

# KIC 009304409

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009304409-01	OBS	No	1.888315	132.993878	28.3	10.913	8.4	10.6	4.43	7176	2.42	34239.60
009304409-02	OBS	No	198.471665	286.715017	447.2	13.782	16.2	10.5	4.43	7176	10.18	69.03
009304409-03	OBS	No	141.329794	259.181382	374.1	19.168	11.3	9.8	4.43	7176	9.04	108.56
009304409-04	OBS	No	95.706297	176.675854	452.0	1.985	7.9	8.1	4.43	7176	10.56	182.55

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009304409-01	OBS	FP	0.00	1	0	0	0	LPP_DV—LPP_ALT—CENT_KIC_POS
009304409-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL_SKYE—TRANS_GAPPED—LPP_DV—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009304409-03	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_ALT—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009304409-04	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_KIC_POS

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

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

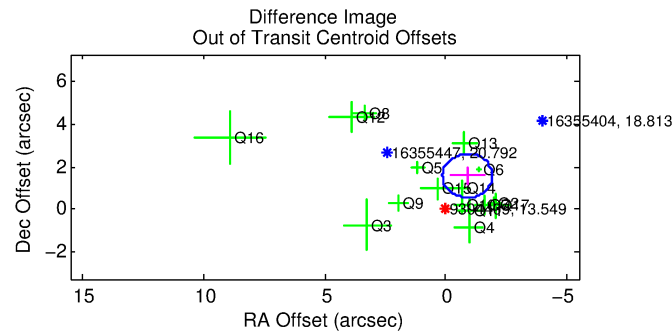
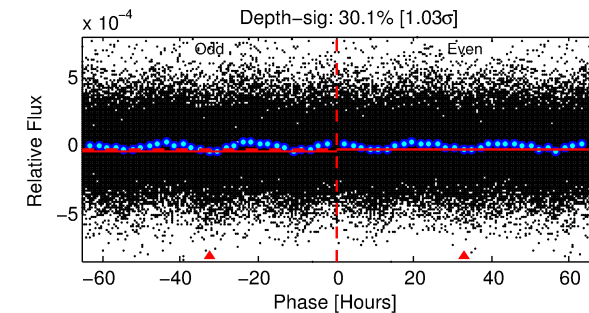
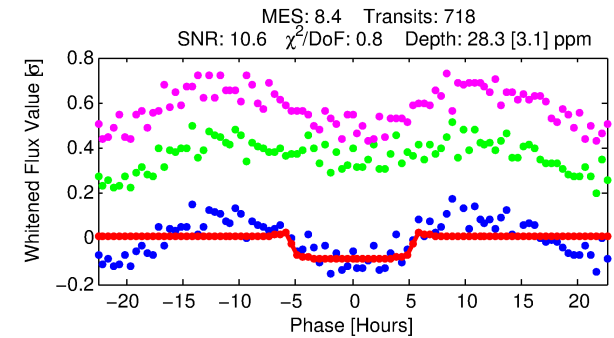
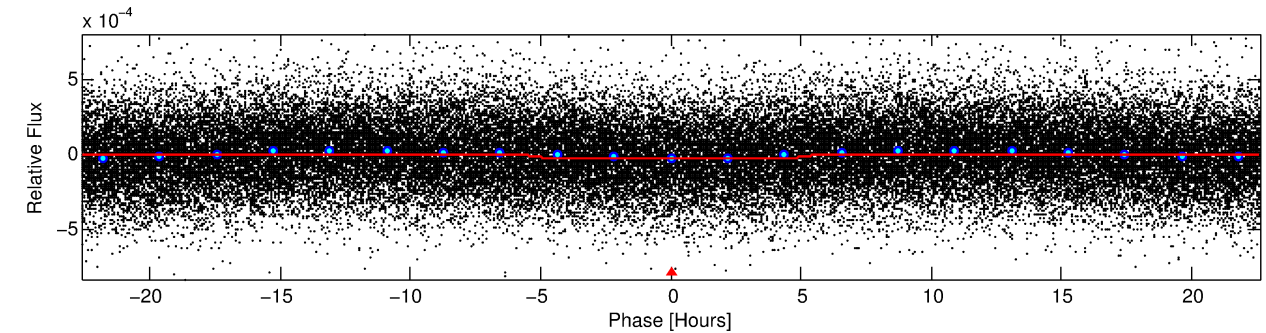
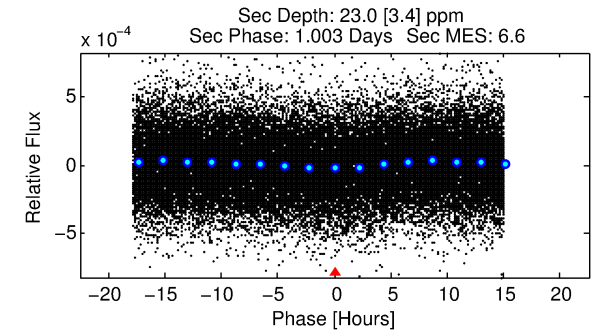
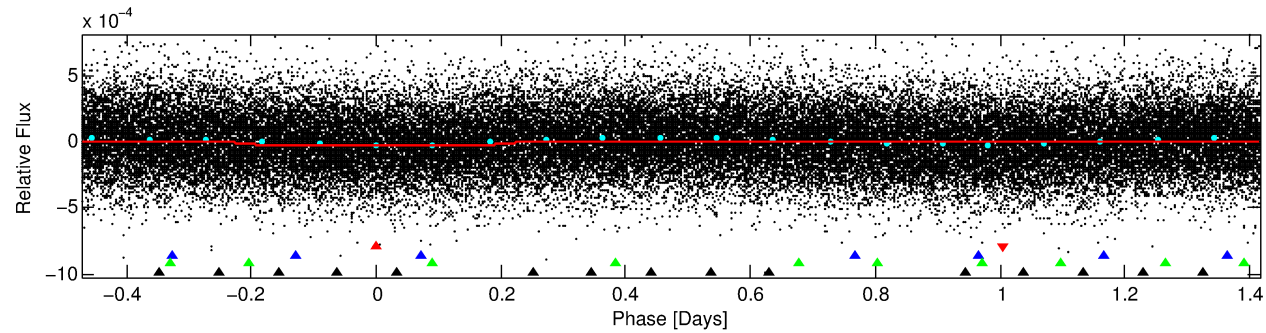
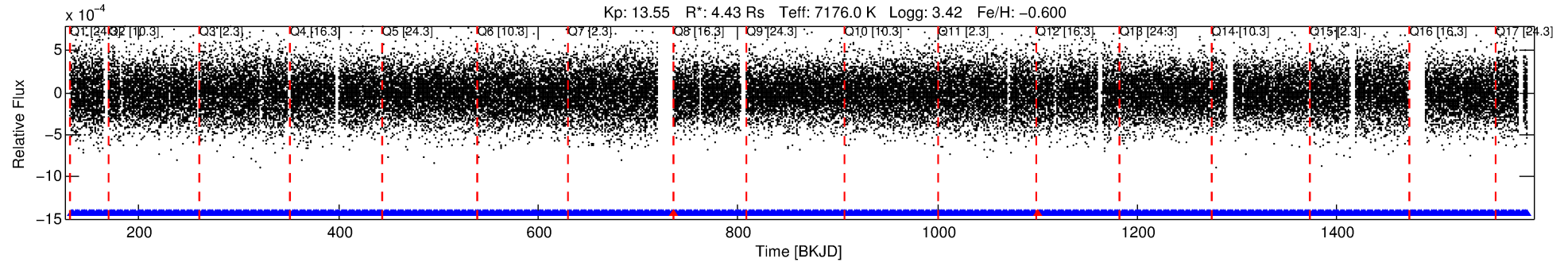
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 009304409-01

No Significant Match Found

# DV One-Page Summary

KIC: 9304409 Candidate: 1 of 4 Period: 1.888 d



## DV Fit Results:

Period = 1.88831 [0.00003] d  
Epoch = 132.9939 [0.0069] BKJD  
Rp/R\* = 0.0050 [0.0033]  
a/R\* = 1.41 [2.72]  
b = 0.37 [9.11]  
Seff = 34239.60 [42955.45]  
Teq = 3469 [1088] K  
Rp = 2.41 [2.29] Re  
a = 0.0369 [0.0271] AU  
Ag = 2.95 [5.39] [0.36σ]  
Teffp = 7029 [2366] K [1.37σ]

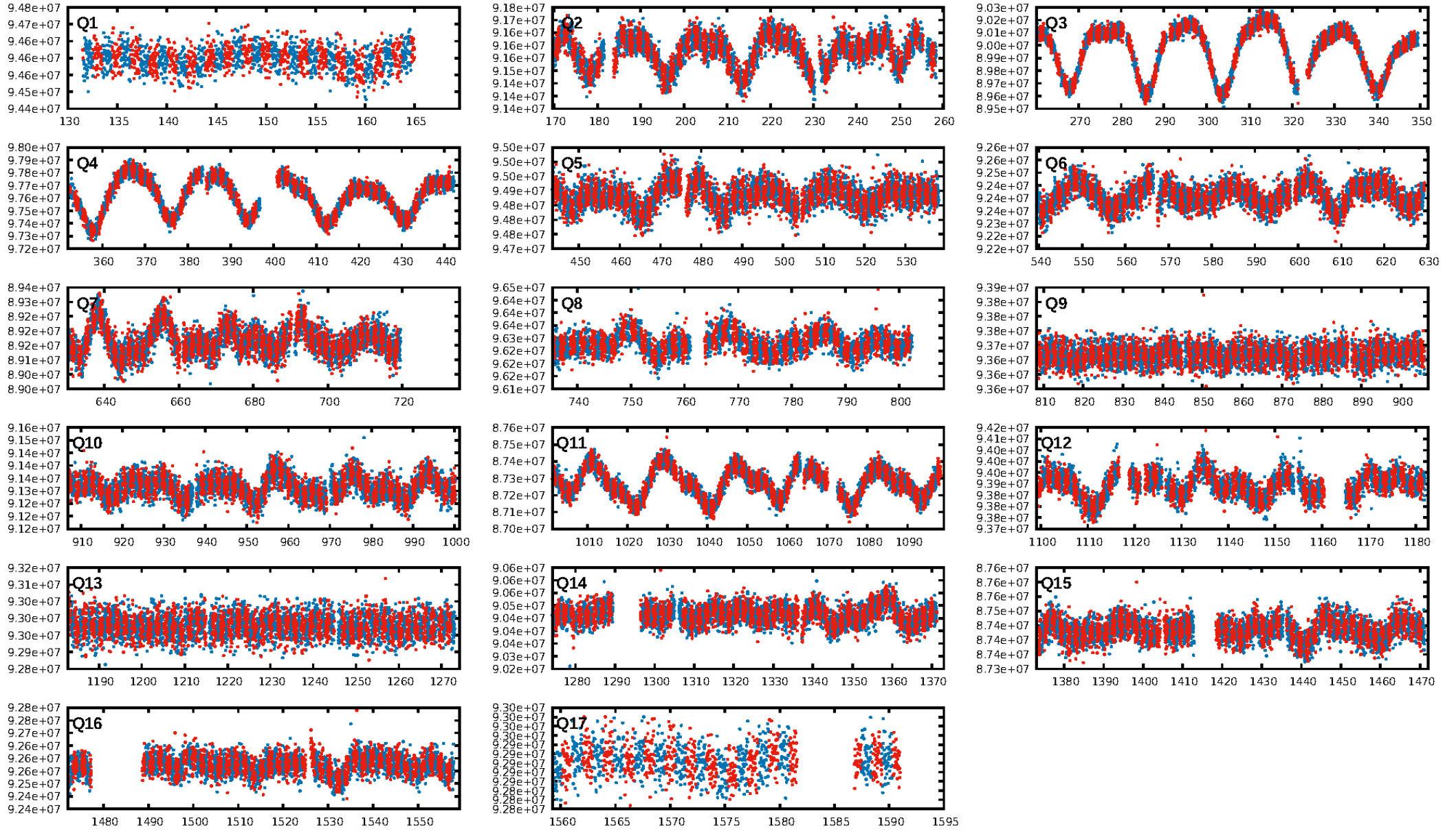
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [203.00σ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
**Bootstrap-pfa: 1.37e-10**  
RollingBand-fgt: 1.00 [683/685]  
GhostDiagnostic-chr: 3.594  
Centroid-sig: 6.8%  
Centroid-so: 0.828 arcsec [0.82σ]  
**OotOffset-rm: 1.808 arcsec [5.28σ]**  
**KicOffset-rm: 1.254 arcsec [3.05σ]**  
OotOffset-st: 4/4/4/4 [16]  
KicOffset-st: 4/4/4/4 [16]  
DiffImageQuality-fgm: 0.75 [12/16]  
DiffImageOverlap-fno: 1.00 [17/17]

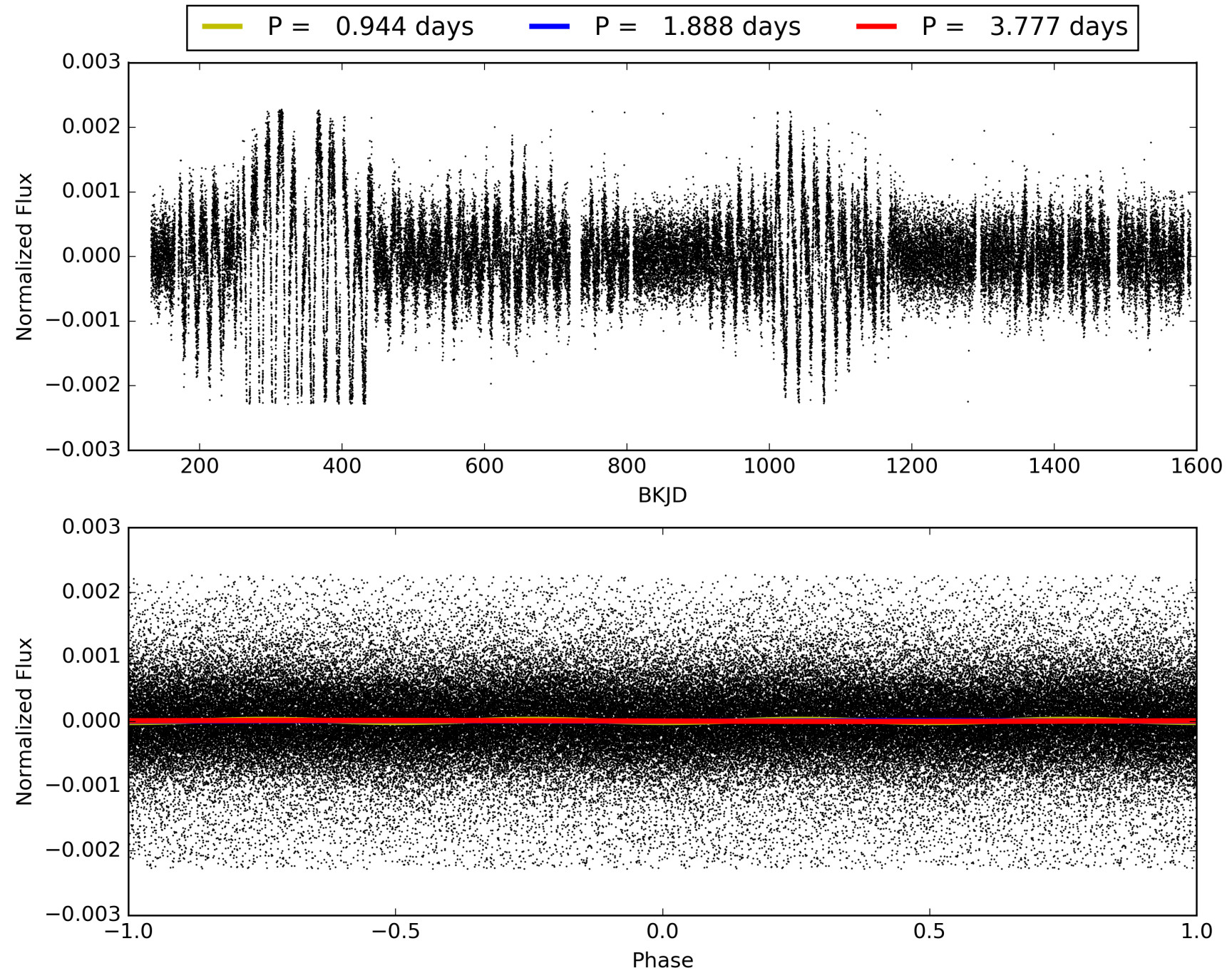
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 13:52:16 Z

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

# TCE 009304409-01, PDC Light Curves



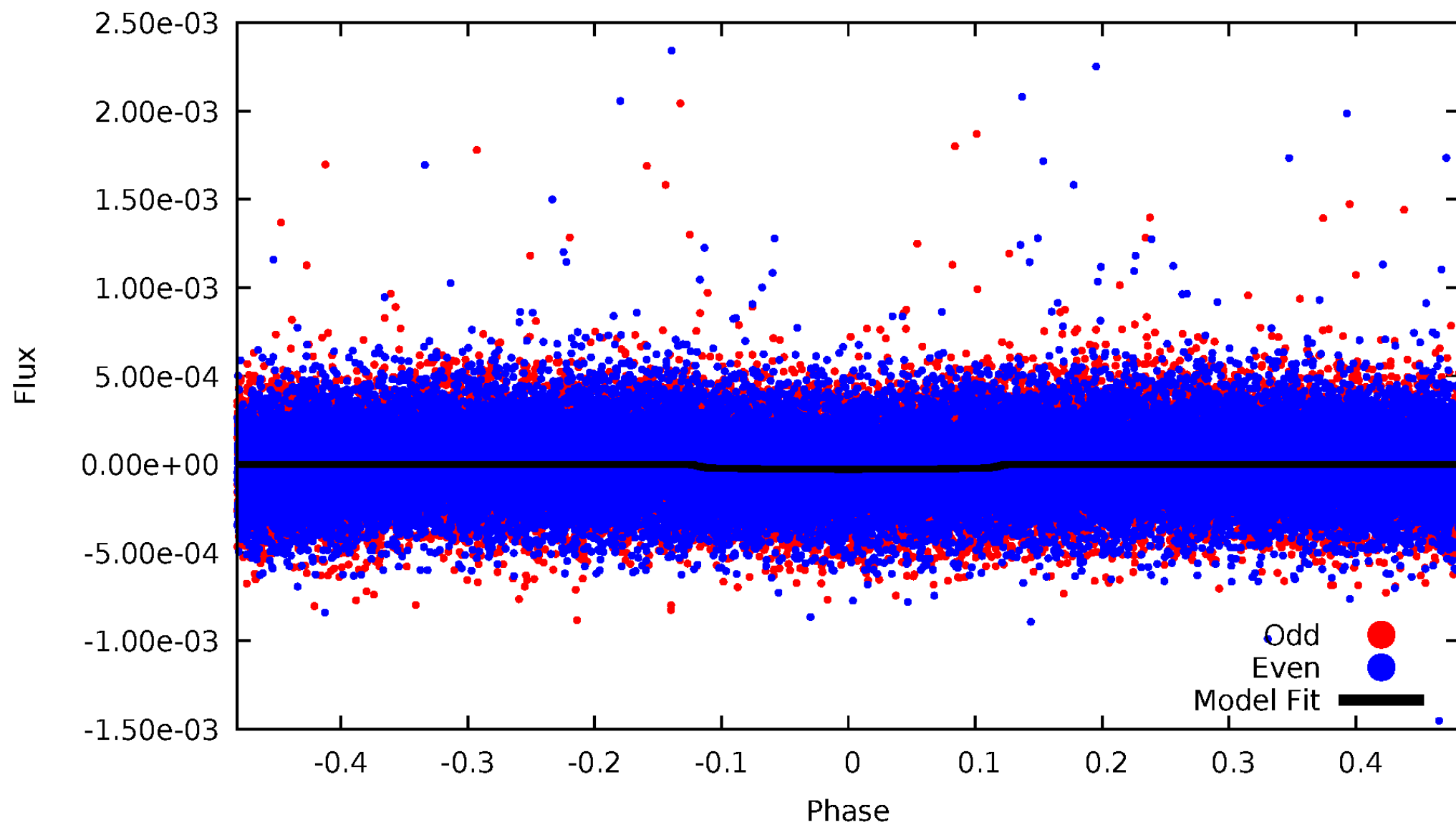
TCE 009304409-01





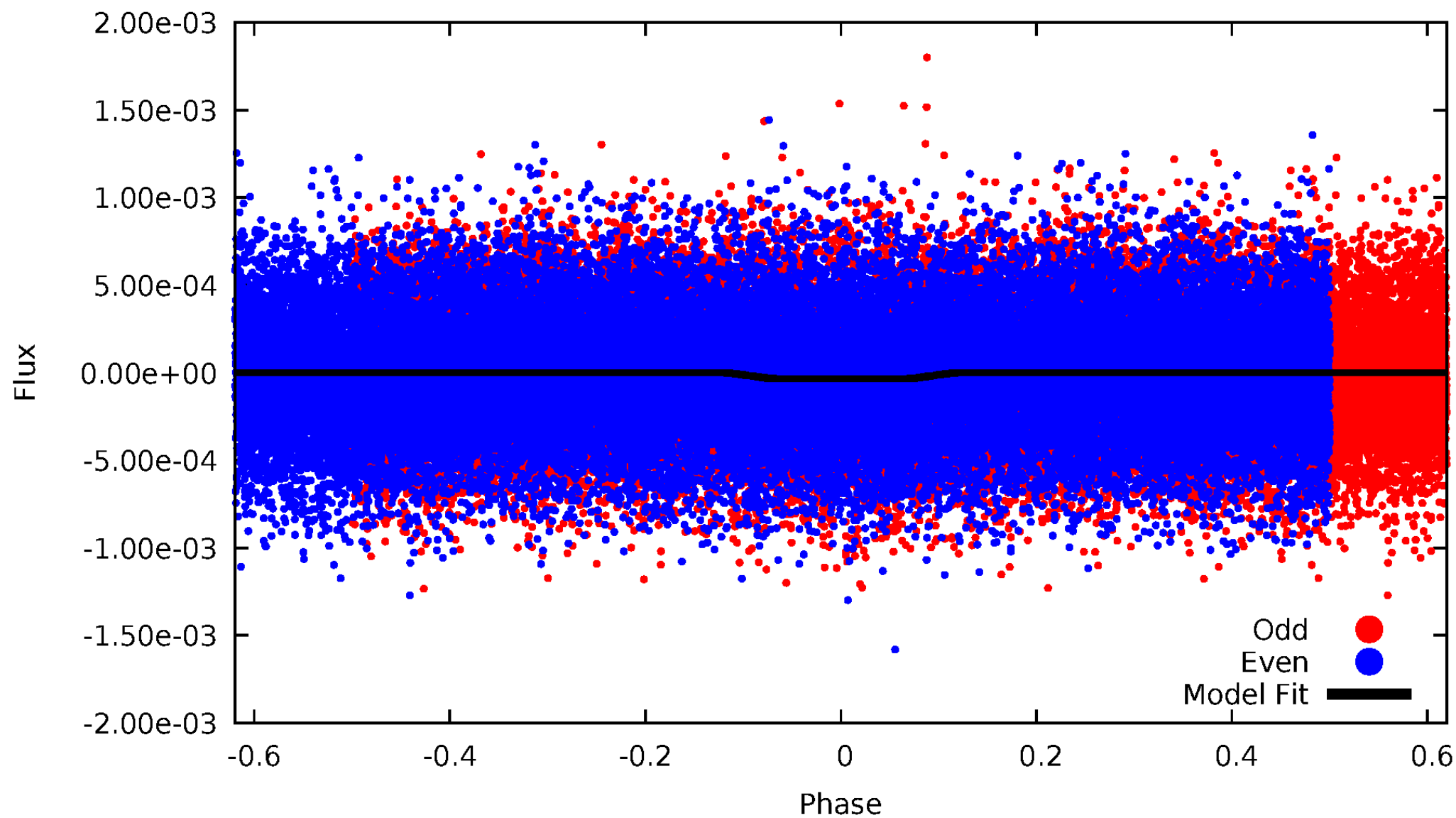
# DV Odd/Even

TCE 009304409-01

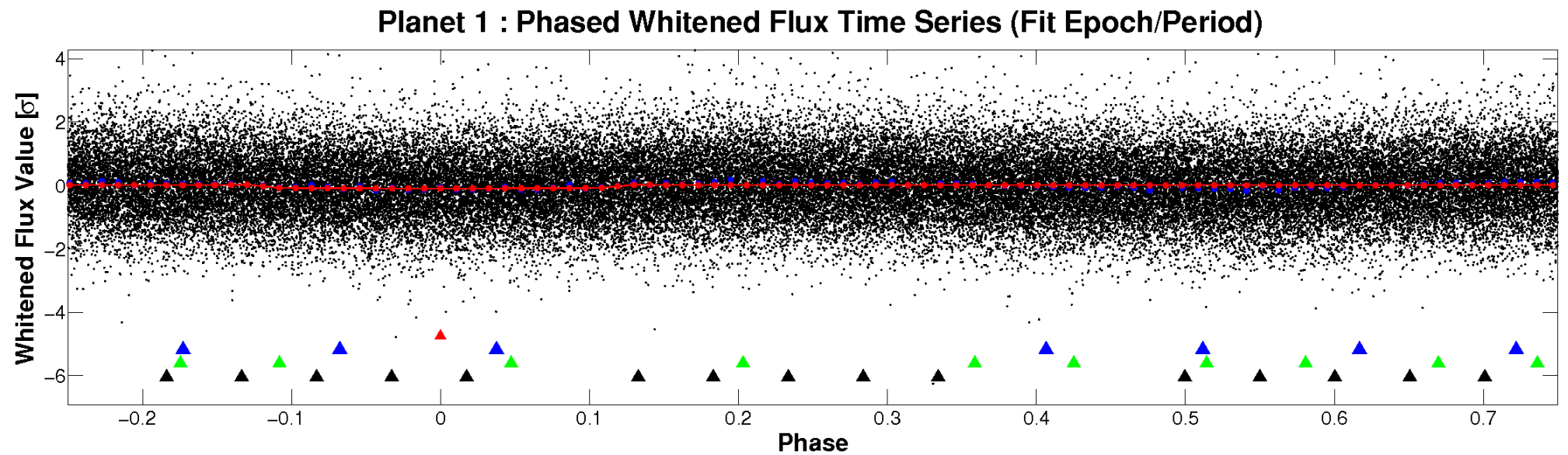
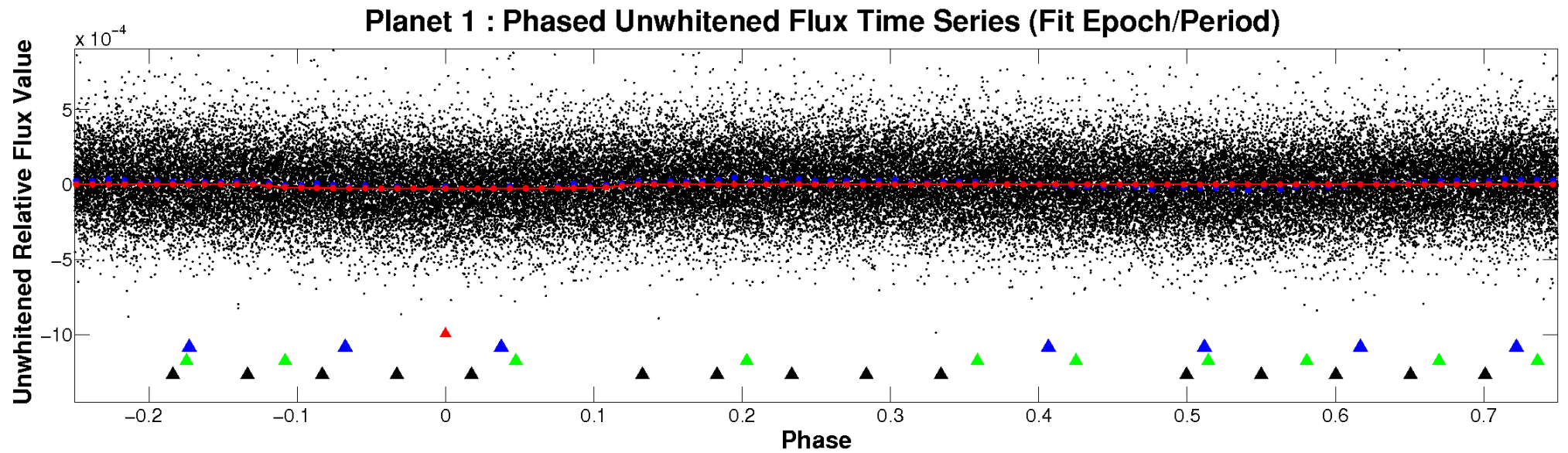


# ALT Odd/Even

TCE 009304409-01

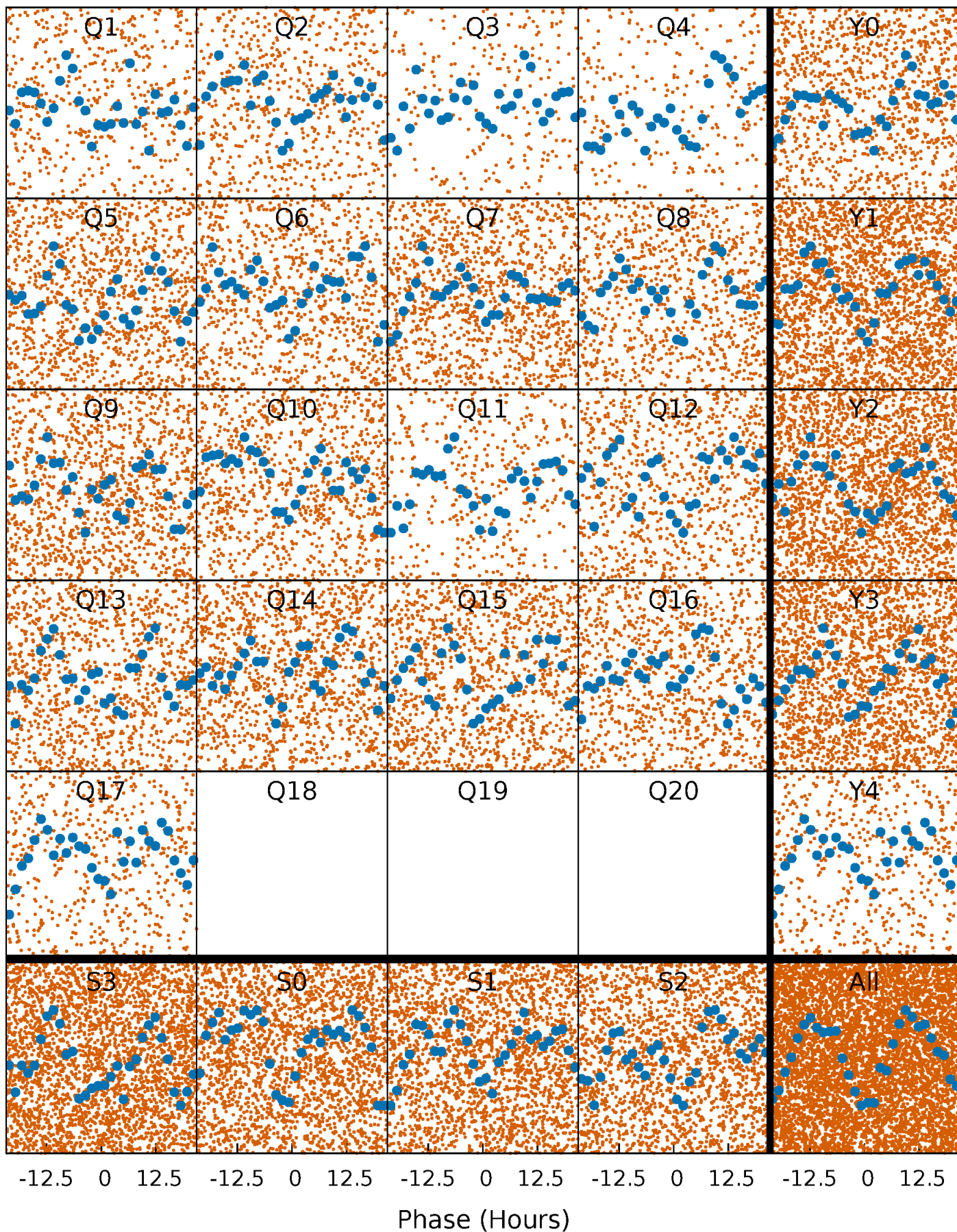


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

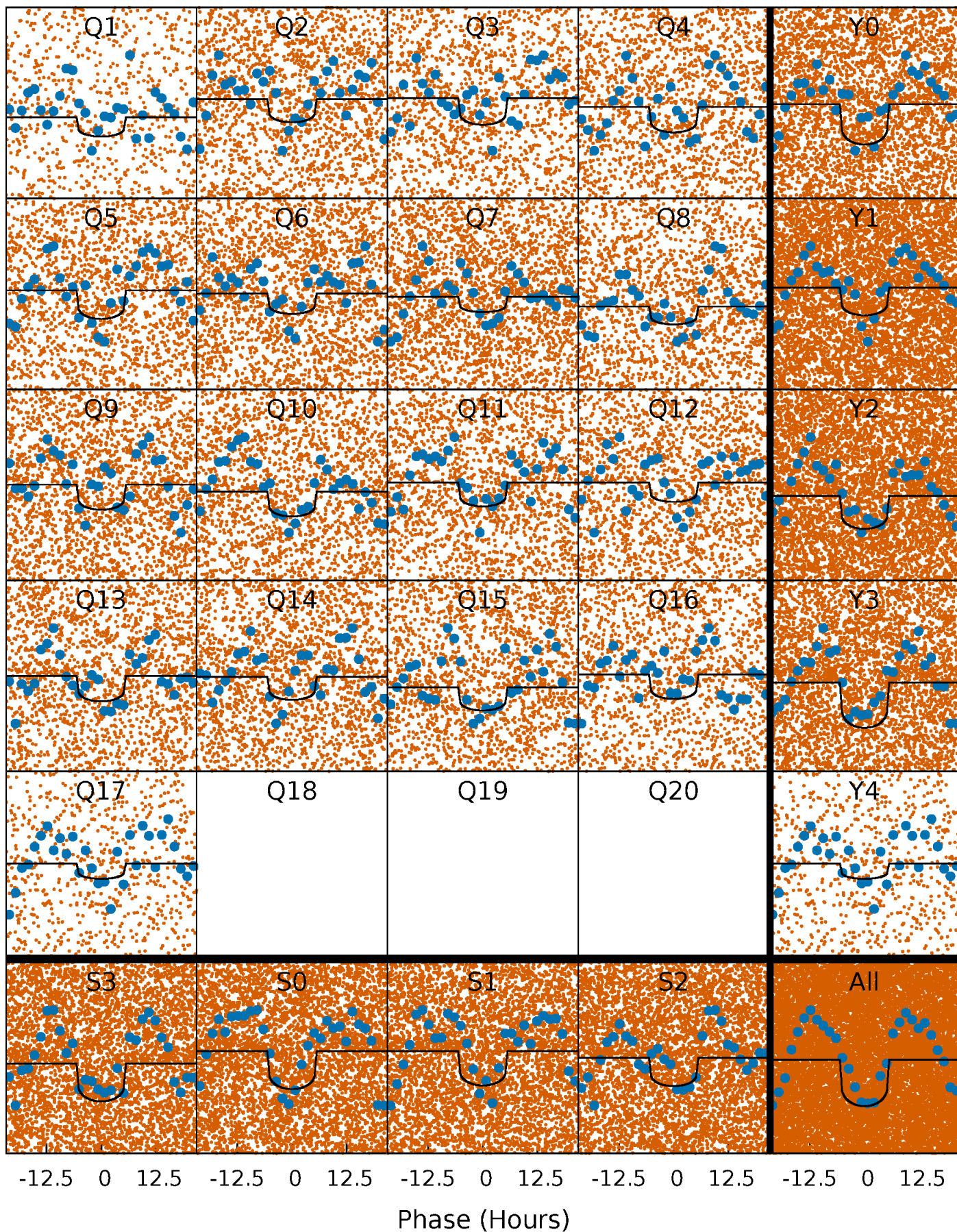
TCE 009304409-01 P= 1.888315 Days  $T_0=132.993878$  (BKJD)





# DV Quarter-Phased Transit Curves

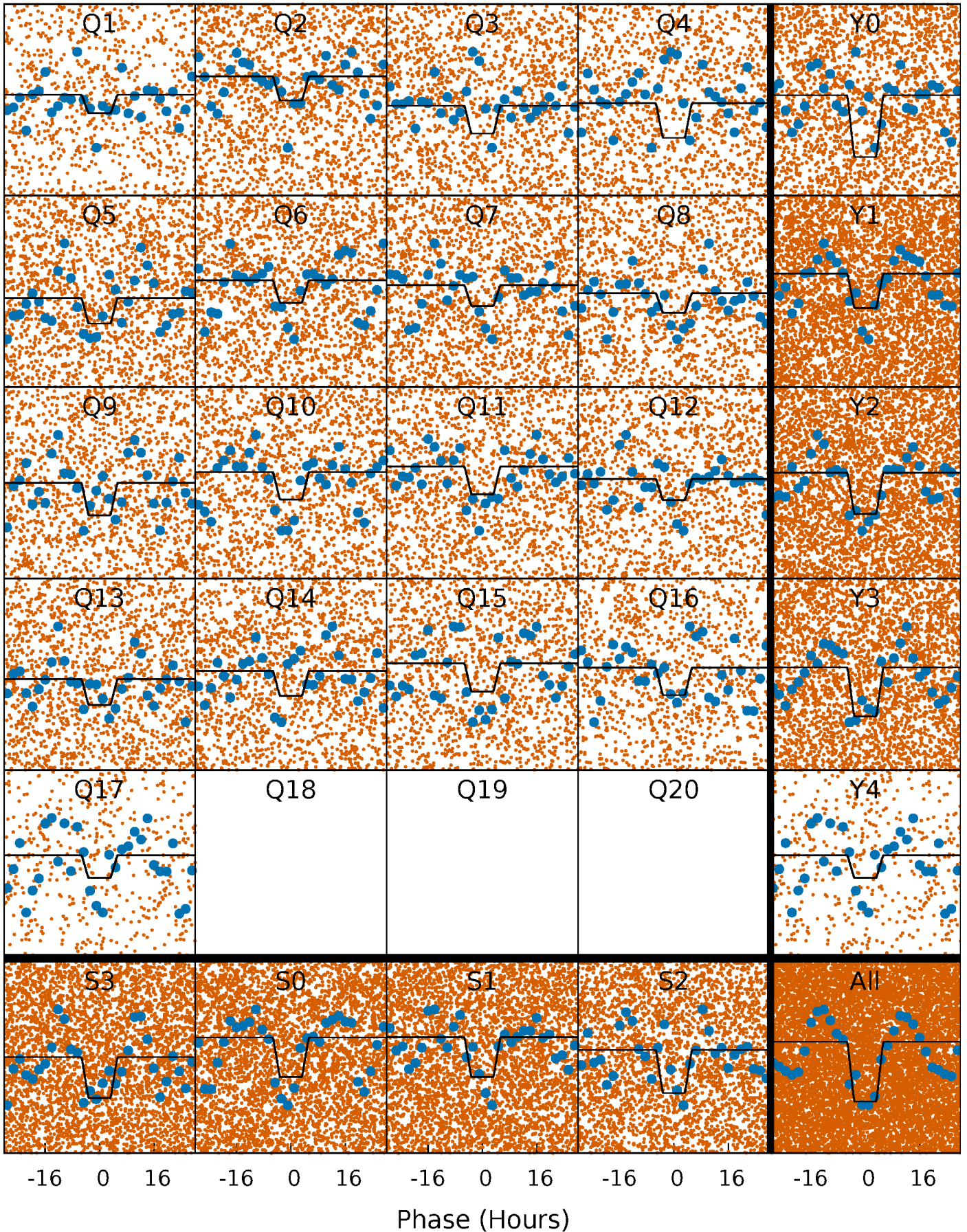
TCE 009304409-01 P= 1.888315 Days  $T_0=132.993878$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

