

# KIC 008780959

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
008780959-01	OBS	3741.01	2.617293	132.389262	2750.7	8.680	602.2	298.0	1.34	6432	12.88	1927.33
008780959-02	OBS	3741.03	5.111751	133.759845	234.1	2.861	27.4	31.3	1.34	6432	2.36	789.47
008780959-03	OBS	3741.04	9.630929	132.736970	228.6	4.901	19.7	23.3	1.34	6432	2.38	339.26
008780959-04	OBS	3741.02	18.578474	141.829942	240.4	3.500	9.4	-1.0	1.34	6432	2.10	141.28

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
008780959-01	OBS	FP	0.00	0	1	1	1	MOD_ODDEVEN_DV—MOD_ODDEVEN_ALT—DEEP_V_SHAPED—SEASONAL_DEPTH_DV—SEASONAL_DEPTH_ALT—CENT_RESOLVED_OFFSET—HALO_GHOST—EPHEM_MATCH
008780959-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT
008780959-03	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED
008780959-04	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED—LPP_ALT—MOD_NONUNIQ_ALT—CENT_NOFITS

**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.

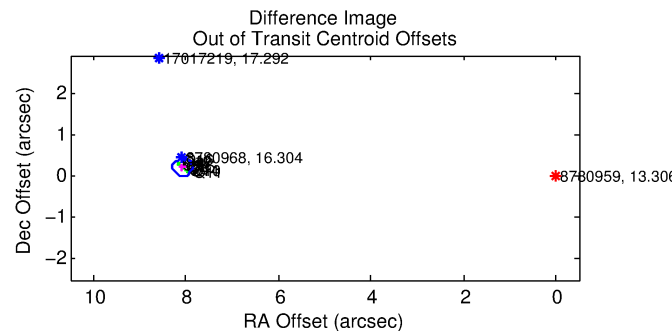
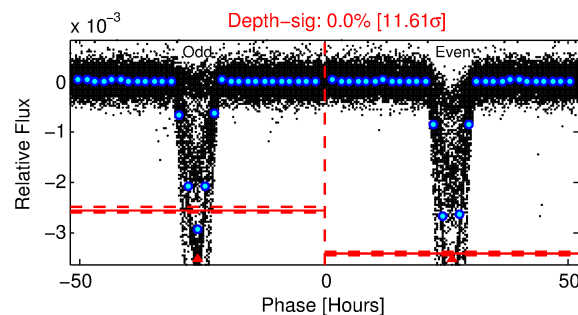
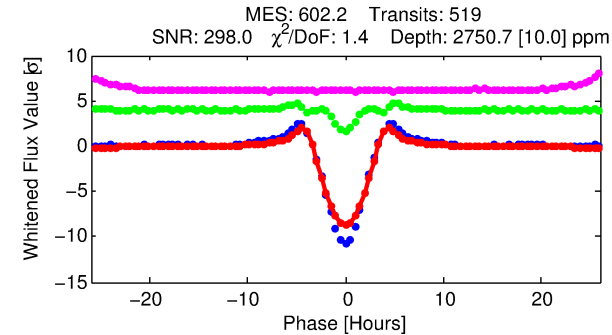
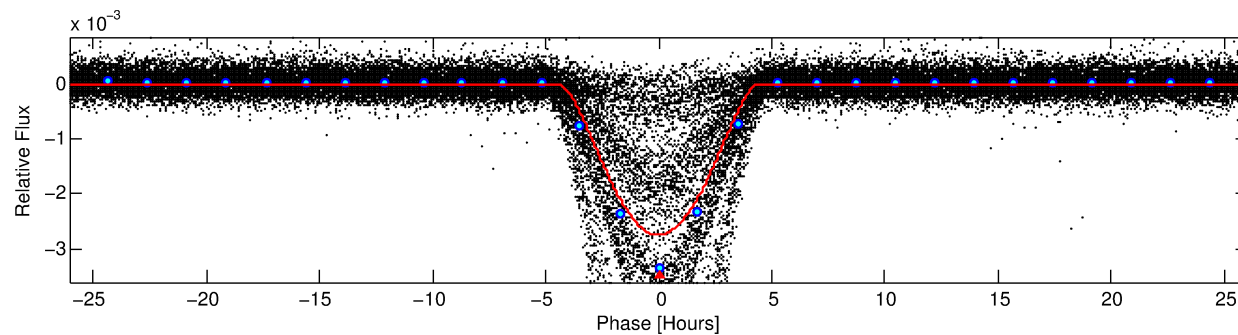
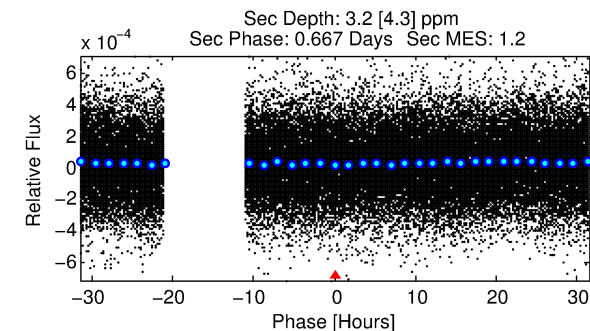
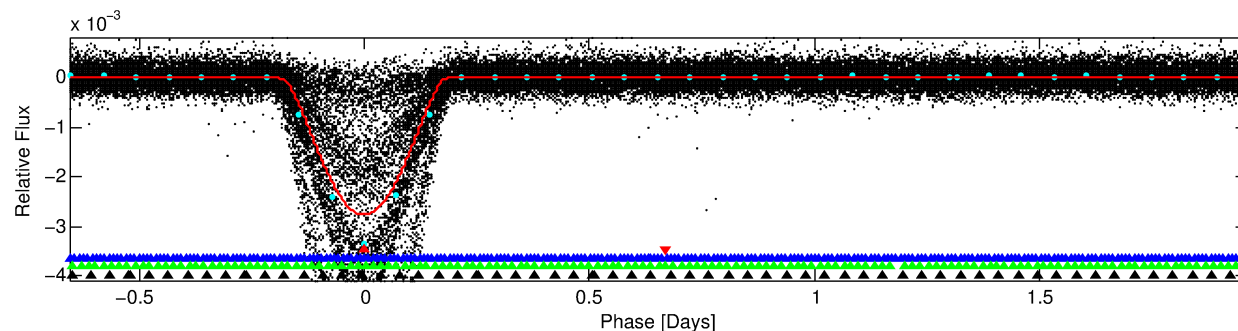
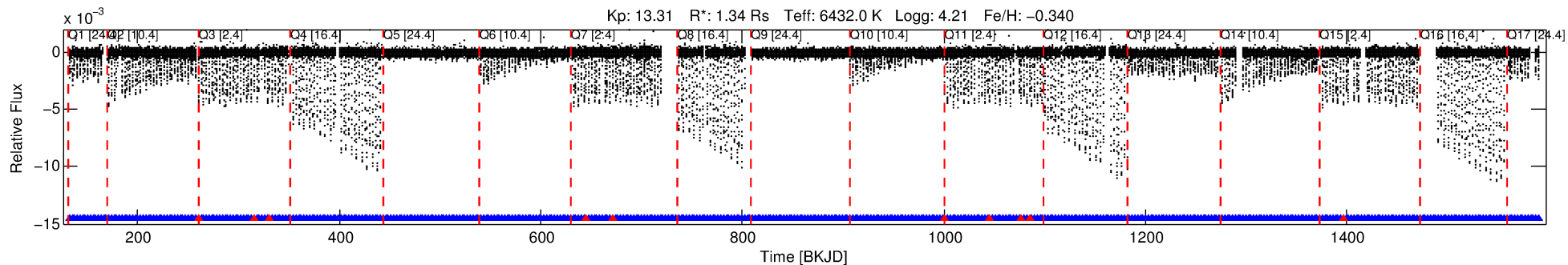
## Ephemeris Match Information For 008780959-01

TCE (1)	KIC	Parent (2)	Parent KIC	$P_1:P_2$	Dist ( $''$ )	$\Delta\text{Row}$	$\Delta\text{Col}$	$m_2$	$m_1$	$D_2/D_1$	Mechanism	Flag	$\sigma_P$	$\sigma_T$
008780959-01	8780959	3653.01	8780968	1:1	8.1	2	1	16.30	13.30	98.86	Direct-PRF	0	0.15	0.04

**Notes:**  $P_1:P_2$  is the period ratio. Dist is the distance in arcseconds.  $\Delta\text{Row}$  and  $\Delta\text{Col}$  are the number of pixels apart in row and column.  $m_2$  and  $m_1$  are the magnitudes of the parent and child.  $D_2/D_1$  is the parent's transit depth divided by the child's.  $\sigma_P$  and  $\sigma_T$  are the significance of the match in period and epoch. For a match to be considered significant  $\sigma_P < 5.0$  and  $\sigma_T < 5.0$ . Matches which have  $\sigma_P$  and  $\sigma_T$  very close to this cutoff should receive extra scrutiny, especially if the period ratio is very large.

# DV One-Page Summary

KIC: 8780959 Candidate: 1 of 4 Period: 2.617 d  
KOI: K03741.01 Corr: 0.955



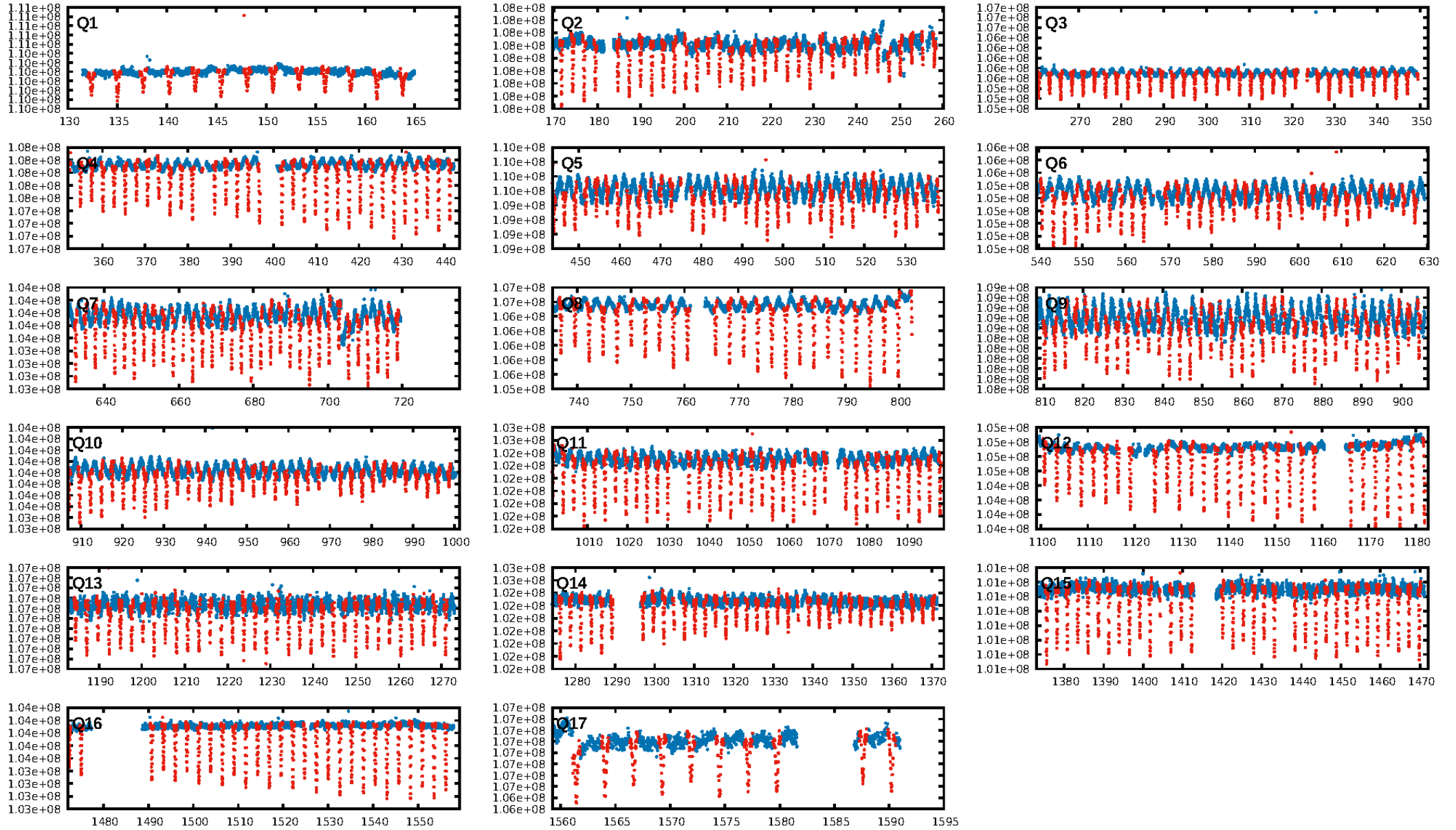
## DV Fit Results:

Period = 2.61729 [0.00000] d  
Epoch = 132.3893 [0.0004] BKJD  
Rp/R\* = 0.0878 [0.0055]  
a/R\* = 1.43 [0.00]  
b = 1.00 [0.01]  
Seff = 1927.33 [717.60]  
Teq = 1690 [157] K  
Rp = 12.89 [3.75] Re  
a = 0.0379 [0.0091] AU  
Ag = 0.02 [0.02] [-46.68 $\sigma$ ]  
Teff = 919 [308] K [-2.23 $\sigma$ ]

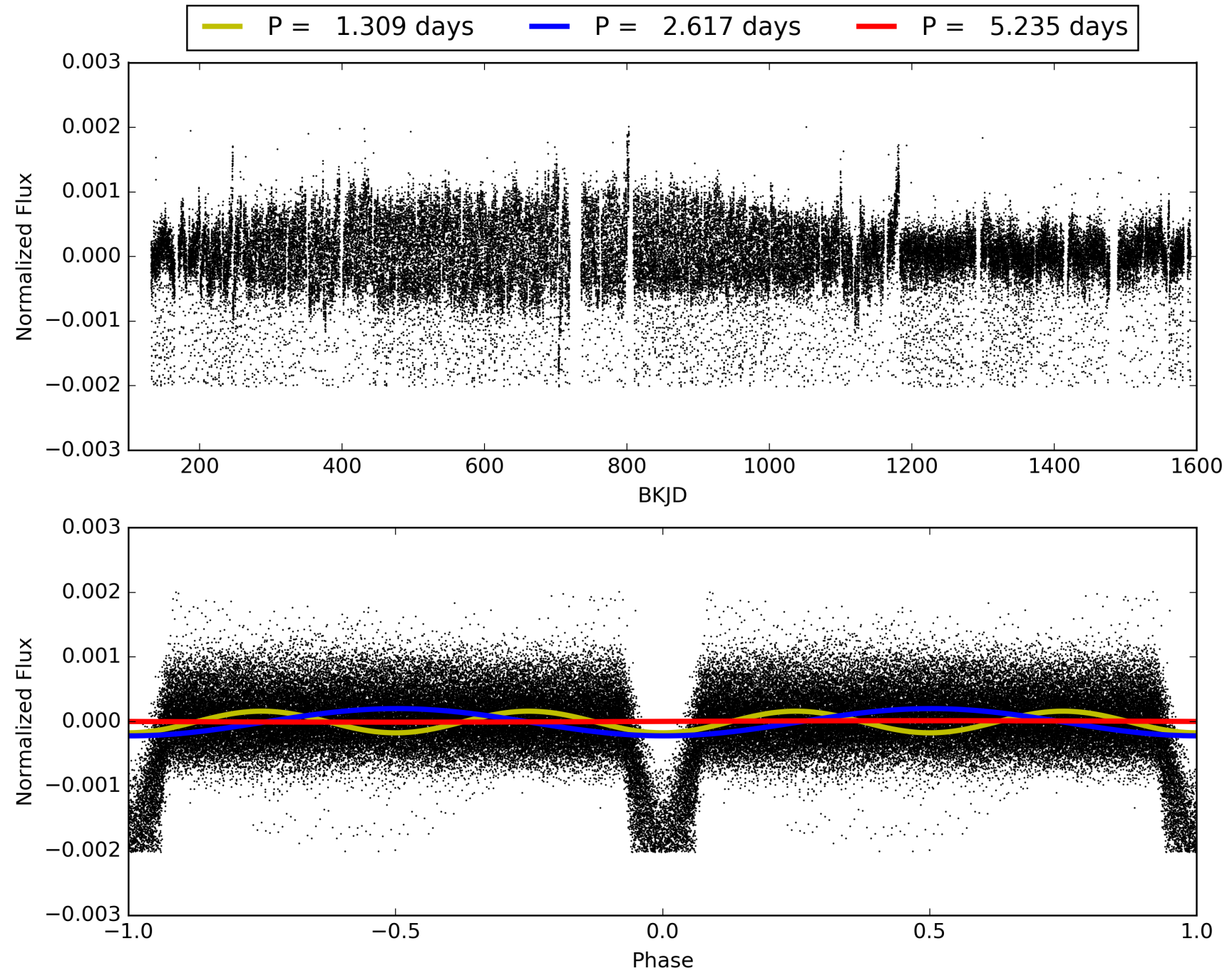
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [6.55 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: N/A  
RollingBand-fgt: 0.98 [486/496]  
GhostDiagnostic-chr: -0.1175  
Centroid-sig: N/A  
Centroid-so: 27.768 arcsec [1063.94 $\sigma$ ]  
OotOffset-rm: 8.080 arcsec [114.49 $\sigma$ ]  
KicOffset-rm: 8.121 arcsec [116.07 $\sigma$ ]  
OotOffset-st: 4/4/4/0 [12]  
KicOffset-st: 4/4/4/0 [12]  
DiffImageQuality-fgm: 1.00 [12/12]  
DiffImageOverlap-fno: 1.00 [17/17]

# TCE 008780959-01, PDC Light Curves



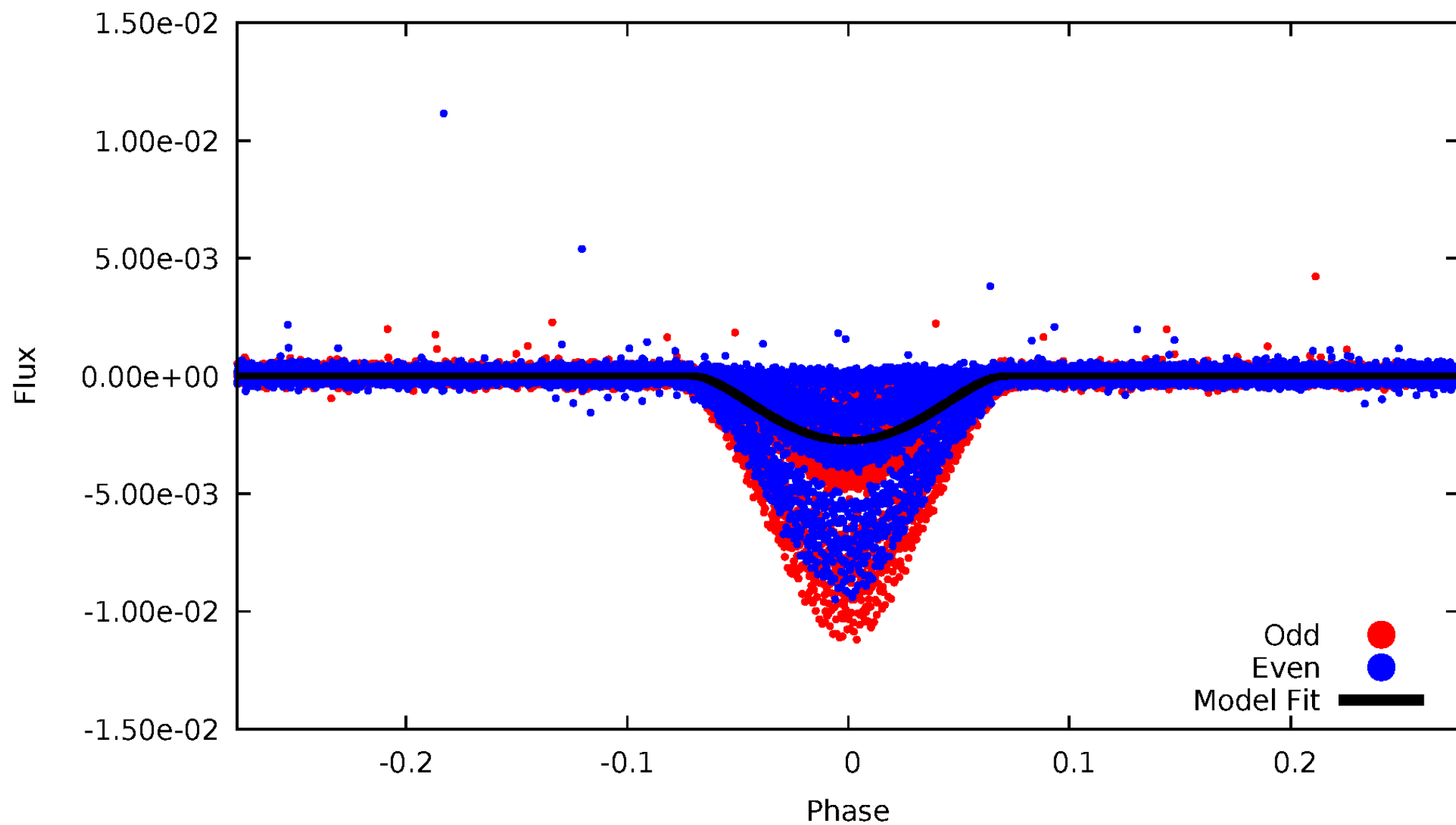
TCE 008780959-01





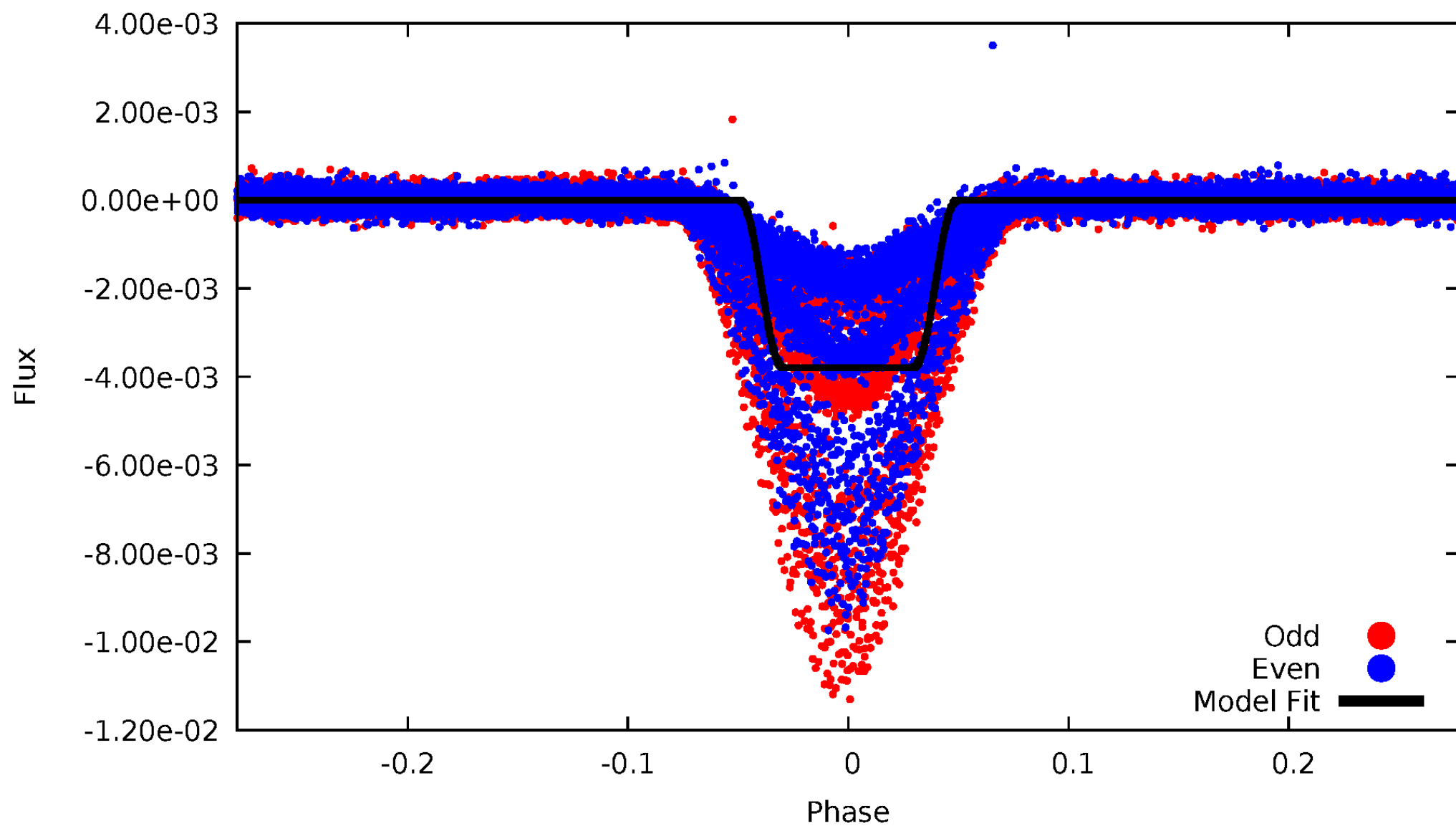
# DV Odd/Even

TCE 008780959-01



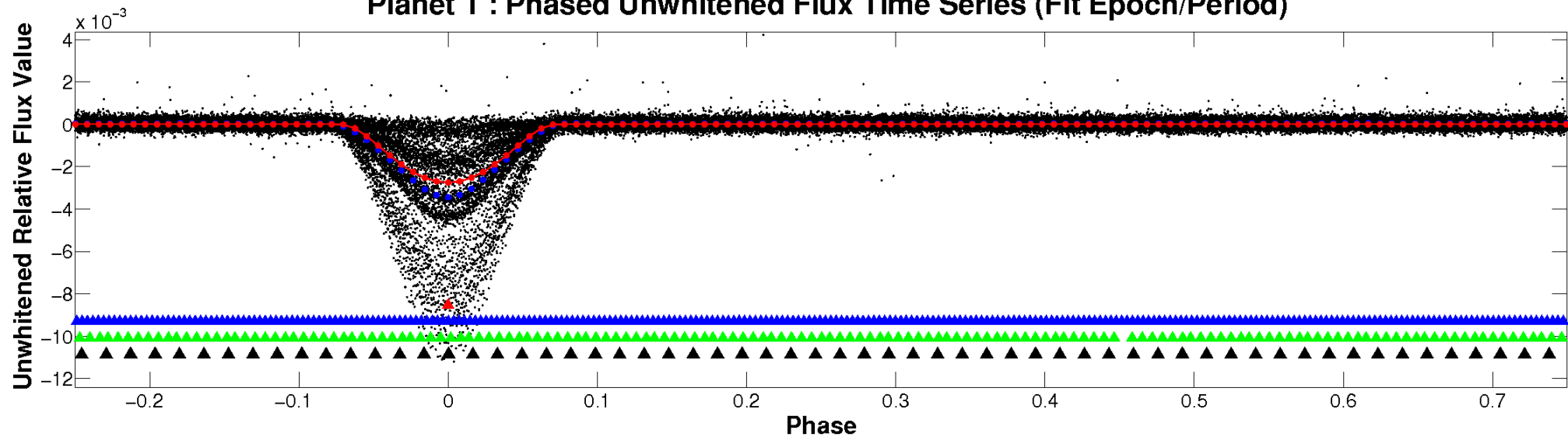
# ALT Odd/Even

TCE 008780959-01

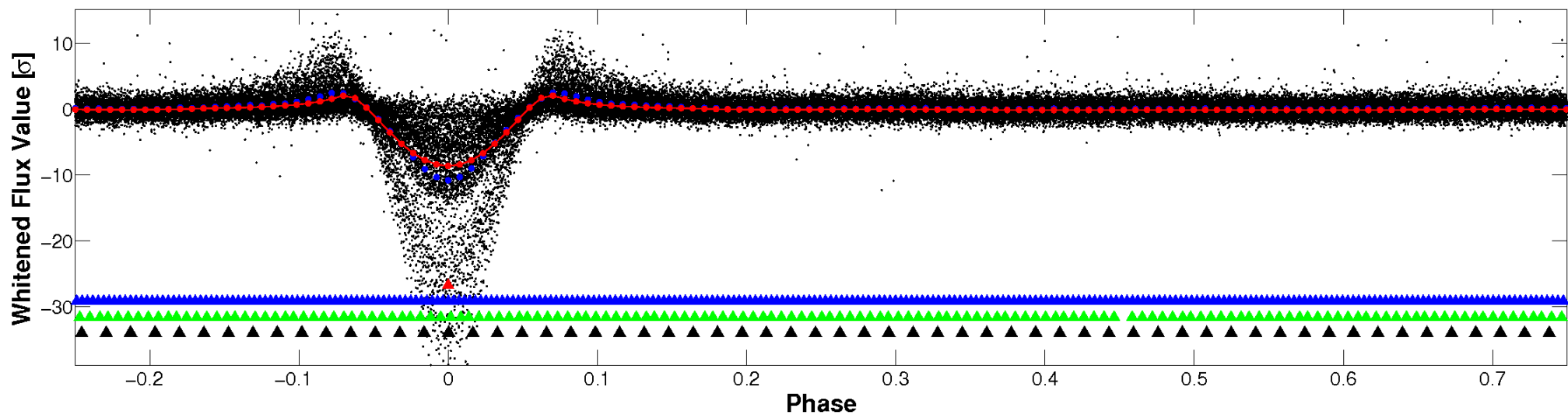


# Non-Whitened Vs. Whitened Light Curve

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

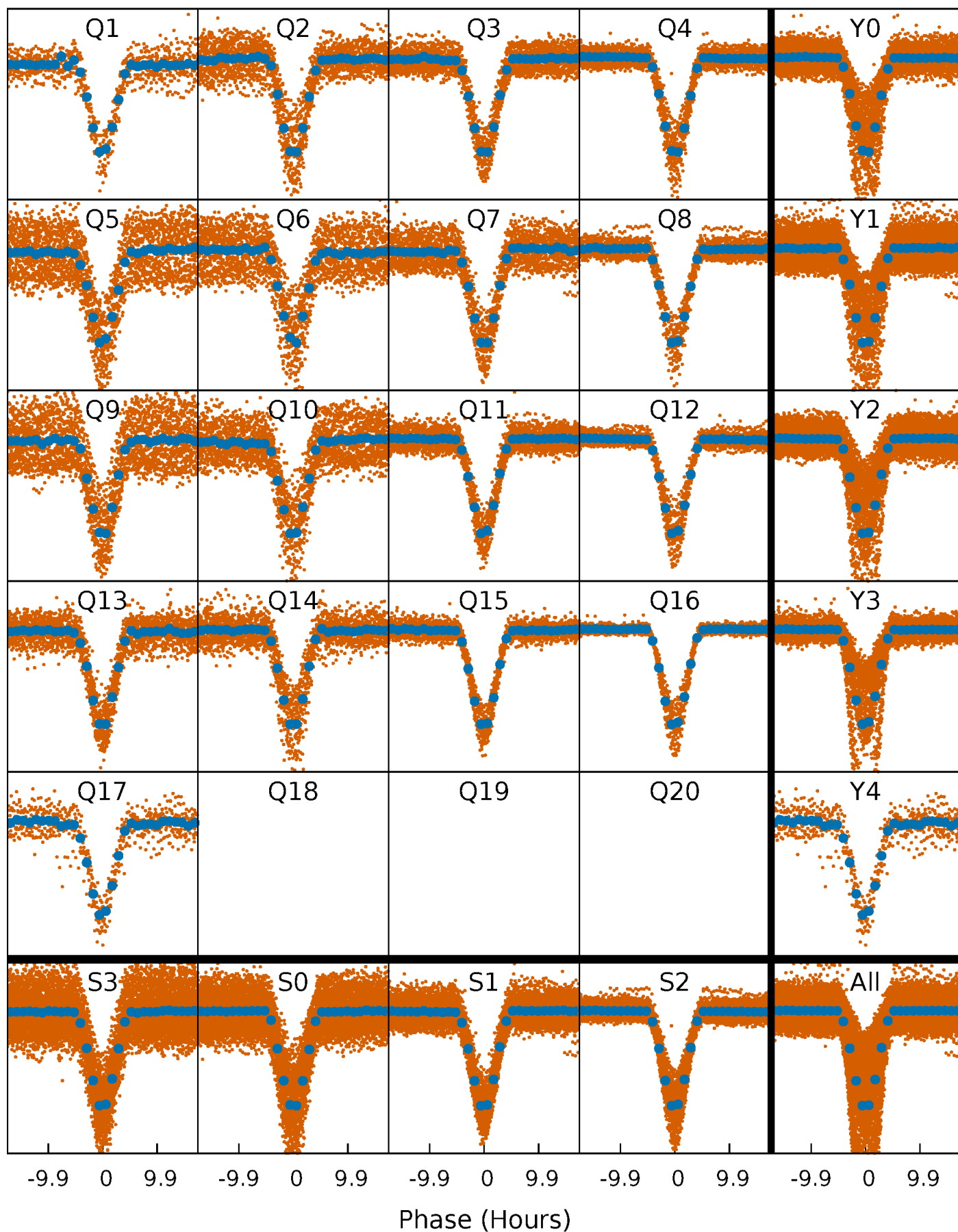


Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

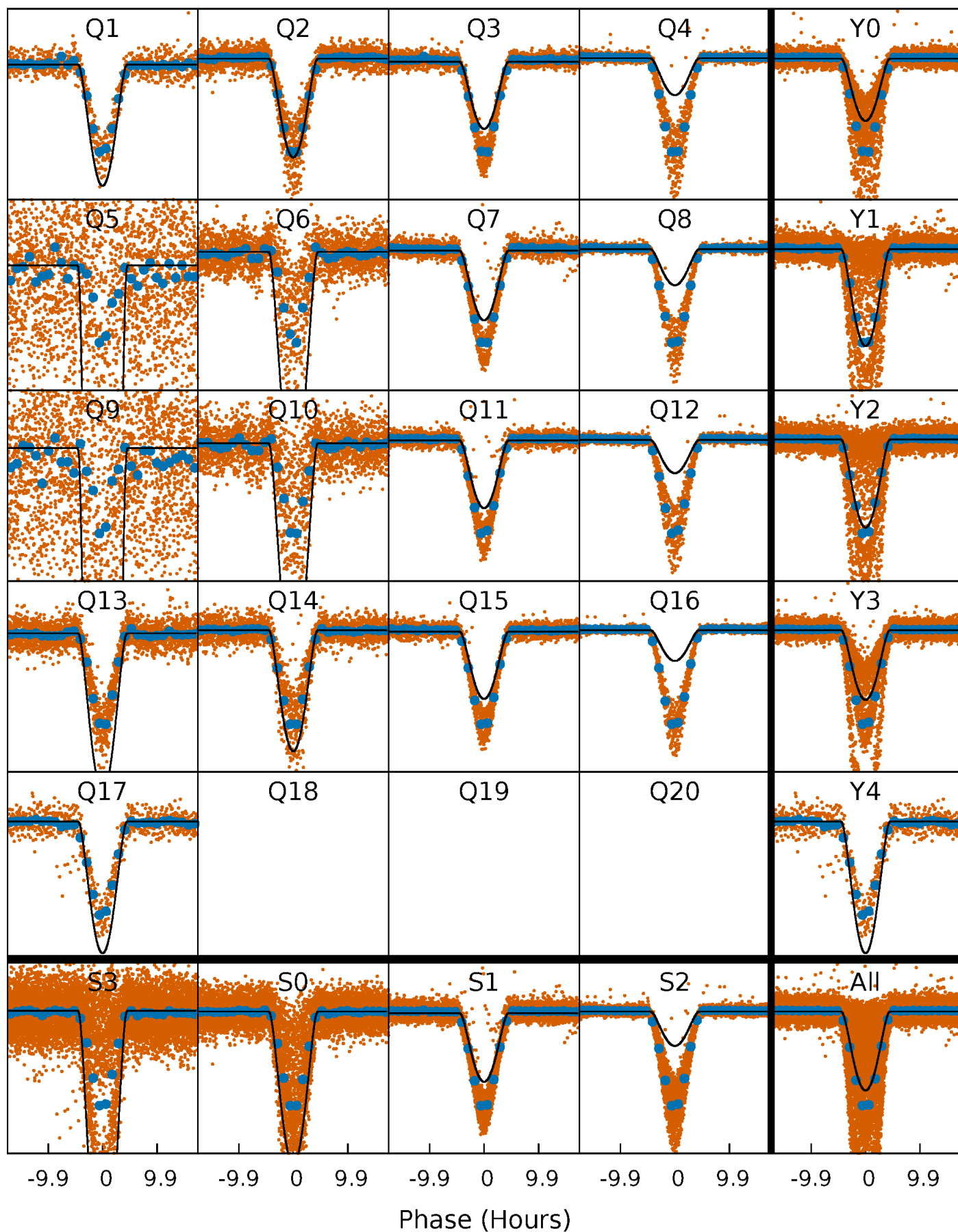
TCE 008780959-01 P= 2.617293 Days  $T_0=132.389262$  (BKJD)





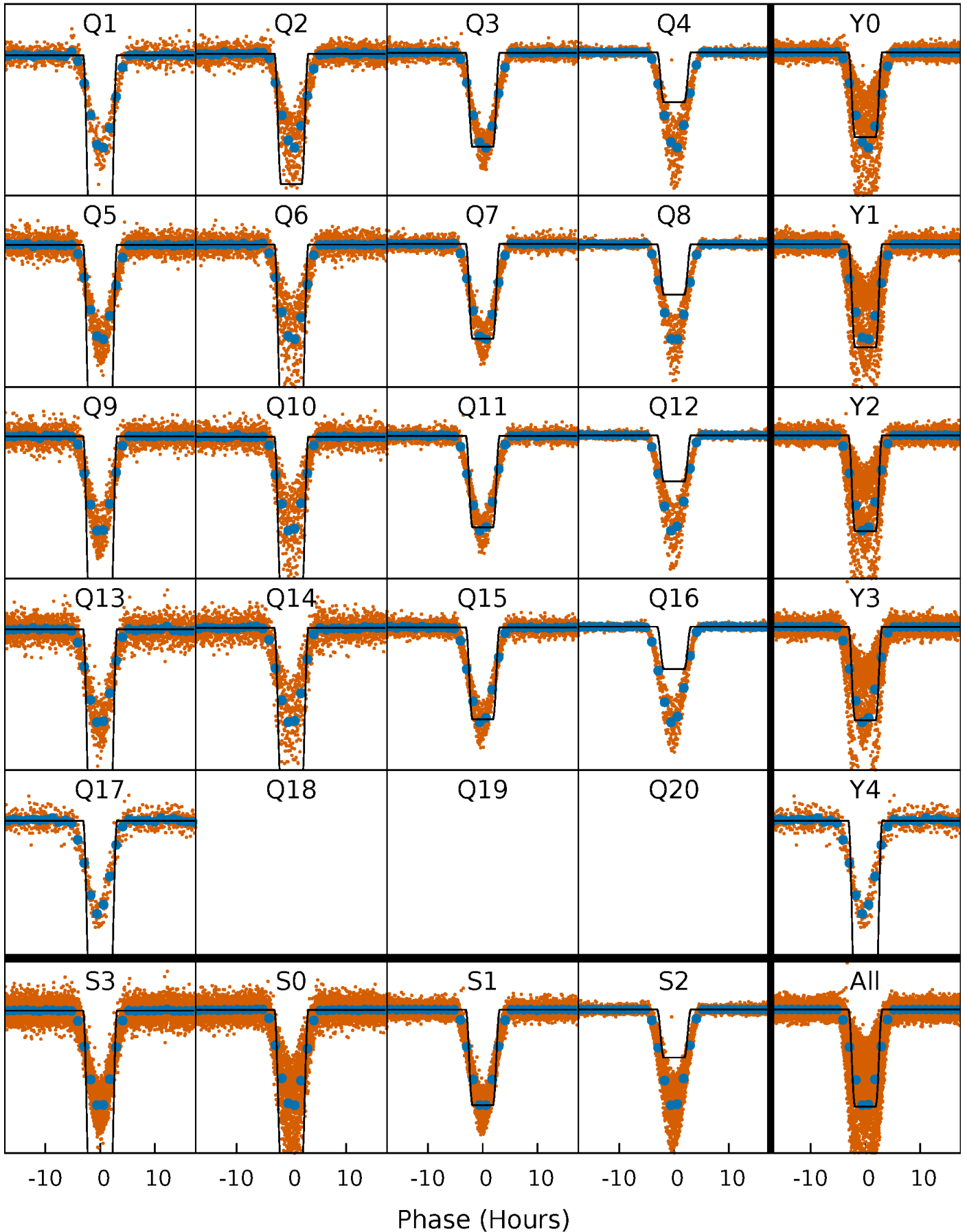
# DV Quarter-Phased Transit Curves

TCE 008780959-01 P= 2.617293 Days  $T_0=132.389262$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

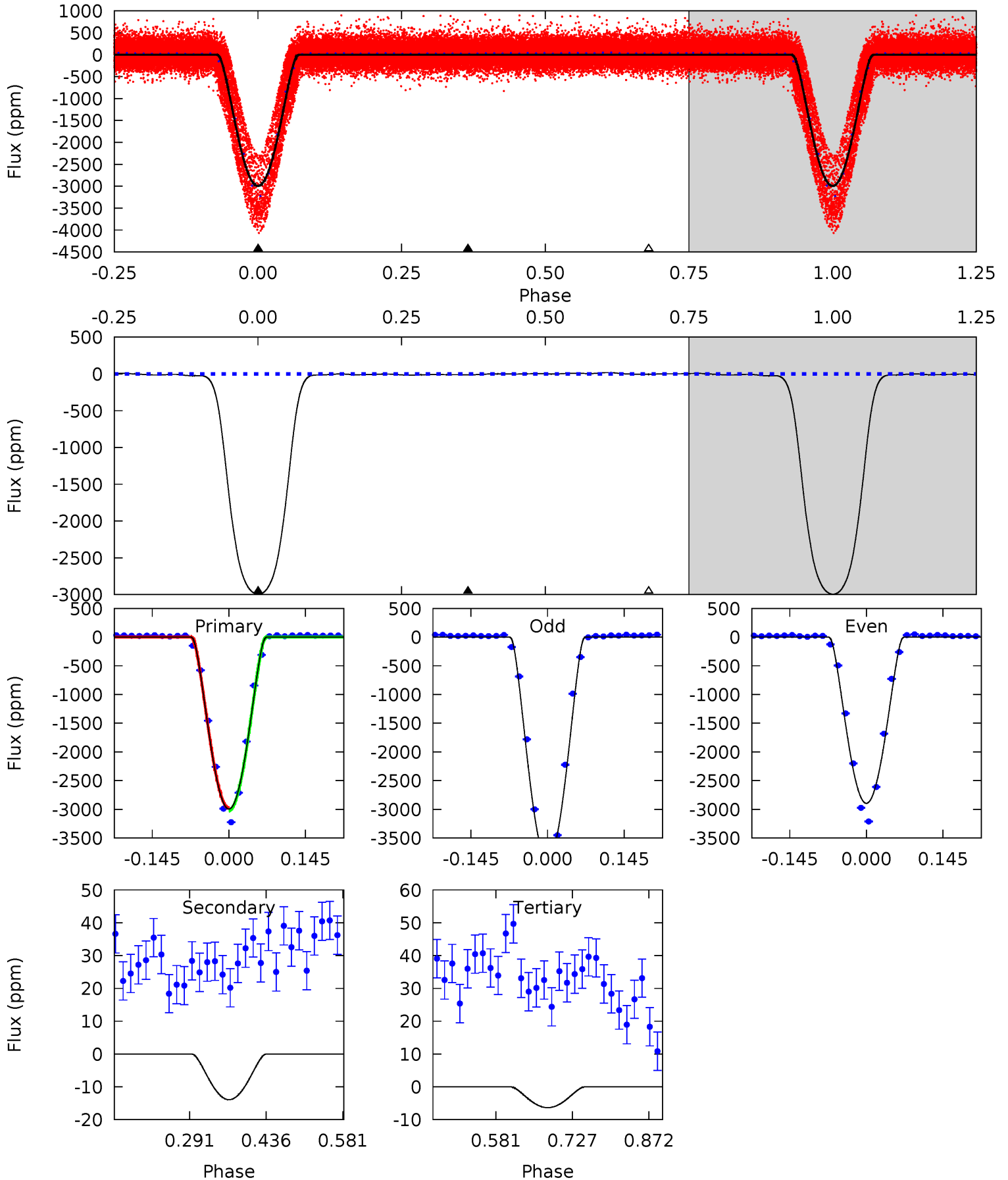
TCE 008780959-01   P= 2.617325 Days    $T_0=132.379849$  (BKJD)



