

# KIC 009837720

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009837720-01	OBS	No	433.329208	448.967496	268.4	20.038	9.9	10.9	0.67	5061	1.17	0.26
009837720-02	OBS	8187.01	353.003368	258.908785	242.4	22.393	8.4	8.8	0.67	5061	1.09	0.35

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009837720-01	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009837720-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE—LPP_DV—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.

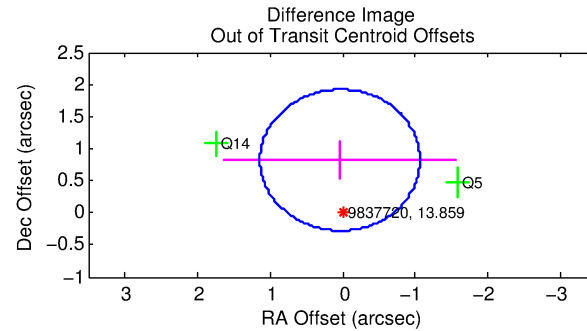
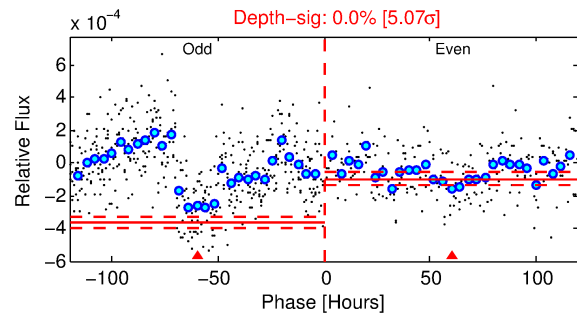
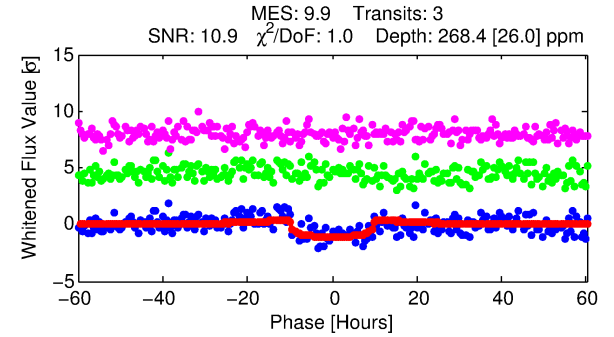
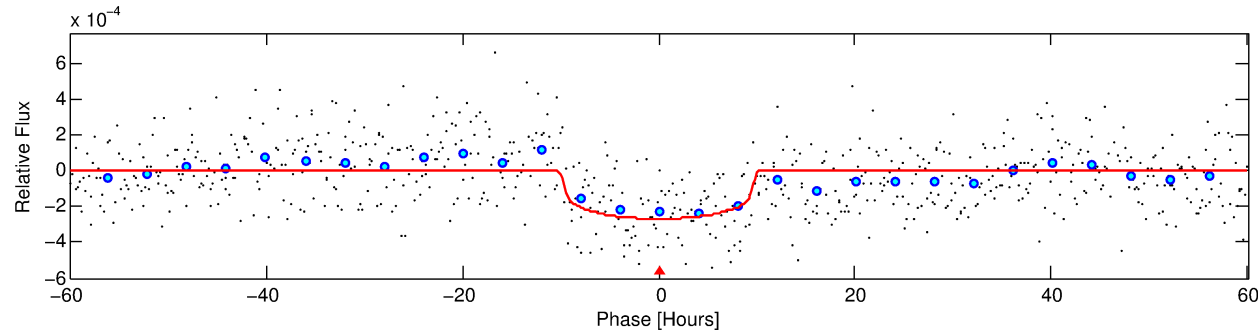
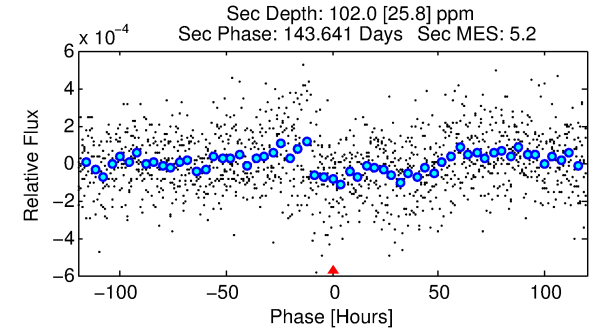
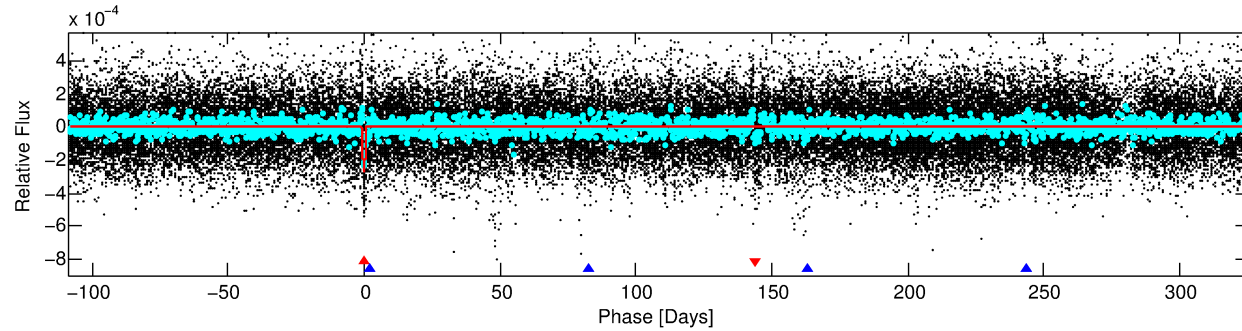
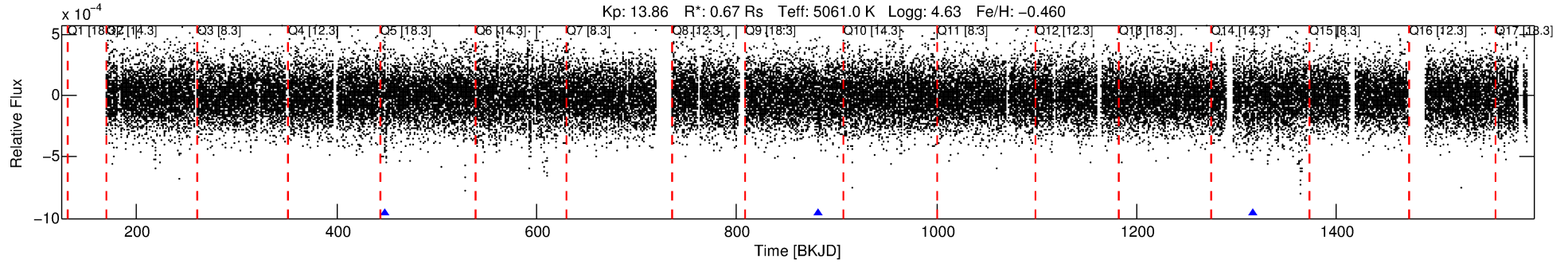
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009837720-01

No Significant Match Found

# DV One-Page Summary

KIC: 9837720 Candidate: 1 of 2 Period: 433.329 d



## DV Fit Results:

Period = 433.32921 [0.01427] d  
Epoch = 448.9675 [0.0176] BKJD  
Rp/R\* = 0.0161 [0.0048]  
a/R\* = 118.89 [133.66]  
b = 0.72 [0.77]  
Seff = 0.26 [0.05]  
Teq = 183 [8] K  
Rp = 1.17 [0.38] Re  
a = 0.9964 [0.0927] AU  
Ag = 40431.55 [26791.25] [1.51σ]  
Teffp = 4008 [667] K [5.73σ]

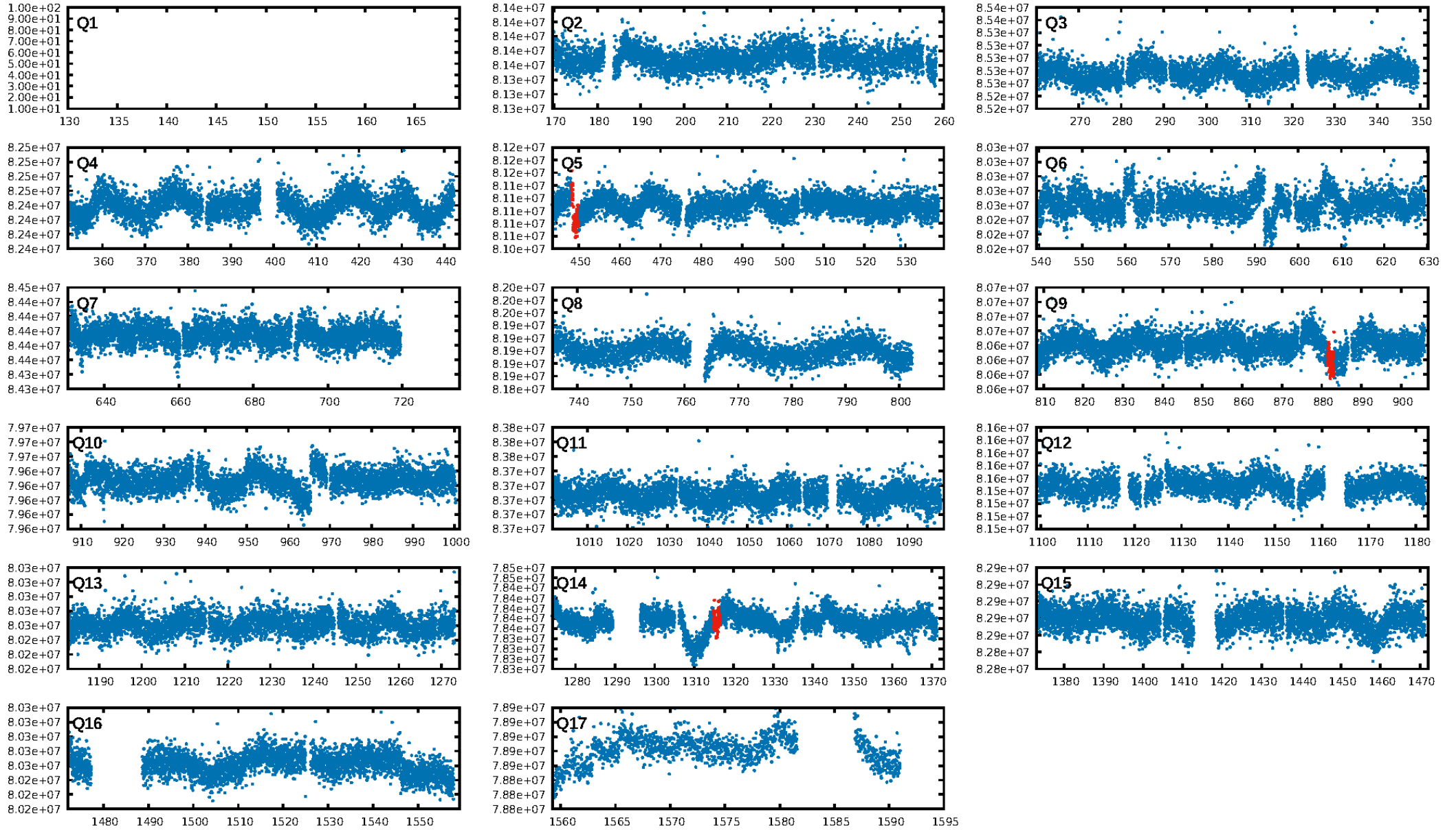
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [64.15σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 99.8%  
Bootstrap-pfa: 1.59e-21  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: -3.248  
Centroid-sig: 2.8%  
Centroid-so: 1.861 arcsec [1.89σ]  
OotOffset-rm: 0.822 arcsec [2.24σ]  
KicOffset-rm: 0.513 arcsec [1.62σ]  
OotOffset-st: 1/0/0/1 [2]  
KicOffset-st: 1/0/0/1 [2]  
DiffImageQuality-fgm: 1.00 [2/2]  
DiffImageOverlap-fno: 1.00 [3/3]

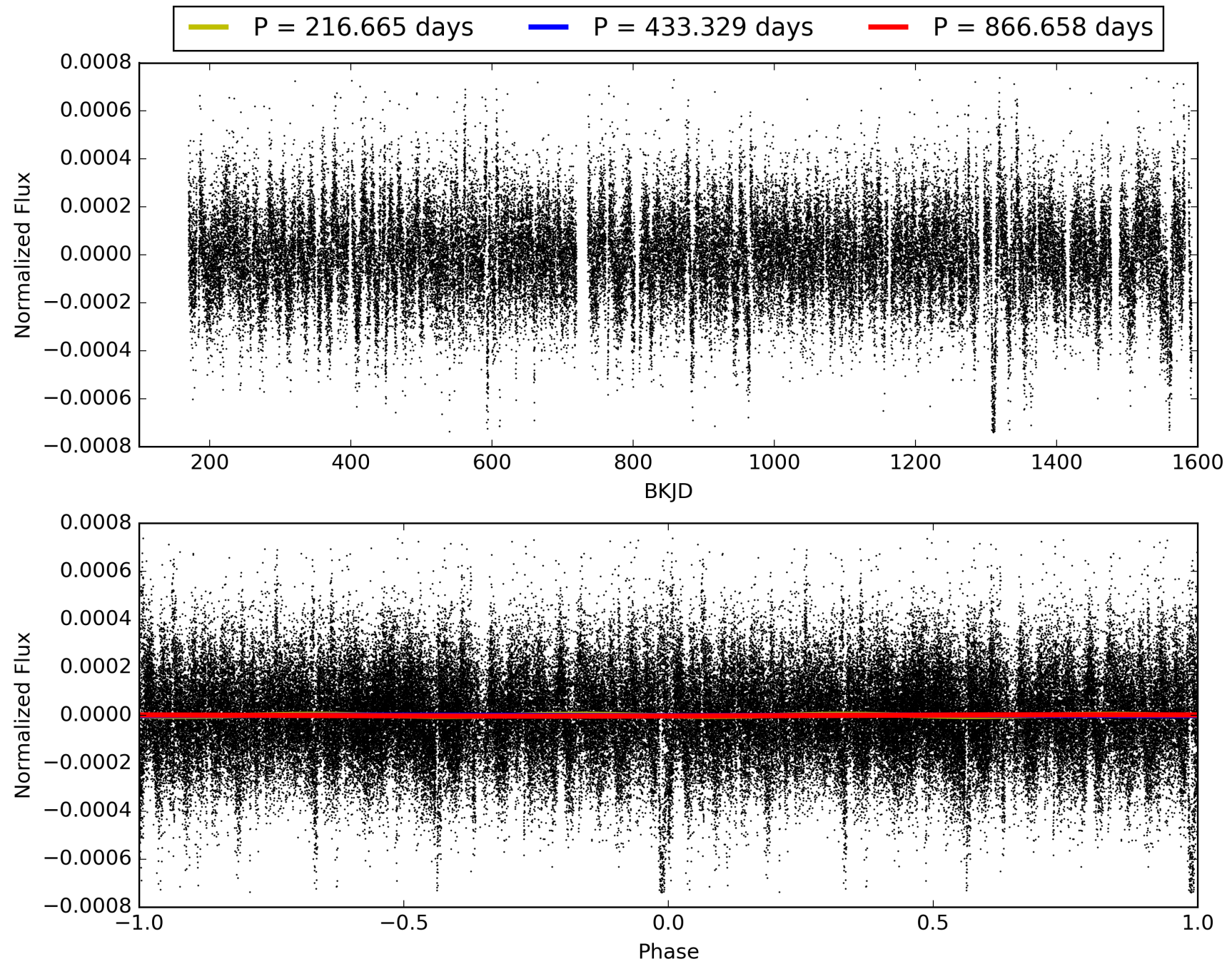
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 19:35:17 Z

