

# KIC 009640946

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009640946-01	OBS	4542.01	1.089042	132.047130	66.3	2.974	11.6	10.7	0.88	5087	0.88	1235.94
009640946-02	OBS	No	452.970269	240.980837	3736.1	51.902	19.6	10.5	0.88	5087	6.79	0.40

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009640946-01	OBS	FP	0.00	0	0	1	1	HALO_GHOST—EPHEM_MATCH
009640946-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL_SKYE—LPP_DV—LPP_ALT—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV— MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—INCONSISTENT_TRANS—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.

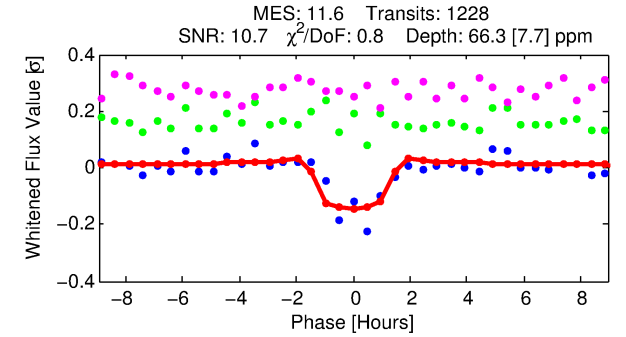
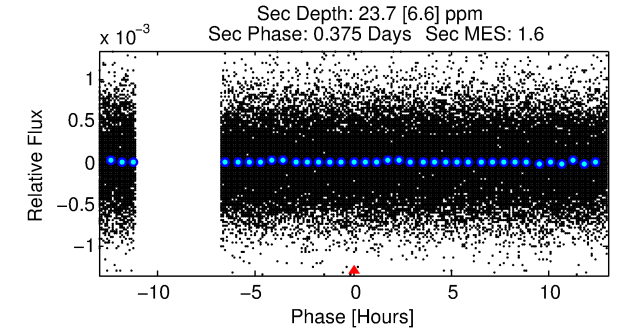
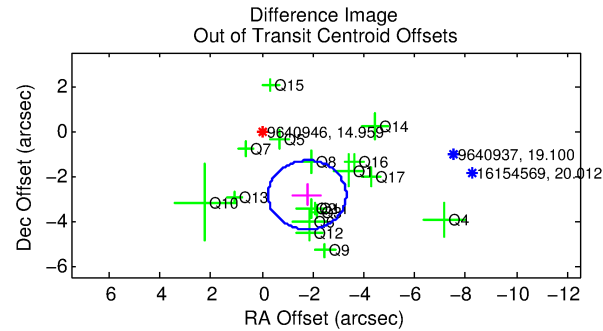
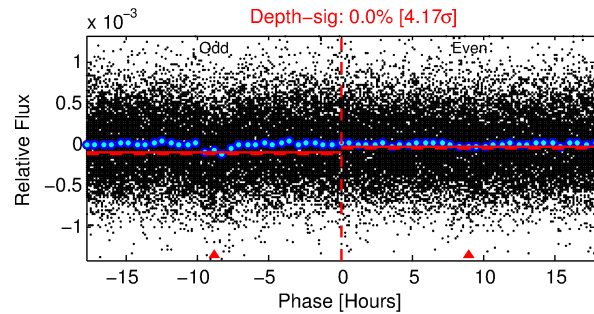
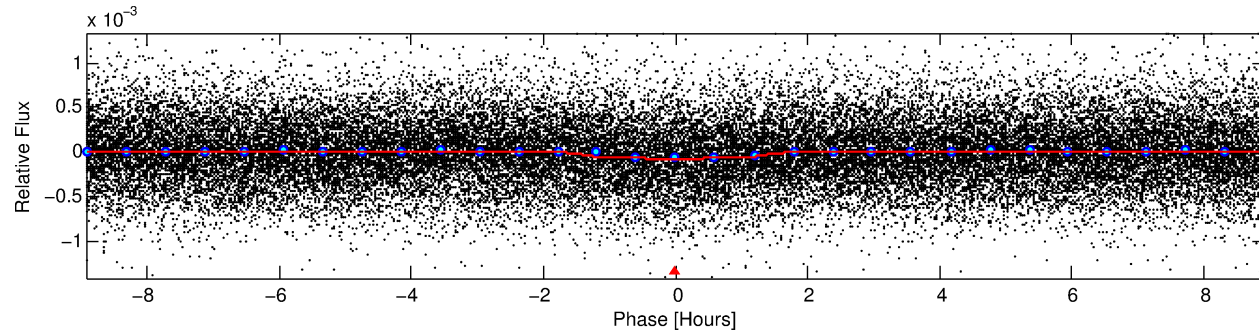
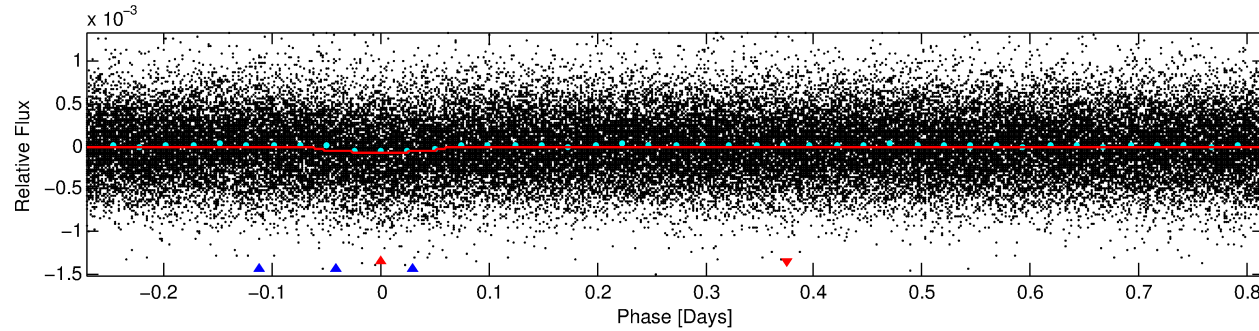
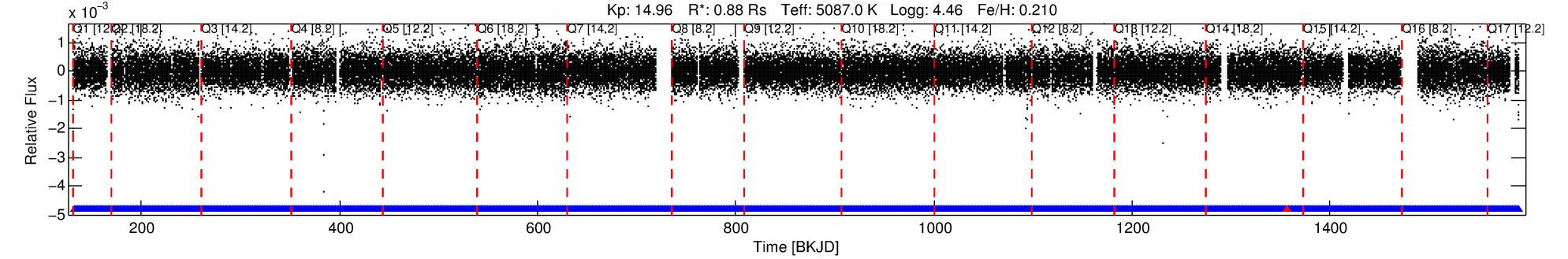
## Ephemeris Match Information For 009640946-01

TCE (1)	KIC	Parent (2)	Parent KIC	P <sub>1</sub> :P <sub>2</sub>	Dist (″)	$\Delta$ Row	$\Delta$ Col	m <sub>2</sub>	m <sub>1</sub>	D <sub>2</sub> /D <sub>1</sub>	Mechanism	Flag	$\sigma_P$	$\sigma_T$
009640946-01	9640946	009641031-01	9641031	1:2	153.8	38	-8	9.18	14.96	6006.60	Direct-PRF	0	4.50	1.45

**Notes:** P<sub>1</sub>:P<sub>2</sub> 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<sub>2</sub> and m<sub>1</sub> are the magnitudes of the parent and child. D<sub>2</sub>/D<sub>1</sub> 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: 9640946 Candidate: 1 of 2 Period: 1.089 d  
KOI: K04542.01 Corr: 0.918



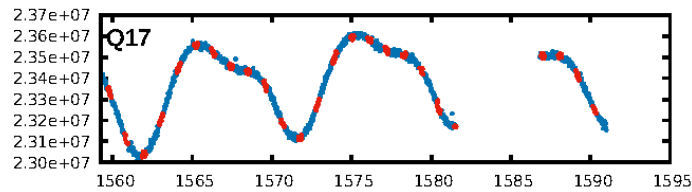
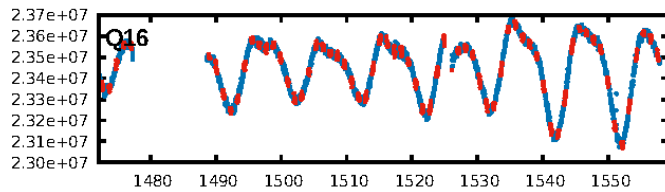
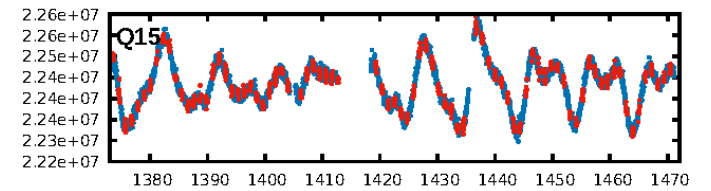
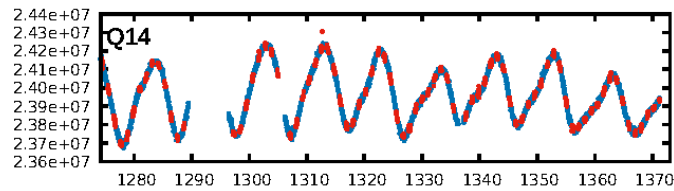
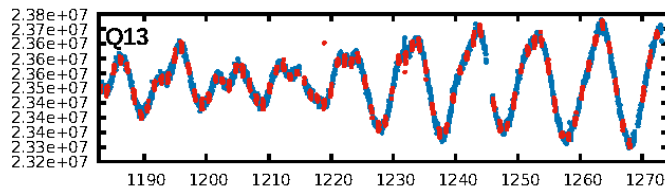
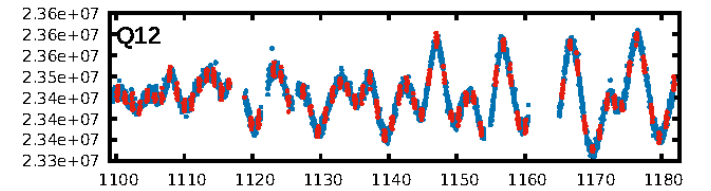
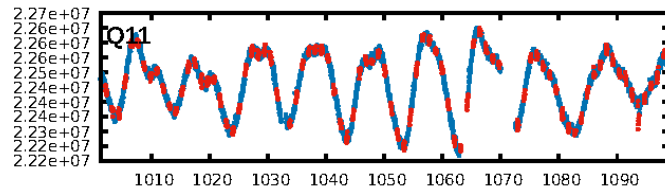
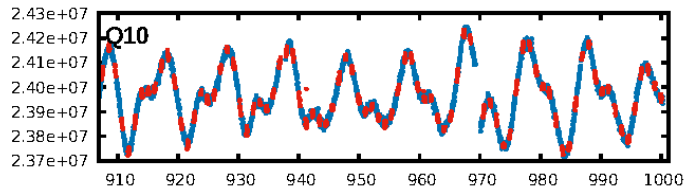
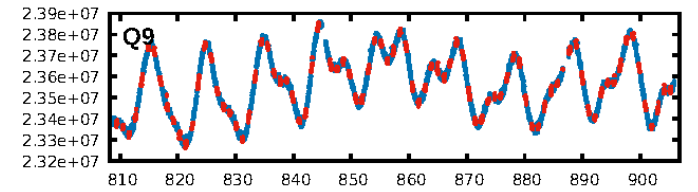
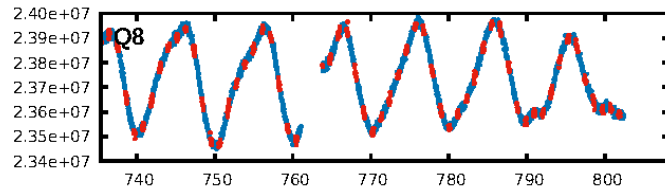
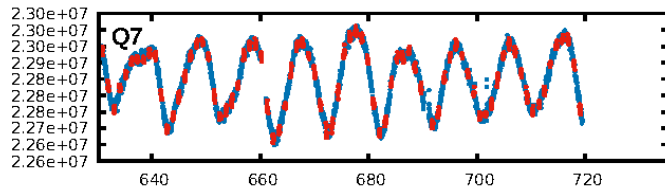
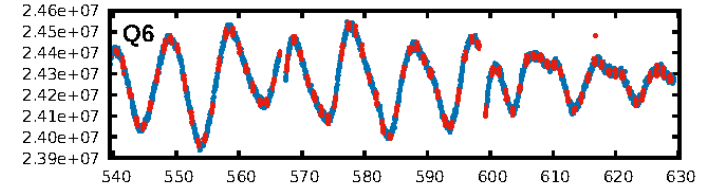
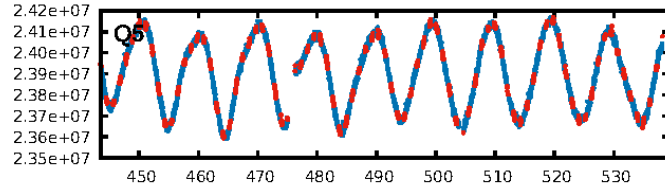
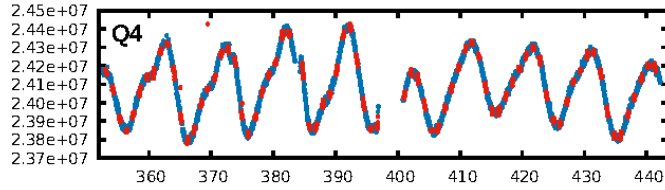
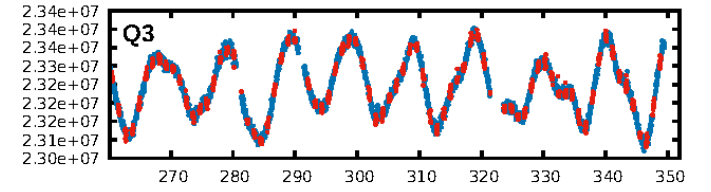
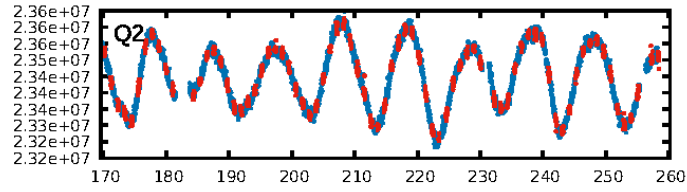
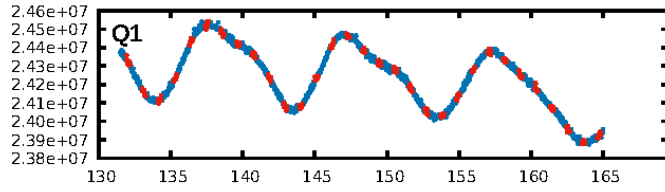
## DV Fit Results:

Period = 1.08904 [0.00001] d  
Epoch = 132.0471 [0.0030] BKJD  
Rp/R\* = 0.0091 [0.0055]  
a/R\* = 1.57 [2.28]  
b = 0.90 [0.51]  
Seff = 1235.94 [288.80]  
Teff = 1512 [88] K  
Rp = 0.88 [0.54] Re  
a = 0.0194 [0.0023] AU  
Ag = 6.37 [7.93] [0.68 $\sigma$ ]  
Teffp = 3713 [1149] K [1.91 $\sigma$ ]

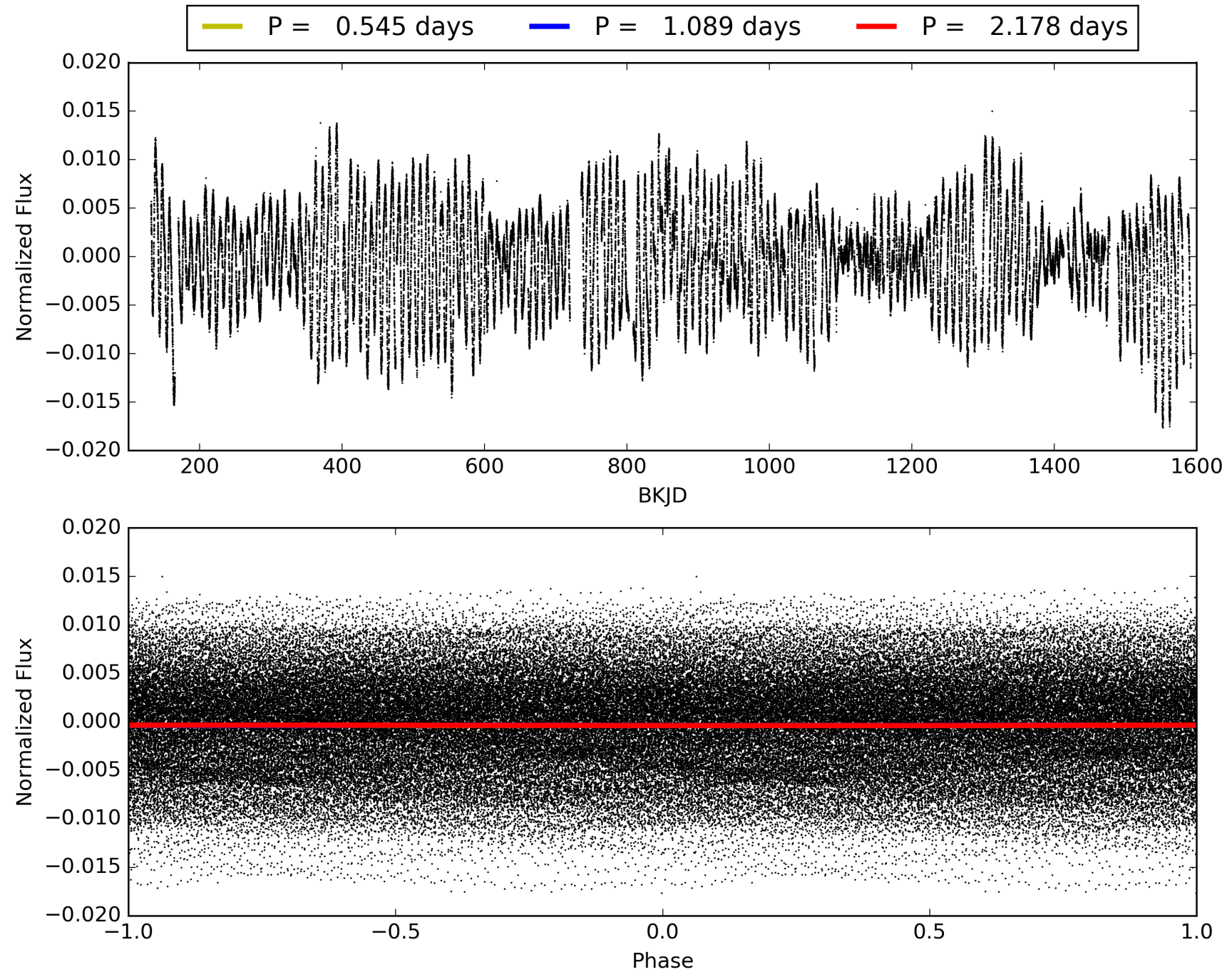
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [208.61 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 4.70e-30  
RollingBand-fgt: 1.00 [1171/1172]  
GhostDiagnostic-chr: -0.07049  
Centroid-sig: 57.6%  
Centroid-so: 0.565 arcsec [0.59 $\sigma$ ]  
OotOffset-rm: 3.360 arcsec [6.57 $\sigma$ ]  
KicOffset-rm: 3.250 arcsec [6.59 $\sigma$ ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 0.00 [0/17]  
DiffImageOverlap-fno: 1.00 [17/17]

