

# KIC 004150390

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004150390-01	OBS	1768.01	55.251795	144.456454	39387.4	6.058	574.7	571.5	0.83	5793	22.74	9.16
004150390-02	OBS	No	55.251673	180.319440	2735.9	5.348	45.6	47.4	0.83	5793	5.29	9.16

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004150390-01	OBS	FP	0.00	0	1	0	0	MOD_SEC_DV—MOD_SEC_ALT—DEEP_V_SHAPED—HAS_SEC_TCE
004150390-02	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.

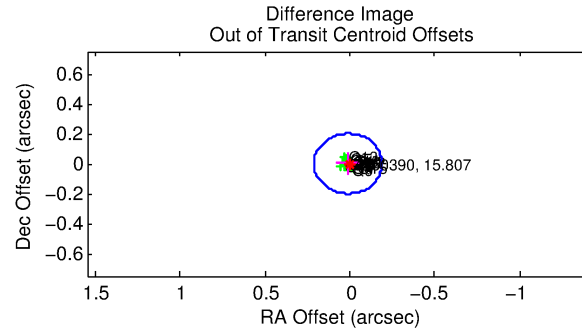
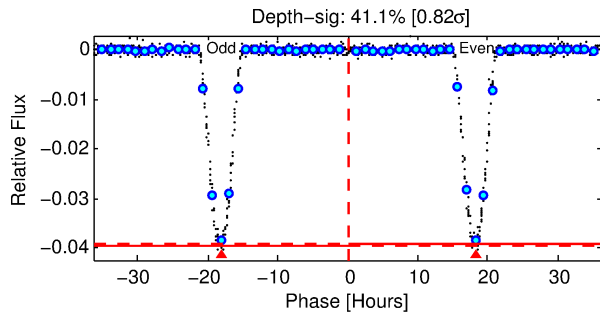
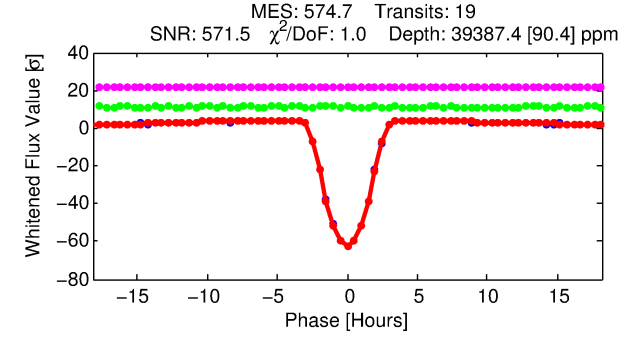
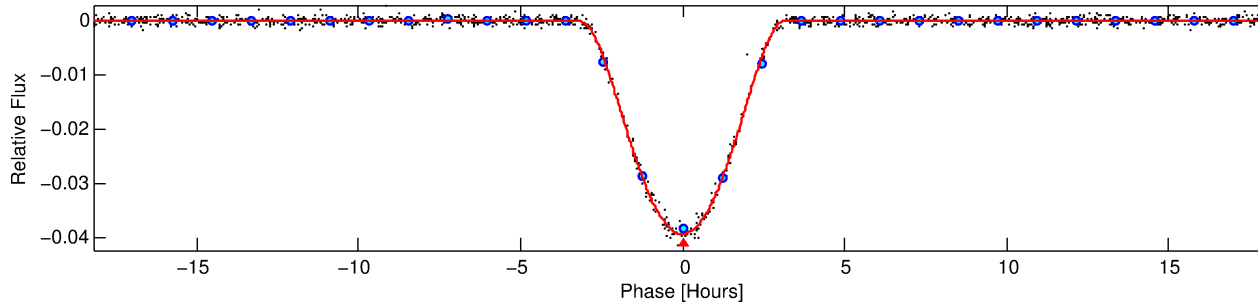
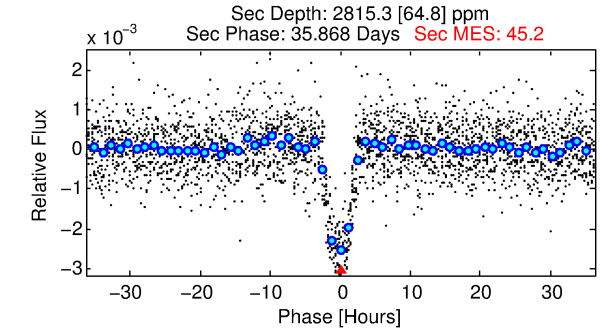
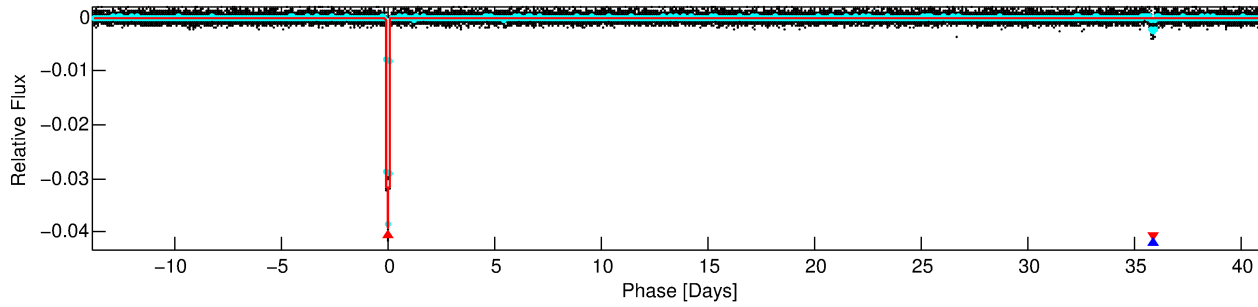
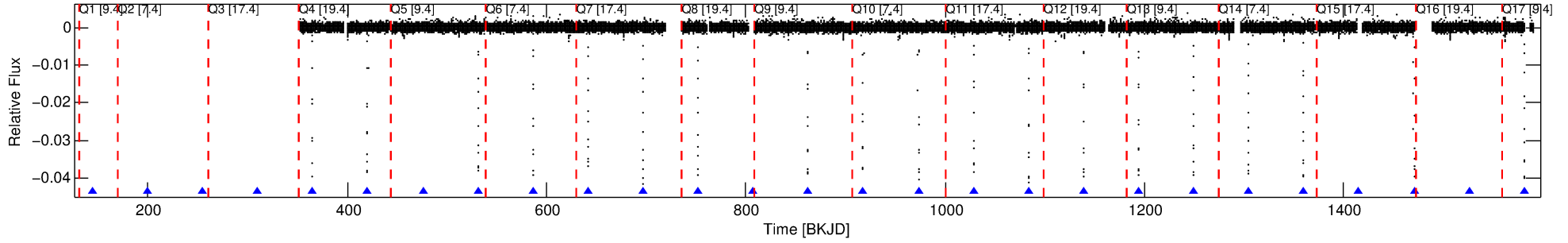
## Ephemeris Match Information For 004150390-01

No Significant Match Found

# DV One-Page Summary

KIC: 4150390 Candidate: 1 of 2 Period: 55.252 d  
KOI: K01768.01 Corr: 0.998

Kp: 15.81 R\*: 0.83 Rs Teff: 5793.0 K Logg: 4.56 Fe/H: -0.260



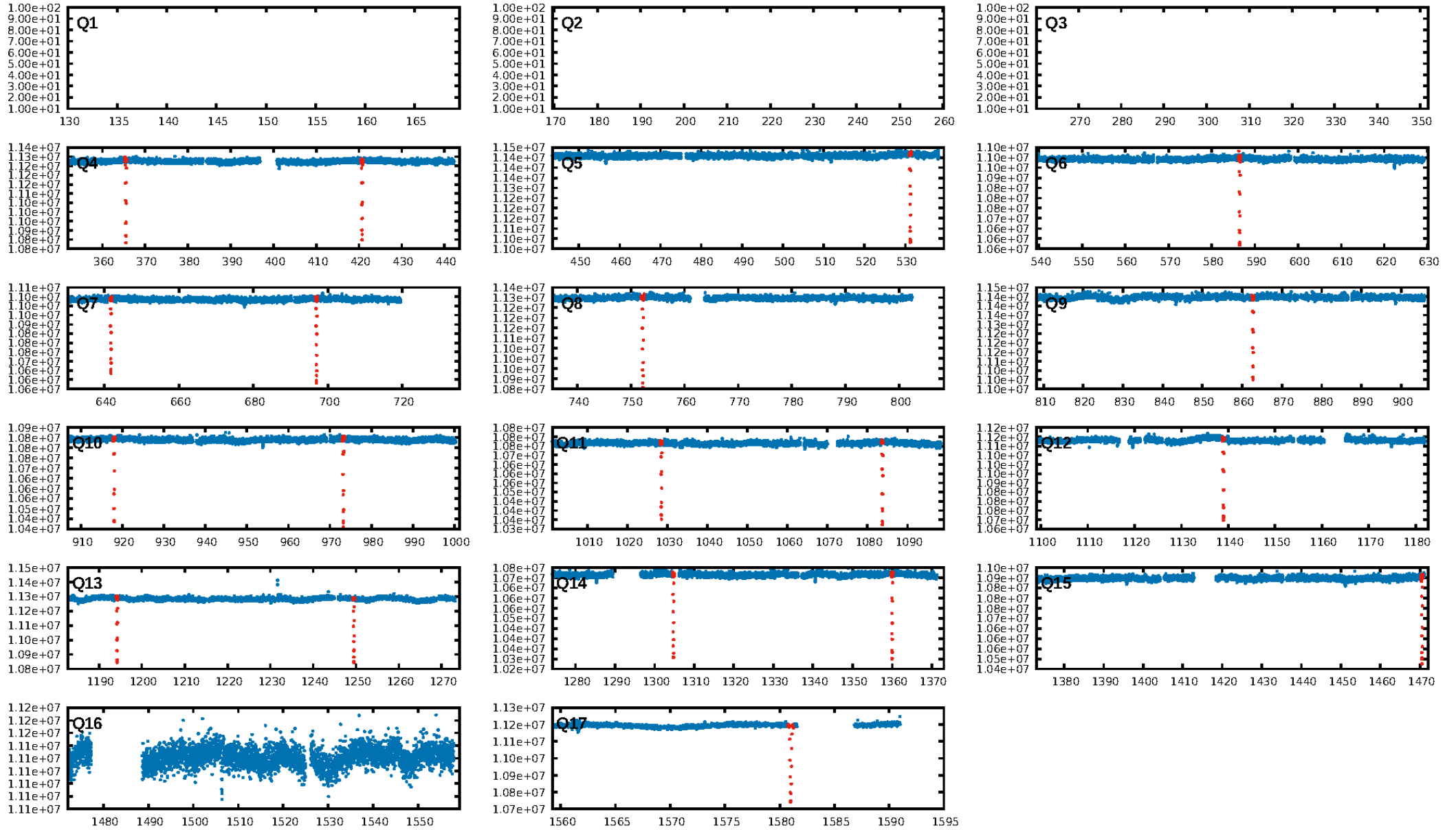
## DV Fit Results:

Period = 55.25180 [0.00002] d  
Epoch = 144.4565 [0.0003] BKJD  
Rp/R\* = 0.2505 [0.0118]  
a/R\* = 60.24 [0.44]  
b = 0.90 [0.02]  
Seff = 9.16 [3.47]  
Teq = 444 [42] K  
Rp = 22.74 [6.62] Re  
a = 0.2761 [0.0671] AU  
Ag = 228.23 [84.06] [2.70σ]  
Teffp = 2666 [108] K [19.13σ]

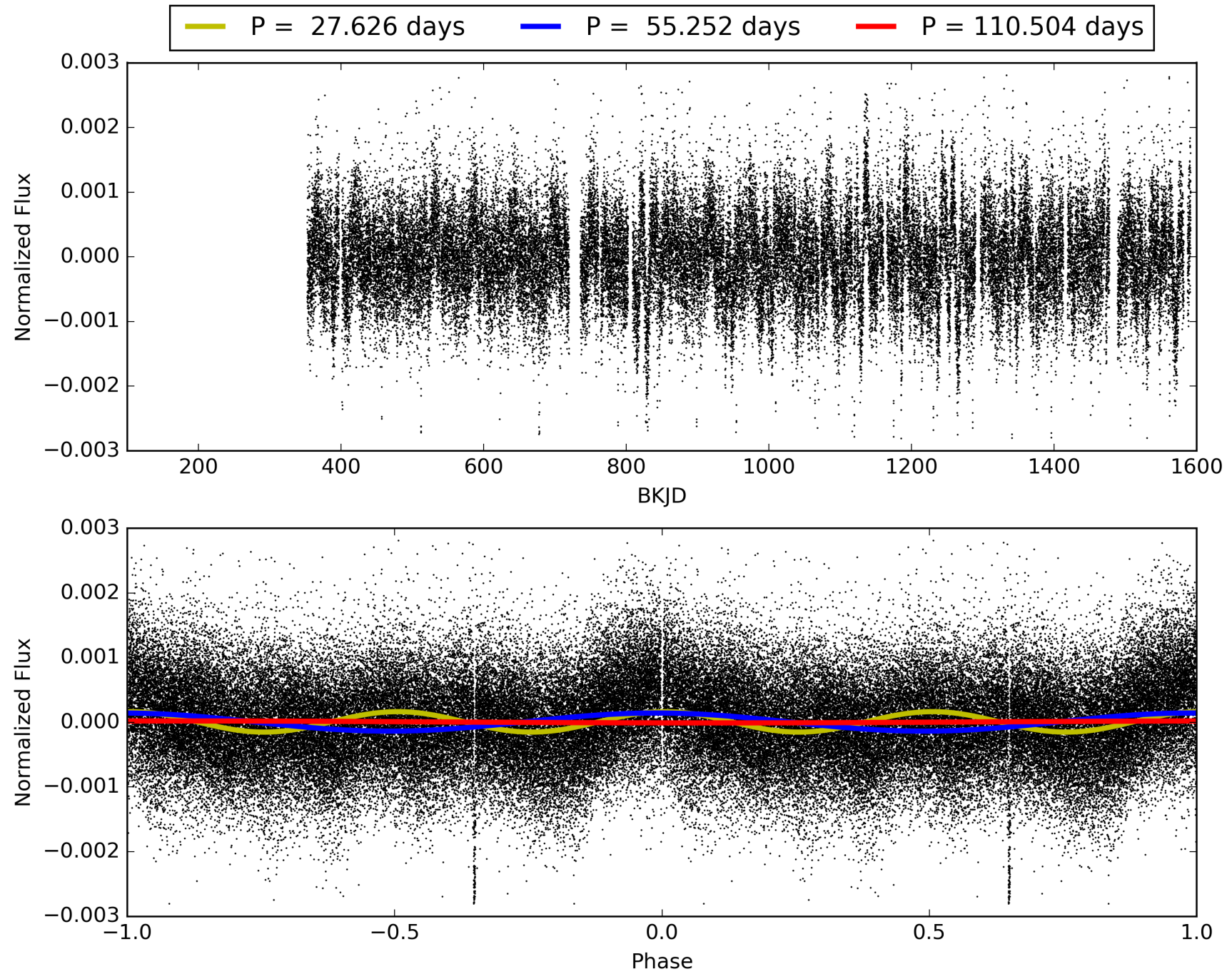
## DV Diagnostic Results:

ShortPeriod-sig: 0.0% [0.00σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 1.00 [18/18]  
GhostDiagnostic-chr: 3.226  
Centroid-sig: 0.0%  
Centroid-so: 0.321 arcsec [14.95σ]  
OotOffset-rm: 0.013 arcsec [0.20σ]  
OotOffset-st: 3/3/3/4 [13]  
KicOffset-rm: 0.239 arcsec [3.12σ]  
KicOffset-st: 3/3/3/4 [13]  
DiffImageQuality-fgm: 1.00 [13/13]  
DiffImageOverlap-fno: 1.00 [13/13]

