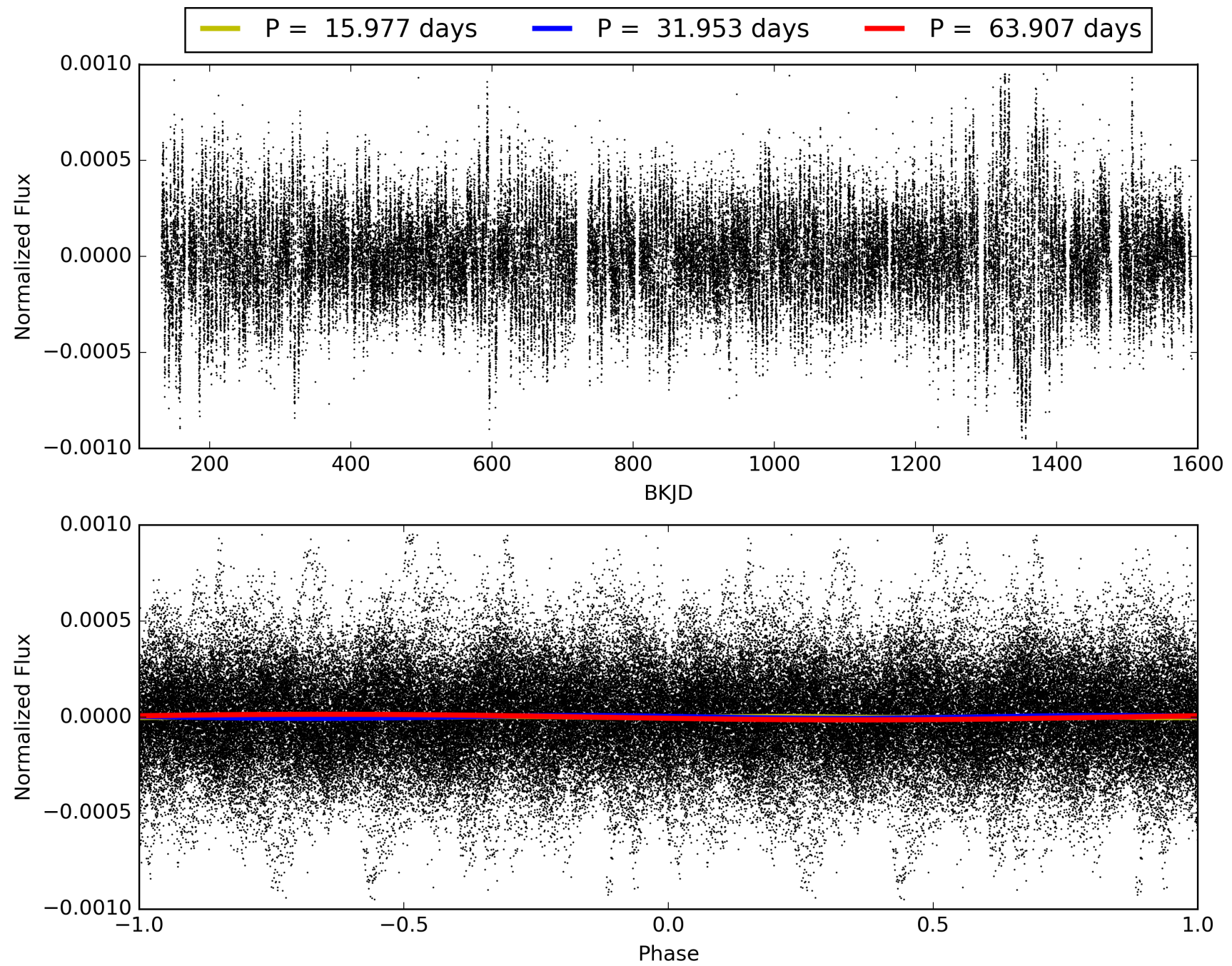
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 11:07:50 Z

This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 004770174-02, PDC Light Curves



