

# KIC 006778008

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
006778008-01	OBS	4373.01	0.945832	131.616136	102.8	1.499	12.1	14.0	0.86	5959	1.04	2431.26
006778008-02	OBS	No	0.945833	132.089673	93.2	1.741	11.0	13.8	0.86	5959	1.01	2431.26

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
006778008-01	OBS	FP	0.00	0	1	1	1	MOD_SEC_DV—MOD_SEC_ALT—HAS_SEC_TCE—CENT_RESOLVED_OFFSET—EPHEM_MATCH
006778008-02	OBS	FP	0.00	1	1	1	1	IS_SEC_TCE—CENT_RESOLVED_OFFSET—EPHEM_MATCH

**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 006778008-01

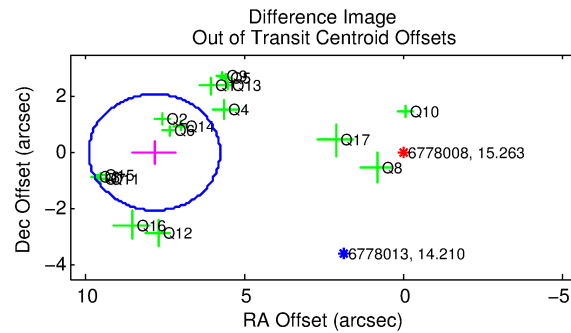
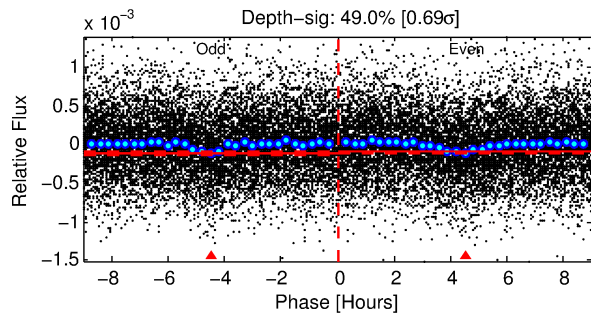
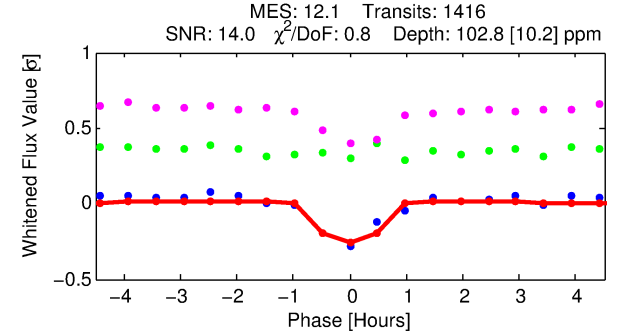
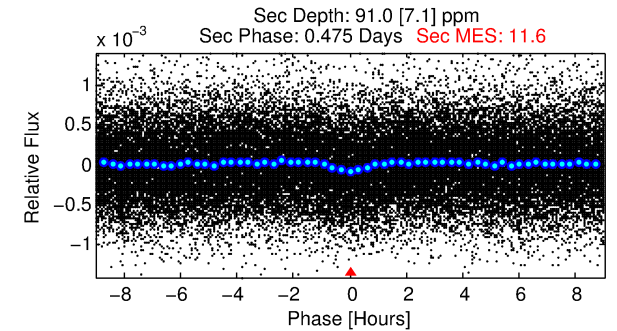
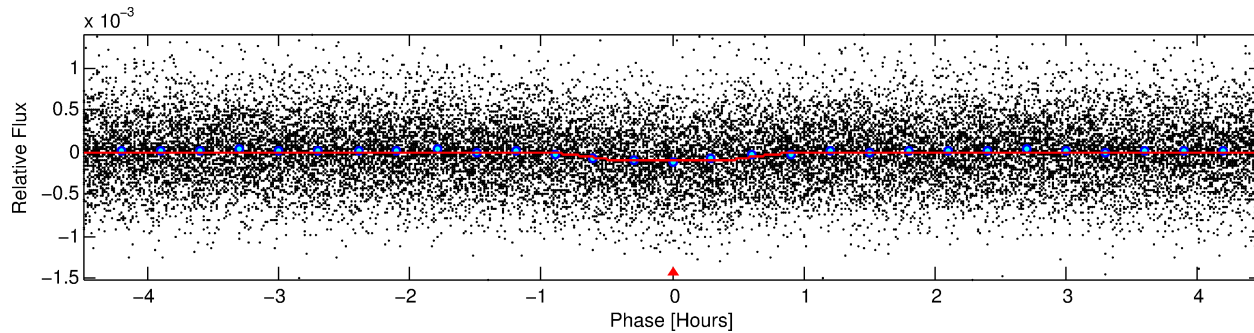
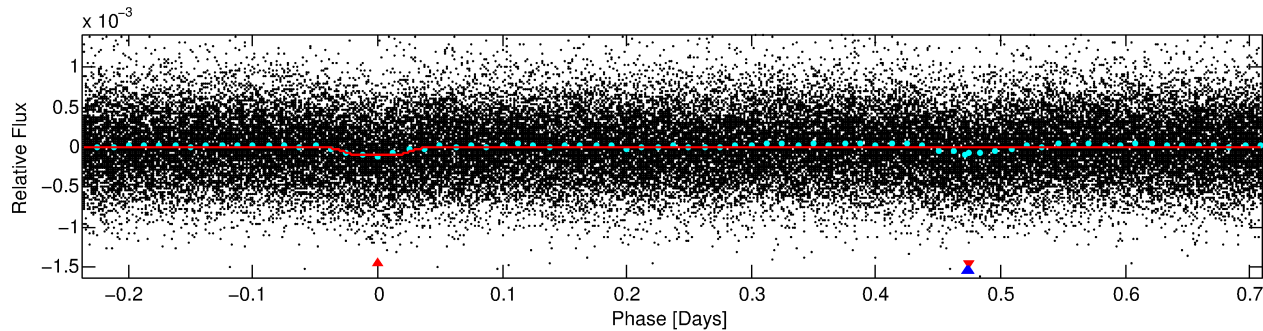
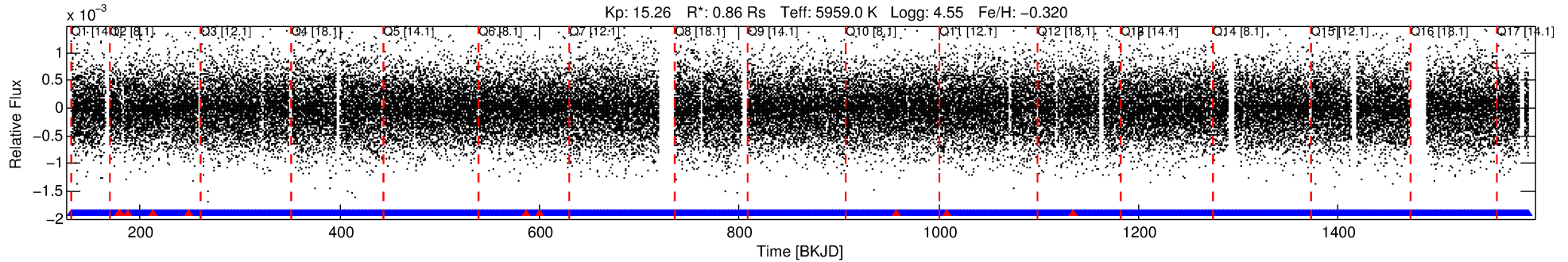
TCE (1)	KIC	Parent (2)	Parent KIC	$P_1:P_2$	Dist ( $''$ )	$\Delta$ Row	$\Delta$ Col	$m_2$	$m_1$	$D_2/D_1$	Mechanism	Flag	$\sigma_P$	$\sigma_T$
006778008-01	6778008	006778050-01	6778050	1:1	22.7	-2	-5	14.51	15.26	2812.50	Direct-PRF	0	0.30	0.24

**Notes:**  $P_1:P_2$  is the period ratio. Dist is the distance in arcseconds.  $\Delta$ Row and  $\Delta$ Col are the number of pixels apart in row and column.  $m_2$  and  $m_1$  are the magnitudes of the parent and child.  $D_2/D_1$  is the parent's transit depth divided by the child's.  $\sigma_P$  and  $\sigma_T$  are the significance of the match in period and epoch. For a match to be considered significant  $\sigma_P < 5.0$  and  $\sigma_T < 5.0$ . Matches which have  $\sigma_P$  and  $\sigma_T$  very close to this cutoff should receive extra scrutiny, especially if the period ratio is very large.

# DV One-Page Summary

KIC: 6778008    Candidate: 1 of 2    Period: 0.946 d

KOI: K04373    Corr: No Ephemeris Match



DV Fit Results:

Period = 0.94583 [0.00001] d

Epoch = 131.6161 [0.0016] BKJD

$$R_p/R^* = 0.0111 [0.0045]$$
$$a/R^* = 2.35 \quad [4.12]$$
$$b = 0.91 [0.43]$$

Coef. 0.421, 0.6 [70]

$$T_{\text{eff}} = 1701.16 [140.16] \text{ K}$$
$$T_{eq} = 1791 [146] \text{ K}$$
$$R_p = 1.04 [0.49] R_e$$
 $a = 0.0185 [0.0038] \text{ AU}$ 
$$Ag = 16.00 [14.02] [1.07\sigma]$$

Teffp = 5536 [1149] K [3.23 $\sigma$ ]

DV Diagnostic Results:

ShortPeriod-sig: N/A

LongPeriod-sig: 0.0% [0.00 $\sigma$ ]

ModelChiSquare2-sig: N/A

ModelChiSquareGof-sig: N/A

Bootstrap-pfa: 1.58e-34

RollingBand-fgt: 0.99 [1341/135]

GhostDiagnostic-chr: -0.5068

Quotient: 0.00%

Centroid-sig: 0.0%  
Centroid-co: 6.615 eeeee [8.50]

Centroid-so: 6.615 arcsec [8.52 $\sigma$ ]  
CatOffset\_xxx: 7.842 arcsec [11.88 $\sigma$ ]

KiaOffset-rm: 7.872 arcsec [11.10 $\sigma$ ]

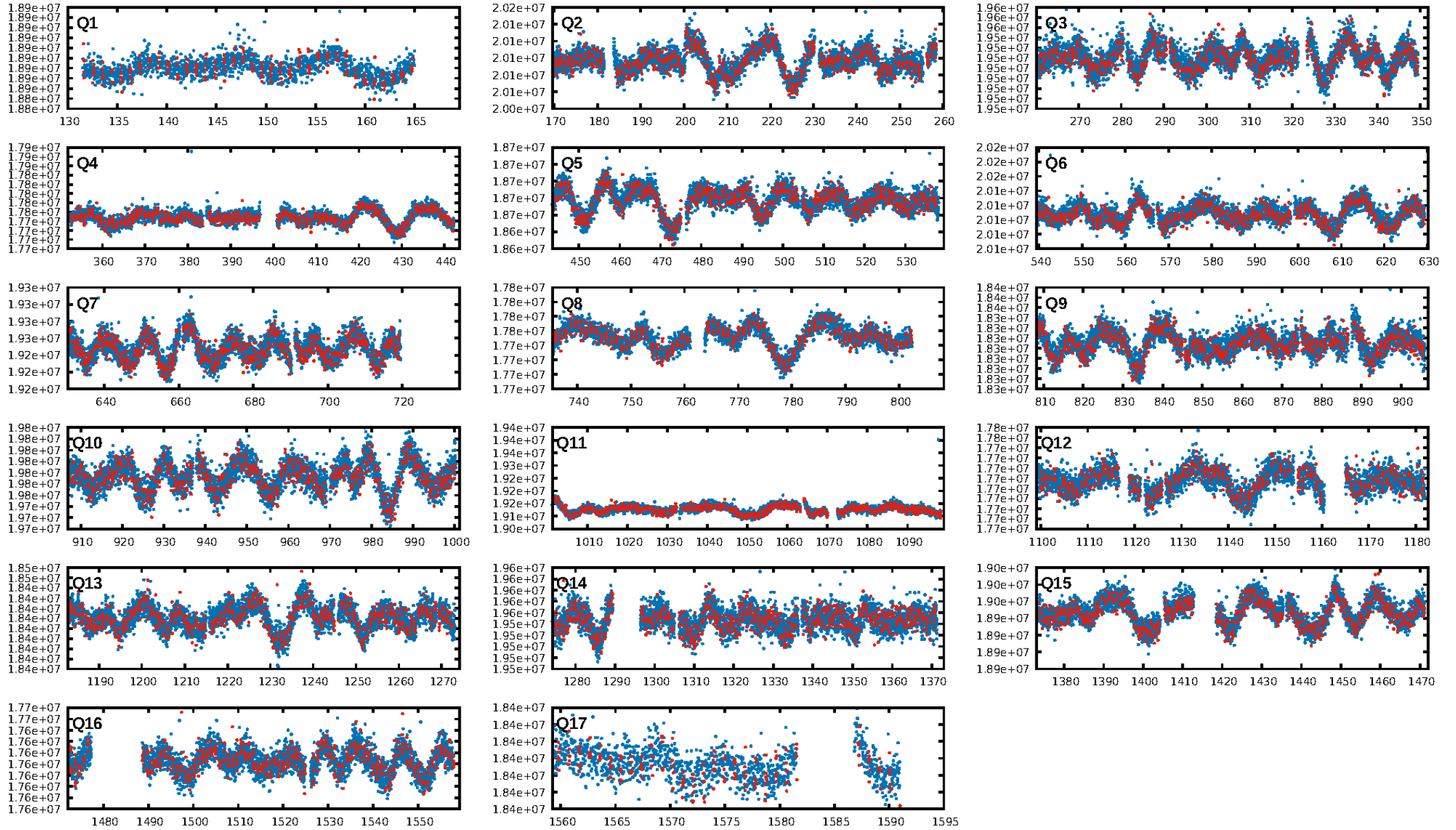
KicOffset-rm: 7.873 arcsec [11.19 $\sigma$ ]  
QatOffset-rt: 4.444/5 [1.7]

KicOffset-st: 4/4/4/5 [17]

**Software Revision:** svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- **Date Generated:** 29-Jan-2016 23:24:01 Z

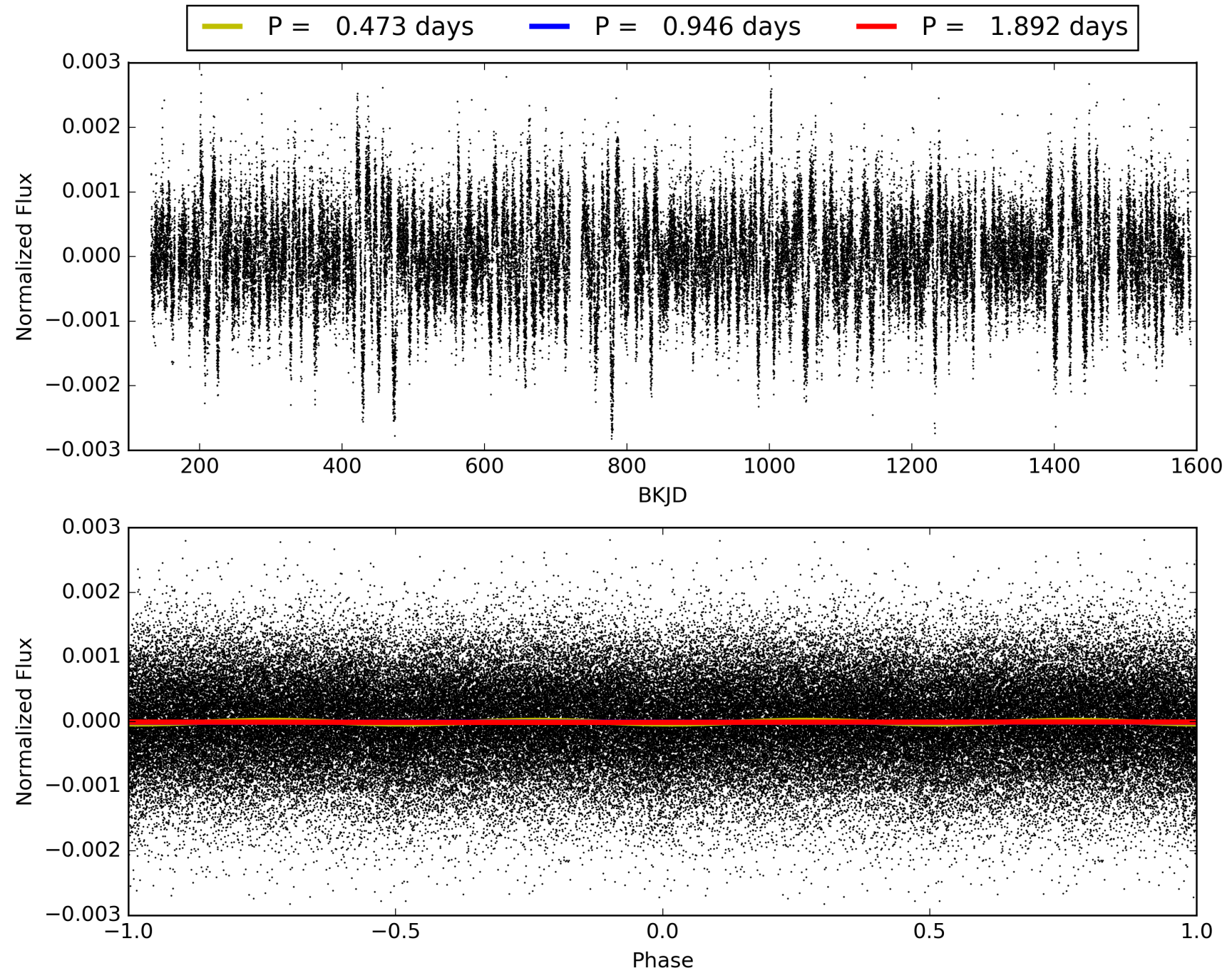
**This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center**

