

# KIC 004059887

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004059887-01	OBS	4887.01	1.018308	131.714557	17.5	4.446	10.9	10.6	2.64	5858	1.17	15237.11
004059887-02	OBS	No	465.337016	424.507923	242.9	9.852	11.9	9.8	2.64	5858	4.48	4.33

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004059887-01	OBS	FP	0.00	0	0	1	1	CENT_UNRESOLVED_OFFSET—EPHEM_MATCH
004059887-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL—LPP_DV—LPP_ALT—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_FEW_DIFFS

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

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

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

## Ephemeris Match Information For 004059887-01

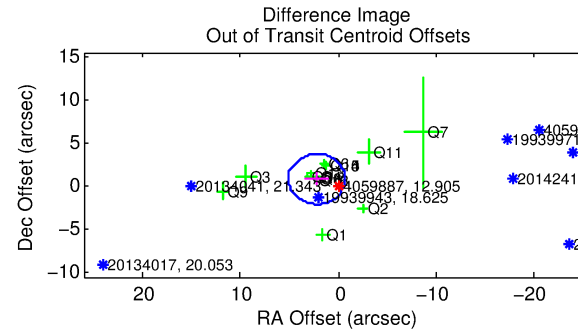
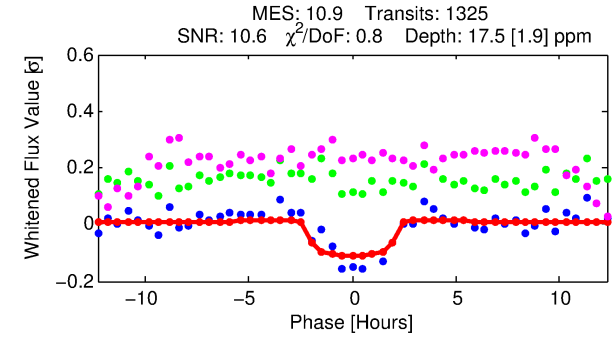
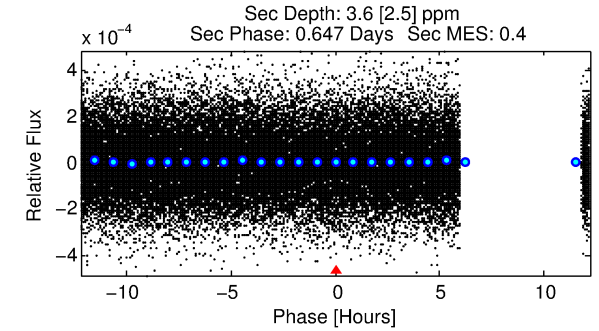
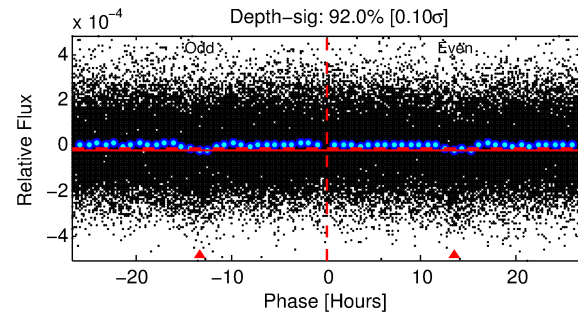
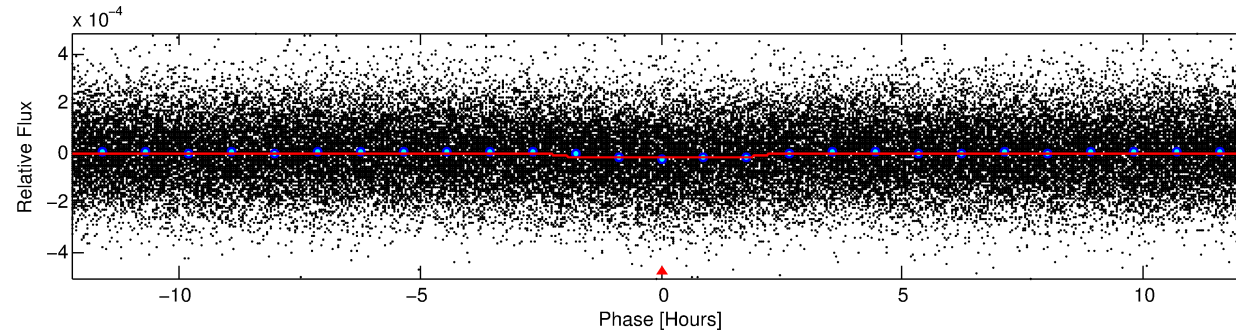
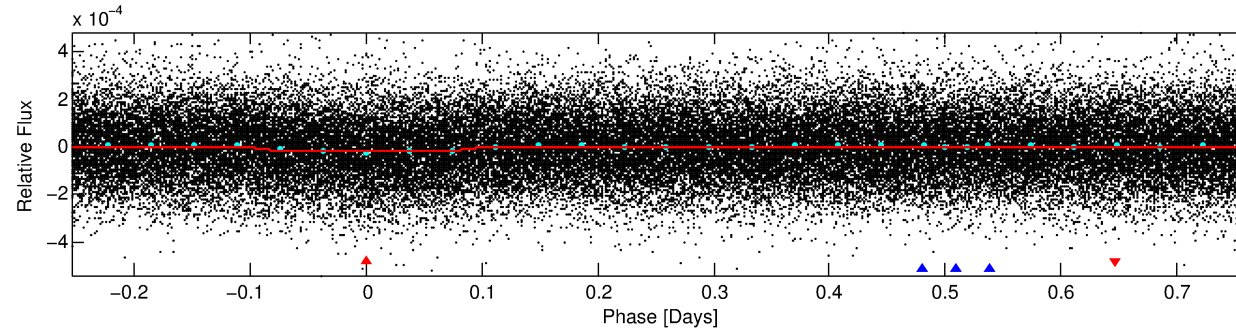
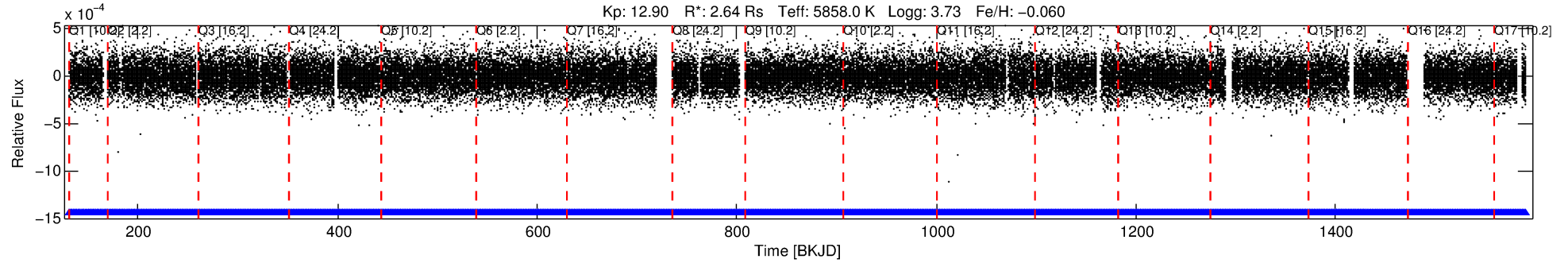
TCE (1)	KIC	Parent (2)	Parent KIC	$P_1:P_2$	Dist ( $''$ )	$\Delta$ Row	$\Delta$ Col	$m_2$	$m_1$	$D_2/D_1$	Mechanism	Flag	$\sigma_P$	$\sigma_T$
004059887-01	4059887	5045.01	4160006	1:1	459.4	115	1	14.30	12.91	23604.00	Col-Anomaly	0	4.57	2.54

**Notes:**  $P_1:P_2$  is the period ratio. Dist is the distance in arcseconds.  $\Delta$ Row and  $\Delta$ 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: 4059887 Candidate: 1 of 2 Period: 1.018 d

KOI: K04887.01 Corr: 0.914



## DV Fit Results:

Period = 1.01831 [0.00001] d  
Epoch = 131.7146 [0.0044] BKJD  
Rp/R\* = 0.0041 [0.0011]  
a/R\* = 1.53 [1.14]  
b = 0.67 [1.06]  
Seff = 15237.11 [6179.92]  
Teff = 2833 [287] K  
Rp = 1.17 [0.49] Re  
a = 0.0220 [0.0059] AU  
Ag = 0.69 [0.68] [-0.45 $\sigma$ ]  
Teffp = 3994 [905] K [1.22 $\sigma$ ]

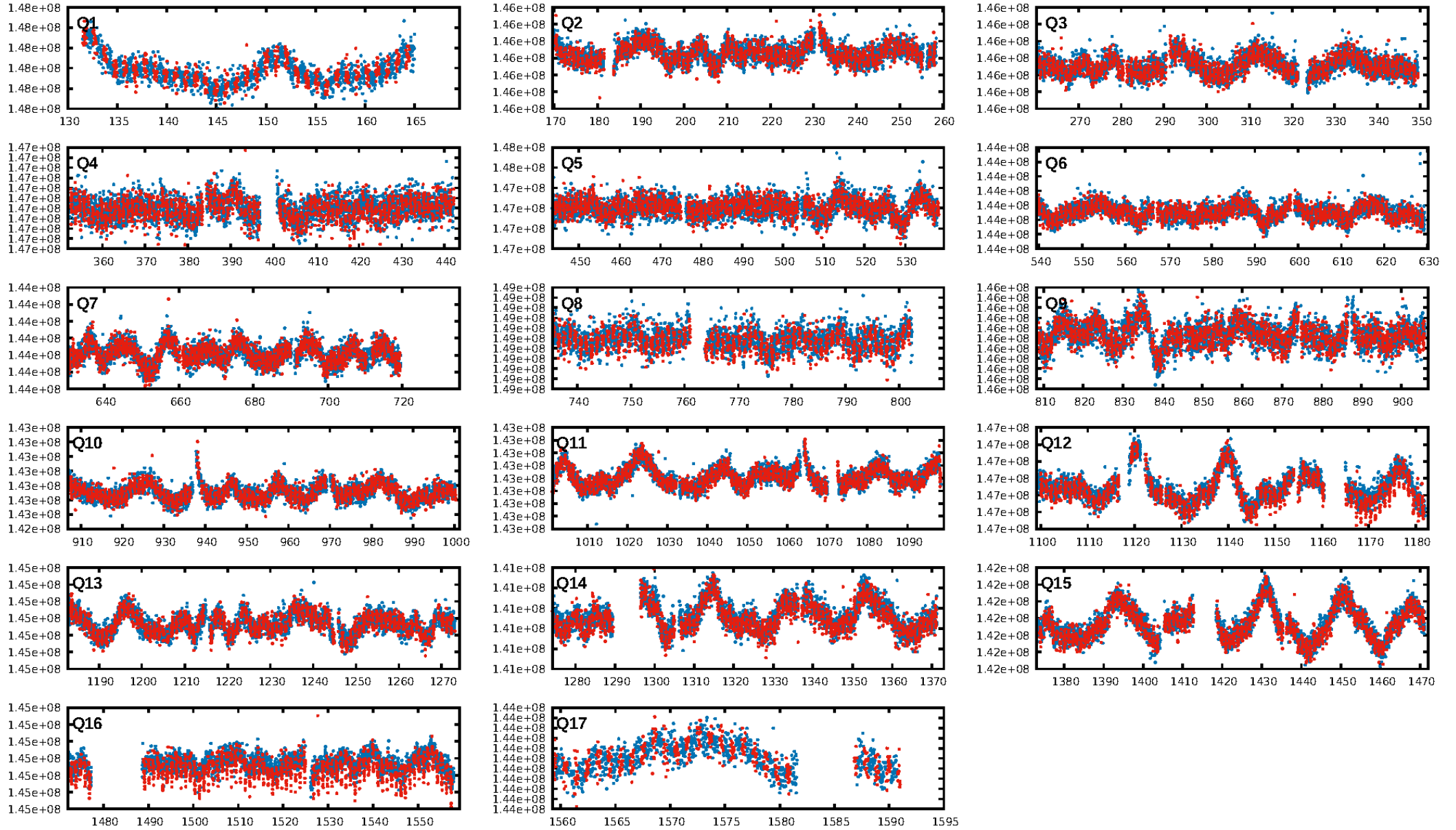
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [1030.97 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 3.30e-23  
RollingBand-igt: 1.00 [1265/1265]  
GhostDiagnostic-chr: -4.362  
Centroid-sig: 0.0%  
Centroid-so: 8.253 arcsec [7.21 $\sigma$ ]  
OotOffset-rm: 2.348 arcsec [2.43 $\sigma$ ]  
KicOffset-rm: 2.340 arcsec [2.58 $\sigma$ ]  
OotOffset-st: 4/4/4/4 [16]  
KicOffset-st: 4/4/4/4 [16]  
DiffImageQuality-fgm: 0.62 [10/16]  
DiffImageOverlap-fno: 1.00 [17/17]

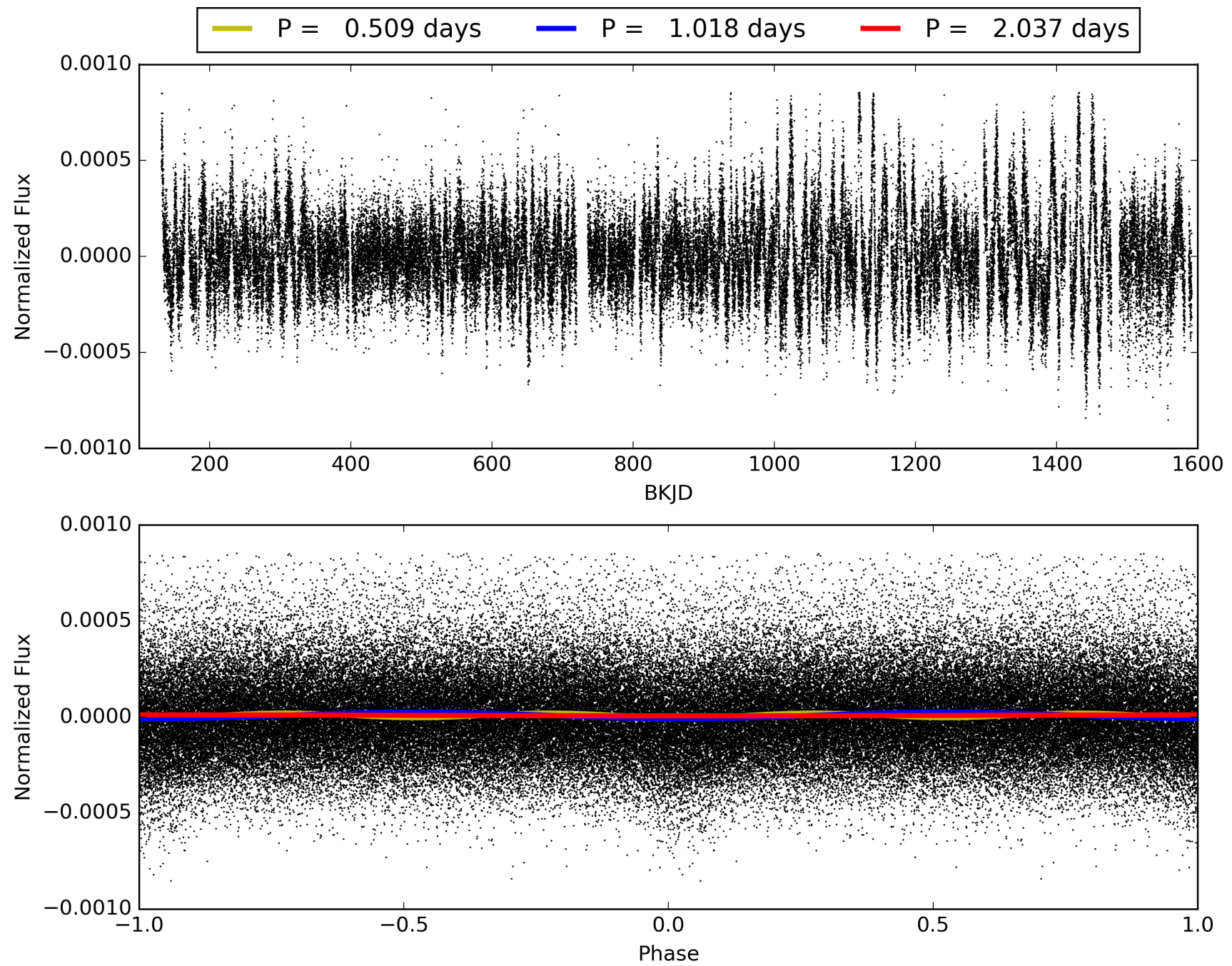
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 03:44:00 Z

