

# KIC 009016734

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009016734-01	OBS	No	399.798762	266.036529	5232.9	14.576	73.6	91.4	0.83	5698	7.13	0.61
009016734-02	OBS	No	364.253206	137.269039	2459.2	12.530	31.0	35.8	0.83	5698	7.78	0.69

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009016734-01	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_CHASES_MARSHALL_ZUMA—LPP_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS—HALO_GHOST
009016734-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE—LPP_DV—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.

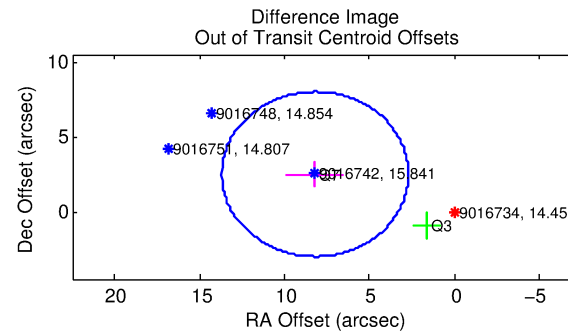
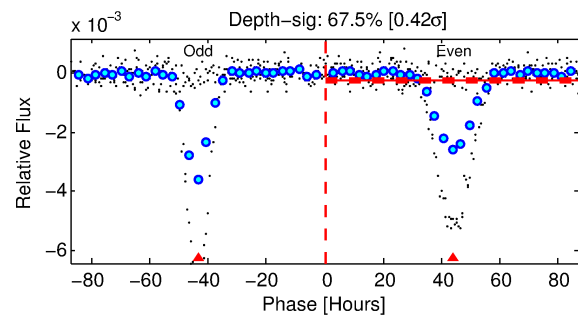
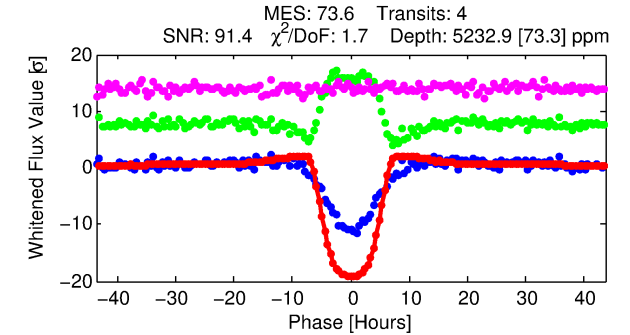
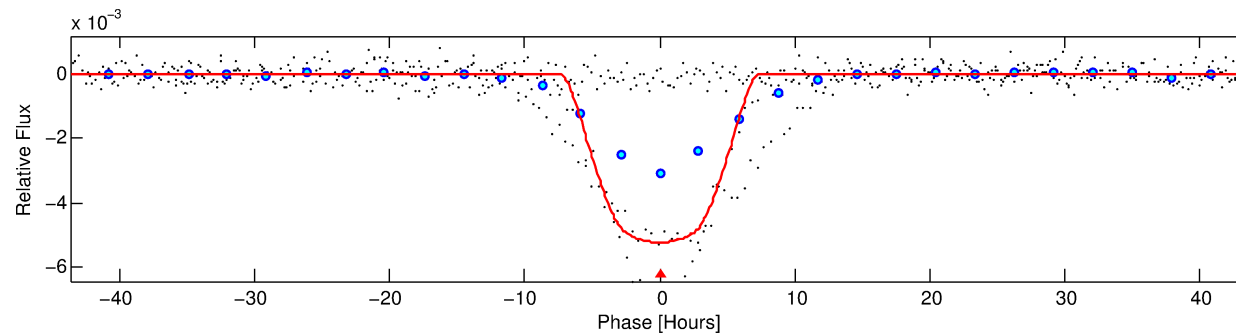
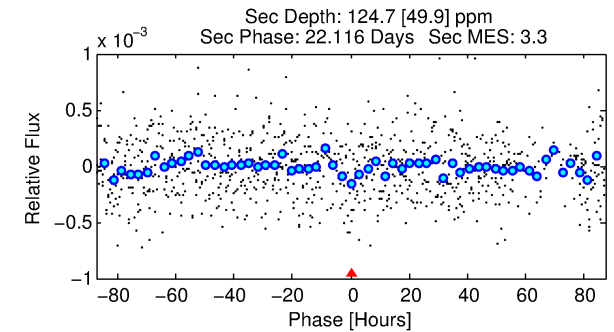
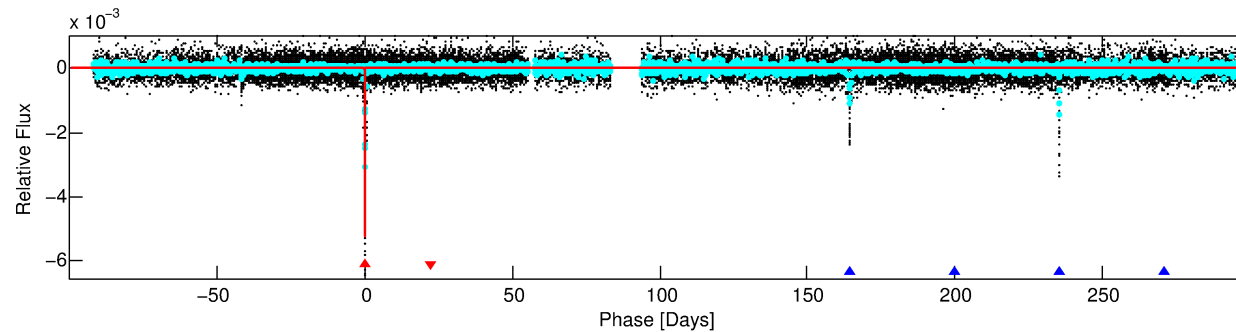
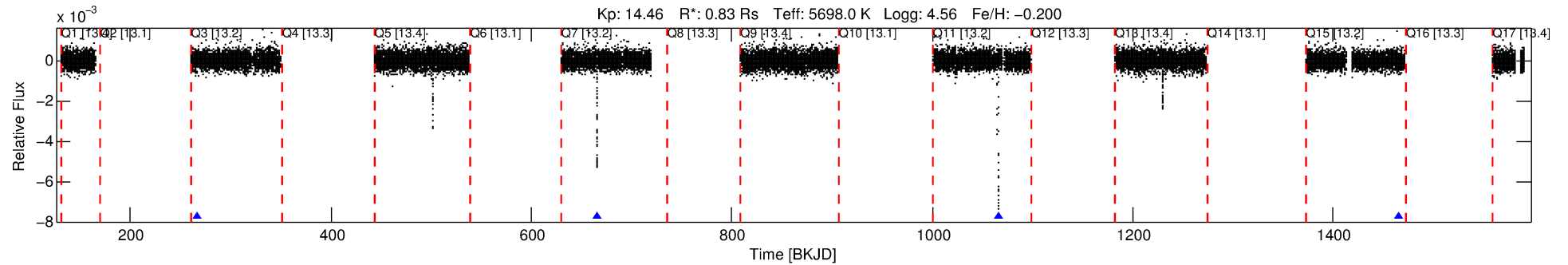
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009016734-01

No Significant Match Found

# DV One-Page Summary

KIC: 9016734 Candidate: 1 of 2 Period: 399.799 d



## DV Fit Results:

Period = 399.79876 [0.00169] d  
Epoch = 266.0365 [0.0031] BKJD  
Rp/R\* = 0.0789 [0.0010]  
a/R\* = 126.29 [3.51]  
b = 0.89 [0.01]  
Seff = 0.61 [0.22]  
Teq = 225 [20] K  
Rp = 7.13 [1.97] Re  
a = 1.0303 [0.2391] AU  
Ag = 1431.13 [749.86] [1.91σ]  
Teff = 2144 [226] K [8.45σ]

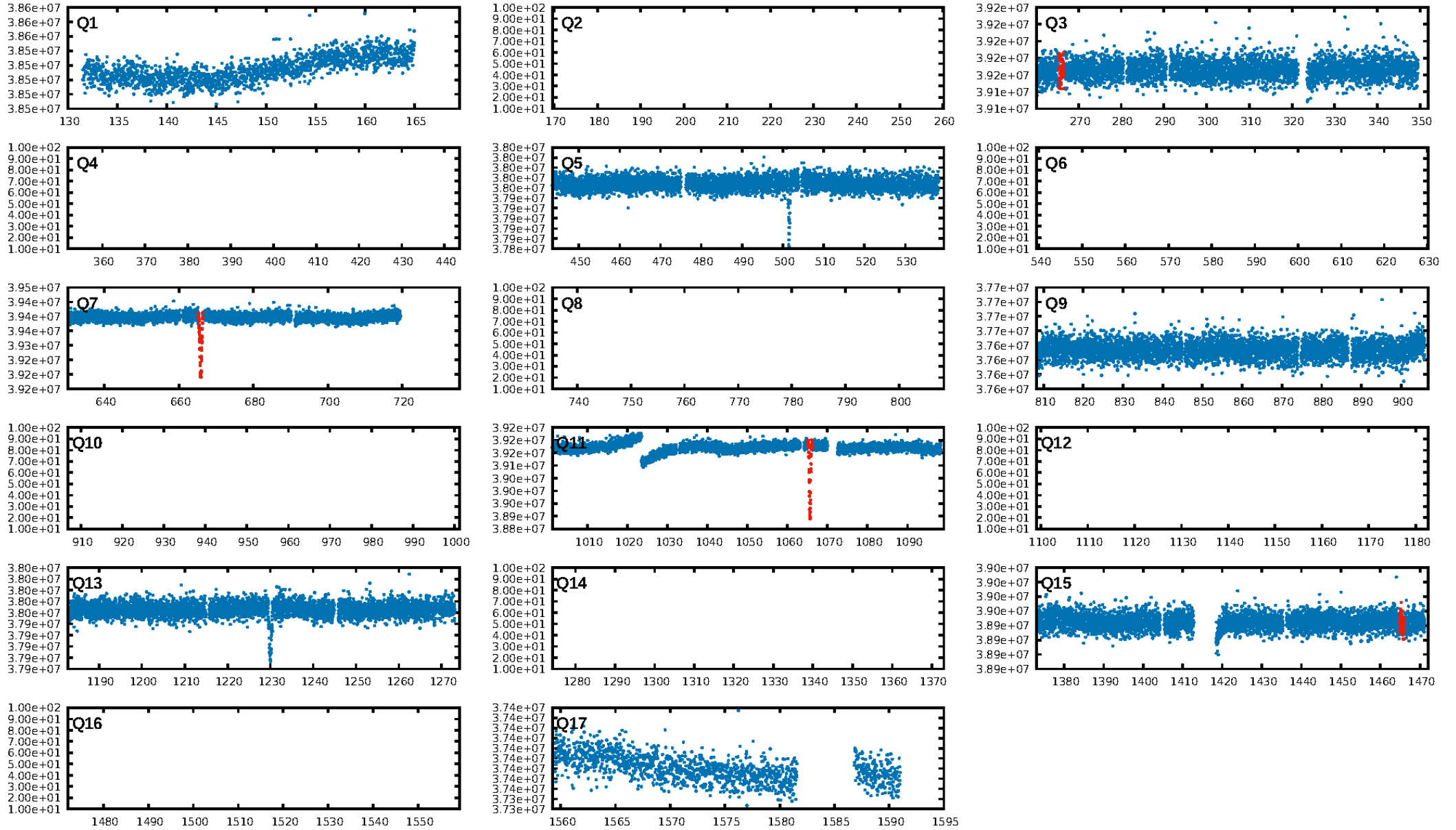
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [44.38σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 94.1%  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: -0.06385  
Centroid-sig: N/A  
Centroid-so: 7.847 arcsec [113.83σ]  
OotOffset-rm: 8.561 arcsec [4.67σ]  
KicOffset-rm: 8.595 arcsec [2.44σ]  
OotOffset-st: 0/2/0/0 [2]  
KicOffset-st: 0/2/0/0 [2]  
DiffImageQuality-fgm: 1.00 [2/2]  
DiffImageOverlap-fno: 1.00 [3/3]

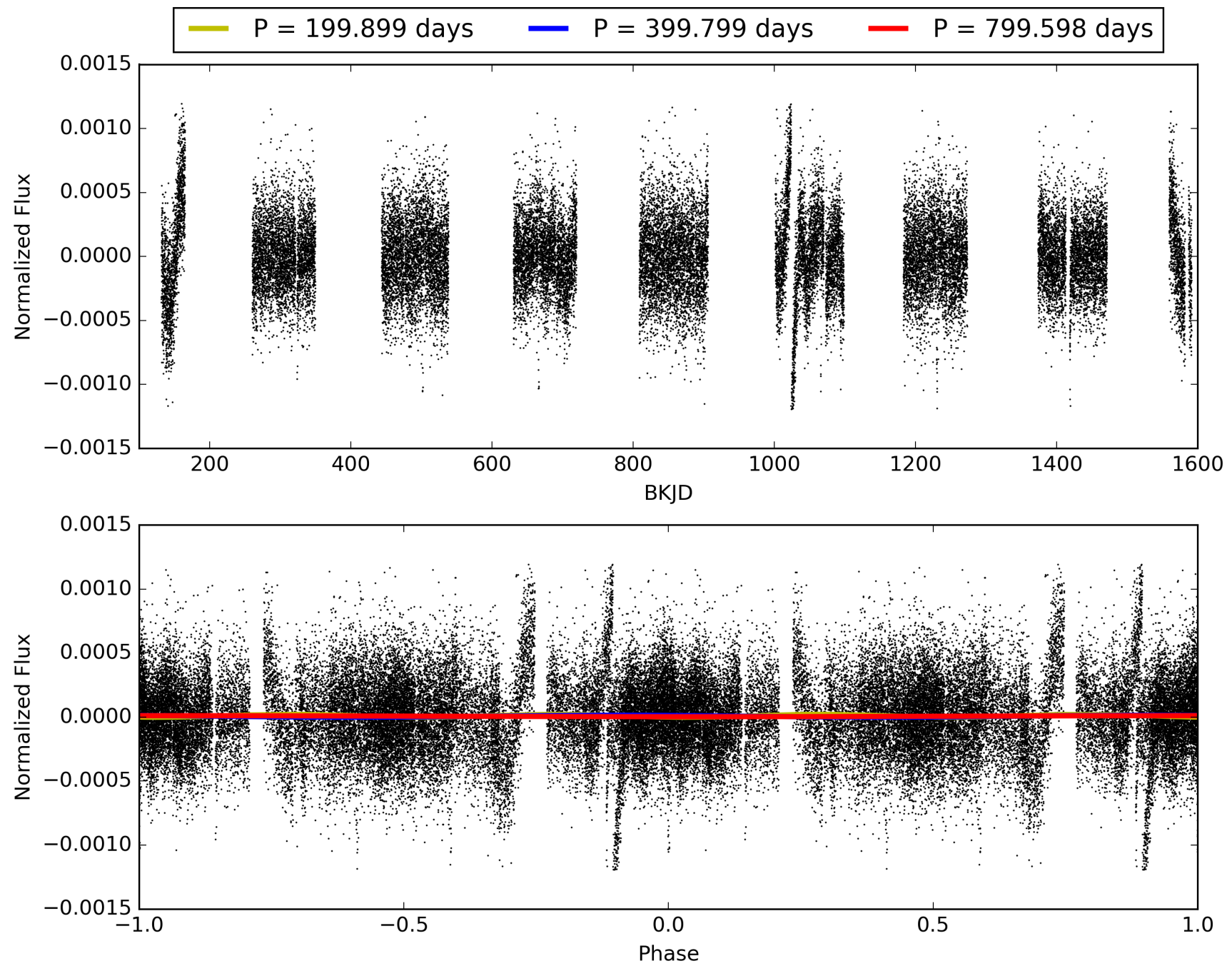
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 01:05:20 Z