# TCE 006778008-01, PDC Light Curves



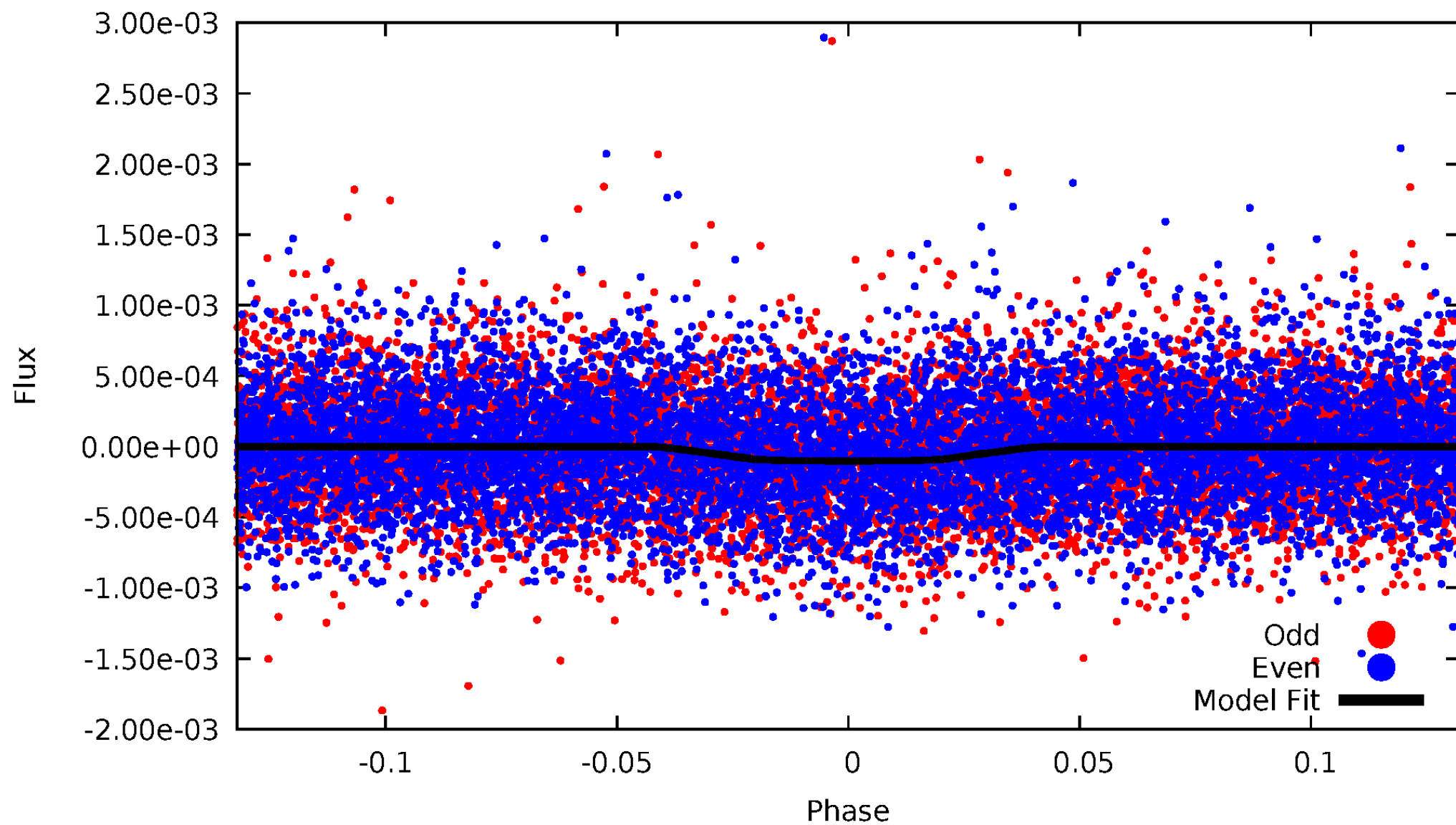


TCE 006778008-01



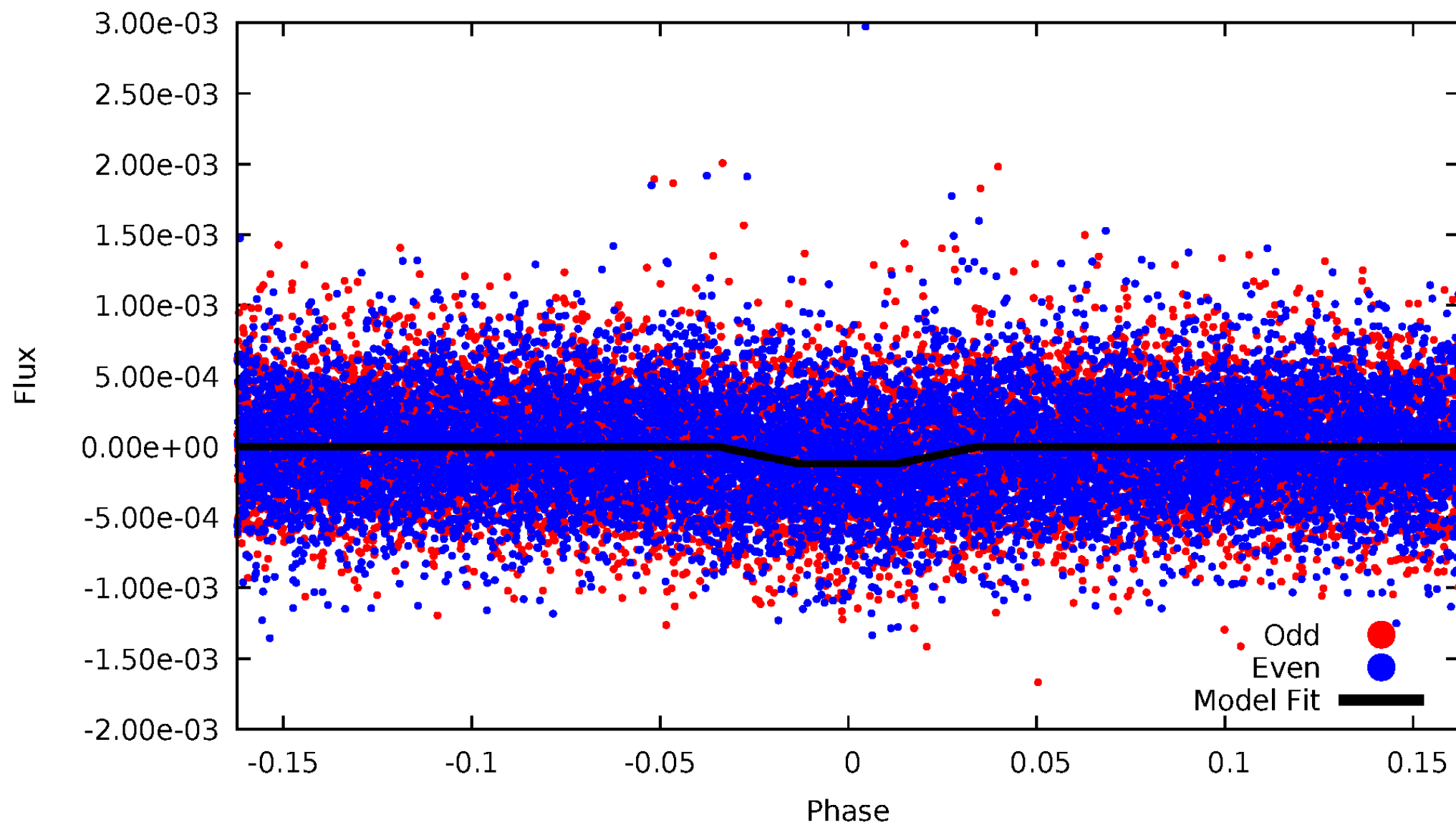
# DV Odd/Even

TCE 006778008-01



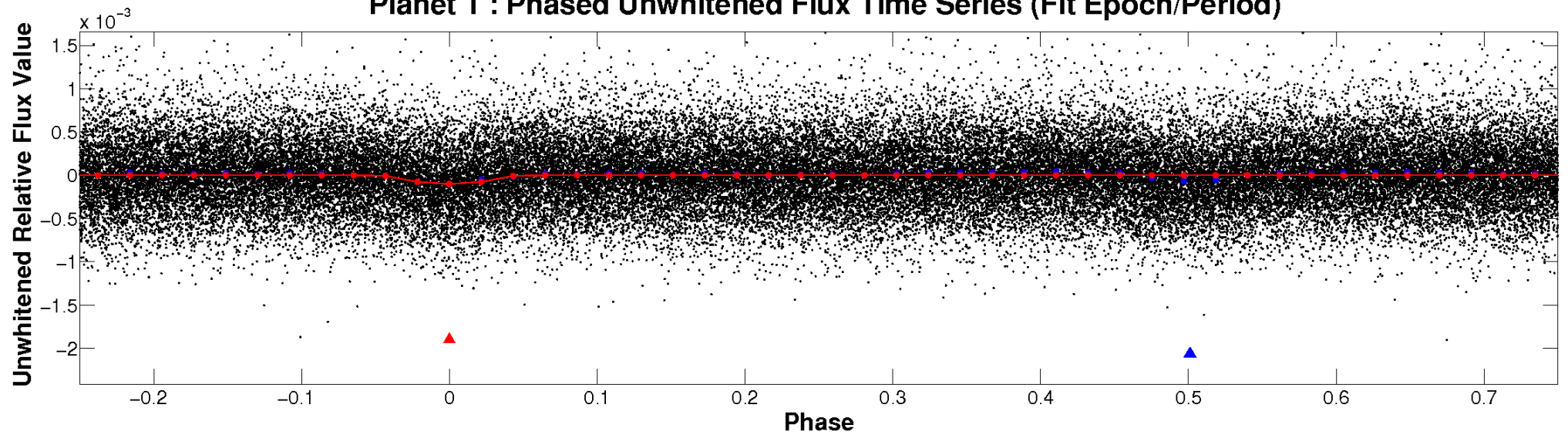
# ALT Odd/Even

TCE 006778008-01

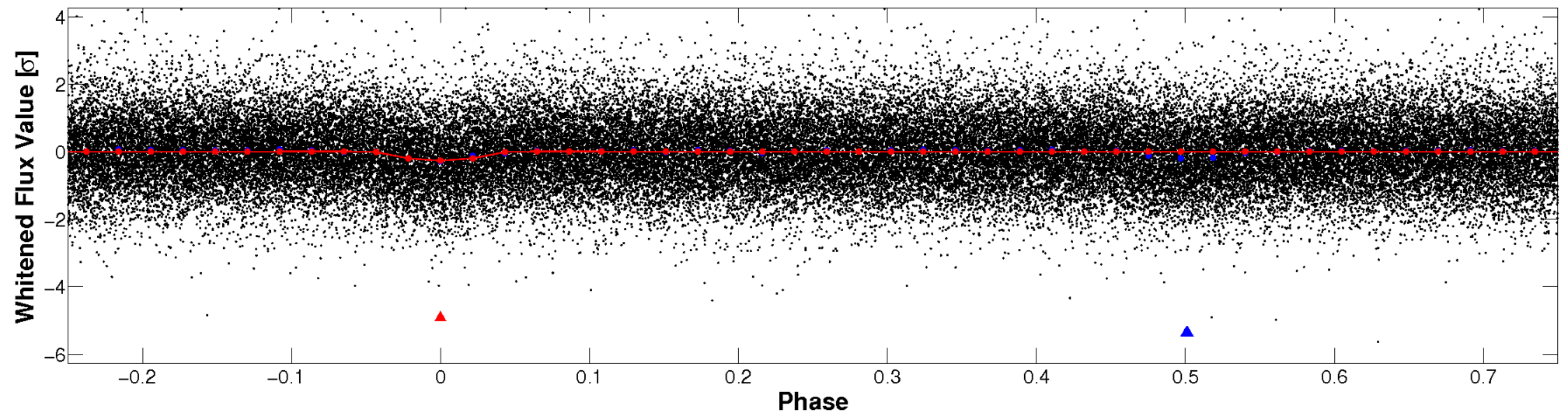


# Non-Whitened Vs. Whitened Light Curve

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



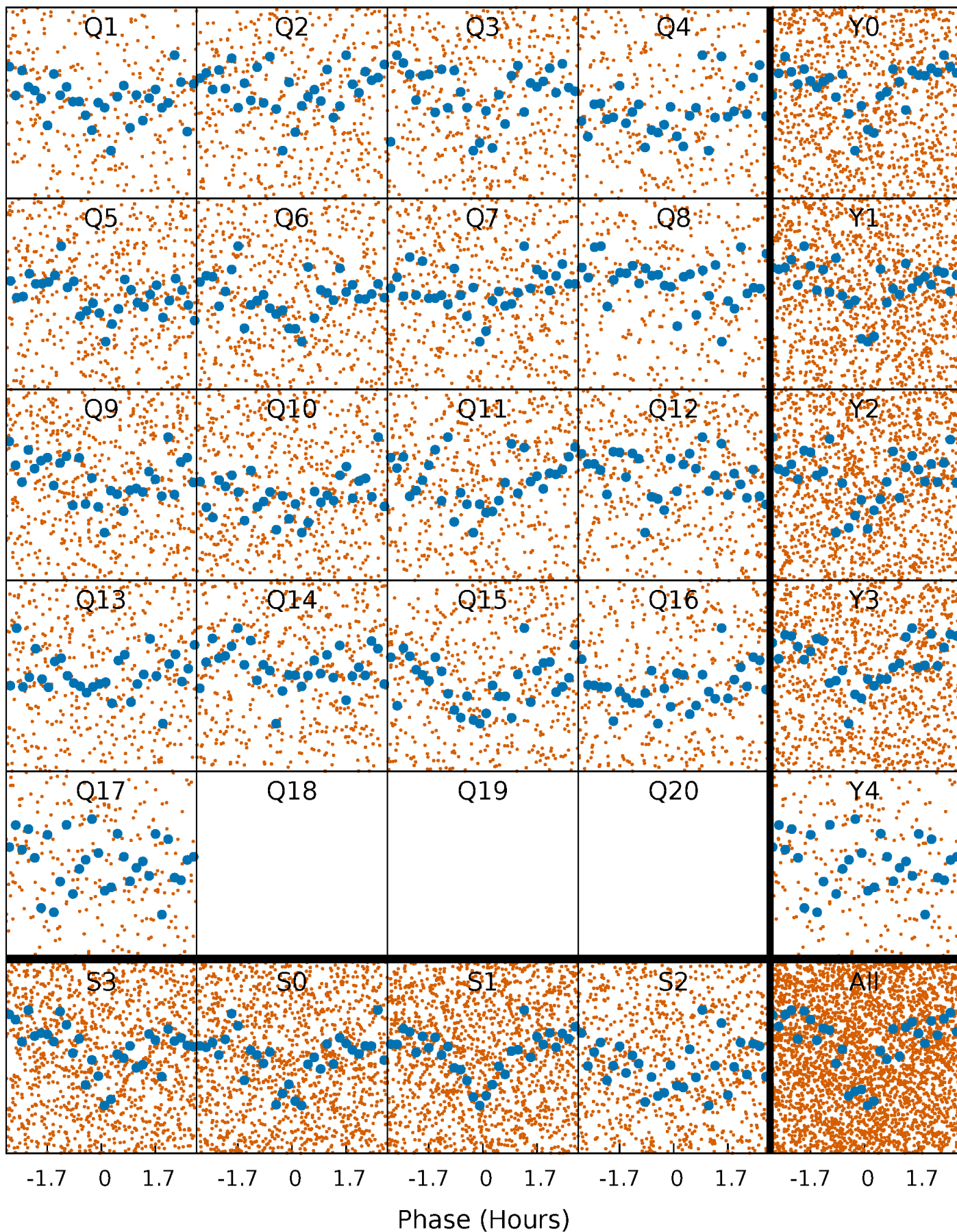
**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**





# PDC Quarter-Phased Transit Curves

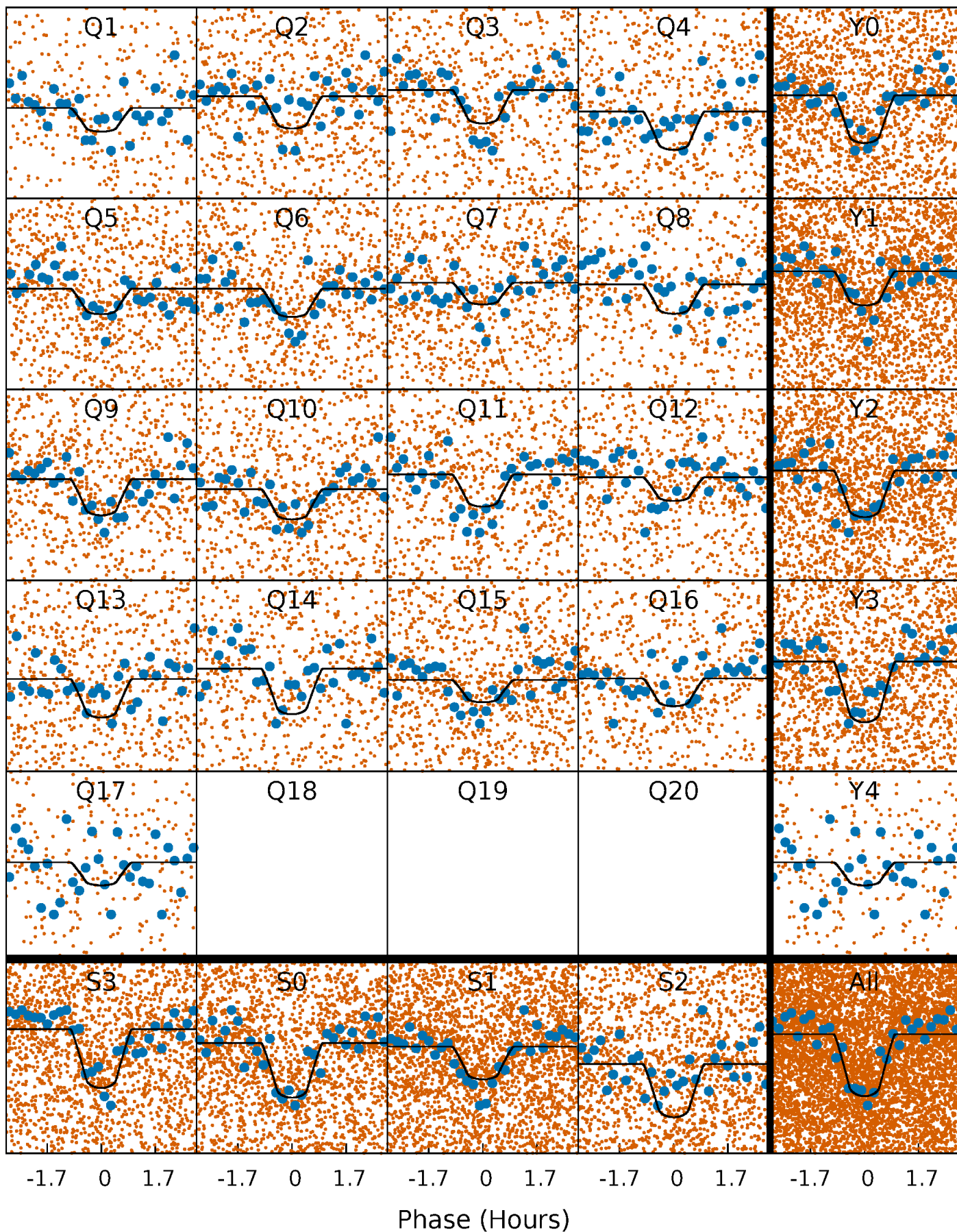
TCE 006778008-01 P= 0.945832 Days  $T_0=131.616136$  (BKJD)





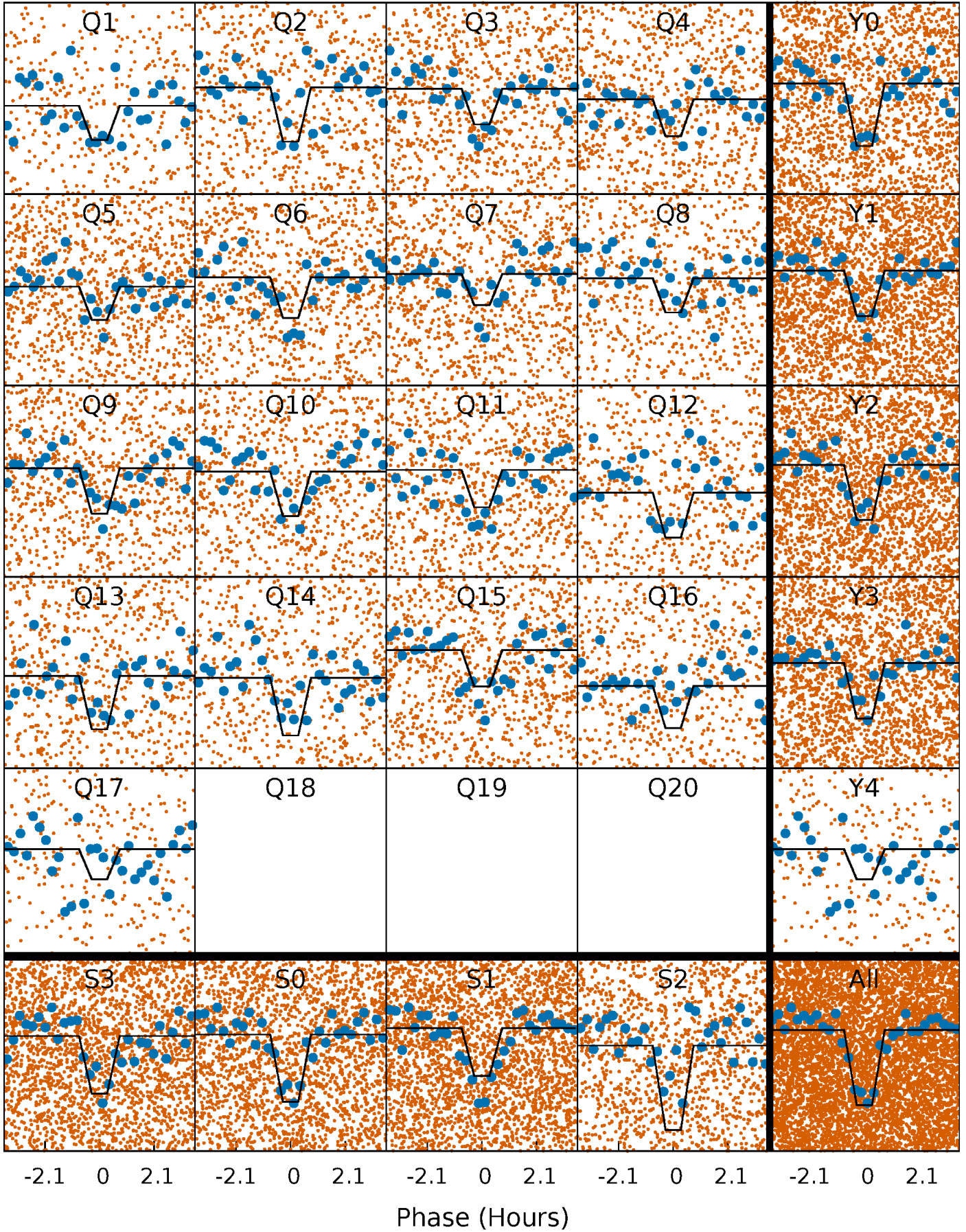
# DV Quarter-Phased Transit Curves

TCE 006778008-01 P= 0.945832 Days  $T_0=131.616136$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

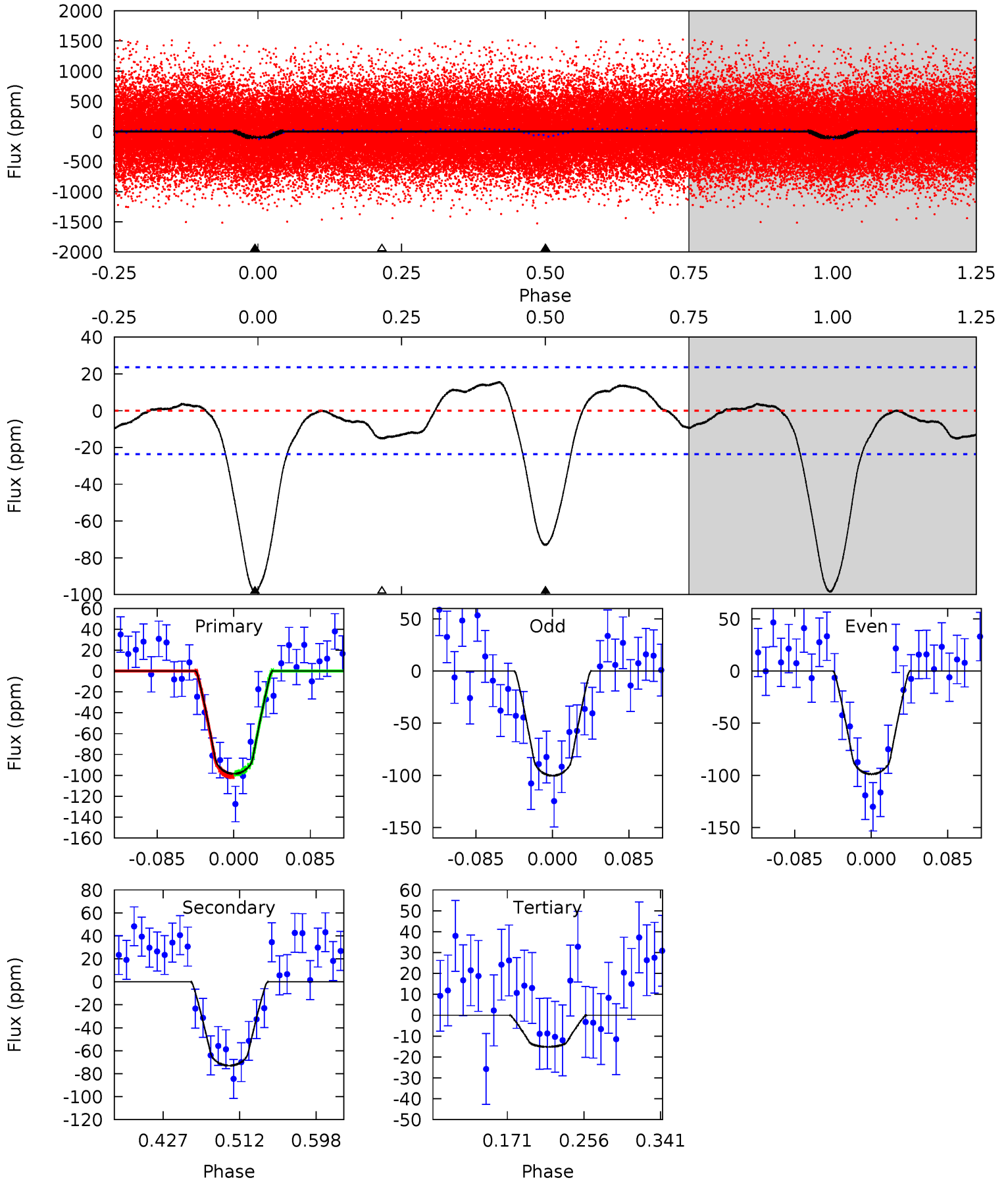
TCE 006778008-01 P= 0.945824 Days  $T_0=131.619015$  (BKJD)



# DV Model-Shift Uniqueness Test

006778008-01, P = 0.945832 Days, E = 130.670304 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
19.1	14.2	2.95	0	4.60	1.72	1.70	16.2	19.1	11.2	14.2	0.14	0.96	0.14	0.25

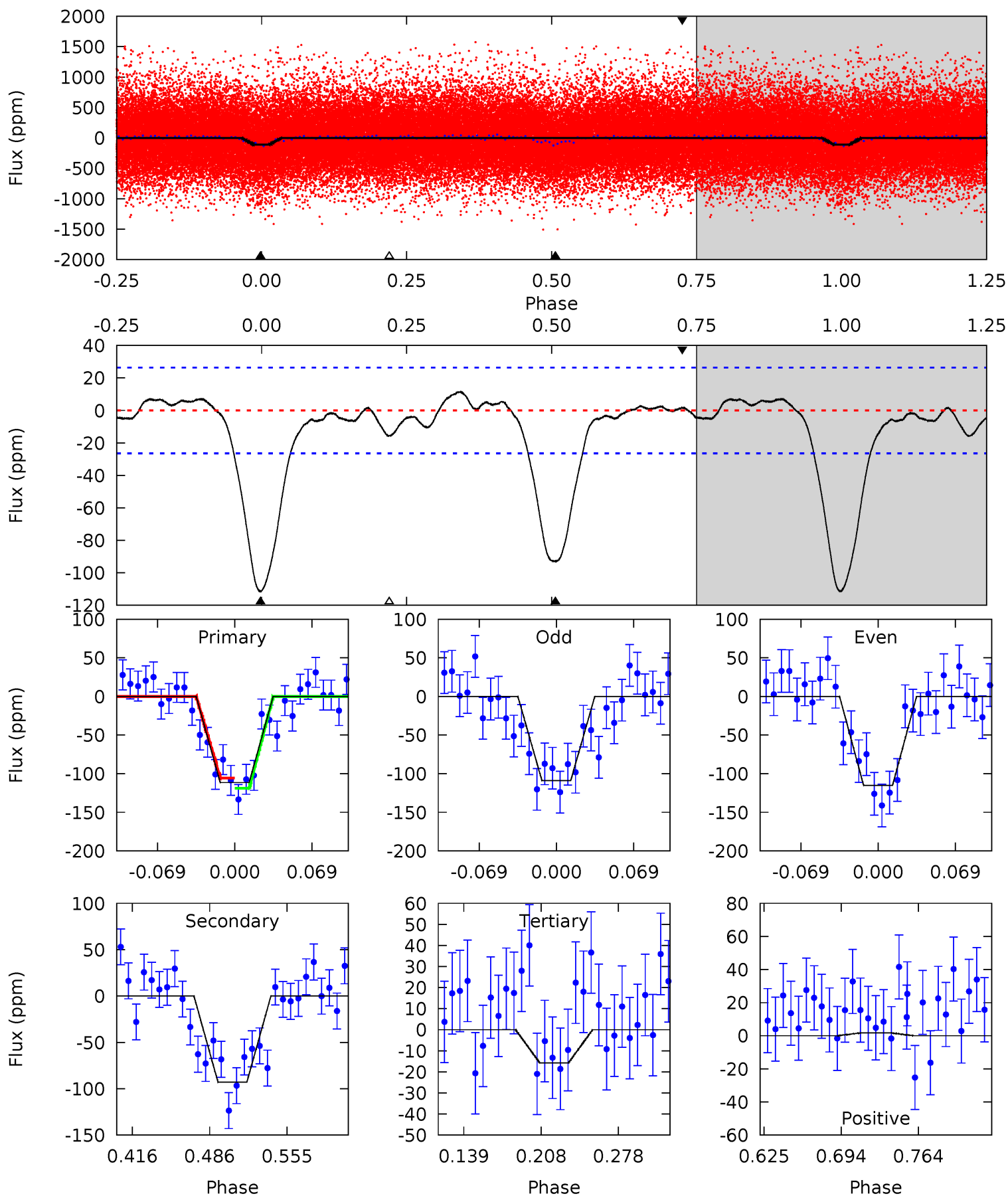




# Alt Model-Shift Uniqueness Test

006778008-01, P = 0.945824 Days, E = 130.673191 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
19.6	16.3	2.76	0.31	4.64	1.82	1.00	16.8	19.3	13.6	16.0	0.58	0.92	0.09	1.18





