

# KIC 009821454

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009821454-01	OBS	1529.01	17.977390	147.753447	251.4	6.354	20.9	22.7	1.01	6296	2.97	75.73
009821454-02	OBS	1529.02	11.869757	137.698547	91.1	5.977	12.8	12.7	1.01	6296	1.12	131.71

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009821454-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009821454-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT

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

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

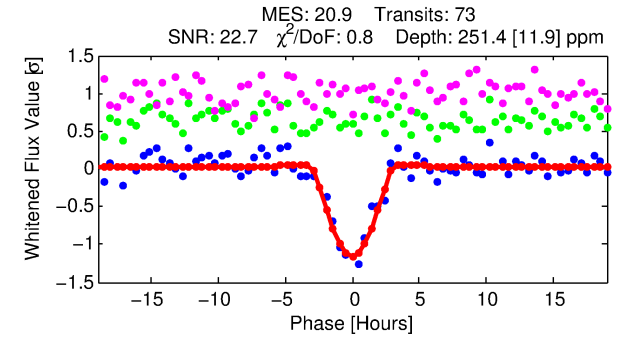
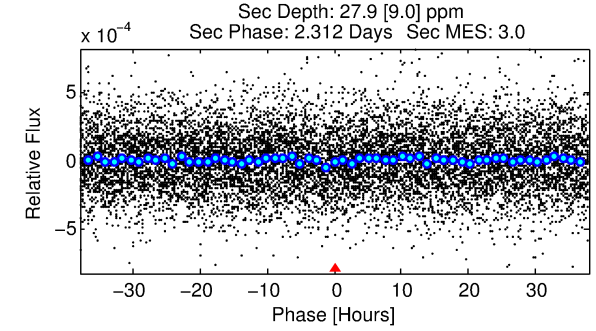
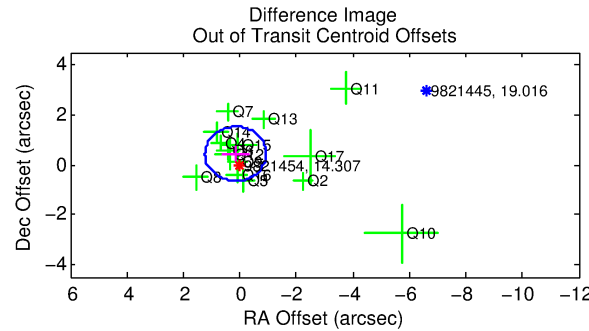
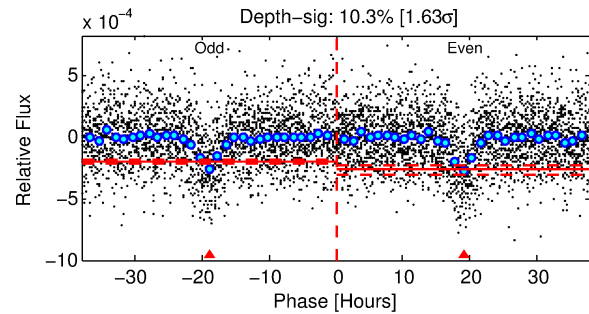
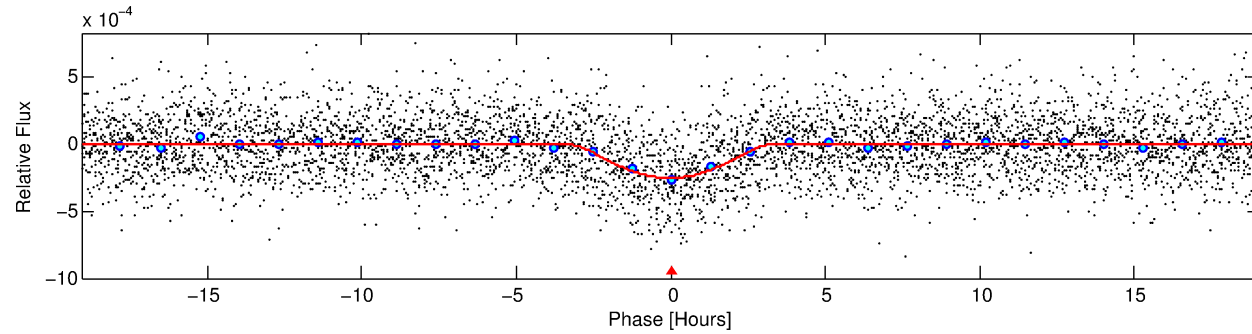
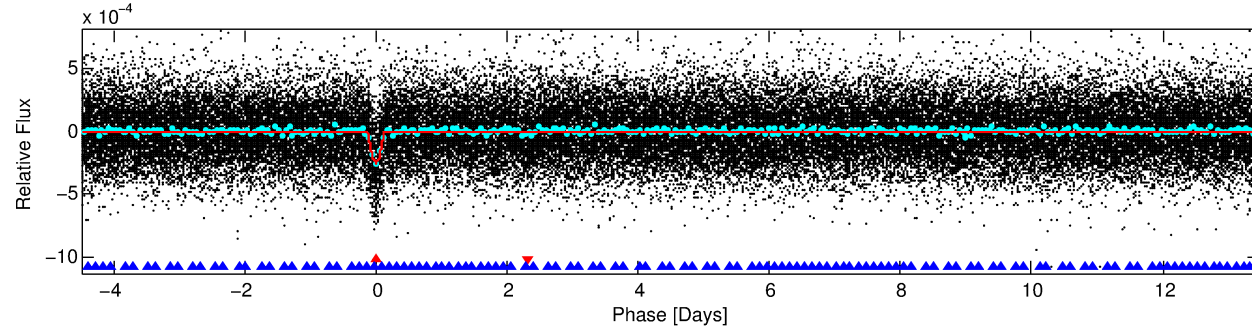
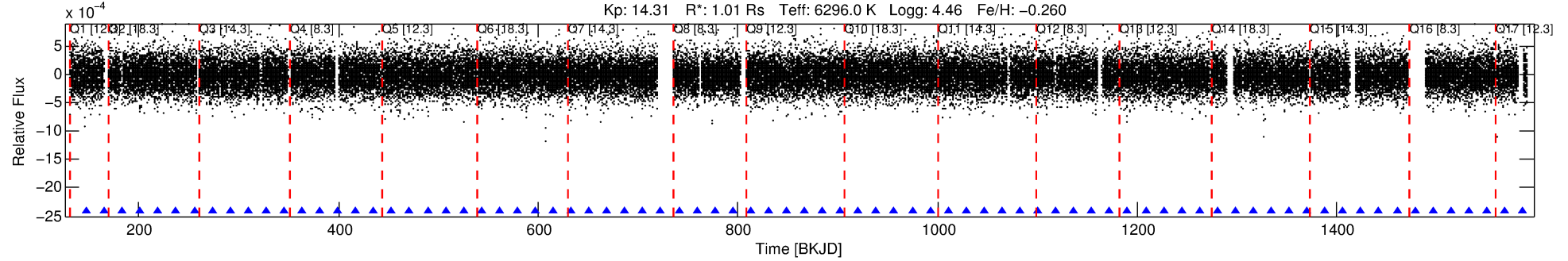
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009821454-01

No Significant Match Found

# DV One-Page Summary

KIC: 9821454 Candidate: 1 of 2 Period: 17.977 d  
KOI: K01529.01 Name: Kepler-59c Corr: 0.884



## DV Fit Results:

Period = 17.97739 [0.00015] d  
Epoch = 147.7534 [0.0069] BKJD  
Rp/R\* = 0.0270 [0.0344]  
a/R\* = 5.39 [1.91]  
b = 1.00 [0.05]  
Seff = 75.73 [31.69]  
Teq = 752 [79] K  
Rp = 2.97 [3.89] Re  
a = 0.1372 [0.0367] AU  
Ag = 32.88 [85.42] [0.37σ]  
Teffp = 2785 [1790] K [1.13σ]

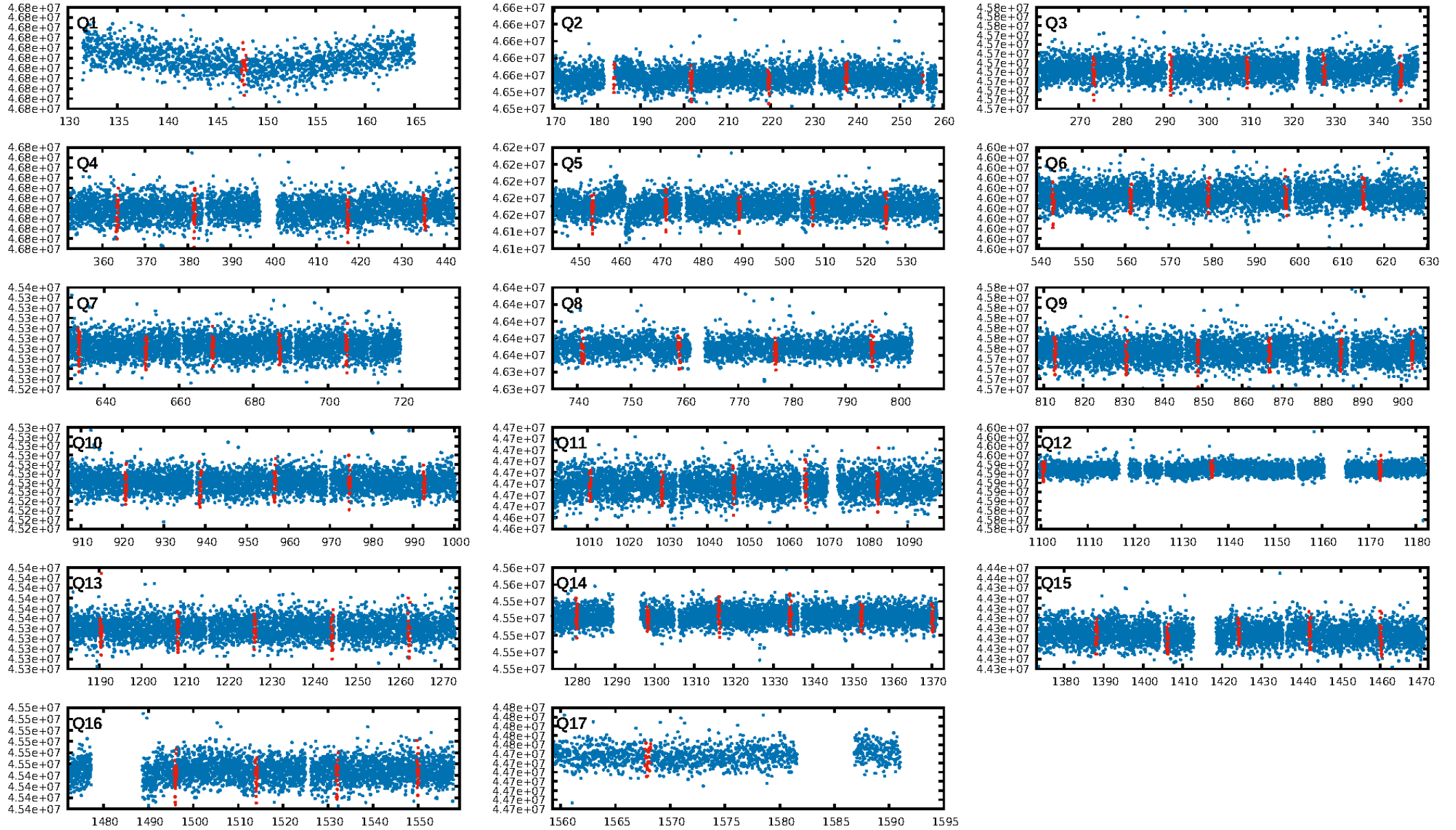
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [16.80σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 97.5%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 5.59e-92  
RollingBand-fgt: 1.00 [71/71]  
GhostDiagnostic-chr: 5.64  
Centroid-sig: 54.5%  
Centroid-so: 0.403 arcsec [0.72σ]  
OotOffset-rm: 0.461 arcsec [1.28σ]  
KicOffset-rm: 0.576 arcsec [1.67σ]  
OotOffset-st: 4/4/4/4 [16]  
KicOffset-st: 4/4/4/4 [16]  
DiffImageQuality-fgm: 0.88 [14/16]  
DiffImageOverlap-fno: 1.00 [17/17]

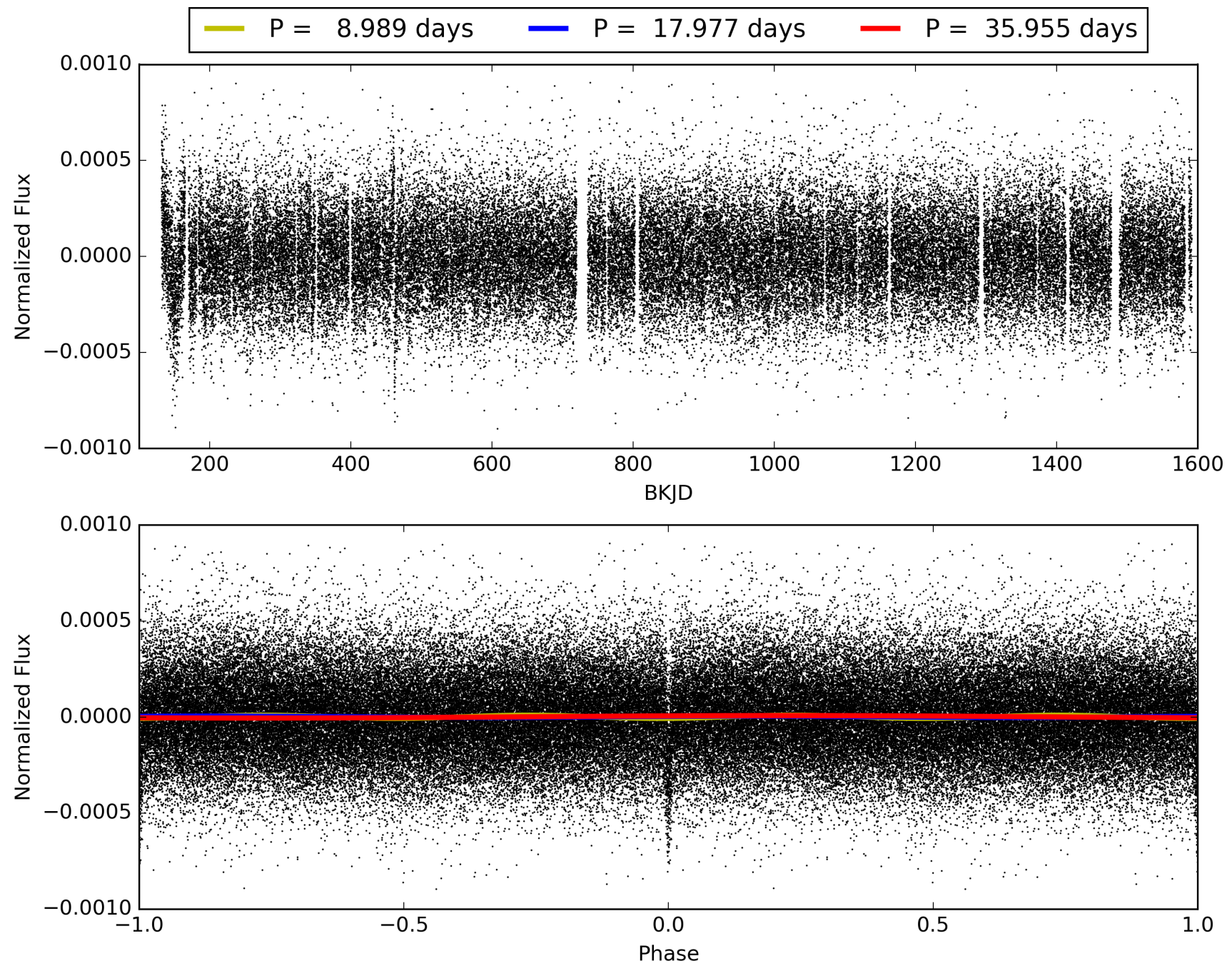
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 03:11:51 Z

