

# KIC 010516986

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
010516986-01	OBS	No	4.039966	131.889210	8.9	11.794	8.9	6.7	3.94	9734	1.42	24595.33
010516986-02	OBS	No	387.930063	276.341989	104.5	9.473	24.1	6.5	3.94	9734	4.66	55.94

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
010516986-01	OBS	FP	0.00	1	0	0	0	SWEET_NTL—LPP_DV—MOD_NONUNIQ_DV—CENT_SATURATED
010516986-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL—LPP_DV—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_SATURATED

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

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

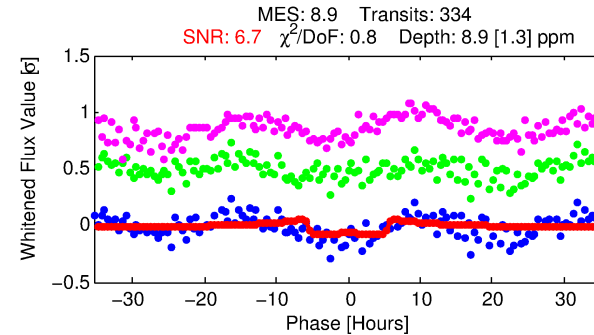
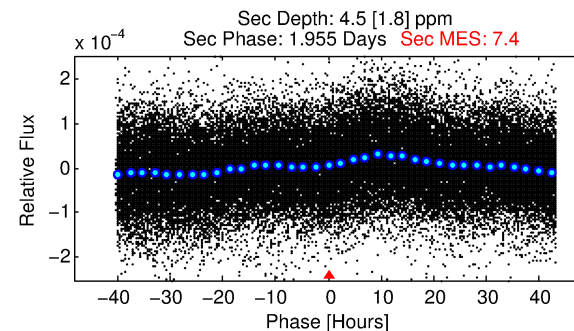
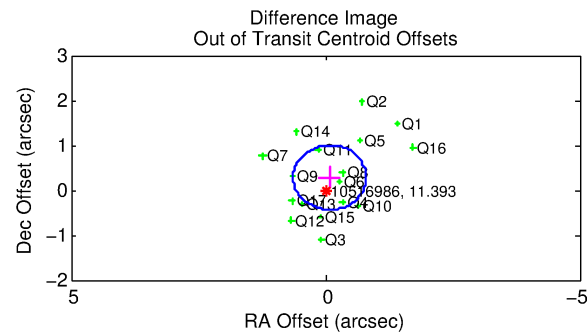
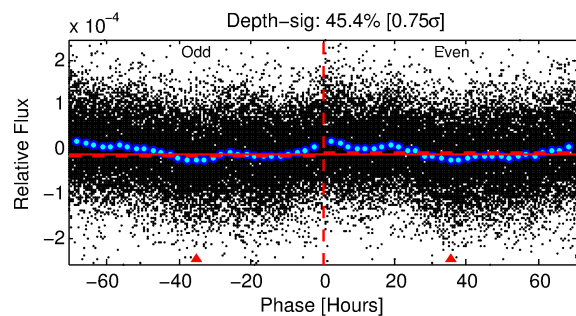
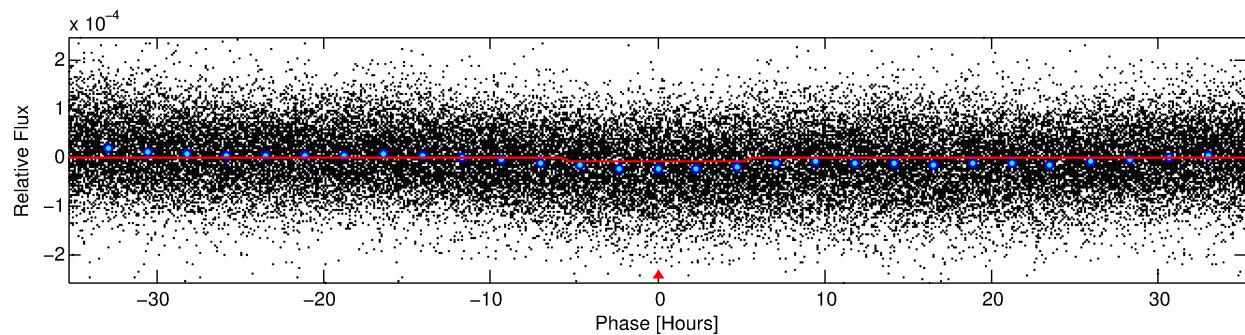
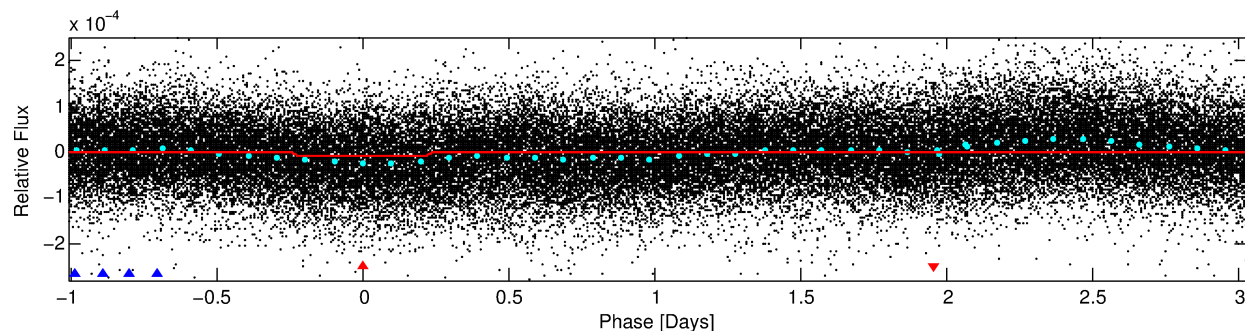
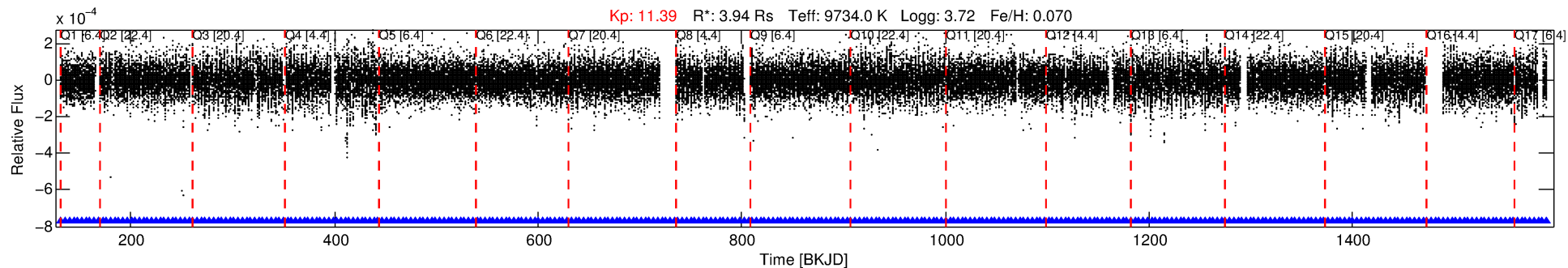
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 010516986-01

