

# KIC 008972058

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
008972058-01	OBS	0159.01	8.990887	136.738757	465.4	4.321	72.1	80.8	1.17	5881	2.91	200.75
008972058-02	OBS	0159.02	2.403622	132.331990	69.6	1.605	15.1	16.0	1.17	5881	1.16	1165.69

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
008972058-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
008972058-02	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.

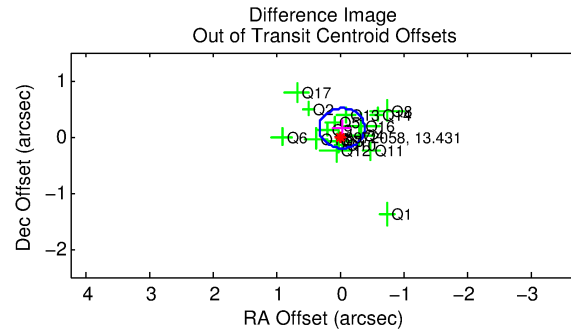
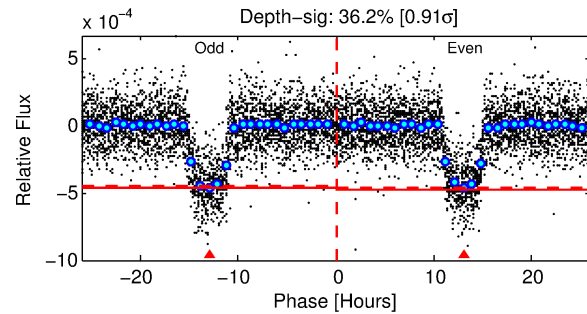
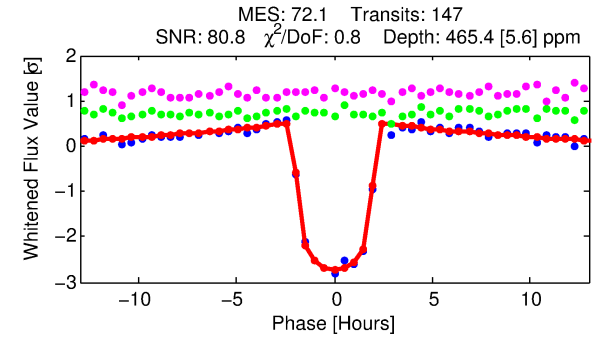
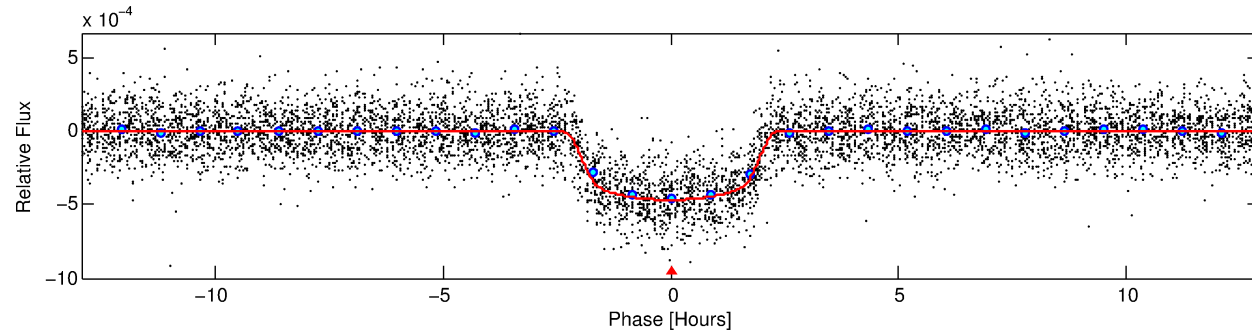
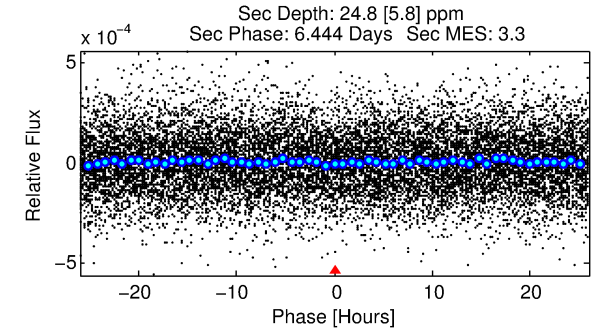
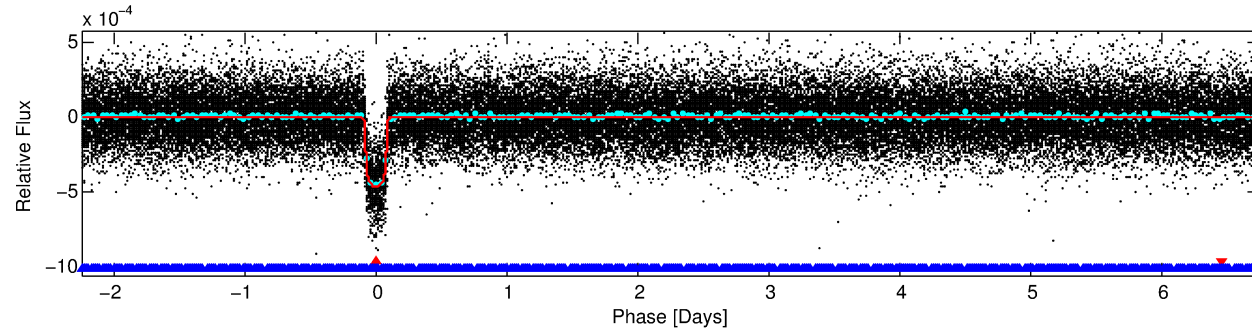
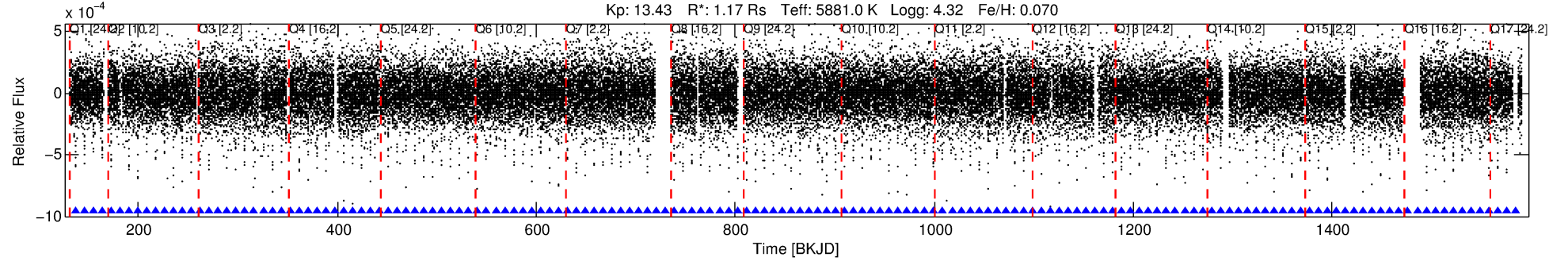
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 008972058-01

No Significant Match Found

# DV One-Page Summary

KIC: 8972058 Candidate: 1 of 2 Period: 8.991 d  
KOI: K00159.01 Name: Kepler-115c Corr: 0.975



## DV Fit Results:

Period = 8.99089 [0.00001] d  
Epoch = 136.7388 [0.0009] BKJD  
Rp/R\* = 0.0228 [0.0011]  
a/R\* = 8.76 [1.98]  
b = 0.86 [0.07]  
Seff = 200.76 [44.87]  
Teq = 960 [54] K  
Rp = 2.91 [0.51] Re  
a = 0.0856 [0.0122] AU  
Ag = 11.82 [3.87] [2.80σ]  
Teffp = 2752 [182] K [9.46σ]

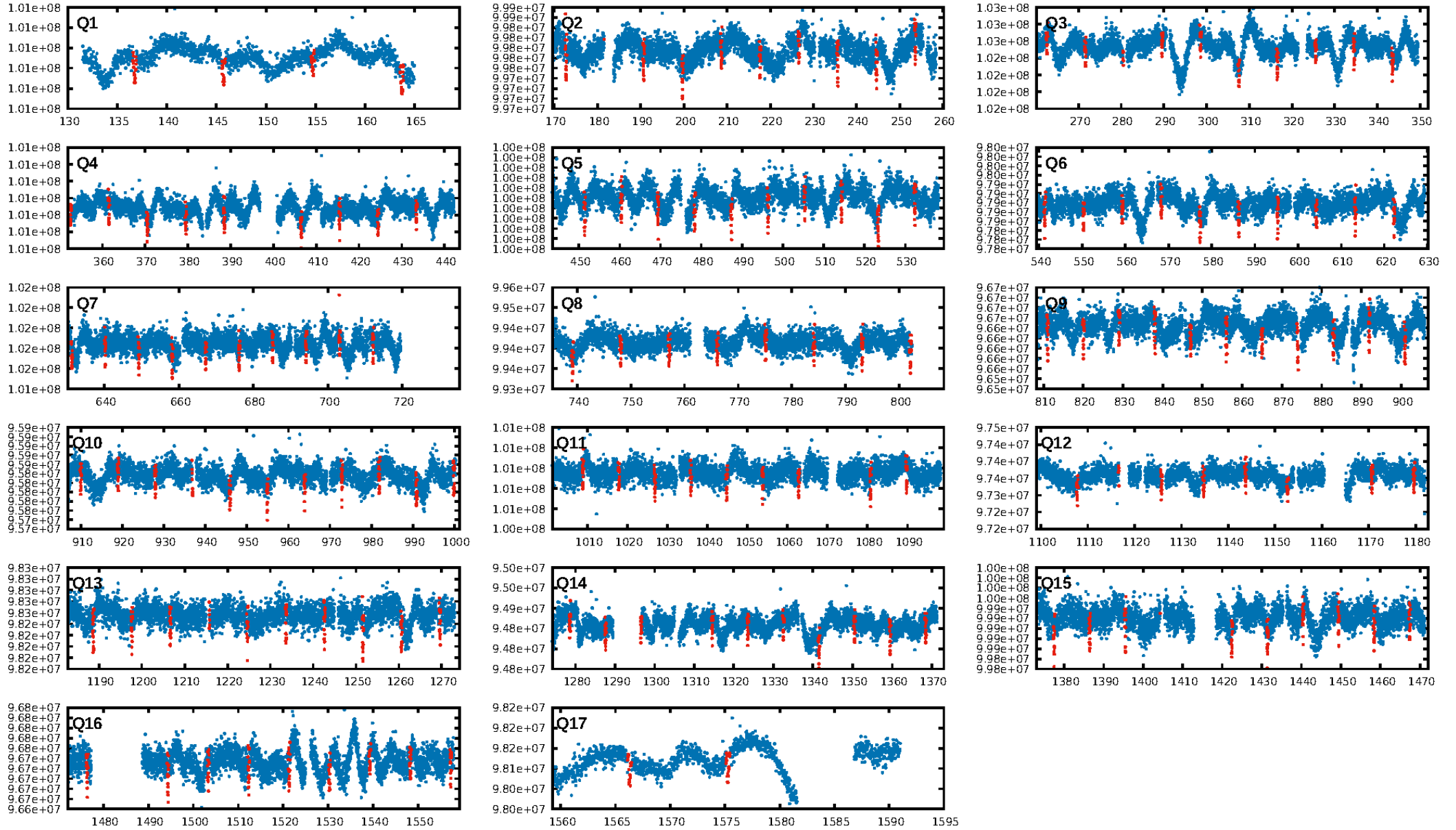
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [34.30σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 99.9%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 1.00 [141/141]  
GhostDiagnostic-chr: 6.372  
Centroid-sig: 94.7%  
Centroid-so: 0.241 arcsec [1.63σ]  
OotOffset-rm: 0.149 arcsec [1.26σ]  
KicOffset-rm: 0.385 arcsec [2.57σ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 1.00 [17/17]  
DiffImageOverlap-fno: 1.00 [17/17]

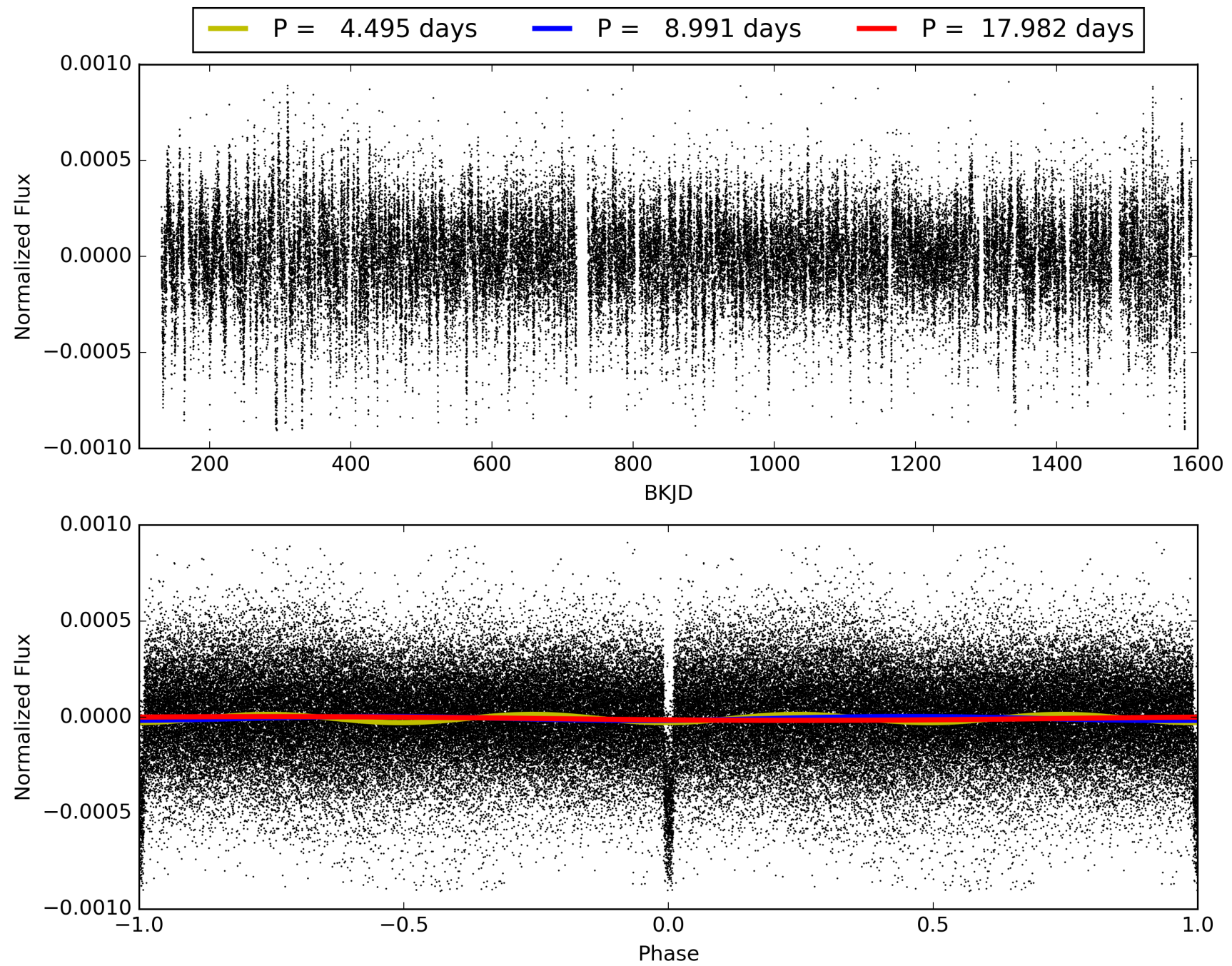
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 20:51:22 Z