# TCE 004150390-01, PDC Light Curves

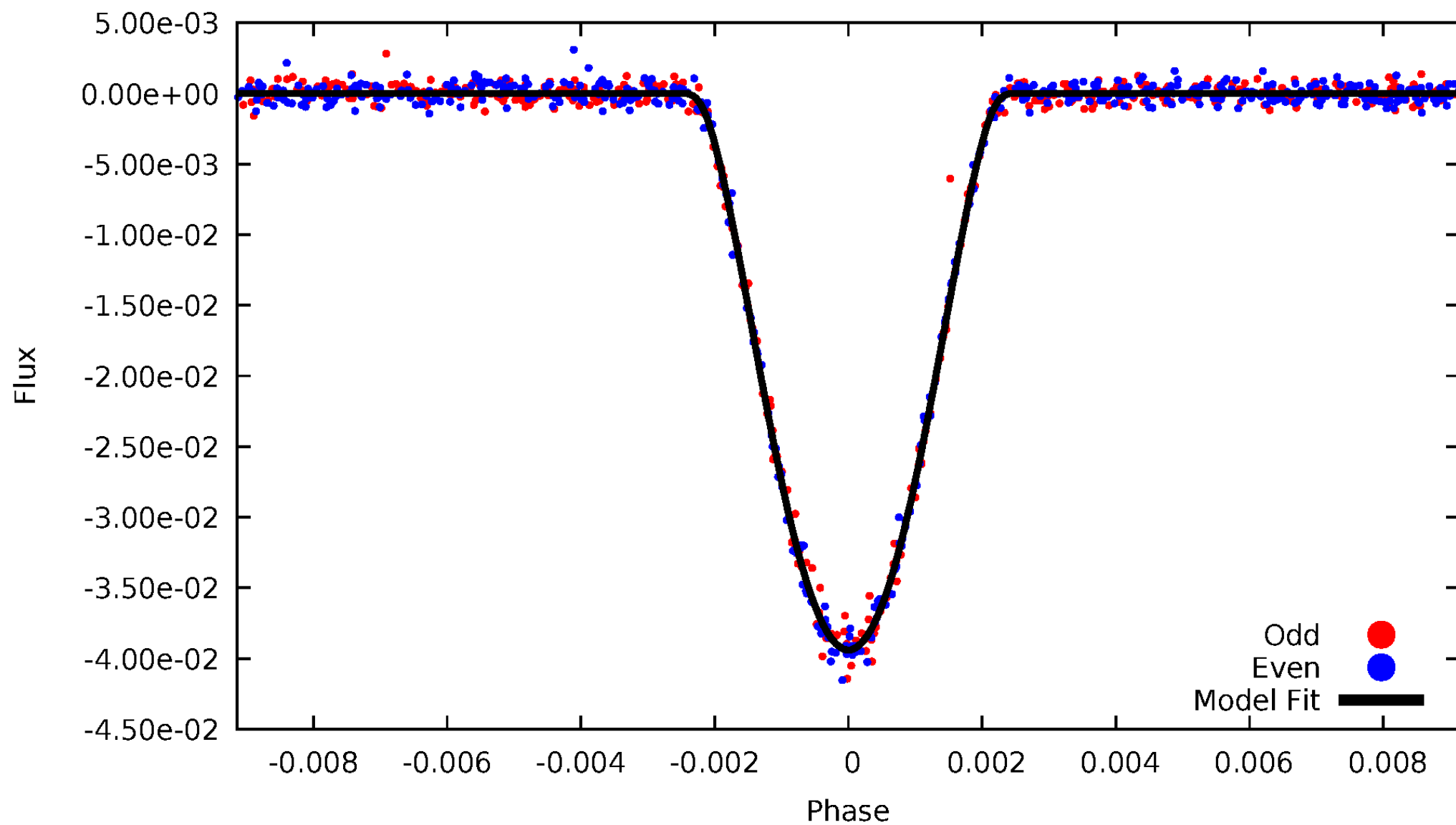


TCE 004150390-01



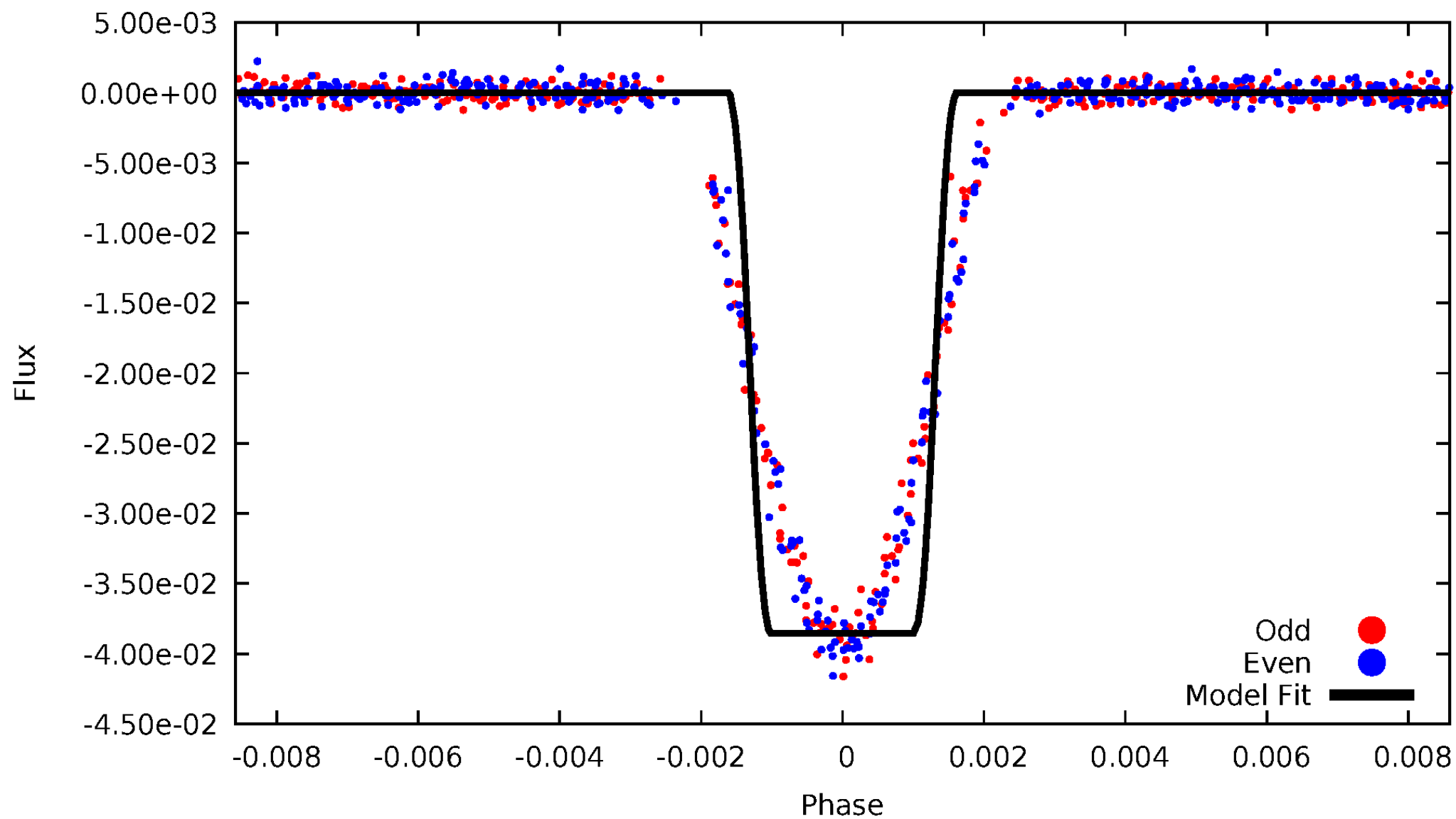
DV Odd/Even

TCE 004150390-01



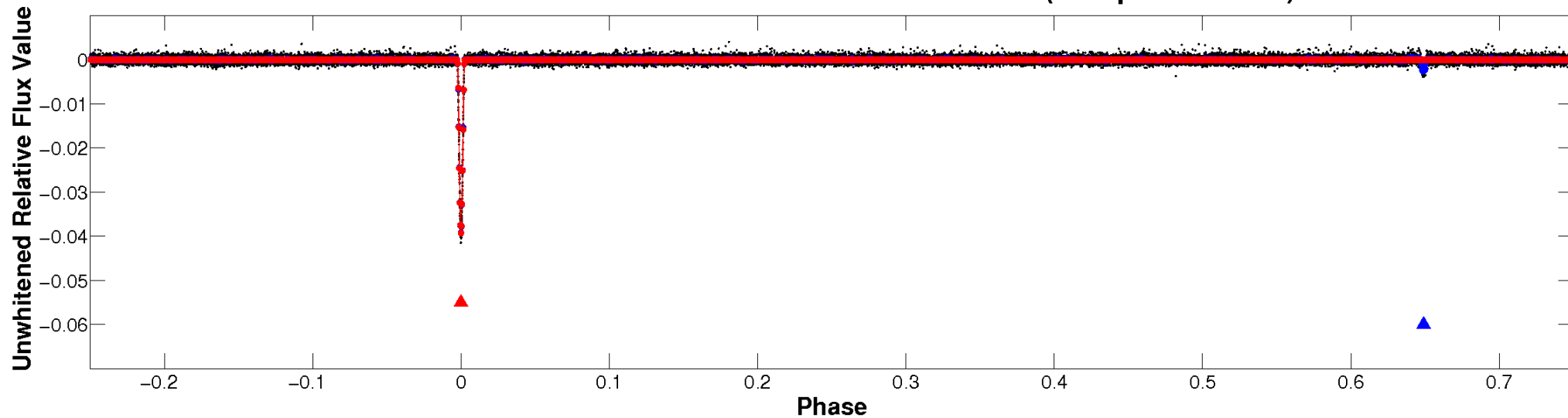
# ALT Odd/Even

TCE 004150390-01

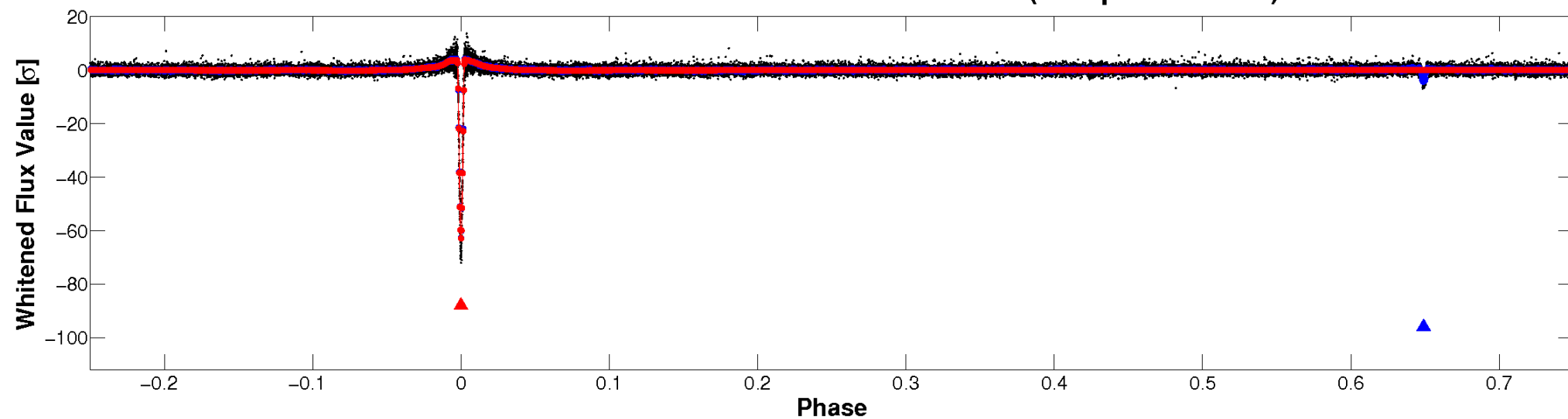


# Non-Whitened Vs. Whitened Light Curve

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

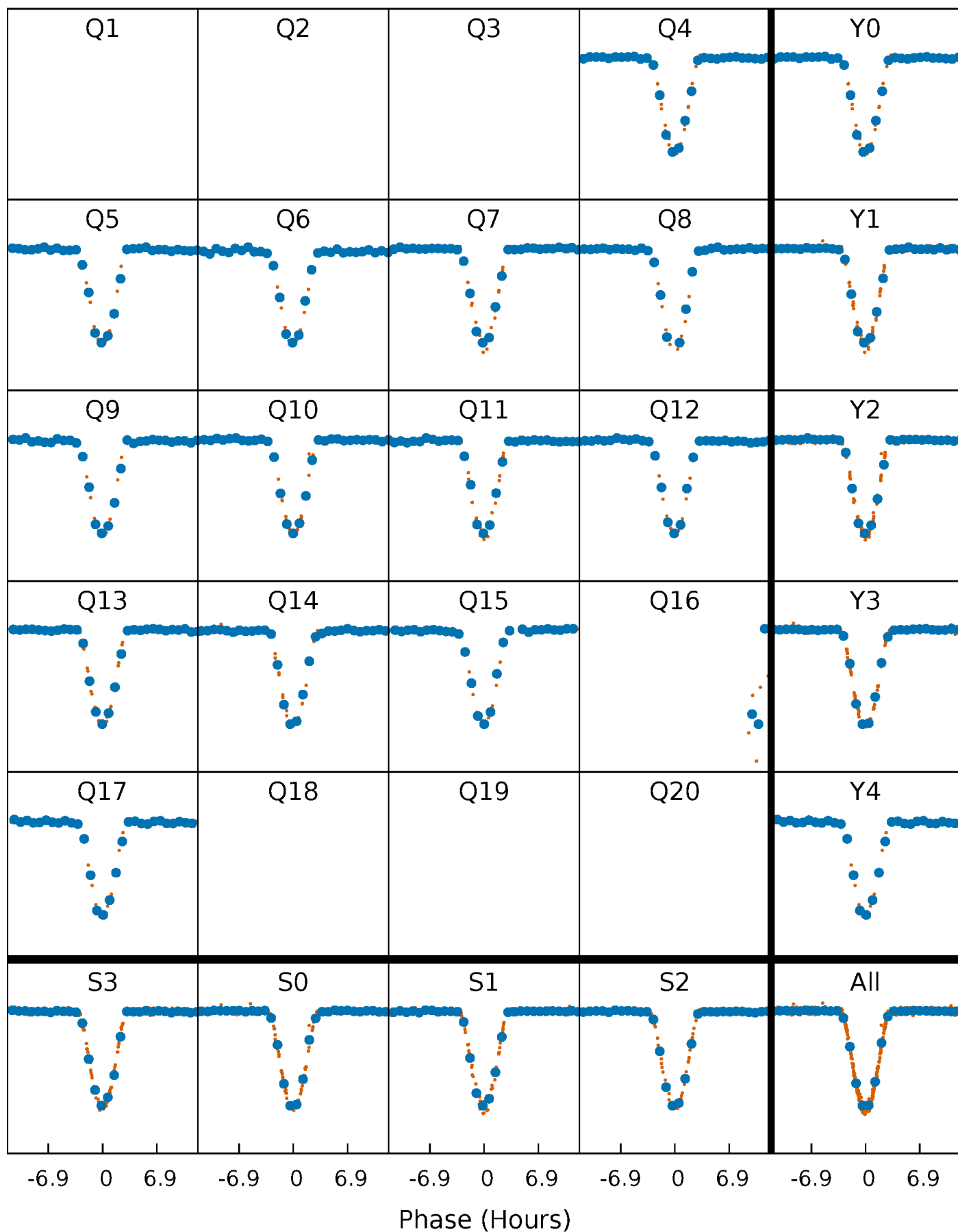


Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

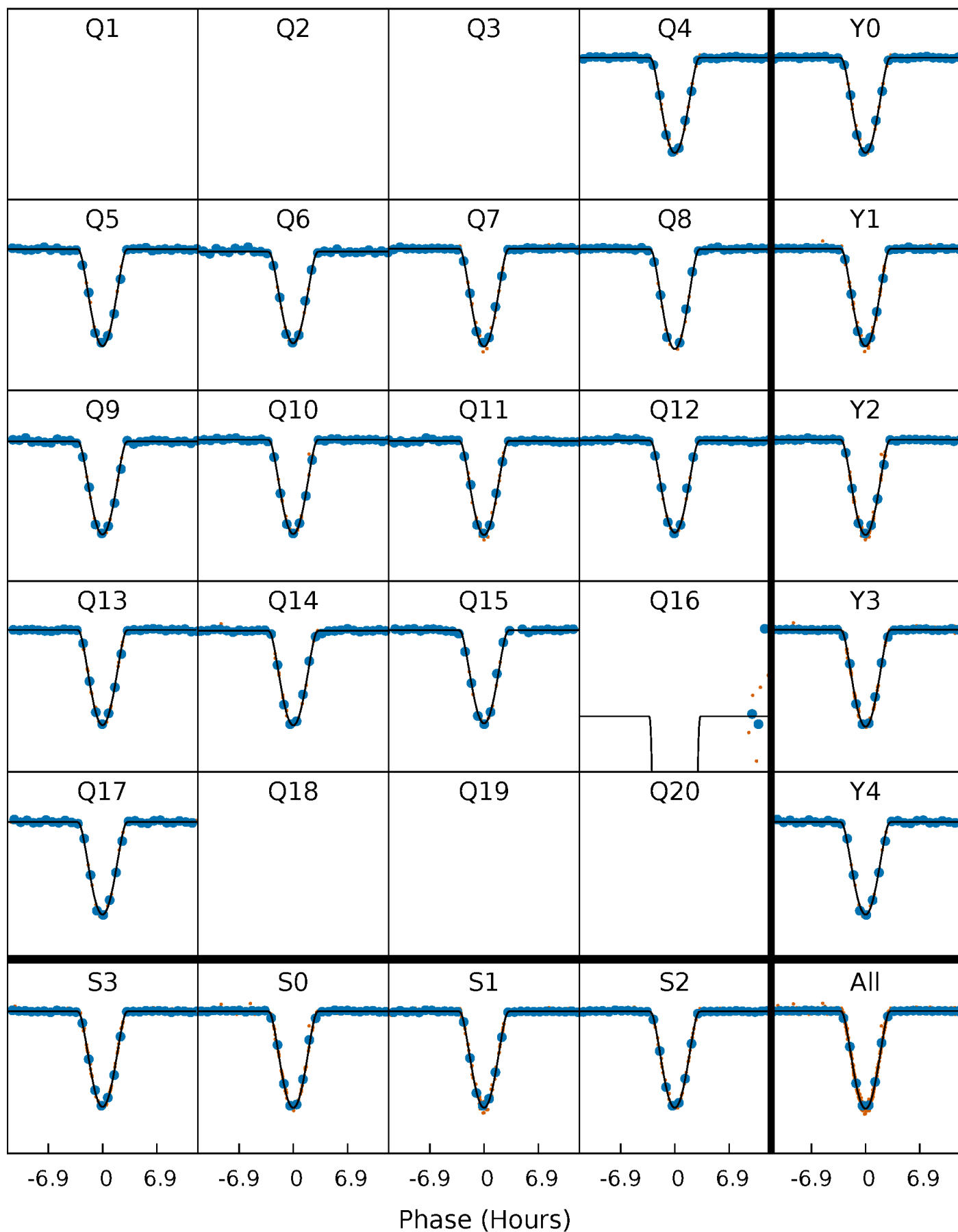
TCE 004150390-01 P= 55.251795 Days  $T_0=144.456454$  (BKJD)





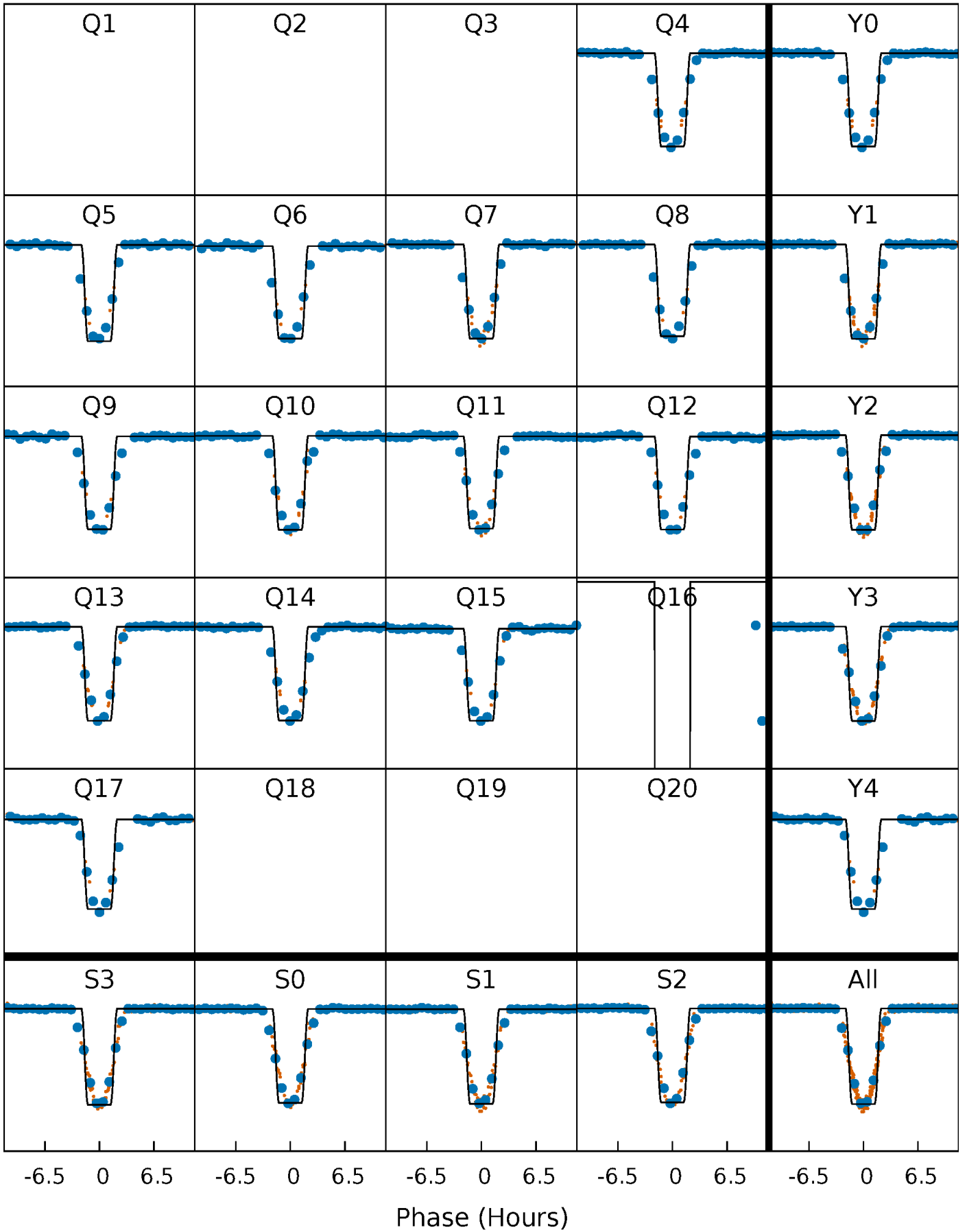
# DV Quarter-Phased Transit Curves

TCE 004150390-01 P= 55.251795 Days  $T_0=144.456454$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

