

# KIC 010616415

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
010616415-01	OBS	1999.01	2.241237	132.727837	272.5	1.630	11.6	29.5	4.03	4972	8.29	5634.55
010616415-02	OBS	No	2.241270	131.597390	190.0	1.086	18.0	19.0	4.03	4972	6.82	5634.44

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
010616415-01	OBS	FP	0.00	0	1	0	0	MOD_SEC_DV—HAS_SEC_TCE
010616415-02	OBS	FP	0.00	1	1	0	0	IS_SEC_TCE

**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.

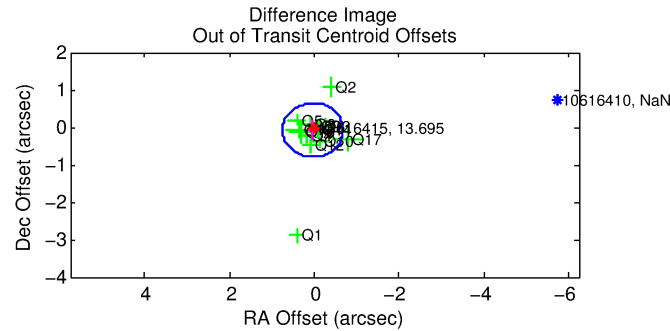
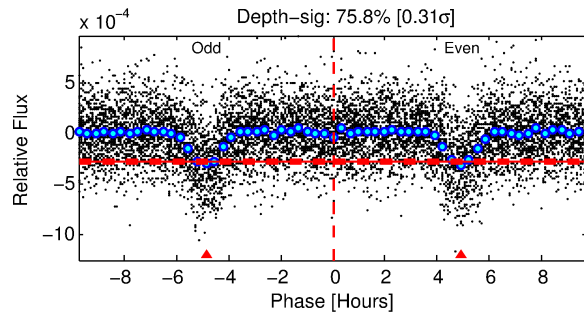
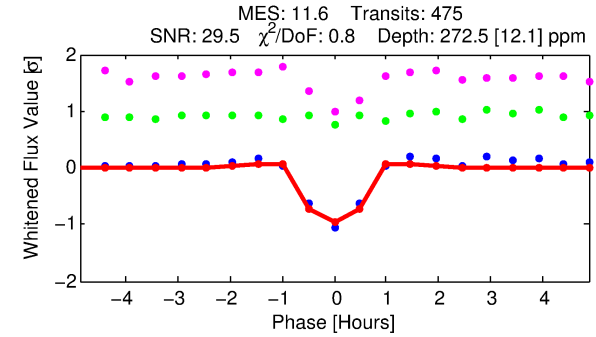
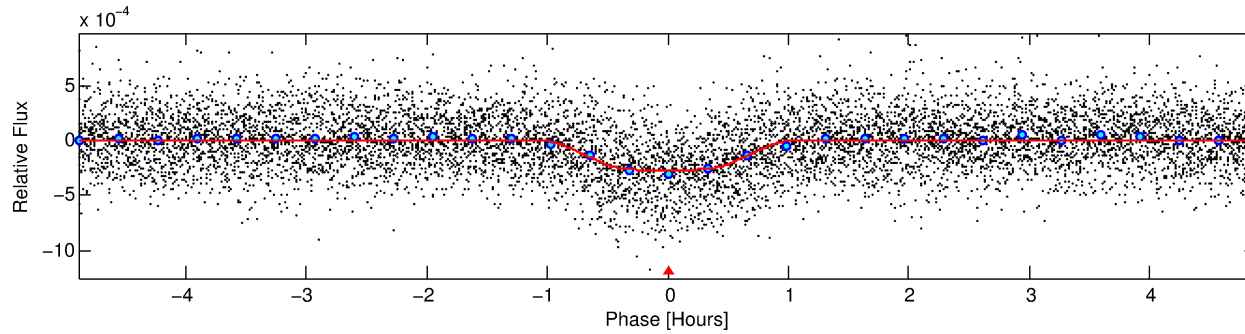
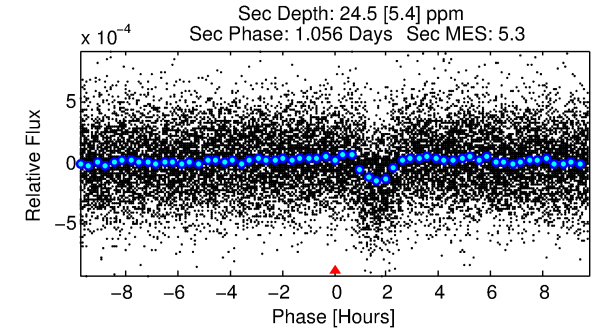
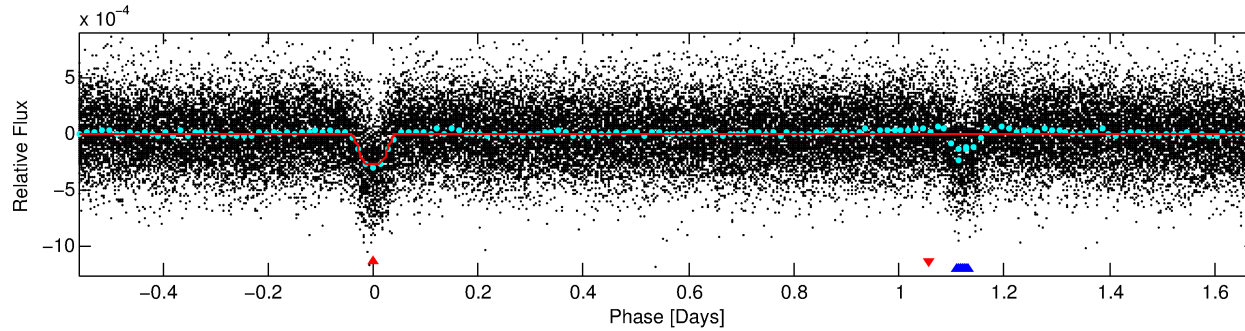
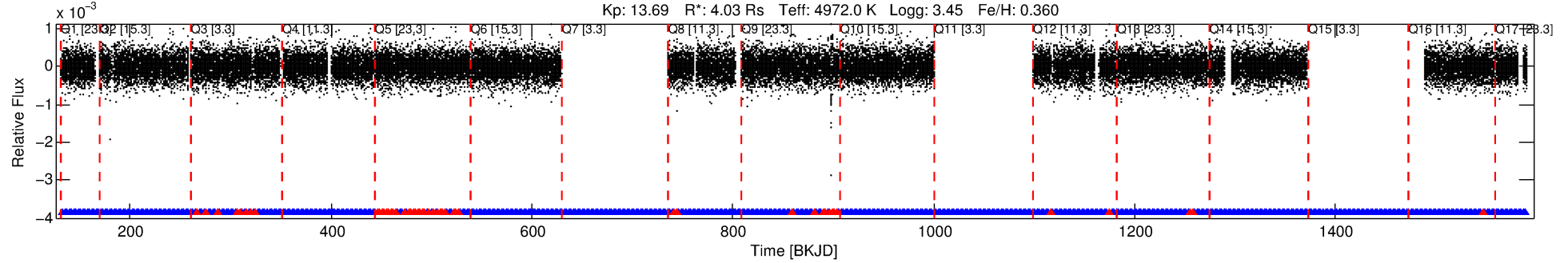
## Ephemeris Match Information For 010616415-01

No Significant Match Found

# DV One-Page Summary

KIC: 10616415 Candidate: 1 of 2 Period: 2.241 d  
KOI: K01999 Corr: No Ephemeris Match

Kp: 13.69 R\*: 4.03 Rs Teff: 4972.0 K Logg: 3.45 Fe/H: 0.360



## DV Fit Results:

Period = 2.24124 [0.00000] d  
Epoch = 132.7278 [0.0008] BKJD  
Rp/R\* = 0.0188 [0.0049]  
a/R\* = 4.89 [4.79]  
b = 0.91 [0.20]  
Seff = 5634.55 [4629.51]  
Teq = 2209 [454] K  
Rp = 8.29 [4.63] Re  
a = 0.0398 [0.0197] AU  
Ag = 0.31 [0.31] [-2.23σ]  
Teffp = 2551 [373] K [0.58σ]

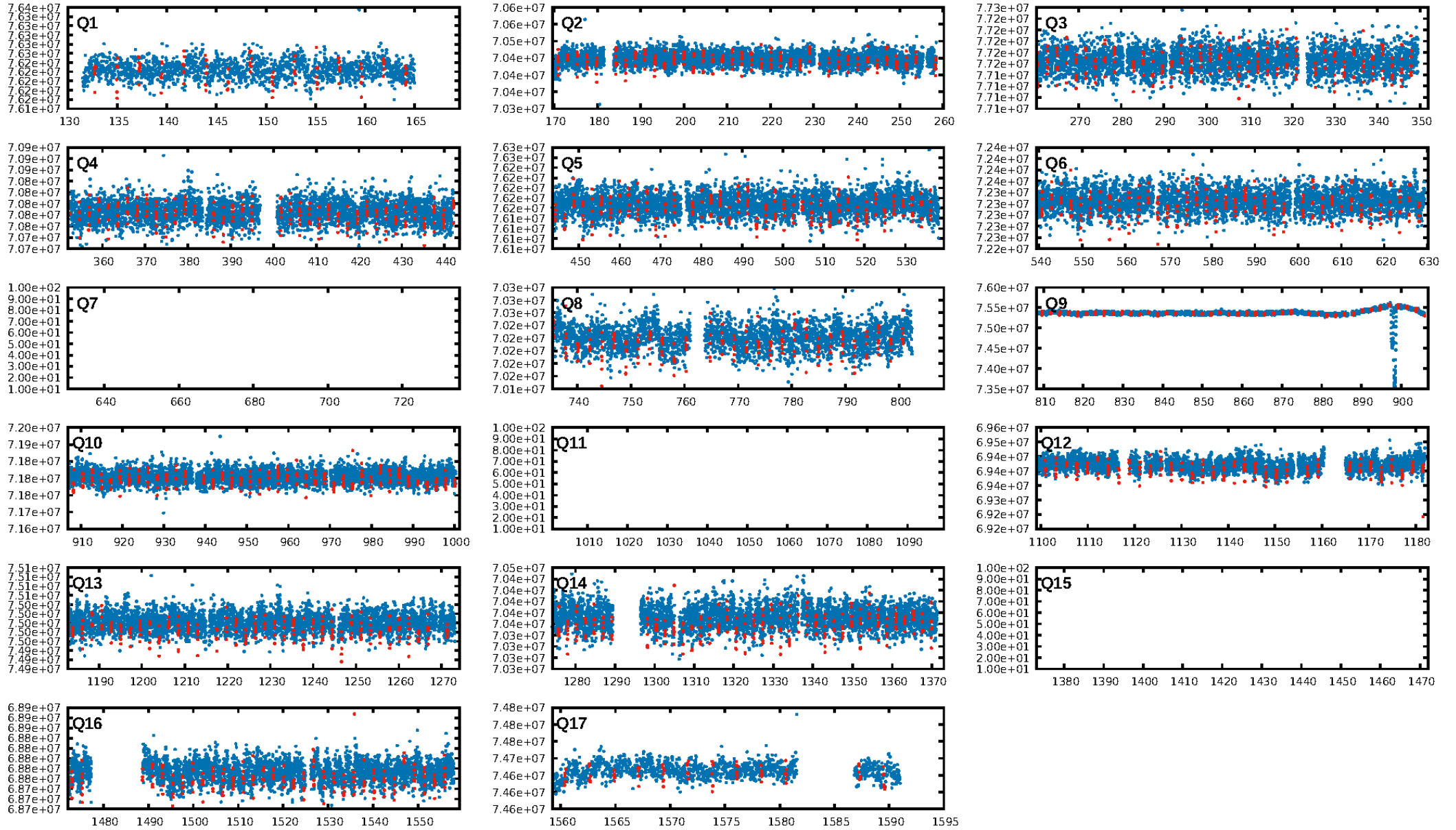
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 0.0% [0.00σ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 1.11e-26  
RollingBand-fgt: 0.89 [398/448]  
GhostDiagnostic-chr: 2.135  
Centroid-sig: 0.1%  
Centroid-so: 0.407 arcsec [1.52σ]  
OotOffset-rm: 0.083 arcsec [0.35σ]  
KicOffset-rm: 0.159 arcsec [0.69σ]  
OotOffset-st: 4/1/4/5 [14]  
KicOffset-st: 4/1/4/5 [14]  
DiffImageQuality-fgm: 1.00 [14/14]  
DiffImageOverlap-fno: 1.00 [14/14]

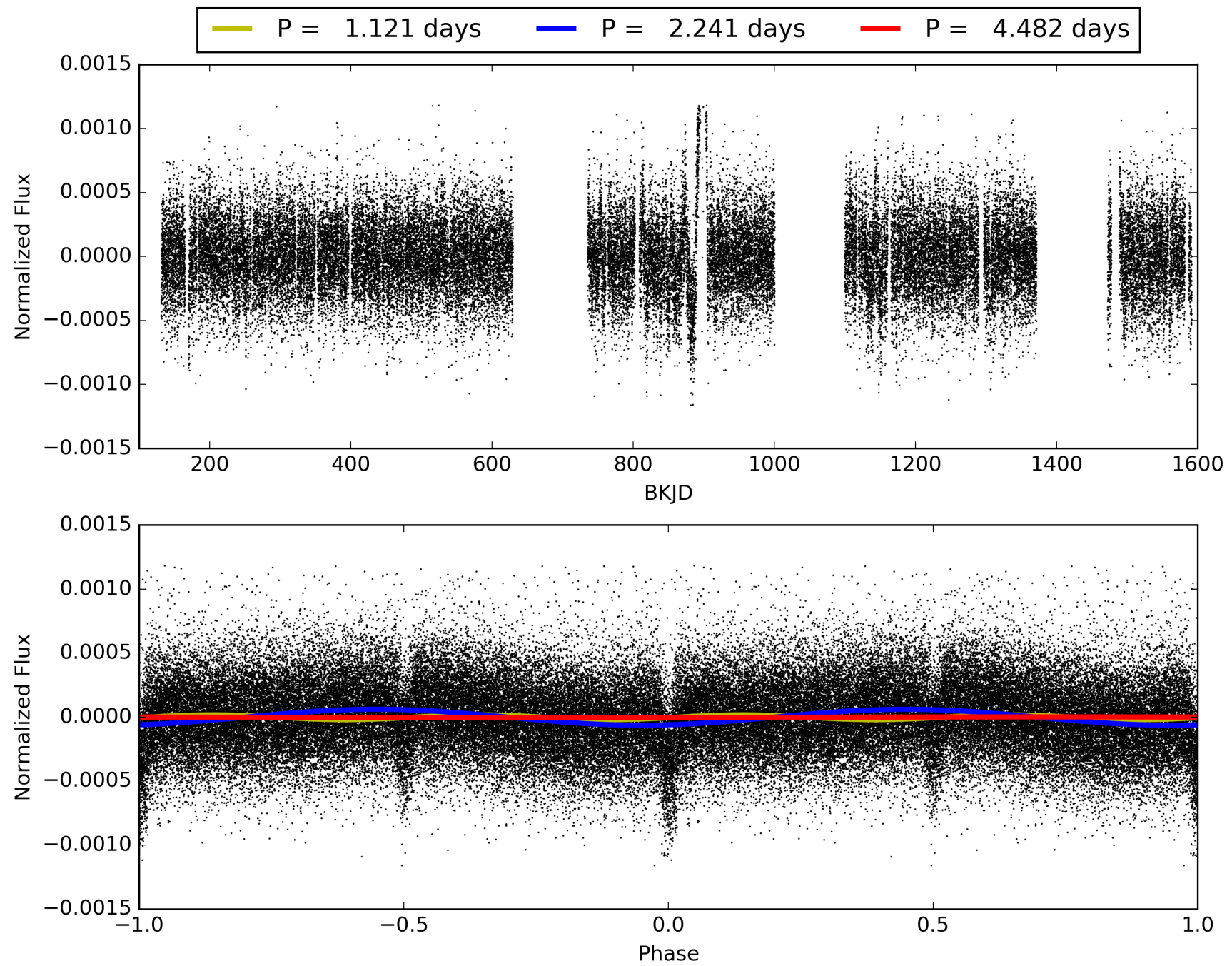
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 11:08:58 Z