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

# TCE 004059887-01, PDC Light Curves



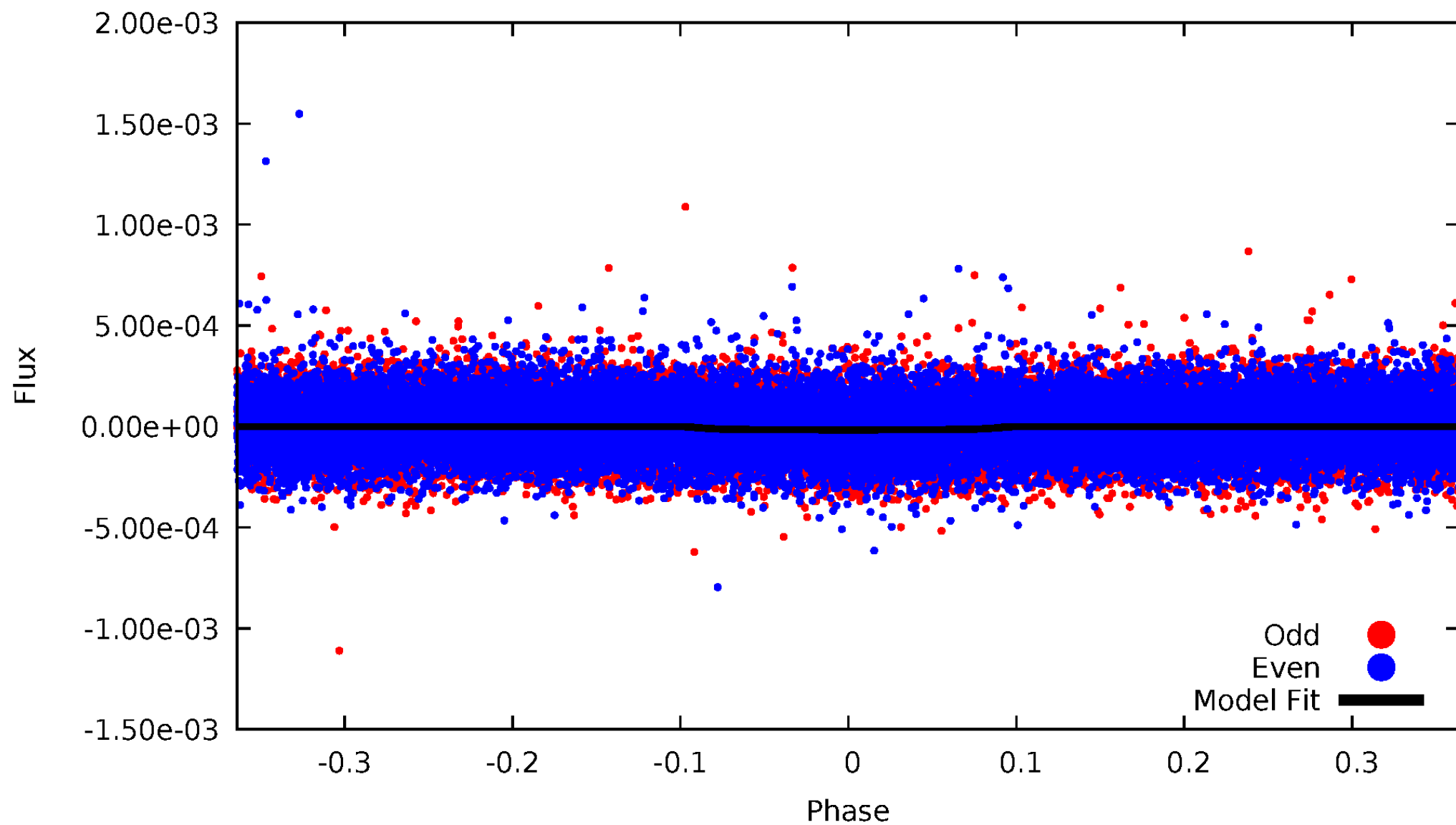
TCE 004059887-01





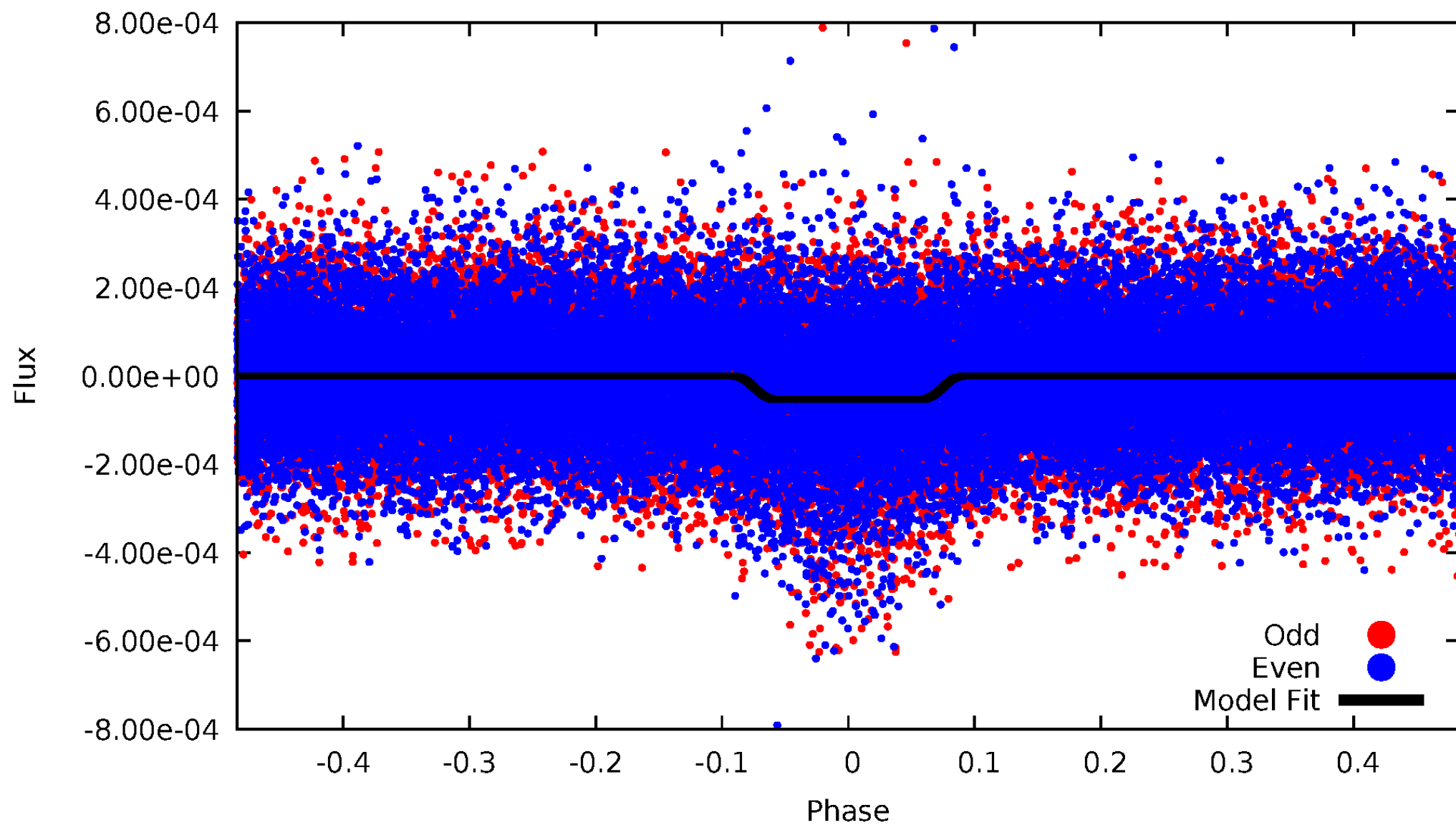
# DV Odd/Even

TCE 004059887-01



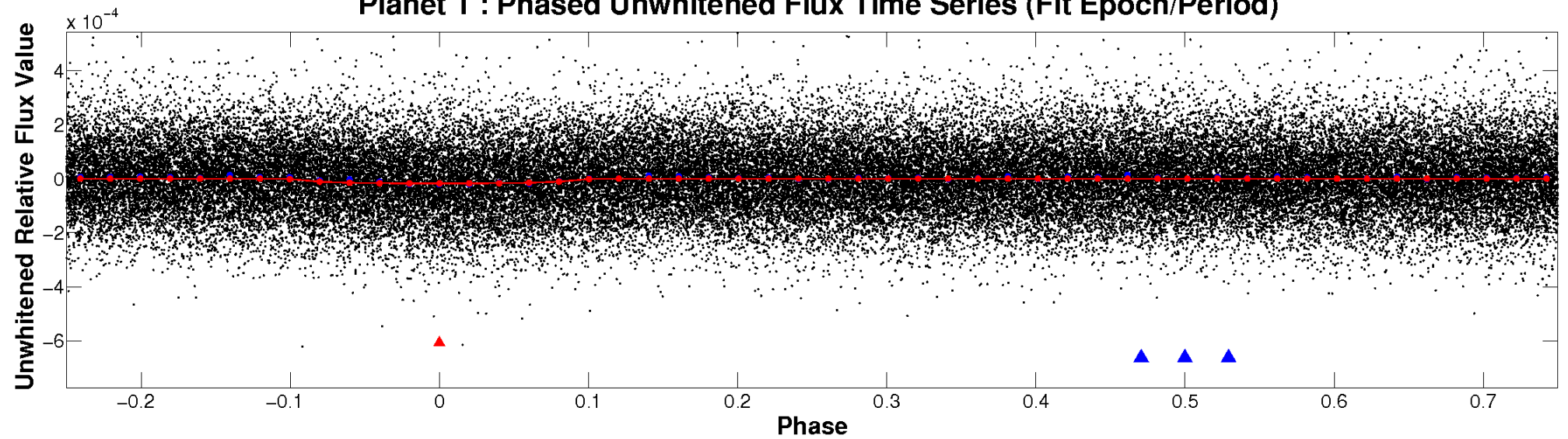
# ALT Odd/Even

TCE 004059887-01

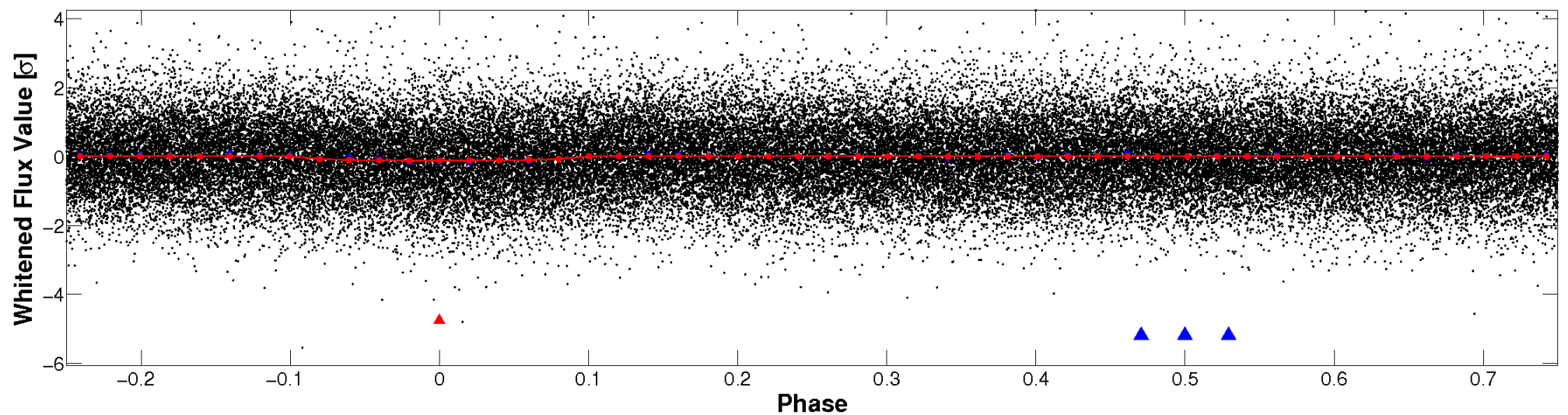


# Non-Whitened Vs. Whitened Light Curve

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

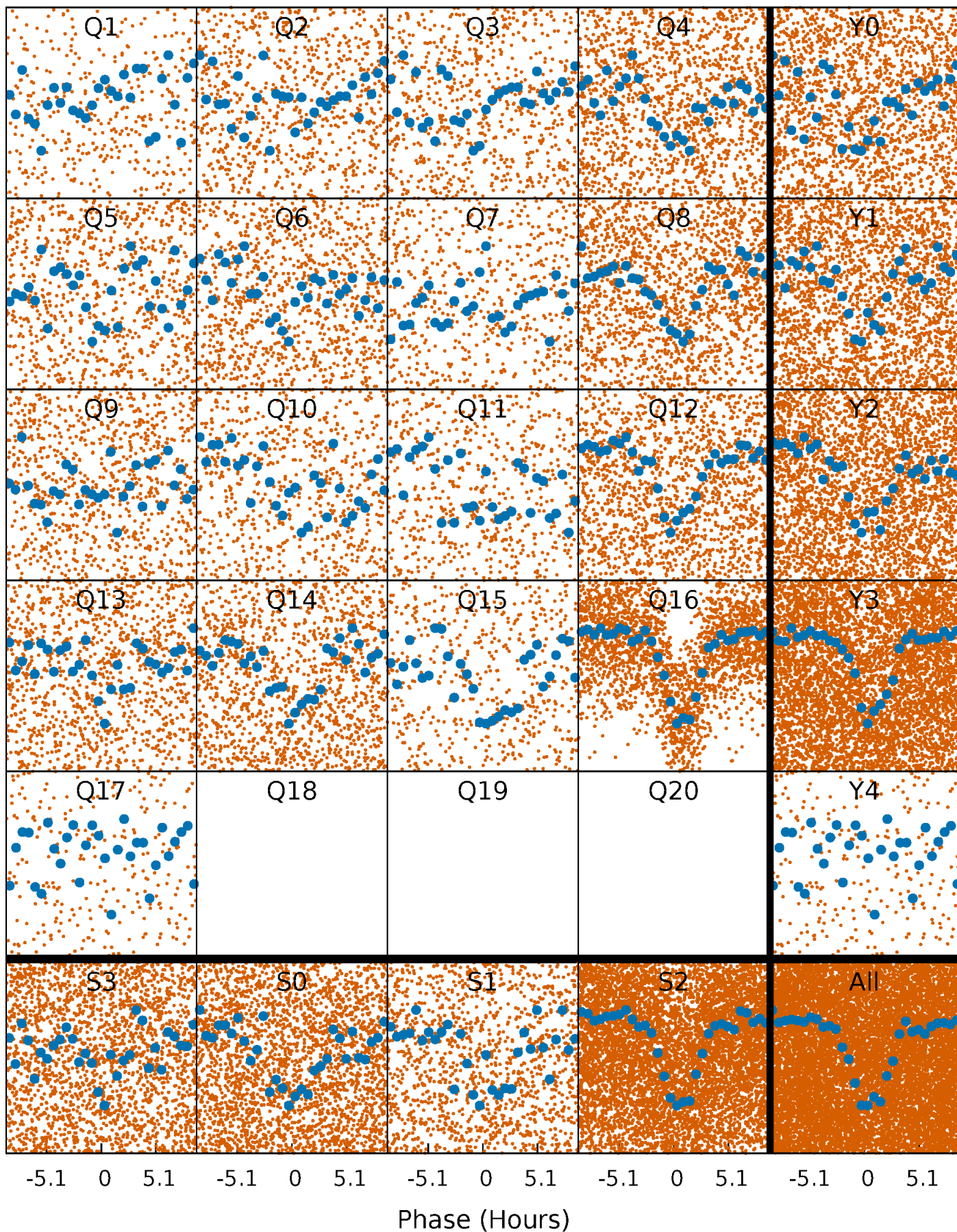


**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**



# PDC Quarter-Phased Transit Curves

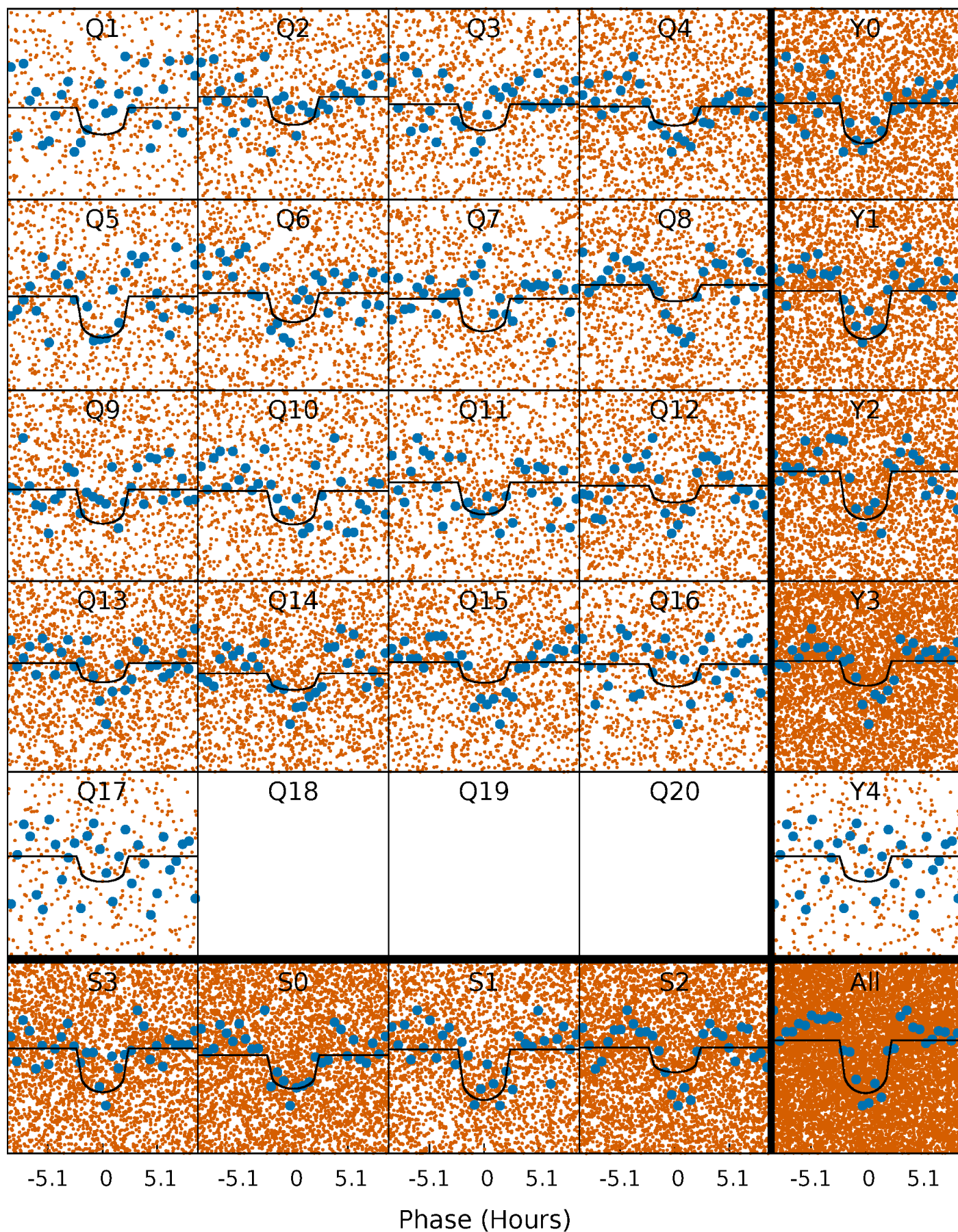
TCE 004059887-01 P= 1.018308 Days  $T_0=131.714557$  (BKJD)