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

# TCE 008972058-01, PDC Light Curves

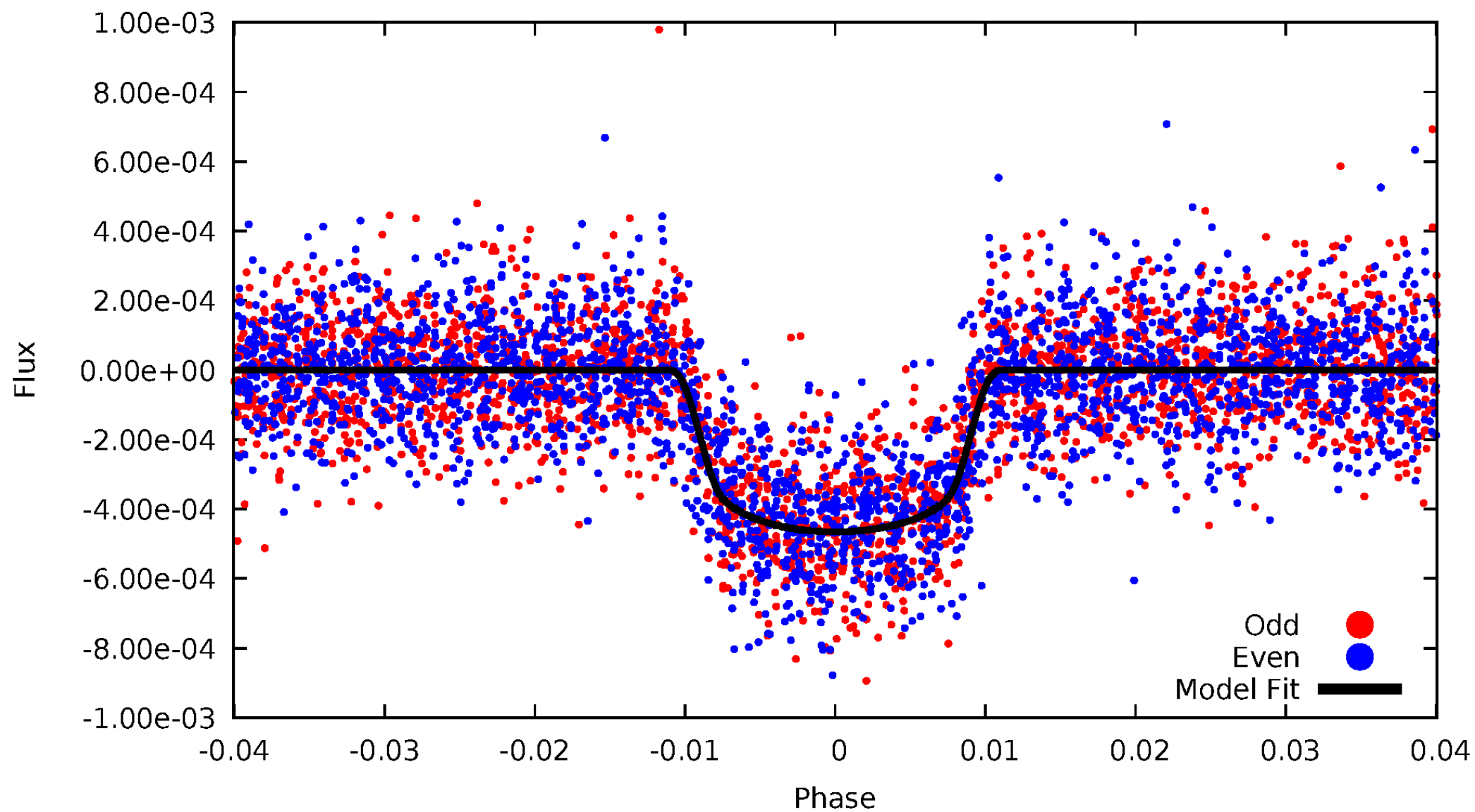


TCE 008972058-01



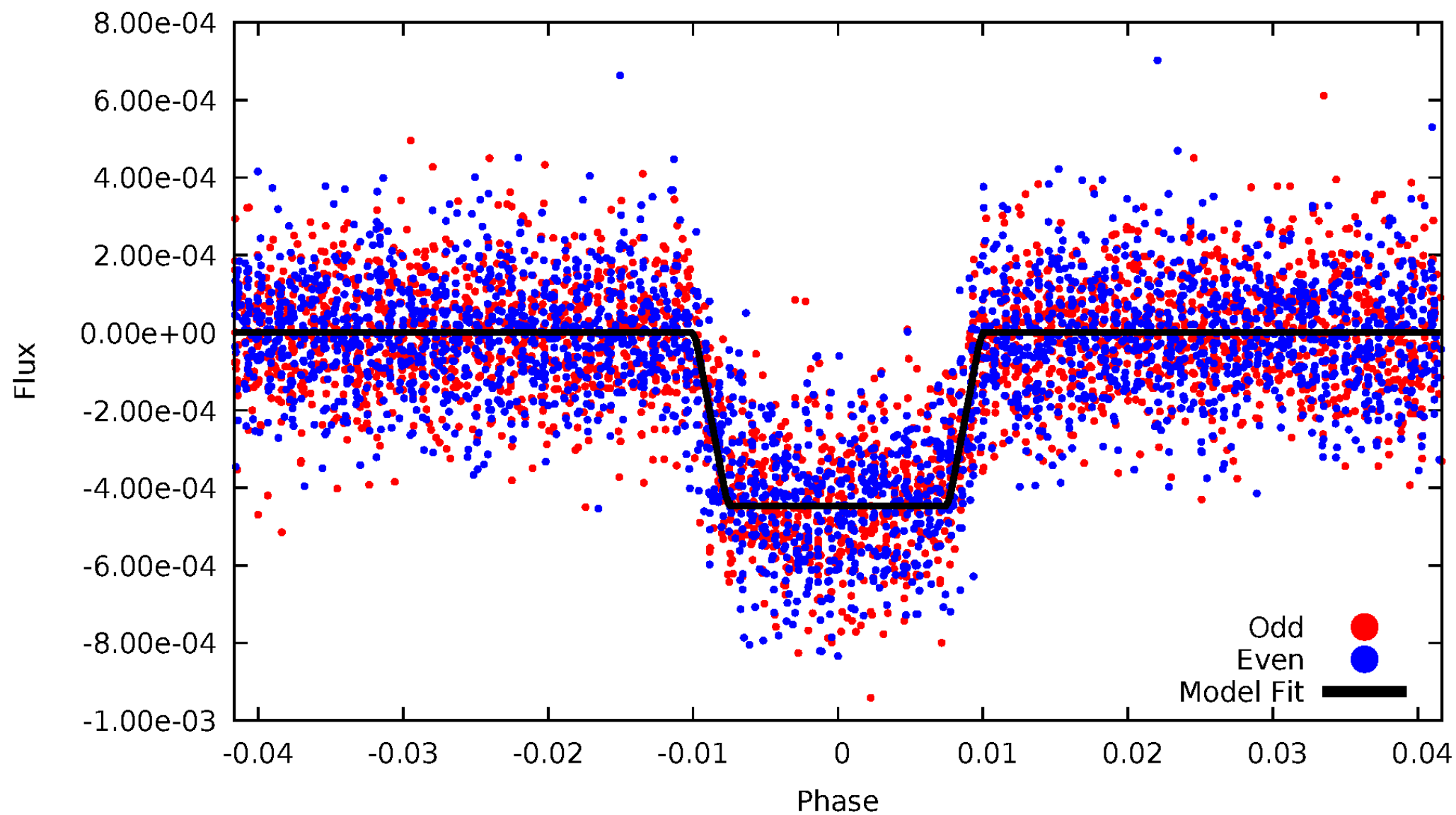
# DV Odd/Even

TCE 008972058-01

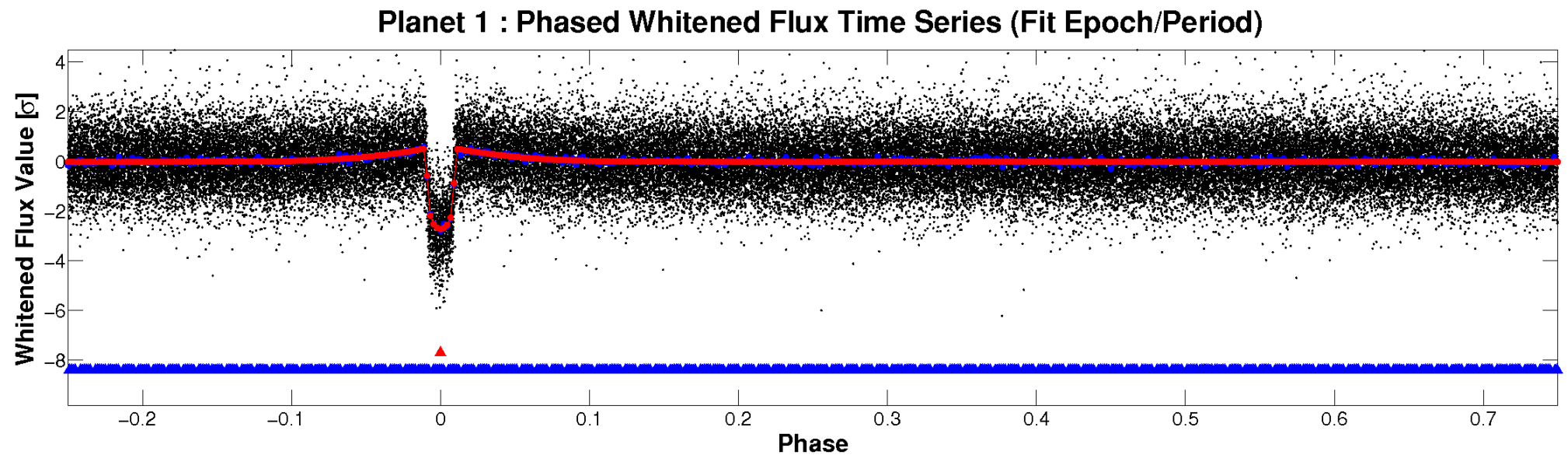
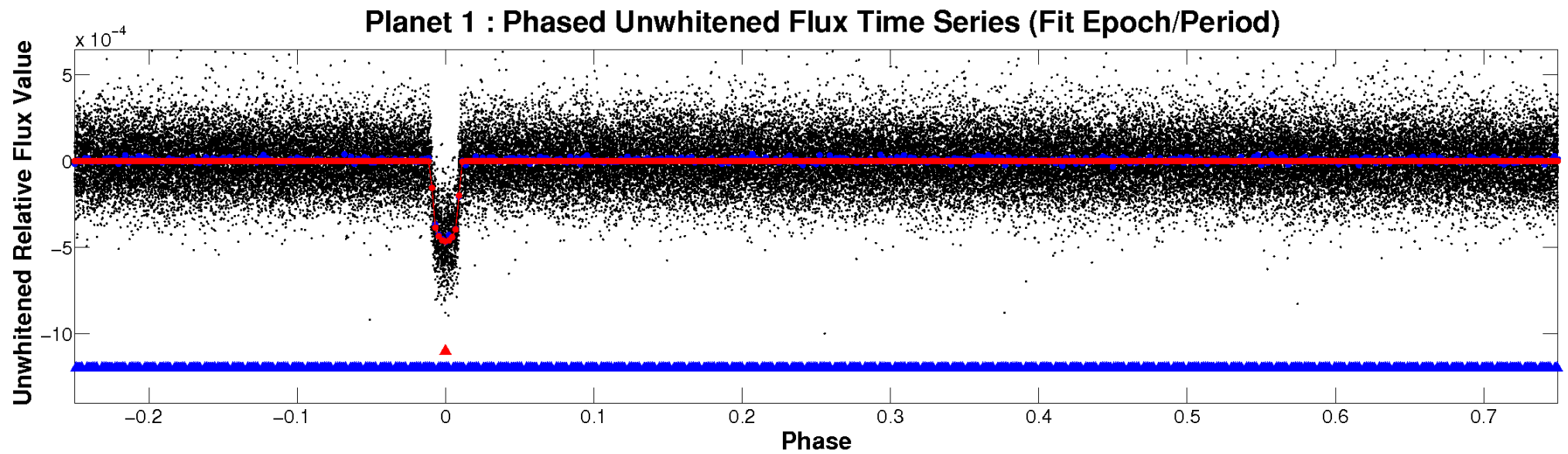


# ALT Odd/Even

TCE 008972058-01

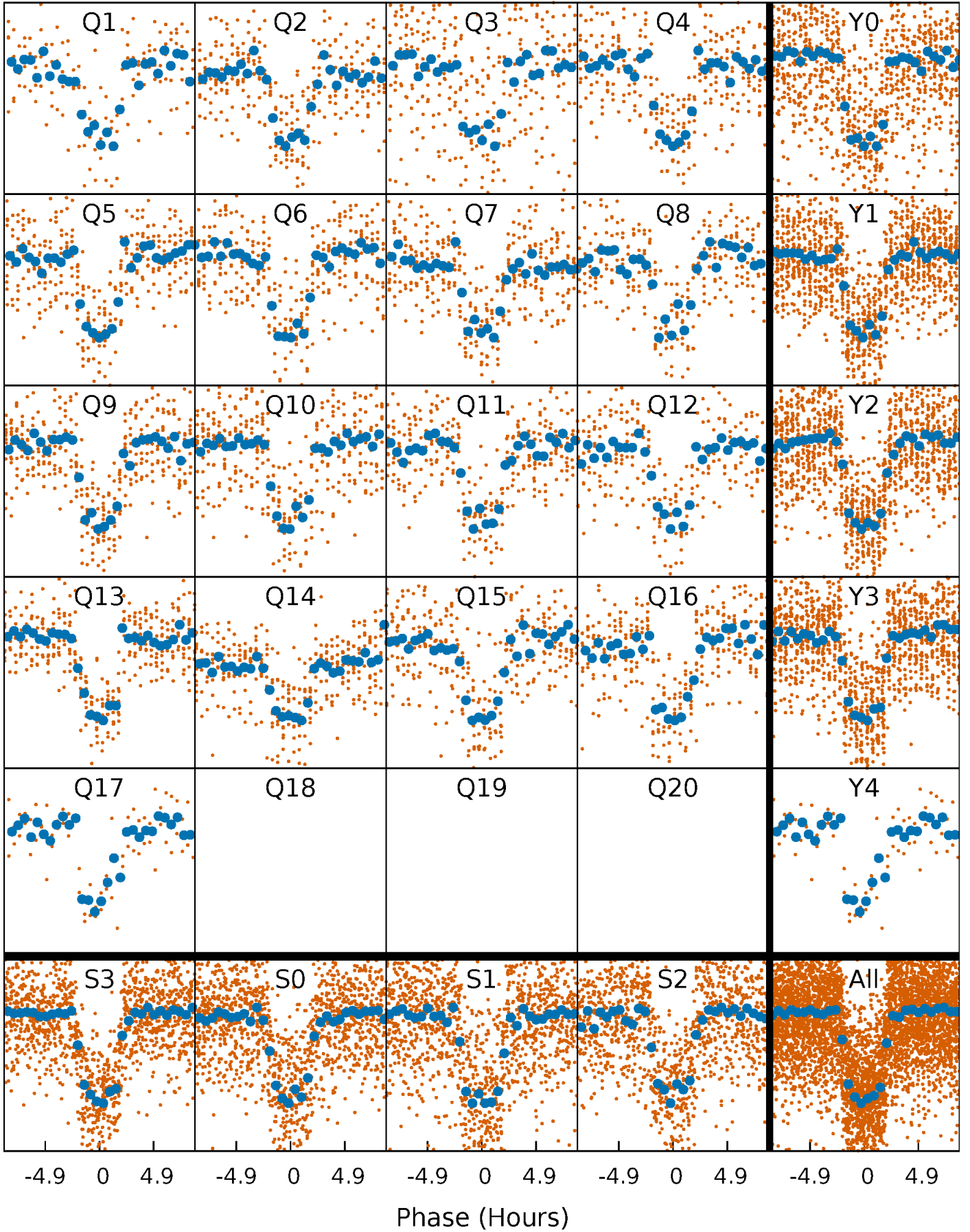


# Non-Whitened Vs. Whitened Light Curve



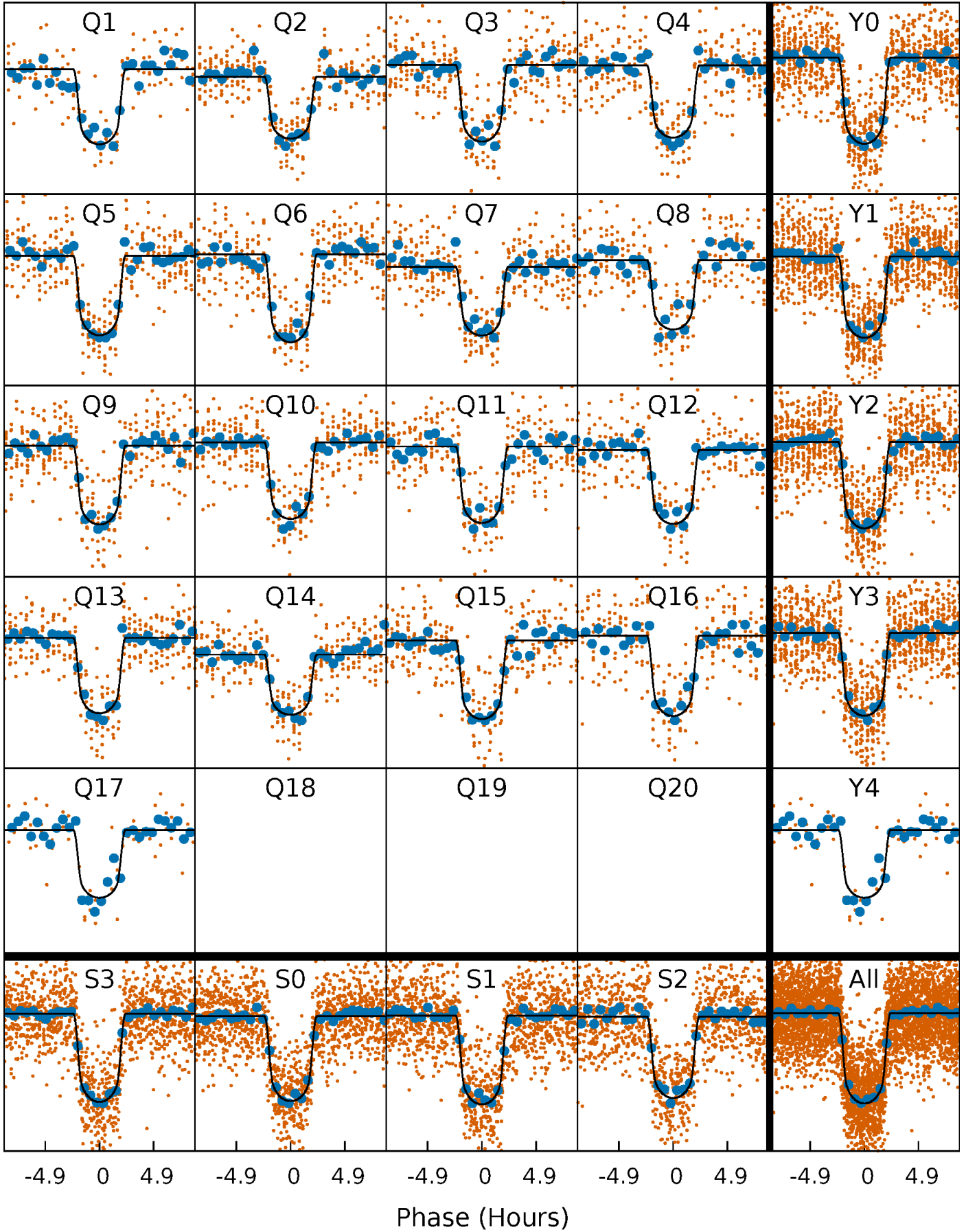
# PDC Quarter-Phased Transit Curves

TCE 008972058-01 P= 8.990887 Days  $T_0=136.738757$  (BKJD)



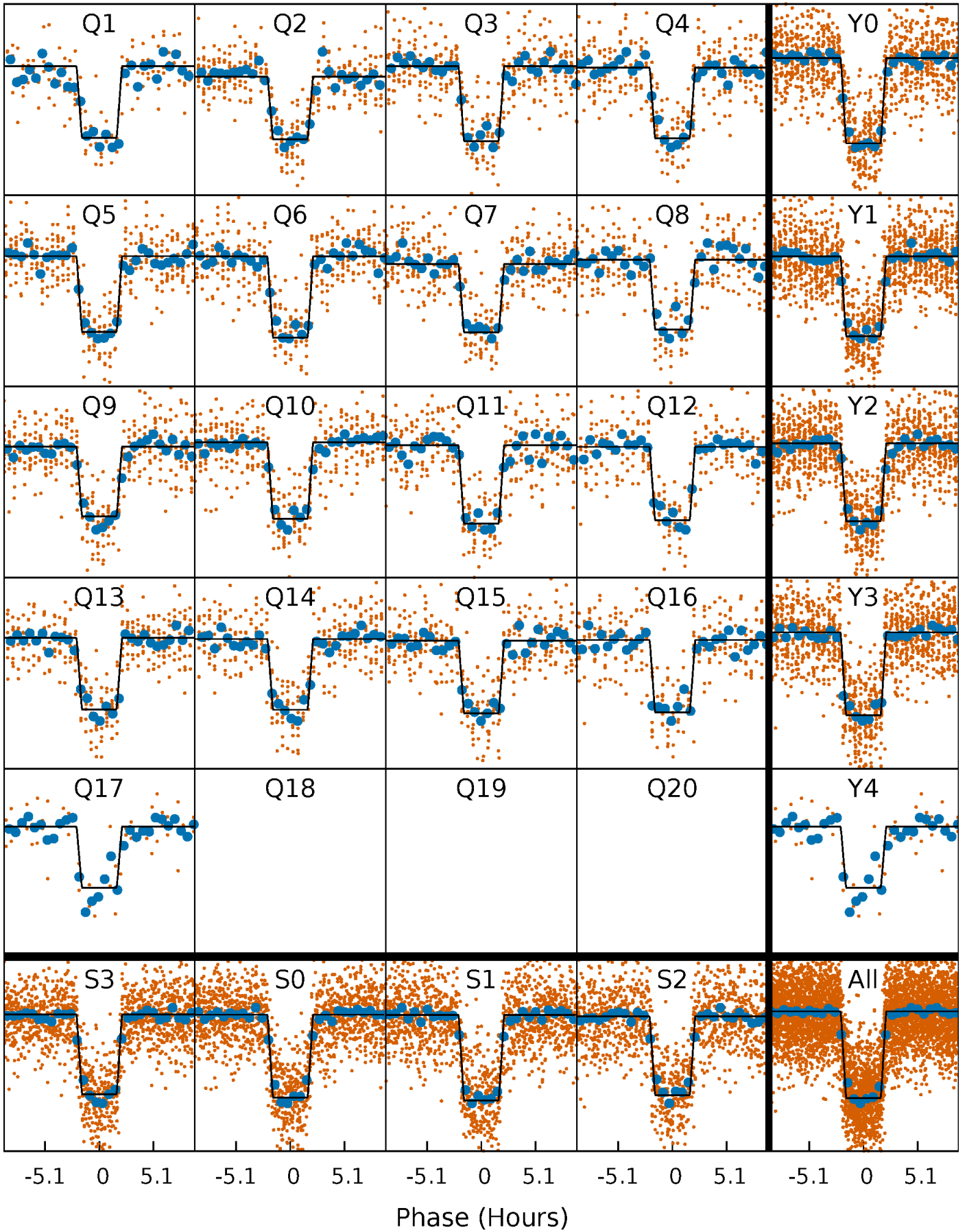
# DV Quarter-Phased Transit Curves

TCE 008972058-01 P= 8.990887 Days  $T_0=136.738757$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

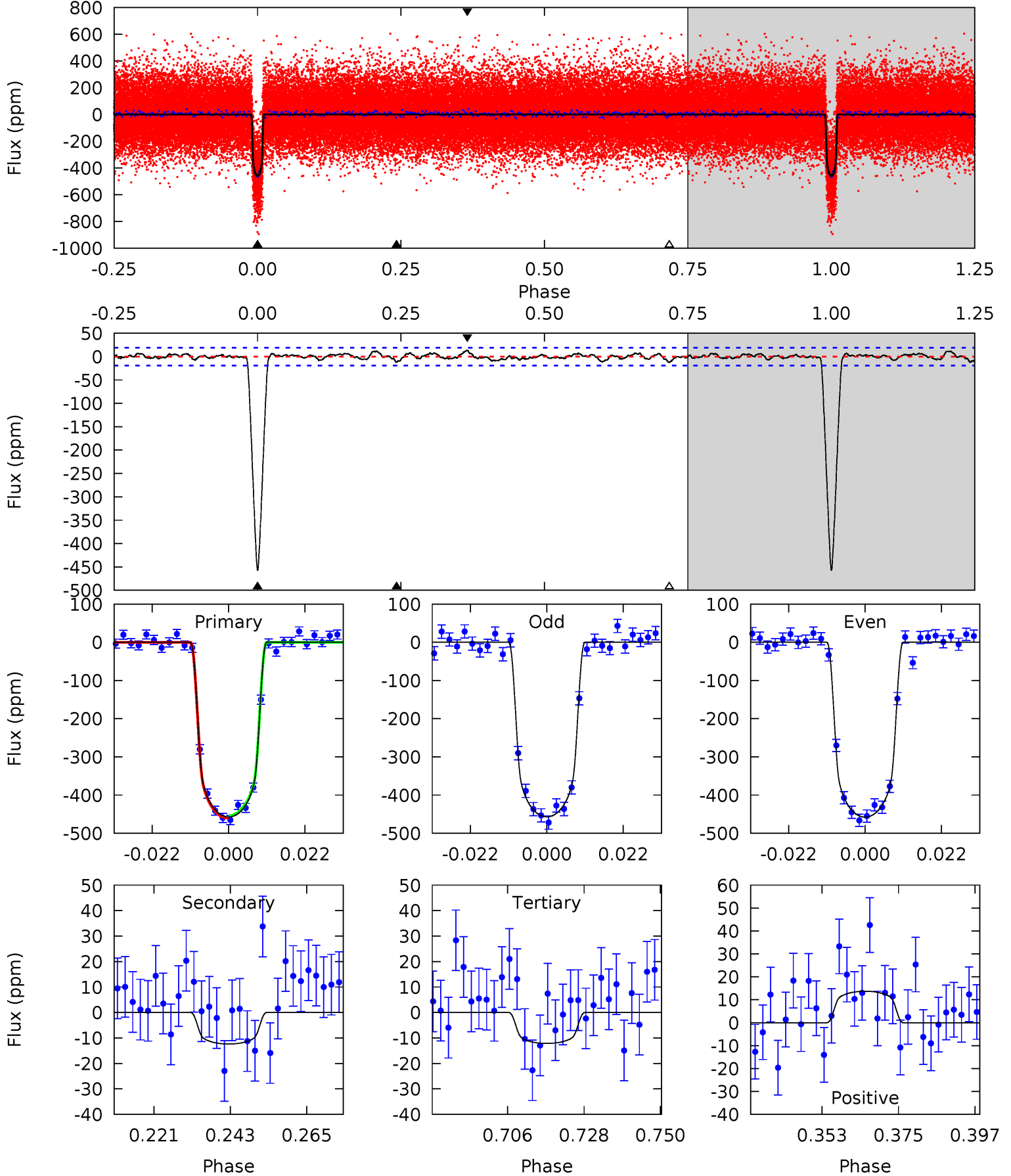
TCE 008972058-01 P= 8.990930 Days  $T_0=136.735877$  (BKJD)



