

# KIC 007440748

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
007440748-01	OBS	0457.01	4.921361	134.928409	738.4	2.080	65.2	71.8	0.80	5076	2.65	134.45
007440748-02	OBS	0457.02	7.064261	135.378308	687.1	1.773	40.0	47.3	0.80	5076	2.87	83.03

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
007440748-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
007440748-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT

**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.

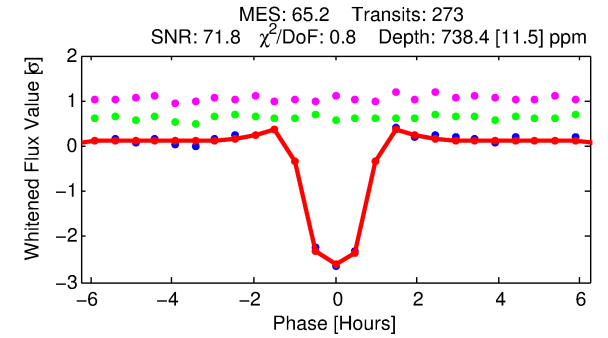
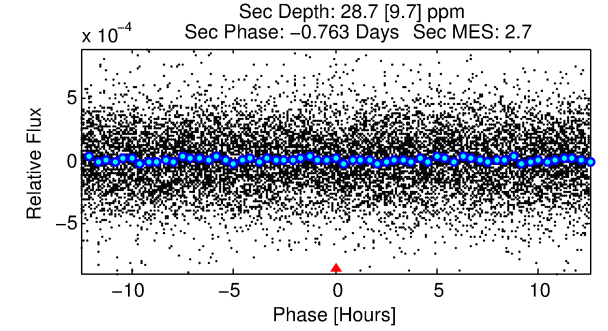
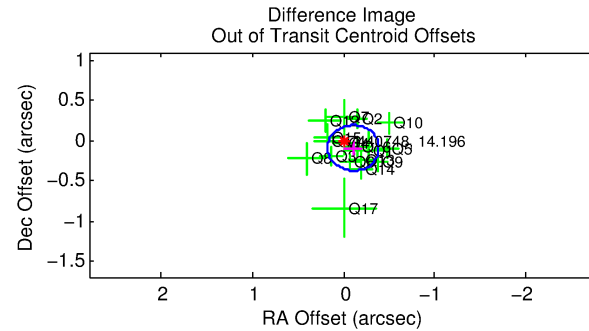
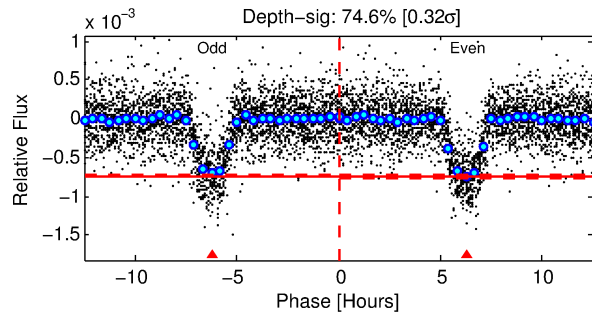
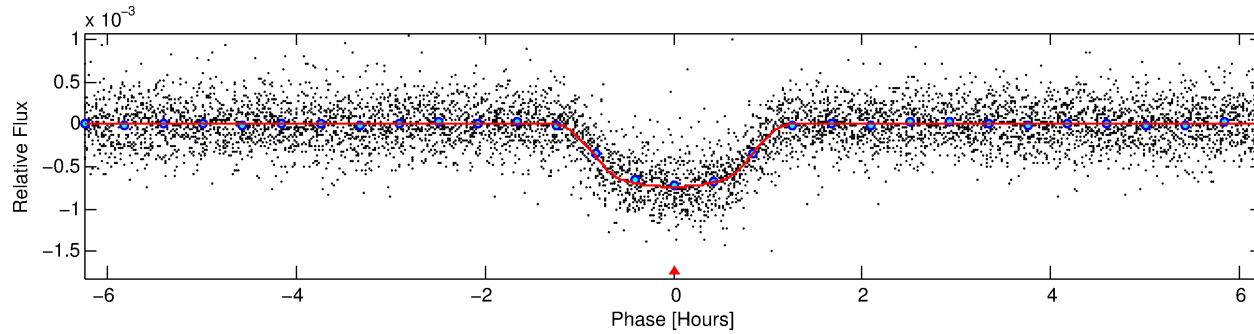
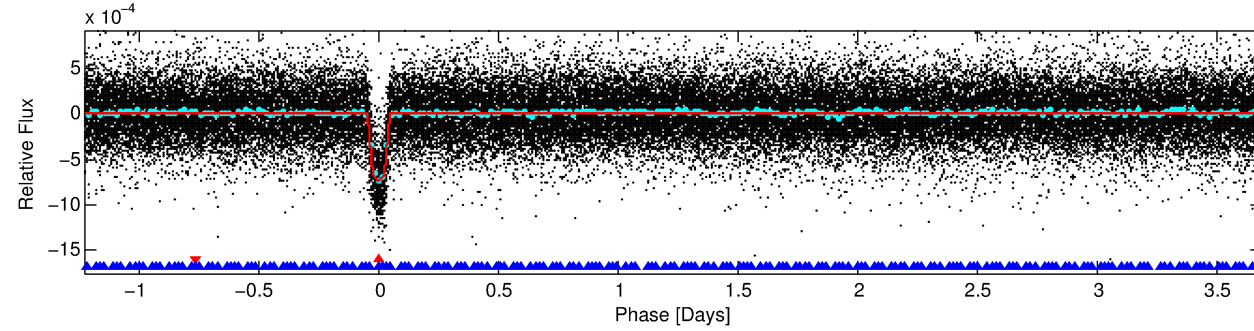
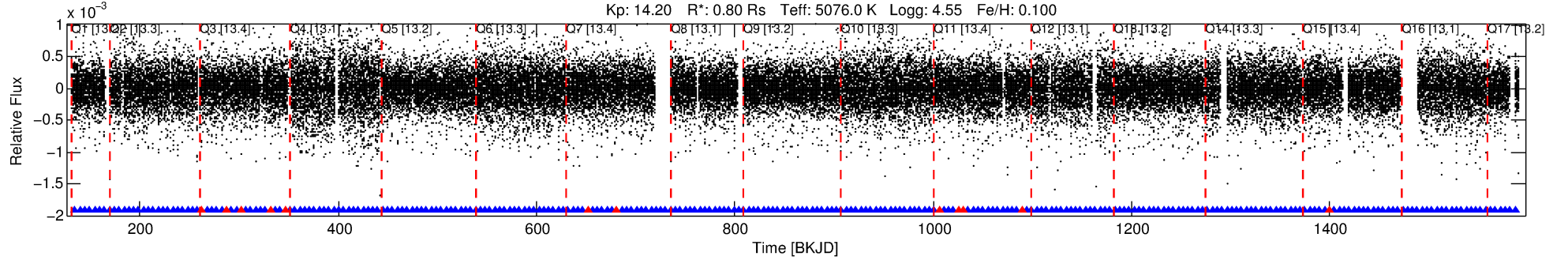
## Ephemeris Match Information For 007440748-01

No Significant Match Found

# DV One-Page Summary

KIC: 7440748 Candidate: 1 of 2 Period: 4.921 d  
KOI: K00457.01 Name: Kepler-161b Corr: 0.947

Kp: 14.20 R\*: 0.80 Rs Teff: 5076.0 K Logg: 4.55 Fe/H: 0.100



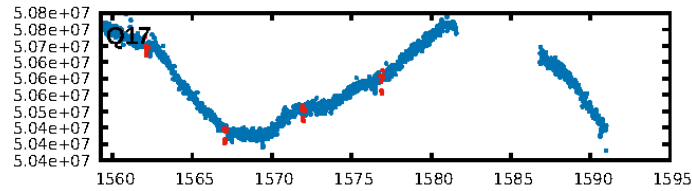
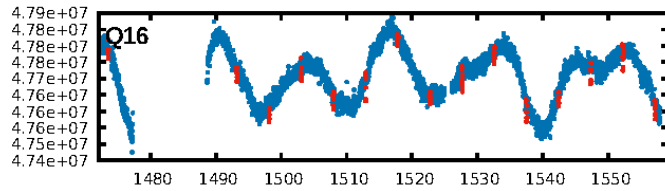
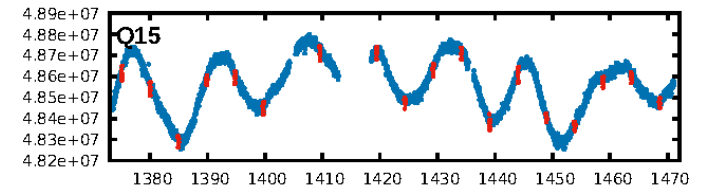
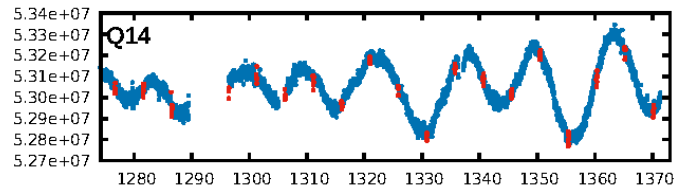
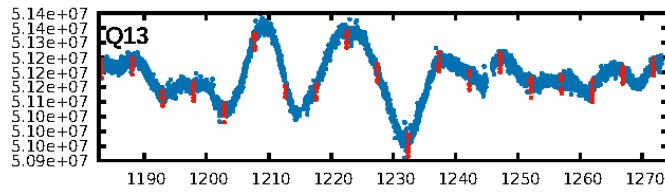
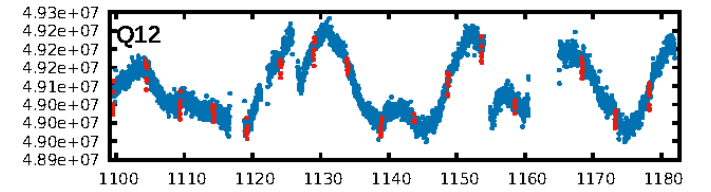
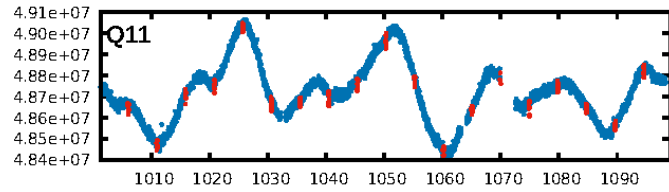
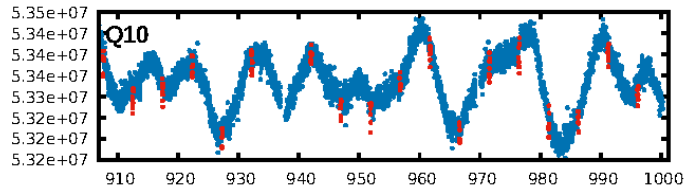
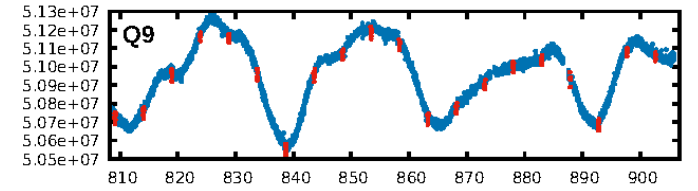
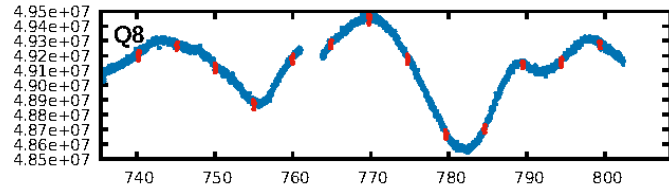
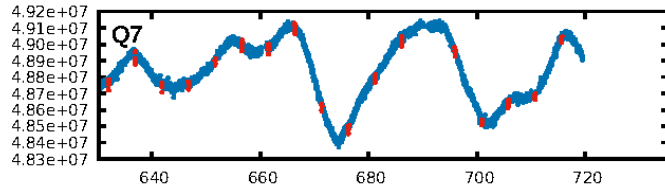
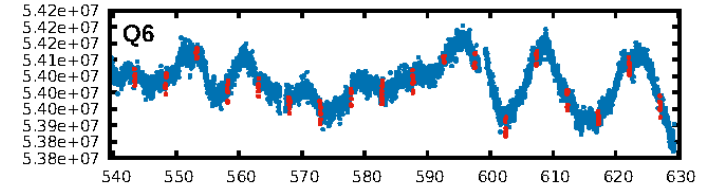
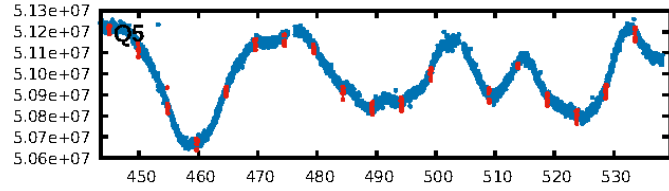
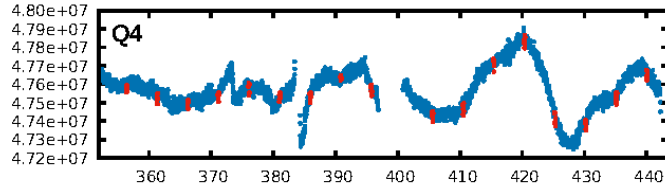
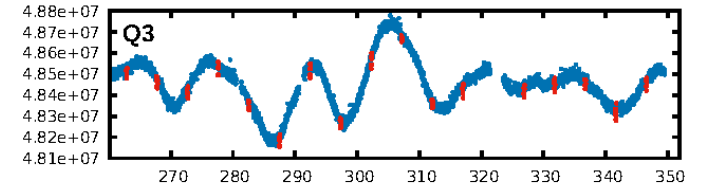
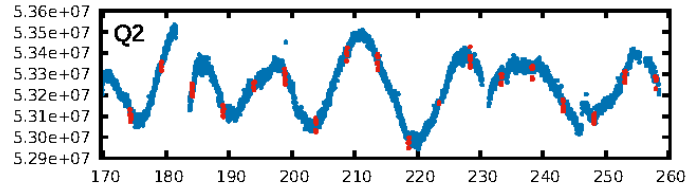
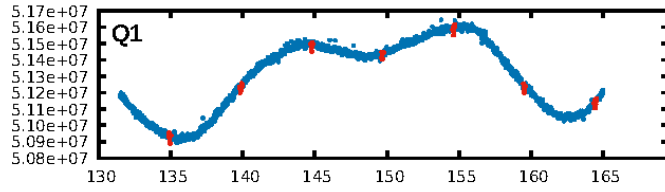
## DV Fit Results:

Period = 4.92136 [0.00000] d  
Epoch = 134.9284 [0.0005] BKJD  
Rp/R\* = 0.0304 [0.0015]  
a/R\* = 9.08 [1.70]  
b = 0.90 [0.04]  
Seff = 134.45 [15.93]  
Teff = 868 [26] K  
Rp = 2.65 [0.22] Re  
a = 0.0531 [0.0030] AU  
Ag = 6.33 [2.31] [2.31σ]  
Teffp = 2129 [193] K [6.47σ]

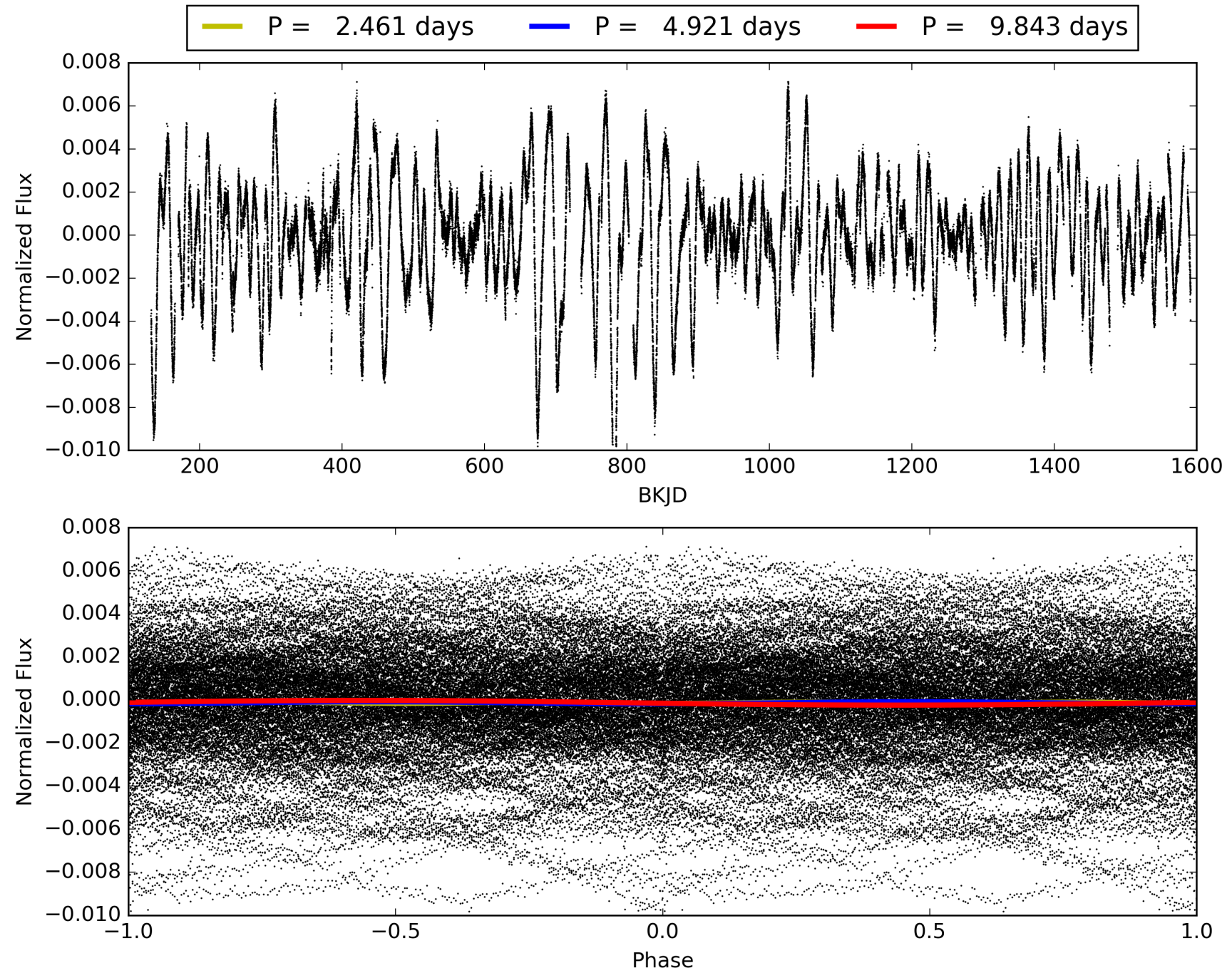
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [18.82σ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 0.95 [250/262]  
GhostDiagnostic-chr: 2.983  
Centroid-sig: 57.7%  
Centroid-so: 0.230 arcsec [1.63σ]  
OotOffset-rm: 0.139 arcsec [1.47σ]  
KicOffset-rm: 0.160 arcsec [1.59σ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 1.00 [17/17]  
DiffImageOverlap-fno: 1.00 [17/17]

