

# KIC 009456389

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009456389-01	OBS	No	0.948947	131.837364	29.7	5.688	7.7	6.1	2.39	7495	1.51	31031.47
009456389-02	OBS	No	273.387603	224.266464	1132.7	15.225	10.6	9.6	2.39	7495	9.71	16.31

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009456389-01	OBS	FP	0.00	1	0	1	0	LPP_DV—MOD_NONUNIQ_DV—HALO_GHOST
009456389-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE—LPP_DV—LPP_ALT—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—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.

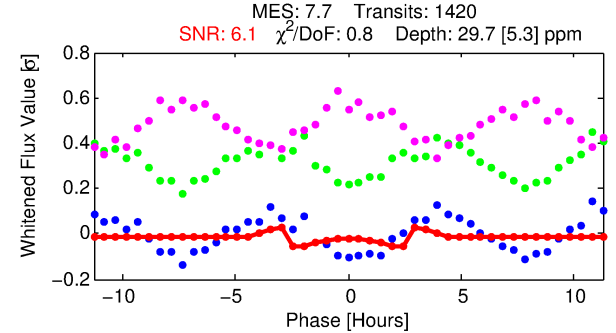
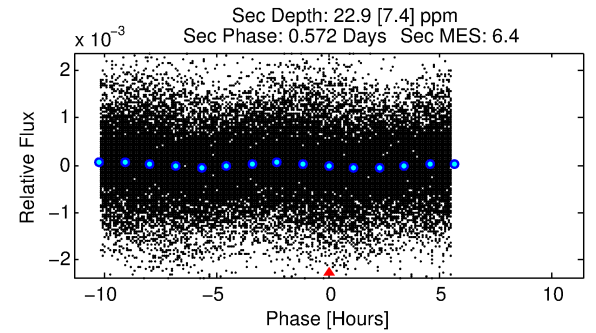
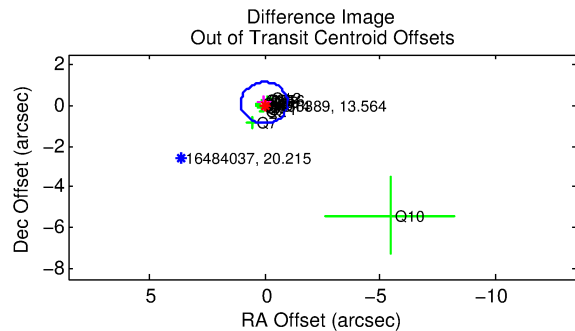
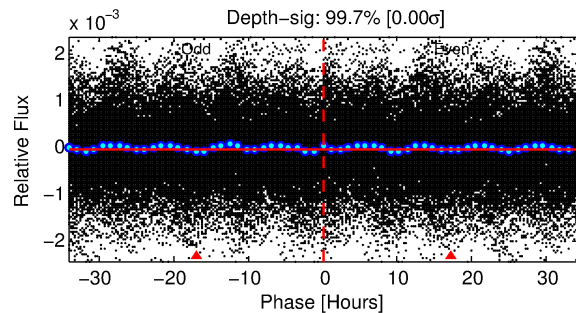
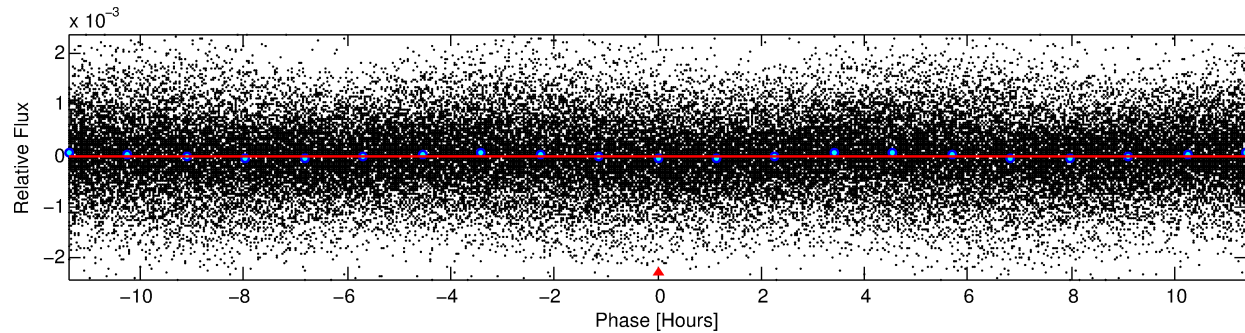
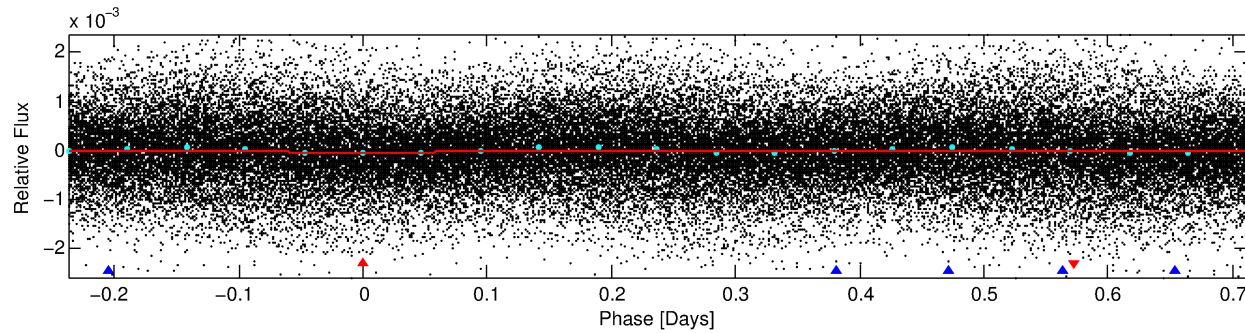
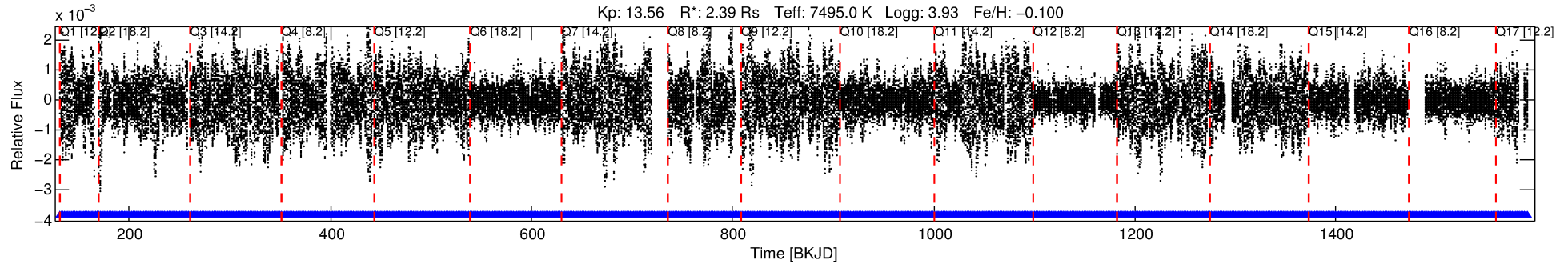
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009456389-01

No Significant Match Found

# DV One-Page Summary

KIC: 9456389 Candidate: 1 of 2 Period: 0.949 d



## DV Fit Results:

Period = 0.94895 [0.00002] d  
Epoch = 131.8374 [0.0033] BKJD  
Rp/R\* = 0.0058 [0.0015]  
a/R\* = 1.10 [0.31]  
b = 0.90 [0.34]  
Seff = 31031.47 [15528.61]  
Teq = 3384 [423] K  
Rp = 1.51 [0.67] Re  
a = 0.0228 [0.0071] AU  
Ag = 2.88 [2.24] [0.84 $\sigma$ ]  
Teffp = 6819 [1094] K [2.93 $\sigma$ ]

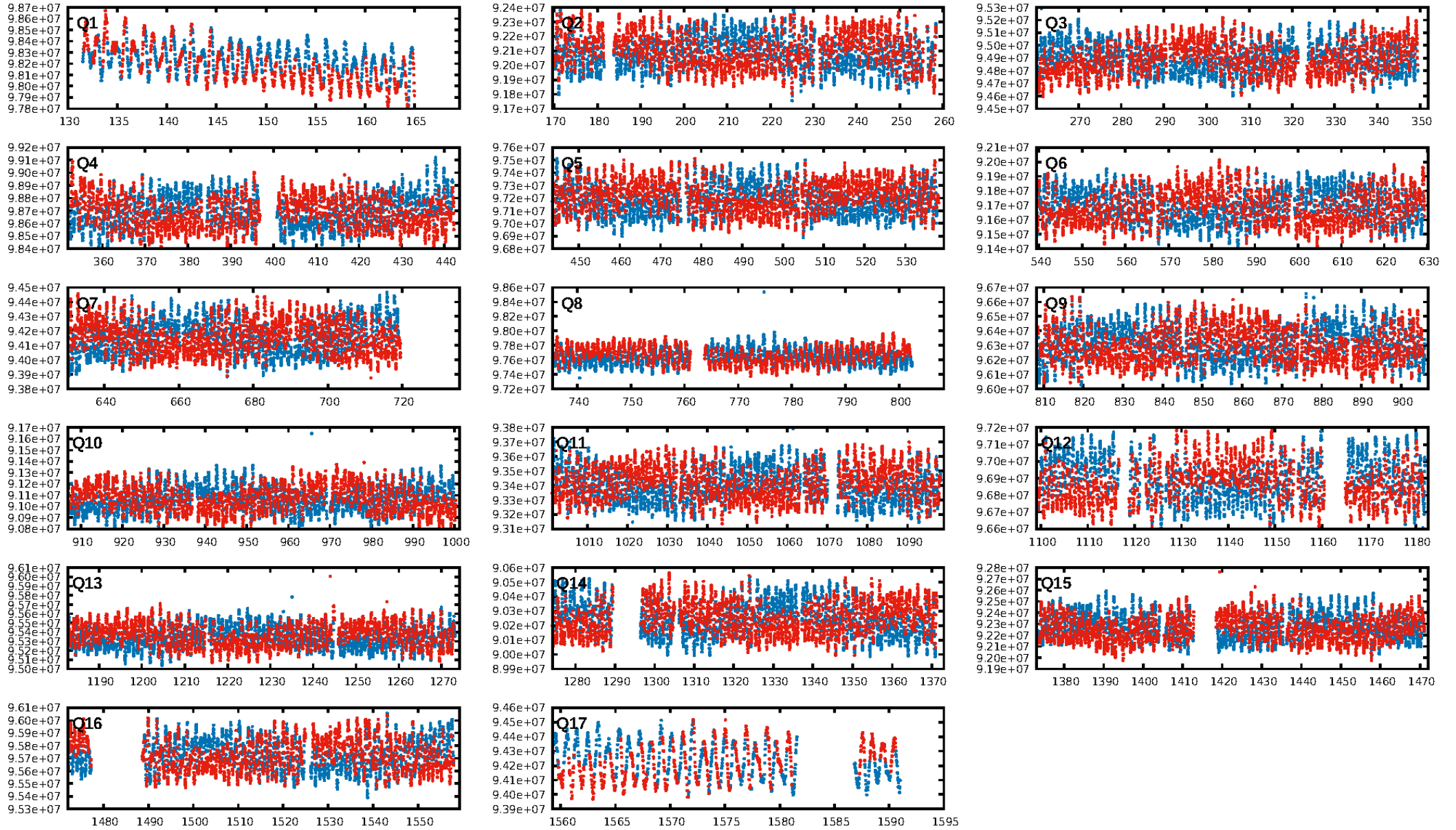
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [402.30 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 1.25e-12  
RollingBand-fgt: 1.00 [1357/1357]  
GhostDiagnostic-chr: 0.2381  
Centroid-sig: 79.9%  
Centroid-so: 0.293 arcsec [0.45 $\sigma$ ]  
OotOffset-rm: 0.128 arcsec [0.38 $\sigma$ ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-rm: 0.116 arcsec [0.57 $\sigma$ ]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 0.59 [10/17]  
DiffImageOverlap-fno: 1.00 [17/17]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 12:25:20 Z

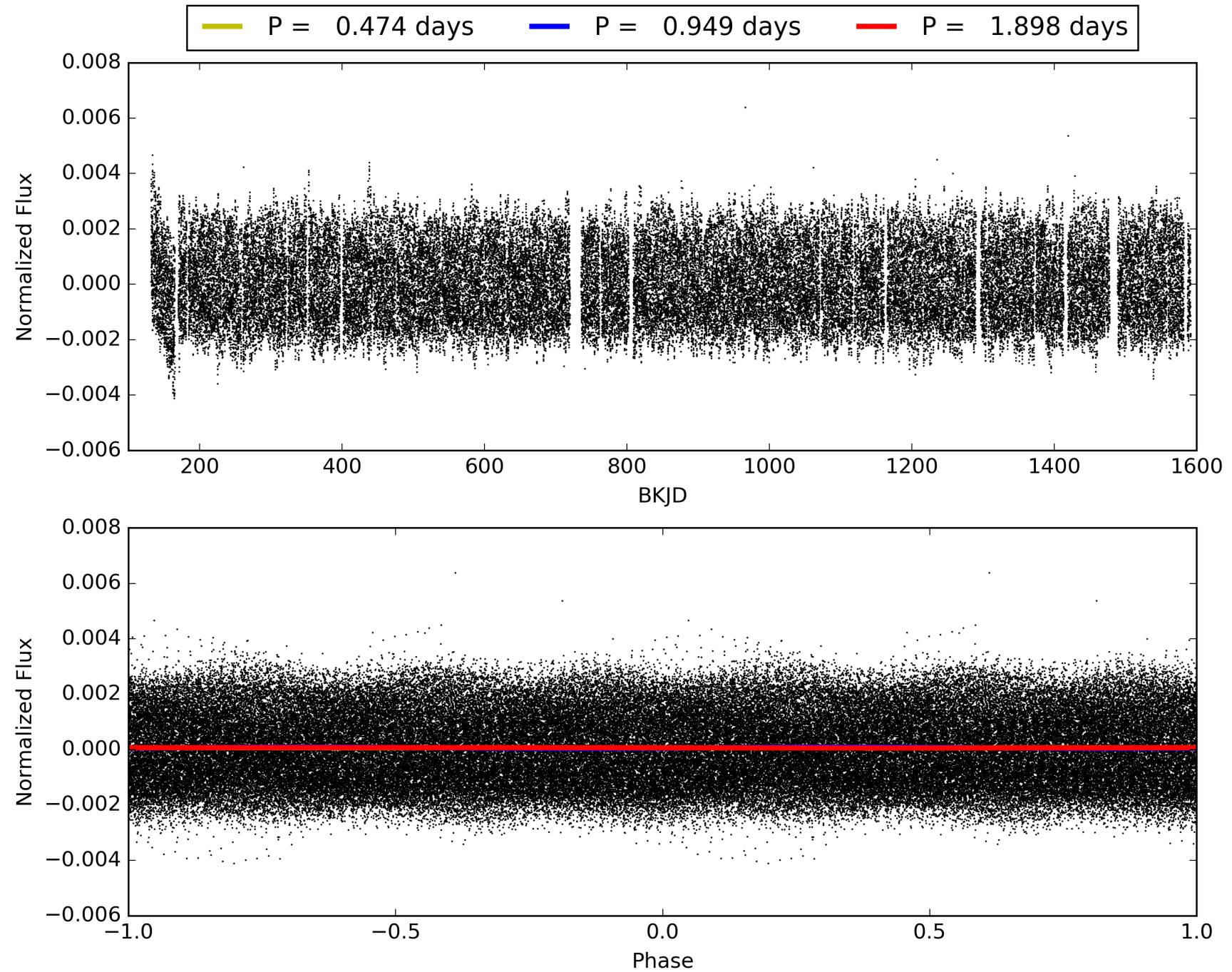
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 009456389-01, PDC Light Curves