# TCE 009640946-01, PDC Light Curves

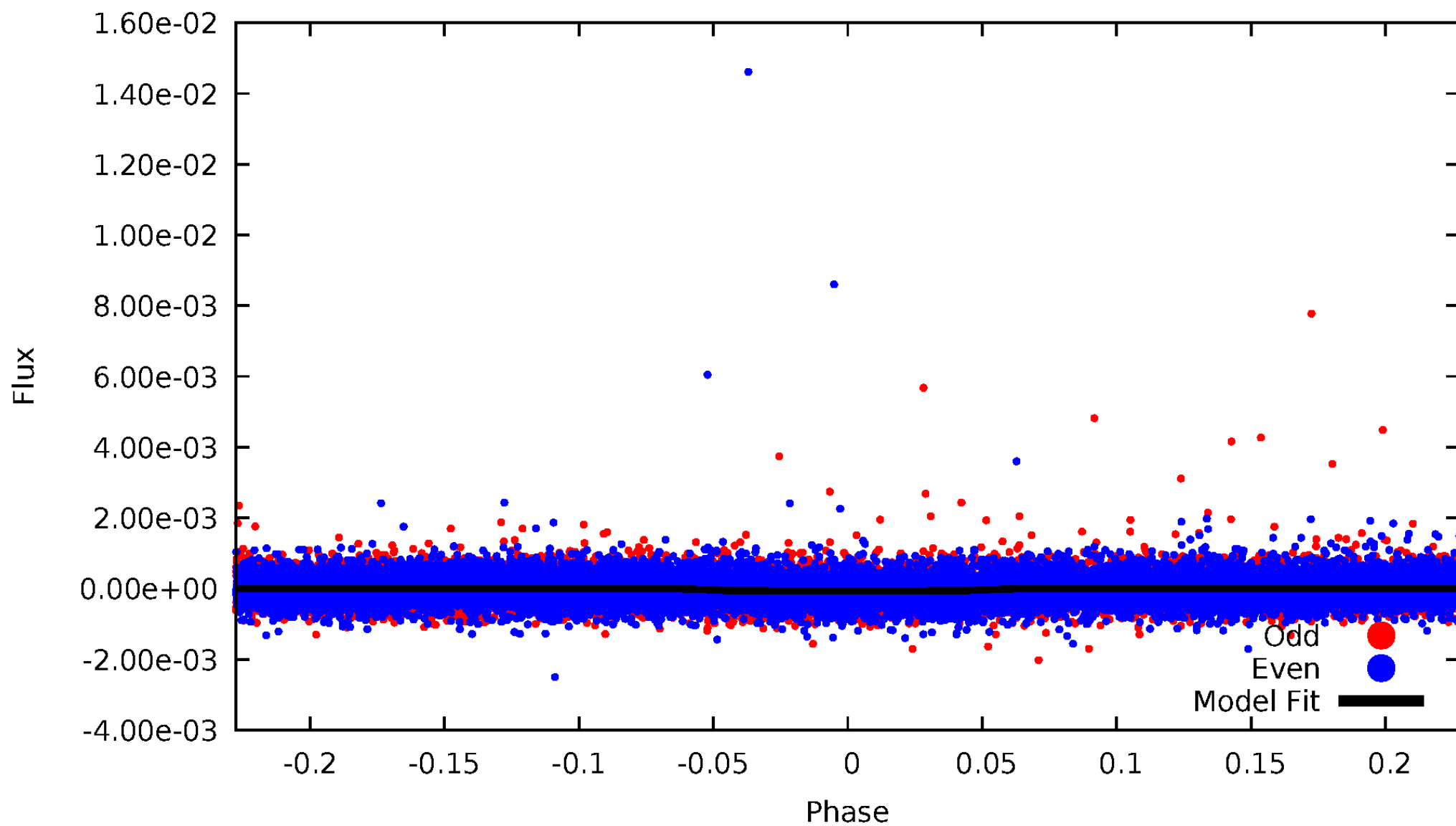


TCE 009640946-01



# DV Odd/Even

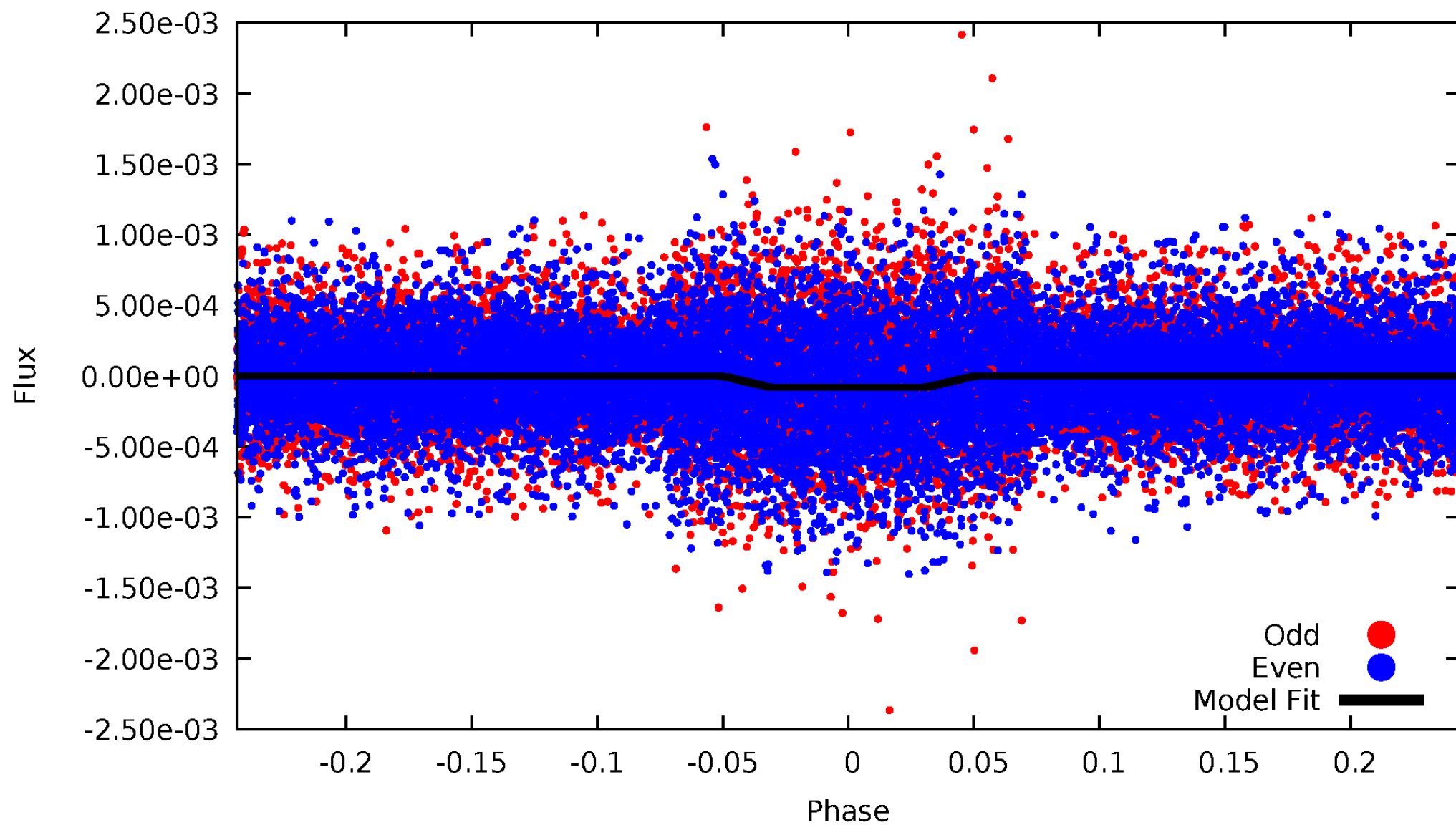
TCE 009640946-01





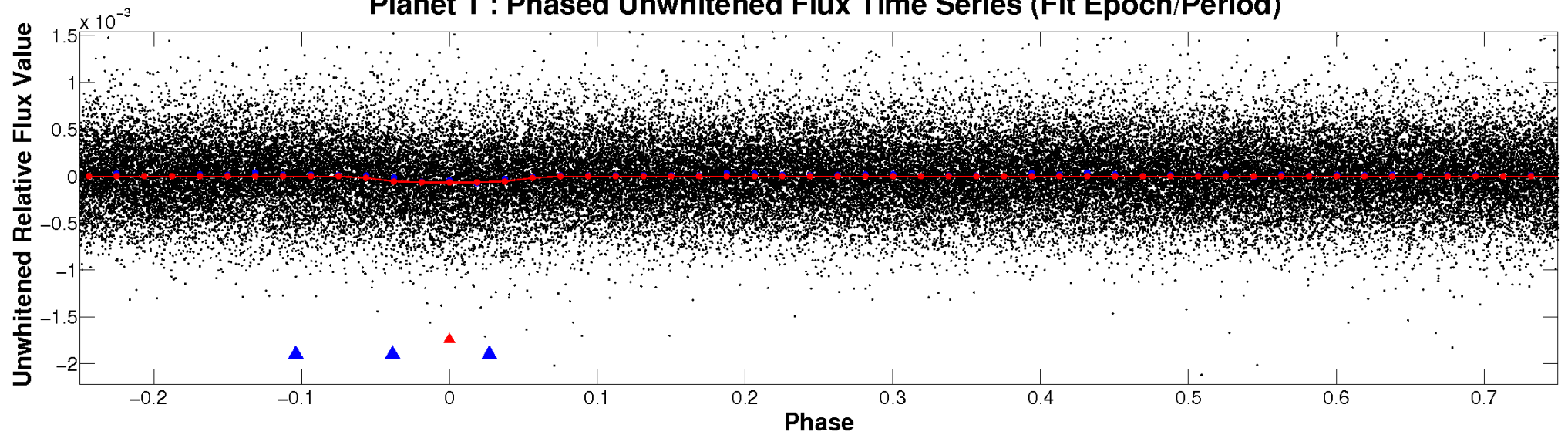
# ALT Odd/Even

TCE 009640946-01

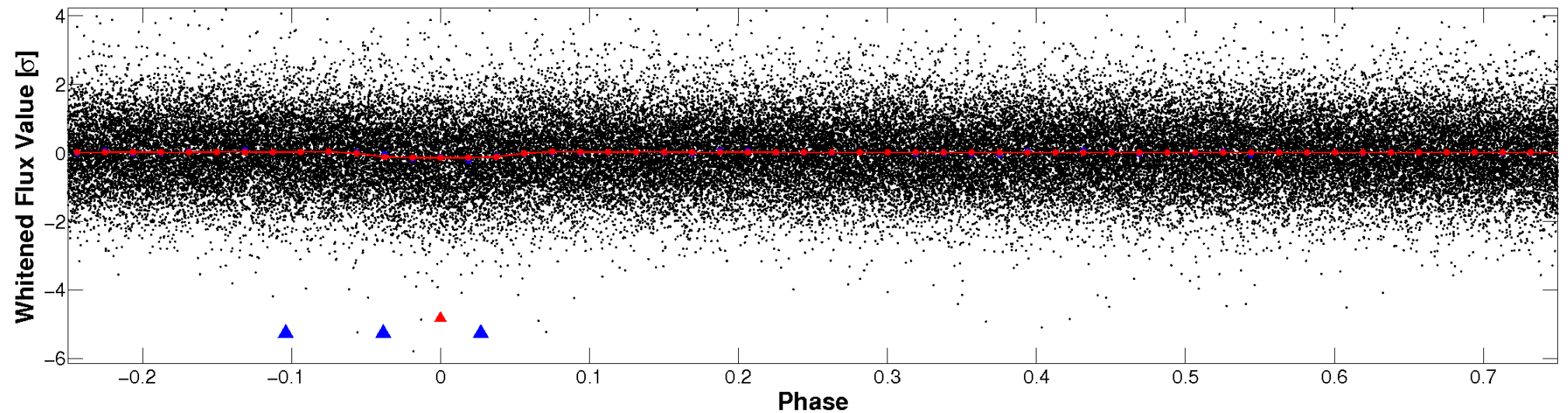


# Non-Whitened Vs. Whitened Light Curve

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

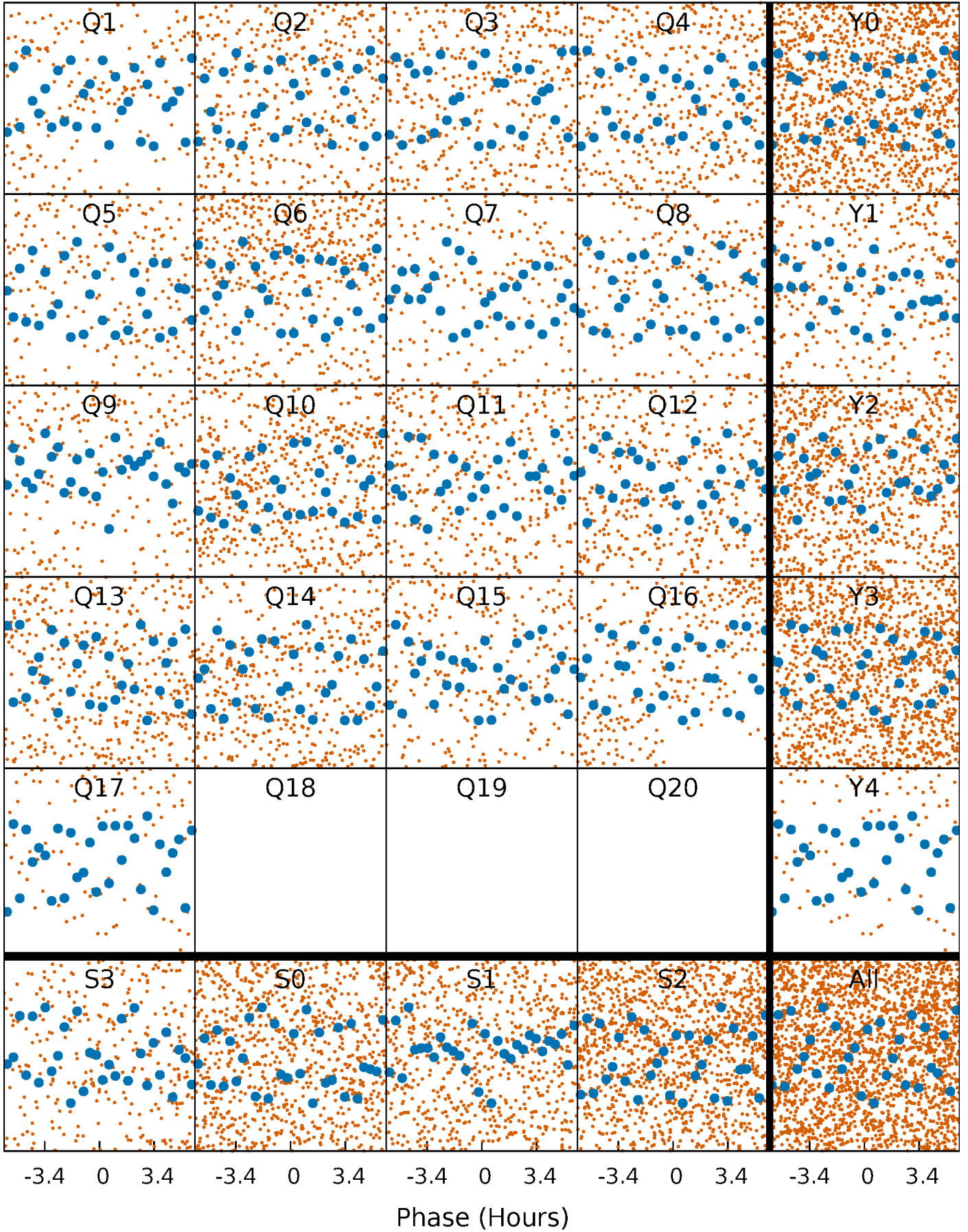


**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**



# PDC Quarter-Phased Transit Curves

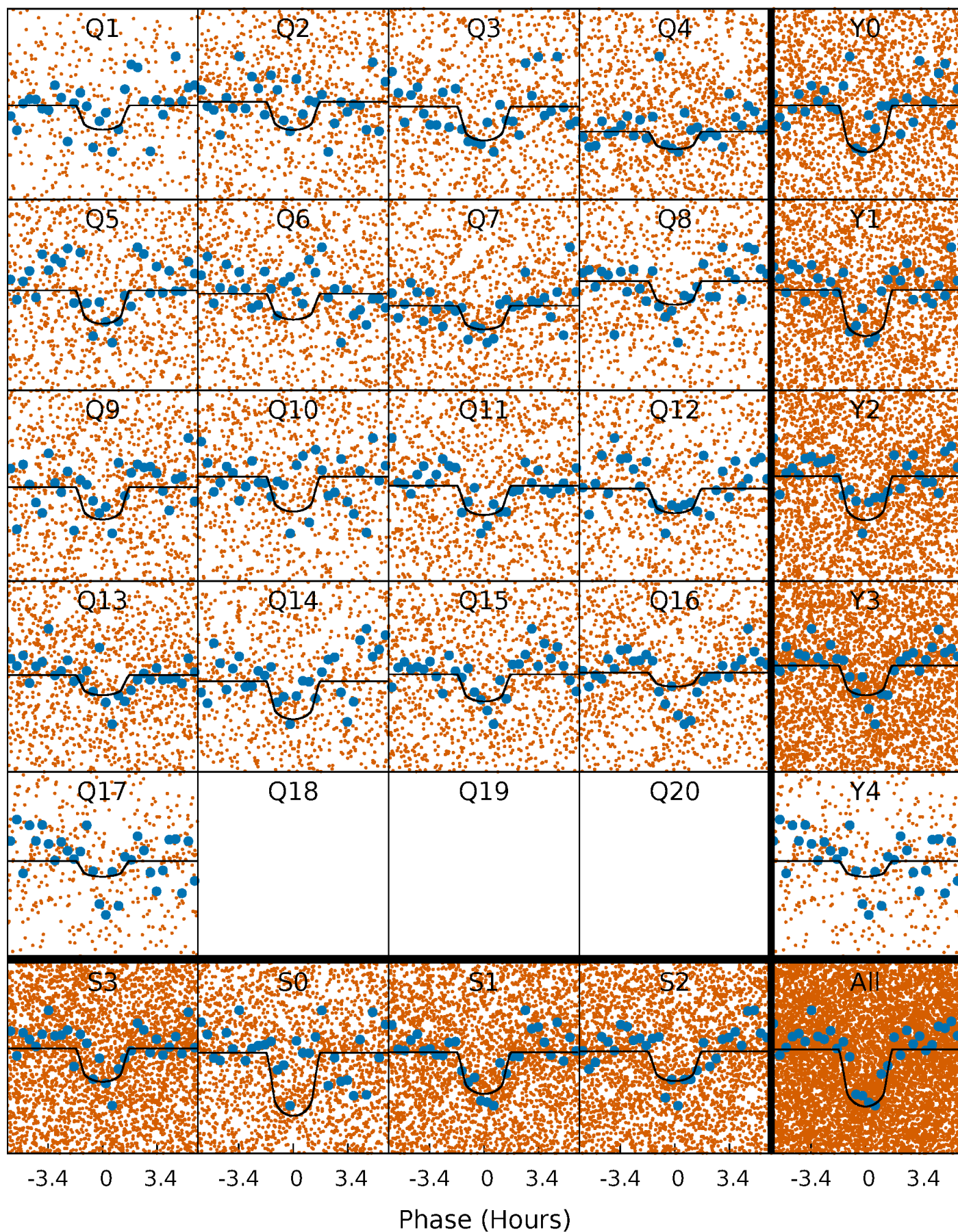
TCE 009640946-01   P= 1.089042 Days    $T_0=132.047130$  (BKJD)





