

# KIC 009772087

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009772087-01	OBS	No	3.412721	133.855647	35.7	12.651	11.9	7.7	2.59	6943	1.82	4754.98
009772087-02	OBS	No	3.412658	132.364309	24.9	26.255	16.3	7.3	2.59	6943	1.31	4755.10

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009772087-01	OBS	FP	0.00	1	0	0	0	LPP_DV
009772087-02	OBS	FP	0.00	1	0	0	0	LPP_DV—LPP_ALT—SAME_NTL_PERIOD

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

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

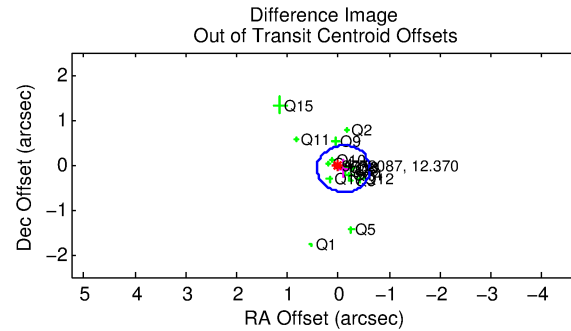
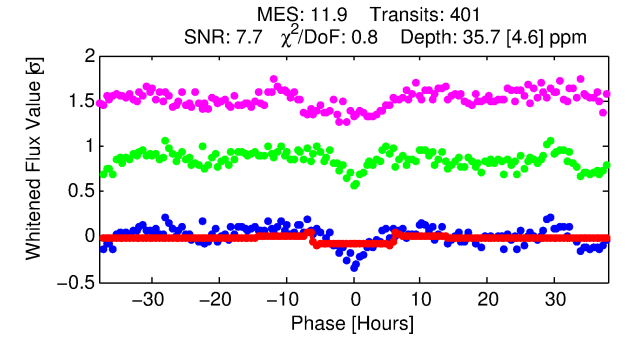
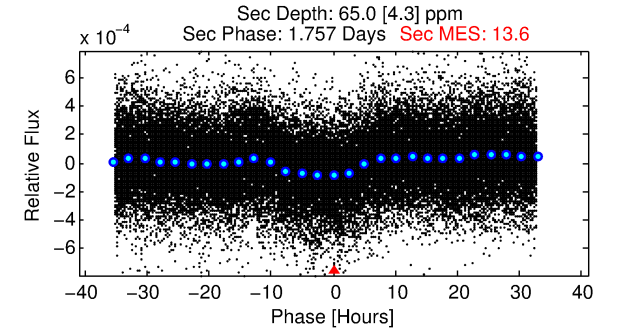
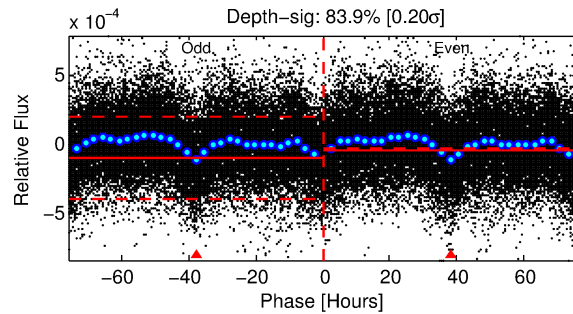
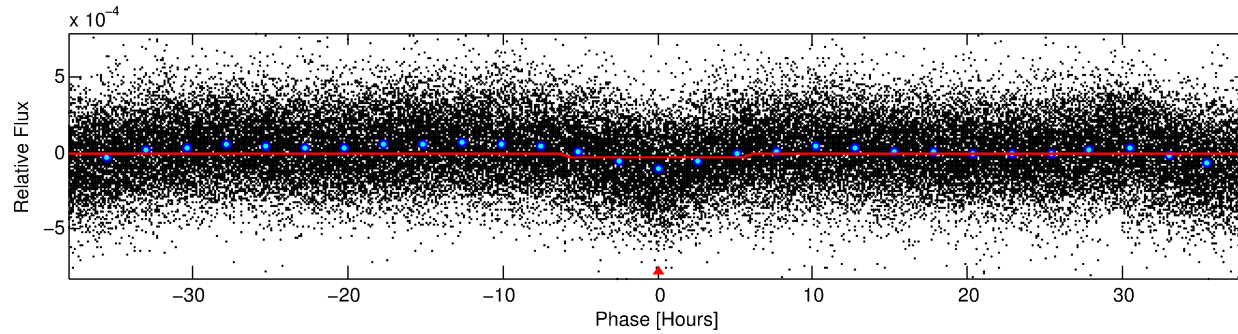
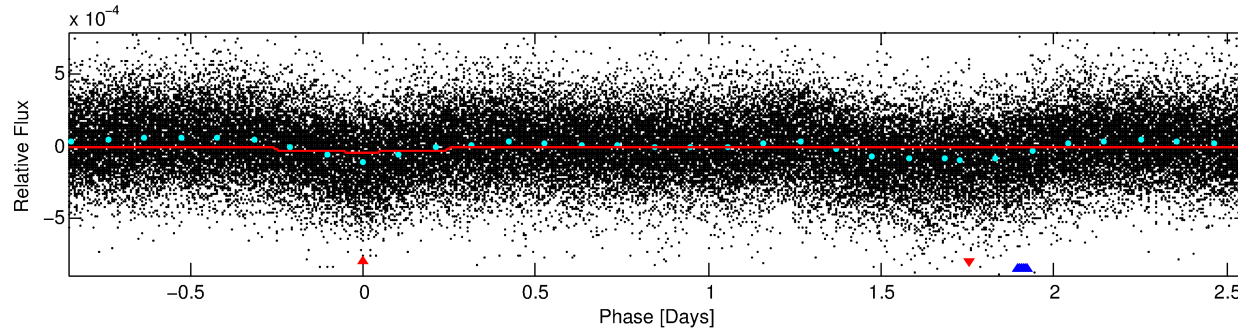
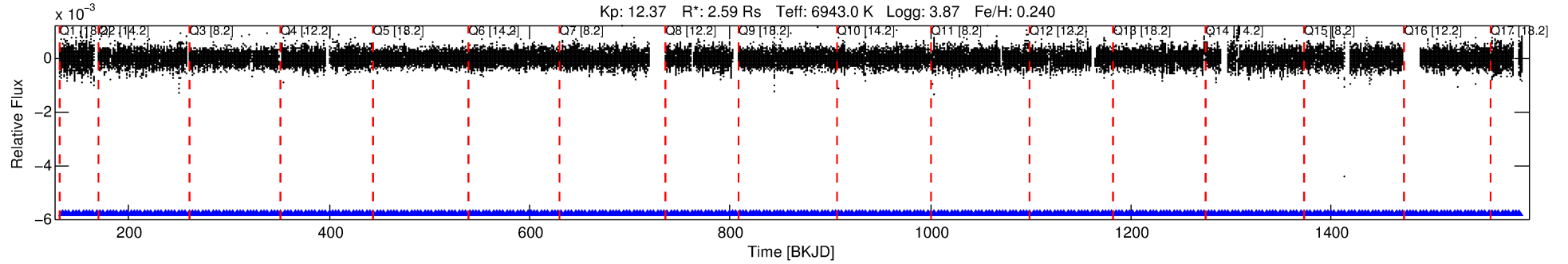
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 009772087-01

No Significant Match Found

# DV One-Page Summary

KIC: 9772087 Candidate: 1 of 2 Period: 3.413 d



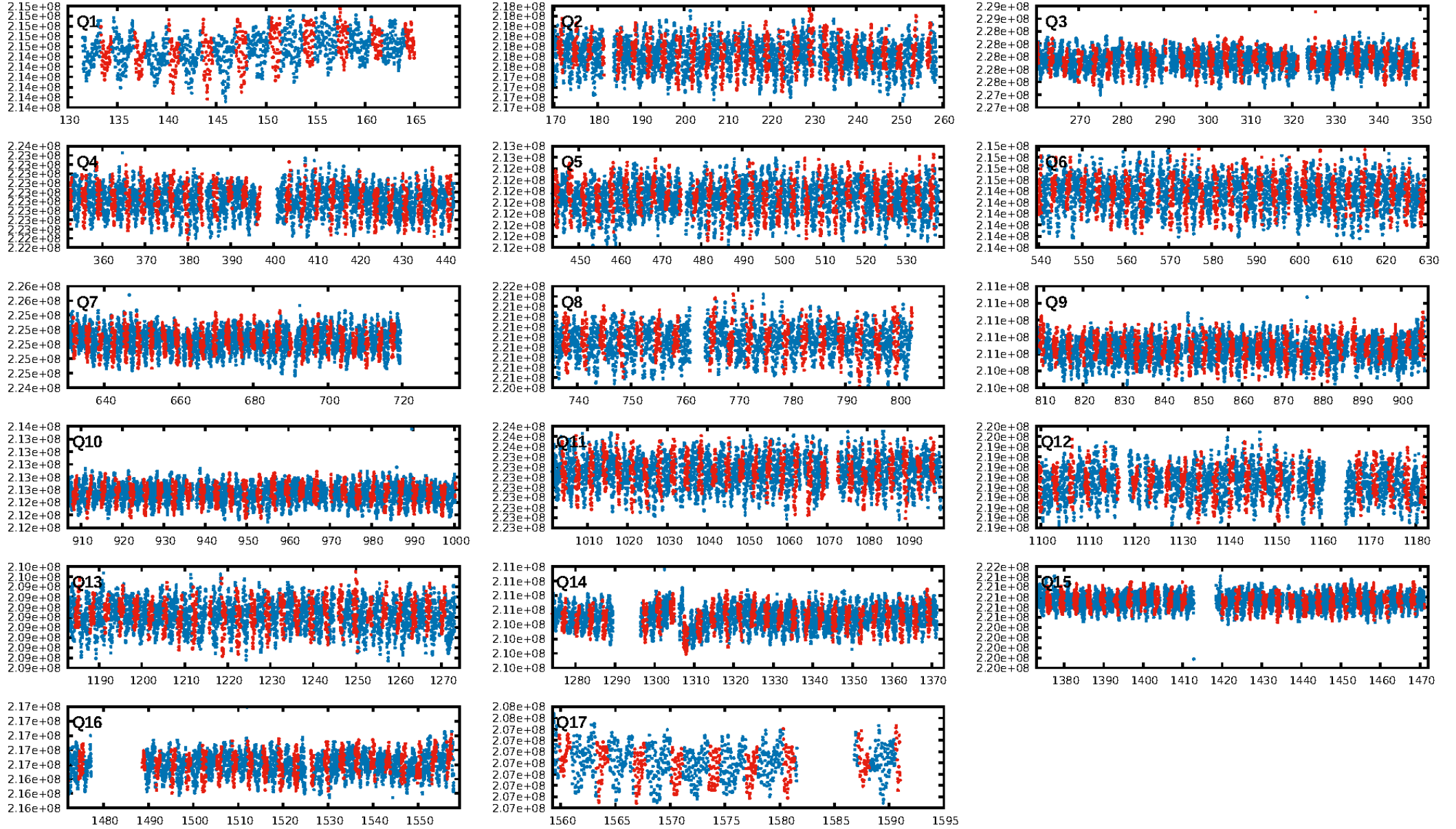
## DV Fit Results:

Period = 3.41272 [0.00003] d  
Epoch = 133.8556 [0.0056] BKJD  
Rp/R\* = 0.0064 [0.0006]  
a/R\* = 1.29 [0.23]  
b = 0.91 [0.08]  
Seff = 4754.98 [2765.78]  
Teq = 2117 [308] K  
Rp = 1.82 [0.70] Re  
a = 0.0542 [0.0190] AU  
Ag = 31.74 [18.80] [1.64 $\sigma$ ]  
Teffp = 7771 [540] K [9.10 $\sigma$ ]

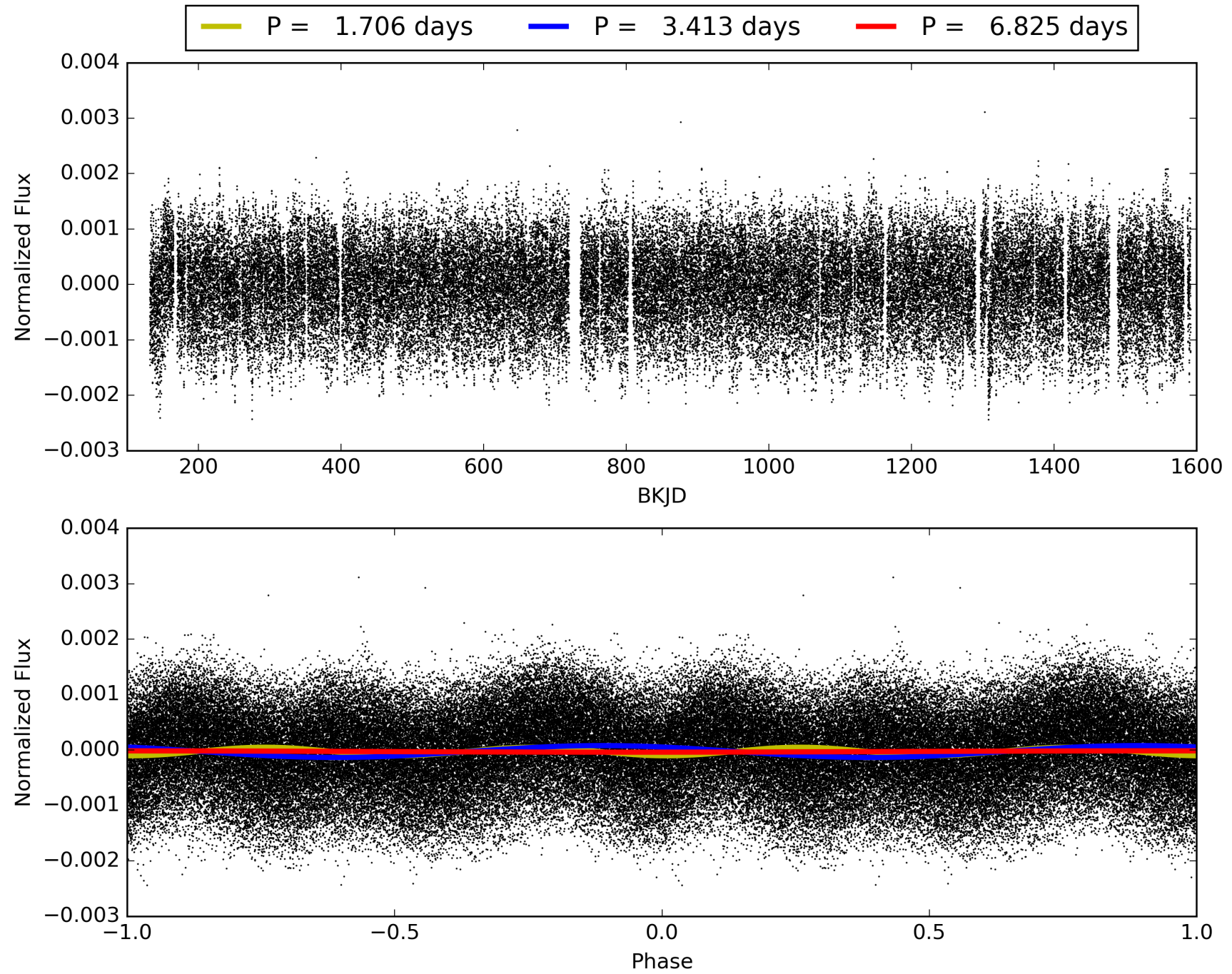
## DV Diagnostic Results:

ShortPeriod-sig: 0.0% [0.00 $\sigma$ ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: N/A  
RollingBand-fgt: 1.00 [382/382]  
GhostDiagnostic-chr: 1.75  
Centroid-sig: 8.5%  
Centroid-so: 0.641 arcsec [1.40 $\sigma$ ]  
OotOffset-rm: 0.139 arcsec [0.80 $\sigma$ ]  
OotOffset-st: 4/4/3/5 [16]  
KicOffset-rm: 0.281 arcsec [1.55 $\sigma$ ]  
KicOffset-st: 4/4/3/5 [16]  
DiffImageQuality-fgm: 1.00 [16/16]  
DiffImageOverlap-fno: 1.00 [17/17]