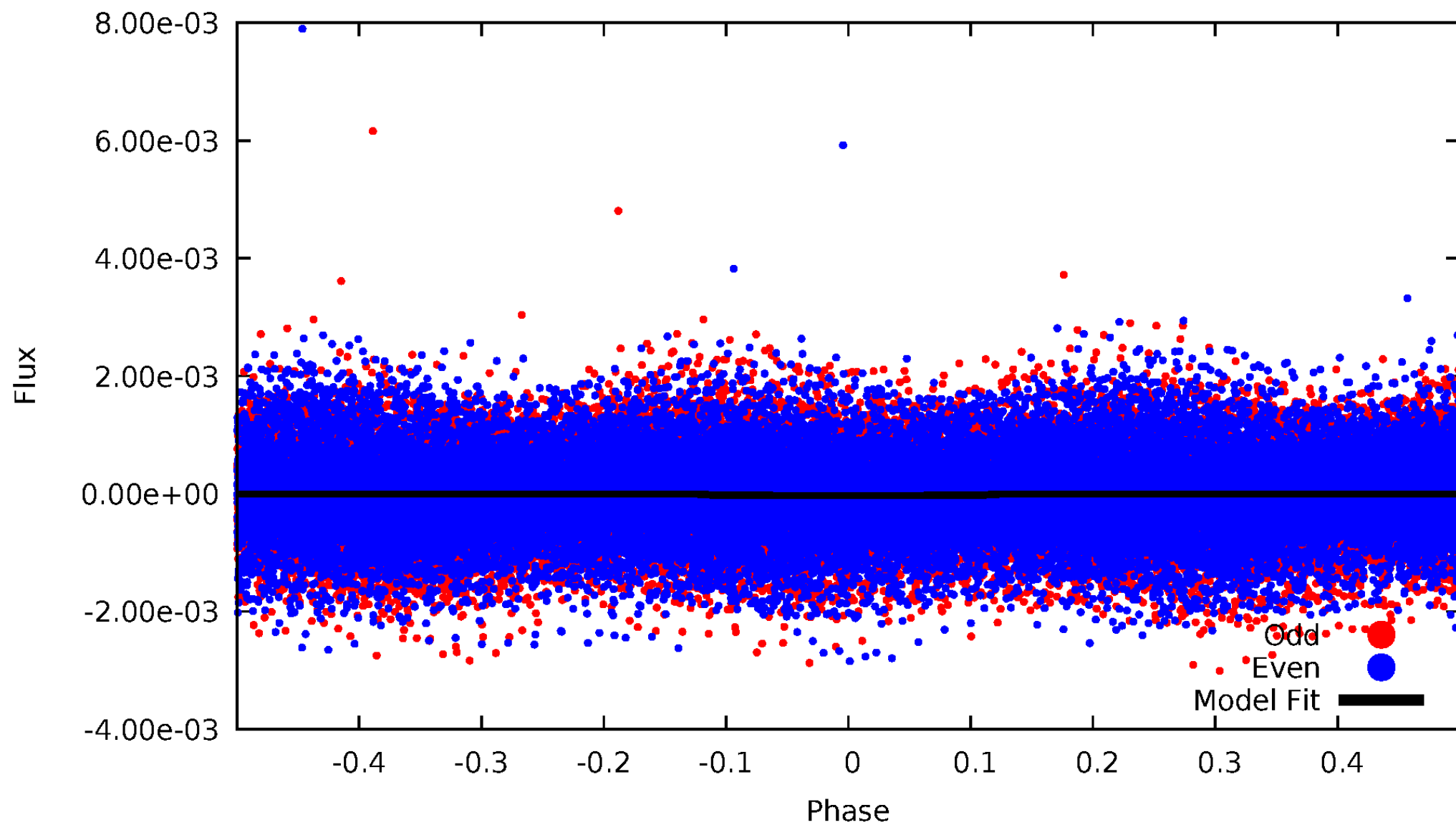


TCE 009456389-01



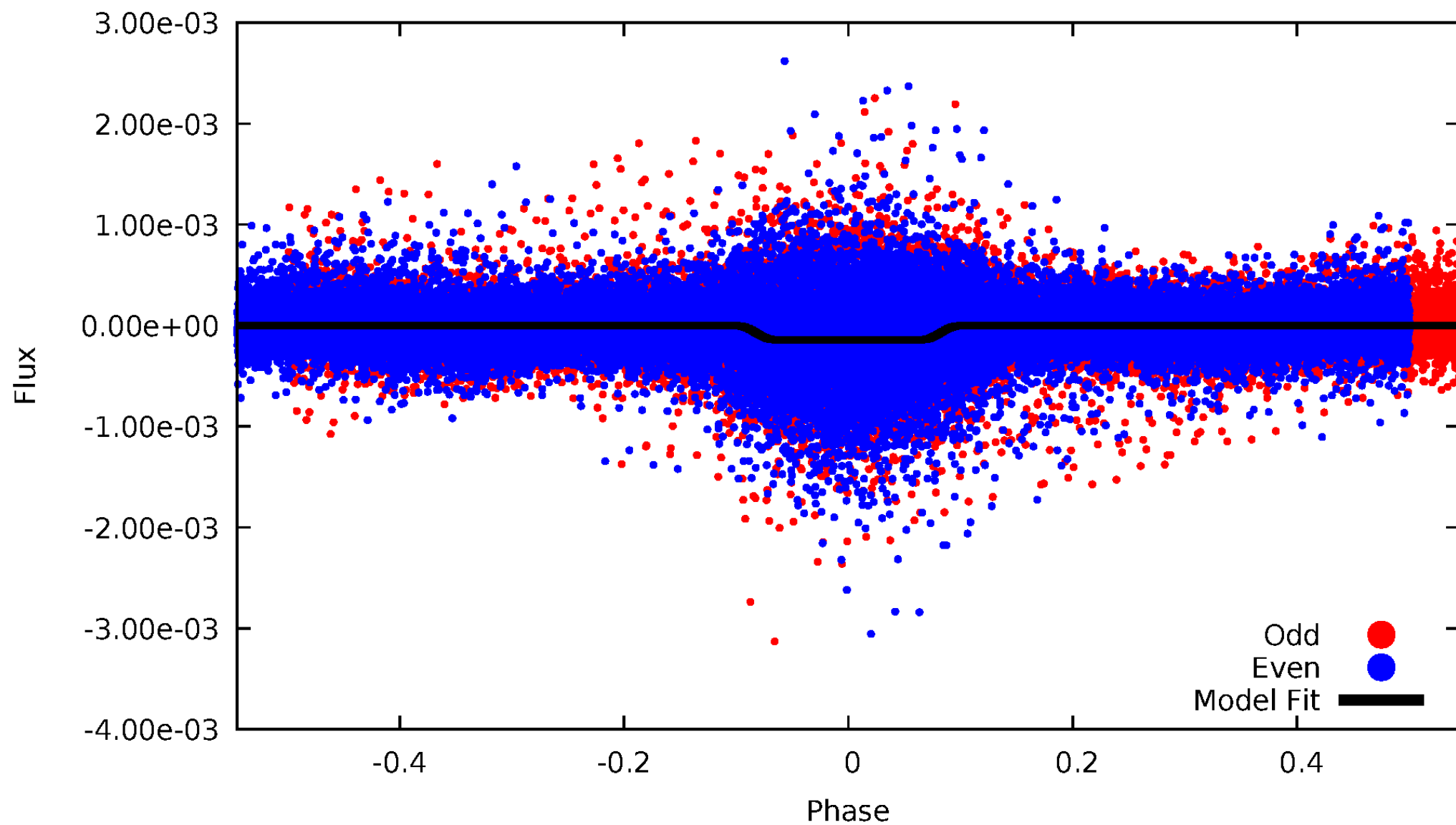
# DV Odd/Even

TCE 009456389-01

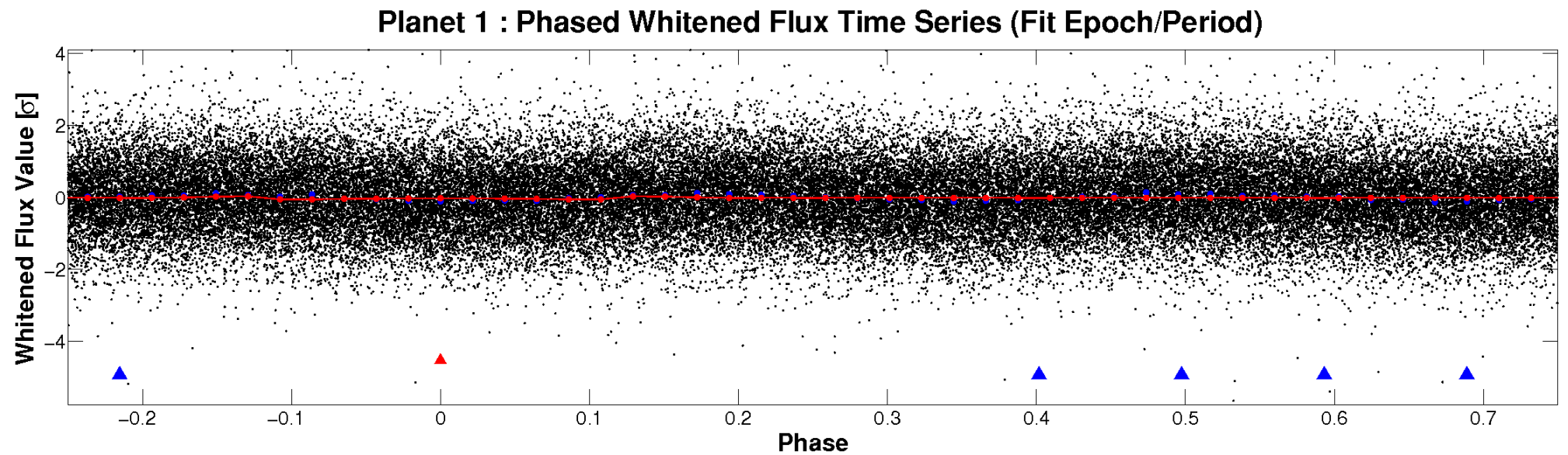
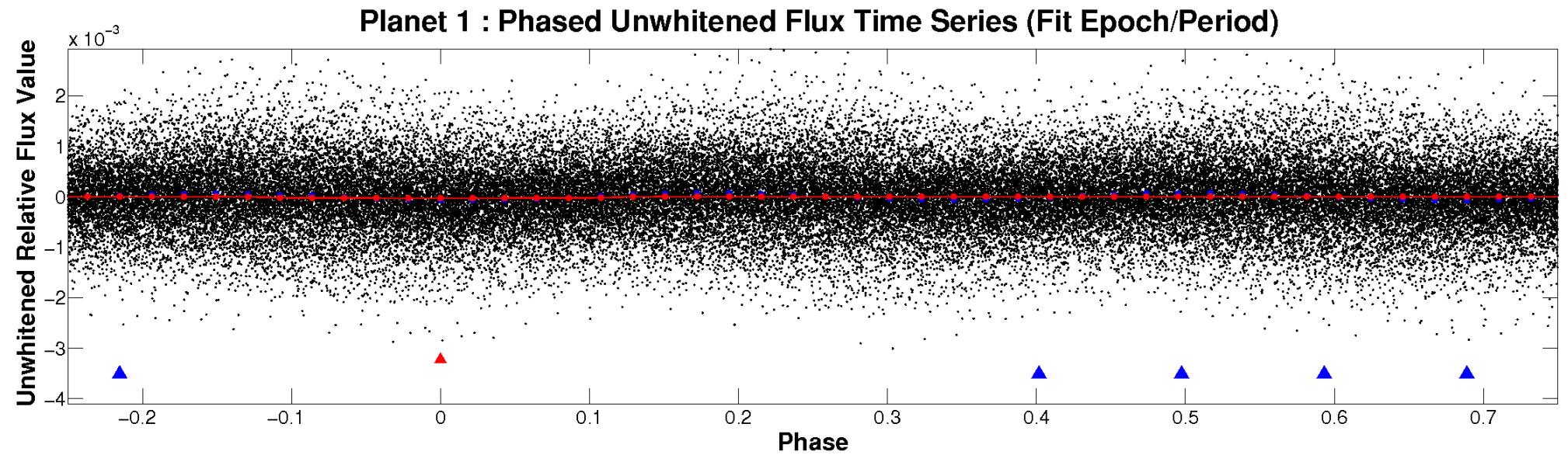


# ALT Odd/Even

TCE 009456389-01



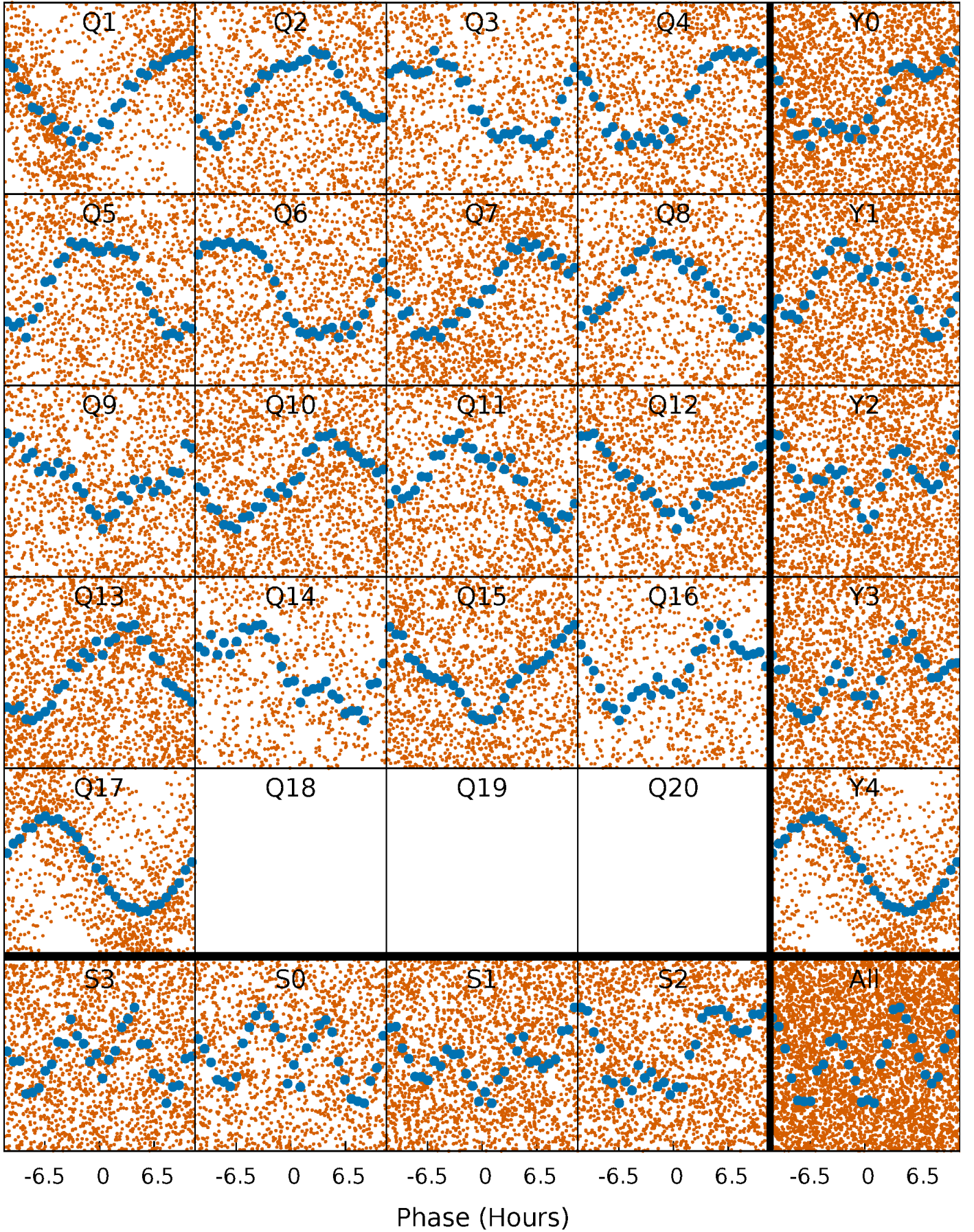
# Non-Whitened Vs. Whitened Light Curve





# PDC Quarter-Phased Transit Curves

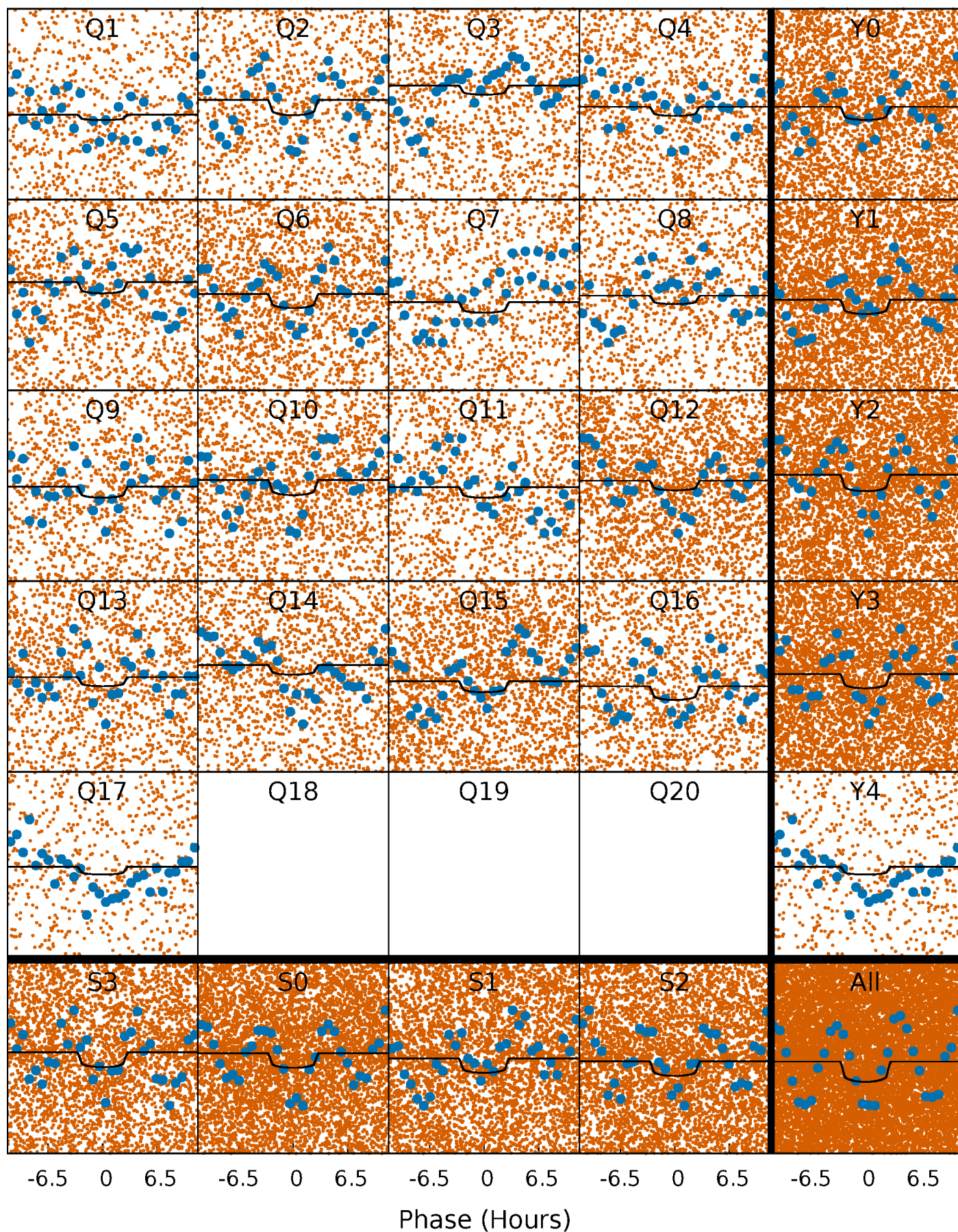
TCE 009456389-01   P= 0.948947 Days    $T_0=131.837364$  (BKJD)





# DV Quarter-Phased Transit Curves

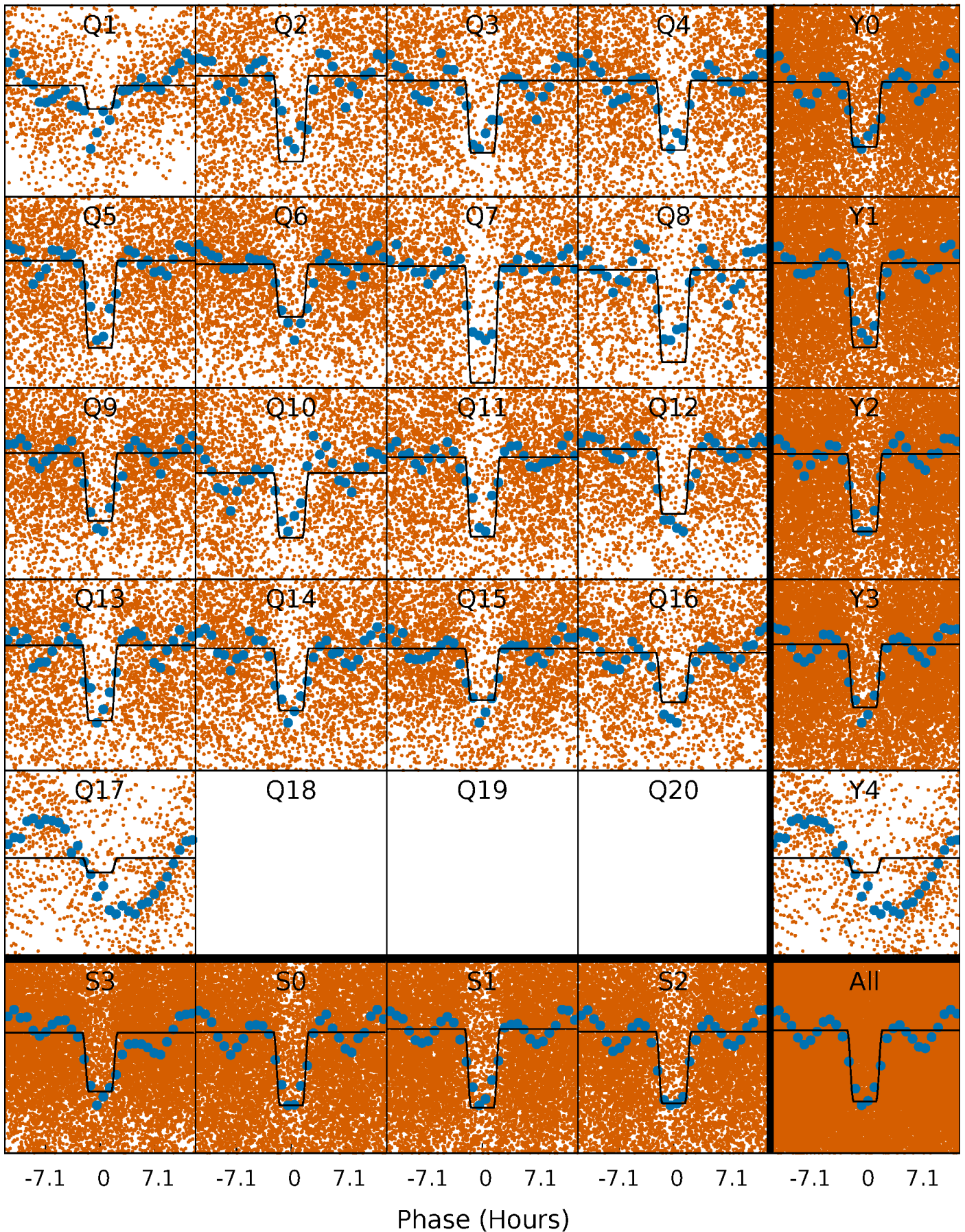
TCE 009456389-01   P= 0.948947 Days    $T_0=131.837364$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