### Stellar Parameters For KIC 006778008

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5959^{+160}_{-178}$	$4.546^{+0.042}_{-0.168}$	$-0.320^{+0.300}_{-0.300}$	$0.859^{+0.209}_{-0.075}$	$0.948^{+0.098}_{-0.120}$	$2.104^{+0.450}_{-0.924}$
	+3%/-3%	+1%/-4%	+94%/-94%	+24%/-9%	+10%/-13%	+21%/-44%
Source	PHO1	KIC0	KIC0	DSEP		

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

### Secondary Eclipse Parameters for KIC 006778008-01 / KOI 4373.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-73 \pm 5$	$1.07^{+0.48}_{-0.44}$	$2557^{+146}_{-111}$	$5262^{+1546}_{-758}$	$12^{+22}_{-6}$
Alt.	$-93 \pm 6$	$1.06^{+0.44}_{-0.45}$	$2541^{+156}_{-104}$	$5570^{+1848}_{-811}$	$15^{+31}_{-8}$

$T_{max}$  = 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

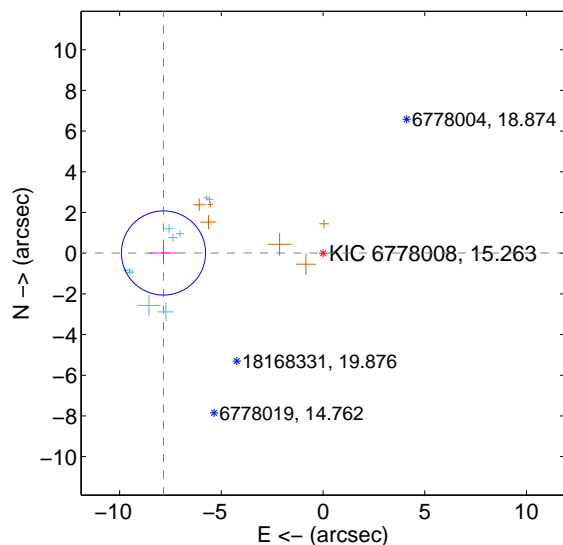
Supplemental centroid analysis for 006778008-01. Kepler magnitude: 15.26. Transit SNR 14.03

There are 11 quarters with good PRF difference image offsets

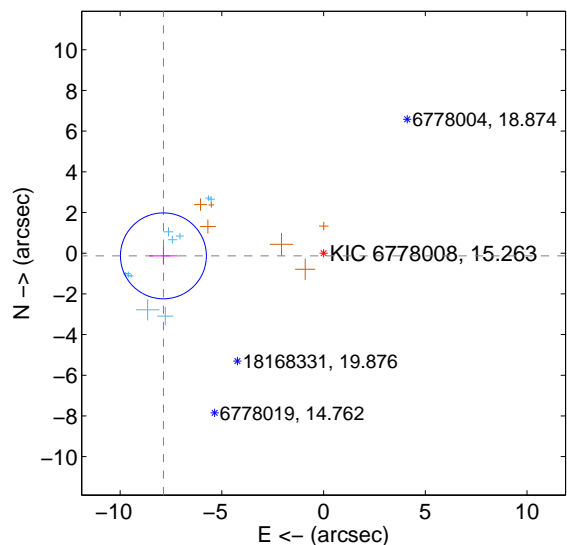
The direct PRF centroid is offset from the target star catalog position by about 0.07 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$7.842 \pm 0.689$	<b>11.38</b>	$7.842 \pm 0.689$	$0.010 \pm 0.408$
PRF-fit source offset from KIC position	$7.873 \pm 0.704$	<b>11.19</b>	$7.872 \pm 0.701$	$-0.131 \pm 0.422$
photometric centroid source offset	$6.62 \pm 0.78$	<b>8.52</b>	$4.91 \pm 0.75$	$4.43 \pm 0.81$

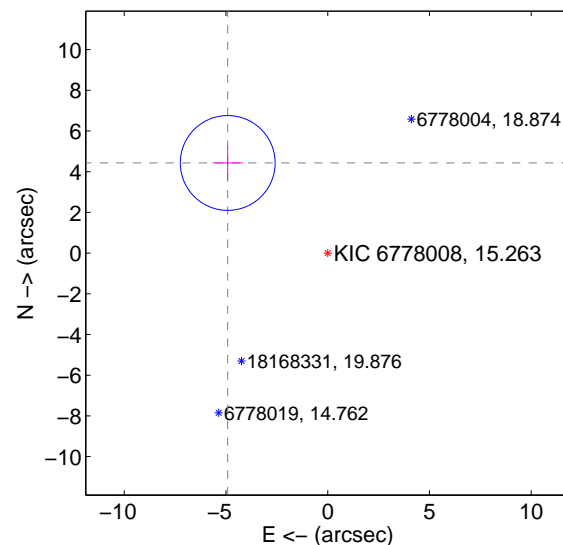
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

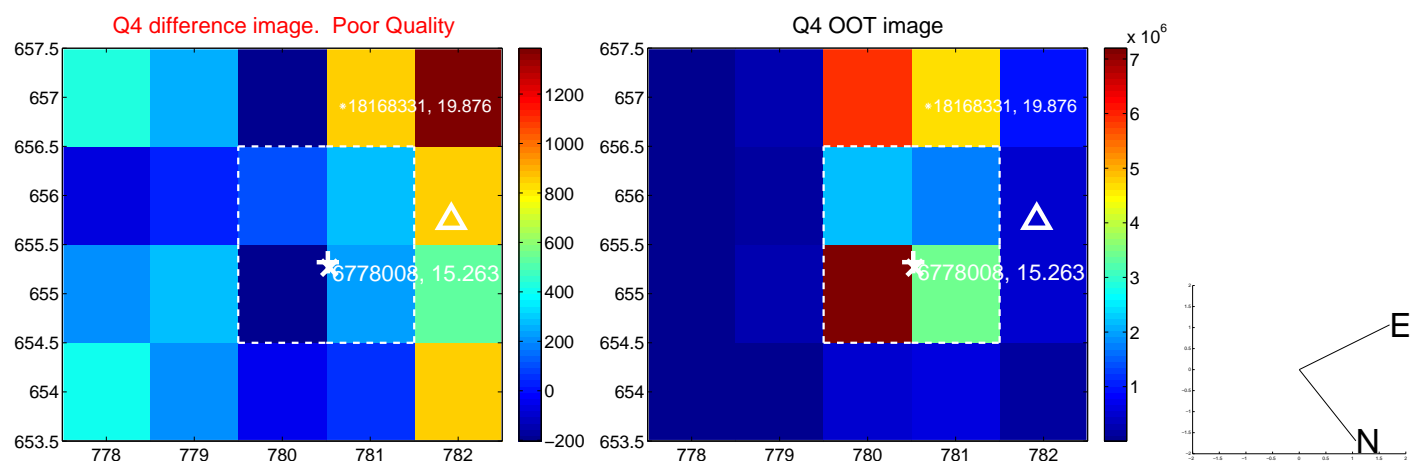
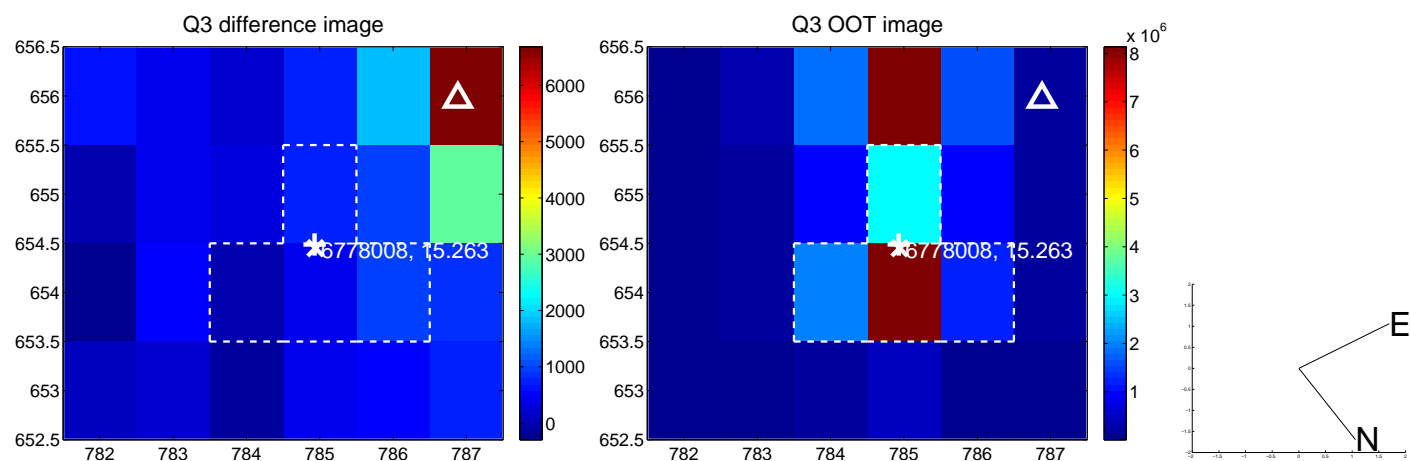
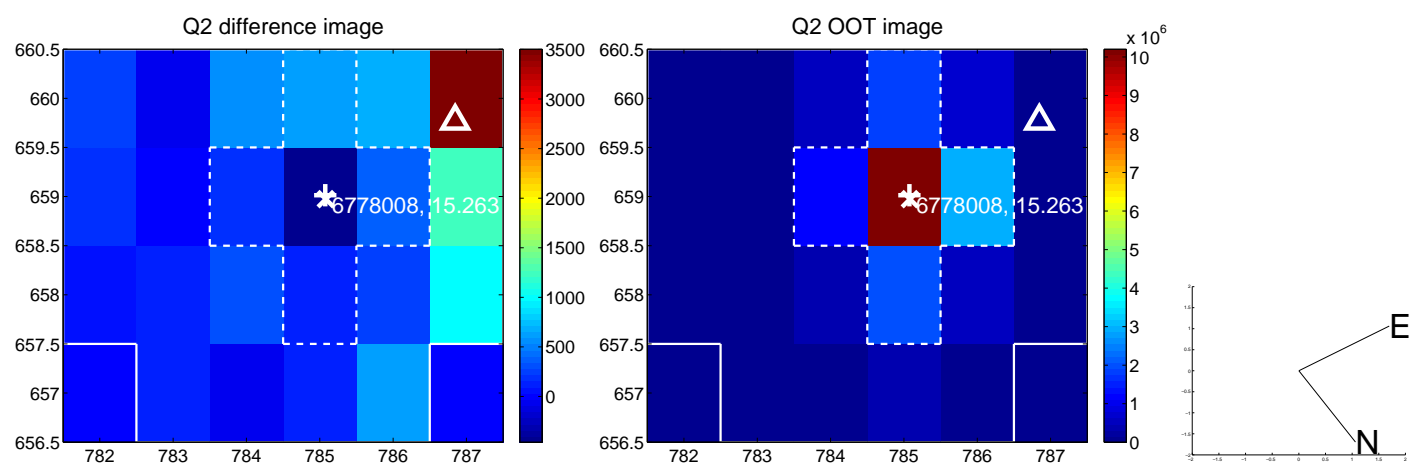
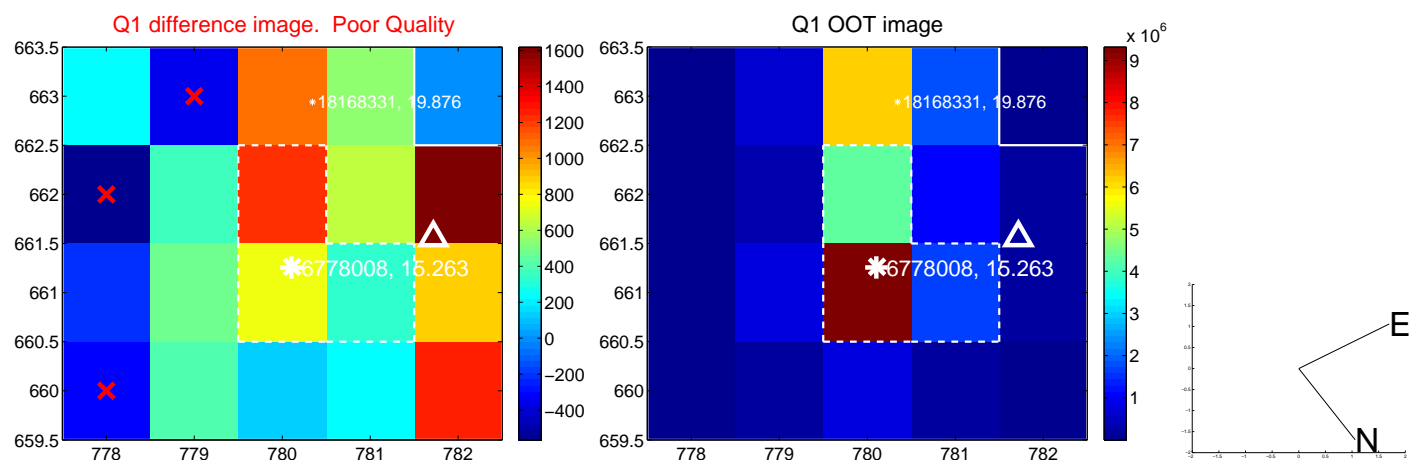


offset from photometric centroids

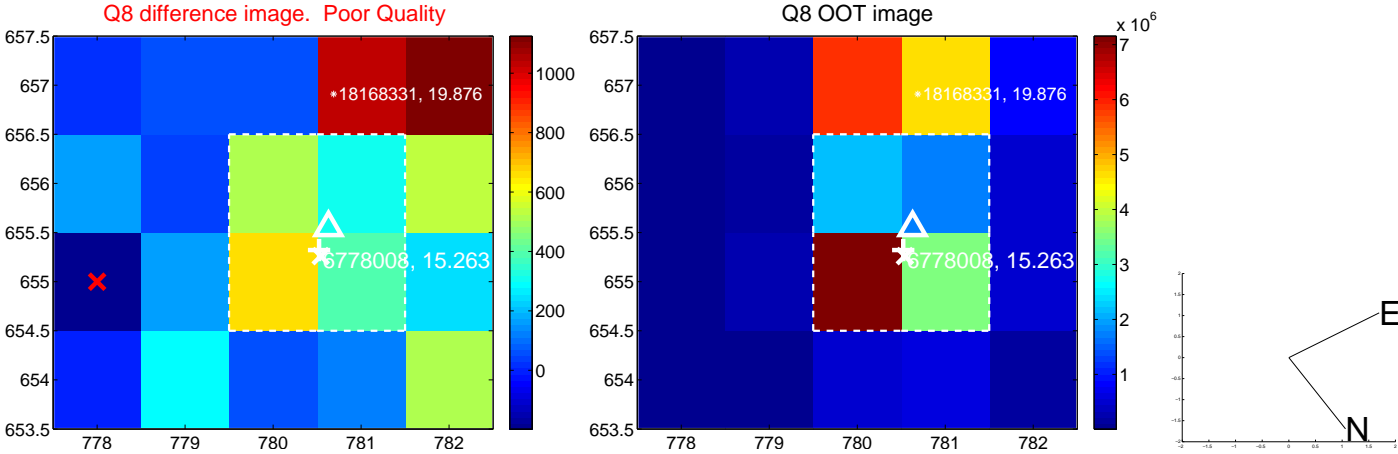
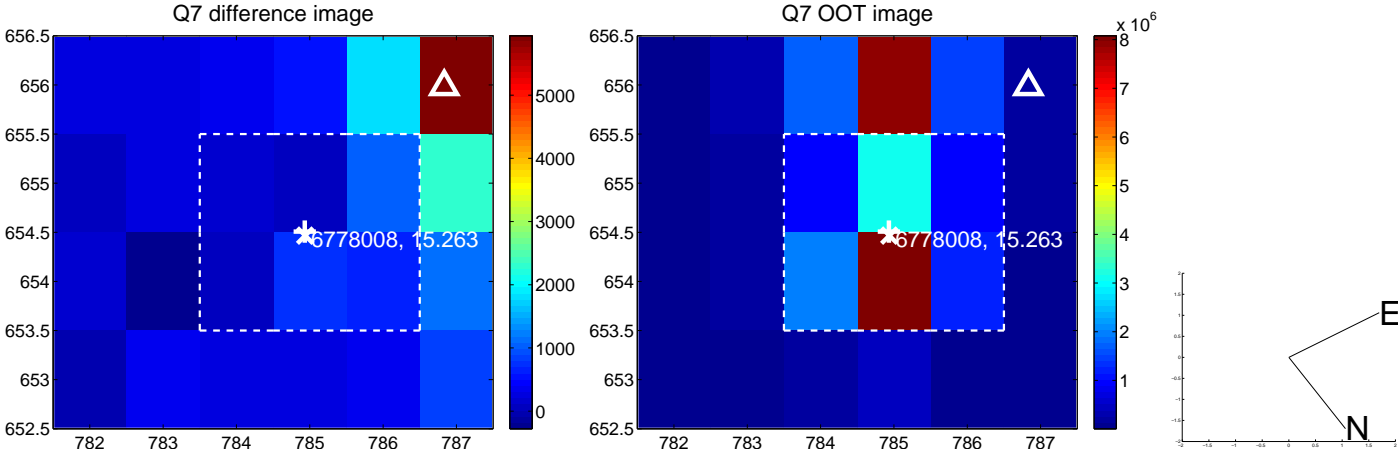
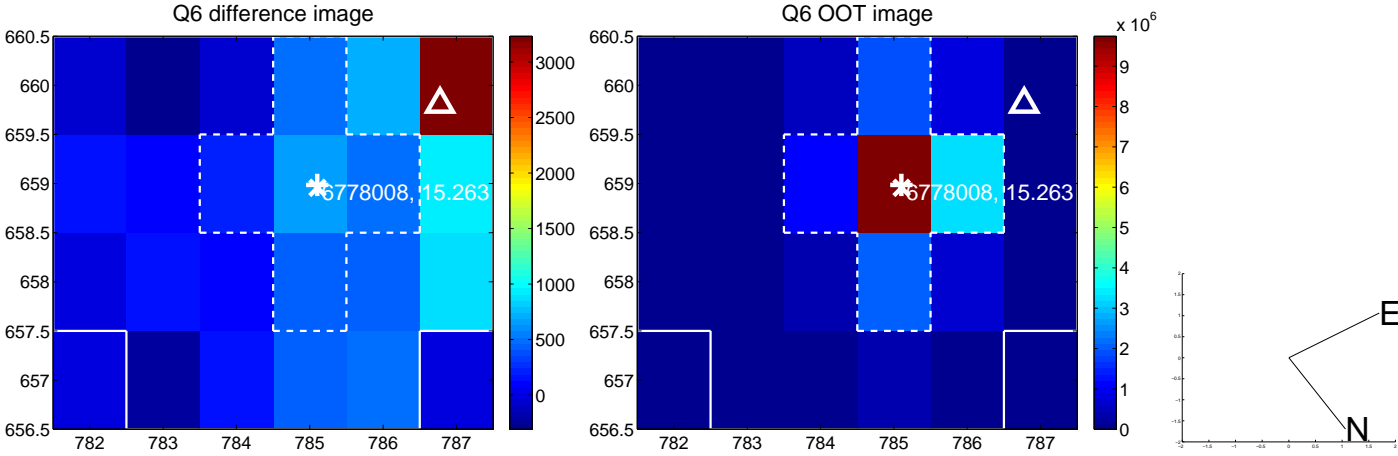
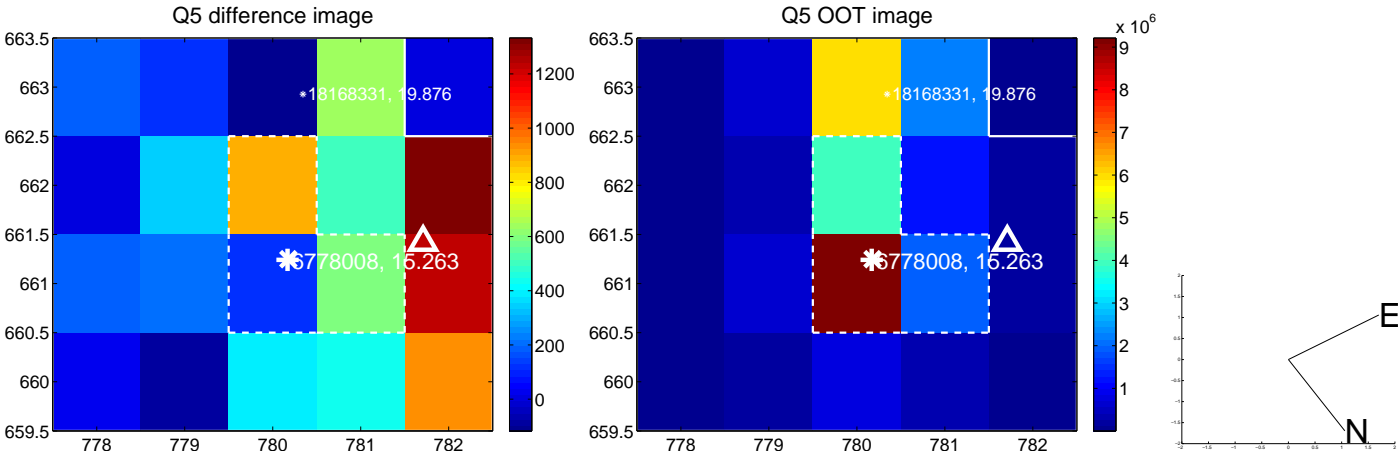


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: 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

