

# KIC 009048976

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009048976-01	OBS	No	471.231168	237.406773	738.2	12.354	10.6	7.6	0.58	4266	1.61	0.10
009048976-02	OBS	No	515.005922	491.302185	623.3	5.011	11.8	4.7	0.58	4266	1.53	0.09

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009048976-01	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES_MARSHALL—LPP_DV—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS
009048976-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—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.

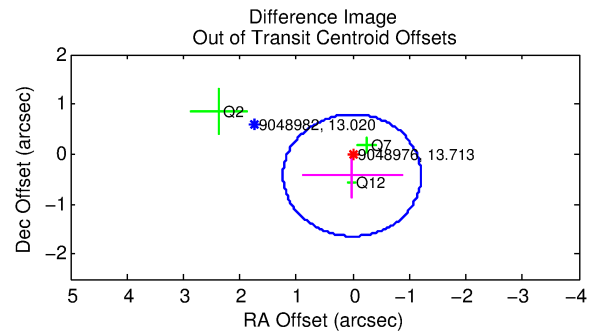
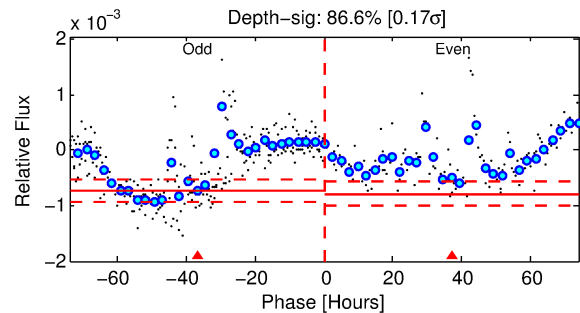
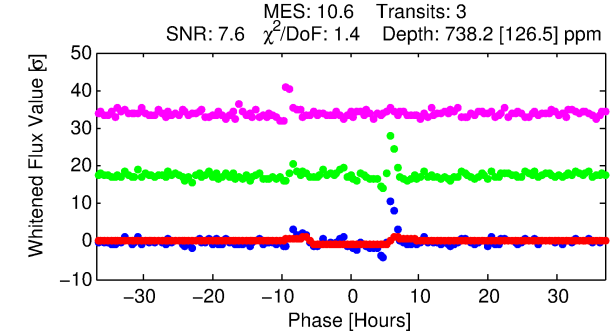
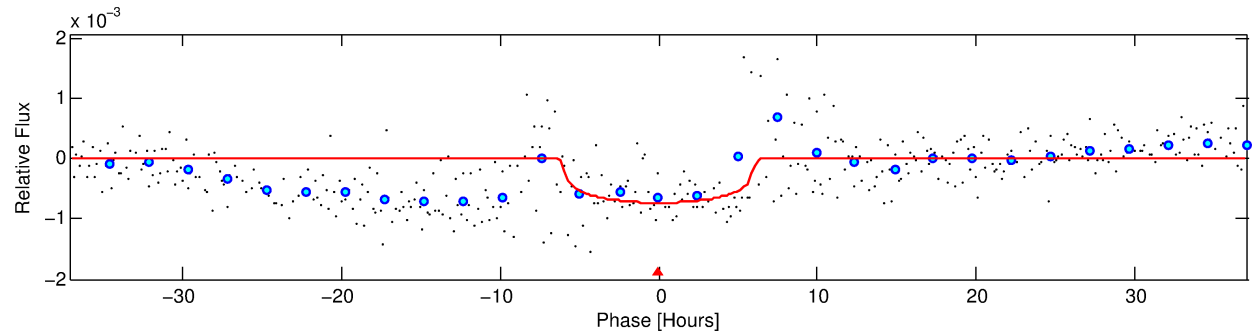
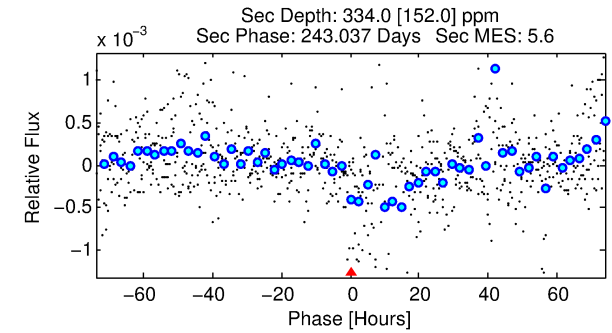
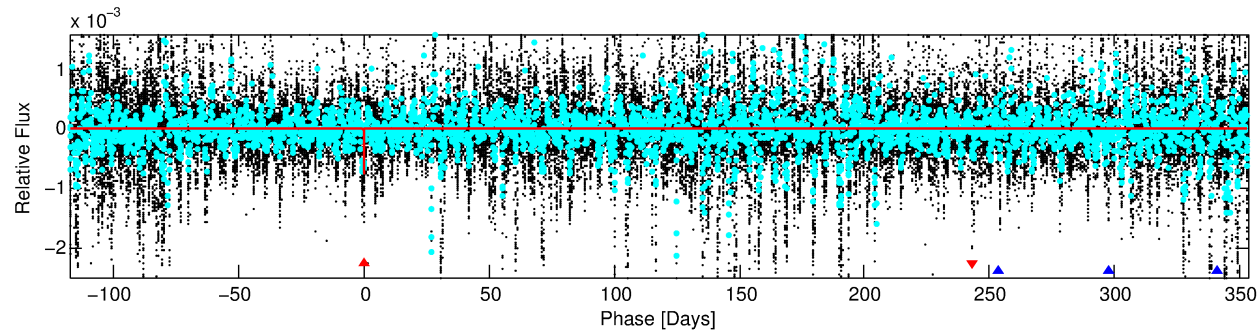
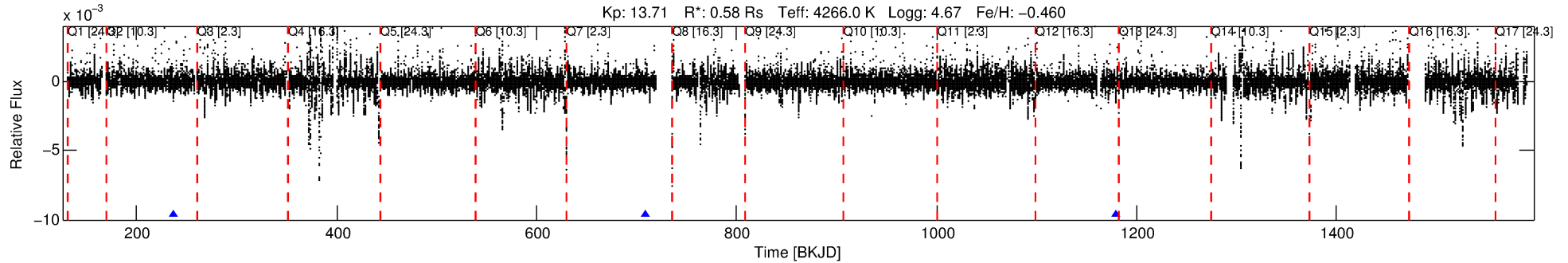
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 009048976-01

No Significant Match Found

# DV One-Page Summary

KIC: 9048976 Candidate: 1 of 2 Period: 471.231 d



## DV Fit Results:

Period = 471.23117 [0.01052] d  
Epoch = 237.4068 [0.0129] BKJD  
Rp/R\* = 0.0255 [0.0114]  
a/R\* = 249.07 [390.76]  
b = 0.57 [1.90]  
Seff = 0.10 [0.02]  
Teq = 145 [6] K  
Rp = 1.61 [0.74] Re  
a = 0.9791 [0.0827] AU  
Ag = 67862.78 [68632.71] [0.99 $\sigma$ ]  
Teffp = 3609 [914] K [3.79 $\sigma$ ]

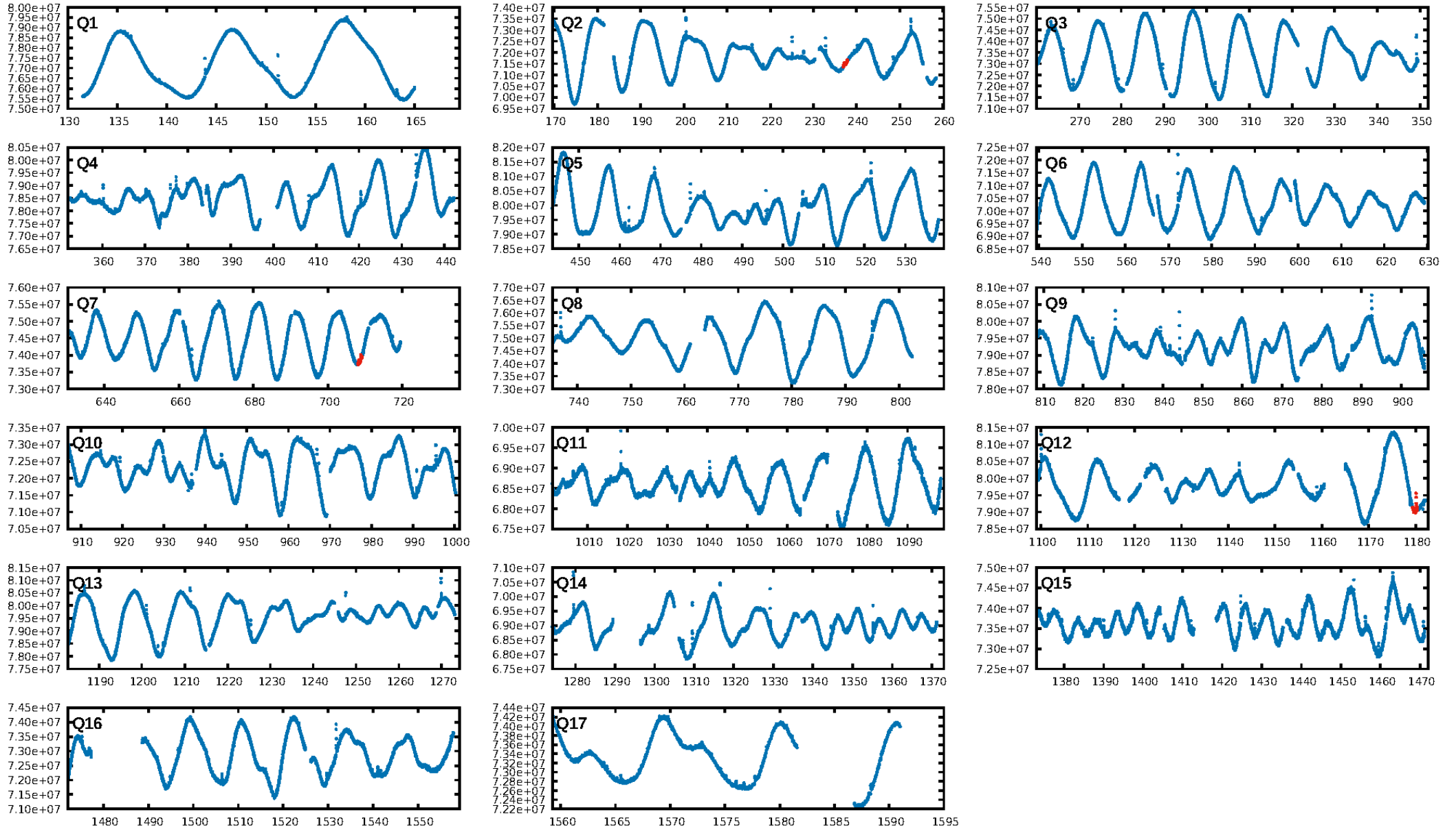
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [78.81 $\sigma$ ]  
ModelChiSquare2-sig: 2.7%  
ModelChiSquareGof-sig: 64.0%  
**Bootstrap-pfa: 4.12e-08**  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: -9.83  
Centroid-sig: 0.8%  
Centroid-so: 1.652 arcsec [2.07 $\sigma$ ]  
OotOffset-rm: 0.423 arcsec [1.04 $\sigma$ ]  
OotOffset-st: 1/1/1/0 [3]  
KicOffset-rm: 0.334 arcsec [0.77 $\sigma$ ]  
KicOffset-st: 1/1/1/0 [3]  
DiffImageQuality-fgm: 1.00 [3/3]  
DiffImageOverlap-fno: 1.00 [3/3]

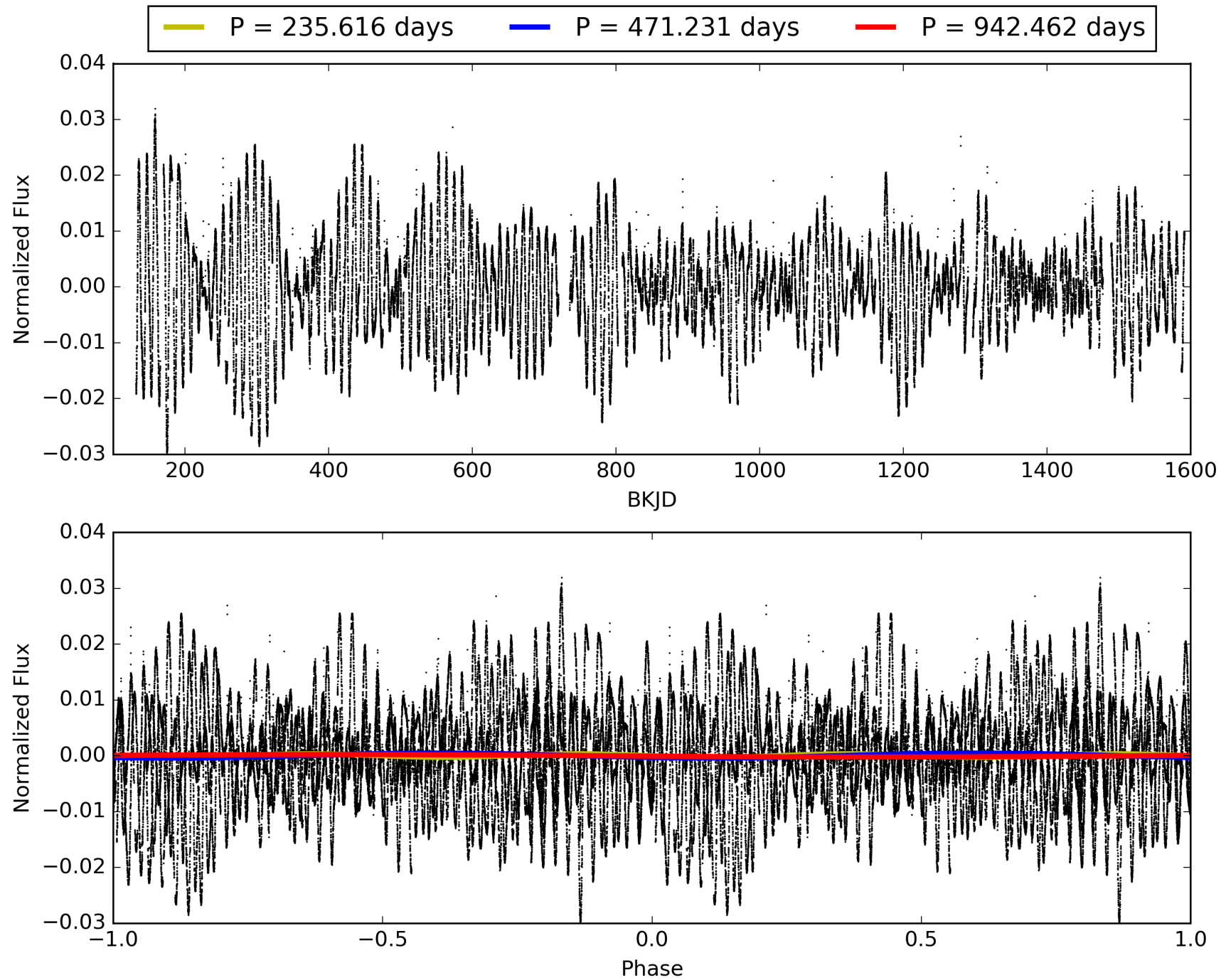
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 21:29:35 Z