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

# TCE 009821454-01, PDC Light Curves



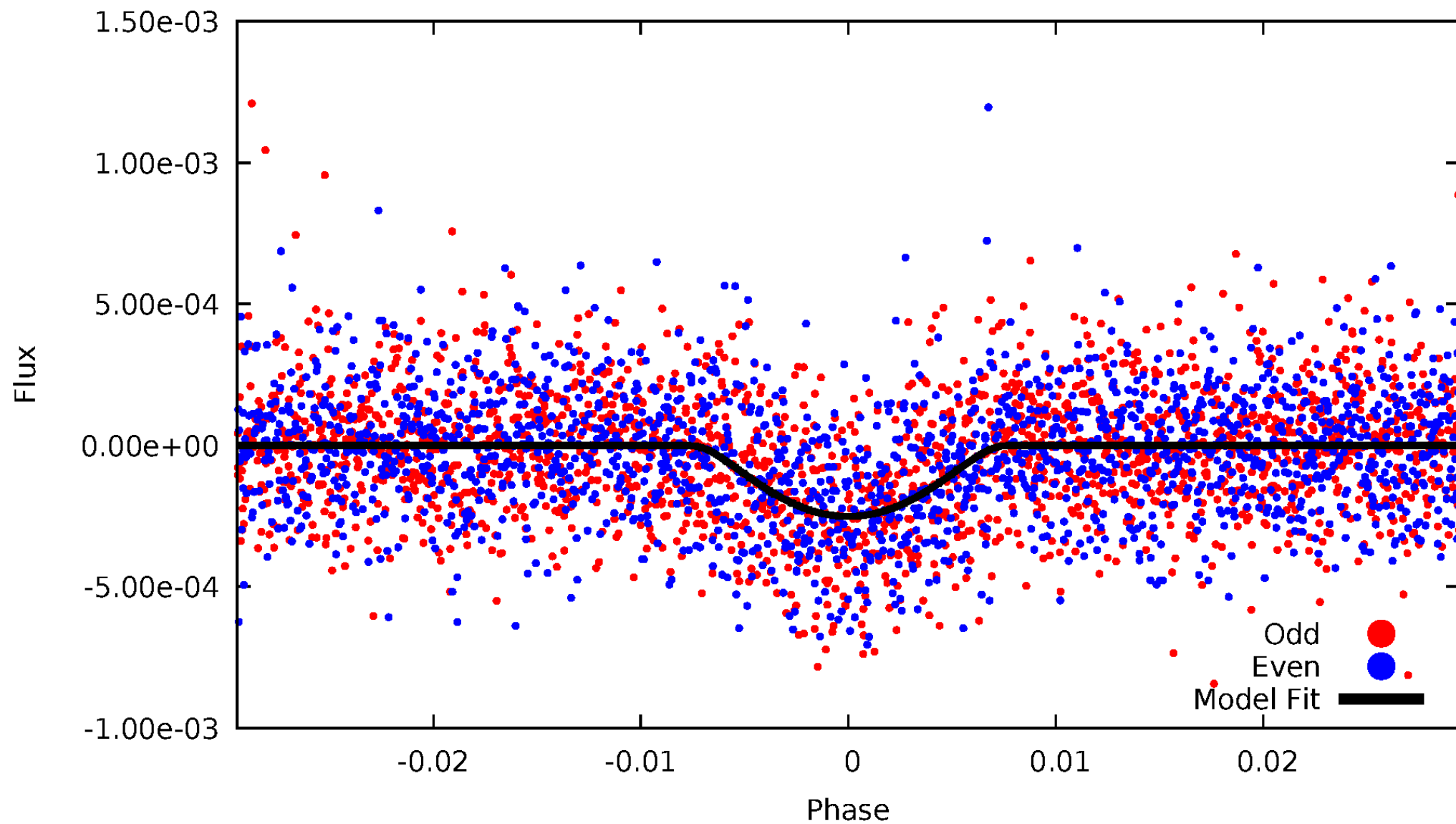
TCE 009821454-01





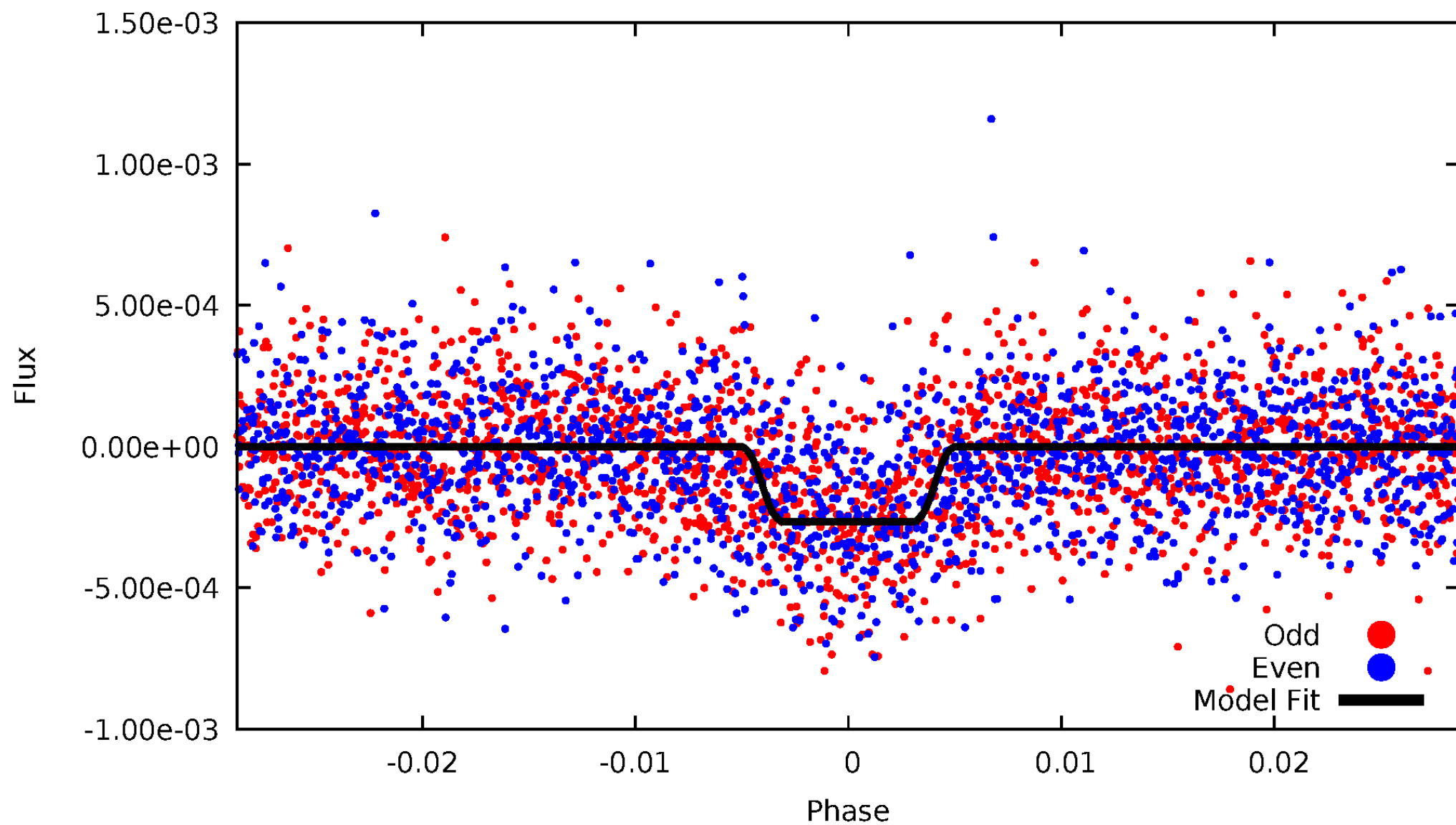
# DV Odd/Even

TCE 009821454-01



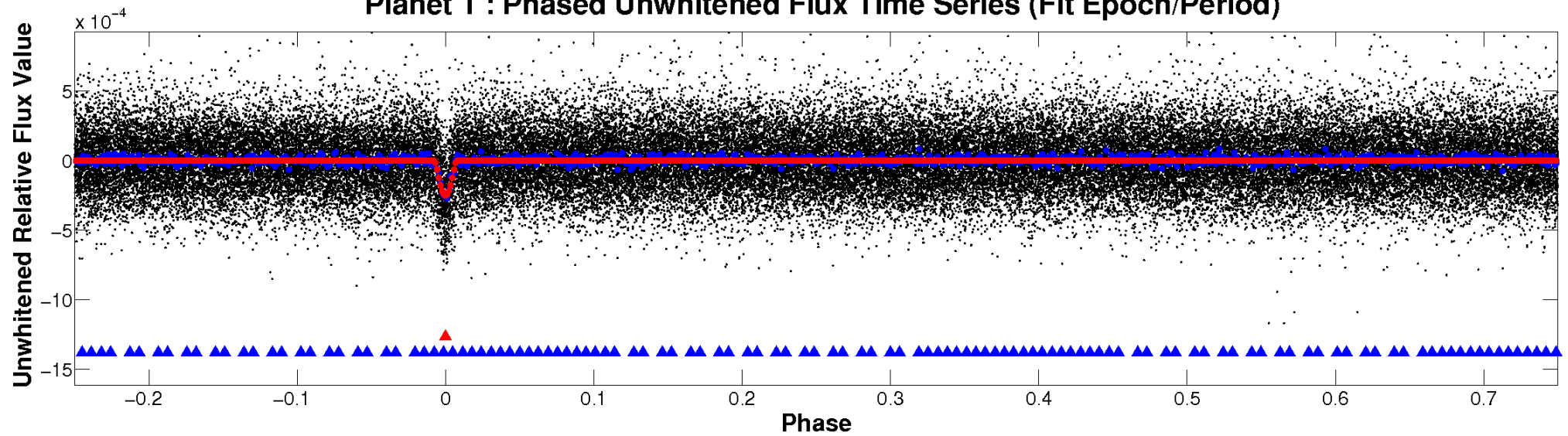
# ALT Odd/Even

TCE 009821454-01

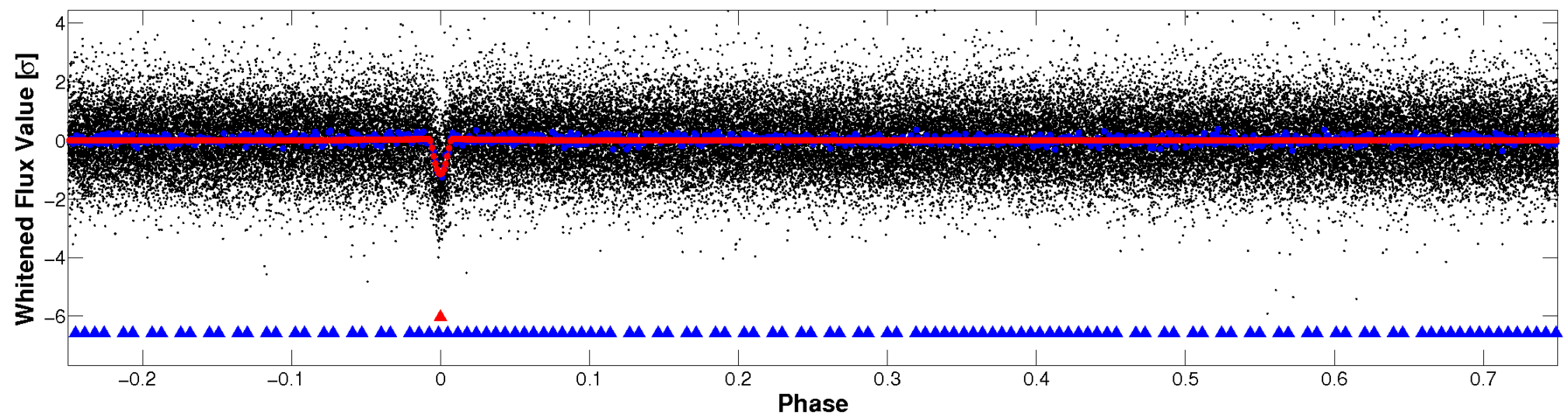


# Non-Whitened Vs. Whitened Light Curve

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

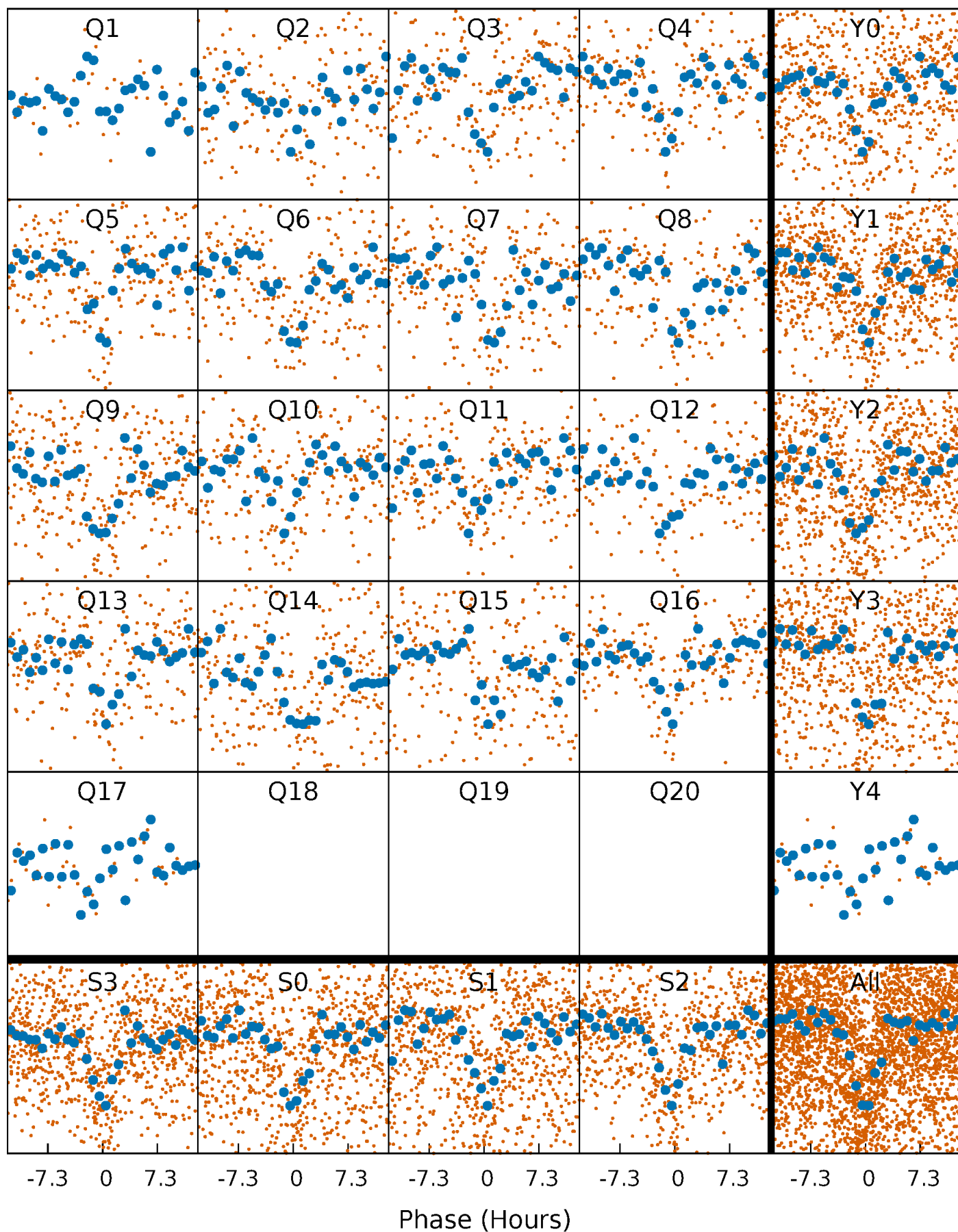


Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

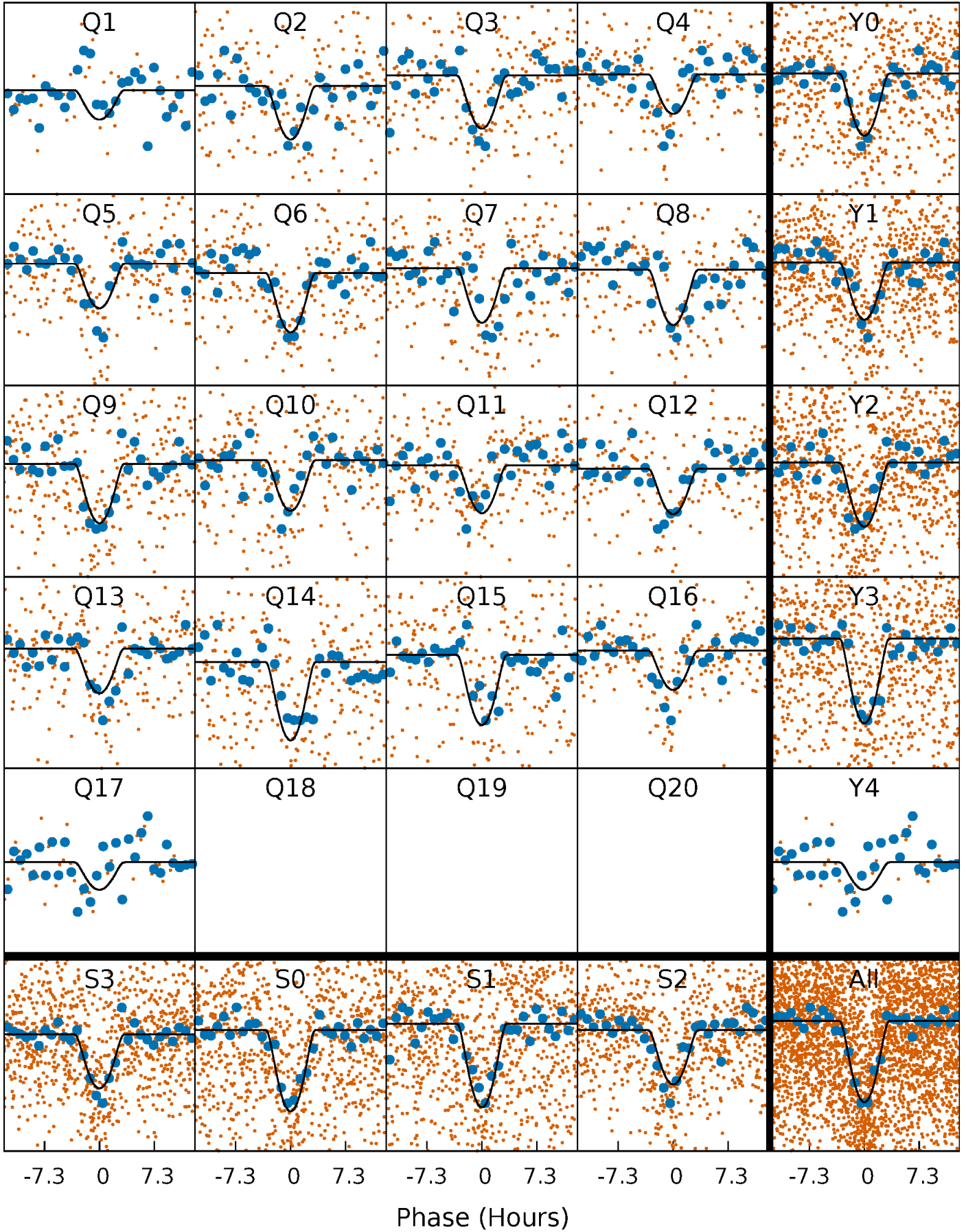
TCE 009821454-01 P= 17.977390 Days  $T_0=147.753447$  (BKJD)





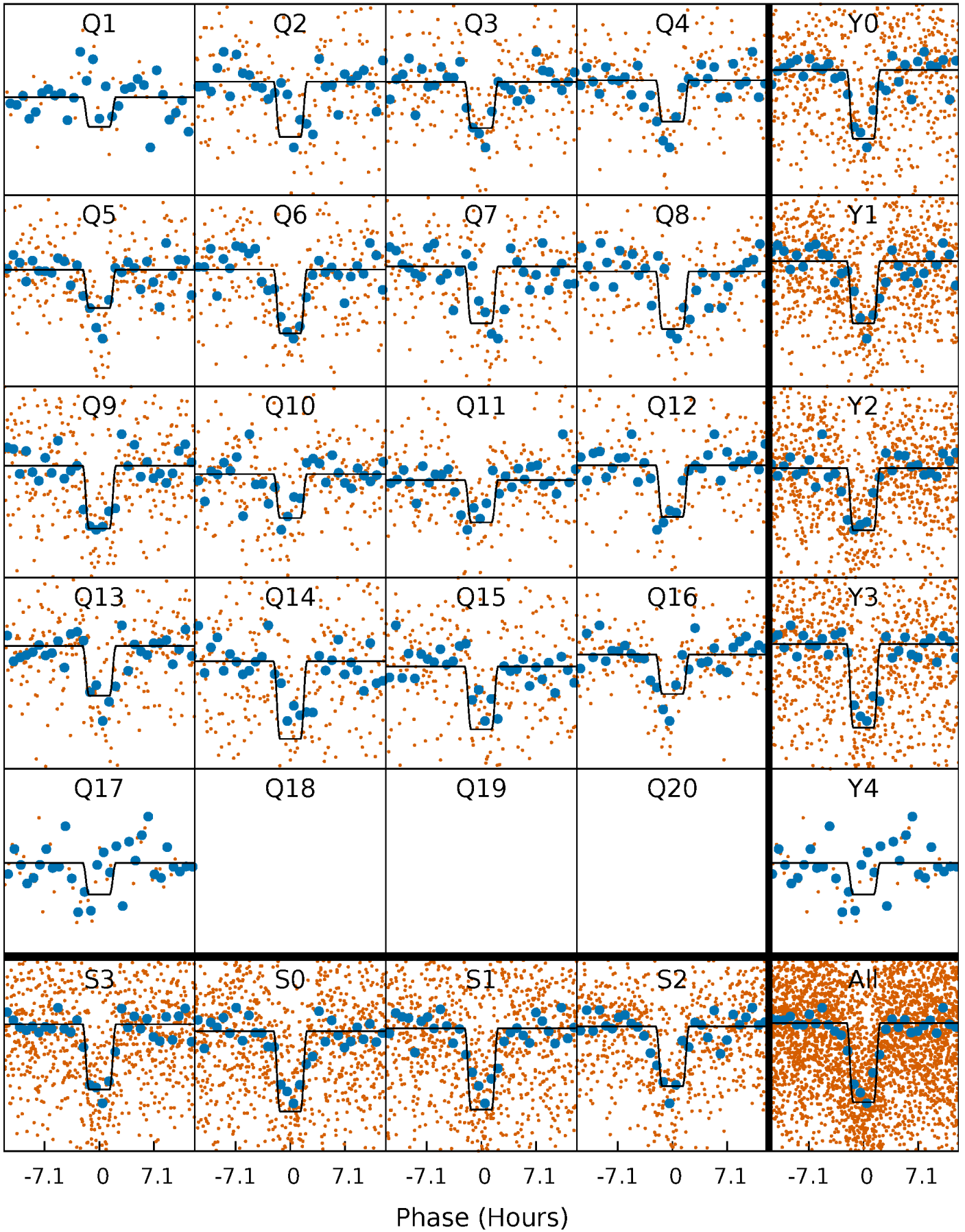
# DV Quarter-Phased Transit Curves

TCE 009821454-01 P= 17.977390 Days  $T_0=147.753447$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

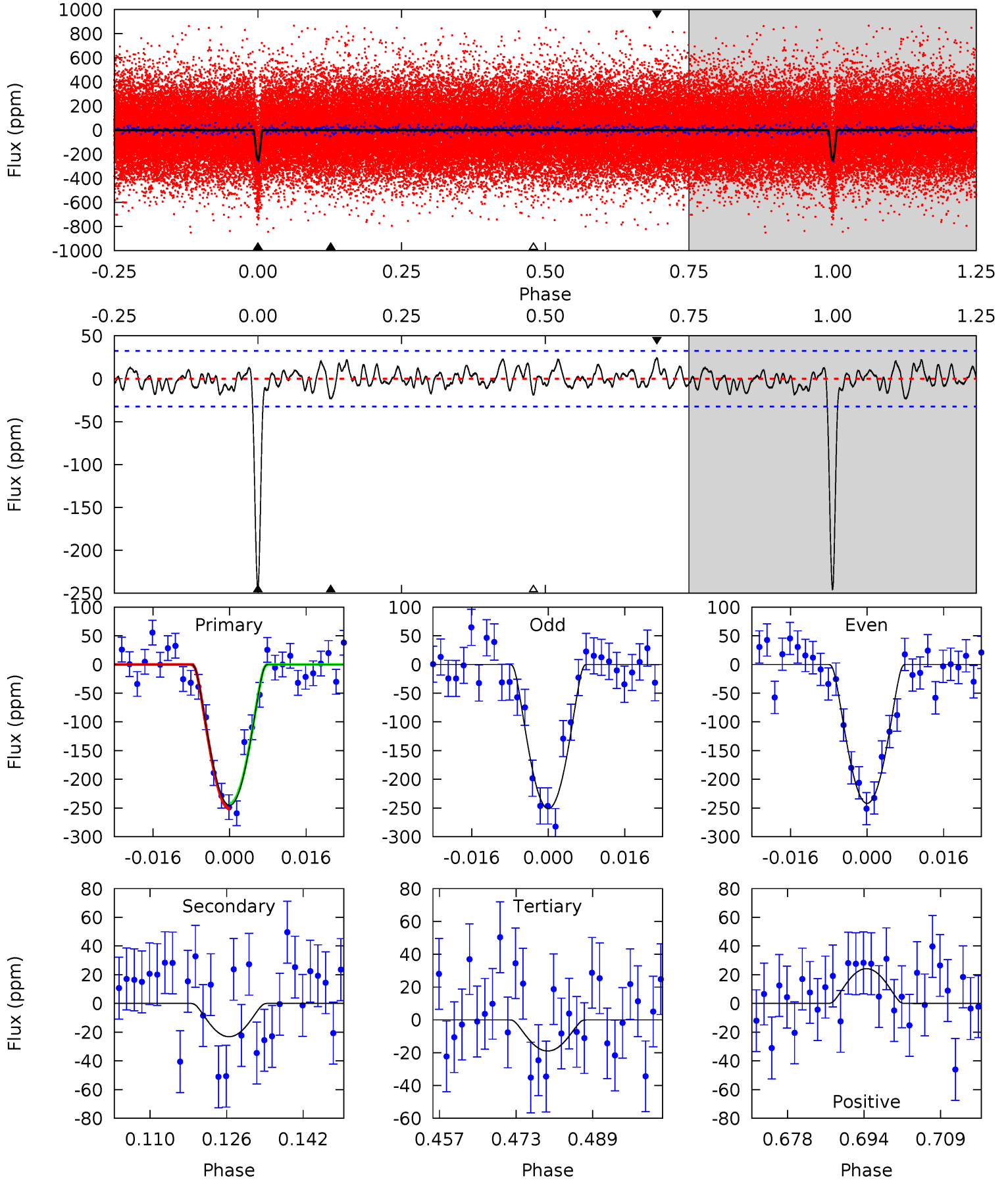
TCE 009821454-01 P= 17.977547 Days  $T_0=147.744987$  (BKJD)



# DV Model-Shift Uniqueness Test

009821454-01, P = 17.977390 Days, E = 129.776057 Days

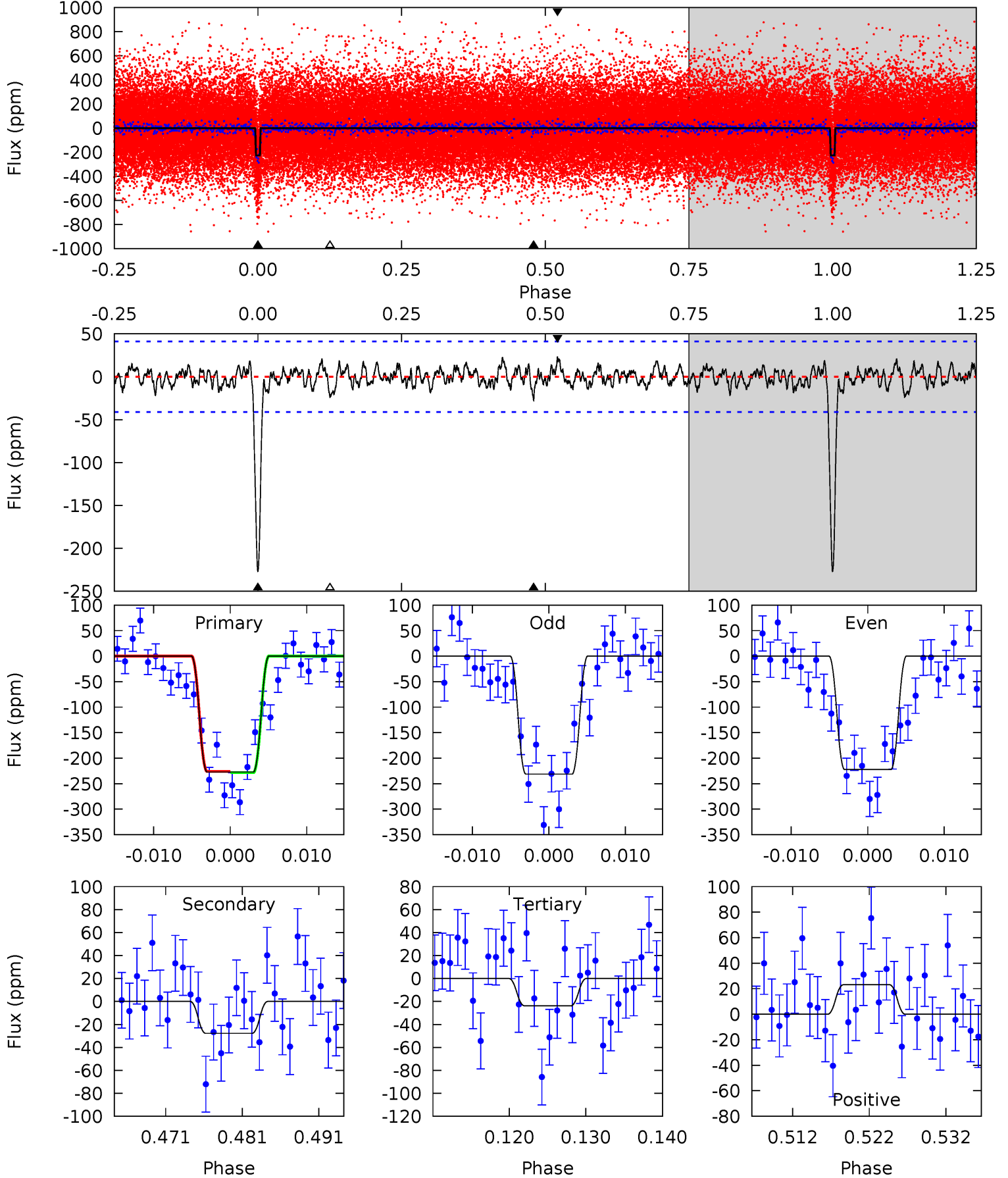
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
37.3	3.52	2.89	3.69	4.94	2.41	1.31	34.4	33.7	0.63	-0.16	0.71	1.01	0.09	0.66