# DV Model-Shift Uniqueness Test

008780959-01, P = 2.617293 Days, E = 129.771969 Days

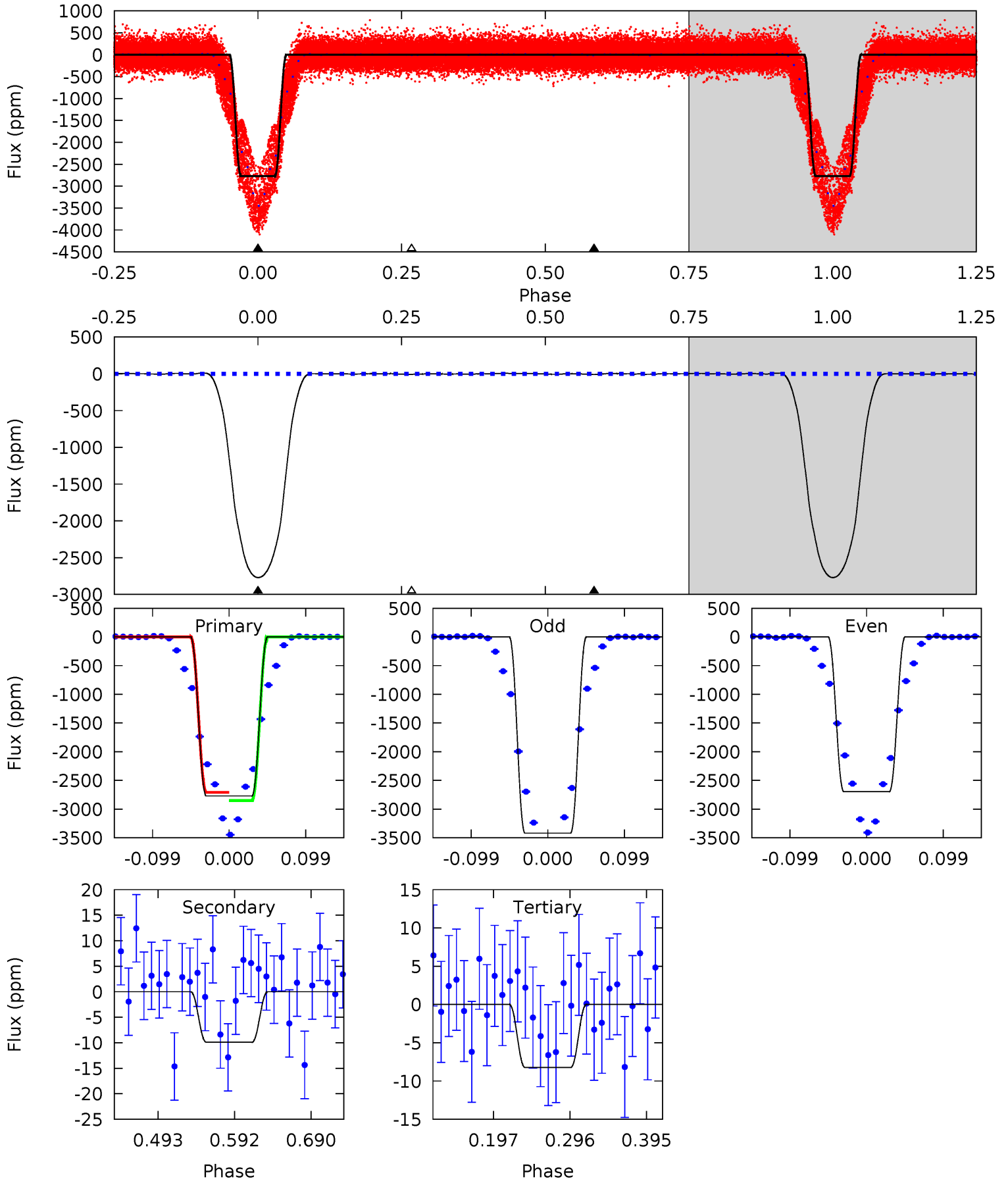
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
1154	5.36	2.45	0	4.49	1.46	3.06	1152	1154	2.91	5.36	191.6	1.09	0.01	0



# Alt Model-Shift Uniqueness Test

008780959-01, P = 2.617325 Days, E = 129.762524 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
866.9	3.10	2.58	0	4.57	1.65	0.98	864.3	866.9	0.52	3.10	115.2	1.16	0.00	0





### Stellar Parameters For KIC 008780959

	$T_{\text{eff}}(K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6432^{+155}_{-214}$	$4.207^{+0.190}_{-0.171}$	$-0.340^{+0.250}_{-0.300}$	$1.345^{+0.382}_{-0.313}$	$1.060^{+0.177}_{-0.133}$	$0.614^{+0.604}_{-0.306}$
	+2%/-3%	+5%/-4%	+74%/-88%	+28%/-23%	+17%/-13%	+99%/-50%
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 008780959-01 / KOI 3741.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-14 \pm 3$	$13.07^{+2.05}_{-1.94}$	$2360^{+167}_{-167}$	$-2624^{+123}_{-119}$	$0.065^{+0.027}_{-0.019}$
Alt.	$-10 \pm 3$	$9.01^{+1.59}_{-1.32}$	$2360^{+148}_{-166}$	$-2581^{+149}_{-125}$	$0.093^{+0.054}_{-0.036}$

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

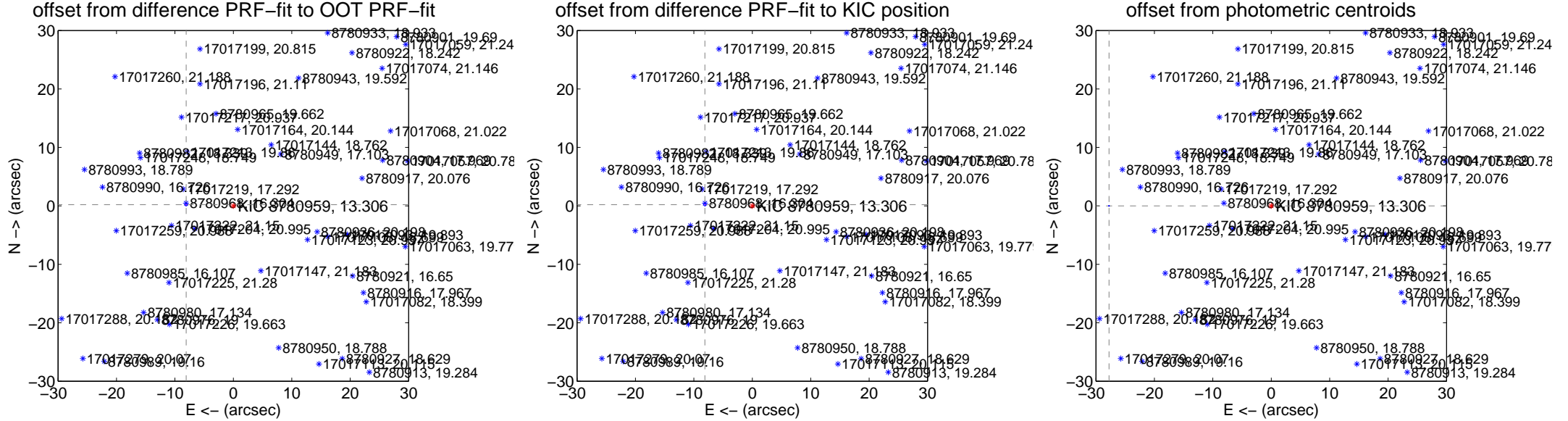
## DV Centroid Data

Supplemental centroid analysis for 008780959-01. Kepler magnitude: 13.31. Transit SNR 298.02

There are 12 quarters with good PRF difference image offsets

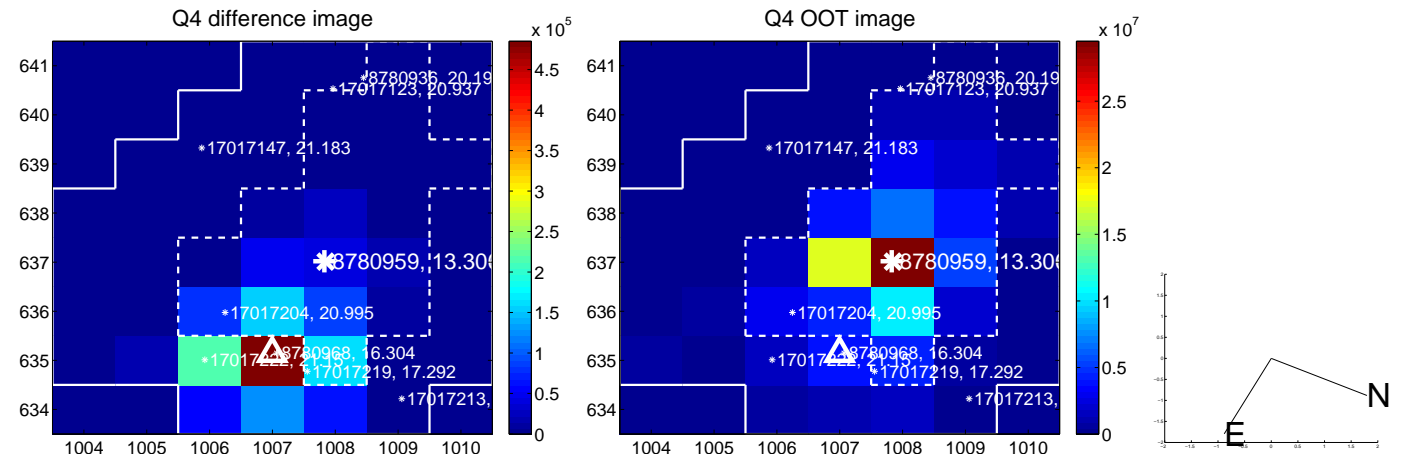
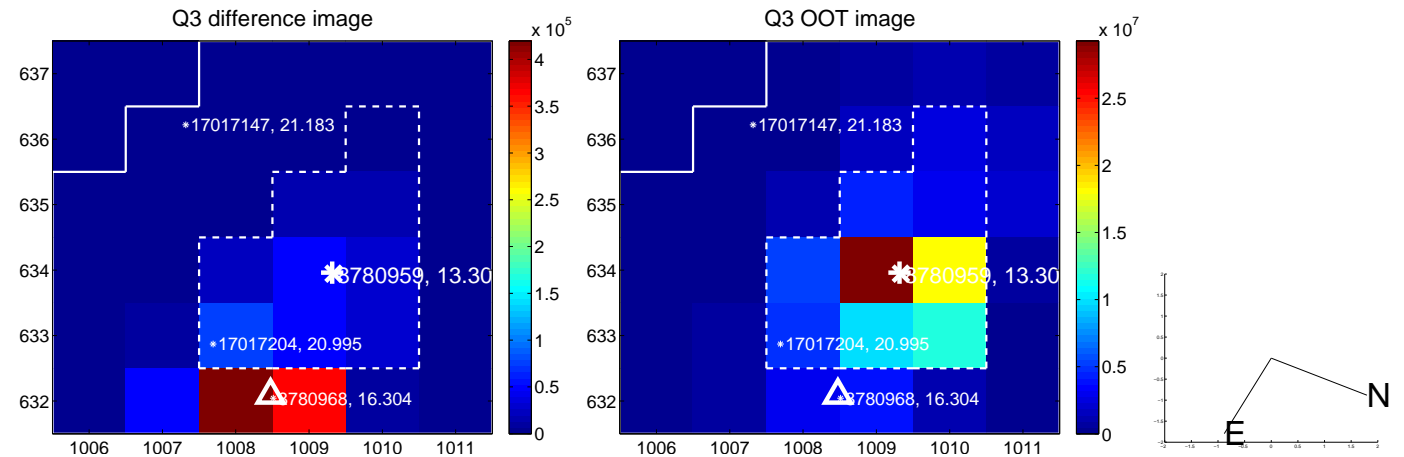
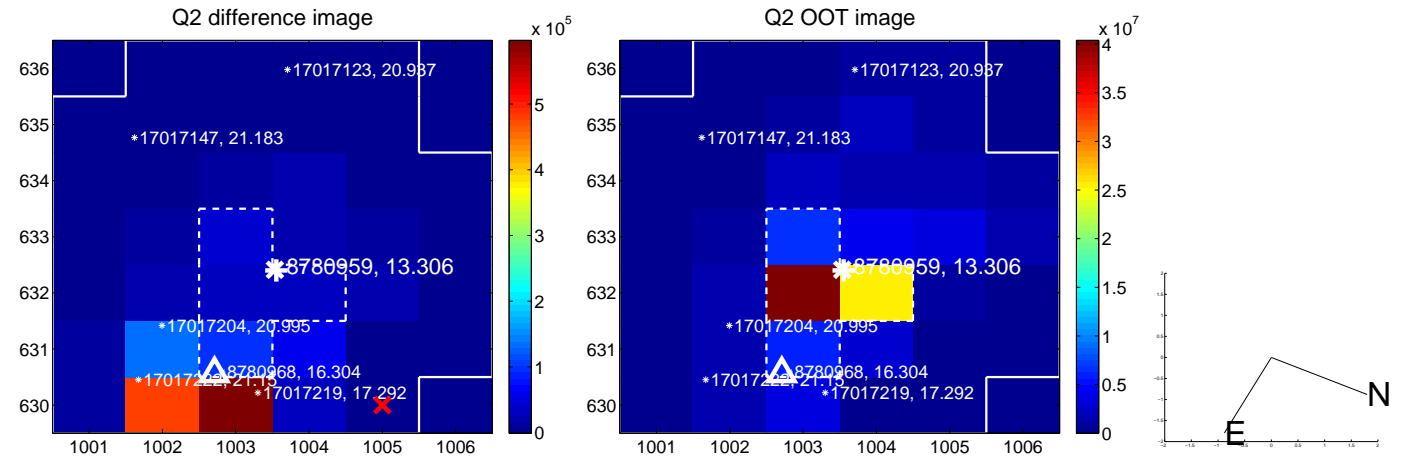
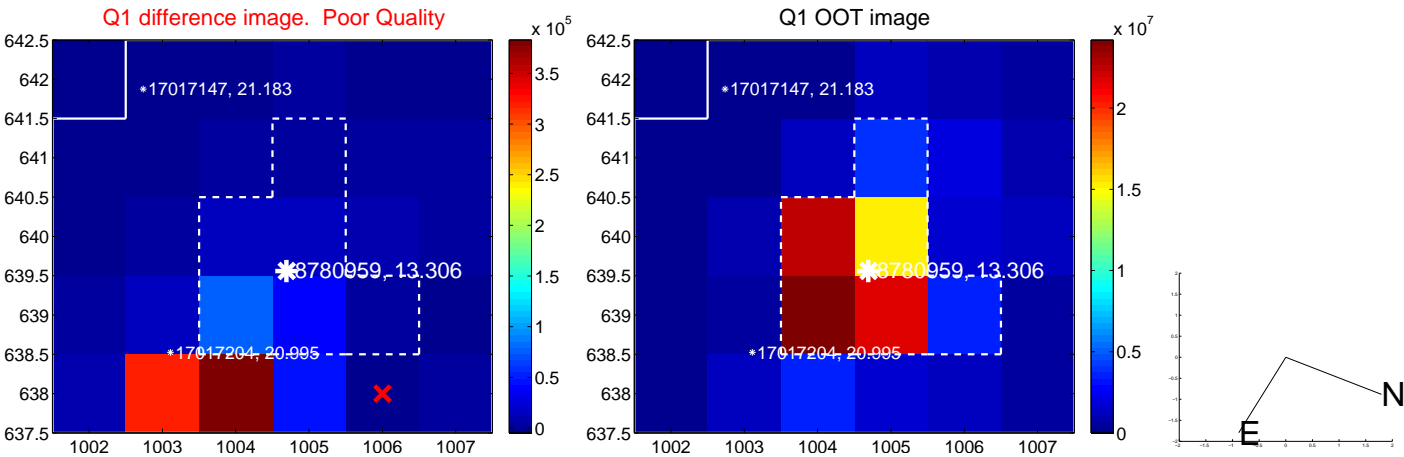
The direct PRF centroid is offset from the target star catalog position by about 0.08 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	<b>8.080 <math>\pm</math> 0.071</b>	<b>114.49</b>	8.077 $\pm$ 0.071	0.206 $\pm$ 0.072
PRF-fit source offset from KIC position	<b>8.121 <math>\pm</math> 0.070</b>	<b>116.07</b>	8.119 $\pm$ 0.070	0.204 $\pm$ 0.072
photometric centroid source offset	<b>27.77 <math>\pm</math> 0.03</b>	<b>1063.94</b>	27.77 $\pm$ 0.03	-0.01 $\pm$ 0.02

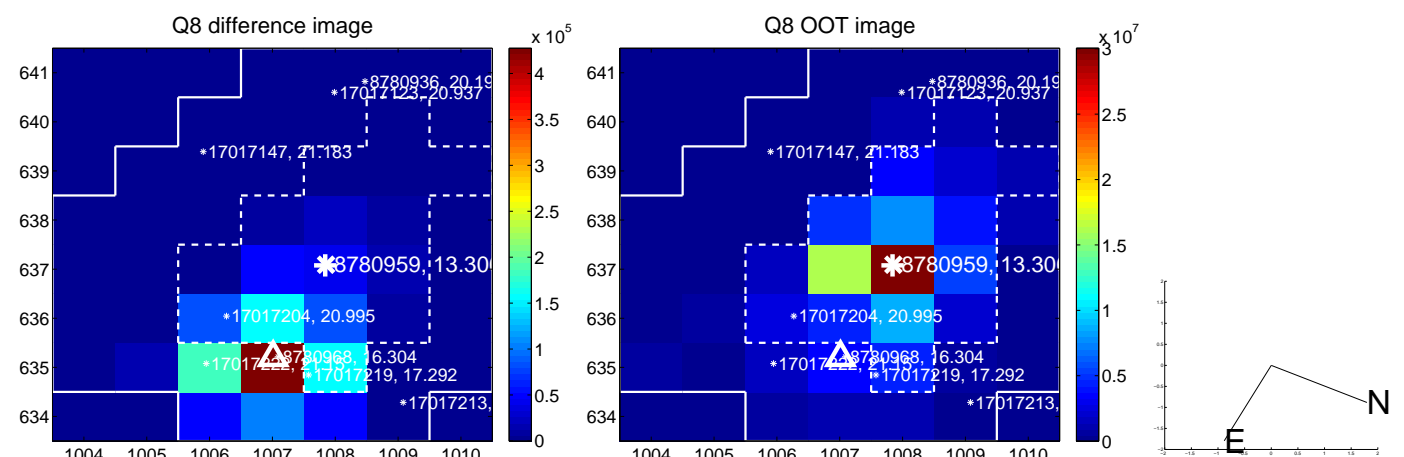
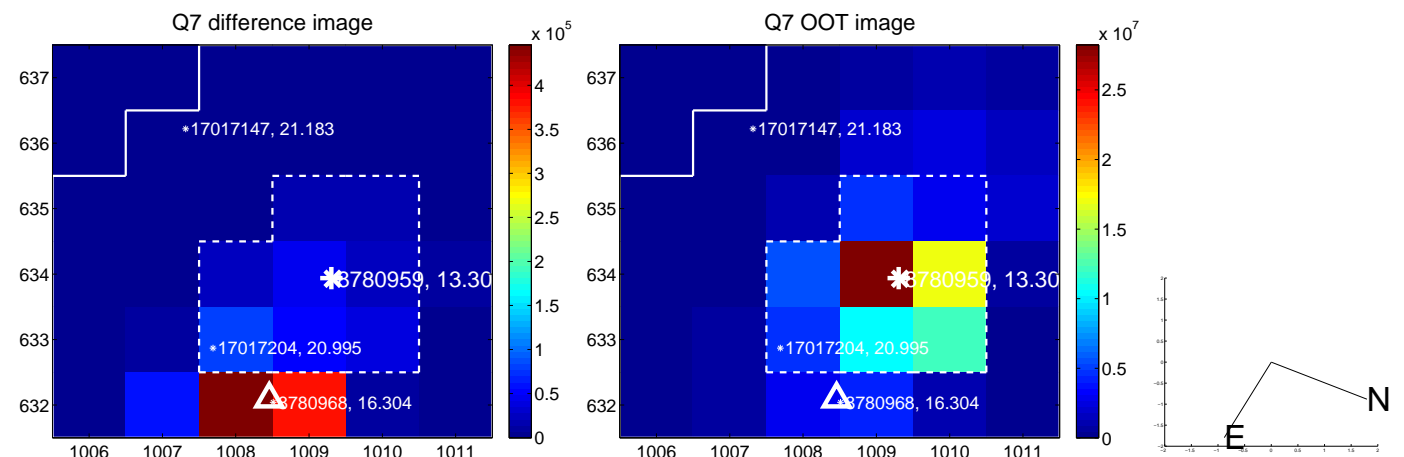
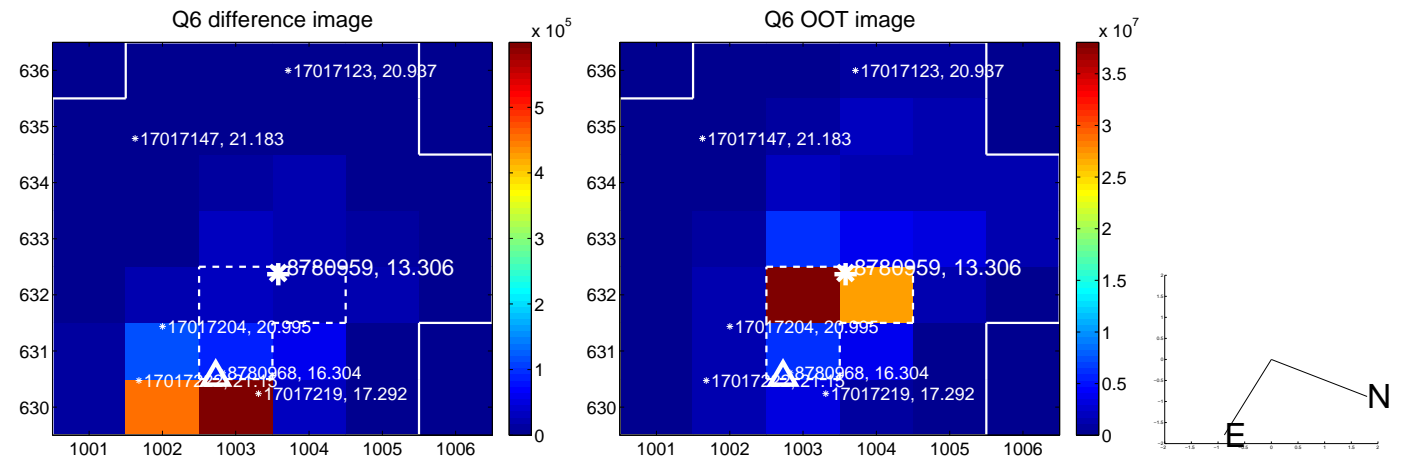
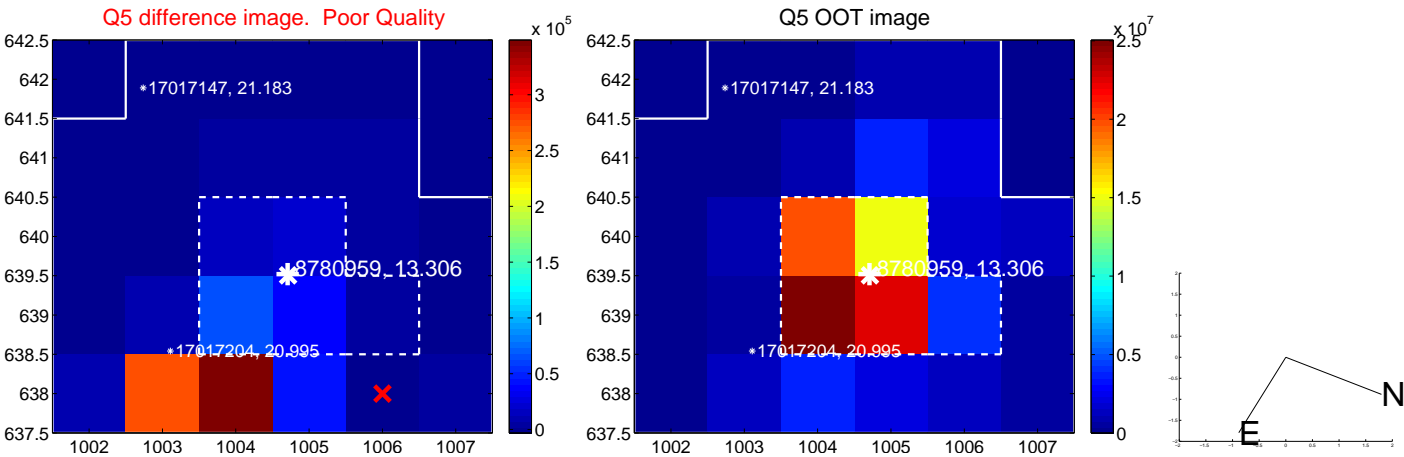


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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



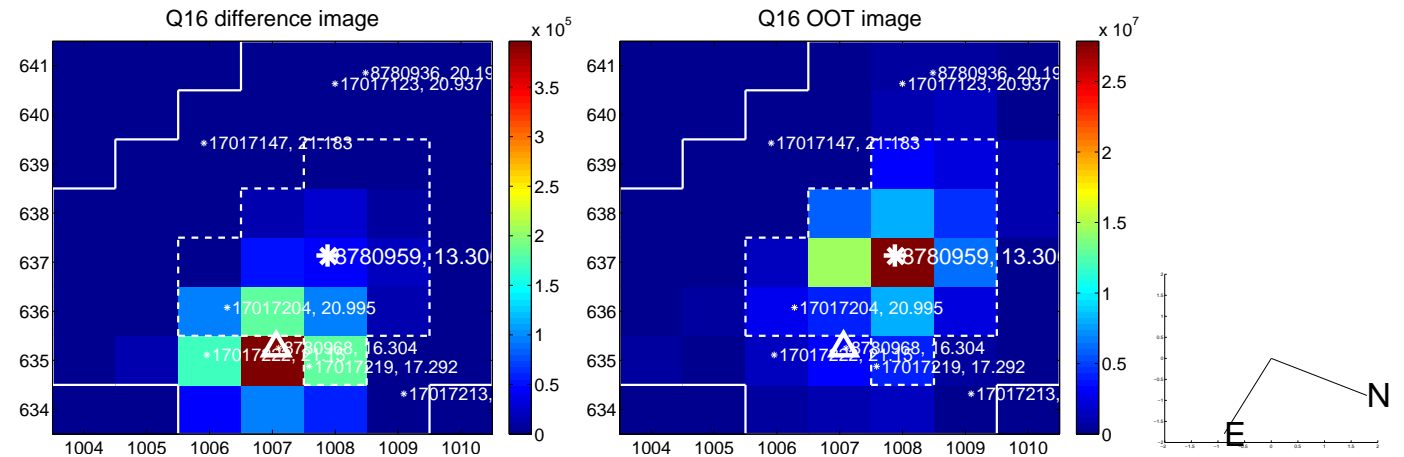
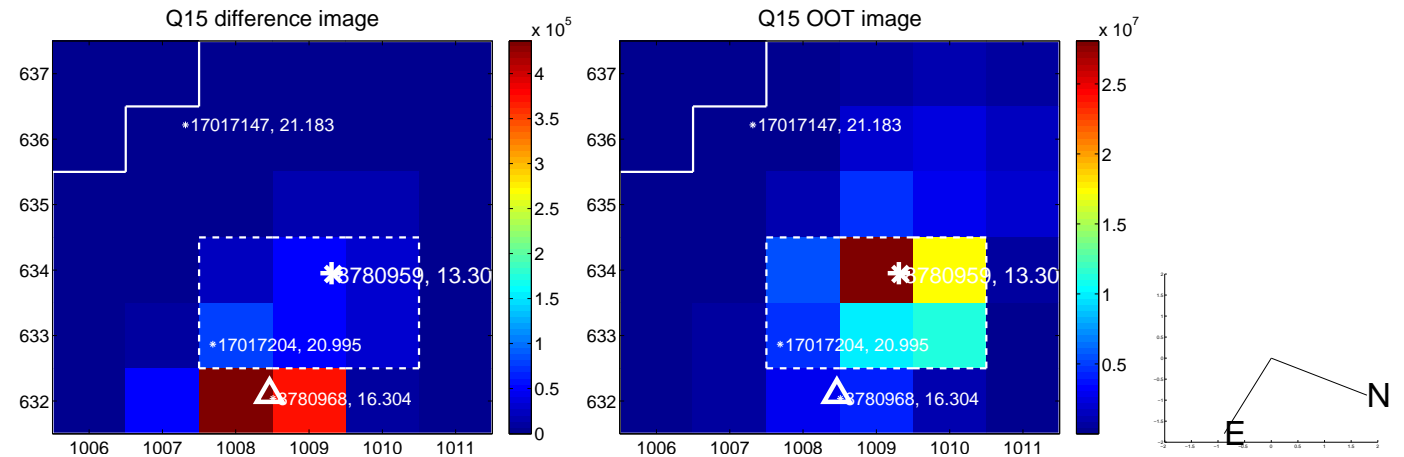
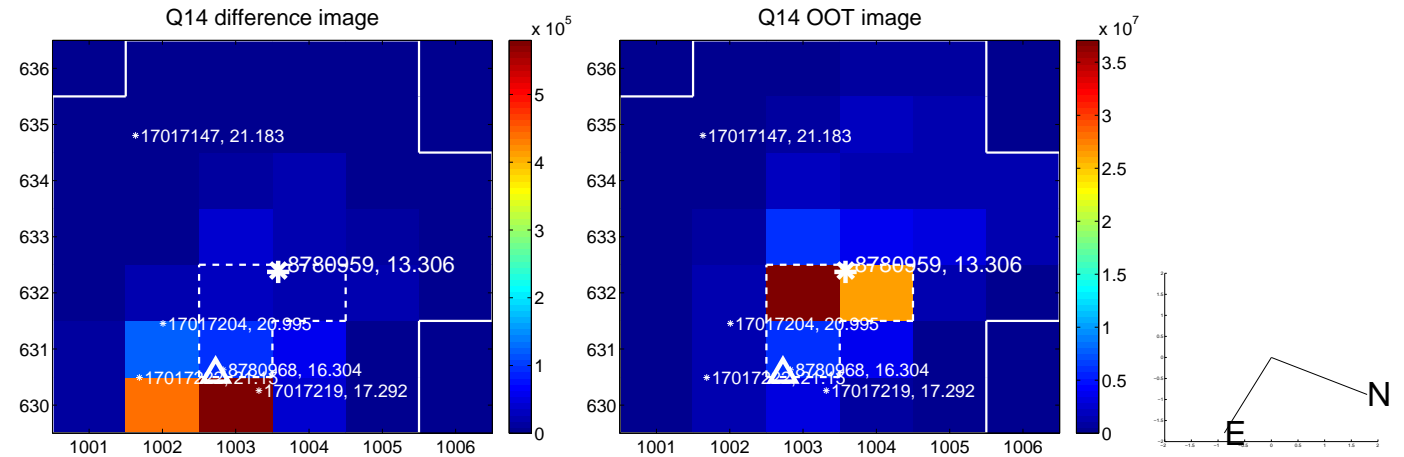
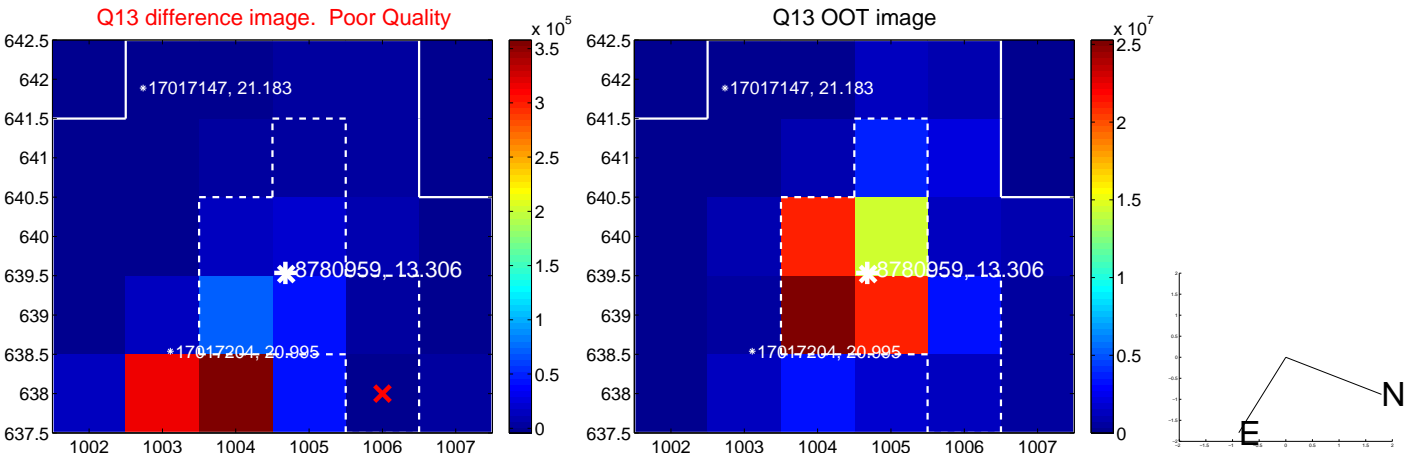
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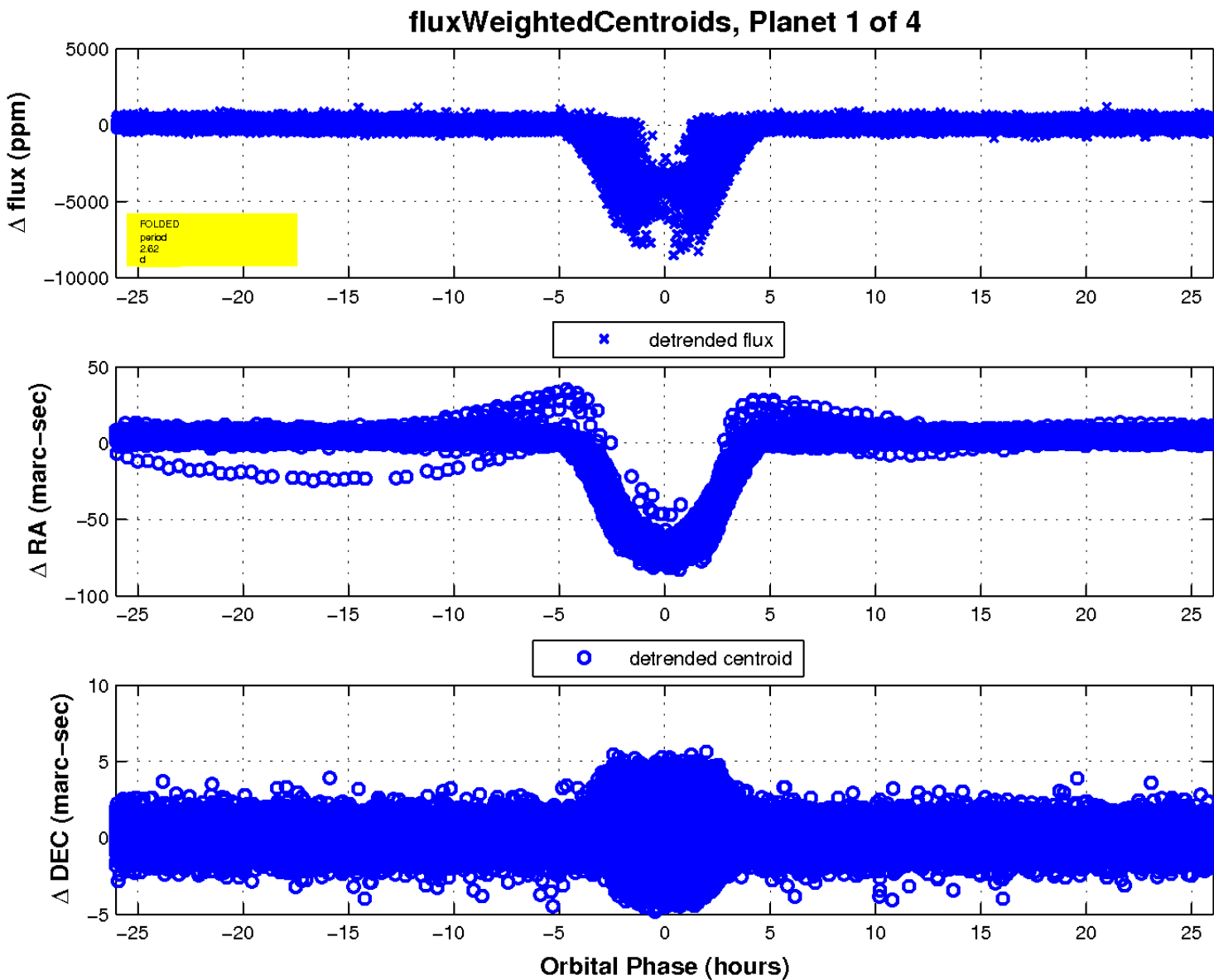
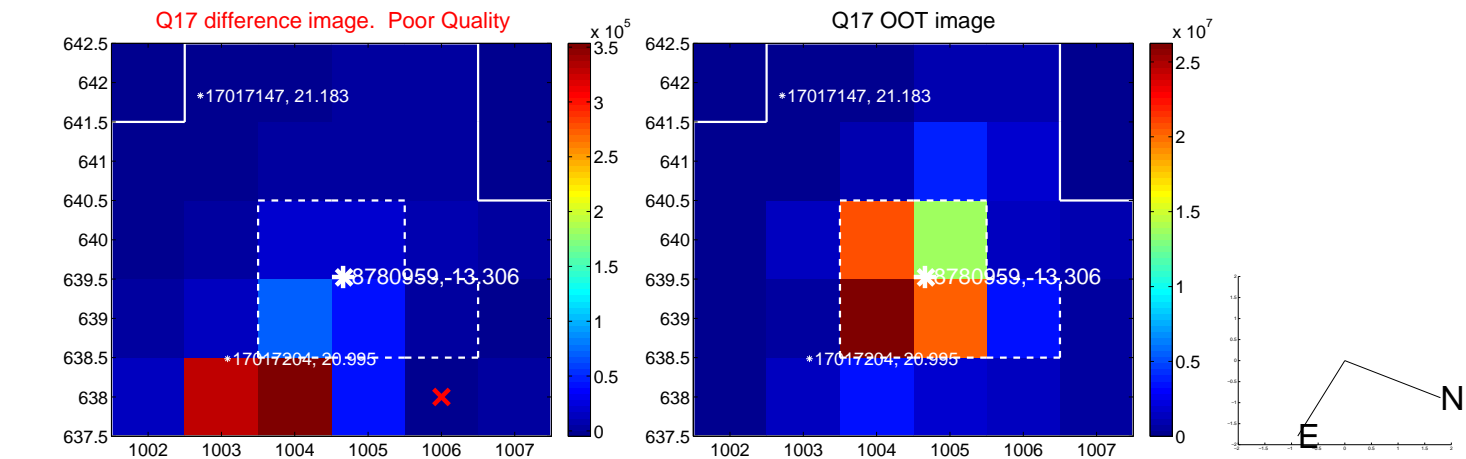




white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

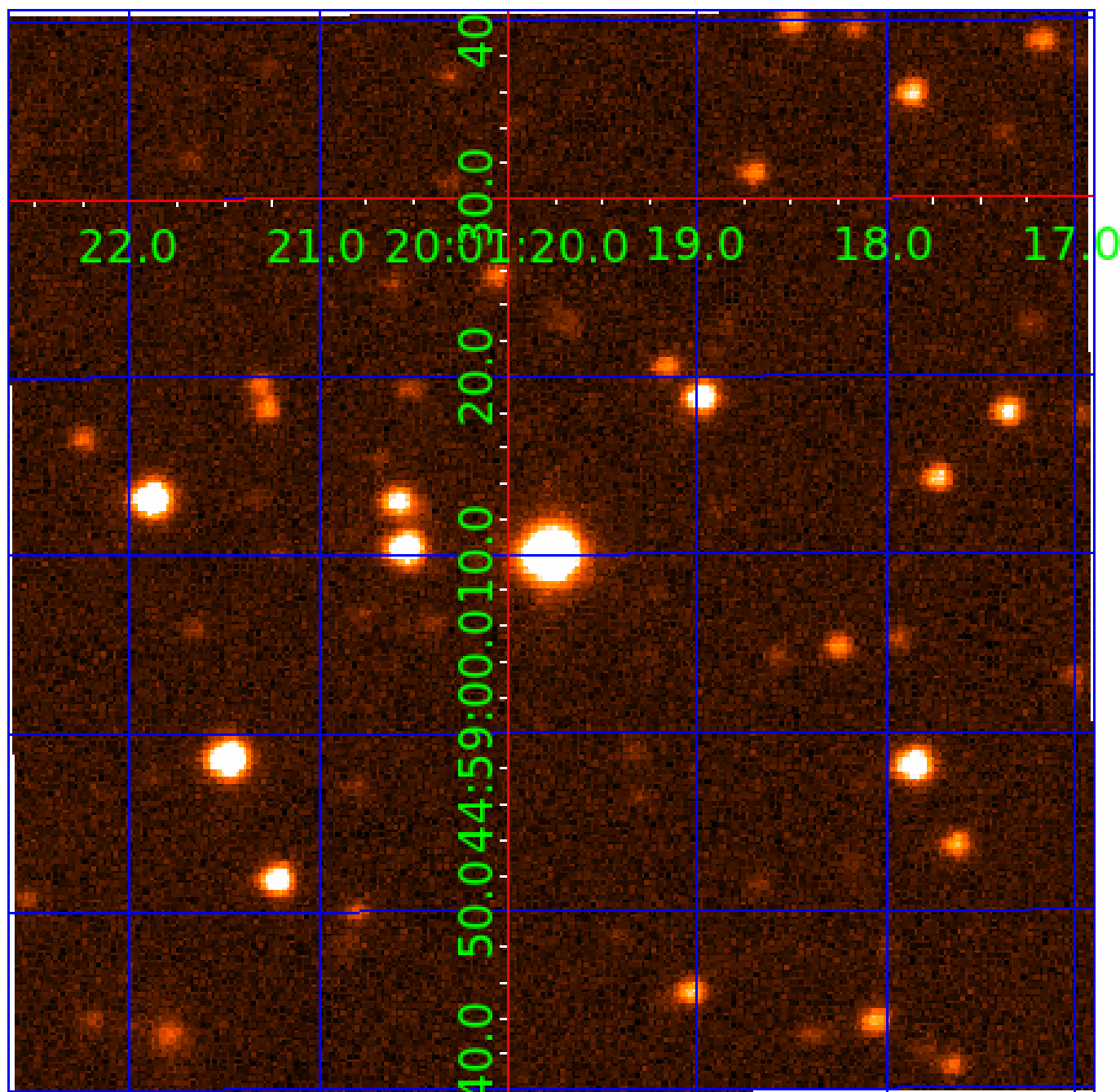


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 008780959

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
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008780959-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT
008780959-03	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED
008780959-04	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED—LPP_ALT—MOD_NONUNIQ_ALT—CENT_NOFITS

