

# KIC 008398221

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
008398221-01	OBS	No	3.956598	133.070469	169.0	14.656	7.8	8.9	0.55	3964	0.79	41.21
008398221-02	OBS	No	301.468936	346.453234	1801.3	22.286	10.0	9.5	0.55	3964	2.64	0.13

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
008398221-01	OBS	FP	0.00	1	0	0	0	LPP_DV—MOD_NONUNIQ_DV
008398221-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL_SKYE—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.

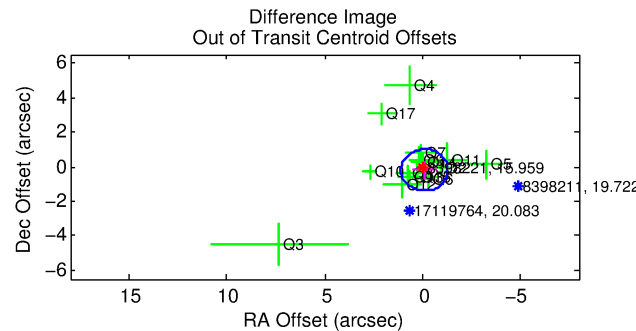
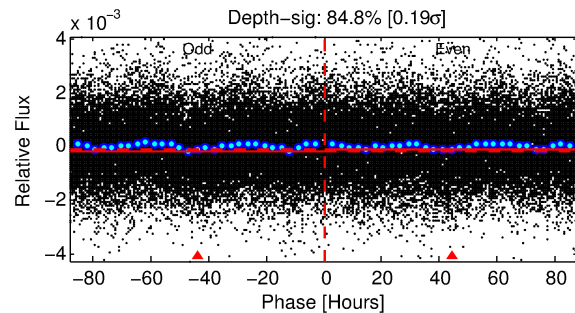
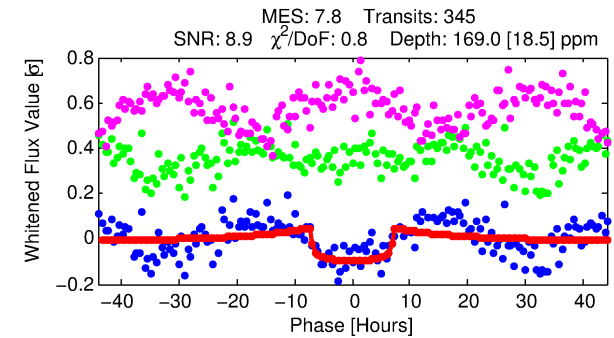
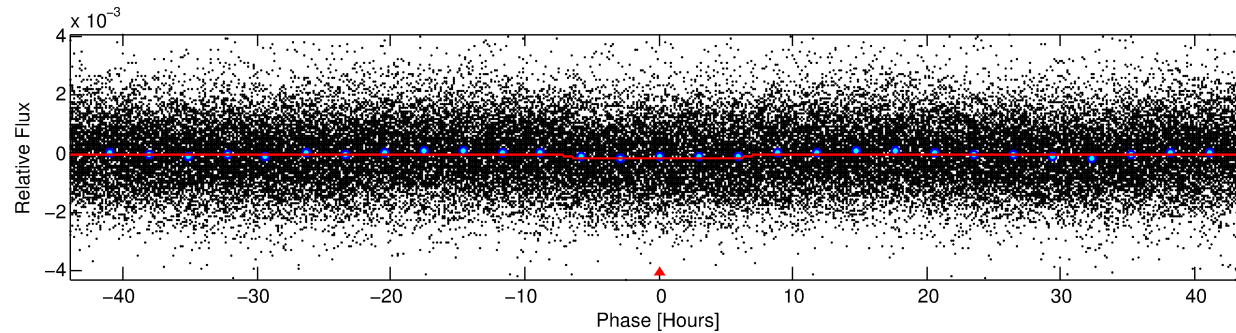
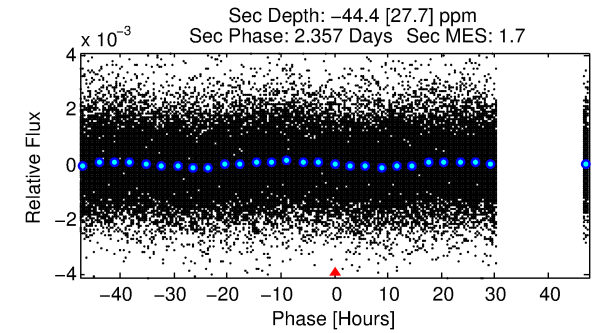
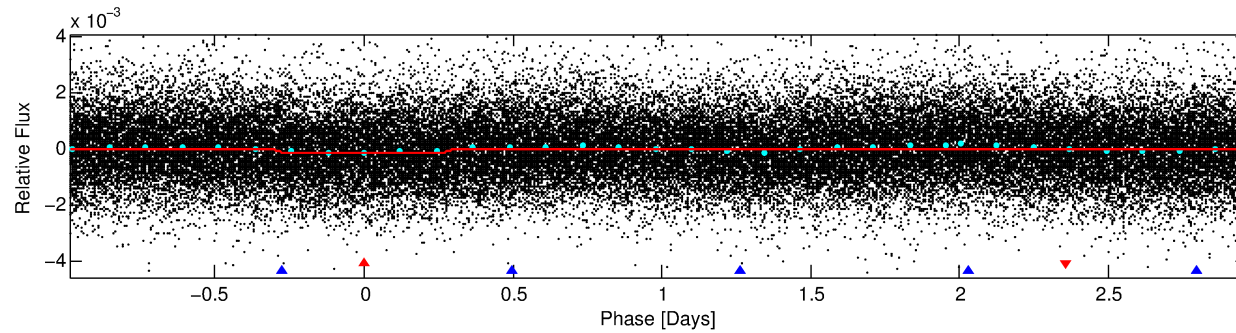
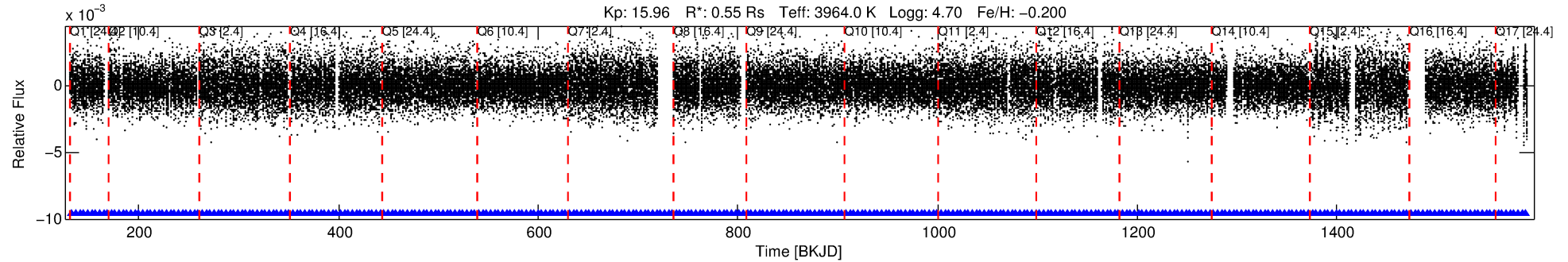
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 008398221-01

No Significant Match Found

# DV One-Page Summary

KIC: 8398221 Candidate: 1 of 2 Period: 3.957 d



## DV Fit Results:

Period = 3.95660 [0.00008] d  
Epoch = 133.0705 [0.0137] BKJD  
Rp/R\* = 0.0133 [0.0037]  
a/R\* = 1.54 [1.07]  
b = 0.81 [0.52]  
Seff = 41.21 [7.80]  
Teq = 646 [31] K  
Rp = 0.79 [0.25] Re  
a = 0.0401 [0.0045] AU  
Ag = N/A  
Teffp = N/A

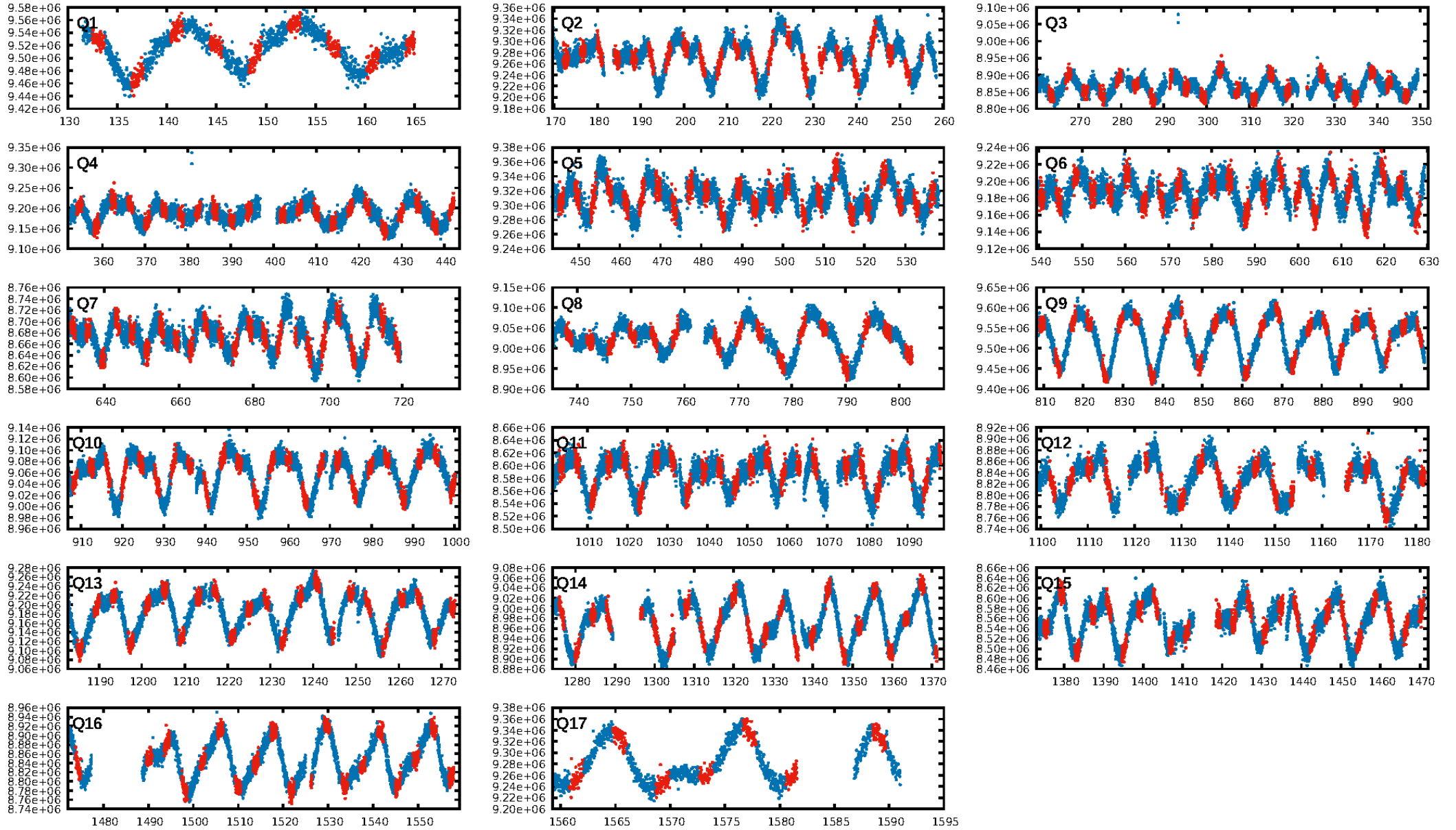
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [267.69σ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 2.53e-13  
RollingBand-fgt: 1.00 [329/329]  
GhostDiagnostic-chr: 1.225  
Centroid-sig: 48.3%  
Centroid-so: 1.332 arcsec [1.13σ]  
OotOffset-rm: 0.212 arcsec [0.53σ]  
KicOffset-rm: 0.121 arcsec [0.19σ]  
OotOffset-st: 4/4/3/4 [15]  
KicOffset-st: 4/4/3/4 [15]  
DiffImageQuality-fgm: 0.60 [9/15]  
DiffImageOverlap-fno: 1.00 [17/17]

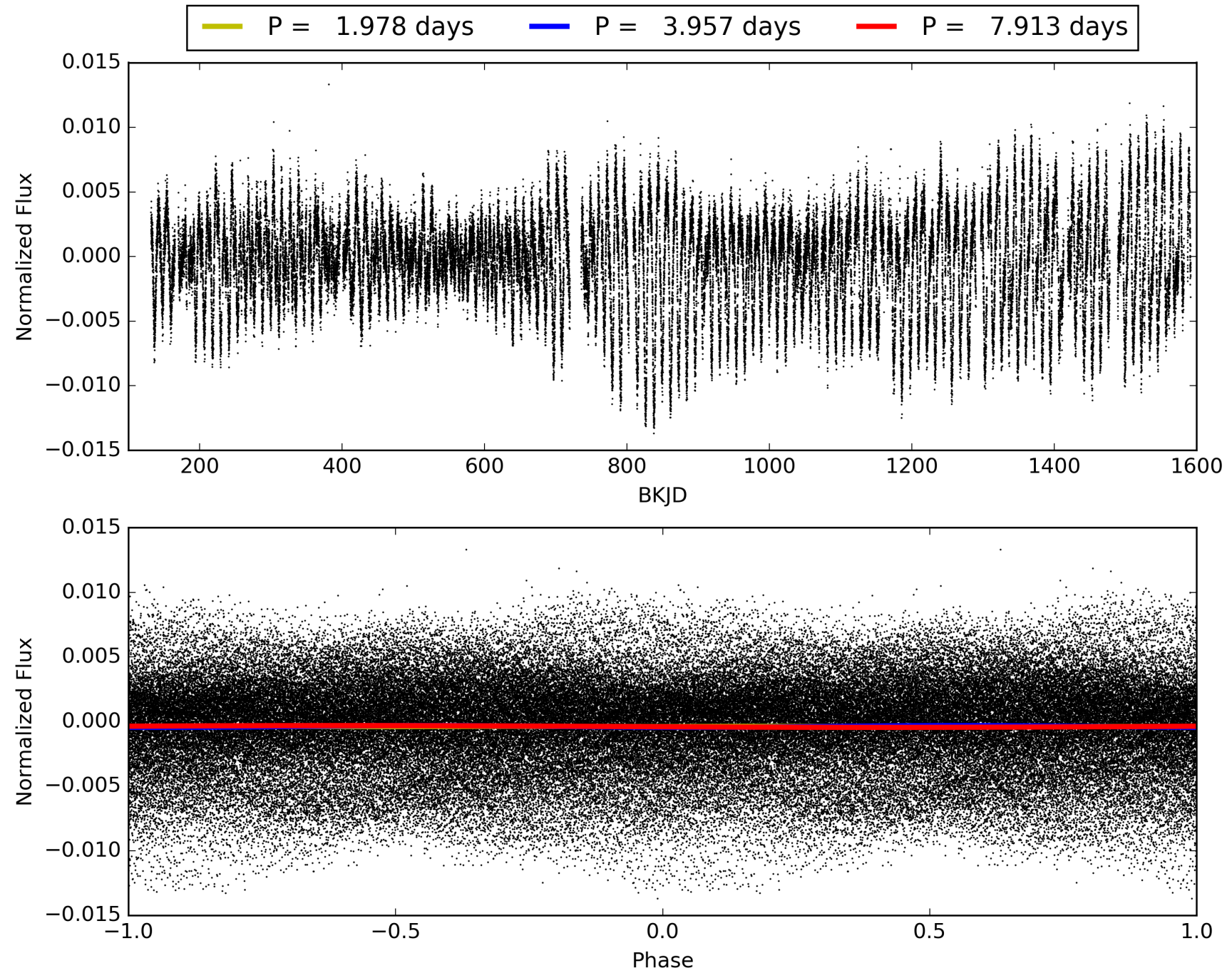
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 30-Jan-2016 08:26:25 Z