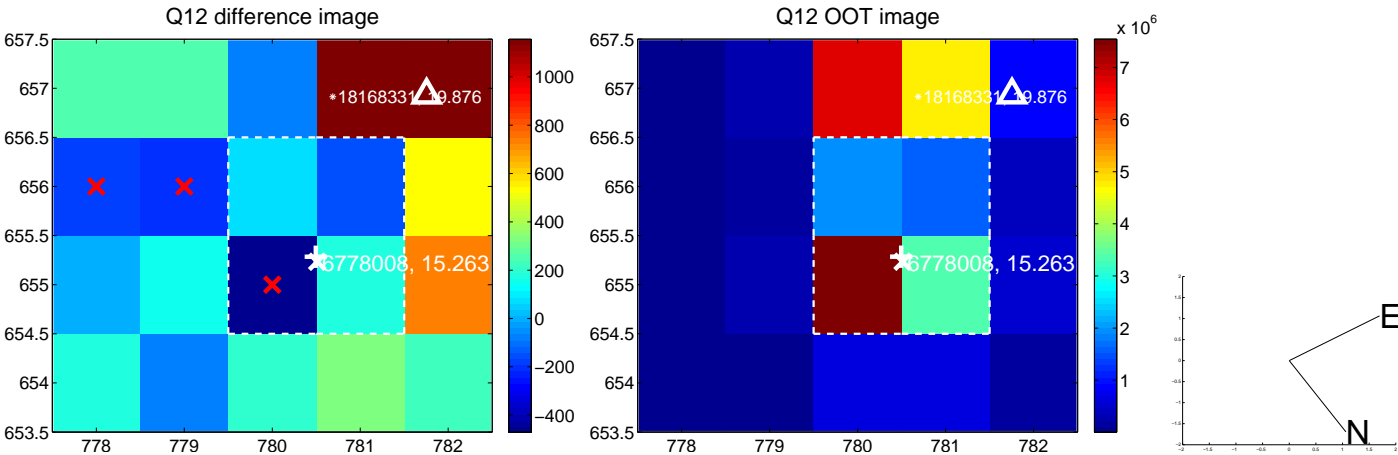
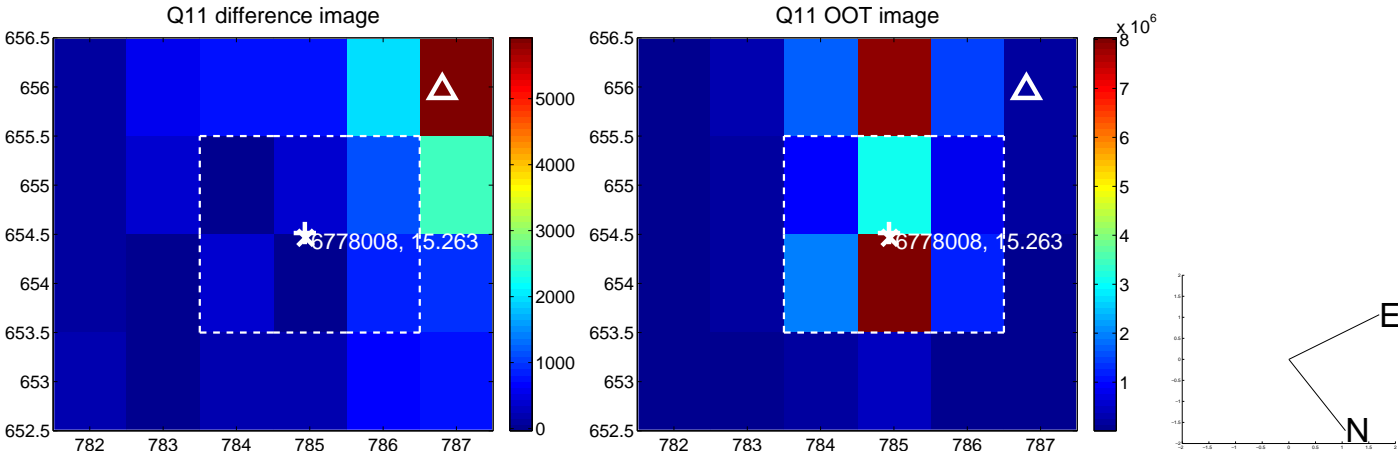
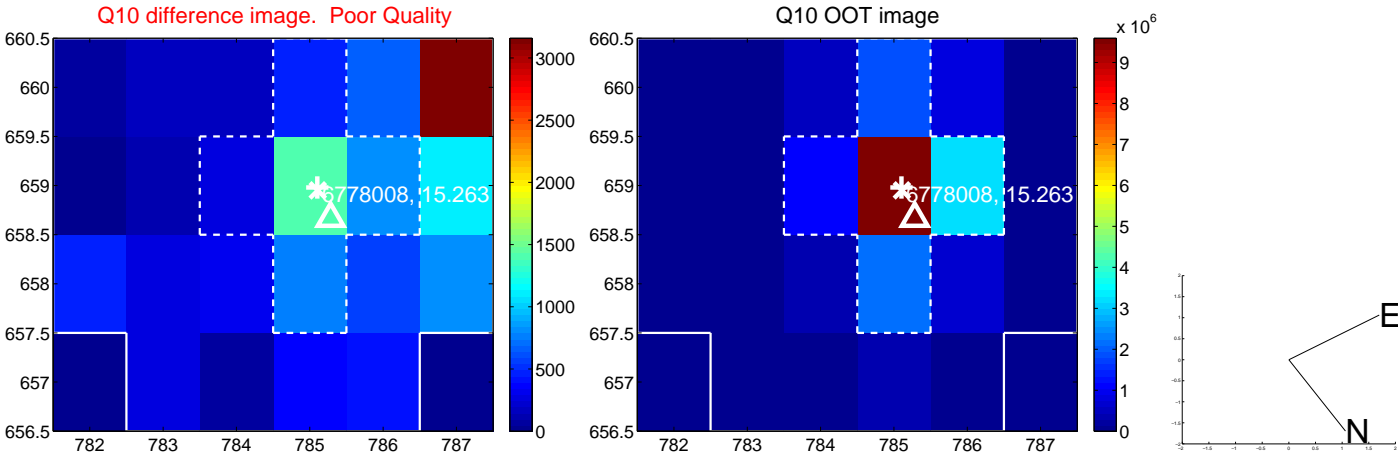
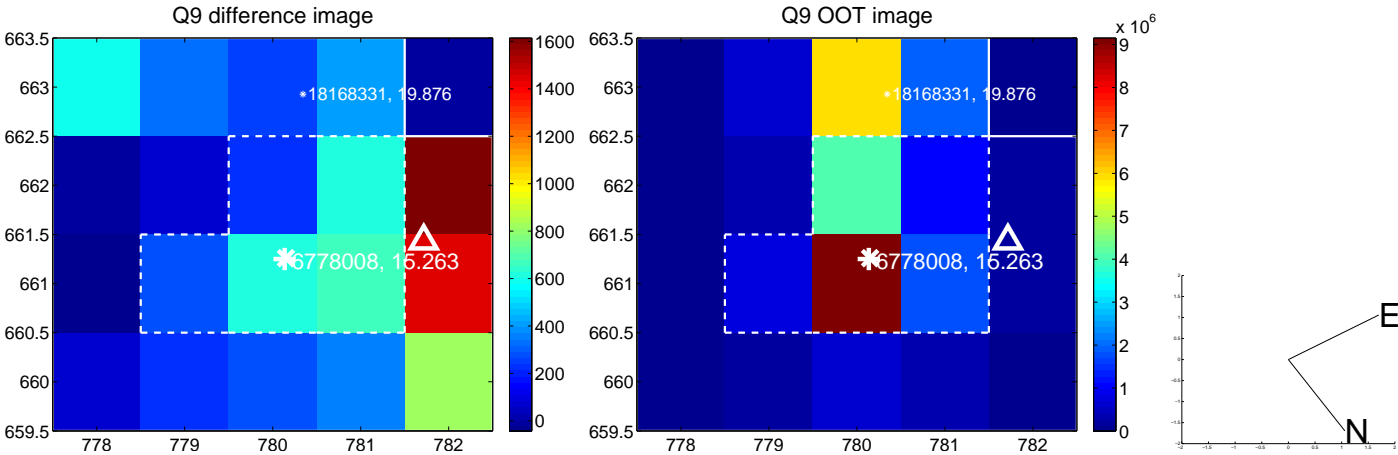


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

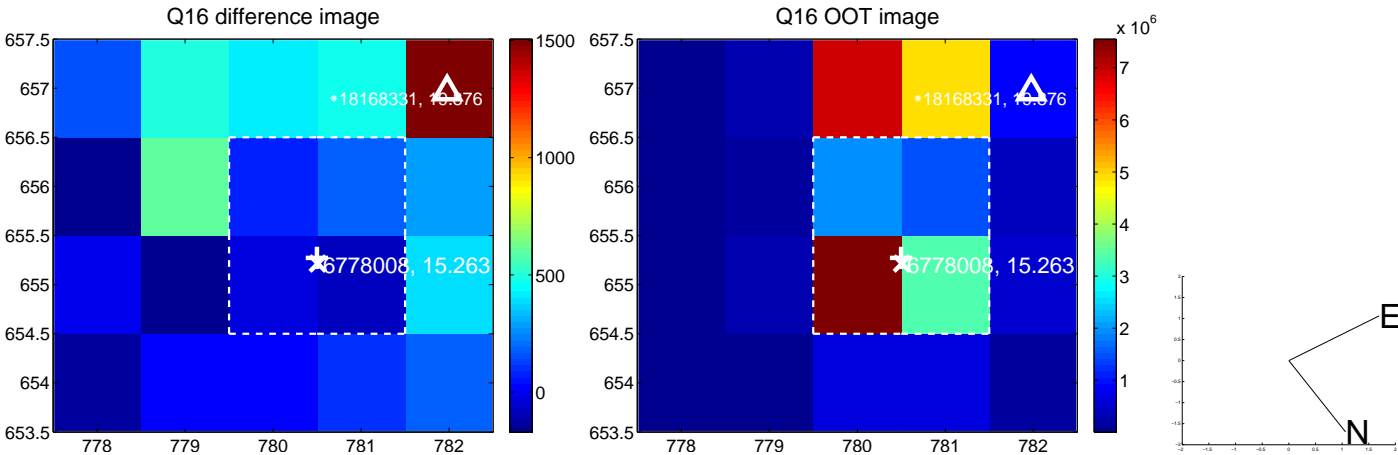
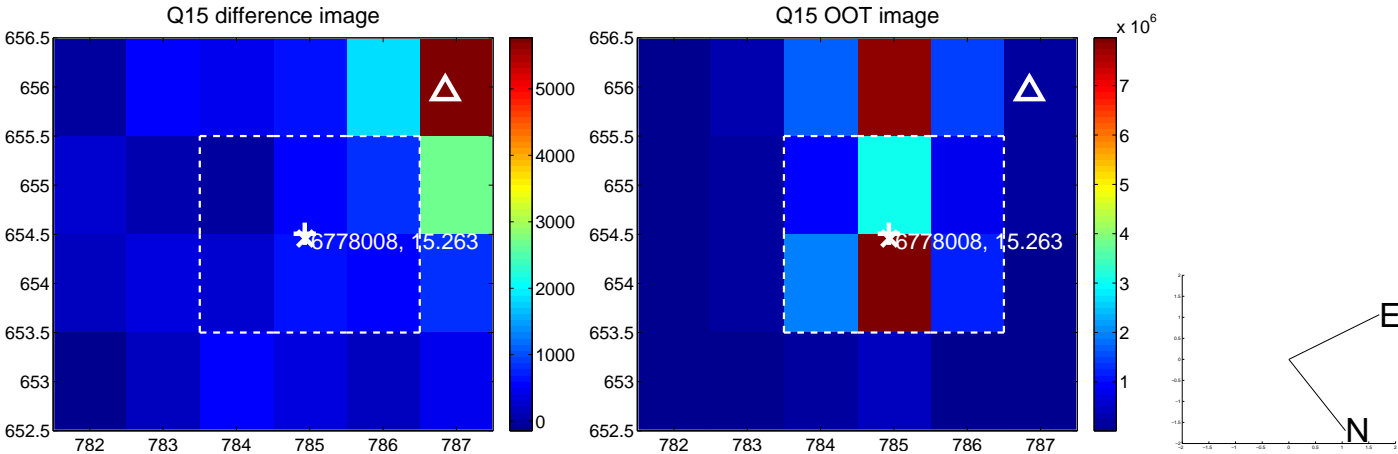
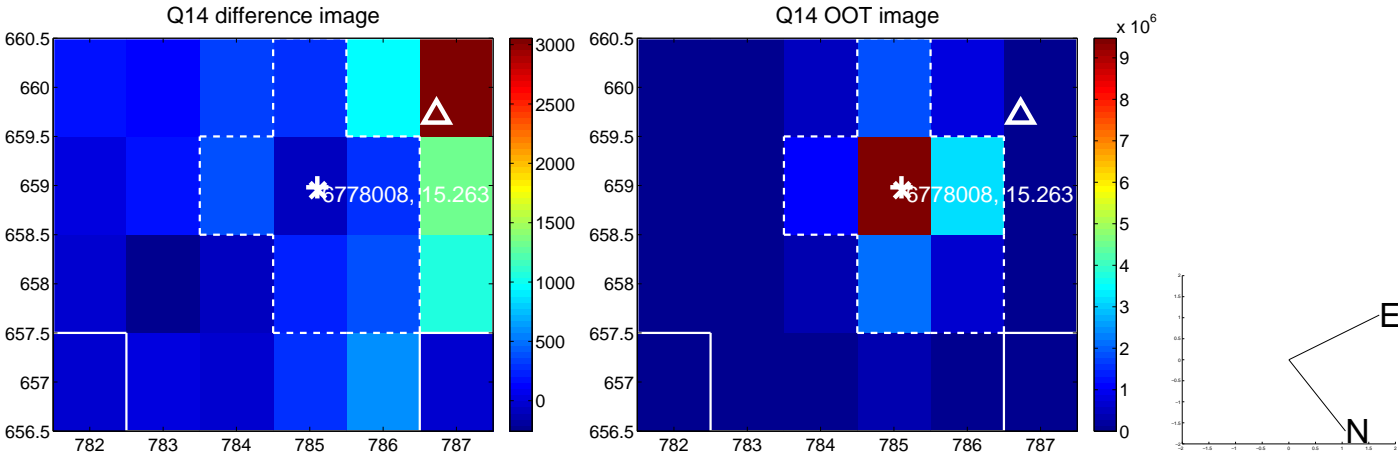
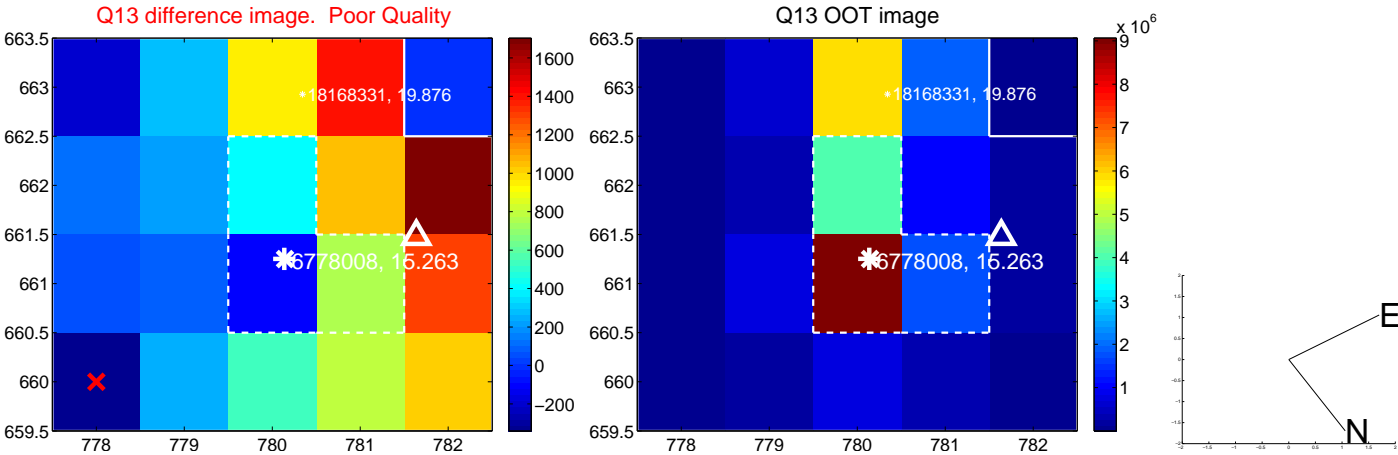




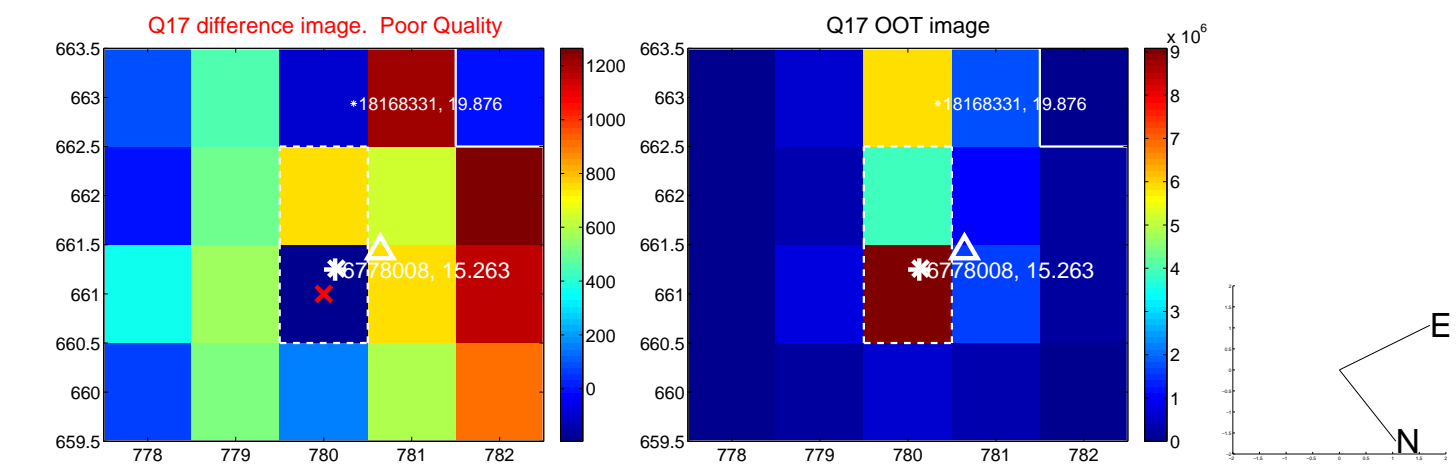
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



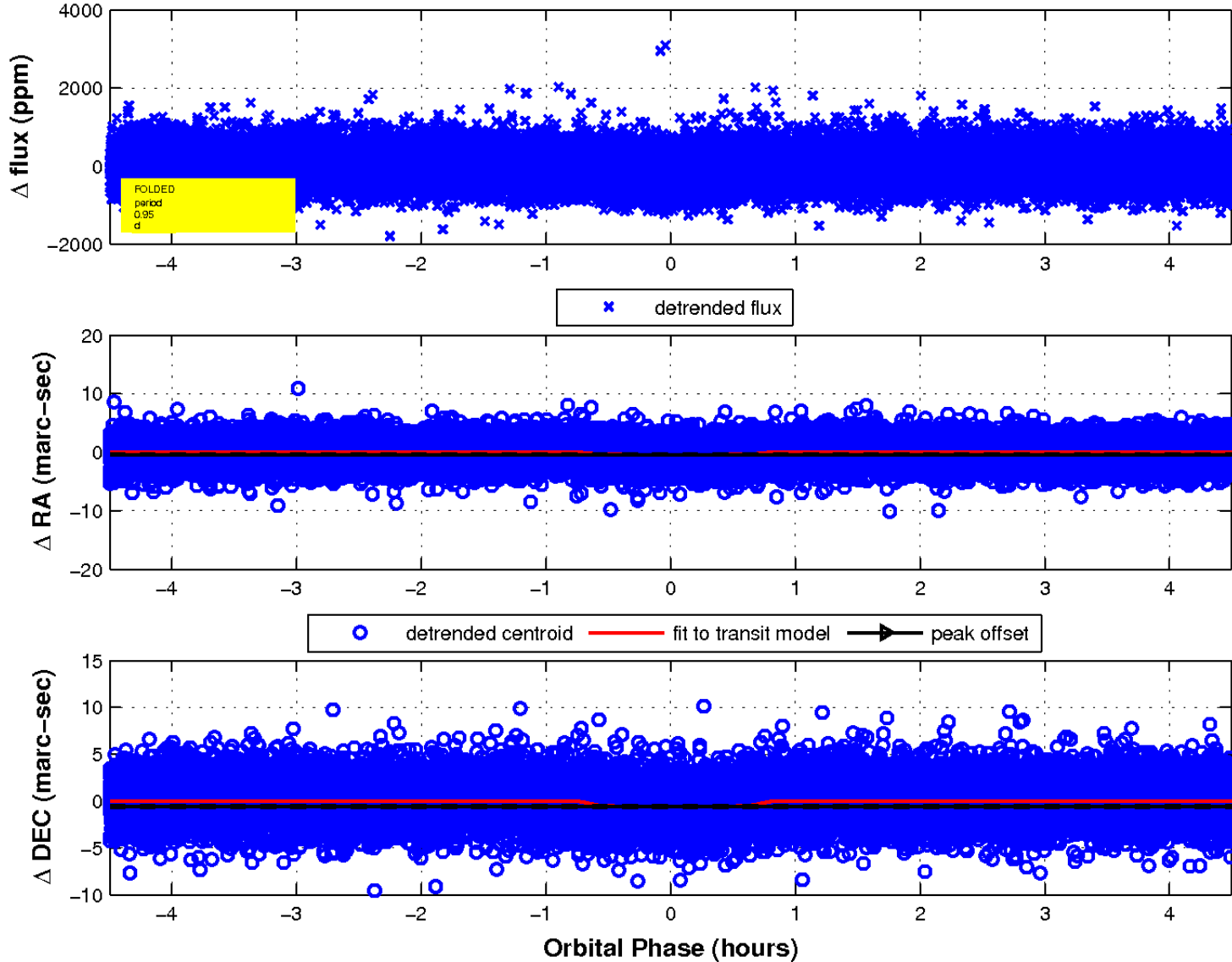
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