# Alt Model-Shift Uniqueness Test

009821454-01,  $P = 17.977547$  Days,  $E = 129.767440$  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
27.7	3.39	2.91	2.82	5.03	2.57	1.01	24.8	24.9	0.49	0.57	0.54	0.98	0.09	0.15



### Stellar Parameters For KIC 009821454

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6296^{+169}_{-207}$	$4.460^{+0.052}_{-0.221}$	$-0.260^{+0.250}_{-0.350}$	$1.006^{+0.312}_{-0.111}$	$1.066^{+0.143}_{-0.143}$	$1.473^{+0.404}_{-0.754}$
	+3%/-3%	+1%/-5%	+96%/-135%	+31%/-11%	+13%/-13%	+27%/-51%
Source	PHO1	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 009821454-01 / KOI 1529.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-23 \pm 7$	$4.16^{+3.50}_{-2.68}$	$1073^{+83}_{-52}$	$2966^{+1135}_{-491}$	$14^{+93}_{-10}$
Alt.	$-28 \pm 8$	$3.43^{+3.57}_{-2.34}$	$1074^{+88}_{-55}$	$3204^{+1578}_{-582}$	$23^{+209}_{-17}$

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



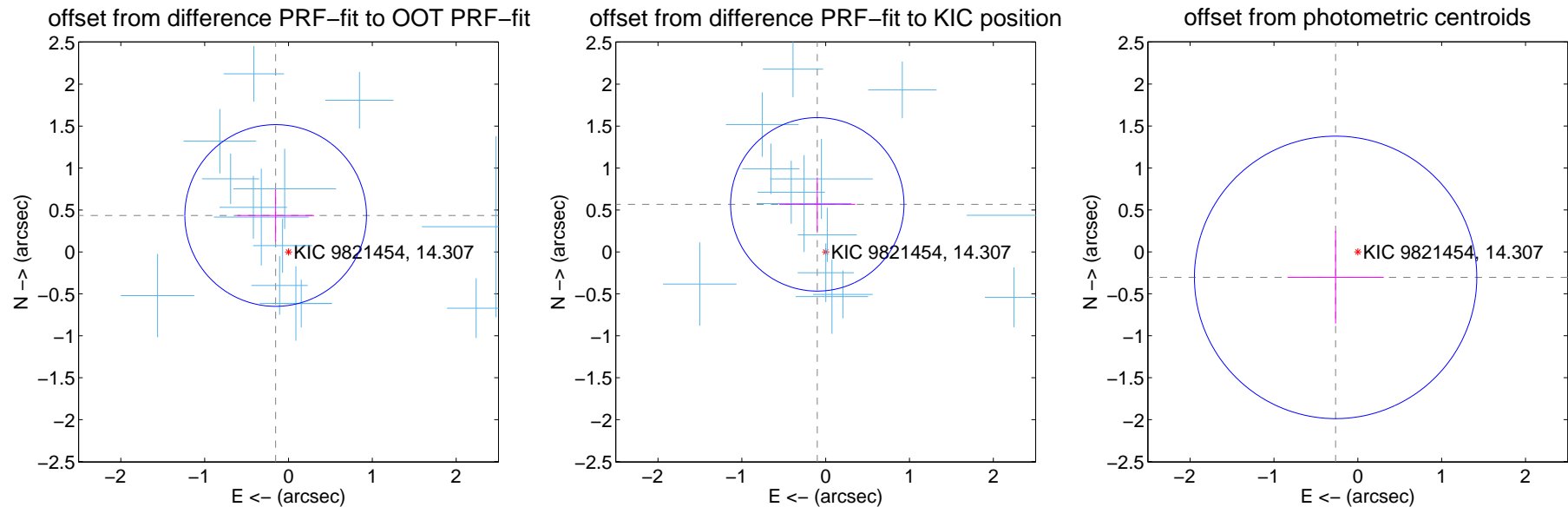
## DV Centroid Data

Supplemental centroid analysis for 009821454-01. Kepler magnitude: 14.31. Transit SNR 22.75

There are 14 quarters with good PRF difference image offsets

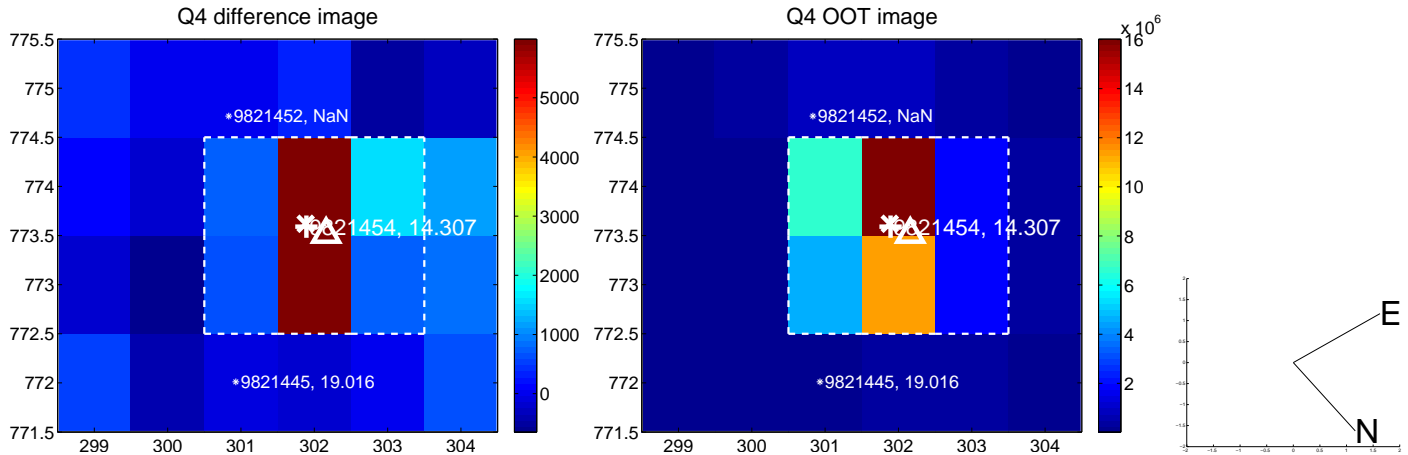
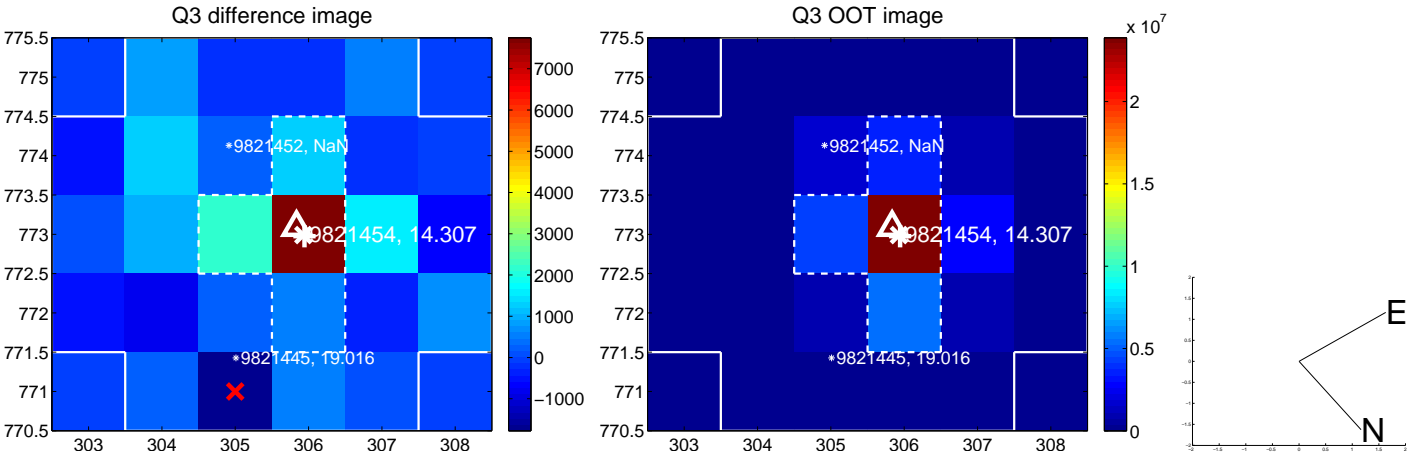
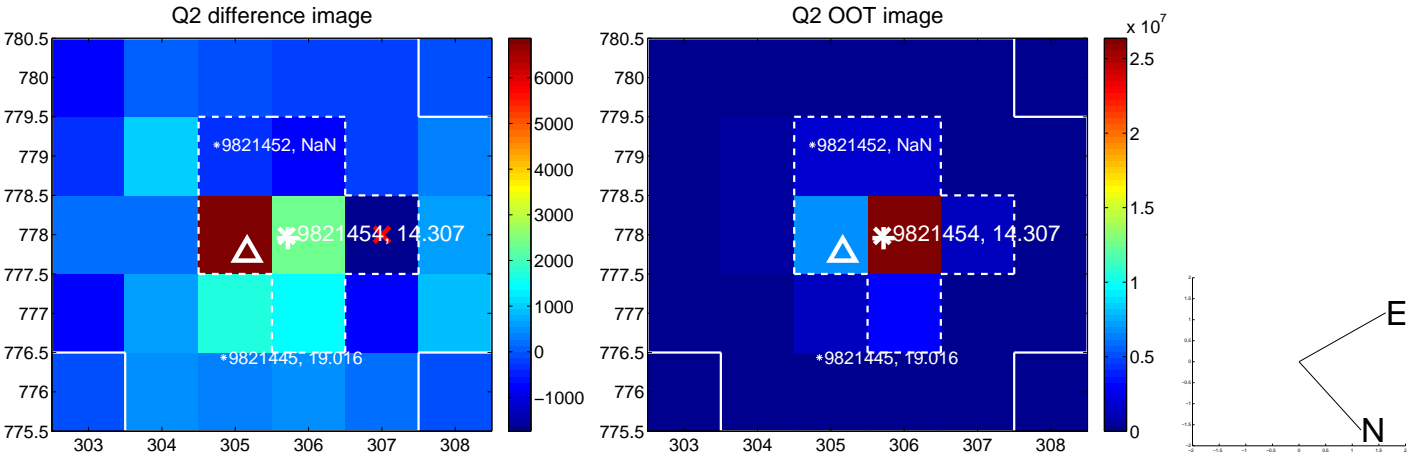
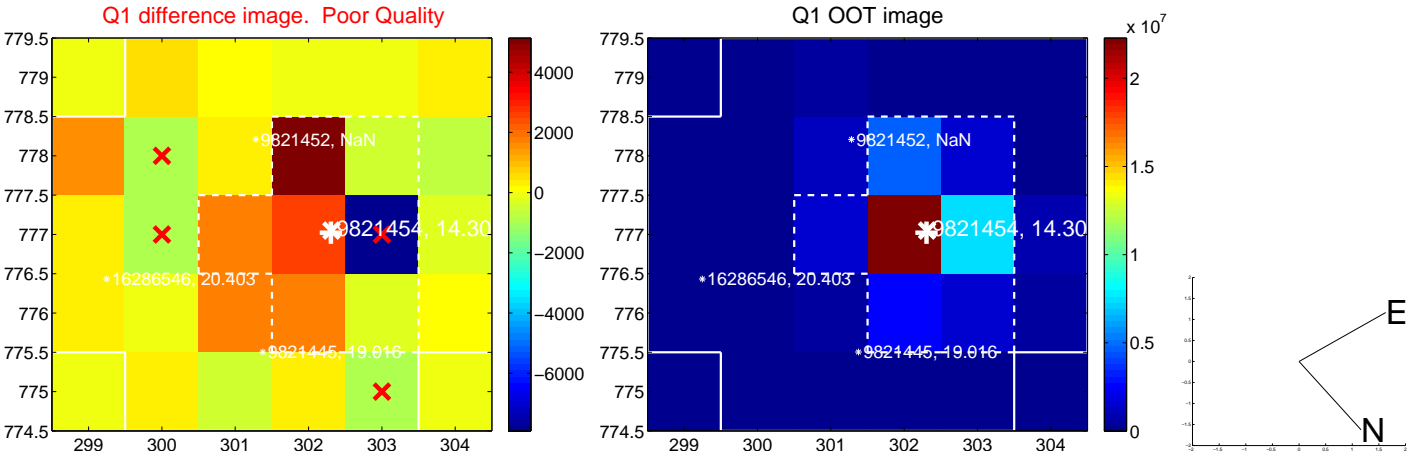
The direct PRF centroid is offset from the target star catalog position by about 0.16 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.461 \pm 0.361$	1.28	$0.153 \pm 0.460$	$0.434 \pm 0.308$
PRF-fit source offset from KIC position	$0.576 \pm 0.345$	1.67	$0.100 \pm 0.453$	$0.567 \pm 0.321$
photometric centroid source offset	$0.40 \pm 0.56$	0.72	$0.26 \pm 0.57$	$-0.30 \pm 0.55$

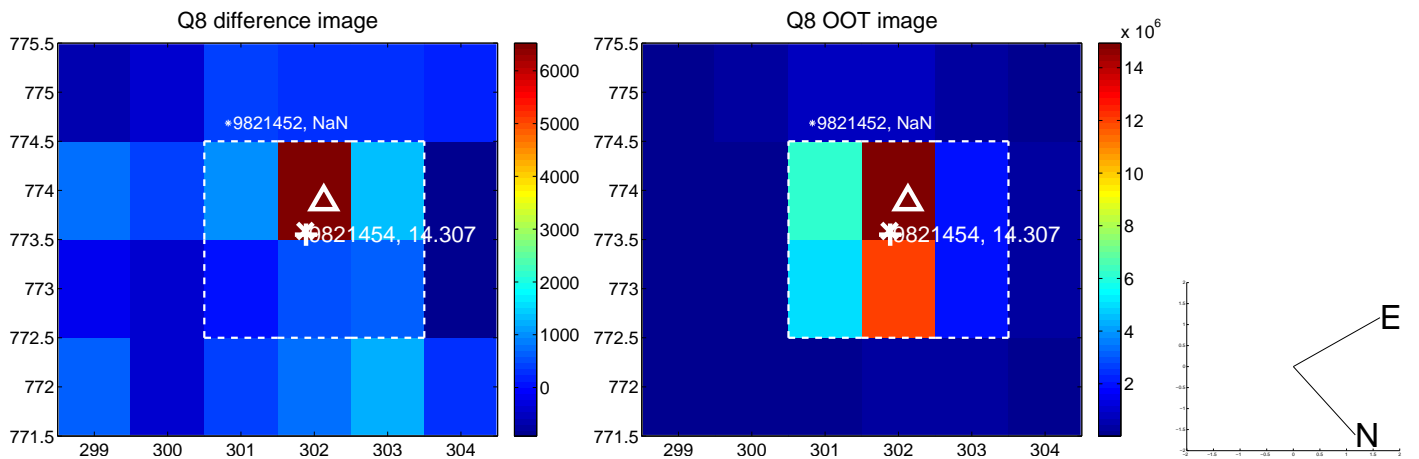
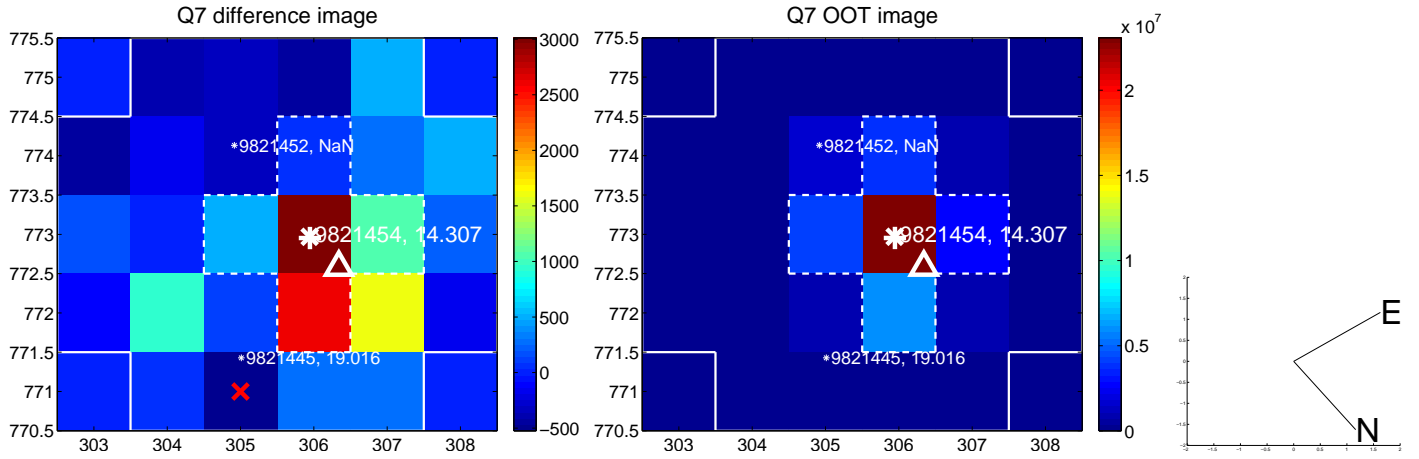
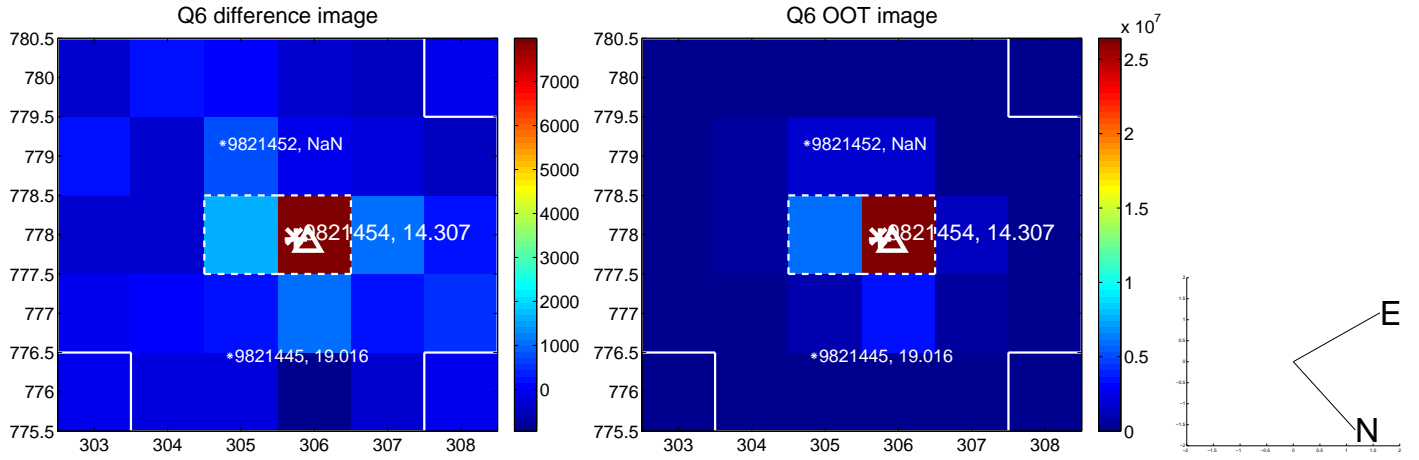
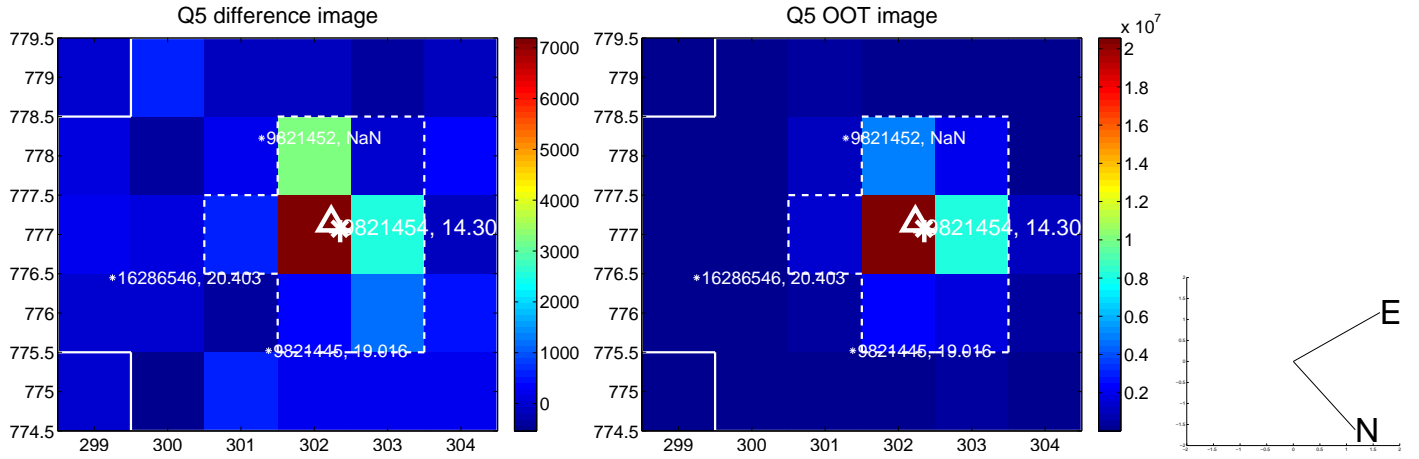