# TCE 009772087-01, PDC Light Curves



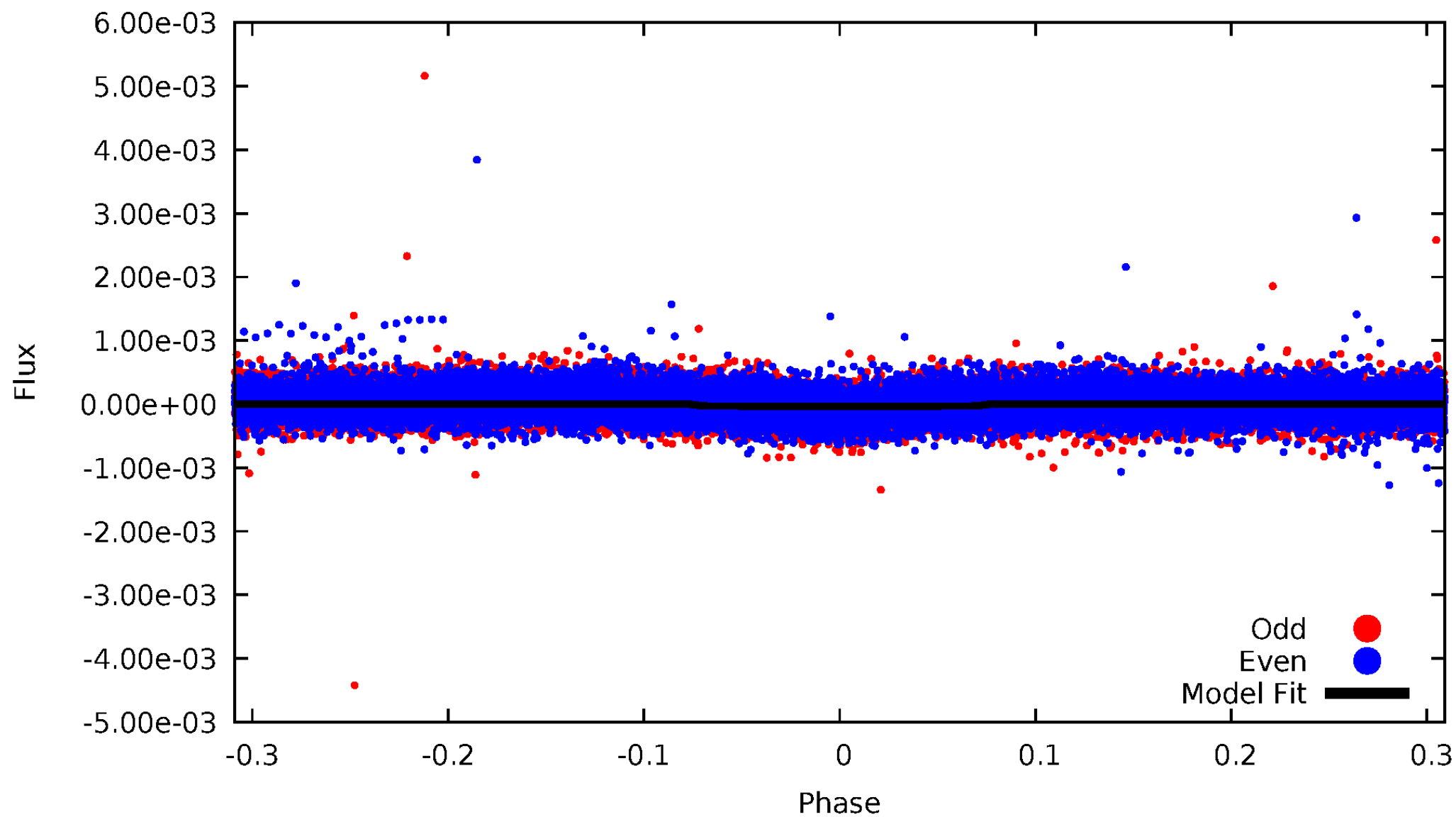
TCE 009772087-01





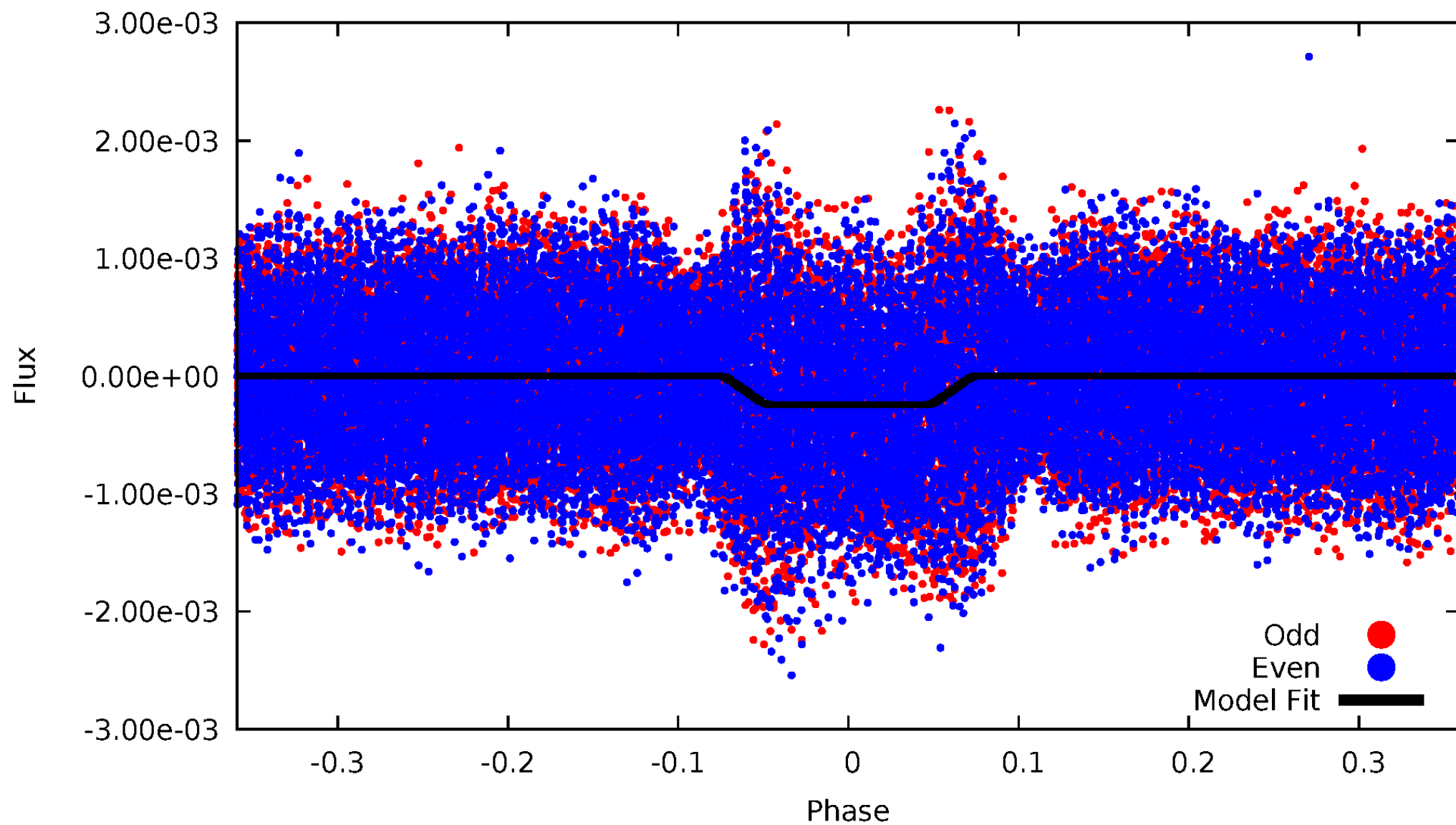
# DV Odd/Even

TCE 009772087-01

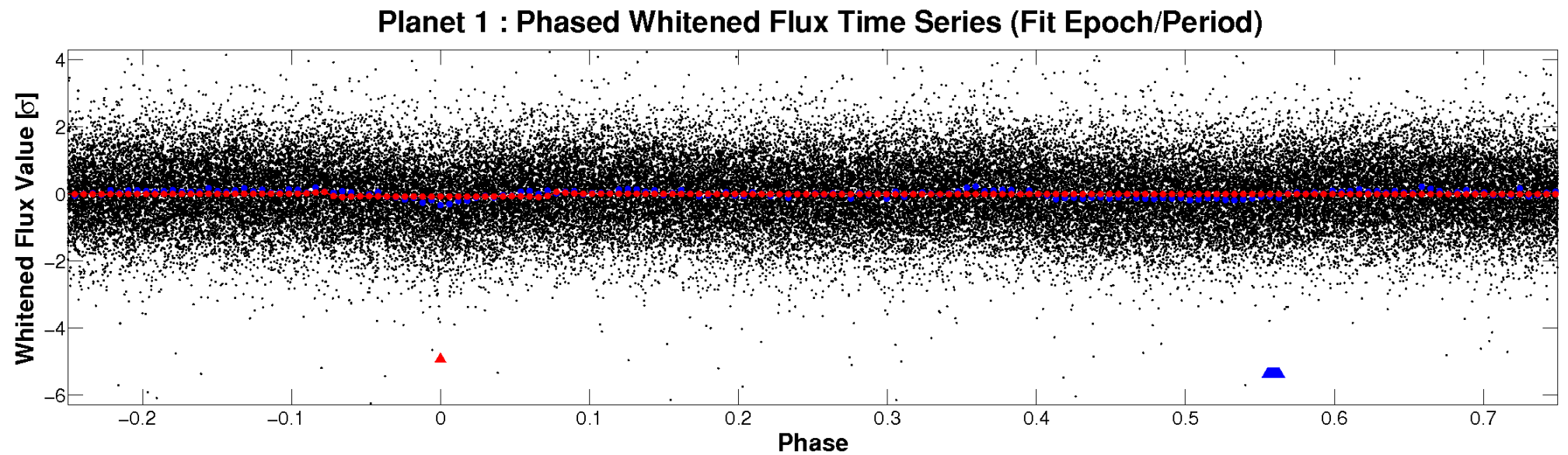
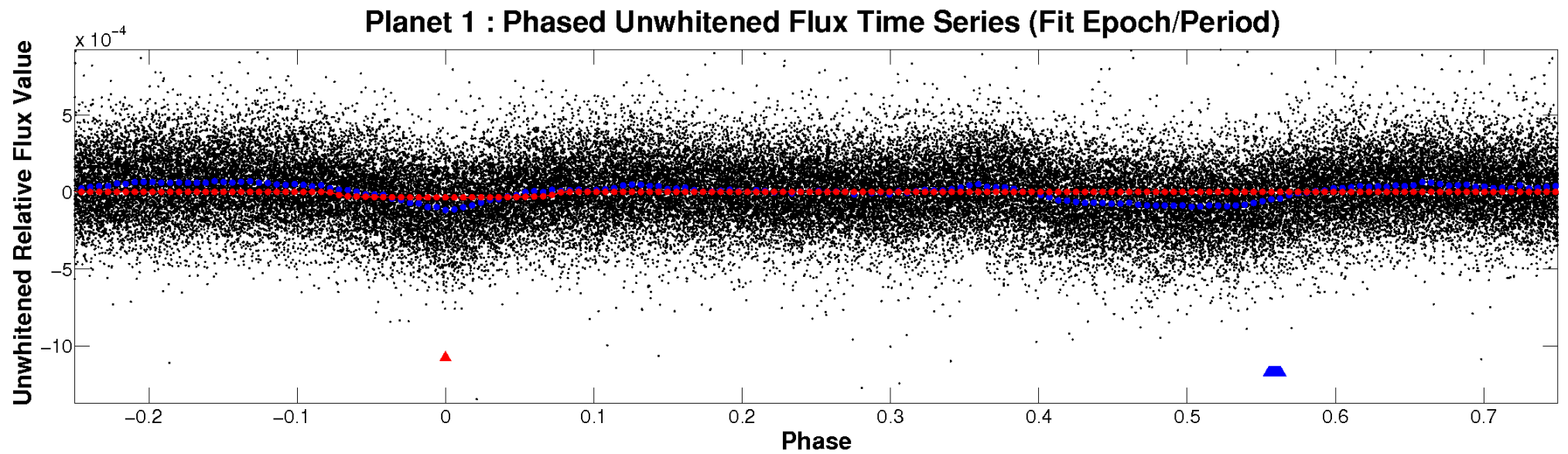


# ALT Odd/Even

TCE 009772087-01

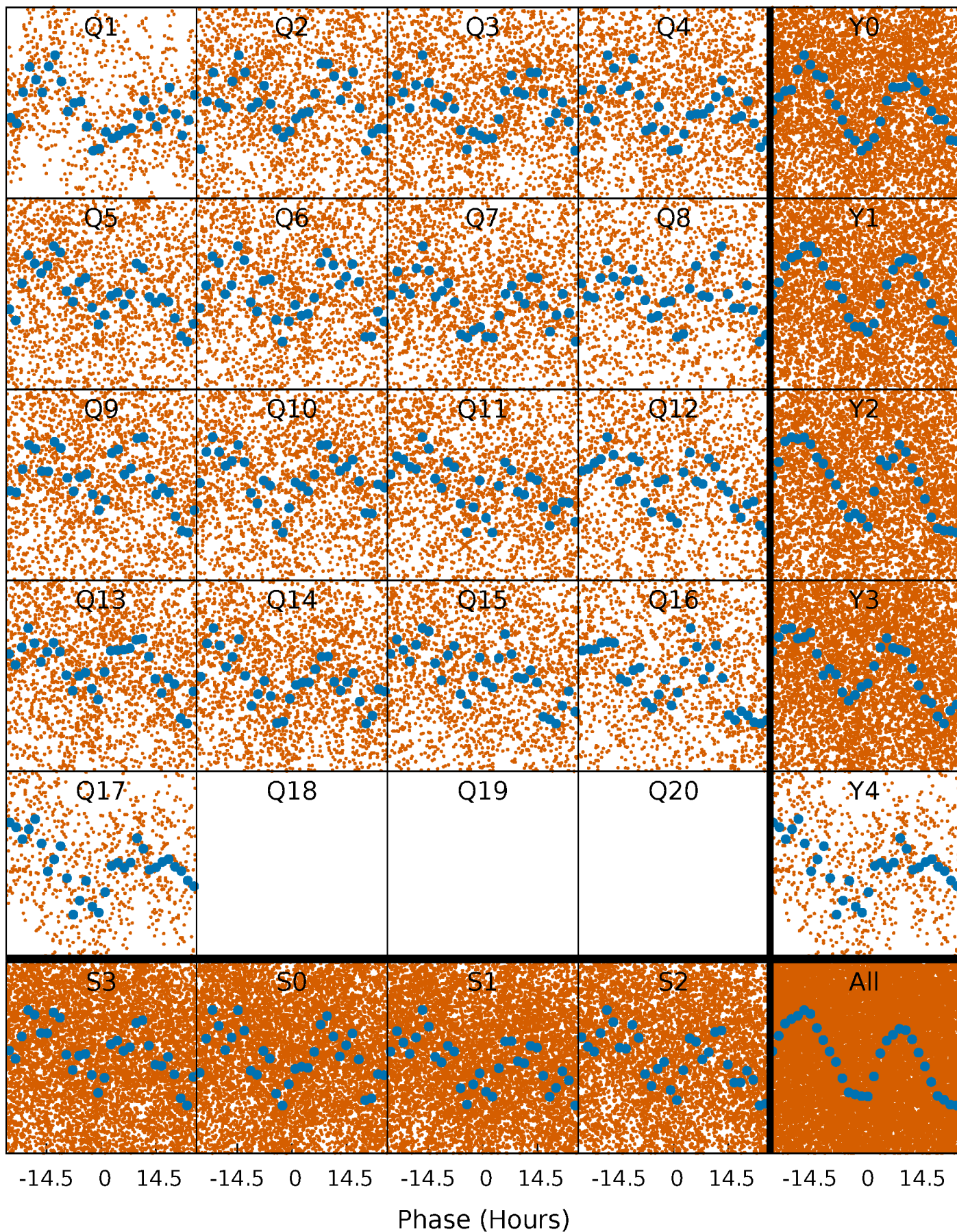


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

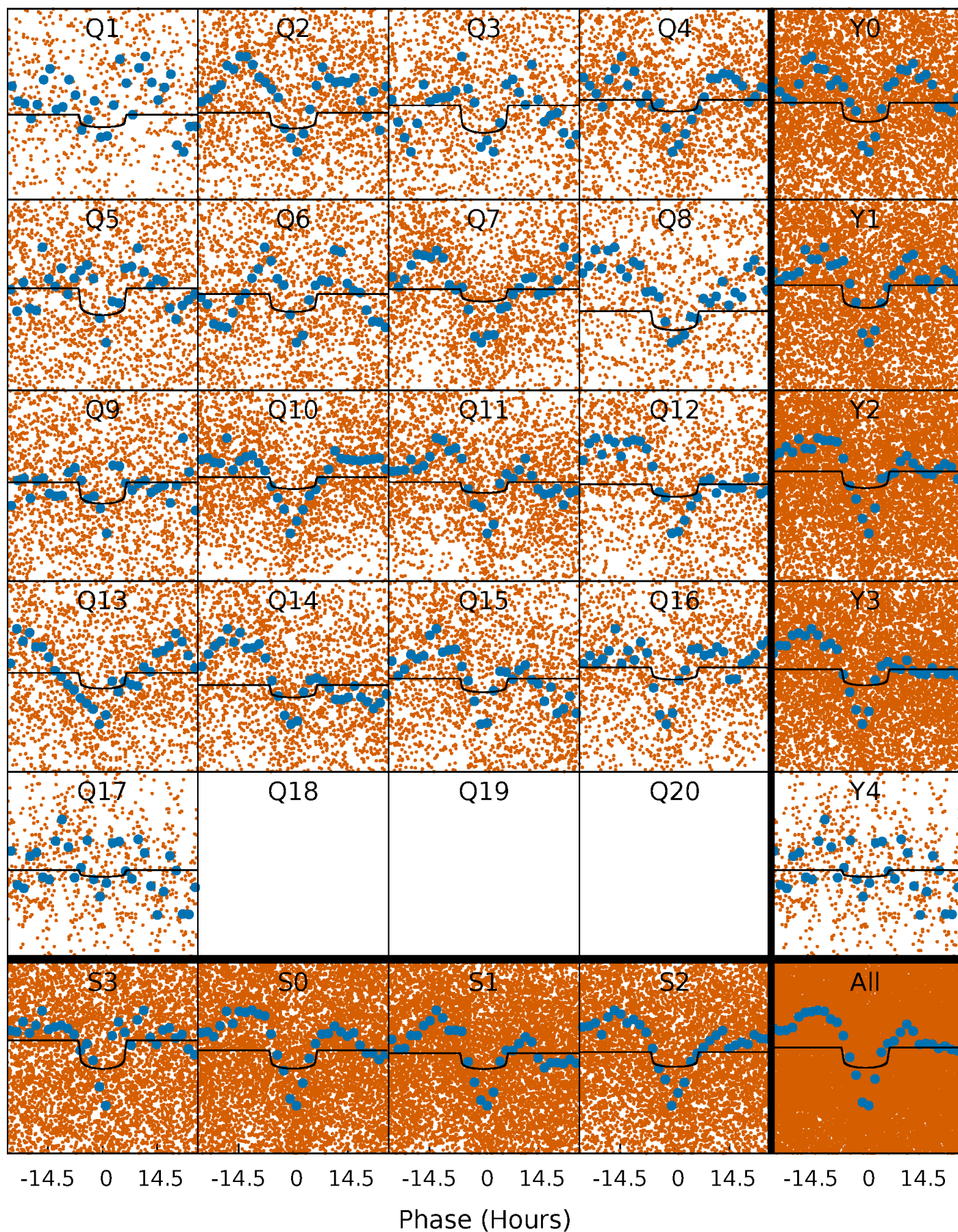
TCE 009772087-01 P= 3.412721 Days  $T_0=133.855648$  (BKJD)





# DV Quarter-Phased Transit Curves

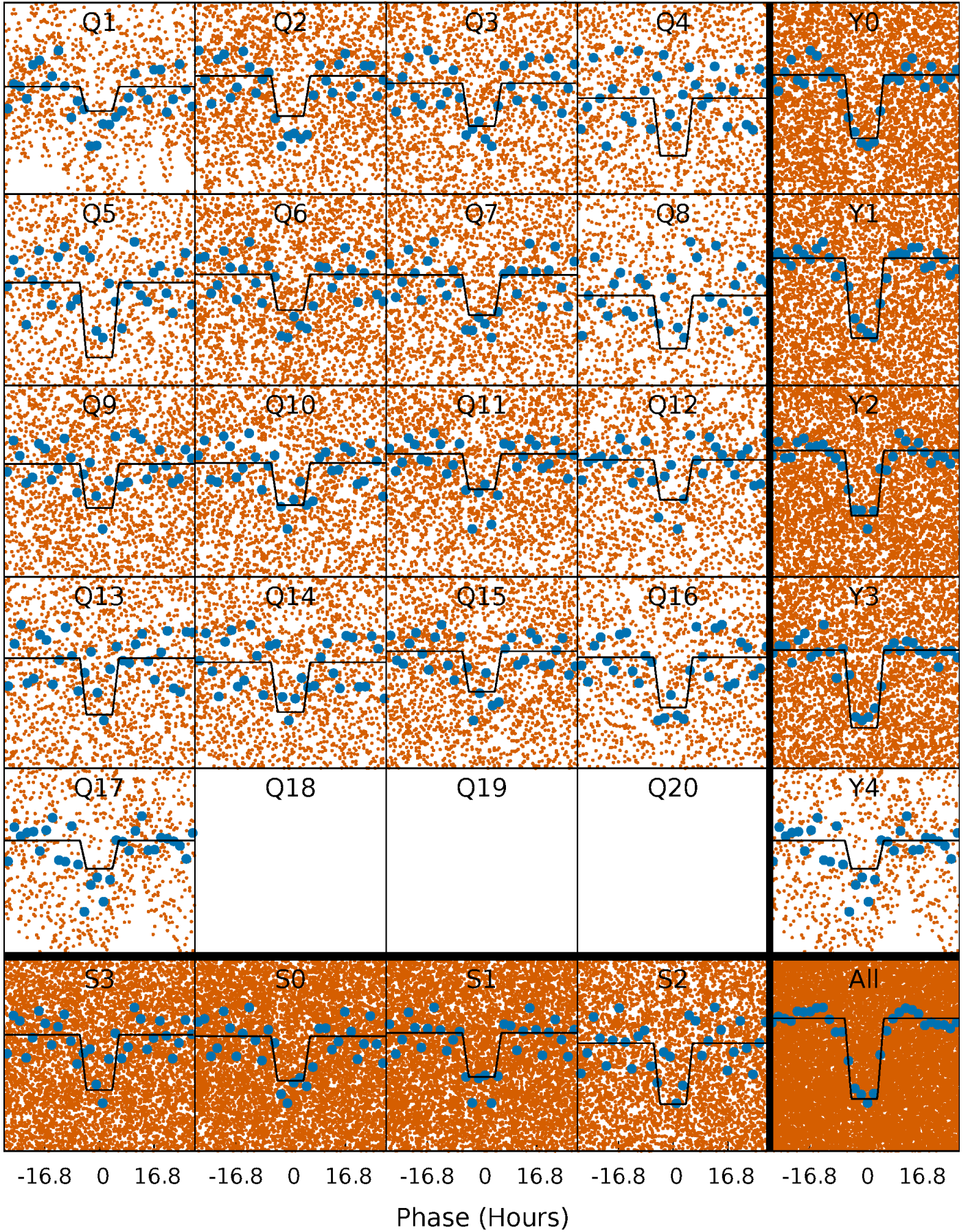
TCE 009772087-01 P= 3.412721 Days  $T_0=133.855648$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

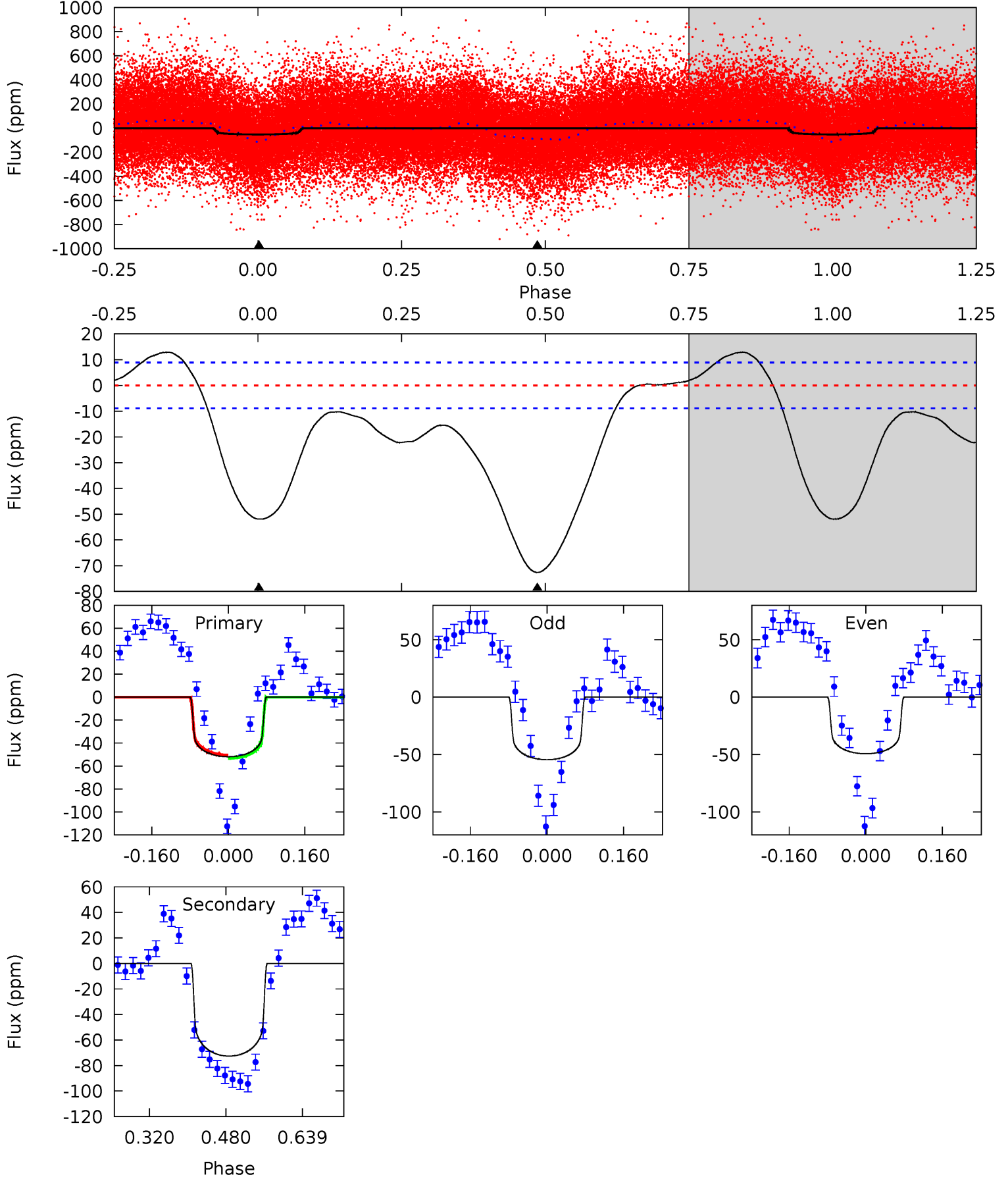
TCE 009772087-01 P= 3.412441 Days  $T_0=133.874718$  (BKJD)



# DV Model-Shift Uniqueness Test

009772087-01, P = 3.412721 Days, E = 130.442927 Days

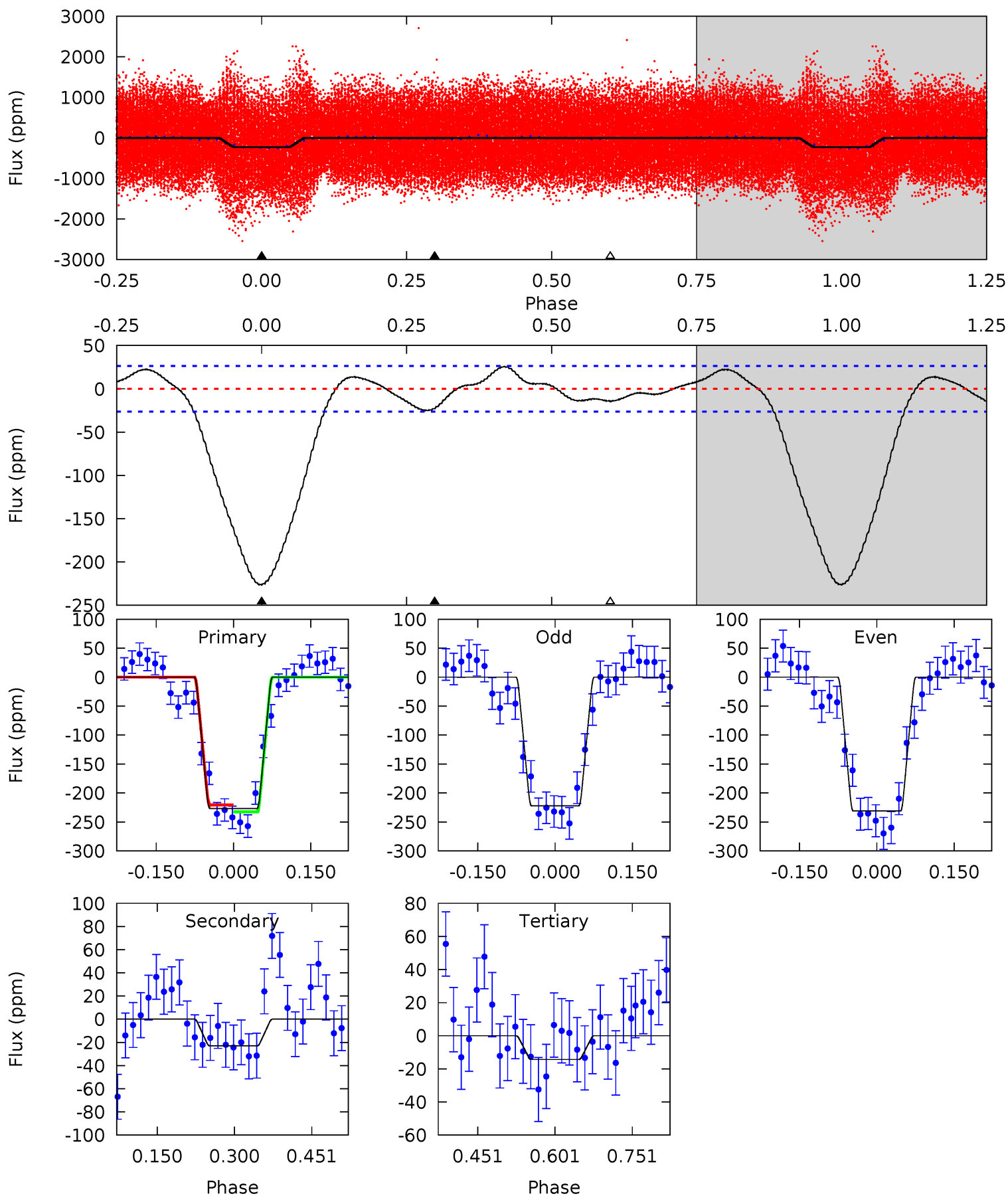
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
26.1	36.5	0	0	4.47	1.41	5.85	26.1	26.1	36.5	36.5	1.31	0.97	0.15	0.69