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

# TCE 010616415-01, PDC Light Curves

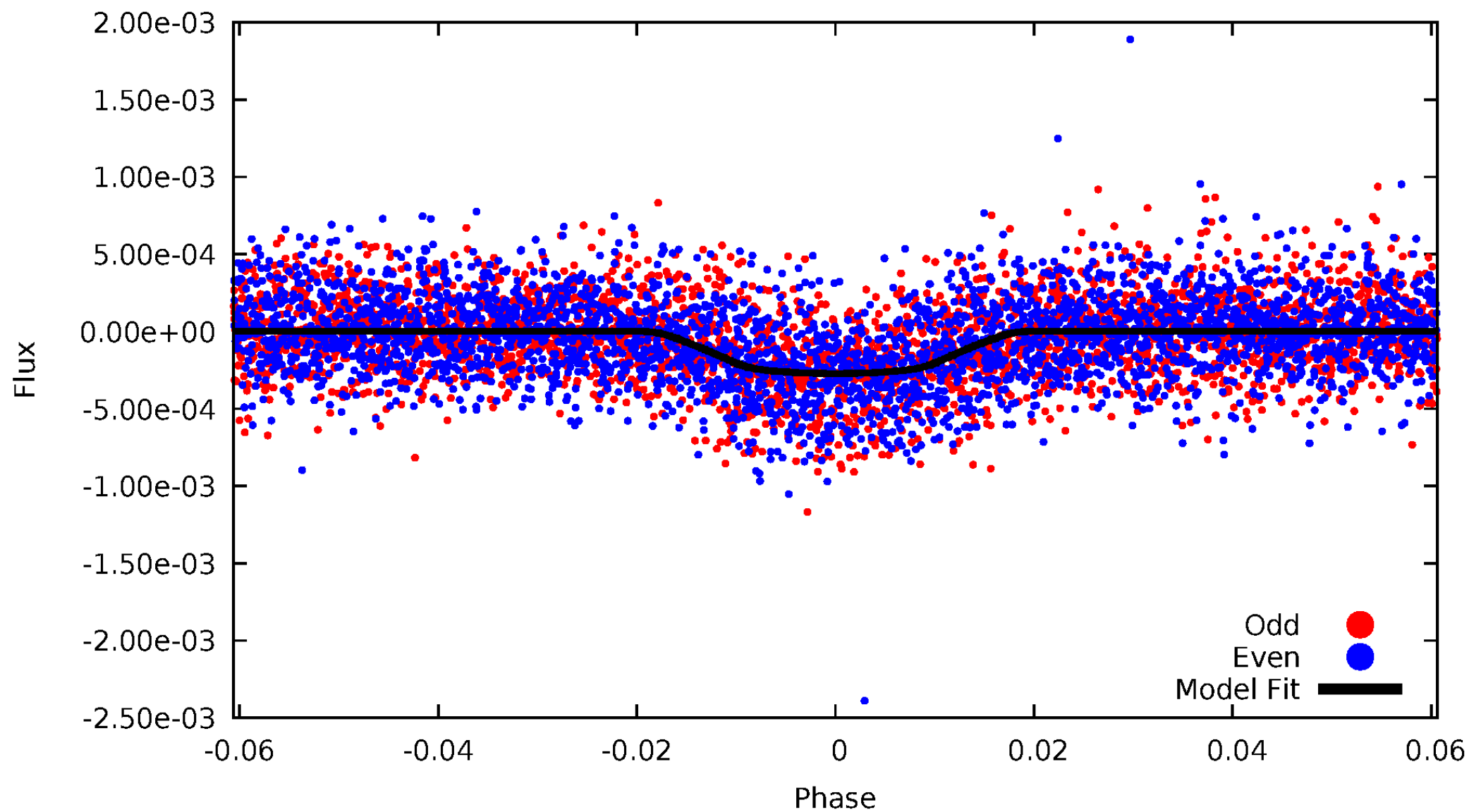


TCE 010616415-01



# DV Odd/Even

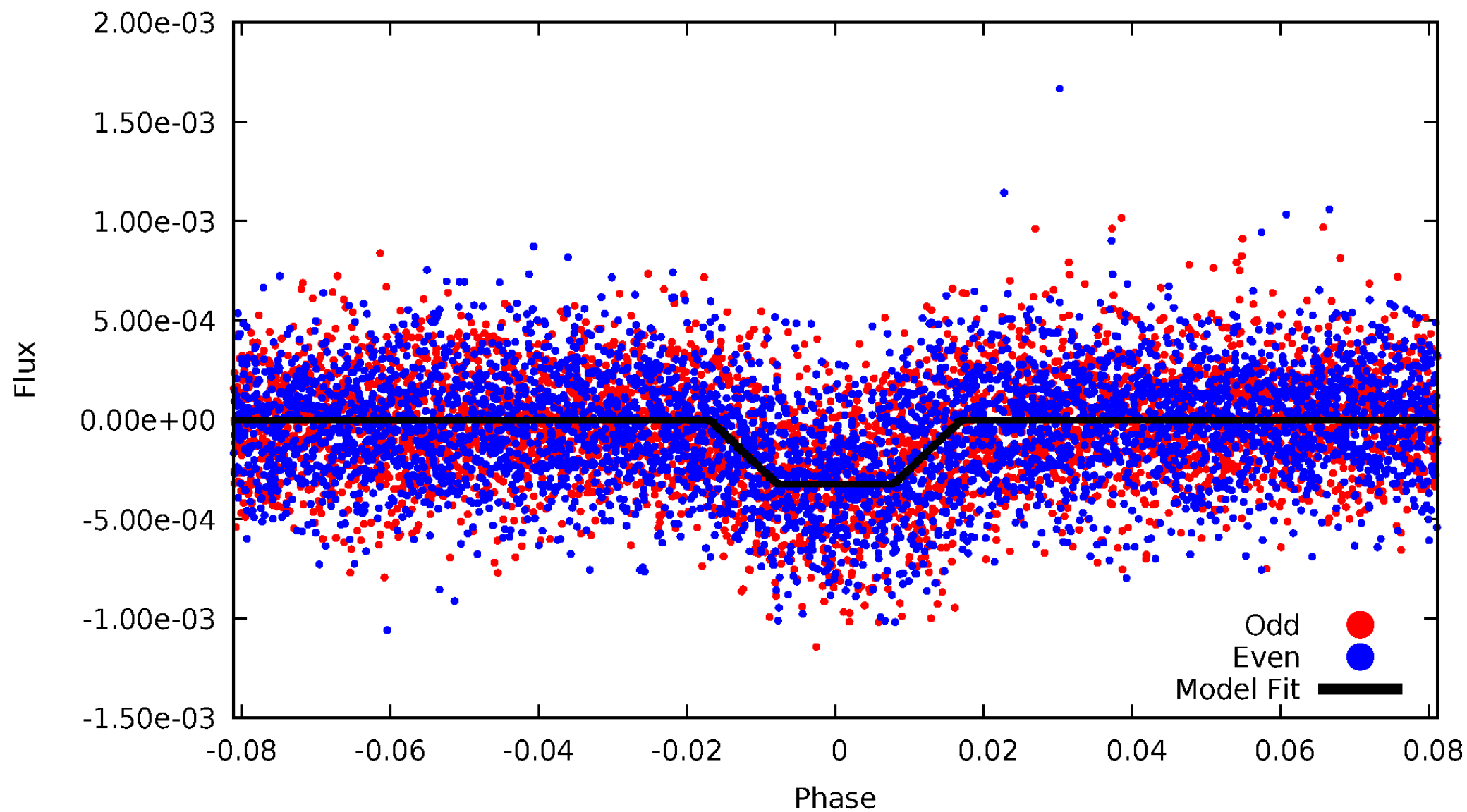
TCE 010616415-01





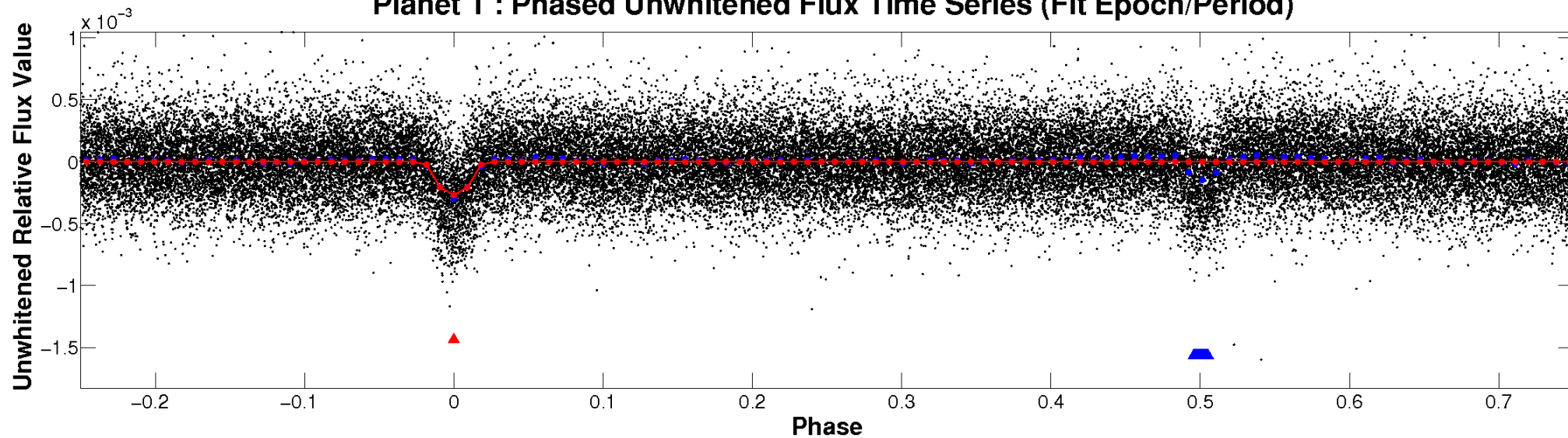
# ALT Odd/Even

TCE 010616415-01

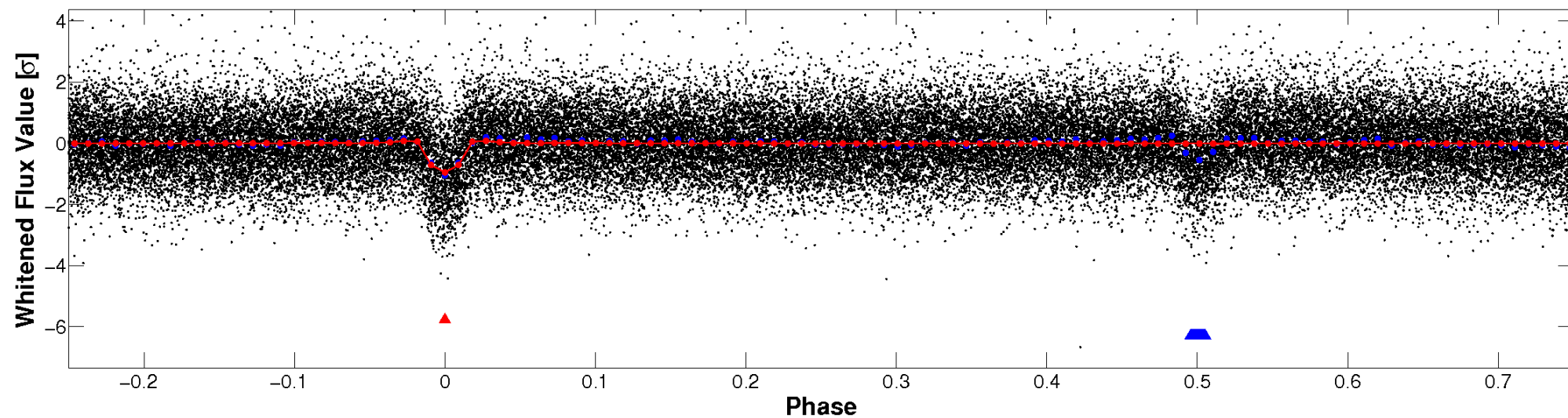


# Non-Whitened Vs. Whitened Light Curve

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

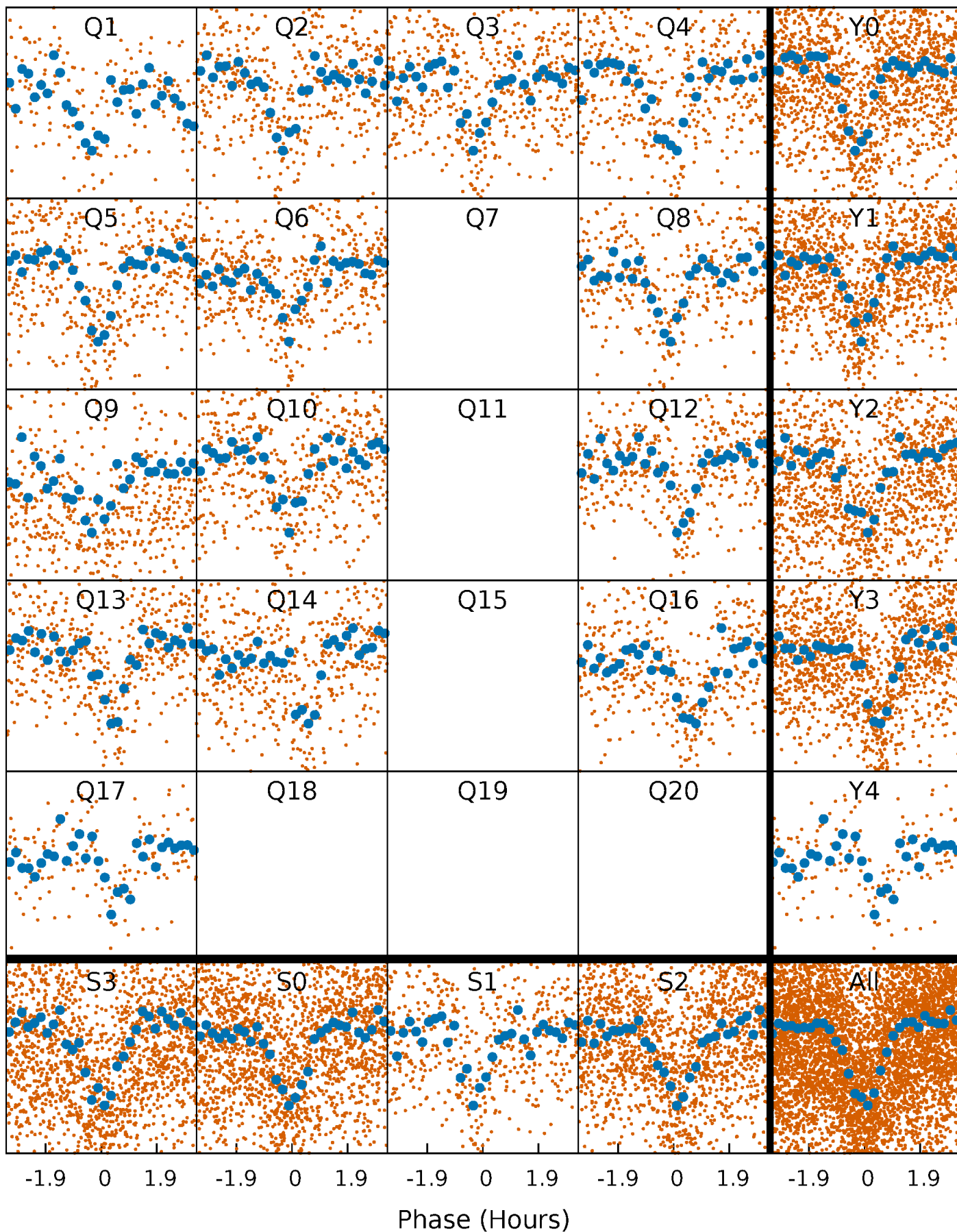


**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**



# PDC Quarter-Phased Transit Curves

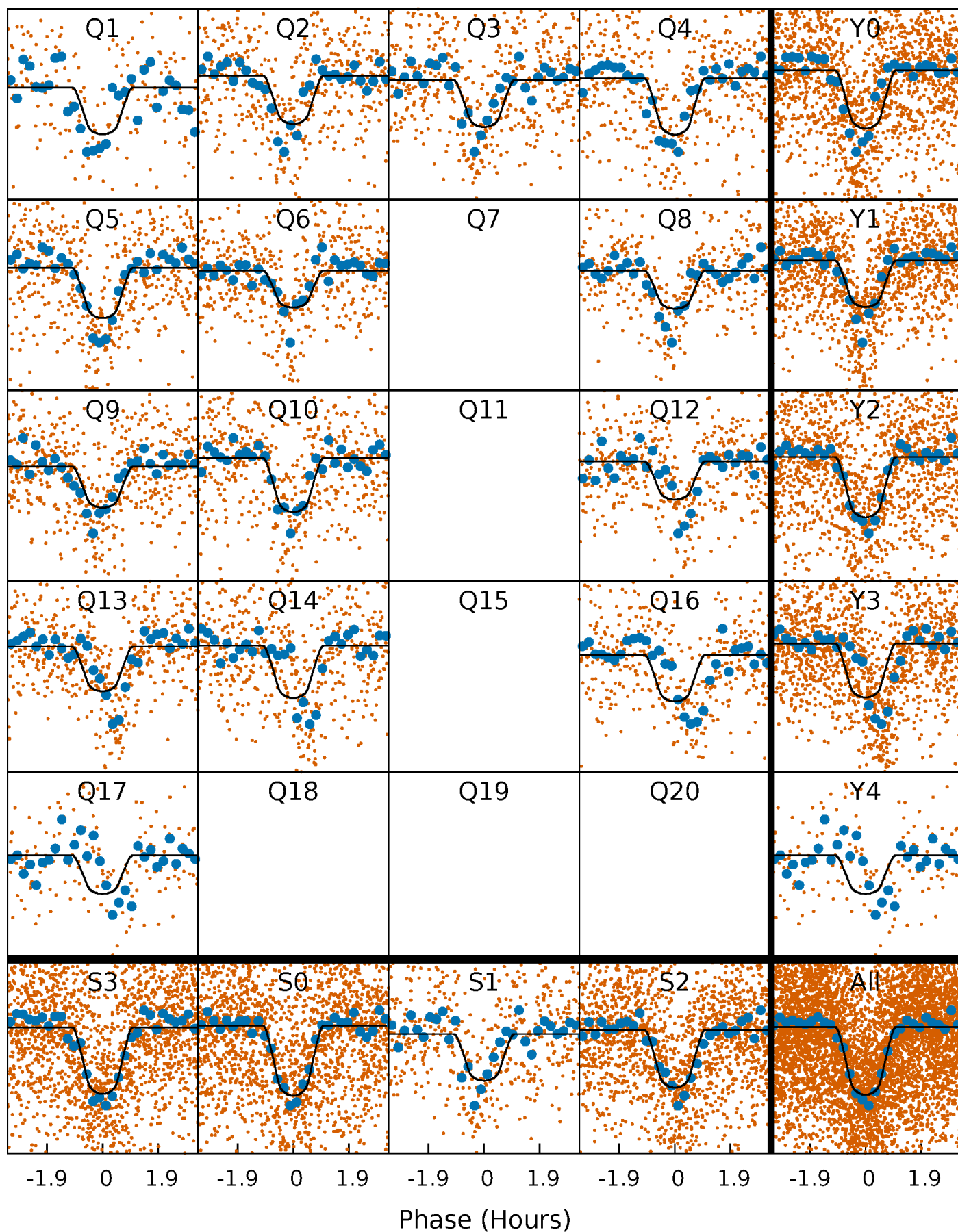
TCE 010616415-01 P= 2.241237 Days  $T_0=132.727837$  (BKJD)





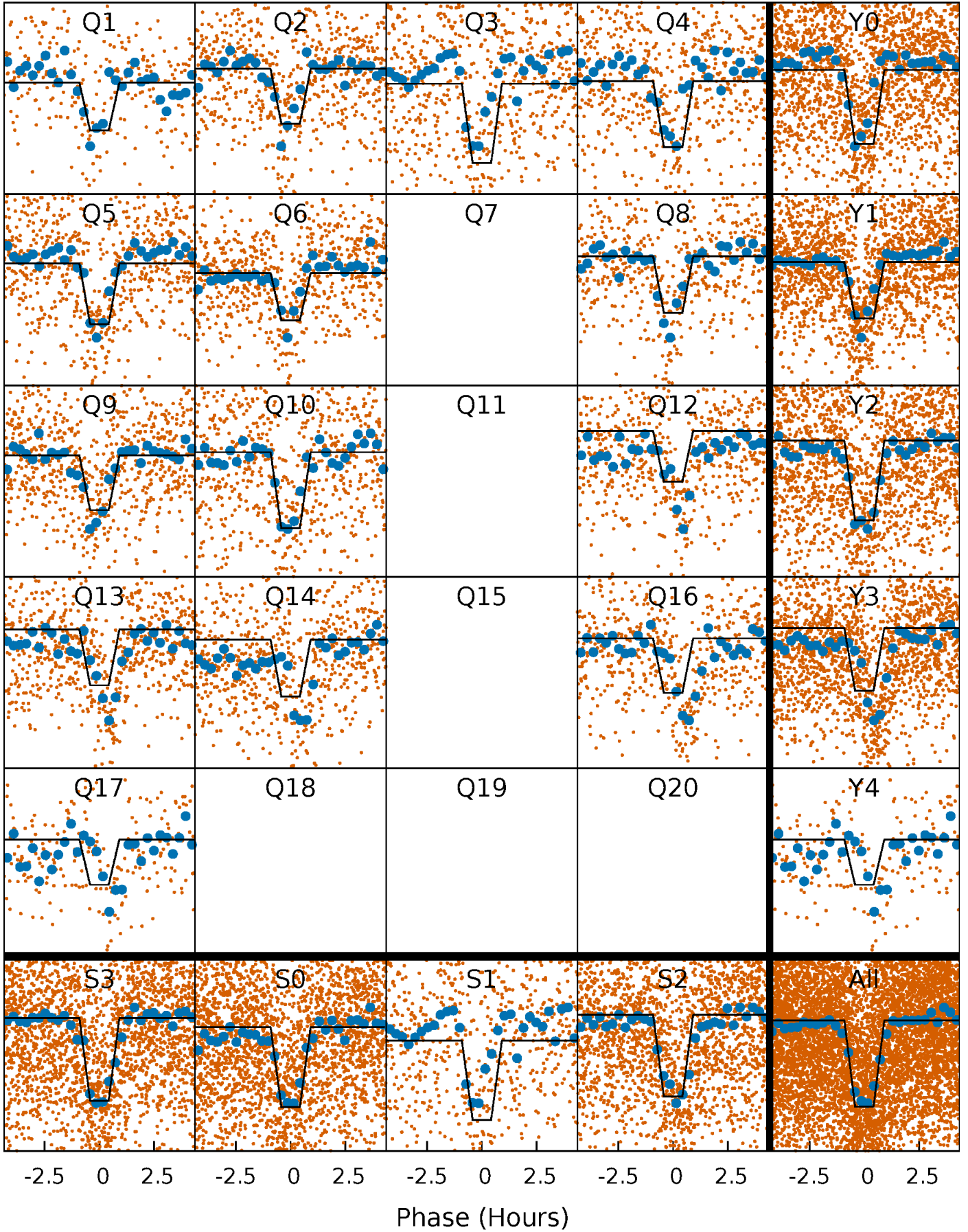
# DV Quarter-Phased Transit Curves

TCE 010616415-01 P= 2.241237 Days  $T_0=132.727837$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

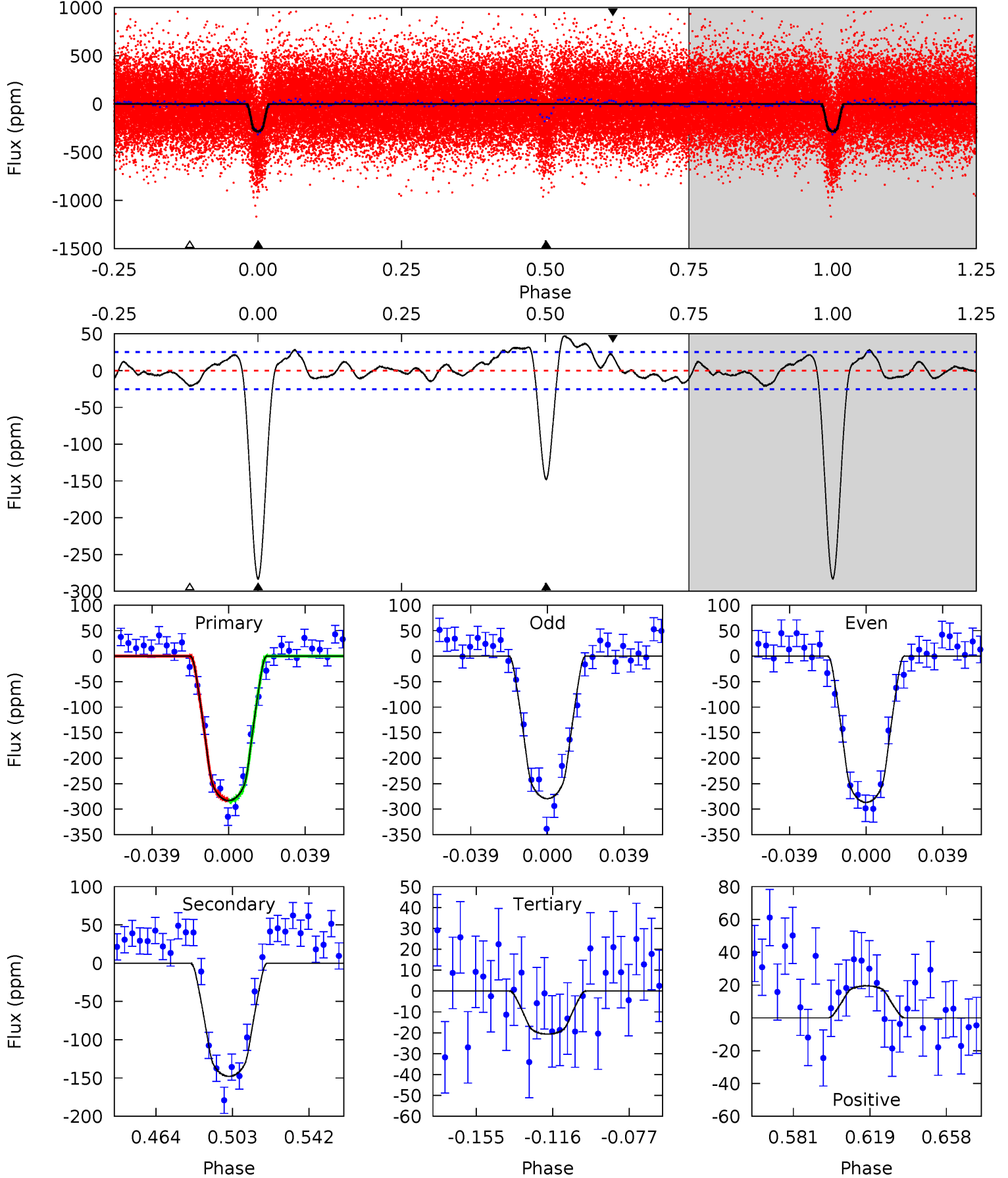
TCE 010616415-01 P= 2.241235 Days  $T_0=132.727833$  (BKJD)