No Significant Match Found

# DV One-Page Summary

KIC: 10516986 Candidate: 1 of 2 Period: 4.040 d



## DV Fit Results:

Period = 4.03997 [0.00006] d  
Epoch = 131.8892 [0.0103] BKJD  
Rp/R\* = 0.0033 [0.0003]  
a/R\* = 1.23 [0.24]  
b = 0.96 [0.05]  
Seff = 24595.32 [19205.95]  
Teq = 3193 [623] K  
Rp = 1.42 [0.72] Re  
a = 0.0712 [0.0339] AU  
Ag = 6.25 [5.53] [0.95 $\sigma$ ]  
Teffp = 7807 [932] K [4.11 $\sigma$ ]

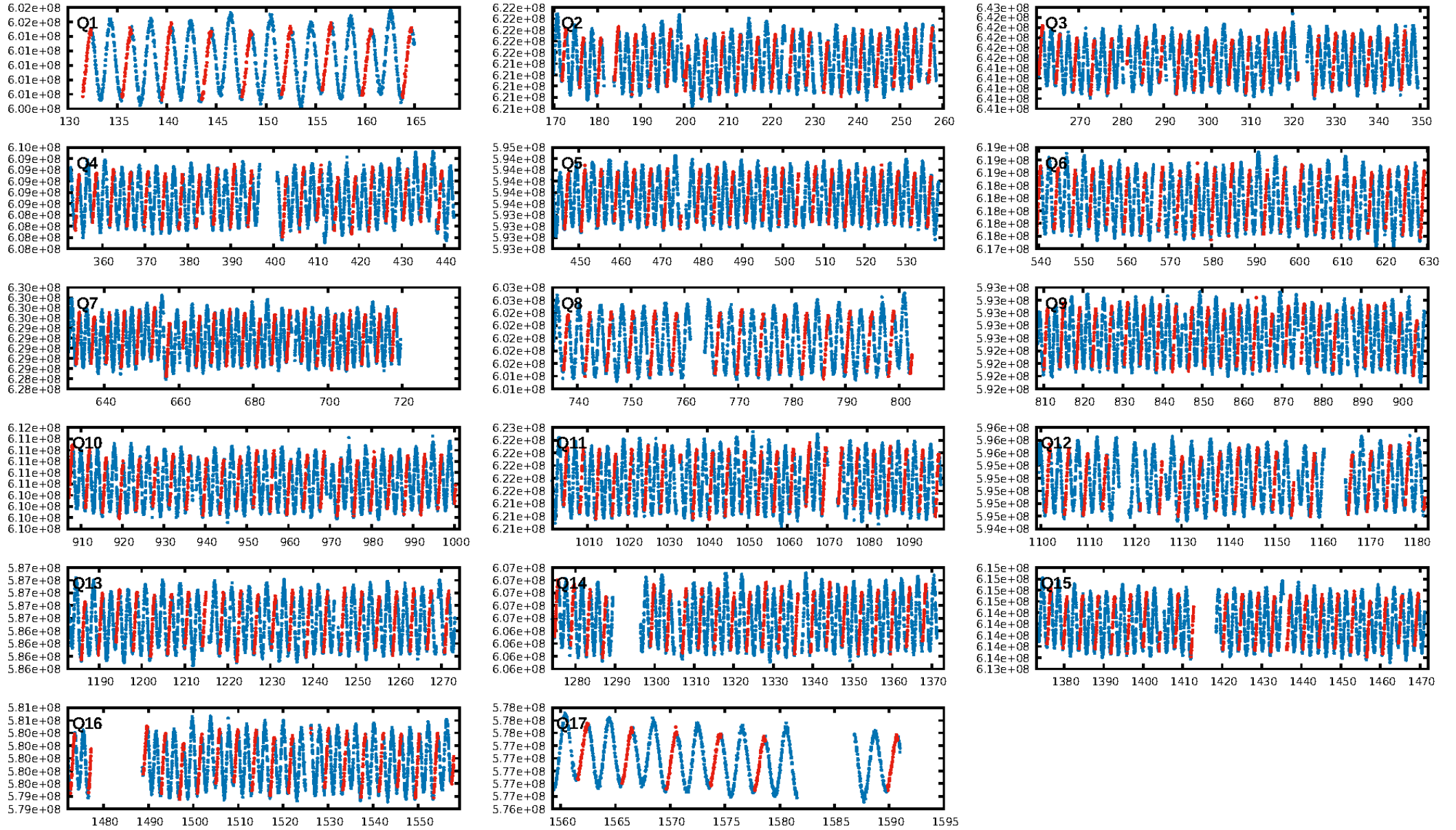
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [609.06 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 2.49e-15  
RollingBand-fgt: 1.00 [319/319]  
GhostDiagnostic-chr: 2.08  
Centroid-sig: 0.3%  
Centroid-so: 4.470 arcsec [2.34 $\sigma$ ]  
OotOffset-rm: 0.291 arcsec [1.22 $\sigma$ ]  
KicOffset-rm: 0.160 arcsec [0.68 $\sigma$ ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 0.00 [0/17]  
DiffImageOverlap-fno: 1.00 [17/17]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 01-Feb-2016 09:37:11 Z