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

# TCE 008398221-01, PDC Light Curves



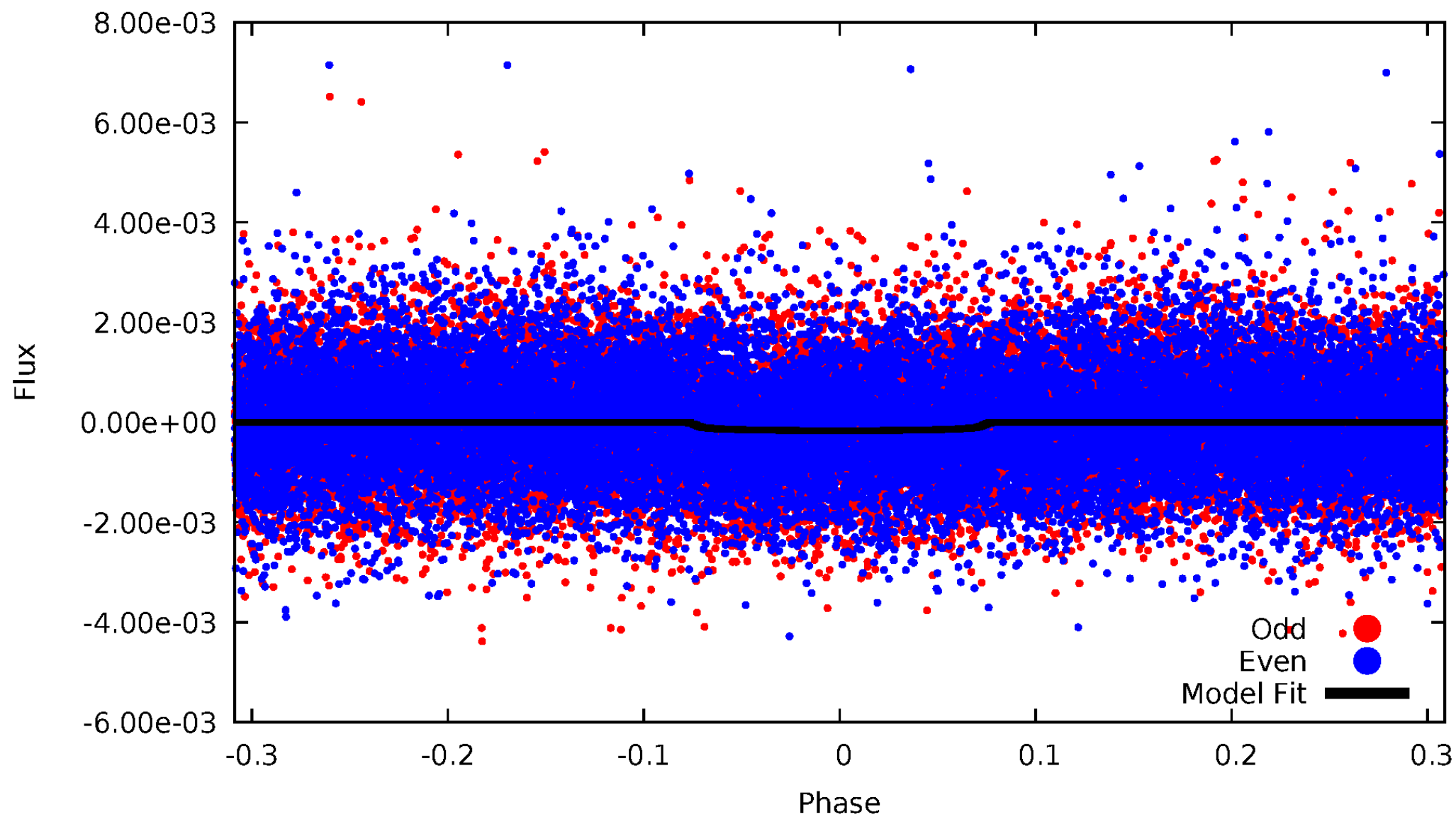
TCE 008398221-01





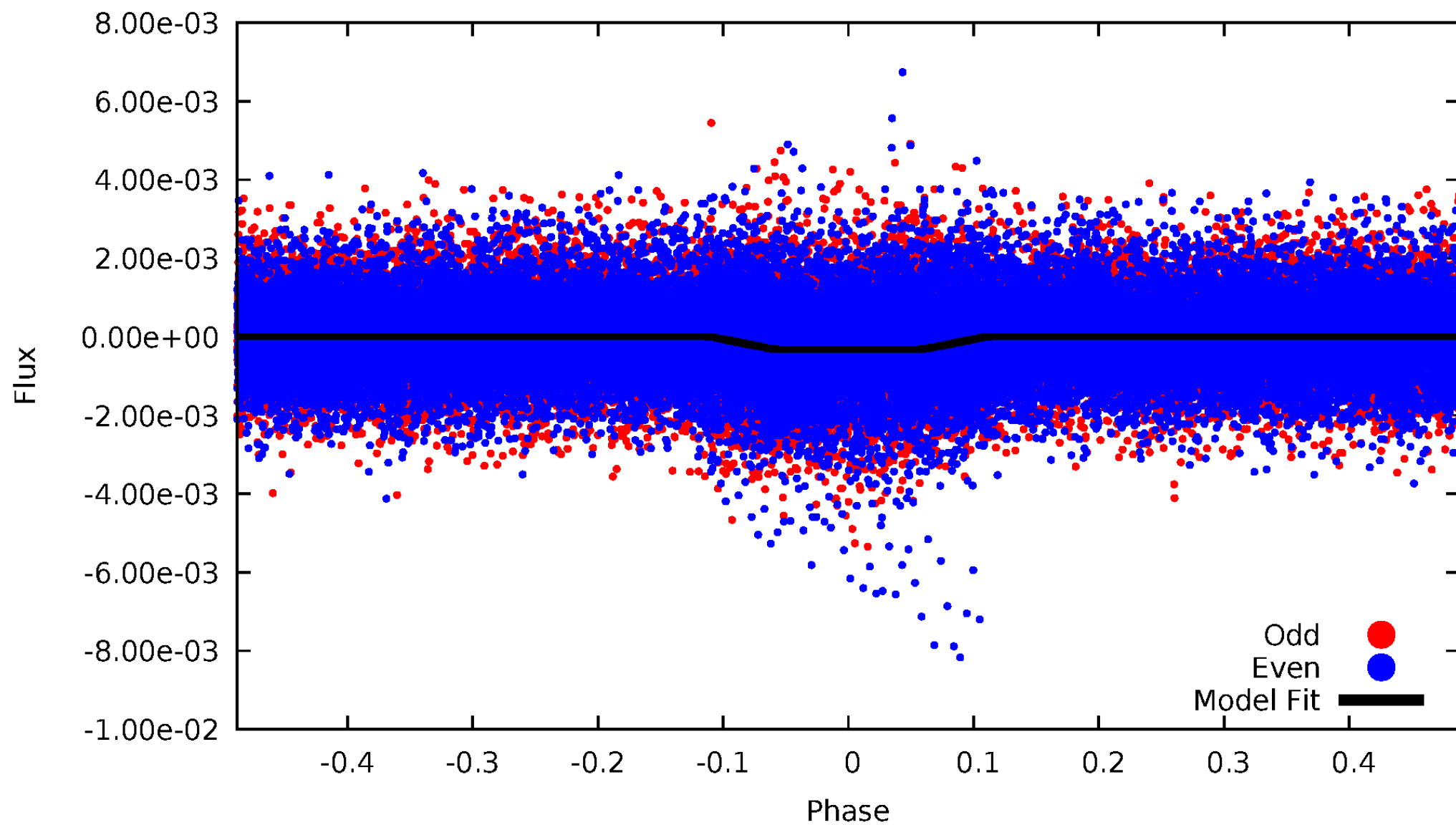
# DV Odd/Even

TCE 008398221-01

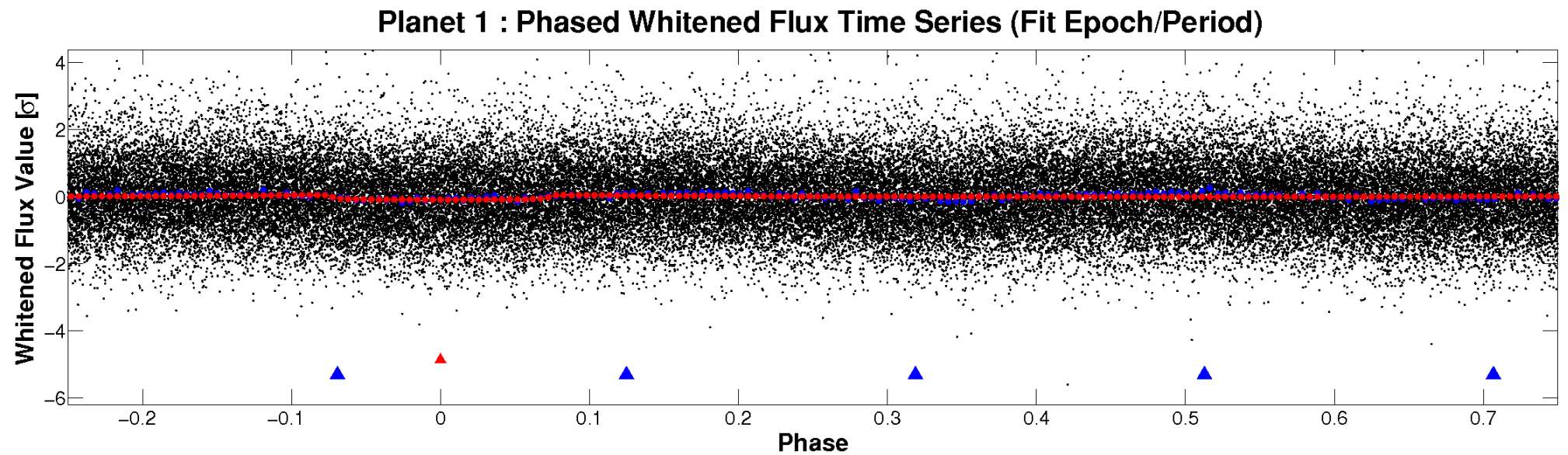
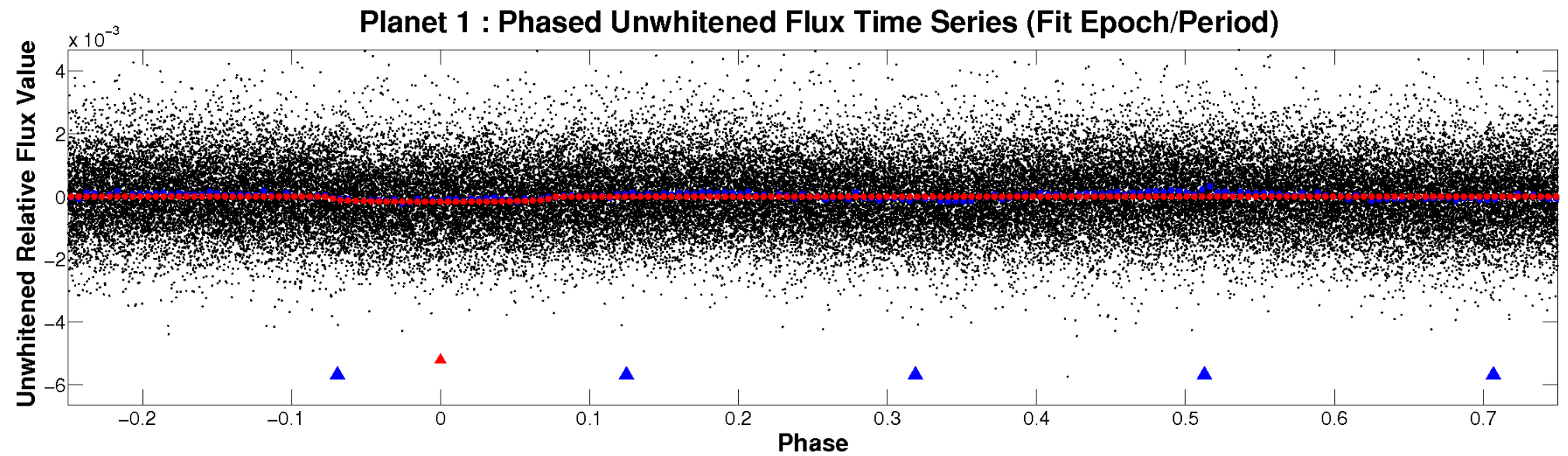


# ALT Odd/Even

TCE 008398221-01

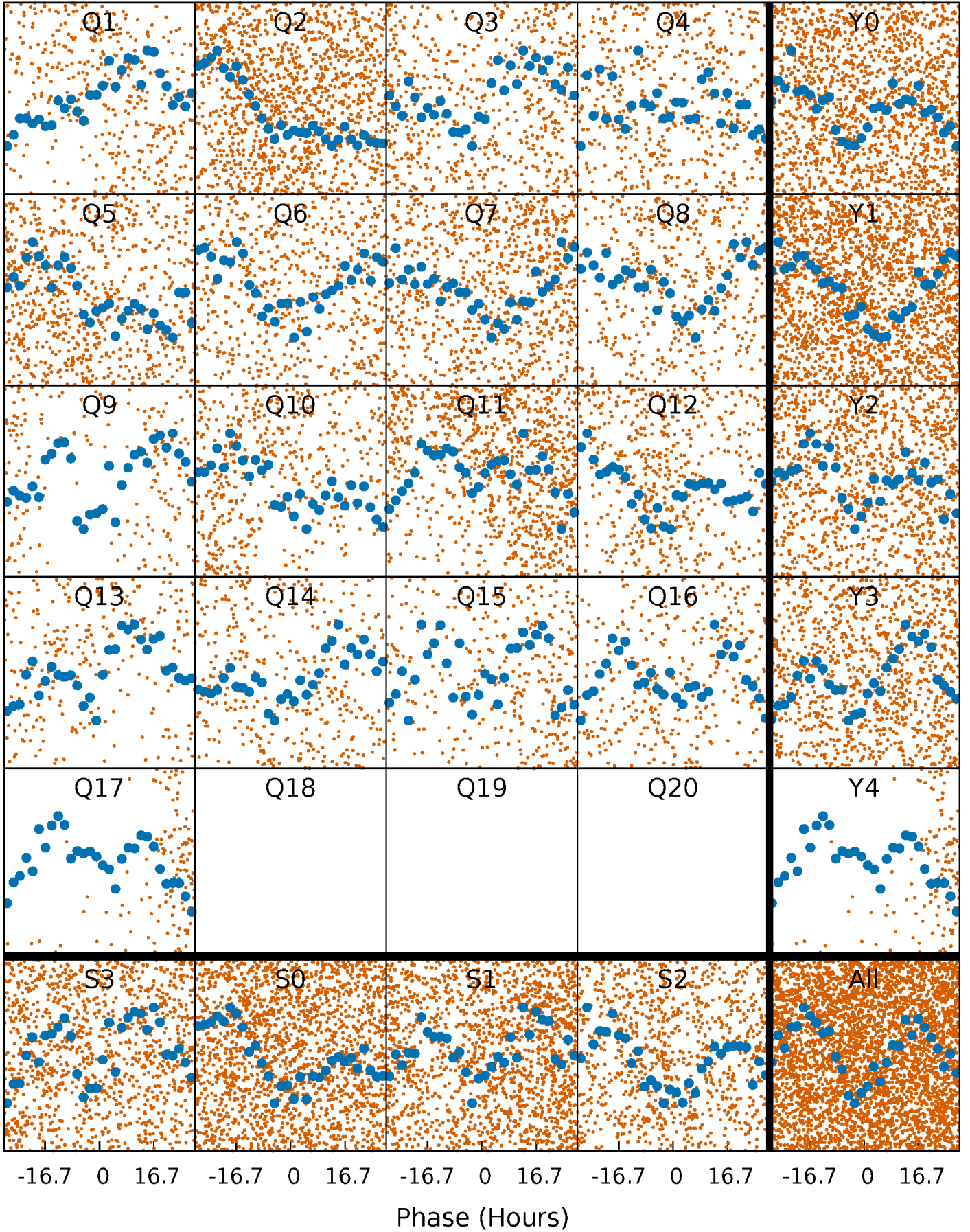


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

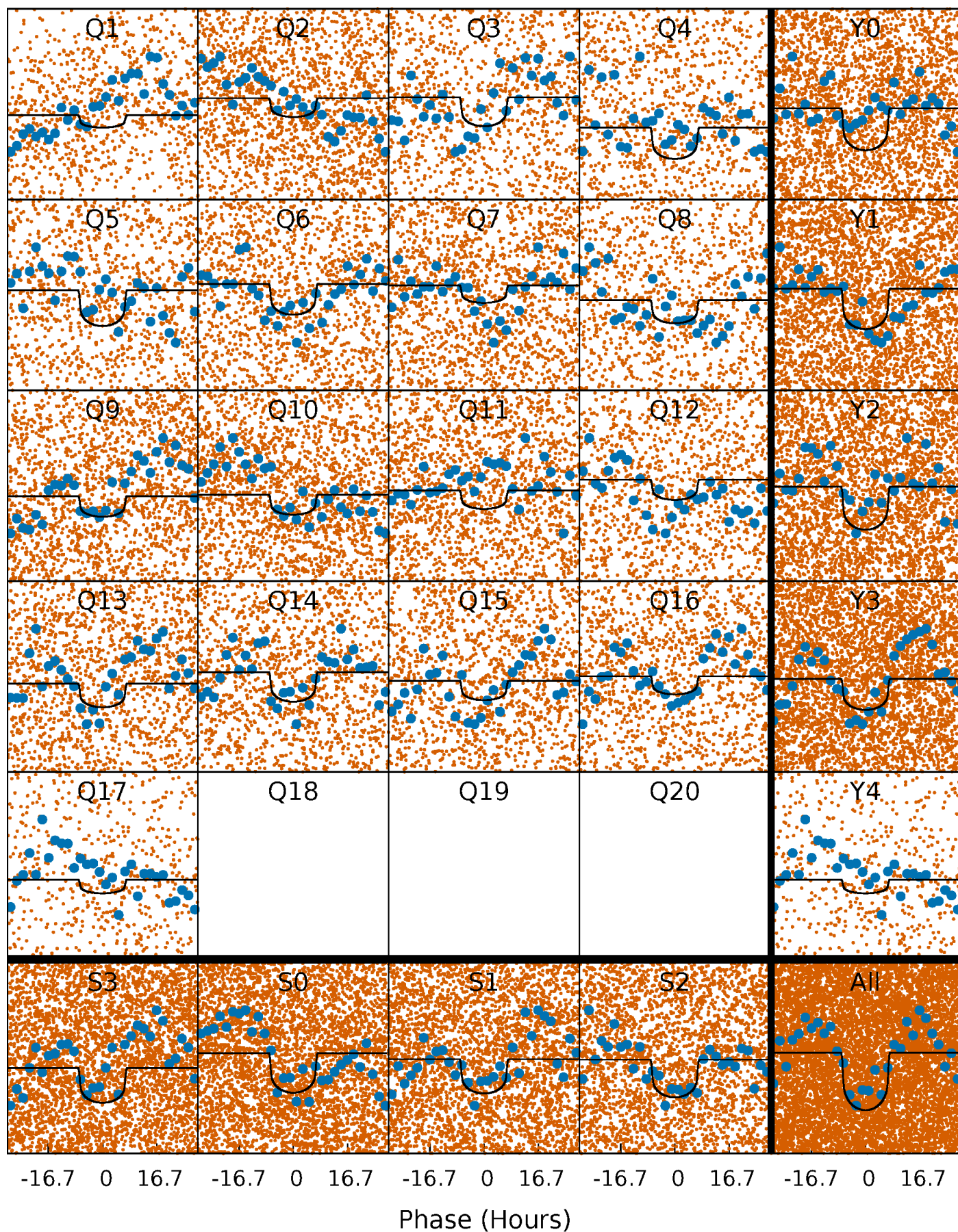
TCE 008398221-01 P= 3.956598 Days  $T_0=133.070469$  (BKJD)





# DV Quarter-Phased Transit Curves

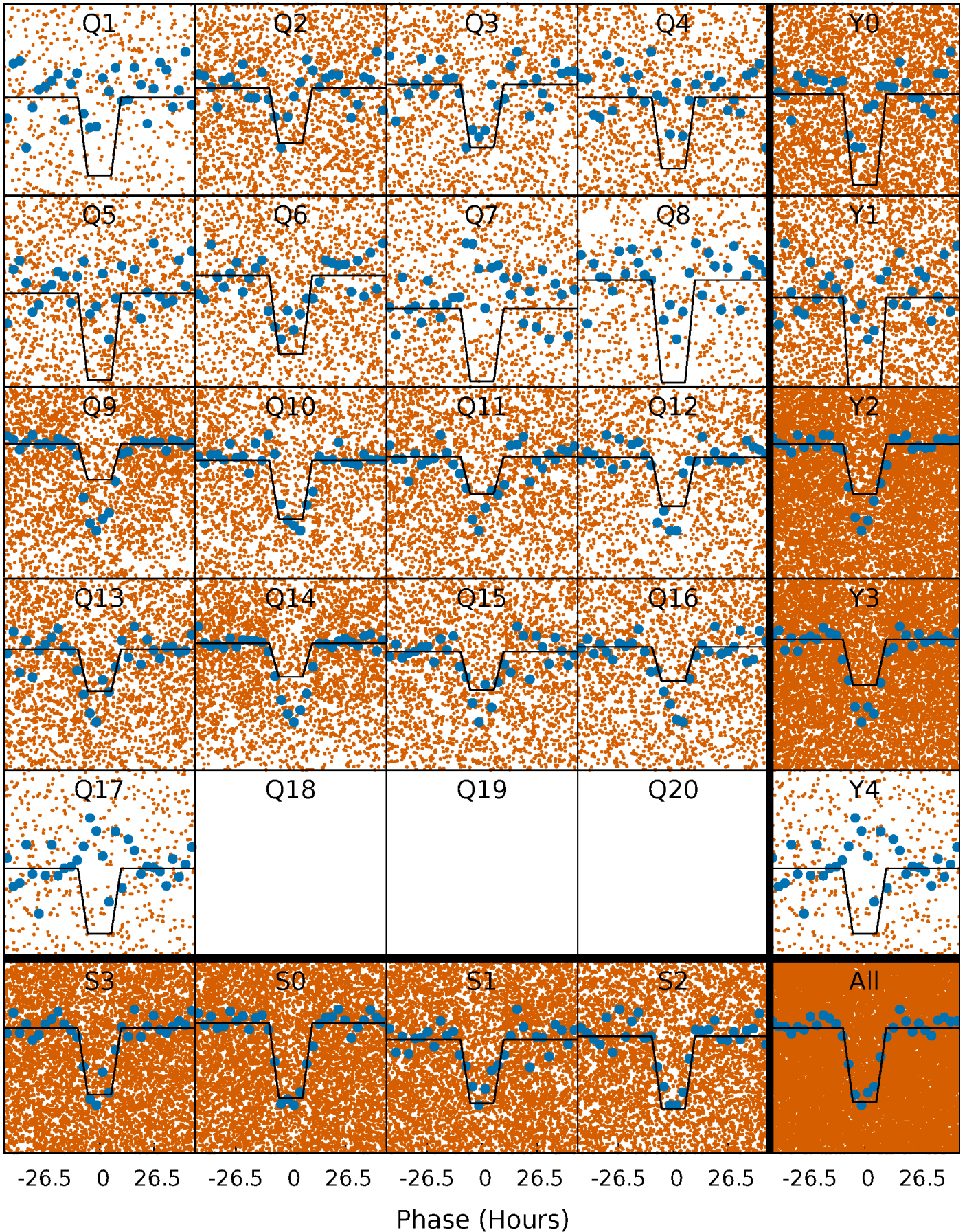
TCE 008398221-01 P= 3.956598 Days  $T_0=133.070469$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

