

# KIC 004037428

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004037428-01	OBS	5993.01	4.264733	135.198001	22430.4	2.199	2931.1	2387.8	1.42	6052	27.76	985.25
004037428-02	OBS	No	4.264725	133.068033	707.9	2.144	86.7	99.9	1.42	6052	5.76	985.25

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004037428-01	OBS	FP	0.29	0	1	0	0	MOD_SEC_DV—MOD_SEC_ALT—DEEP_V_SHAPED—HAS_SEC_TCE
004037428-02	OBS	FP	0.00	1	1	0	0	IS_SEC_TCE

**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.

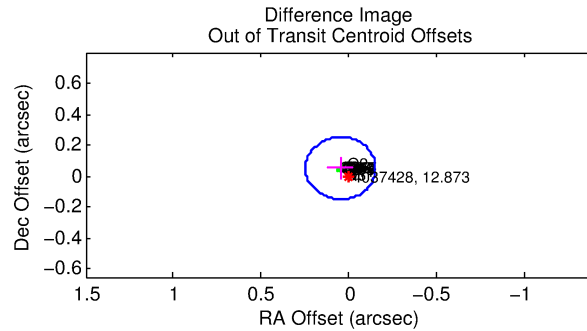
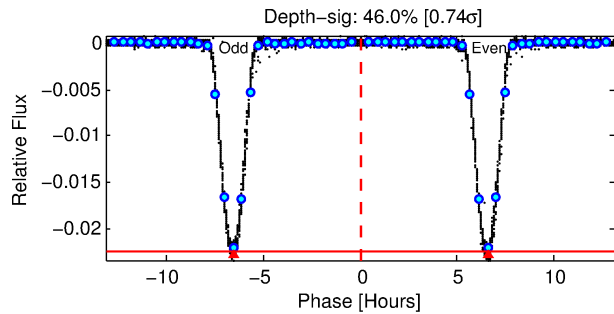
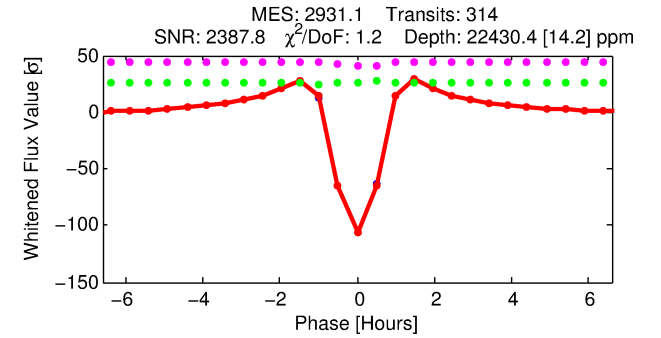
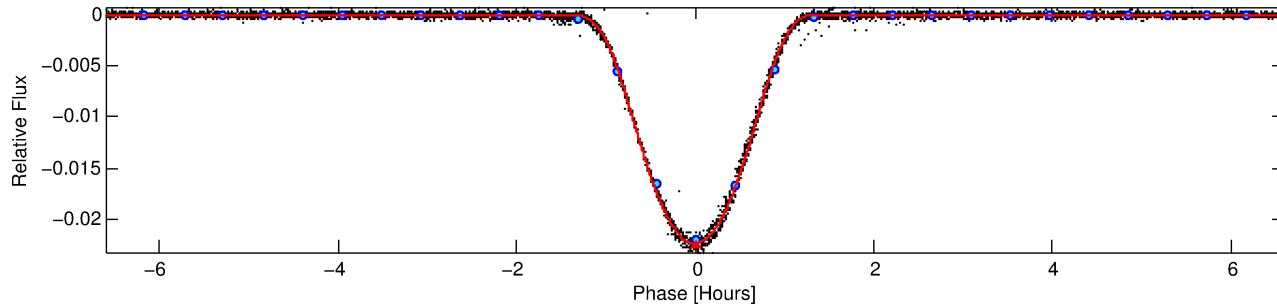
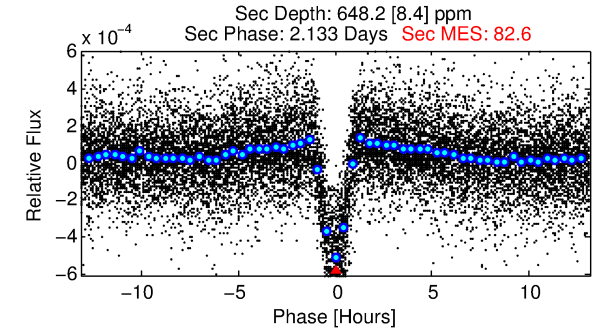
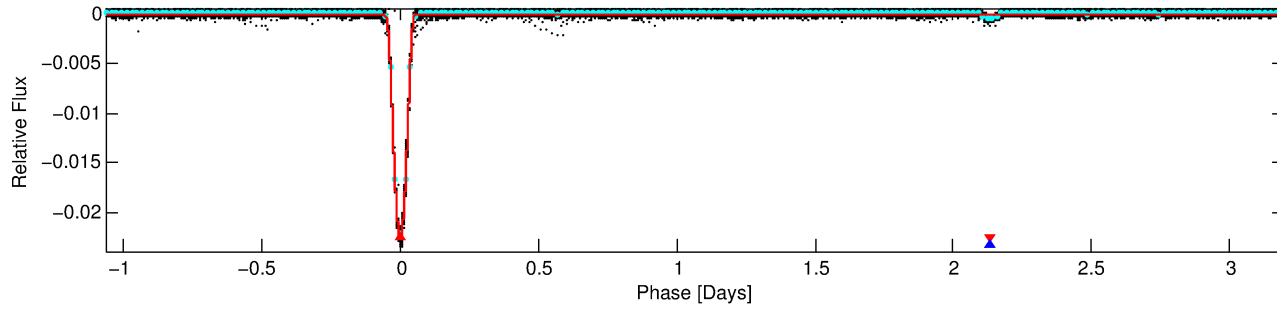
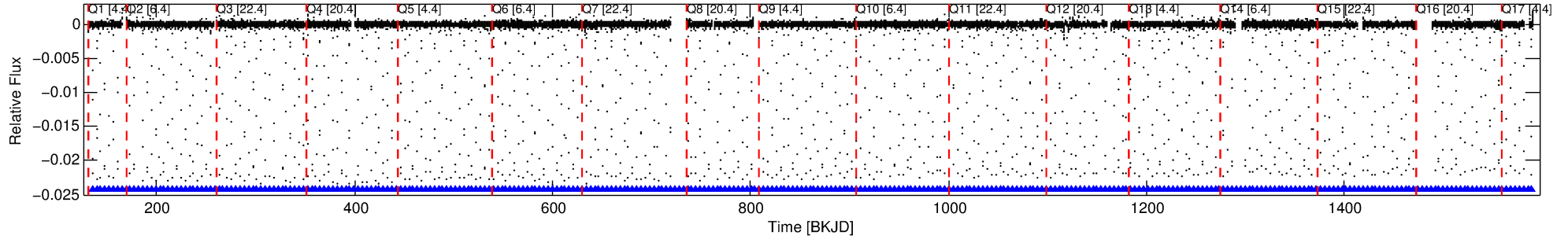
## Ephemeris Match Information For 004037428-01

No Significant Match Found

# DV One-Page Summary

KIC: 4037428 Candidate: 1 of 2 Period: 4.265 d  
KOI: K05993.01 Corr: 0.996

Kp: 12.87 R\*: 1.42 Rs Teff: 6052.0 K Logg: 4.08 Fe/H: -0.580



## DV Fit Results:

Period = 4.26473 [0.00000] d  
Epoch = 135.1980 [0.0000] BKJD  
Rp/R\* = 0.1795 [0.0012]  
a/R\* = 11.34 [0.02]  
b = 0.90 [0.00]  
Seff = 985.25 [652.24]  
Teq = 1429 [236] K  
Rp = 27.76 [10.58] Re  
a = 0.0495 [0.0195] AU  
Ag = 1.13 [0.74] [0.18σ]  
Teff = 2279 [62] K [3.48σ]

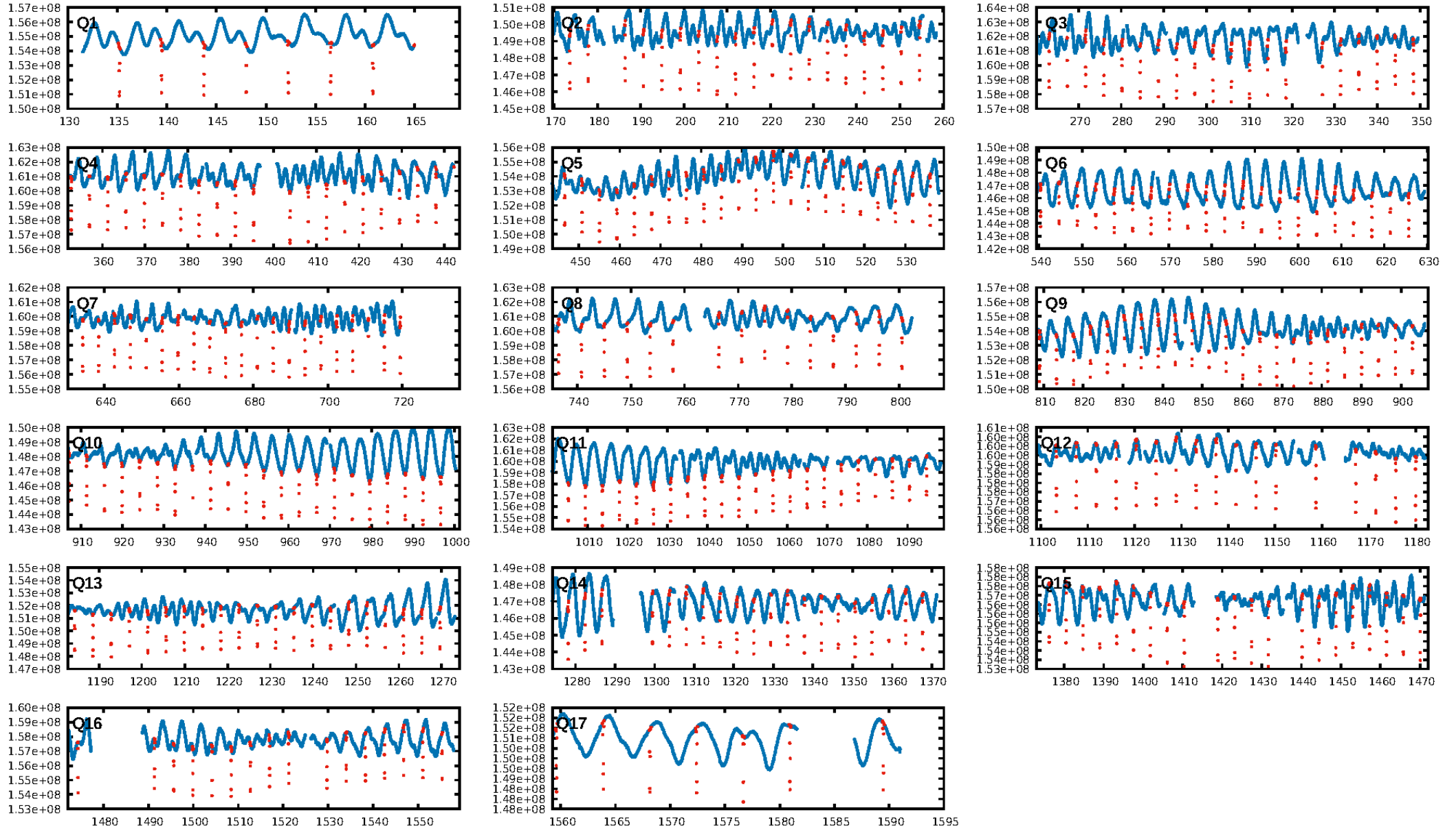
## DV Diagnostic Results:

ShortPeriod-sig: 0.0% [0.00σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 1.00 [300/300]  
GhostDiagnostic-chr: 2.905  
Centroid-sig: 0.0%  
Centroid-so: 0.249 arcsec [77.86σ]  
OotOffset-rm: 0.071 arcsec [1.06σ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-rm: 0.279 arcsec [4.07σ]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 1.00 [17/17]  
DiffImageOverlap-fno: 1.00 [17/17]

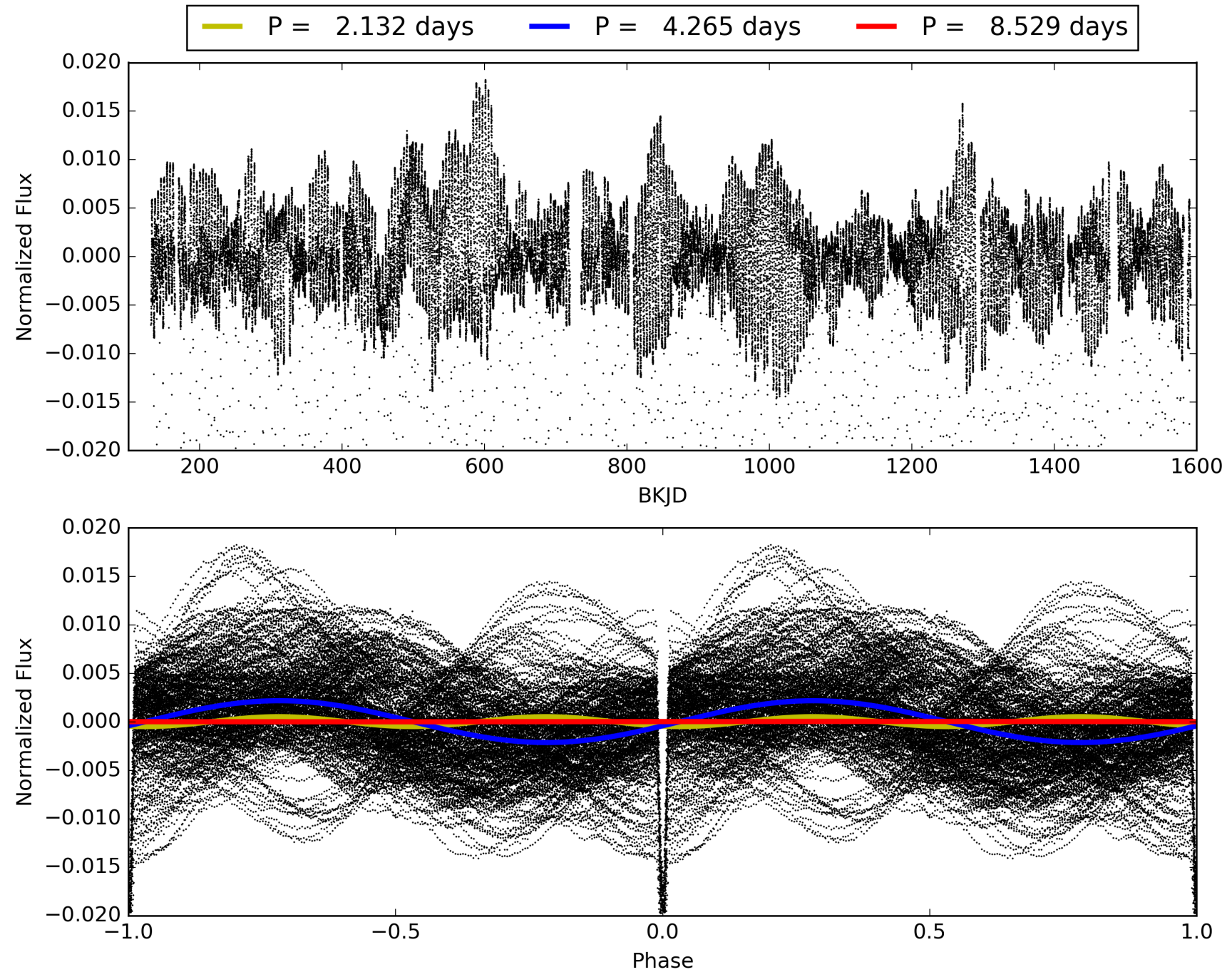
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 01-Feb-2016 14:00:36 Z