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

# TCE 009016734-01, PDC Light Curves

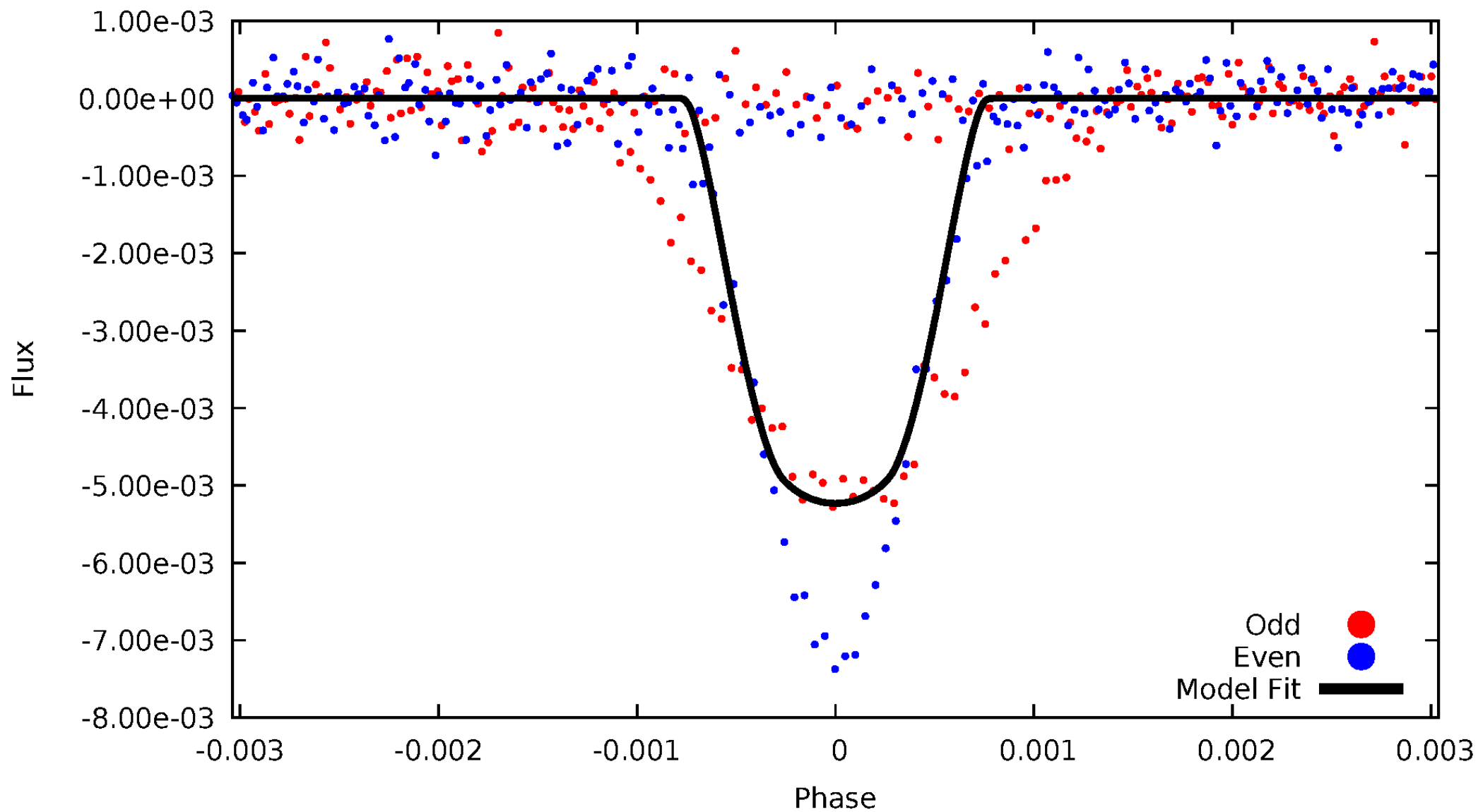


TCE 009016734-01



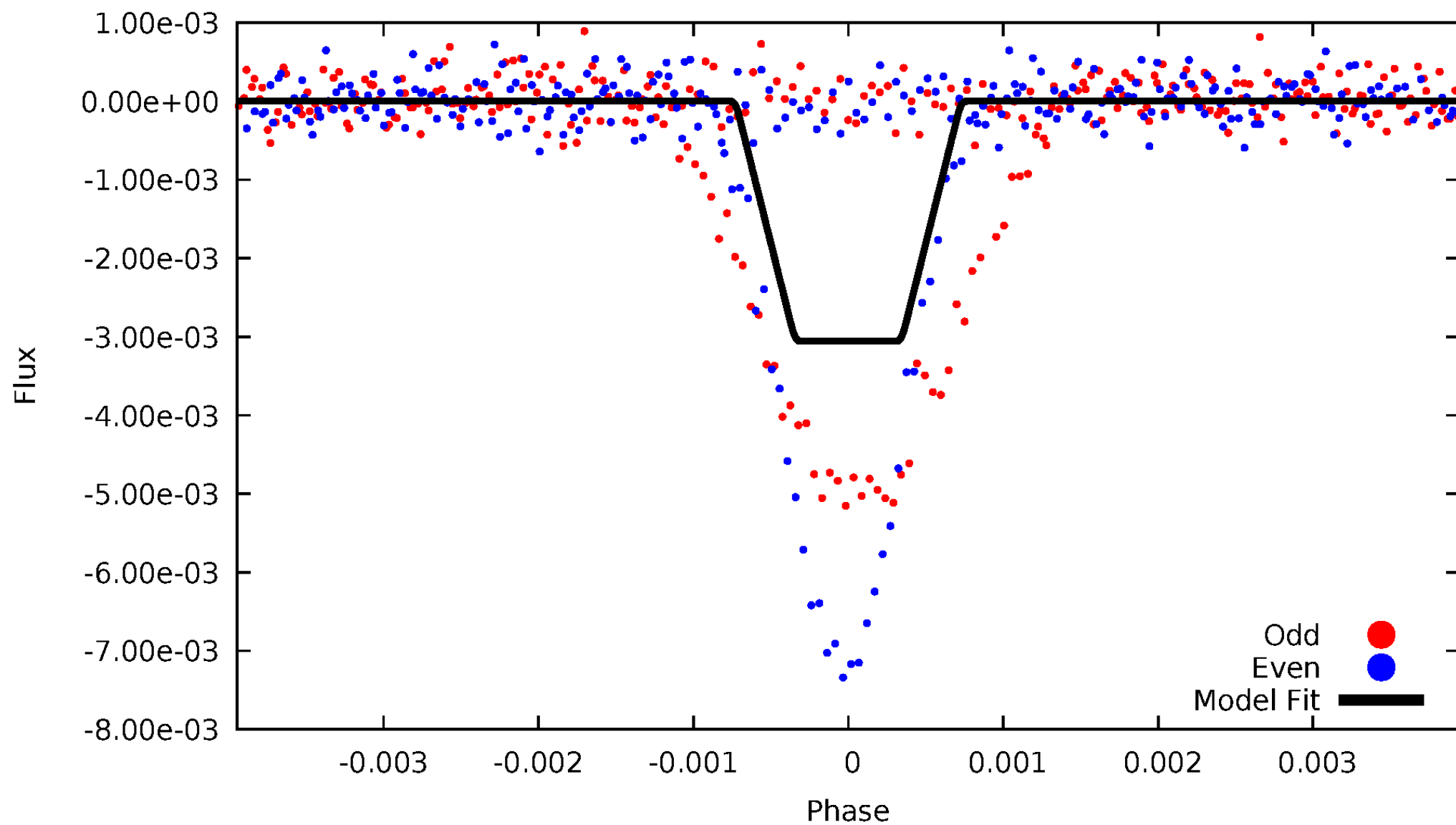
# DV Odd/Even

TCE 009016734-01

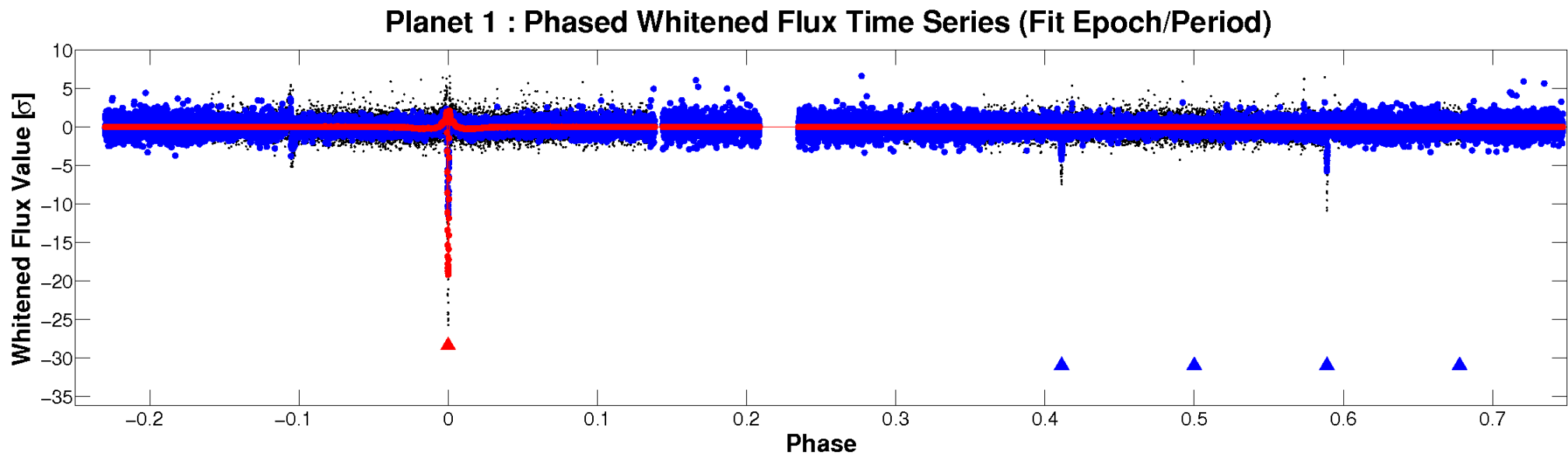
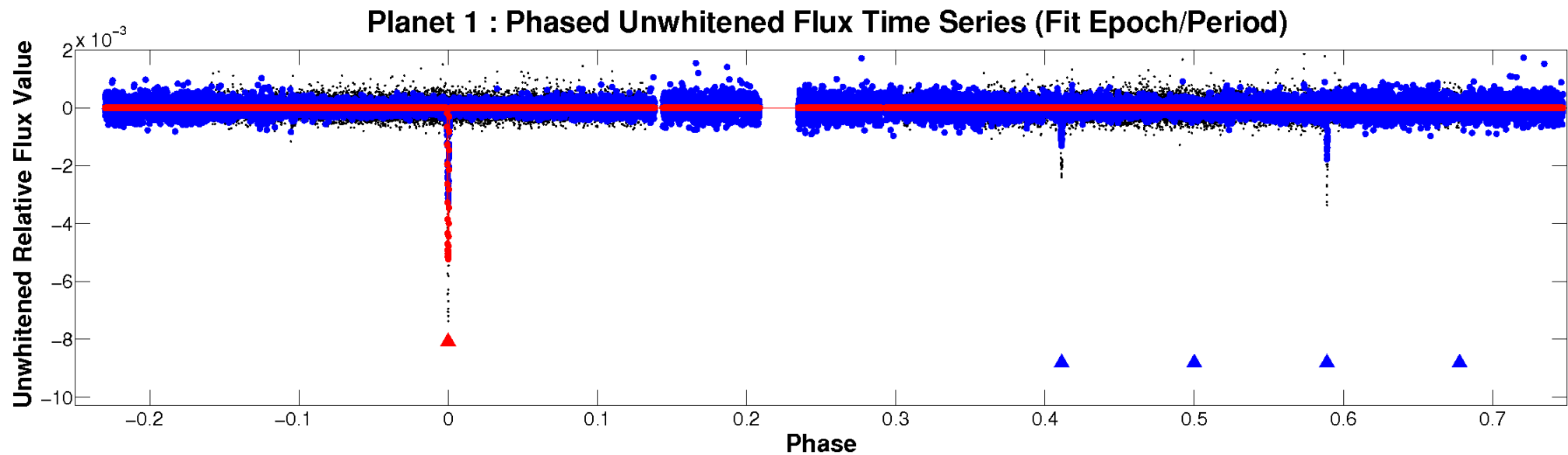


# ALT Odd/Even

TCE 009016734-01

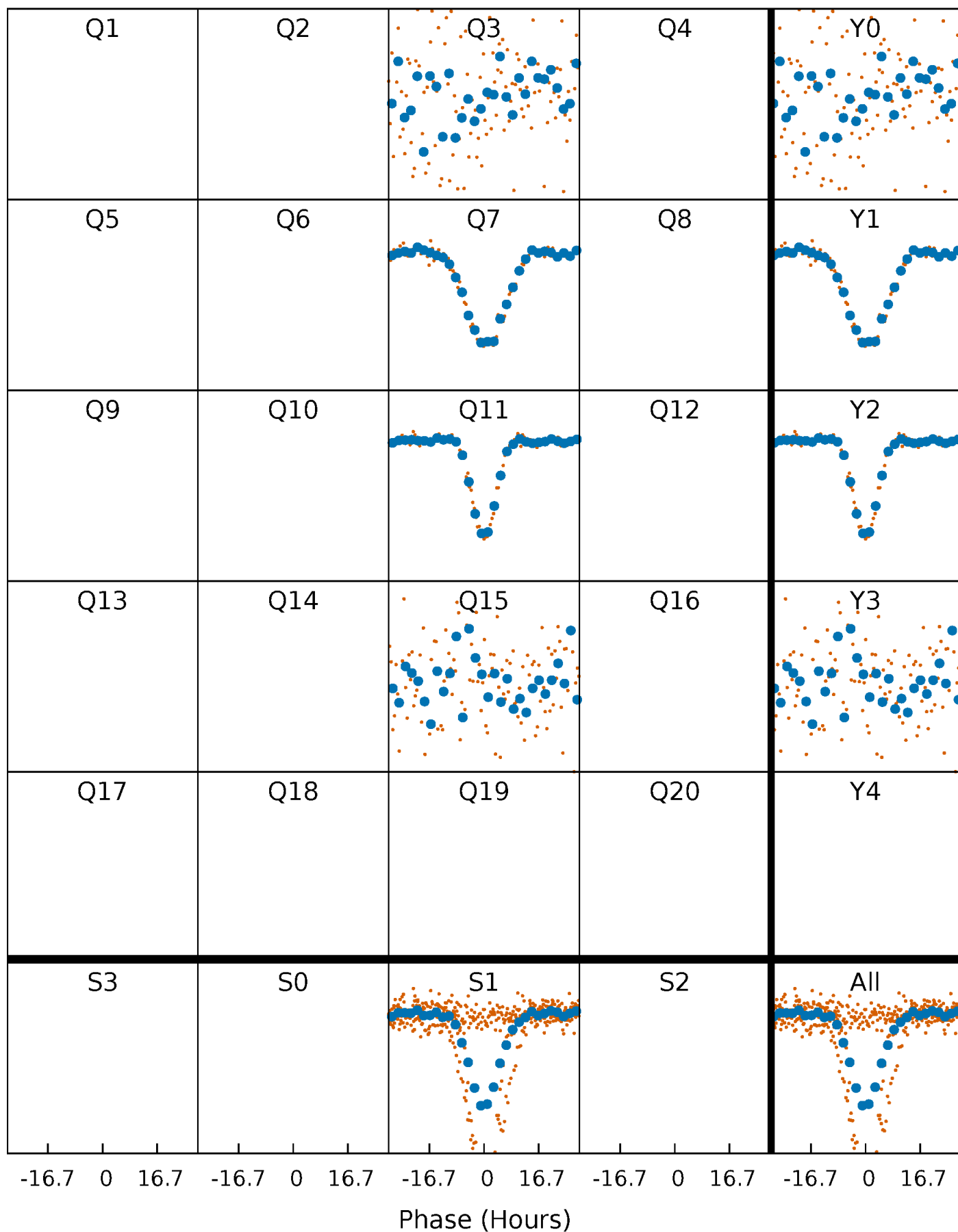


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

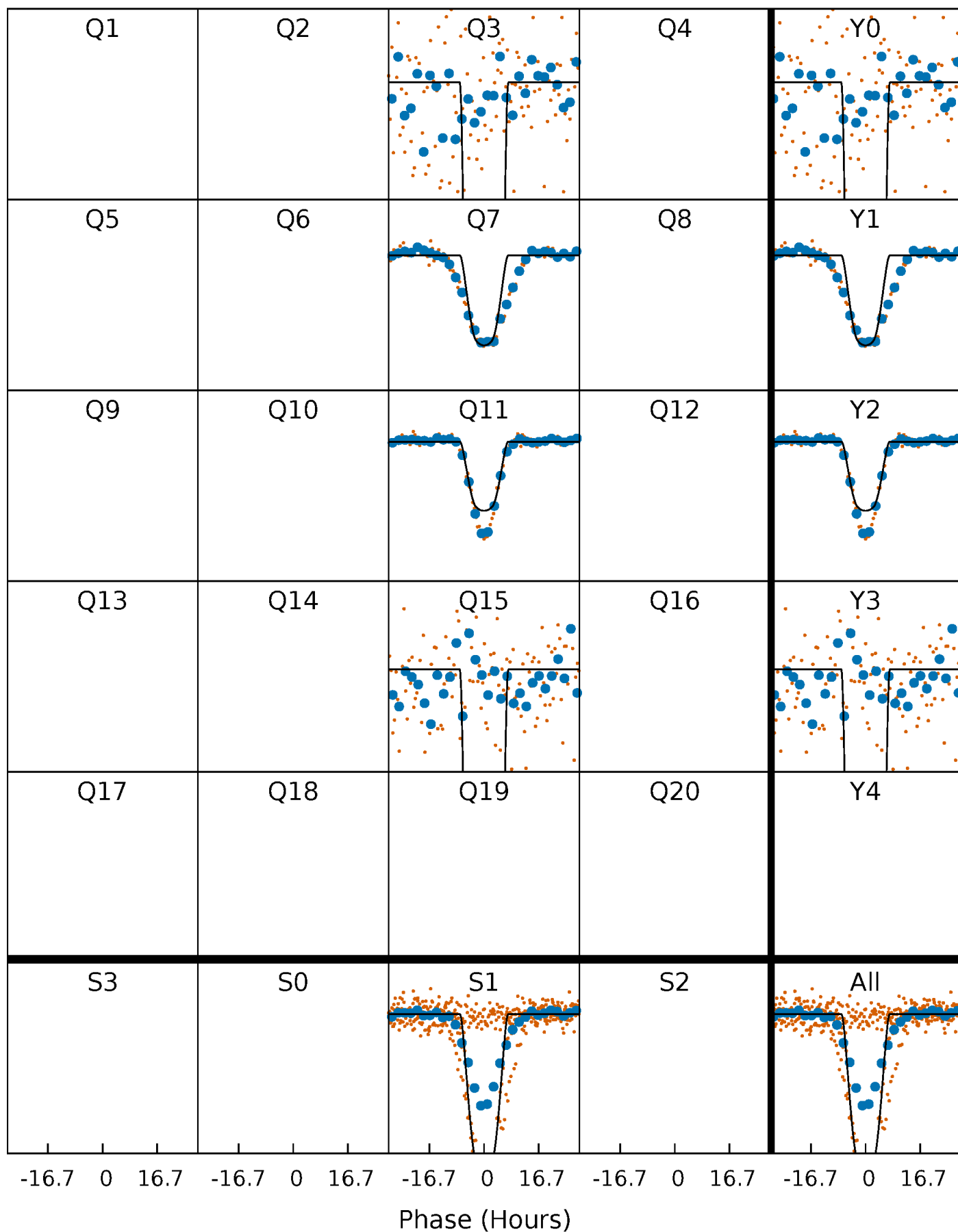
TCE 009016734-01 P=399.798762 Days  $T_0=266.036529$  (BKJD)





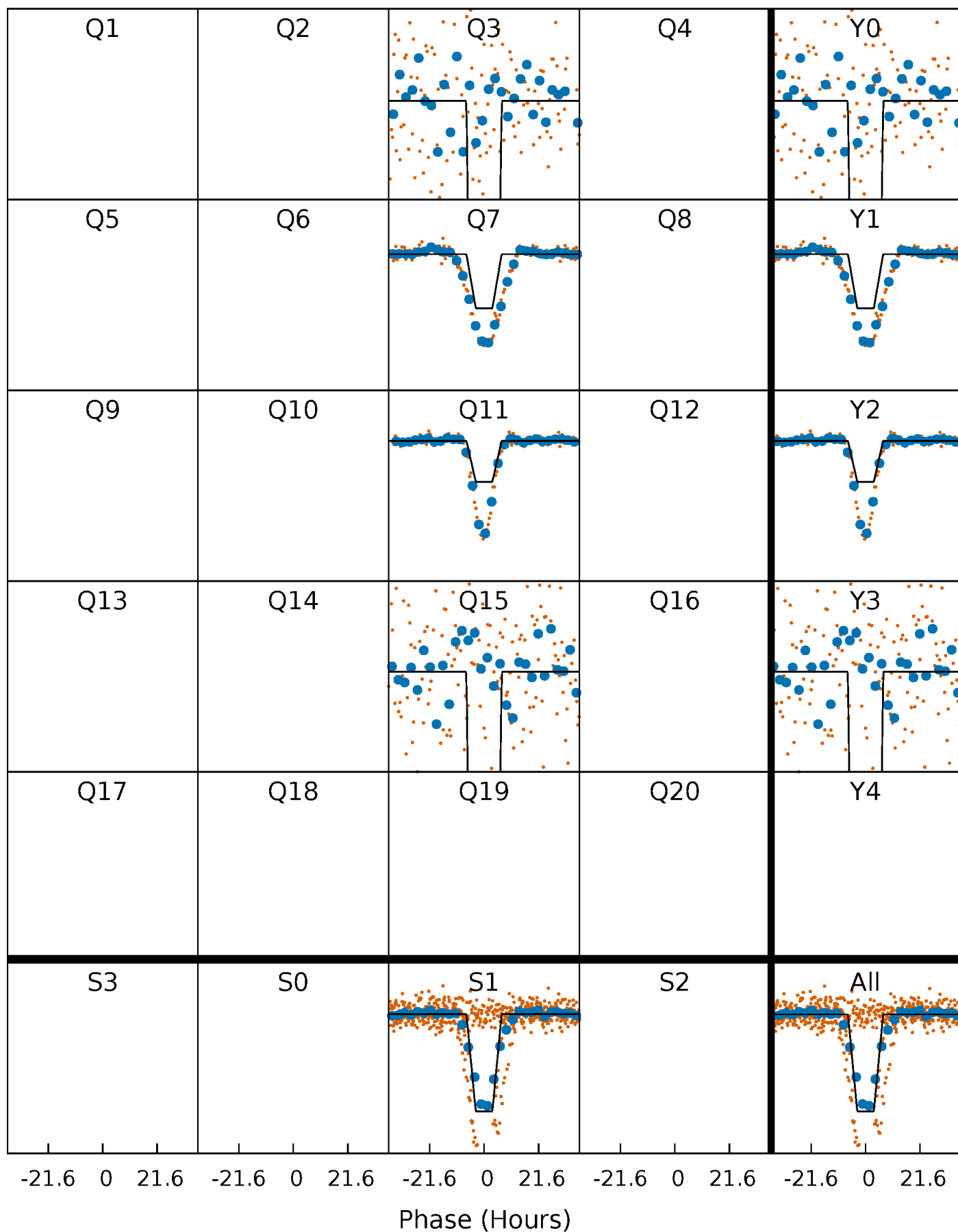
# DV Quarter-Phased Transit Curves

TCE 009016734-01 P=399.798762 Days  $T_0=266.036529$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