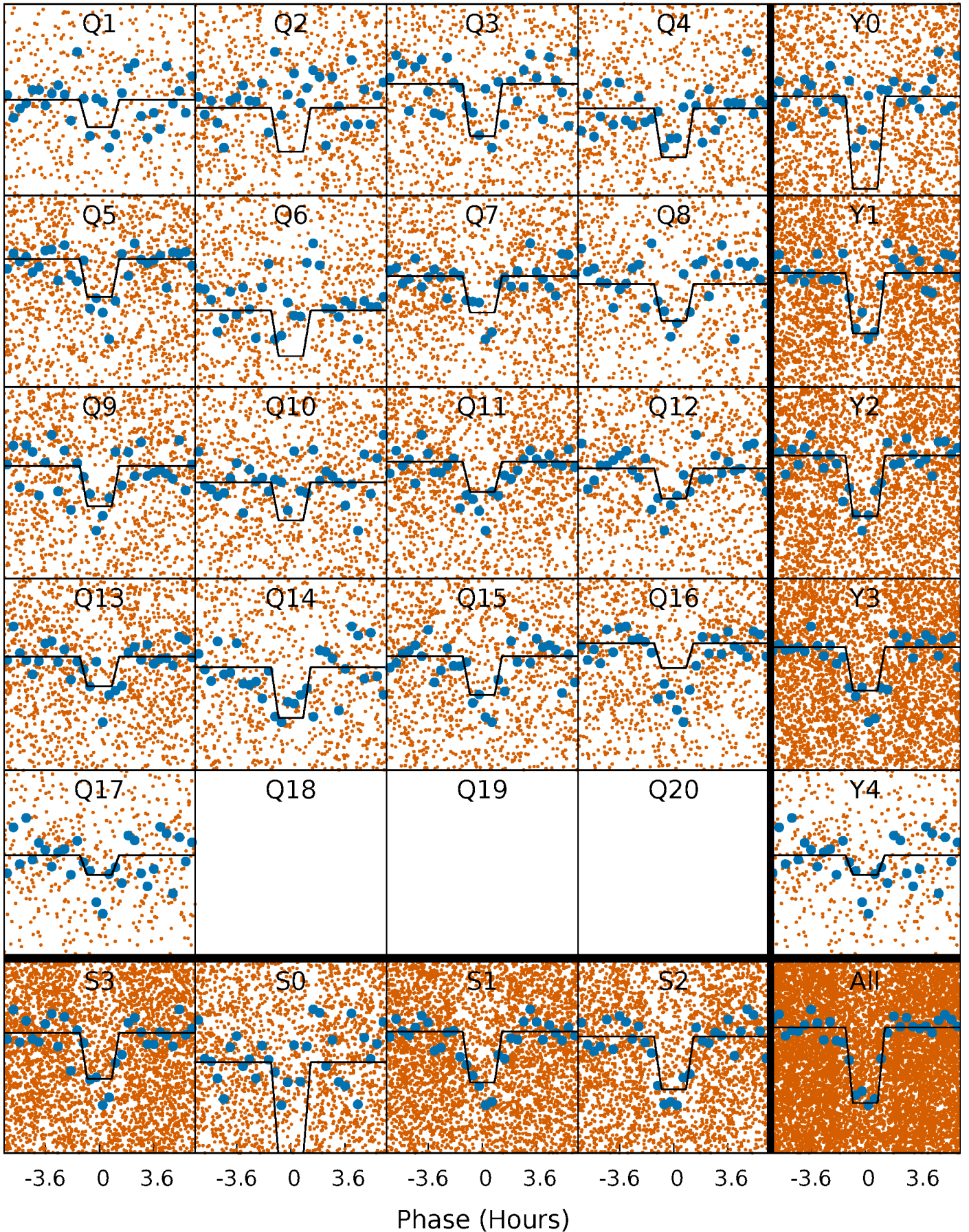
# DV Quarter-Phased Transit Curves

TCE 009640946-01 P= 1.089042 Days  $T_0=132.047130$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

TCE 009640946-01 P= 1.089052 Days  $T_0=132.043274$  (BKJD)

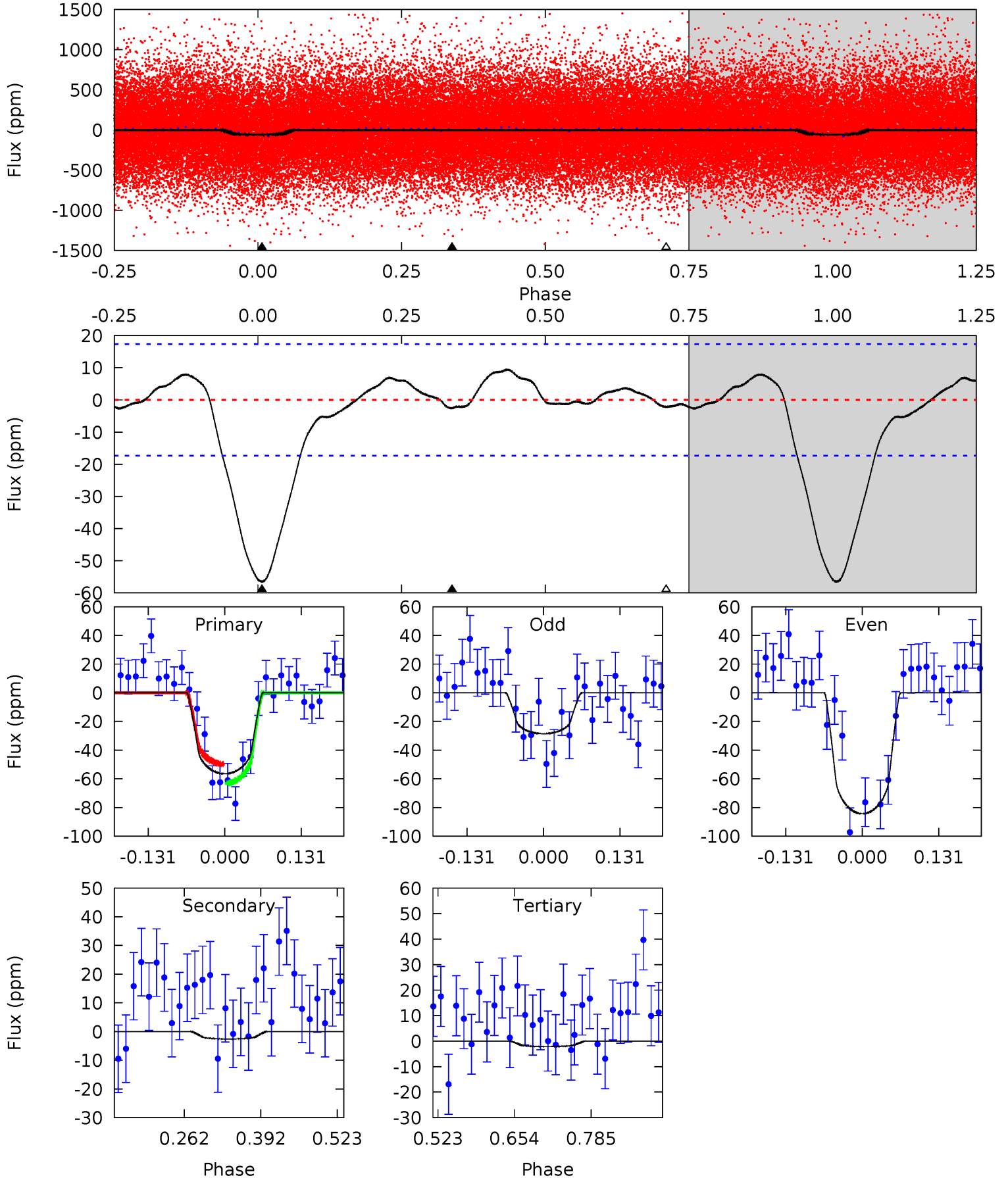




# DV Model-Shift Uniqueness Test

009640946-01, P = 1.089042 Days, E = 130.958088 Days

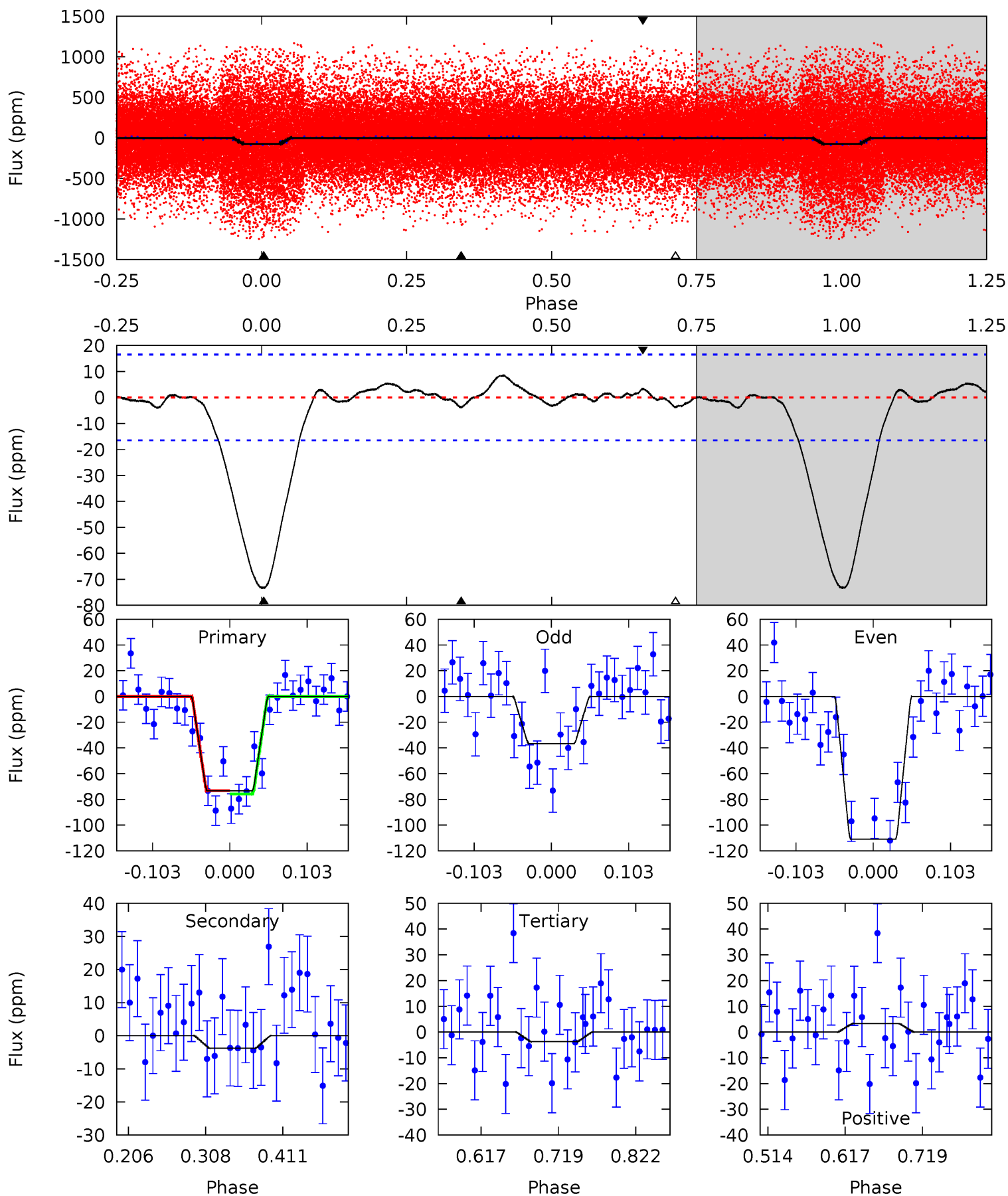
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
14.7	0.68	0.56	0	4.51	1.51	0.71	14.1	14.7	0.12	0.68	7.24	0.87	0.14	1.74



# Alt Model-Shift Uniqueness Test

009640946-01, P = 1.089052 Days, E = 130.954222 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
20.2	1.04	1.04	0.91	4.56	1.63	0.57	19.2	19.3	0.00	0.13	10.2	0.97	0.10	0.35



### Stellar Parameters For KIC 009640946

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5087^{+167}_{-152}$	$4.463^{+0.104}_{-0.115}$	$0.210^{+0.200}_{-0.300}$	$0.881^{+0.104}_{-0.104}$	$0.822^{+0.077}_{-0.058}$	$1.691^{+0.774}_{-0.529}$
	+3%/-3%	+2%/-3%	+95%/-143%	+12%/-12%	+9%/-7%	+46%/-31%
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 009640946-01 / KOI 4542.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-3\pm4$	$0.89^{+0.54}_{-0.45}$	$2114^{+101}_{-93}$	$2486^{+961}_{-5242}$	$0.565^{+2.330}_{-0.816}$
Alt.	$-4\pm4$	$0.90^{+0.56}_{-0.46}$	$2116^{+110}_{-96}$	$2706^{+965}_{-5237}$	$0.843^{+3.639}_{-0.805}$

$T_{max}$  = 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  $A_{obs} \gg 1.0$



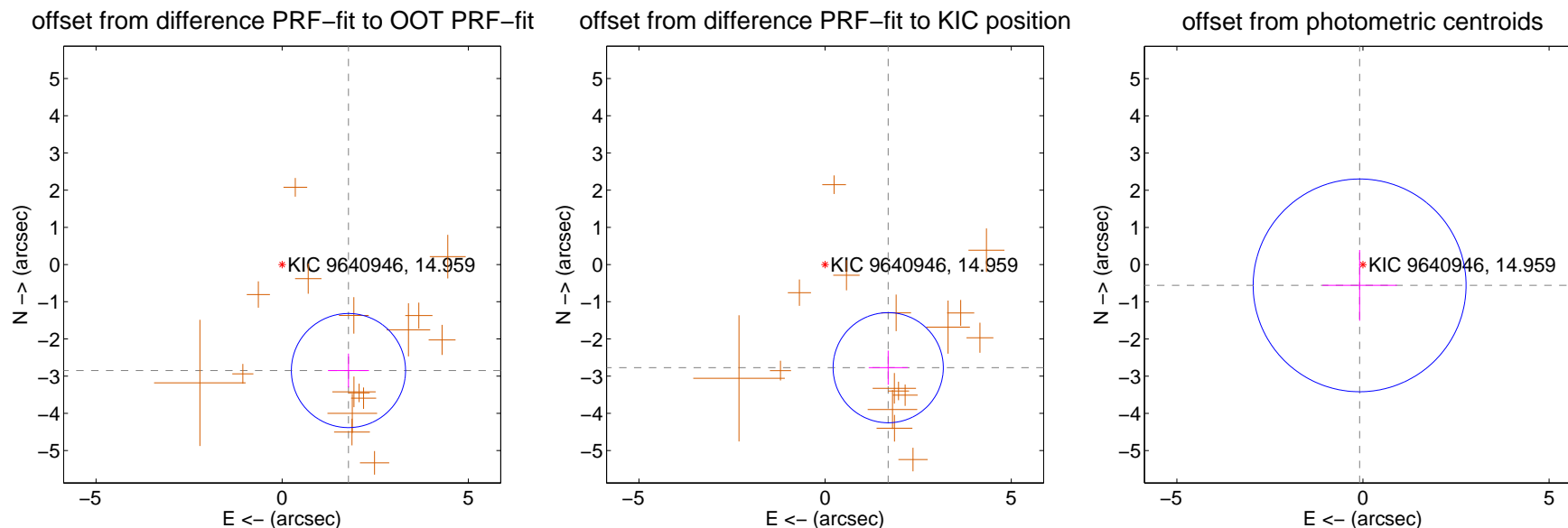
## DV Centroid Data

Supplemental centroid analysis for 009640946-01. Kepler magnitude: 14.96. Transit SNR 10.66

There are 0 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.15 arcsec

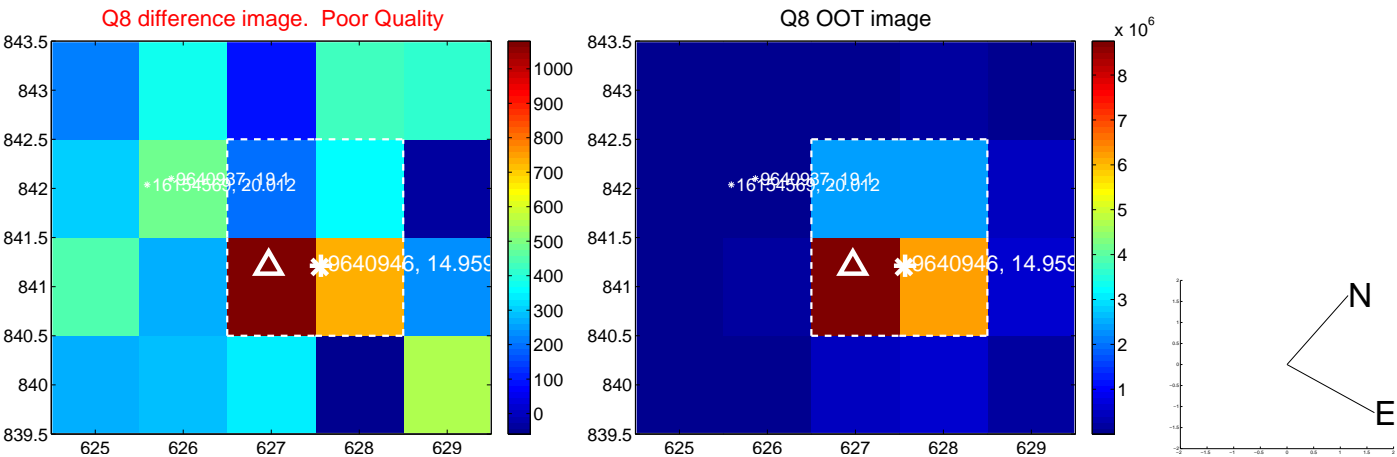
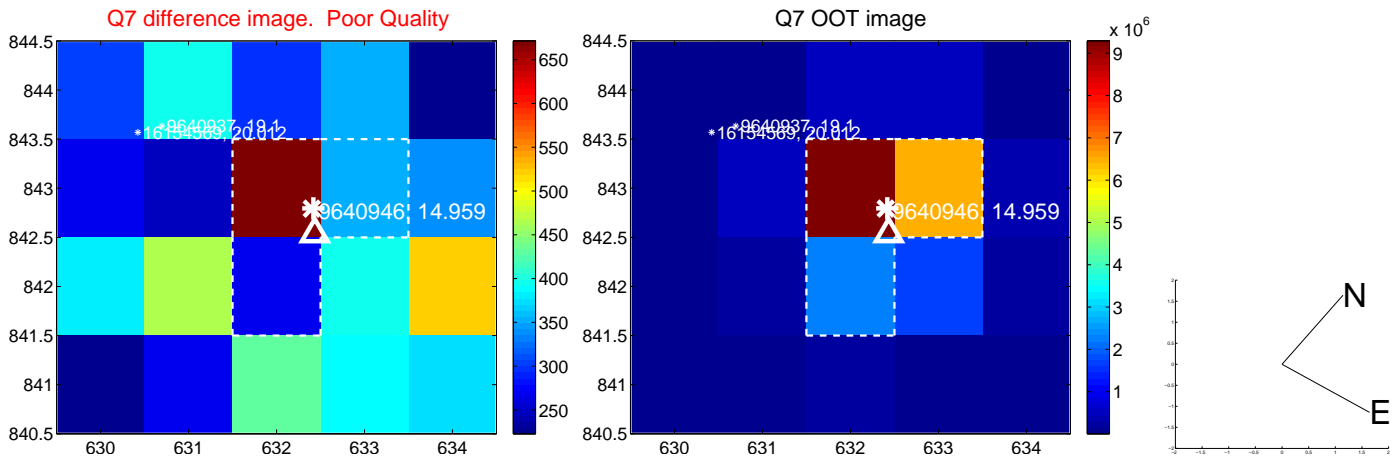
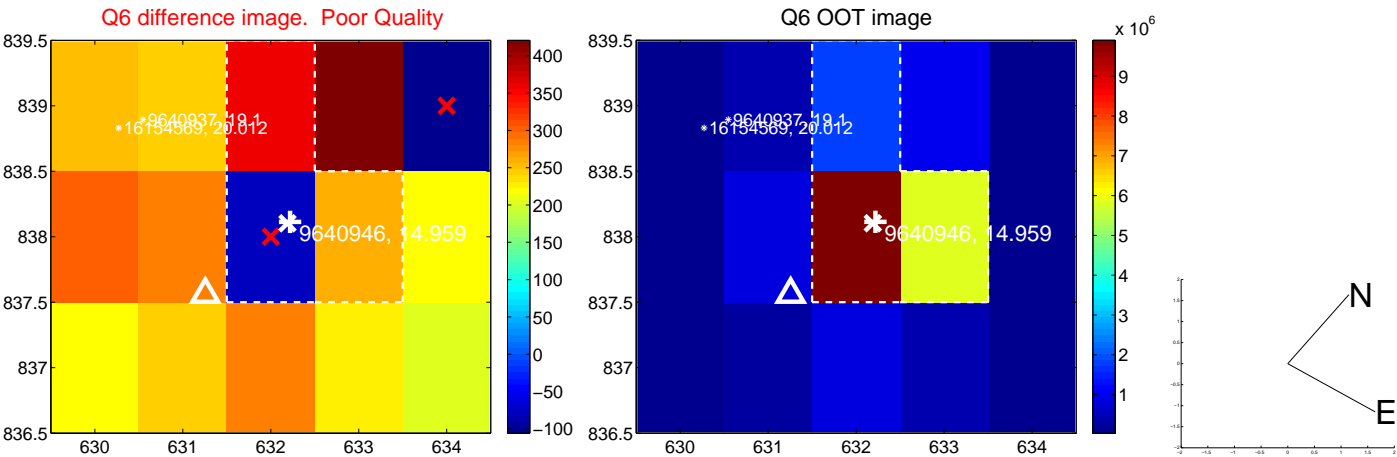
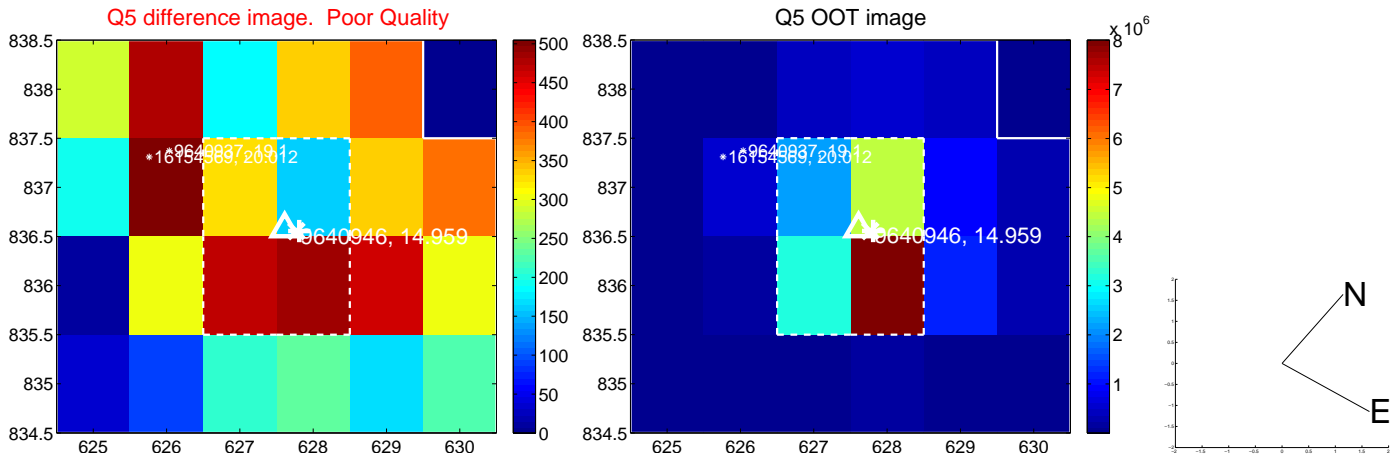
	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$3.360 \pm 0.511$	6.57	$-1.780 \pm 0.551$	$-2.850 \pm 0.456$
PRF-fit source offset from KIC position	$3.250 \pm 0.493$	6.59	$-1.695 \pm 0.524$	$-2.773 \pm 0.461$
photometric centroid source offset	$0.57 \pm 0.95$	0.59	$0.09 \pm 1.00$	$-0.56 \pm 0.95$