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

# TCE 009048976-01, PDC Light Curves

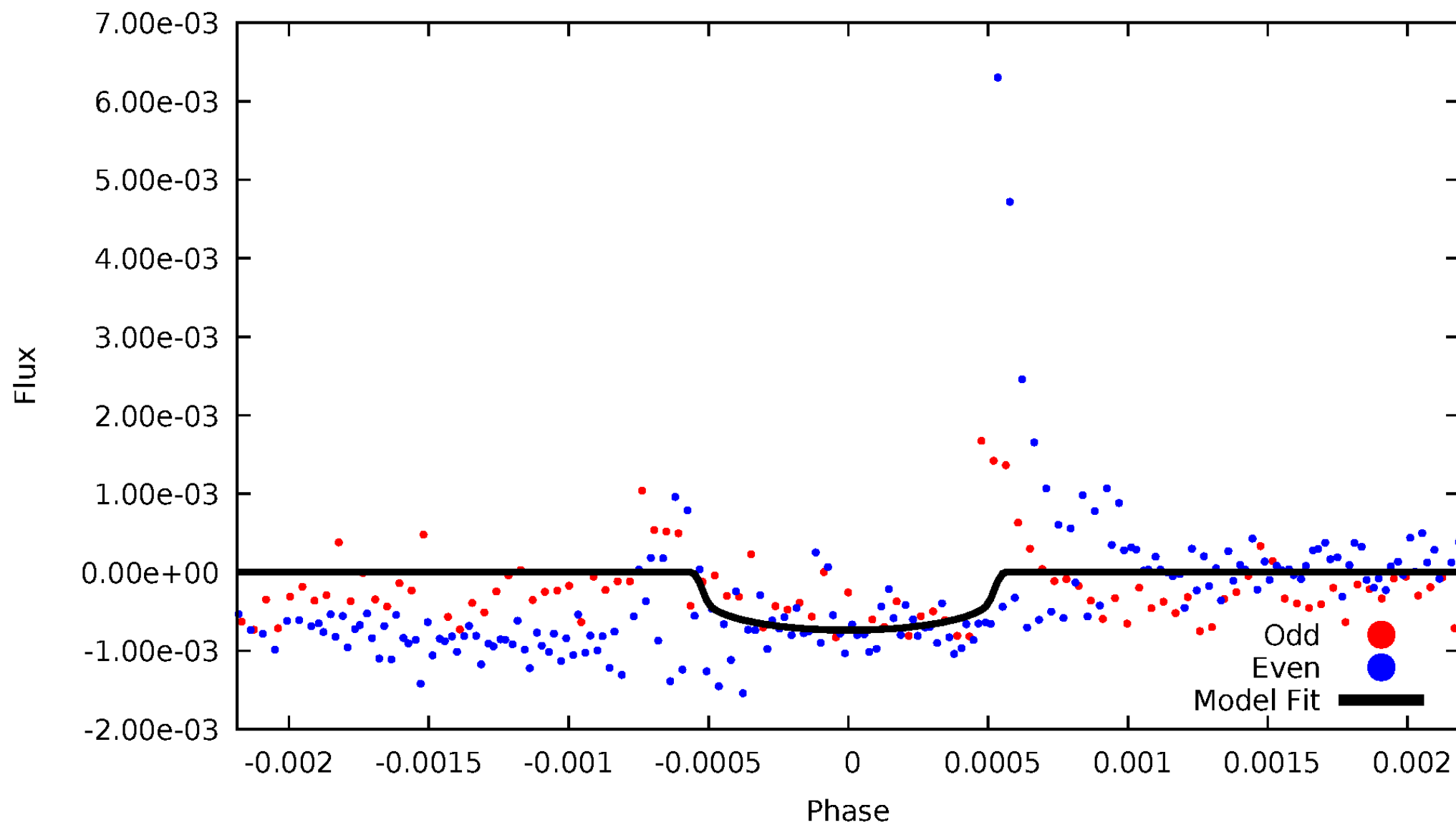


TCE 009048976-01



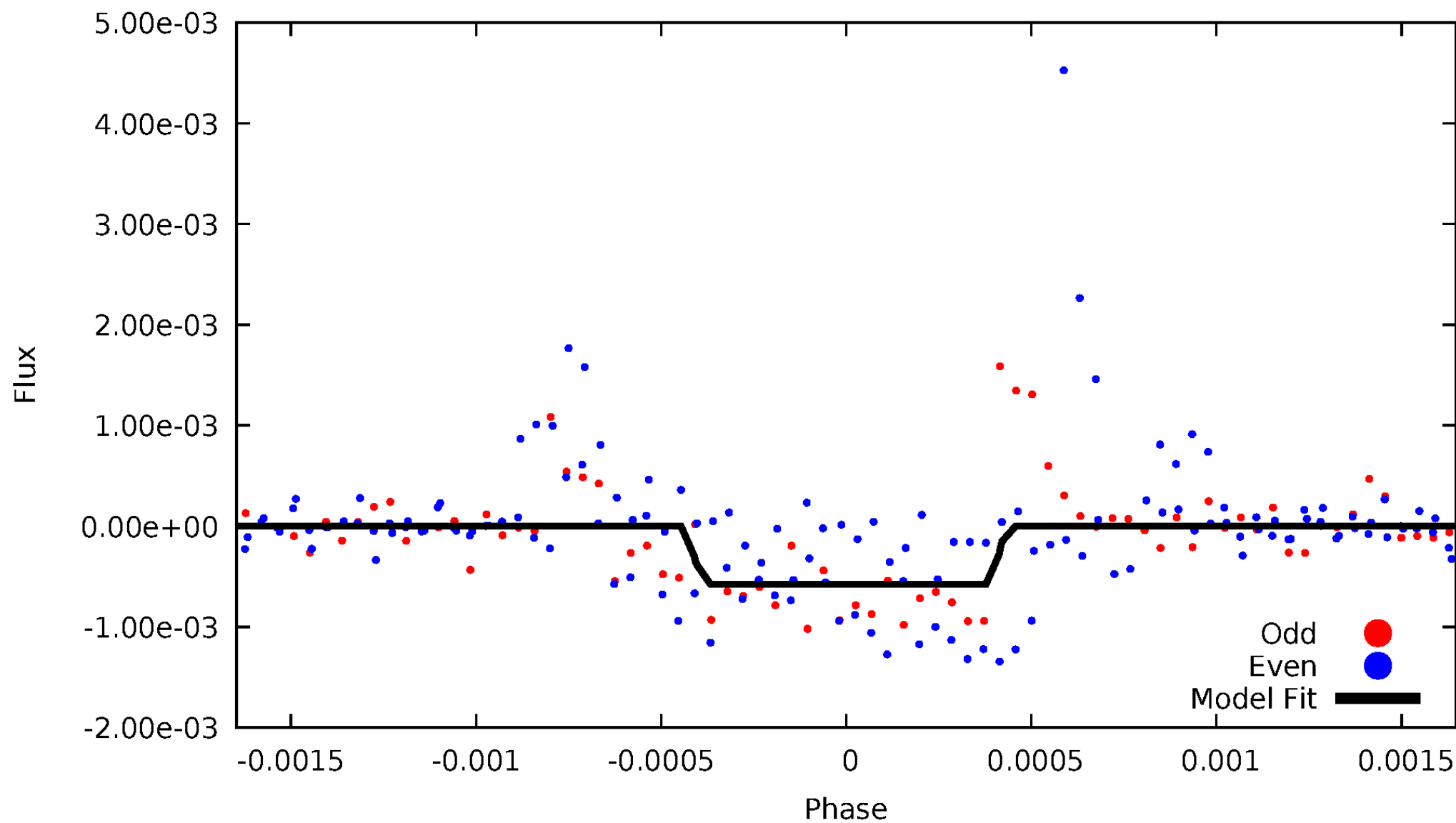
# DV Odd/Even

TCE 009048976-01



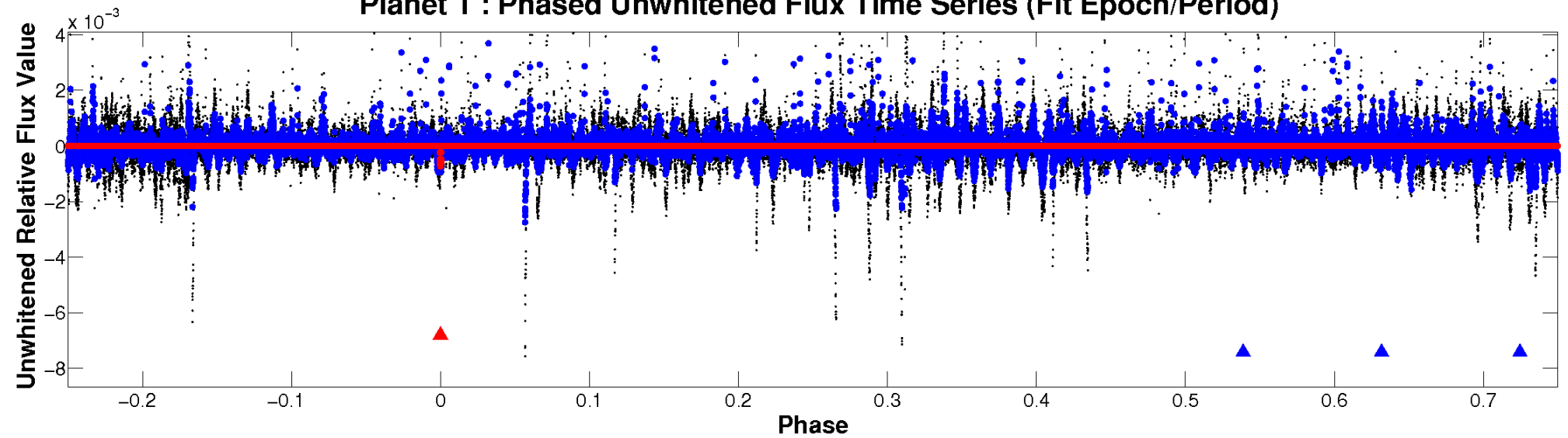
# ALT Odd/Even

TCE 009048976-01

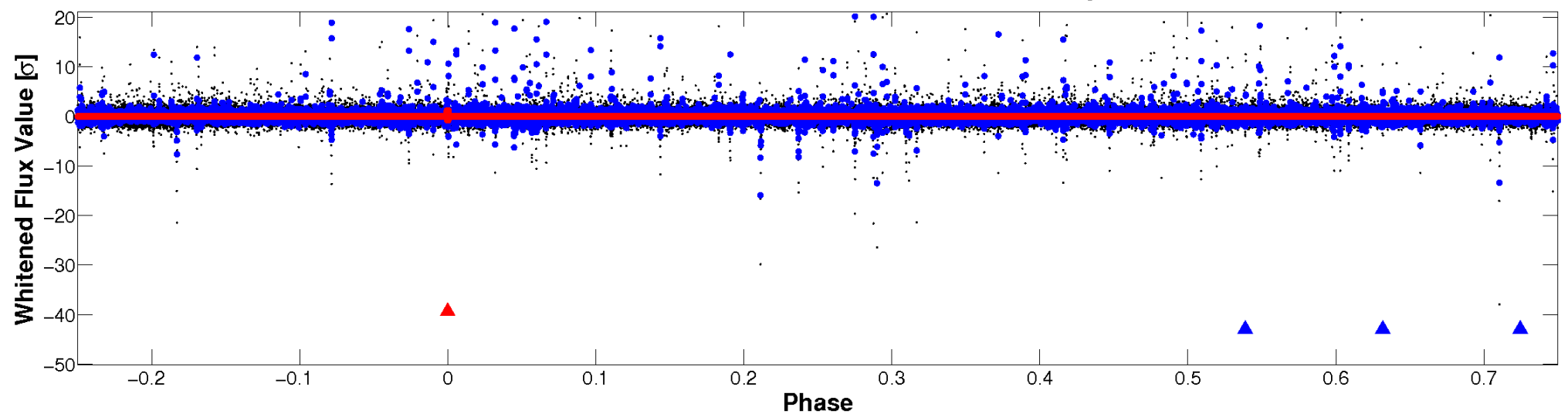


# Non-Whitened Vs. Whitened Light Curve

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

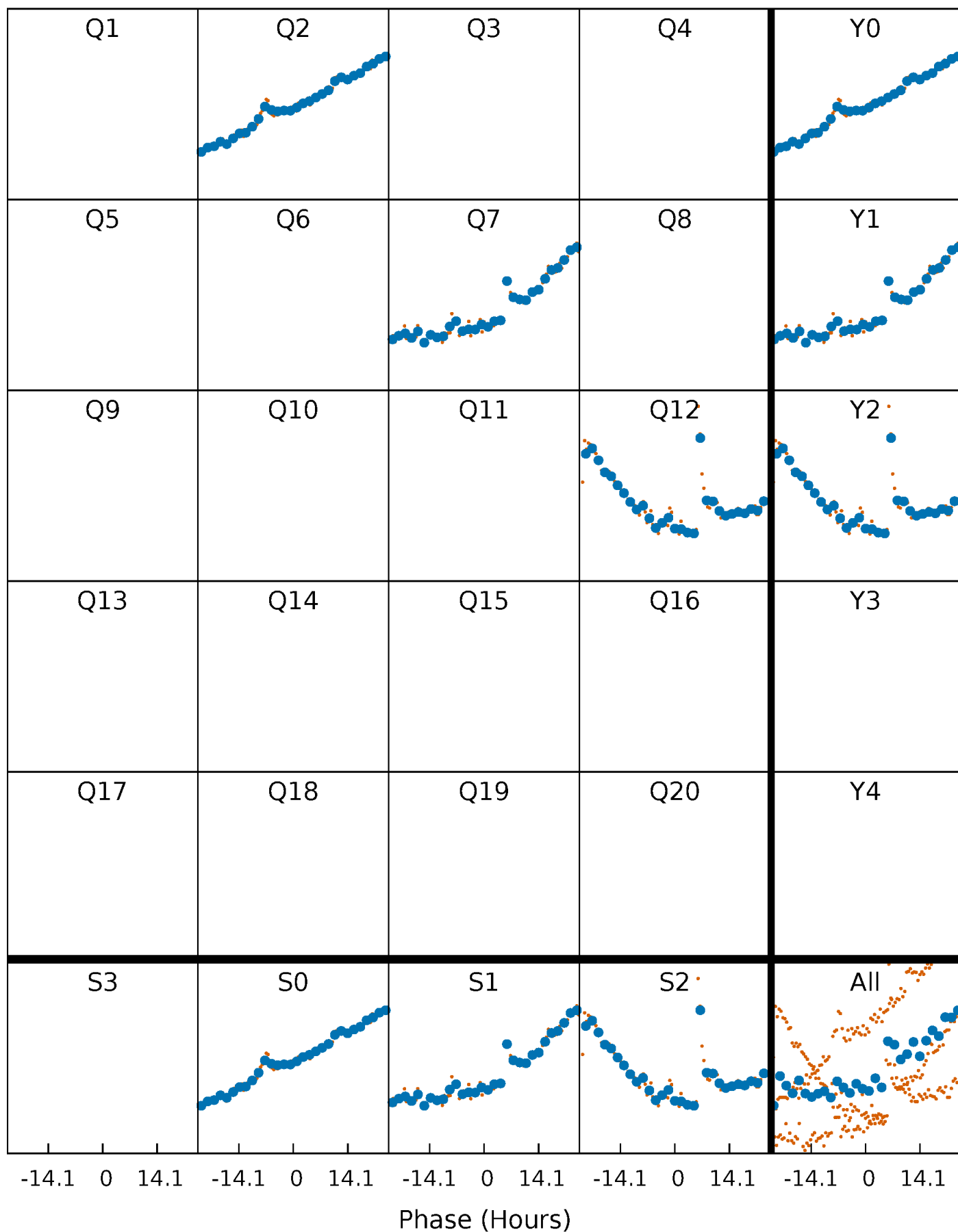


Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

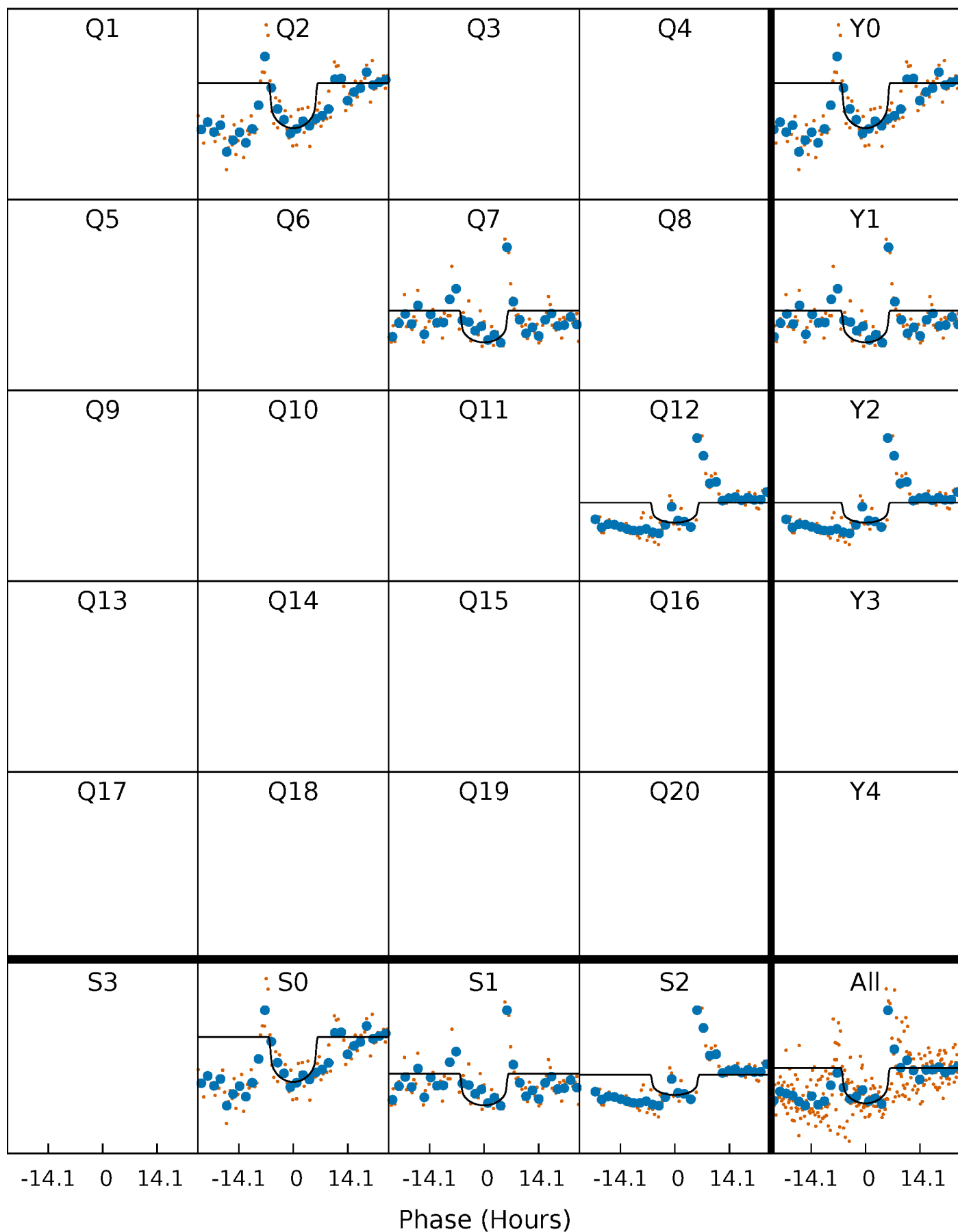
TCE 009048976-01 P=471.231168 Days  $T_0=237.406774$  (BKJD)





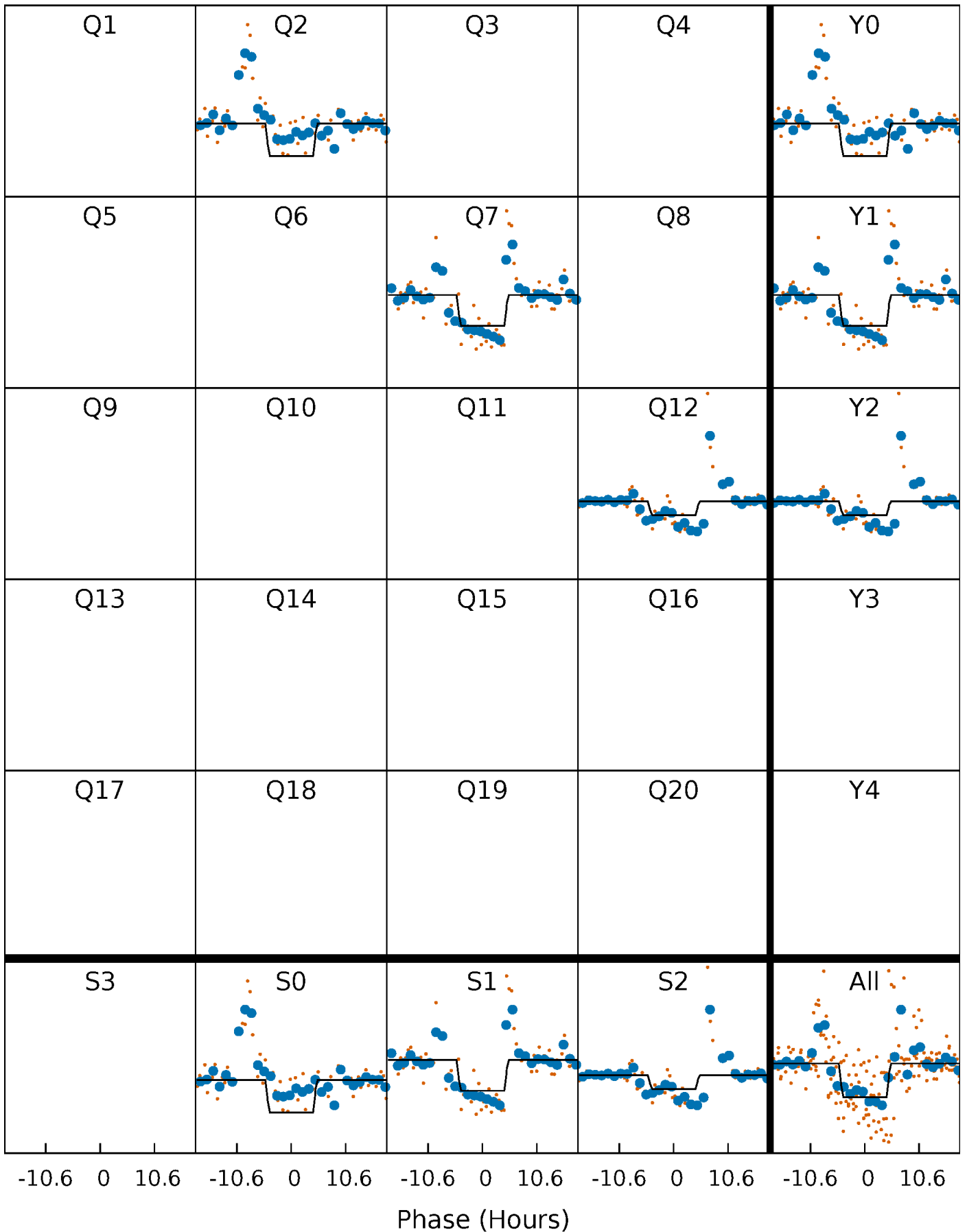
# DV Quarter-Phased Transit Curves

TCE 009048976-01 P=471.231168 Days  $T_0=237.406774$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