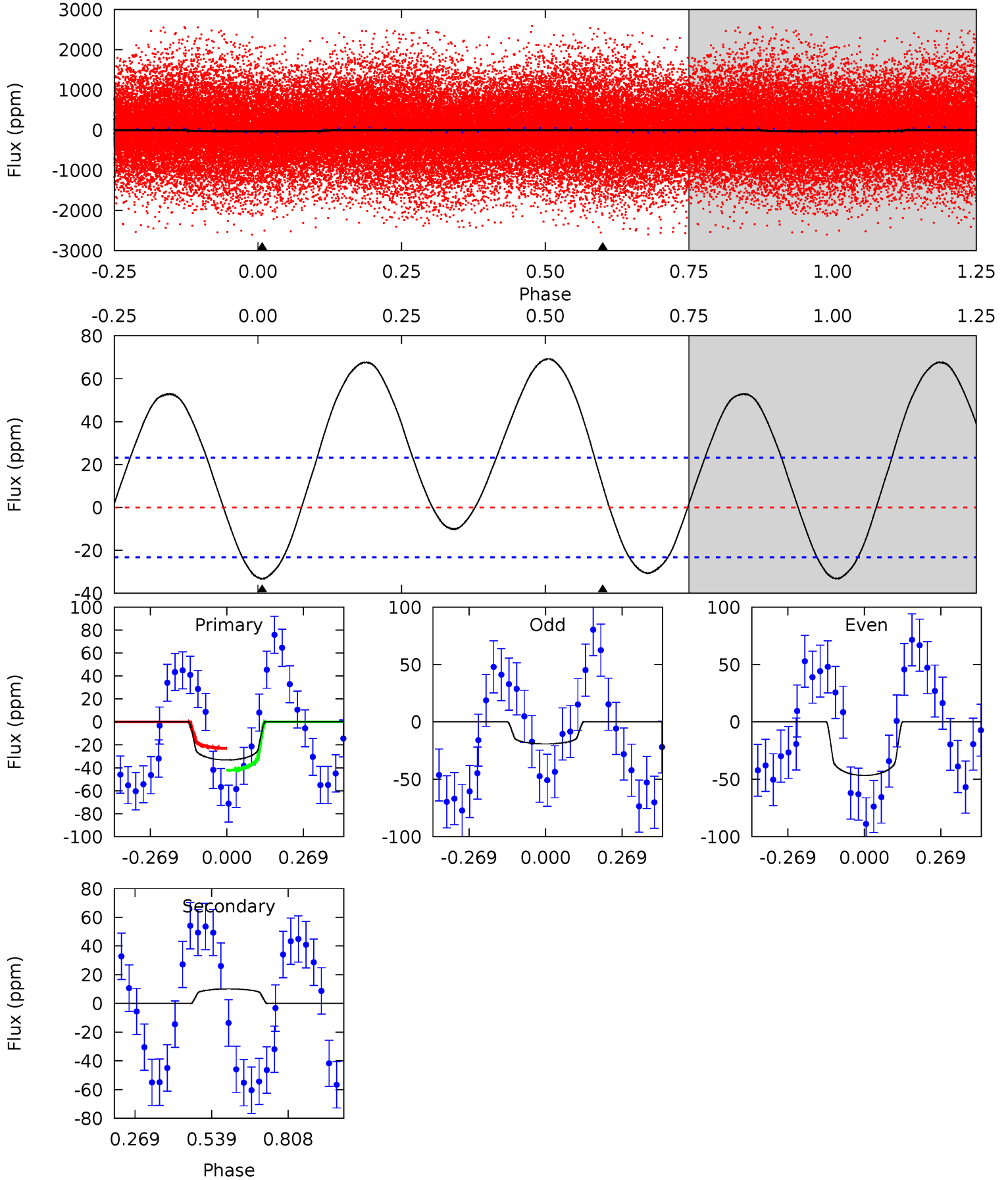
TCE 009456389-01 P= 0.948973 Days  $T_0=131.831848$  (BKJD)



# DV Model-Shift Uniqueness Test

009456389-01, P = 0.948947 Days, E = 130.888417 Days

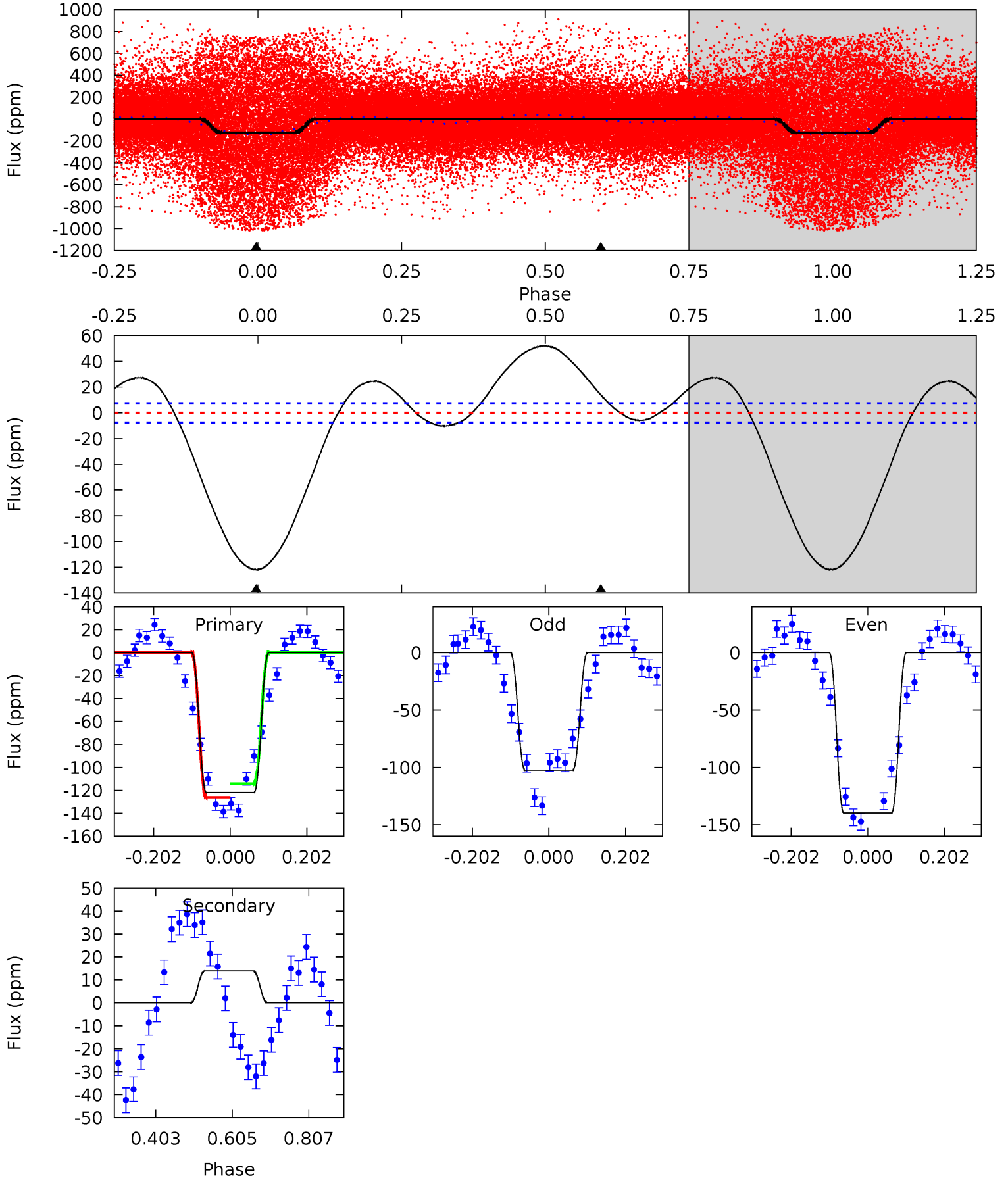
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
6.22	-1.90	0	0	4.35	1.10	2.74	6.22	6.22	-1.90	-1.90	2.77	1.18	0.68	1.89



# Alt Model-Shift Uniqueness Test

009456389-01, P = 0.948973 Days, E = 130.882875 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
71.0	-8.13	0	0	4.42	1.28	6.85	71.0	71.0	-8.13	-8.13	10.7	1.17	0.30	3.54





### Stellar Parameters For KIC 009456389

	$T_{\text{eff}} (K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R (R_{\odot})$	$M (M_{\odot})$	$\rho_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$7495^{+235}_{-314}$	$3.926^{+0.266}_{-0.123}$	$-0.100^{+0.200}_{-0.350}$	$2.389^{+0.520}_{-0.845}$	$1.754^{+0.195}_{-0.391}$	$0.181^{+0.317}_{-0.077}$
	+3%/-4%	+7%/-3%	+200%/-350%	+22%/-35%	+11%/-22%	+175%/-42%
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 009456389-01 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$10 \pm 5$	$1.43^{+0.47}_{-0.46}$	$4649^{+338}_{-386}$	$-5713^{+827}_{-1013}$	$-1.271^{+0.797}_{-1.787}$
Alt.	$14 \pm 2$	$2.98^{+0.64}_{-0.59}$	$4646^{+339}_{-420}$	$-4825^{+246}_{-234}$	$-0.440^{+0.142}_{-0.236}$

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

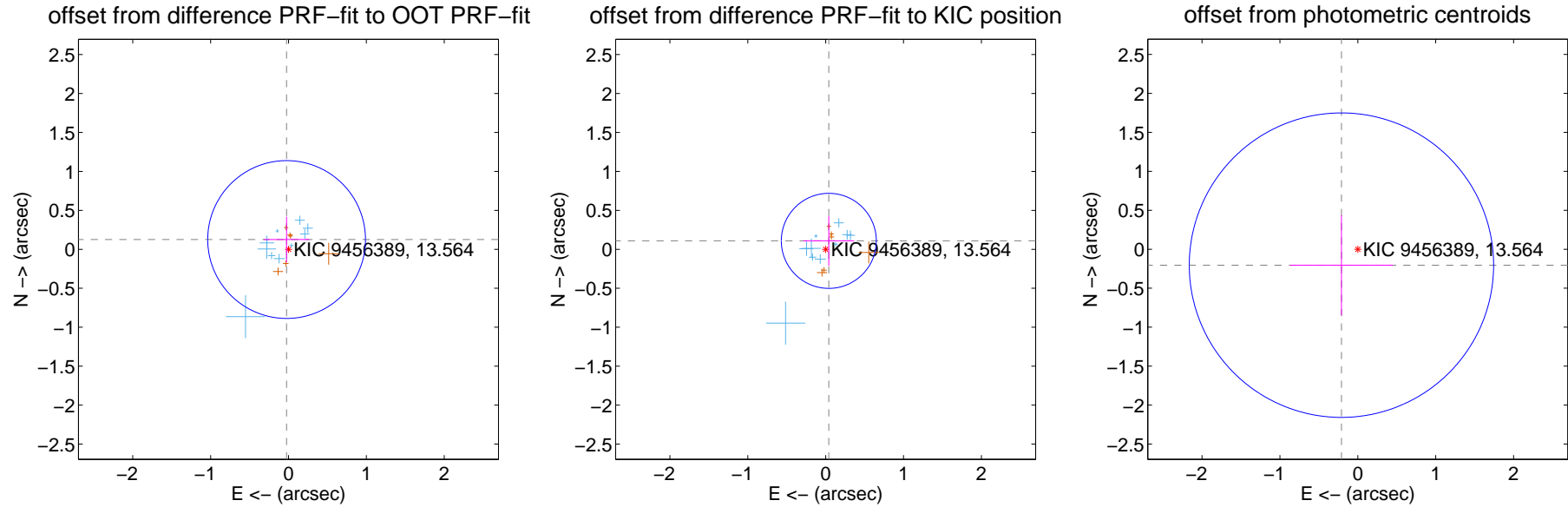
## DV Centroid Data

Supplemental centroid analysis for 009456389-01. Kepler magnitude: 13.56. Transit SNR 6.09

There are 10 quarters with good PRF difference image offsets

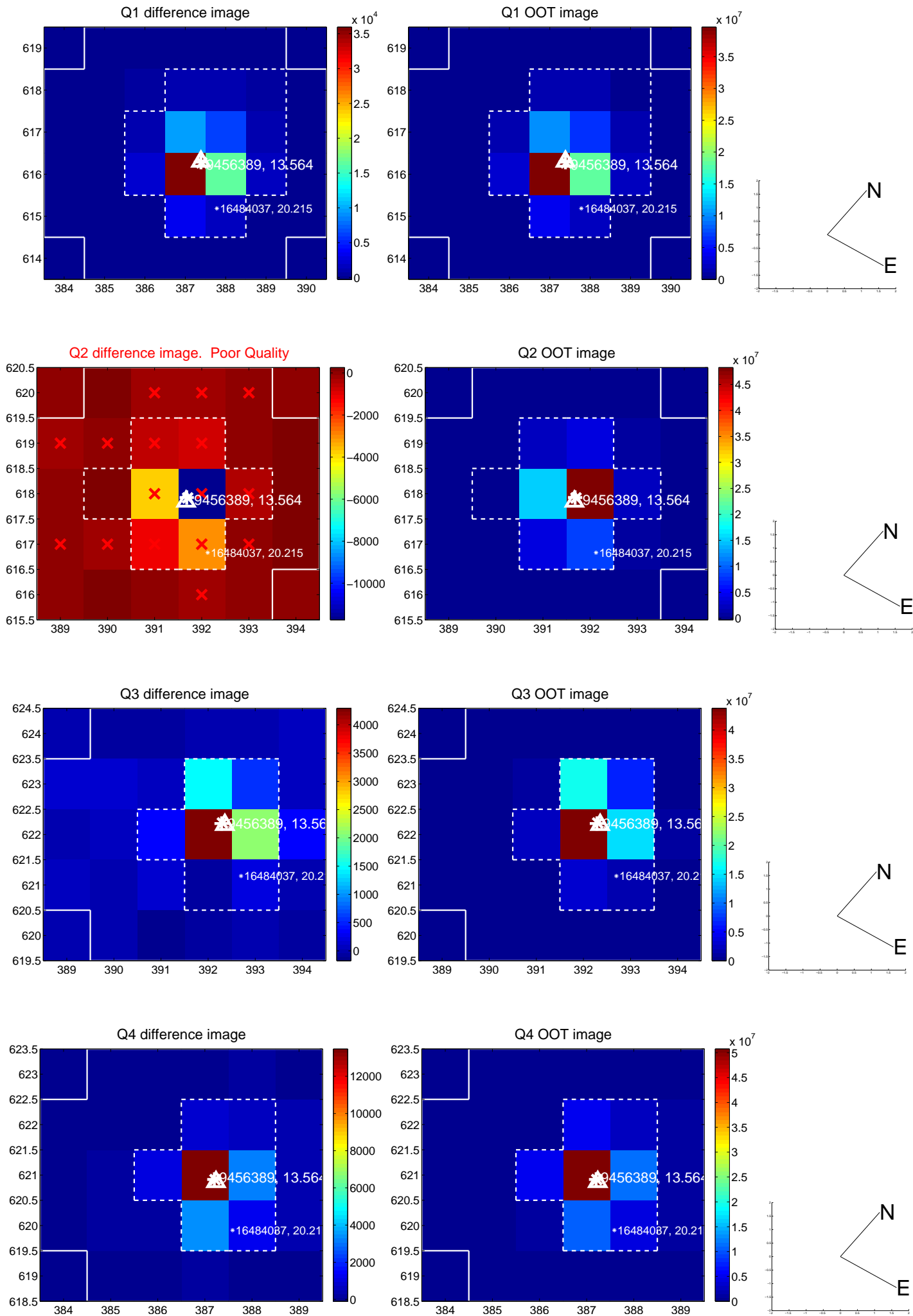
The direct PRF centroid is offset from the target star catalog position by about 0.10 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.128 \pm 0.338$	0.38	$0.024 \pm 0.293$	$0.125 \pm 0.293$
PRF-fit source offset from KIC position	$0.116 \pm 0.203$	0.57	$-0.041 \pm 0.326$	$0.108 \pm 0.319$
photometric centroid source offset	$0.29 \pm 0.65$	0.45	$0.21 \pm 0.66$	$-0.20 \pm 0.64$