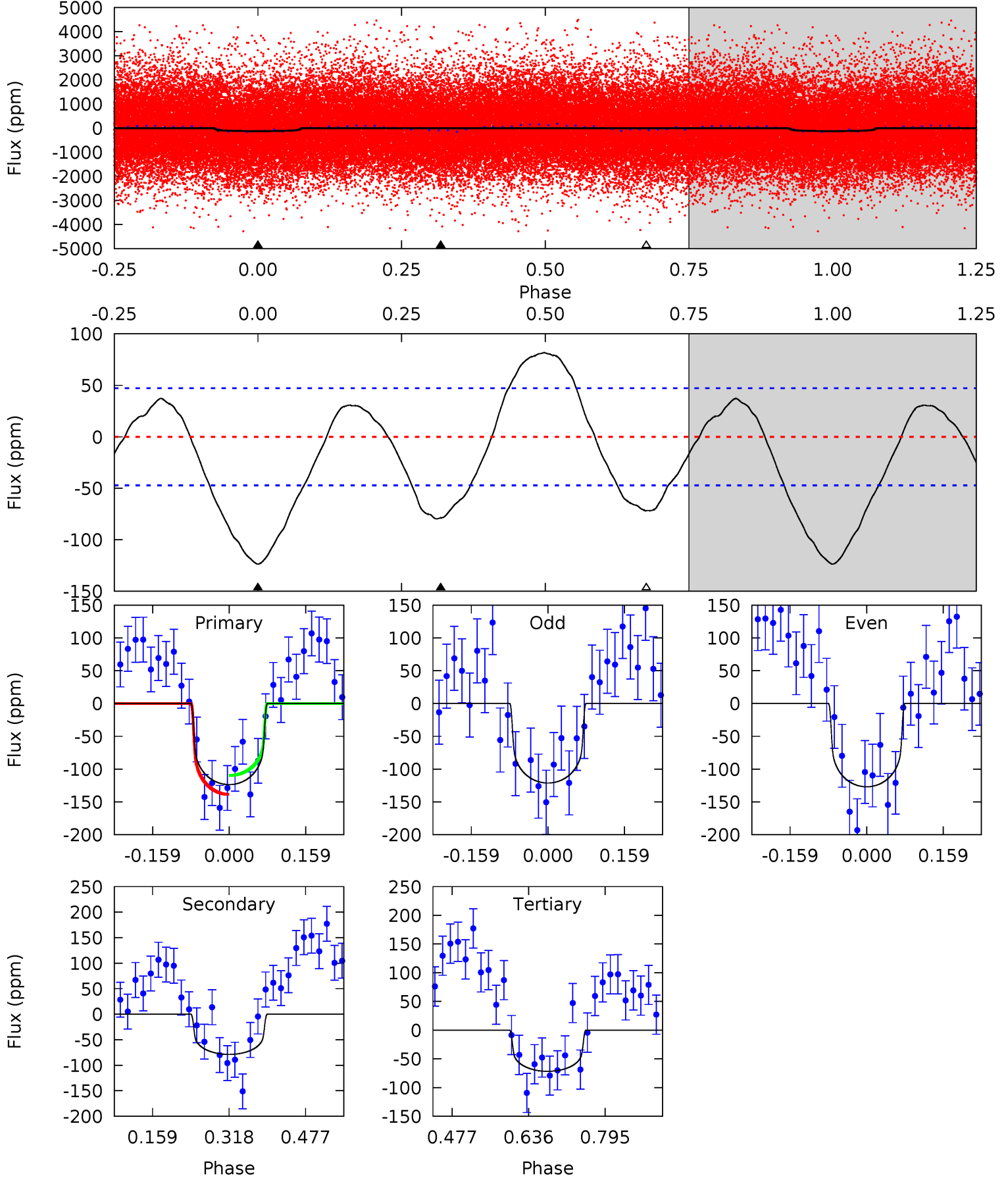
TCE 008398221-01 P= 3.956685 Days  $T_0=133.052650$  (BKJD)



# DV Model-Shift Uniqueness Test

008398221-01, P = 3.956598 Days, E = 129.113871 Days

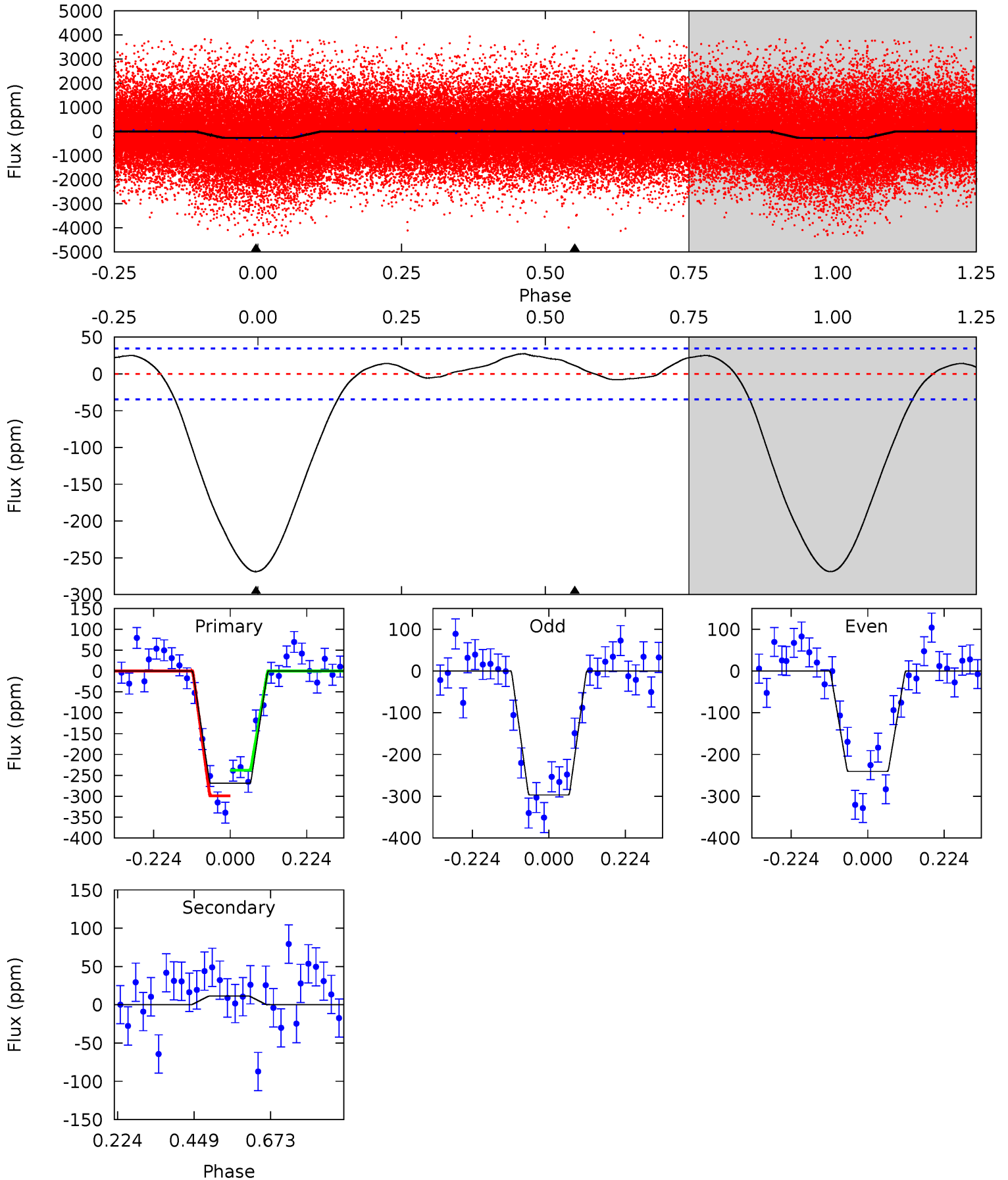
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
11.7	7.45	6.78	0	4.47	1.41	4.78	4.91	11.7	0.67	7.45	0.27	1.00	0.40	1.37



# Alt Model-Shift Uniqueness Test

008398221-01, P = 3.956685 Days, E = 129.095965 Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
34.1	-1.44	0	0	4.39	1.21	0.92	34.1	34.1	-1.44	-1.44	3.58	1.18	0.09	3.85





### Stellar Parameters For KIC 008398221

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$3964^{+118}_{-118}$	$4.701^{+0.071}_{-0.033}$	$-0.200^{+0.350}_{-0.400}$	$0.547^{+0.054}_{-0.081}$	$0.548^{+0.065}_{-0.072}$	$4.719^{+1.828}_{-0.761}$
	+3%/-3%	+2%/-1%	+175%/-200%	+10%/-15%	+12%/-13%	+39%/-16%
Source	PHO2	PHO2	PHO2	DSEP		

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

### Secondary Eclipse Parameters for KIC 008398221-01 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-79 \pm 11$	$0.79^{+0.20}_{-0.25}$	$894^{+35}_{-34}$	$3444^{+484}_{-268}$	$111^{+127}_{-43}$
Alt.	$11 \pm 8$	$1.03^{+0.23}_{-0.21}$	$895^{+32}_{-32}$	$-2462^{+330}_{-233}$	$-9.417^{+6.990}_{-9.381}$

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

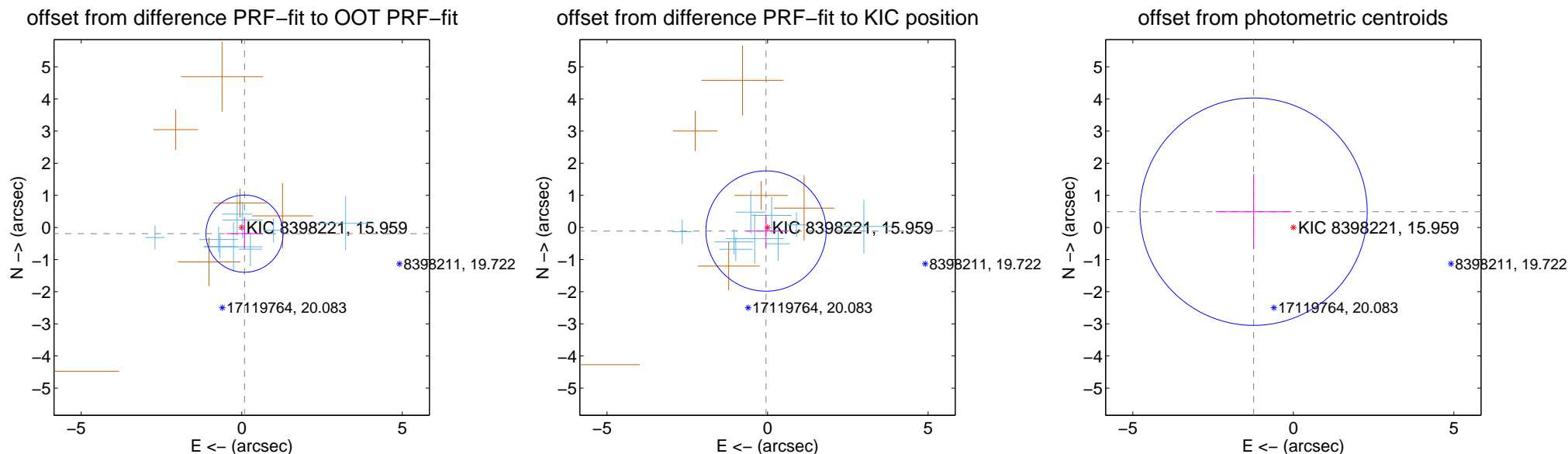
## DV Centroid Data

Supplemental centroid analysis for 008398221-01. Kepler magnitude: 15.96. Transit SNR 8.89

There are 9 quarters with good PRF difference image offsets

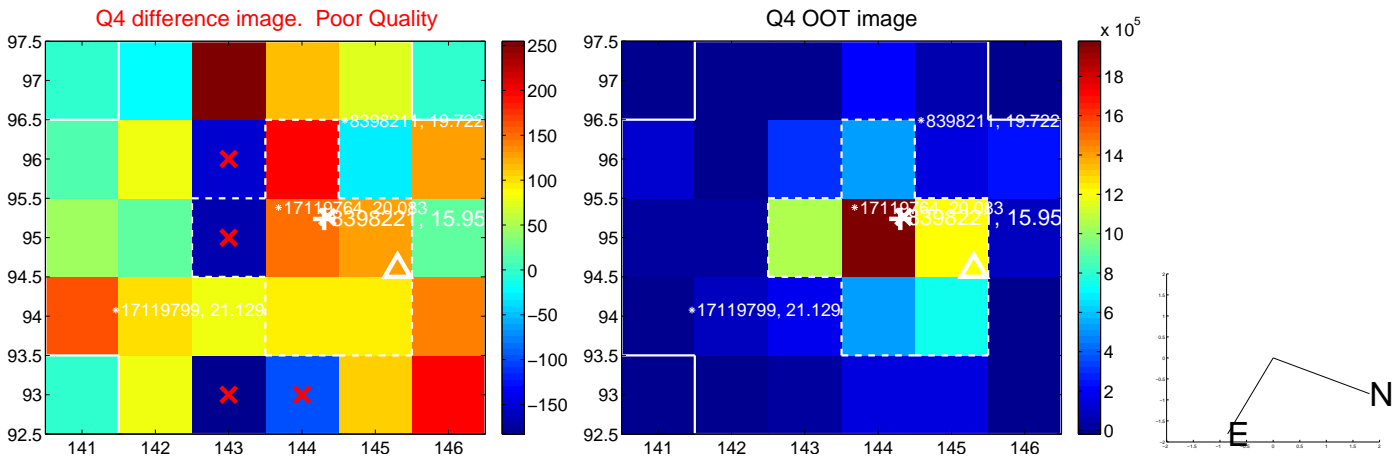
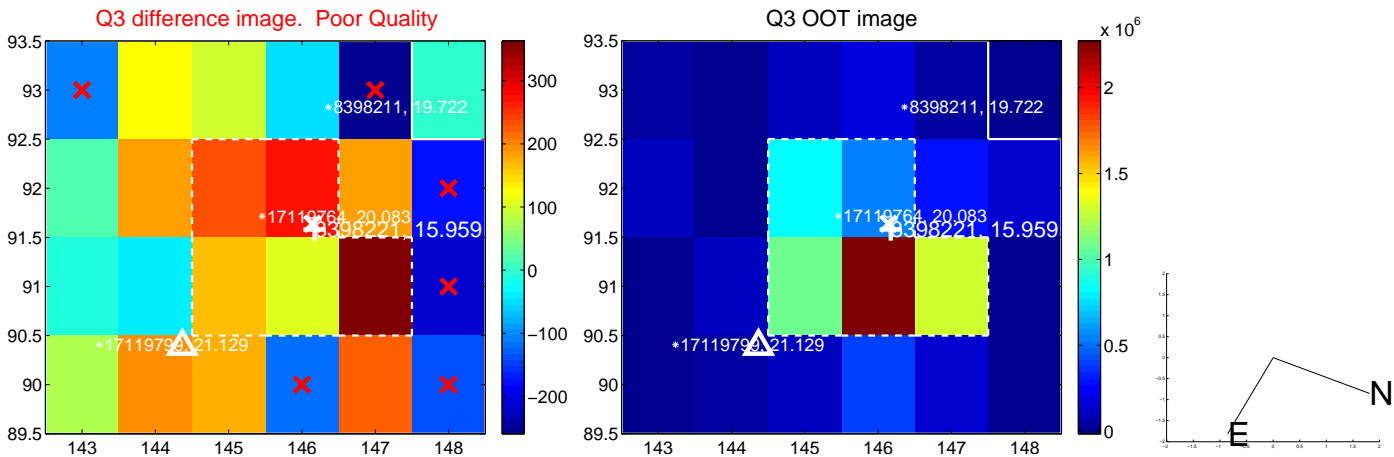
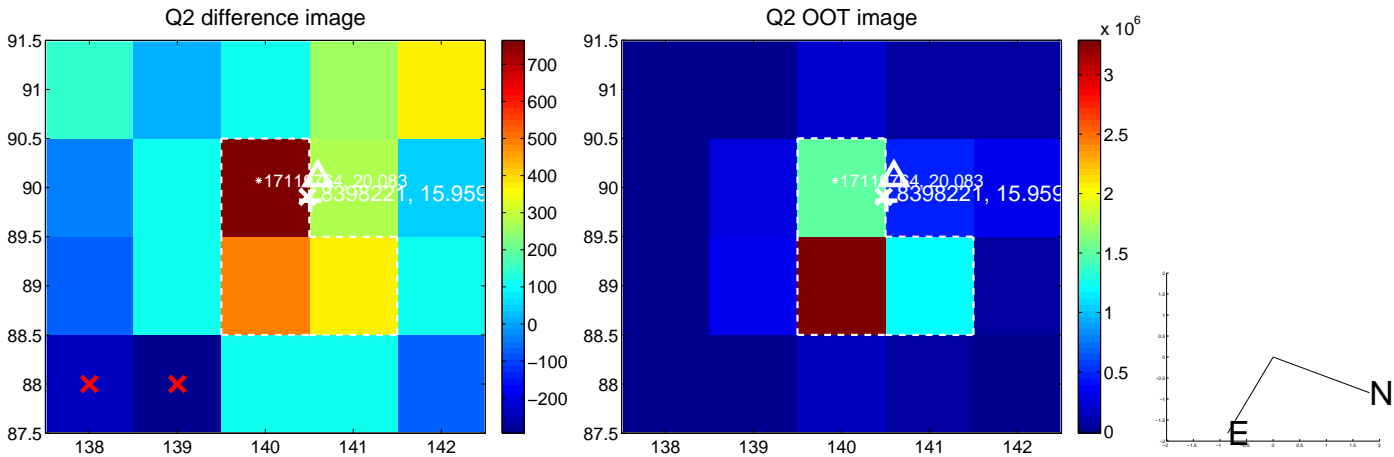
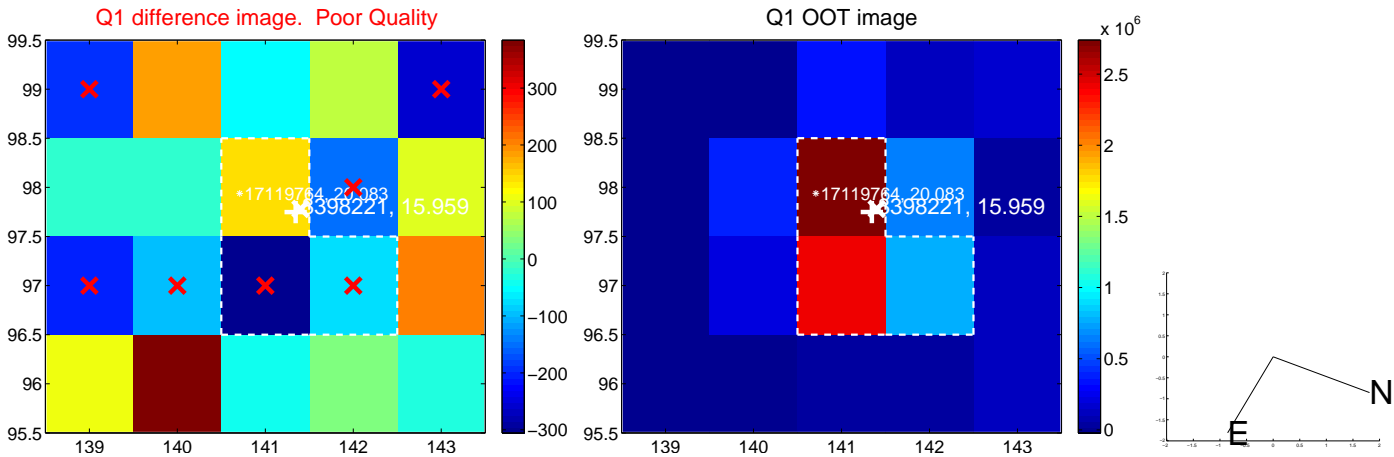
The direct PRF centroid is offset from the target star catalog position by about 0.20 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.212 \pm 0.401$	0.53	$-0.087 \pm 0.570$	$-0.193 \pm 0.469$
PRF-fit source offset from KIC position	$0.121 \pm 0.624$	0.19	$0.047 \pm 0.611$	$-0.111 \pm 0.514$
photometric centroid source offset	$1.33 \pm 1.18$	1.13	$1.24 \pm 1.18$	$0.49 \pm 1.17$