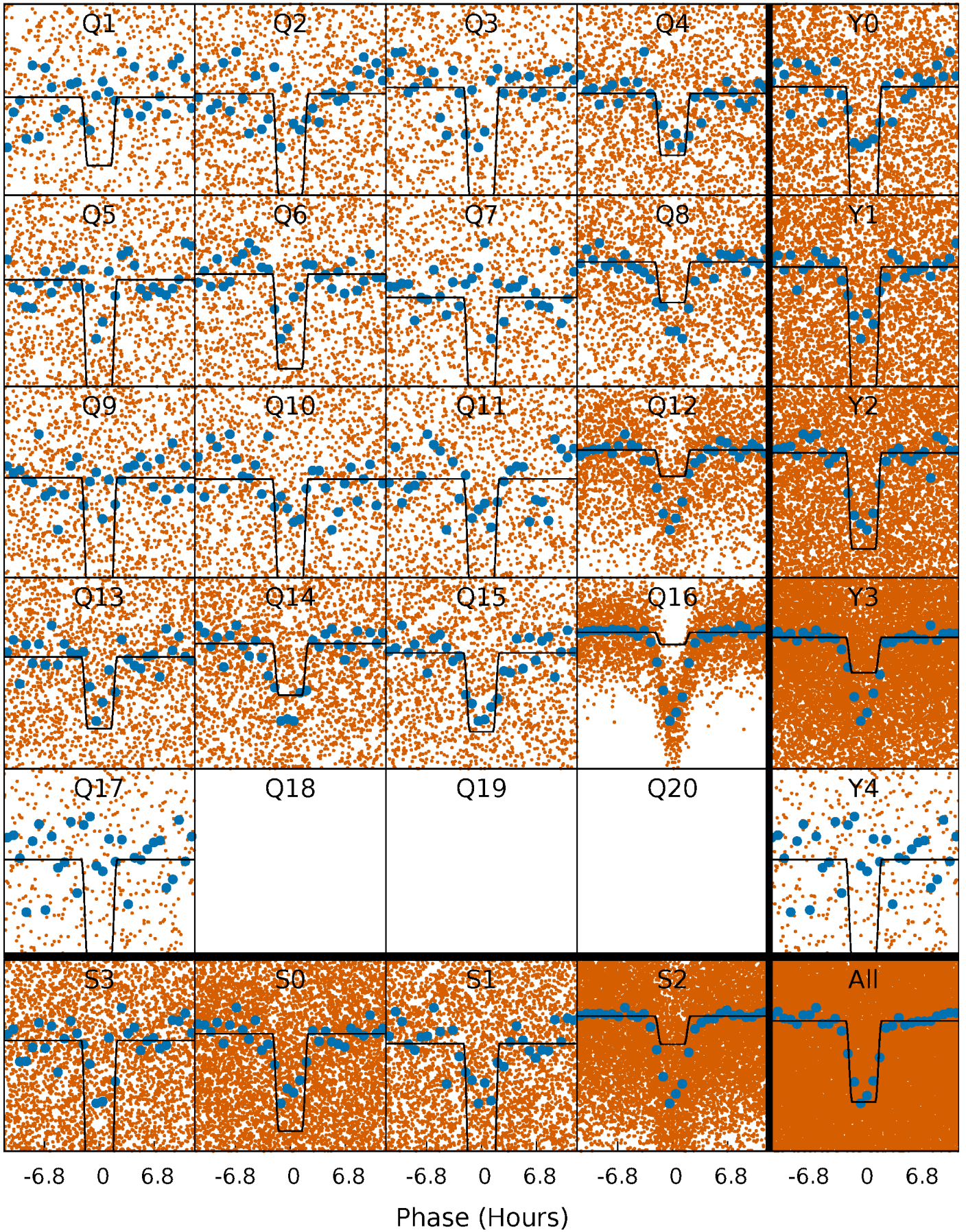
# DV Quarter-Phased Transit Curves

TCE 004059887-01 P= 1.018308 Days  $T_0=131.714557$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

TCE 004059887-01 P= 1.018350 Days  $T_0=131.690646$  (BKJD)

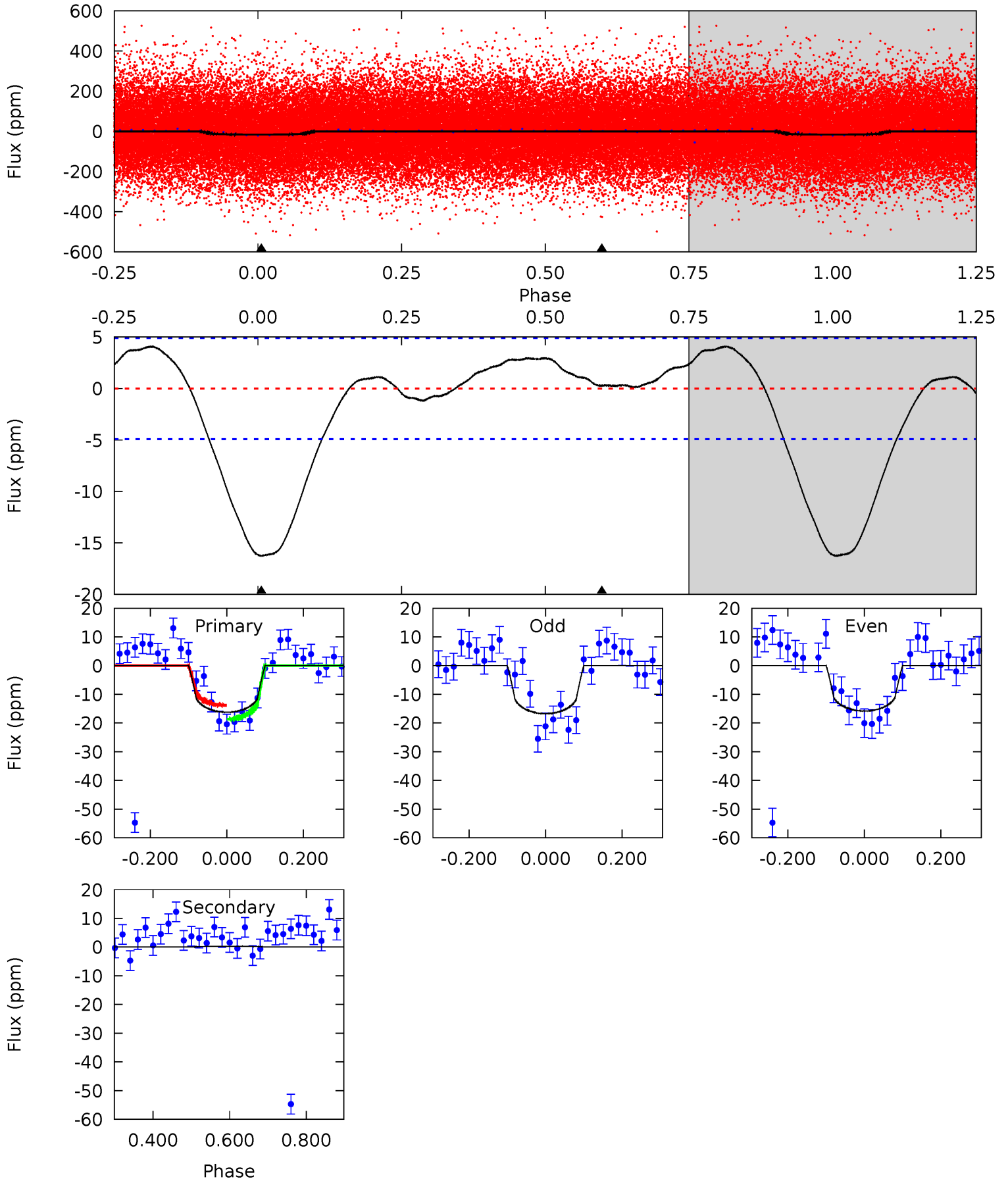




# DV Model-Shift Uniqueness Test

004059887-01, P = 1.018308 Days, E = 130.696249 Days

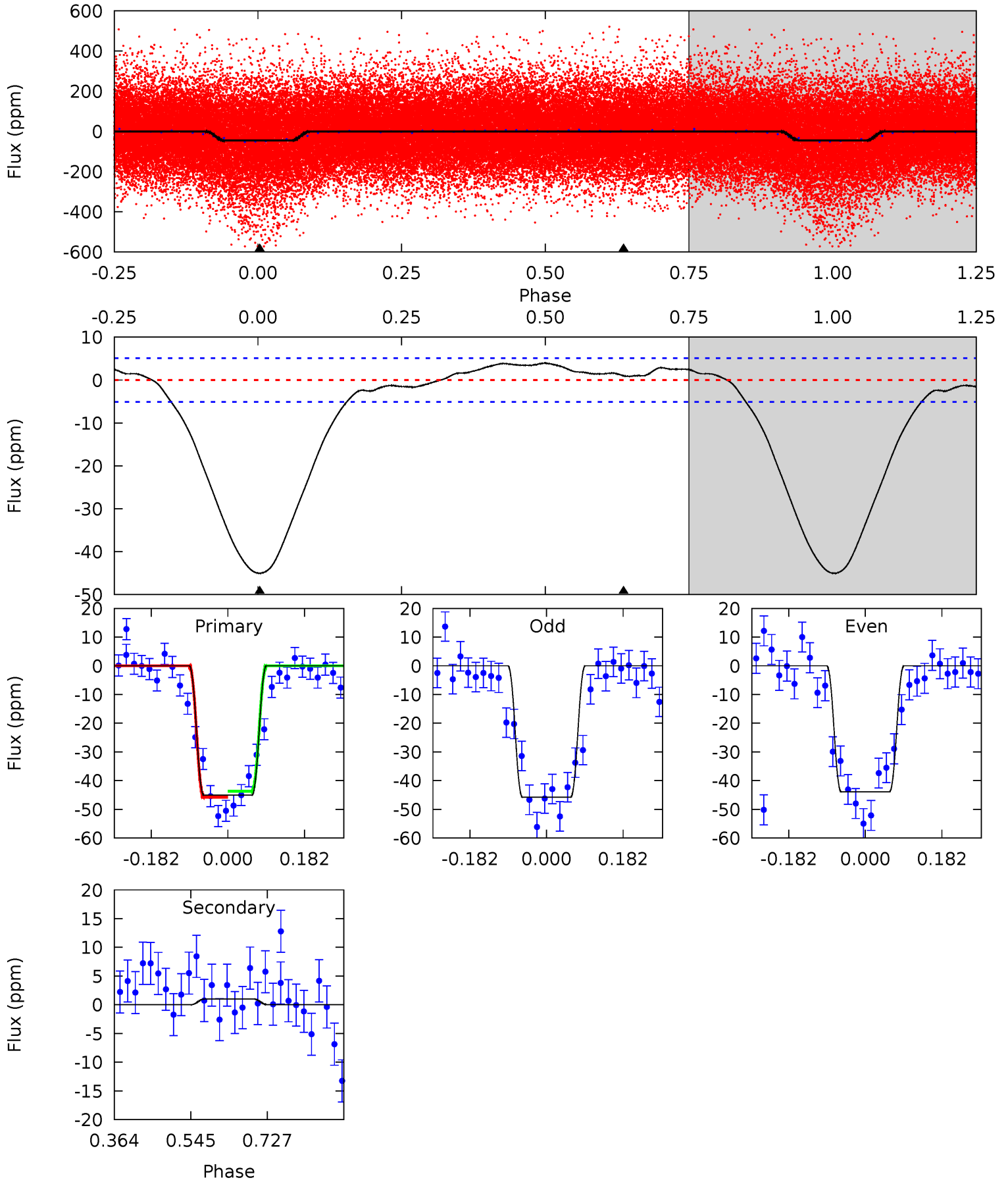
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
14.6	-0.24	0	0	4.42	1.28	1.05	14.6	14.6	-0.24	-0.24	0.42	1.00	0.20	2.17



# Alt Model-Shift Uniqueness Test

004059887-01, P = 1.018350 Days, E = 130.672296 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
39.2	-0.88	0	0	4.44	1.34	1.86	39.2	39.2	-0.88	-0.88	0.80	1.52	0.08	0.92





### Stellar Parameters For KIC 004059887

	$T_{\text{eff}} (K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R (R_{\odot})$	$M (M_{\odot})$	$\rho_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5858^{+87}_{-70}$	$3.729^{+0.224}_{-0.096}$	$-0.060^{+0.150}_{-0.150}$	$2.638^{+0.441}_{-0.818}$	$1.358^{+0.136}_{-0.252}$	$0.104^{+0.156}_{-0.034}$
	+1%/-1%	+6%/-3%	+250%/-250%	+17%/-31%	+10%/-19%	+150%/-33%
Source	SPE68	SPE68	SPE68	DSEP		

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

### Secondary Eclipse Parameters for KIC 004059887-01 / KOI 4887.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$0 \pm 1$	$1.11^{+0.35}_{-0.34}$	$3921^{+192}_{-275}$	$-3773^{+573}_{-401}$	$-0.065^{+0.228}_{-0.298}$
Alt.	$1 \pm 1$	$1.98^{+0.45}_{-0.42}$	$3910^{+201}_{-272}$	$-3757^{+205}_{-175}$	$-0.065^{+0.073}_{-0.091}$

$T_{\text{max}}$  = 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

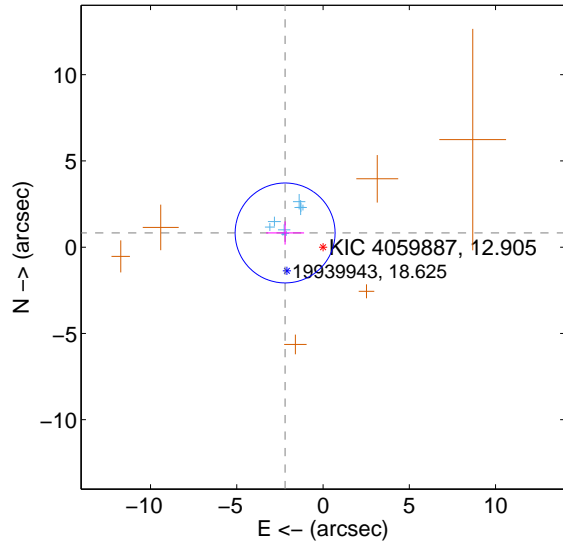
Supplemental centroid analysis for 004059887-01. Kepler magnitude: 12.90. Transit SNR 10.62

There are 10 quarters with good PRF difference image offsets

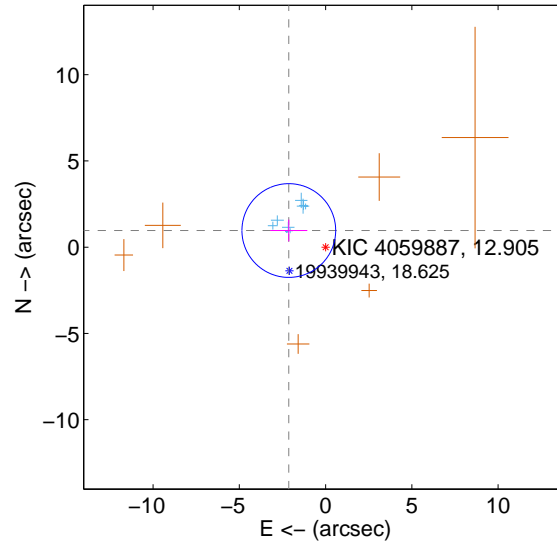
The direct PRF centroid is offset from the target star catalog position by about 0.16 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$2.348 \pm 0.965$	2.43	$2.198 \pm 1.102$	$0.824 \pm 0.675$
PRF-fit source offset from KIC position	$2.340 \pm 0.906$	2.58	$2.132 \pm 1.071$	$0.965 \pm 0.633$
photometric centroid source offset	$8.25 \pm 1.15$	7.21	$4.74 \pm 1.00$	$6.76 \pm 1.21$

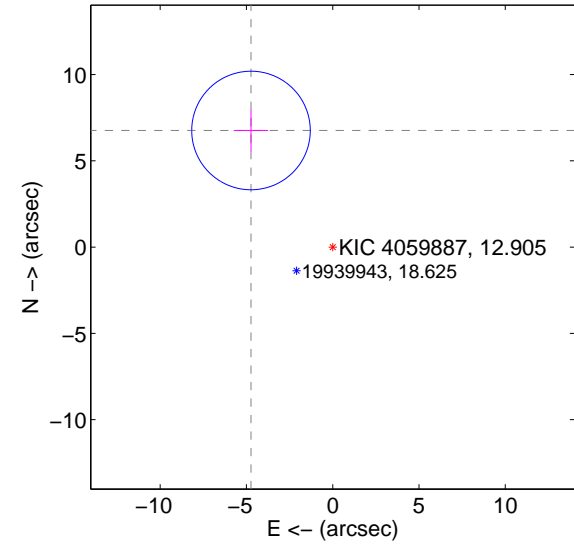
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