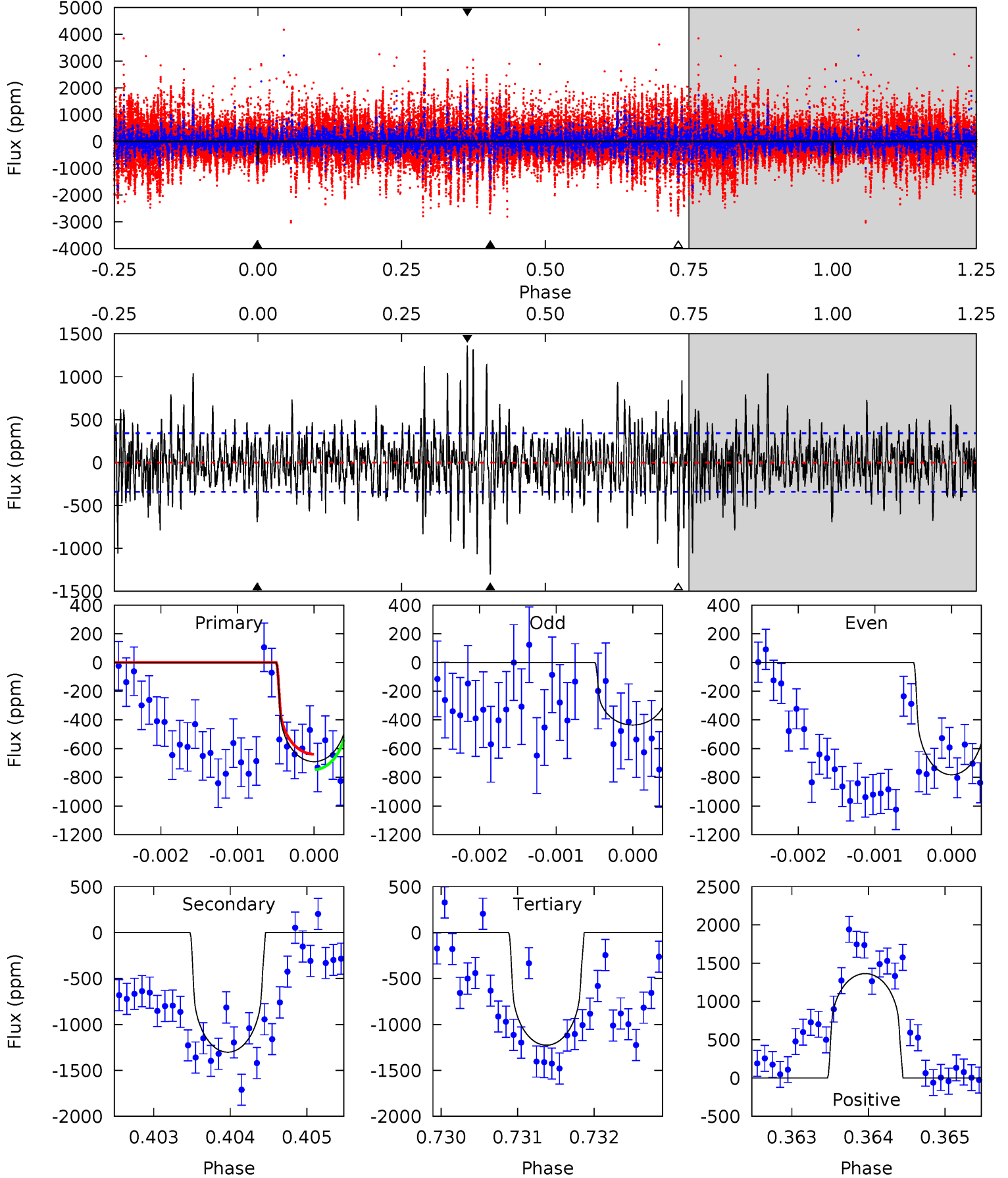
TCE 009048976-01 P=471.197894 Days  $T_0=237.468652$  (BKJD)



# DV Model-Shift Uniqueness Test

009048976-01, P = 471.231168 Days, E = 237.406774 Days

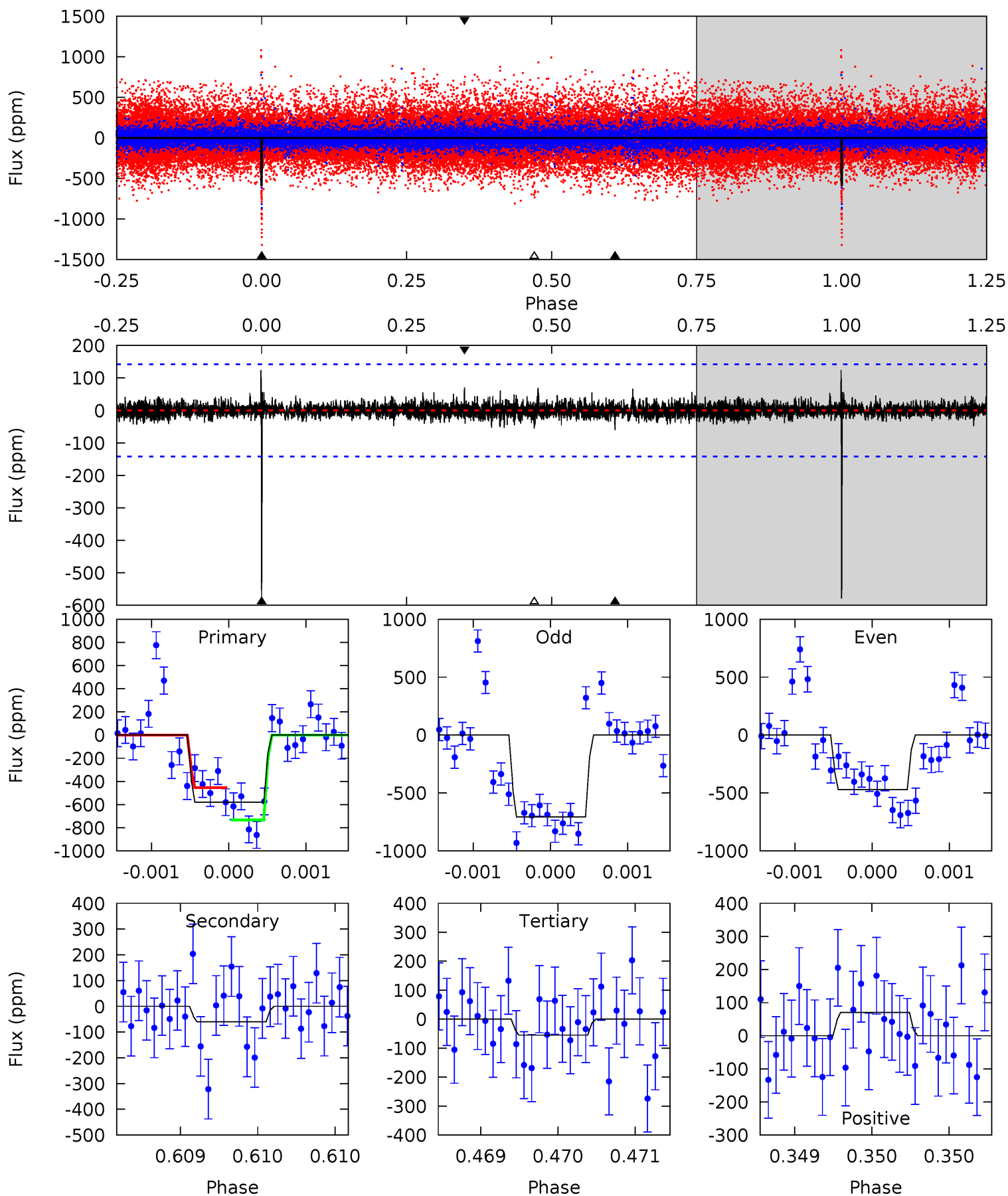
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
11.0	20.8	19.6	21.8	5.43	3.25	4.38	-8.54	-10.7	1.21	-0.99	2.20	0.90	0.51	0.87



# Alt Model-Shift Uniqueness Test

009048976-01, P = 471.197894 Days, E = 237.468652 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
22.4	2.34	2.13	2.72	5.48	3.34	0.50	20.3	19.7	0.21	-0.38	4.56	0.83	0.18	0



### Stellar Parameters For KIC 009048976

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$4266^{+115}_{-140}$	$4.665^{+0.063}_{-0.027}$	$-0.460^{+0.300}_{-0.300}$	$0.578^{+0.044}_{-0.060}$	$0.563^{+0.061}_{-0.046}$	$4.106^{+1.199}_{-0.530}$
	+3%/-3%	+1%/-1%	+65%/-65%	+8%/-10%	+11%/-8%	+29%/-13%
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 009048976-01 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-1302 \pm 63$	$1.59^{+0.73}_{-0.67}$	$200^{+7}_{-7}$	$4868^{+1414}_{-647}$	$272481^{+554884}_{-142590}$
Alt.	$-61 \pm 26$	$1.51^{+0.71}_{-0.64}$	$201^{+7}_{-7}$	$2941^{+595}_{-347}$	$13084^{+32055}_{-7836}$

$T_{max}$  = 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

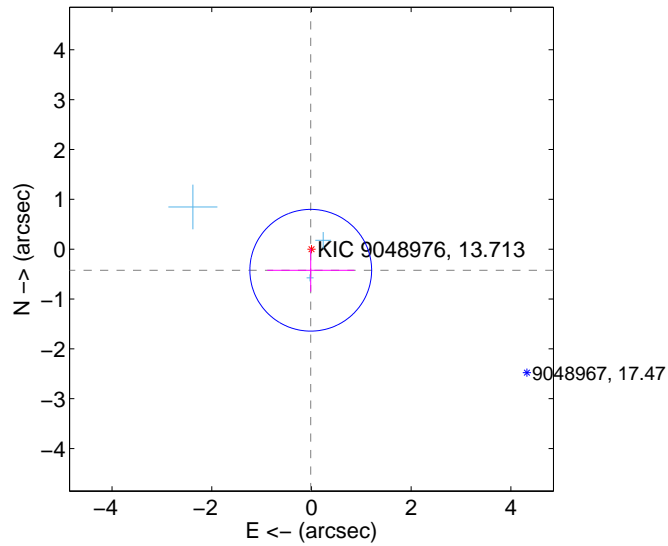
Supplemental centroid analysis for 009048976-01. Kepler magnitude: 13.71. Transit SNR 7.62

There are 3 quarters with good PRF difference image offsets

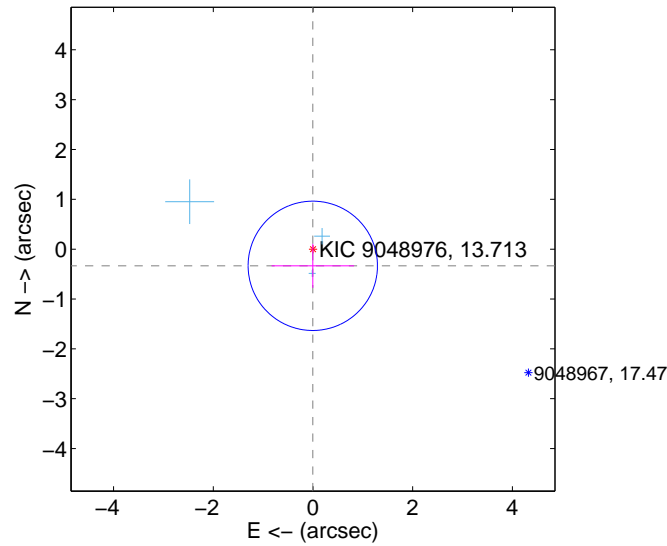
The direct PRF centroid is offset from the target star catalog position by about 0.09 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.423 \pm 0.407$	1.04	$0.014 \pm 0.874$	$-0.423 \pm 0.432$
PRF-fit source offset from KIC position	$0.334 \pm 0.432$	0.77	$0.004 \pm 0.827$	$-0.334 \pm 0.440$
photometric centroid source offset	$1.65 \pm 0.80$	2.07	$-1.62 \pm 0.80$	$0.32 \pm 0.63$

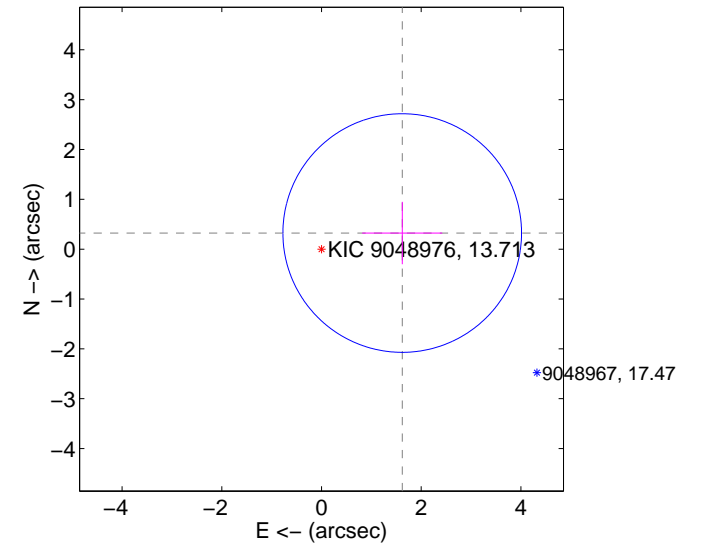
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