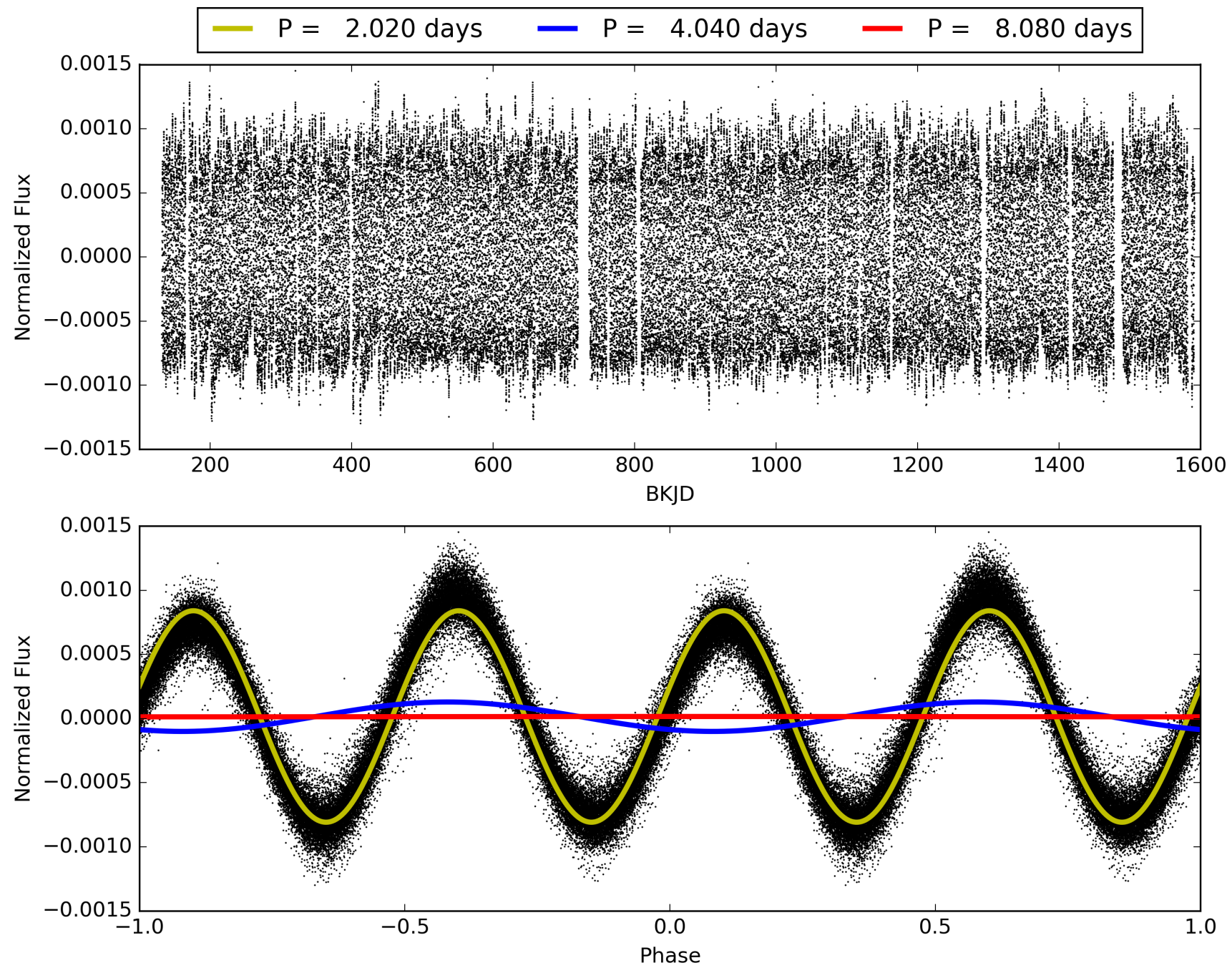
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 010516986-01, PDC Light Curves