# DV Model-Shift Uniqueness Test

008972058-01, P = 8.990887 Days, E = 127.747870 Days

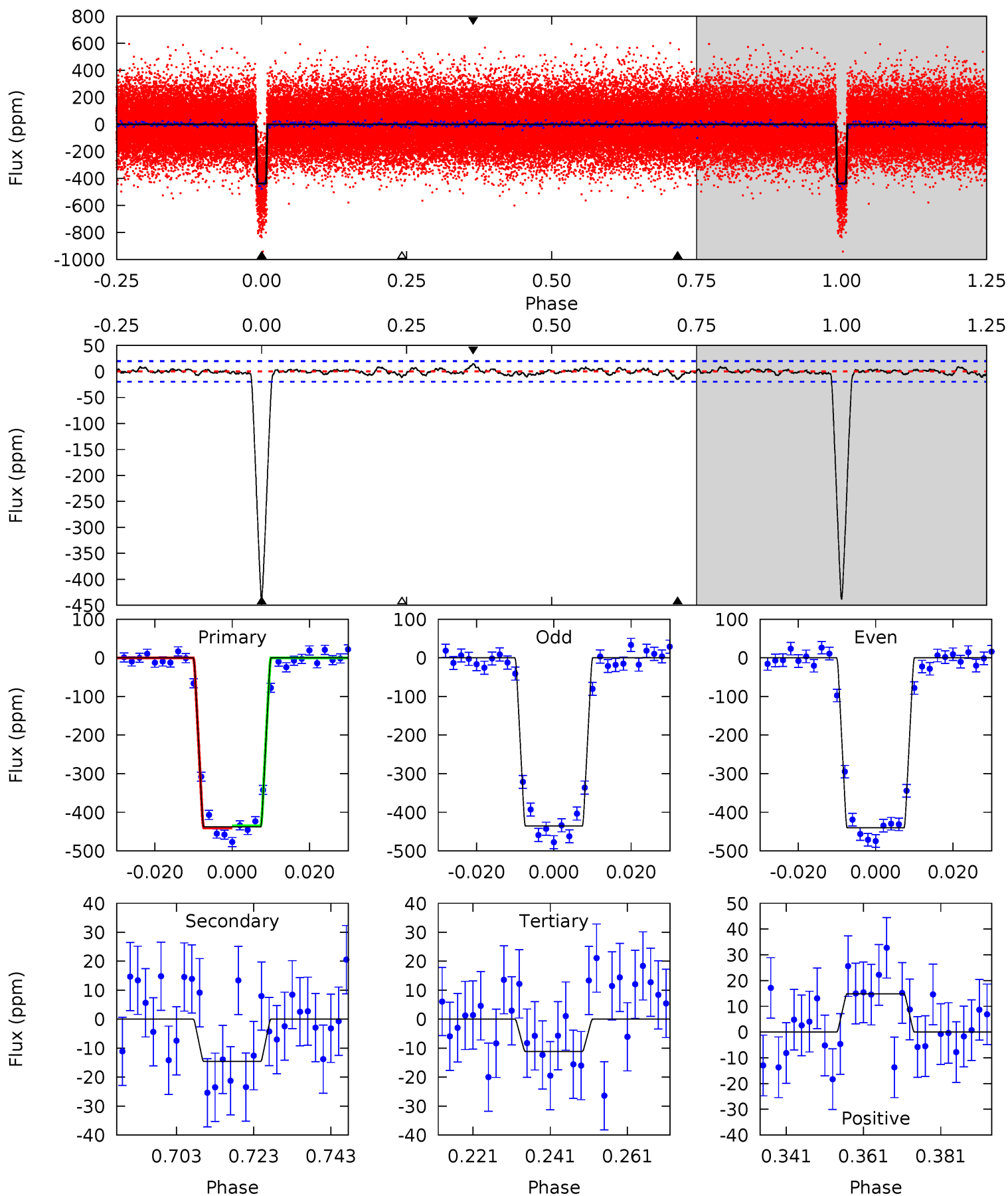
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
117.2	3.17	3.11	3.51	4.87	2.29	1.11	114.0	113.6	0.06	-0.34	0.10	0.99	0.03	0.73



# Alt Model-Shift Uniqueness Test

008972058-01, P = 8.990930 Days, E = 127.744947 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
108.2	3.61	2.75	3.67	4.89	2.32	0.98	105.5	104.6	0.86	-0.06	0.54	1.00	0.03	0.64



### Stellar Parameters For KIC 008972058

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5881^{+105}_{-117}$	$4.315^{+0.115}_{-0.115}$	$0.070^{+0.150}_{-0.150}$	$1.171^{+0.196}_{-0.161}$	$1.032^{+0.089}_{-0.067}$	$0.905^{+0.458}_{-0.302}$
	+2%/-2%	+3%/-3%	+214%/-214%	+17%/-14%	+9%/-6%	+51%/-33%
Source	SPE59	SPE59	SPE59	DSEP		

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

### Secondary Eclipse Parameters for KIC 008972058-01 / KOI 0159.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-12 \pm 4$	$2.93^{+0.30}_{-0.29}$	$1341^{+62}_{-57}$	$2957^{+142}_{-165}$	$5.756^{+2.276}_{-2.056}$
Alt.	$-15 \pm 4$	$2.70^{+0.31}_{-0.27}$	$1343^{+62}_{-67}$	$3099^{+147}_{-160}$	$7.868^{+3.160}_{-2.573}$

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

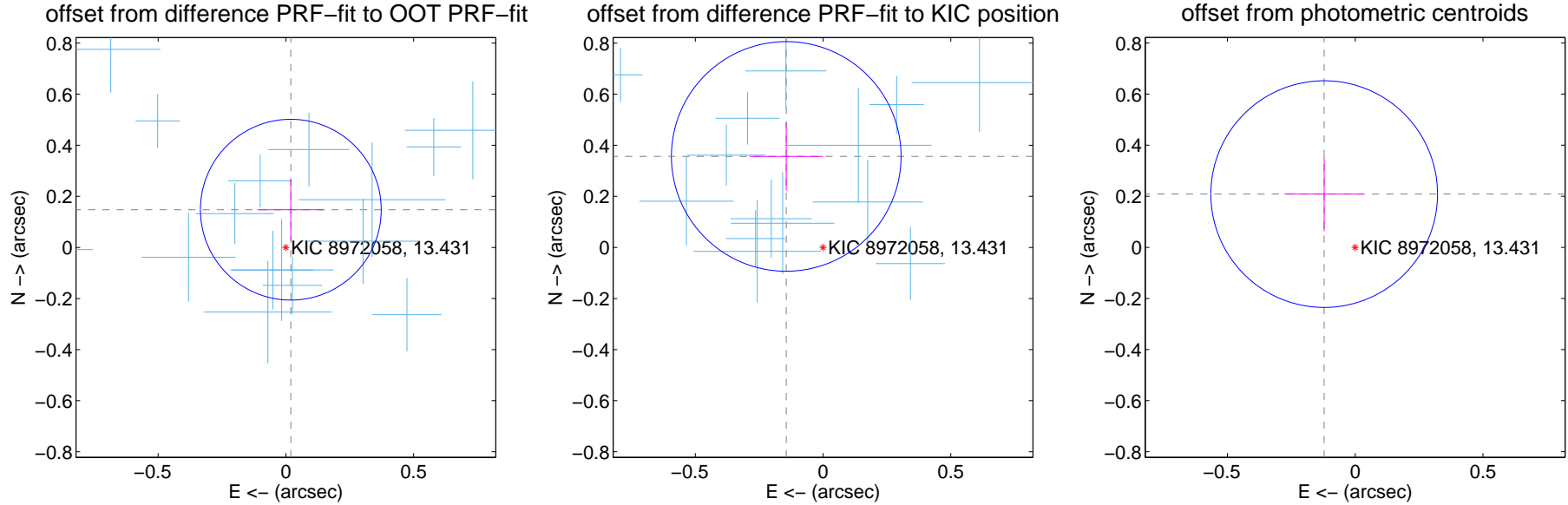
## DV Centroid Data

Supplemental centroid analysis for 008972058-01. Kepler magnitude: 13.43. Transit SNR 80.83

There are 17 quarters with good PRF difference image offsets

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

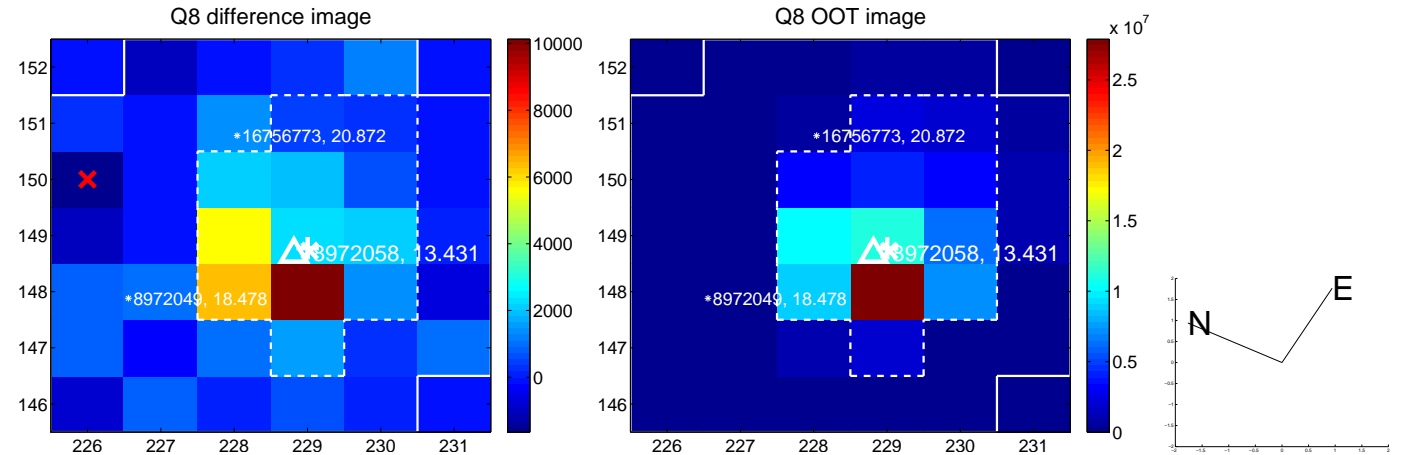
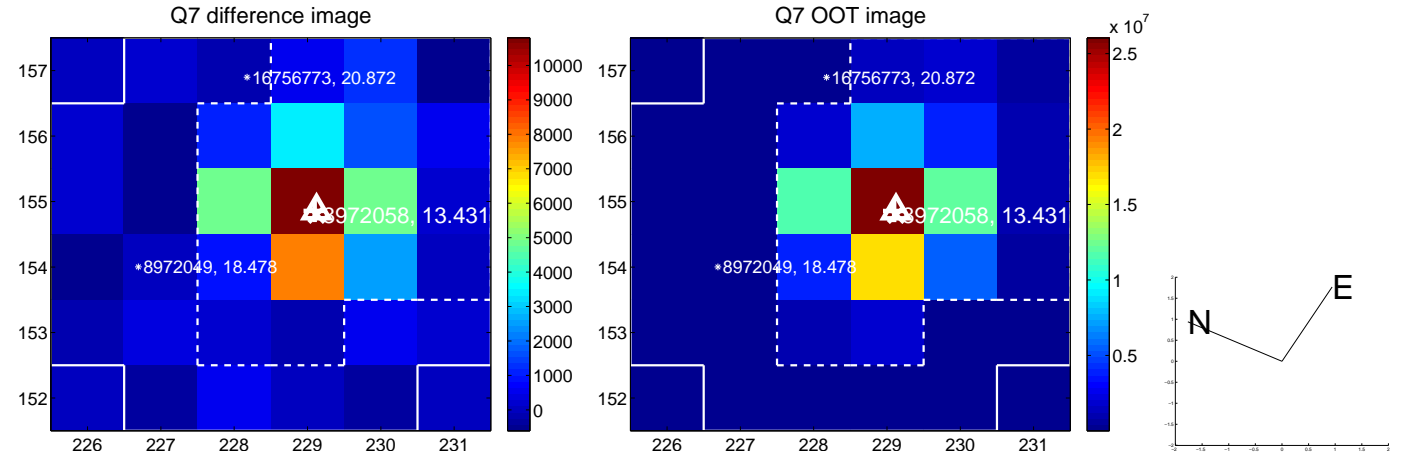
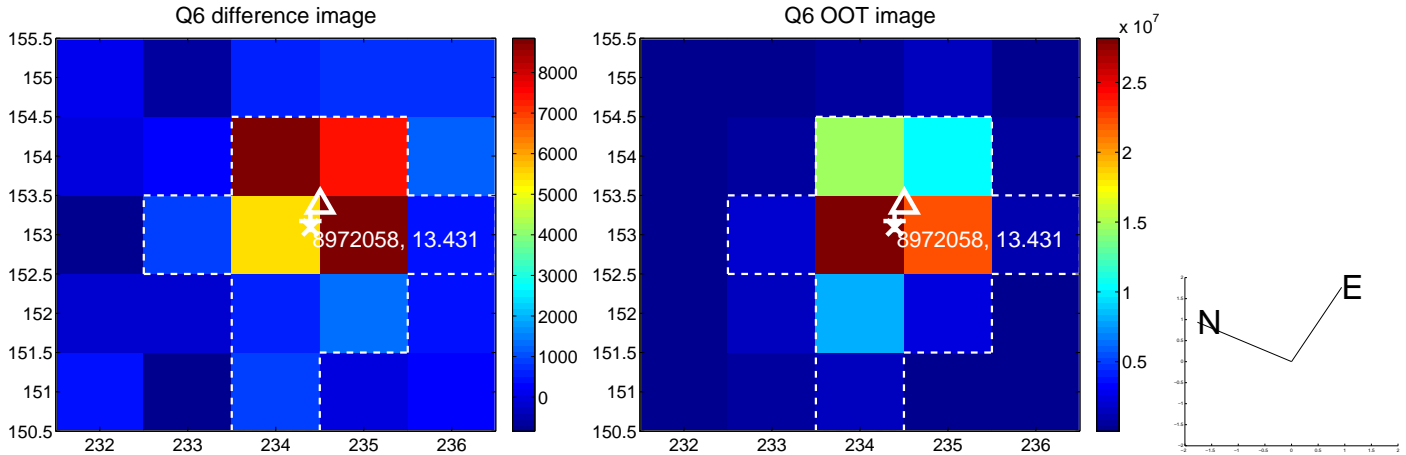
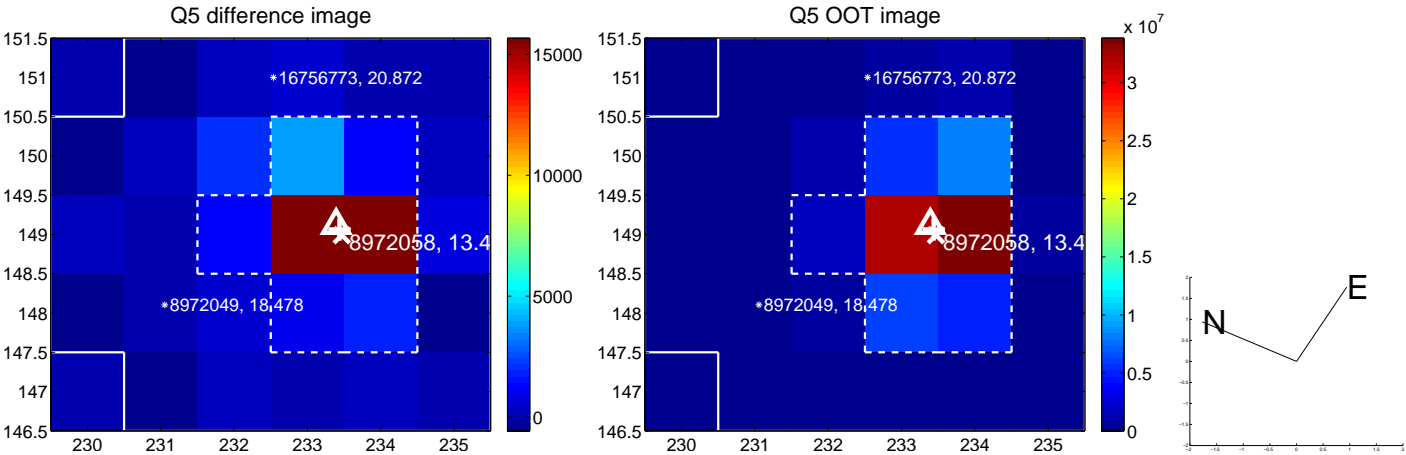
	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.149 \pm 0.118$	1.26	$-0.019 \pm 0.131$	$0.148 \pm 0.121$
PRF-fit source offset from KIC position	$0.385 \pm 0.150$	2.57	$0.144 \pm 0.144$	$0.356 \pm 0.133$
photometric centroid source offset	$0.24 \pm 0.15$	1.63	$0.12 \pm 0.16$	$0.21 \pm 0.15$



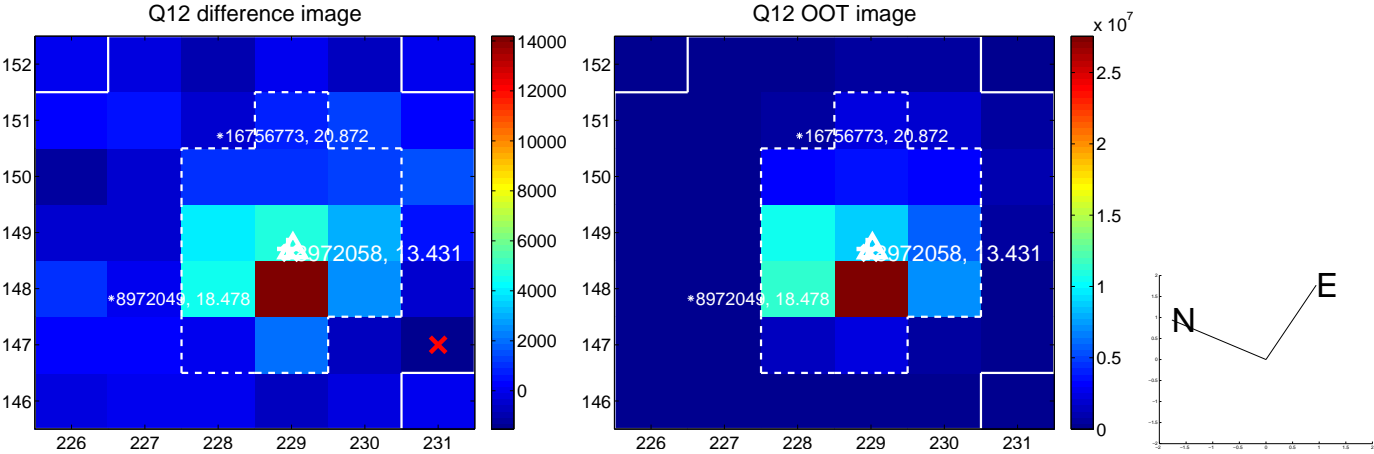
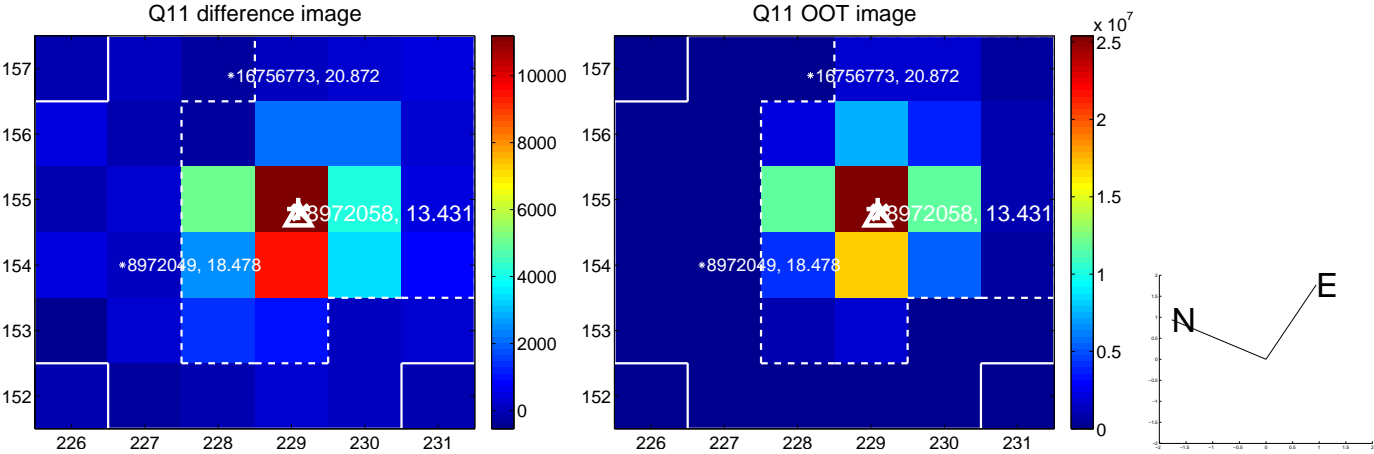
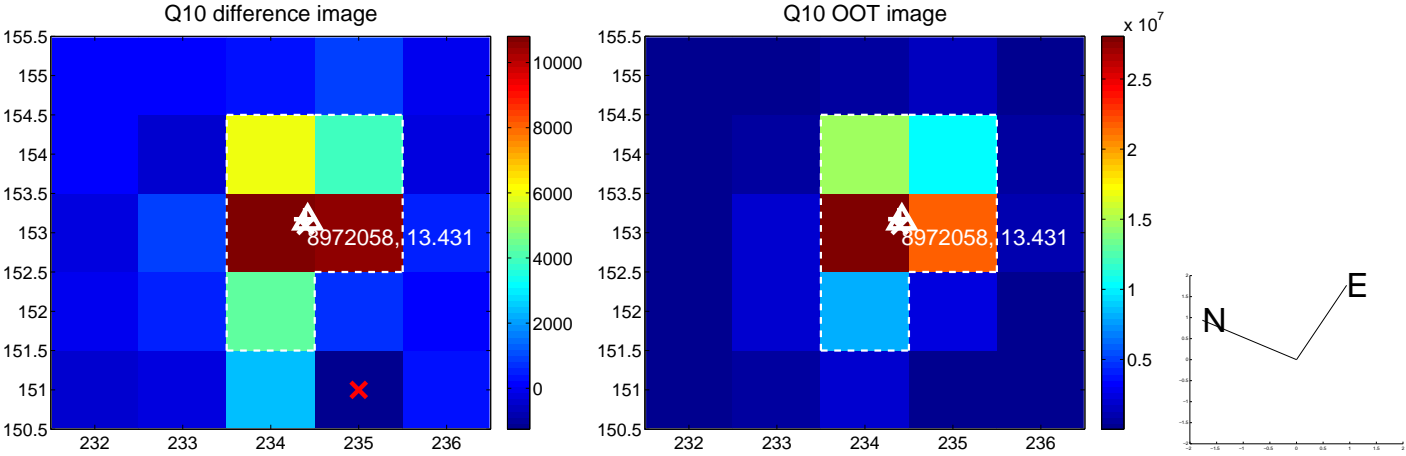
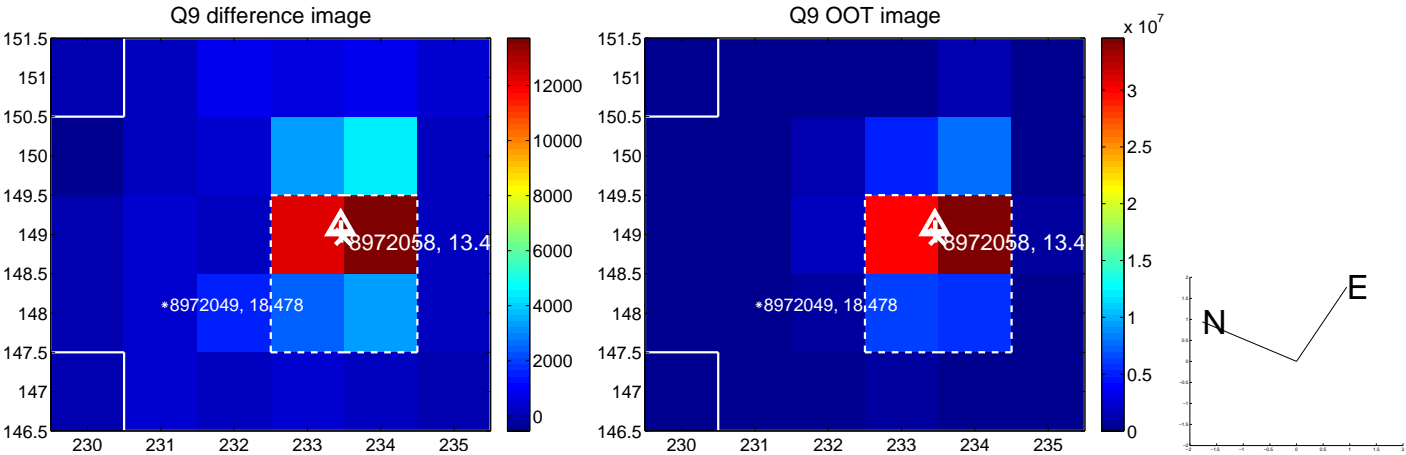
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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