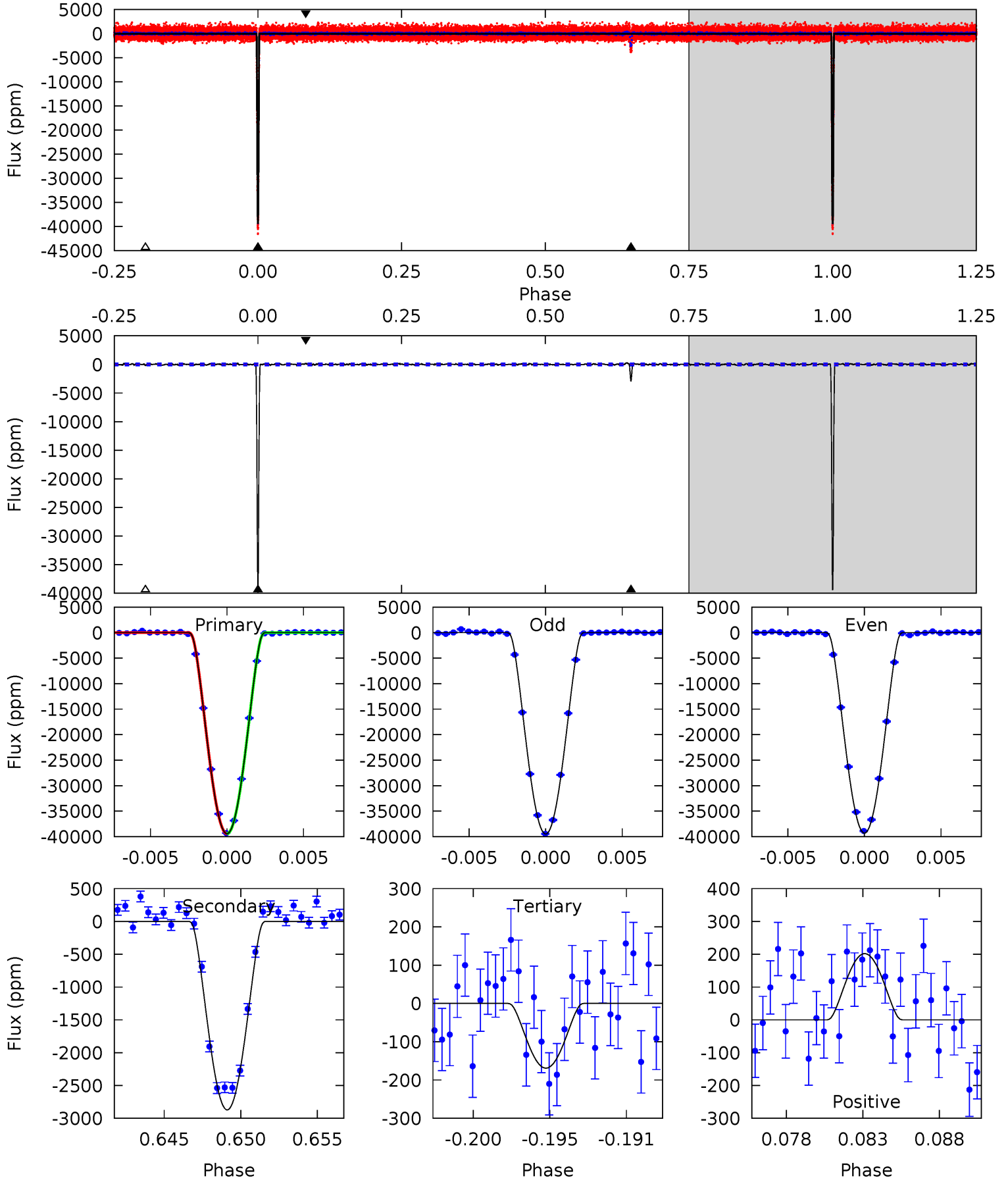
TCE 004150390-01 P= 55.251204 Days  $T_0=144.465039$  (BKJD)



# DV Model-Shift Uniqueness Test

004150390-01, P = 55.251795 Days, E = 144.456454 Days

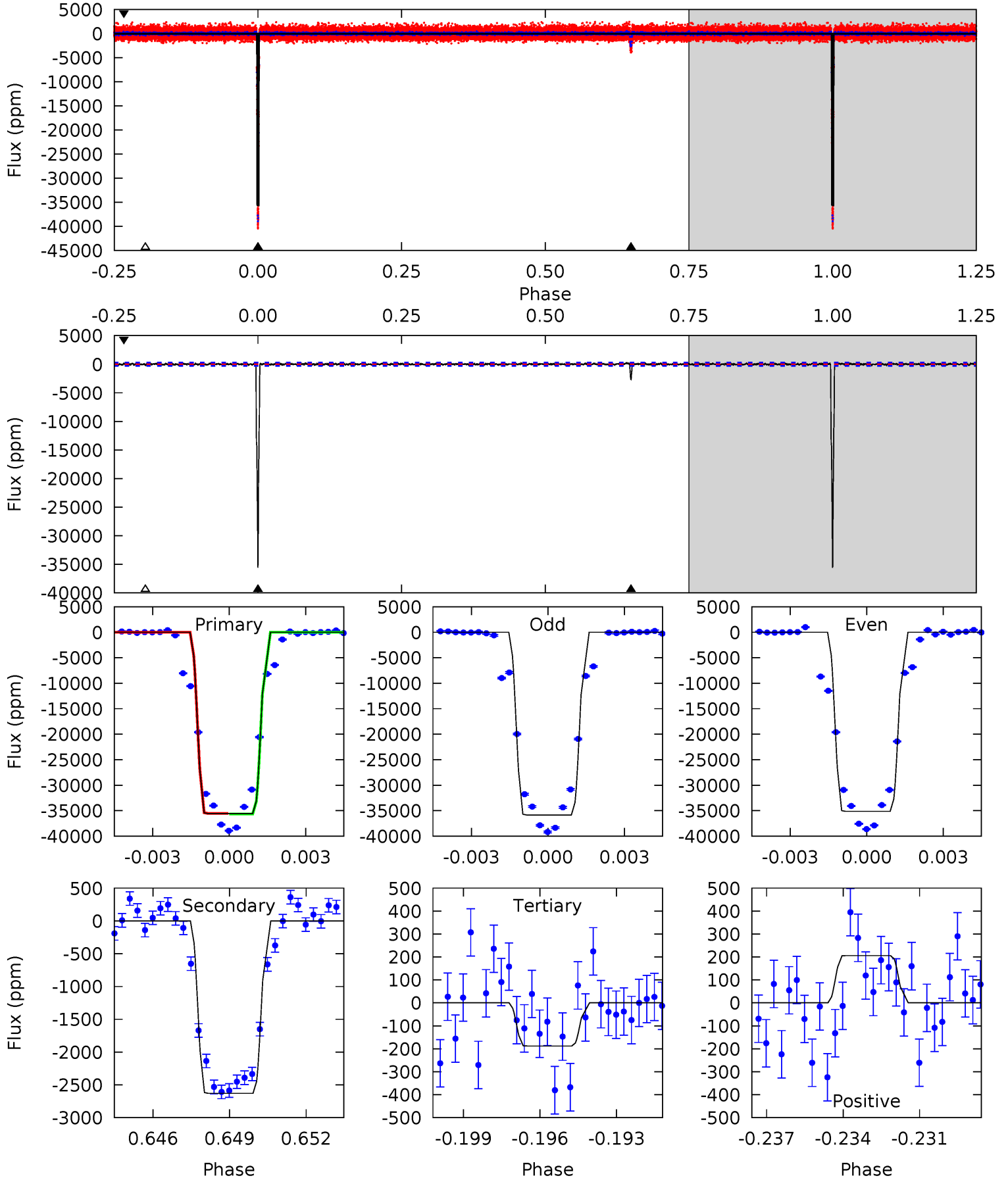
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
1073	78.2	4.60	5.49	5.16	2.81	1.59	1068	1067	73.6	72.7	2.31	1.00	0.01	0.14



# Alt Model-Shift Uniqueness Test

004150390-01, P = 55.251204 Days, E = 144.465039 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
661.5	48.9	3.49	3.83	5.24	2.95	1.54	658.0	657.7	45.4	45.1	6.65	1.00	0.01	0.96



### Stellar Parameters For KIC 004150390

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M$ ( $M_{\odot}$ )	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5793^{+172}_{-189}$	$4.561^{+0.034}_{-0.195}$	$-0.260^{+0.300}_{-0.300}$	$0.832^{+0.239}_{-0.075}$	$0.921^{+0.098}_{-0.109}$	$2.251^{+0.432}_{-1.137}$
	+3%/-3%	+1%/-4%	+115%/-115%	+29%/-9%	+11%/-12%	+19%/-51%
Source	KIC0	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 004150390-01 / KOI 1768.01

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-2872 \pm 37$	$23.76^{+3.30}_{-2.27}$	$634^{+43}_{-26}$	$3252^{+80}_{-76}$	$211^{+40}_{-45}$
Alt.	$-2629 \pm 54$	$18.58^{+2.72}_{-1.77}$	$635^{+42}_{-30}$	$3454^{+103}_{-95}$	$314^{+64}_{-69}$

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

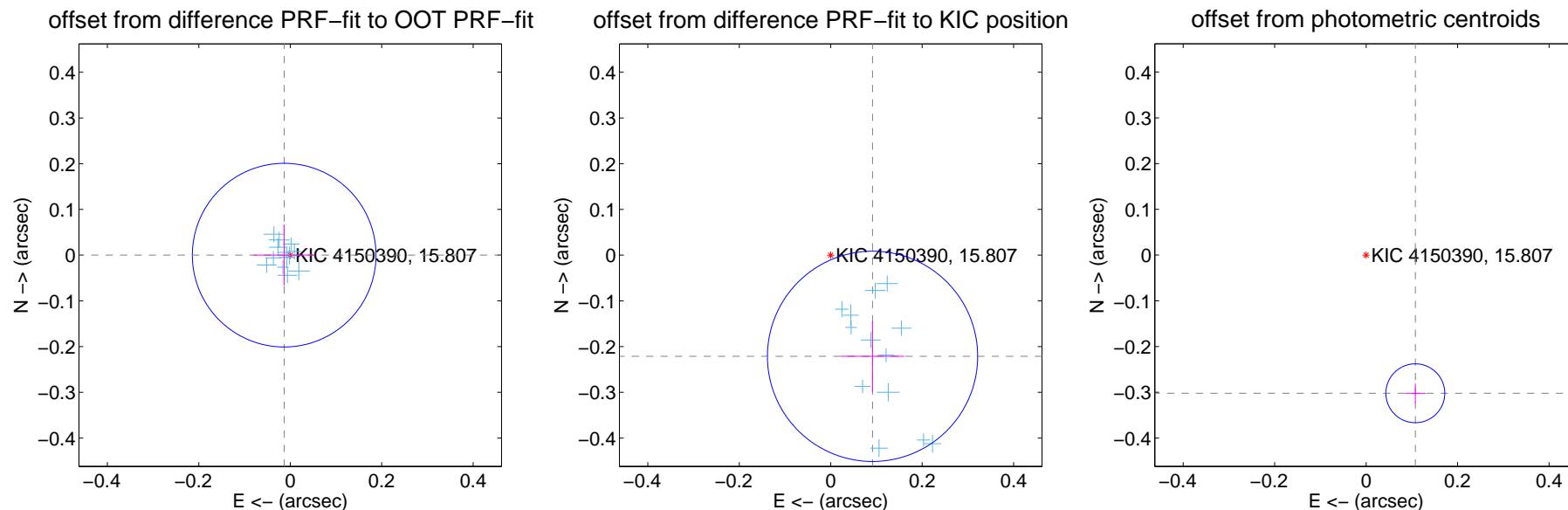
## DV Centroid Data

Supplemental centroid analysis for 004150390-01. Kepler magnitude: 15.81. Transit SNR 571.50

There are 13 quarters with good PRF difference image offsets

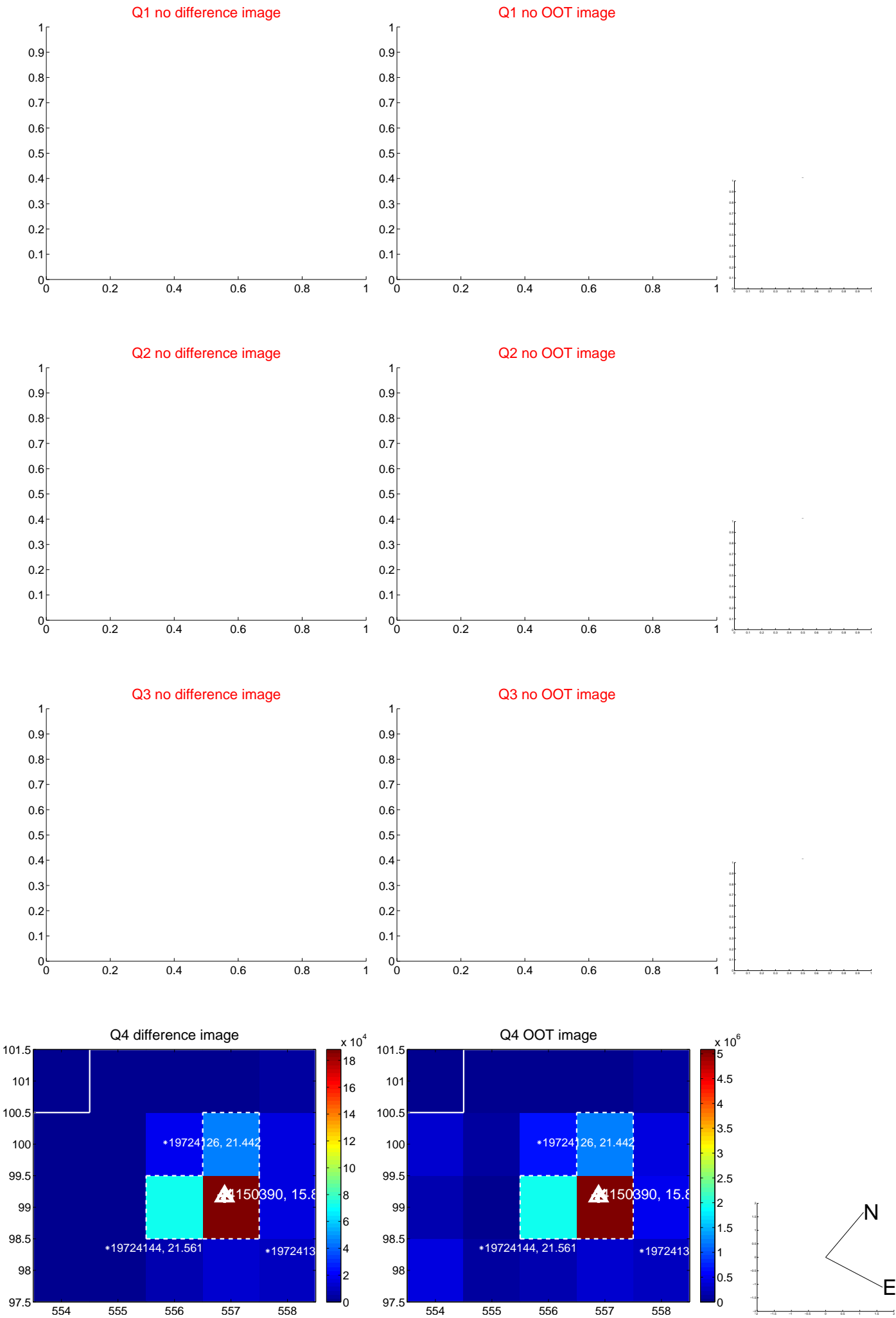
The direct PRF centroid is offset from the target star catalog position by about 0.22 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.013 \pm 0.067$	0.20	$0.013 \pm 0.067$	$0.000 \pm 0.067$
PRF-fit source offset from KIC position	$0.239 \pm 0.077$	3.12	$-0.092 \pm 0.070$	$-0.221 \pm 0.078$
photometric centroid source offset	$0.32 \pm 0.02$	14.95	$-0.11 \pm 0.02$	$-0.30 \pm 0.02$