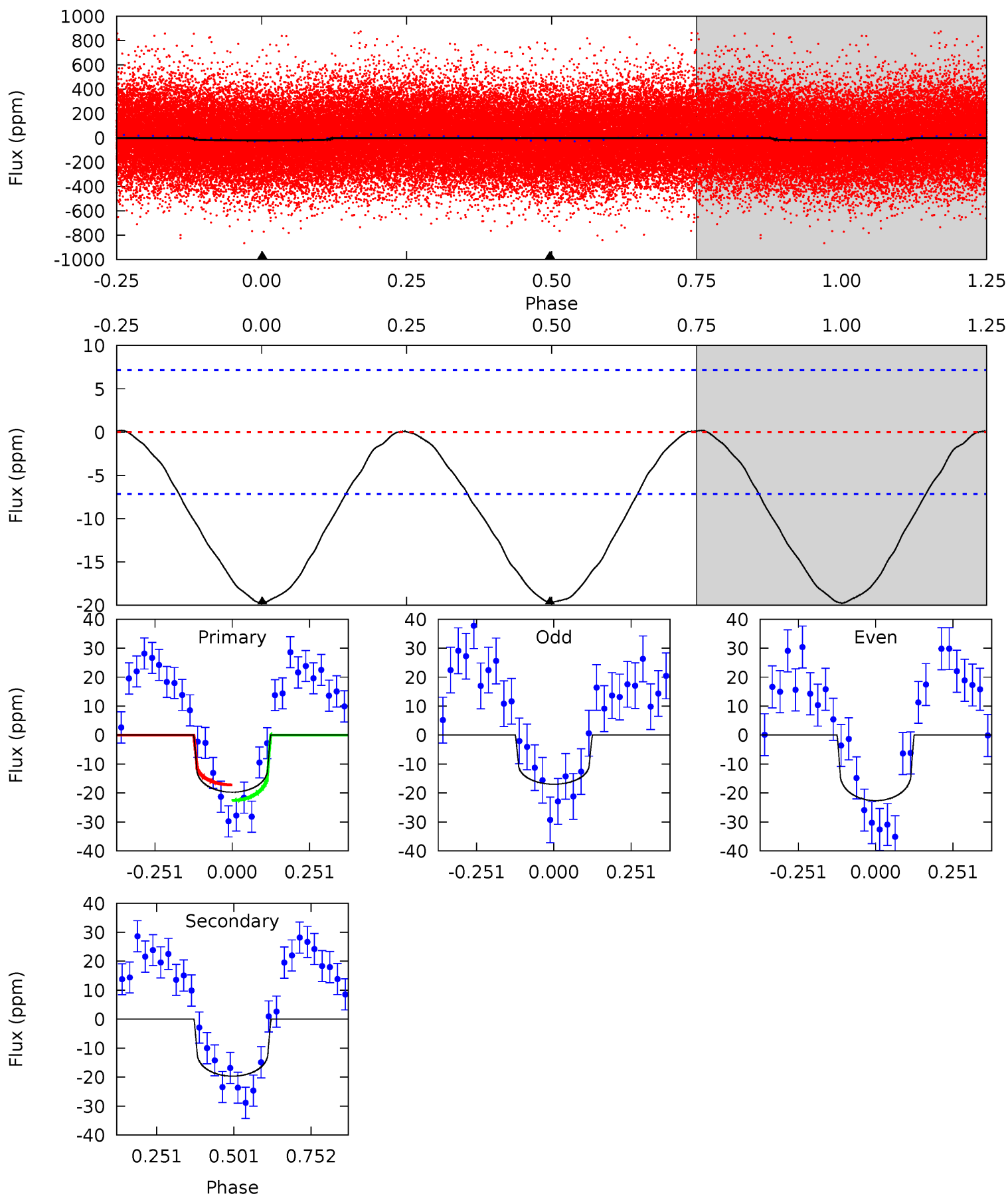
TCE 009304409-01 P= 1.888386 Days  $T_0=132.970665$  (BKJD)



# DV Model-Shift Uniqueness Test

009304409-01, P = 1.888315 Days, E = 131.105563 Days

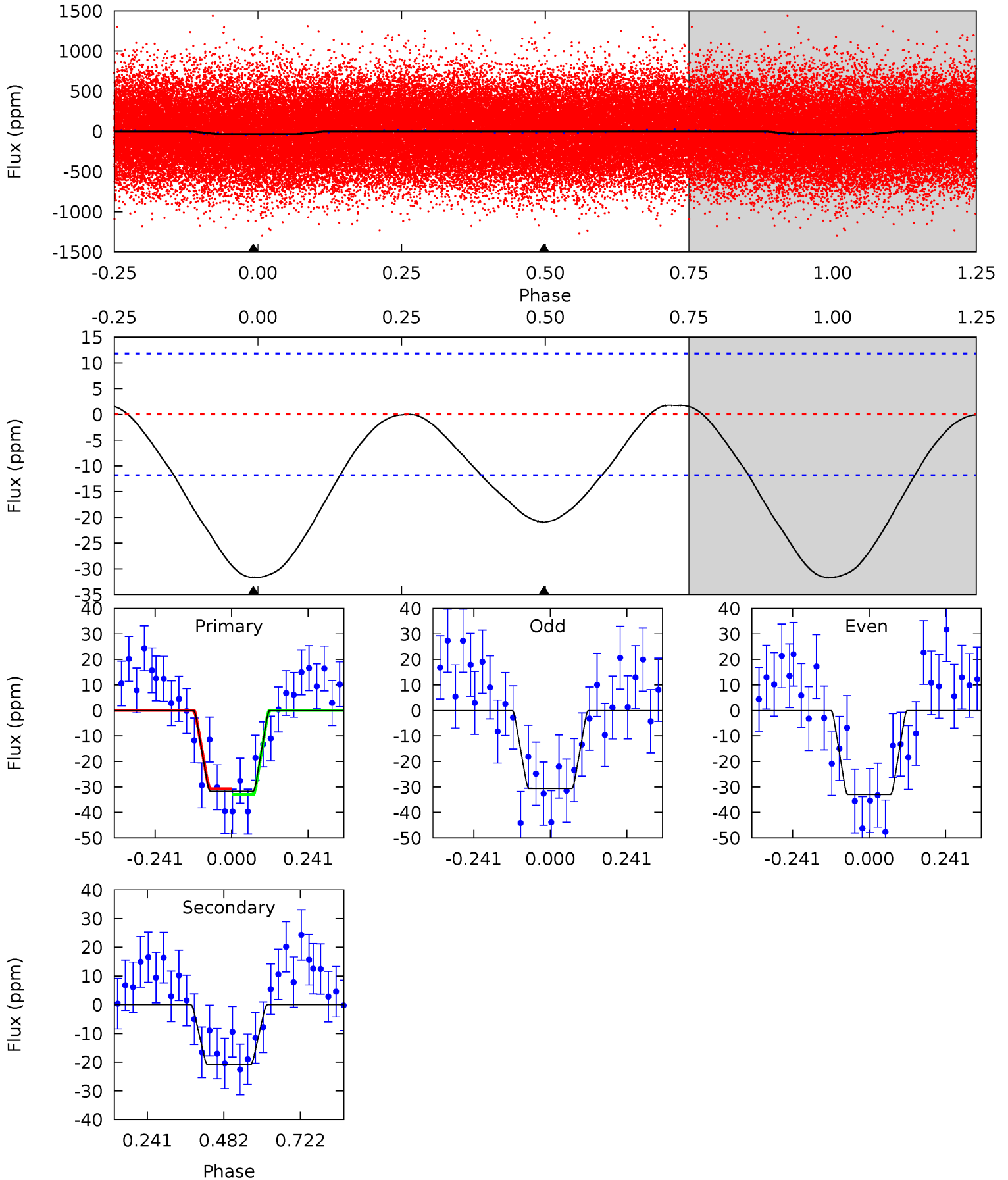
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
12.1	12.0	0	0	4.37	1.15	0.11	12.1	12.1	12.0	12.0	1.72	0.92	0.01	1.65



# Alt Model-Shift Uniqueness Test

009304409-01, P = 1.888386 Days, E = 131.082279 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	7.76	0	0	4.38	1.17	0.37	11.7	11.7	7.76	7.76	0.43	0.86	0.05	0.41





### Stellar Parameters For KIC 009304409

	$T_{\text{eff}}(K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R$ ( $R_{\odot}$ )	$M$ ( $M_{\odot}$ )	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$7176^{+225}_{-275}$	$3.419^{+0.756}_{-0.084}$	$-0.600^{+0.300}_{-0.250}$	$4.429^{+0.333}_{-2.998}$	$1.876^{+0.133}_{-0.752}$	$0.030^{+0.559}_{-0.008}$
	$+3\%/-4\%$	$+22\%/-2\%$	$+50\%/-42\%$	$+8\%/-68\%$	$+7\%/-40\%$	$+1840\%/-27\%$
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 009304409-01 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-20 \pm 2$	$2.11^{+1.74}_{-1.24}$	$4694^{+320}_{-739}$	$6384^{+4021}_{-1601}$	$3.255^{+15.618}_{-2.283}$
Alt.	$-21 \pm 3$	$2.37^{+1.64}_{-1.25}$	$4693^{+328}_{-720}$	$6109^{+3192}_{-1375}$	$2.763^{+8.836}_{-1.821}$

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

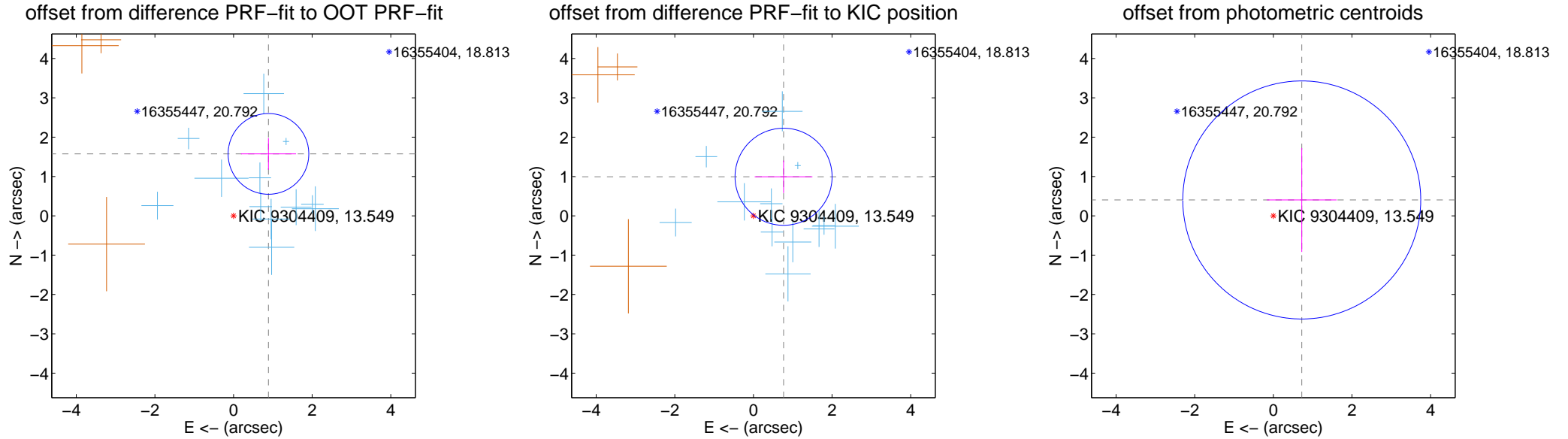
## DV Centroid Data

Supplemental centroid analysis for 009304409-01. Kepler magnitude: 13.55. Transit SNR 10.55

There are 12 quarters with good PRF difference image offsets

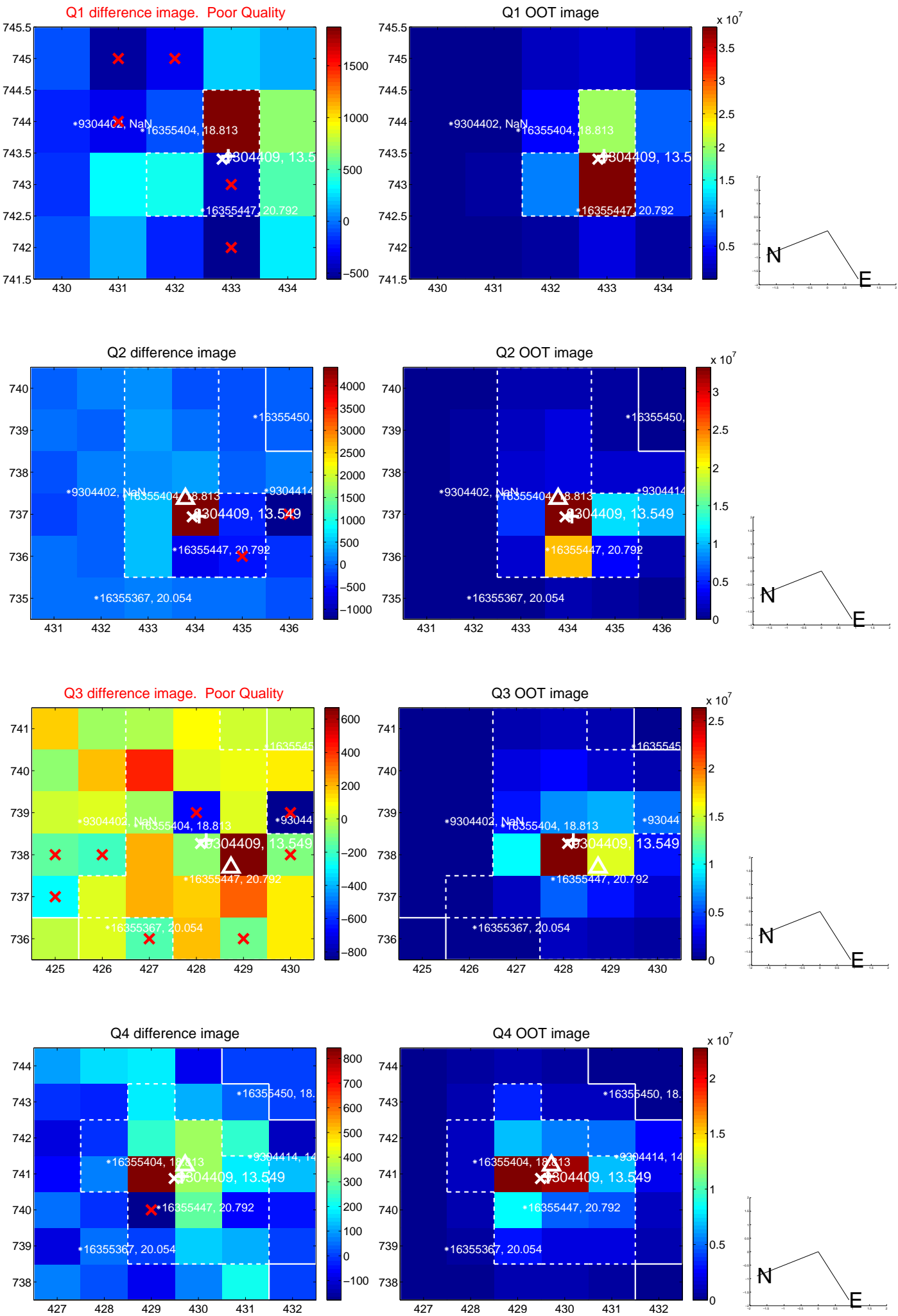
The direct PRF centroid is offset from the target star catalog position by about 0.45 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.808 \pm 0.342$	<b>5.28</b>	$-0.888 \pm 0.701$	$1.574 \pm 0.401$
PRF-fit source offset from KIC position	$1.254 \pm 0.411$	<b>3.05</b>	$-0.766 \pm 0.734$	$0.993 \pm 0.413$
photometric centroid source offset	$0.83 \pm 1.01$	0.82	$-0.72 \pm 0.89$	$0.40 \pm 1.32$

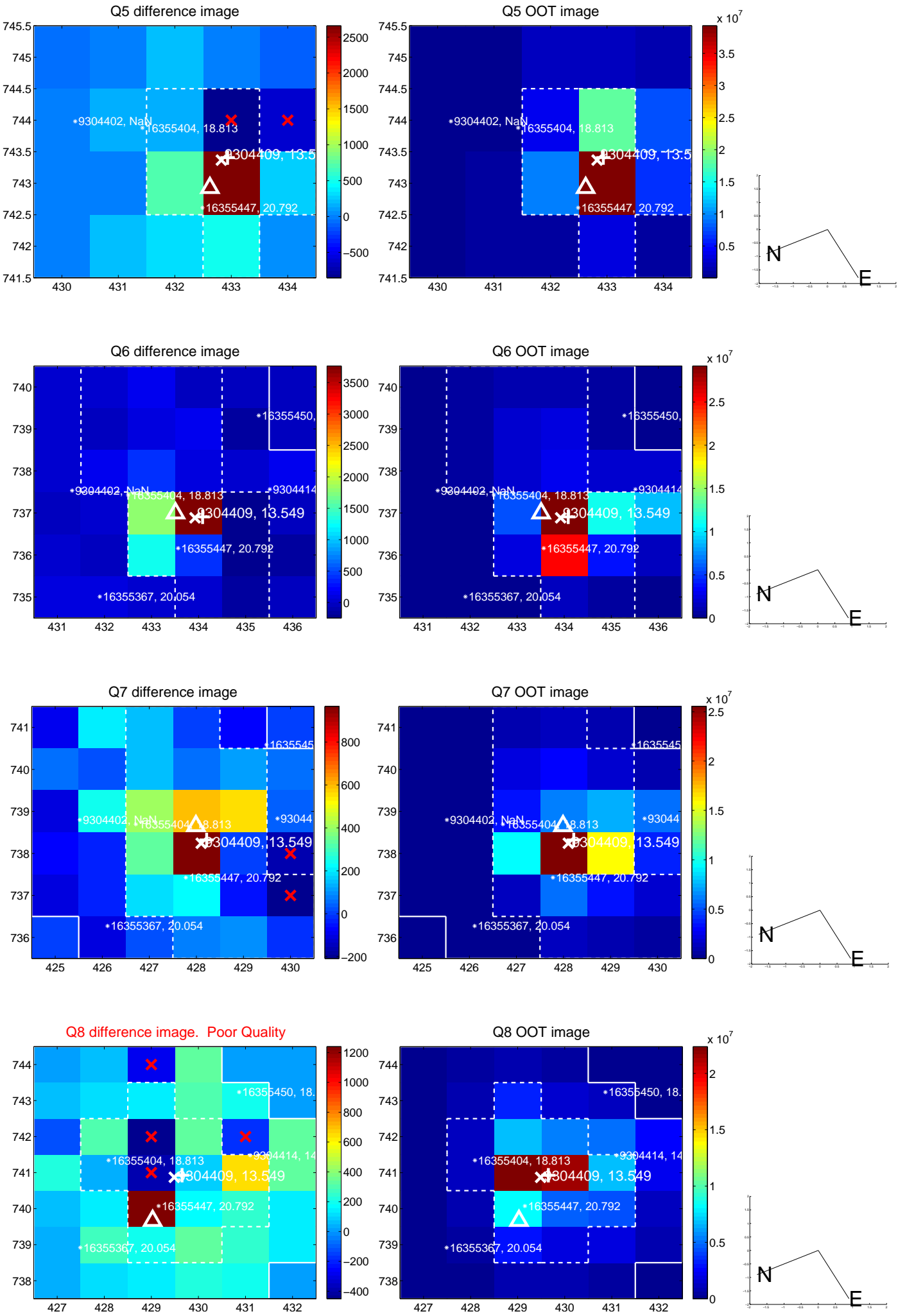


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

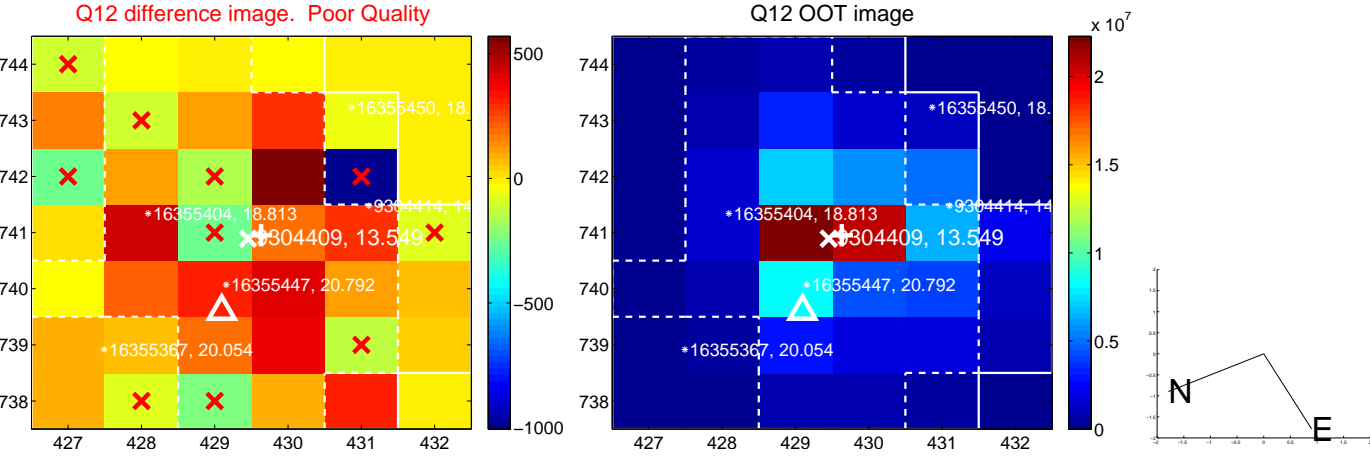
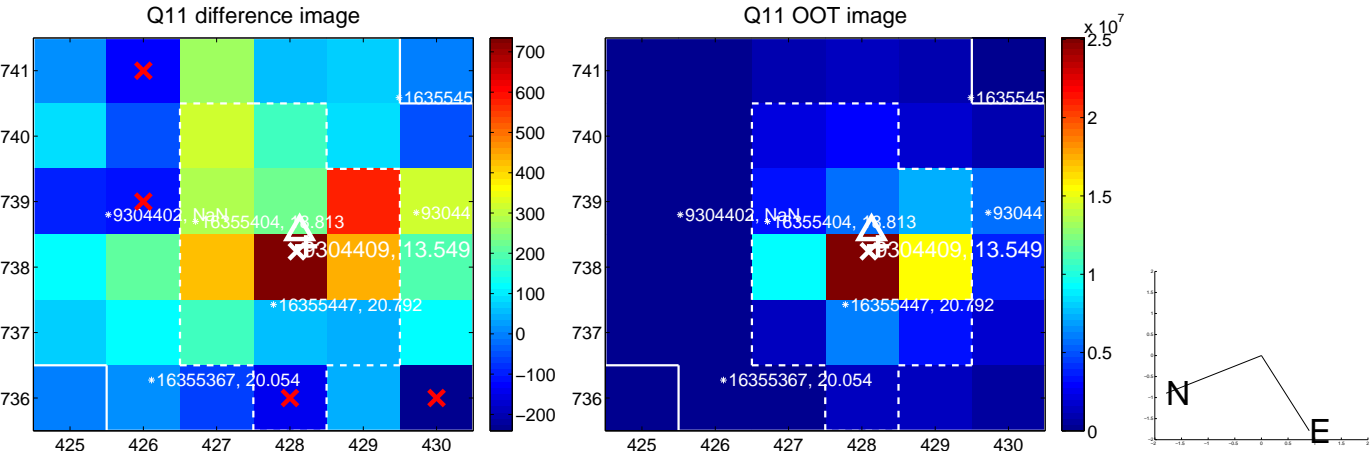
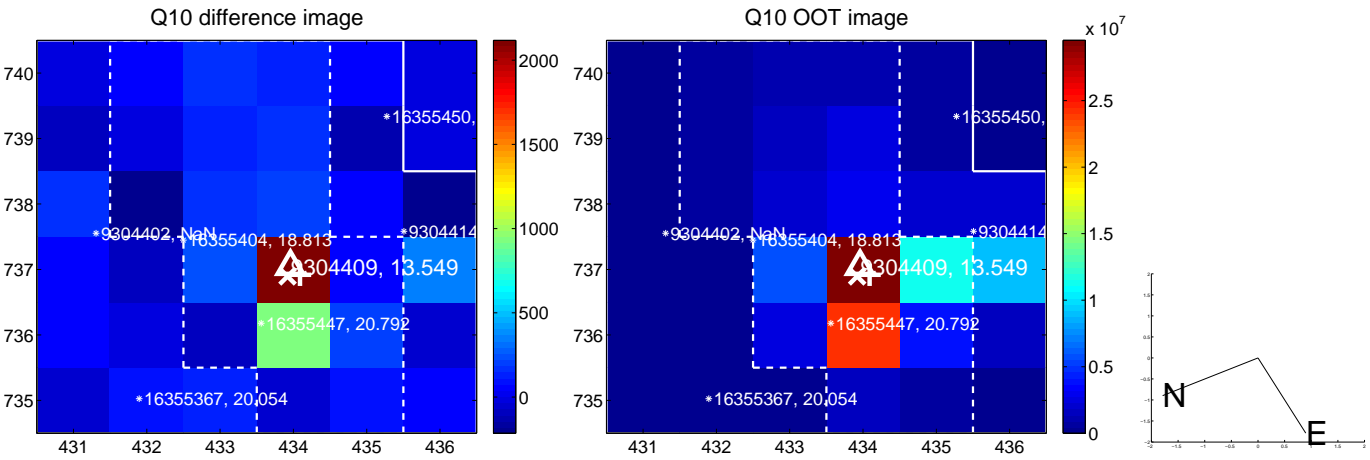
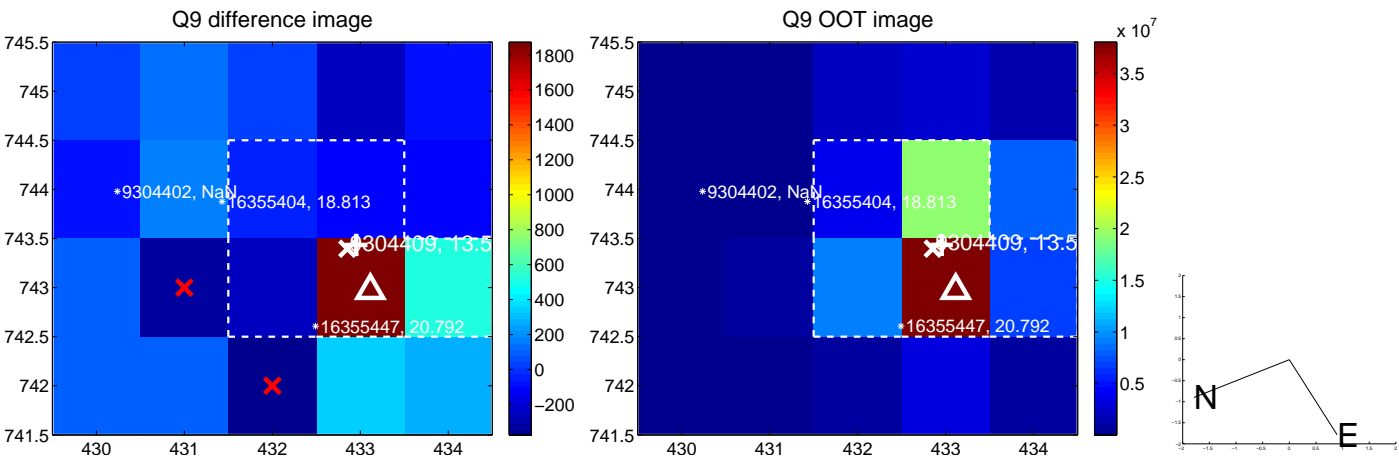


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

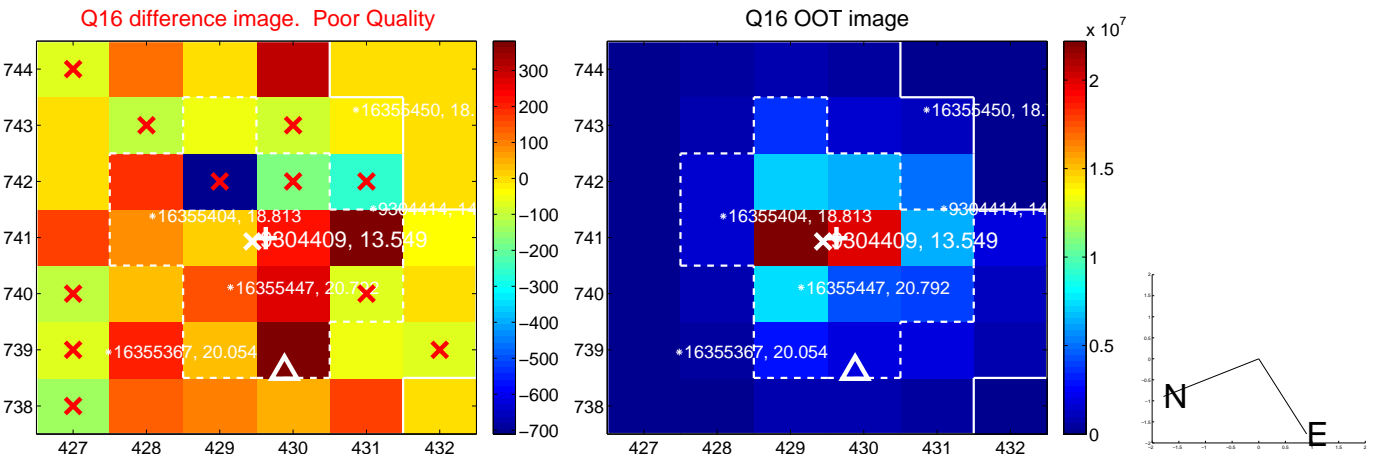
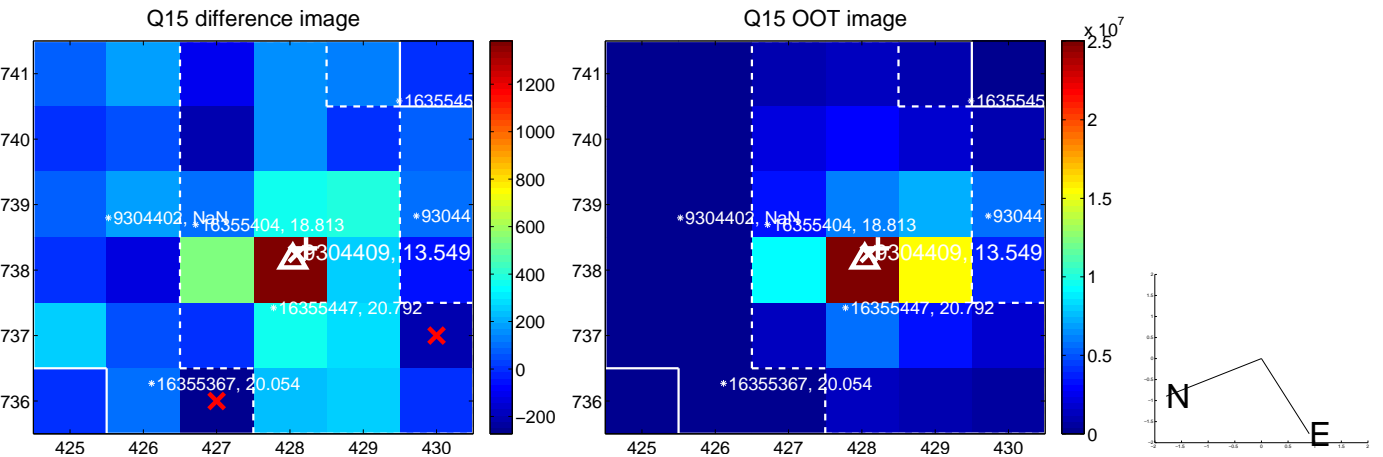
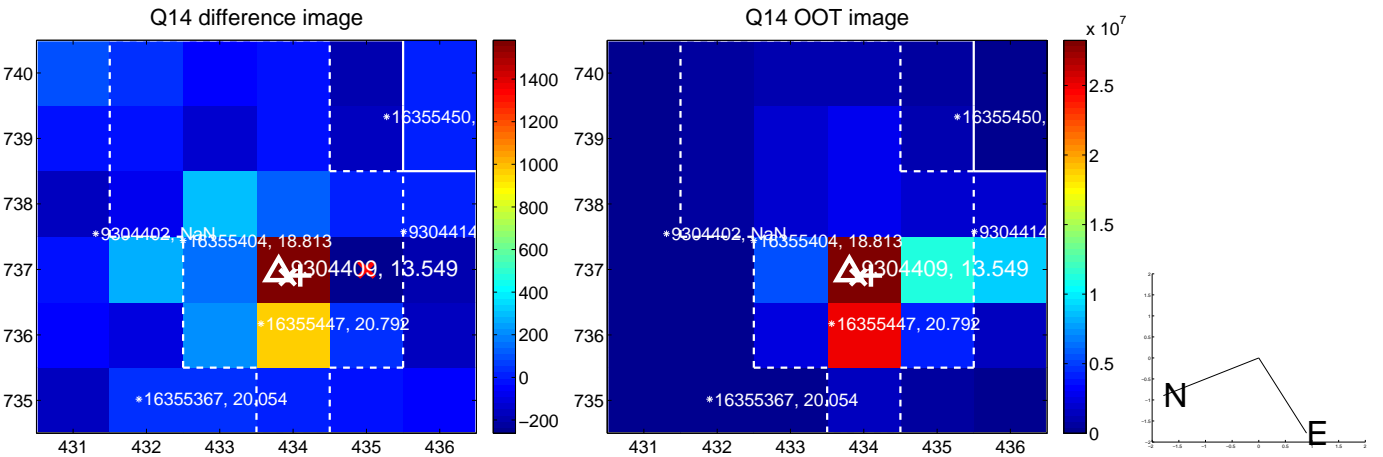
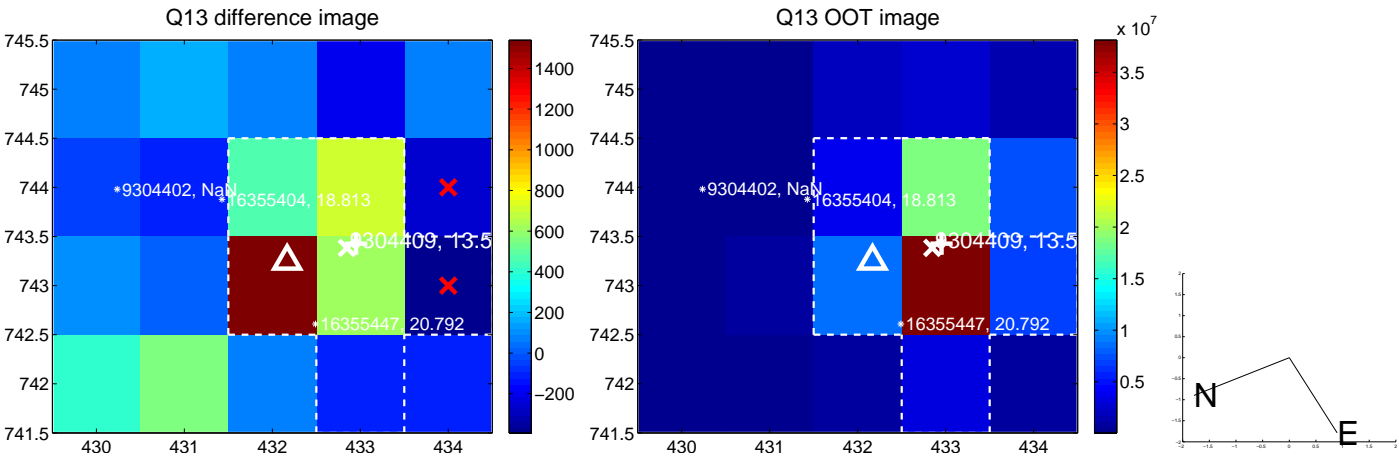




white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



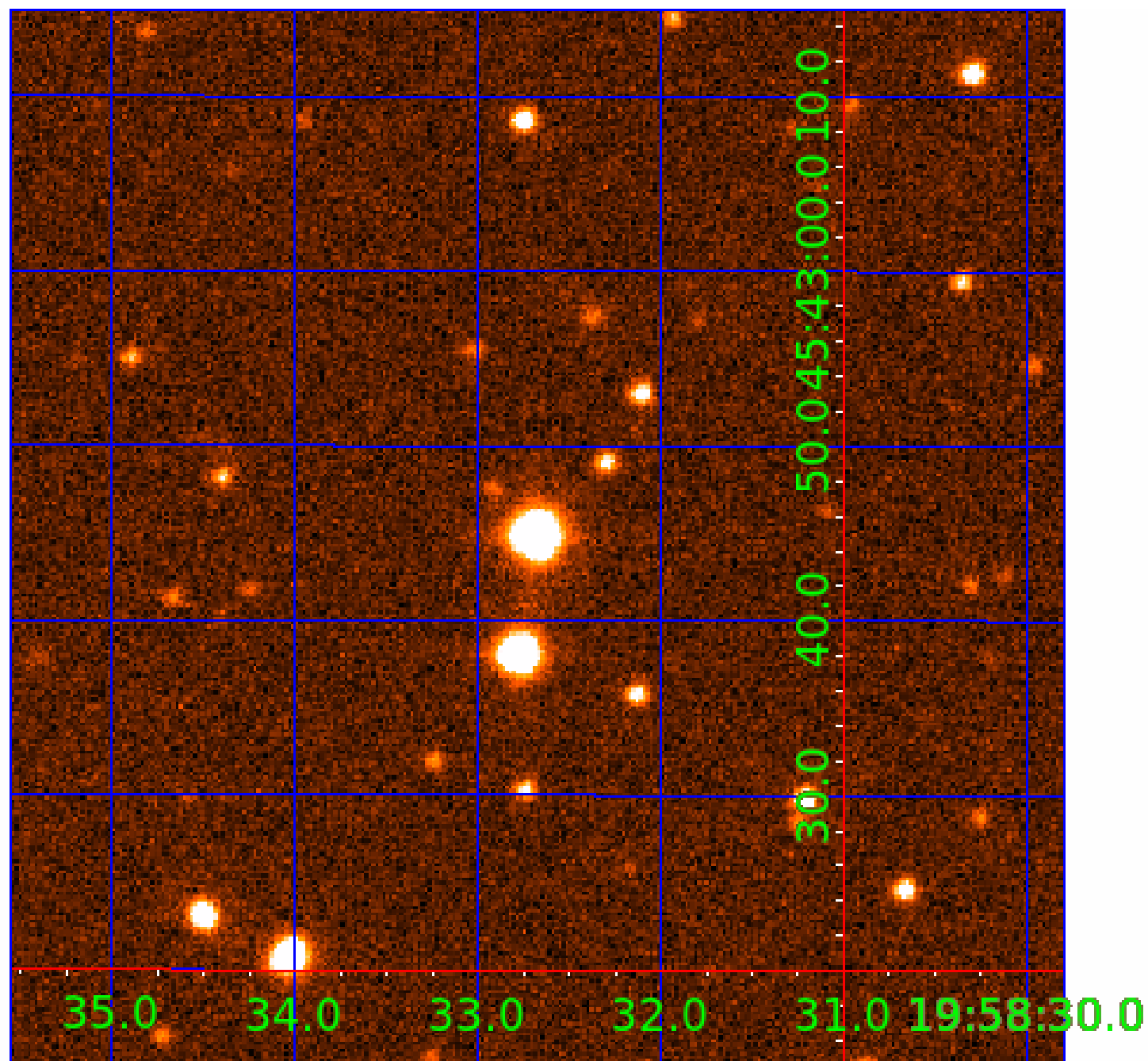
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.