# TCE 007440748-01, PDC Light Curves

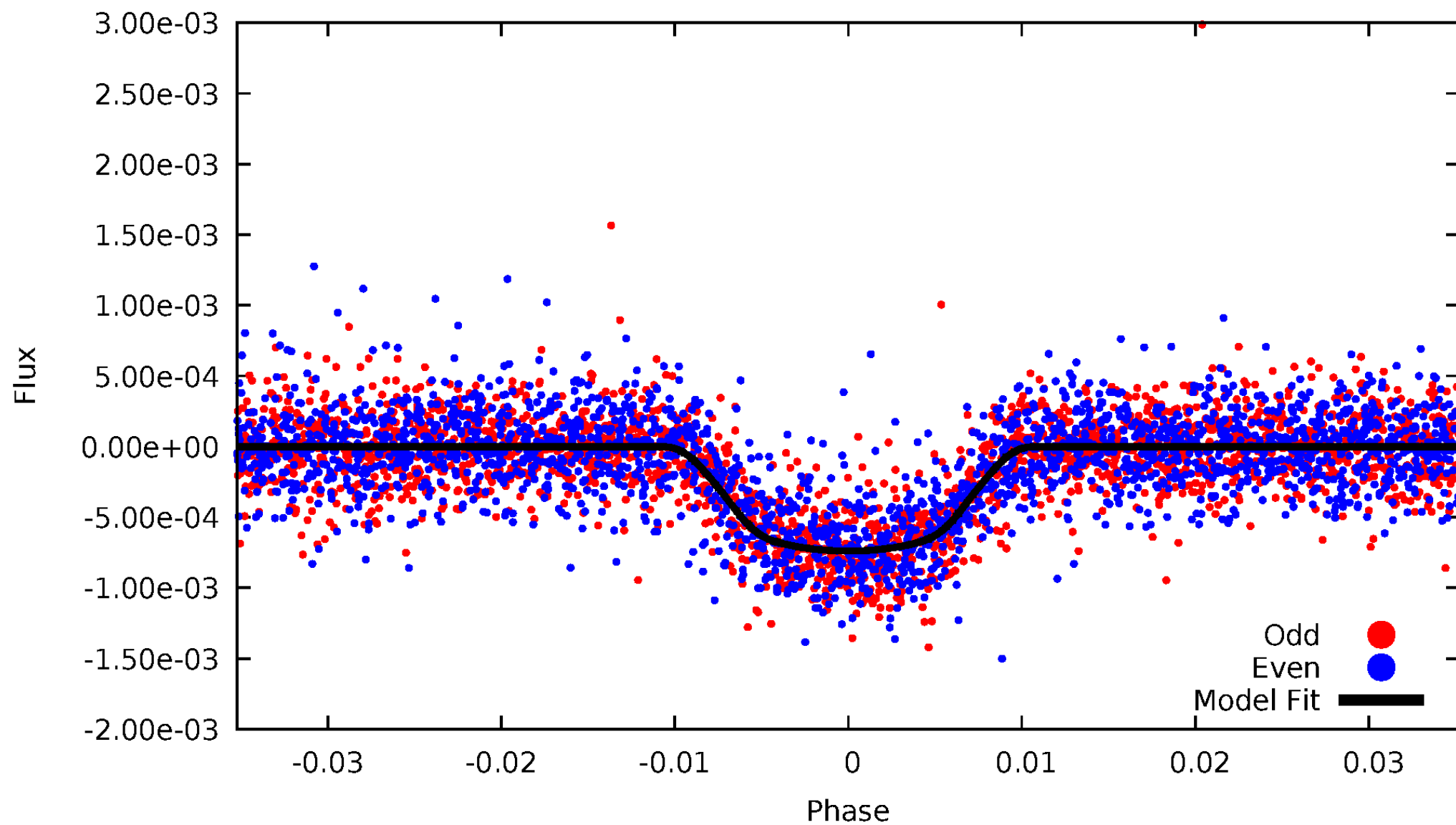


TCE 007440748-01



# DV Odd/Even

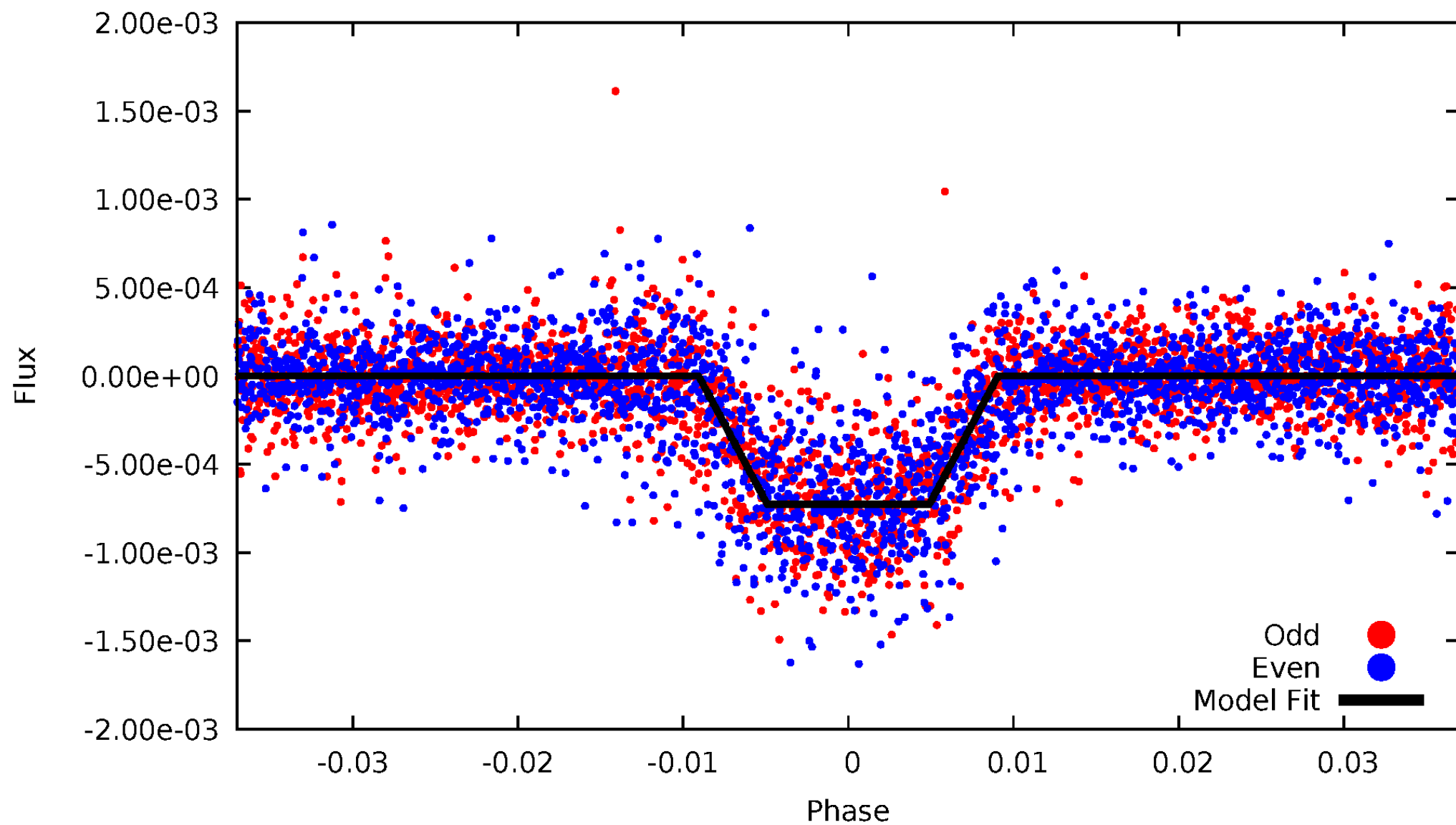
TCE 007440748-01





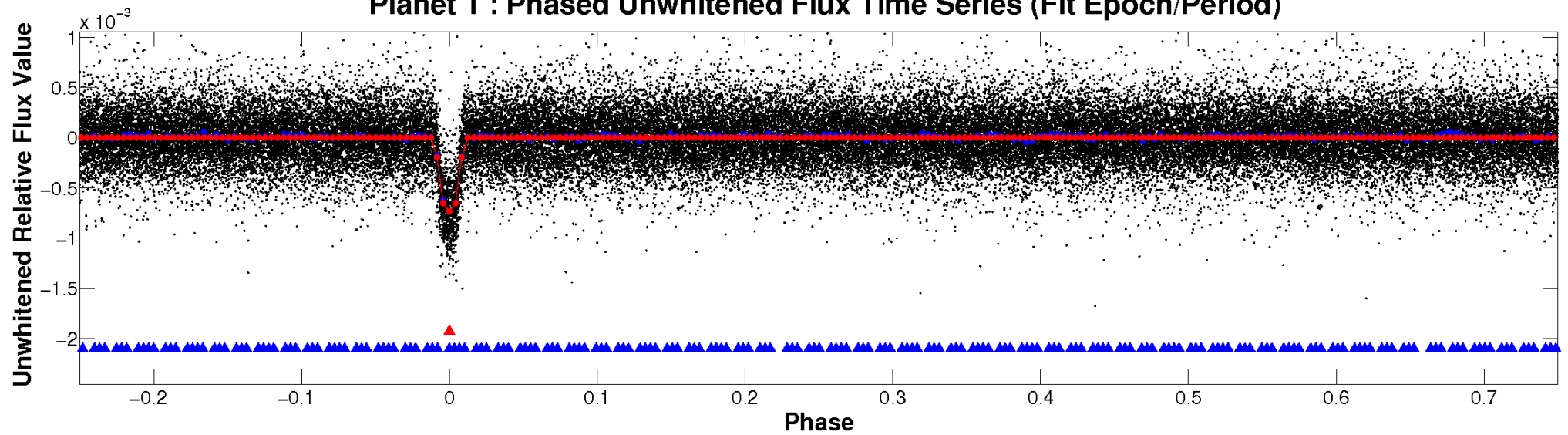
# ALT Odd/Even

TCE 007440748-01

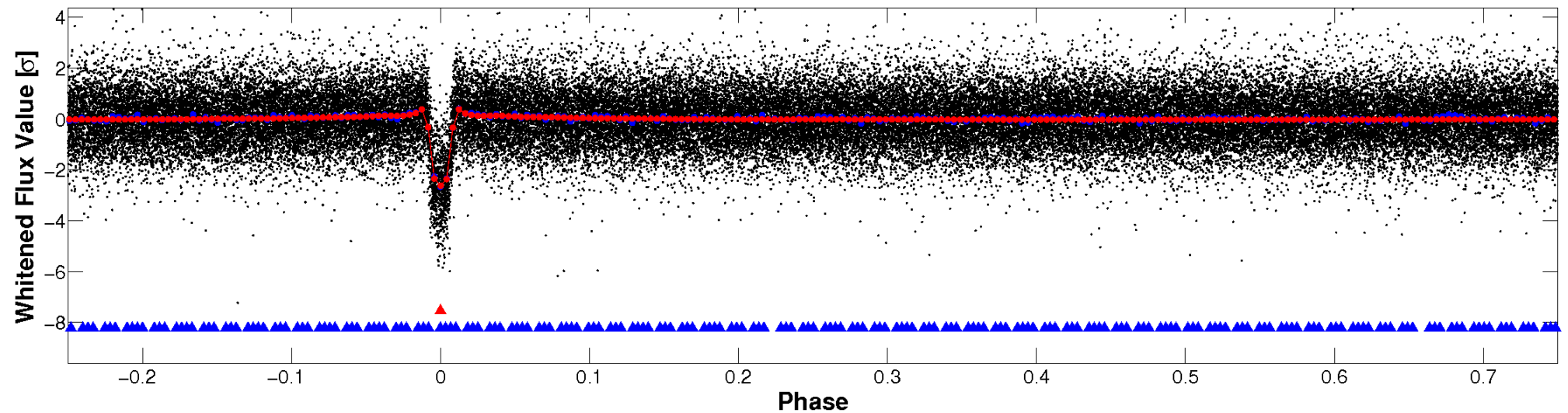


# Non-Whitened Vs. Whitened Light Curve

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

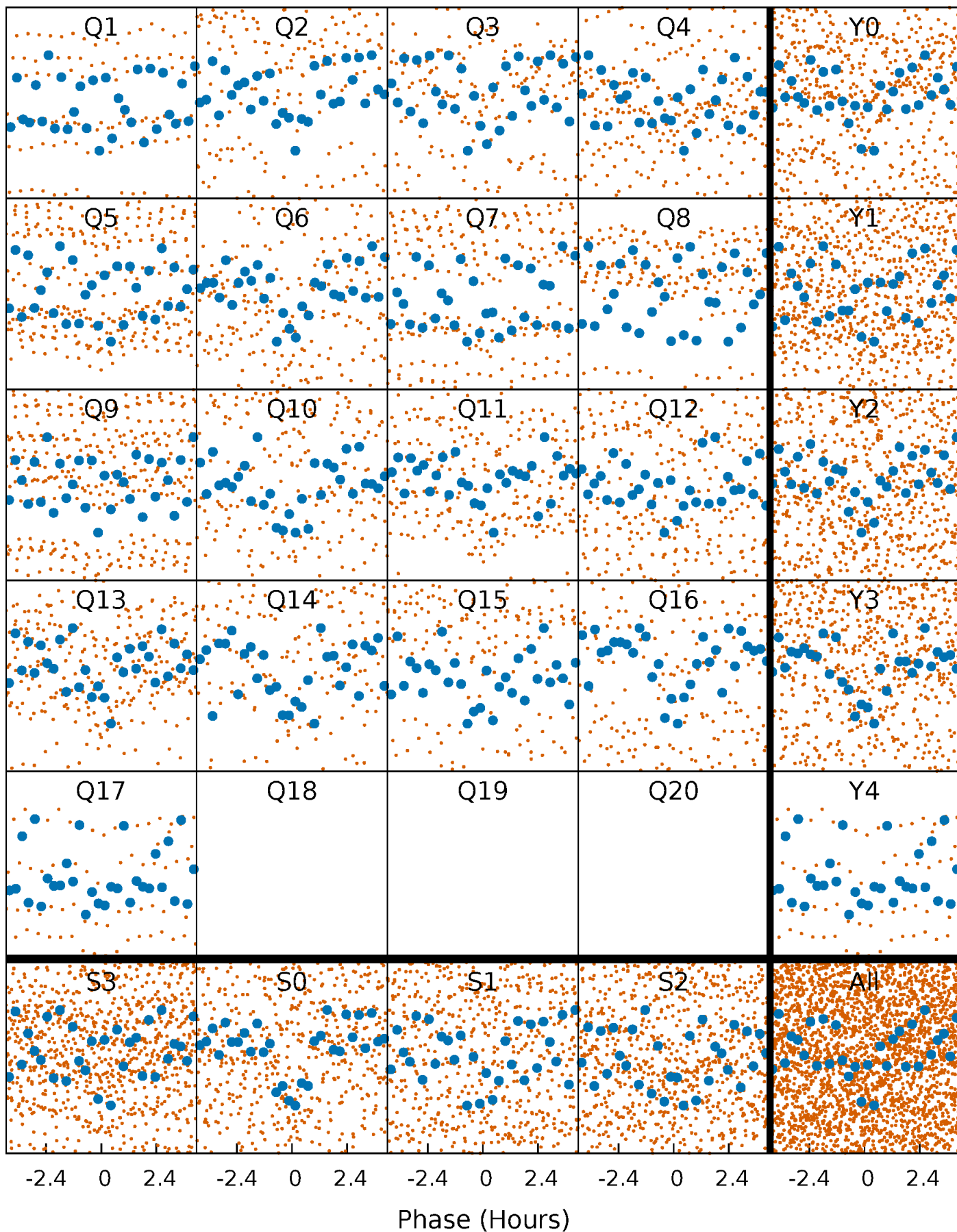


**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**



# PDC Quarter-Phased Transit Curves

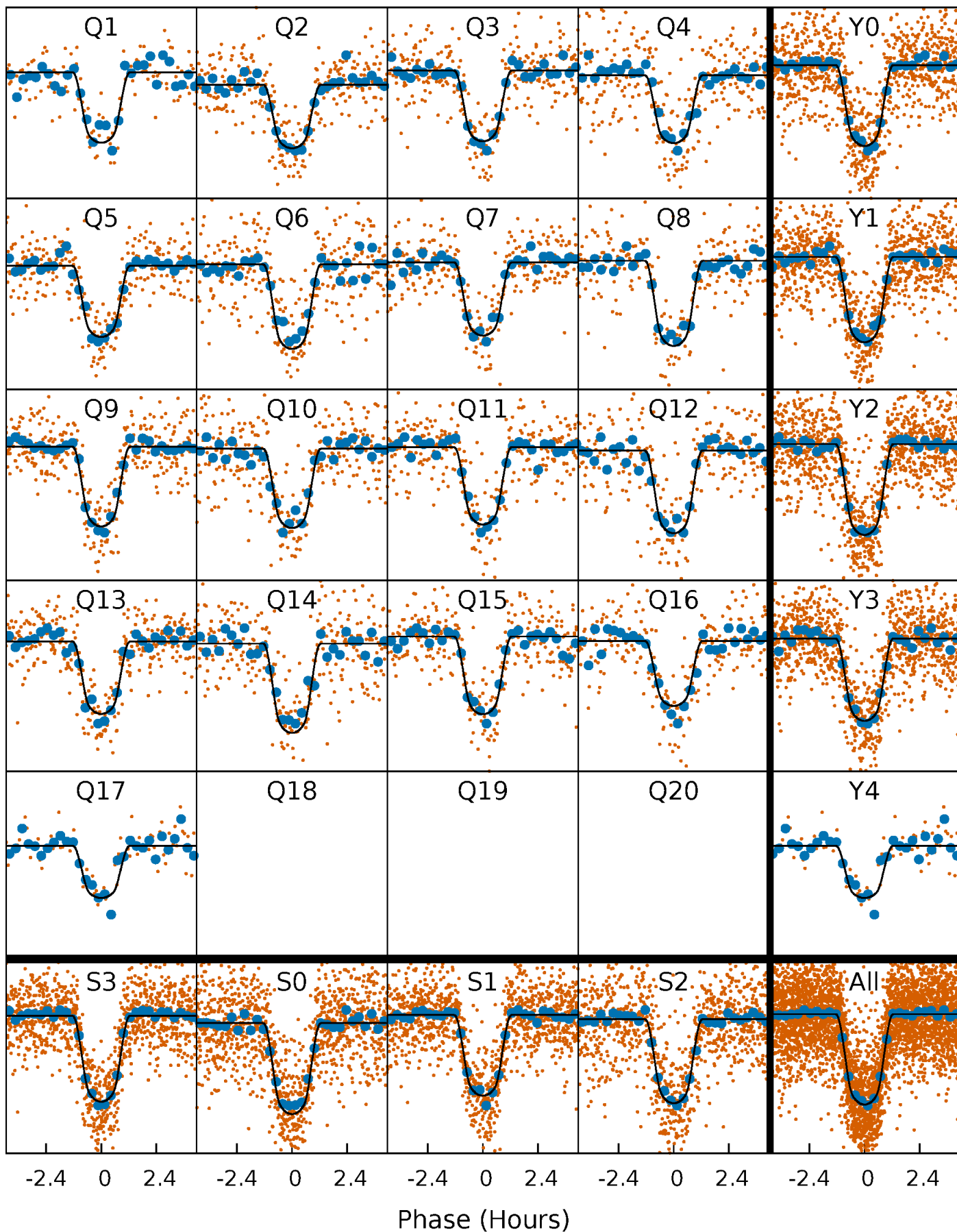
TCE 007440748-01 P= 4.921361 Days  $T_0=134.928409$  (BKJD)