# Alt Model-Shift Uniqueness Test

009772087-01, P = 3.412441 Days, E = 130.462277 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
38.6	3.93	2.45	0	4.48	1.44	1.87	36.2	38.6	1.48	3.93	0.77	1.19	0.10	1.03





### Stellar Parameters For KIC 009772087

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6943^{+192}_{-312}$	$3.872^{+0.322}_{-0.138}$	$0.240^{+0.150}_{-0.350}$	$2.590^{+0.563}_{-0.965}$	$1.823^{+0.185}_{-0.431}$	$0.148^{+0.342}_{-0.058}$
	+3%/-4%	+8%/-4%	+62%/-146%	+22%/-37%	+10%/-24%	+231%/-39%
Source	PHO54	PHO54	PHO54	DSEP		

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

### Secondary Eclipse Parameters for KIC 009772087-01 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-73 \pm 2$	$1.73^{+0.31}_{-0.36}$	$2874^{+238}_{-269}$	$8102^{+671}_{-581}$	$39^{+21}_{-11}$
Alt.	$-23 \pm 6$	$4.29^{+0.66}_{-0.91}$	$2904^{+227}_{-309}$	$3984^{+228}_{-278}$	$2.033^{+1.207}_{-0.705}$

$T_{\text{max}}$  = 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

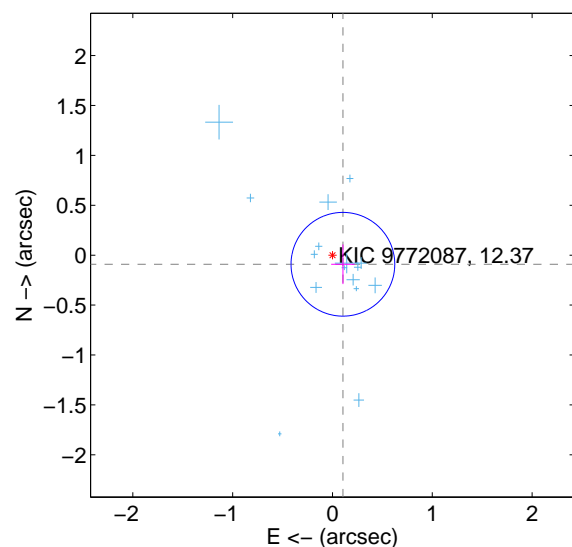
Supplemental centroid analysis for 009772087-01. Kepler magnitude: 12.37. Transit SNR 7.72

There are 16 quarters with good PRF difference image offsets

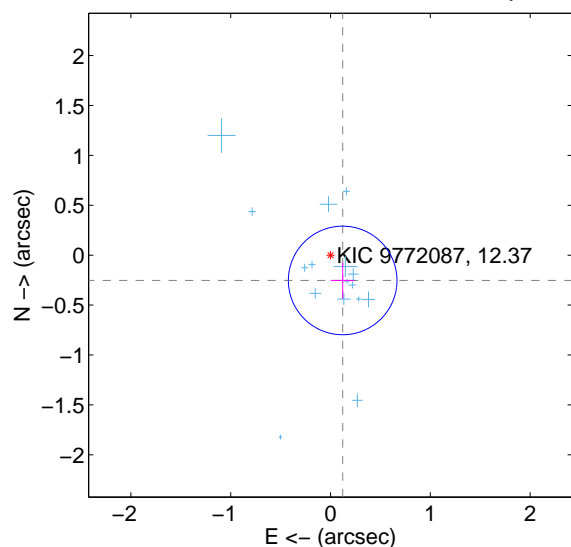
The direct PRF centroid is offset from the target star catalog position by about 0.06 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.139 \pm 0.173$	0.80	$-0.104 \pm 0.117$	$-0.091 \pm 0.198$
PRF-fit source offset from KIC position	$0.281 \pm 0.181$	1.55	$-0.122 \pm 0.119$	$-0.253 \pm 0.181$
photometric centroid source offset	$0.64 \pm 0.46$	1.40	$-0.57 \pm 0.44$	$0.30 \pm 0.53$

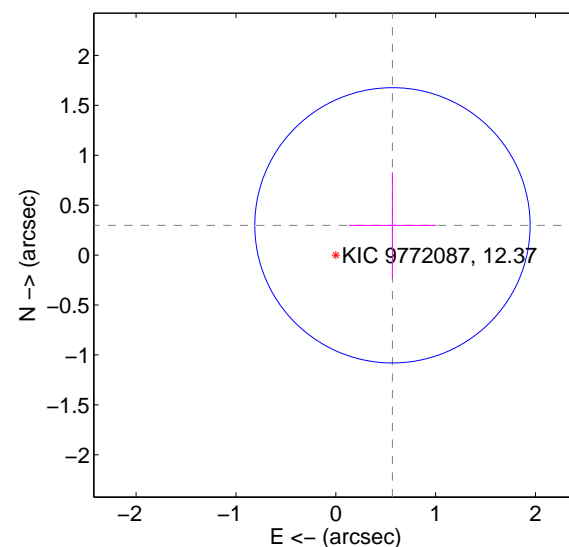
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

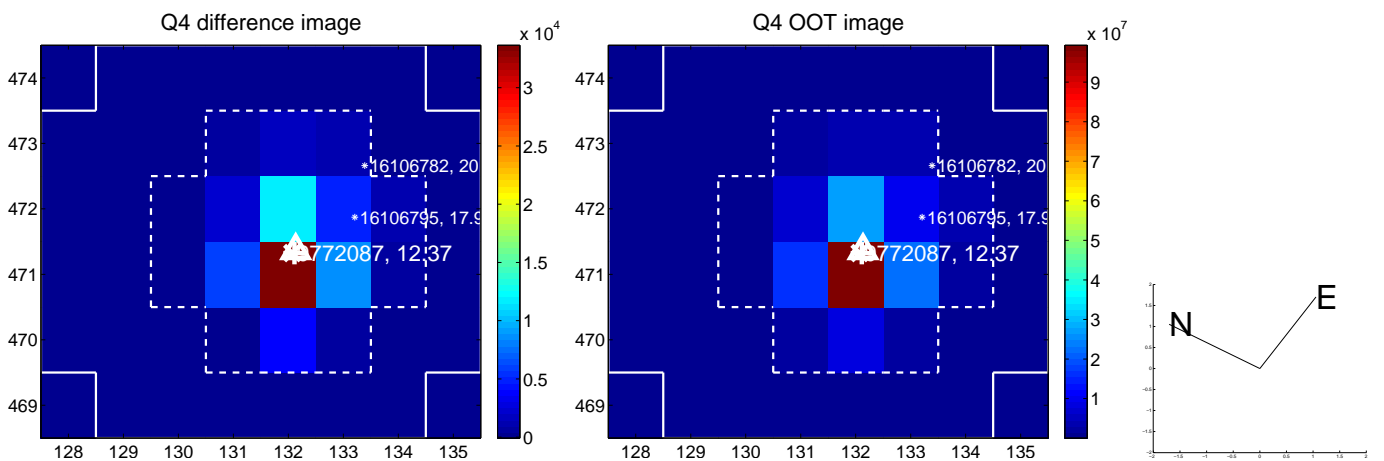
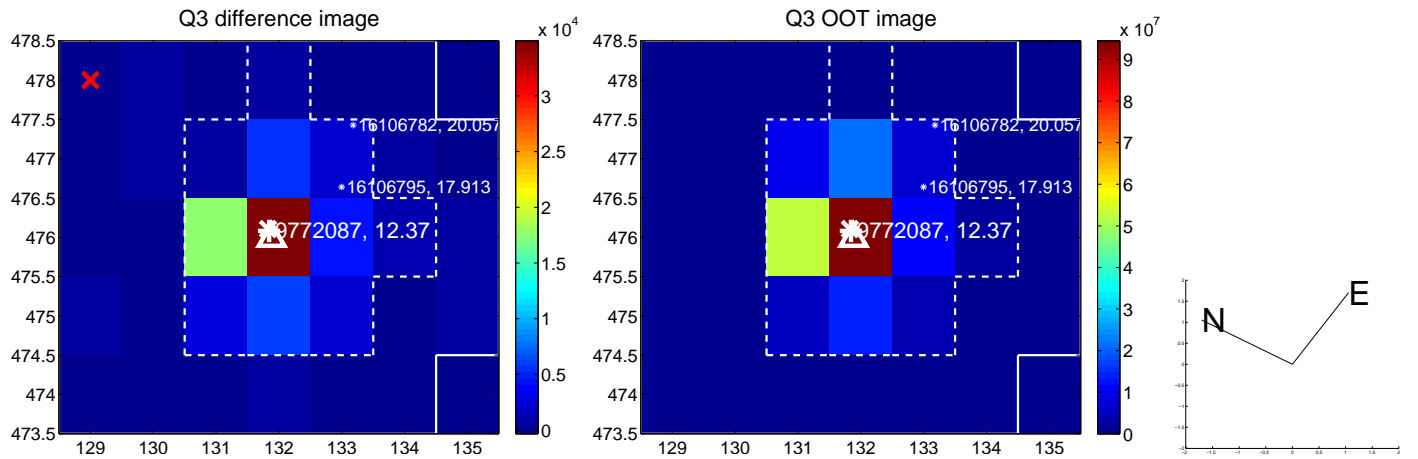
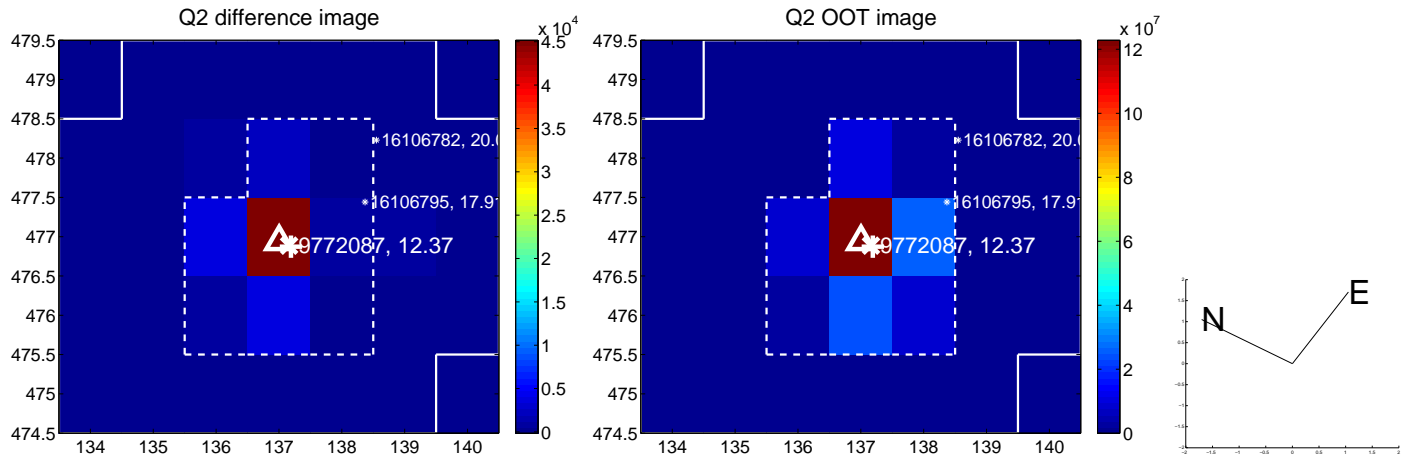
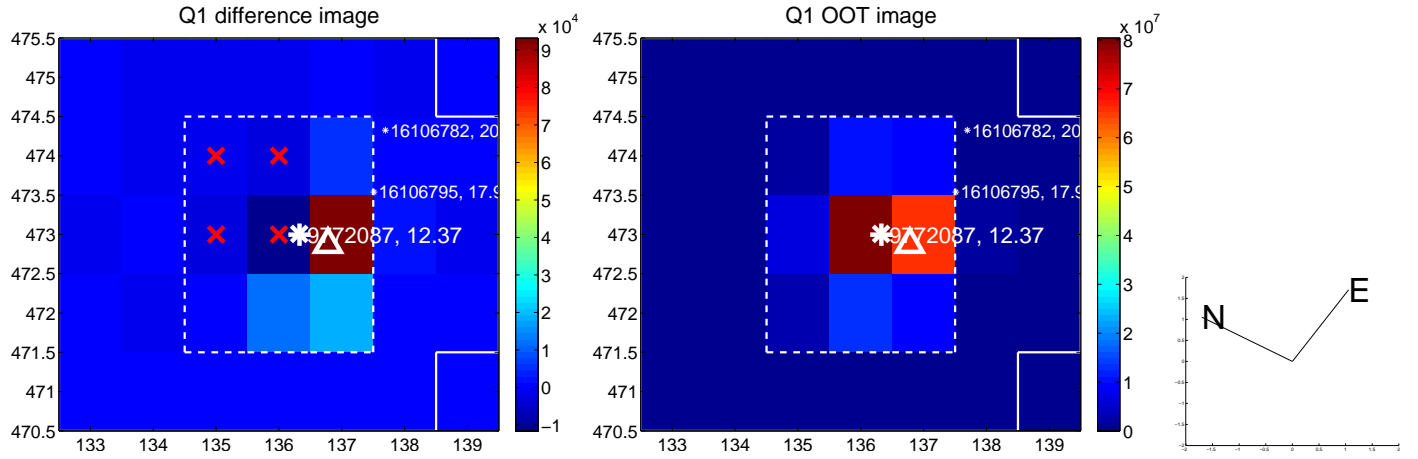


offset from photometric centroids

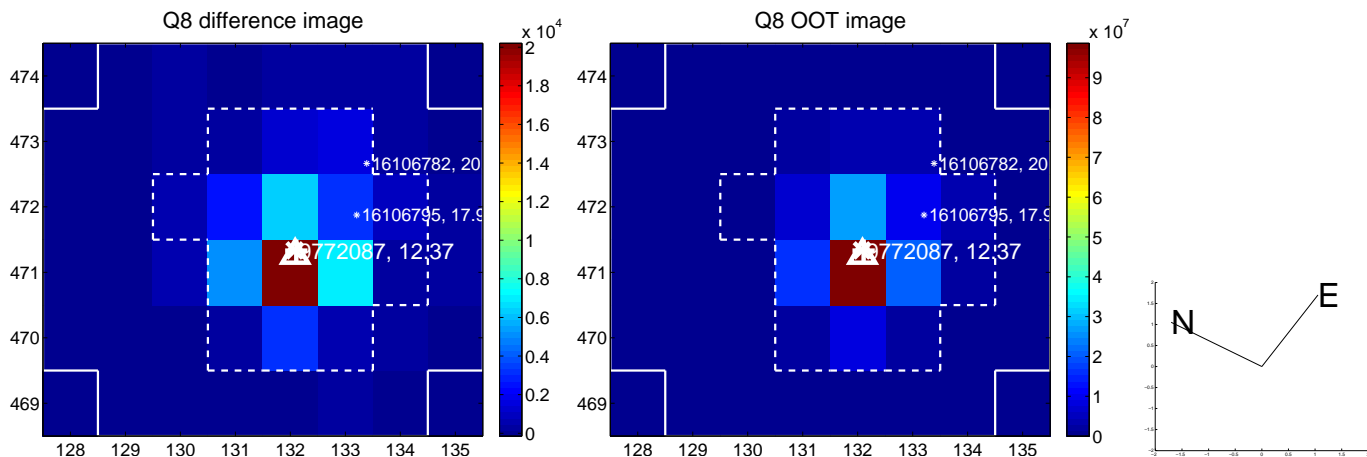
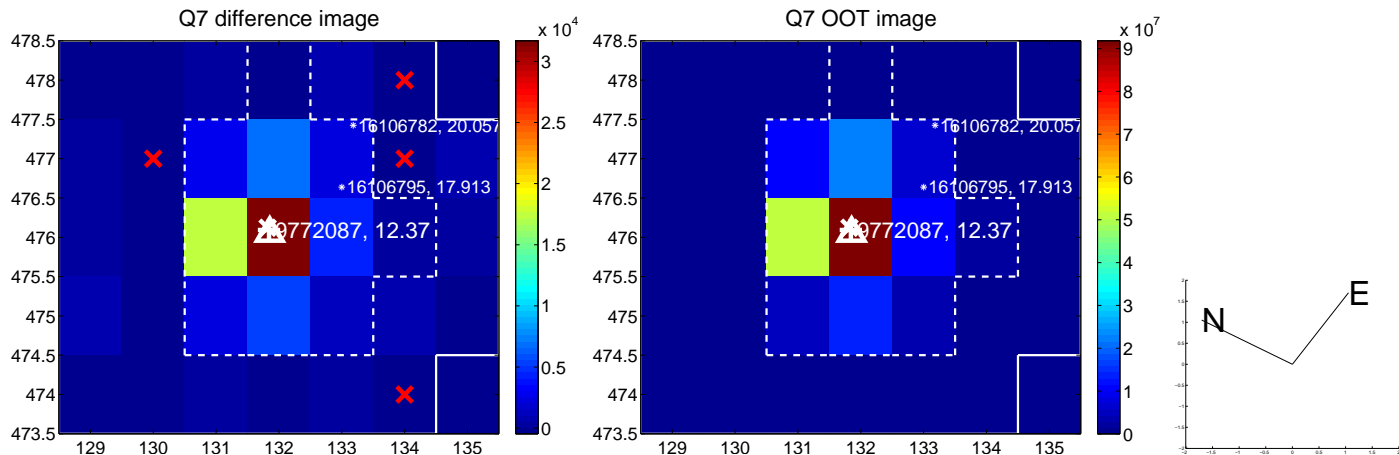
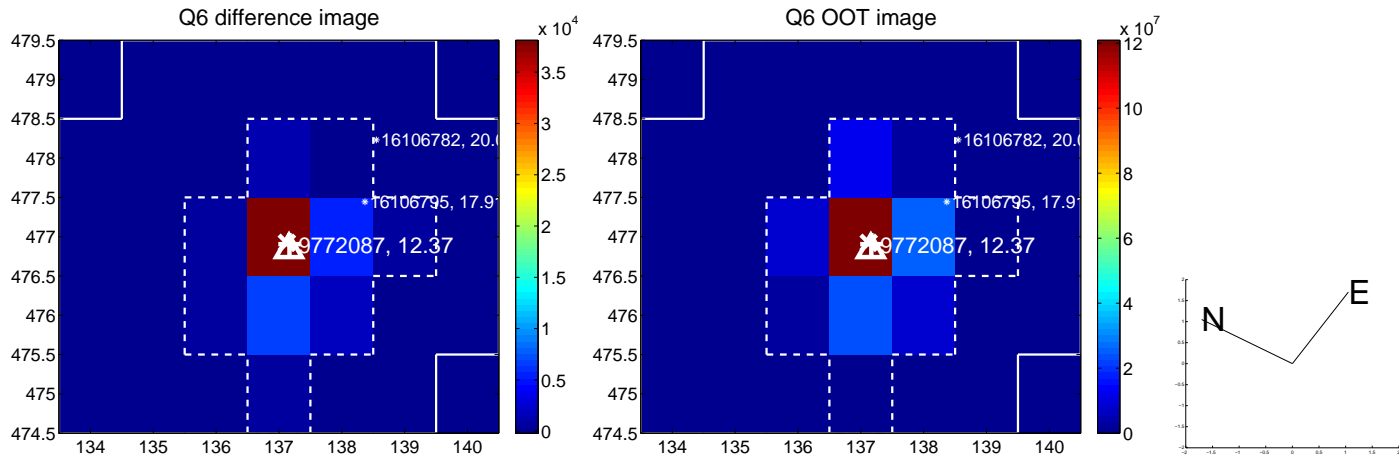
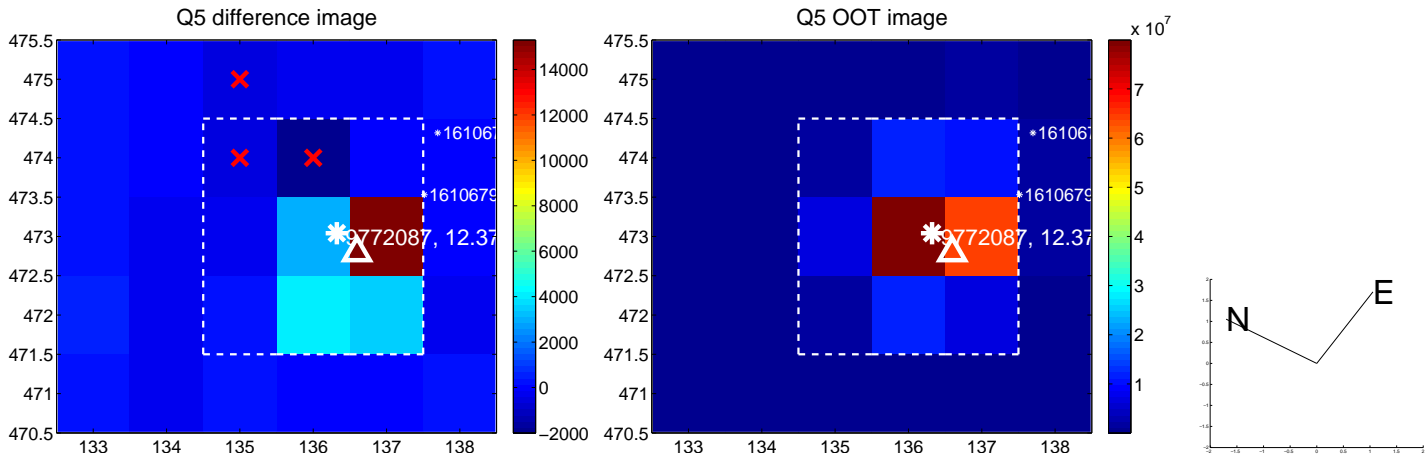