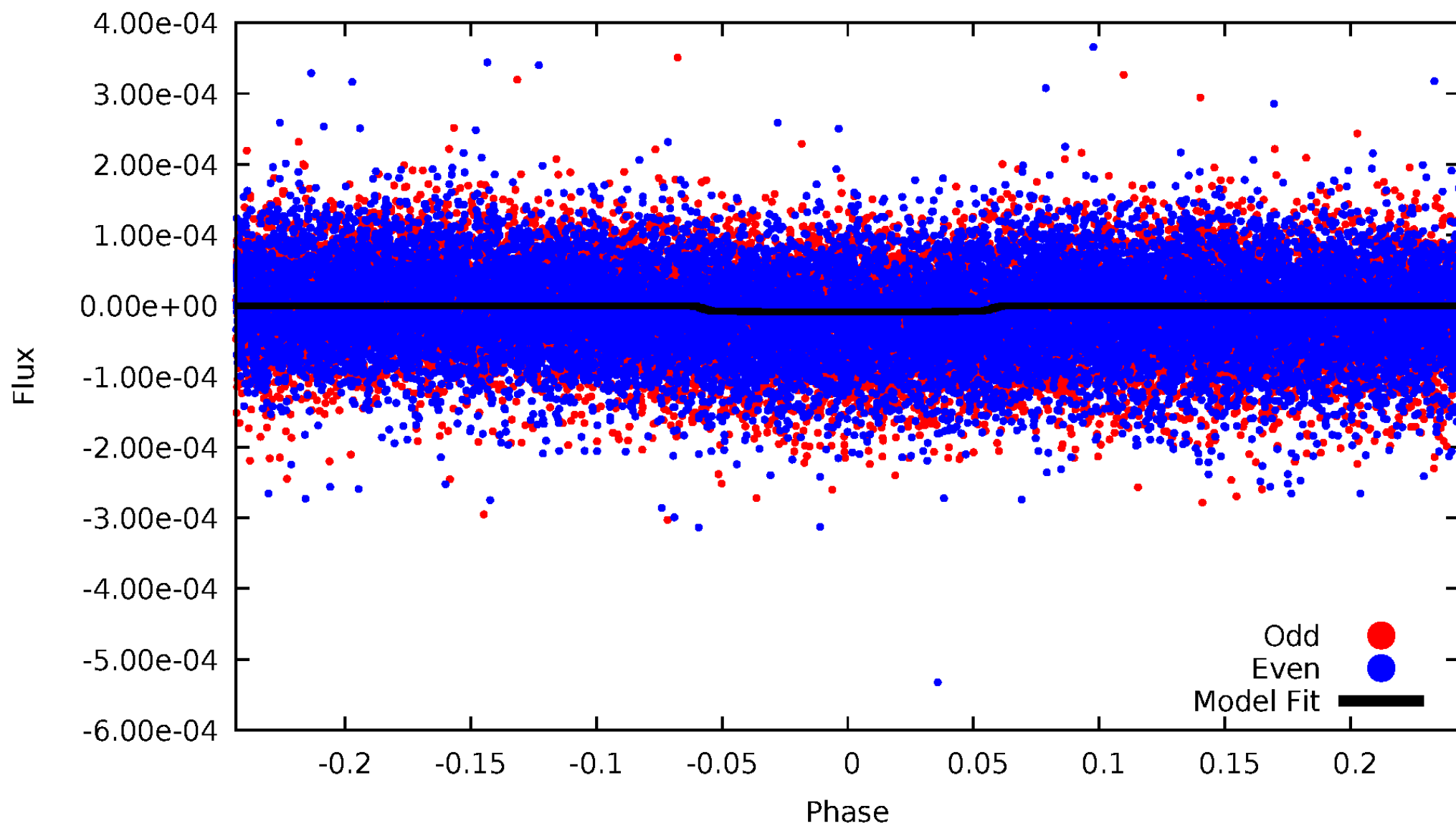


# TCE 010516986-01



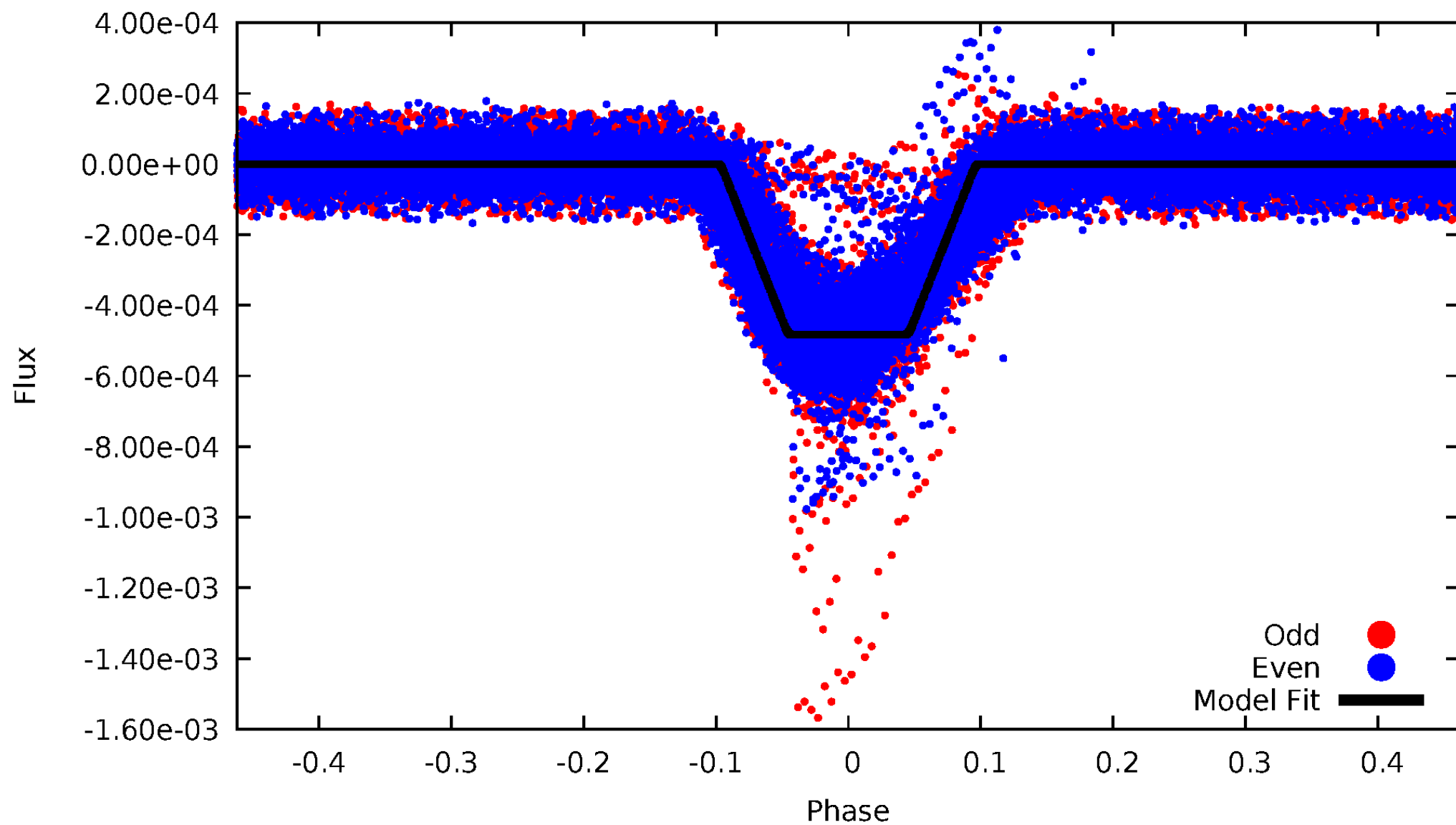
# DV Odd/Even

TCE 010516986-01