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

# TCE 004037428-01, PDC Light Curves

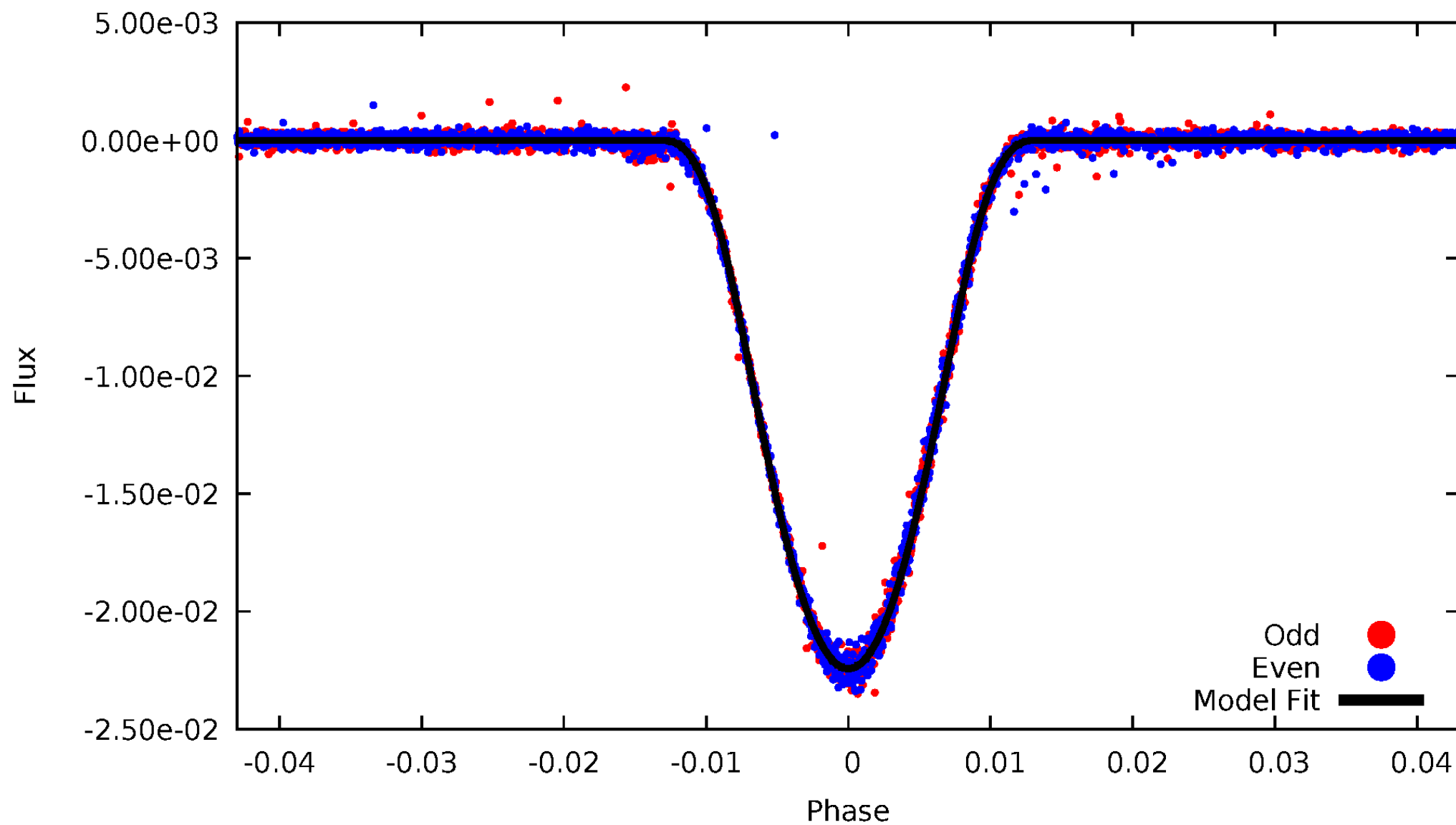


TCE 004037428-01



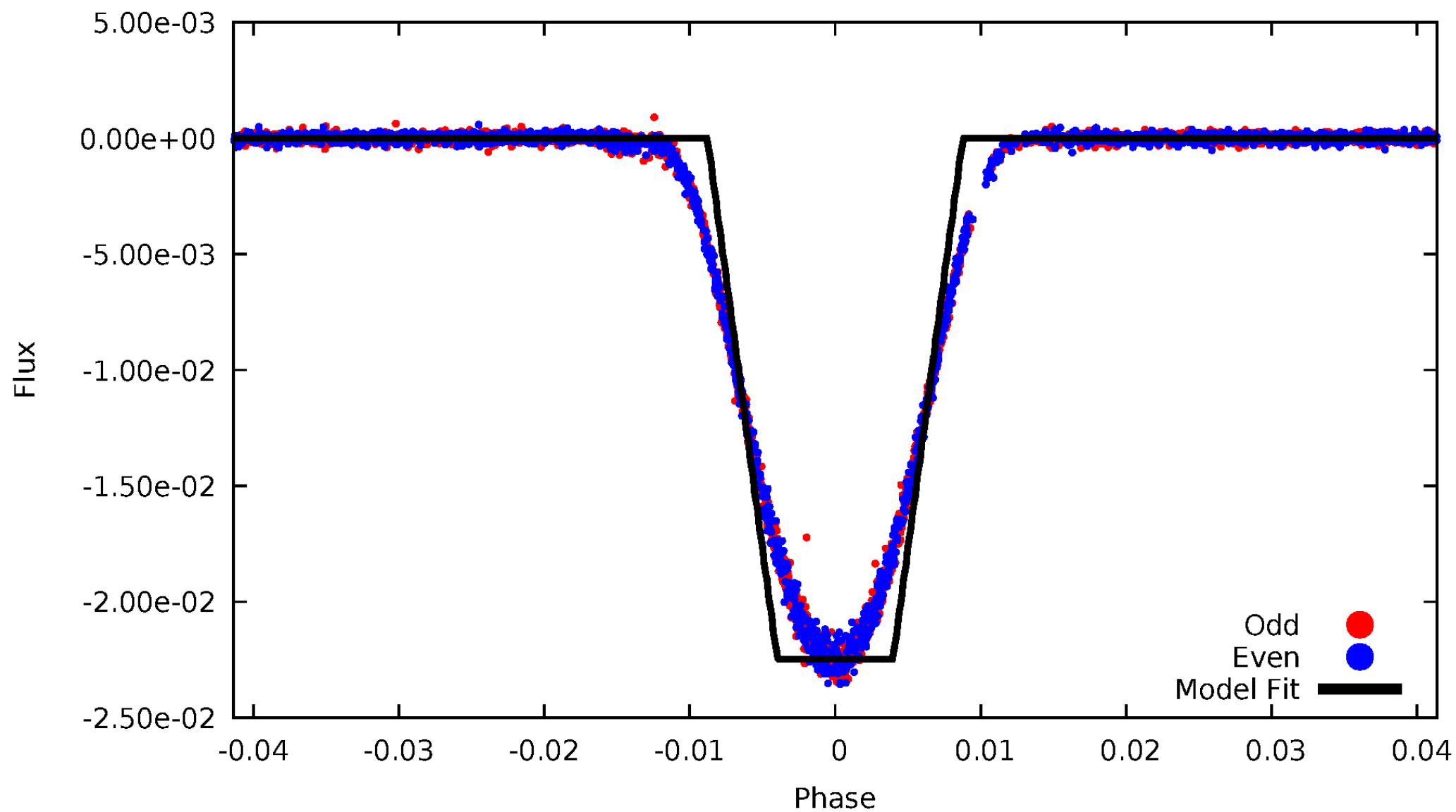
# DV Odd/Even

TCE 004037428-01



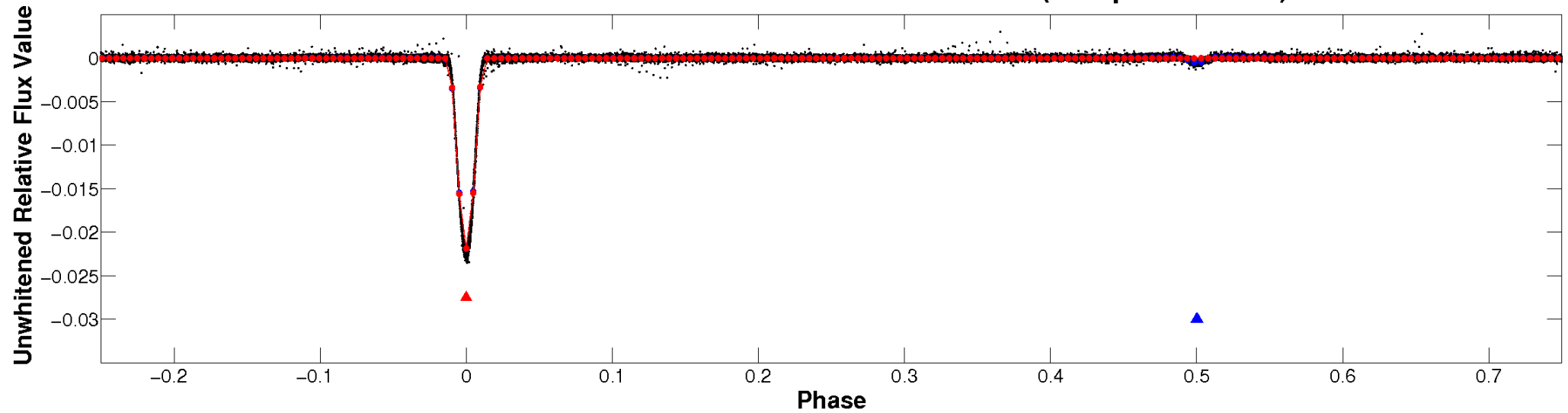
# ALT Odd/Even

TCE 004037428-01

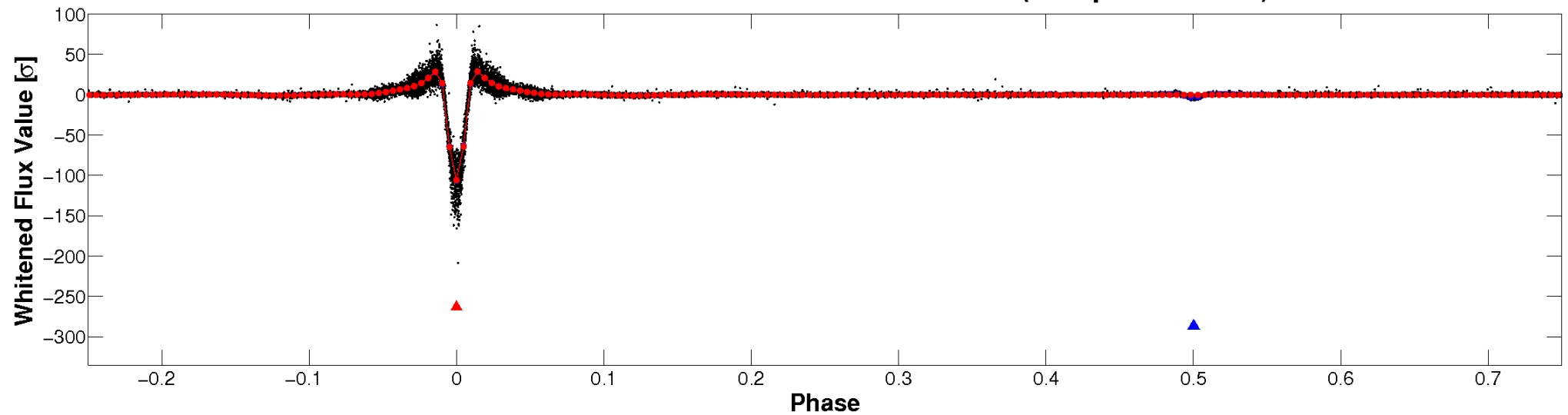


# Non-Whitened Vs. Whitened Light Curve

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



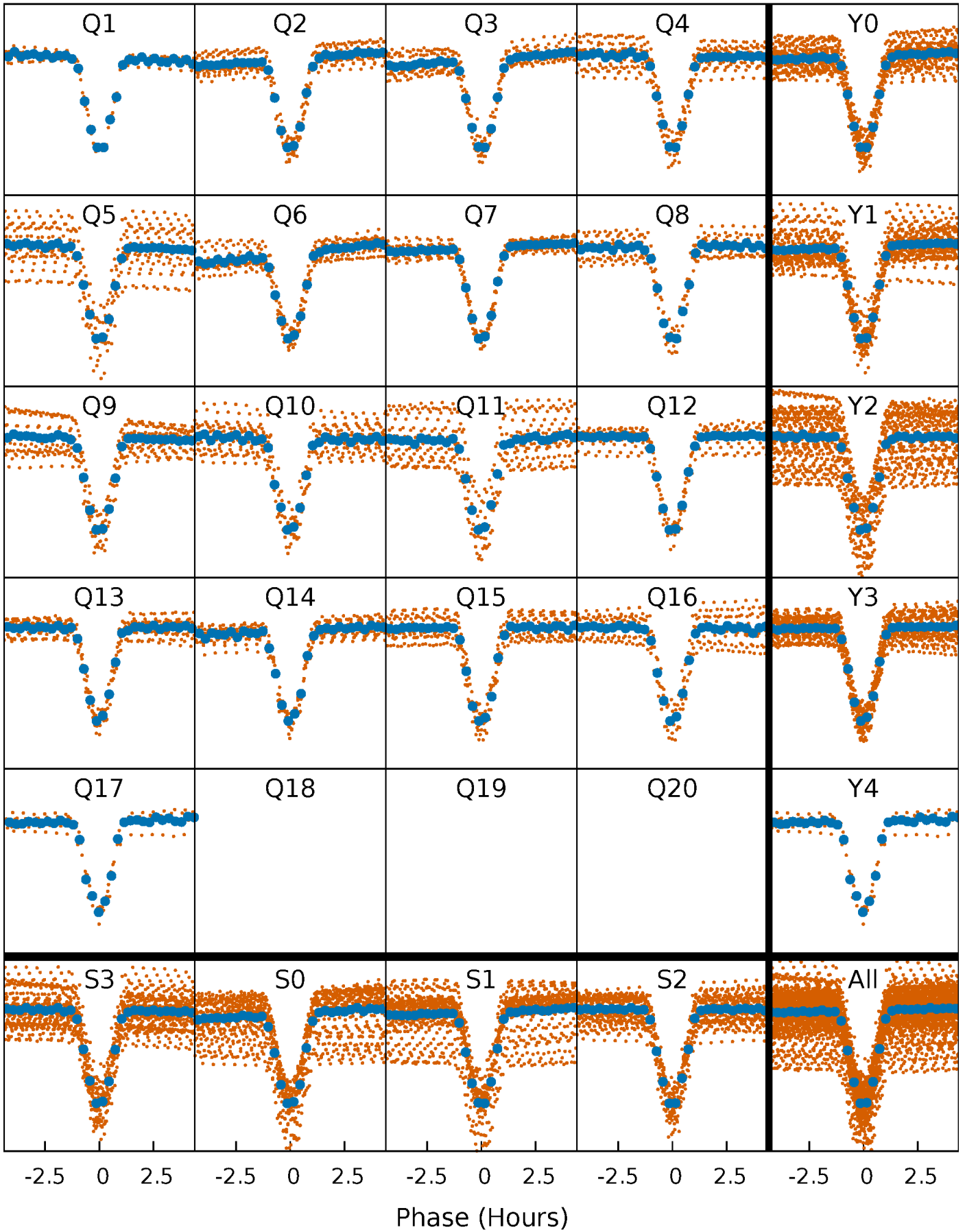
**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**





# PDC Quarter-Phased Transit Curves

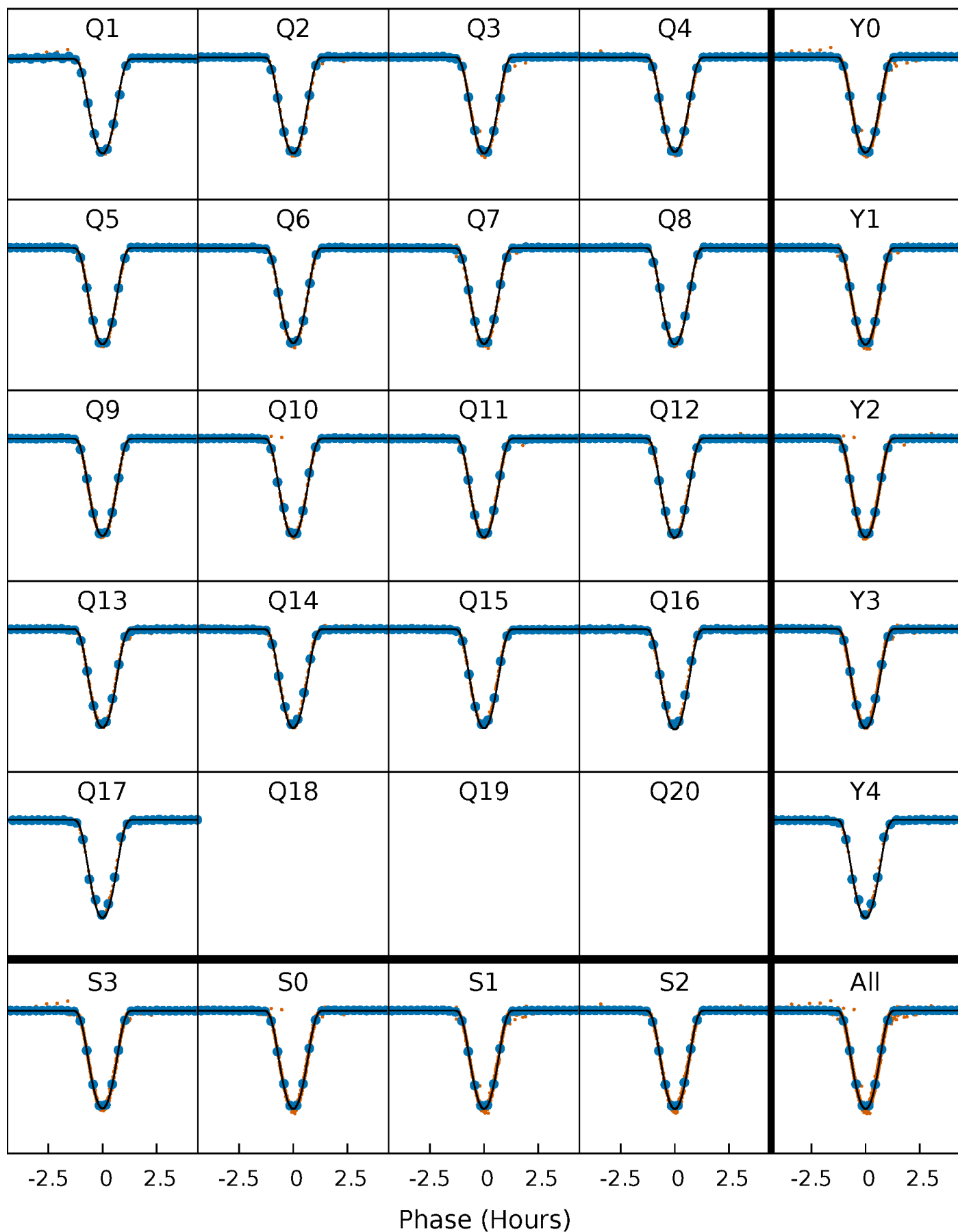
TCE 004037428-01 P= 4.264733 Days  $T_0=135.198001$  (BKJD)





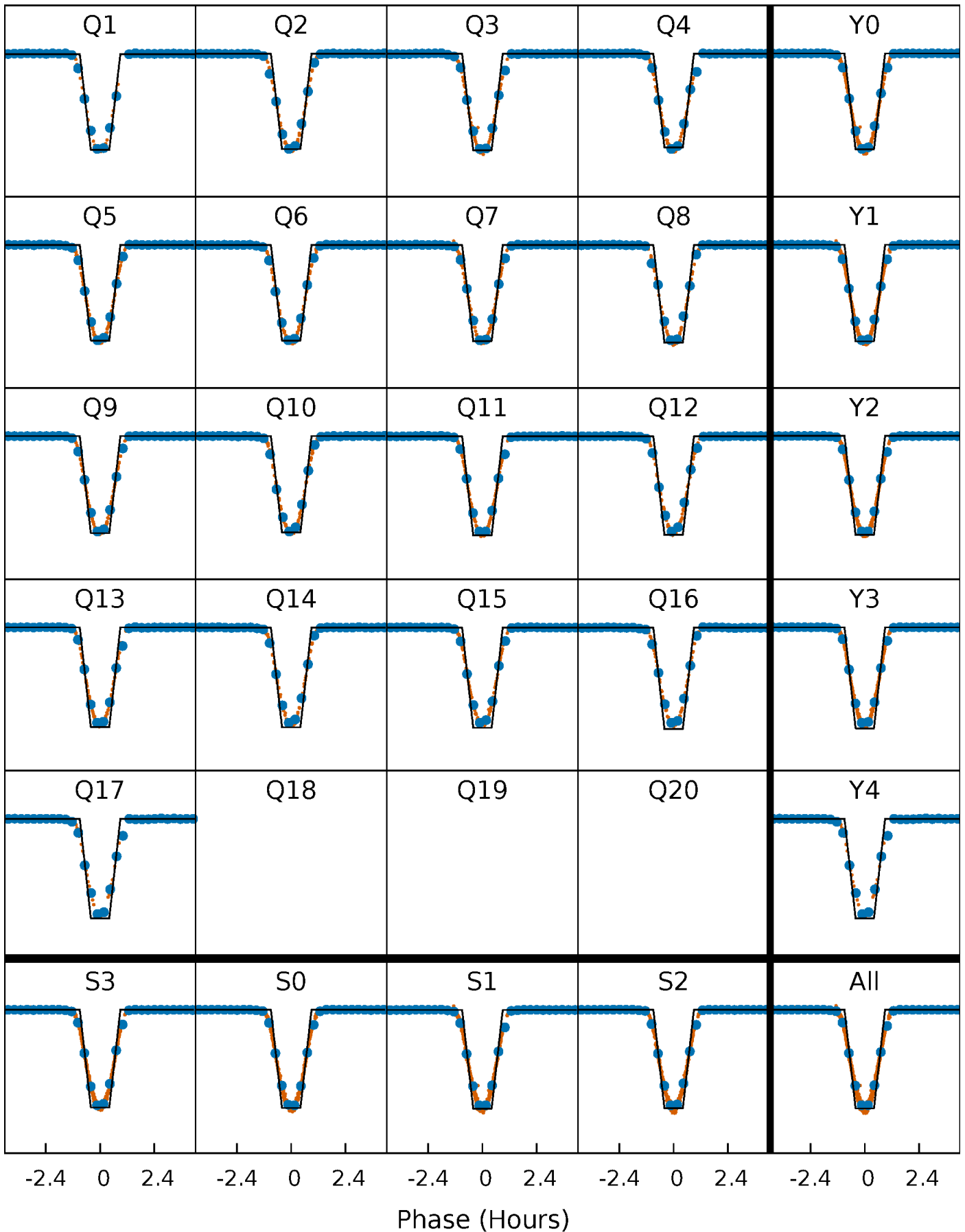
# DV Quarter-Phased Transit Curves

TCE 004037428-01 P= 4.264733 Days  $T_0=135.198001$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