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

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

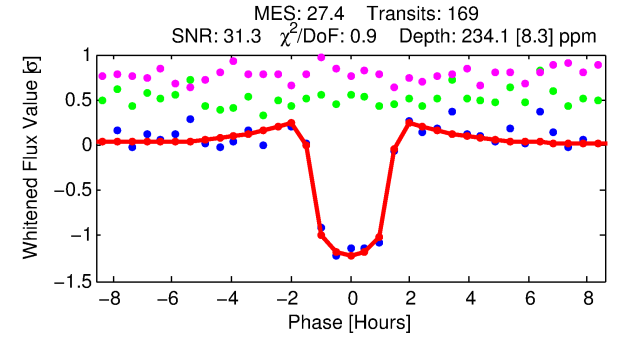
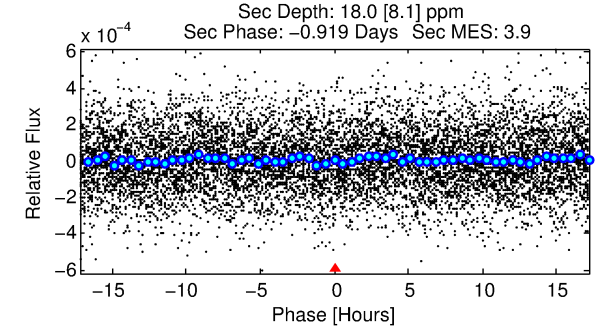
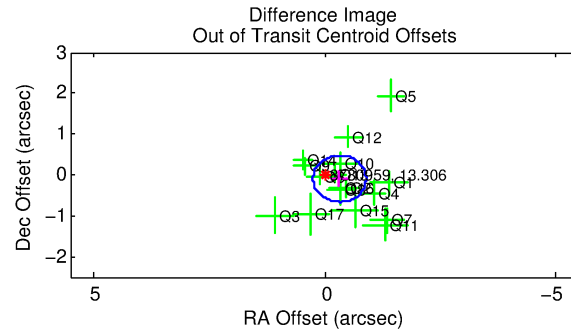
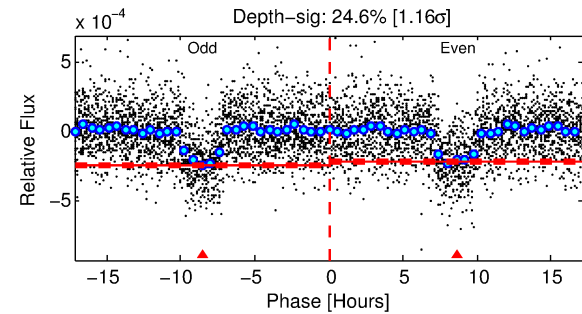
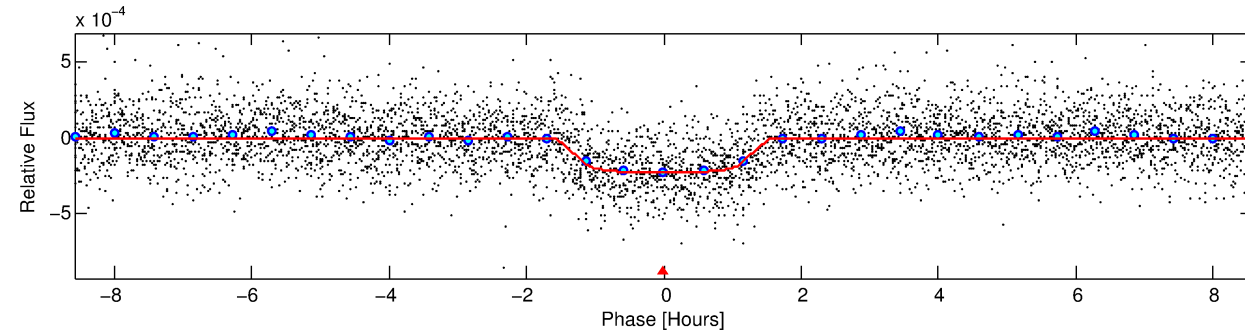
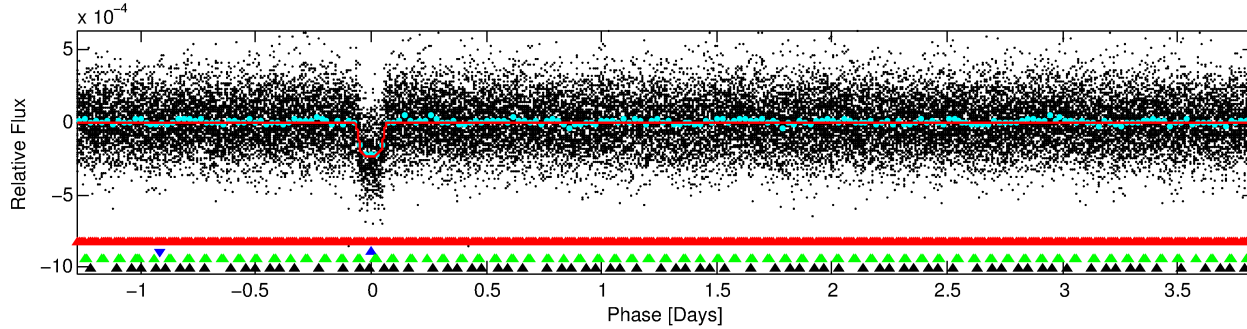
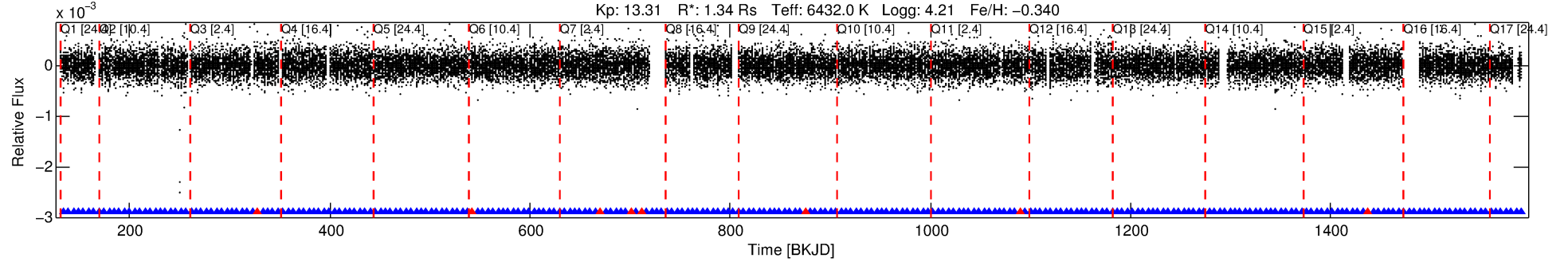
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 008780959-02

No Significant Match Found

# DV One-Page Summary

KIC: 8780959 Candidate: 2 of 4 Period: 5.112 d  
KOI: K03741.03 Corr: 0.979



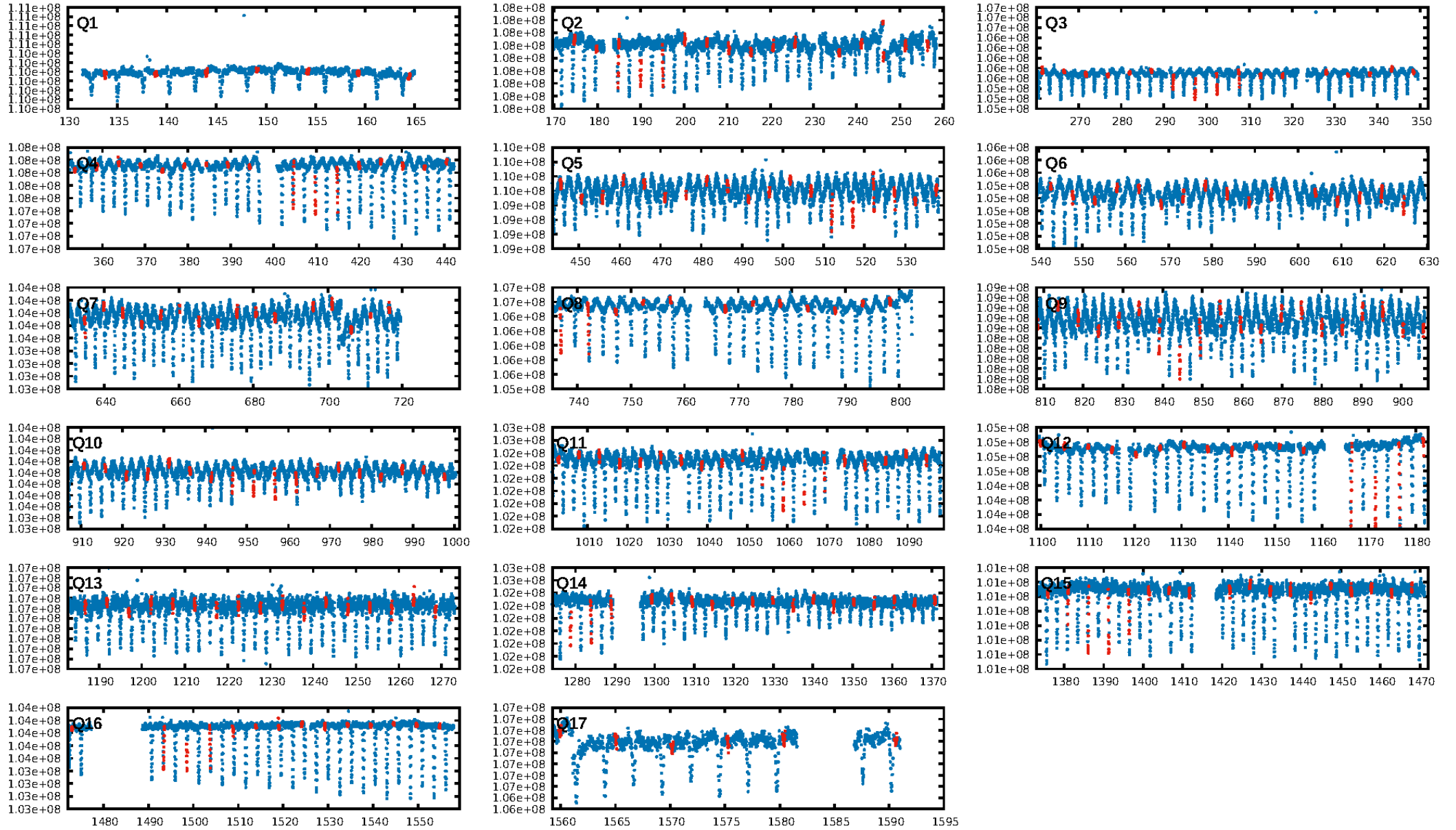
## DV Fit Results:

Period = 5.11175 [0.00001] d  
Epoch = 133.7598 [0.0014] BKJD  
Rp/R\* = 0.0161 [0.0026]  
a/R\* = 7.08 [6.21]  
b = 0.88 [0.24]  
Seff = 789.47 [293.94]  
Teq = 1352 [126] K  
Rp = 2.36 [0.77] Re  
a = 0.0593 [0.0142] AU  
Ag = 6.21 [4.06] [1.28 $\sigma$ ]  
Teffp = 3299 [469] K [4.01 $\sigma$ ]

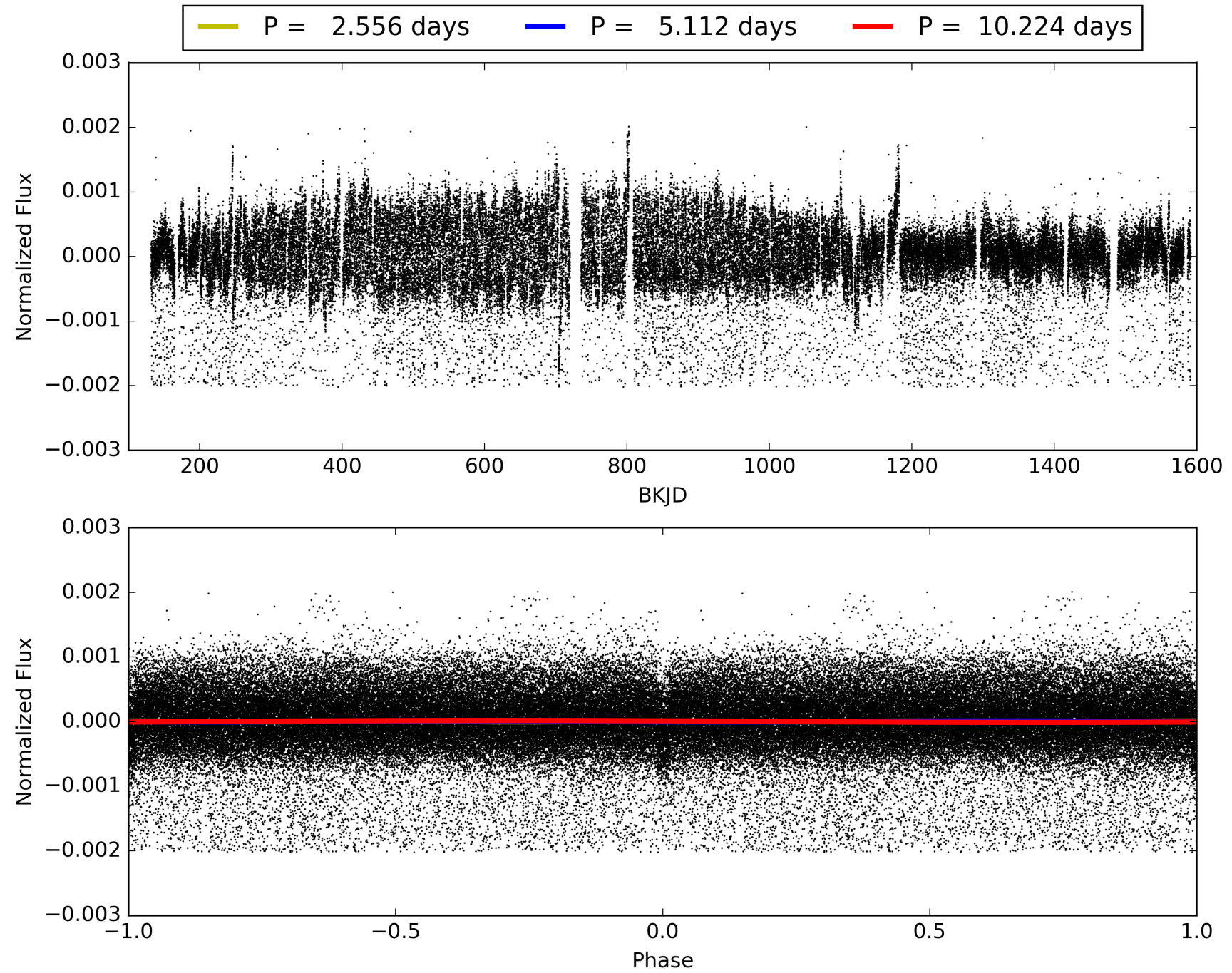
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [6.55 $\sigma$ ]  
LongPeriod-sig: 100.0% [19.11 $\sigma$ ]  
ModelChiSquare2-sig: 95.6%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: N/A  
RollingBand-fgt: 0.95 [149/157]  
GhostDiagnostic-chr: 6.755  
Centroid-sig: N/A  
Centroid-so: 0.241 arcsec [0.62 $\sigma$ ]  
OotOffset-rm: 0.336 arcsec [1.77 $\sigma$ ]  
KicOffset-rm: 0.328 arcsec [1.74 $\sigma$ ]  
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]

# TCE 008780959-02, PDC Light Curves

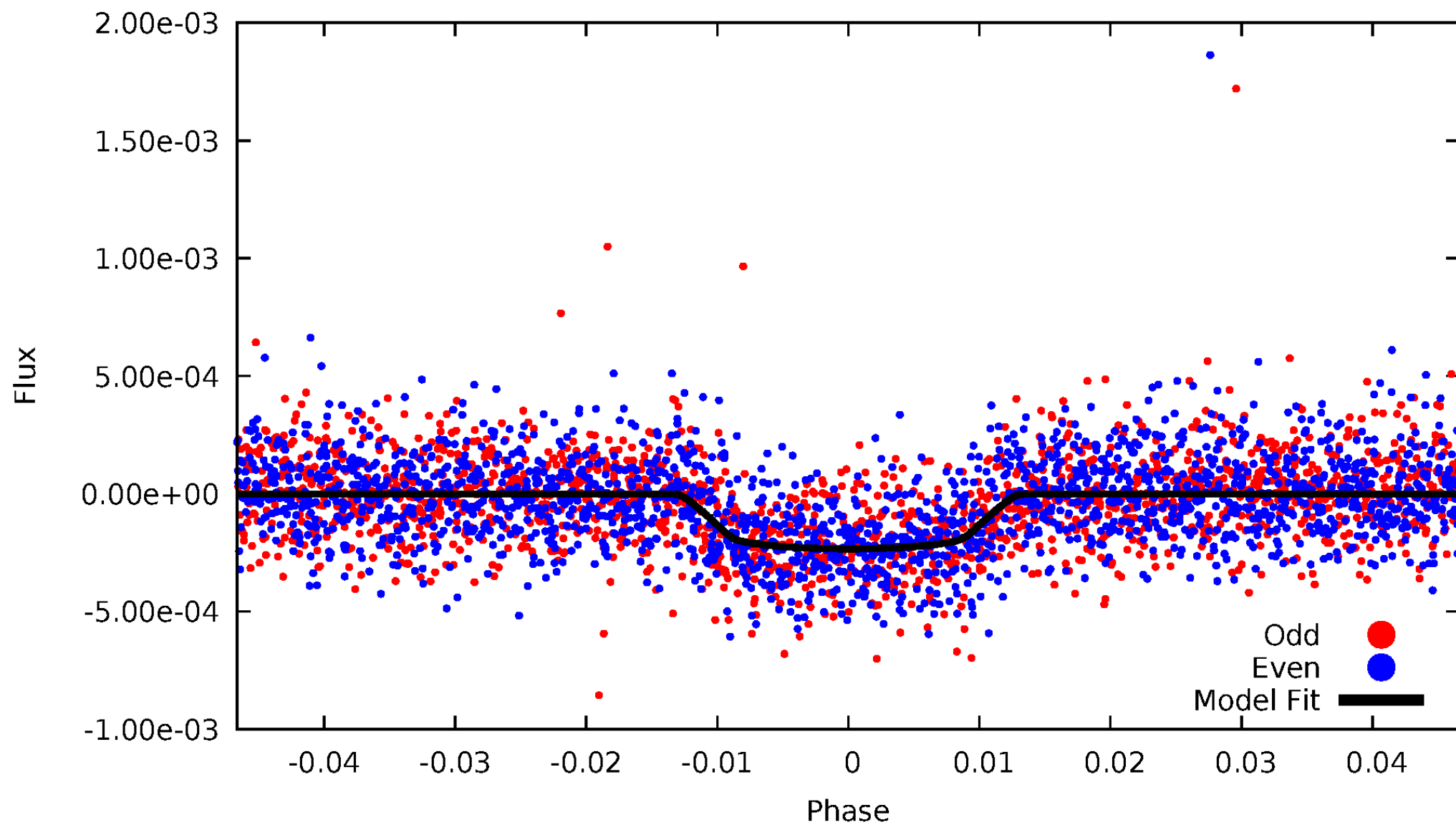


TCE 008780959-02



# DV Odd/Even

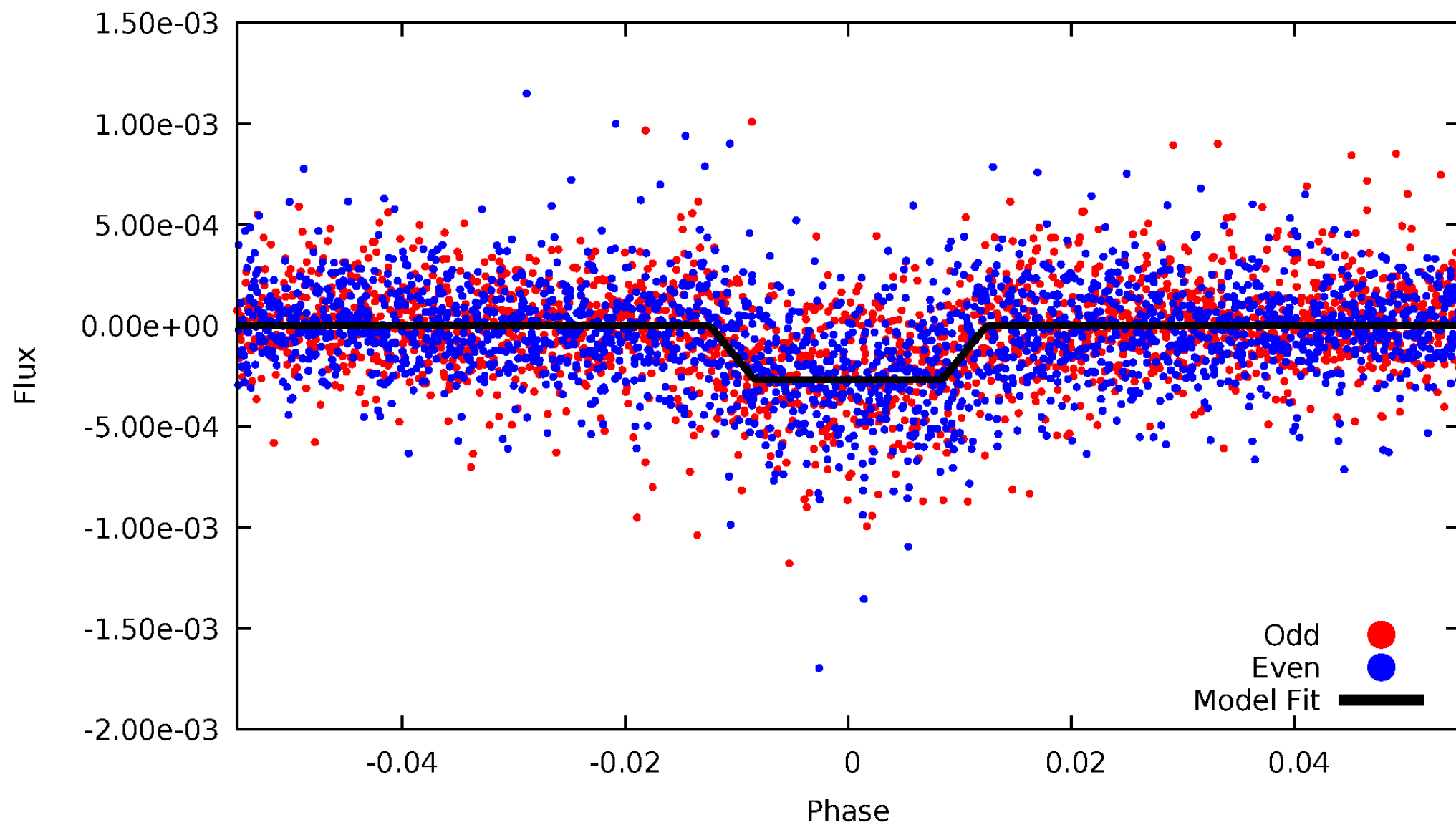
TCE 008780959-02





# ALT Odd/Even

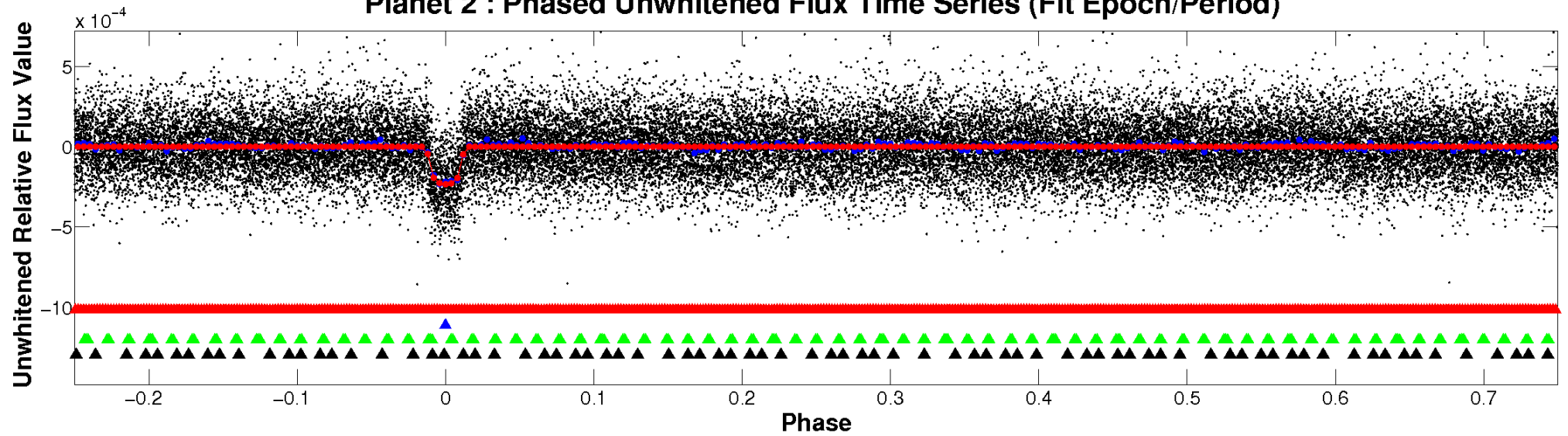
TCE 008780959-02



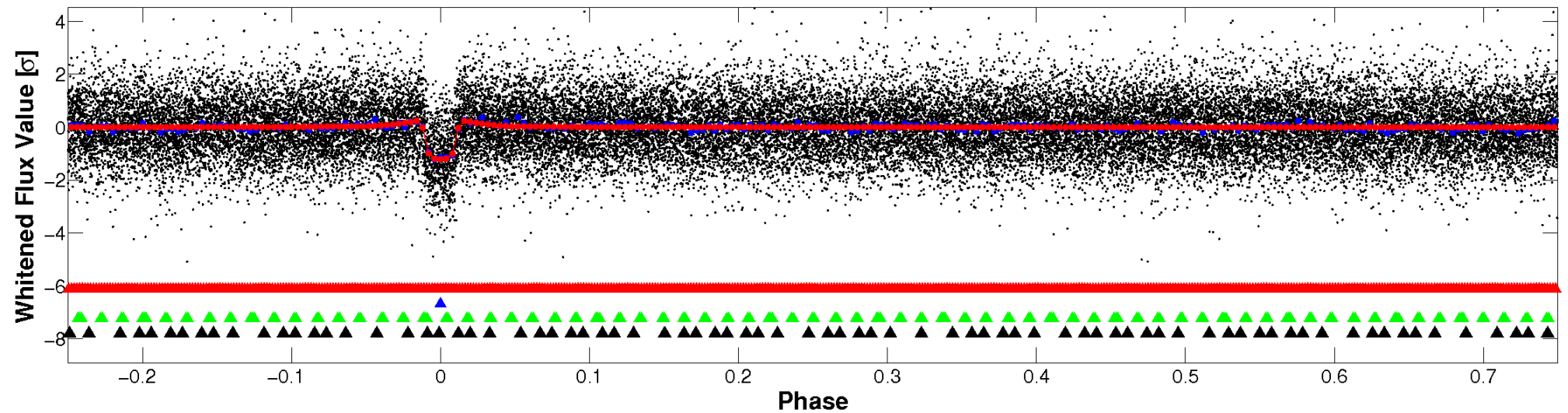


# Non-Whitened Vs. Whitened Light Curve

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

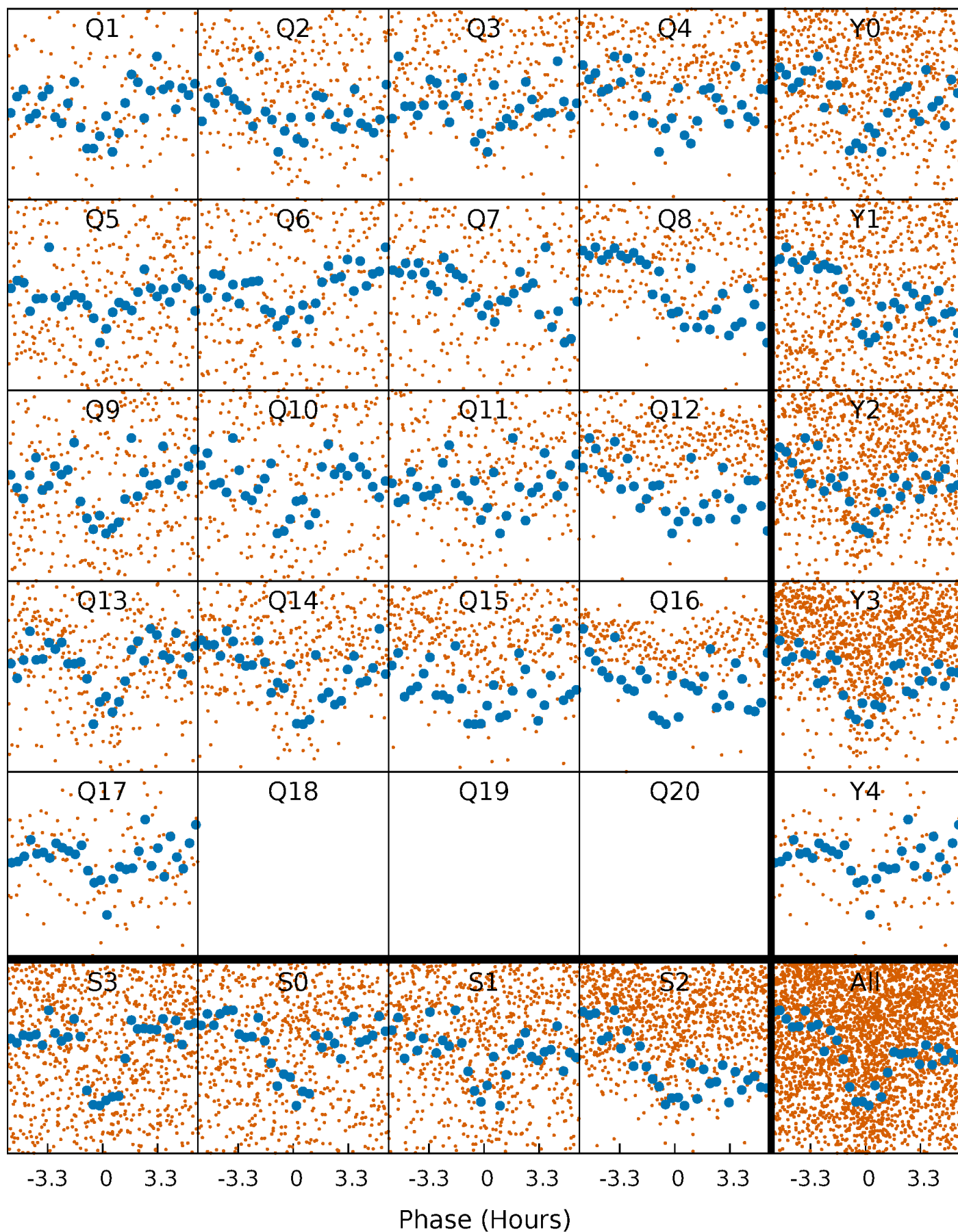


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



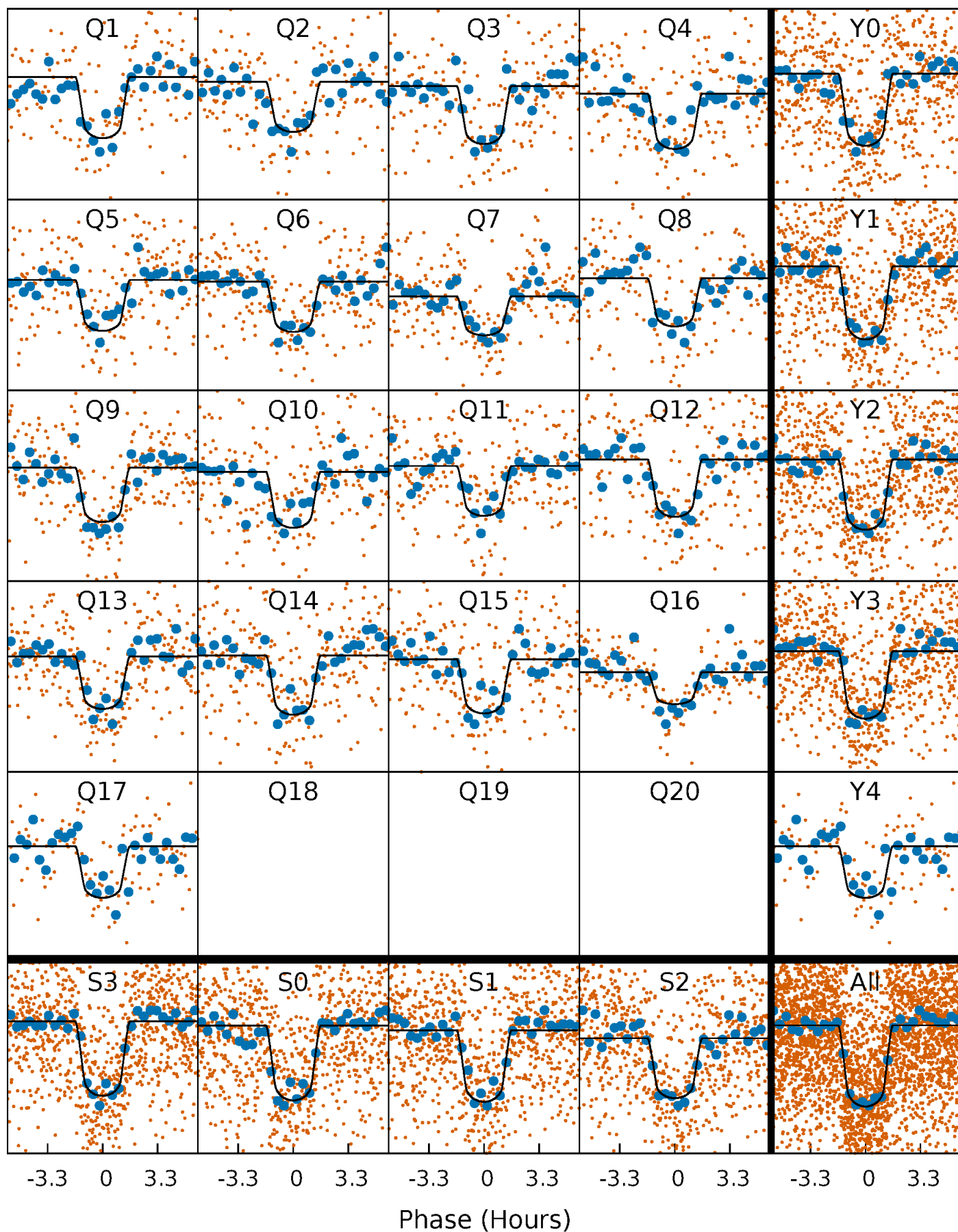
# PDC Quarter-Phased Transit Curves

TCE 008780959-02 P= 5.111751 Days  $T_0=133.759845$  (BKJD)



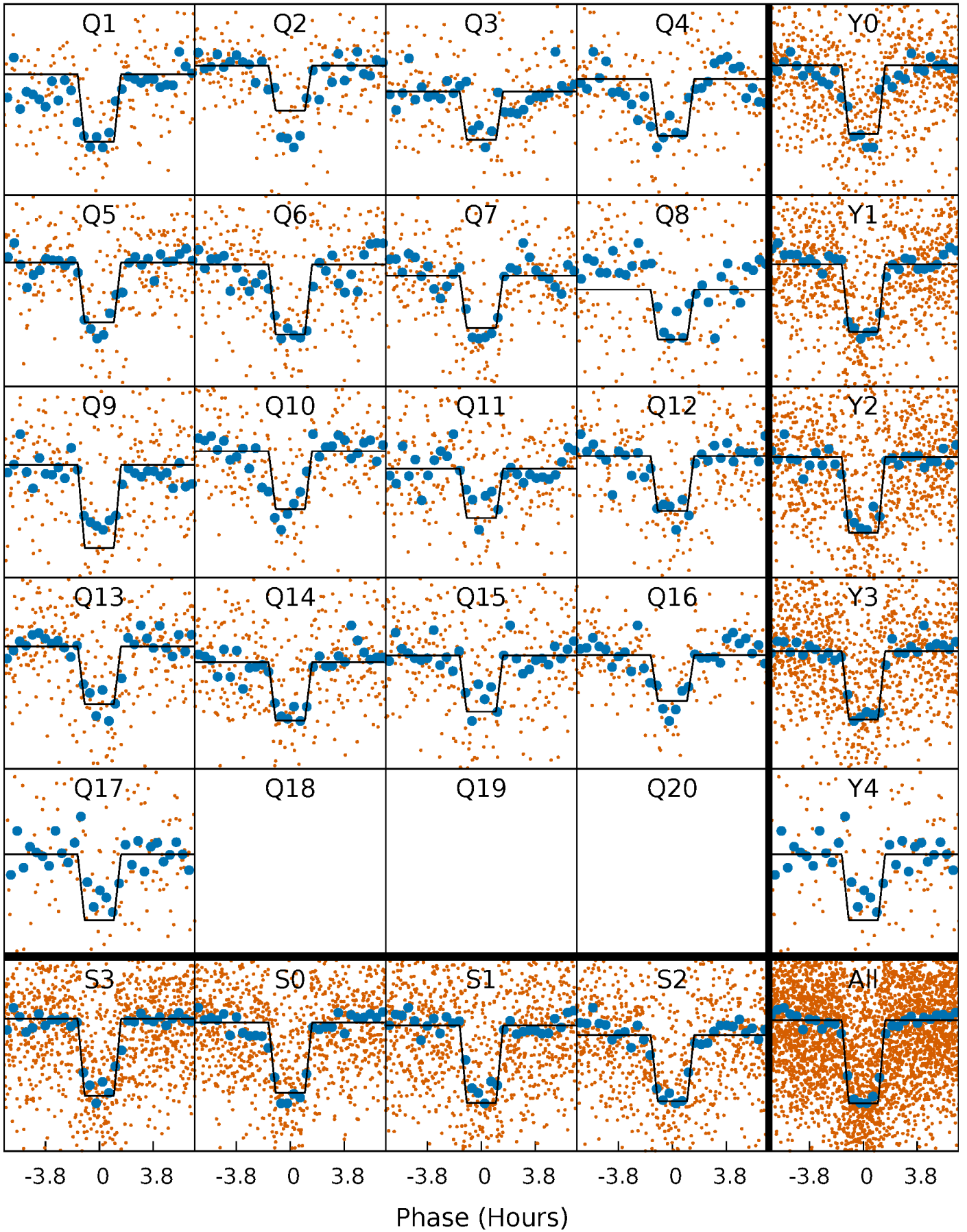
# DV Quarter-Phased Transit Curves

TCE 008780959-02   P= 5.111751 Days    $T_0=133.759845$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

TCE 008780959-02   P= 5.111735 Days    $T_0=133.763307$  (BKJD)