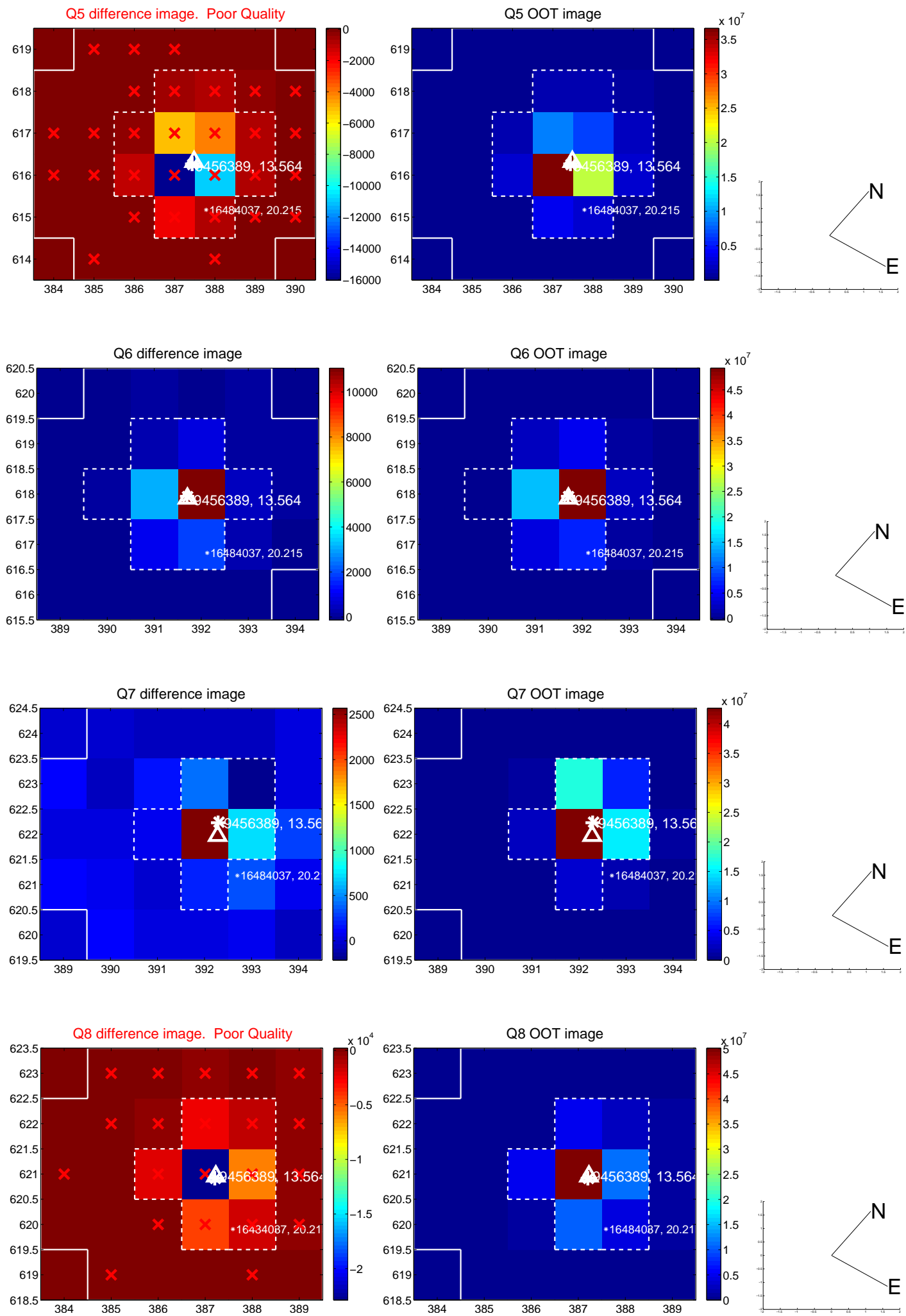


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

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

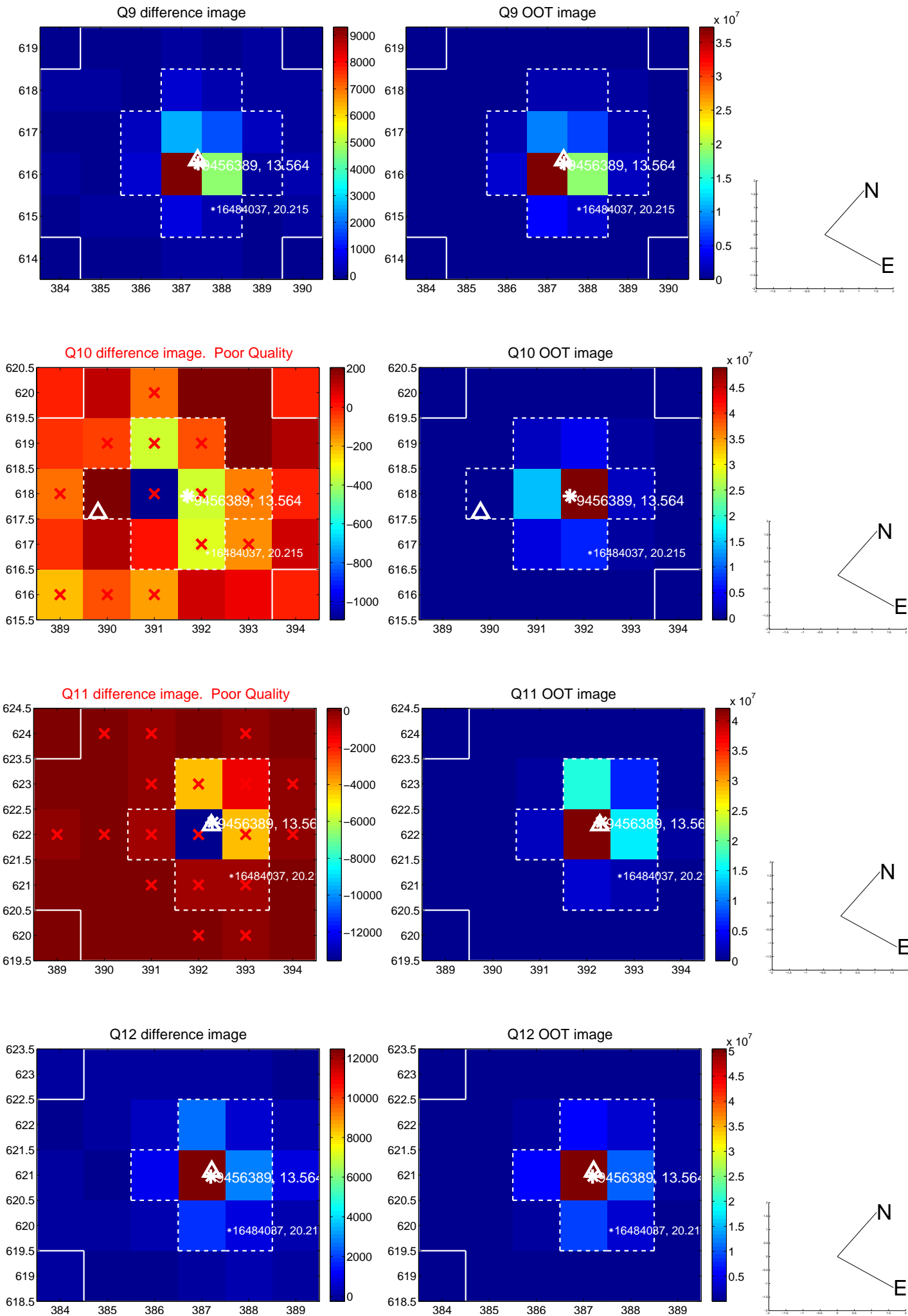


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

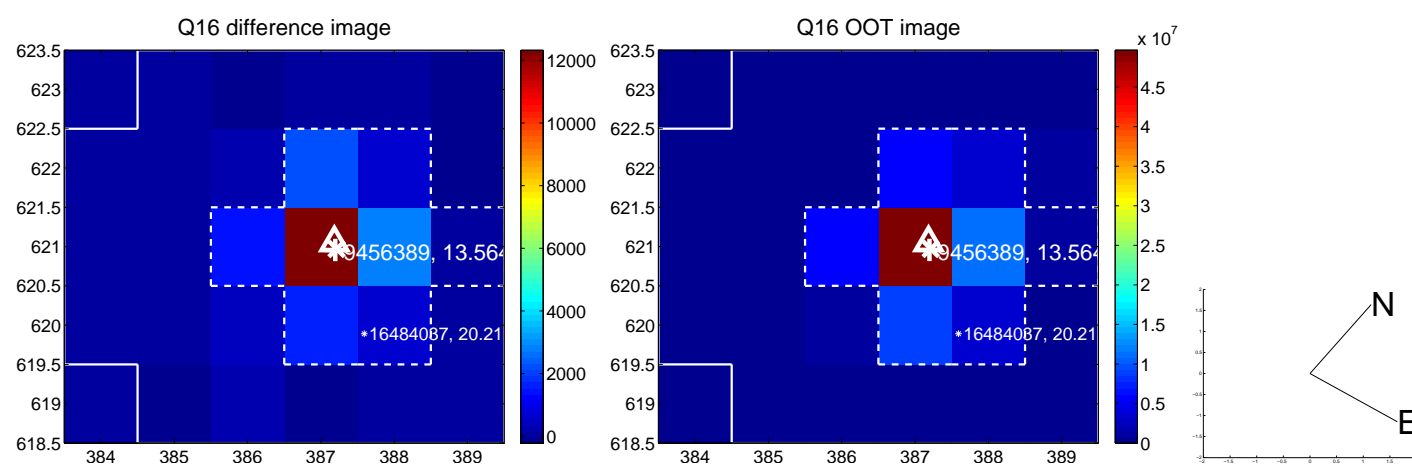
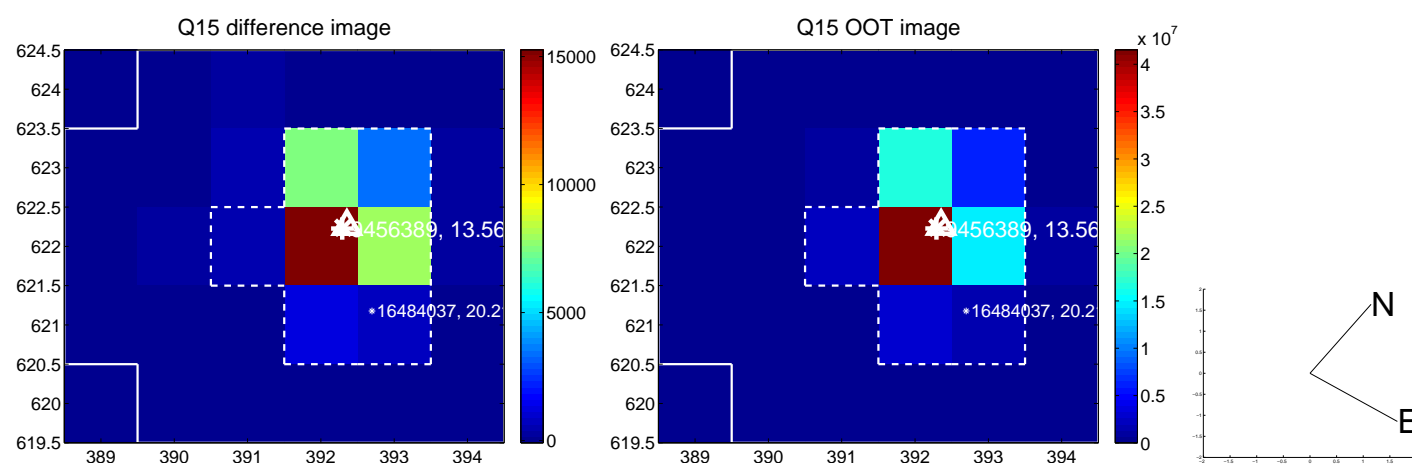
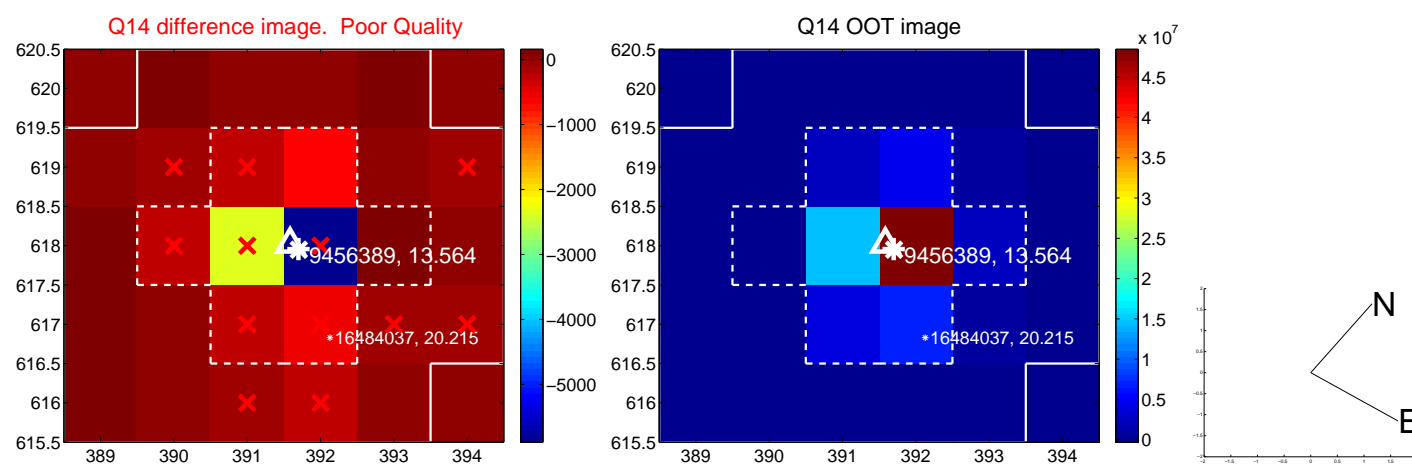
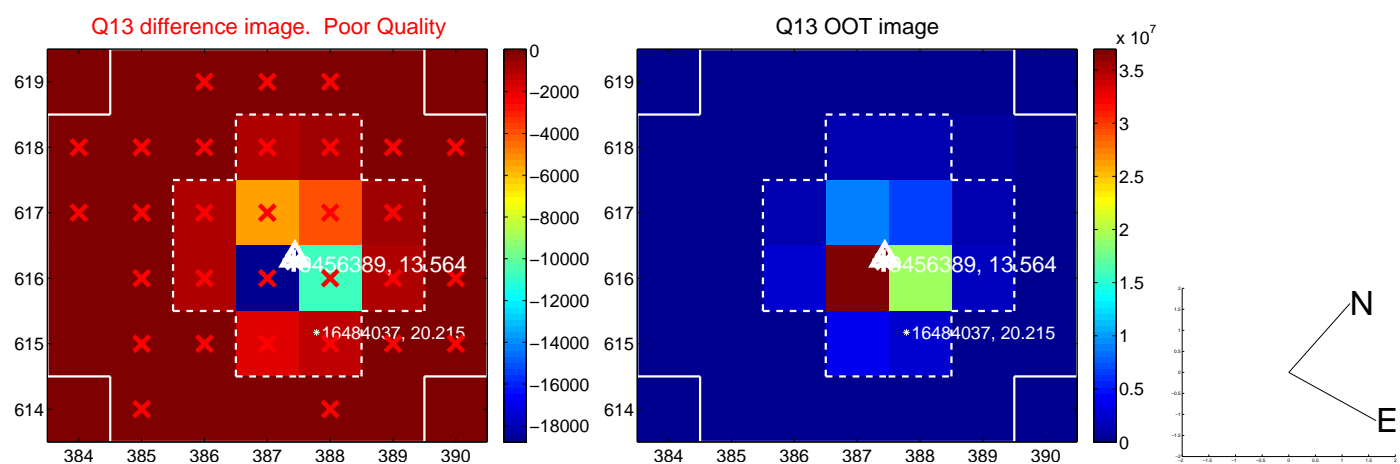




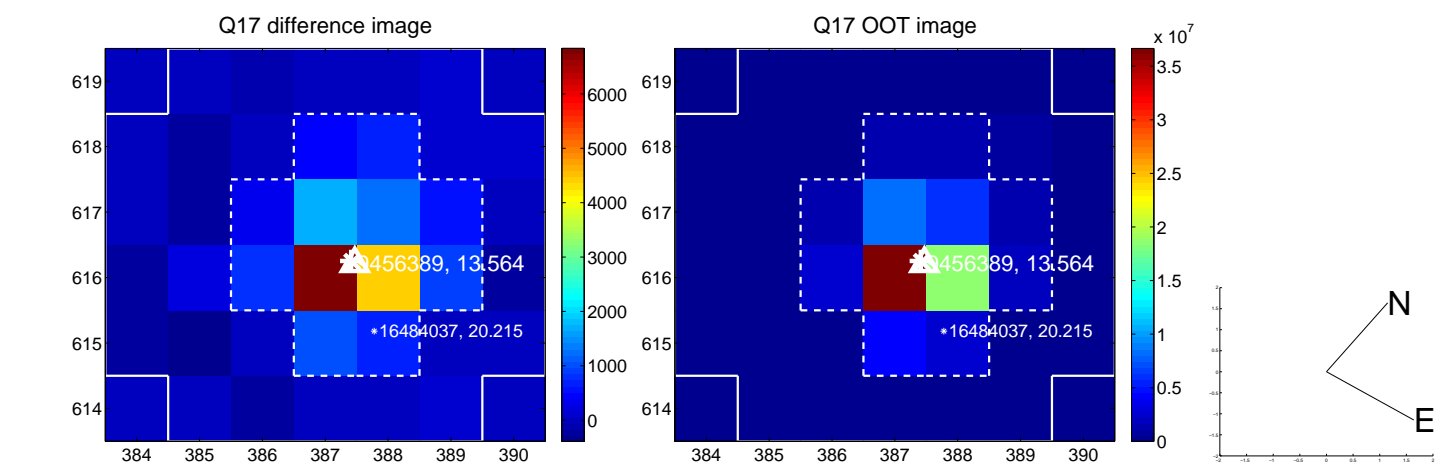
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