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

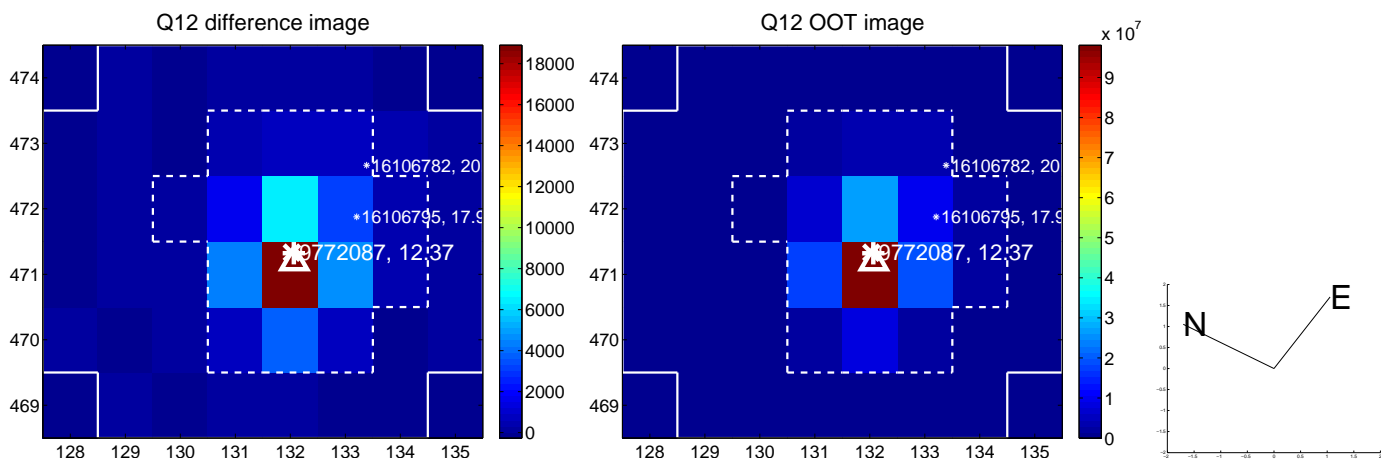
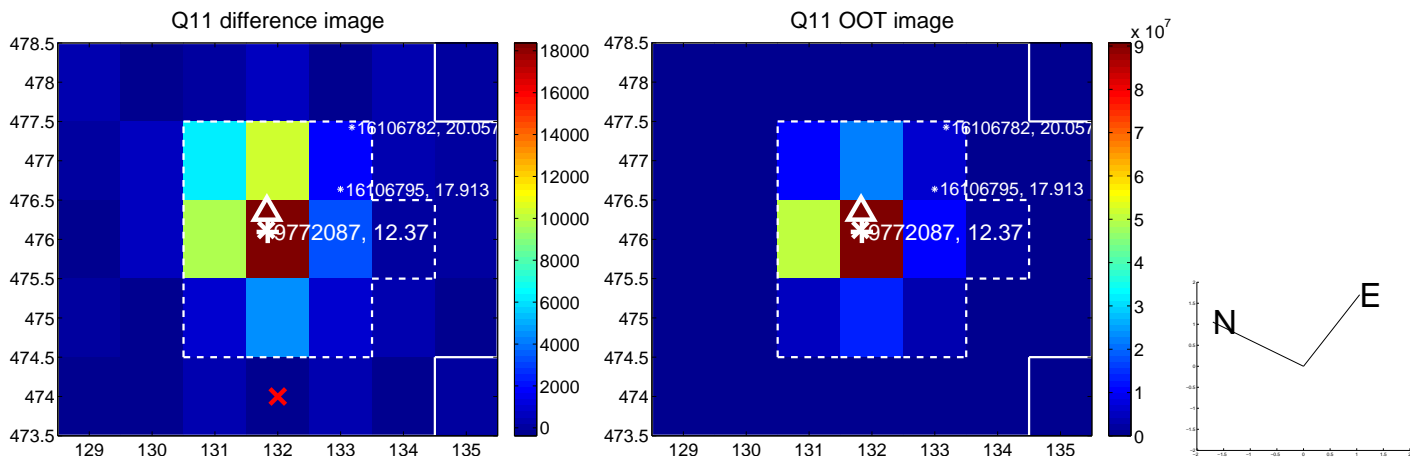
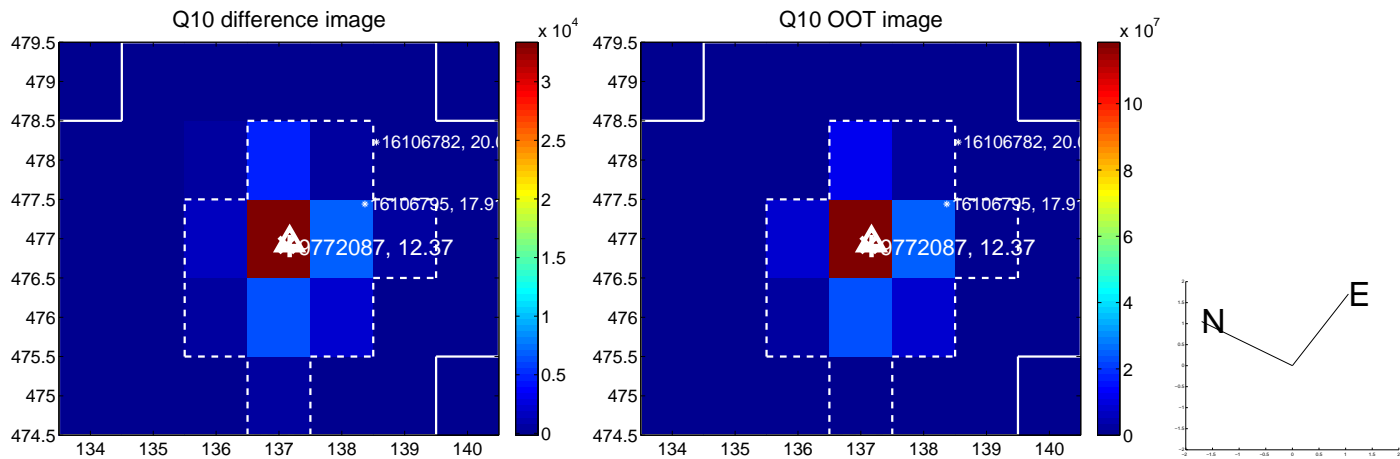
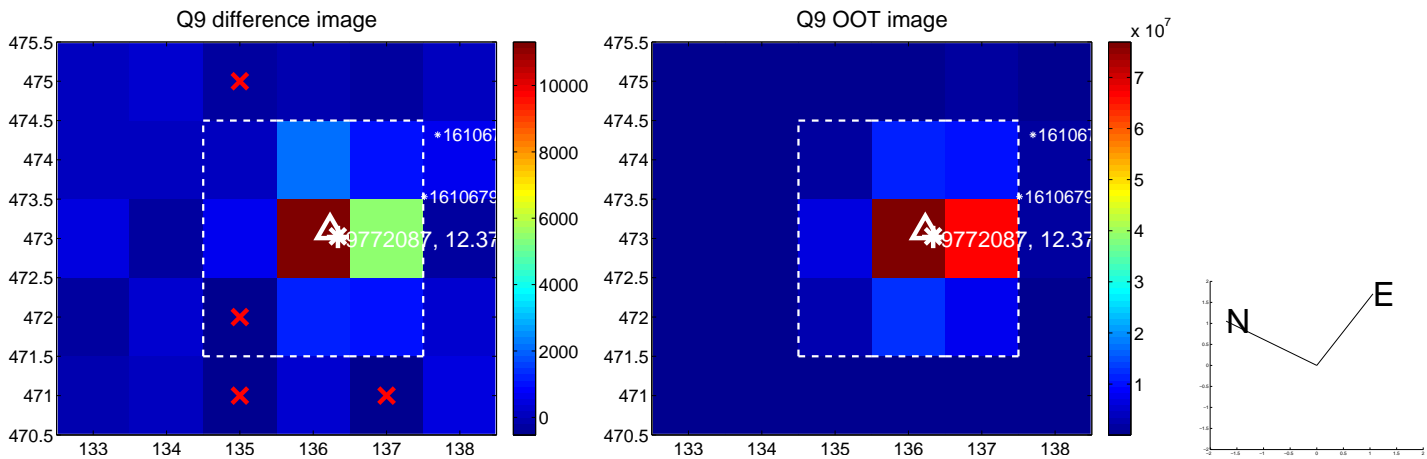


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

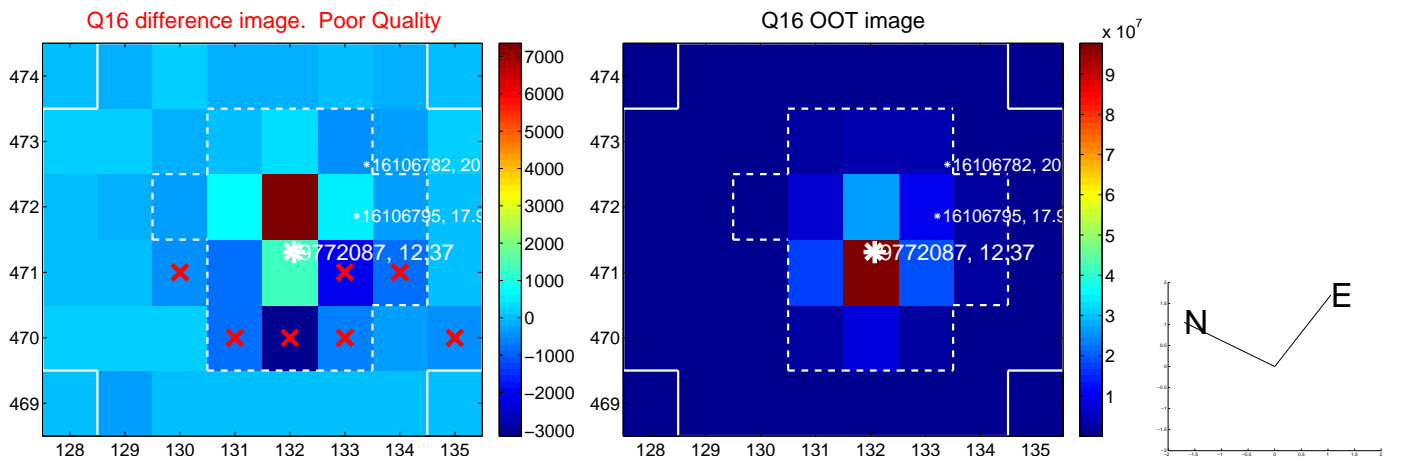
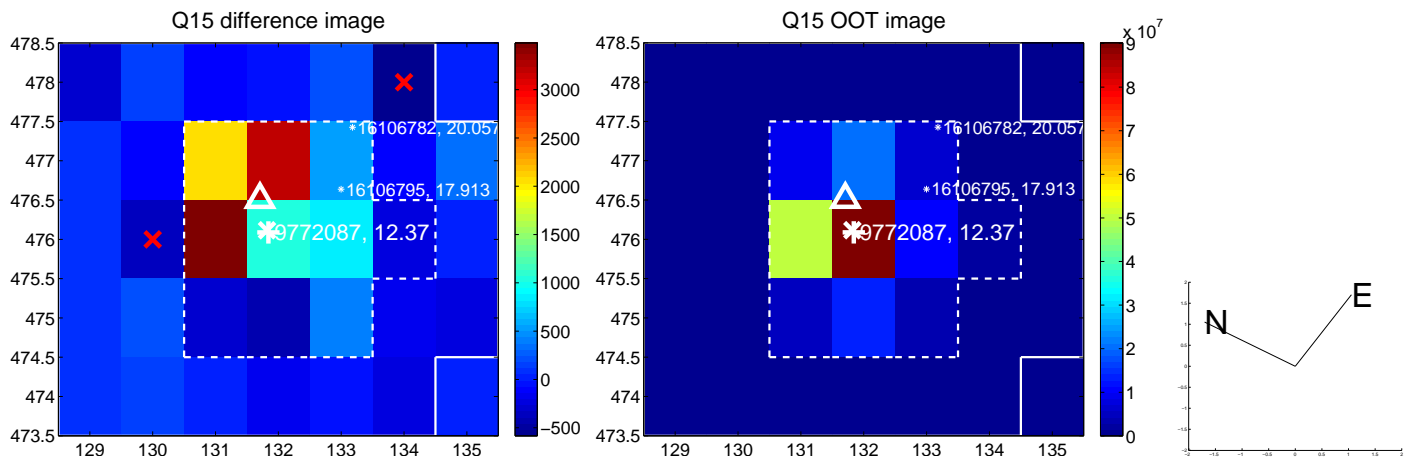
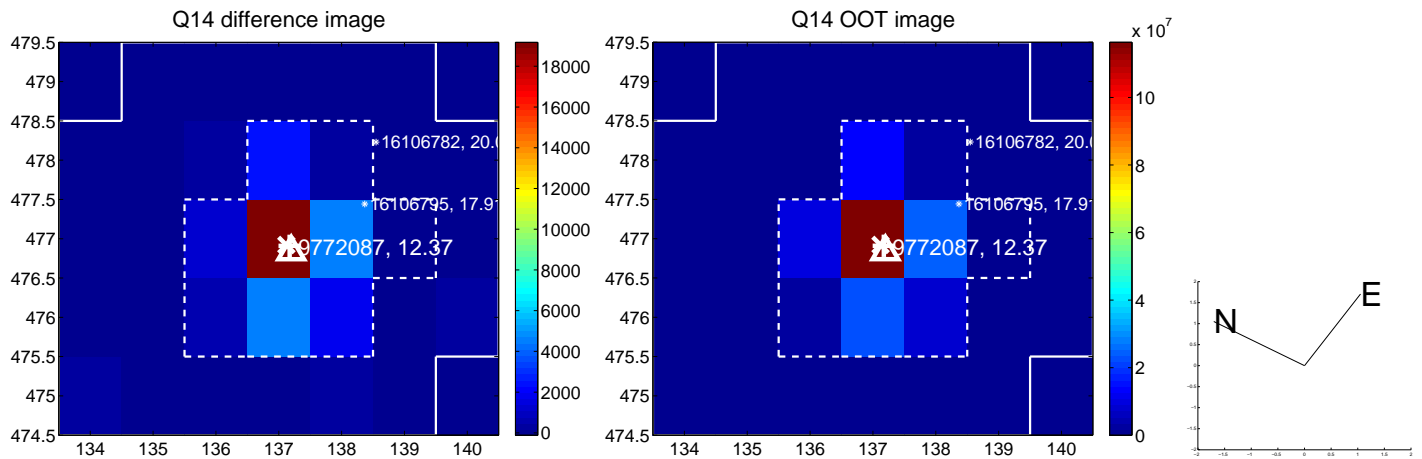
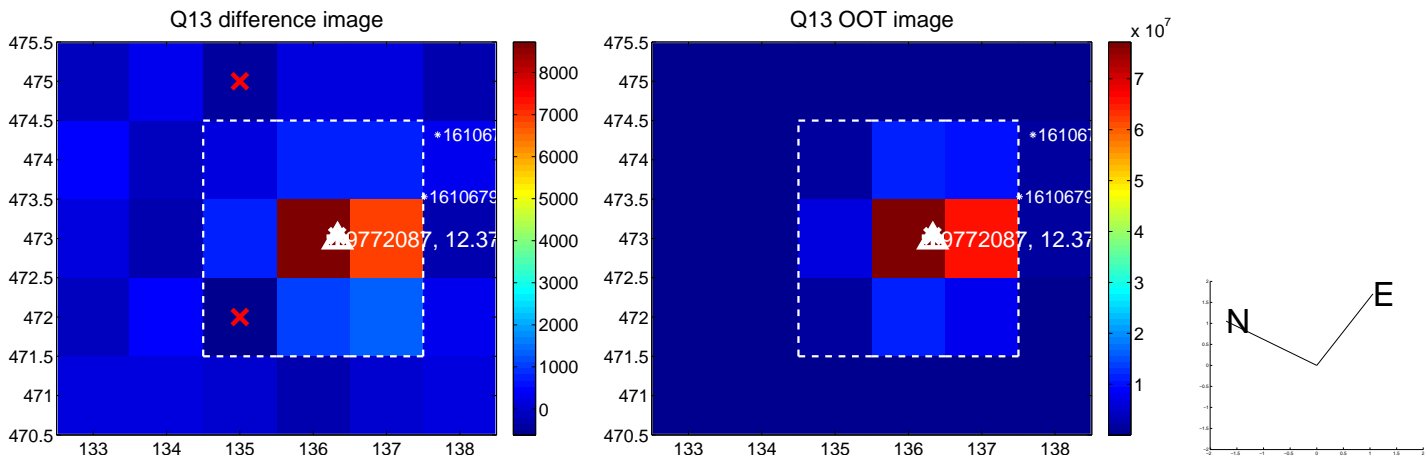




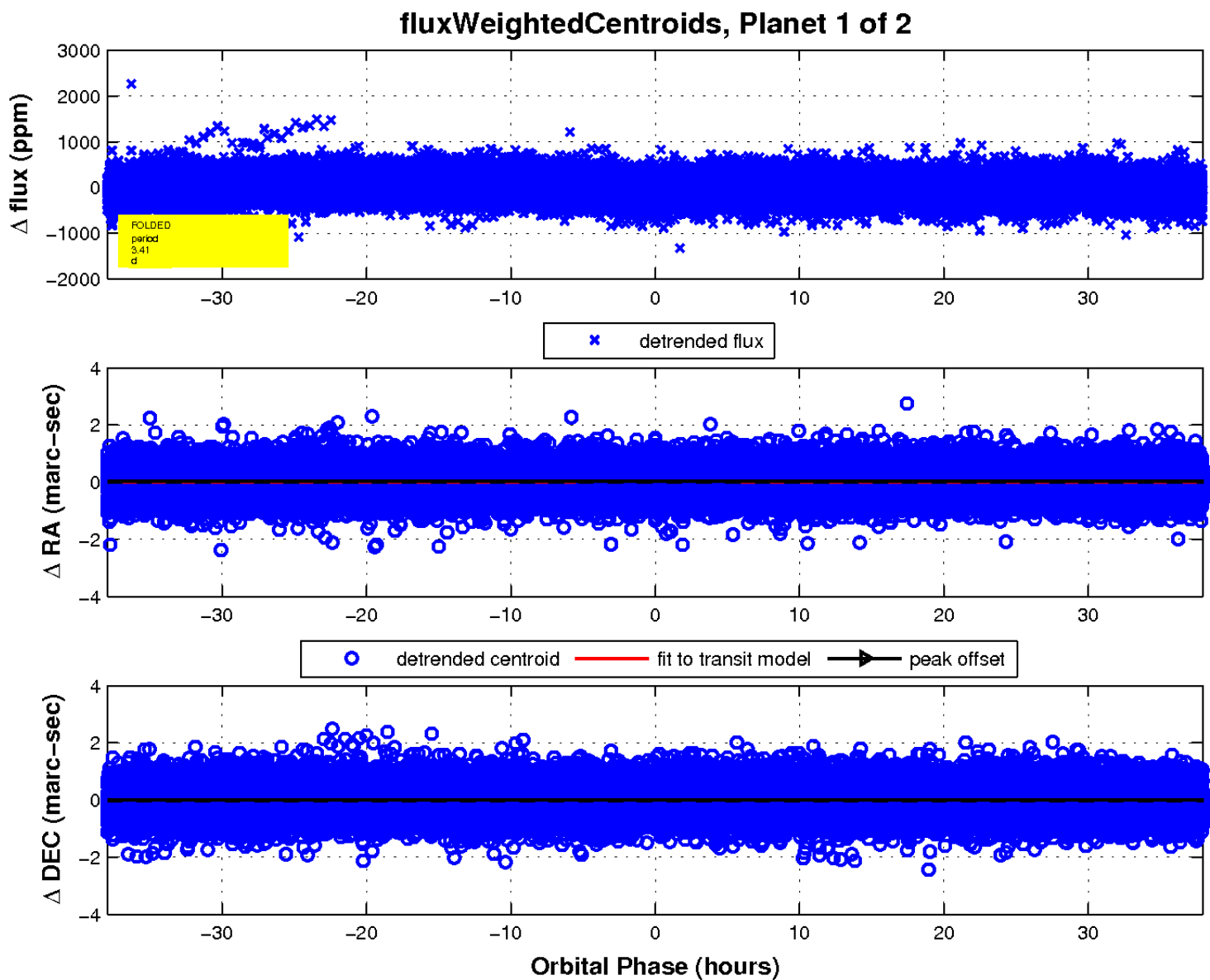
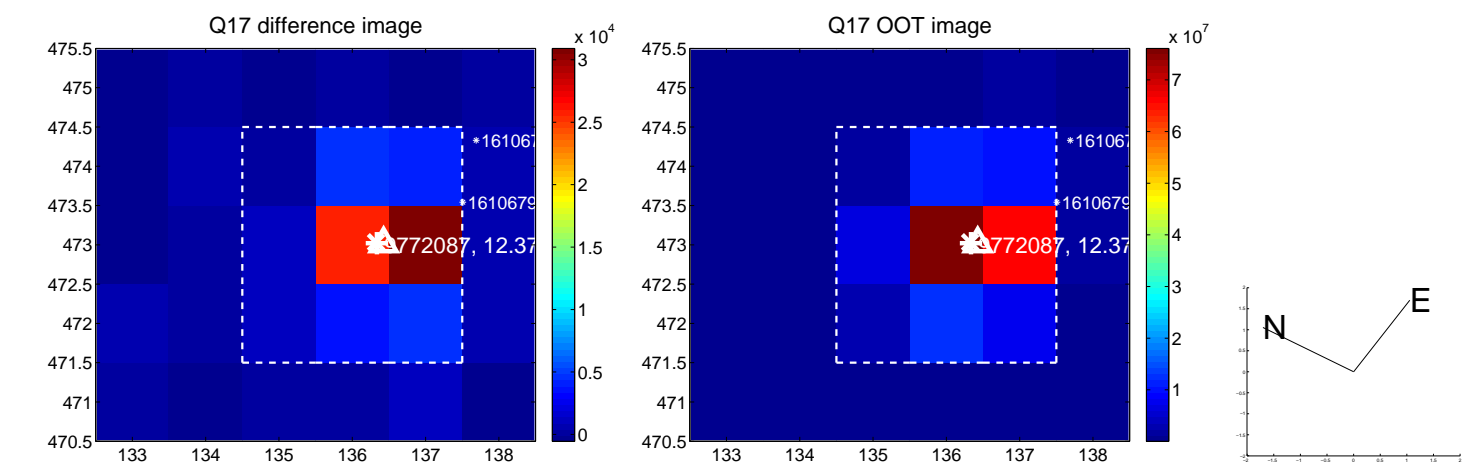
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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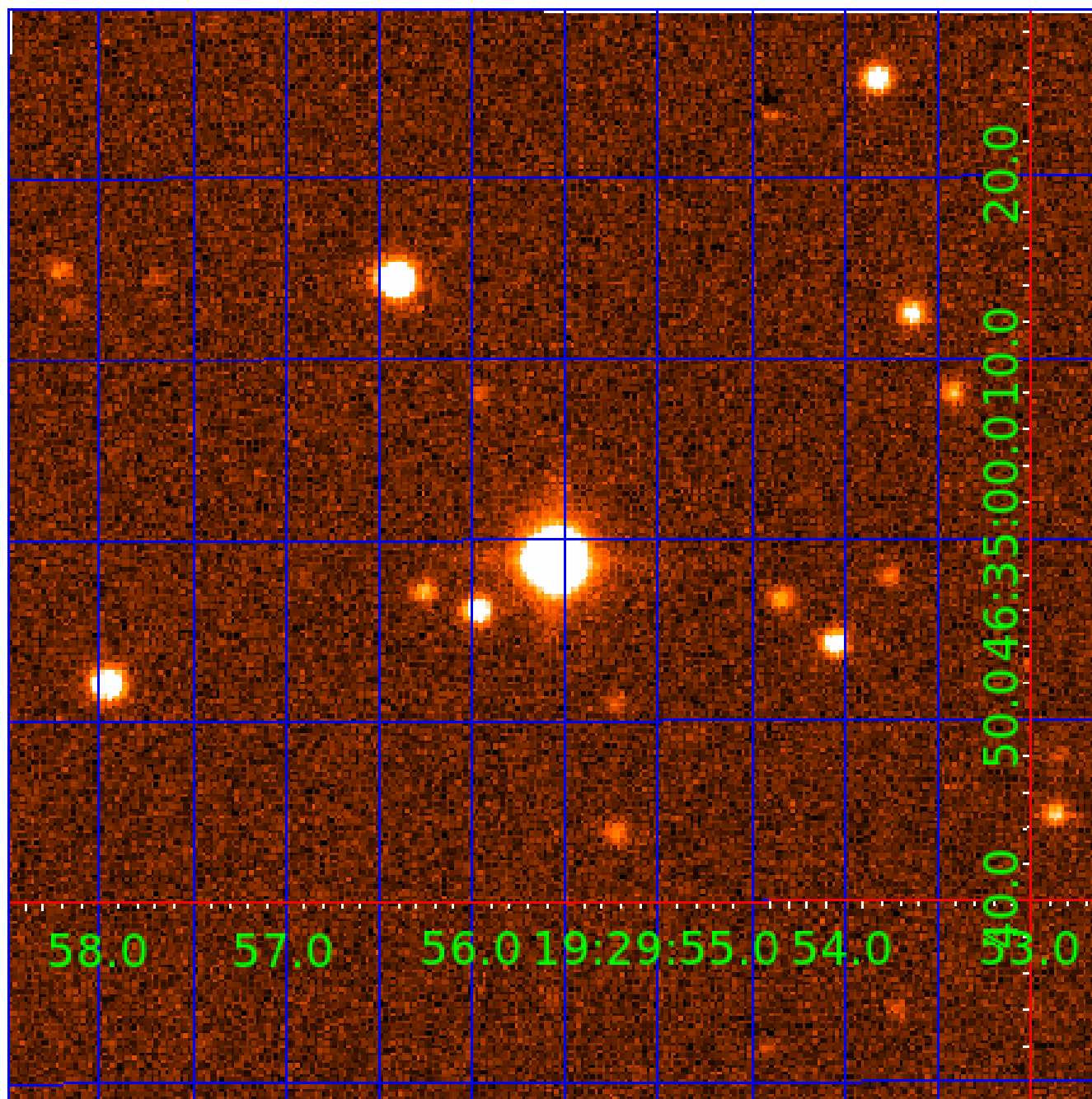