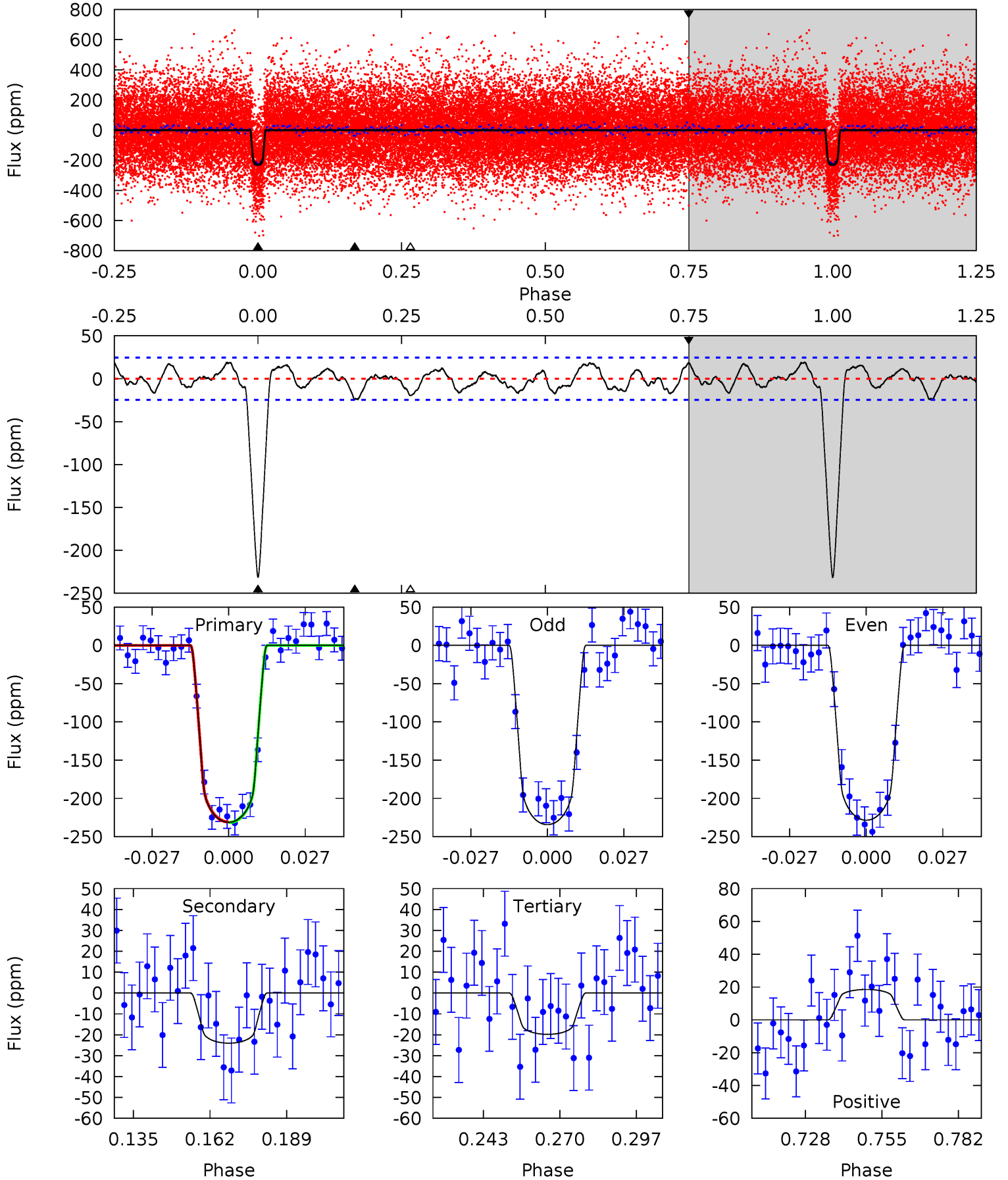




# DV Model-Shift Uniqueness Test

008780959-02, P = 5.111751 Days, E = 128.648094 Days

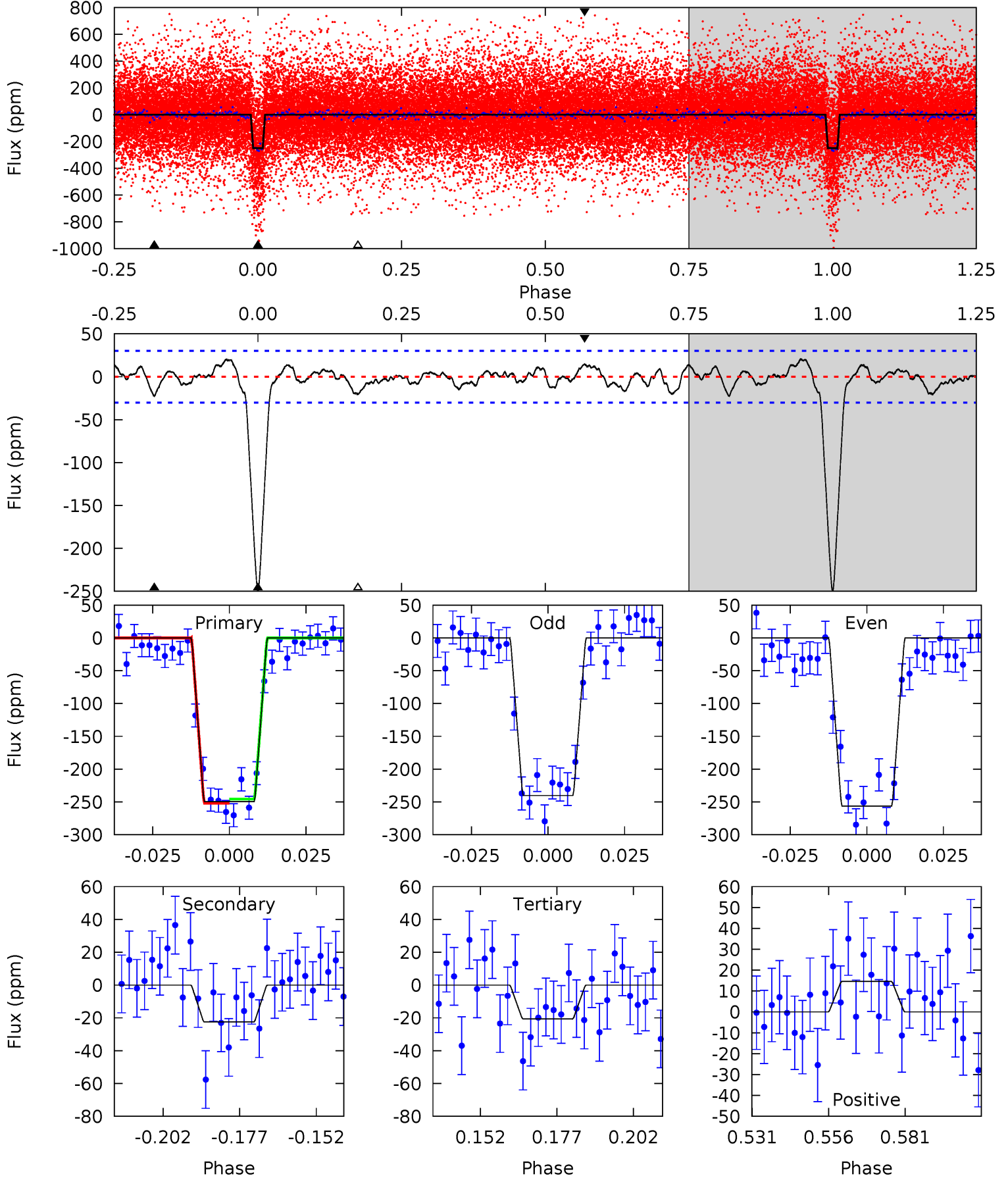
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
45.5	4.73	3.90	3.65	4.83	2.21	1.85	41.6	41.9	0.83	1.08	0.57	0.98	0.08	0.07



# Alt Model-Shift Uniqueness Test

008780959-02, P = 5.111735 Days, E = 128.651572 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
40.2	3.62	3.32	2.34	4.85	2.24	1.30	36.8	37.8	0.30	1.27	1.30	0.99	0.07	0.50



### Stellar Parameters For KIC 008780959

	$T_{\text{eff}} (K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R (R_{\odot})$	$M (M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6432^{+155}_{-214}$	$4.207^{+0.190}_{-0.171}$	$-0.340^{+0.250}_{-0.300}$	$1.345^{+0.382}_{-0.313}$	$1.060^{+0.177}_{-0.133}$	$0.614^{+0.604}_{-0.306}$
	+2%/-3%	+5%/-4%	+74%/-88%	+28%/-23%	+17%/-13%	+99%/-50%
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 008780959-02 / KOI 3741.03

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-24 \pm 5$	$2.35^{+0.53}_{-0.47}$	$1874^{+135}_{-119}$	$3861^{+293}_{-254}$	$8.327^{+4.869}_{-2.956}$
Alt.	$-23 \pm 6$	$2.42^{+0.55}_{-0.46}$	$1878^{+141}_{-134}$	$3775^{+321}_{-256}$	$7.529^{+4.484}_{-3.149}$

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

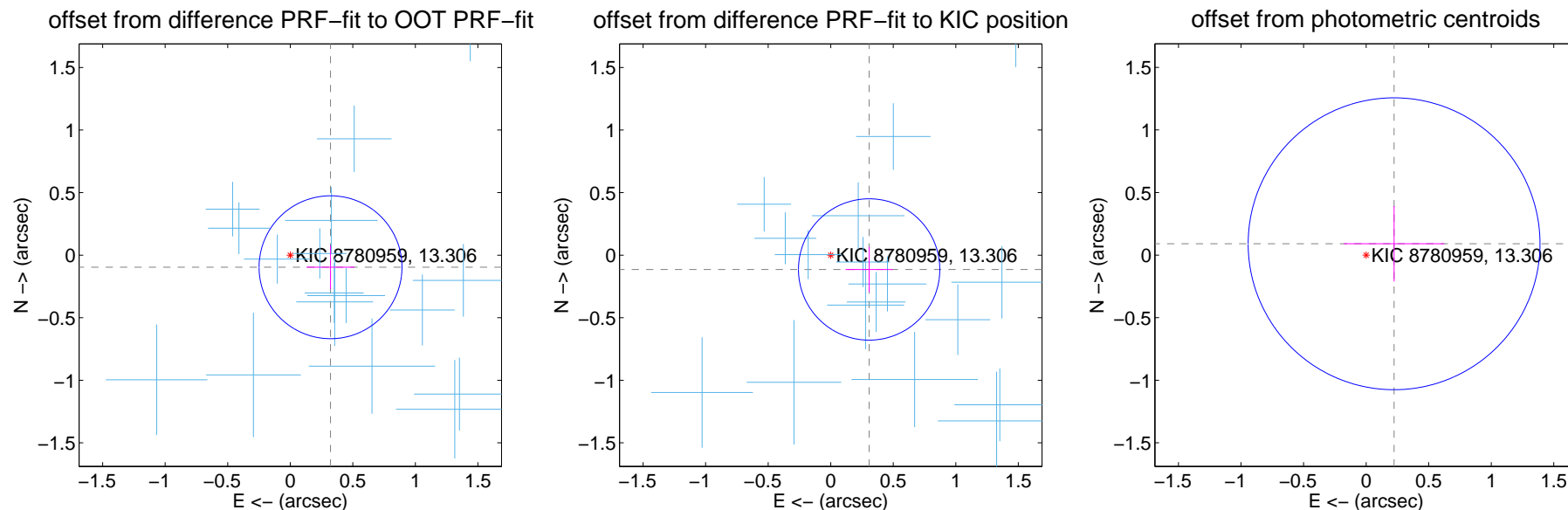
## DV Centroid Data

Supplemental centroid analysis for 008780959-02. Kepler magnitude: 13.31. Transit SNR 31.28

There are 17 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.06 arcsec

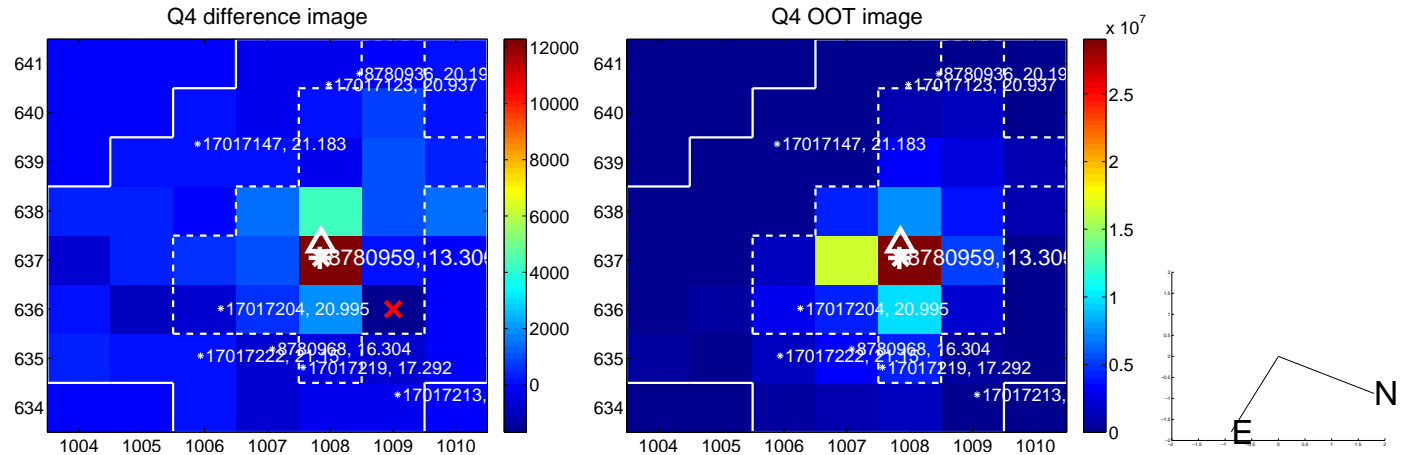
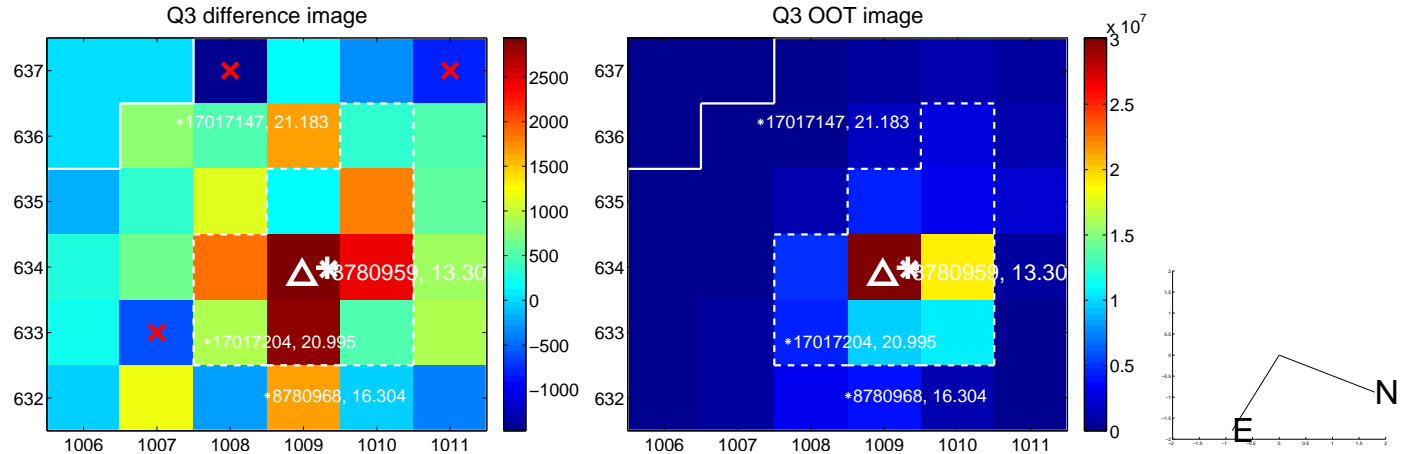
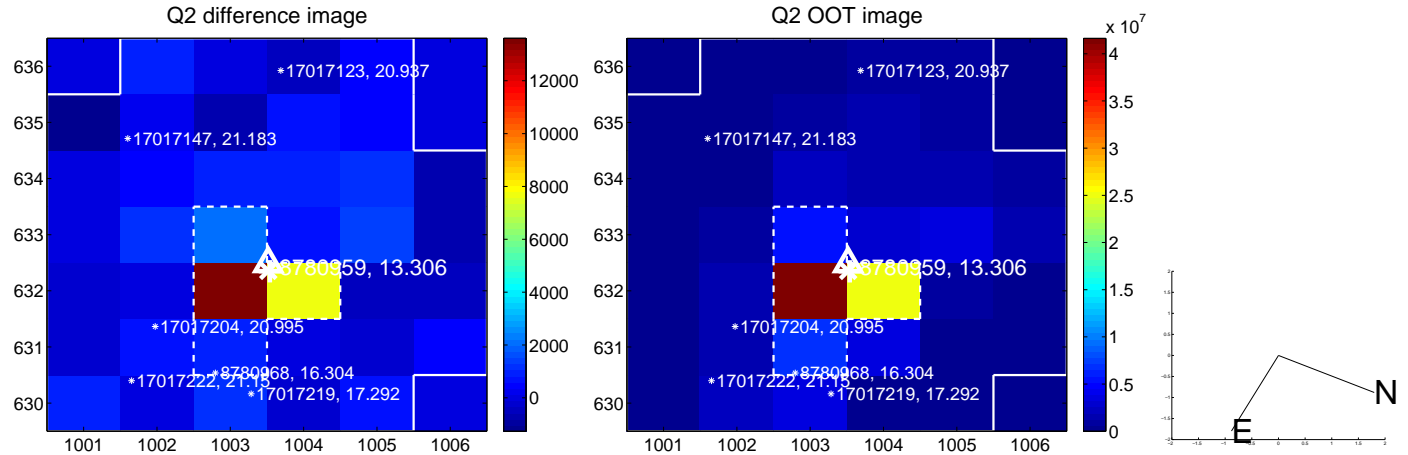
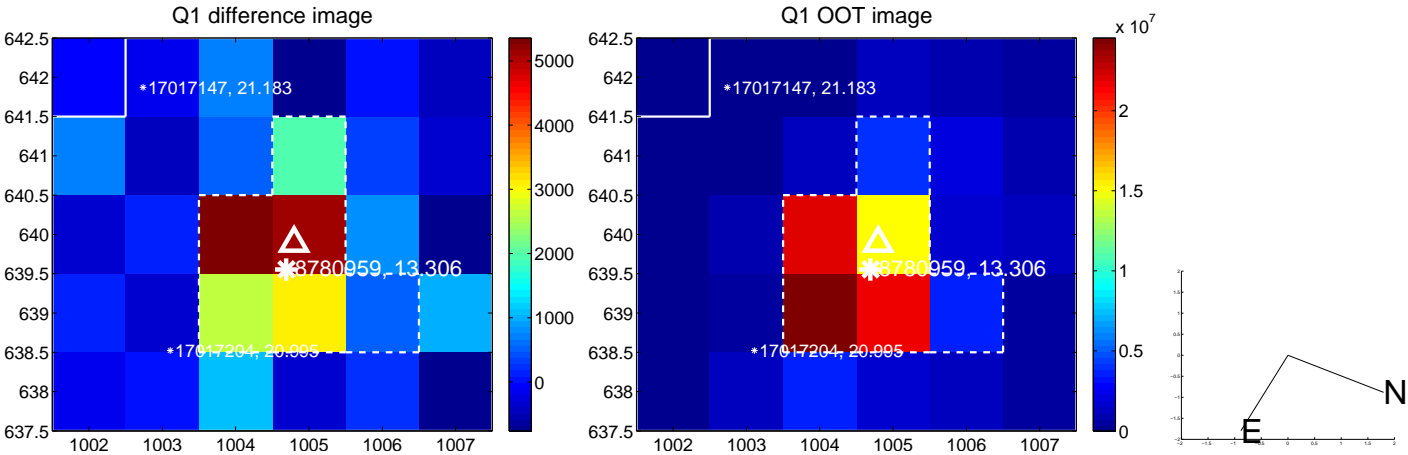
	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.336 \pm 0.190$	1.77	$-0.322 \pm 0.192$	$-0.097 \pm 0.174$
PRF-fit source offset from KIC position	$0.328 \pm 0.188$	1.74	$-0.307 \pm 0.189$	$-0.114 \pm 0.181$
photometric centroid source offset	$0.24 \pm 0.39$	0.62	$-0.22 \pm 0.40$	$0.09 \pm 0.30$



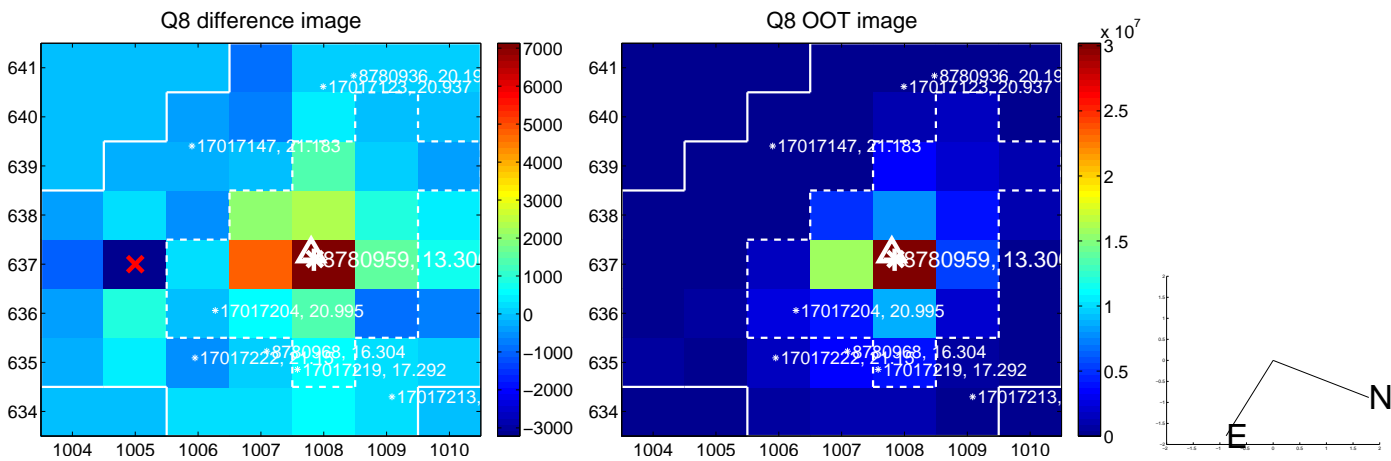
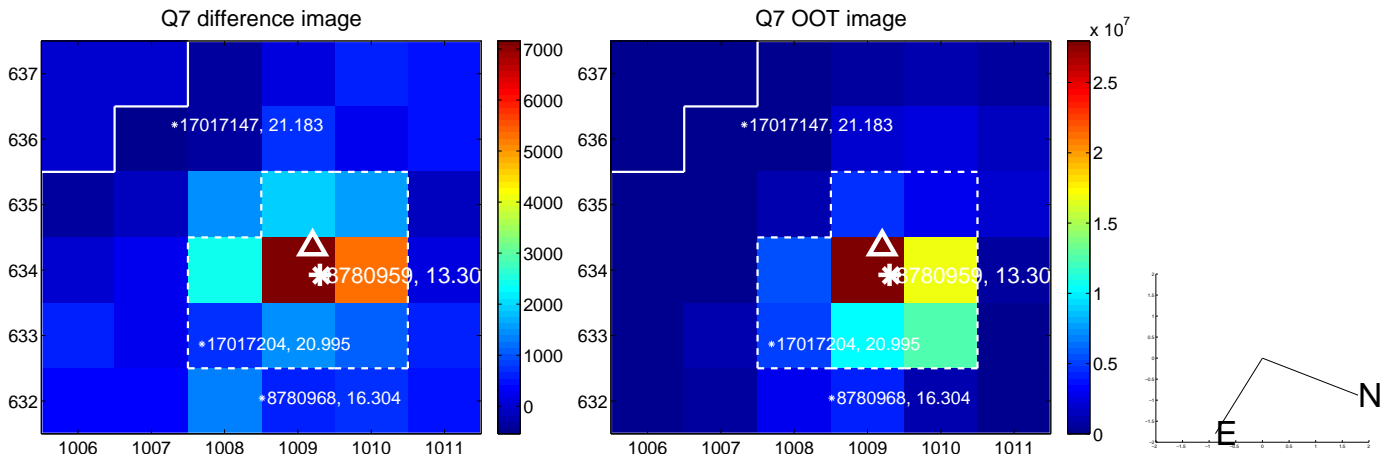
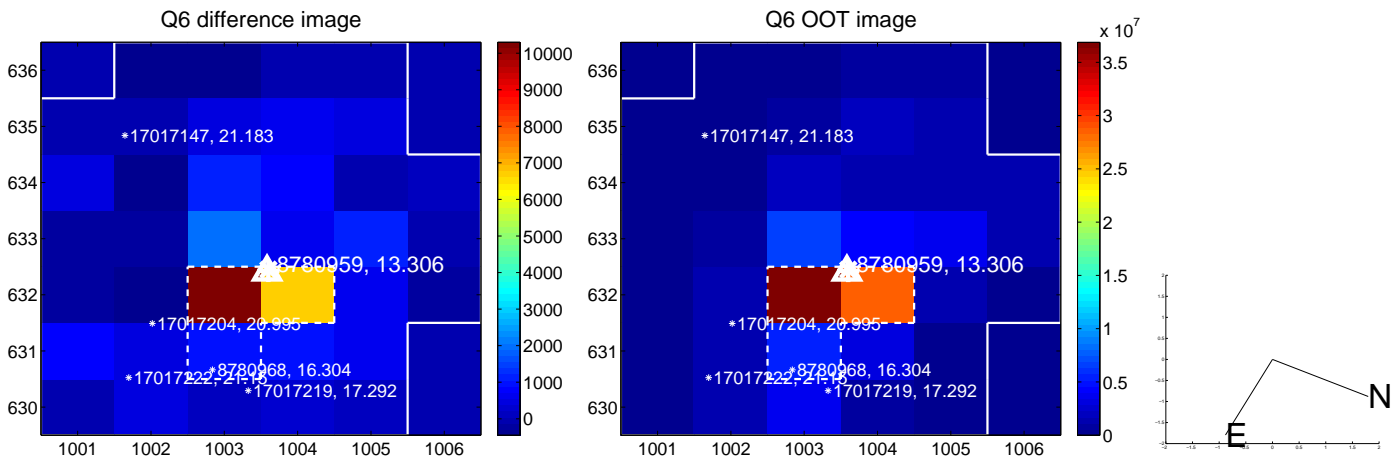
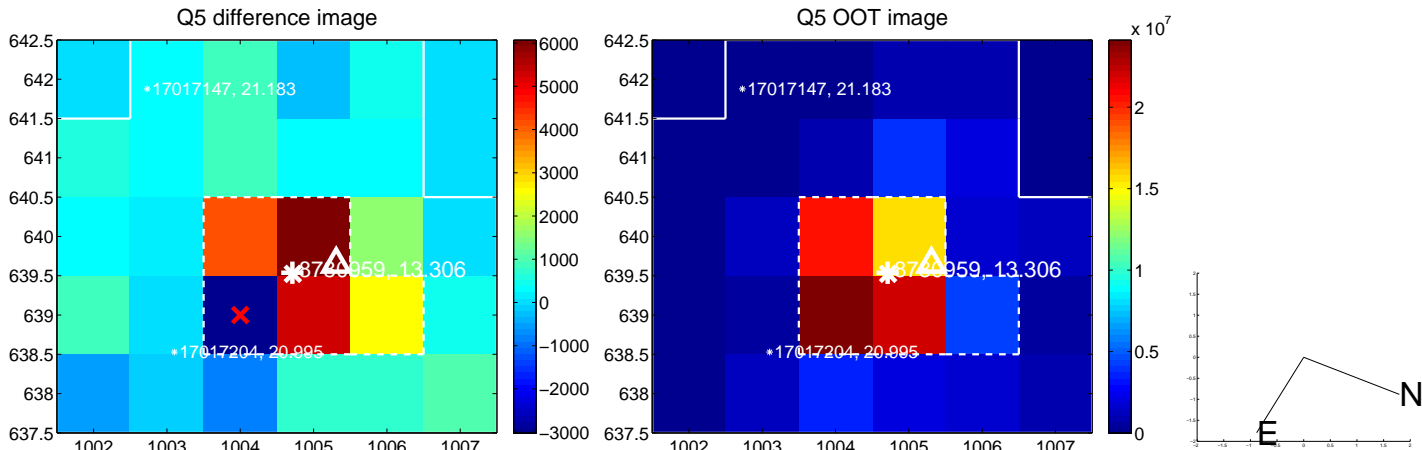
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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



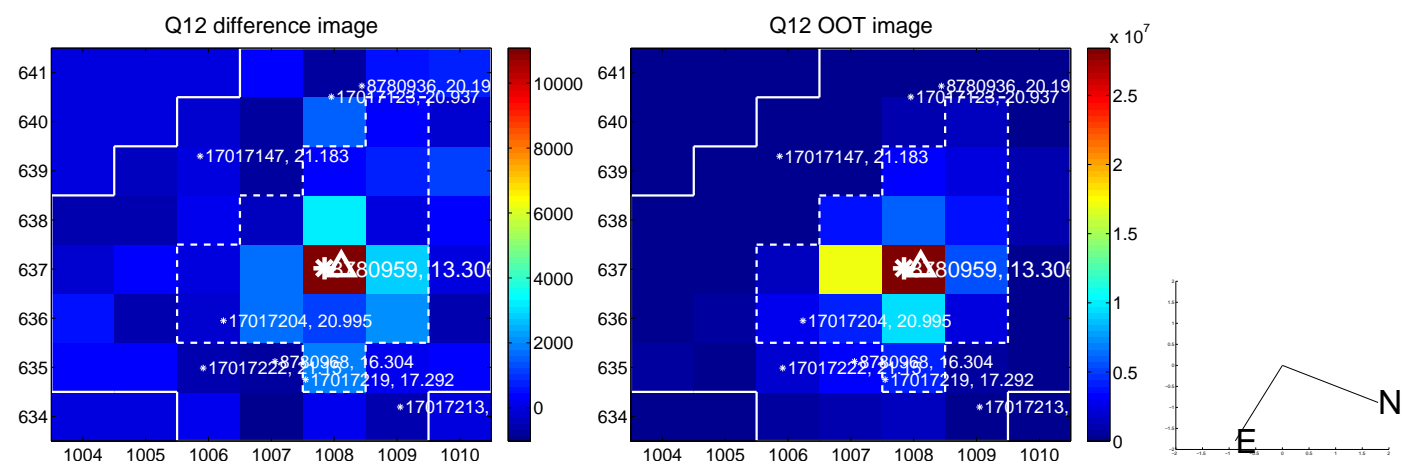
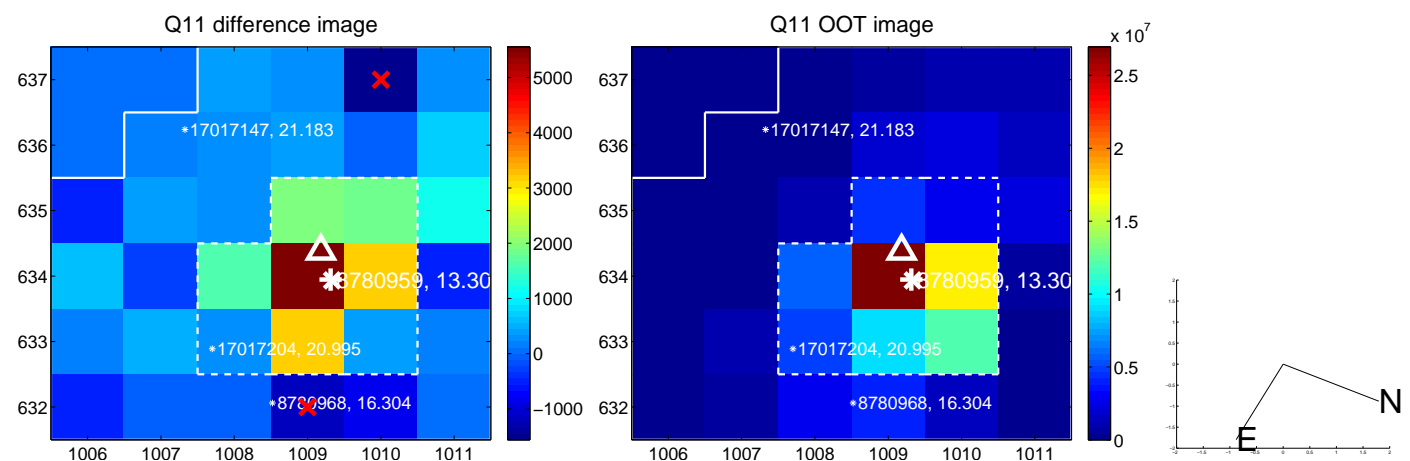
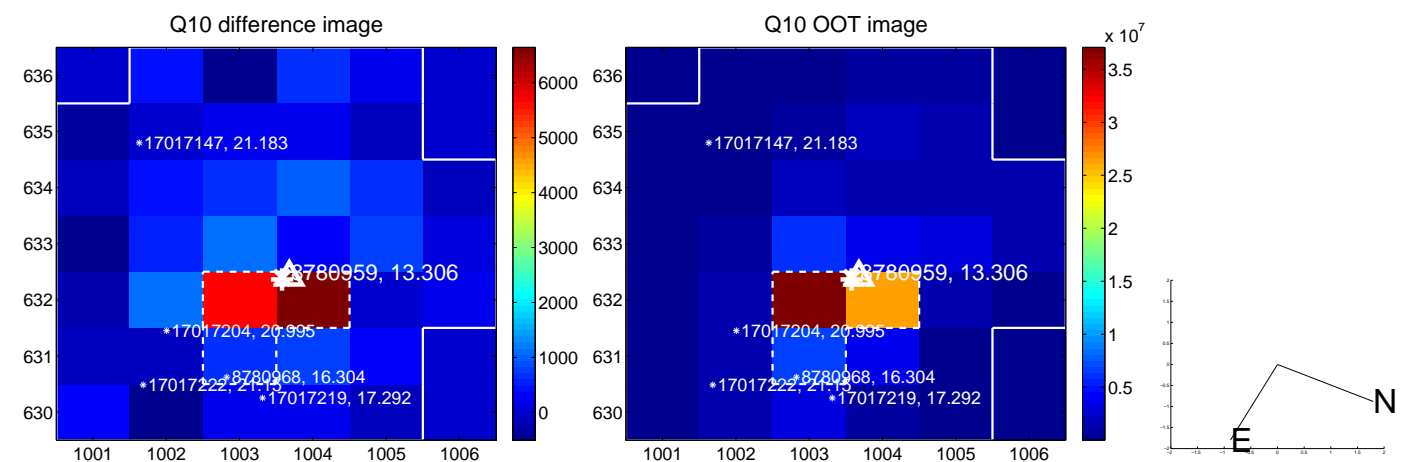
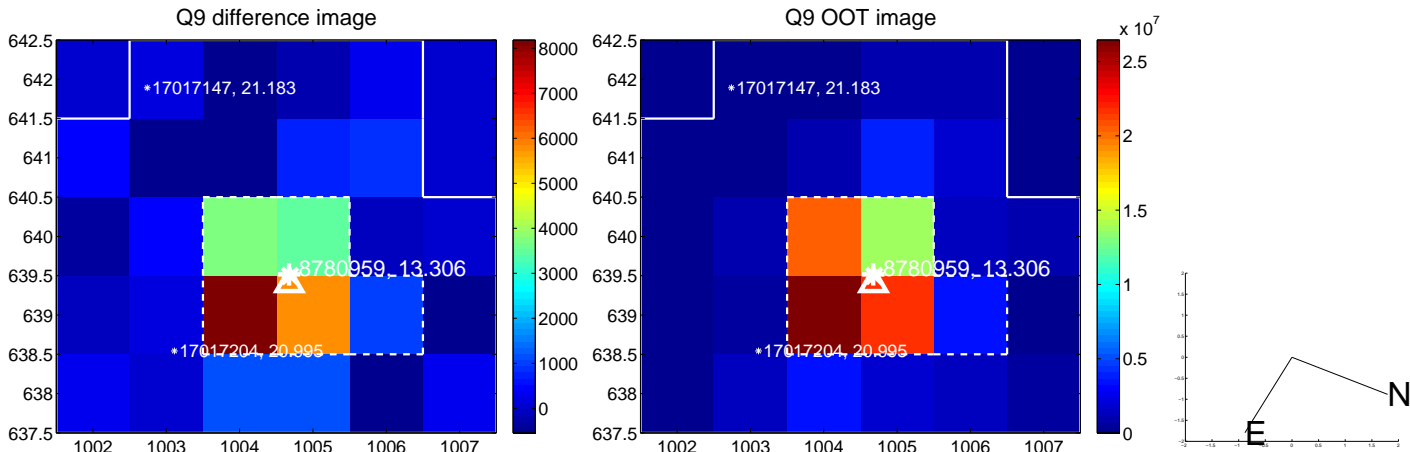
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



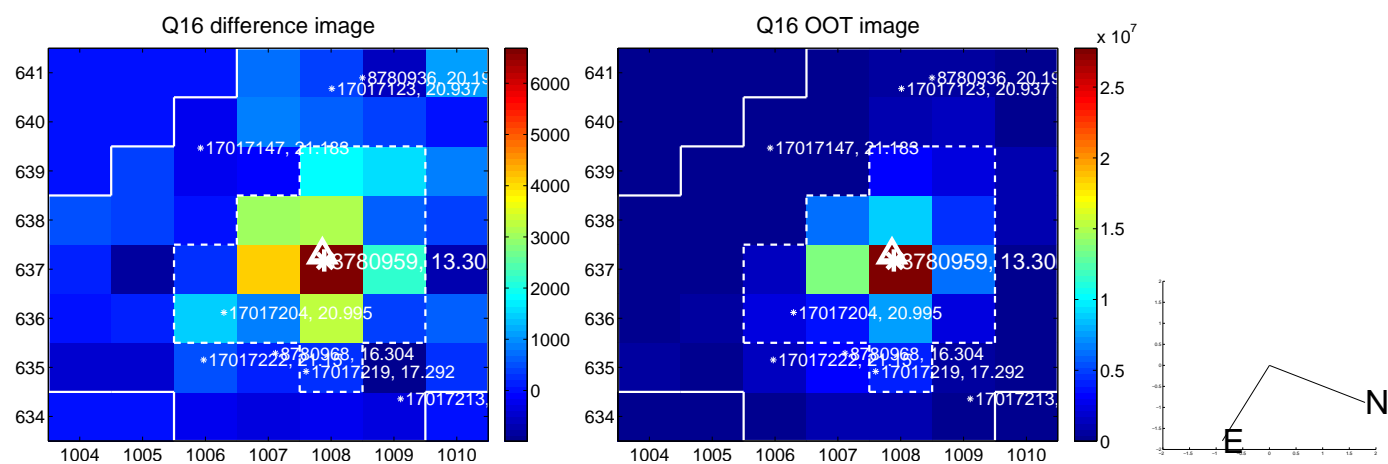
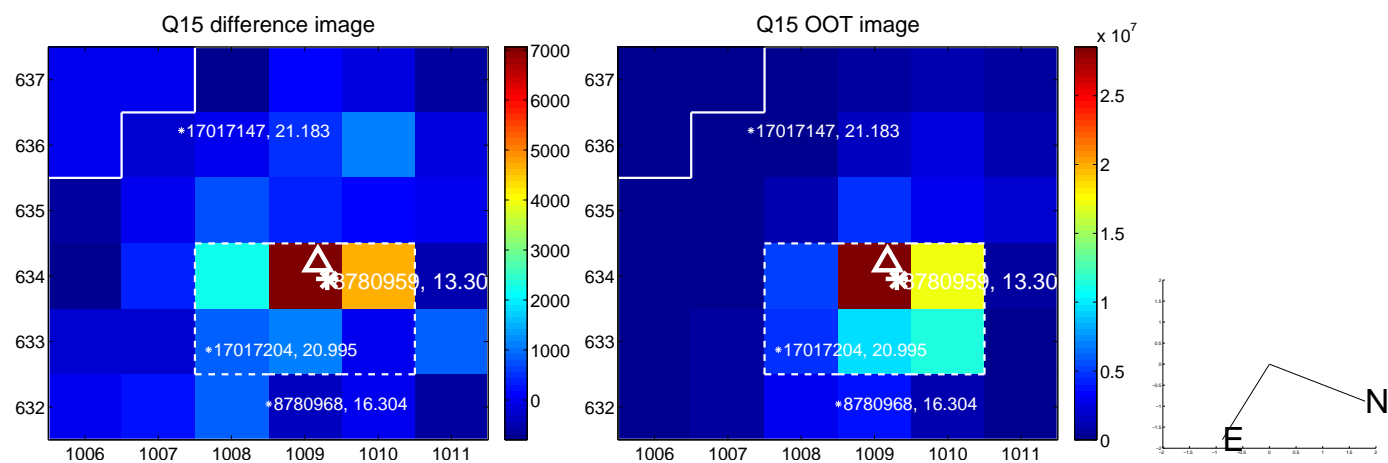
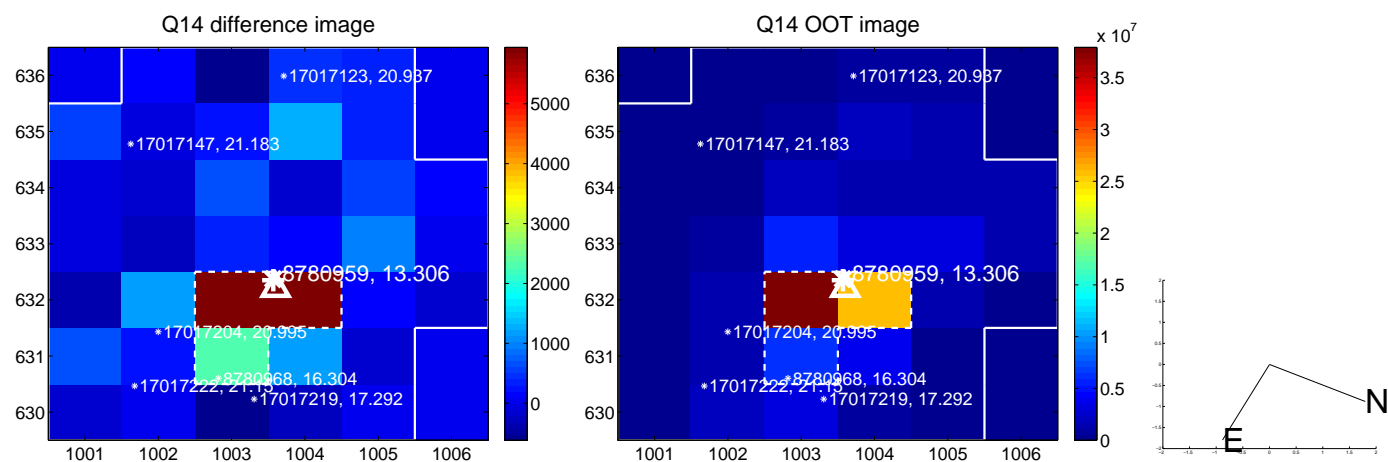
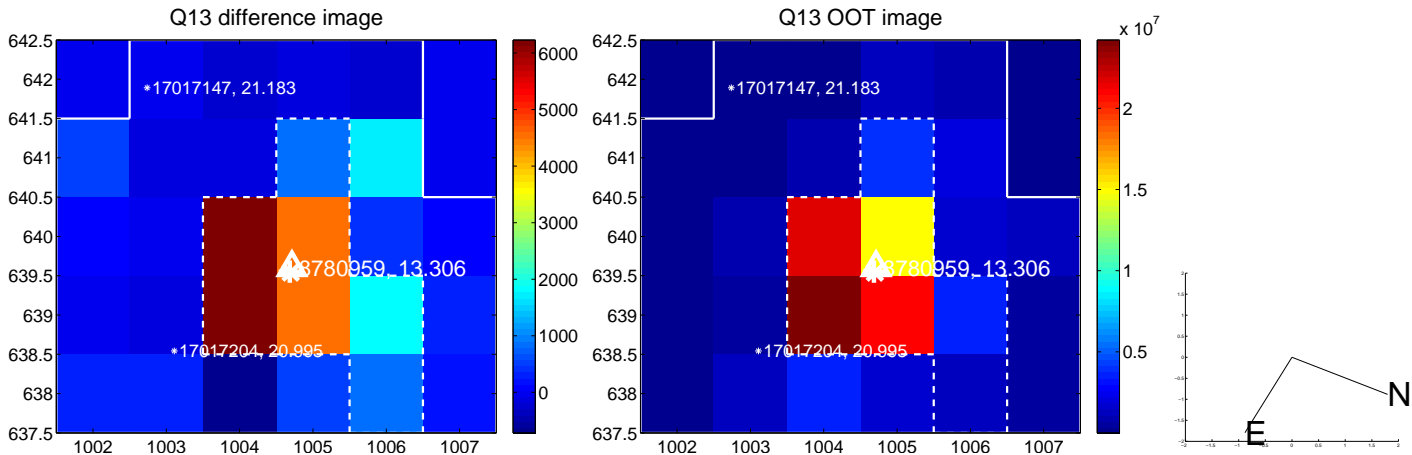
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