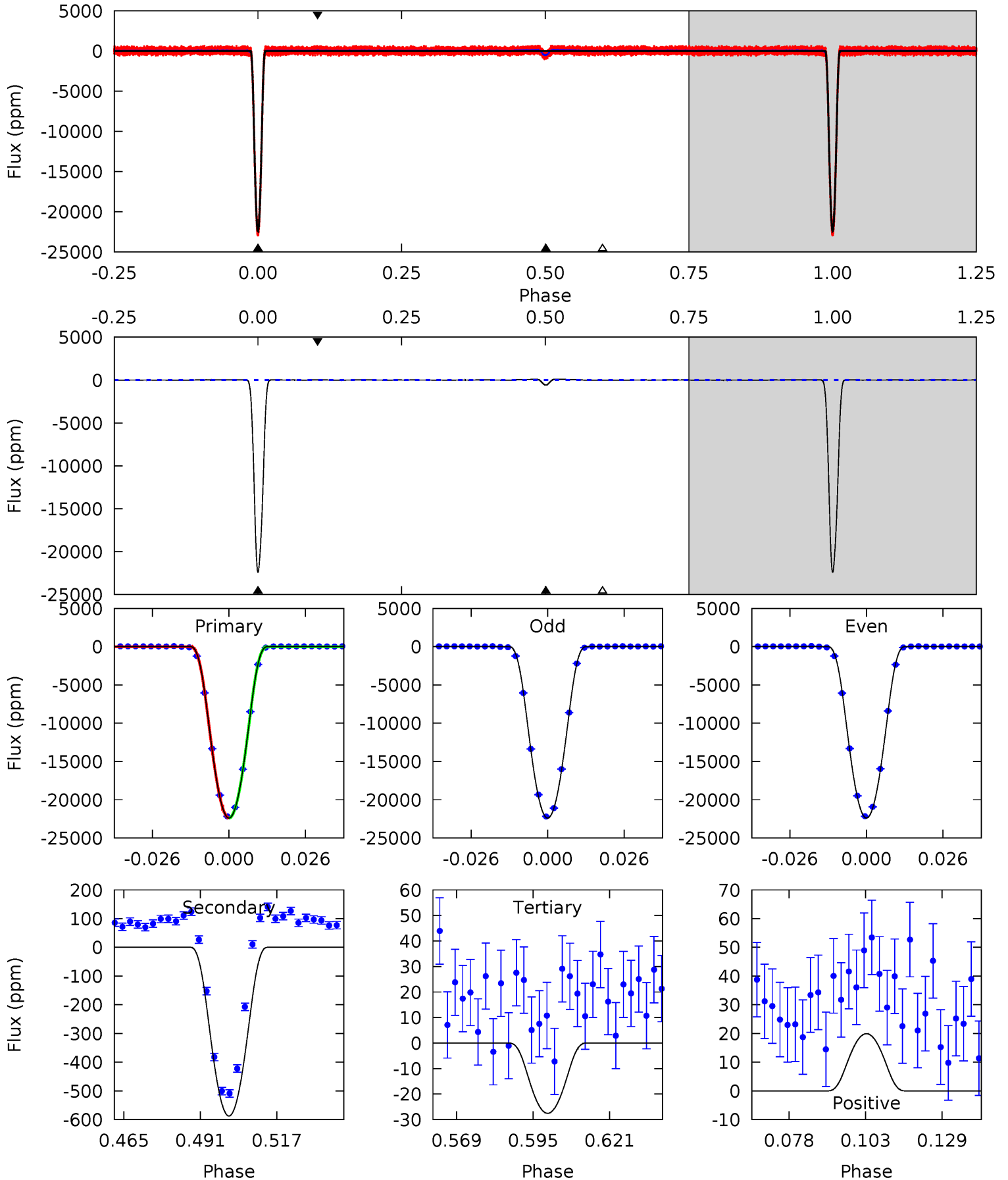
TCE 004037428-01 P= 4.264728 Days  $T_0=135.198813$  (BKJD)



# DV Model-Shift Uniqueness Test

004037428-01, P = 4.264733 Days, E = 130.933268 Days

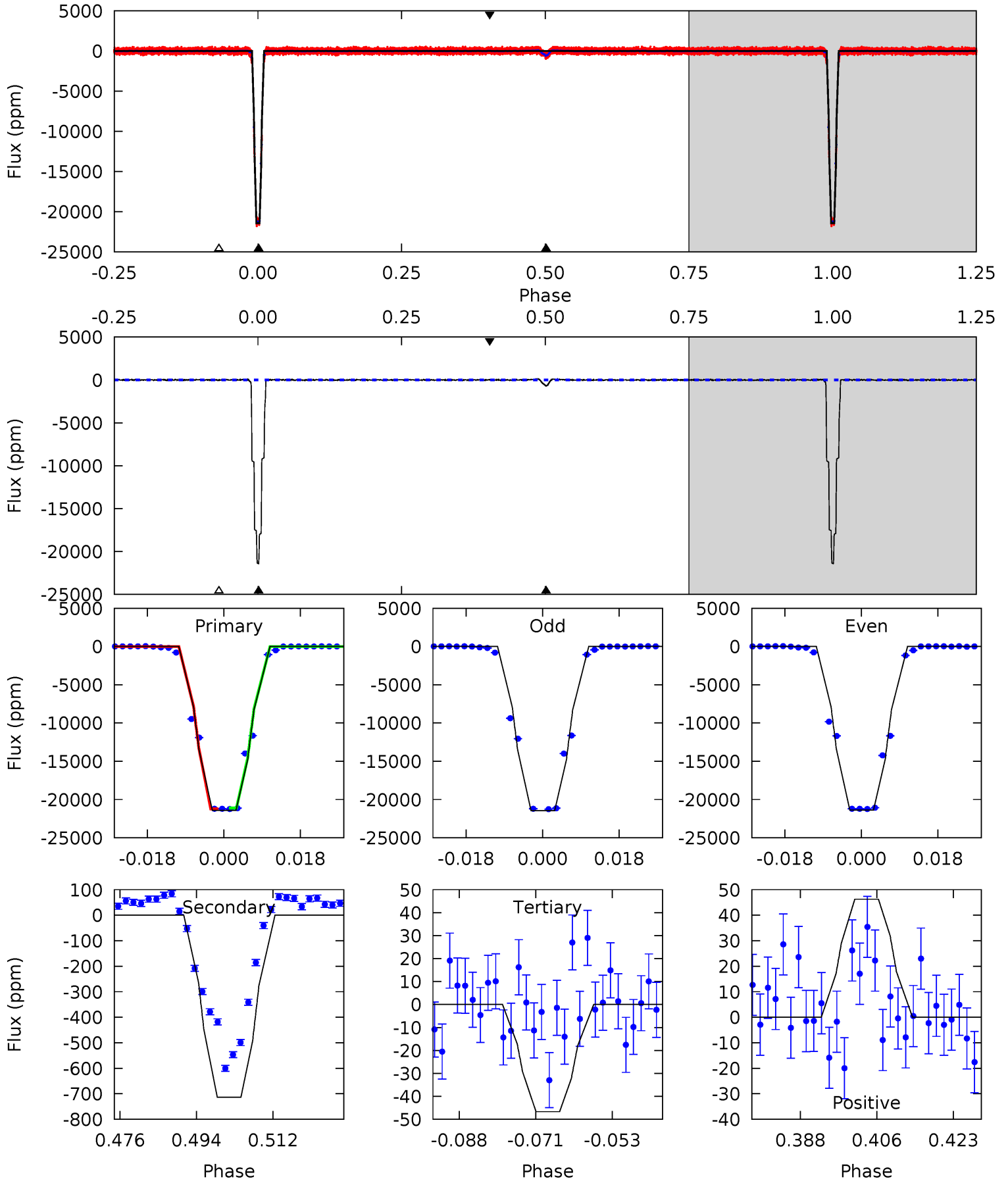
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
5360	140.6	6.59	4.77	4.84	2.23	4.32	5354	5355	134.1	135.9	0.85	1.00	0.00	2.28



# Alt Model-Shift Uniqueness Test

004037428-01, P = 4.264728 Days, E = 130.934085 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
2209	73.6	4.81	4.77	4.92	2.37	1.70	2204	2204	68.8	68.9	3.81	1.00	0.01	0



### Stellar Parameters For KIC 004037428

	$T_{\text{eff}} (K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M (M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6052^{+163}_{-163}$	$4.084^{+0.392}_{-0.168}$	$-0.580^{+0.300}_{-0.250}$	$1.417^{+0.405}_{-0.540}$	$0.887^{+0.119}_{-0.089}$	$0.439^{+1.293}_{-0.193}$
	+3%/-3%	+10%/-4%	+52%/-43%	+29%/-38%	+13%/-10%	+295%/-44%
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 004037428-01 / KOI 5993.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-588 \pm 4$	$27.81^{+4.38}_{-6.01}$	$1984^{+153}_{-214}$	$2796^{+64}_{-72}$	$1.046^{+0.610}_{-0.249}$
Alt.	$-714 \pm 10$	$22.82^{+3.88}_{-4.74}$	$1965^{+172}_{-208}$	$3083^{+58}_{-59}$	$1.873^{+1.063}_{-0.496}$

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

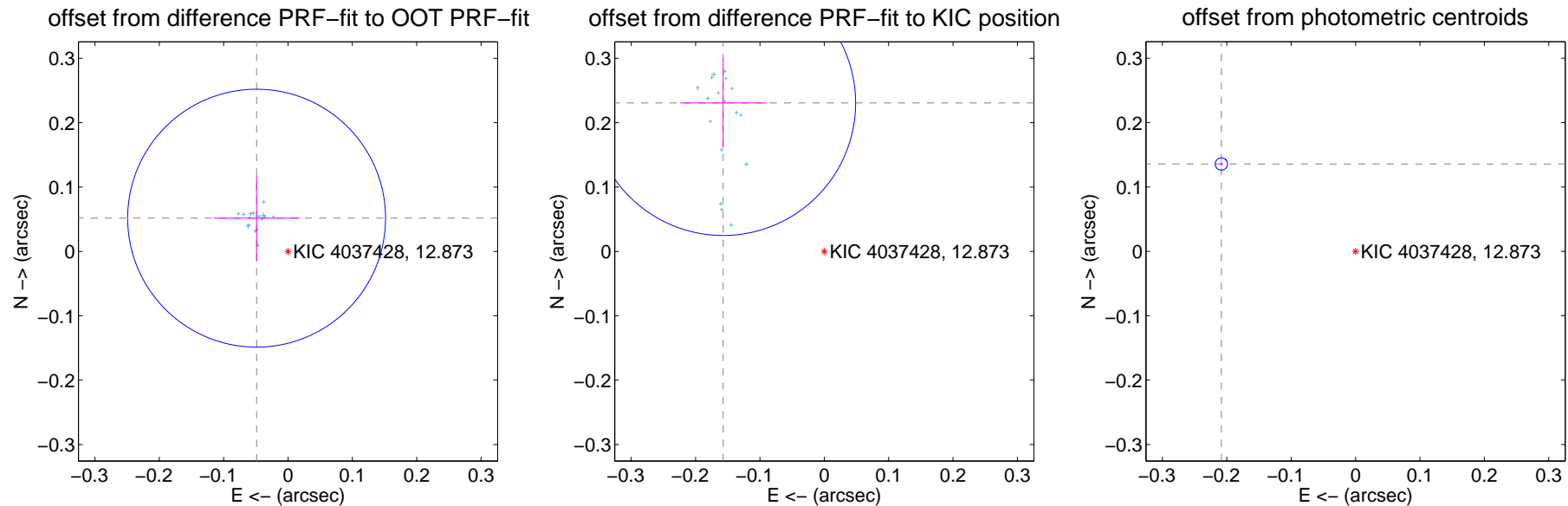
## DV Centroid Data

Supplemental centroid analysis for 004037428-01. Kepler magnitude: 12.87. Transit SNR 2387.80

There are 17 quarters with good PRF difference image offsets

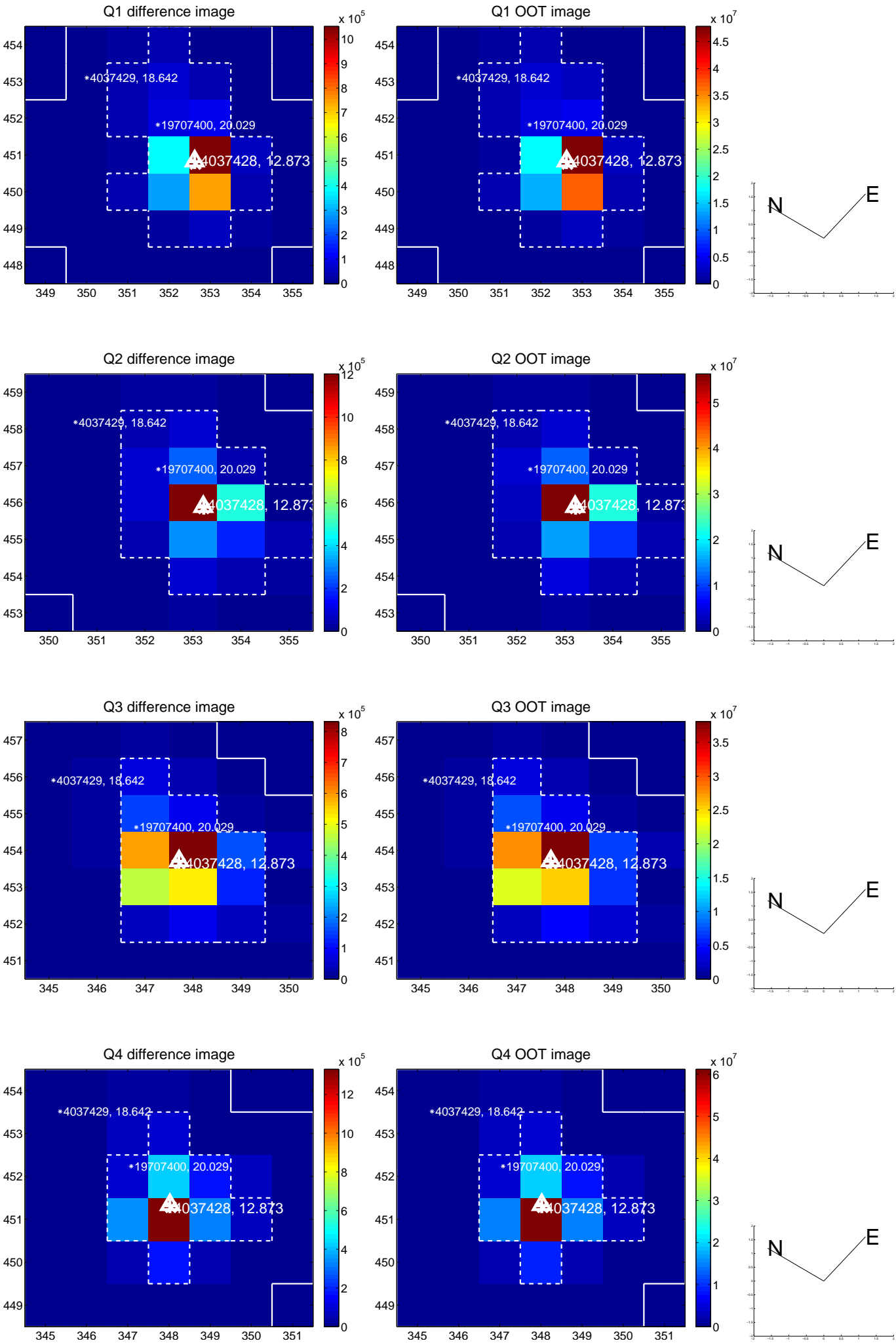
The direct PRF centroid is offset from the target star catalog position by about 0.26 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.071 \pm 0.067$	1.06	$0.049 \pm 0.067$	$0.052 \pm 0.067$
PRF-fit source offset from KIC position	$0.279 \pm 0.069$	4.07	$0.157 \pm 0.067$	$0.231 \pm 0.069$
photometric centroid source offset	$0.25 \pm 0.00$	77.86	$0.21 \pm 0.00$	$0.14 \pm 0.00$



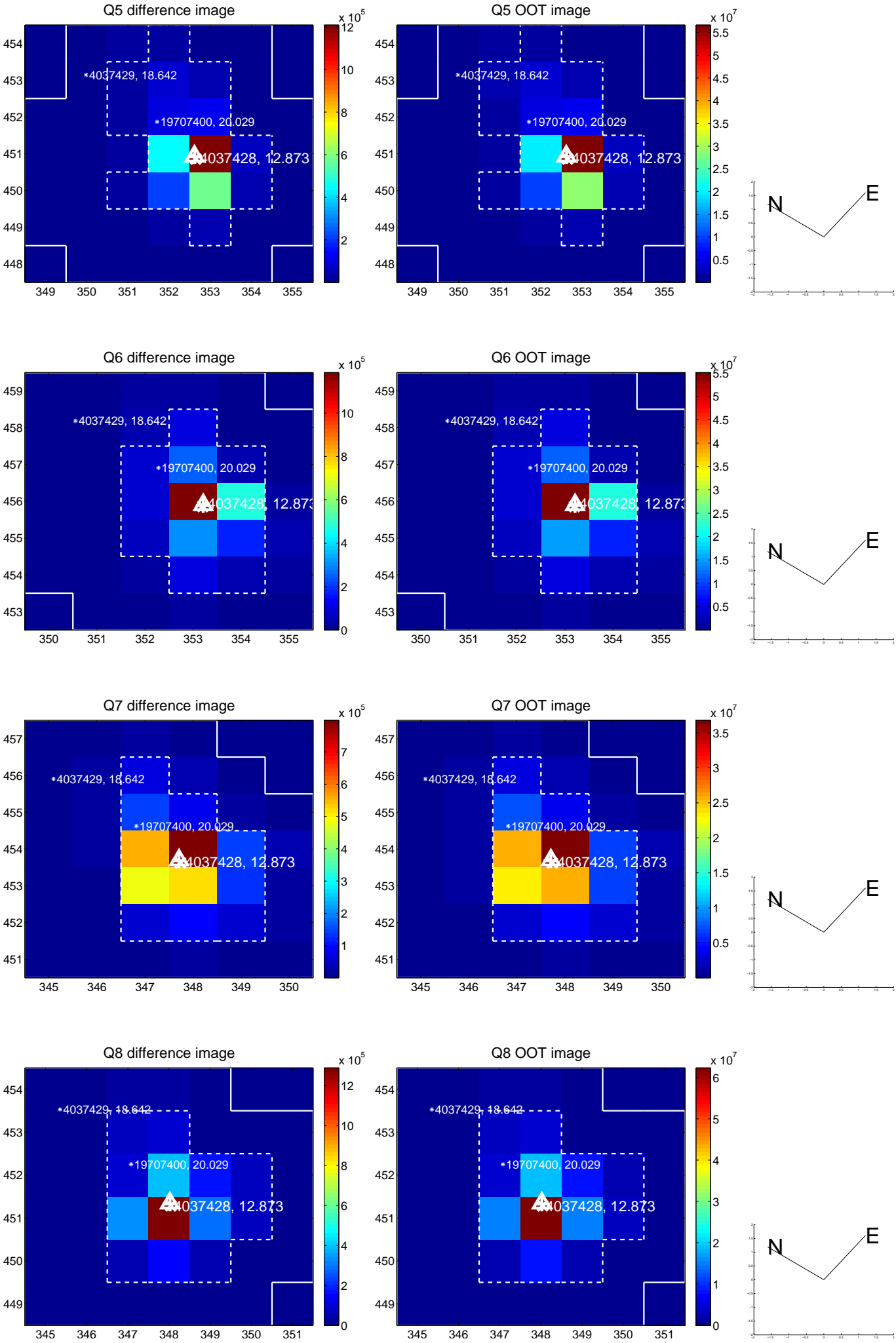
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