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

# TCE 009837720-01, PDC Light Curves

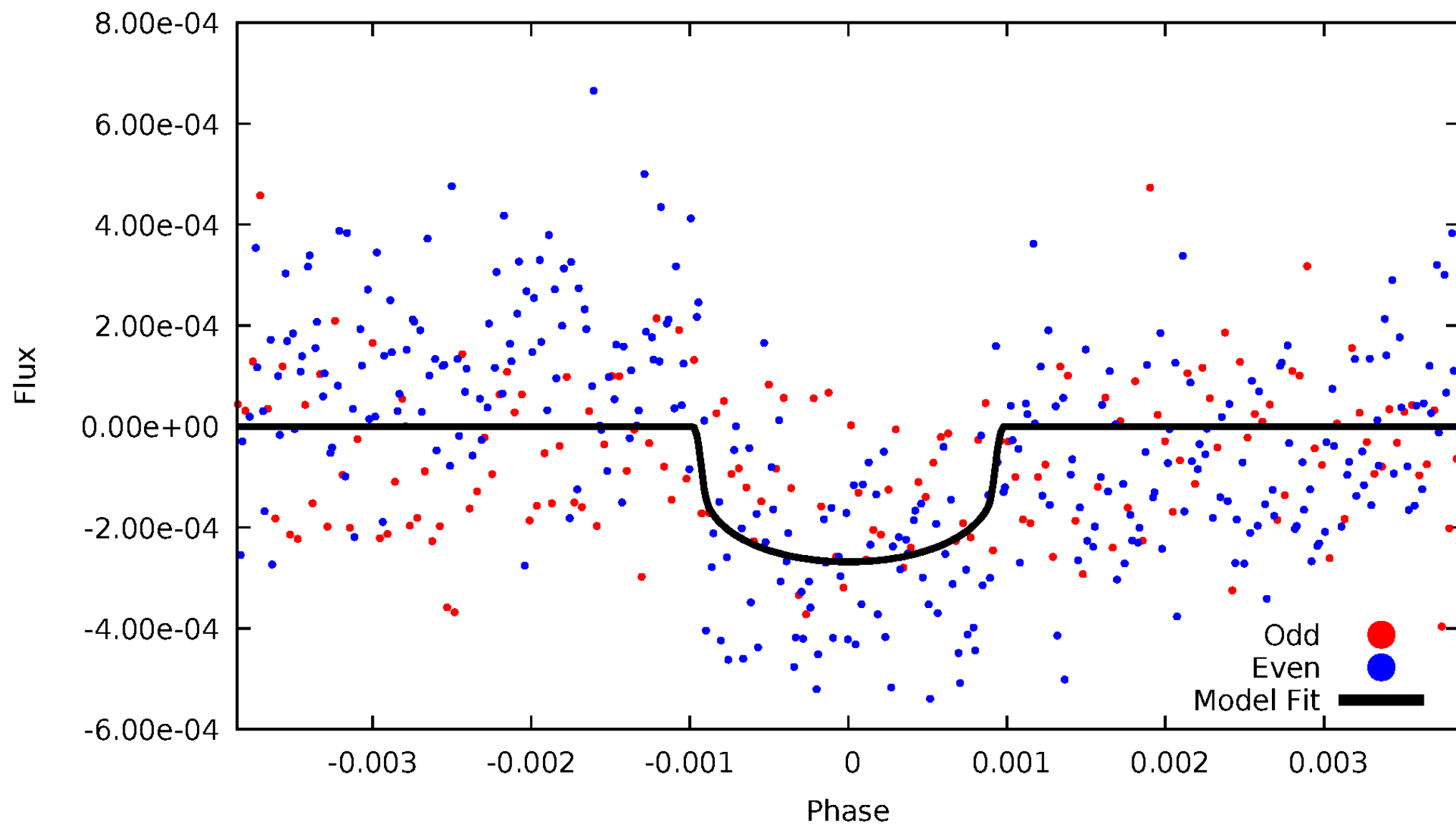


TCE 009837720-01



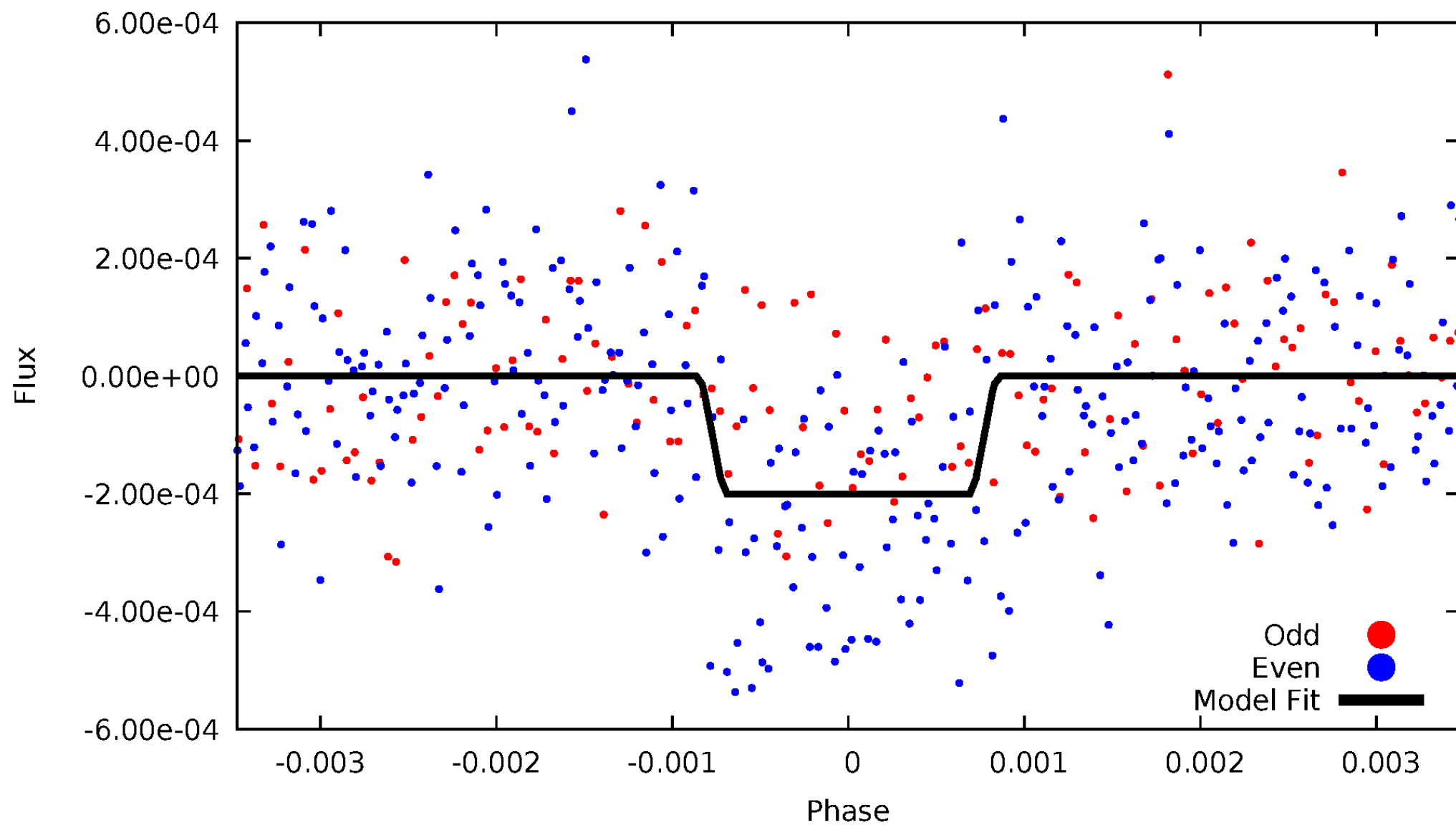
# DV Odd/Even

TCE 009837720-01



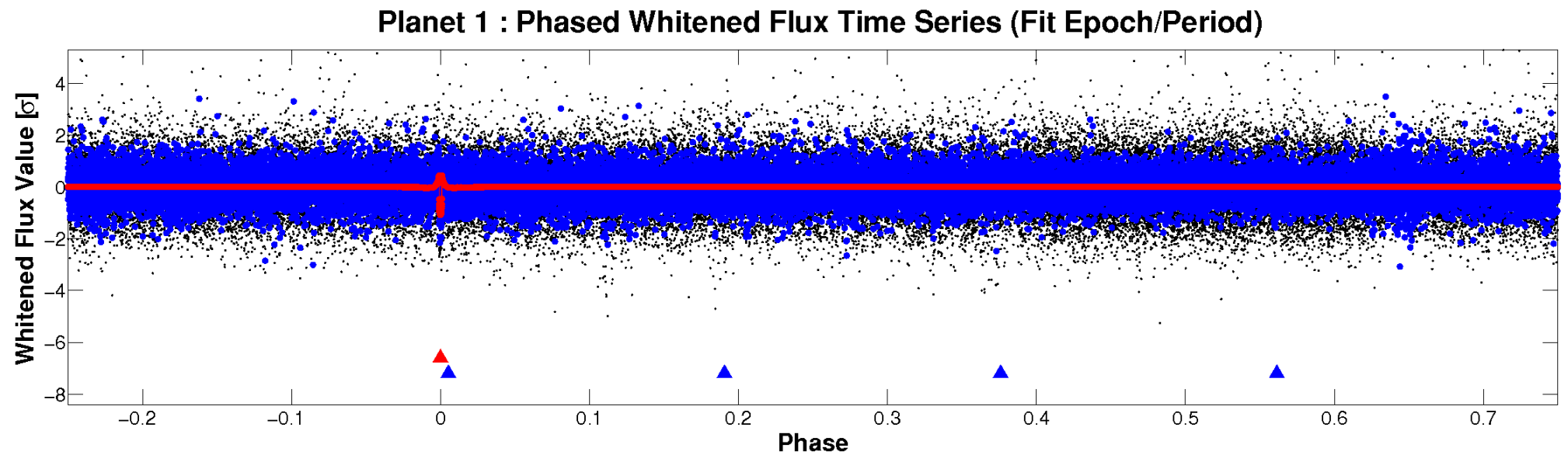
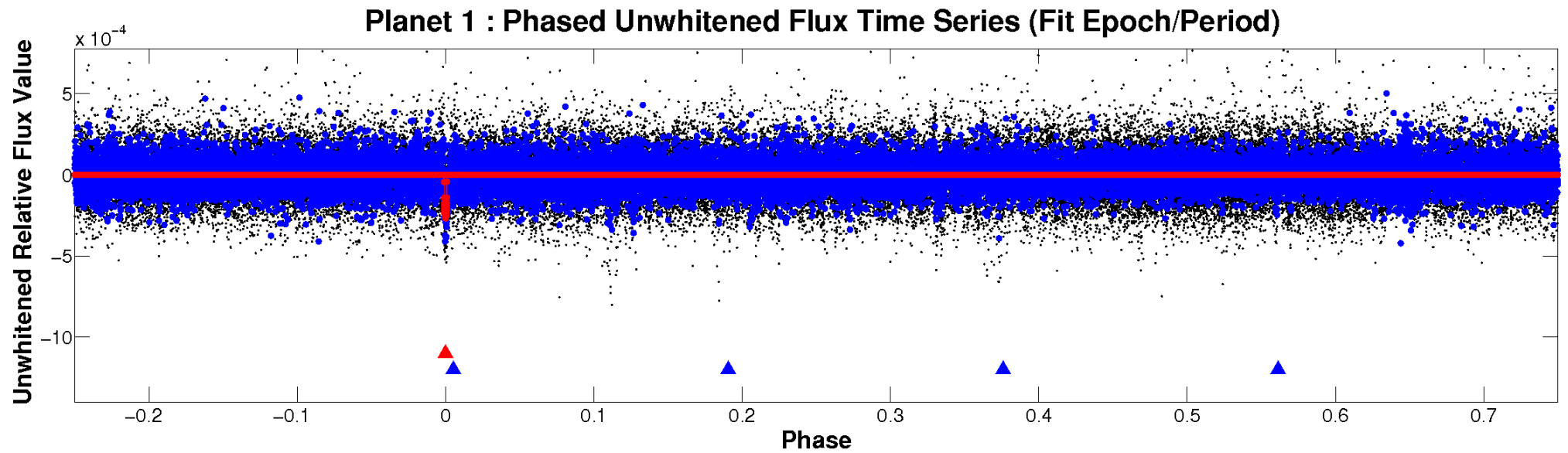
# ALT Odd/Even

TCE 009837720-01



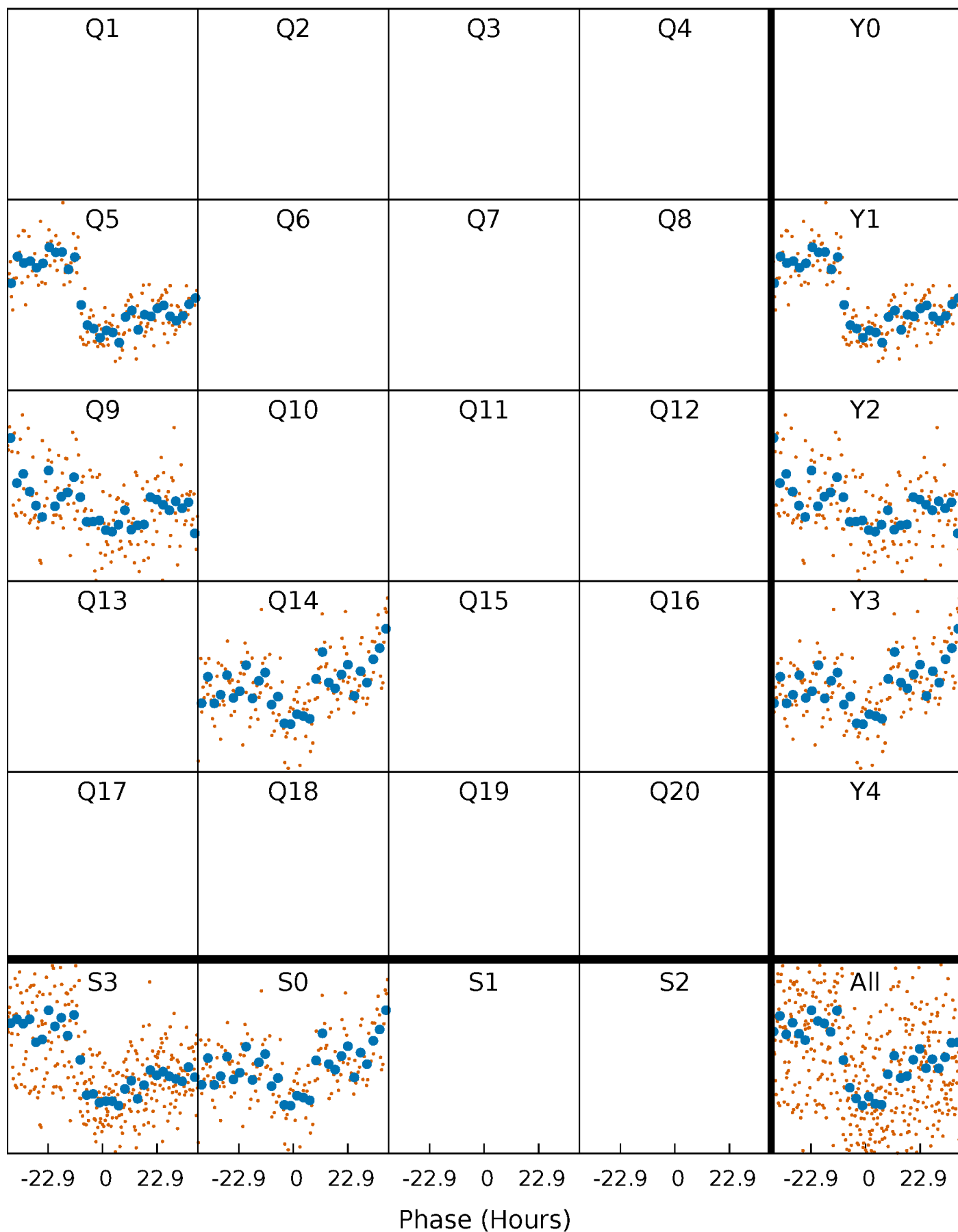


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

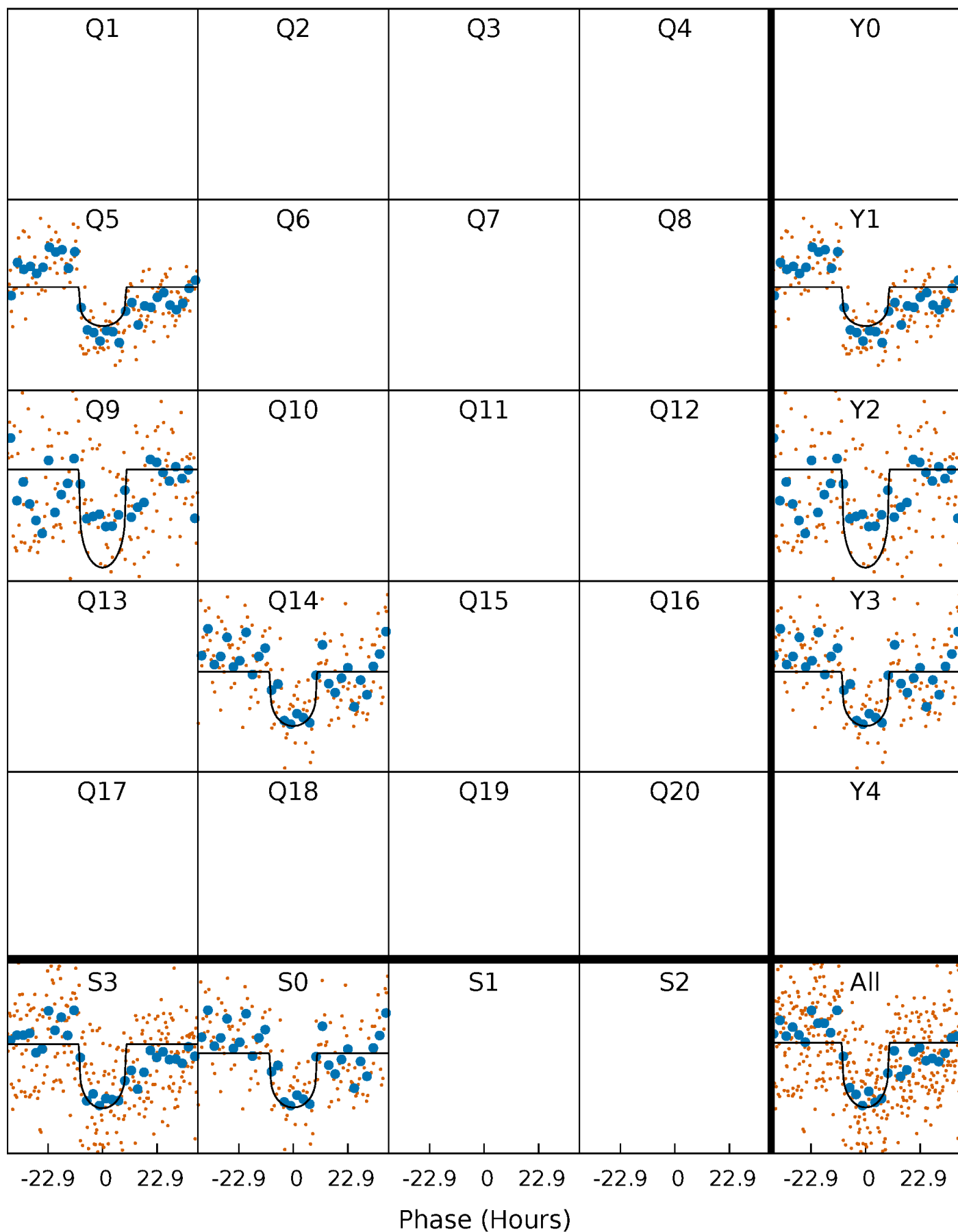
TCE 009837720-01 P=433.329208 Days  $T_0=448.967496$  (BKJD)