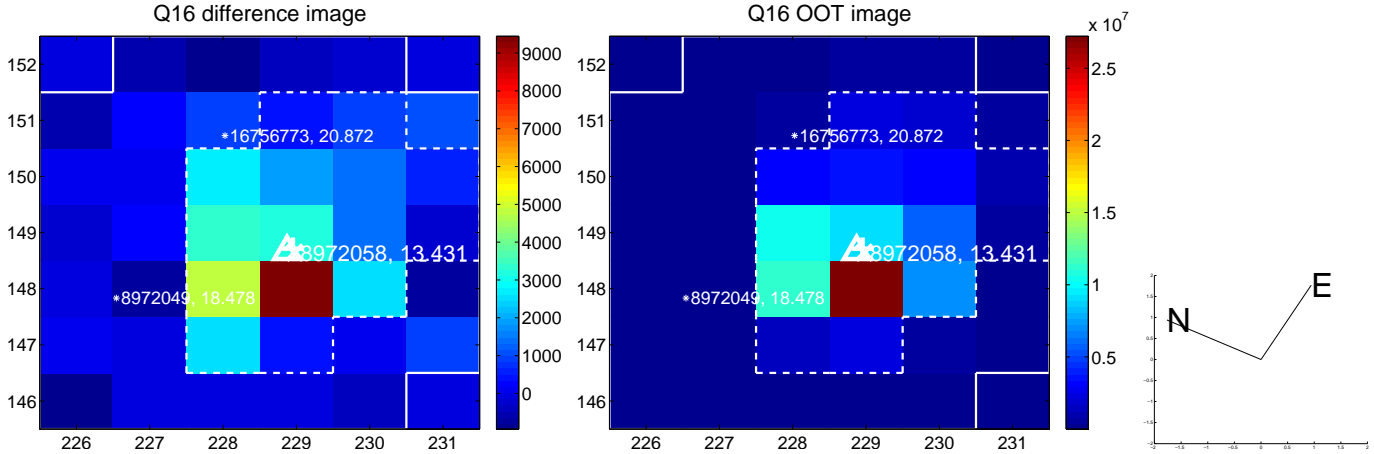
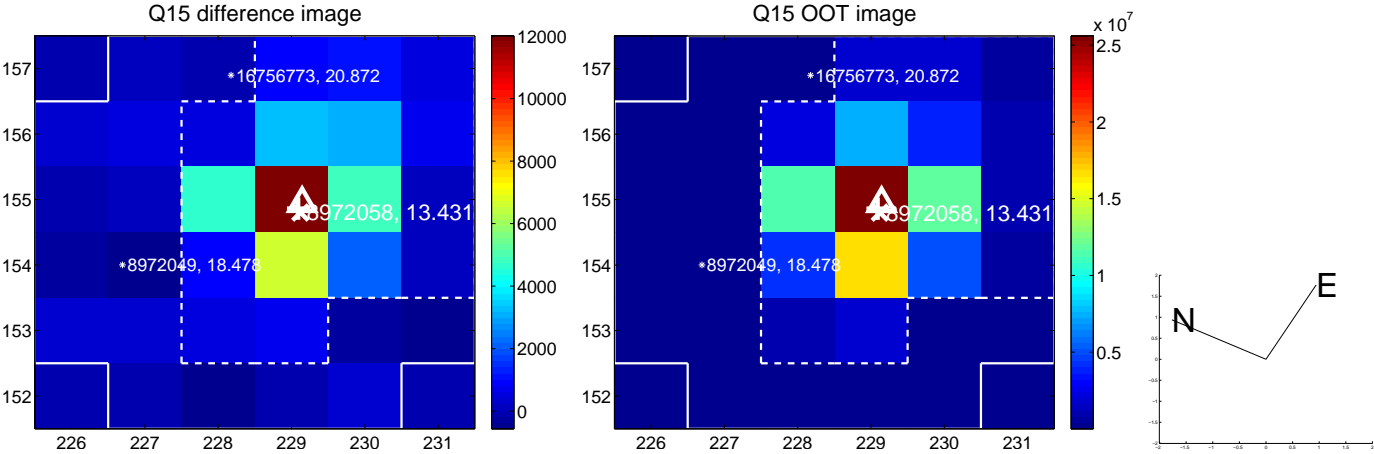
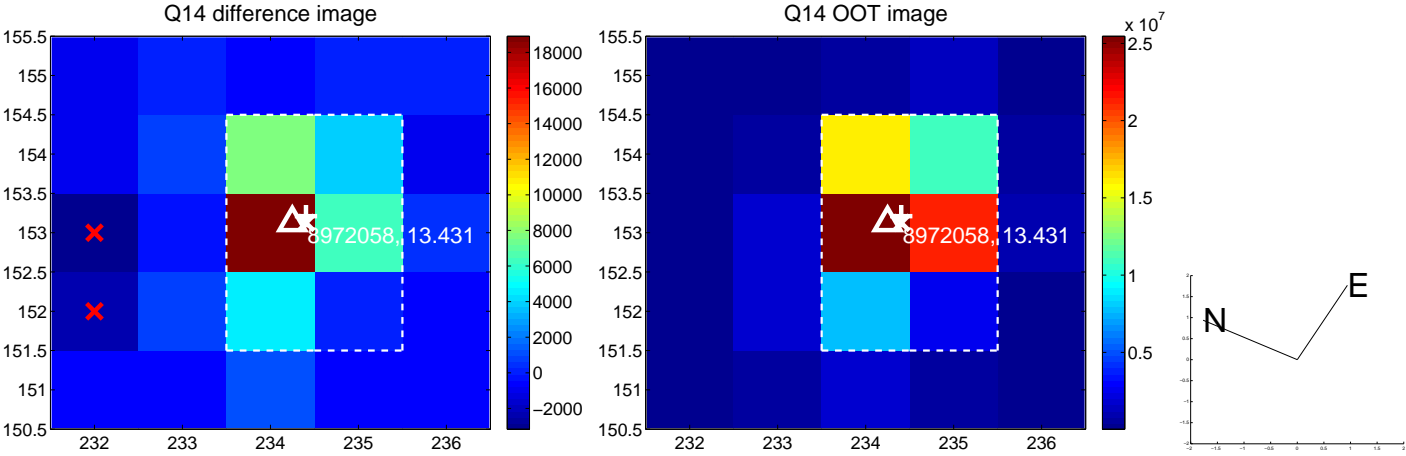
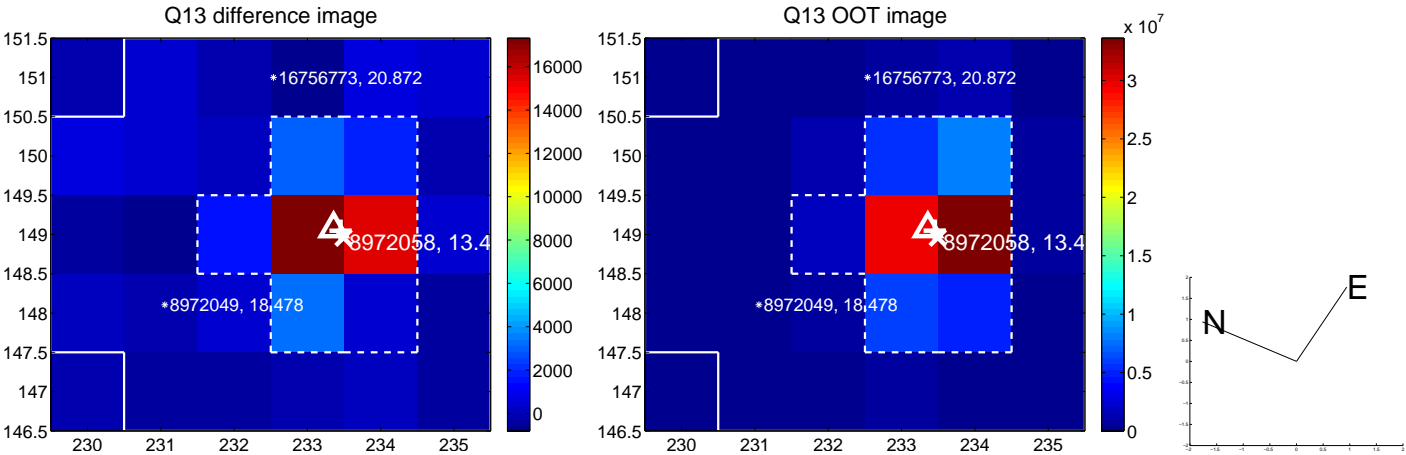
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



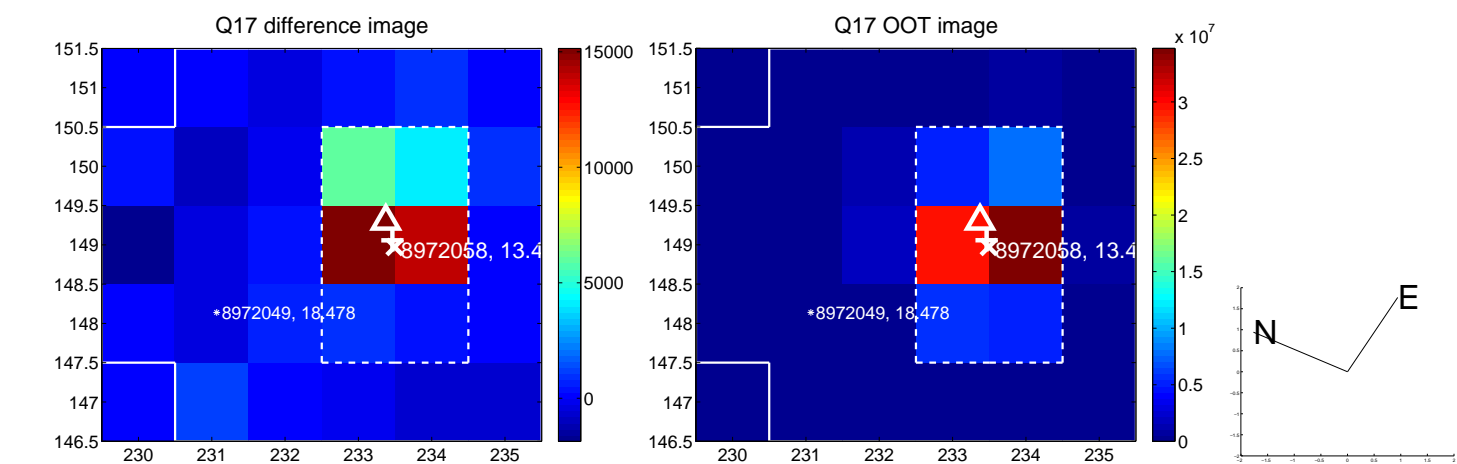
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



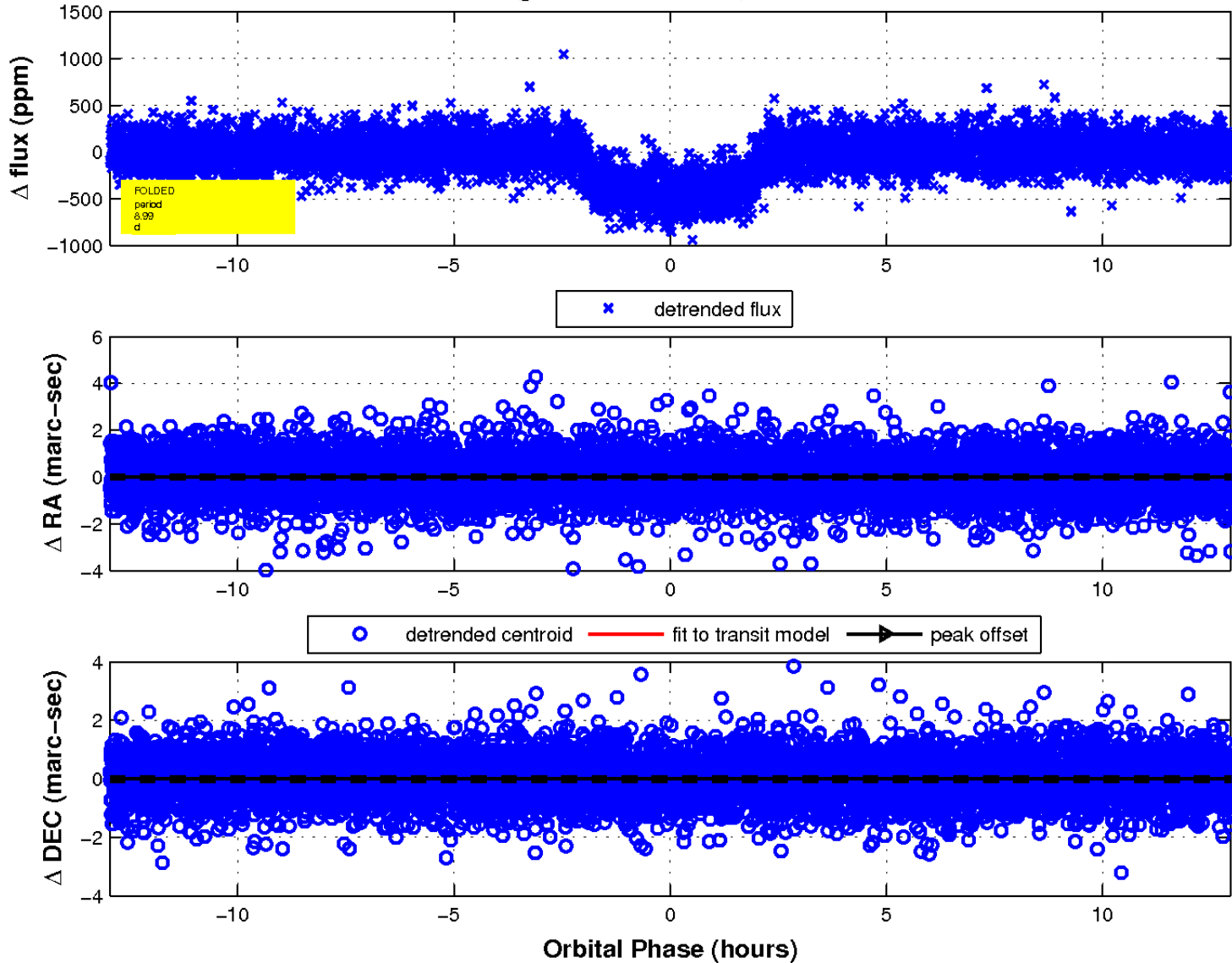
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

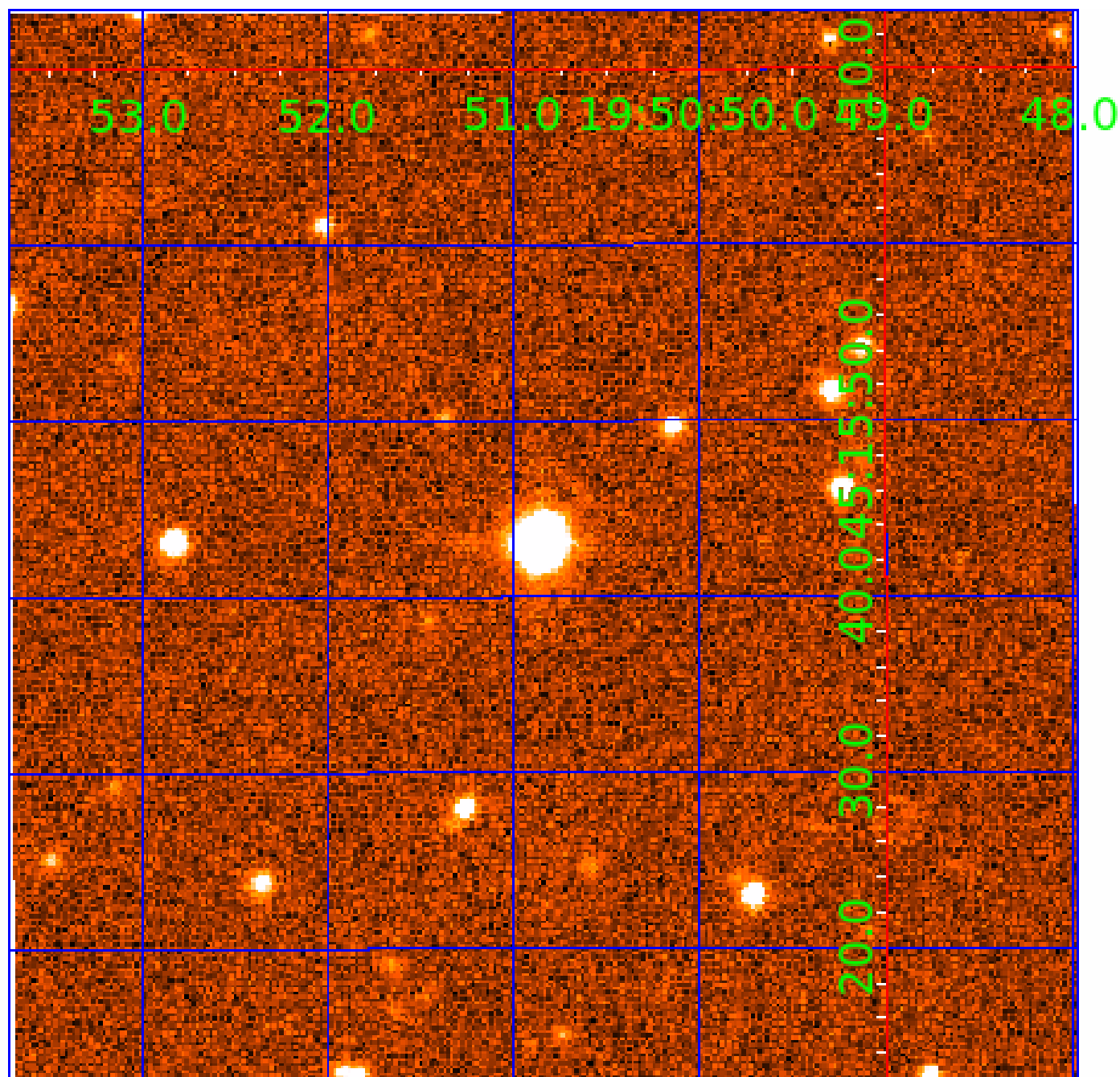


fluxWeightedCentroids, Planet 1 of 2



UKIRT Image

Declination



# KIC 008972058

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
008972058-01	OBS	0159.01	8.990887	136.738757	465.4	4.321	72.1	80.8	1.17	5881	2.91	200.75
008972058-02	OBS	0159.02	2.403622	132.331990	69.6	1.605	15.1	16.0	1.17	5881	1.16	1165.69

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
008972058-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
008972058-02	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.