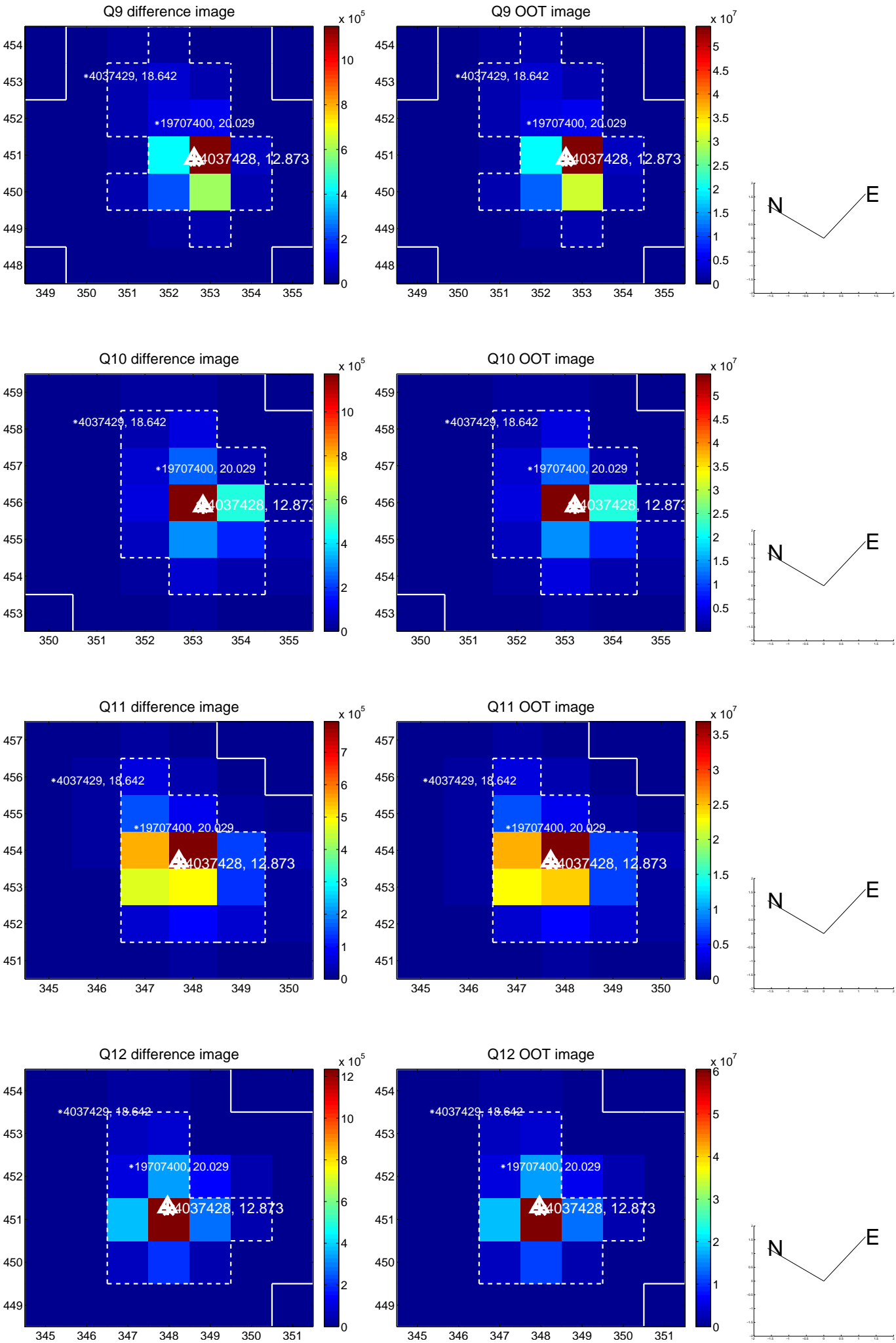




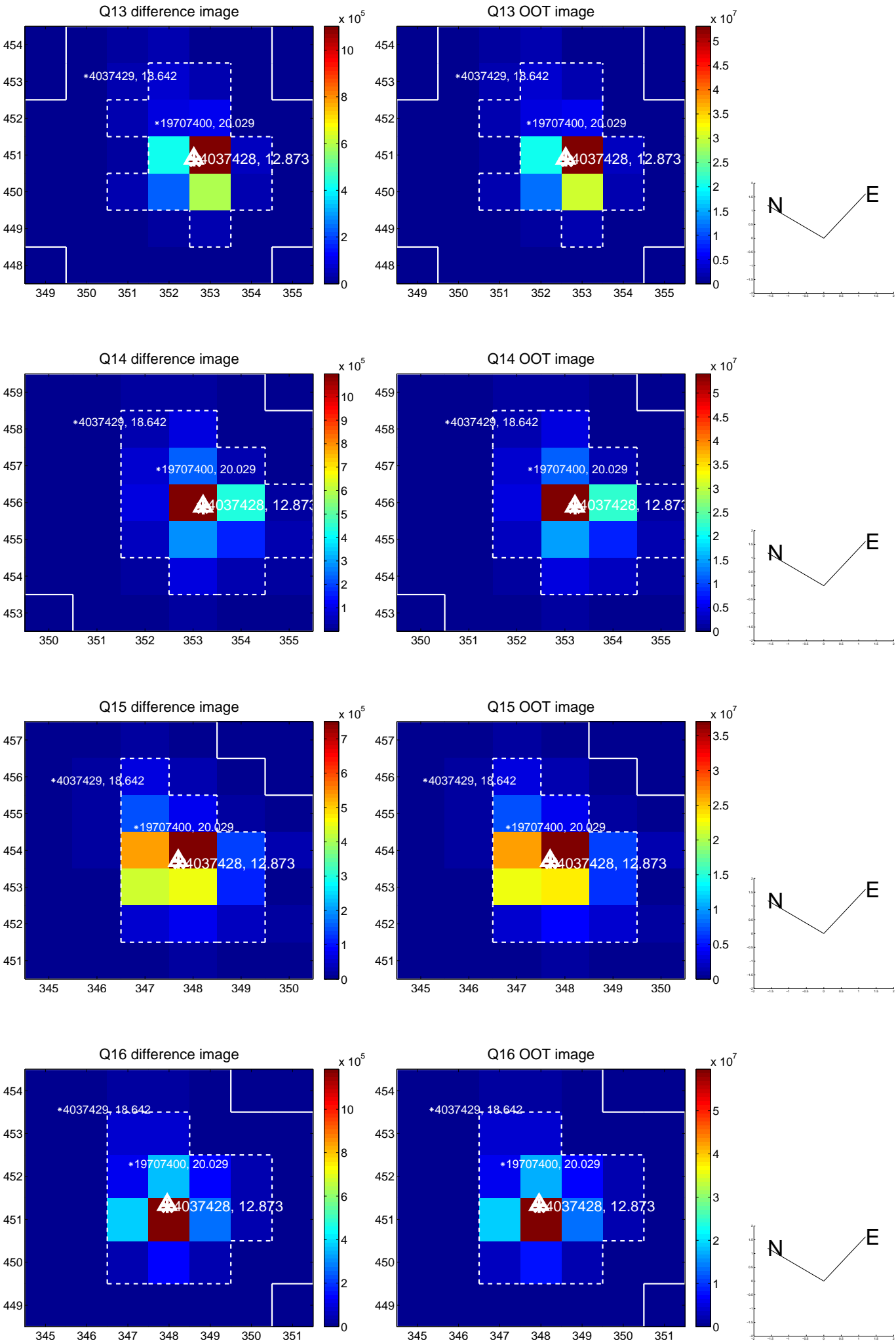
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



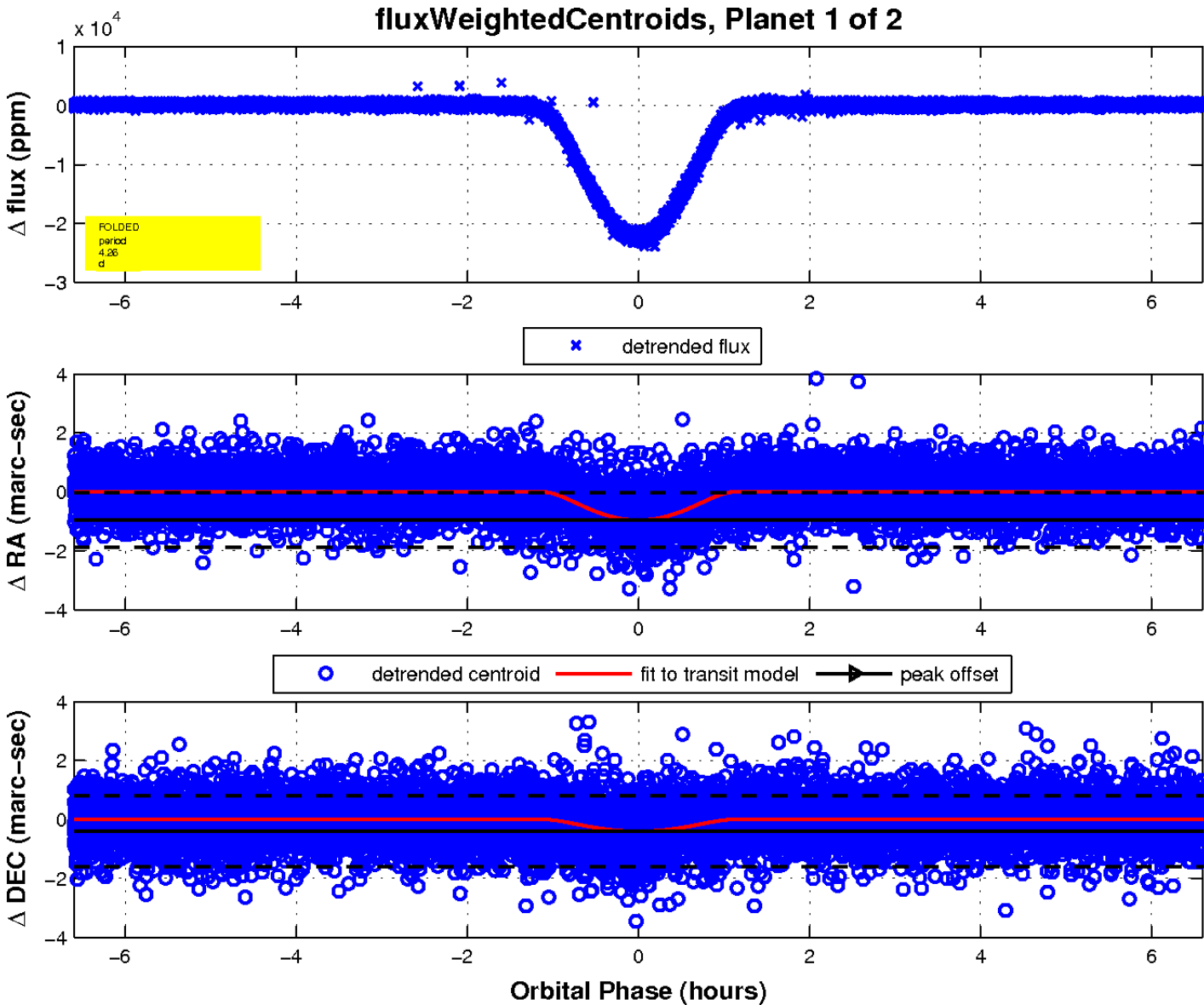
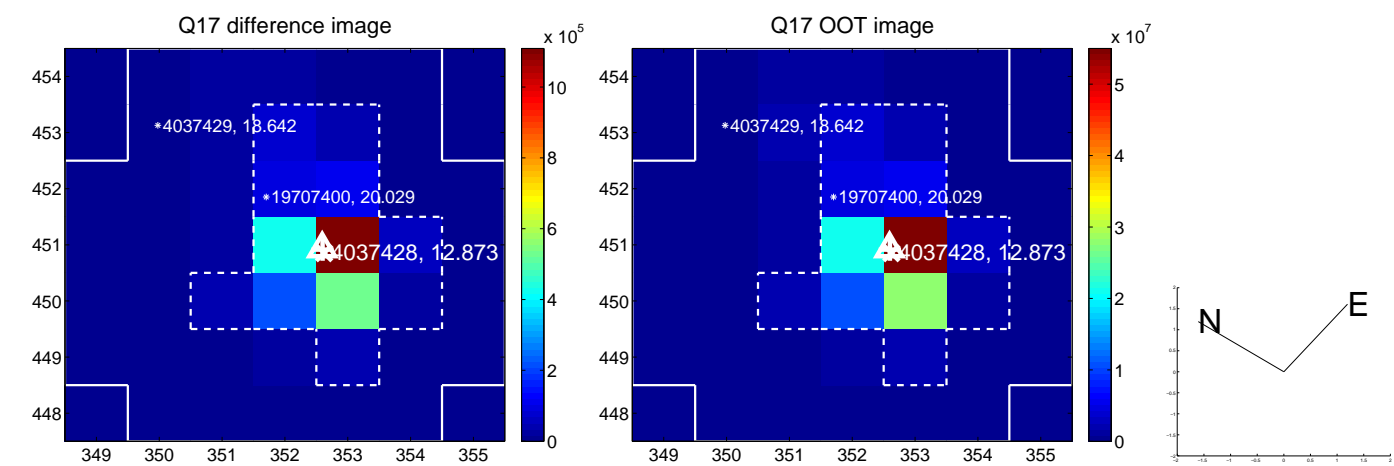
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

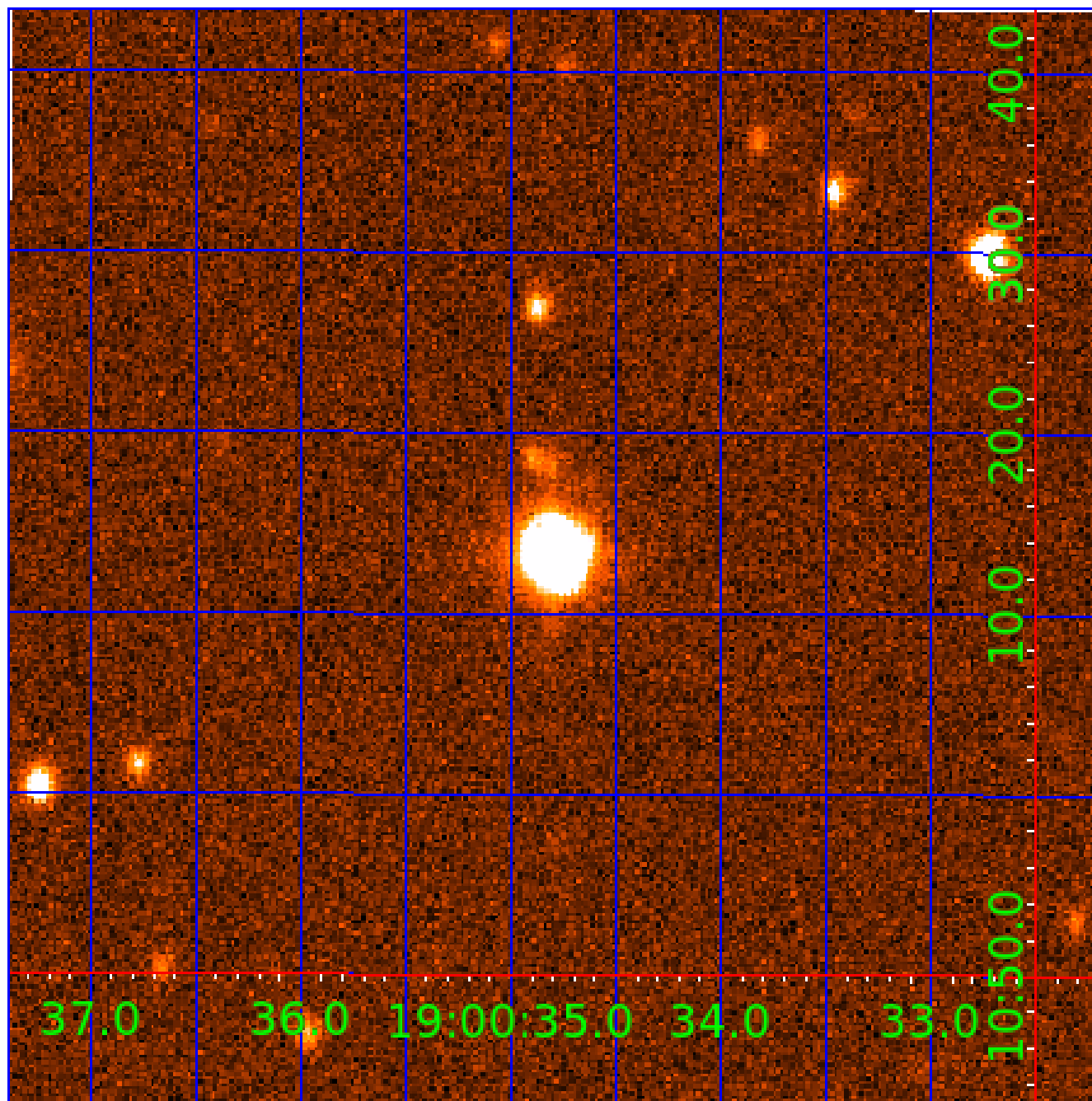


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 004037428

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004037428-01	OBS	5993.01	4.264733	135.198001	22430.4	2.199	2931.1	2387.8	1.42	6052	27.76	985.25
004037428-02	OBS	No	4.264725	133.068033	707.9	2.144	86.7	99.9	1.42	6052	5.76	985.25

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004037428-01	OBS	FP	0.29	0	1	0	0	MOD_SEC_DV—MOD_SEC_ALT—DEEP_V_SHAPED—HAS_SEC_TCE
004037428-02	OBS	FP	0.00	1	1	0	0	IS_SEC_TCE