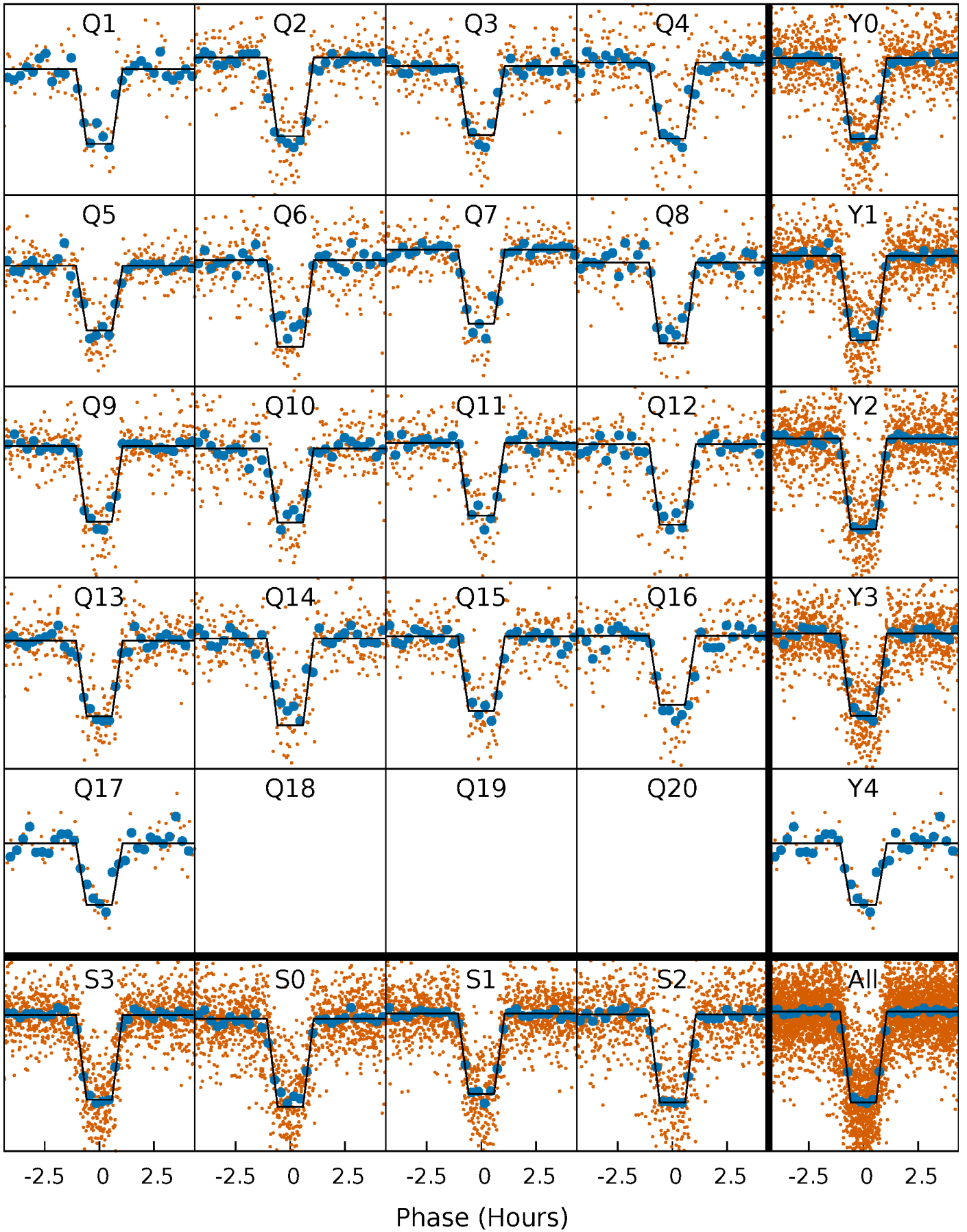
# DV Quarter-Phased Transit Curves

TCE 007440748-01 P= 4.921361 Days  $T_0=134.928409$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

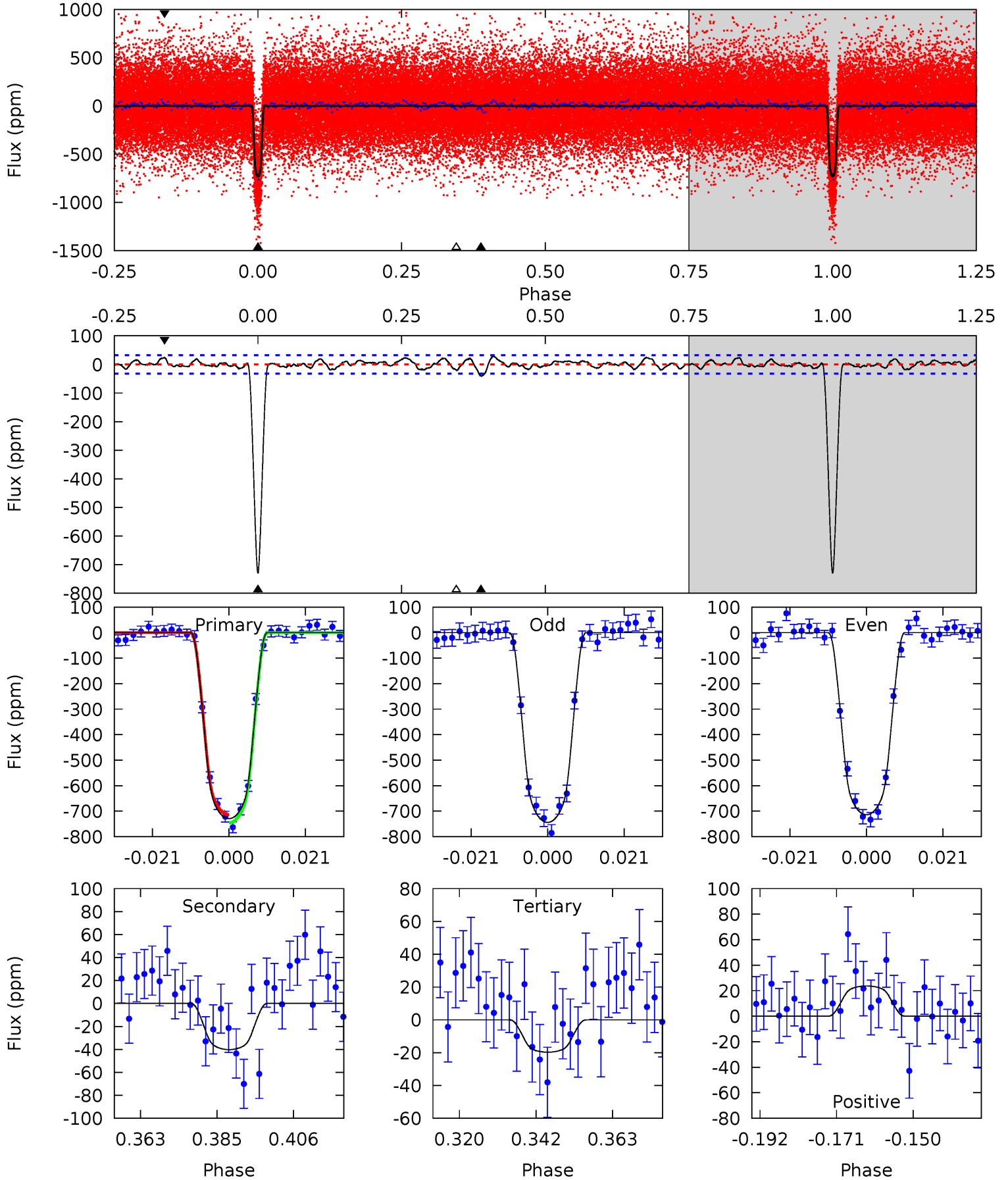
TCE 007440748-01 P= 4.921334 Days  $T_0=134.932221$  (BKJD)



# DV Model-Shift Uniqueness Test

007440748-01, P = 4.921361 Days, E = 130.007048 Days

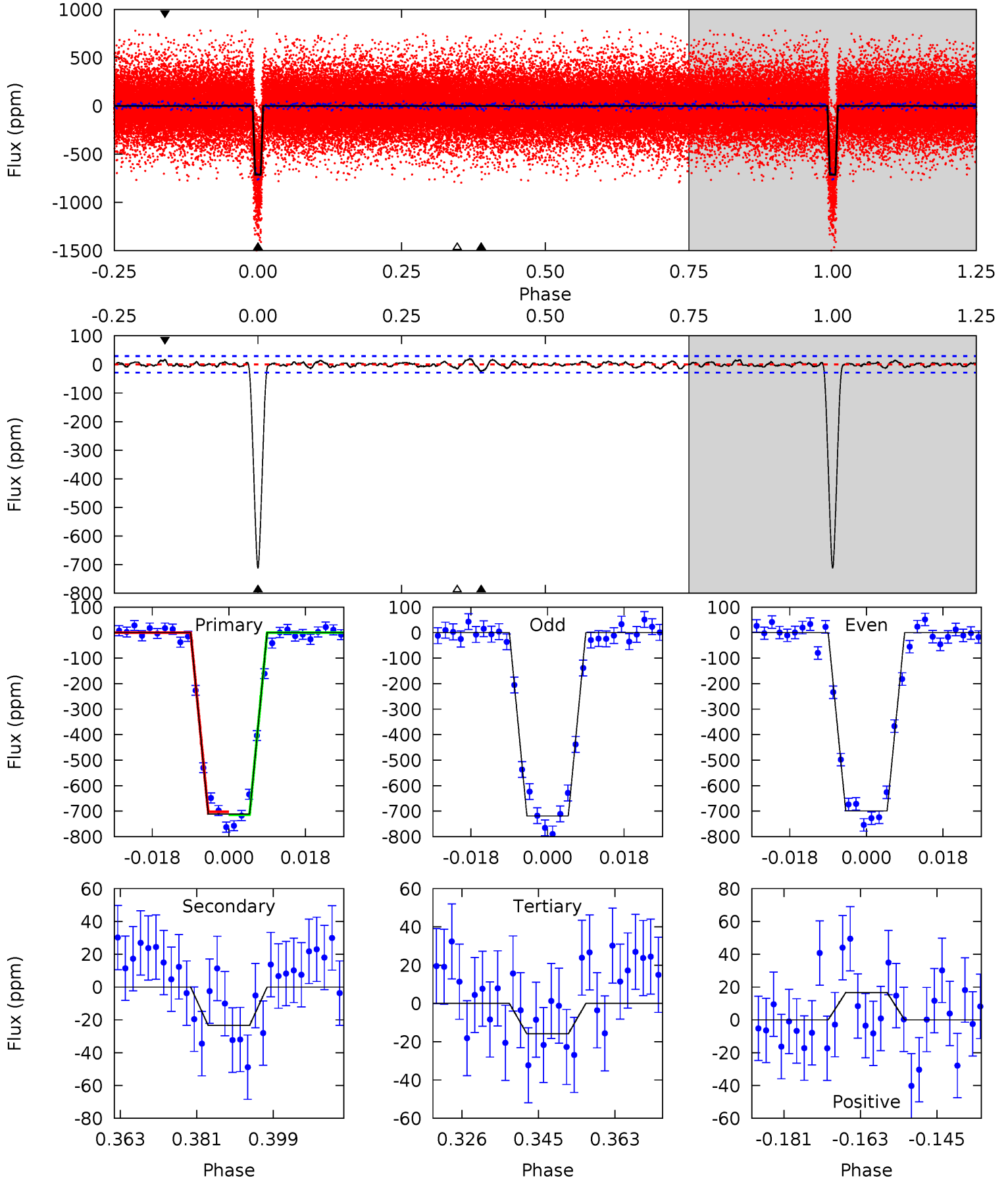
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
110.3	6.08	2.98	3.59	4.88	2.30	1.51	107.3	106.7	3.10	2.50	2.27	0.97	0.04	2.37



# Alt Model-Shift Uniqueness Test

007440748-01, P = 4.921334 Days, E = 130.010887 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
121.4	3.99	2.71	2.83	4.91	2.36	1.09	118.7	118.5	1.28	1.16	1.69	0.99	0.03	0.99



### Stellar Parameters For KIC 007440748

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5076^{+101}_{-101}$	$4.550^{+0.036}_{-0.050}$	$0.100^{+0.150}_{-0.150}$	$0.799^{+0.051}_{-0.043}$	$0.827^{+0.043}_{-0.043}$	$2.282^{+0.331}_{-0.348}$
	+2%/-2%	+1%/-1%	+150%/-150%	+6%/-5%	+5%/-5%	+15%/-15%
Source	SPE58	SPE58	SPE58	DSEP		

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

### Secondary Eclipse Parameters for KIC 007440748-01 / KOI 0457.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-40 \pm 7$	$2.68^{+0.16}_{-0.16}$	$1215^{+31}_{-30}$	$2946^{+89}_{-85}$	$8.760^{+1.848}_{-1.764}$
Alt.	$-23 \pm 6$	$2.37^{+0.16}_{-0.17}$	$1217^{+33}_{-33}$	$2821^{+119}_{-125}$	$6.429^{+1.959}_{-1.829}$

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



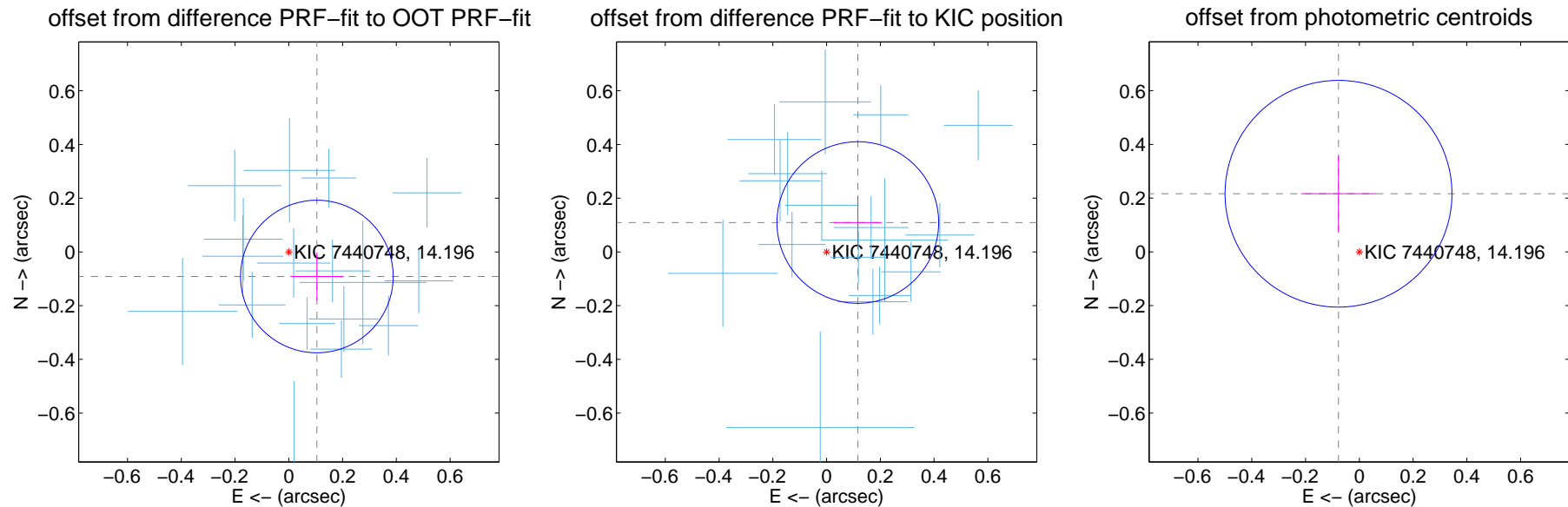
## DV Centroid Data

Supplemental centroid analysis for 007440748-01. Kepler magnitude: 14.20. Transit SNR 71.76

There are 17 quarters with good PRF difference image offsets

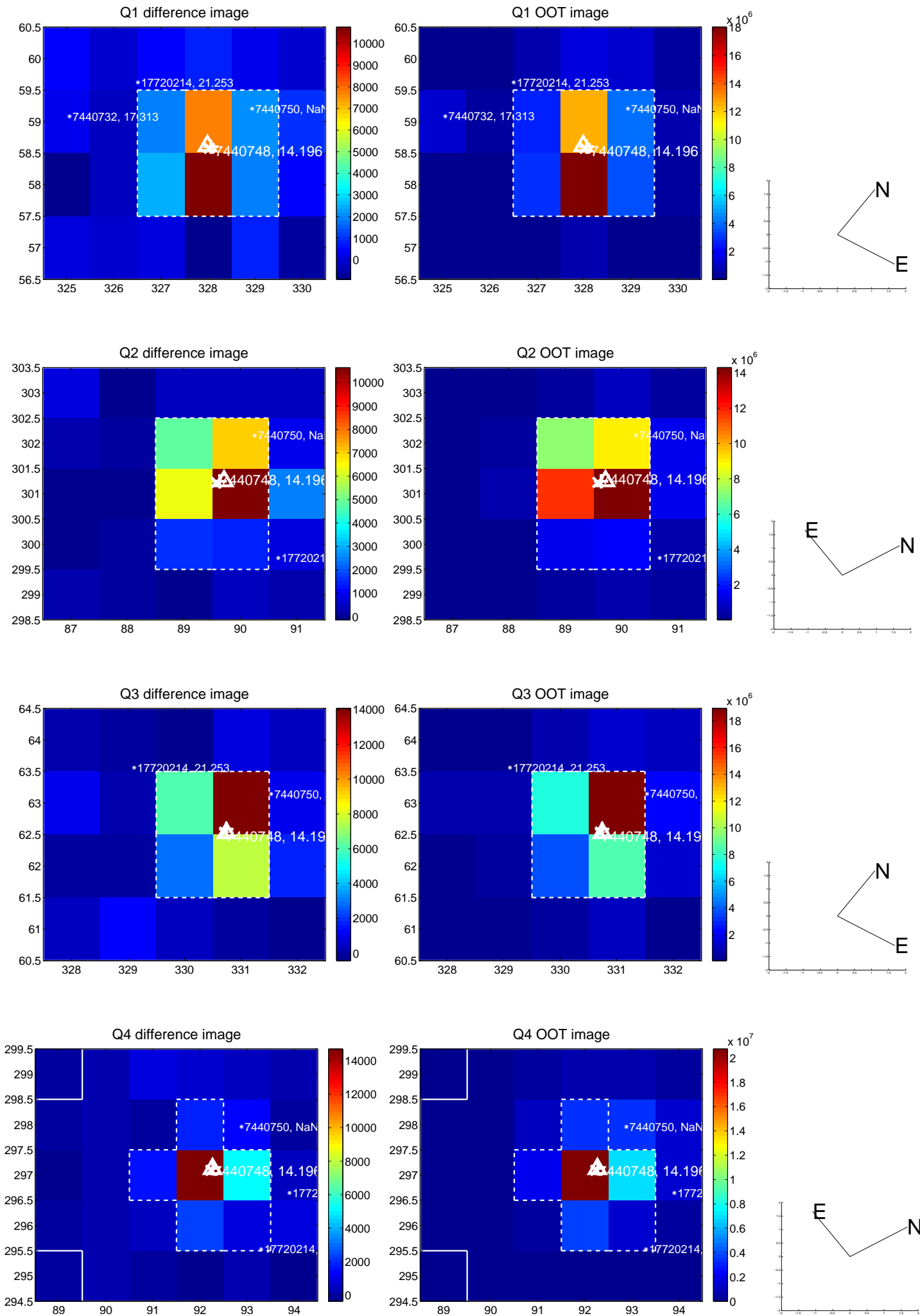
The direct PRF centroid is offset from the target star catalog position by about 0.19 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.139 \pm 0.095$	1.47	$-0.104 \pm 0.098$	$-0.092 \pm 0.090$
PRF-fit source offset from KIC position	$0.160 \pm 0.100$	1.59	$-0.116 \pm 0.089$	$0.109 \pm 0.100$
photometric centroid source offset	$0.23 \pm 0.14$	1.63	$0.08 \pm 0.14$	$0.22 \pm 0.14$