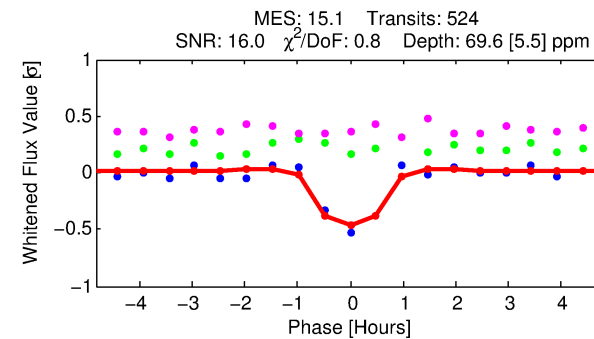
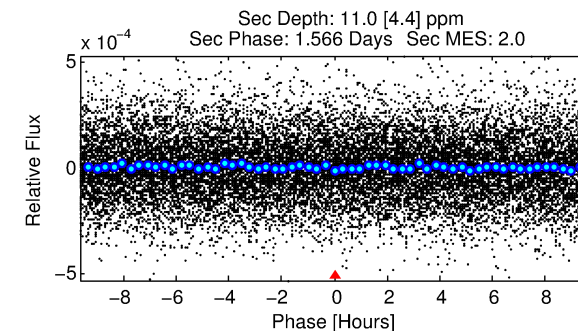
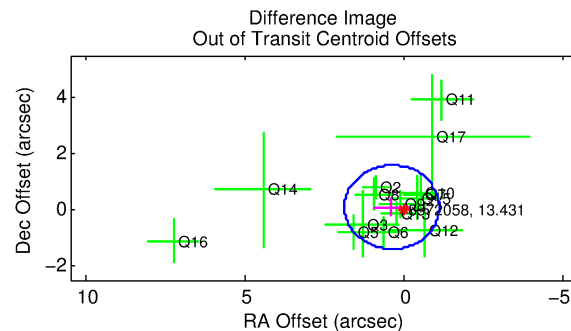
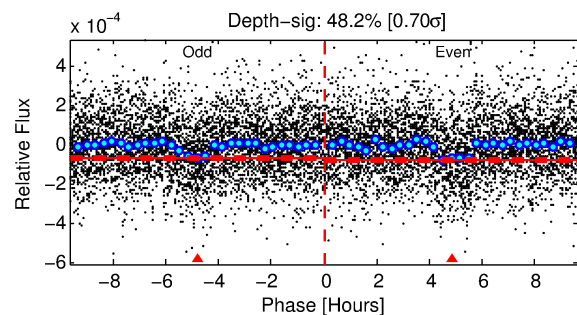
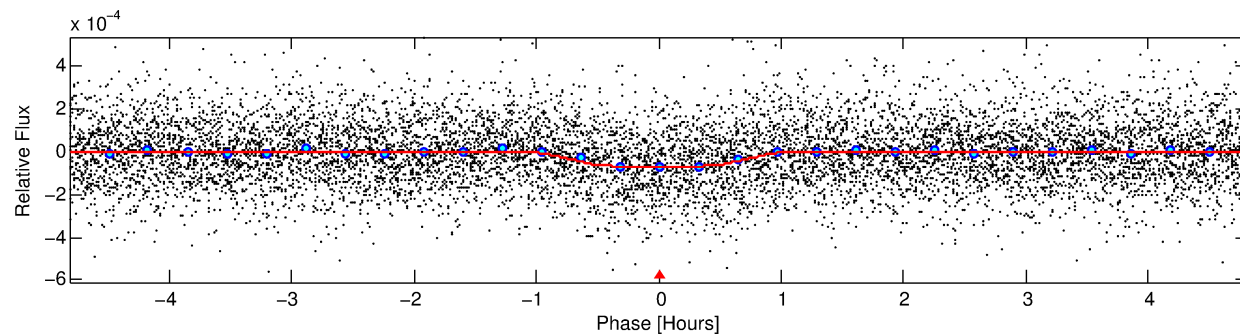
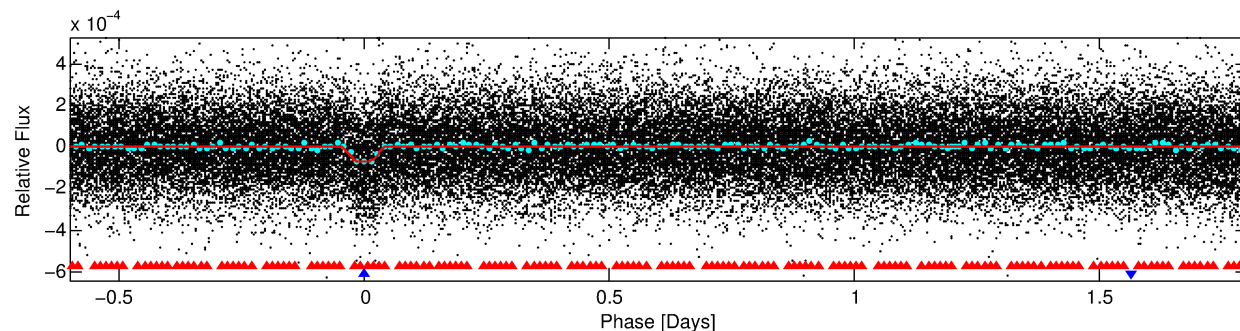
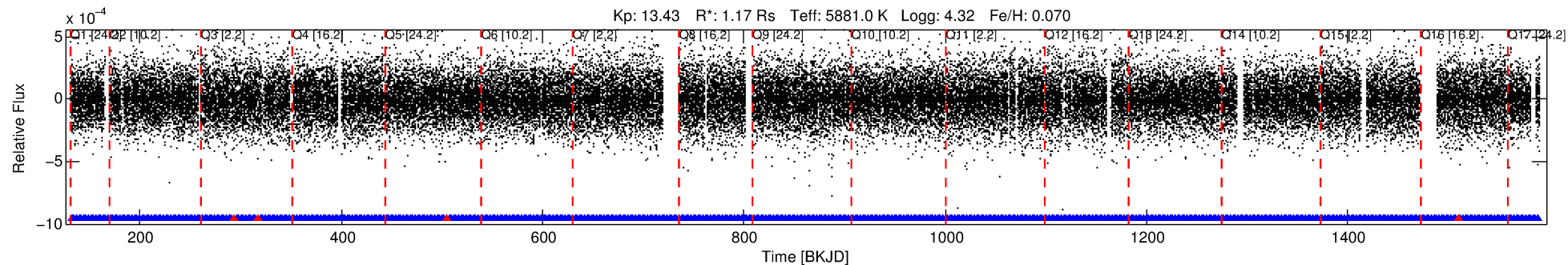
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 008972058-02

No Significant Match Found

# DV One-Page Summary

KIC: 8972058 Candidate: 2 of 2 Period: 2.404 d  
KOI: K00159.02 Name: Kepler-115b Corr: 0.906



## DV Fit Results:

Period = 2.40362 [0.00001] d  
Epoch = 132.3320 [0.0017] BKJD  
Rp/R\* = 0.0091 [0.0038]  
a/R\* = 5.31 [10.60]  
b = 0.90 [0.45]  
Seff = 1165.69 [260.52]  
Teq = 1490 [83] K  
Rp = 1.16 [0.53] Re  
a = 0.0355 [0.0051] AU  
Ag = 5.67 [5.43] [0.86 $\sigma$ ]  
Teffp = 3555 [833] K [2.47 $\sigma$ ]

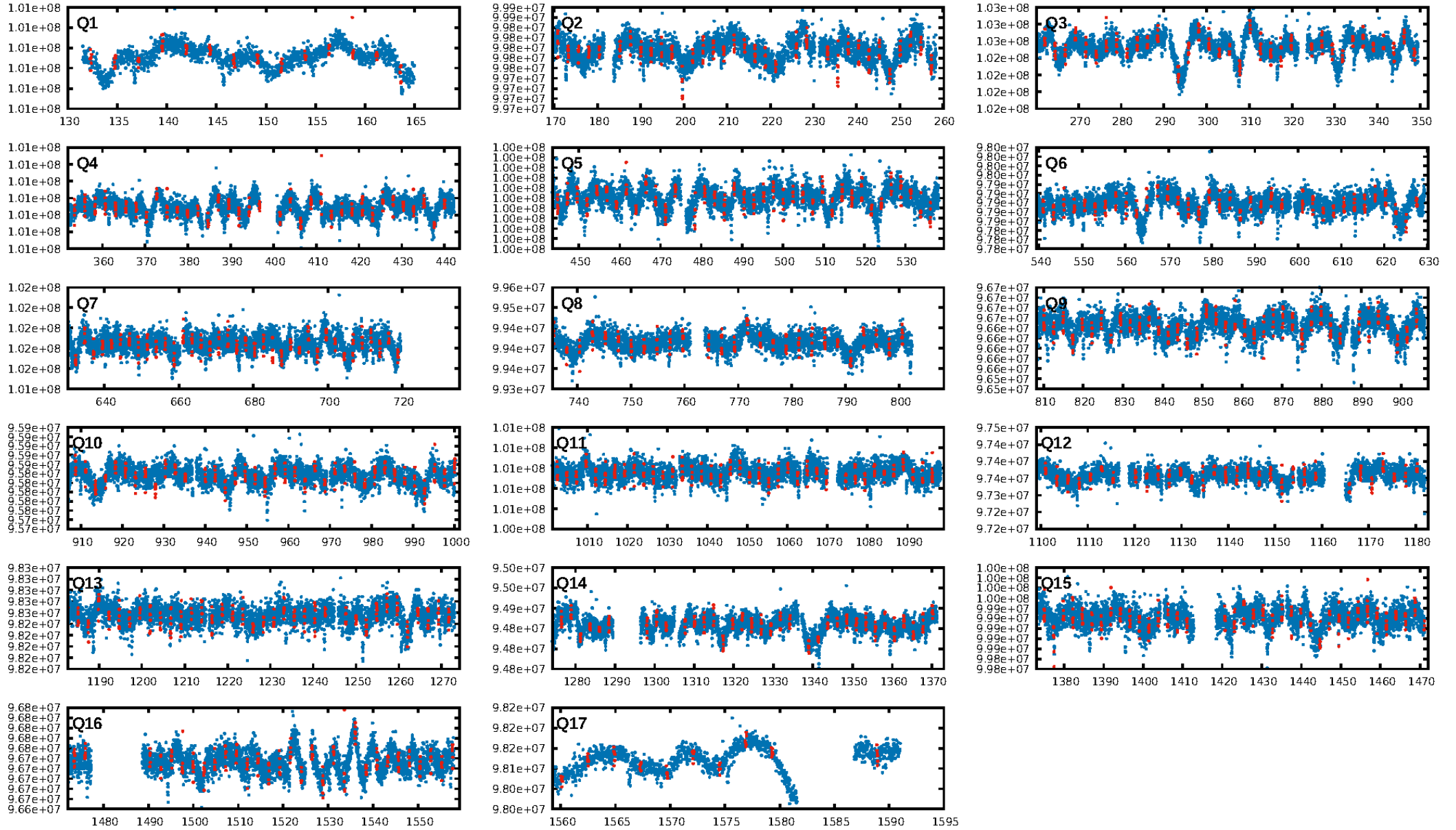
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [34.30 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 3.65e-50  
RollingBand-fgt: 0.99 [497/501]  
GhostDiagnostic-chr: 2.197  
Centroid-sig: 22.1%  
Centroid-so: 0.967 arcsec [1.19 $\sigma$ ]  
OotOffset-rm: 0.400 arcsec [0.80 $\sigma$ ]  
KicOffset-rm: 0.689 arcsec [1.61 $\sigma$ ]  
OotOffset-st: 4/4/3/4 [15]  
KicOffset-st: 4/4/3/4 [15]  
DiffImageQuality-fgm: 0.73 [11/15]  
DiffImageOverlap-fno: 1.00 [17/17]

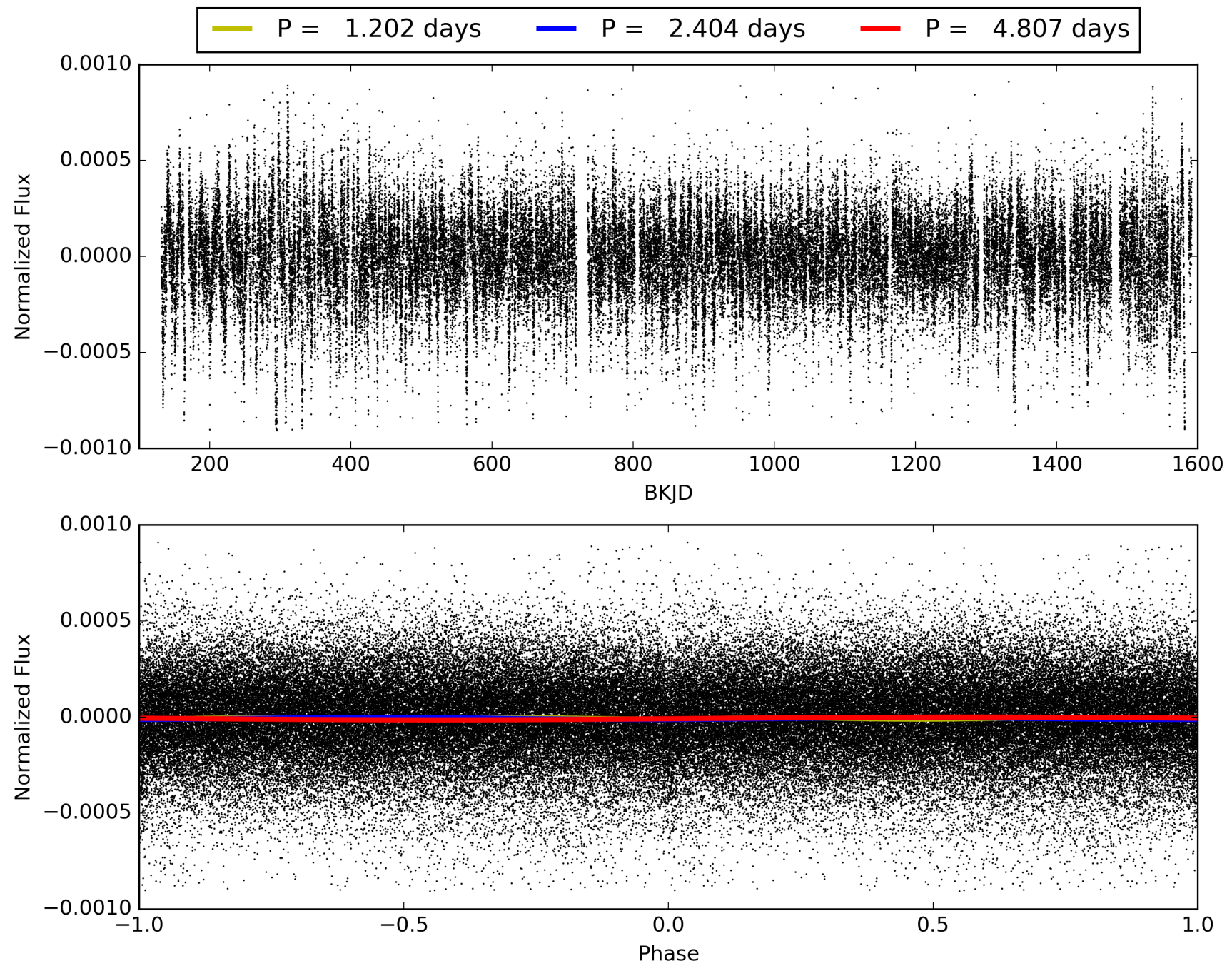
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 20:51:30 Z