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

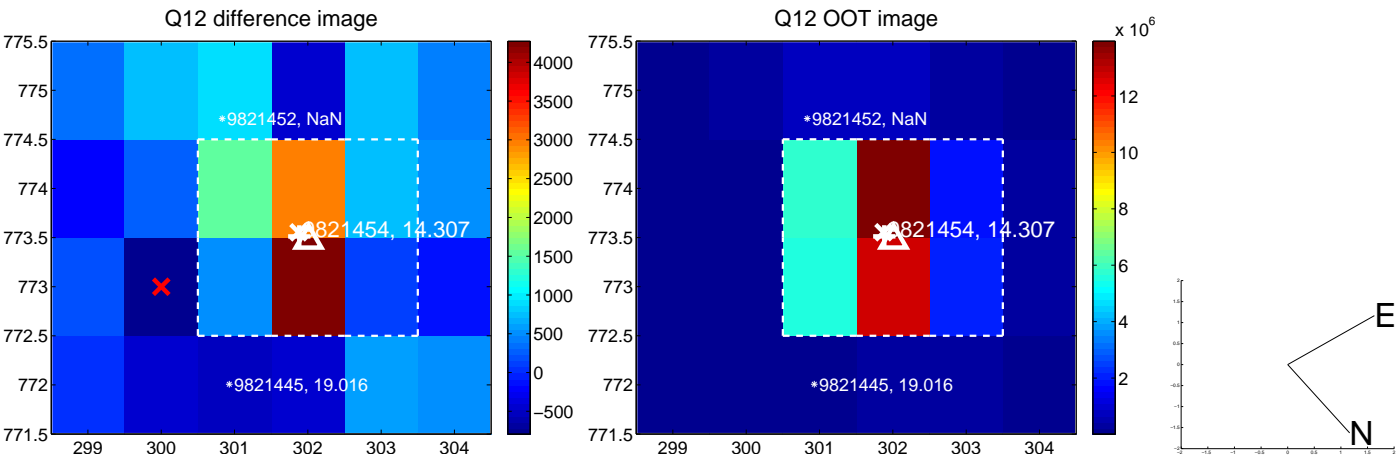
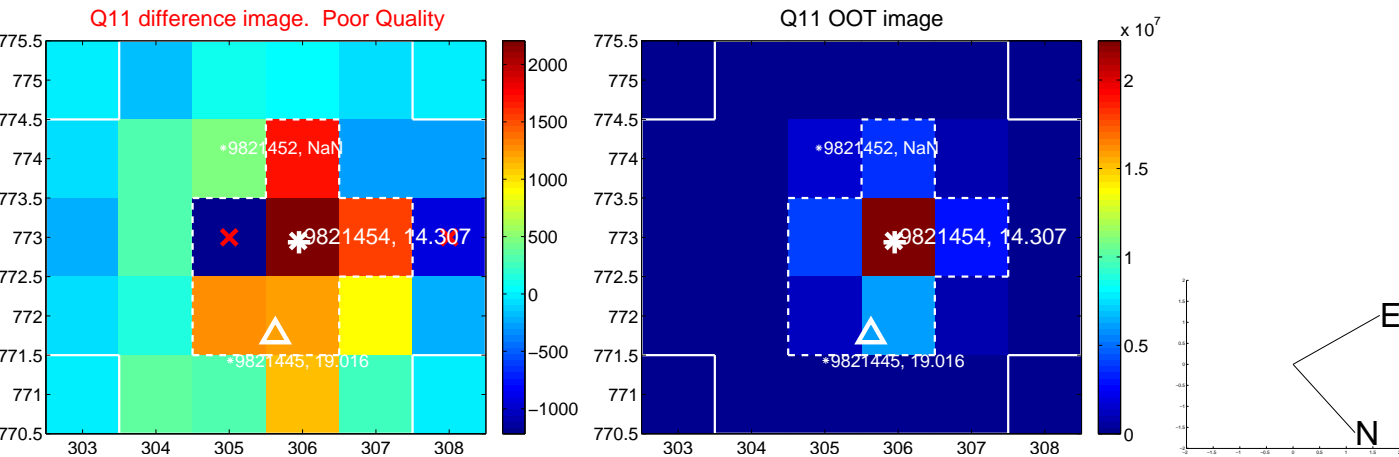
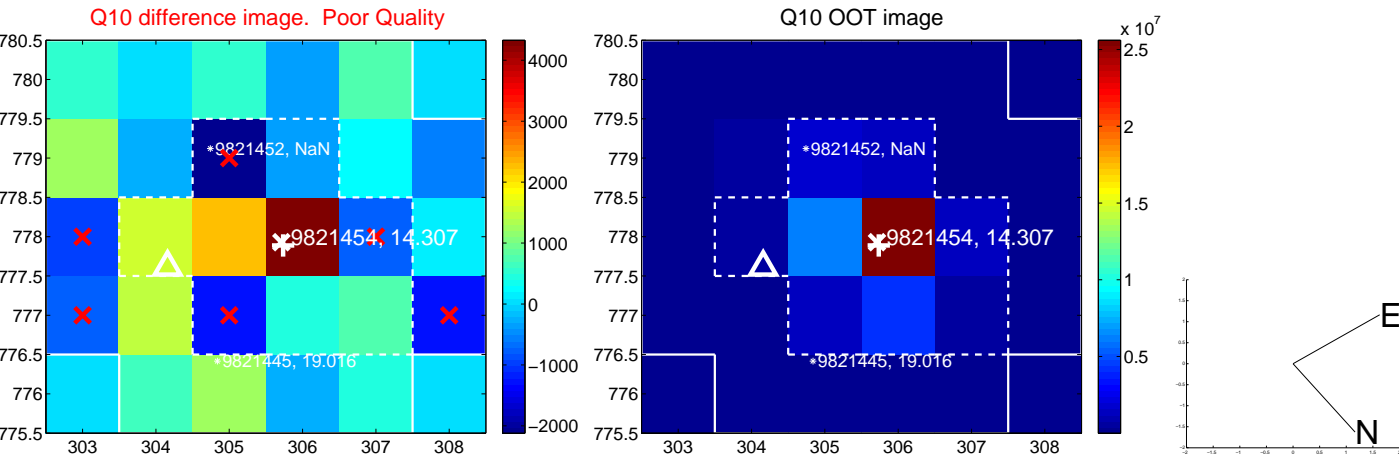
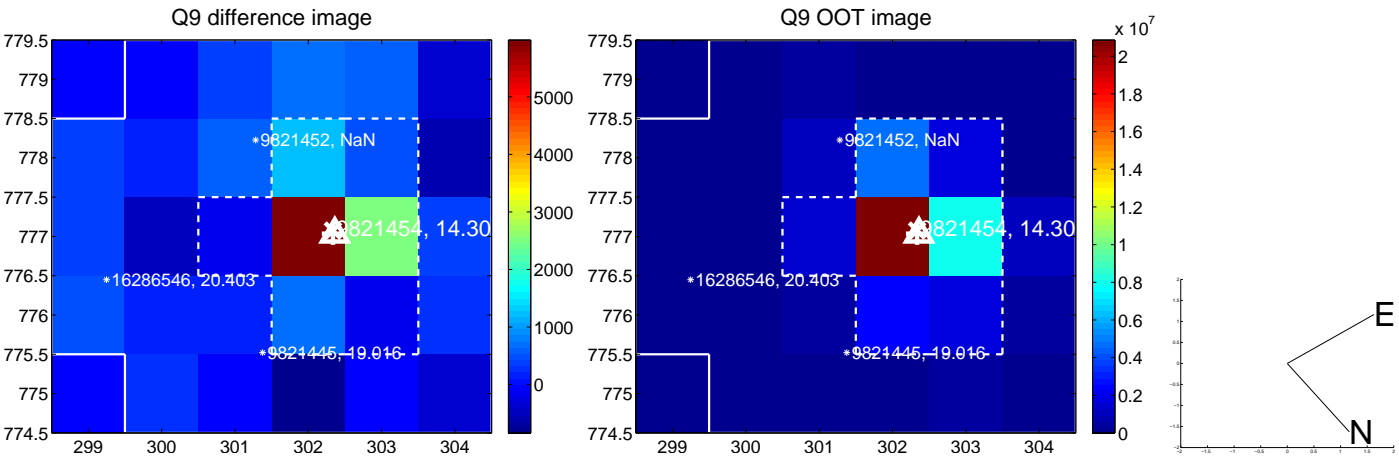
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



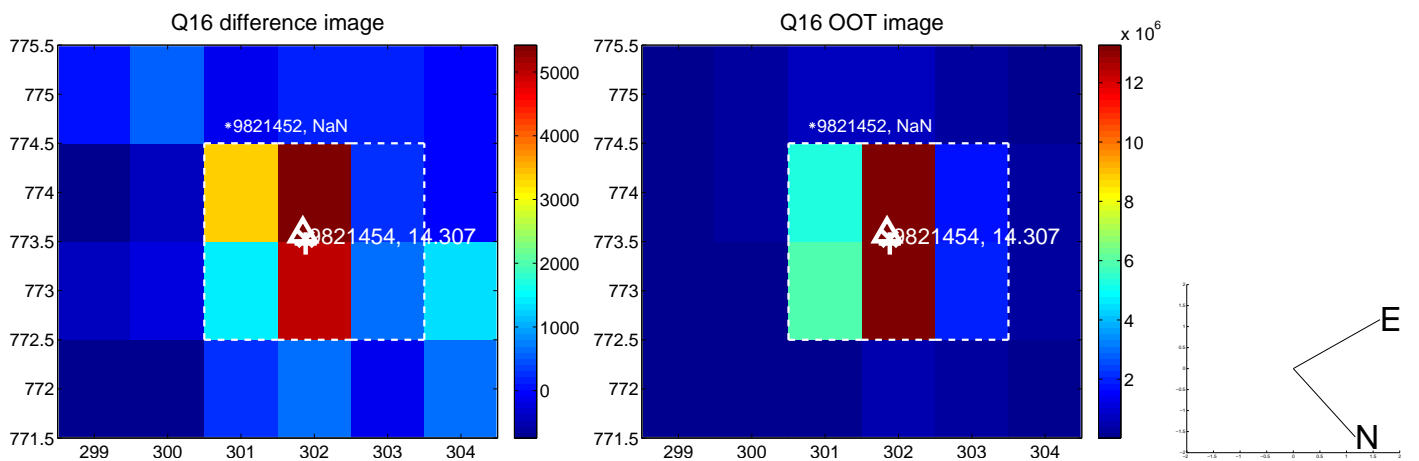
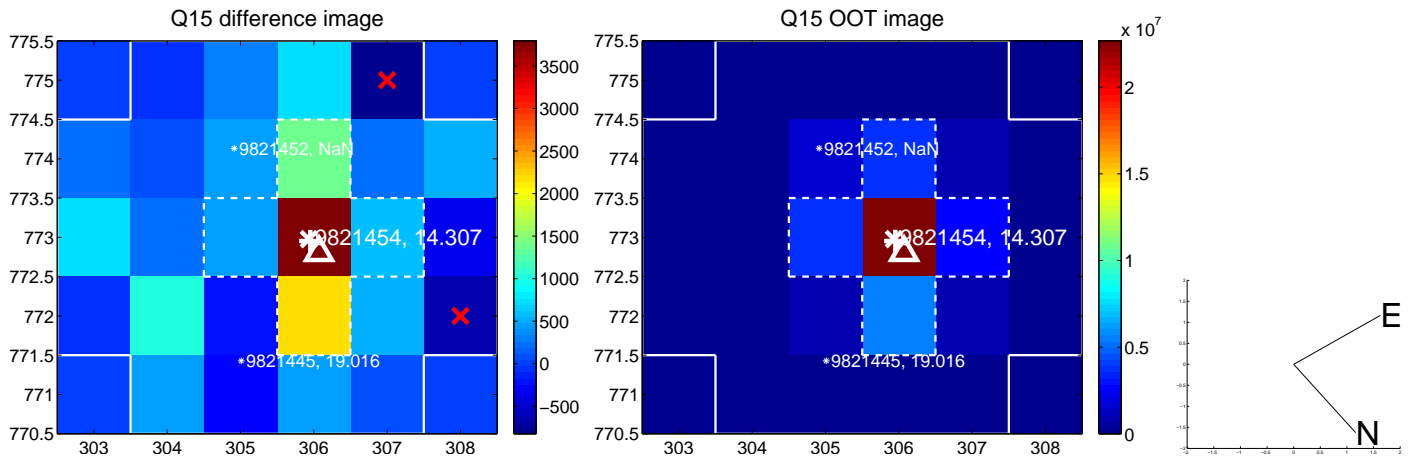
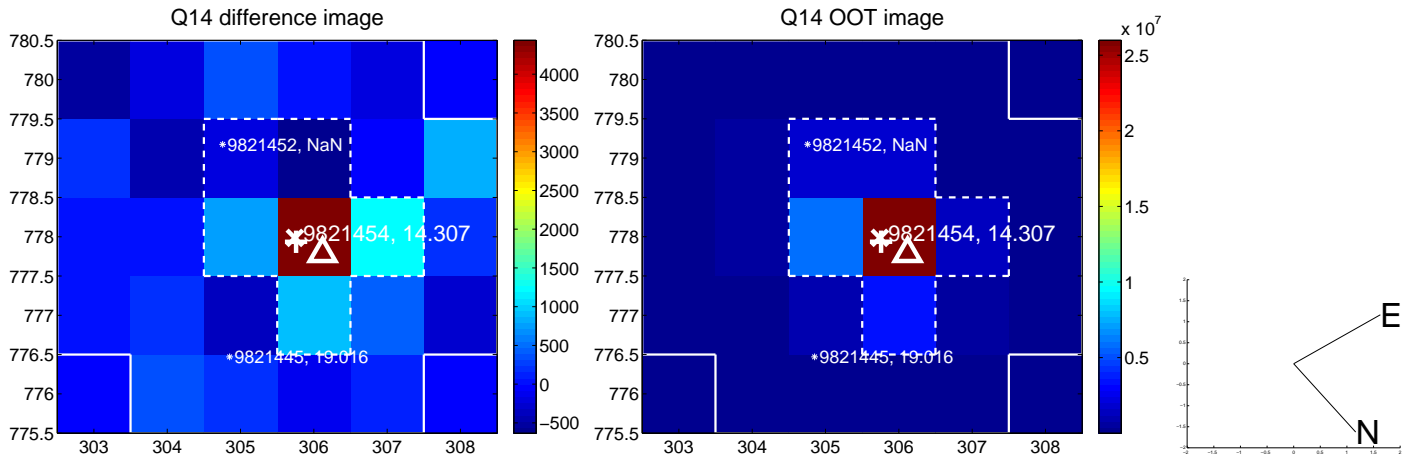
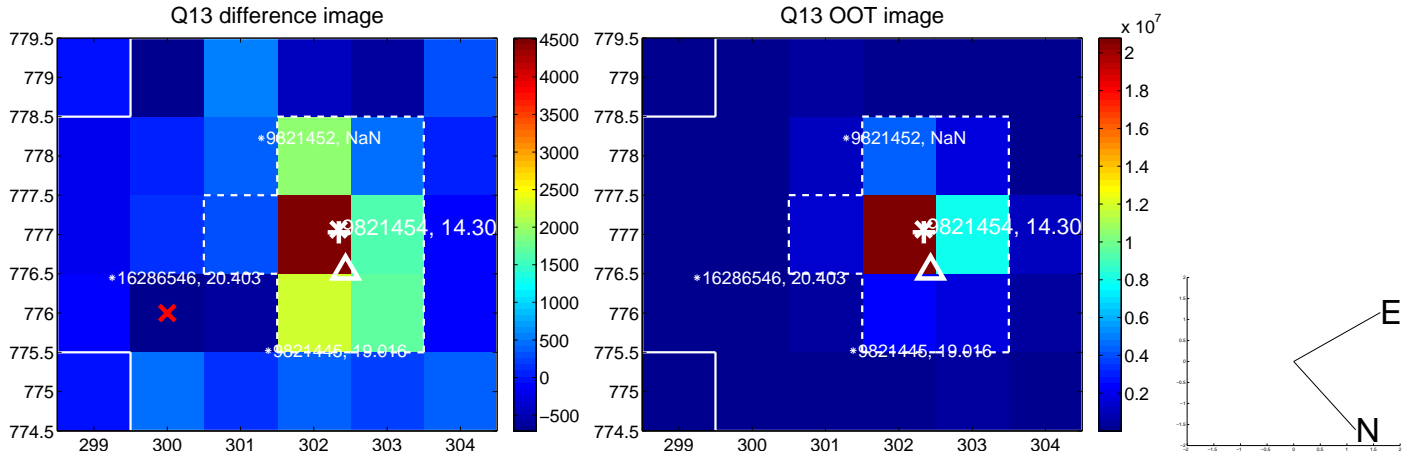
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

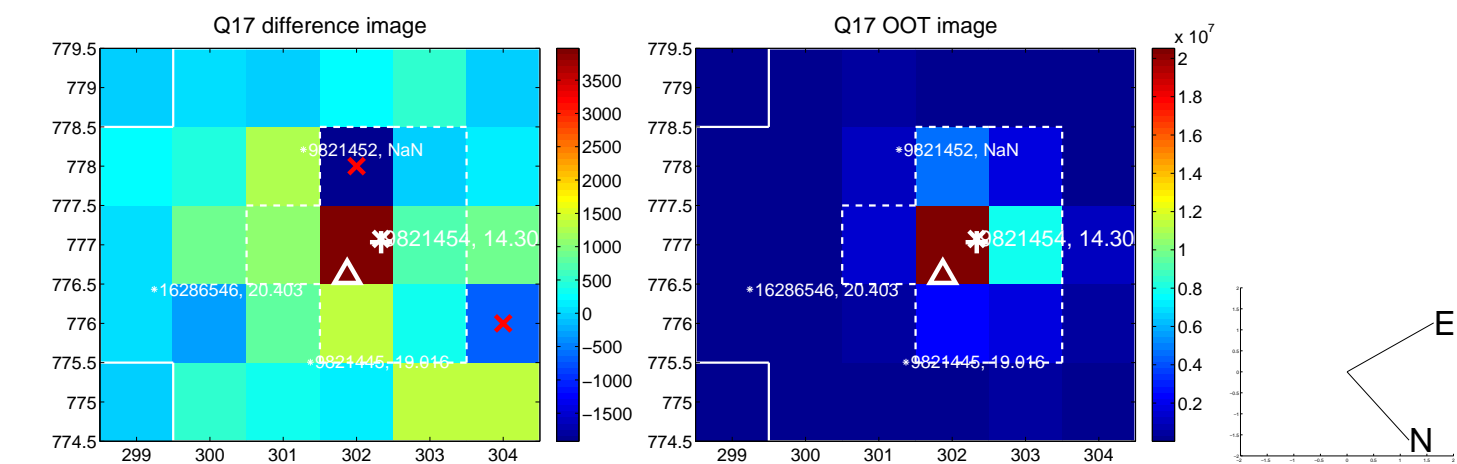


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

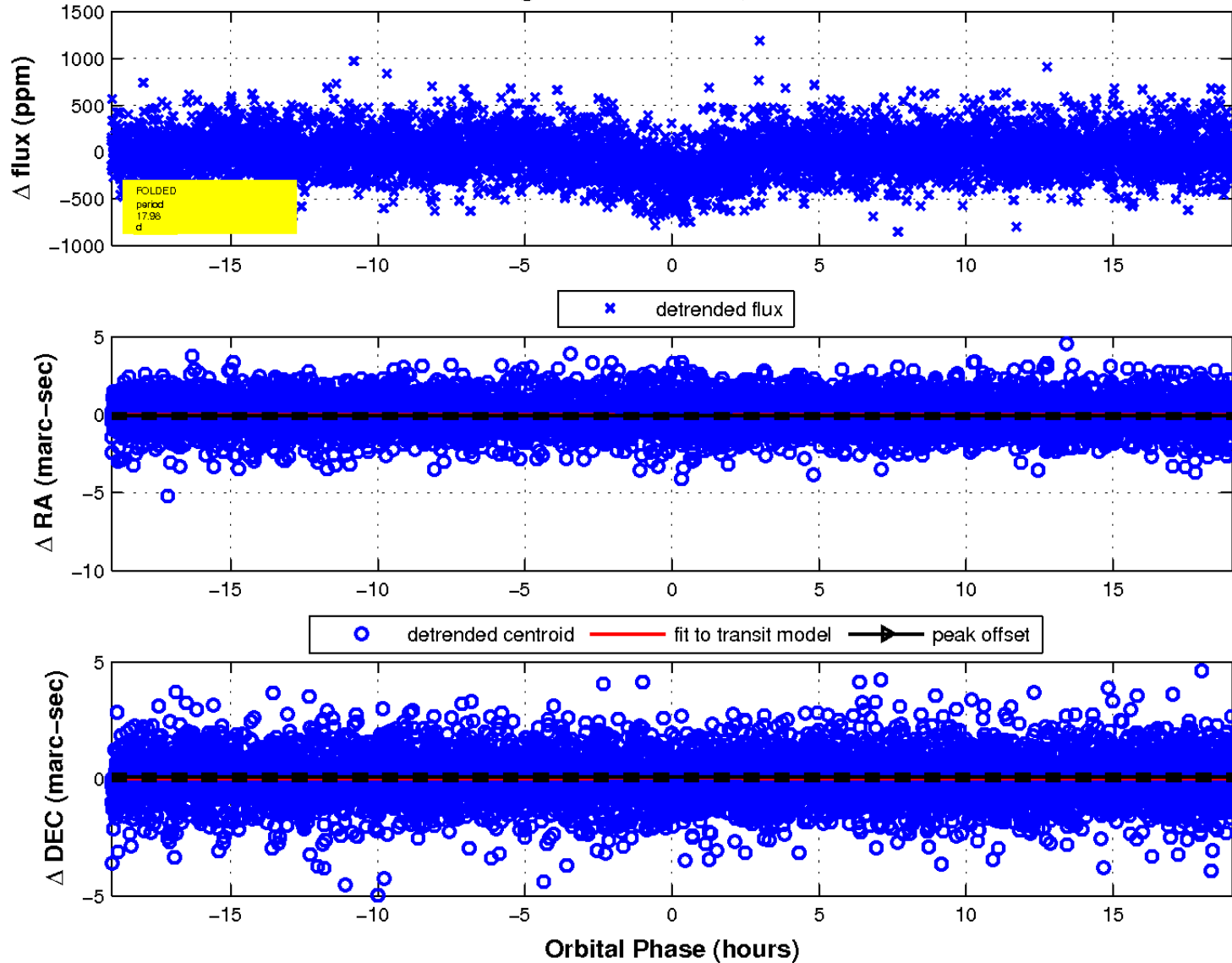




white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

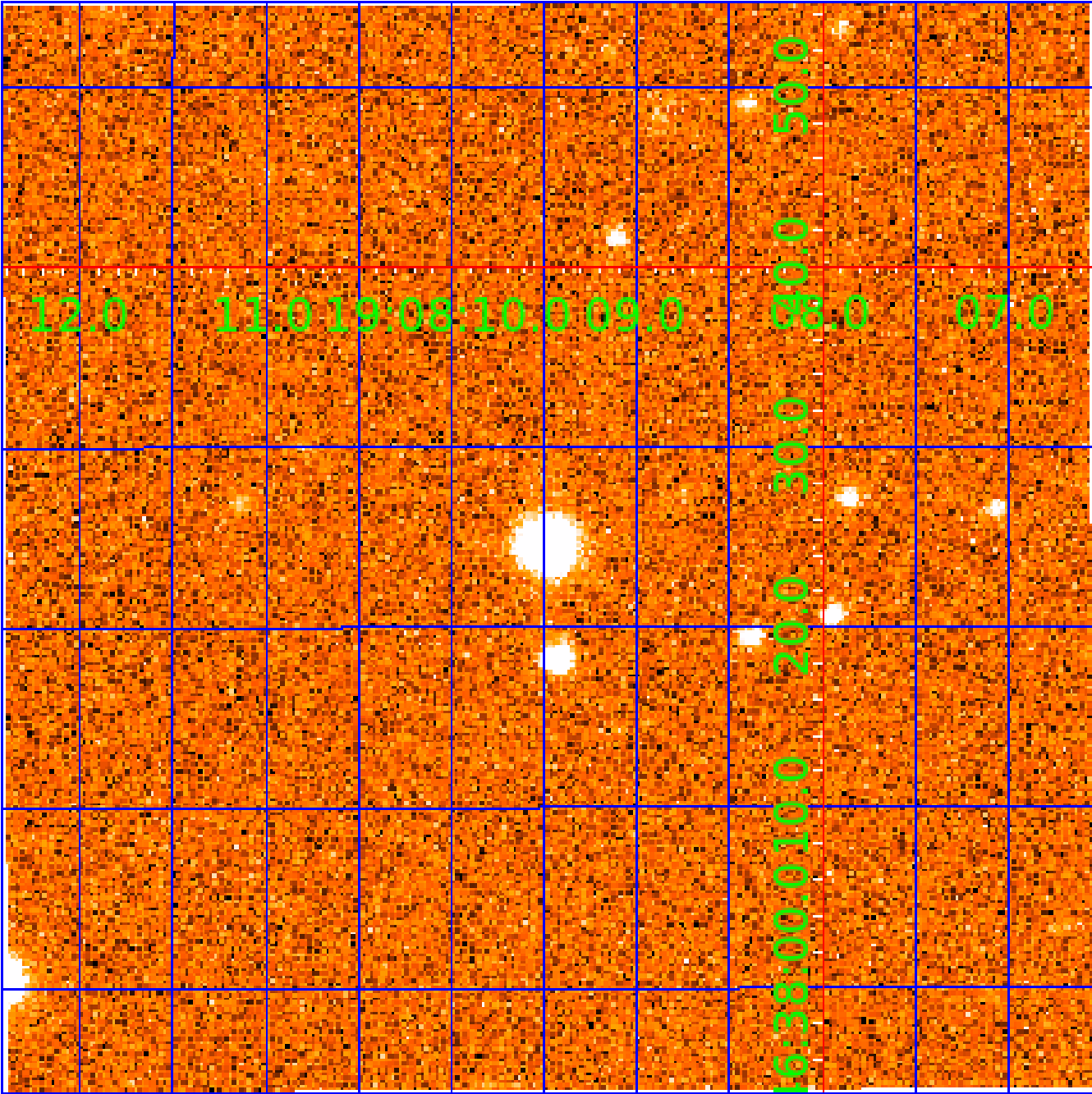


fluxWeightedCentroids, Planet 1 of 2



UKIRT Image

Declination



# KIC 009821454

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009821454-01	OBS	1529.01	17.977390	147.753447	251.4	6.354	20.9	22.7	1.01	6296	2.97	75.73
009821454-02	OBS	1529.02	11.869757	137.698547	91.1	5.977	12.8	12.7	1.01	6296	1.12	131.71