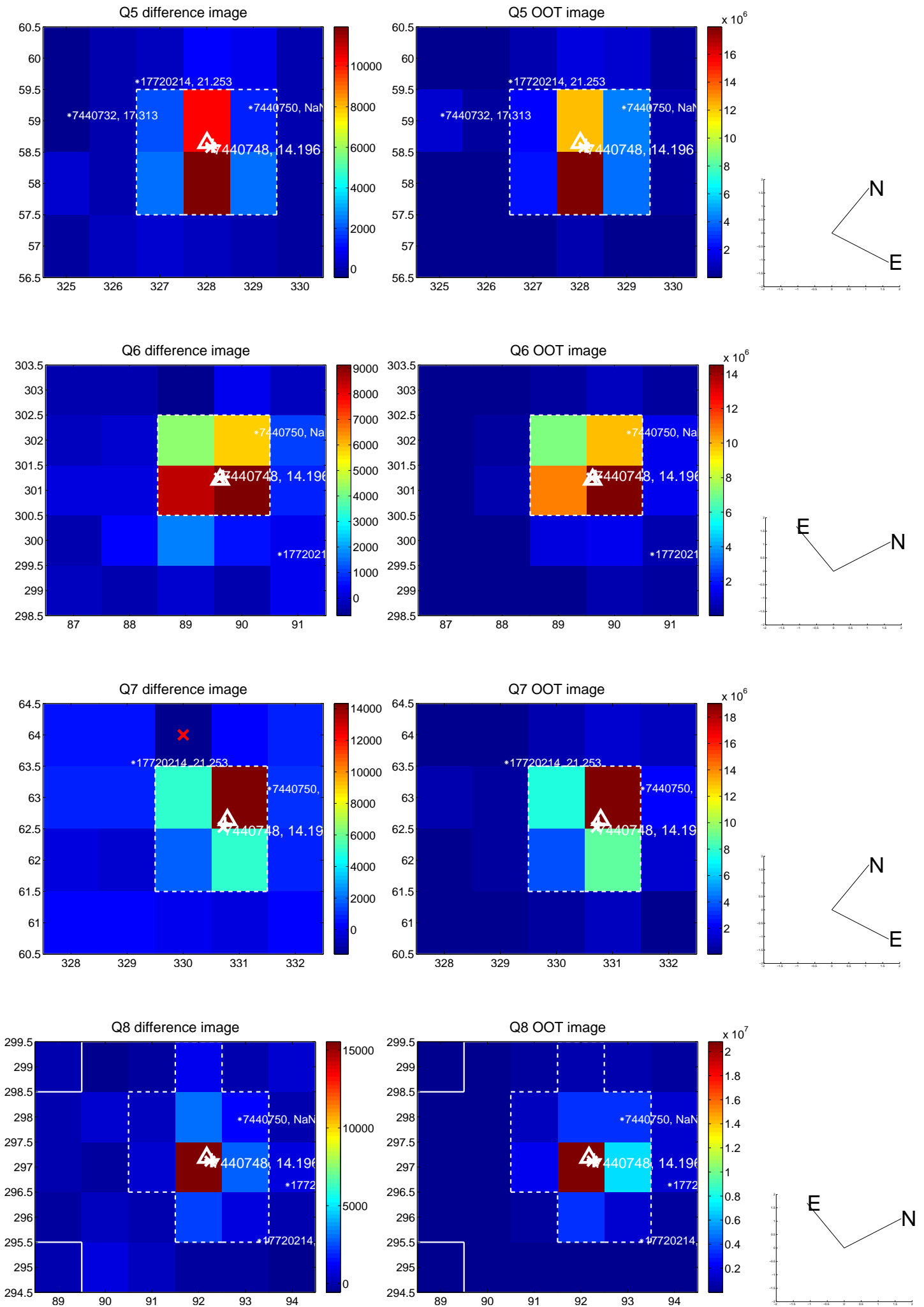


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

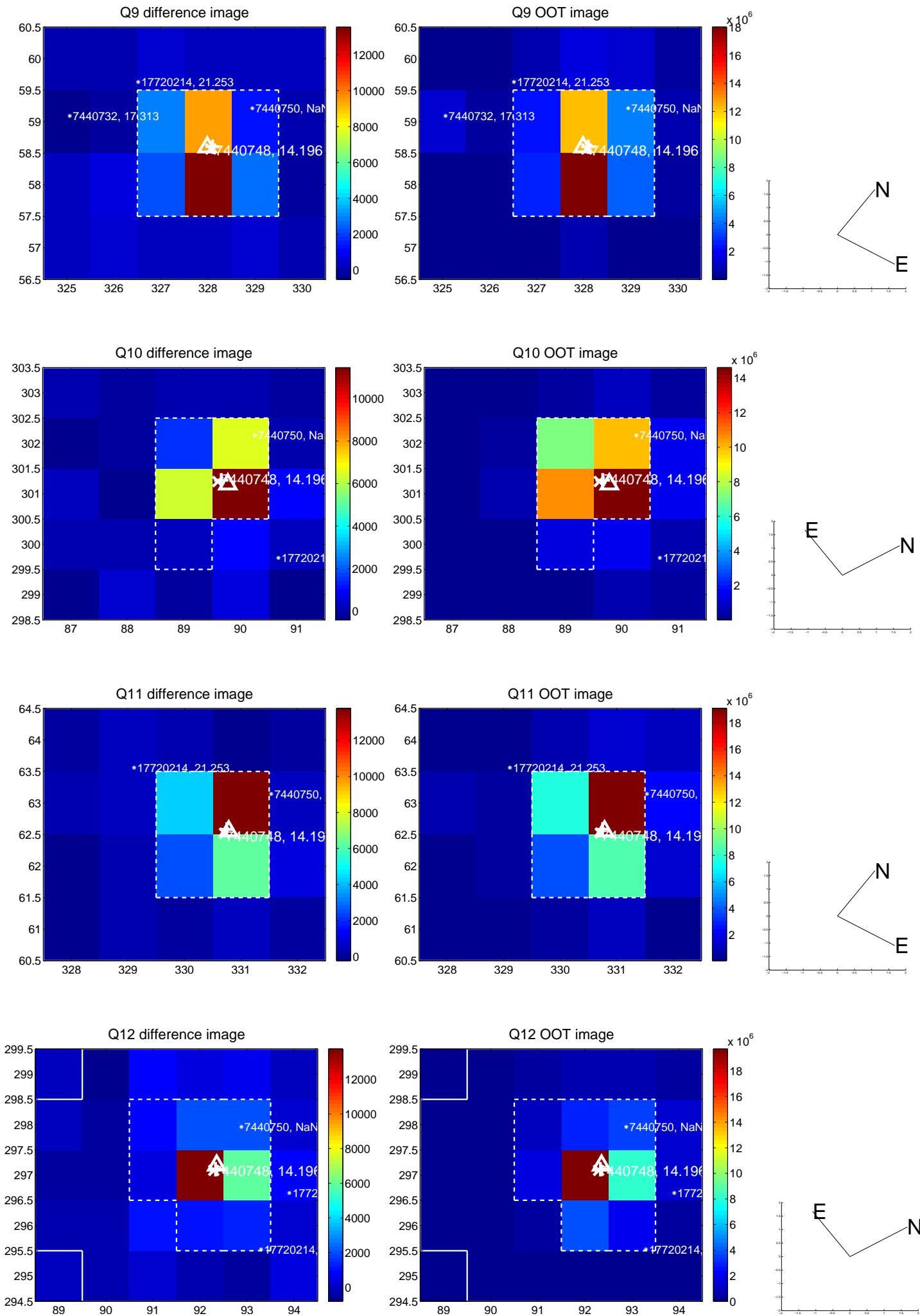
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



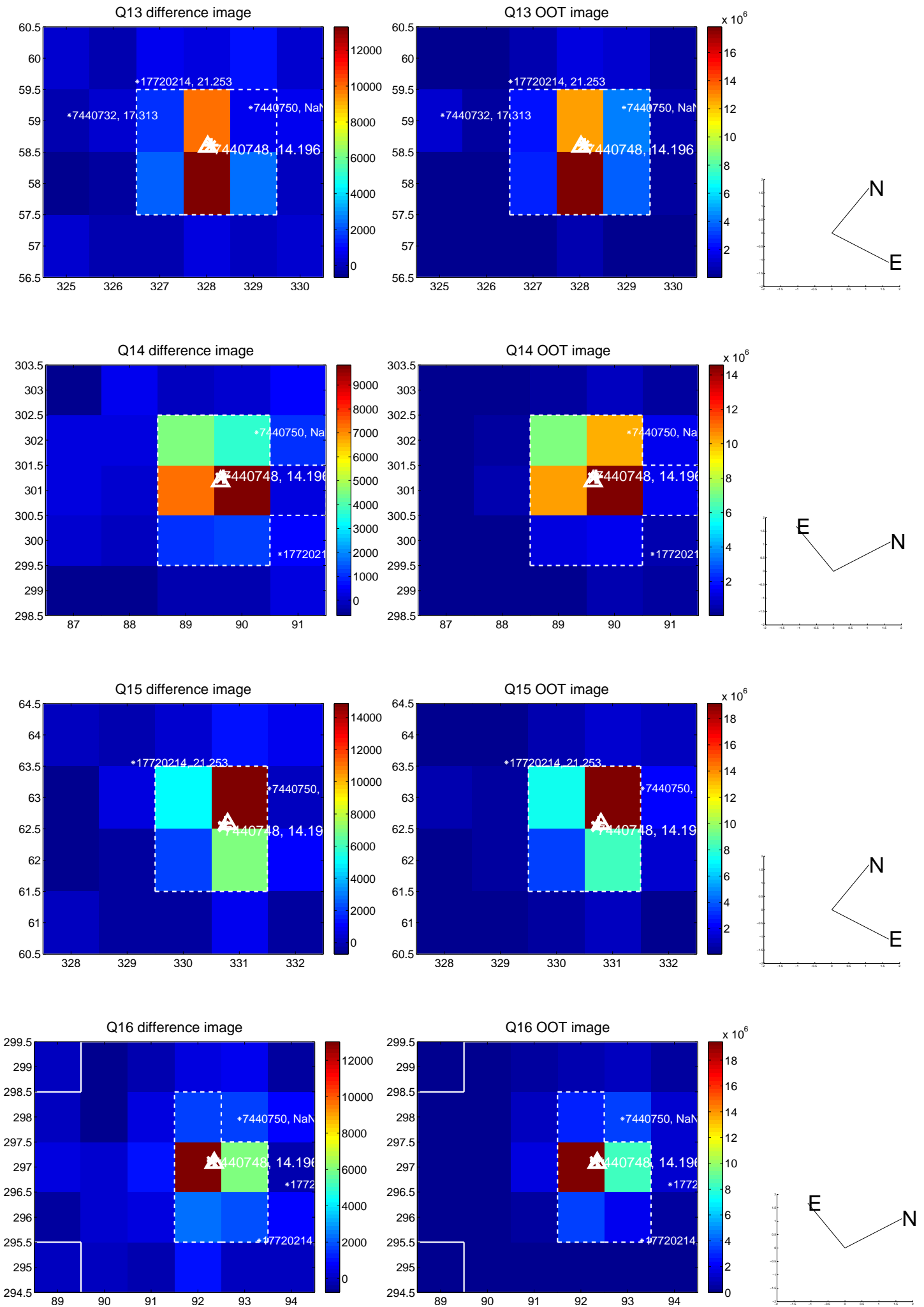
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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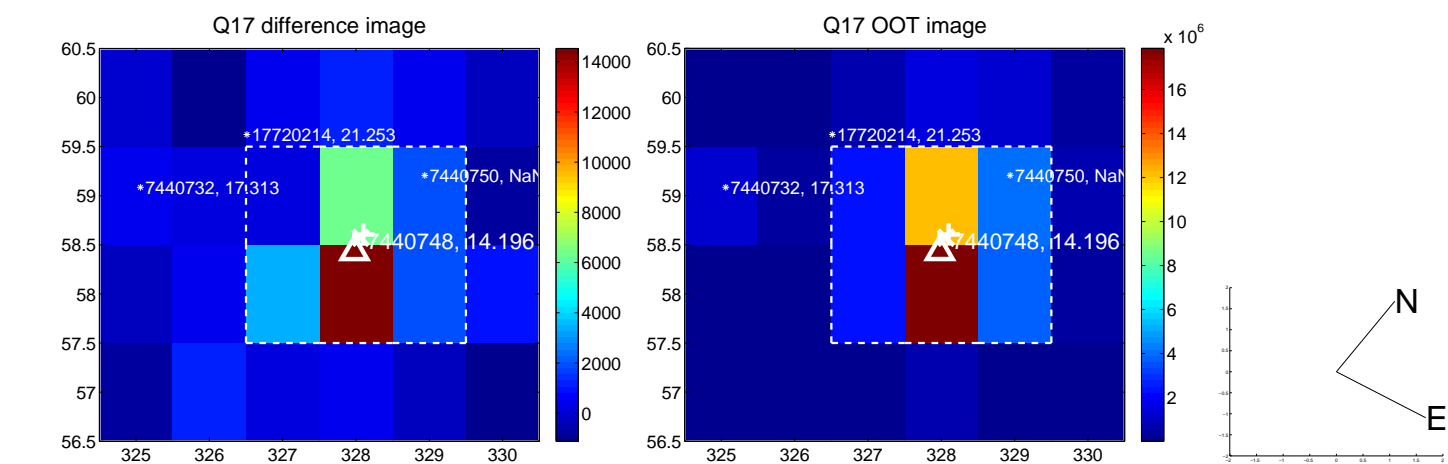