UKIRT Image

Declination





# KIC 009304409

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009304409-01	OBS	No	1.888315	132.993878	28.3	10.913	8.4	10.6	4.43	7176	2.42	34239.60
009304409-02	OBS	No	198.471665	286.715017	447.2	13.782	16.2	10.5	4.43	7176	10.18	69.03
009304409-03	OBS	No	141.329794	259.181382	374.1	19.168	11.3	9.8	4.43	7176	9.04	108.56
009304409-04	OBS	No	95.706297	176.675854	452.0	1.985	7.9	8.1	4.43	7176	10.56	182.55

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009304409-01	OBS	FP	0.00	1	0	0	0	LPP_DV—LPP_ALT—CENT_KIC_POS
009304409-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL_SKYE—TRANS_GAPPED—LPP_DV—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009304409-03	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_ALT—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009304409-04	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_KIC_POS

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

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

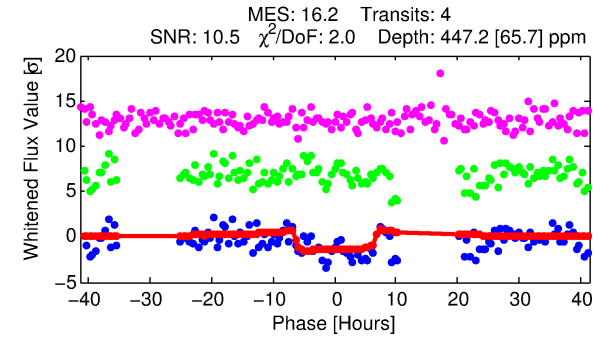
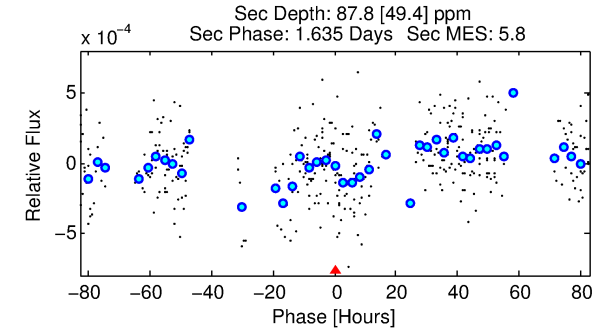
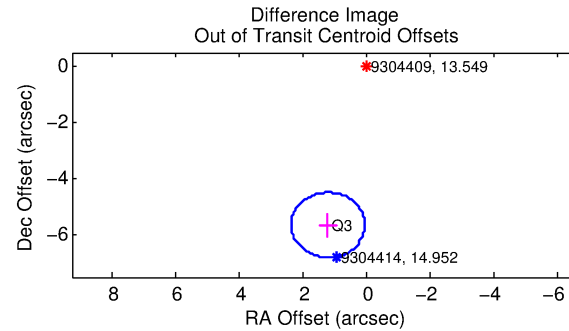
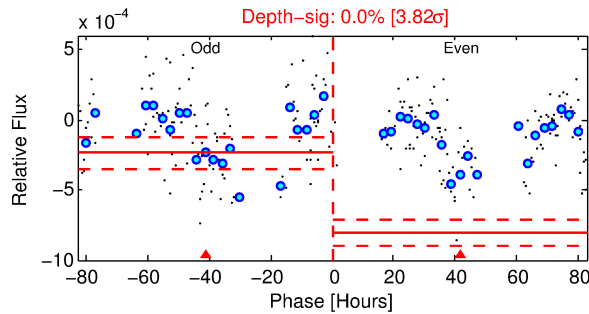
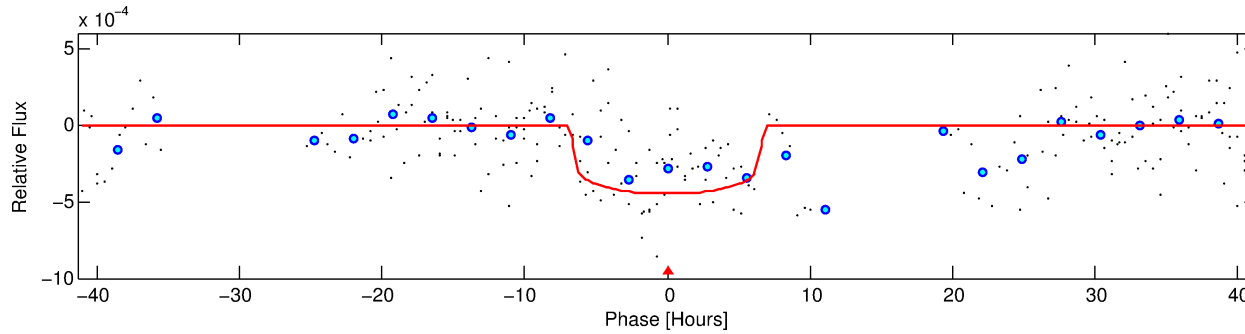
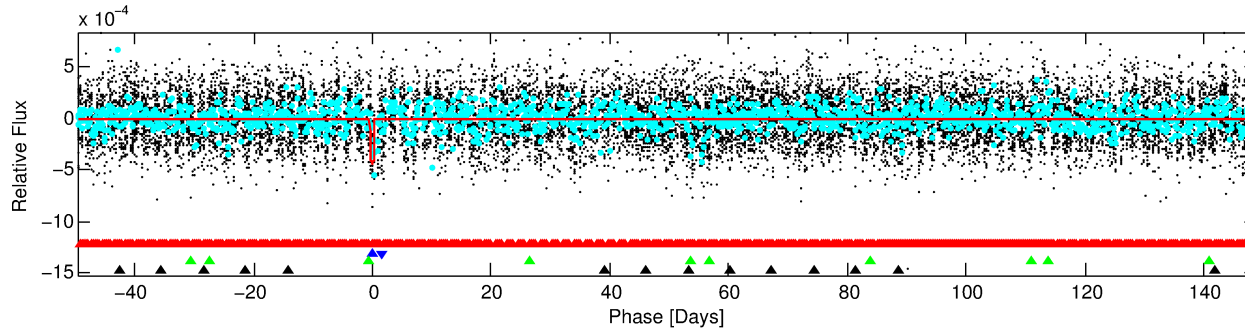
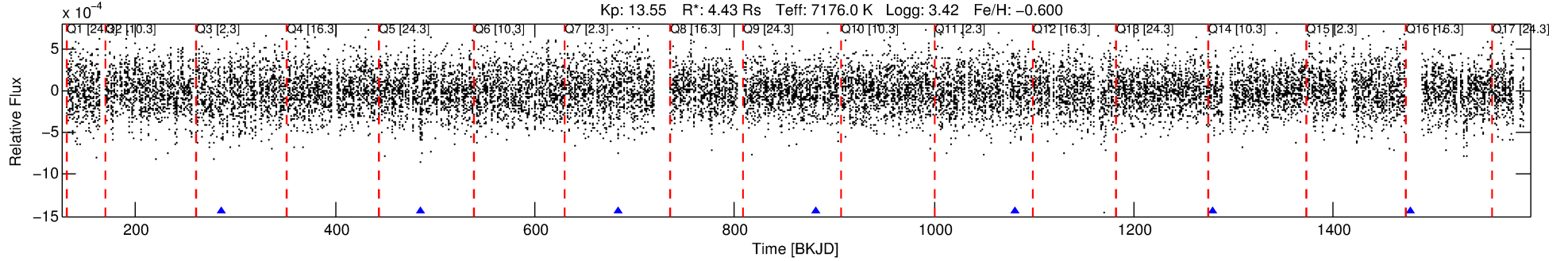
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 009304409-02

No Significant Match Found

# DV One-Page Summary

KIC: 9304409 Candidate: 2 of 4 Period: 198.472 d



## DV Fit Results:

Period = 198.47167 [0.02201] d  
Epoch = 286.7150 [0.0320] BKJD  
Rp/R\* = 0.0211 [0.0062]  
a/R\* = 75.63 [127.40]  
b = 0.75 [0.95]  
Seff = 69.03 [86.60]  
Teq = 735 [231] K  
Rp = 10.18 [7.51] Re  
a = 0.8217 [0.6040] AU  
Ag = 314.67 [467.94] [0.67σ]  
Teffp = 4786 [990] K [3.99σ]

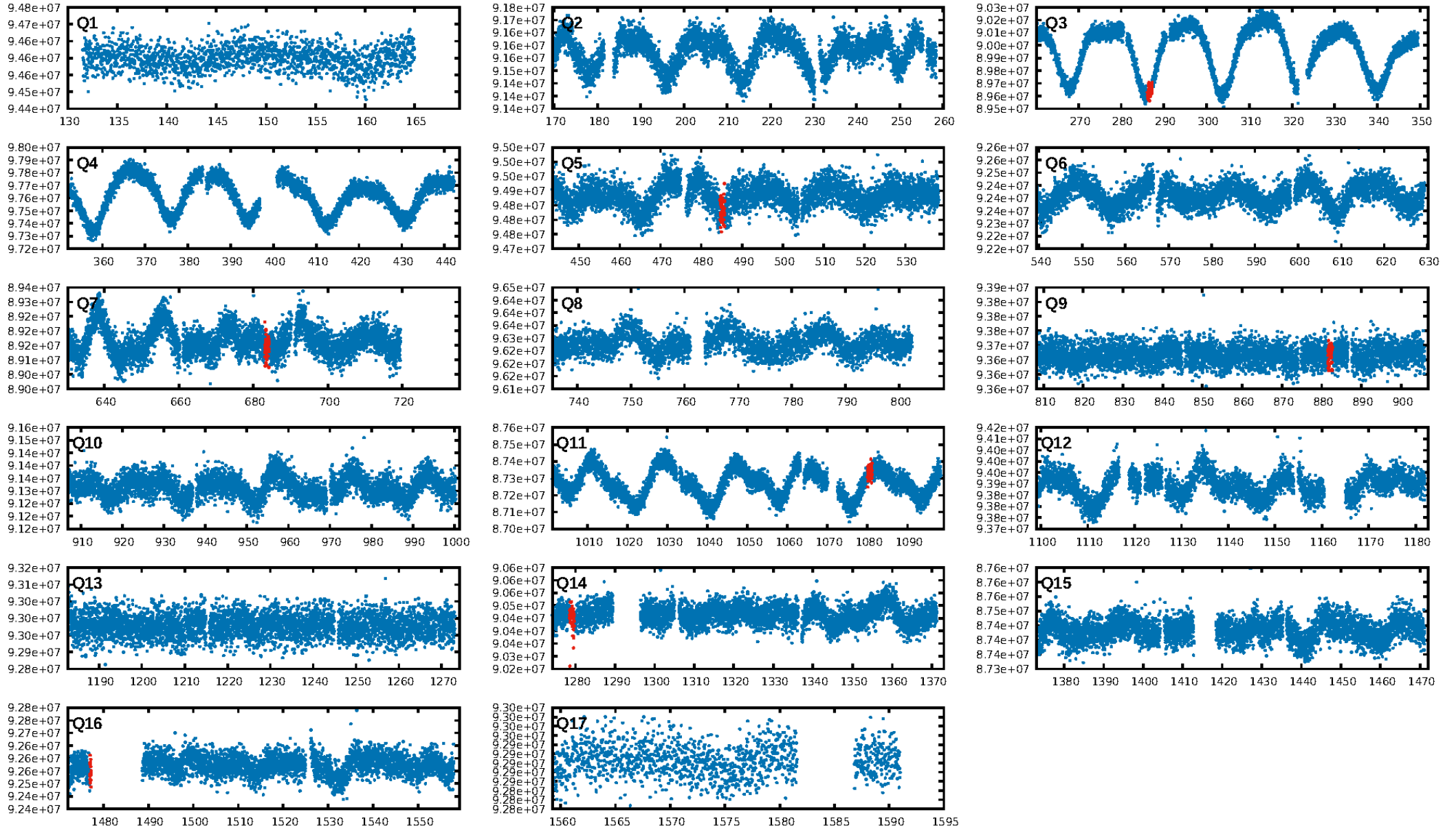
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [58.09σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 61.9%  
Bootstrap-pfa: 4.81e-31  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: 7.495  
Centroid-sig: 56.3%  
Centroid-so: 1.018 arcsec [1.22σ]  
OotOffset-rm: 5.780 arcsec [14.95σ]  
KicOffset-rm: 6.322 arcsec [16.32σ]  
OotOffset-st: 0/1/0/0 [1]  
KicOffset-st: 0/1/0/0 [1]  
DiffImageQuality-fgm: 1.00 [1/1]  
DiffImageOverlap-fno: 0.00 [0/5]

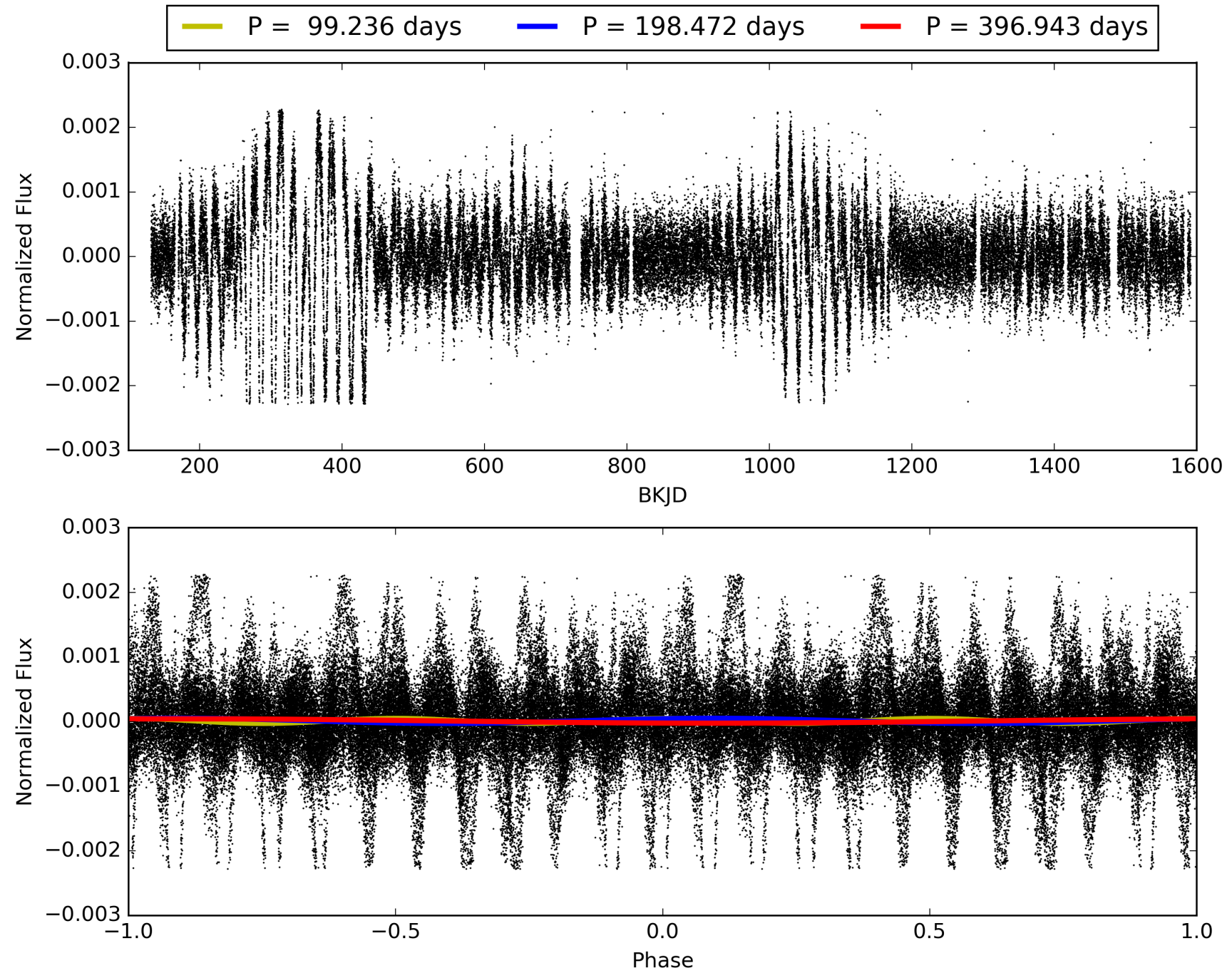
Software Revision: svn-ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 13:52:27 Z

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

# TCE 009304409-02, PDC Light Curves

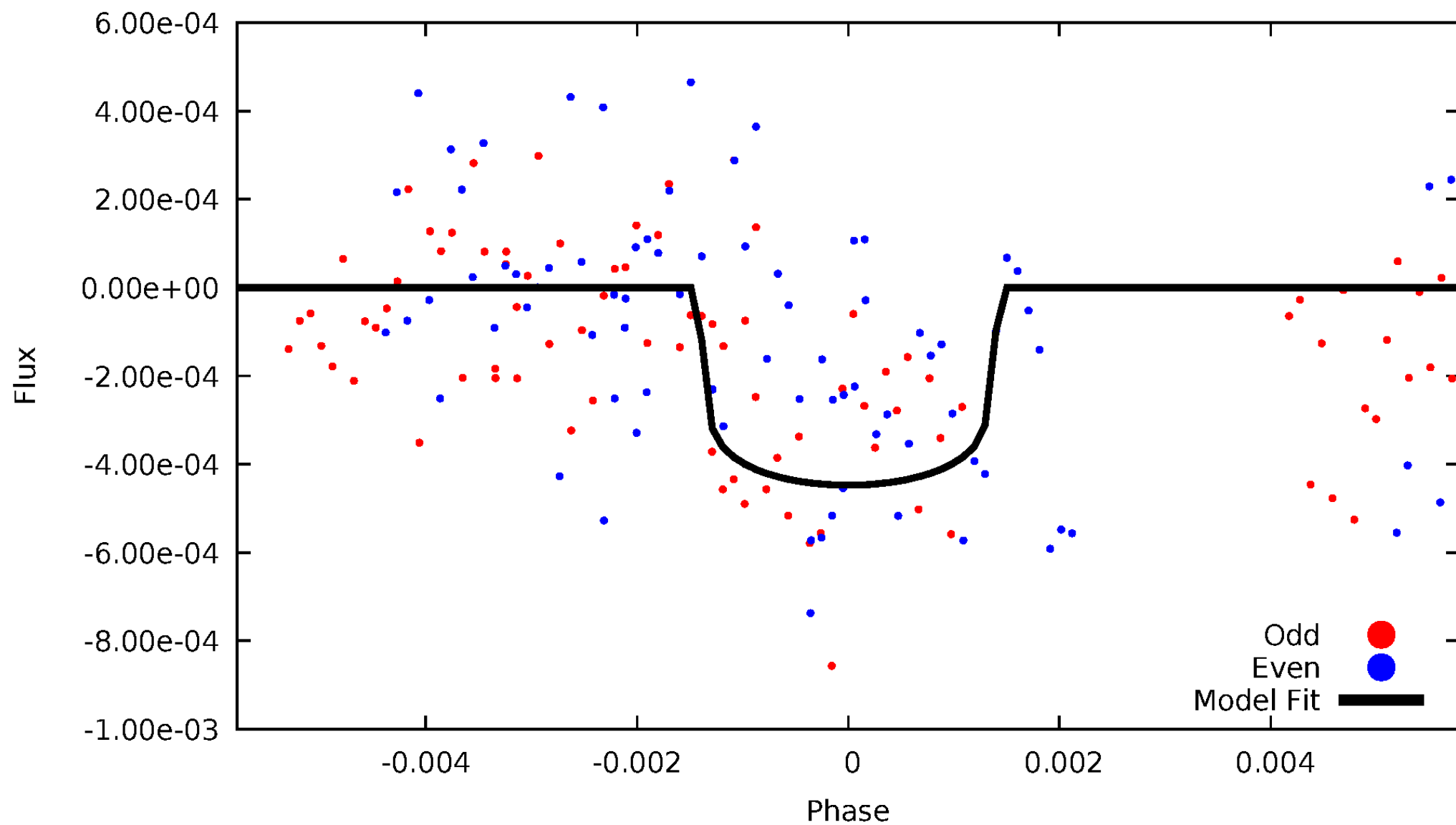


TCE 009304409-02



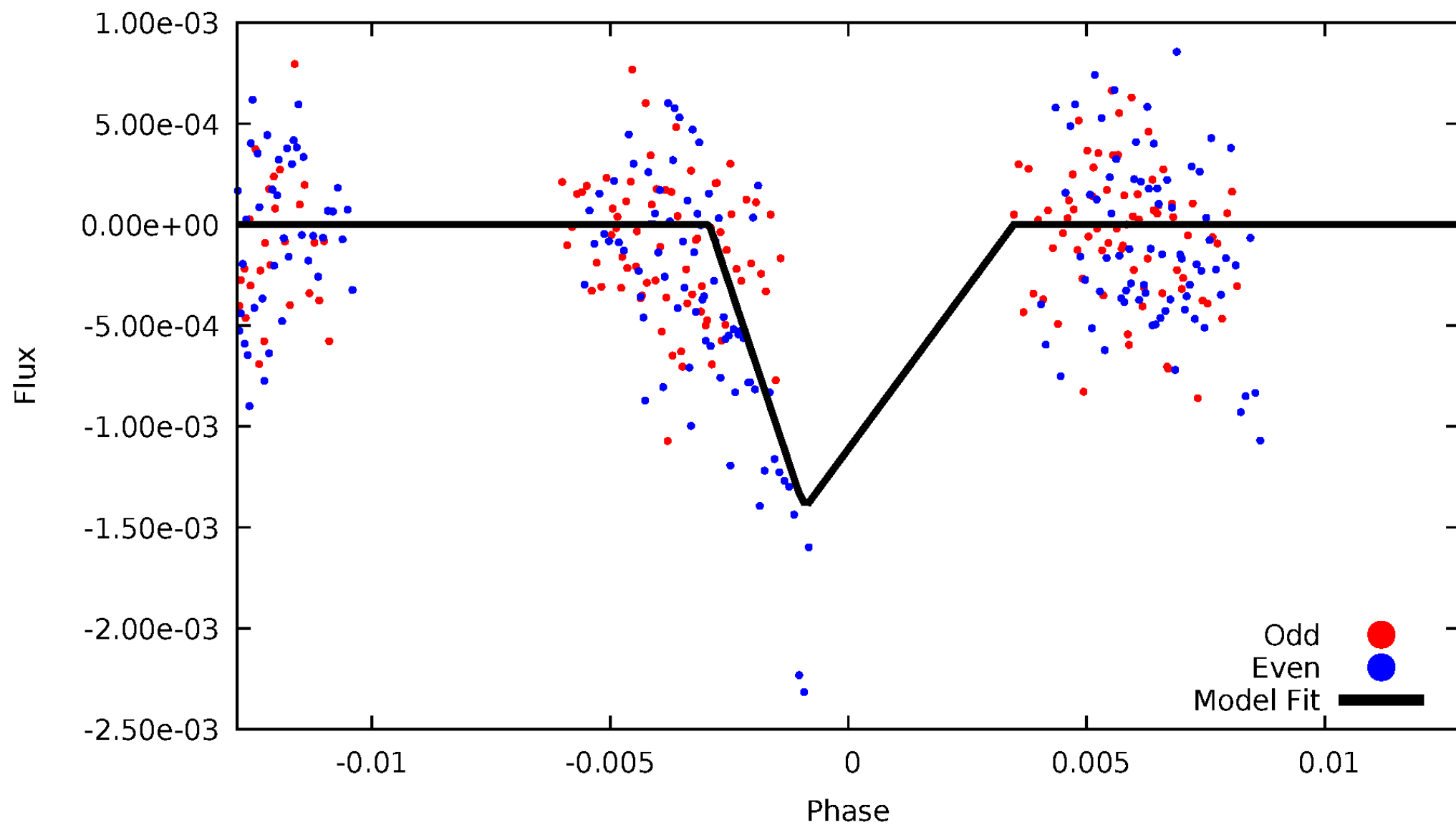
# DV Odd/Even

TCE 009304409-02



# ALT Odd/Even

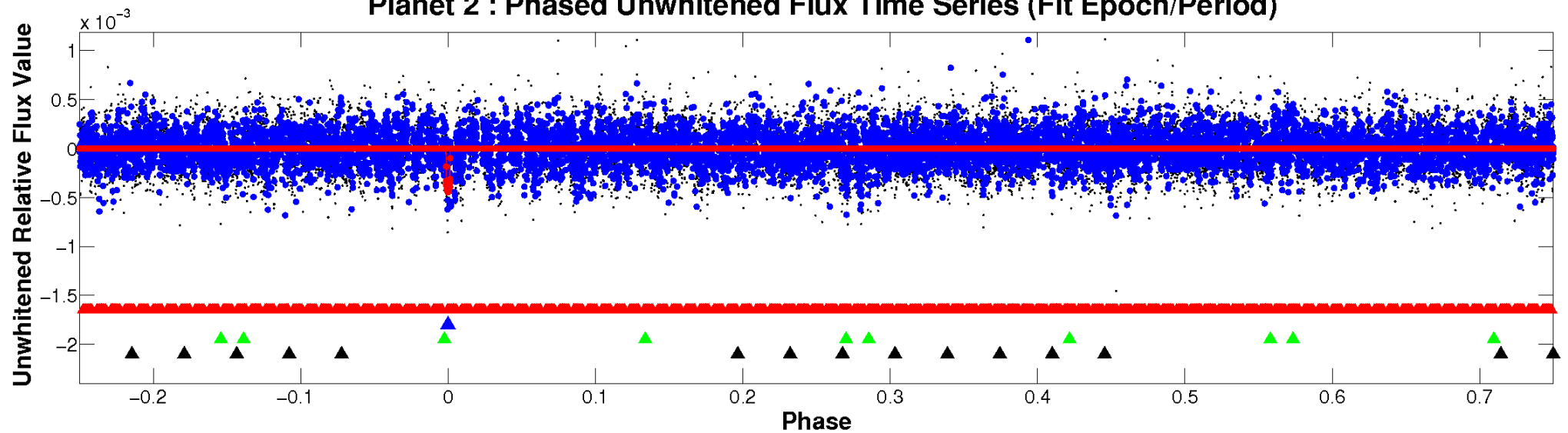
TCE 009304409-02



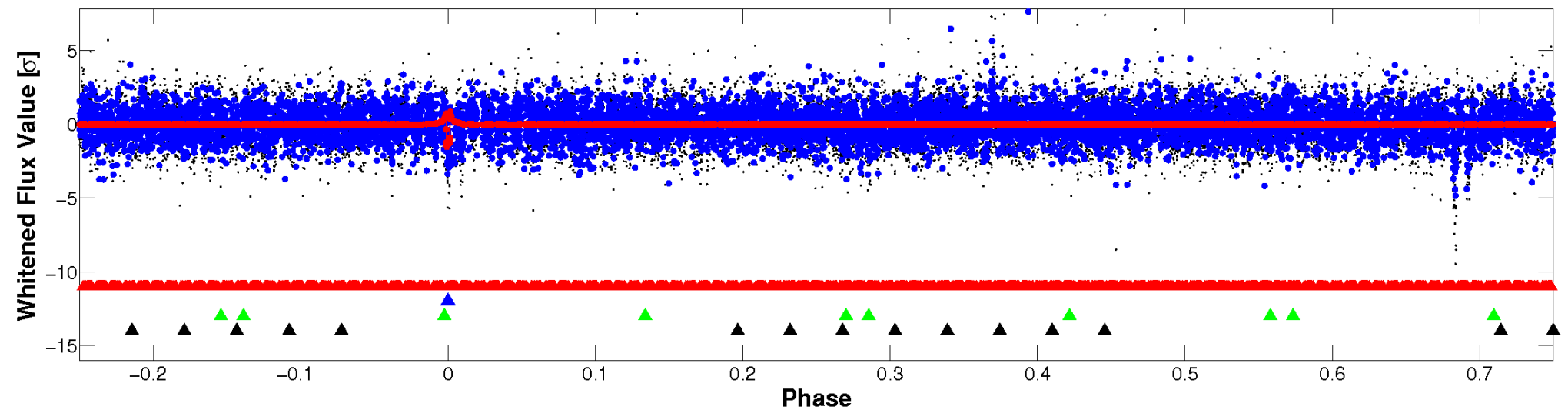


# Non-Whitened Vs. Whitened Light Curve

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

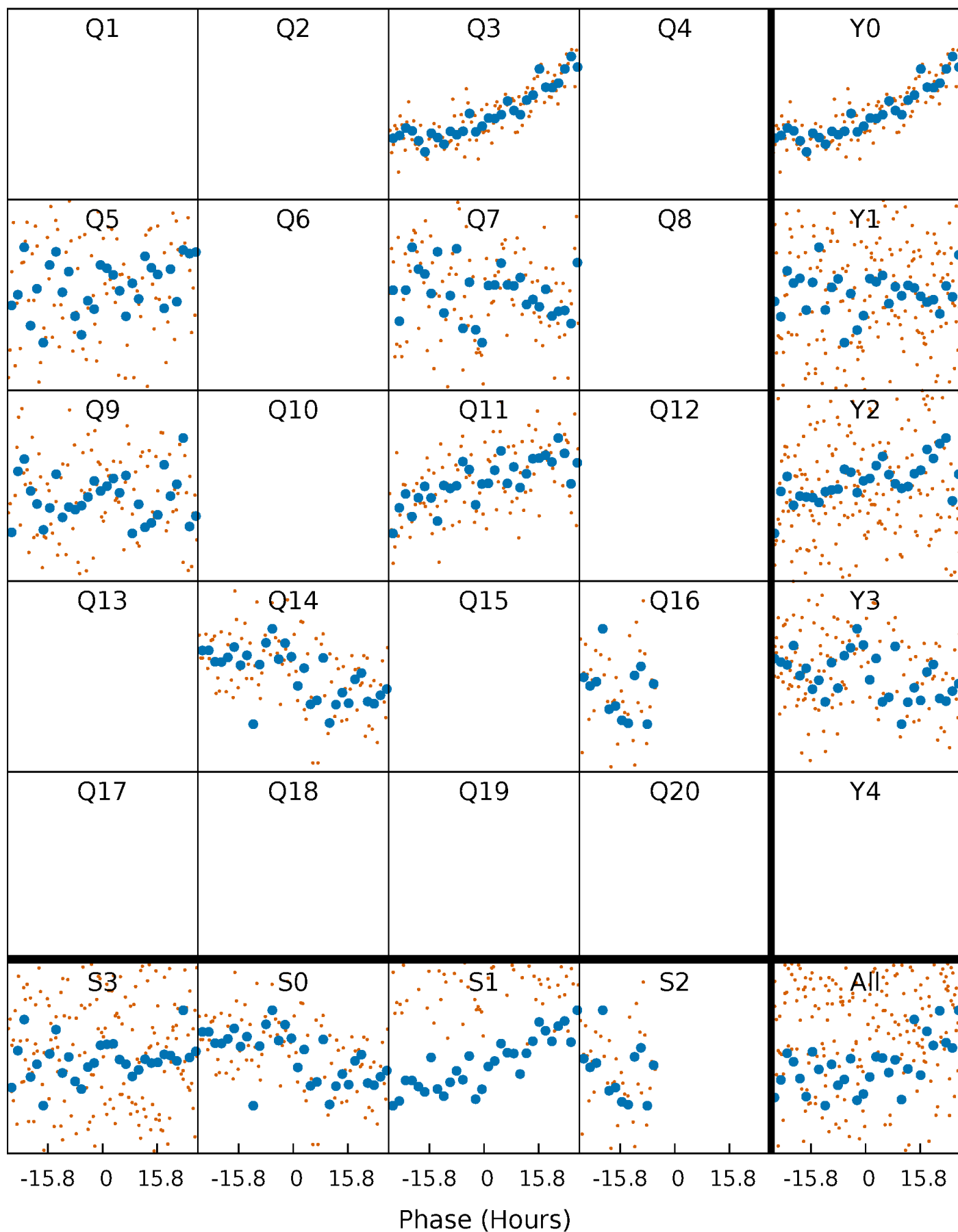


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



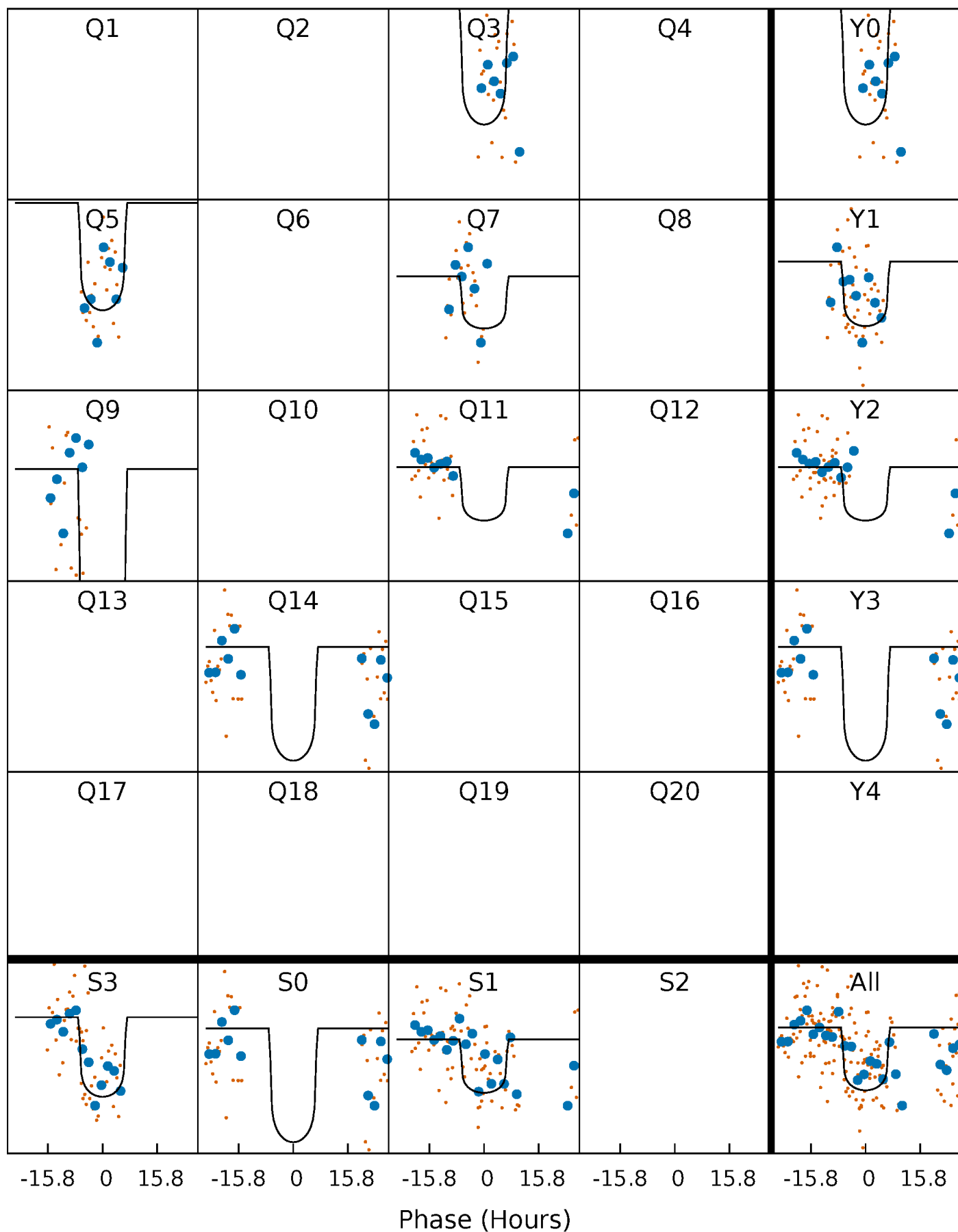
# PDC Quarter-Phased Transit Curves

TCE 009304409-02 P=198.471665 Days  $T_0=286.715017$  (BKJD)