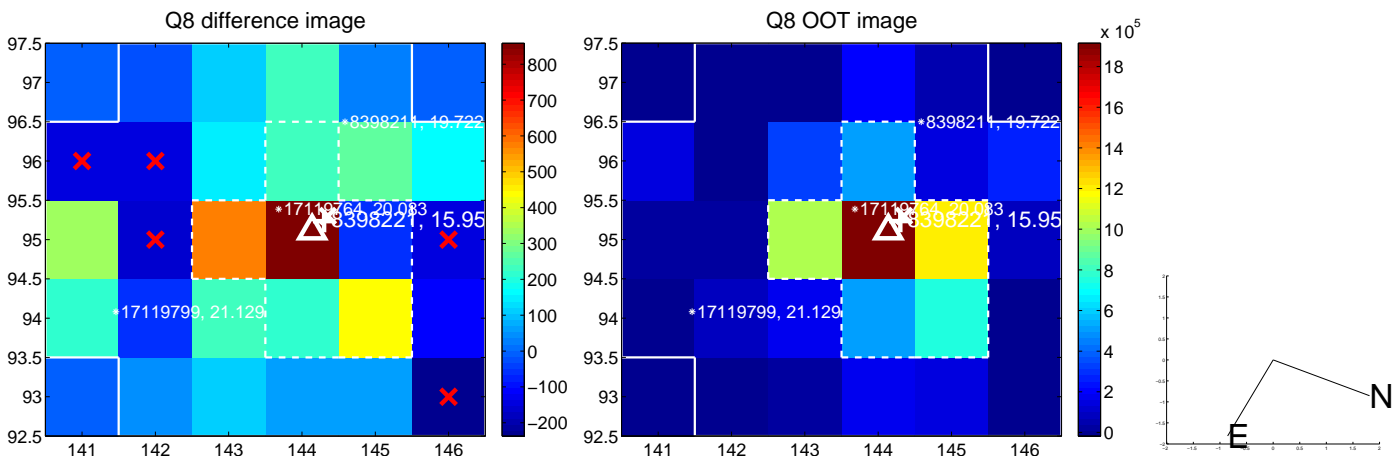
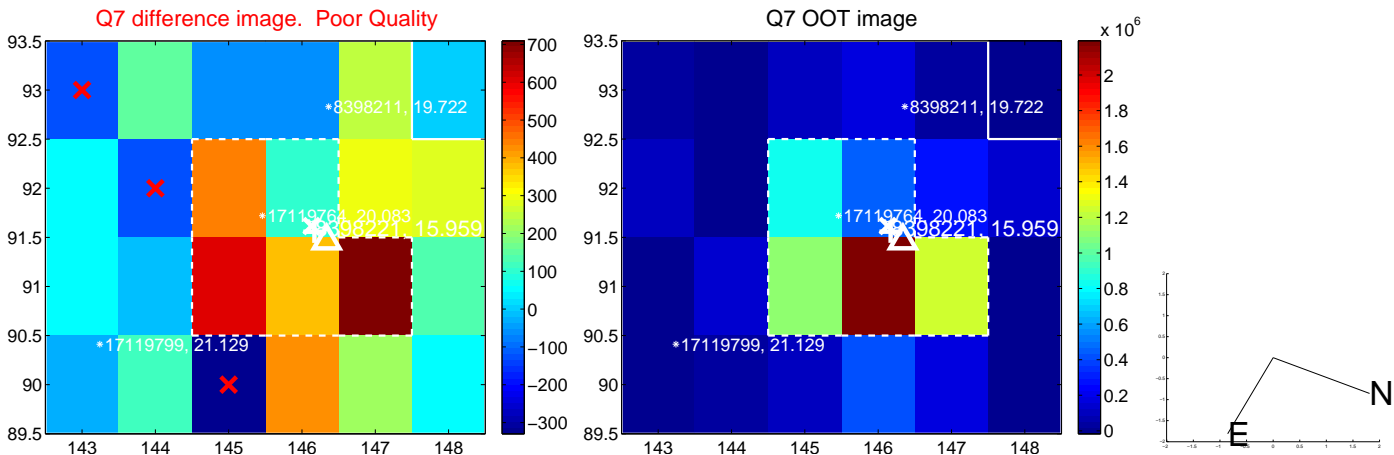
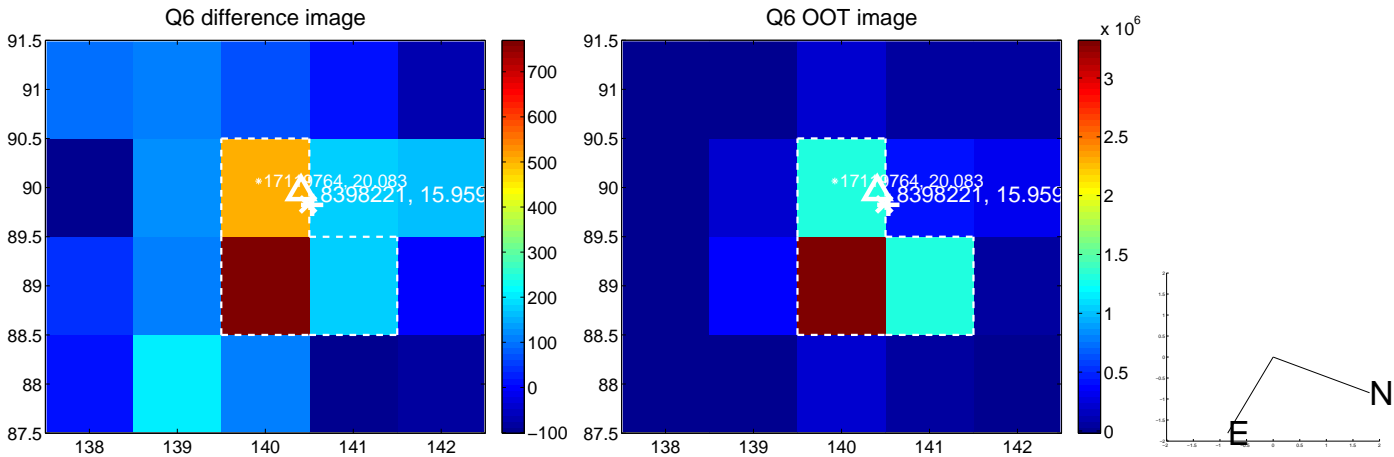
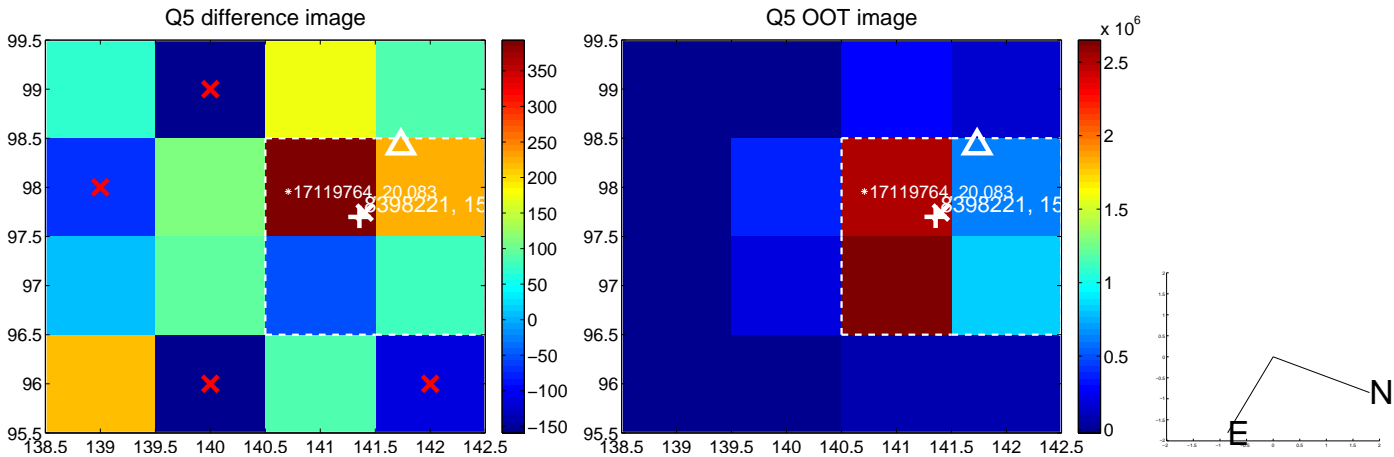


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

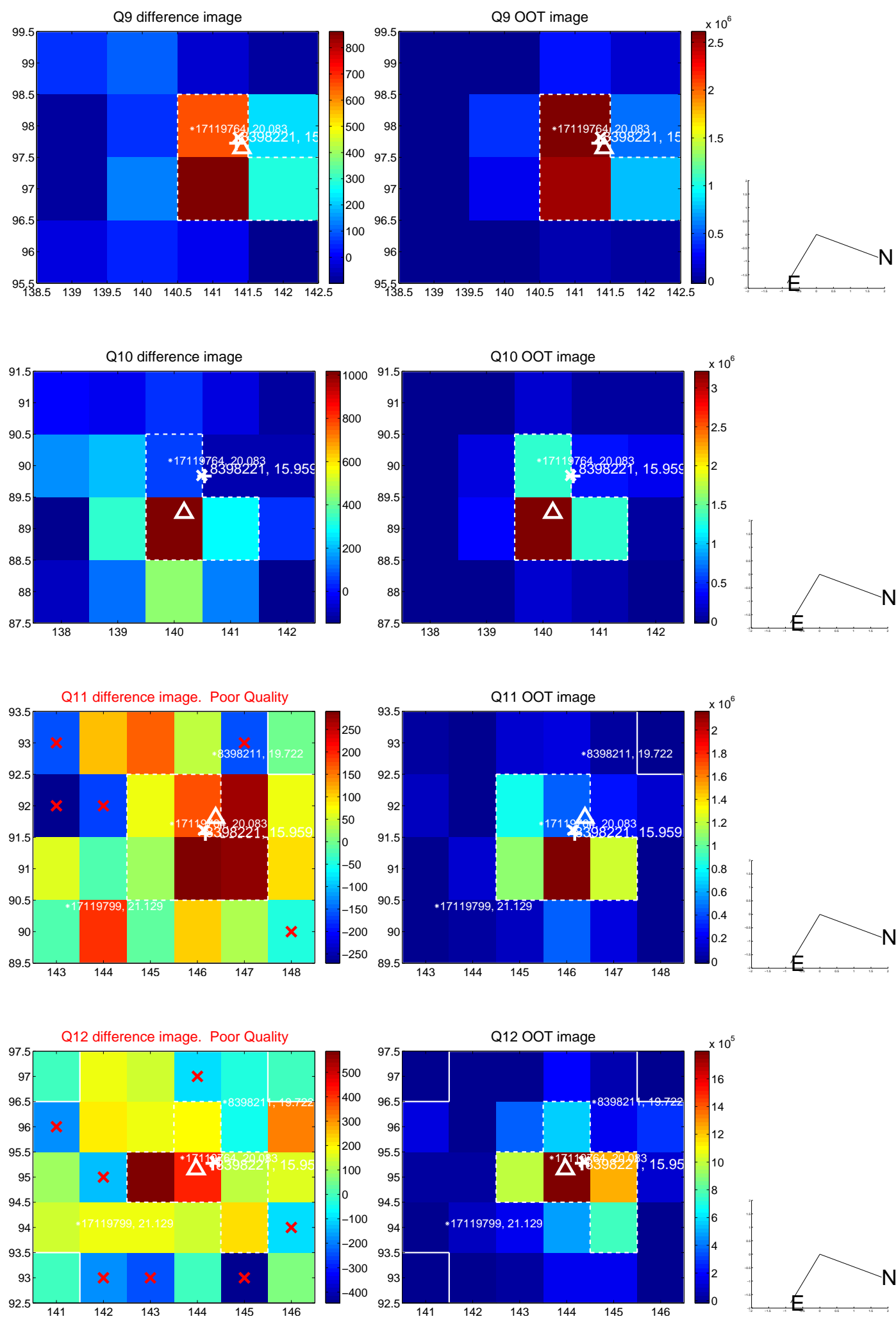


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

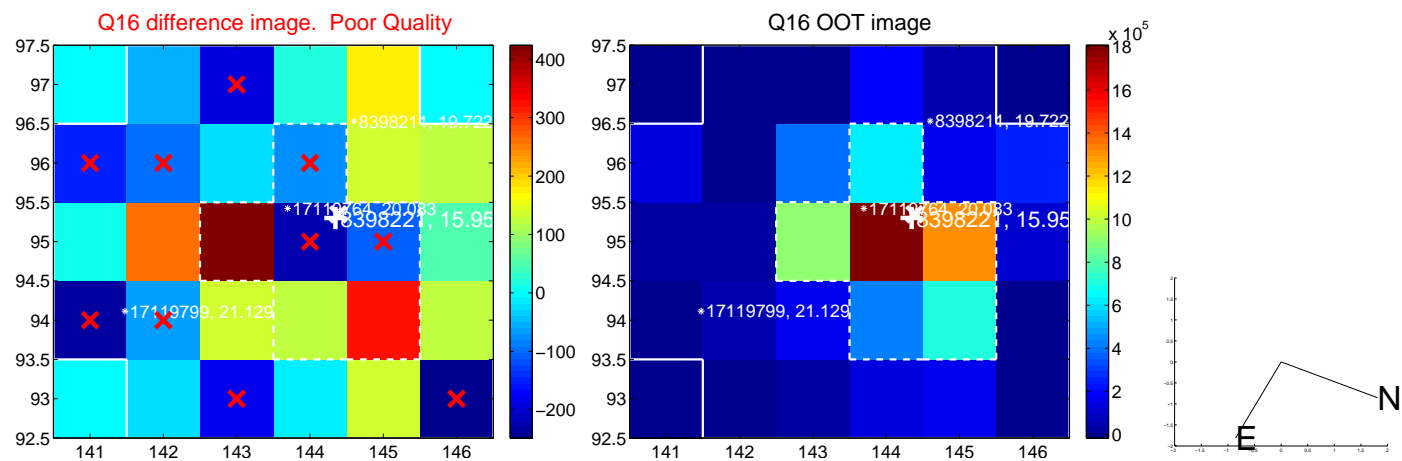
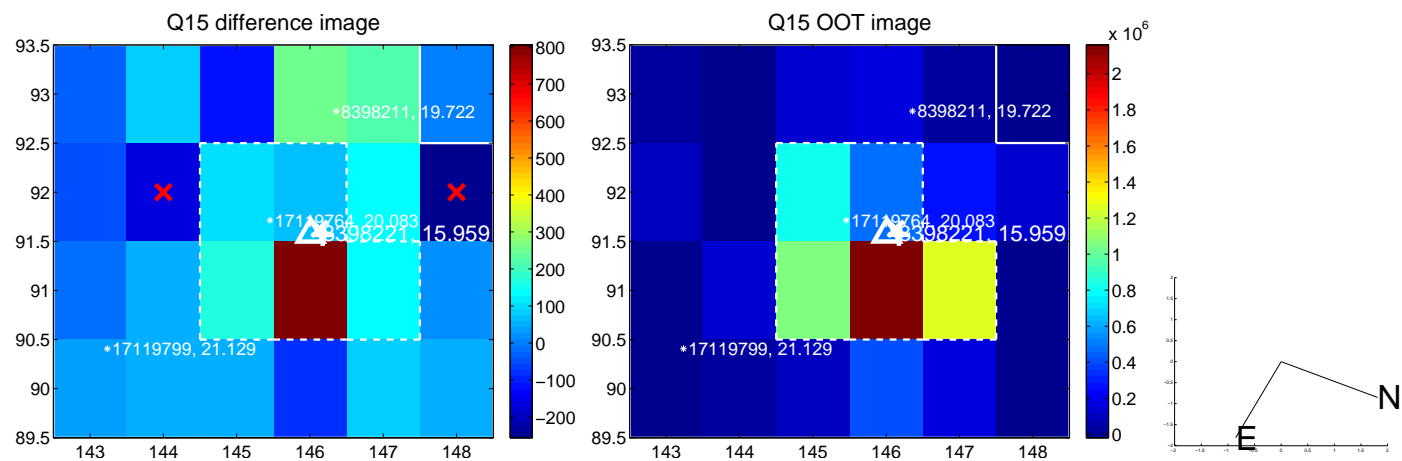
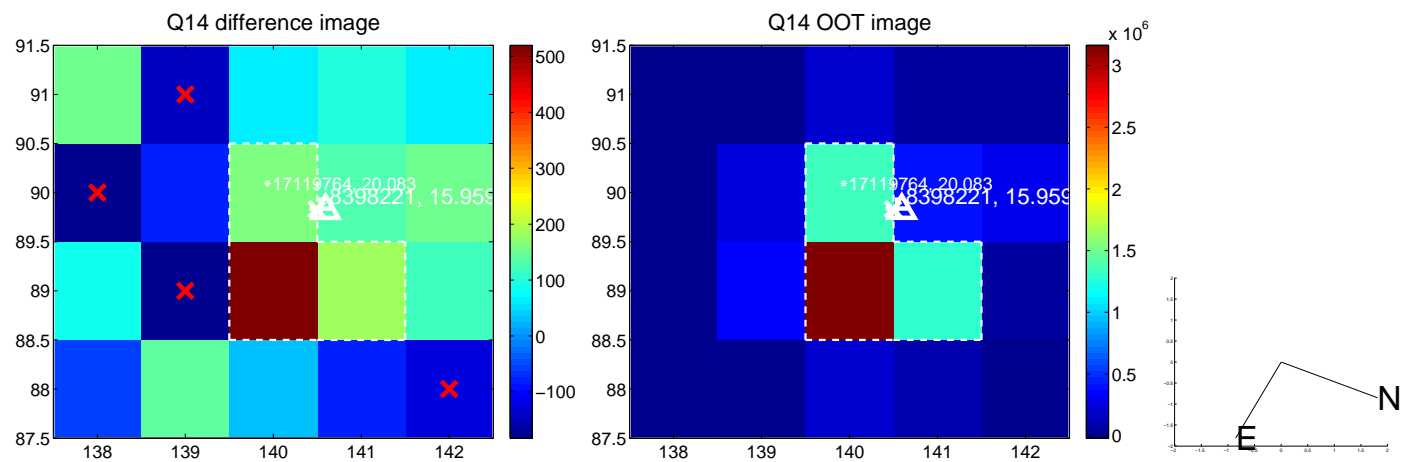
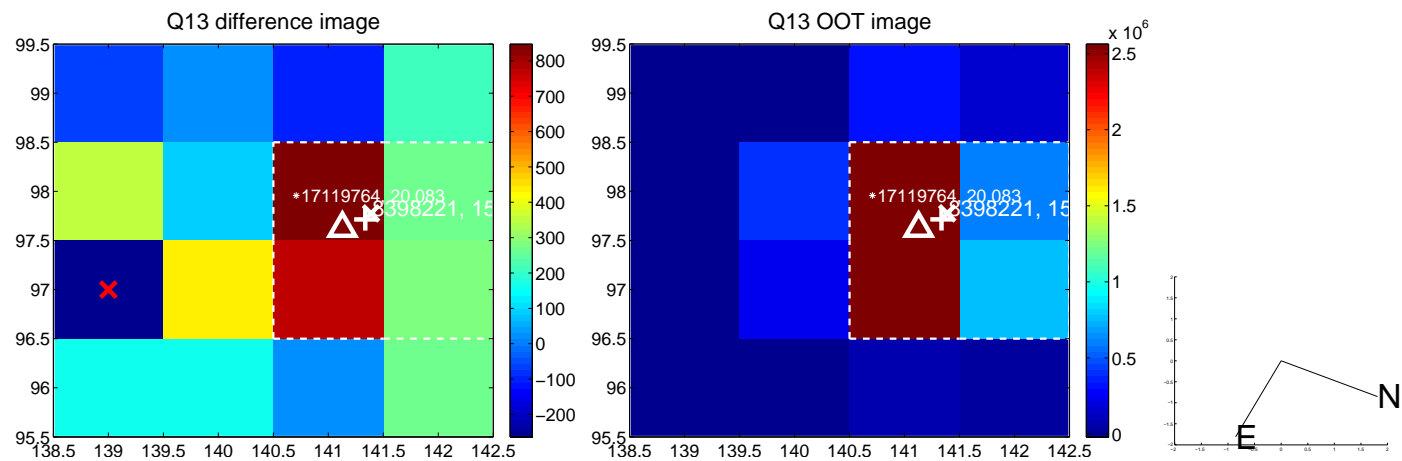




