

# KIC 004165473

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004165473-01	OBS	0550.01	13.023675	139.452786	607.7	4.330	43.6	47.0	0.94	5627	2.75	72.00
004165473-02	OBS	No	224.756196	317.645696	364.3	5.859	9.1	7.0	0.94	5627	2.03	1.61

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004165473-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
004165473-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_CHASES_MARSHALL—ALL_TRANS_CHASES—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.

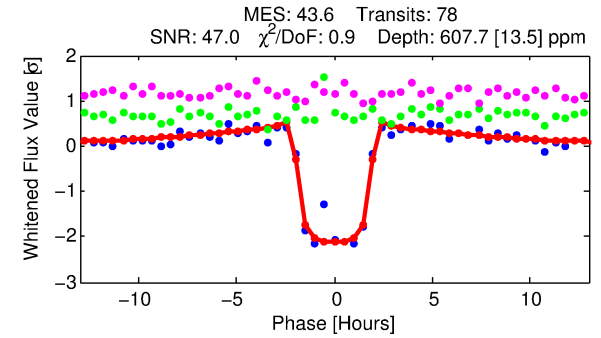
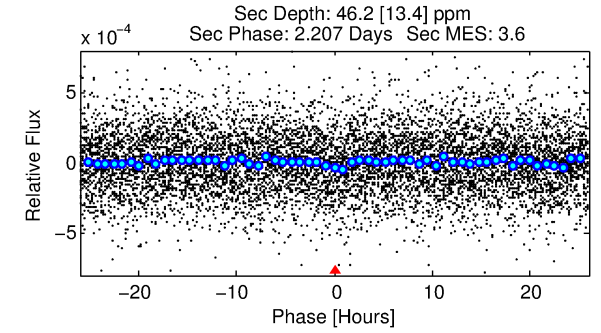
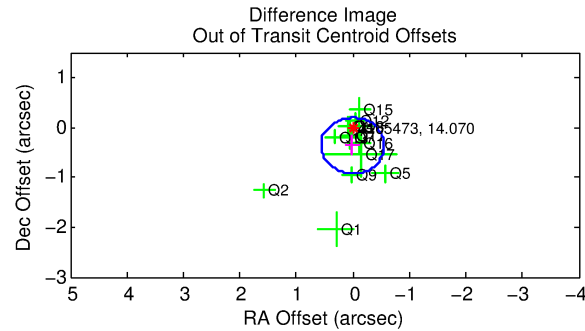
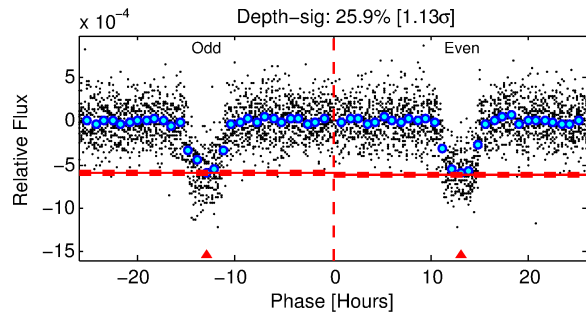
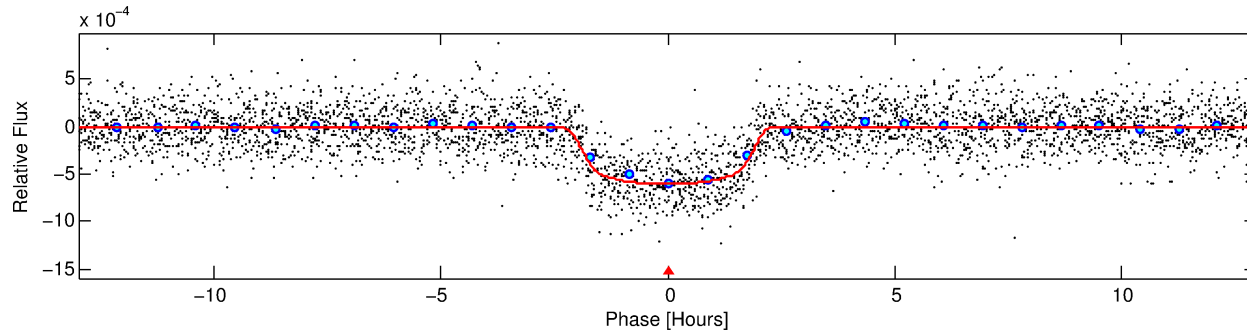
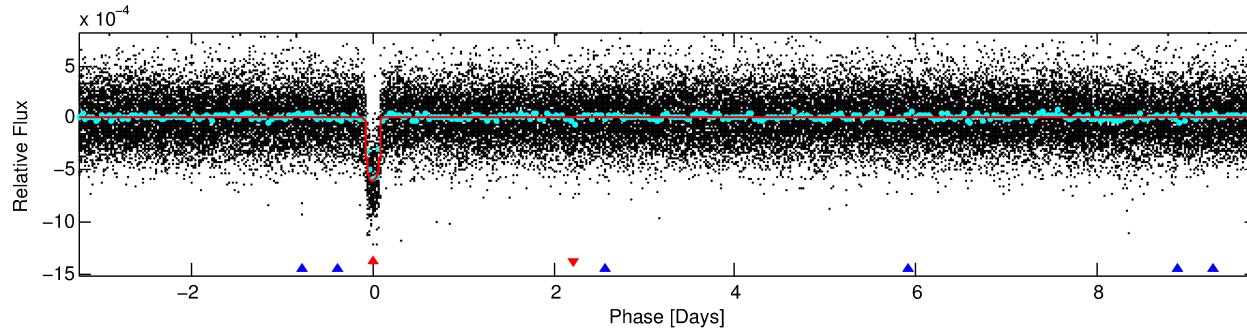
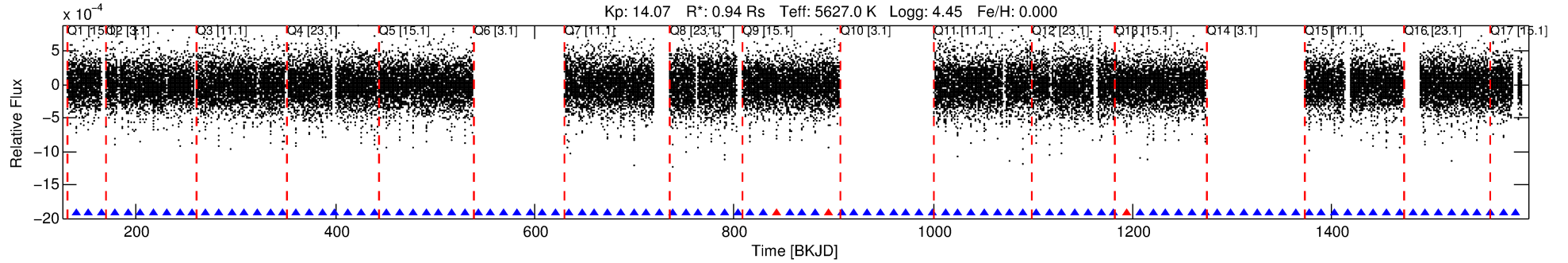
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 004165473-01

No Significant Match Found

# DV One-Page Summary

KIC: 4165473 Candidate: 1 of 2 Period: 13.024 d  
KOI: K00550.01 Corr: 0.958



## DV Fit Results:

Period = 13.02368 [0.00003] d  
Epoch = 139.4528 [0.0016] BKJD  
Rp/R\* = 0.0267 [0.0013]  
a/R\* = 11.86 [2.32]  
b = 0.89 [0.05]  
Seff = 72.00 [14.64]  
Teq = 743 [38] K  
Rp = 2.75 [0.38] Re  
a = 0.1056 [0.0127] AU  
Ag = 37.36 [13.40] [2.71 $\sigma$ ]  
Teffp = 2839 [224] K [9.22 $\sigma$ ]

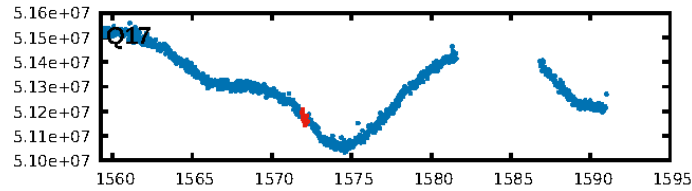
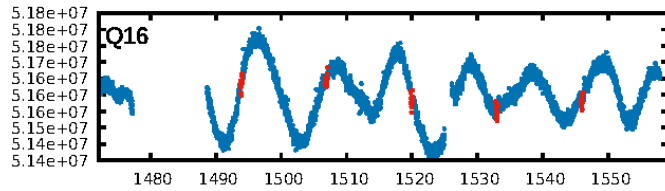
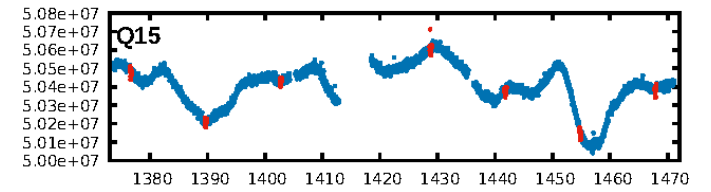
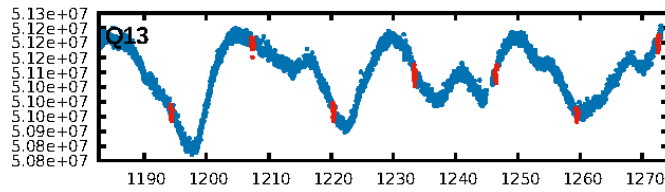
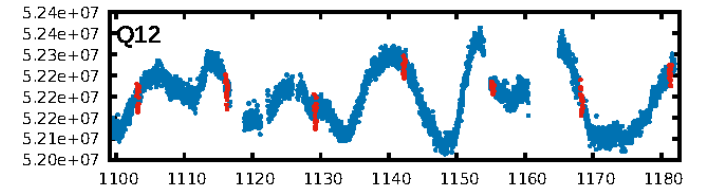
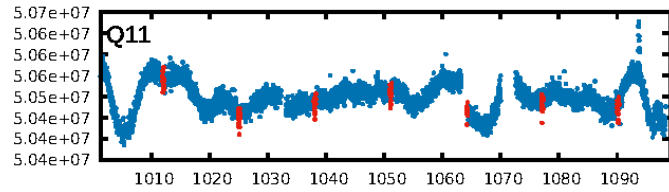
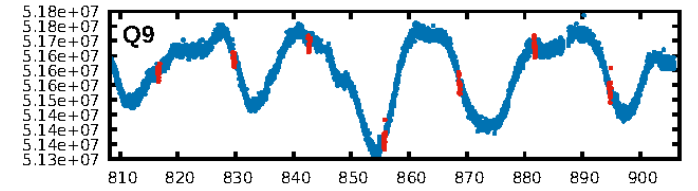
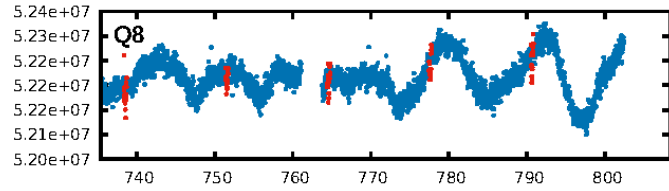
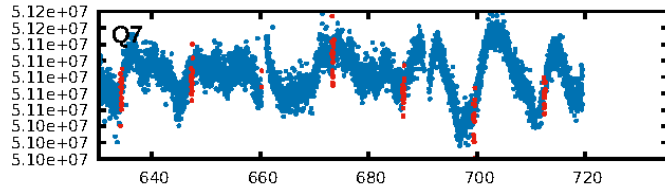
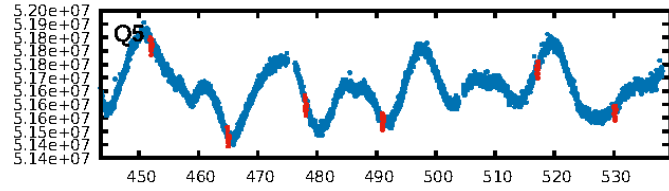
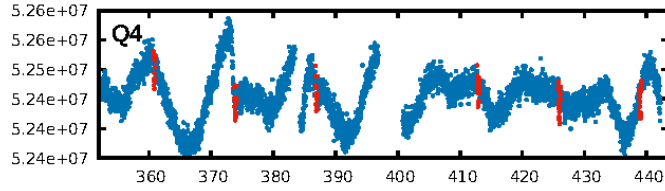
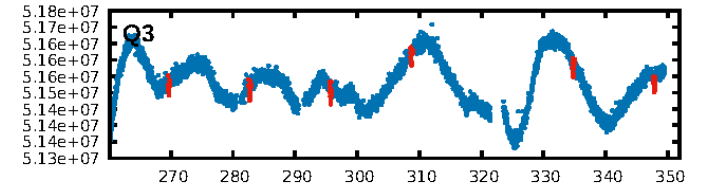
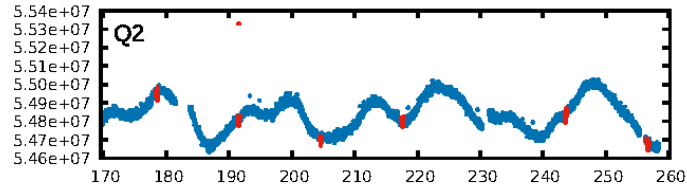
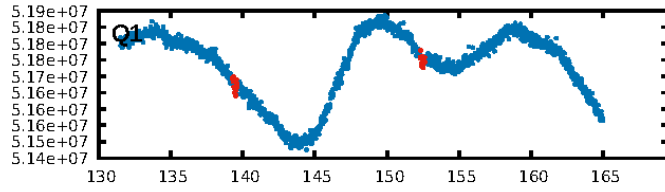
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [697.46 $\sigma$ ]  
ModelChiSquare2-sig: 86.5%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 0.96 [72/75]  
GhostDiagnostic-chr: 3.379  
Centroid-sig: 0.0%  
Centroid-so: 0.533 arcsec [2.56 $\sigma$ ]  
OotOffset-rm: 0.370 arcsec [1.98 $\sigma$ ]  
KicOffset-rm: 0.263 arcsec [1.48 $\sigma$ ]  
OotOffset-st: 1/4/4/5 [14]  
KicOffset-st: 1/4/4/5 [14]  
DiffImageQuality-fgm: 1.00 [14/14]  
DiffImageOverlap-fno: 1.00 [14/14]

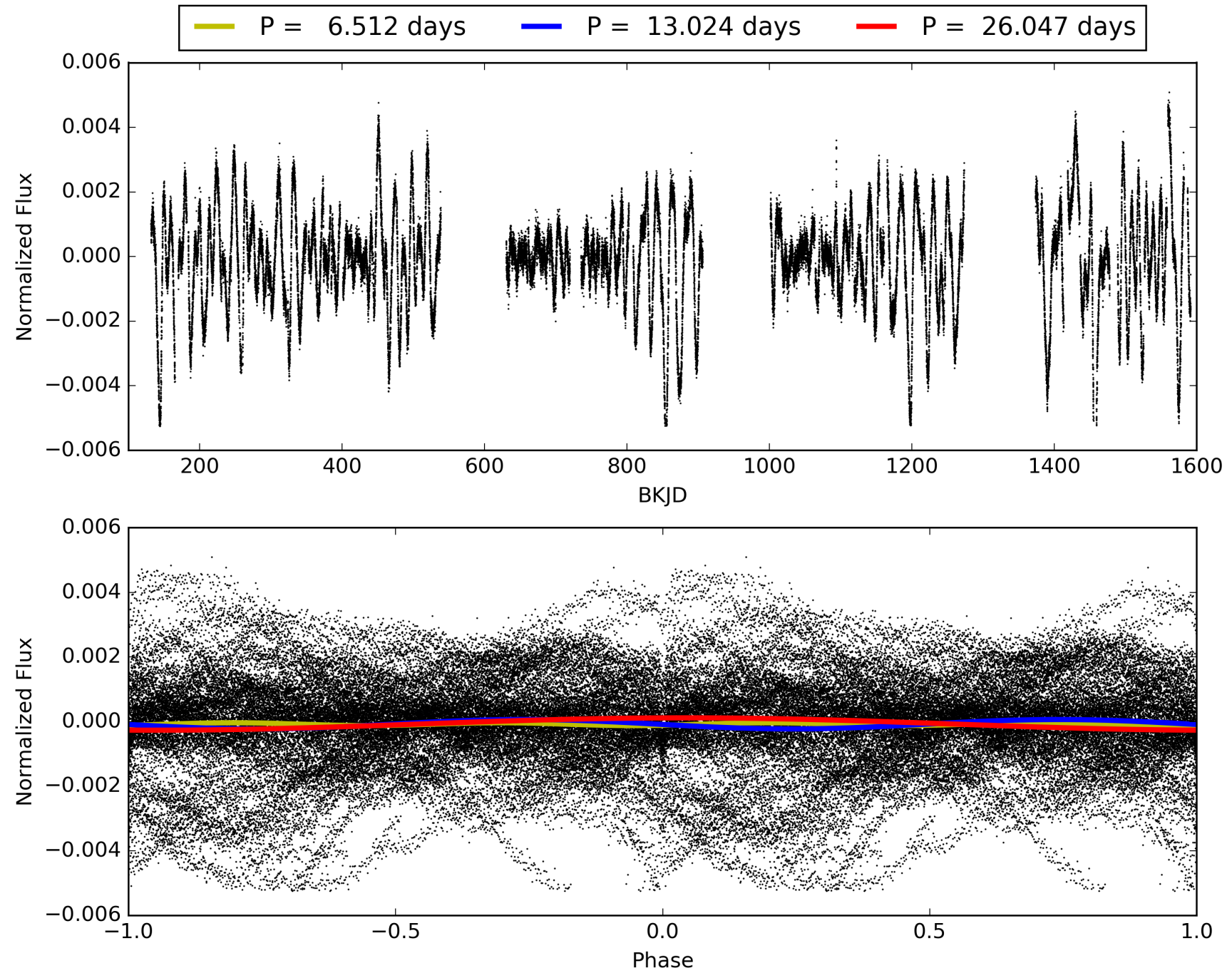
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 08:18:10 Z