# DV Model-Shift Uniqueness Test

010616415-01, P = 2.241237 Days, E = 130.486600 Days

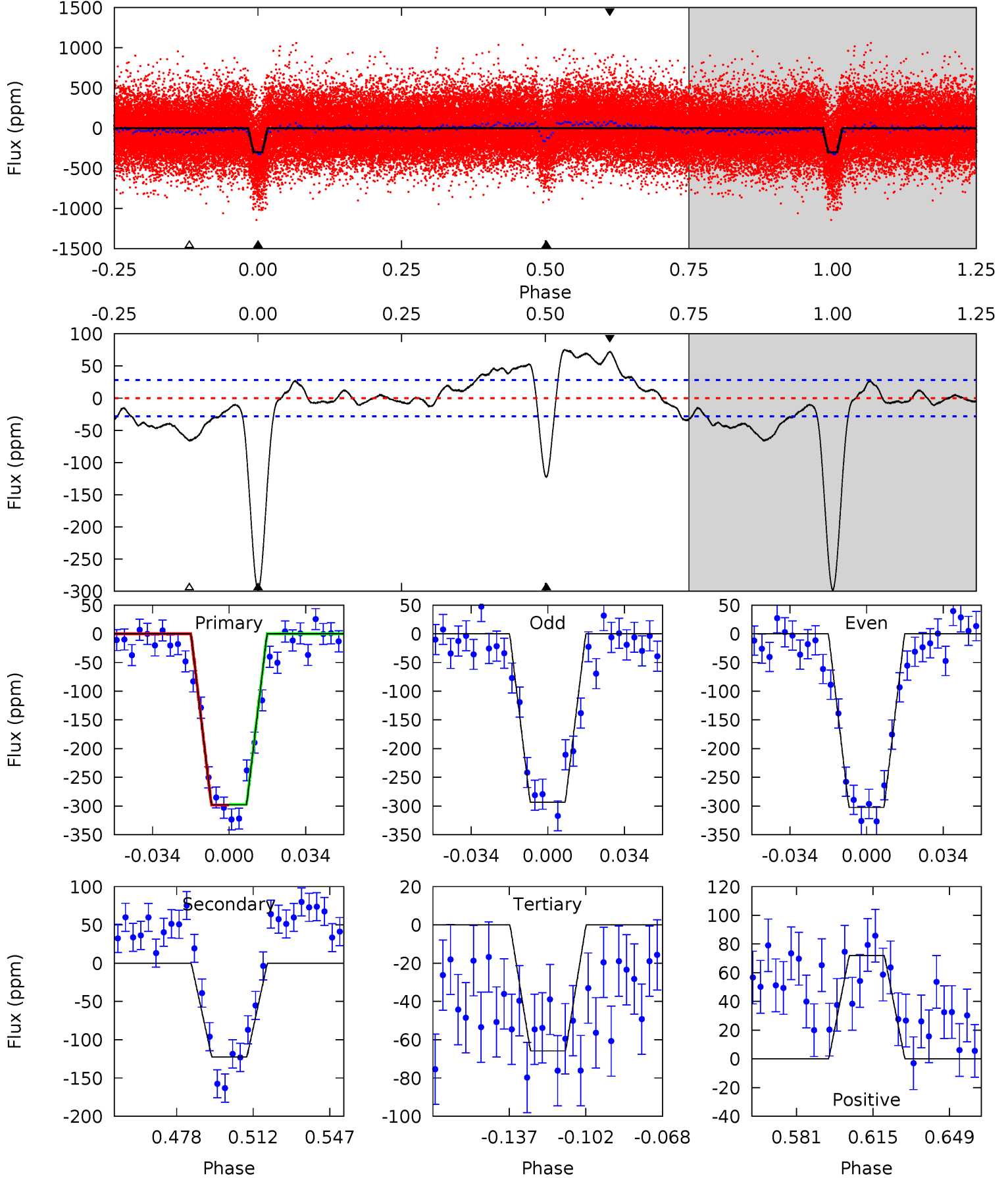
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
53.3	27.8	3.89	3.68	4.76	2.07	2.55	49.4	49.6	23.9	24.2	0.69	0.98	0.14	0.26



# Alt Model-Shift Uniqueness Test

010616415-01, P = 2.241235 Days, E = 130.486598 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
50.6	20.8	11.2	12.2	4.79	2.12	5.74	39.4	38.4	9.61	8.57	0.79	1.01	0.20	0.07



### Stellar Parameters For KIC 010616415

	$T_{\text{eff}} (K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M (M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$4972^{+148}_{-163}$	$3.449^{+0.483}_{-0.241}$	$0.360^{+0.100}_{-0.300}$	$4.034^{+1.327}_{-1.990}$	$1.668^{+0.239}_{-0.670}$	$0.036^{+0.170}_{-0.018}$
	+3%/-3%	+14%/-7%	+28%/-83%	+33%/-49%	+14%/-40%	+475%/-51%
Source	PHO1	KIC0	KIC0	DSEP		

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

### Secondary Eclipse Parameters for KIC 010616415-01 / KOI 1999.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-148 \pm 5$	$7.80^{+3.05}_{-2.65}$	$3066^{+317}_{-416}$	$4048^{+511}_{-392}$	$2.003^{+2.417}_{-0.922}$
Alt.	$-122 \pm 6$	$7.25^{+2.91}_{-2.85}$	$3037^{+348}_{-377}$	$4001^{+618}_{-408}$	$1.934^{+2.782}_{-0.925}$

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



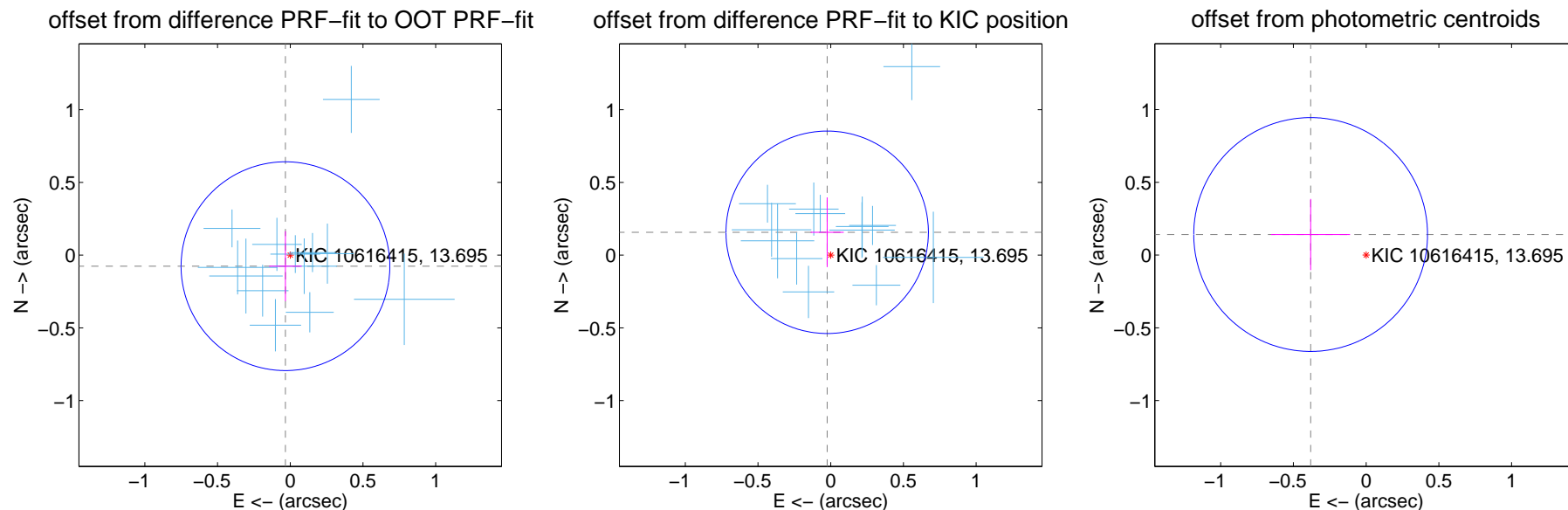
## DV Centroid Data

Supplemental centroid analysis for 010616415-01. Kepler magnitude: 13.70. Transit SNR 29.51

There are 14 quarters with good PRF difference image offsets

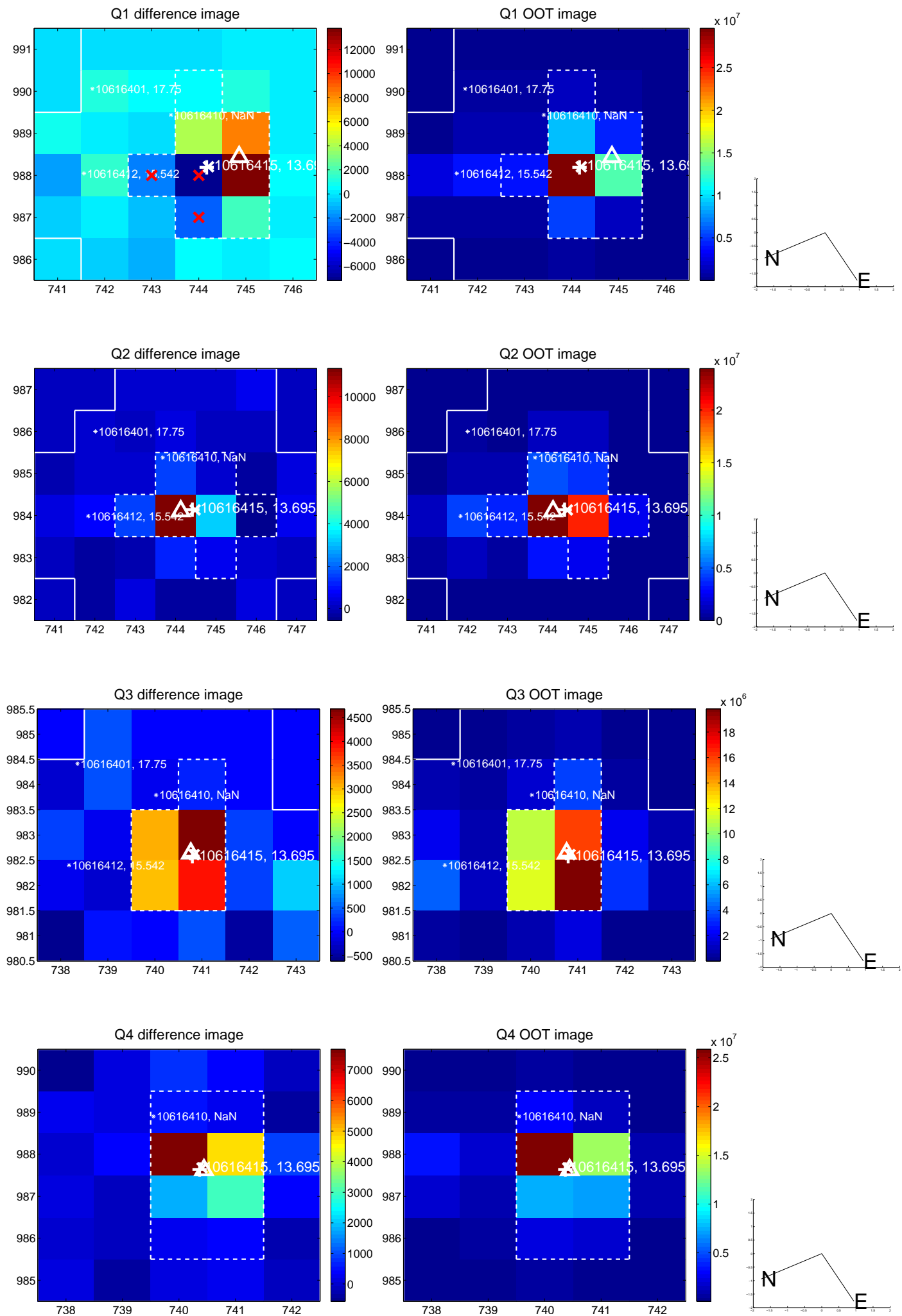
The direct PRF centroid is offset from the target star catalog position by about 0.30 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.083 \pm 0.239$	0.35	$0.033 \pm 0.112$	$-0.076 \pm 0.240$
PRF-fit source offset from KIC position	$0.159 \pm 0.232$	0.69	$0.024 \pm 0.114$	$0.157 \pm 0.240$
photometric centroid source offset	$0.41 \pm 0.27$	1.52	$0.38 \pm 0.27$	$0.14 \pm 0.24$

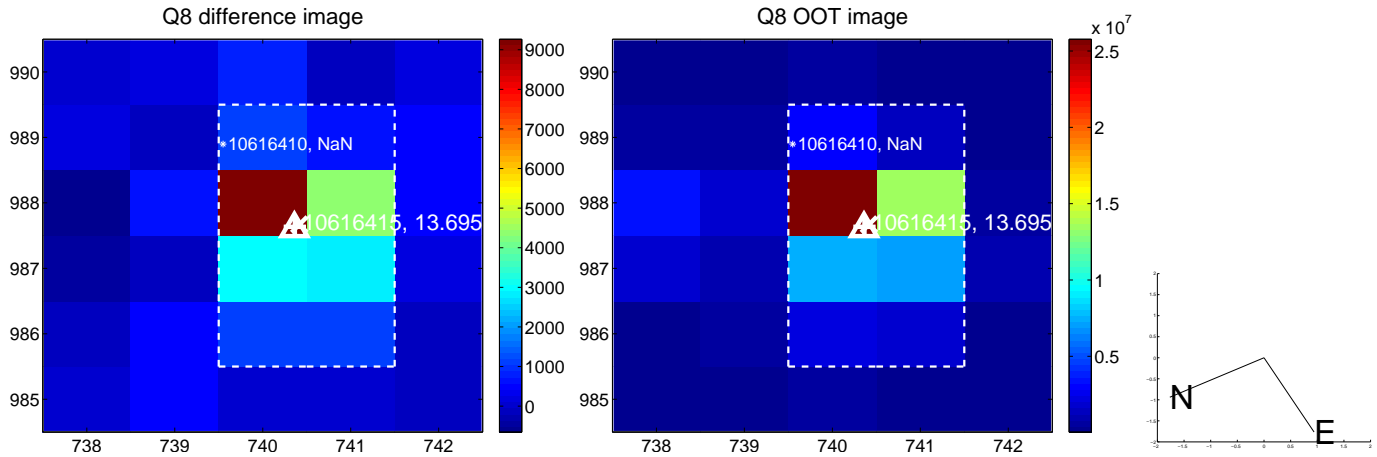
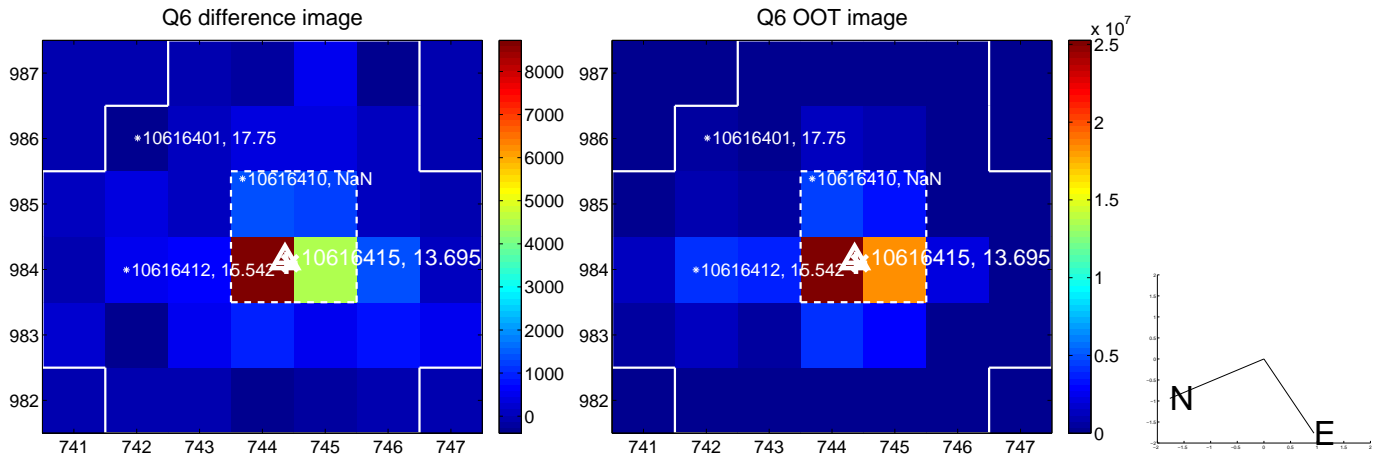
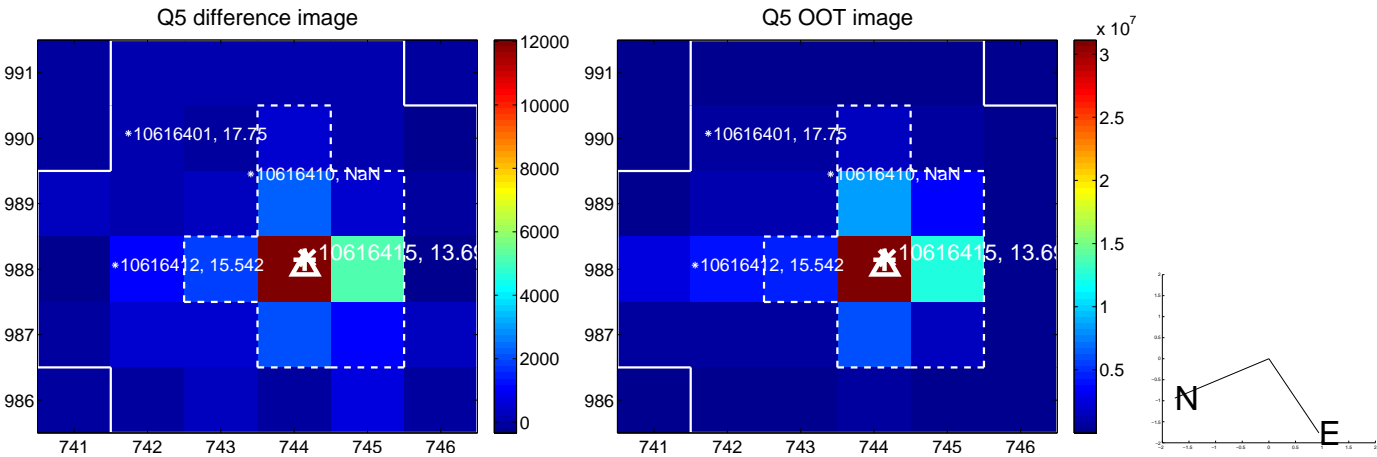