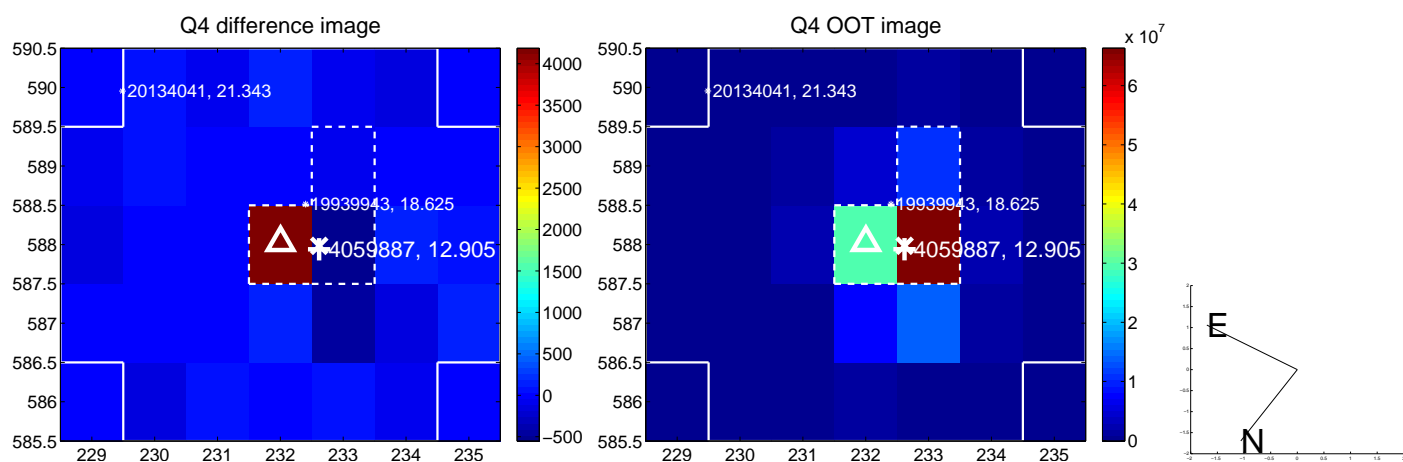
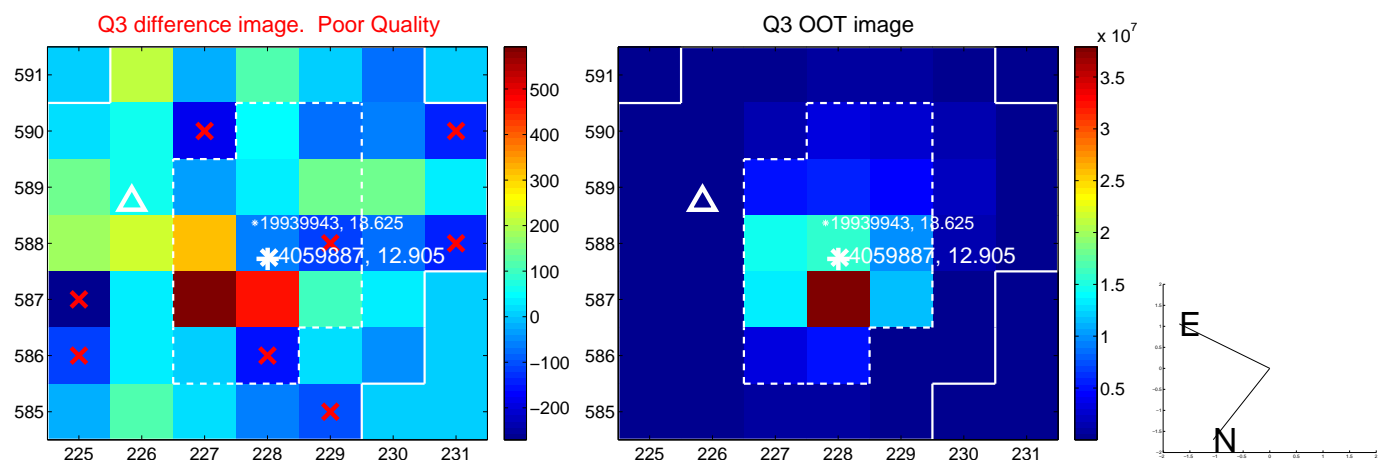
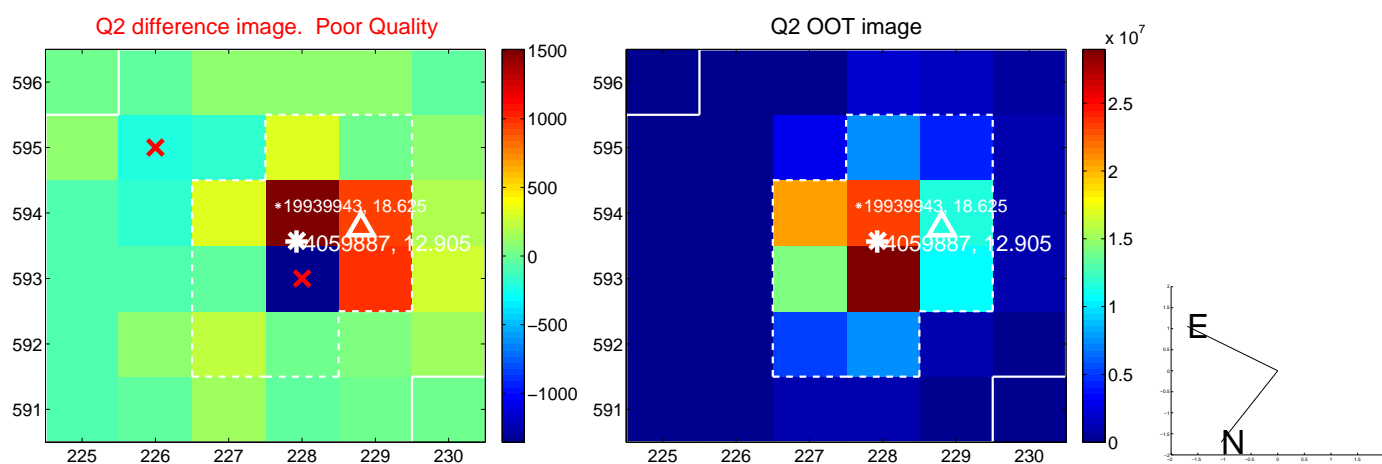
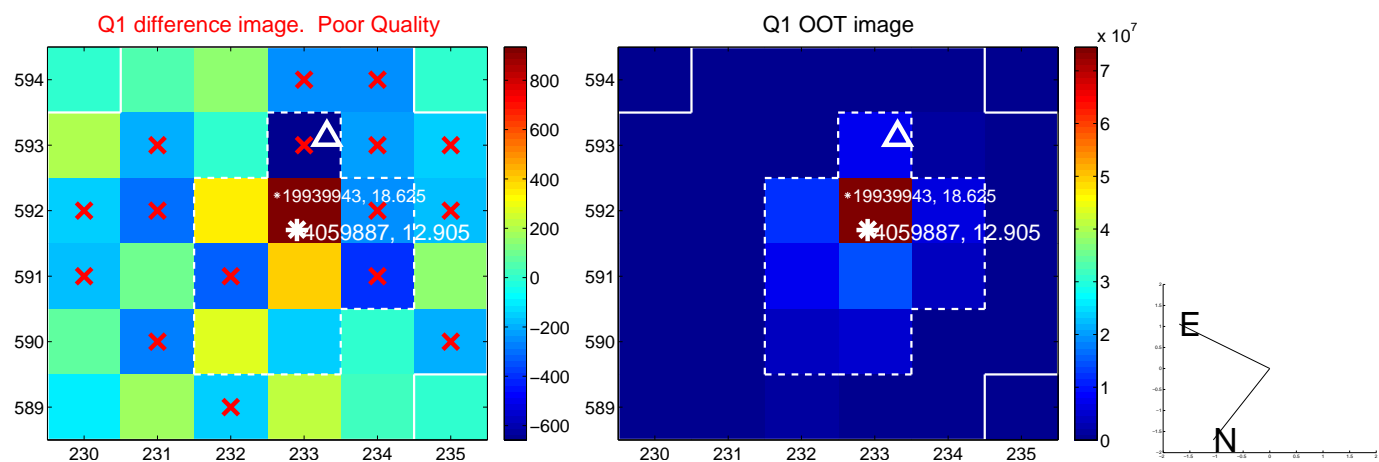


offset from photometric centroids

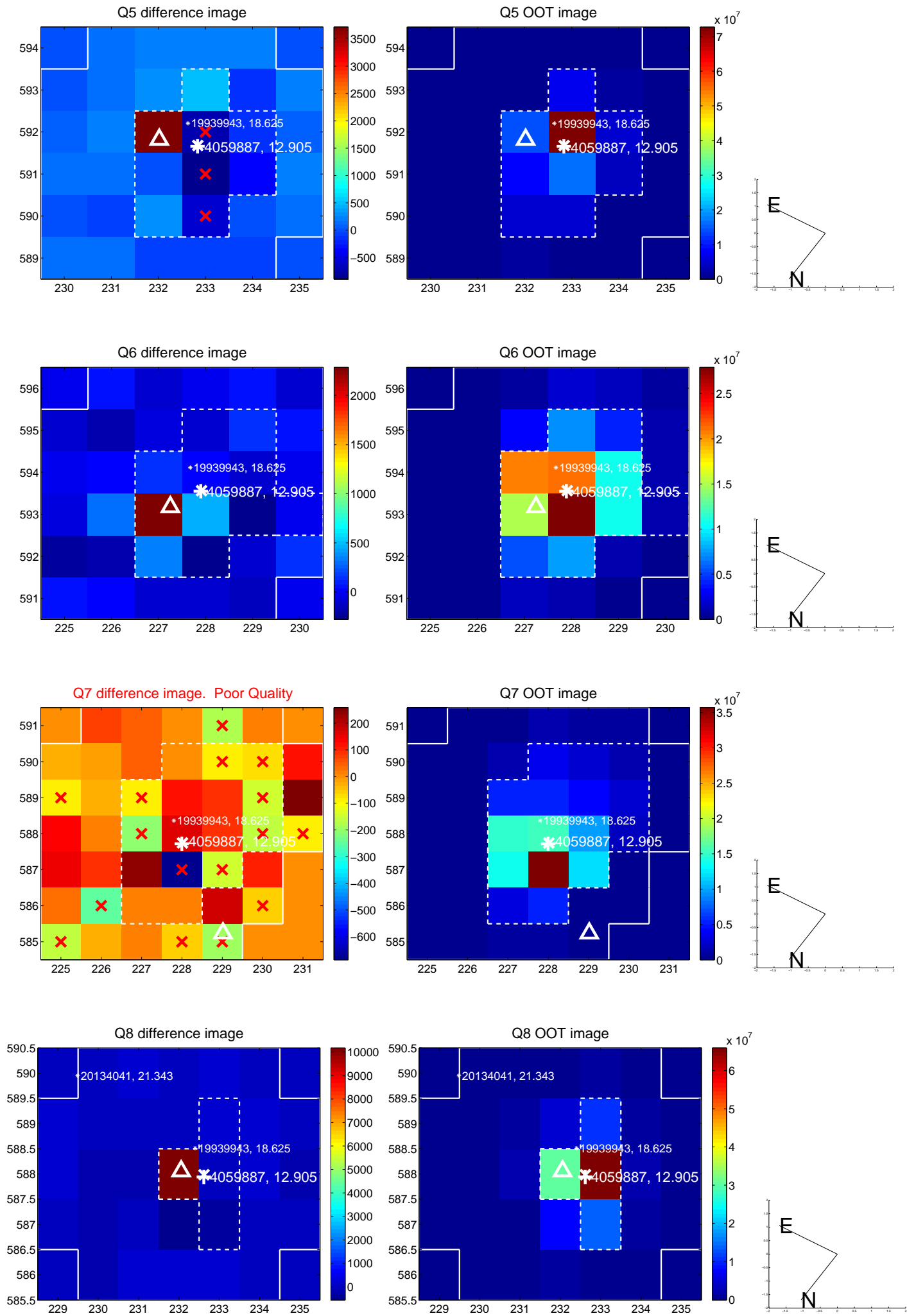


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

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

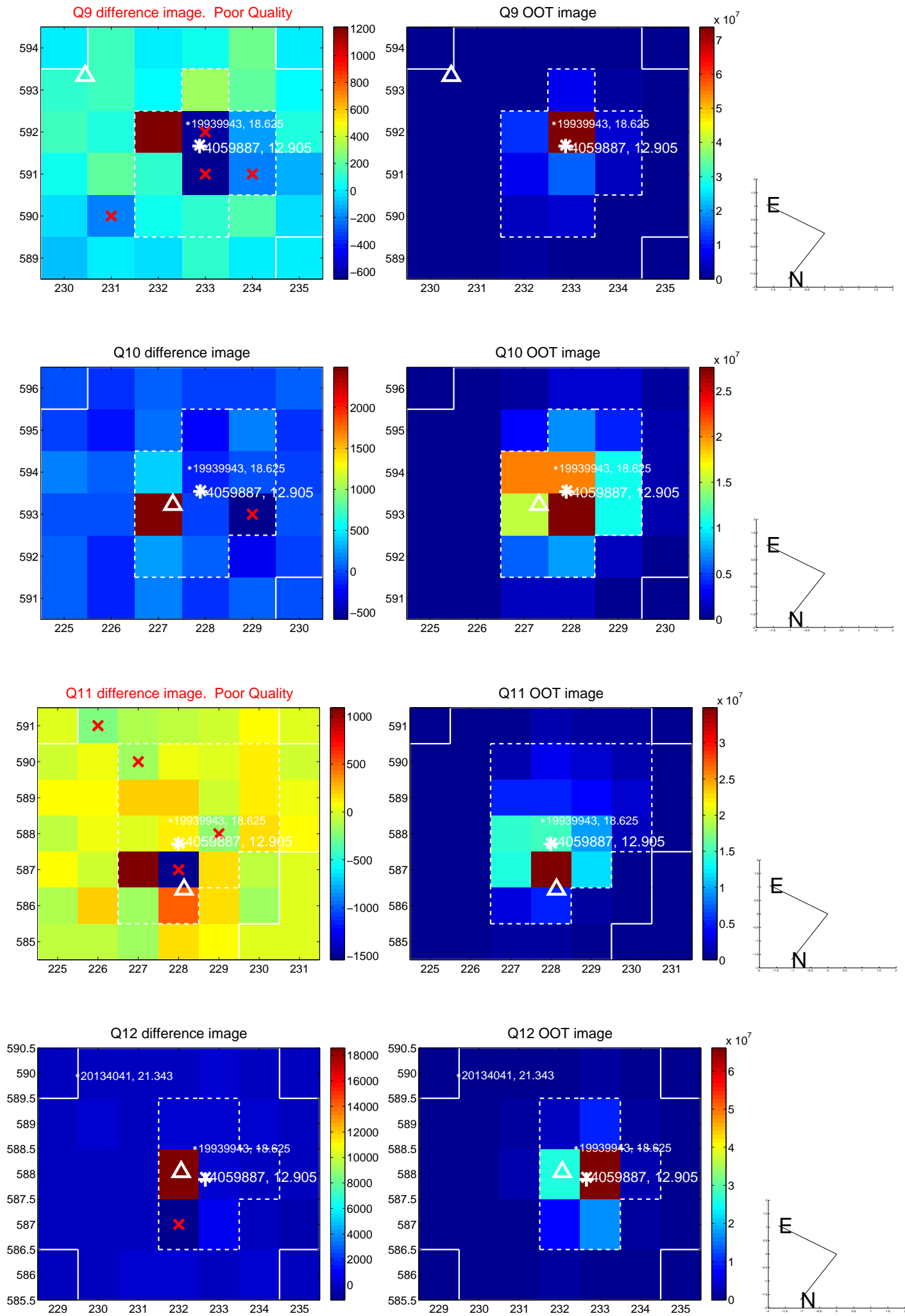


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

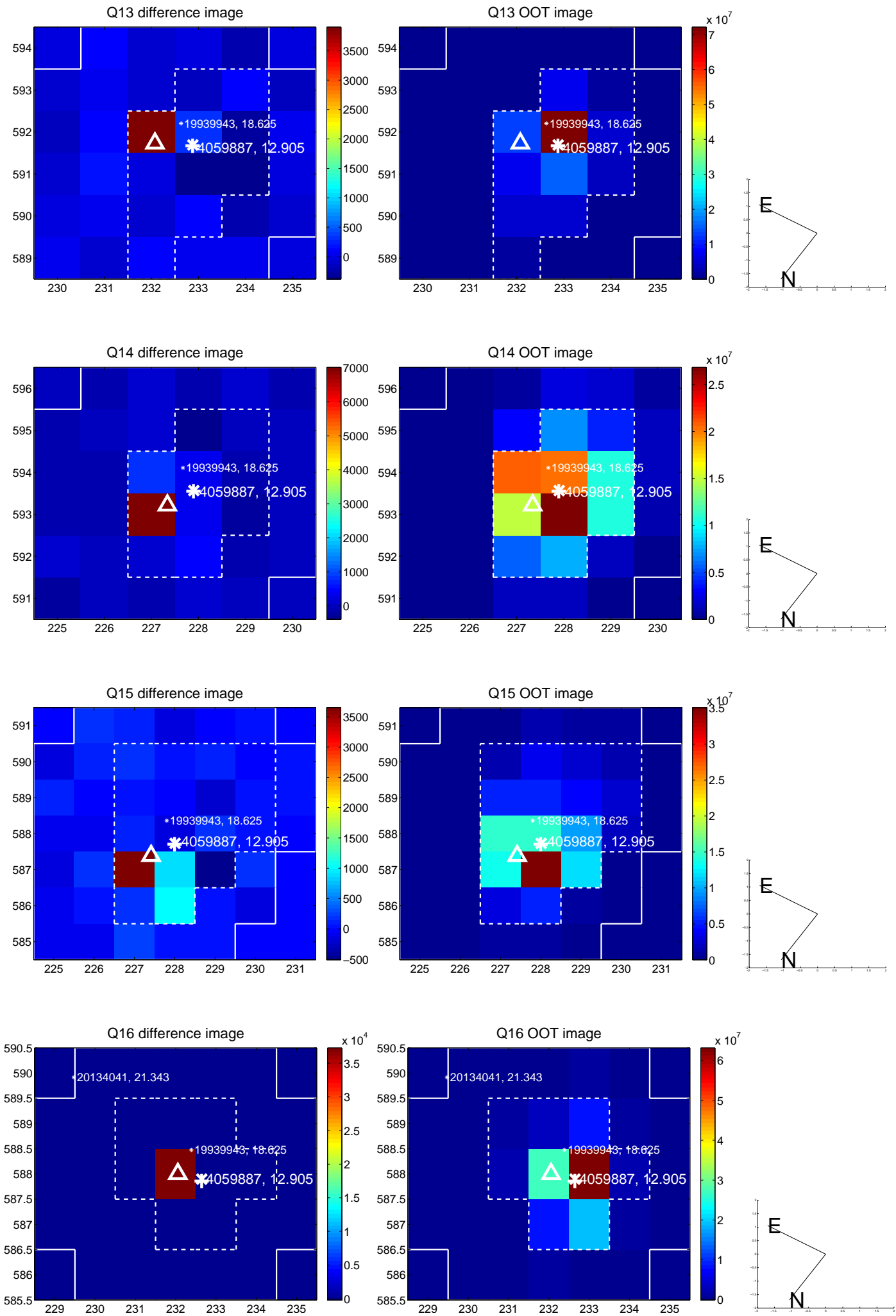




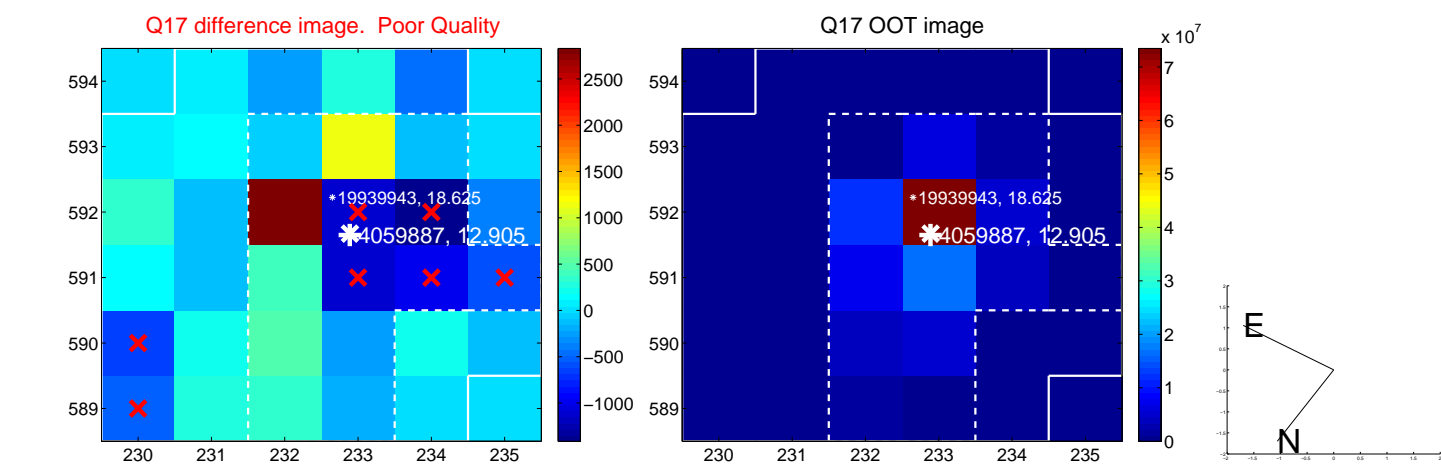
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