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 009772087

## 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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## Robovetter Results

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009772087-02	OBS	FP	0.00	1	0	0	0	LPP_DV—LPP_ALT—SAME_NTL_PERIOD

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

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

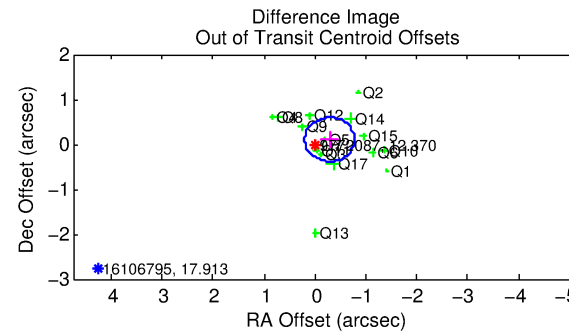
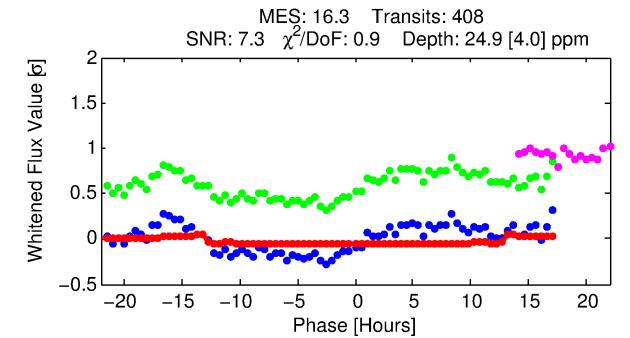
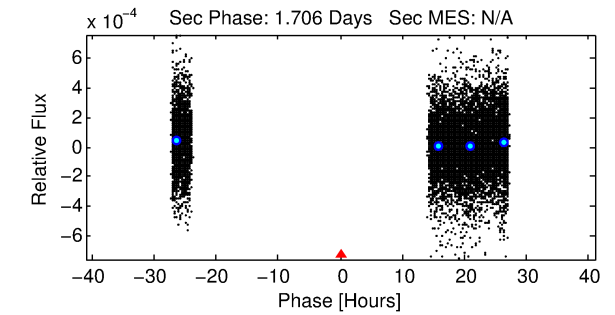
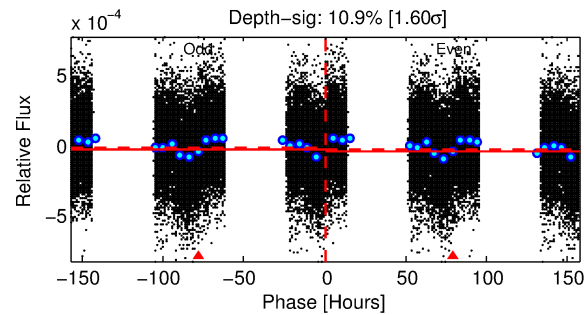
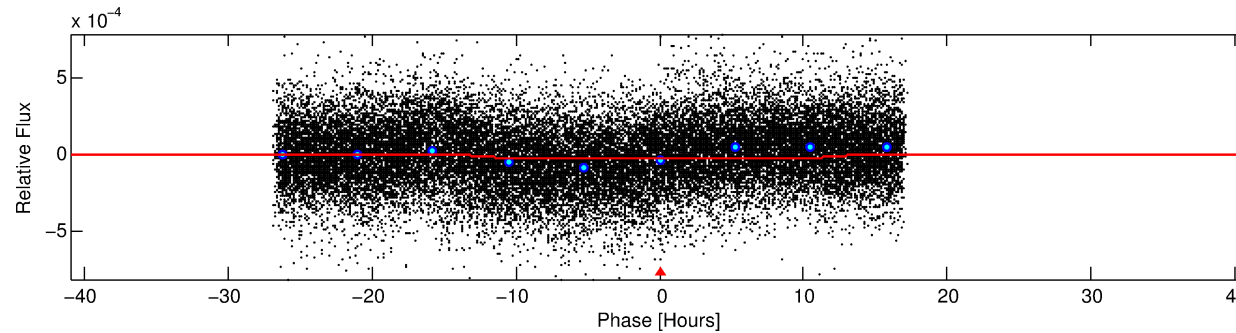
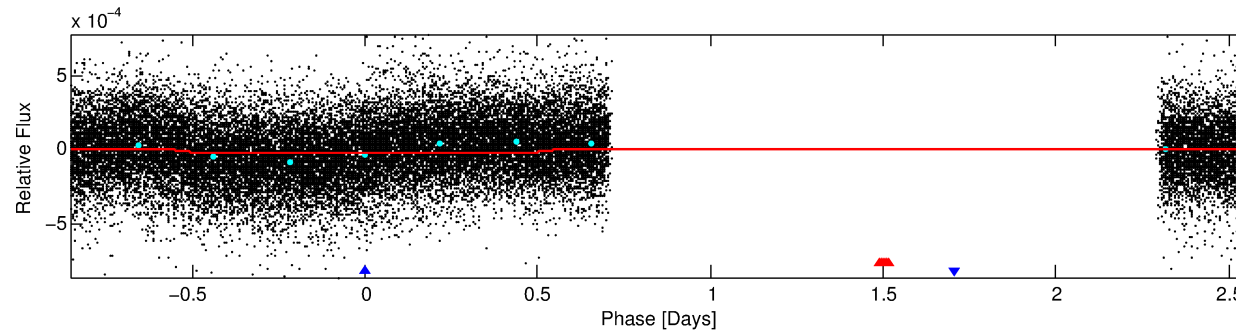
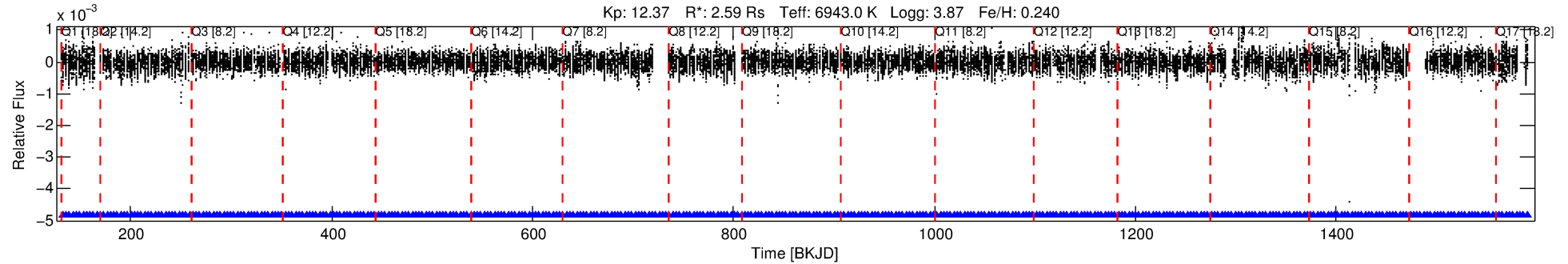
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009772087-02

No Significant Match Found

# DV One-Page Summary

KIC: 9772087 Candidate: 2 of 2 Period: 3.413 d



## DV Fit Results:

Period = 3.41266 [0.00005] d  
Epoch = 132.3643 [0.0094] BKJD  
Rp/R\* = 0.0047 [0.0036]  
a/R\* = 1.17 [1.42]  
b = 0.29 [13.81]  
Seff = 4755.09 [2765.85]  
Teq = 2117 [308] K  
Rp = 1.31 [1.12] Re  
a = 0.0542 [0.0190] AU

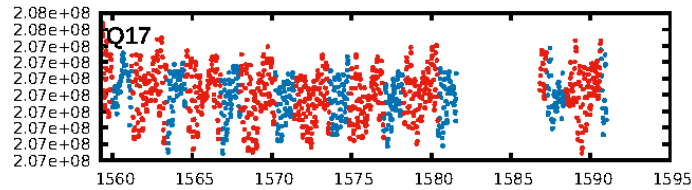
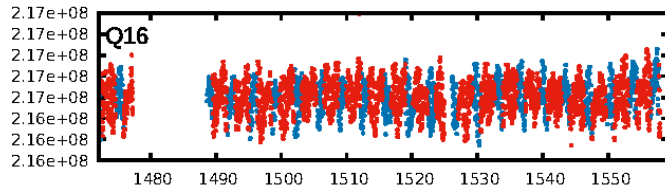
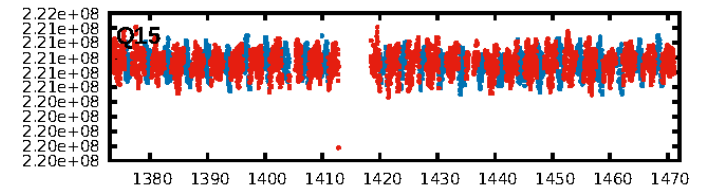
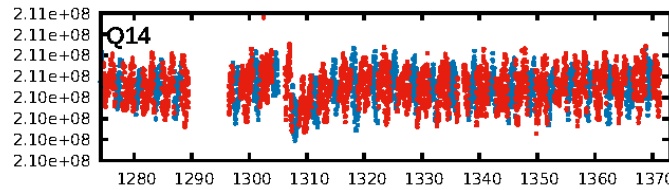
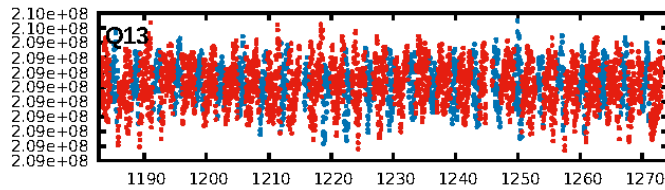
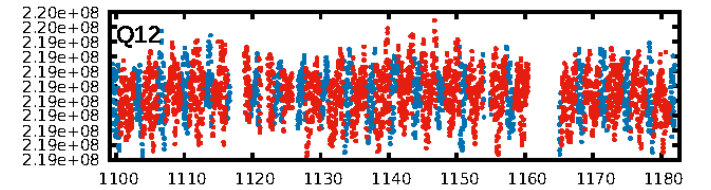
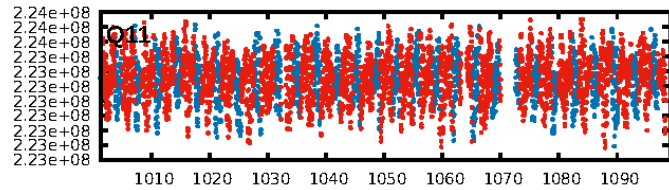
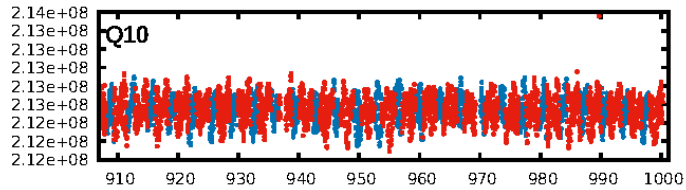
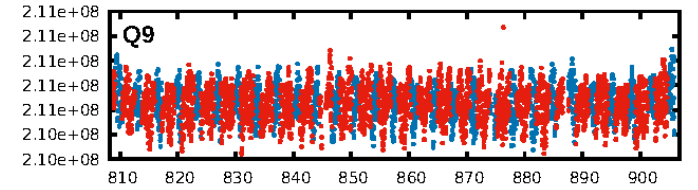
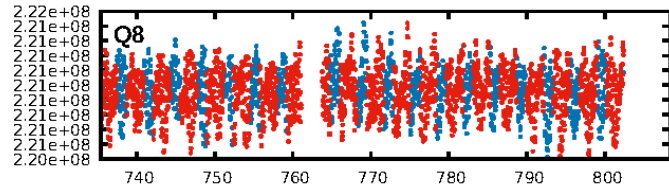
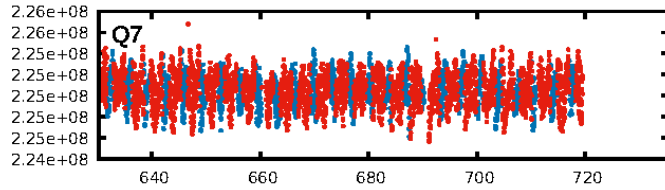
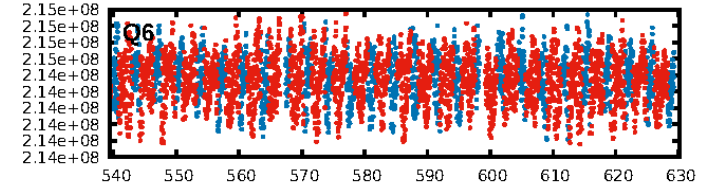
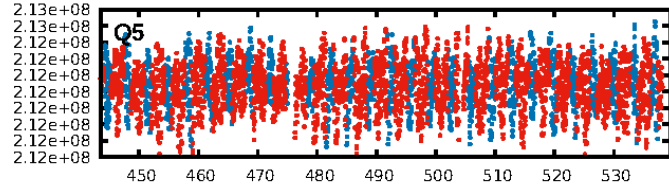
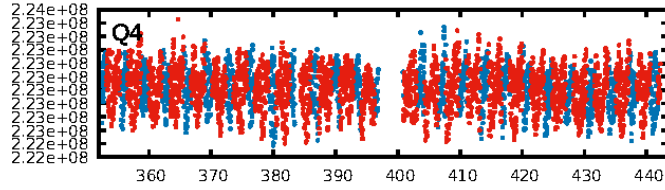
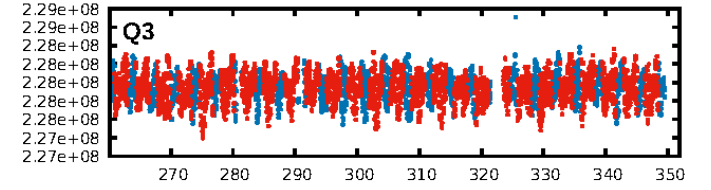
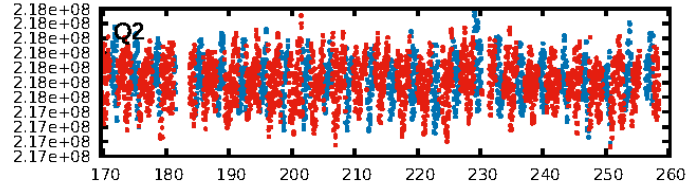
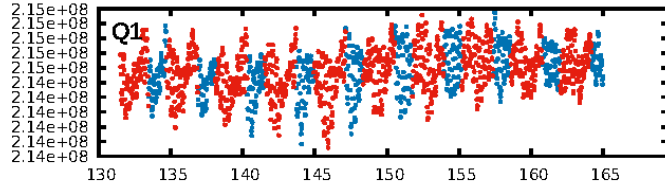
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 0.0% [0.00 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: N/A  
RollingBand-fgt: 1.00 [390/390]  
GhostDiagnostic-chr: 1.299  
Centroid-sig: 0.2%  
Centroid-so: 1.098 arcsec [1.92 $\sigma$ ]  
OotOffset-rm: 0.308 arcsec [1.88 $\sigma$ ]  
KicOffset-rm: 0.325 arcsec [1.72 $\sigma$ ]  
OotOffset-st: 4/4/3/5 [16]  
KicOffset-st: 4/4/3/5 [16]  
DiffImageQuality-fgm: 0.94 [15/16]  
DiffImageOverlap-fno: 0.00 [0/17]

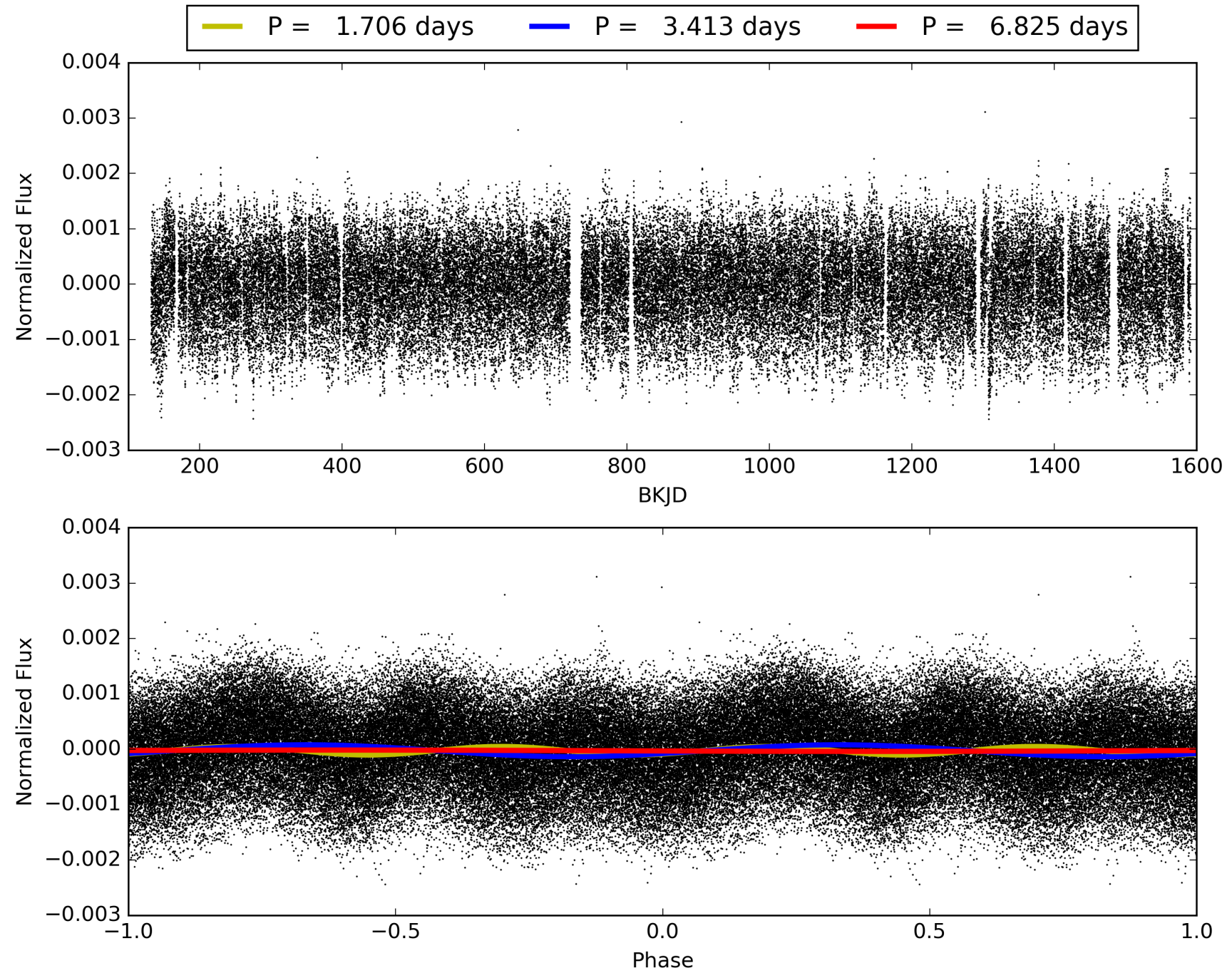
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 30-Jan-2016 20:13:18 Z

