

# KIC 010010440

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
010010440-01	OBS	2309.01	53.599049	147.430881	525.4	6.827	19.3	20.6	1.03	6319	2.55	18.58
010010440-02	OBS	No	473.245098	172.592071	430.1	13.331	7.6	6.9	1.03	6319	2.30	1.02

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
010010440-01	OBS	PC	0.97	0	0	0	0	NO_COMMENT
010010440-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE—MOD_POS_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS

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

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

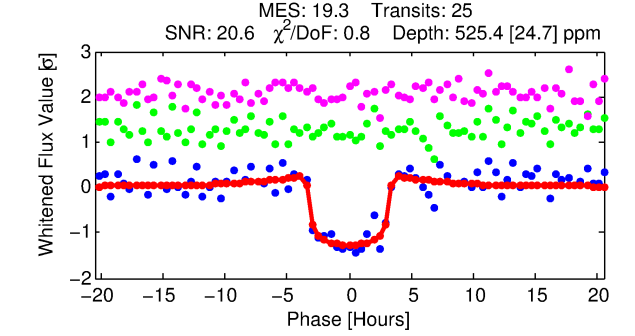
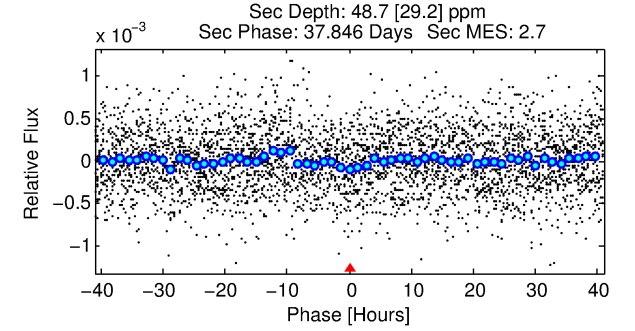
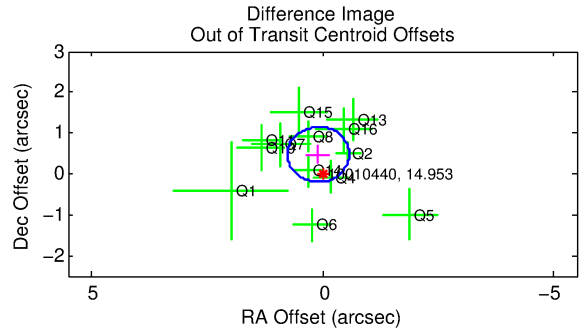
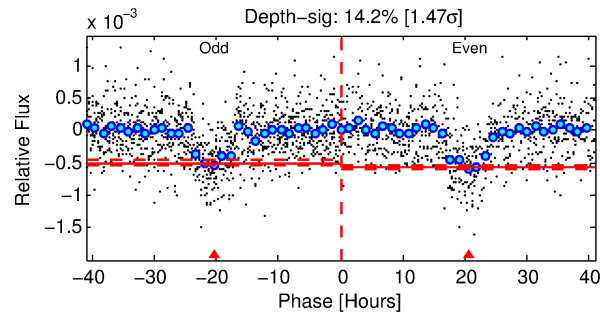
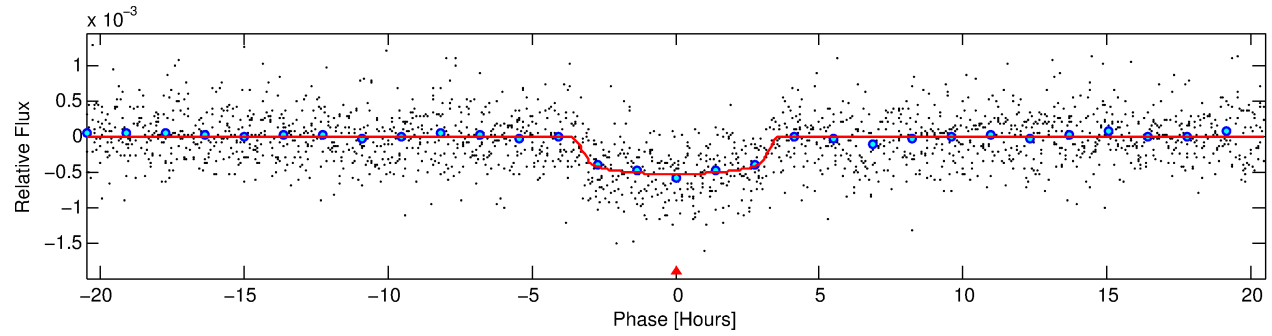
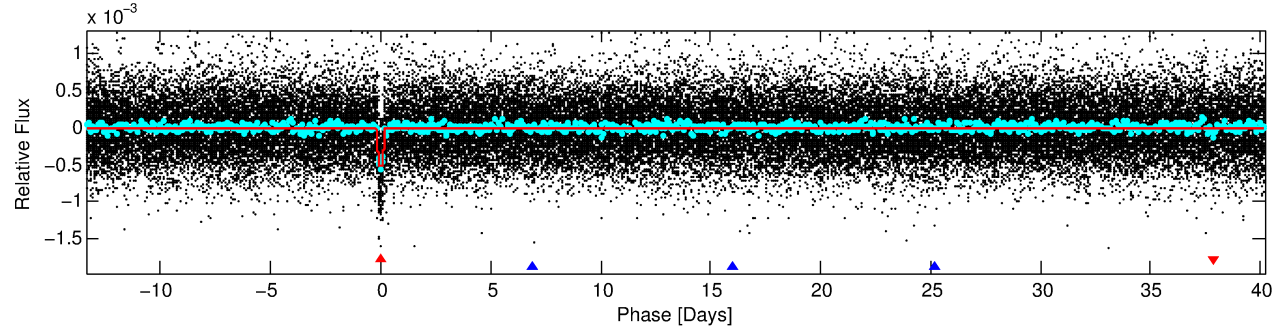
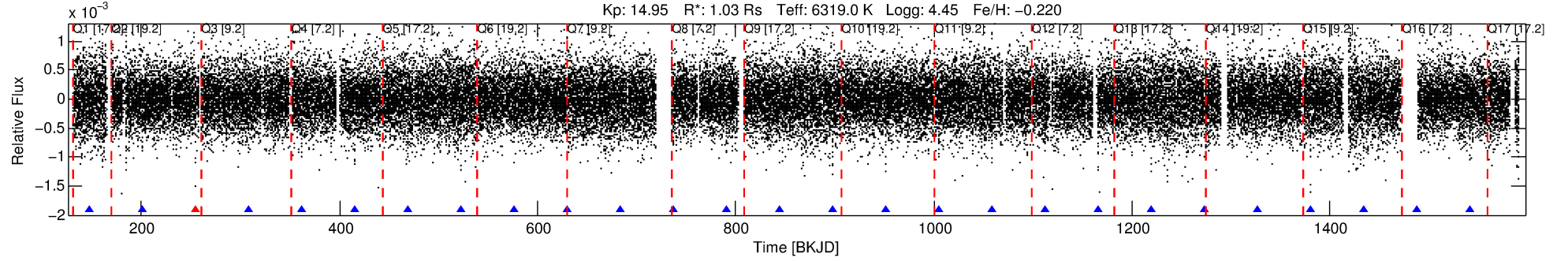
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 010010440-01

No Significant Match Found

# DV One-Page Summary

KIC: 10010440 Candidate: 1 of 2 Period: 53.599 d  
KOI: K02309.01 Corr: 0.988



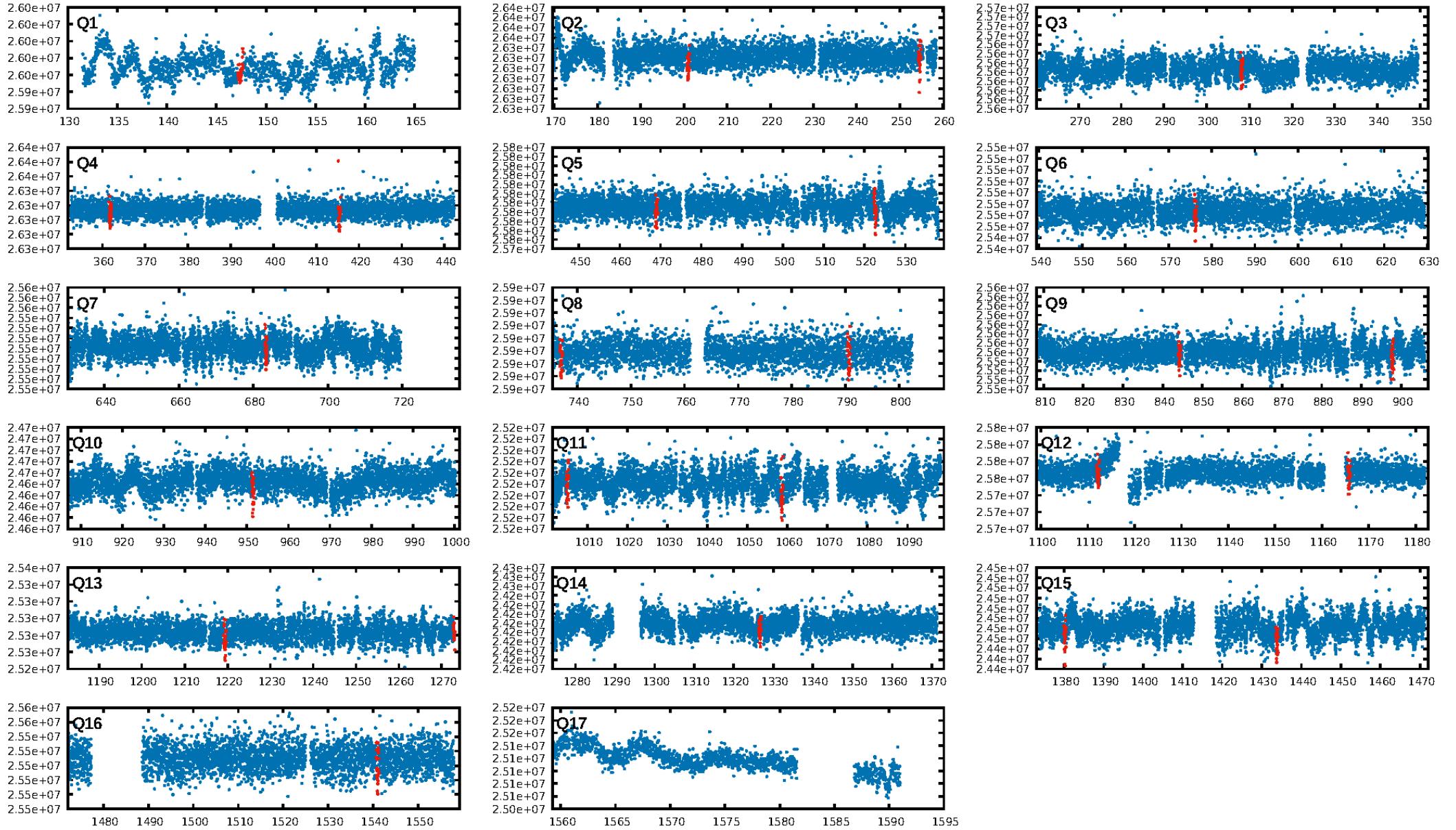
## DV Fit Results:

Period = 53.59905 [0.00035] d  
Epoch = 147.4309 [0.0054] BKJD  
Rp/R\* = 0.0226 [0.0048]  
a/R\* = 43.27 [47.47]  
b = 0.72 [0.72]  
Seff = 18.58 [7.47]  
Teff = 529 [53] K  
Rp = 2.55 [0.95] Re  
a = 0.2861 [0.0747] AU  
Ag = 338.36 [279.05] [1.21 $\sigma$ ]  
Teffp = 3511 [652] K [4.55 $\sigma$ ]

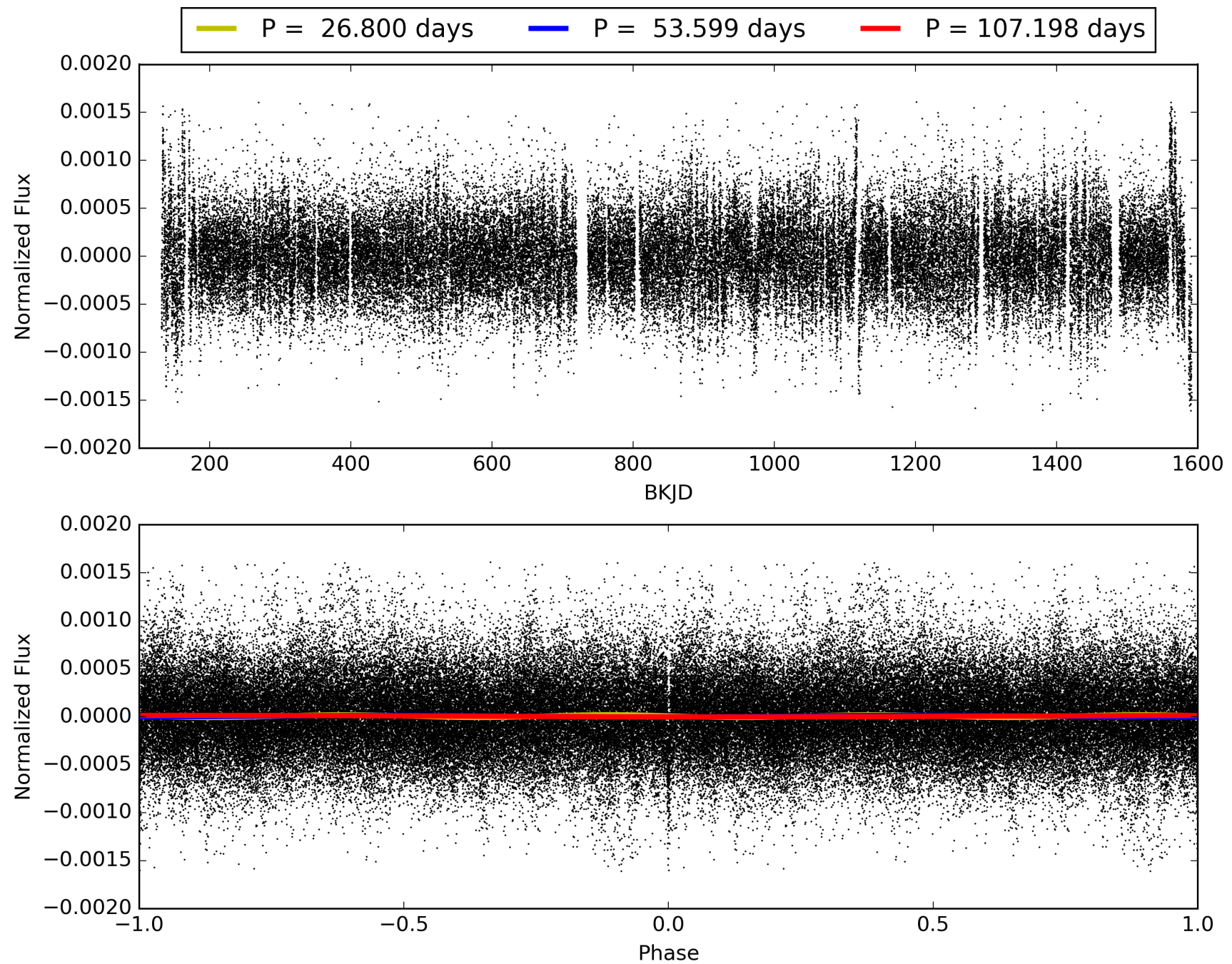
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [672.47 $\sigma$ ]  
ModelChiSquare2-sig: 95.2%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 4.22e-73  
RollingBand-fgt: 0.96 [23/24]  
GhostDiagnostic-chr: 6.307  
Centroid-sig: 13.6%  
Centroid-so: 1.301 arcsec [1.44 $\sigma$ ]  
OotOffset-rm: 0.483 arcsec [2.15 $\sigma$ ]  
KicOffset-rm: 0.369 arcsec [1.48 $\sigma$ ]  
OotOffset-st: 4/3/3/3 [13]  
KicOffset-st: 4/3/3/3 [13]  
DiffImageQuality-fgm: 0.77 [10/13]  
DiffImageOverlap-fno: 1.00 [16/16]