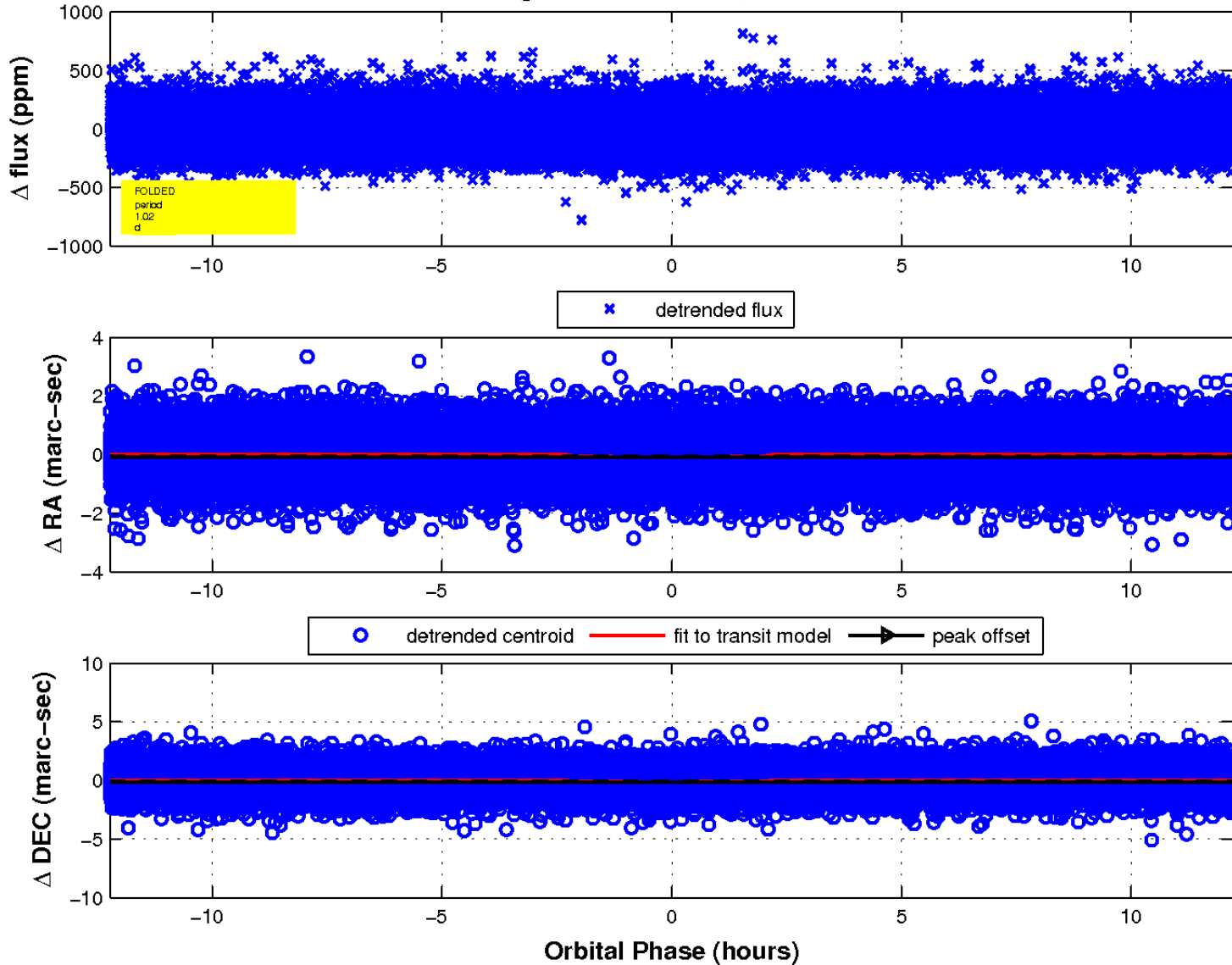
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



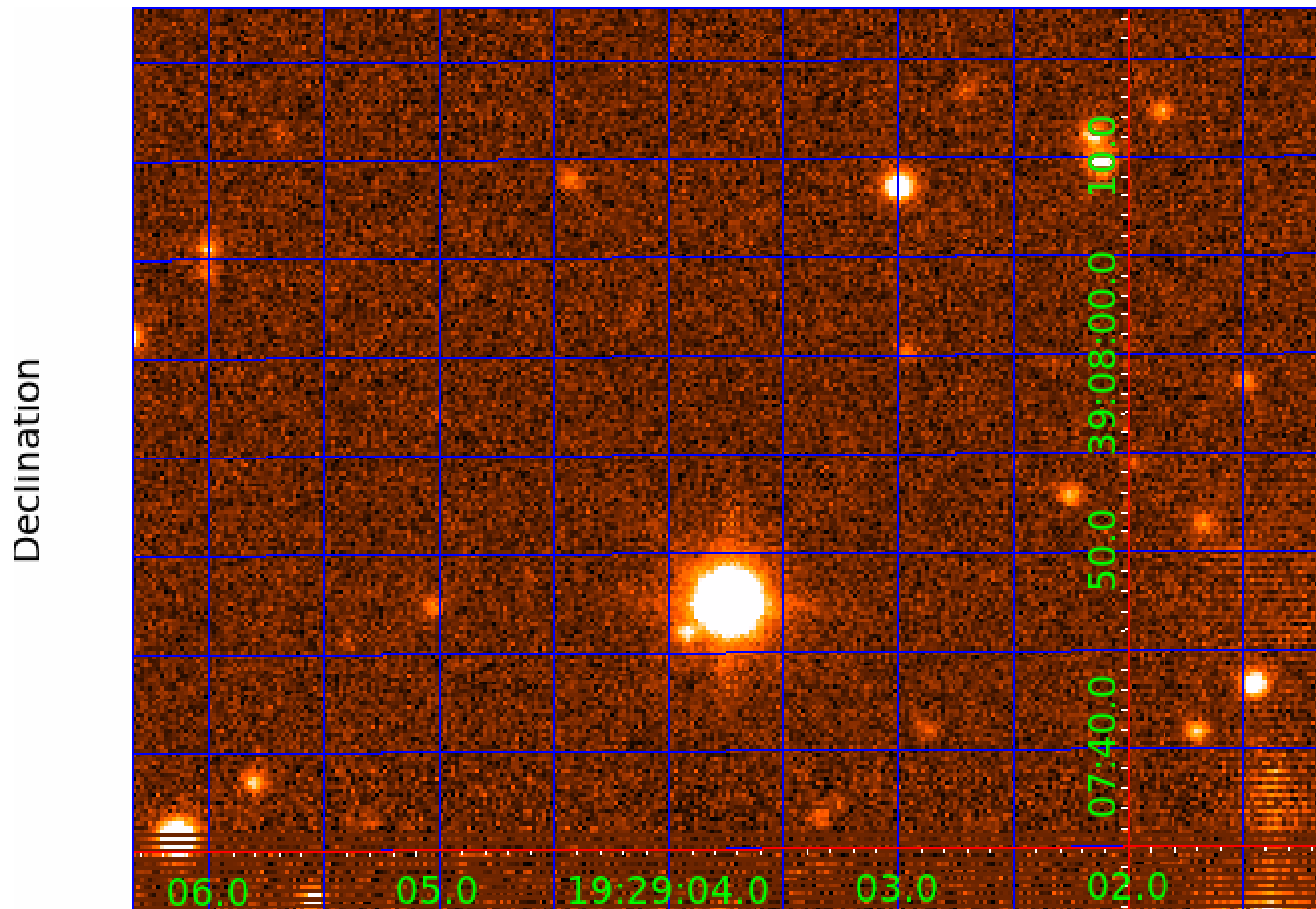
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



fluxWeightedCentroids, Planet 1 of 2



UKIRT Image





# KIC 004059887

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
004059887-01	OBS	4887.01	1.018308	131.714557	17.5	4.446	10.9	10.6	2.64	5858	1.17	15237.11
004059887-02	OBS	No	465.337016	424.507923	242.9	9.852	11.9	9.8	2.64	5858	4.48	4.33

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
004059887-01	OBS	FP	0.00	0	0	1	1	CENT_UNRESOLVED_OFFSET—EPHEM_MATCH
004059887-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL—LPP_DV—LPP_ALT—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_FEW_DIFFS

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

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

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

## Ephemeris Match Information For 004059887-02

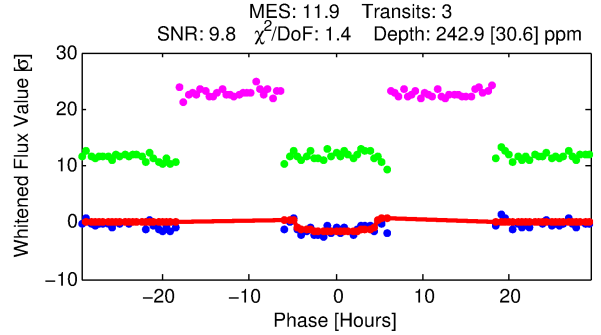
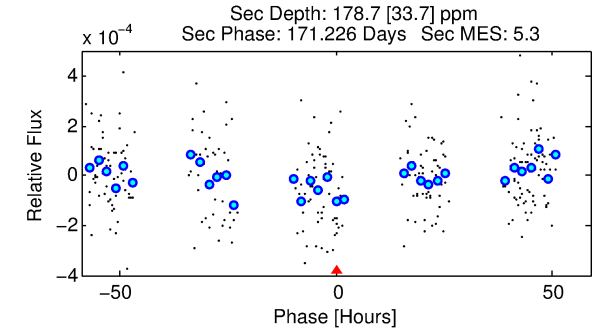
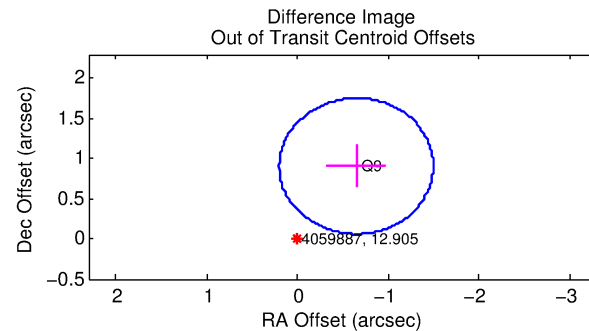
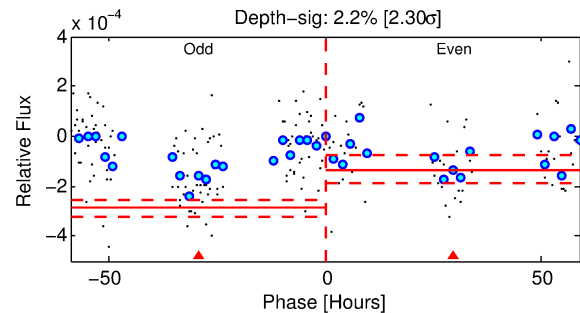
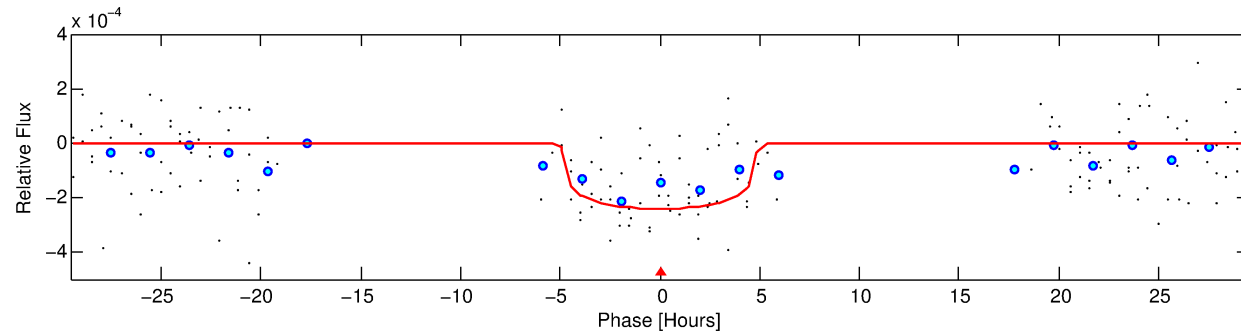
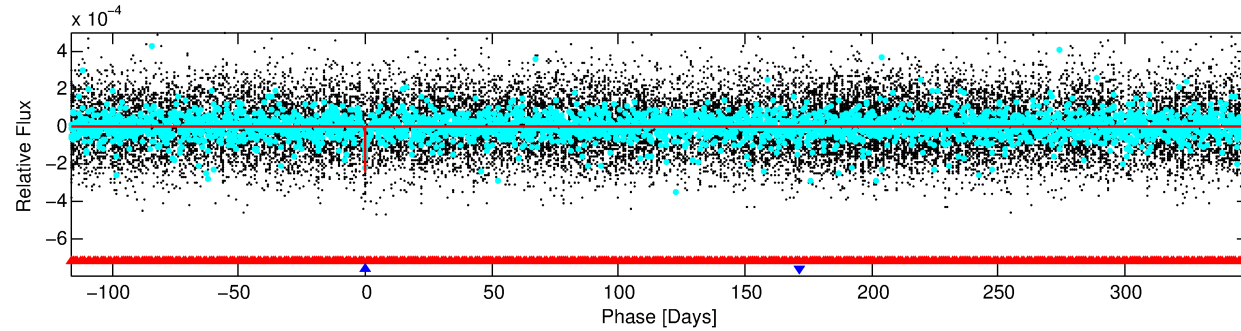
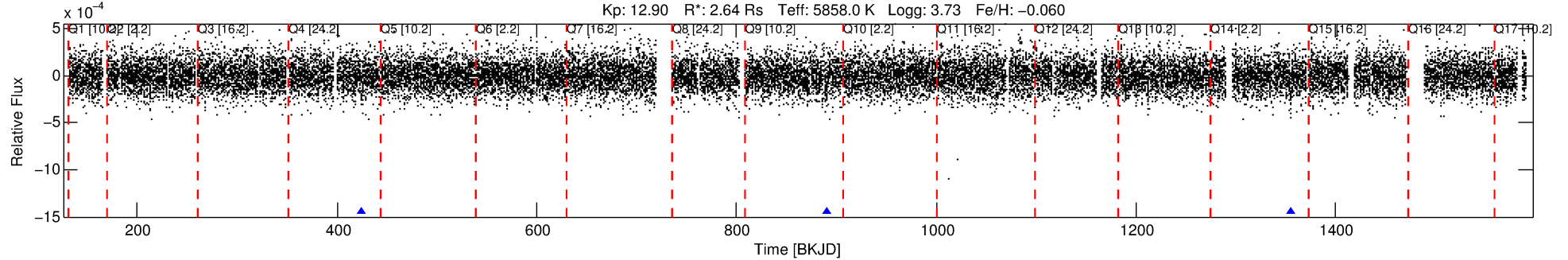
No Significant Match Found

# DV One-Page Summary

KIC: 4059887 Candidate: 2 of 2 Period: 465.337 d

KOI: K04887 Corr: No Ephemeris Match

Kp: 12.90 R\*: 2.64 Rs Teff: 5858.0 K Logg: 3.73 Fe/H: -0.060



## DV Fit Results:

Period = 465.33702 [0.01549] d  
Epoch = 424.5079 [0.0217] BKJD  
Rp/R\* = 0.0156 [0.0083]  
a/R\* = 242.80 [595.03]  
b = 0.76 [1.38]  
Seff = 4.33 [1.76]  
Teq = 368 [37] K  
Rp = 4.48 [2.75] Re  
a = 1.3023 [0.3502] AU  
Ag = 8301.53 [9548.17] [0.87σ]  
Teffp = 5428 [1465] K [3.45σ]

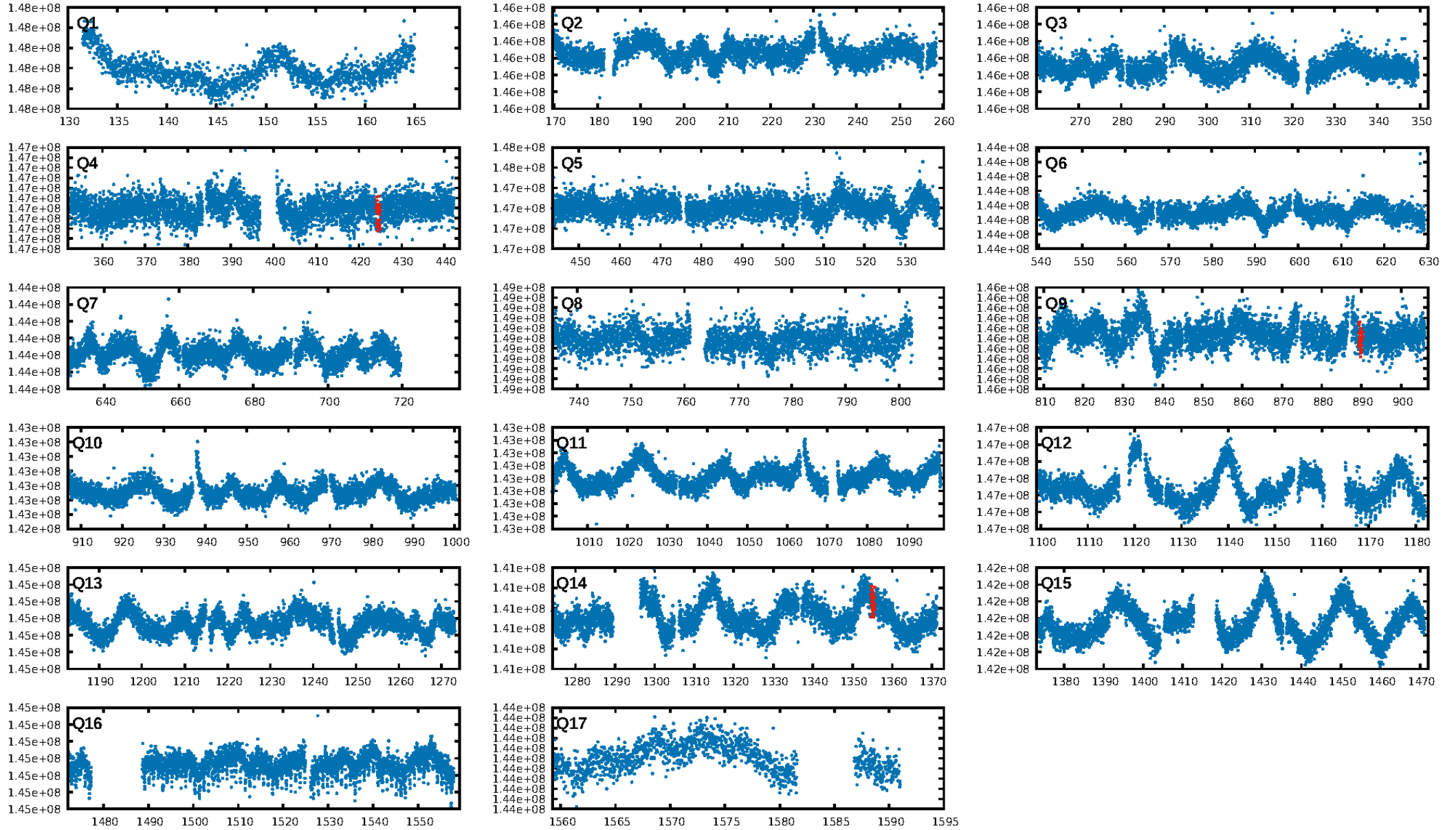
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [1030.97σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 45.0%  
Bootstrap-pfa: 2.30e-17  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: 29  
Centroid-sig: 74.9%  
Centroid-so: 0.561 arcsec [0.48σ]  
OotOffset-rm: 1.113 arcsec [3.94σ]  
KicOffset-rm: 1.148 arcsec [4.09σ]  
OotOffset-st: 0/0/0/1 [1]  
KicOffset-st: 0/0/0/1 [1]  
DiffImageQuality-fgm: 1.00 [1/1]  
DiffImageOverlap-fno: 0.00 [0/3]