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

# TCE 004165473-01, PDC Light Curves

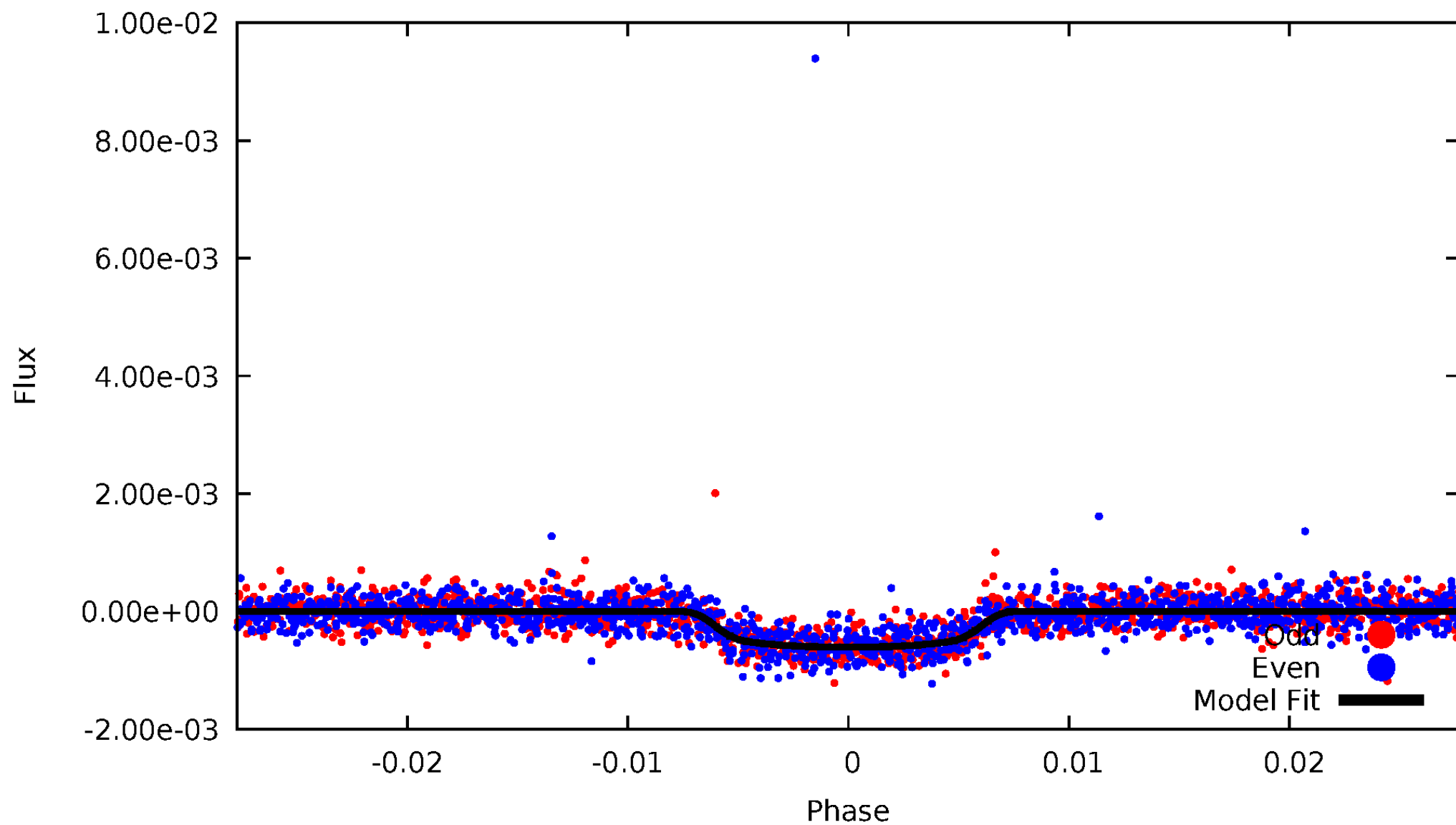


TCE 004165473-01



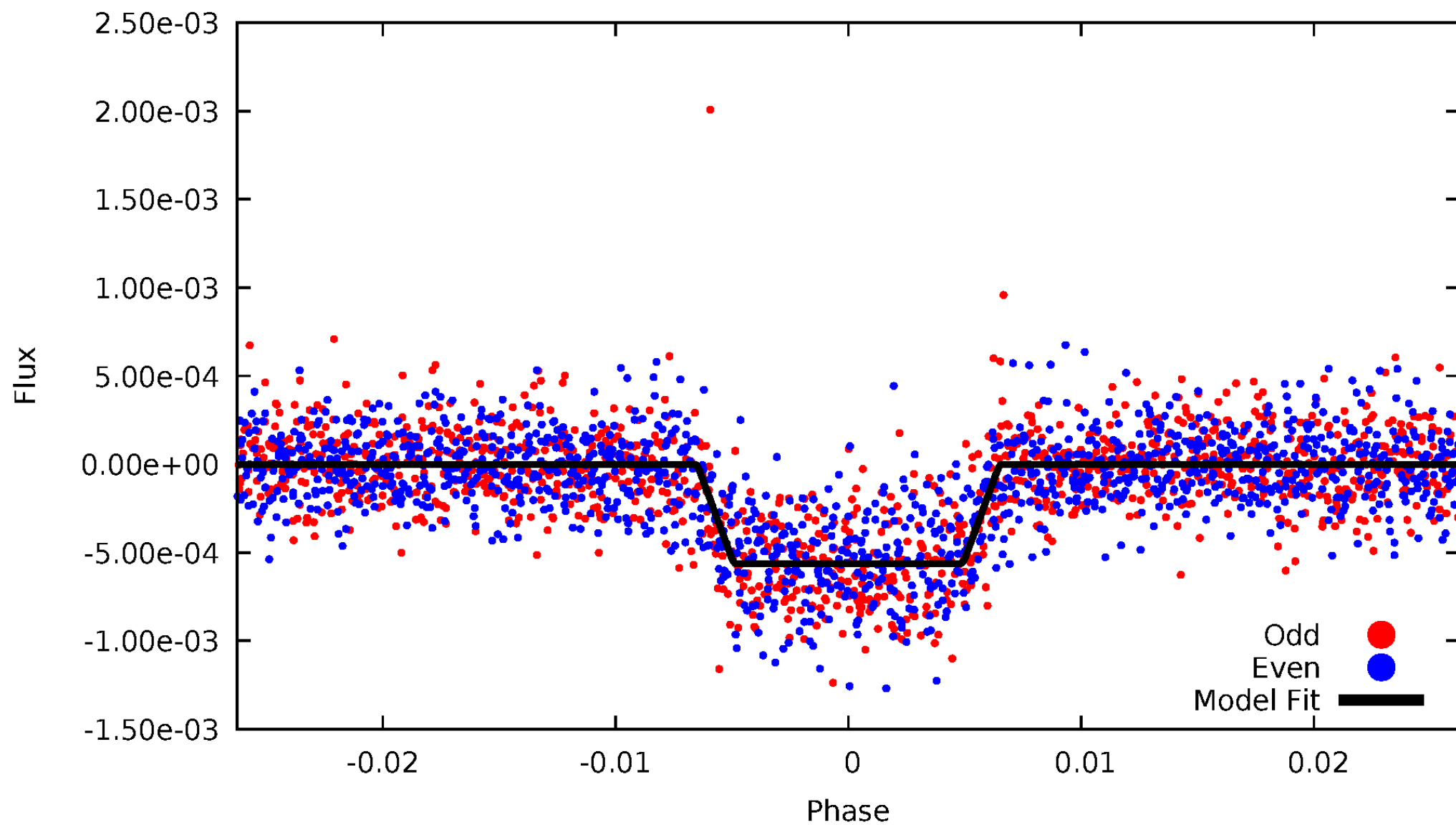
# DV Odd/Even

TCE 004165473-01



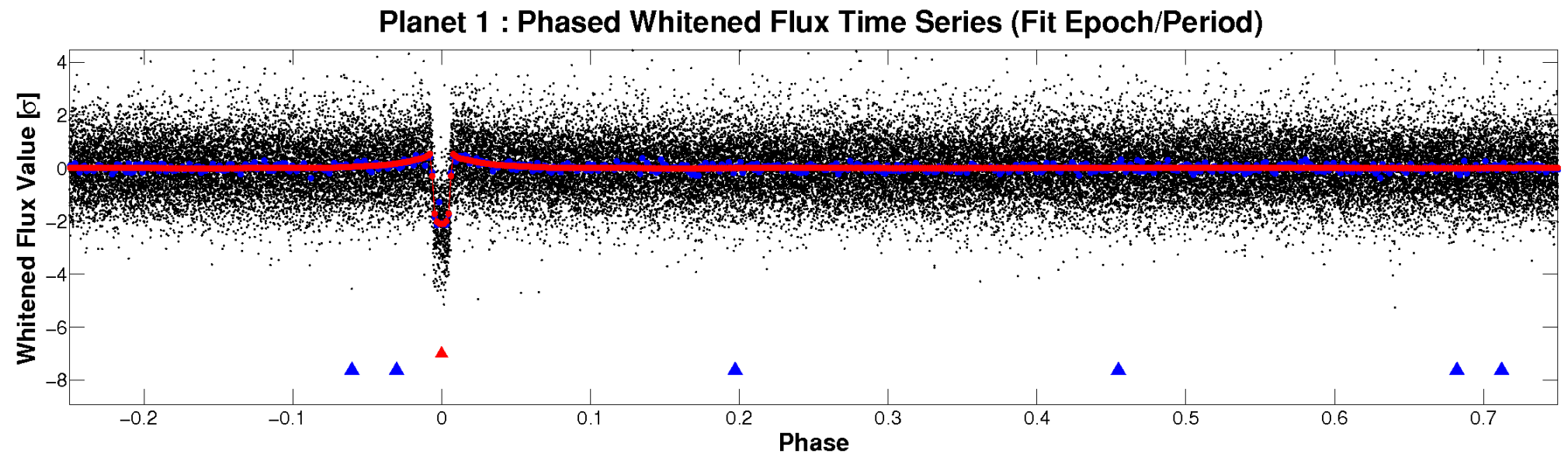
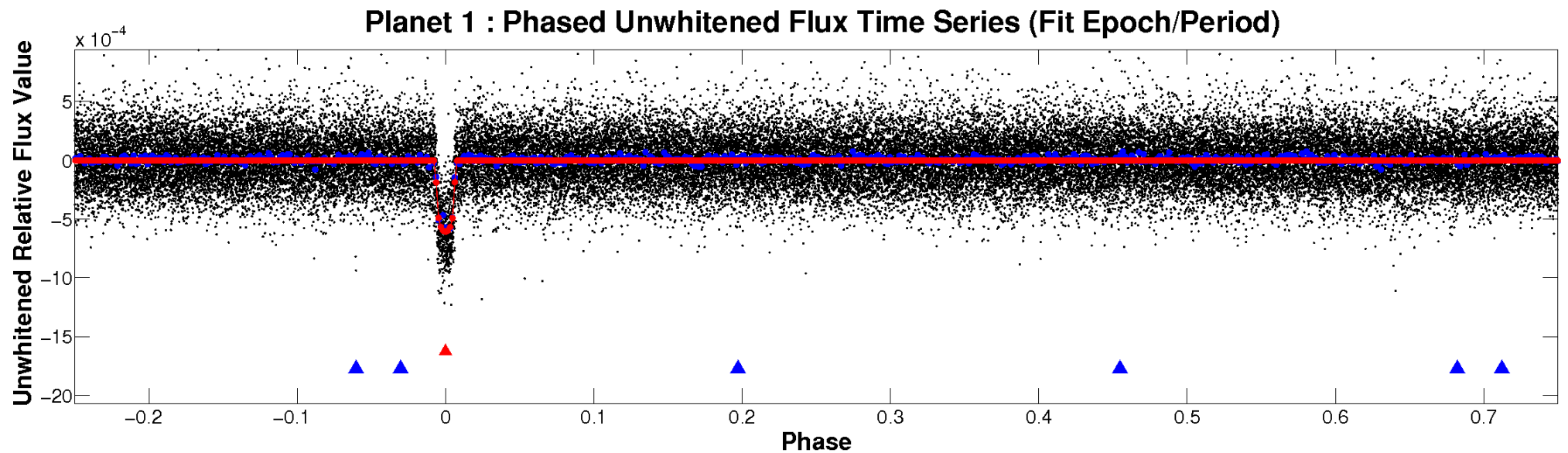
# ALT Odd/Even

TCE 004165473-01



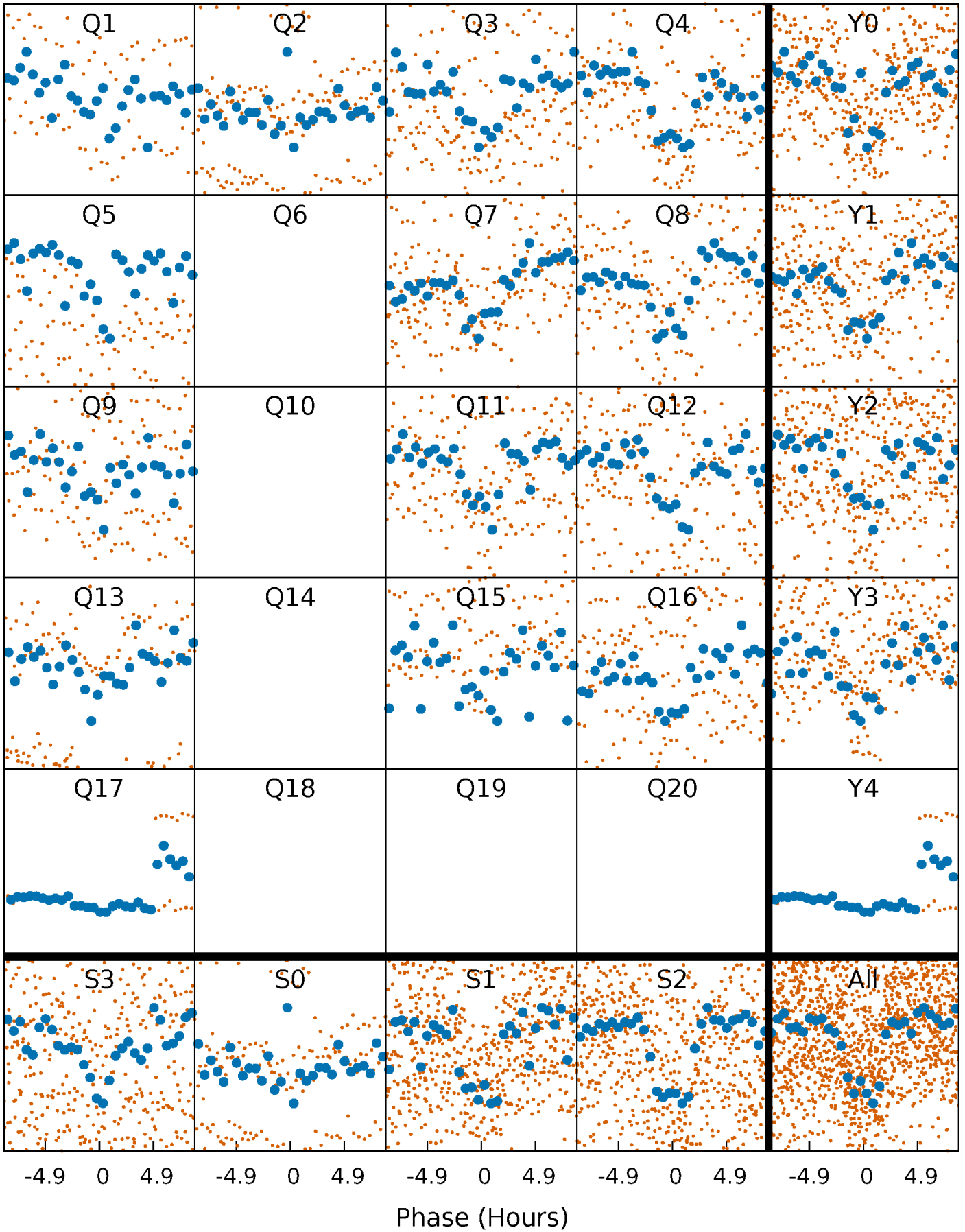


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

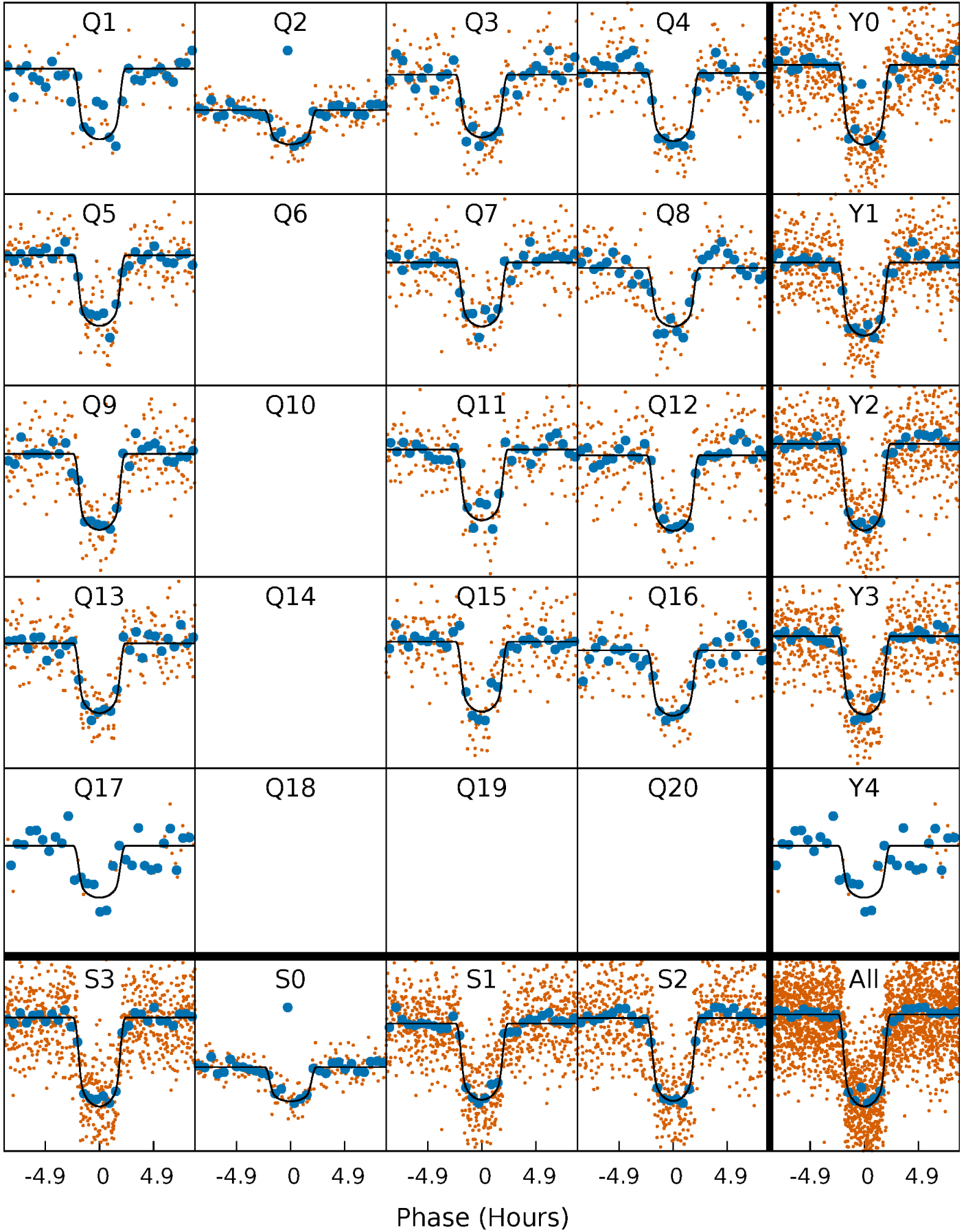
TCE 004165473-01 P= 13.023675 Days  $T_0=139.452786$  (BKJD)





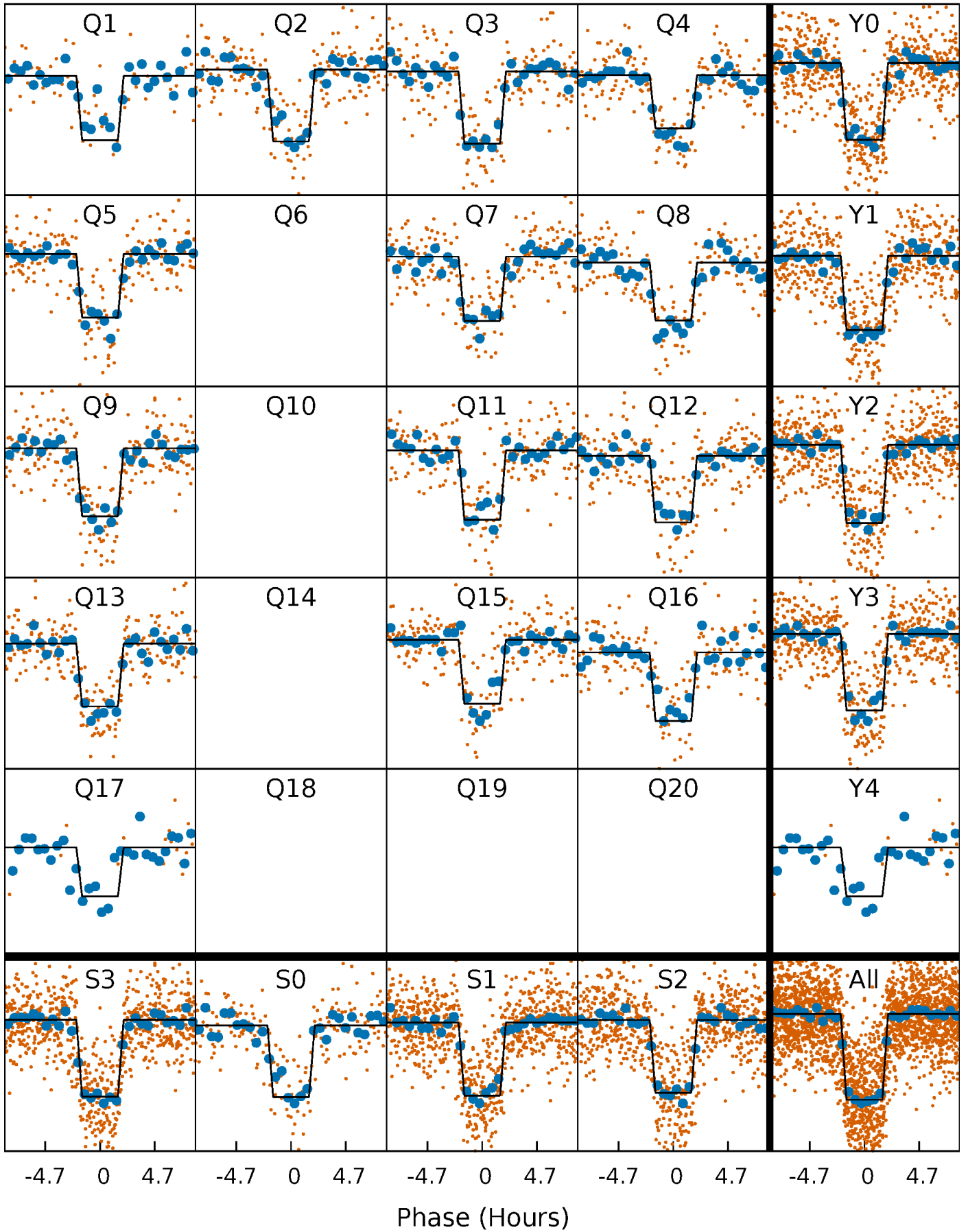
# DV Quarter-Phased Transit Curves

TCE 004165473-01 P= 13.023675 Days  $T_0=139.452786$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

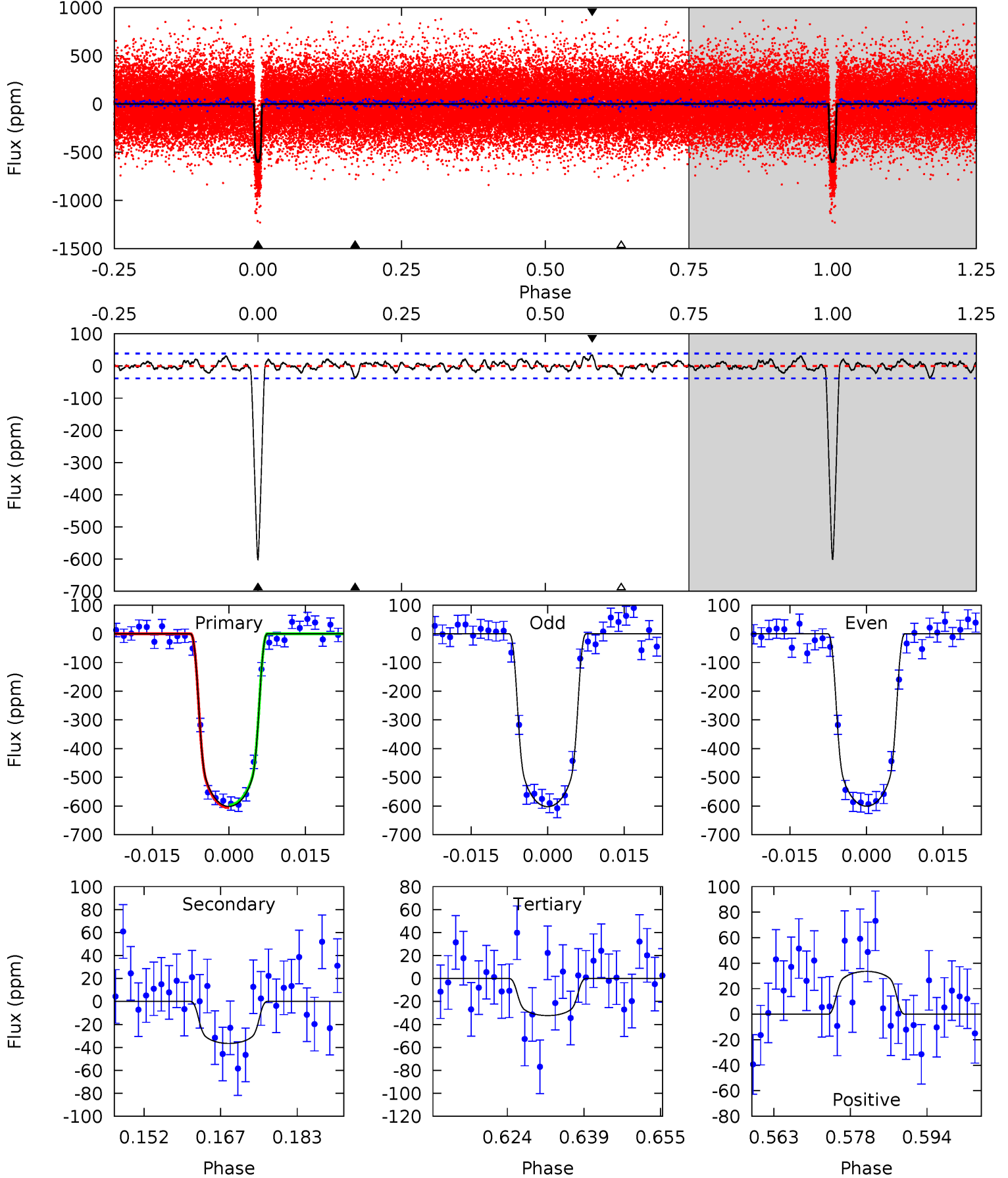
TCE 004165473-01 P= 13.023646 Days  $T_0=139.454378$  (BKJD)