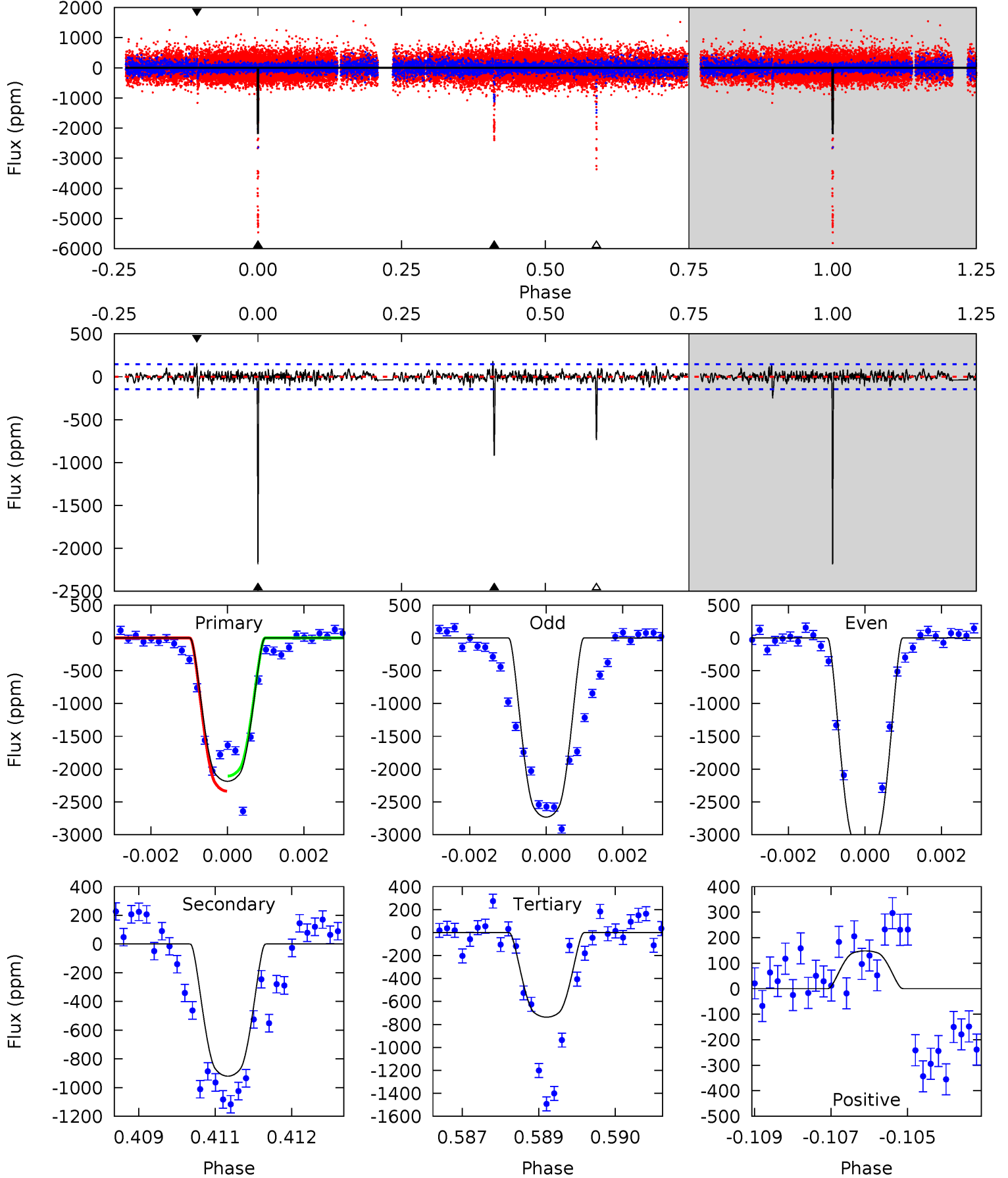
TCE 009016734-01 P=399.809846 Days  $T_0=266.027186$  (BKJD)



# DV Model-Shift Uniqueness Test

009016734-01, P = 399.798762 Days, E = 266.036529 Days

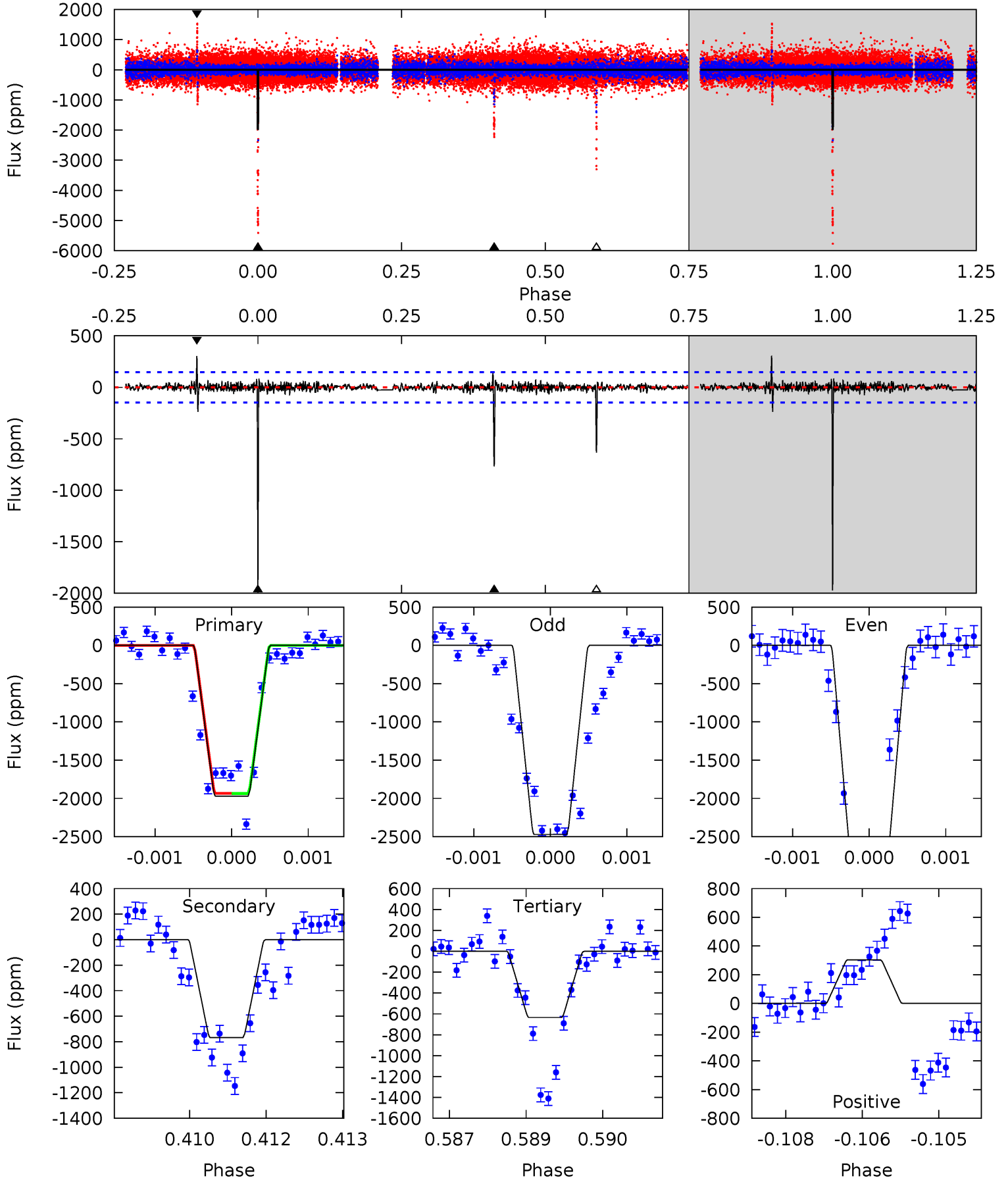
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
80.7	34.0	27.2	5.47	5.37	3.16	1.73	53.5	75.2	6.78	28.5	10.6	1.07	0.08	0



# Alt Model-Shift Uniqueness Test

009016734-01, P = 399.809846 Days, E = 266.027186 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
71.7	27.9	23.1	11.1	5.38	3.18	1.29	48.6	60.6	4.85	16.9	10.6	1.08	0.13	0.03



### Stellar Parameters For KIC 009016734

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M$ ( $M_{\odot}$ )	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5698^{+169}_{-186}$	$4.561^{+0.035}_{-0.184}$	$-0.200^{+0.300}_{-0.300}$	$0.829^{+0.229}_{-0.076}$	$0.916^{+0.102}_{-0.112}$	$2.261^{+0.438}_{-1.152}$
	+3%/-3%	+1%/-4%	+150%/-150%	+28%/-9%	+11%/-12%	+19%/-51%
Source	KIC0	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 009016734-01 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-920 \pm 27$	$7.35^{+0.98}_{-0.49}$	$322^{+20}_{-14}$	$3888^{+88}_{-97}$	$9803^{+1221}_{-2001}$
Alt.	$-768 \pm 28$	$5.19^{+0.69}_{-0.39}$	$323^{+19}_{-15}$	$4268^{+111}_{-112}$	$16383^{+2454}_{-3296}$

$T_{max}$  = 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

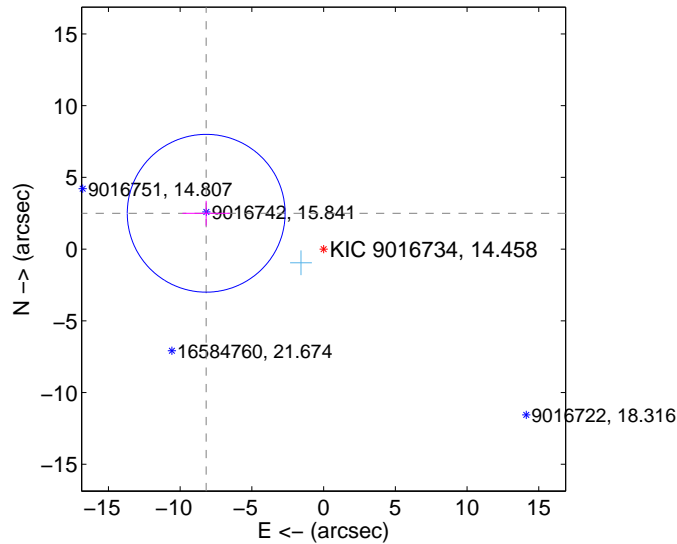
Supplemental centroid analysis for 009016734-01. Kepler magnitude: 14.46. Transit SNR 91.41

There are 2 quarters with good PRF difference image offsets

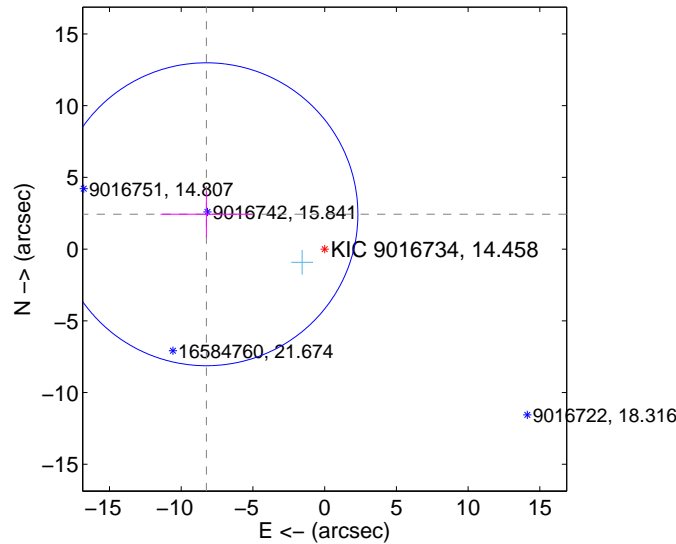
The direct PRF centroid is offset from the target star catalog position by about 0.09 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$8.561 \pm 1.834$	4.67	$8.188 \pm 1.654$	$2.499 \pm 0.866$
PRF-fit source offset from KIC position	$8.595 \pm 3.520$	2.44	$8.245 \pm 3.197$	$2.429 \pm 1.606$
photometric centroid source offset	$7.85 \pm 0.07$	113.83	$6.35 \pm 0.07$	$4.61 \pm 0.07$

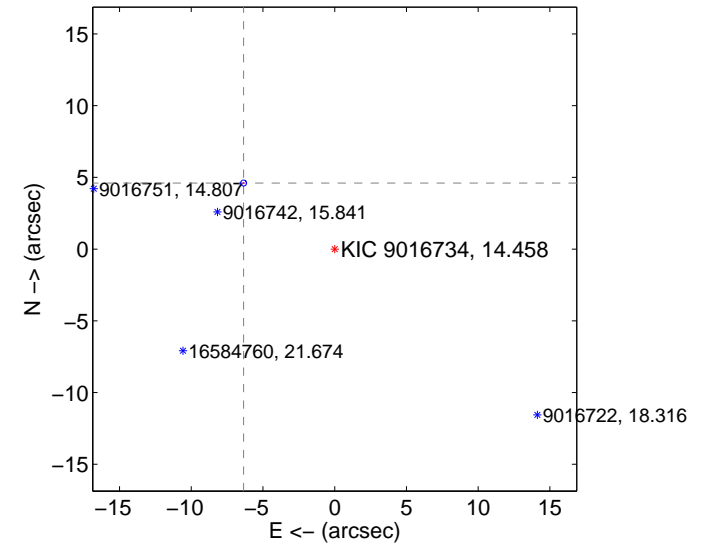
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

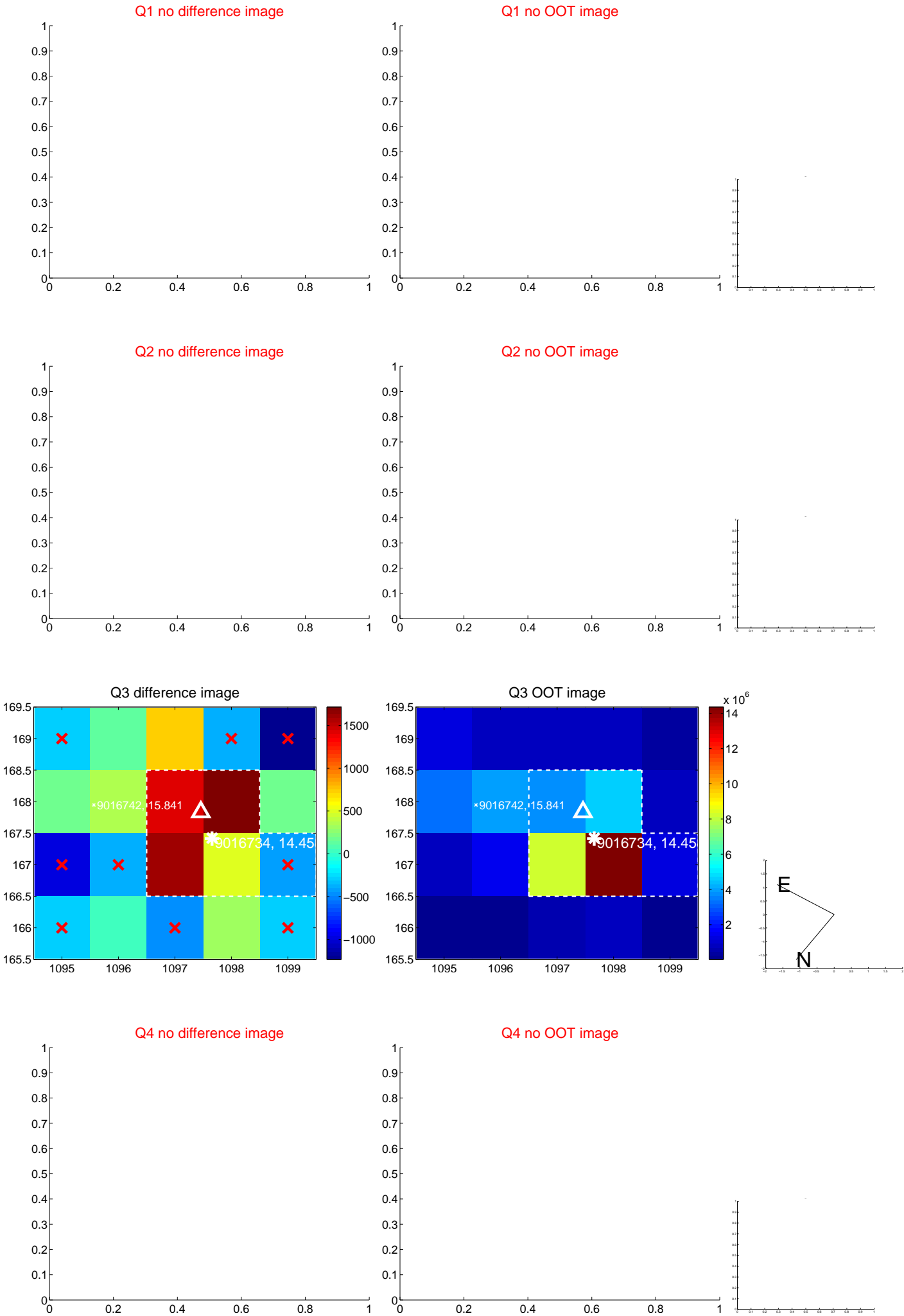


offset from photometric centroids



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.