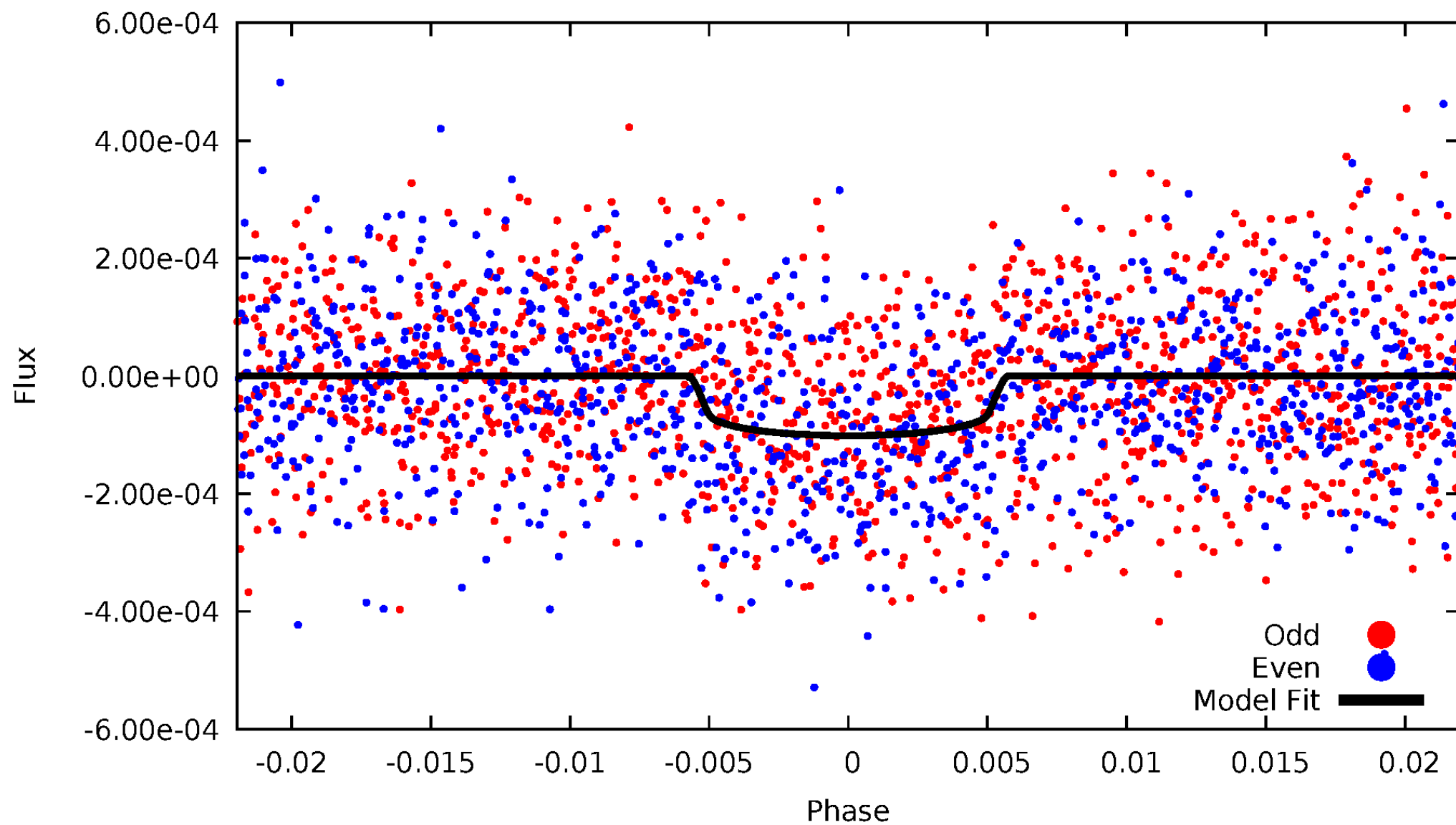
TCE 004770174-02





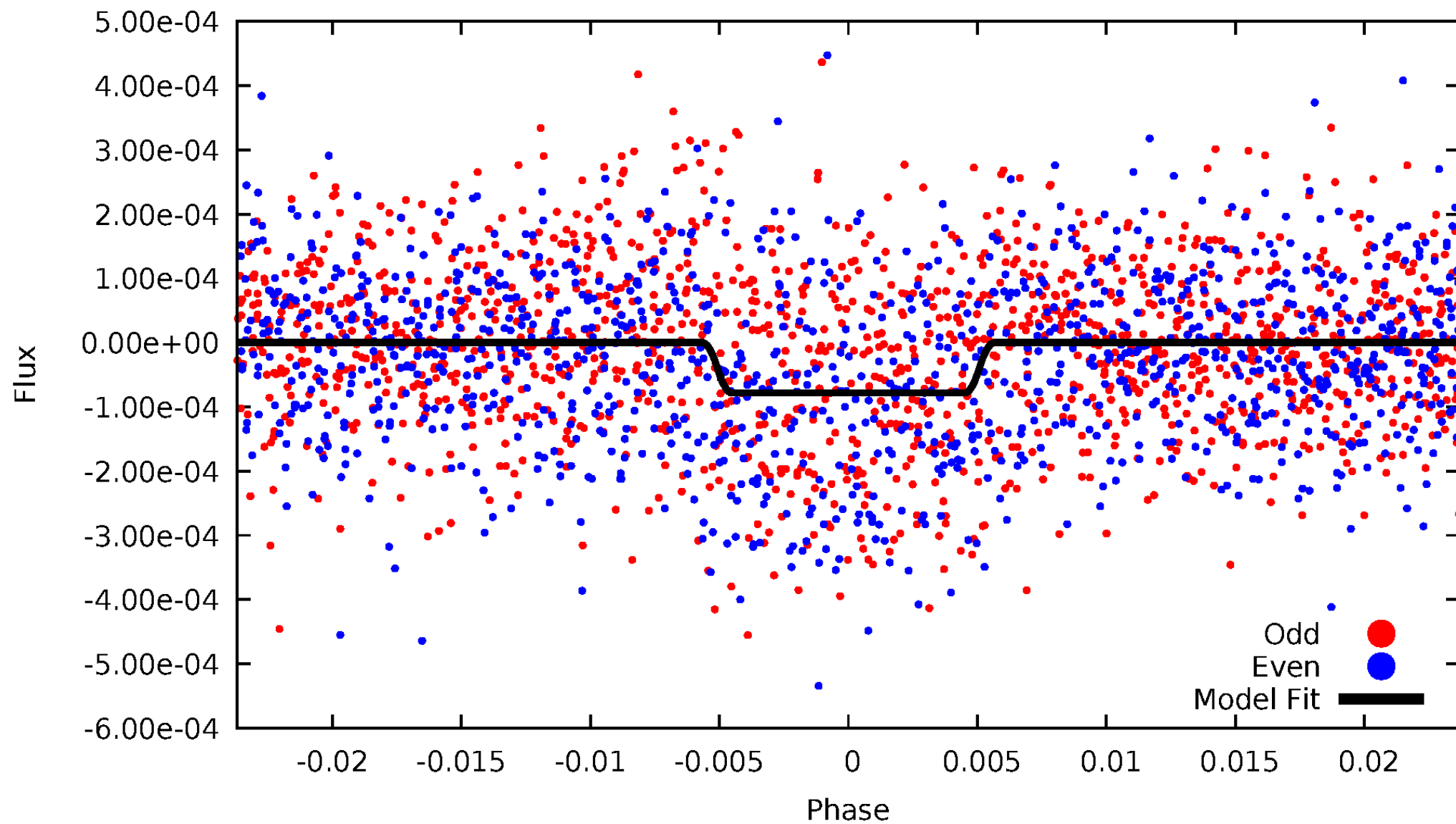
# DV Odd/Even

TCE 004770174-02



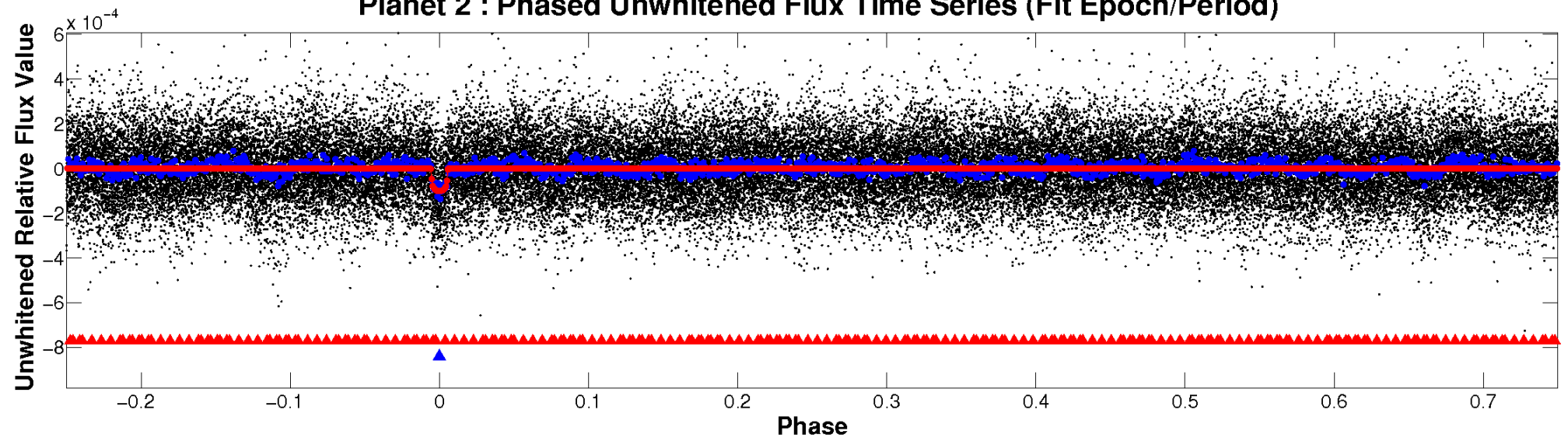
# ALT Odd/Even

TCE 004770174-02

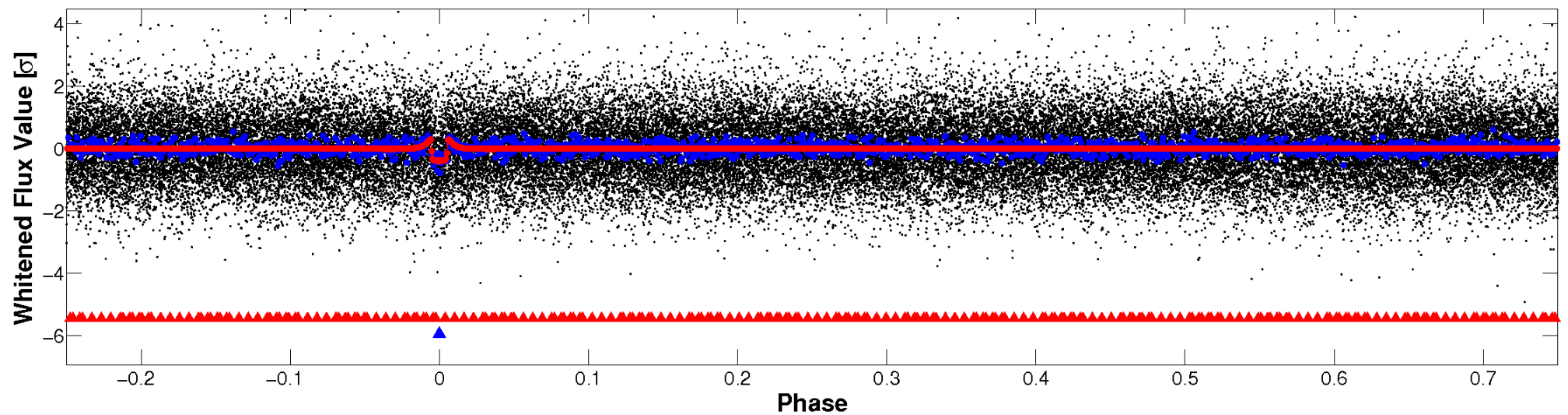


# Non-Whitened Vs. Whitened Light Curve

## Planet 