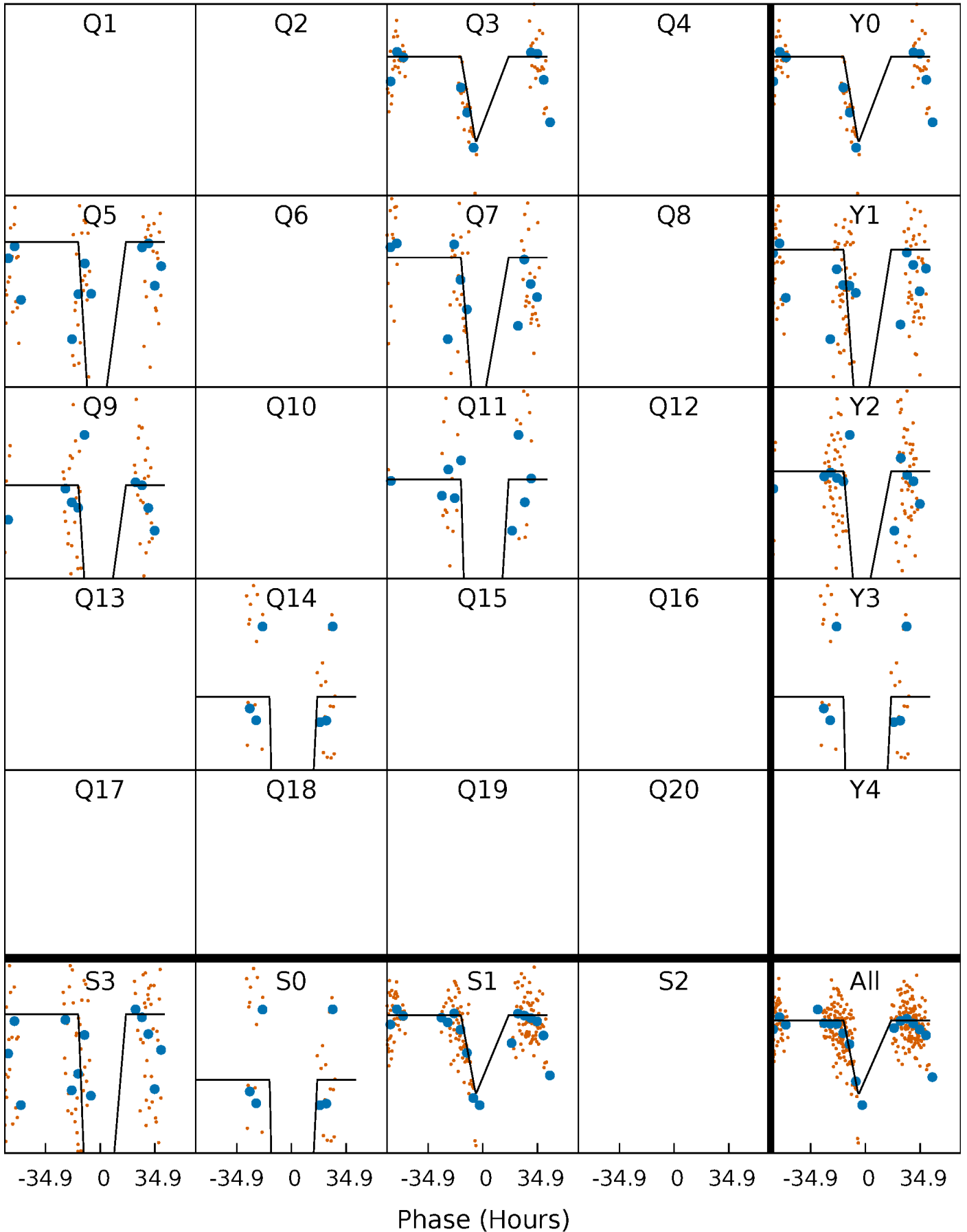
# DV Quarter-Phased Transit Curves

TCE 009304409-02     $P=198.471665$  Days     $T_0=286.715017$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

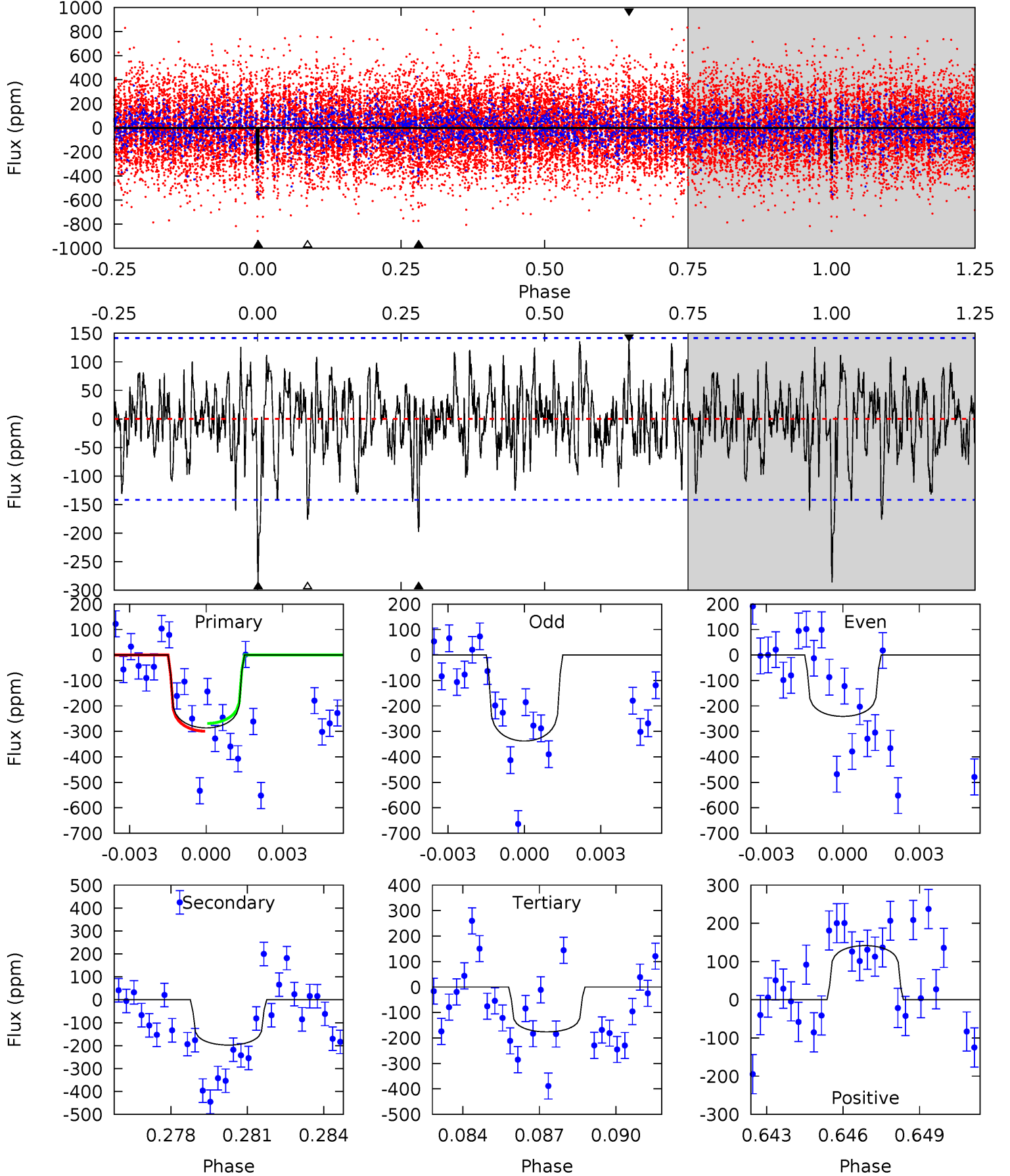
TCE 009304409-02 P=198.382623 Days  $T_0=287.299888$  (BKJD)



# DV Model-Shift Uniqueness Test

009304409-02, P = 198.471665 Days, E = 88.243352 Days

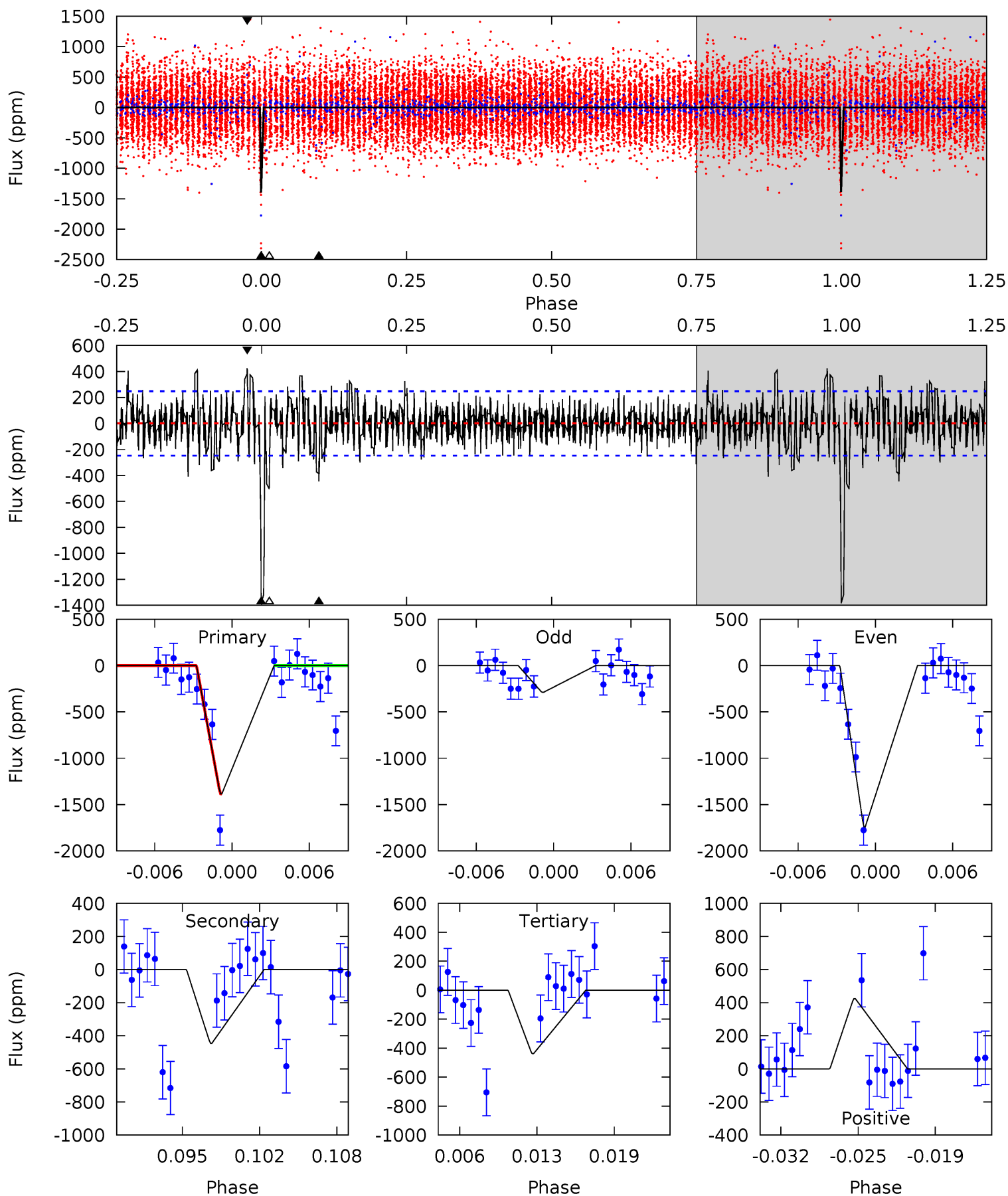
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
10.6	7.33	6.53	5.25	5.25	2.97	1.80	4.08	5.36	0.79	2.07	1.80	0.89	0.33	0.56



# Alt Model-Shift Uniqueness Test

009304409-02, P = 198.382623 Days, E = 88.917265 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
28.5	9.20	9.05	8.75	5.11	2.73	1.95	19.5	19.8	0.15	0.44	14.7	0	0.23	0





### Stellar Parameters For KIC 009304409

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$7176^{+225}_{-275}$	$3.419^{+0.756}_{-0.084}$	$-0.600^{+0.300}_{-0.250}$	$4.429^{+0.333}_{-2.998}$	$1.876^{+0.133}_{-0.752}$	$0.030^{+0.559}_{-0.008}$
	+3%/-4%	+22%/-2%	+50%/-42%	+8%/-68%	+7%/-40%	+1840%/-27%
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 009304409-02 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-198 \pm 27$	$8.85^{+3.36}_{-3.75}$	$995^{+64}_{-165}$	$5801^{+1160}_{-653}$	$924^{+1510}_{-443}$
Alt.	$-446 \pm 48$	$15.55^{+4.60}_{-5.22}$	$989^{+70}_{-178}$	$5392^{+535}_{-380}$	$648^{+740}_{-244}$

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

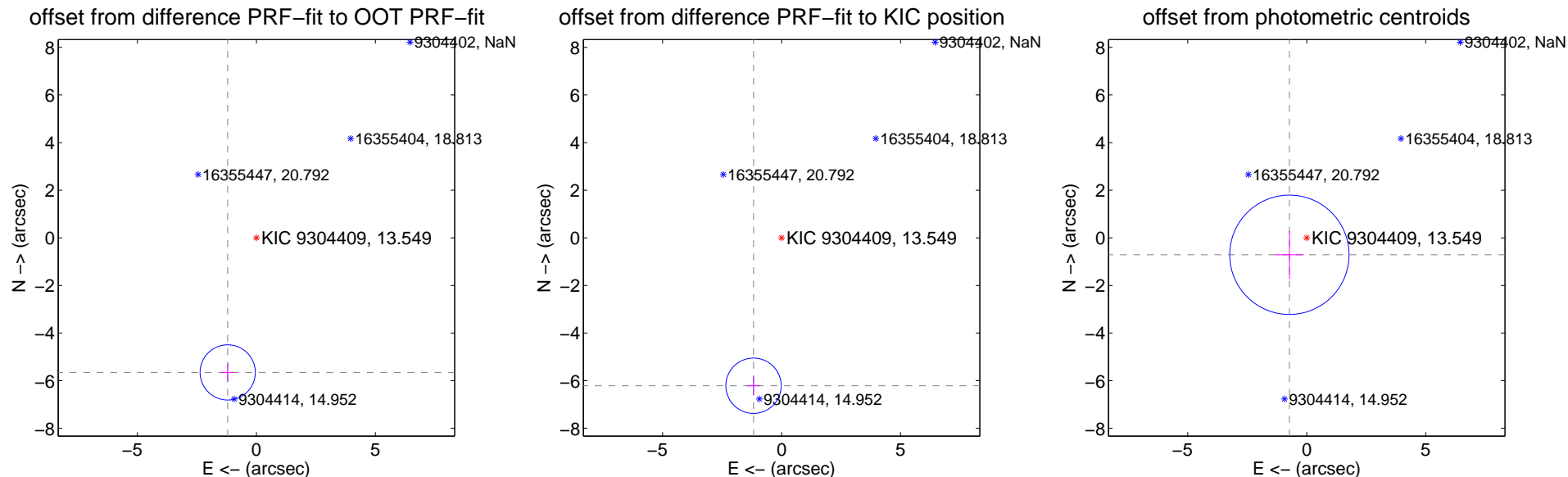
## DV Centroid Data

Supplemental centroid analysis for 009304409-02. Kepler magnitude: 13.55. Transit SNR 10.48

There are 1 quarters with good PRF difference image offsets

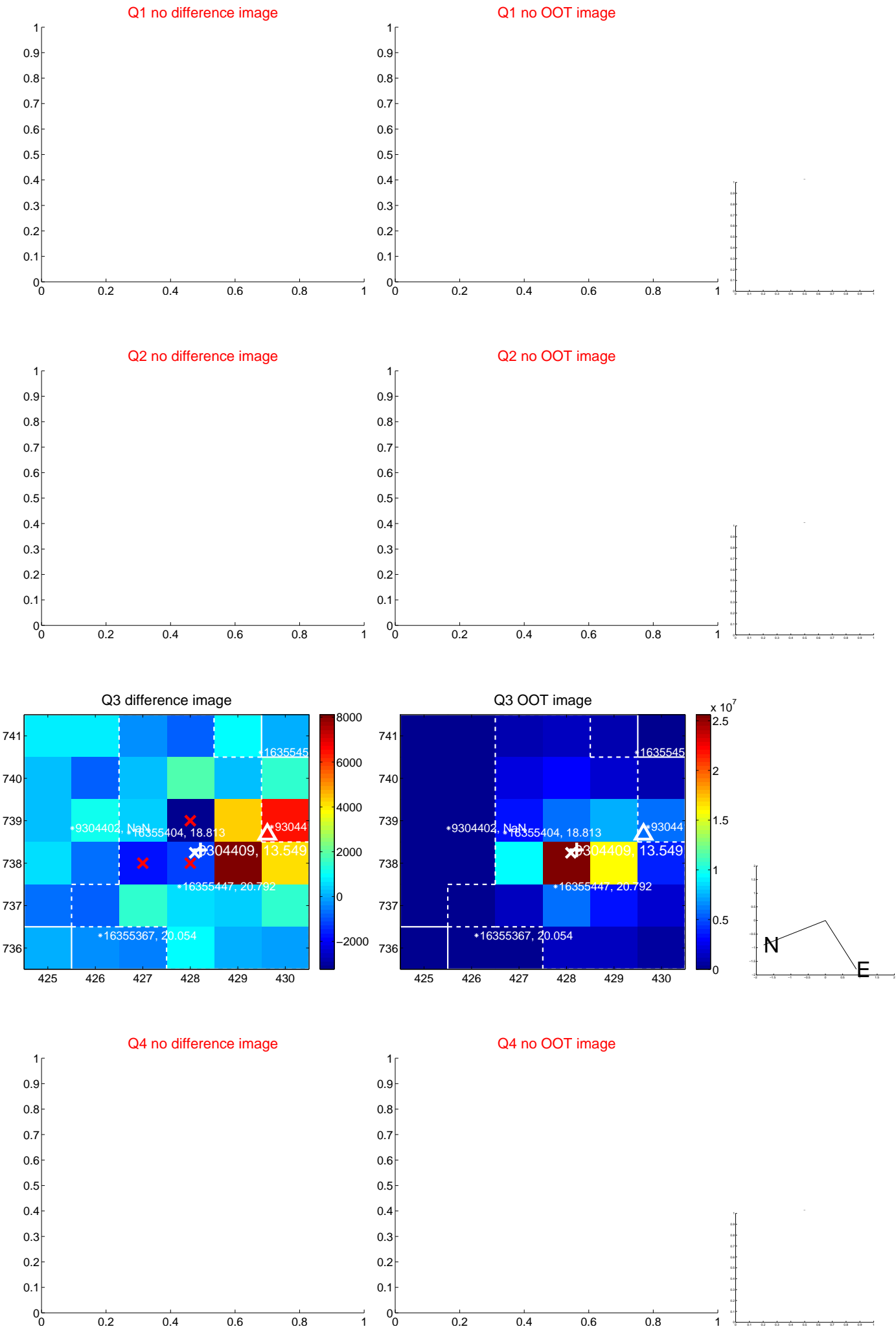
The direct PRF centroid is offset from the target star catalog position by about 0.56 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$5.780 \pm 0.387$	14.95	$1.206 \pm 0.276$	$-5.653 \pm 0.391$
PRF-fit source offset from KIC position	$6.322 \pm 0.387$	16.32	$1.178 \pm 0.276$	$-6.212 \pm 0.391$
photometric centroid source offset	$1.02 \pm 0.84$	1.22	$0.73 \pm 0.61$	$-0.71 \pm 1.02$

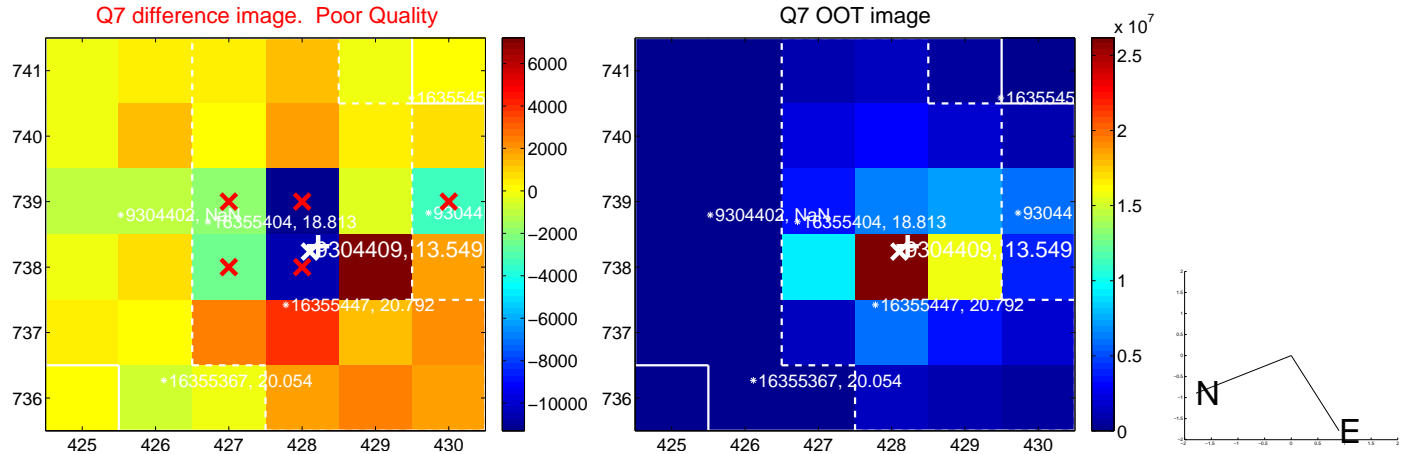
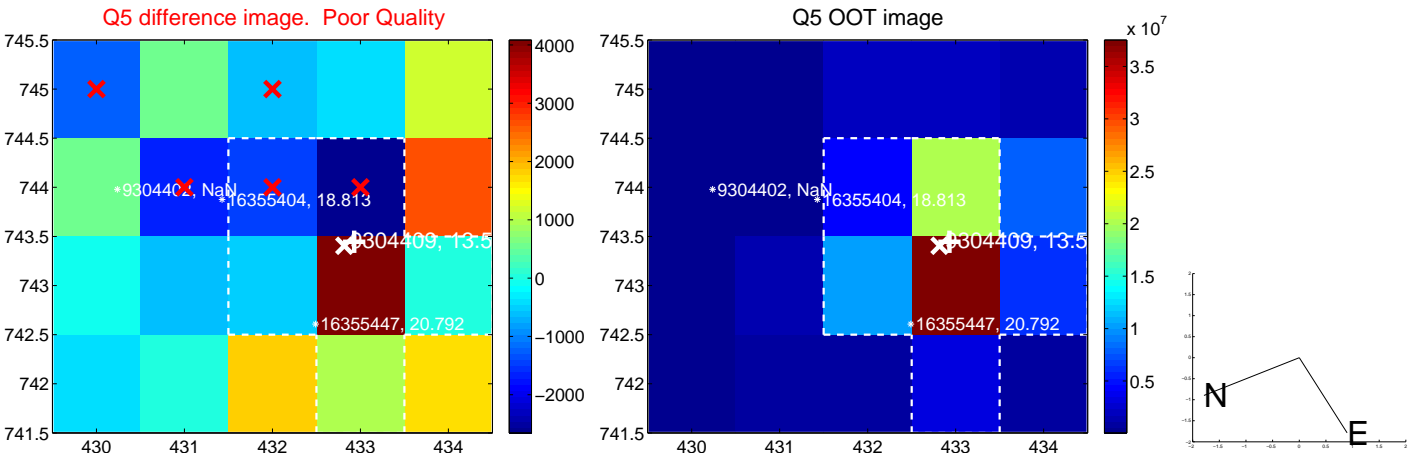


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

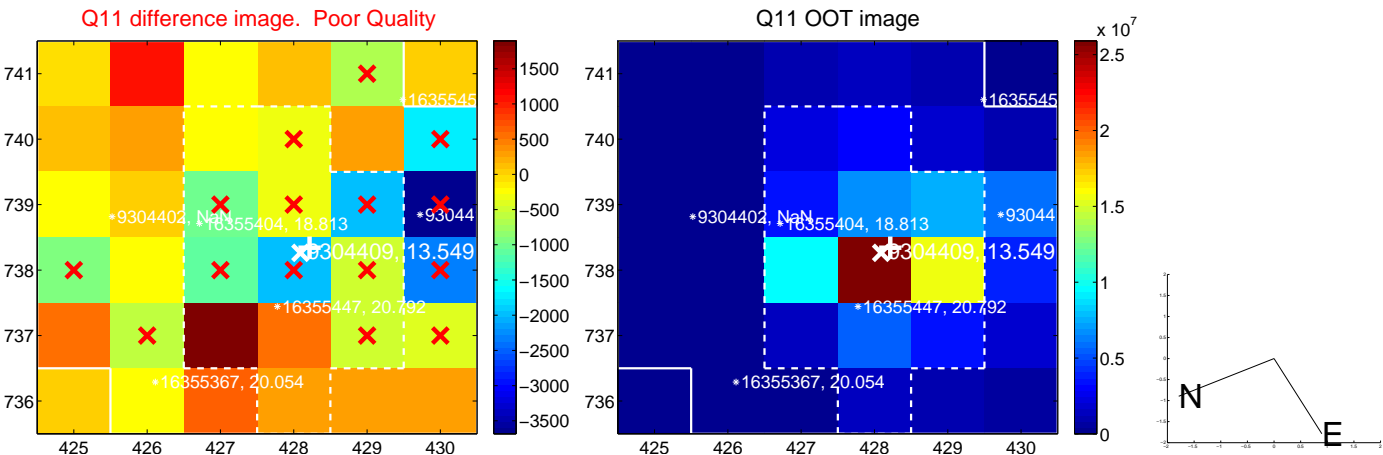
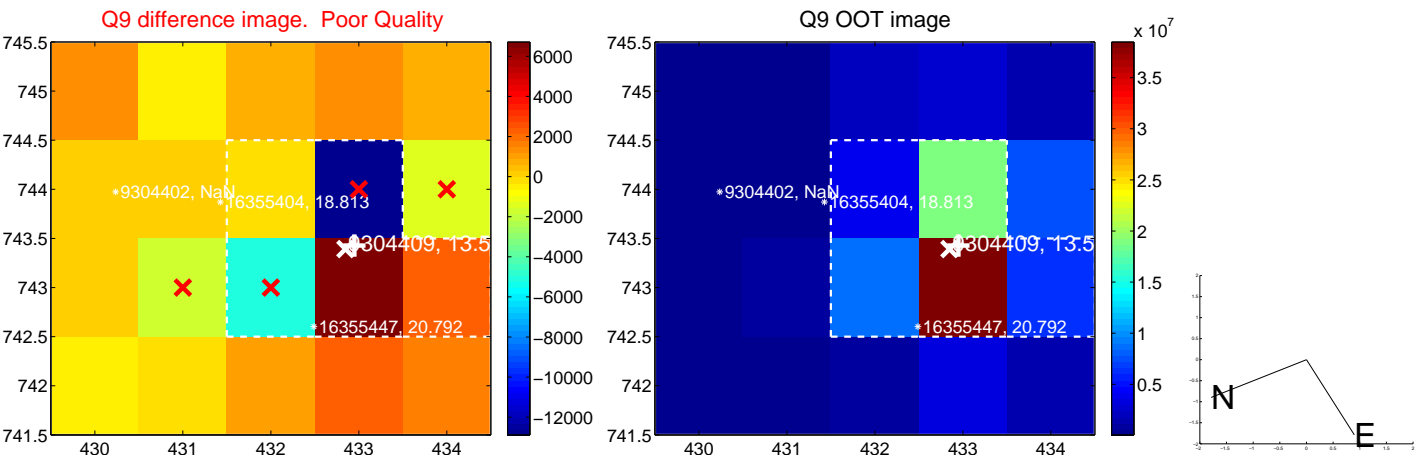
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



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

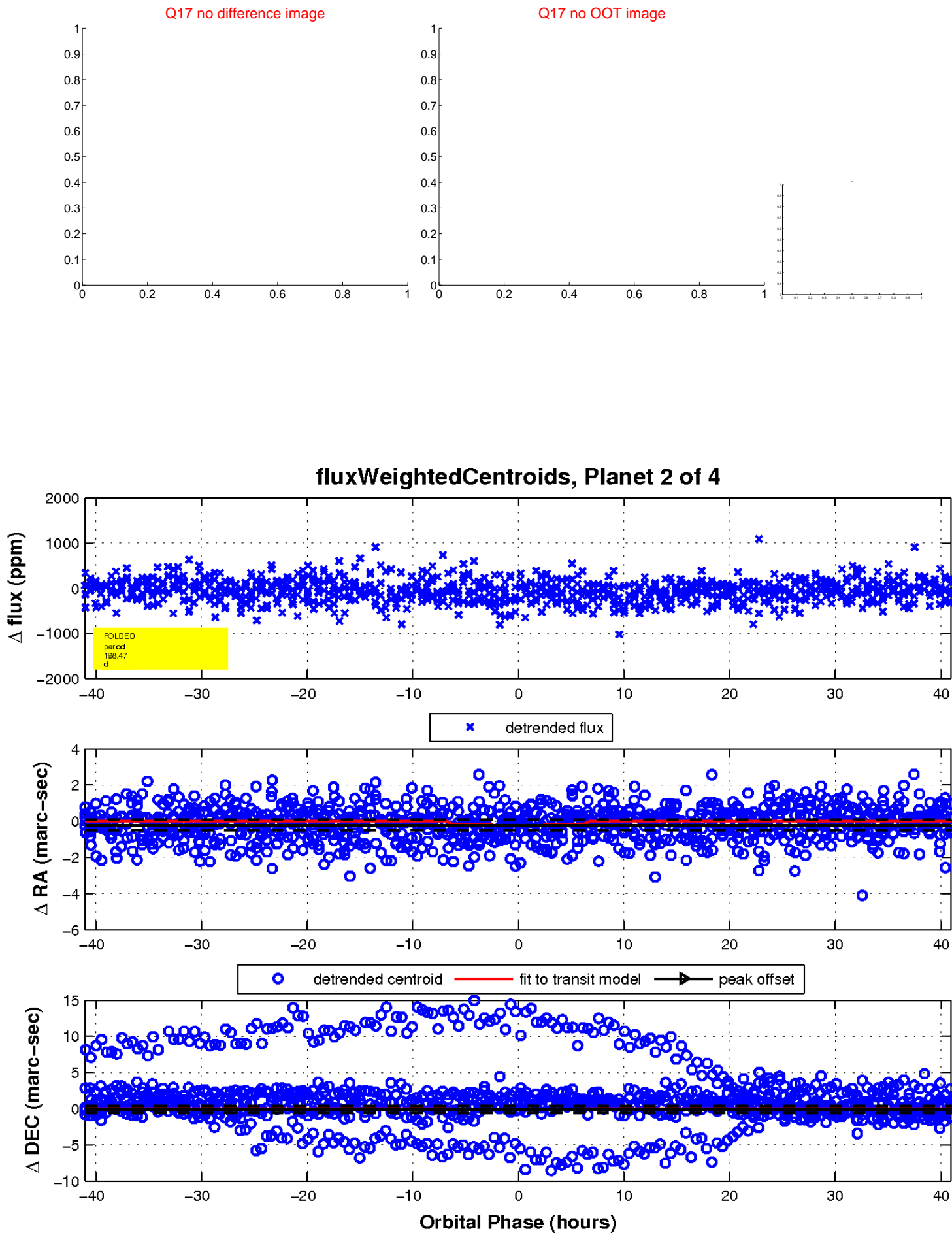




white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

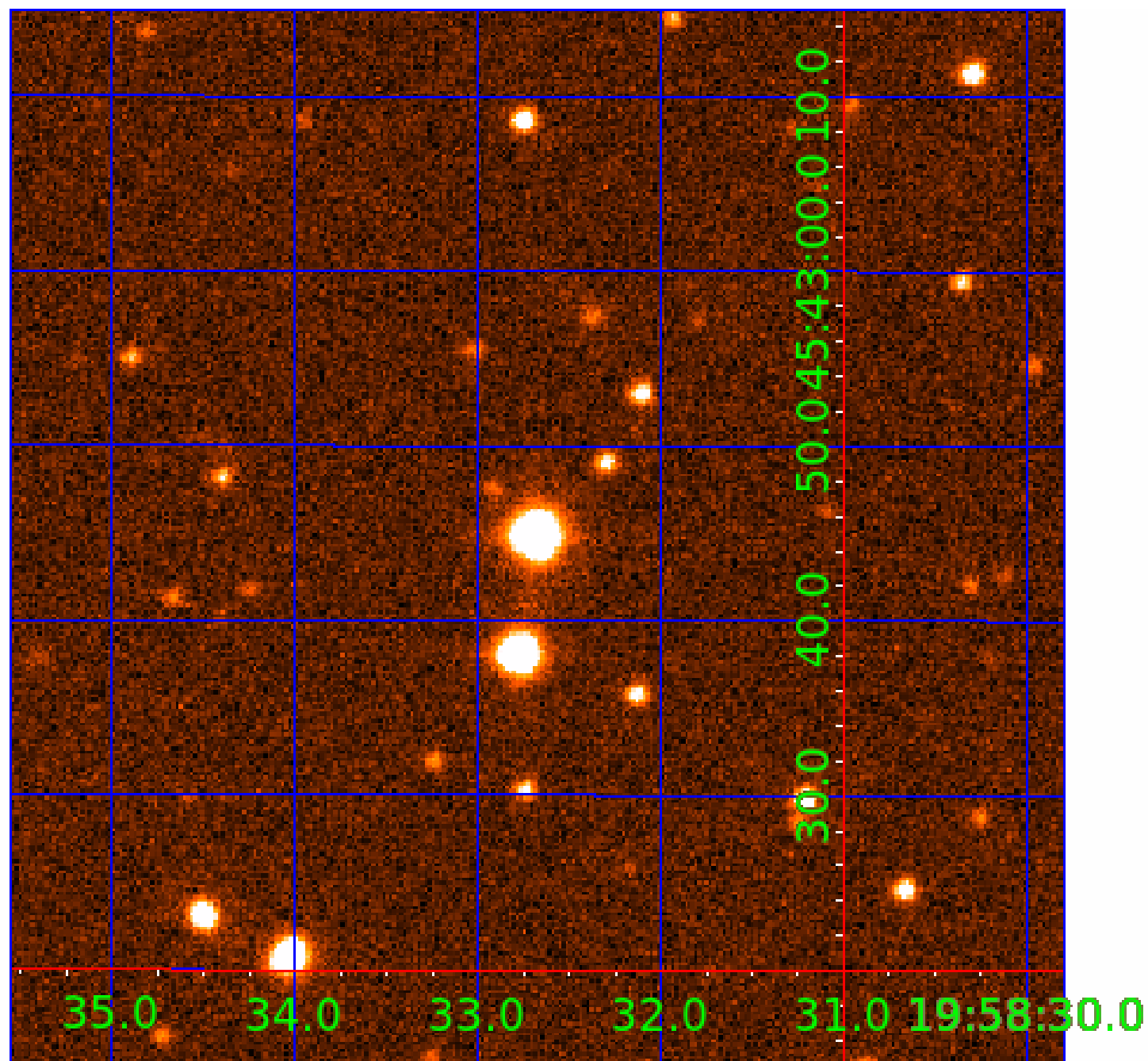


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 009304409

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009304409-01	OBS	No	1.888315	132.993878	28.3	10.913	8.4	10.6	4.43	7176	2.42	34239.60
009304409-02	OBS	No	198.471665	286.715017	447.2	13.782	16.2	10.5	4.43	7176	10.18	69.03
009304409-03	OBS	No	141.329794	259.181382	374.1	19.168	11.3	9.8	4.43	7176	9.04	108.56
009304409-04	OBS	No	95.706297	176.675854	452.0	1.985	7.9	8.1	4.43	7176	10.56	182.55

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009304409-01	OBS	FP	0.00	1	0	0	0	LPP_DV—LPP_ALT—CENT_KIC_POS
009304409-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL_SKYE—TRANS_GAPPED—LPP_DV—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009304409-03	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_ALT—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009304409-04	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_KIC_POS