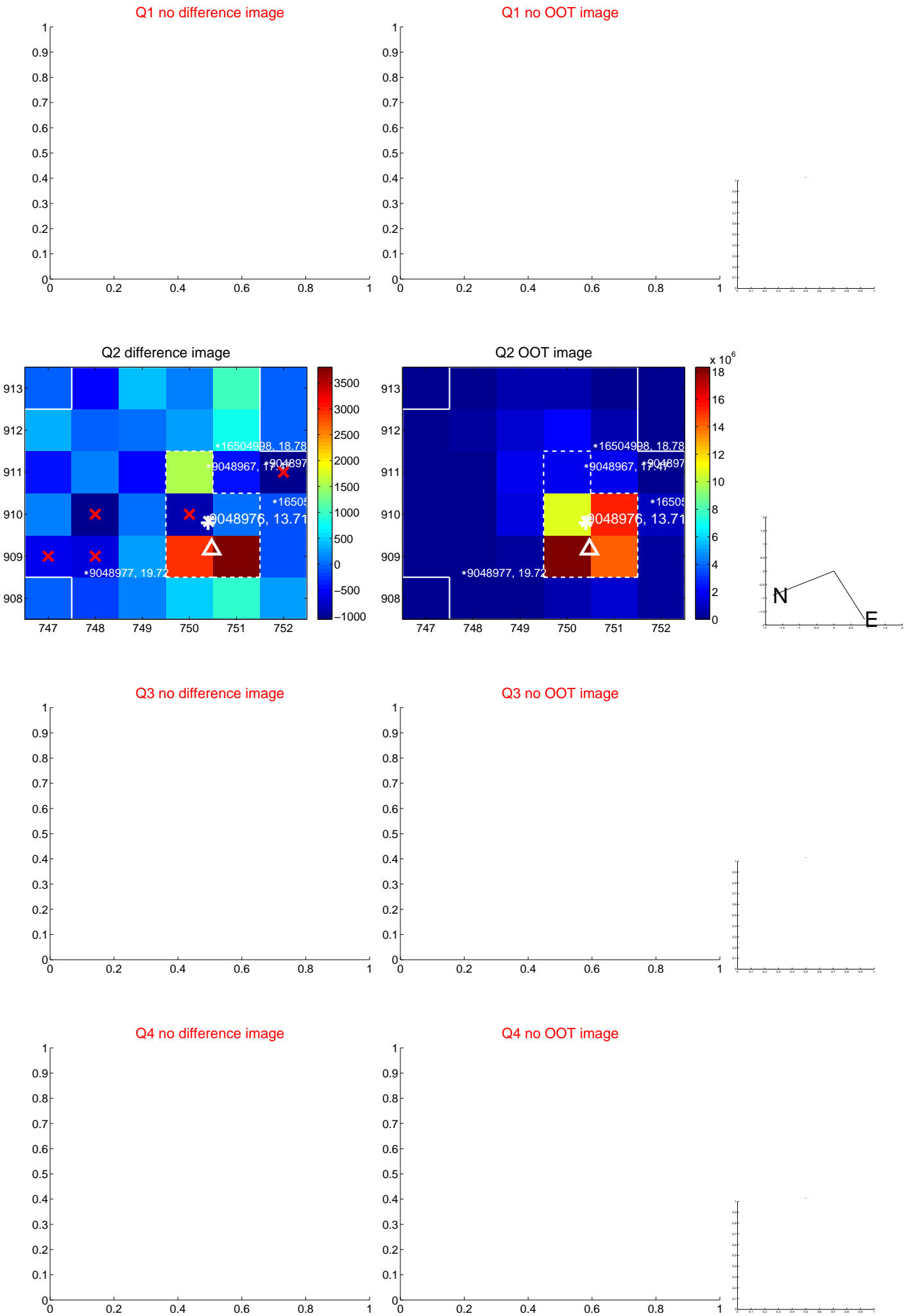


offset from photometric centroids

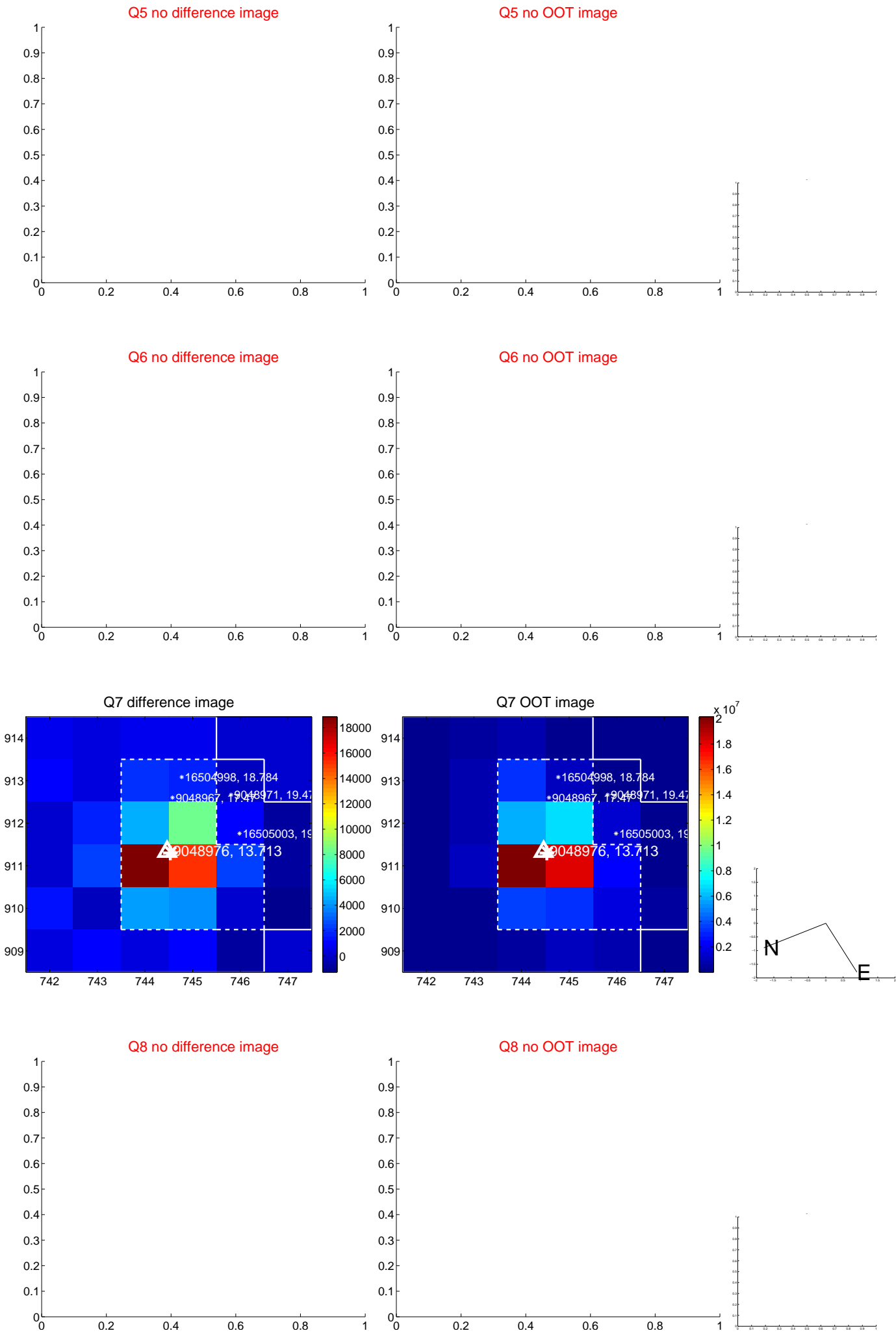


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

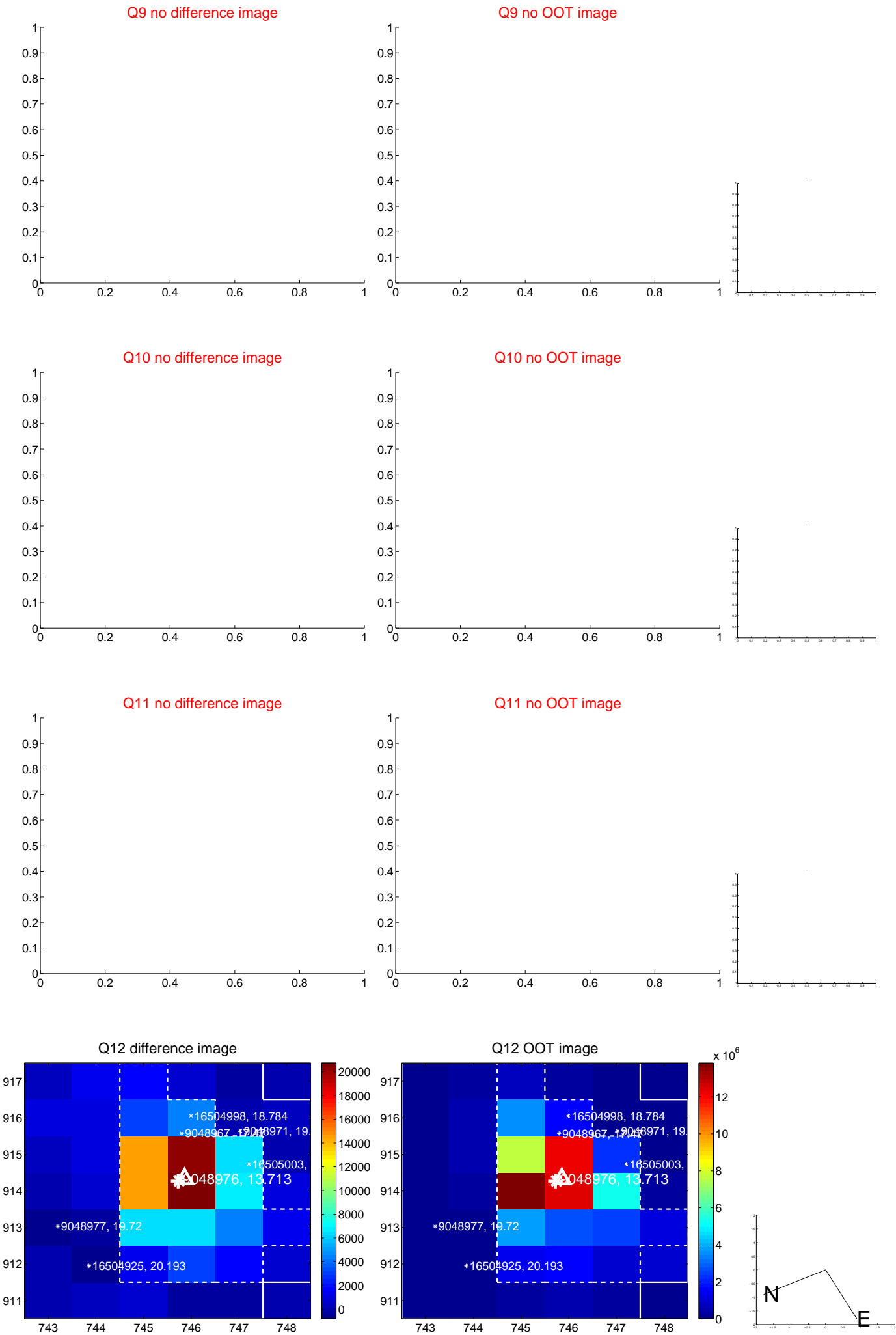


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.





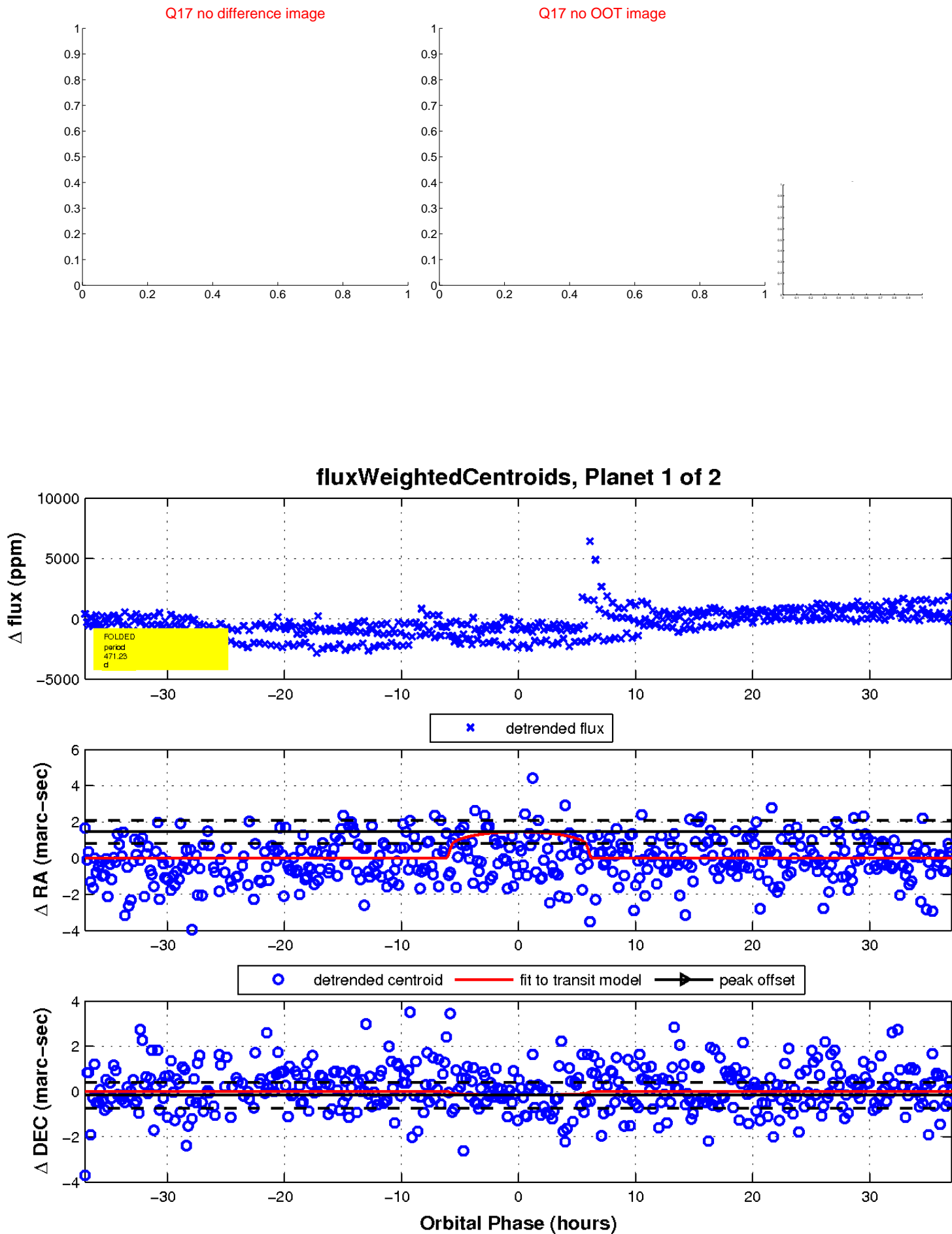
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

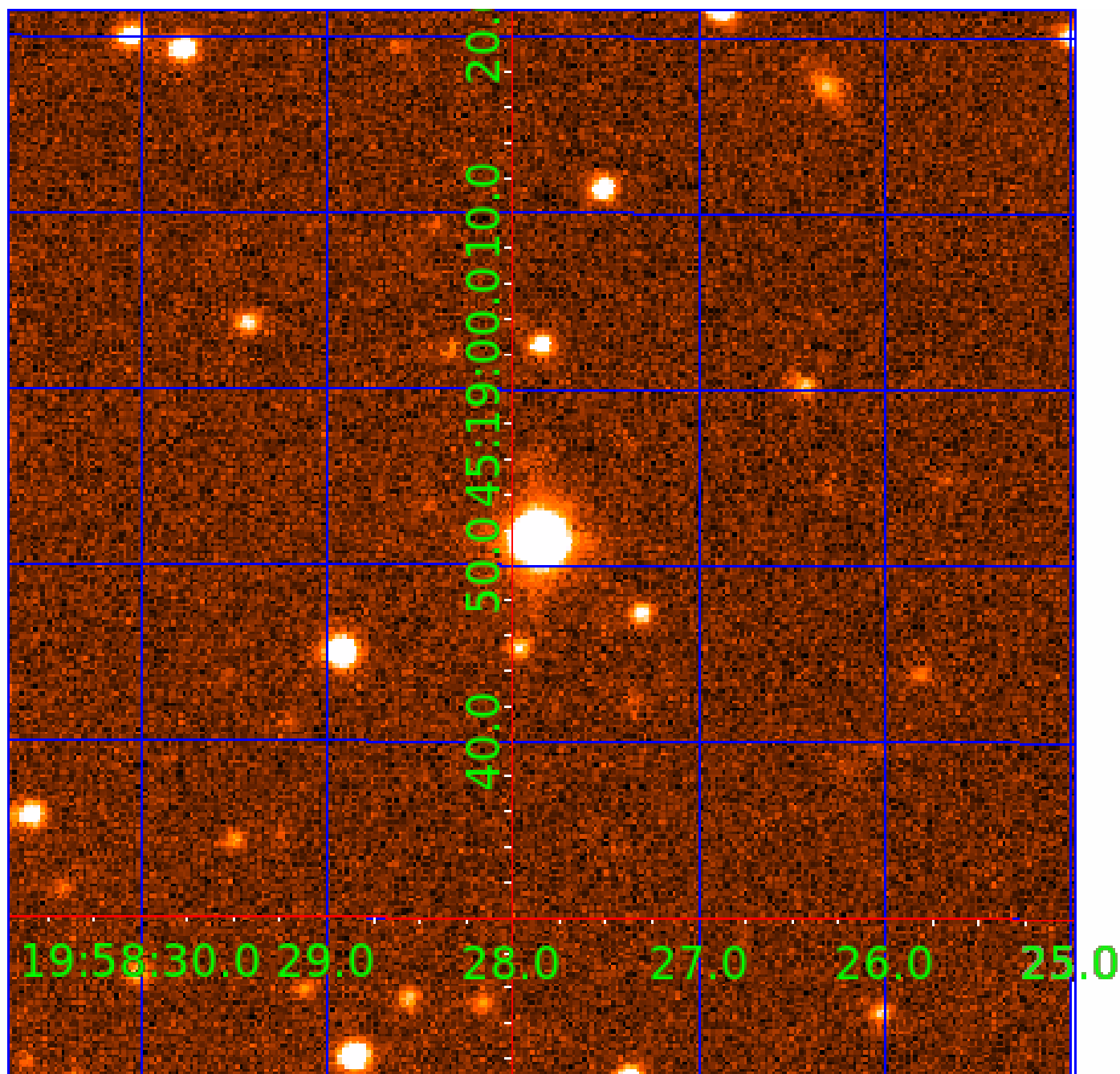


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 009048976

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009048976-01	OBS	No	471.231168	237.406773	738.2	12.354	10.6	7.6	0.58	4266	1.61	0.10
009048976-02	OBS	No	515.005922	491.302185	623.3	5.011	11.8	4.7	0.58	4266	1.53	0.09

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009048976-01	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES_MARSHALL—LPP_DV—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS
009048976-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—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.

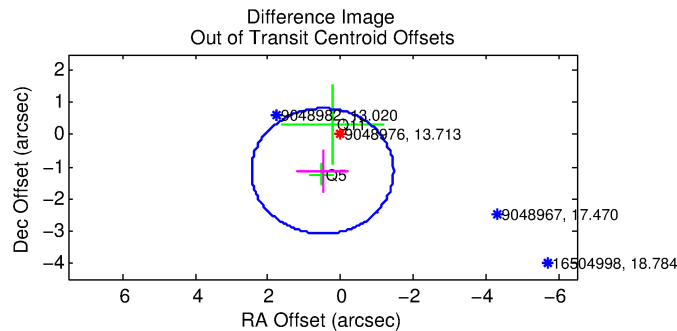
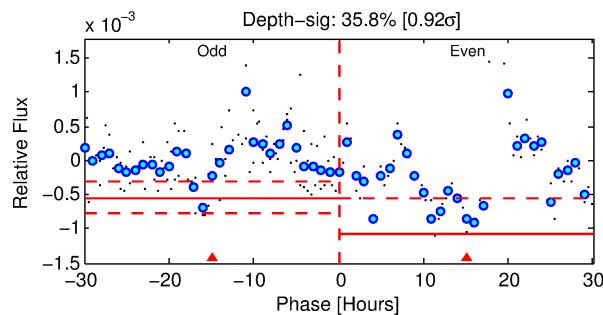
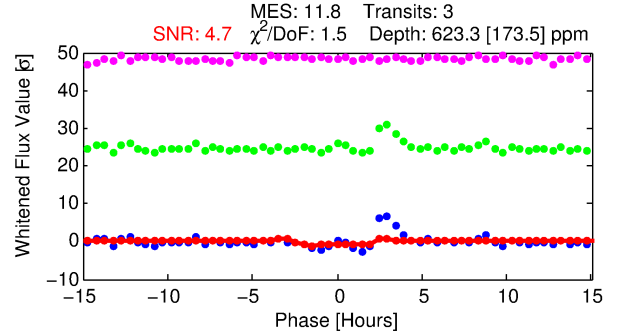
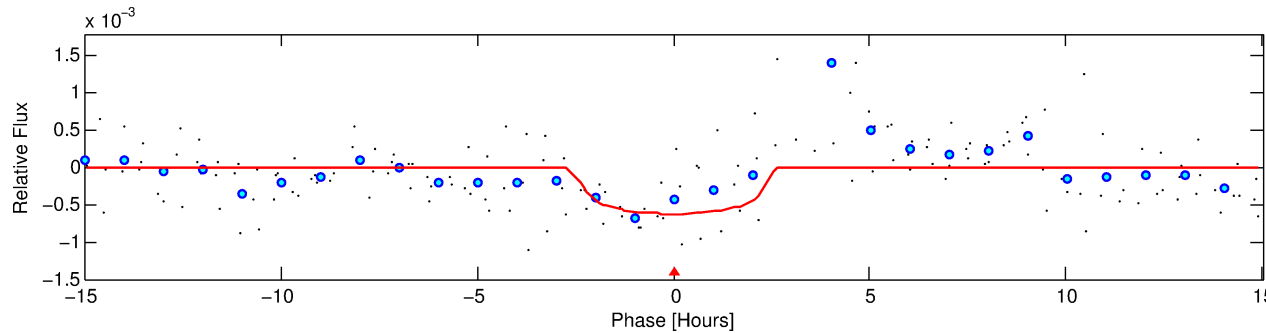
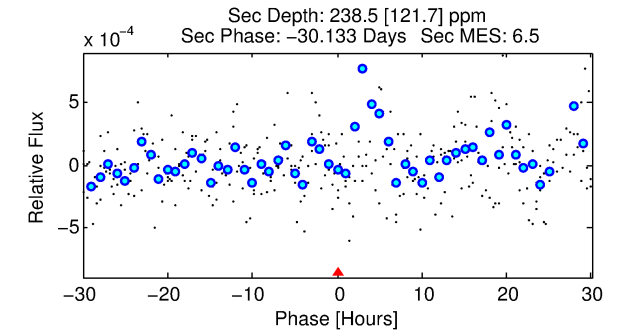
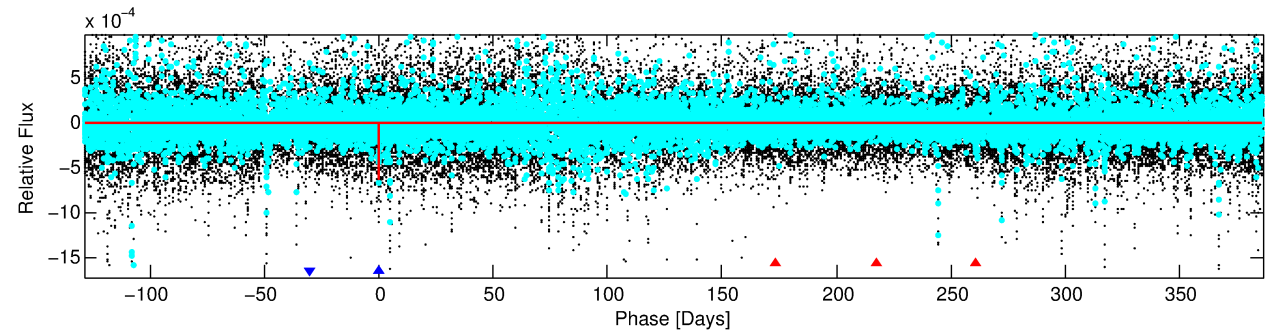
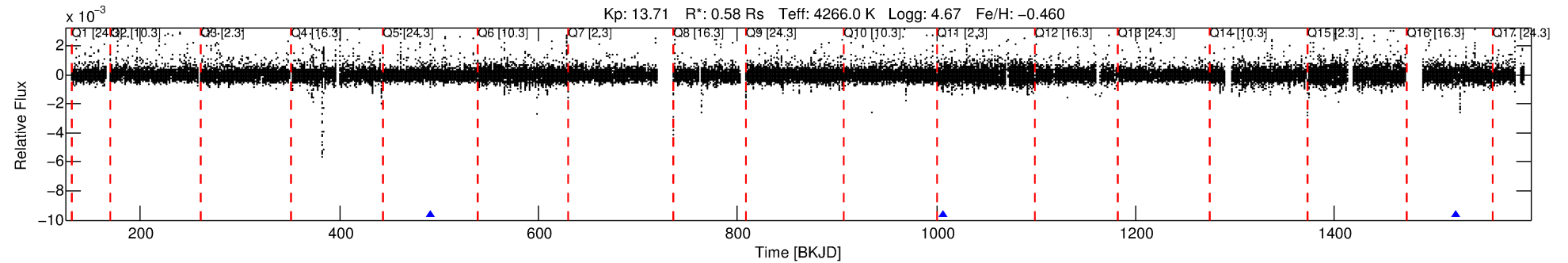
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009048976-02