2 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

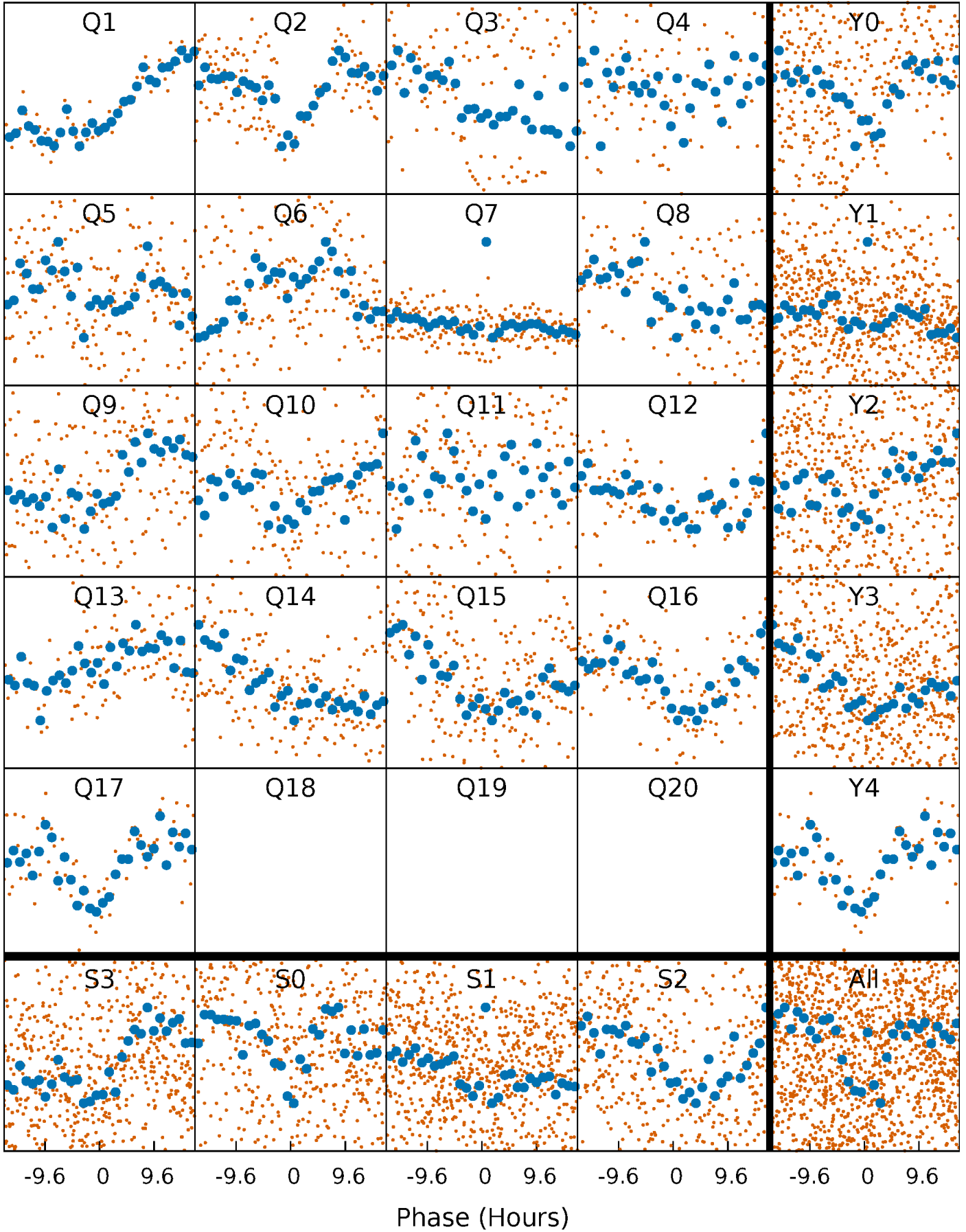


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



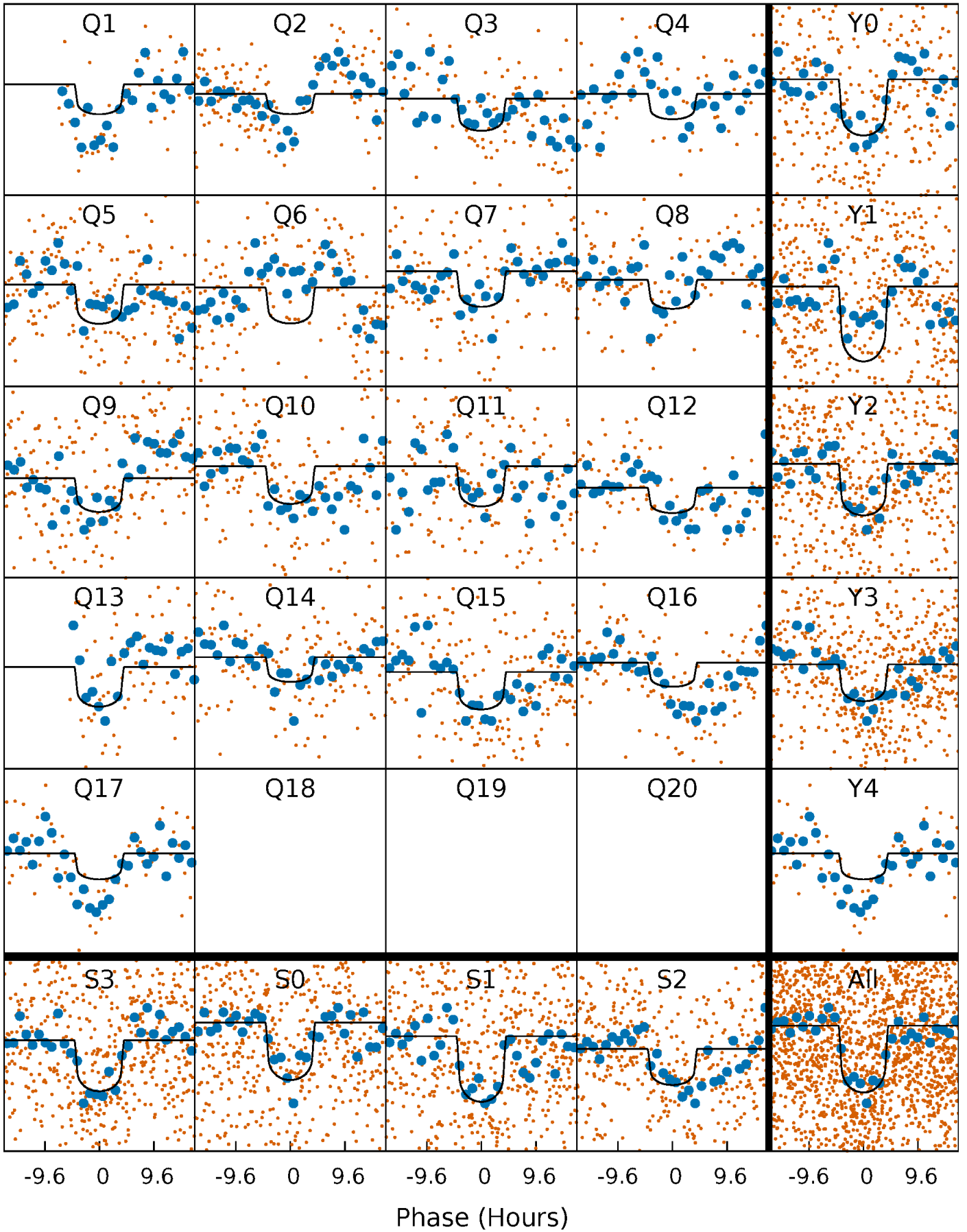
# PDC Quarter-Phased Transit Curves

TCE 004770174-02 P= 31.953341 Days  $T_0=159.659139$  (BKJD)