Q5 no difference image



Q5 no OOT image



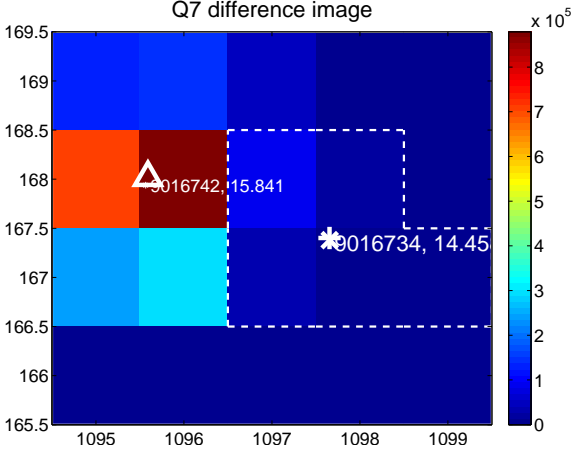
Q6 no difference image



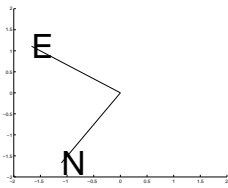
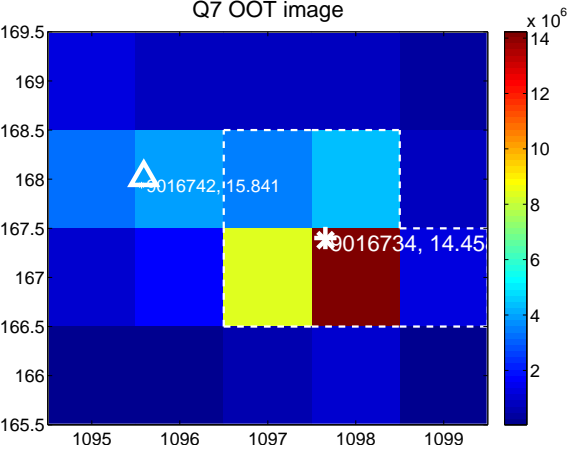
Q6 no OOT image



Q7 difference image



Q7 OOT image



Q8 no difference image



Q8 no OOT image

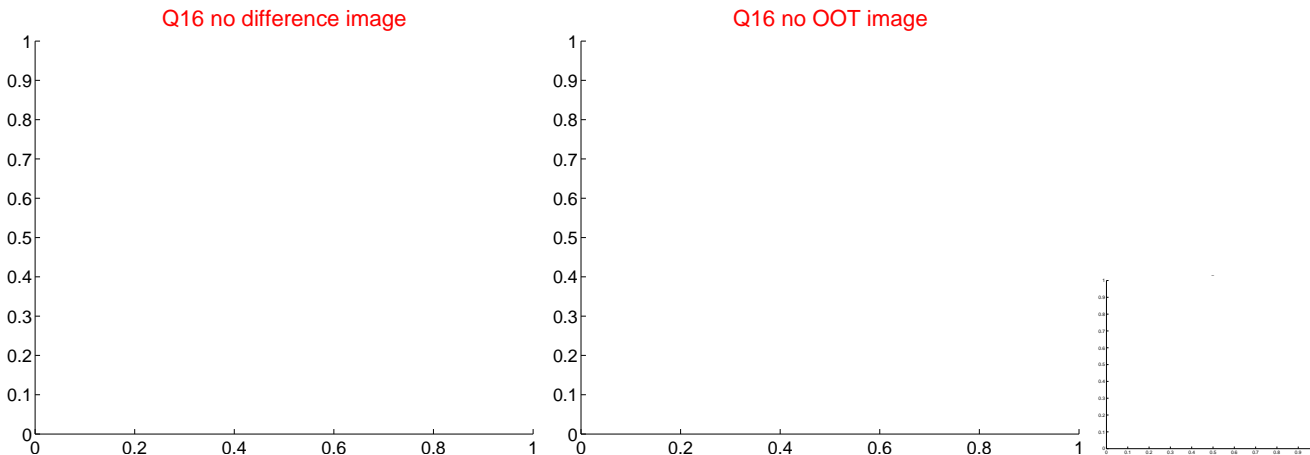
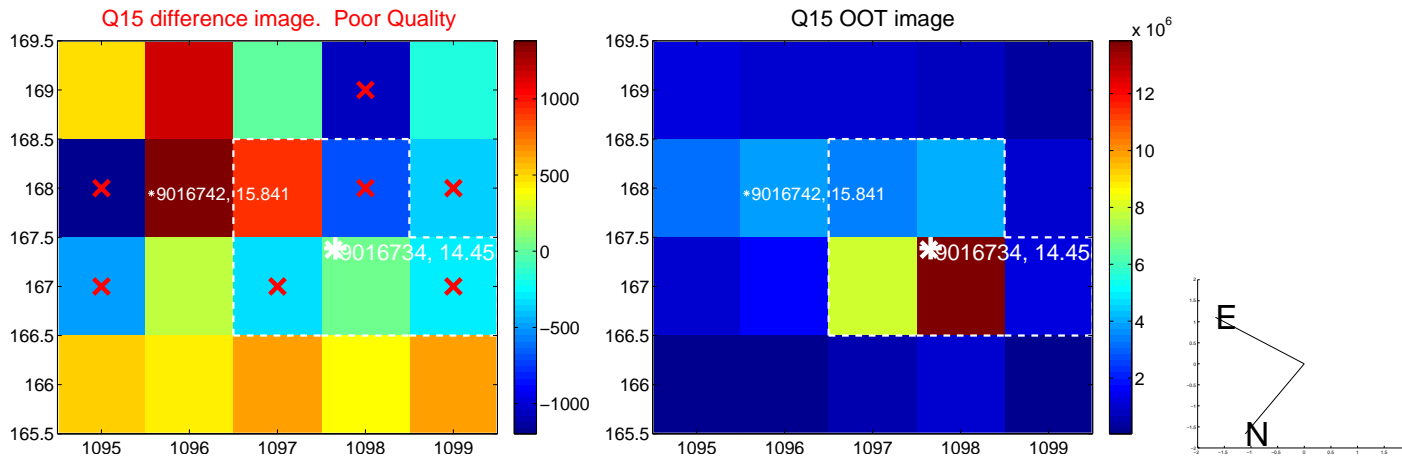
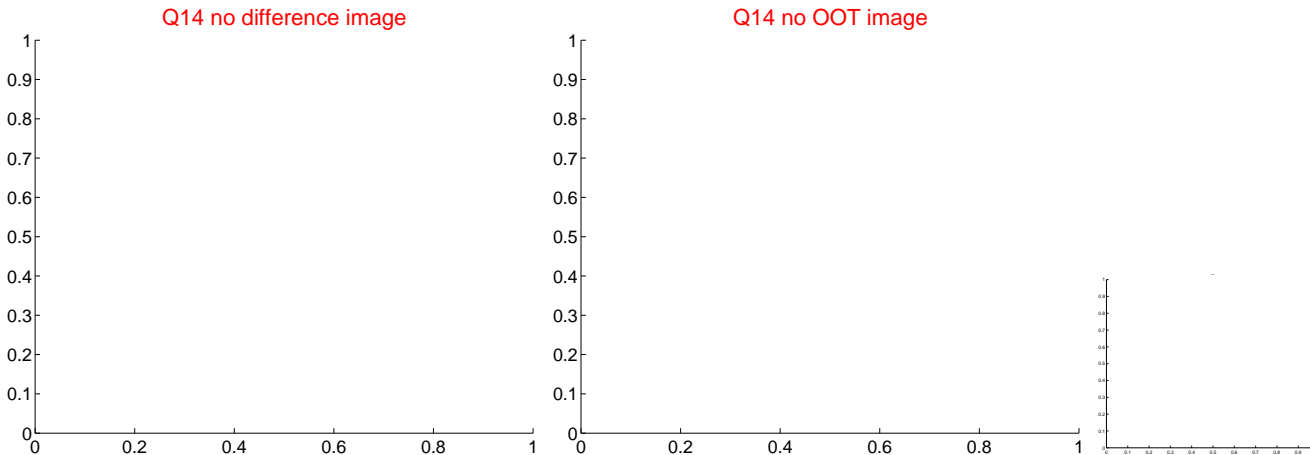
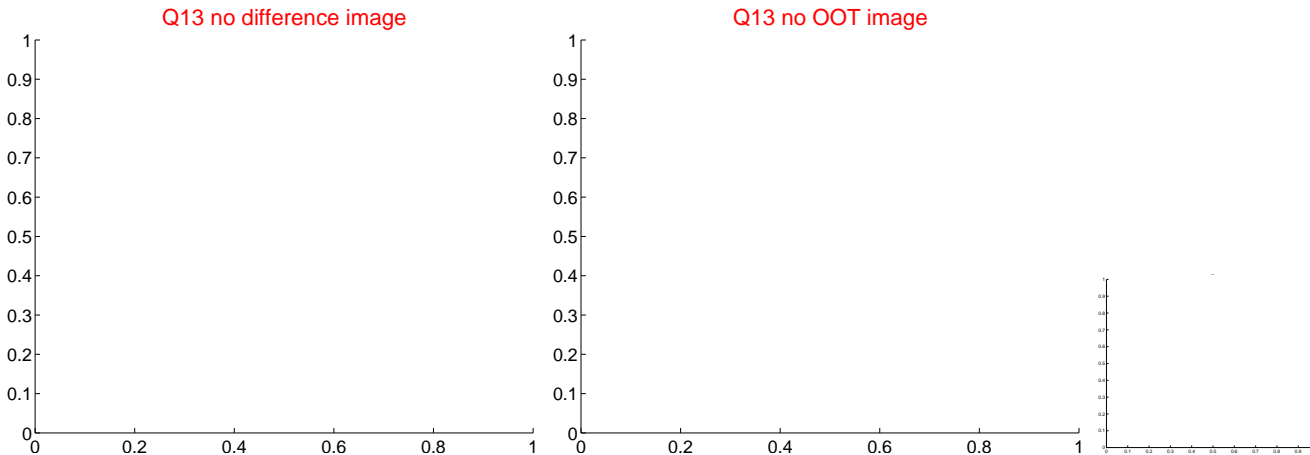




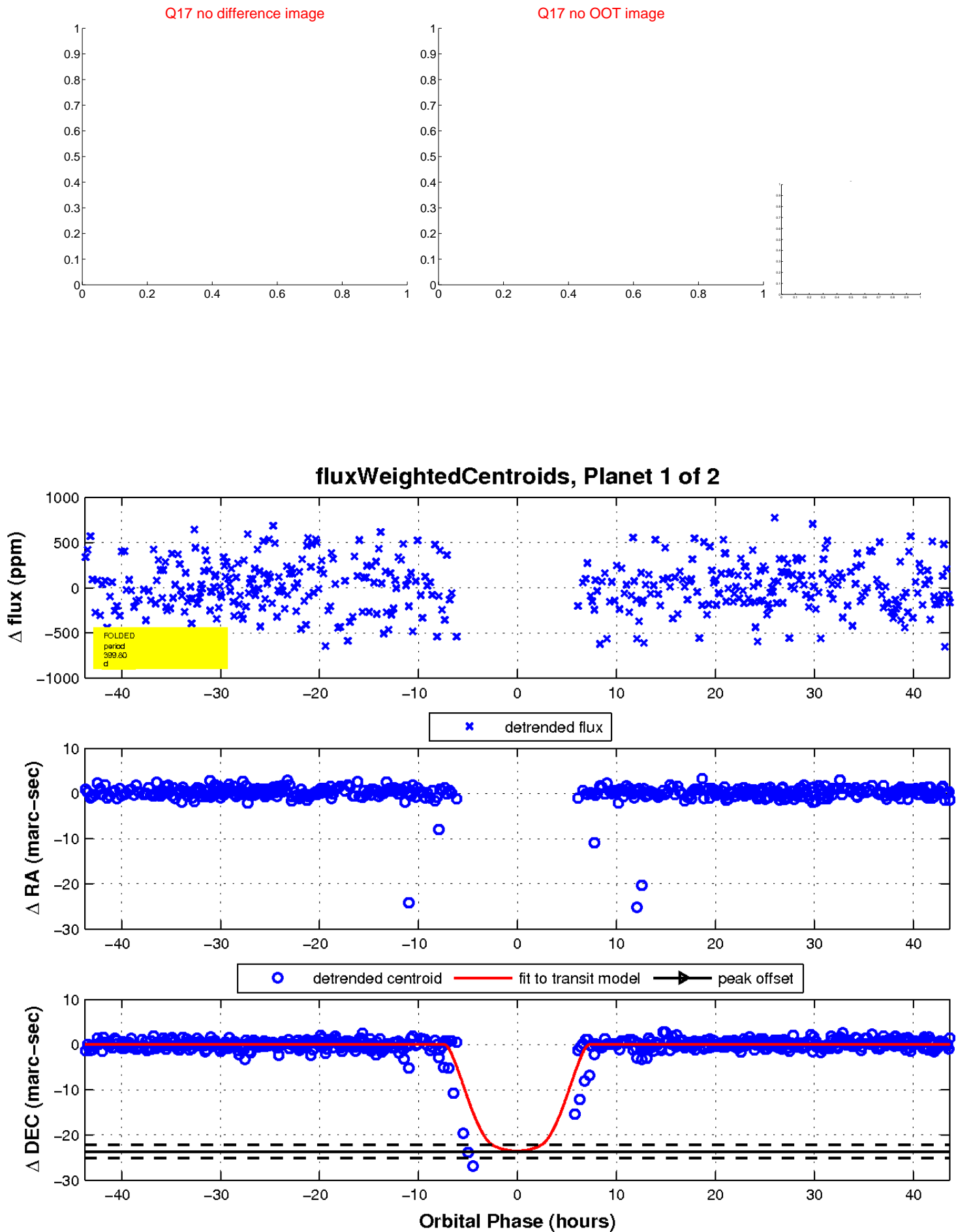
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

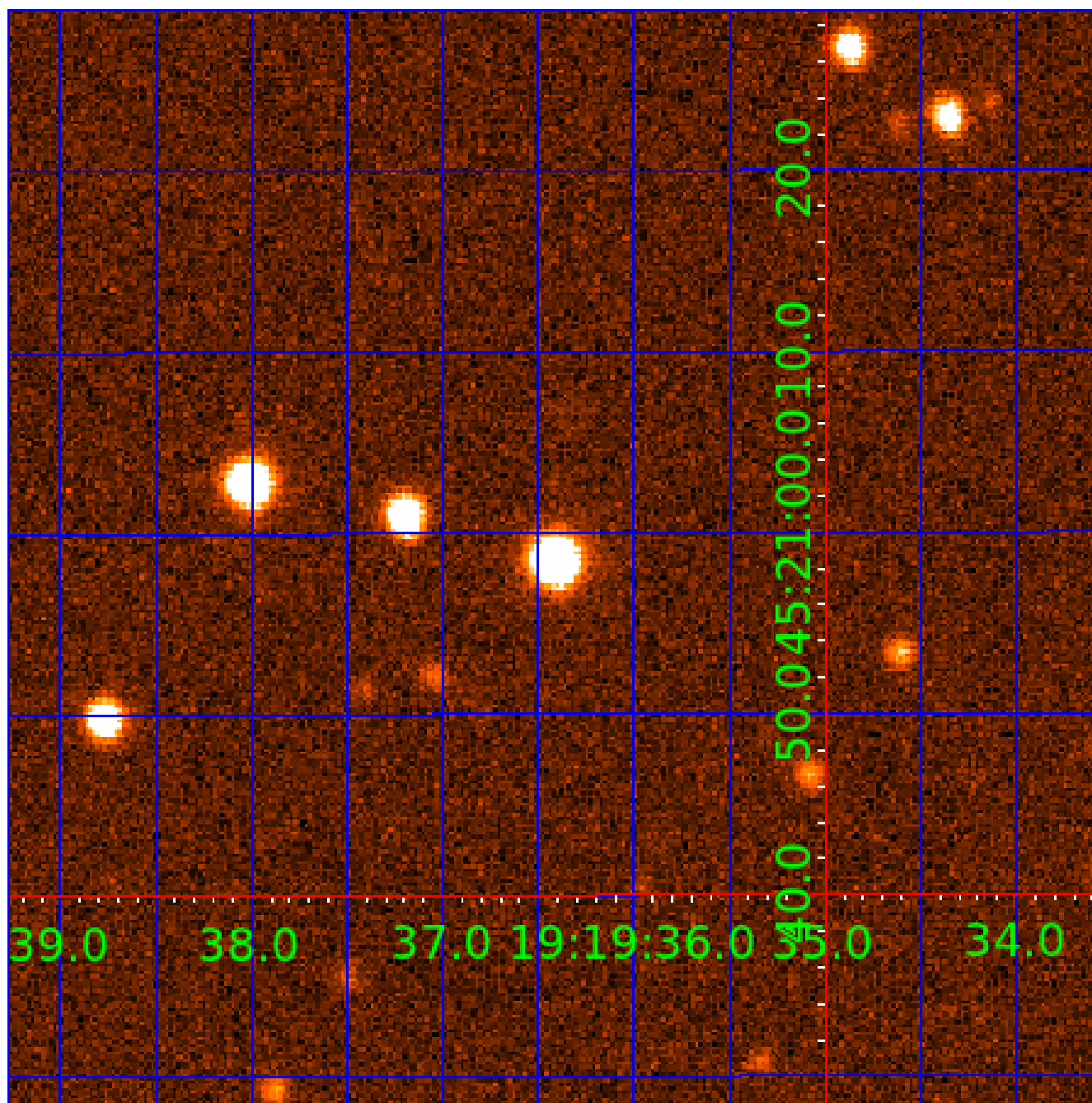


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 009016734

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009016734-01	OBS	No	399.798762	266.036529	5232.9	14.576	73.6	91.4	0.83	5698	7.13	0.61
009016734-02	OBS	No	364.253206	137.269039	2459.2	12.530	31.0	35.8	0.83	5698	7.78	0.69

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009016734-01	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_CHASES_MARSHALL_ZUMA—LPP_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS—HALO_GHOST
009016734-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE—LPP_DV—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.