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

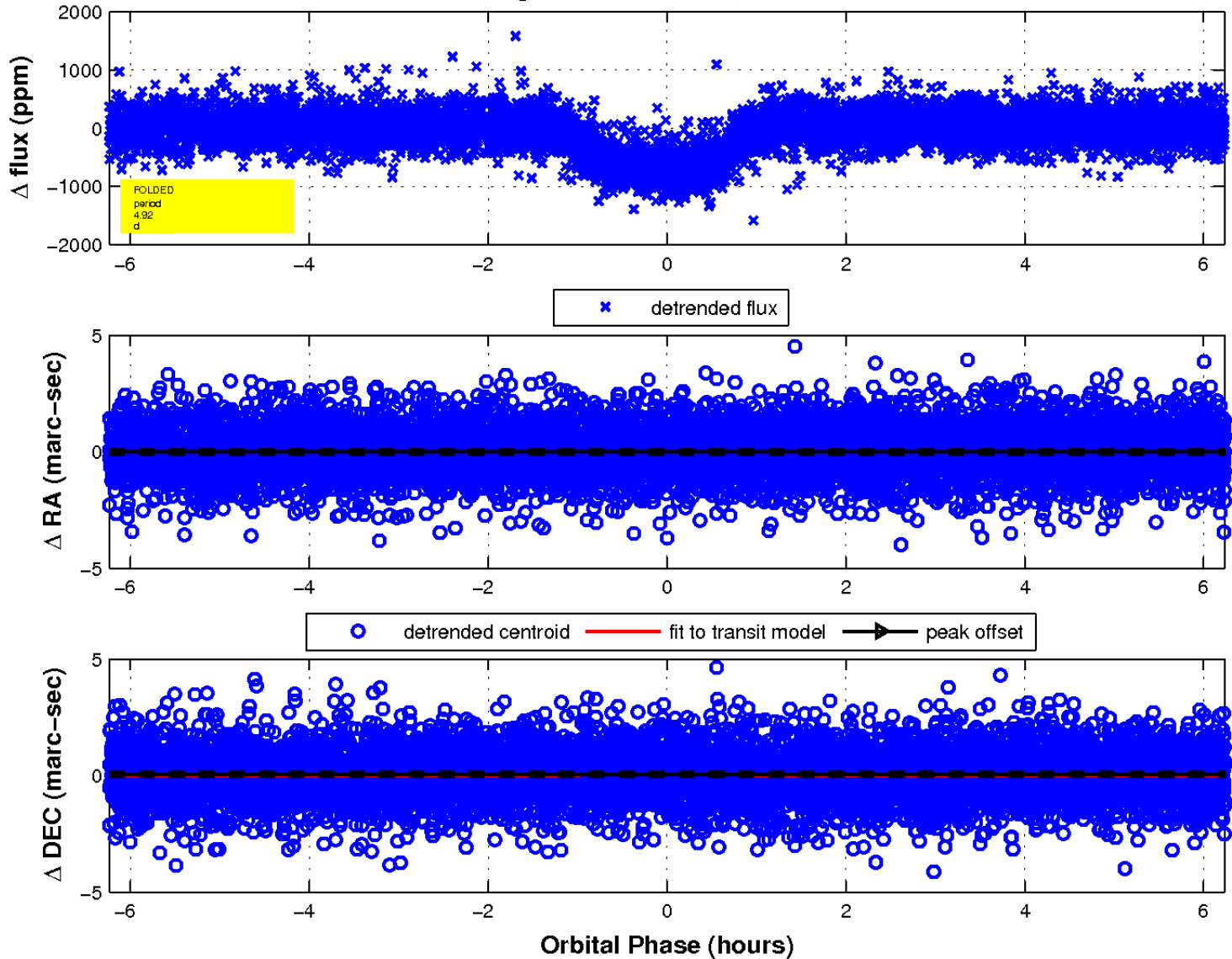




white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

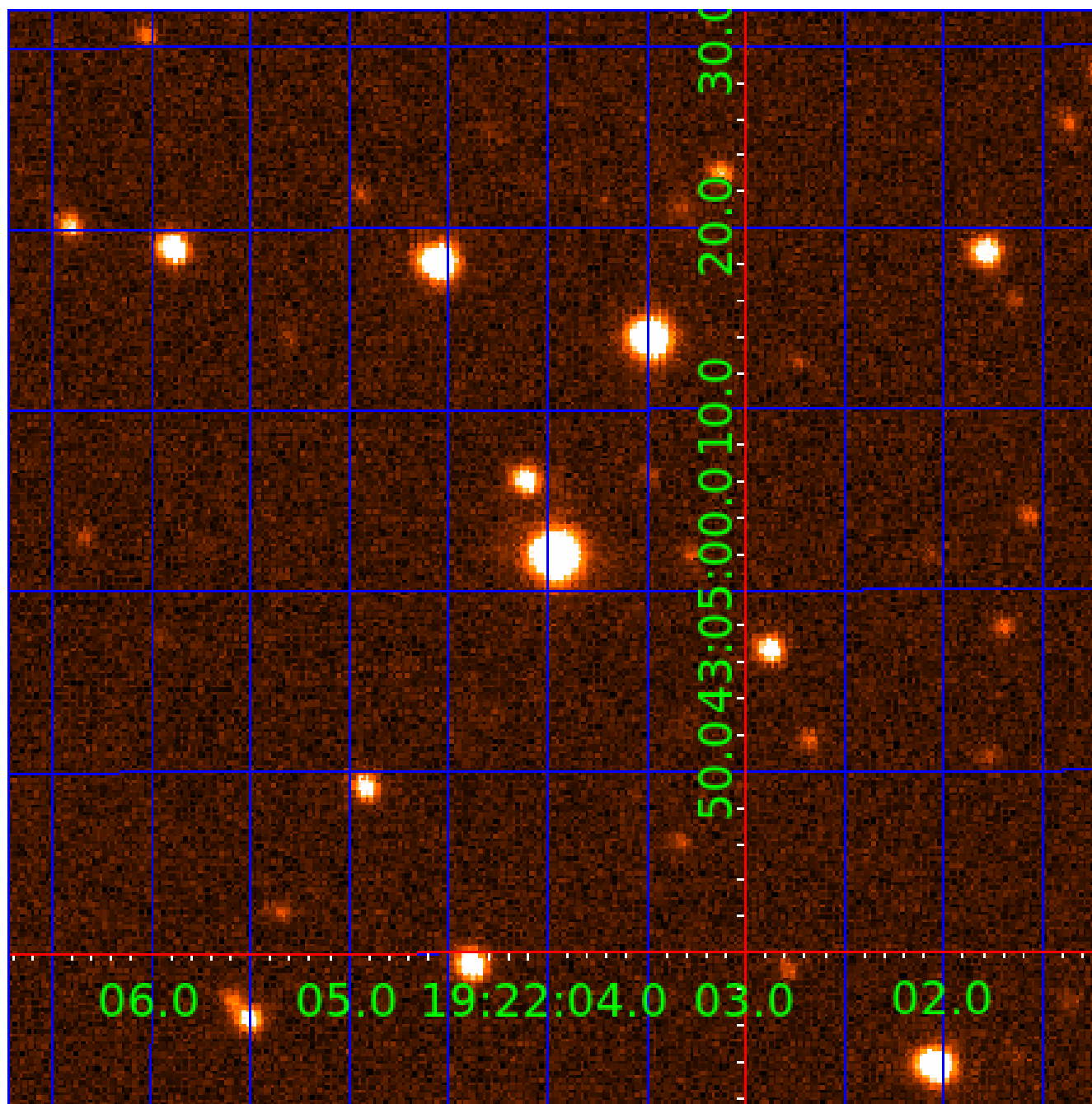


fluxWeightedCentroids, Planet 1 of 2



UKIRT Image

Declination



# KIC 007440748

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
007440748-01	OBS	0457.01	4.921361	134.928409	738.4	2.080	65.2	71.8	0.80	5076	2.65	134.45
007440748-02	OBS	0457.02	7.064261	135.378308	687.1	1.773	40.0	47.3	0.80	5076	2.87	83.03

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
007440748-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
007440748-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT

**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.

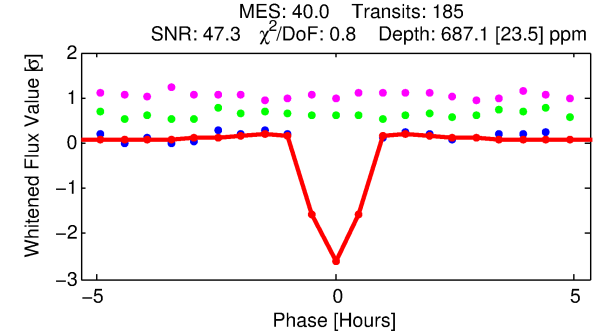
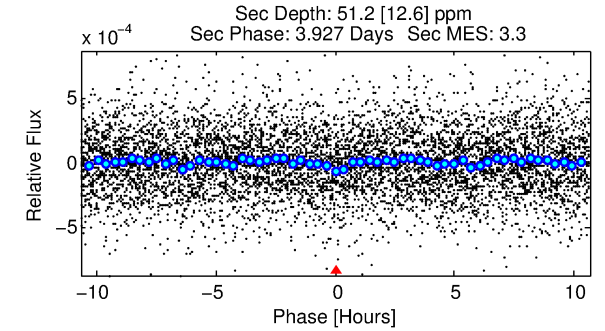
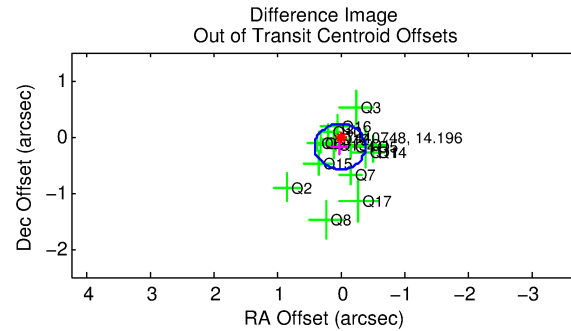
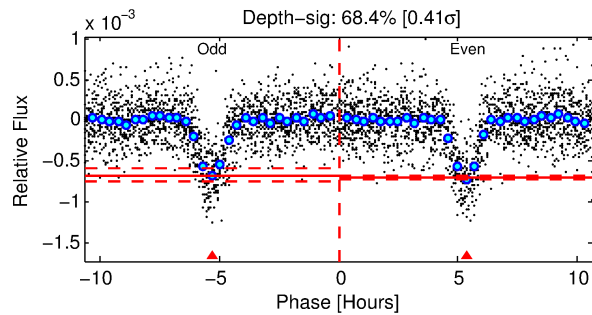
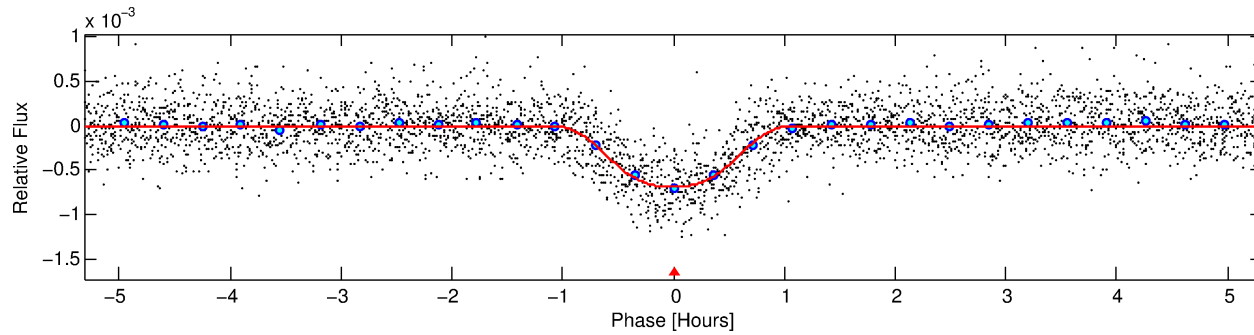
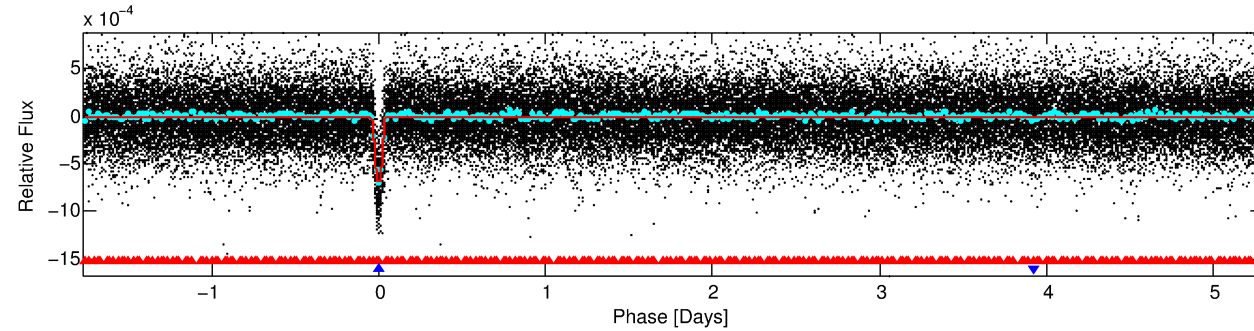
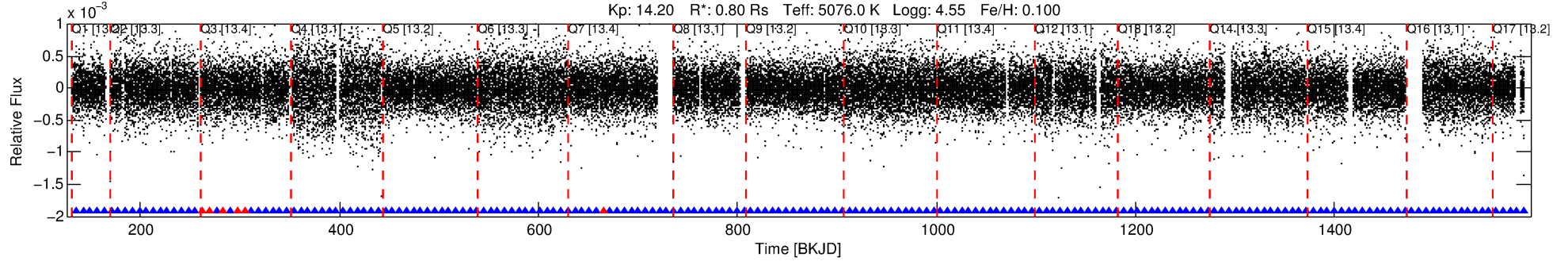
## Ephemeris Match Information For 007440748-02

No Significant Match Found

# DV One-Page Summary

KIC: 7440748 Candidate: 2 of 2 Period: 7.064 d  
KOI: K00457.02 Name: Kepler-161c Corr: 0.883

Kp: 14.20 R\*: 0.80 Rs Teff: 5076.0 K Logg: 4.55 Fe/H: 0.100



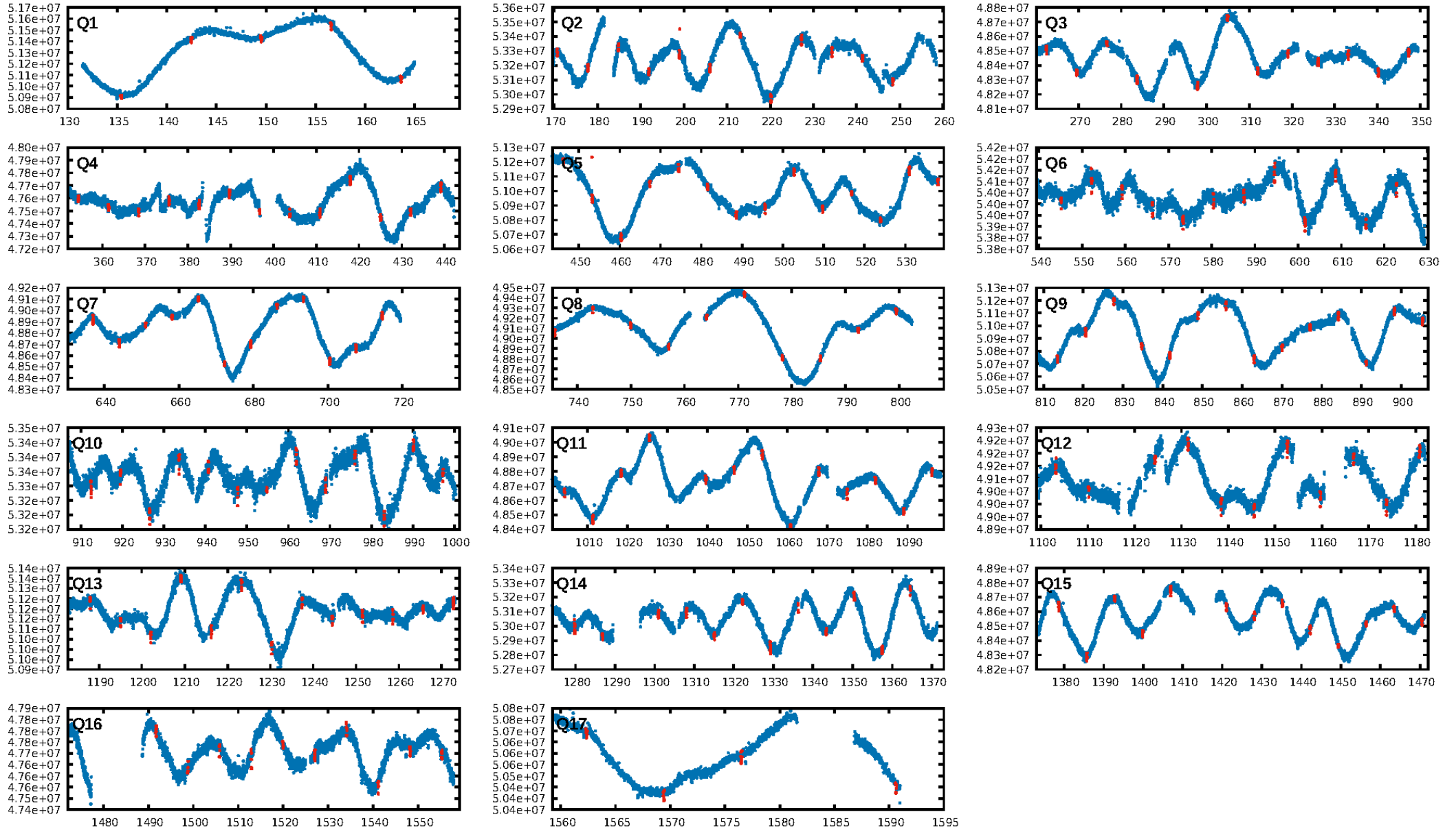
## DV Fit Results:

Period = 7.06426 [0.00001] d  
Epoch = 135.3783 [0.0008] BKJD  
Rp/R\* = 0.0329 [0.0011]  
a/R\* = 11.40 [0.83]  
b = 0.96 [0.01]  
Seff = 83.03 [9.84]  
Teff = 770 [23] K  
Rp = 2.87 [0.21] Re  
a = 0.0676 [0.0039] AU  
Ag = 15.61 [4.20] [3.48σ]  
Teffp = 2366 [158] K [10.01σ]

## DV Diagnostic Results:

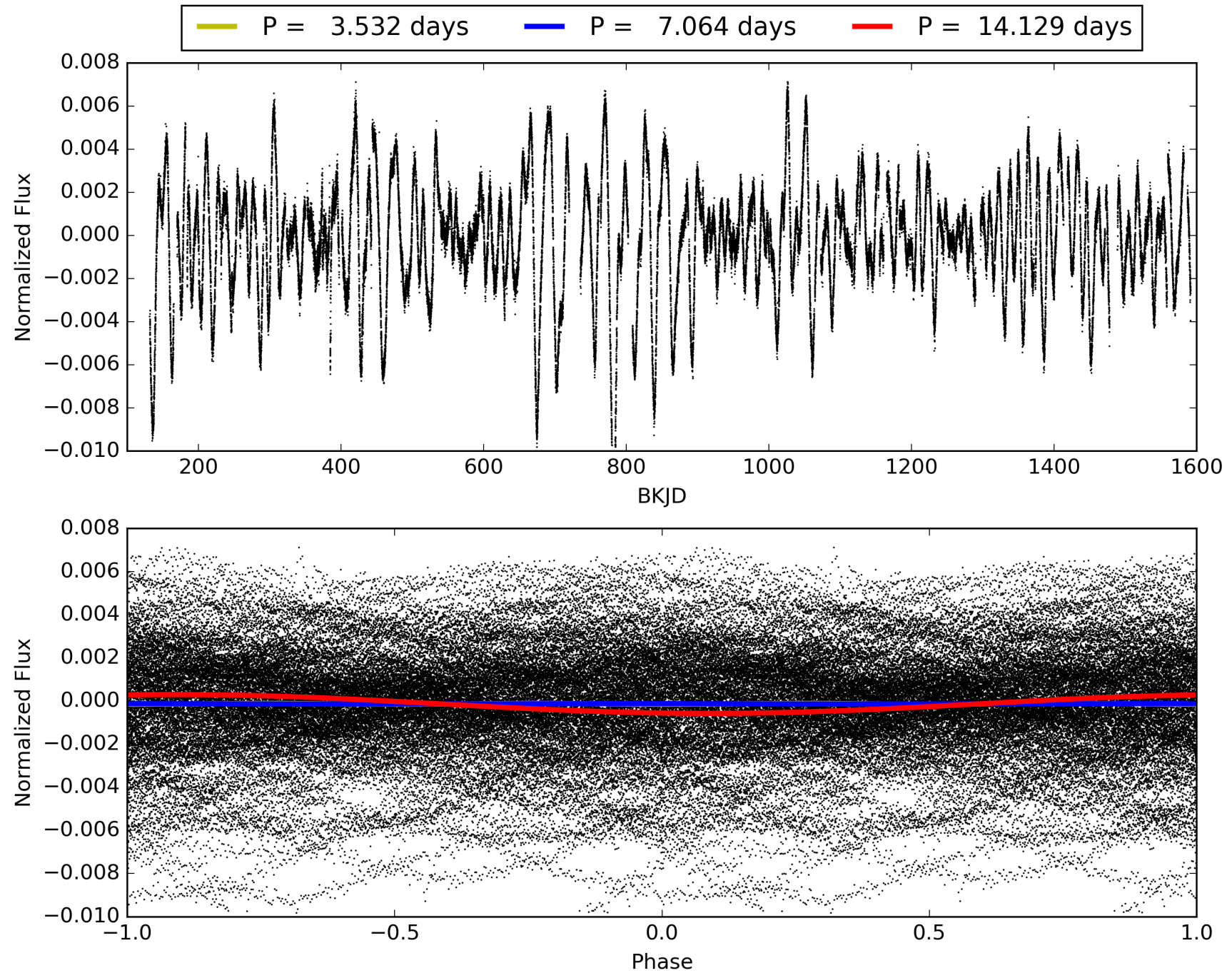
ShortPeriod-sig: 100.0% [18.82σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 100.0%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 0.97 [170/176]  
GhostDiagnostic-chr: 2.833  
Centroid-sig: 1.3%  
Centroid-so: 0.201 arcsec [0.93σ]  
OotOffset-rm: 0.179 arcsec [1.34σ]  
KicOffset-rm: 0.026 arcsec [0.21σ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 1.00 [17/17]  
DiffImageOverlap-fno: 1.00 [17/17]