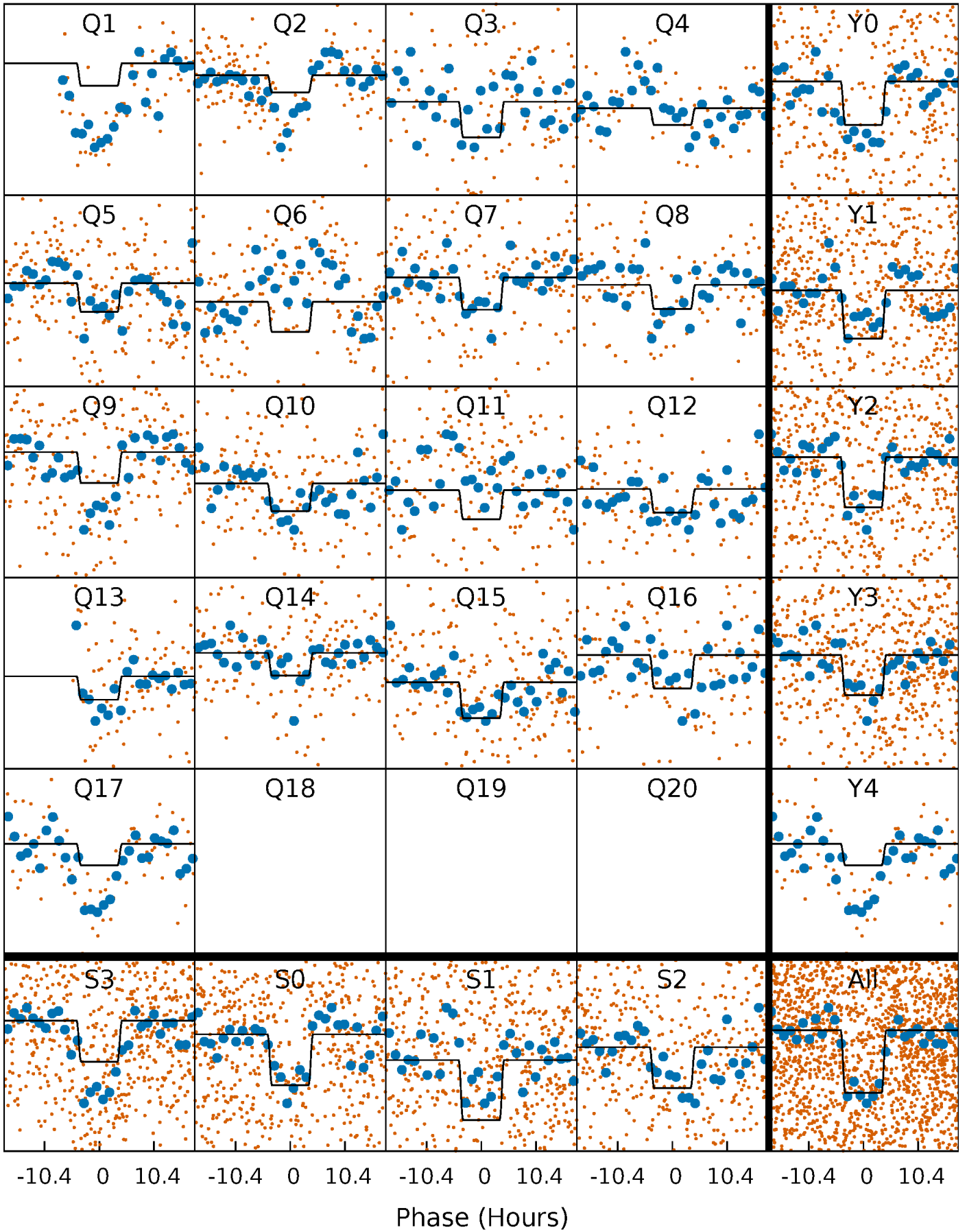
# DV Quarter-Phased Transit Curves

TCE 004770174-02 P= 31.953341 Days  $T_0=159.659139$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

TCE 004770174-02 P= 31.952582 Days  $T_0=159.677979$  (BKJD)

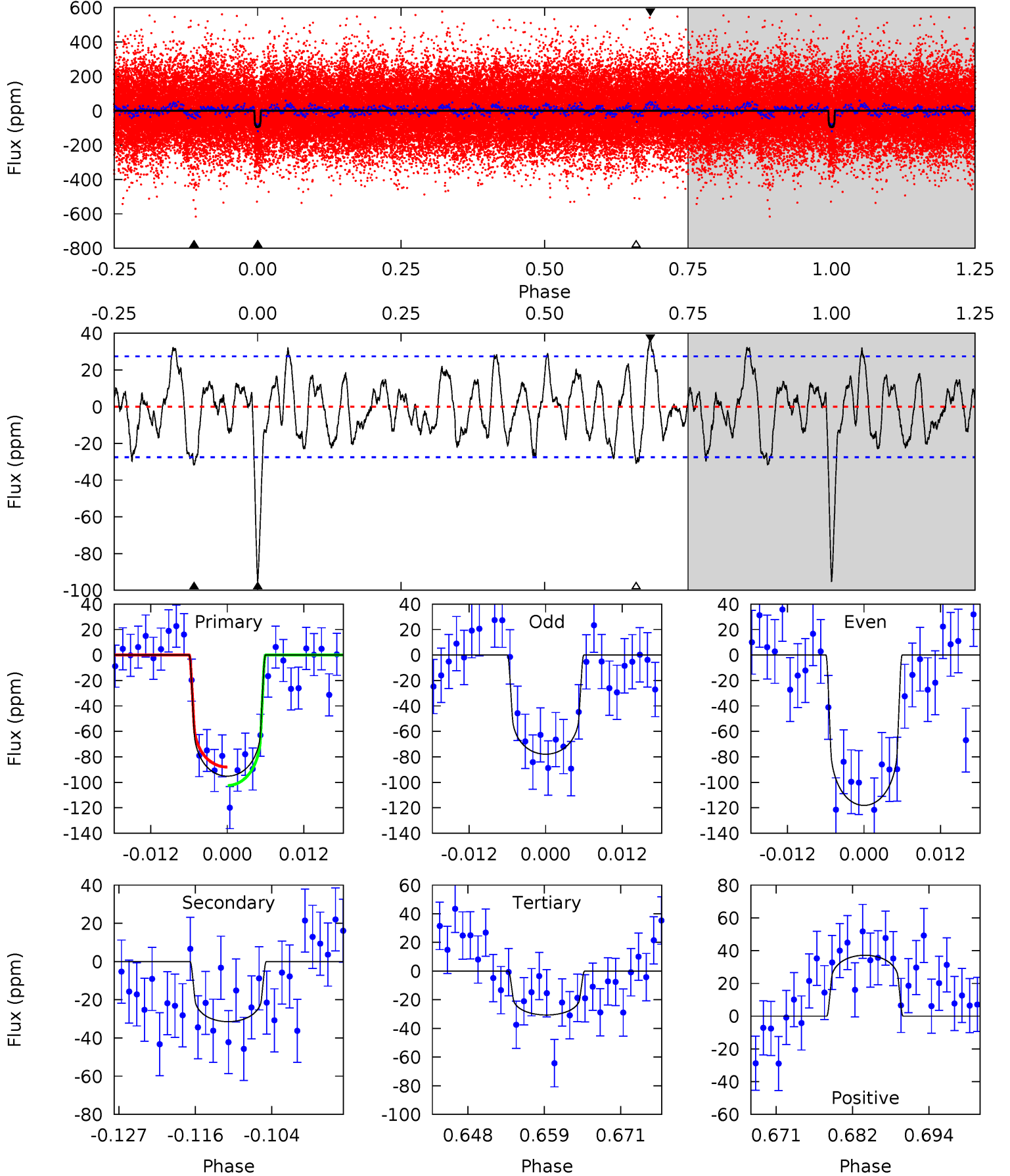




# DV Model-Shift Uniqueness Test

004770174-02, P = 31.953341 Days, E = 127.705798 Days

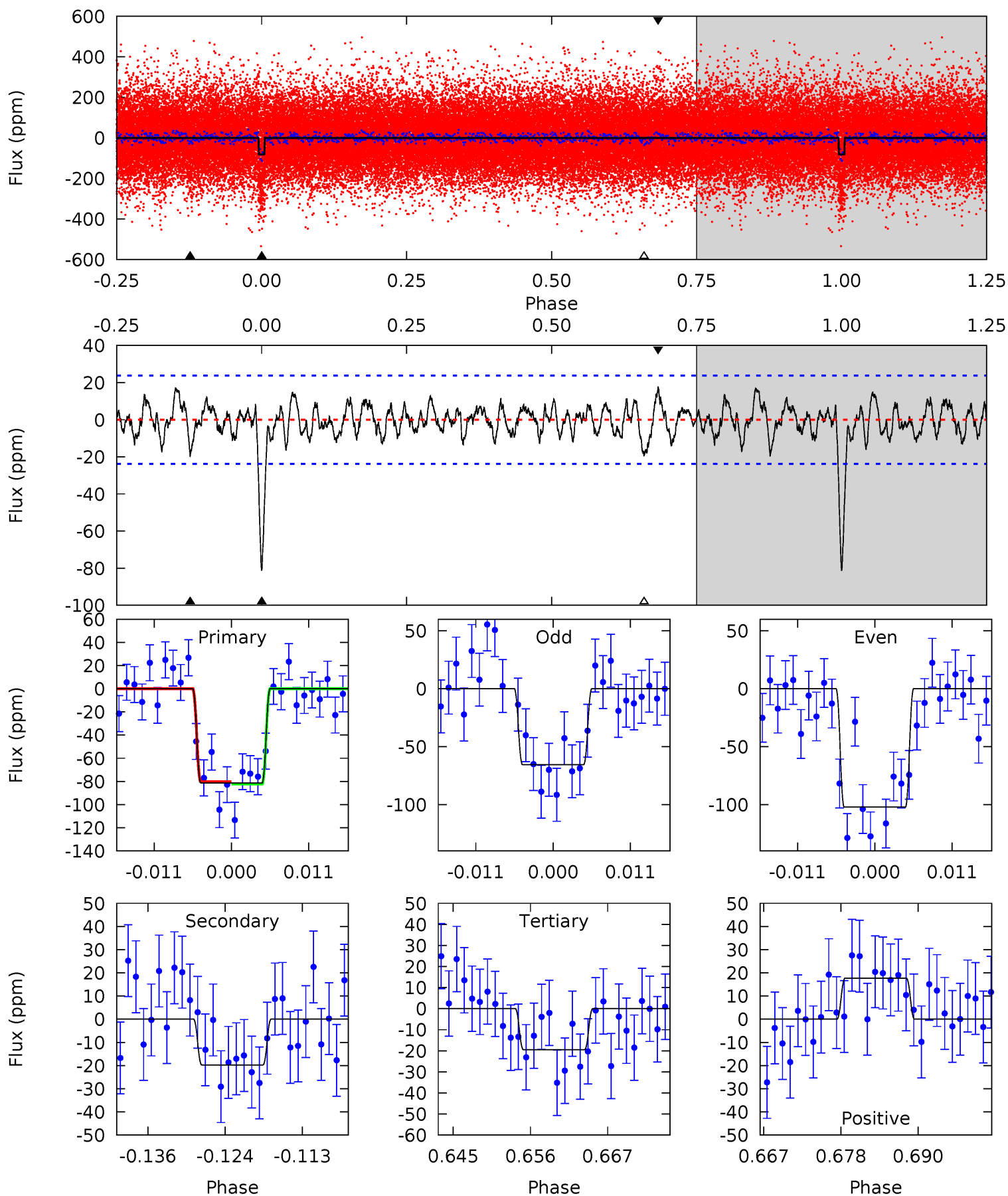
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
17.3	5.73	5.58	6.77	5.00	2.53	2.44	11.7	10.6	0.15	-1.04	3.62	1.01	0.28	1.32