# DV Model-Shift Uniqueness Test

004165473-01,  $P = 13.023675$  Days,  $E = 126.429111$  Days

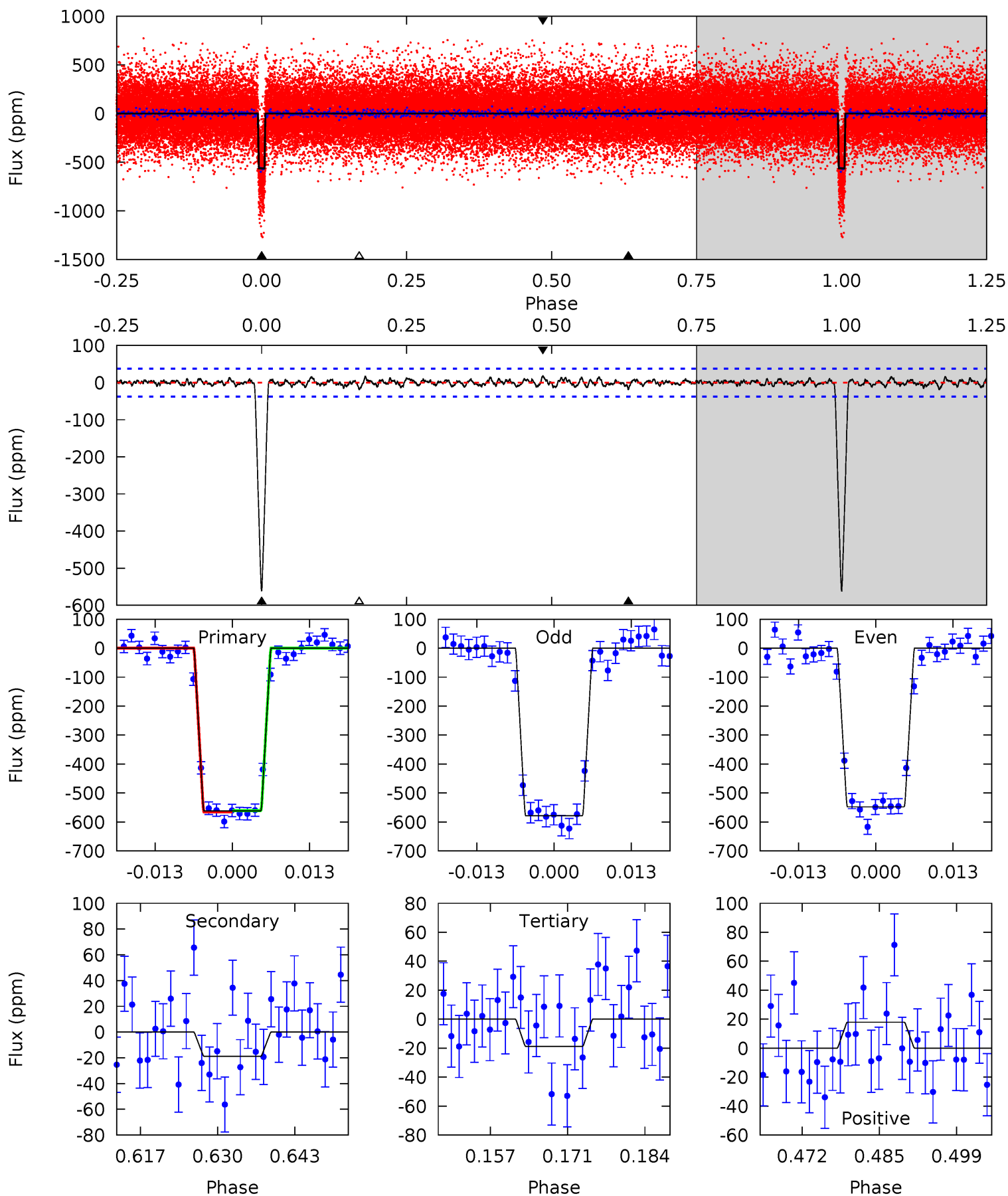
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
77.2	4.69	4.15	4.30	4.95	2.43	1.35	73.0	72.8	0.54	0.39	0.12	0.99	0.05	0.53



# Alt Model-Shift Uniqueness Test

004165473-01,  $P = 13.023646$  Days,  $E = 126.430732$  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
74.4	2.49	2.48	2.38	4.97	2.48	0.77	71.9	72.1	0.00	0.11	2.03	0.98	0.03	0.31



### Stellar Parameters For KIC 004165473

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5627^{+101}_{-112}$	$4.453^{+0.072}_{-0.108}$	$0.000^{+0.150}_{-0.150}$	$0.945^{+0.123}_{-0.076}$	$0.925^{+0.063}_{-0.057}$	$1.541^{+0.437}_{-0.482}$
	+2%/-2%	+2%/-2%	+inf%/-inf%	+13%/-8%	+7%/-6%	+28%/-31%
Source	SPE57	SPE57	SPE57	DSEP		

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

### Secondary Eclipse Parameters for KIC 004165473-01 / KOI 0550.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-37 \pm 8$	$2.78^{+0.26}_{-0.21}$	$1044^{+42}_{-35}$	$3235^{+119}_{-122}$	$28^{+8}_{-7}$
Alt.	$-19 \pm 8$	$2.48^{+0.22}_{-0.21}$	$1042^{+39}_{-36}$	$3036^{+166}_{-219}$	$18^{+9}_{-7}$

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

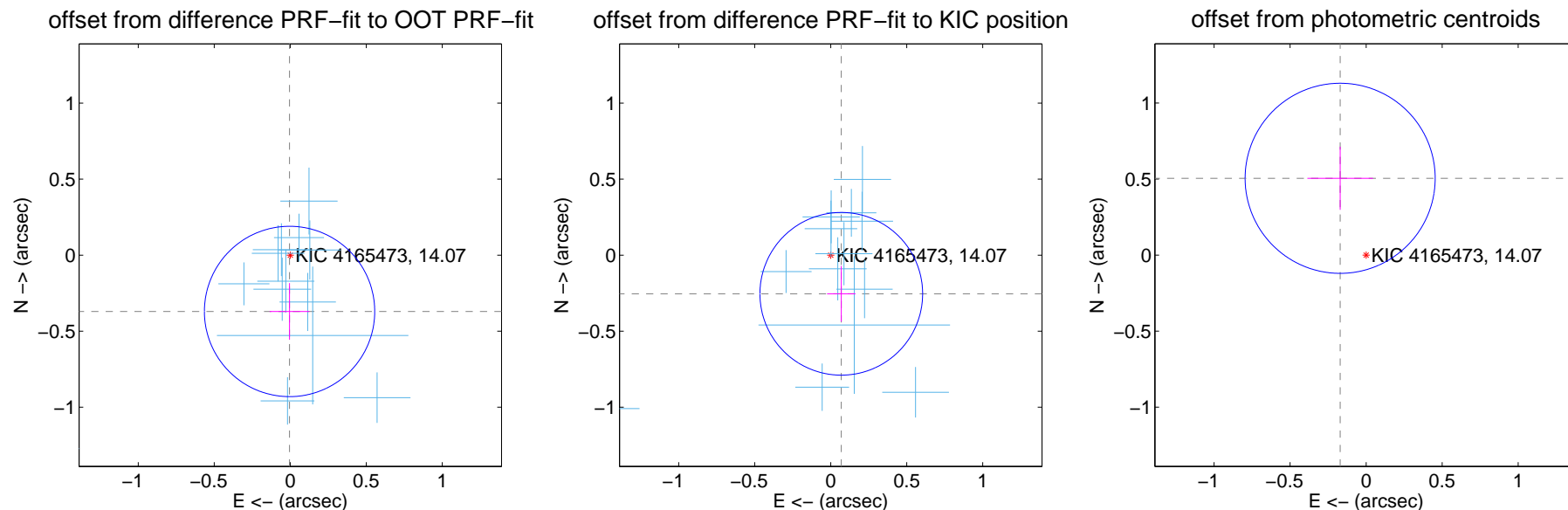
## DV Centroid Data

Supplemental centroid analysis for 004165473-01. Kepler magnitude: 14.07. Transit SNR 47.03

There are 14 quarters with good PRF difference image offsets

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

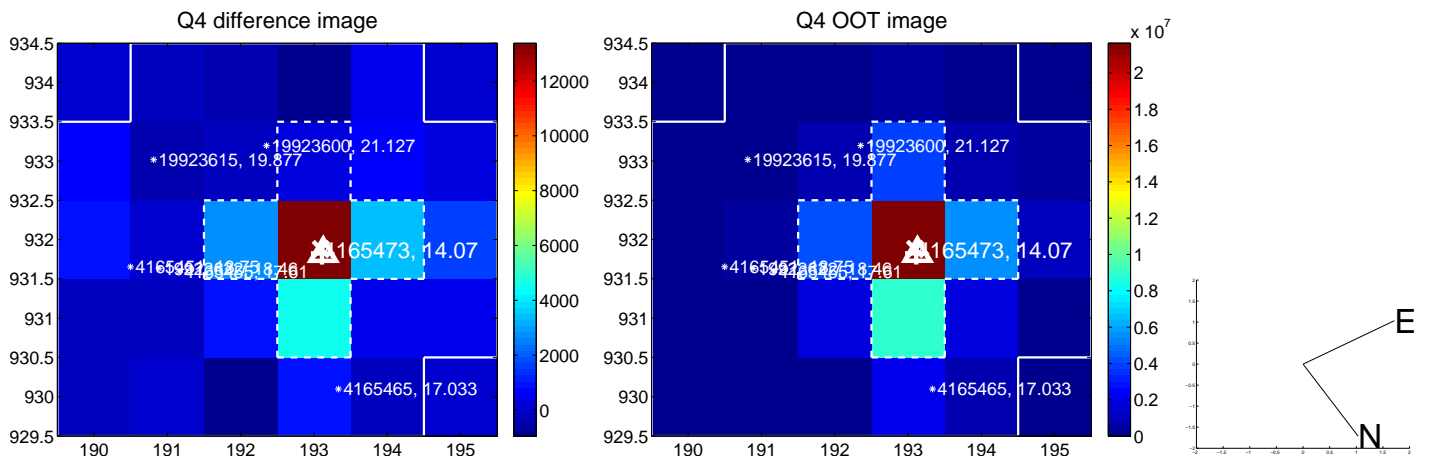
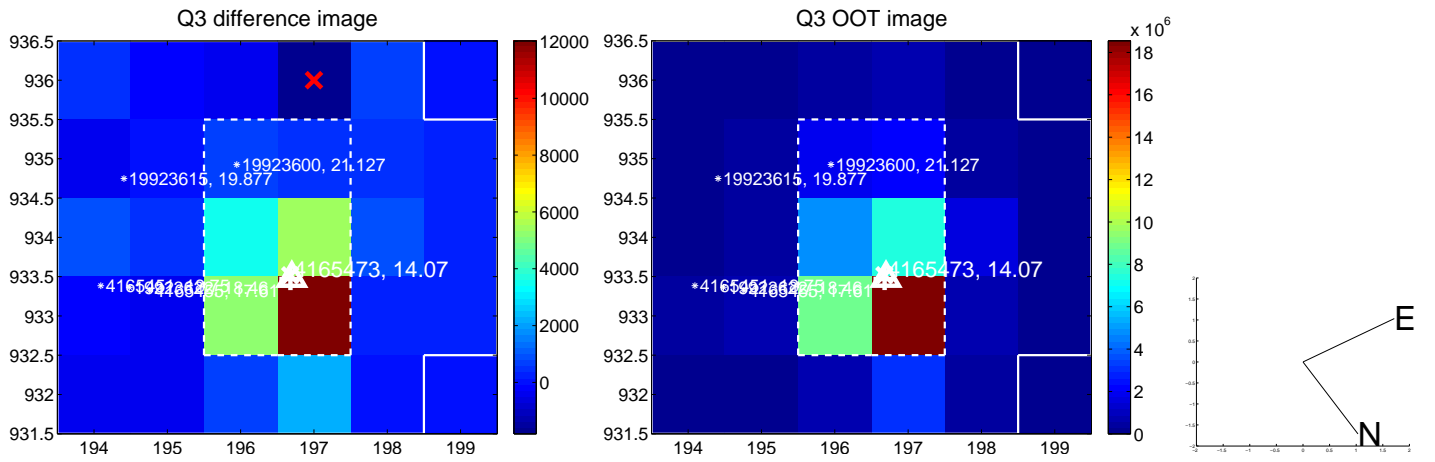
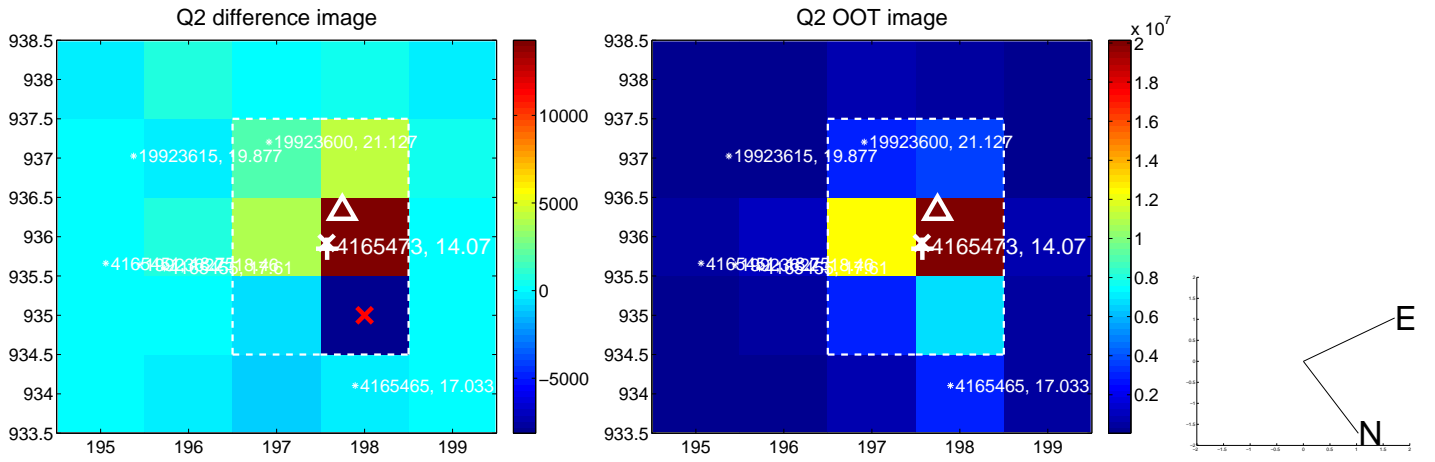
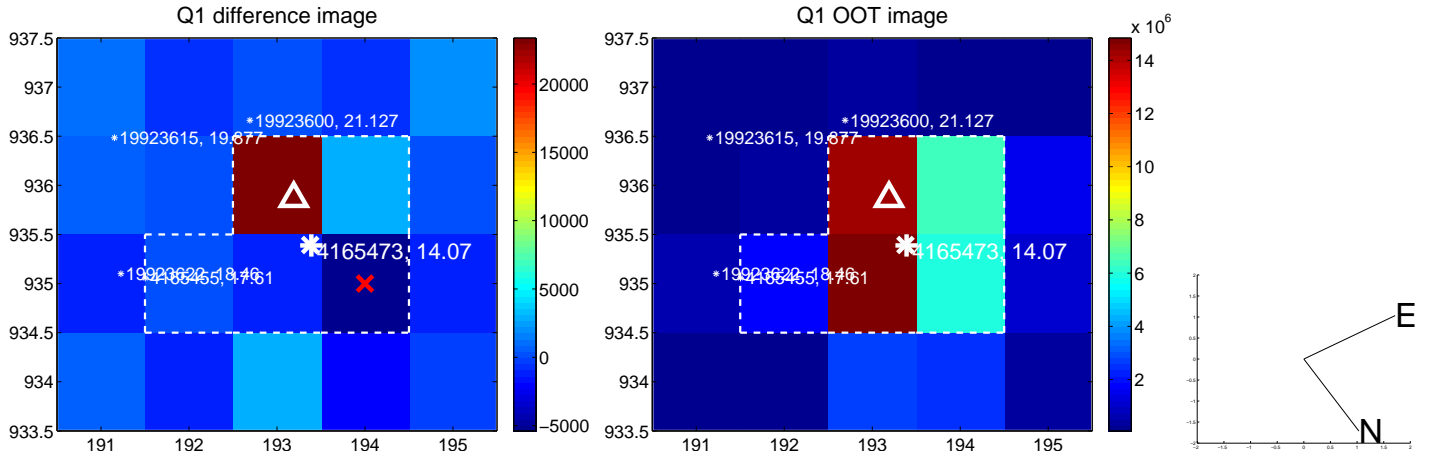
	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.370 \pm 0.187$	1.98	$0.005 \pm 0.131$	$-0.370 \pm 0.186$
PRF-fit source offset from KIC position	$0.263 \pm 0.178$	1.48	$-0.069 \pm 0.093$	$-0.254 \pm 0.183$
photometric centroid source offset	$0.53 \pm 0.21$	2.56	$0.17 \pm 0.22$	$0.50 \pm 0.21$



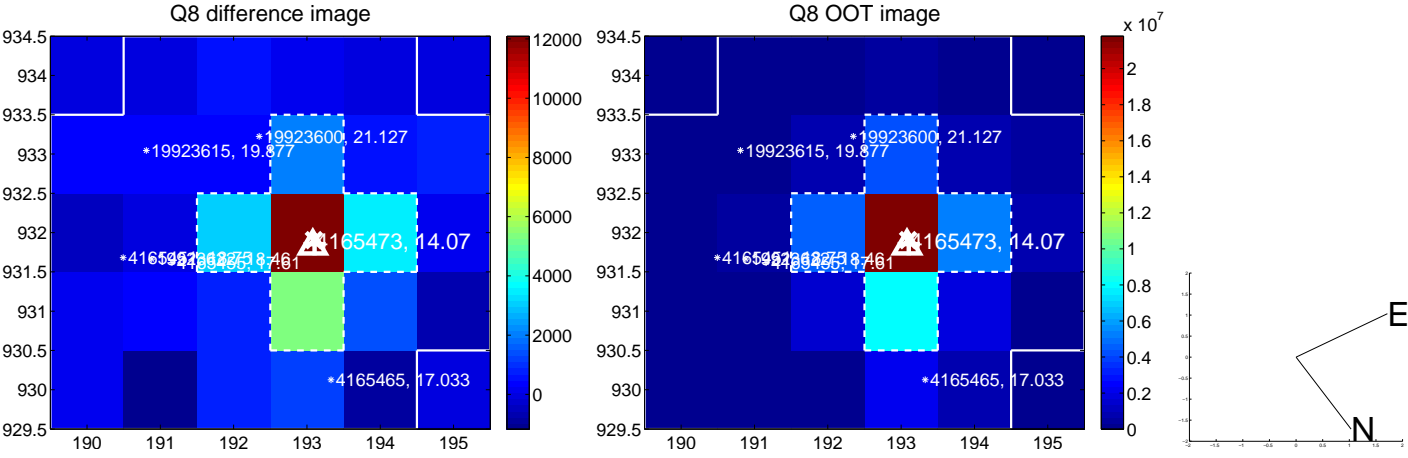
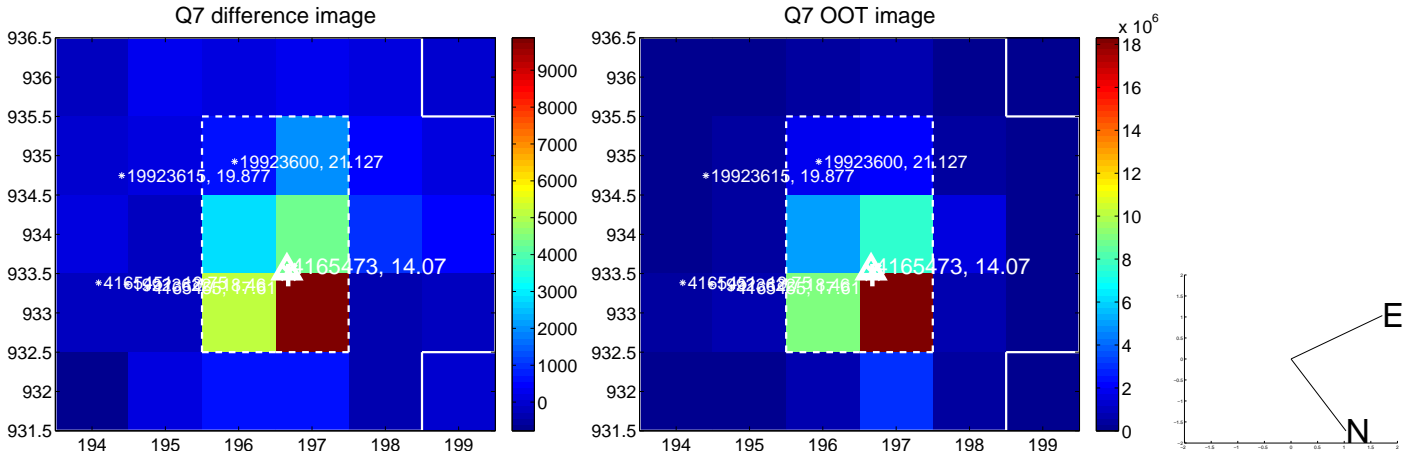
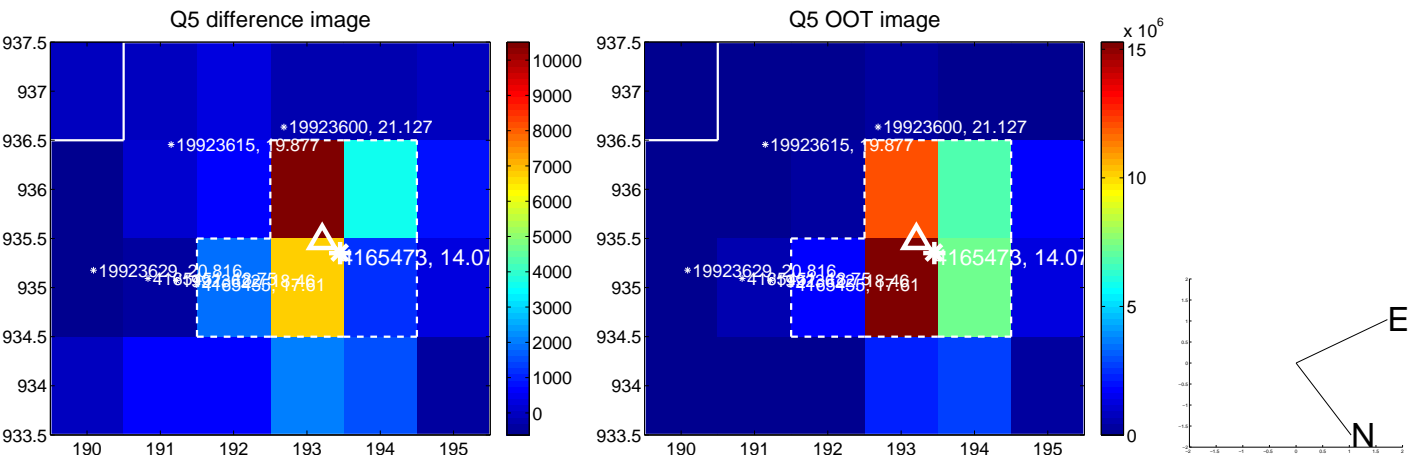
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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