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

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

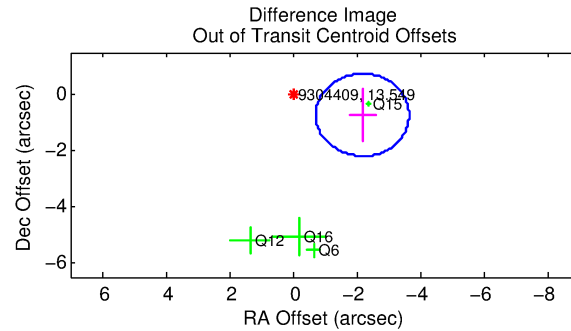
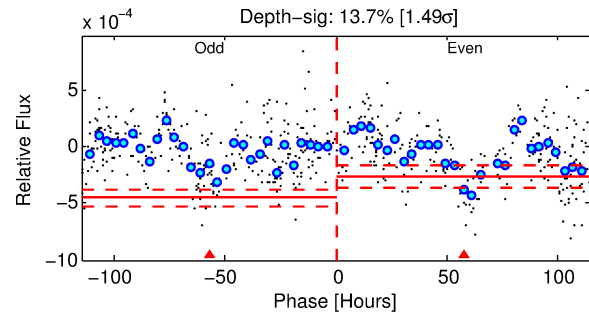
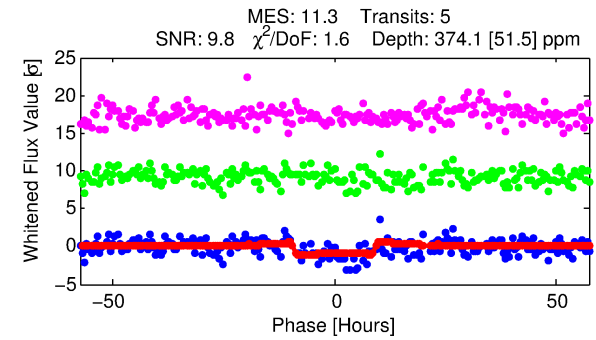
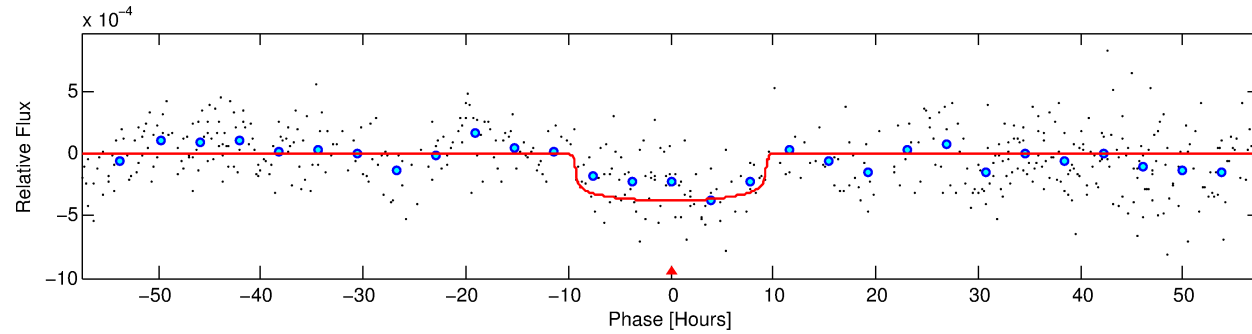
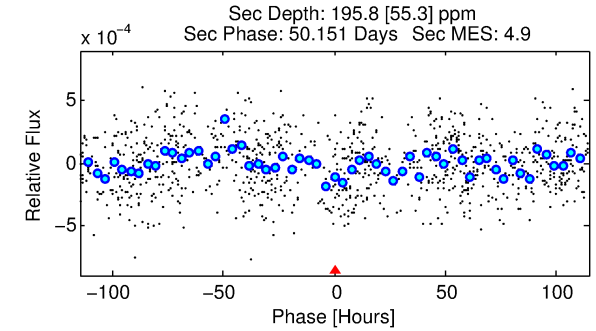
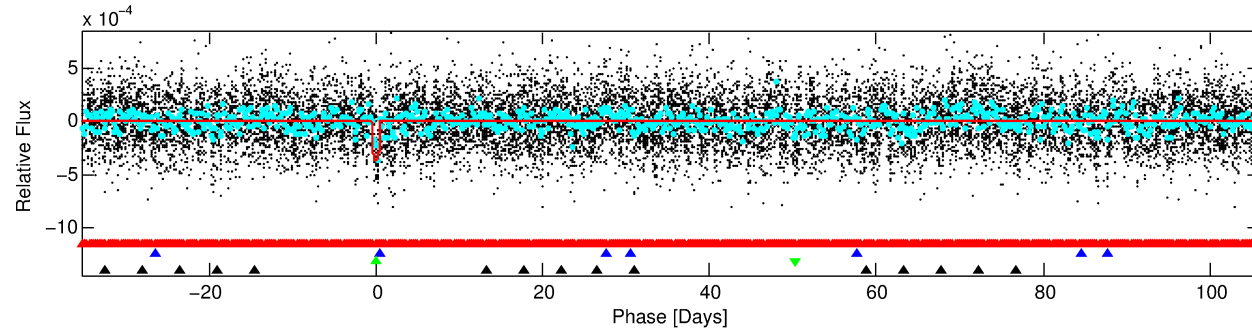
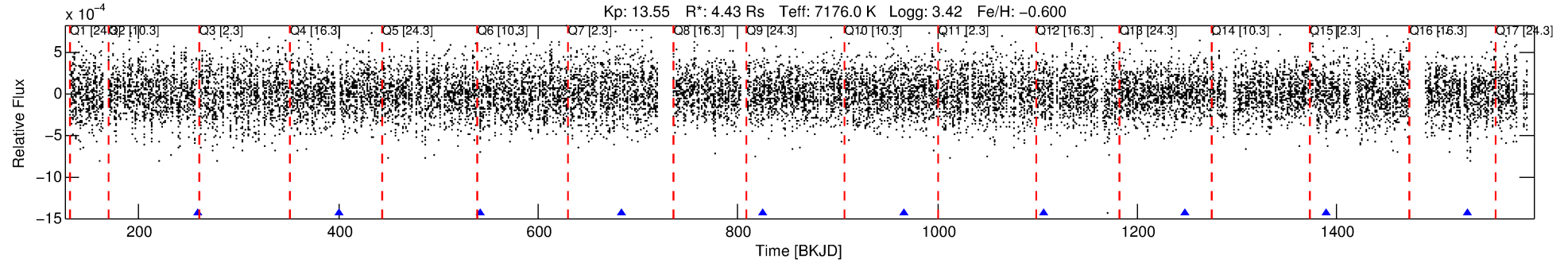
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 009304409-03

No Significant Match Found

# DV One-Page Summary

KIC: 9304409 Candidate: 3 of 4 Period: 141.330 d



## DV Fit Results:

Period = 141.32979 [0.00541] d  
Epoch = 259.1814 [0.0410] BKJD  
Rp/R\* = 0.0187 [0.0047]  
a/R\* = 45.45 [64.58]  
b = 0.62 [1.41]  
Seff = 108.55 [136.19]  
Teq = 823 [258] K  
Rp = 9.04 [6.53] Re  
a = 0.6552 [0.4816] AU  
Ag = 566.02 [777.53] [0.73 $\sigma$ ]  
Teffp = 6207 [931] K [5.57 $\sigma$ ]

## DV Diagnostic Results:

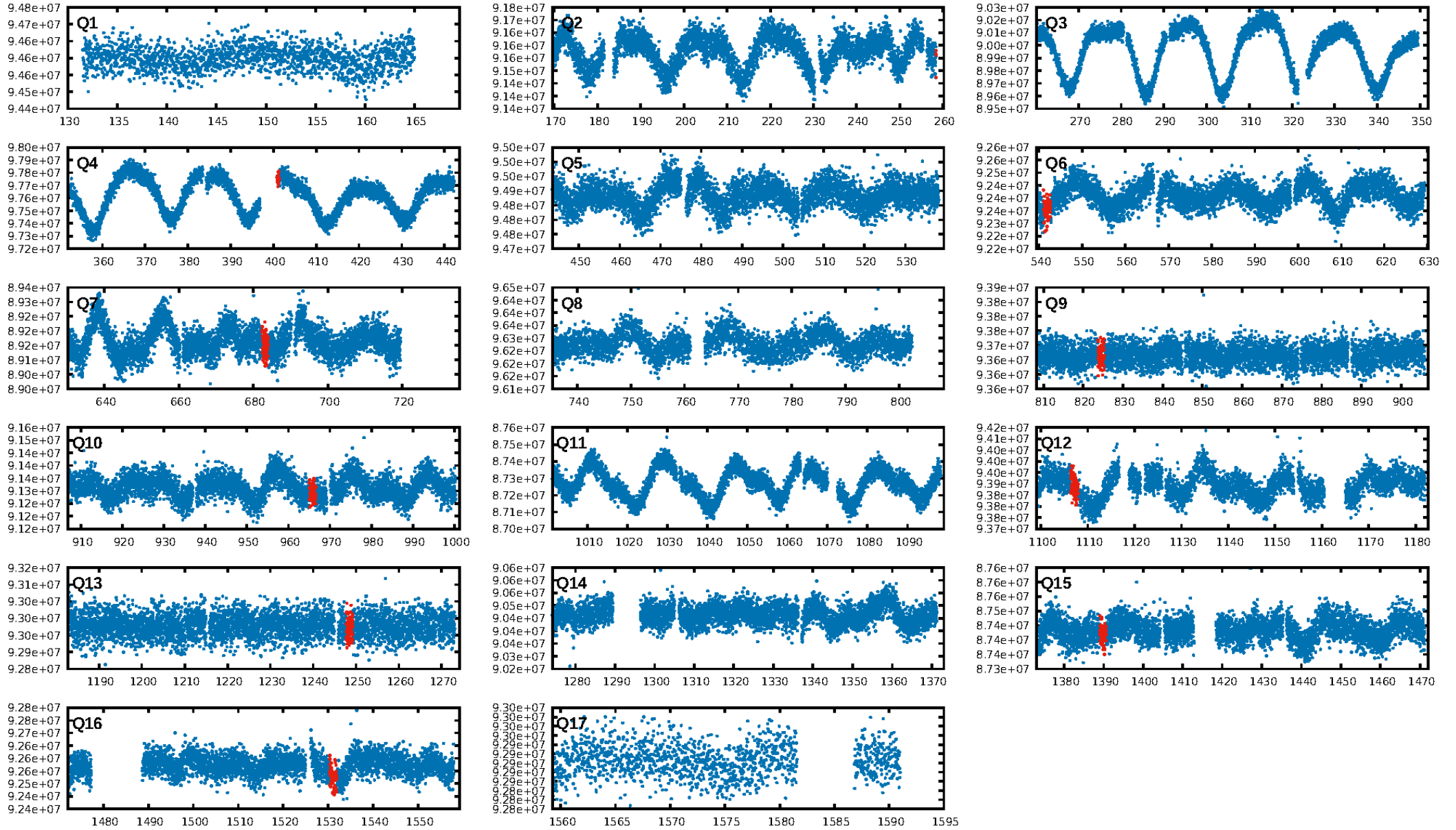
ShortPeriod-sig: 100.0% [56.82 $\sigma$ ]  
LongPeriod-sig: 100.0% [58.09 $\sigma$ ]  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGoF-sig: 100.0%  
Bootstrap-pfa: 1.89e-16  
RollingBand-fgt: 1.00 [5/5]  
GhostDiagnostic-chr: 1.149  
Centroid-sig: 0.0%  
Centroid-so: 3.014 arcsec [3.35 $\sigma$ ]  
OotOffset-rm: 2.305 arcsec [4.72 $\sigma$ ]  
KicOffset-rm: 2.567 arcsec [4.10 $\sigma$ ]  
OotOffset-st: 1/1/2/0 [4]  
KicOffset-st: 1/1/2/0 [4]  
DiffImageQuality-fgm: 0.50 [2/4]  
DiffImageOverlap-fno: 0.00 [0/7]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 13:52:32 Z

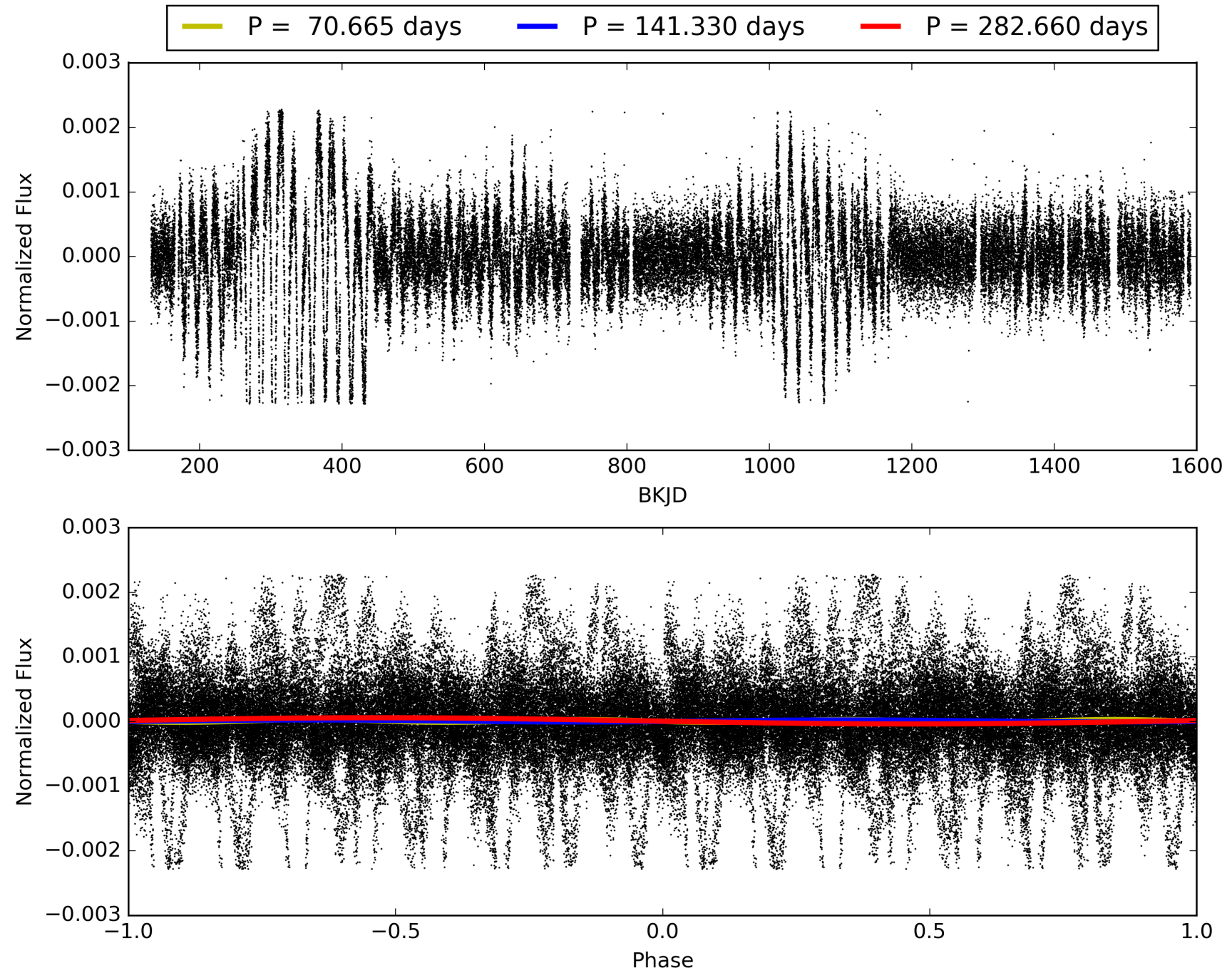
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center



# TCE 009304409-03, PDC Light Curves

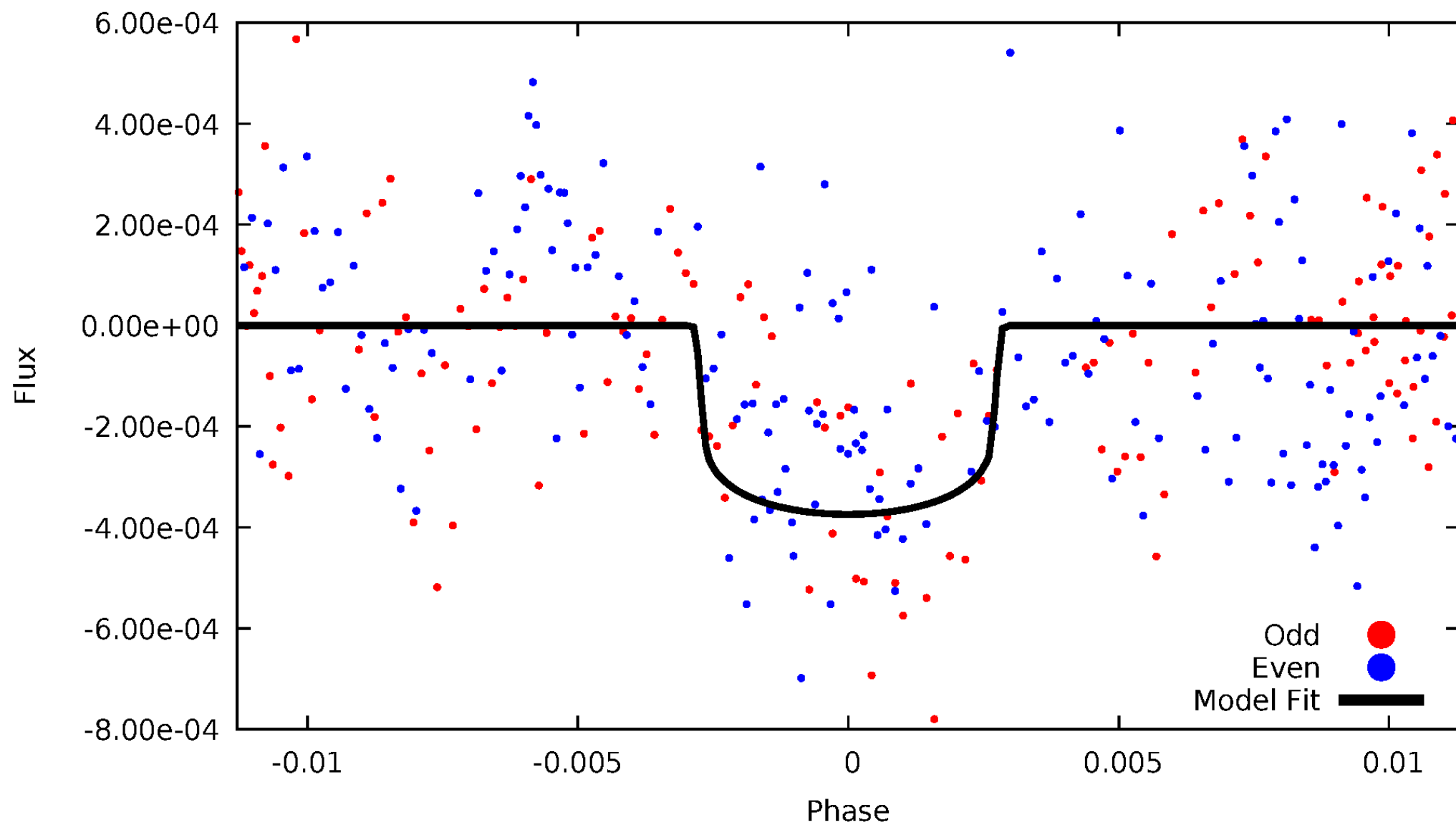


TCE 009304409-03



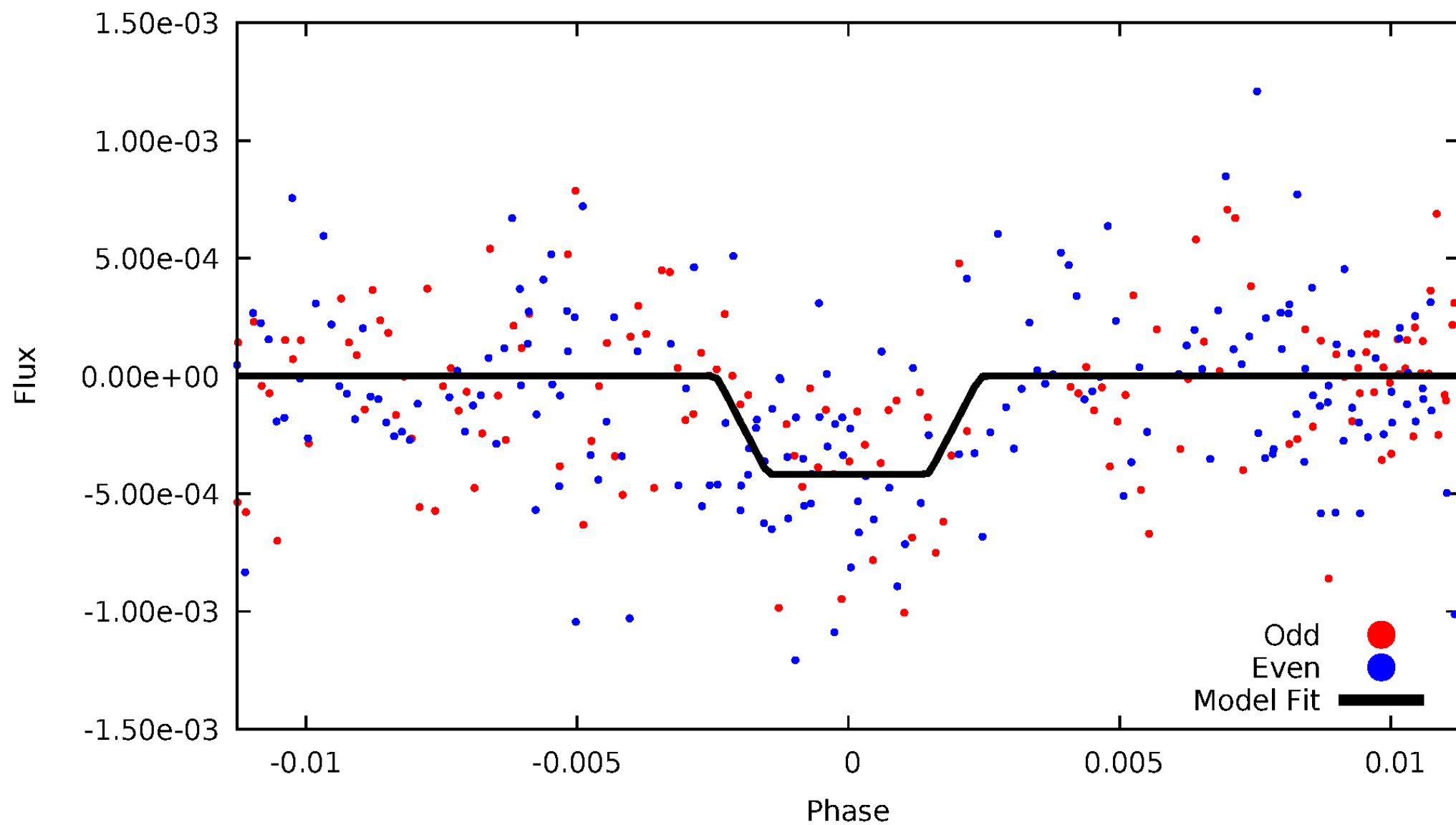
# DV Odd/Even

TCE 009304409-03



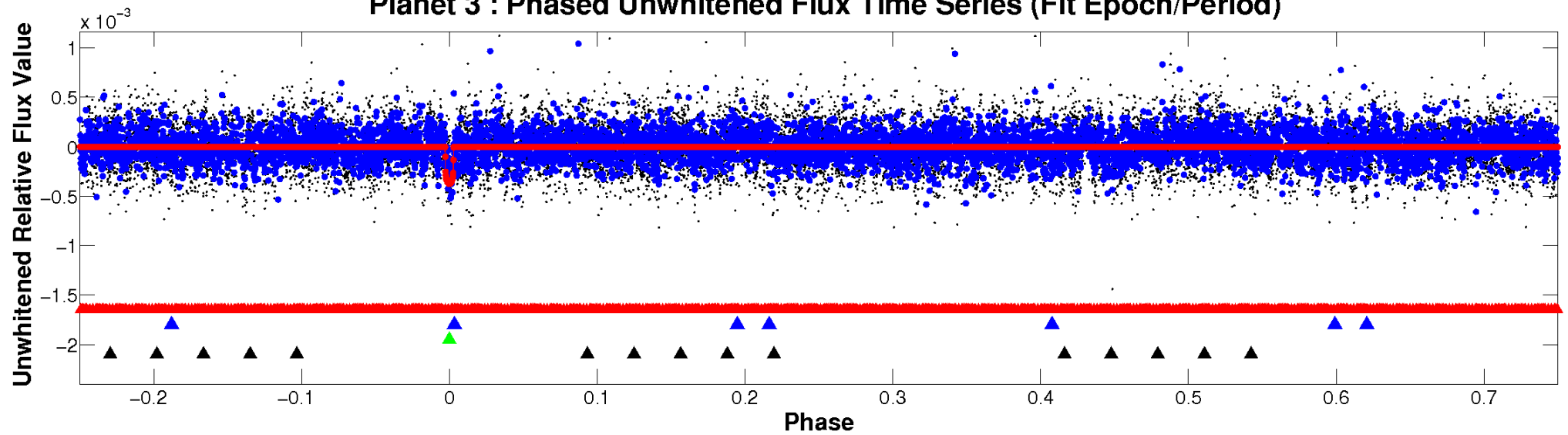
# ALT Odd/Even

TCE 009304409-03

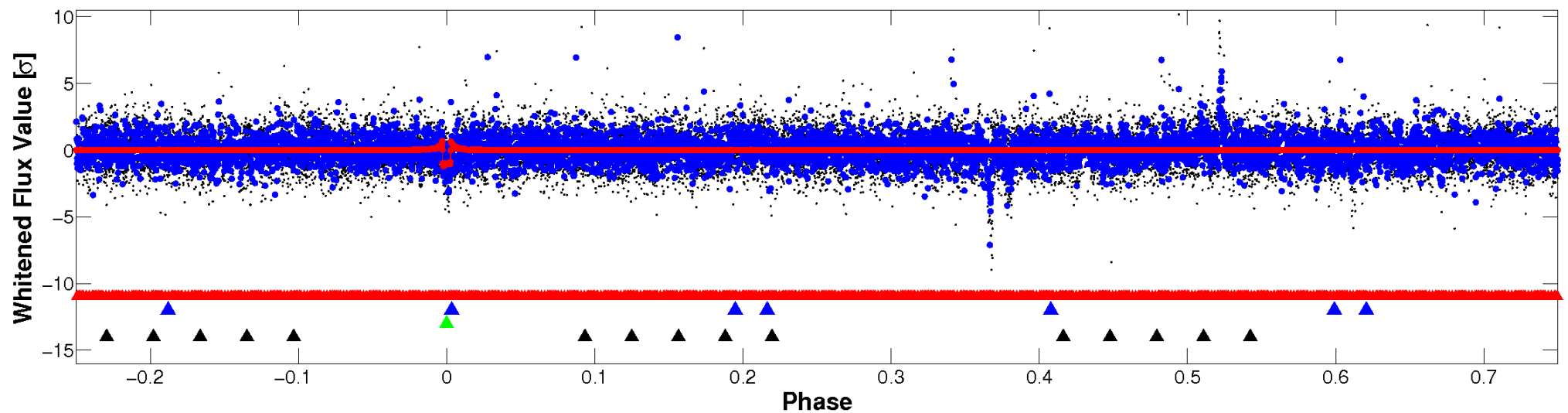


# Non-Whitened Vs. Whitened Light Curve

Planet 3 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

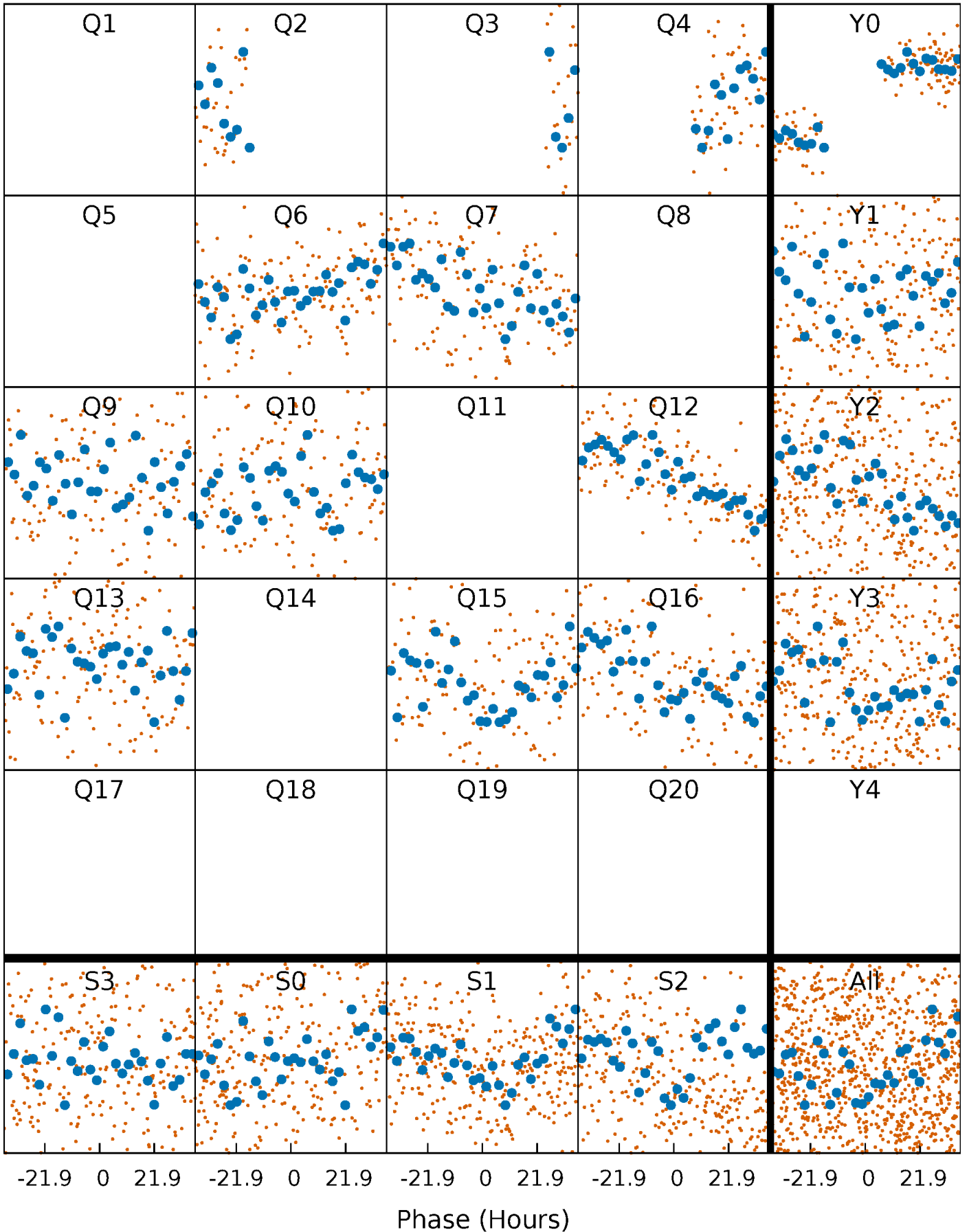


Planet 3 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

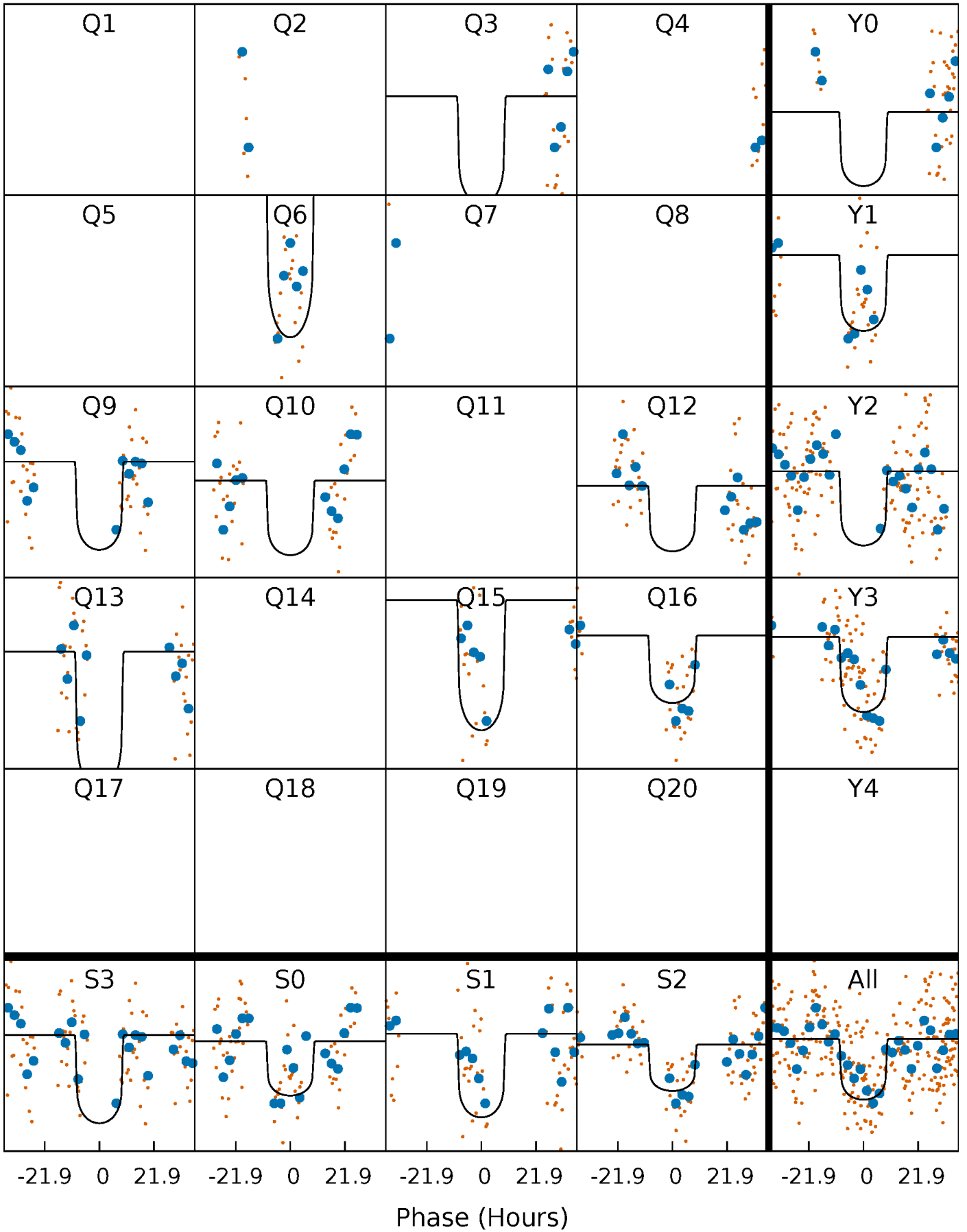
TCE 009304409-03     $P=141.329793$  Days     $T_0=259.181382$  (BKJD)





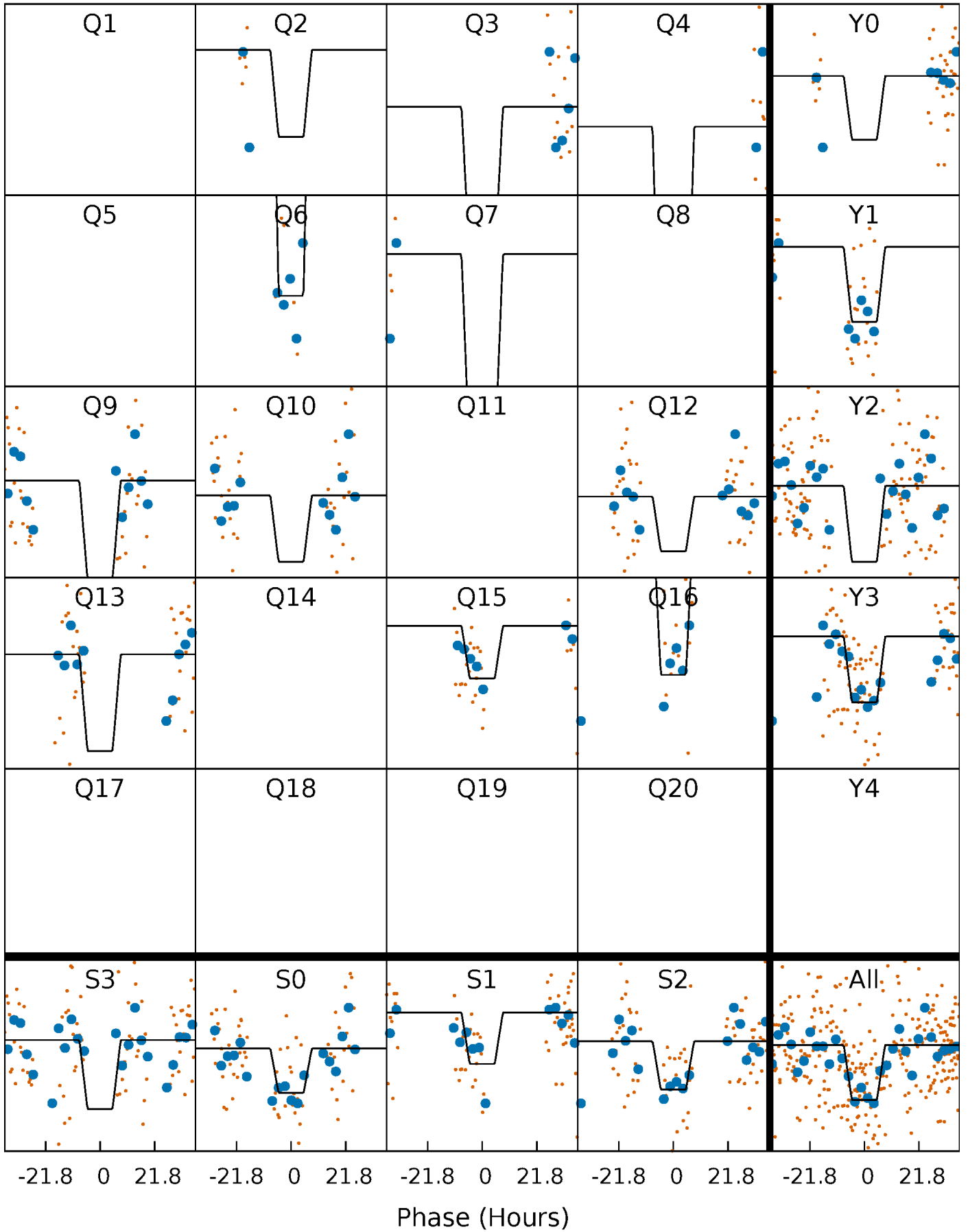
# DV Quarter-Phased Transit Curves

TCE 009304409-03     $P=141.329793$  Days     $T_0=259.181382$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

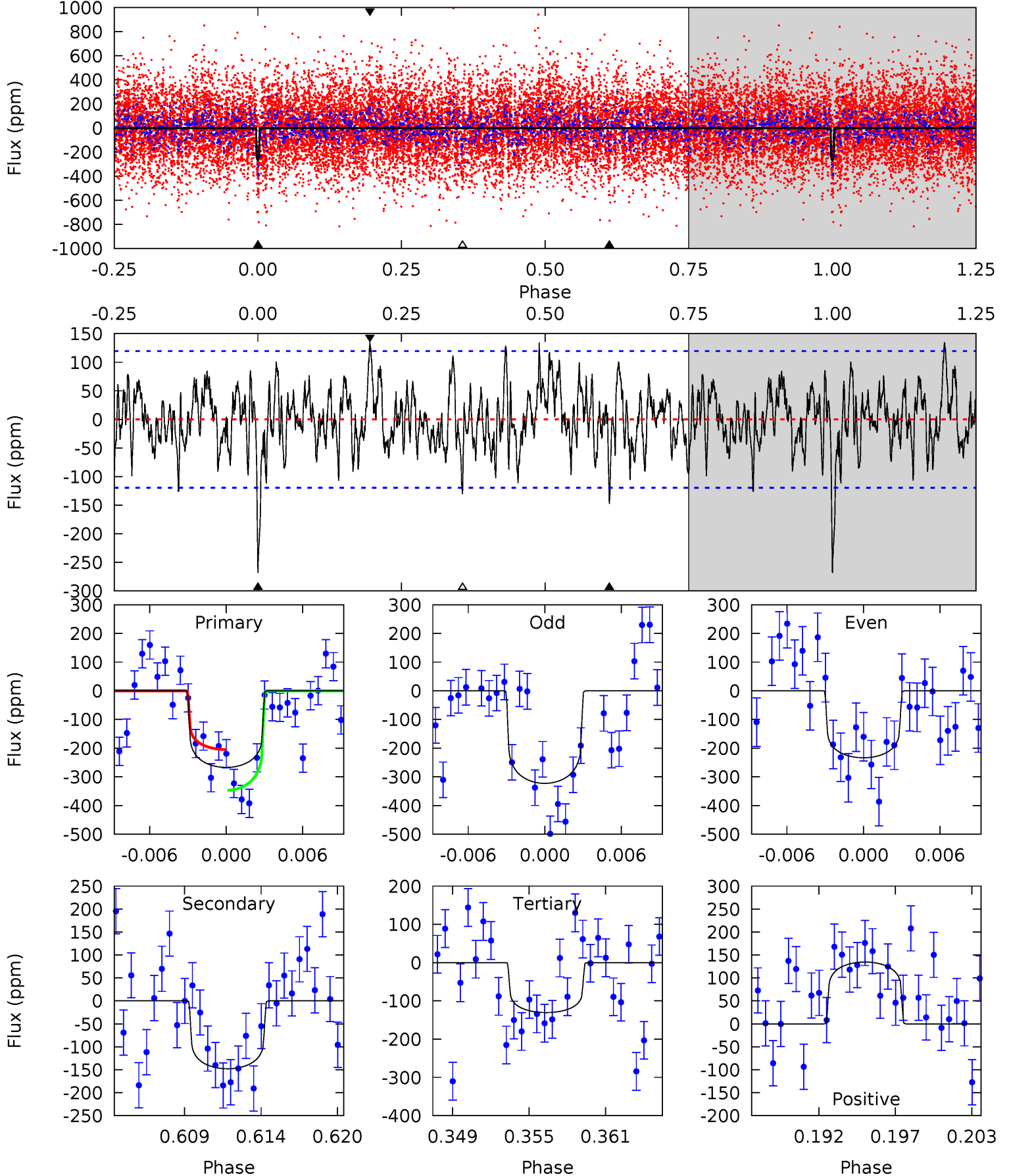
TCE 009304409-03 P=141.338934 Days  $T_0=259.178088$  (BKJD)