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

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

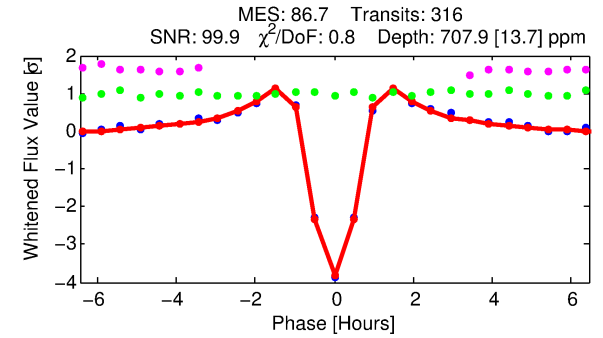
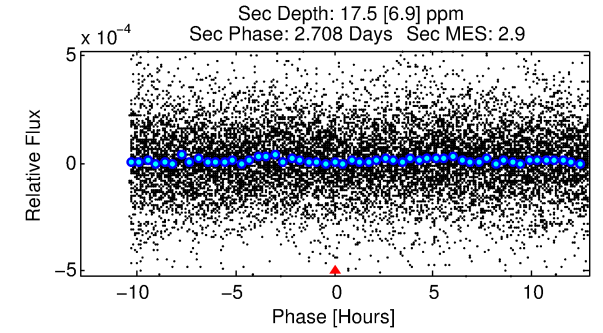
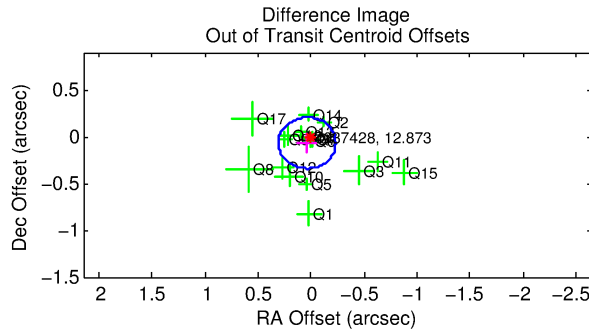
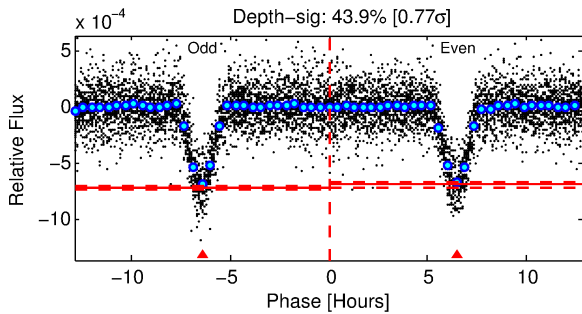
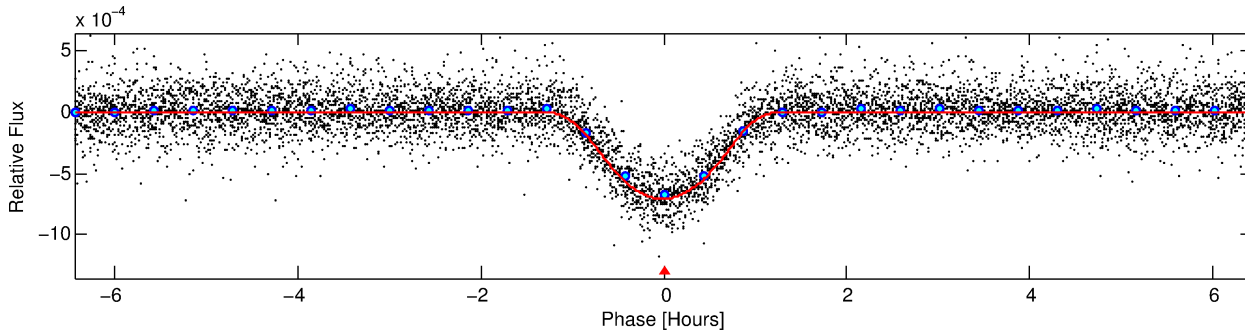
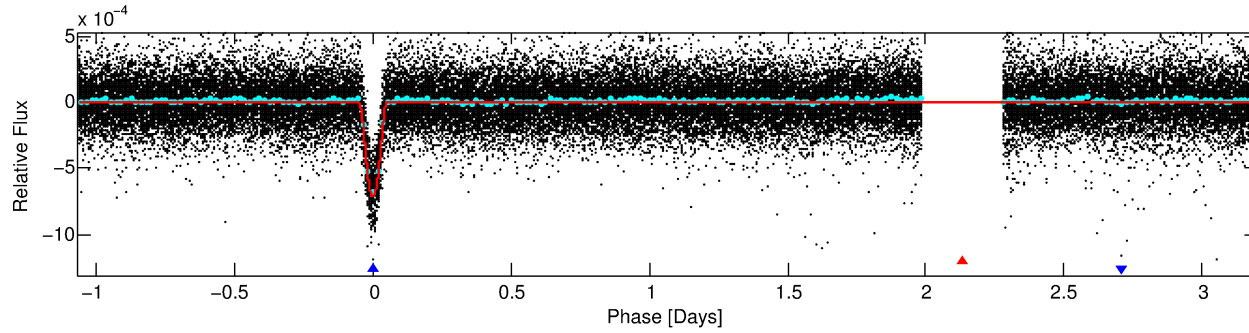
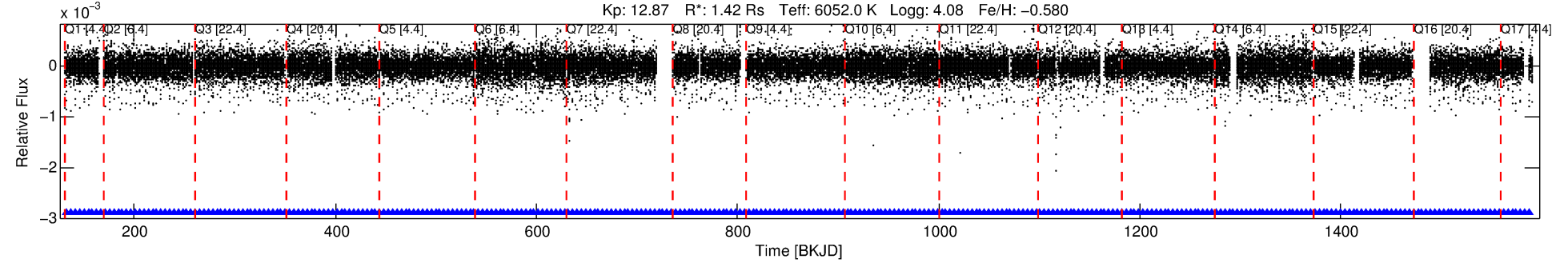
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 004037428-02

No Significant Match Found

# DV One-Page Summary

KIC: 4037428 Candidate: 2 of 2 Period: 4.265 d  
KOI: K05993 Corr: No Ephemeris Match



## DV Fit Results:

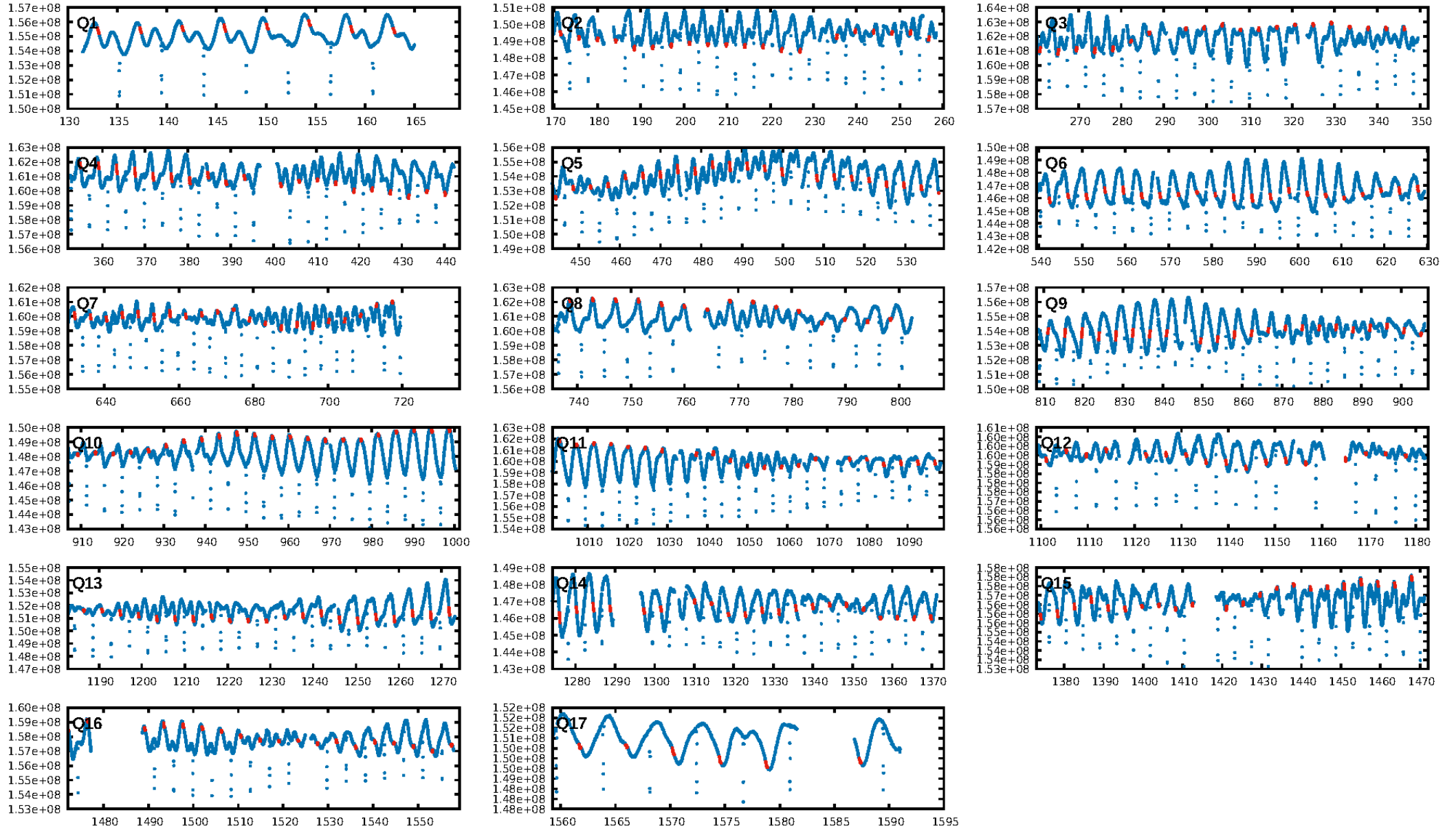
Period = 4.26473 [0.00000] d  
Epoch = 133.0680 [0.0003] BKJD  
Rp/R\* = 0.0372 [0.0050]  
a/R\* = 5.13 [0.28]  
b = 0.98 [0.01]  
Seff = 985.25 [652.24]  
Teq = 1429 [236] K  
Rp = 5.76 [2.33] Re  
a = 0.0495 [0.0195] AU  
Ag = 0.71 [0.58] [-0.50 $\sigma$ ]  
Teffp = 2029 [250] K [1.75 $\sigma$ ]

## DV Diagnostic Results:

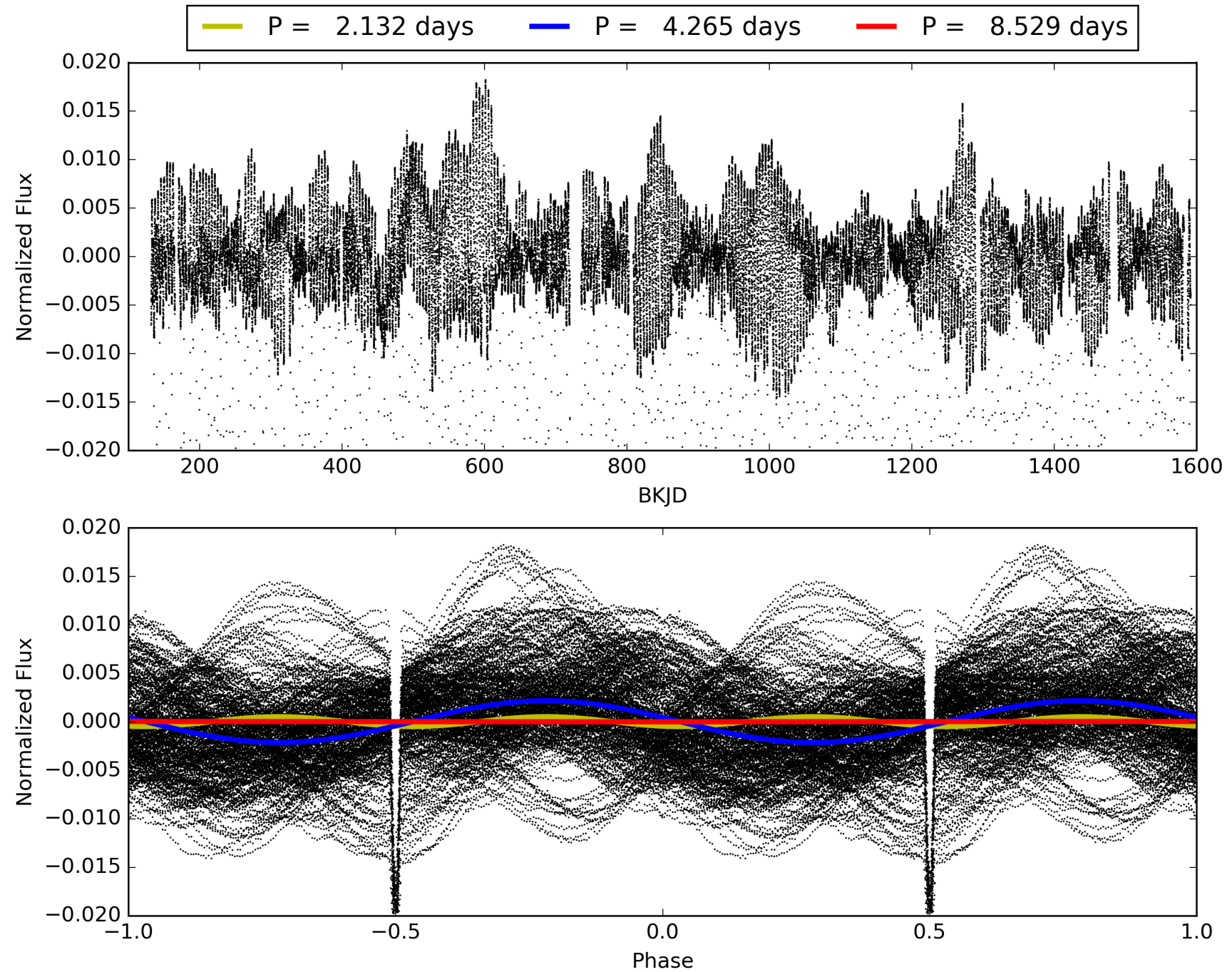
ShortPeriod-sig: N/A  
LongPeriod-sig: 0.0% [0.00 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 1.00 [302/302]  
GhostDiagnostic-chr: 3.947  
Centroid-sig: 5.7%  
Centroid-so: 0.214 arcsec [2.22 $\sigma$ ]  
OotOffset-rm: 0.079 arcsec [0.87 $\sigma$ ]  
KicOffset-rm: 0.141 arcsec [1.28 $\sigma$ ]  
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 004037428-02, PDC Light Curves