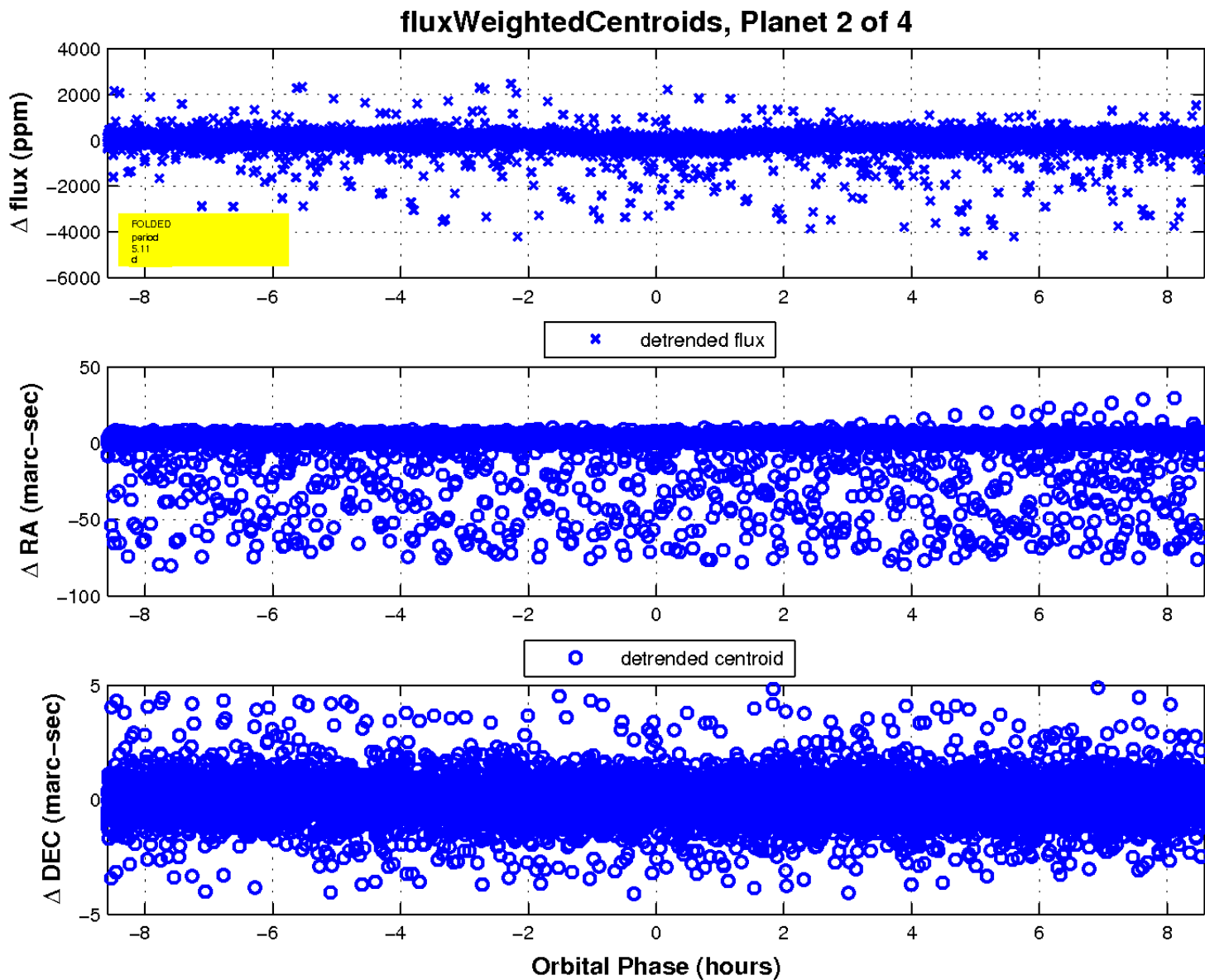
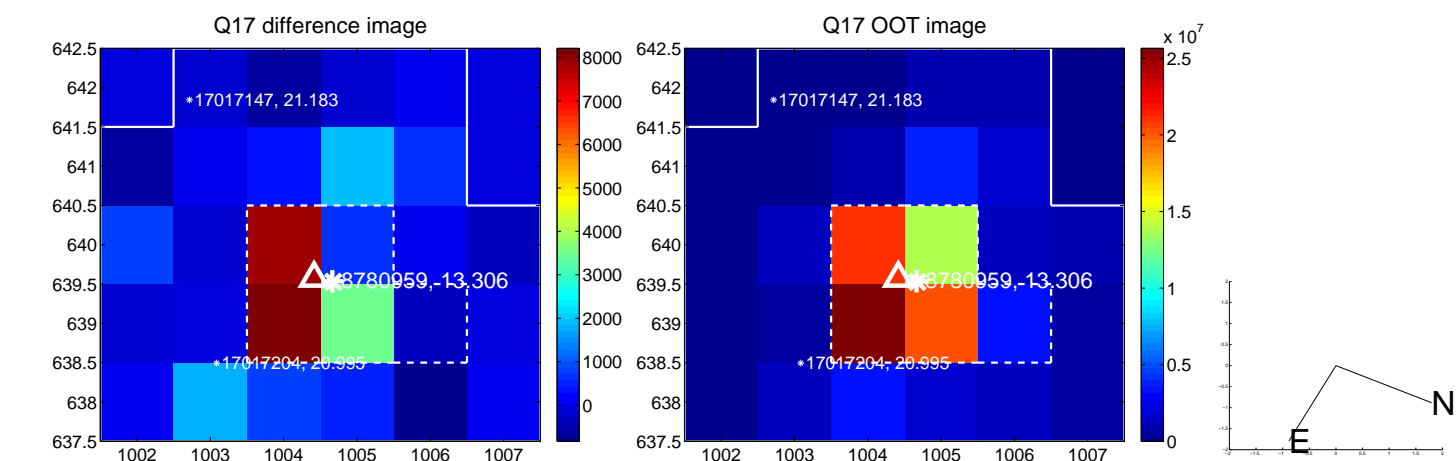
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

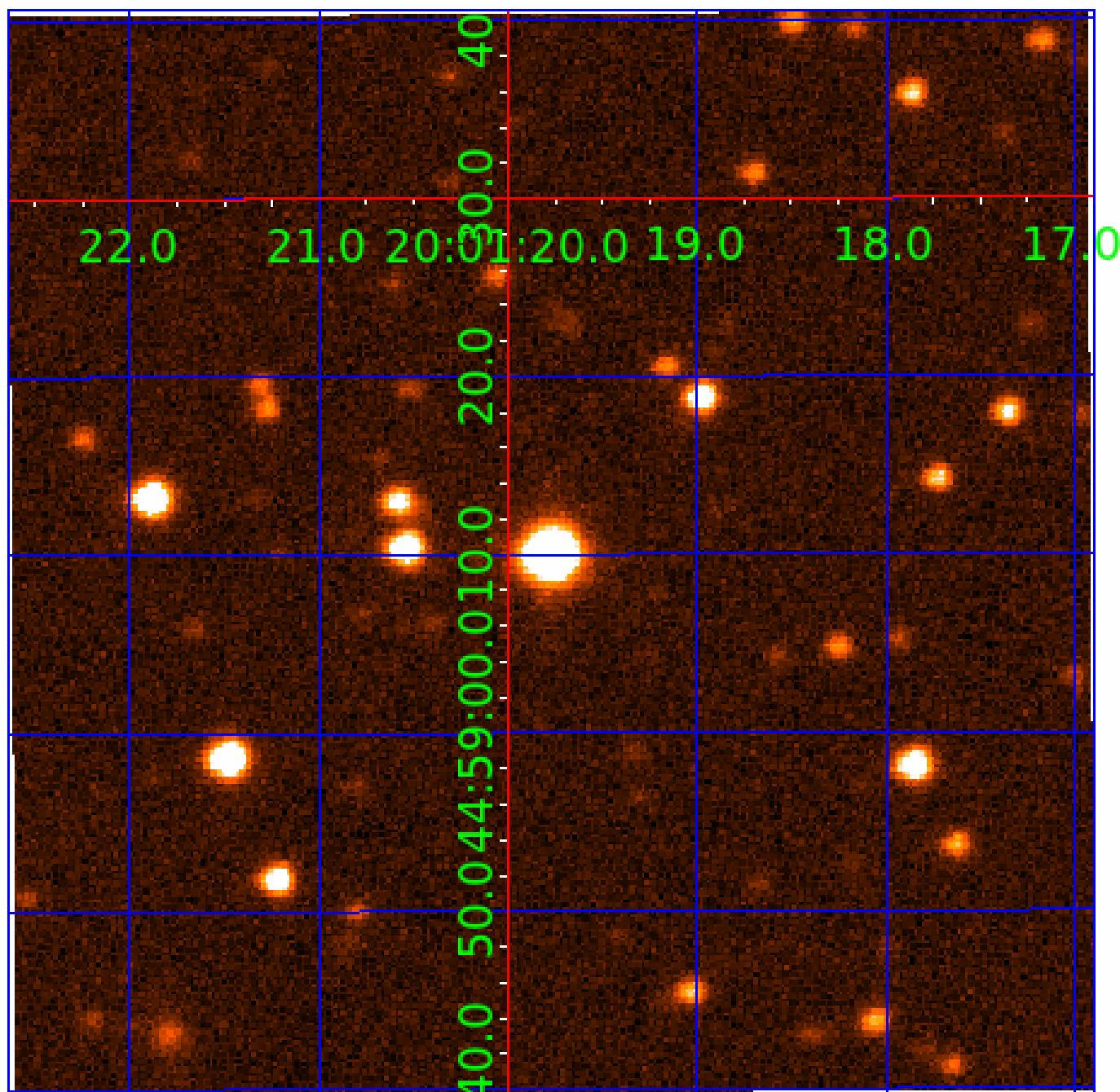


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 008780959

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
008780959-01	OBS	3741.01	2.617293	132.389262	2750.7	8.680	602.2	298.0	1.34	6432	12.88	1927.33
008780959-02	OBS	3741.03	5.111751	133.759845	234.1	2.861	27.4	31.3	1.34	6432	2.36	789.47
008780959-03	OBS	3741.04	9.630929	132.736970	228.6	4.901	19.7	23.3	1.34	6432	2.38	339.26
008780959-04	OBS	3741.02	18.578474	141.829942	240.4	3.500	9.4	-1.0	1.34	6432	2.10	141.28

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
008780959-01	OBS	FP	0.00	0	1	1	1	MOD_ODDEVEN_DV—MOD_ODDEVEN_ALT—DEEP_V_SHAPED—SEASONAL_DEPTH_DV—SEASONAL_DEPTH_ALT—CENT_RESOLVED_OFFSET—HALO_GHOST—EPHEM_MATCH
008780959-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT
008780959-03	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED
008780959-04	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED—LPP_ALT—MOD_NONUNIQ_ALT—CENT_NOFITS

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

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

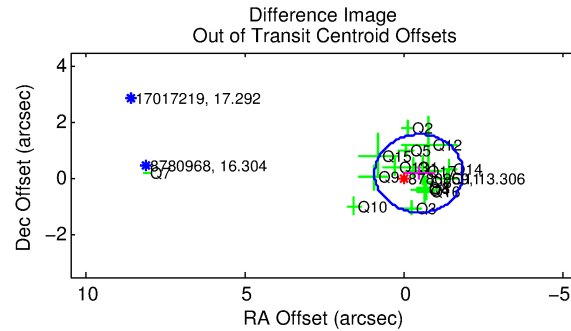
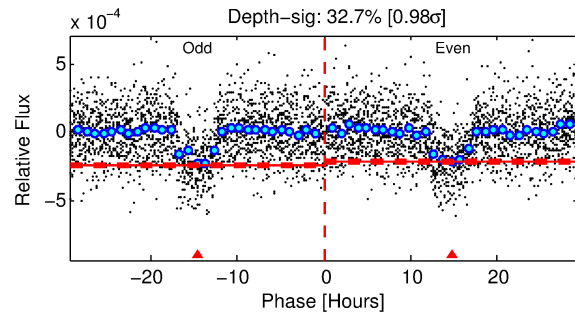
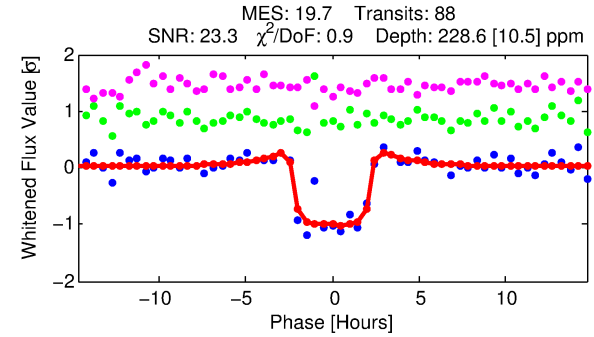
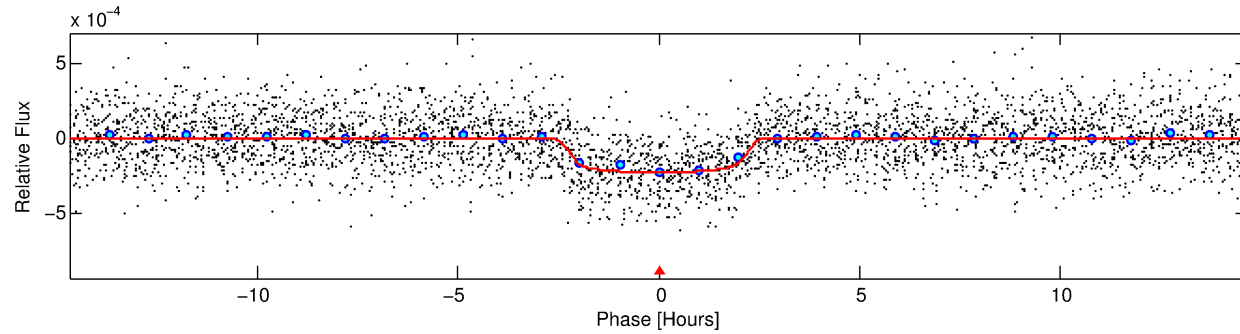
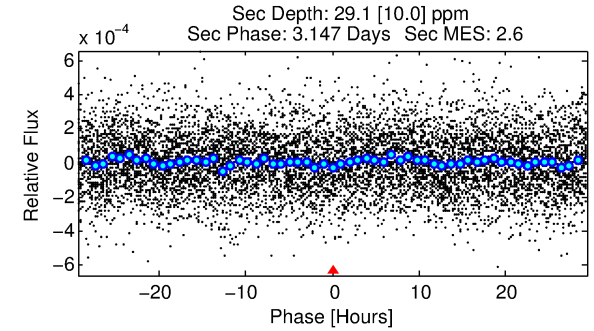
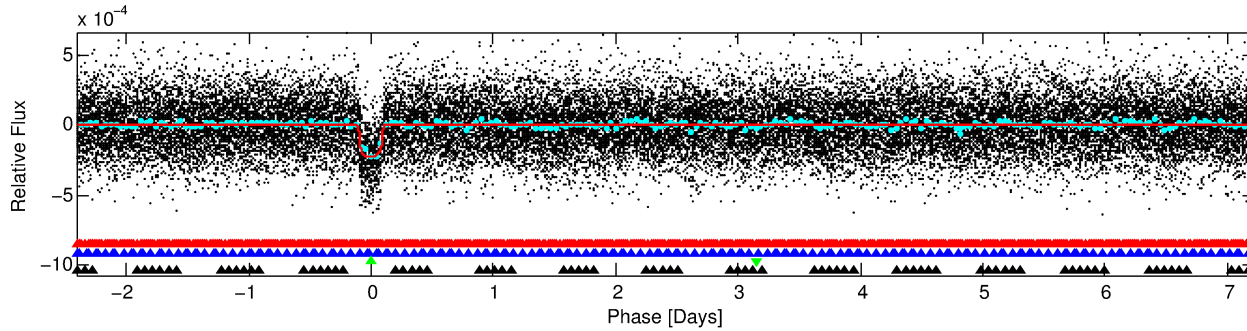
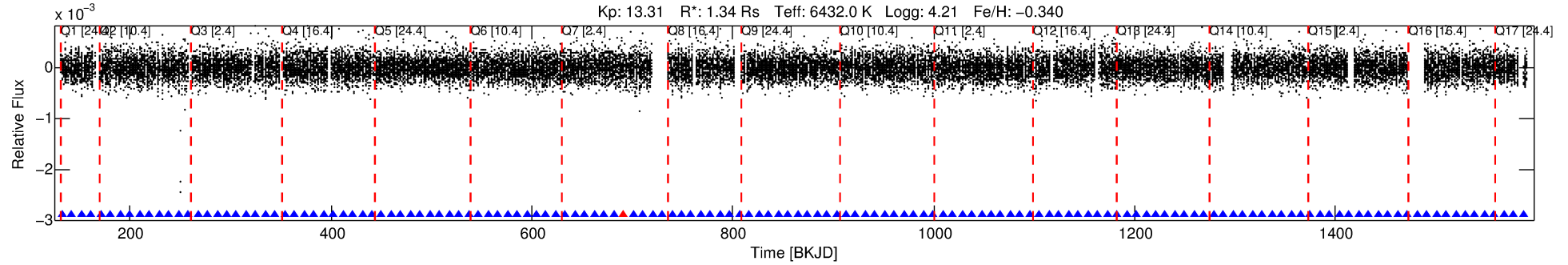
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 008780959-03

No Significant Match Found

# DV One-Page Summary

KIC: 8780959 Candidate: 3 of 4 Period: 9.631 d  
KOI: K03741.04 Corr: 0.918



## DV Fit Results:

Period = 9.63093 [0.00004] d  
Epoch = 132.7370 [0.0032] BKJD  
Rp/R\* = 0.0162 [0.0013]  
a/R\* = 7.02 [3.01]  
b = 0.90 [0.09]  
Seff = 339.26 [126.32]  
Teq = 1094 [102] K  
Rp = 2.38 [0.71] Re  
a = 0.0904 [0.0216] AU  
Ag = 23.03 [11.86] [1.86σ]  
Teffp = 3707 [373] K [6.76σ]

## DV Diagnostic Results:

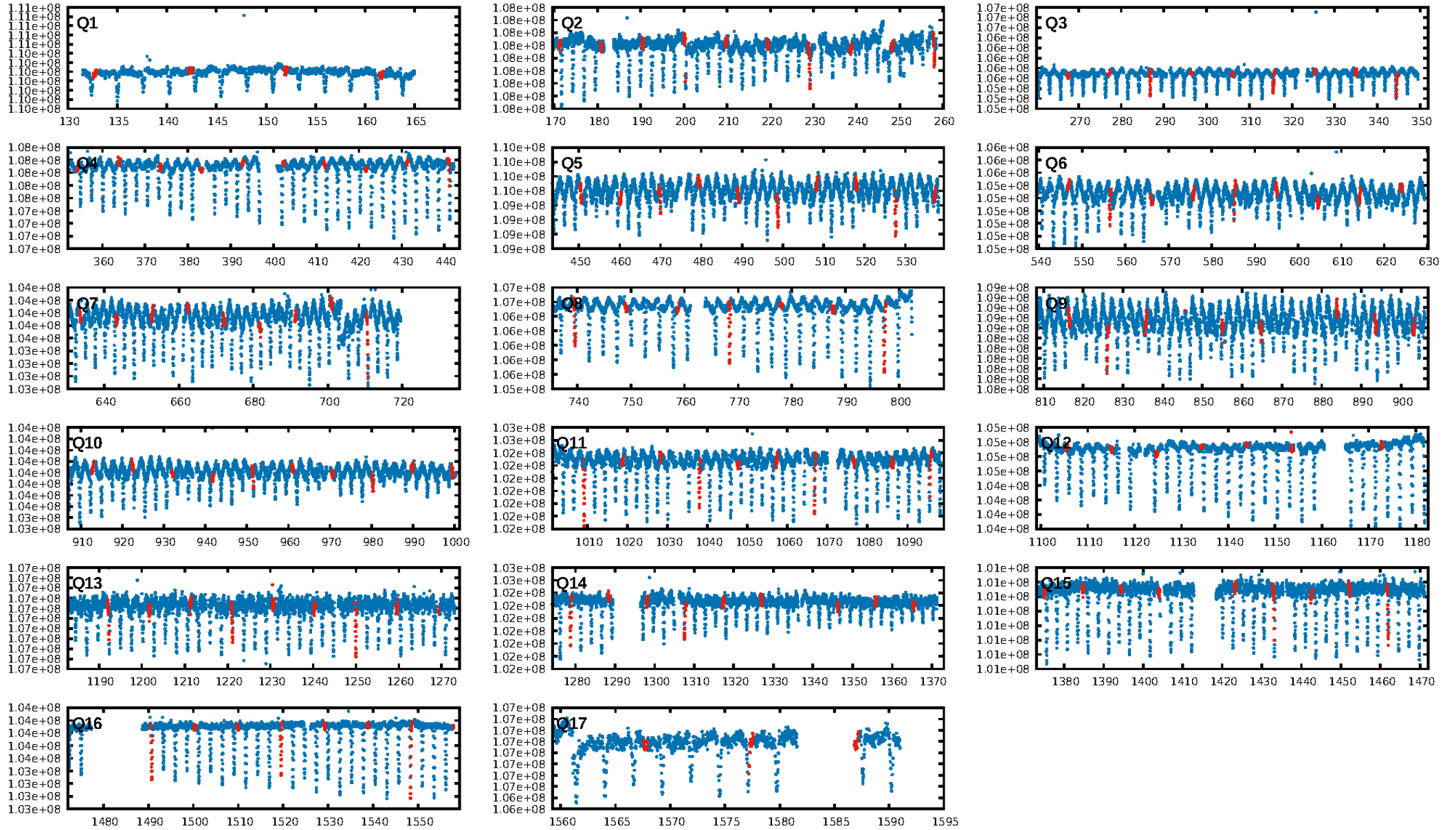
ShortPeriod-sig: 100.0% [19.11σ]  
LongPeriod-sig: 100.0% [35.65σ]  
ModelChiSquare2-sig: 22.8%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: N/A  
RollingBand-fgt: 0.99 [82/83]  
GhostDiagnostic-chr: 3.123  
Centroid-sig: N/A  
Centroid-so: 0.141 arcsec [0.39σ]  
OotOffset-rm: 0.497 arcsec [1.07σ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-rm: 0.477 arcsec [0.89σ]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 0.82 [14/17]  
DiffImageOverlap-fno: 0.94 [16/17]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 06:35:41 Z

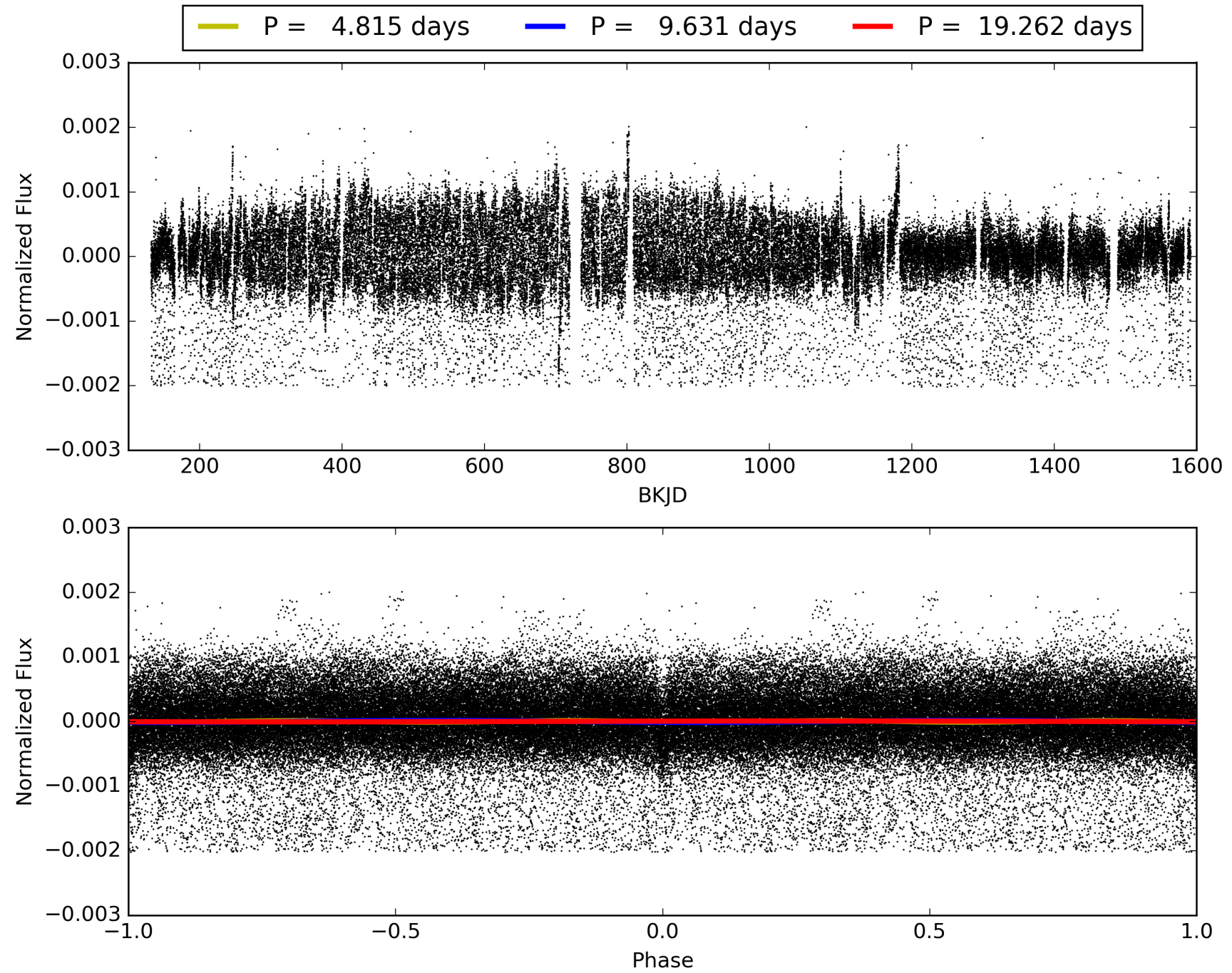
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center



# TCE 008780959-03, PDC Light Curves

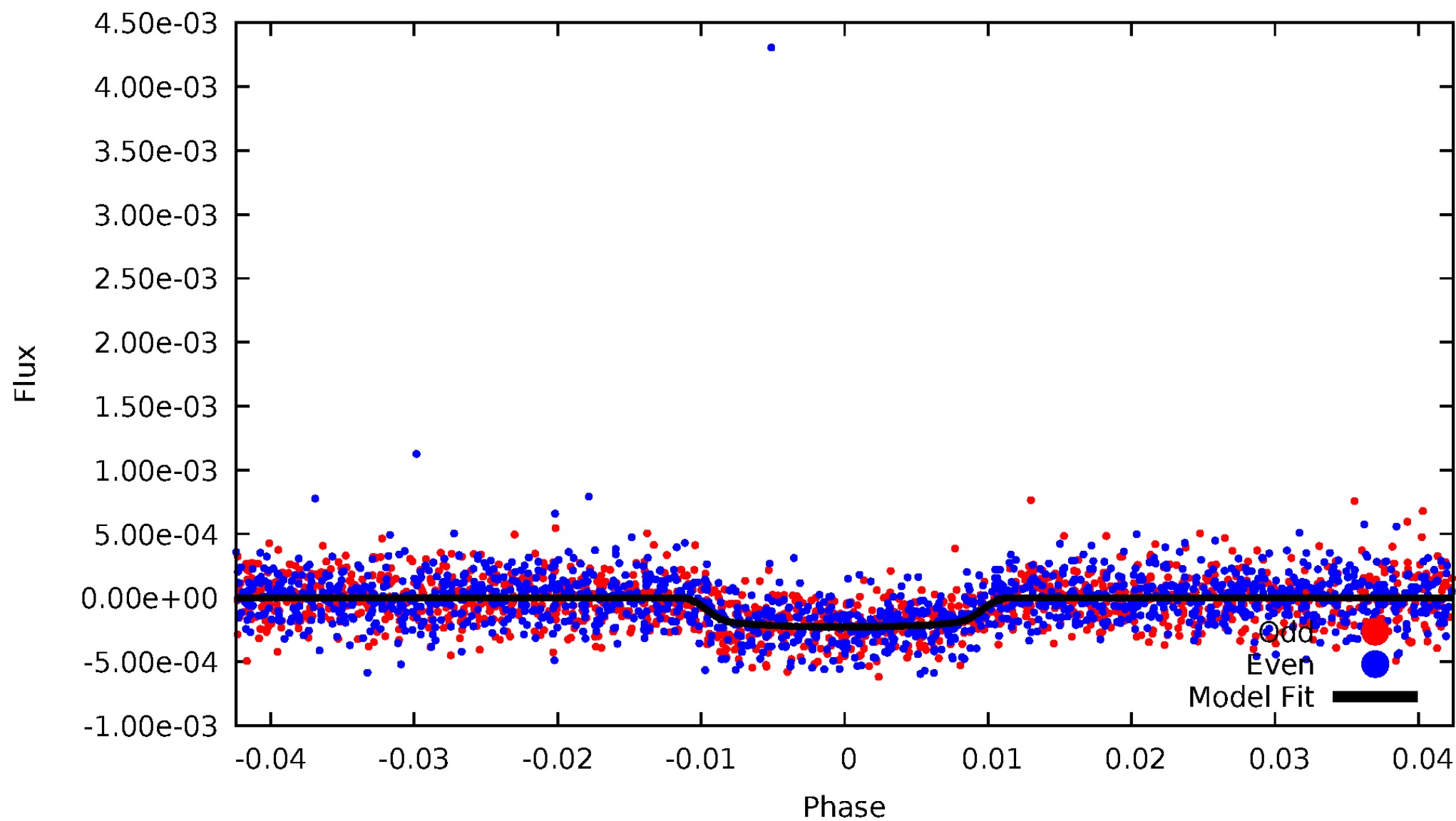


# TCE 008780959-03



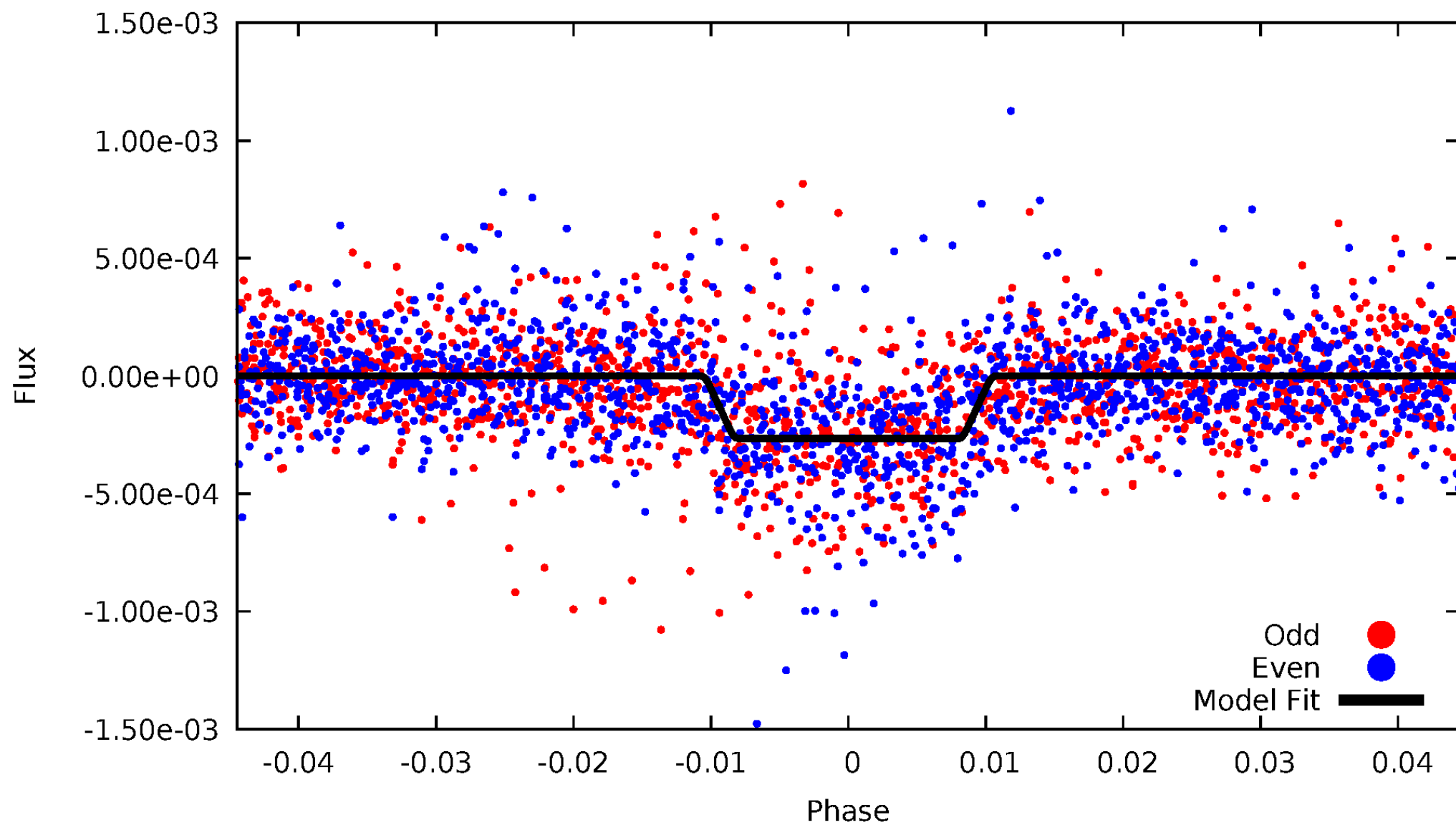
# DV Odd/Even

TCE 008780959-03



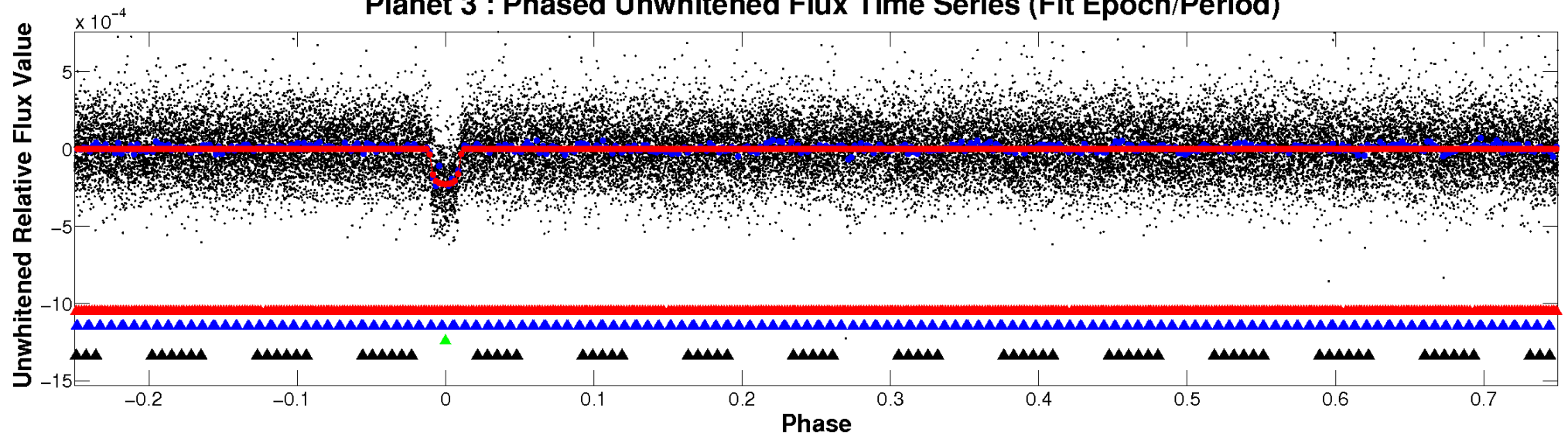
# ALT Odd/Even

TCE 008780959-03

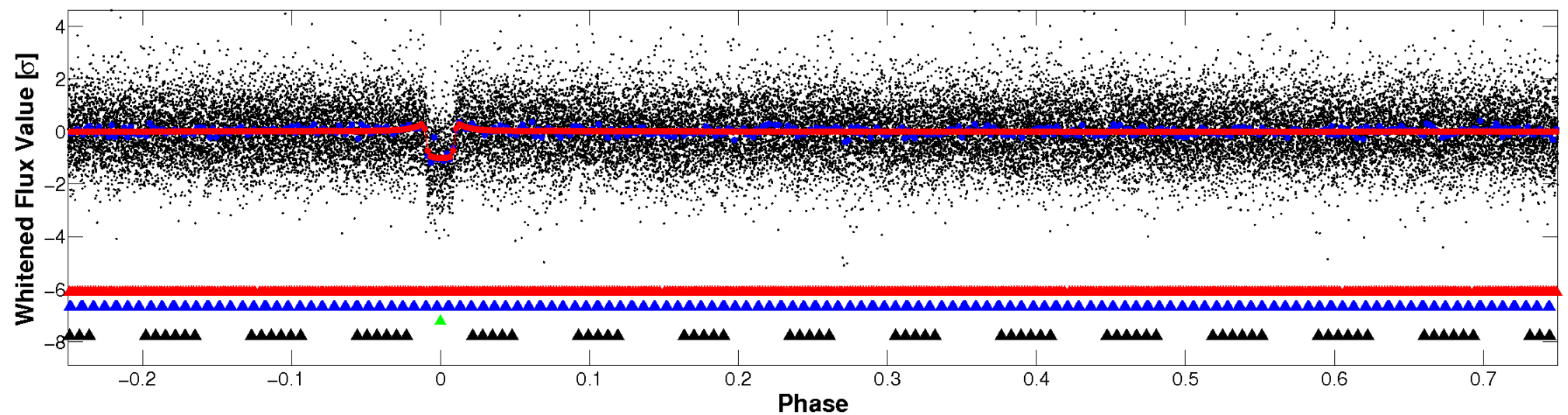


# Non-Whitened Vs. Whitened Light Curve

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



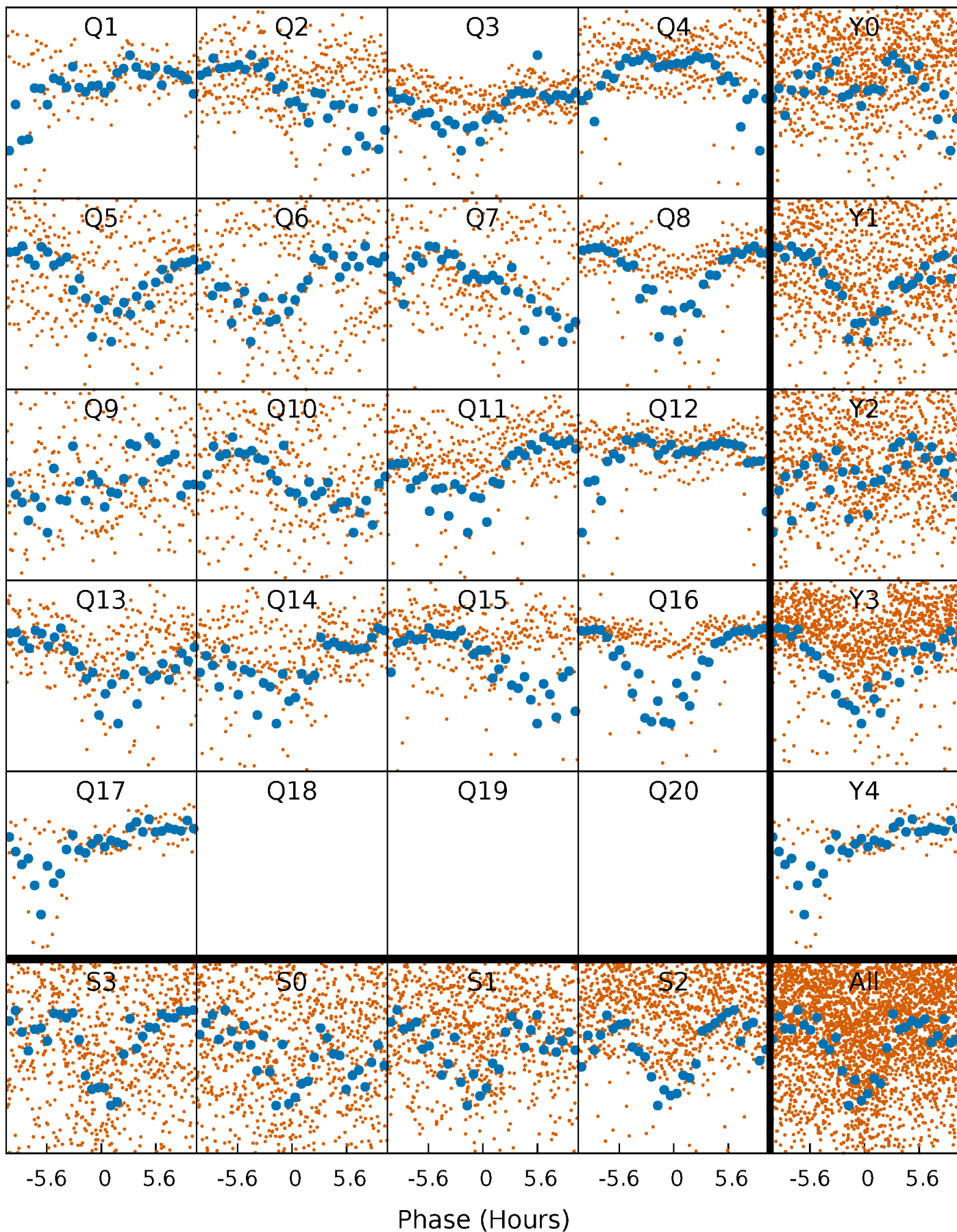
## Planet 3 : Phased Whitened Flux Time Series (Fit Epoch/Period)