No Significant Match Found

# DV One-Page Summary

KIC: 9048976 Candidate: 2 of 2 Period: 515.006 d



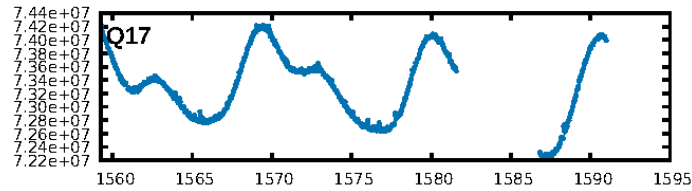
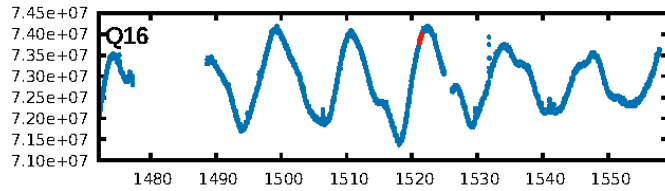
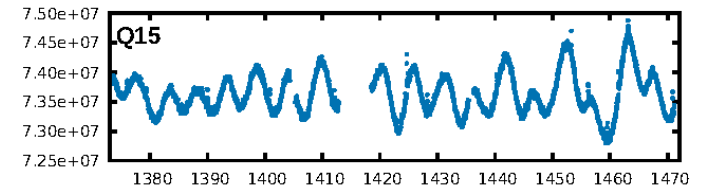
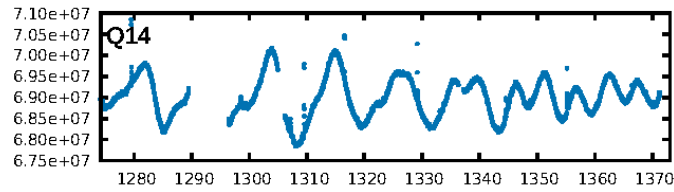
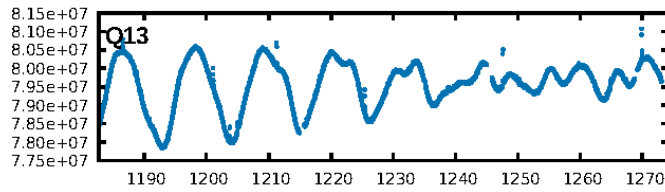
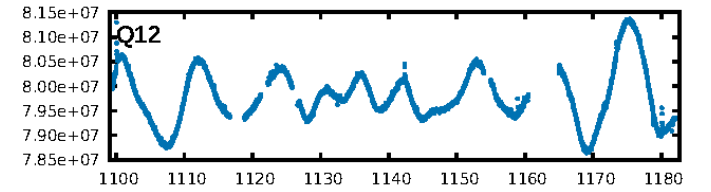
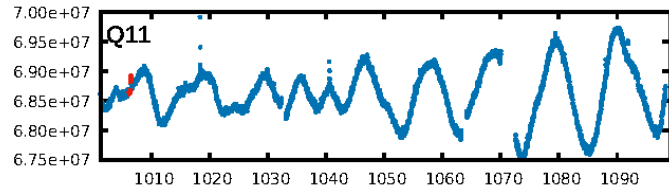
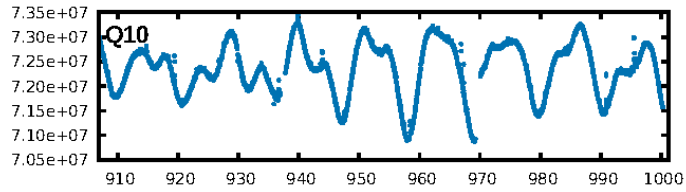
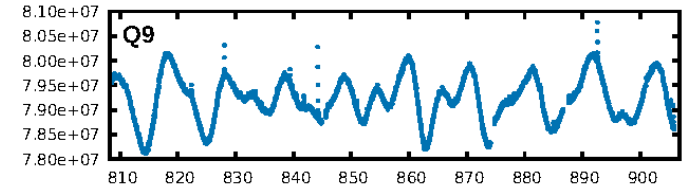
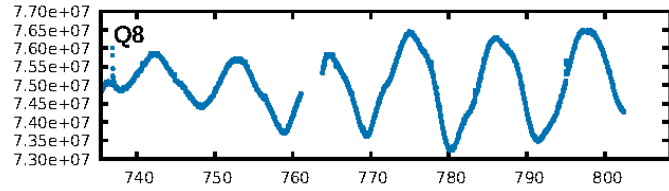
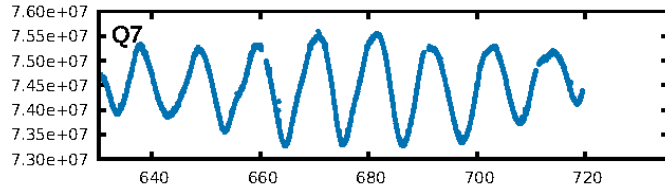
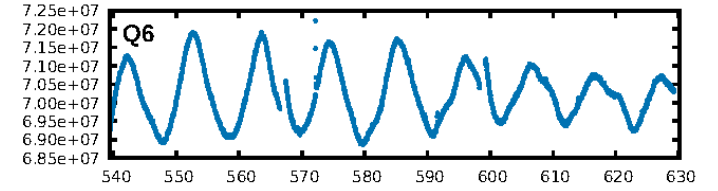
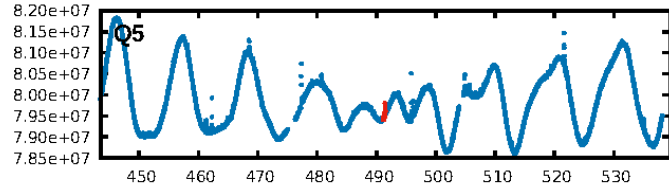
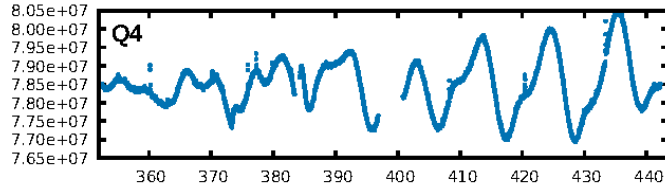
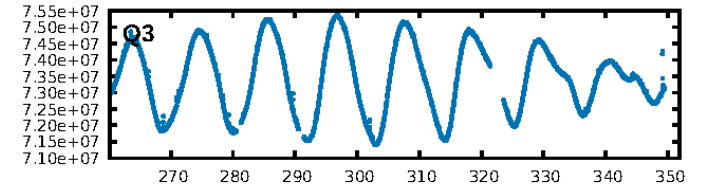
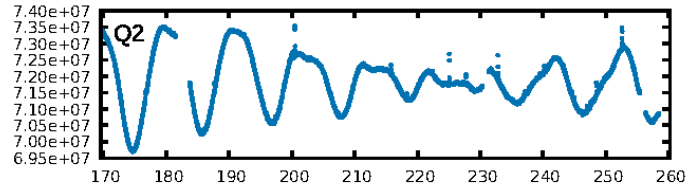
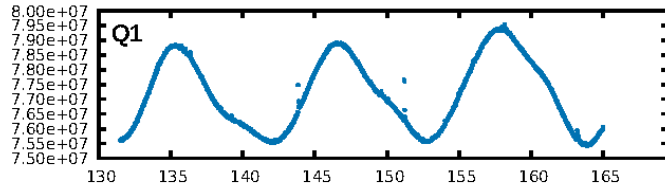
## DV Fit Results:

Period = 515.00592 [0.00906] d  
Epoch = 491.3022 [0.0102] BKJD  
Rp/R\* = 0.0242 [0.0301]  
a/R\* = 604.74 [2754.59]  
b = 0.68 [3.74]  
Seff = 0.09 [0.02]  
Teq = 140 [6] K  
Rp = 1.53 [1.91] Re  
a = 1.0388 [0.0877] AU  
Ag = 60651.78 [154130.74] [0.39σ]  
Teffp = 3406 [2165] K [1.51σ]

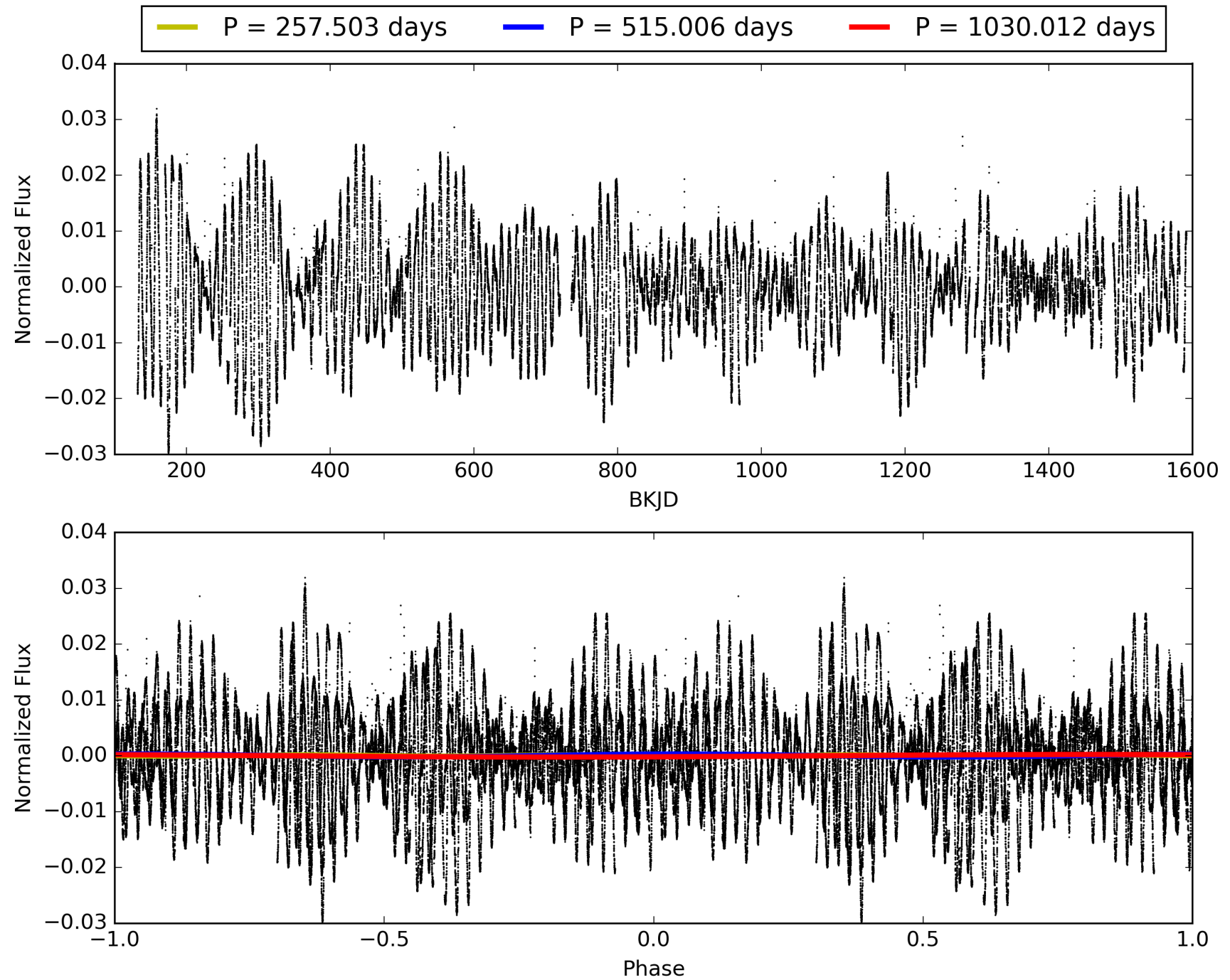
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [78.81σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 10.6%  
ModelChiSquareGof-sig: 66.5%  
**Bootstrap-pfa: 9.88e-09**  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: 1.584  
Centroid-sig: 21.9%  
Centroid-so: 1.326 arcsec [1.29σ]  
OotOffset-rm: 1.245 arcsec [1.91σ]  
KicOffset-rm: 1.222 arcsec [1.58σ]  
OotOffset-st: 0/1/0/1 [2]  
KicOffset-st: 0/1/0/1 [2]  
DiffImageQuality-fgm: 0.50 [1/2]  
DiffImageOverlap-fno: 1.00 [3/3]