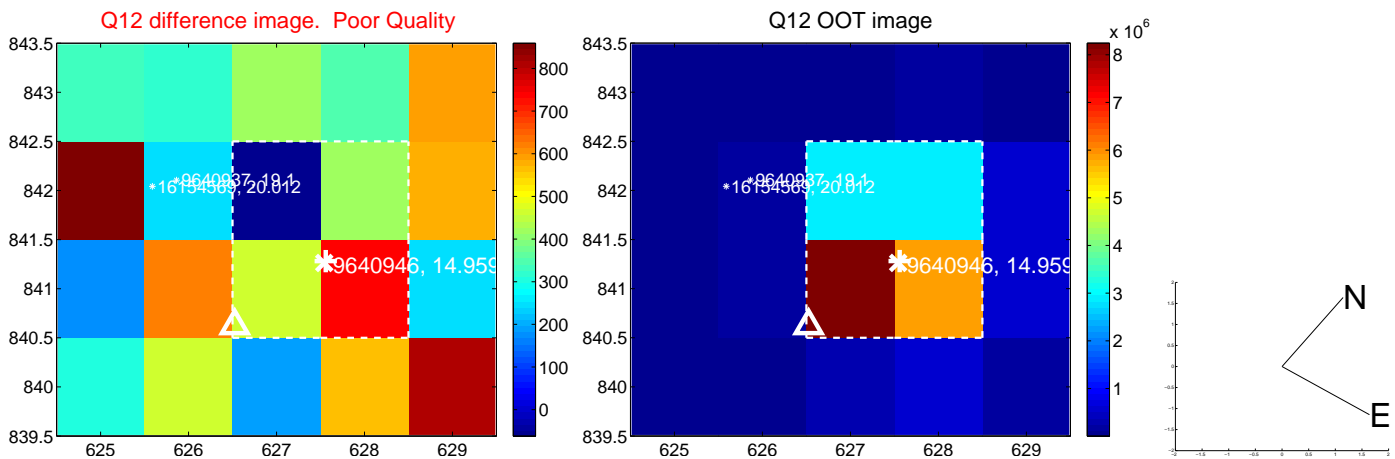
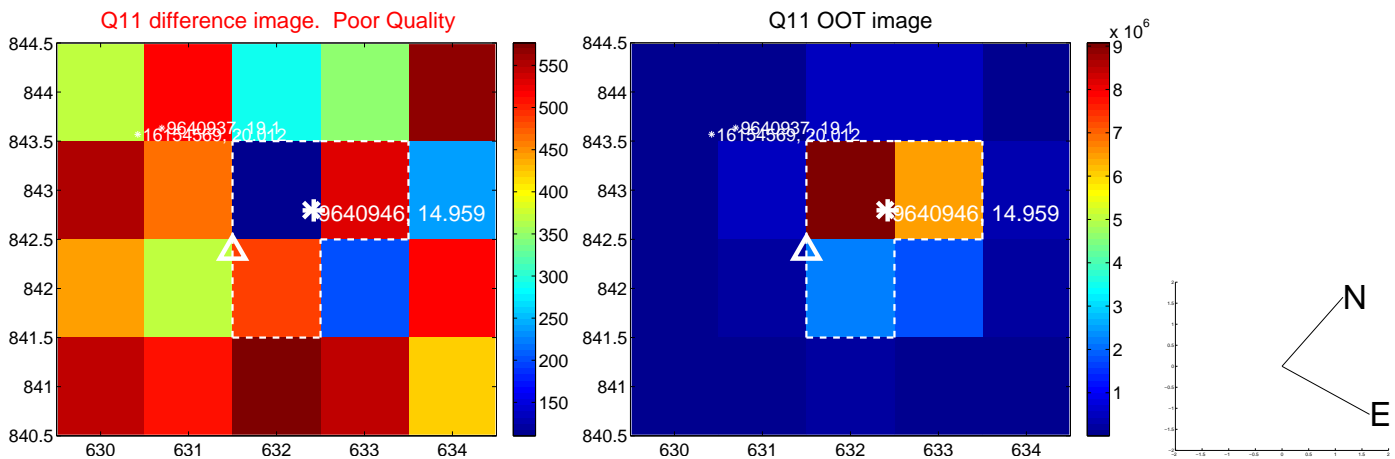
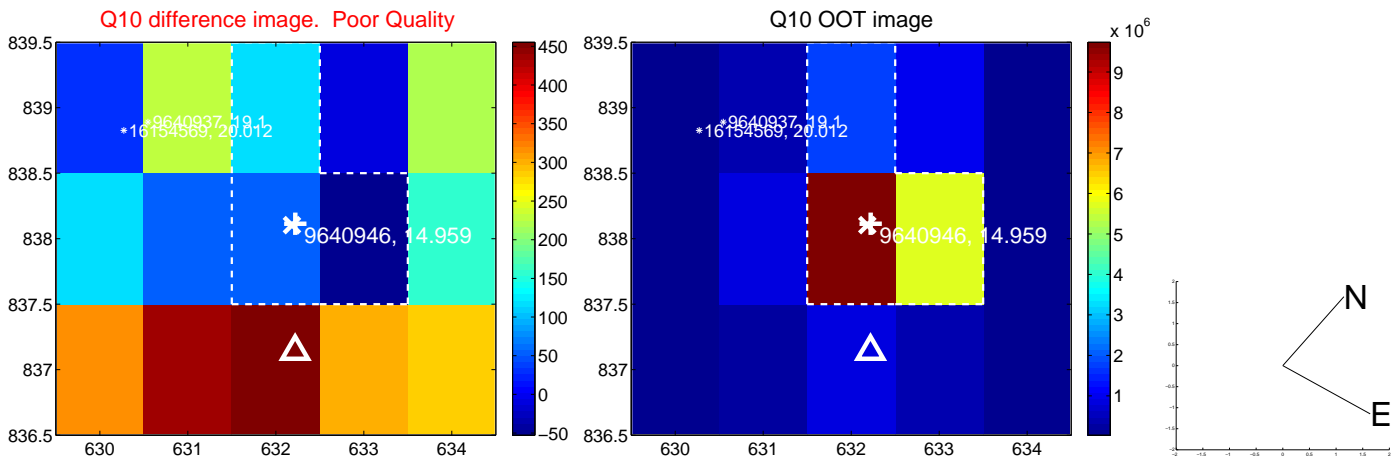
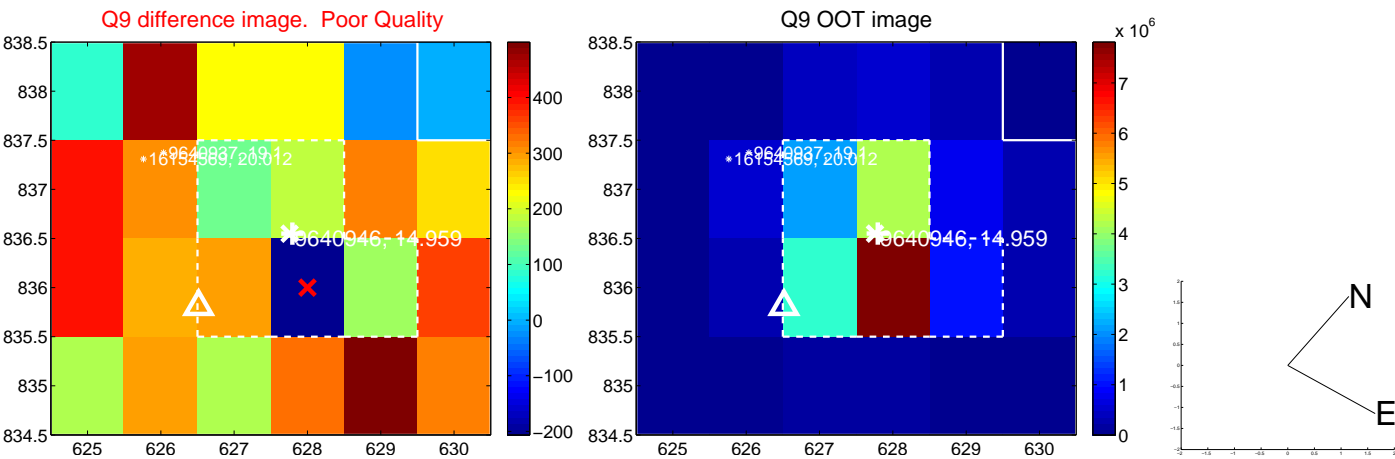
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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



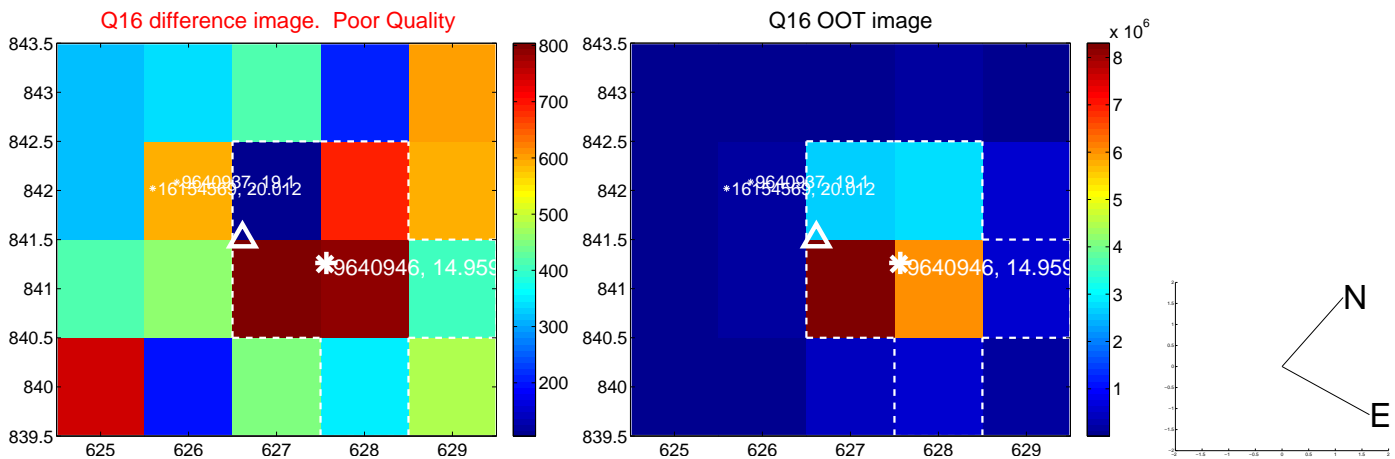
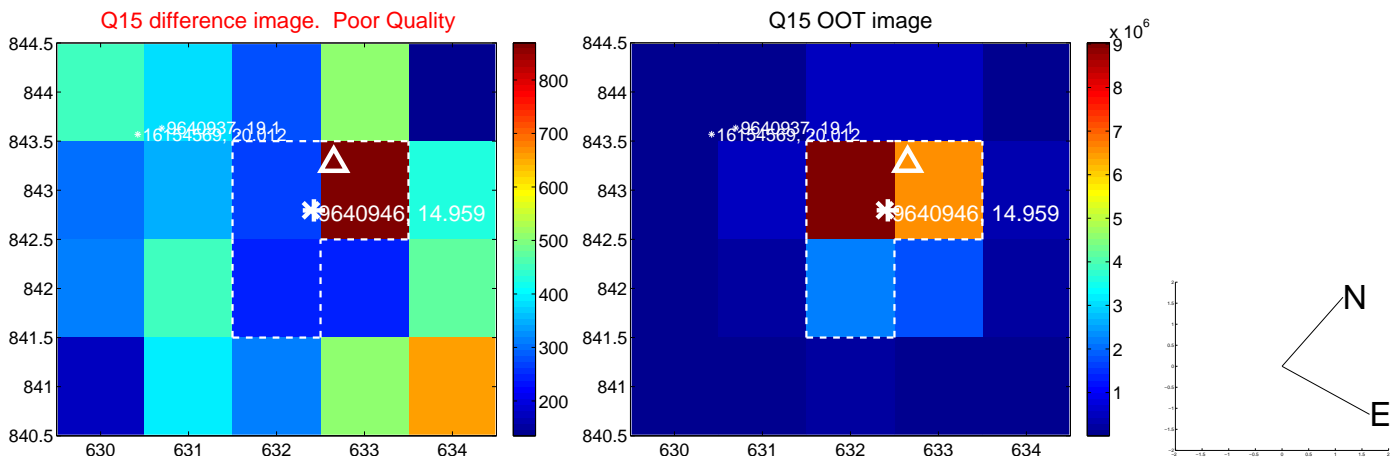
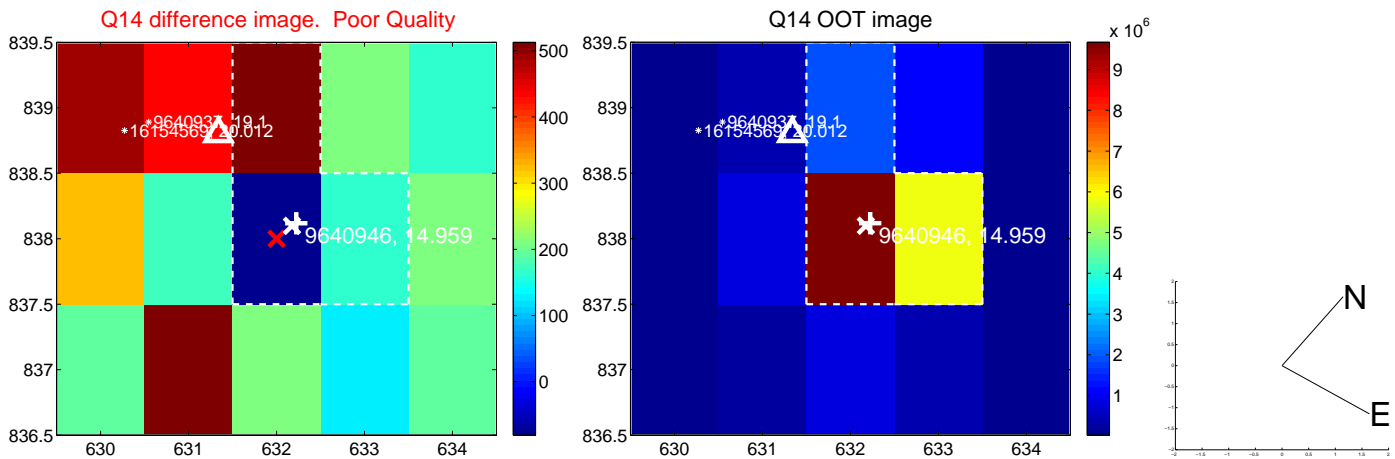
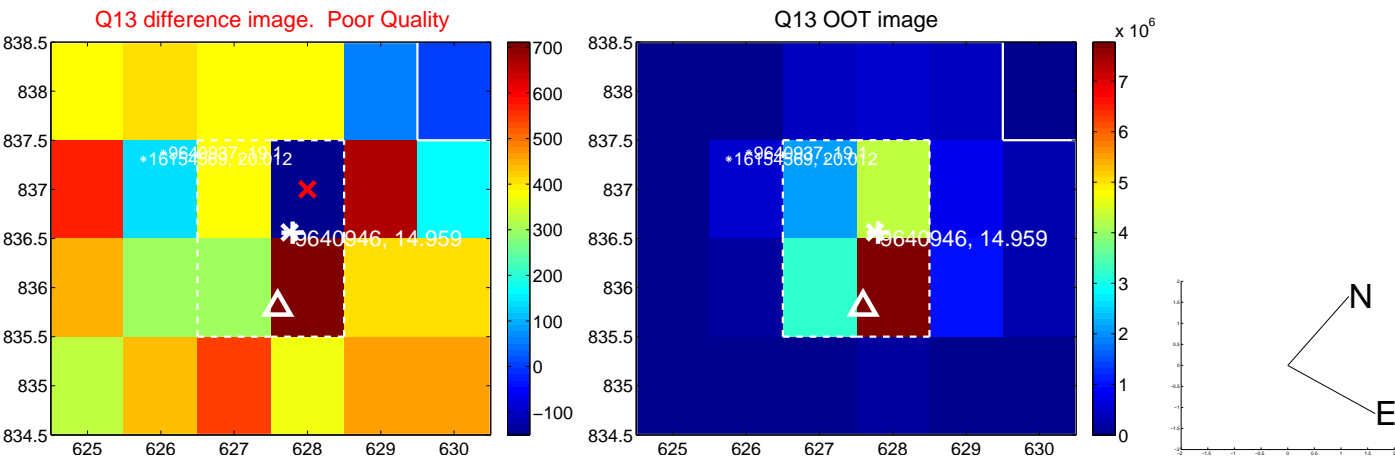
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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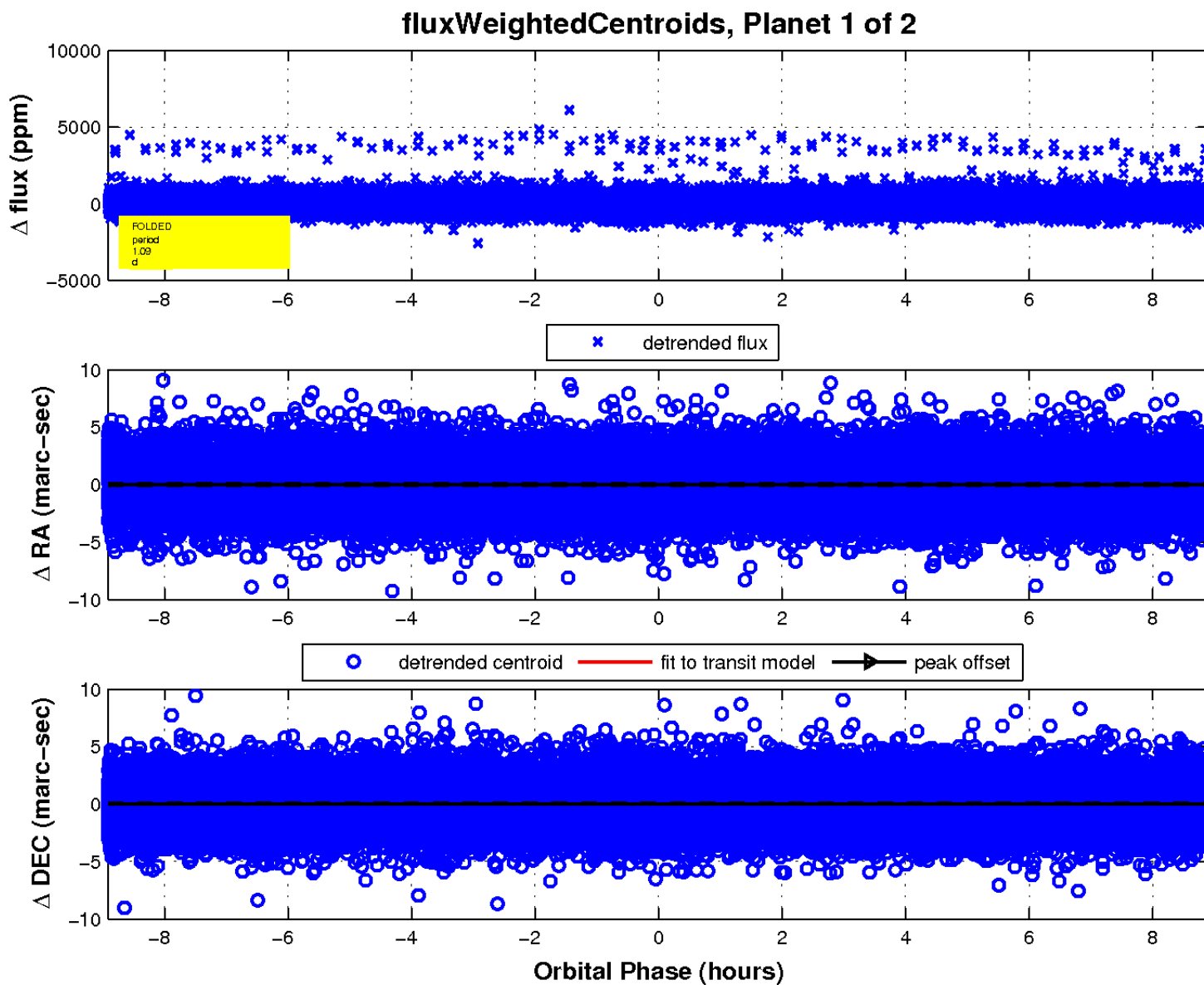
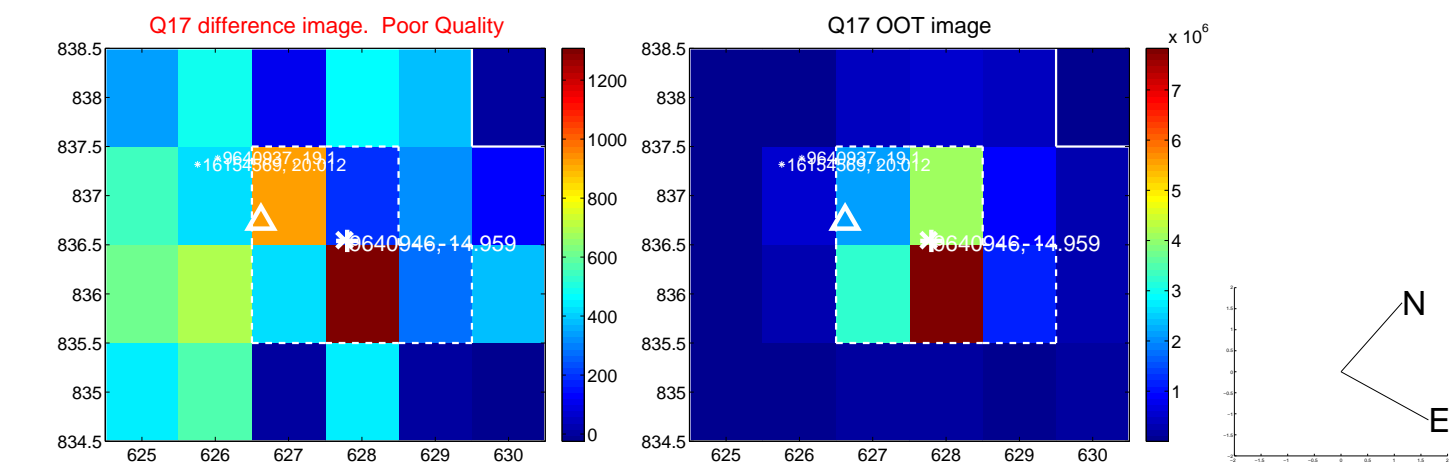