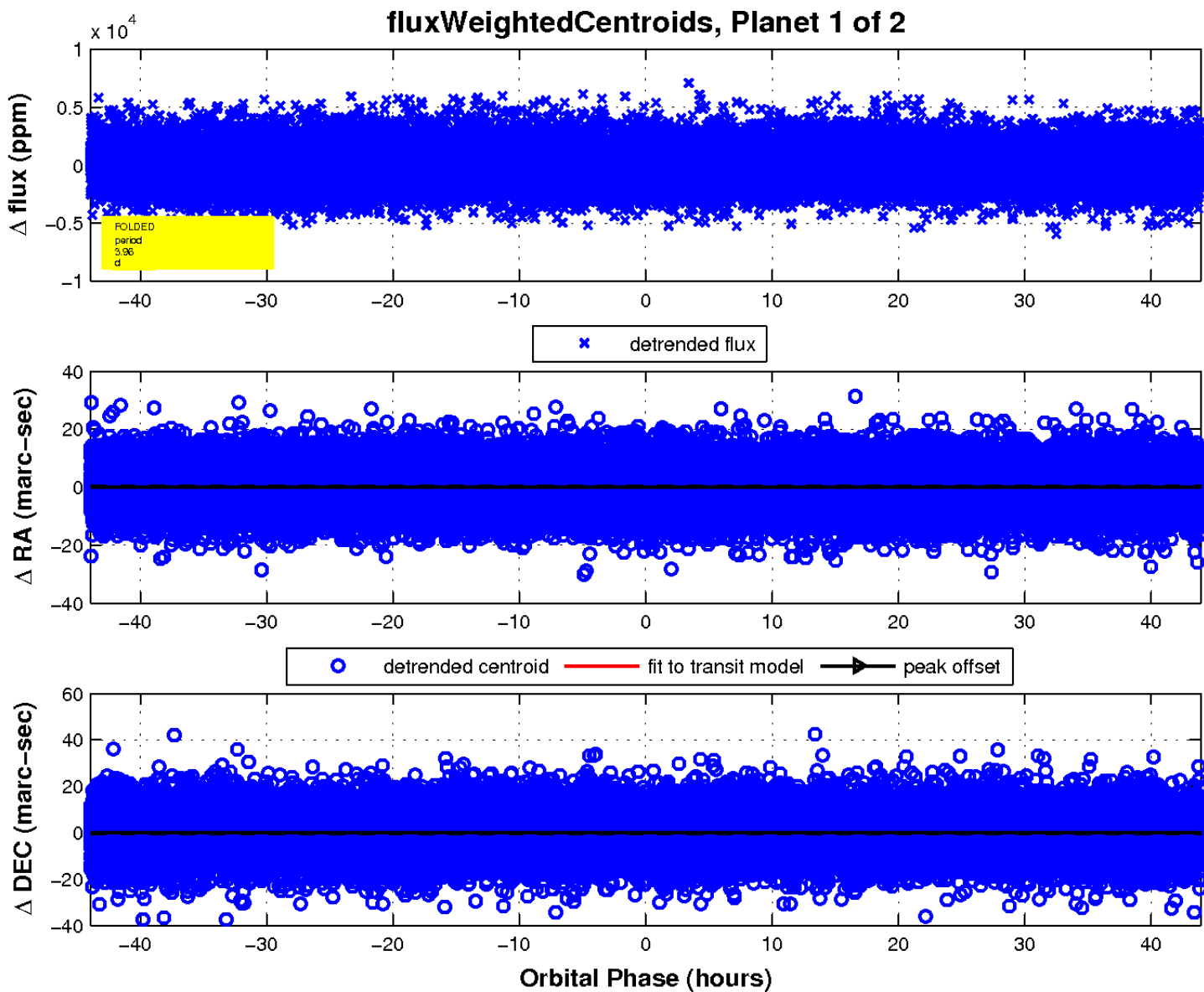
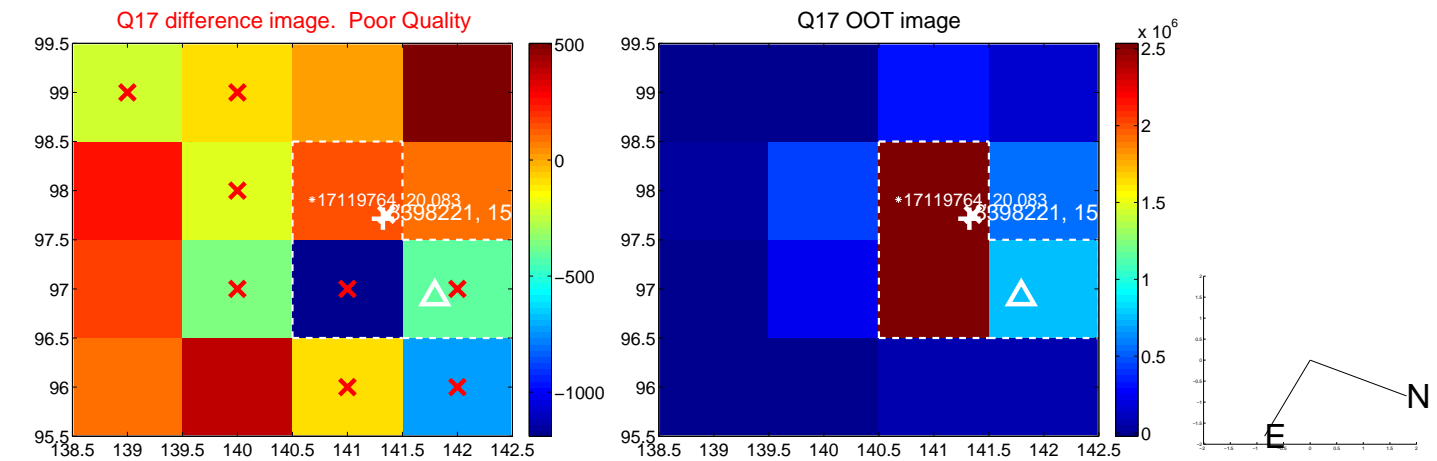
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

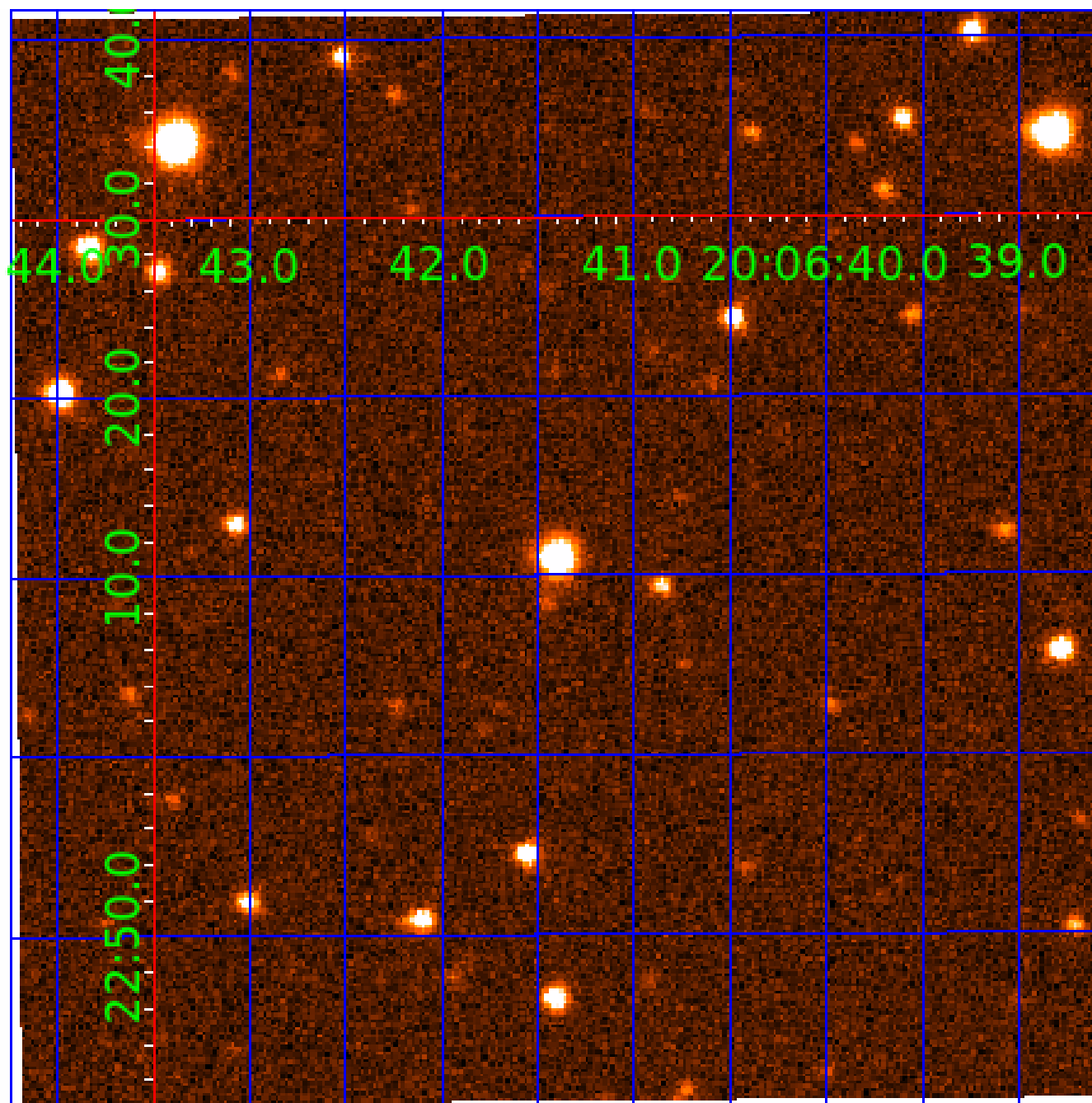


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 008398221

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
008398221-01	OBS	No	3.956598	133.070469	169.0	14.656	7.8	8.9	0.55	3964	0.79	41.21
008398221-02	OBS	No	301.468936	346.453234	1801.3	22.286	10.0	9.5	0.55	3964	2.64	0.13

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
008398221-01	OBS	FP	0.00	1	0	0	0	LPP_DV—MOD_NONUNIQ_DV
008398221-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL_SKYE—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.

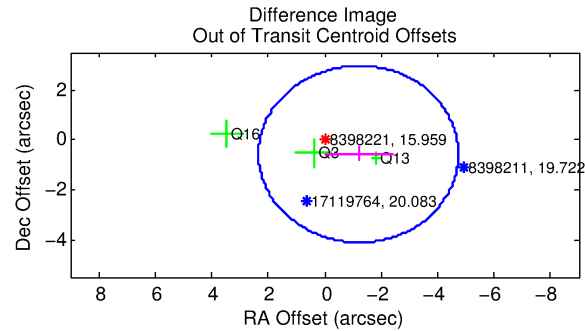
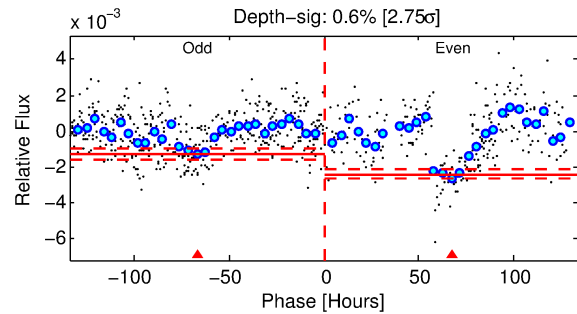
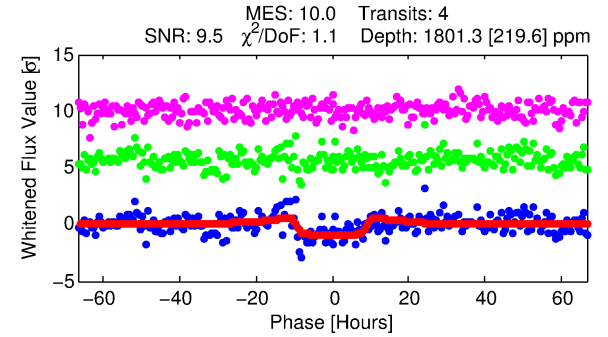
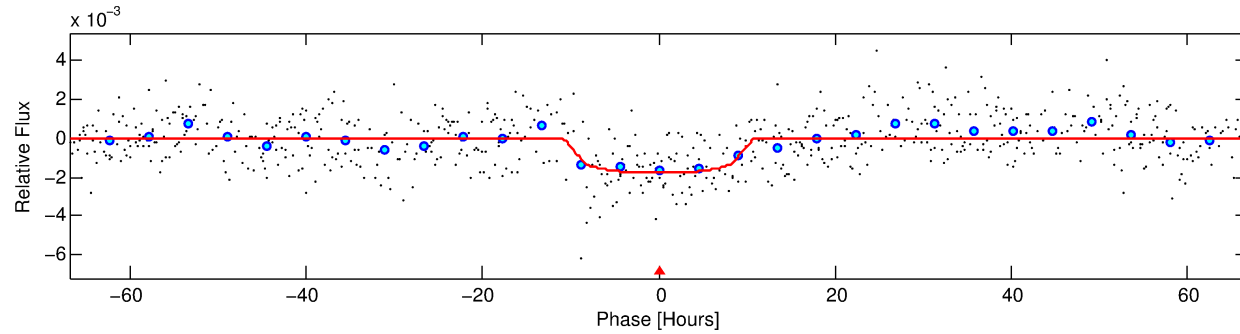
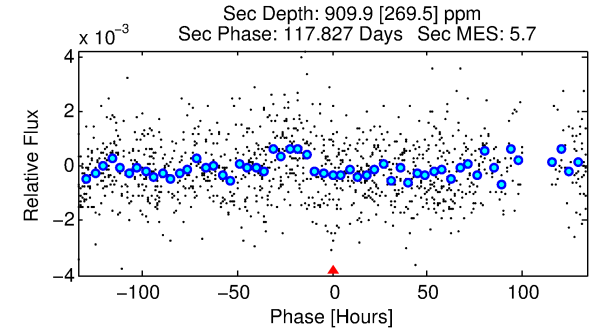
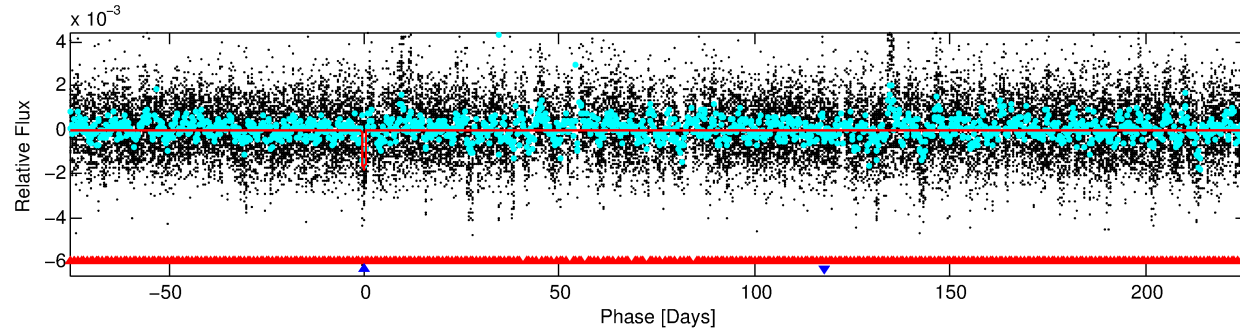
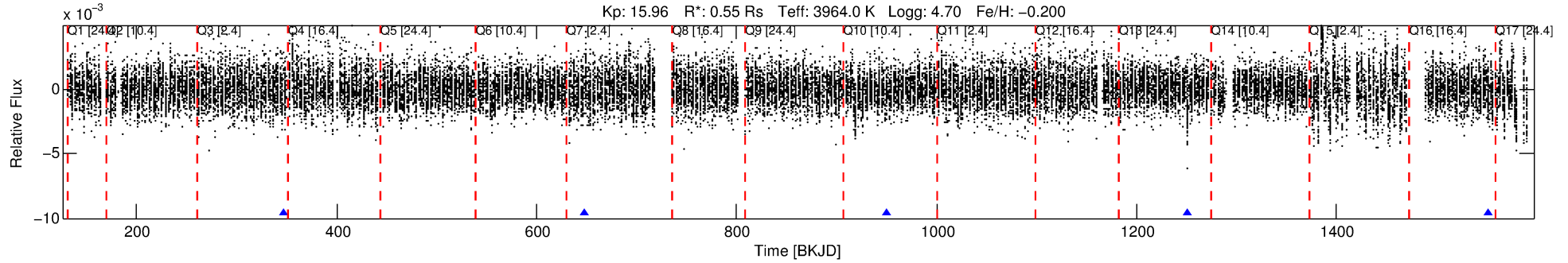
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 008398221-02

No Significant Match Found

# DV One-Page Summary

KIC: 8398221 Candidate: 2 of 2 Period: 301.469 d



## DV Fit Results:

Period = 301.46894 [0.03579] d  
Epoch = 346.4532 [0.1080] BKJD  
Rp/R\* = 0.0443 [0.0051]  
a/R\* = 63.69 [25.18]  
b = 0.84 [0.13]  
Seff = 0.13 [0.02]  
Teq = 152 [7] K  
Rp = 2.64 [0.50] Re  
a = 0.7203 [0.0812] AU  
Ag = 37149.64 [14979.59] [2.48σ]  
Teffp = 3271 [322] K [9.68σ]