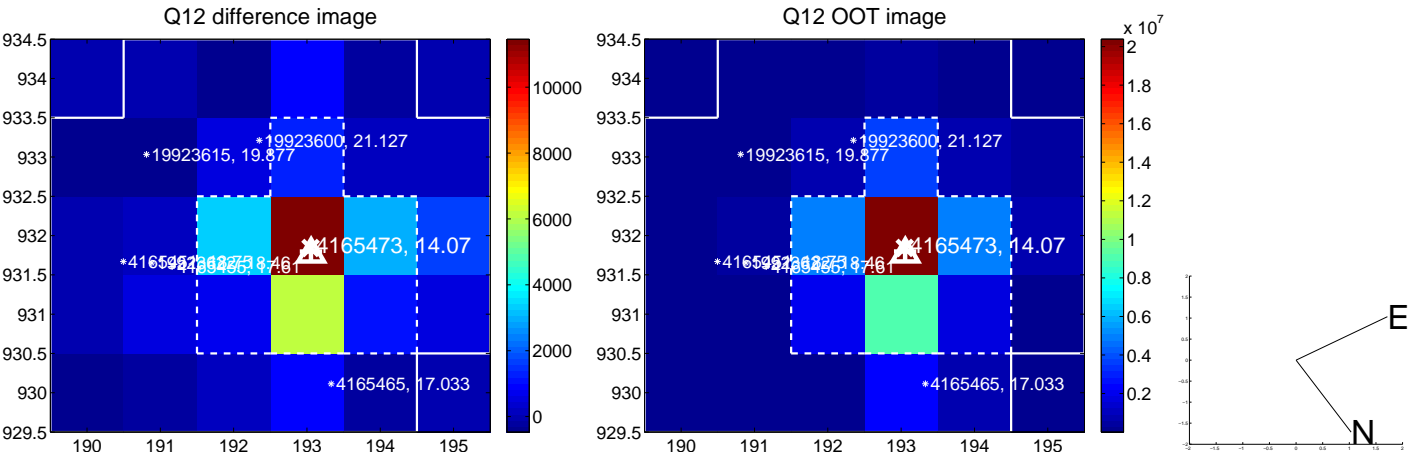
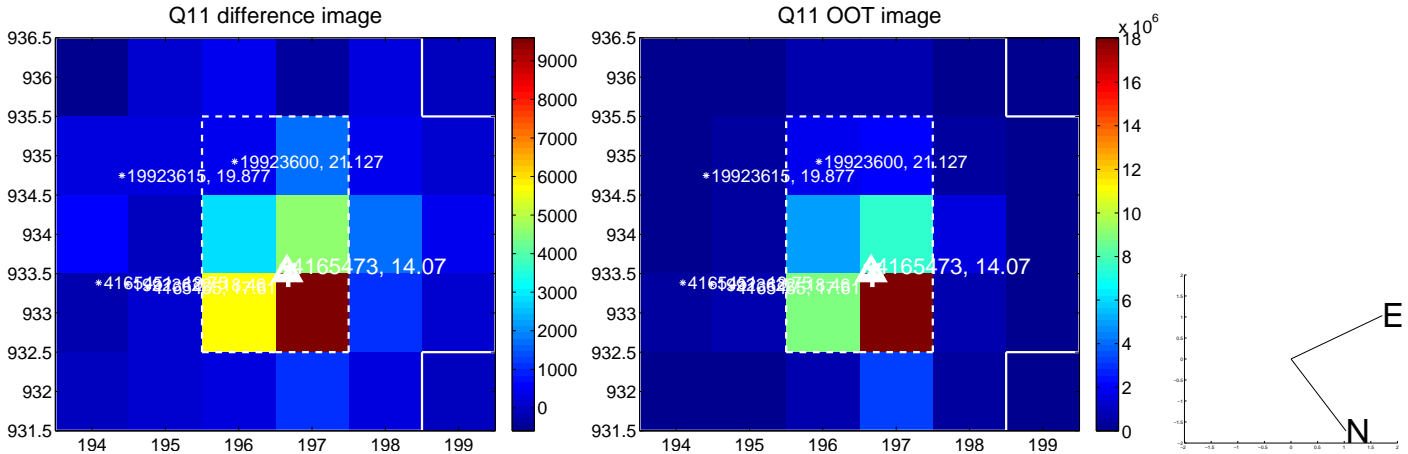
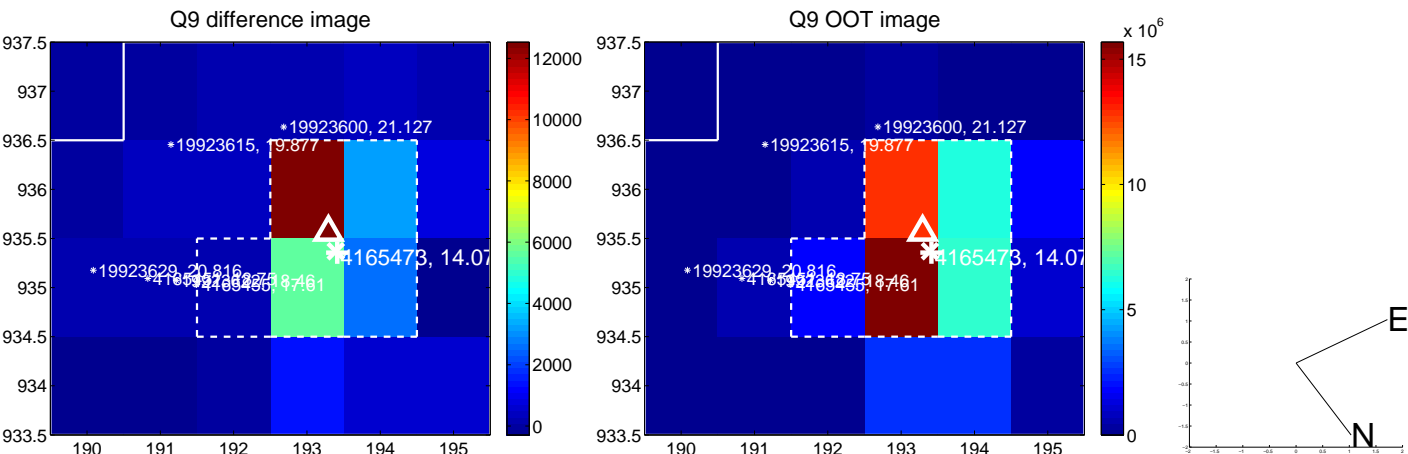
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



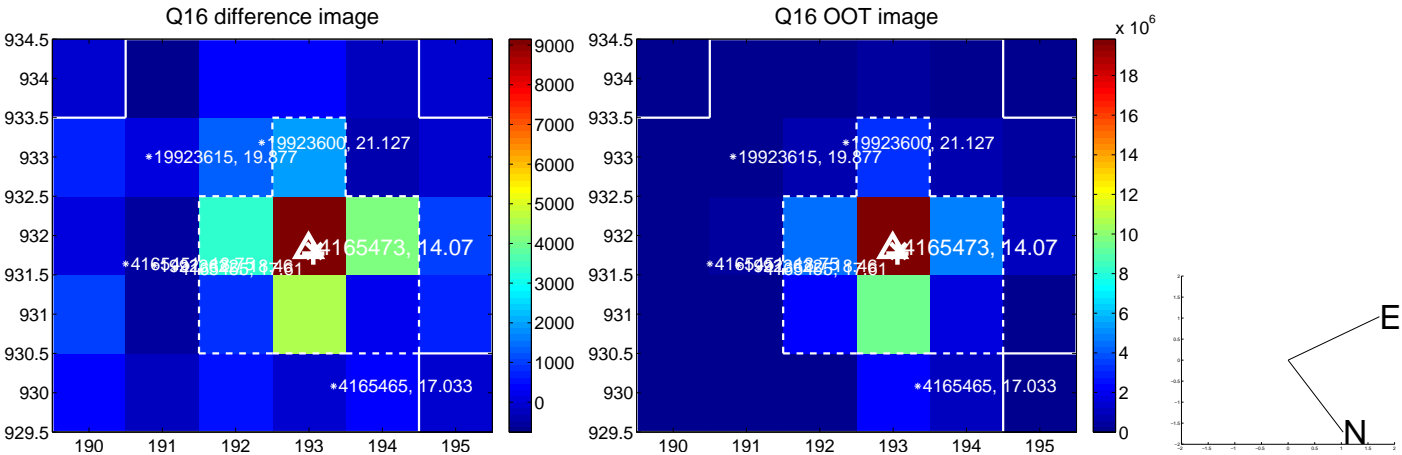
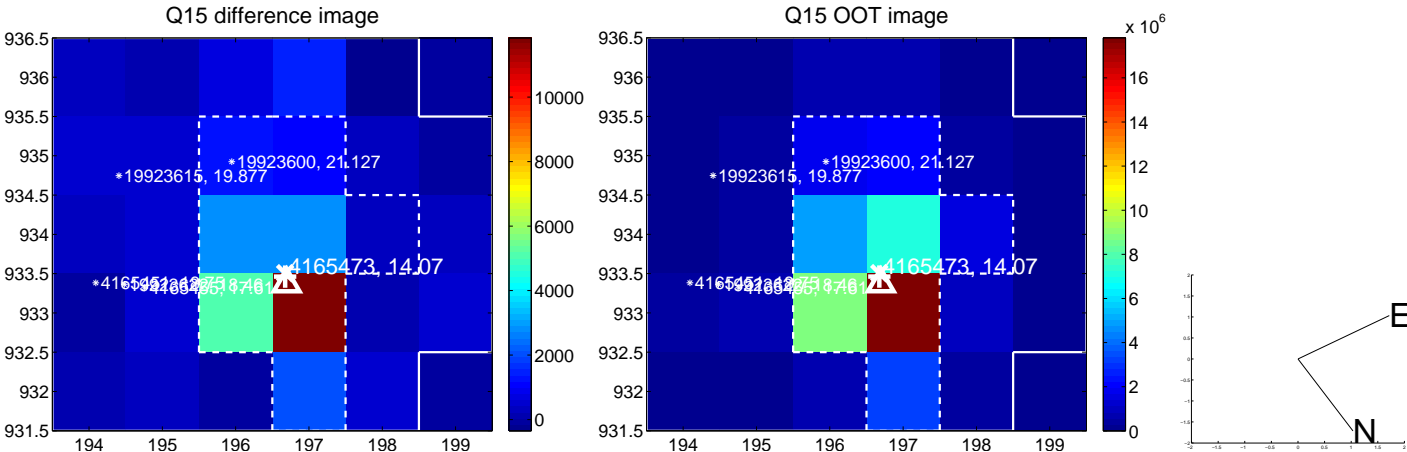
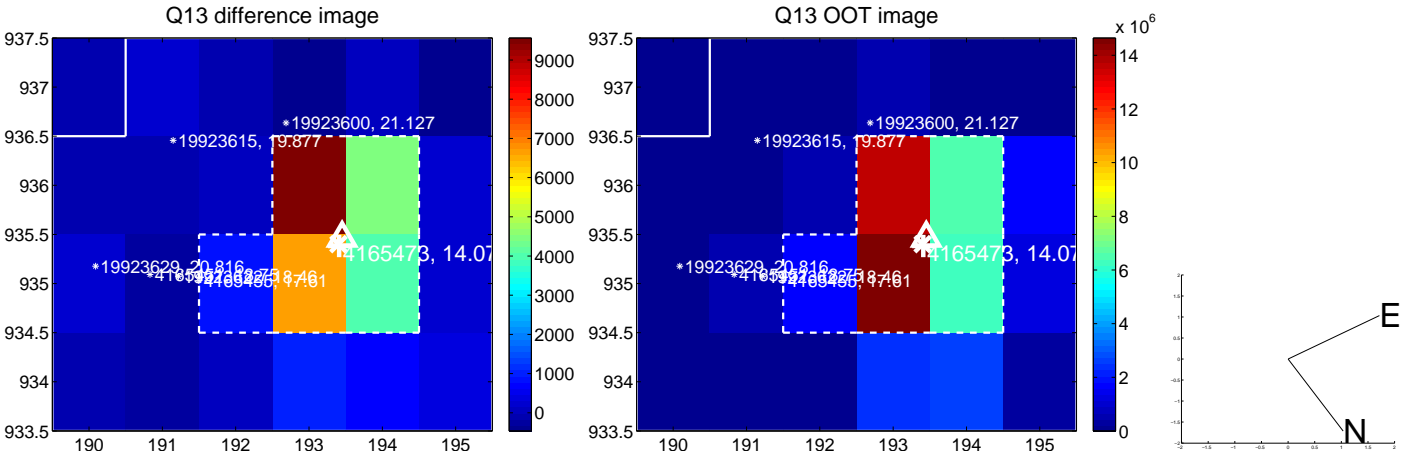
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



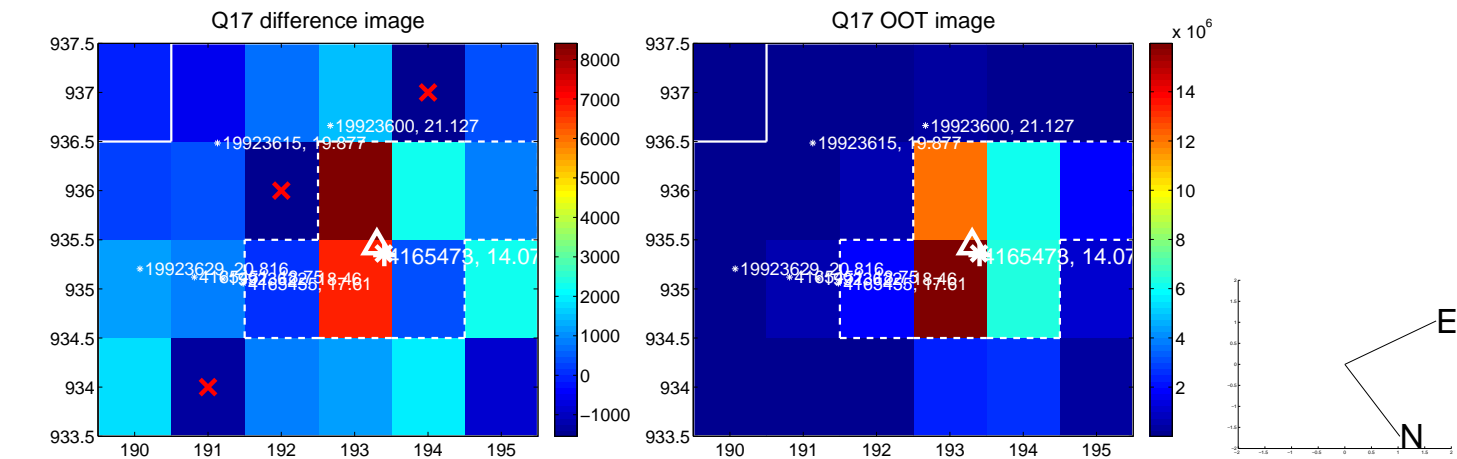
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



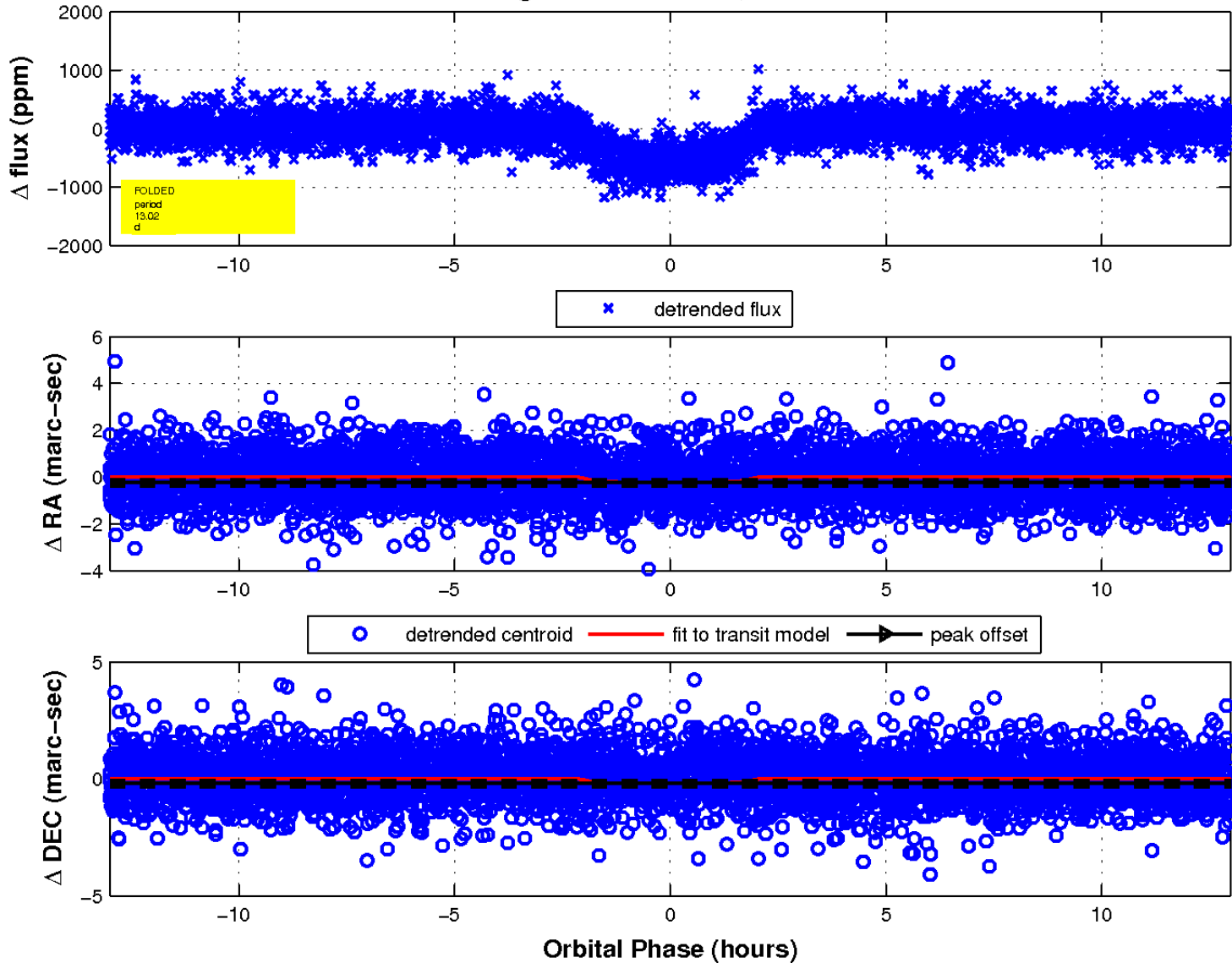
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