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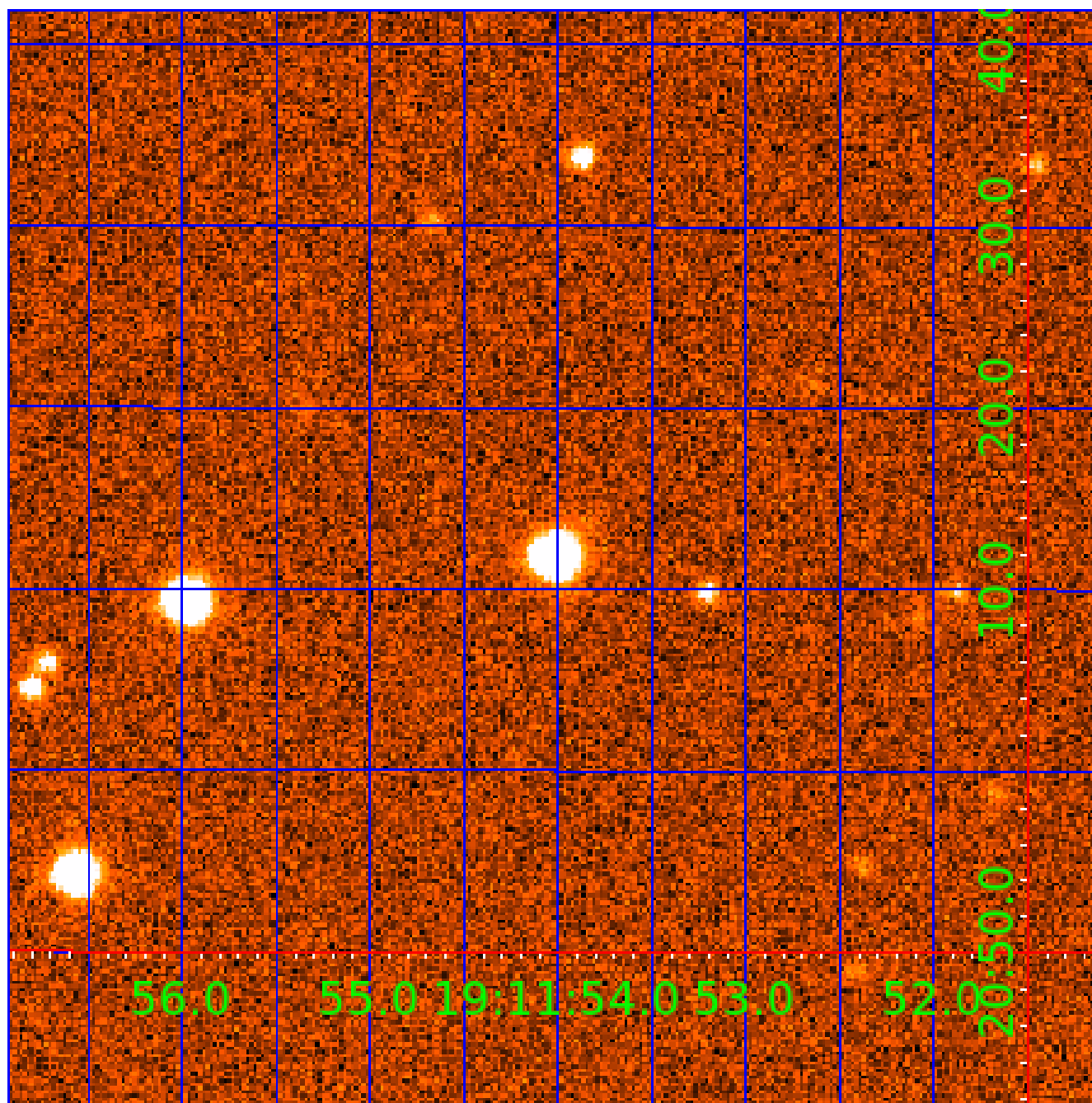


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 009640946

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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 009640946-02

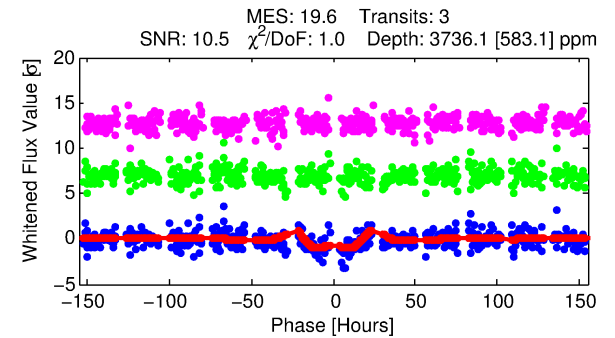
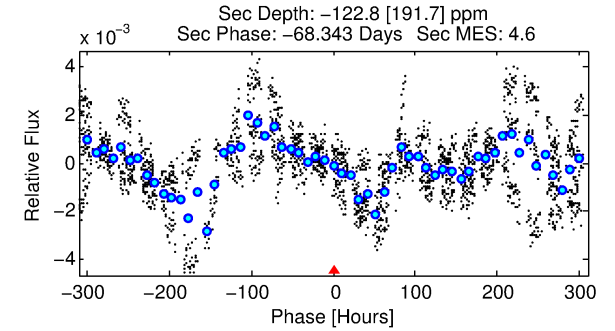
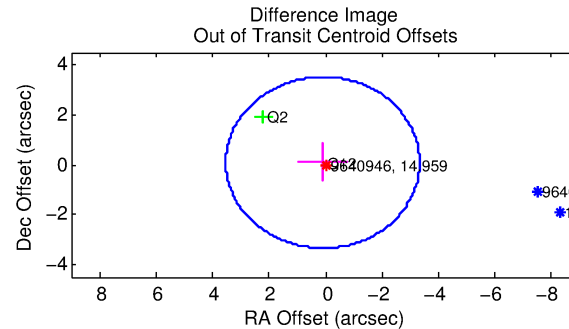
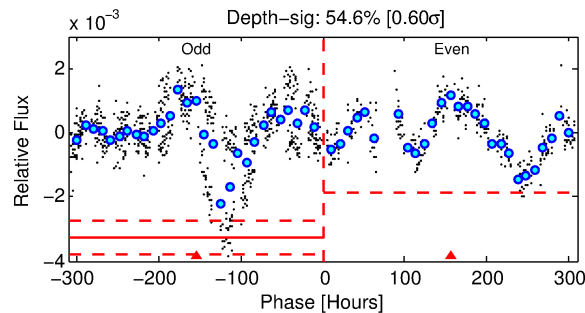
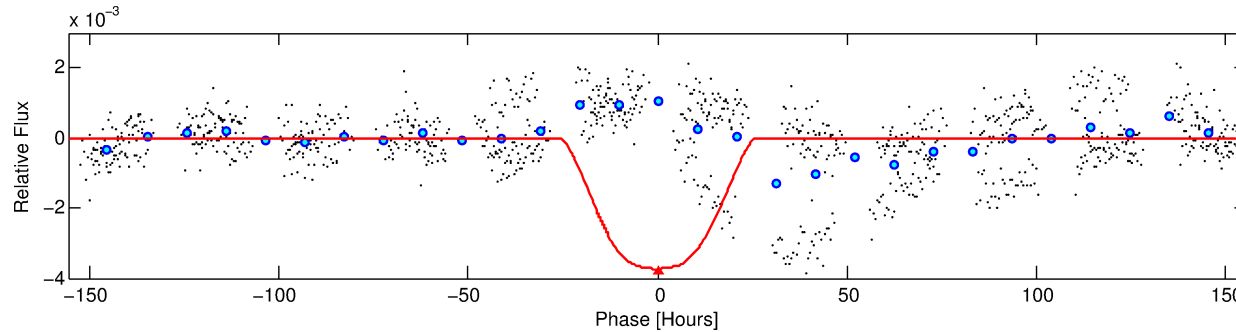
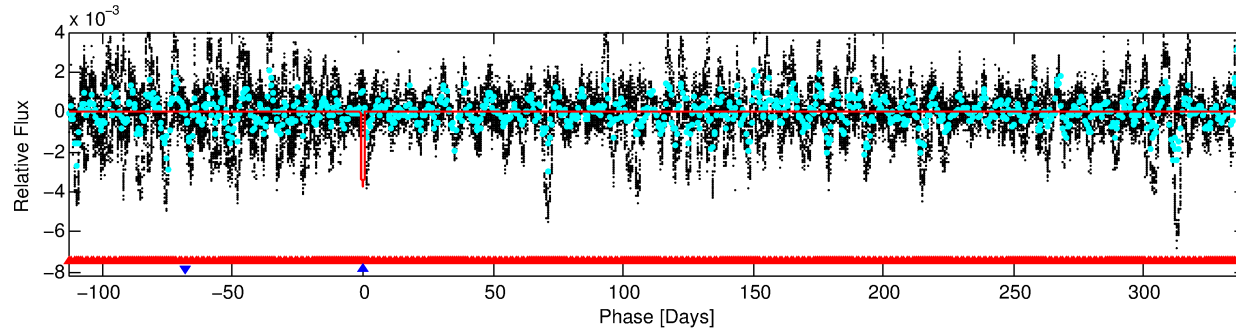
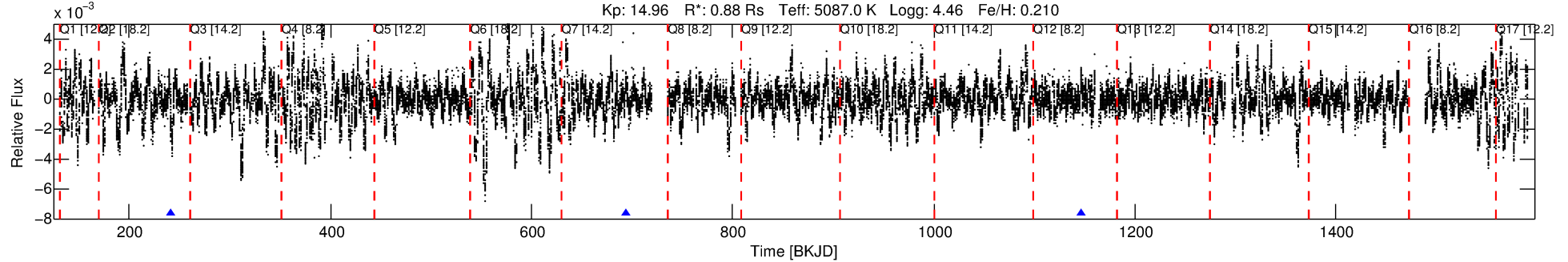
No Significant Match Found

# DV One-Page Summary

KIC: 9640946 Candidate: 2 of 2 Period: 452.970 d

KOI: K04542 Corr: No Ephemeris Match

Kp: 14.96 R\*: 0.88 Rs Teff: 5087.0 K Logg: 4.46 Fe/H: 0.210



## DV Fit Results:

Period = 452.97027 [0.02765] d  
Epoch = 240.9808 [0.0321] BKJD  
Rp/R\* = 0.0706 [0.0061]  
a/R\* = 36.45 [1.48]  
b = 0.92 [0.01]  
Seff = 0.40 [0.09]  
Teq = 203 [12] K  
Rp = 6.79 [0.99] Re  
a = 1.0816 [0.1279] AU  
Ag = N/A  
Teffp = N/A

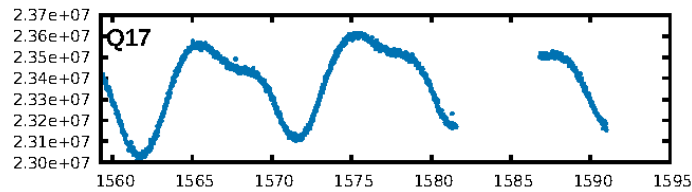
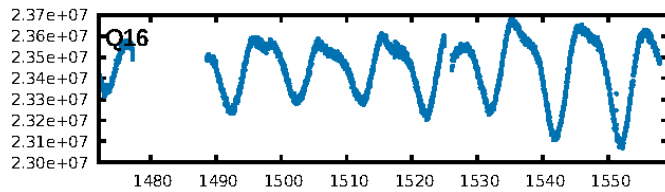
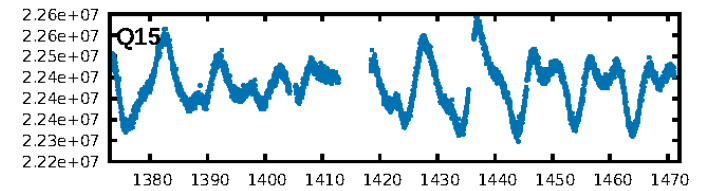
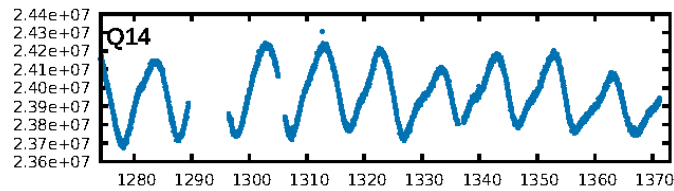
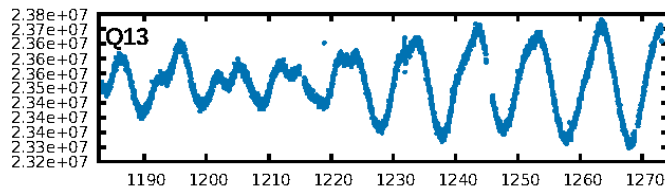
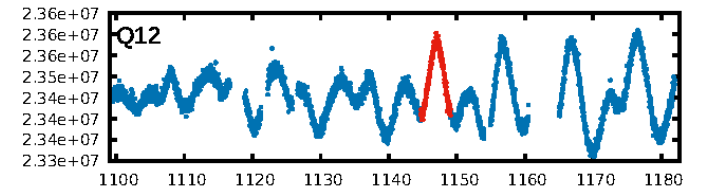
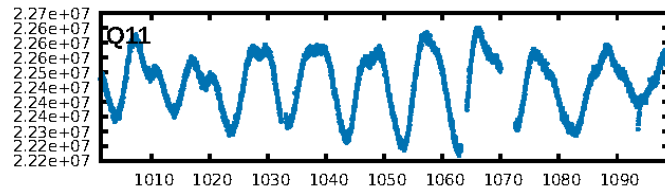
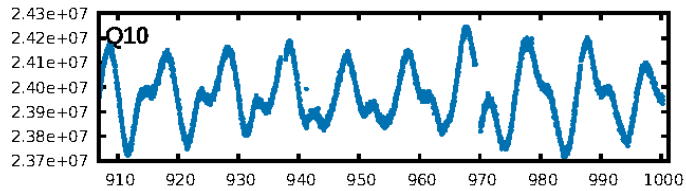
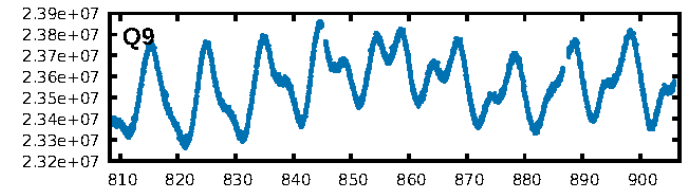
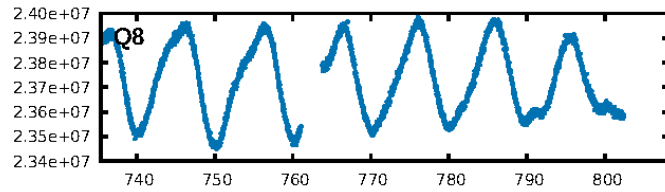
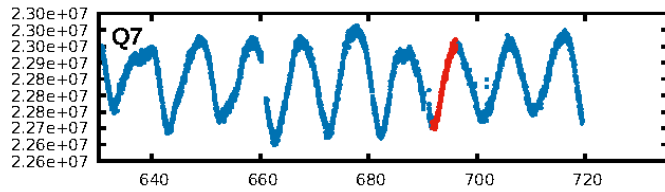
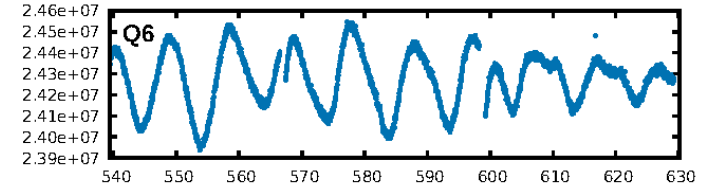
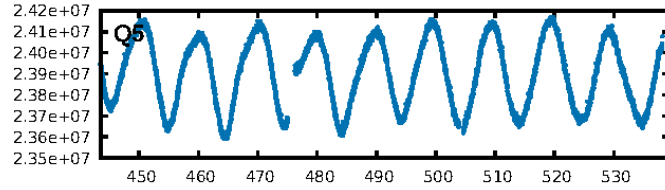
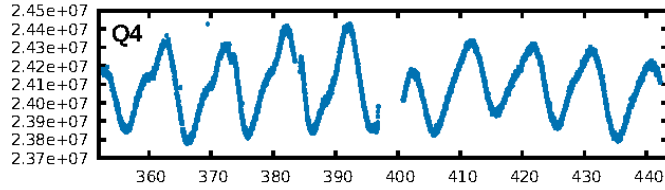
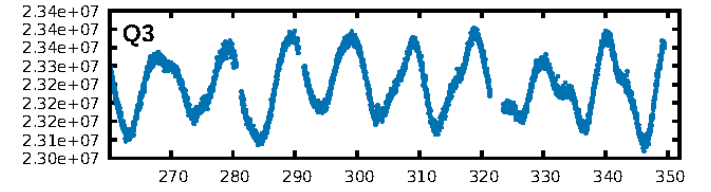
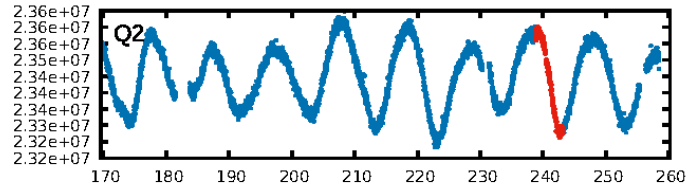
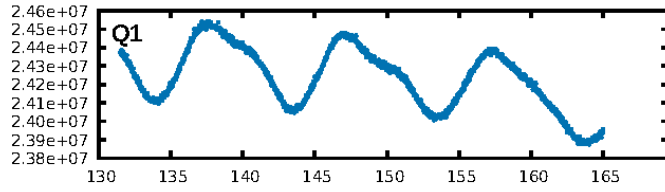
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [208.61σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 1.66e-21  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: 1.862  
Centroid-sig: 75.2%  
Centroid-so: 0.172 arcsec [1.38σ]  
OotOffset-rm: 0.129 arcsec [0.11σ]  
OotOffset-st: 1/0/1/0 [2]  
KicOffset-rm: 0.208 arcsec [0.16σ]  
KicOffset-st: 1/0/1/0 [2]  
DiffImageQuality-fgm: 0.00 [0/2]  
DiffImageOverlap-fno: 0.00 [0/2]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 03:18:47 Z