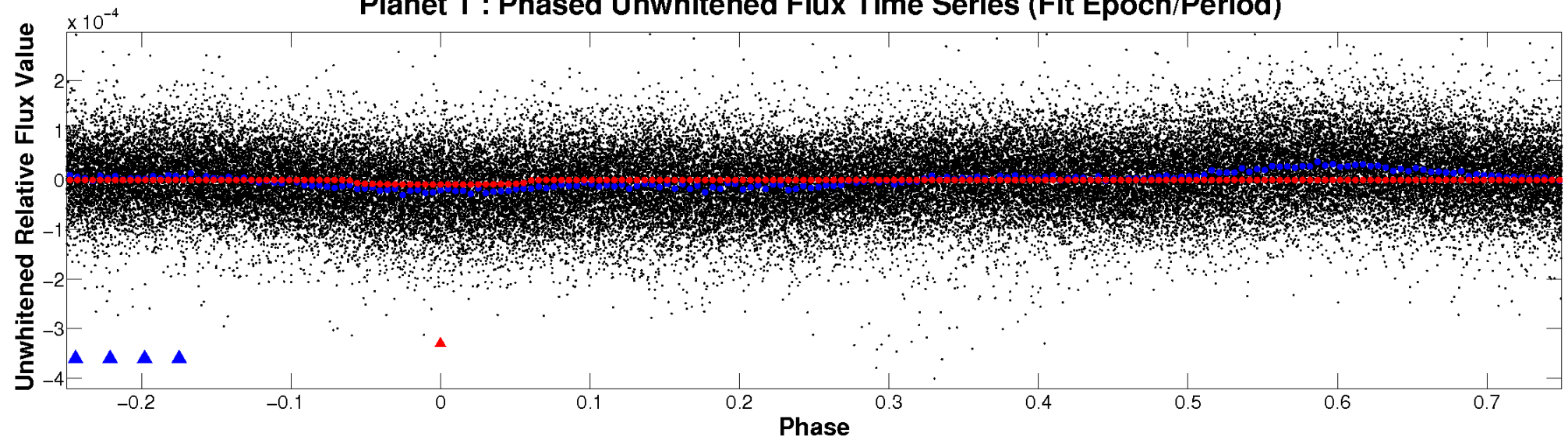
# ALT Odd/Even

TCE 010516986-01

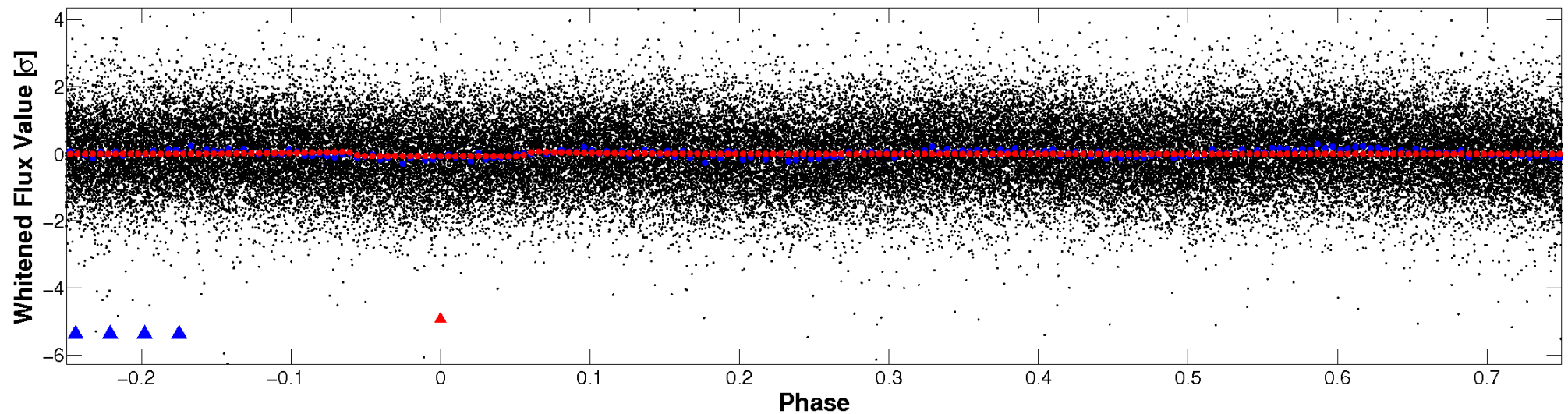