# TCE 010010440-01, PDC Light Curves

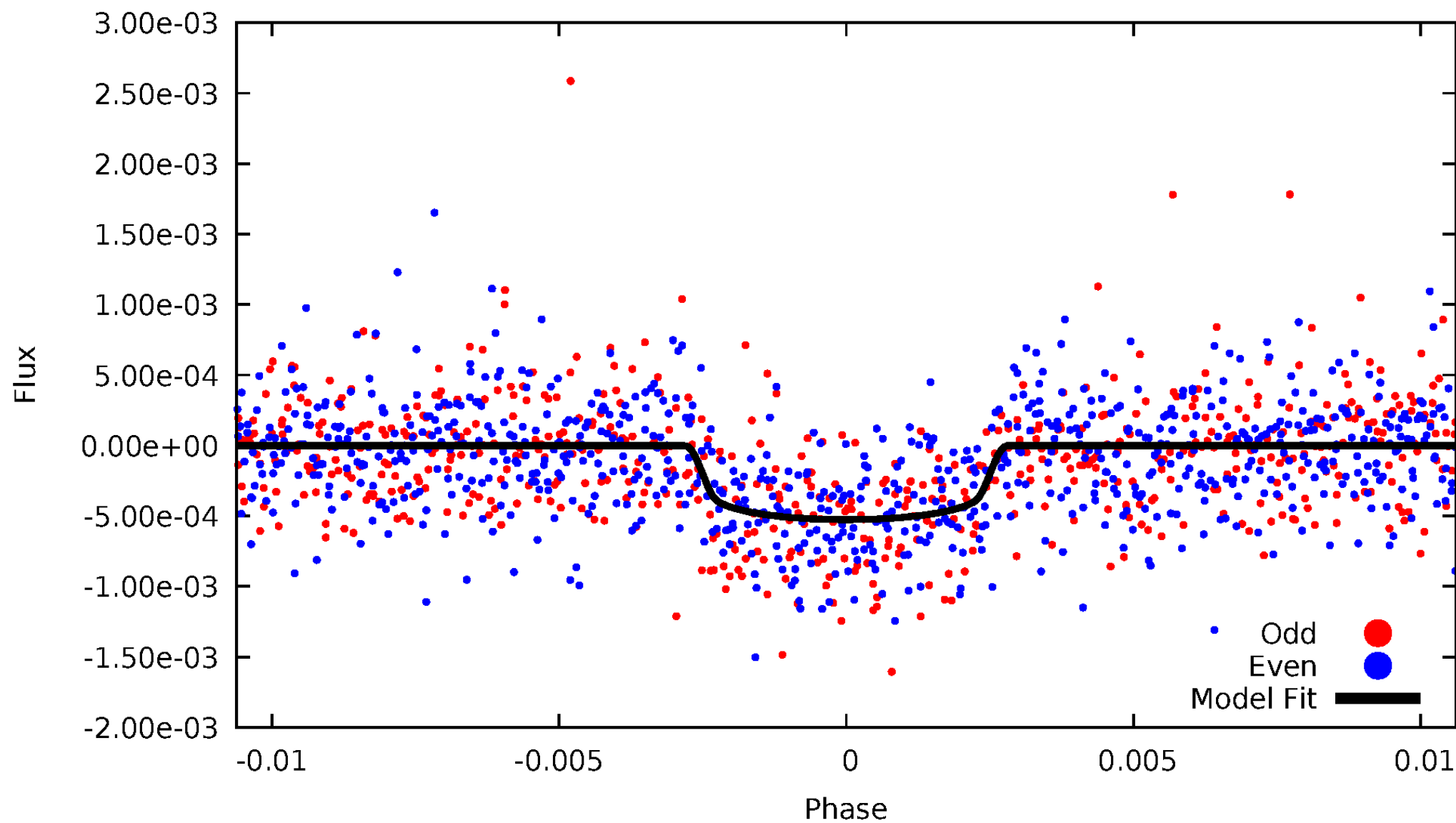


# TCE 010010440-01



# DV Odd/Even

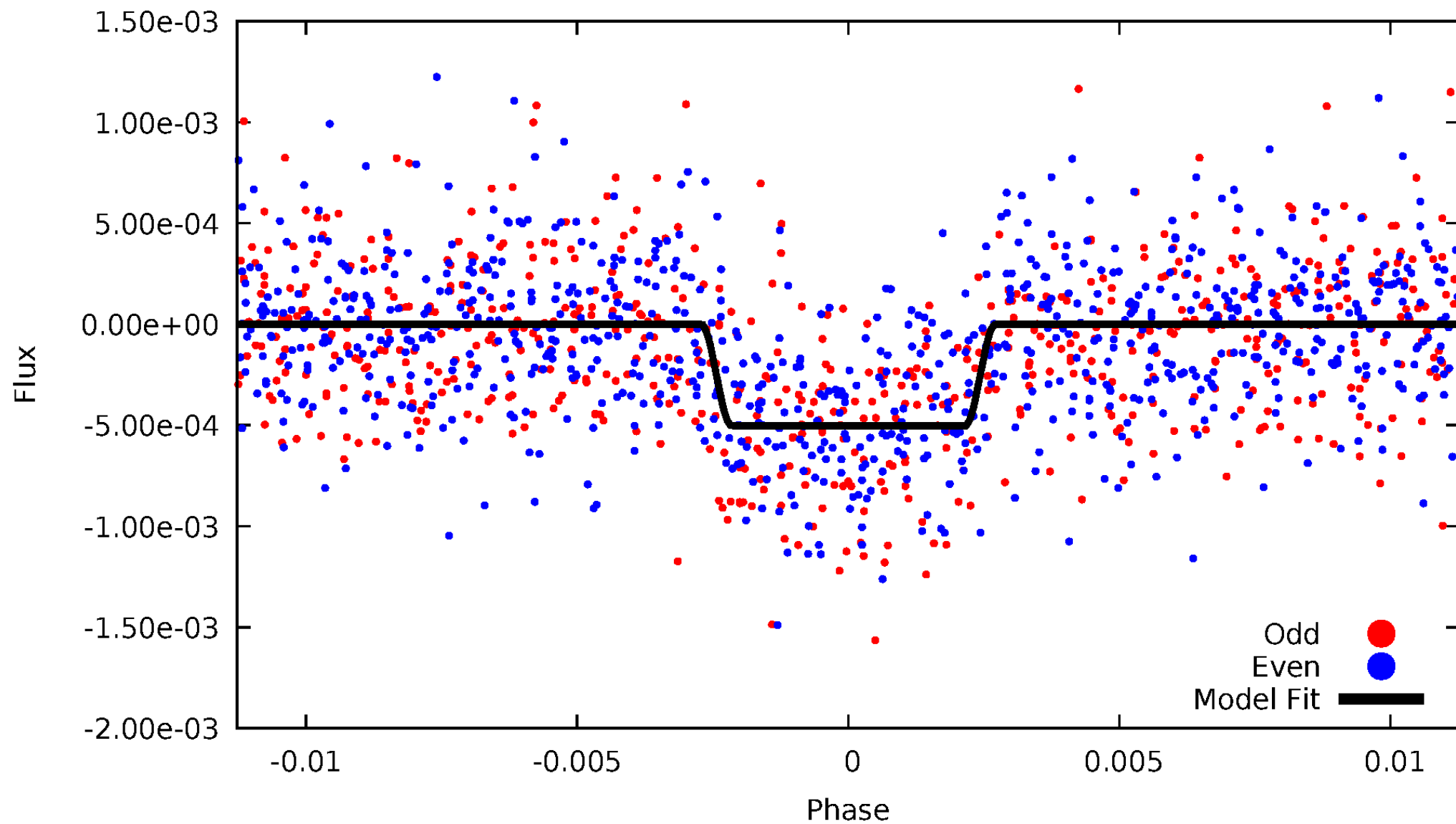
TCE 010010440-01



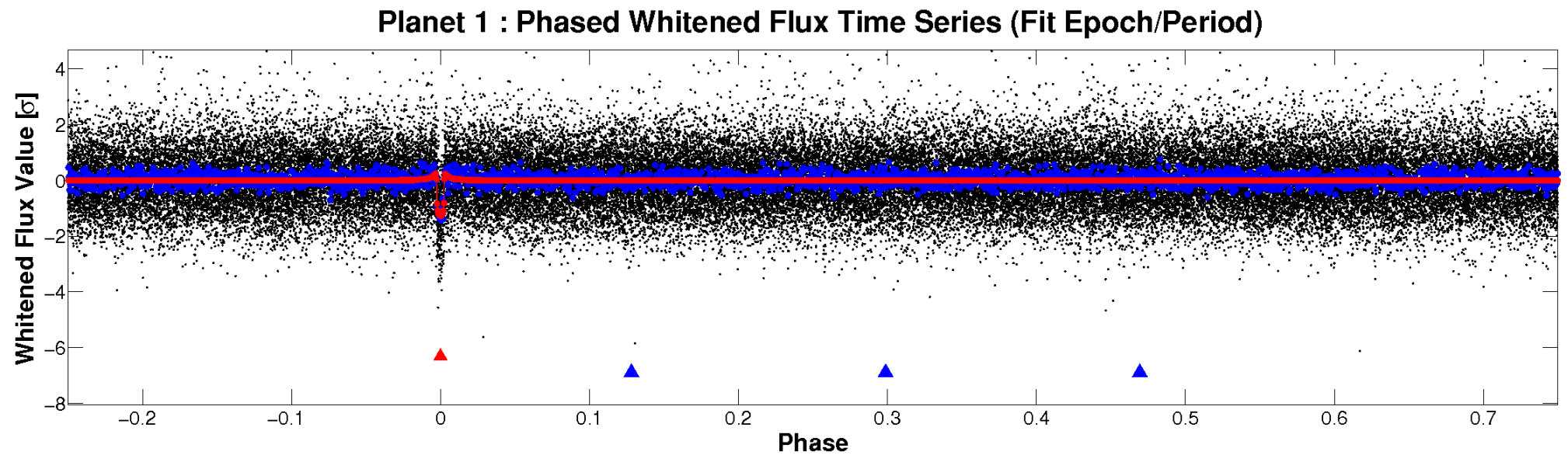
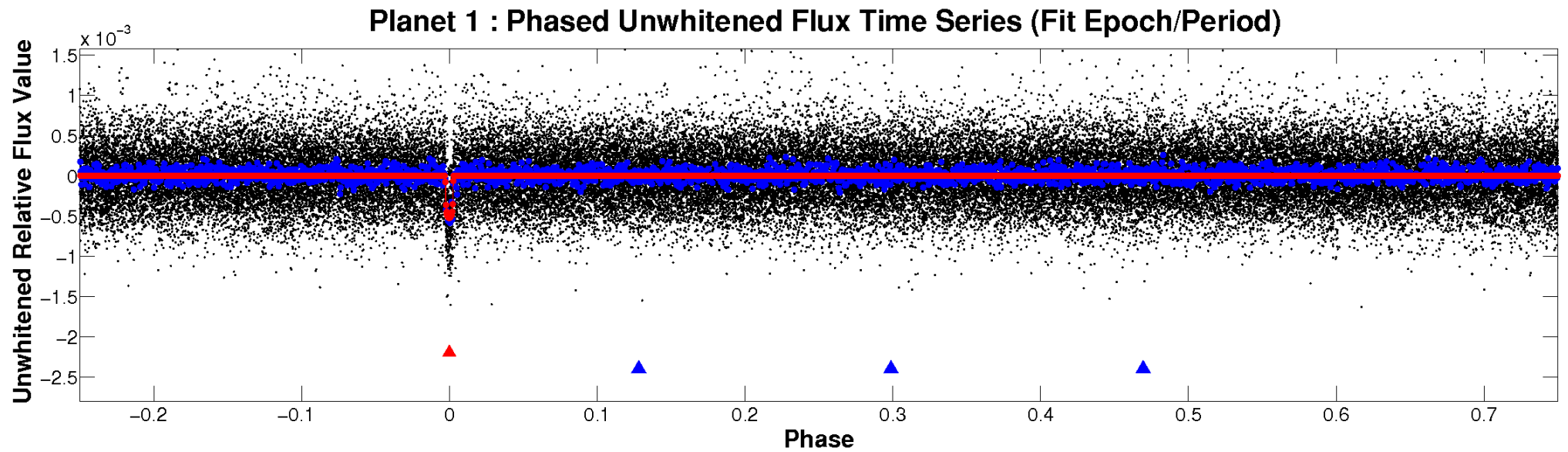


# ALT Odd/Even

TCE 010010440-01

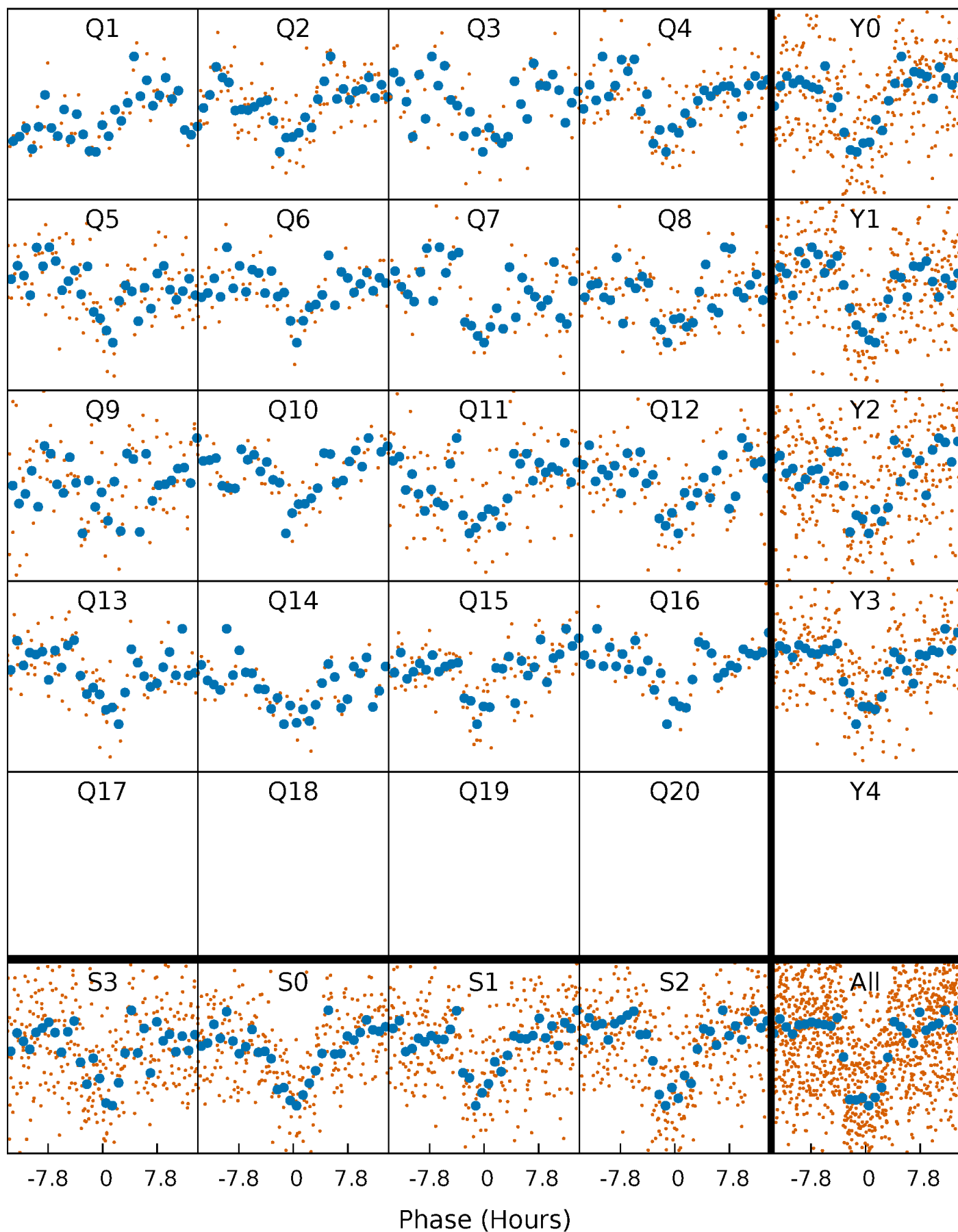


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

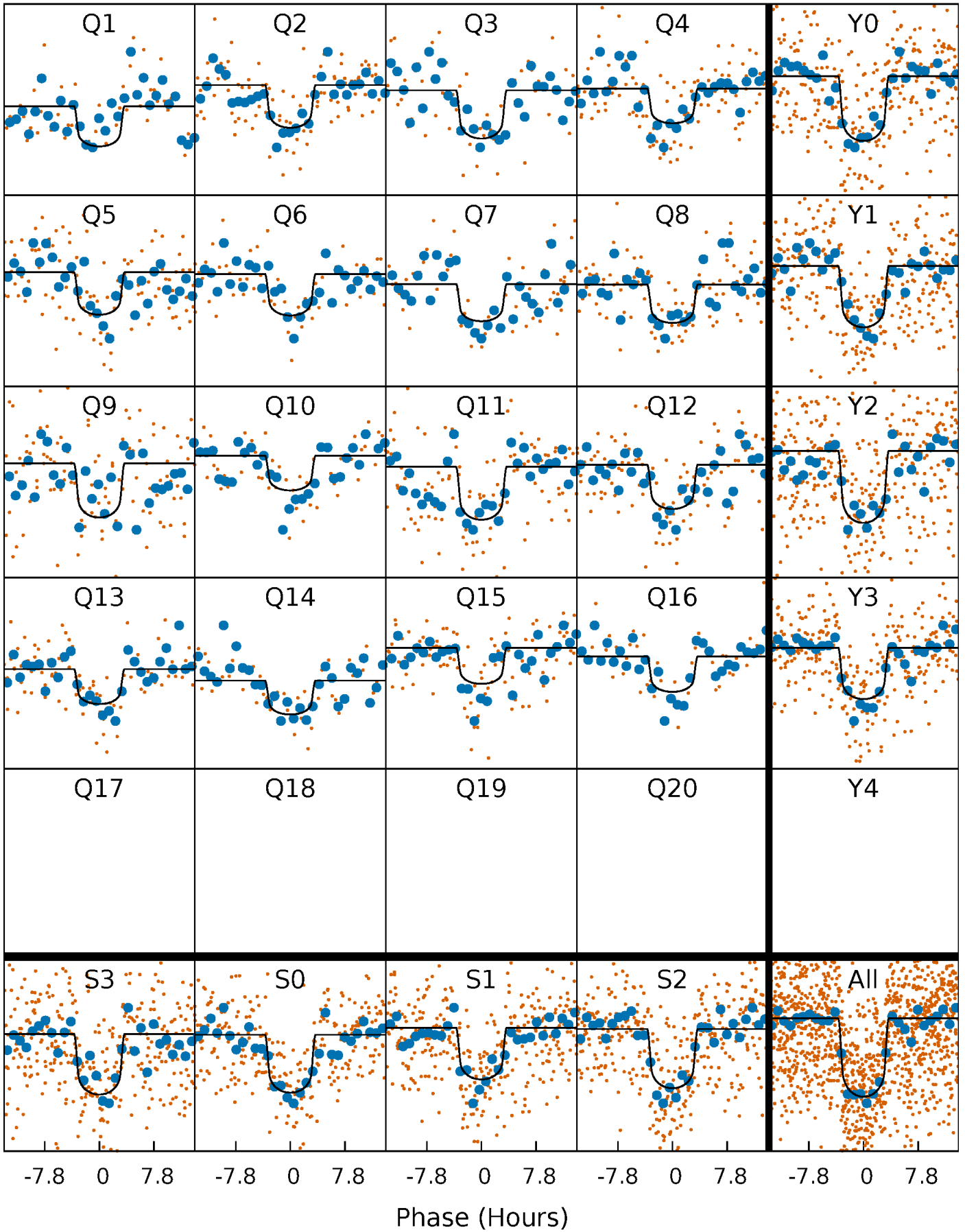
TCE 010010440-01 P= 53.599049 Days  $T_0=147.430881$  (BKJD)





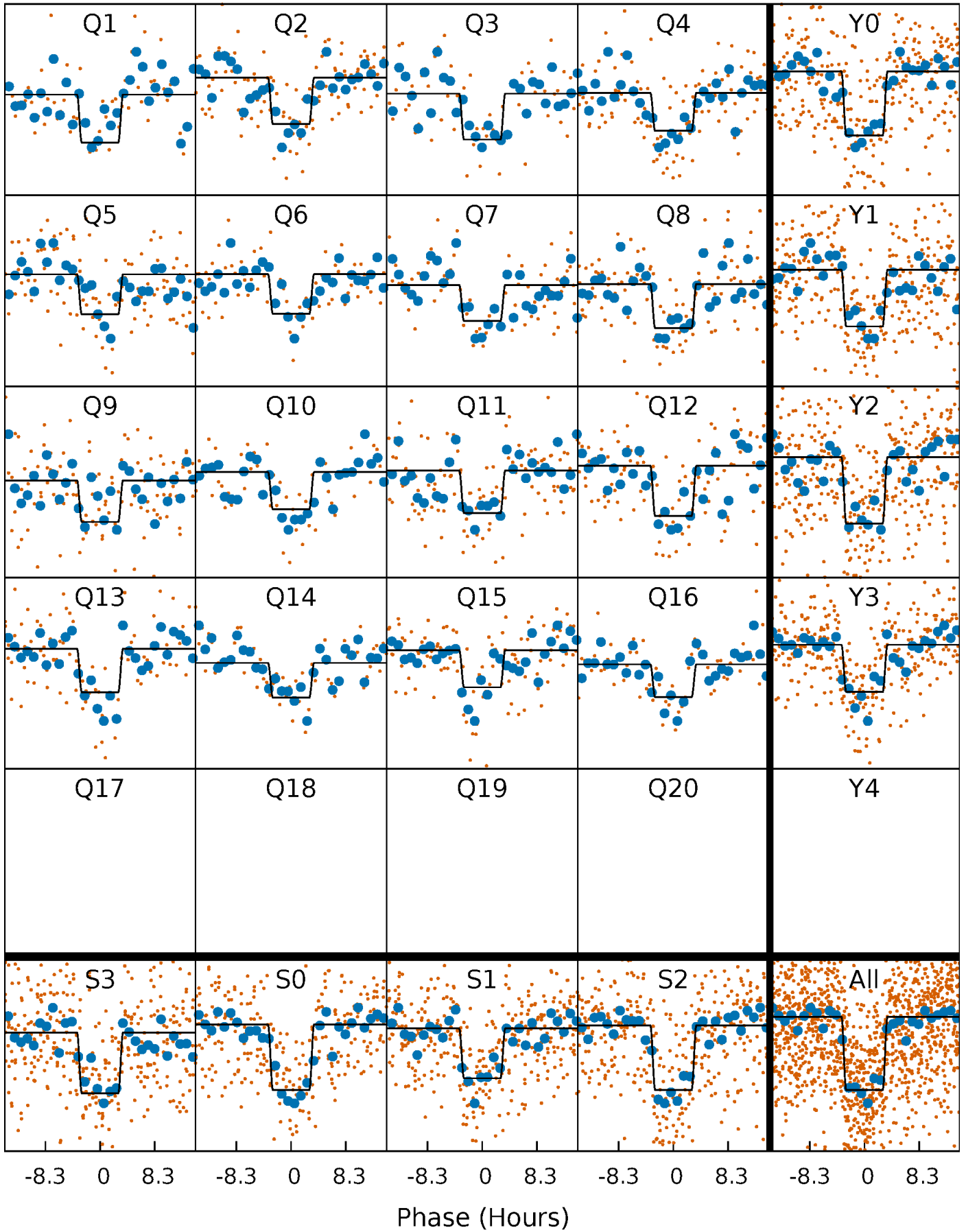
# DV Quarter-Phased Transit Curves

TCE 010010440-01 P= 53.599049 Days  $T_0=147.430881$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