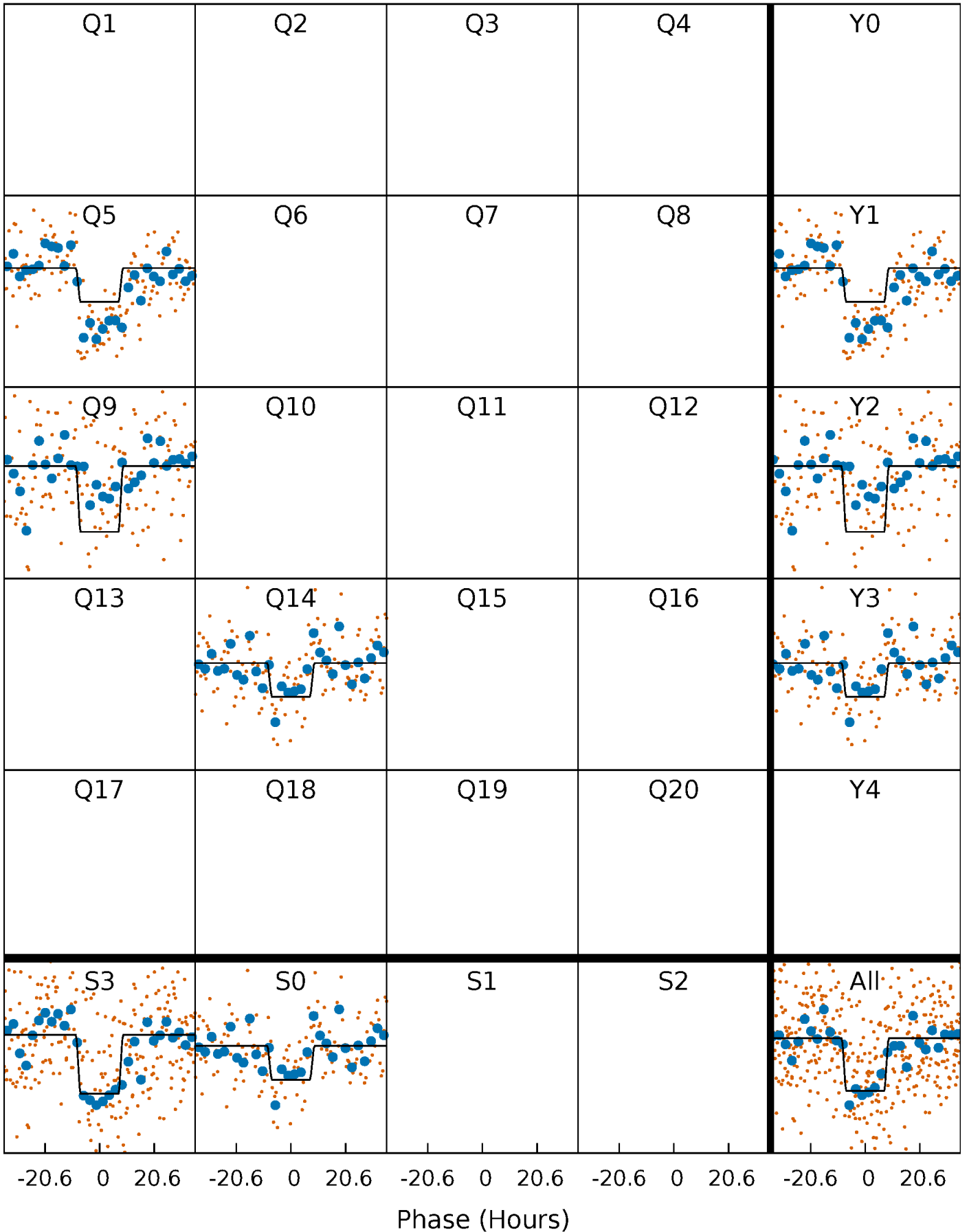
# DV Quarter-Phased Transit Curves

TCE 009837720-01 P=433.329208 Days  $T_0=448.967496$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

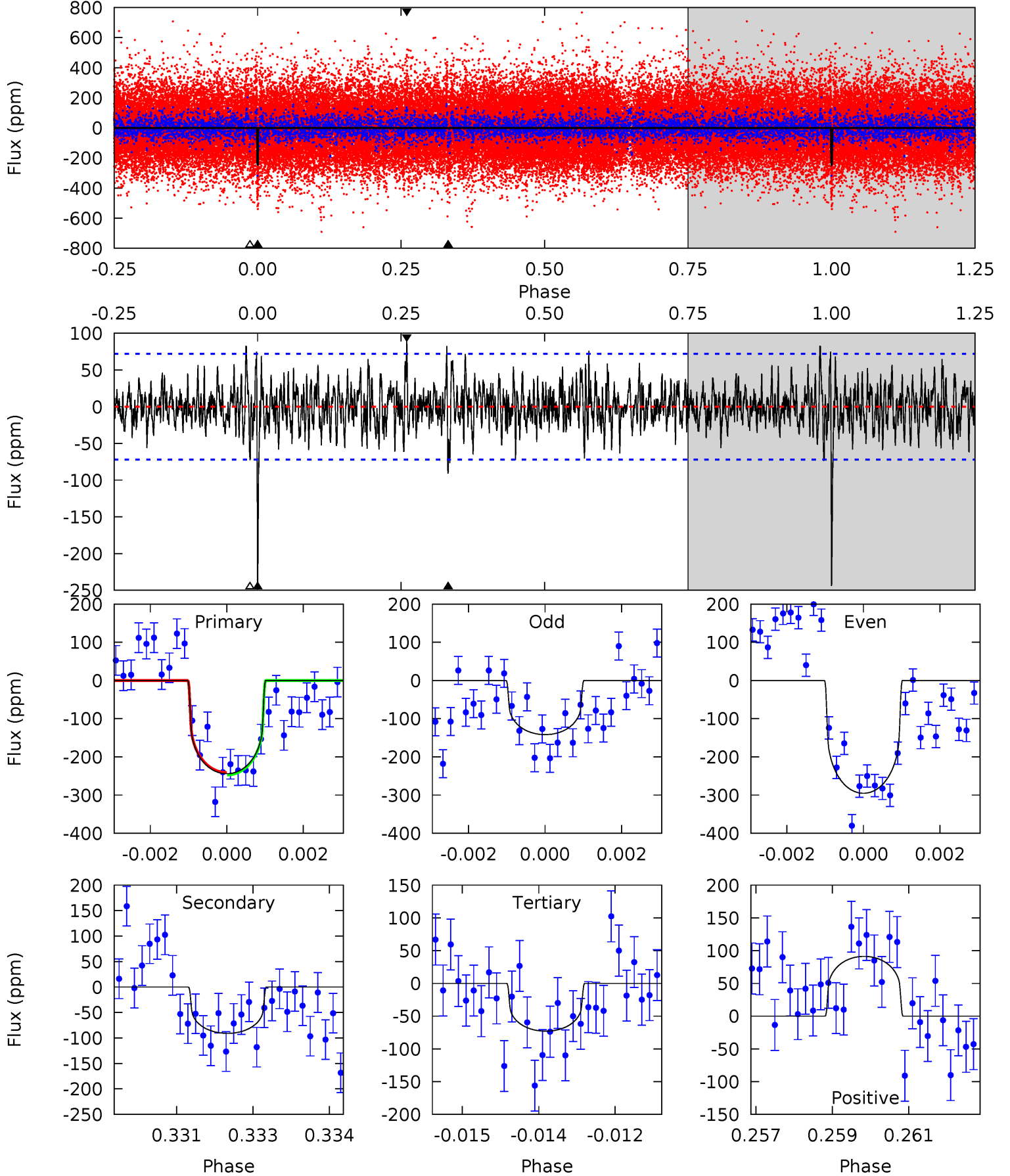
TCE 009837720-01 P=433.416241 Days  $T_0=448.918008$  (BKJD)



# DV Model-Shift Uniqueness Test

009837720-01,  $P = 433.329208$  Days,  $E = 15.638288$  Days

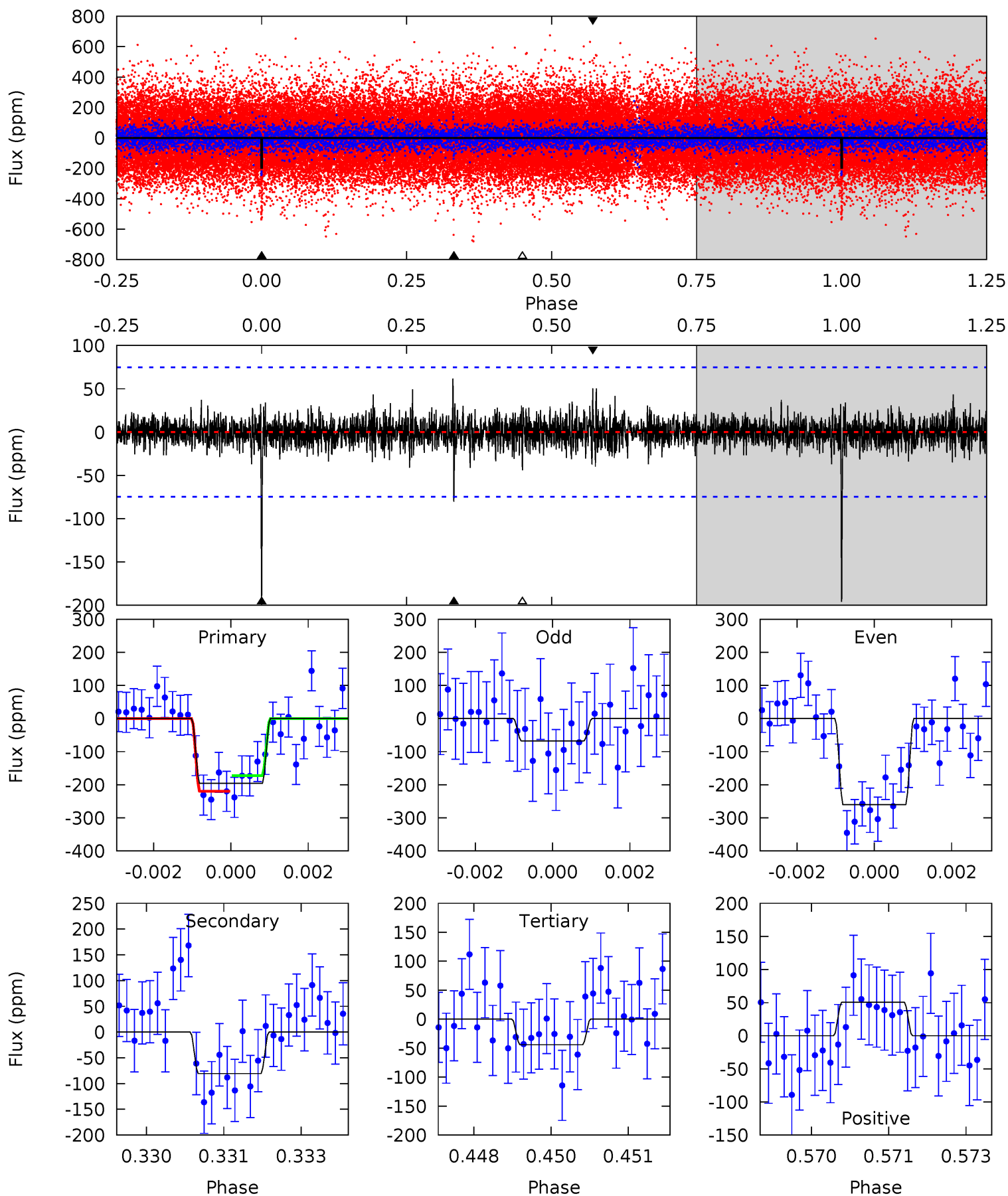
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
18.1	6.74	5.41	6.76	5.33	3.10	1.74	12.7	11.3	1.33	-0.02	5.42	1.09	0.27	0.25



# Alt Model-Shift Uniqueness Test

009837720-01, P = 433.416241 Days, E = 15.501767 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
14.0	5.77	3.16	3.62	5.36	3.14	0.81	10.9	10.4	2.62	2.16	6.52	1.24	0.24	1.69



### Stellar Parameters For KIC 009837720

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5061^{+176}_{-176}$	$4.635^{+0.040}_{-0.060}$	$-0.460^{+0.300}_{-0.300}$	$0.668^{+0.081}_{-0.054}$	$0.704^{+0.077}_{-0.056}$	$3.319^{+0.600}_{-0.733}$
	+3%/-3%	+1%/-1%	+65%/-65%	+12%/-8%	+11%/-8%	+18%/-22%
Source	PHO54	PHO54	PHO54	DSEP		

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

### Secondary Eclipse Parameters for KIC 009837720-01 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-91 \pm 13$	$1.19^{+0.37}_{-0.36}$	$256^{+12}_{-11}$	$4096^{+652}_{-370}$	$35189^{+40068}_{-15737}$
Alt.	$-81 \pm 14$	$1.05^{+0.38}_{-0.34}$	$256^{+12}_{-10}$	$4212^{+764}_{-473}$	$39983^{+50306}_{-19712}$

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

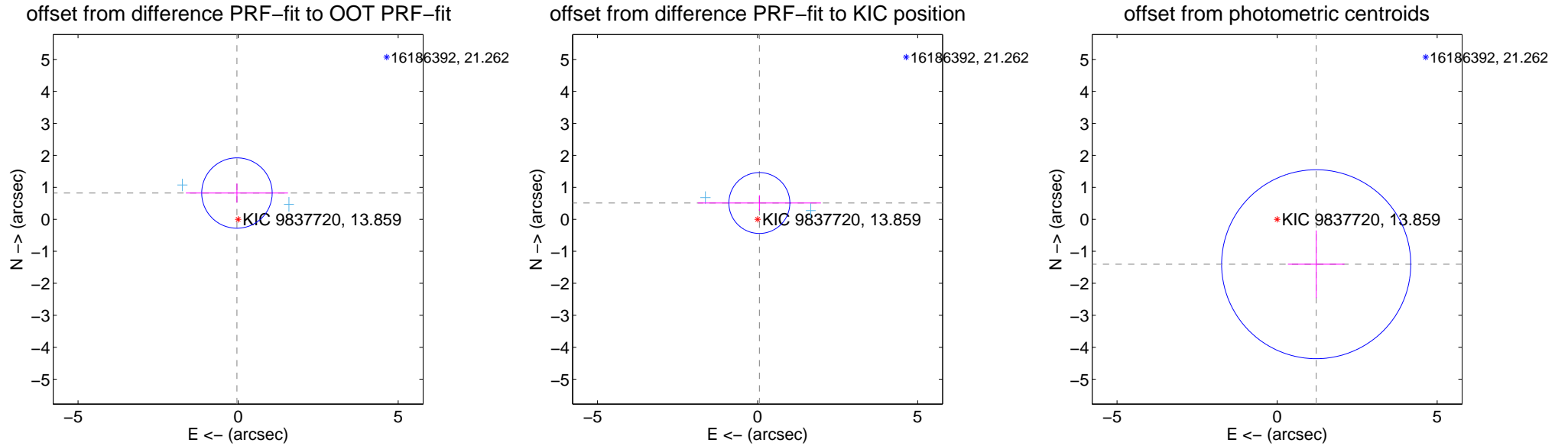
## DV Centroid Data

Supplemental centroid analysis for 009837720-01. Kepler magnitude: 13.86. Transit SNR 10.95

There are 2 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.41 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.822 \pm 0.367$	2.24	$0.037 \pm 1.594$	$0.821 \pm 0.298$
PRF-fit source offset from KIC position	$0.513 \pm 0.317$	1.62	$-0.055 \pm 1.923$	$0.510 \pm 0.244$
photometric centroid source offset	$1.86 \pm 0.98$	1.89	$-1.22 \pm 0.88$	$-1.40 \pm 1.06$



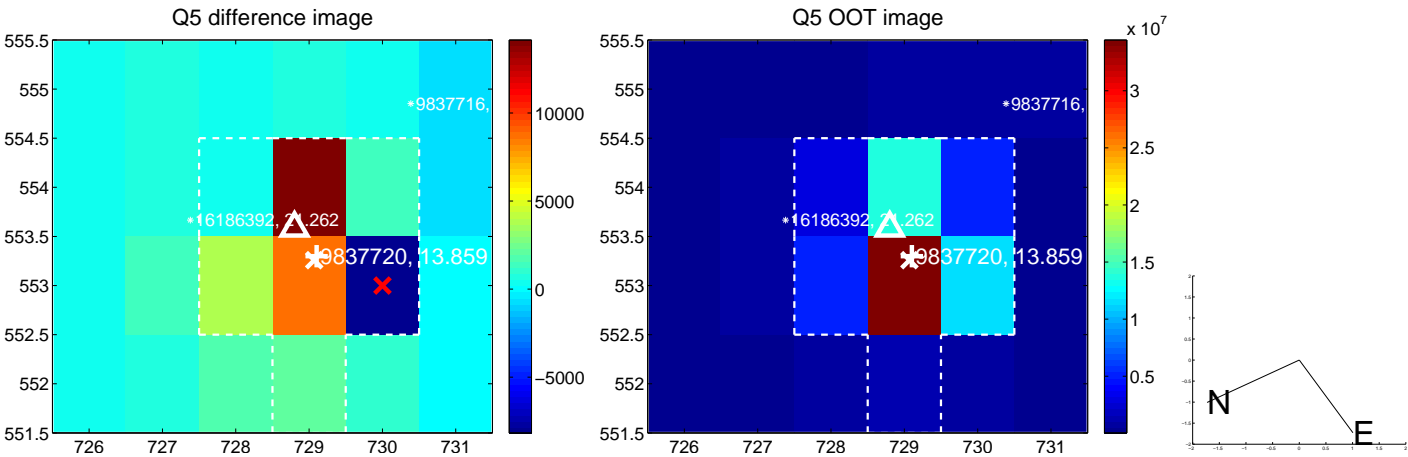
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets**; **Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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