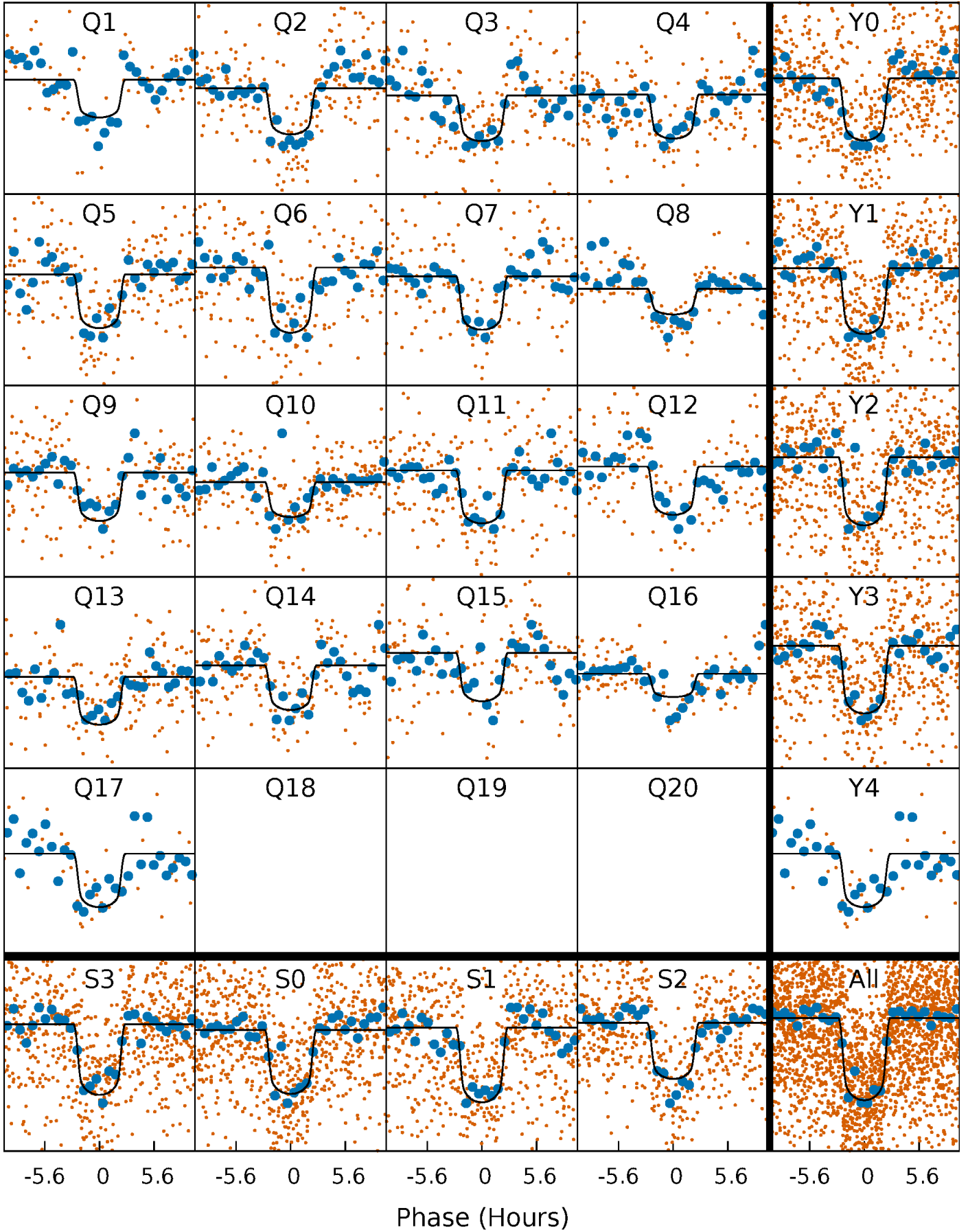
# PDC Quarter-Phased Transit Curves

TCE 008780959-03 P= 9.630929 Days  $T_0=132.736970$  (BKJD)



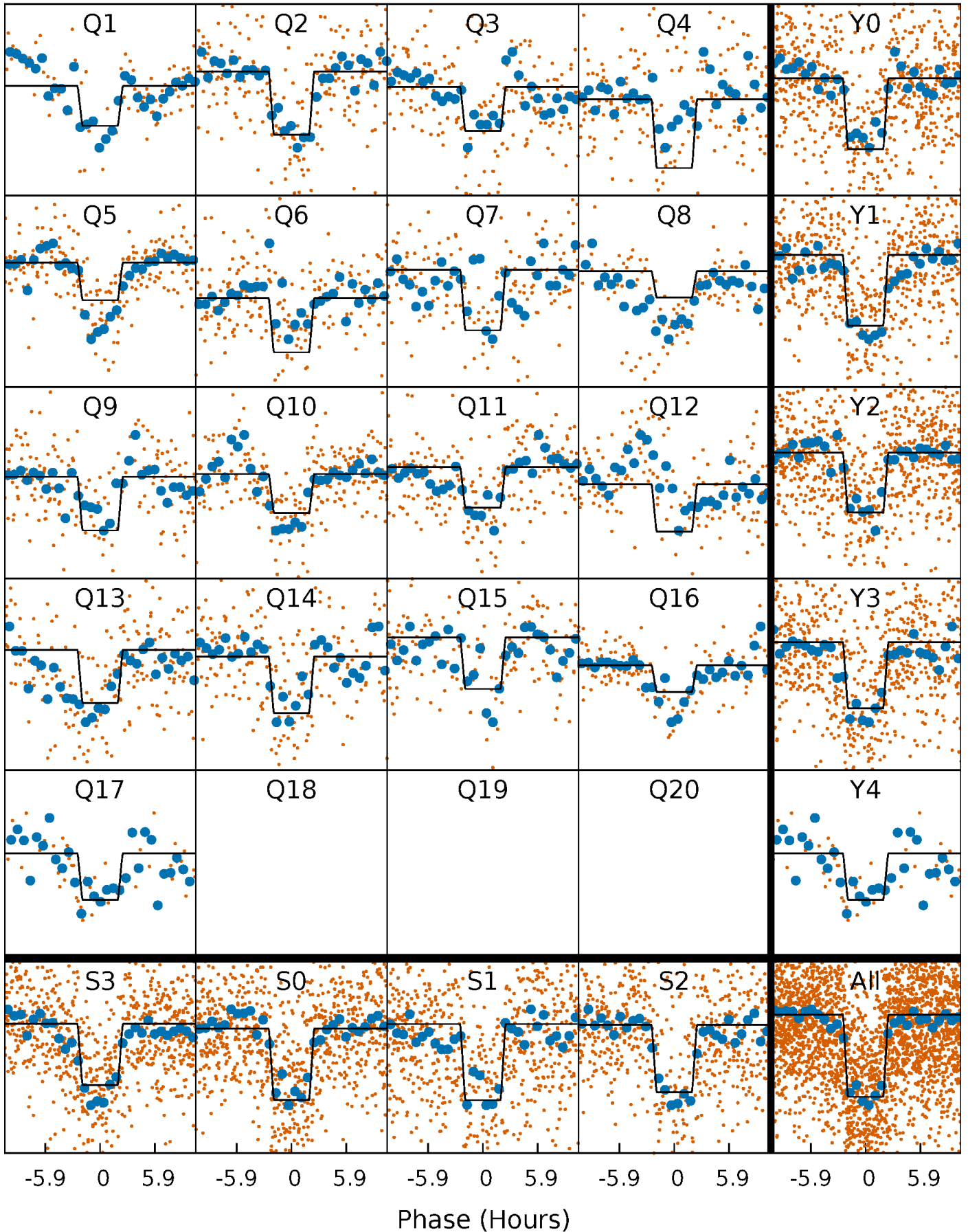
# DV Quarter-Phased Transit Curves

TCE 008780959-03   P= 9.630929 Days    $T_0=132.736970$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

TCE 008780959-03 P= 9.630986 Days  $T_0=132.733682$  (BKJD)

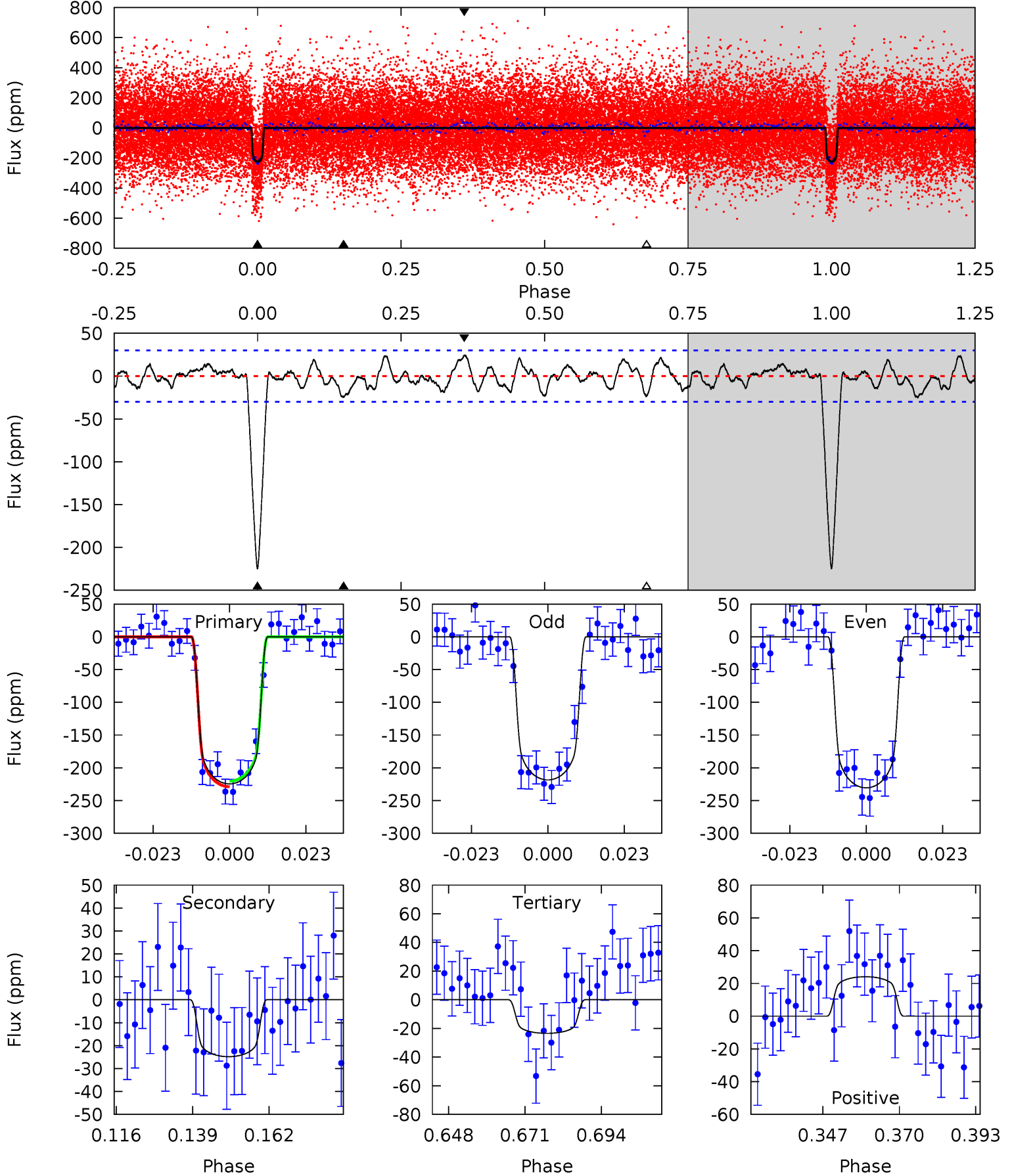




# DV Model-Shift Uniqueness Test

008780959-03, P = 9.630929 Days, E = 123.106041 Days

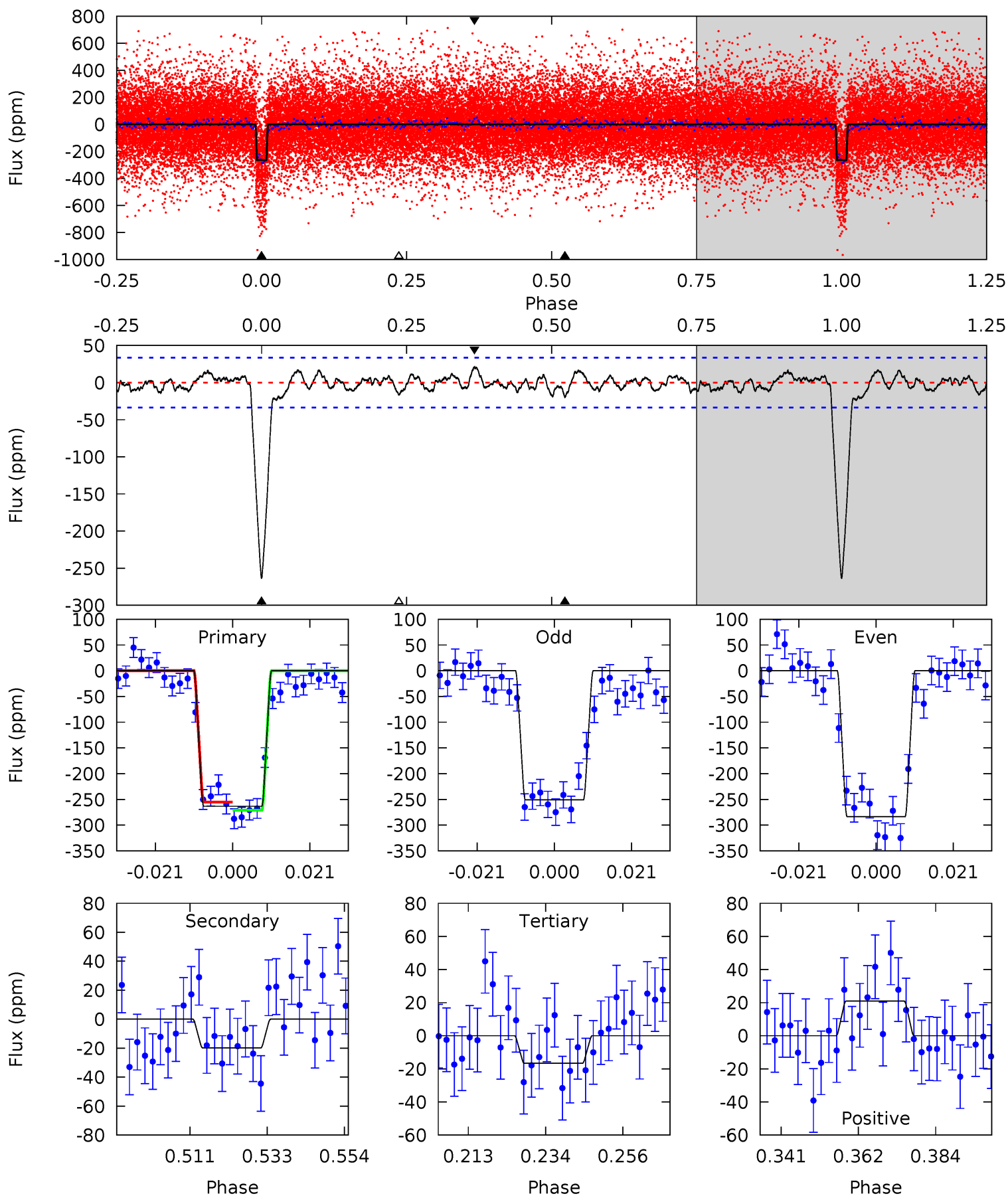
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
36.4	4.02	3.80	3.90	4.86	2.27	1.61	32.6	32.5	0.22	0.12	0.98	1.00	0.10	0.68



# Alt Model-Shift Uniqueness Test

008780959-03, P = 9.630986 Days, E = 123.102696 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
38.2	2.88	2.42	3.04	4.88	2.30	1.14	35.8	35.2	0.46	-0.16	2.36	1.07	0.07	1.15



### Stellar Parameters For KIC 008780959

	$T_{\text{eff}} (K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R (R_{\odot})$	$M (M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6432^{+155}_{-214}$	$4.207^{+0.190}_{-0.171}$	$-0.340^{+0.250}_{-0.300}$	$1.345^{+0.382}_{-0.313}$	$1.060^{+0.177}_{-0.133}$	$0.614^{+0.604}_{-0.306}$
	+2%/-3%	+5%/-4%	+74%/-88%	+28%/-23%	+17%/-13%	+99%/-50%
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 008780959-03 / KOI 3741.04

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-25 \pm 6$	$2.39^{+0.41}_{-0.35}$	$1524^{+113}_{-108}$	$3882^{+225}_{-231}$	$19^{+9}_{-7}$
Alt.	$-20 \pm 7$	$2.38^{+0.42}_{-0.37}$	$1517^{+121}_{-105}$	$3733^{+243}_{-272}$	$15^{+9}_{-6}$

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

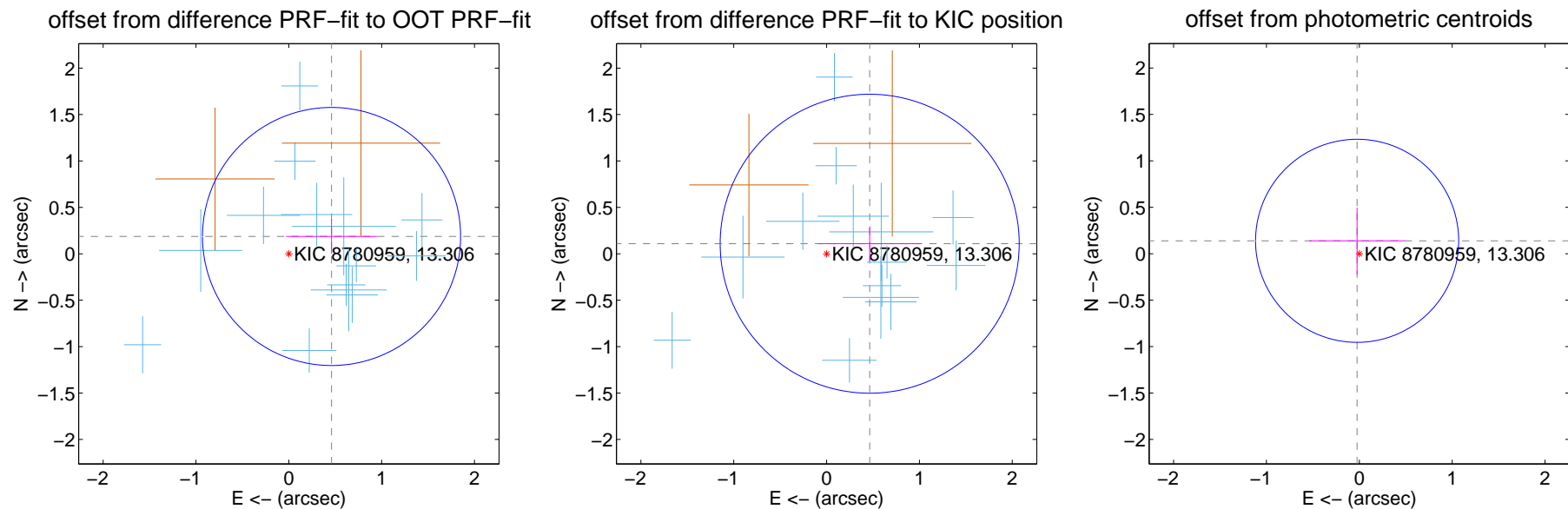
## DV Centroid Data

Supplemental centroid analysis for 008780959-03. Kepler magnitude: 13.31. Transit SNR 23.35

There are 14 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.06 arcsec

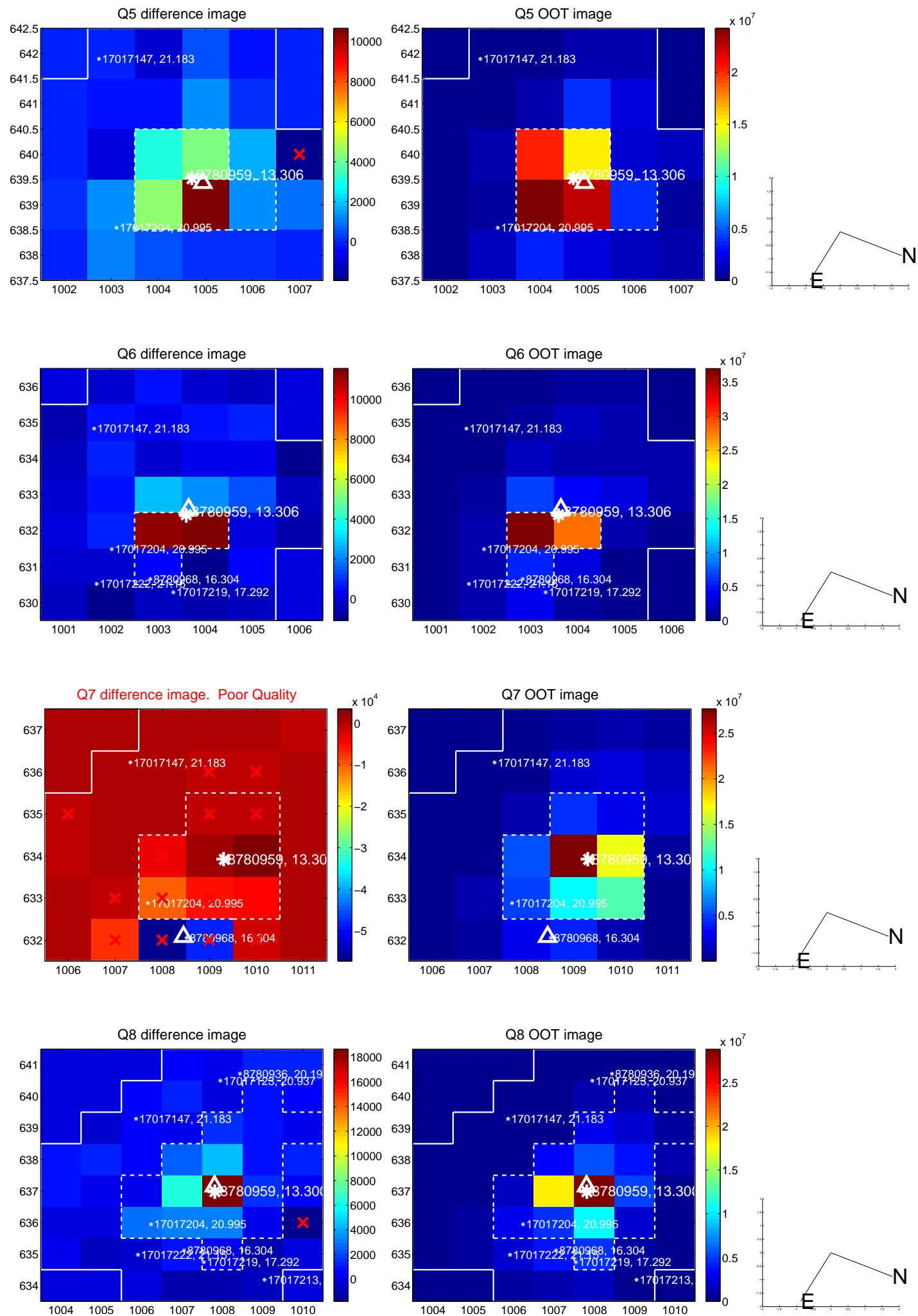
	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.497 \pm 0.463$	1.07	$-0.460 \pm 0.489$	$0.186 \pm 0.185$
PRF-fit source offset from KIC position	$0.477 \pm 0.537$	0.89	$-0.464 \pm 0.550$	$0.108 \pm 0.186$
photometric centroid source offset	$0.14 \pm 0.36$	0.39	$0.02 \pm 0.52$	$0.14 \pm 0.36$



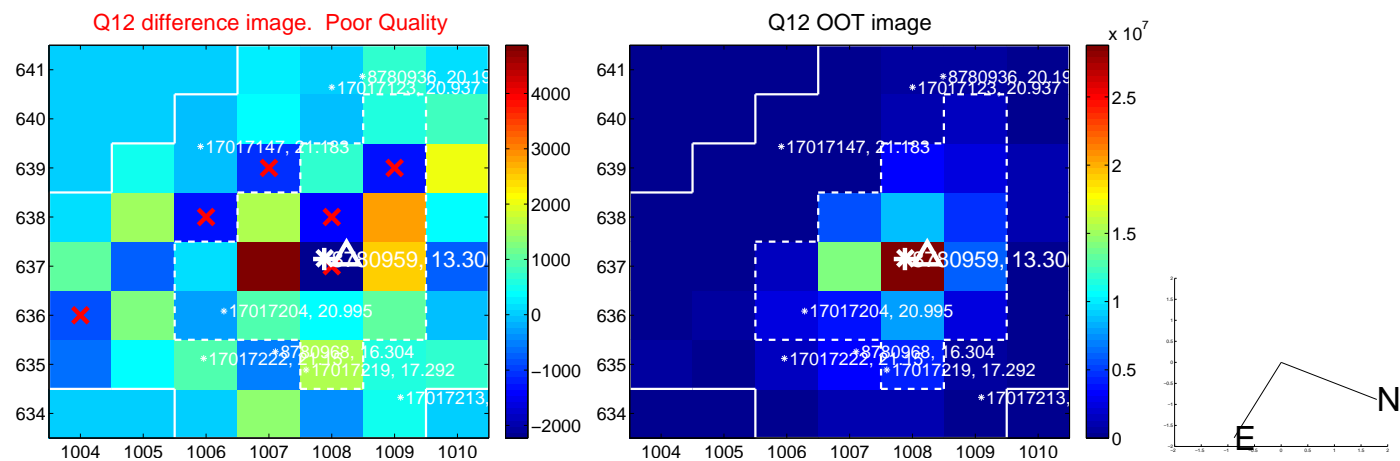
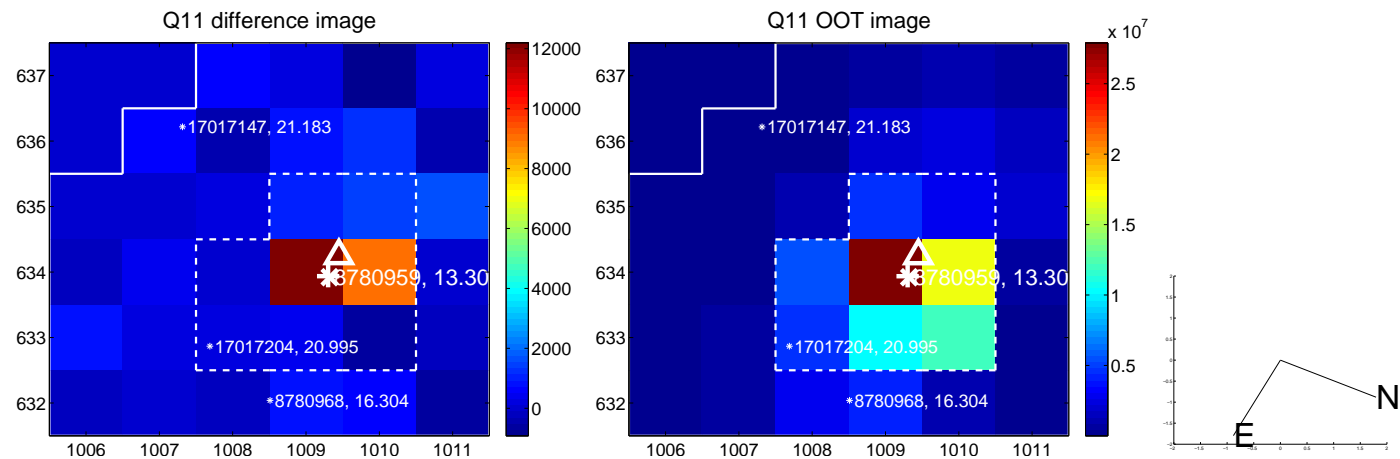
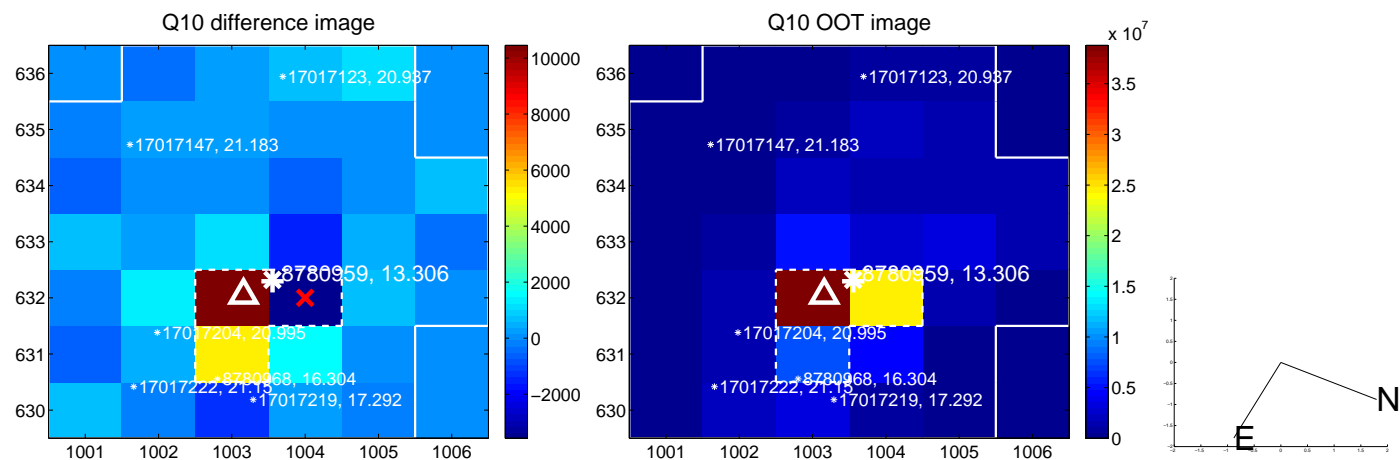
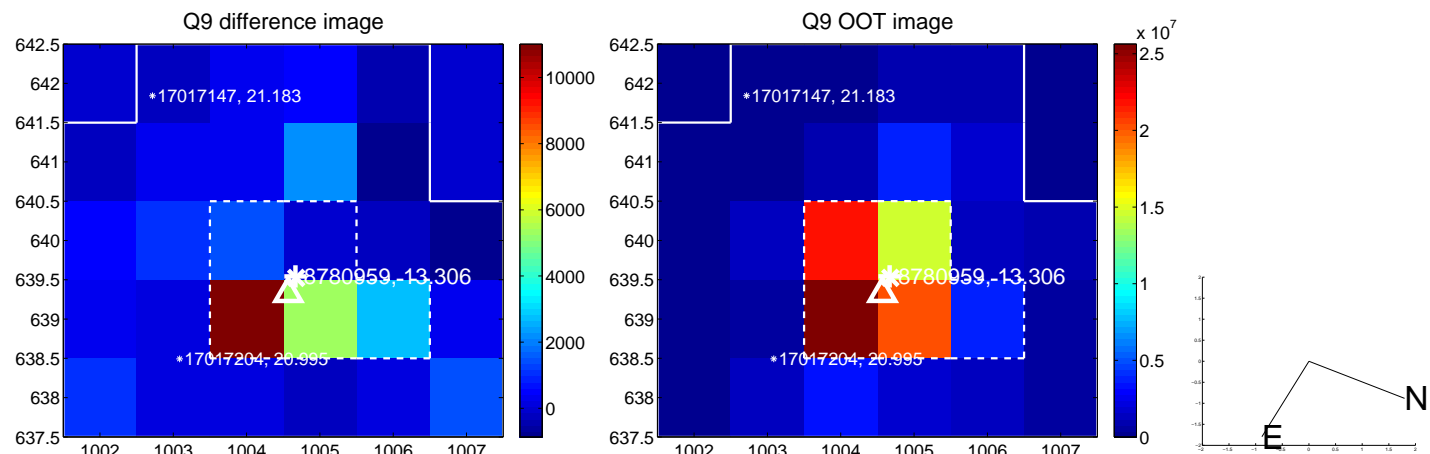
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

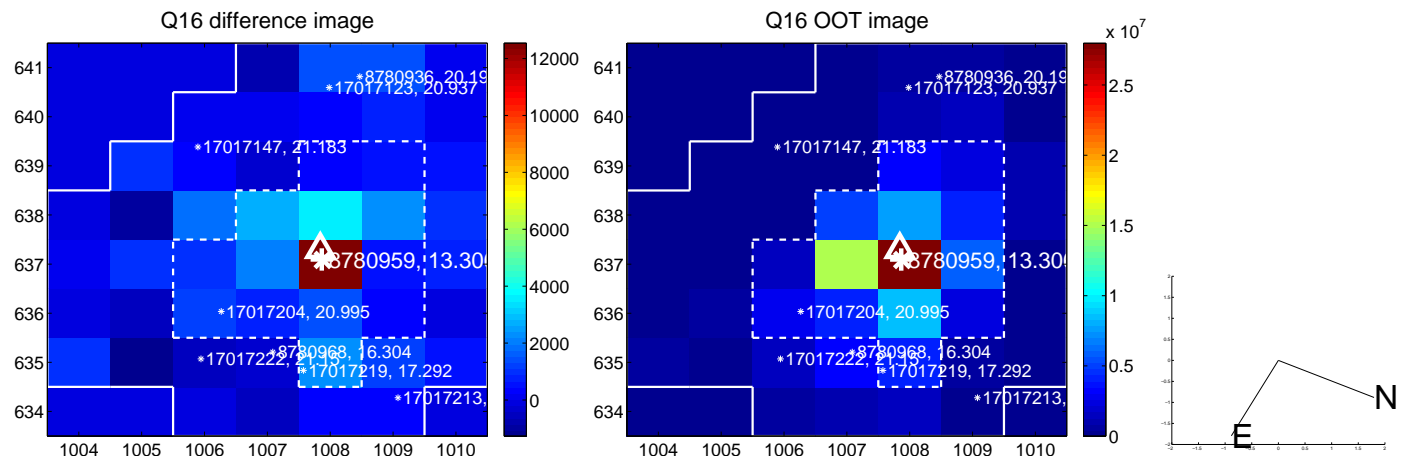
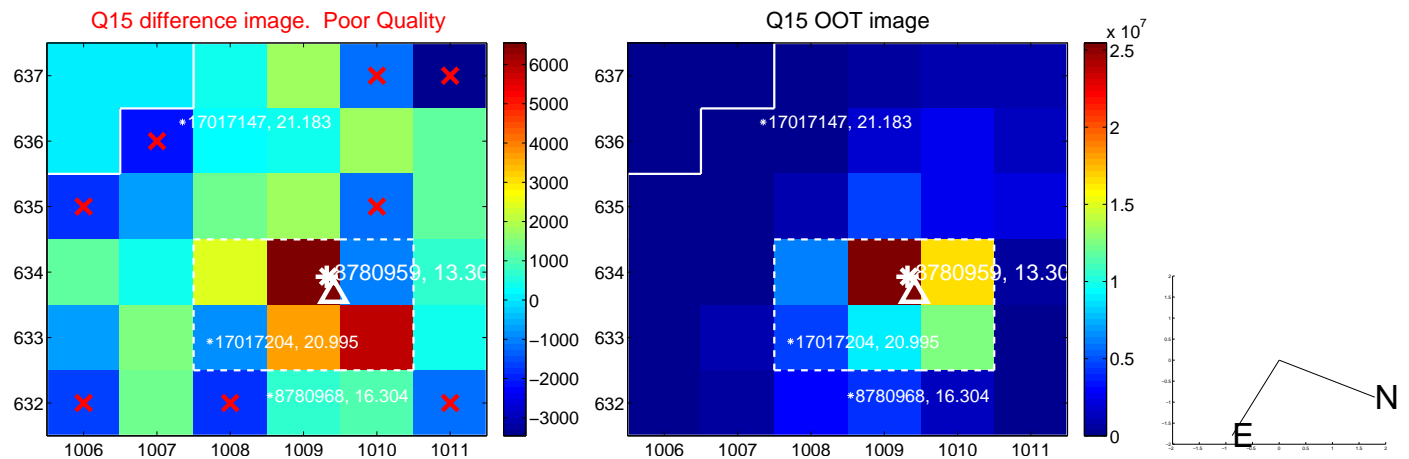
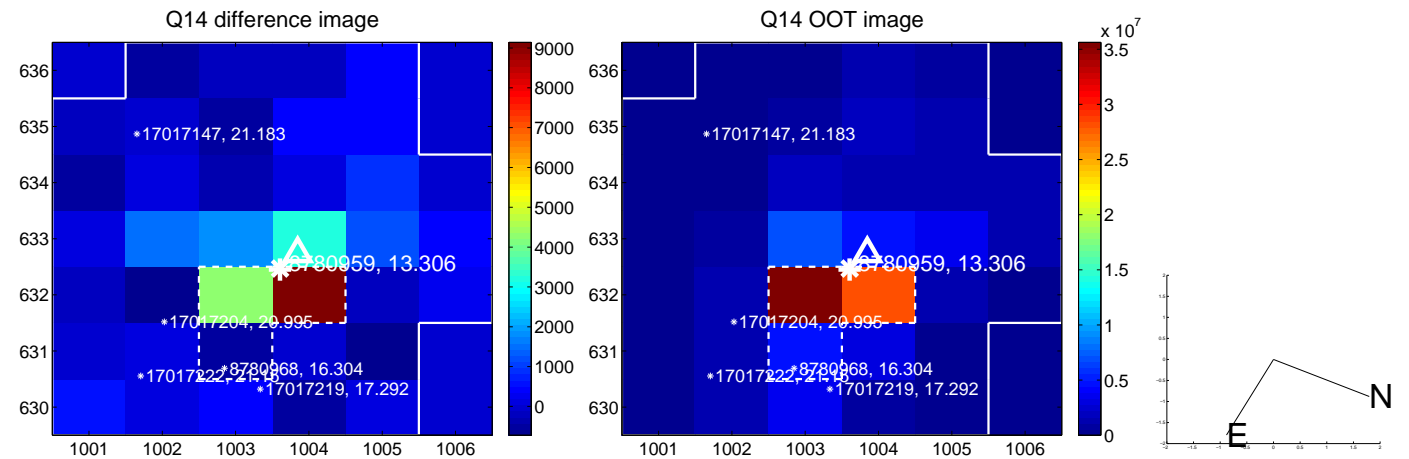
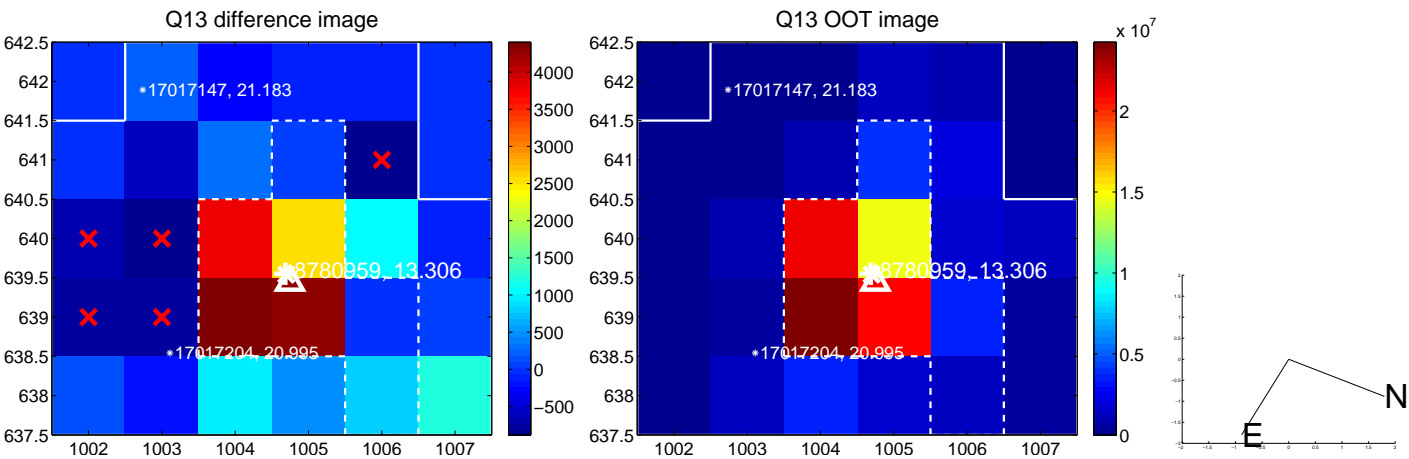


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

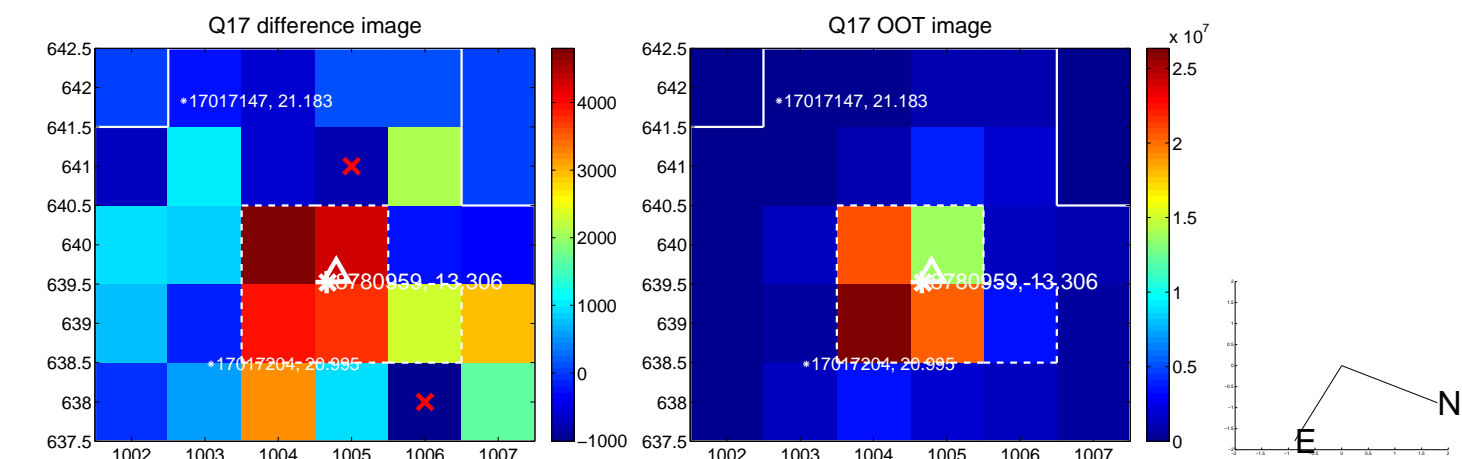




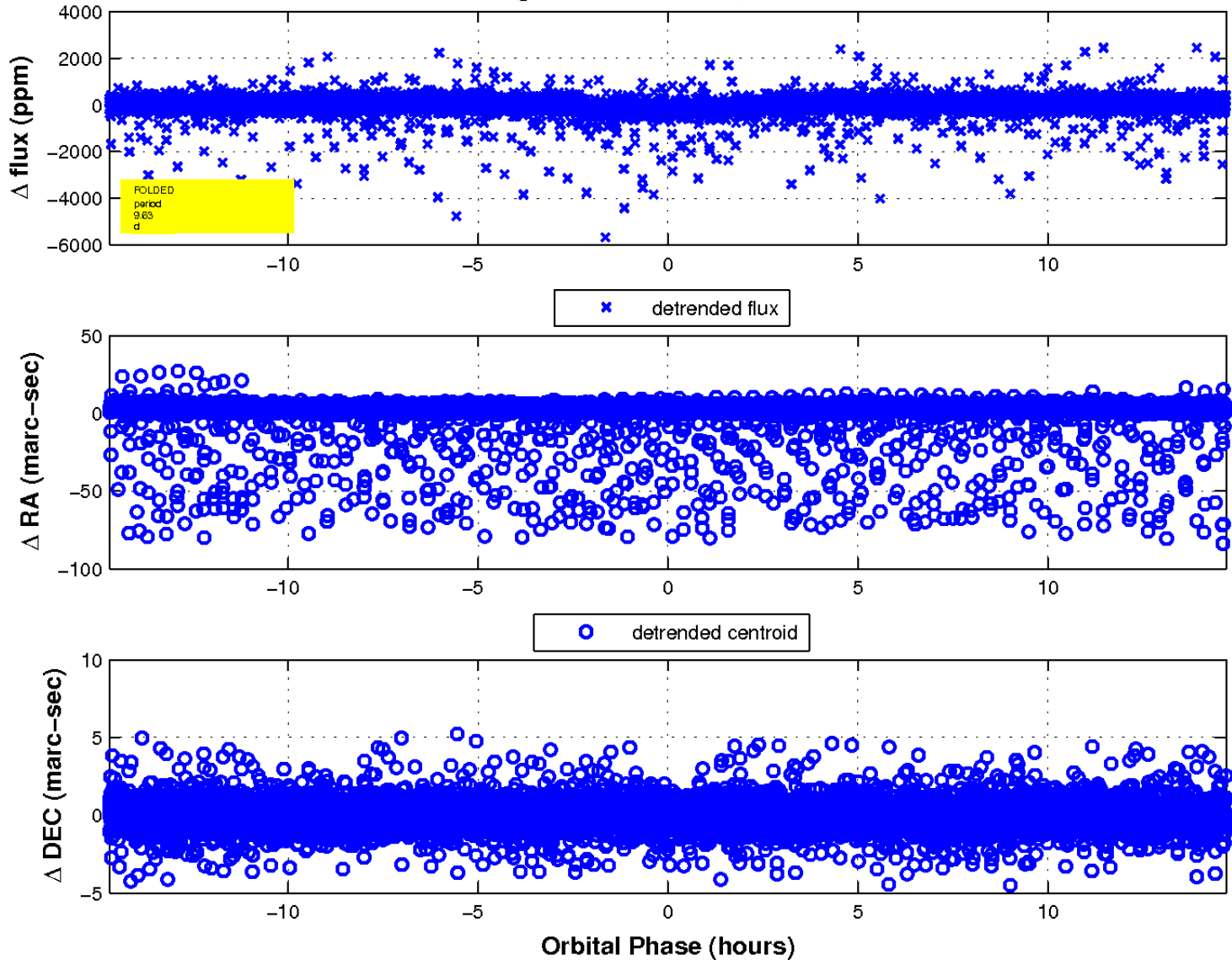
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