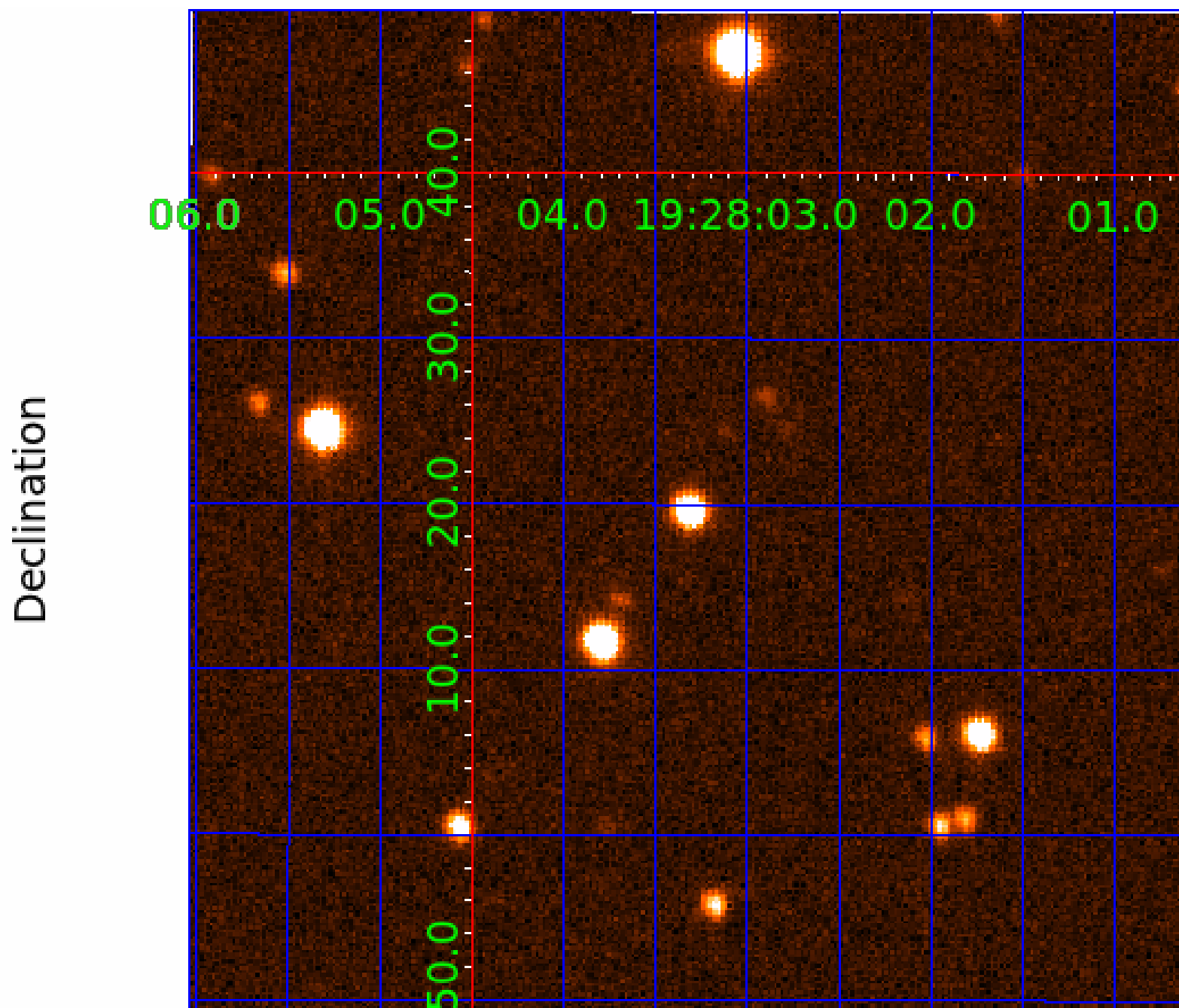
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



fluxWeightedCentroids, Planet 1 of 2



UKIRT Image





# KIC 006778008

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
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006778008-02	OBS	No	0.945833	132.089673	93.2	1.741	11.0	13.8	0.86	5959	1.01	2431.26

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
006778008-01	OBS	FP	0.00	0	1	1	1	MOD_SEC_DV—MOD_SEC_ALT—HAS_SEC_TCE—CENT_RESOLVED_OFFSET—EPHEM_MATCH
006778008-02	OBS	FP	0.00	1	1	1	1	IS_SEC_TCE—CENT_RESOLVED_OFFSET—EPHEM_MATCH

**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 006778008-02

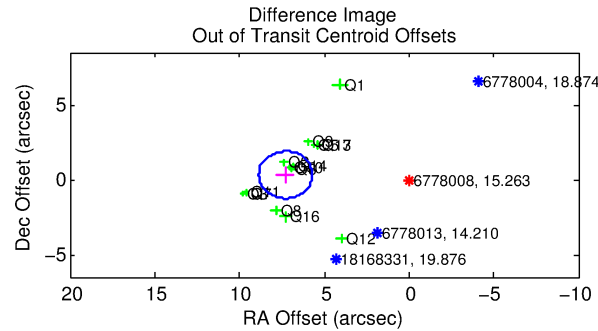
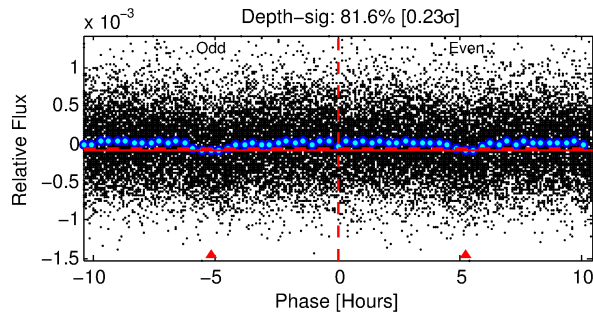
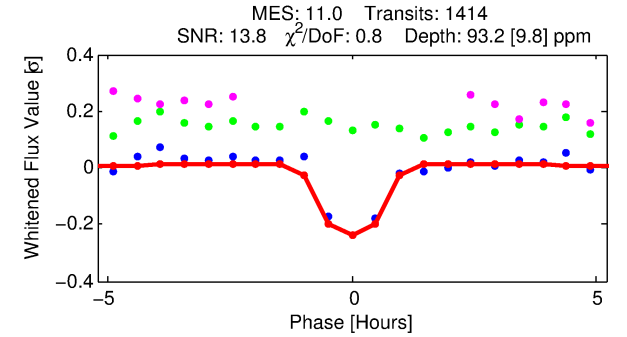
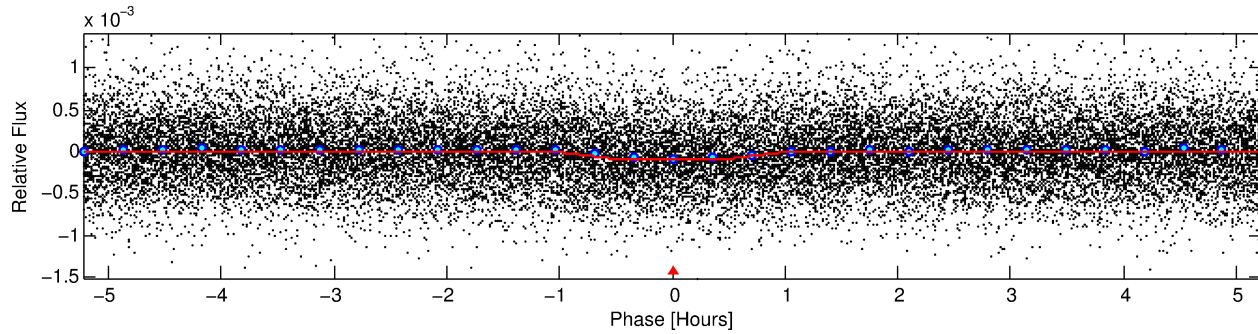
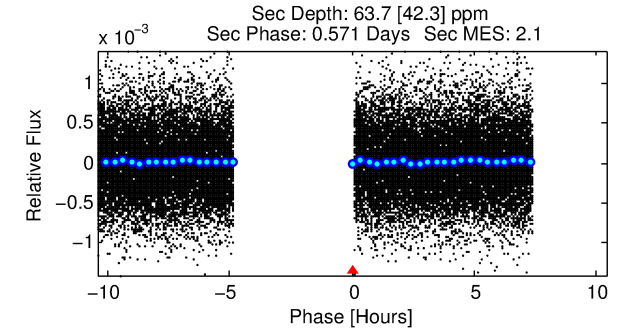
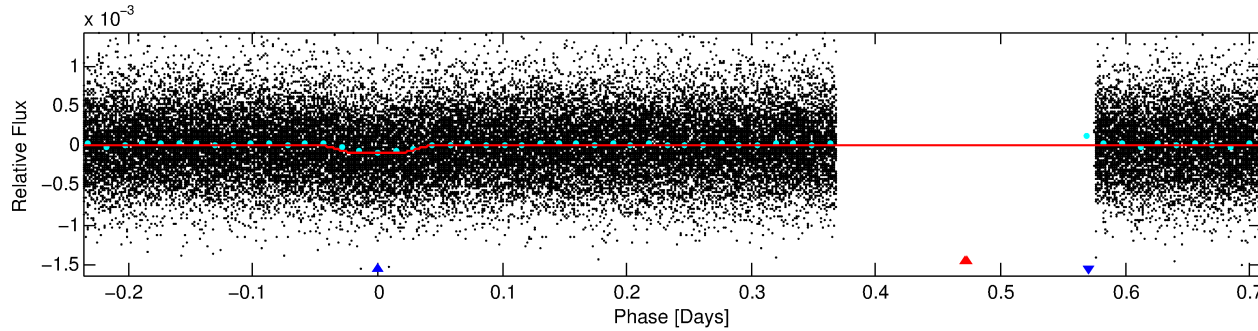
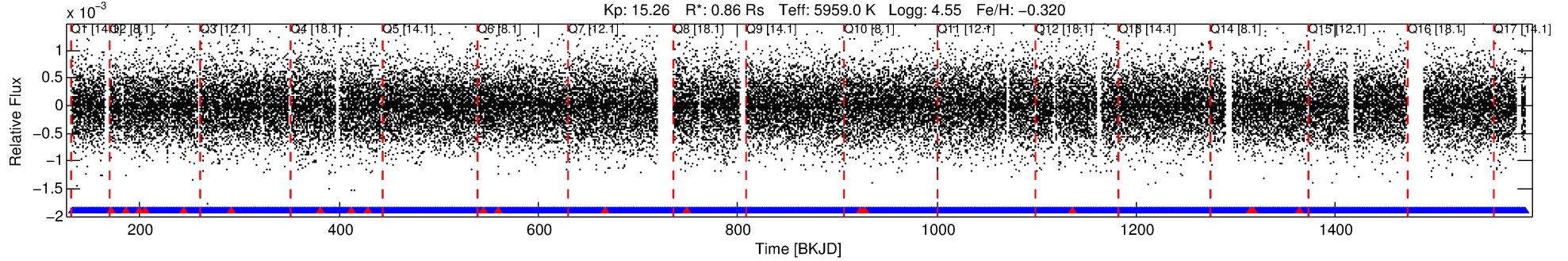
TCE (1)	KIC	Parent (2)	Parent KIC	$P_1:P_2$	Dist ( $''$ )	$\Delta$ Row	$\Delta$ Col	$m_2$	$m_1$	$D_2/D_1$	Mechanism	Flag	$\sigma_P$	$\sigma_T$
006778008-02	6778008	006778050-sec	6778050	1:1	22.7	-2	-5	14.51	15.26	2554.80	Direct-PRF	0	0.49	0.20

**Notes:**  $P_1:P_2$  is the period ratio. Dist is the distance in arcseconds.  $\Delta$ Row and  $\Delta$ Col are the number of pixels apart in row and column.  $m_2$  and  $m_1$  are the magnitudes of the parent and child.  $D_2/D_1$  is the parent's transit depth divided by the child's.  $\sigma_P$  and  $\sigma_T$  are the significance of the match in period and epoch. For a match to be considered significant  $\sigma_P < 5.0$  and  $\sigma_T < 5.0$ . Matches which have  $\sigma_P$  and  $\sigma_T$  very close to this cutoff should receive extra scrutiny, especially if the period ratio is very large.

# DV One-Page Summary

KIC: 6778008 Candidate: 2 of 2 Period: 0.946 d  
KOI: K04373.01 Corr: 0.933

Kp: 15.26 R\*: 0.86 Rs Teff: 5959.0 K Logg: 4.55 Fe/H: -0.320



## DV Fit Results:

Period = 0.94583 [0.00001] d  
Epoch = 132.0897 [0.0018] BKJD  
Rp/R\* = 0.0108 [0.0044]  
a/R\* = 1.90 [2.97]  
b = 0.93 [0.32]  
Seff = 2431.26 [795.63]  
Teq = 1791 [146] K  
Rp = 1.01 [0.48] Re  
a = 0.0185 [0.0038] AU  
Ag = 11.76 [12.80] [0.84σ]  
Teffp = 5126 [1348] K [2.46σ]

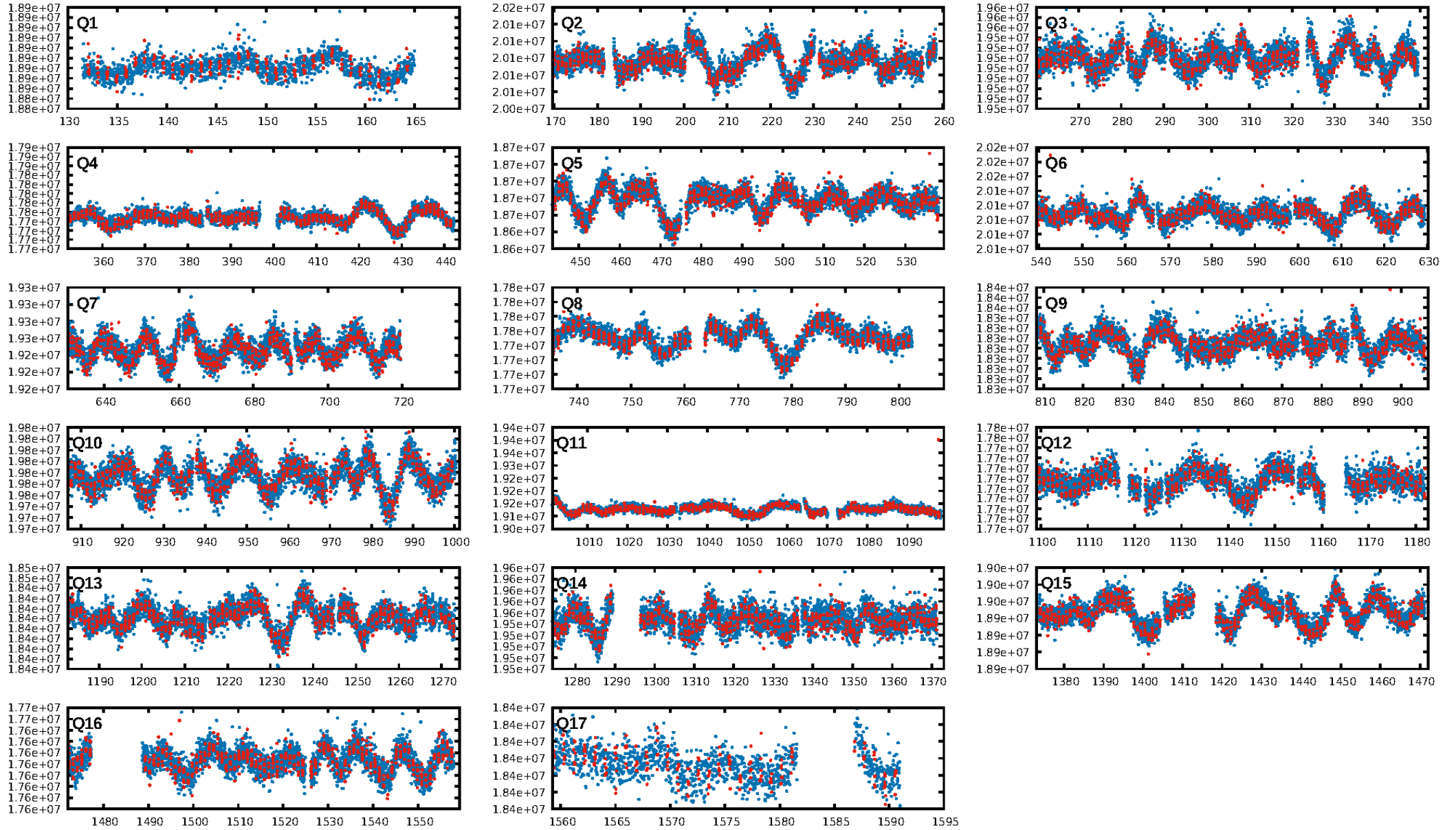
## DV Diagnostic Results:

ShortPeriod-sig: 0.0% [0.00σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 4.16e-29  
RollingBand-fgt: 0.99 [1332/1351]  
GhostDiagnostic-chr: -0.744  
Centroid-sig: 0.0%  
Centroid-so: 4.331 arcsec [5.45σ]  
OotOffset-rm: 7.298 arcsec [13.92σ]  
KicOffset-rm: 7.320 arcsec [13.68σ]  
OotOffset-st: 4/3/3/5 [15]  
KicOffset-st: 4/3/3/5 [15]  
DiffImageQuality-fgm: 0.87 [13/15]  
DiffImageOverlap-fno: 1.00 [17/17]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 23:24:11 Z

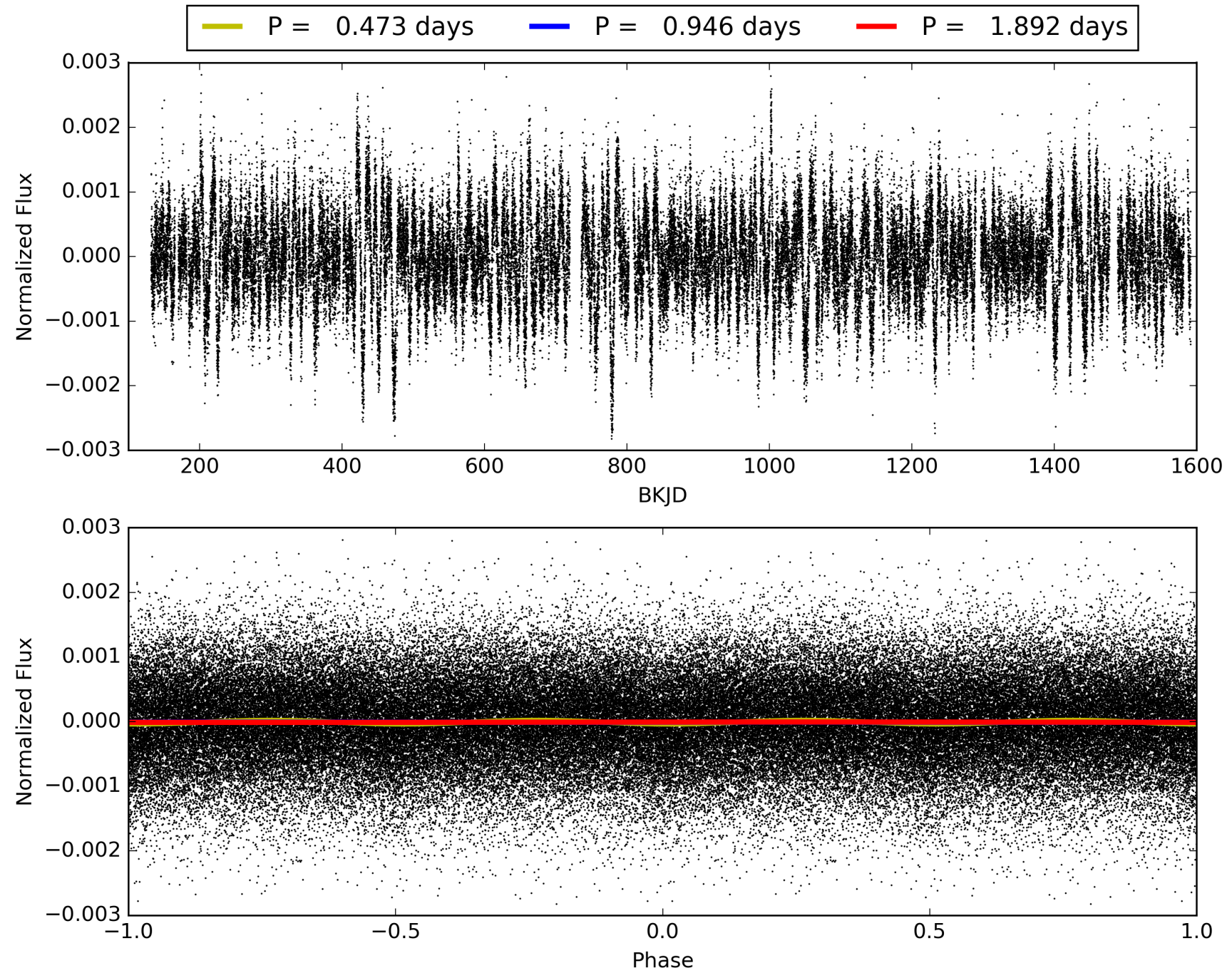
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 006778008-02, PDC Light Curves