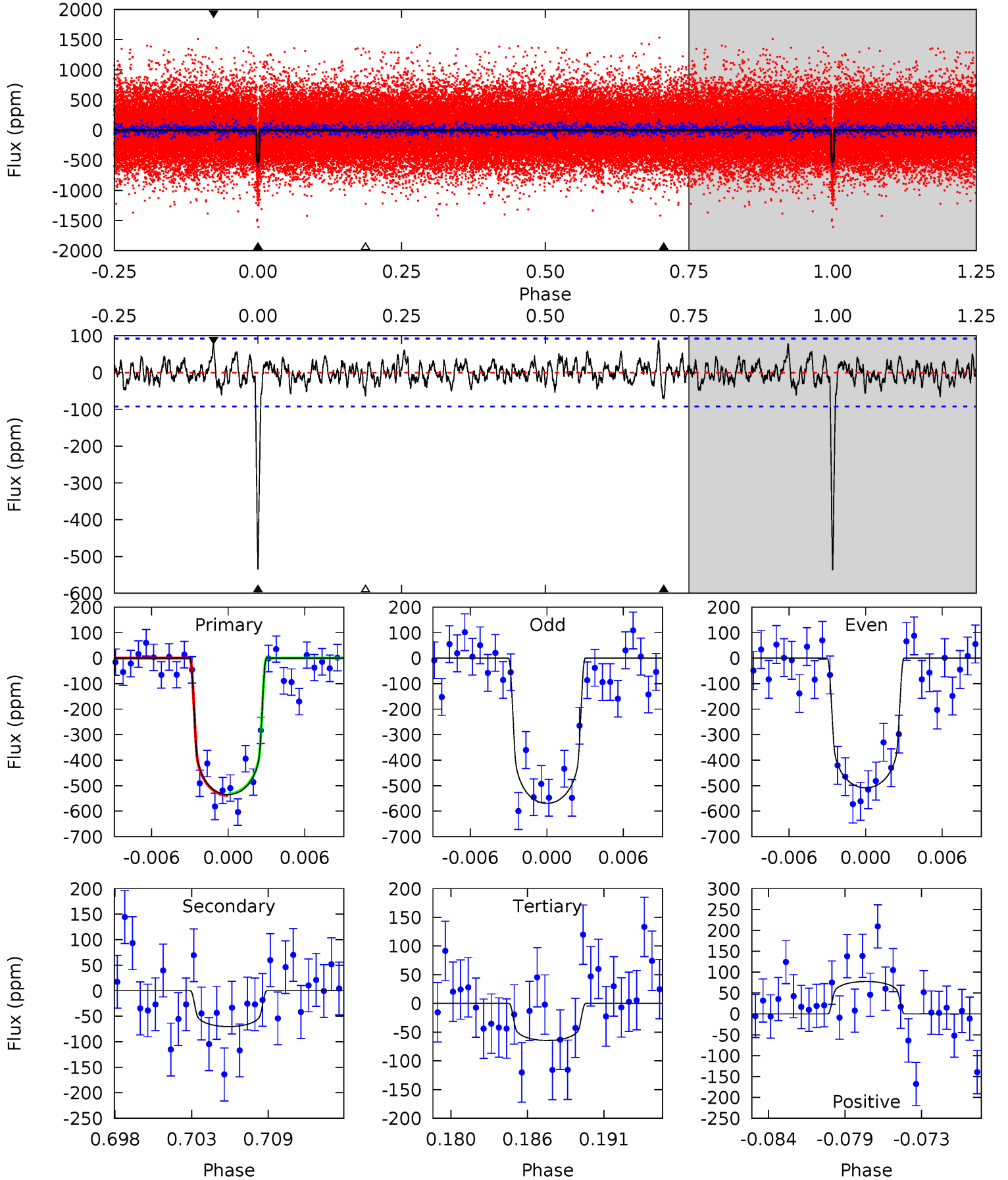
TCE 010010440-01 P= 53.600498 Days  $T_0=147.413332$  (BKJD)



# DV Model-Shift Uniqueness Test

010010440-01, P = 53.599049 Days, E = 93.831832 Days

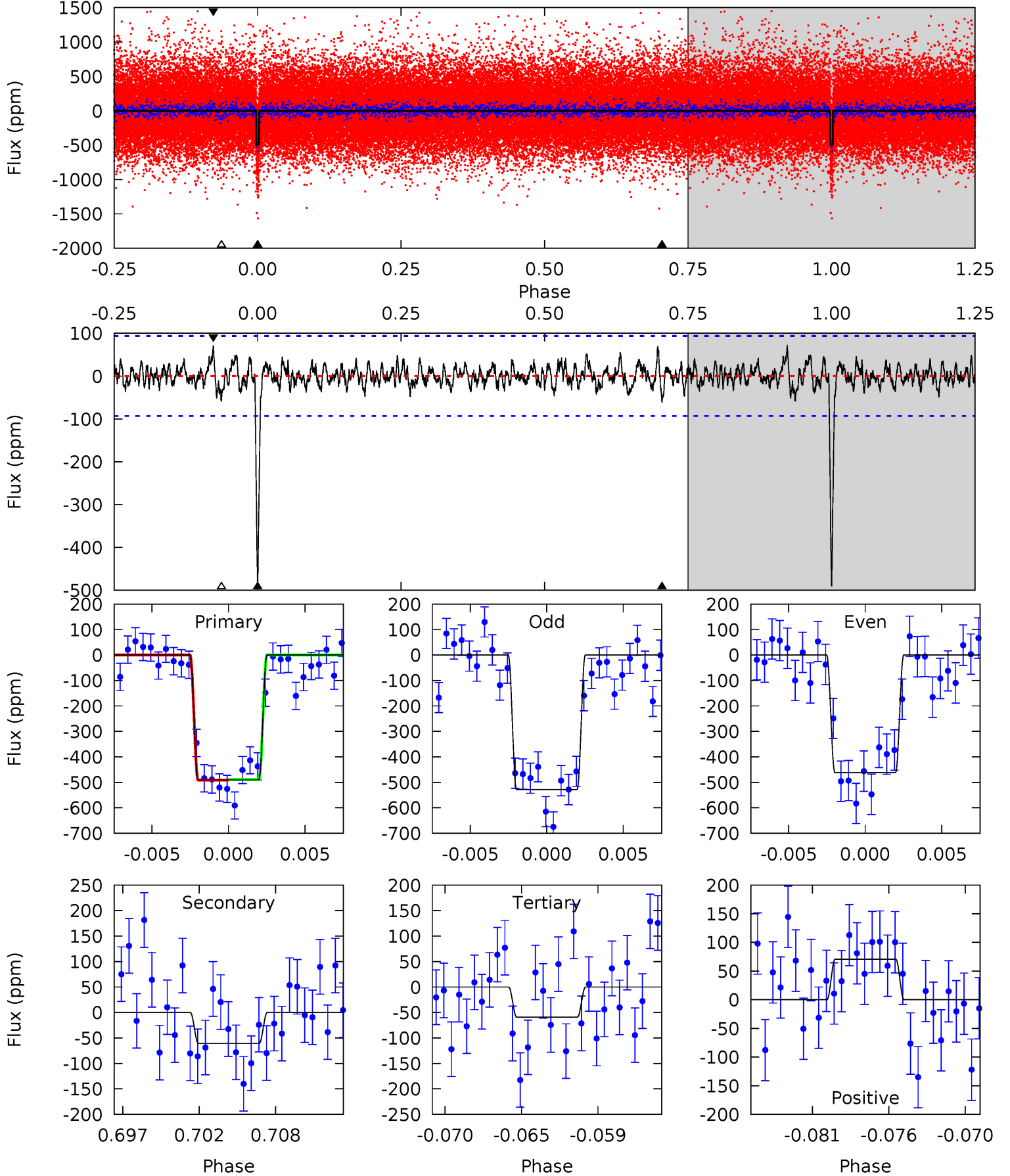
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
29.7	3.91	3.58	4.31	5.14	2.77	1.24	26.1	25.4	0.32	-0.41	1.68	1.04	0.14	0.18



# Alt Model-Shift Uniqueness Test

010010440-01, P = 53.600498 Days, E = 93.812834 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
27.0	3.35	3.25	3.89	5.14	2.78	1.06	23.7	23.1	0.10	-0.55	1.81	1.04	0.13	0.09



### Stellar Parameters For KIC 010010440

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6319^{+169}_{-206}$	$4.447^{+0.052}_{-0.208}$	$-0.220^{+0.250}_{-0.350}$	$1.032^{+0.320}_{-0.107}$	$1.084^{+0.144}_{-0.144}$	$1.389^{+0.393}_{-0.733}$
	+3%/-3%	+1%/-5%	+114%/-159%	+31%/-10%	+13%/-13%	+28%/-53%
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 010010440-01 / KOI 2309.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-70 \pm 18$	$2.66^{+0.68}_{-0.62}$	$757^{+51}_{-39}$	$4137^{+429}_{-337}$	$437^{+315}_{-174}$
Alt.	$-61 \pm 18$	$2.58^{+0.76}_{-0.57}$	$755^{+56}_{-37}$	$4061^{+413}_{-366}$	$397^{+286}_{-174}$

$T_{\text{max}}$  = Theoretical Maximum Planetary Temperature

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

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

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



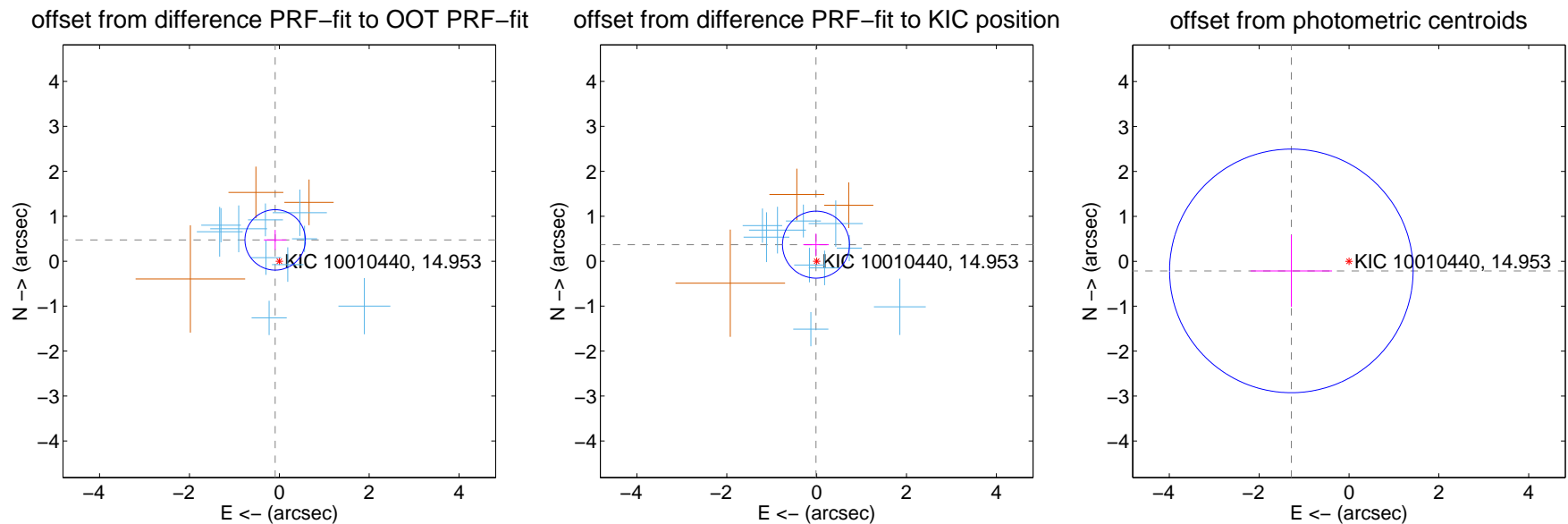
## DV Centroid Data

Supplemental centroid analysis for 010010440-01. Kepler magnitude: 14.95. Transit SNR 20.63

There are 10 quarters with good PRF difference image offsets

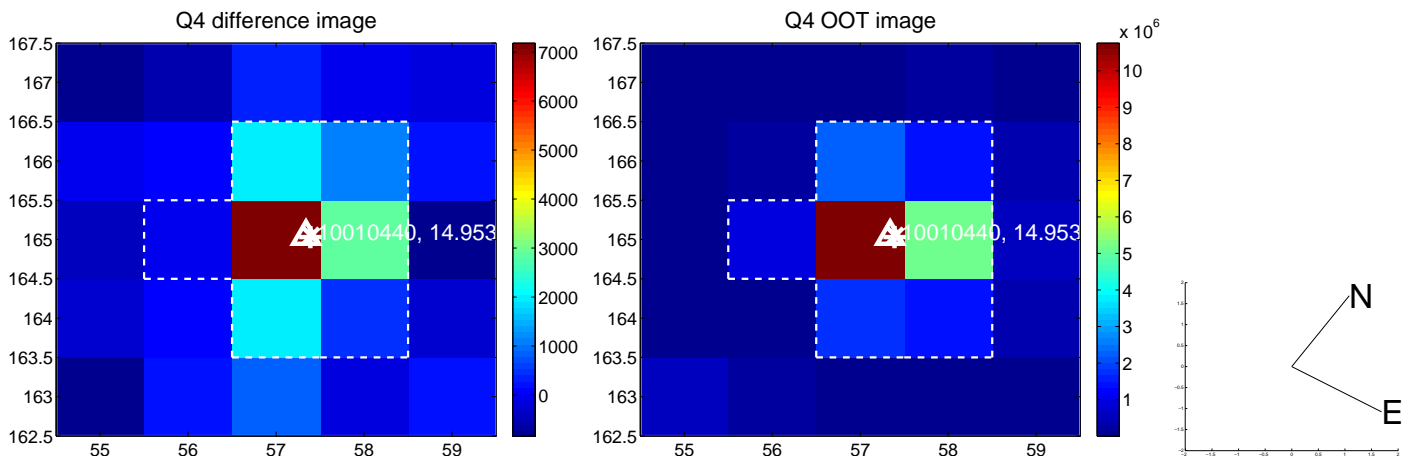
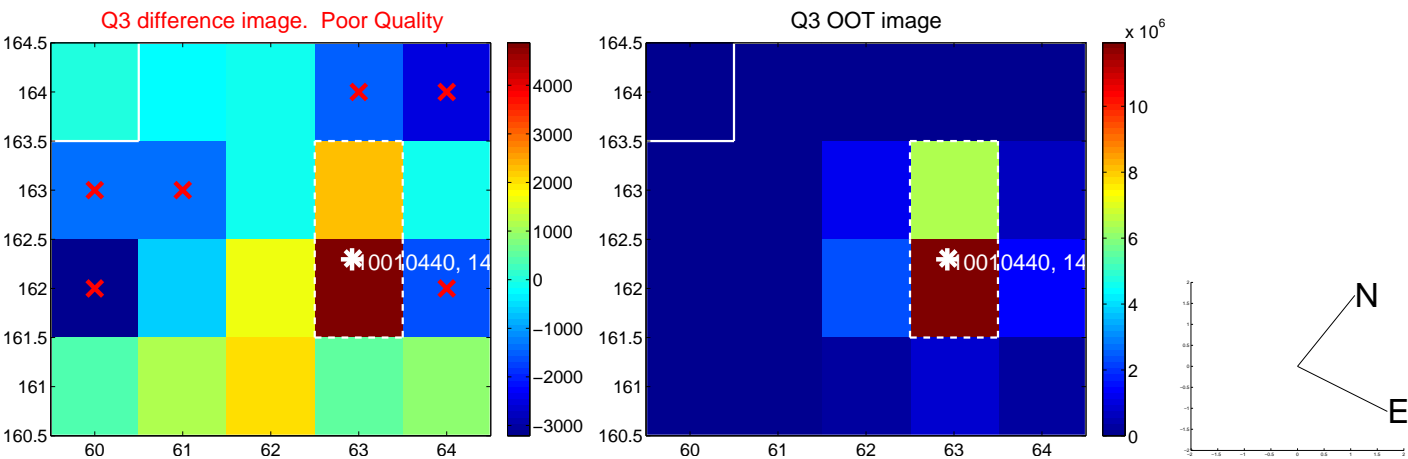
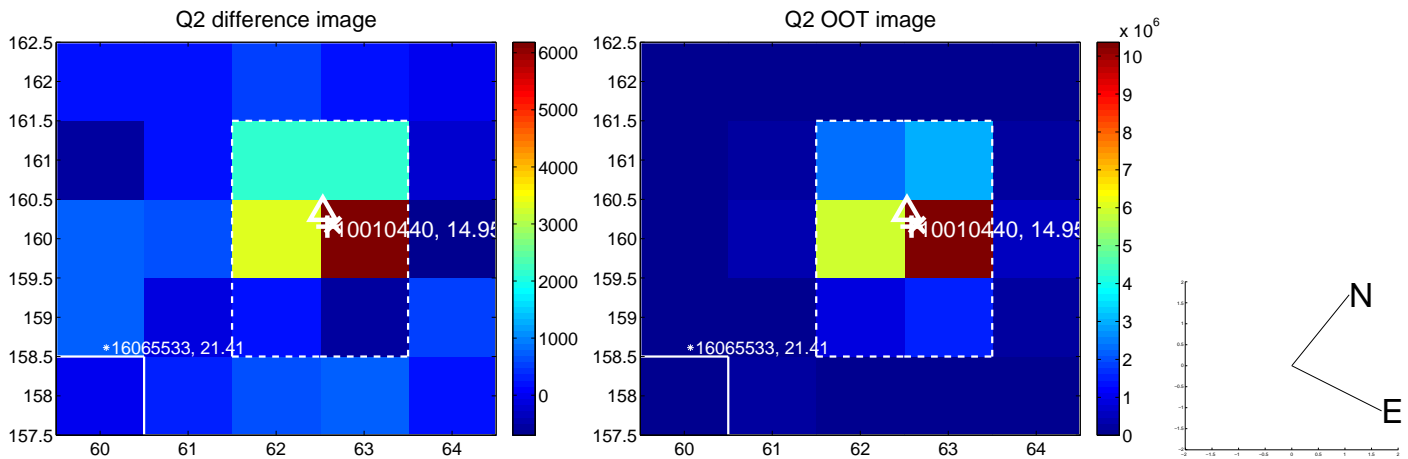
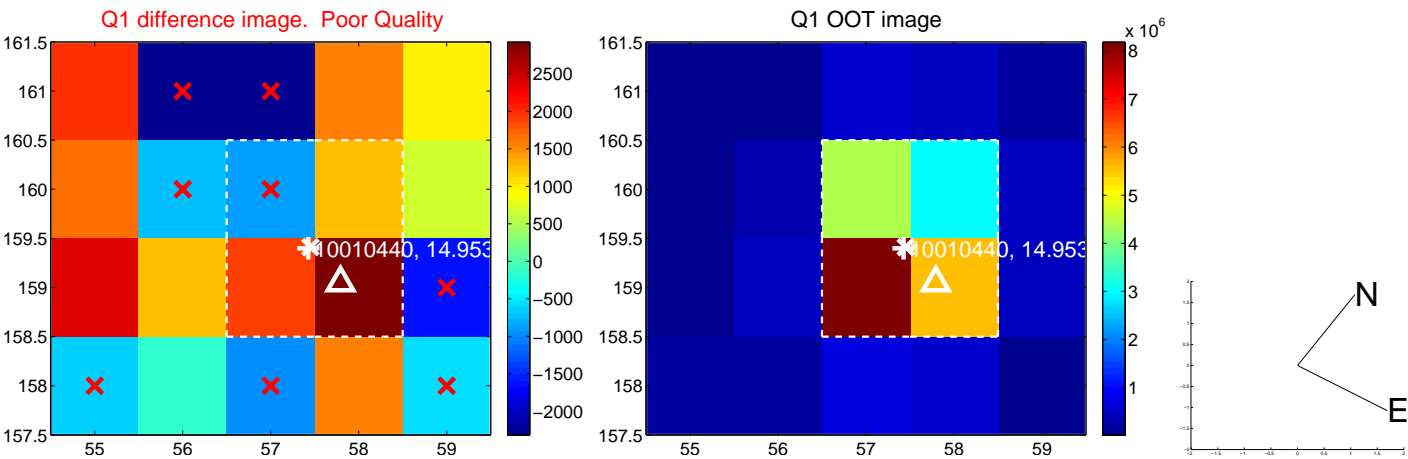
The direct PRF centroid is offset from the target star catalog position by about 0.24 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.483 \pm 0.224$	2.15	$0.092 \pm 0.251$	$0.474 \pm 0.223$
PRF-fit source offset from KIC position	$0.369 \pm 0.248$	1.48	$0.015 \pm 0.282$	$0.368 \pm 0.247$
photometric centroid source offset	$1.30 \pm 0.90$	1.44	$1.28 \pm 0.91$	$-0.21 \pm 0.80$