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009821454-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009821454-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT

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

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

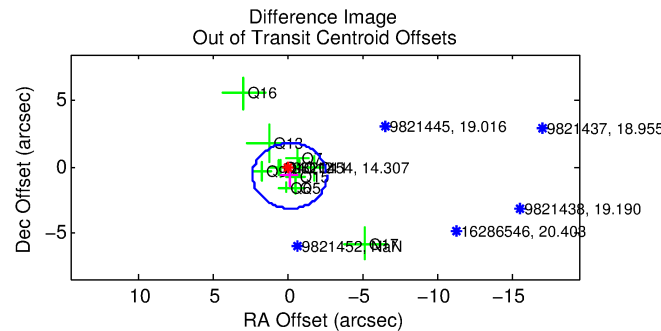
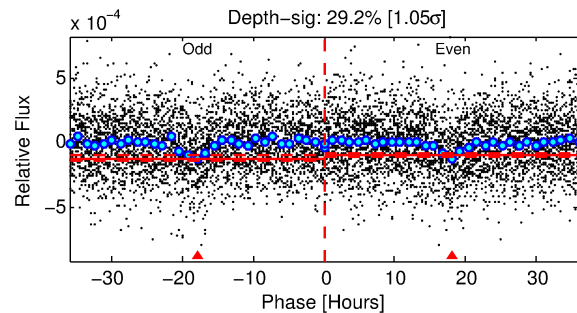
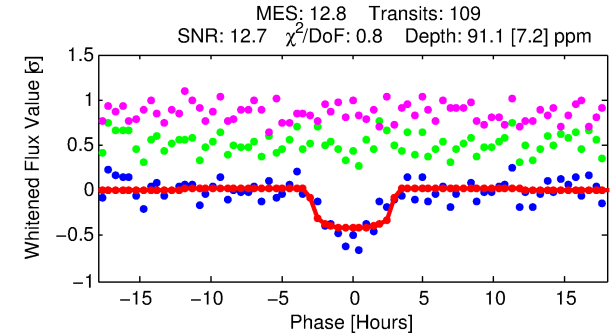
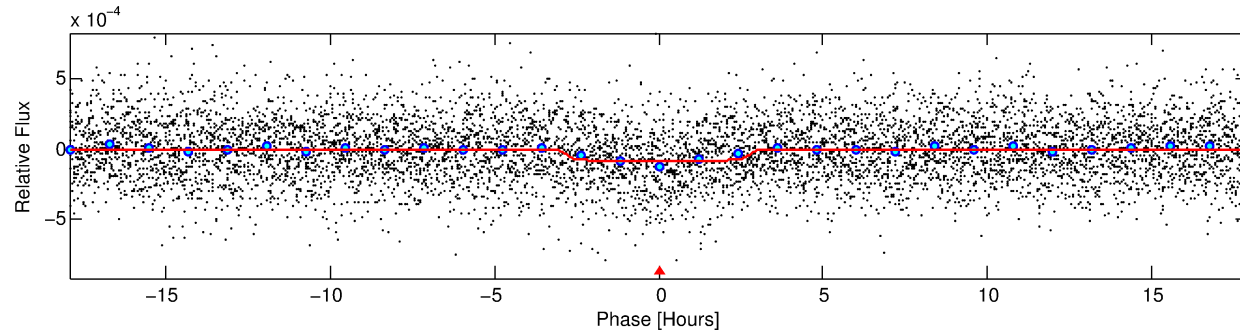
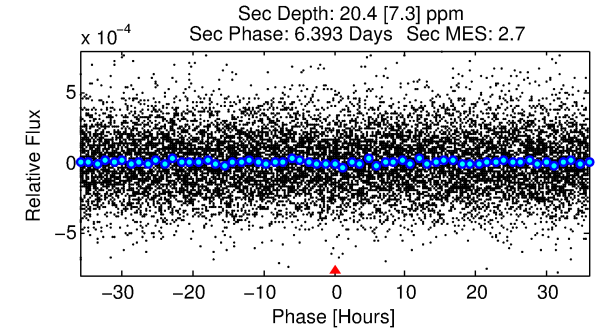
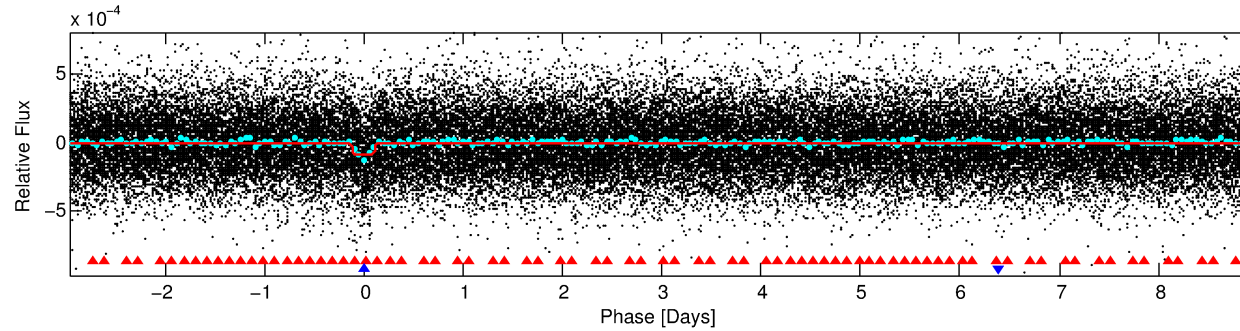
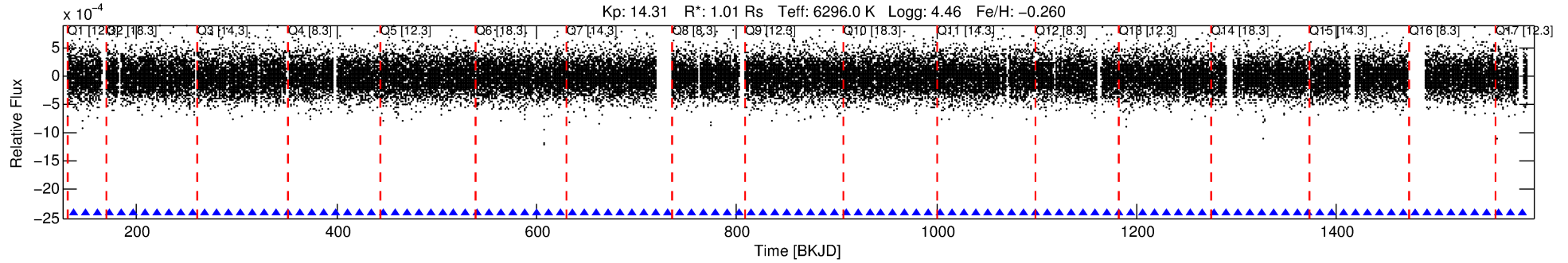
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009821454-02

No Significant Match Found

# DV One-Page Summary

KIC: 9821454 Candidate: 2 of 2 Period: 11.870 d  
KOI: K01529.02 Name: Kepler-59b Corr: 0.869



## DV Fit Results:

Period = 11.86976 [0.00013] d  
Epoch = 137.6985 [0.0087] BKJD  
Rp/R\* = 0.0102 [0.0029]  
a/R\* = 7.23 [11.06]  
b = 0.89 [0.36]  
Seff = 131.71 [55.12]  
Teq = 864 [90] K  
Rp = 1.12 [0.47] Re  
a = 0.1040 [0.0278] AU  
Ag = 97.19 [75.40] [1.28σ]  
Teffp = 4194 [712] K [4.64σ]

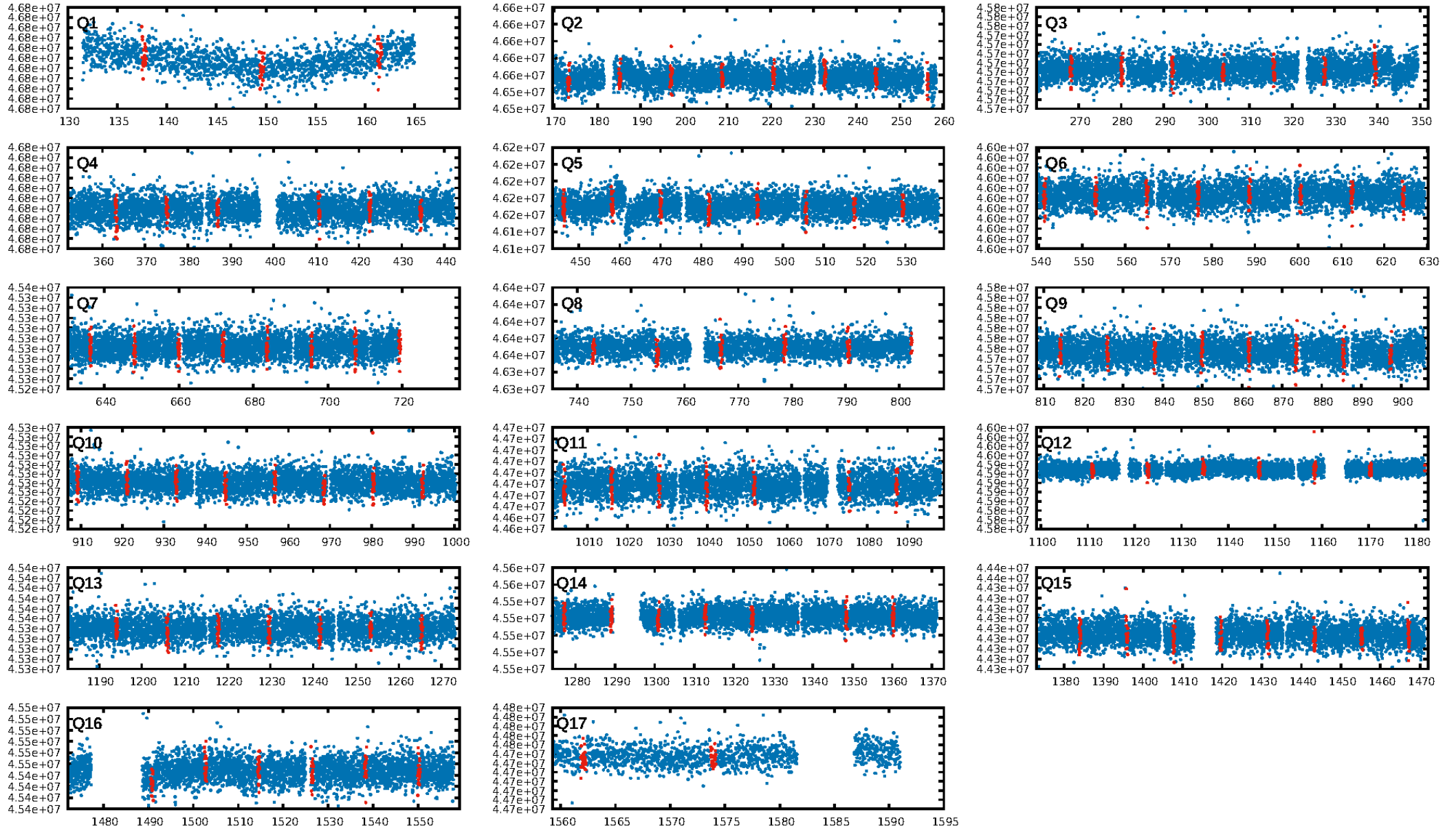
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [16.80σ]  
ModelChiSquare2-sig: 100.0%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 5.55e-36  
RollingBand-fgt: 1.00 [104/104]  
GhostDiagnostic-chr: 10.81  
Centroid-sig: 1.6%  
Centroid-so: 2.192 arcsec [2.14σ]  
OotOffset-rm: 0.708 arcsec [0.86σ]  
KicOffset-rm: 0.584 arcsec [0.73σ]  
OotOffset-st: 2/3/3/4 [12]  
KicOffset-st: 2/3/3/4 [12]  
DiffImageQuality-fgm: 0.58 [7/12]  
DiffImageOverlap-fno: 1.00 [17/17]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 03:11:58 Z

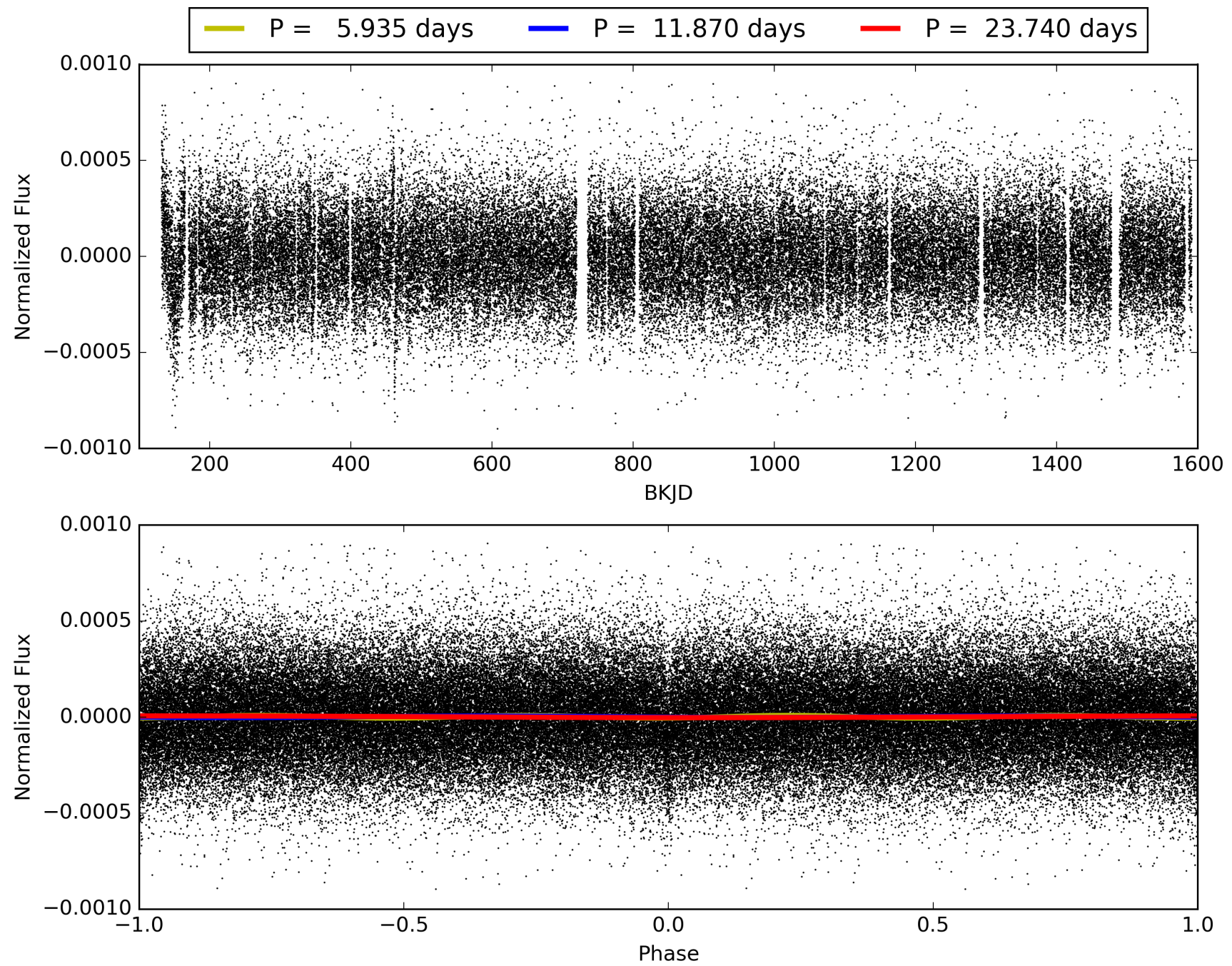
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 009821454-02, PDC Light Curves