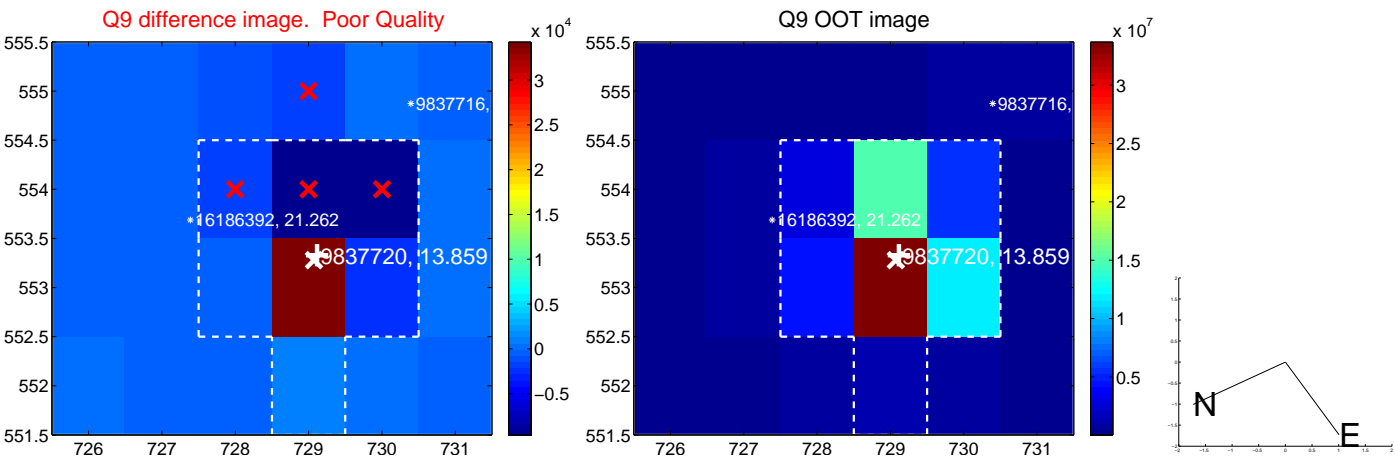
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



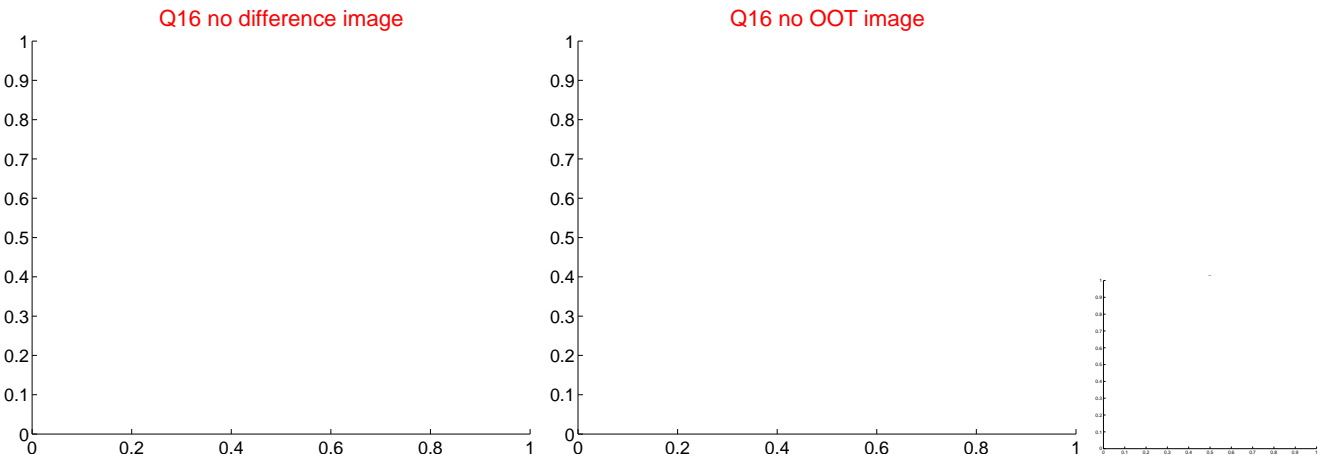
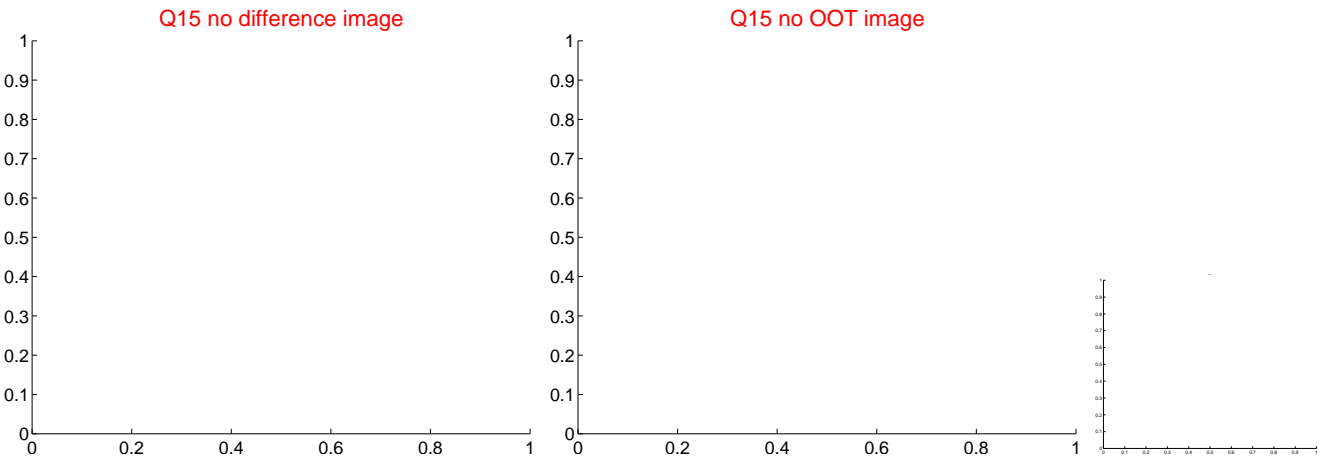
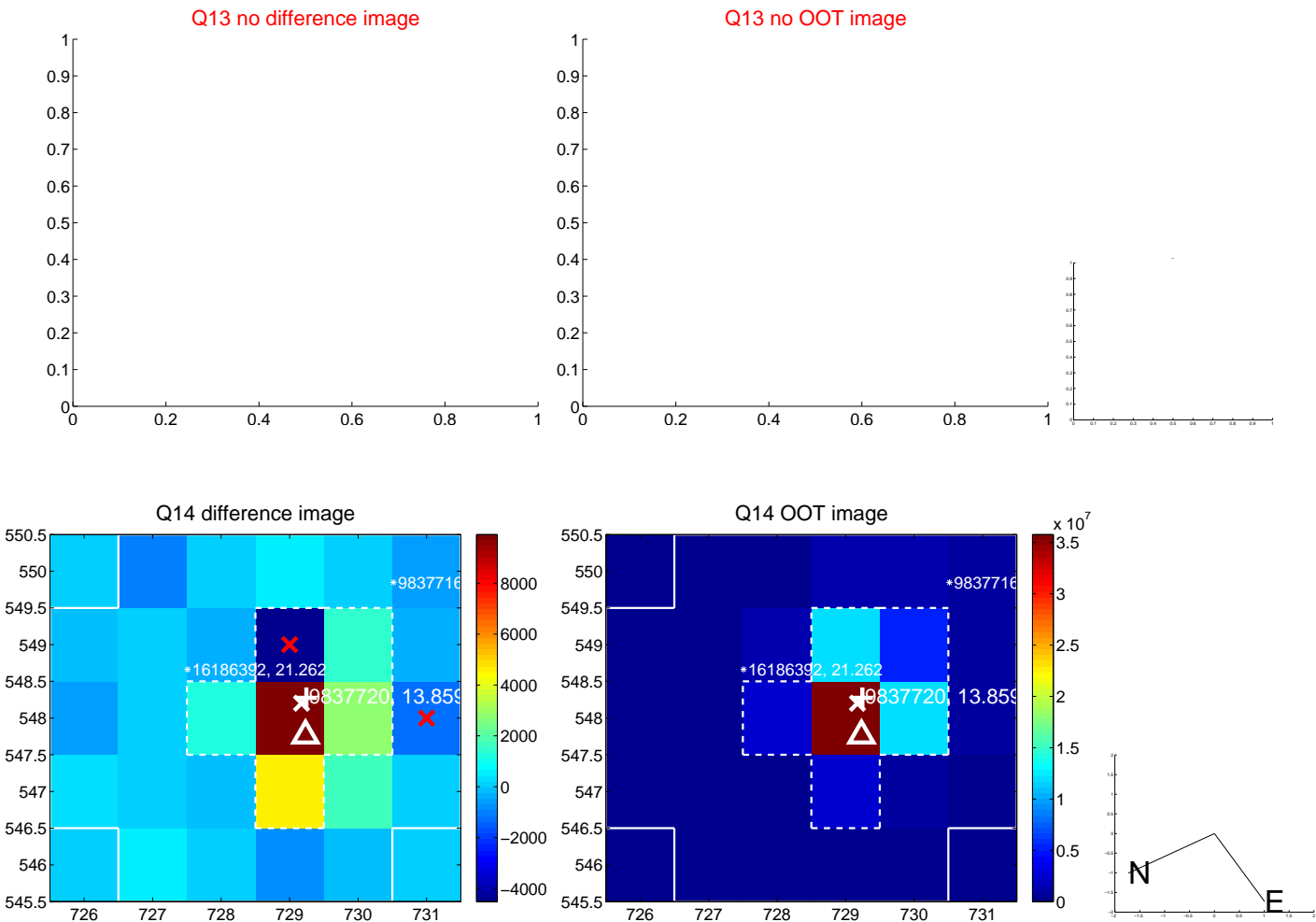
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



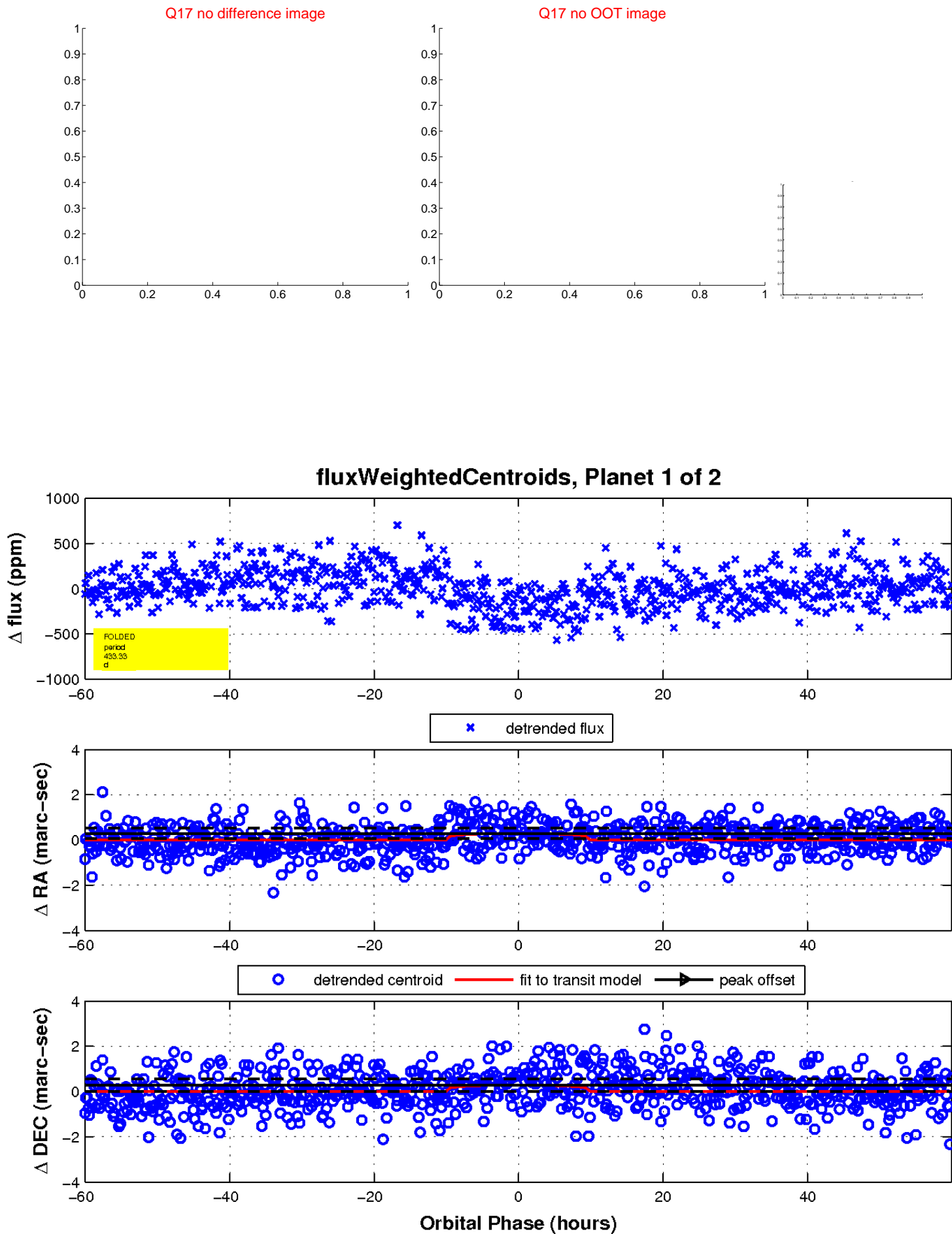
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

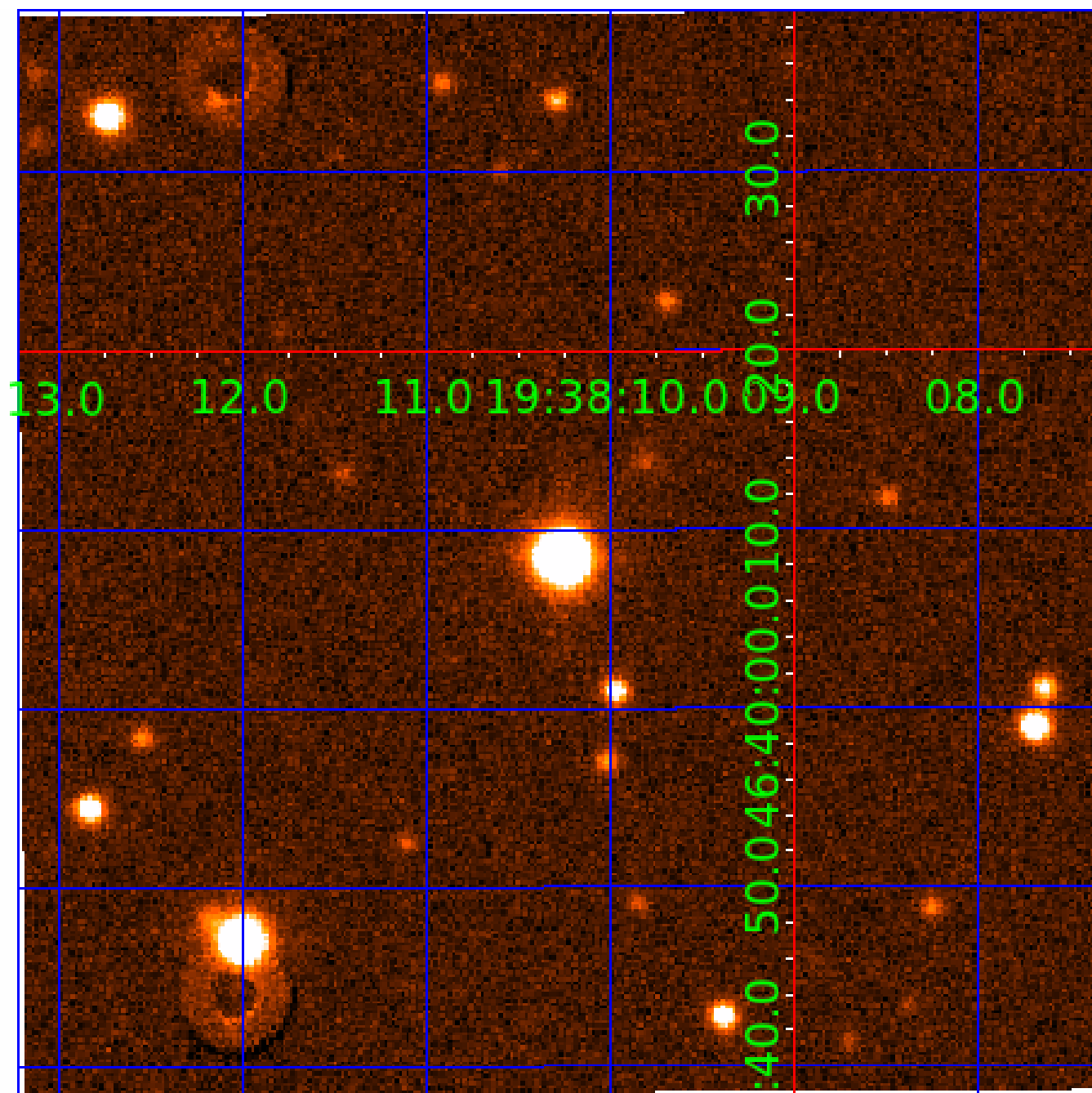


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 009837720

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009837720-01	OBS	No	433.329208	448.967496	268.4	20.038	9.9	10.9	0.67	5061	1.17	0.26
009837720-02	OBS	8187.01	353.003368	258.908785	242.4	22.393	8.4	8.8	0.67	5061	1.09	0.35

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009837720-01	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009837720-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE—LPP_DV—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.