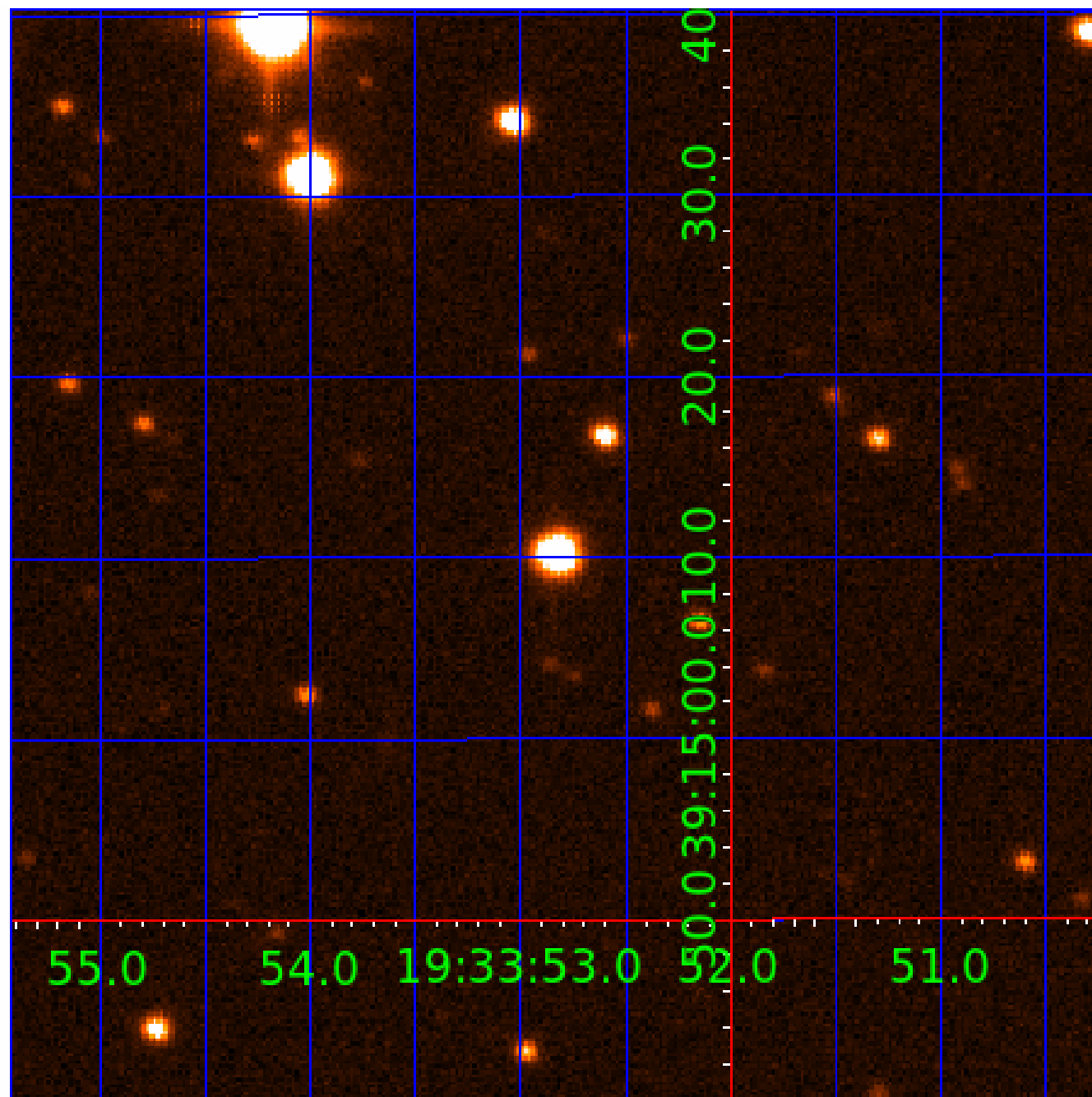


fluxWeightedCentroids, Planet 1 of 2



UKIRT Image

Declination





# KIC 004165473

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004165473-01	OBS	0550.01	13.023675	139.452786	607.7	4.330	43.6	47.0	0.94	5627	2.75	72.00
004165473-02	OBS	No	224.756196	317.645696	364.3	5.859	9.1	7.0	0.94	5627	2.03	1.61

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004165473-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
004165473-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_CHASES_MARSHALL—ALL_TRANS_CHASES—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.

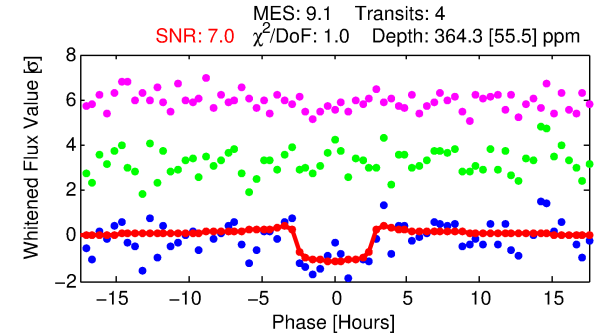
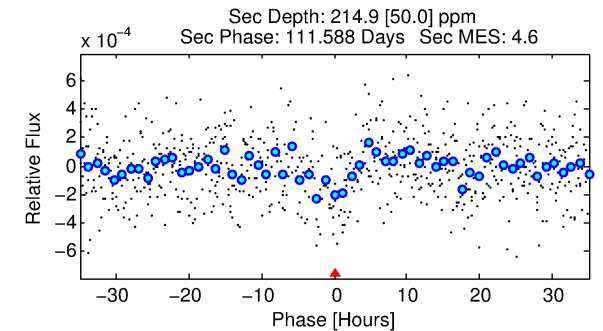
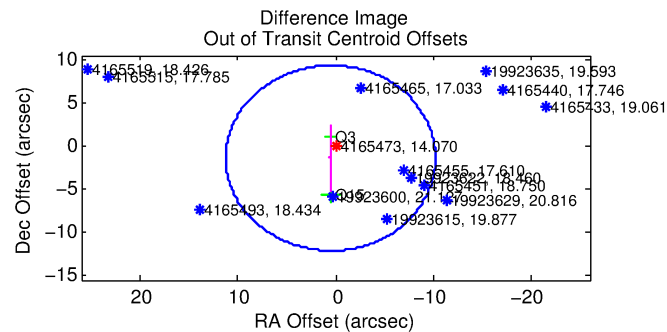
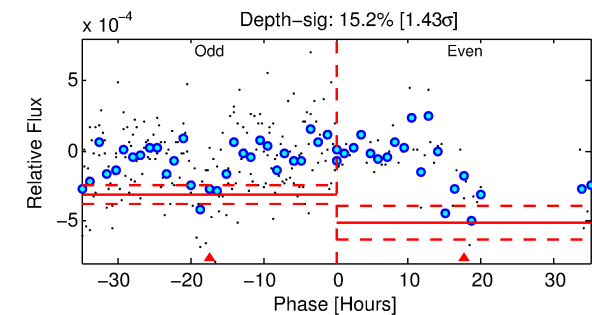
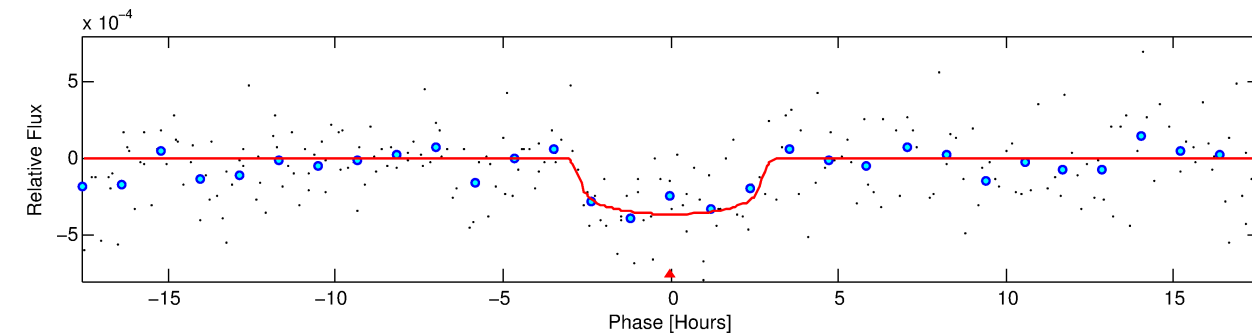
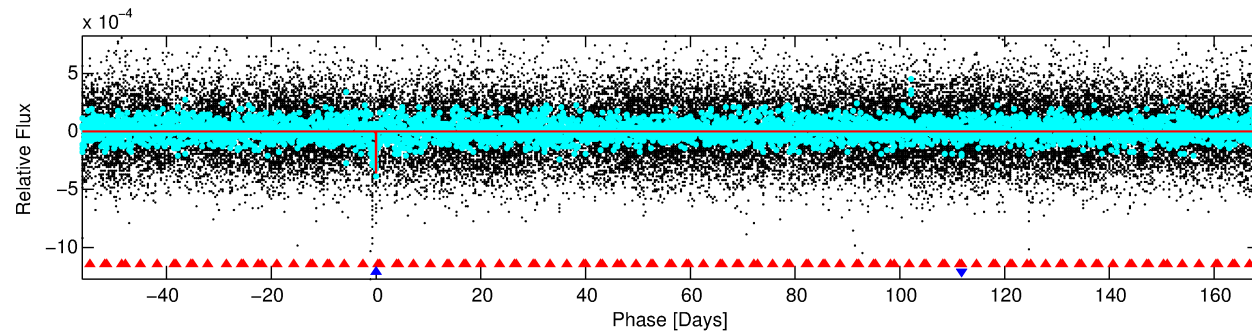
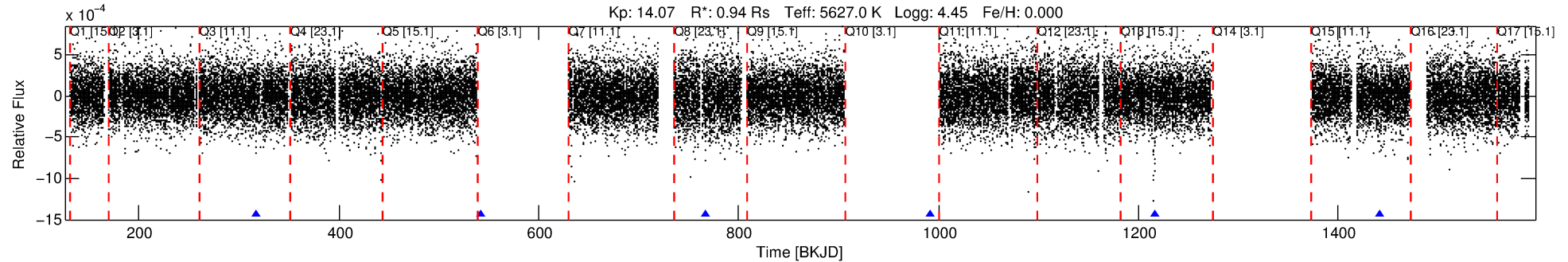
## Ephemeris Match Information For 004165473-02

No Significant Match Found

# DV One-Page Summary

KIC: 4165473 Candidate: 2 of 2 Period: 224.756 d  
KOI: K00550 Corr: No Ephemeris Match

Kp: 14.07 R\*: 0.94 Rs Teff: 5627.0 K Logg: 4.45 Fe/H: 0.000



## DV Fit Results:

Period = 224.75620 [0.00405] d  
Epoch = 317.6457 [0.0127] BKJD  
Rp/R\* = 0.0197 [0.0126]  
a/R\* = 176.27 [487.34]  
b = 0.82 [1.09]  
Seff = 1.61 [0.33]  
Teq = 287 [15] K  
Rp = 2.03 [1.33] Re  
a = 0.7049 [0.0846] AU  
Ag = 14239.94 [18770.96] [0.76σ]  
Teffp = 4855 [1587] K [2.88σ]

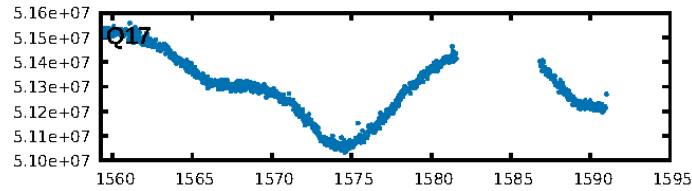
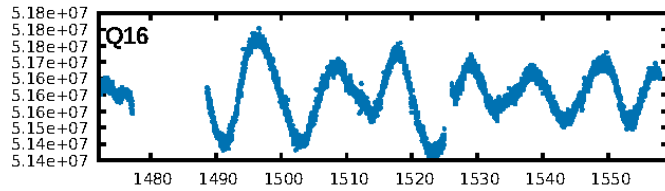
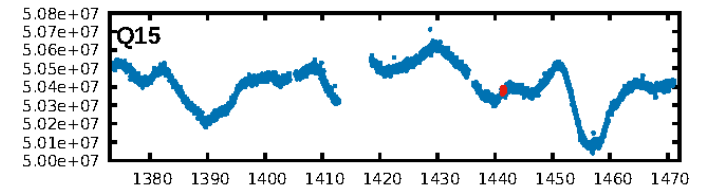
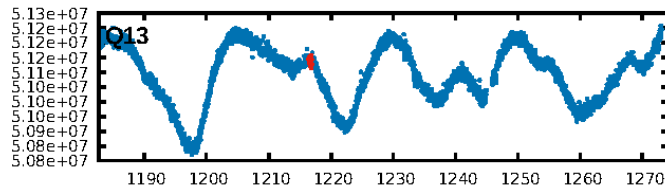
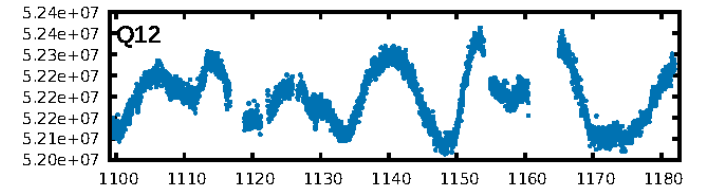
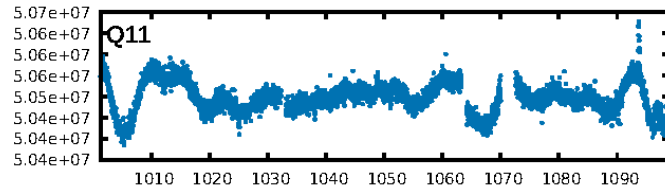
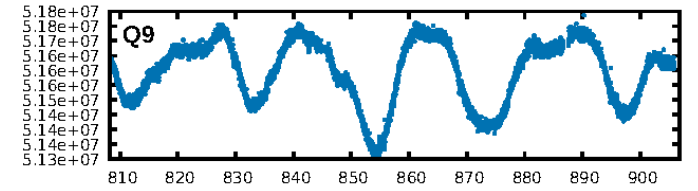
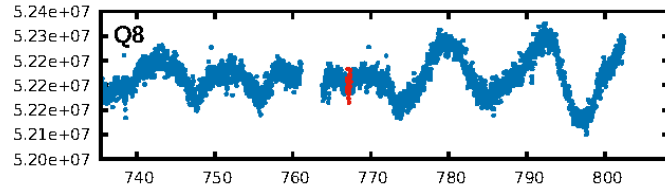
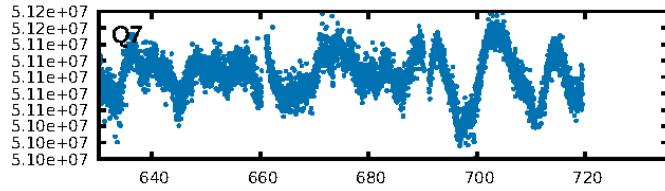
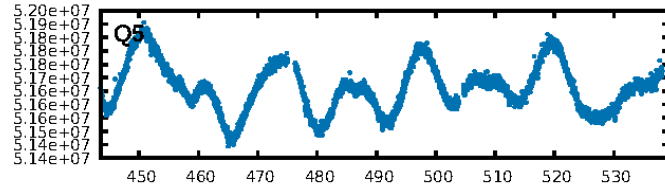
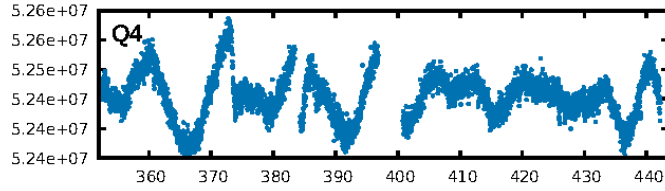
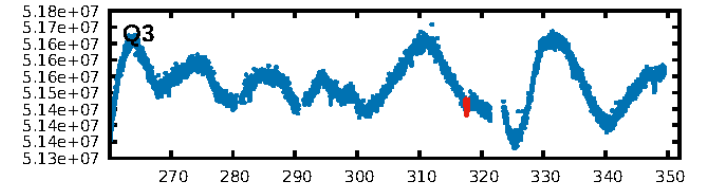
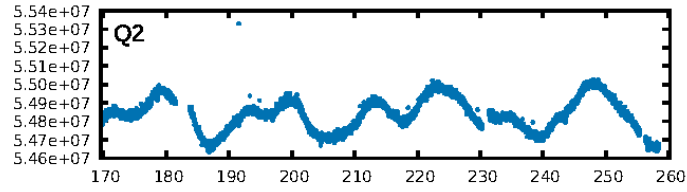
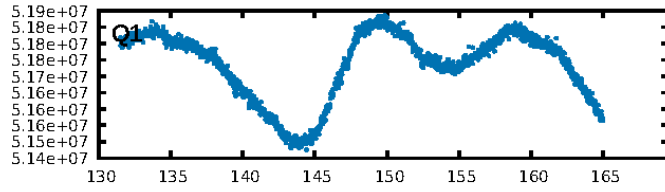
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [697.46σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 3.6%  
ModelChiSquareGof-sig: 94.3%  
Bootstrap-pfa: 4.24e-13  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: 5.488  
Centroid-sig: 21.1%  
Centroid-so: 1.354 arcsec [1.03σ]  
OotOffset-rm: 1.484 arcsec [0.42σ]  
OotOffset-st: 0/2/0/0 [2]  
KicOffset-rm: 1.286 arcsec [0.36σ]  
KicOffset-st: 0/2/0/0 [2]  
DiffImageQuality-fgm: 0.50 [1/2]  
DiffImageOverlap-fno: 0.67 [2/3]

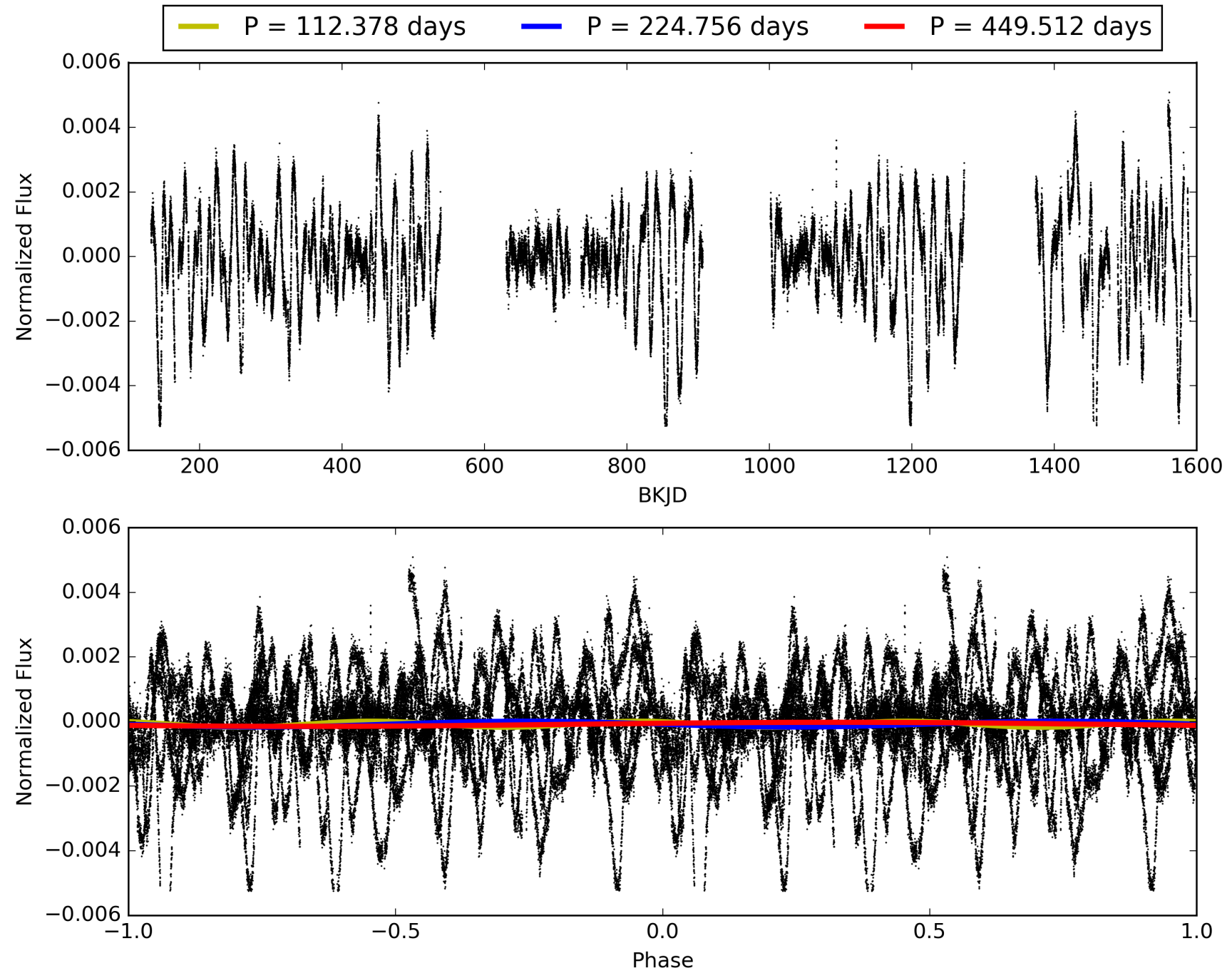
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 08:18:26 Z