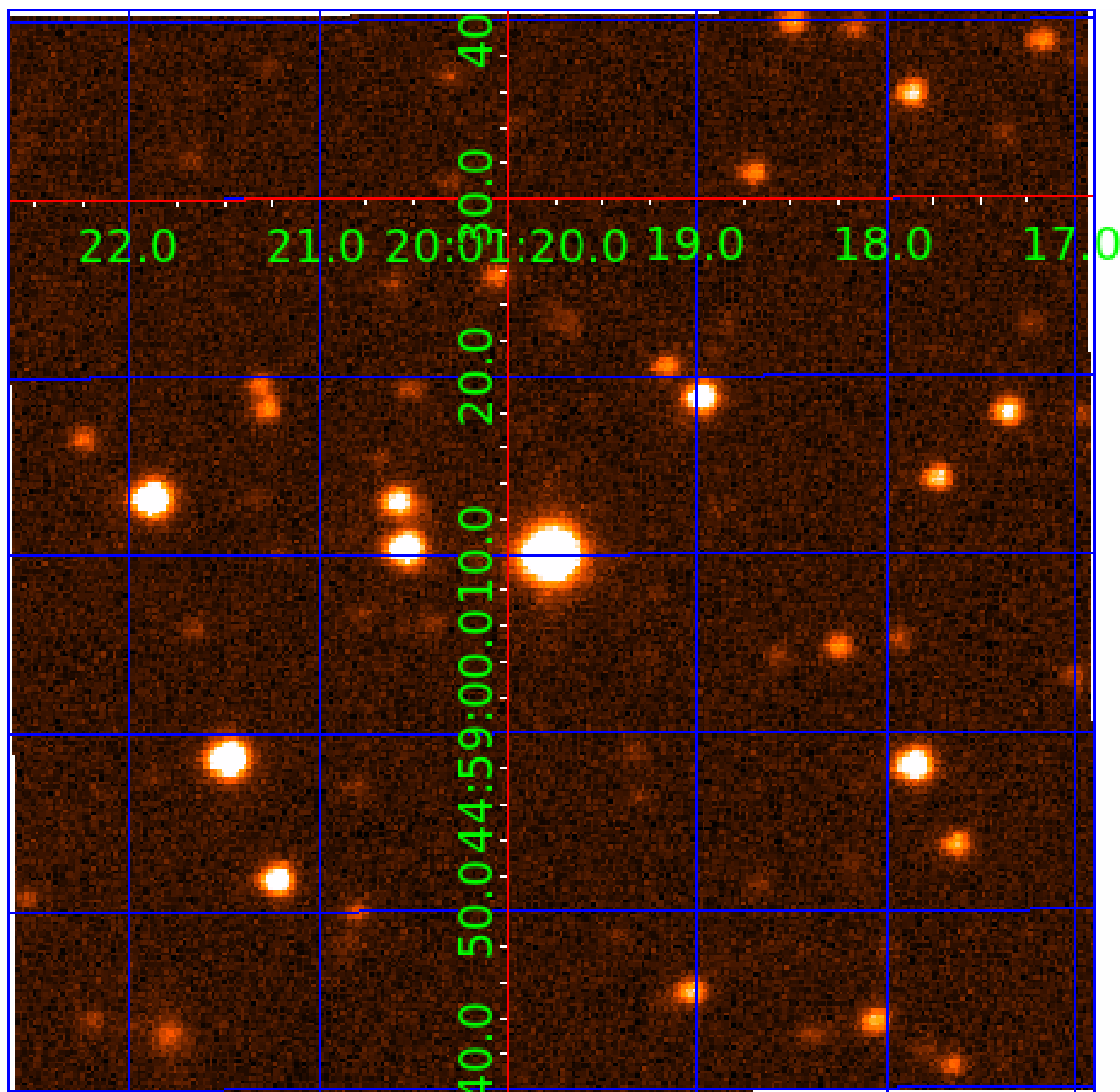


fluxWeightedCentroids, Planet 3 of 4



UKIRT Image

Declination



# KIC 008780959

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
008780959-01	OBS	3741.01	2.617293	132.389262	2750.7	8.680	602.2	298.0	1.34	6432	12.88	1927.33
008780959-02	OBS	3741.03	5.111751	133.759845	234.1	2.861	27.4	31.3	1.34	6432	2.36	789.47
008780959-03	OBS	3741.04	9.630929	132.736970	228.6	4.901	19.7	23.3	1.34	6432	2.38	339.26
008780959-04	OBS	3741.02	18.578474	141.829942	240.4	3.500	9.4	-1.0	1.34	6432	2.10	141.28

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
008780959-01	OBS	FP	0.00	0	1	1	1	MOD_ODDEVEN_DV—MOD_ODDEVEN_ALT—DEEP_V_SHAPED—SEASONAL_DEPTH_DV—SEASONAL_DEPTH_ALT—CENT_RESOLVED_OFFSET—HALO_GHOST—EPHEM_MATCH
008780959-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT
008780959-03	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED
008780959-04	OBS	FP	0.00	1	0	0	0	TRANS_GAPPED—LPP_ALT—MOD_NONUNIQ_ALT—CENT_NOFITS

**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 008780959-04

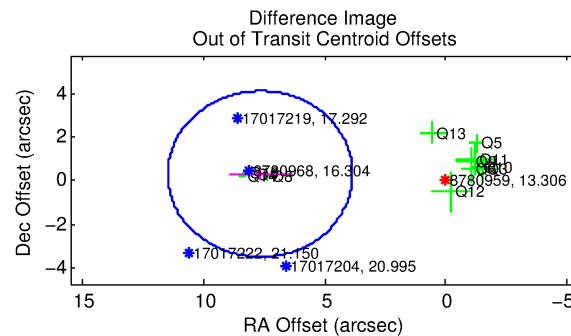
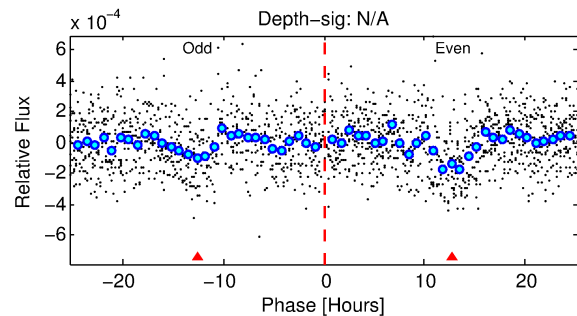
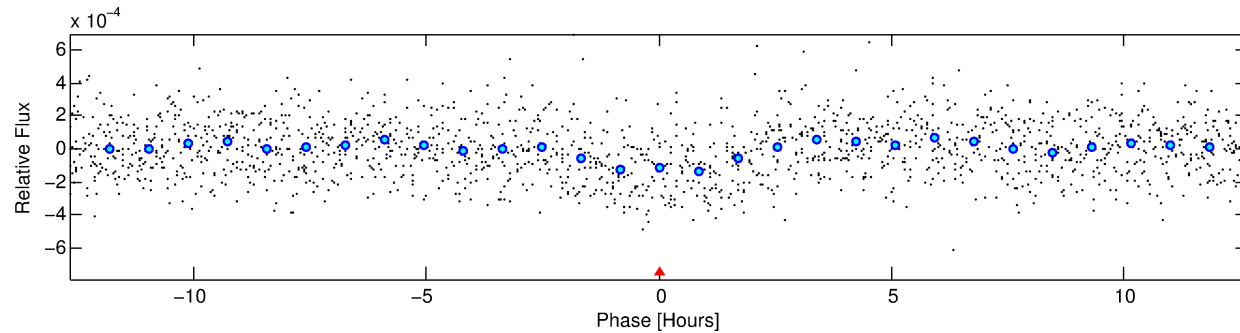
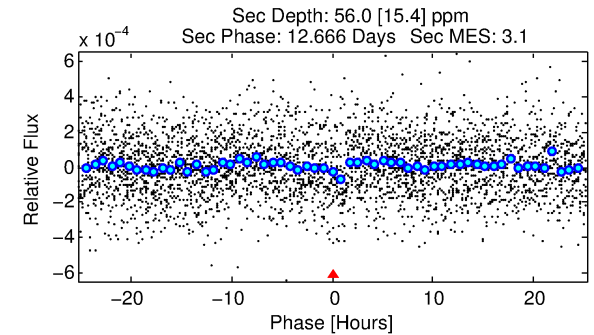
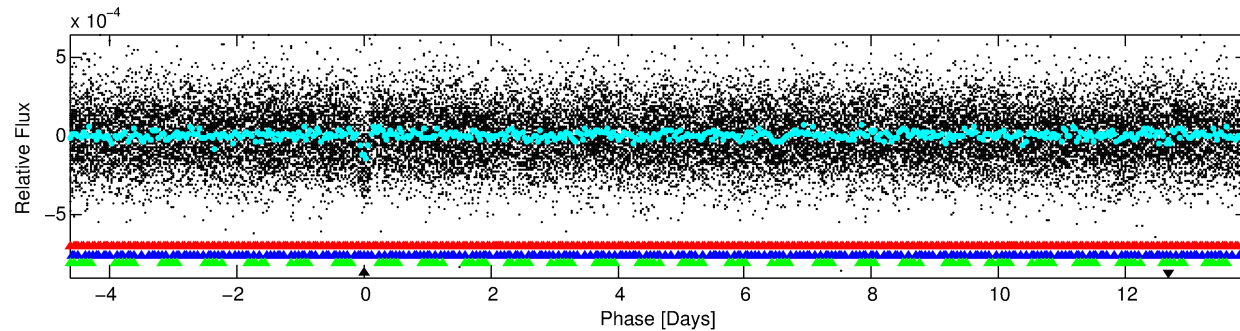
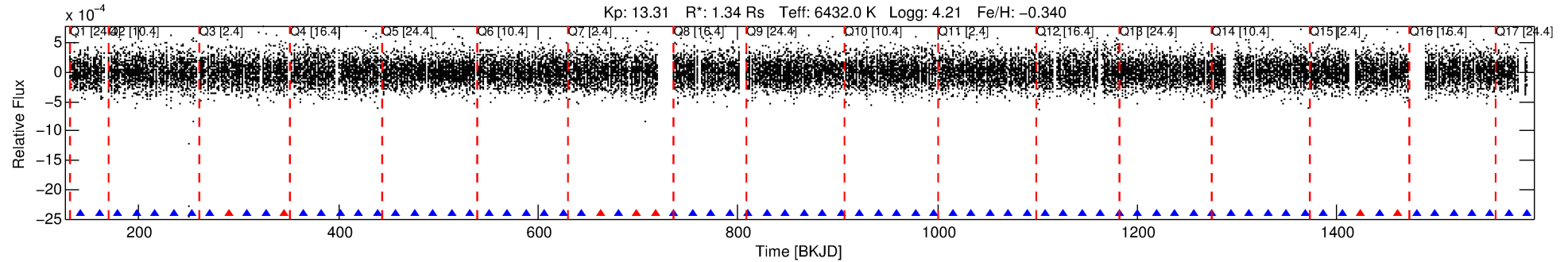
No Significant Match Found

# DV One-Page Summary

KIC: 8780959 Candidate: 4 of 4 Period: 18.578 d

KOI: K03741 Corr: No Ephemeris Match

Kp: 13.31 R\*: 1.34 Rs Teff: 6432.0 K Logg: 4.21 Fe/H: -0.340



## TPS TCE Results:

Period = 18.57847 d  
Epoch = 141.8299 BKJD

DV fit results are unavailable

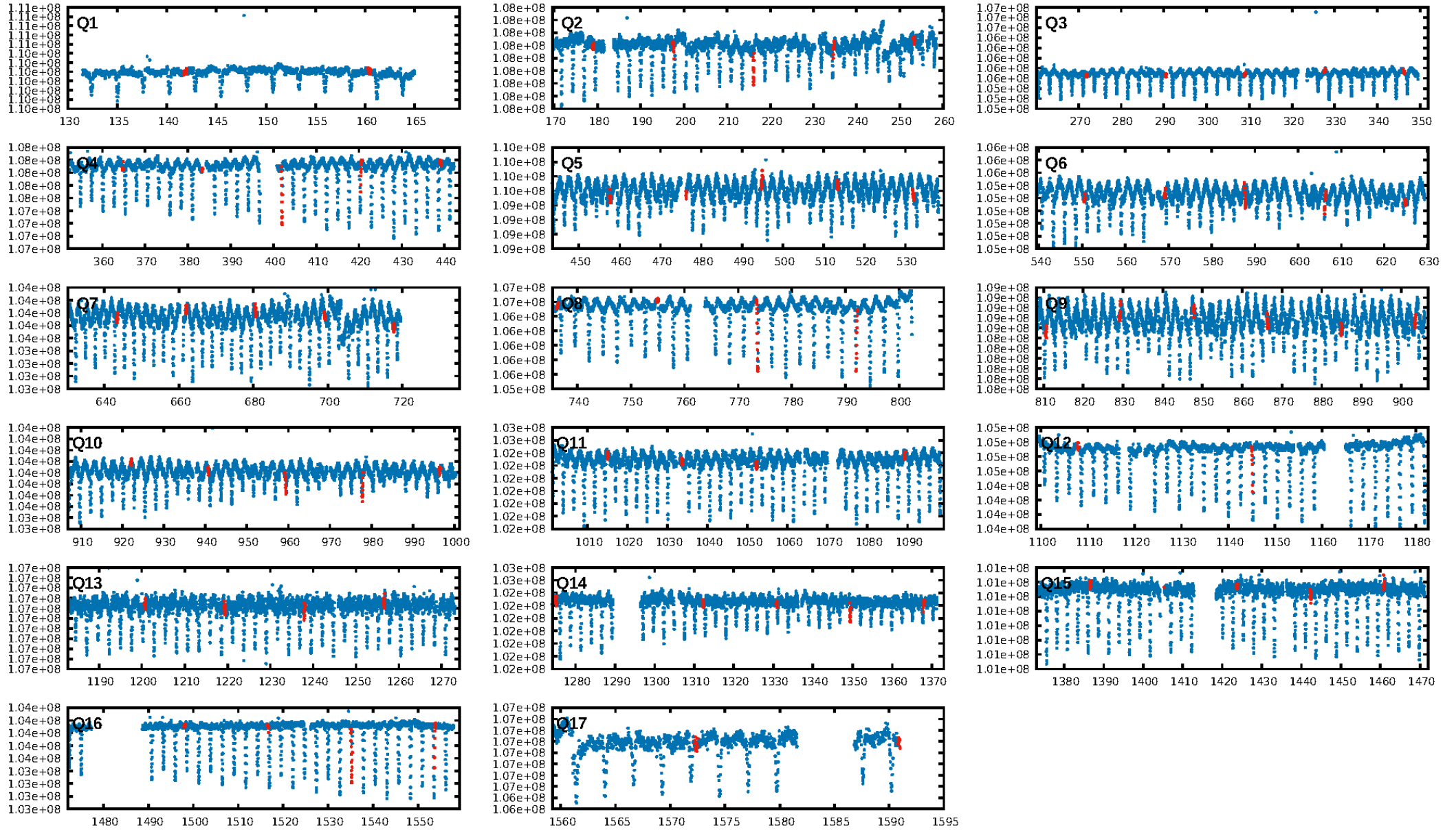
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [35.65σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: N/A  
RollingBand-fgt: 0.82 [31/38]  
GhostDiagnostic-chr: 85.98  
Centroid-sig: N/A  
Centroid-so: 3.205 arcsec [1.85σ]  
OotOffset-rm: 7.666 arcsec [6.02σ]  
KicOffset-rm: 7.708 arcsec [6.93σ]  
OotOffset-st: 3/2/4/3 [12]  
KicOffset-st: 3/2/4/3 [12]  
DiffImageQuality-fgm: 0.83 [10/12]  
DiffImageOverlap-fno: 0.59 [10/17]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 06:35:46 Z

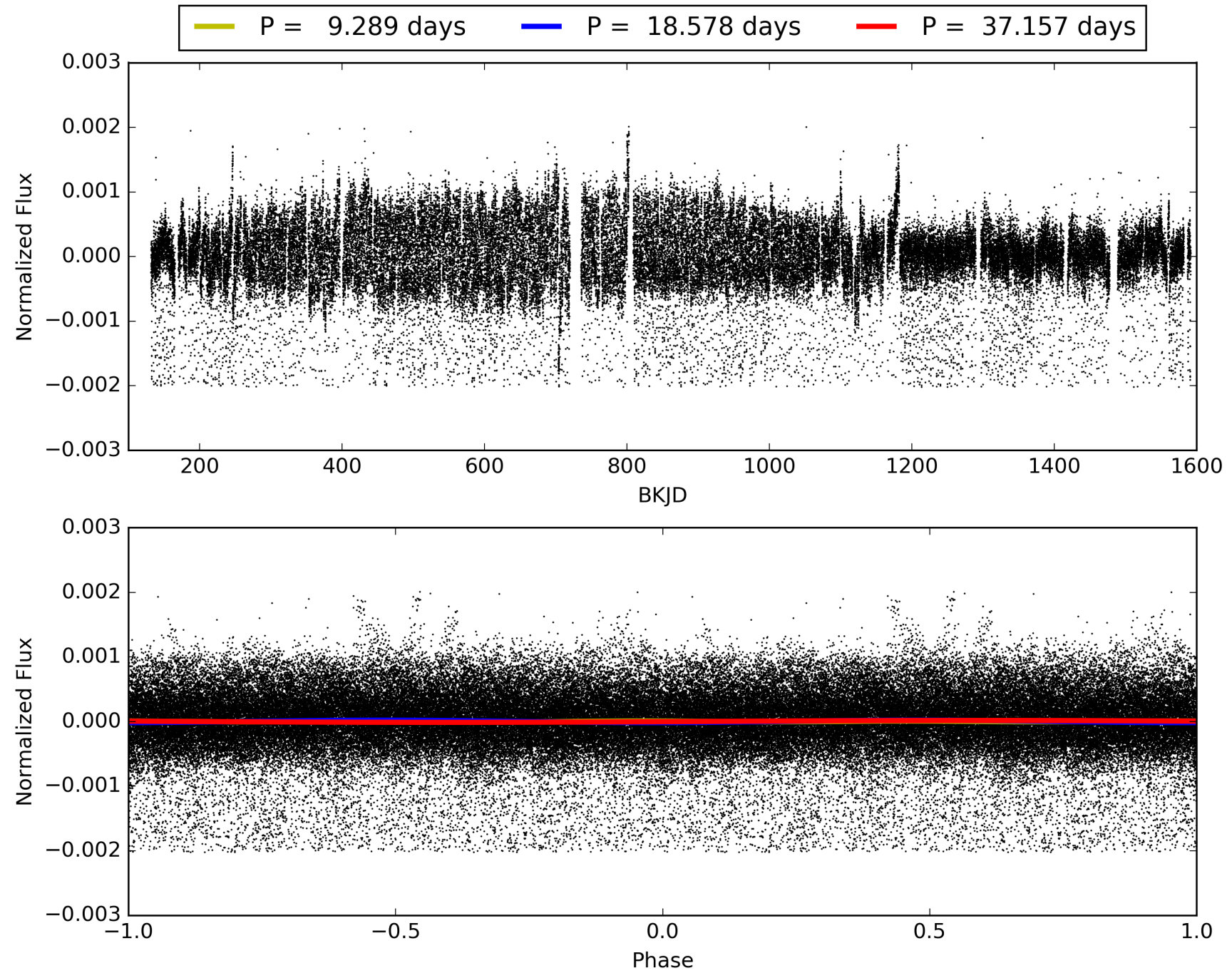
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 008780959-04, PDC Light Curves



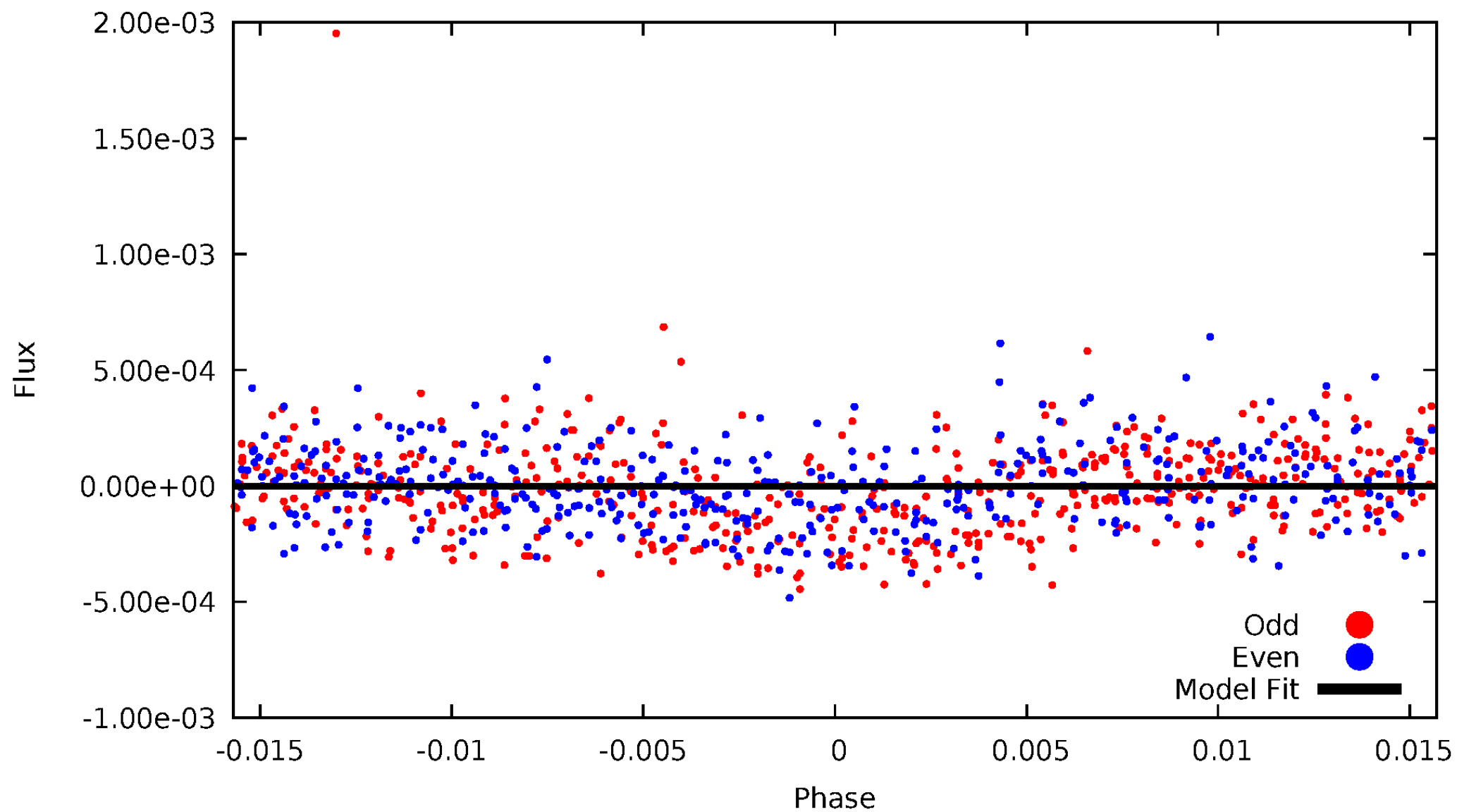


TCE 008780959-04



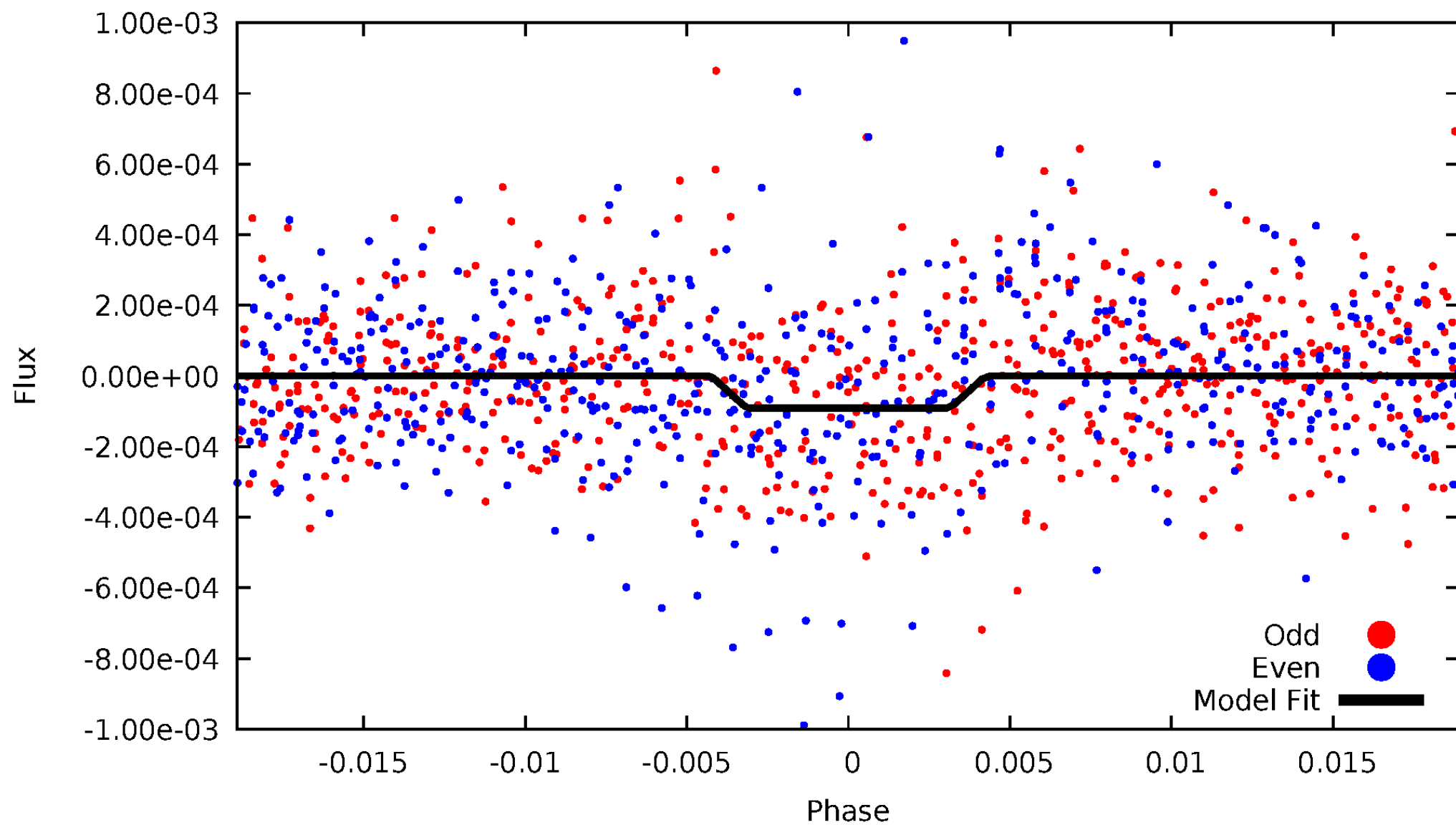
DV Odd/Even

TCE 008780959-04



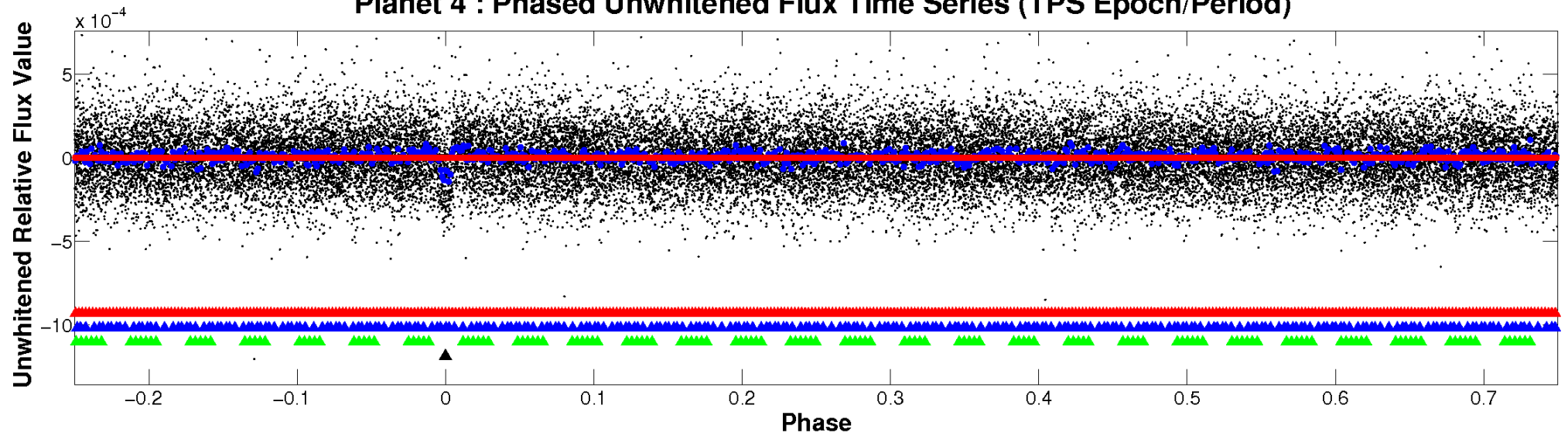
# ALT Odd/Even

TCE 008780959-04

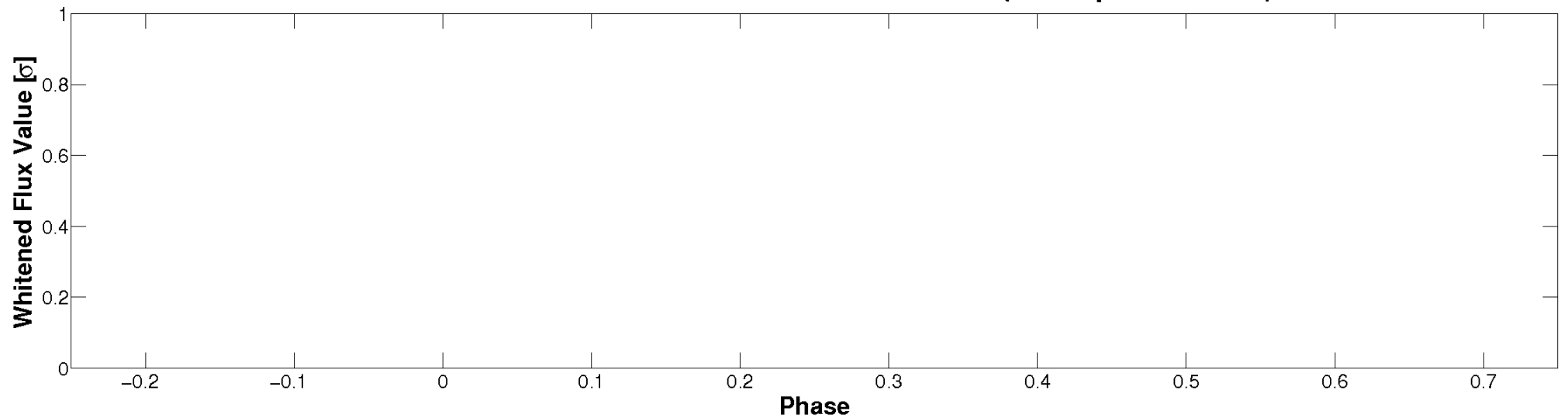


# Non-Whitened Vs. Whitened Light Curve

**Planet 4 : Phased Unwhitened Flux Time Series (TPS Epoch/Period)**

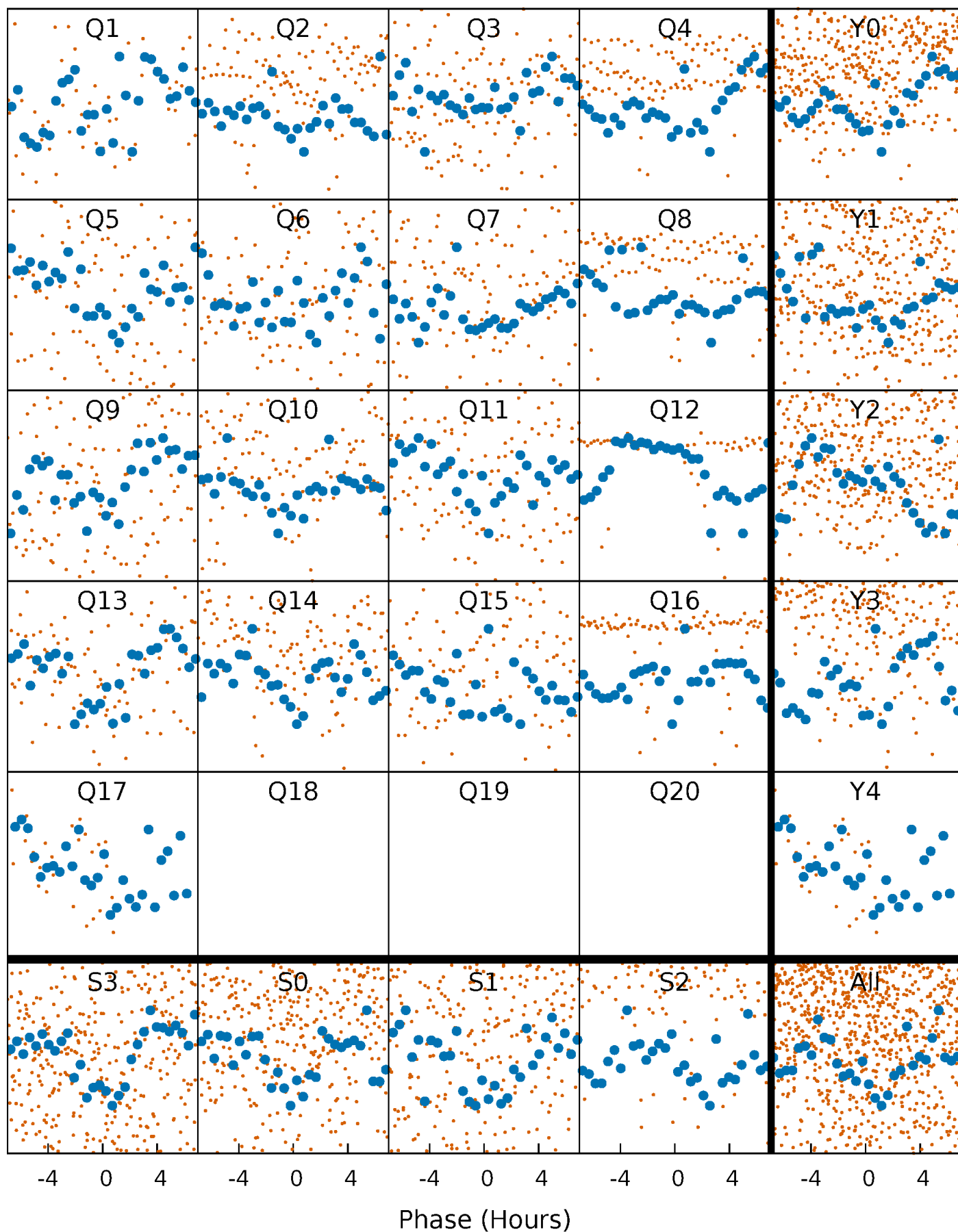


**Planet 4 : Phased Whitened Flux Time Series (TPS Epoch/Period)**



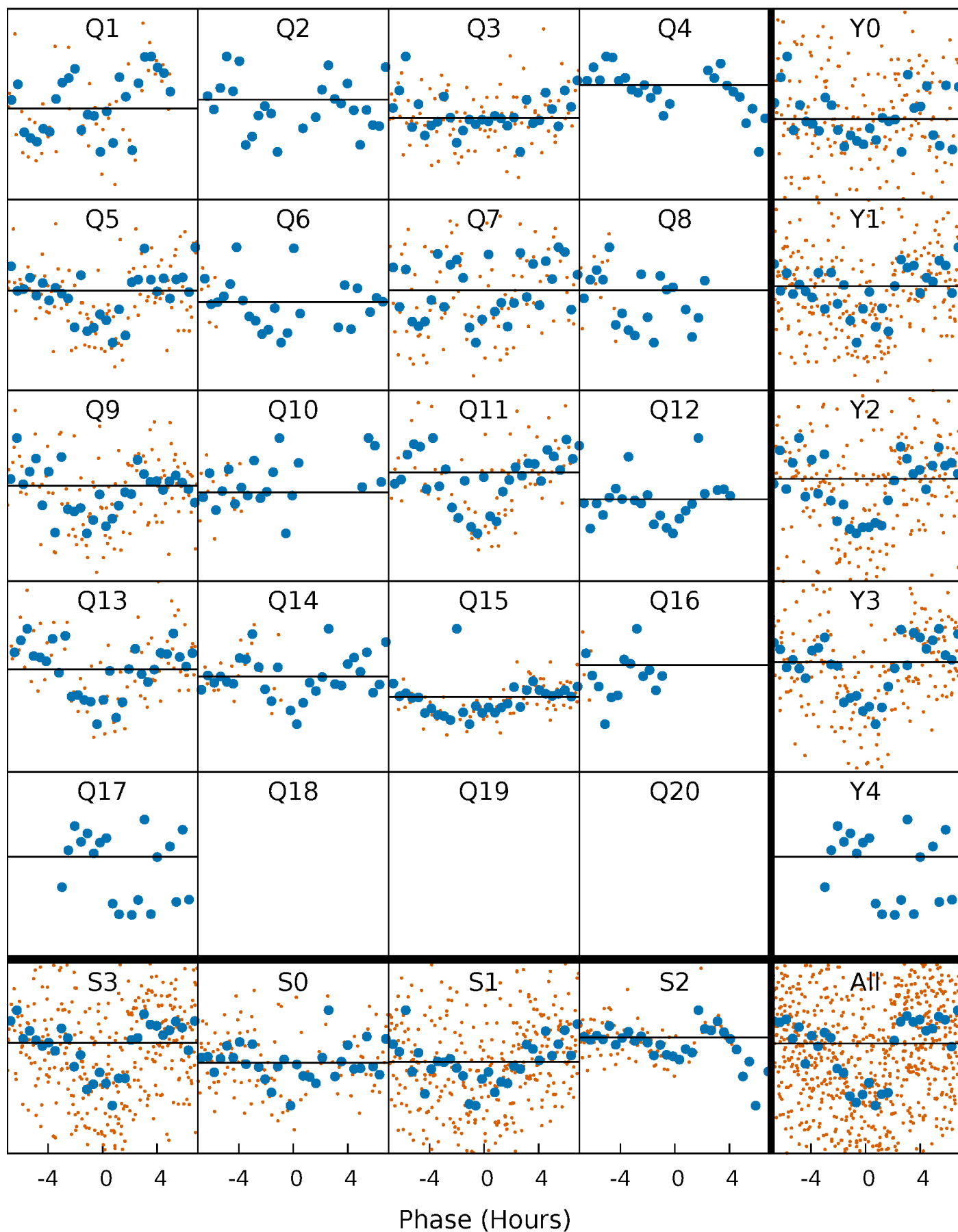
# PDC Quarter-Phased Transit Curves

TCE 008780959-04   P= 18.578474 Days    $T_0=141.829942$  (BKJD)



# DV Quarter-Phased Transit Curves

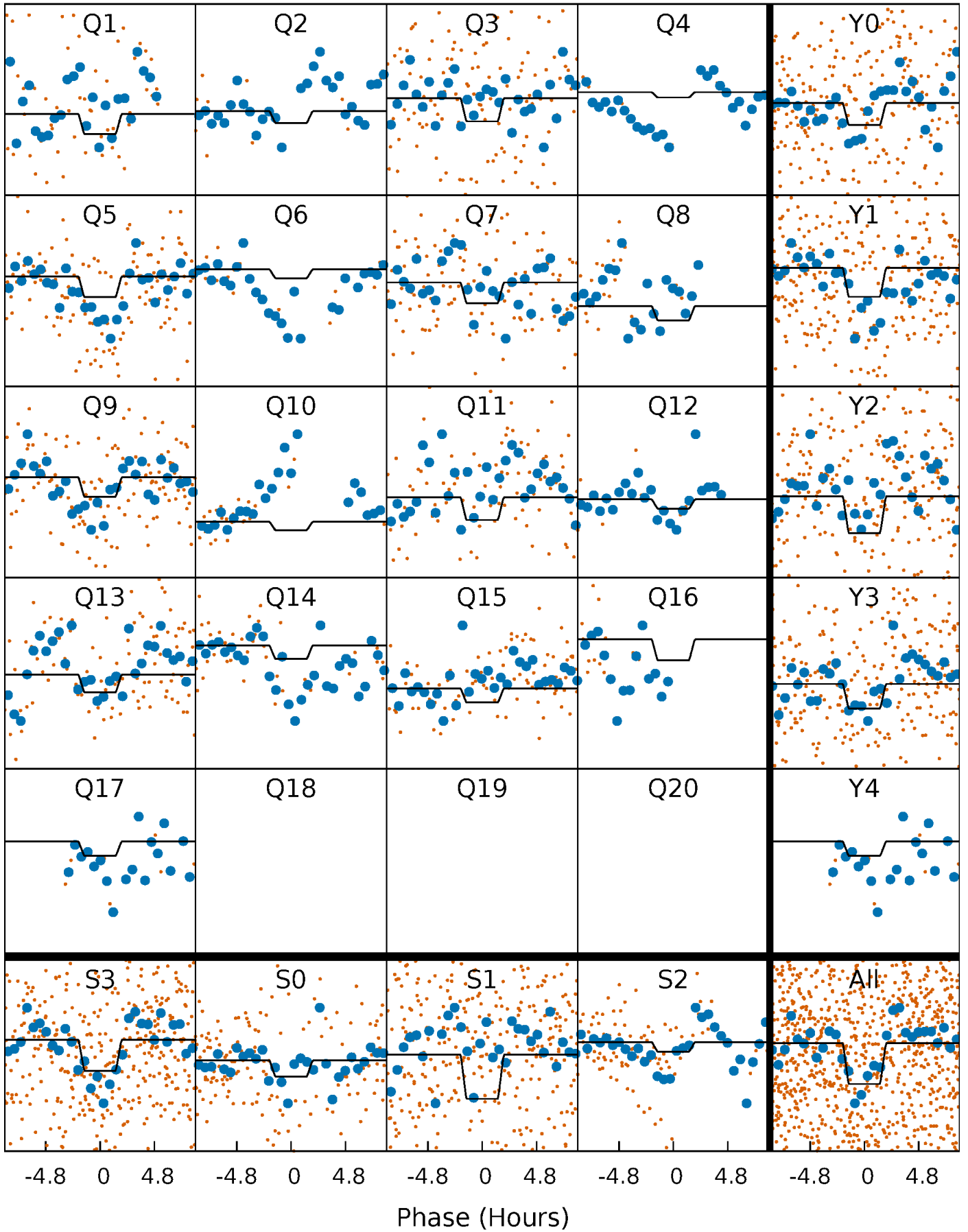
TCE 008780959-04   P= 18.578474 Days    $T_0=141.829942$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