# TCE 009048976-02, PDC Light Curves



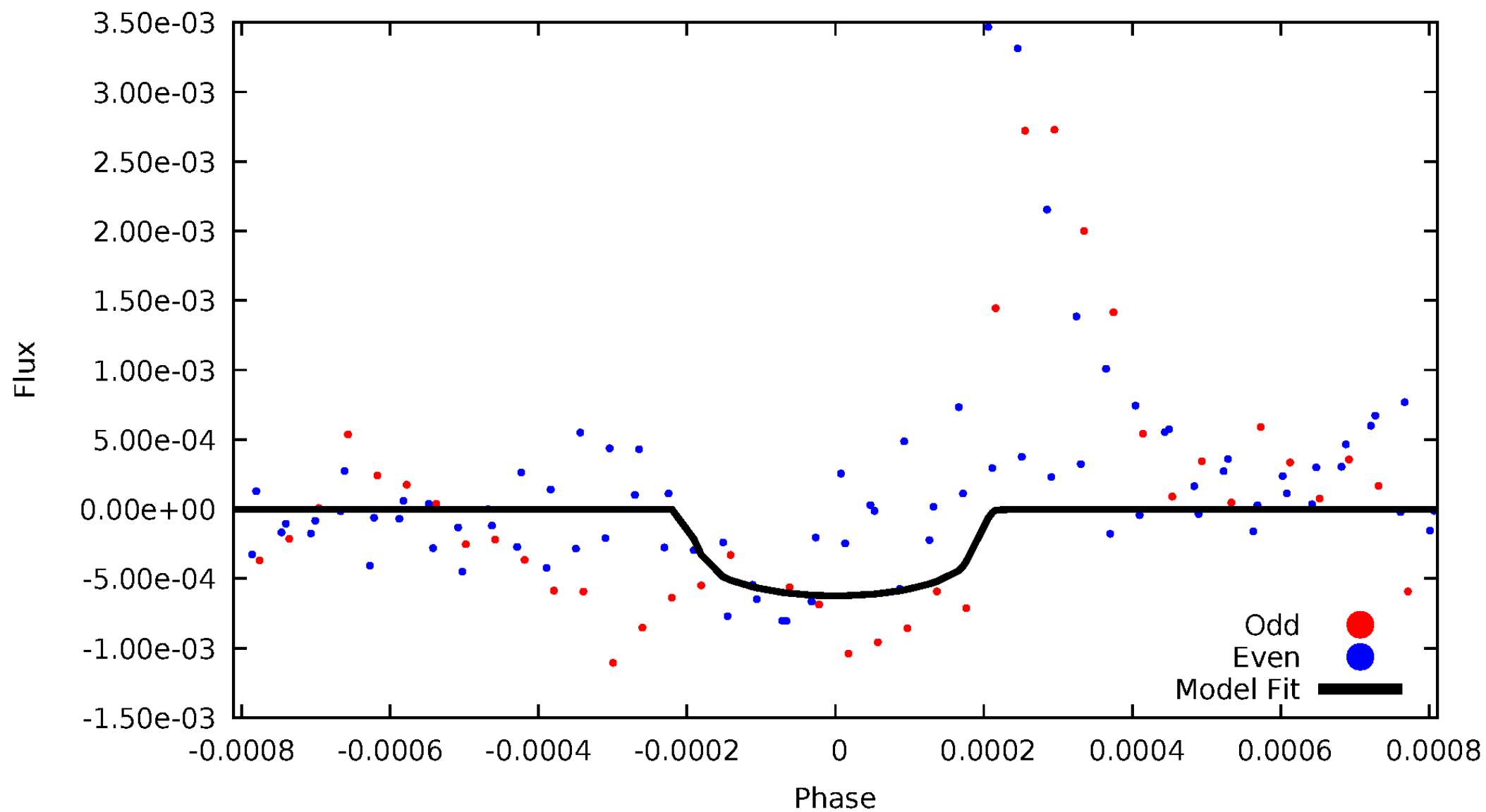
# TCE 009048976-02





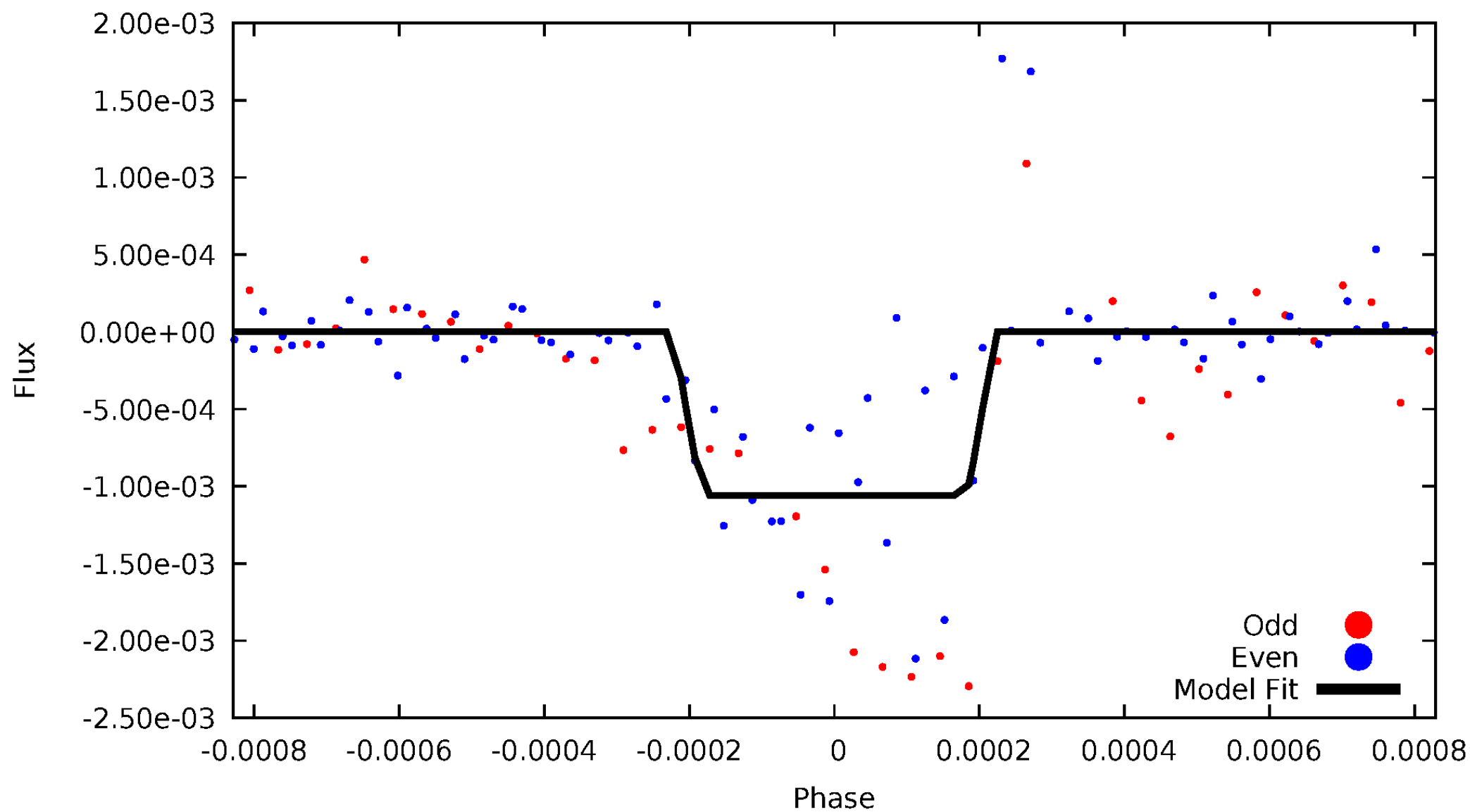
# DV Odd/Even

TCE 009048976-02



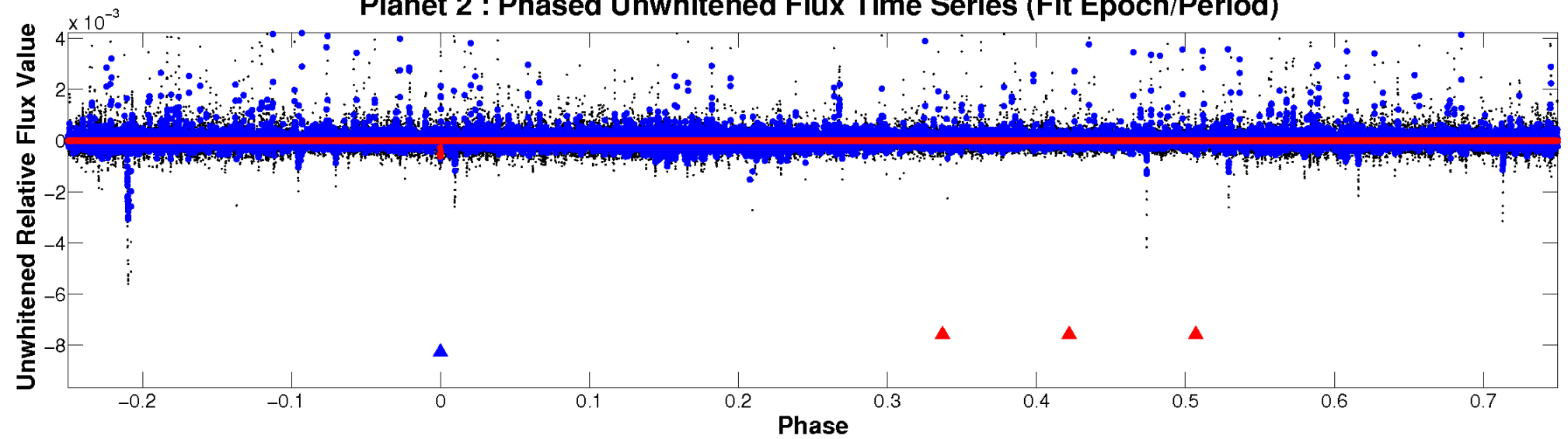
# ALT Odd/Even

TCE 009048976-02

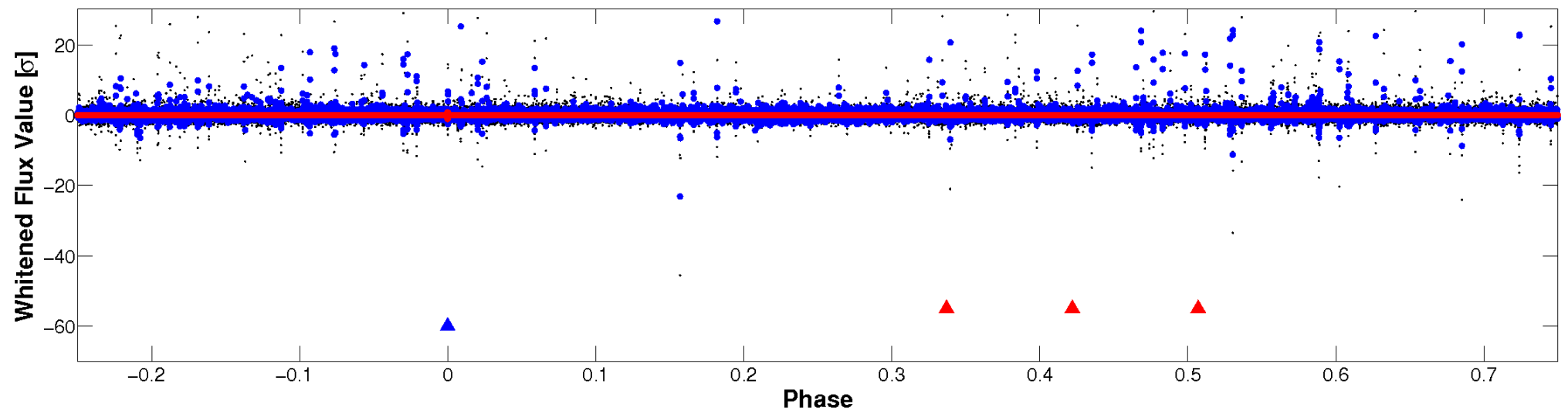


# Non-Whitened Vs. Whitened Light Curve

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

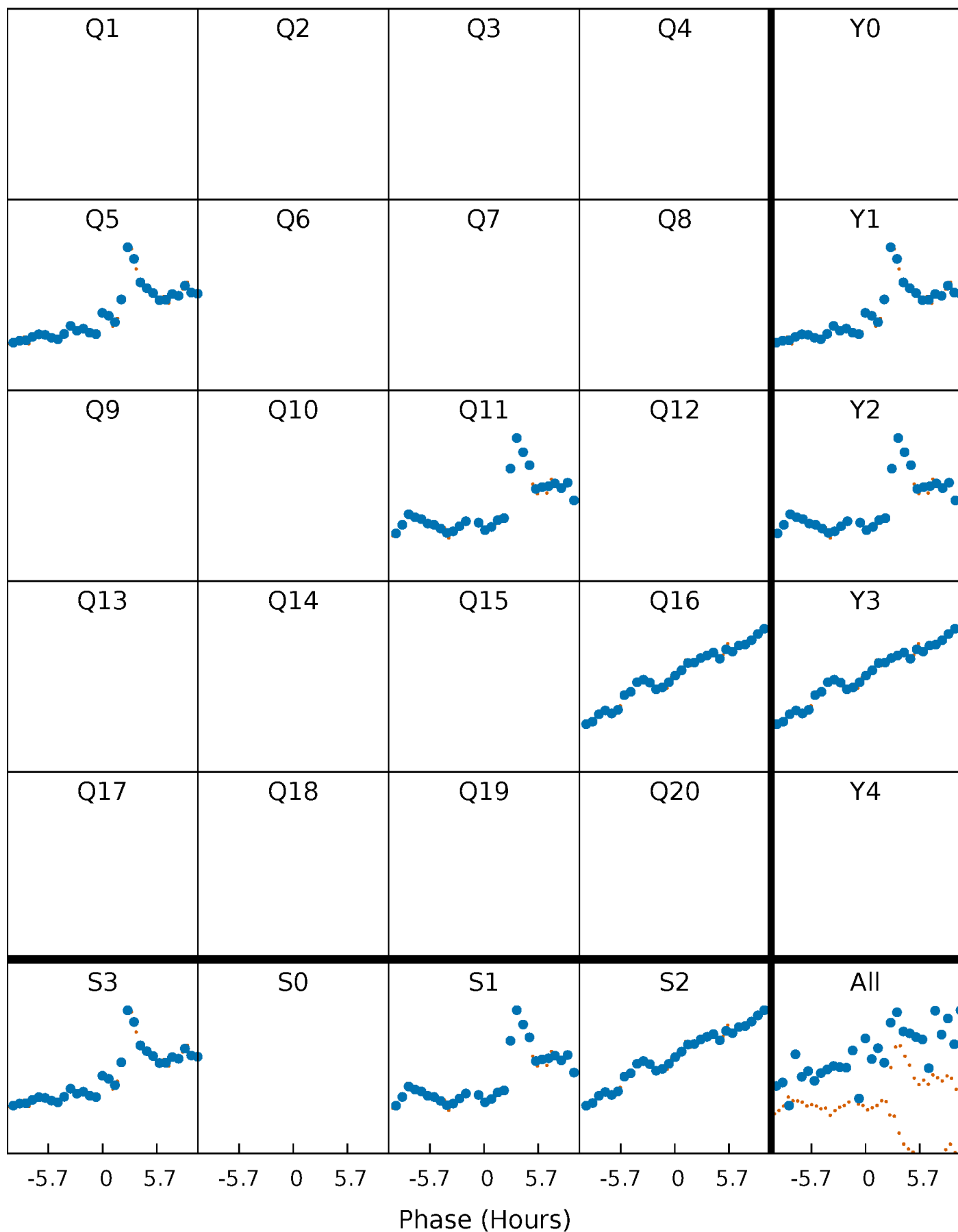


Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



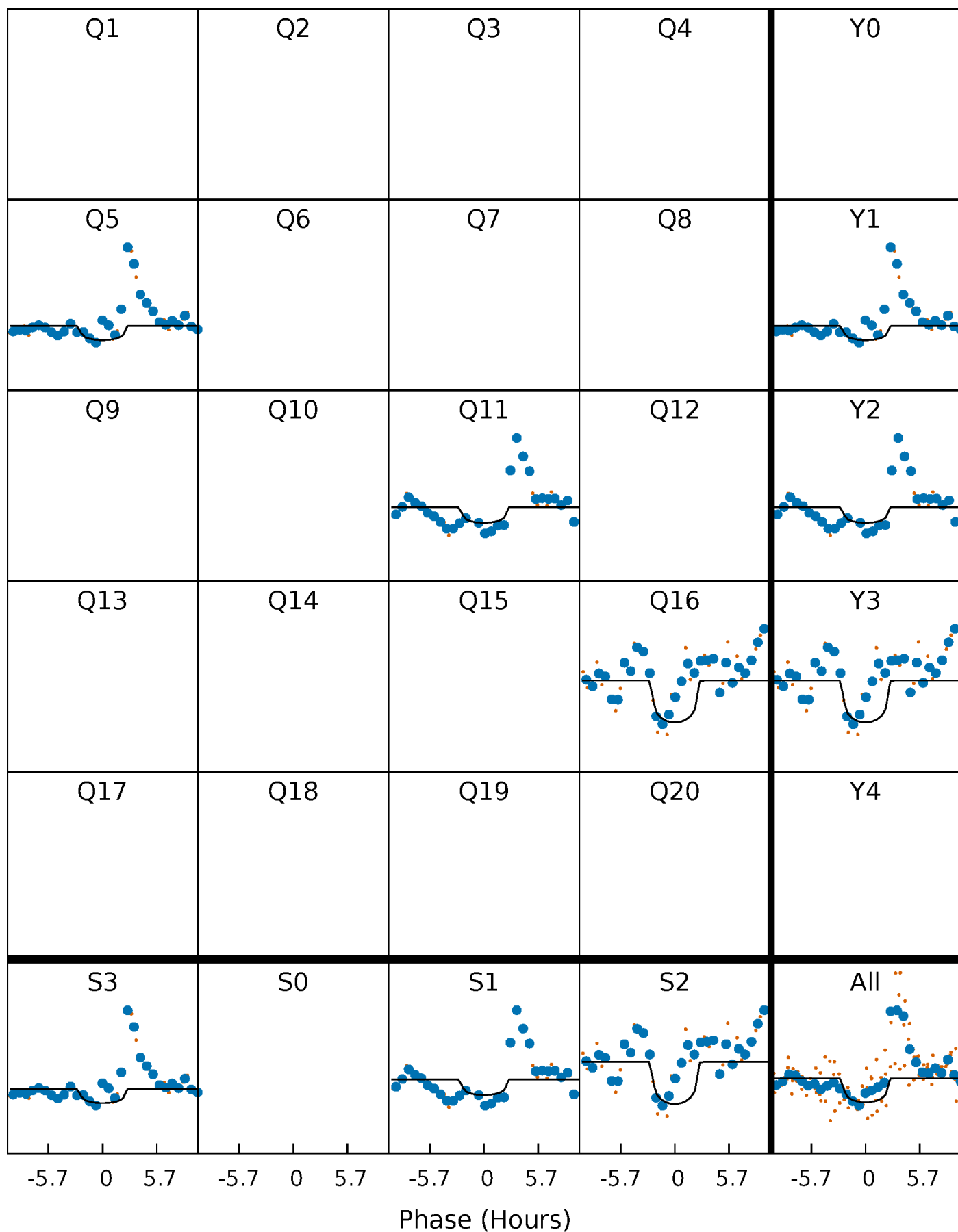
# PDC Quarter-Phased Transit Curves

TCE 009048976-02     $P=515.005922$  Days     $T_0=491.302185$  (BKJD)



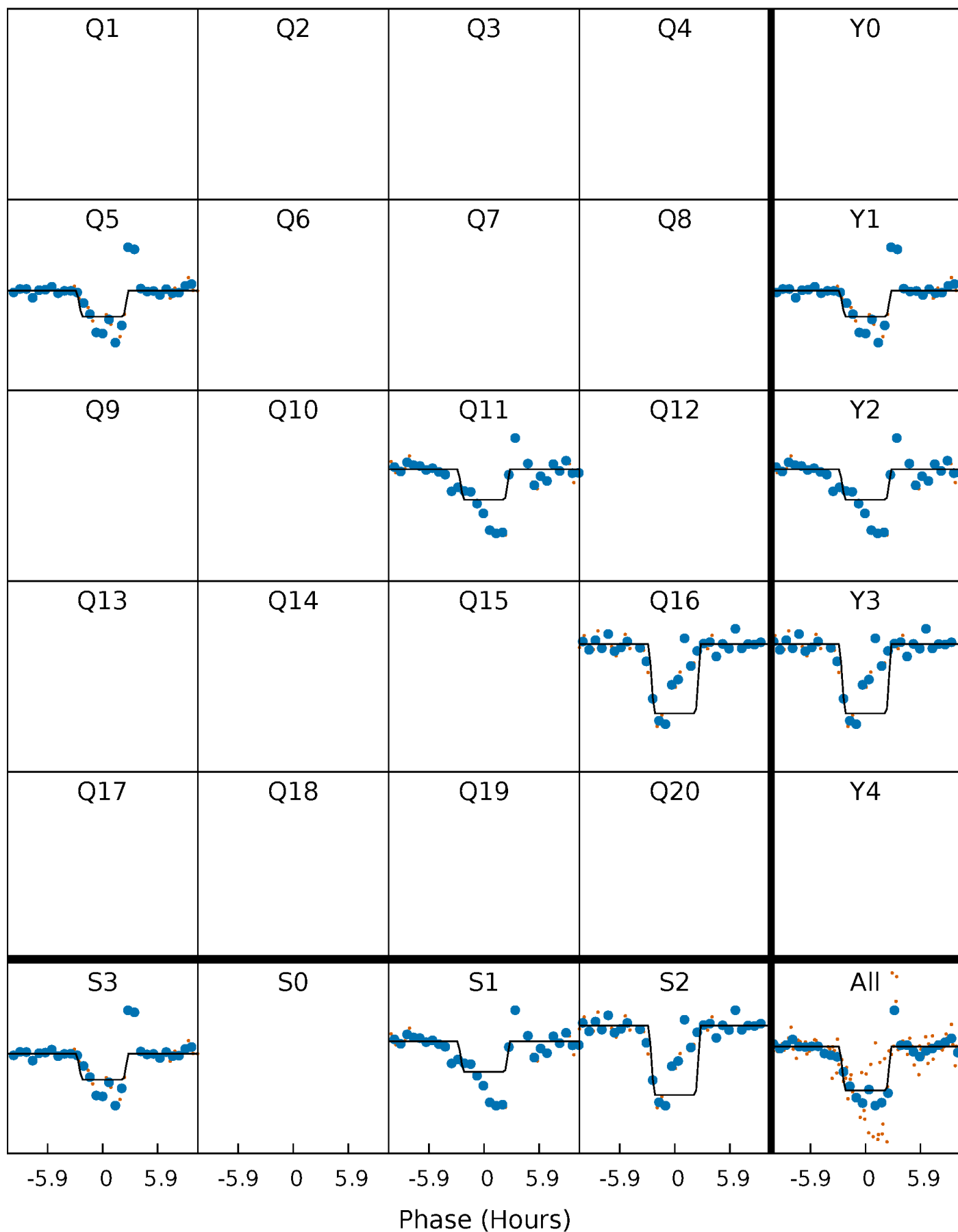
# DV Quarter-Phased Transit Curves

TCE 009048976-02     $P=515.005922$  Days     $T_0=491.302185$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

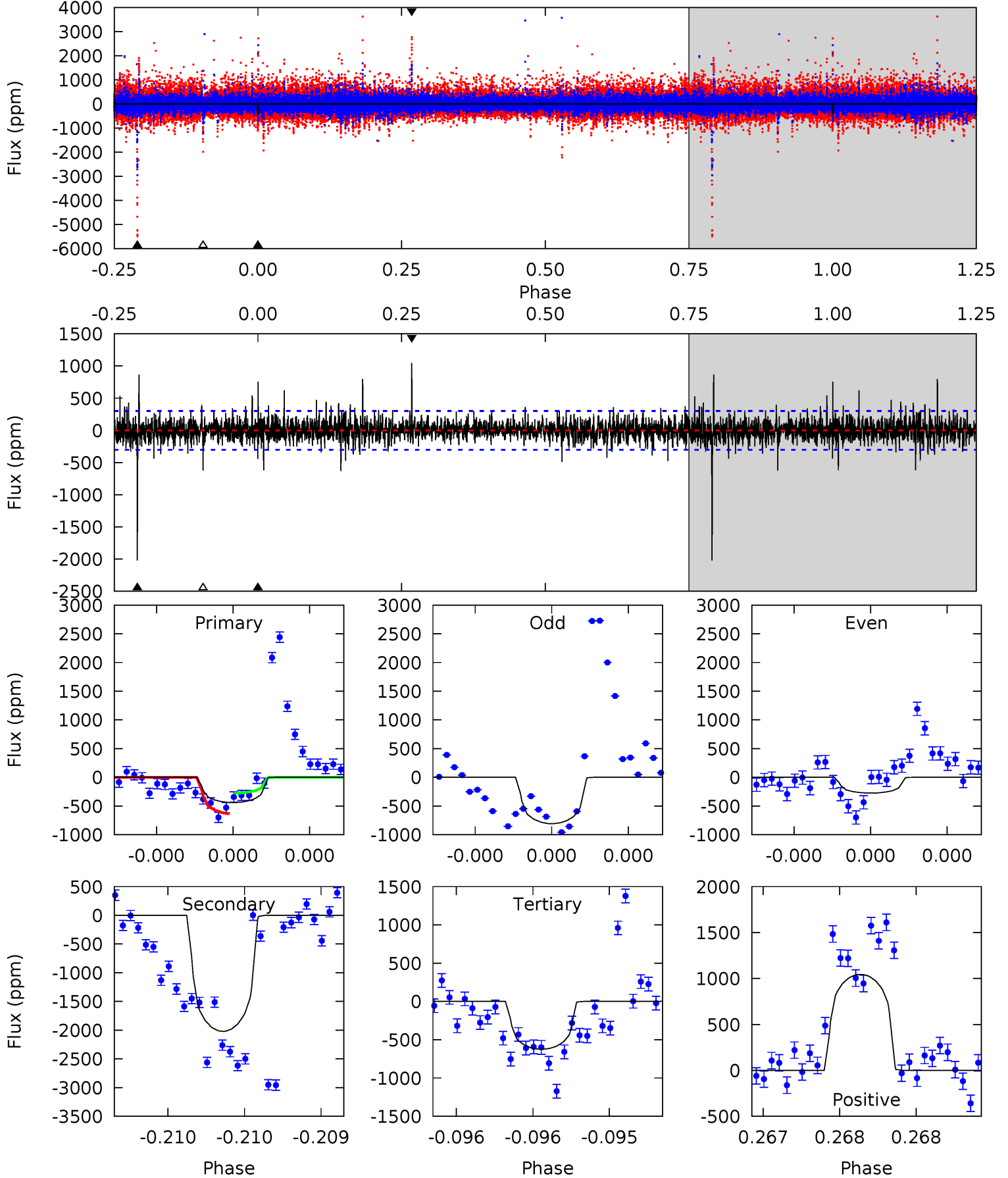
TCE 009048976-02 P=515.014257 Days  $T_0=491.289158$  (BKJD)