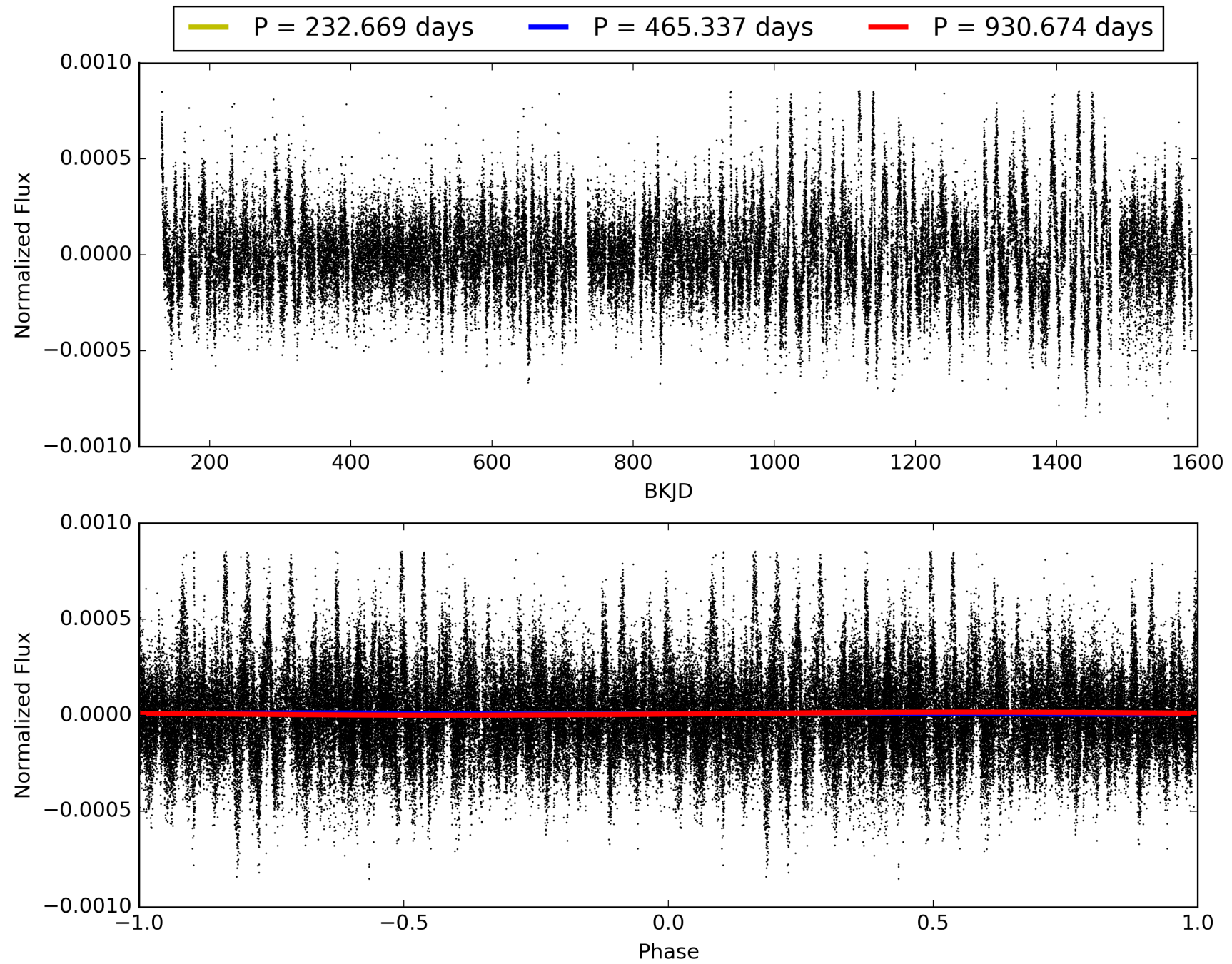
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 03:44:12 Z