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

# TCE 004165473-02, PDC Light Curves

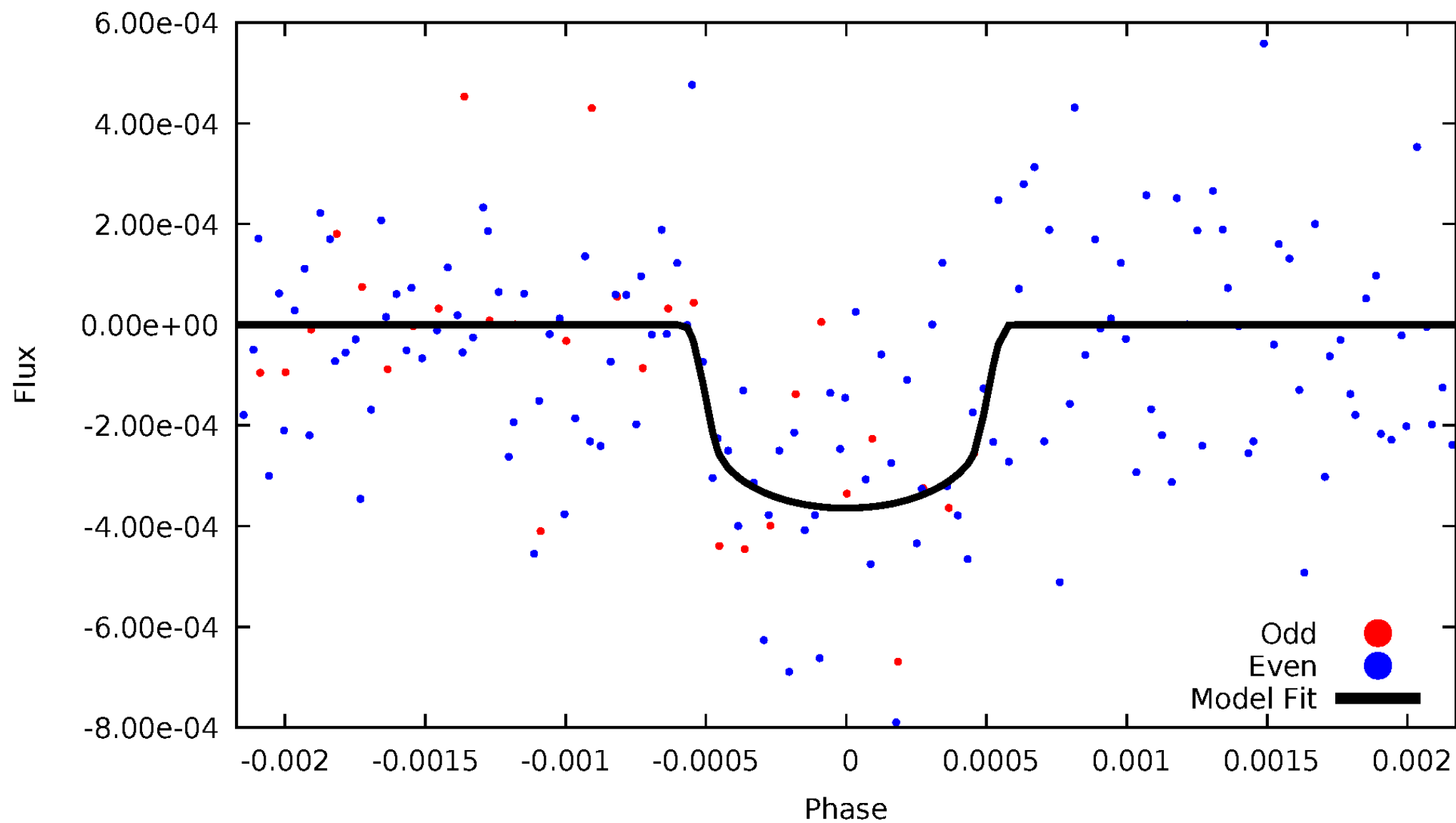


TCE 004165473-02



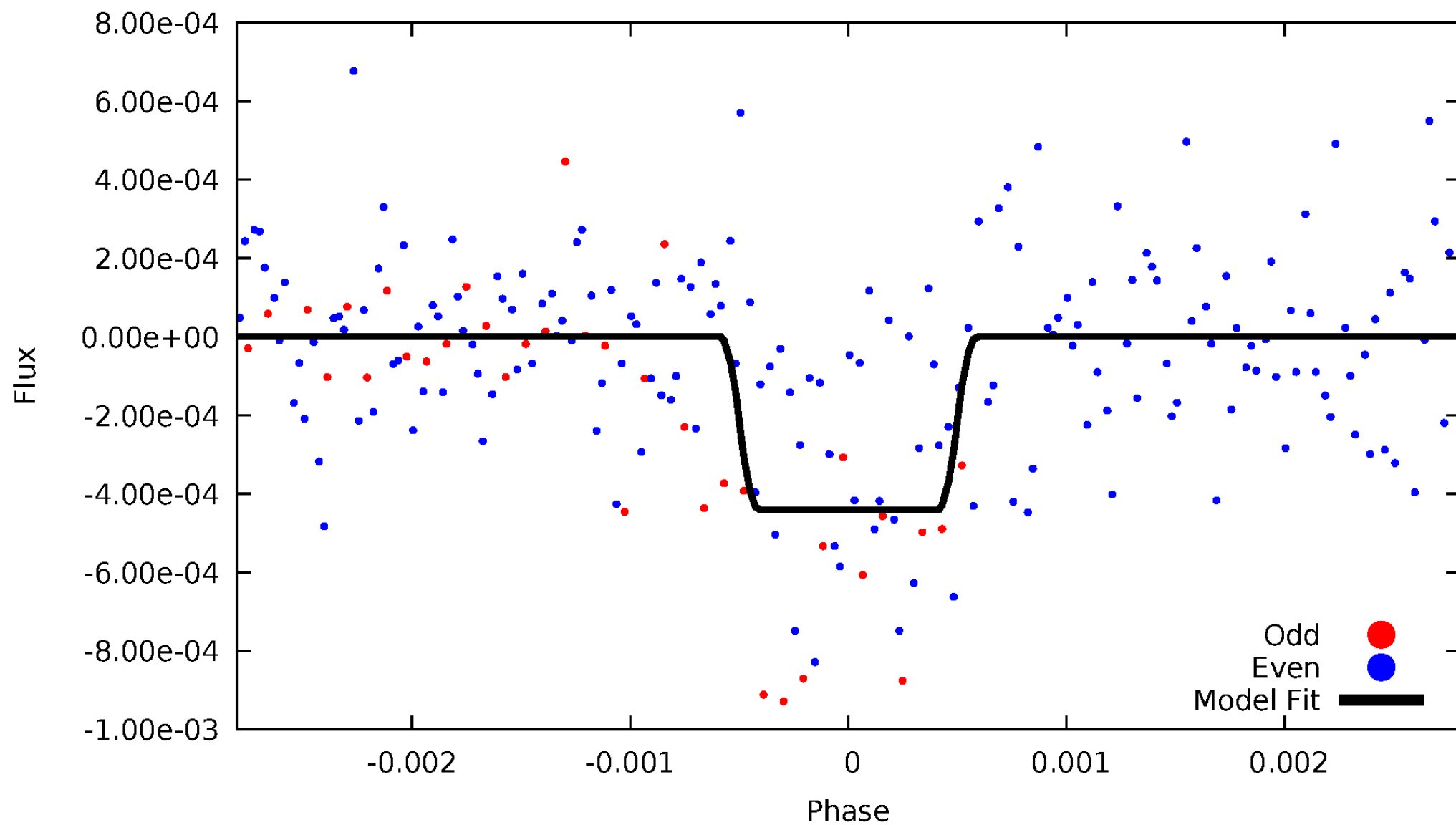
# DV Odd/Even

TCE 004165473-02



# ALT Odd/Even

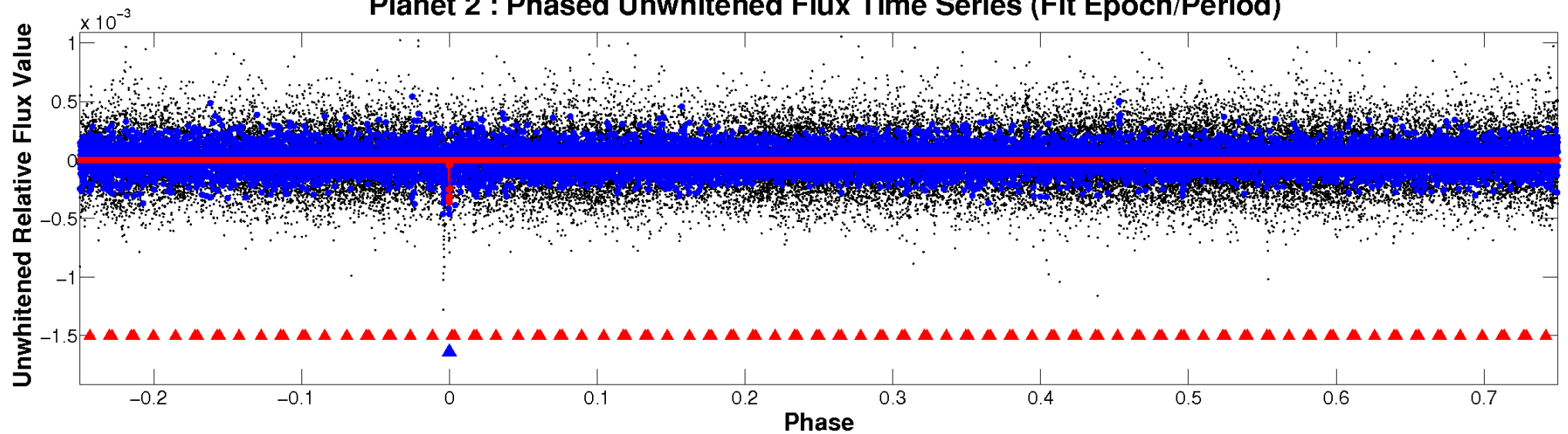
TCE 004165473-02



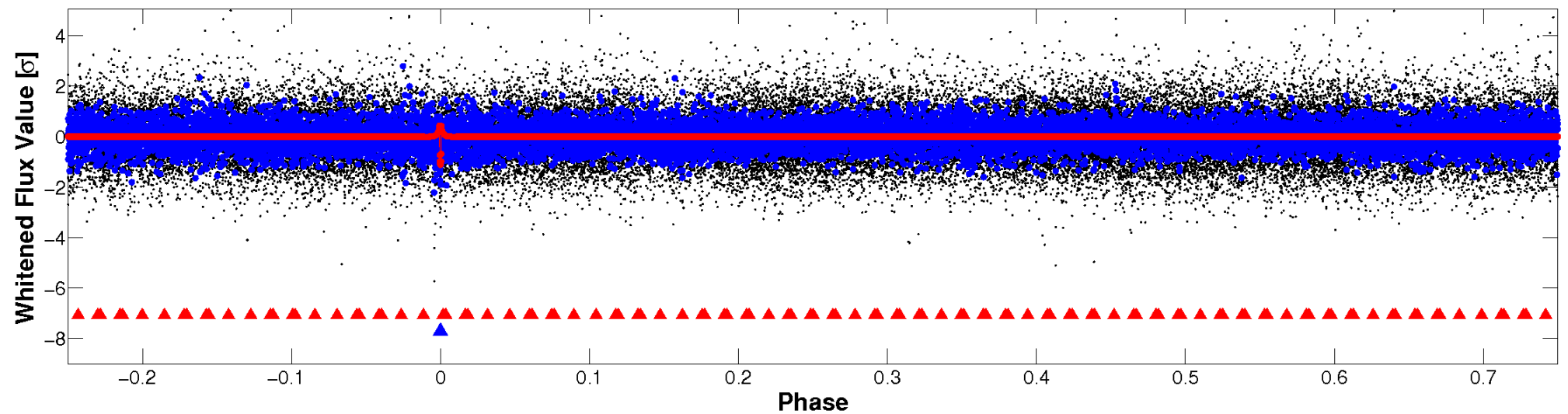


# Non-Whitened Vs. Whitened Light Curve

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

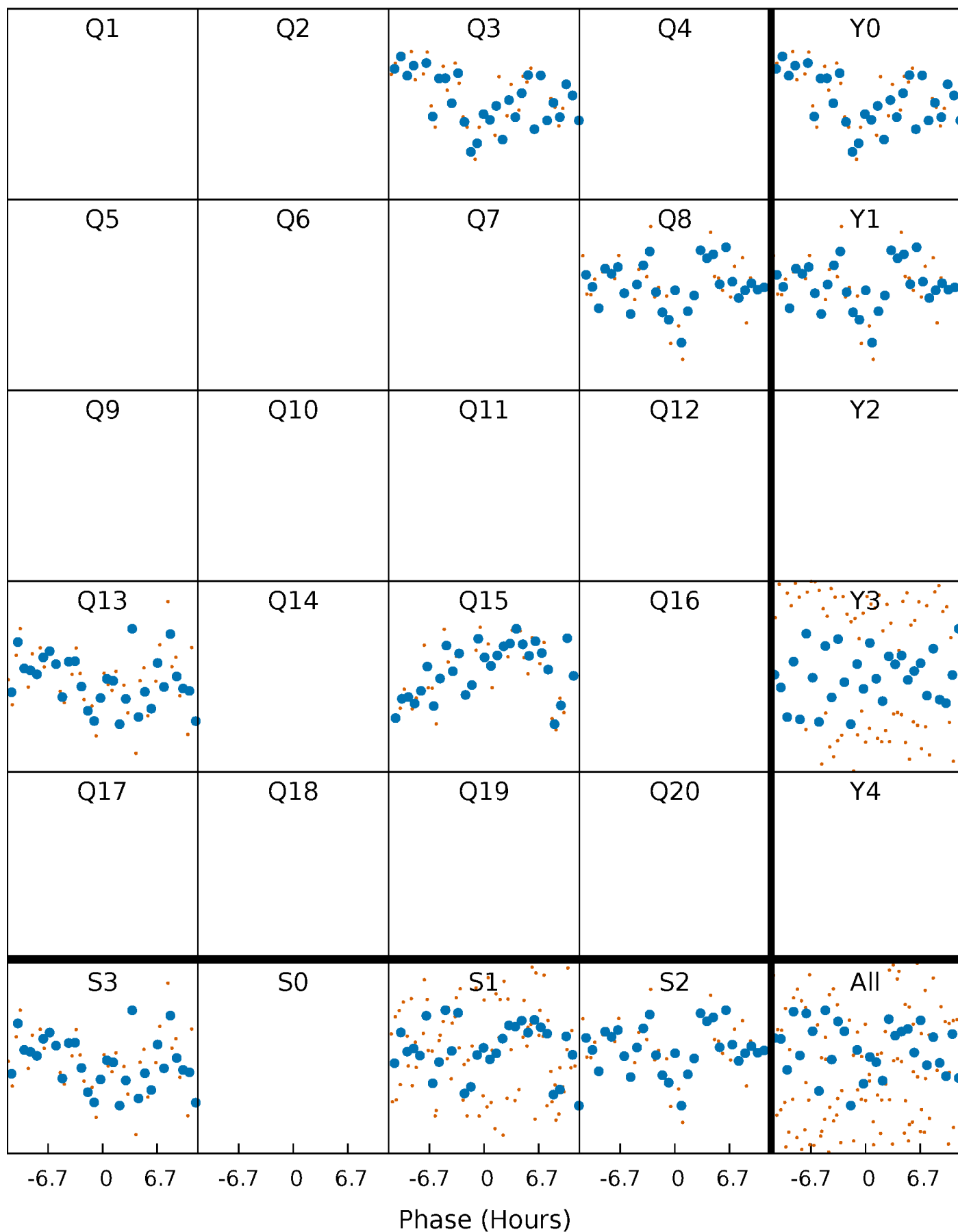


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



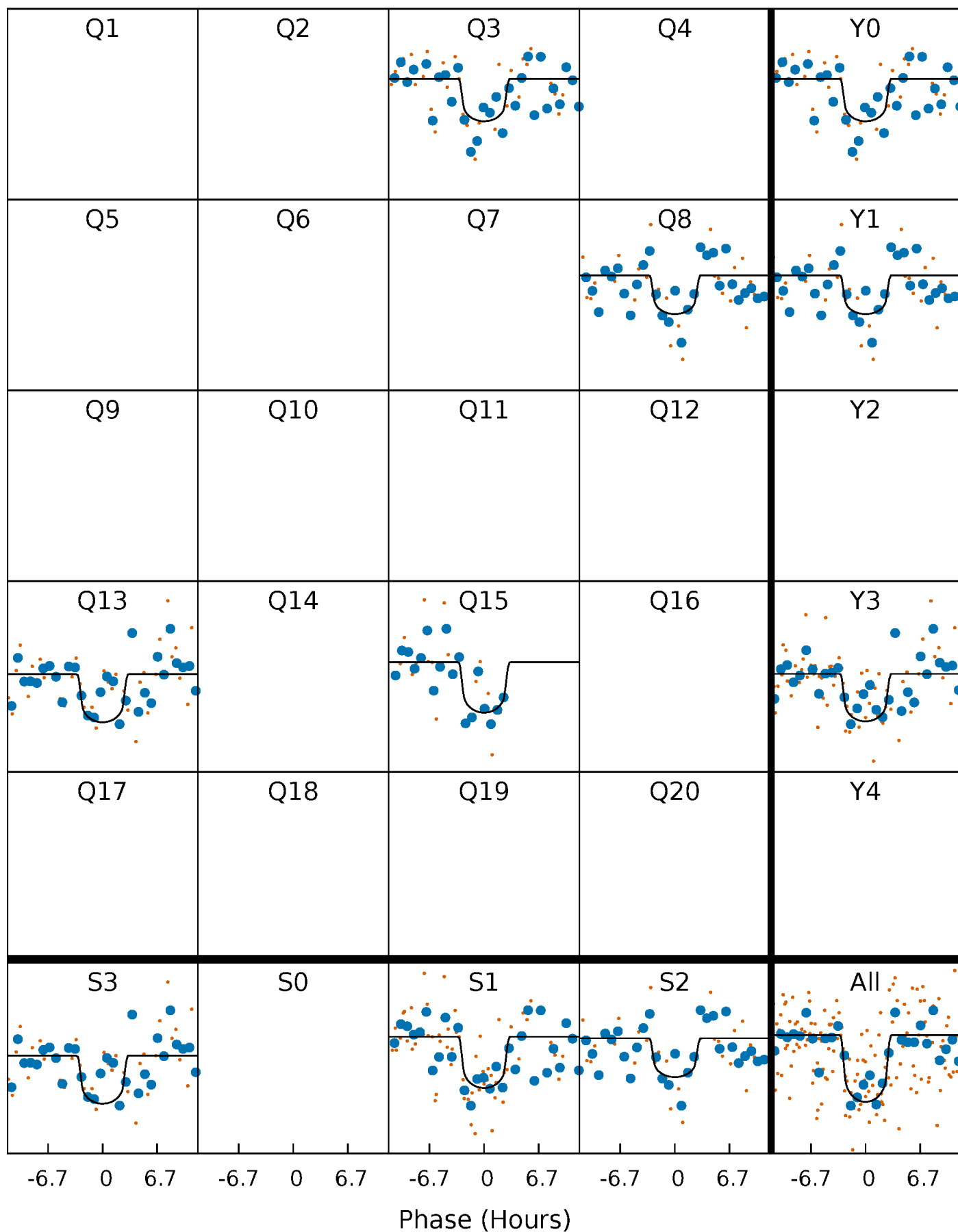
# PDC Quarter-Phased Transit Curves

TCE 004165473-02     $P=224.756196$  Days     $T_0=317.645696$  (BKJD)



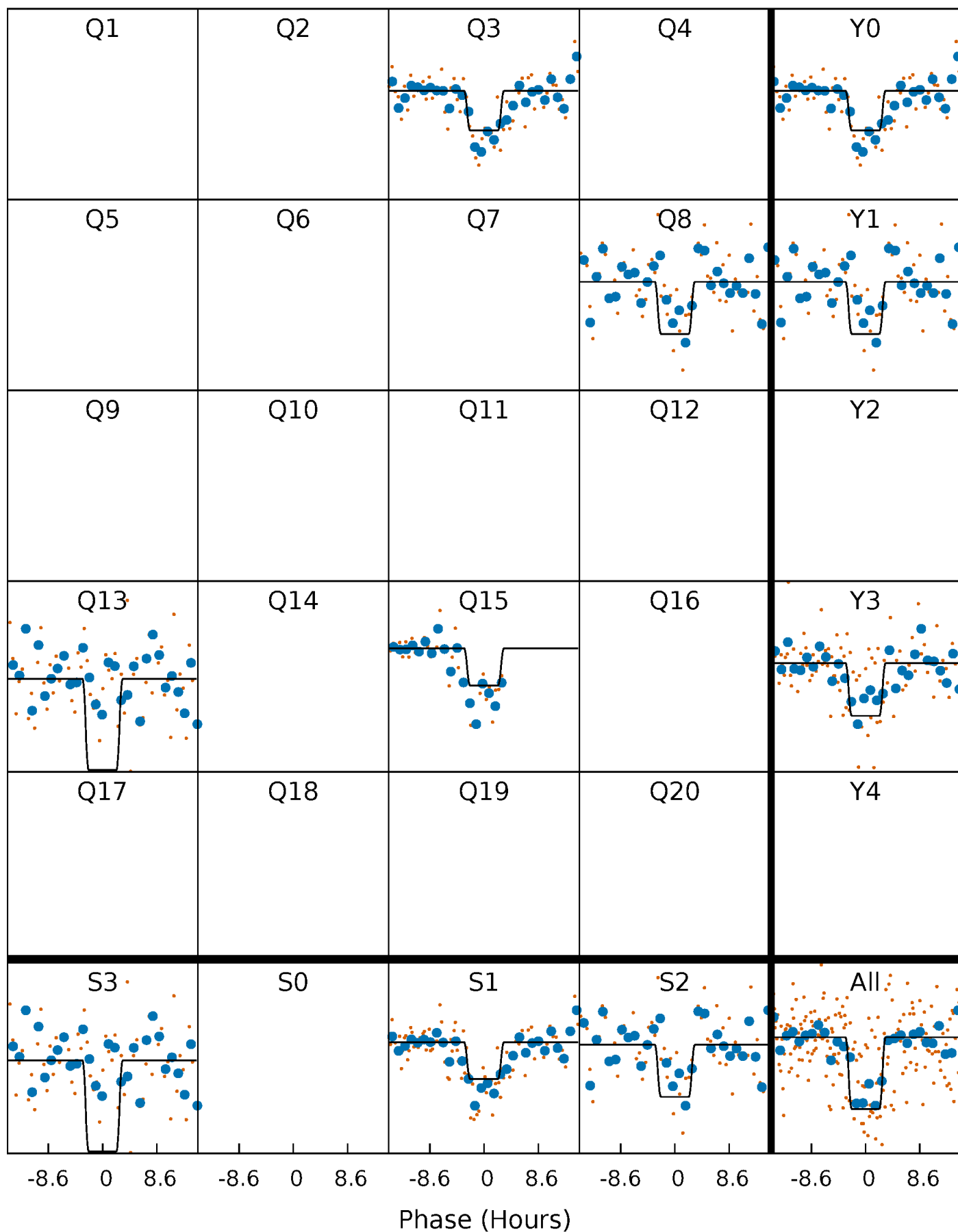
# DV Quarter-Phased Transit Curves

TCE 004165473-02     $P=224.756196$  Days     $T_0=317.645696$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