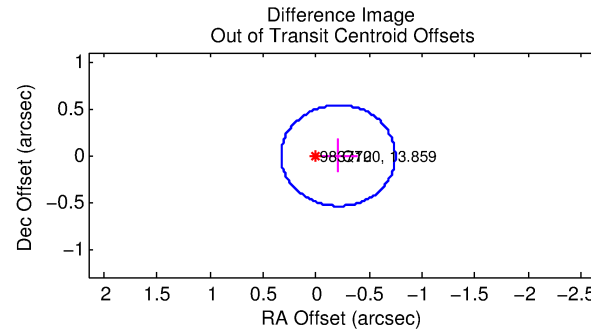
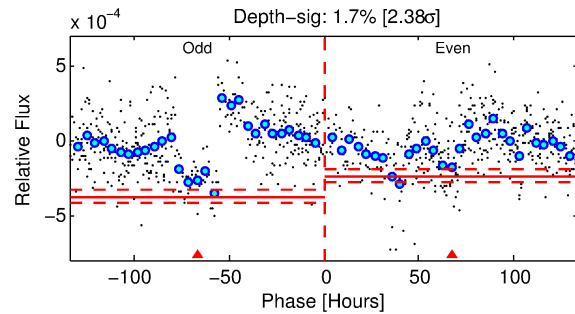
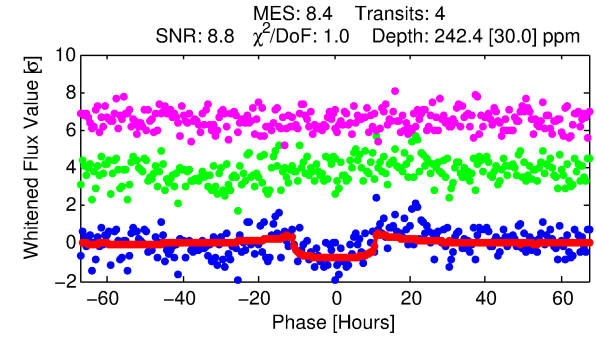
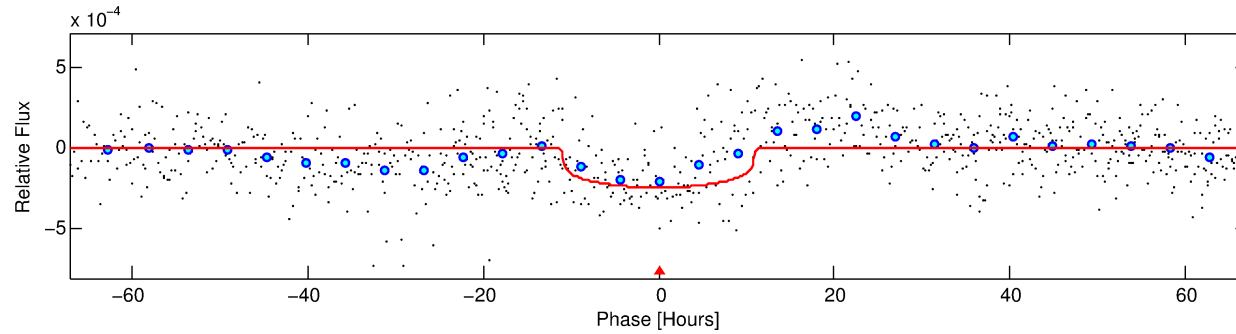
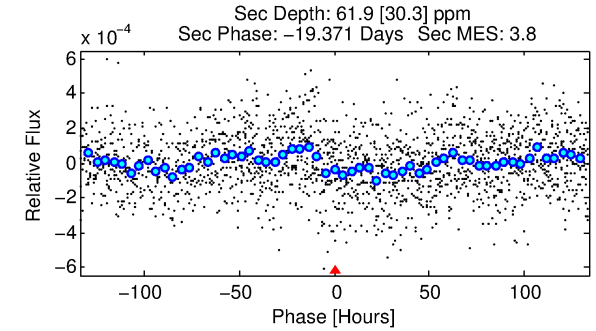
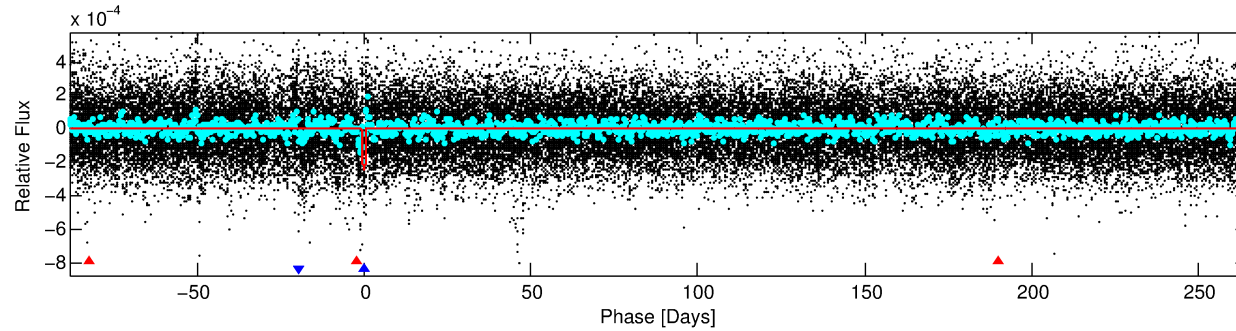
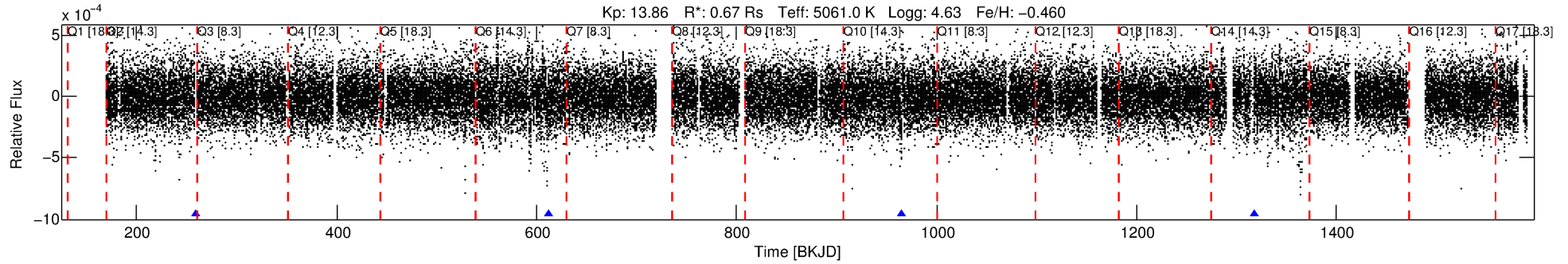
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009837720-02

No Significant Match Found

# DV One-Page Summary

KIC: 9837720 Candidate: 2 of 2 Period: 353.003 d



## DV Fit Results:

Period = 353.00337 [0.01329] d  
Epoch = 258.9088 [0.0270] BKJD  
Rp/R\* = 0.0150 [0.0051]  
a/R\* = 92.40 [114.66]  
b = 0.66 [1.05]  
Seff = 0.35 [0.06]  
Teq = 196 [9] K  
Rp = 1.10 [0.39] Re  
a = 0.8691 [0.0809] AU  
Ag = 21448.90 [18037.55] [1.19σ]  
Teffp = 3663 [772] K [4.49σ]

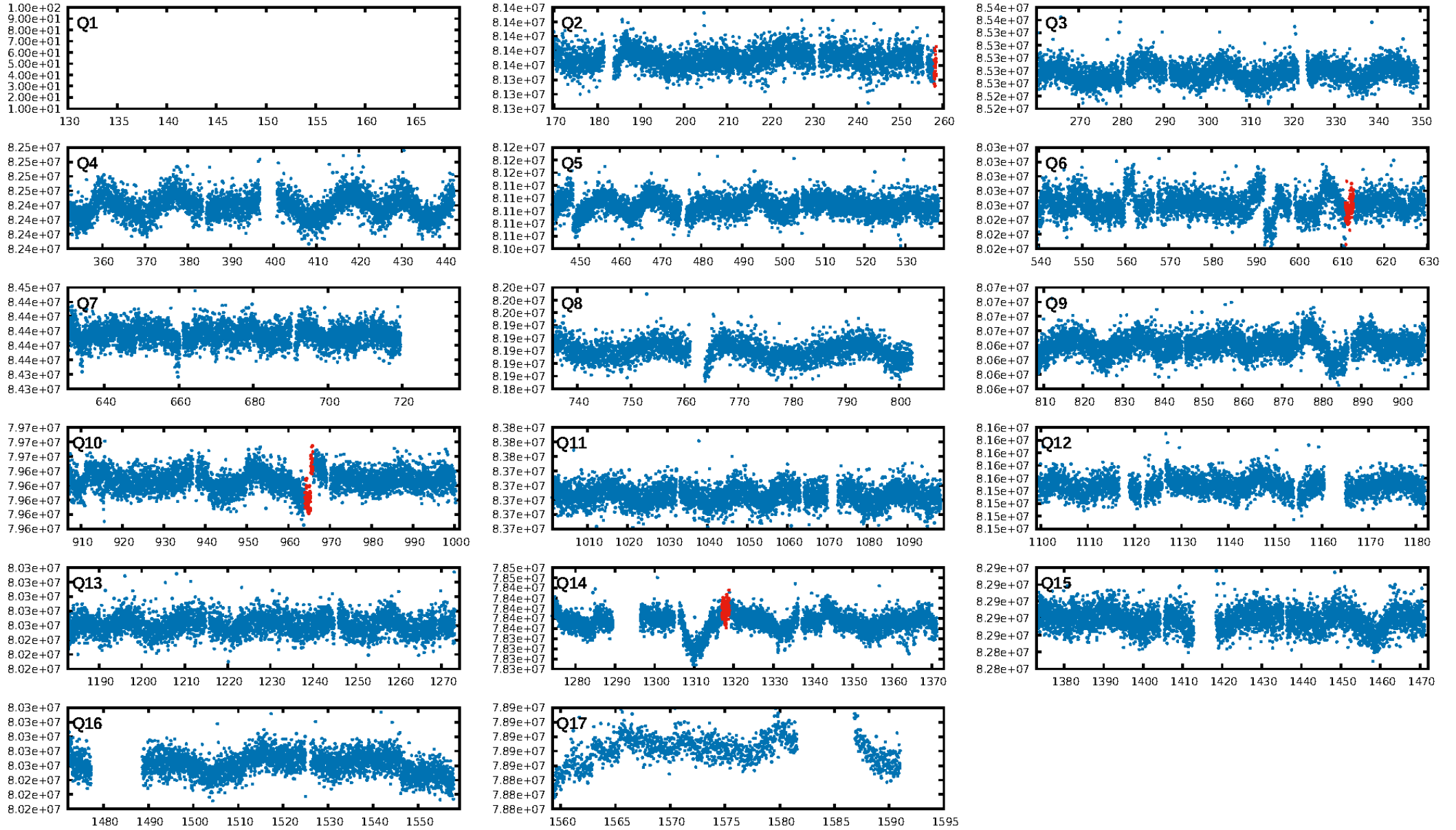
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [64.15σ]  
ModelChiSquare2-sig: 0.6%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 9.65e-16  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: 13  
Centroid-sig: 10.1%  
Centroid-so: 1.196 arcsec [1.10σ]  
OotOffset-rm: 0.207 arcsec [1.15σ]  
OotOffset-st: 1/0/0/0 [1]  
KicOffset-rm: 0.464 arcsec [2.67σ]  
KicOffset-st: 1/0/0/0 [1]  
DiffImageQuality-fgm: 1.00 [1/1]  
DiffImageOverlap-fno: 1.00 [3/3]

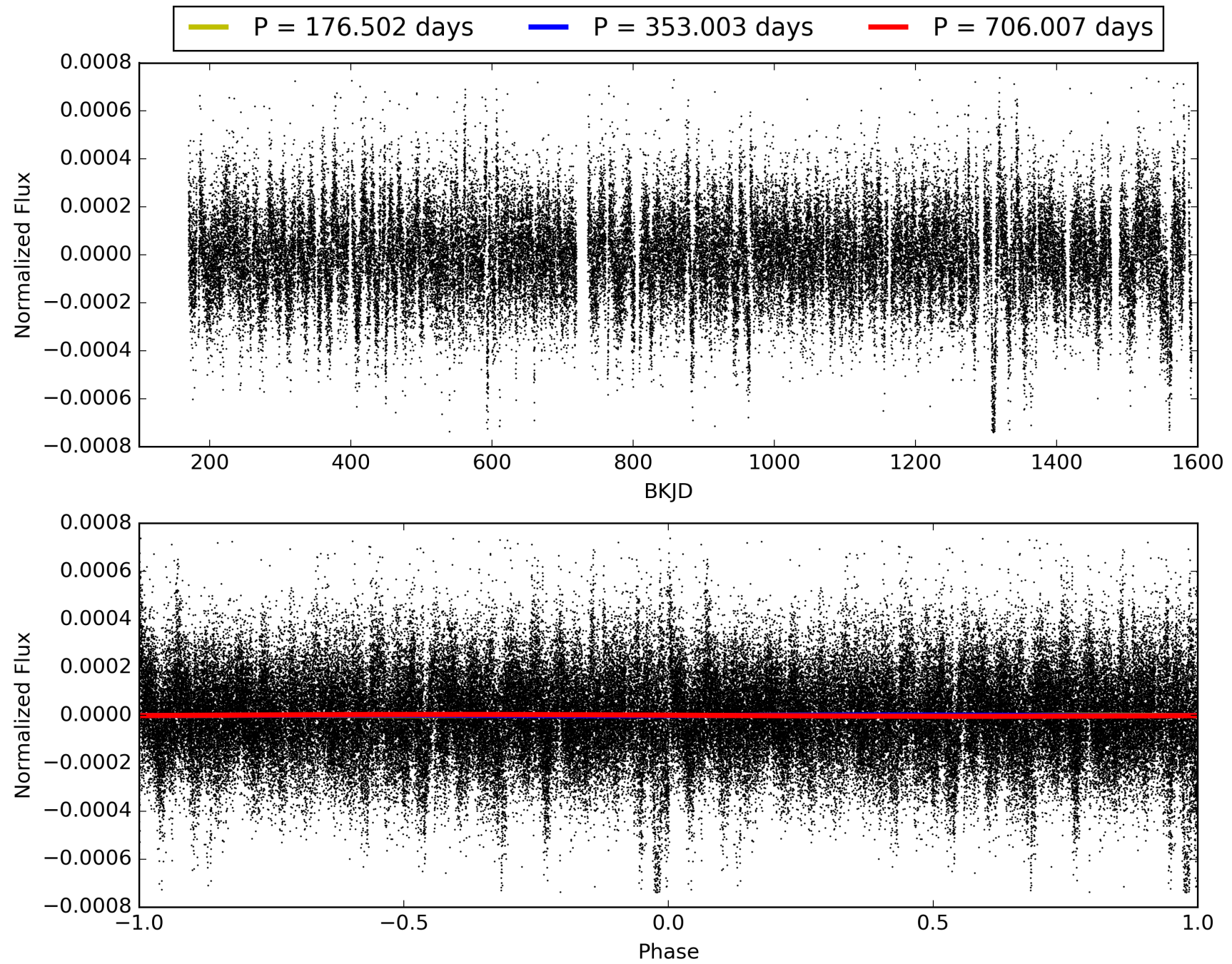
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 19:35:25 Z