# Alt Model-Shift Uniqueness Test

004770174-02,  $P = 31.952582$  Days,  $E = 127.725397$  Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
17.1	4.15	4.09	3.72	5.00	2.53	1.39	13.0	13.4	0.06	0.42	3.83	0.91	0.18	0.21



### Stellar Parameters For KIC 004770174

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$6313^{+113}_{-139}$	$4.228^{+0.084}_{-0.126}$	$0.320^{+0.100}_{-0.150}$	$1.467^{+0.259}_{-0.188}$	$1.325^{+0.101}_{-0.092}$	$0.591^{+0.239}_{-0.215}$
	+2%/-2%	+2%/-3%	+31%/-47%	+18%/-13%	+8%/-7%	+41%/-36%
Source	SPE59	SPE59	SPE59	DSEP		

KIC = Kepler Input Catalog; PHO = Photometry; SPE = Spectroscopy; AST = Asteroseismology  
 TRA = Transits; DESP = Dartmouth Models; MULT = Multiple Models

### Secondary Eclipse Parameters for KIC 004770174-02 / KOI 2971.02

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-31 \pm 5$	$1.66^{+0.49}_{-0.44}$	$1017^{+53}_{-42}$	$4765^{+743}_{-427}$	$288^{+268}_{-117}$
Alt.	$-20 \pm 5$	$1.44^{+0.47}_{-0.45}$	$1018^{+52}_{-40}$	$4615^{+803}_{-488}$	$238^{+274}_{-108}$

$T_{max}$  = Theoretical Maximum Planetary Temperature

$T_{obs}$  = Observed Planetary Temperature (Assuming  $A=0.3$ )

$A_{obs}$  = Observed Albedo (Assuming  $T=0$ )

If a secondary eclipse is present, the system is likely an EB if  $T_{obs} \gg T_{max}$  AND  $A_{obs} \gg 1.0$

## DV Centroid Data

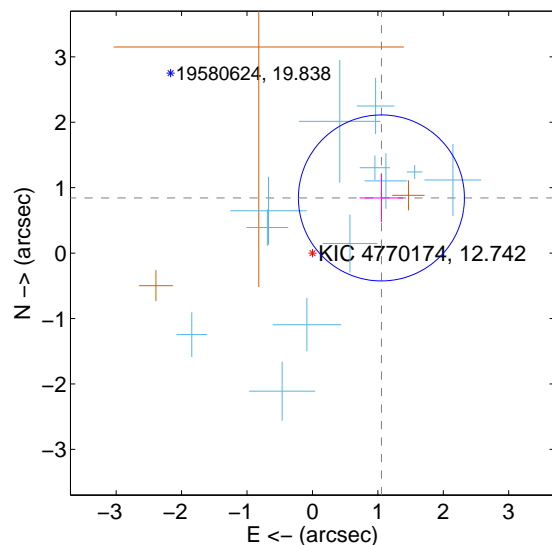
Supplemental centroid analysis for 004770174-02. Kepler magnitude: 12.74. Transit SNR 9.63

There are 12 quarters with good PRF difference image offsets

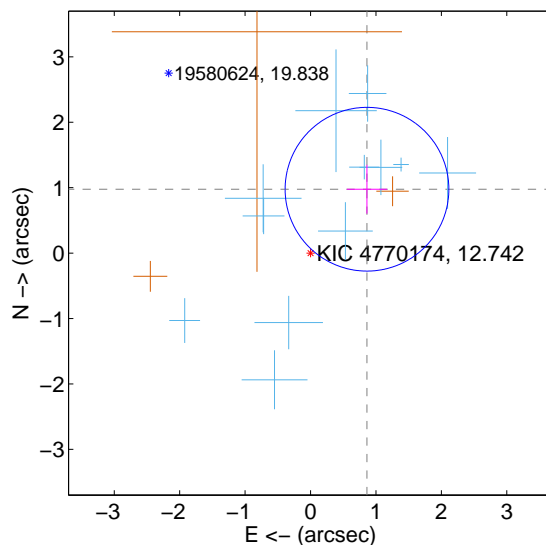
The direct PRF centroid is offset from the target star catalog position by about 0.18 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.350 \pm 0.423$	<b>3.19</b>	$-1.054 \pm 0.333$	$0.843 \pm 0.371$
PRF-fit source offset from KIC position	$1.303 \pm 0.417$	<b>3.12</b>	$-0.863 \pm 0.309$	$0.976 \pm 0.373$
photometric centroid source offset	$0.82 \pm 0.75$	1.08	$0.61 \pm 0.78$	$-0.54 \pm 0.72$

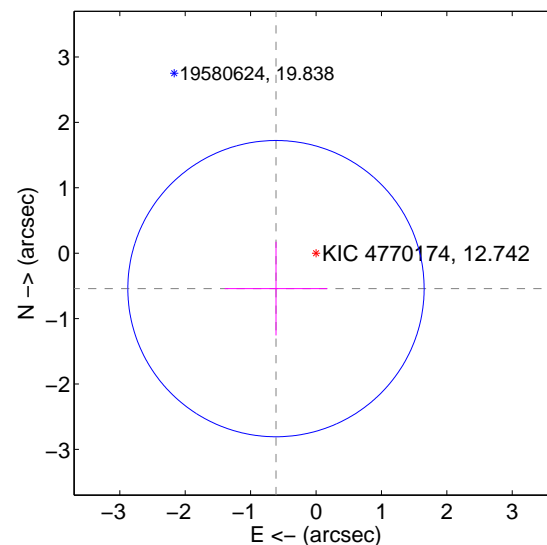
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position