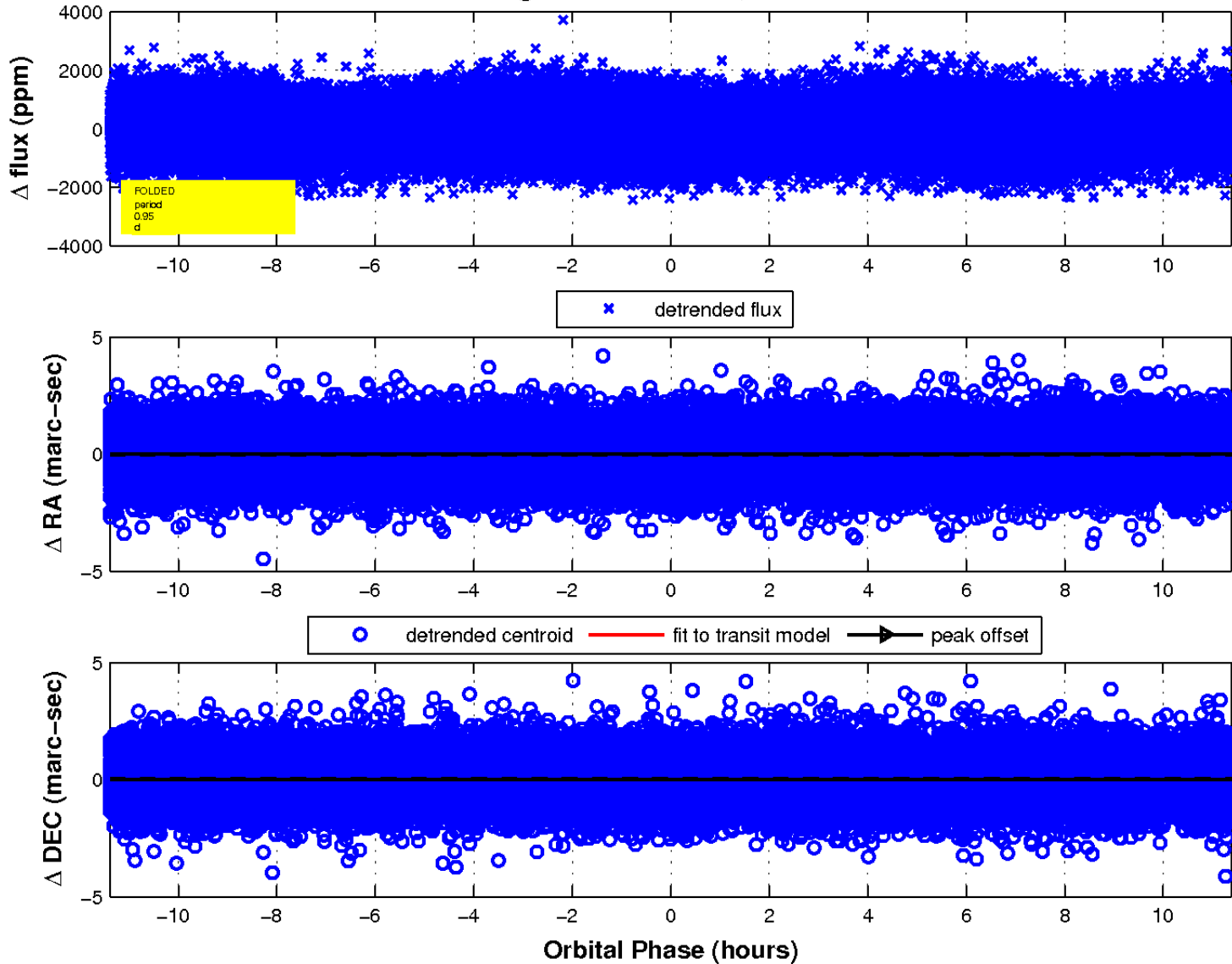
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

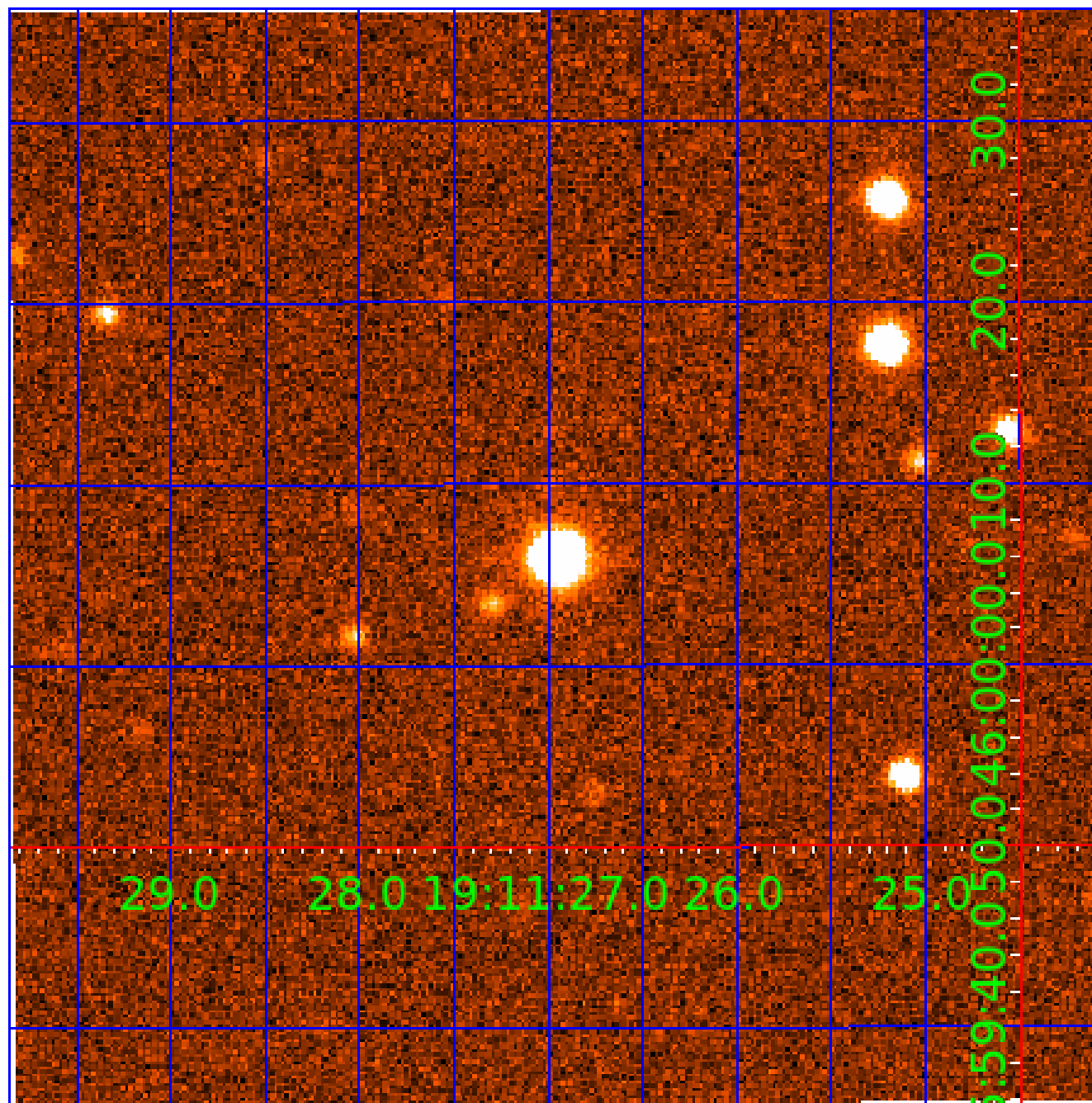


fluxWeightedCentroids, Planet 1 of 2



UKIRT Image

Declination





# KIC 009456389

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009456389-01	OBS	No	0.948947	131.837364	29.7	5.688	7.7	6.1	2.39	7495	1.51	31031.47
009456389-02	OBS	No	273.387603	224.266464	1132.7	15.225	10.6	9.6	2.39	7495	9.71	16.31

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009456389-01	OBS	FP	0.00	1	0	1	0	LPP_DV—MOD_NONUNIQ_DV—HALO_GHOST
009456389-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE—LPP_DV—LPP_ALT—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—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.

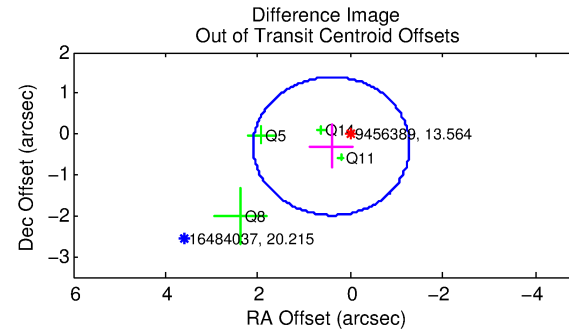
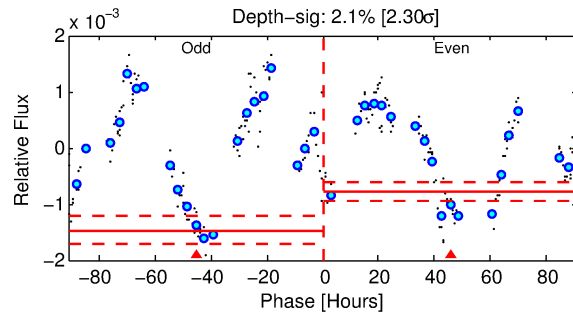
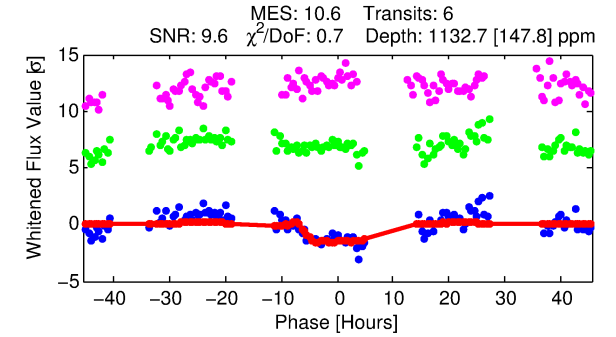
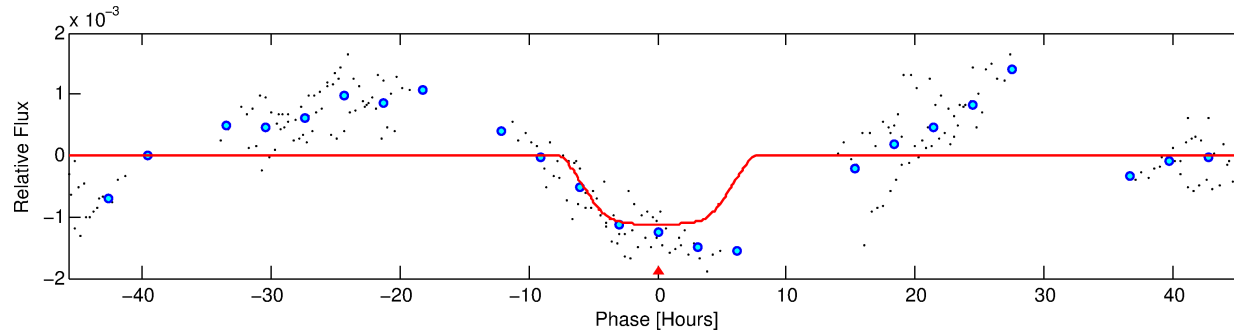
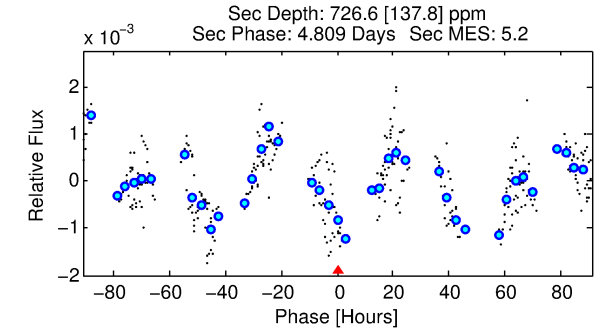
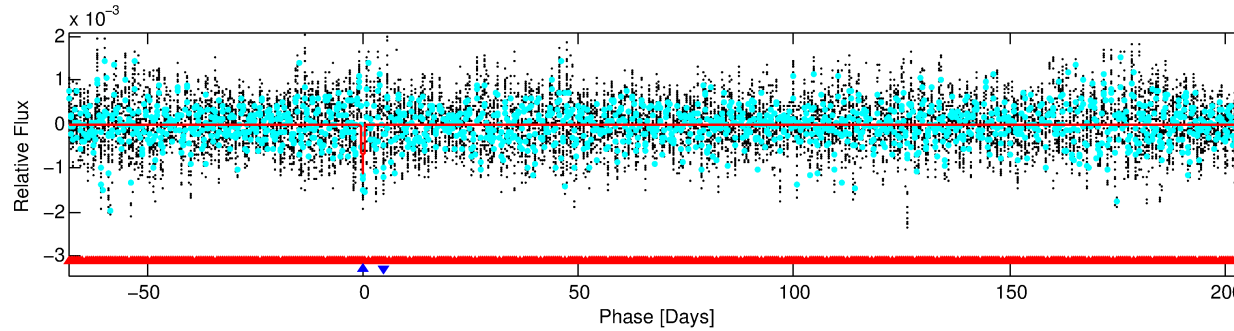
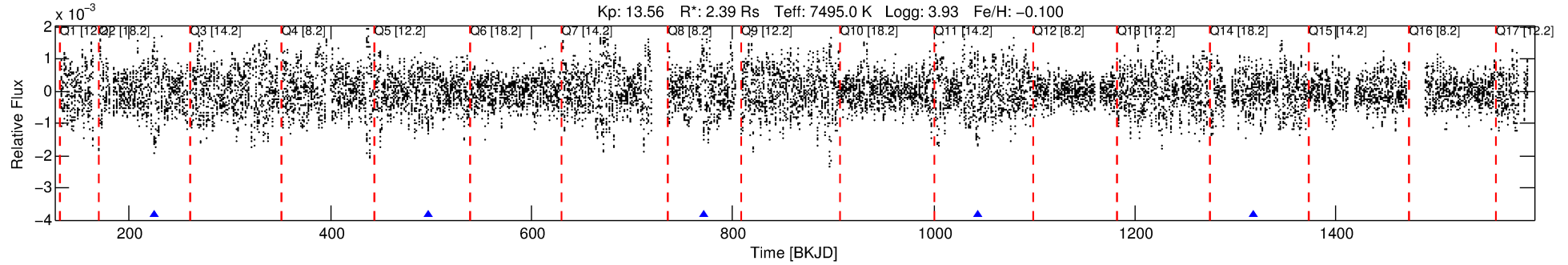
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009456389-02

No Significant Match Found

# DV One-Page Summary

KIC: 9456389 Candidate: 2 of 2 Period: 273.388 d



## DV Fit Results:

Period = 273.38760 [0.01836] d  
Epoch = 224.2665 [0.0550] BKJD  
Rp/R\* = 0.0372 [0.0029]  
a/R\* = 59.50 [11.59]  
b = 0.94 [0.02]  
Seff = 16.31 [8.16]  
Teq = 512 [64] K  
Rp = 9.71 [3.51] Re  
a = 0.9947 [0.3103] AU  
Ag = 4197.92 [2230.58] [1.88σ]  
Teffp = 6377 [473] K [12.28σ]

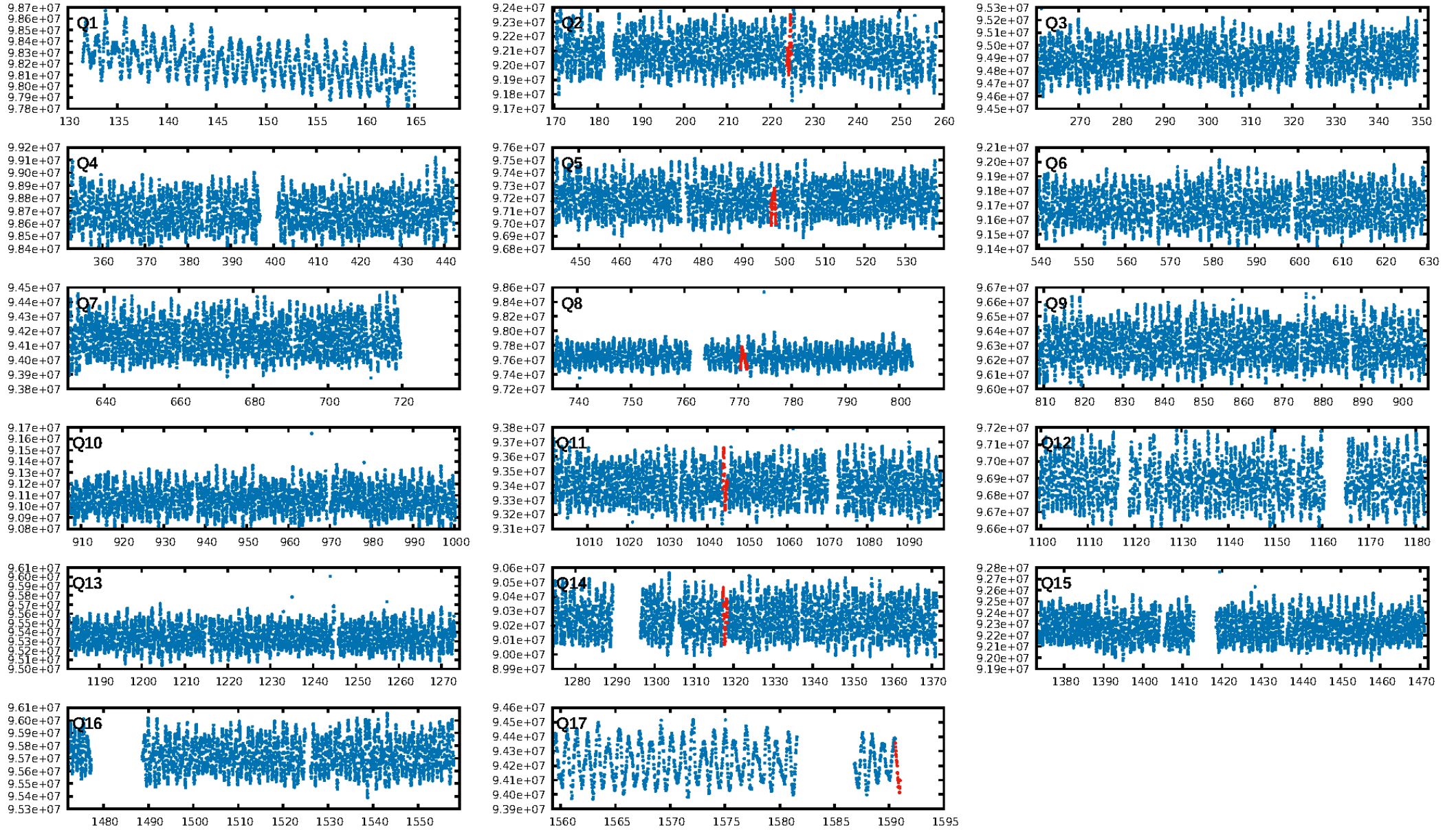
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [402.30σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 1.9%  
ModelChiSquareGof-sig: 100.0%  
**Bootstrap-pfa: 1.04e-09**  
RollingBand-fgt: 1.00 [5/5]  
GhostDiagnostic-chr: 1.236  
Centroid-sig: 28.3%  
Centroid-so: 0.146 arcsec [0.67σ]  
OotOffset-rm: 0.510 arcsec [0.90σ]  
KicOffset-rm: 0.512 arcsec [0.86σ]  
OotOffset-st: 1/1/1/1 [4]  
KicOffset-st: 1/1/1/1 [4]  
DiffImageQuality-fgm: 0.50 [2/4]  
DiffImageOverlap-fno: 0.00 [0/4]