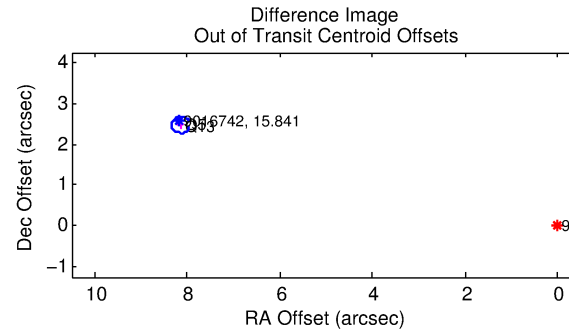
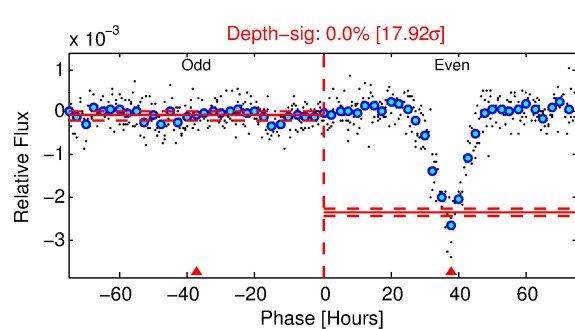
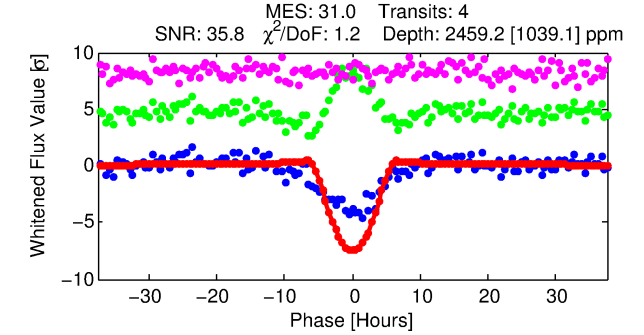
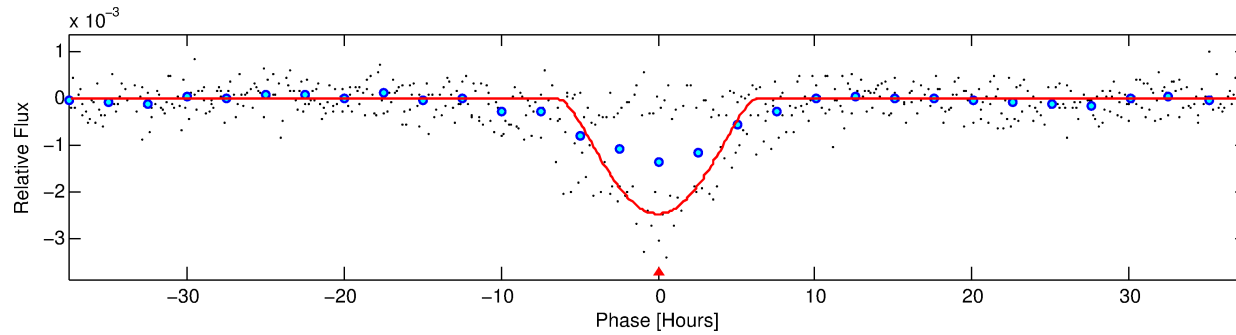
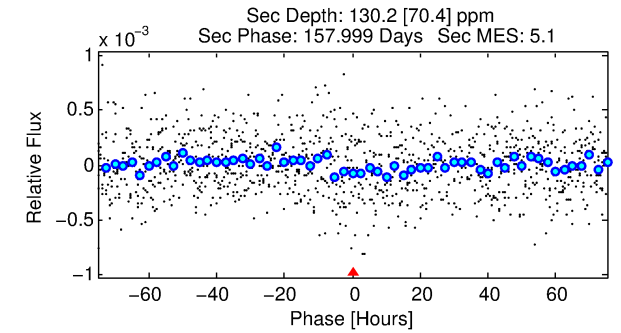
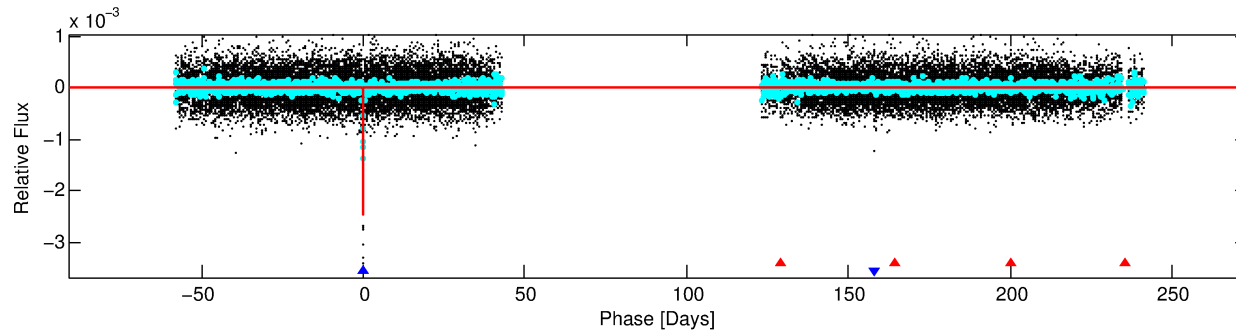
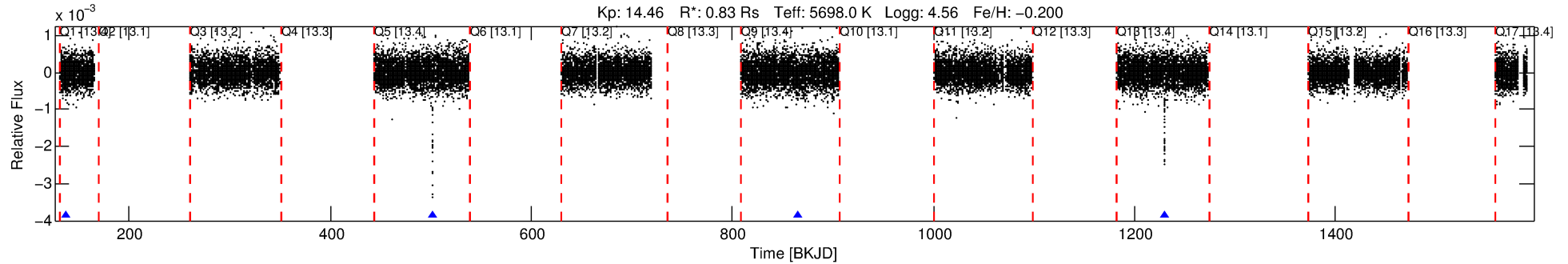
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009016734-02

No Significant Match Found

# DV One-Page Summary

KIC: 9016734 Candidate: 2 of 2 Period: 364.253 d



## DV Fit Results:

Period = 364.25321 [0.00348] d  
Epoch = 137.2690 [0.0067] BKJD  
Rp/R\* = 0.0860 [0.0921]  
a/R\* = 94.08 [20.95]  
b = 1.00 [0.15]  
Seff = 0.69 [0.25]  
Teq = 233 [21] K  
Rp = 7.78 [8.60] Re  
a = 0.9683 [0.2247] AU  
Ag = 1109.39 [2478.30] [0.45σ]  
Teff = 2075 [1148] K [1.61σ]

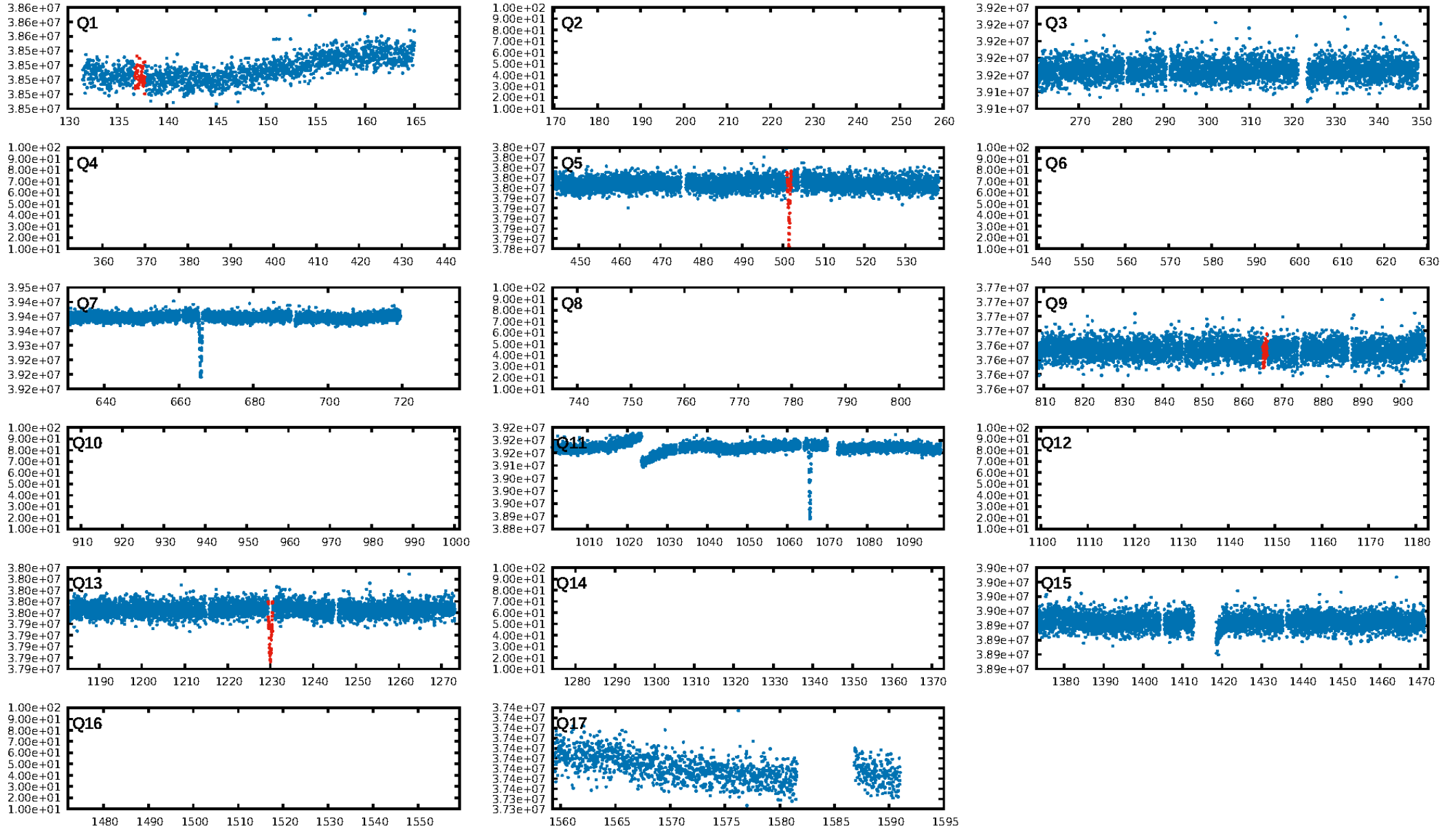
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [44.38σ]  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 86.0%  
Bootstrap-pfa: 1.90e-170  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: -11.15  
Centroid-sig: N/A  
Centroid-so: 37.219 arcsec [135.10σ]  
OotOffset-rm: 8.514 arcsec [127.37σ]  
KicOffset-rm: 8.636 arcsec [128.01σ]  
OotOffset-st: 0/0/0/2 [2]  
KicOffset-st: 0/0/0/2 [2]  
DiffImageQuality-fgm: 1.00 [2/2]  
DiffImageOverlap-fno: 1.00 [4/4]

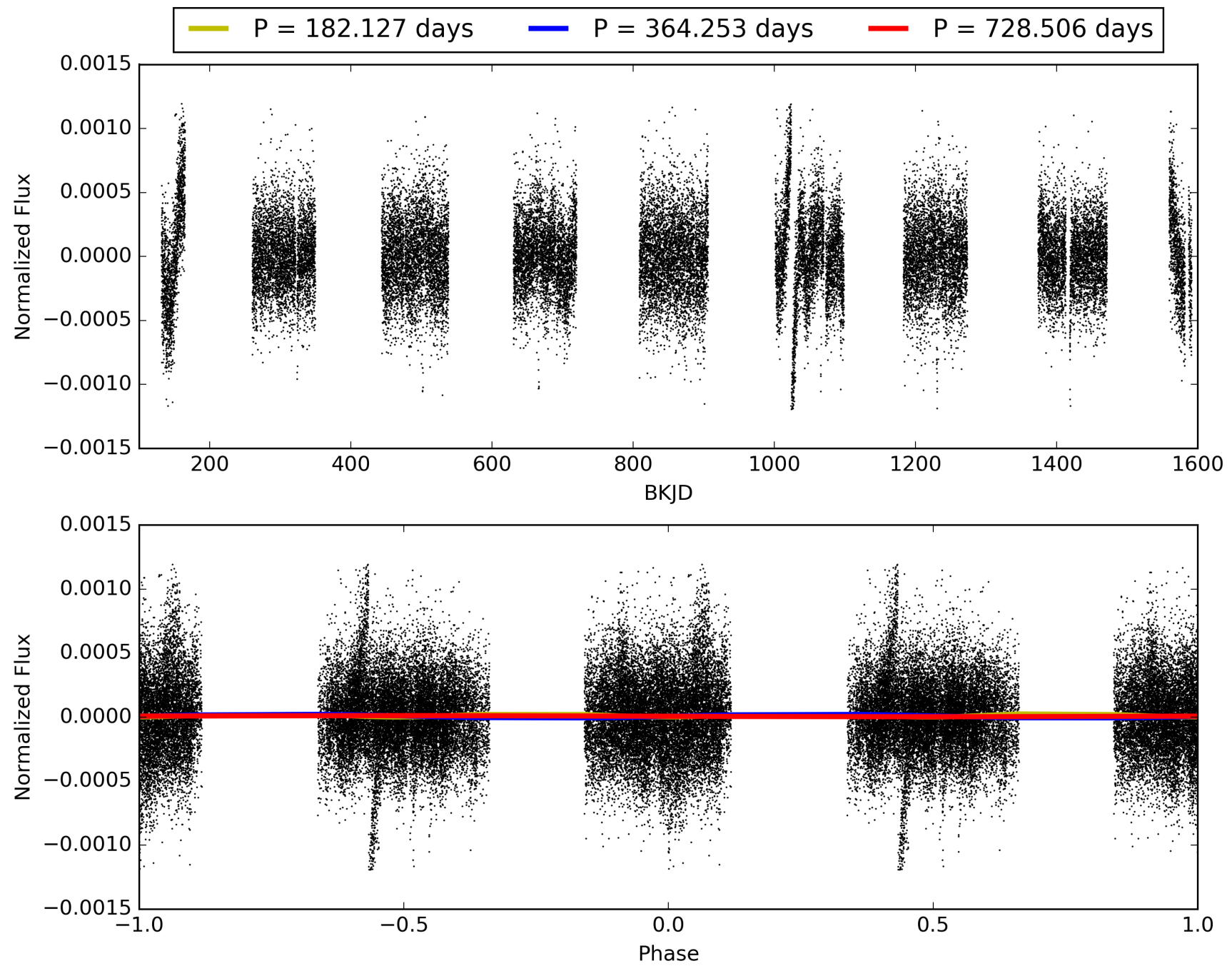
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 01:05:26 Z