# DV Model-Shift Uniqueness Test

009304409-03, P = 141.329793 Days, E = 117.851589 Days

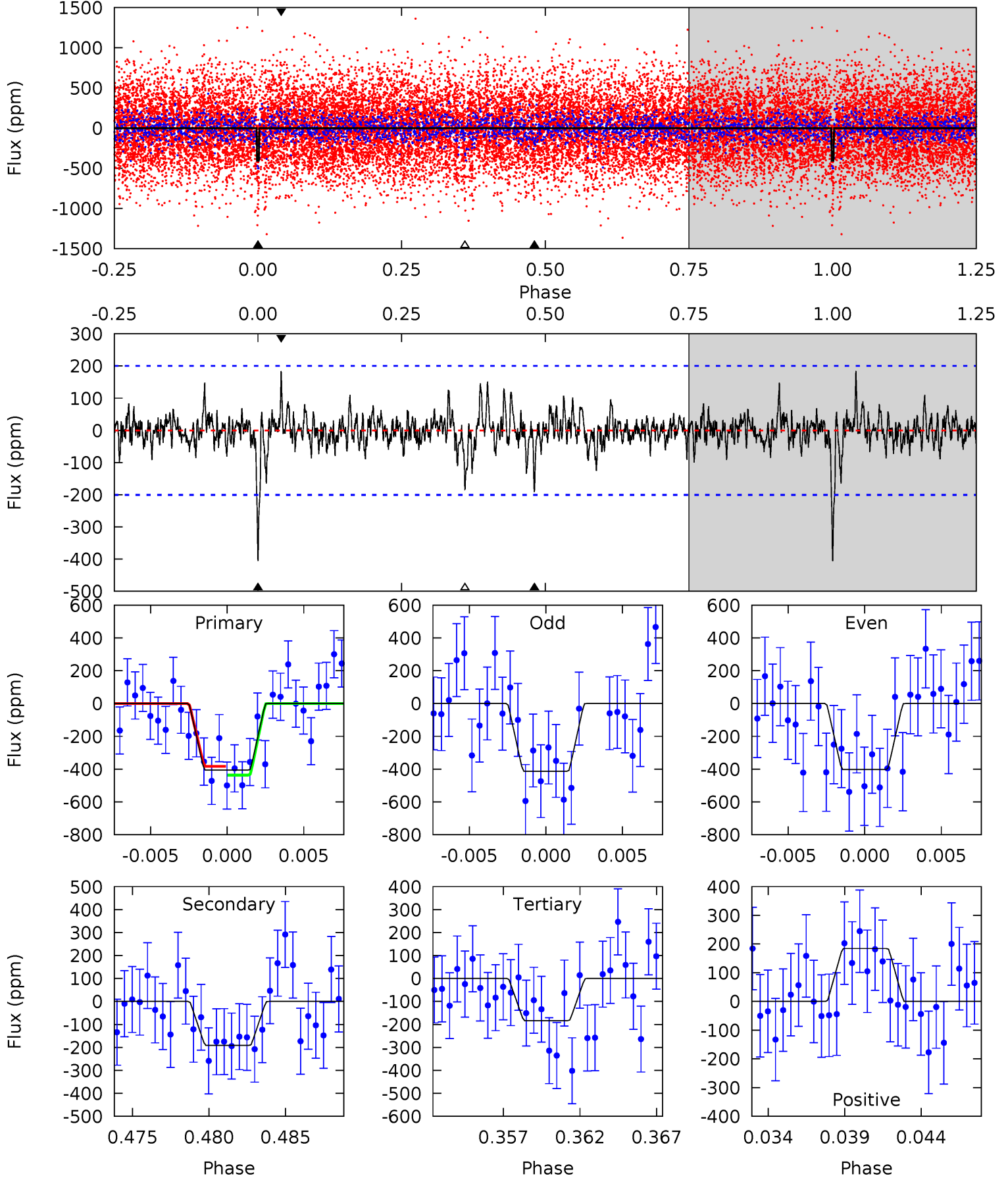
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
11.5	6.36	5.61	5.79	5.14	2.77	1.93	5.87	5.69	0.74	0.57	1.88	0.93	0.34	3.03



# Alt Model-Shift Uniqueness Test

009304409-03, P = 141.338934 Days, E = 117.839154 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
10.5	4.92	4.72	4.75	5.16	2.81	1.06	5.73	5.70	0.20	0.17	0.13	0.86	0.31	0.68



### Stellar Parameters For KIC 009304409

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$7176^{+225}_{-275}$	$3.419^{+0.756}_{-0.084}$	$-0.600^{+0.300}_{-0.250}$	$4.429^{+0.333}_{-2.998}$	$1.876^{+0.133}_{-0.752}$	$0.030^{+0.559}_{-0.008}$
	+3%/-4%	+22%/-2%	+50%/-42%	+8%/-68%	+7%/-40%	+1840%/-27%
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 009304409-03 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-148 \pm 23$	$7.94^{+3.05}_{-2.89}$	$1122^{+67}_{-180}$	$5724^{+948}_{-618}$	$537^{+722}_{-260}$
Alt.	$-191 \pm 39$	$8.73^{+3.07}_{-3.25}$	$1117^{+69}_{-190}$	$5829^{+987}_{-637}$	$576^{+769}_{-260}$

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

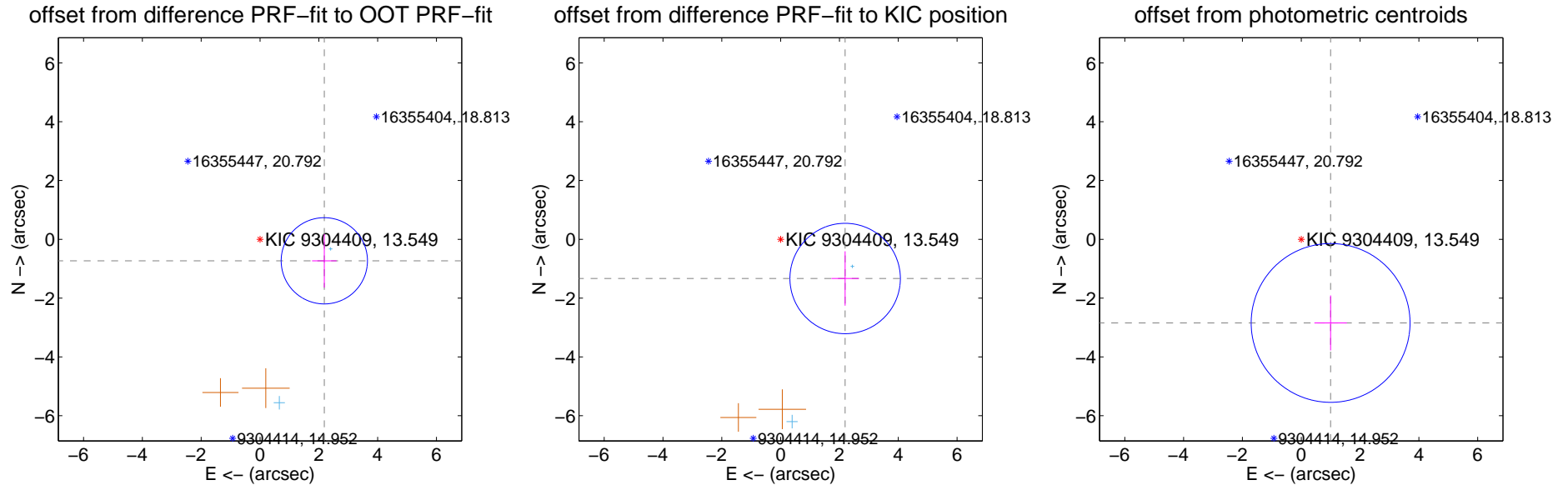
## DV Centroid Data

Supplemental centroid analysis for 009304409-03. Kepler magnitude: 13.55. Transit SNR 9.77

There are 2 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.73 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$2.305 \pm 0.489$	4.72	$-2.186 \pm 0.416$	$-0.731 \pm 0.909$
PRF-fit source offset from KIC position	$2.567 \pm 0.626$	4.10	$-2.193 \pm 0.470$	$-1.333 \pm 0.925$
photometric centroid source offset	$3.01 \pm 0.90$	3.35	$-1.00 \pm 0.55$	$-2.84 \pm 0.93$



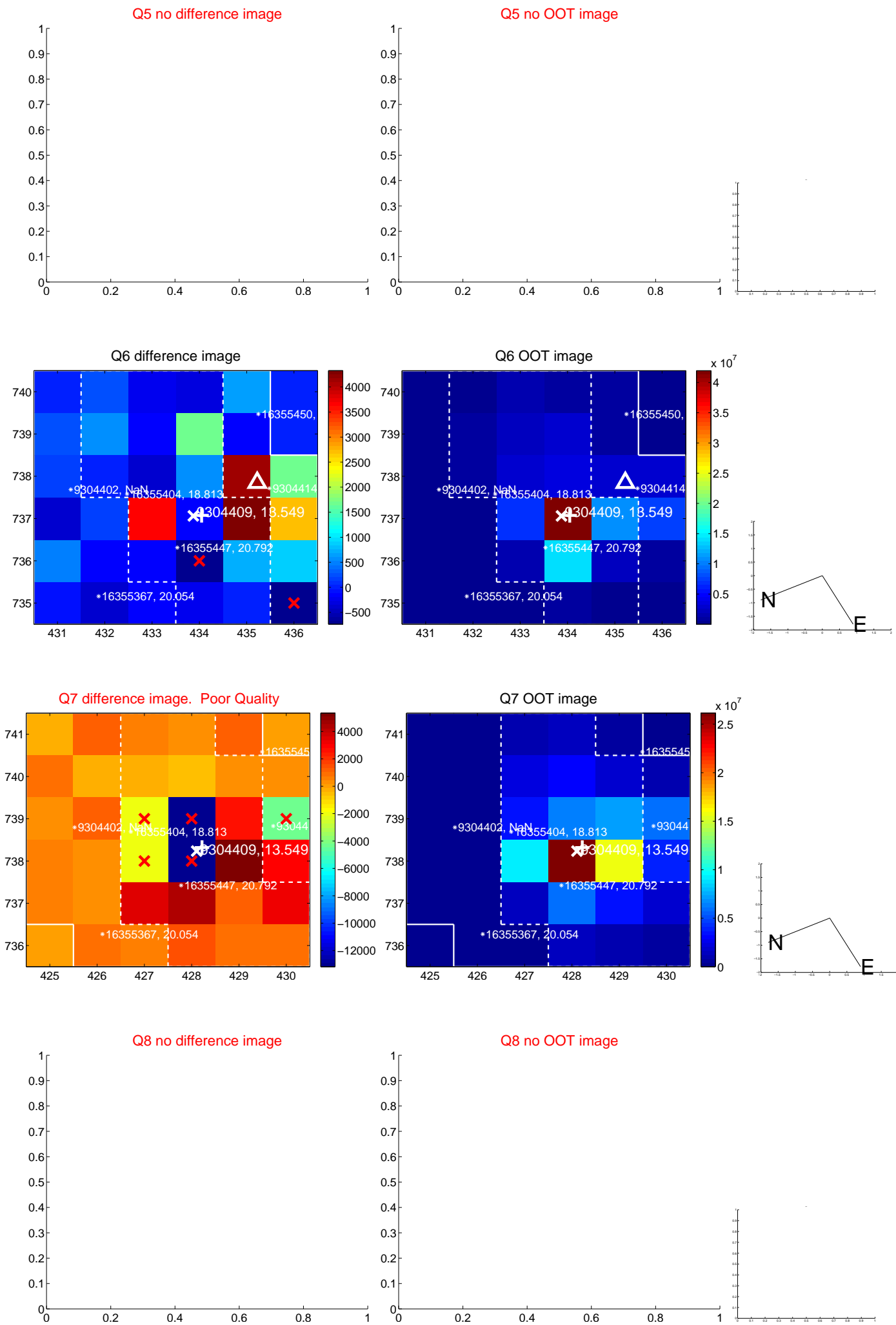
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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



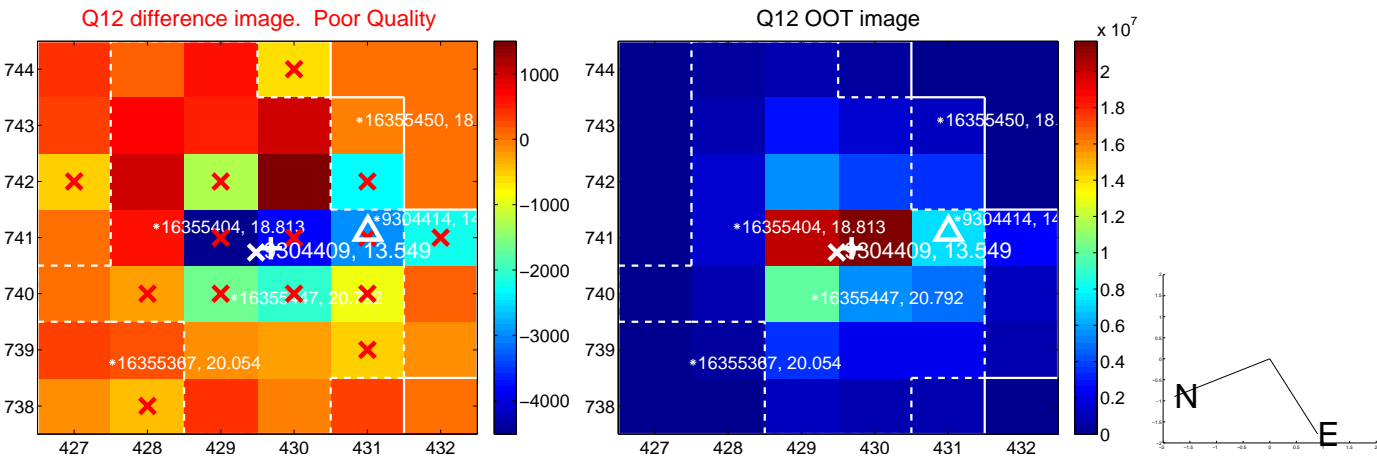
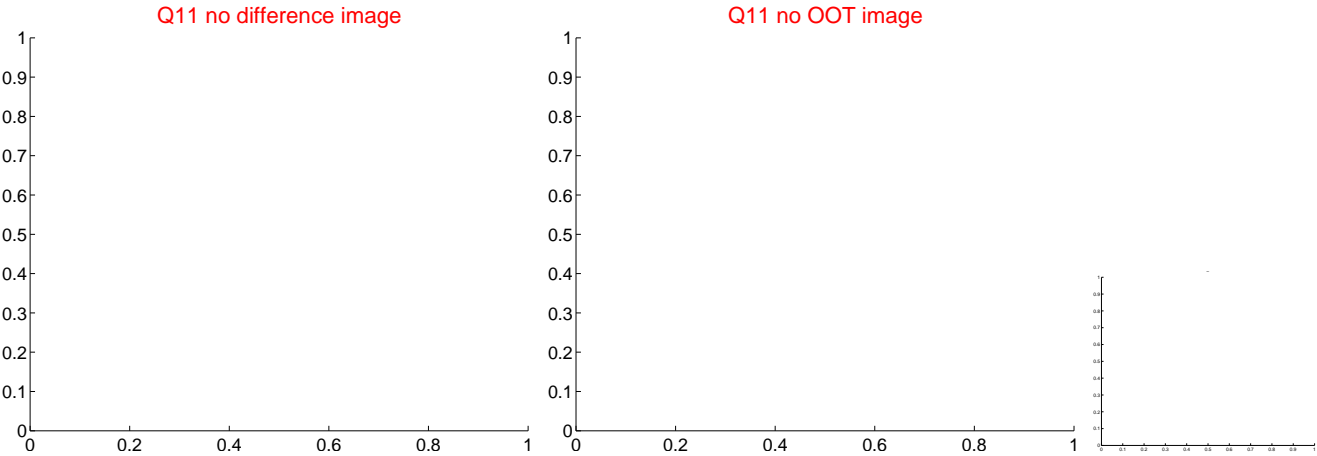
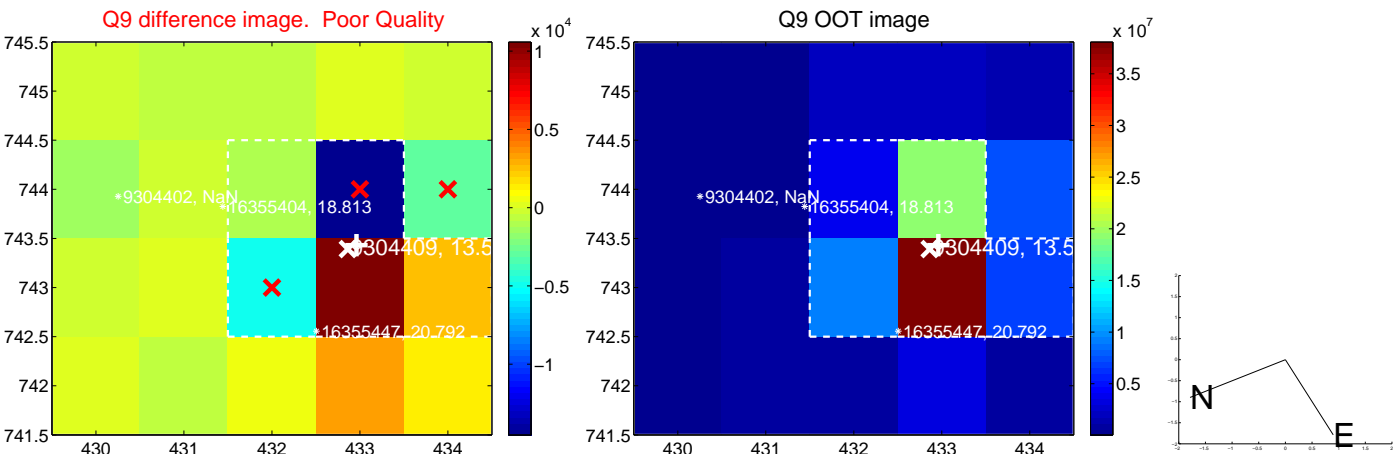
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



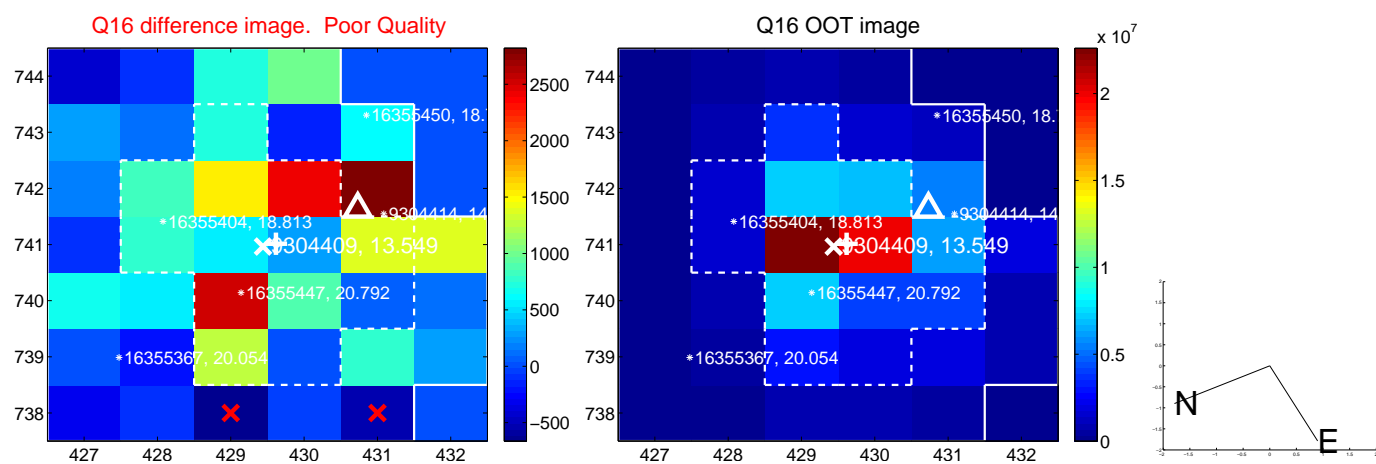
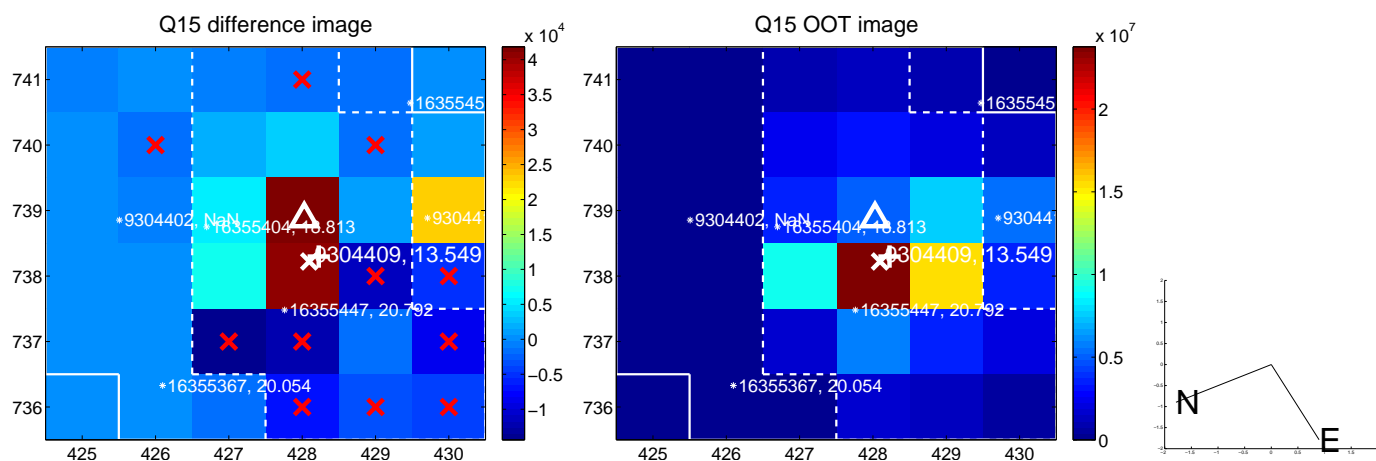
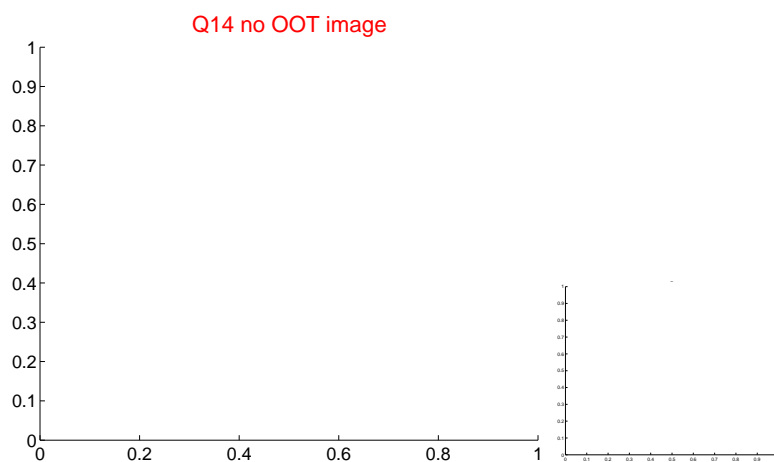
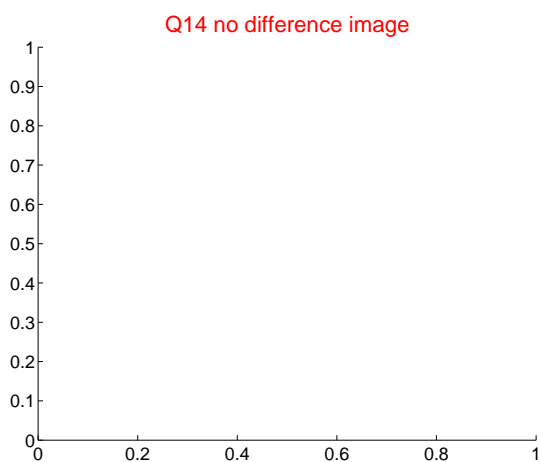
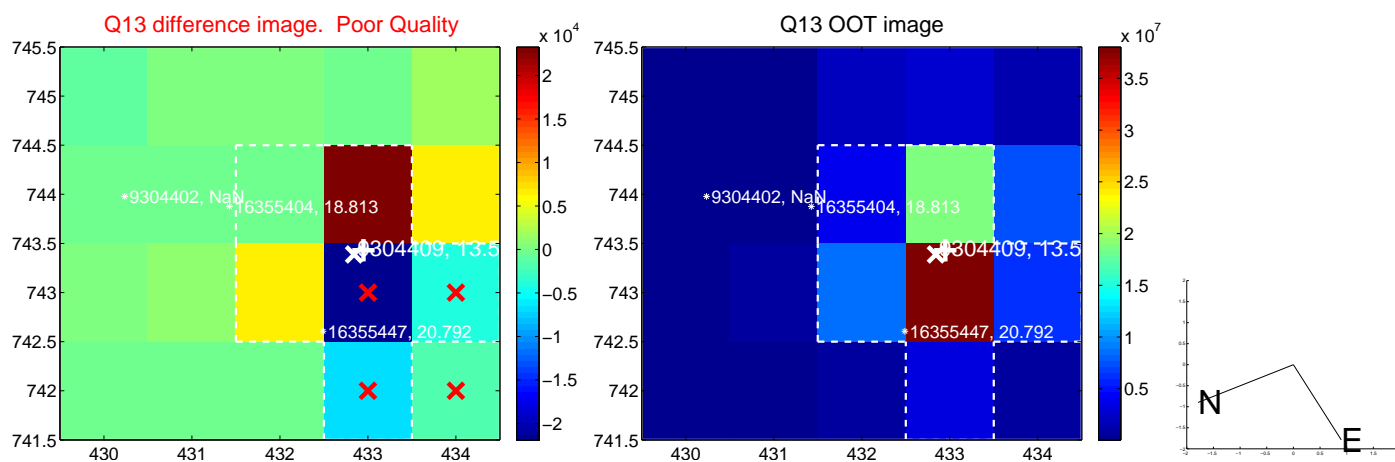
white ×: KIC target position; +: OOT centroid; △: difference centroid. red ✕: large negative pixel value.



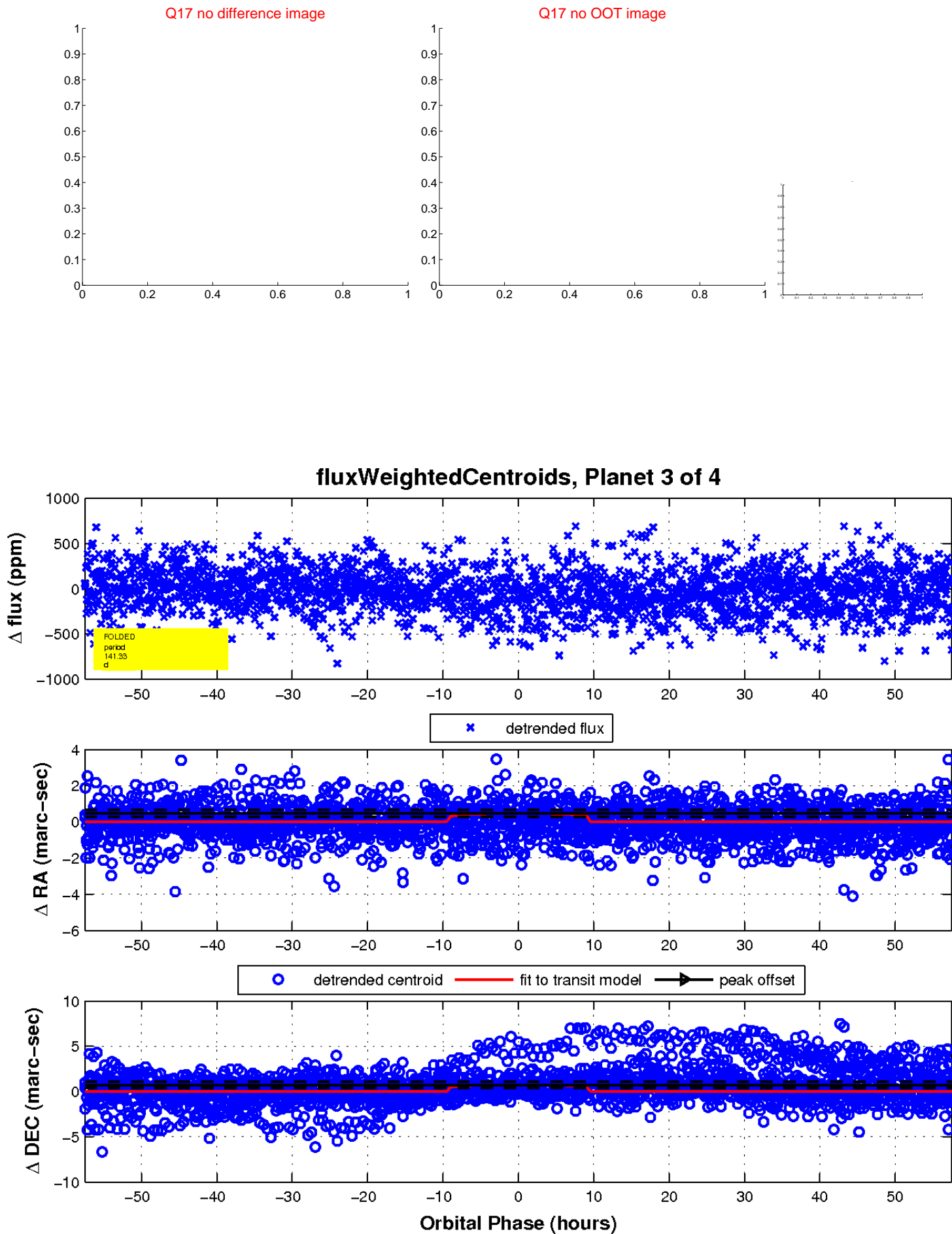
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

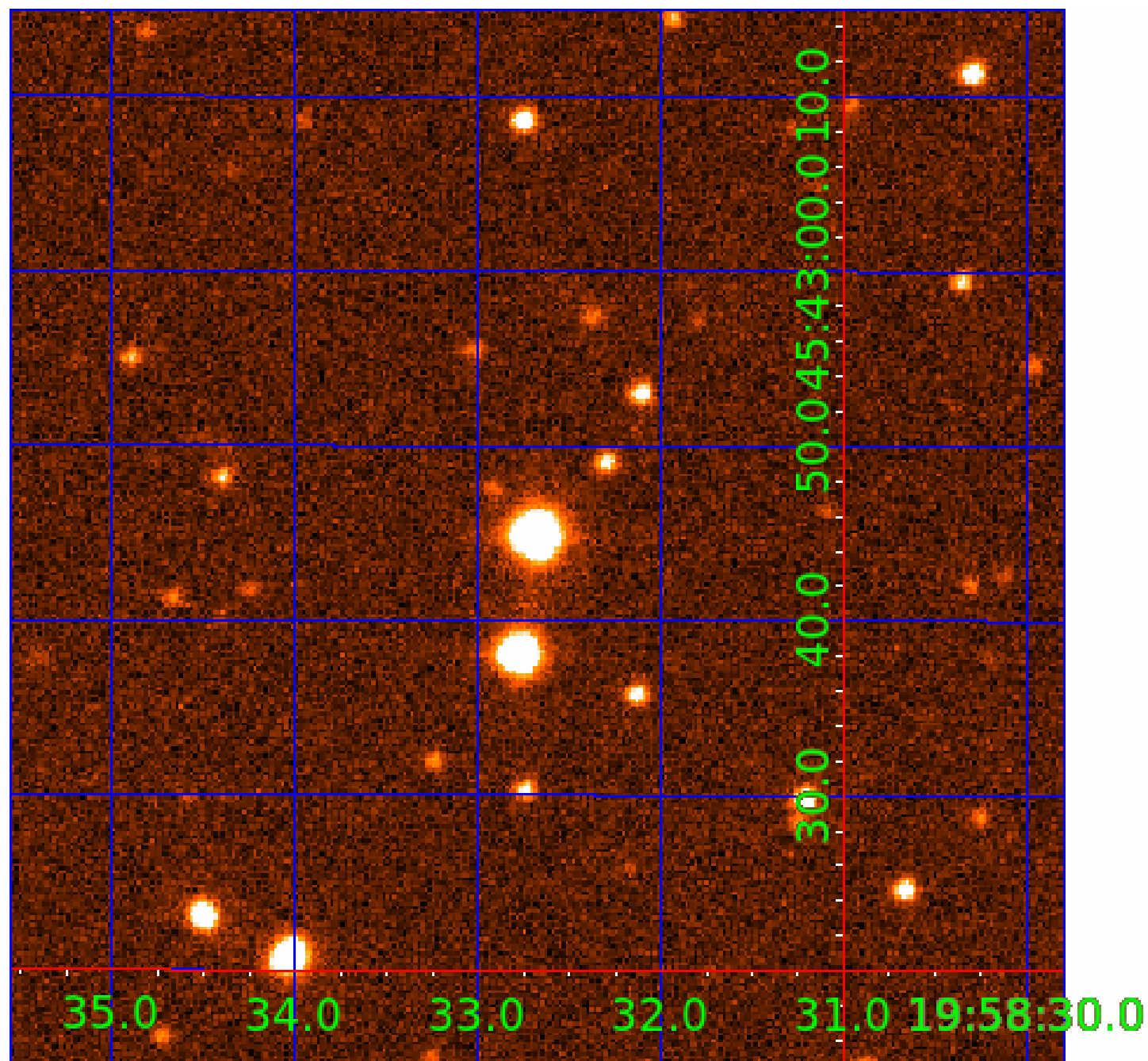


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 009304409

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009304409-01	OBS	No	1.888315	132.993878	28.3	10.913	8.4	10.6	4.43	7176	2.42	34239.60
009304409-02	OBS	No	198.471665	286.715017	447.2	13.782	16.2	10.5	4.43	7176	10.18	69.03
009304409-03	OBS	No	141.329794	259.181382	374.1	19.168	11.3	9.8	4.43	7176	9.04	108.56
009304409-04	OBS	No	95.706297	176.675854	452.0	1.985	7.9	8.1	4.43	7176	10.56	182.55

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009304409-01	OBS	FP	0.00	1	0	0	0	LPP_DV—LPP_ALT—CENT_KIC_POS
009304409-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL_SKYE—TRANS_GAPPED—LPP_DV—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009304409-03	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_ALT—INCONSISTENT_TRANS—CENT_FEW_DIFFS
009304409-04	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_KIC_POS