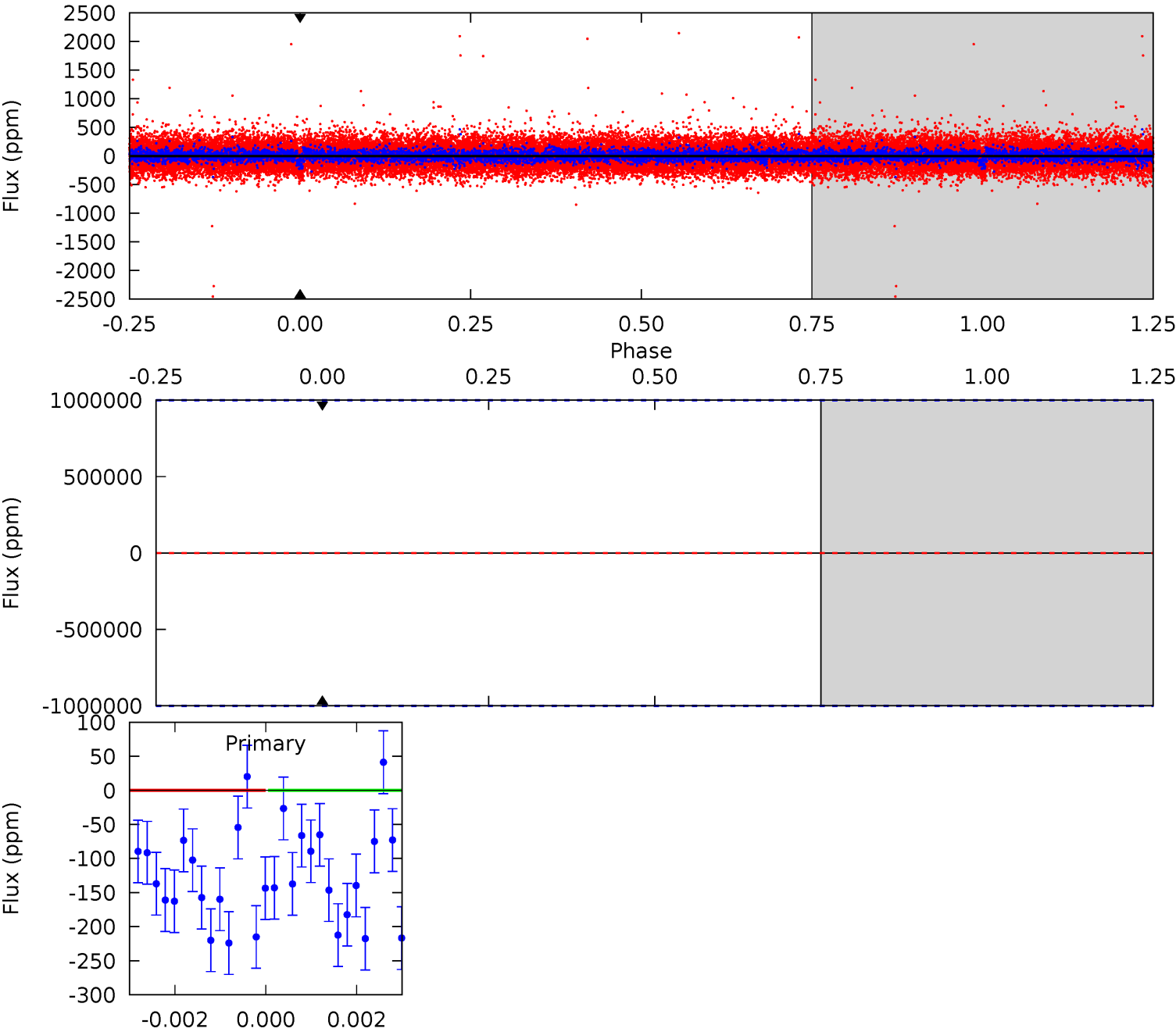
TCE 008780959-04 P= 18.578474 Days  $T_0=141.822897$  (BKJD)



DV Model-Shift Uniqueness Test

008780959-04, P = 18.578474 Days, E = 123.251468 Days

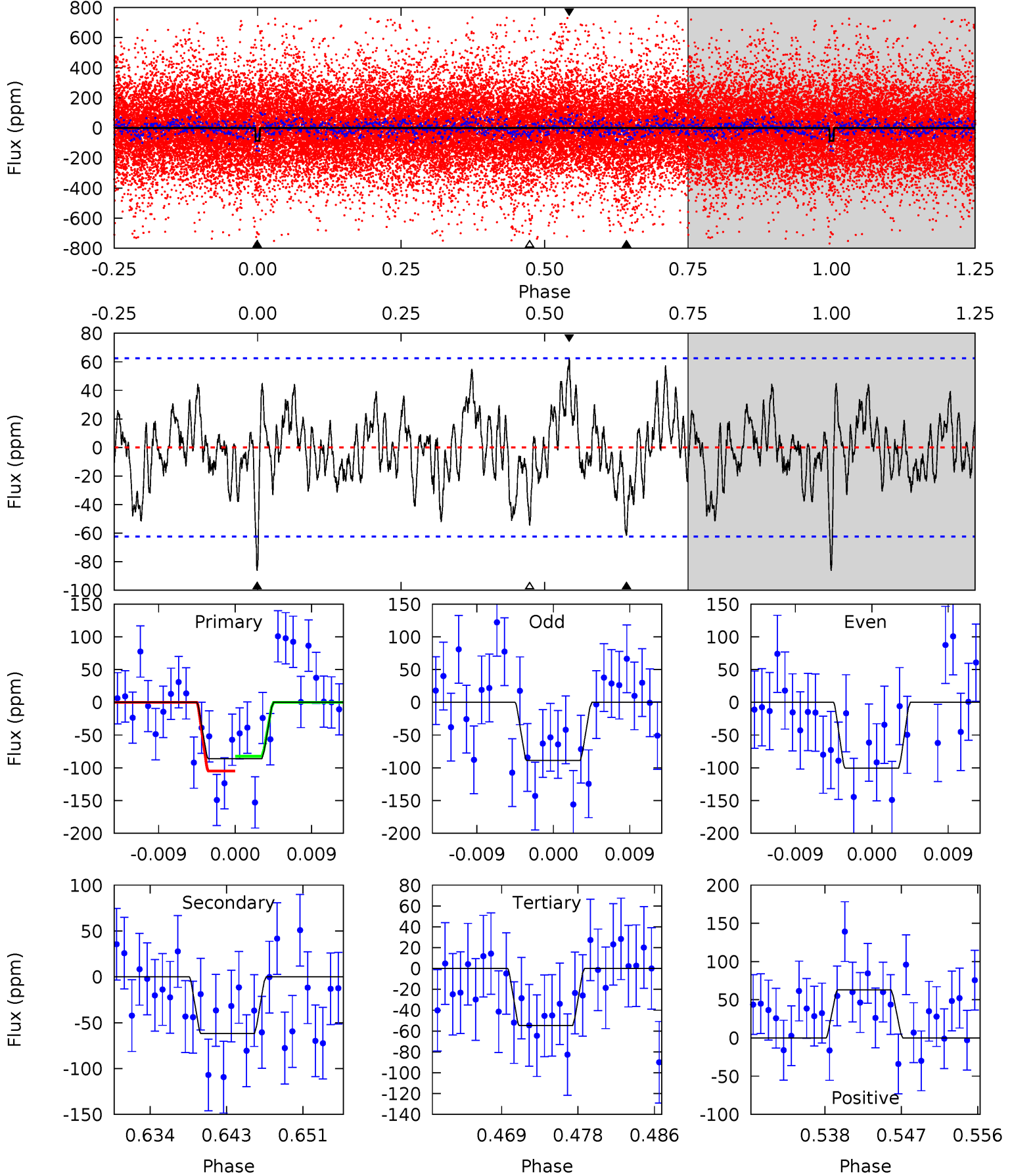
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
0	0	0	0	1.00	1.00	1.00	0	0	0	0	0	0	0	0



# Alt Model-Shift Uniqueness Test

008780959-04, P = 18.578474 Days, E = 123.244423 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
6.98	5.00	4.42	5.09	5.05	2.62	1.69	2.55	1.89	0.57	-0.09	0.47	1.26	0.42	0.91



### Stellar Parameters For KIC 008780959

	$T_{\text{eff}} (K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R (R_{\odot})$	$M (M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6432^{+155}_{-214}$	$4.207^{+0.190}_{-0.171}$	$-0.340^{+0.250}_{-0.300}$	$1.345^{+0.382}_{-0.313}$	$1.060^{+0.177}_{-0.133}$	$0.614^{+0.604}_{-0.306}$
	+2%/-3%	+5%/-4%	+74%/-88%	+28%/-23%	+17%/-13%	+99%/-50%
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 008780959-04 / KOI 3741.02

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$0 \pm 1000000$	$11.08^{+11.71}_{-7.87}$	$1226^{+91}_{-85}$	$5137^{+27019}_{-27694}$	$153^{+22634}_{-11863}$
Alt.	$-62 \pm 12$	$10.07^{+10.56}_{-7.16}$	$1222^{+90}_{-90}$	$2852^{+1368}_{-507}$	$6.349^{+71.822}_{-4.767}$

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

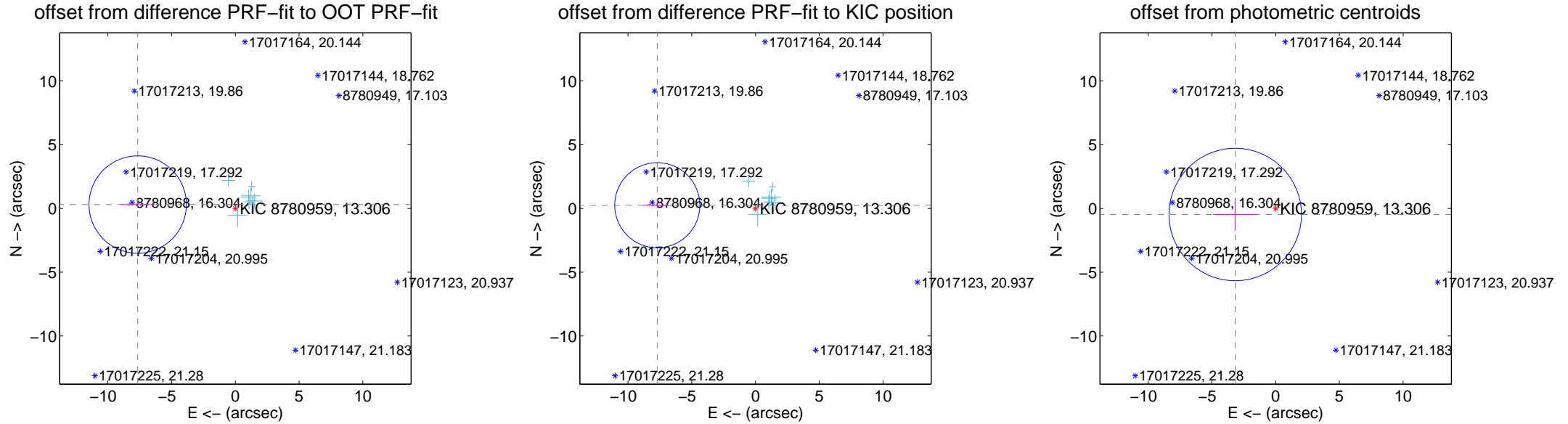
## DV Centroid Data

Supplemental centroid analysis for 008780959-04. Kepler magnitude: 13.31. Transit SNR -1.00

There are 10 quarters with good PRF difference image offsets

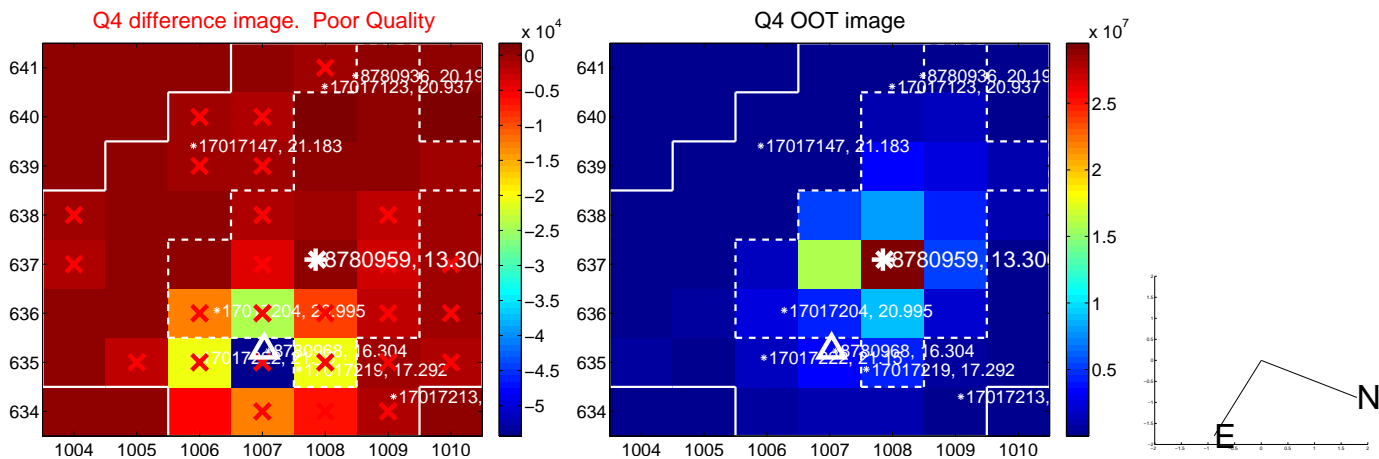
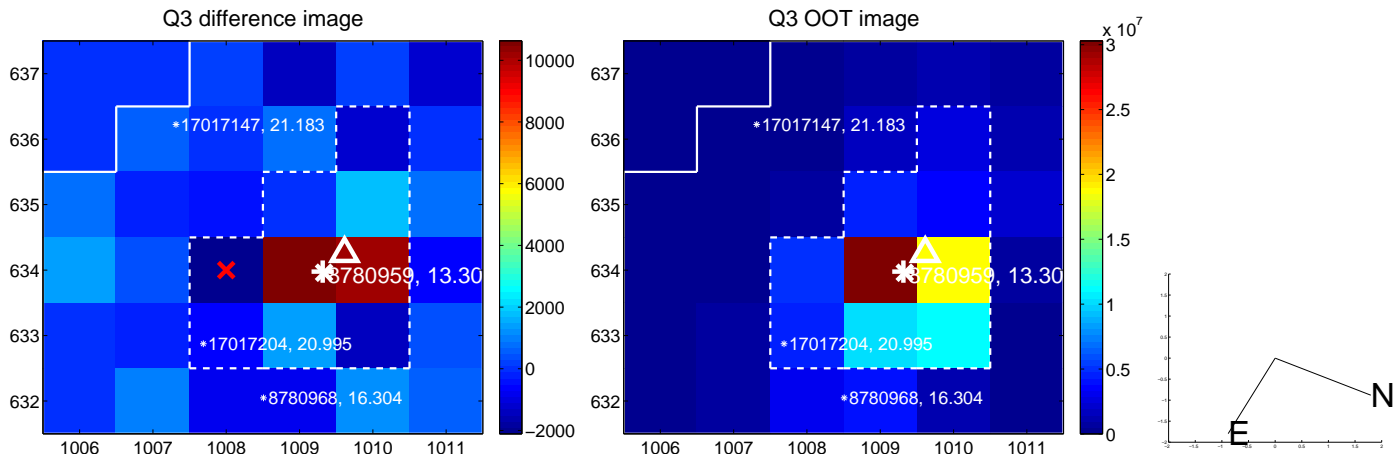
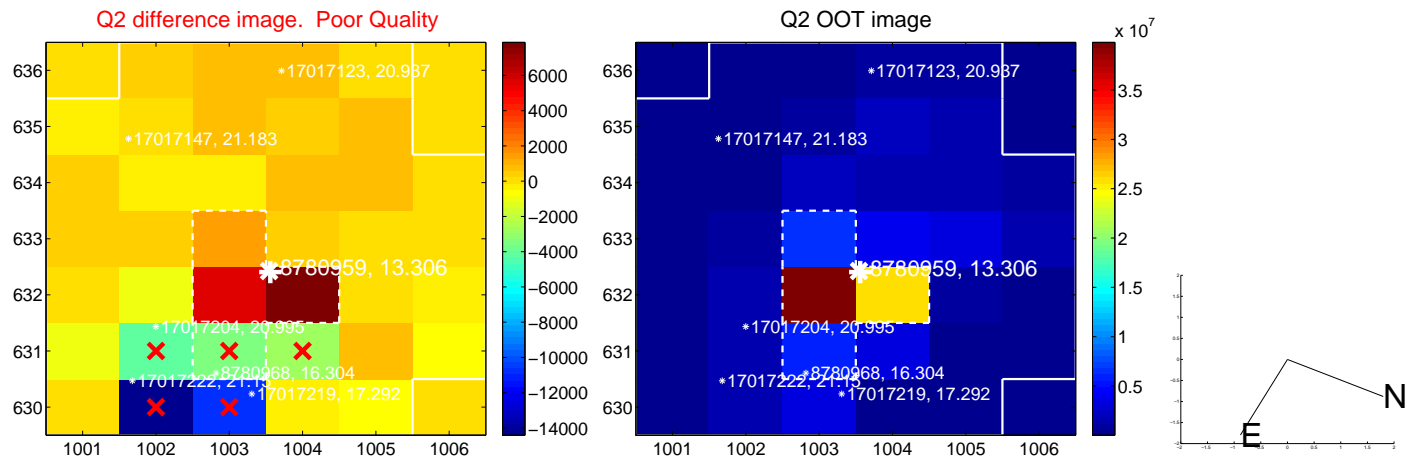
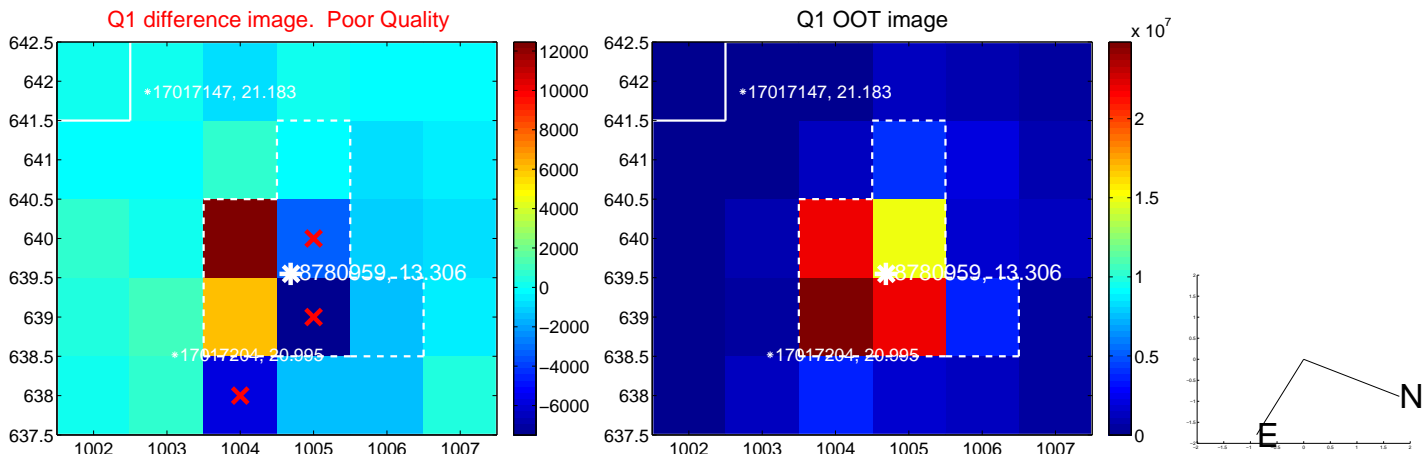
The direct PRF centroid is offset from the target star catalog position by about 0.07 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	<b>7.666 <math>\pm</math> 1.273</b>	<b>6.02</b>	7.660 $\pm$ 1.277	0.304 $\pm$ 0.200
PRF-fit source offset from KIC position	<b>7.708 <math>\pm</math> 1.113</b>	<b>6.93</b>	7.704 $\pm$ 1.116	0.252 $\pm$ 0.217
photometric centroid source offset	3.21 $\pm$ 1.73	1.85	3.17 $\pm$ 1.74	-0.48 $\pm$ 1.28



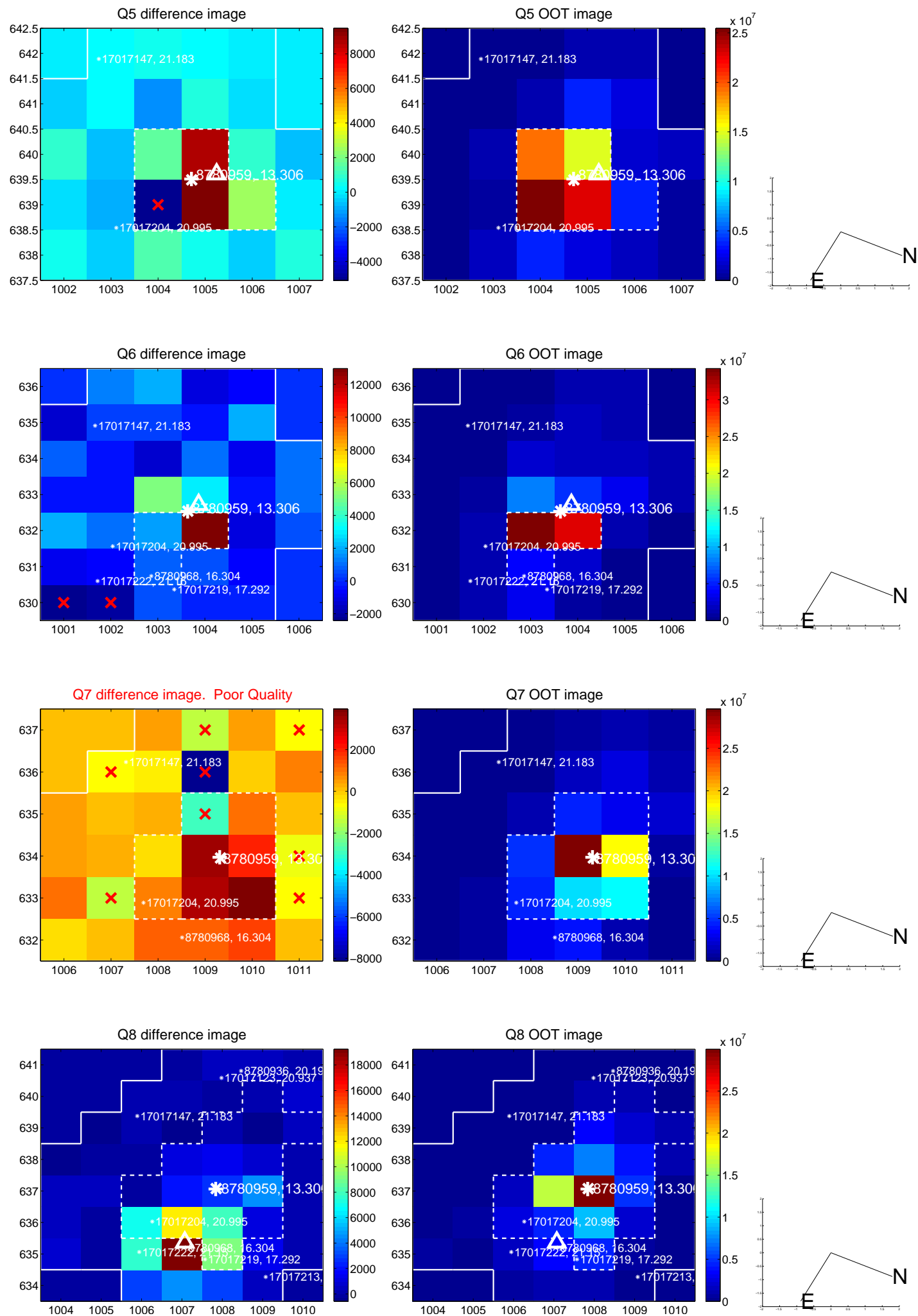
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

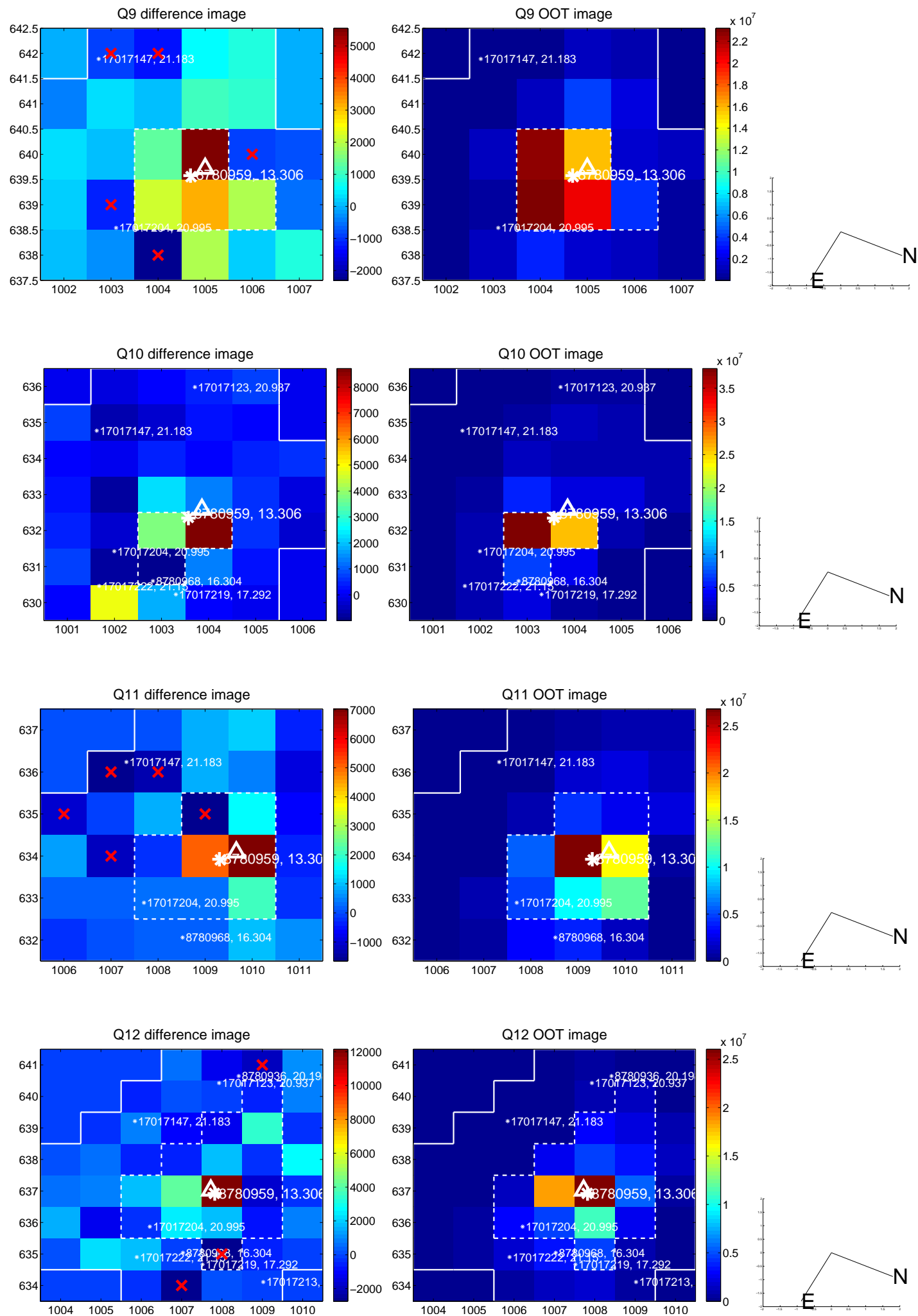




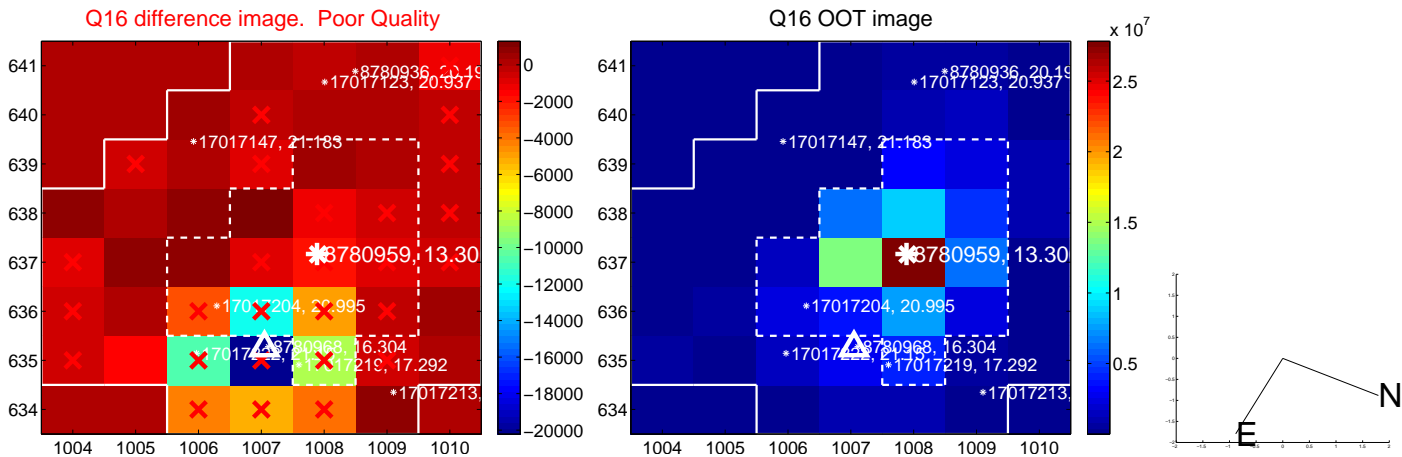
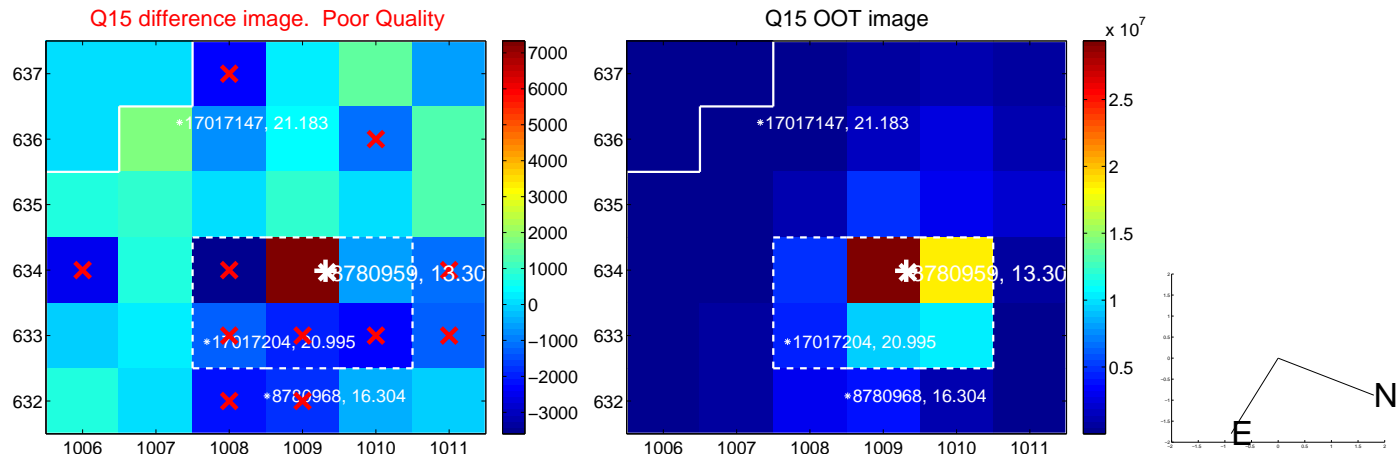
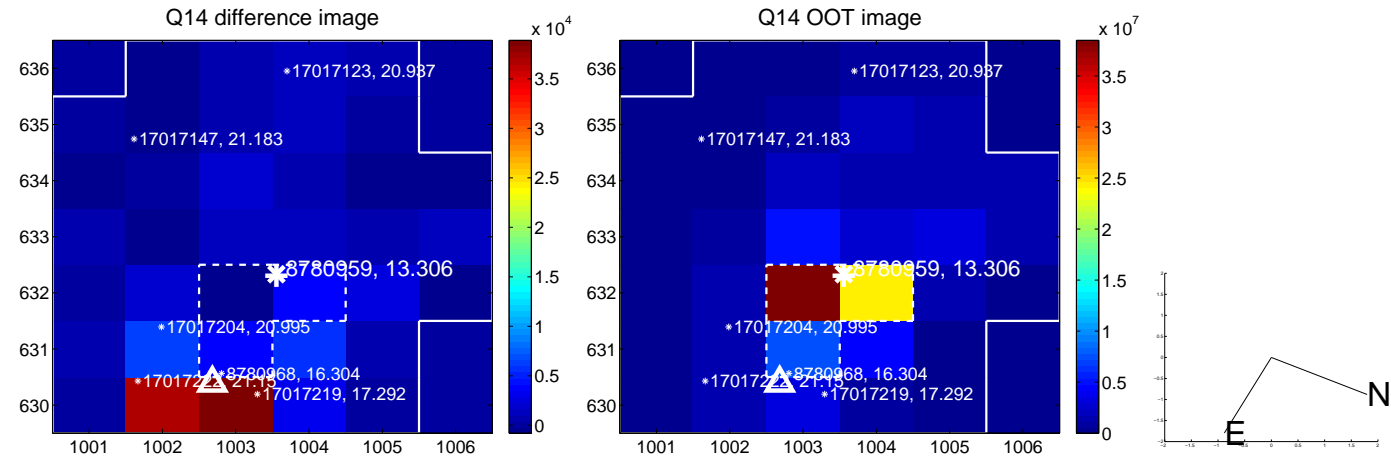
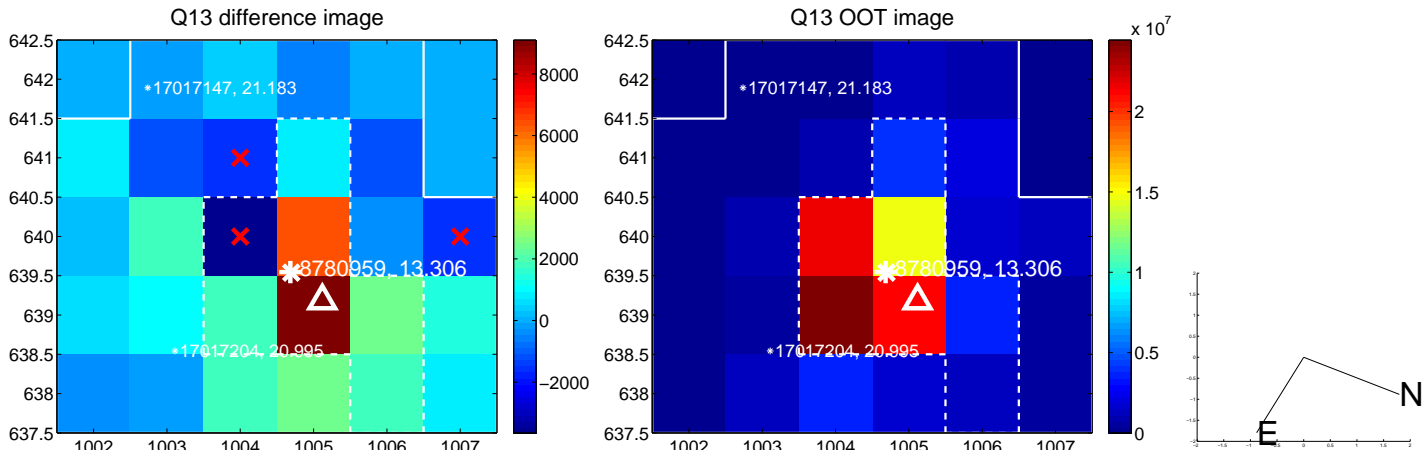
white ×: KIC target position; +: OOT centroid; △: difference centroid. red ×: large negative pixel value.



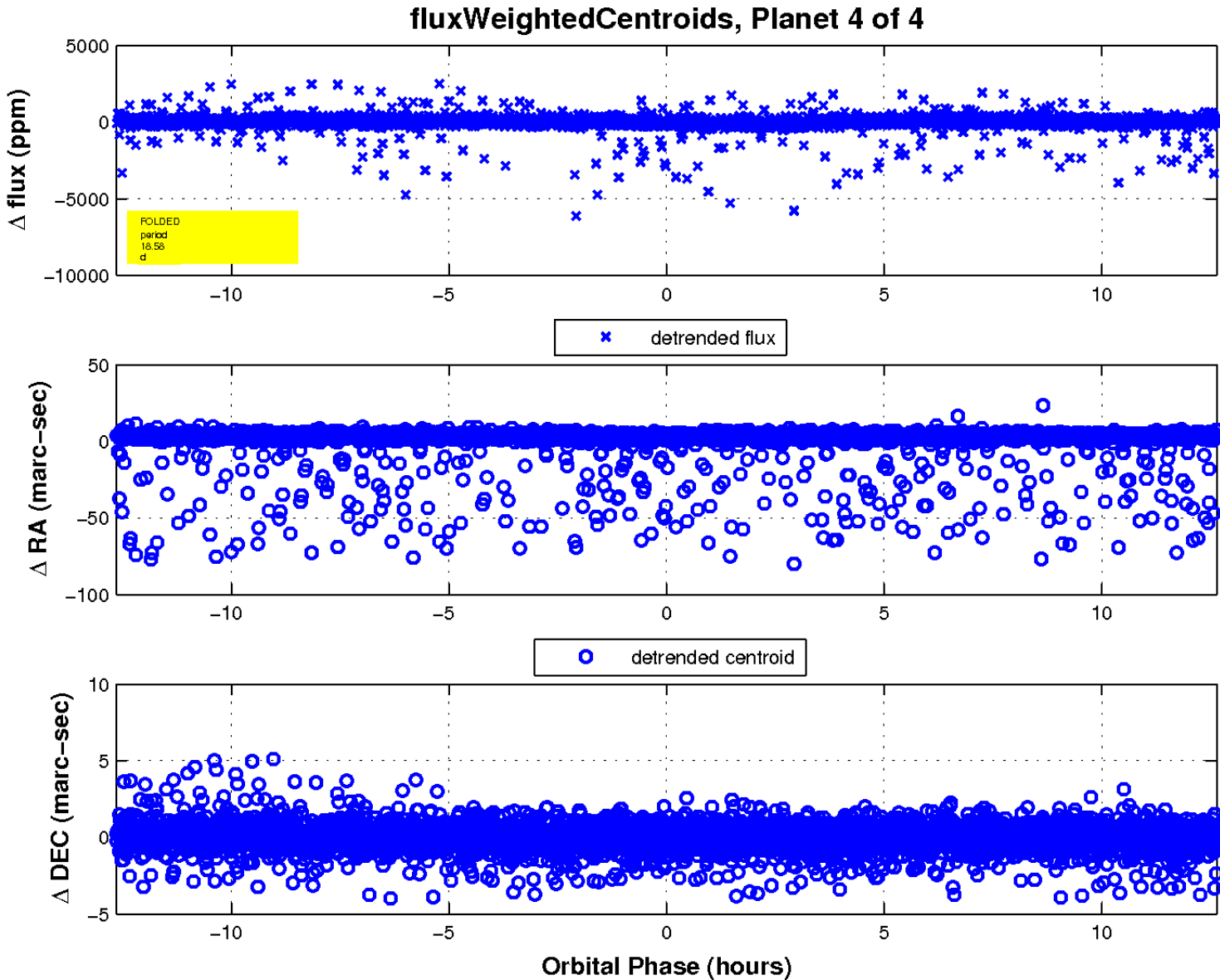
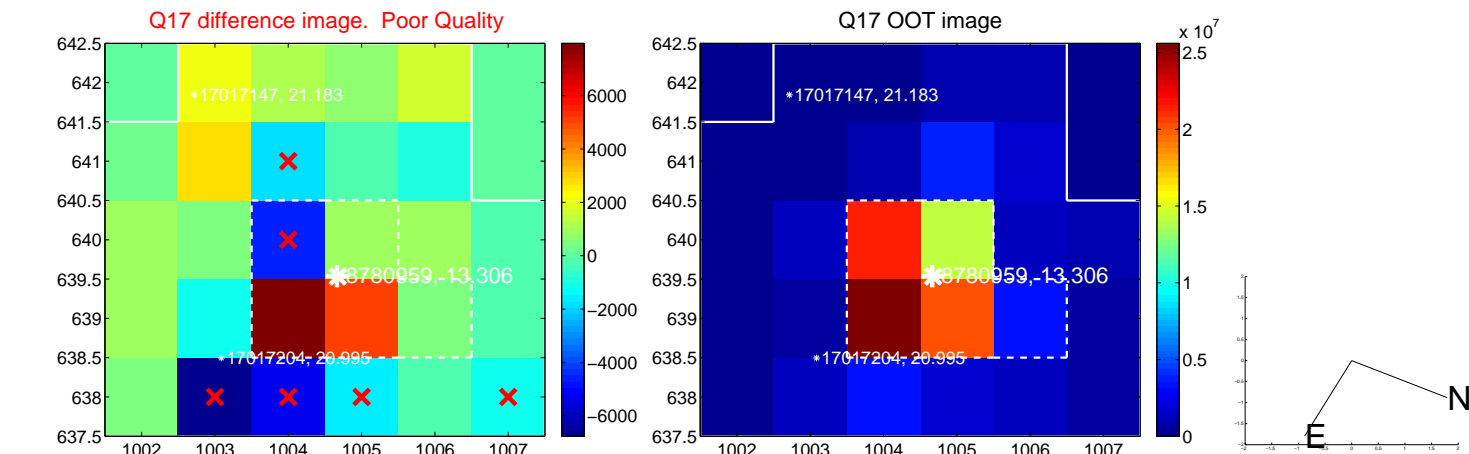
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