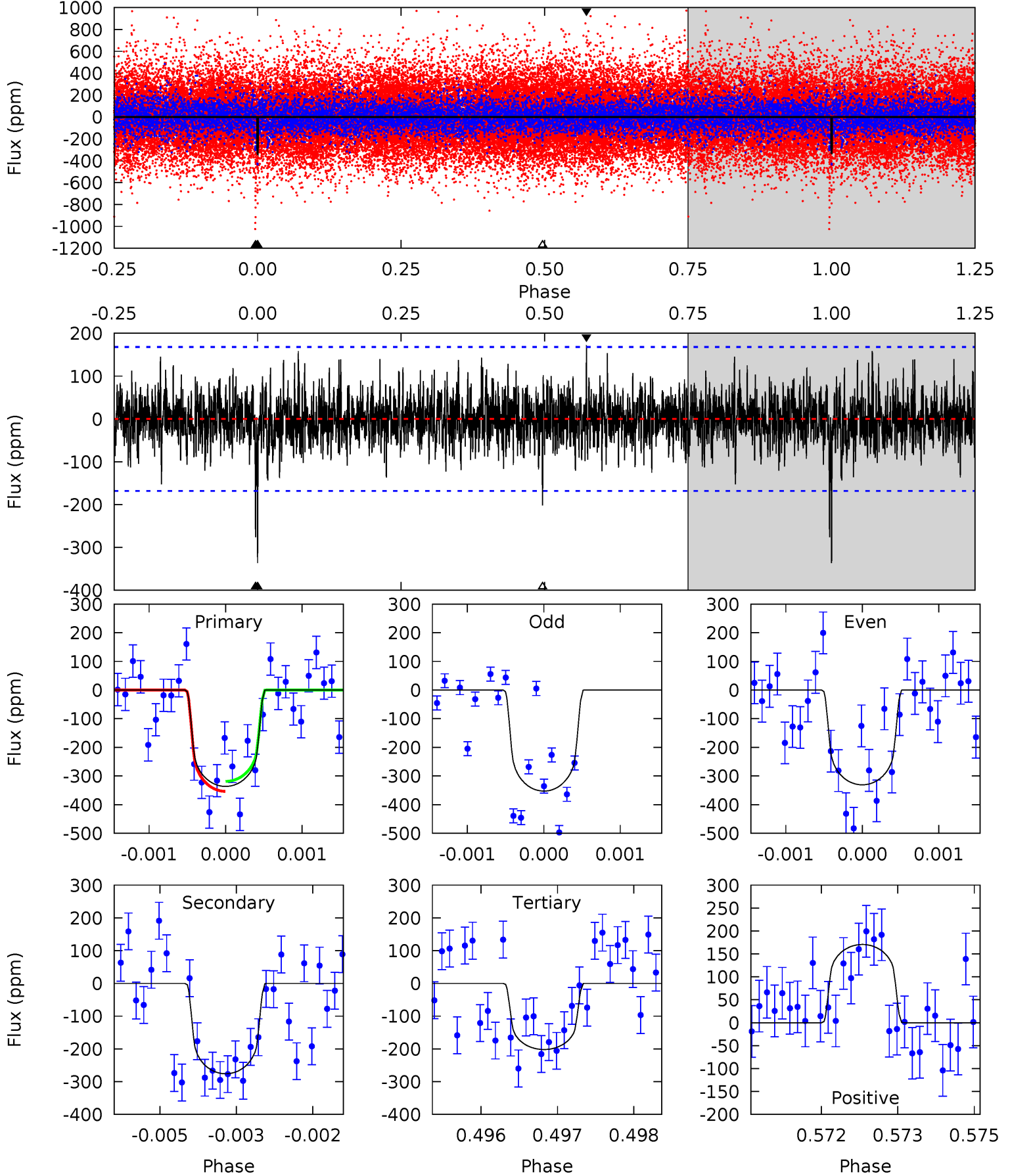
TCE 004165473-02 P=224.755538 Days  $T_0=317.634500$  (BKJD)



# DV Model-Shift Uniqueness Test

004165473-02, P = 224.756196 Days, E = 92.889500 Days

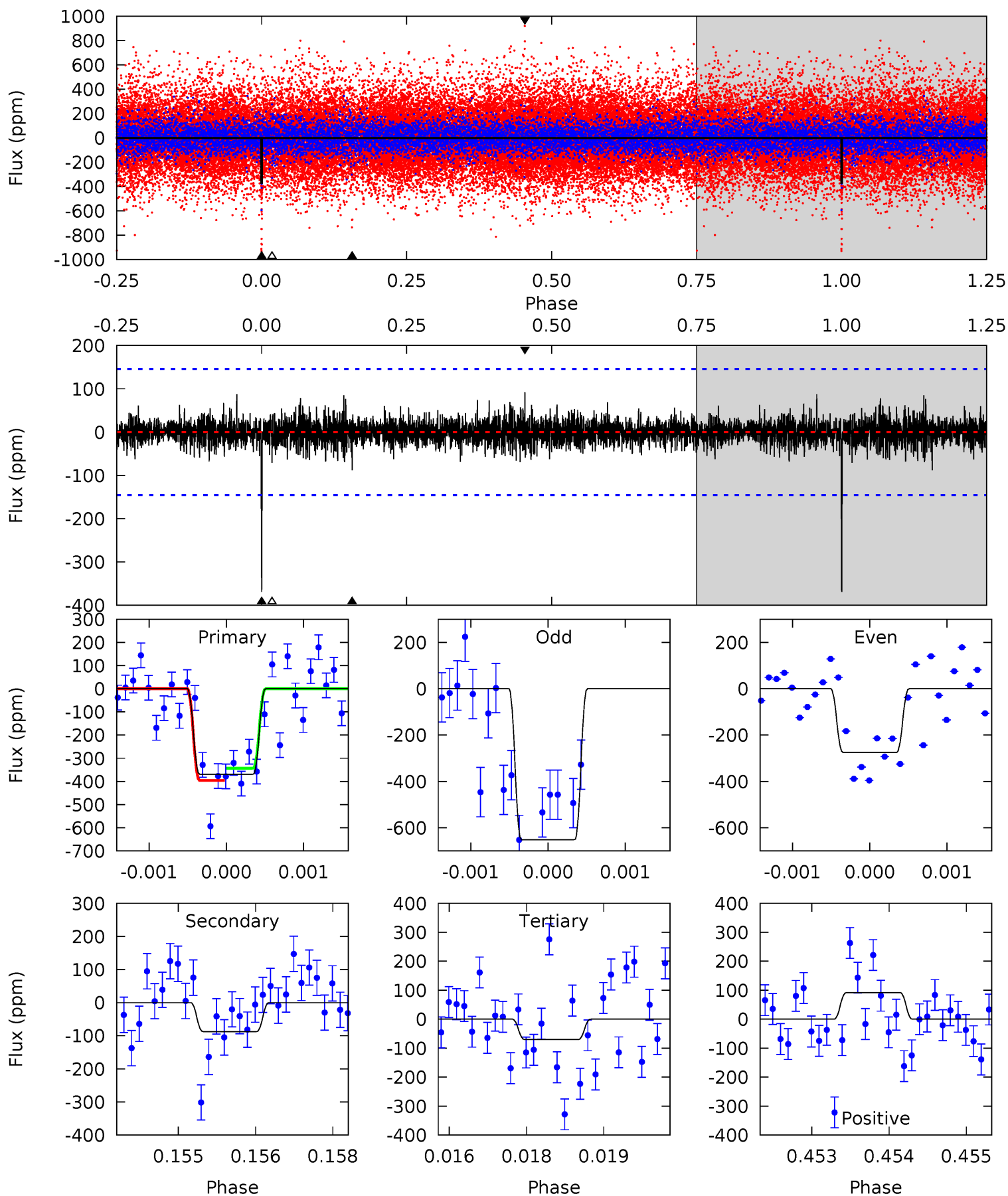
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
10.9	8.92	6.52	5.51	5.43	3.26	1.39	4.34	5.36	2.39	3.41	0.31	0.91	0.34	0.56



# Alt Model-Shift Uniqueness Test

004165473-02, P = 224.755538 Days, E = 92.878962 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
13.7	3.26	2.62	3.42	5.42	3.25	0.75	11.1	10.3	0.64	-0.16	6.05	0.94	0.20	0.98



### Stellar Parameters For KIC 004165473

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5627^{+101}_{-112}$	$4.453^{+0.072}_{-0.108}$	$0.000^{+0.150}_{-0.150}$	$0.945^{+0.123}_{-0.076}$	$0.925^{+0.063}_{-0.057}$	$1.541^{+0.437}_{-0.482}$
	+2%/-2%	+2%/-2%	+inf%/-inf%	+13%/-8%	+7%/-6%	+28%/-31%
Source	SPE57	SPE57	SPE57	DSEP		

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

### Secondary Eclipse Parameters for KIC 004165473-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-276 \pm 31$	$2.13^{+1.32}_{-1.19}$	$402^{+17}_{-13}$	$5124^{+2521}_{-910}$	$16754^{+69775}_{-10582}$
Alt.	$-88 \pm 27$	$2.32^{+1.29}_{-1.27}$	$403^{+15}_{-13}$	$3960^{+1411}_{-581}$	$4294^{+16750}_{-2613}$

$T_{max}$  = 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

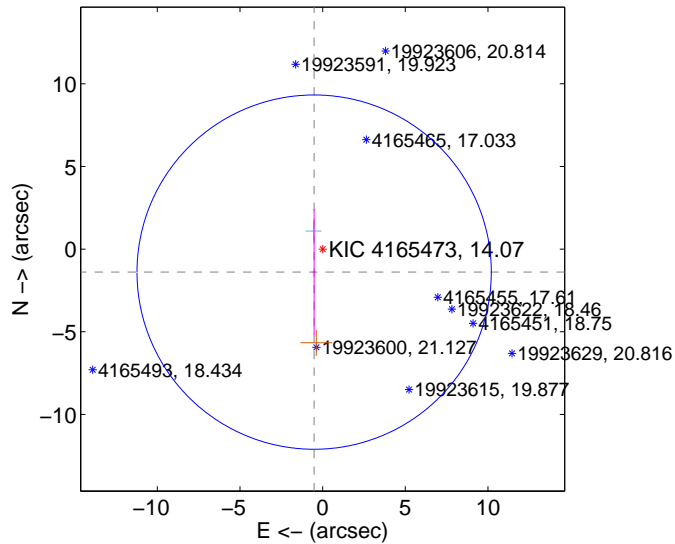
Supplemental centroid analysis for 004165473-02. Kepler magnitude: 14.07. Transit SNR 6.97

There are 1 quarters with good PRF difference image offsets

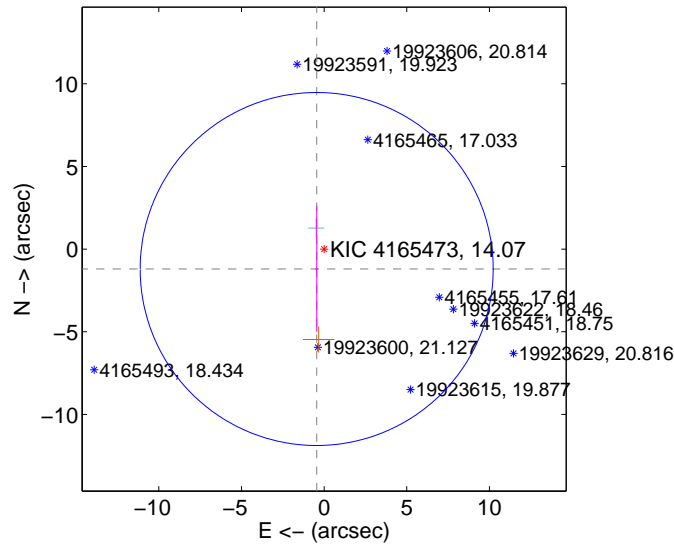
The direct PRF centroid is offset from the target star catalog position by about 0.21 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.484 \pm 3.573$	0.42	$0.514 \pm 0.100$	$-1.392 \pm 3.808$
PRF-fit source offset from KIC position	$1.286 \pm 3.560$	0.36	$0.450 \pm 0.097$	$-1.204 \pm 3.800$
photometric centroid source offset	$1.35 \pm 1.32$	1.03	$-0.13 \pm 1.30$	$1.35 \pm 1.32$

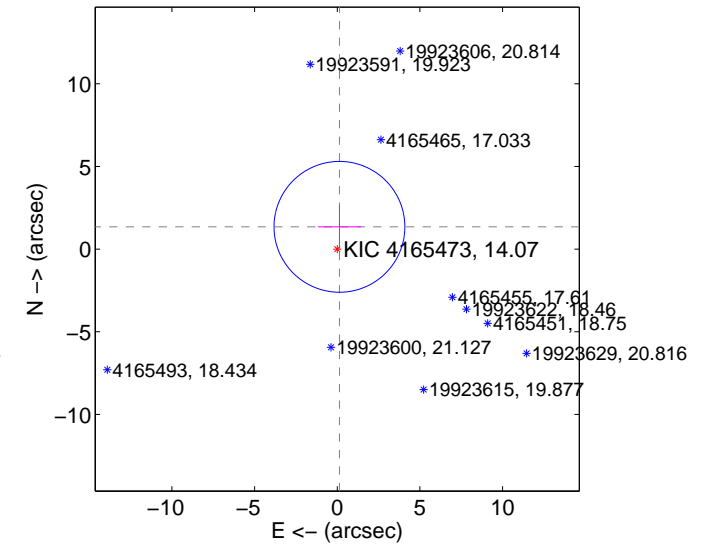
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