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

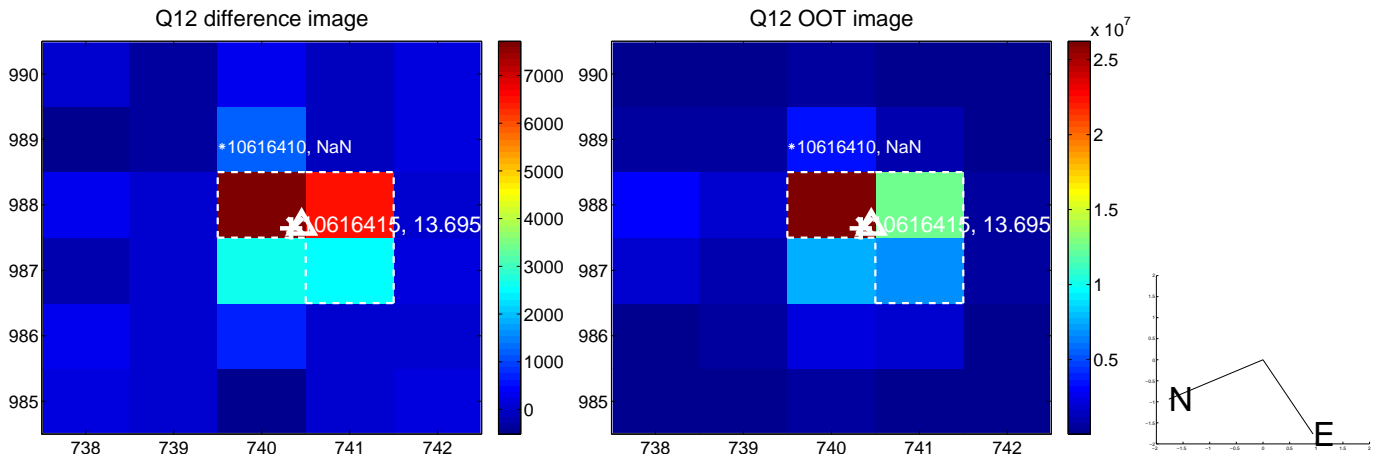
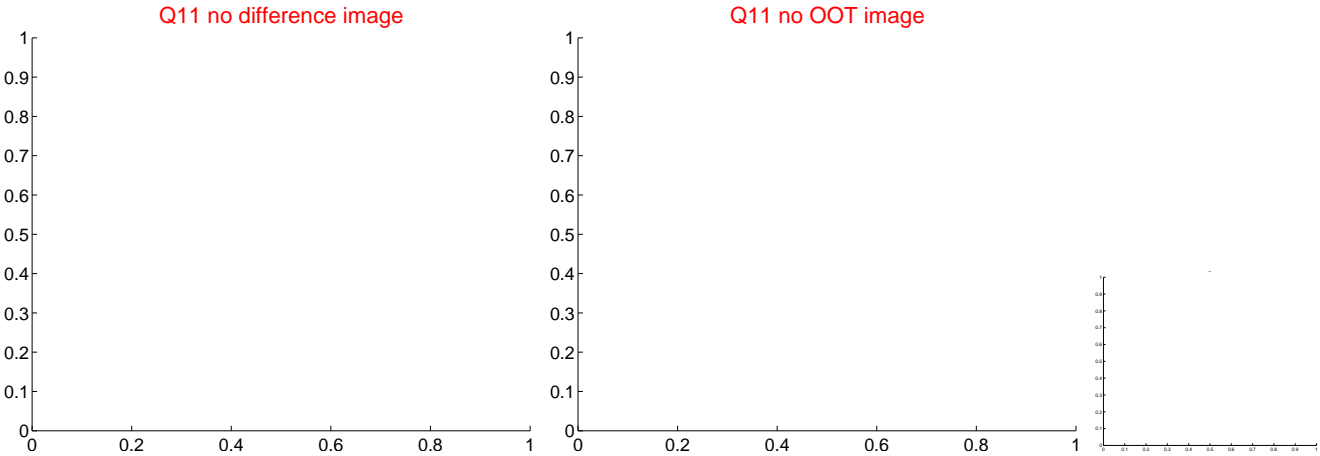
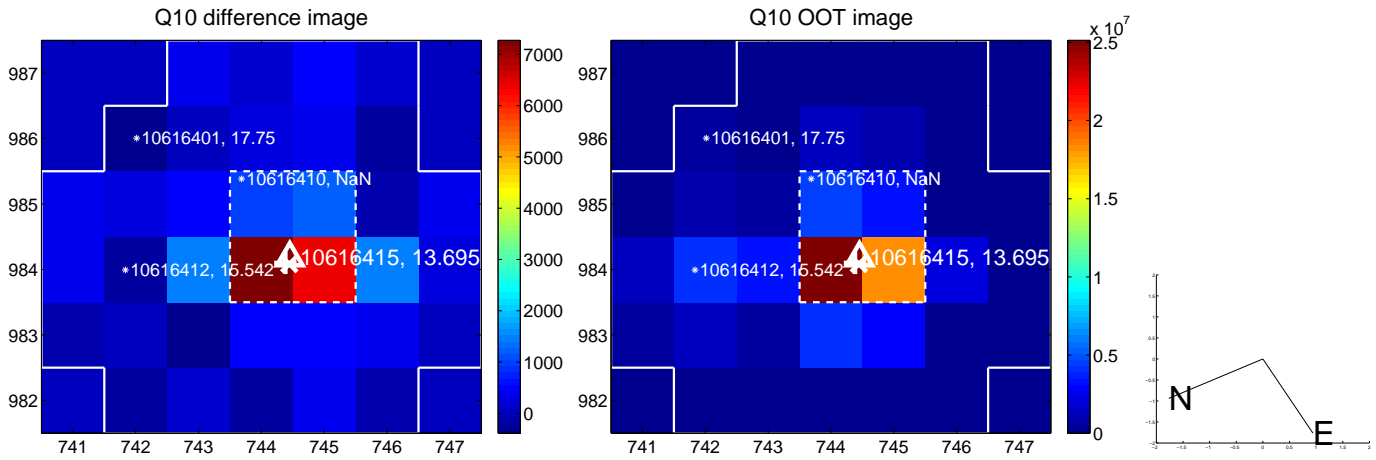
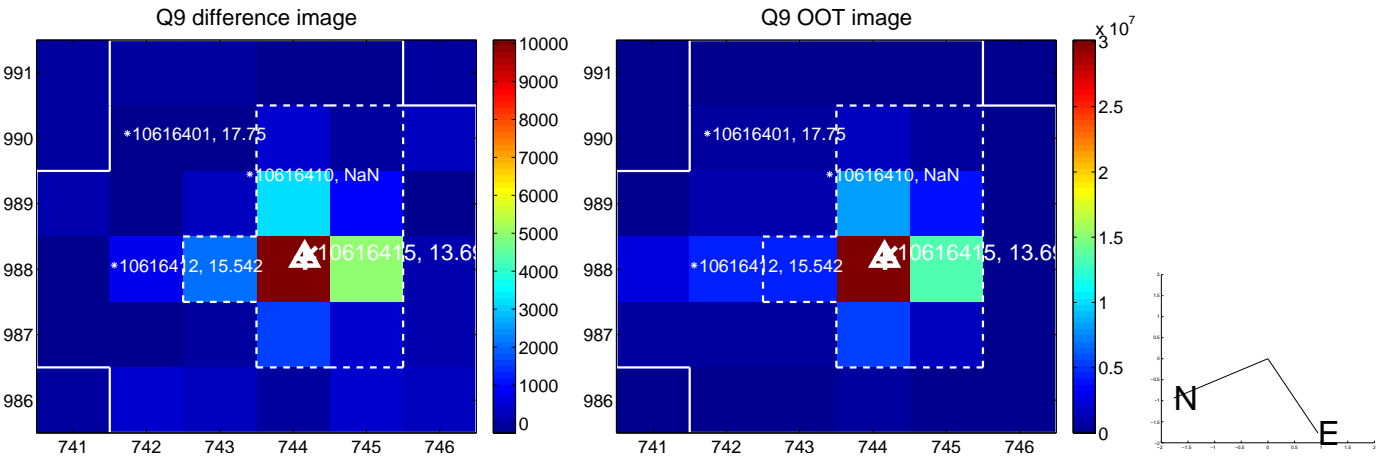
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



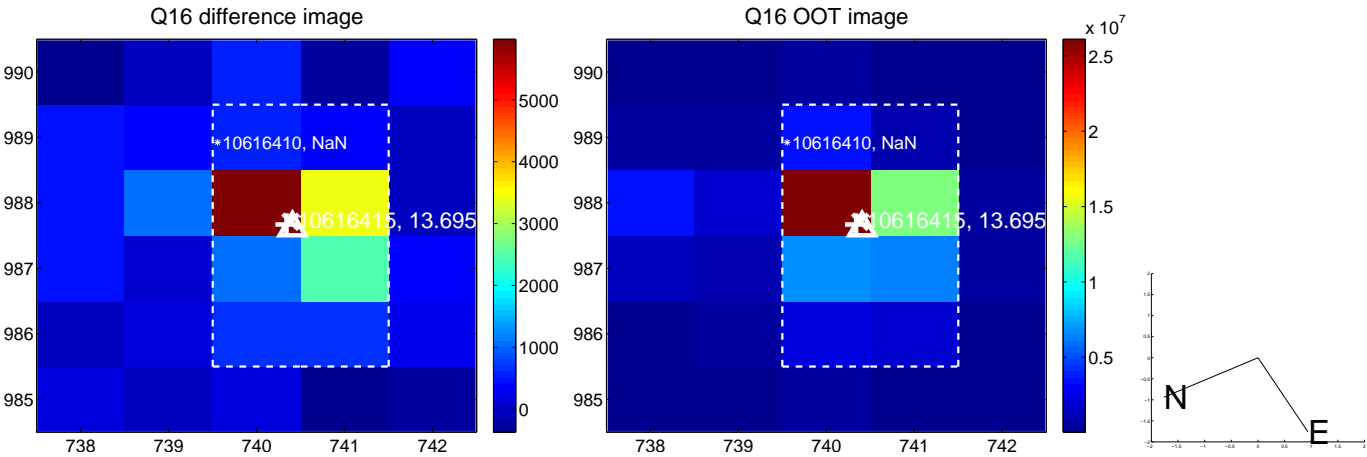
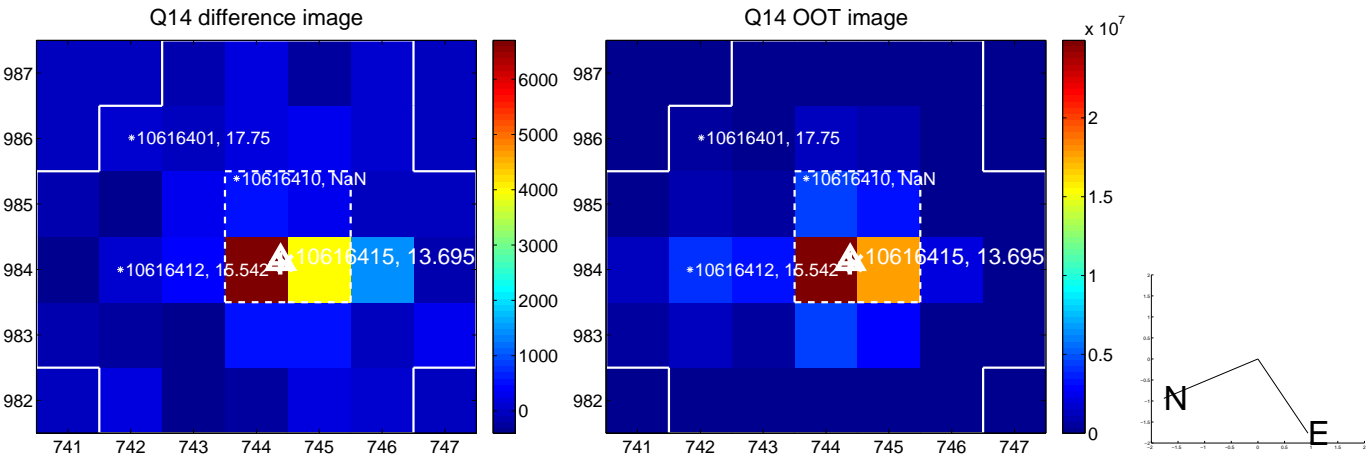
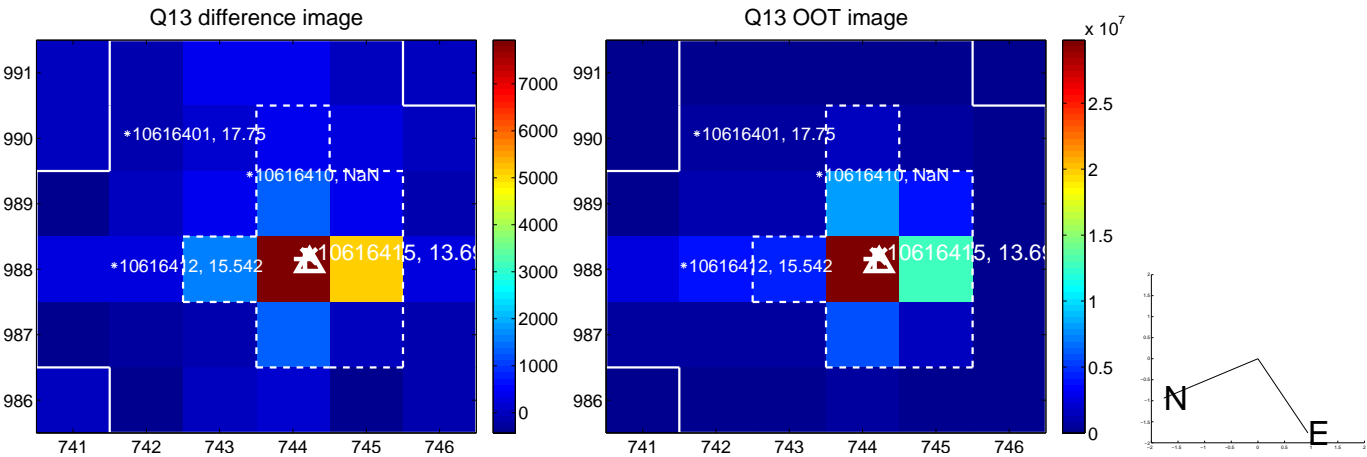
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

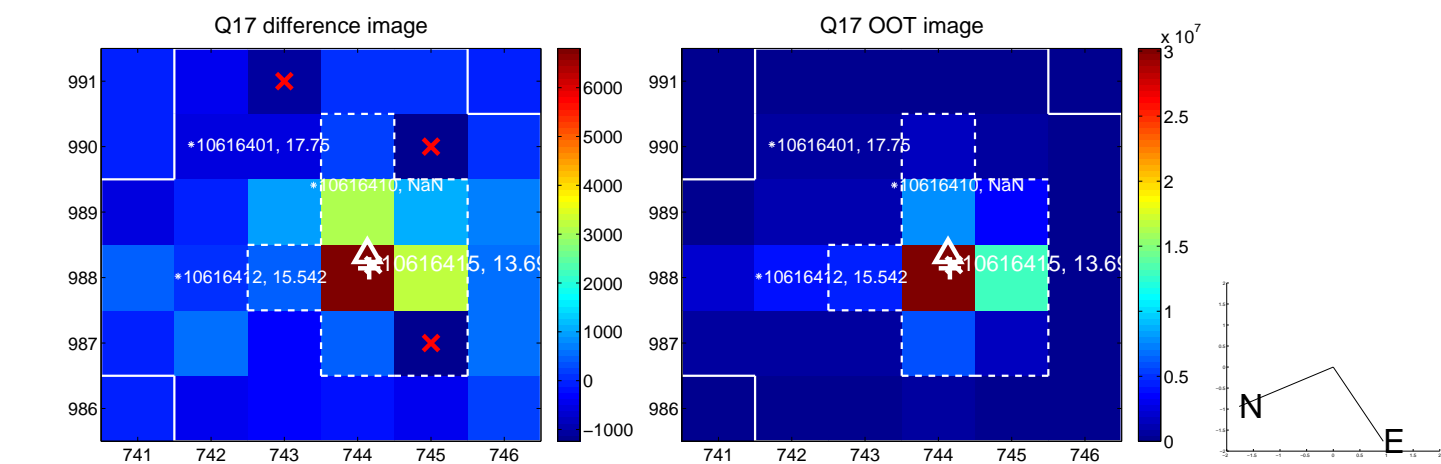


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

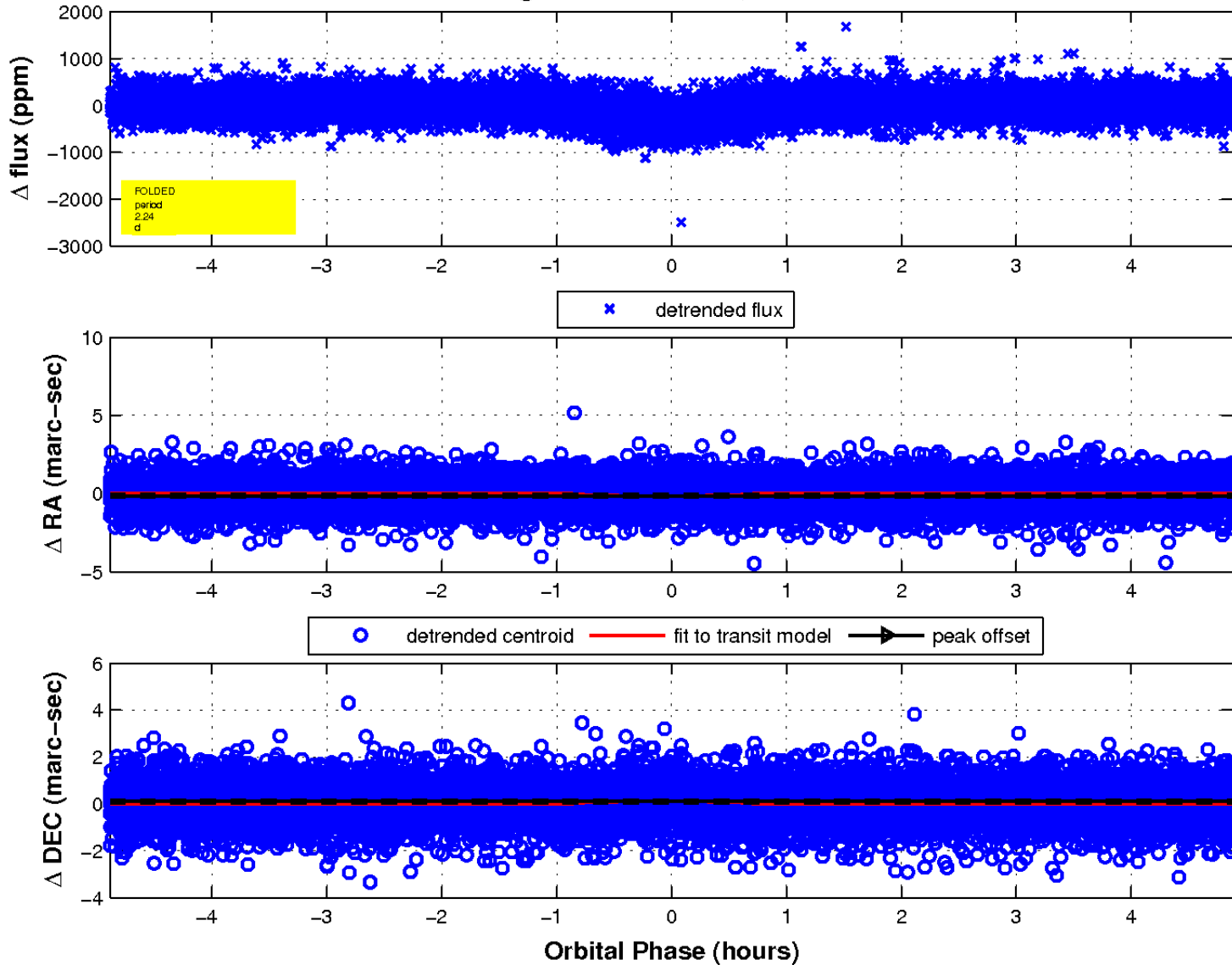




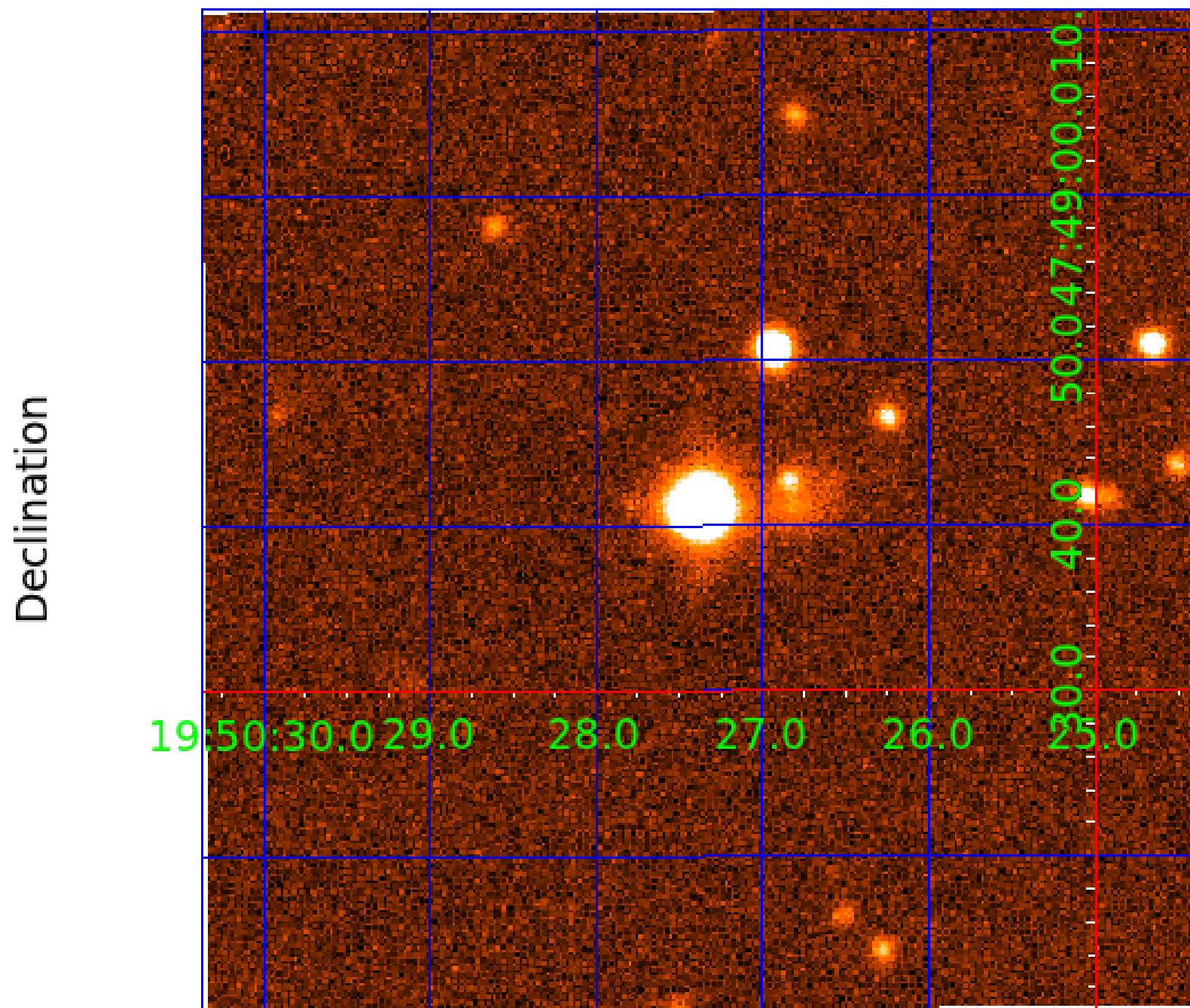
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



fluxWeightedCentroids, Planet 1 of 2



UKIRT Image



# KIC 010616415

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
010616415-01	OBS	1999.01	2.241237	132.727837	272.5	1.630	11.6	29.5	4.03	4972	8.29	5634.55
010616415-02	OBS	No	2.241270	131.597390	190.0	1.086	18.0	19.0	4.03	4972	6.82	5634.44