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

# TCE 004059887-02, PDC Light Curves



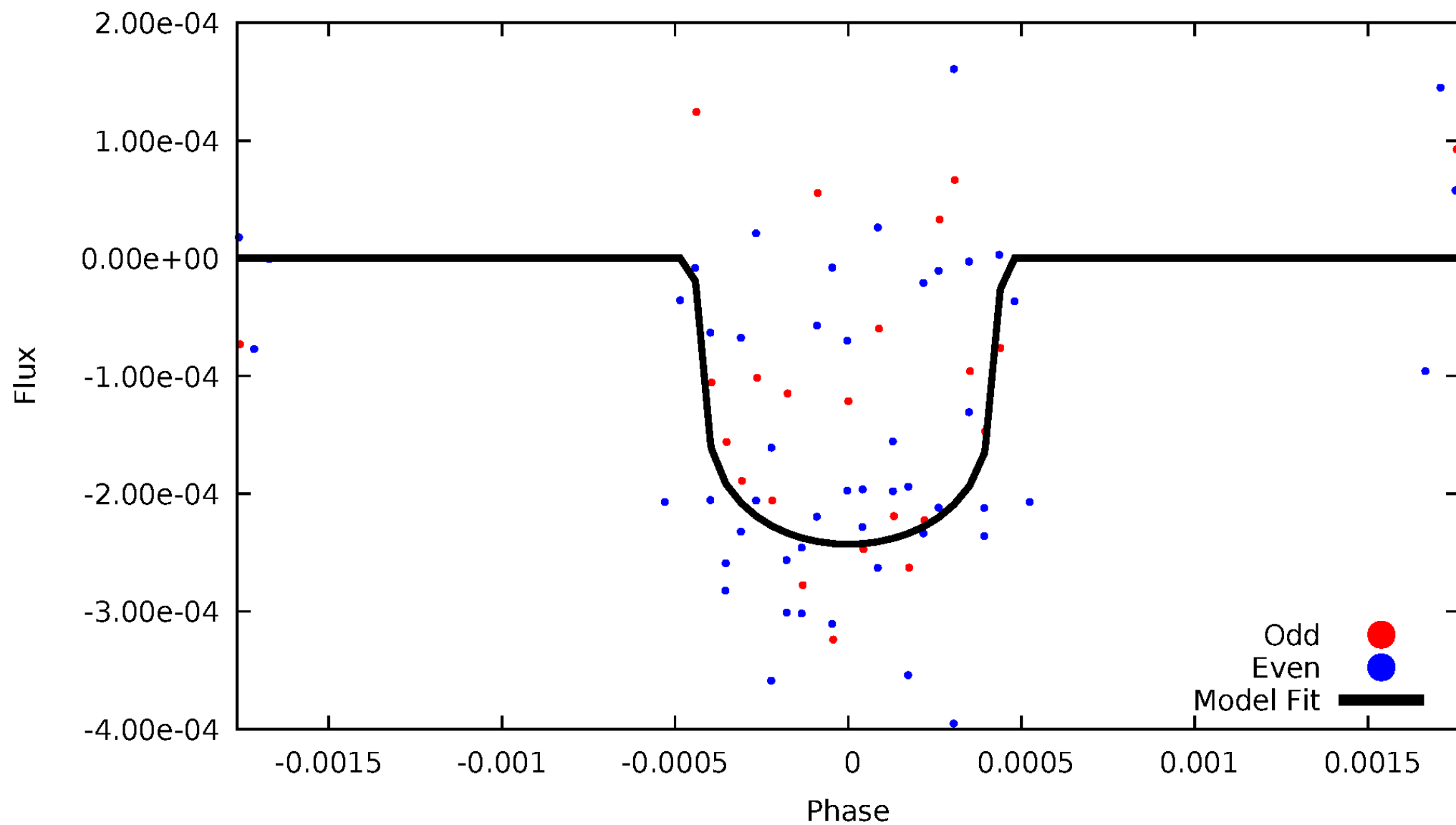
TCE 004059887-02





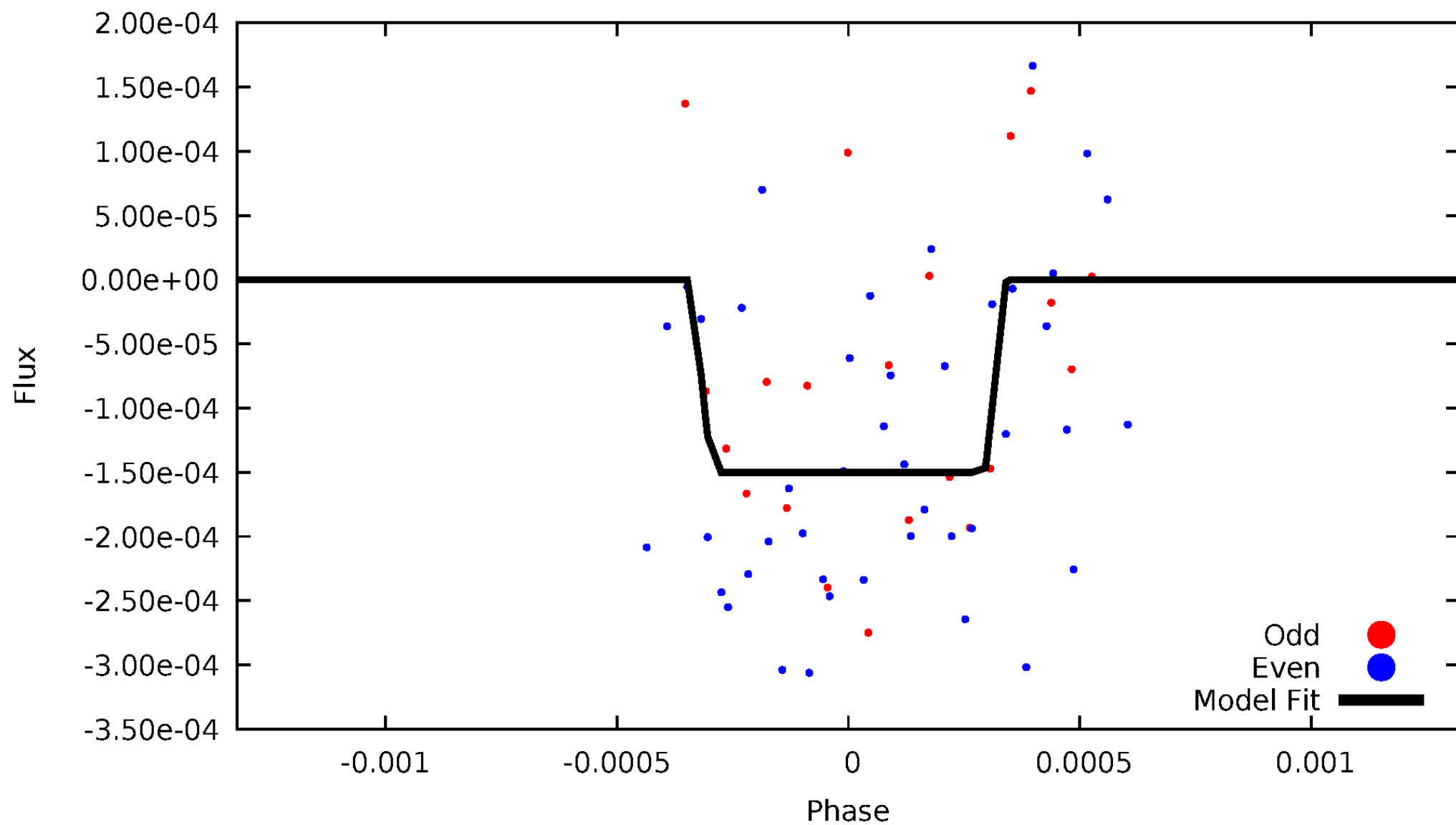
# DV Odd/Even

TCE 004059887-02



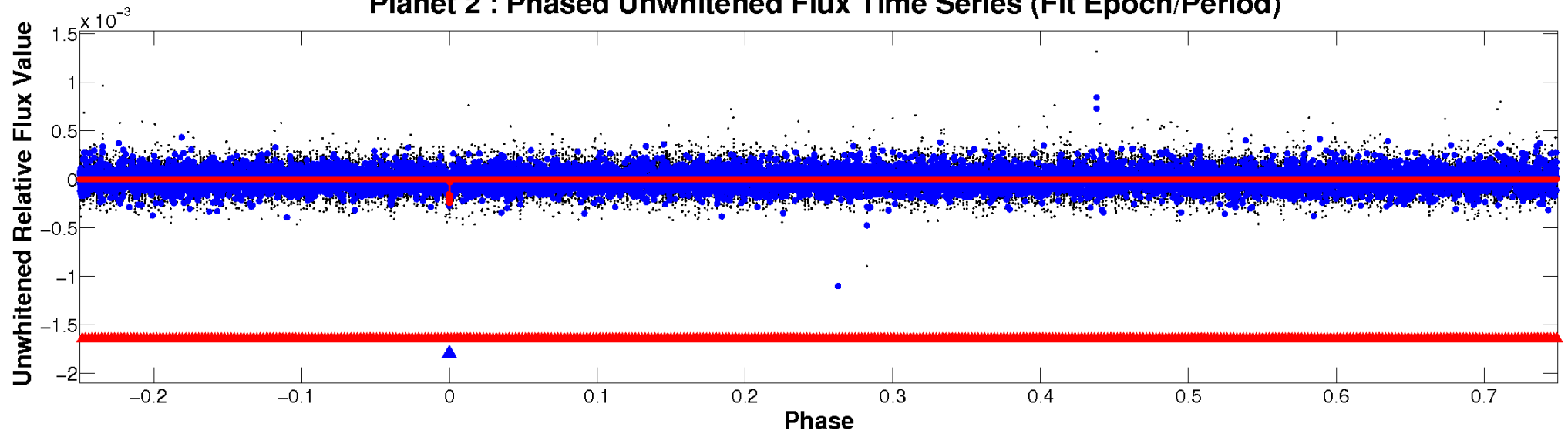
# ALT Odd/Even

TCE 004059887-02

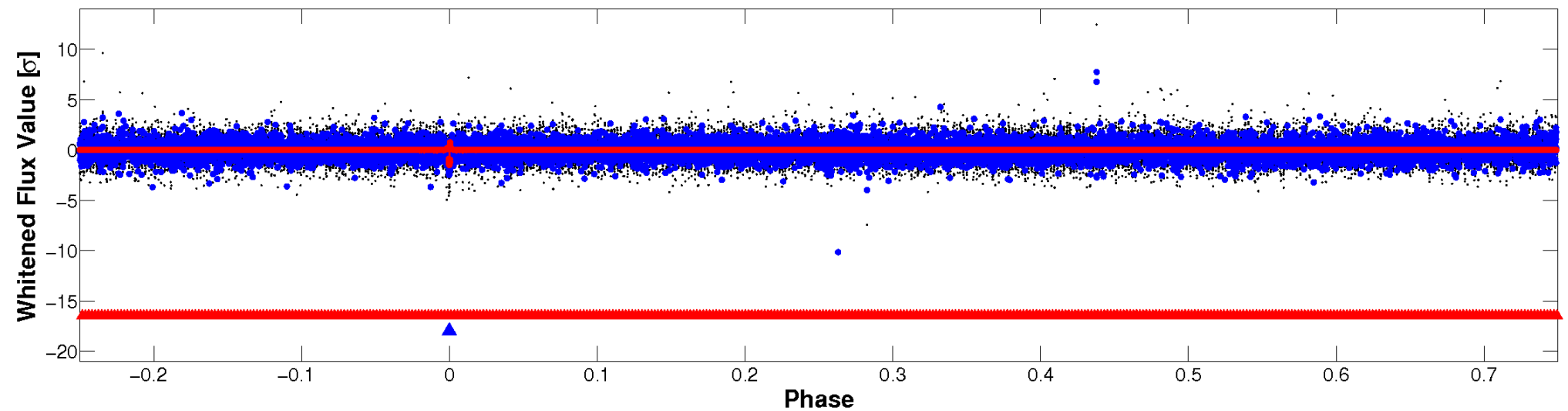


# Non-Whitened Vs. Whitened Light Curve

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

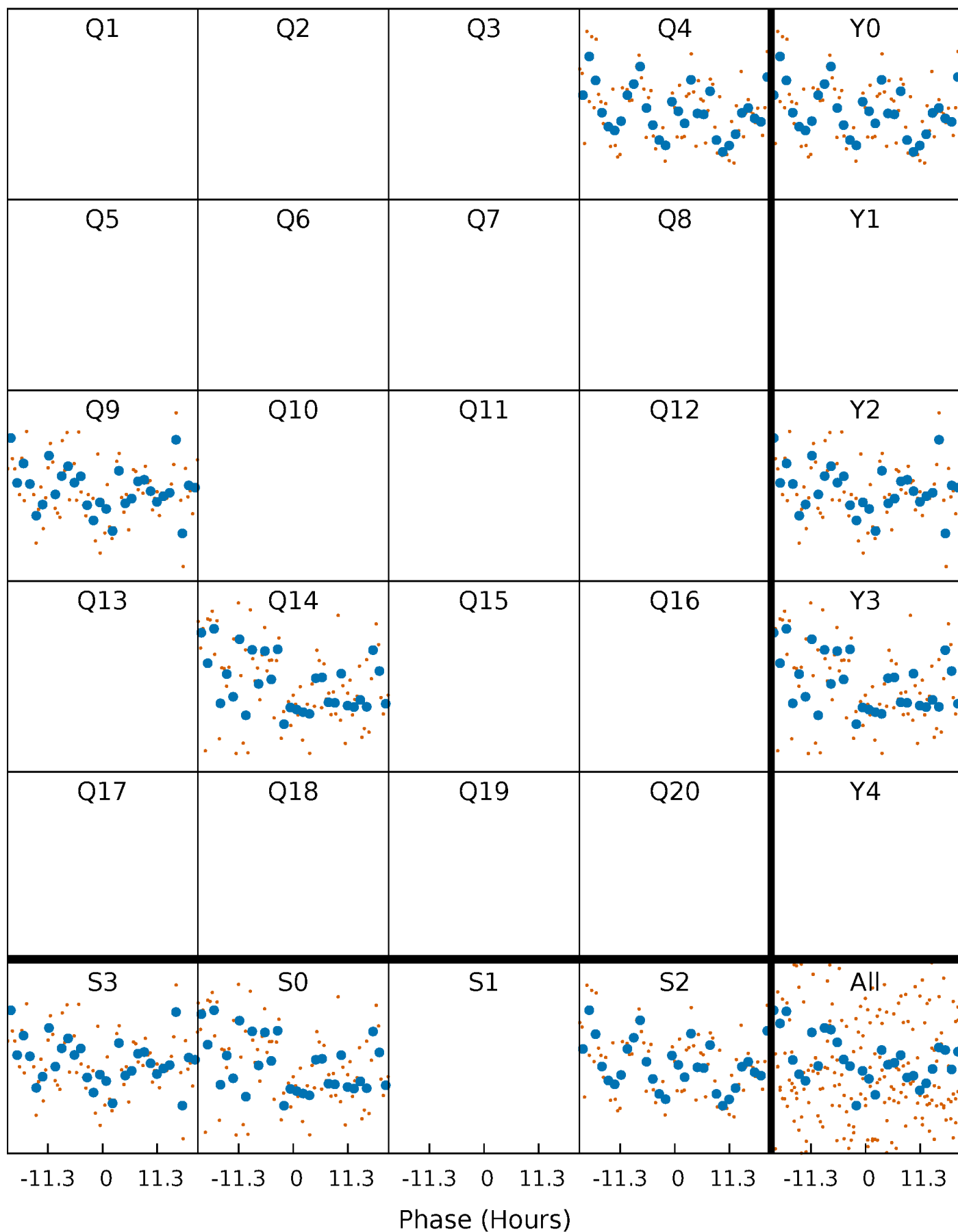


**Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)**



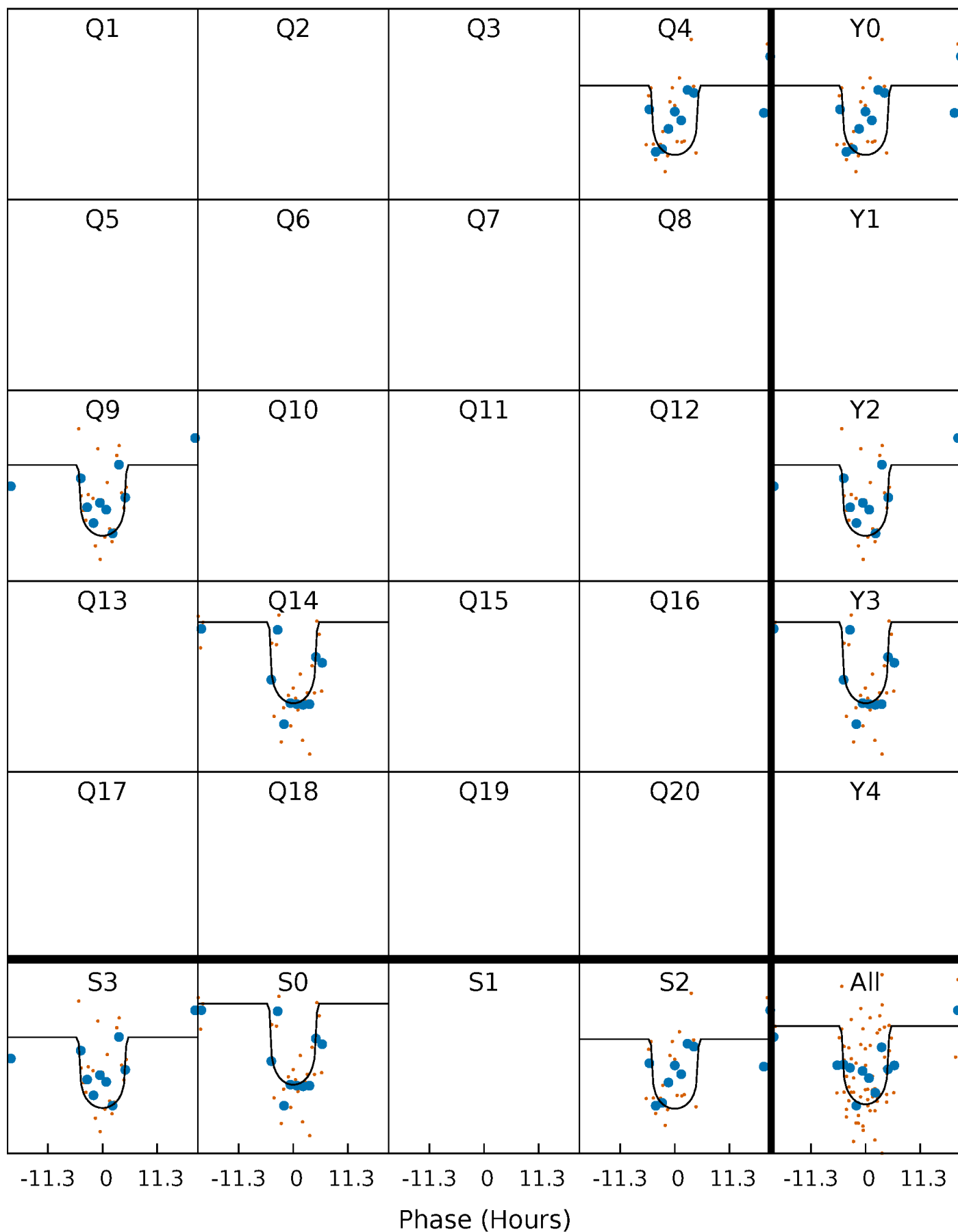
# PDC Quarter-Phased Transit Curves

TCE 004059887-02     $P=465.337016$  Days     $T_0=424.507923$  (BKJD)



# DV Quarter-Phased Transit Curves

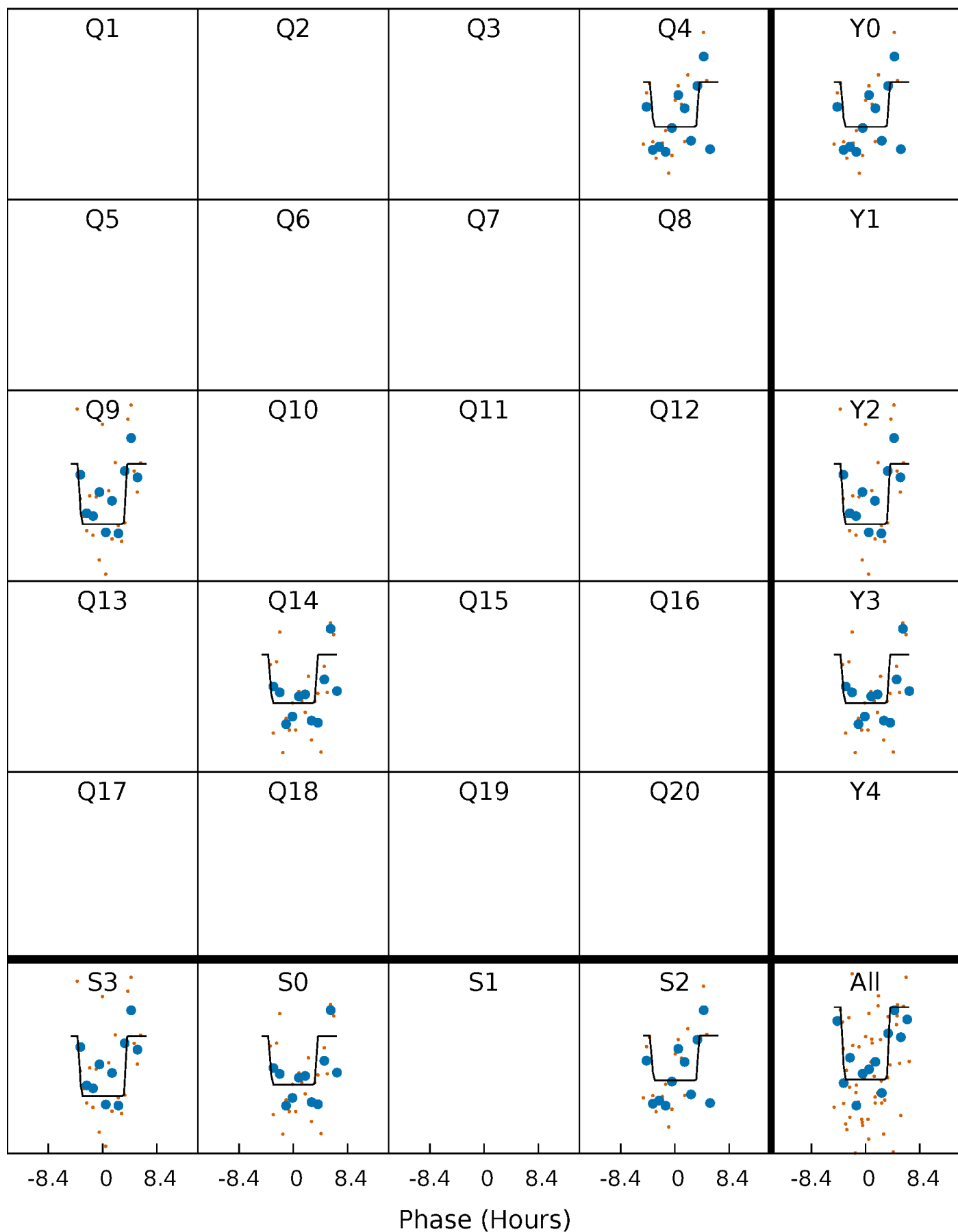
TCE 004059887-02 P=465.337016 Days  $T_0=424.507923$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

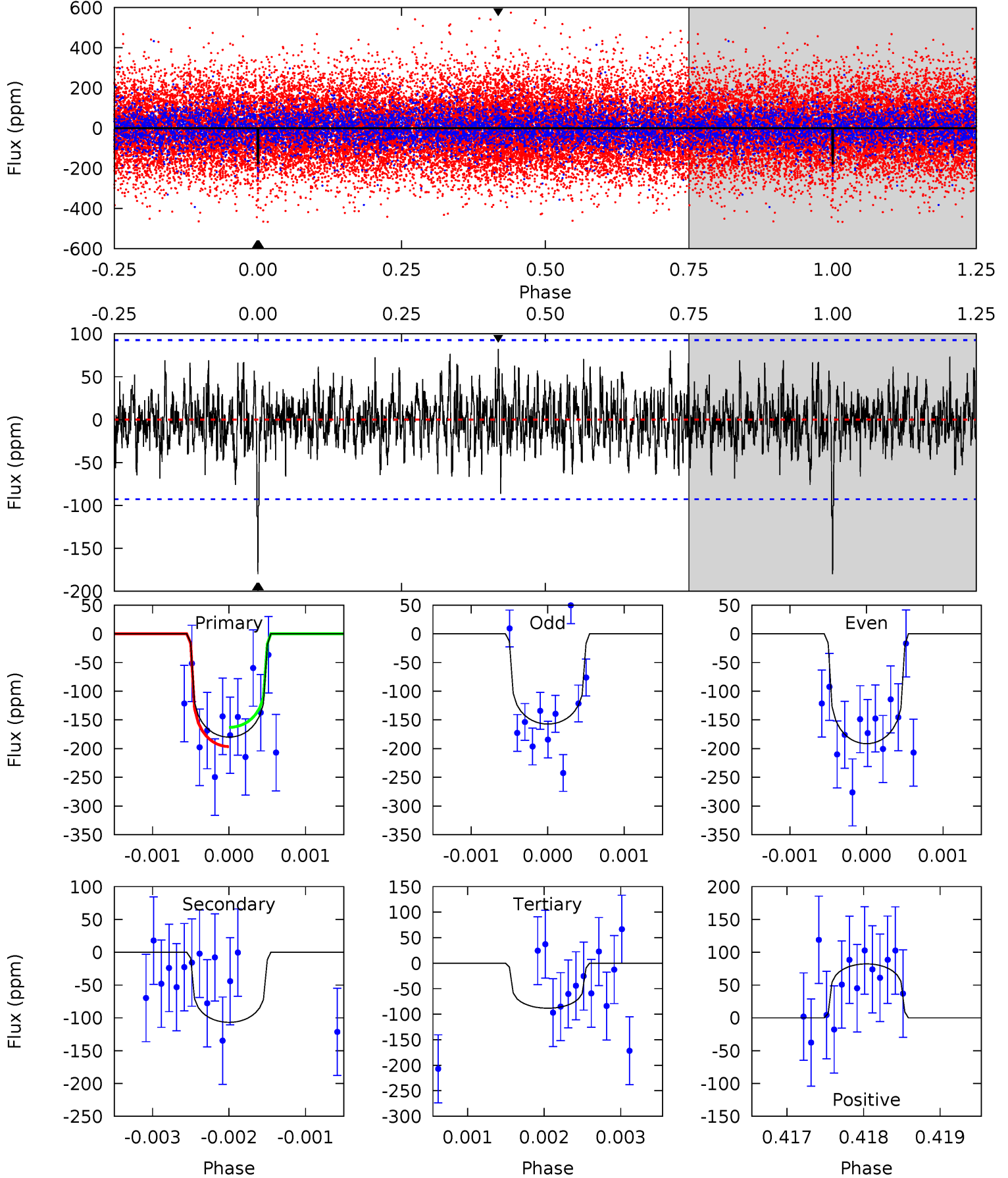
TCE 004059887-02 P=465.340273 Days  $T_0=424.464151$  (BKJD)



# DV Model-Shift Uniqueness Test

004059887-02, P = 465.337016 Days, E = 424.507923 Days

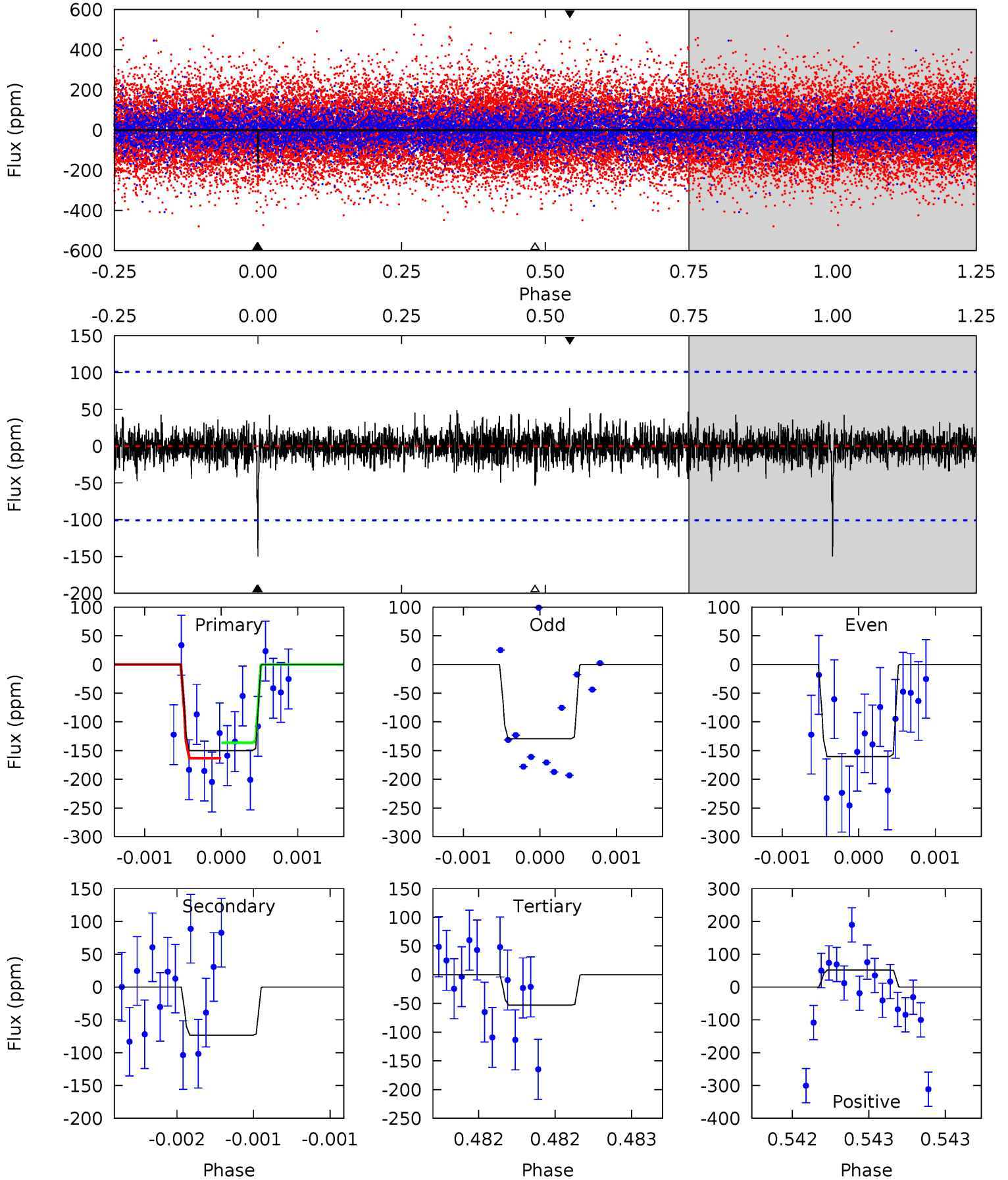
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
10.6	6.31	5.21	4.86	5.47	3.33	1.45	5.42	5.77	1.10	1.45	0.94	1.15	0.31	0.99



# Alt Model-Shift Uniqueness Test

004059887-02, P = 465.340273 Days, E = 424.464151 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
8.21	4.02	2.89	2.83	5.53	3.41	0.72	5.31	5.38	1.13	1.19	0.78	0.95	0.26	0.74



### Stellar Parameters For KIC 004059887

	$T_{\text{eff}} (K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M (M_{\odot})$	$\rho_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5858^{+87}_{-70}$	$3.729^{+0.224}_{-0.096}$	$-0.060^{+0.150}_{-0.150}$	$2.638^{+0.441}_{-0.818}$	$1.358^{+0.136}_{-0.252}$	$0.104^{+0.156}_{-0.034}$
	+1%/-1%	+6%/-3%	+250%/-250%	+17%/-31%	+10%/-19%	+150%/-33%
Source	SPE68	SPE68	SPE68	DSEP		

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

### Secondary Eclipse Parameters for KIC 004059887-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-107 \pm 17$	$4.29^{+2.43}_{-2.05}$	$510^{+24}_{-33}$	$4909^{+1733}_{-814}$	$5374^{+14560}_{-3244}$
Alt.	$-74 \pm 18$	$3.55^{+2.45}_{-1.91}$	$508^{+26}_{-38}$	$4849^{+2048}_{-853}$	$5204^{+20403}_{-3416}$