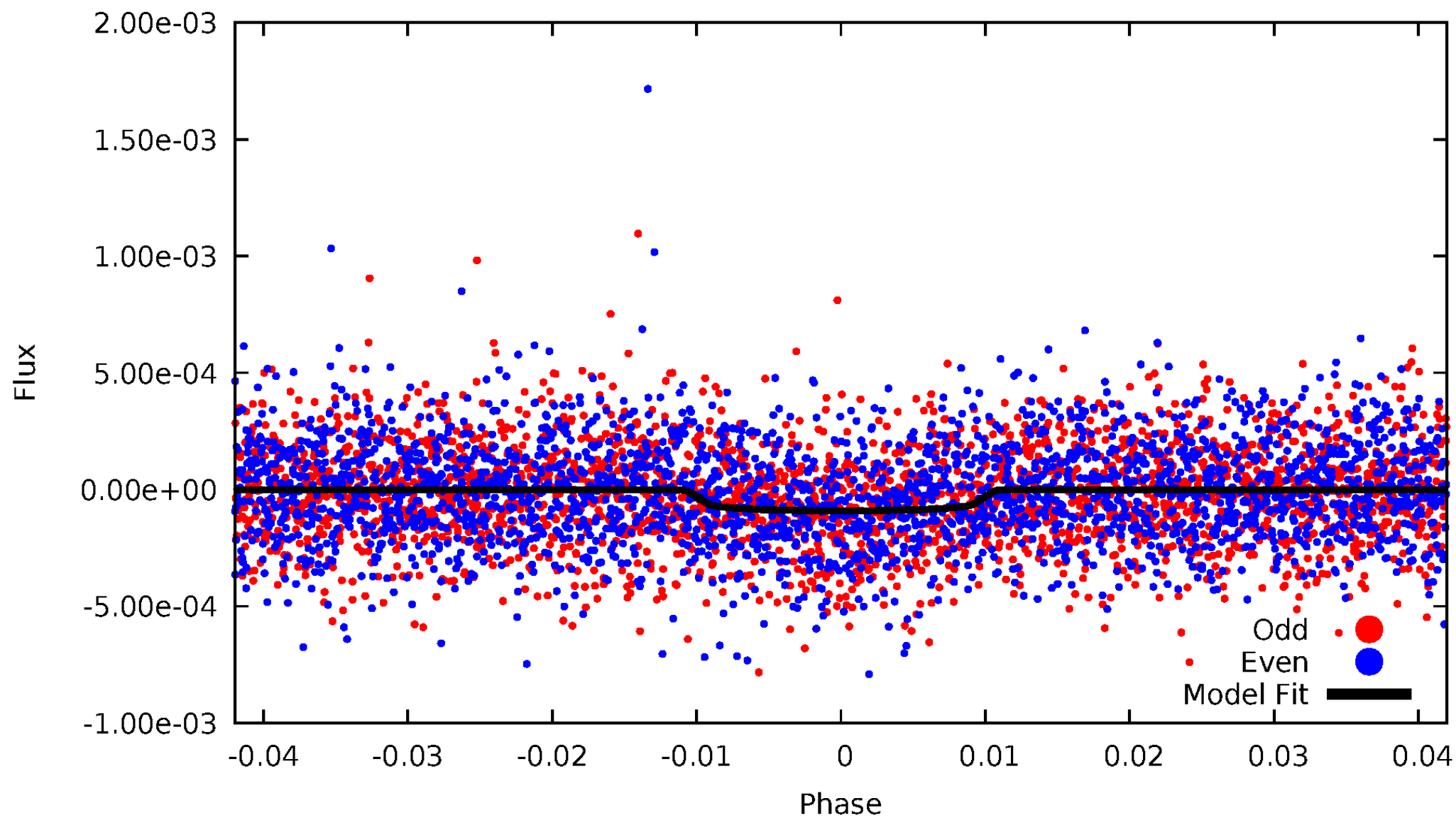


TCE 009821454-02



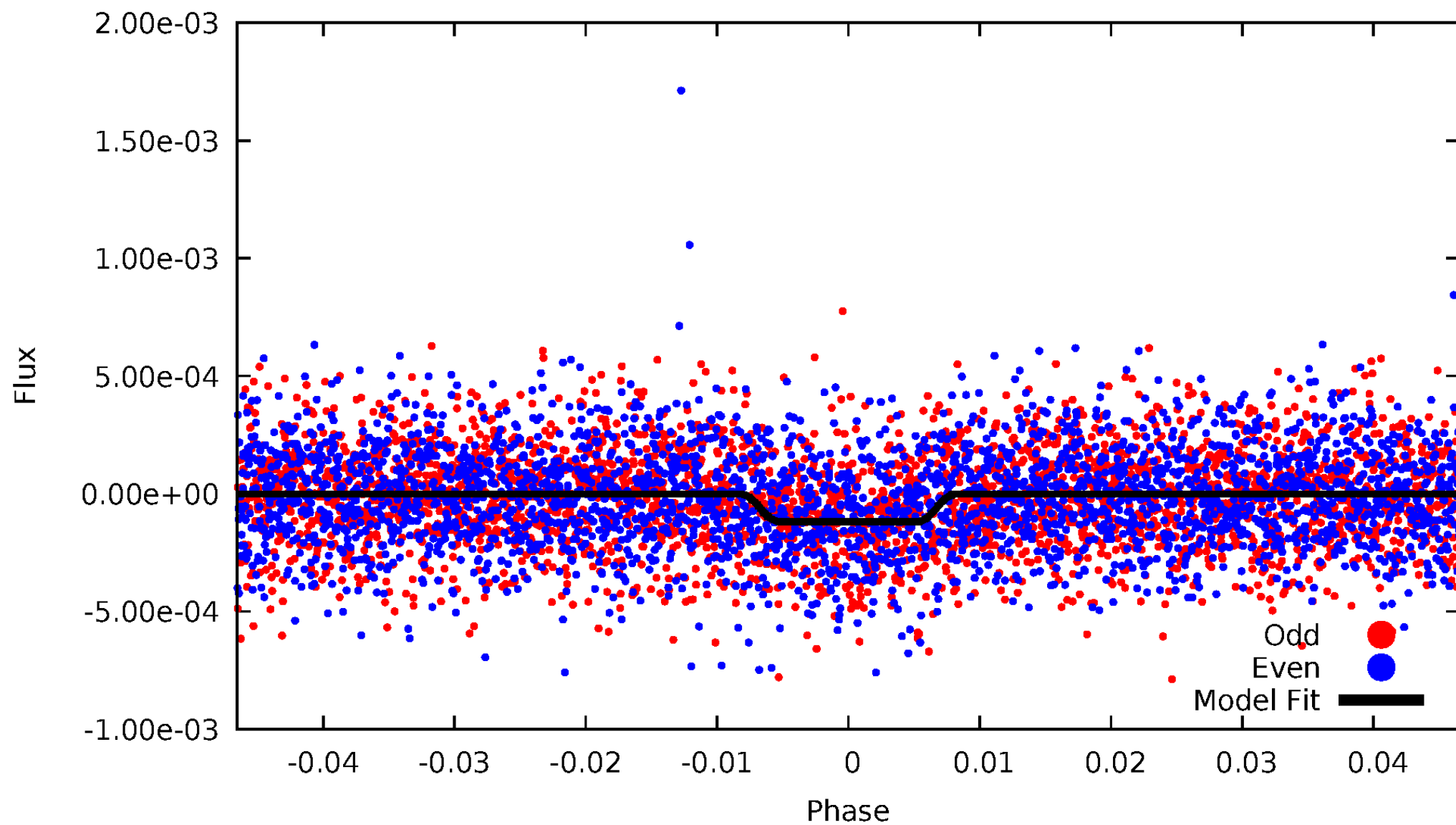
# DV Odd/Even

TCE 009821454-02



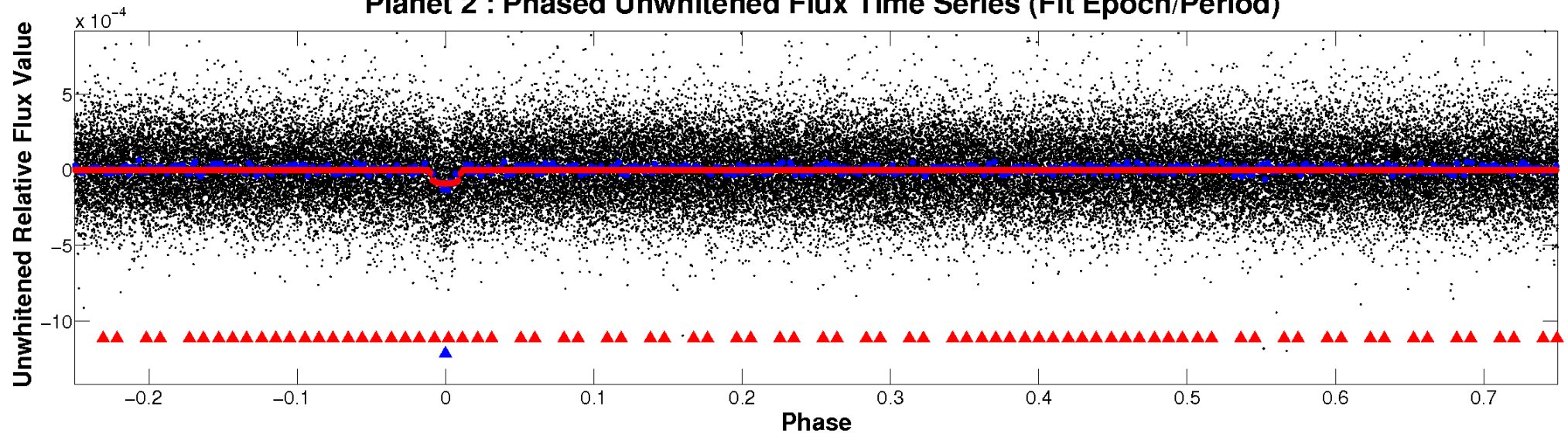
# ALT Odd/Even

TCE 009821454-02

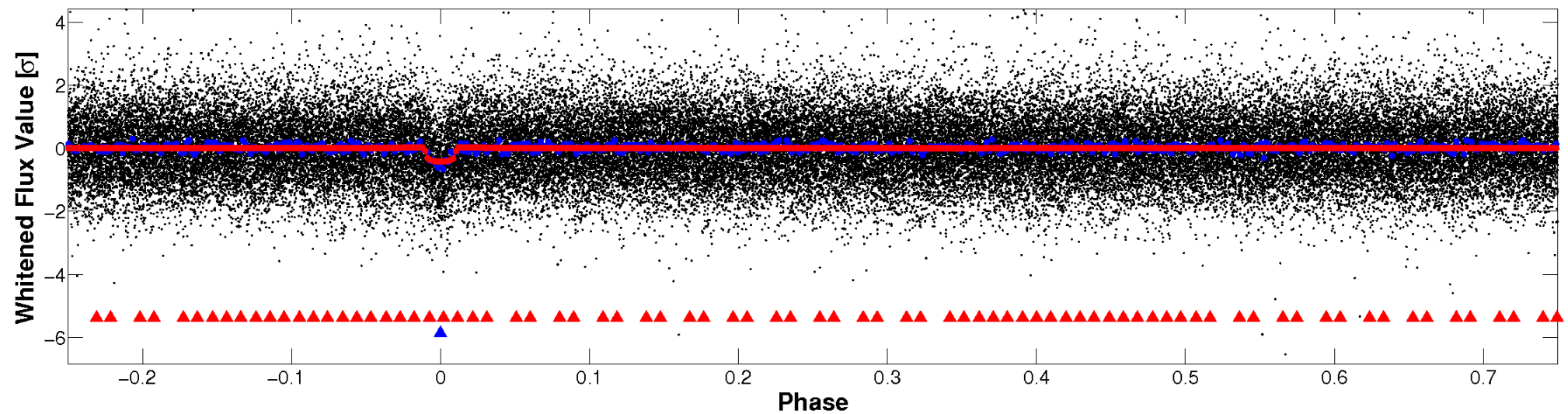


# Non-Whitened Vs. Whitened Light Curve

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



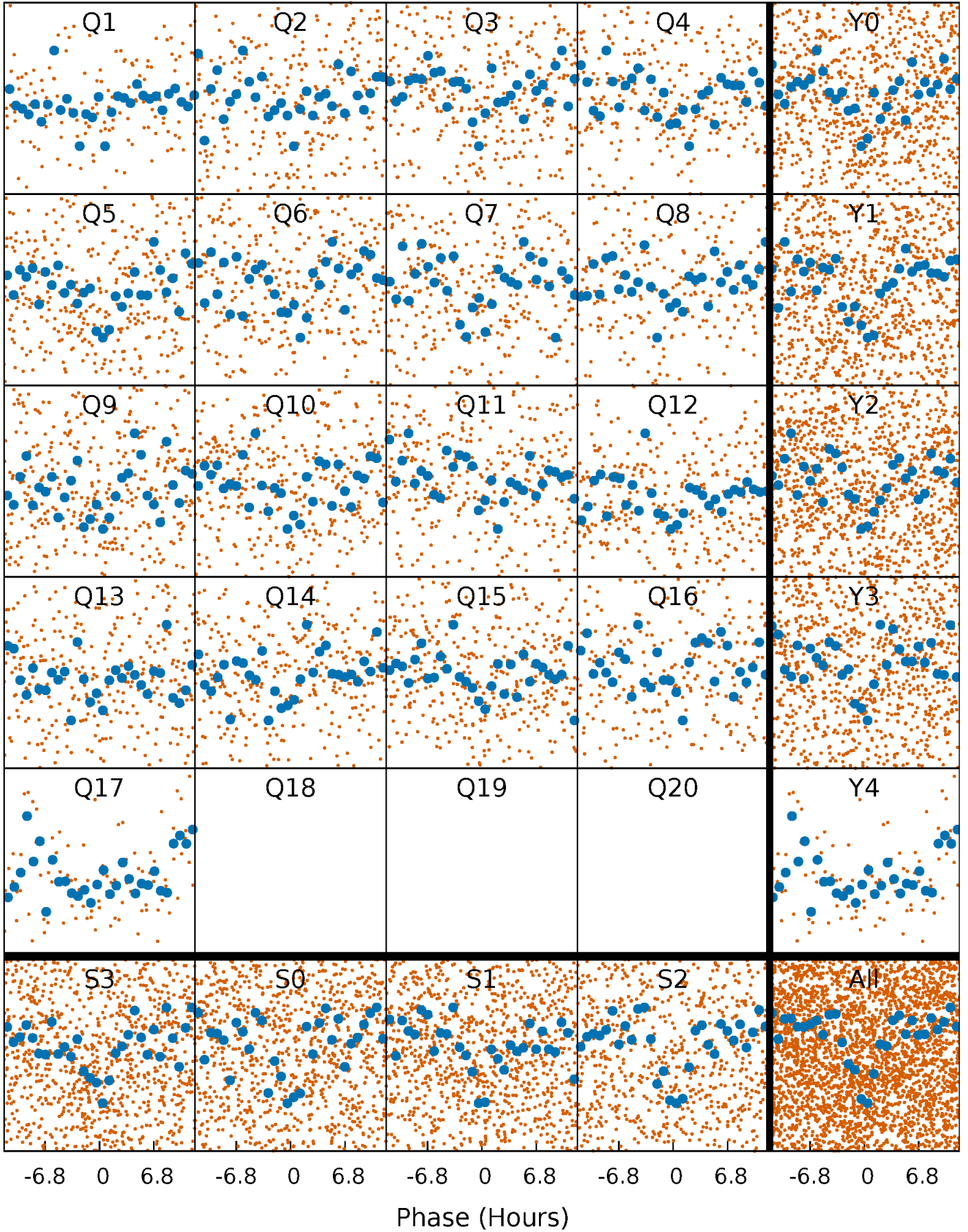
## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)





# PDC Quarter-Phased Transit Curves

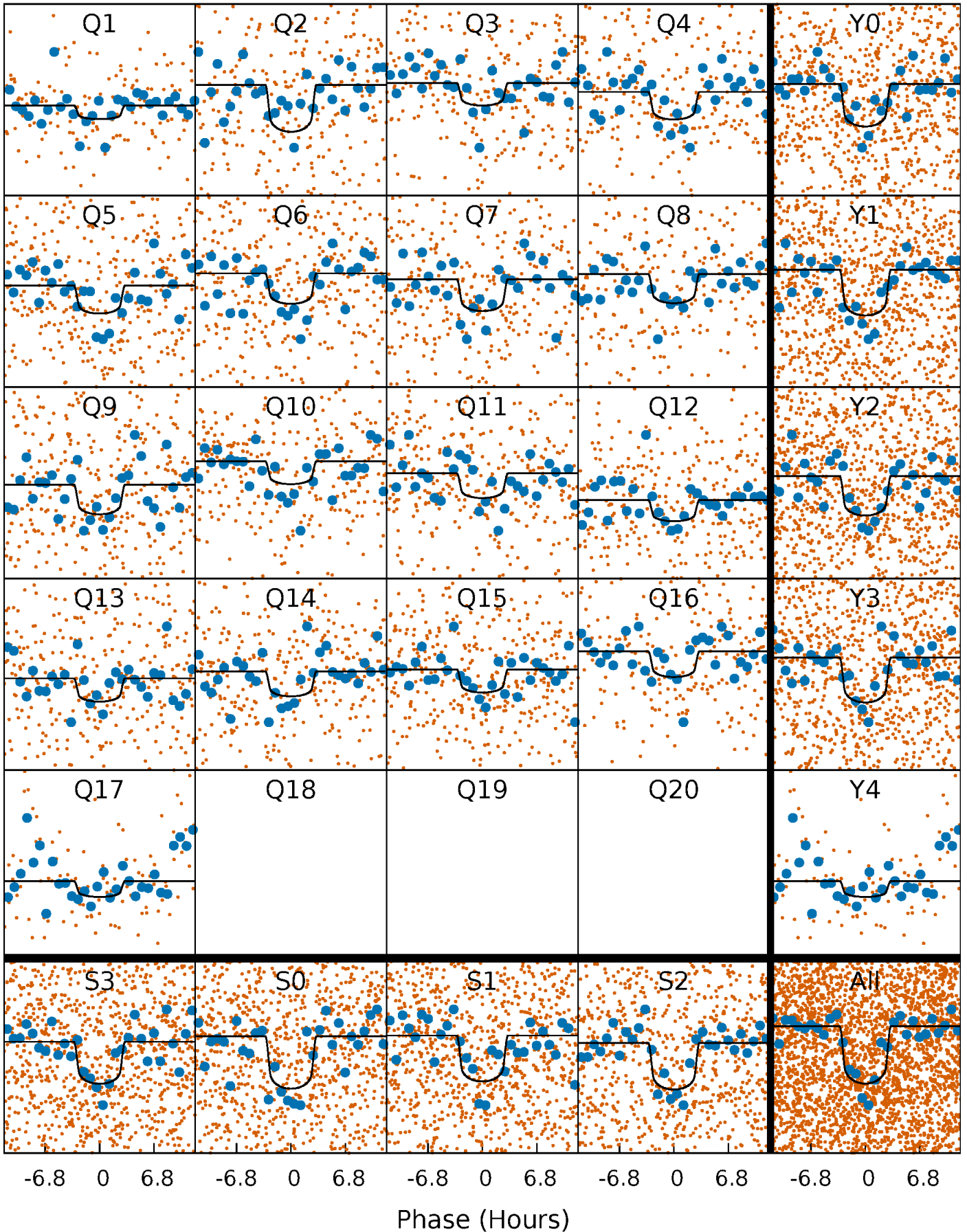
TCE 009821454-02 P= 11.869757 Days  $T_0=137.698547$  (BKJD)





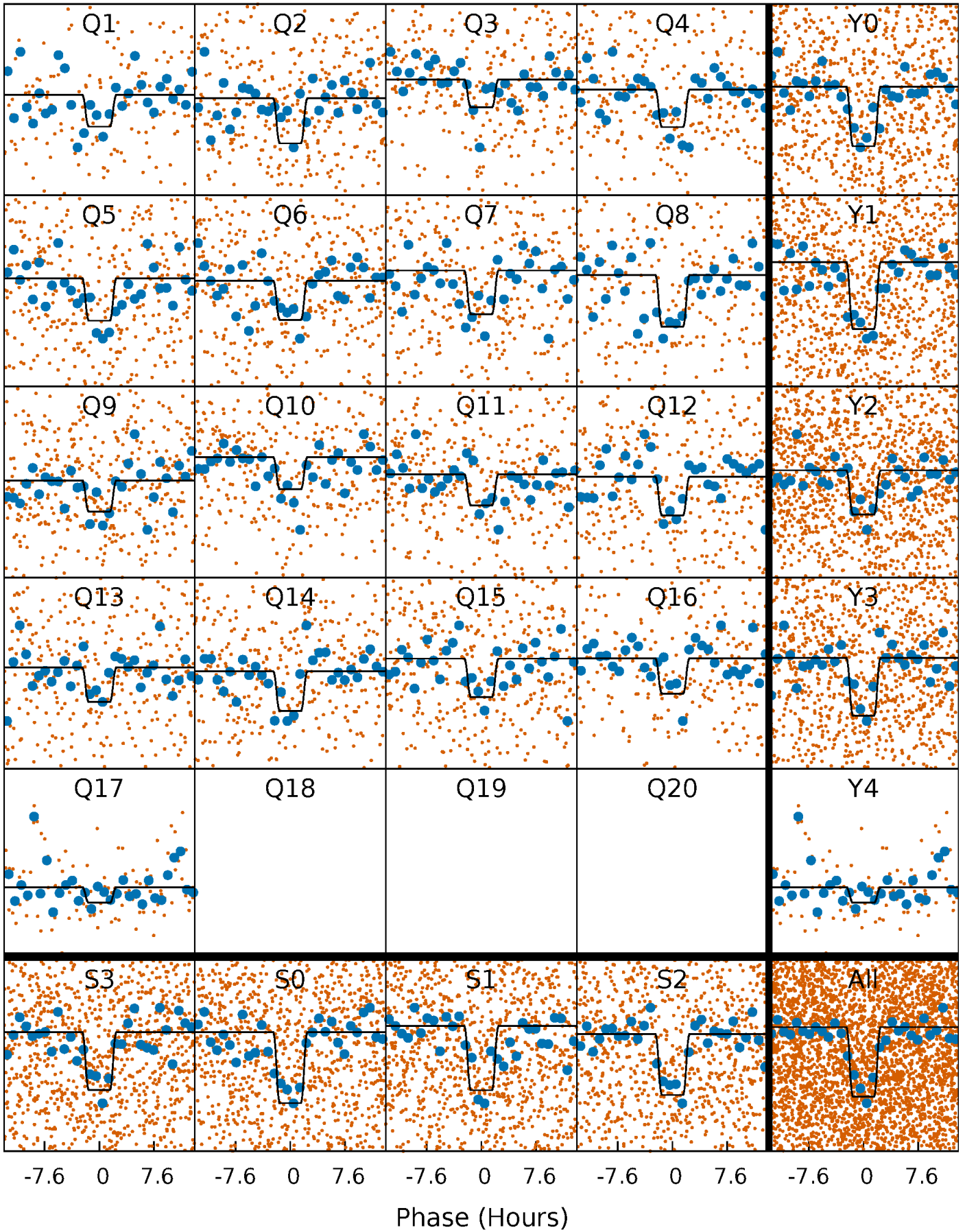
# DV Quarter-Phased Transit Curves

TCE 009821454-02 P= 11.869757 Days  $T_0=137.698547$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

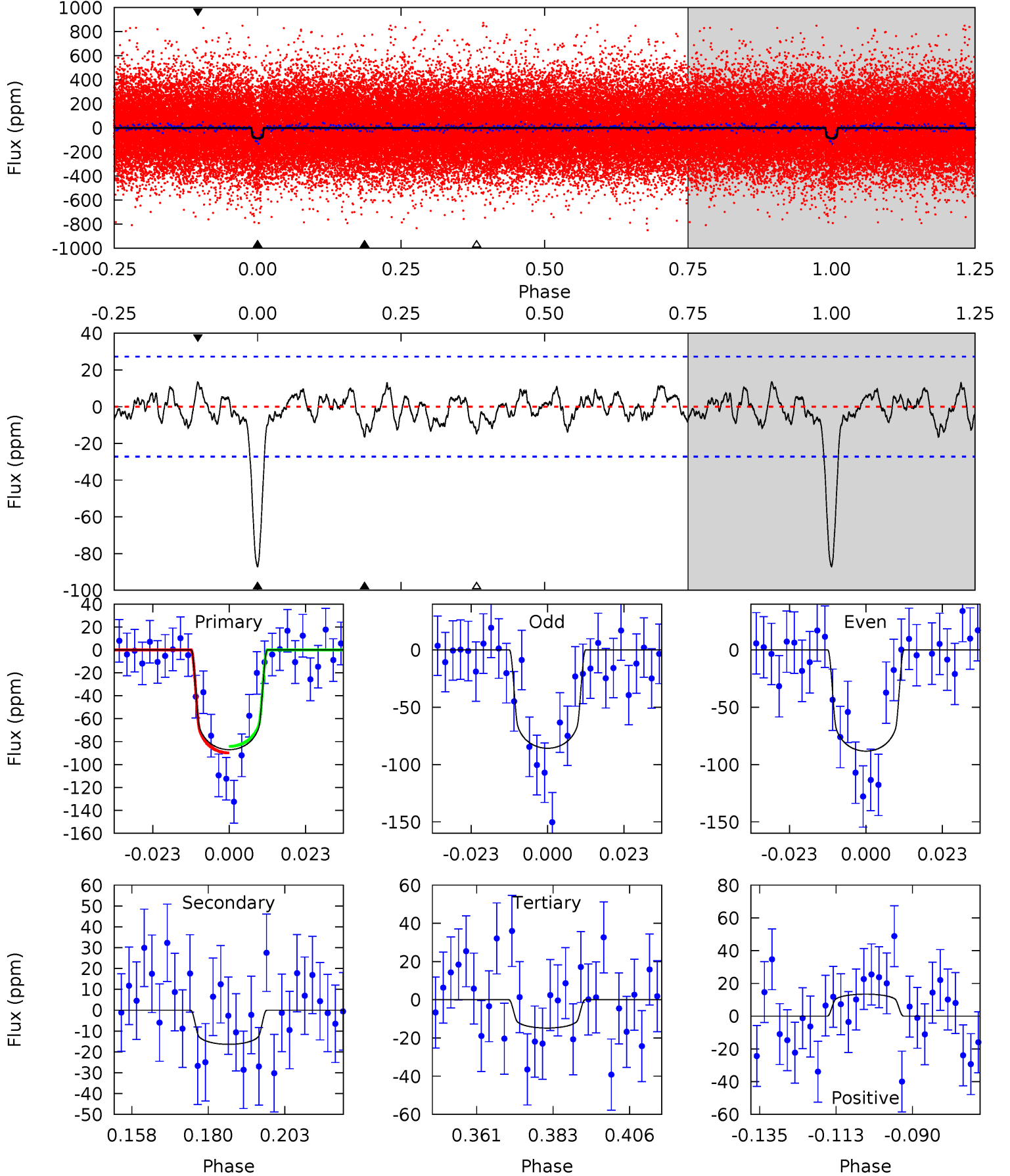
TCE 009821454-02 P= 11.869639 Days  $T_0=137.701211$  (BKJD)