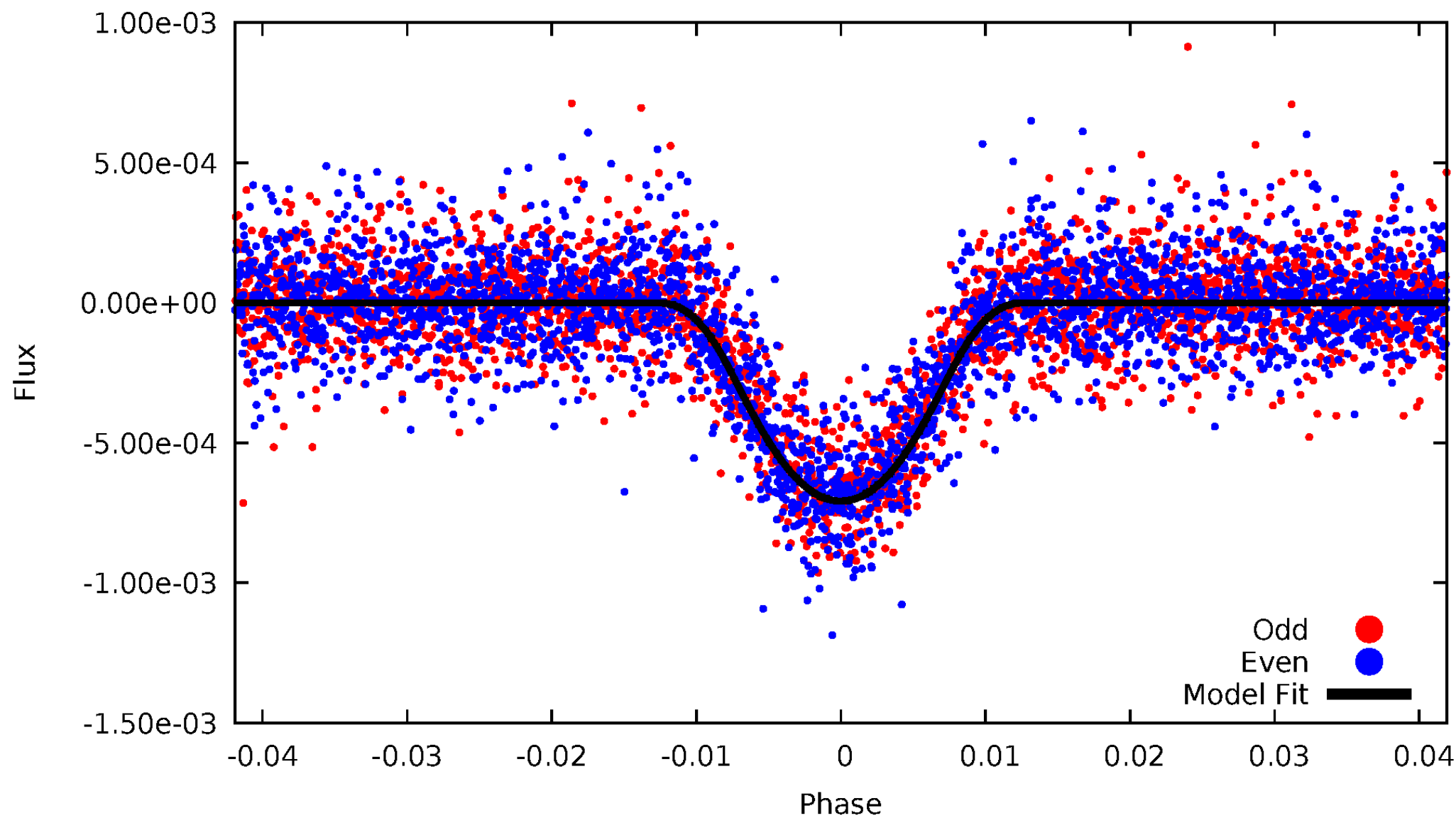


TCE 004037428-02



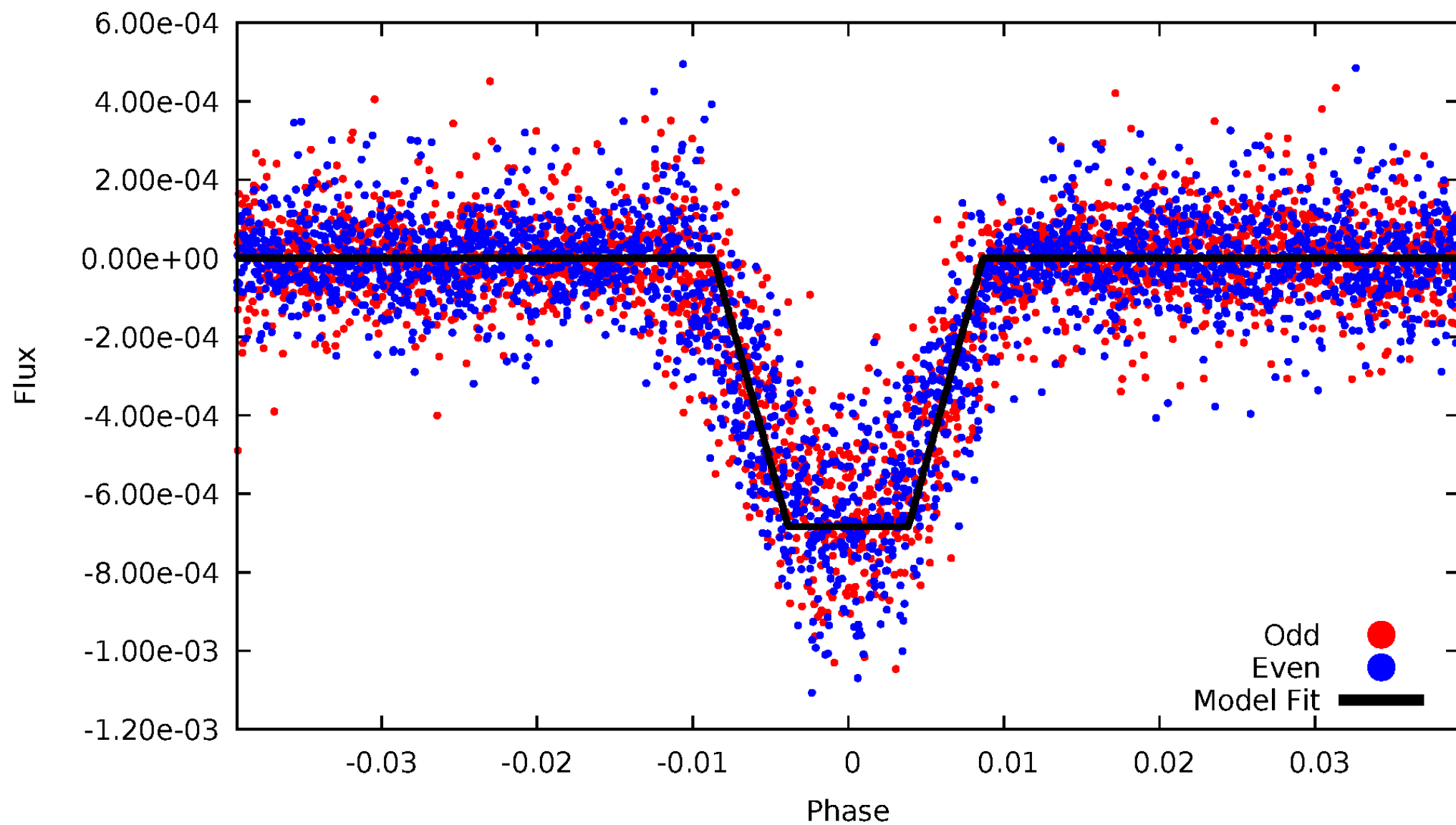
# DV Odd/Even

TCE 004037428-02



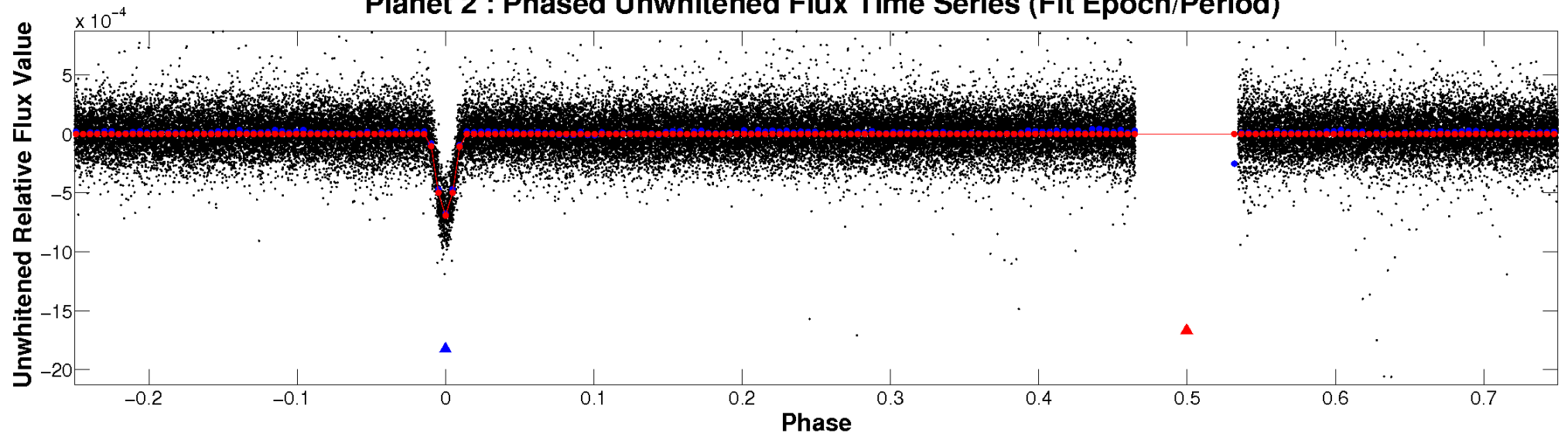
# ALT Odd/Even

TCE 004037428-02

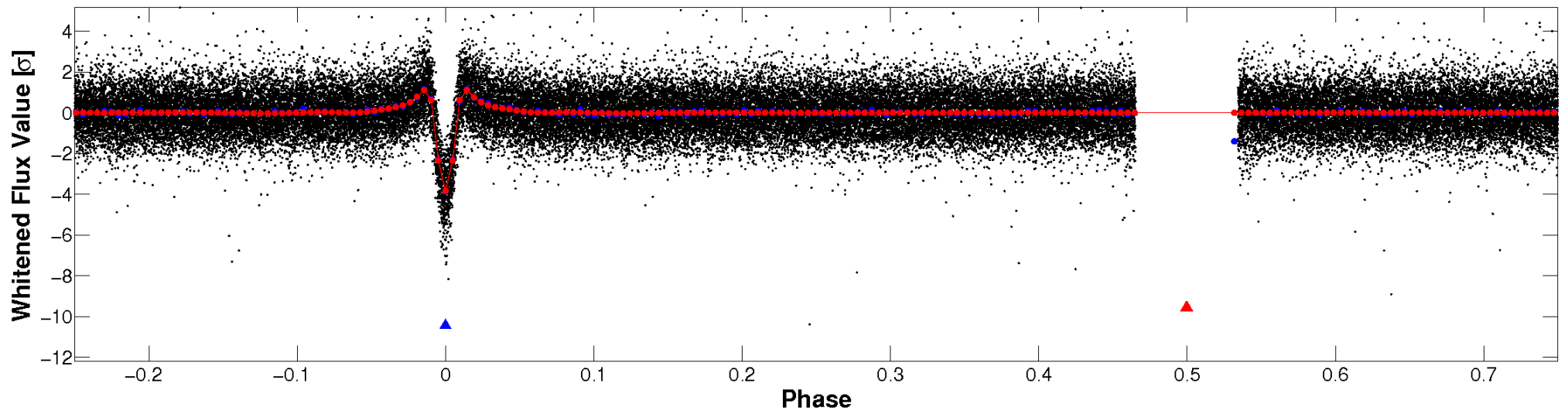


# Non-Whitened Vs. Whitened Light Curve

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



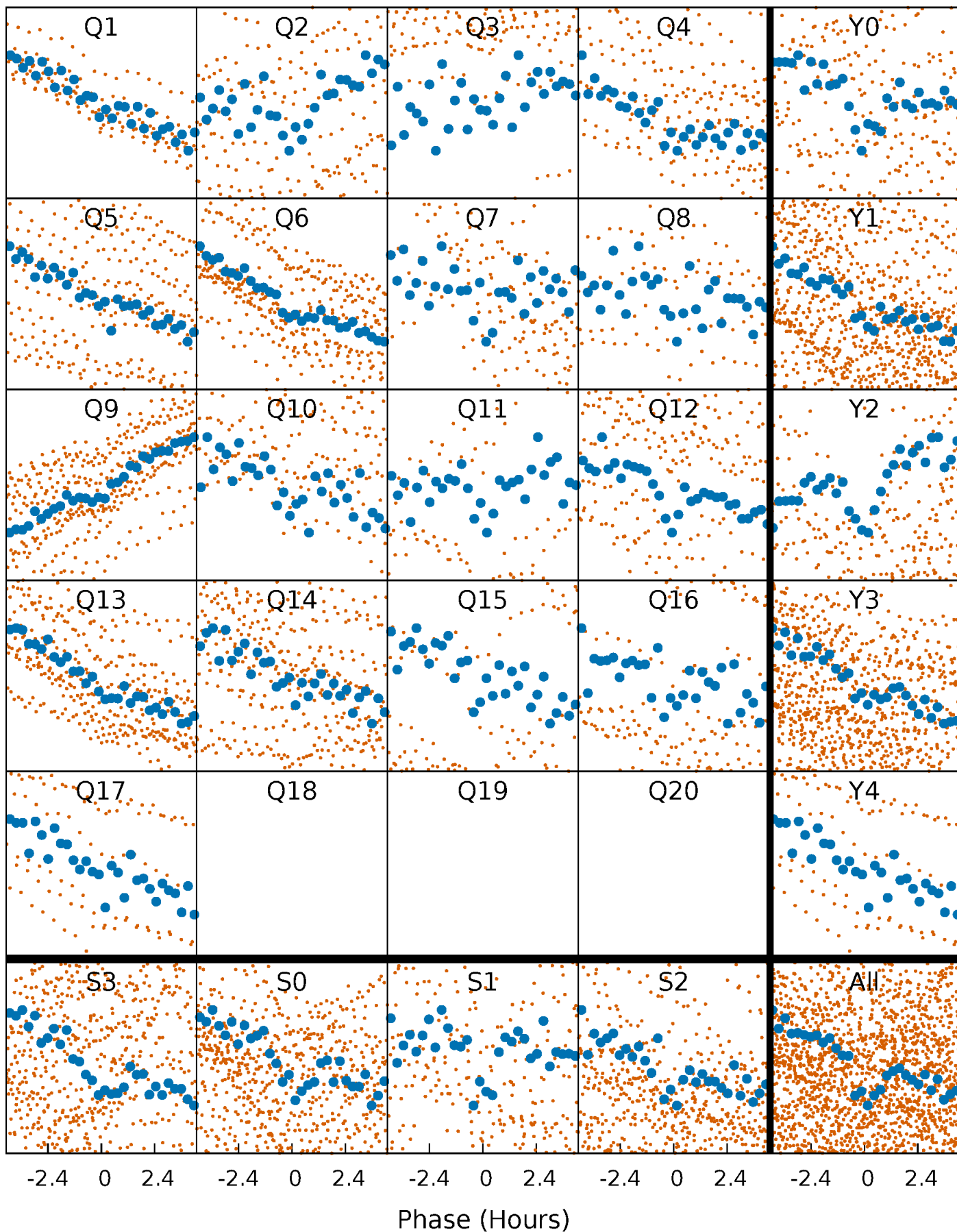
## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)





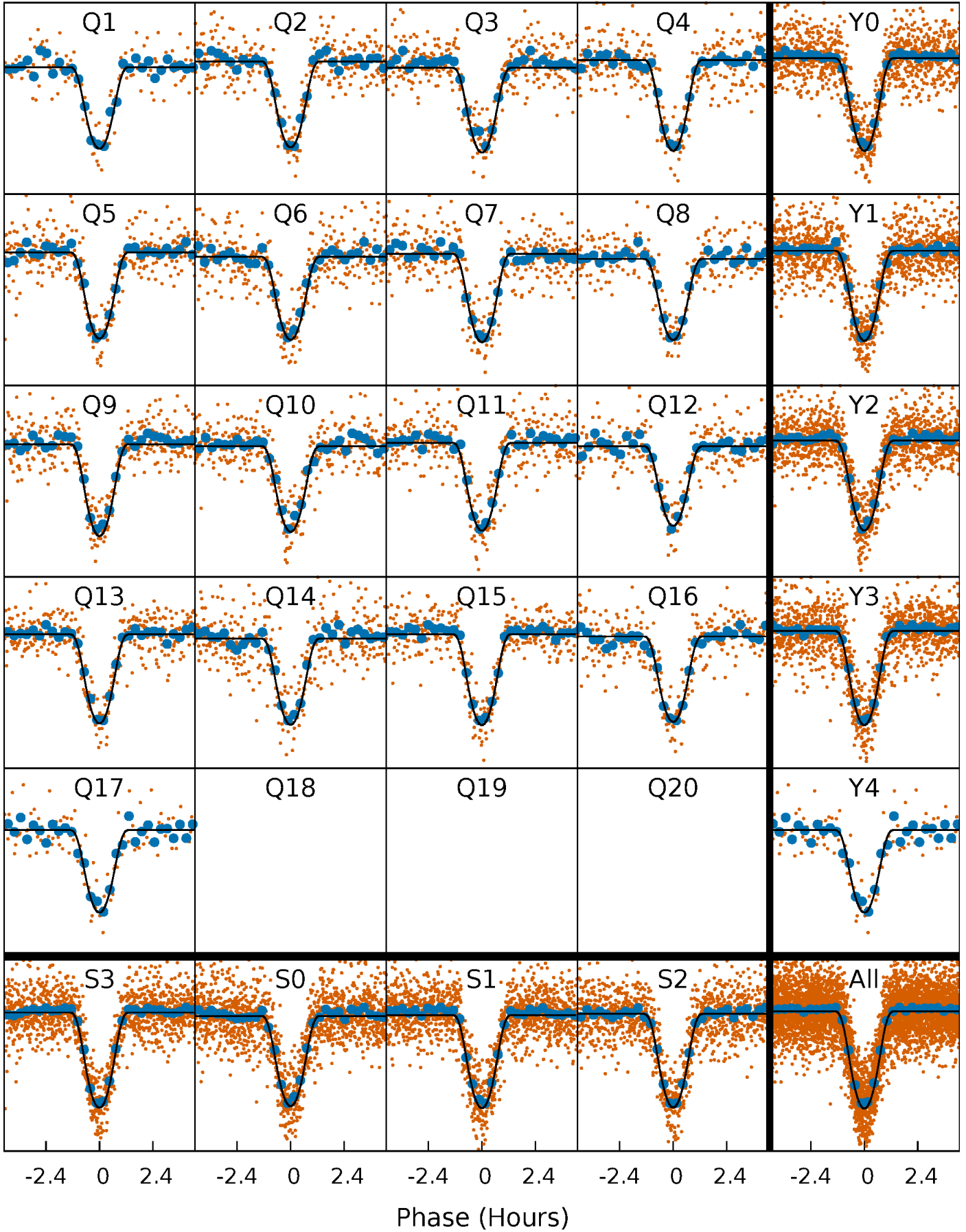
# PDC Quarter-Phased Transit Curves

TCE 004037428-02   P= 4.264725 Days    $T_0=133.068033$  (BKJD)



# DV Quarter-Phased Transit Curves

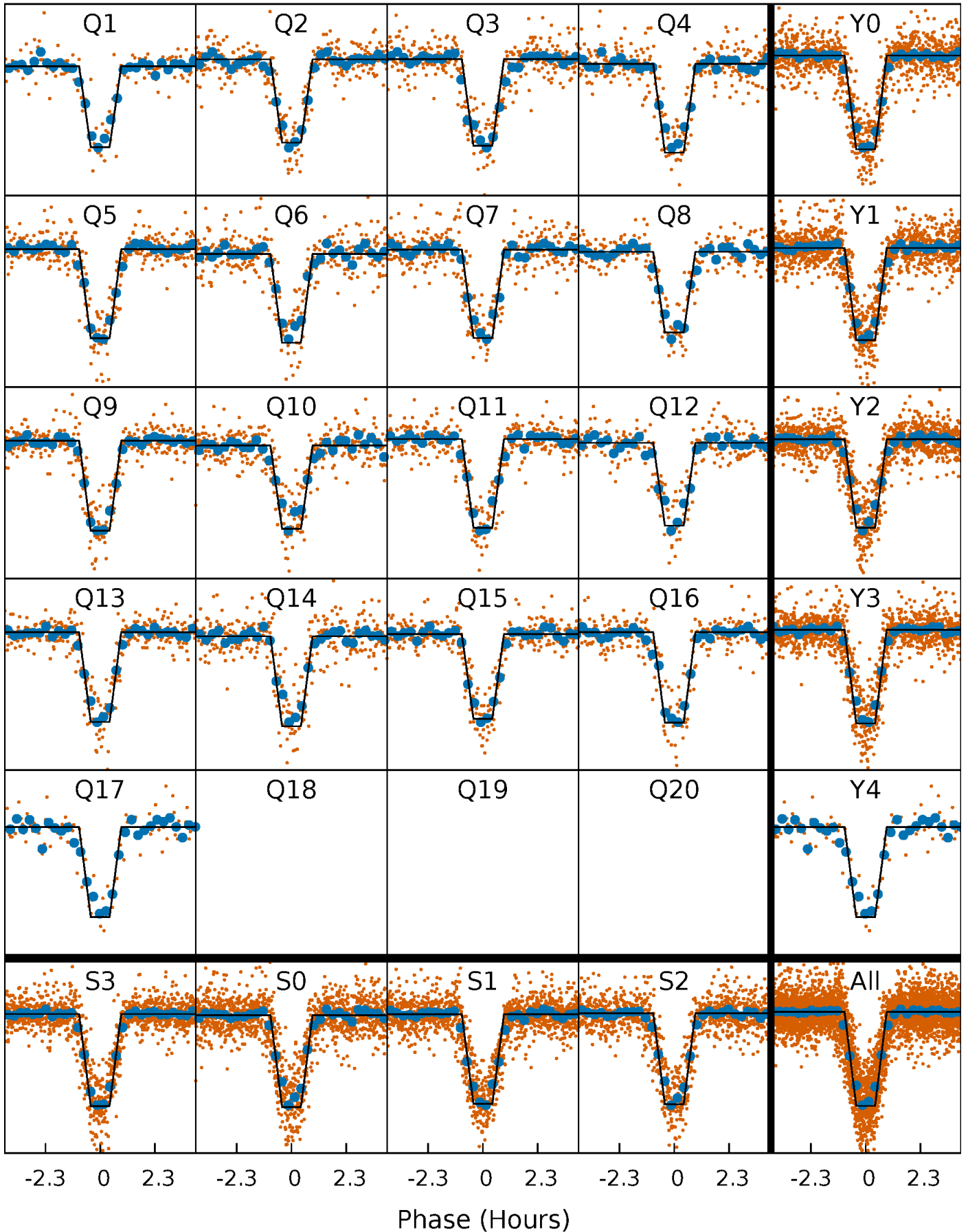
TCE 004037428-02   P= 4.264725 Days    $T_0=133.068033$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

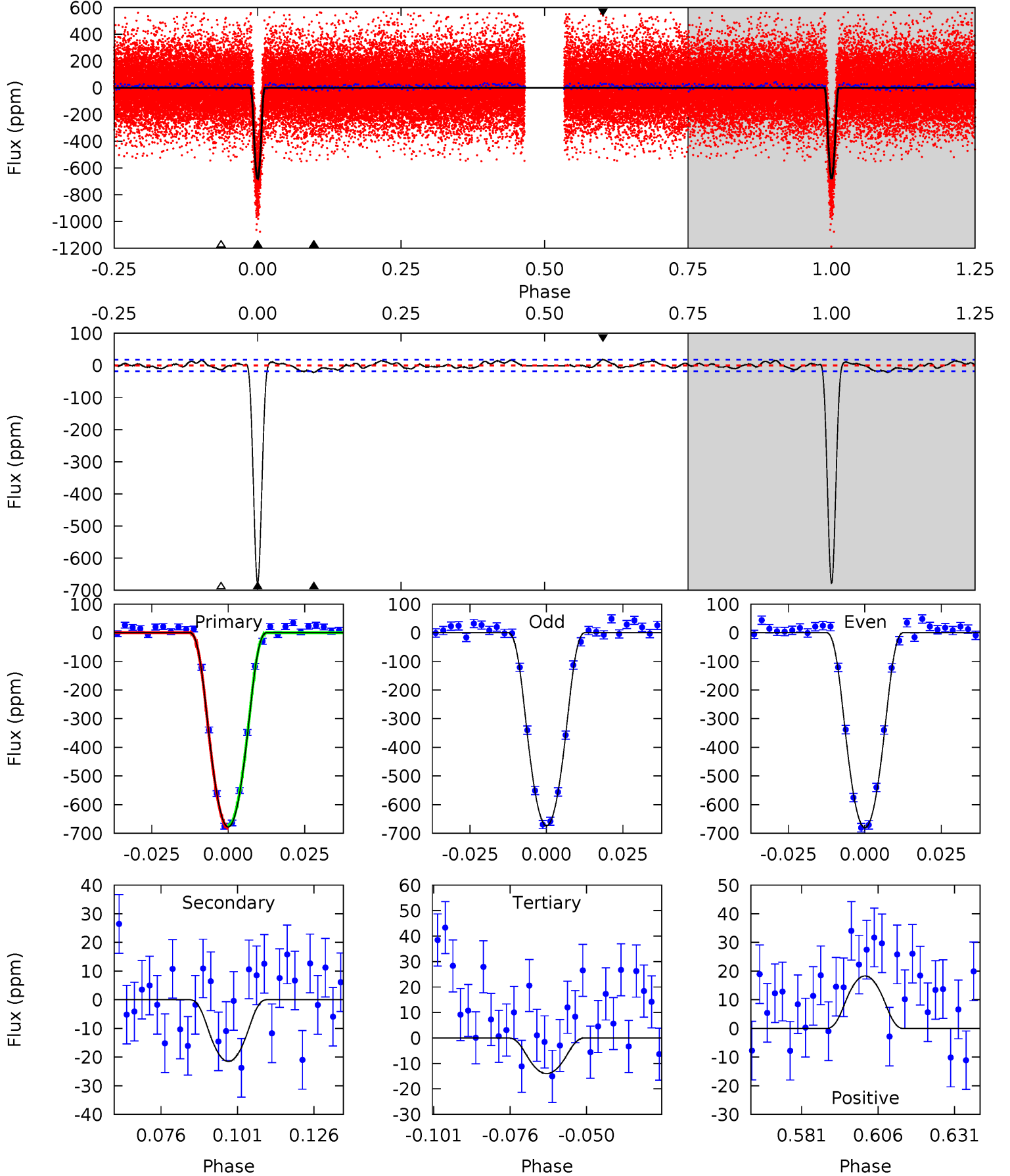
TCE 004037428-02     $P = 4.264725$  Days     $T_0 = 133.068098$  (BKJD)