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

# TCE 008972058-02, PDC Light Curves

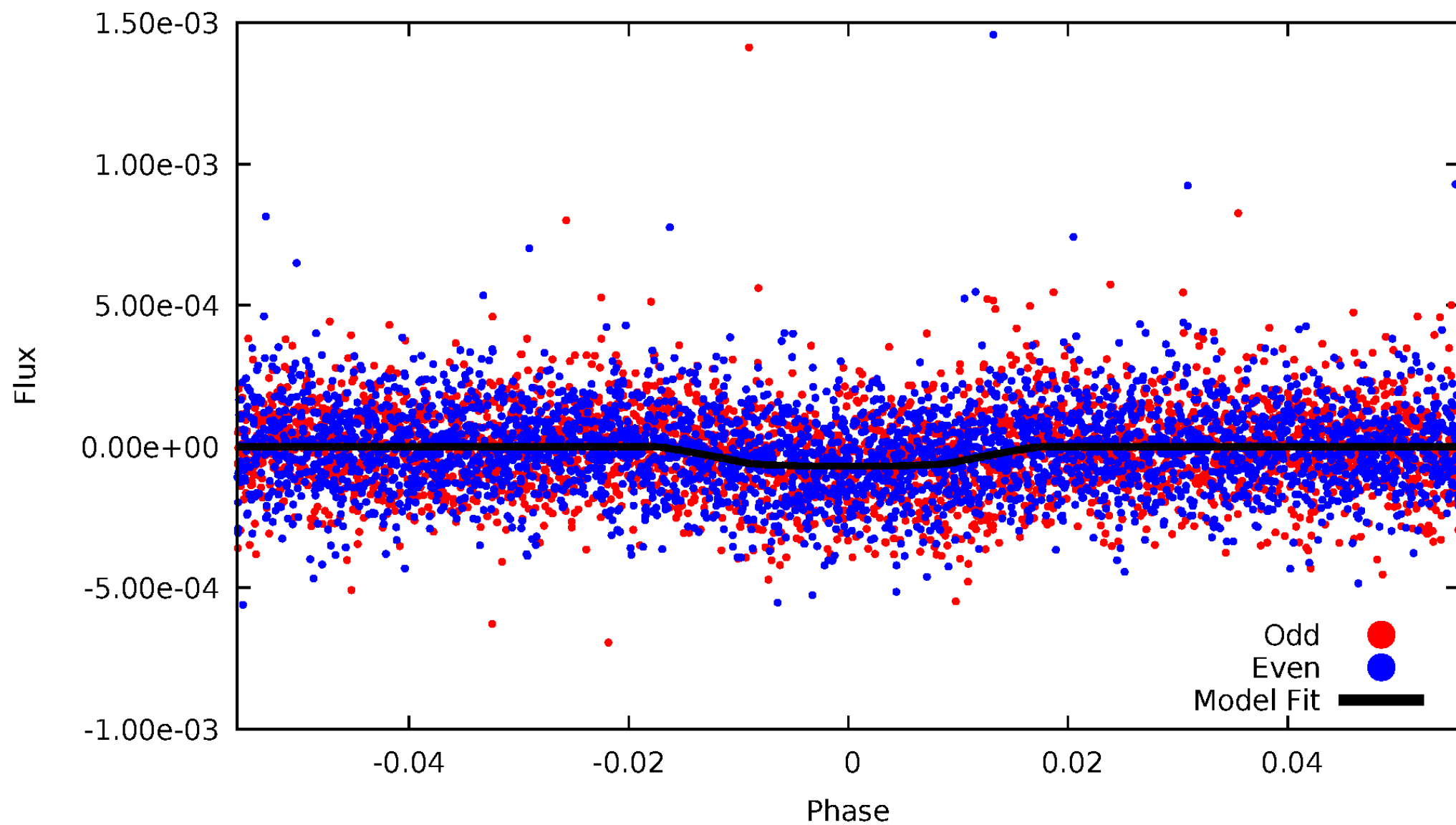


TCE 008972058-02



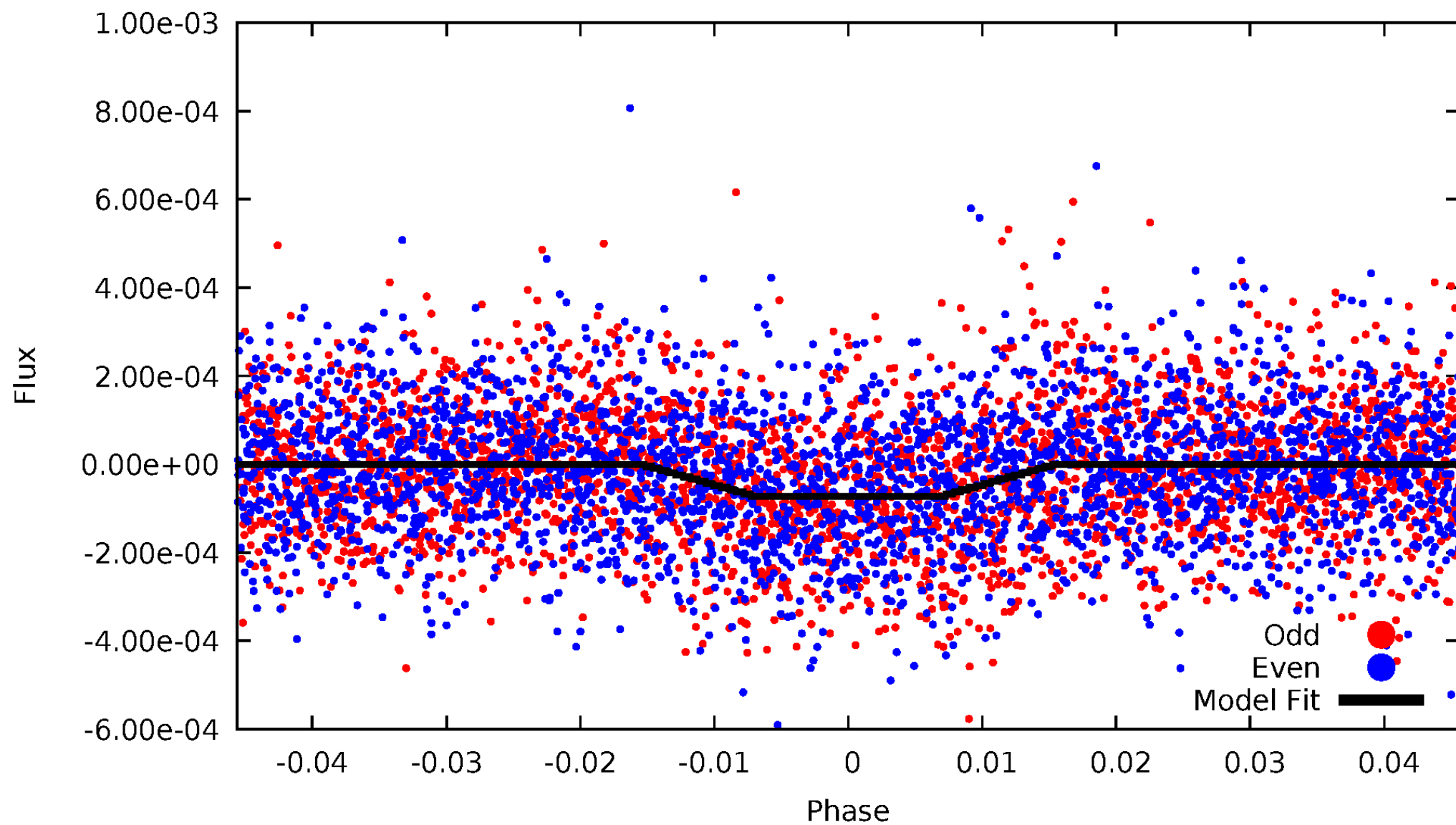
DV Odd/Even

TCE 008972058-02



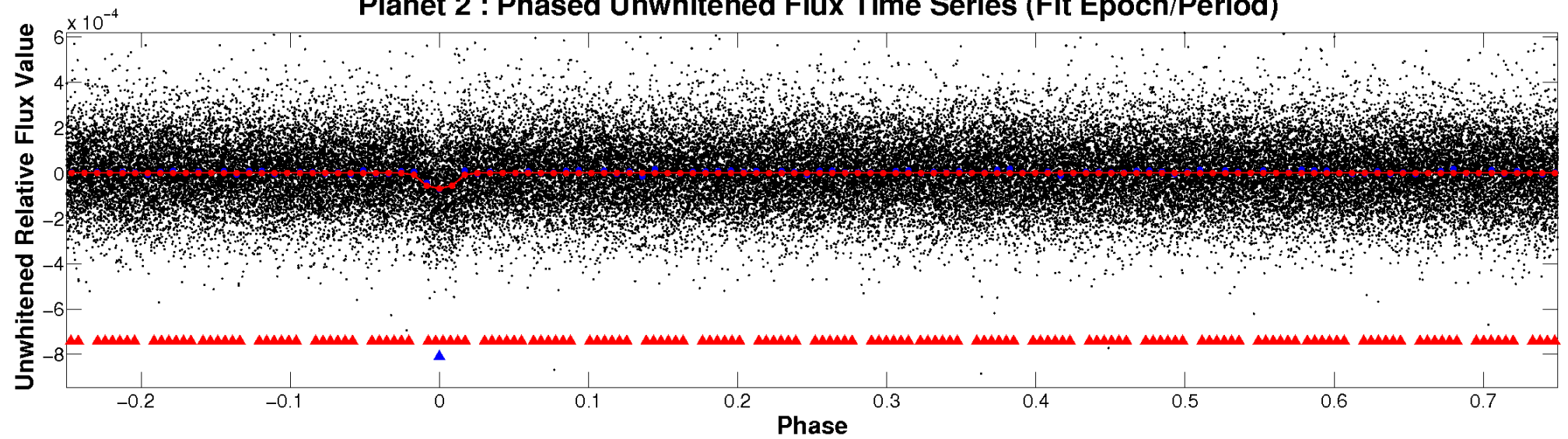
# ALT Odd/Even

TCE 008972058-02

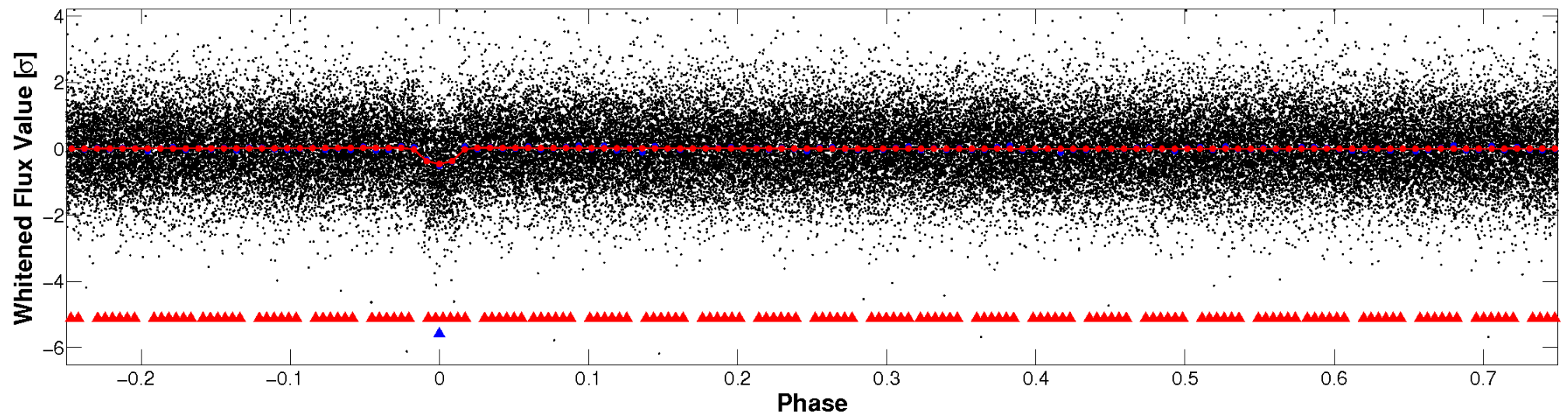


# Non-Whitened Vs. Whitened Light Curve

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

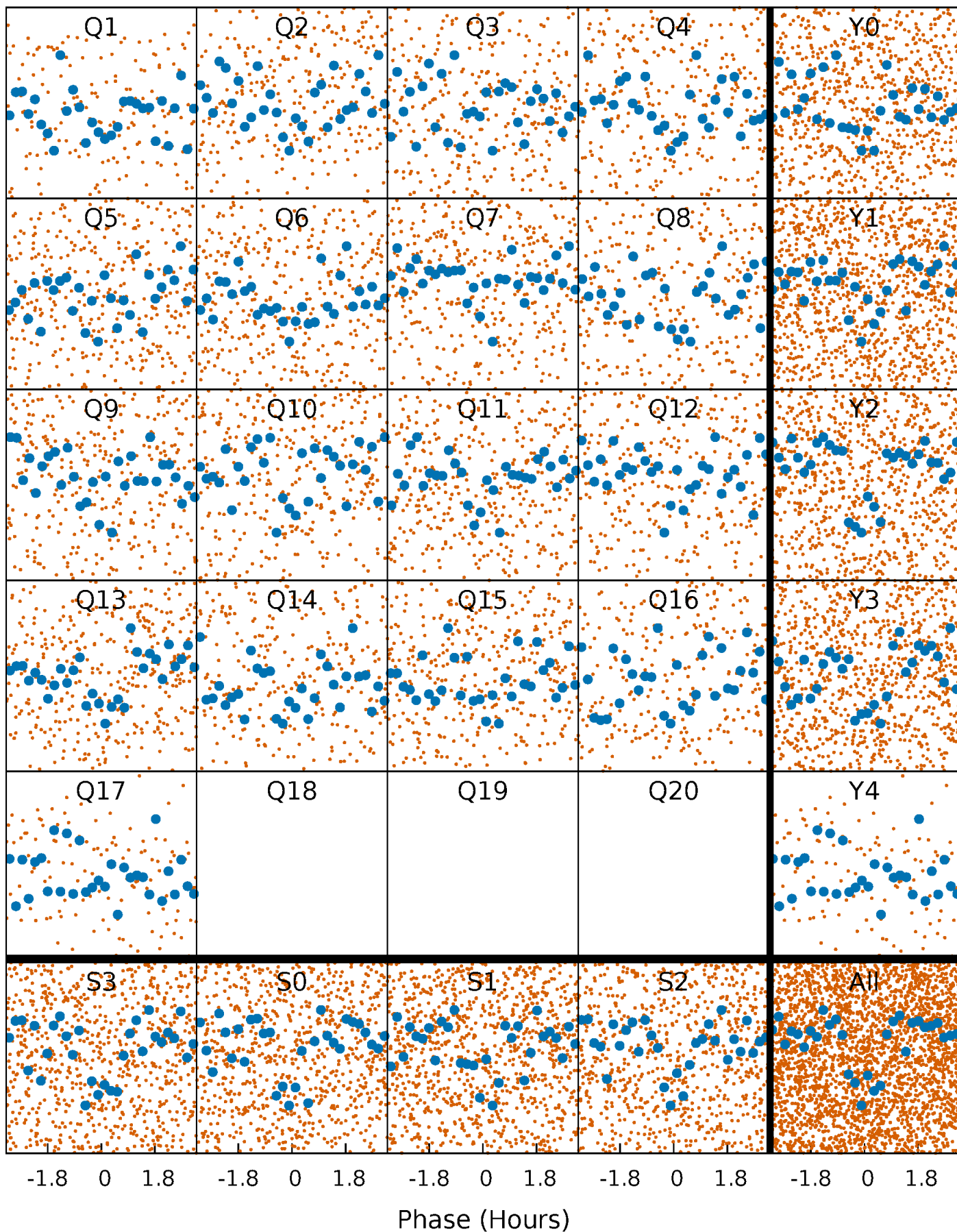


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



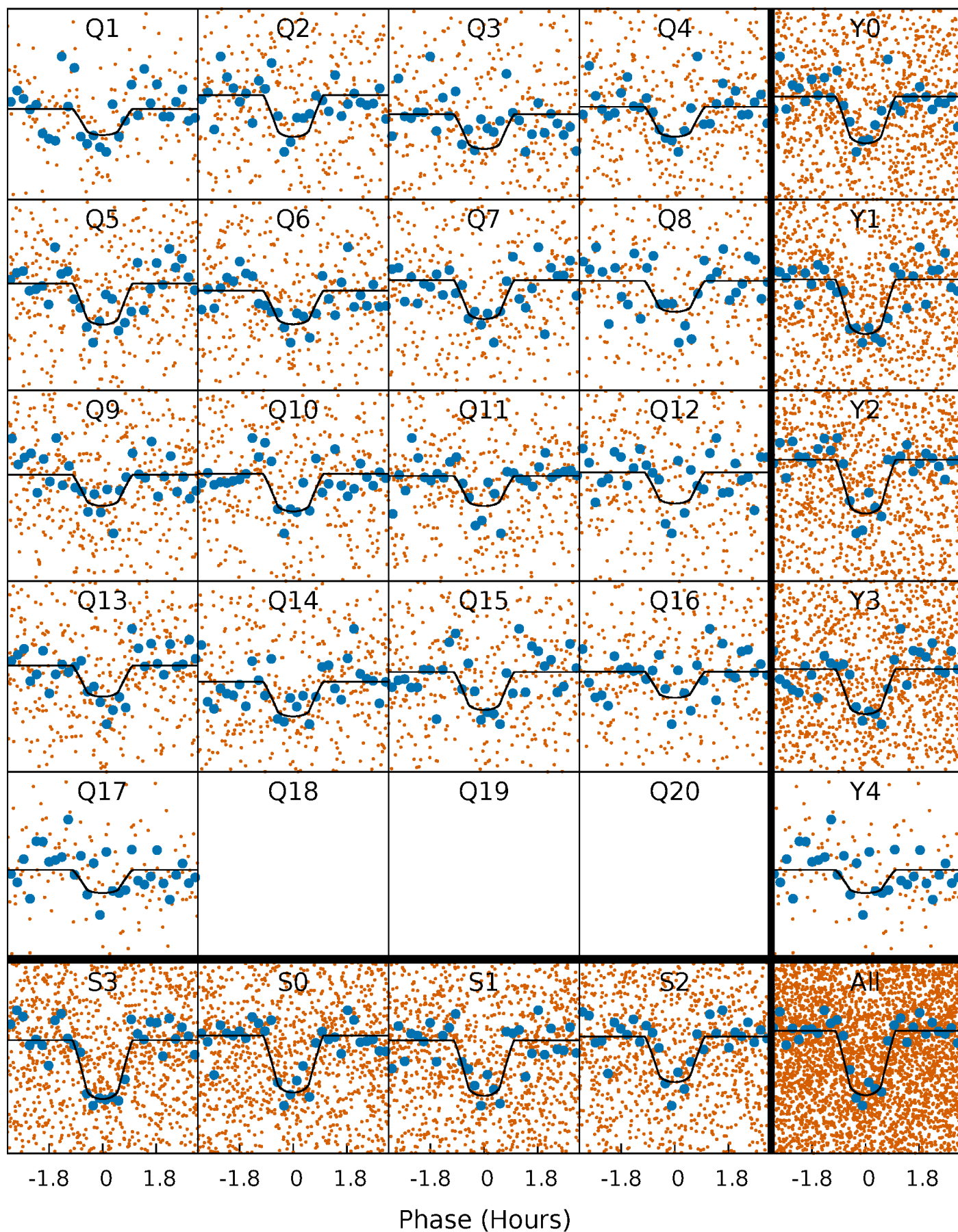
# PDC Quarter-Phased Transit Curves

TCE 008972058-02   P= 2.403622 Days    $T_0=132.331990$  (BKJD)



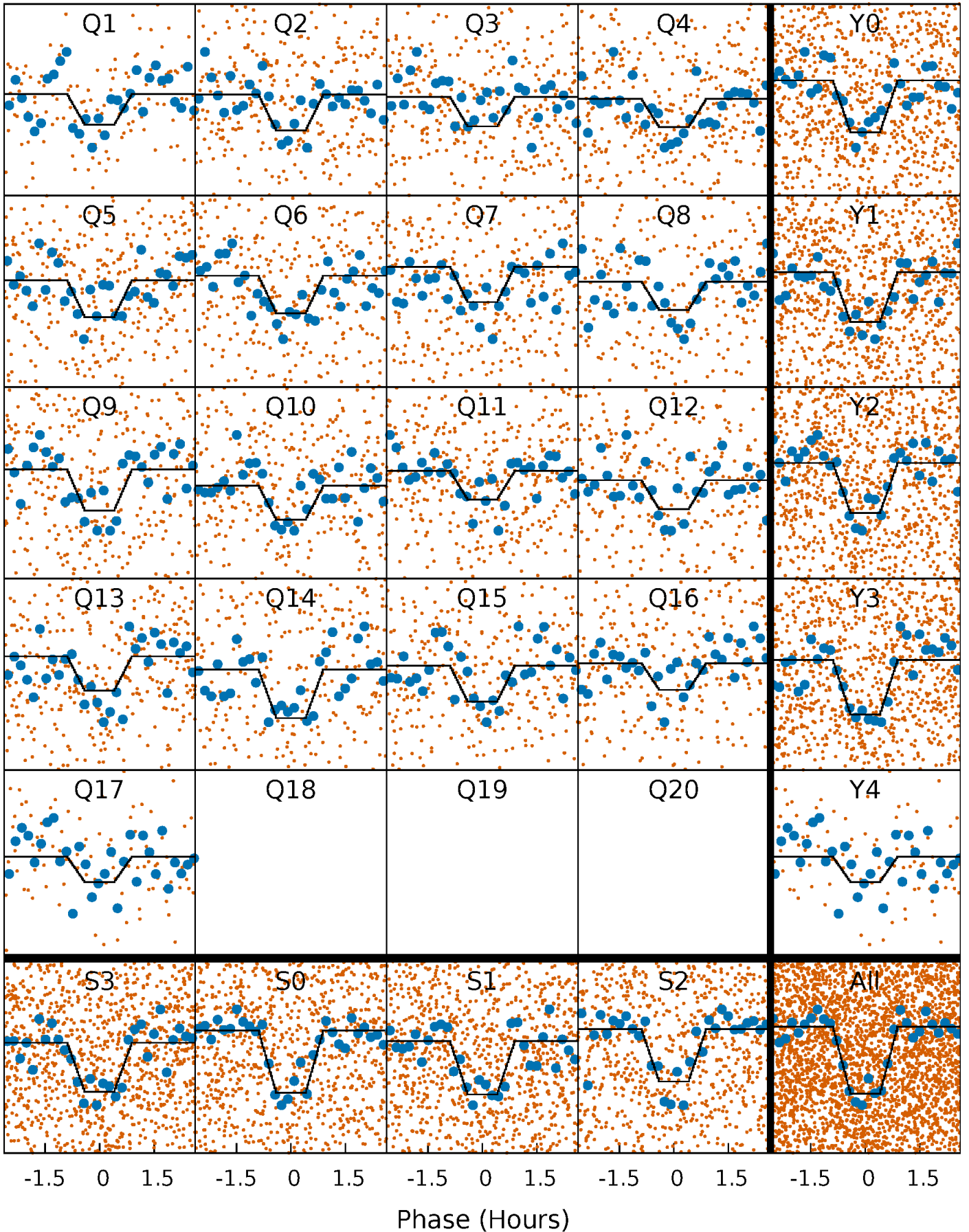
# DV Quarter-Phased Transit Curves

TCE 008972058-02 P= 2.403622 Days  $T_0=132.331990$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

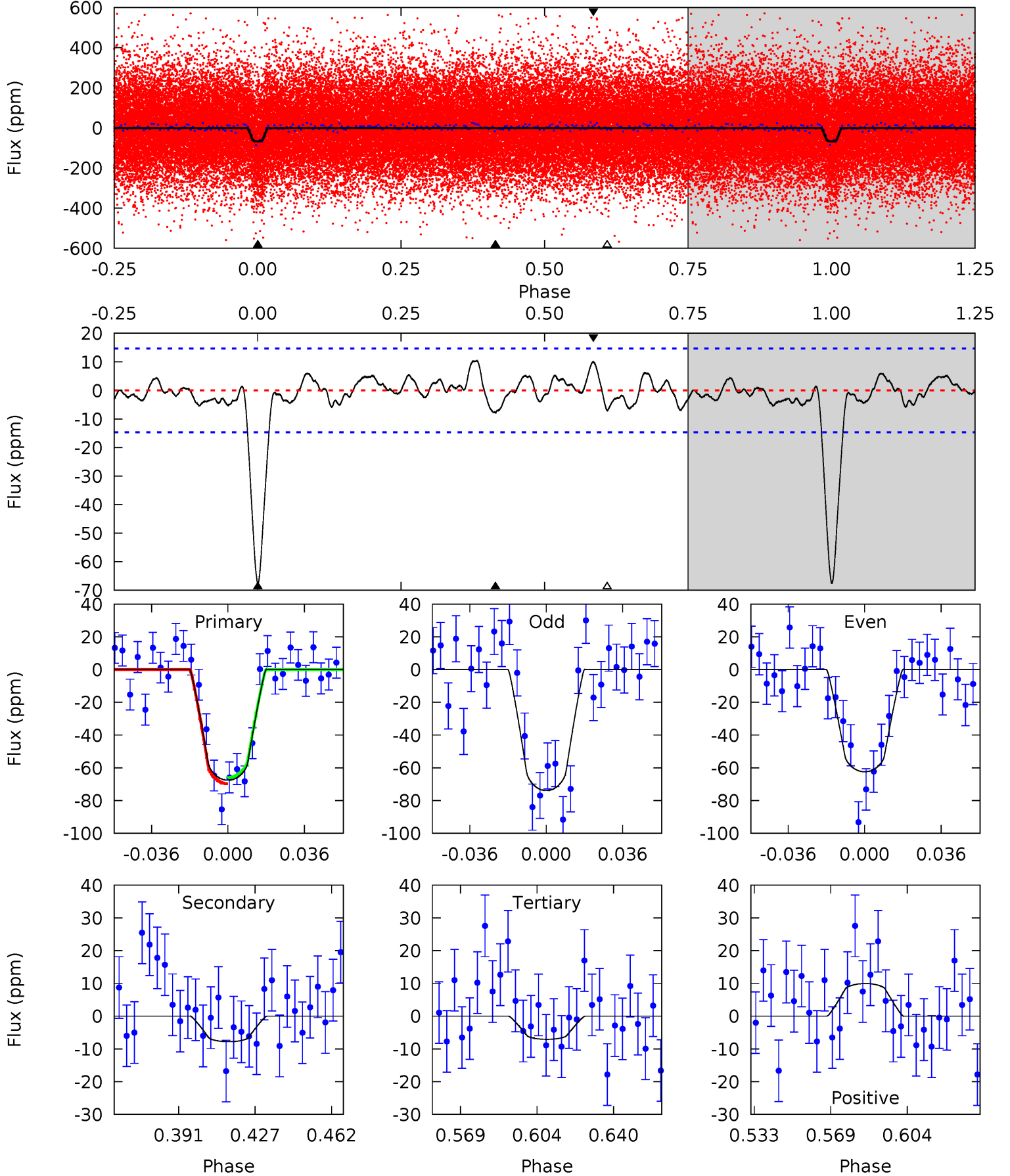
TCE 008972058-02   P= 2.403631 Days    $T_0=132.331541$  (BKJD)



# DV Model-Shift Uniqueness Test

008972058-02, P = 2.403622 Days, E = 129.928368 Days

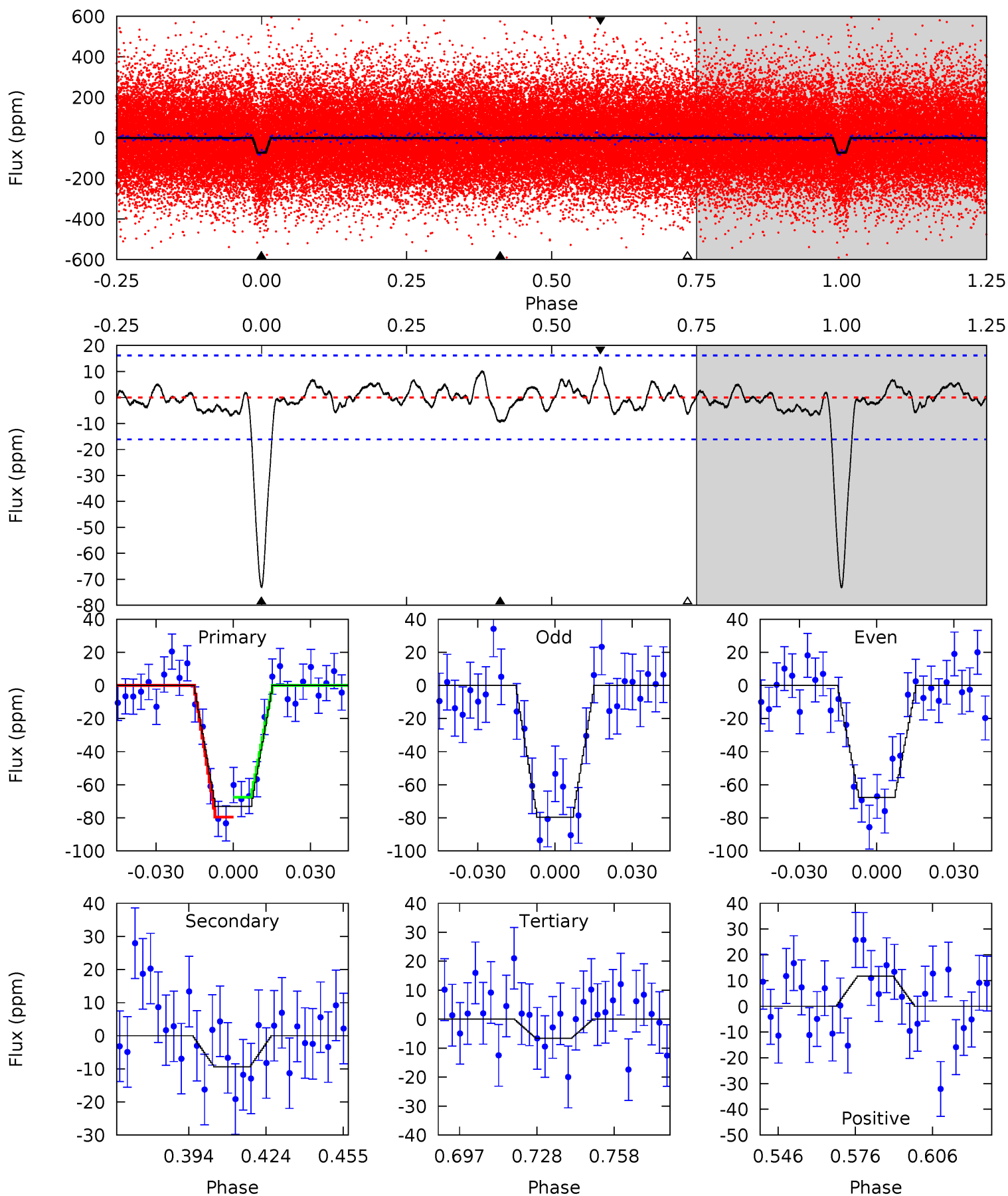
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
22.0	2.55	2.31	3.24	4.78	2.10	1.15	19.7	18.8	0.24	-0.69	1.88	0.94	0.13	0.61