# DV Model-Shift Uniqueness Test

009048976-02, P = 515.005922 Days, E = 491.302185 Days

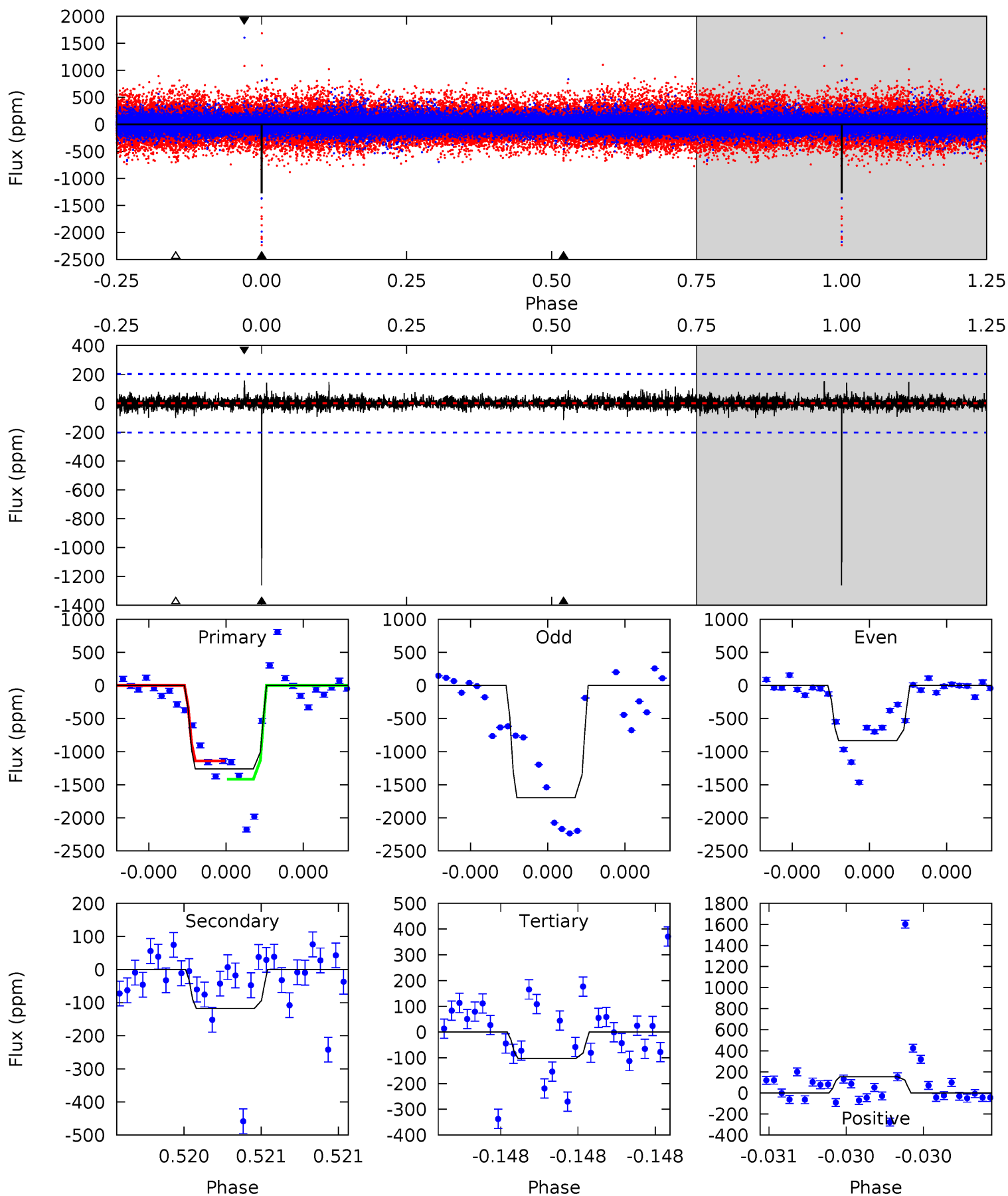
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
8.14	37.4	11.5	19.3	5.59	3.50	2.04	-3.41	-11.2	25.9	18.1	3.76	1.64	0.34	3.32



# Alt Model-Shift Uniqueness Test

009048976-02, P = 515.014257 Days, E = 491.289158 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
34.9	3.25	2.82	4.23	5.60	3.52	0.57	32.1	30.7	0.43	-0.98	11.3	0.93	0.11	3.71





### Stellar Parameters For KIC 009048976

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (g \cdot \text{cm}^{-3})$
	$4266^{+115}_{-140}$	$4.665^{+0.063}_{-0.027}$	$-0.460^{+0.300}_{-0.300}$	$0.578^{+0.044}_{-0.060}$	$0.563^{+0.061}_{-0.046}$	$4.106^{+1.199}_{-0.530}$
	+3%/-3%	+1%/-1%	+65%/-65%	+8%/-10%	+11%/-8%	+29%/-13%
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 009048976-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-2021 \pm 54$	$2.02^{+1.65}_{-1.25}$	$194^{+6}_{-7}$	$4877^{+2886}_{-1031}$	$303566^{+1782371}_{-212144}$
Alt.	$-118 \pm 36$	$2.43^{+1.81}_{-1.46}$	$195^{+7}_{-7}$	$2843^{+928}_{-380}$	$11869^{+66165}_{-8135}$

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

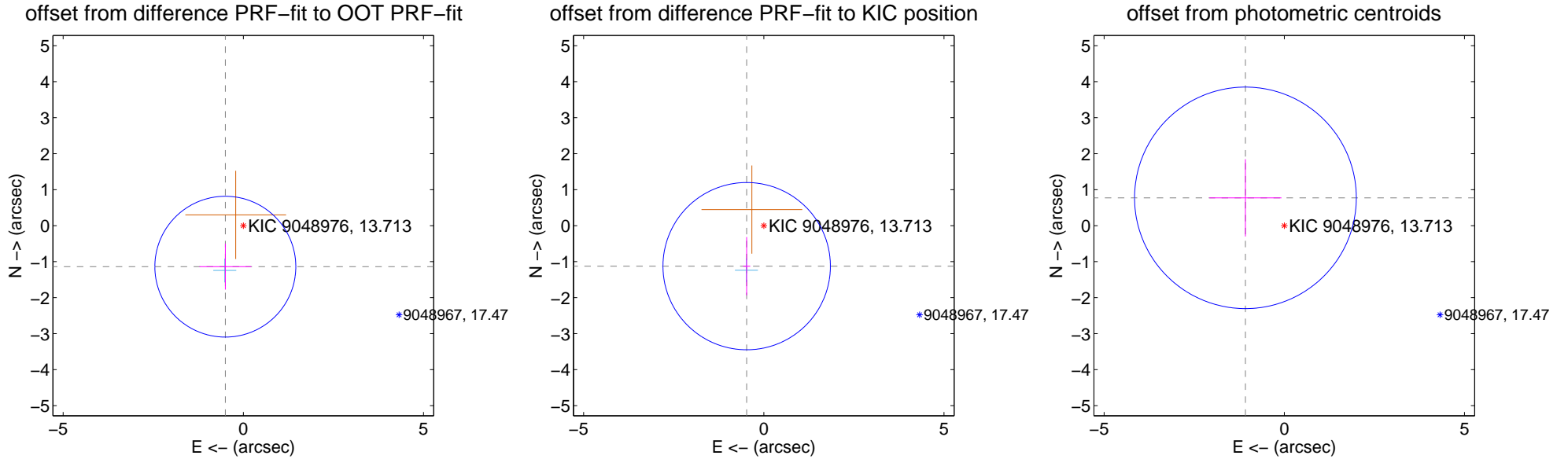
## DV Centroid Data

Supplemental centroid analysis for 009048976-02. Kepler magnitude: 13.71. Transit SNR 4.73

There are 1 quarters with good PRF difference image offsets

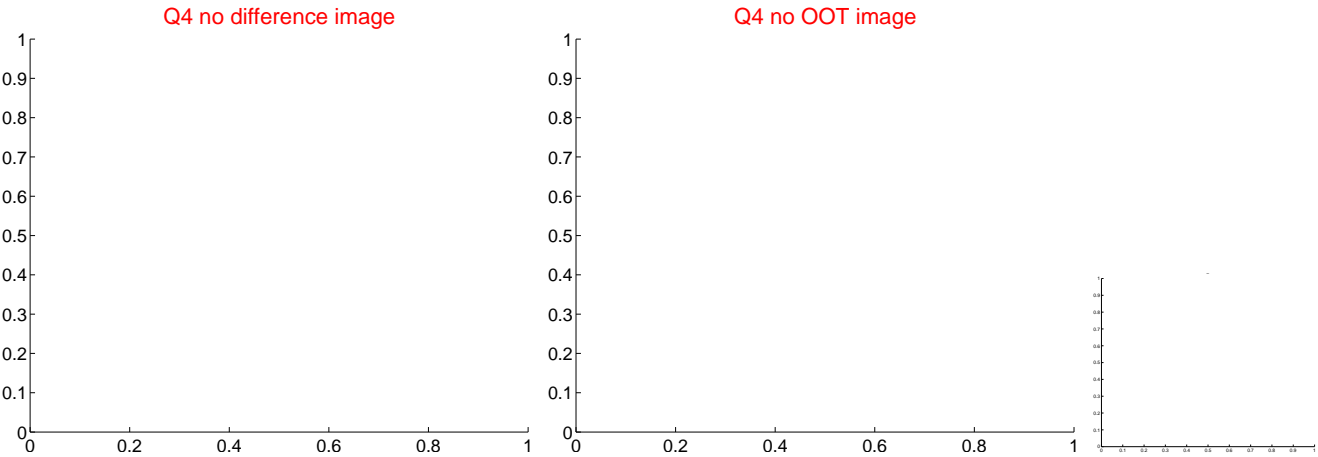
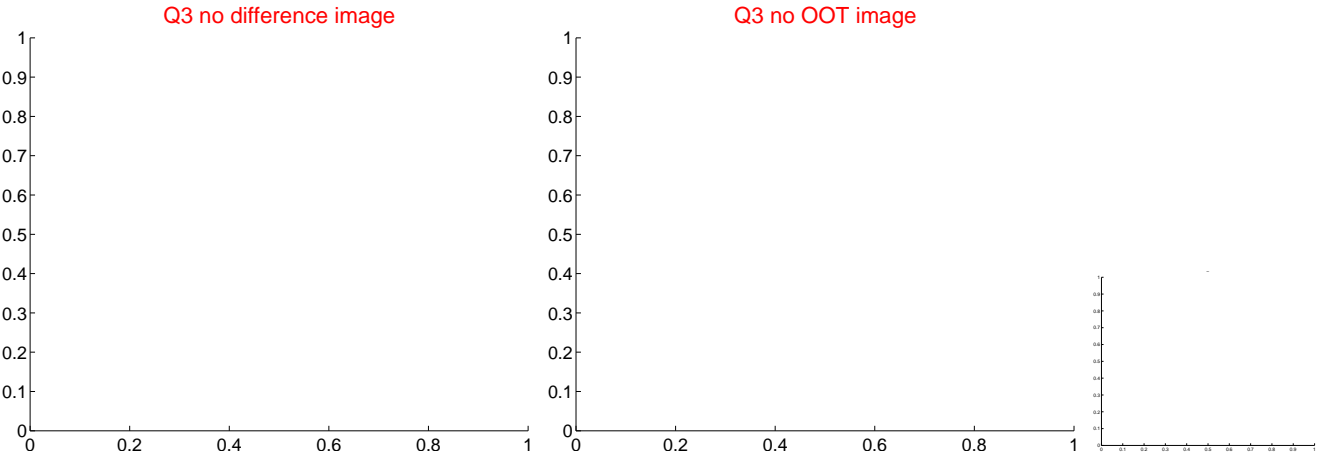
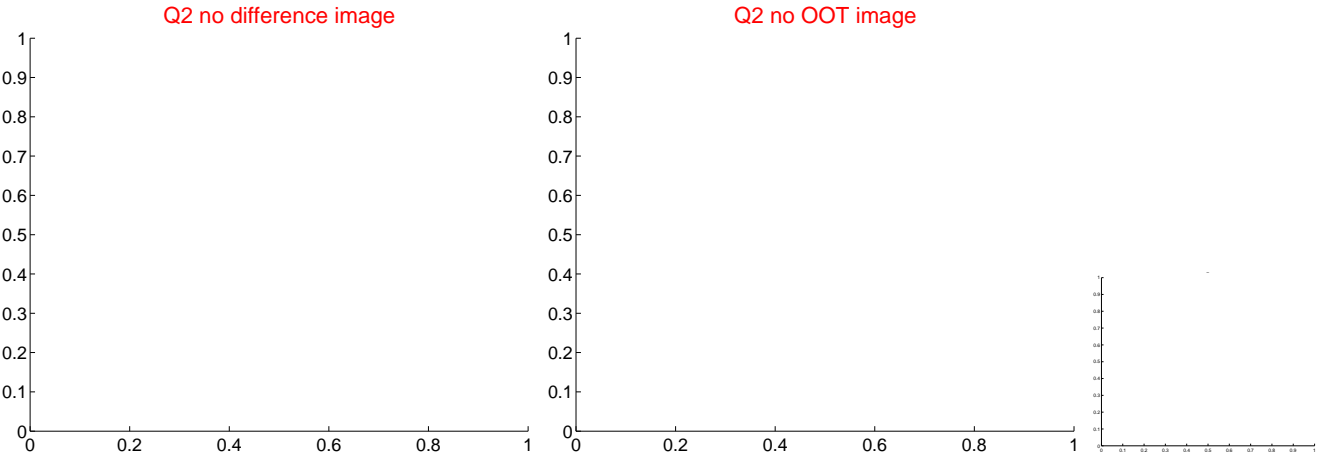
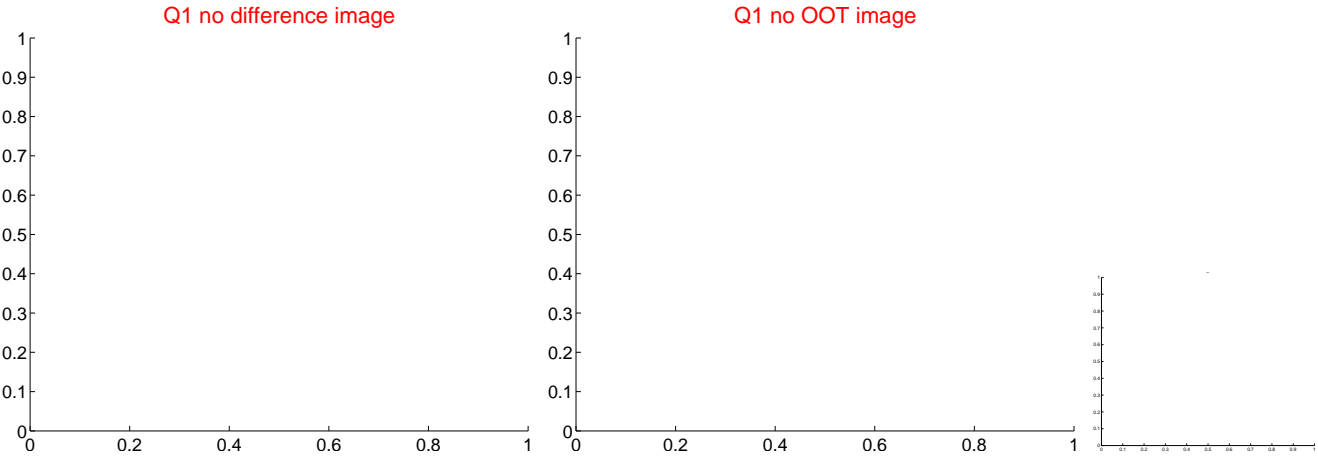
The direct PRF centroid is offset from the target star catalog position by about 0.19 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.245 \pm 0.652$	1.91	$0.500 \pm 0.720$	$-1.140 \pm 0.638$
PRF-fit source offset from KIC position	$1.222 \pm 0.774$	1.58	$0.476 \pm 0.098$	$-1.125 \pm 0.810$
photometric centroid source offset	$1.33 \pm 1.03$	1.29	$1.08 \pm 1.00$	$0.77 \pm 1.07$