# DV Model-Shift Uniqueness Test

004037428-02, P = 4.264725 Days, E = 128.803308 Days

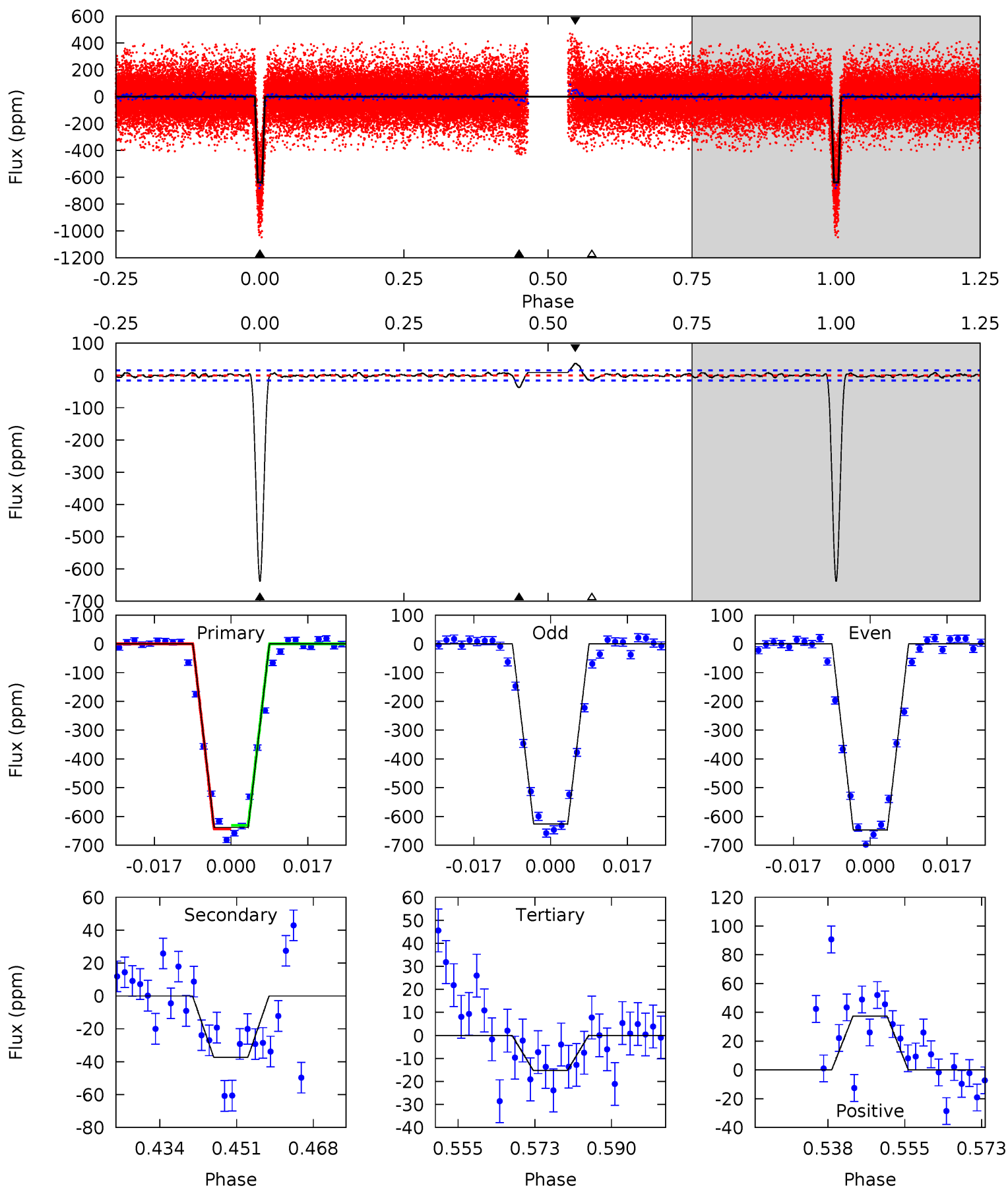
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
183.8	5.84	3.79	4.97	4.85	2.24	1.94	180.0	178.9	2.05	0.87	0.97	0.99	0.03	1.10



# Alt Model-Shift Uniqueness Test

004037428-02, P = 4.264725 Days, E = 128.803373 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
200.6	11.7	4.79	11.8	4.92	2.38	1.71	195.8	188.8	6.95	-0.02	3.17	1.02	0.06	1.95



### Stellar Parameters For KIC 004037428

	$T_{\text{eff}} (K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M (M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6052^{+163}_{-163}$	$4.084^{+0.392}_{-0.168}$	$-0.580^{+0.300}_{-0.250}$	$1.417^{+0.405}_{-0.540}$	$0.887^{+0.119}_{-0.089}$	$0.439^{+1.293}_{-0.193}$
	+3%/-3%	+10%/-4%	+52%/-43%	+29%/-38%	+13%/-10%	+295%/-44%
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 004037428-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-22 \pm 4$	$5.50^{+1.33}_{-1.26}$	$1969^{+163}_{-214}$	$2709^{+190}_{-191}$	$0.935^{+0.708}_{-0.334}$
Alt.	$-37 \pm 3$	$3.83^{+1.10}_{-1.08}$	$1971^{+175}_{-202}$	$3406^{+293}_{-219}$	$3.467^{+3.271}_{-1.395}$

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

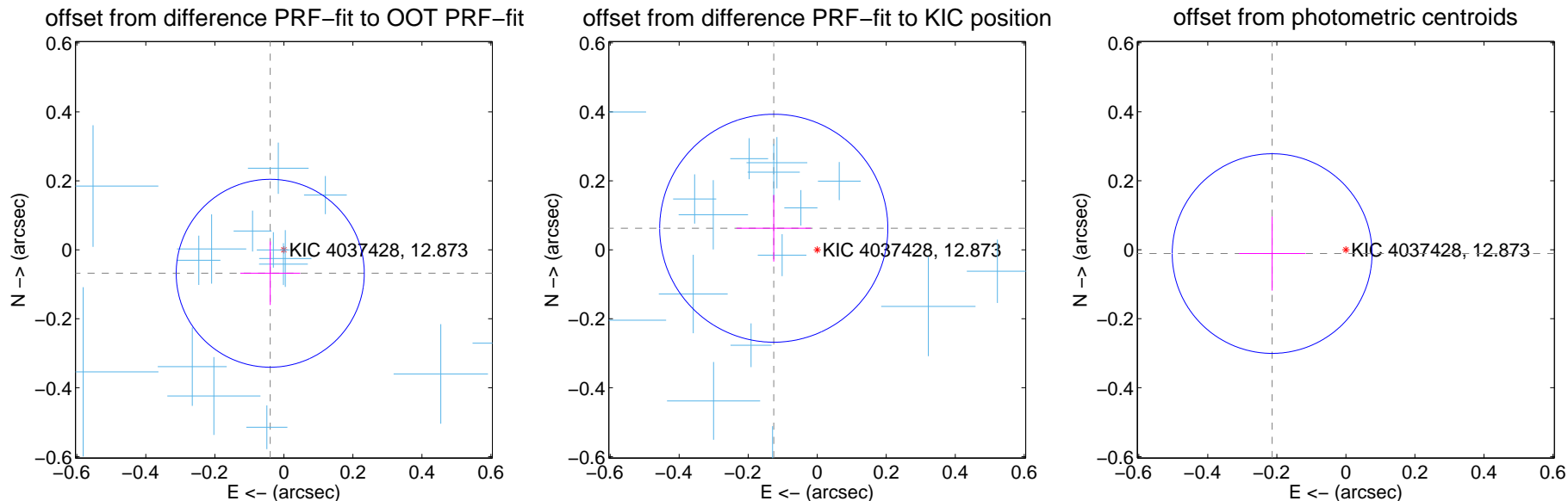
## DV Centroid Data

Supplemental centroid analysis for 004037428-02. Kepler magnitude: 12.87. Transit SNR 99.94

There are 17 quarters with good PRF difference image offsets

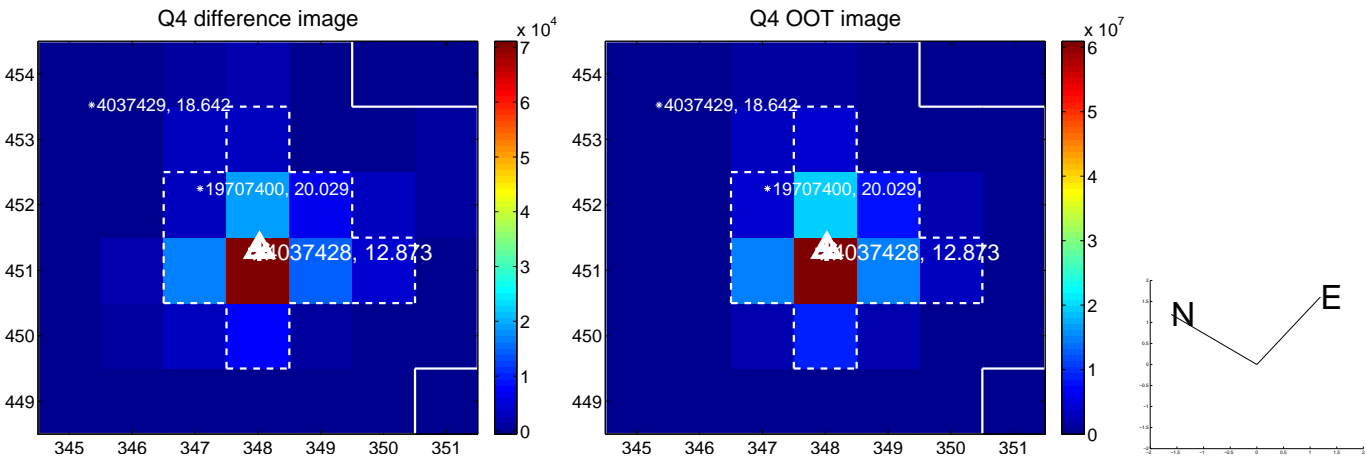
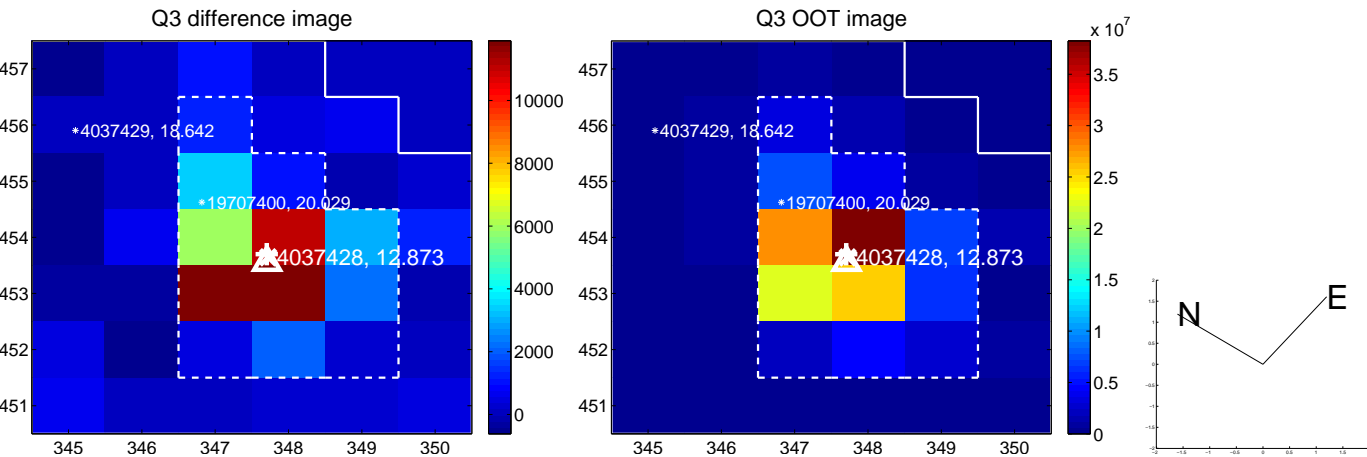
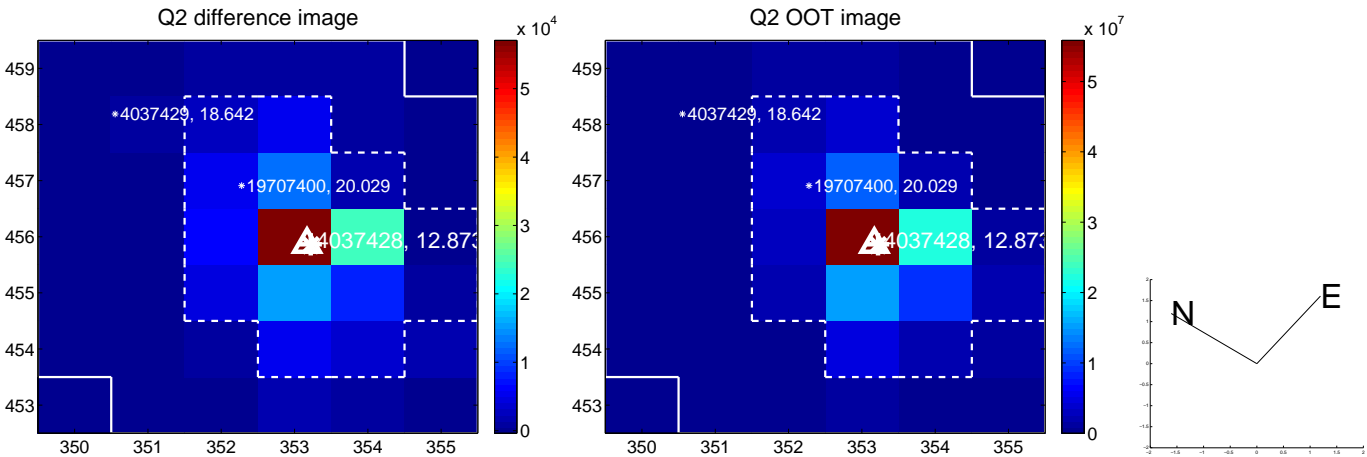
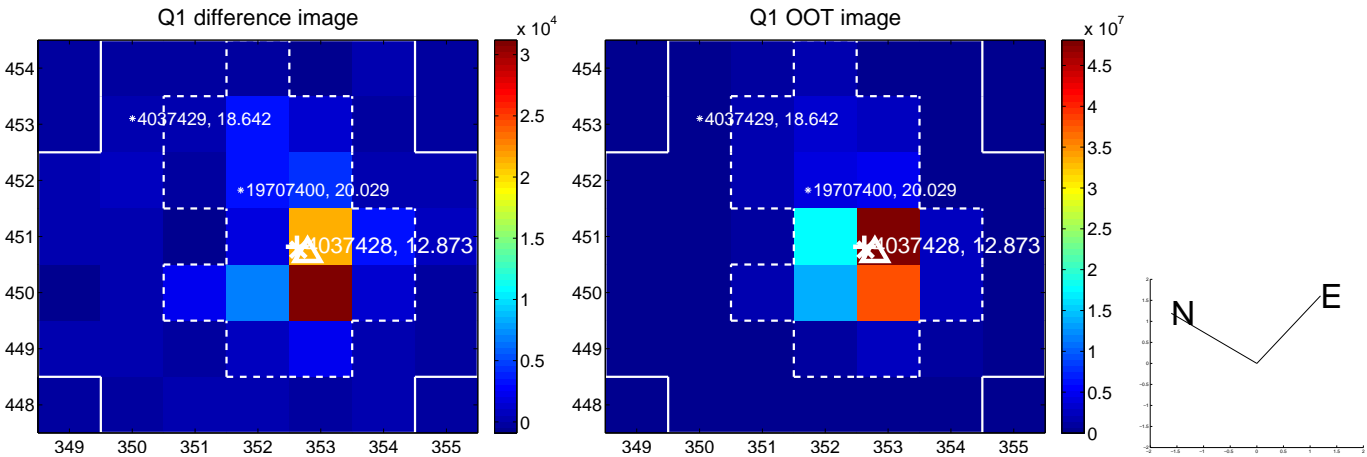
The direct PRF centroid is offset from the target star catalog position by about 0.25 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.079 \pm 0.091$	0.87	$0.040 \pm 0.087$	$-0.068 \pm 0.092$
PRF-fit source offset from KIC position	$0.141 \pm 0.110$	1.28	$0.126 \pm 0.108$	$0.063 \pm 0.097$
photometric centroid source offset	$0.21 \pm 0.10$	2.22	$0.21 \pm 0.10$	$-0.01 \pm 0.11$