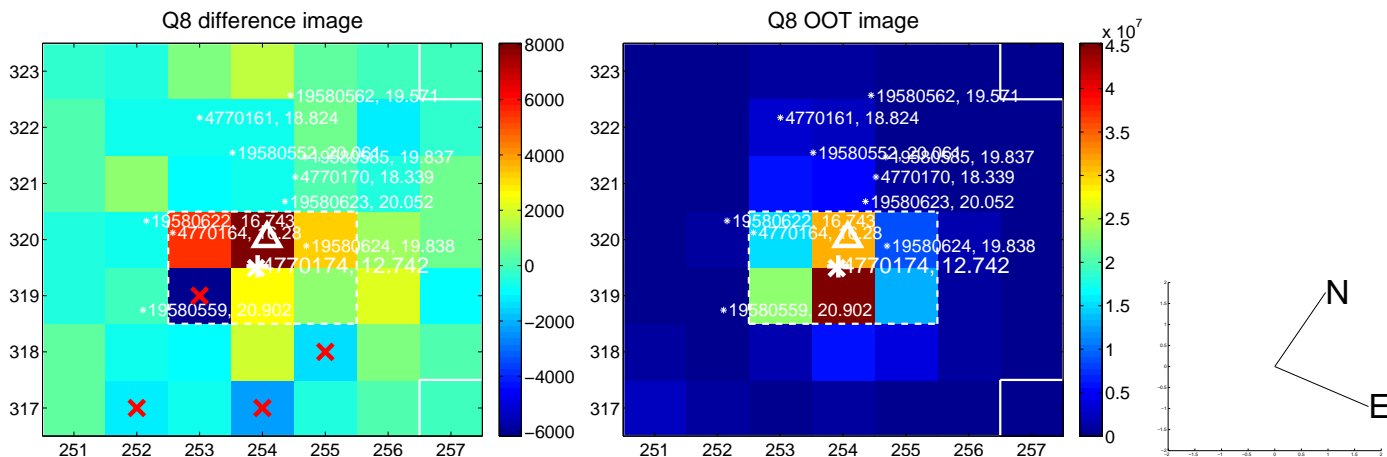
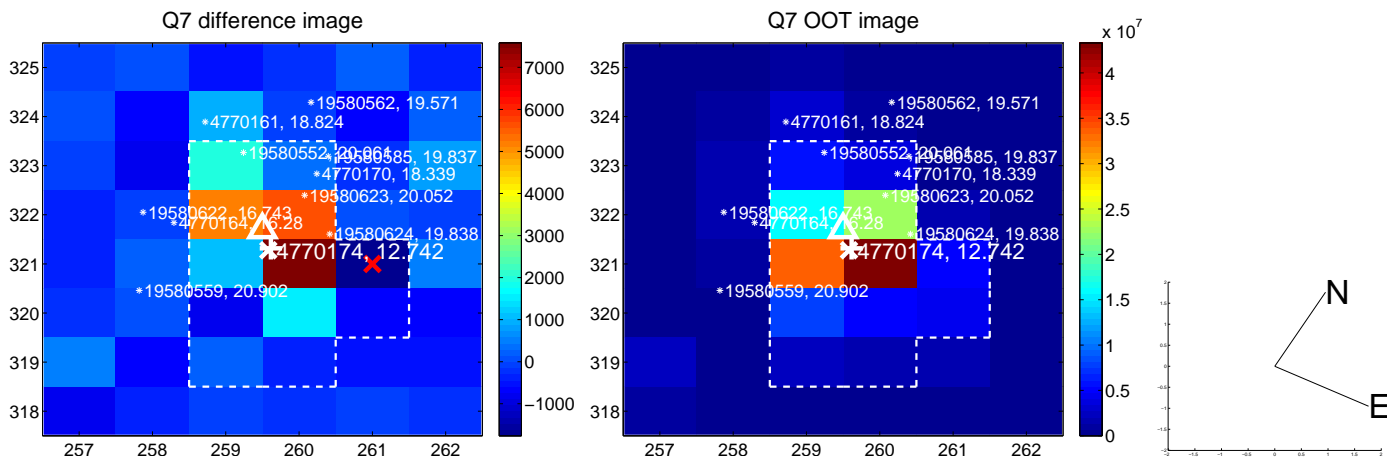
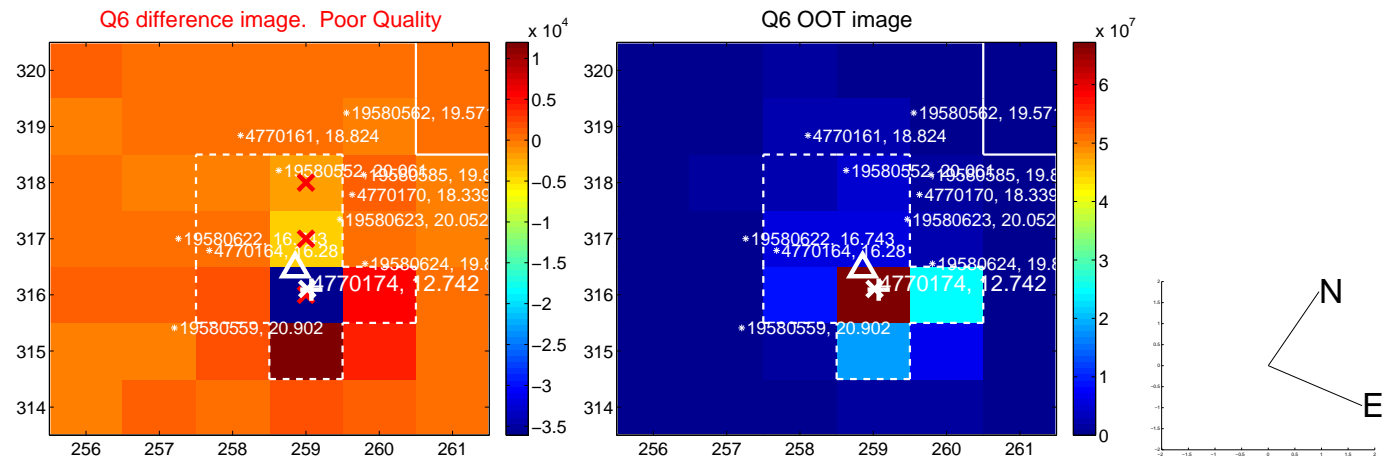
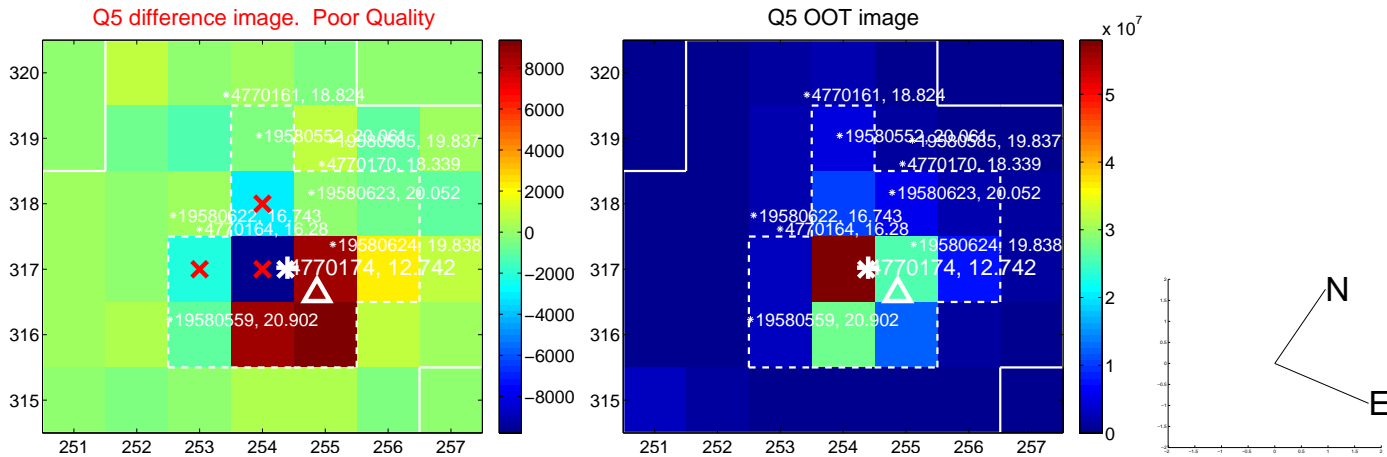
offset from photometric centroids



Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three- $\sigma$ . Red \*: target star. Blue \*: Other stars. Text next to a star gives its KIC ID and kepmag. KIC IDs > 15,000,000 are from the UKIRT catalog.