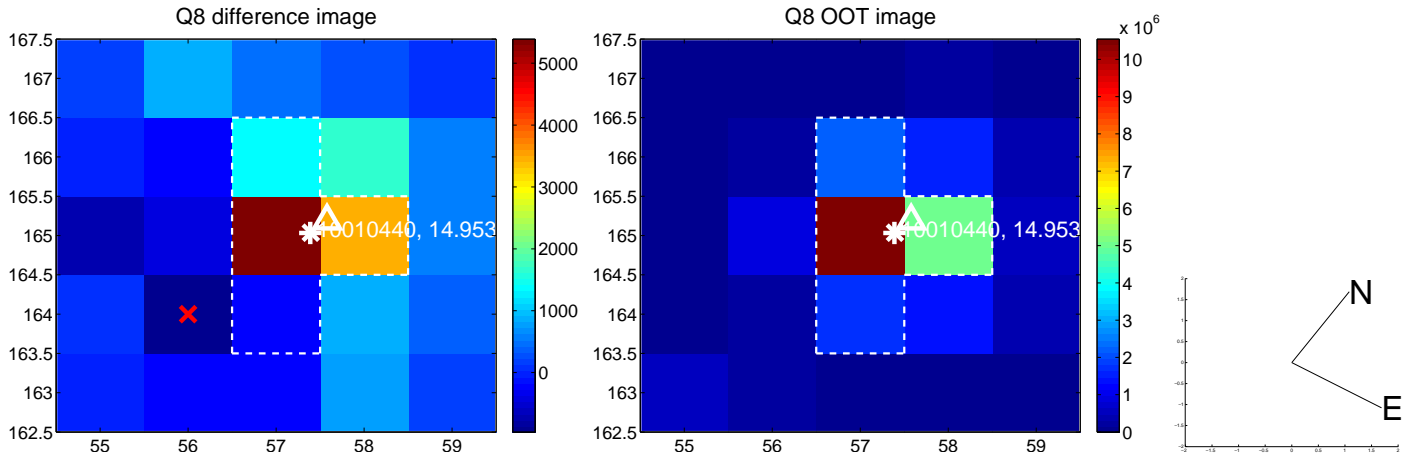
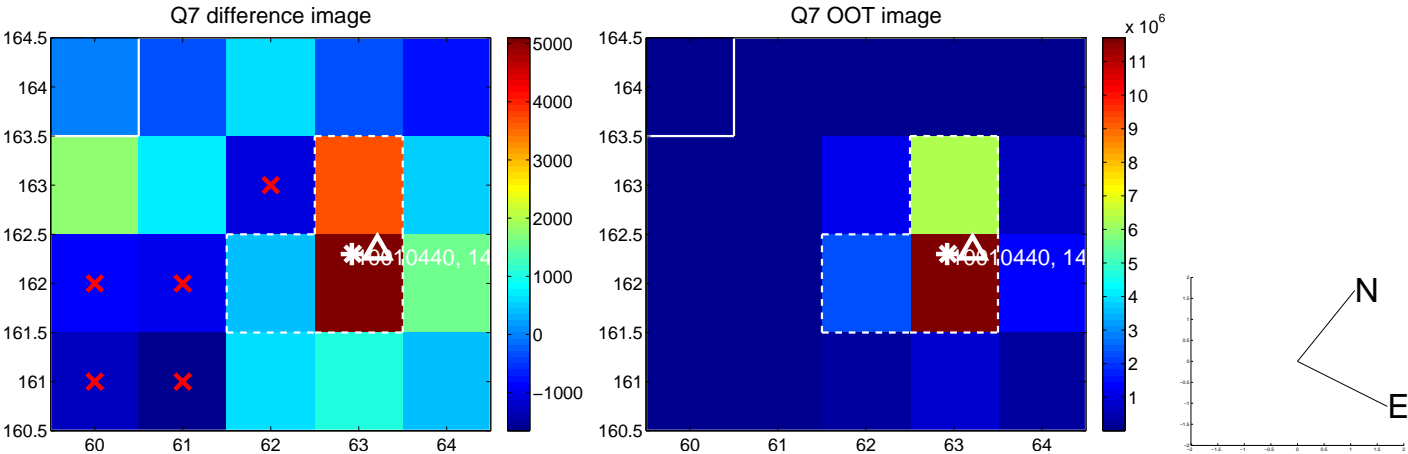
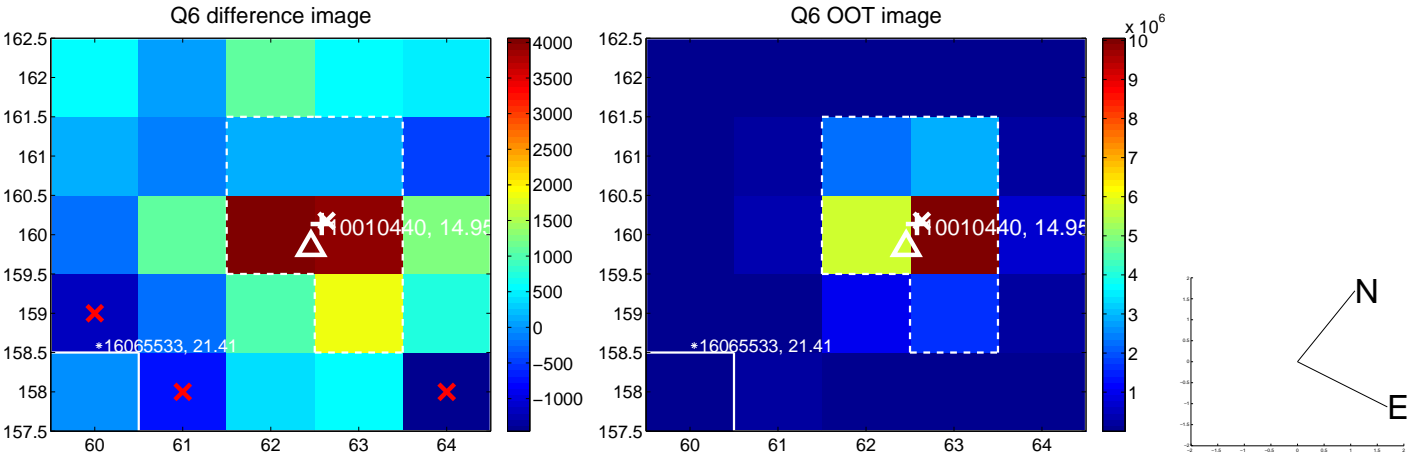
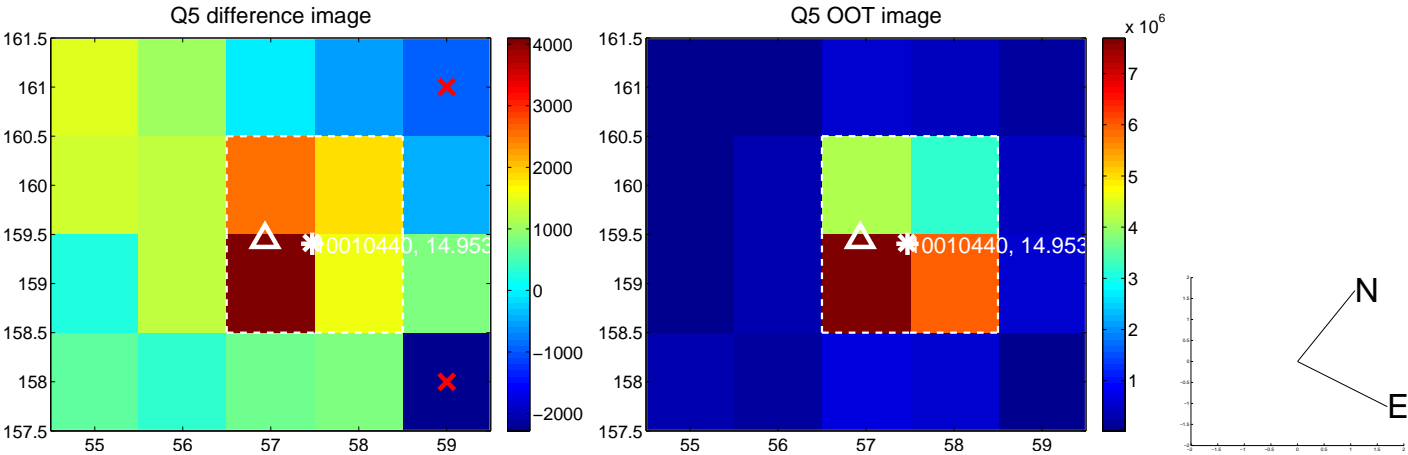


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

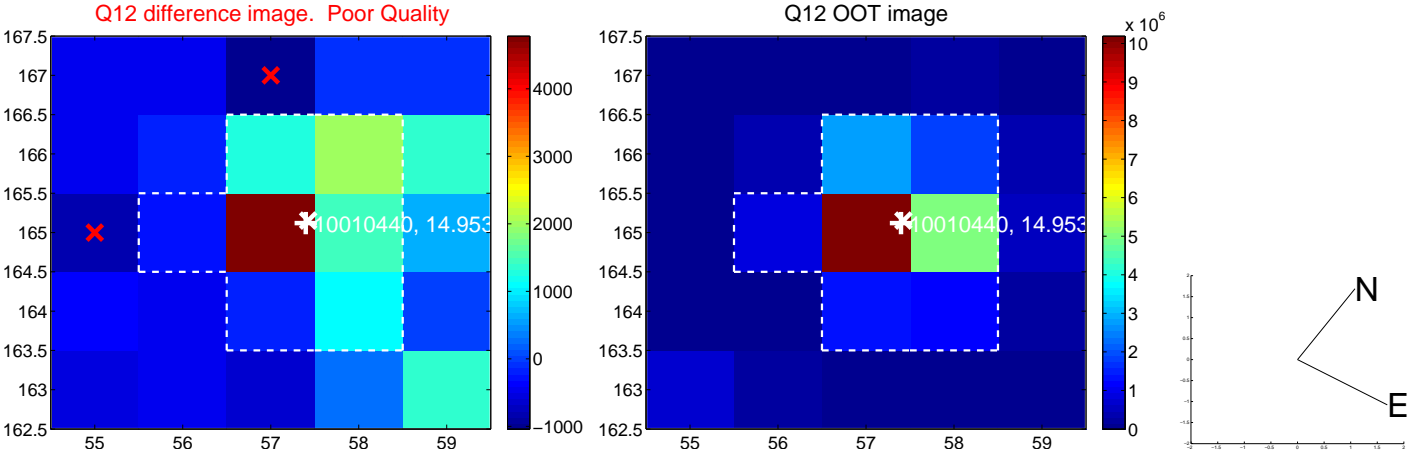
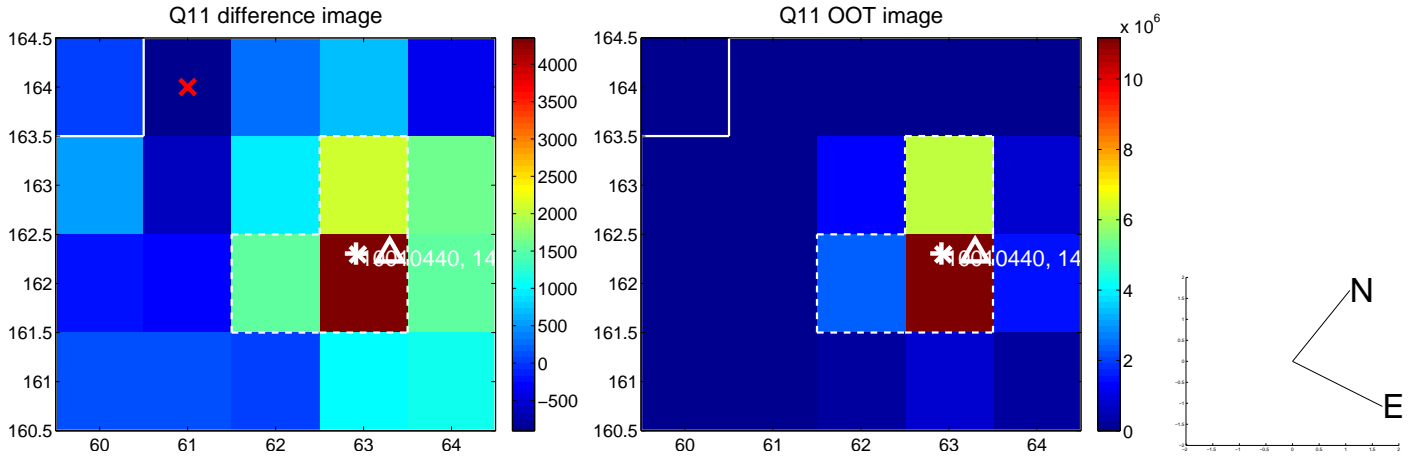
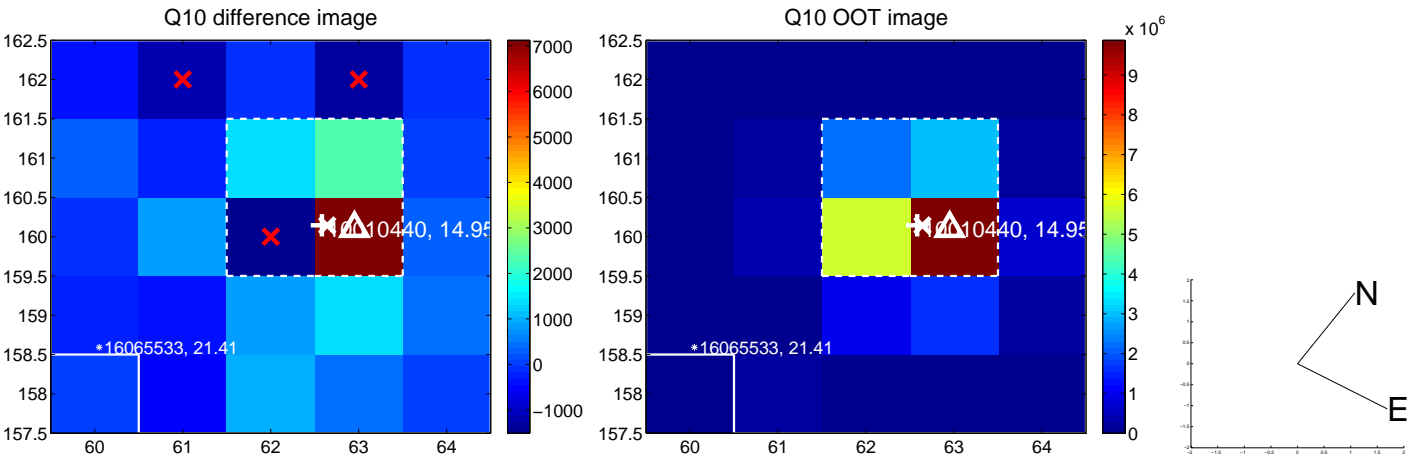
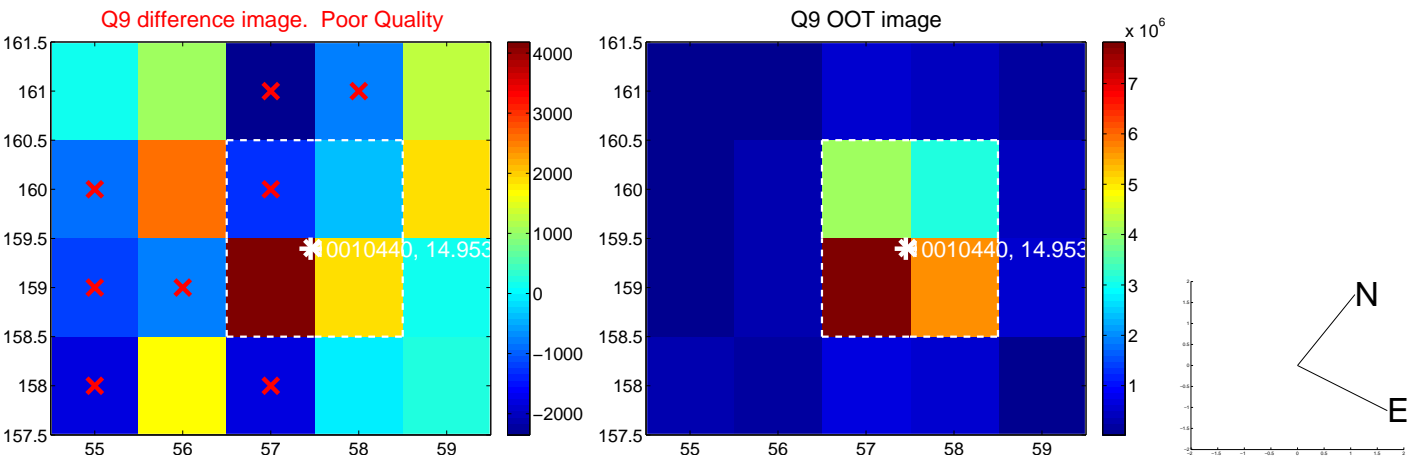
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