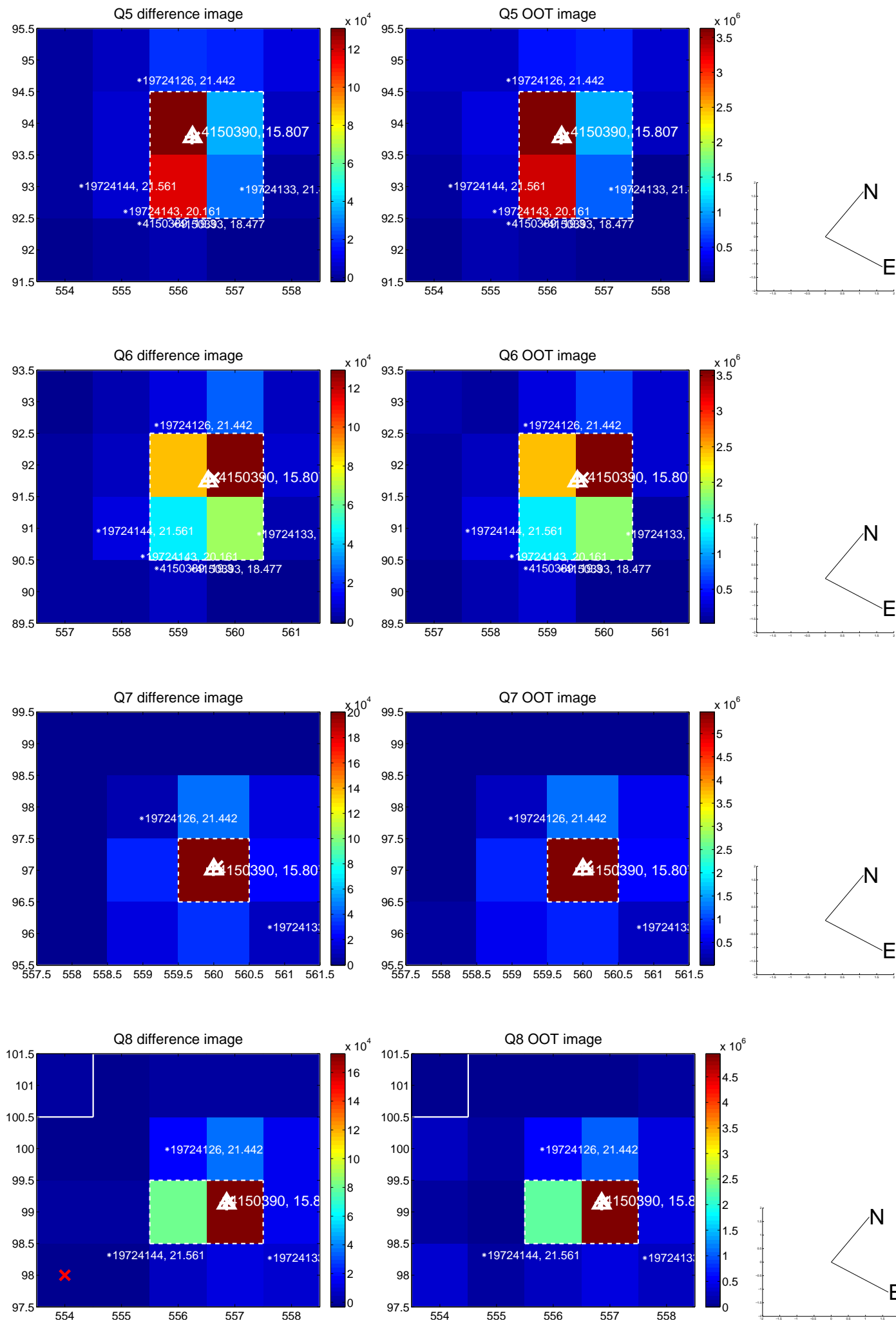


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

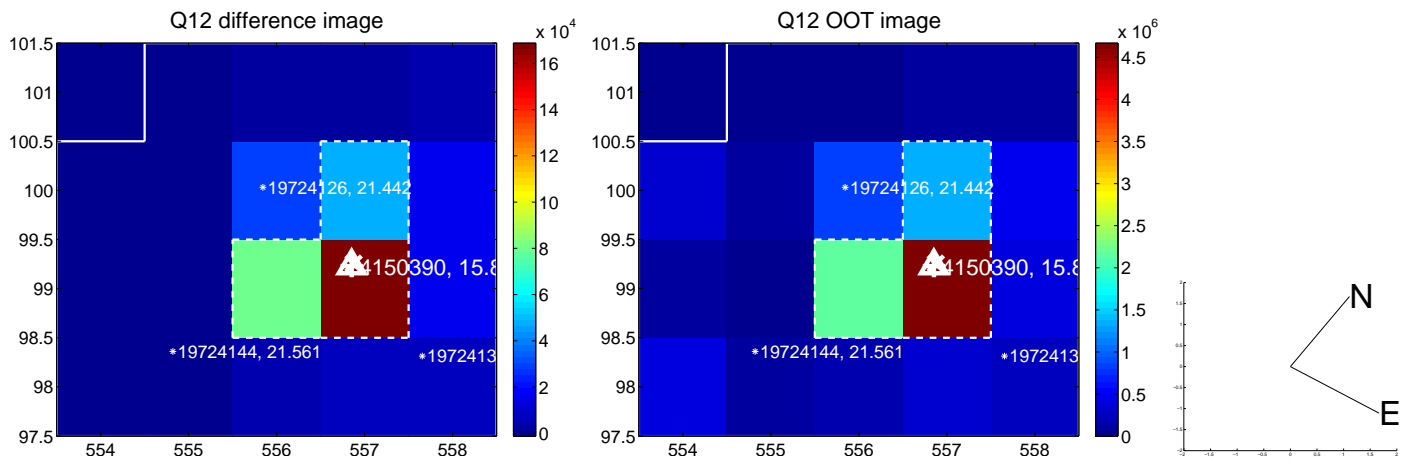
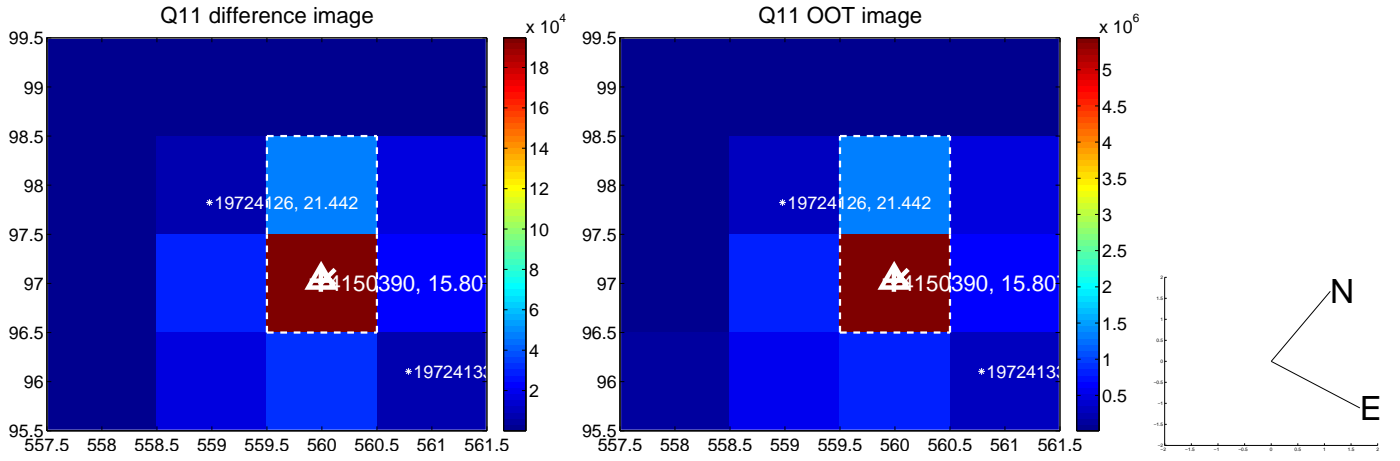
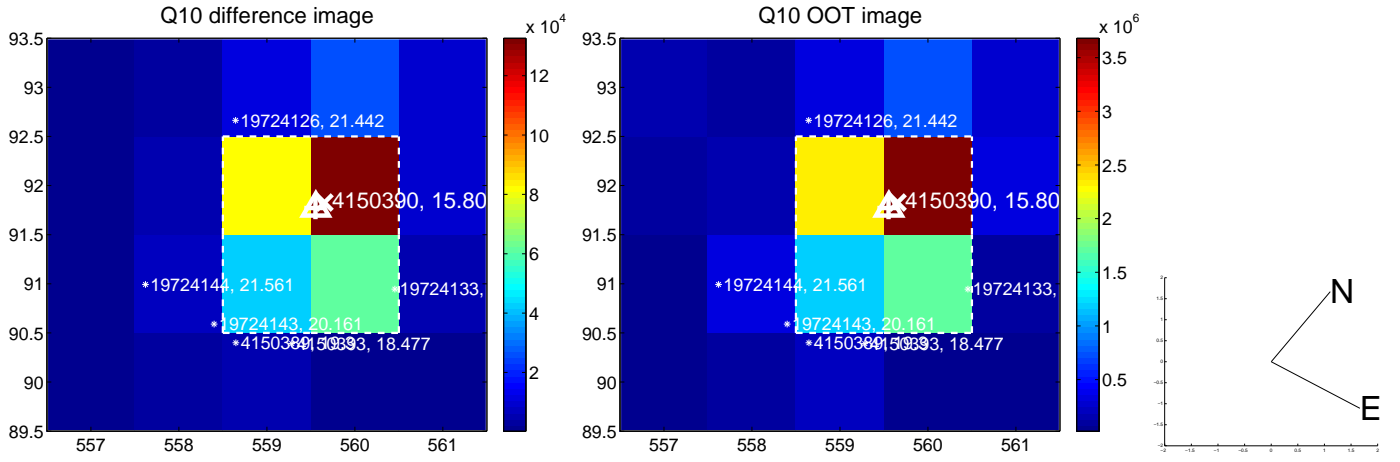
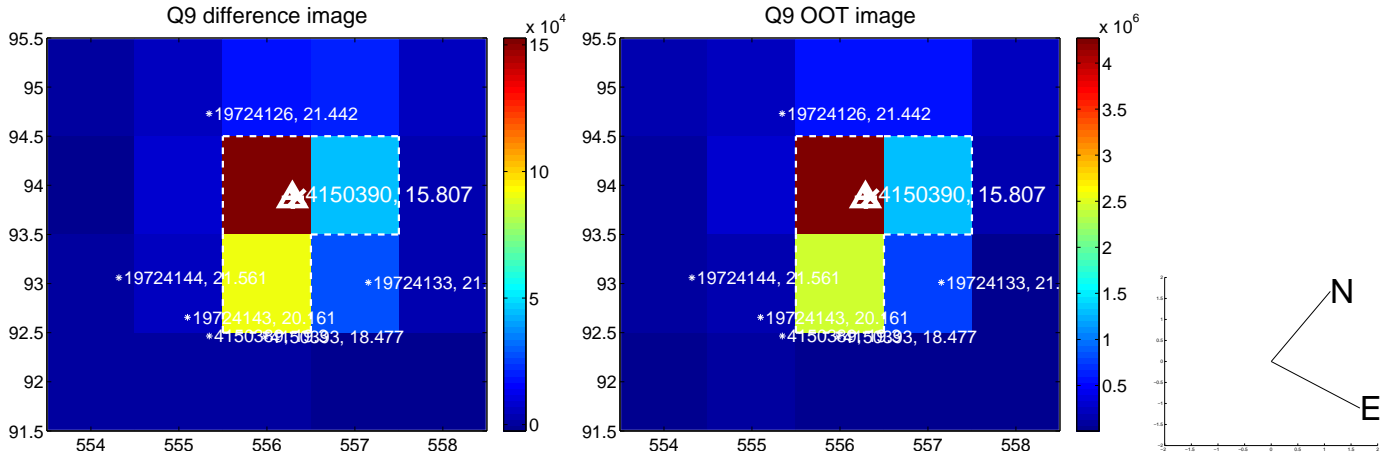


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

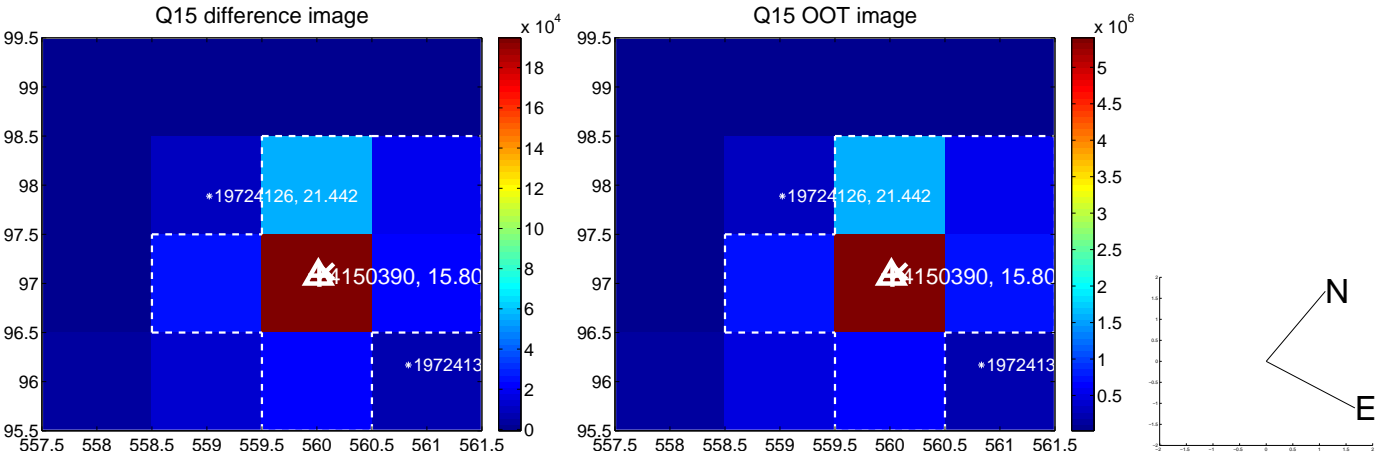
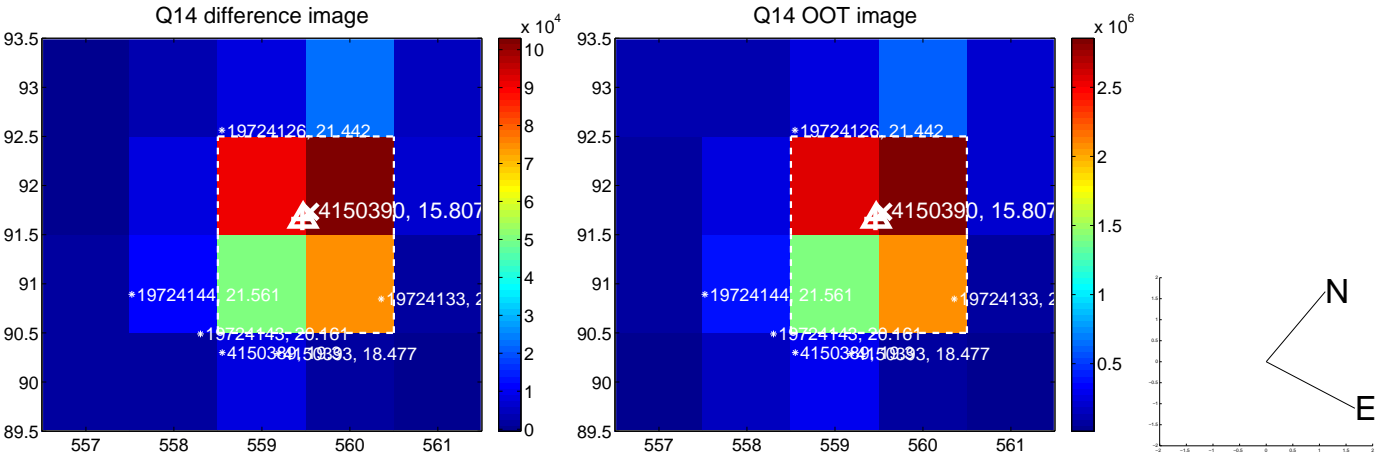
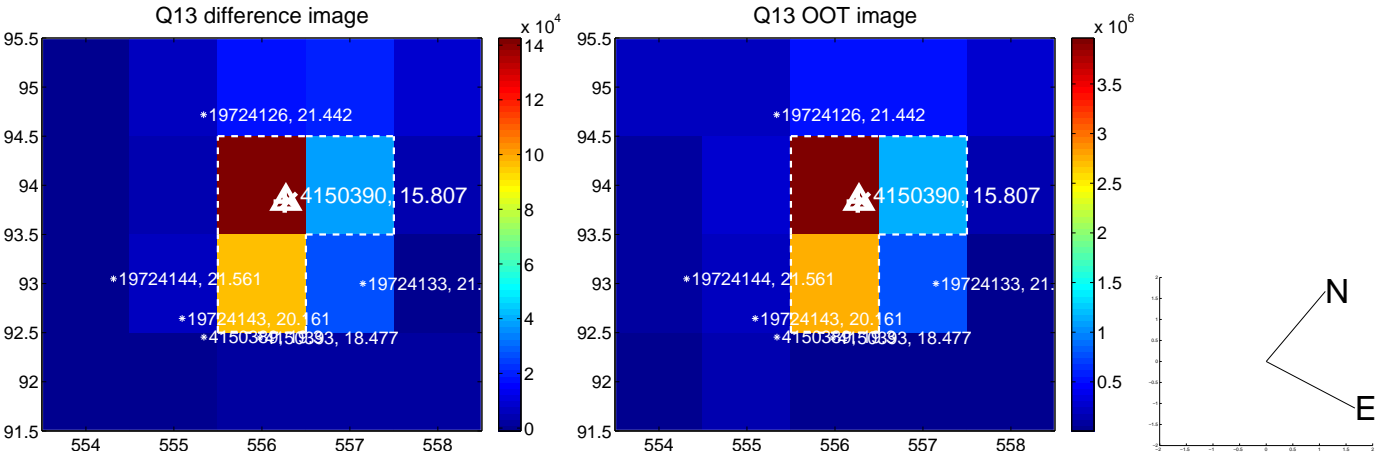