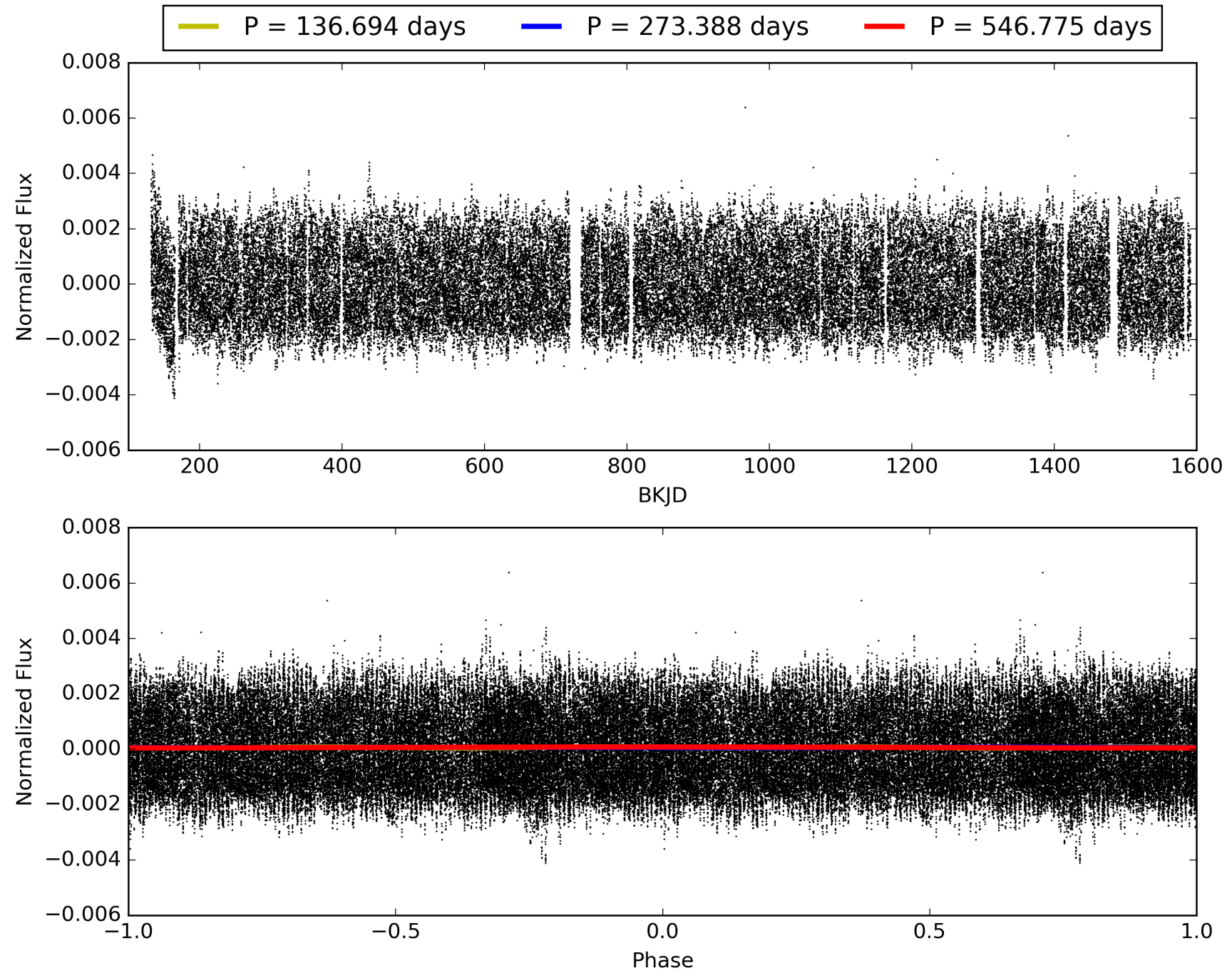
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This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 009456389-02, PDC Light Curves