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
010616415-01	OBS	FP	0.00	0	1	0	0	MOD_SEC_DV—HAS_SEC_TCE
010616415-02	OBS	FP	0.00	1	1	0	0	IS_SEC_TCE

**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 010616415-02

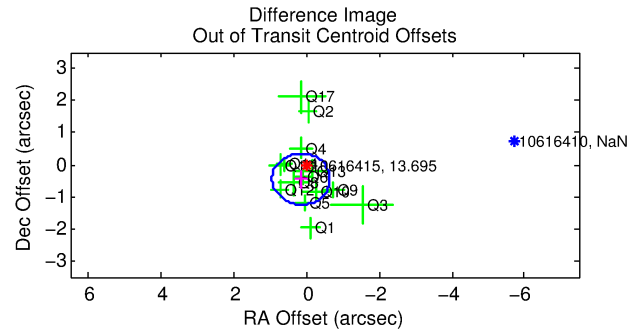
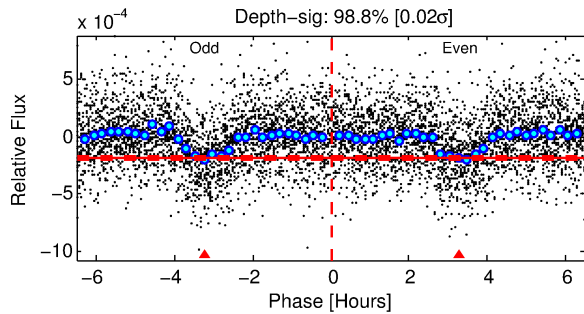
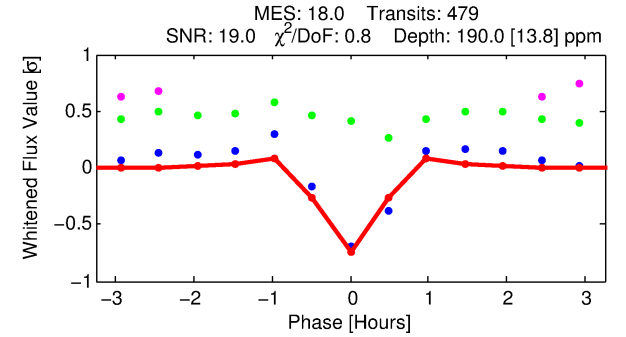
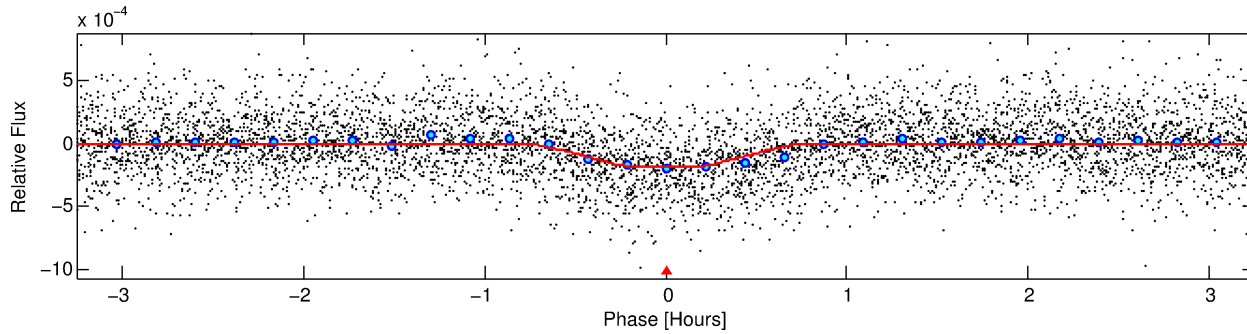
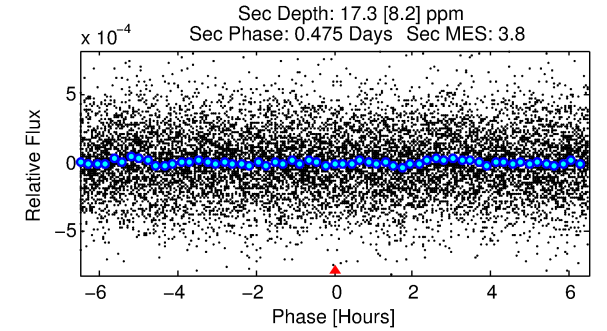
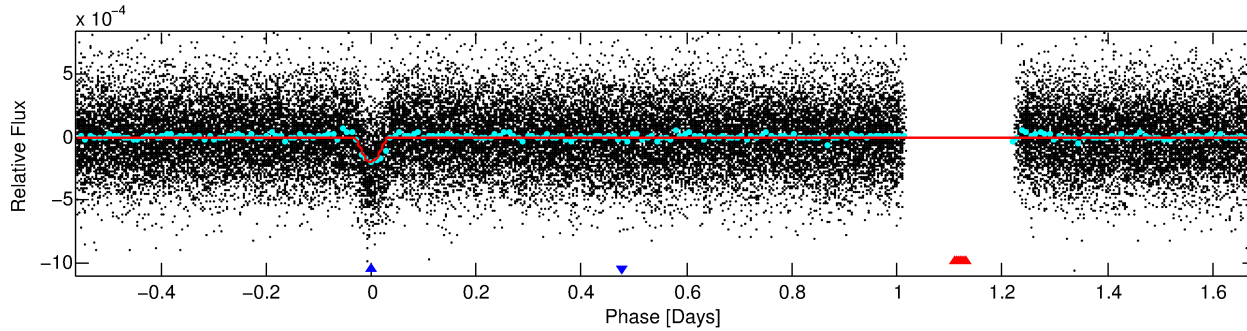
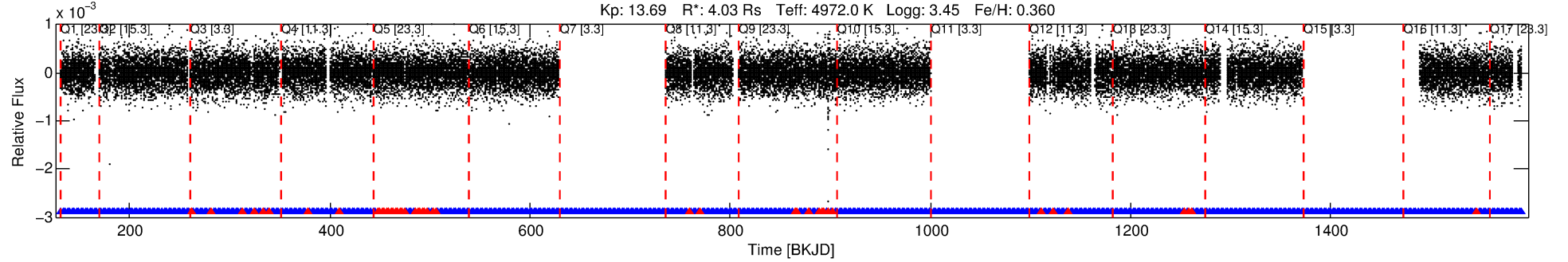
No Significant Match Found

# DV One-Page Summary

KIC: 10616415 Candidate: 2 of 2 Period: 2.241 d

KOI: K01999 Corr: No Ephemeris Match

Kp: 13.69 R\*: 4.03 Rs Teff: 4972.0 K Logg: 3.45 Fe/H: 0.360



## DV Fit Results:

Period = 2.24127 [0.00001] d  
Epoch = 131.5974 [0.0009] BKJD  
Rp/R\* = 0.0155 [0.0083]  
a/R\* = 7.63 [15.32]  
b = 0.89 [0.47]  
Seff = 5634.44 [4629.42]  
Teq = 2209 [454] K  
Rp = 6.82 [4.97] Re  
a = 0.0398 [0.0197] AU  
Ag = 0.32 [0.46] [-1.47σ]  
Teffp = 2576 [760] K [0.41σ]

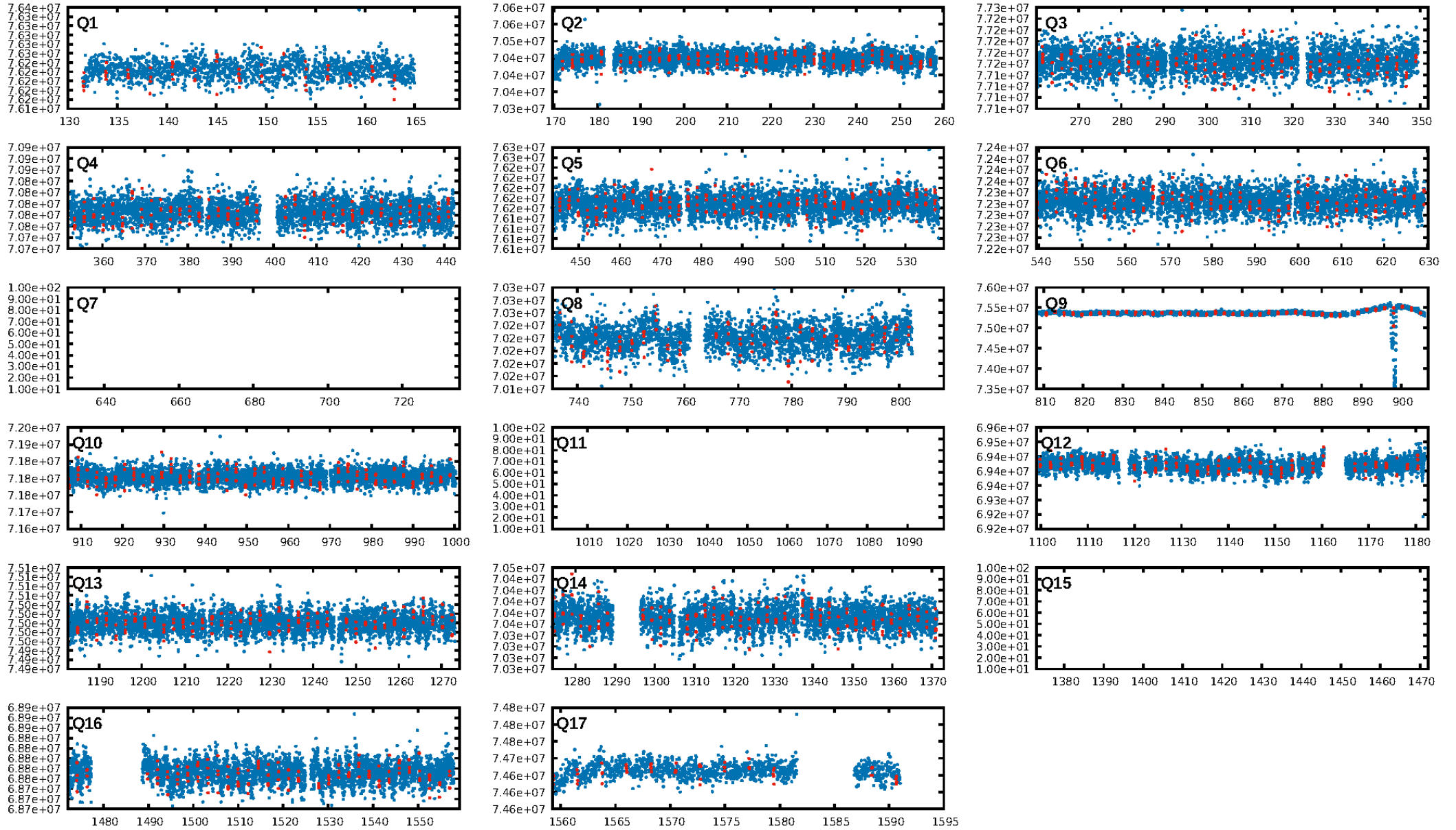
## DV Diagnostic Results:

ShortPeriod-sig: 0.0% [0.00σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 6.74e-64  
RollingBand-fgt: 0.90 [406/452]  
GhostDiagnostic-chr: 2.118  
Centroid-sig: 44.0%  
Centroid-so: 0.688 arcsec [1.60σ]  
OotOffset-rm: 0.476 arcsec [1.80σ]  
KicOffset-rm: 0.249 arcsec [0.95σ]  
OotOffset-st: 4/1/4/5 [14]  
KicOffset-st: 4/1/4/5 [14]  
DiffImageQuality-fgm: 0.93 [13/14]  
DiffImageOverlap-fno: 1.00 [14/14]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 11:09:19 Z

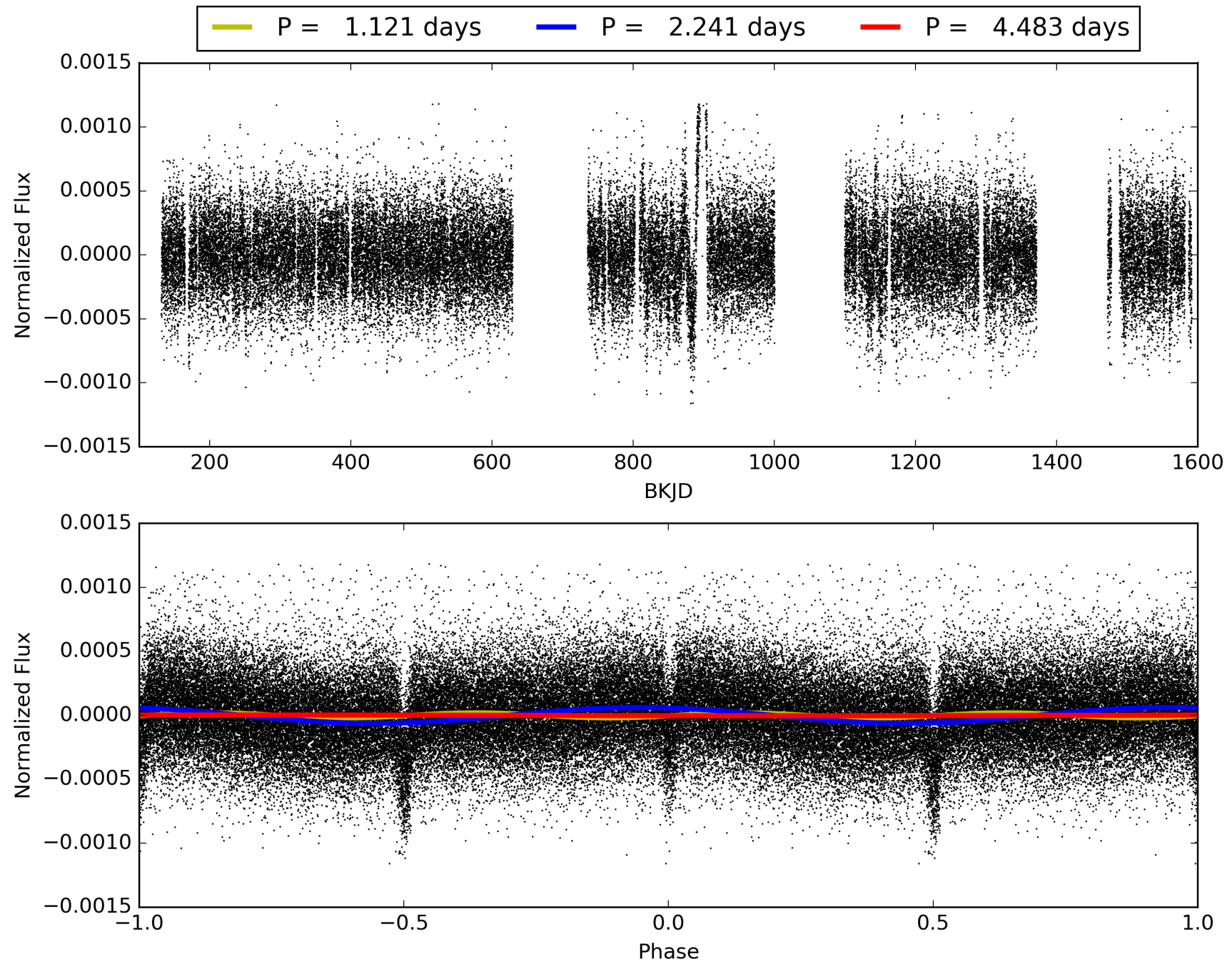
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 010616415-02, PDC Light Curves