# Alt Model-Shift Uniqueness Test

008972058-02, P = 2.403631 Days, E = 129.927910 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
21.8	2.80	1.96	3.49	4.81	2.17	1.08	19.8	18.3	0.84	-0.69	1.78	0.95	0.14	1.79



### Stellar Parameters For KIC 008972058

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5881^{+105}_{-117}$	$4.315^{+0.115}_{-0.115}$	$0.070^{+0.150}_{-0.150}$	$1.171^{+0.196}_{-0.161}$	$1.032^{+0.089}_{-0.067}$	$0.905^{+0.458}_{-0.302}$
	+2%/-2%	+3%/-3%	+214%/-214%	+17%/-14%	+9%/-6%	+51%/-33%
Source	SPE59	SPE59	SPE59	DSEP		

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

### Secondary Eclipse Parameters for KIC 008972058-02 / KOI 0159.02

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-8 \pm 3$	$1.16^{+0.50}_{-0.46}$	$2074^{+101}_{-83}$	$3601^{+789}_{-510}$	$3.837^{+7.439}_{-2.264}$
Alt.	$-9 \pm 3$	$1.09^{+0.49}_{-0.50}$	$2078^{+104}_{-91}$	$3814^{+974}_{-517}$	$5.325^{+12.021}_{-3.035}$

$T_{\text{max}}$  = 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

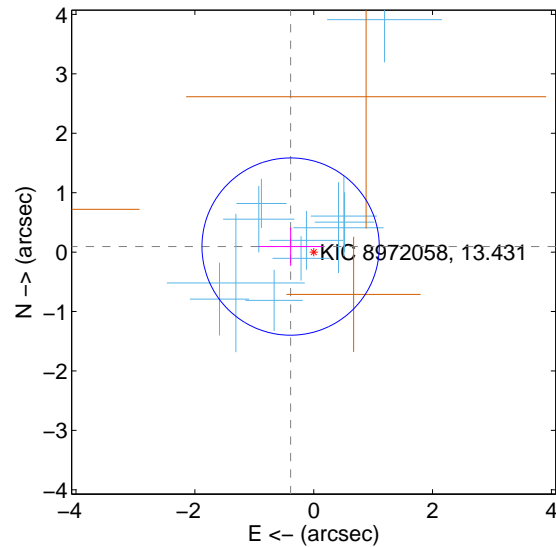
Supplemental centroid analysis for 008972058-02. Kepler magnitude: 13.43. Transit SNR 16.00

There are 11 quarters with good PRF difference image offsets

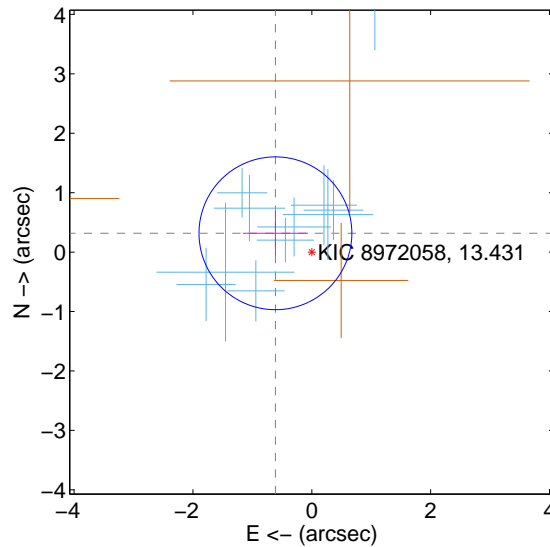
The direct PRF centroid is offset from the target star catalog position by about 0.36 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.400 \pm 0.497$	0.80	$0.389 \pm 0.537$	$0.093 \pm 0.323$
PRF-fit source offset from KIC position	$0.689 \pm 0.429$	1.61	$0.612 \pm 0.547$	$0.317 \pm 0.368$
photometric centroid source offset	$0.97 \pm 0.81$	1.19	$-0.71 \pm 0.83$	$0.65 \pm 0.79$

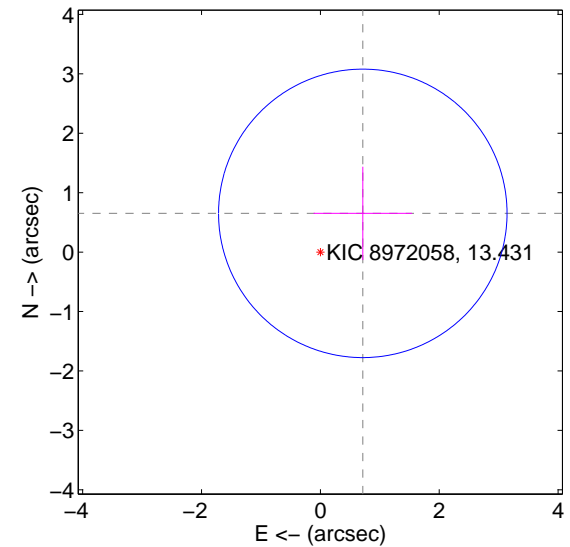
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

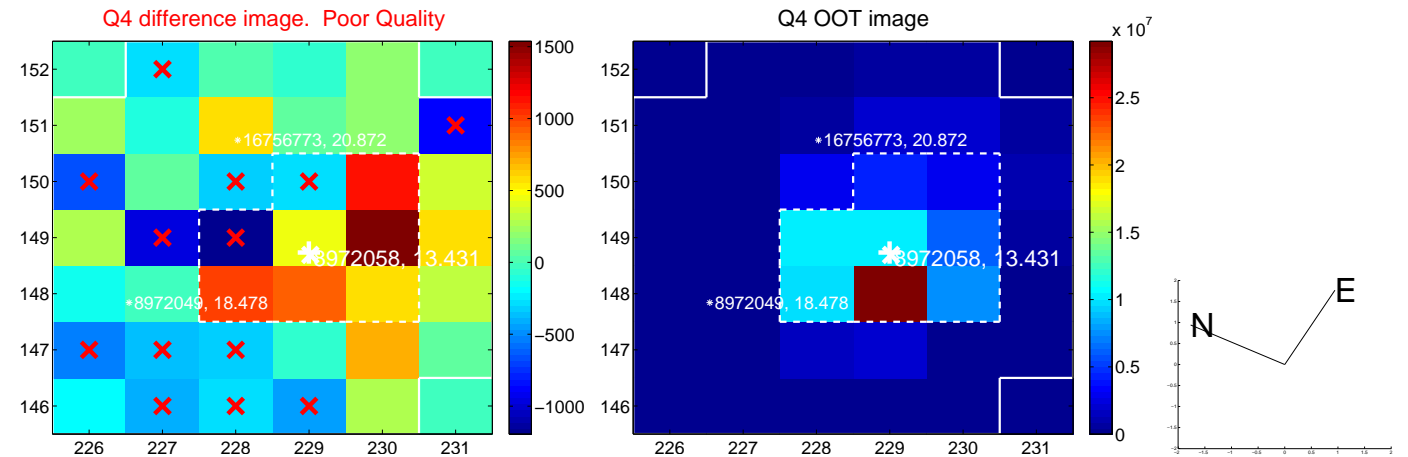
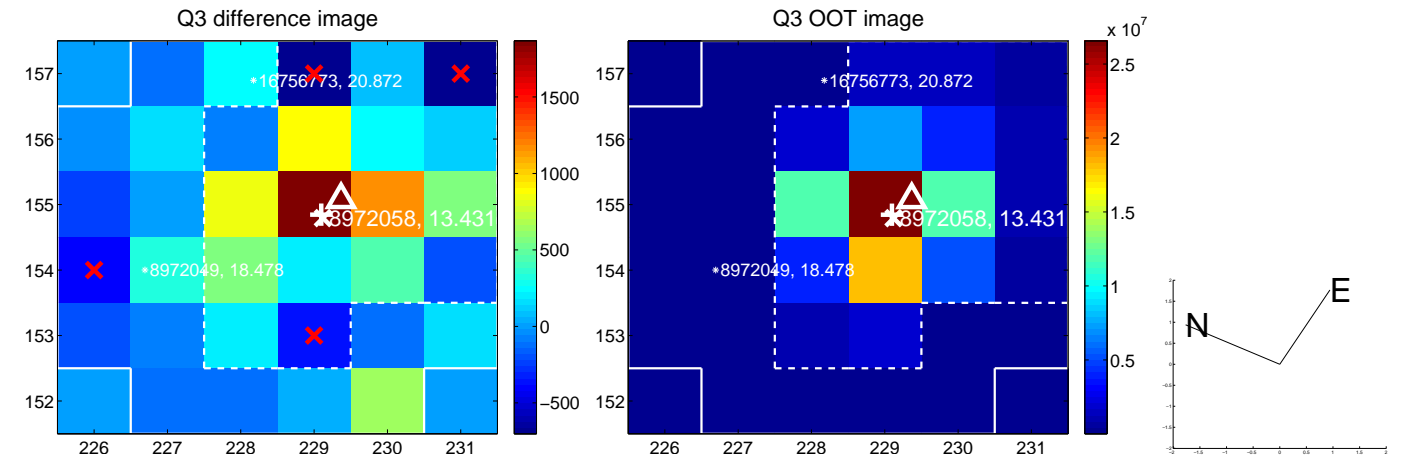
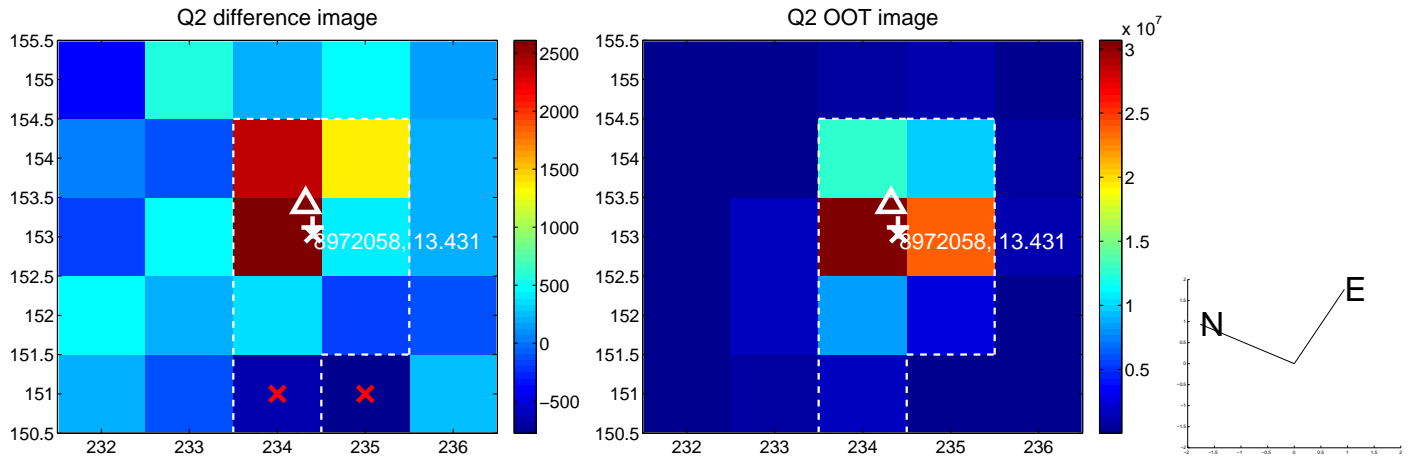
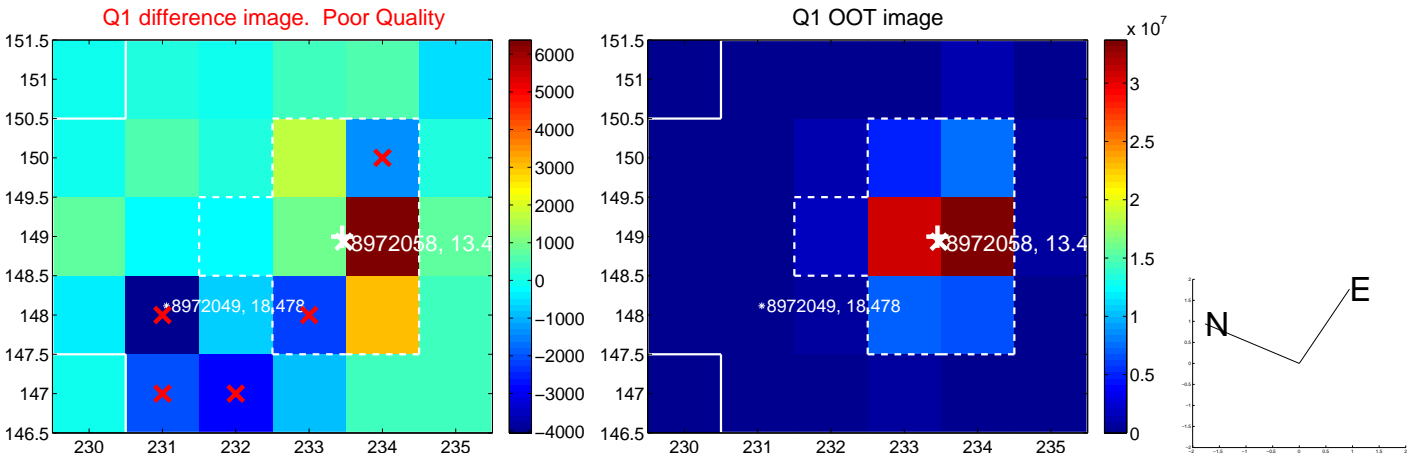


offset from photometric centroids

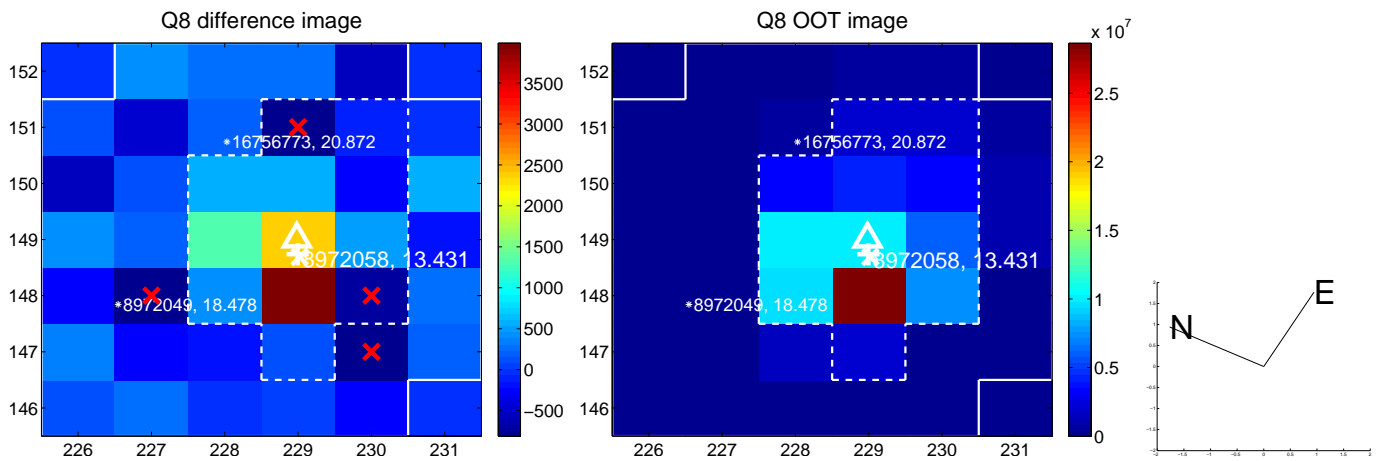
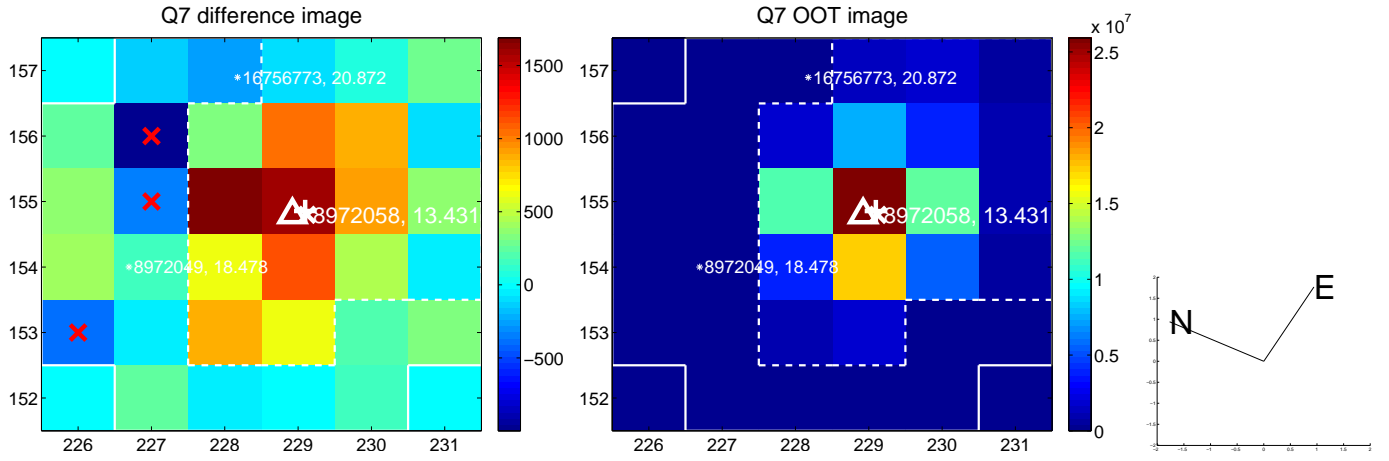
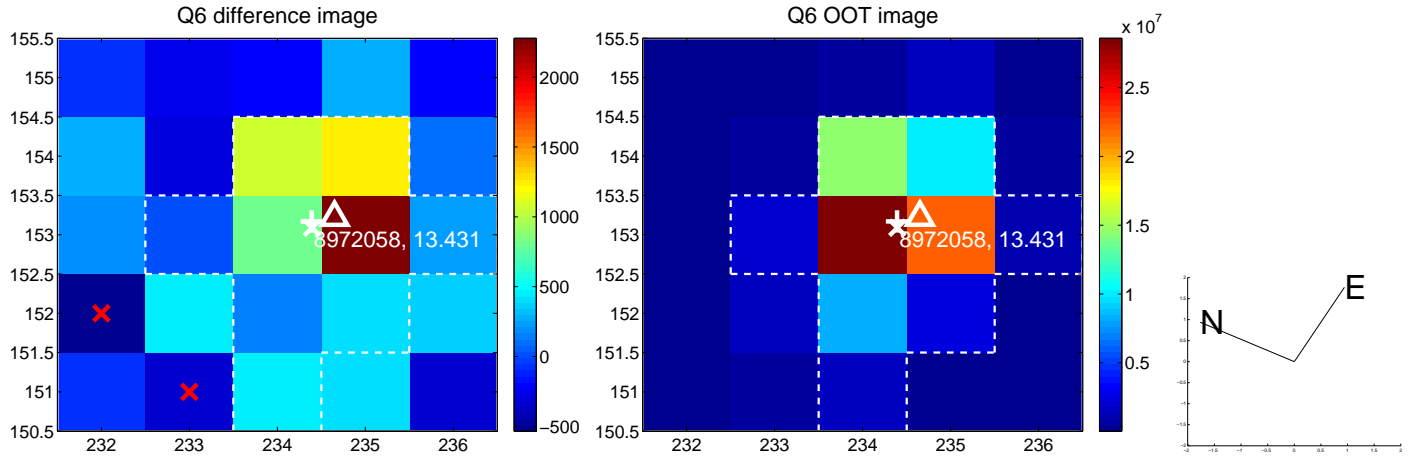
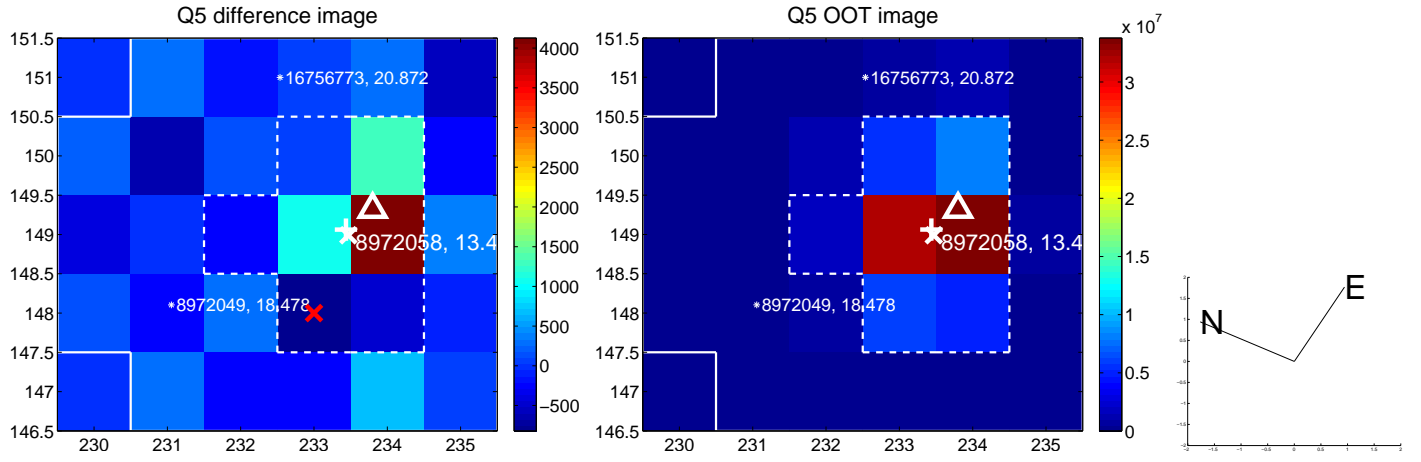