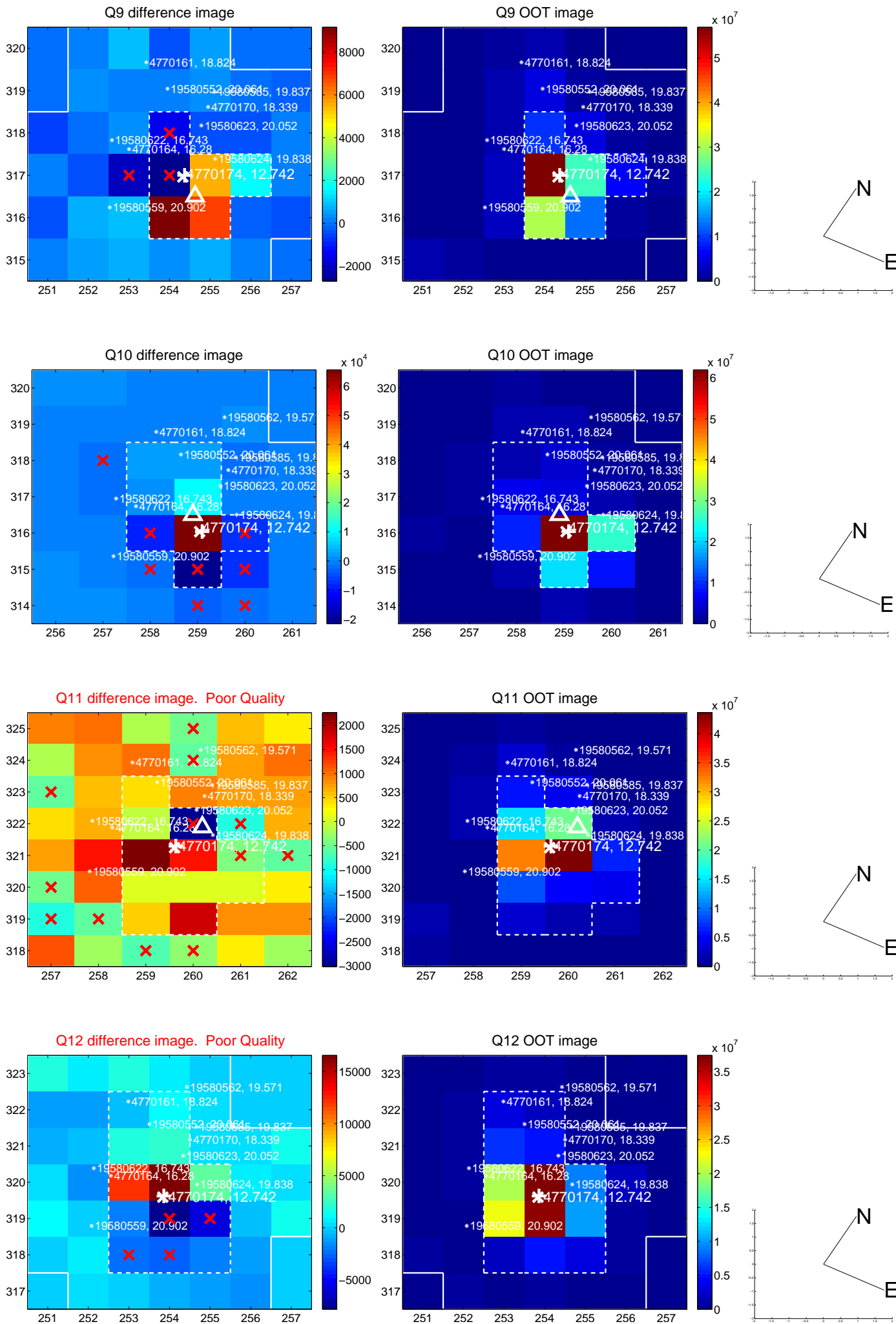


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

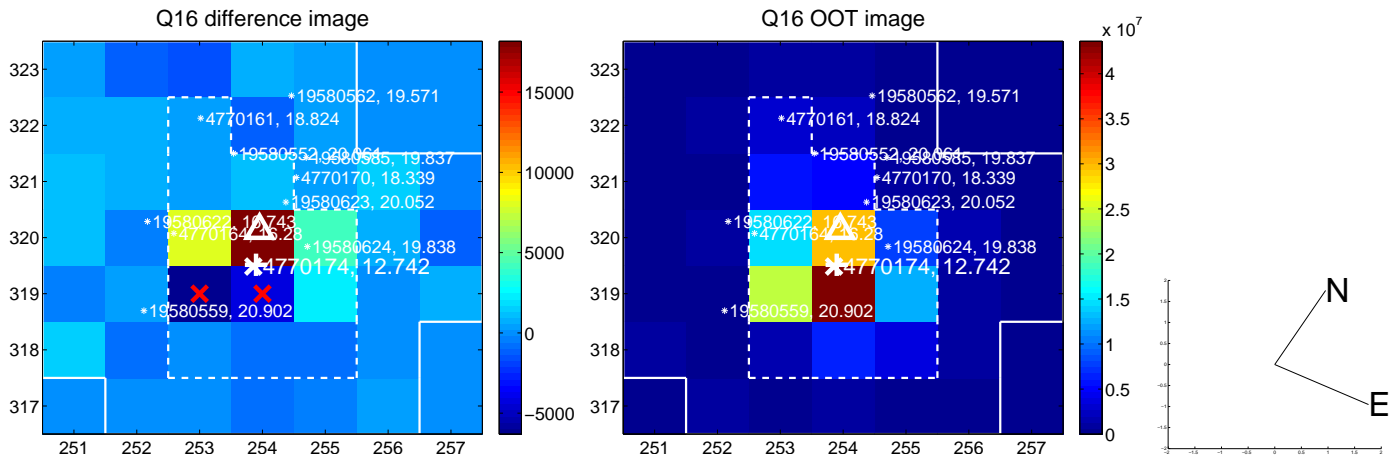
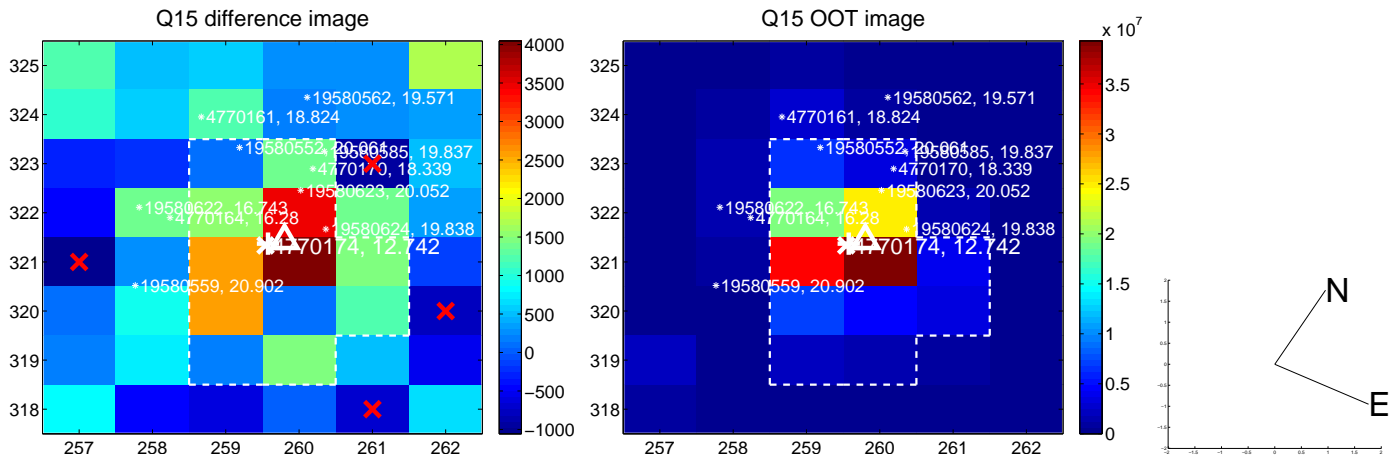
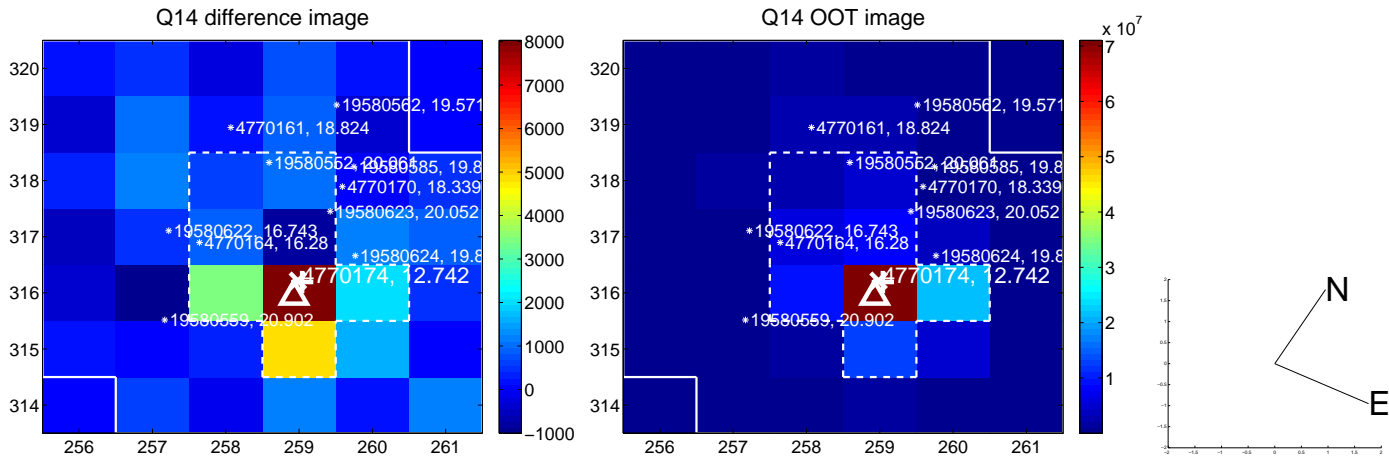
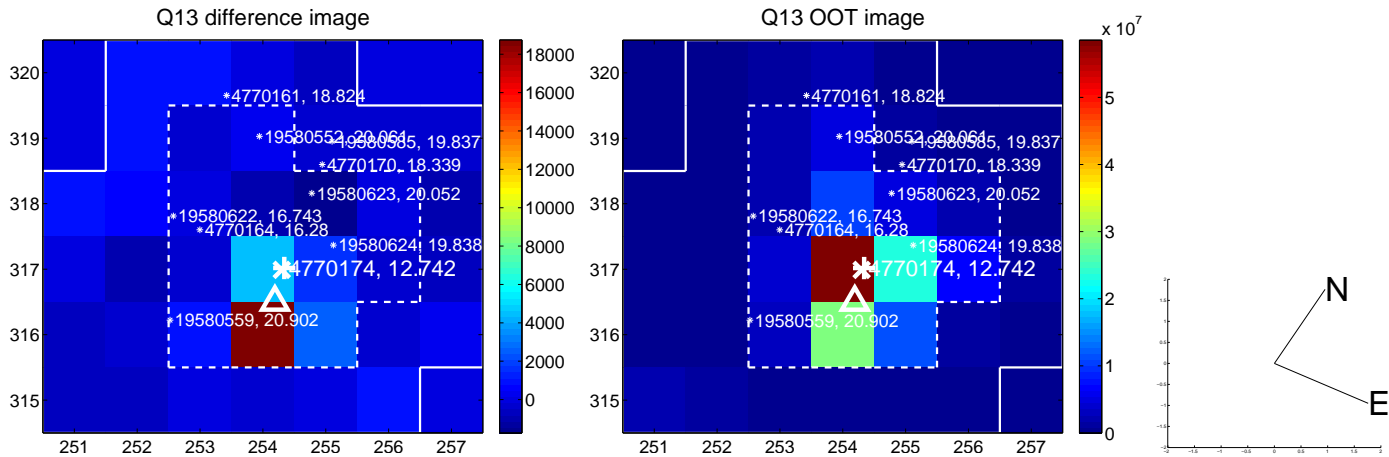