# TCE 007440748-02, PDC Light Curves



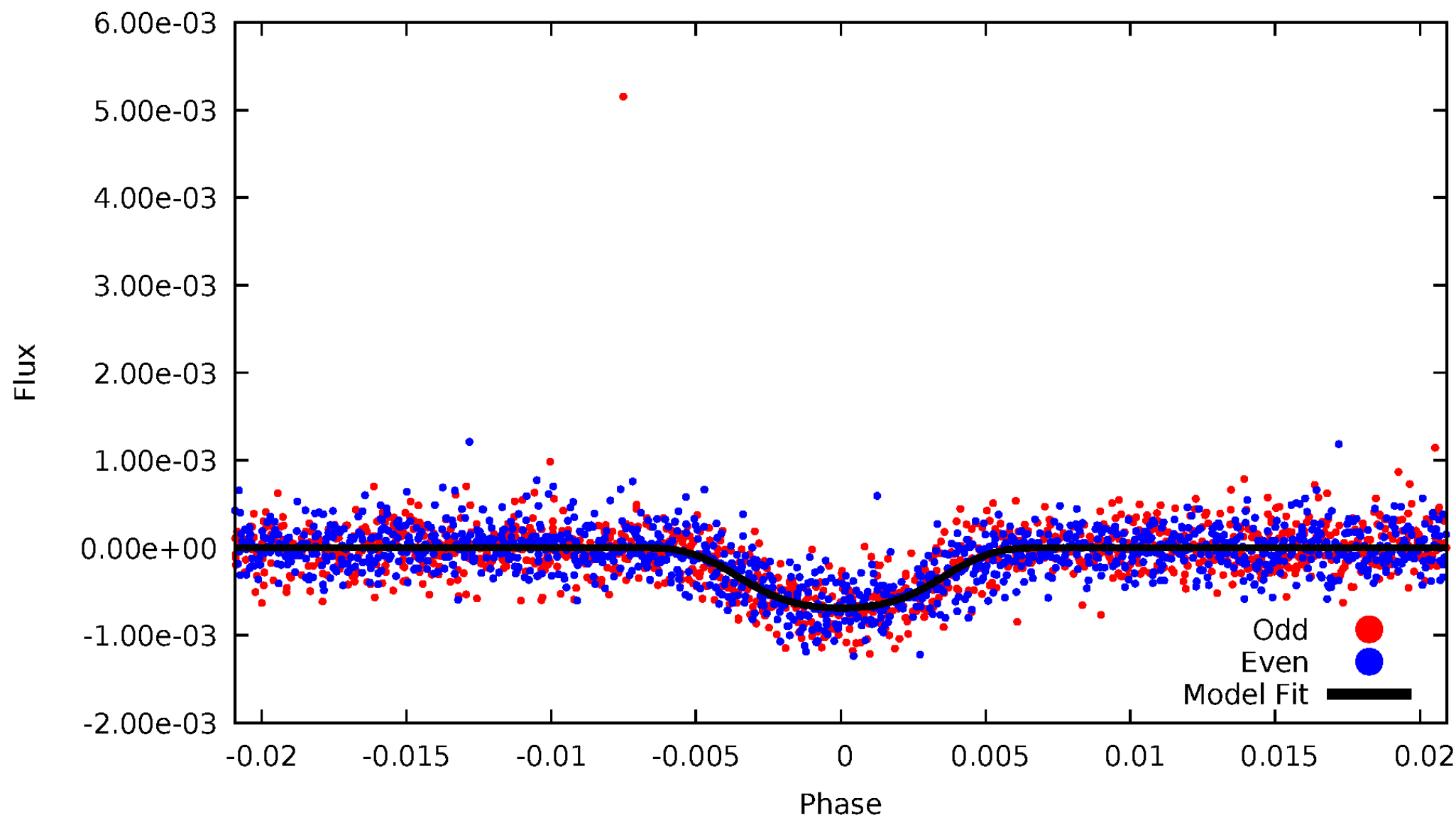


TCE 007440748-02



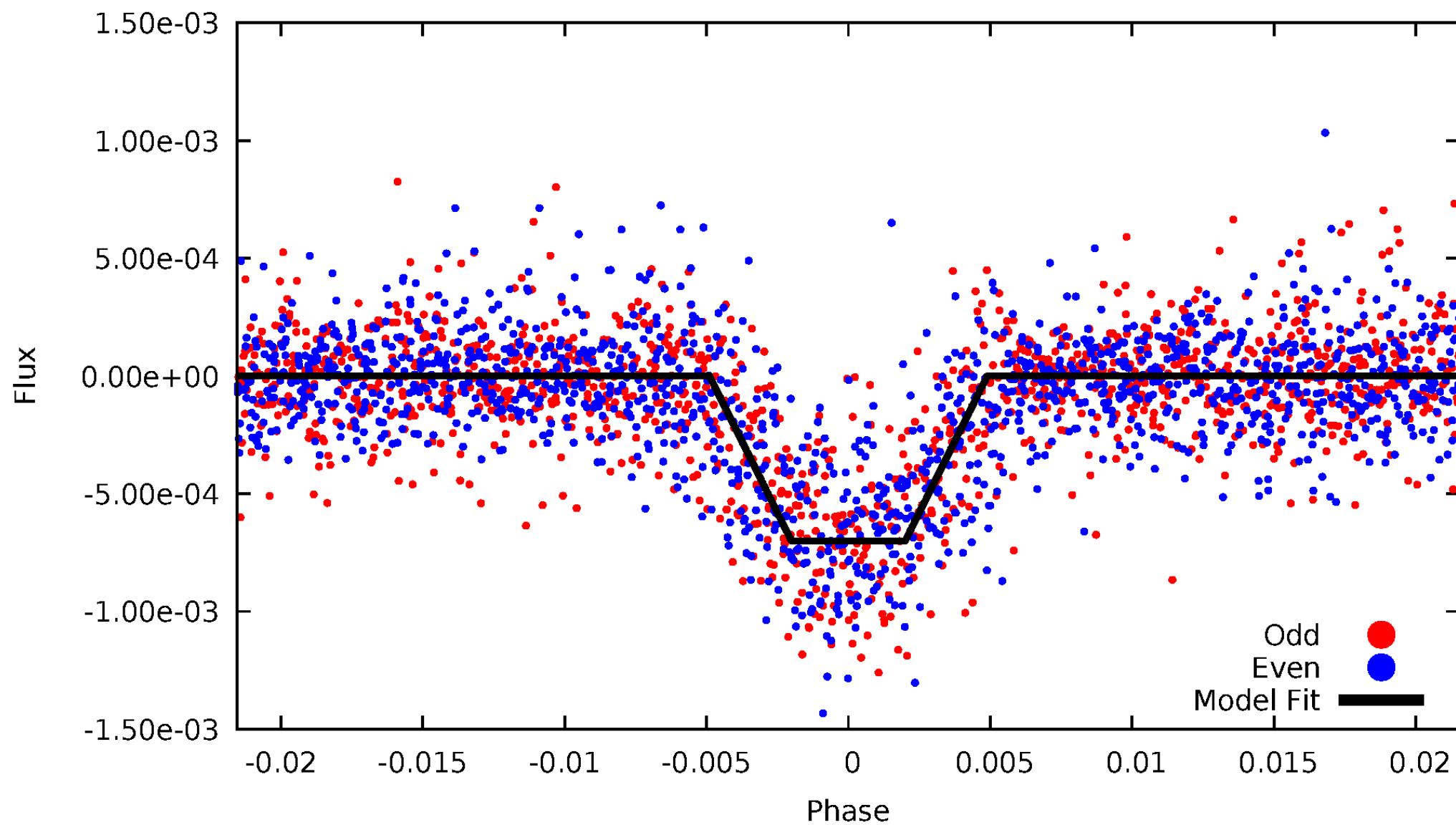
# DV Odd/Even

TCE 007440748-02



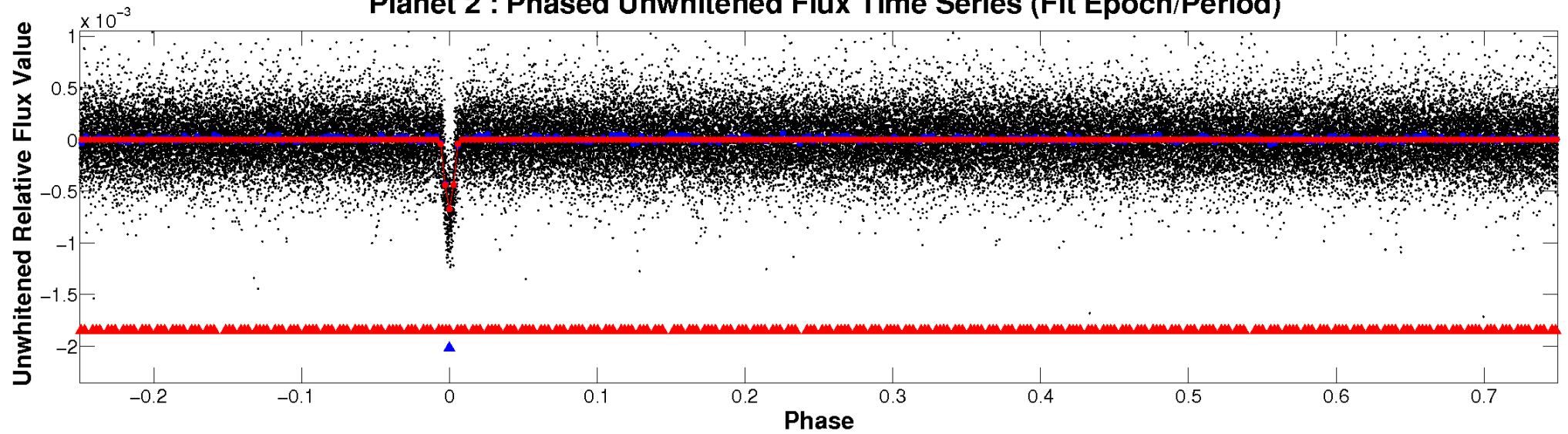
# ALT Odd/Even

TCE 007440748-02

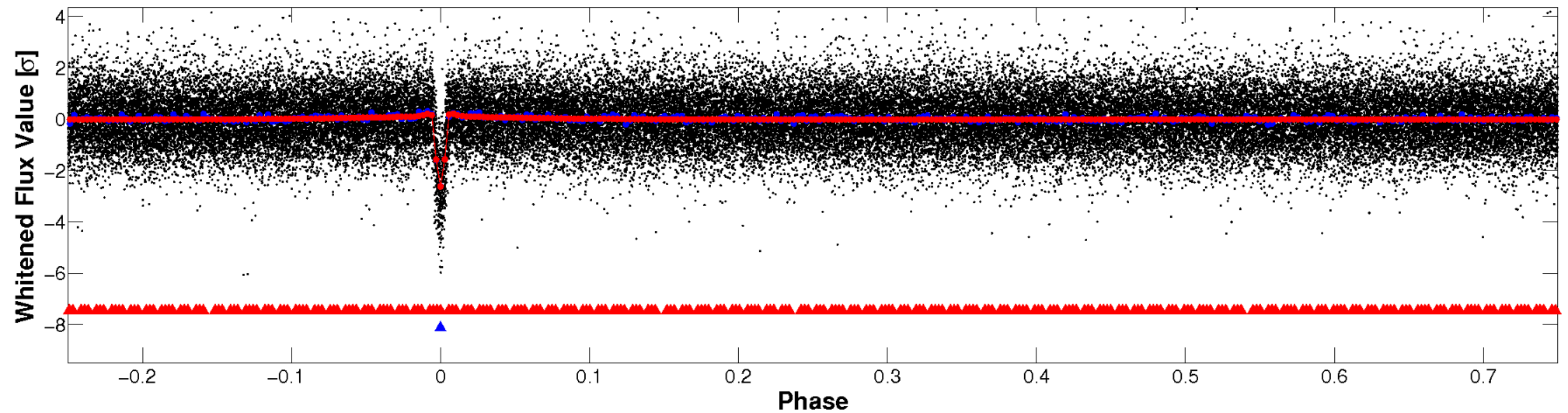


# Non-Whitened Vs. Whitened Light Curve

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

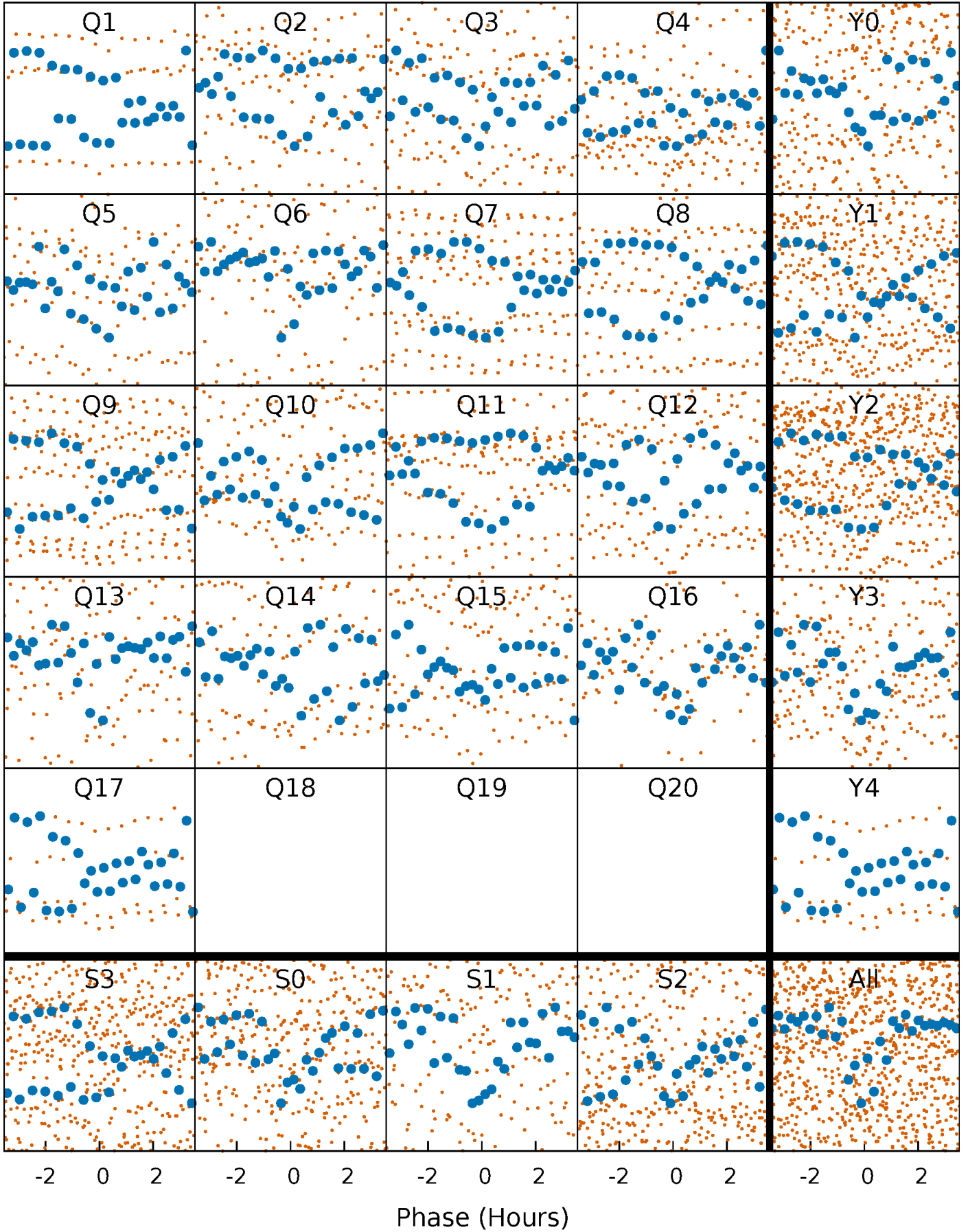


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

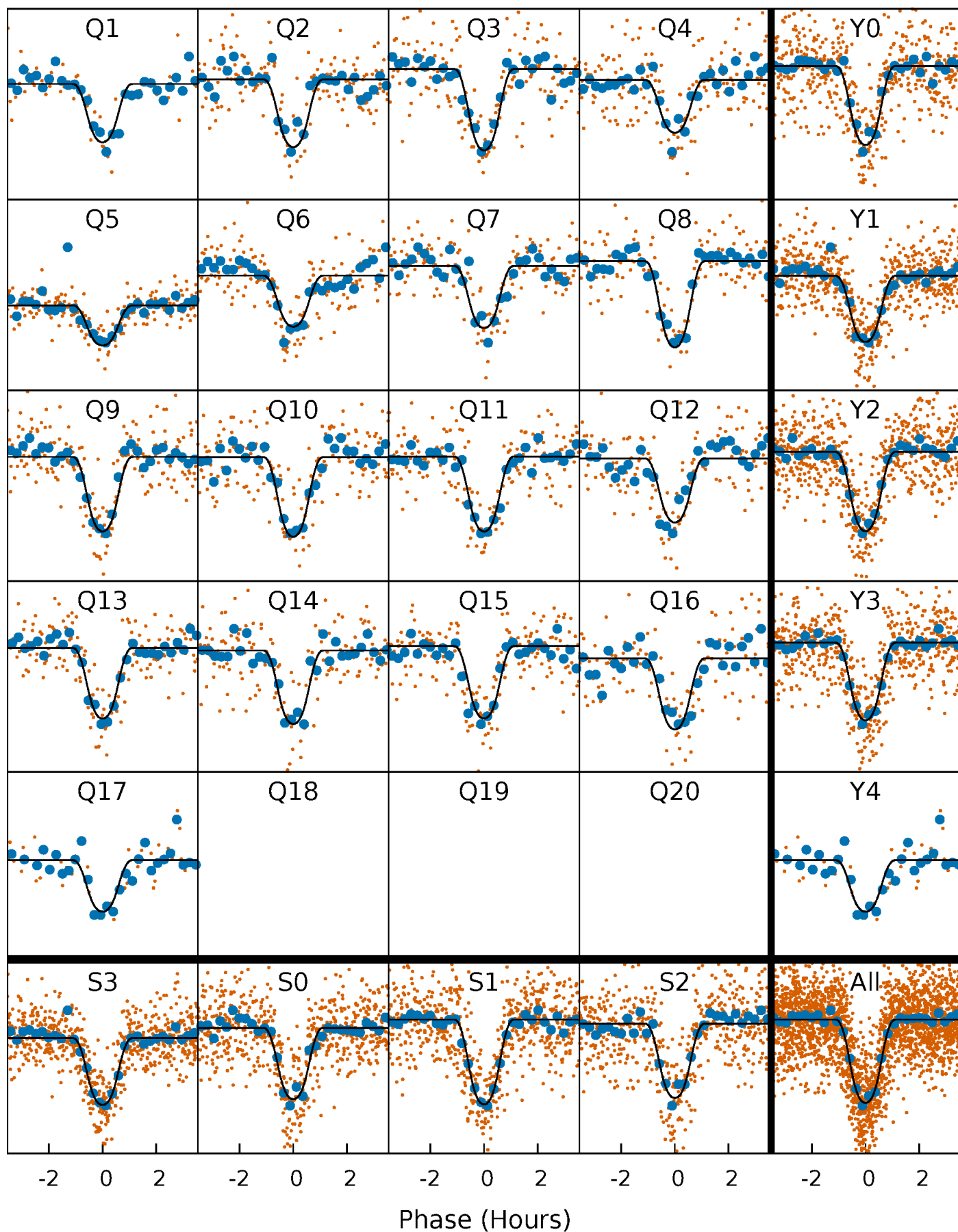
TCE 007440748-02     $P = 7.064261$  Days     $T_0 = 135.378308$  (BKJD)