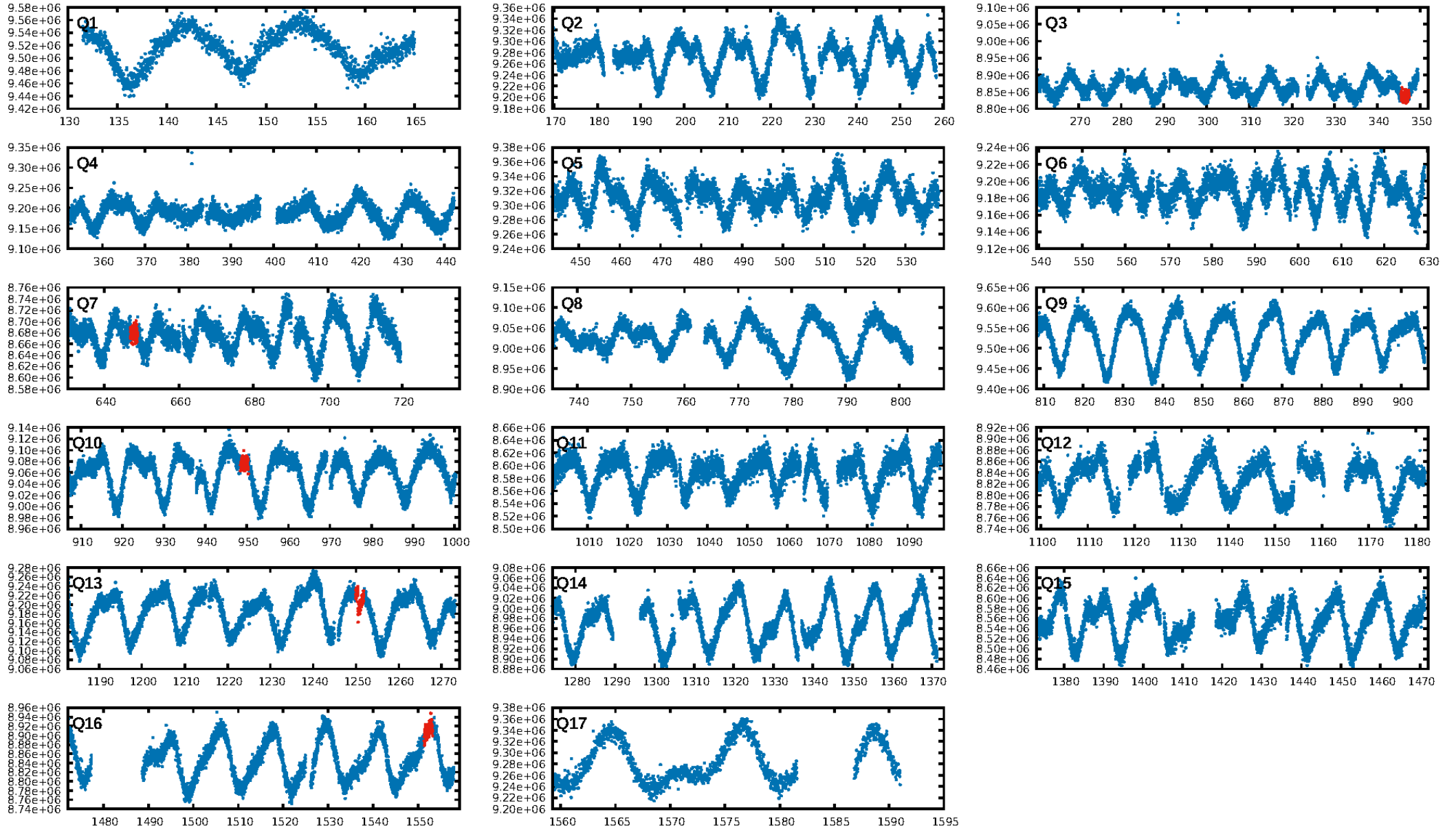
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [267.69σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 4.5%  
ModelChiSquareGof-sig: 100.0%  
**Bootstrap-pfa: 4.03e-12**  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: -5.892  
Centroid-sig: 1.7%  
Centroid-so: 1.231 arcsec [1.41σ]  
OotOffset-rm: 1.331 arcsec [1.13σ]  
KicOffset-rm: 1.086 arcsec [1.10σ]  
OotOffset-st: 0/1/1/1 [3]  
KicOffset-st: 0/1/1/1 [3]  
DiffImageQuality-fgm: 0.67 [2/3]  
DiffImageOverlap-fno: 0.20 [1/5]

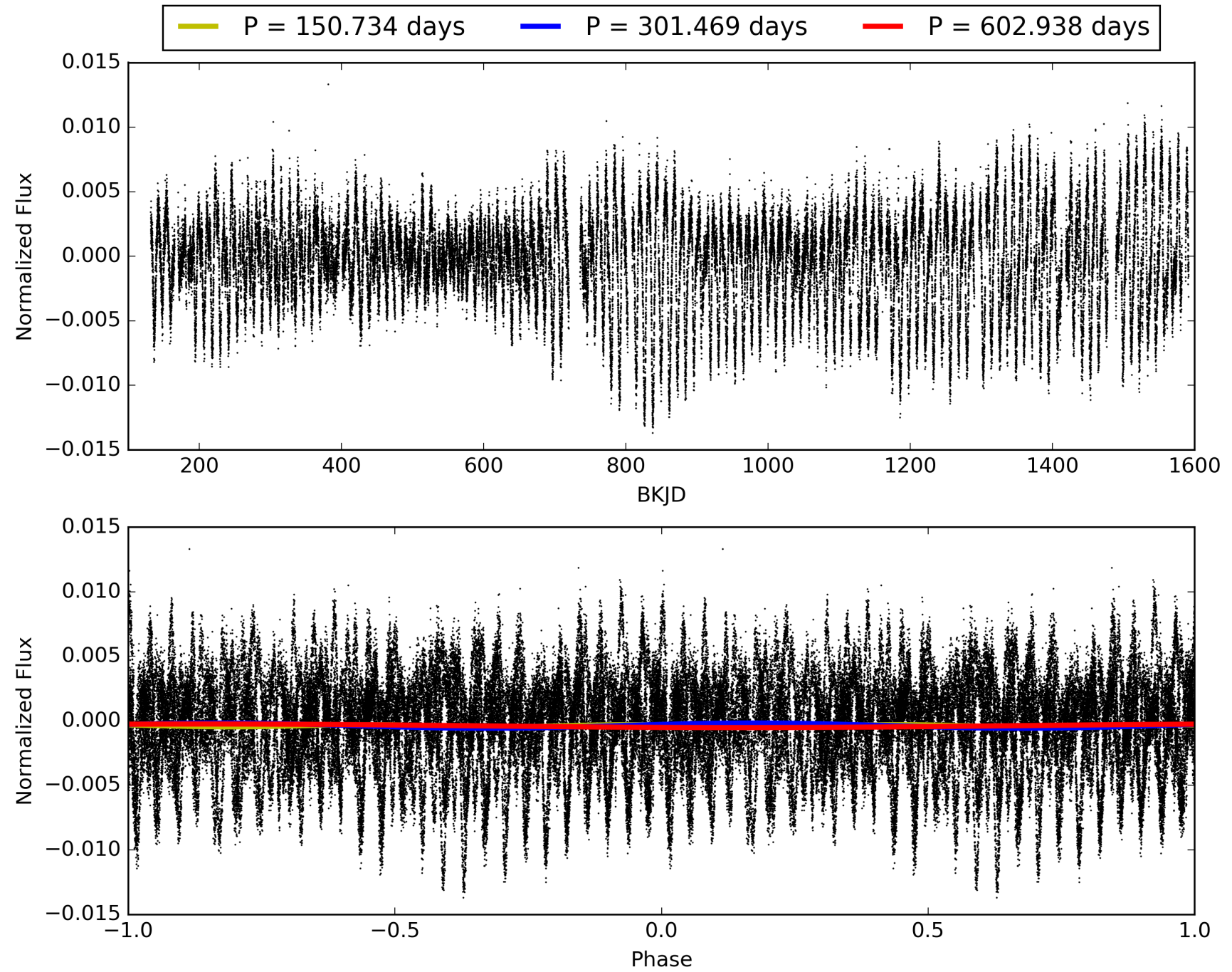
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 30-Jan-2016 08:26:36 Z

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

# TCE 008398221-02, PDC Light Curves



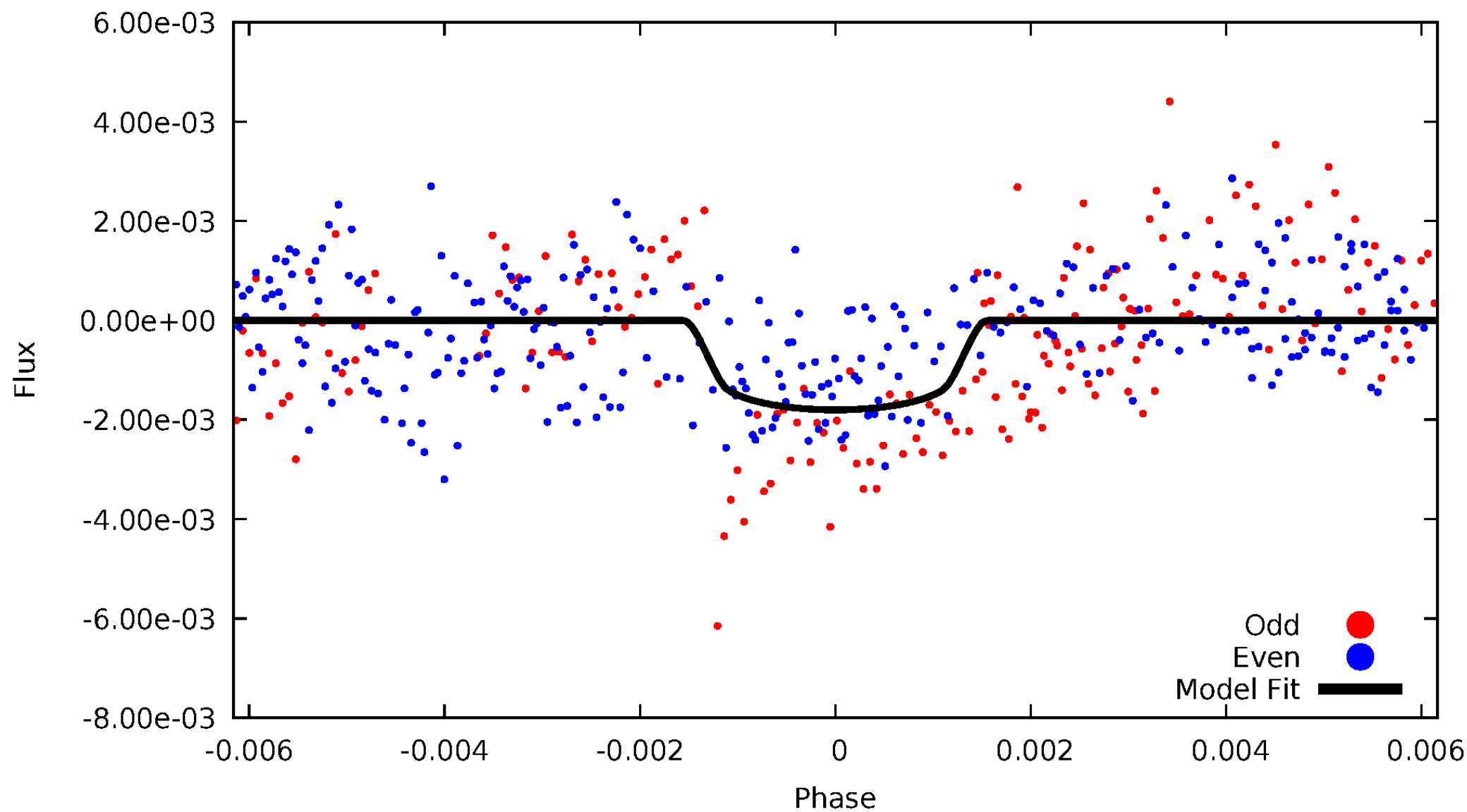
# TCE 008398221-02





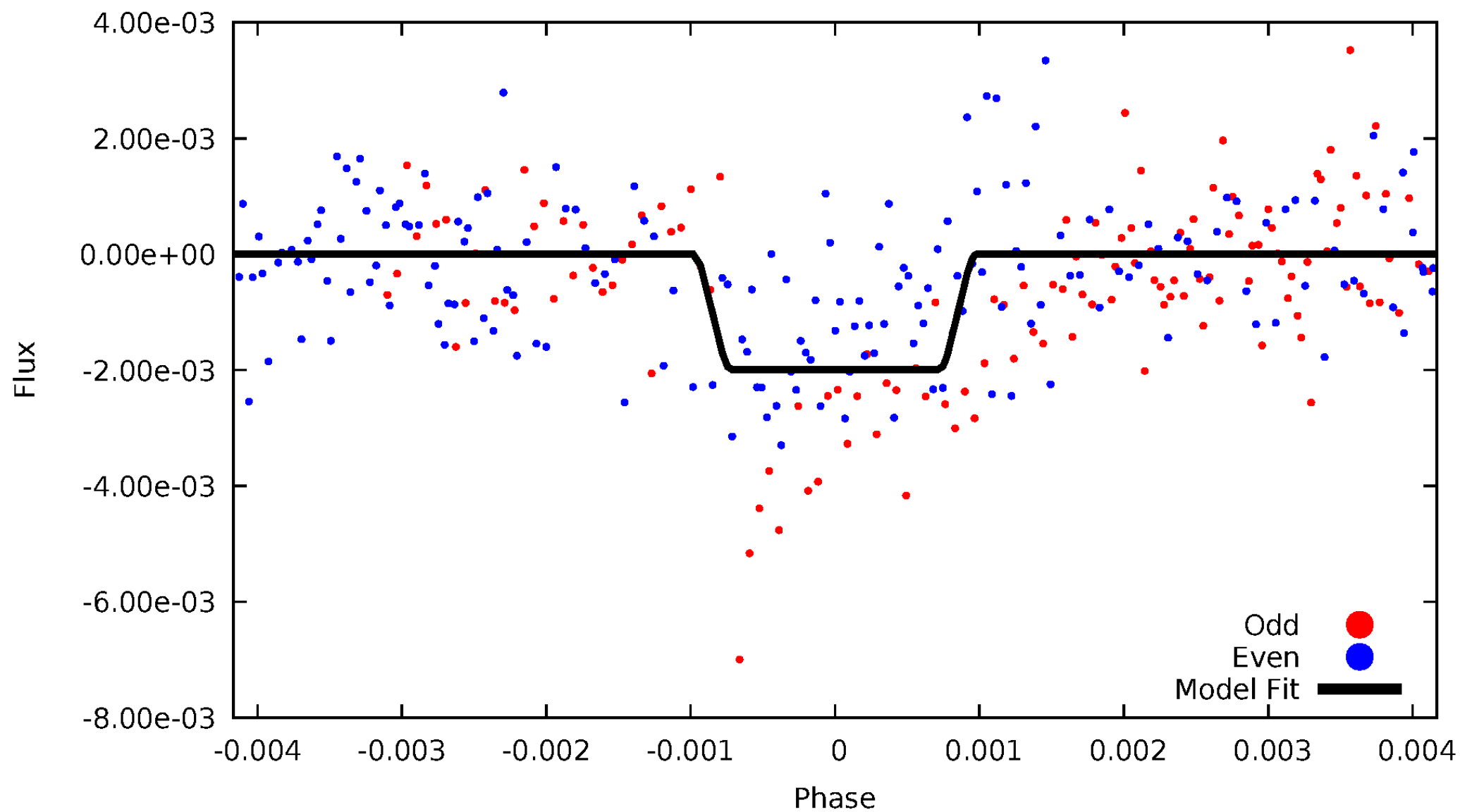
# DV Odd/Even

TCE 008398221-02



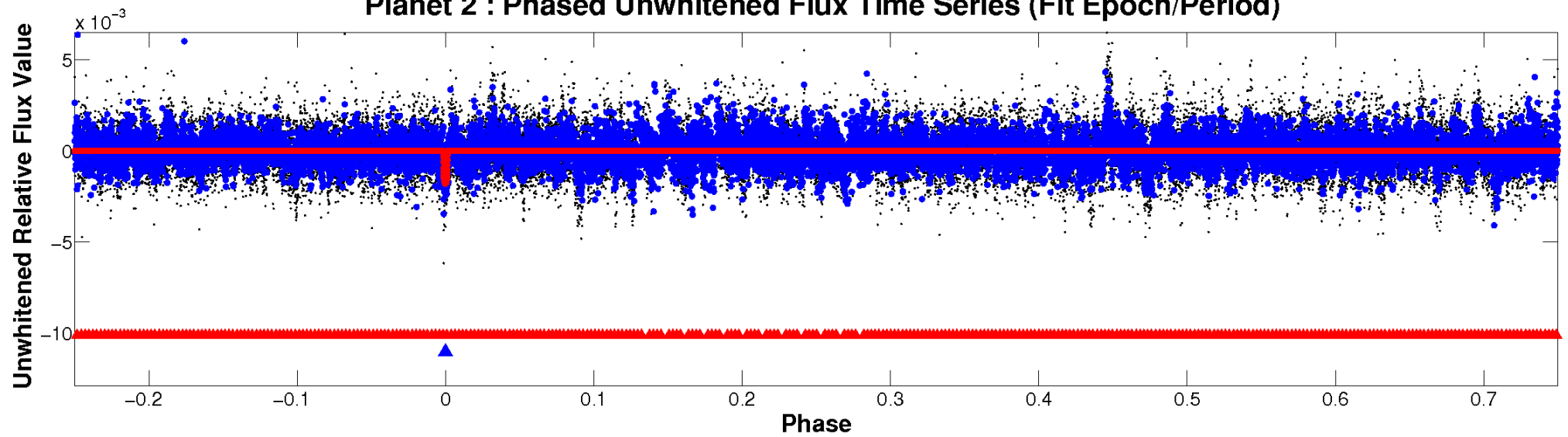
# ALT Odd/Even

TCE 008398221-02

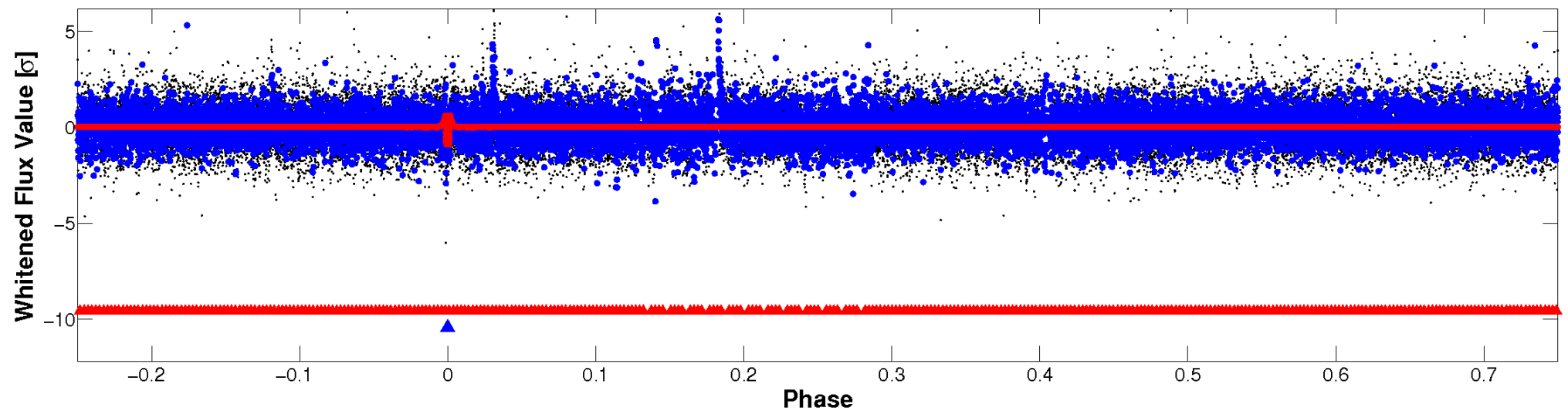


# Non-Whitened Vs. Whitened Light Curve

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



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



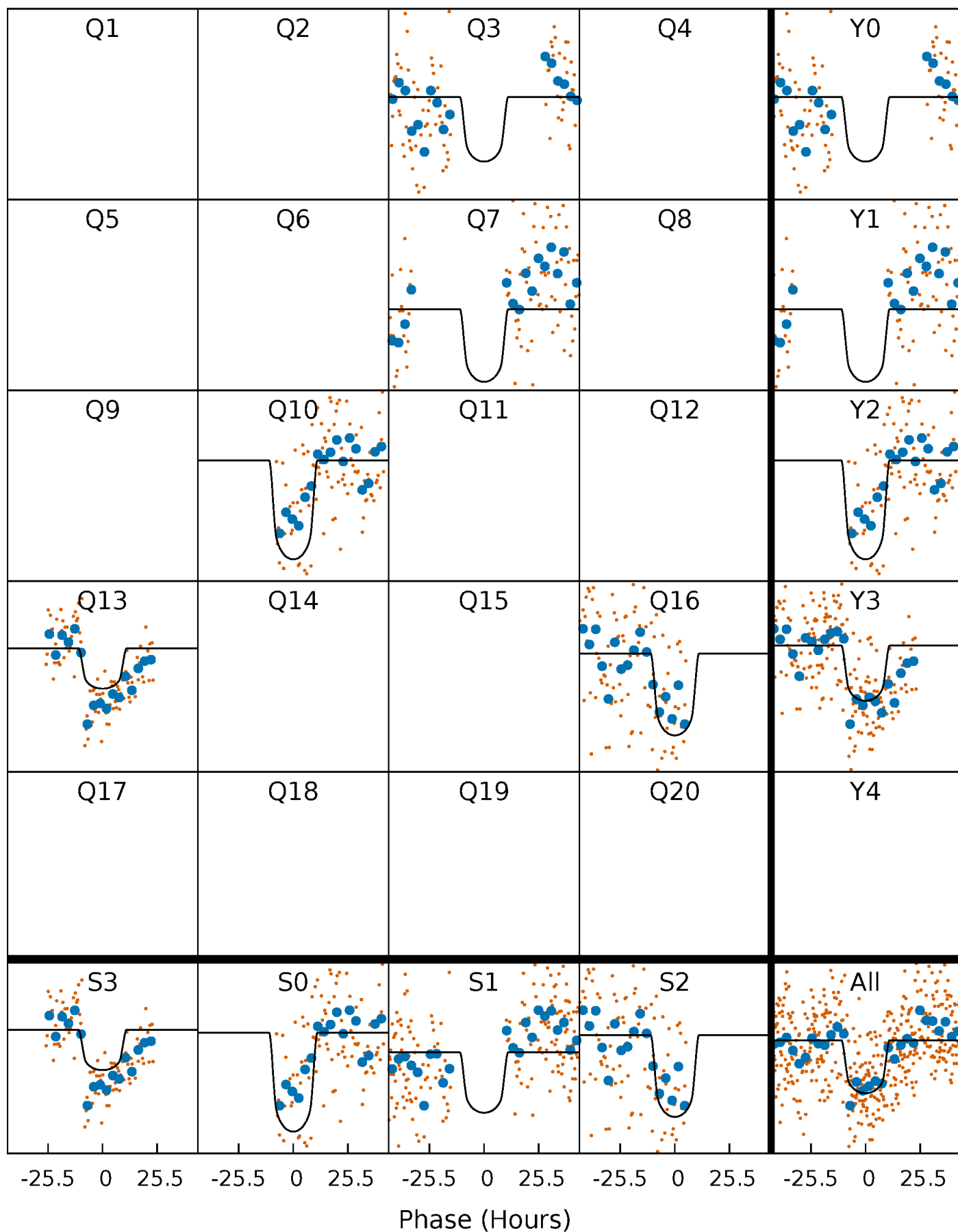
# PDC Quarter-Phased Transit Curves

TCE 008398221-02   P=301.468936 Days    $T_0=346.453234$  (BKJD)