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

# TCE 009837720-02, PDC Light Curves

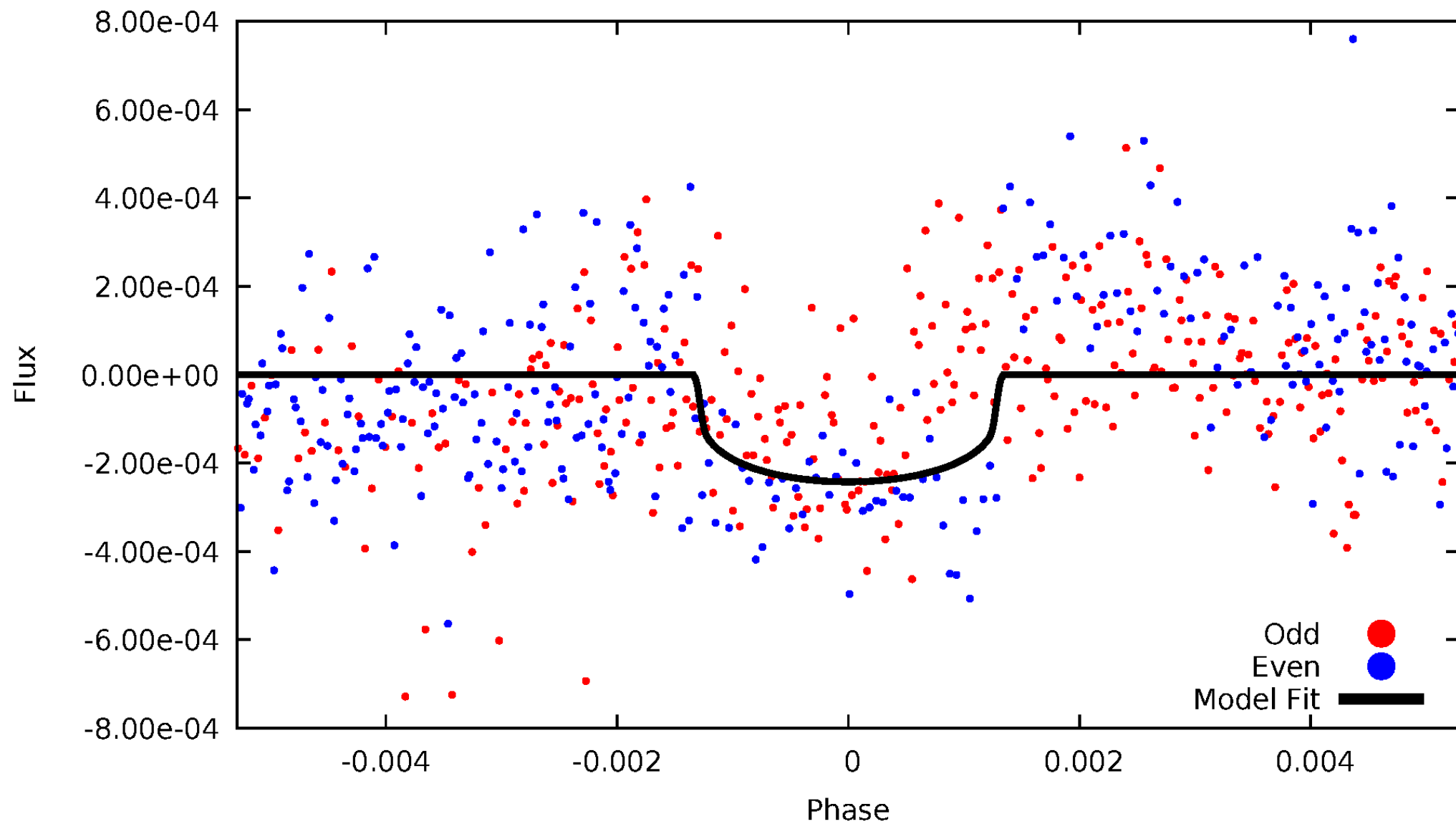


TCE 009837720-02



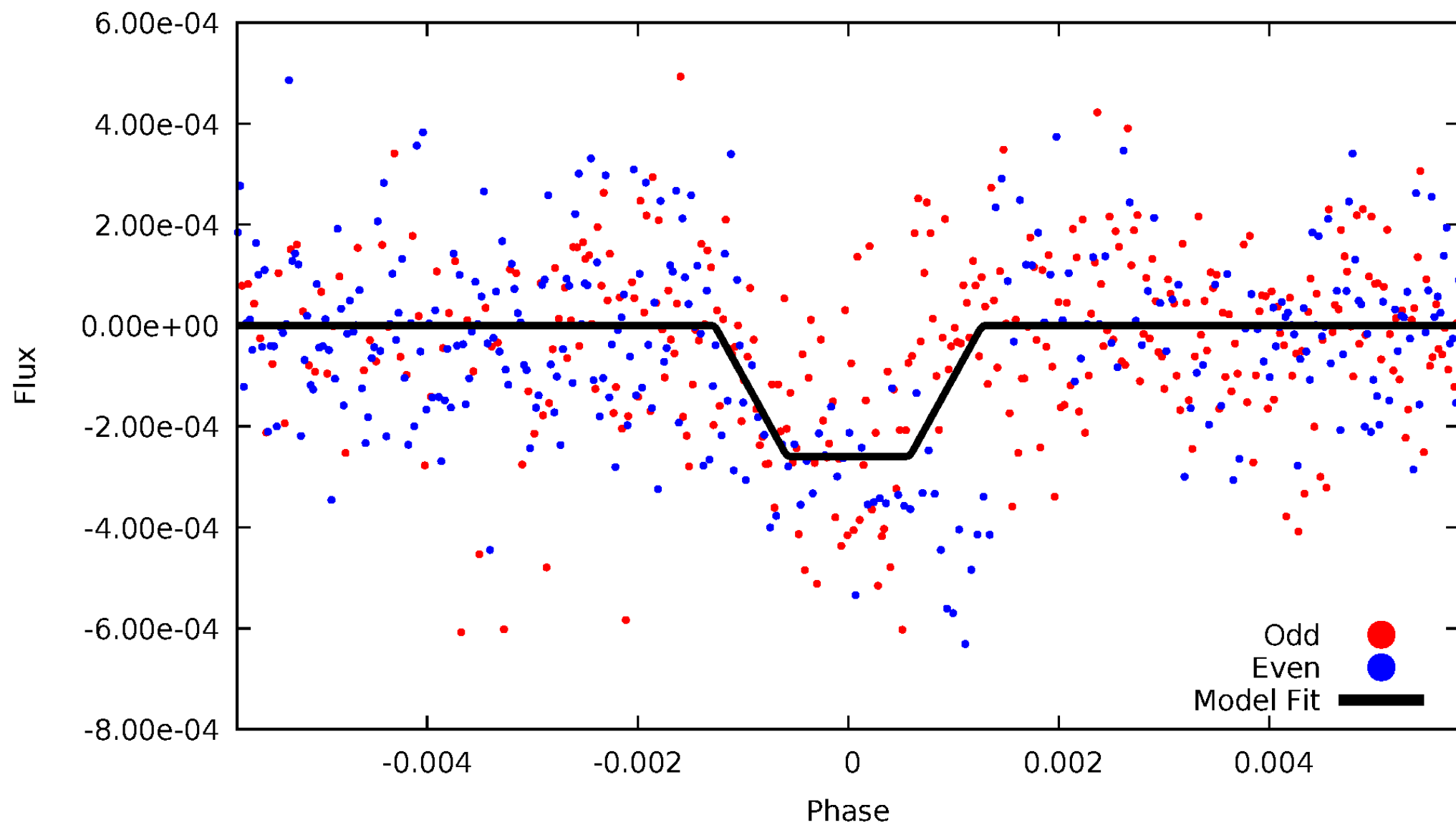
DV Odd/Even

TCE 009837720-02



# ALT Odd/Even

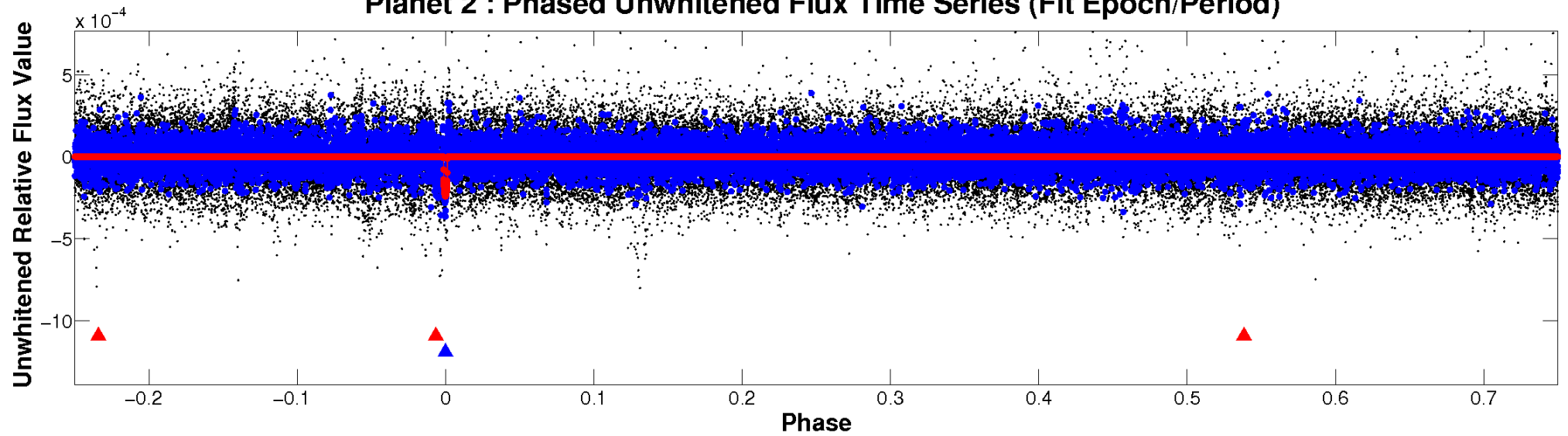
TCE 009837720-02



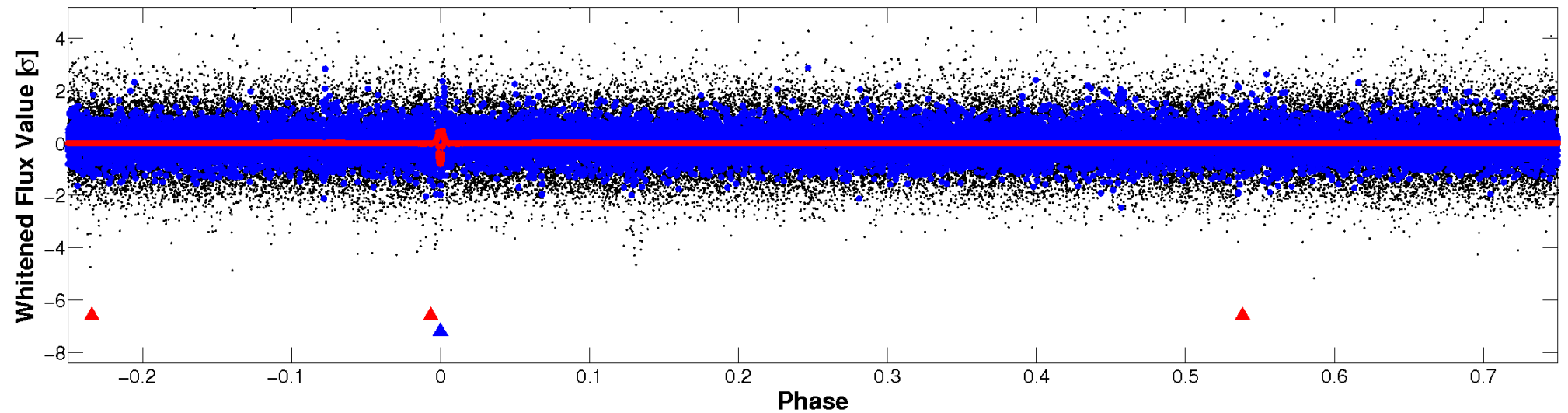


# Non-Whitened Vs. Whitened Light Curve

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

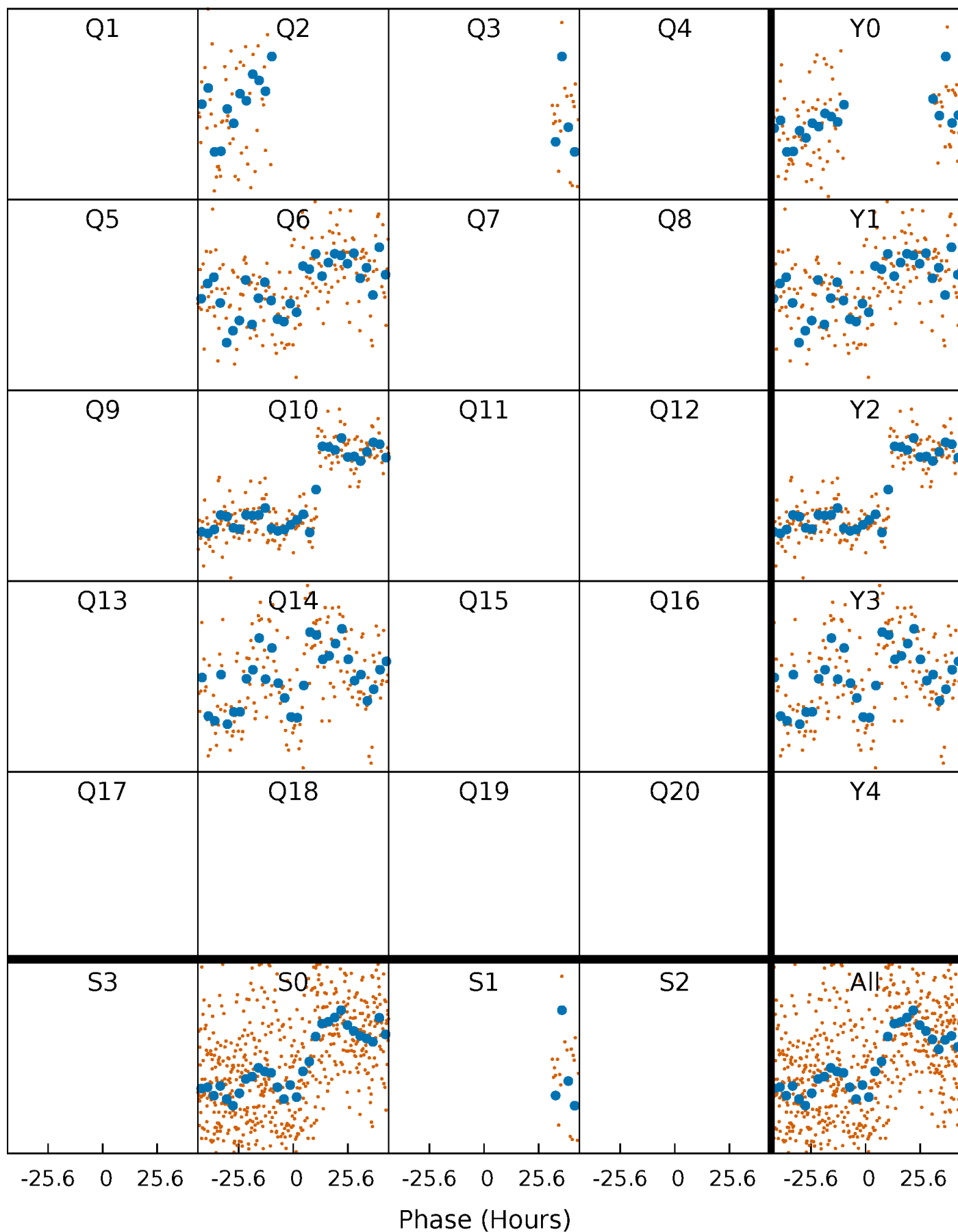


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



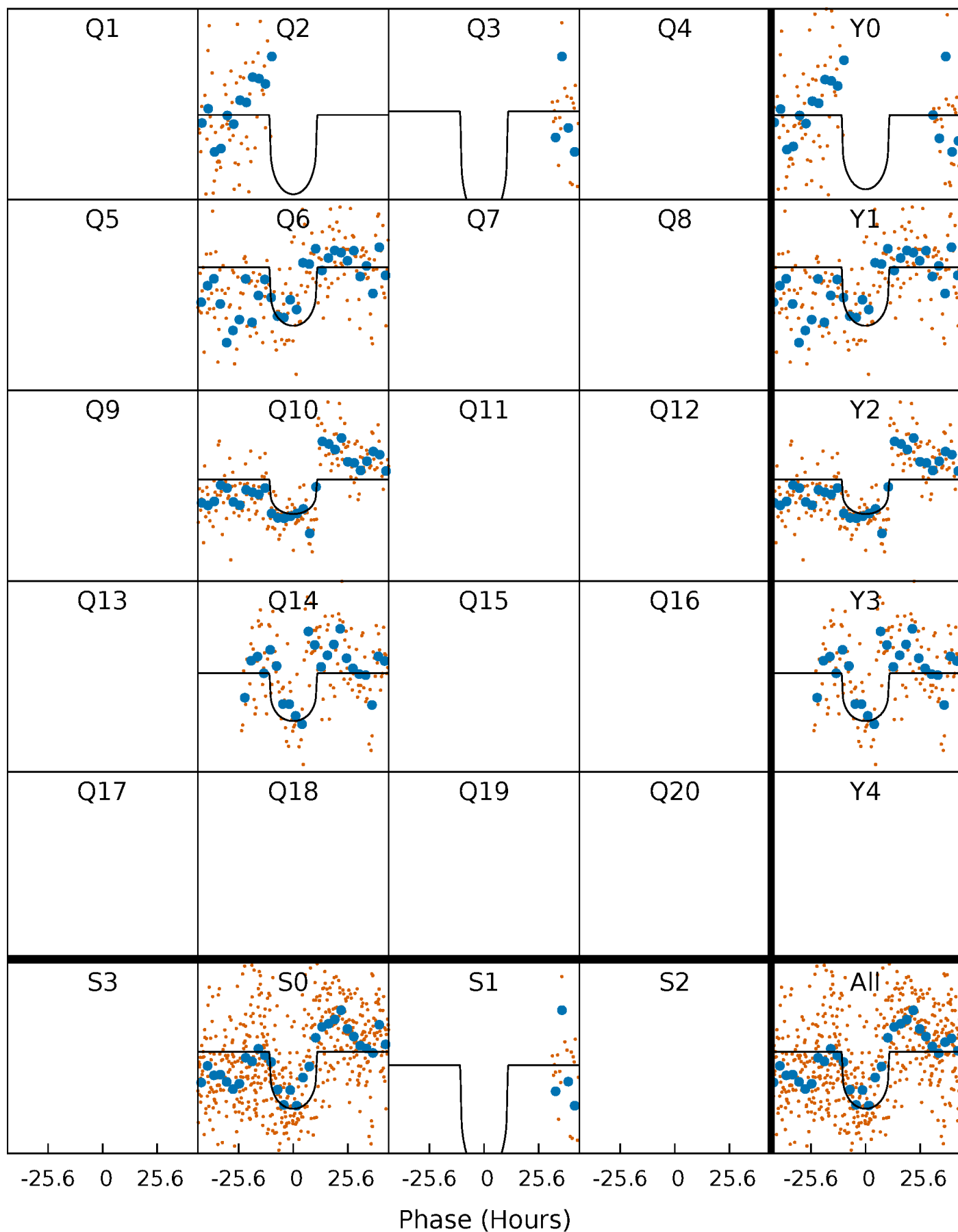
# PDC Quarter-Phased Transit Curves

TCE 009837720-02 P=353.003368 Days  $T_0=258.908785$  (BKJD)