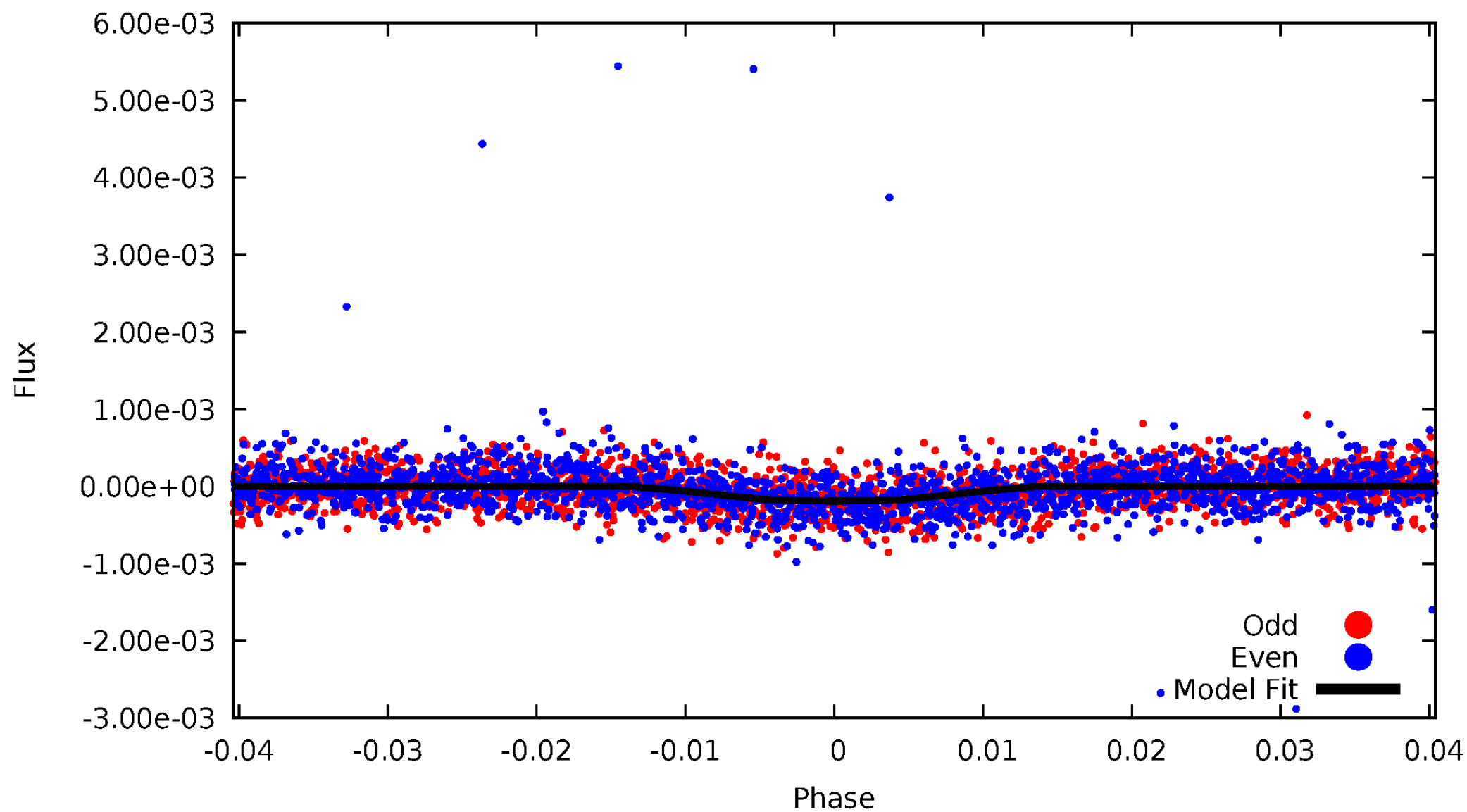


TCE 010616415-02



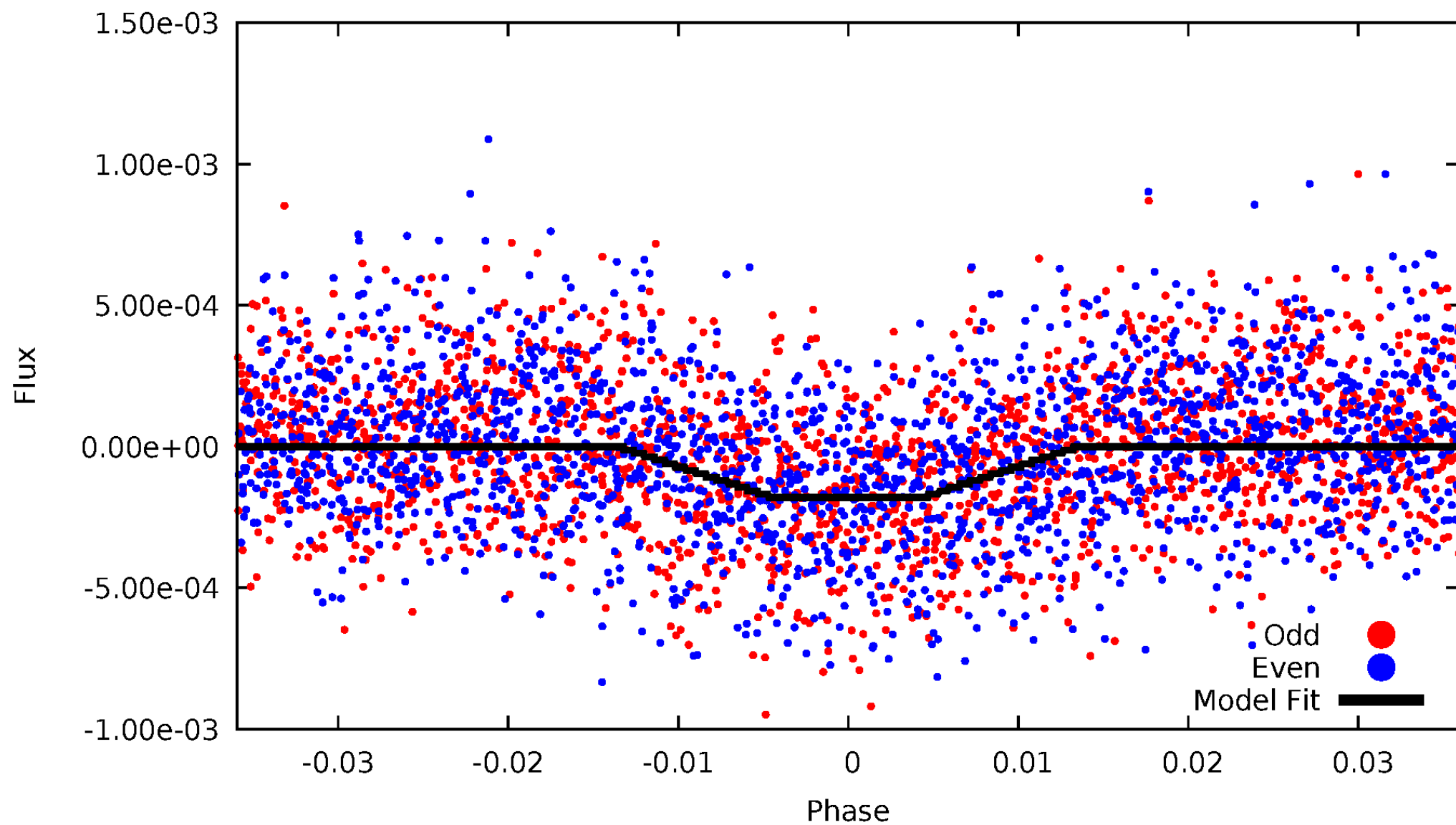
# DV Odd/Even

TCE 010616415-02



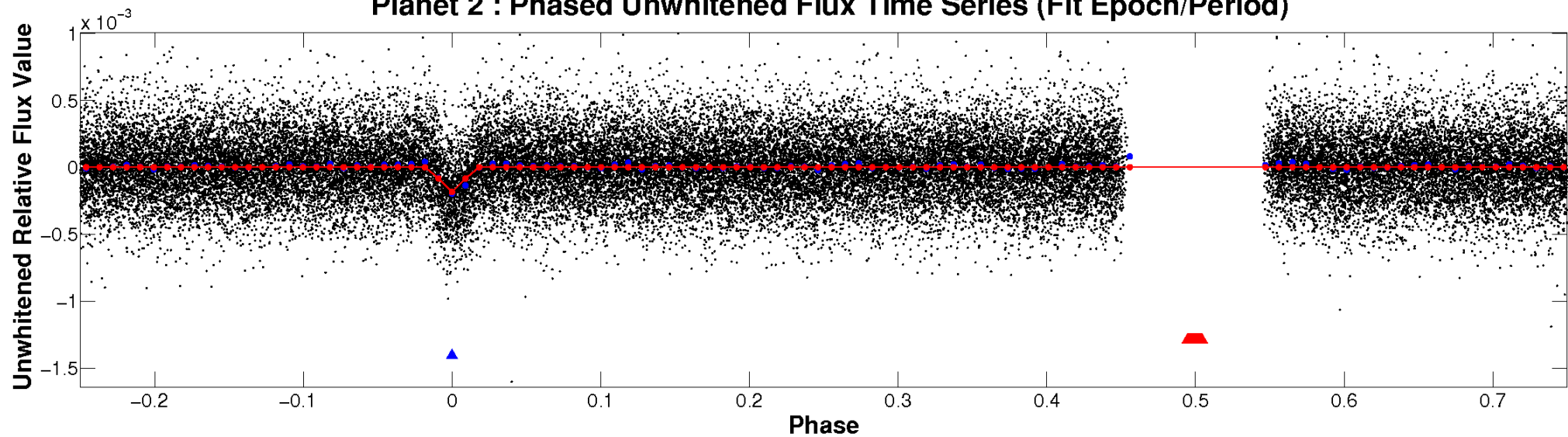
# ALT Odd/Even

TCE 010616415-02

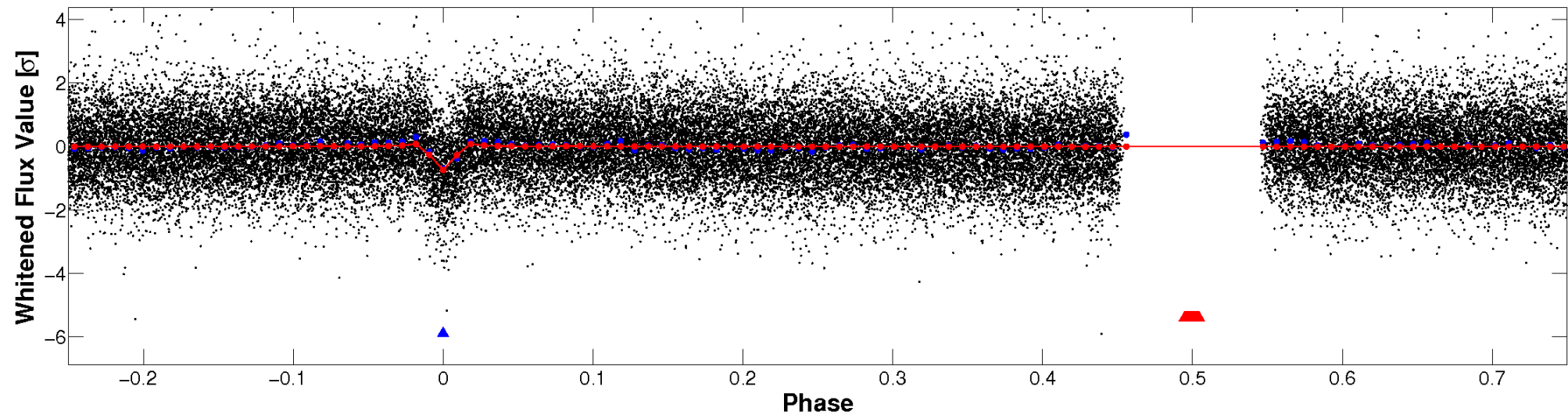


# Non-Whitened Vs. Whitened Light Curve

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

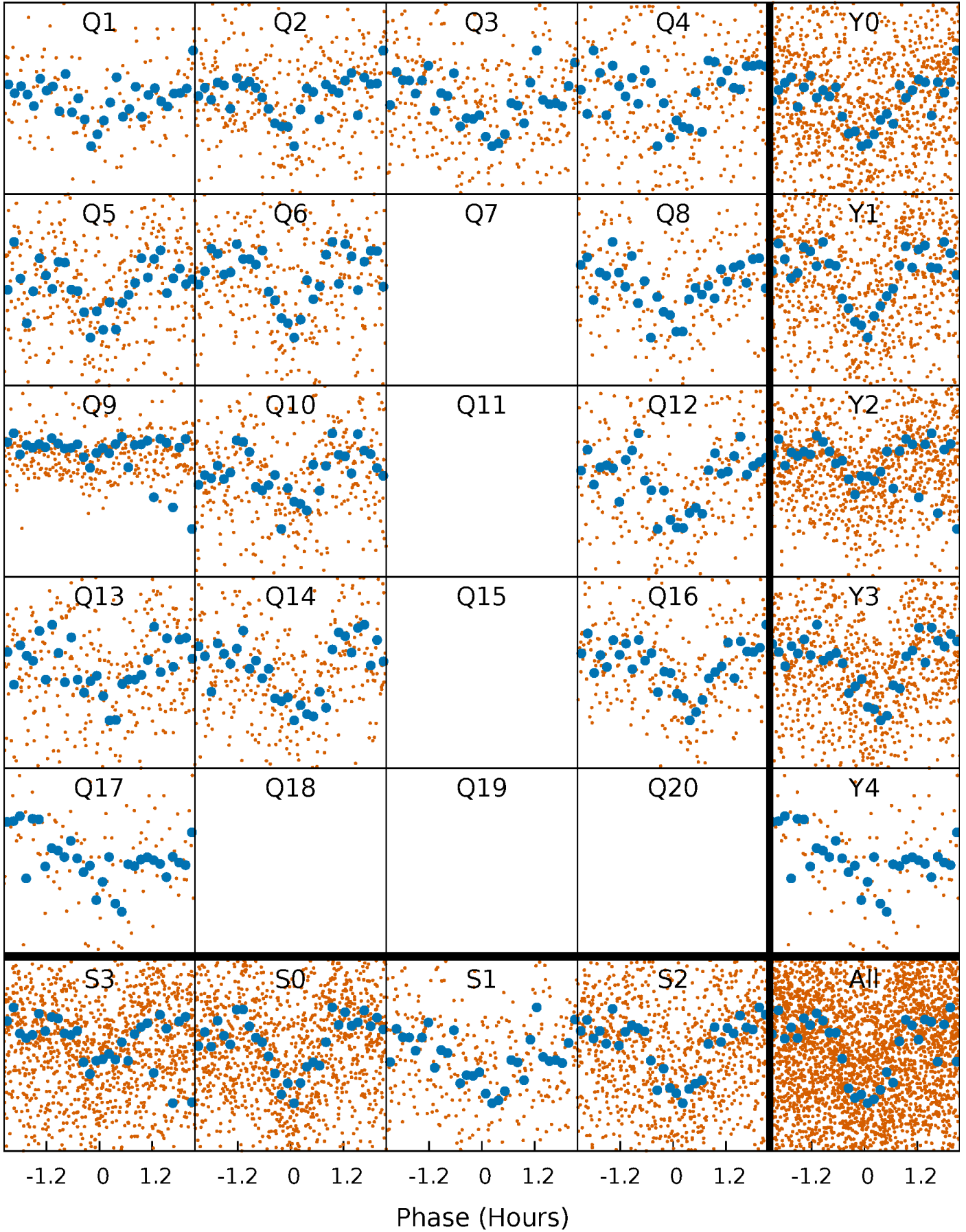


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

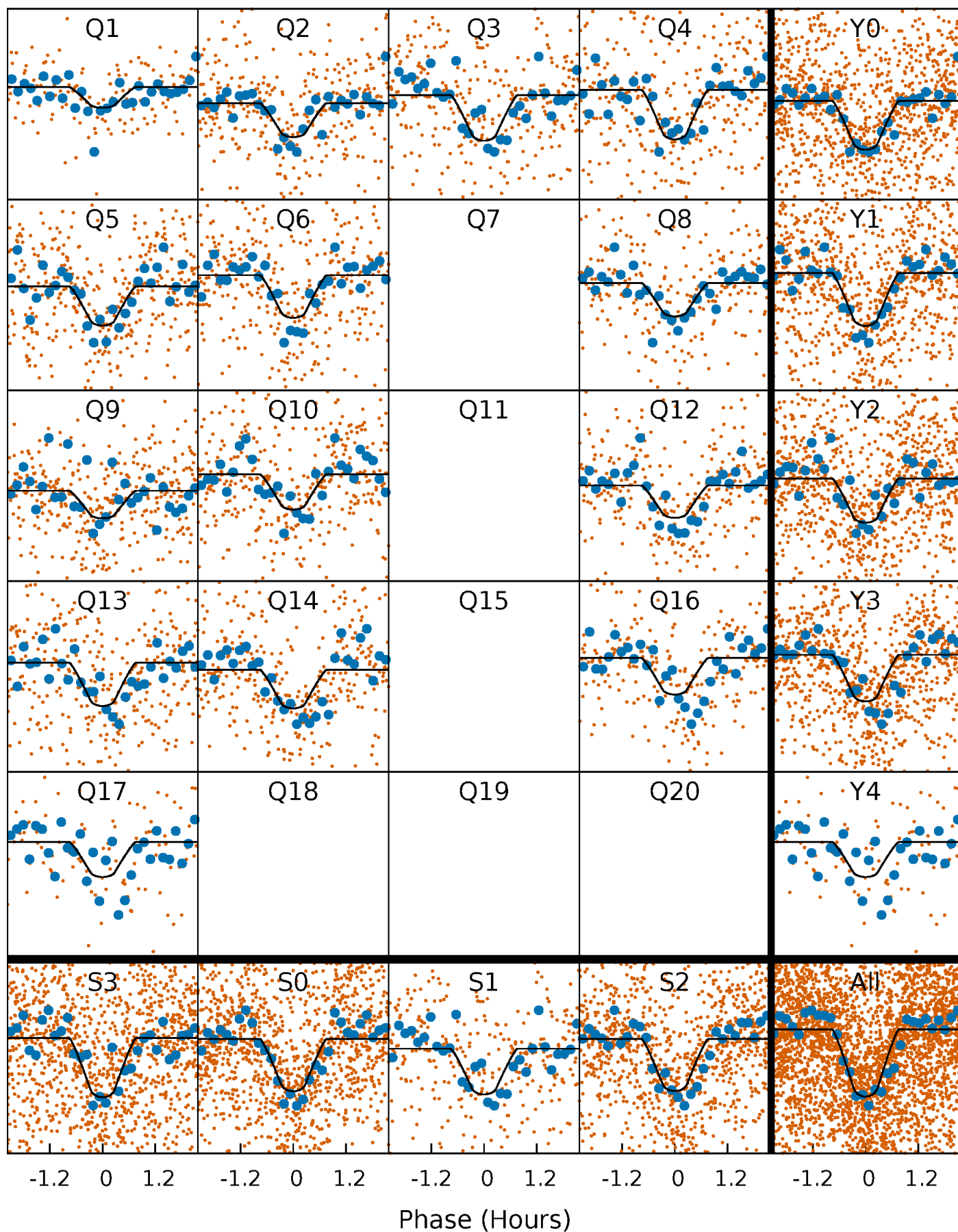
TCE 010616415-02   P= 2.241270 Days    $T_0=131.597390$  (BKJD)





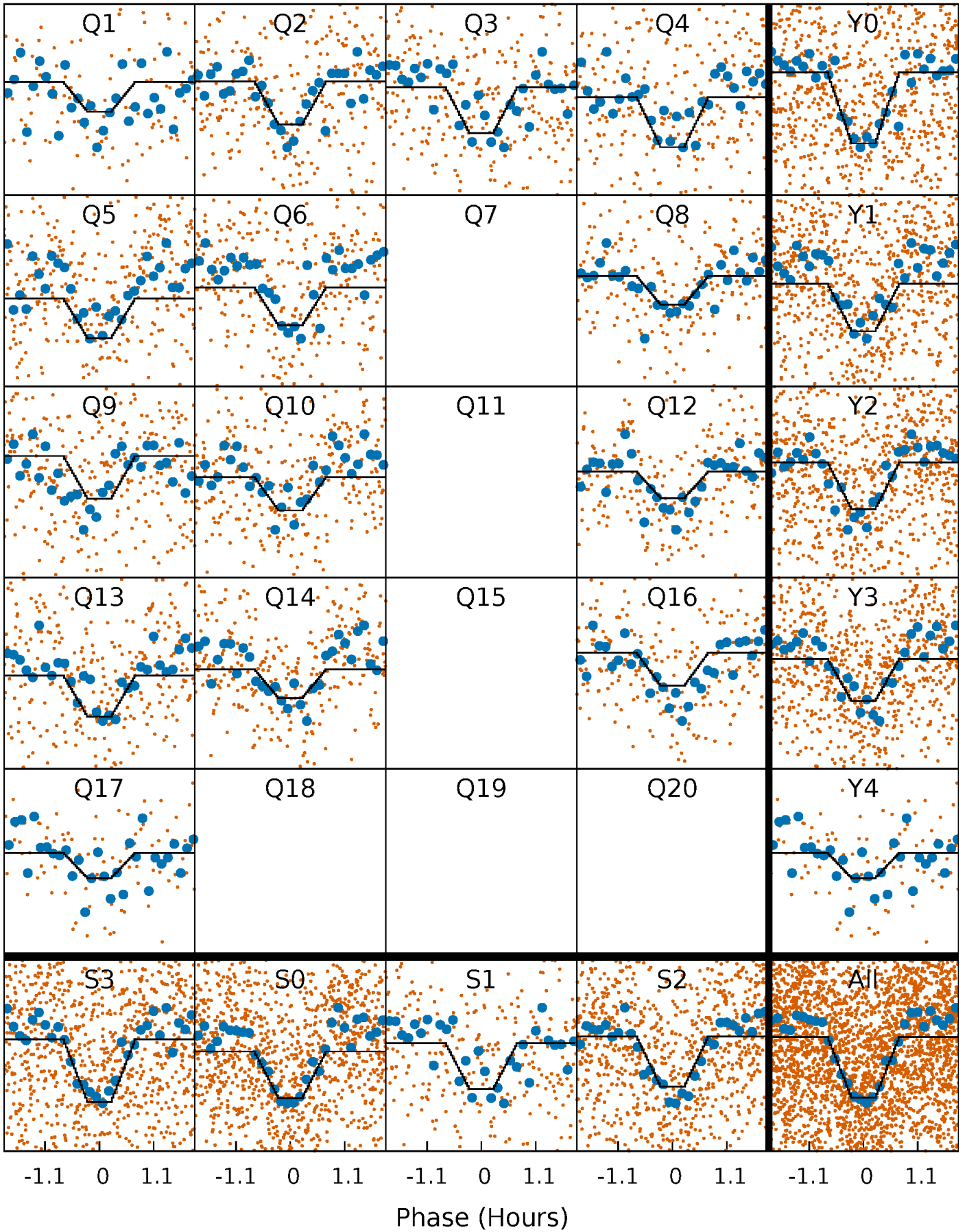
# DV Quarter-Phased Transit Curves

TCE 010616415-02   P= 2.241270 Days    $T_0=131.597390$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

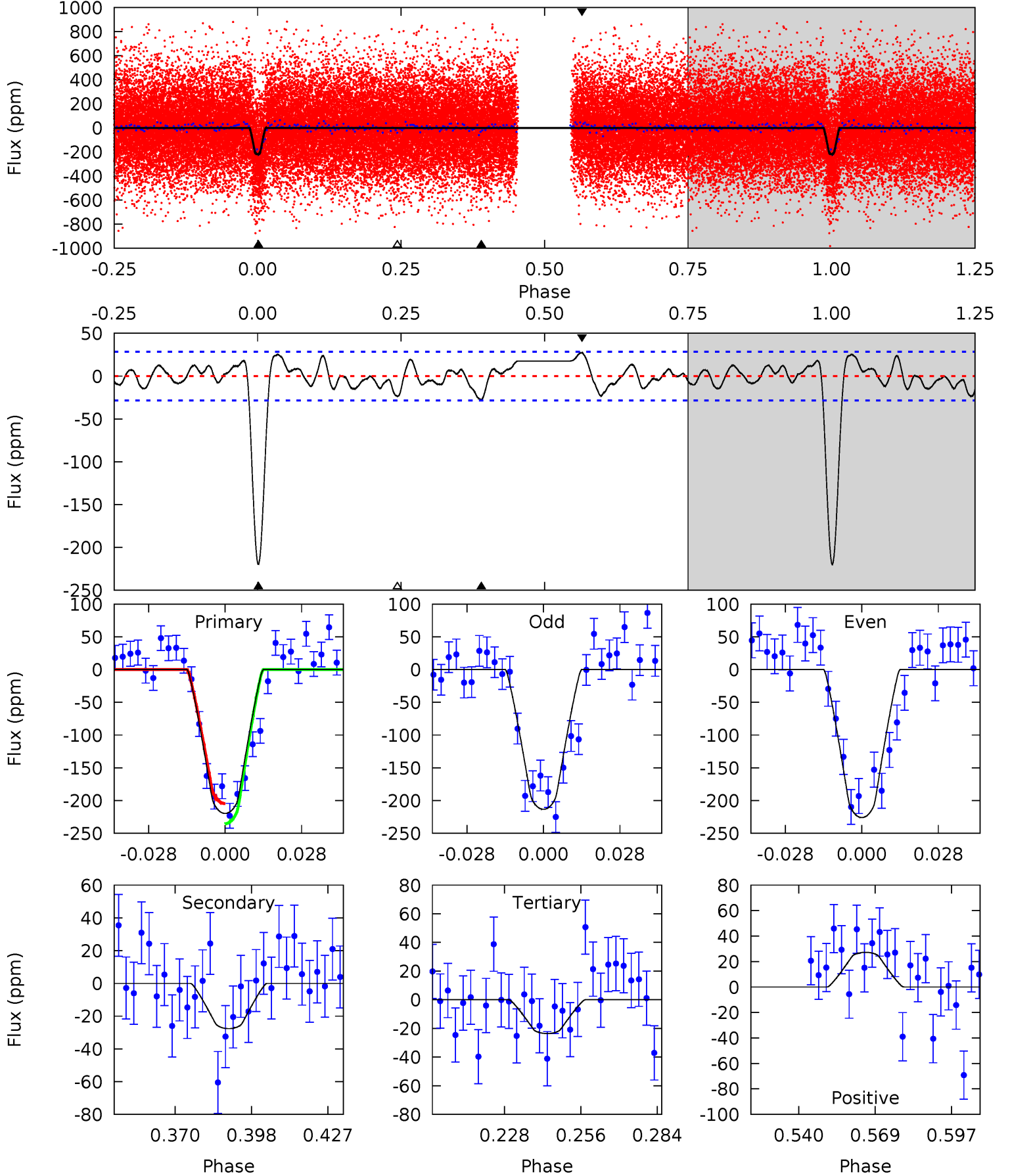
TCE 010616415-02   P= 2.241289 Days    $T_0=131.594211$  (BKJD)