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

# TCE 009016734-02, PDC Light Curves



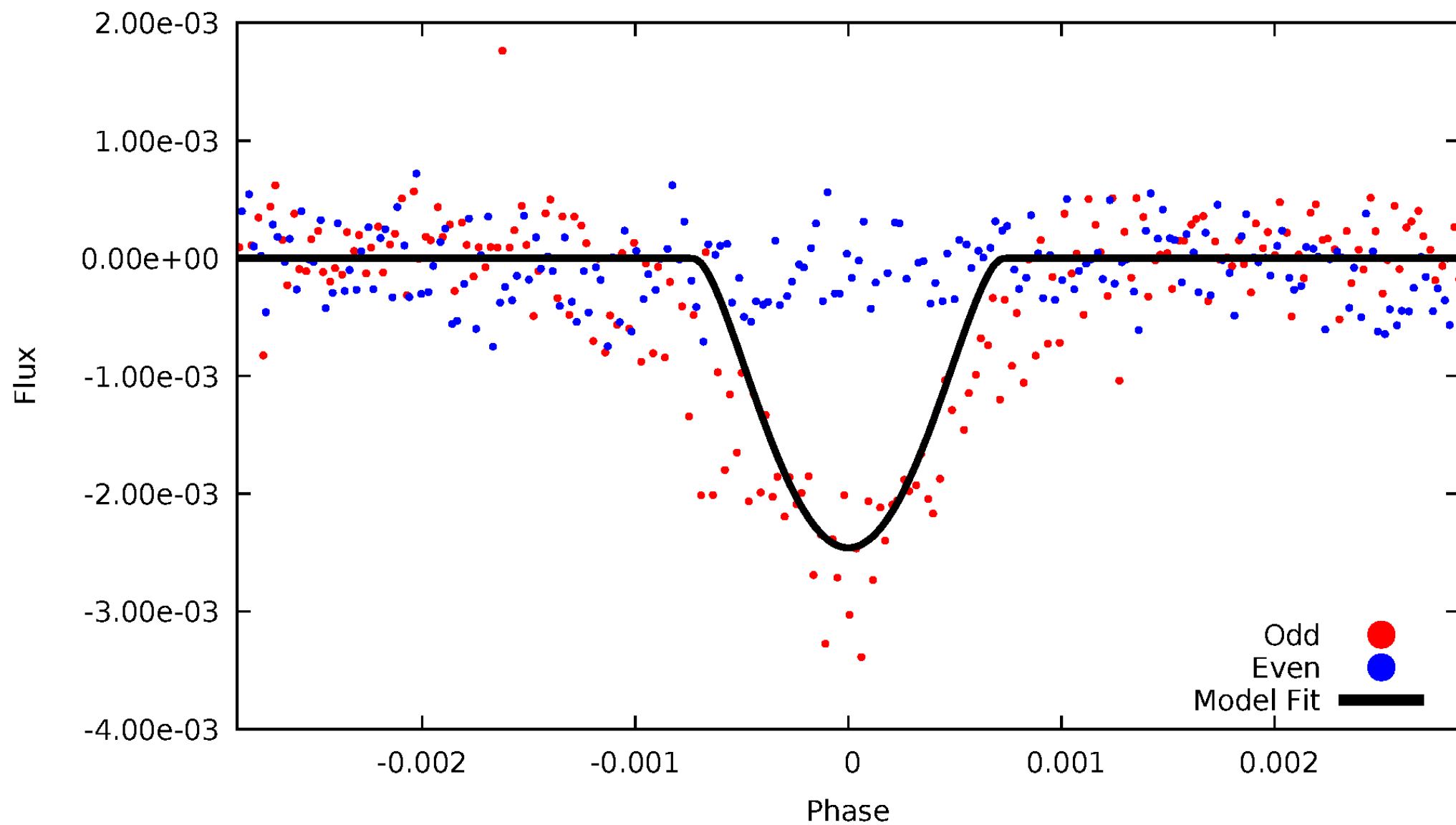
TCE 009016734-02





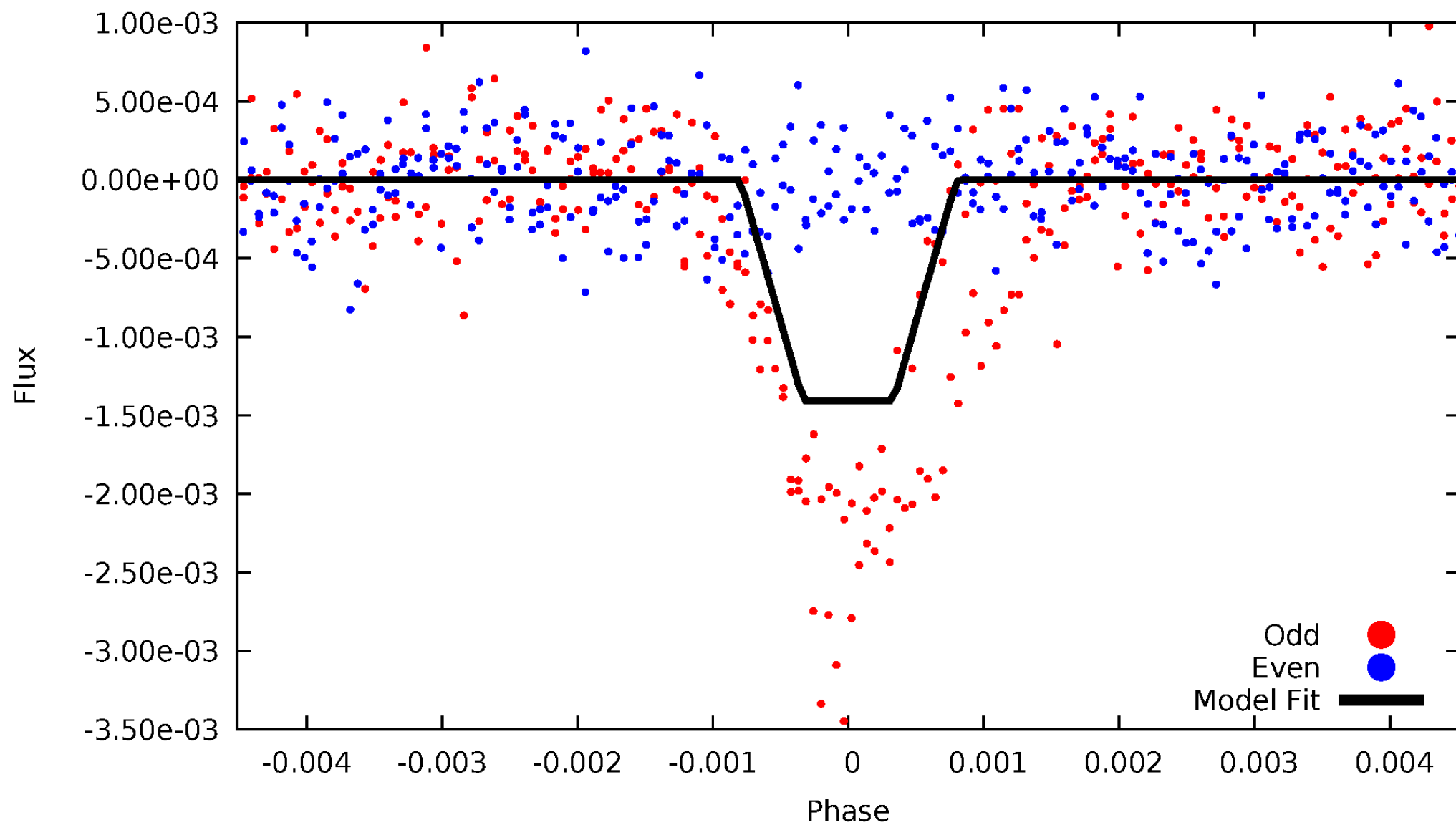
# DV Odd/Even

TCE 009016734-02



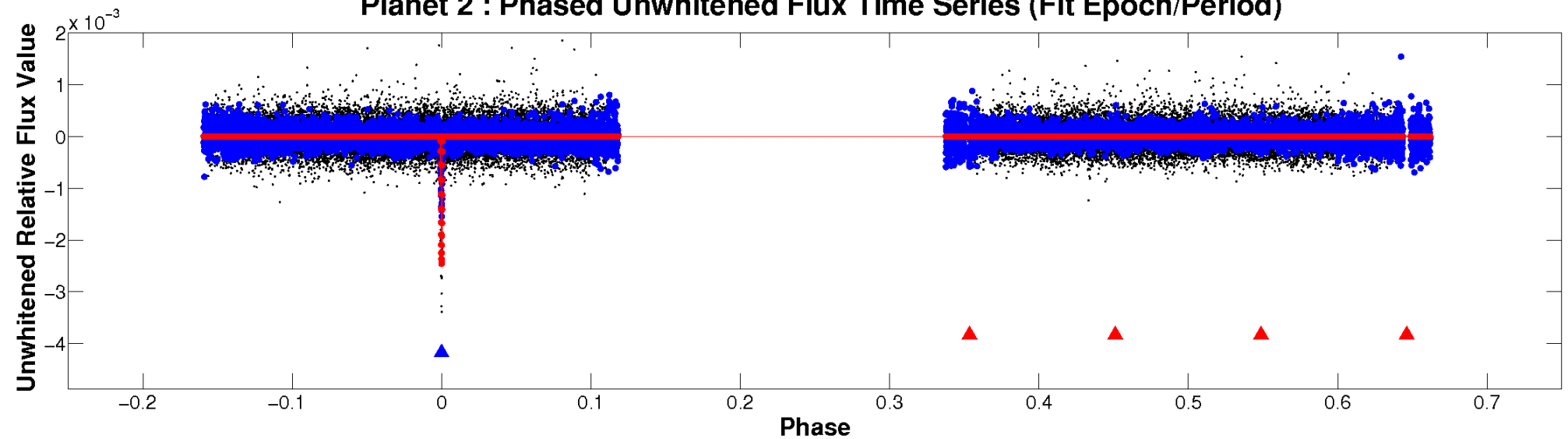
# ALT Odd/Even

TCE 009016734-02

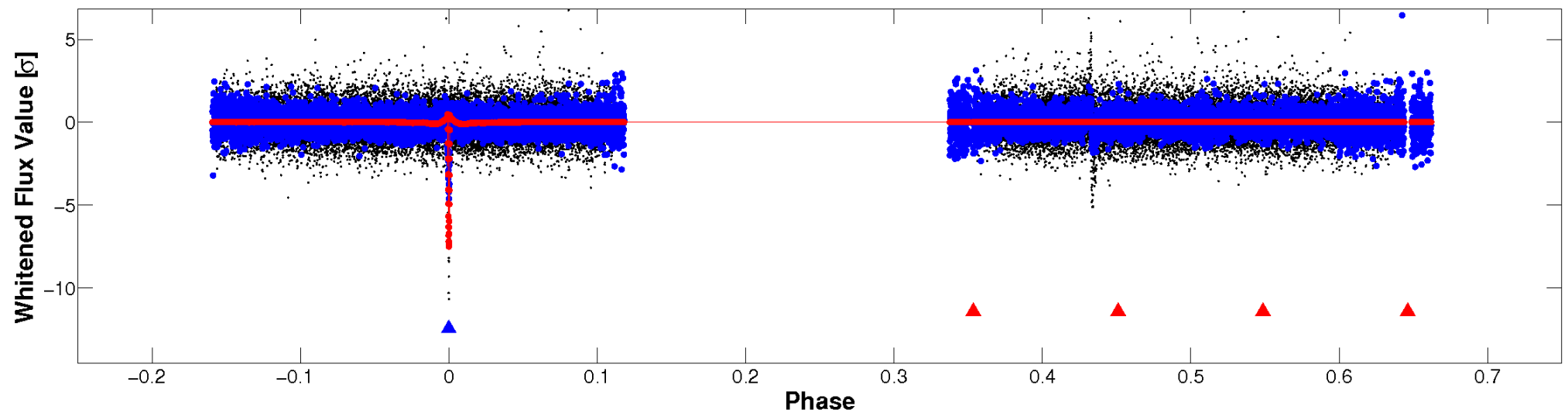


# Non-Whitened Vs. Whitened Light Curve

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

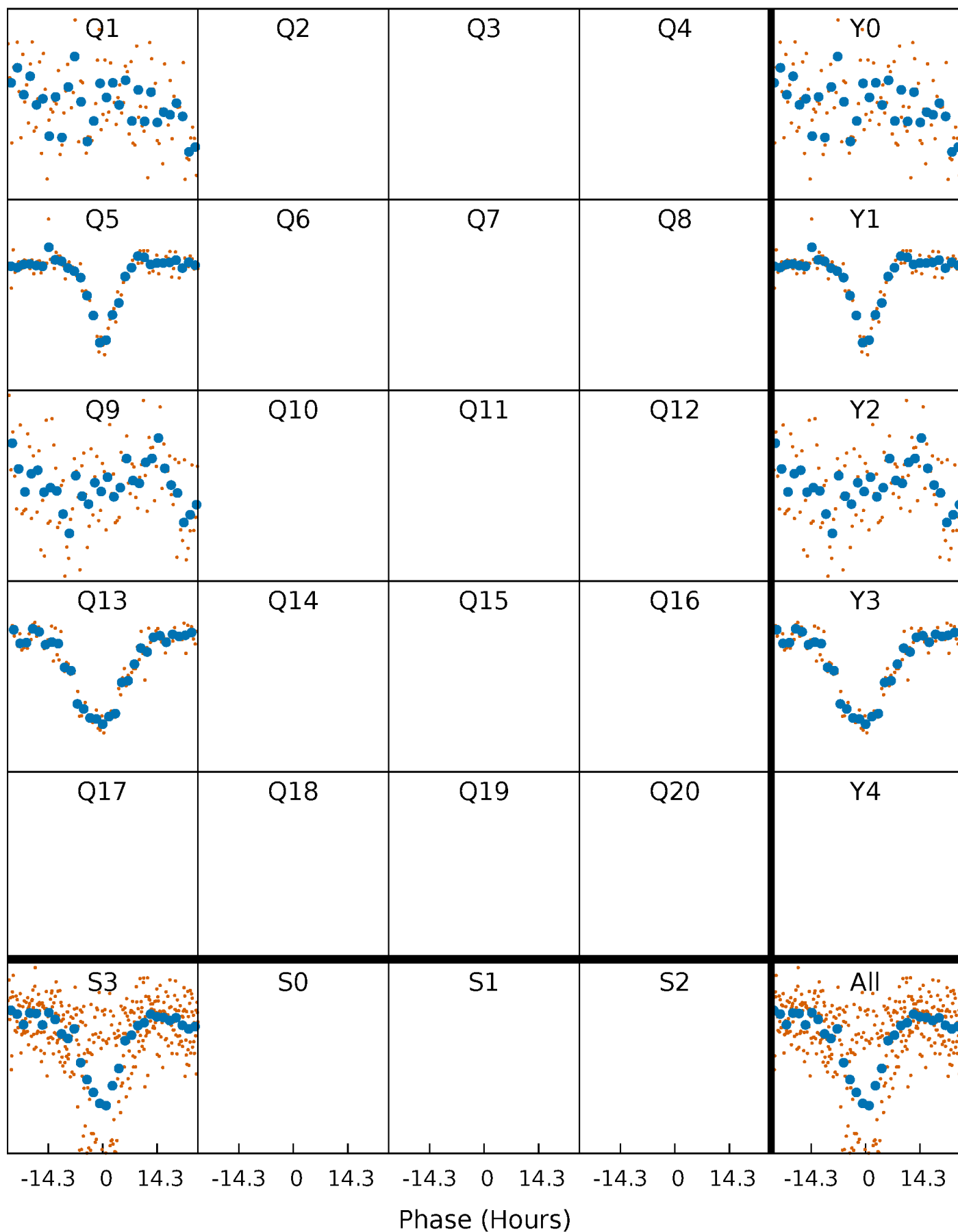


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



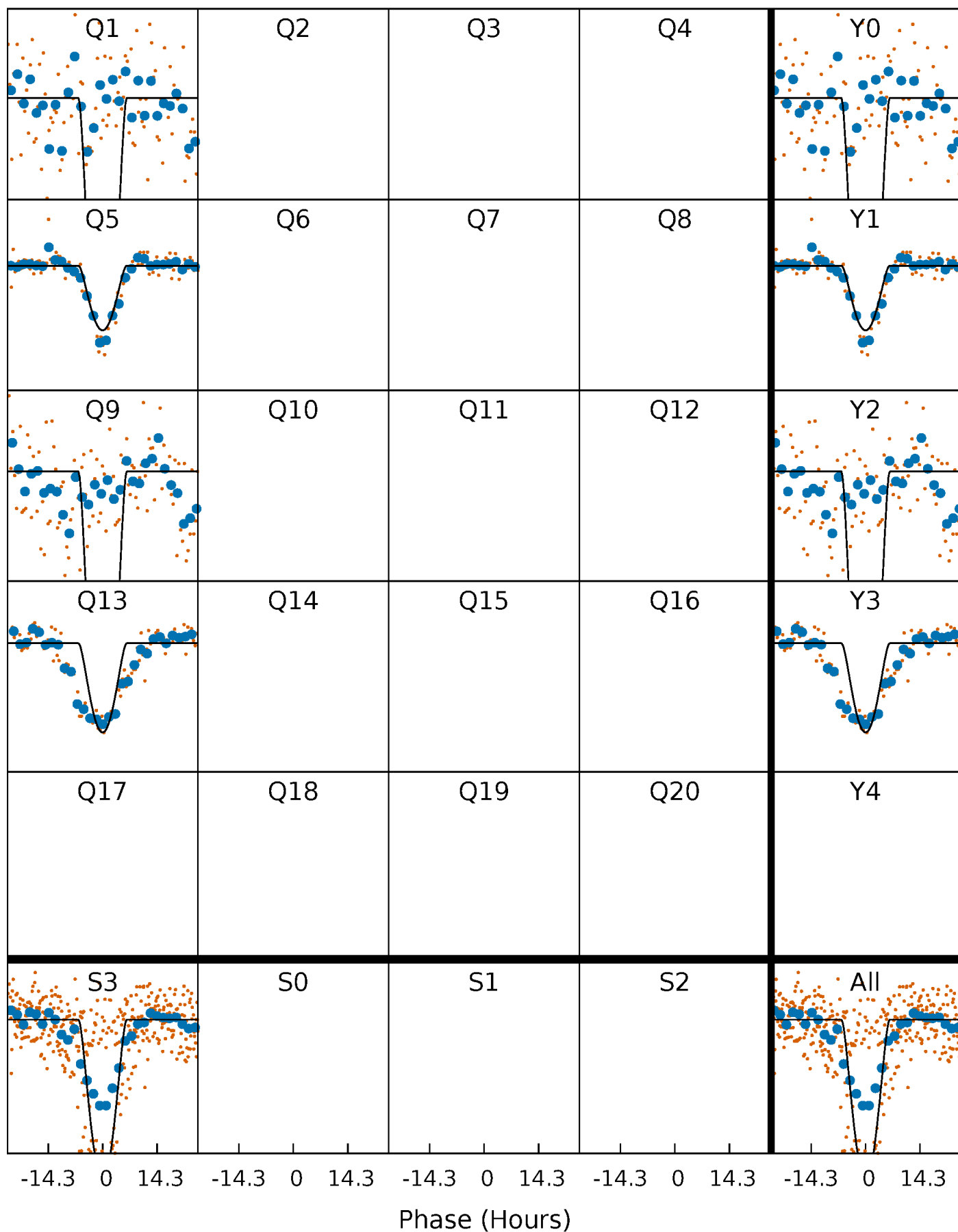
# PDC Quarter-Phased Transit Curves

TCE 009016734-02 P=364.253206 Days  $T_0=137.269039$  (BKJD)



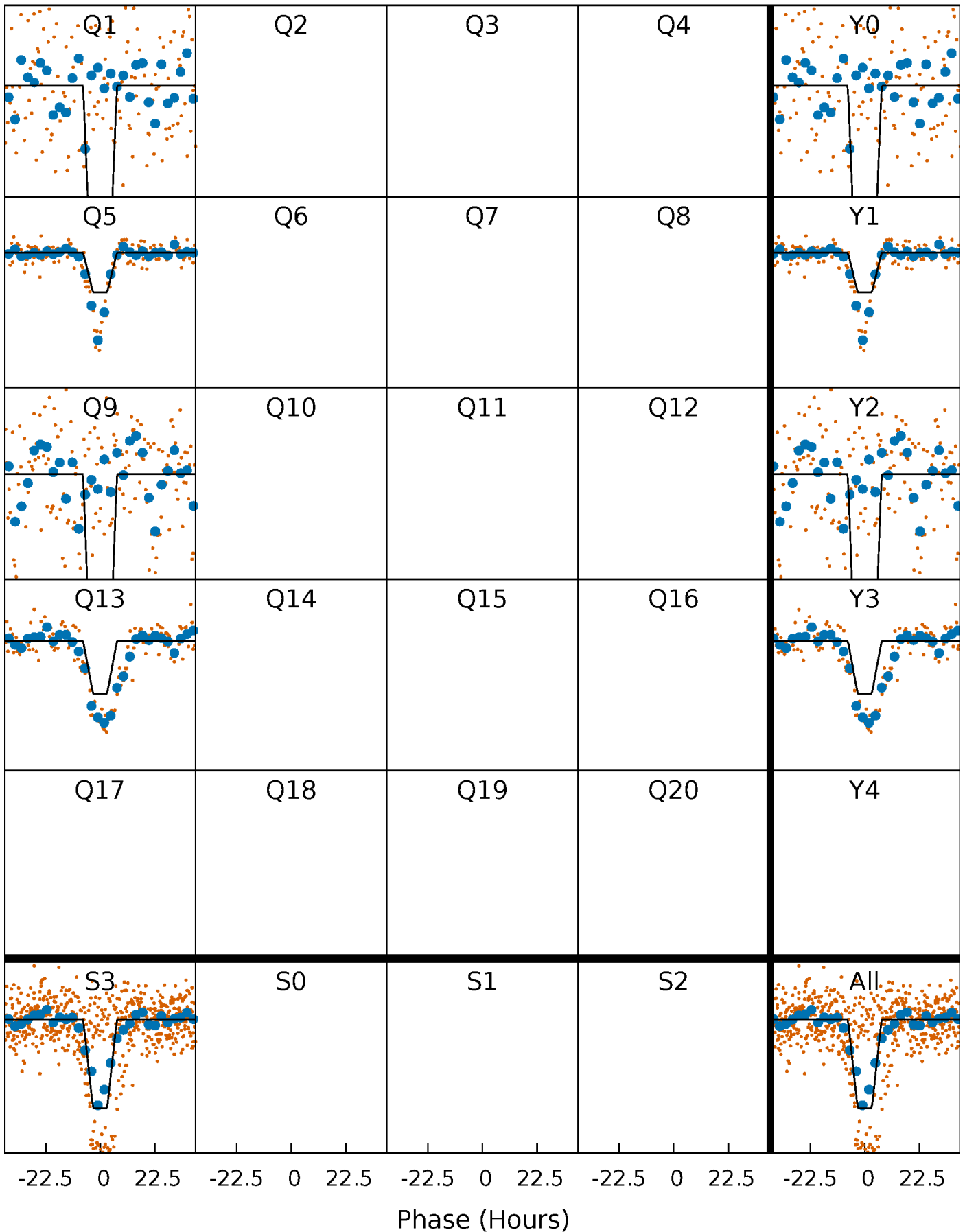
# DV Quarter-Phased Transit Curves

TCE 009016734-02     $P=364.253206$  Days     $T_0=137.269039$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