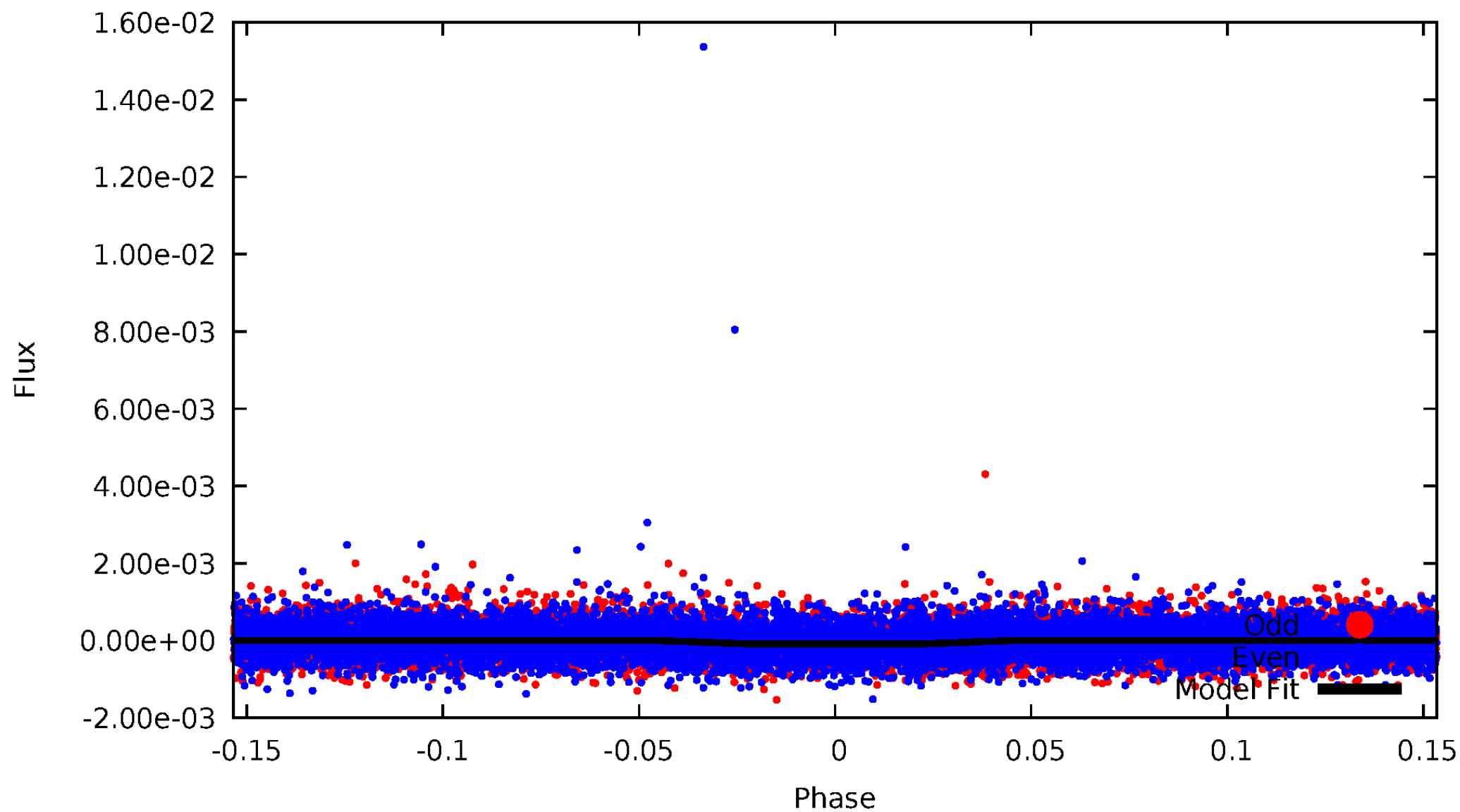
TCE 006778008-02





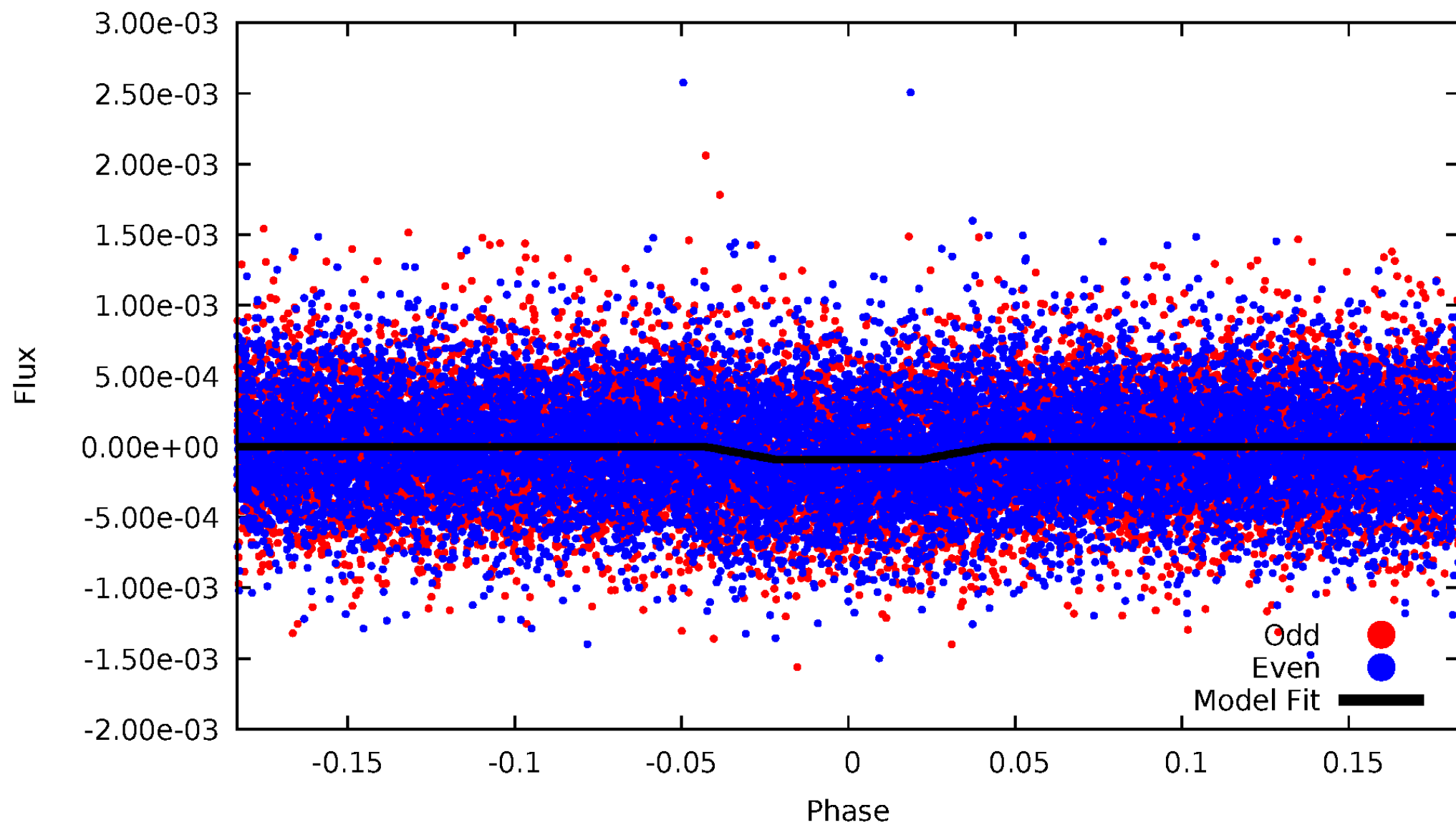
# DV Odd/Even

TCE 006778008-02



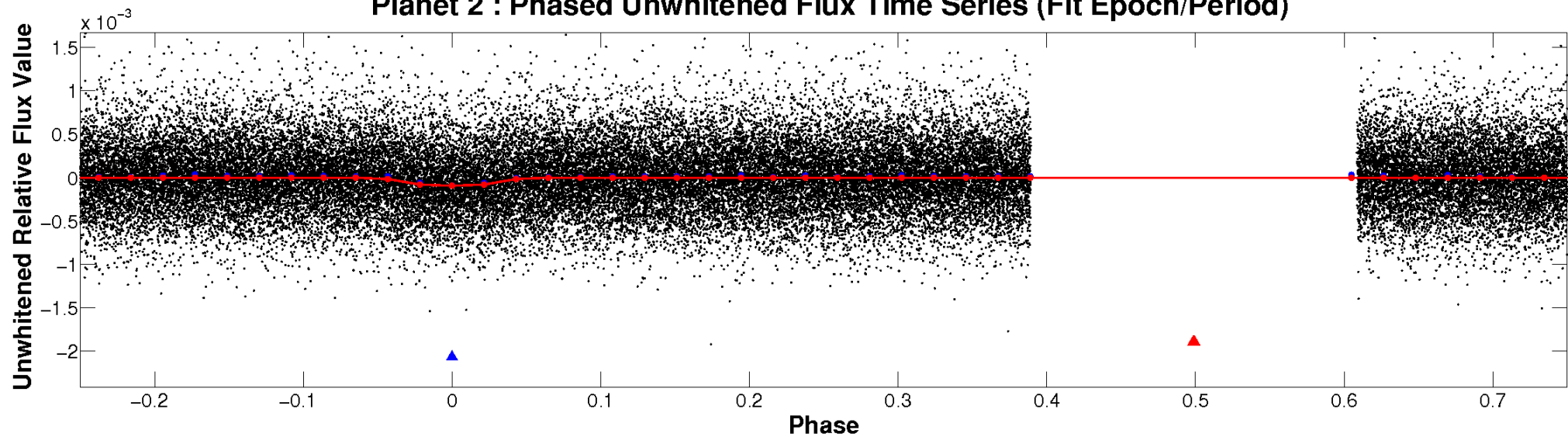
# ALT Odd/Even

TCE 006778008-02

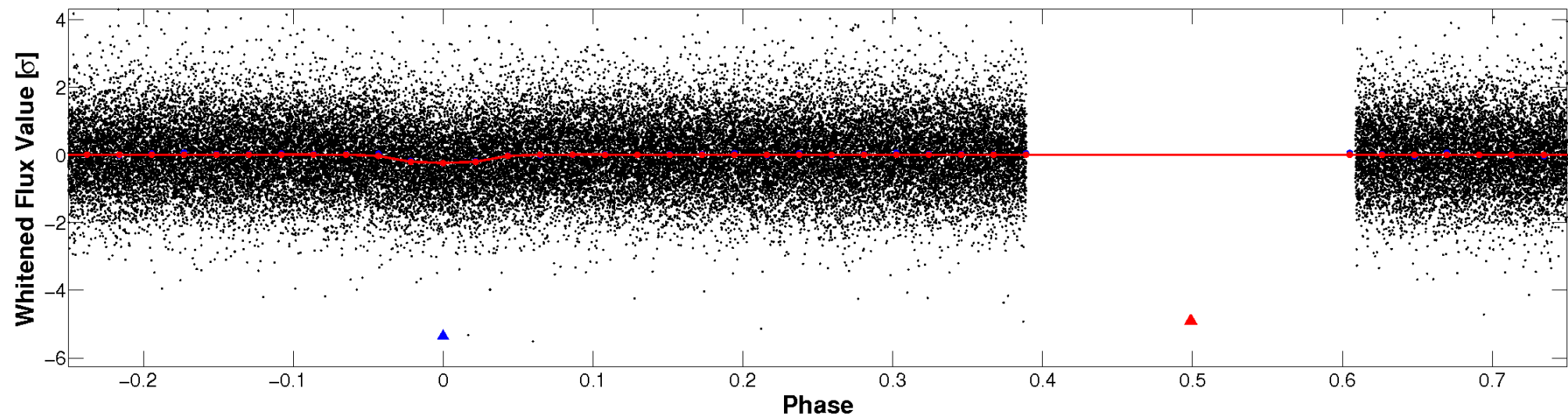


# Non-Whitened Vs. Whitened Light Curve

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

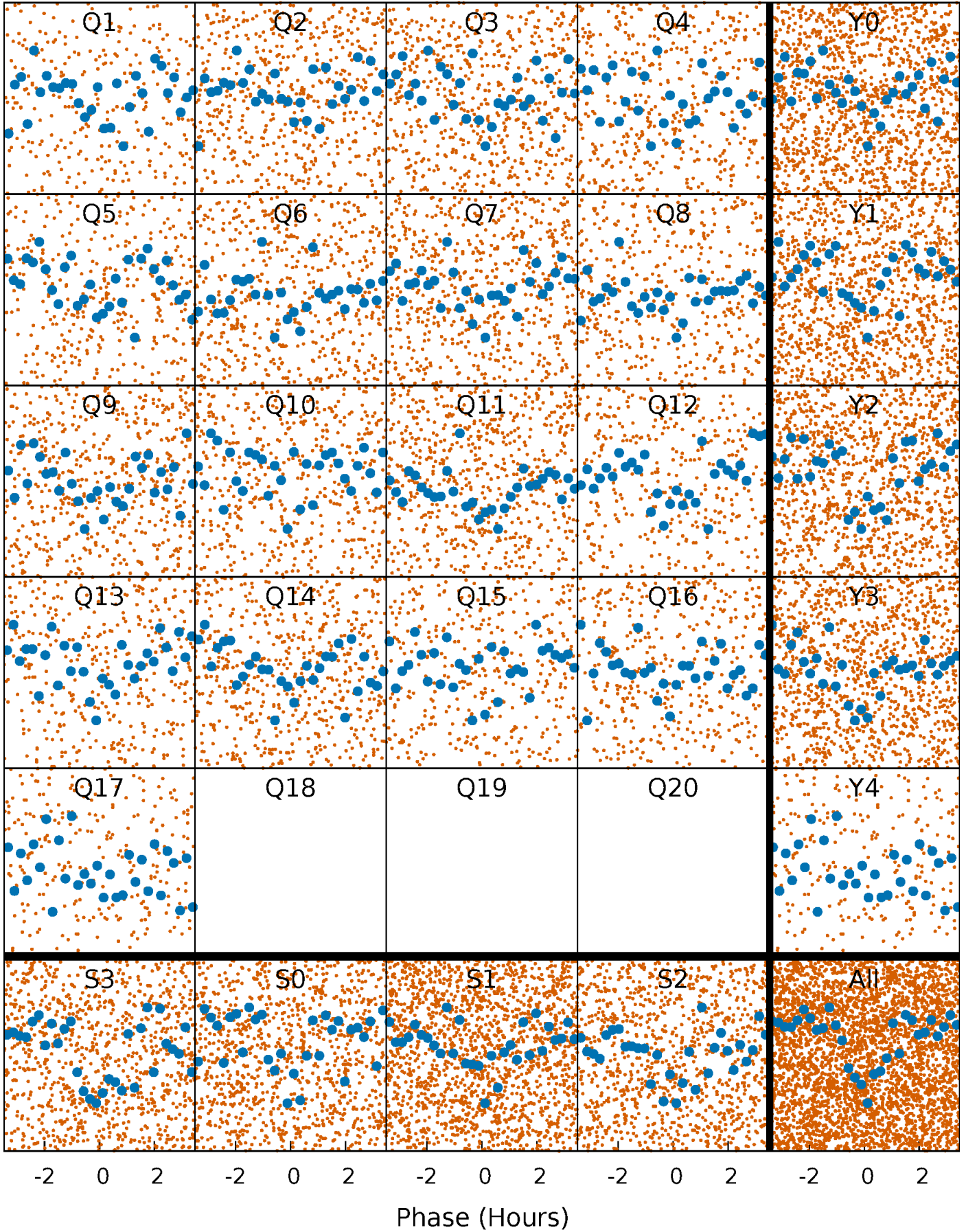


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

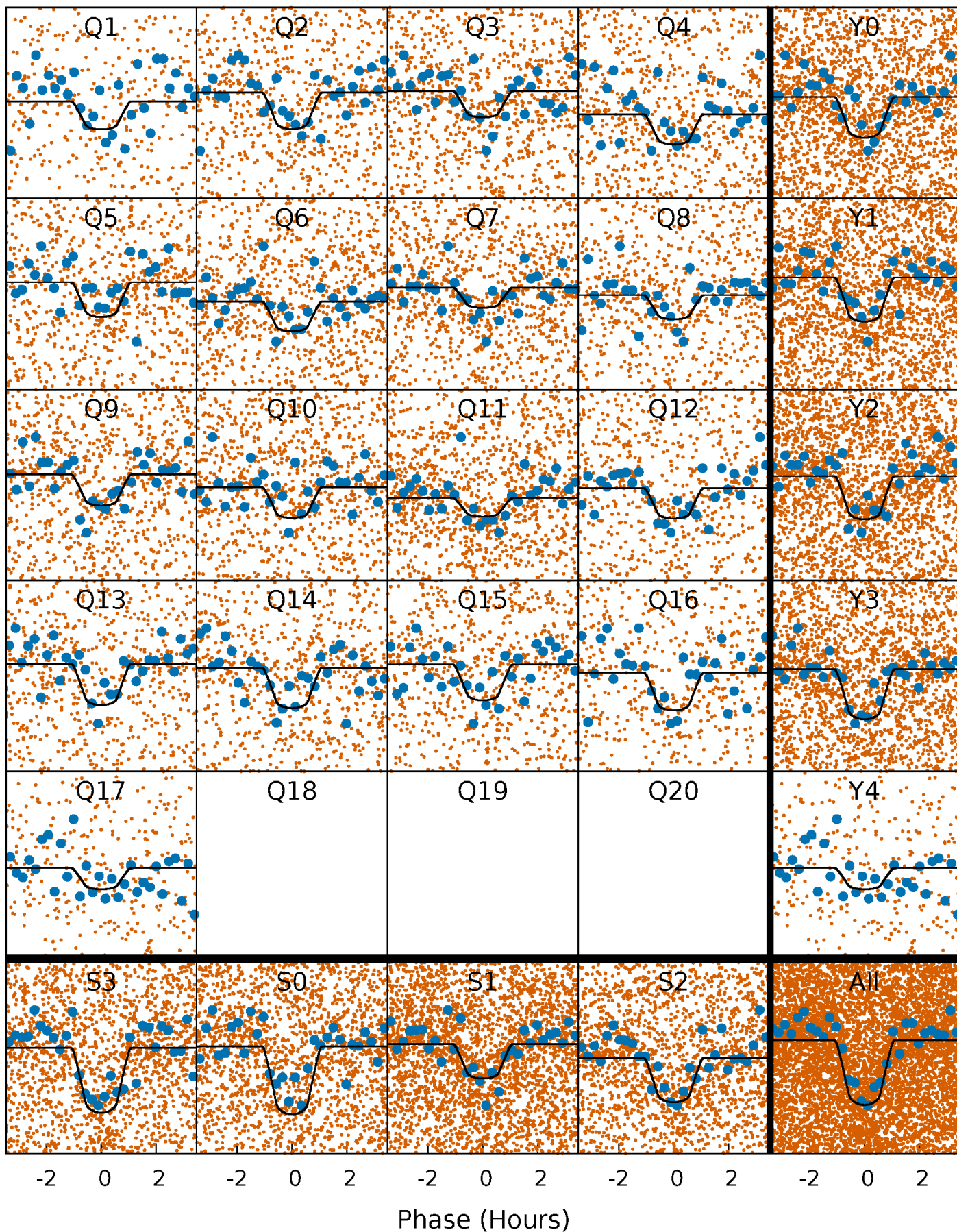
TCE 006778008-02   P= 0.945833 Days    $T_0=132.089673$  (BKJD)





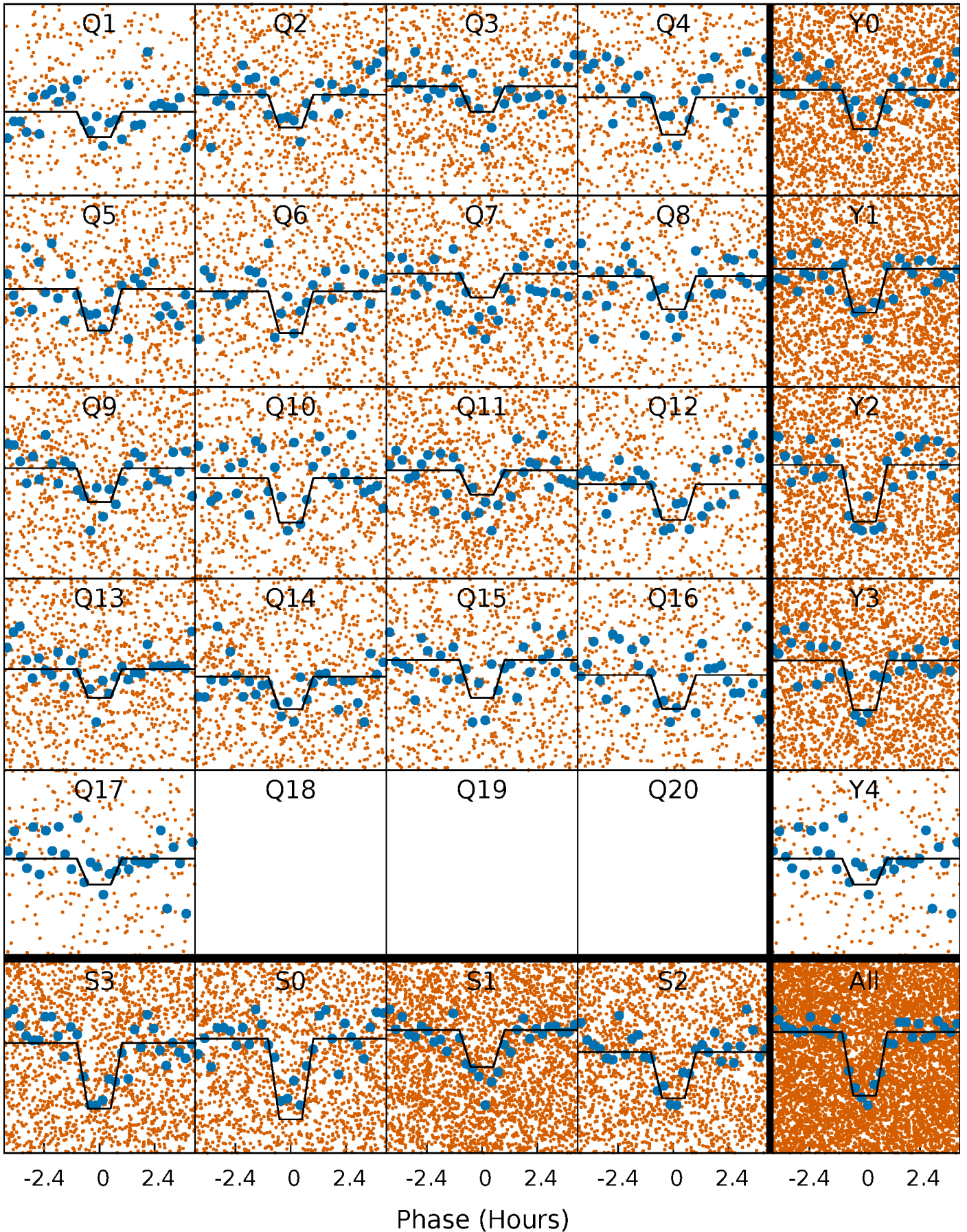
# DV Quarter-Phased Transit Curves

TCE 006778008-02   P= 0.945833 Days    $T_0=132.089673$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

TCE 006778008-02   P= 0.945832 Days    $T_0=132.090303$  (BKJD)

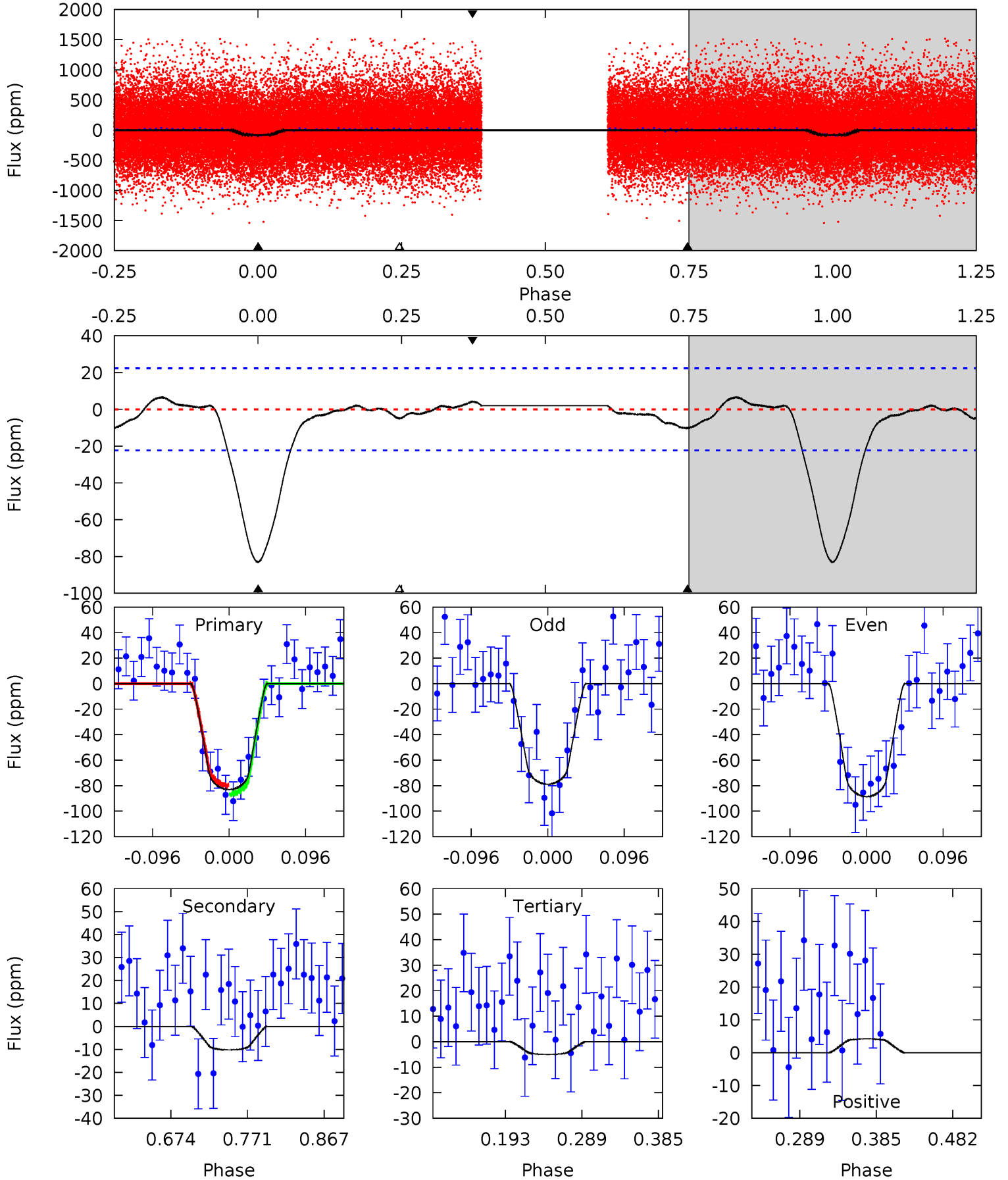




# DV Model-Shift Uniqueness Test

006778008-02, P = 0.945833 Days, E = 131.143840 Days

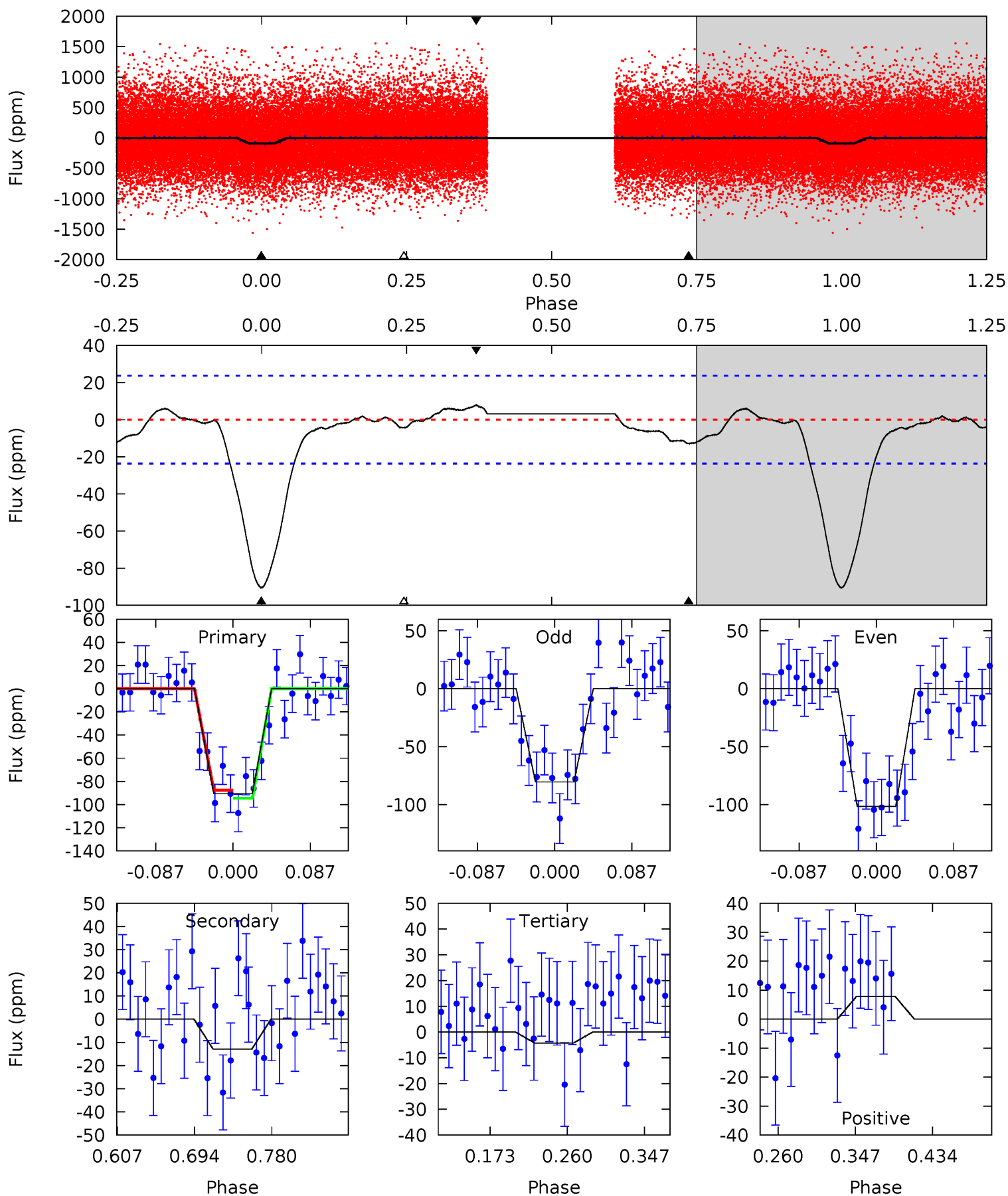
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
17.0	2.10	1.02	0.87	4.57	1.66	0.47	16.0	16.2	1.08	1.23	1.00	0.89	0.07	0.68