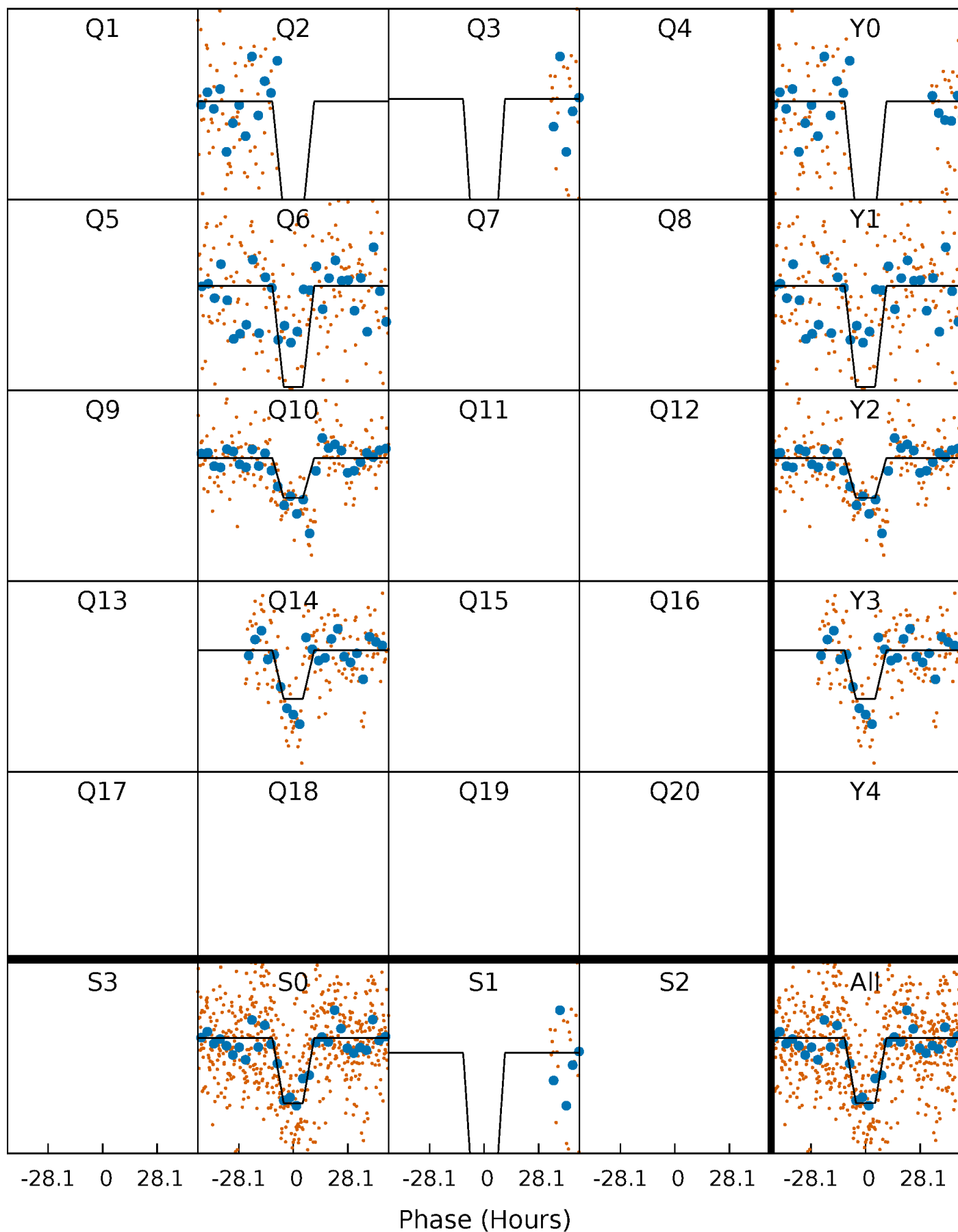
# DV Quarter-Phased Transit Curves

TCE 009837720-02 P=353.003368 Days  $T_0=258.908785$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

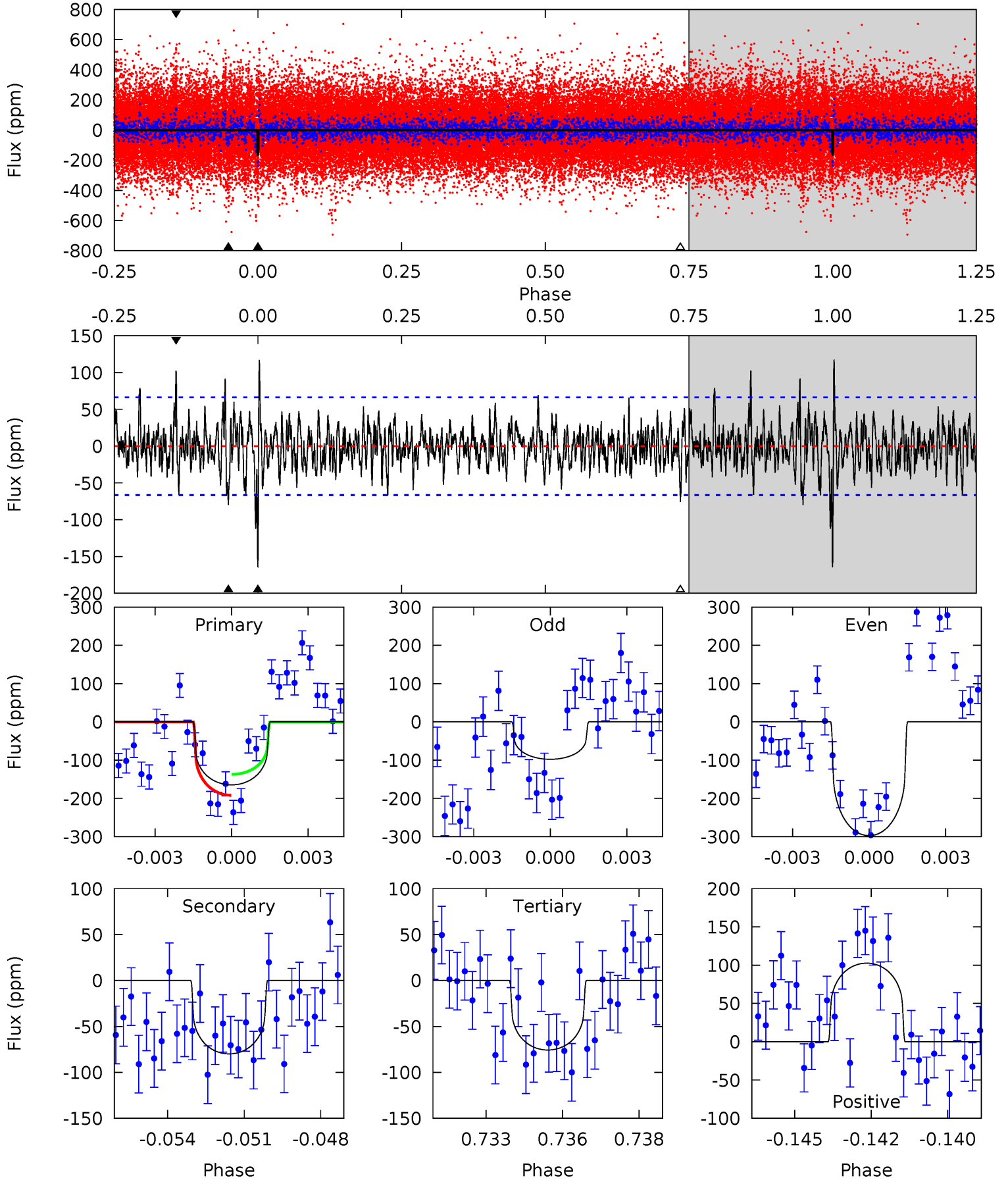
TCE 009837720-02 P=353.037427 Days  $T_0=258.820001$  (BKJD)



# DV Model-Shift Uniqueness Test

009837720-02,  $P = 353.003368$  Days,  $E = 258.908785$  Days

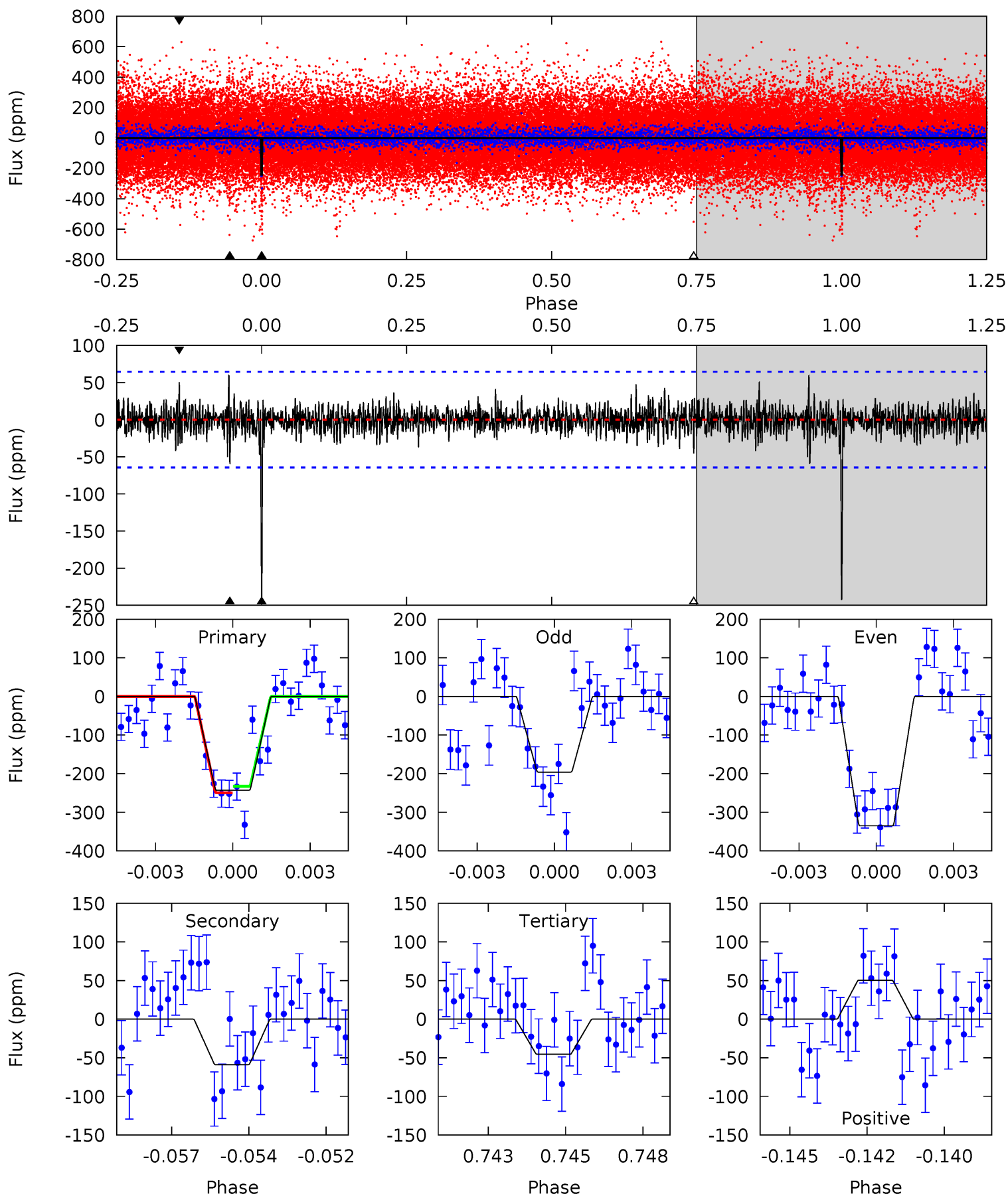
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
13.1	6.34	6.01	8.14	5.27	3.00	1.85	7.05	4.92	0.33	-1.80	7.53	1.42	0.42	2.17



# Alt Model-Shift Uniqueness Test

009837720-02, P = 353.037427 Days, E = 258.820001 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
19.9	4.82	3.71	4.13	5.28	3.01	1.03	16.2	15.7	1.10	0.69	5.46	0.68	0.20	0.68





### Stellar Parameters For KIC 009837720

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M$ ( $M_{\odot}$ )	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5061^{+176}_{-176}$	$4.635^{+0.040}_{-0.060}$	$-0.460^{+0.300}_{-0.300}$	$0.668^{+0.081}_{-0.054}$	$0.704^{+0.077}_{-0.056}$	$3.319^{+0.600}_{-0.733}$
	+3%/-3%	+1%/-1%	+65%/-65%	+12%/-8%	+11%/-8%	+18%/-22%
Source	PHO54	PHO54	PHO54	DSEP		

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

### Secondary Eclipse Parameters for KIC 009837720-02 / KOI 8187.01

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-80 \pm 13$	$1.13^{+0.39}_{-0.38}$	$275^{+12}_{-11}$	$4110^{+741}_{-445}$	$25871^{+34455}_{-11389}$
Alt.	$-59 \pm 12$	$1.20^{+0.38}_{-0.36}$	$274^{+11}_{-10}$	$3789^{+592}_{-349}$	$16791^{+21271}_{-7366}$

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

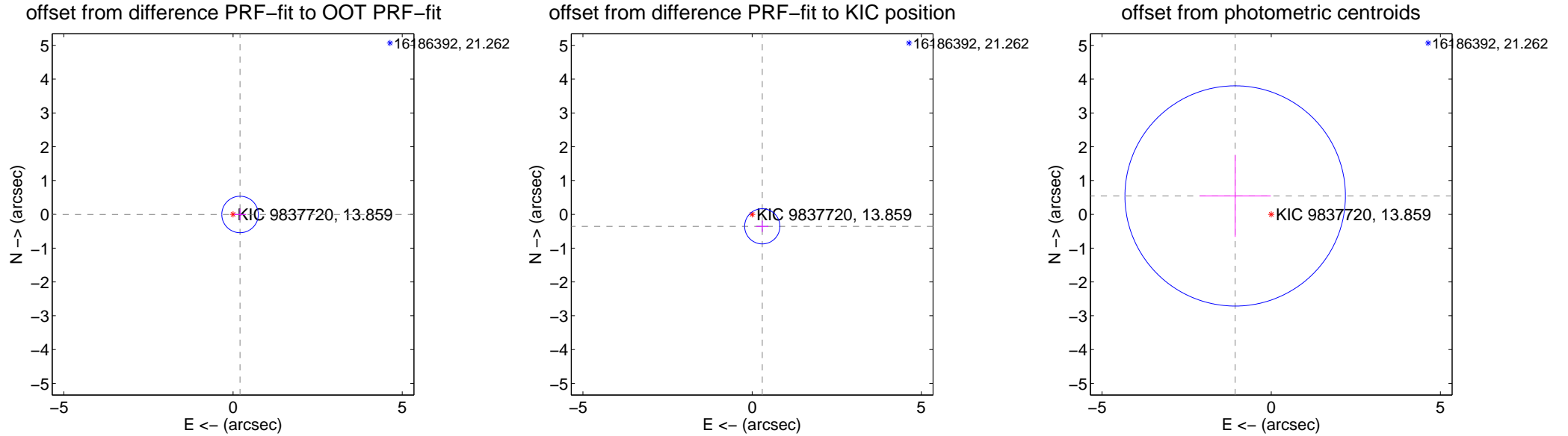
## DV Centroid Data

Supplemental centroid analysis for 009837720-02. Kepler magnitude: 13.86. Transit SNR 8.78

There are 1 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.36 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.207 \pm 0.180$	1.15	$-0.207 \pm 0.180$	$-0.004 \pm 0.169$
PRF-fit source offset from KIC position	$0.464 \pm 0.174$	2.67	$-0.300 \pm 0.180$	$-0.354 \pm 0.169$
photometric centroid source offset	$1.20 \pm 1.09$	1.10	$1.07 \pm 1.05$	$0.54 \pm 1.21$



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.

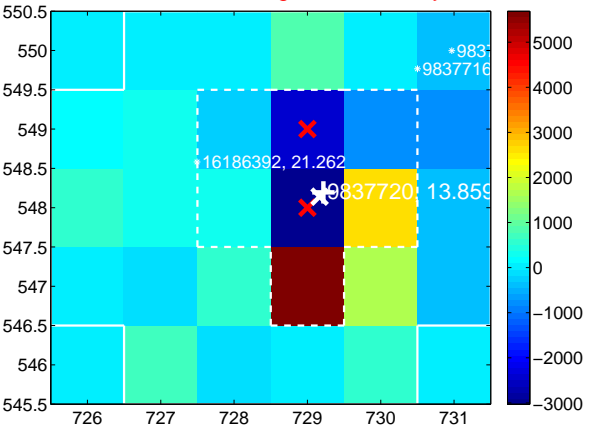
Q5 no difference image



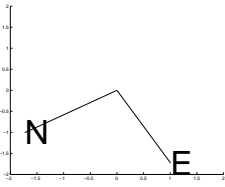
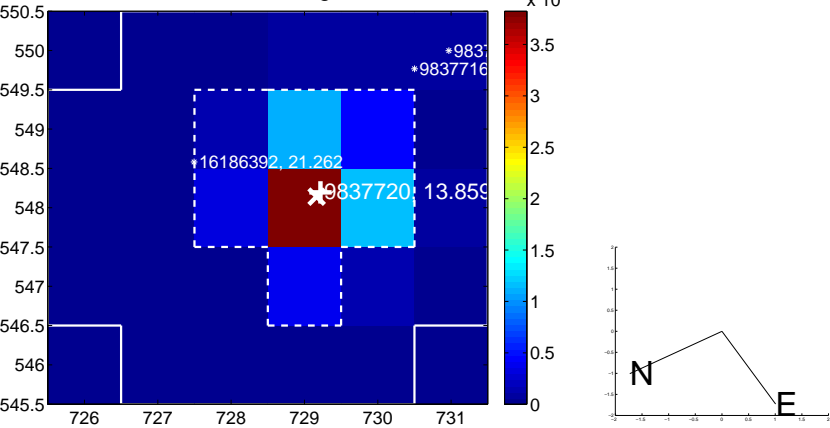
Q5 no OOT image