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

# TCE 009772087-02, PDC Light Curves

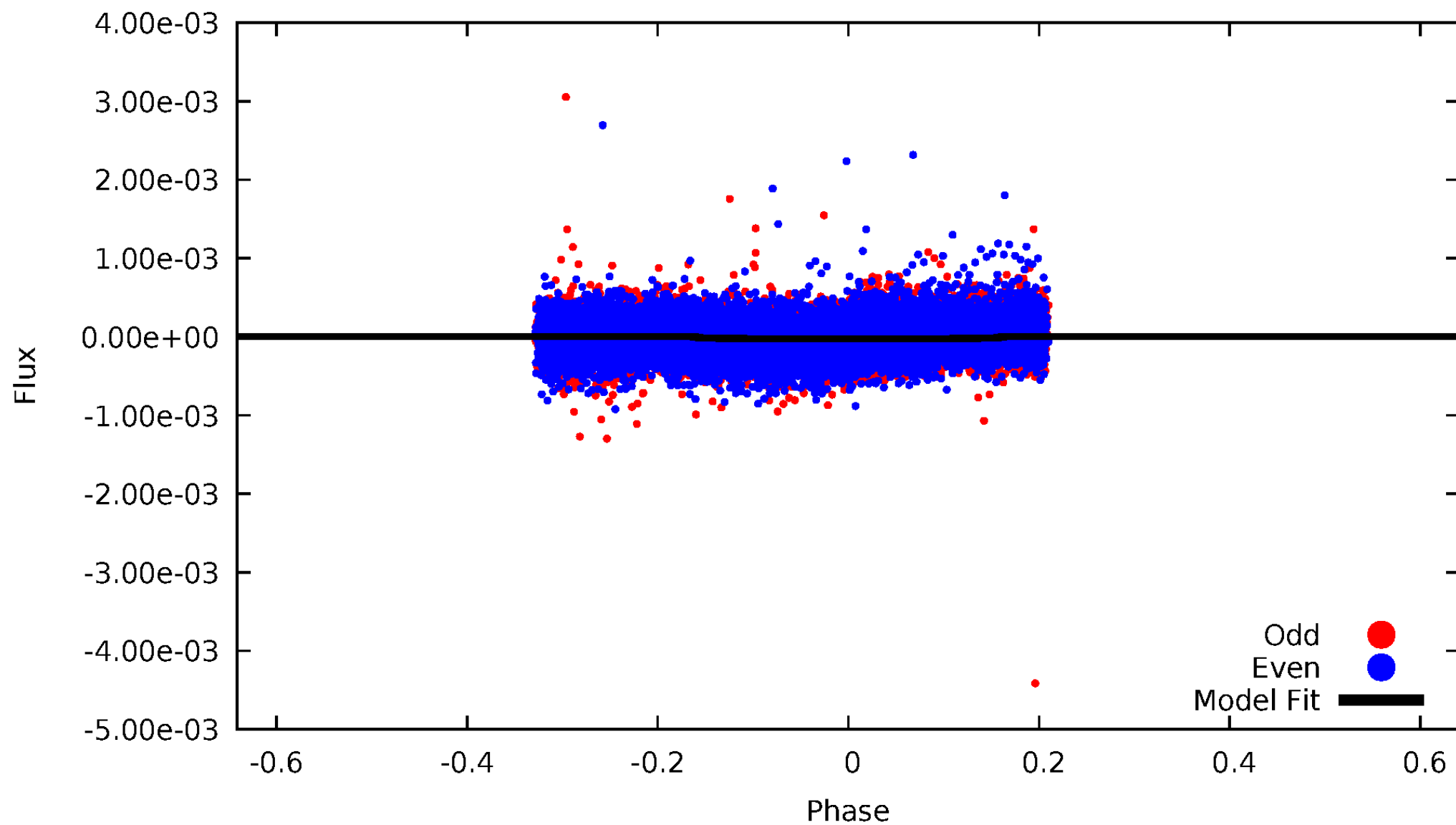


TCE 009772087-02



DV Odd/Even

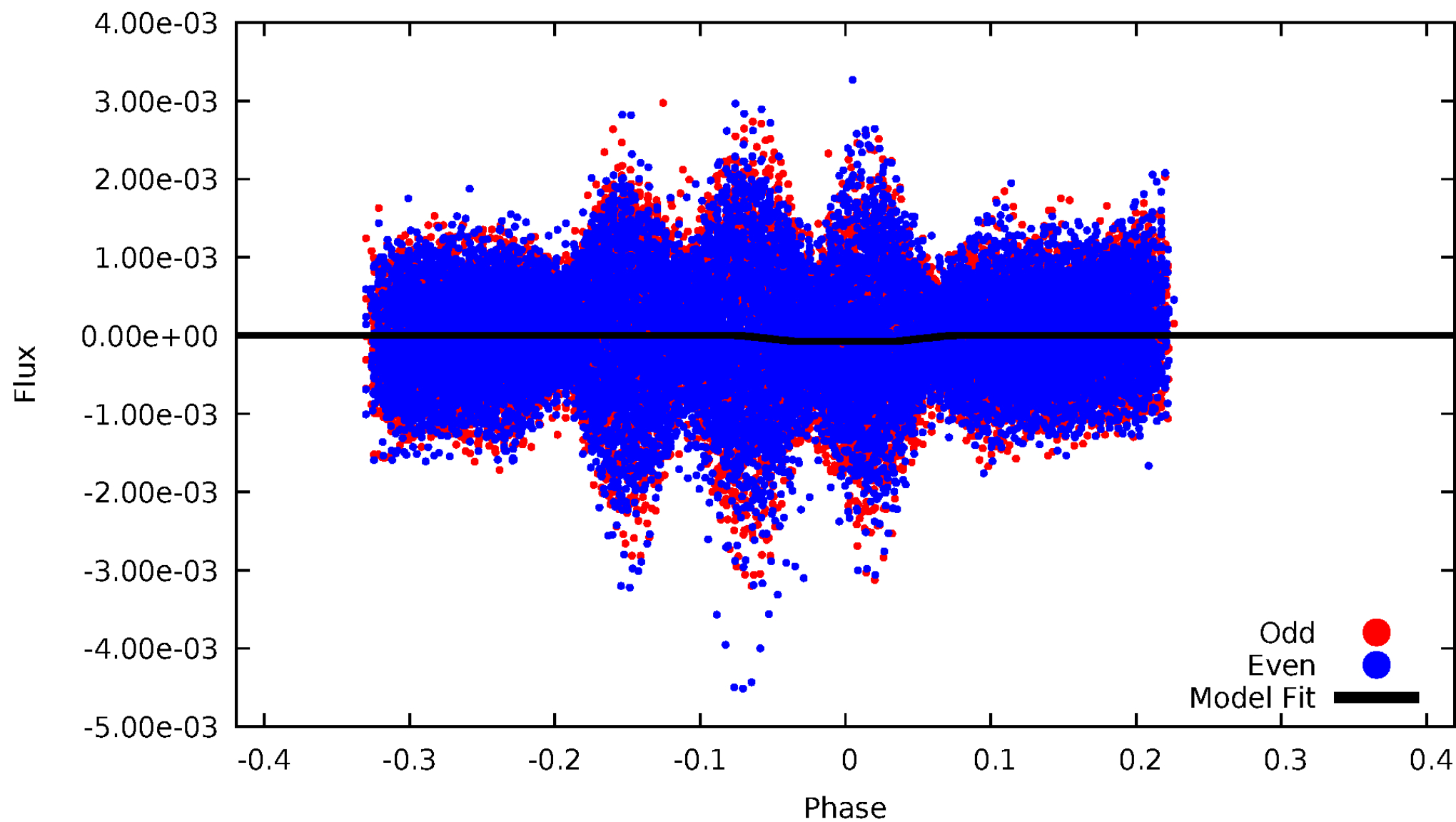
TCE 009772087-02





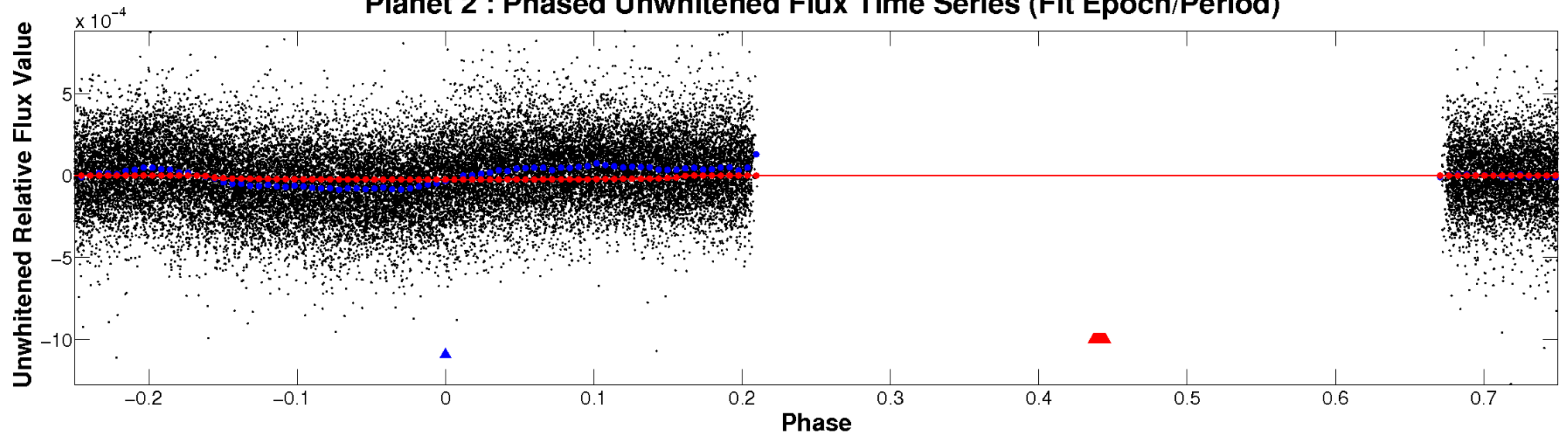
# ALT Odd/Even

TCE 009772087-02

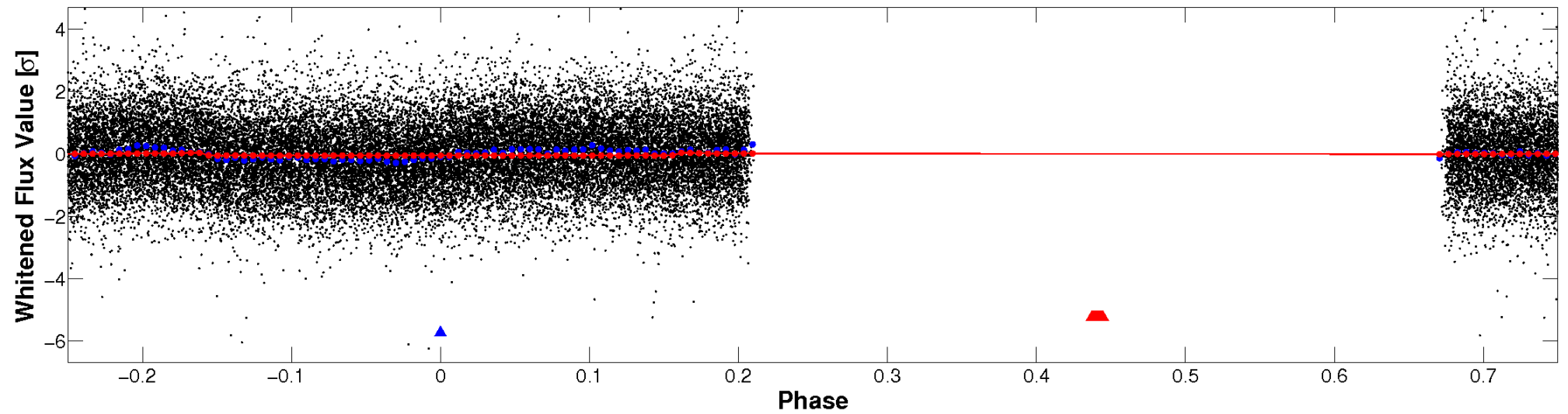


# Non-Whitened Vs. Whitened Light Curve

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

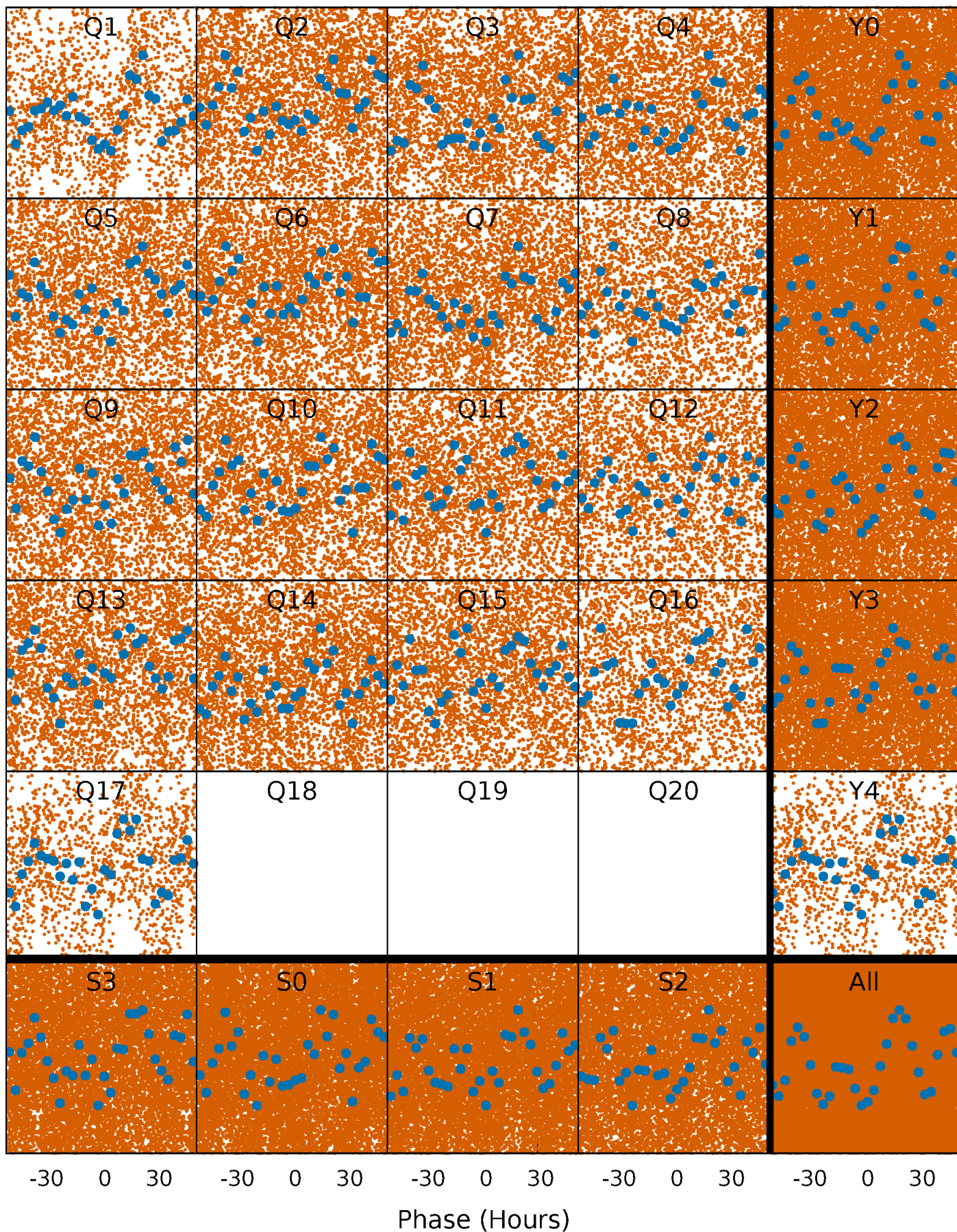


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



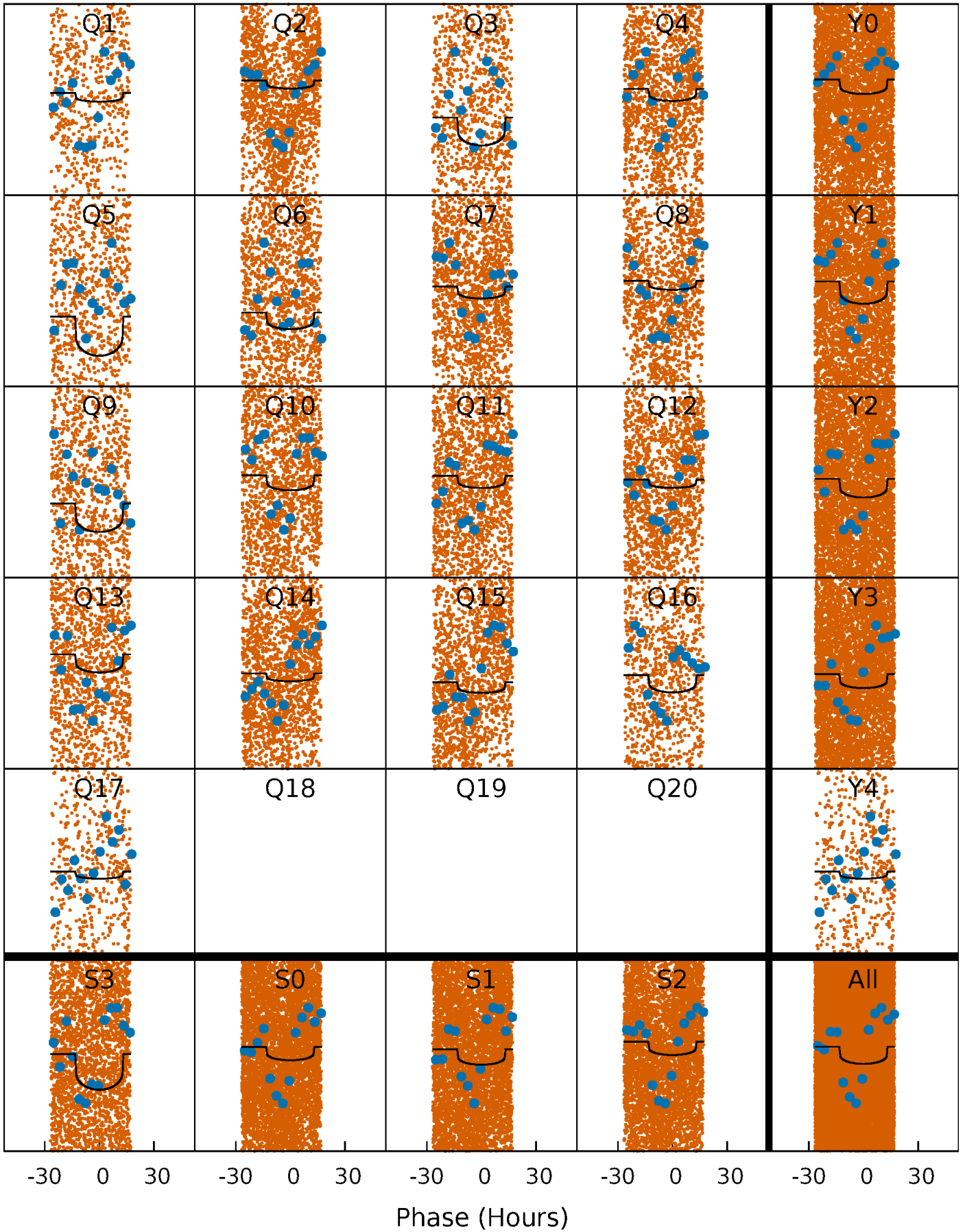
# PDC Quarter-Phased Transit Curves

TCE 009772087-02   P= 3.412658 Days    $T_0=132.364309$  (BKJD)



# DV Quarter-Phased Transit Curves

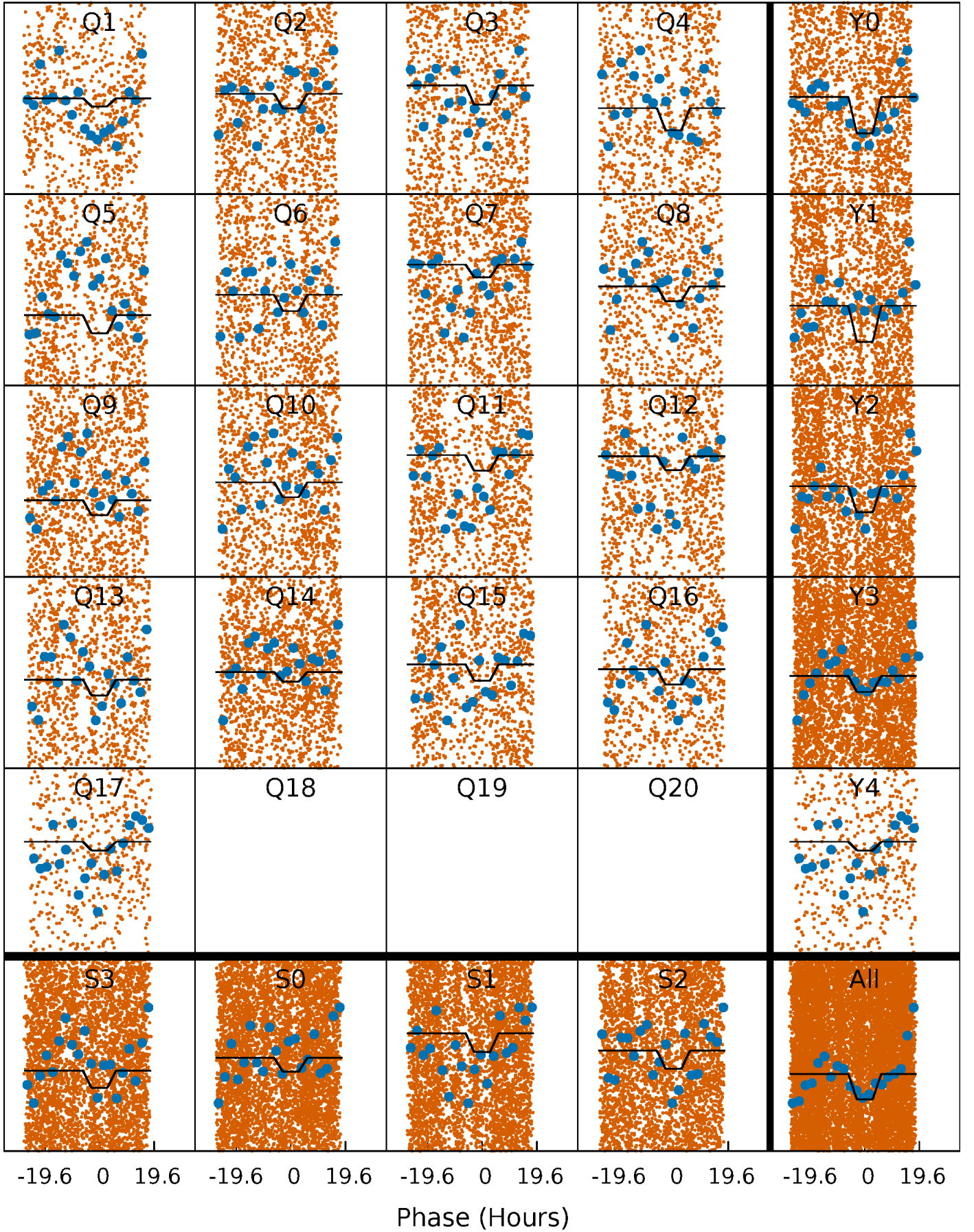
TCE 009772087-02     $P = 3.412658$  Days     $T_0 = 132.364309$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

TCE 009772087-02   P= 3.412510 Days    $T_0=132.372544$  (BKJD)