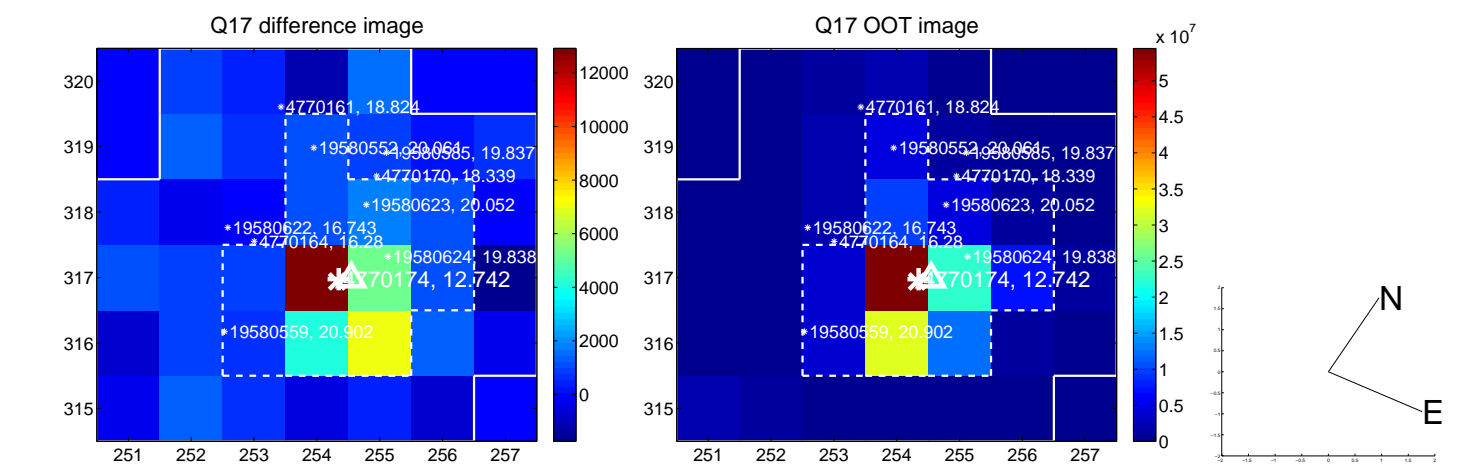
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



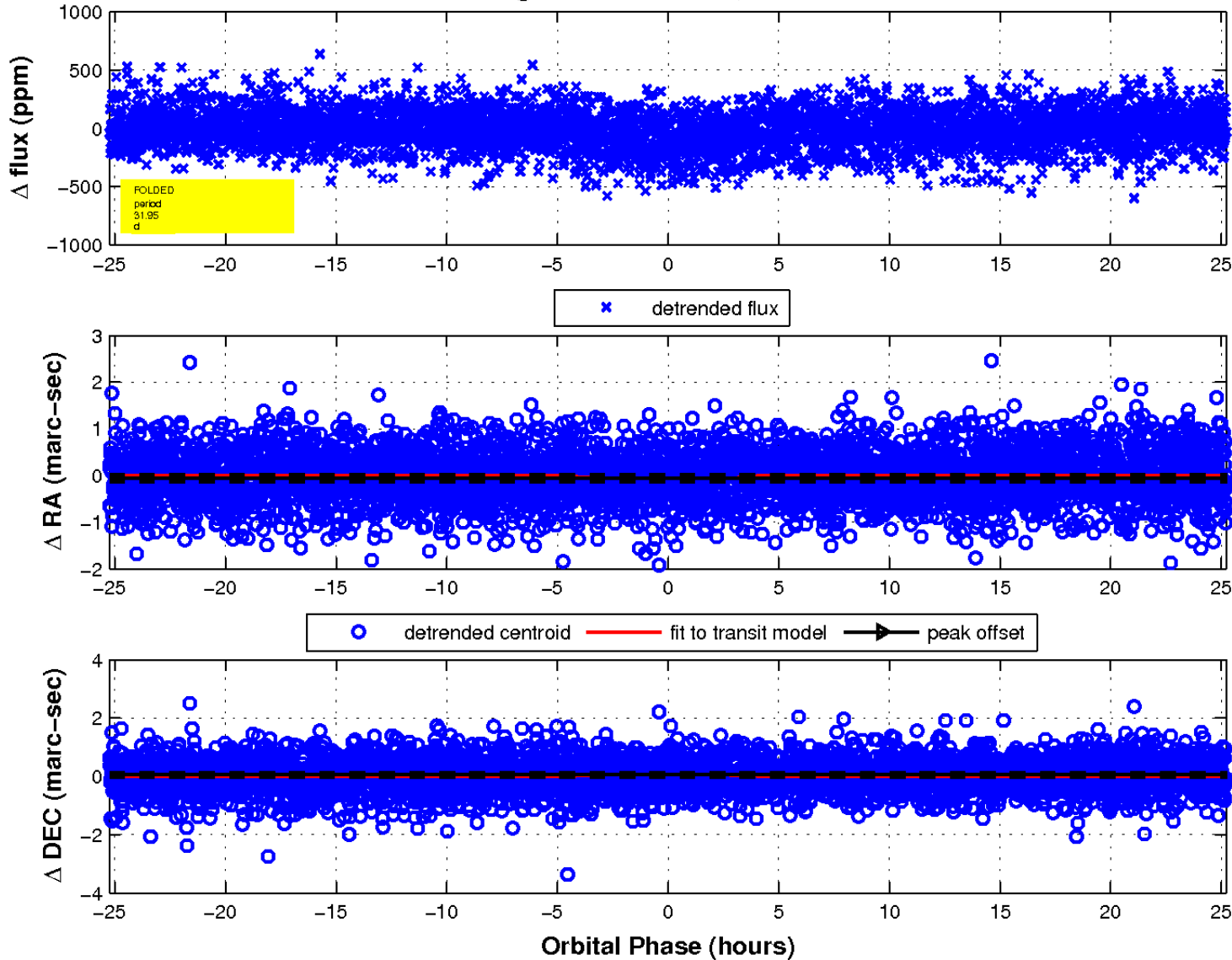
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

Declination