# DV Model-Shift Uniqueness Test

010616415-02, P = 2.241270 Days, E = 129.356120 Days

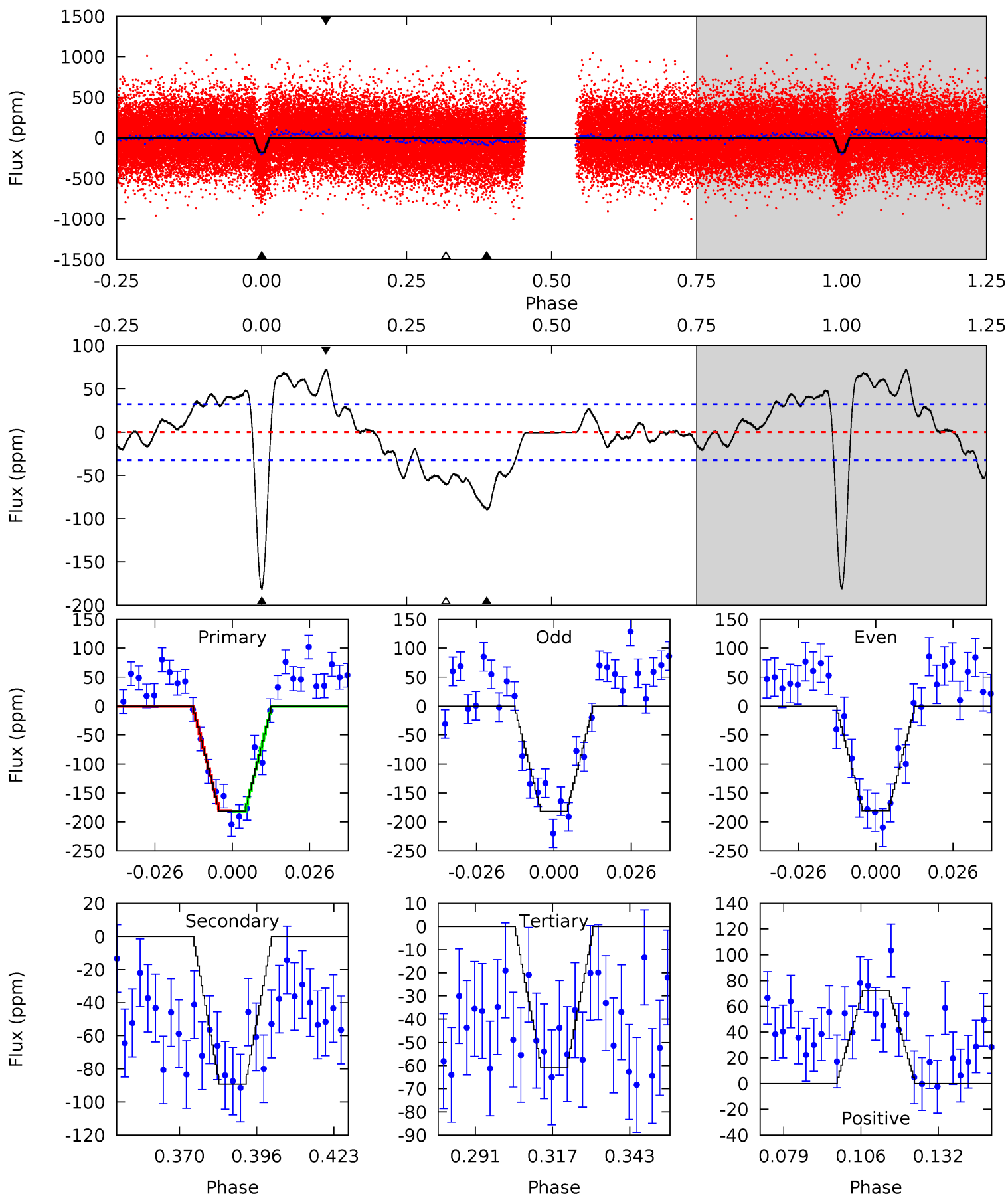
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
37.1	4.67	3.98	4.60	4.82	2.19	1.79	33.1	32.5	0.69	0.07	1.06	0.95	0.11	2.59



# Alt Model-Shift Uniqueness Test

010616415-02, P = 2.241289 Days, E = 129.352922 Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
27.2	13.4	9.13	10.8	4.84	2.22	5.05	18.1	16.3	4.30	2.59	0.07	1.08	0.29	0.10



### Stellar Parameters For KIC 010616415

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M$ ( $M_{\odot}$ )	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$4972^{+148}_{-163}$	$3.449^{+0.483}_{-0.241}$	$0.360^{+0.100}_{-0.300}$	$4.034^{+1.327}_{-1.990}$	$1.668^{+0.239}_{-0.670}$	$0.036^{+0.170}_{-0.018}$
	+3%/-3%	+14%/-7%	+28%/-83%	+33%/-49%	+14%/-40%	+475%/-51%
Source	PHO1	KIC0	KIC0	DSEP		

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

### Secondary Eclipse Parameters for KIC 010616415-02 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-28 \pm 6$	$6.02^{+4.05}_{-2.93}$	$3048^{+332}_{-409}$	$3017^{+1066}_{-5647}$	$0.591^{+1.953}_{-0.376}$
Alt.	$-89 \pm 7$	$5.46^{+4.29}_{-3.19}$	$3068^{+305}_{-420}$	$4143^{+1948}_{-790}$	$2.471^{+12.326}_{-1.672}$

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

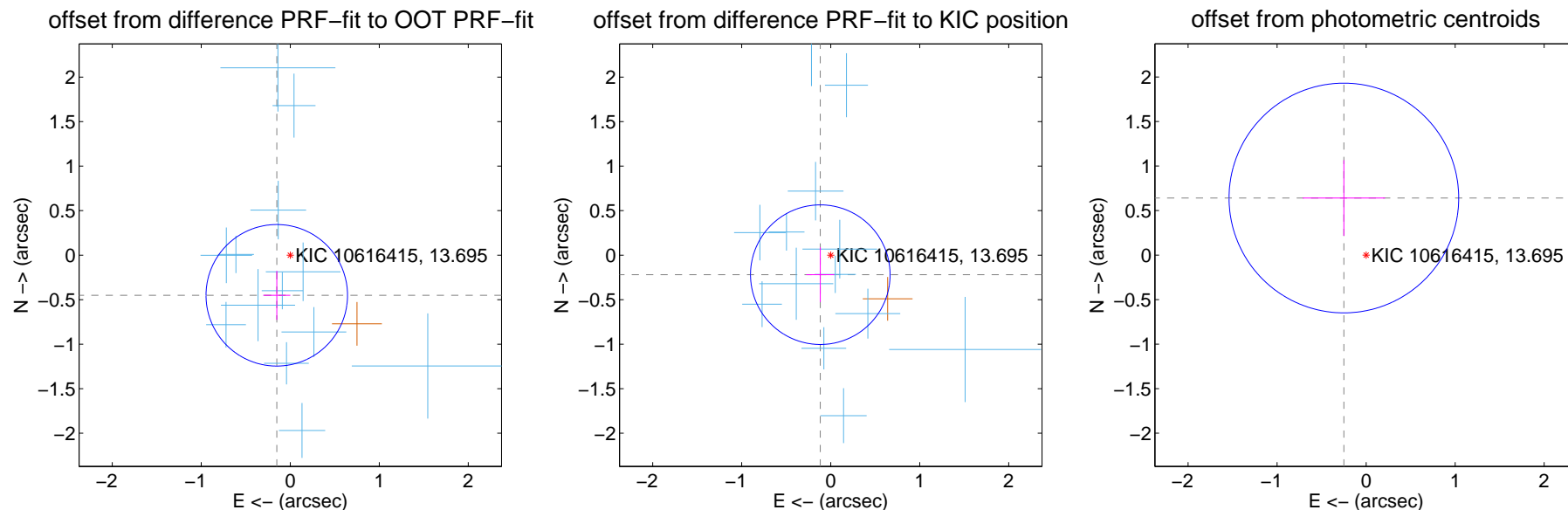
## DV Centroid Data

Supplemental centroid analysis for 010616415-02. Kepler magnitude: 13.70. Transit SNR 19.01

There are 13 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.30 arcsec

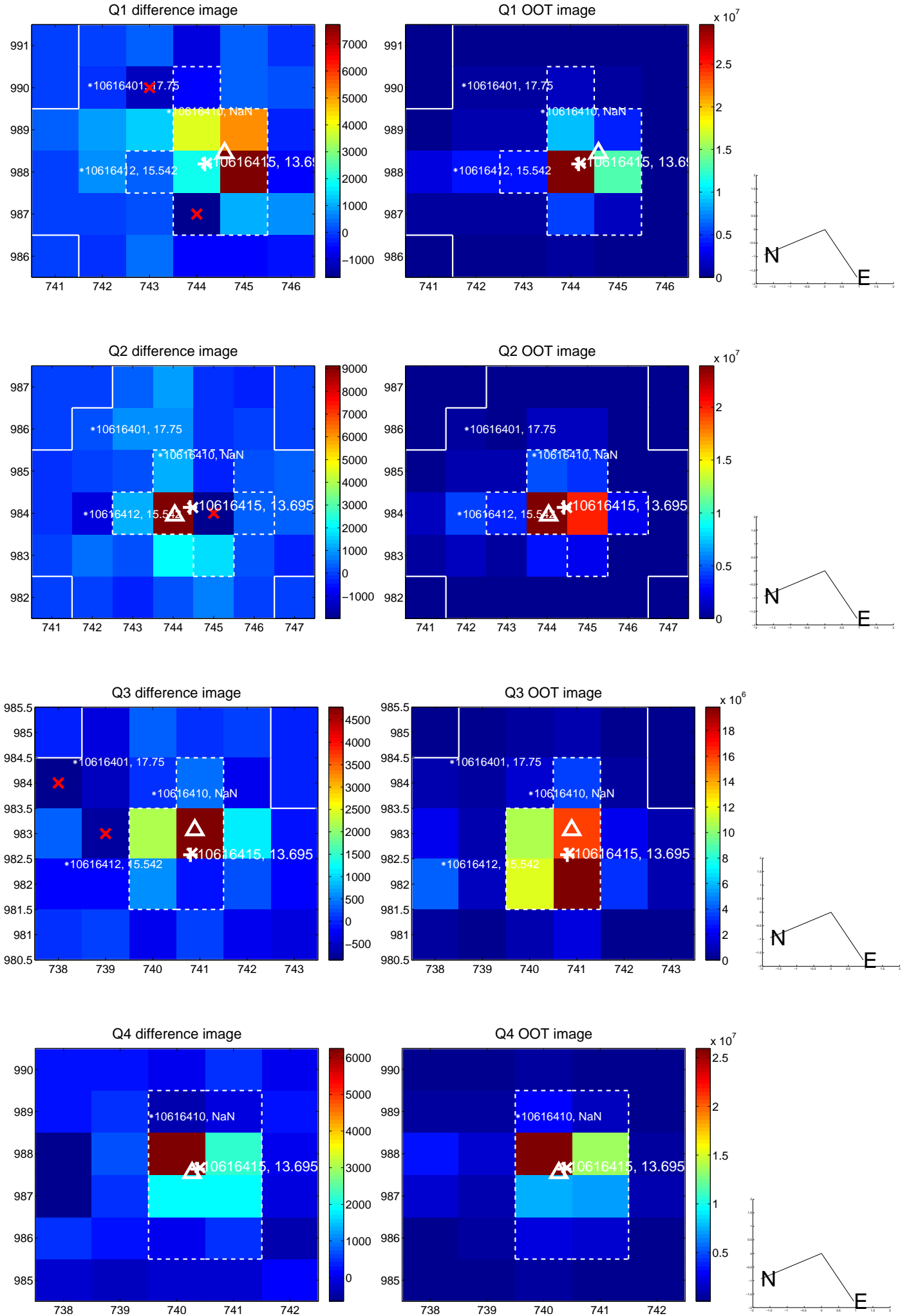
	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.476 \pm 0.265$	1.80	$0.152 \pm 0.152$	$-0.451 \pm 0.275$
PRF-fit source offset from KIC position	$0.249 \pm 0.261$	0.95	$0.117 \pm 0.157$	$-0.219 \pm 0.307$
photometric centroid source offset	$0.69 \pm 0.43$	1.60	$0.25 \pm 0.46$	$0.64 \pm 0.42$



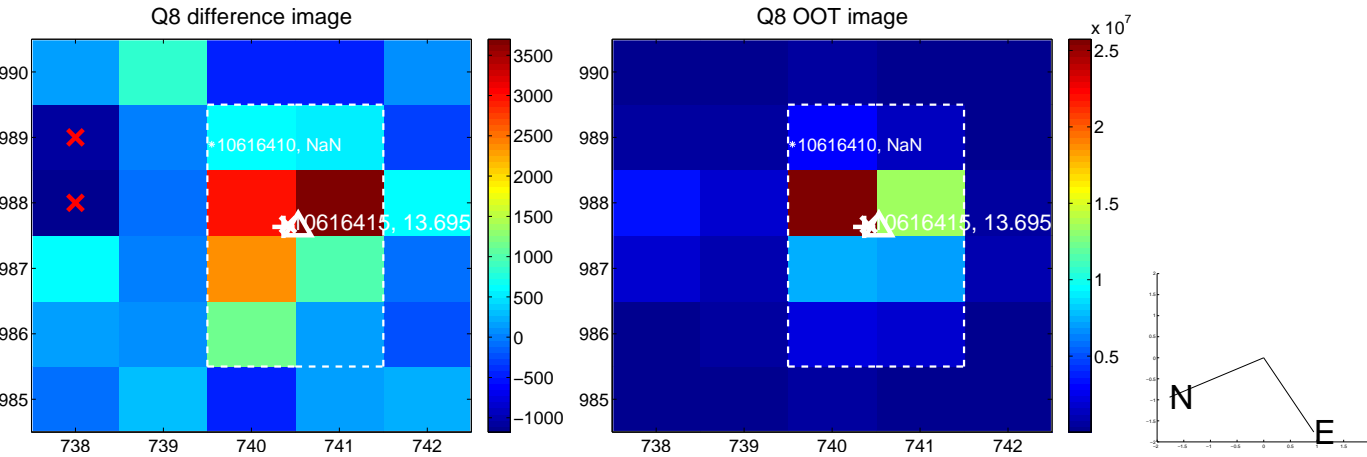
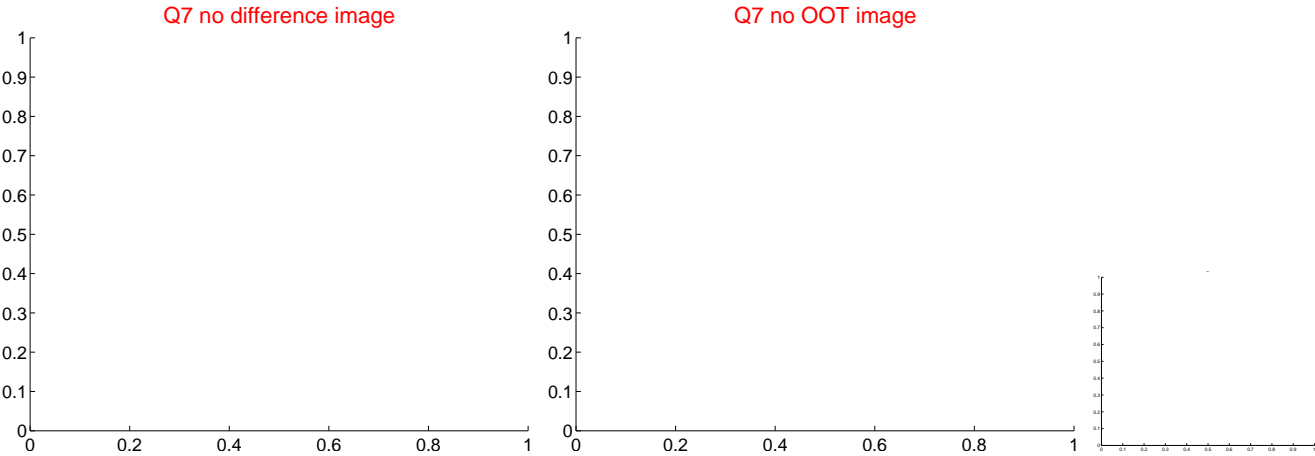
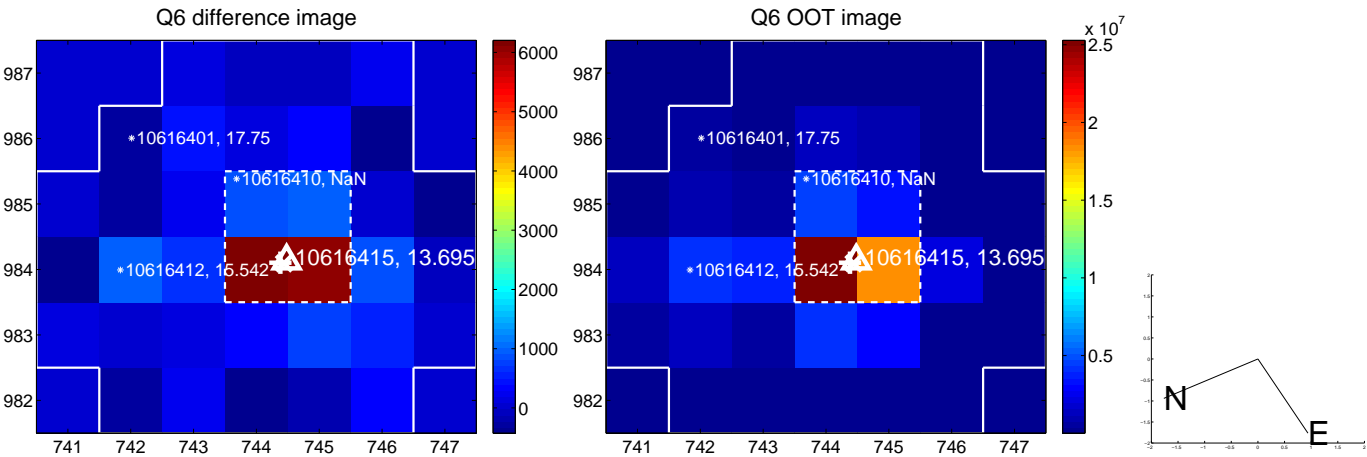
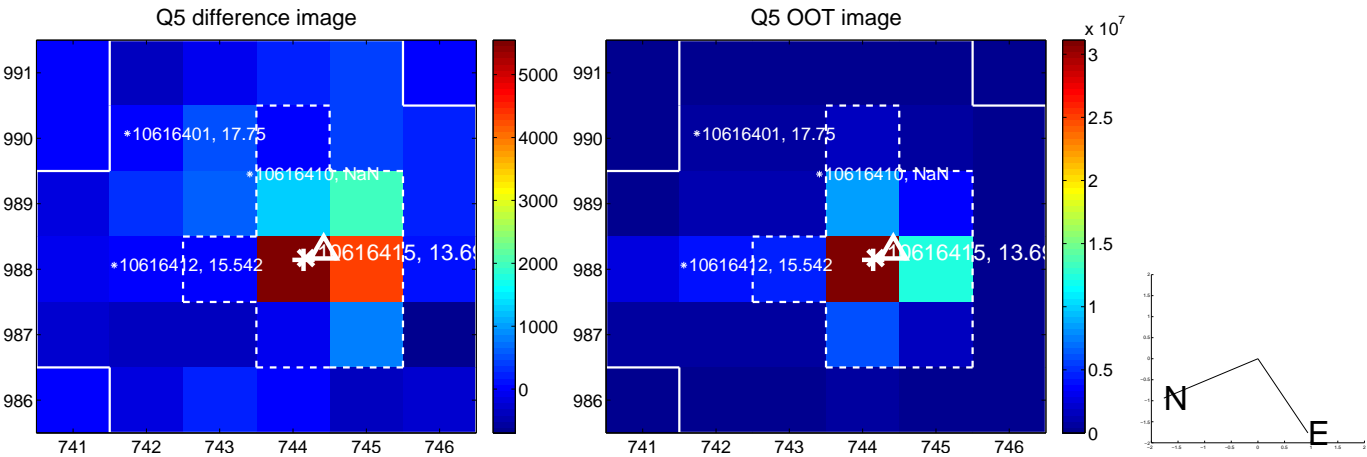
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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