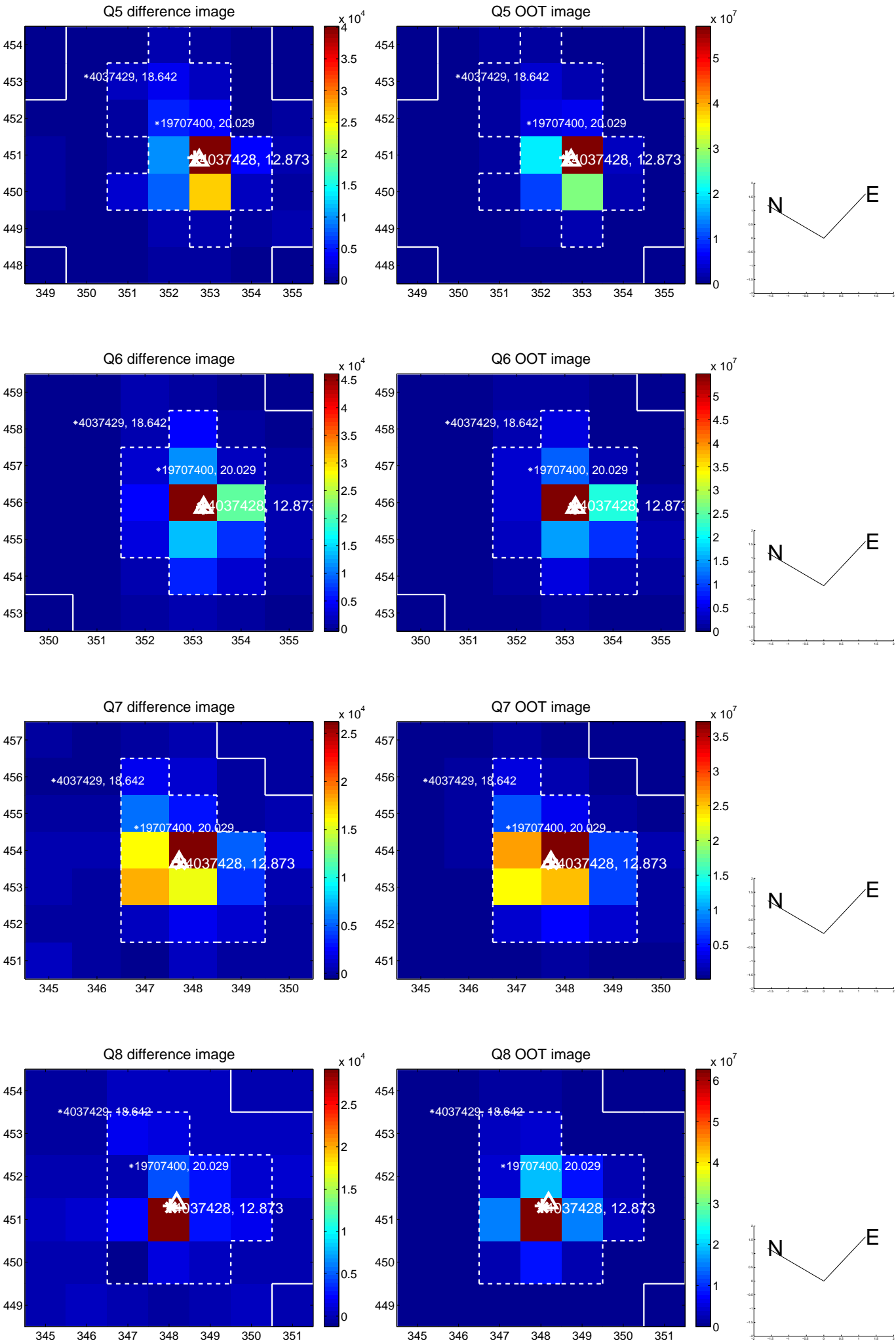


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

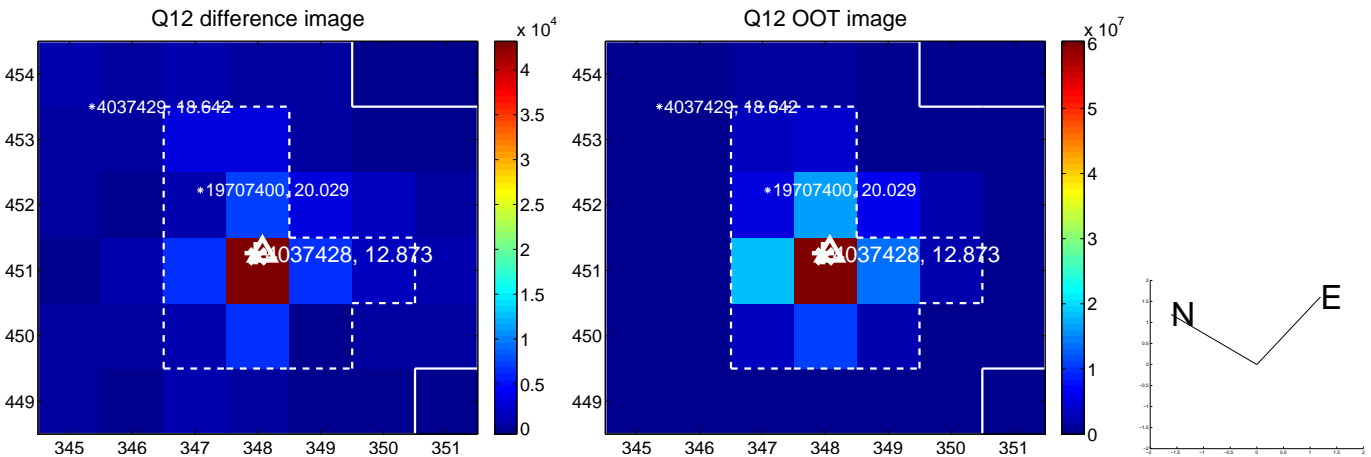
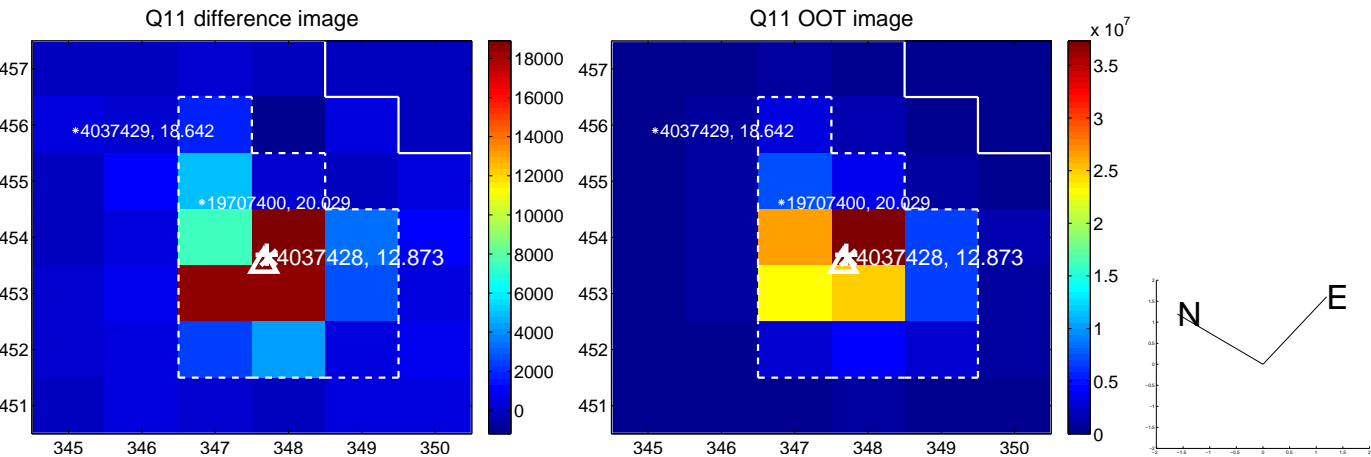
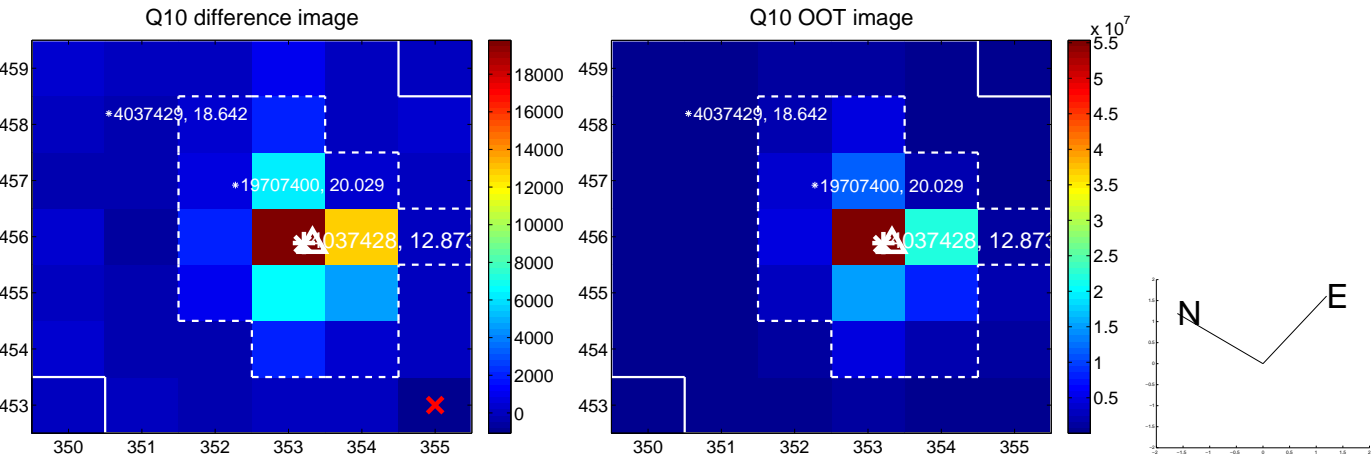
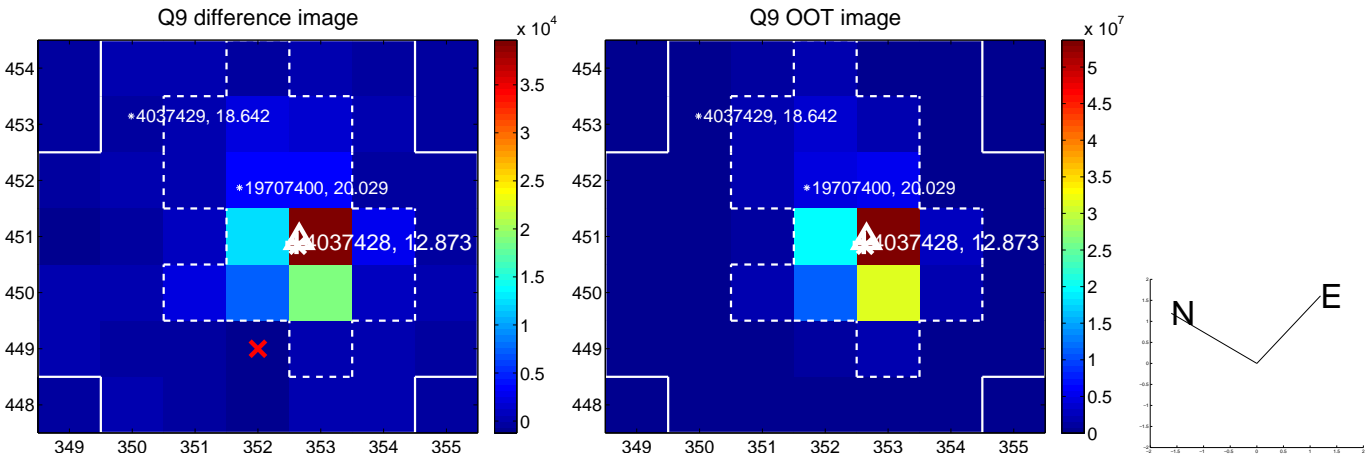


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

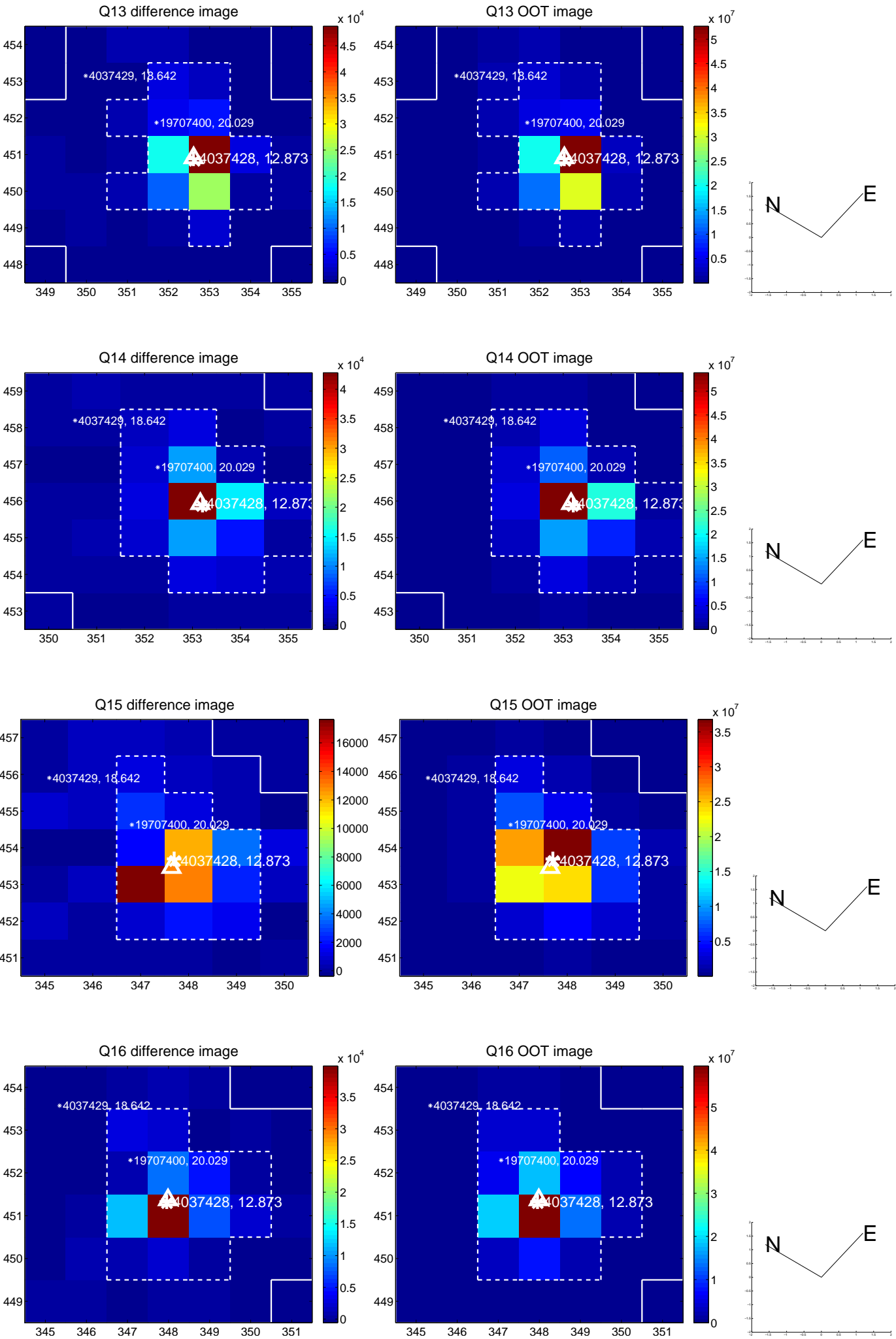




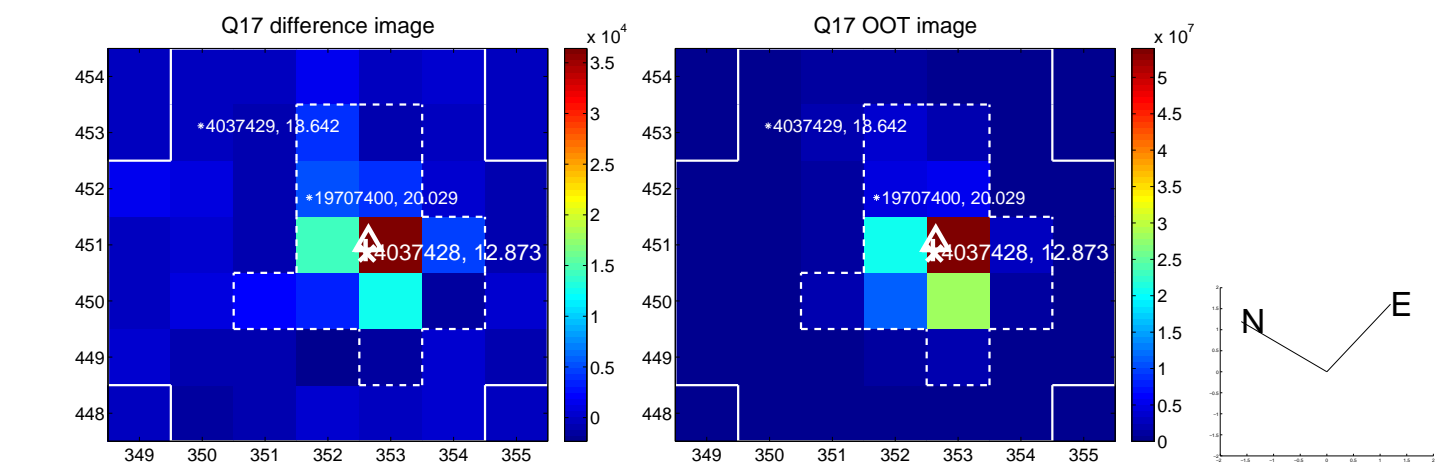
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



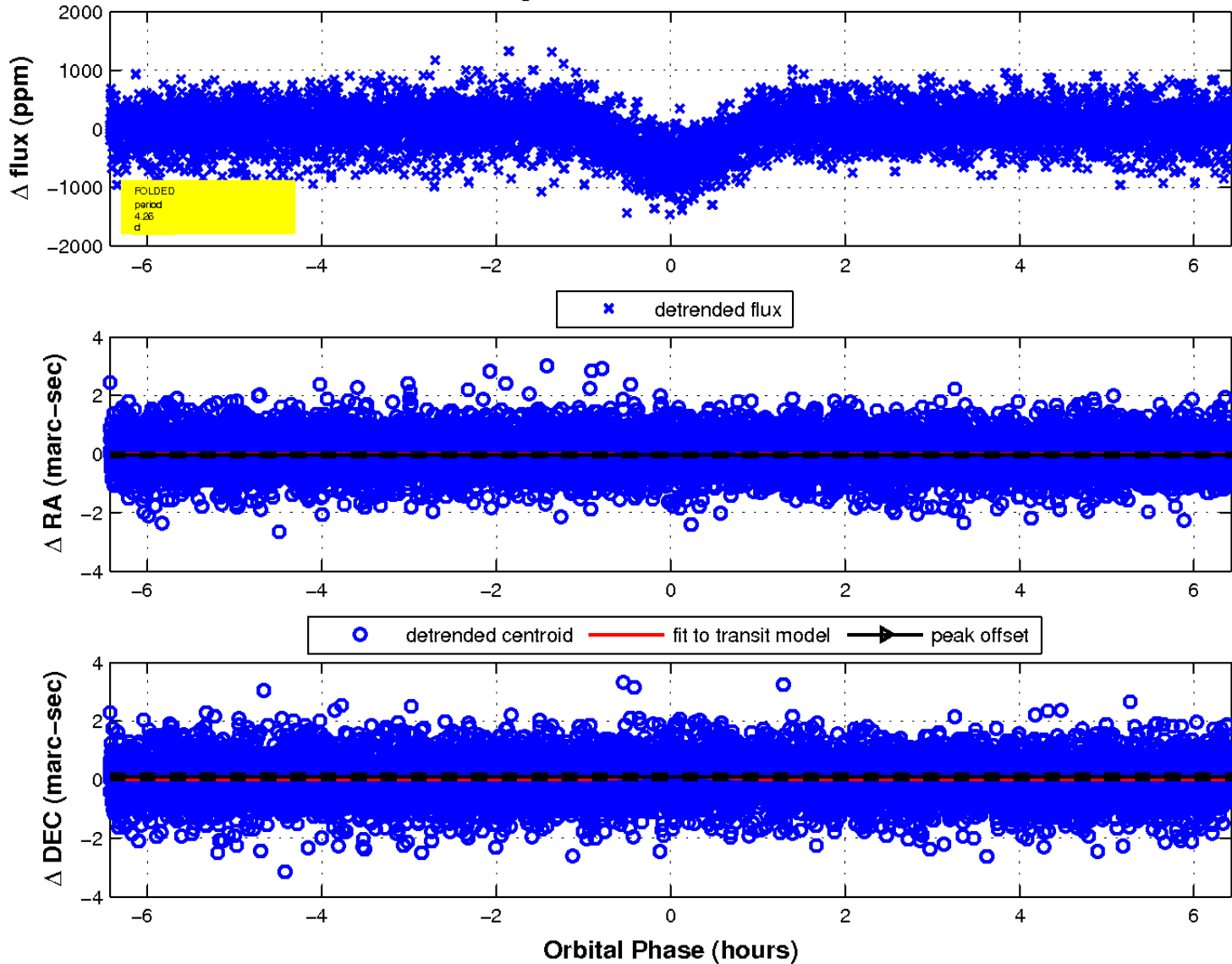
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

Declination