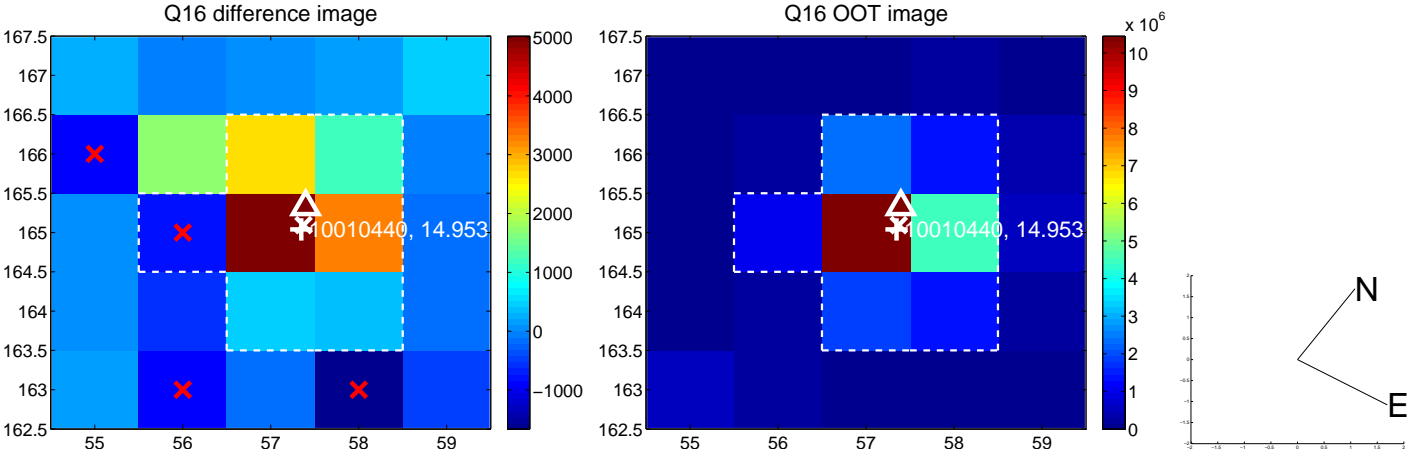
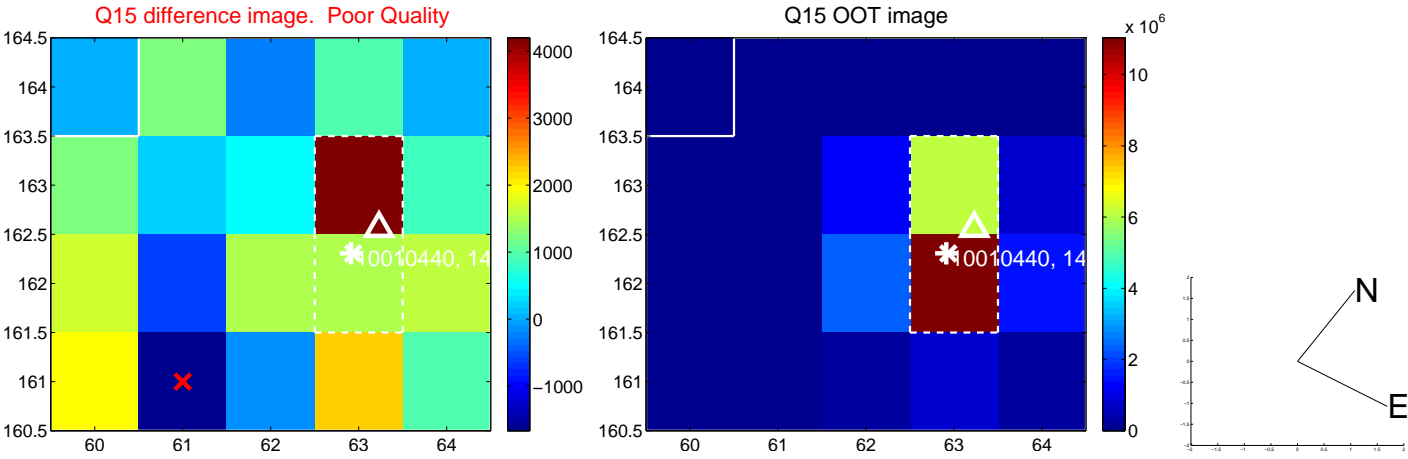
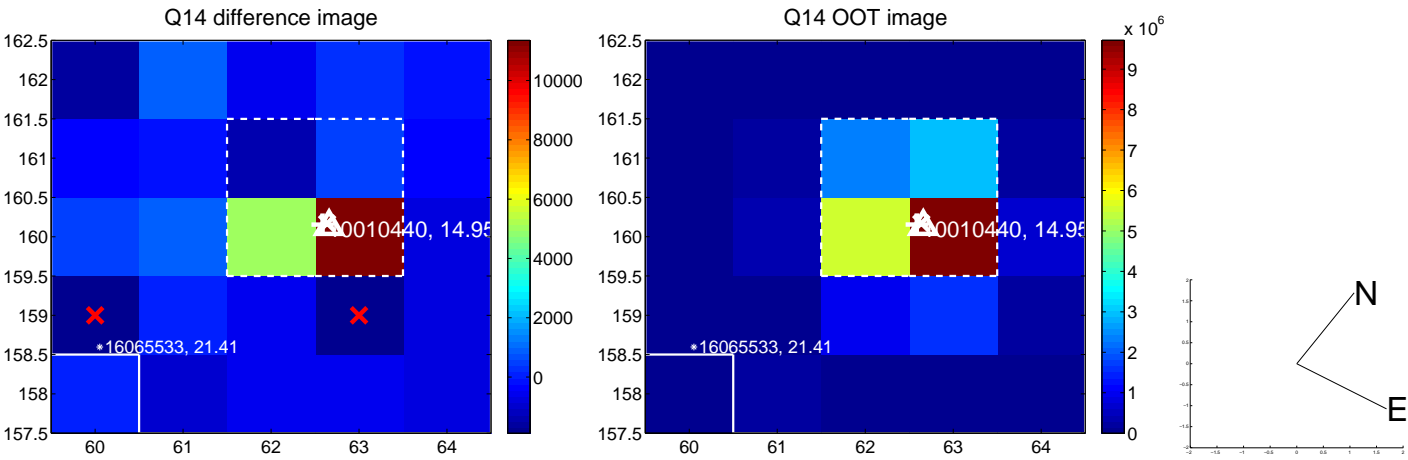
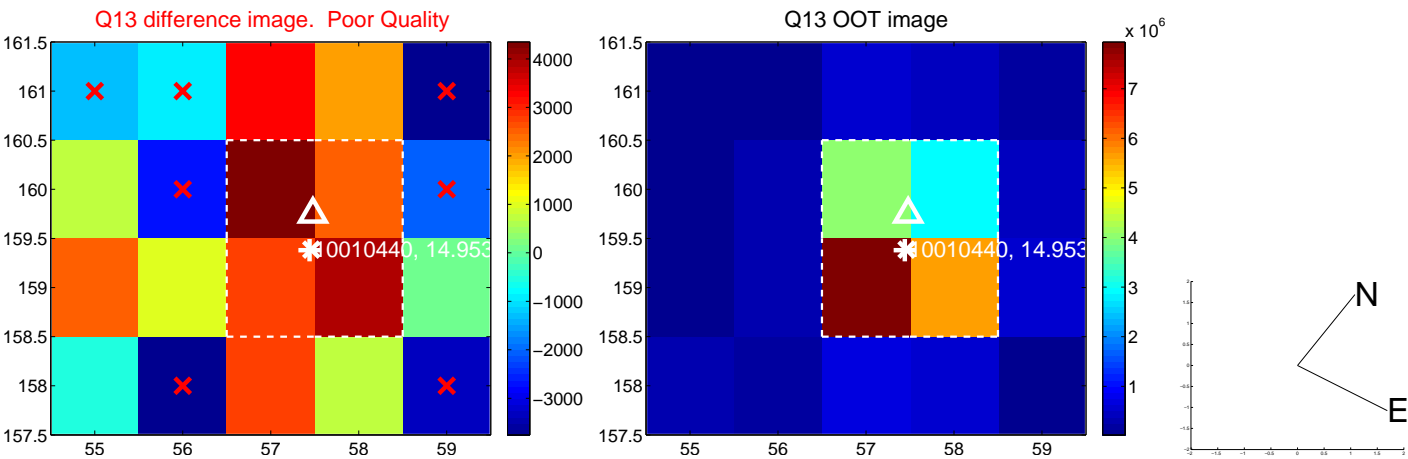
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

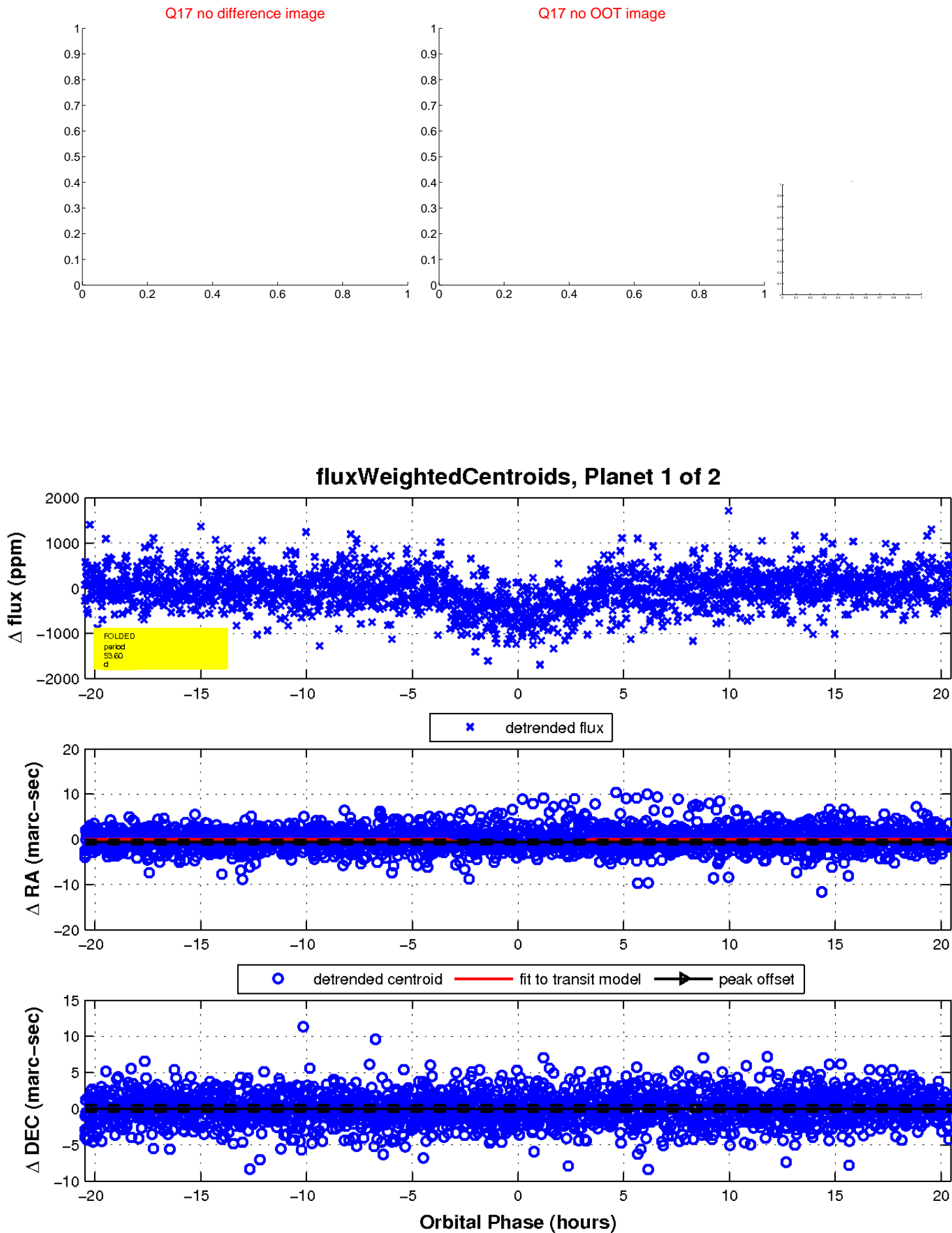


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



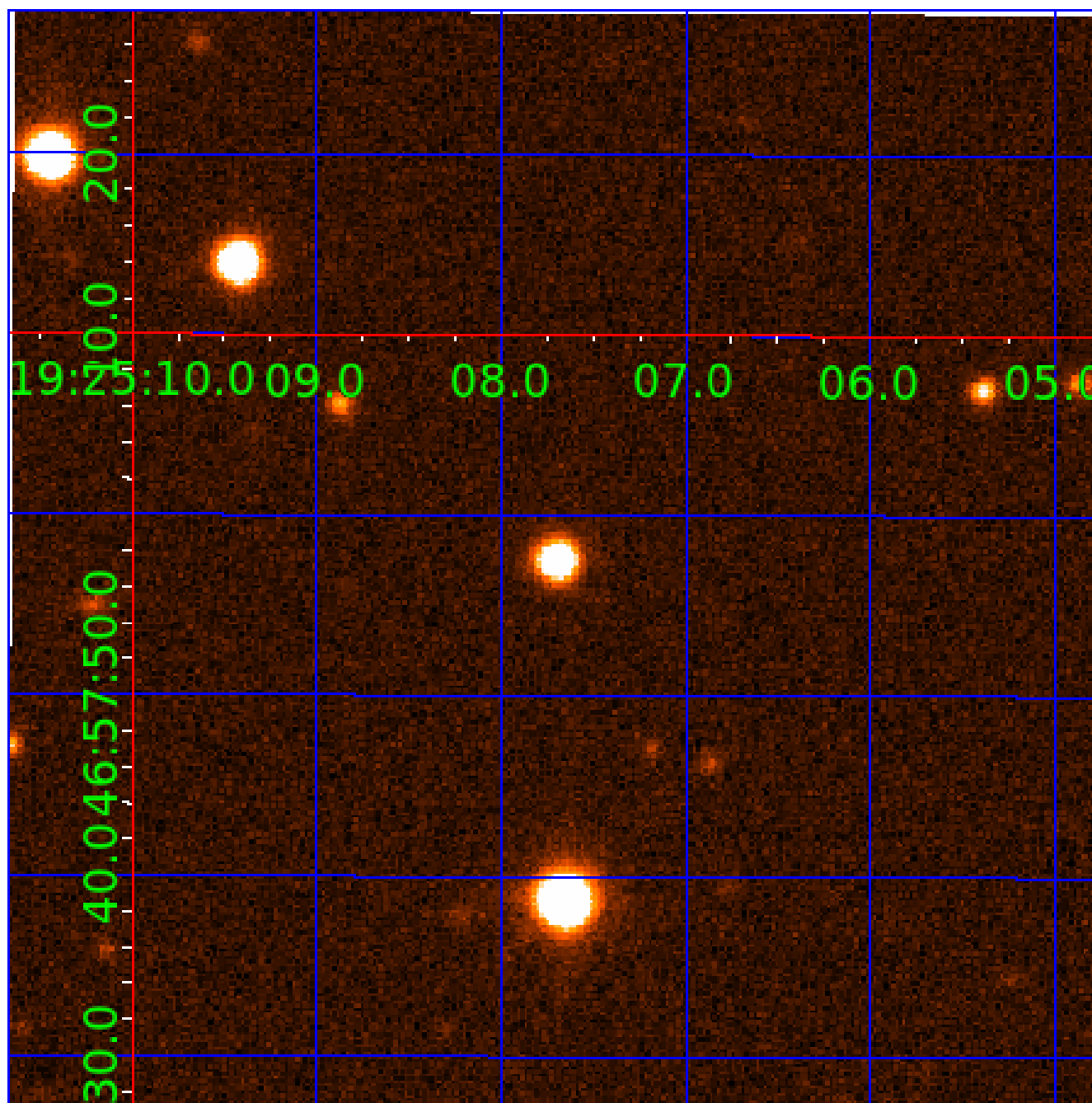


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 010010440

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
010010440-01	OBS	2309.01	53.599049	147.430881	525.4	6.827	19.3	20.6	1.03	6319	2.55	18.58
010010440-02	OBS	No	473.245098	172.592071	430.1	13.331	7.6	6.9	1.03	6319	2.30	1.02

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
010010440-01	OBS	PC	0.97	0	0	0	0	NO_COMMENT
010010440-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE—MOD_POS_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS