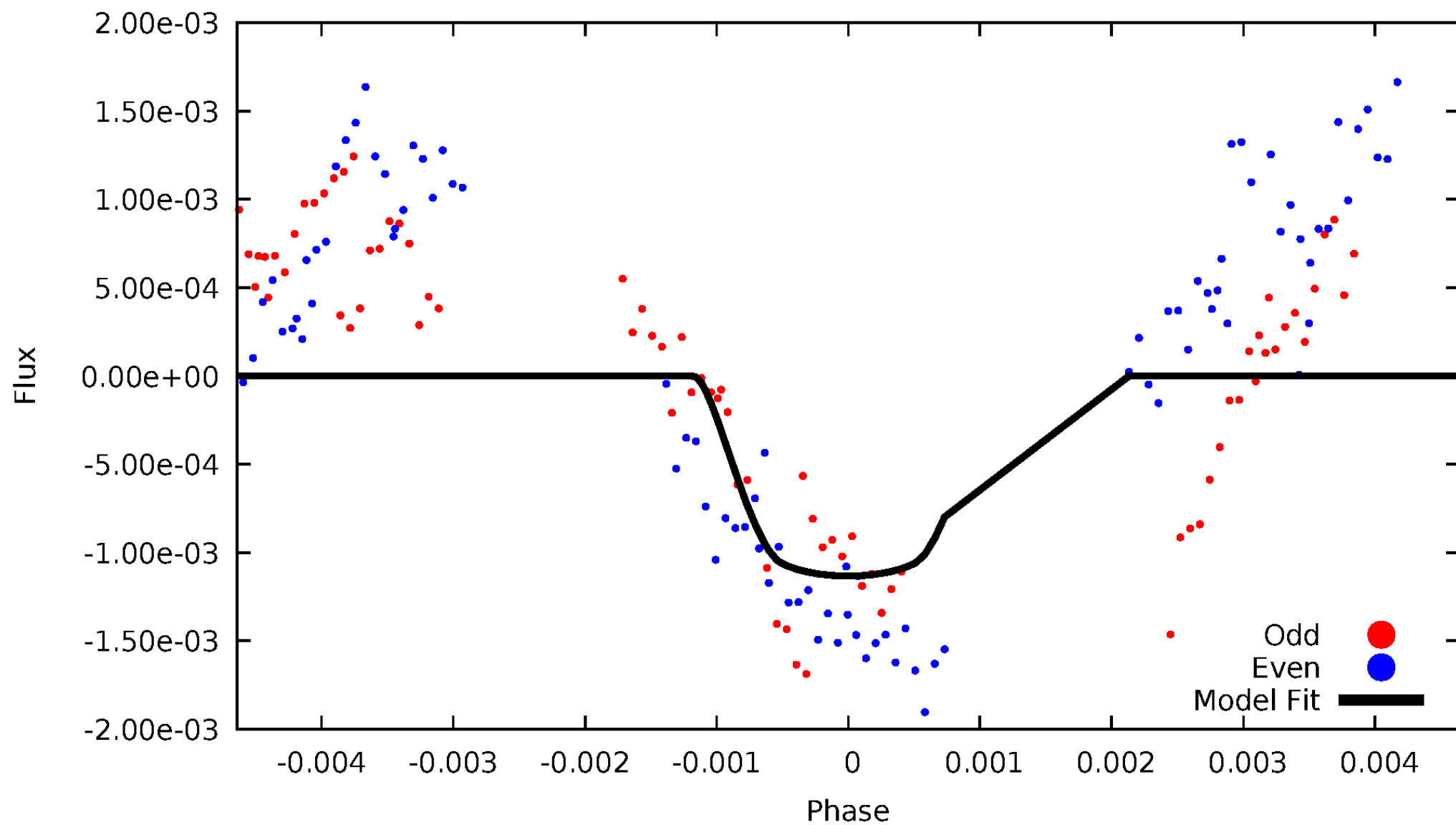
TCE 009456389-02





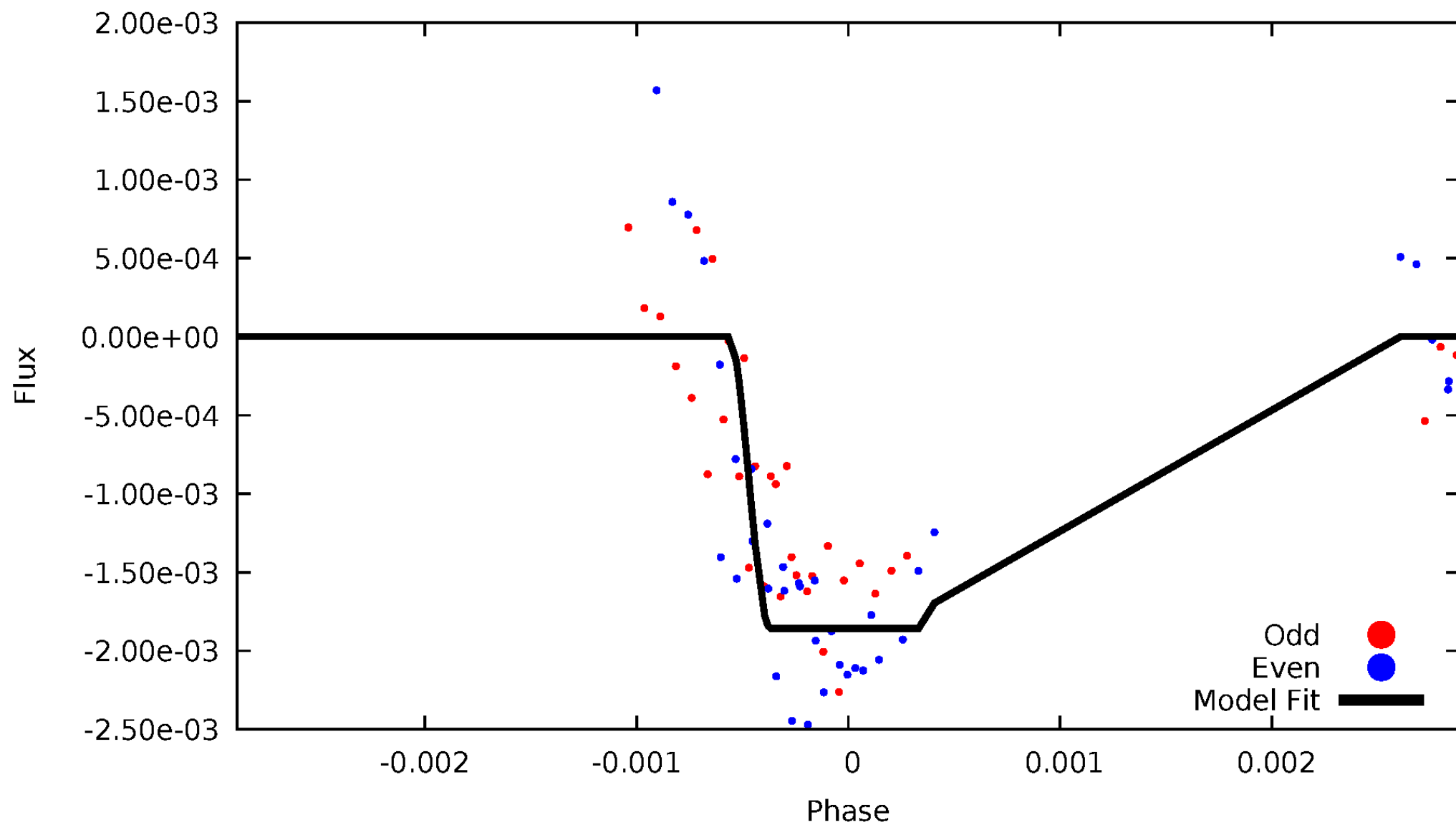
# DV Odd/Even

TCE 009456389-02



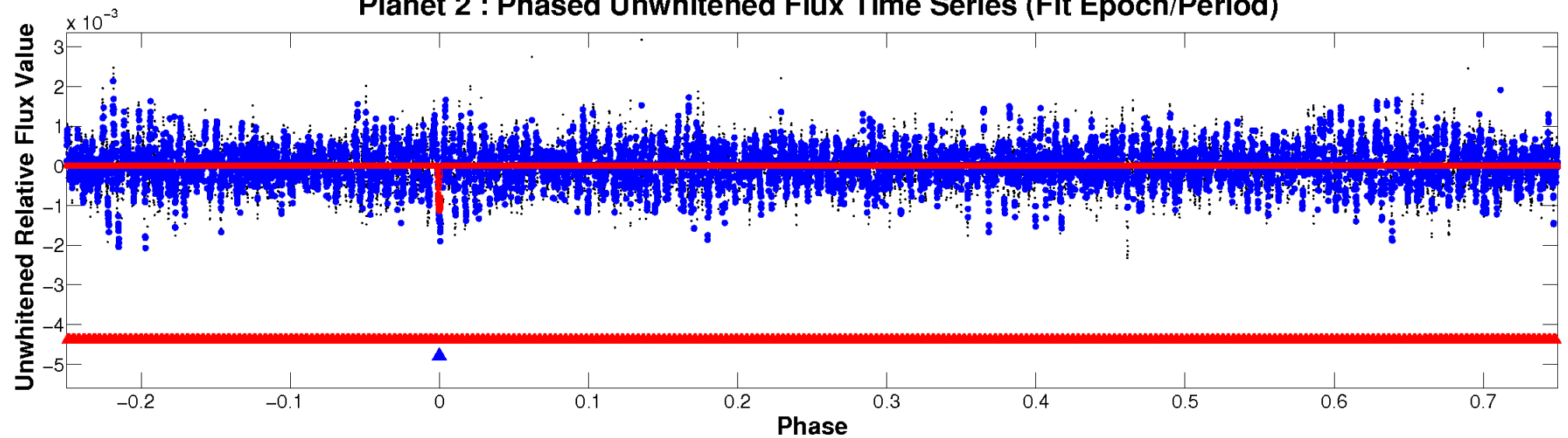
# ALT Odd/Even

TCE 009456389-02

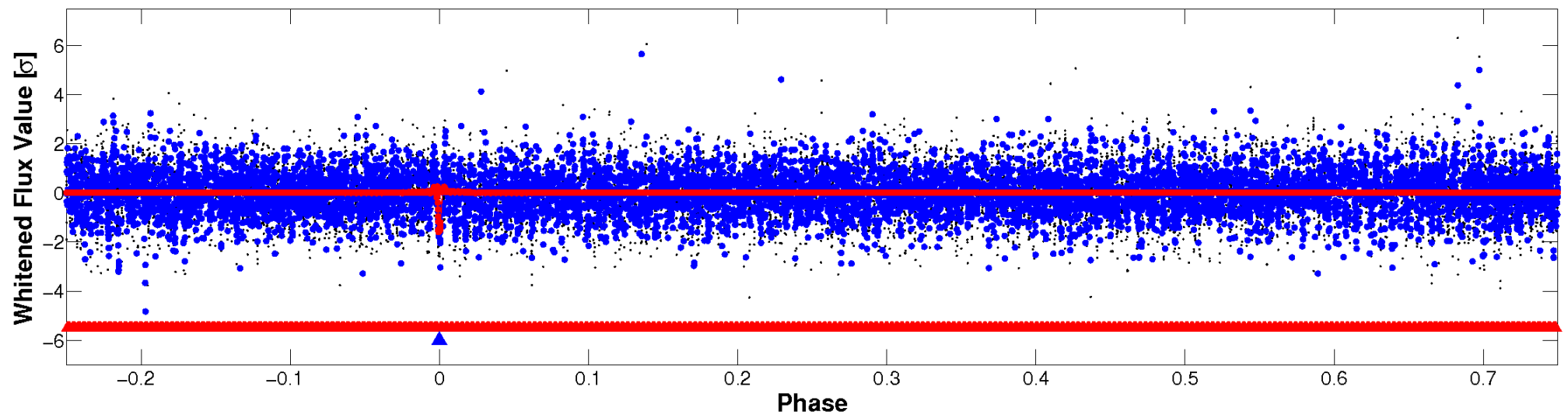


# Non-Whitened Vs. Whitened Light Curve

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

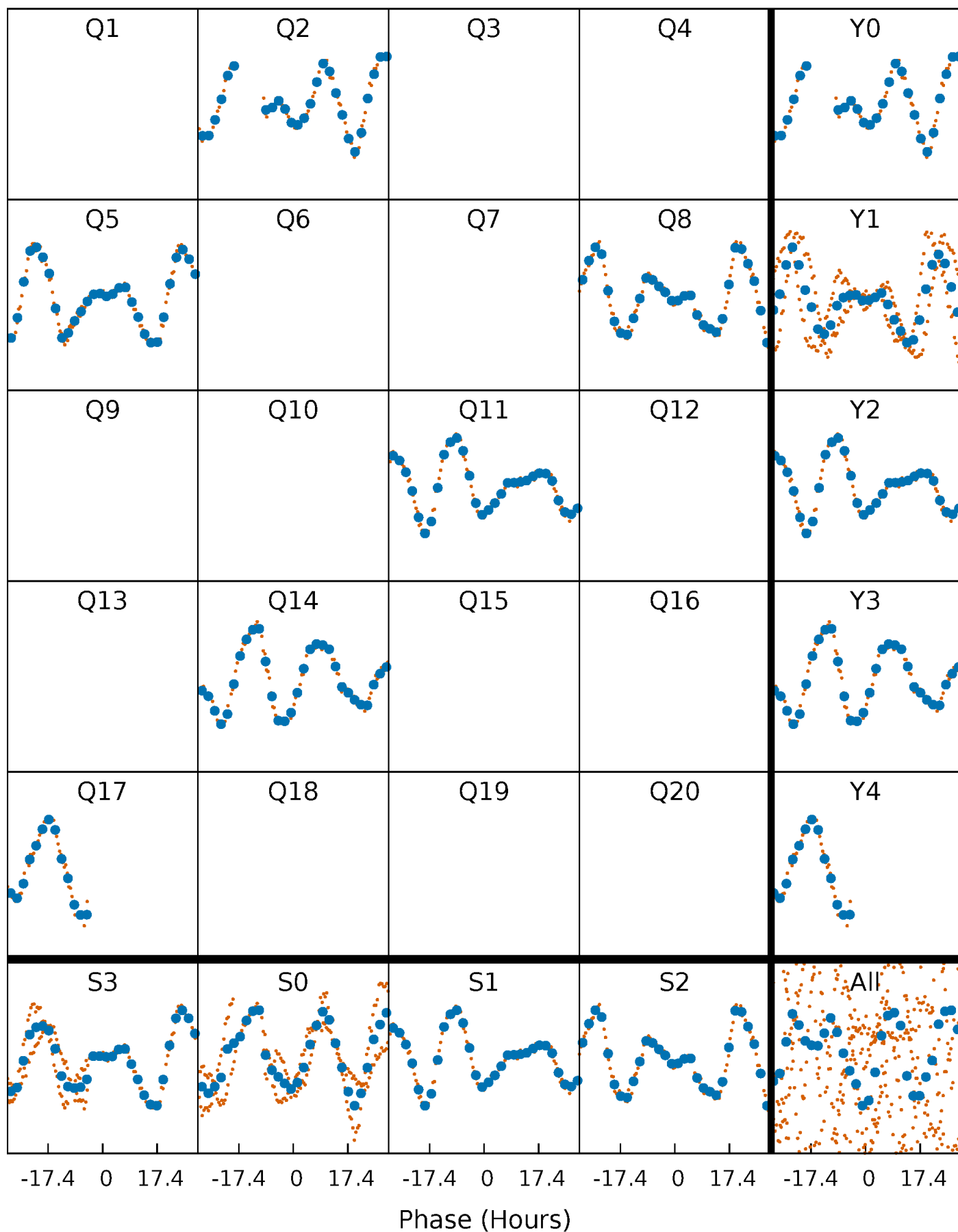


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



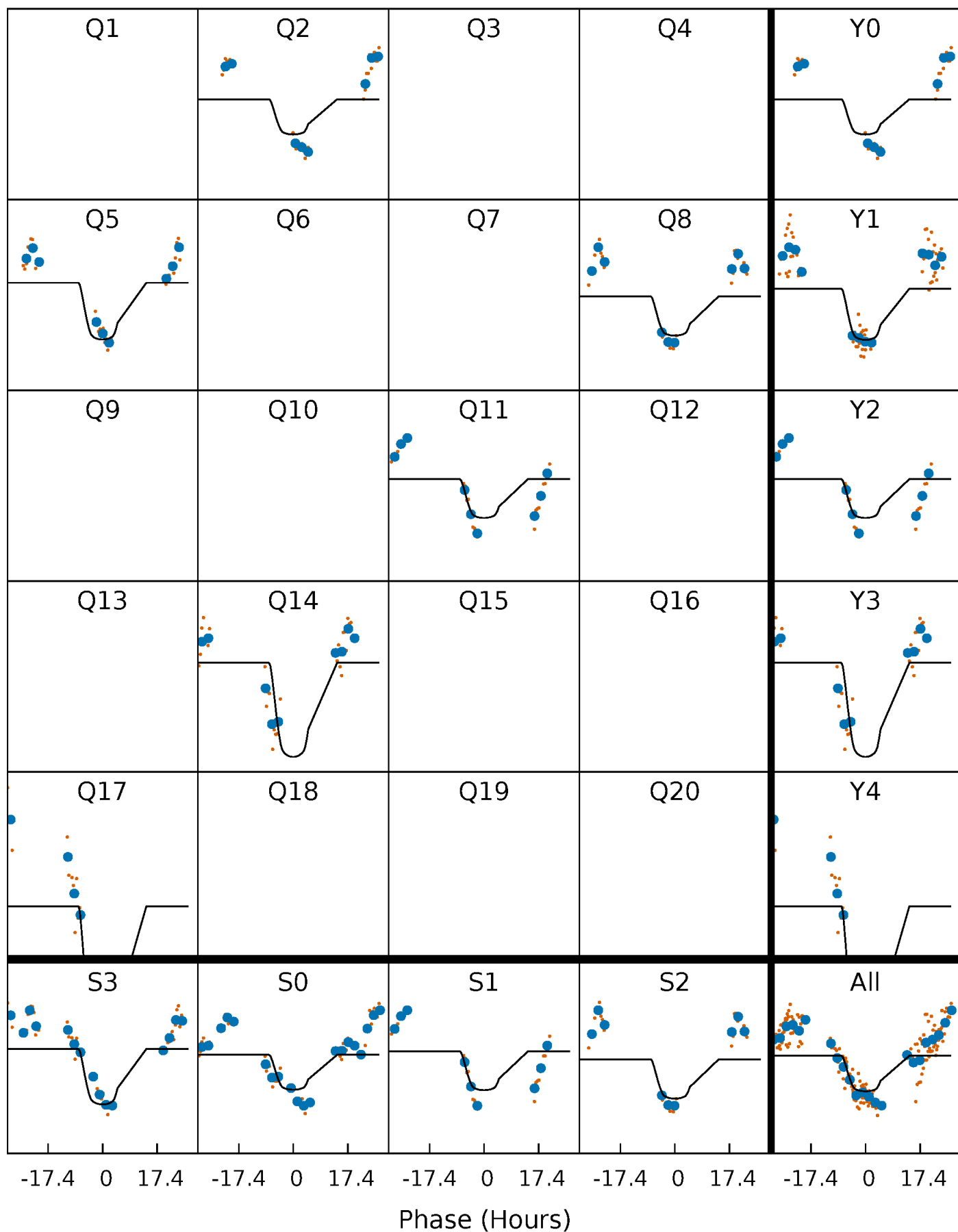
# PDC Quarter-Phased Transit Curves

TCE 009456389-02     $P=273.387603$  Days     $T_0=224.266464$  (BKJD)



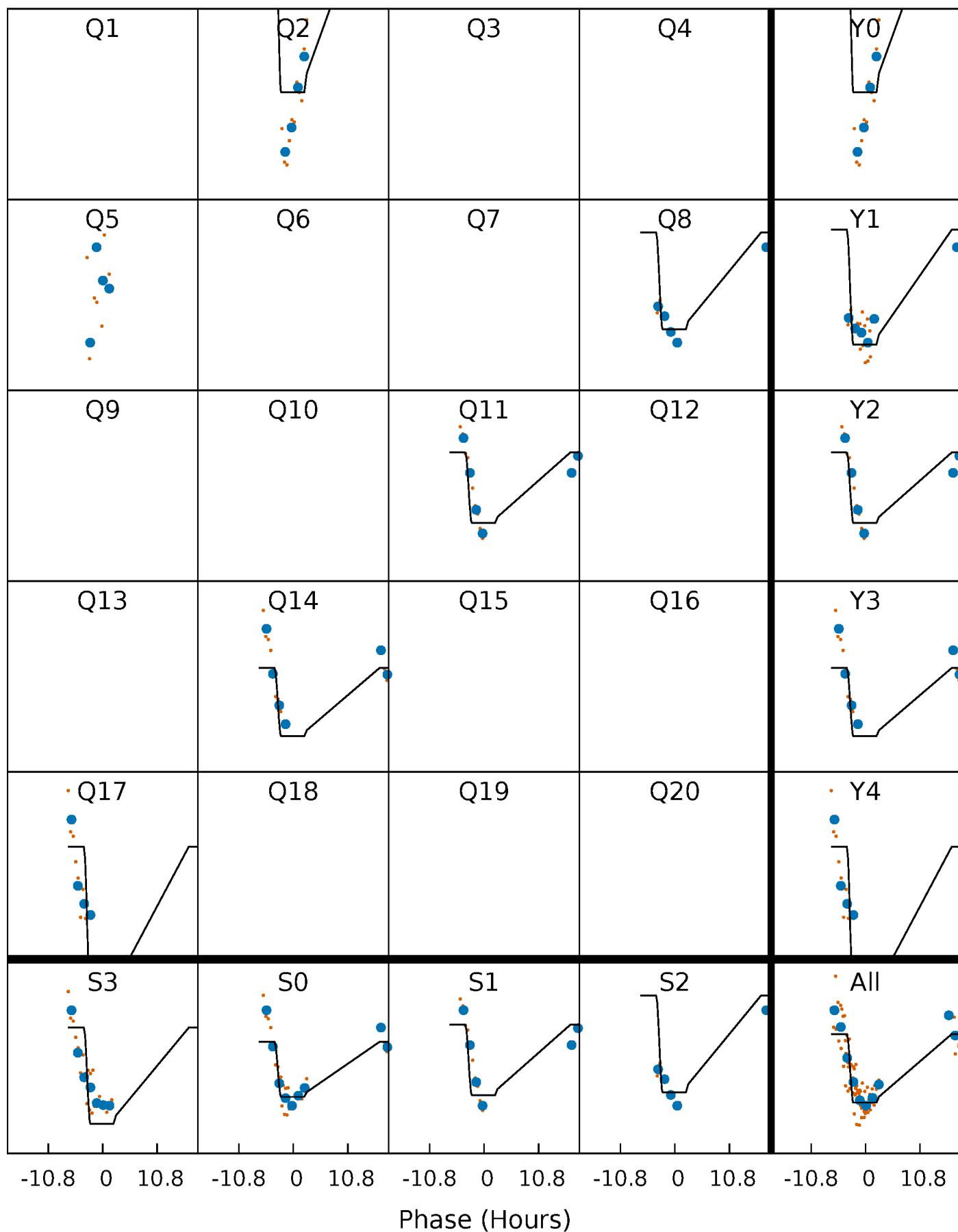
# DV Quarter-Phased Transit Curves

TCE 009456389-02     $P=273.387603$  Days     $T_0=224.266464$  (BKJD)



## Alt. Detrend Quarter-Phased Transit Curves

TCE 009456389-02 P=273.332921 Days  $T_0=224.355202$  (BKJD)

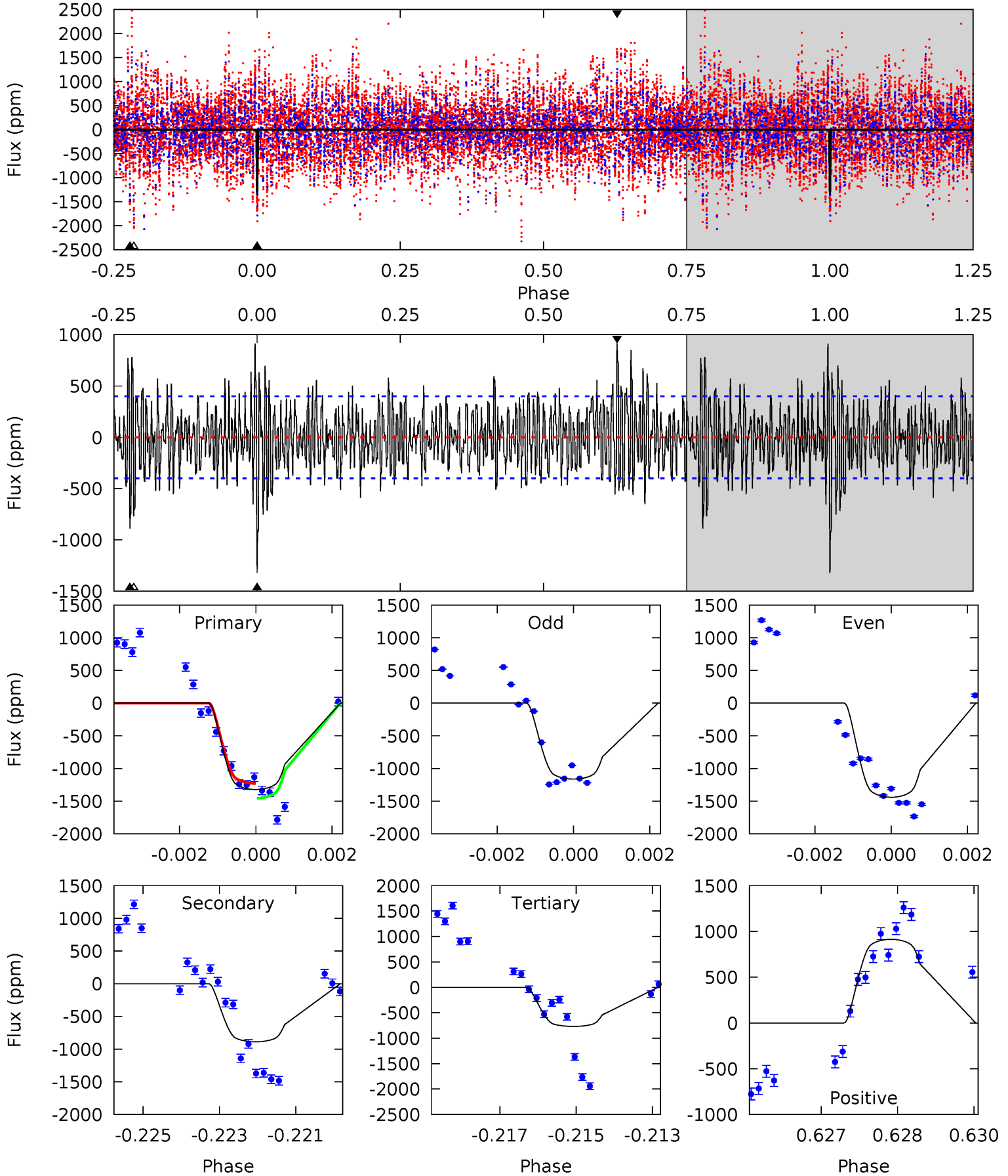




# DV Model-Shift Uniqueness Test

009456389-02, P = 273.387603 Days, E = 224.266464 Days

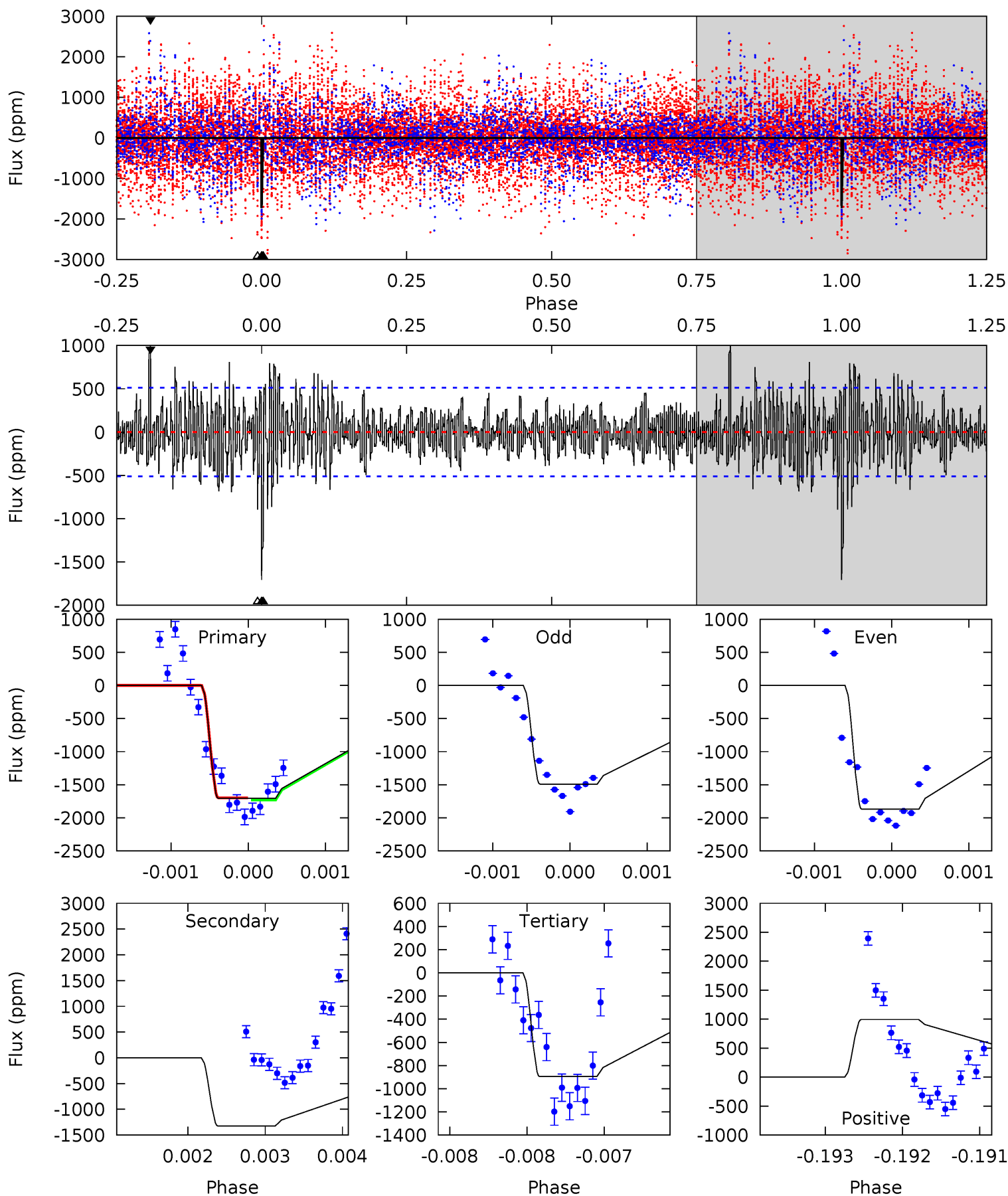
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
17.6	11.8	10.2	12.2	5.33	3.10	3.44	7.37	5.45	1.59	-0.34	1.88	1.00	0.41	1.41



# Alt Model-Shift Uniqueness Test

009456389-02, P = 273.332921 Days, E = 224.355202 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
18.2	14.1	9.55	10.6	5.46	3.31	2.46	8.66	7.59	4.58	3.52	2.03	1.05	0.37	0.14



### Stellar Parameters For KIC 009456389

	$T_{\text{eff}} (K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R (R_{\odot})$	$M (M_{\odot})$	$\rho_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$7495^{+235}_{-314}$	$3.926^{+0.266}_{-0.123}$	$-0.100^{+0.200}_{-0.350}$	$2.389^{+0.520}_{-0.845}$	$1.754^{+0.195}_{-0.391}$	$0.181^{+0.317}_{-0.077}$
	+3%/-4%	+7%/-3%	+200%/-350%	+22%/-35%	+11%/-22%	+175%/-42%
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 009456389-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-888 \pm 75$	$9.35^{+1.56}_{-1.76}$	$703^{+50}_{-63}$	$6596^{+415}_{-386}$	$5483^{+2355}_{-1449}$
Alt.	$-1324 \pm 94$	$10.84^{+1.80}_{-2.13}$	$701^{+51}_{-64}$	$6777^{+382}_{-330}$	$6092^{+3002}_{-1573}$

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

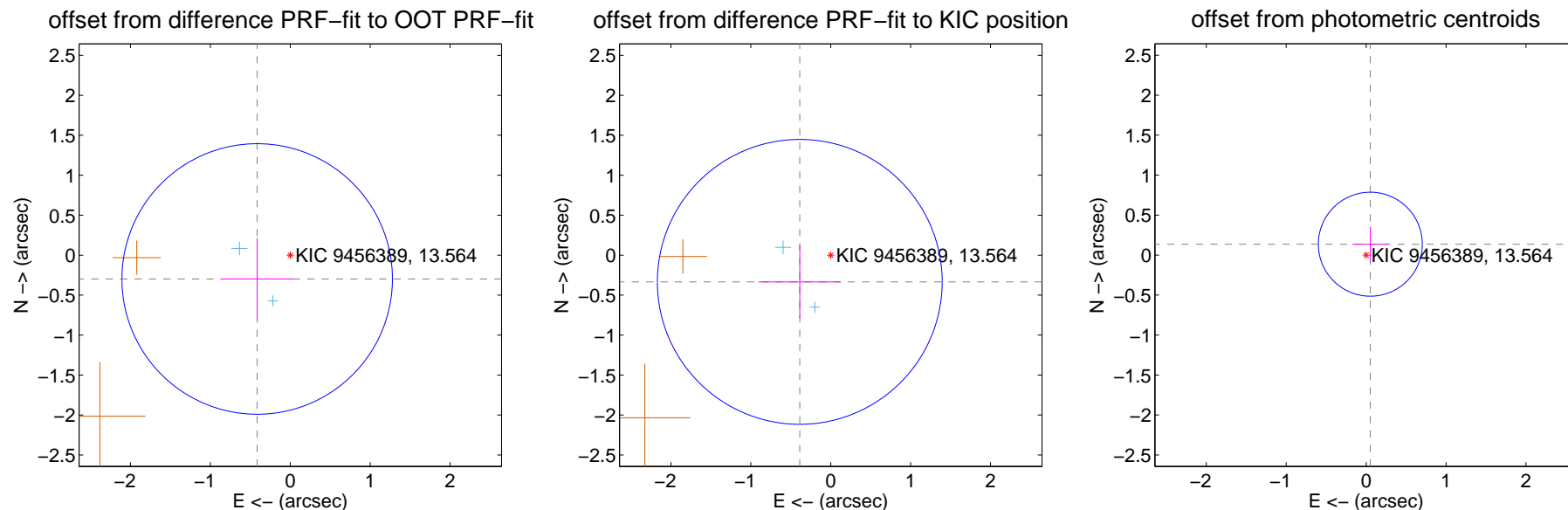
## DV Centroid Data

Supplemental centroid analysis for 009456389-02. Kepler magnitude: 13.56. Transit SNR 9.55