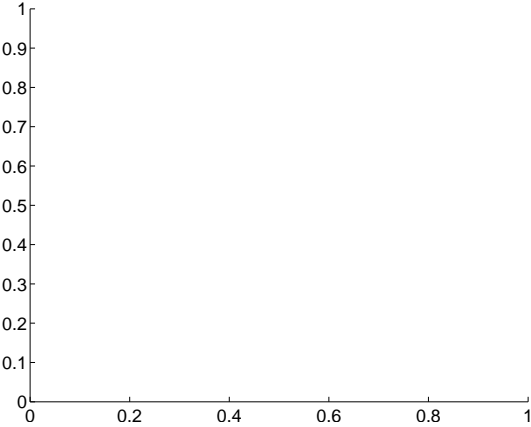
Q6 difference image. Poor Quality



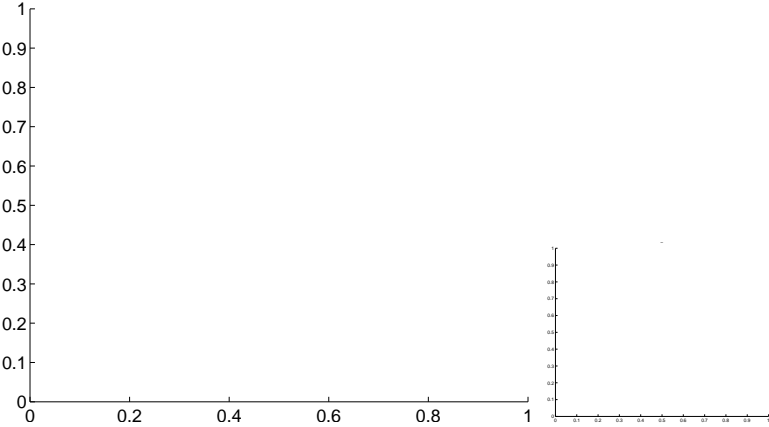
Q6 OOT image



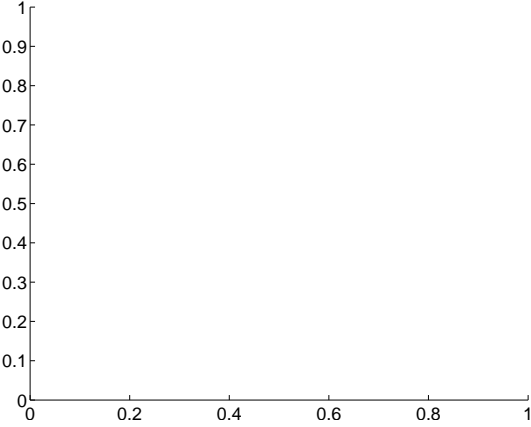
Q7 no difference image



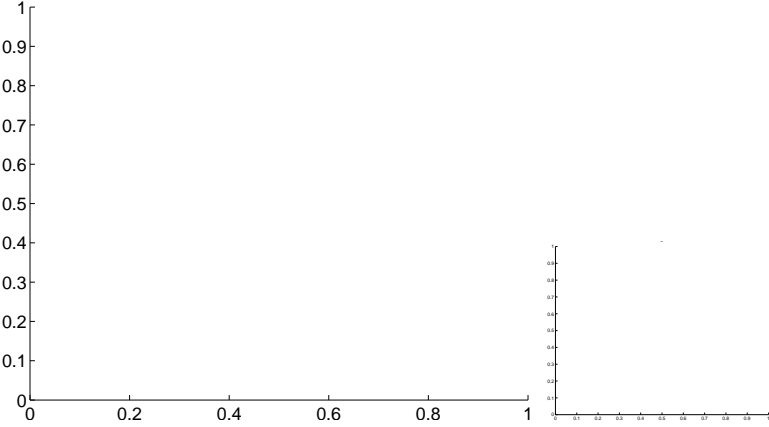
Q7 no OOT image



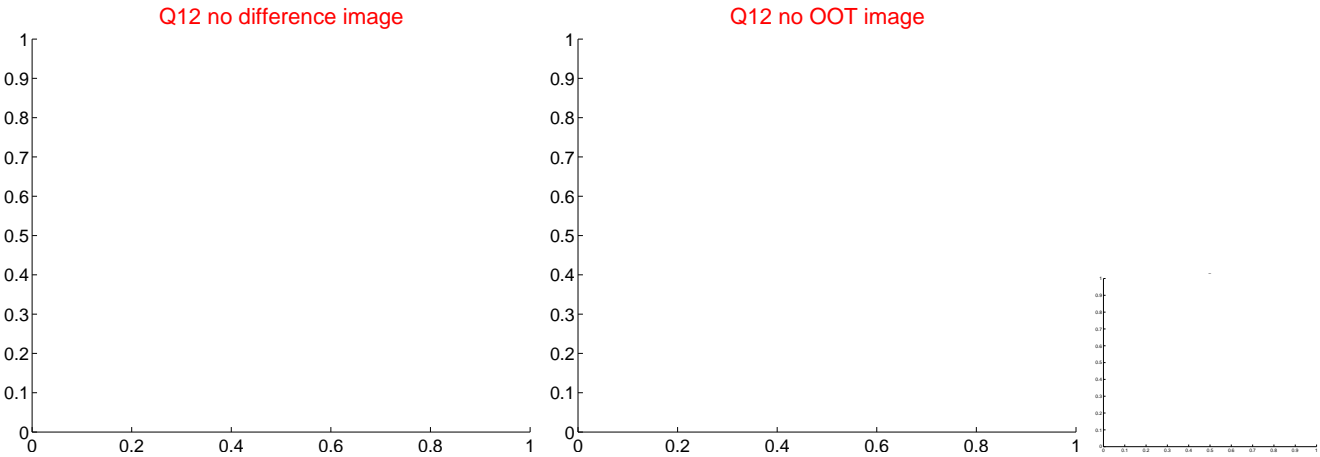
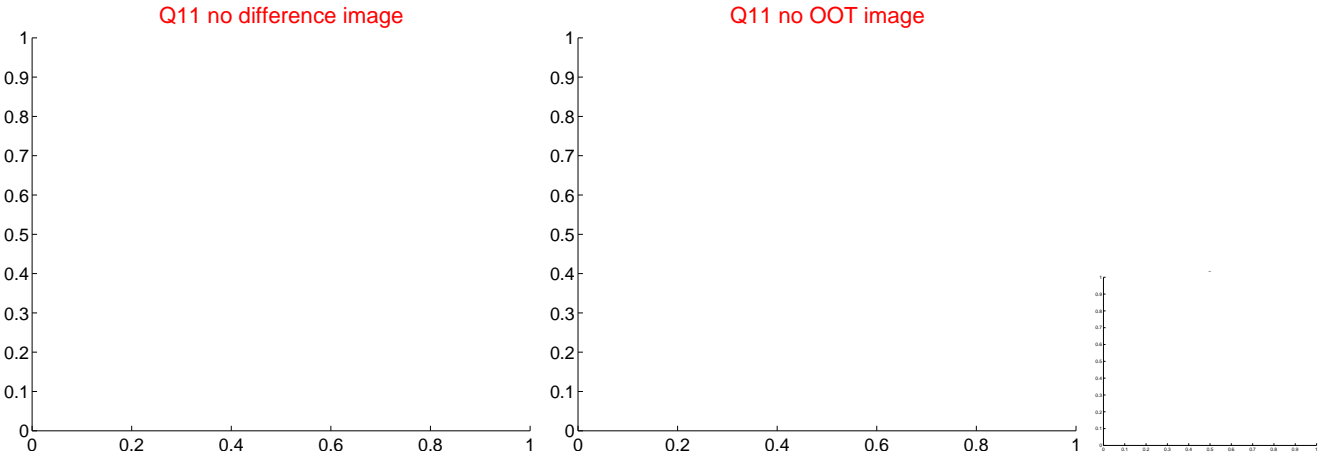
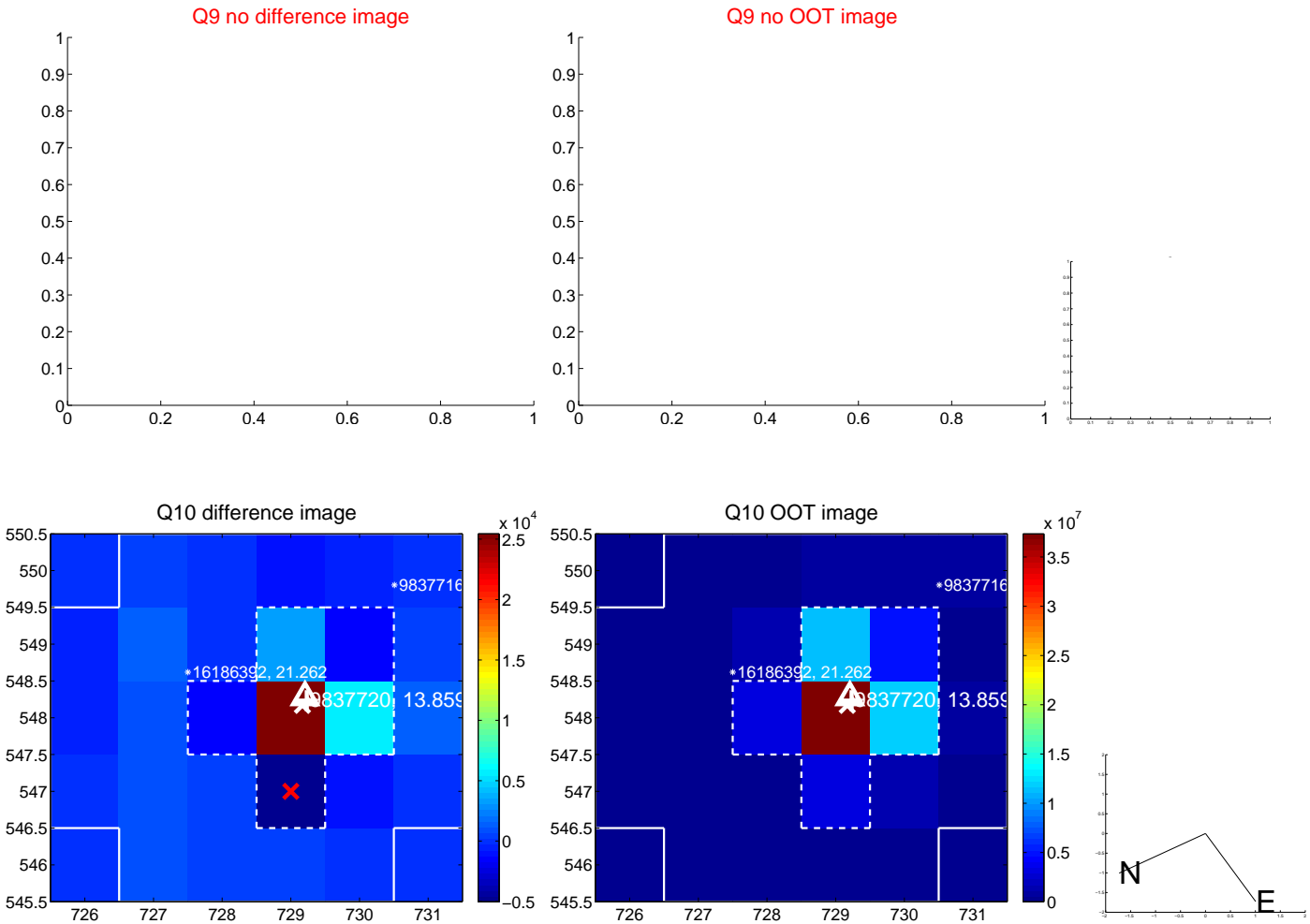
Q8 no difference image



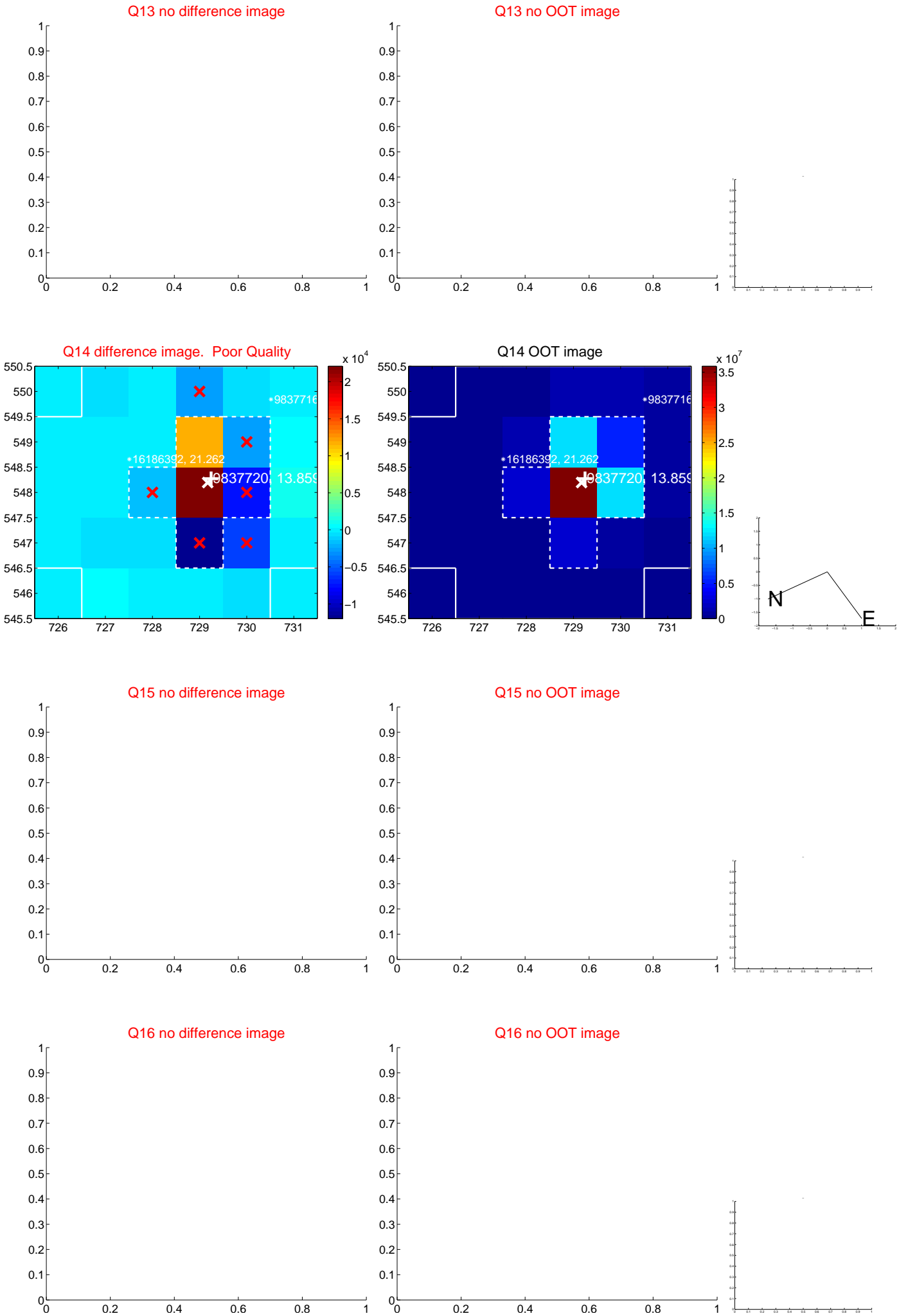
Q8 no OOT image



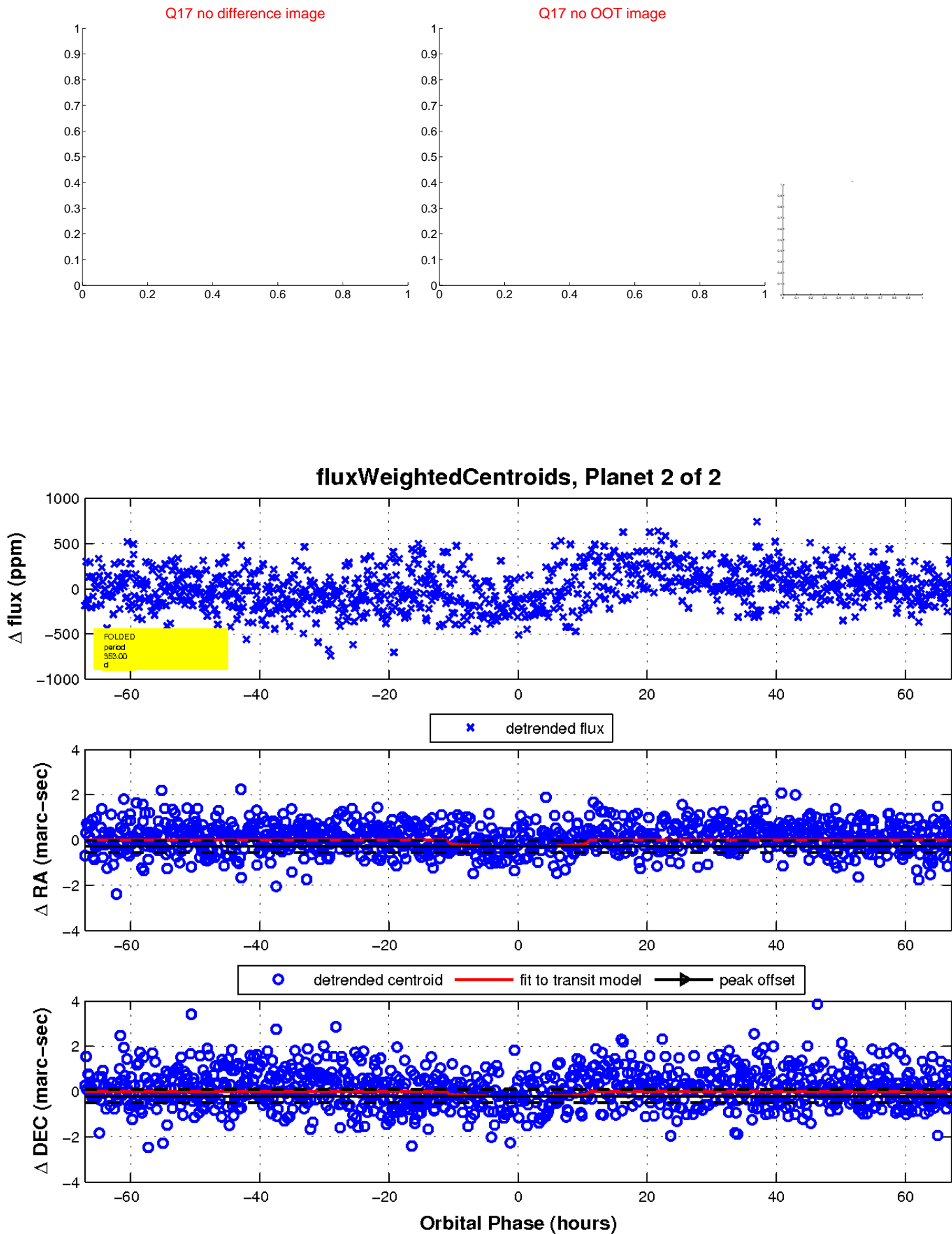
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