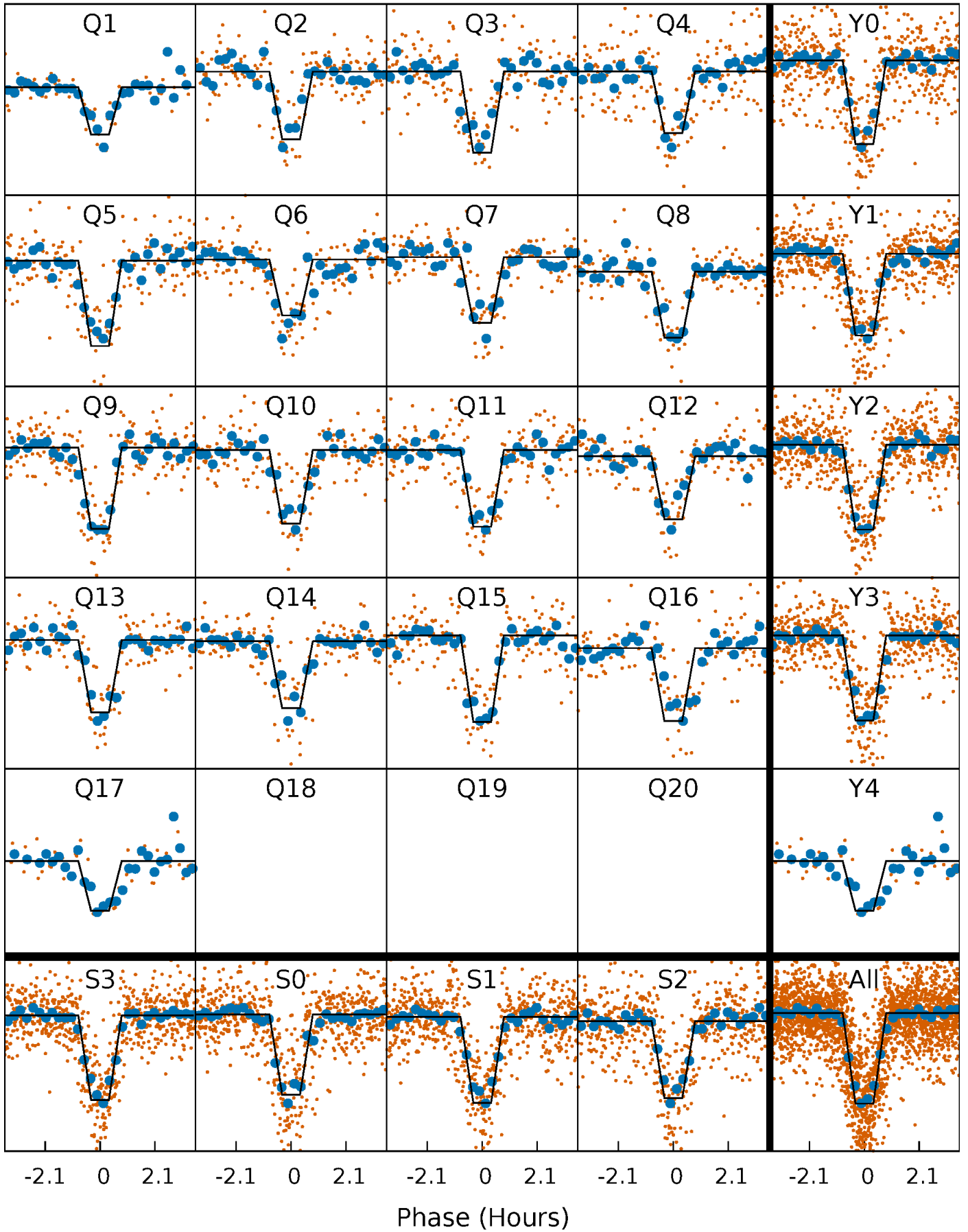
# DV Quarter-Phased Transit Curves

TCE 007440748-02   P= 7.064261 Days    $T_0=135.378308$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

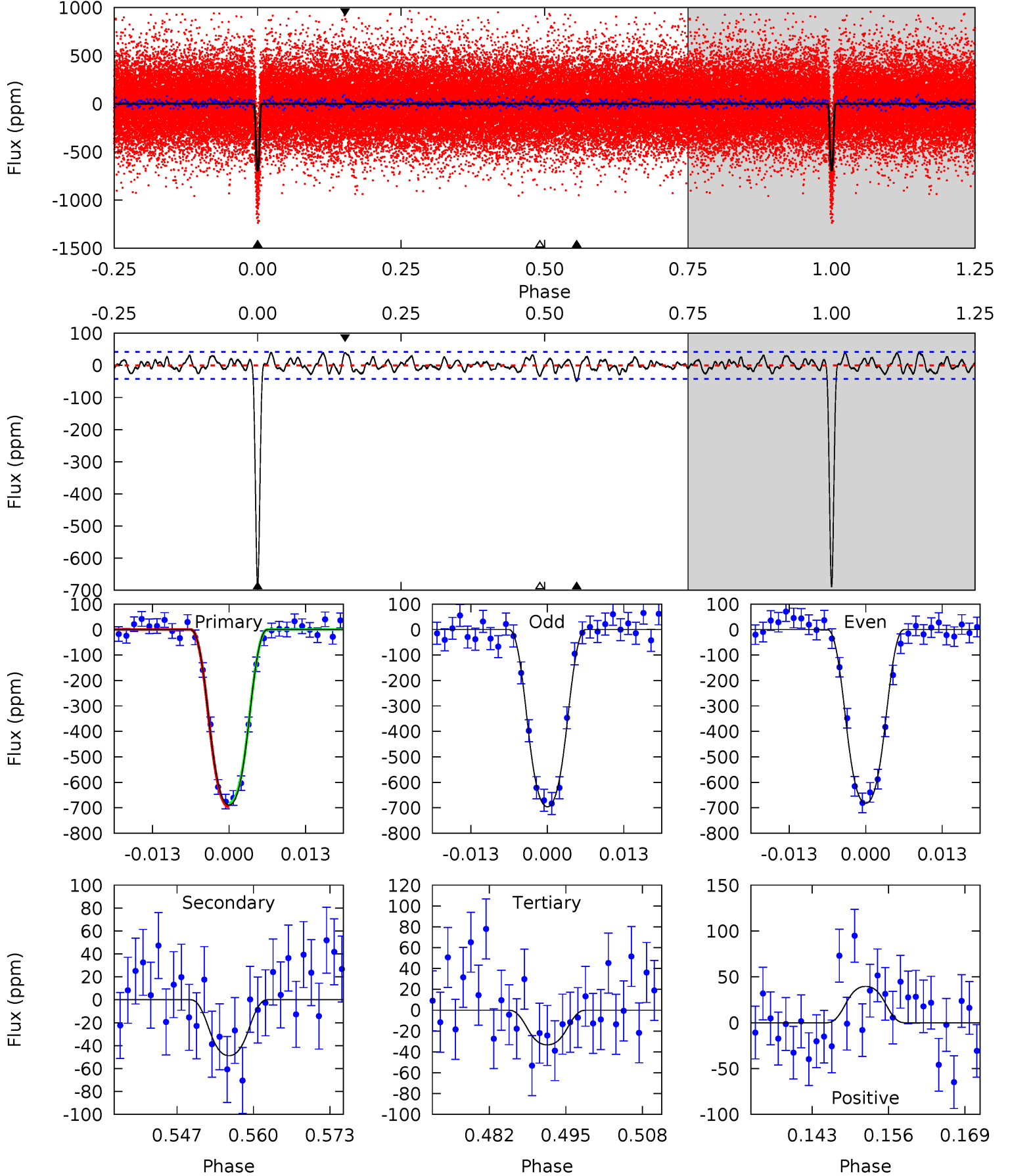
TCE 007440748-02   P= 7.064218 Days    $T_0=135.382719$  (BKJD)



# DV Model-Shift Uniqueness Test

007440748-02, P = 7.064261 Days, E = 128.314047 Days

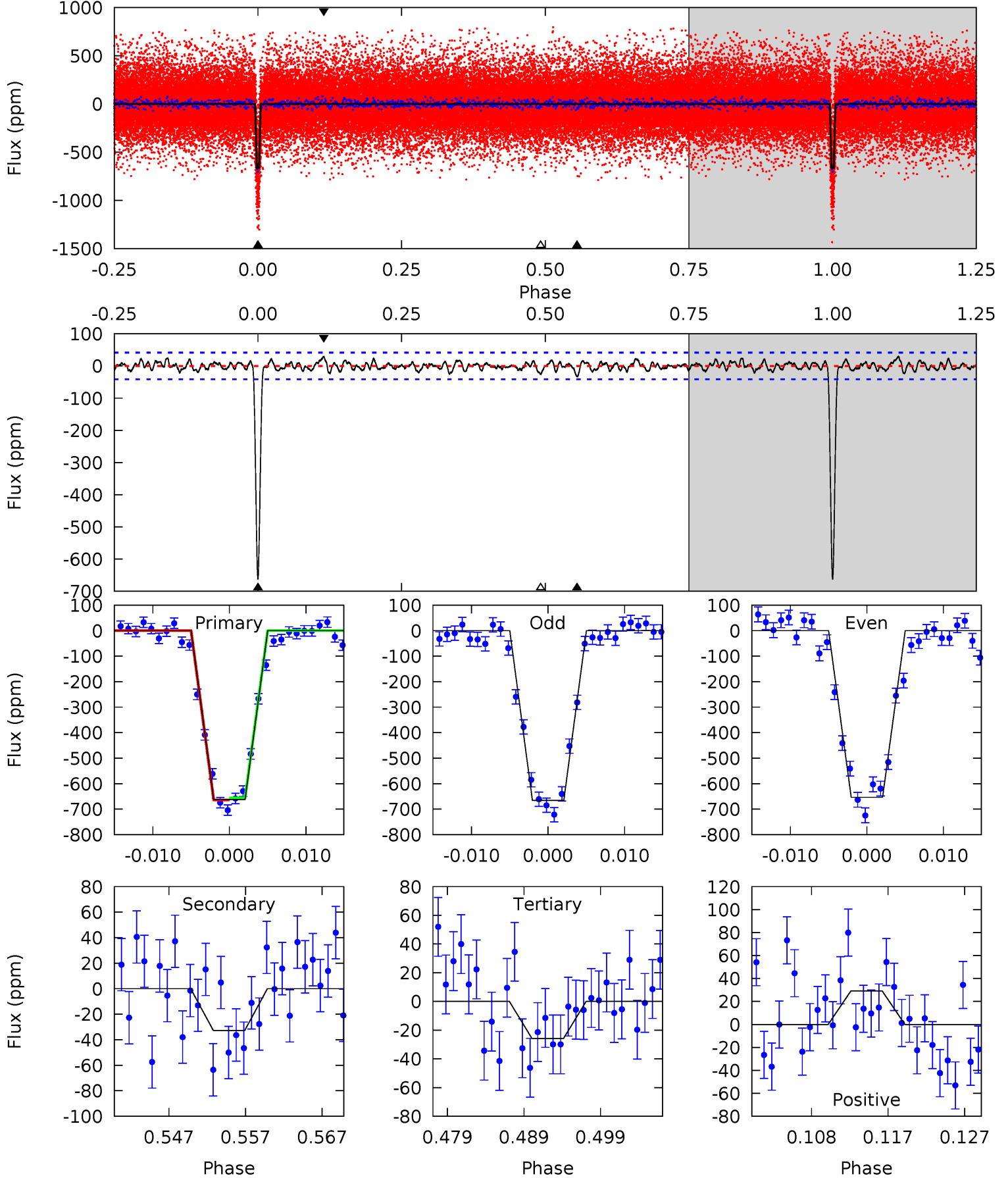
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
81.5	5.77	3.94	4.69	4.98	2.48	1.67	77.6	76.8	1.83	1.08	0.81	1.00	0.06	0.81



# Alt Model-Shift Uniqueness Test

007440748-02, P = 7.064218 Days, E = 128.318501 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
80.4	3.98	3.15	3.54	5.03	2.58	1.17	77.3	76.9	0.83	0.45	0.76	1.00	0.04	0.48



### Stellar Parameters For KIC 007440748

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5076^{+101}_{-101}$	$4.550^{+0.036}_{-0.050}$	$0.100^{+0.150}_{-0.150}$	$0.799^{+0.051}_{-0.043}$	$0.827^{+0.043}_{-0.043}$	$2.282^{+0.331}_{-0.348}$
	+2%/-2%	+1%/-1%	+150%/-150%	+6%/-5%	+5%/-5%	+15%/-15%
Source	SPE58	SPE58	SPE58	DSEP		

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

### Secondary Eclipse Parameters for KIC 007440748-02 / KOI 0457.02

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-49 \pm 8$	$2.88^{+0.16}_{-0.13}$	$1078^{+27}_{-30}$	$2967^{+91}_{-90}$	$15^{+3}_{-3}$
Alt.	$-33 \pm 8$	$2.32^{+0.13}_{-0.12}$	$1077^{+28}_{-27}$	$2994^{+105}_{-127}$	$16^{+4}_{-4}$

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

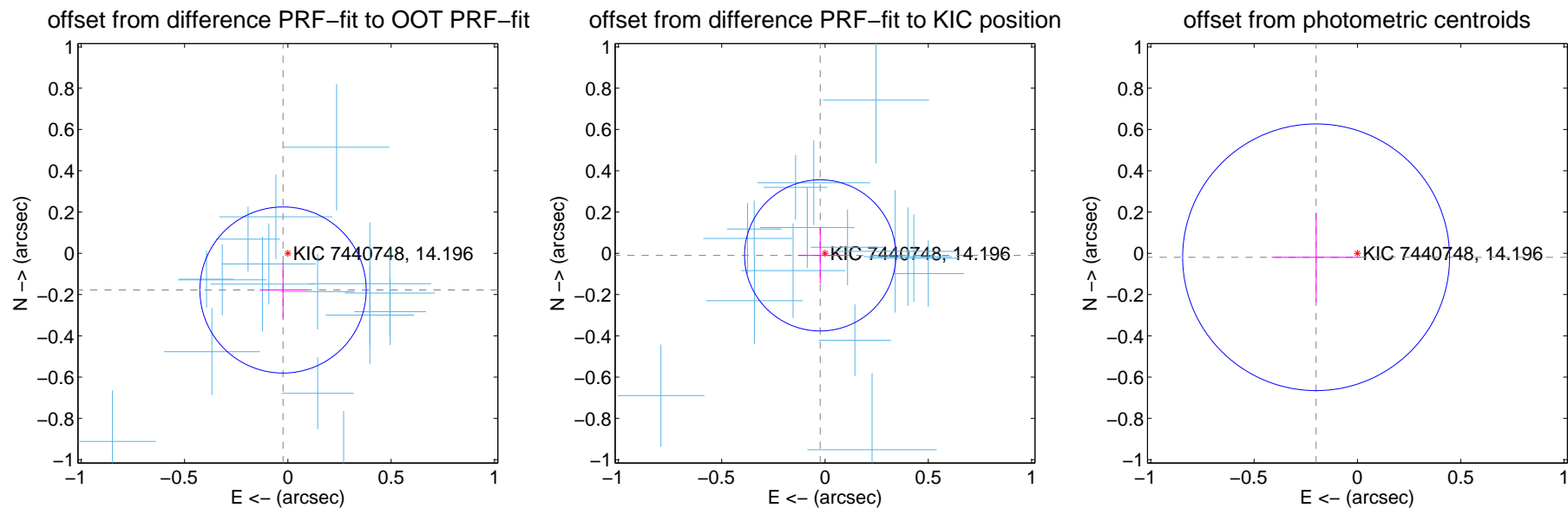
## DV Centroid Data

Supplemental centroid analysis for 007440748-02. Kepler magnitude: 14.20. Transit SNR 47.33

There are 17 quarters with good PRF difference image offsets

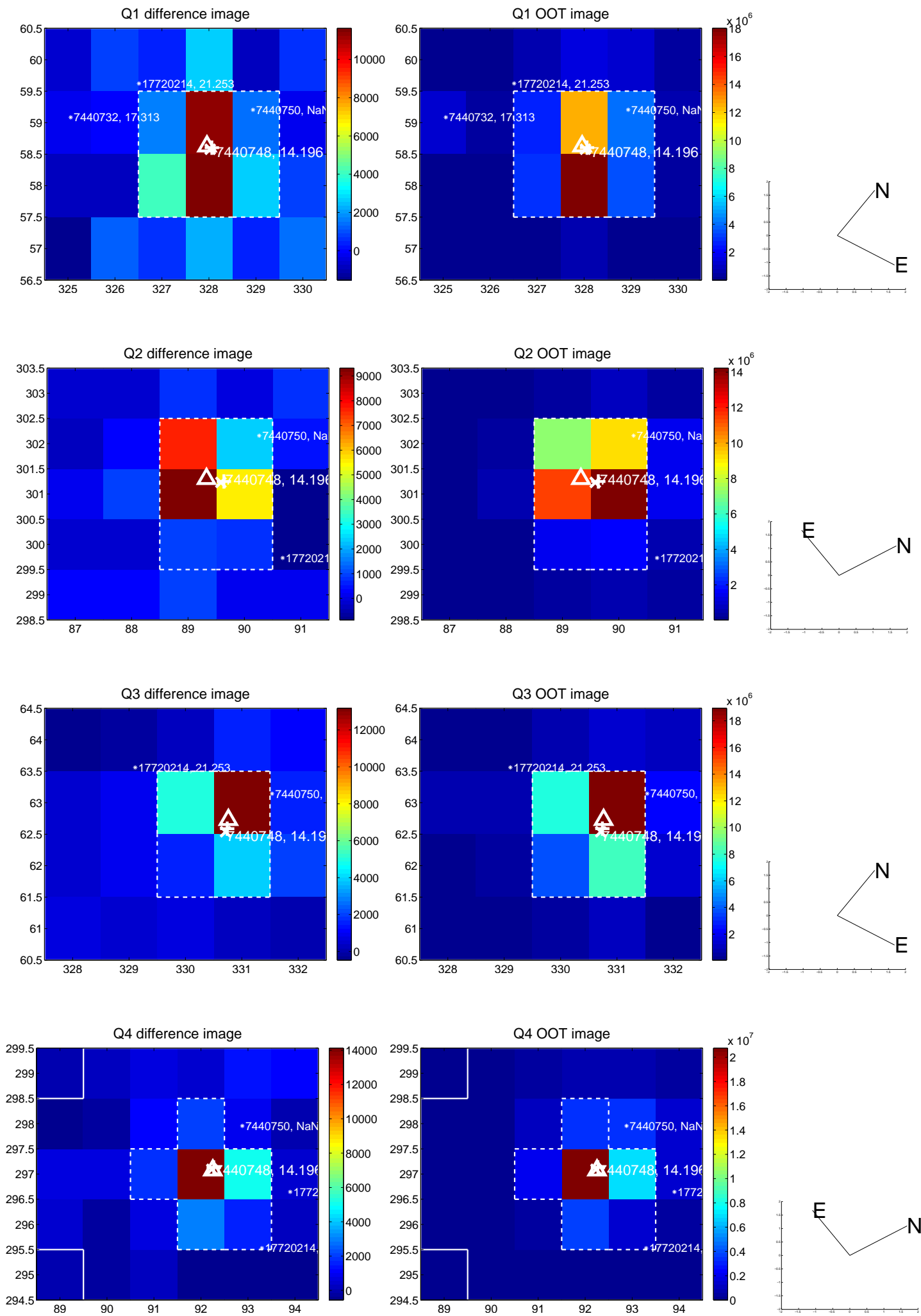
The direct PRF centroid is offset from the target star catalog position by about 0.19 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.179 \pm 0.134$	1.34	$0.023 \pm 0.112$	$-0.178 \pm 0.132$
PRF-fit source offset from KIC position	$0.026 \pm 0.122$	0.21	$0.023 \pm 0.108$	$-0.010 \pm 0.137$
photometric centroid source offset	$0.20 \pm 0.22$	0.93	$0.20 \pm 0.22$	$-0.02 \pm 0.22$