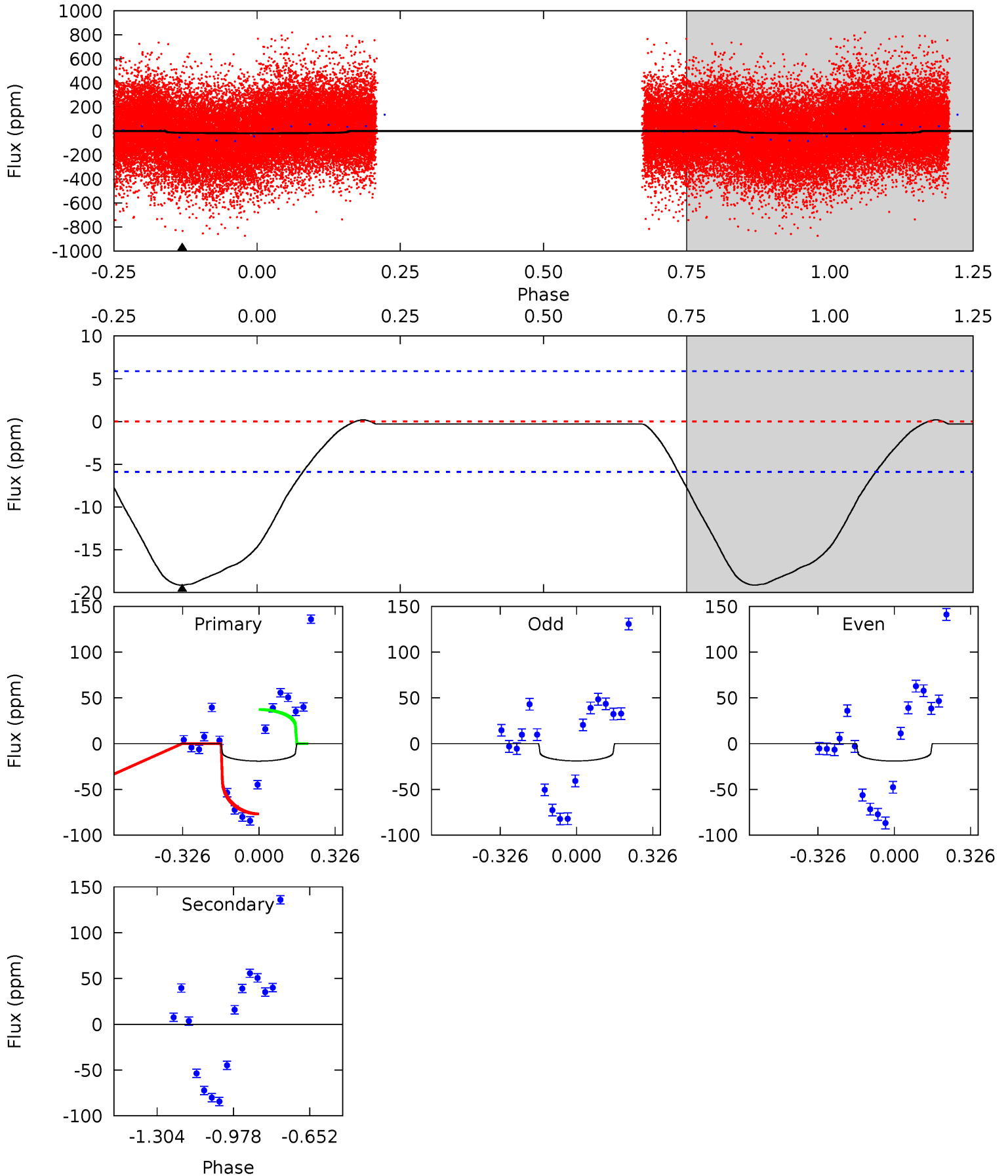




# DV Model-Shift Uniqueness Test

009772087-02, P = 3.412658 Days, E = 128.951651 Days

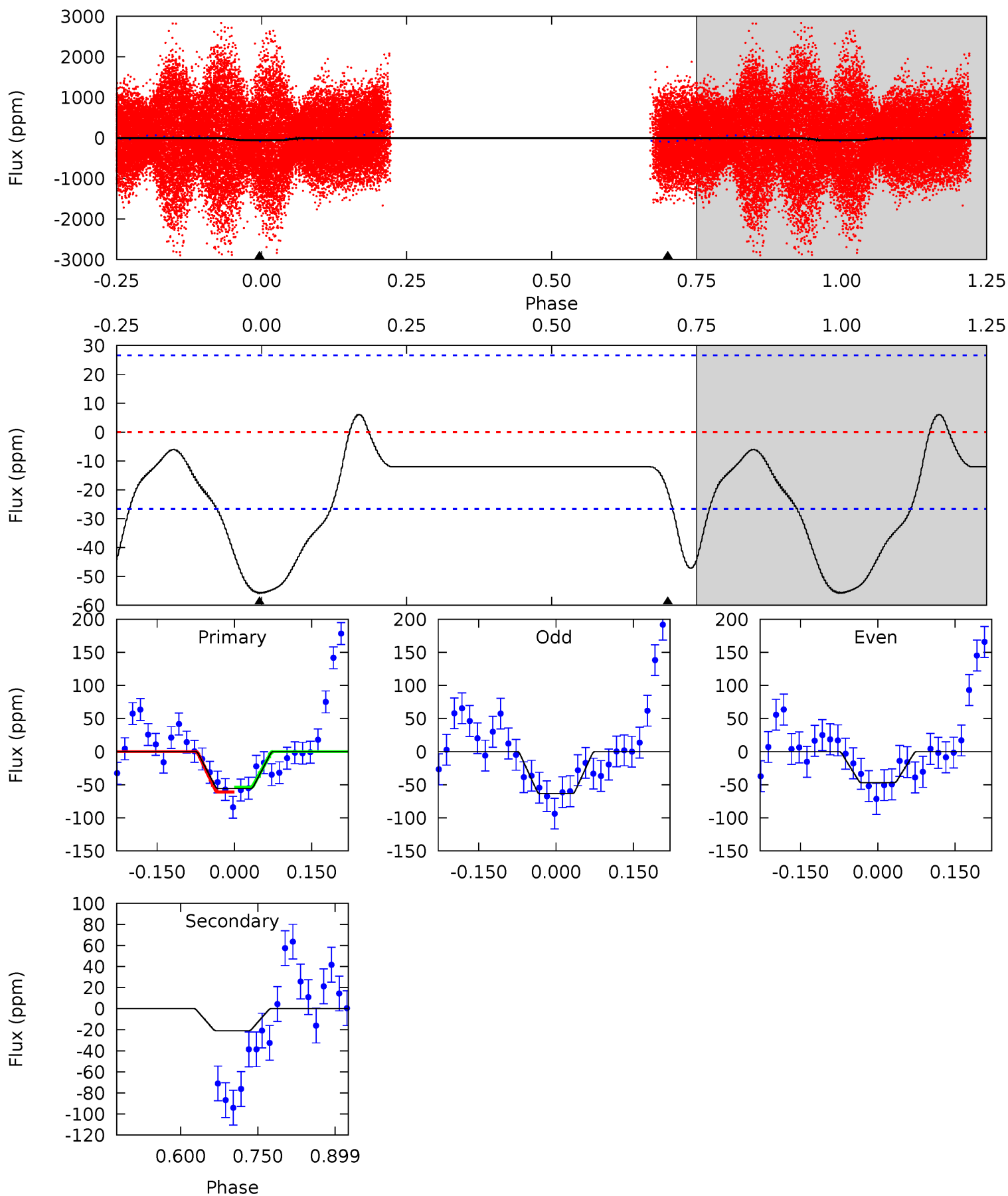
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
14.0	0	0	0	4.31	0.98	0.17	14.0	14.0	0	0	0.05	1.10	0.01	14.6



# Alt Model-Shift Uniqueness Test

009772087-02, P = 3.412510 Days, E = 128.960034 Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
9.41	3.52	0	0	4.48	1.44	0.94	9.41	9.41	3.52	3.52	1.29	0.88	0.10	0.49



### Stellar Parameters For KIC 009772087

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6943^{+192}_{-312}$	$3.872^{+0.322}_{-0.138}$	$0.240^{+0.150}_{-0.350}$	$2.590^{+0.563}_{-0.965}$	$1.823^{+0.185}_{-0.431}$	$0.148^{+0.342}_{-0.058}$
	+3%/-4%	+8%/-4%	+62%/-146%	+22%/-37%	+10%/-24%	+231%/-39%
Source	PHO54	PHO54	PHO54	DSEP		

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

### Secondary Eclipse Parameters for KIC 009772087-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$0 \pm 1$	$1.38^{+0.99}_{-0.79}$	$2883^{+228}_{-277}$	$-3000^{+6705}_{-1012}$	$0.002^{+1.538}_{-1.735}$
Alt.	$-21 \pm 6$	$2.26^{+1.10}_{-0.92}$	$2884^{+243}_{-270}$	$5034^{+1384}_{-775}$	$6.449^{+11.684}_{-3.634}$

$T_{max}$  = Theoretical Maximum Planetary Temperature

$T_{obs}$  = Observed Planetary Temperature (Assuming A=0.3)

$A_{obs}$  = Observed Albedo (Assuming T=0)

If a secondary eclipse is present, the system is likely an EB if  $T_{obs} \gg T_{max}$  AND  $A_{obs} \gg 1.0$

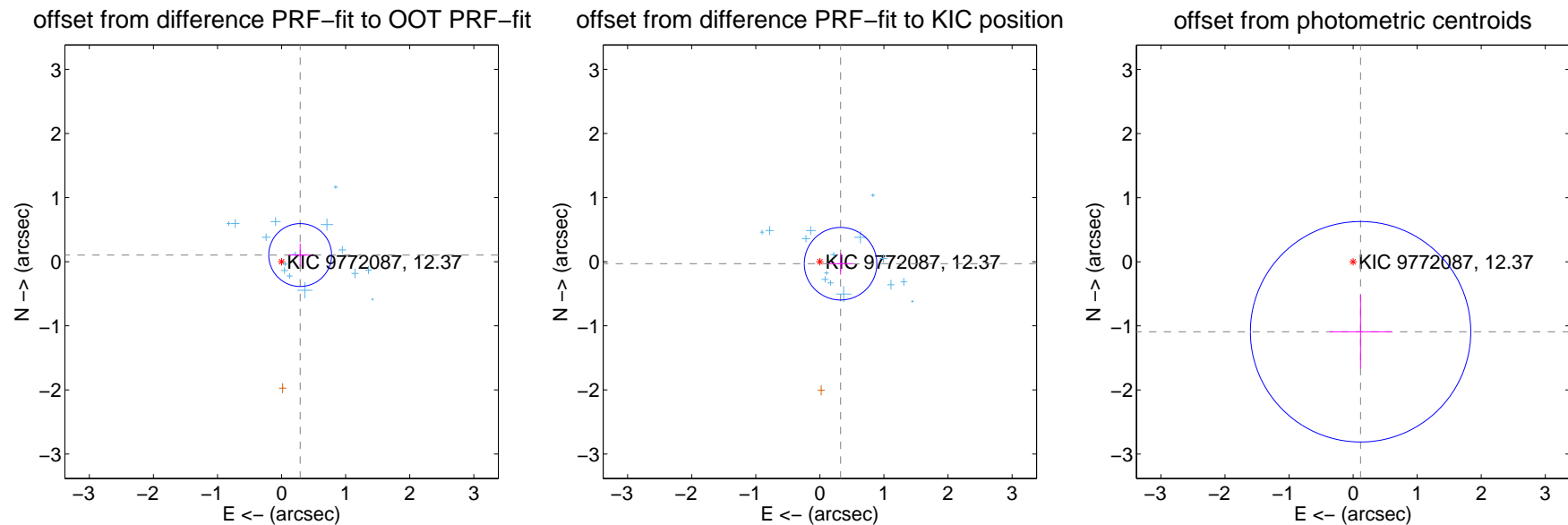
## DV Centroid Data

Supplemental centroid analysis for 009772087-02. Kepler magnitude: 12.37. Transit SNR 7.26

There are 15 quarters with good PRF difference image offsets

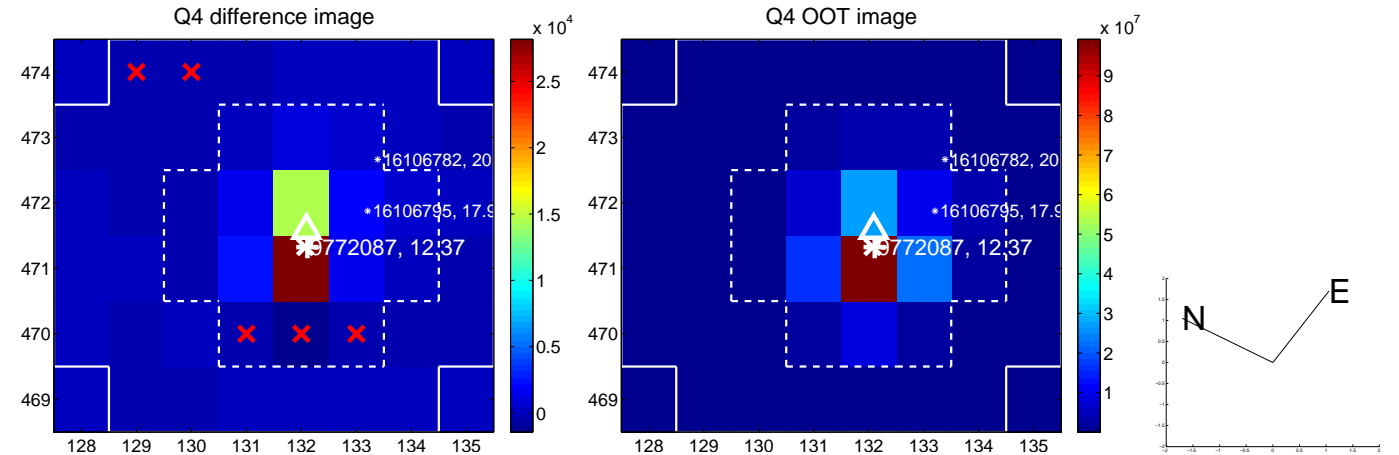
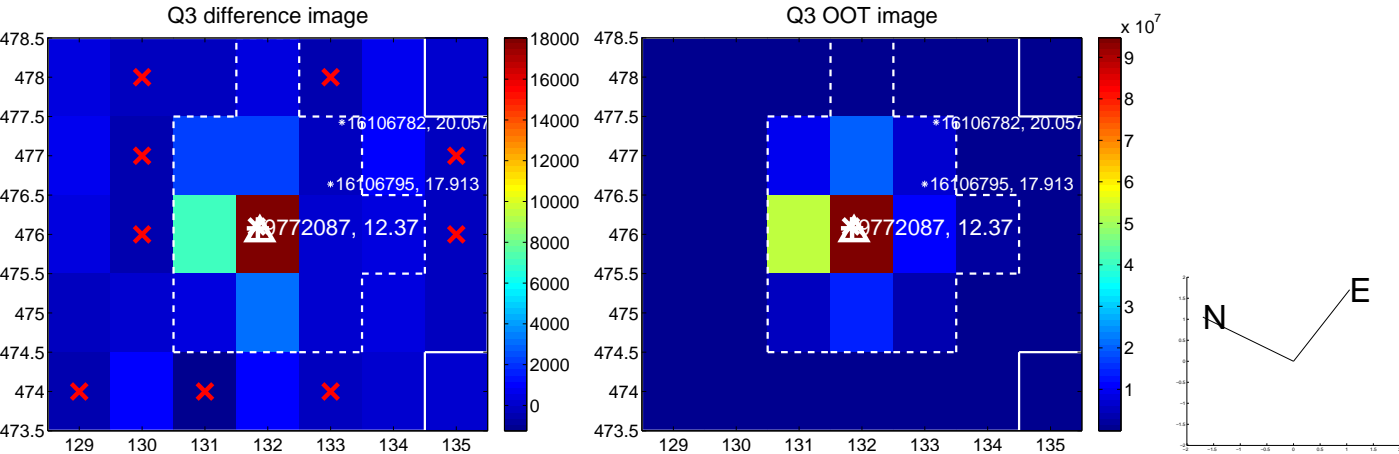
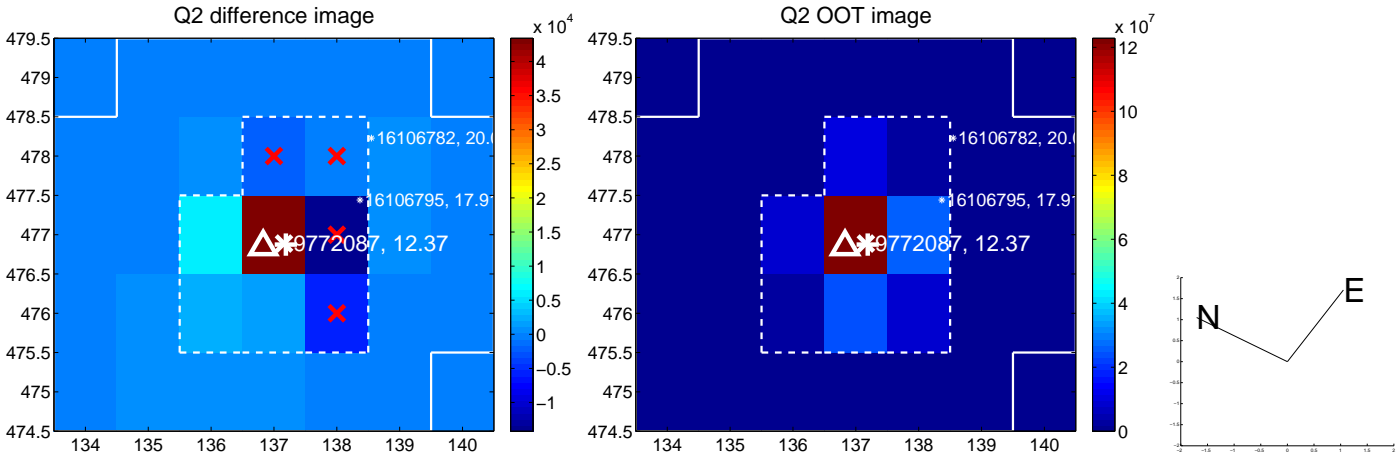
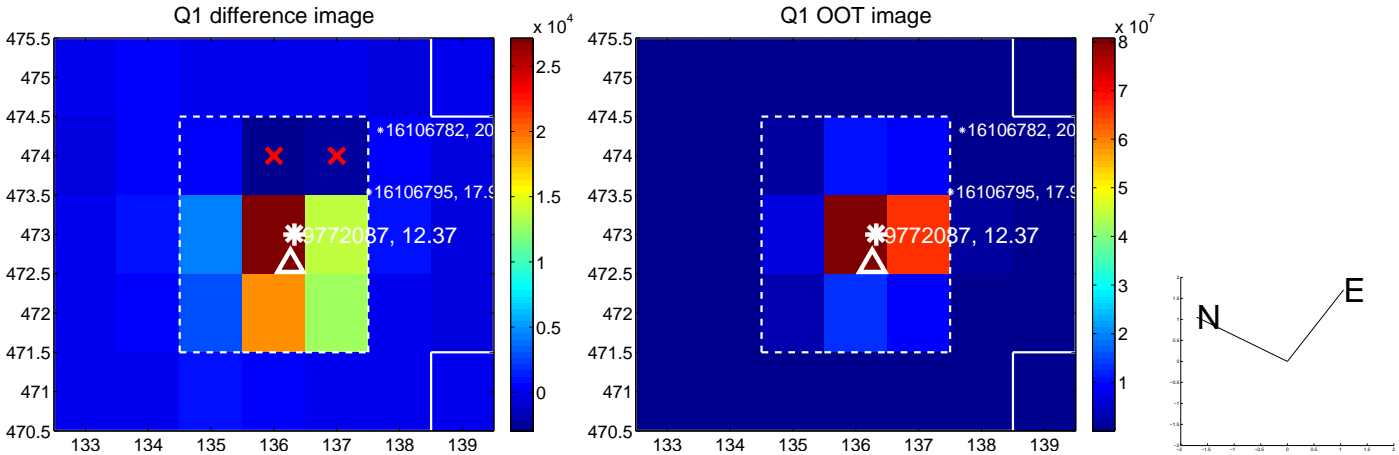
The direct PRF centroid is offset from the target star catalog position by about 0.06 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.308 \pm 0.163$	1.88	$-0.290 \pm 0.170$	$0.104 \pm 0.180$
PRF-fit source offset from KIC position	$0.325 \pm 0.189$	1.72	$-0.324 \pm 0.185$	$-0.031 \pm 0.171$
photometric centroid source offset	$1.10 \pm 0.57$	1.92	$-0.12 \pm 0.48$	$-1.09 \pm 0.57$