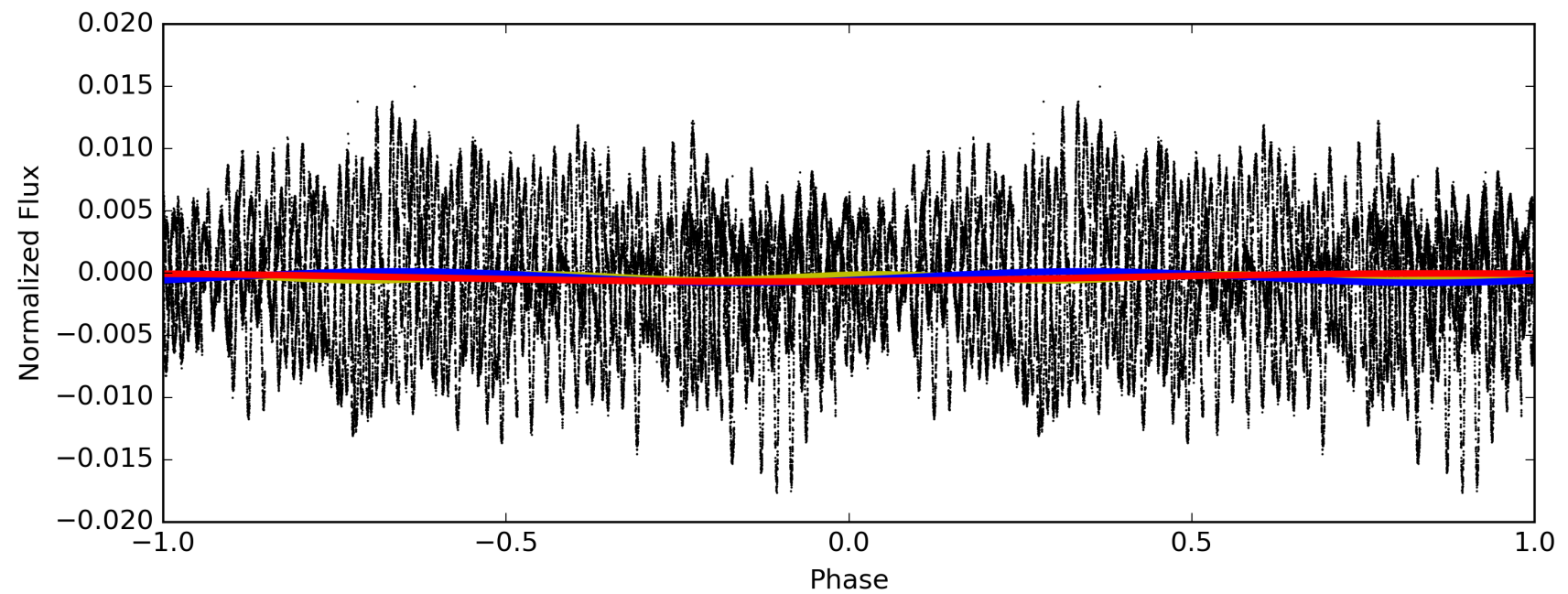
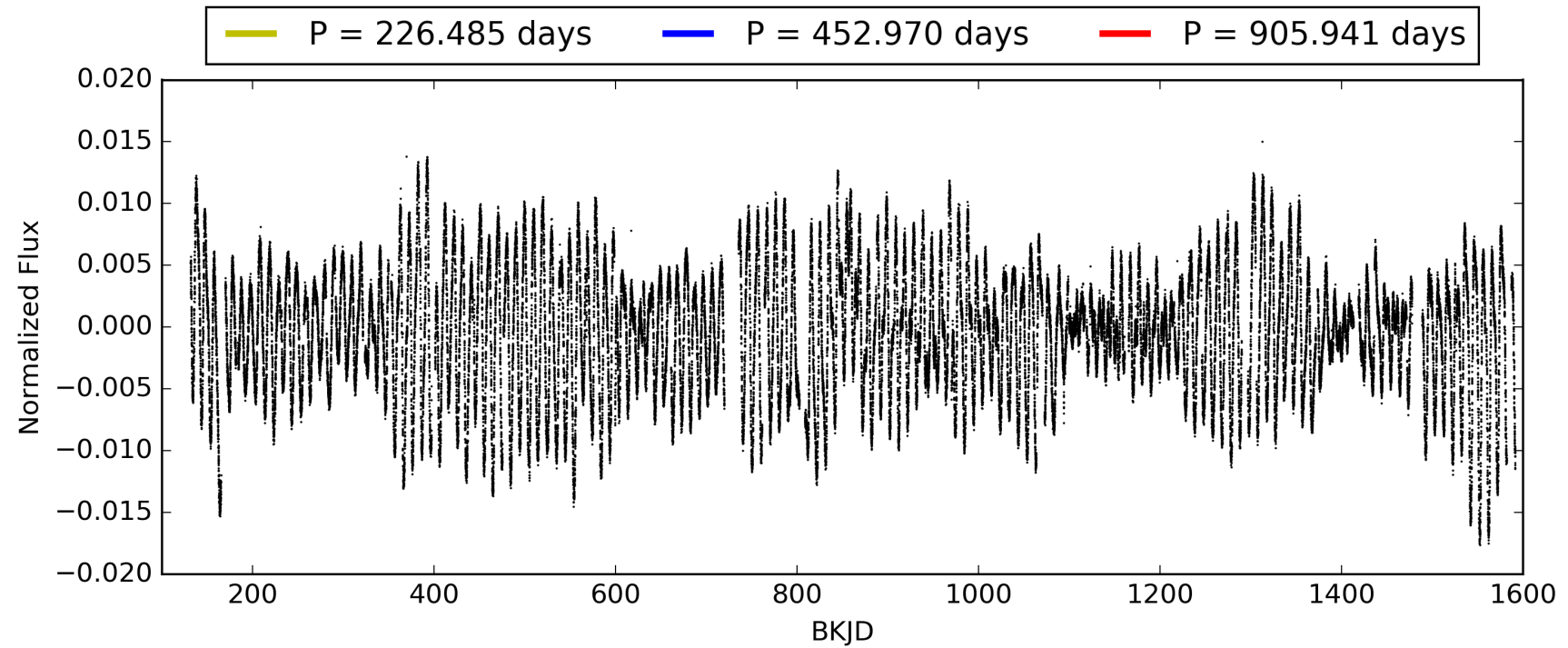
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 009640946-02, PDC Light Curves