There are 2 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.04 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.510 \pm 0.564$	0.90	$0.414 \pm 0.462$	$-0.298 \pm 0.511$
PRF-fit source offset from KIC position	$0.512 \pm 0.594$	0.86	$0.387 \pm 0.514$	$-0.334 \pm 0.459$
photometric centroid source offset	$0.15 \pm 0.22$	0.67	$-0.05 \pm 0.22$	$0.14 \pm 0.22$

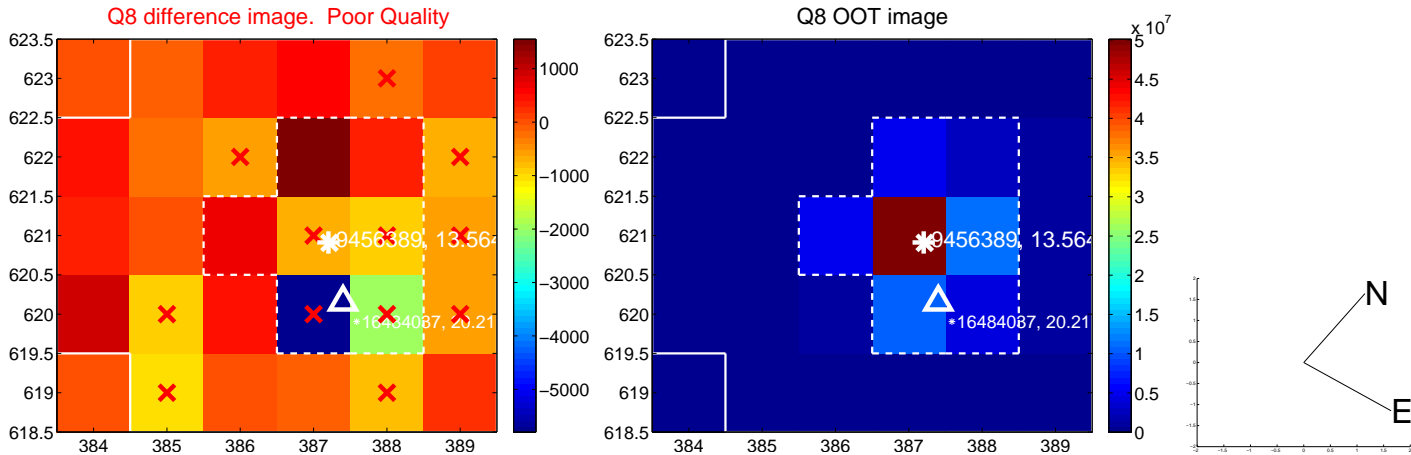
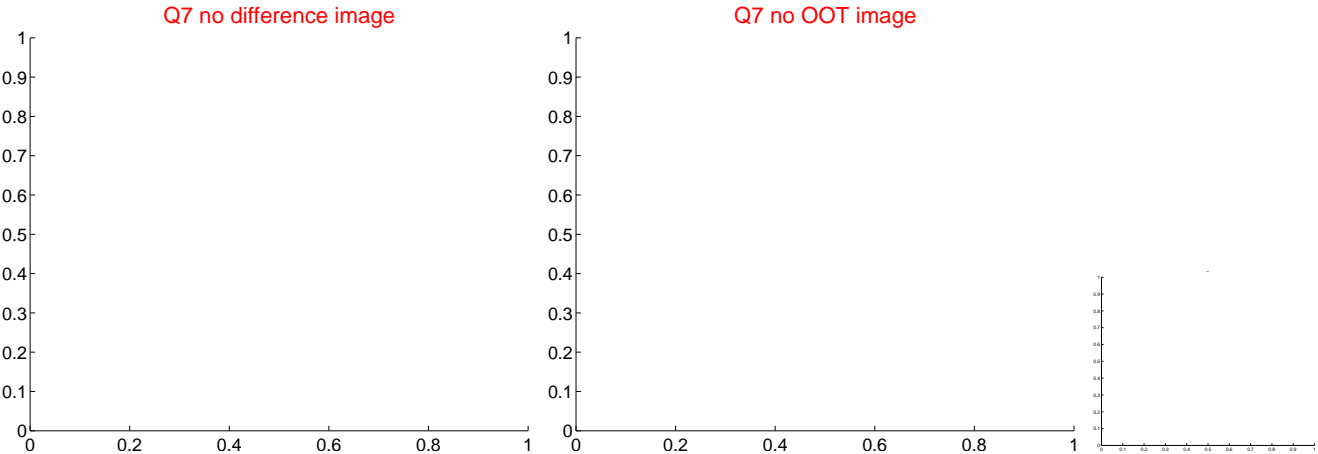
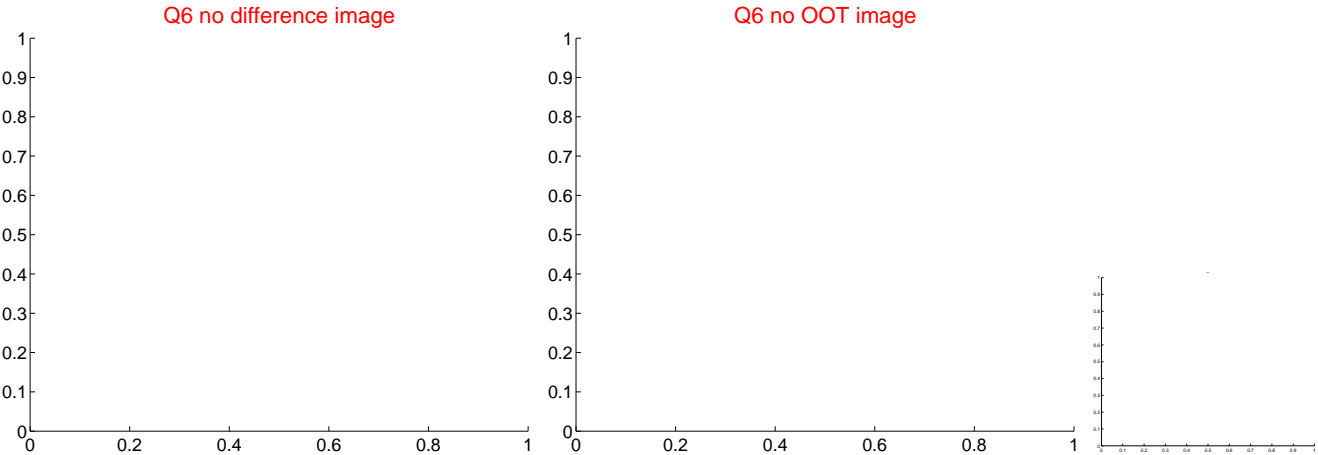
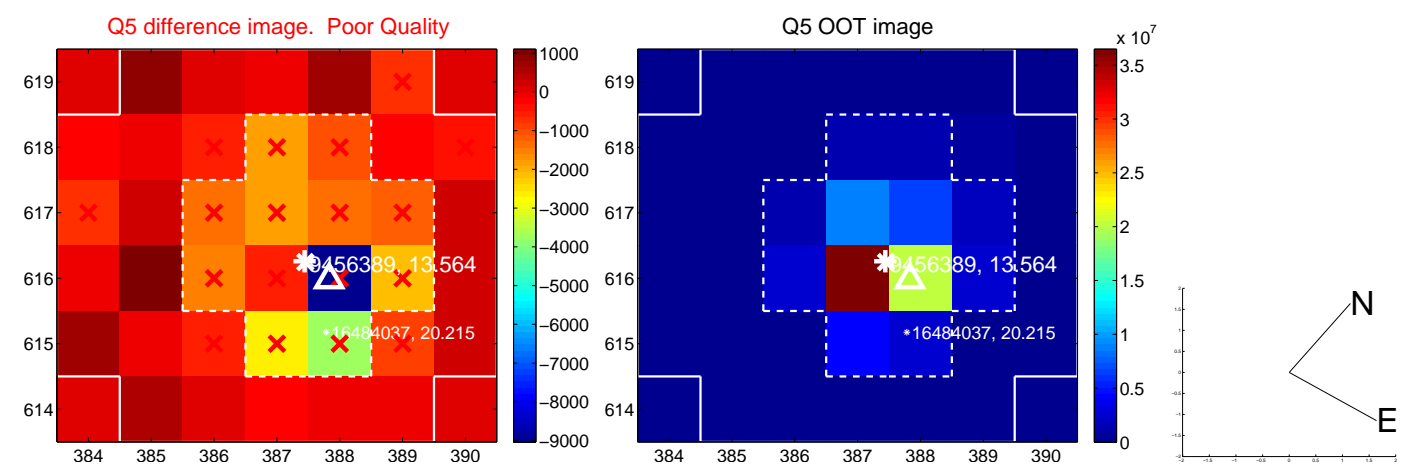


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

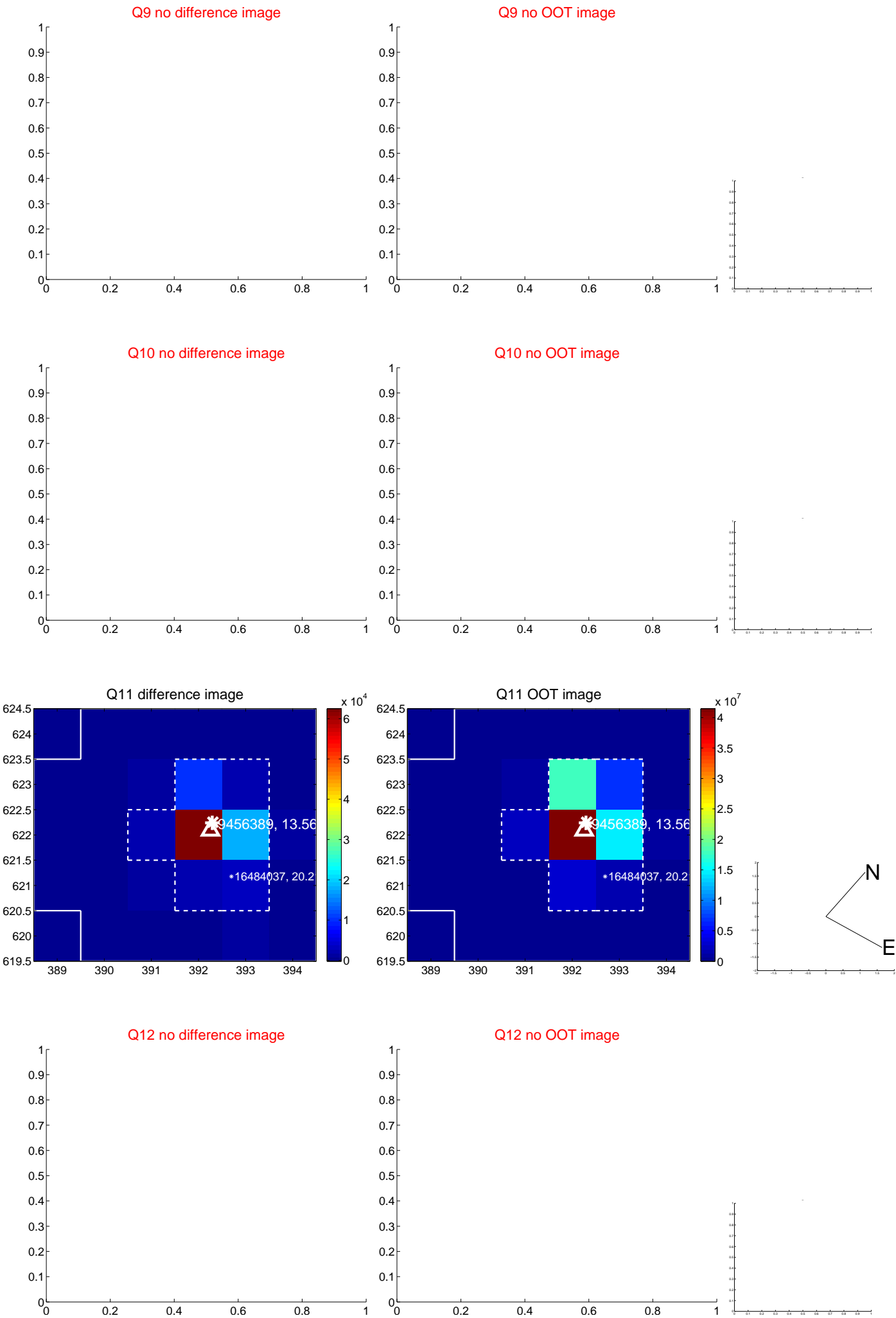


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.





white ×: 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.

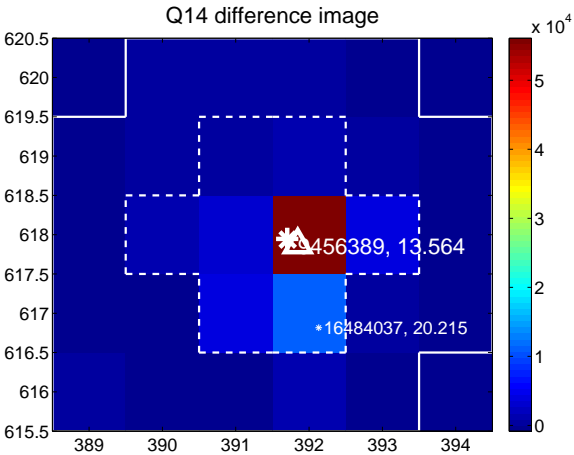
Q13 no difference image



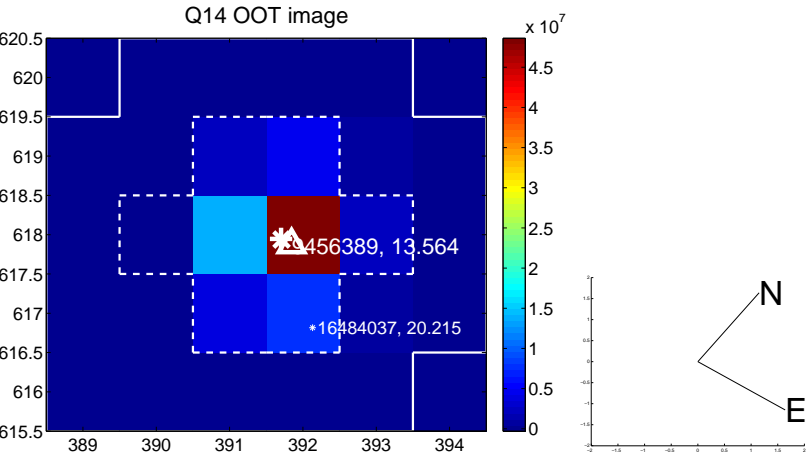
Q13 no OOT image



Q14 difference image



Q14 OOT image



Q15 no difference image



Q15 no OOT image



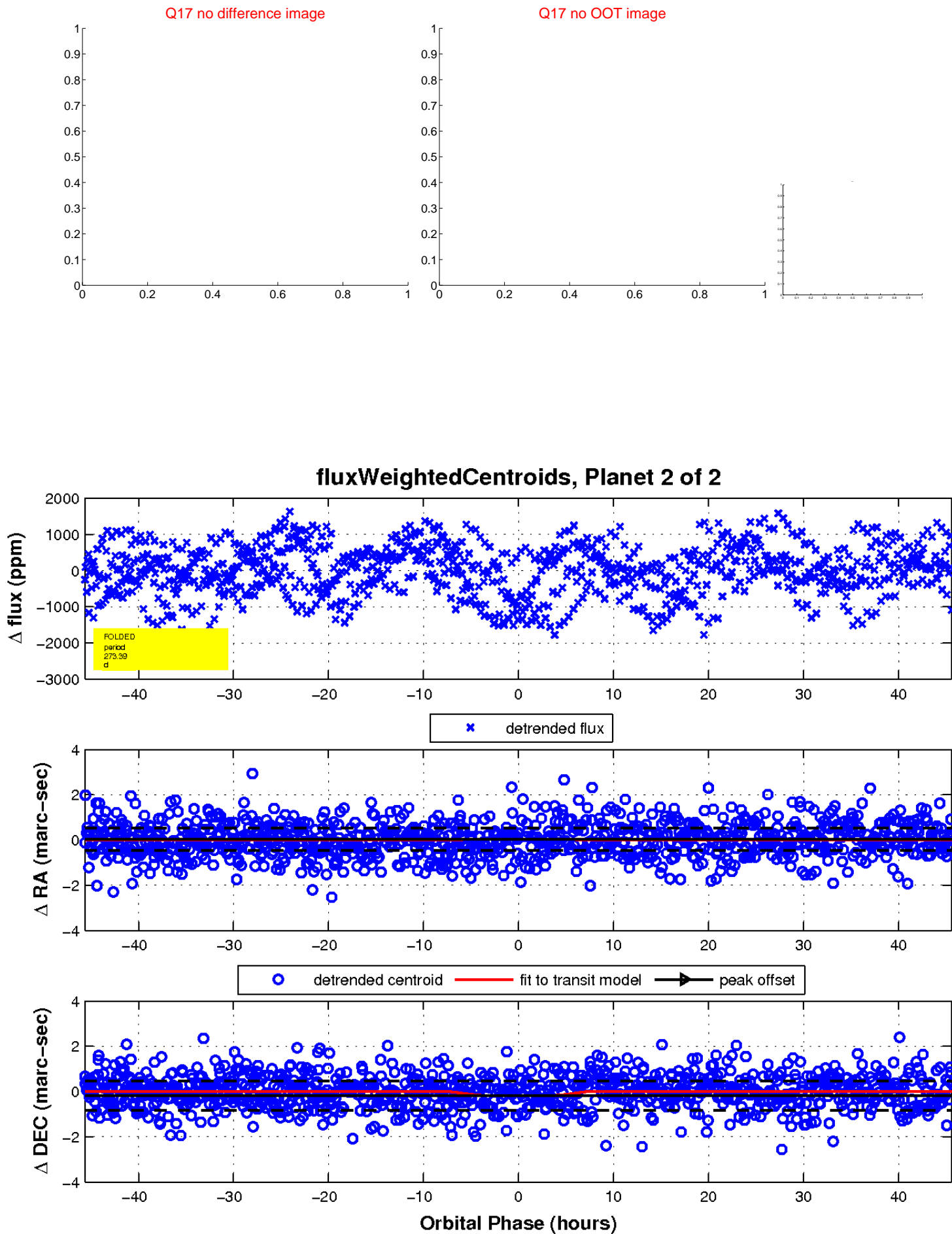
Q16 no difference image



Q16 no OOT image



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



# UKIRT Image

Declination