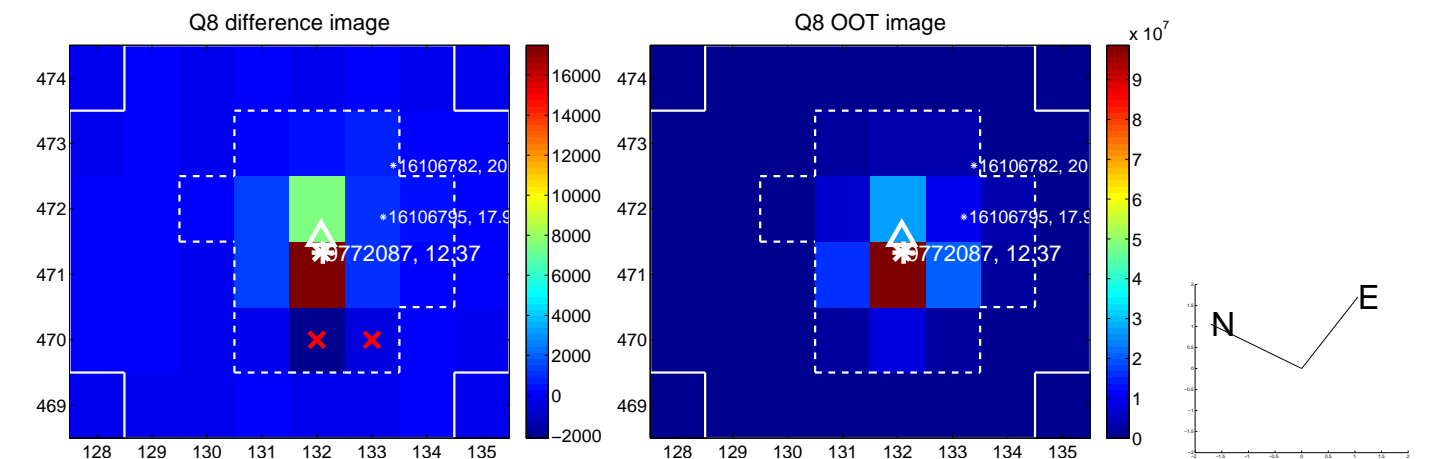
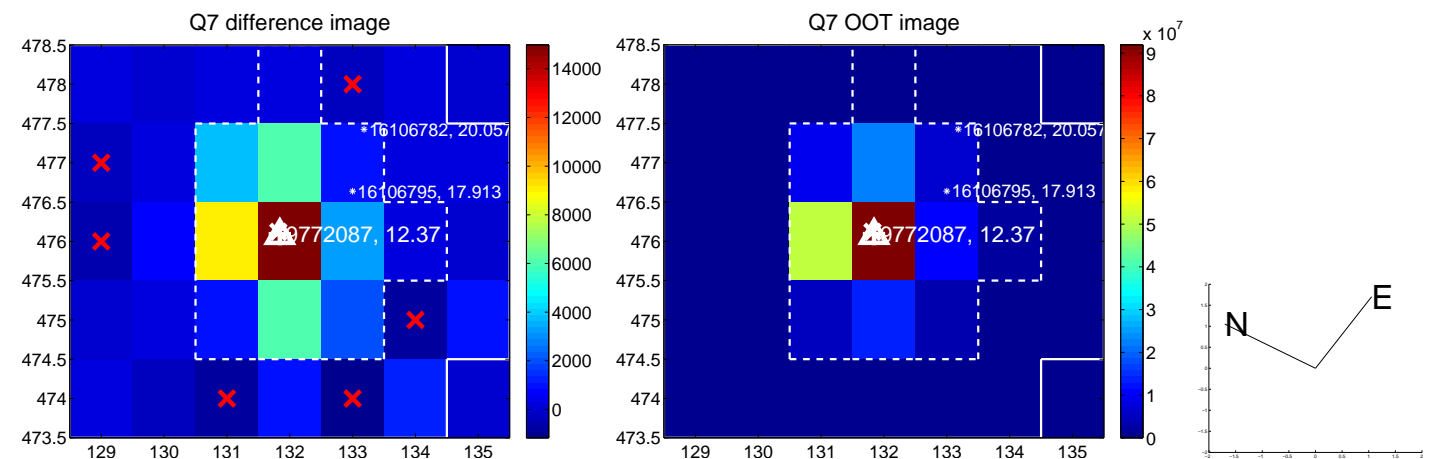
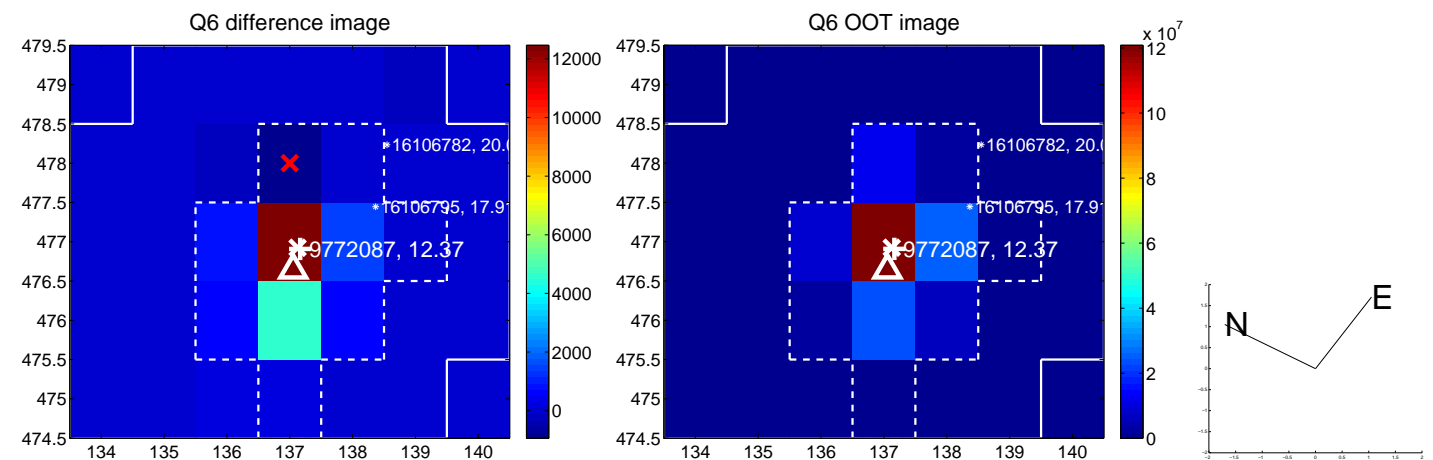
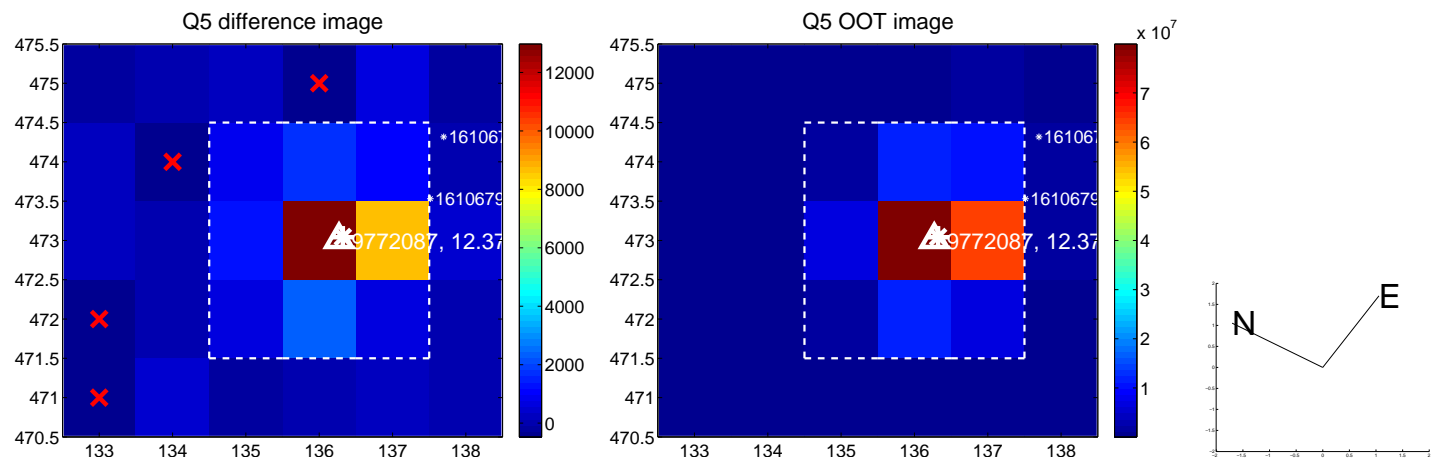


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

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

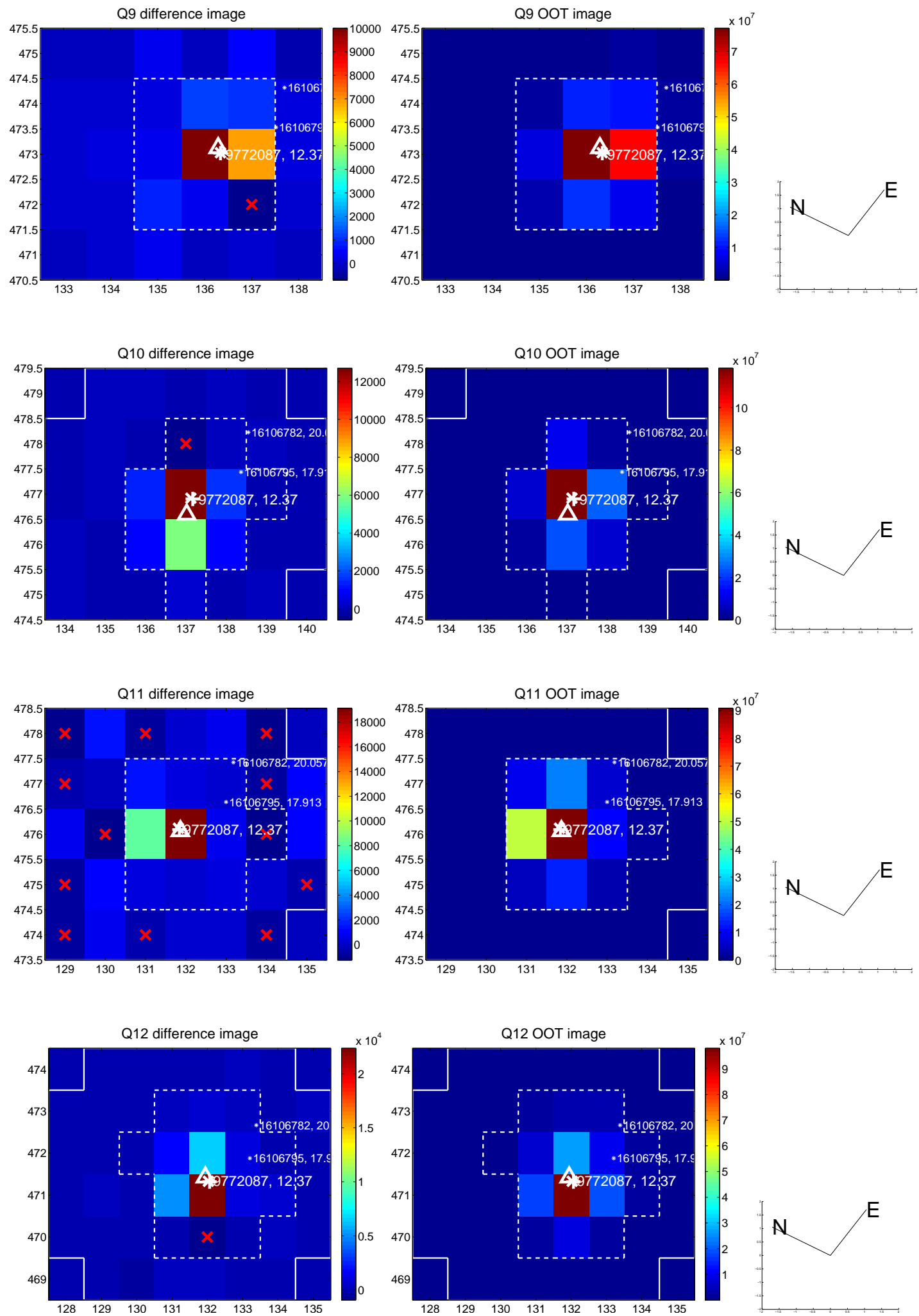


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

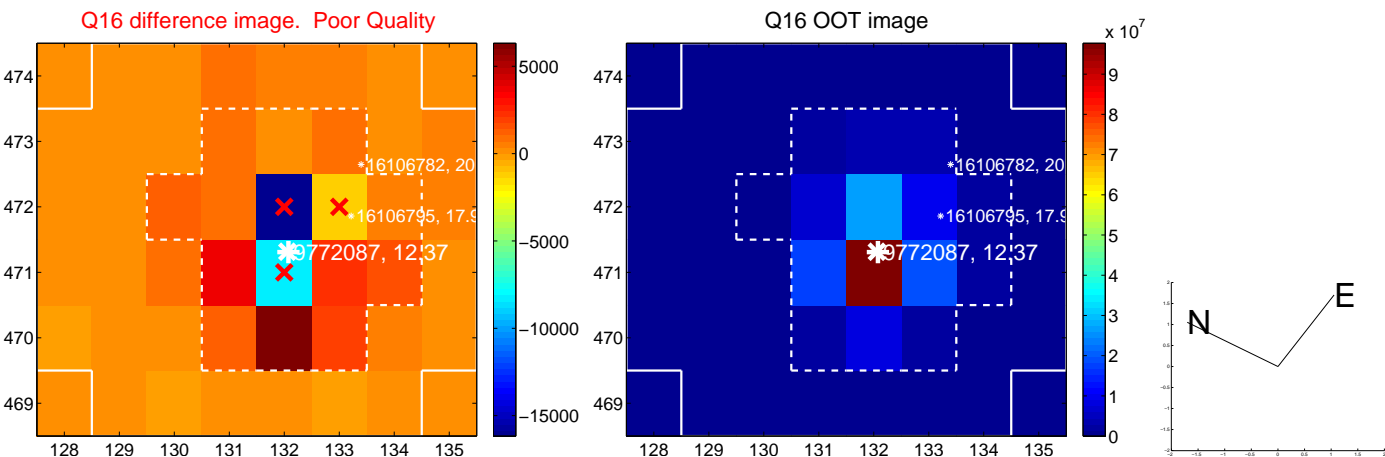
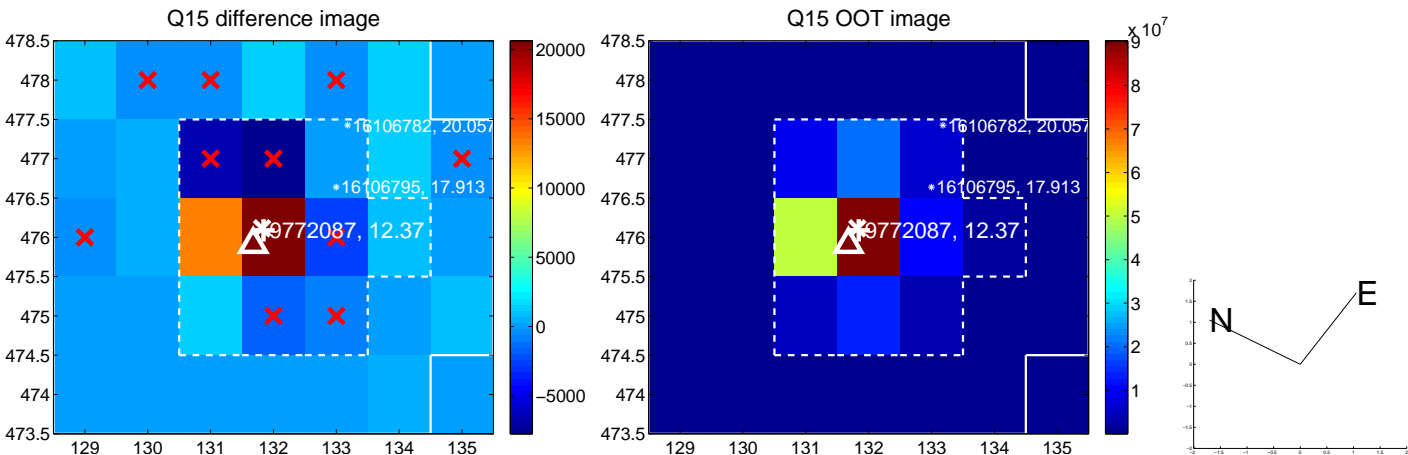
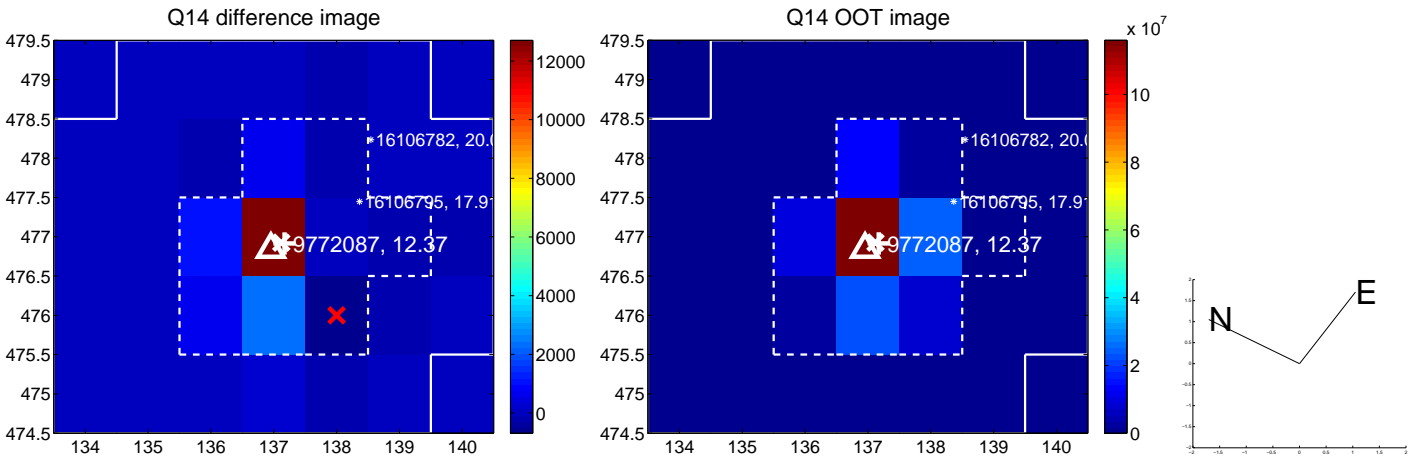
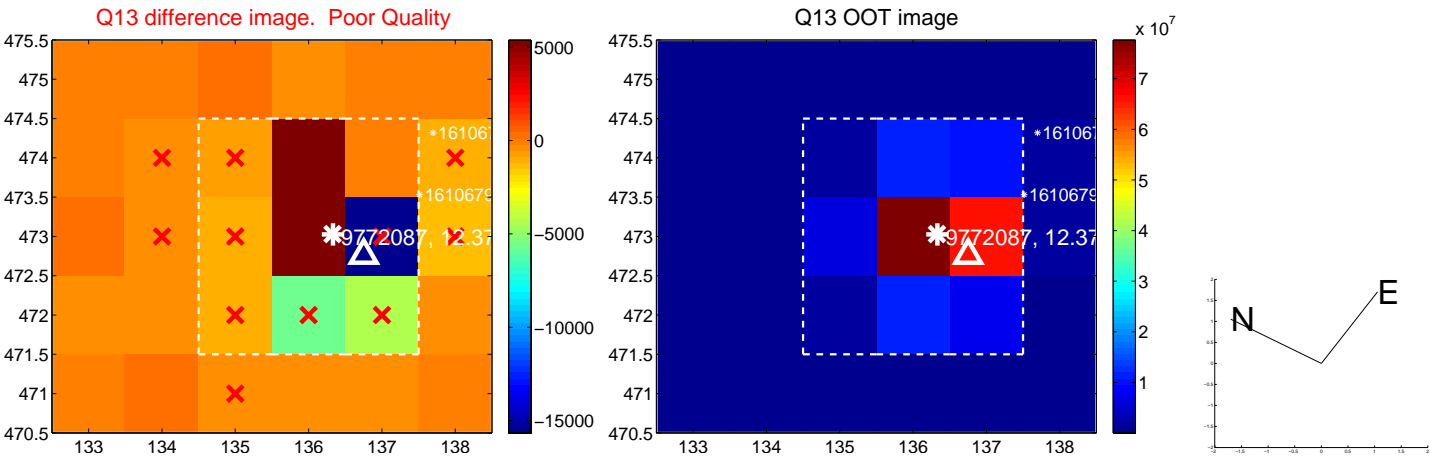




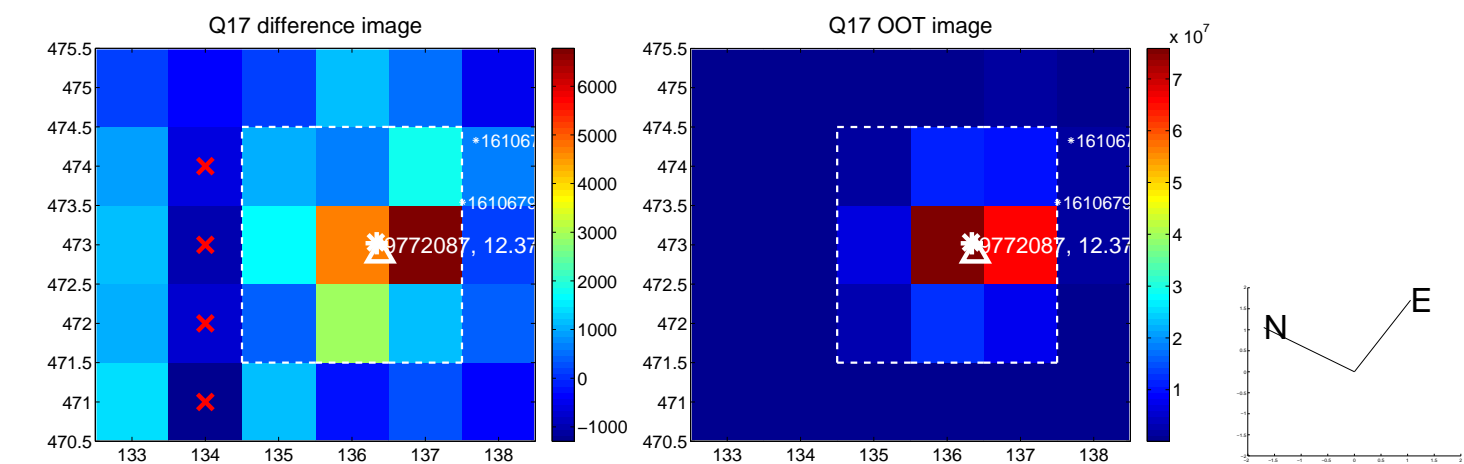
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



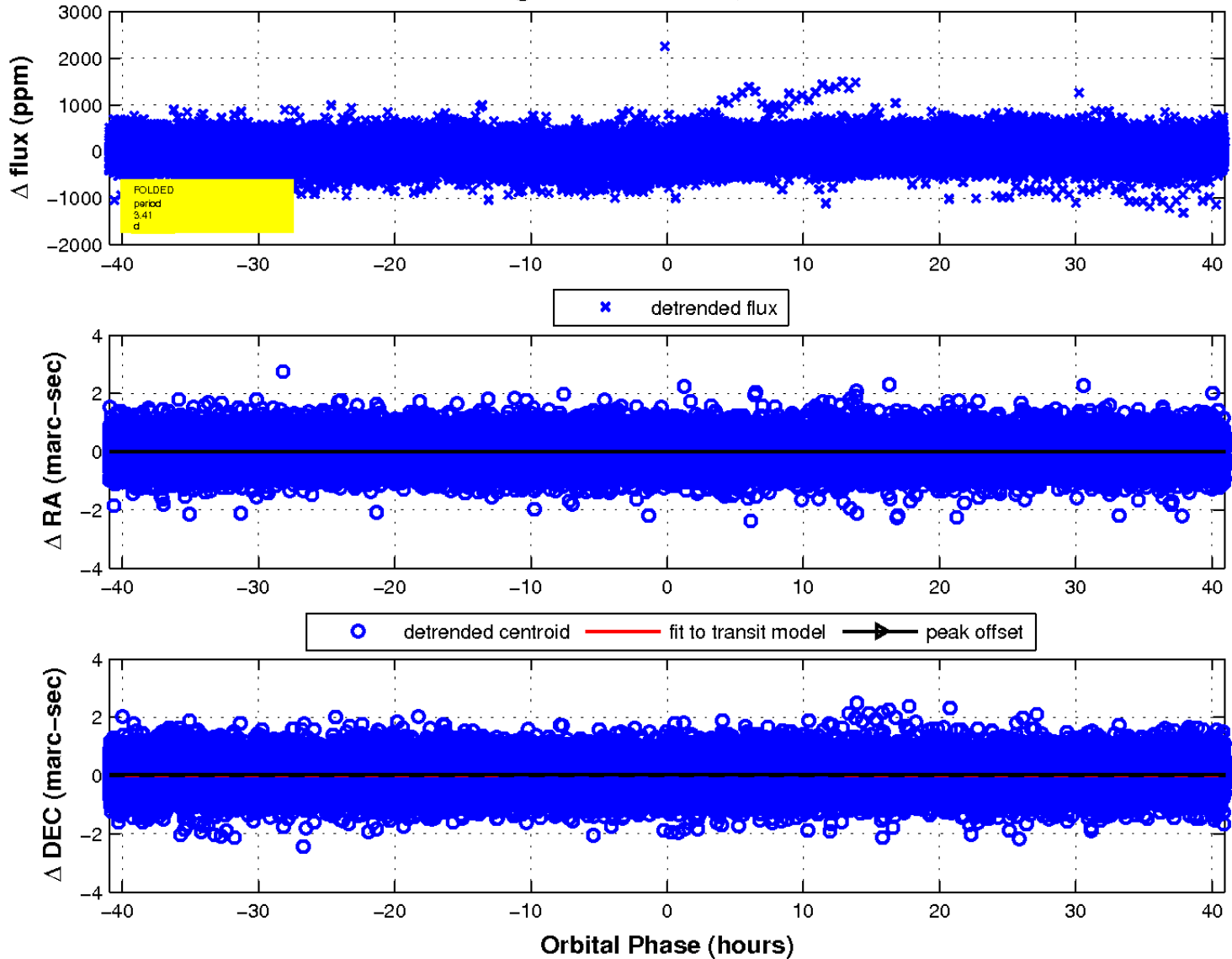
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

Declination