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

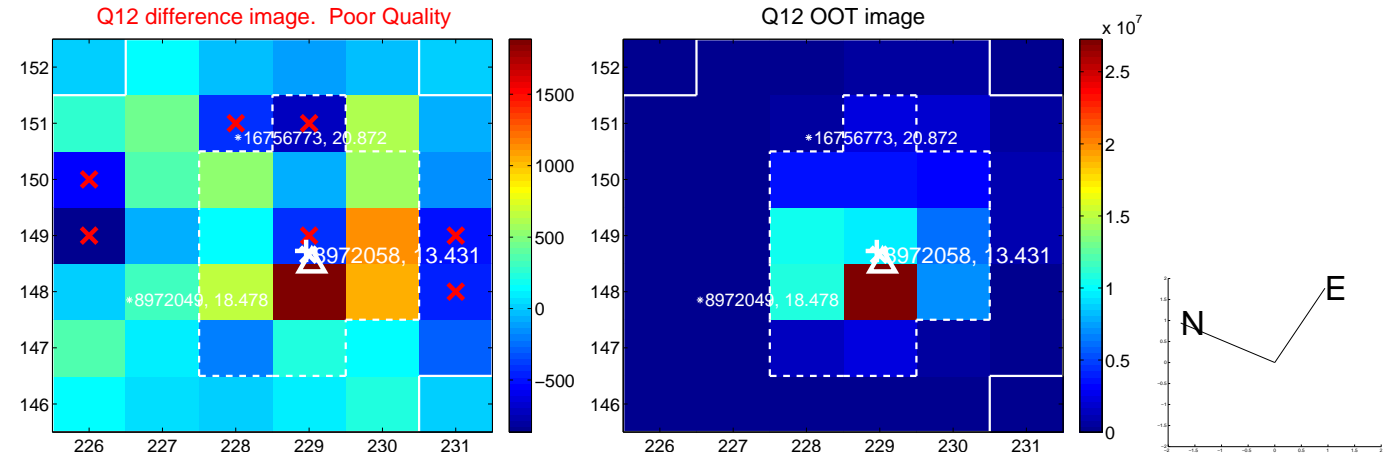
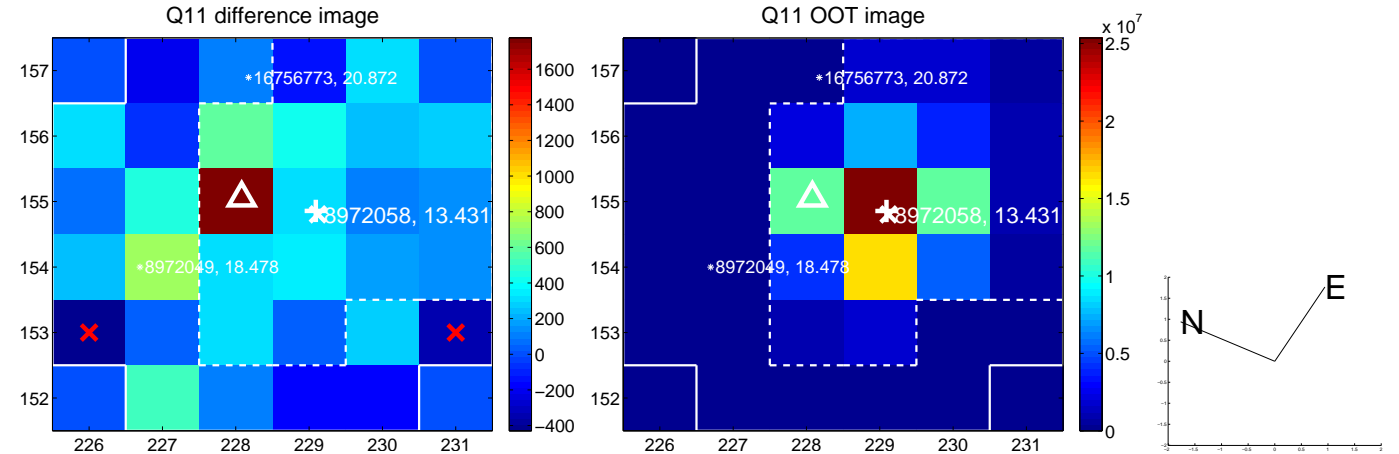
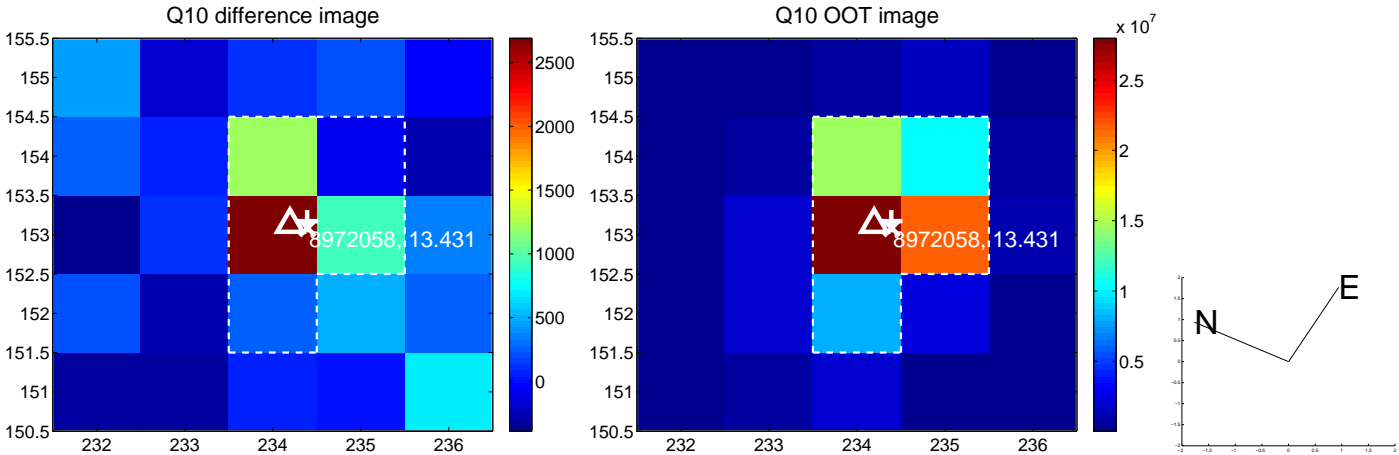
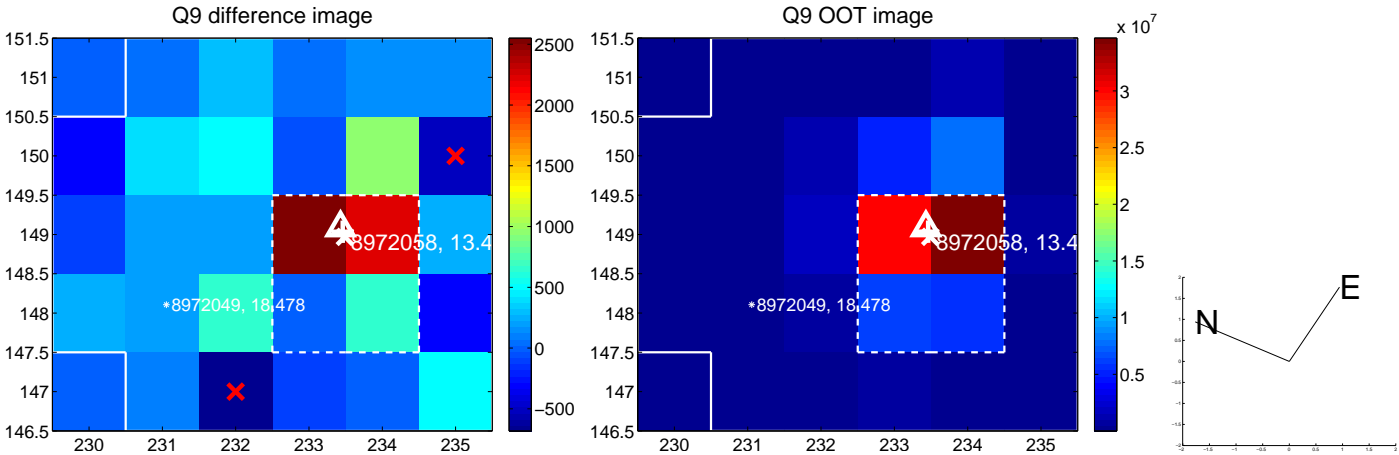
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



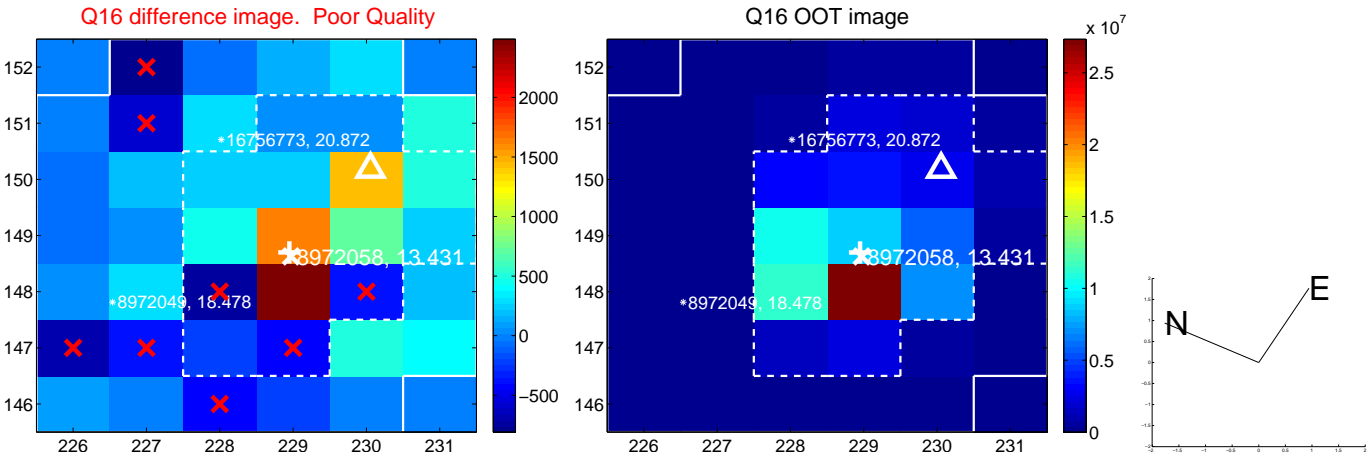
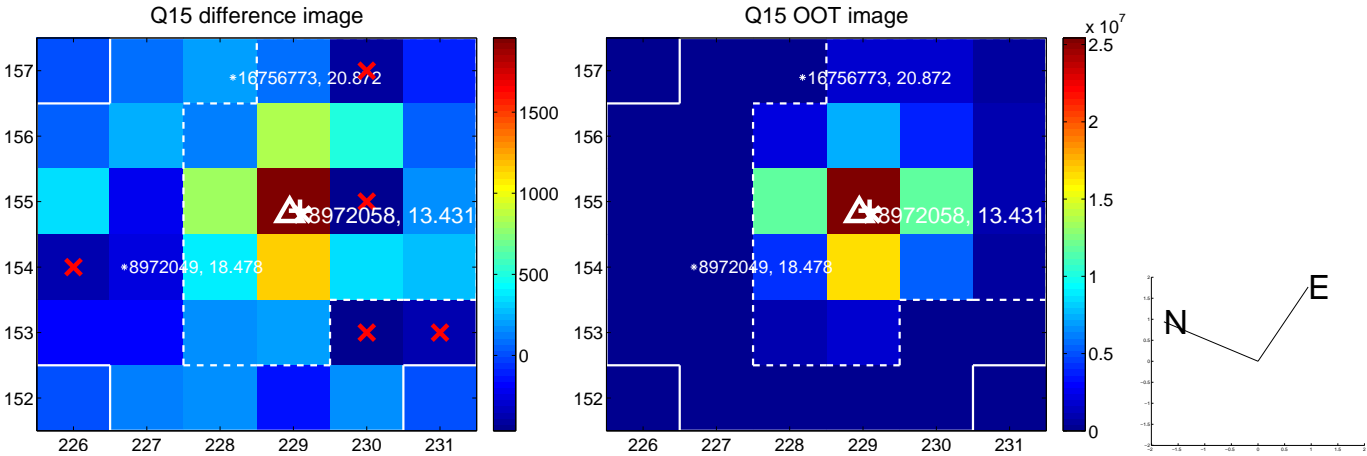
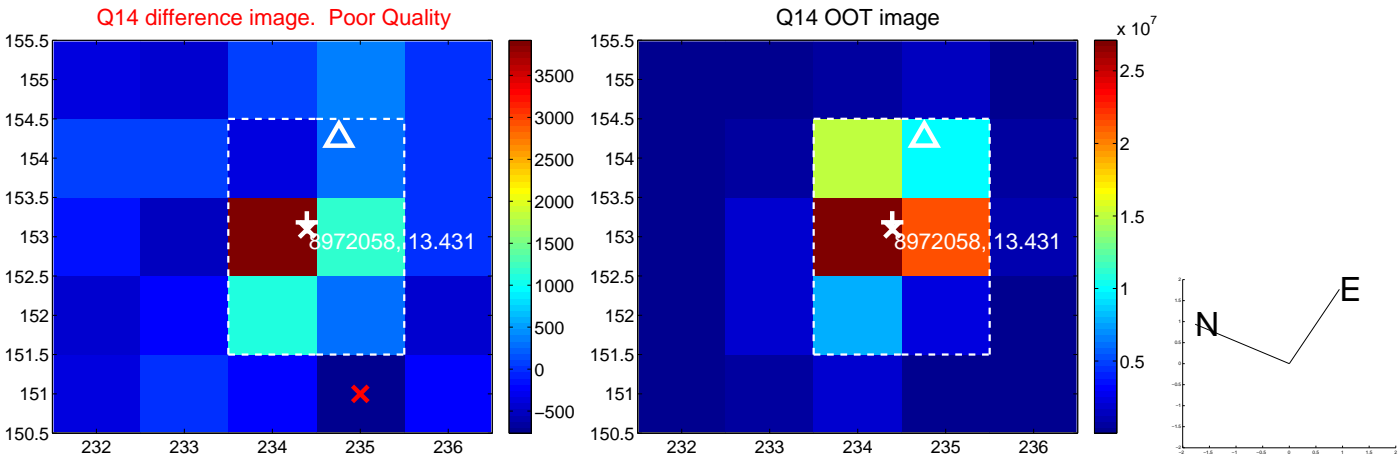
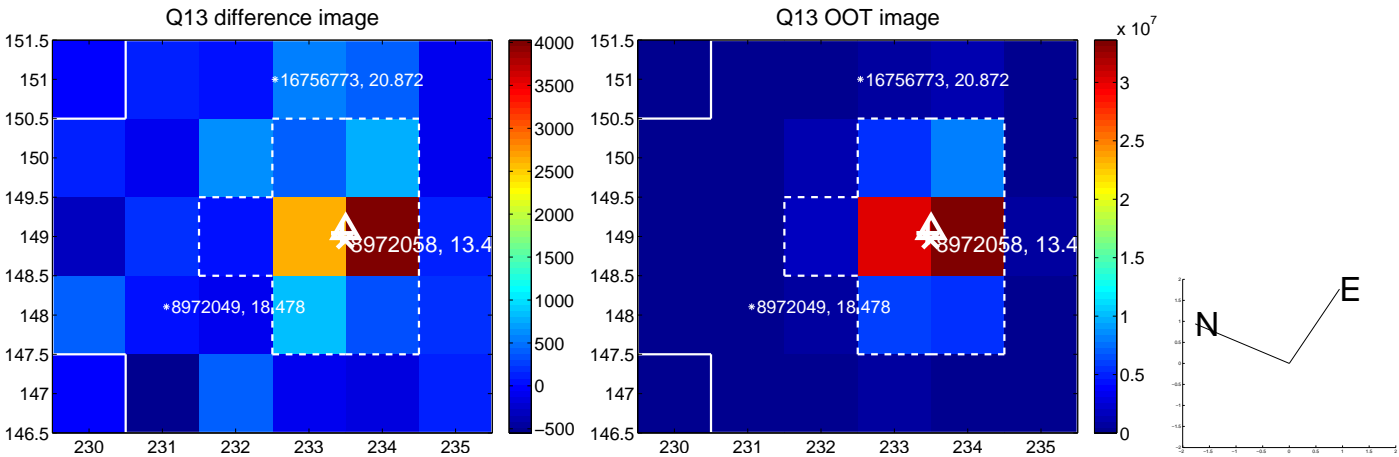
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



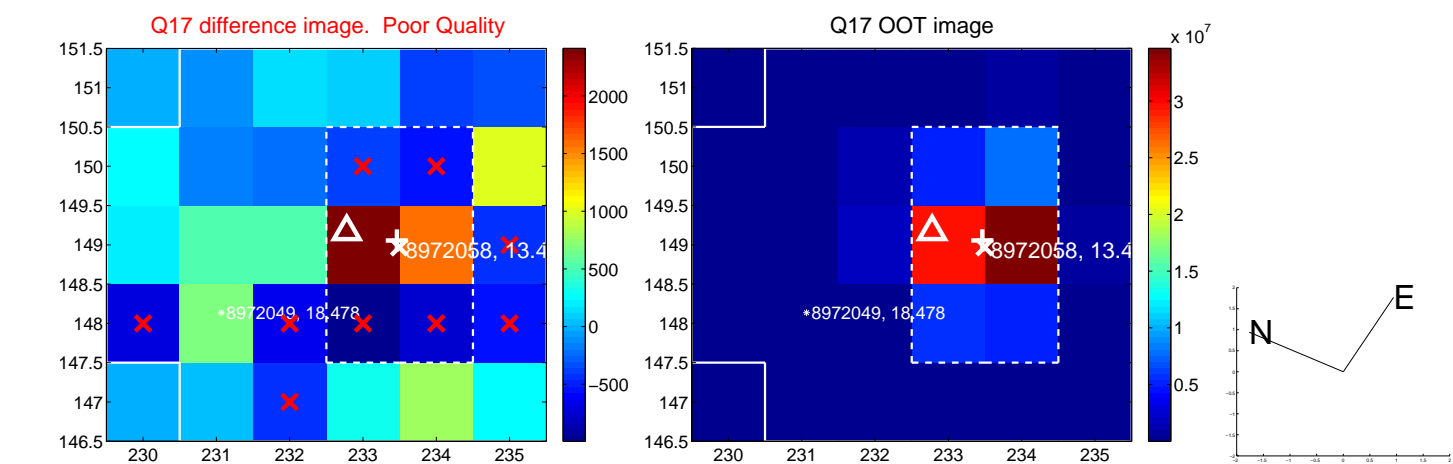
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



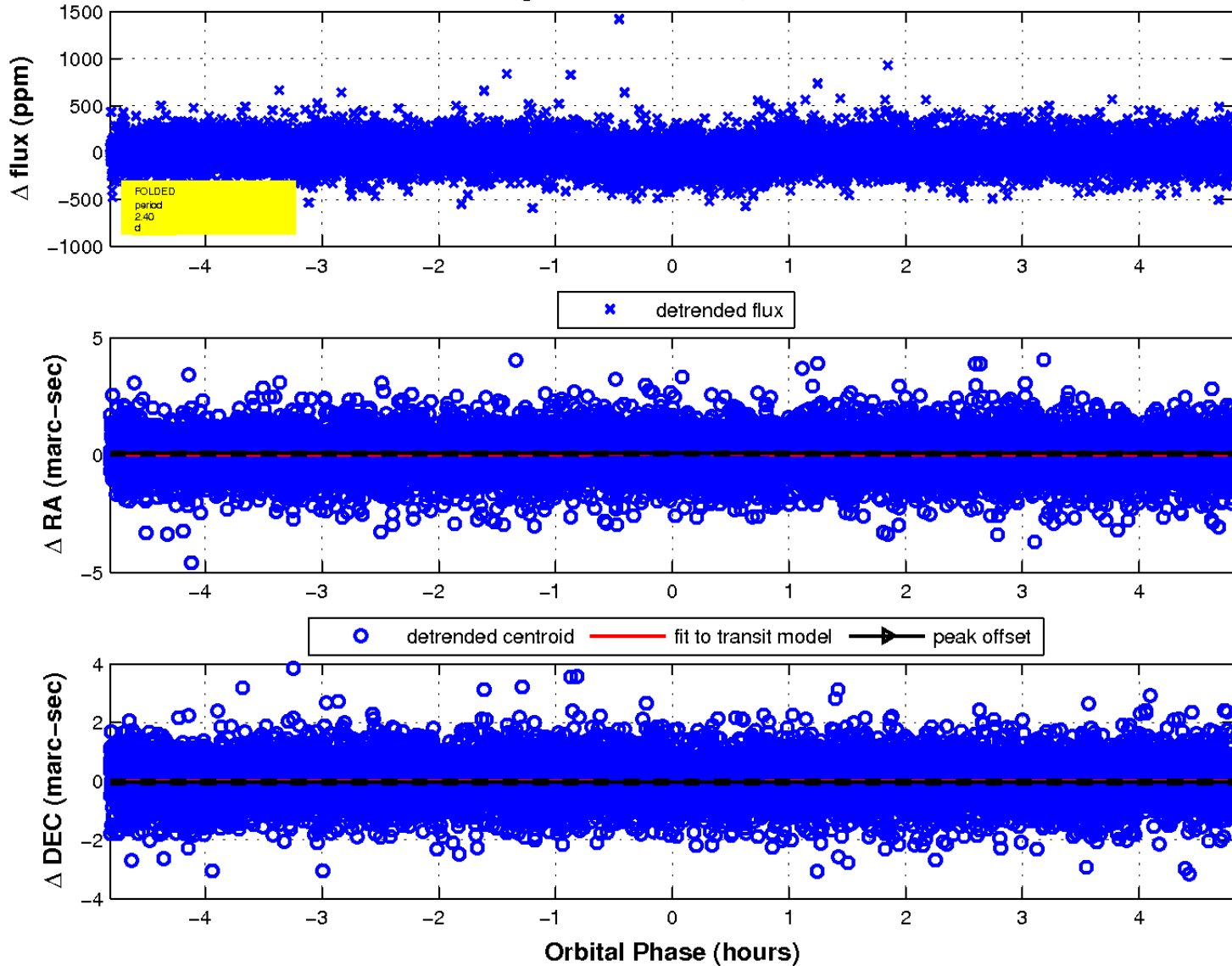
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

Declination