# Alt Model-Shift Uniqueness Test

006778008-02, P = 0.945832 Days, E = 131.144471 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
17.6	2.51	0.83	1.53	4.59	1.71	0.71	16.7	16.0	1.68	0.99	2.06	1.01	0.08	0.67



### Stellar Parameters For KIC 006778008

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5959^{+160}_{-178}$	$4.546^{+0.042}_{-0.168}$	$-0.320^{+0.300}_{-0.300}$	$0.859^{+0.209}_{-0.075}$	$0.948^{+0.098}_{-0.120}$	$2.104^{+0.450}_{-0.924}$
	+3%/-3%	+1%/-4%	+94%/-94%	+24%/-9%	+10%/-13%	+21%/-44%
Source	PHO1	KIC0	KIC0	DSEP		

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

### Secondary Eclipse Parameters for KIC 006778008-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-10 \pm 5$	$1.07^{+0.41}_{-0.47}$	$2557^{+143}_{-112}$	$3542^{+895}_{-693}$	$1.635^{+3.632}_{-1.016}$
Alt.	$-13 \pm 5$	$0.94^{+0.46}_{-0.39}$	$2550^{+147}_{-107}$	$3808^{+1013}_{-657}$	$2.534^{+5.535}_{-1.611}$

$T_{max}$  = 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

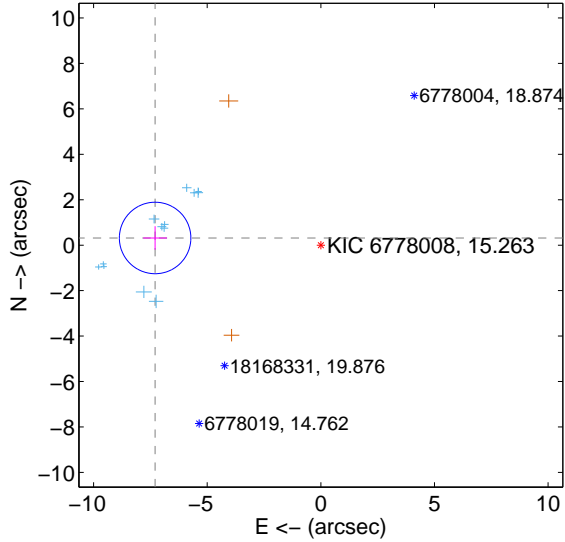
Supplemental centroid analysis for 006778008-02. Kepler magnitude: 15.26. Transit SNR 13.76

There are 13 quarters with good PRF difference image offsets

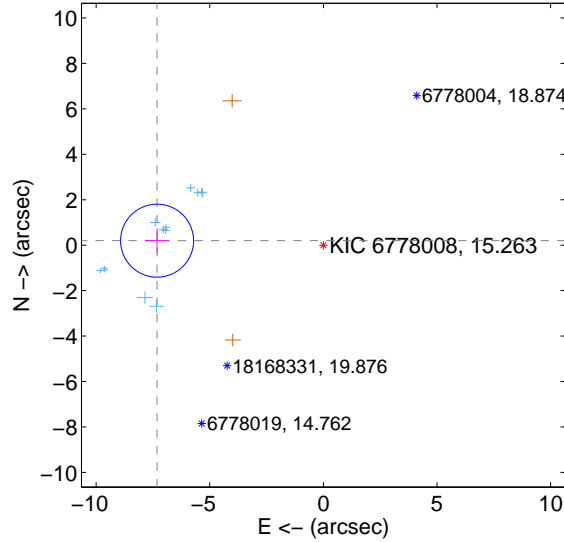
The direct PRF centroid is offset from the target star catalog position by about 0.07 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$7.298 \pm 0.524$	<b>13.92</b>	$7.291 \pm 0.524$	$0.317 \pm 0.515$
PRF-fit source offset from KIC position	$7.320 \pm 0.535$	<b>13.68</b>	$7.317 \pm 0.535$	$0.198 \pm 0.532$
photometric centroid source offset	$4.33 \pm 0.80$	<b>5.45</b>	$3.44 \pm 0.77$	$2.64 \pm 0.84$

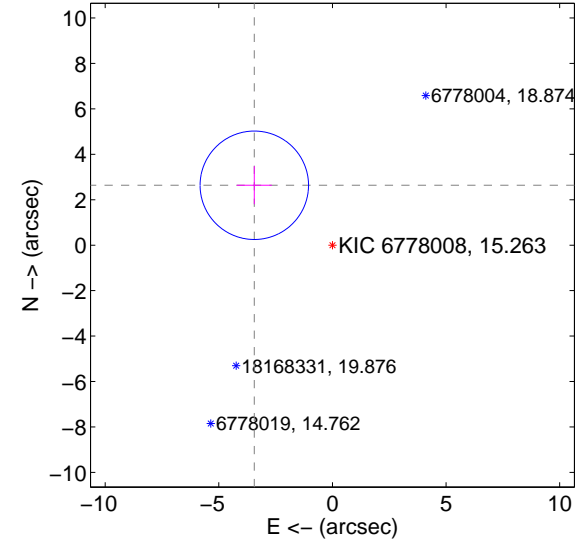
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

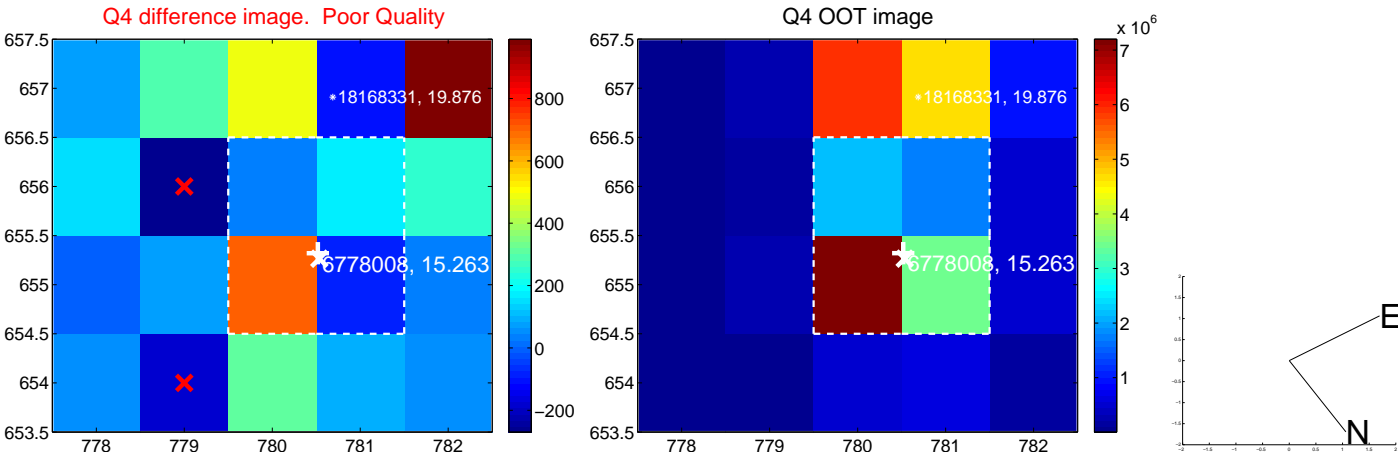
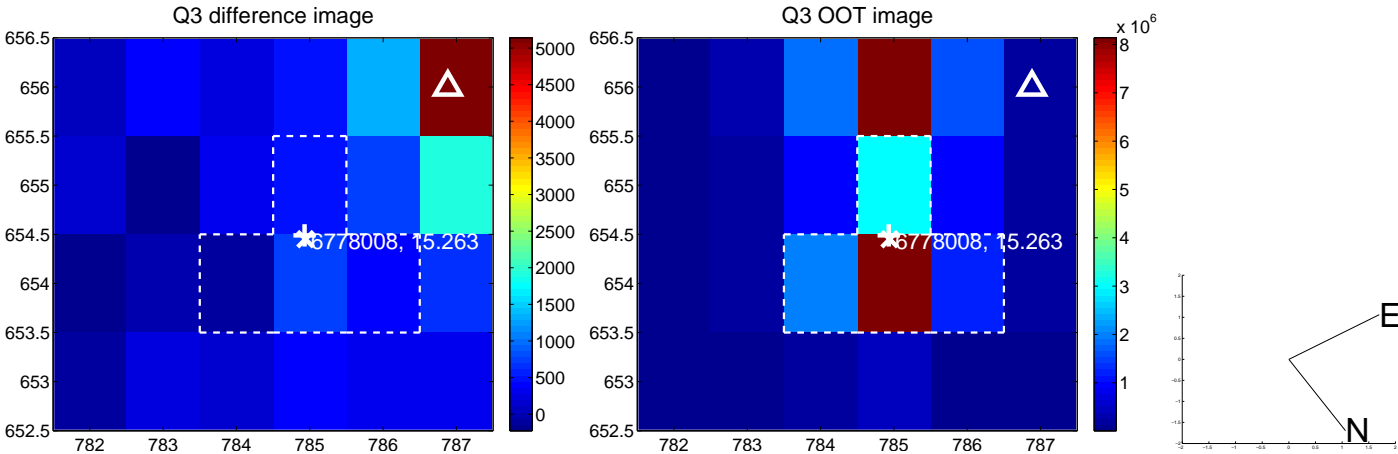
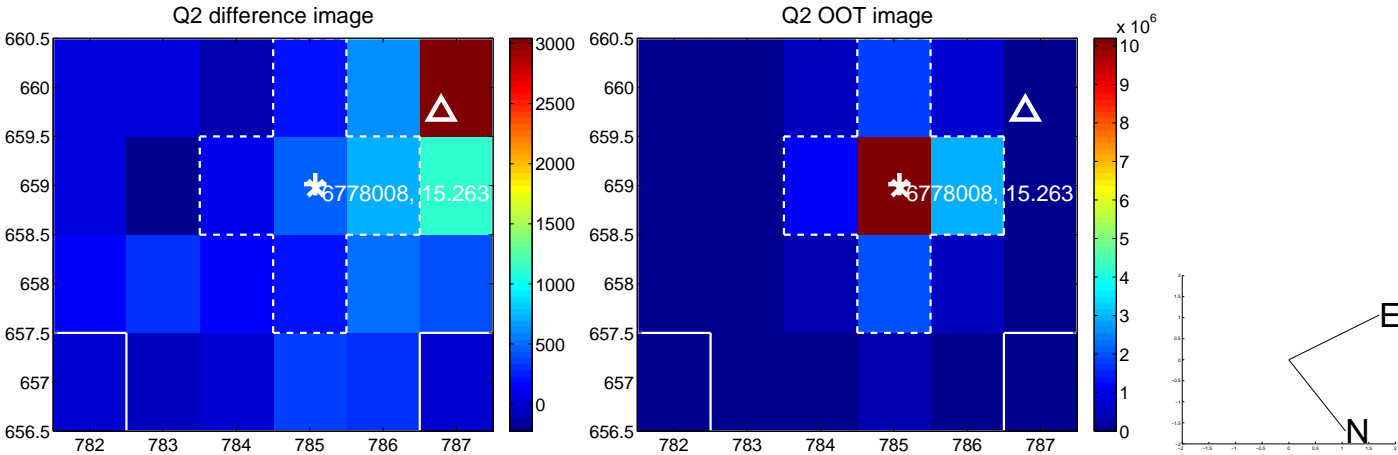
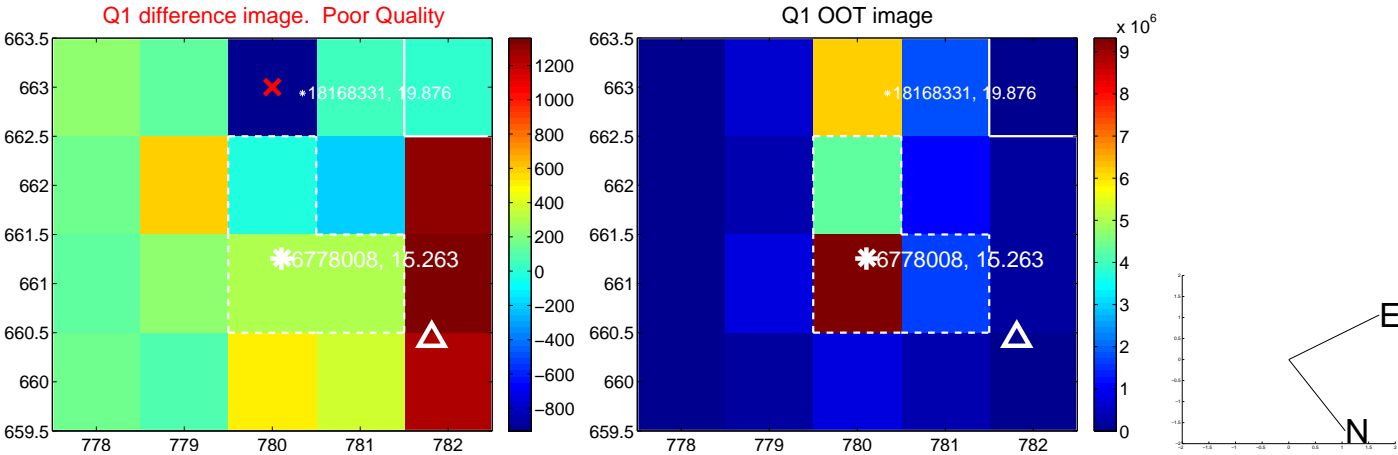


offset from photometric centroids

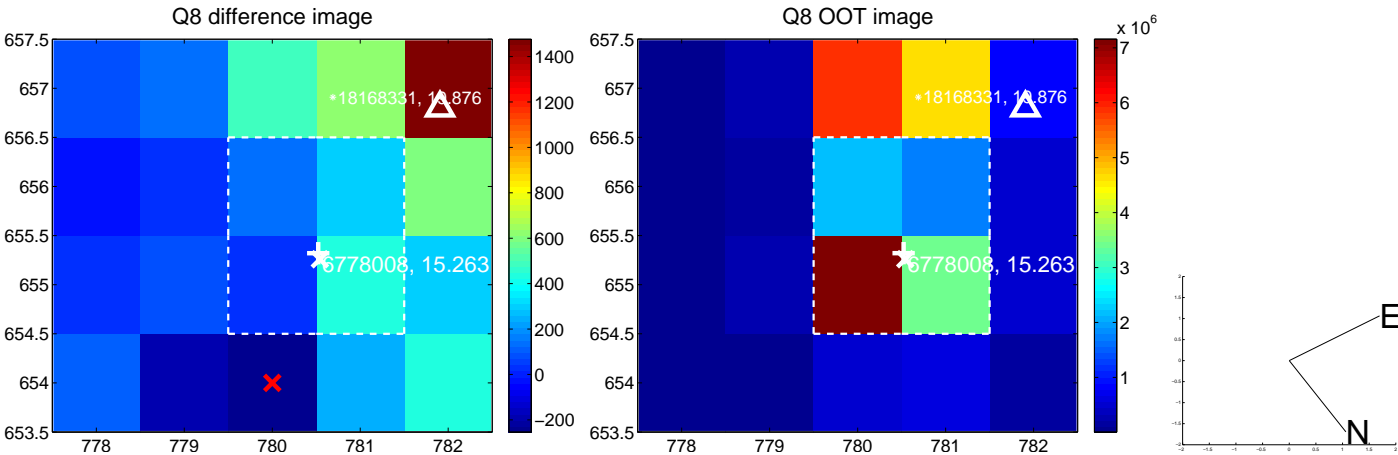
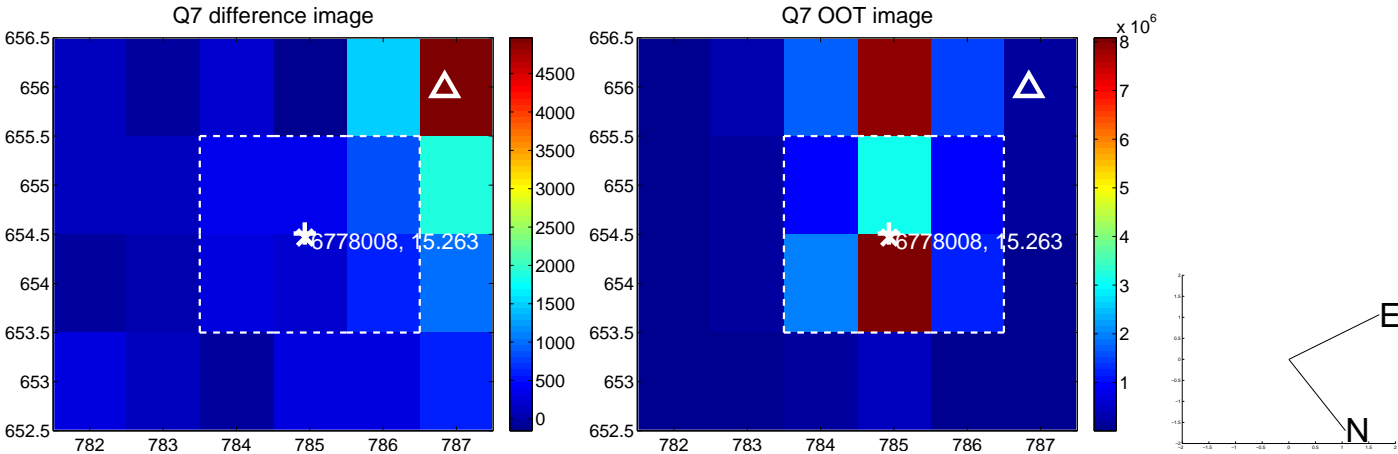
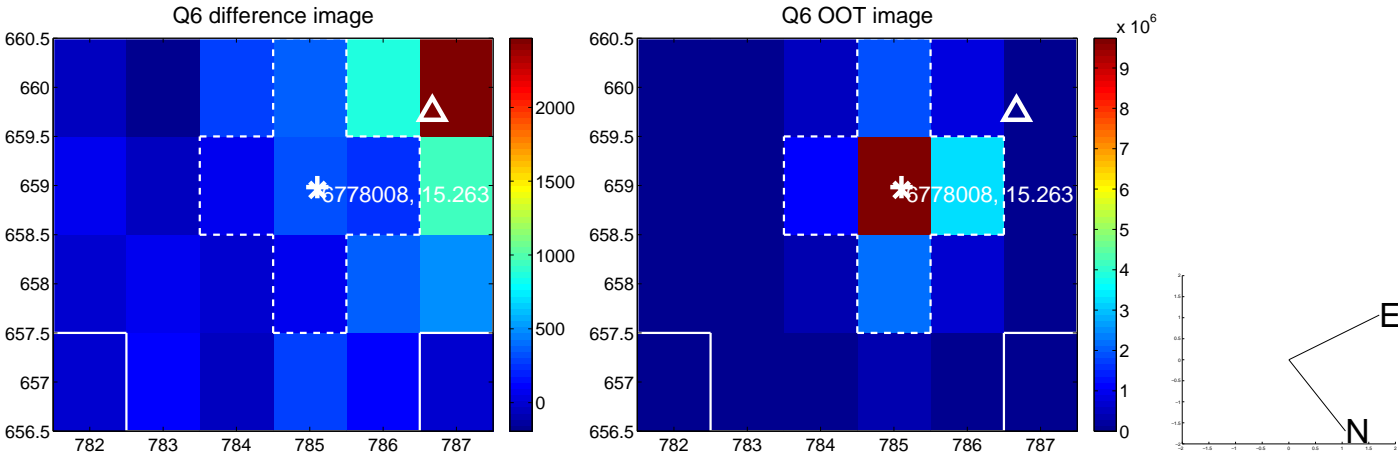
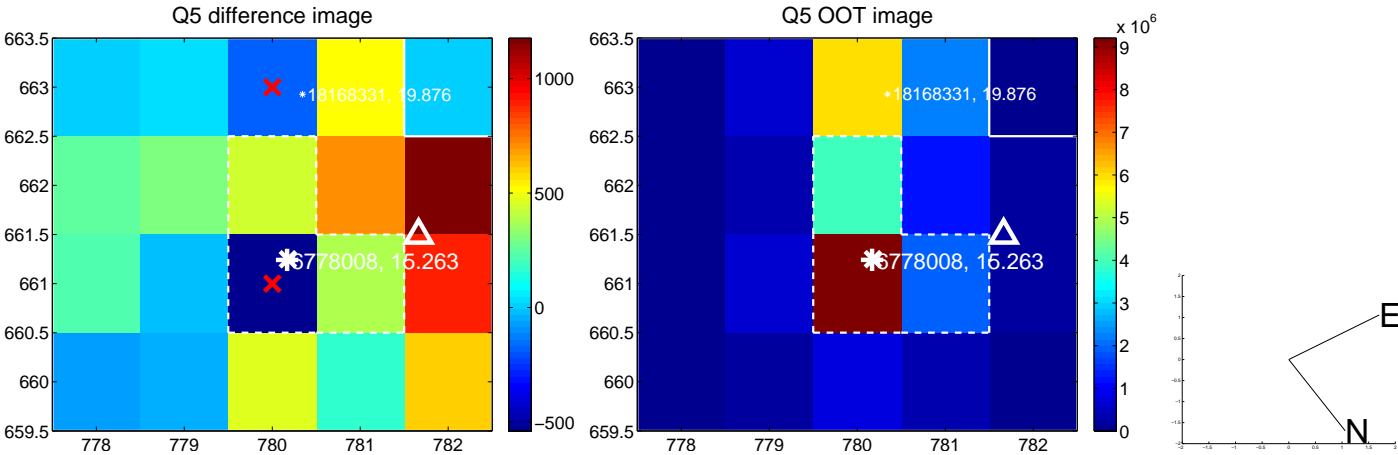


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: 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.