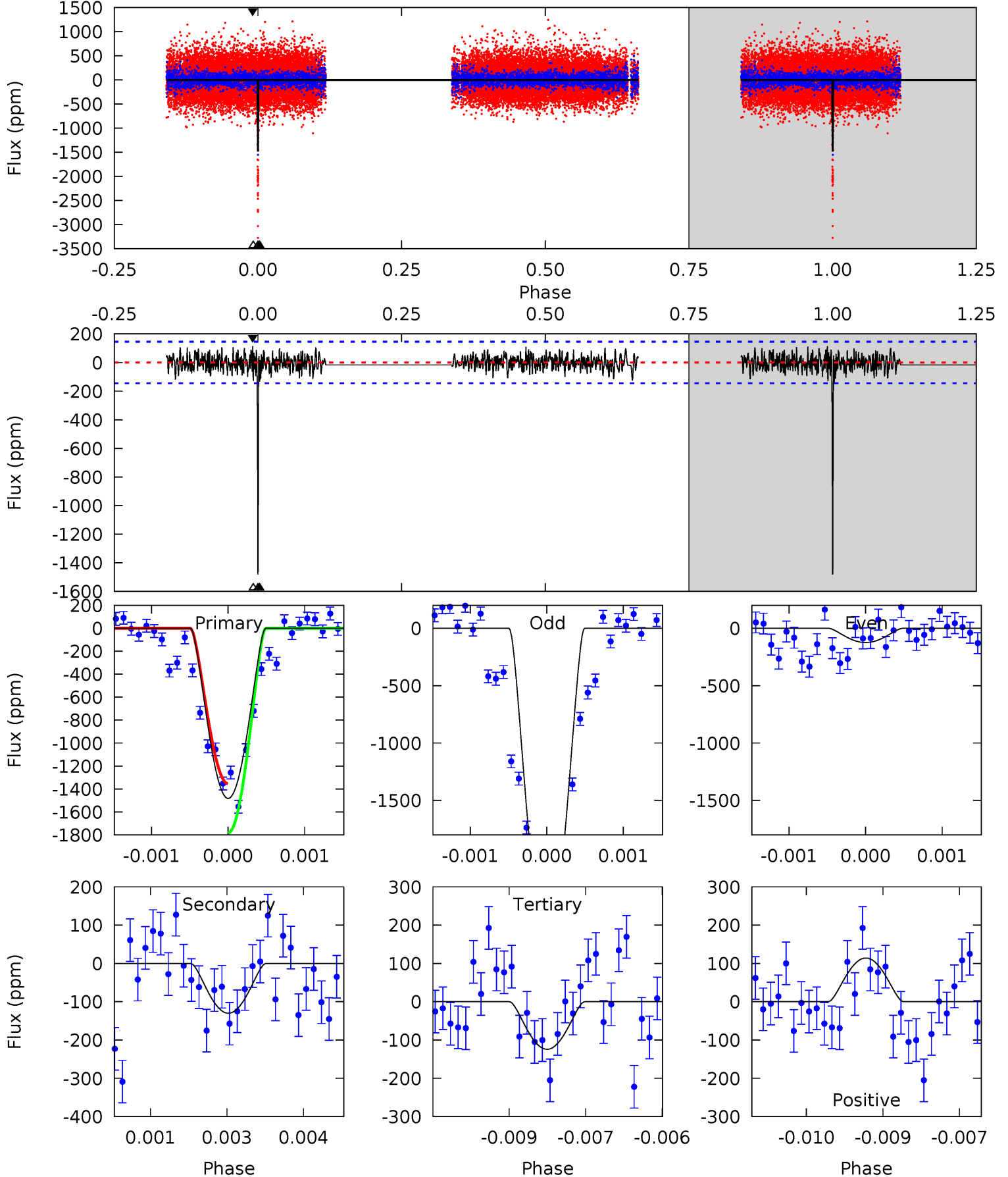
TCE 009016734-02 P=364.187340 Days  $T_0=137.369060$  (BKJD)



# DV Model-Shift Uniqueness Test

009016734-02, P = 364.253206 Days, E = 137.269039 Days

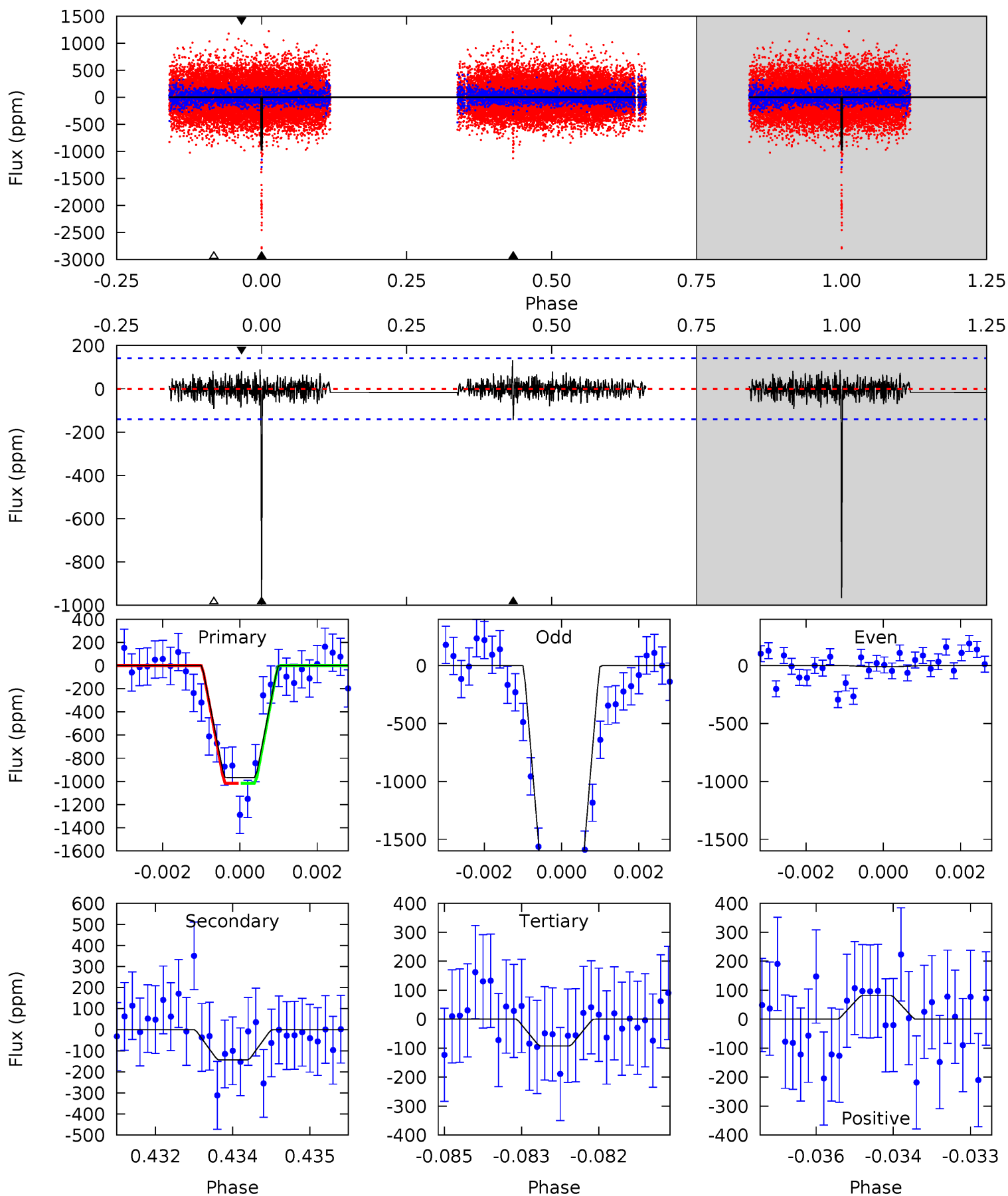
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
55.1	4.83	4.61	4.24	5.38	3.18	1.50	50.5	50.8	0.22	0.59	50.1	1.01	0.07	7.79



# Alt Model-Shift Uniqueness Test

009016734-02, P = 364.187340 Days, E = 137.369060 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
36.8	5.46	3.52	3.11	5.36	3.15	1.01	33.3	33.7	1.94	2.35	46.9	1.01	0.12	0.00





### Stellar Parameters For KIC 009016734

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M$ ( $M_{\odot}$ )	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5698^{+169}_{-186}$	$4.561^{+0.035}_{-0.184}$	$-0.200^{+0.300}_{-0.300}$	$0.829^{+0.229}_{-0.076}$	$0.916^{+0.102}_{-0.112}$	$2.261^{+0.438}_{-1.152}$
	+3%/-3%	+1%/-4%	+150%/-150%	+28%/-9%	+11%/-12%	+19%/-51%
Source	KIC0	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 009016734-02 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-130 \pm 27$	$10.29^{+9.09}_{-6.55}$	$334^{+22}_{-15}$	$2636^{+880}_{-351}$	$603^{+3827}_{-429}$
Alt.	$-143 \pm 26$	$7.58^{+6.84}_{-5.09}$	$334^{+22}_{-17}$	$2917^{+1205}_{-454}$	$1317^{+10646}_{-976}$

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

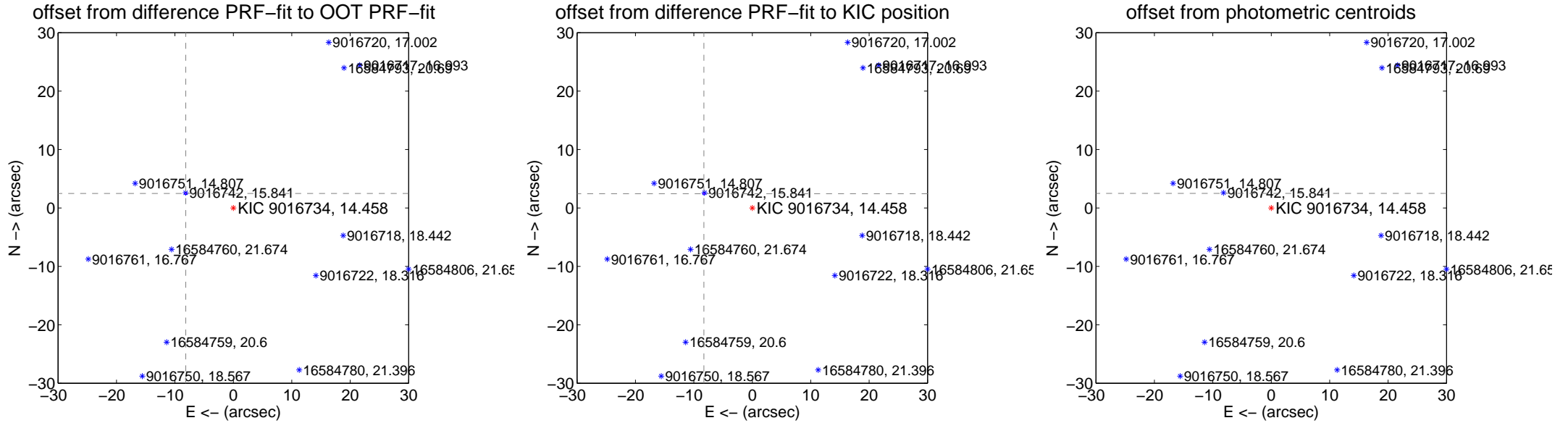
## DV Centroid Data

Supplemental centroid analysis for 009016734-02. Kepler magnitude: 14.46. Transit SNR 35.76

There are 2 quarters with good PRF difference image offsets

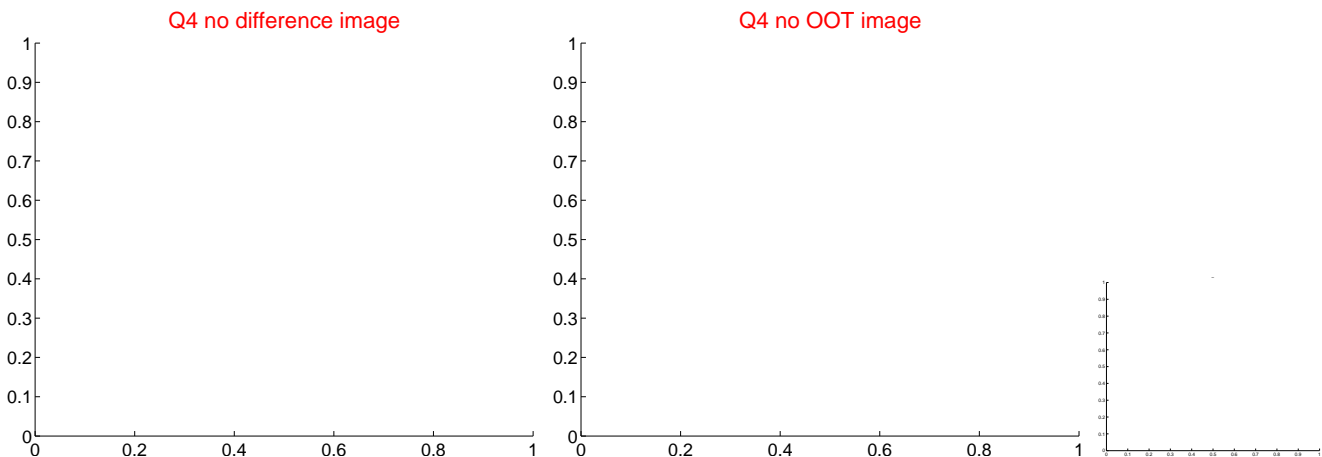
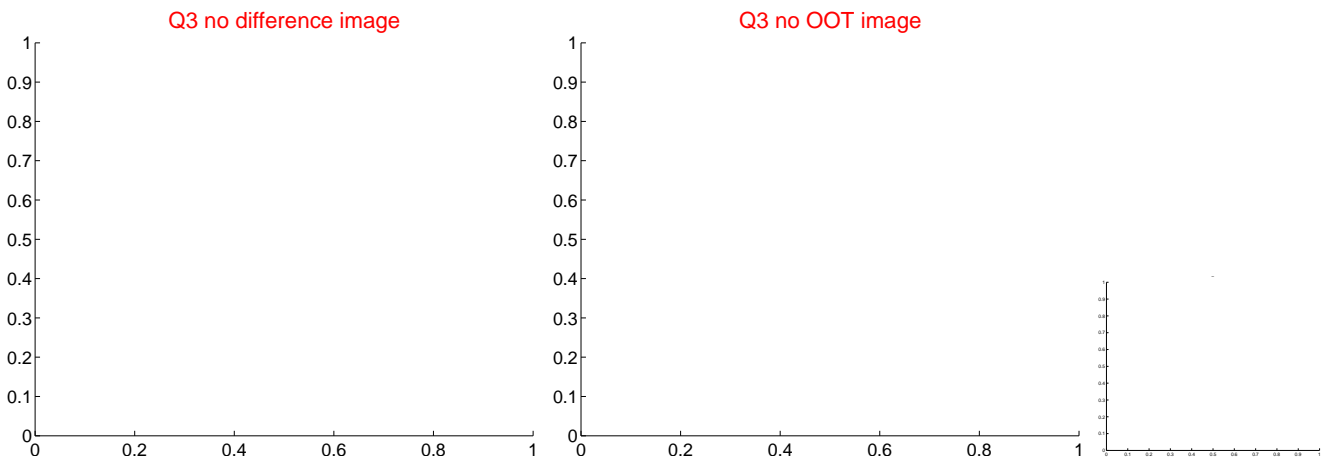
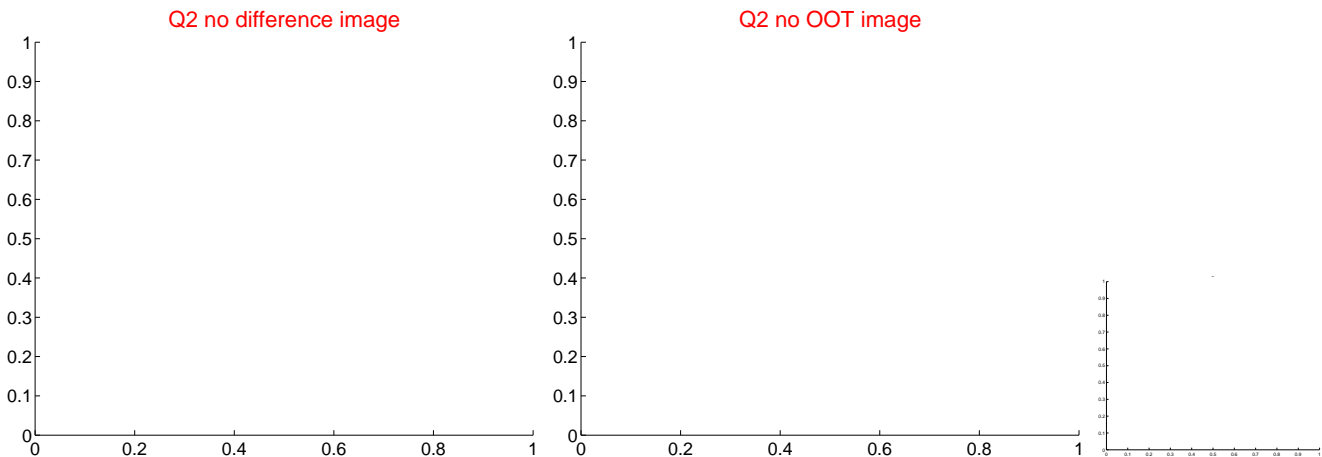
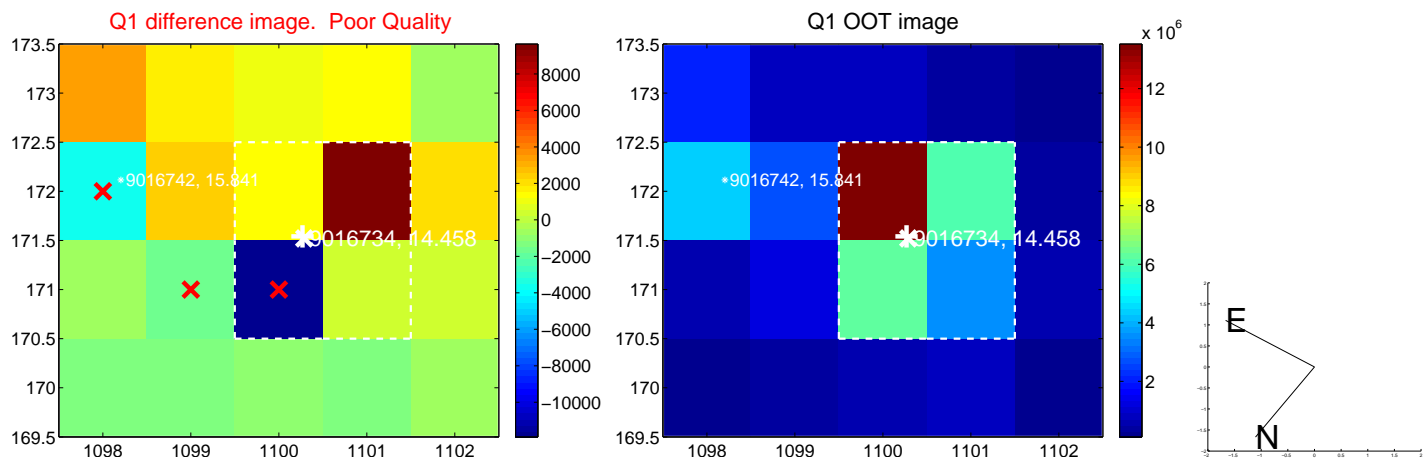
The direct PRF centroid is offset from the target star catalog position by about 0.15 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	8.514 $\pm$ 0.067	127.37	8.146 $\pm$ 0.067	2.474 $\pm$ 0.068
PRF-fit source offset from KIC position	8.636 $\pm$ 0.067	128.01	8.284 $\pm$ 0.067	2.441 $\pm$ 0.069
photometric centroid source offset	37.22 $\pm$ 0.28	135.10	37.13 $\pm$ 0.28	2.50 $\pm$ 0.24