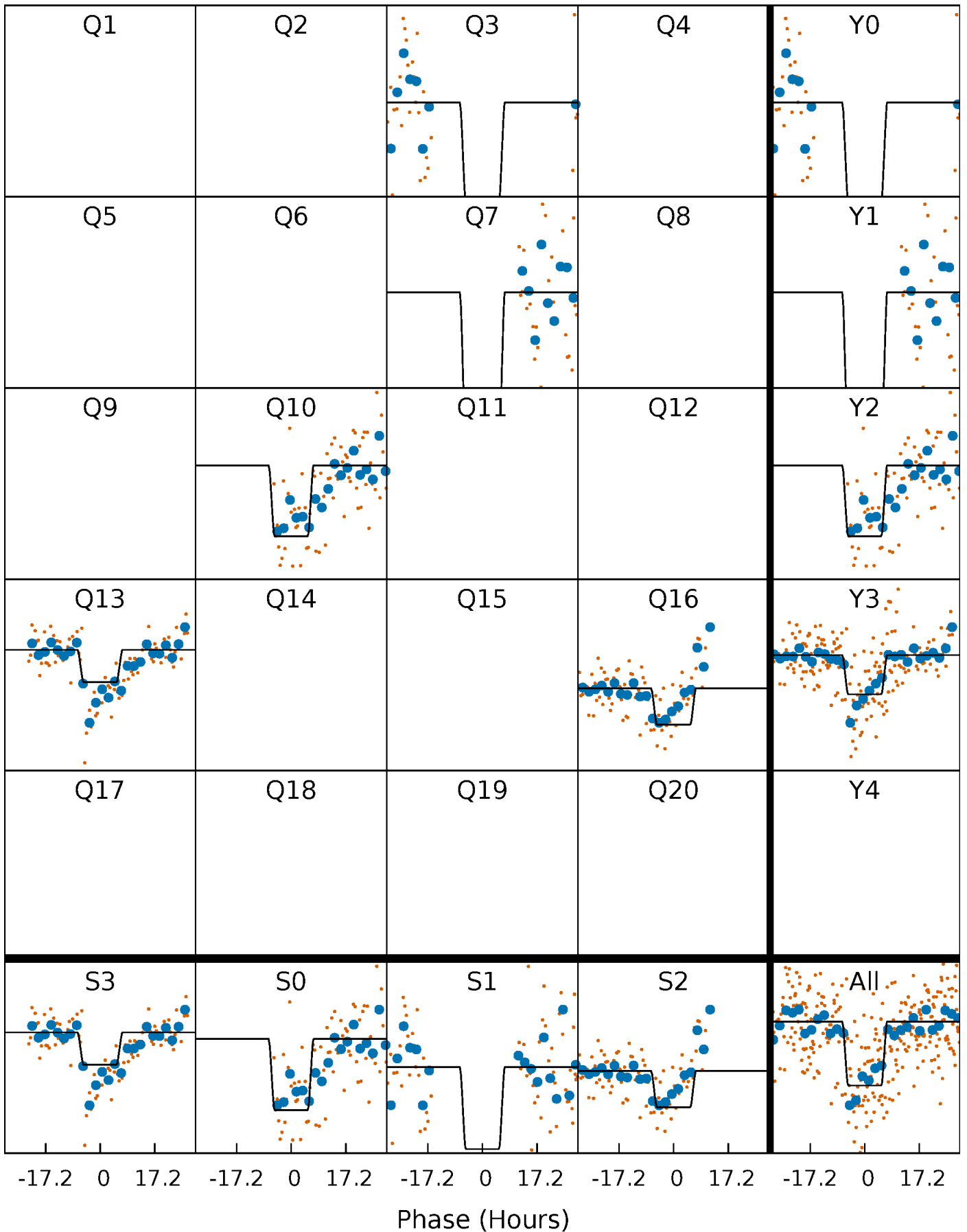
# DV Quarter-Phased Transit Curves

TCE 008398221-02     $P=301.468936$  Days     $T_0=346.453234$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

TCE 008398221-02 P=301.408632 Days  $T_0=346.469693$  (BKJD)

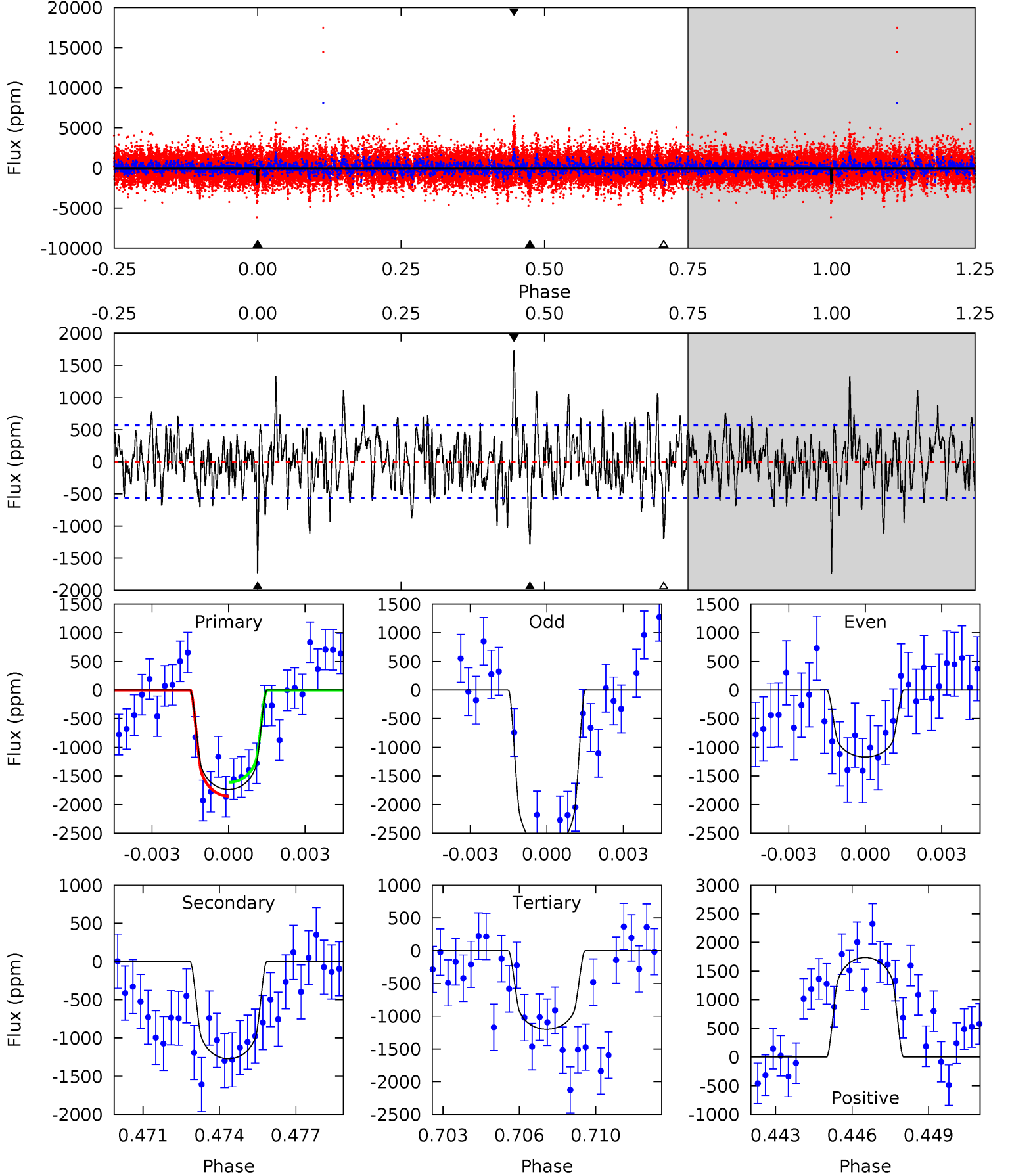




# DV Model-Shift Uniqueness Test

008398221-02, P = 301.468936 Days, E = 44.984298 Days

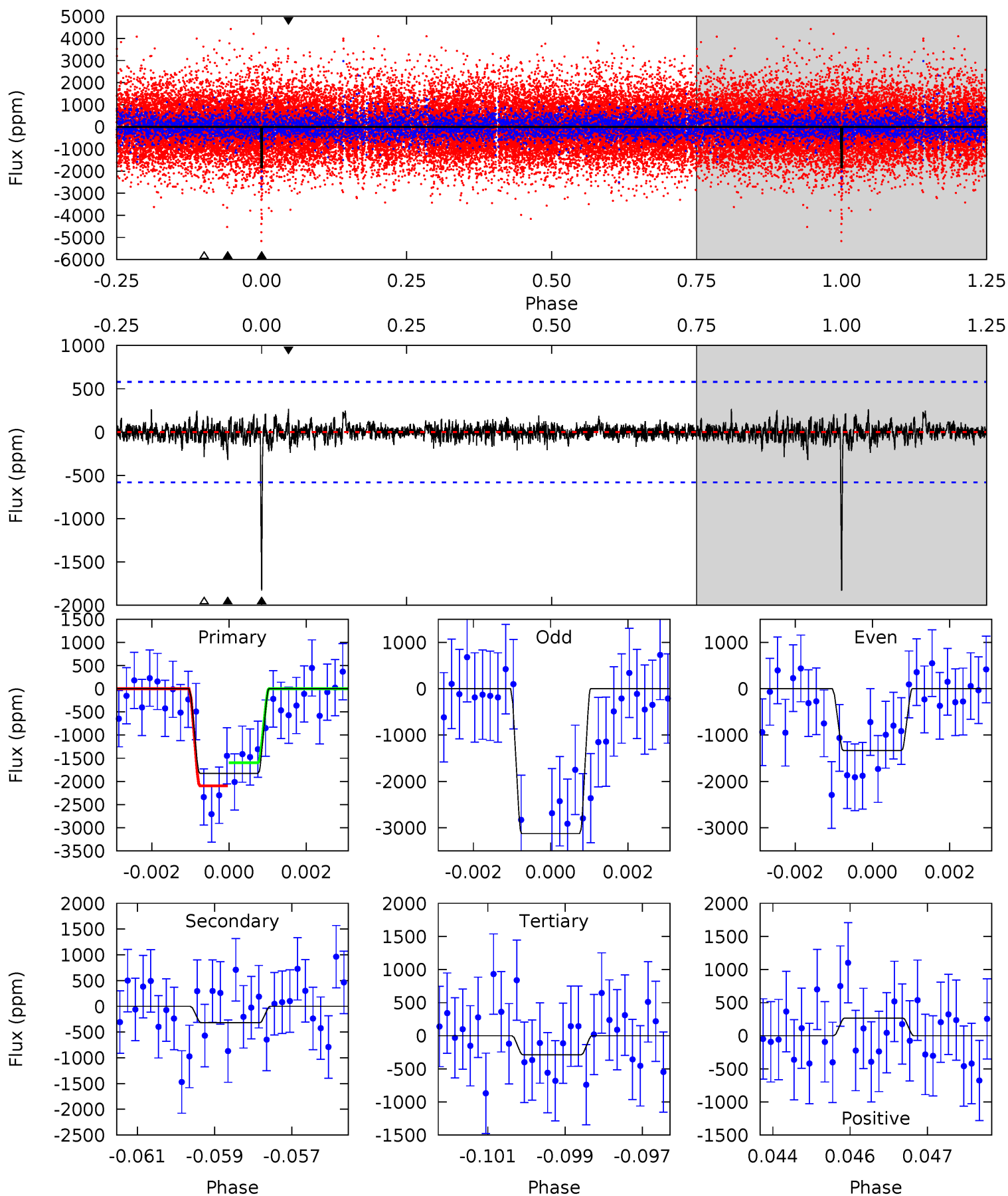
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
16.1	11.8	11.1	16.1	5.25	2.96	3.40	4.95	-0.02	0.66	-4.31	7.37	-1.23	0.50	1.10



# Alt Model-Shift Uniqueness Test

008398221-02, P = 301.408632 Days, E = 45.061061 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
16.8	2.95	2.64	2.45	5.34	3.11	0.57	14.2	14.4	0.31	0.50	7.81	1.20	0.13	2.29



### Stellar Parameters For KIC 008398221

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$3964^{+118}_{-118}$	$4.701^{+0.071}_{-0.033}$	$-0.200^{+0.350}_{-0.400}$	$0.547^{+0.054}_{-0.081}$	$0.548^{+0.065}_{-0.072}$	$4.719^{+1.828}_{-0.761}$
	+3%/-3%	+2%/-1%	+175%/-200%	+10%/-15%	+12%/-13%	+39%/-16%
Source	PHO2	PHO2	PHO2	DSEP		

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

### Secondary Eclipse Parameters for KIC 008398221-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-1272 \pm 108$	$2.61^{+0.35}_{-0.35}$	$212^{+8}_{-8}$	$3692^{+194}_{-174}$	$54390^{+17018}_{-12392}$
Alt.	$-320 \pm 109$	$2.63^{+0.34}_{-0.34}$	$211^{+8}_{-9}$	$2972^{+183}_{-193}$	$13284^{+5878}_{-4600}$

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

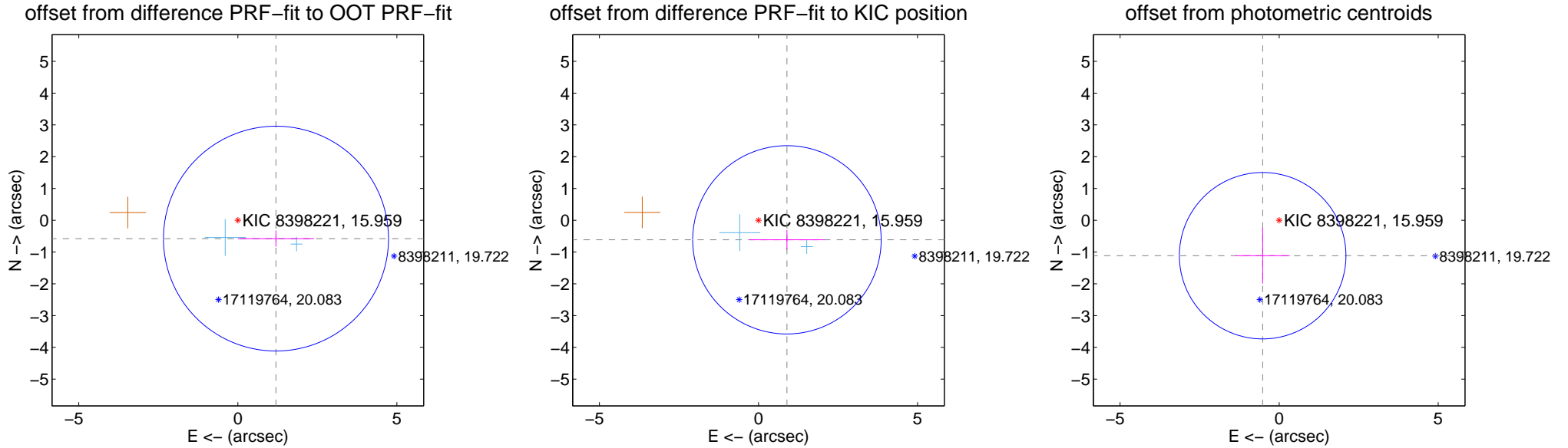
## DV Centroid Data

Supplemental centroid analysis for 008398221-02. Kepler magnitude: 15.96. Transit SNR 9.54