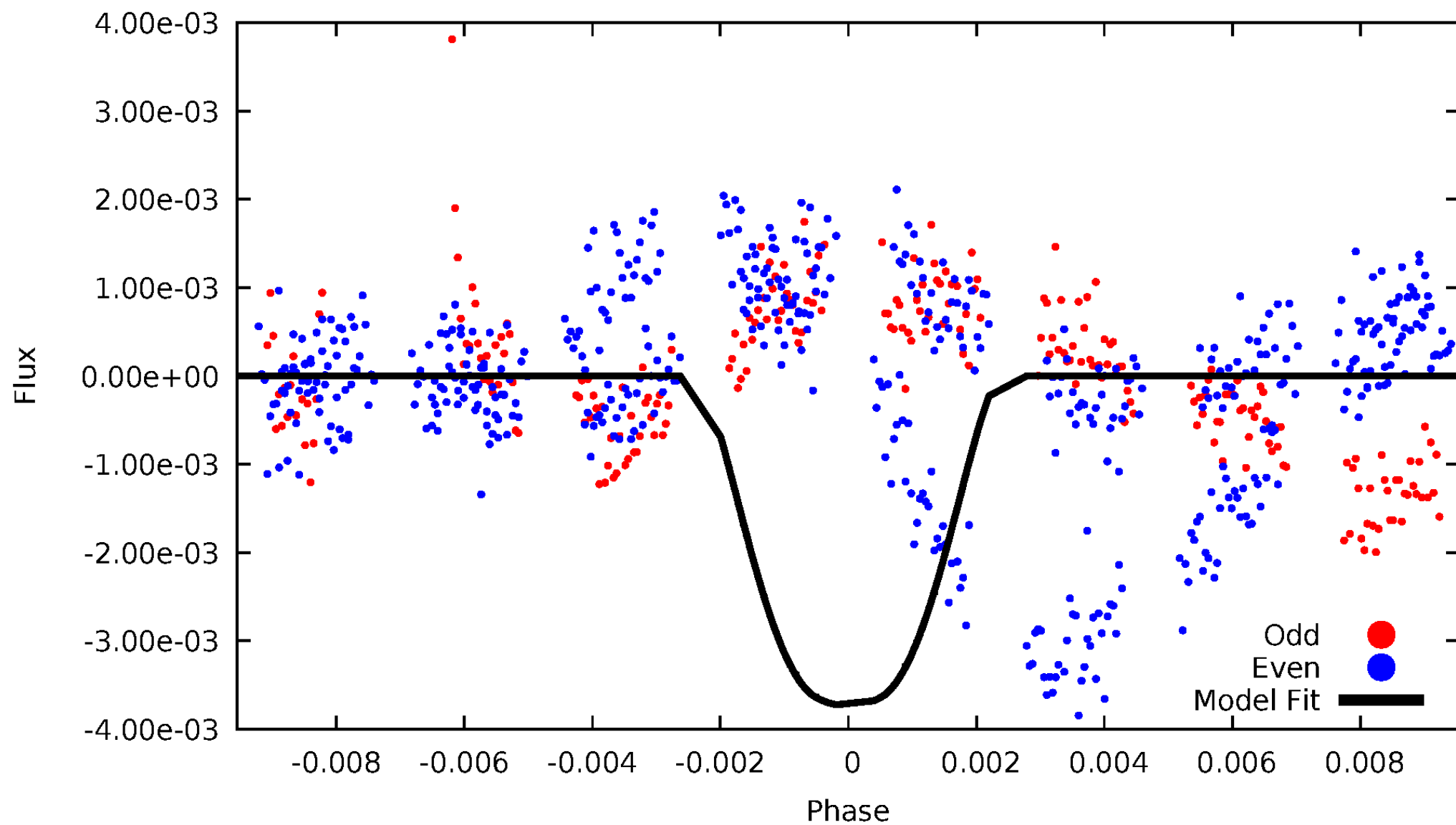


TCE 009640946-02



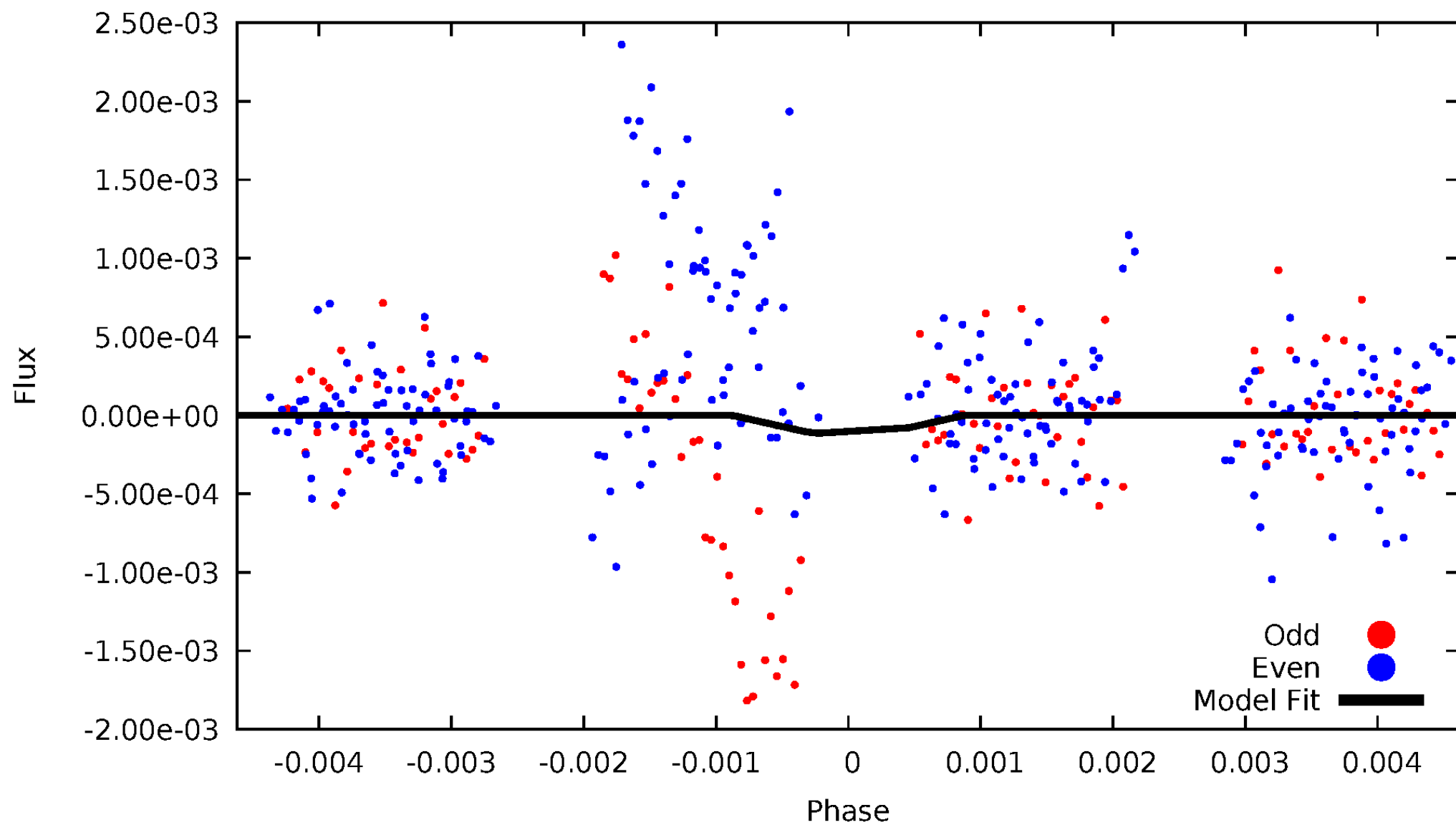
# DV Odd/Even

TCE 009640946-02



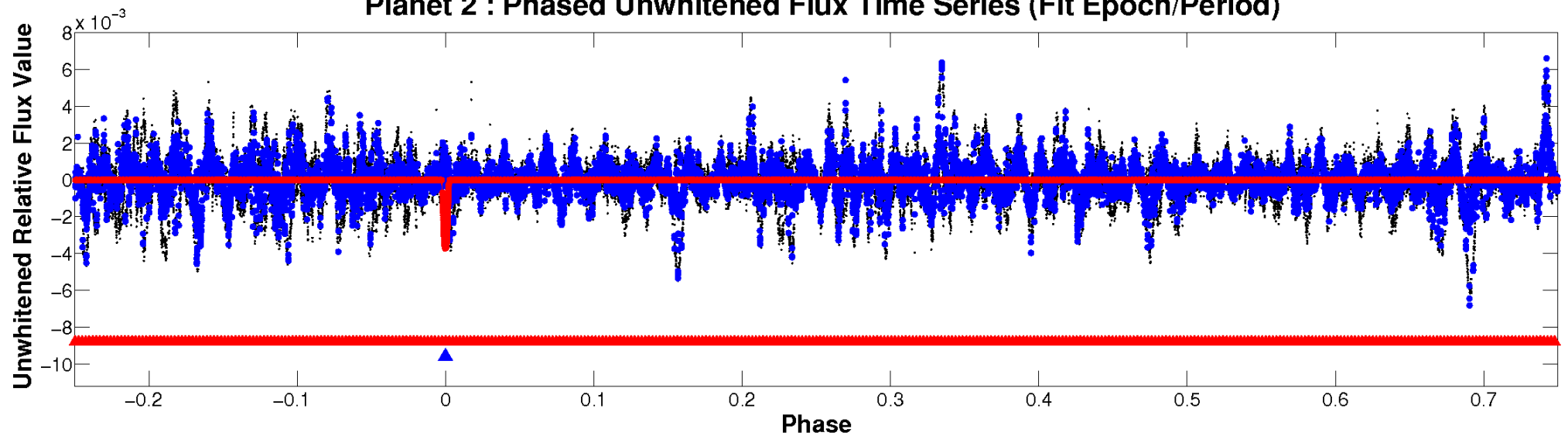
# ALT Odd/Even

TCE 009640946-02

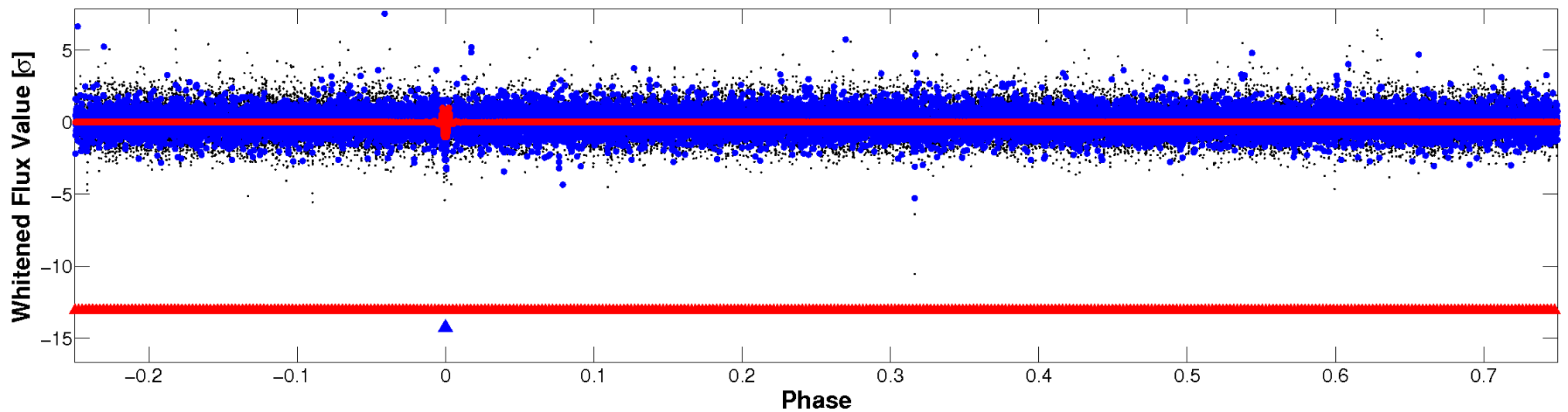


# Non-Whitened Vs. Whitened Light Curve

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

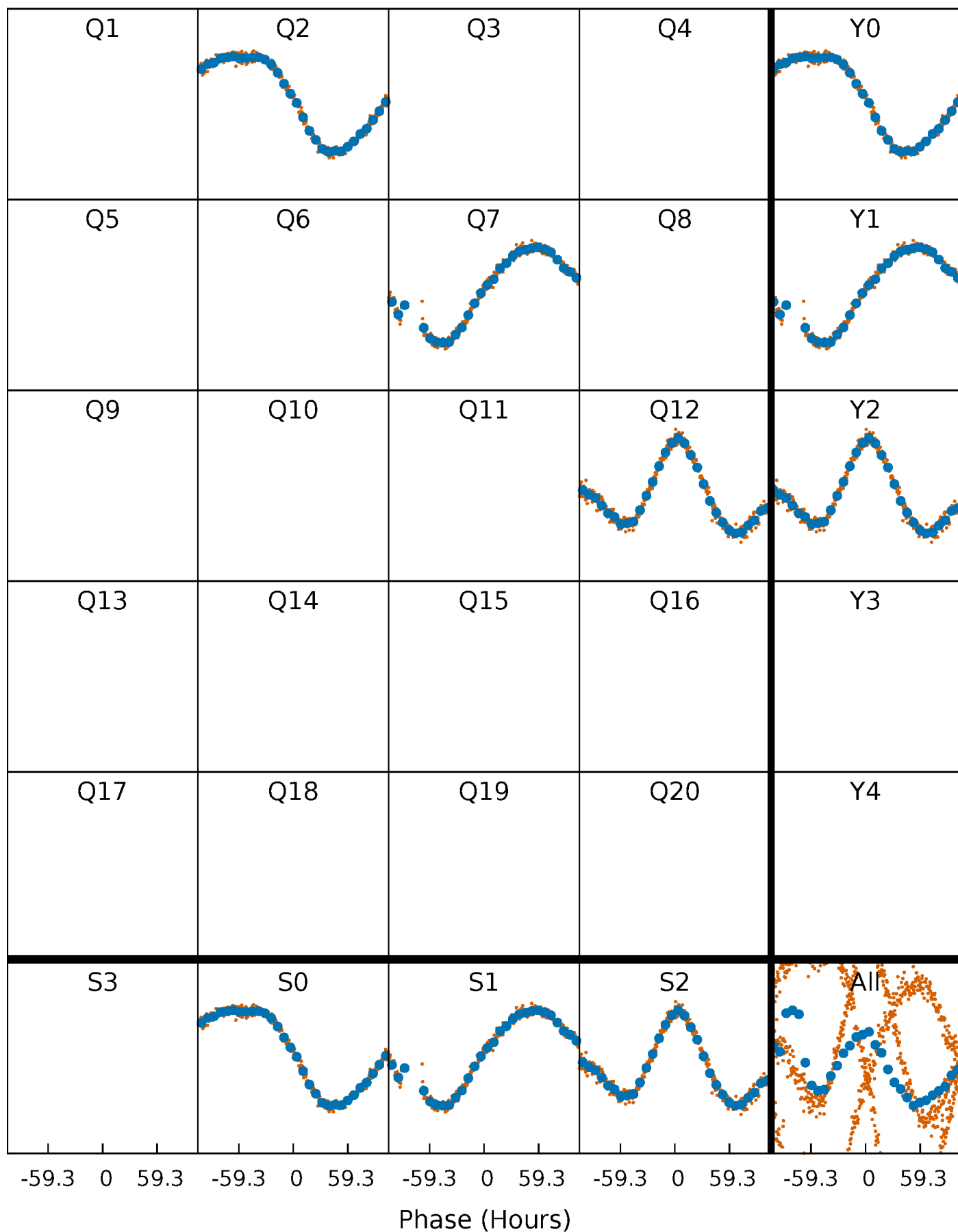


Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



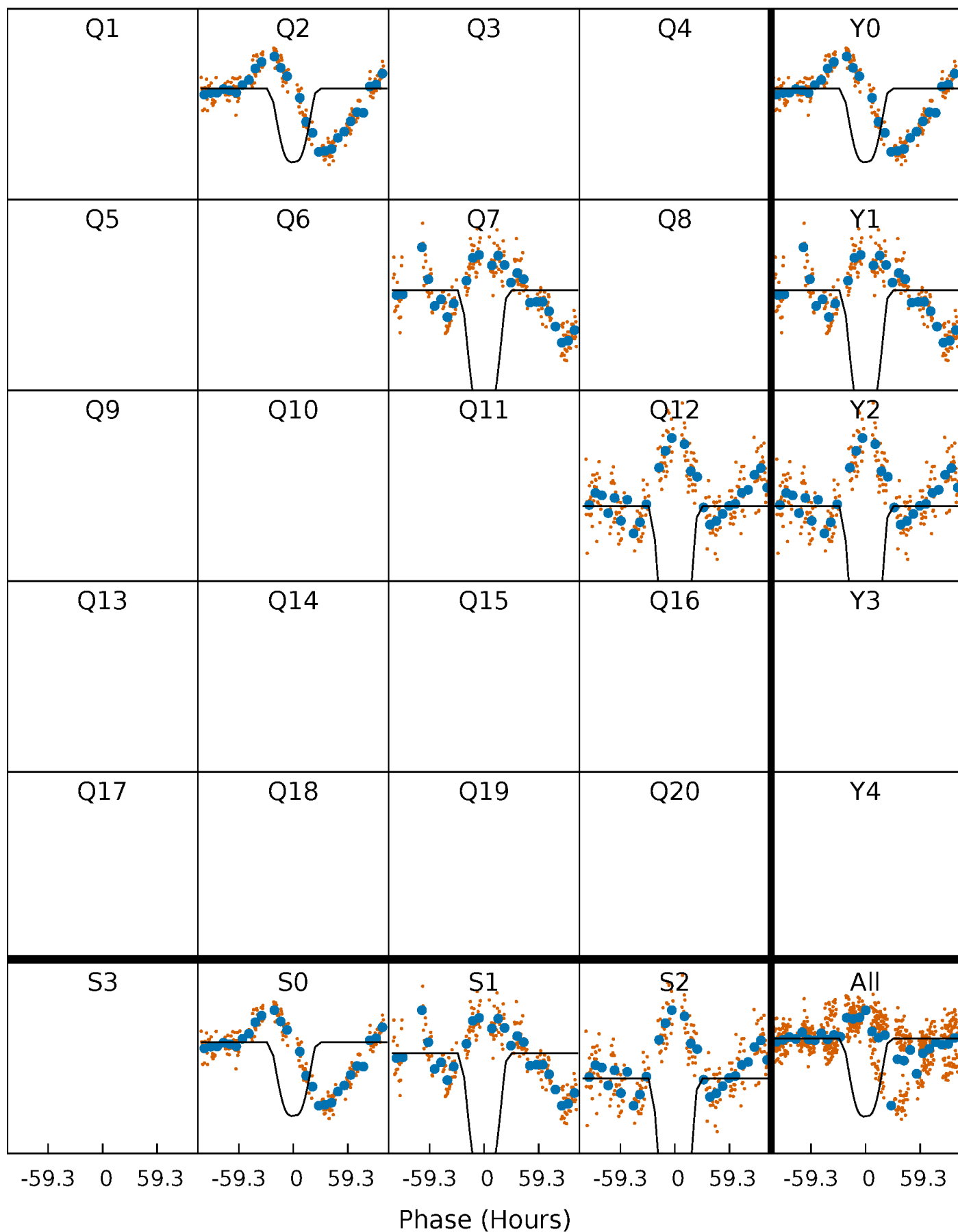
# PDC Quarter-Phased Transit Curves

TCE 009640946-02 P=452.970269 Days  $T_0=240.980837$  (BKJD)



# DV Quarter-Phased Transit Curves

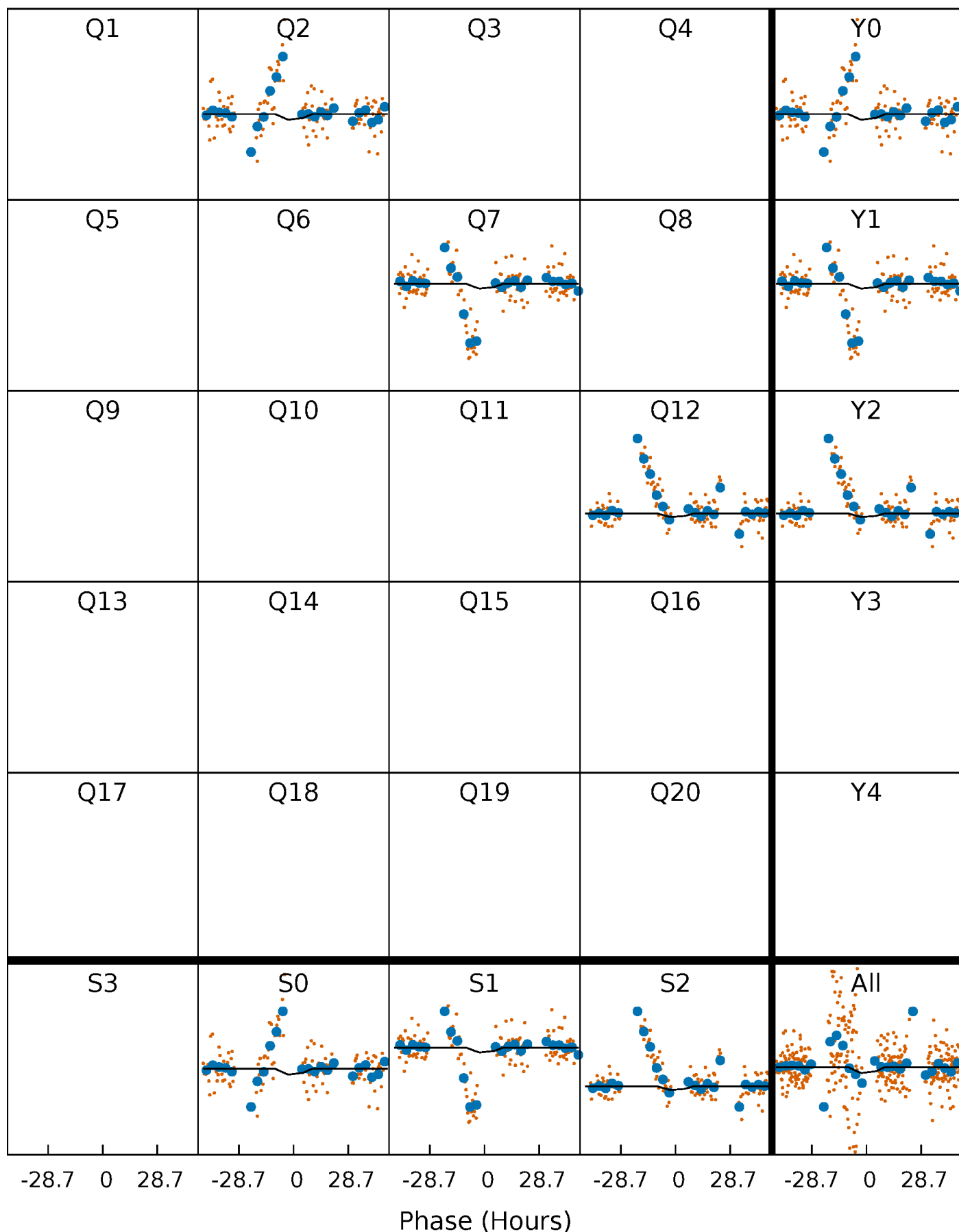
TCE 009640946-02 P=452.970269 Days  $T_0=240.980837$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

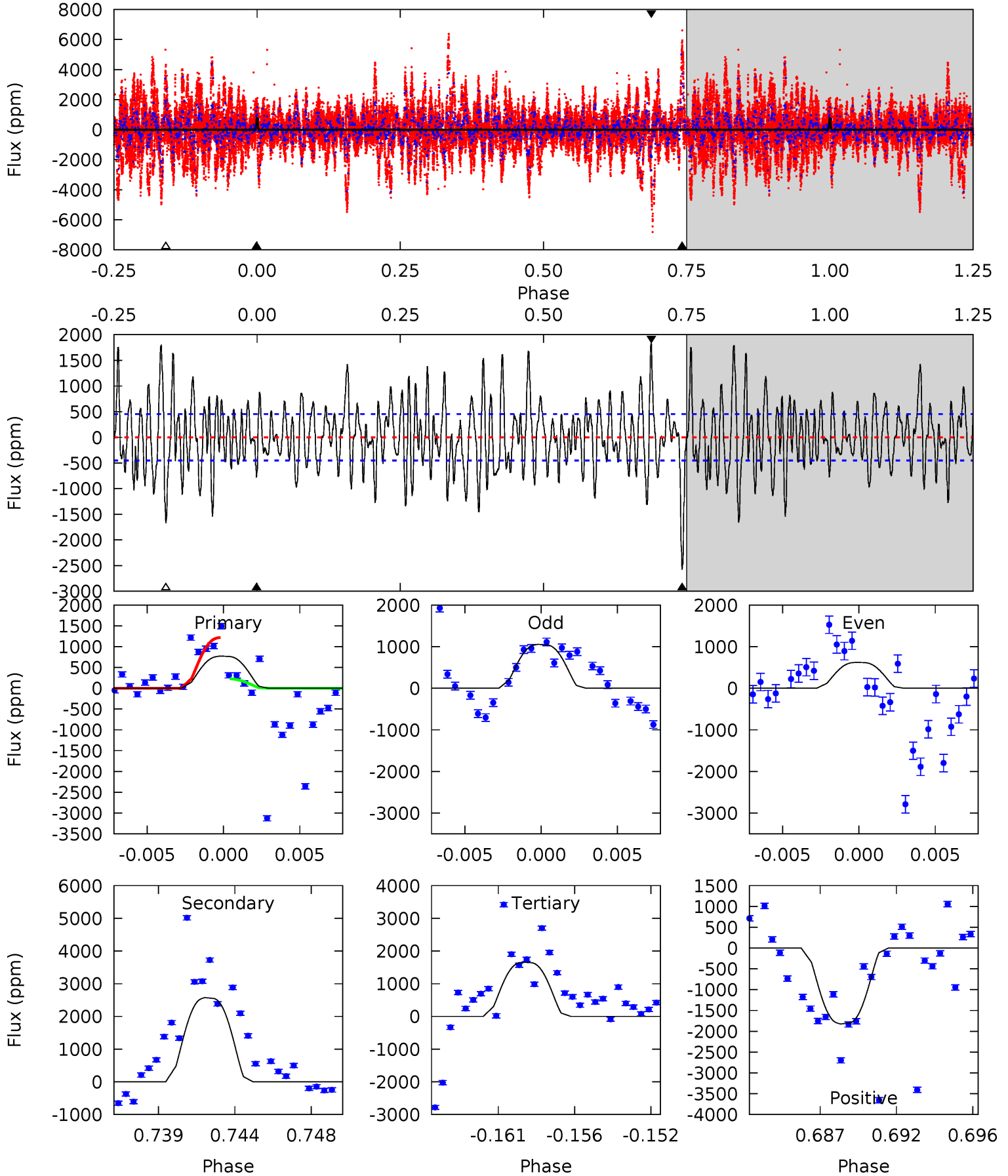
TCE 009640946-02     $P=452.991592$  Days     $T_0=240.953636$  (BKJD)



# DV Model-Shift Uniqueness Test

009640946-02, P = 452.970269 Days, E = 240.980837 Days

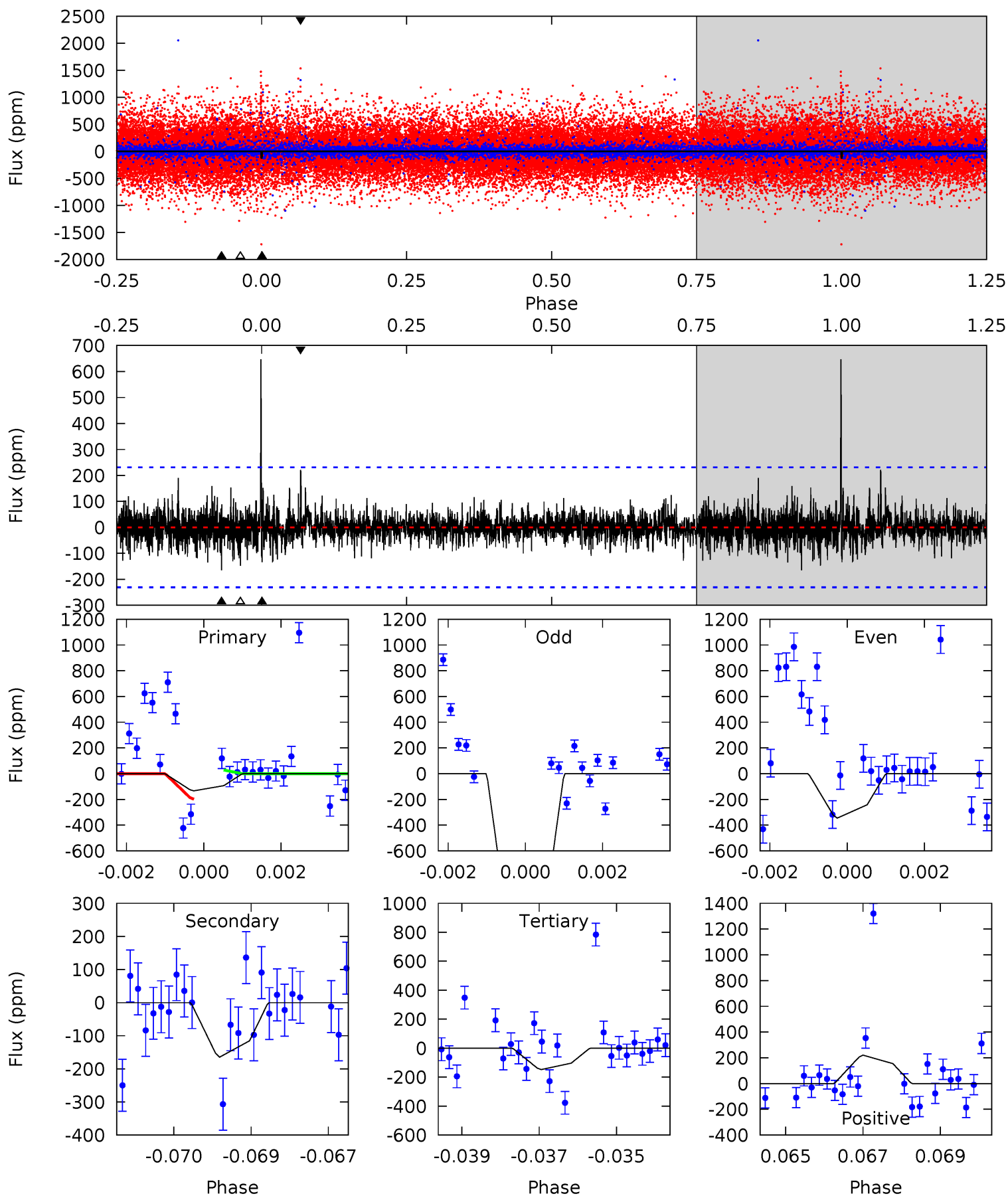
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
8.84	29.5	19.0	20.9	5.17	2.82	6.85	-10.1	-12.0	10.5	8.61	2.31	0.73	0.41	5.69