**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.

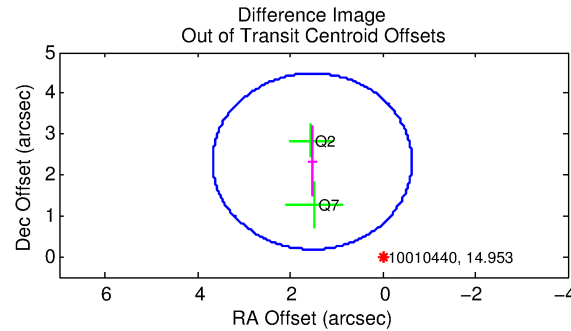
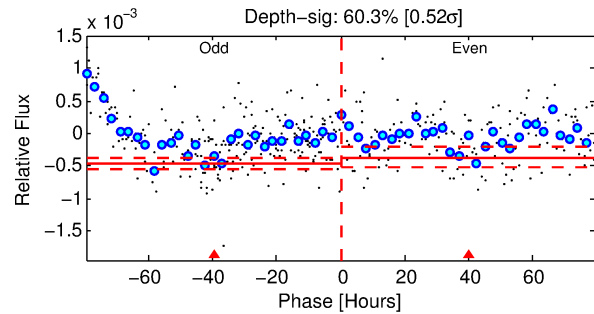
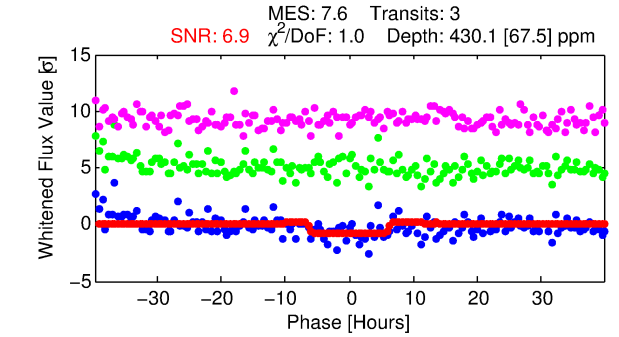
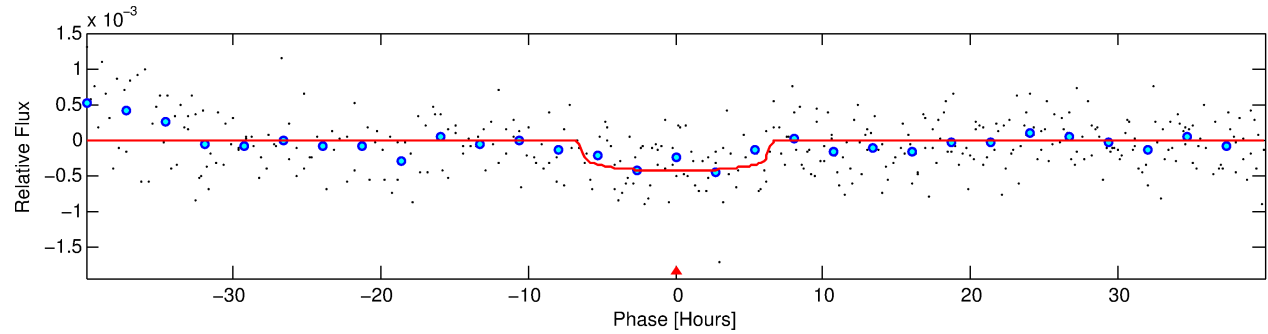
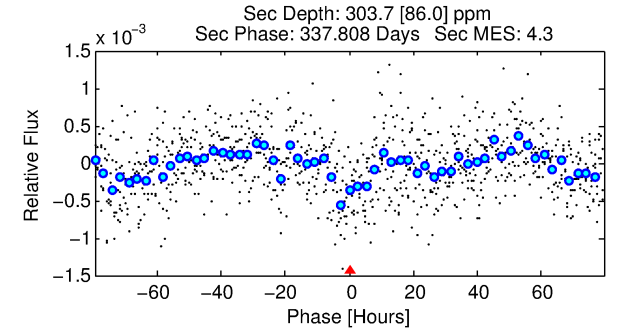
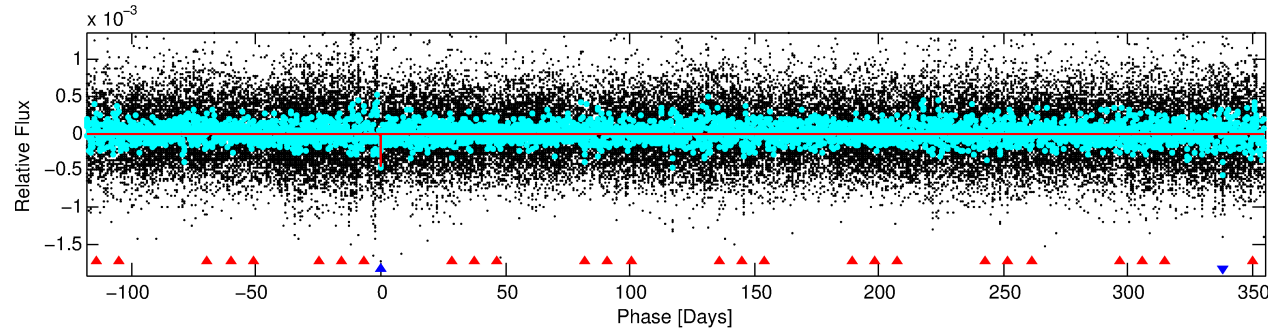
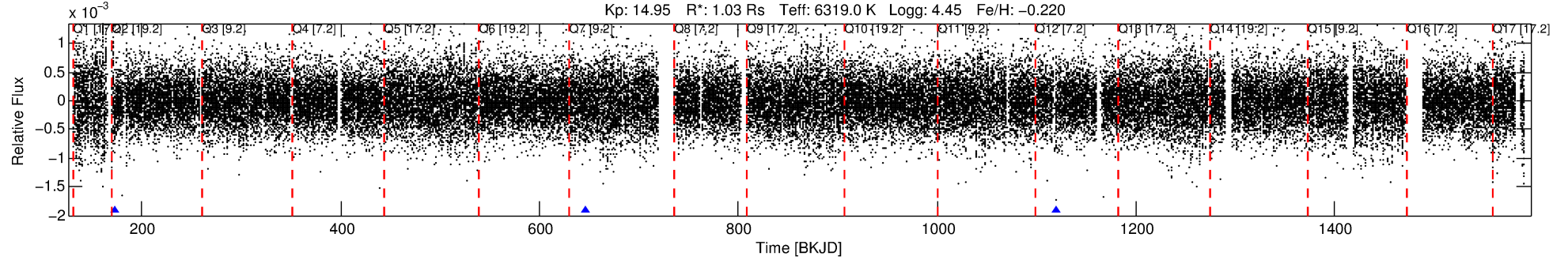
## Ephemeris Match Information For 010010440-02

No Significant Match Found

# DV One-Page Summary

KIC: 10010440 Candidate: 2 of 2 Period: 473.245 d

KOI: K02309 Corr: No Ephemeris Match



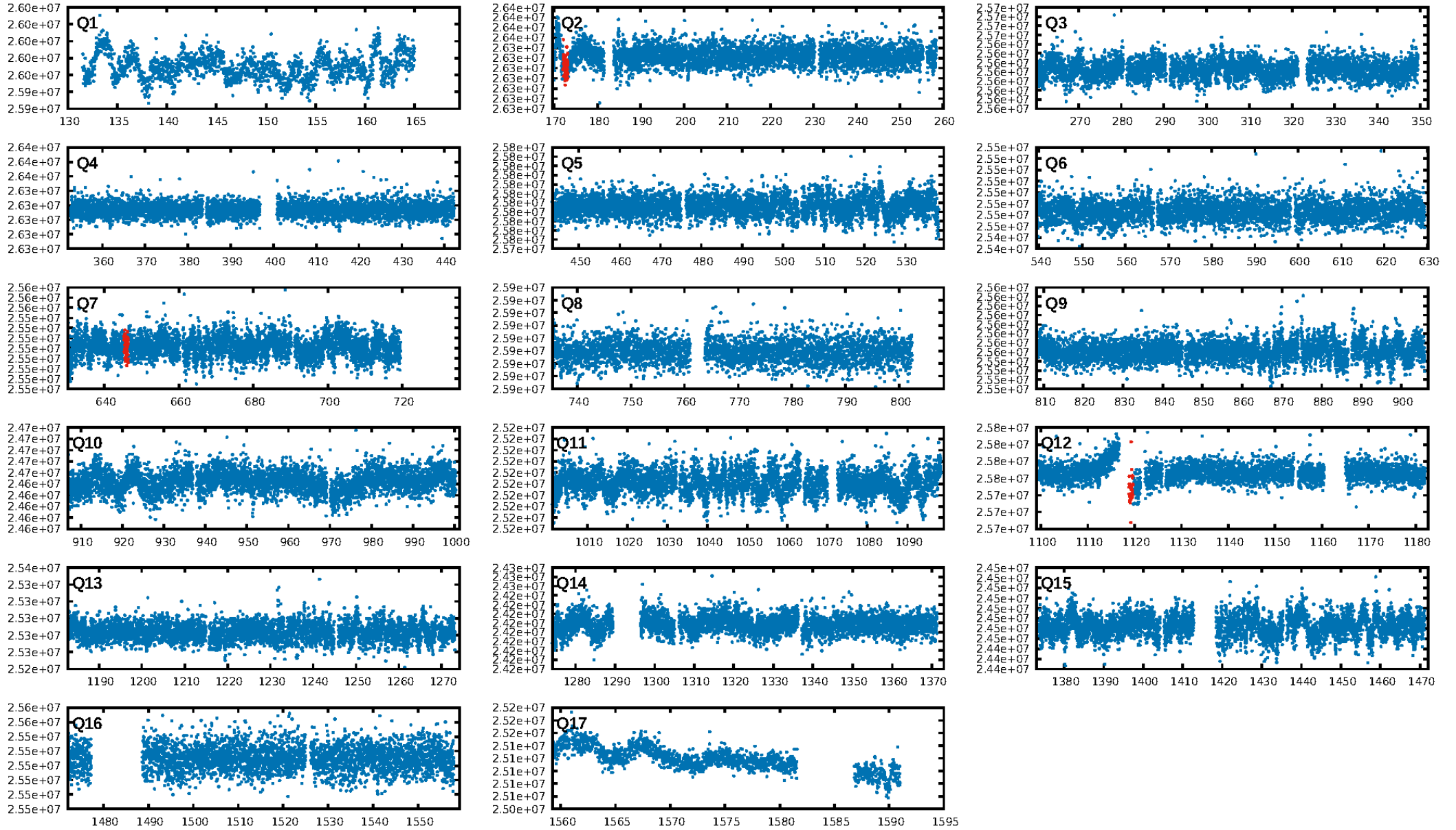
## DV Fit Results:

Period = 473.24510 [0.01979] d  
Epoch = 172.5921 [0.0205] BKJD  
Rp/R\* = 0.0204 [0.0067]  
a/R\* = 196.81 [326.50]  
b = 0.72 [1.13]  
Seff = 1.02 [0.41]  
Teq = 256 [26] K  
Rp = 2.30 [1.04] Re  
a = 1.2224 [0.3193] AU  
Ag = 47190.13 [38279.25] [1.23 $\sigma$ ]  
Teffp = 5837 [1063] K [5.25 $\sigma$ ]

## DV Diagnostic Results:

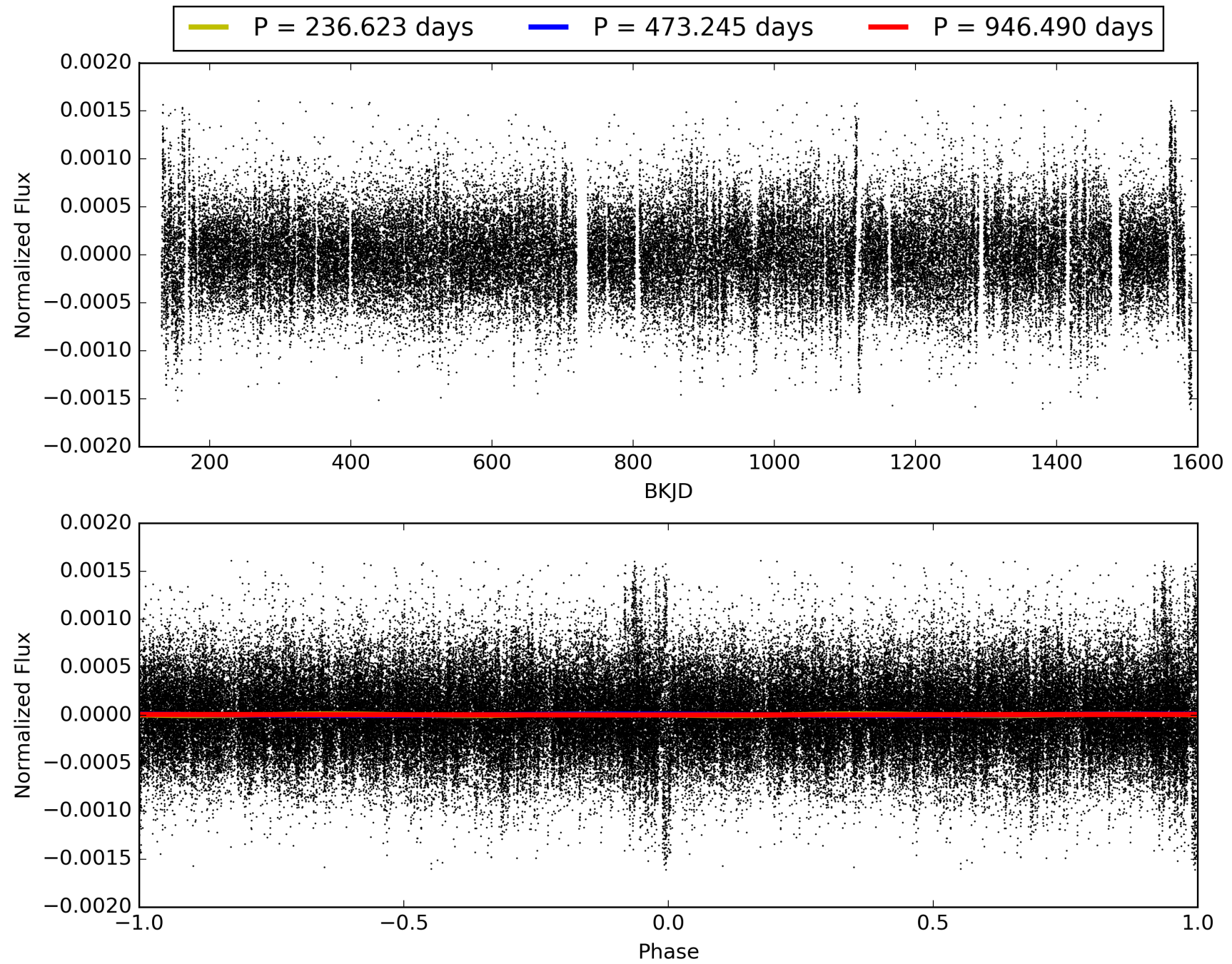
ShortPeriod-sig: 100.0% [672.47 $\sigma$ ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 18.3%  
ModelChiSquareGof-sig: 99.1%  
Bootstrap-pfa: 4.11e-08  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: -0.7707  
Centroid-sig: 4.4%  
Centroid-so: 4.033 arcsec [1.39 $\sigma$ ]  
OotOffset-rm: 2.785 arcsec [3.88 $\sigma$ ]  
KicOffset-rm: 2.585 arcsec [4.27 $\sigma$ ]  
OotOffset-st: 1/1/0/0 [2]  
KicOffset-st: 1/1/0/0 [2]  
DiffImageQuality-fgm: 0.50 [1/2]  
DiffImageOverlap-fno: 1.00 [2/2]