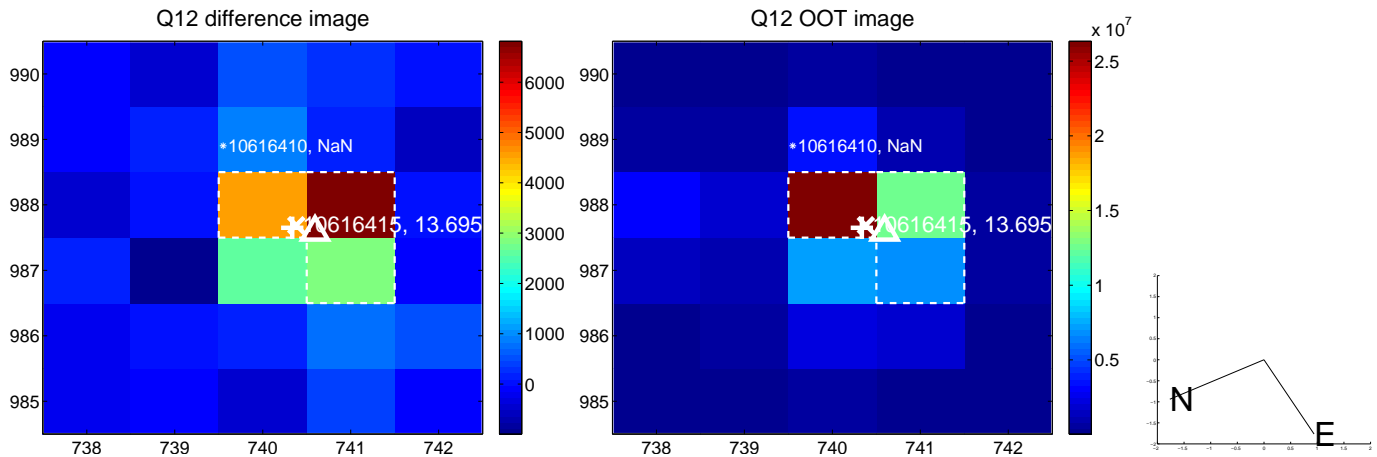
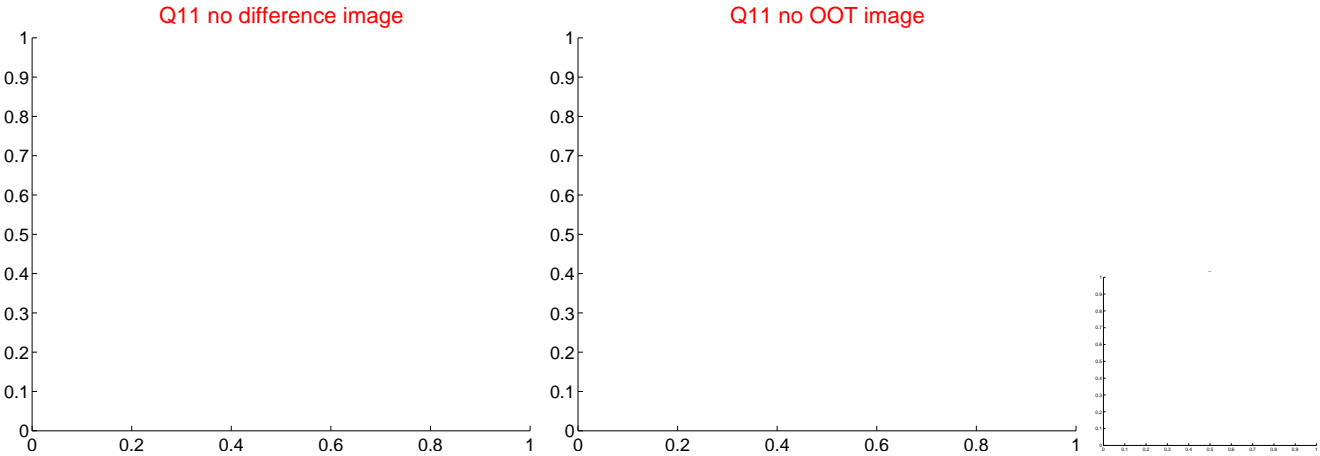
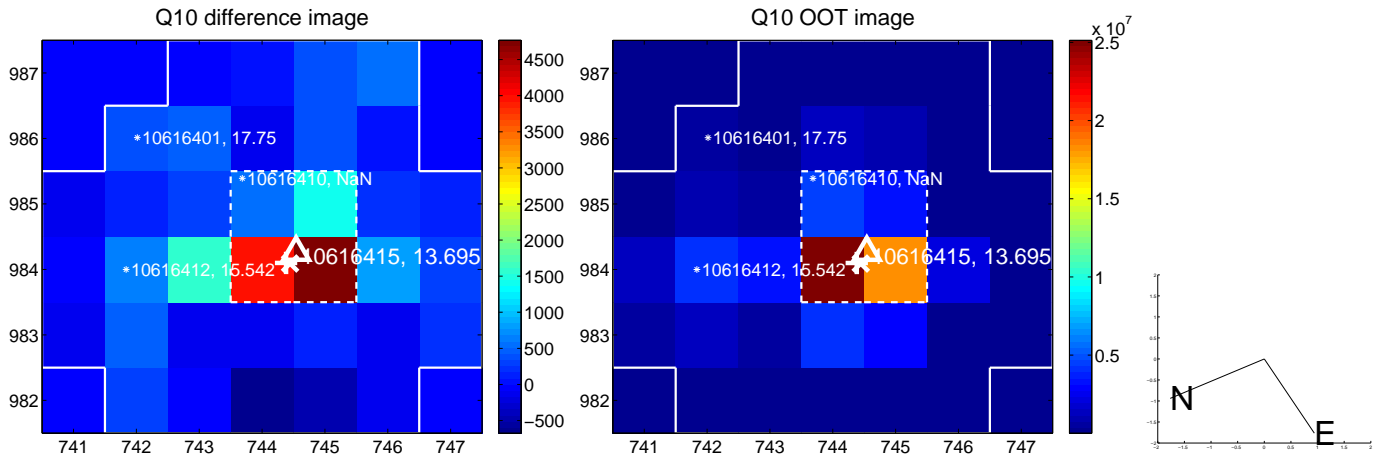
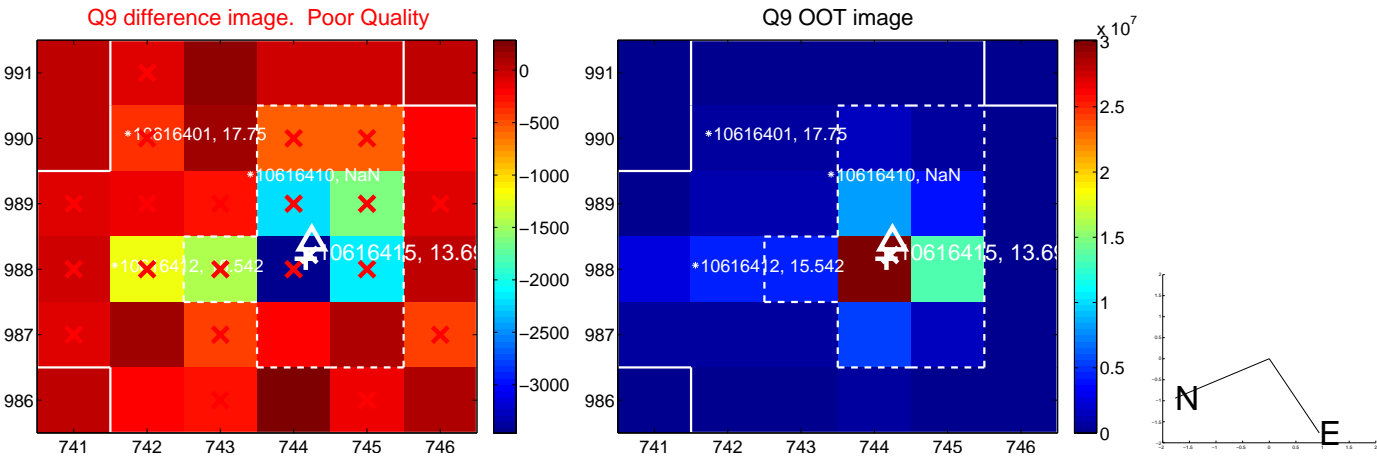
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



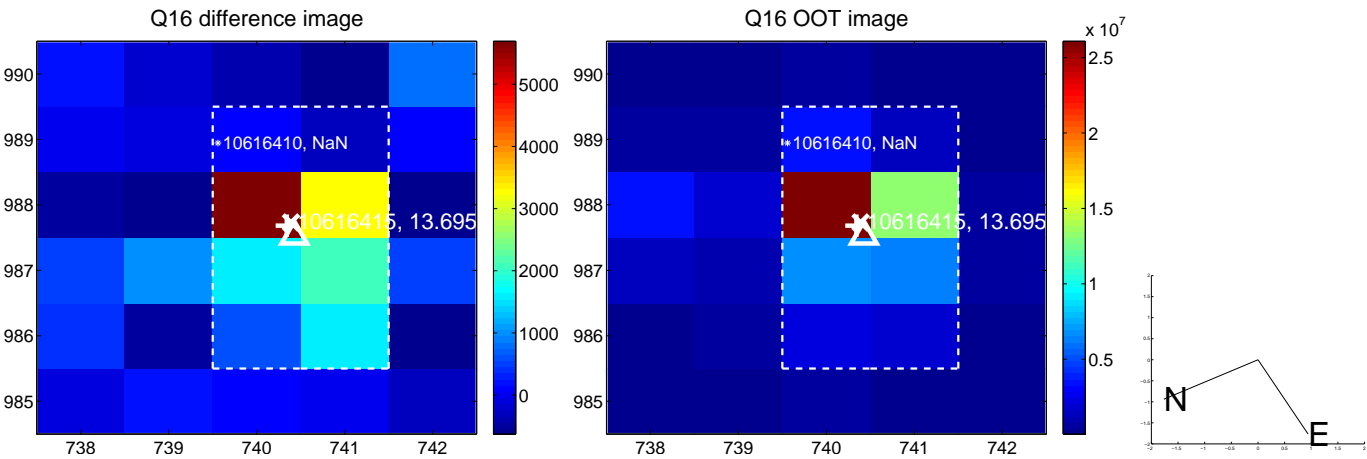
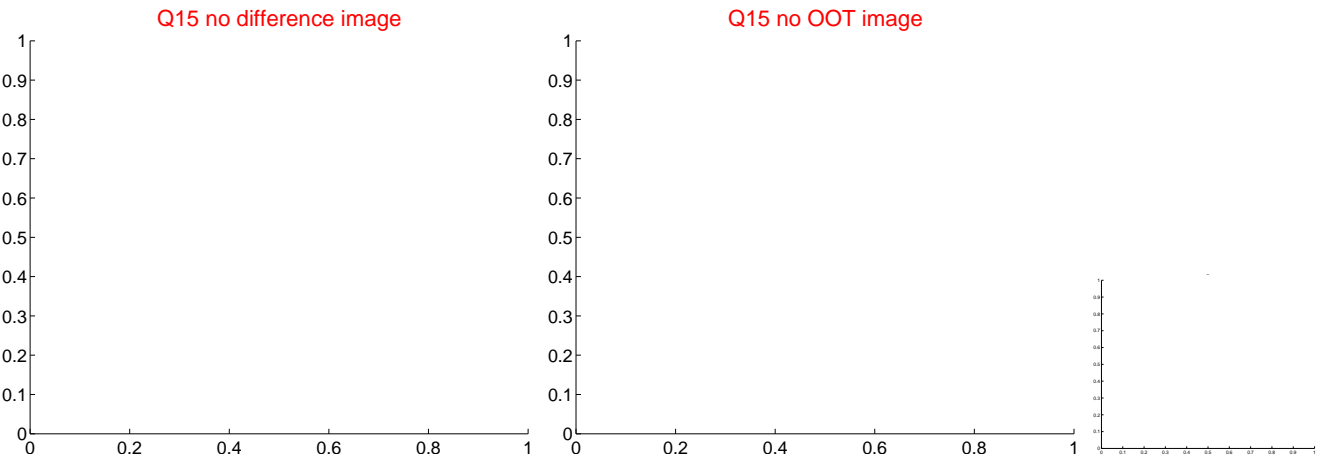
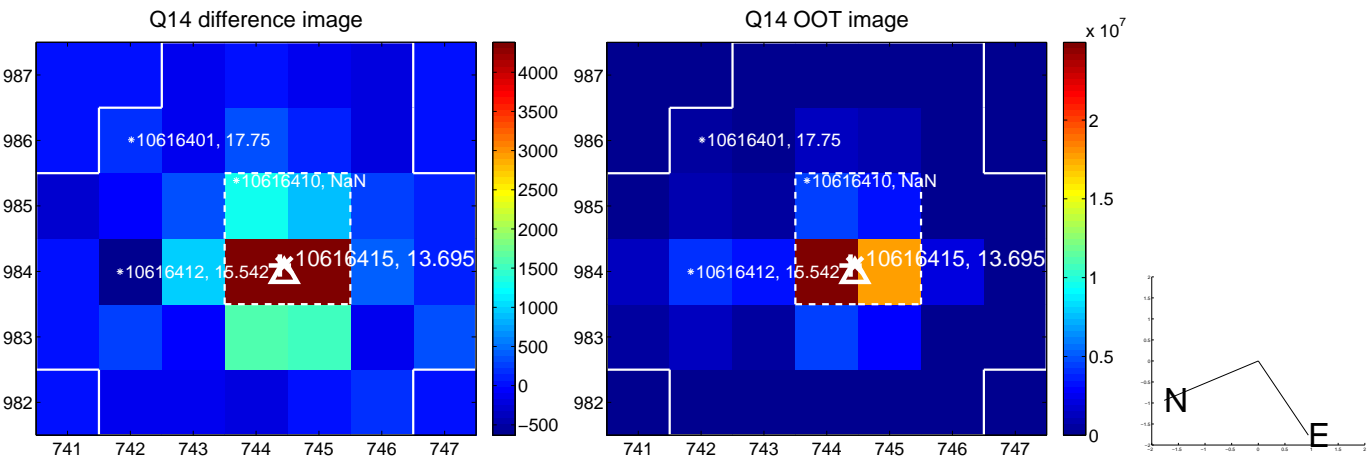
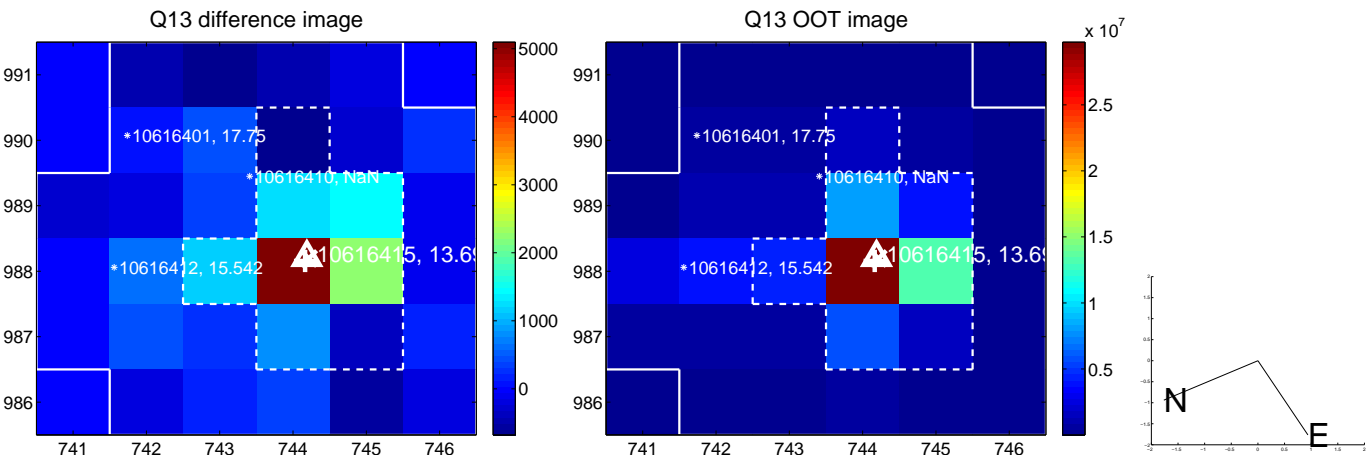
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



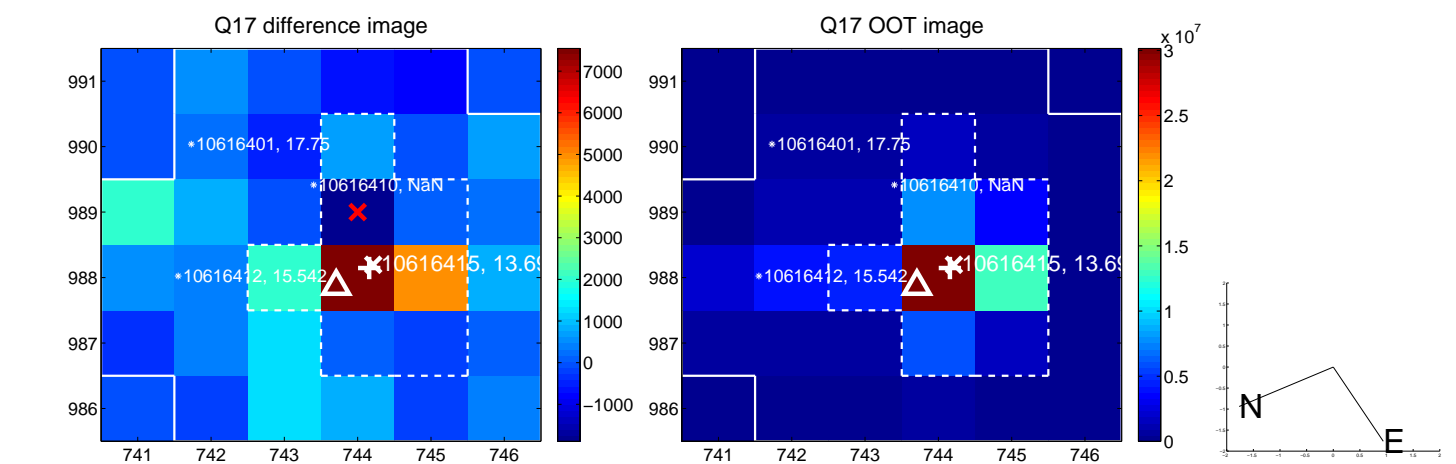
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



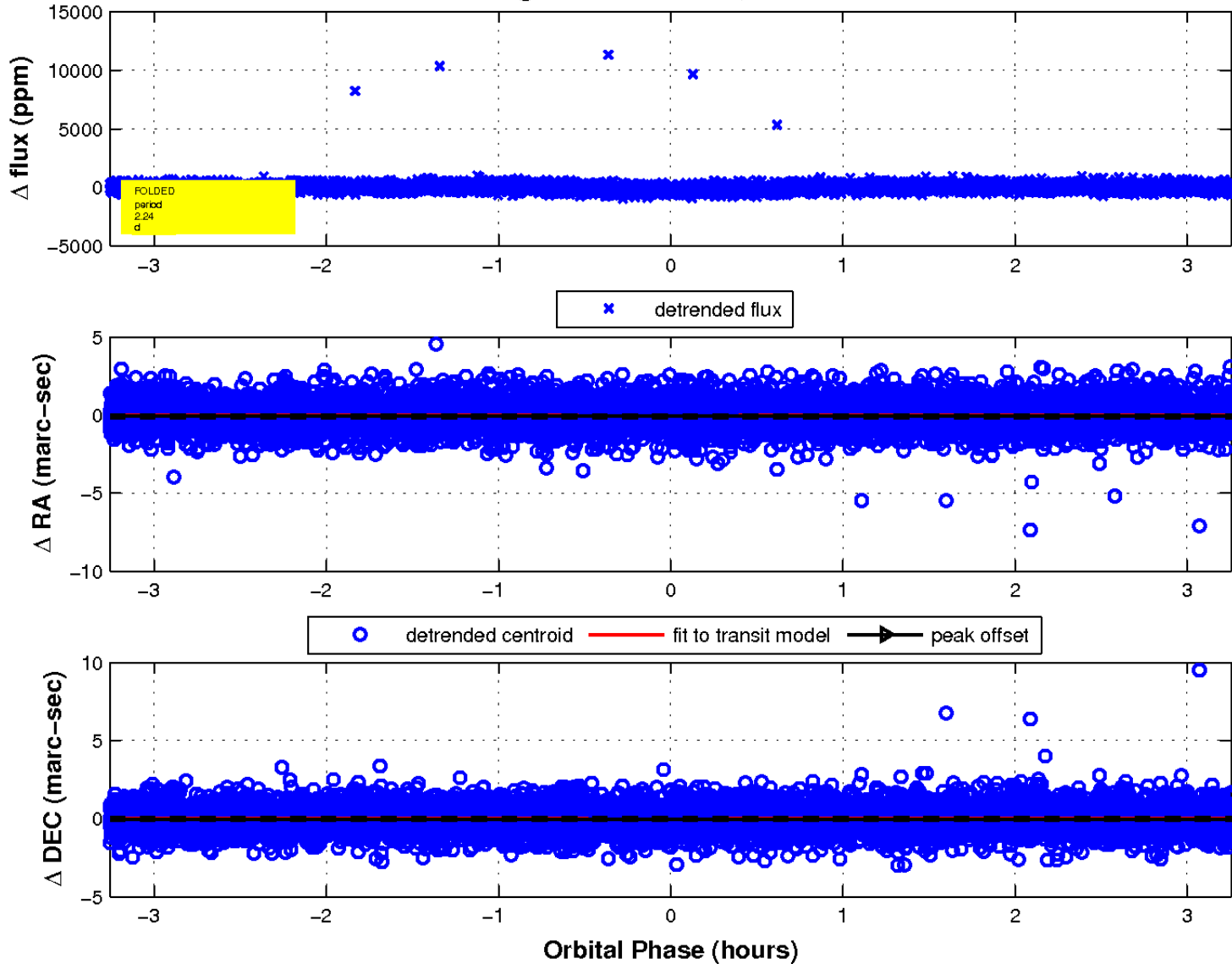
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