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

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

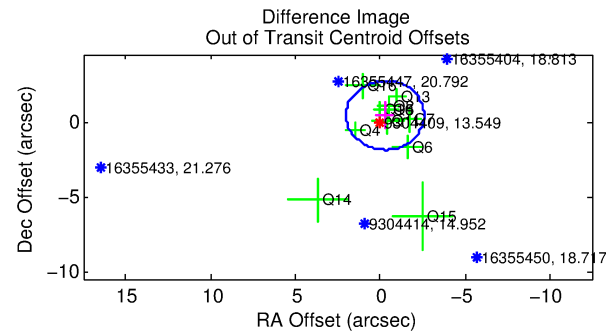
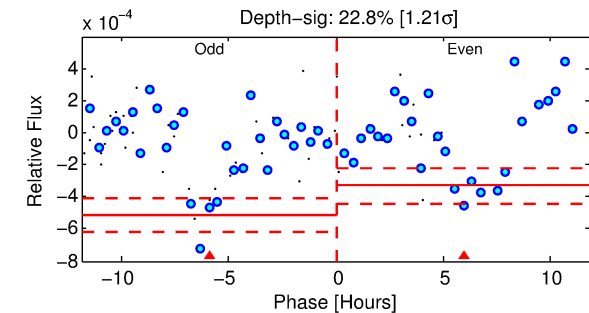
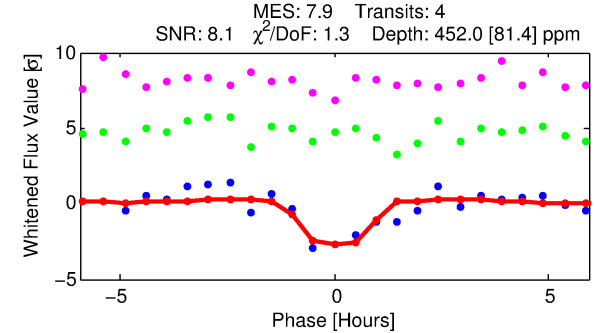
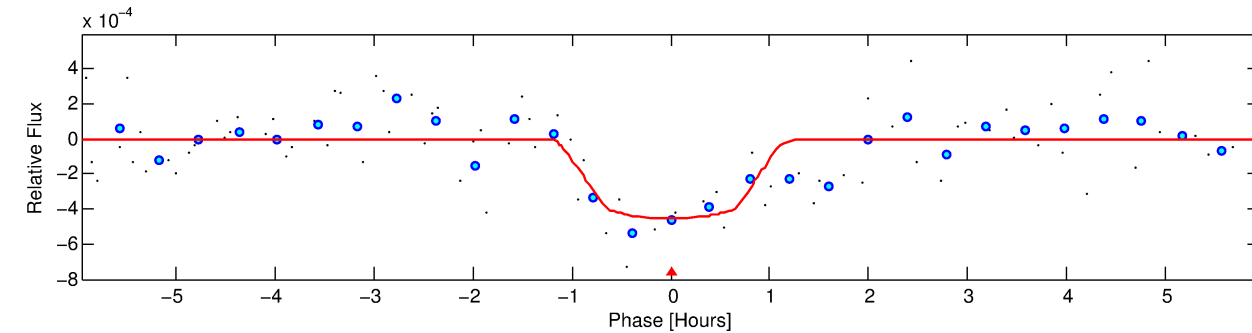
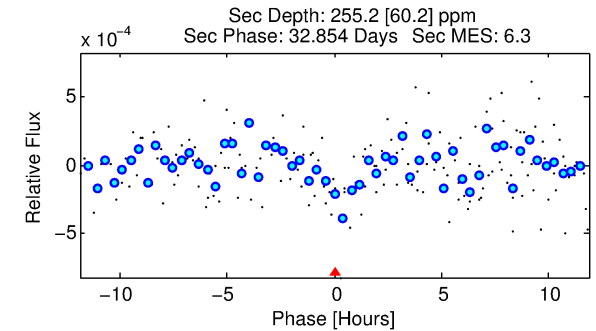
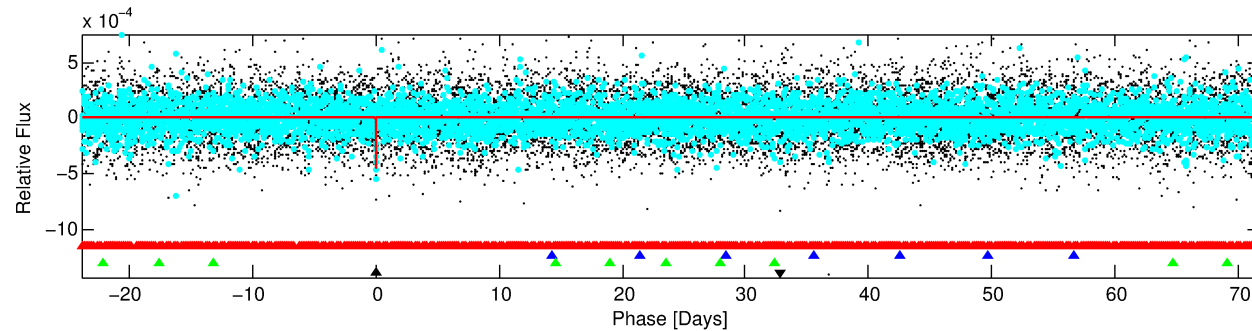
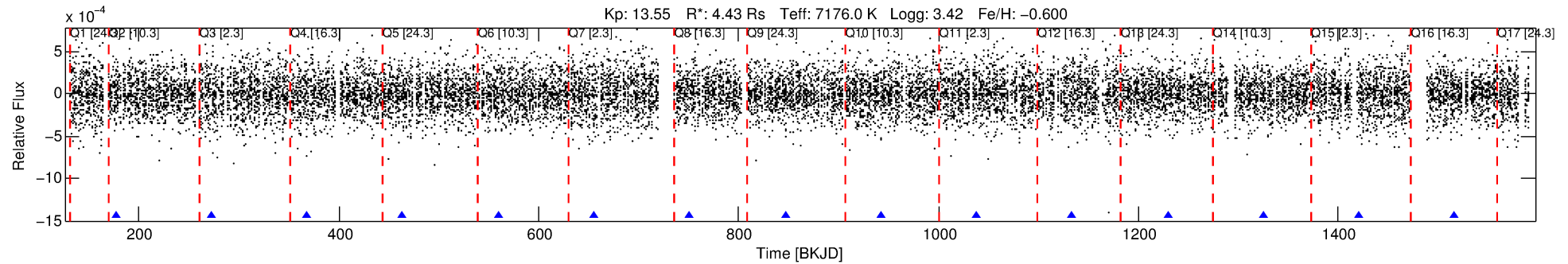
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 009304409-04

No Significant Match Found

# DV One-Page Summary

KIC: 9304409 Candidate: 4 of 4 Period: 95.706 d



## DV Fit Results:

Period = 95.70630 [0.00127] d  
Epoch = 176.6759 [0.0087] BKJD  
Rp/R\* = 0.0219 [0.0230]  
a/R\* = 215.06 [1375.39]  
b = 0.84 [2.29]  
Seff = 182.55 [229.01]  
Teq = 937 [294] K  
Rp = 10.56 [13.21] Re  
a = 0.5053 [0.3714] AU  
Ag = 321.21 [788.86] [0.41σ]  
Teffp = 6135 [3255] K [1.59σ]

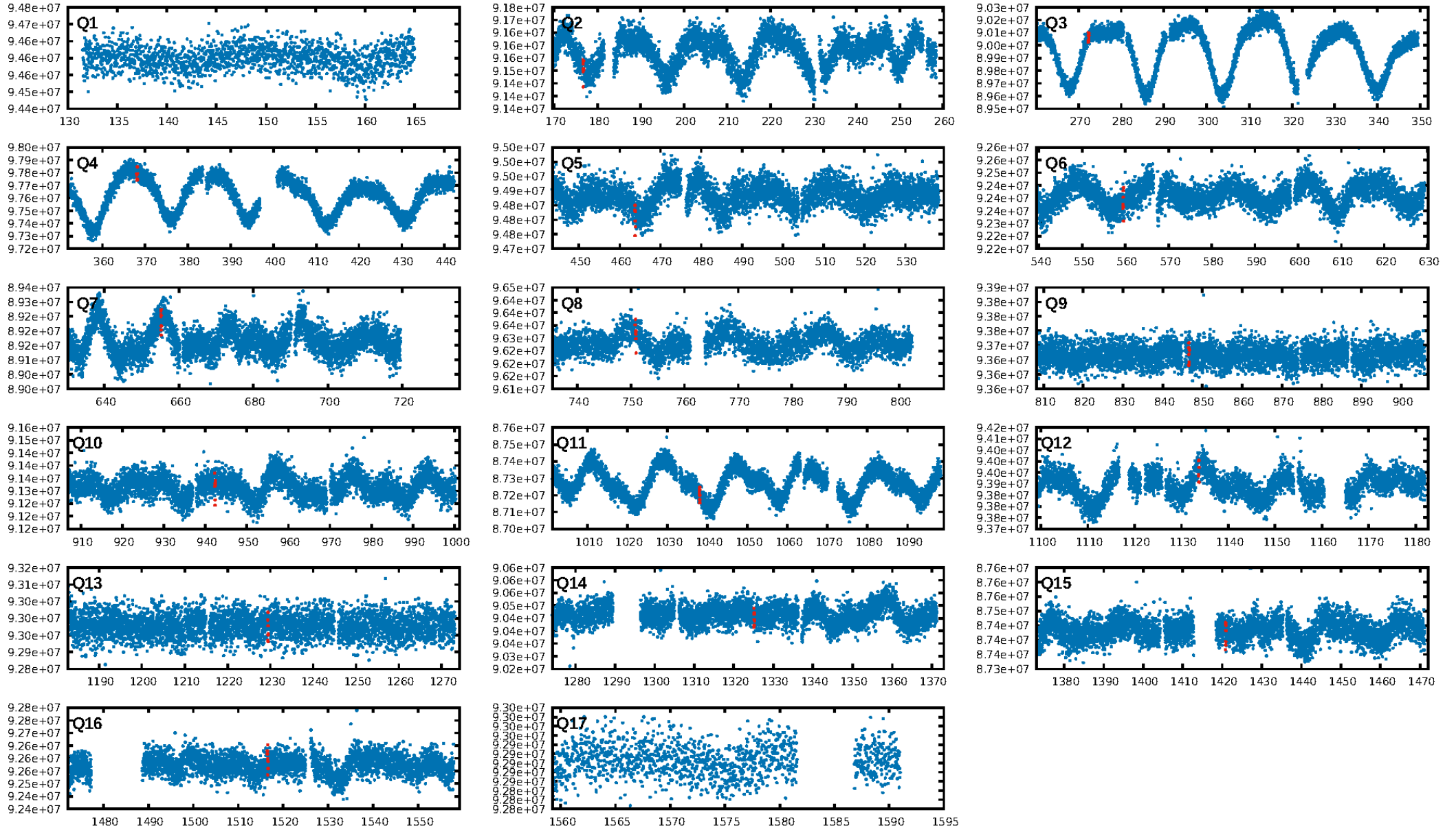
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [203.00σ]  
LongPeriod-sig: 100.0% [56.82σ]  
ModelChiSquare2-sig: 43.0%  
ModelChiSquareGof-sig: 96.7%  
**Bootstrap-pfa: 1.19e-08**  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: -3.213  
Centroid-sig: 6.4%  
Centroid-so: 1.181 arcsec [1.36σ]  
OotOffset-rm: 0.516 arcsec [0.67σ]  
KicOffset-rm: 0.233 arcsec [0.38σ]  
OotOffset-st: 4/3/2/2 [11]  
KicOffset-st: 4/3/2/2 [11]  
DiffImageQuality-fgm: 0.45 [5/11]  
DiffImageOverlap-fno: 0.50 [7/14]

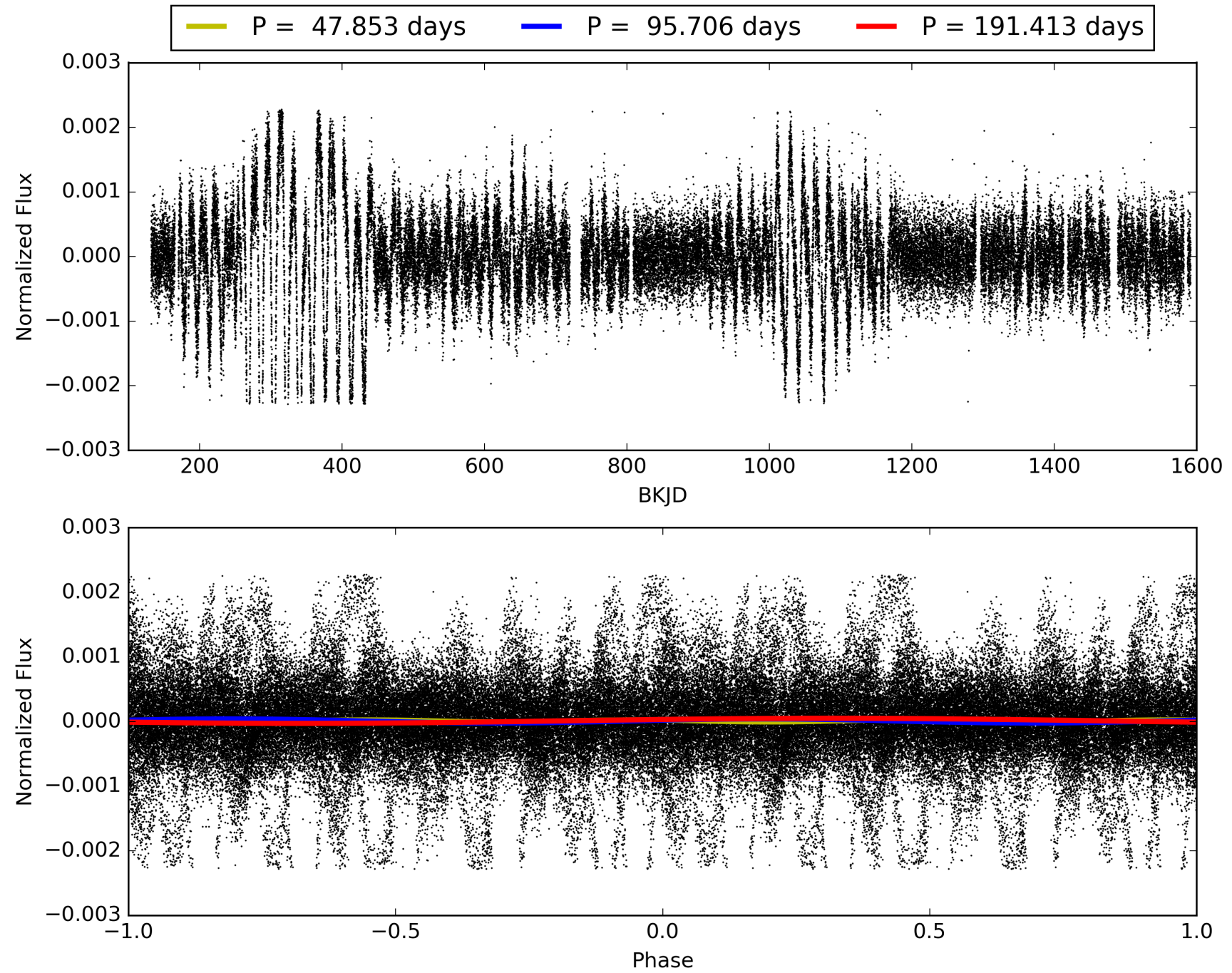
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 13:52:37 Z

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

# TCE 009304409-04, PDC Light Curves

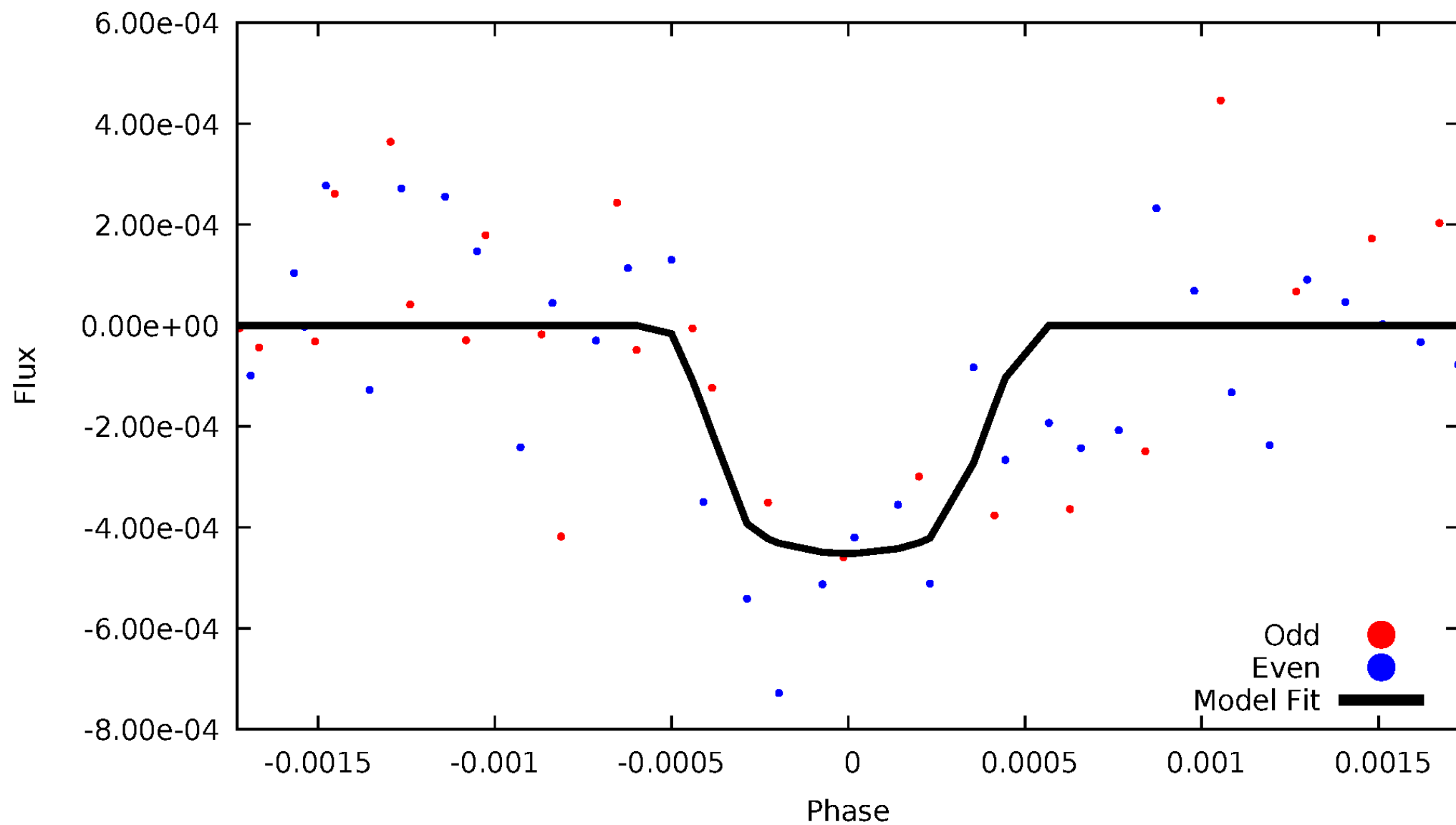


TCE 009304409-04



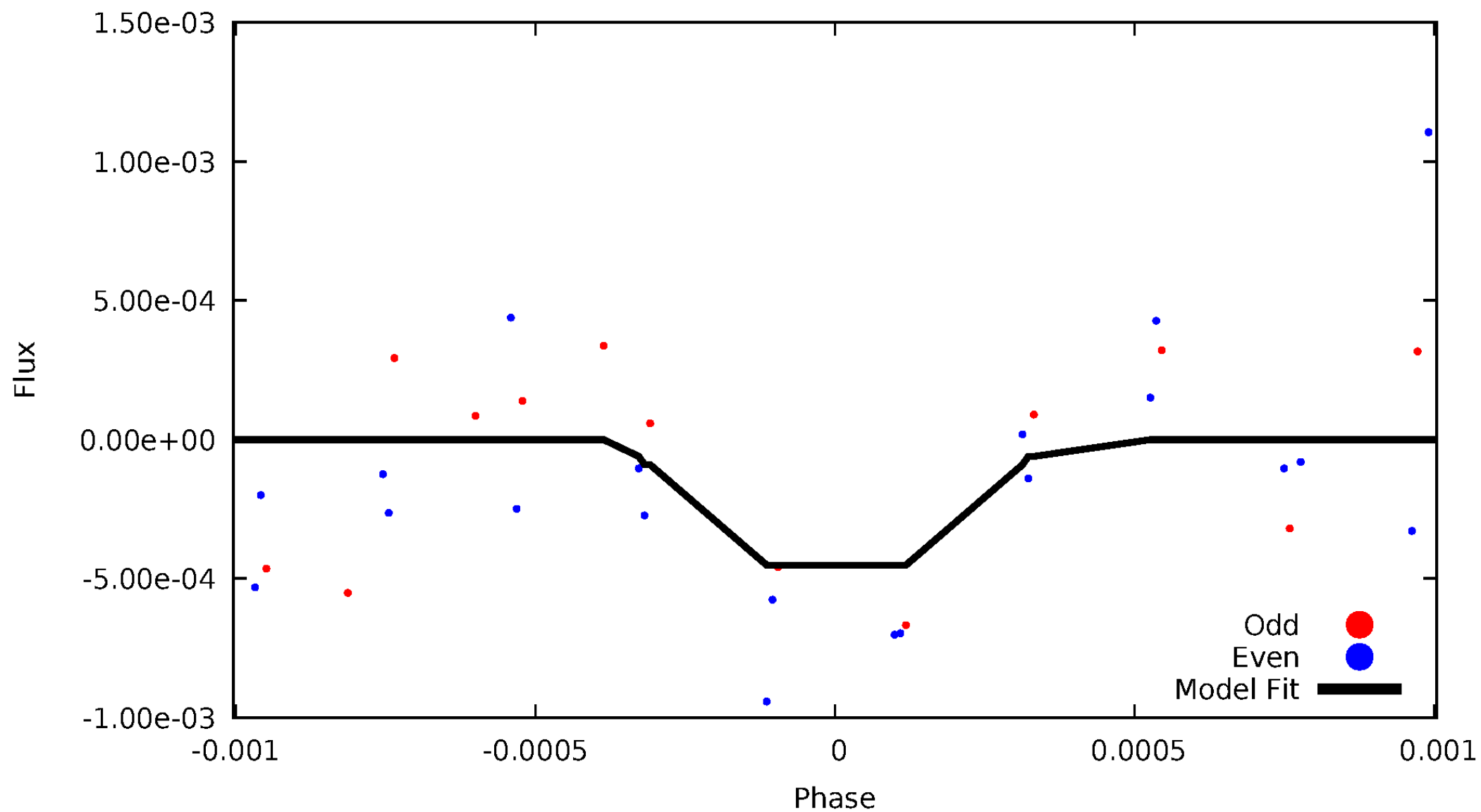
# DV Odd/Even

TCE 009304409-04



# ALT Odd/Even

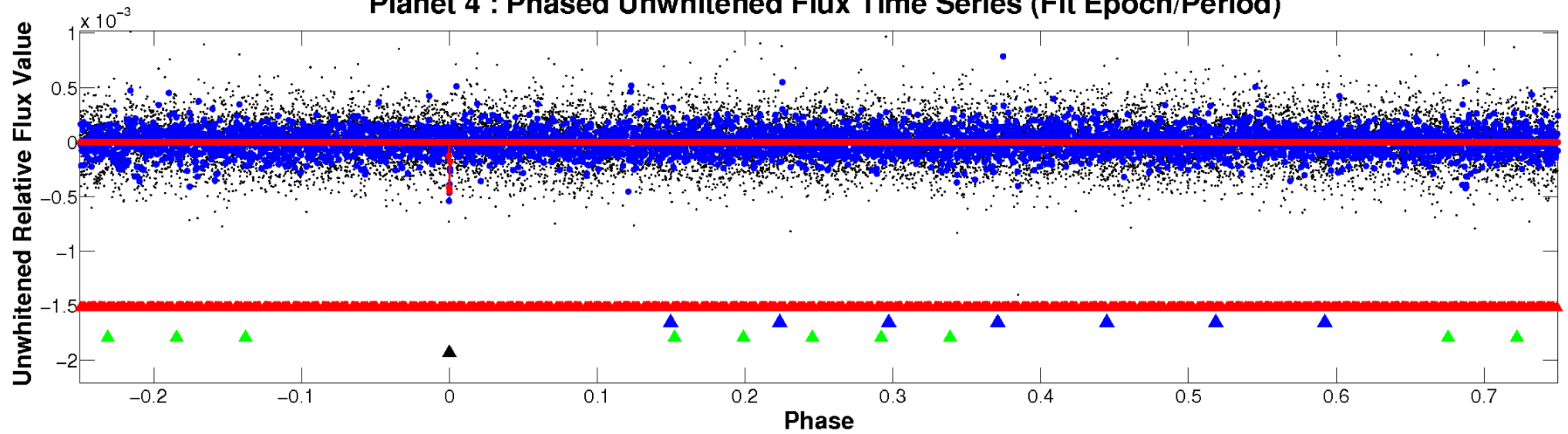
TCE 009304409-04



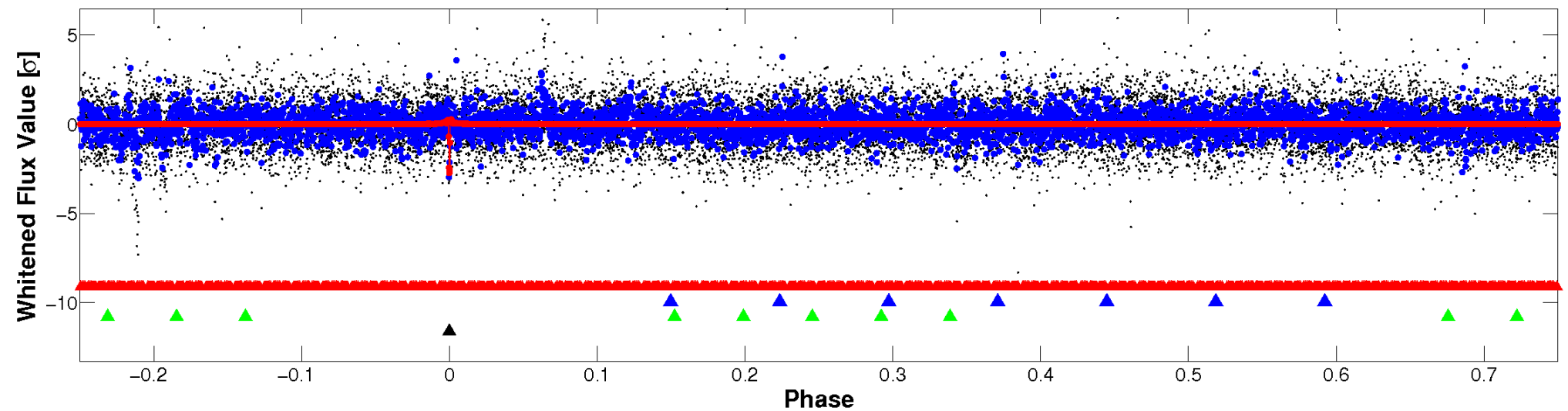


# Non-Whitened Vs. Whitened Light Curve

## Planet 4 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

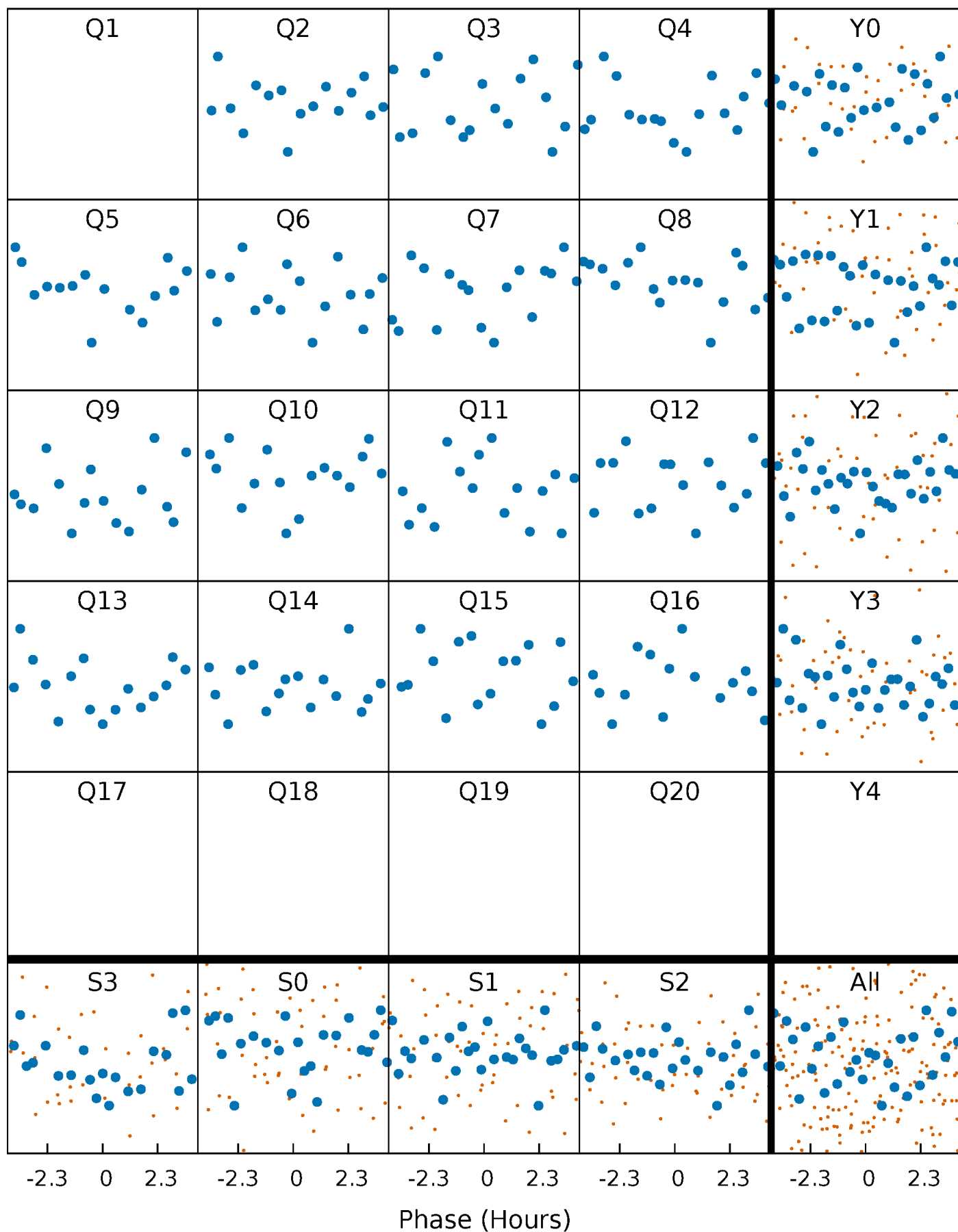


## Planet 4 : Phased Whitened Flux Time Series (Fit Epoch/Period)



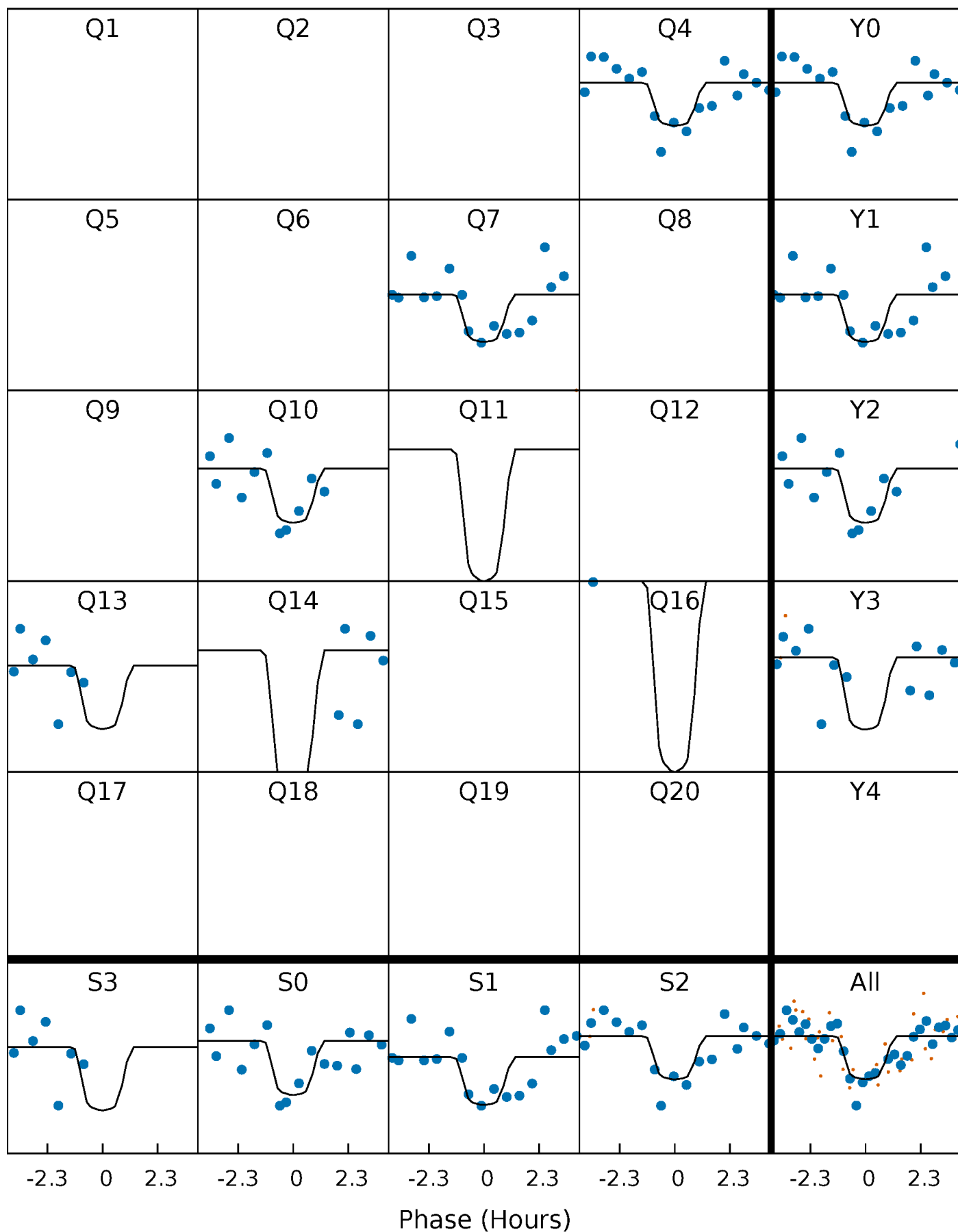
# PDC Quarter-Phased Transit Curves

TCE 009304409-04   P= 95.706297 Days    $T_0=176.675854$  (BKJD)



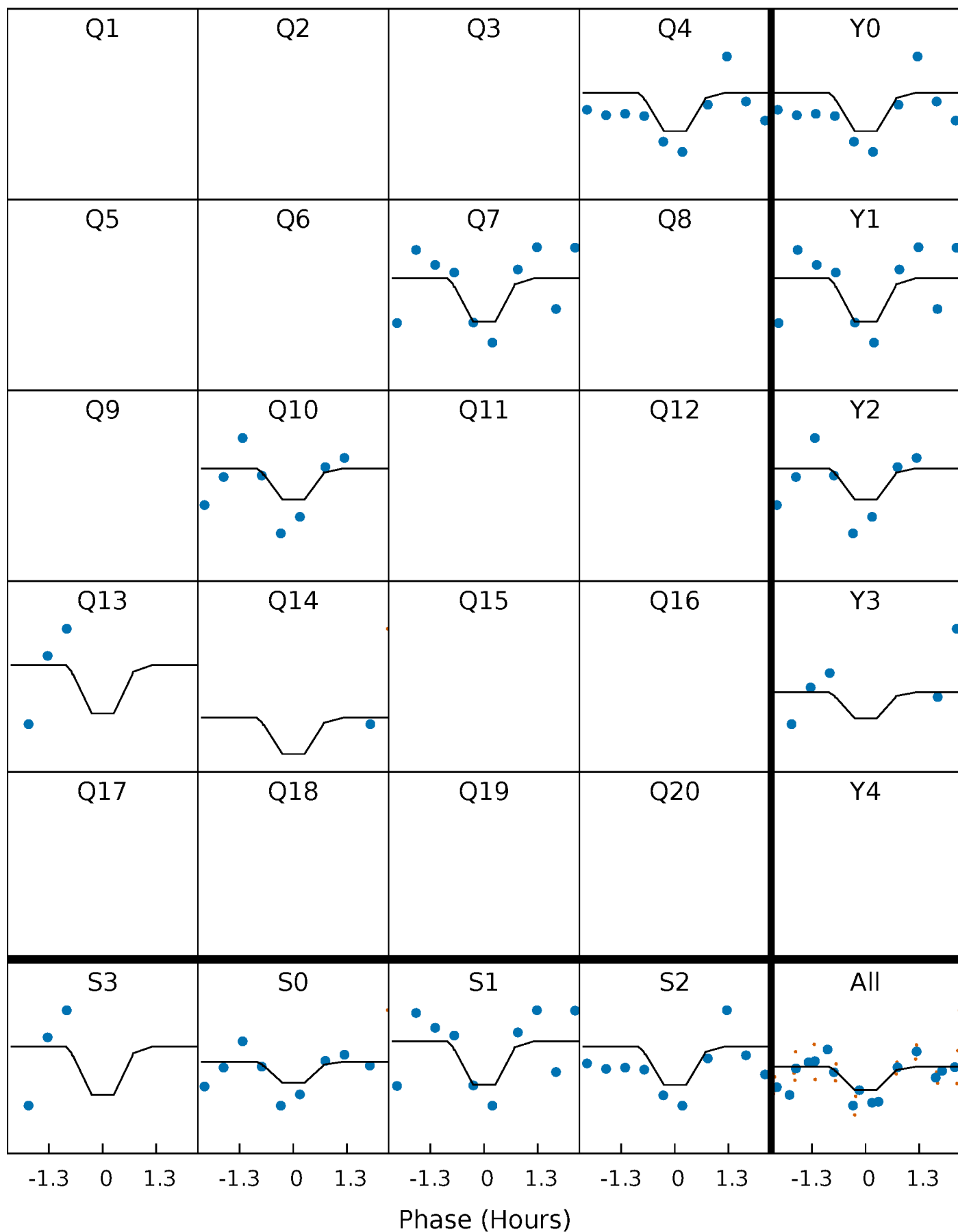
# DV Quarter-Phased Transit Curves

TCE 009304409-04 P= 95.706297 Days  $T_0=176.675854$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

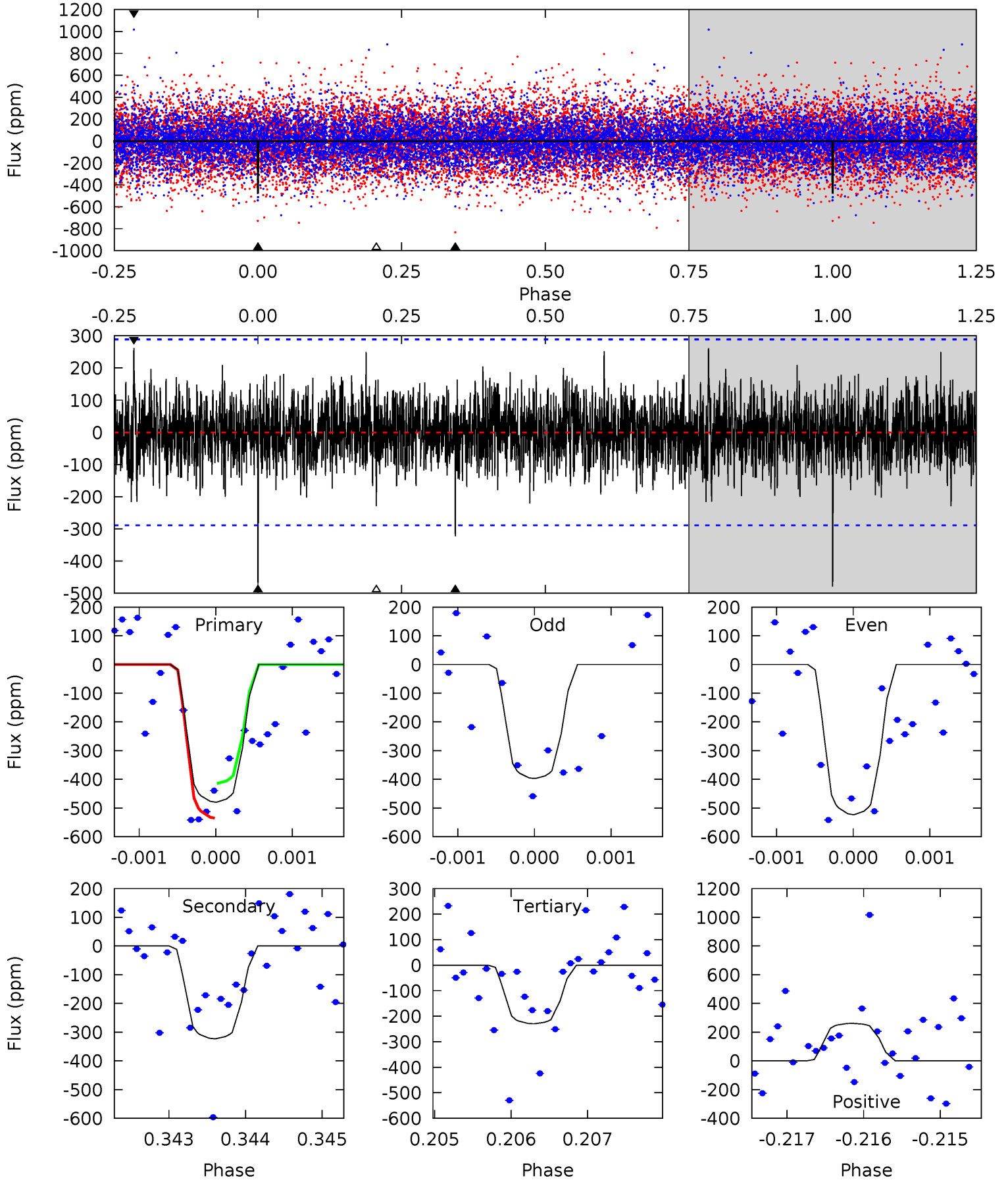
TCE 009304409-04 P= 95.705015 Days  $T_0=176.690033$  (BKJD)