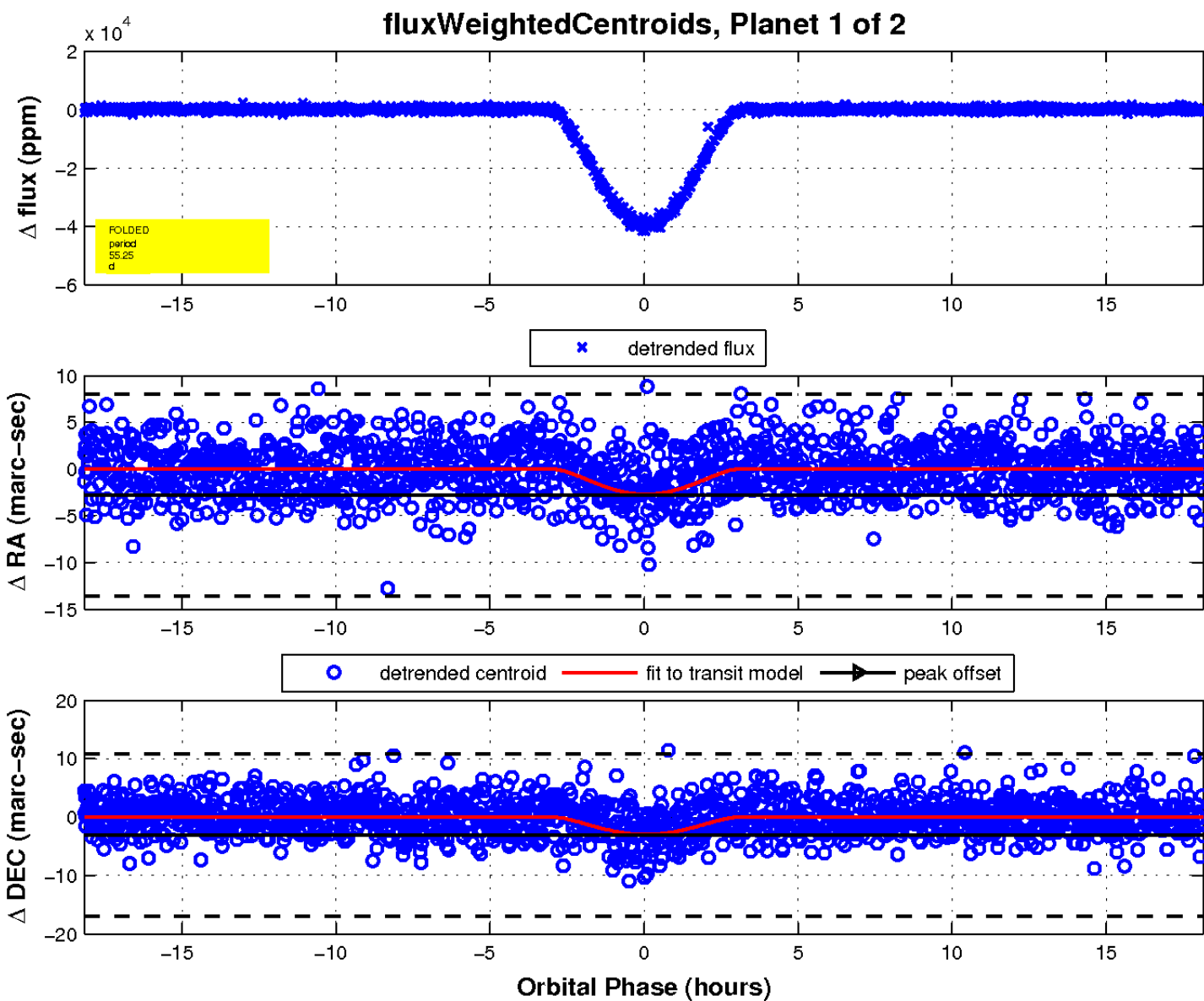
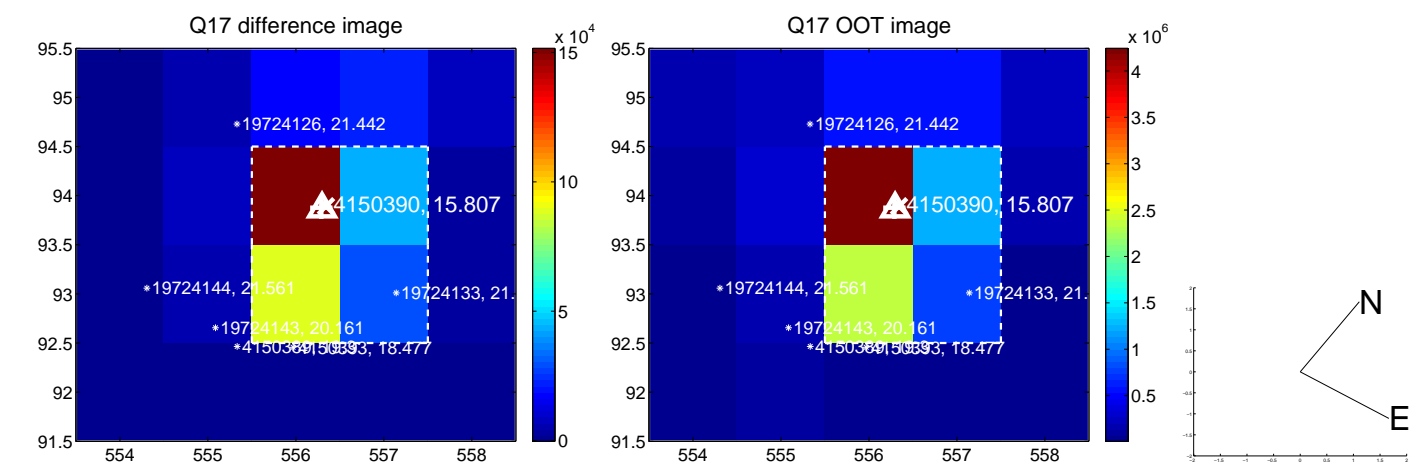
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

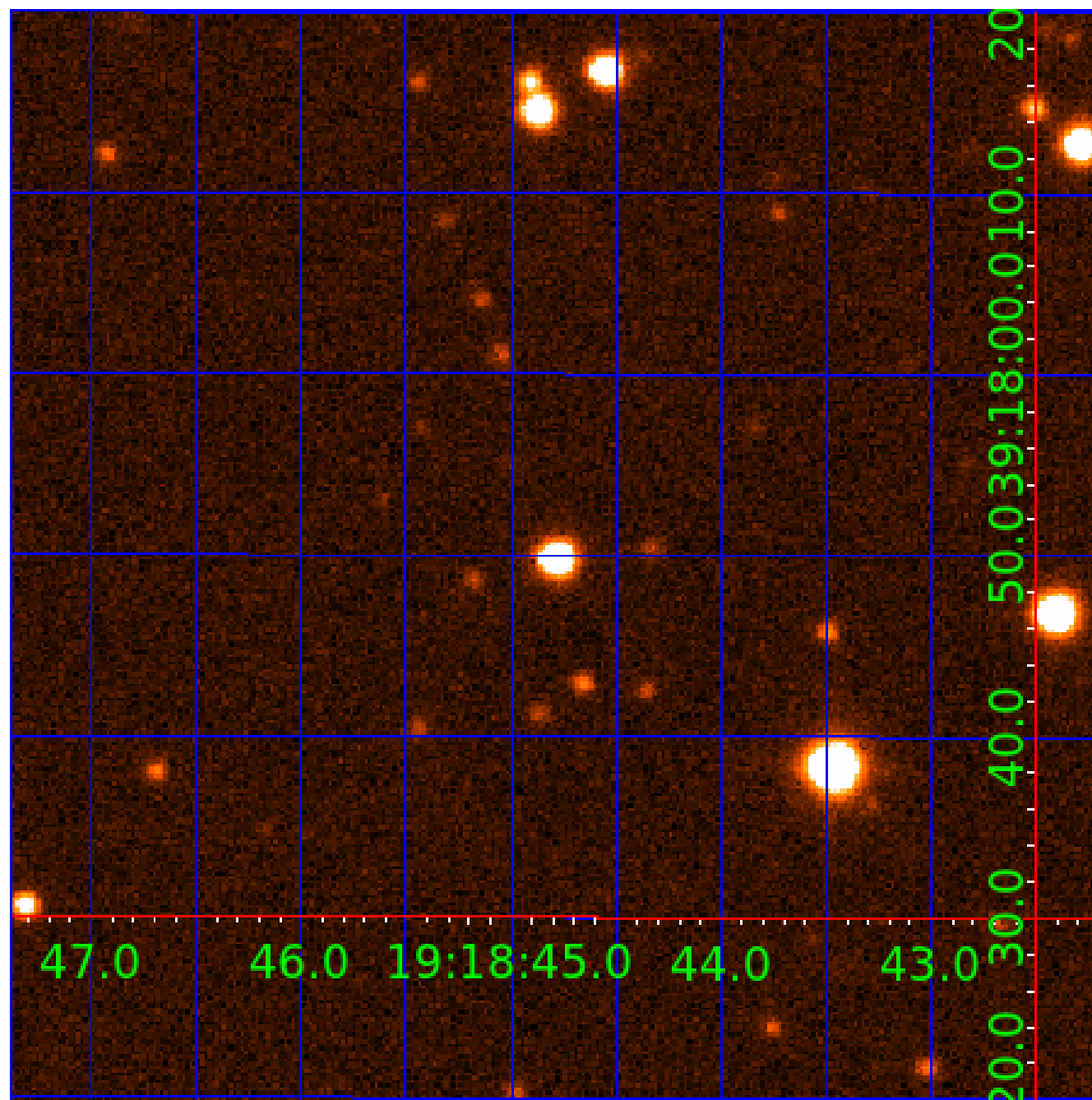


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 004150390

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004150390-01	OBS	1768.01	55.251795	144.456454	39387.4	6.058	574.7	571.5	0.83	5793	22.74	9.16
004150390-02	OBS	No	55.251673	180.319440	2735.9	5.348	45.6	47.4	0.83	5793	5.29	9.16

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004150390-01	OBS	FP	0.00	0	1	0	0	MOD_SEC_DV—MOD_SEC_ALT—DEEP_V_SHAPED—HAS_SEC_TCE
004150390-02	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.

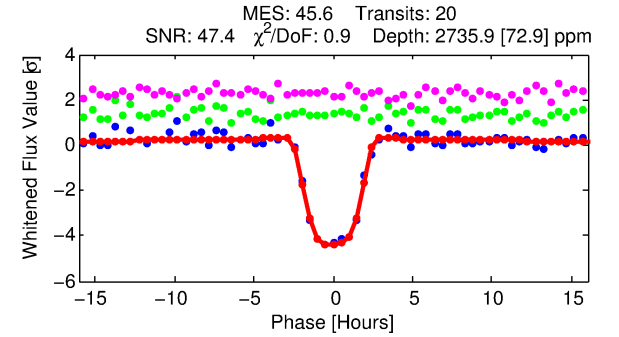
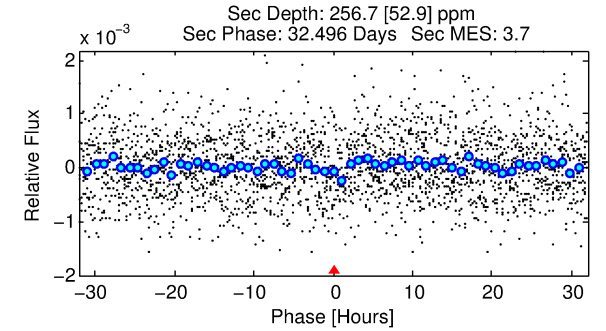
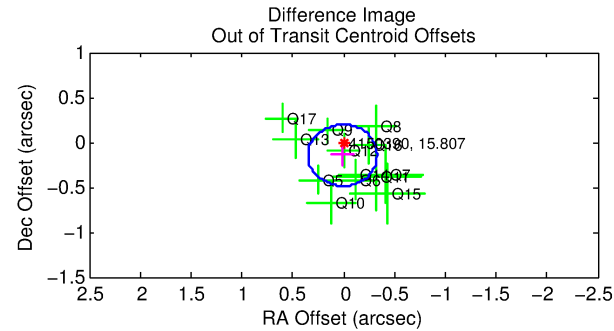
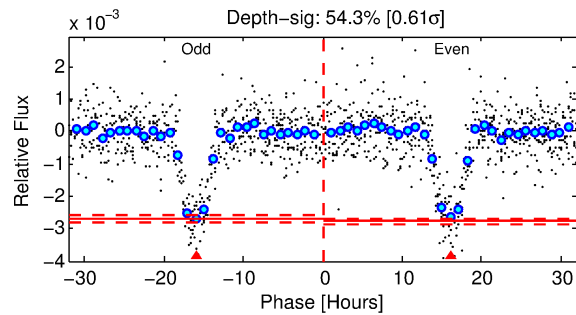
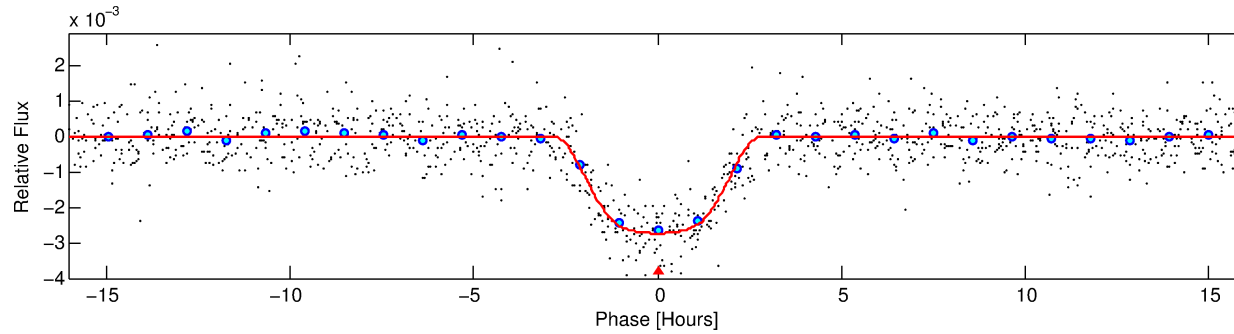
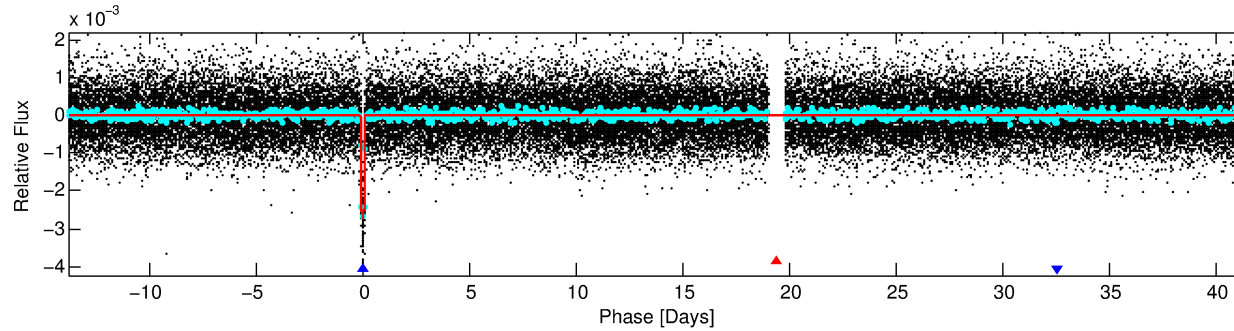
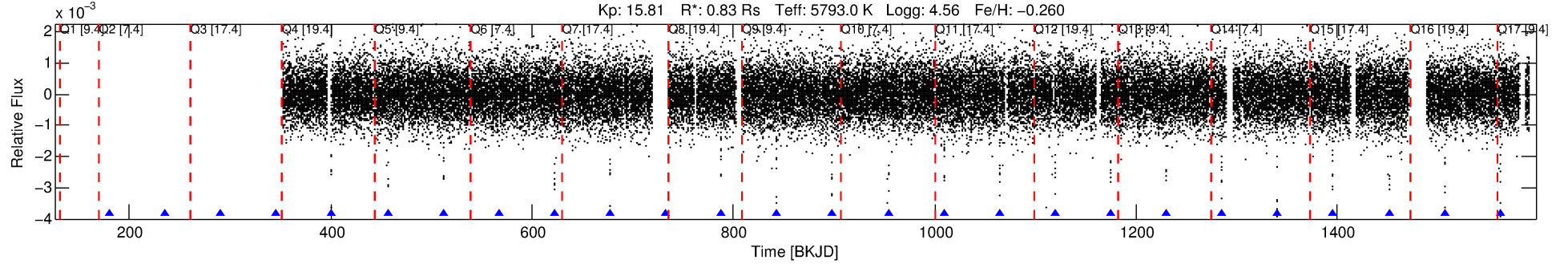
## Ephemeris Match Information For 004150390-02

No Significant Match Found

# DV One-Page Summary

KIC: 4150390 Candidate: 2 of 2 Period: 55.252 d  
KOI: K01768 Corr: No Ephemeris Match

Kp: 15.81 R\*: 0.83 Rs Teff: 5793.0 K Logg: 4.56 Fe/H: -0.260



## DV Fit Results:

Period = 55.25167 [0.00021] d  
Epoch = 180.3194 [0.0035] BKJD  
Rp/R\* = 0.0583 [0.0013]  
a/R\* = 41.30 [2.38]  
b = 0.92 [0.01]  
Seff = 9.16 [3.47]  
Teq = 444 [42] K  
Rp = 5.29 [1.52] Re  
a = 0.2761 [0.0671] AU  
Ag = 384.72 [159.05] [2.41σ]  
Teff = 3038 [189] K [13.43σ]

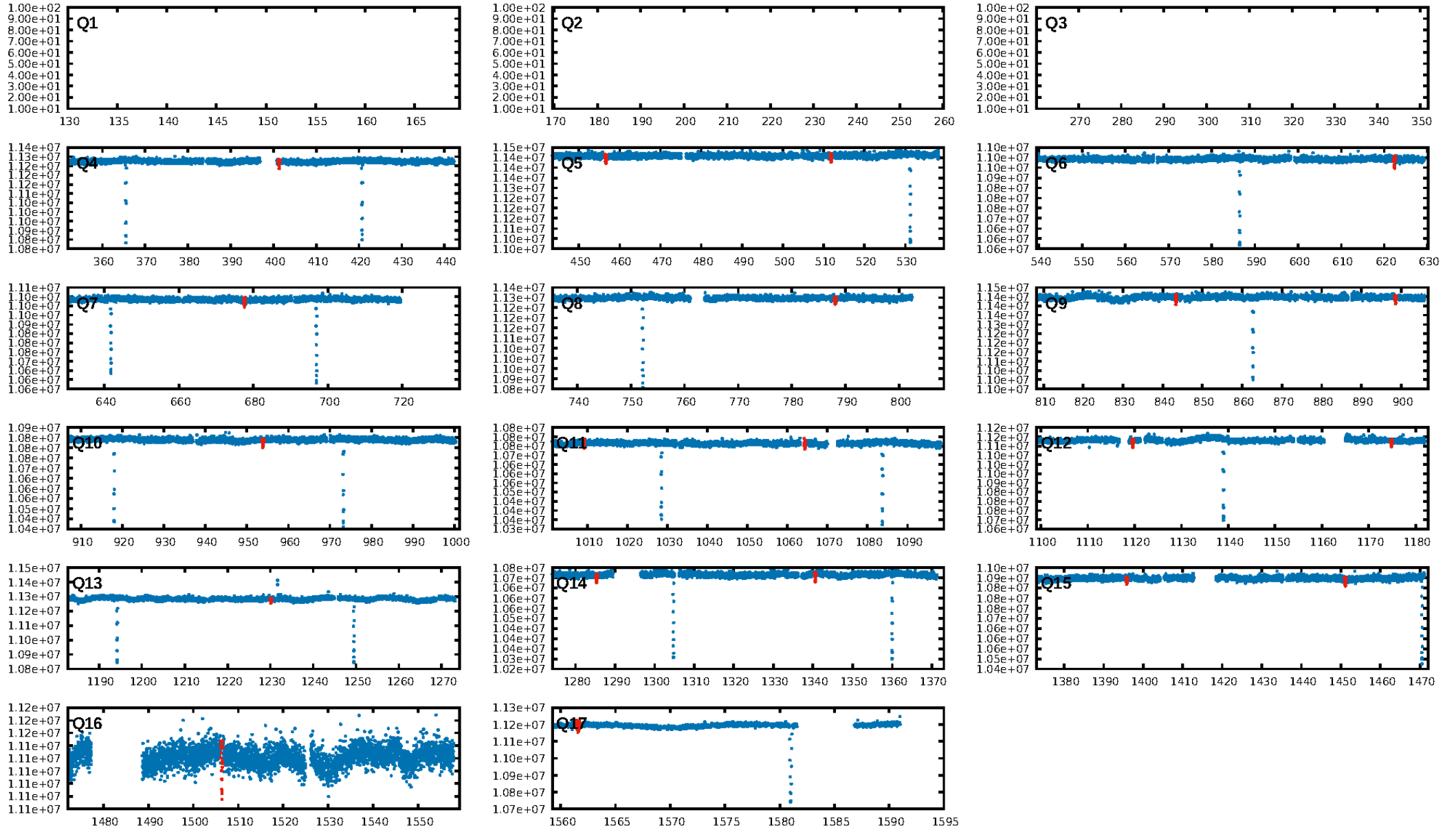
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 0.0% [0.00σ]  
ModelChiSquare2-sig: 69.1%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 1.00 [19/19]  
GhostDiagnostic-chr: 3.265  
Centroid-sig: 63.5%  
Centroid-so: 0.570 arcsec [1.98σ]  
OotOffset-rm: 0.146 arcsec [1.29σ]  
KicOffset-rm: 0.355 arcsec [2.53σ]  
OotOffset-st: 3/3/3/4 [13]  
KicOffset-st: 3/3/3/4 [13]  
DiffImageQuality-fgm: 1.00 [13/13]  
DiffImageOverlap-fno: 1.00 [13/13]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 17:30:40 Z