# DV Model-Shift Uniqueness Test

009821454-02,  $P = 11.869757$  Days,  $E = 125.828790$  Days

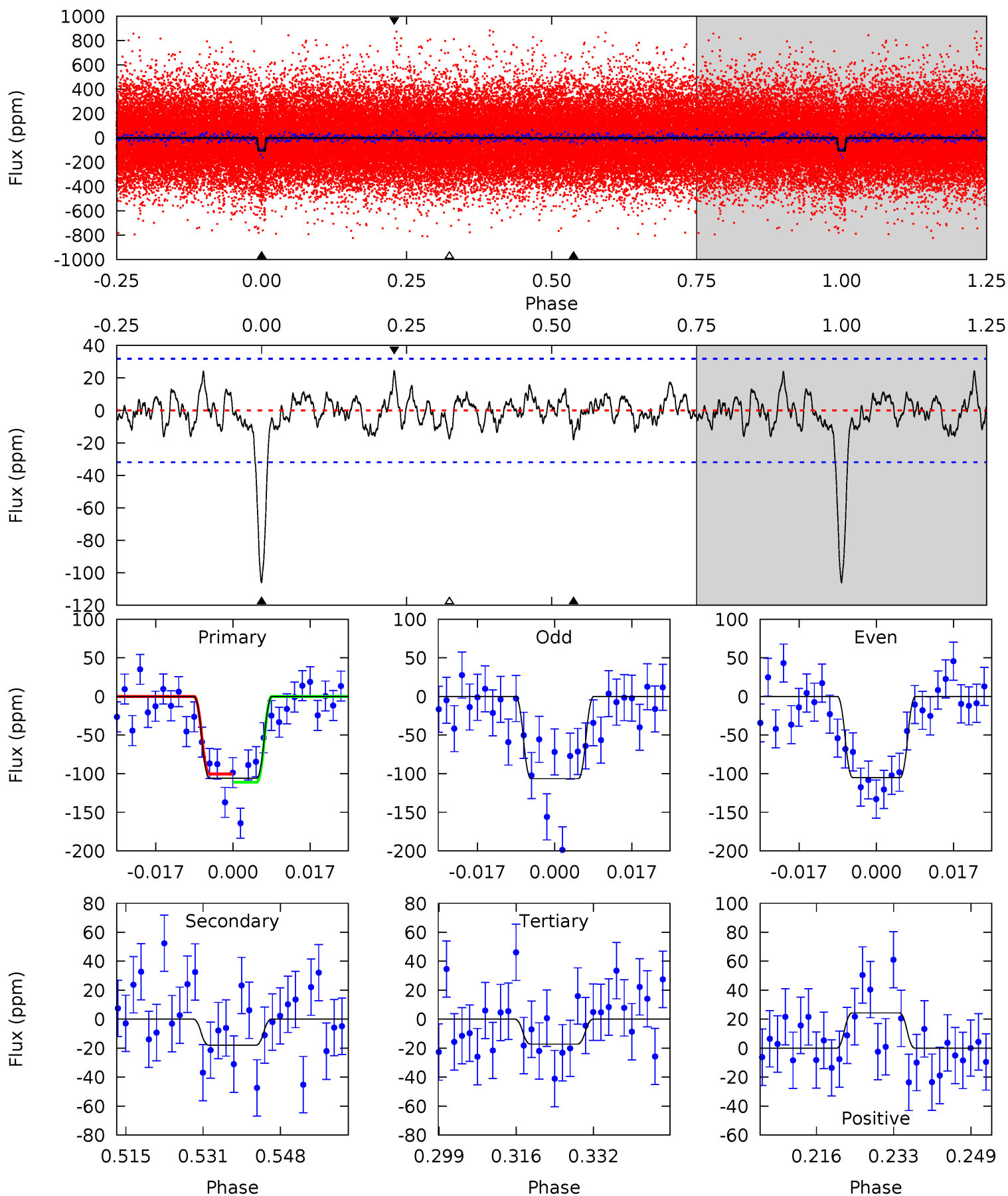
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
15.6	2.93	2.65	2.40	4.87	2.28	1.02	12.9	13.2	0.28	0.53	0.23	1.09	0.13	0.52



# Alt Model-Shift Uniqueness Test

009821454-02,  $P = 11.869639$  Days,  $E = 125.831572$  Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
16.4	2.78	2.66	3.76	4.93	2.40	1.12	13.7	12.6	0.12	-0.97	0.11	1.06	0.19	0.83



### Stellar Parameters For KIC 009821454

	$T_{\text{eff}}(K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6296^{+169}_{-207}$	$4.460^{+0.052}_{-0.221}$	$-0.260^{+0.250}_{-0.350}$	$1.006^{+0.312}_{-0.111}$	$1.066^{+0.143}_{-0.143}$	$1.473^{+0.404}_{-0.754}$
	+3%/-3%	+1%/-5%	+96%/-135%	+31%/-11%	+13%/-13%	+27%/-51%
Source	PHO1	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 009821454-02 / KOI 1529.02

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-16 \pm 6$	$1.17^{+0.42}_{-0.34}$	$1234^{+92}_{-60}$	$4181^{+628}_{-446}$	$66^{+76}_{-35}$
Alt.	$-18 \pm 6$	$1.26^{+0.37}_{-0.31}$	$1234^{+90}_{-59}$	$4184^{+543}_{-476}$	$66^{+60}_{-33}$

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

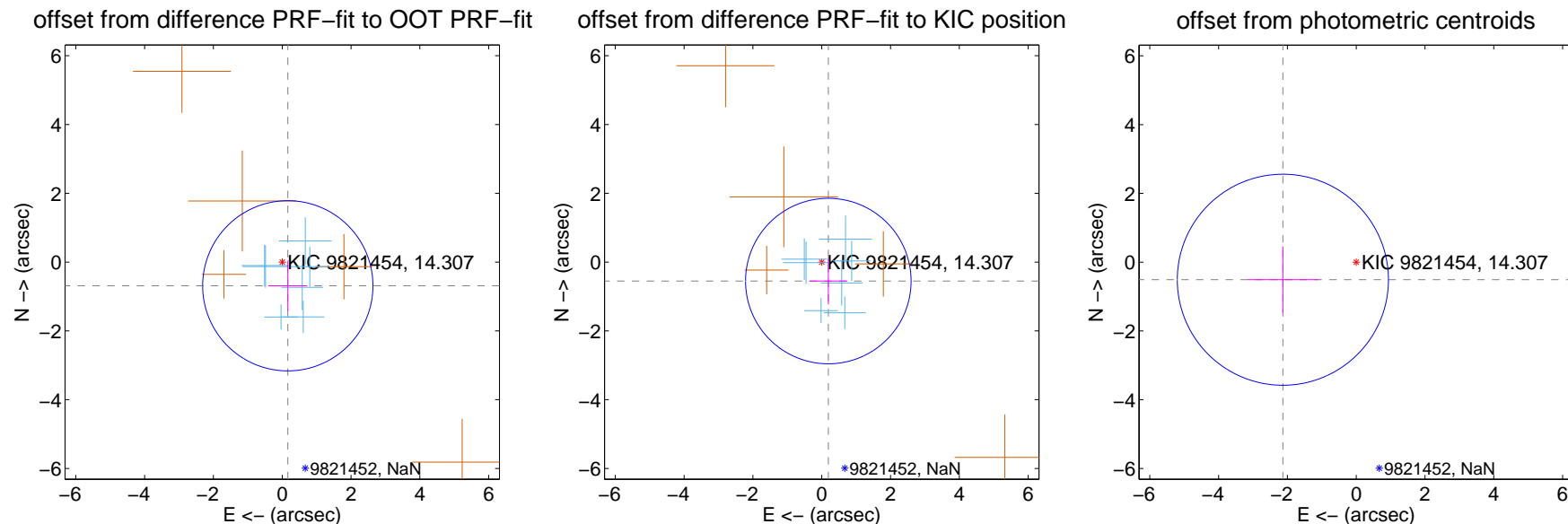
## DV Centroid Data

Supplemental centroid analysis for 009821454-02. Kepler magnitude: 14.31. Transit SNR 12.73

There are 7 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.16 arcsec

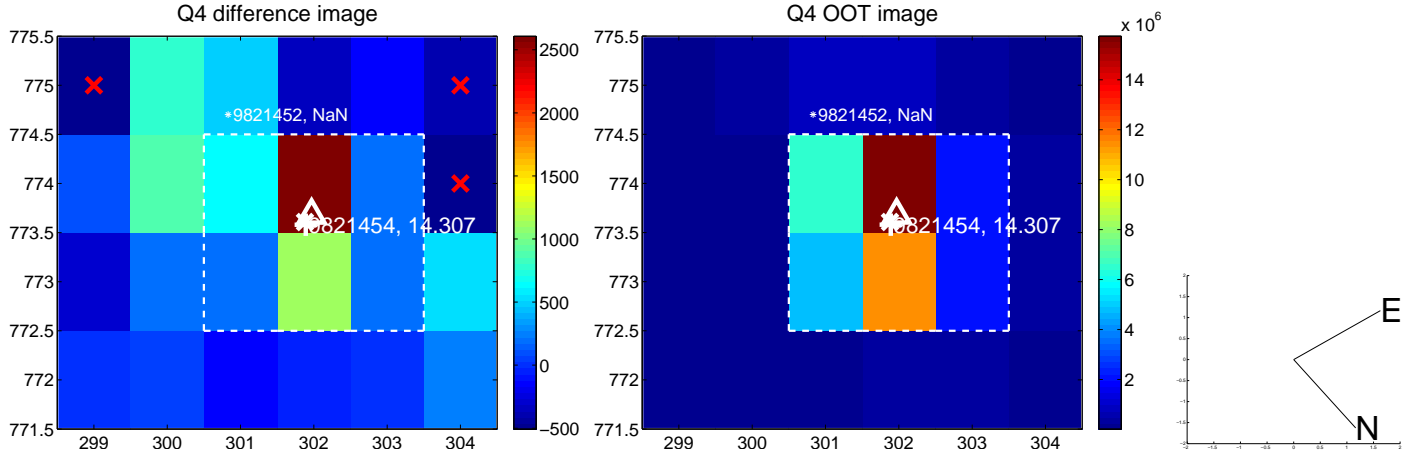
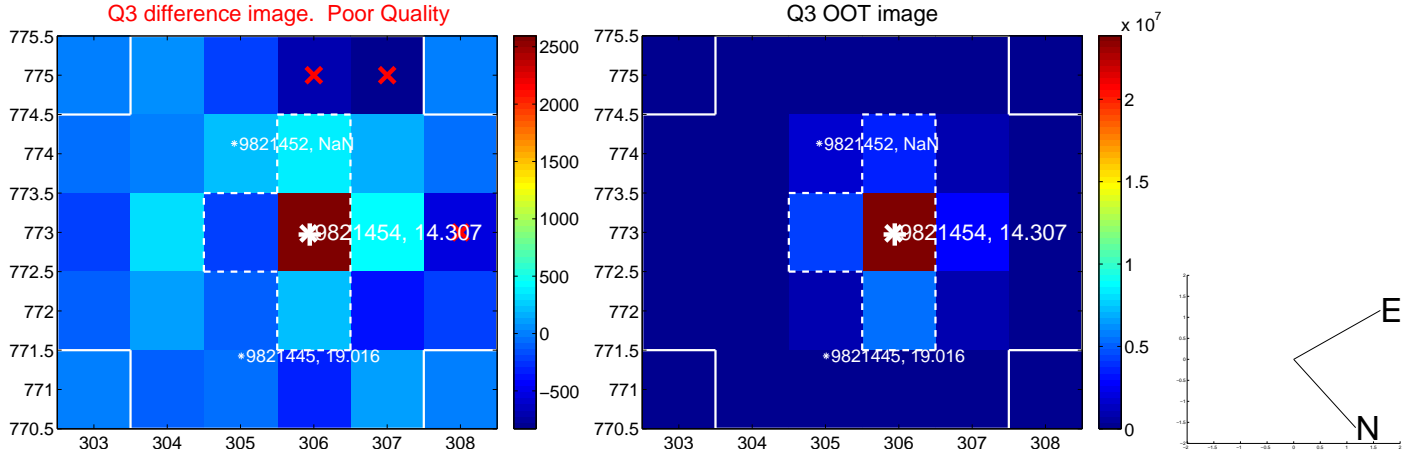
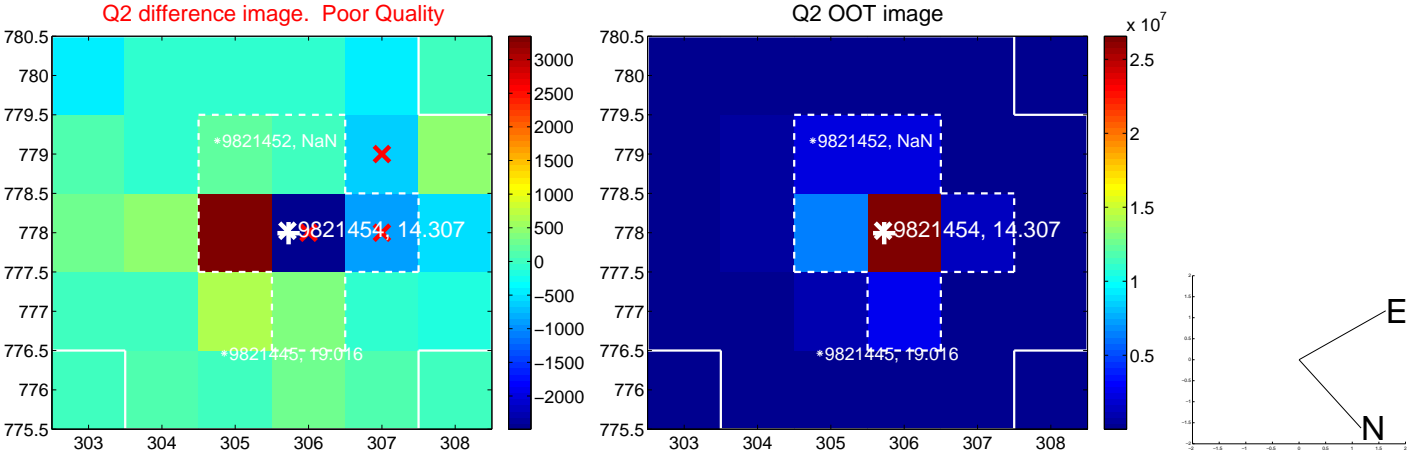
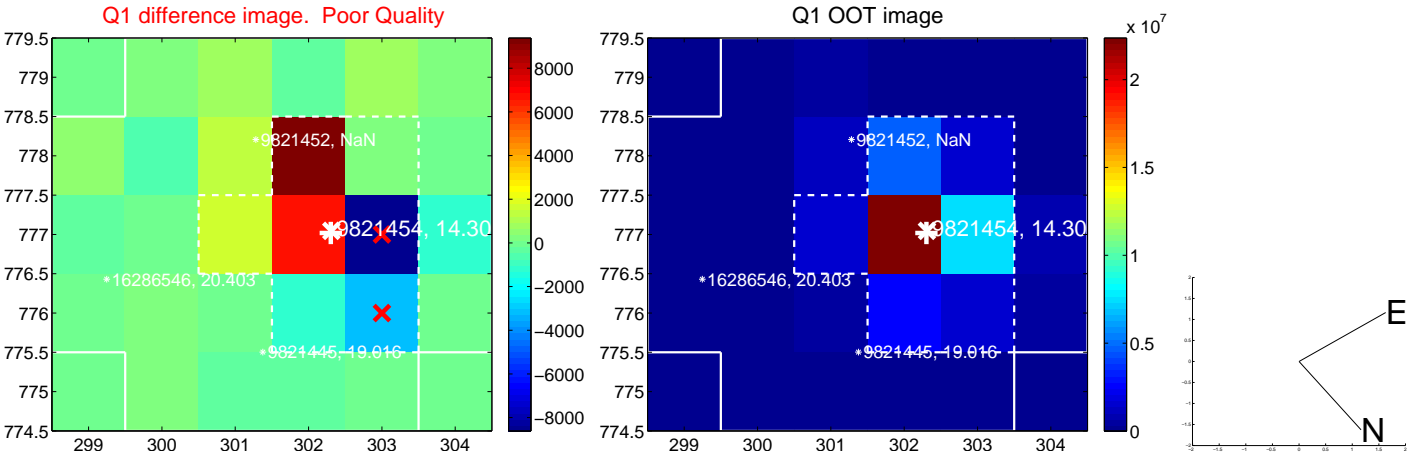
	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.708 \pm 0.825$	0.86	$-0.162 \pm 0.565$	$-0.689 \pm 0.733$
PRF-fit source offset from KIC position	$0.584 \pm 0.802$	0.73	$-0.192 \pm 0.551$	$-0.552 \pm 0.679$
photometric centroid source offset	$2.19 \pm 1.02$	2.14	$2.13 \pm 1.03$	$-0.51 \pm 0.97$



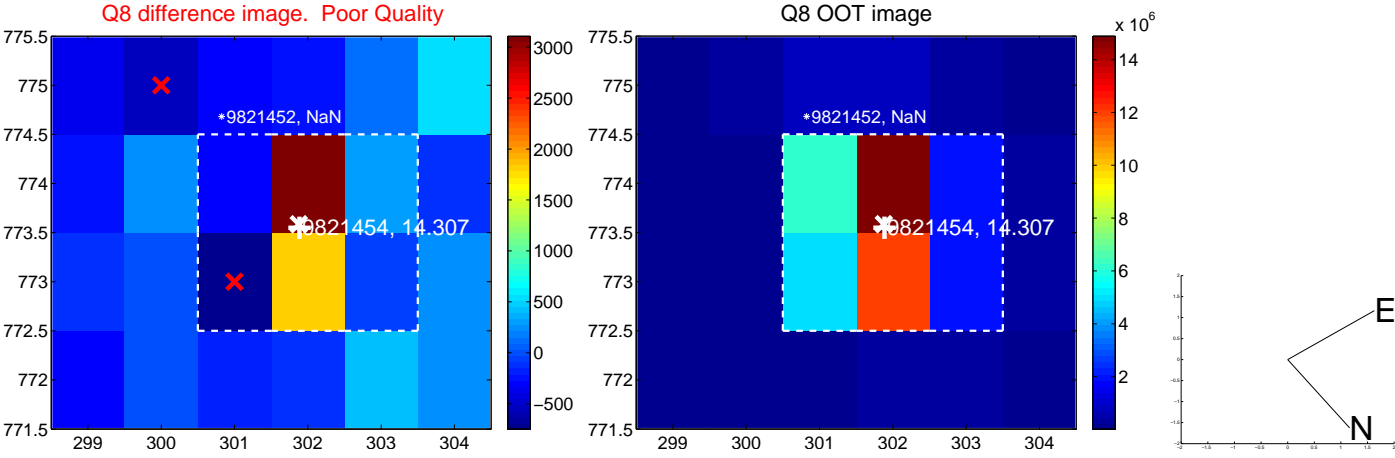
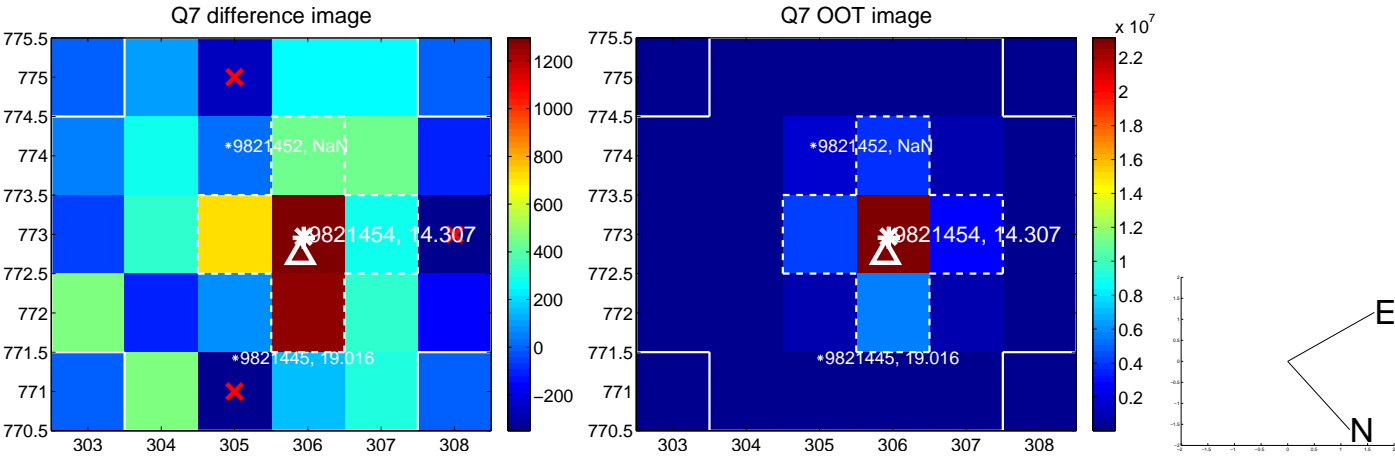
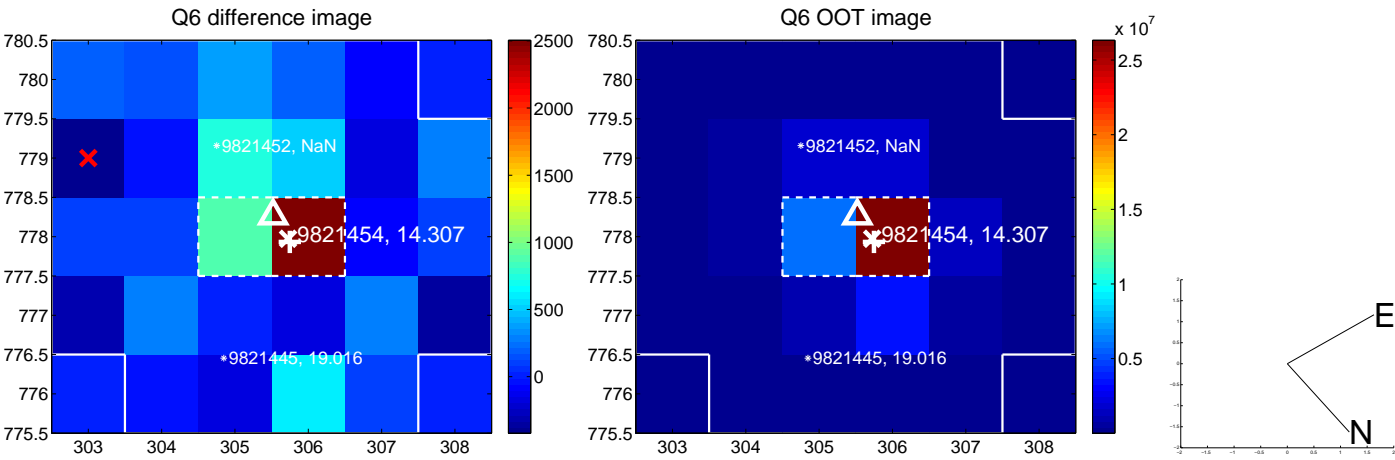
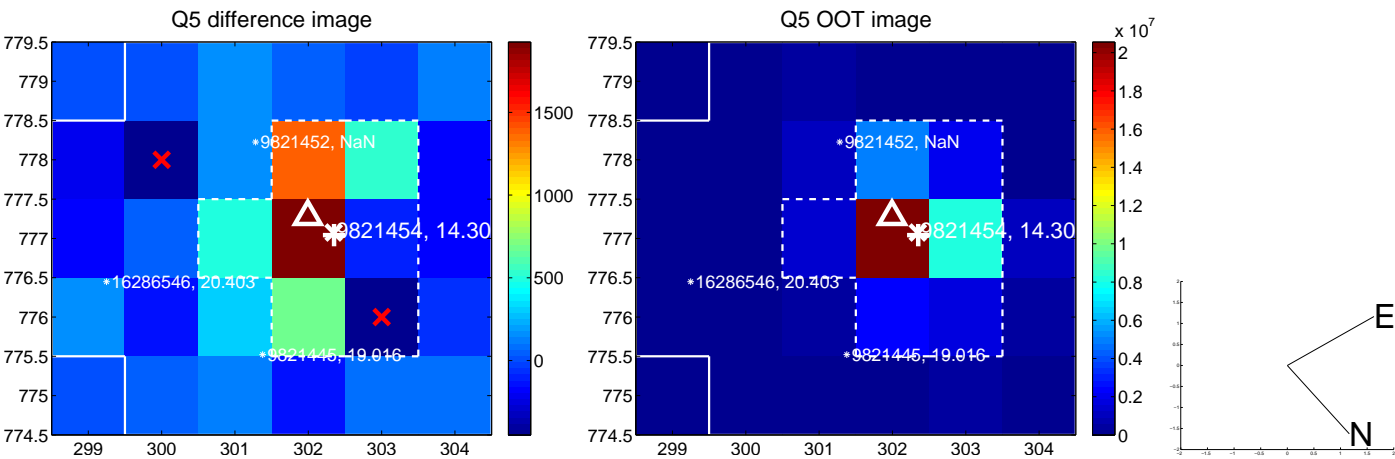
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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