# TCE 010010440-02, PDC Light Curves



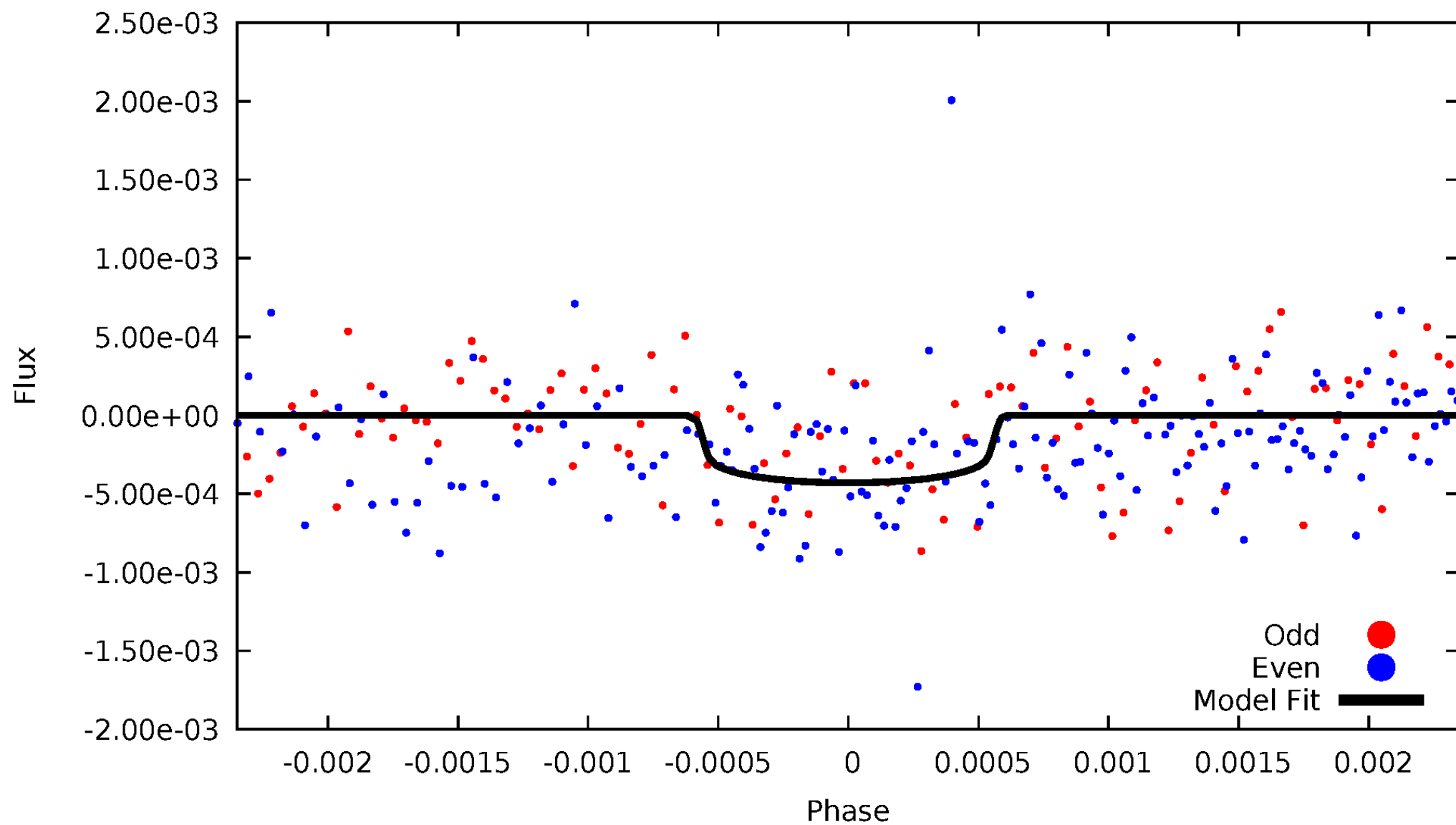


TCE 010010440-02



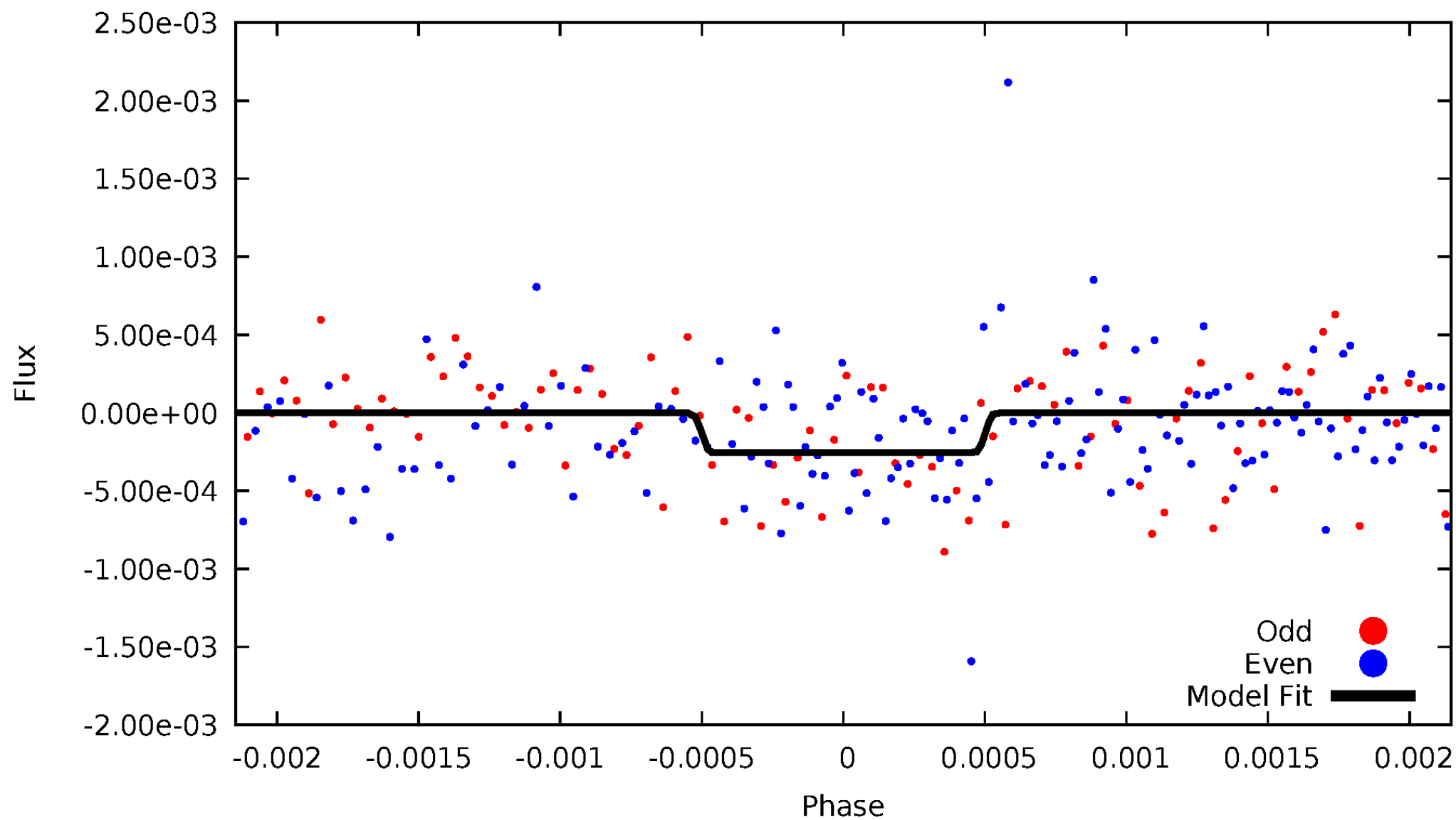
# DV Odd/Even

TCE 010010440-02



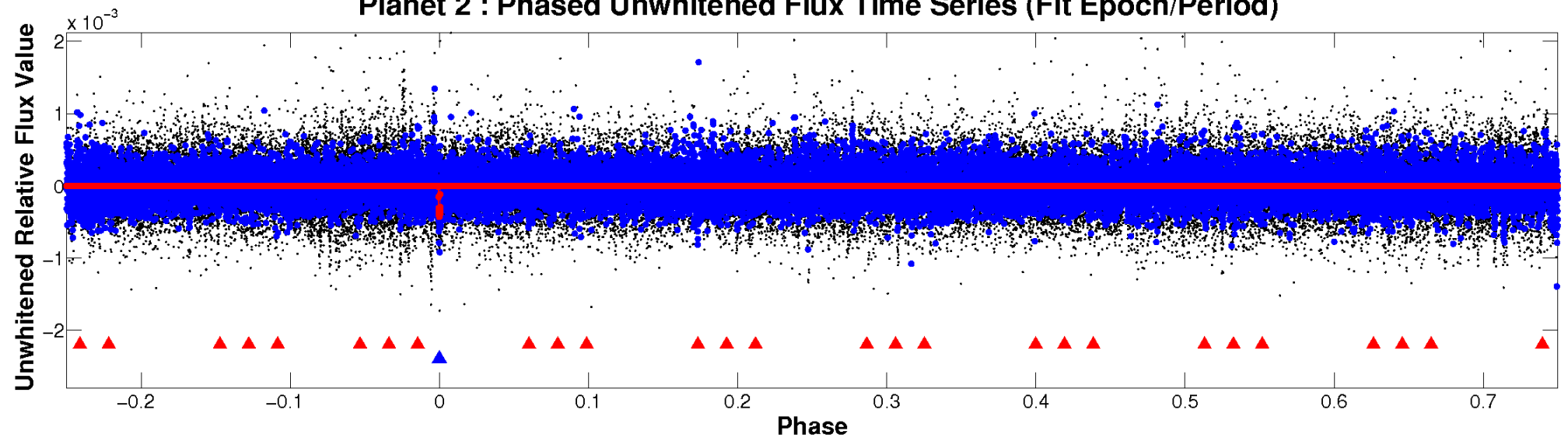
# ALT Odd/Even

TCE 010010440-02

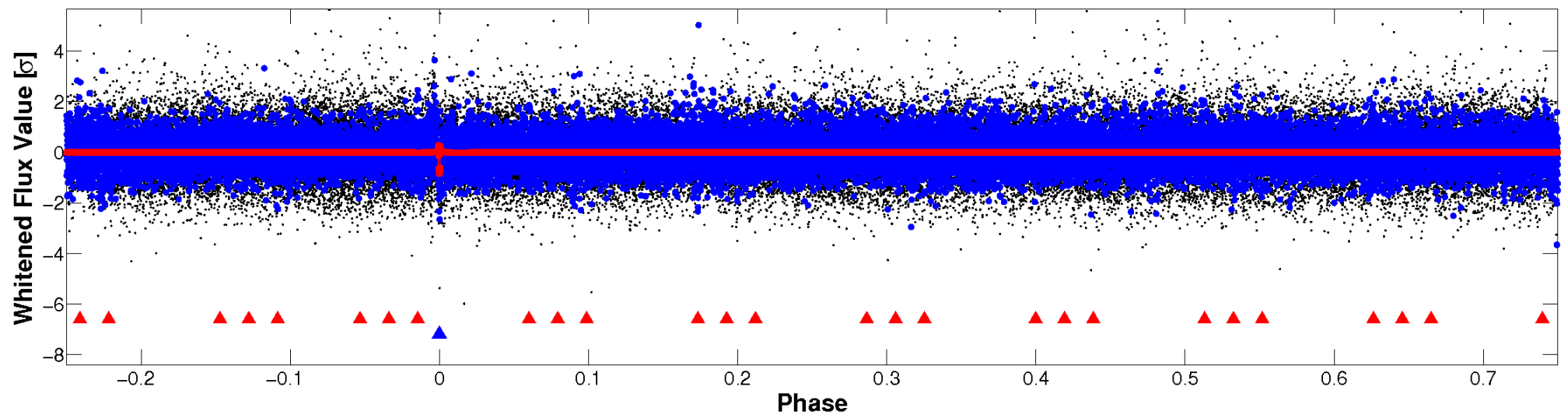


# Non-Whitened Vs. Whitened Light Curve

## 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

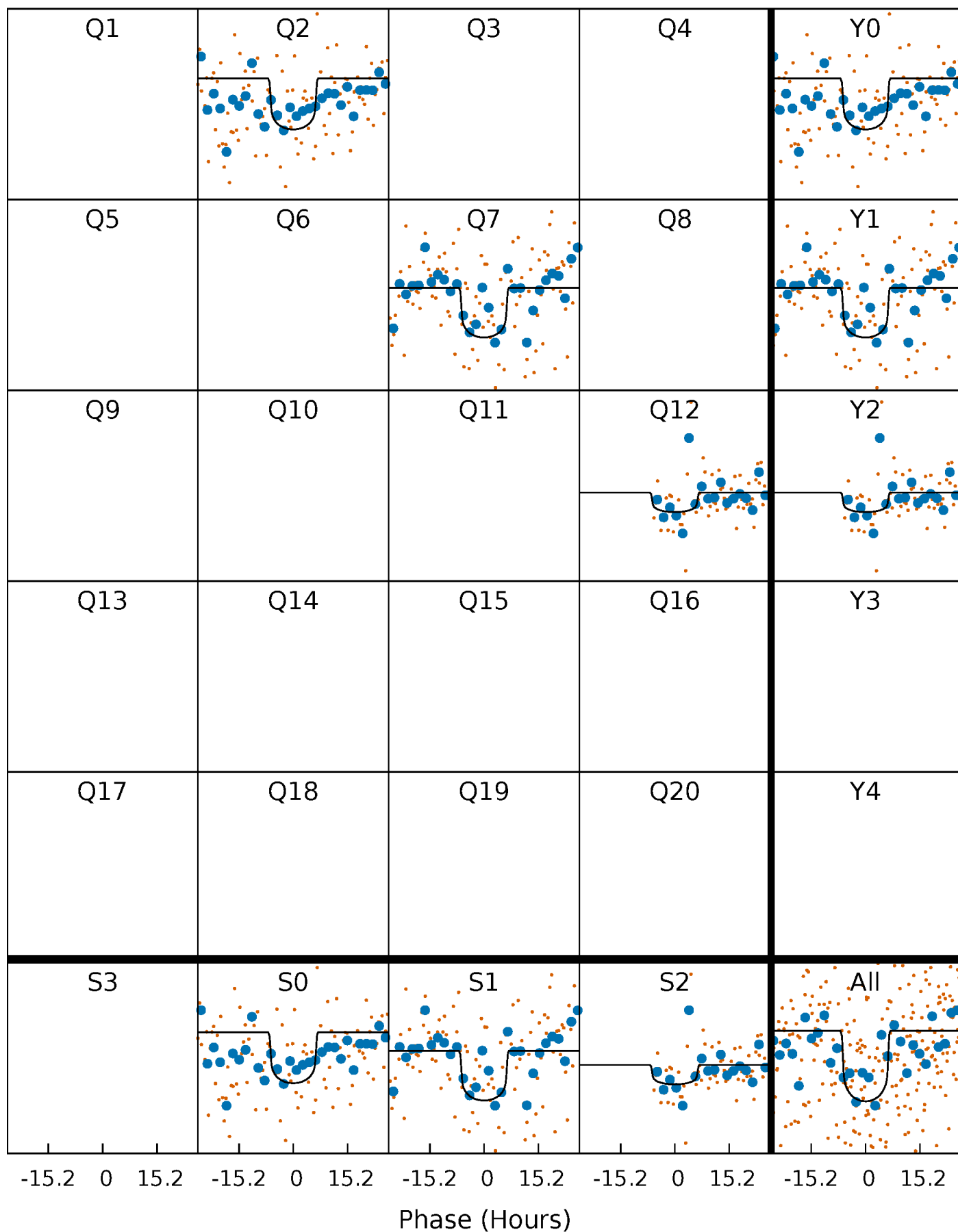
TCE 010010440-02 P=473.245098 Days  $T_0=172.592071$  (BKJD)





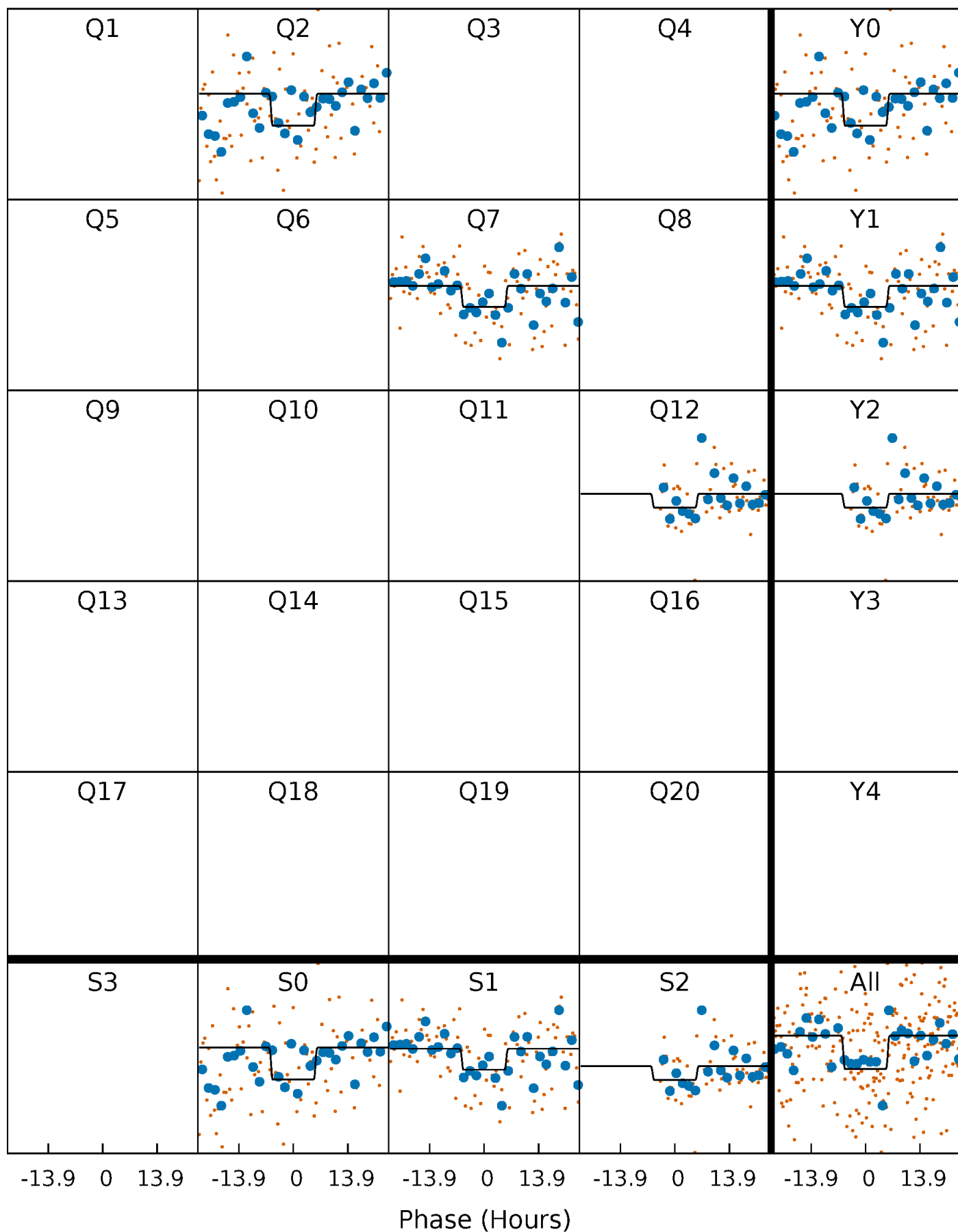
# DV Quarter-Phased Transit Curves

TCE 010010440-02 P=473.245098 Days  $T_0=172.592071$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

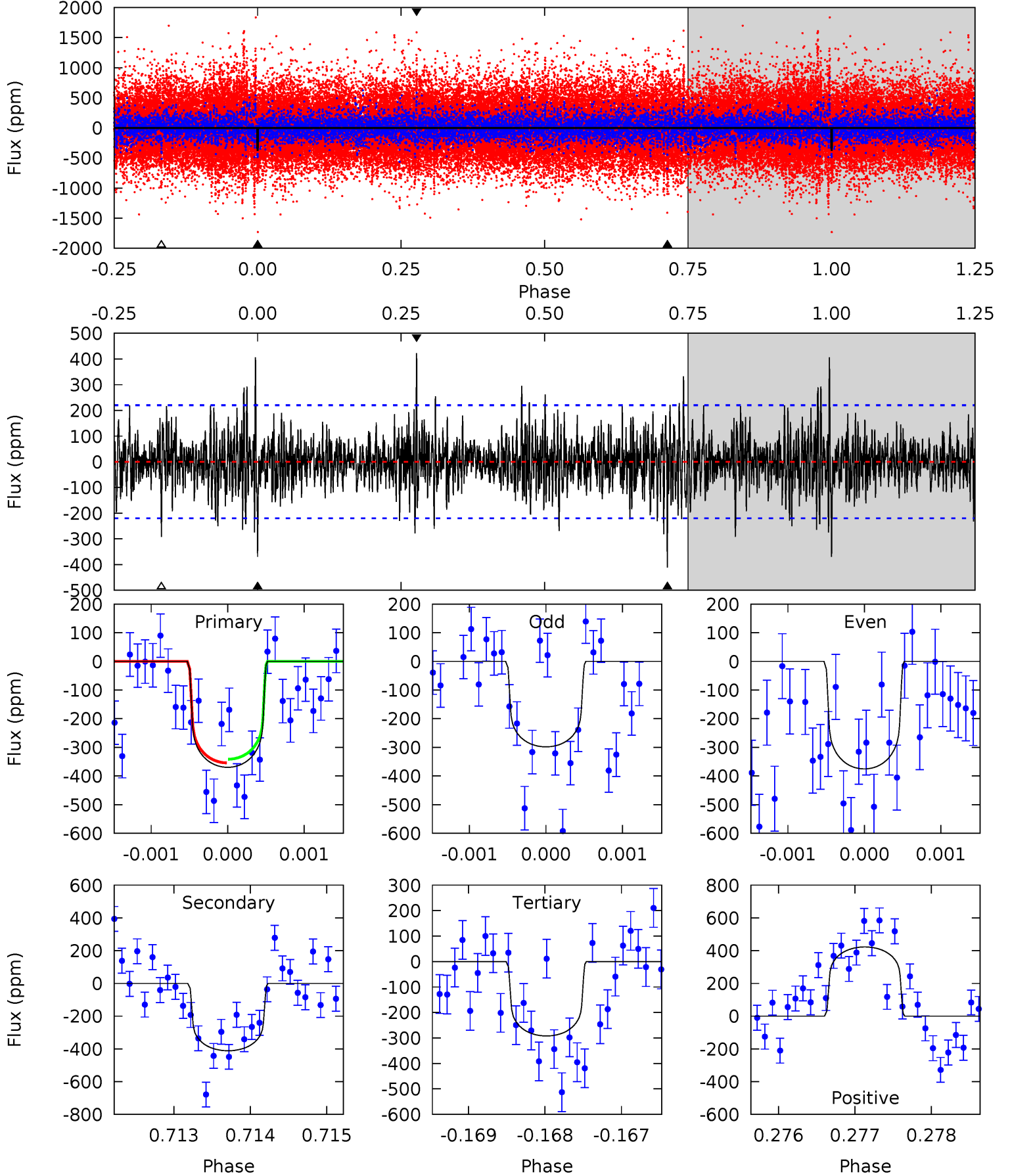
TCE 010010440-02 P=473.193571 Days  $T_0=172.607497$  (BKJD)