$T_{\text{max}}$  = 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

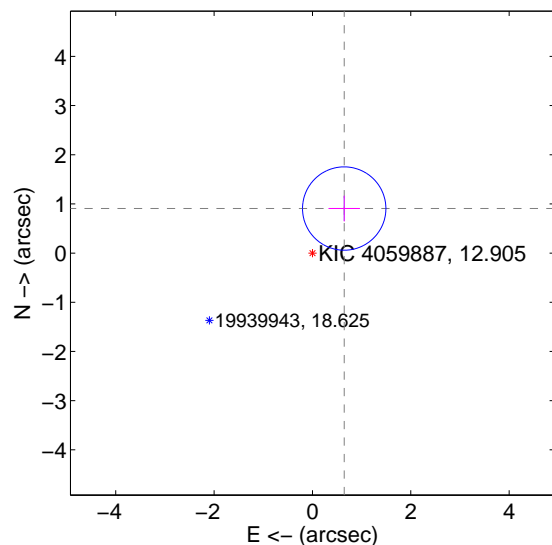
Supplemental centroid analysis for 004059887-02. Kepler magnitude: 12.90. Transit SNR 9.84

There are 1 quarters with good PRF difference image offsets

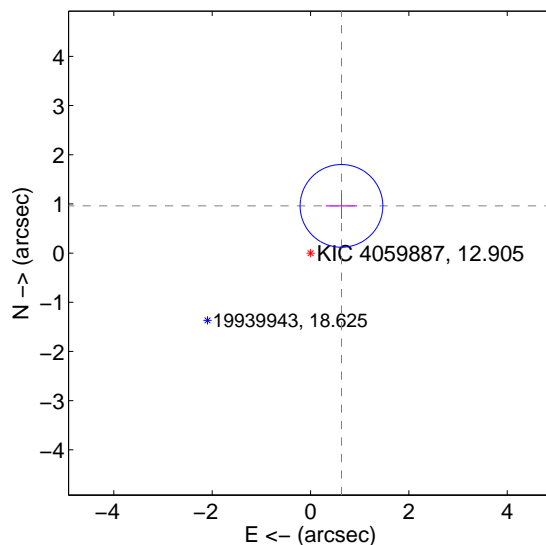
The direct PRF centroid is offset from the target star catalog position by about 0.06 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.113 \pm 0.282$	3.94	$-0.646 \pm 0.318$	$0.906 \pm 0.262$
PRF-fit source offset from KIC position	$1.148 \pm 0.280$	4.09	$-0.629 \pm 0.318$	$0.960 \pm 0.262$
photometric centroid source offset	$0.56 \pm 1.18$	0.48	$-0.43 \pm 1.03$	$-0.36 \pm 1.37$

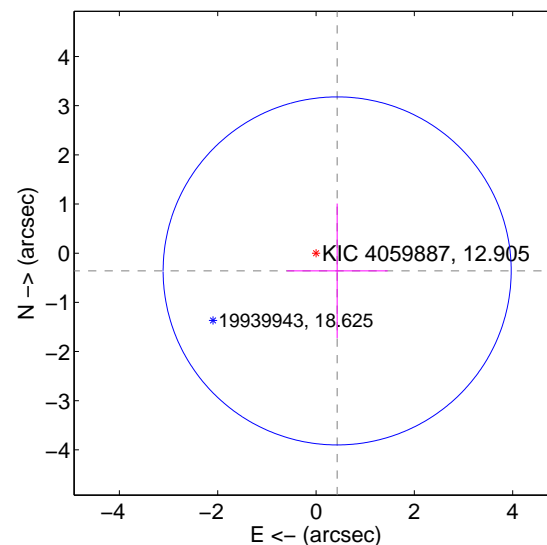
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

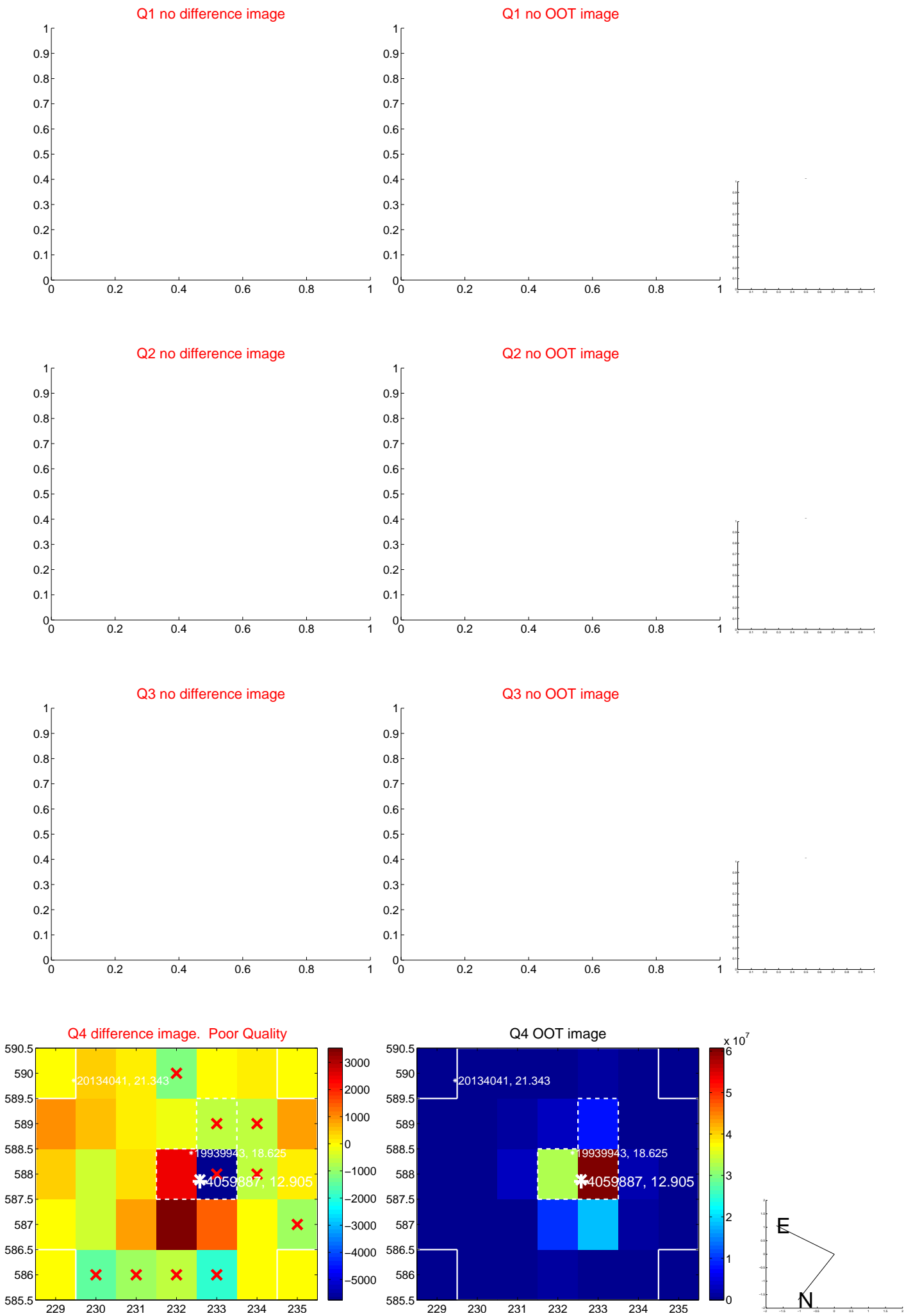


offset from photometric centroids



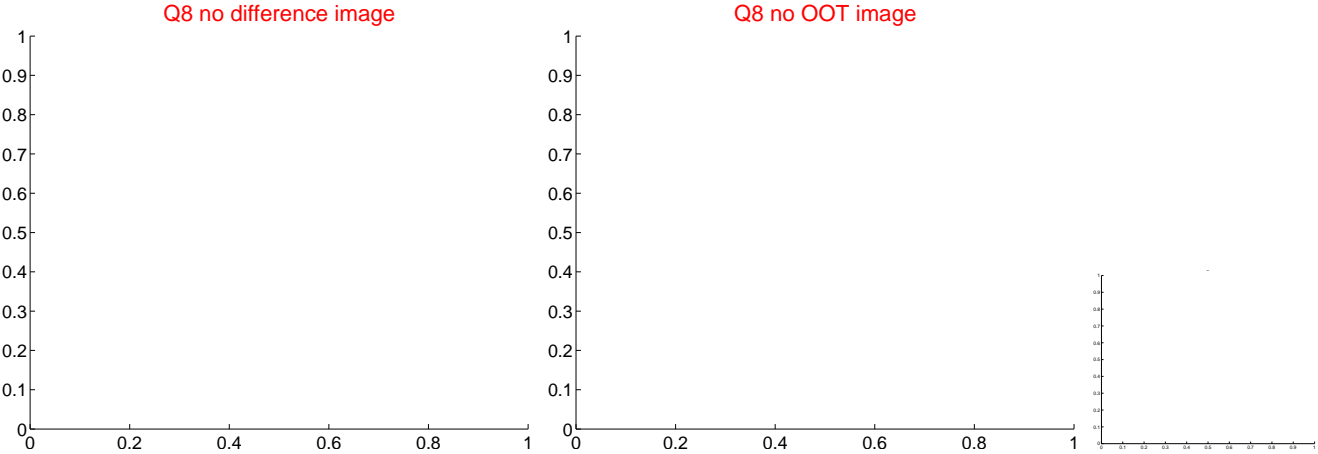
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

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

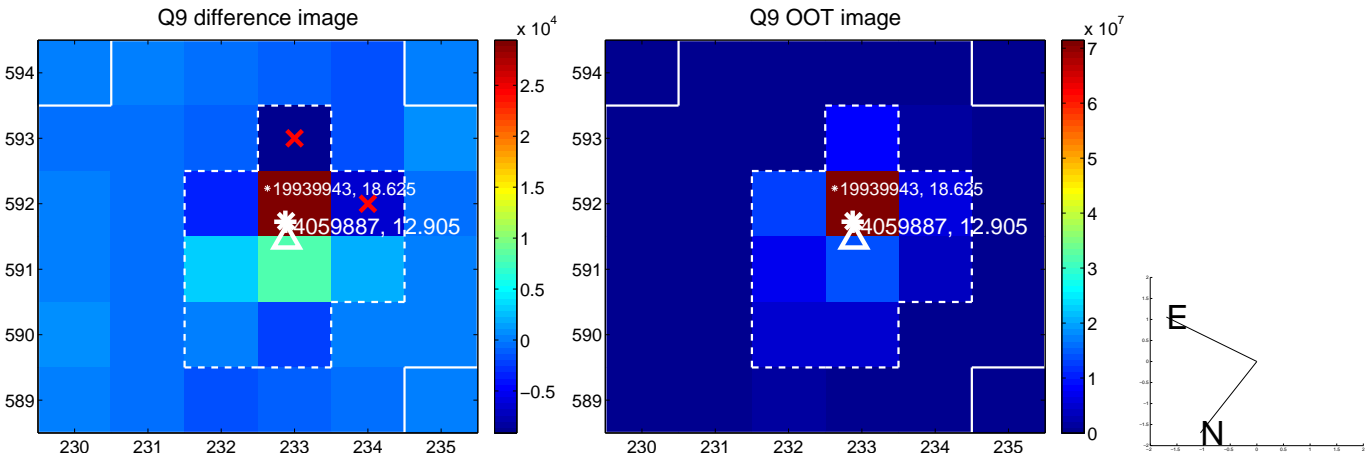




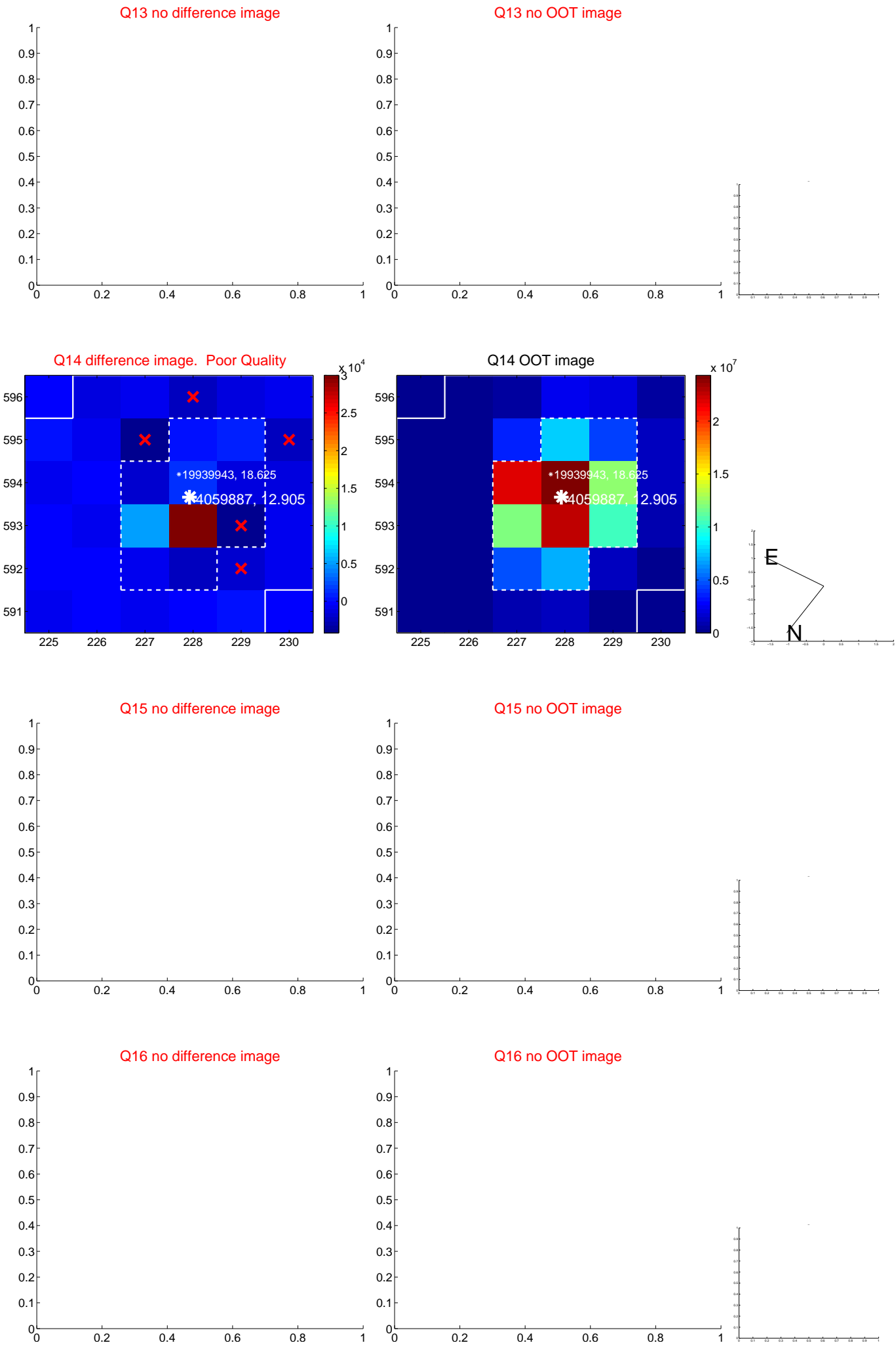
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



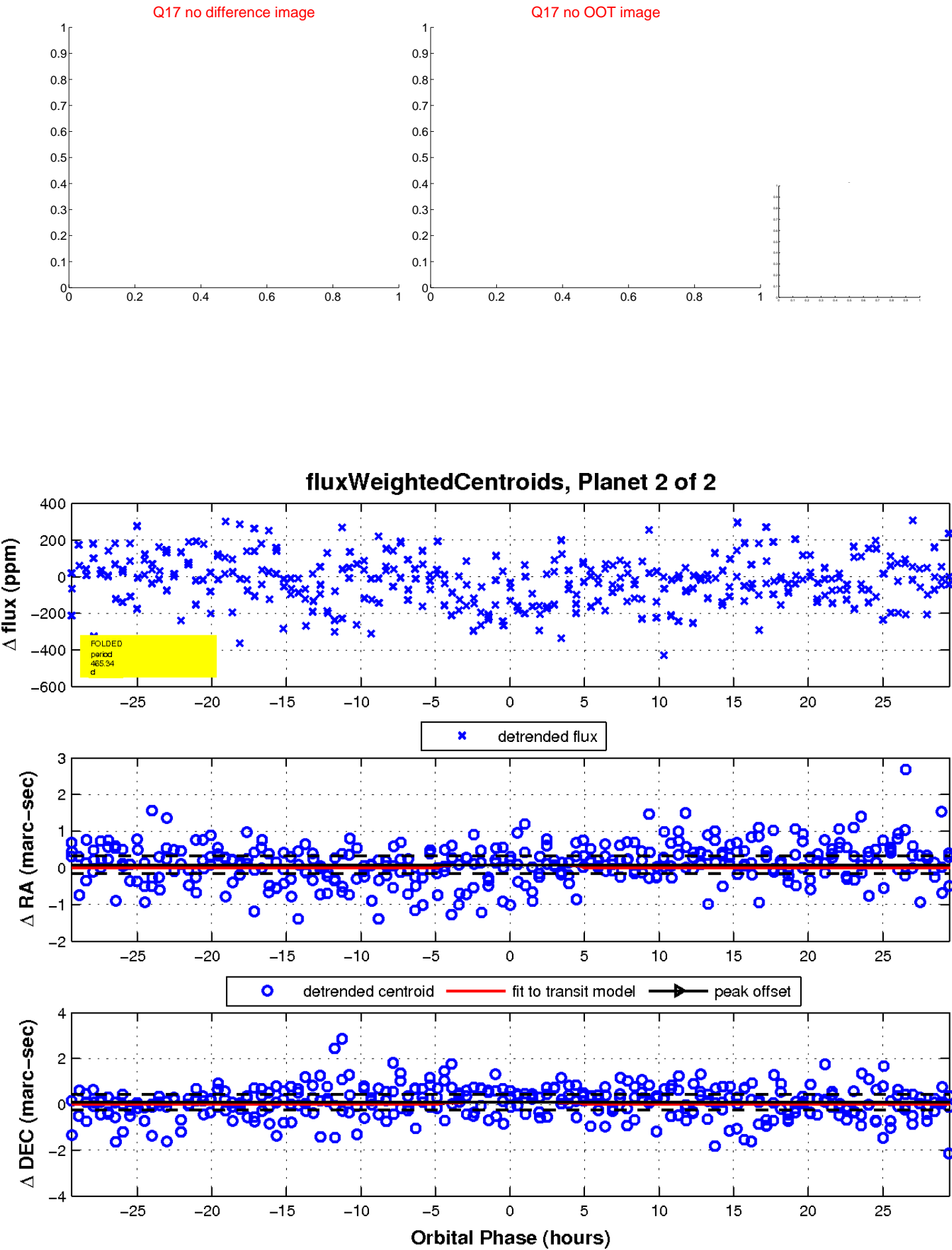
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



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



UKIRT Image