# Alt Model-Shift Uniqueness Test

009640946-02, P = 452.991592 Days, E = 240.953636 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
3.09	3.81	3.43	5.11	5.35	3.13	0.83	-0.34	-2.03	0.38	-1.30	14.2	7.60	0.80	1.98



### Stellar Parameters For KIC 009640946

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (g \cdot \text{cm}^{-3})$
	$5087^{+167}_{-152}$	$4.463^{+0.104}_{-0.115}$	$0.210^{+0.200}_{-0.300}$	$0.881^{+0.104}_{-0.104}$	$0.822^{+0.077}_{-0.058}$	$1.691^{+0.774}_{-0.529}$
	+3%/-3%	+2%/-3%	+95%/-143%	+12%/-12%	+9%/-7%	+46%/-31%
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 009640946-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-2576 \pm 87$	$6.86^{+0.82}_{-0.79}$	$284^{+13}_{-12}$	$4460^{+189}_{-178}$	$35165^{+10207}_{-6679}$
Alt.	$-165 \pm 43$	$1.03^{+0.64}_{-0.50}$	$284^{+14}_{-13}$	$5533^{+2320}_{-1041}$	$96948^{+298336}_{-61278}$

$T_{max}$  = 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  $A_{obs} \gg 1.0$

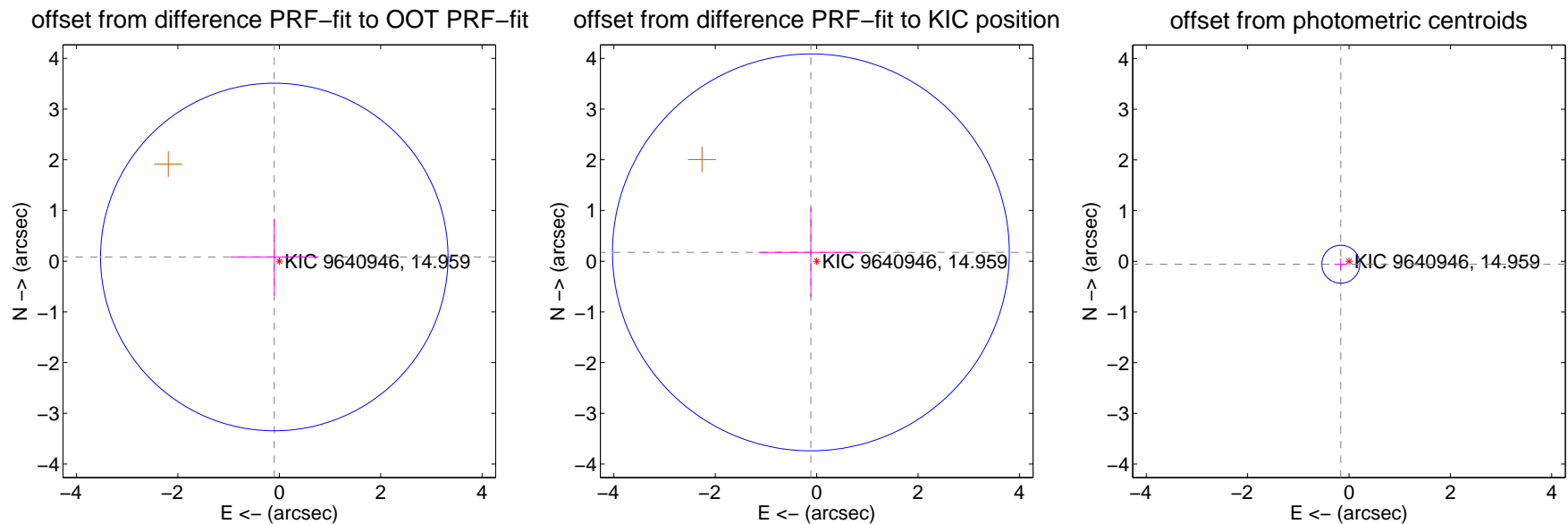
## DV Centroid Data

Supplemental centroid analysis for 009640946-02. Kepler magnitude: 14.96. Transit SNR 10.51

There are 0 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.09 arcsec

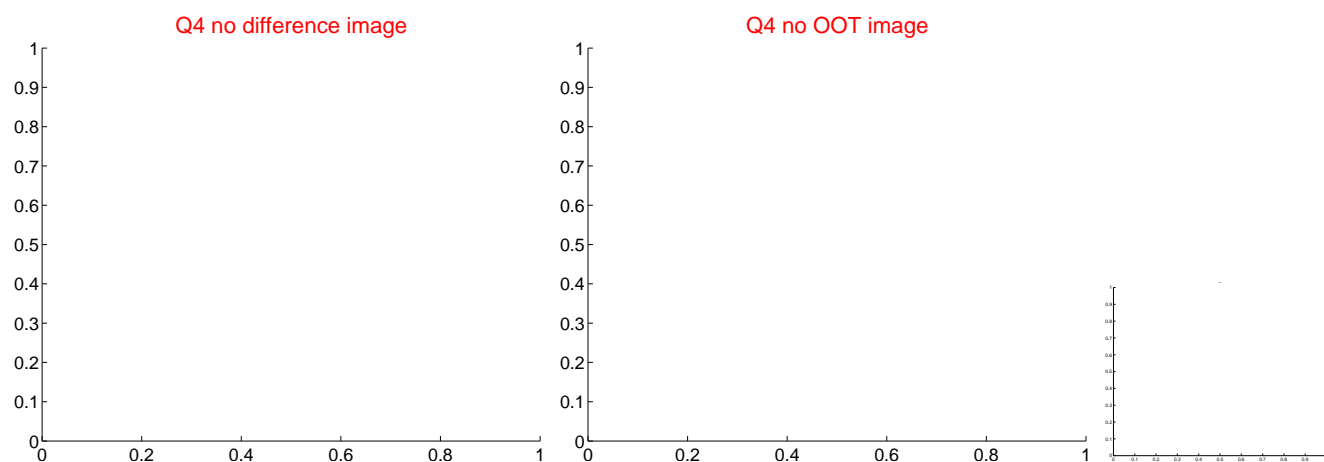
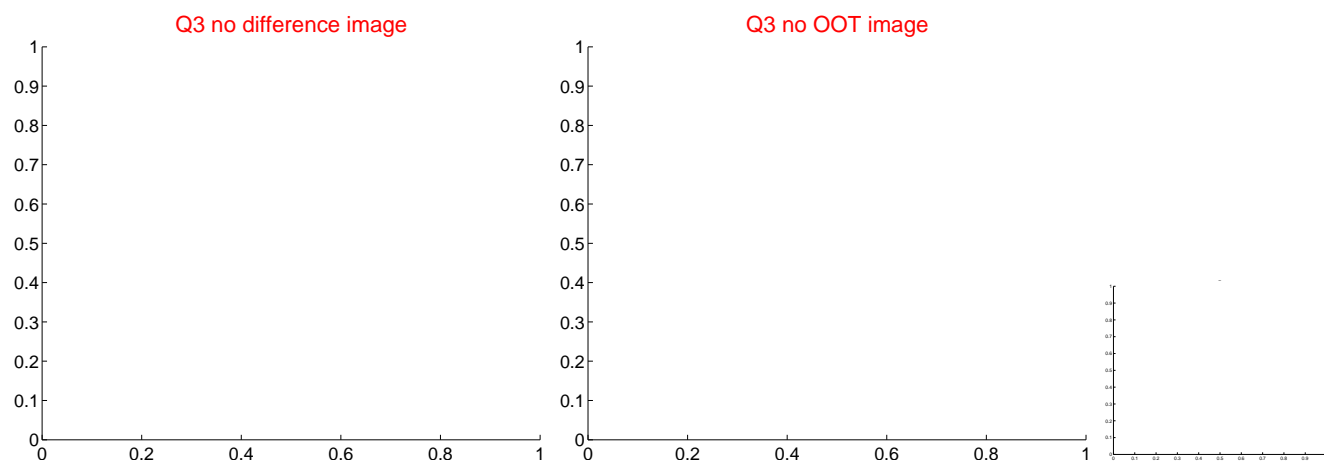
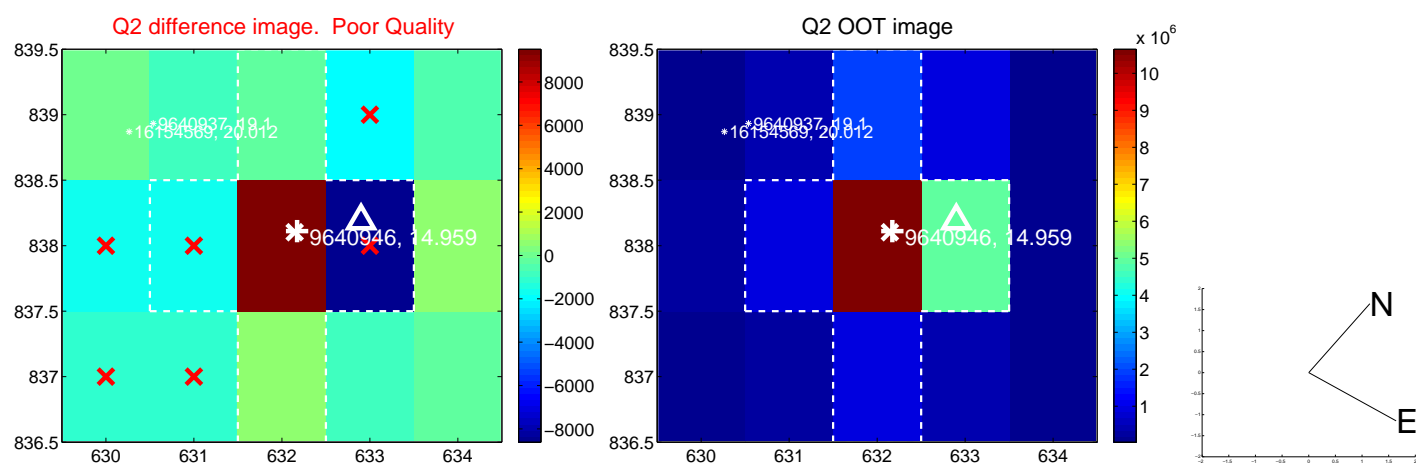
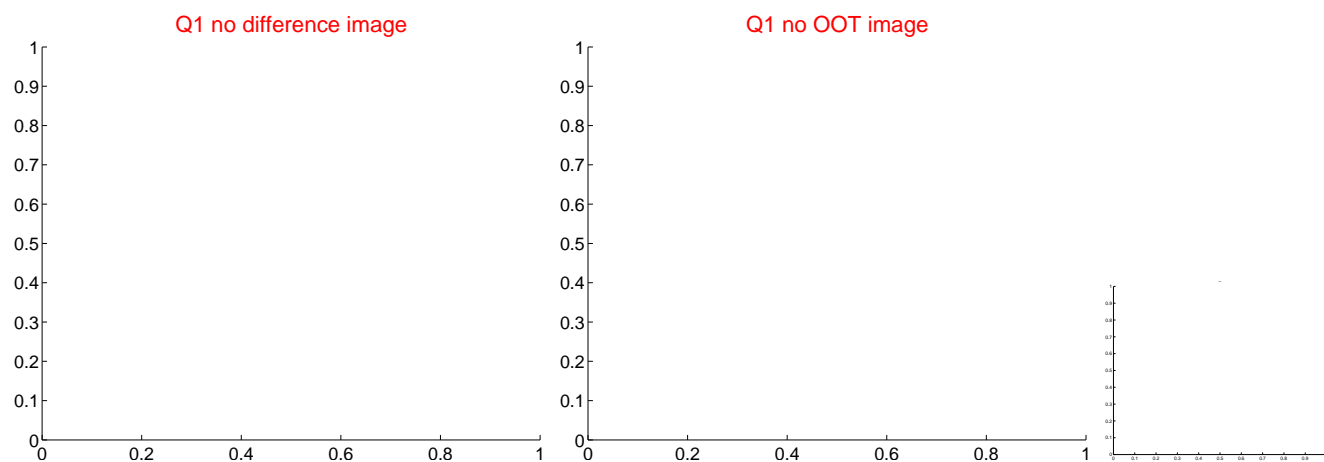
	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.129 \pm 1.143$	0.11	$0.099 \pm 0.860$	$0.083 \pm 0.755$
PRF-fit source offset from KIC position	$0.208 \pm 1.305$	0.16	$0.114 \pm 1.035$	$0.174 \pm 0.884$
photometric centroid source offset	$0.17 \pm 0.12$	1.38	$0.16 \pm 0.13$	$-0.06 \pm 0.12$



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.



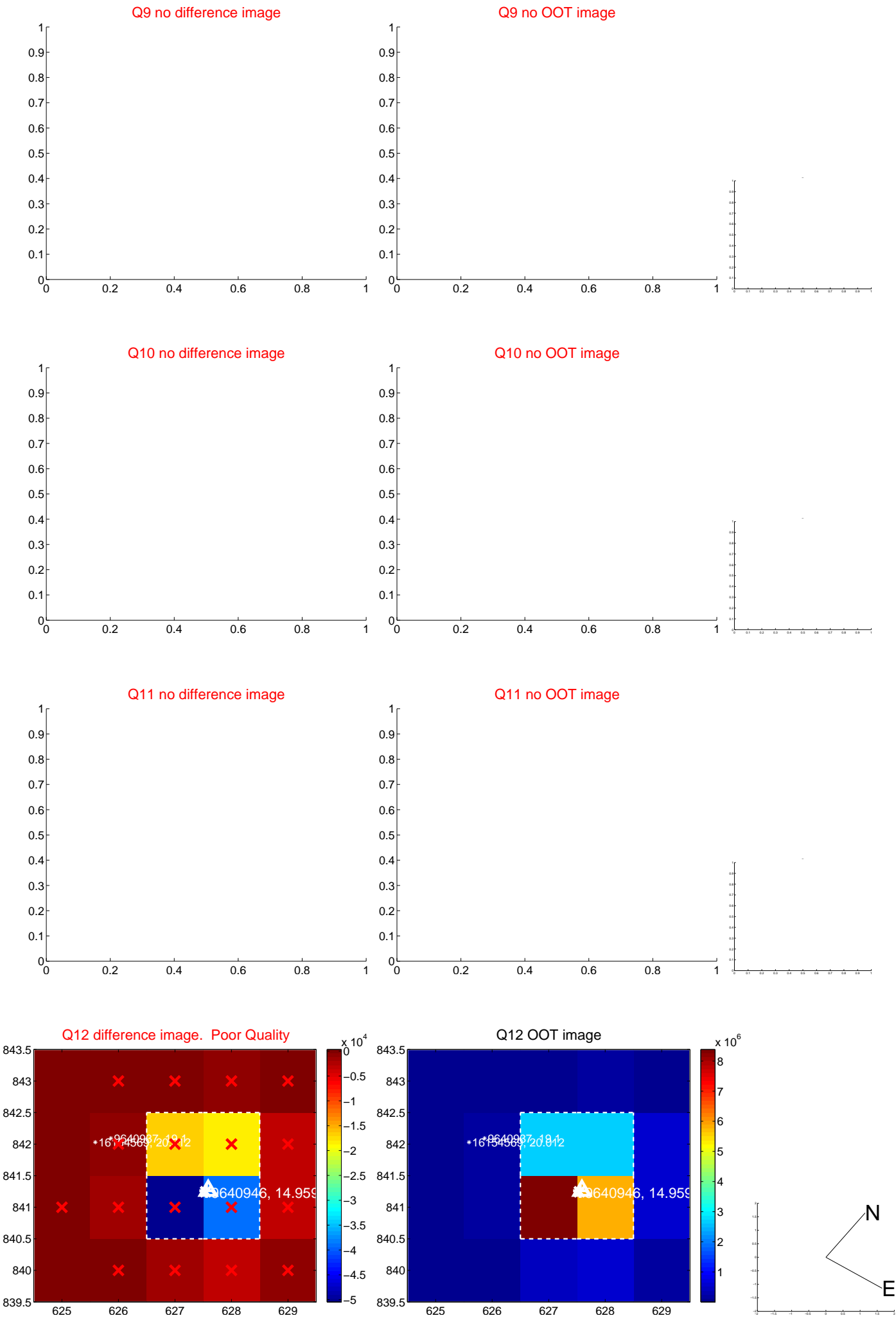
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value



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



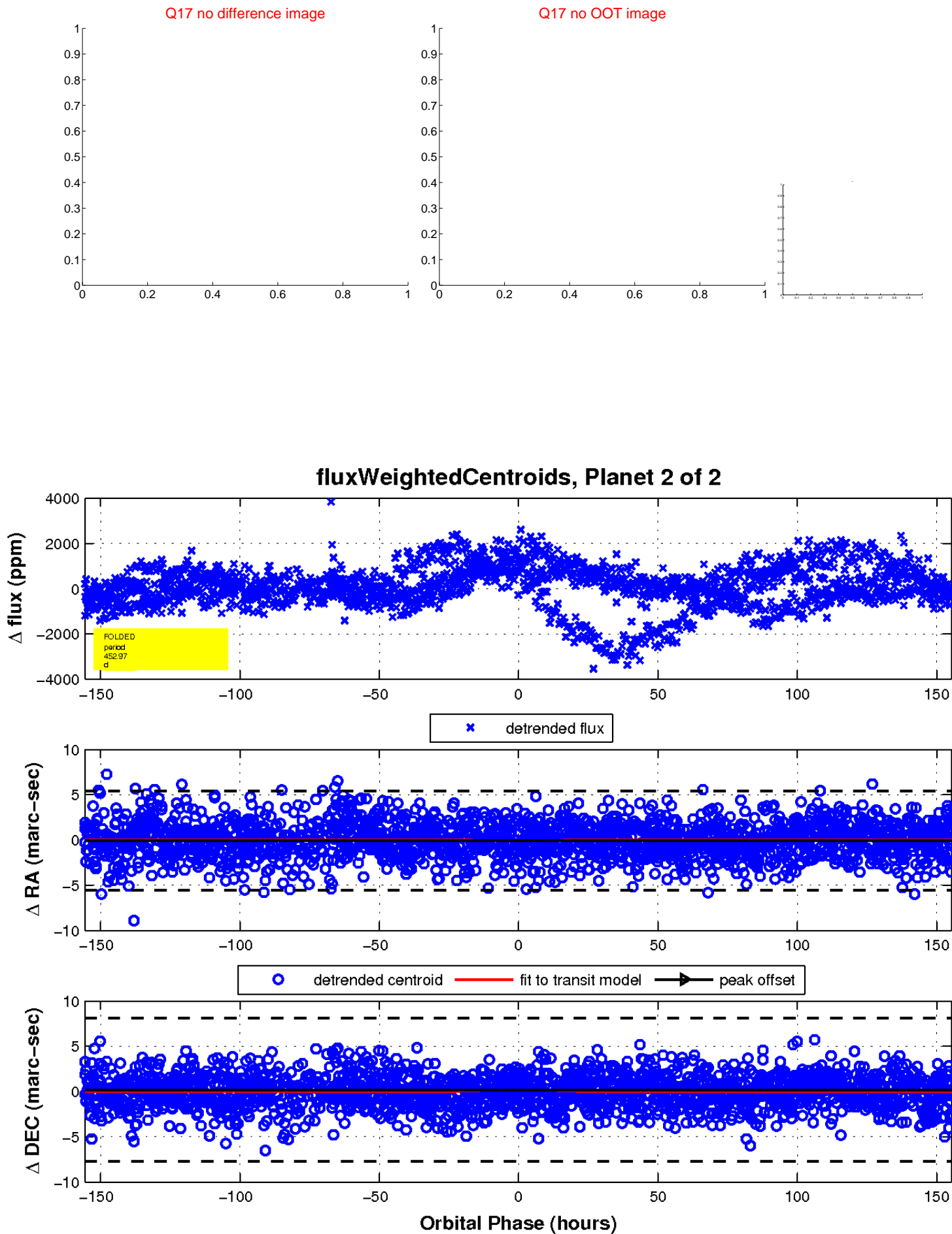
white ×: KIC target position; +: OOT centroid; △: difference centroid. red ✕: large negative pixel value.



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.





UKIRT Image

Declination