# DV Model-Shift Uniqueness Test

010010440-02, P = 473.245098 Days, E = 172.592071 Days

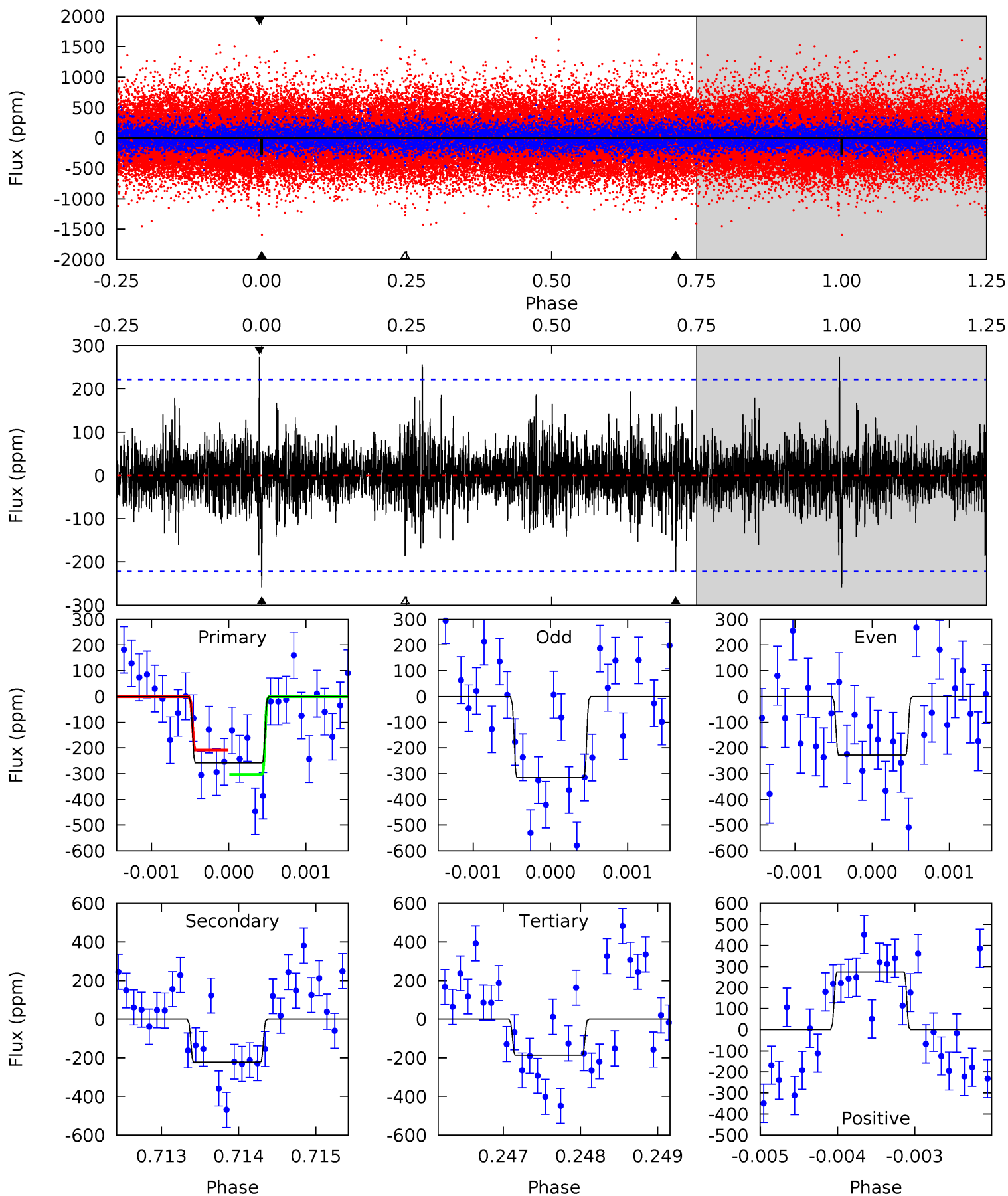
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
9.11	10.1	7.20	10.4	5.42	3.25	1.99	1.91	-1.30	2.94	-0.27	0.90	0.98	0.51	0.16



# Alt Model-Shift Uniqueness Test

010010440-02, P = 473.193571 Days, E = 172.607497 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
6.33	5.43	4.55	6.73	5.44	3.27	1.16	1.78	-0.40	0.88	-1.29	1.02	0.95	0.52	1.15



### Stellar Parameters For KIC 010010440

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$\rho_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6319^{+169}_{-206}$	$4.447^{+0.052}_{-0.208}$	$-0.220^{+0.250}_{-0.350}$	$1.032^{+0.320}_{-0.107}$	$1.084^{+0.144}_{-0.144}$	$1.389^{+0.393}_{-0.733}$
	+3%/-3%	+1%/-5%	+114%/-159%	+31%/-10%	+13%/-13%	+28%/-53%
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 010010440-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	-411±41	$2.37^{+0.93}_{-0.81}$	$366^{+27}_{-18}$	$6322^{+1649}_{-850}$	$57734^{+76254}_{-27326}$
Alt.	-222±41	$1.89^{+0.87}_{-0.74}$	$365^{+25}_{-16}$	$6060^{+2008}_{-966}$	$49145^{+88682}_{-26189}$

$T_{\text{max}}$  = Theoretical Maximum Planetary Temperature  
 $T_{\text{obs}}$  = Observed Planetary Temperature (Assuming A=0.3)  
 $A_{\text{obs}}$  = Observed Albedo (Assuming T=0)

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

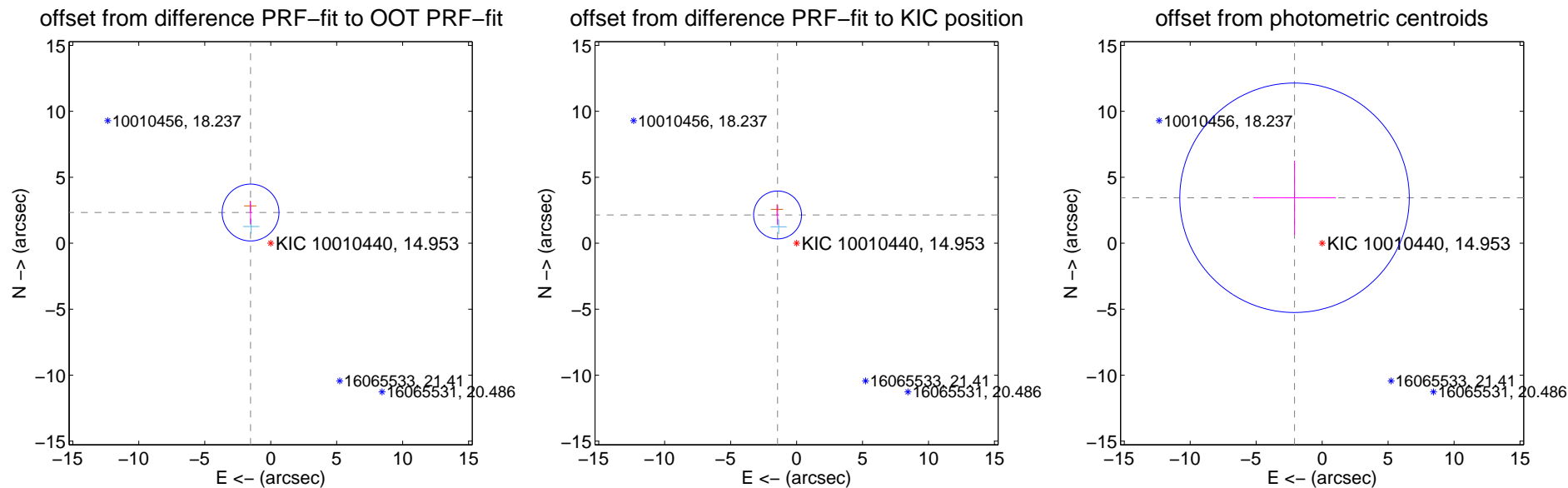
## DV Centroid Data

Supplemental centroid analysis for 010010440-02. Kepler magnitude: 14.95. Transit SNR 6.88

There are 1 quarters with good PRF difference image offsets

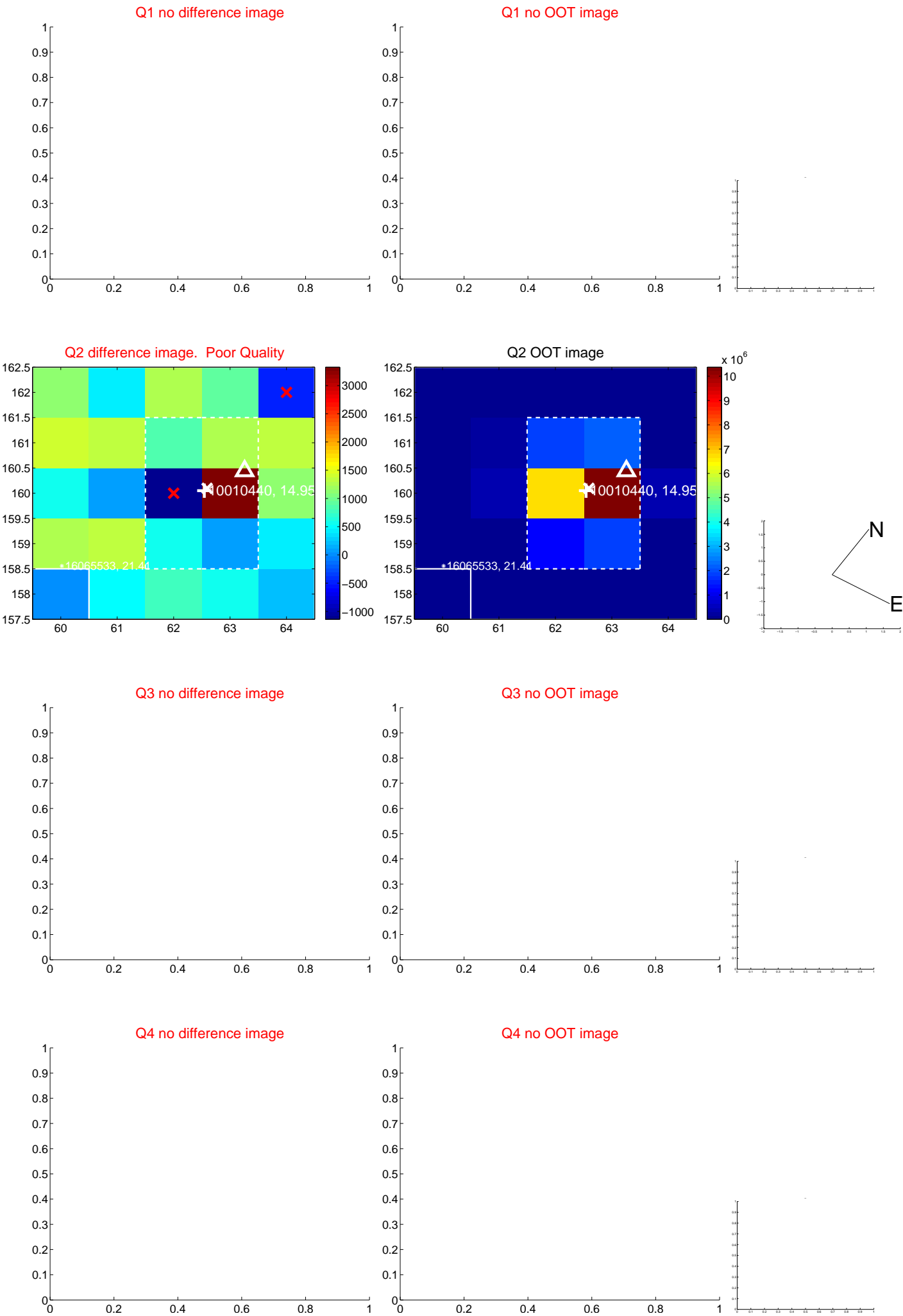
The direct PRF centroid is offset from the target star catalog position by about 0.12 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$2.785 \pm 0.718$	3.88	$1.528 \pm 0.079$	$2.329 \pm 0.858$
PRF-fit source offset from KIC position	$2.585 \pm 0.605$	4.27	$1.441 \pm 0.099$	$2.146 \pm 0.726$
photometric centroid source offset	$4.03 \pm 2.90$	1.39	$2.09 \pm 3.13$	$3.45 \pm 2.81$



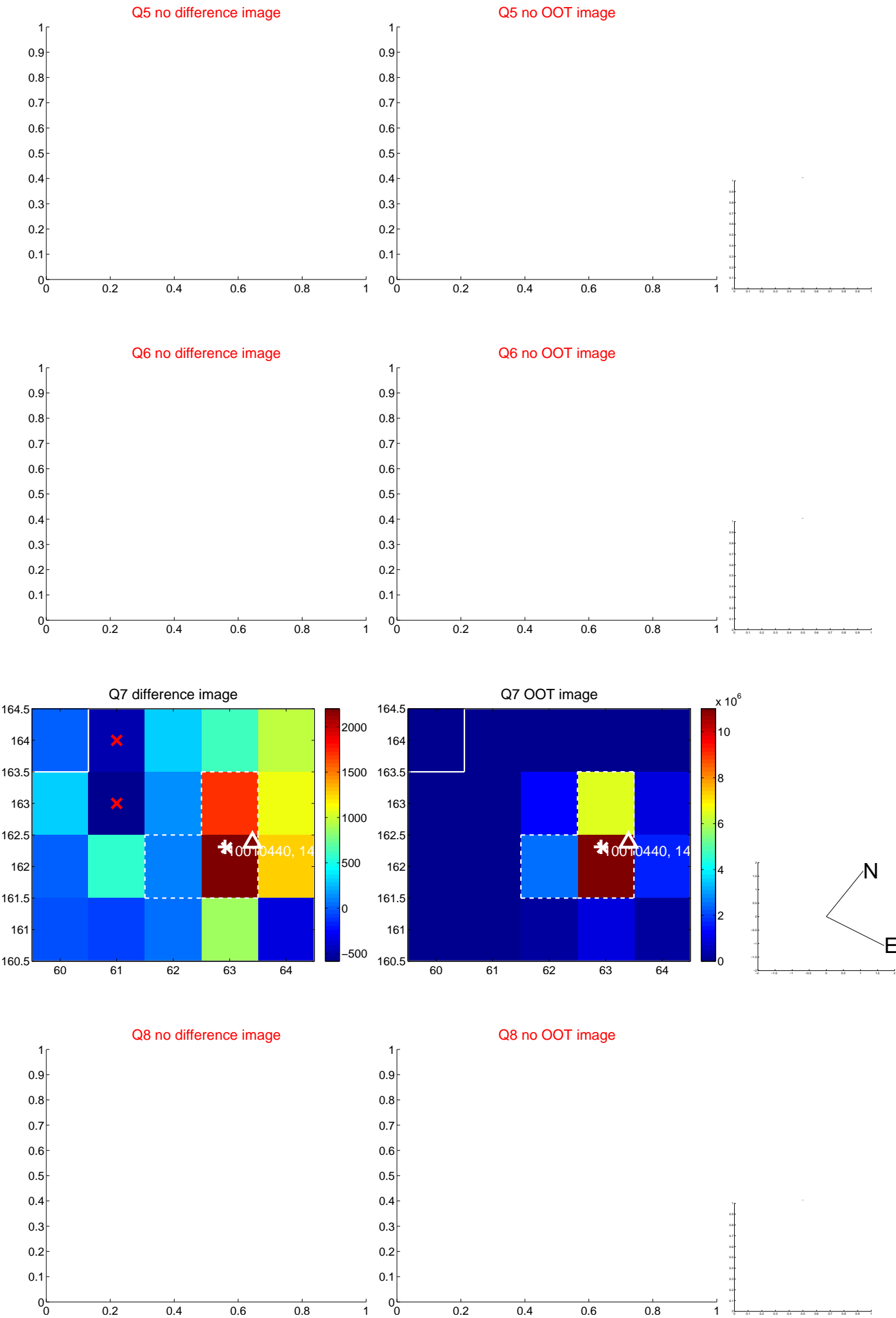
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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



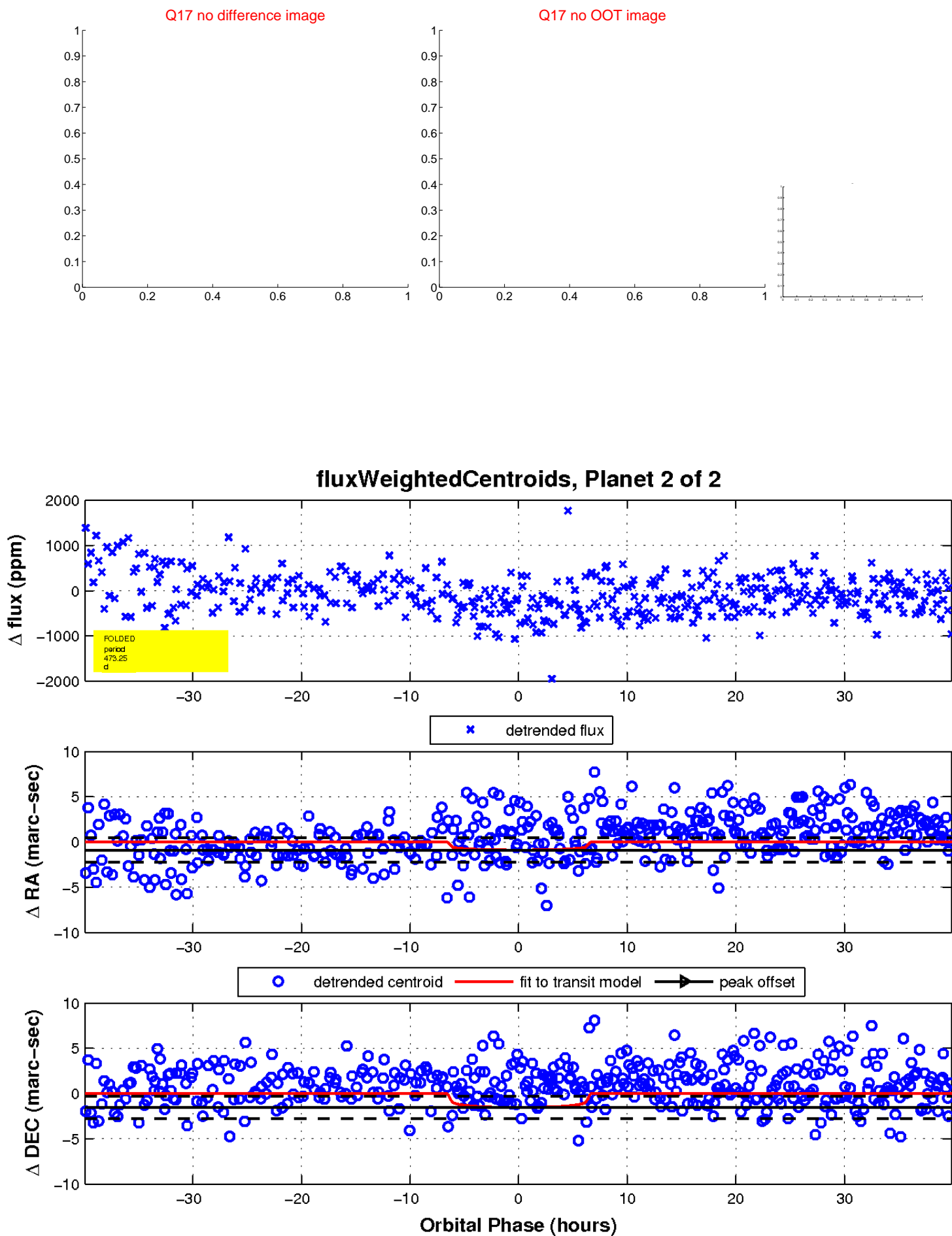
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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.



UKIRT Image

Declination