There are 2 quarters with good PRF difference image offsets

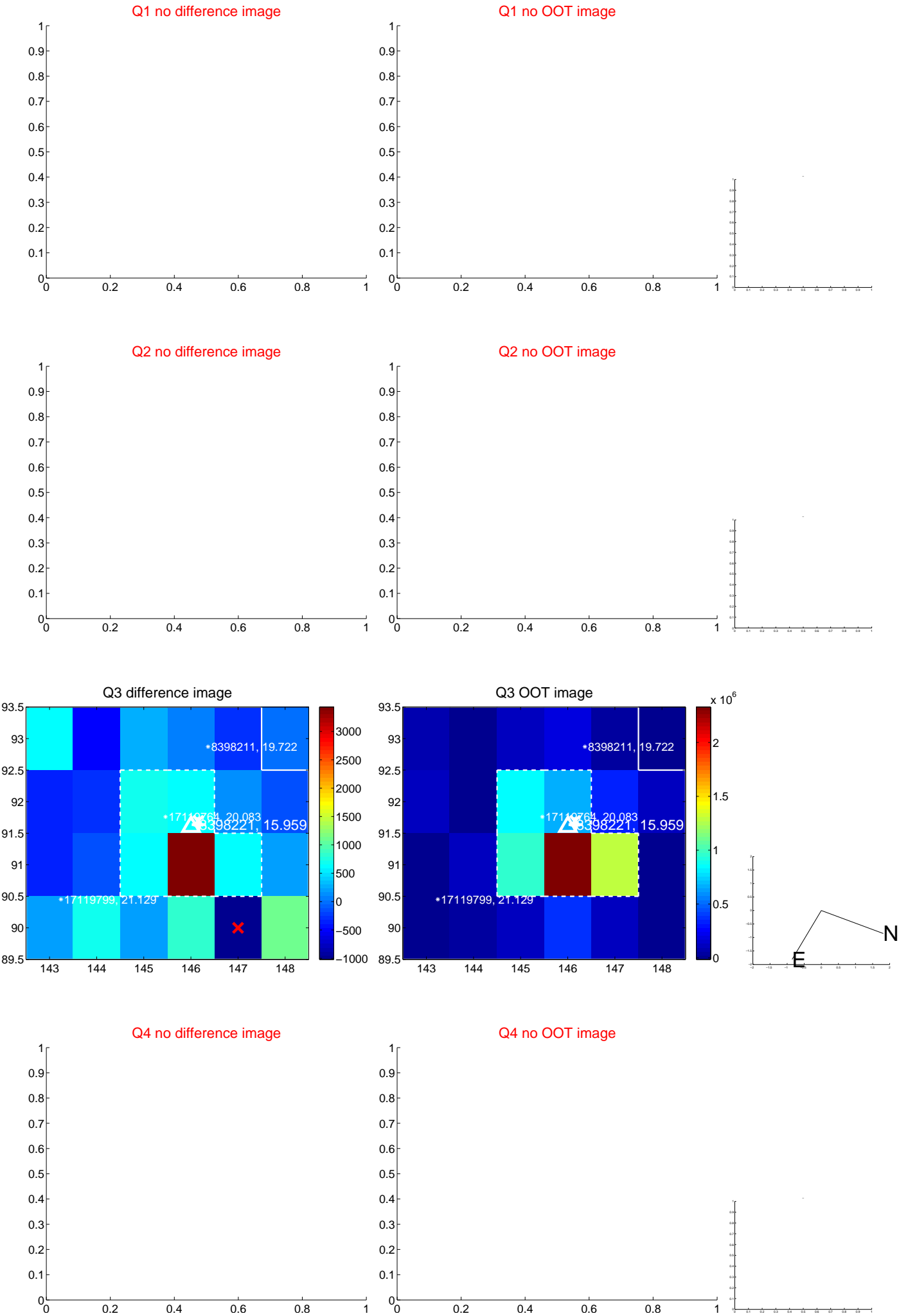
The direct PRF centroid is offset from the target star catalog position by about 0.19 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.331 \pm 1.179$	1.13	$-1.199 \pm 1.195$	$-0.578 \pm 0.255$
PRF-fit source offset from KIC position	$1.086 \pm 0.988$	1.10	$-0.894 \pm 1.181$	$-0.616 \pm 0.305$
photometric centroid source offset	$1.23 \pm 0.87$	1.41	$0.52 \pm 0.85$	$-1.12 \pm 0.88$

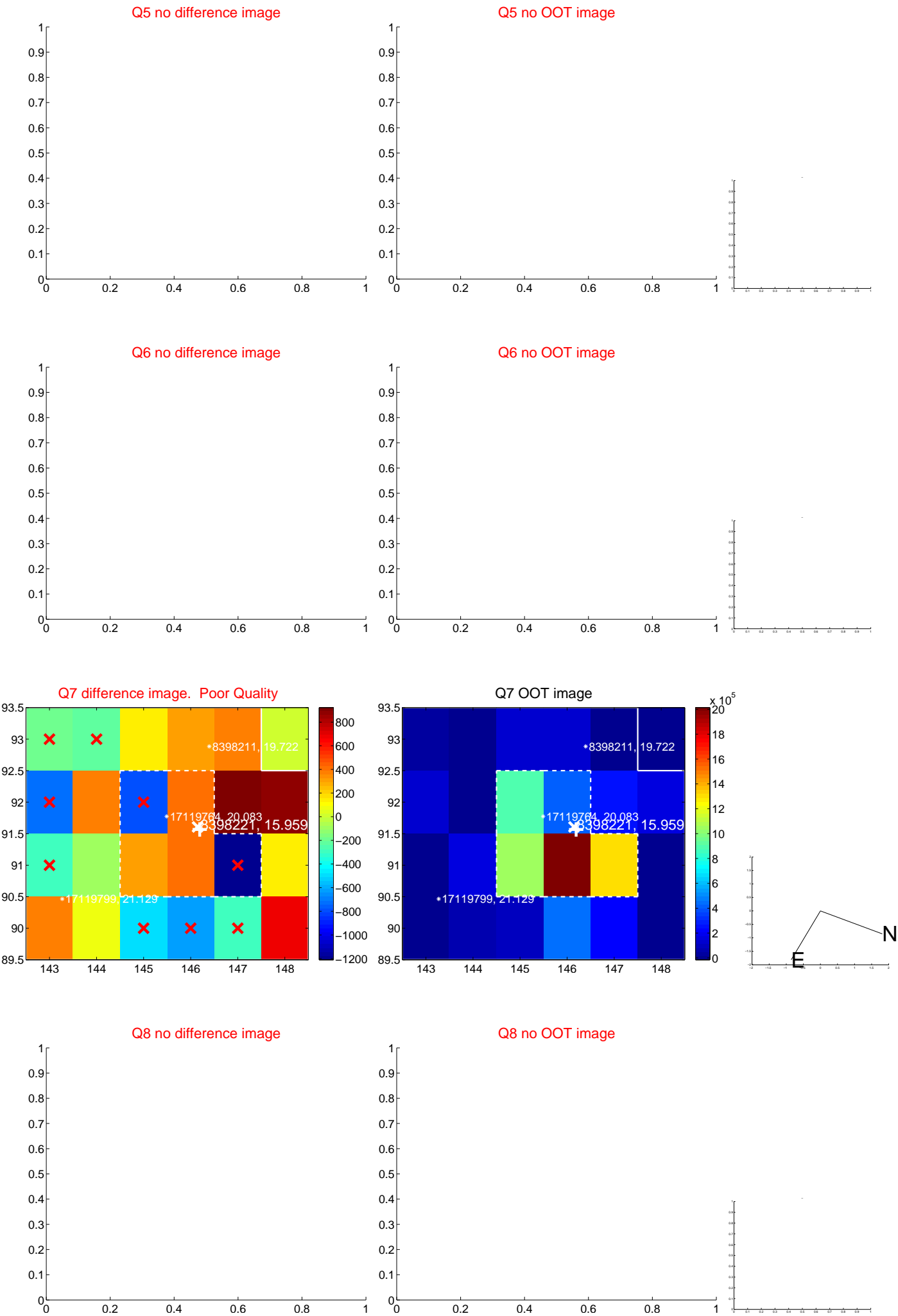


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

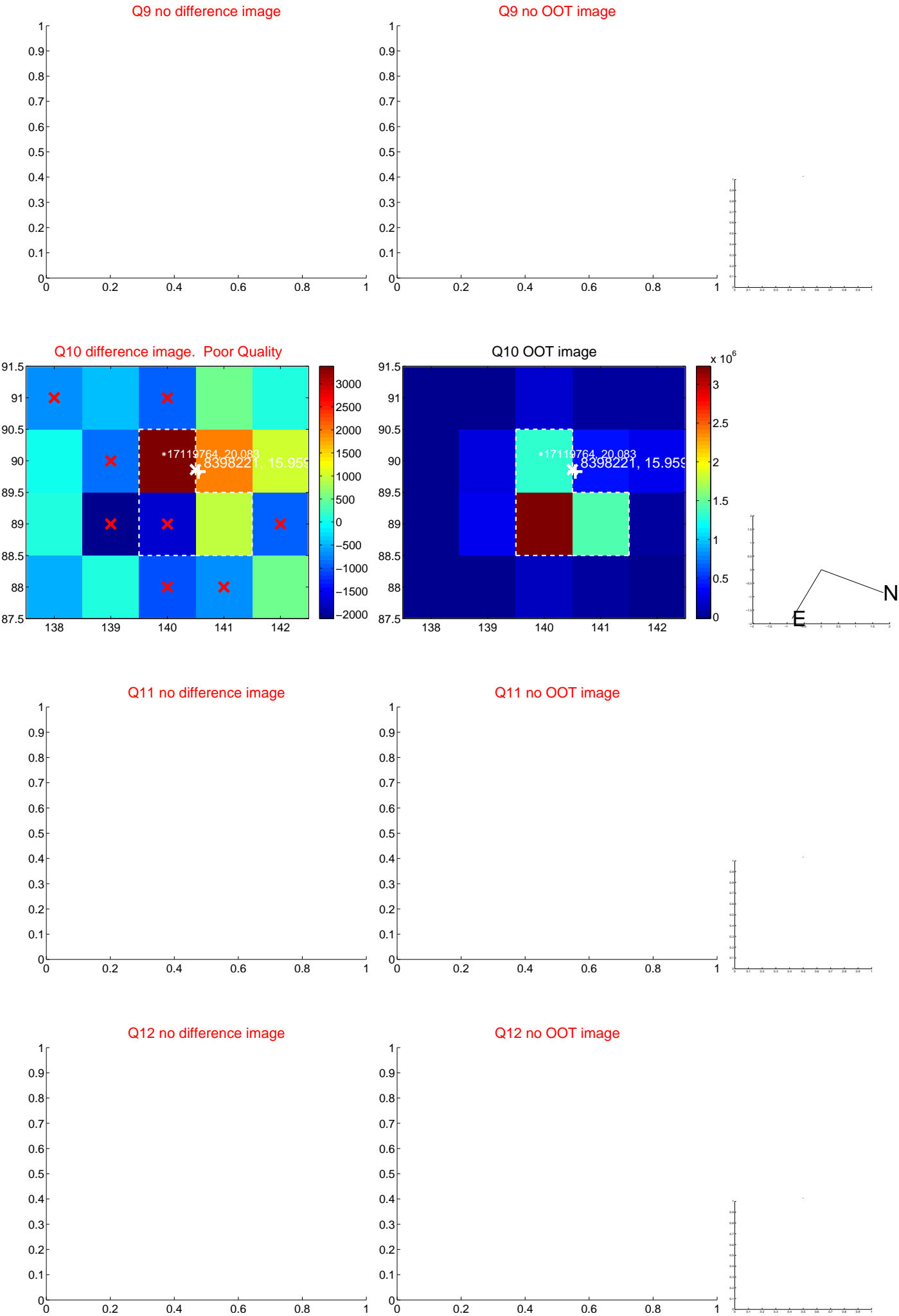


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

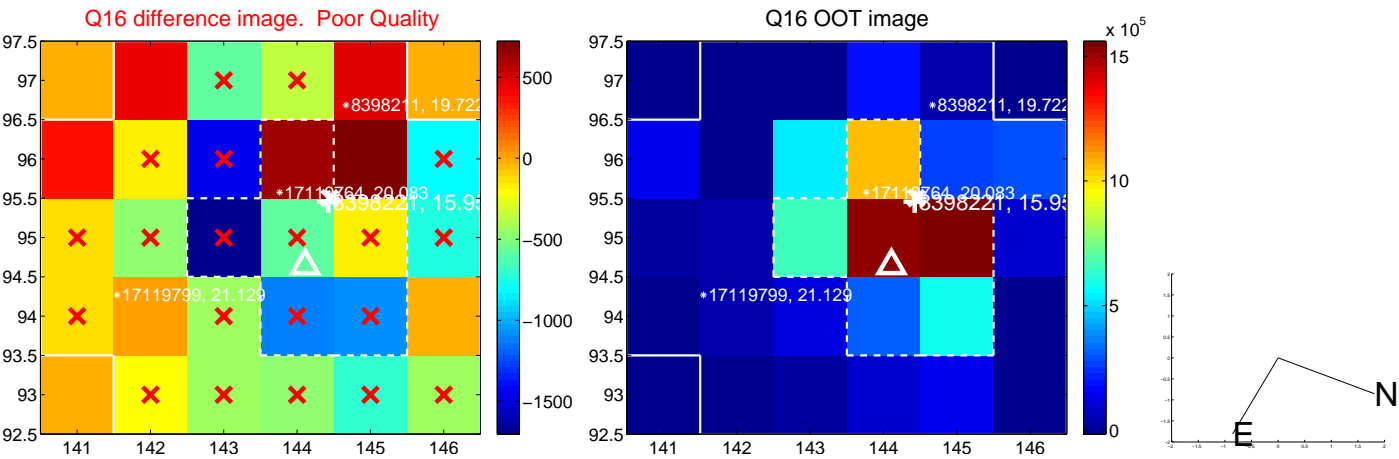
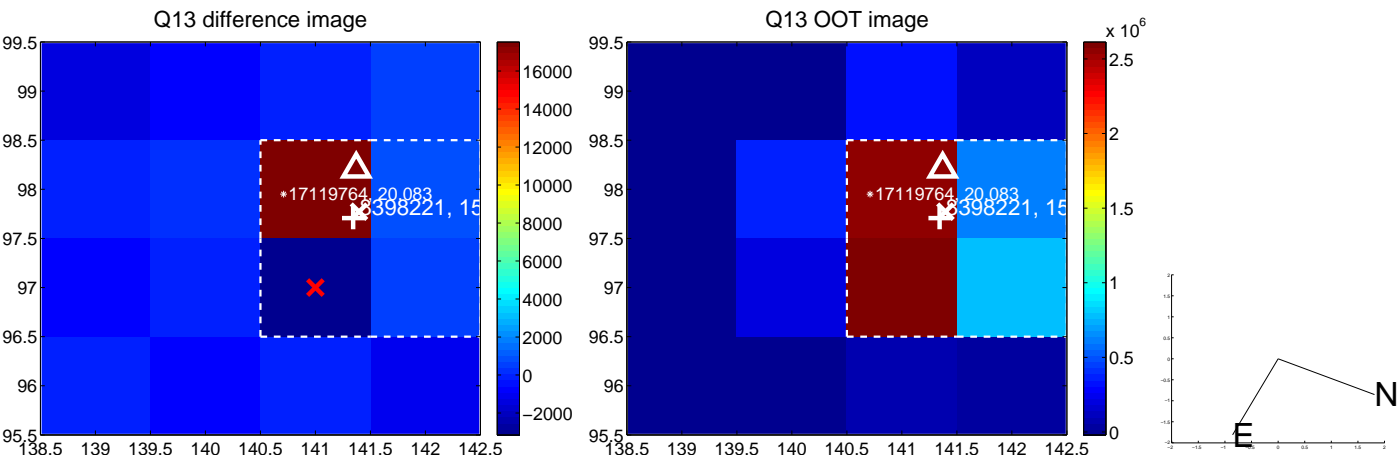




white ×: KIC target position; +: OOT centroid; △: difference centroid. red ✕: large negative pixel value.

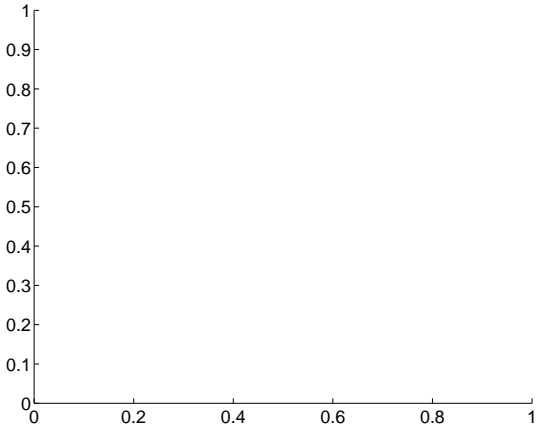


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

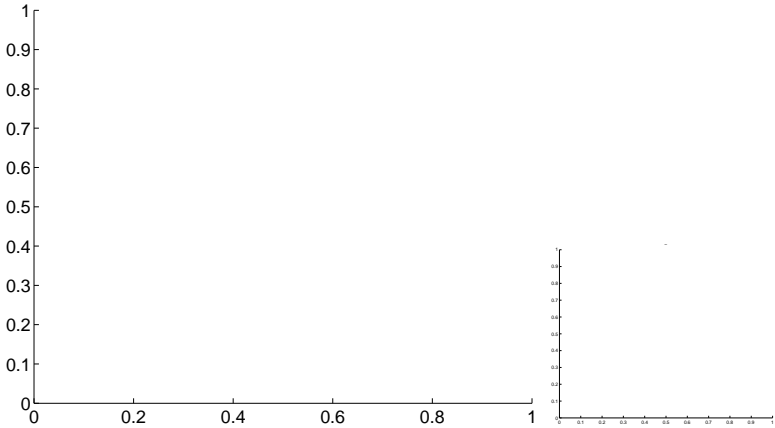


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

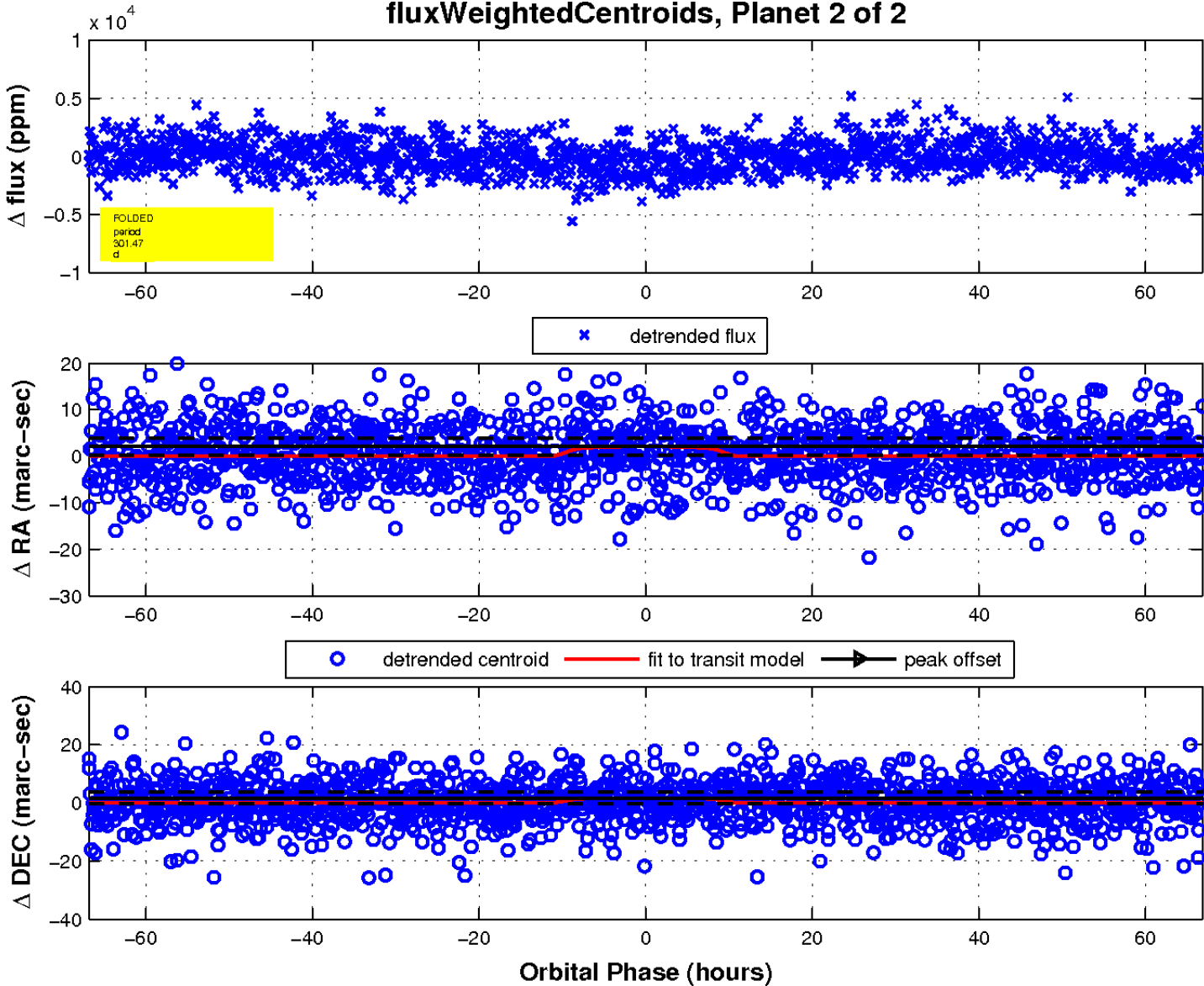
Q17 no difference image



Q17 no OOT image



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

Declination