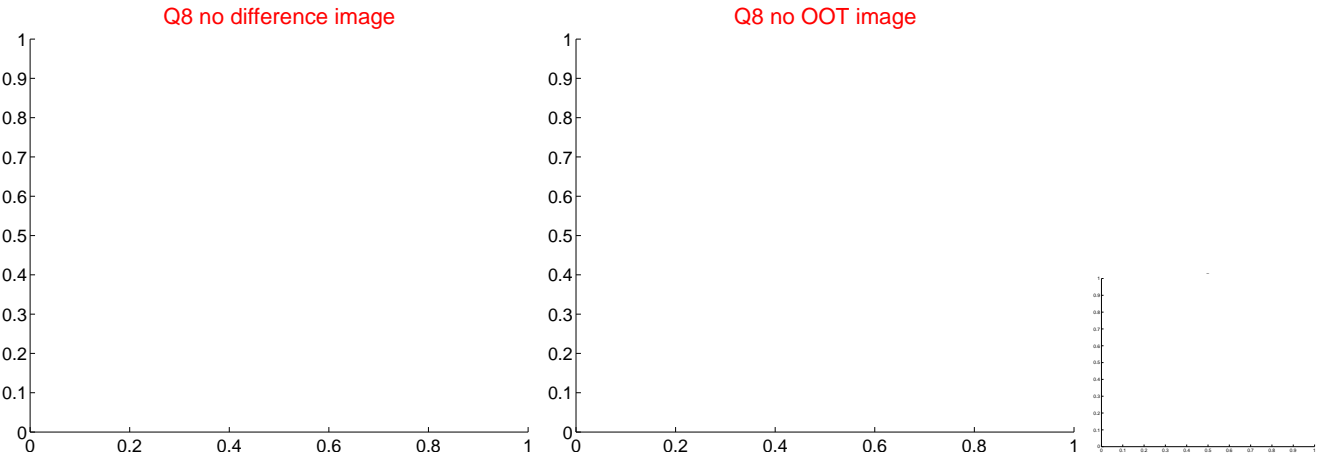
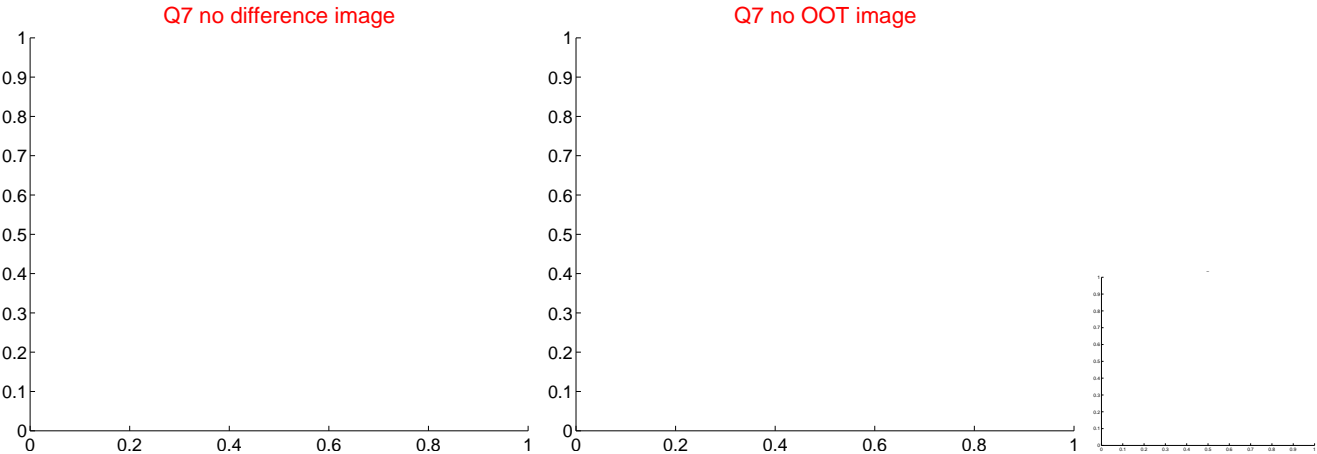
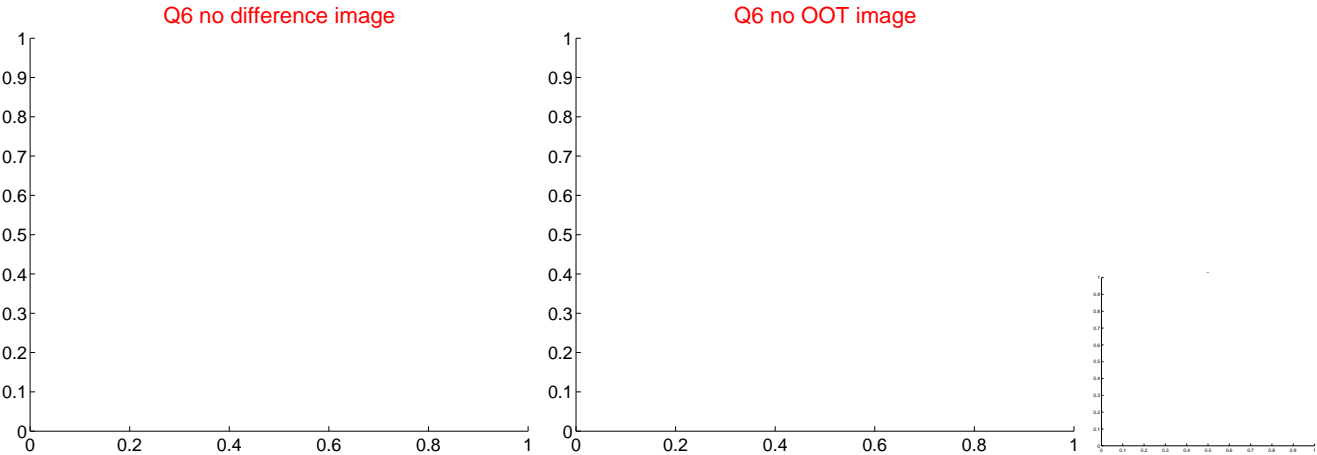
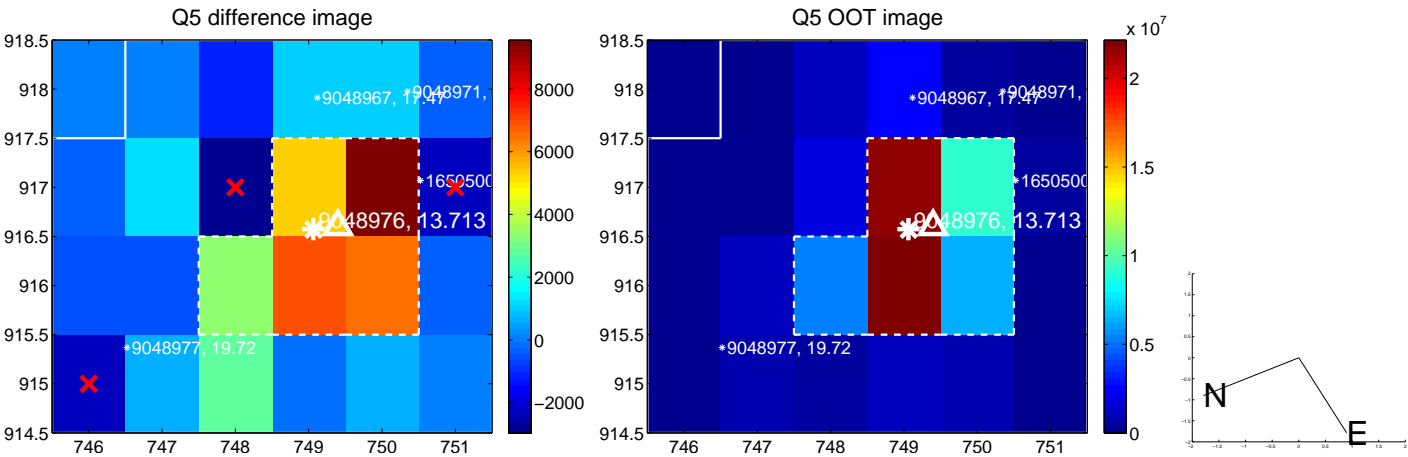


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

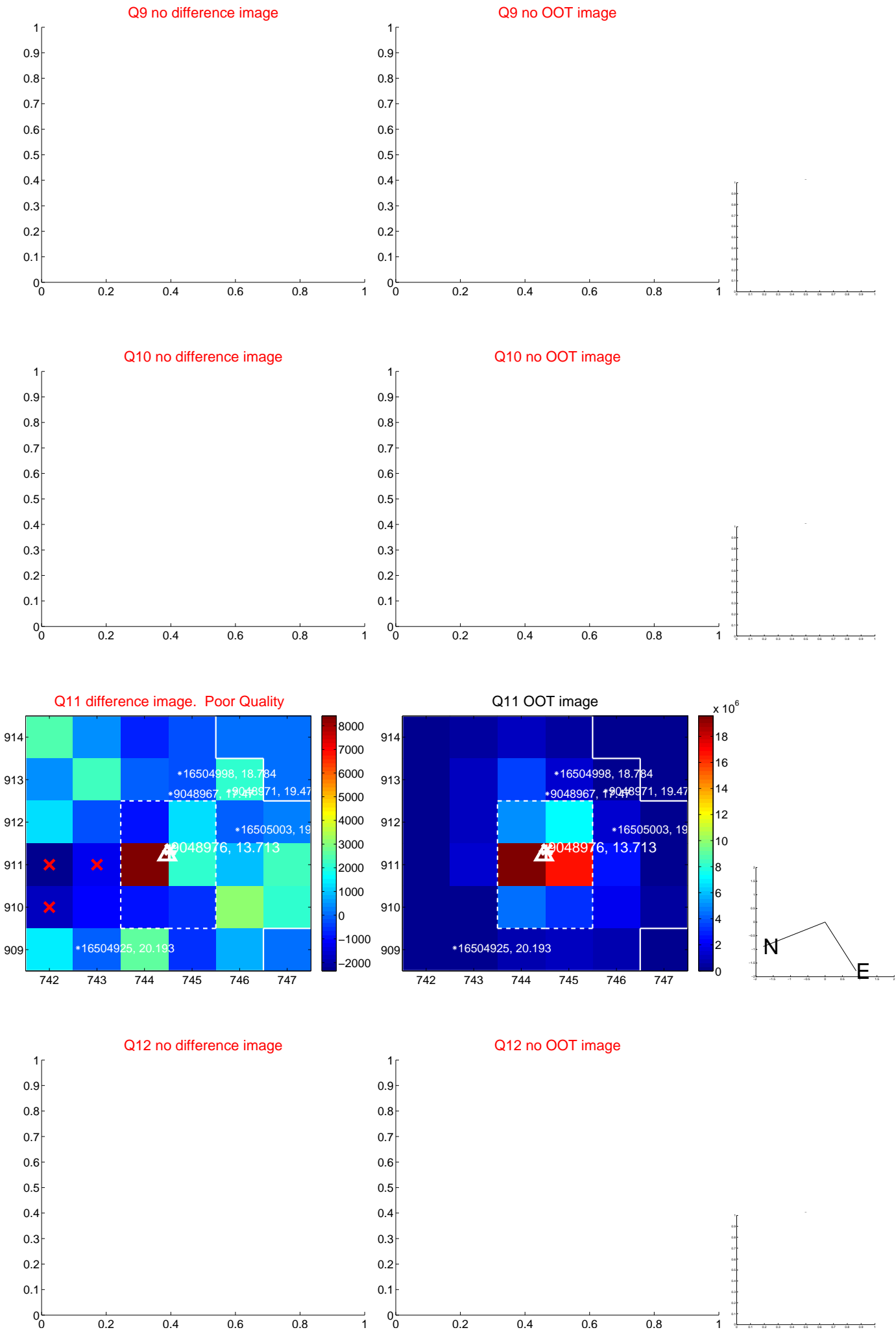
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



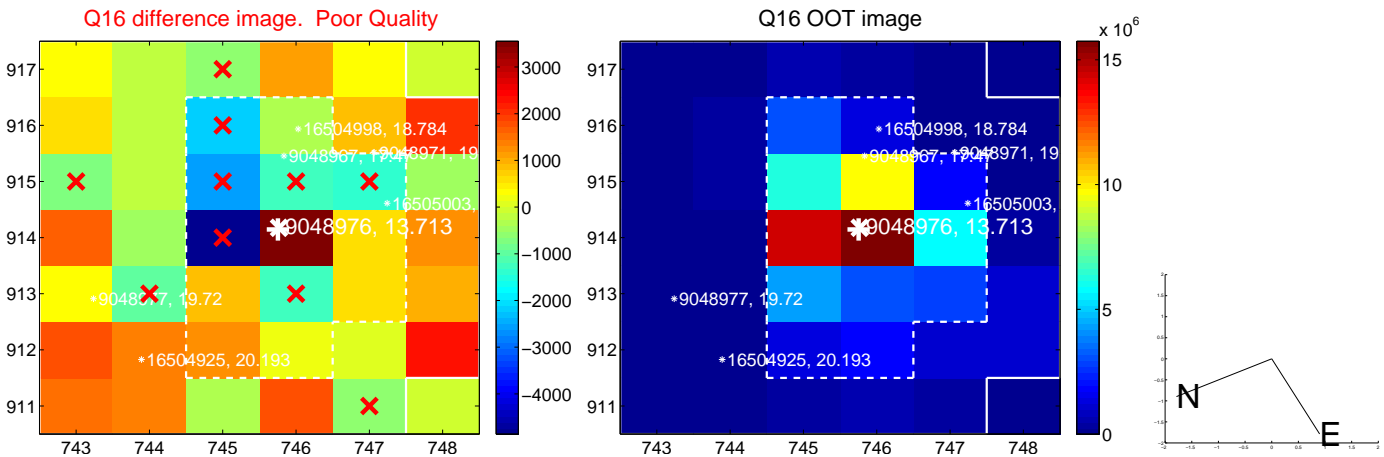
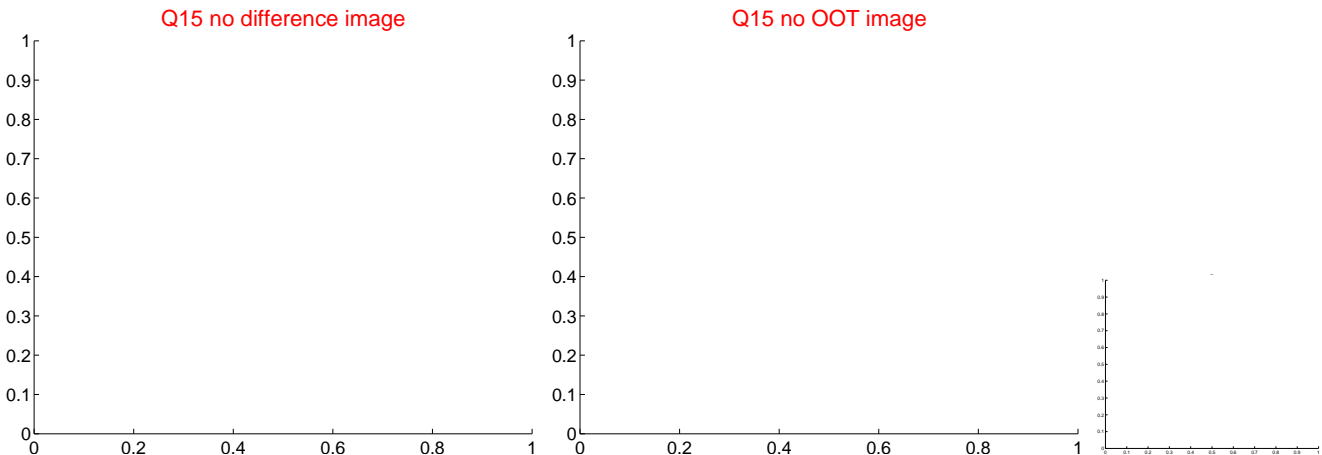
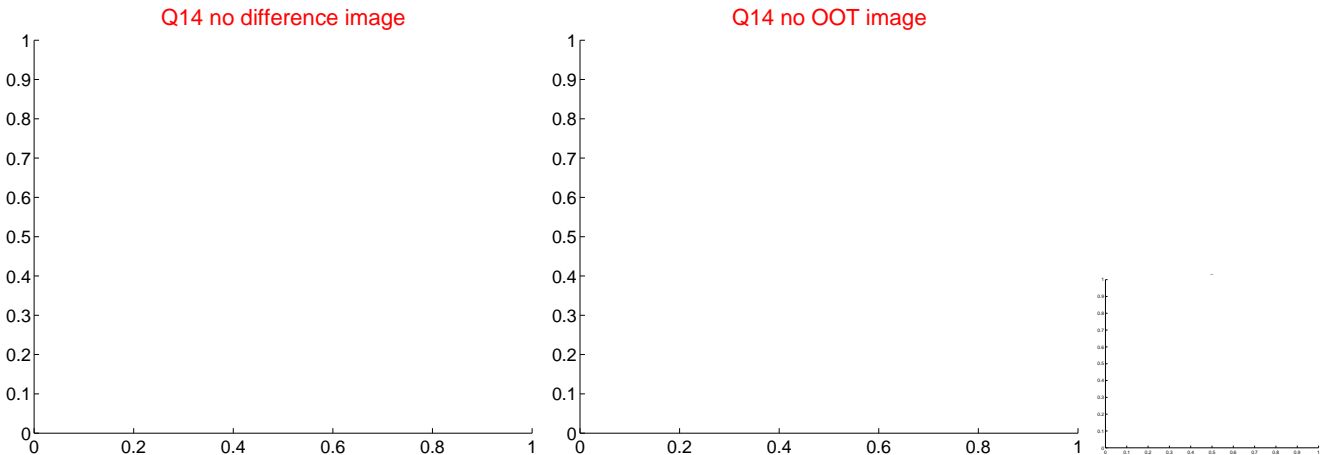
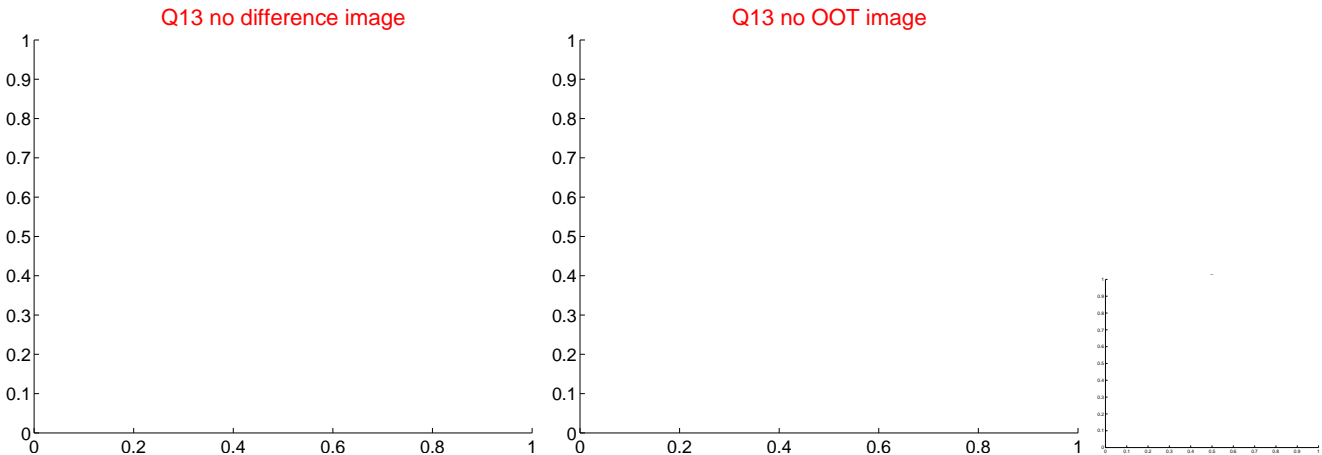
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



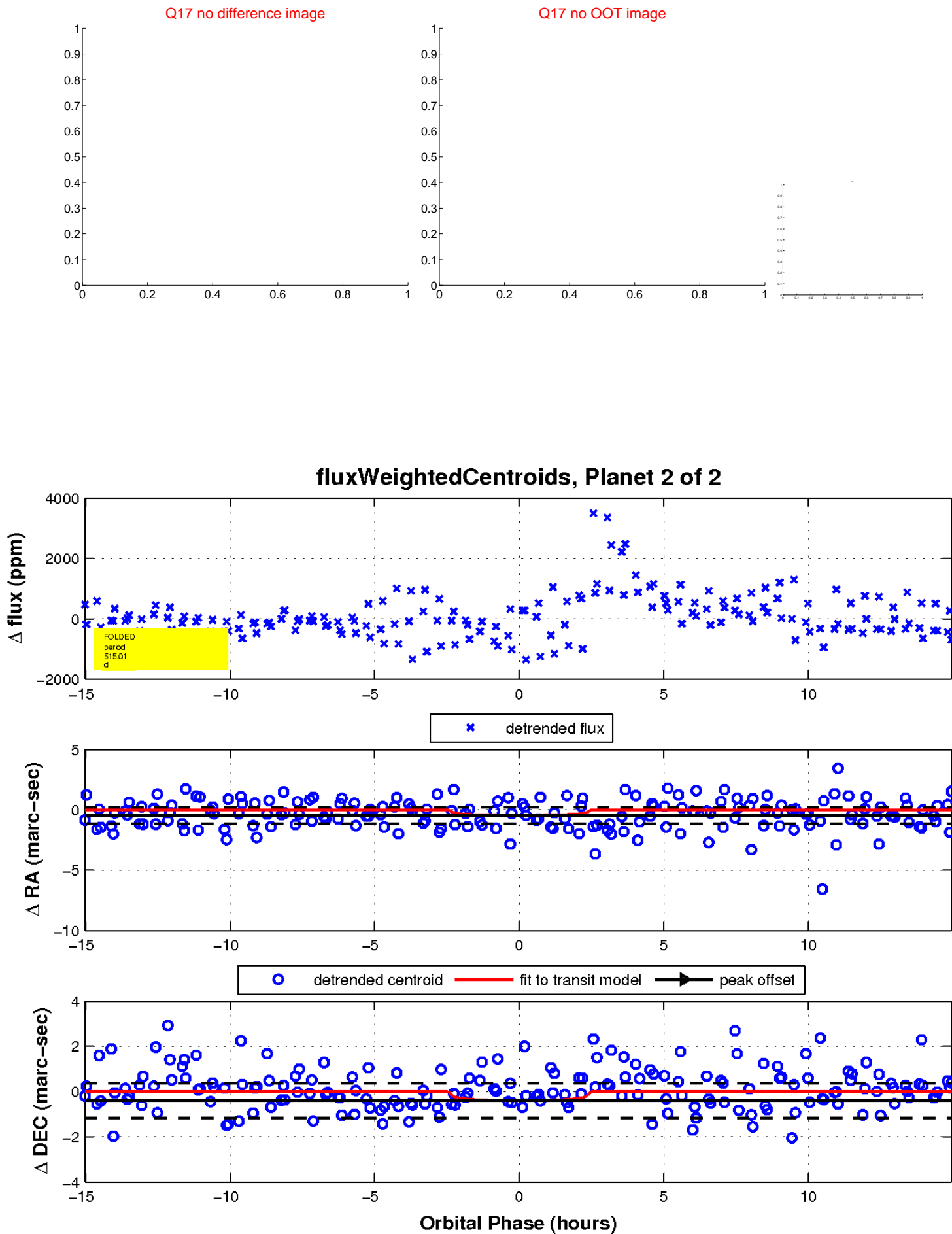
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