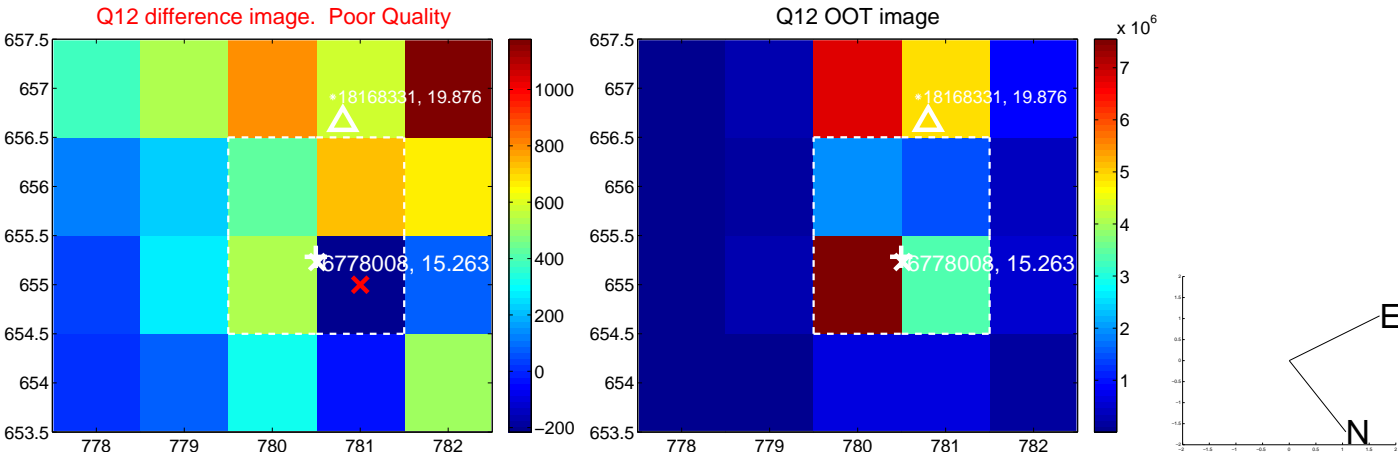
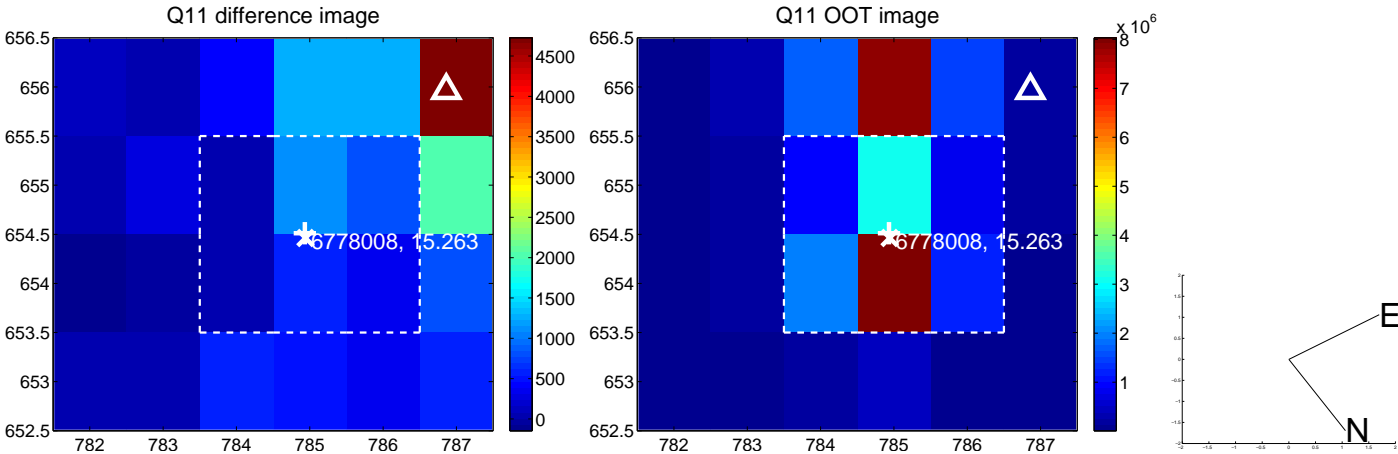
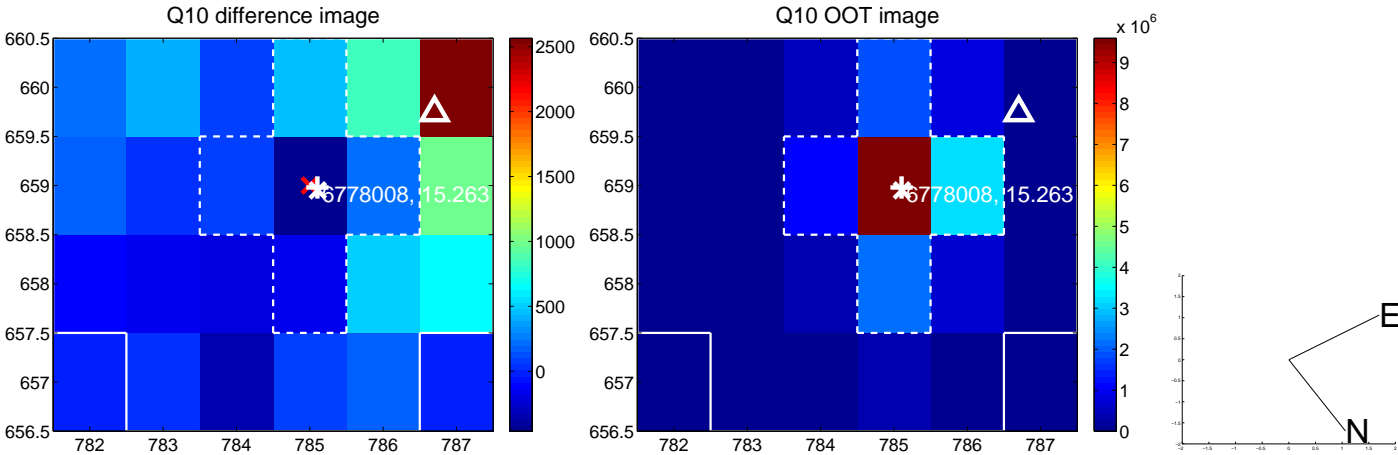
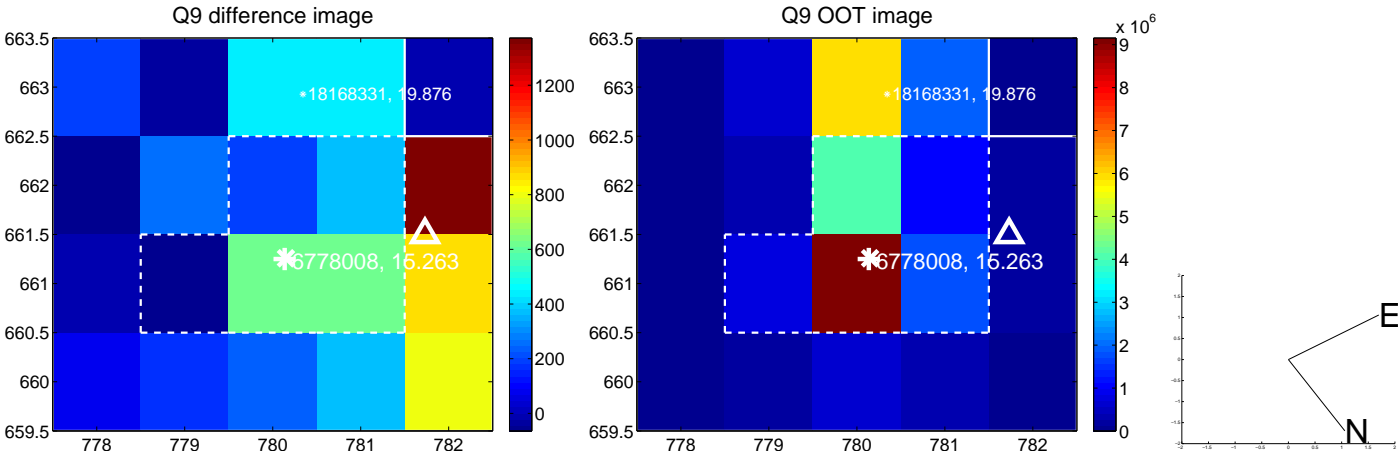


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

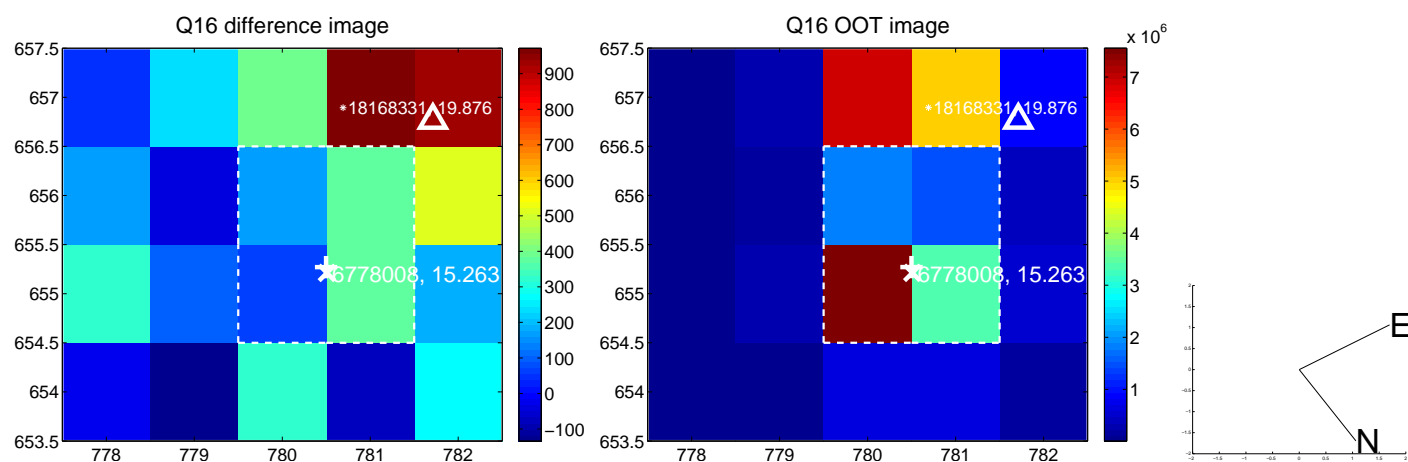
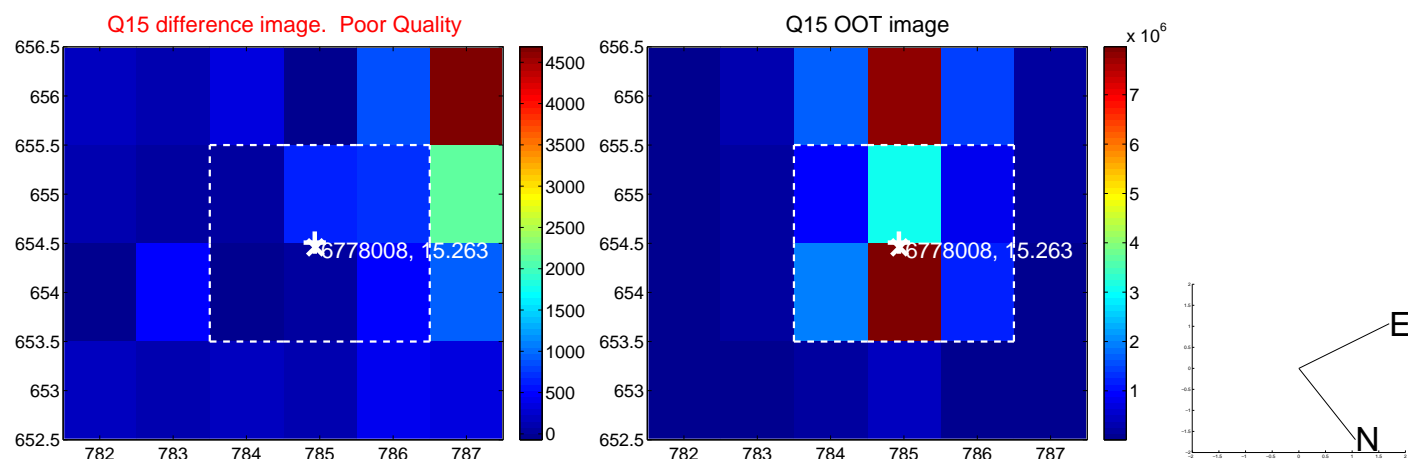
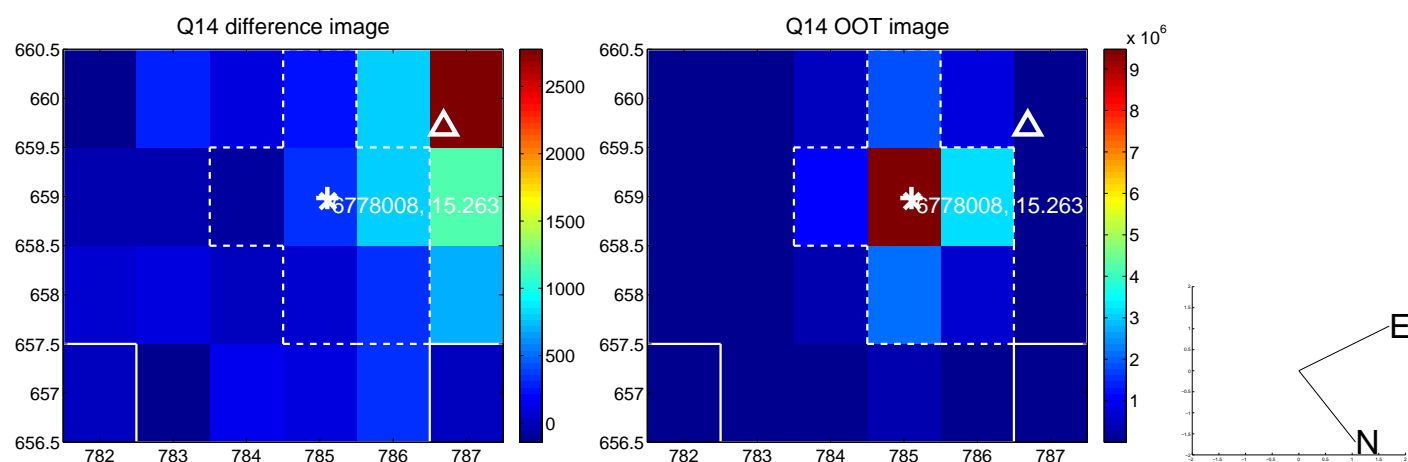
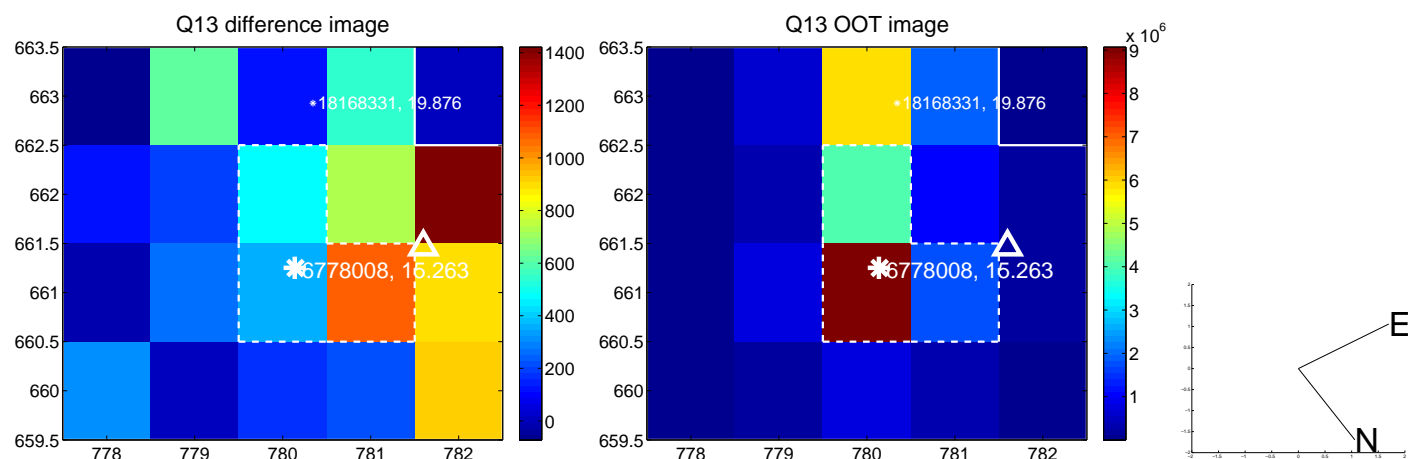




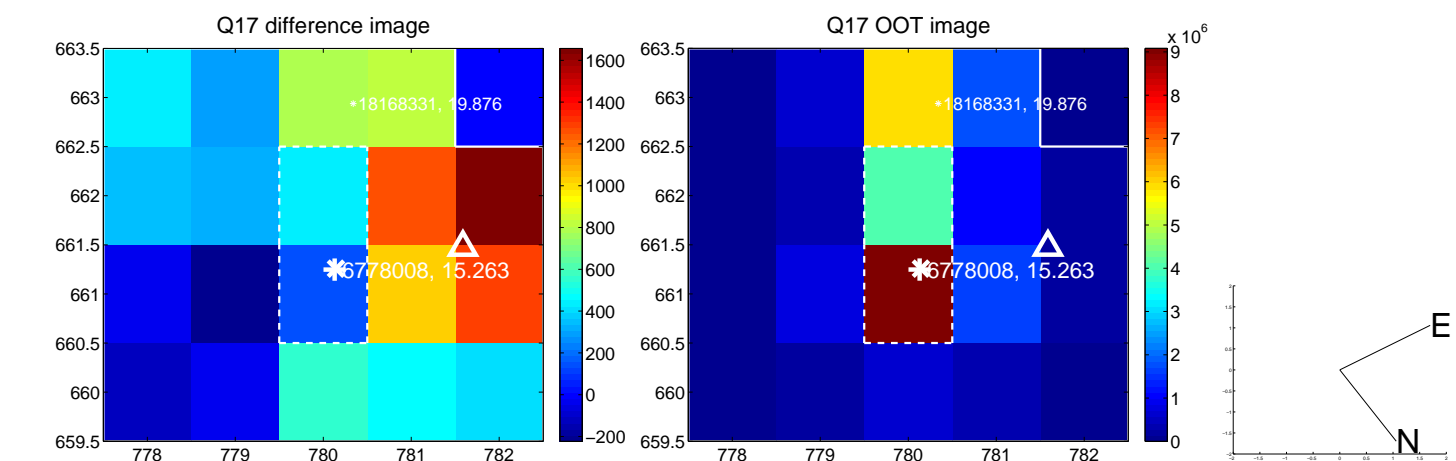
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



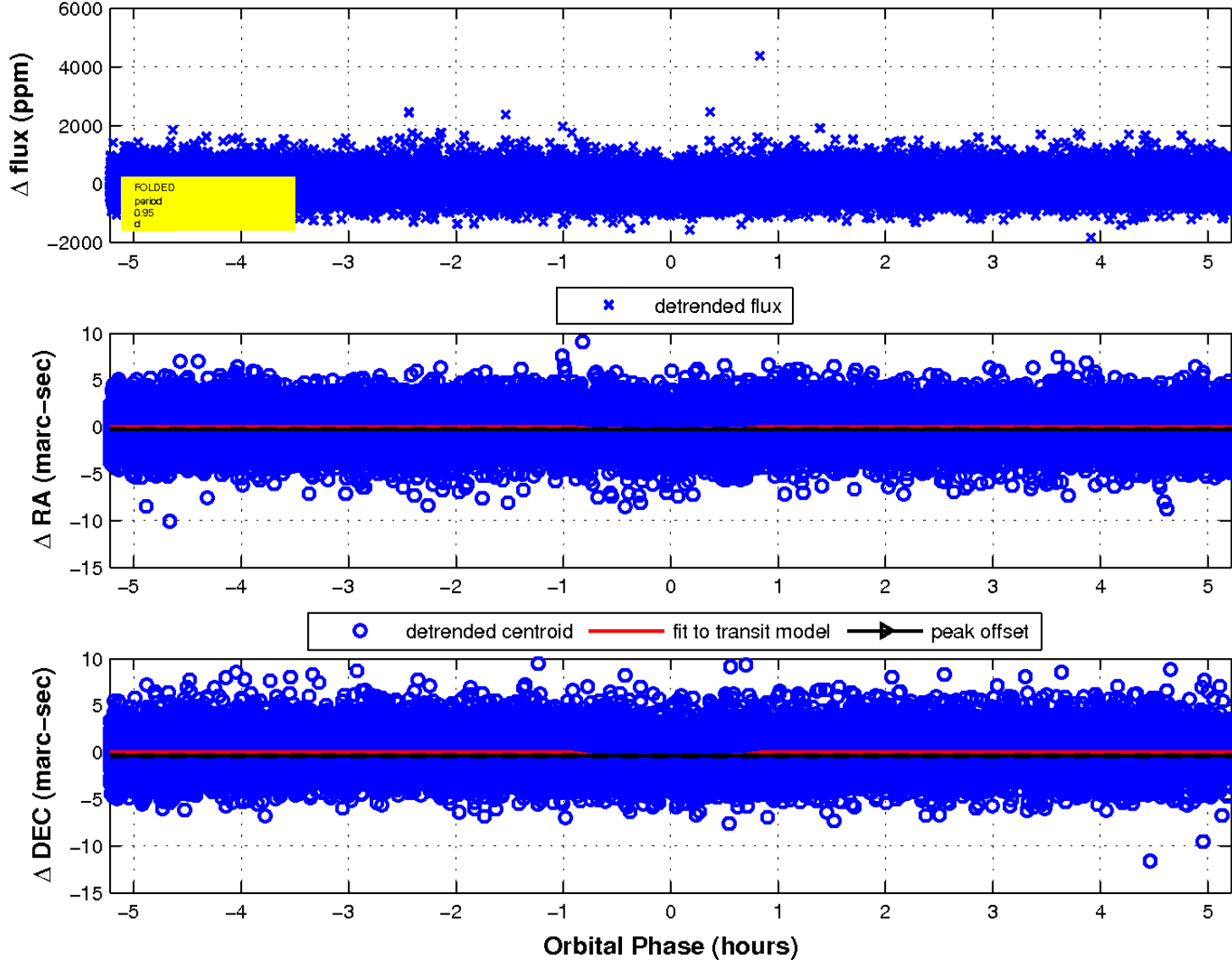
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value



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



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