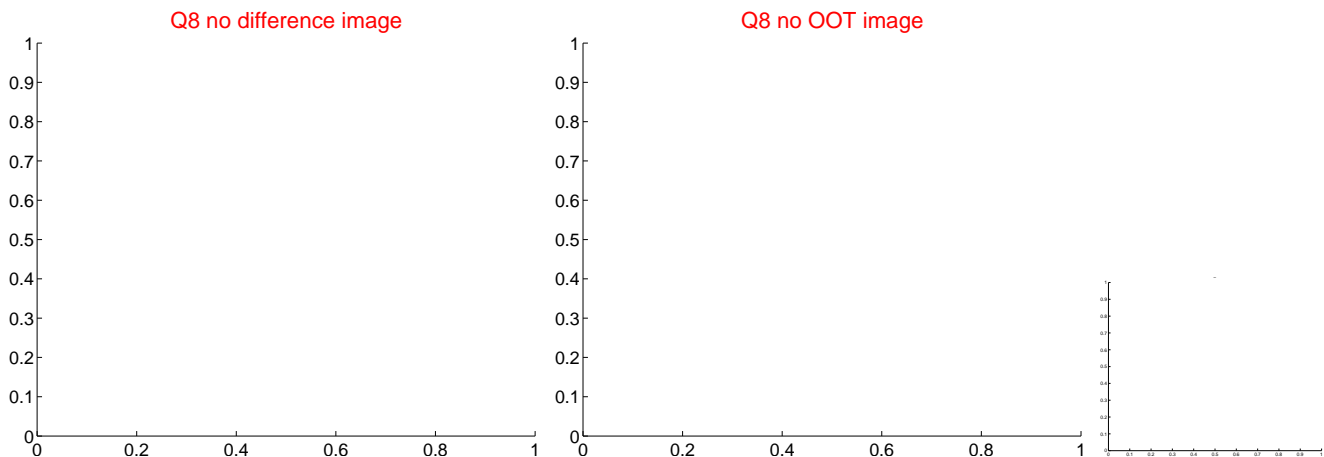
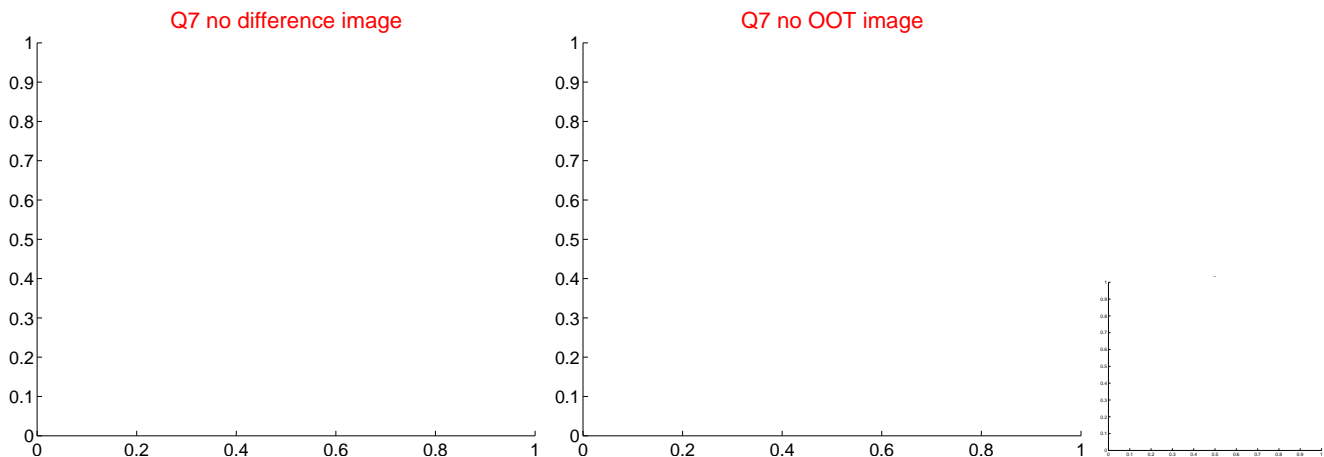
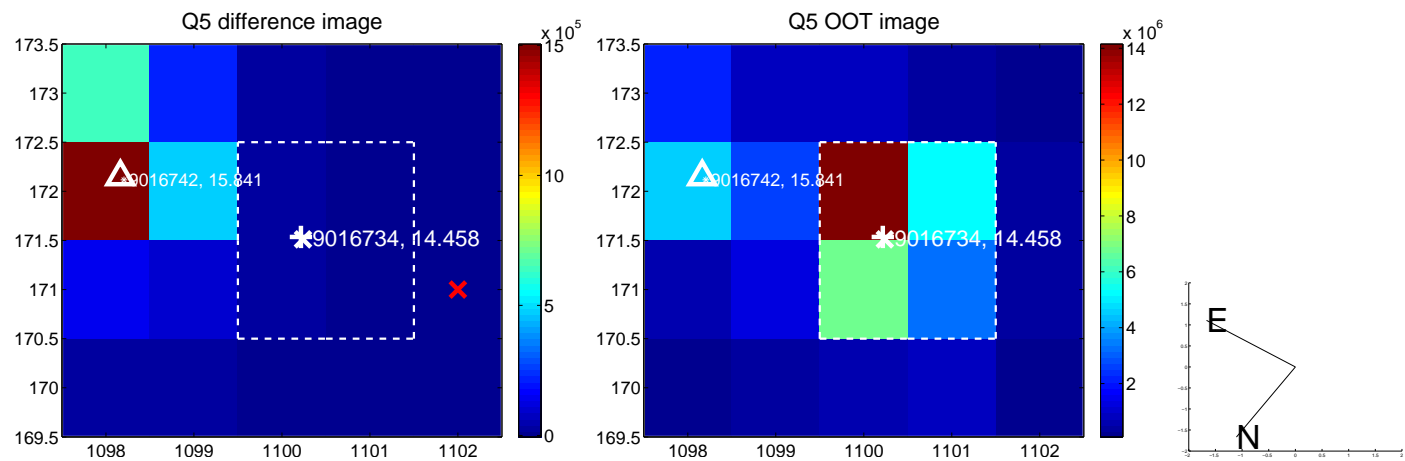


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

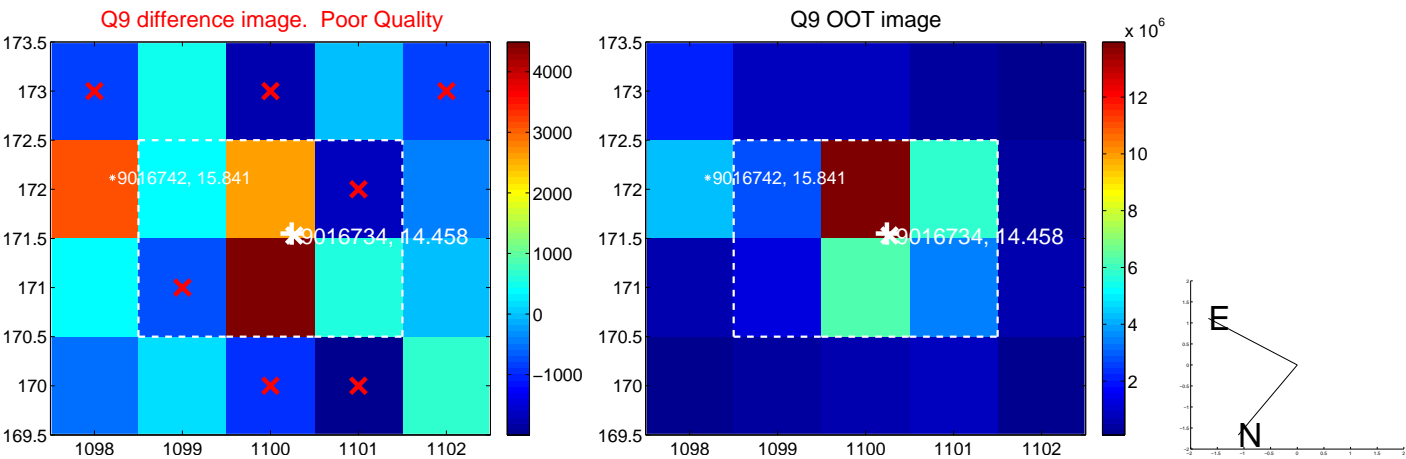
white ×: KIC target position; +: OOT centroid; △: difference centroid. red ✕: large negative pixel value.



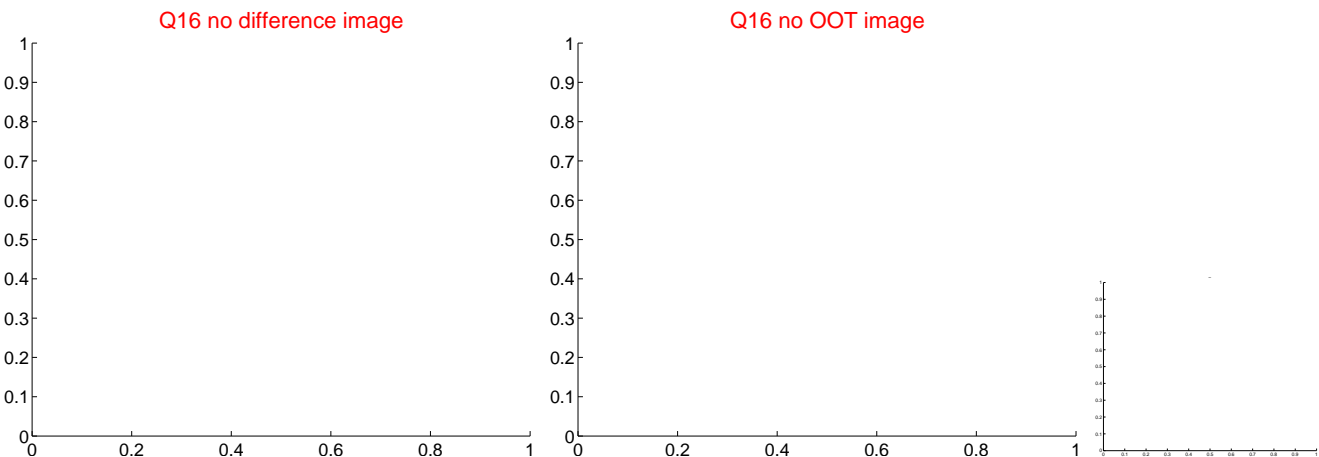
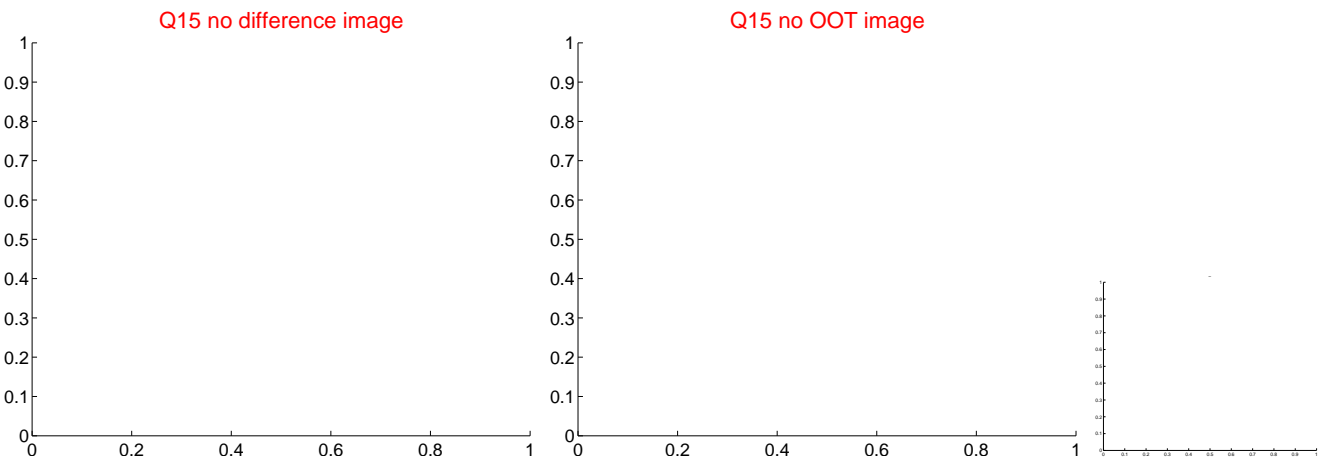
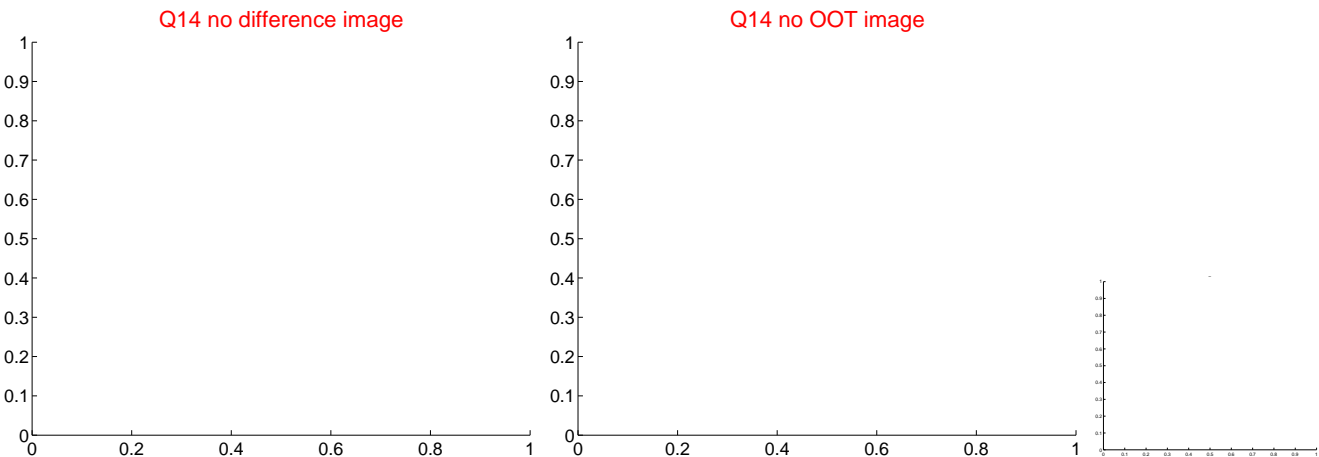
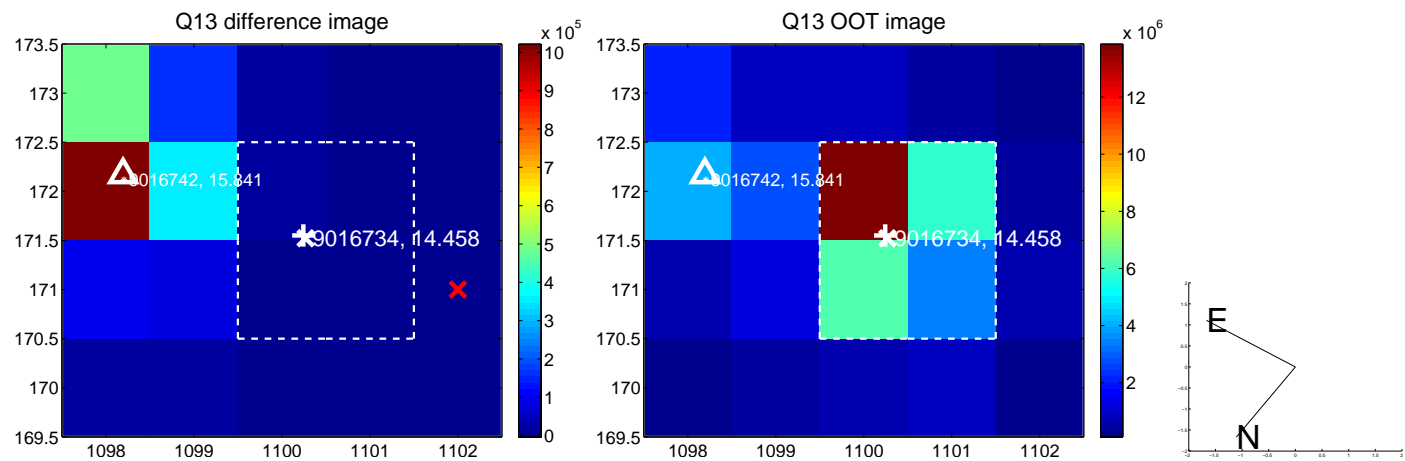
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



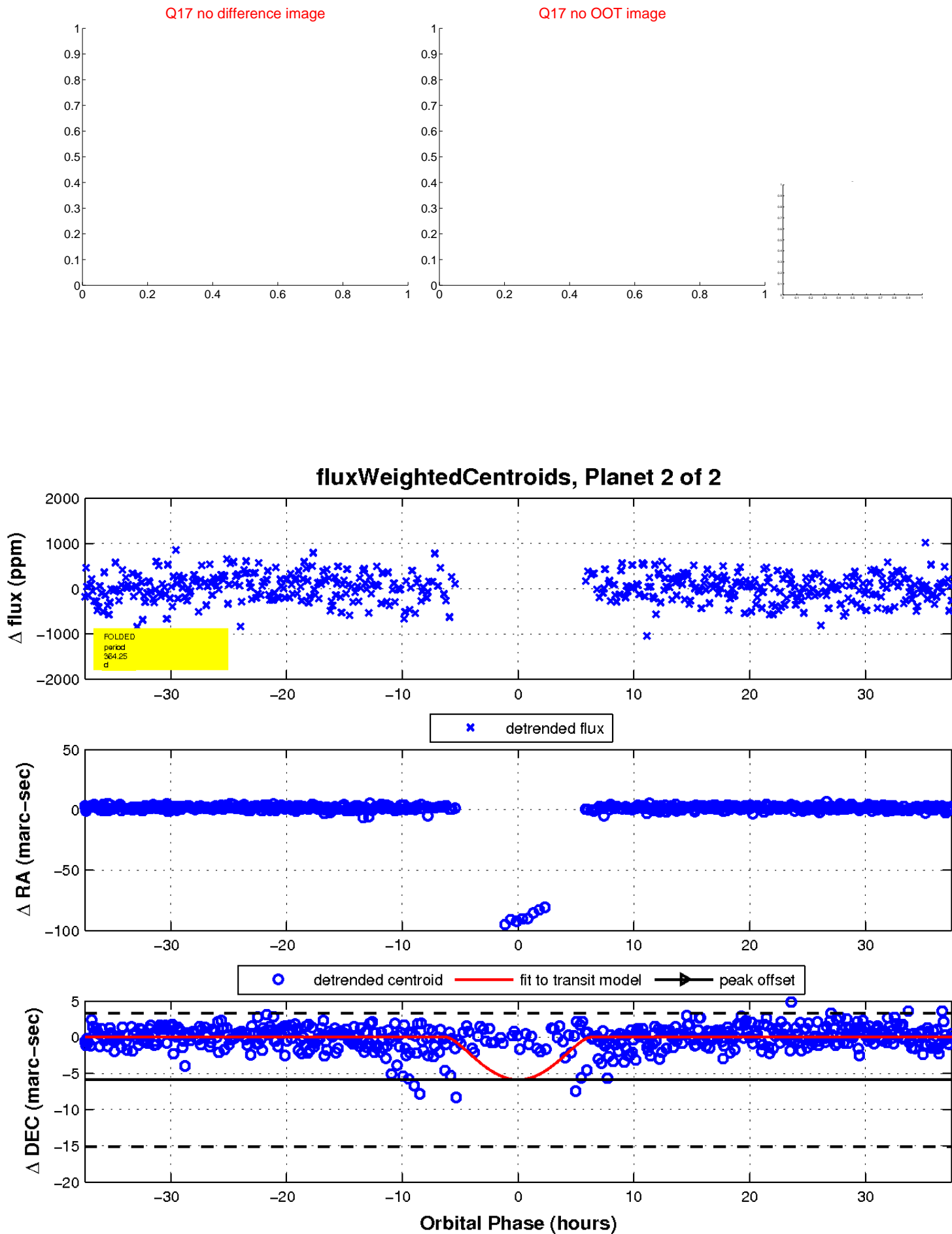
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



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



UKIRT Image

Declination