# DV Model-Shift Uniqueness Test

009304409-04, P = 95.706297 Days, E = 80.969557 Days

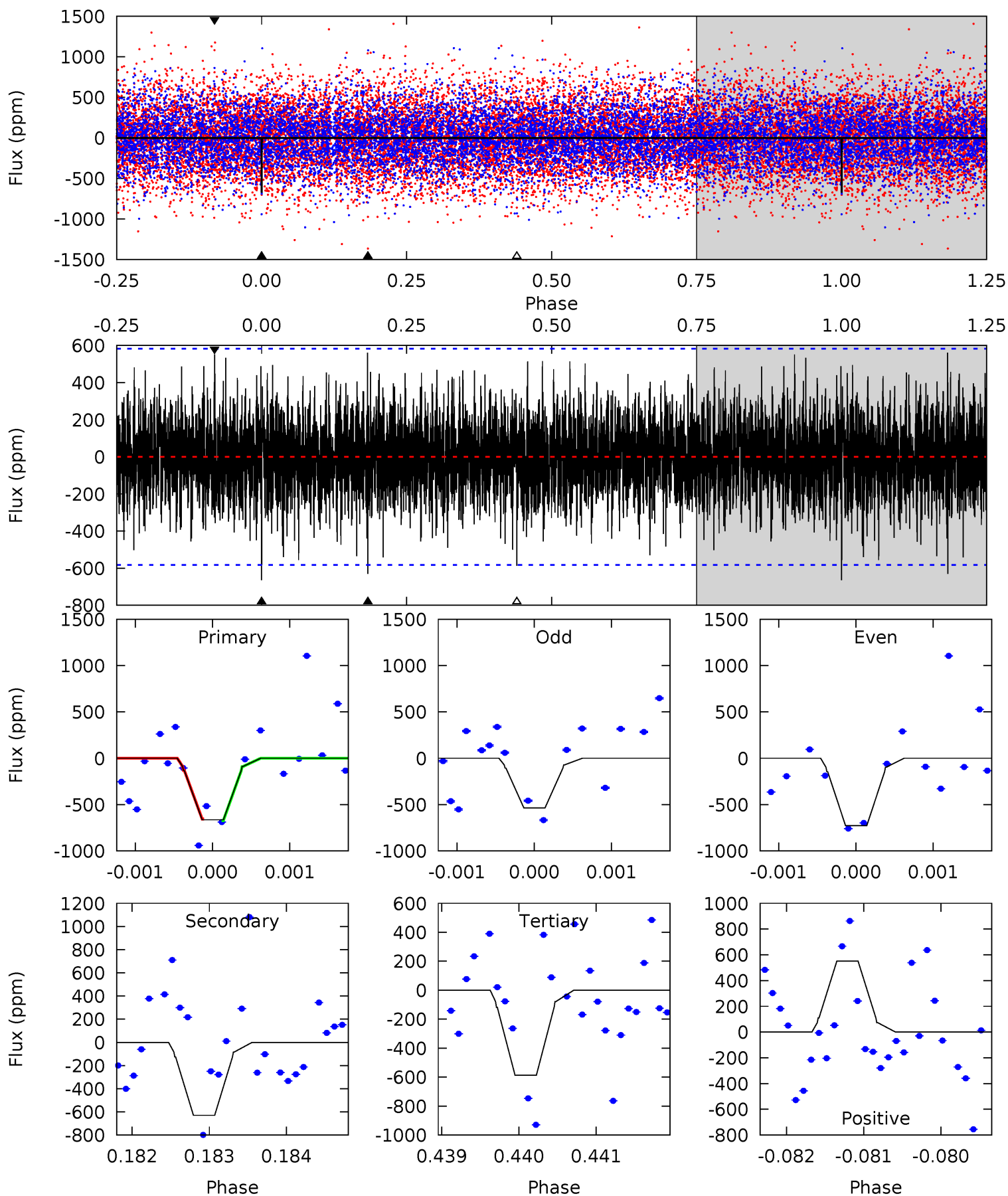
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
9.05	6.09	4.33	4.93	5.45	3.29	1.30	4.72	4.11	1.76	1.15	1.13	1.08	0.35	1.14



# Alt Model-Shift Uniqueness Test

009304409-04, P = 95.705015 Days, E = 80.985018 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
6.25	5.92	5.53	5.18	5.48	3.34	1.48	0.72	1.07	0.40	0.74	0.89	1.02	0.46	0.08



### Stellar Parameters For KIC 009304409

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$7176^{+225}_{-275}$	$3.419^{+0.756}_{-0.084}$	$-0.600^{+0.300}_{-0.250}$	$4.429^{+0.333}_{-2.998}$	$1.876^{+0.133}_{-0.752}$	$0.030^{+0.559}_{-0.008}$
	+3%/-4%	+22%/-2%	+50%/-42%	+8%/-68%	+7%/-40%	+1840%/-27%
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 009304409-04 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-323 \pm 53$	$11.31^{+9.10}_{-6.84}$	$1268^{+83}_{-218}$	$5672^{+3562}_{-1125}$	$338^{+1889}_{-234}$
Alt.	$-630 \pm 106$	$10.44^{+9.98}_{-6.55}$	$1269^{+80}_{-213}$	$6911^{+6814}_{-1735}$	$764^{+4466}_{-562}$

$T_{\text{max}}$  = 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

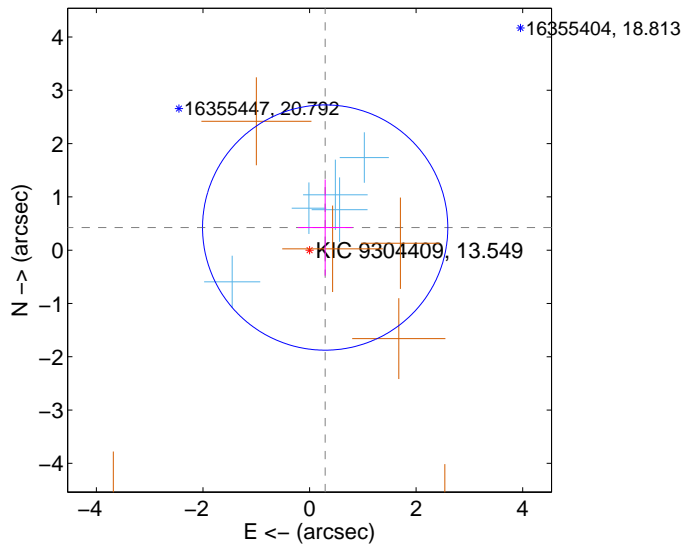
Supplemental centroid analysis for 009304409-04. Kepler magnitude: 13.55. Transit SNR 8.09

There are 5 quarters with good PRF difference image offsets

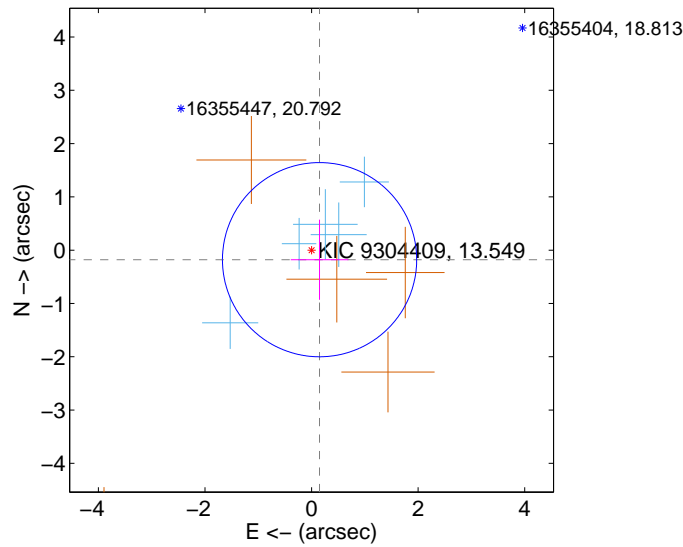
The direct PRF centroid is offset from the target star catalog position by about 0.74 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.516 \pm 0.767$	0.67	$-0.293 \pm 0.511$	$0.424 \pm 0.903$
PRF-fit source offset from KIC position	$0.233 \pm 0.607$	0.38	$-0.150 \pm 0.541$	$-0.178 \pm 0.752$
photometric centroid source offset	$1.18 \pm 0.87$	1.36	$1.18 \pm 0.87$	$0.02 \pm 0.91$

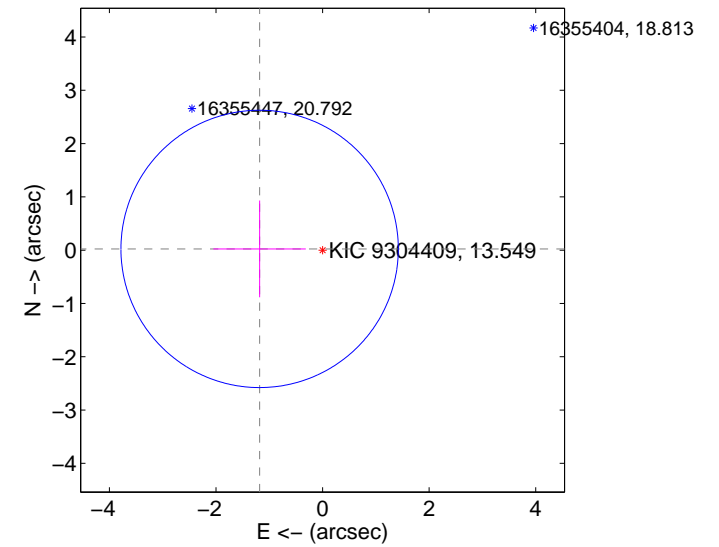
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

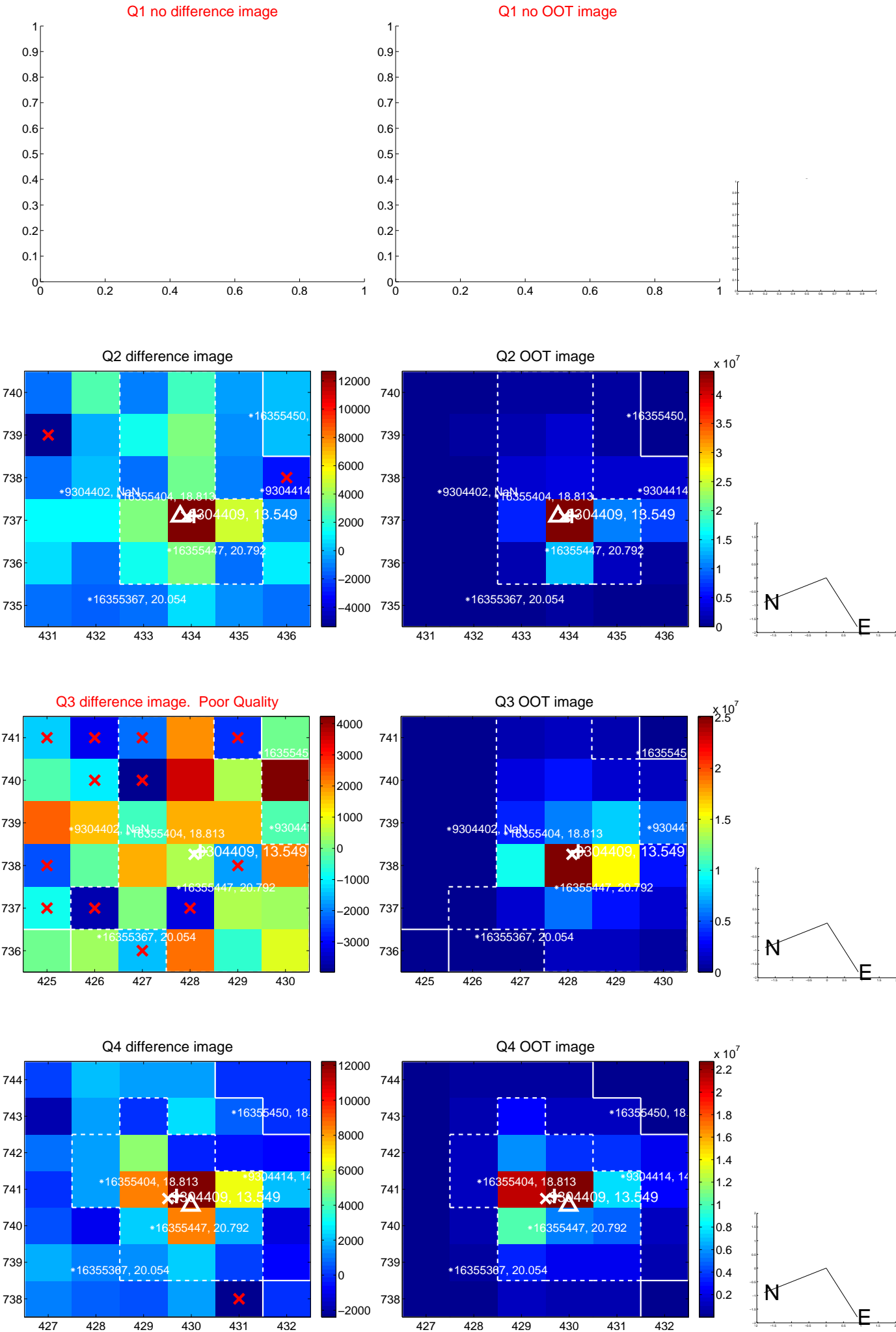


offset from photometric centroids

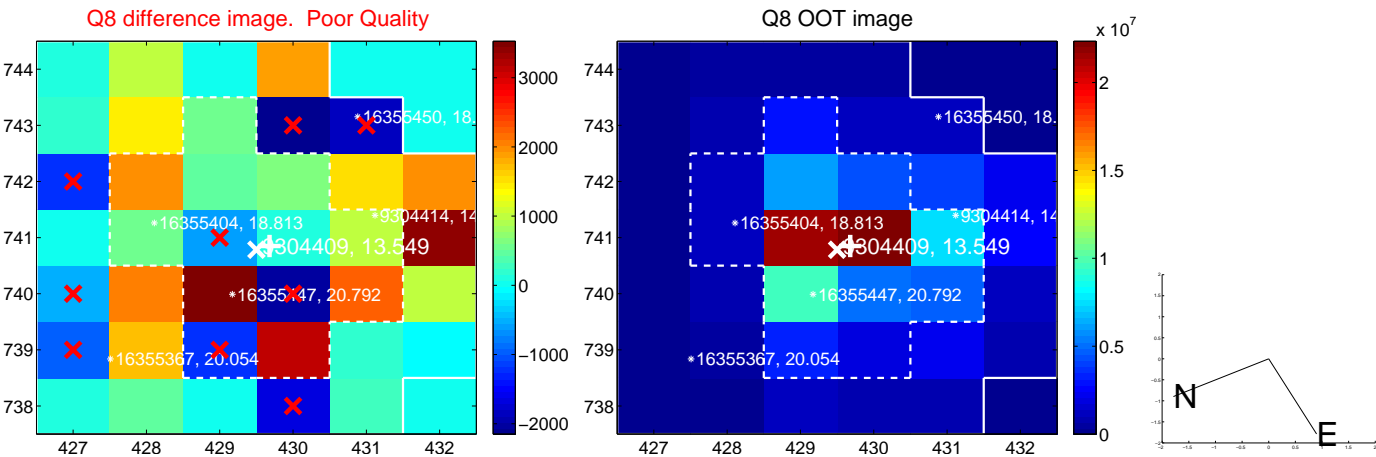
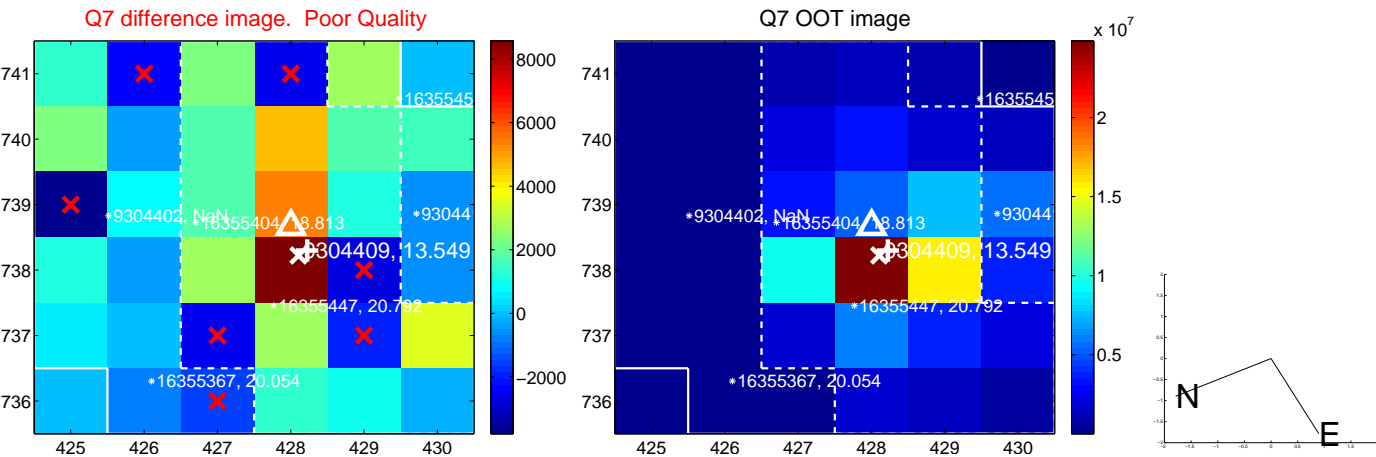
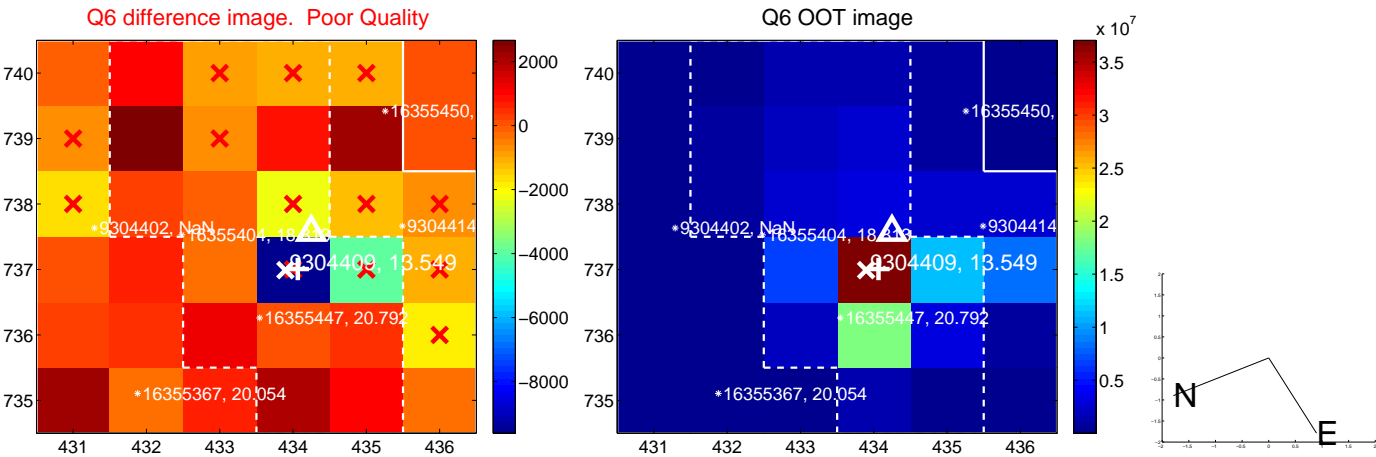
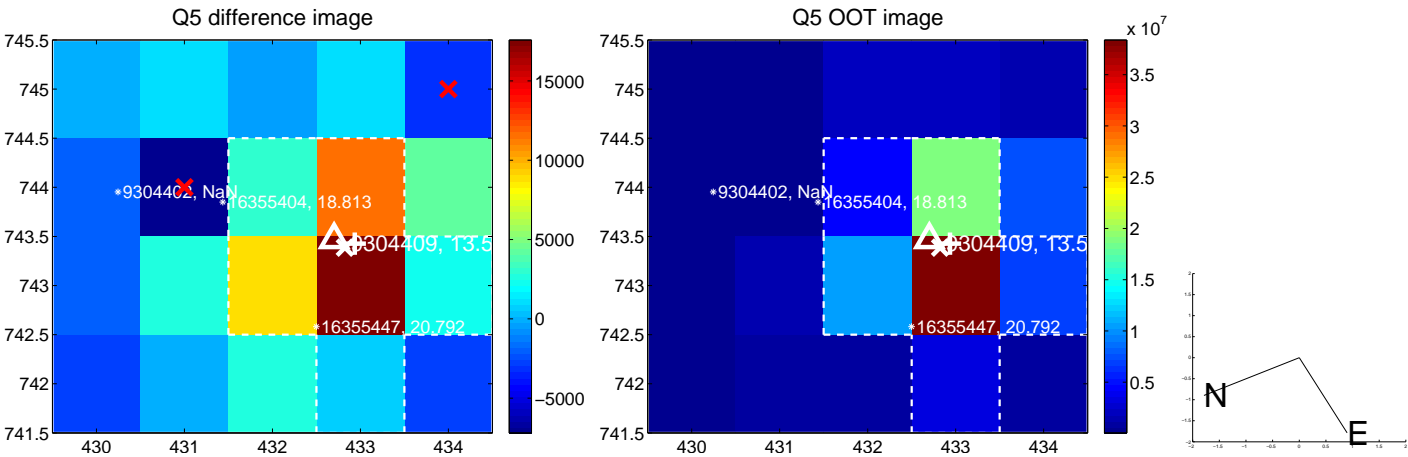


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

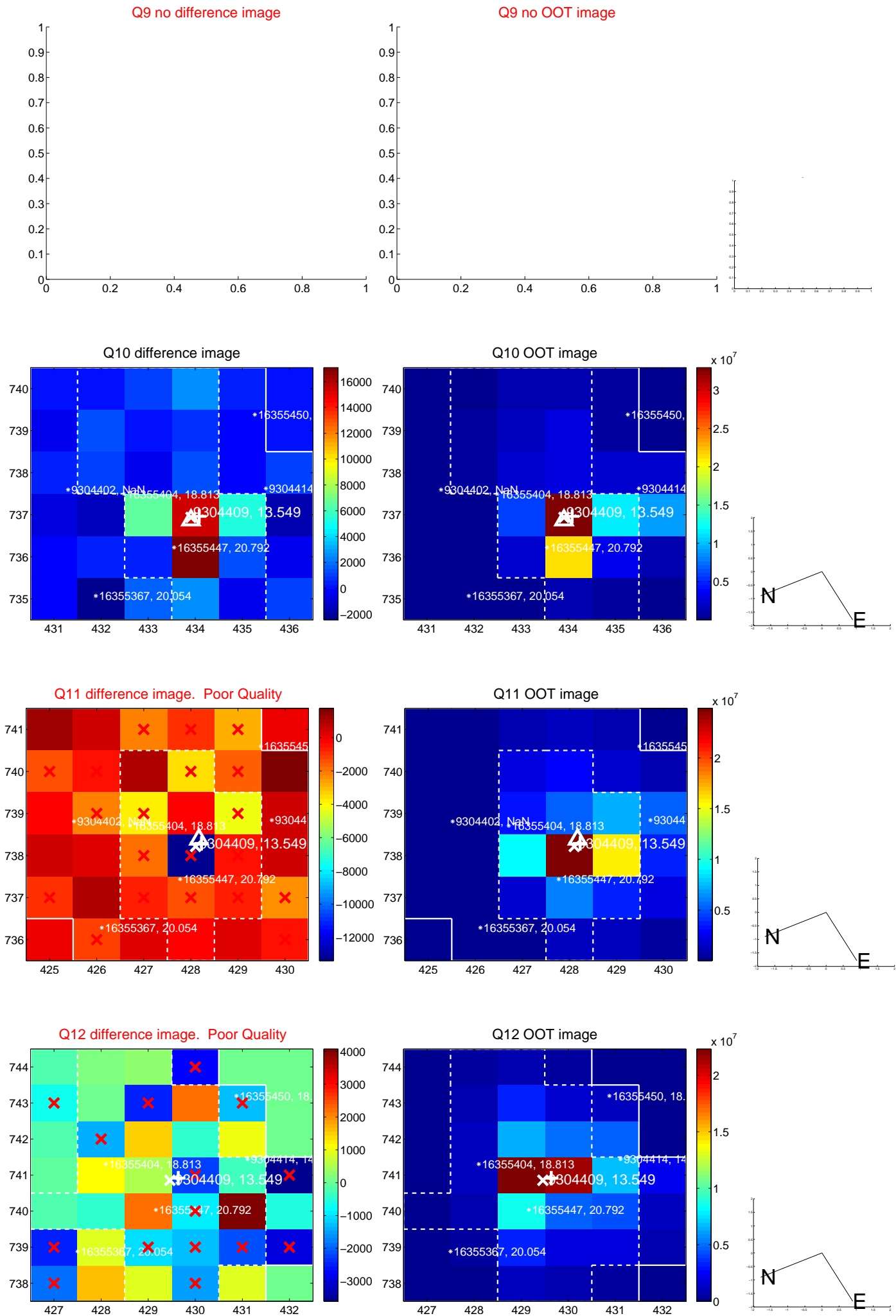
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



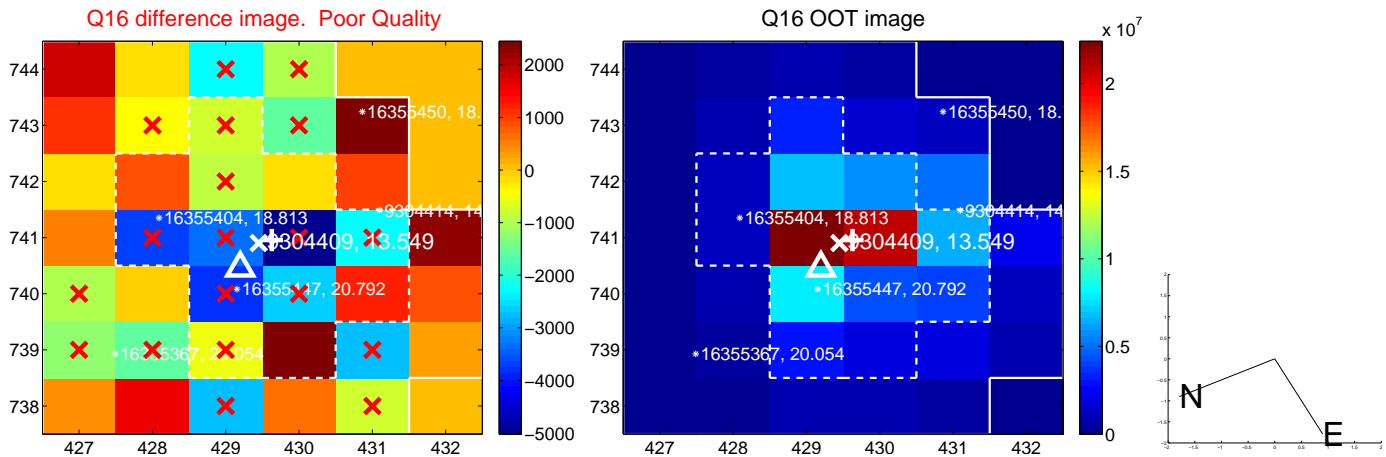
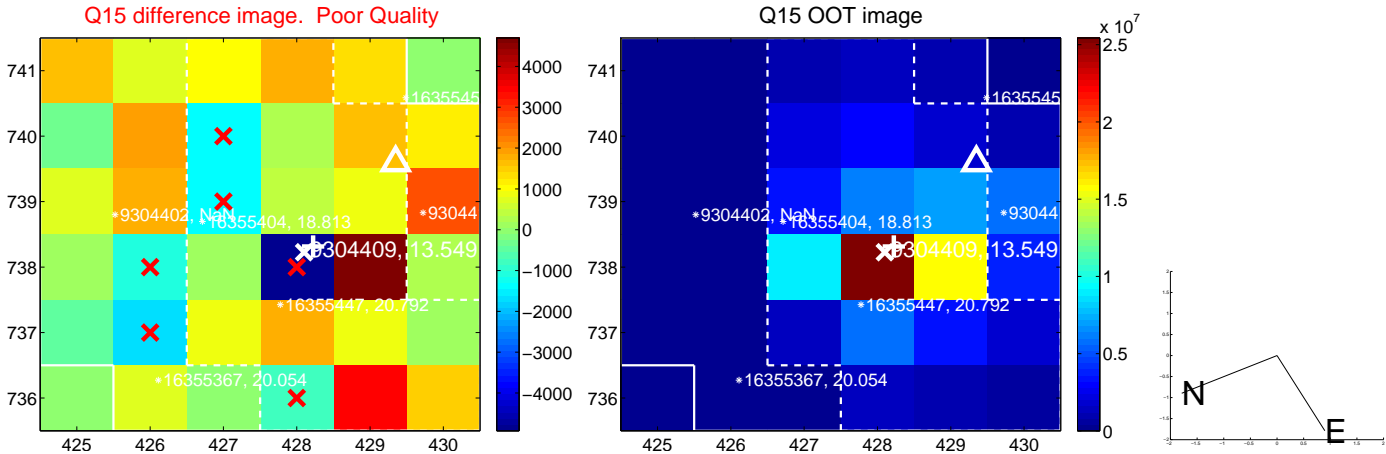
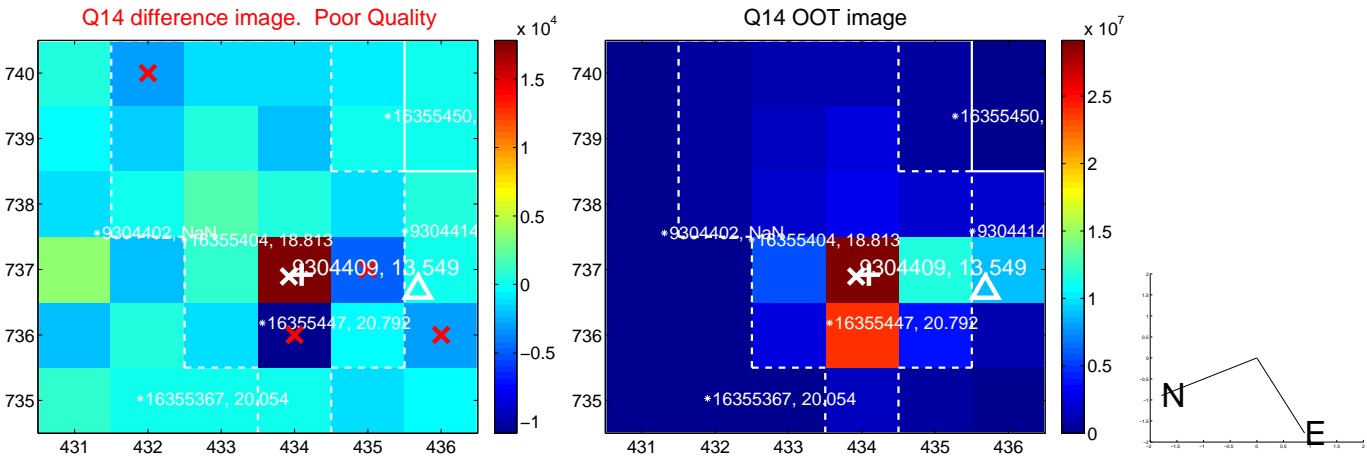
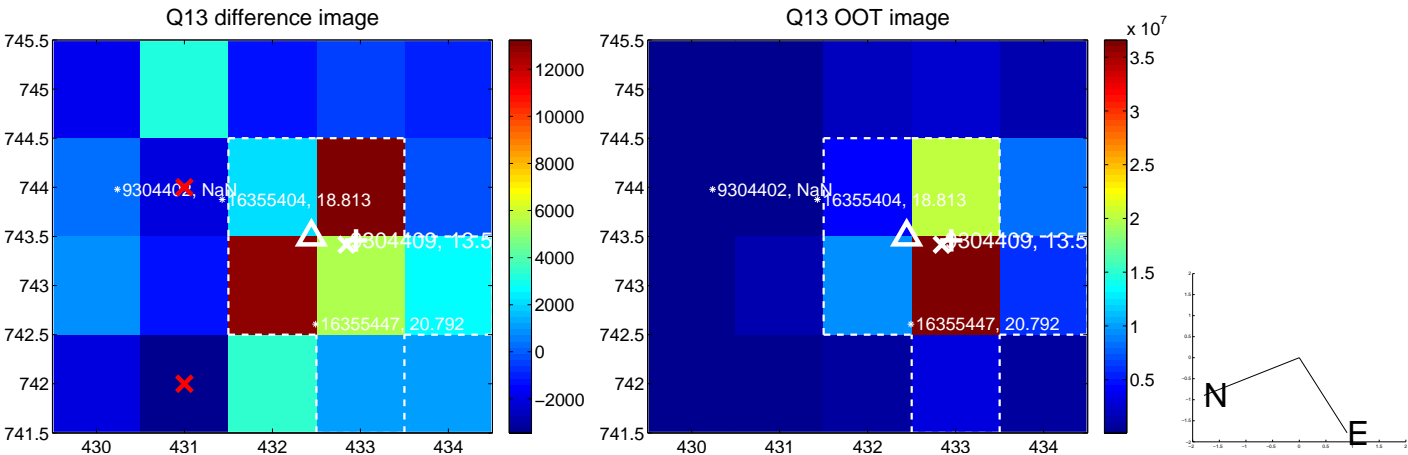
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



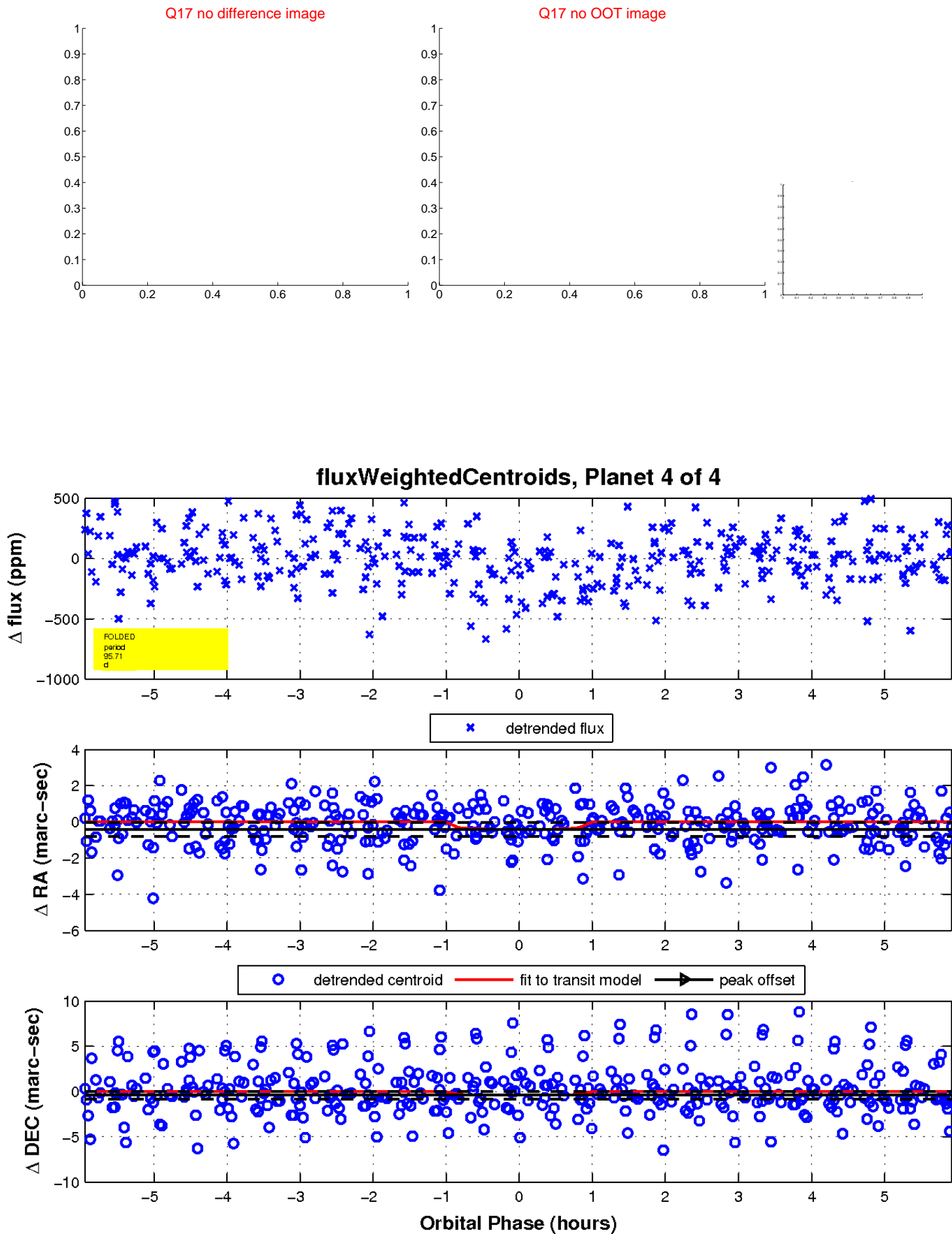
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