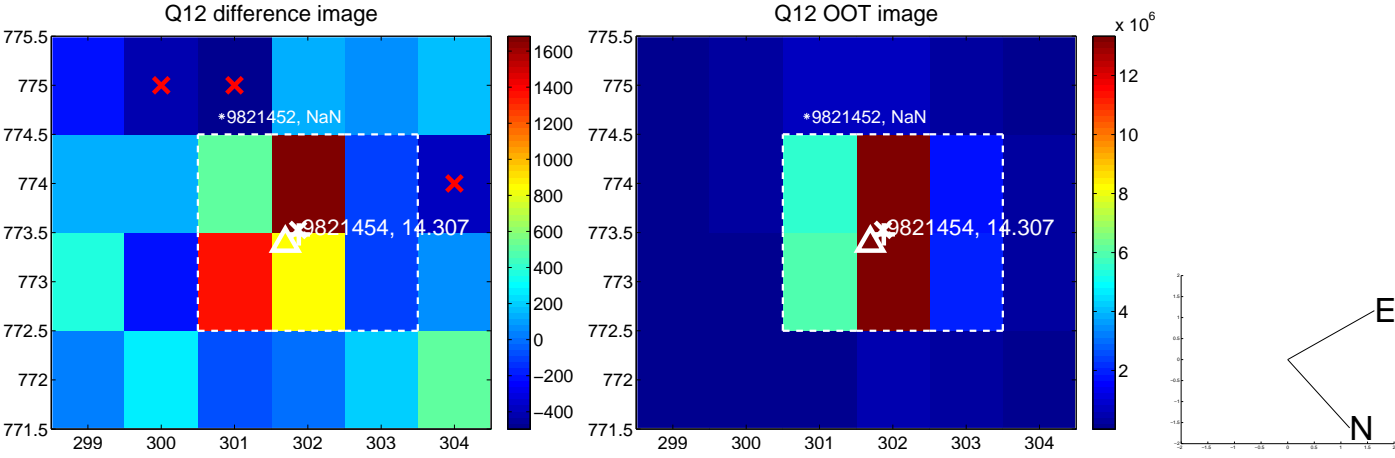
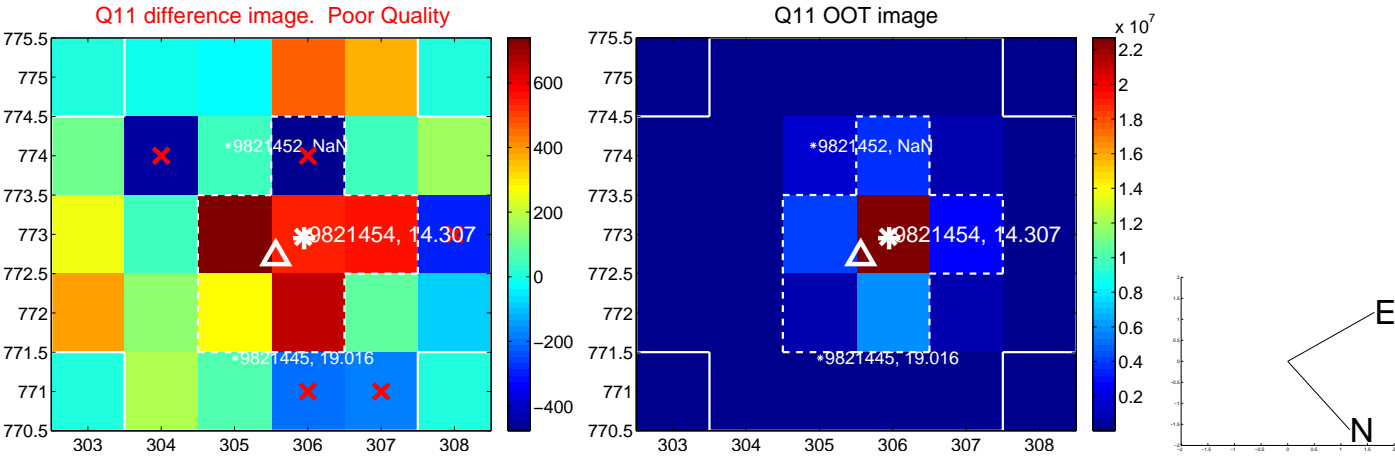
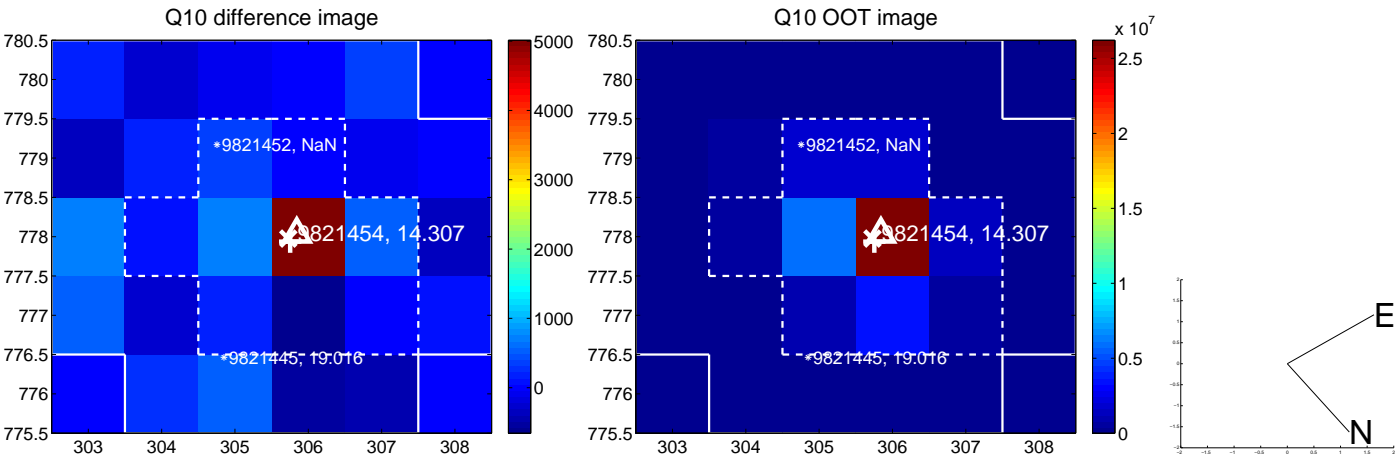
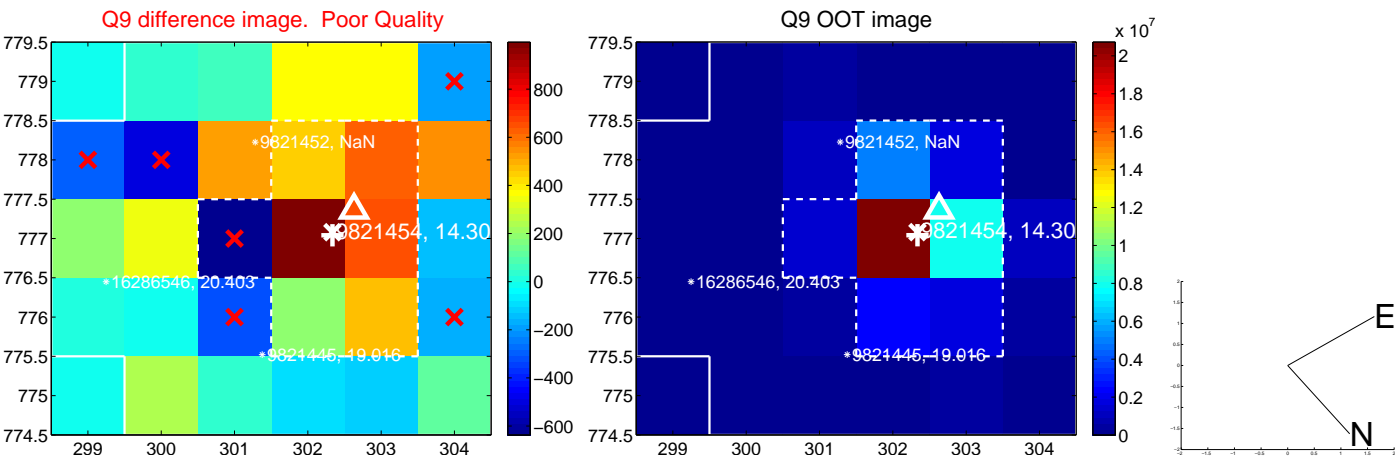
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



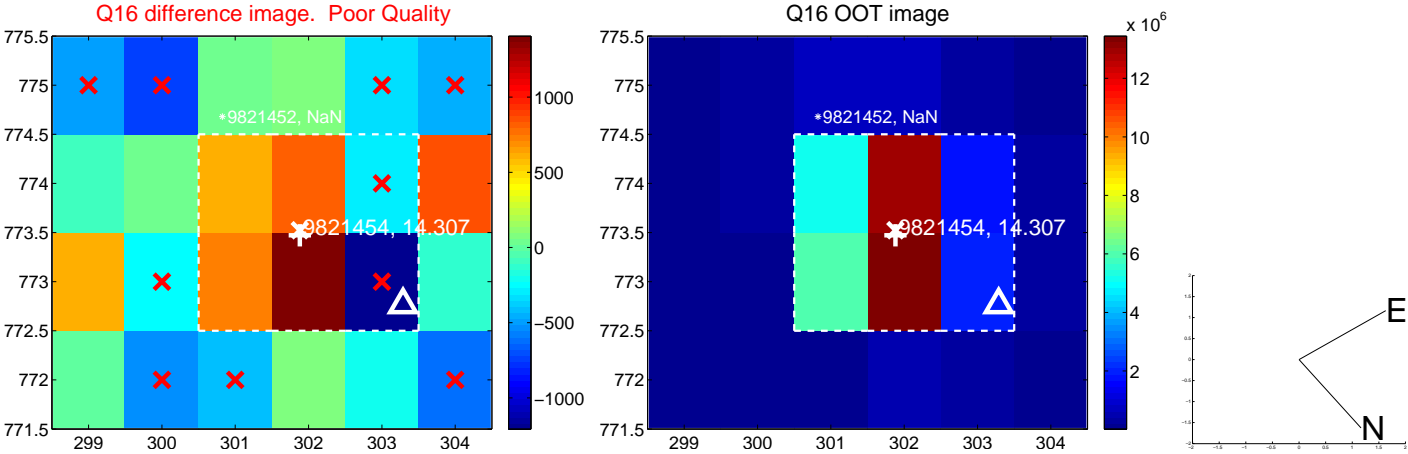
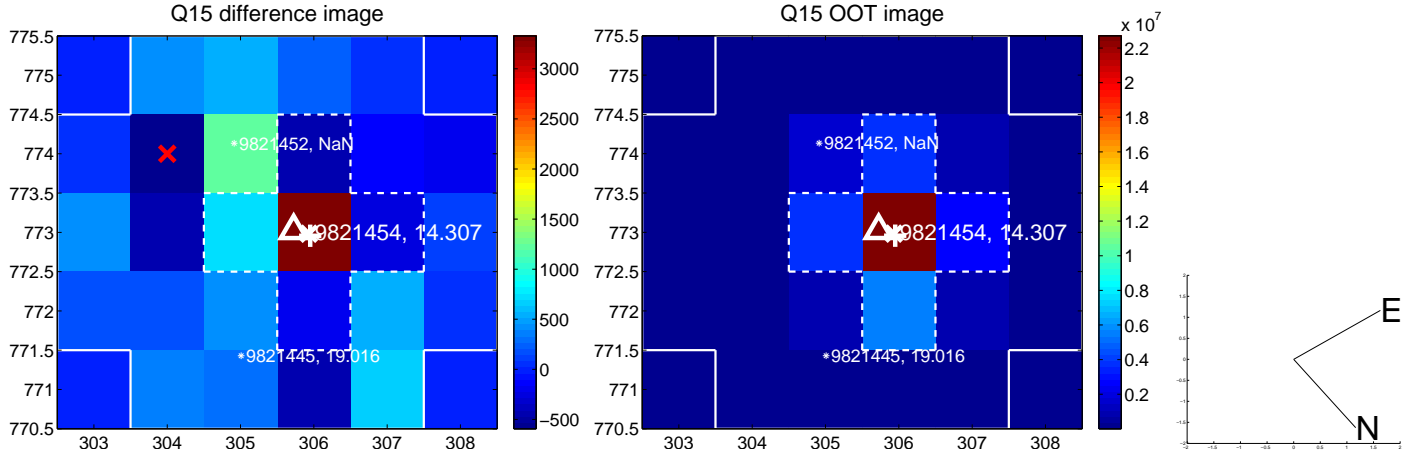
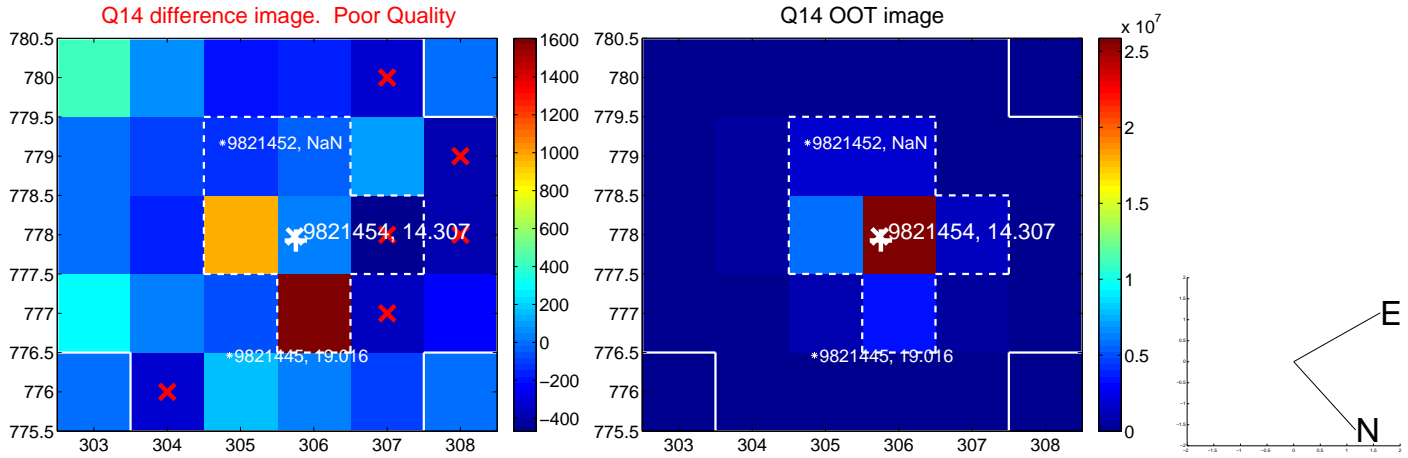
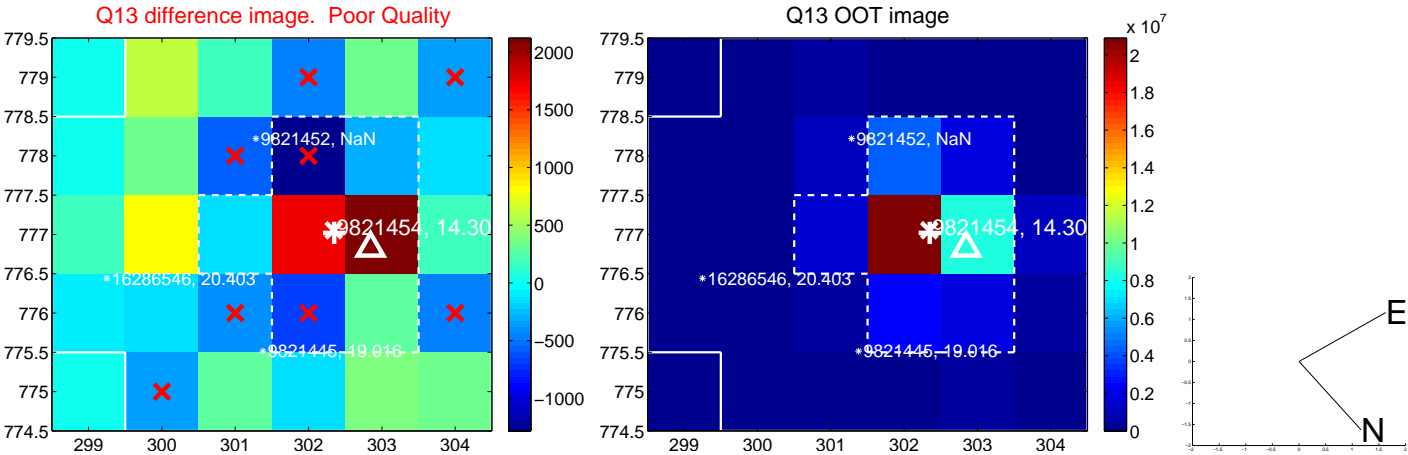
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



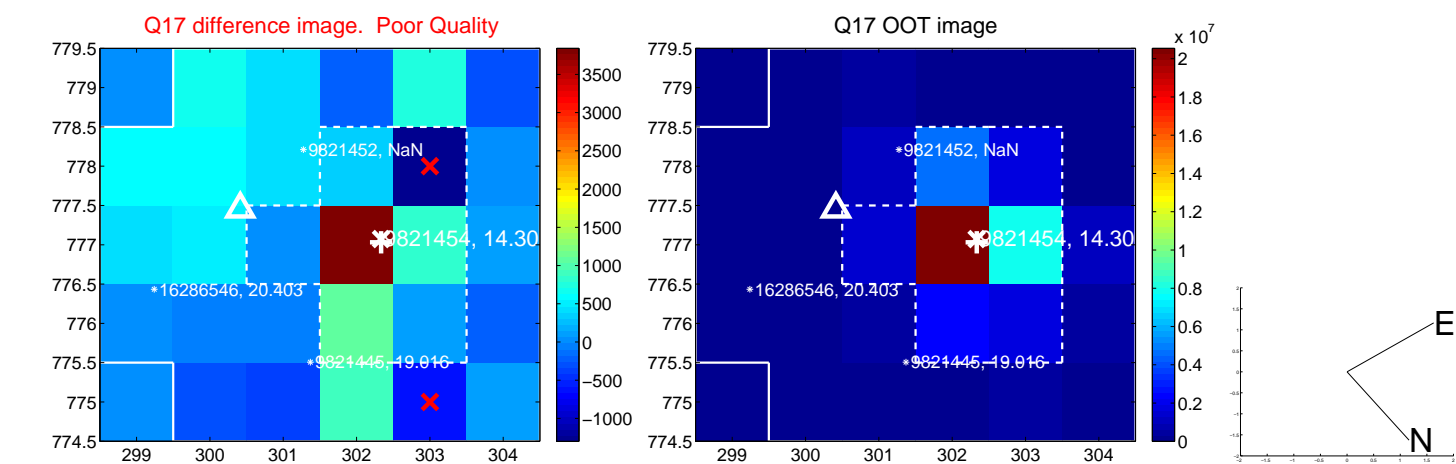
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



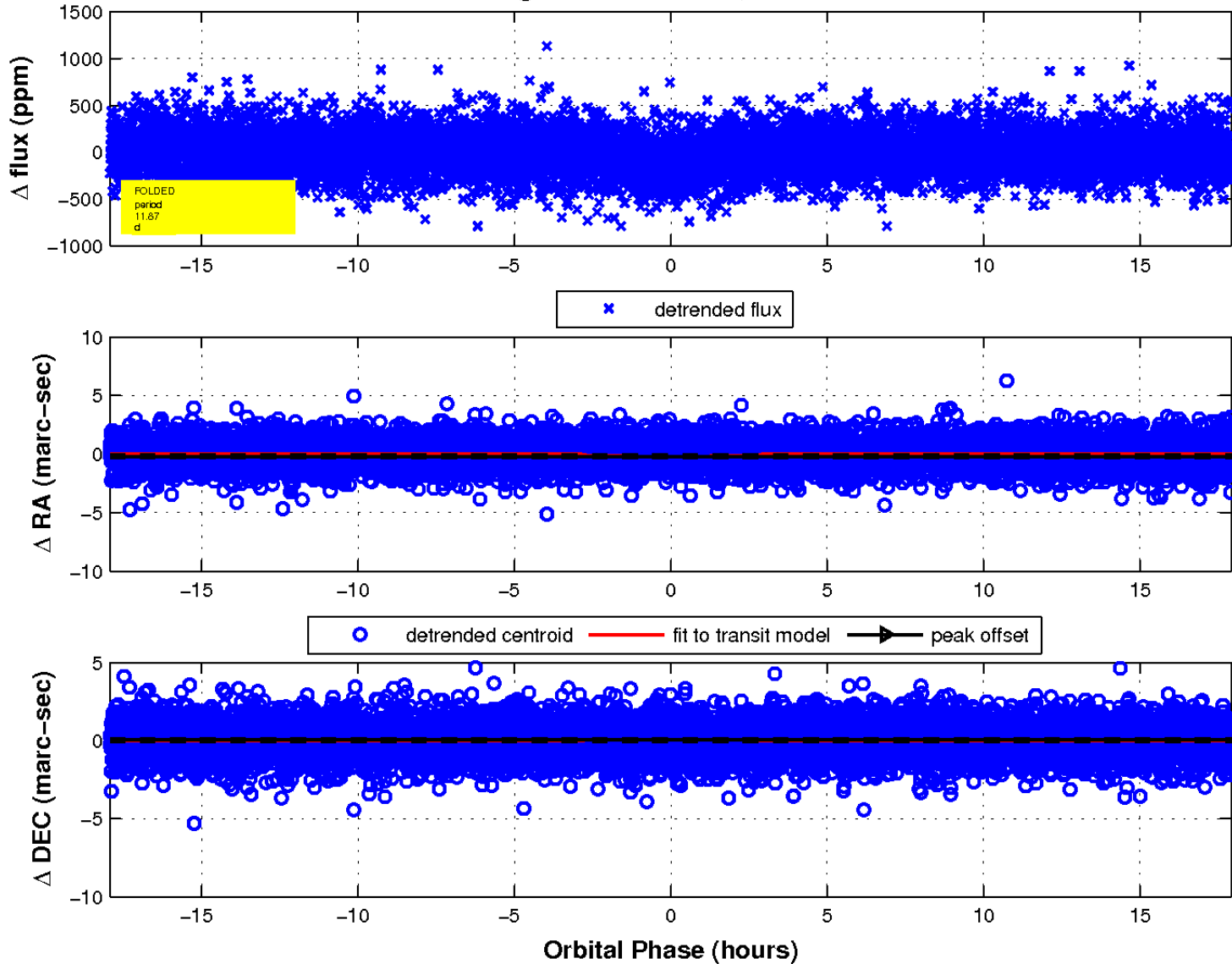
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 2 of 2



# UKIRT Image

Declination