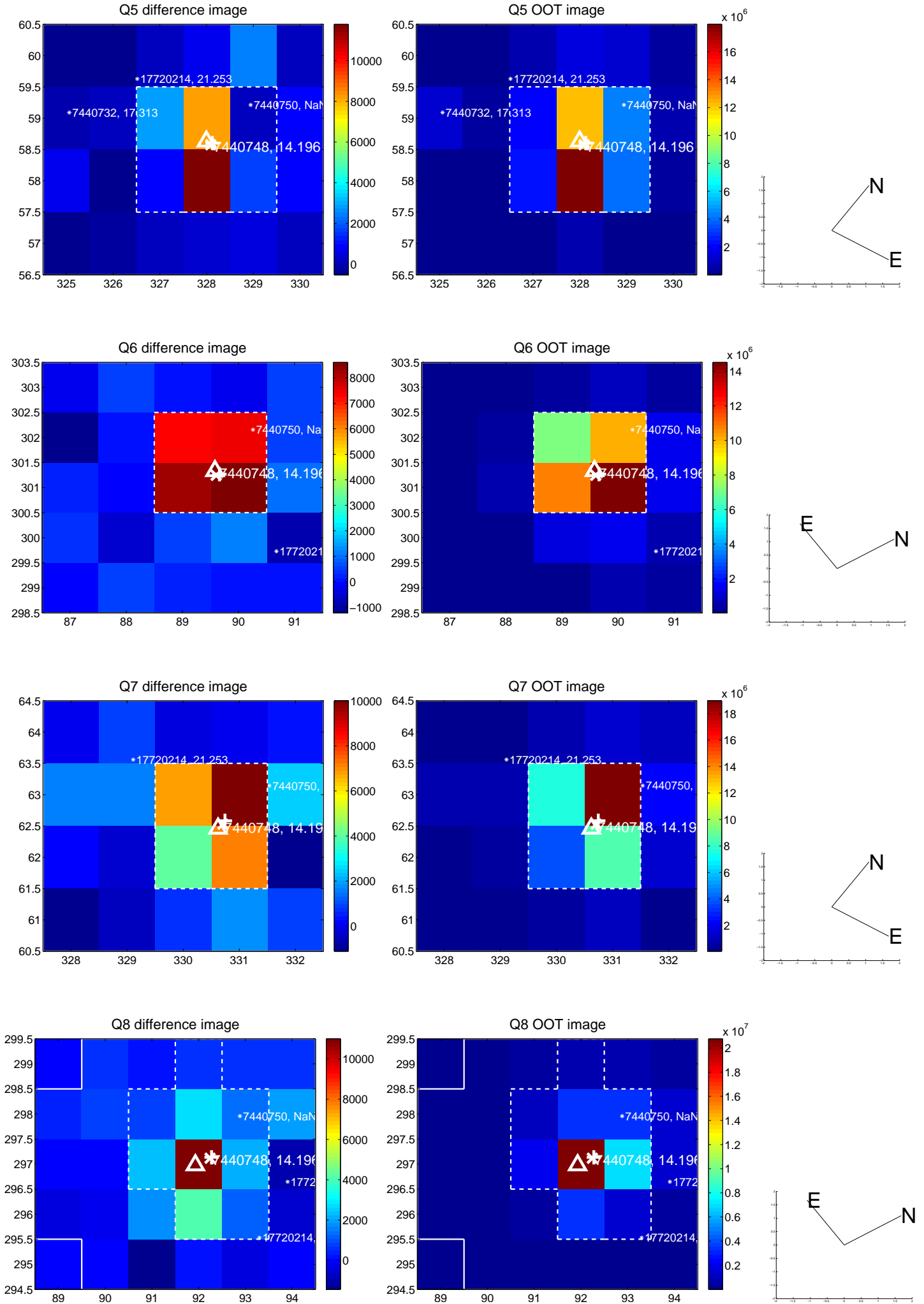
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets**; **Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three- $\sigma$ . Red \*: target star. Blue \*: Other stars. Text next to a star gives its KIC ID and kepmag. KIC IDs > 15,000,000 are from the UKIRT catalog.

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

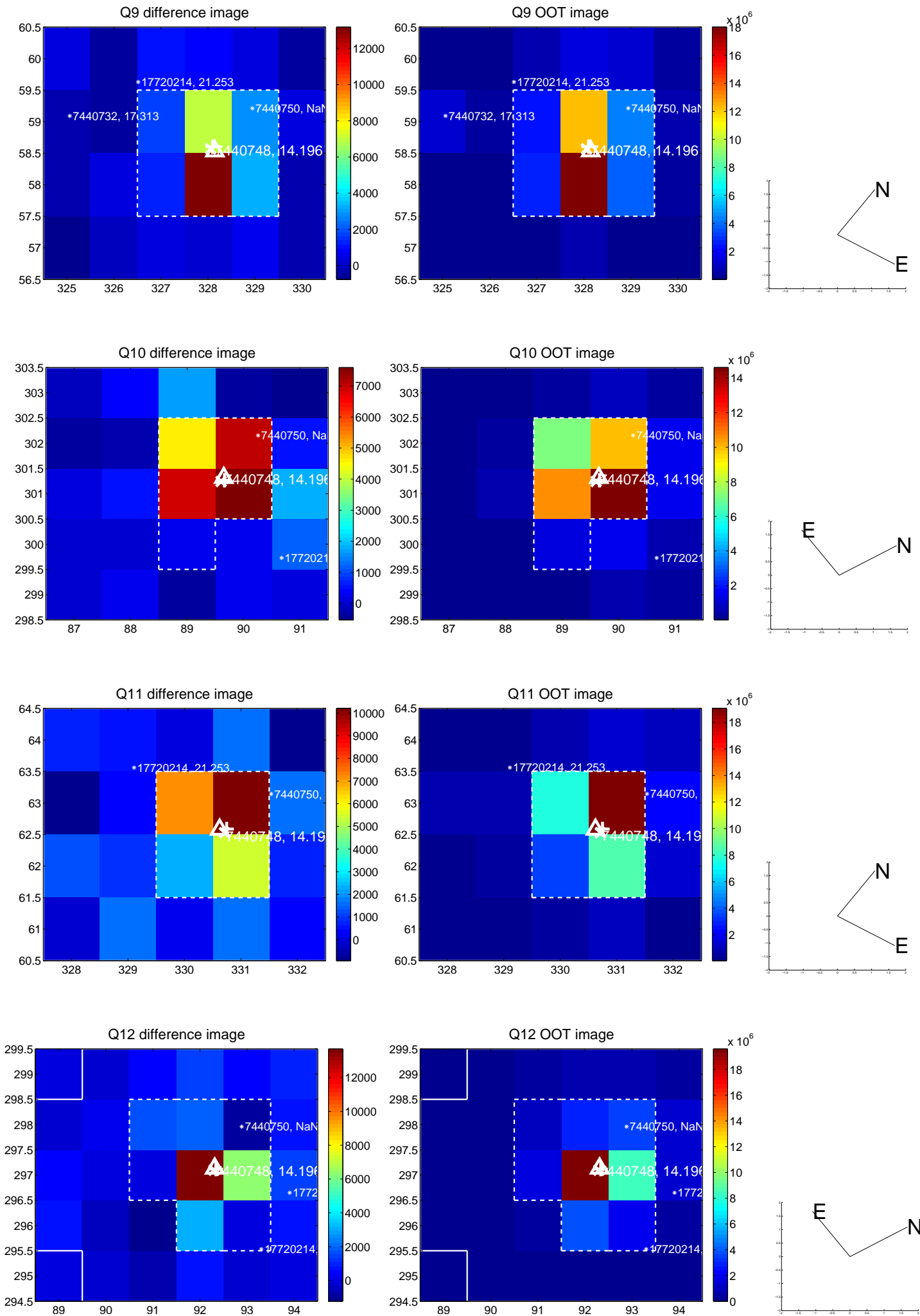




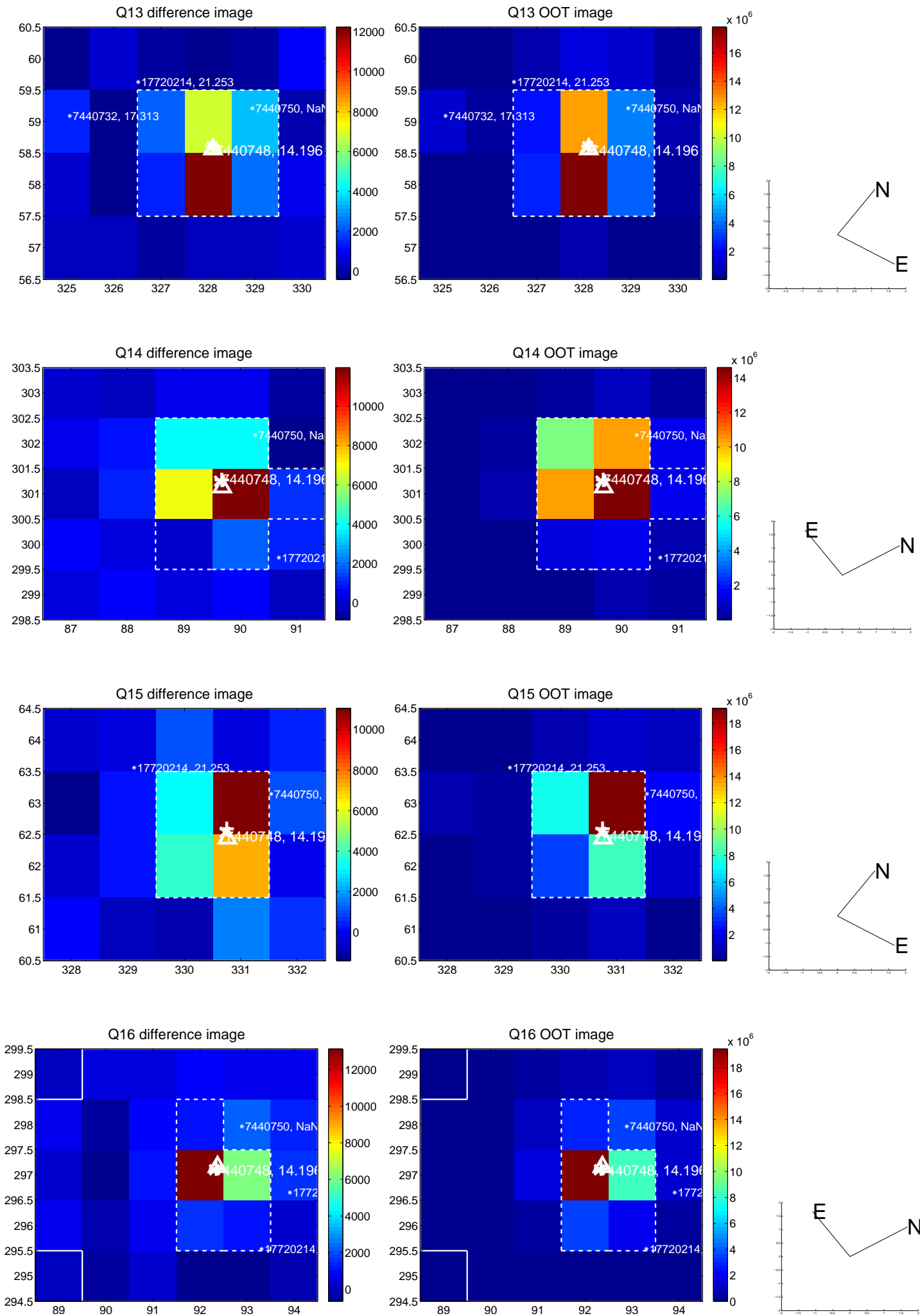
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



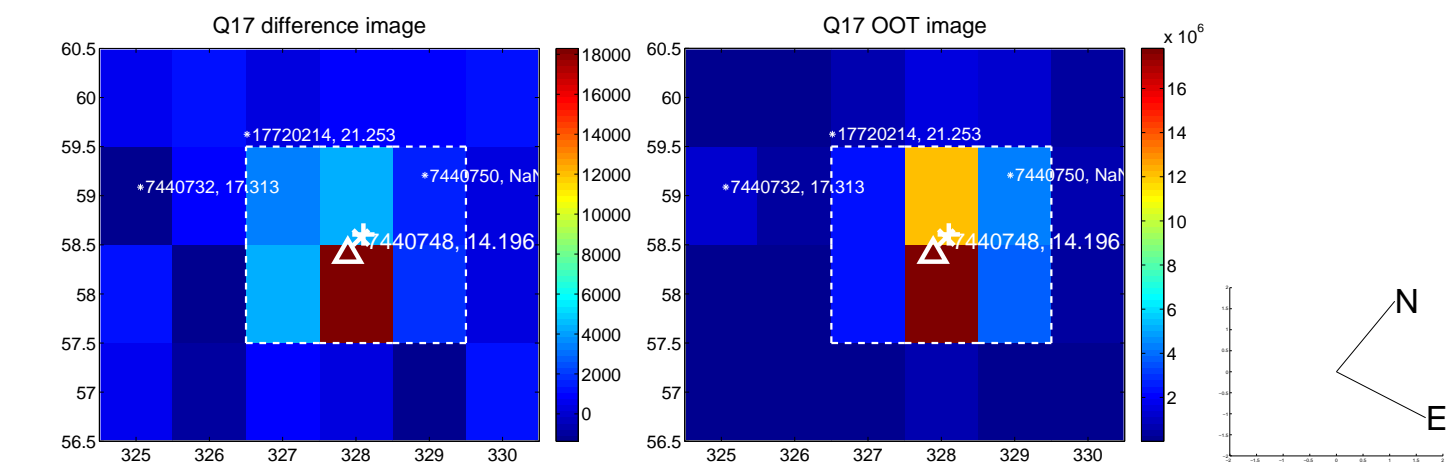
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



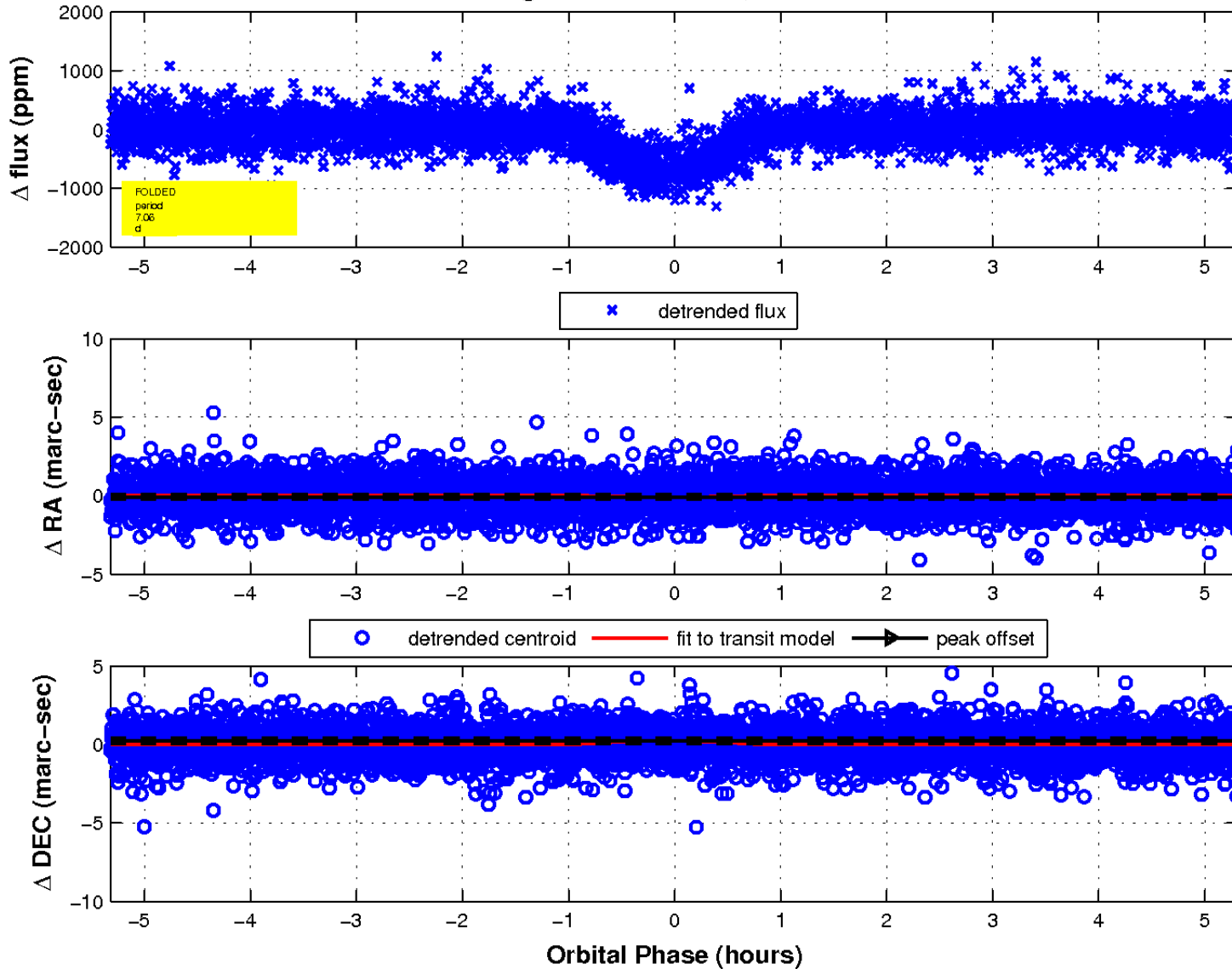
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

Declination