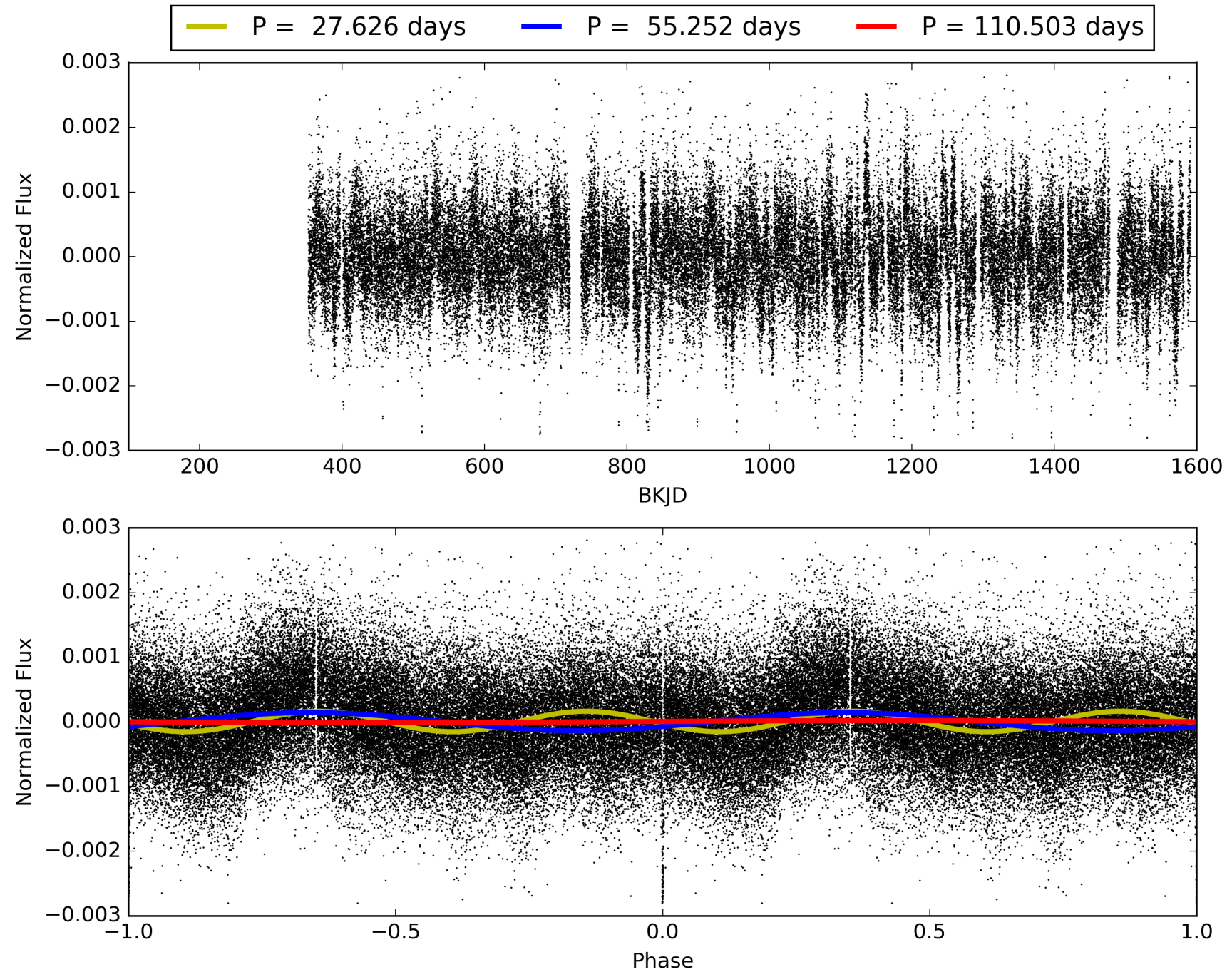
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 004150390-02, PDC Light Curves