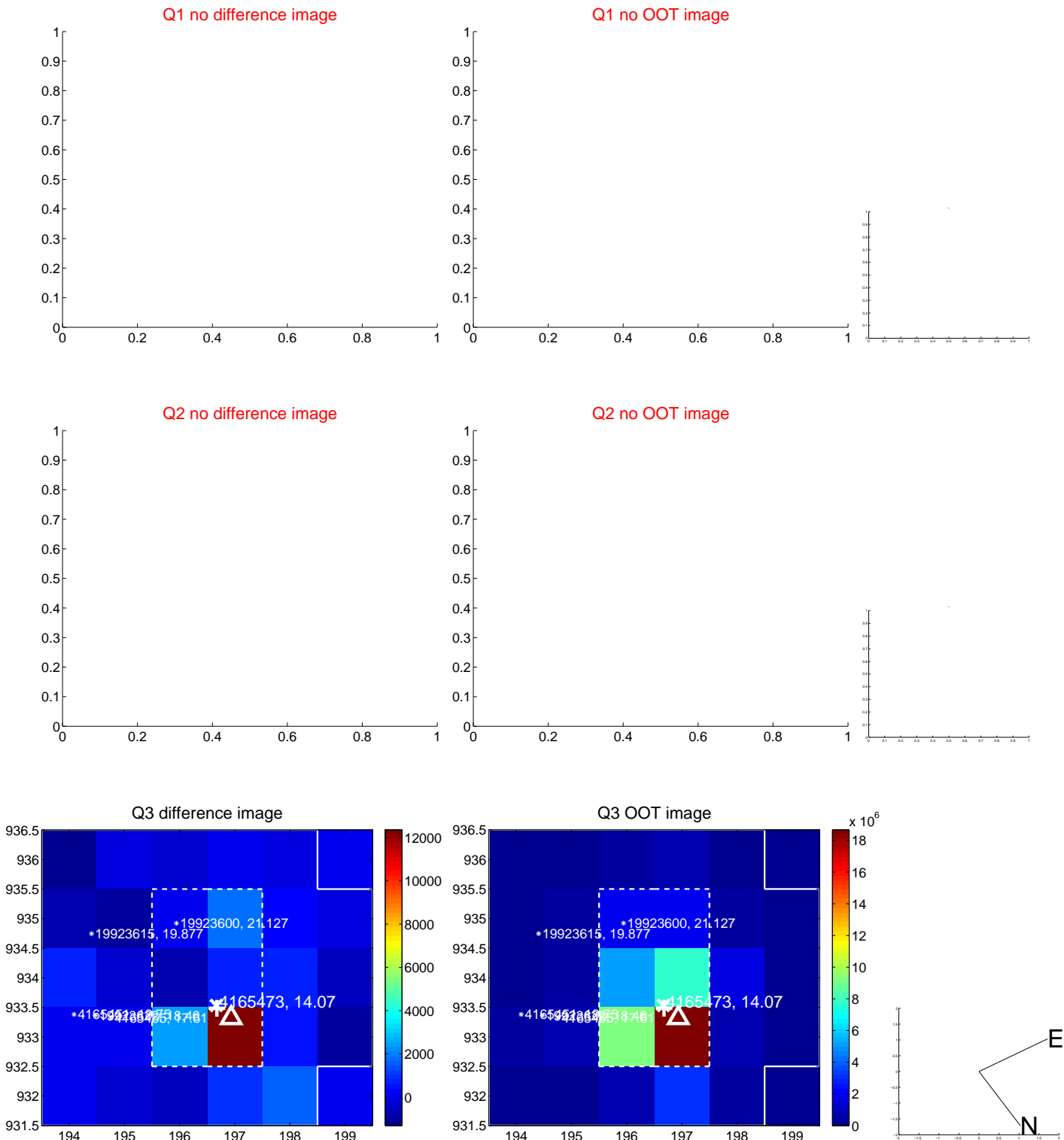


offset from photometric centroids

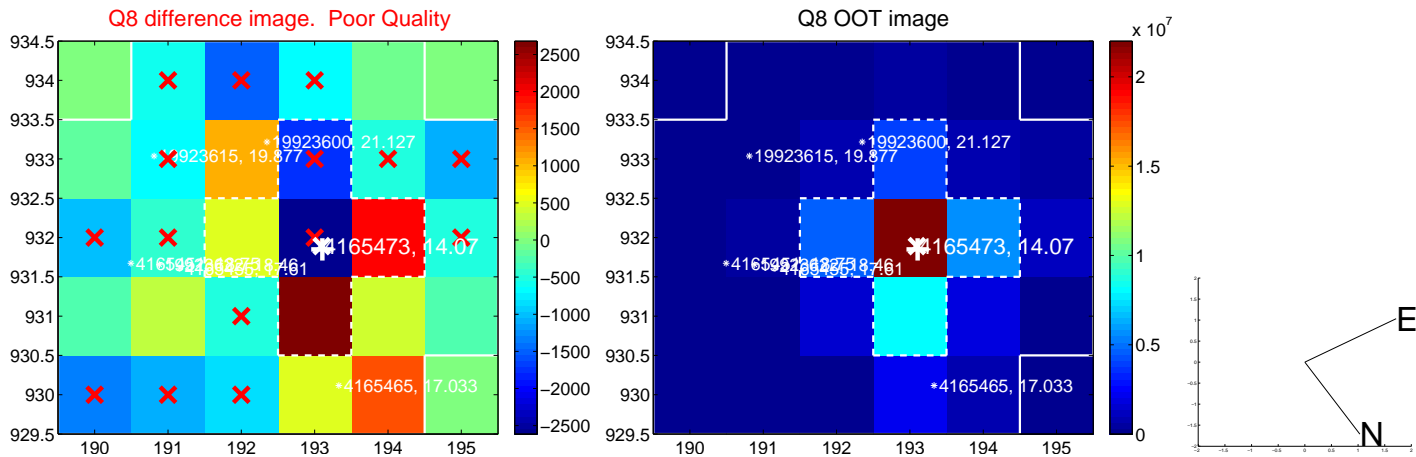
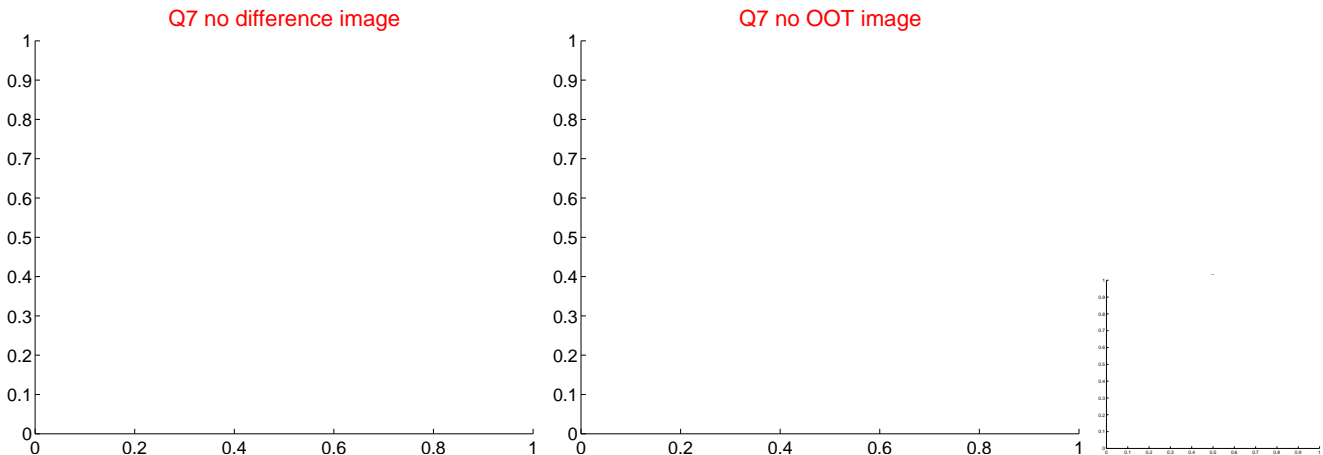
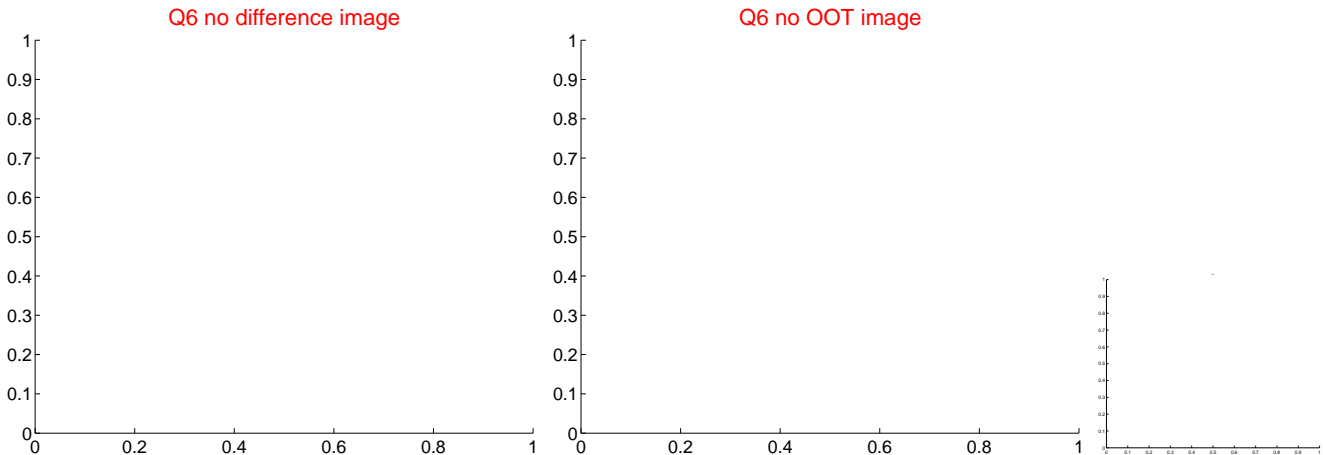
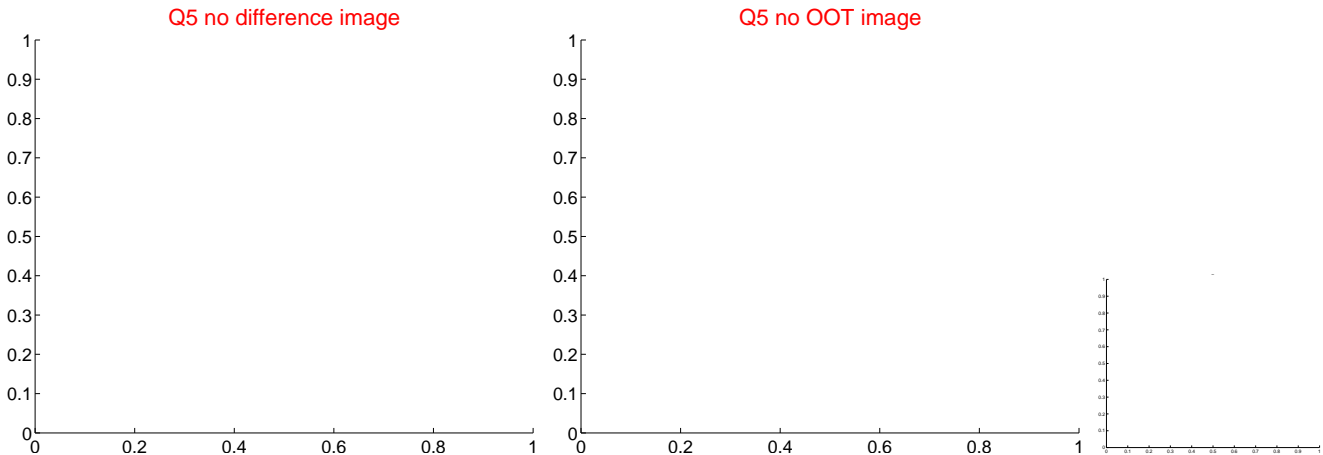


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

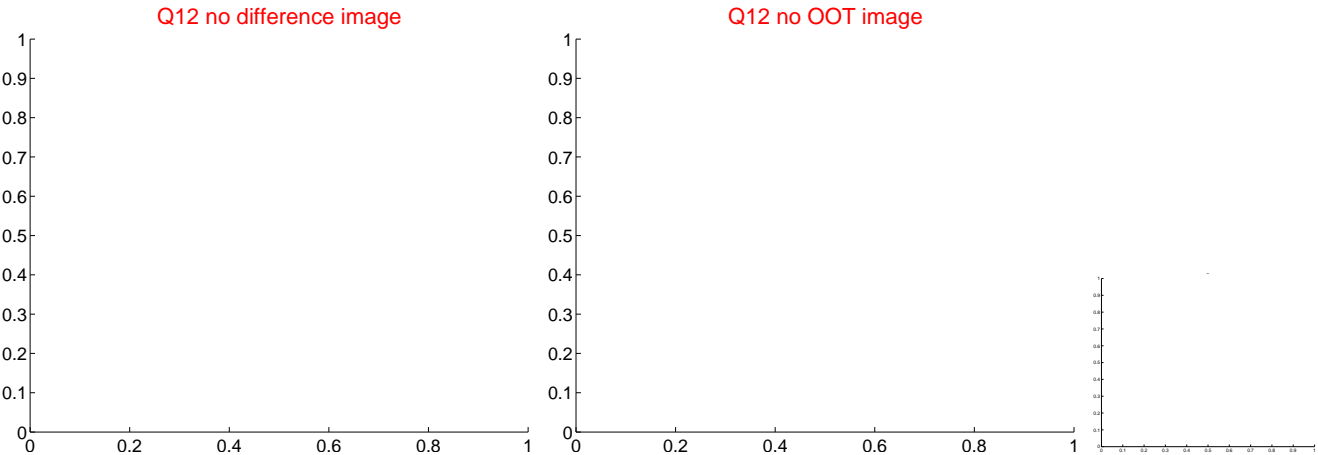
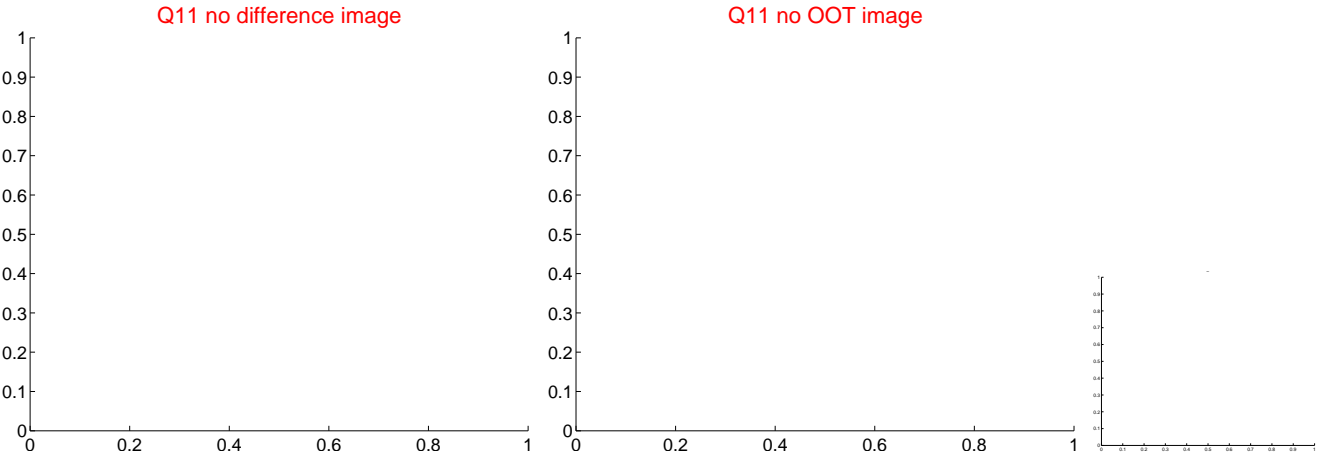
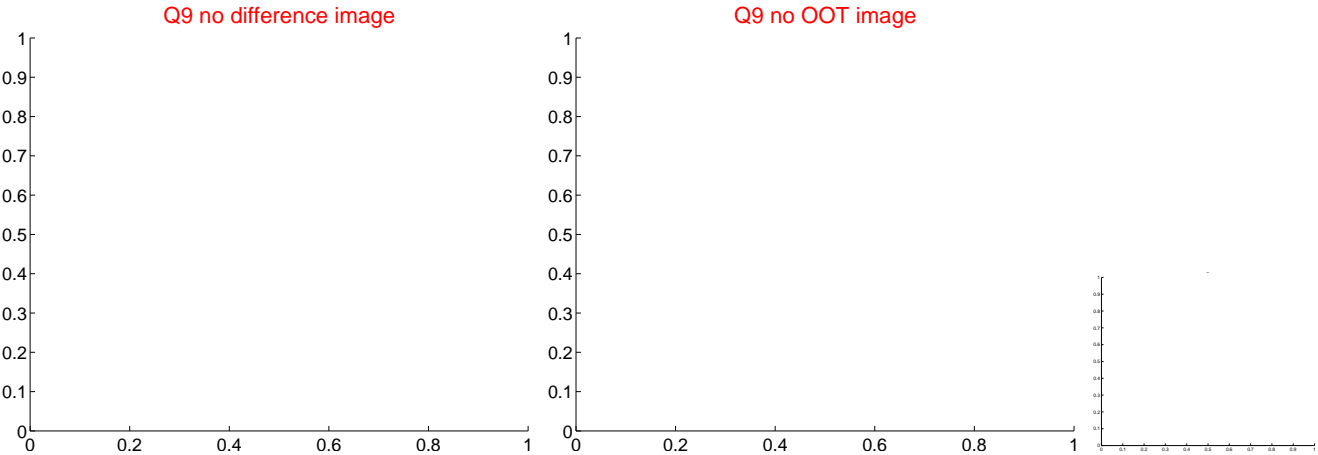
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



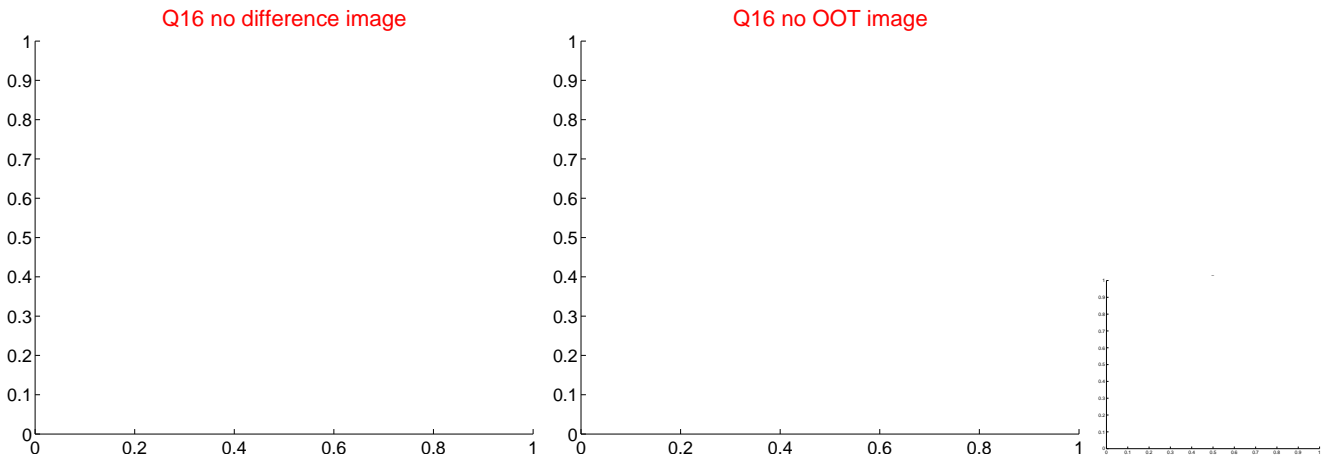
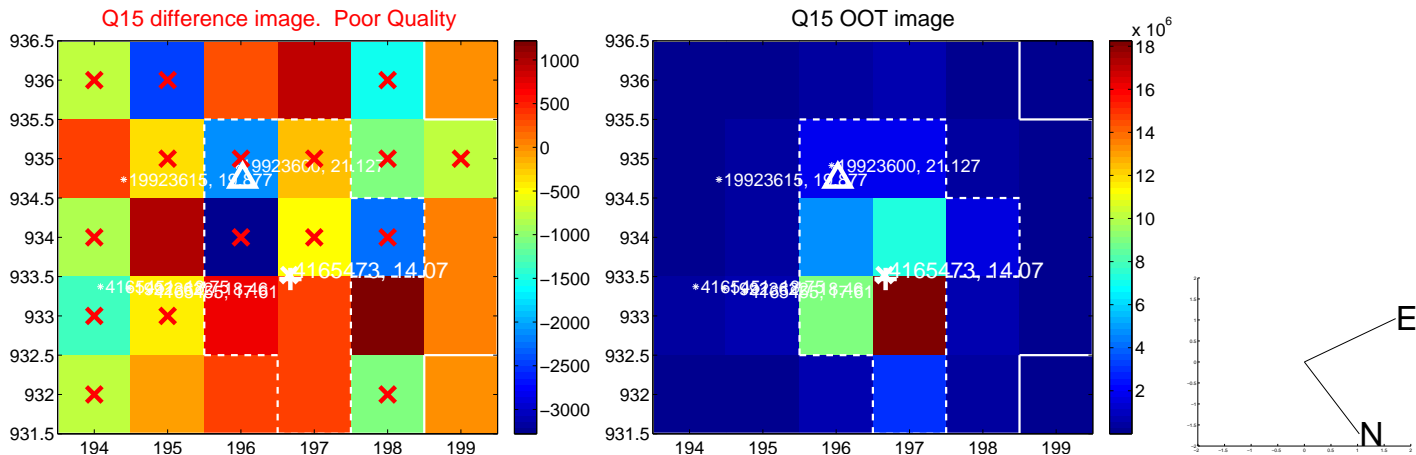
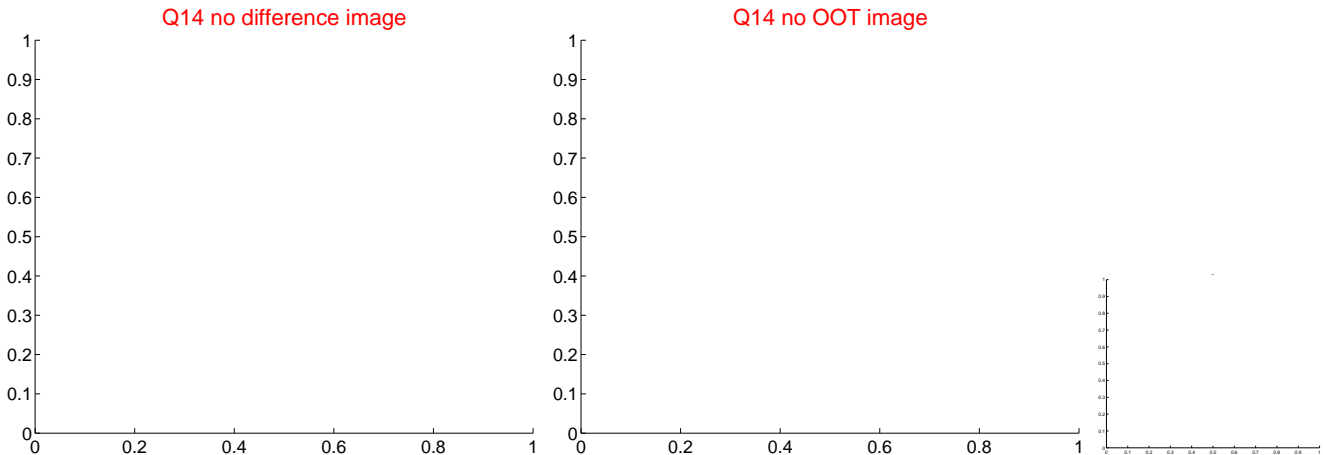
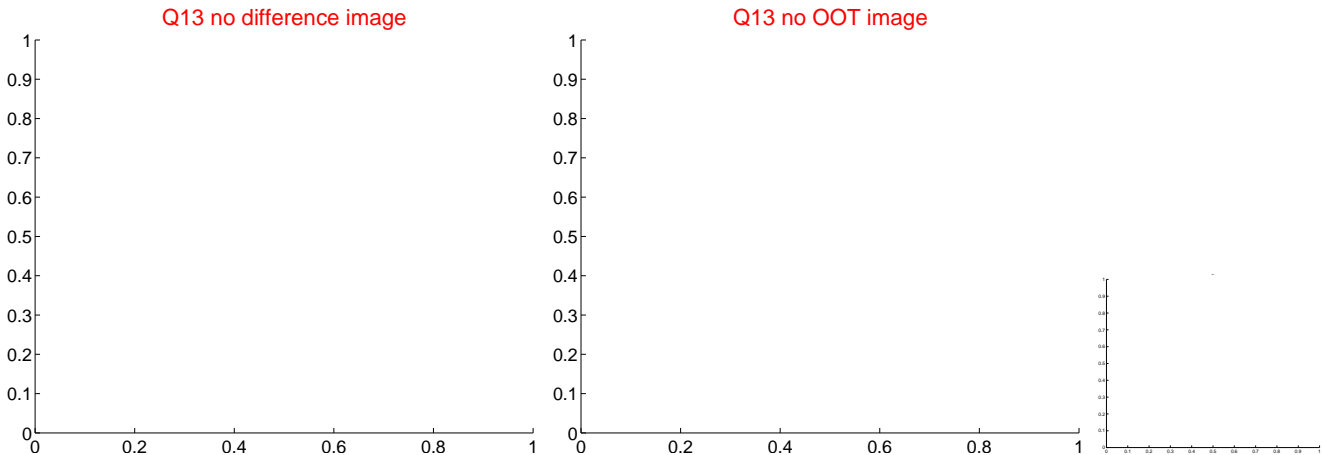
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value



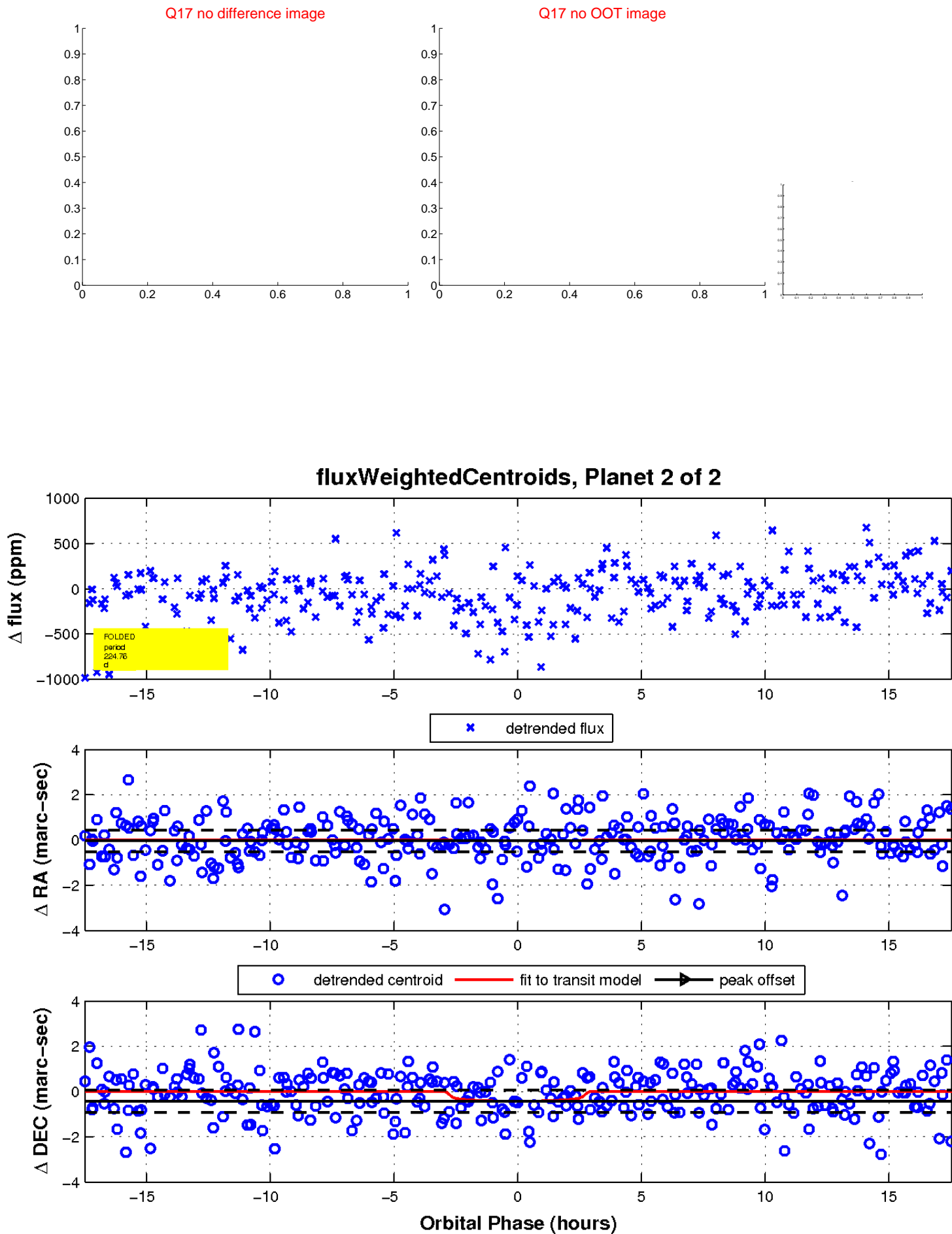
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