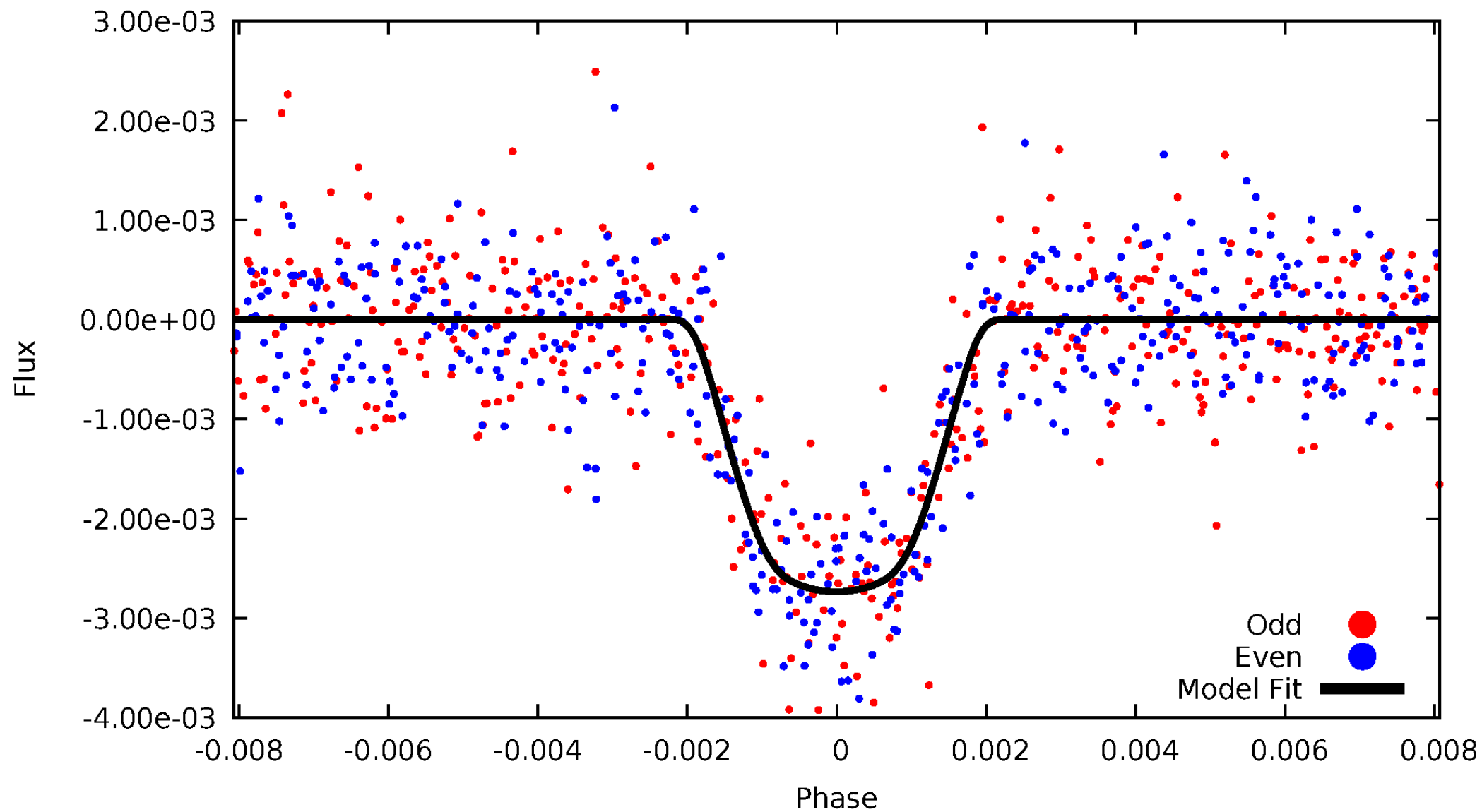
# TCE 004150390-02





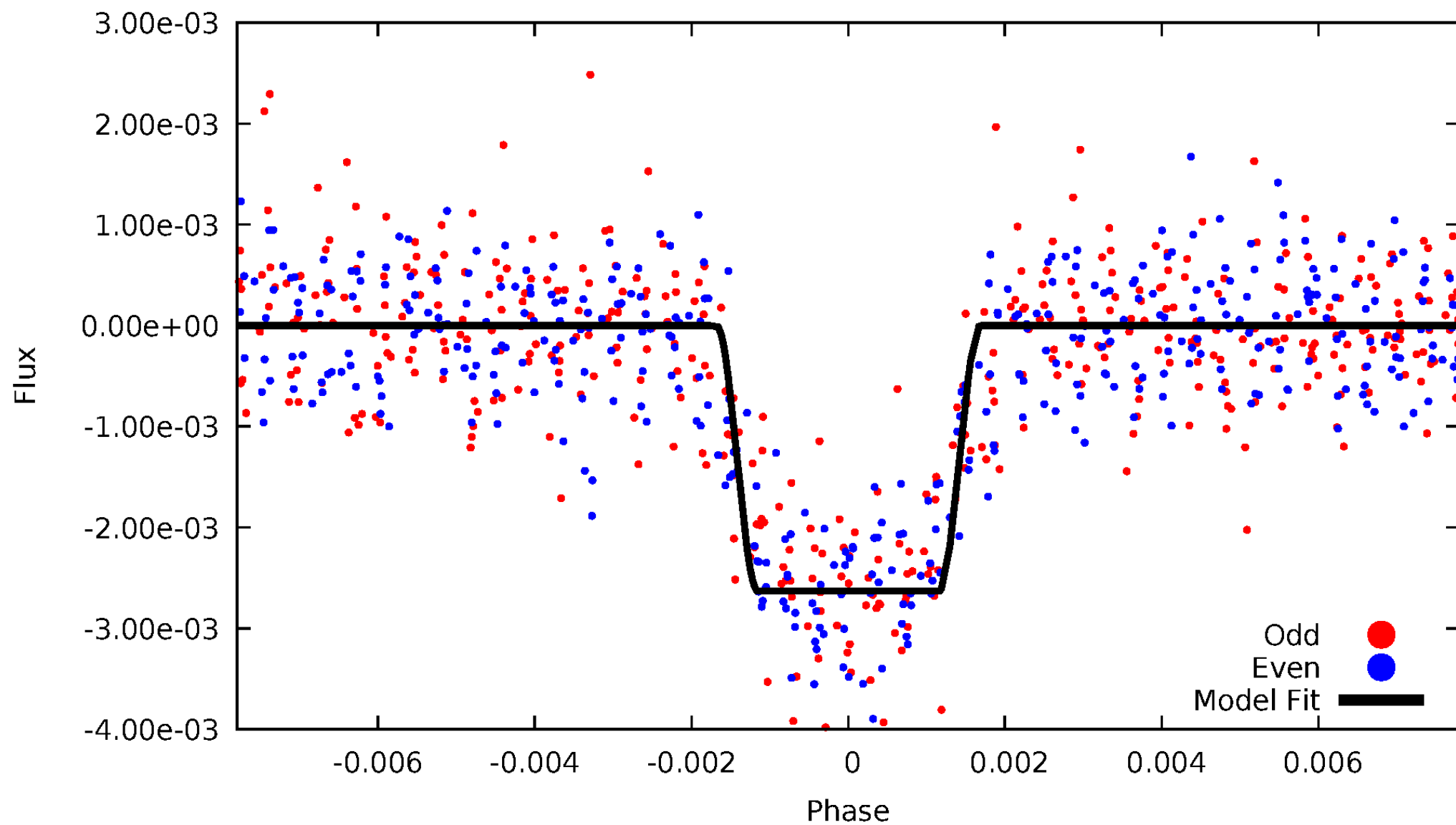
# DV Odd/Even

TCE 004150390-02



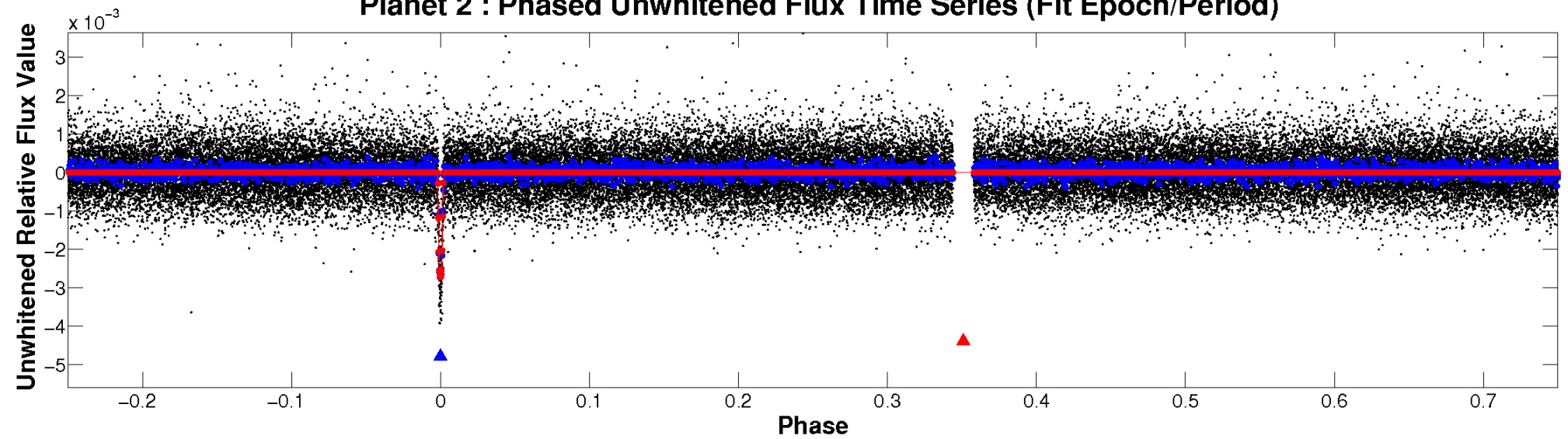
# ALT Odd/Even

TCE 004150390-02

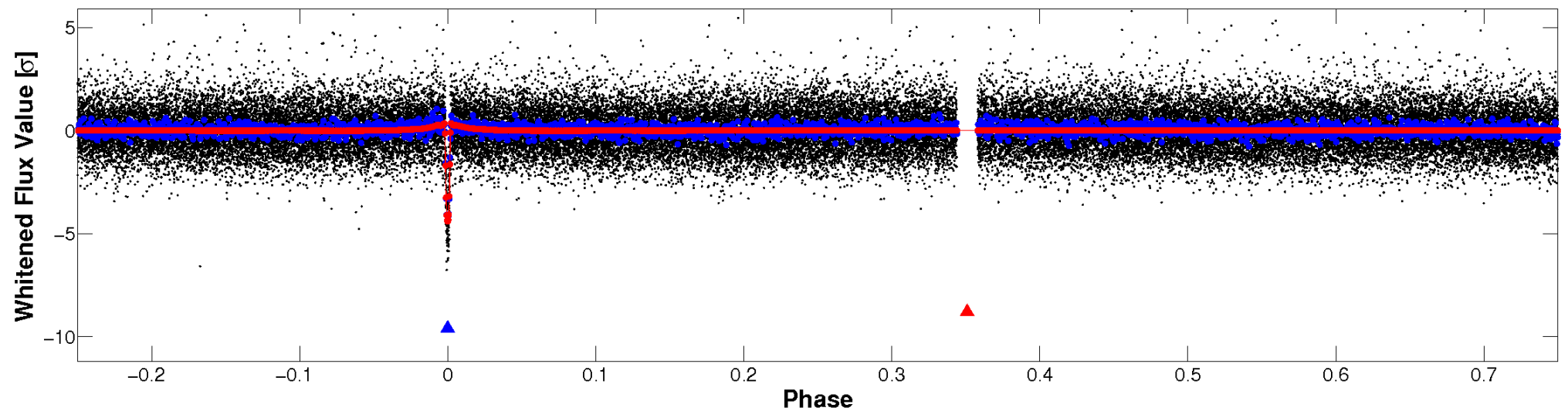


# Non-Whitened Vs. Whitened Light Curve

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

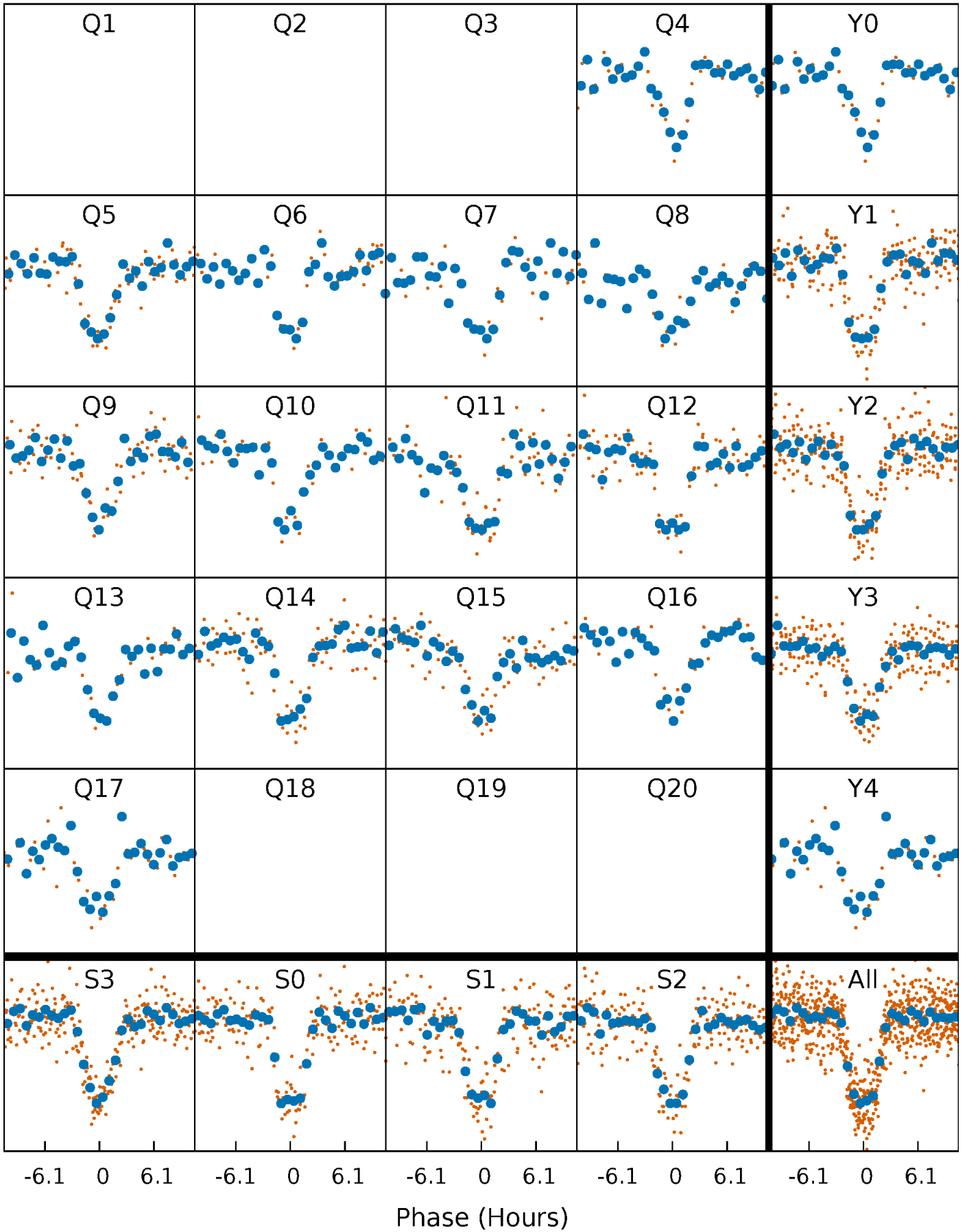


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



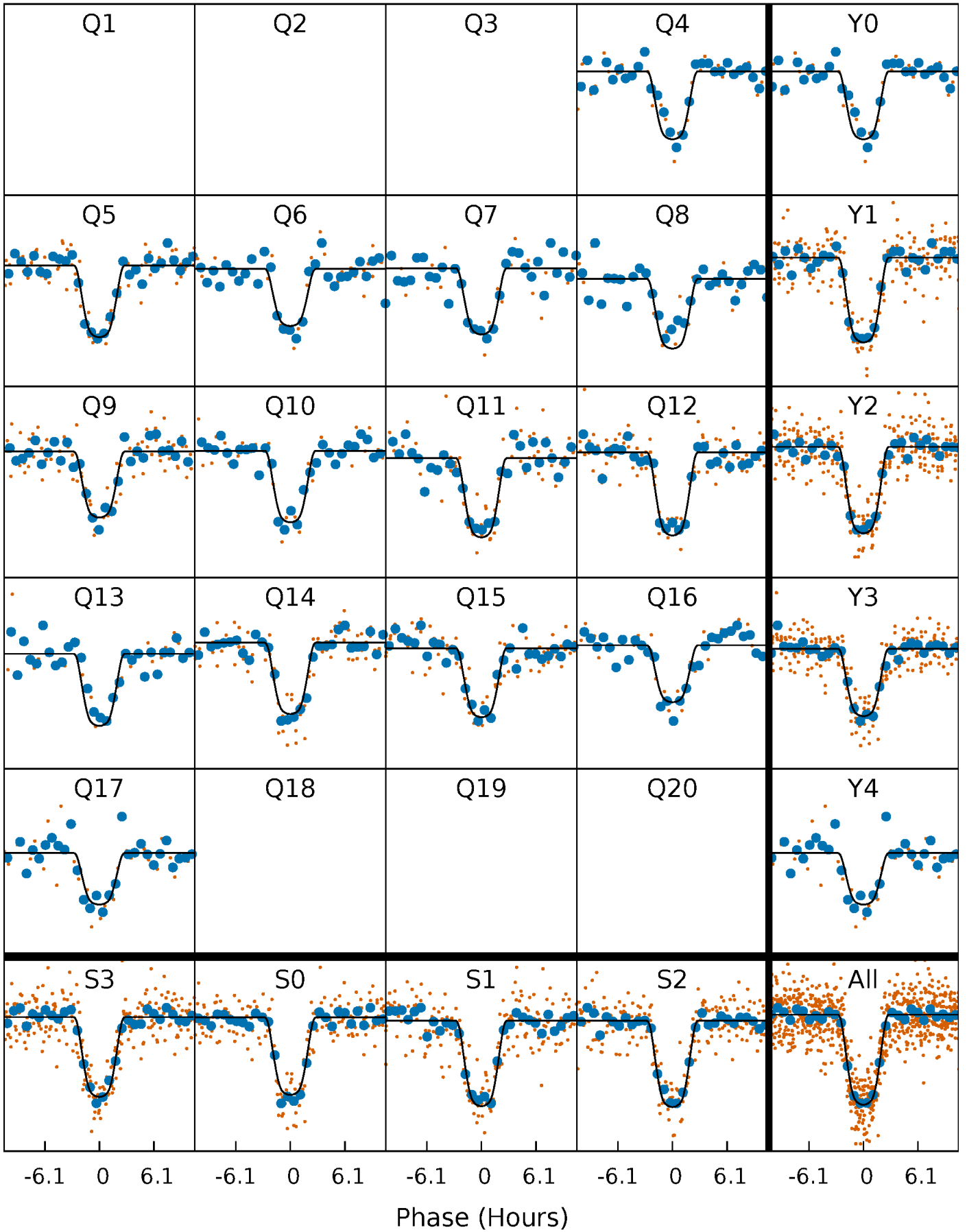
# PDC Quarter-Phased Transit Curves

TCE 004150390-02     $P = 55.251673$  Days     $T_0 = 180.319440$  (BKJD)



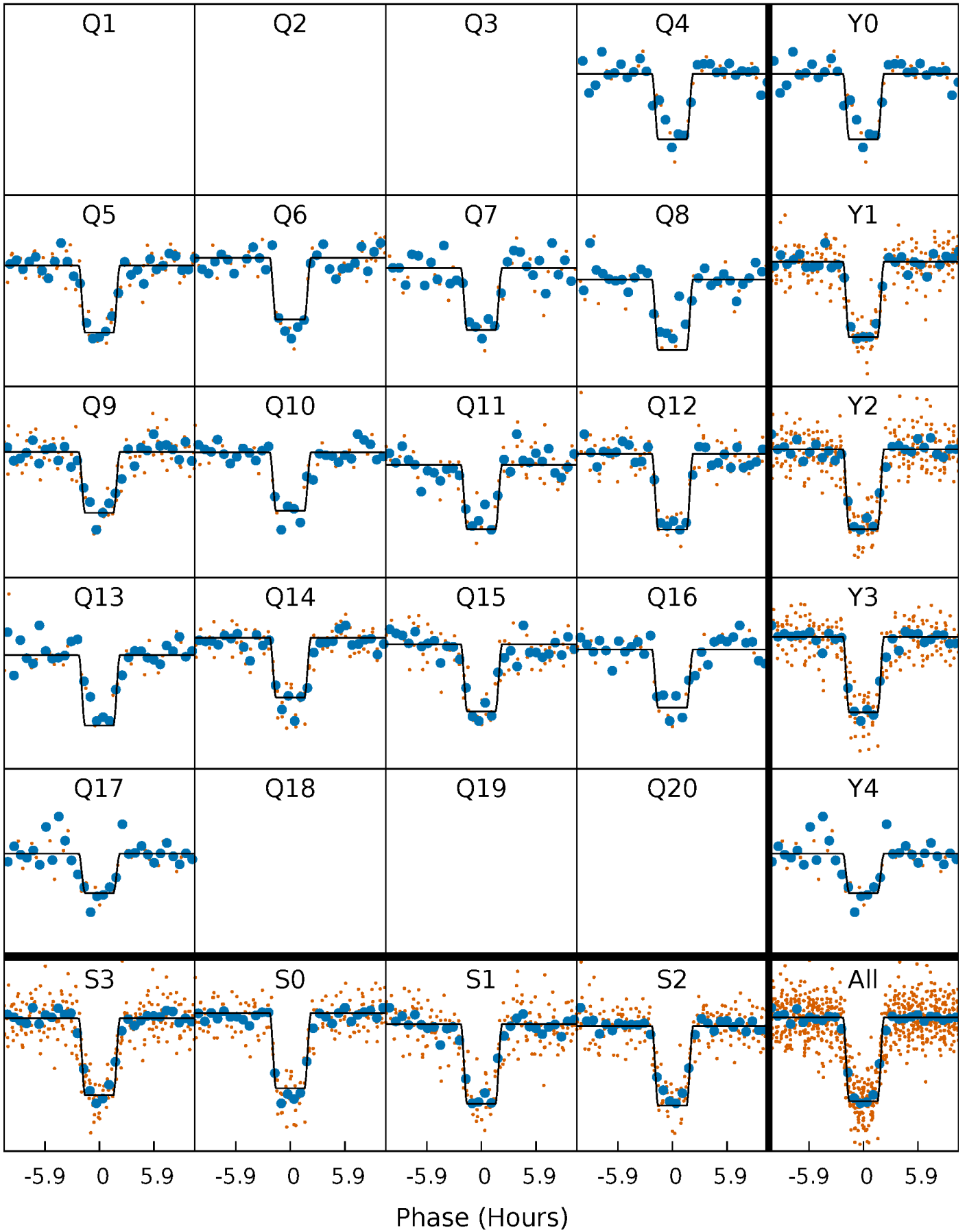
# DV Quarter-Phased Transit Curves

TCE 004150390-02   P= 55.251673 Days    $T_0=180.319440$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

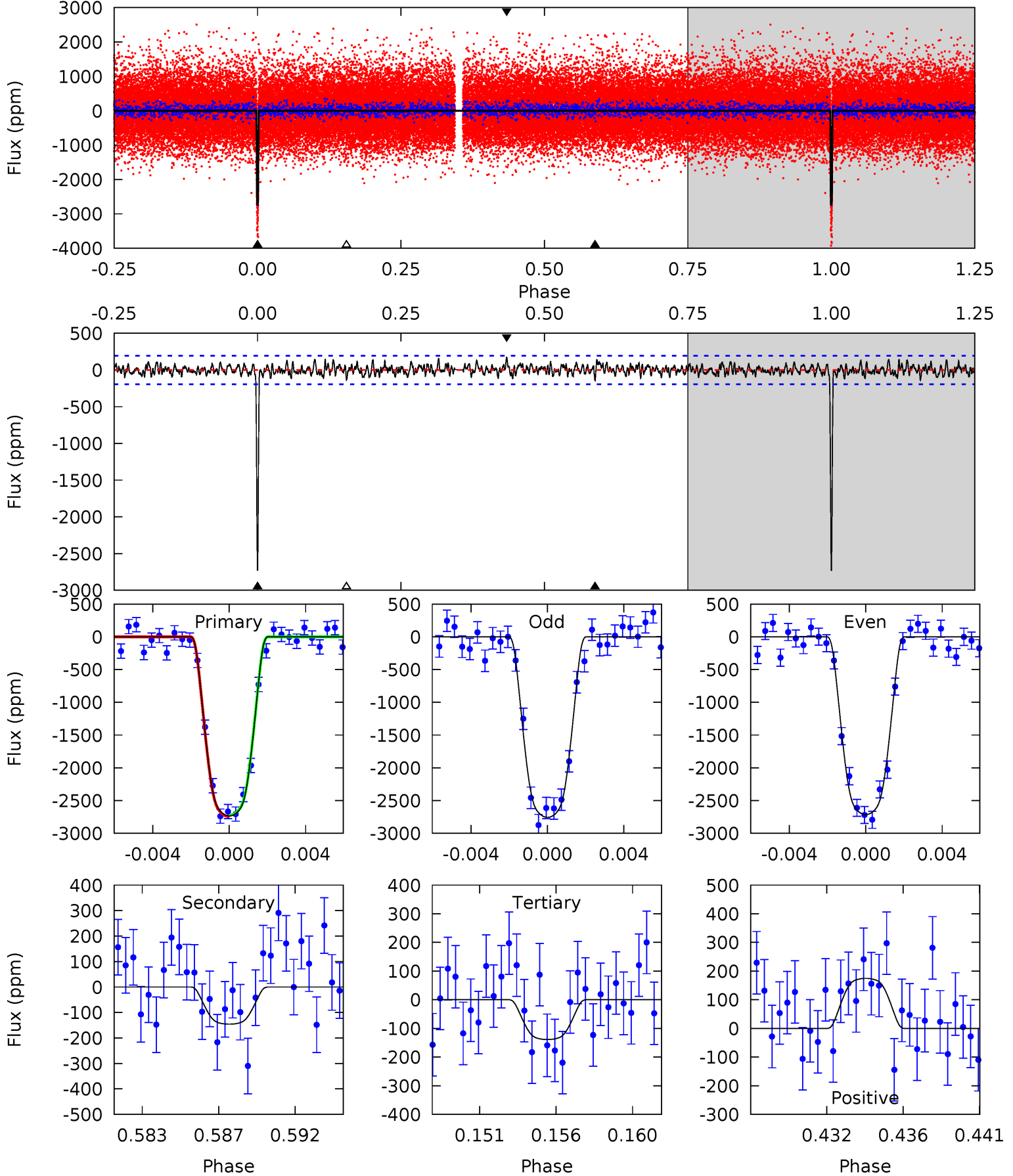
TCE 004150390-02   P= 55.251929 Days    $T_0=180.316578$  (BKJD)



# DV Model-Shift Uniqueness Test

004150390-02, P = 55.251673 Days, E = 180.319440 Days

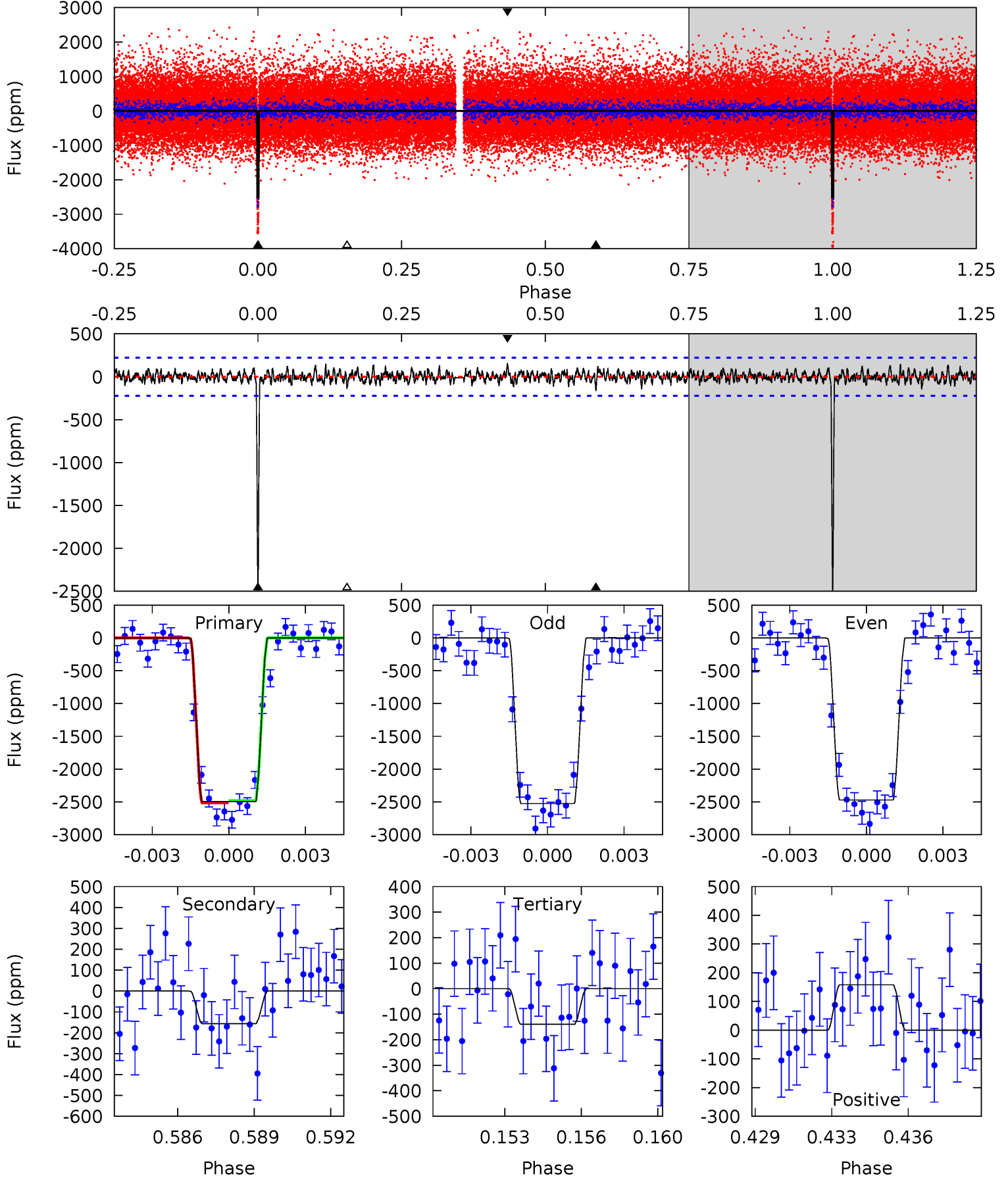
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
72.8	3.88	3.70	4.65	5.19	2.85	1.30	69.1	68.2	0.19	-0.77	0.58	1.01	0.06	0.29



# Alt Model-Shift Uniqueness Test

004150390-02, P = 55.251929 Days, E = 180.316578 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
59.0	3.71	3.30	3.73	5.23	2.94	1.03	55.7	55.2	0.40	-0.02	0.63	1.01	0.06	0.39





### Stellar Parameters For KIC 004150390

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M$ ( $M_{\odot}$ )	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5793^{+172}_{-189}$	$4.561^{+0.034}_{-0.195}$	$-0.260^{+0.300}_{-0.300}$	$0.832^{+0.239}_{-0.075}$	$0.921^{+0.098}_{-0.109}$	$2.251^{+0.432}_{-1.137}$
	+3%/-3%	+1%/-4%	+115%/-115%	+29%/-9%	+11%/-12%	+19%/-51%
Source	KIC0	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 004150390-02 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-146 \pm 38$	$5.45^{+0.84}_{-0.43}$	$634^{+39}_{-28}$	$3210^{+147}_{-135}$	$195^{+65}_{-58}$
Alt.	$-157 \pm 42$	$4.81^{+0.75}_{-0.34}$	$635^{+40}_{-28}$	$3375^{+143}_{-182}$	$267^{+88}_{-91}$

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

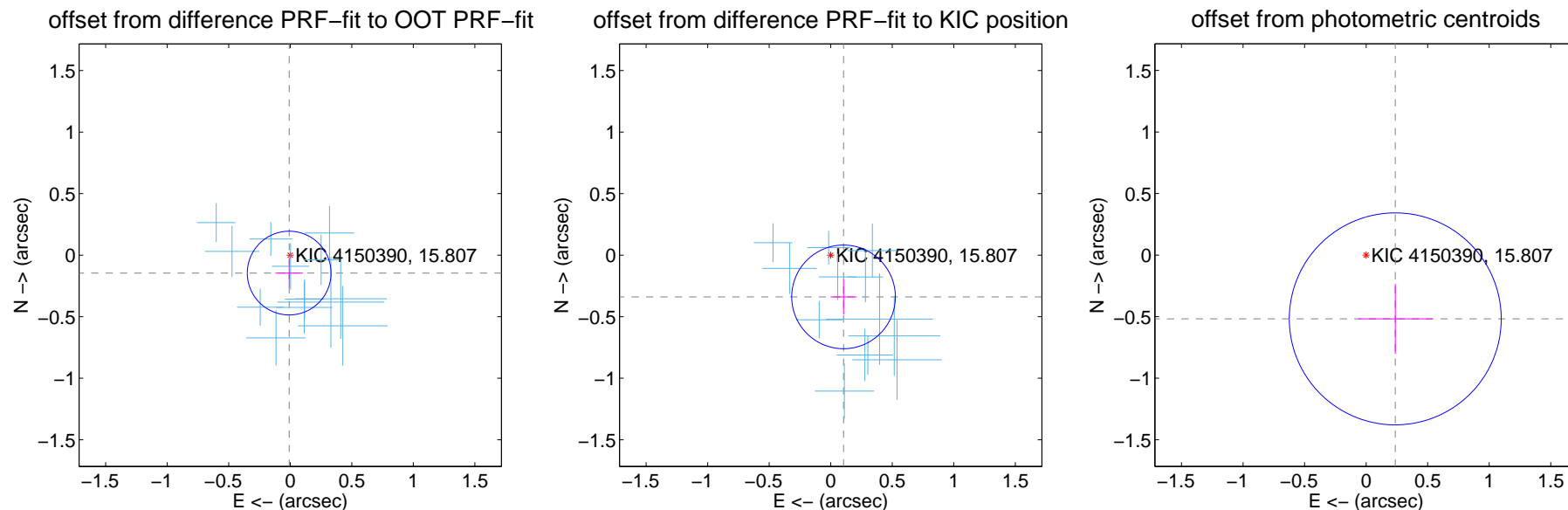
## DV Centroid Data

Supplemental centroid analysis for 004150390-02. Kepler magnitude: 15.81. Transit SNR 47.39

There are 13 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	$0.146 \pm 0.113$	1.29	$0.009 \pm 0.112$	$-0.146 \pm 0.113$
PRF-fit source offset from KIC position	$0.355 \pm 0.140$	2.53	$-0.104 \pm 0.105$	$-0.339 \pm 0.143$
photometric centroid source offset	$0.57 \pm 0.29$	1.98	$-0.24 \pm 0.30$	$-0.52 \pm 0.28$

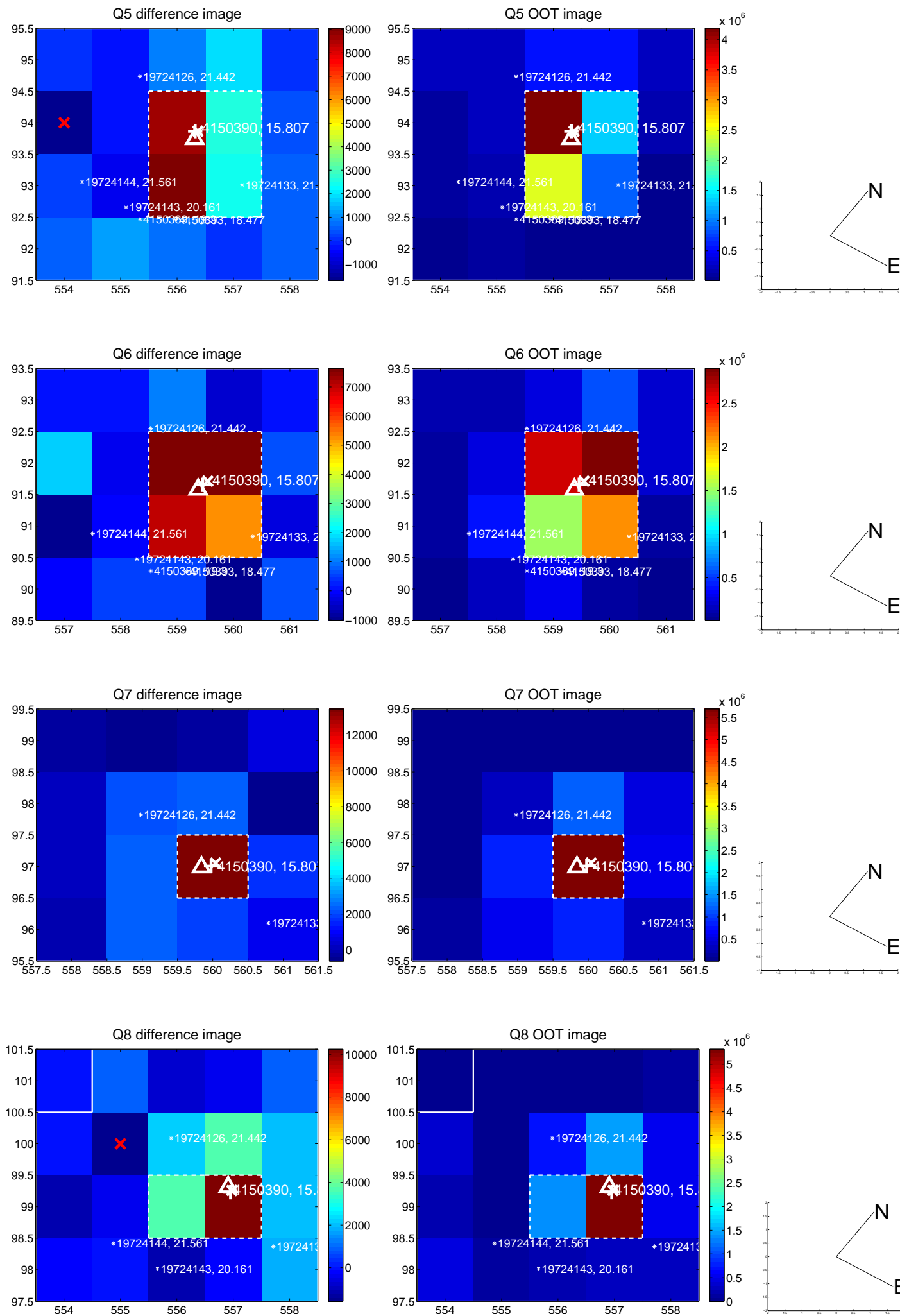


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

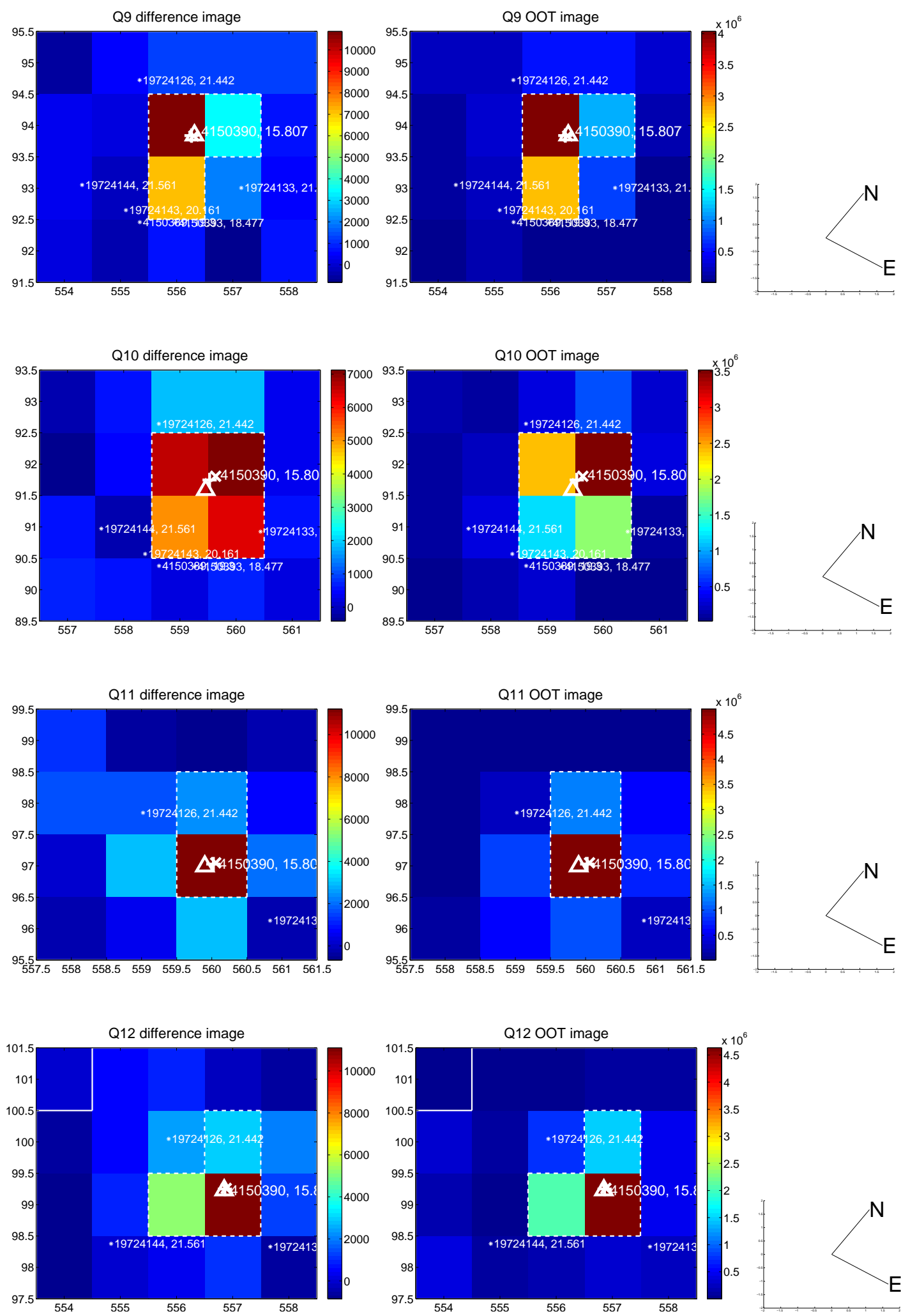
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



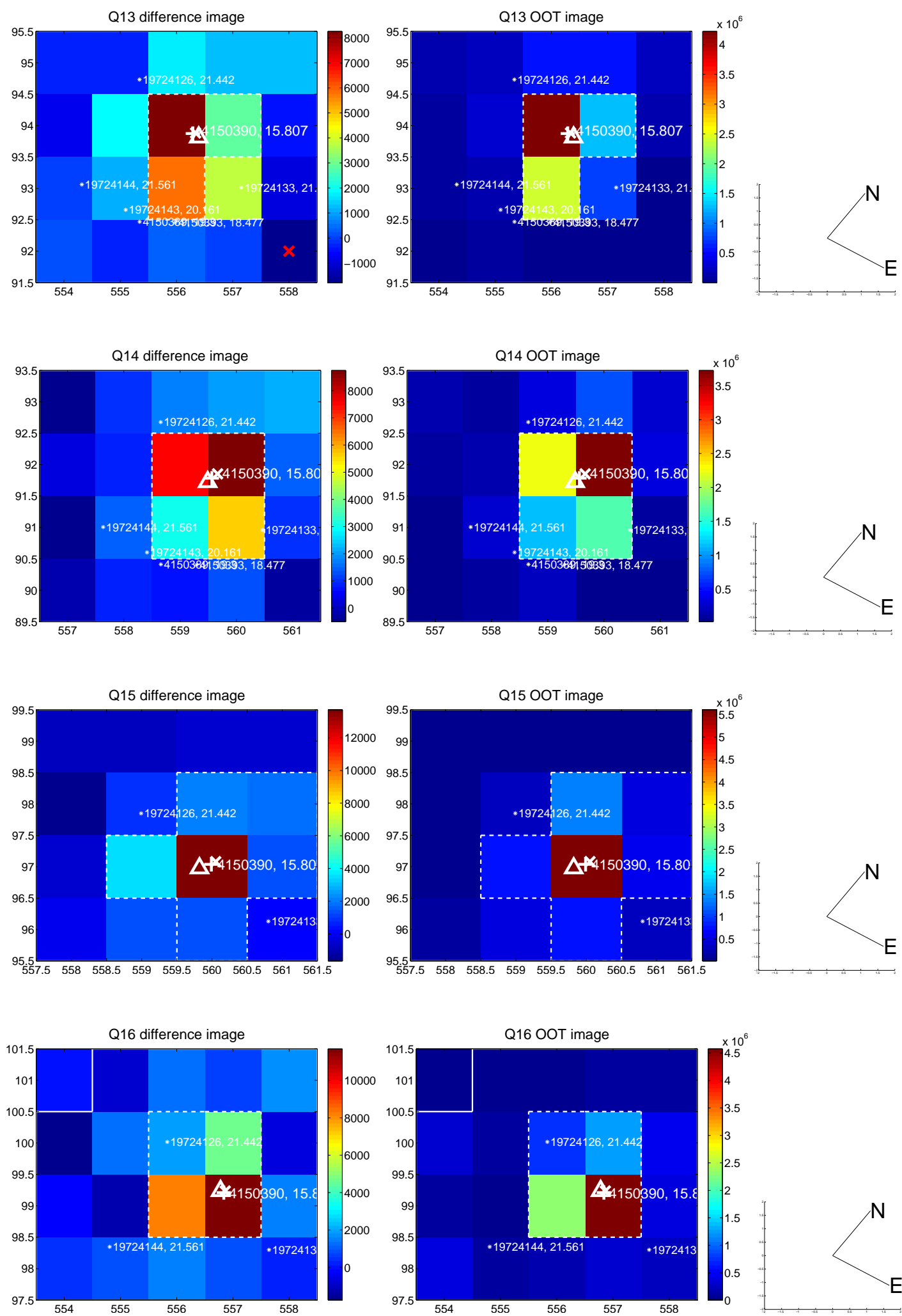
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



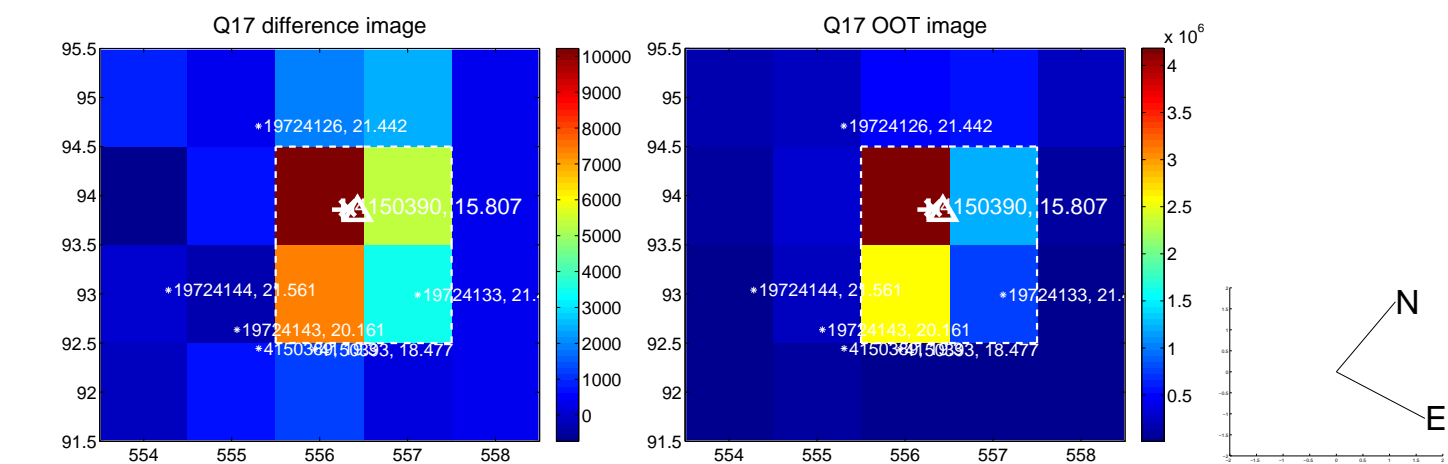
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



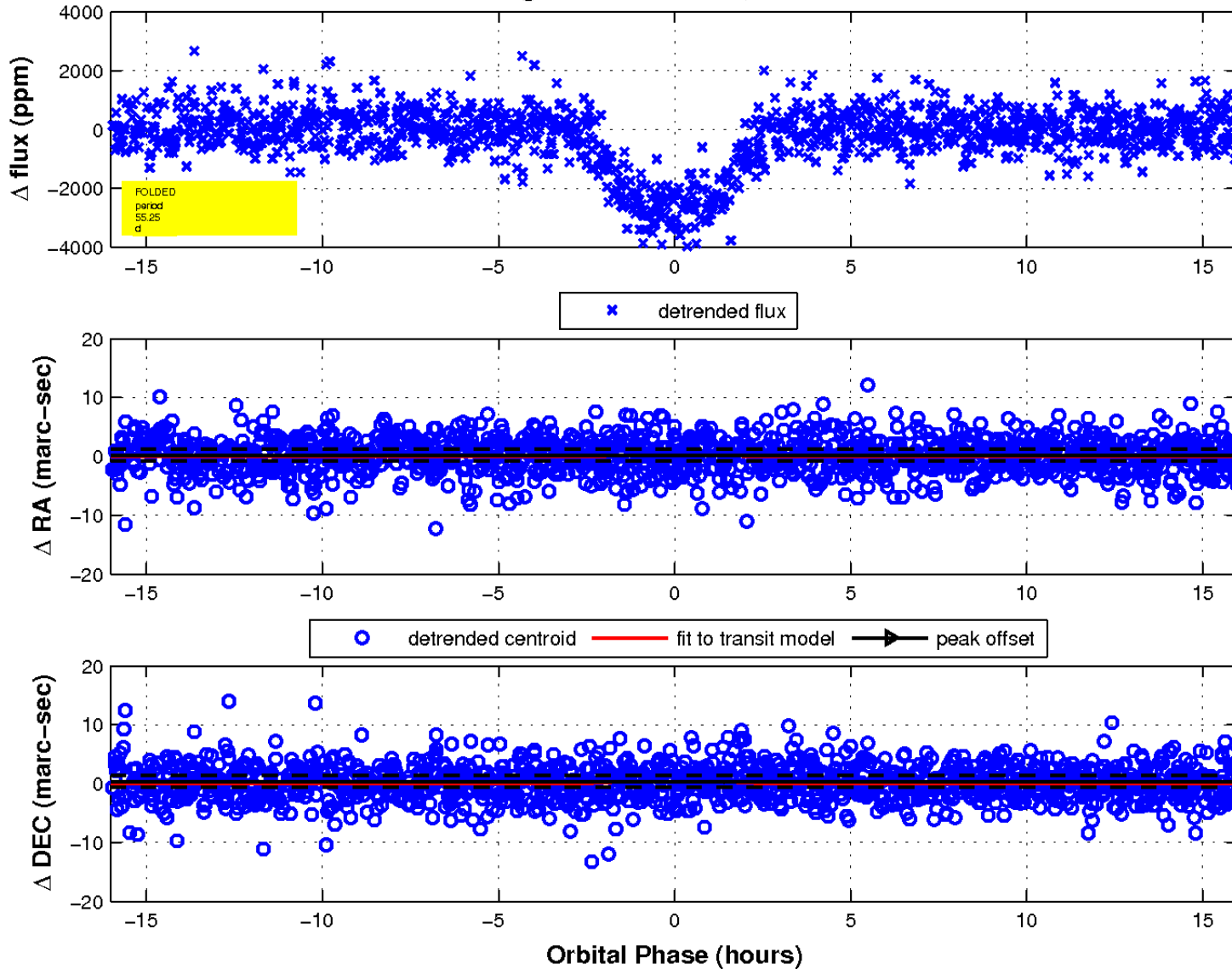
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

Declination