# Non-Whitened Vs. Whitened Light Curve

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

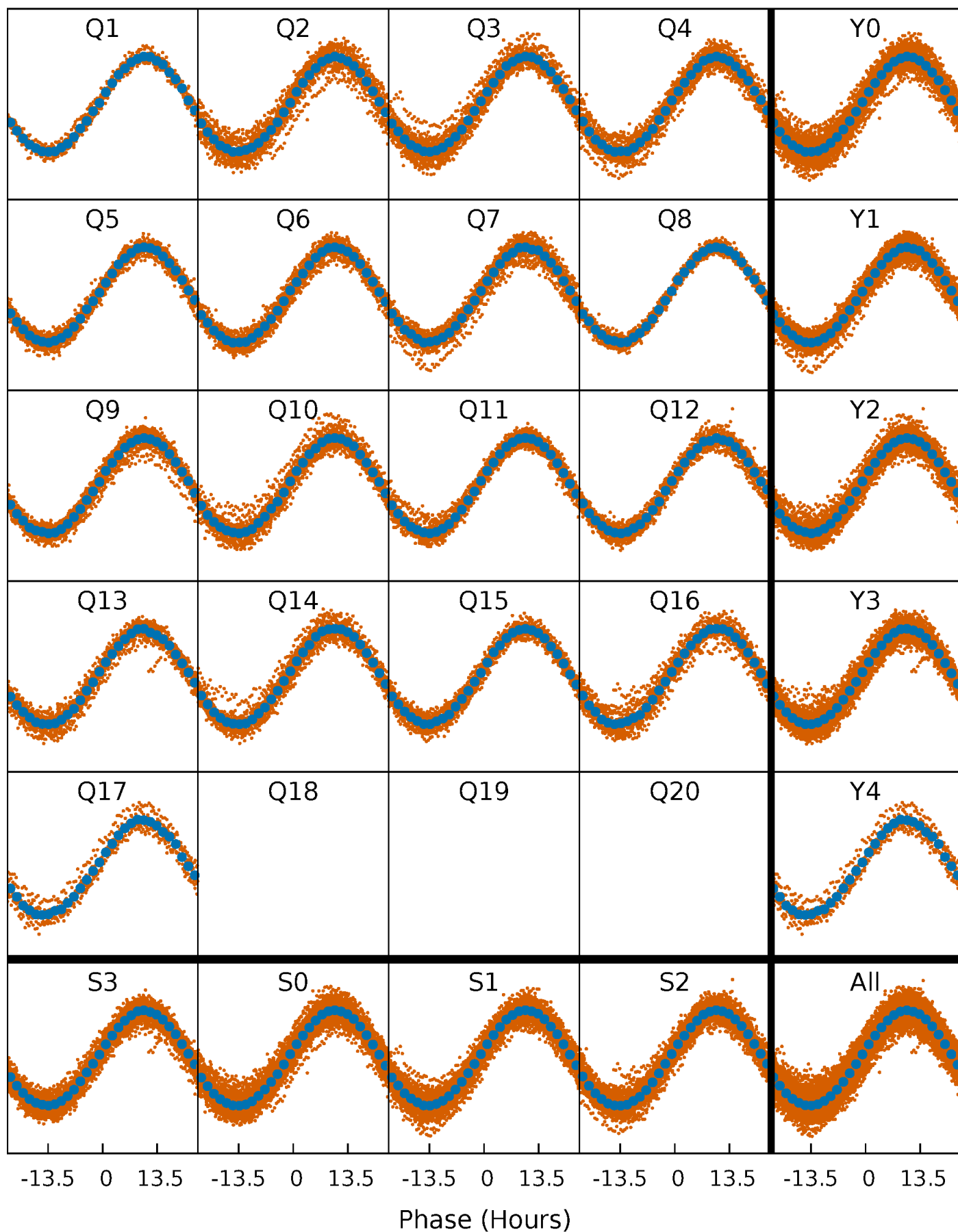


**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**



# PDC Quarter-Phased Transit Curves

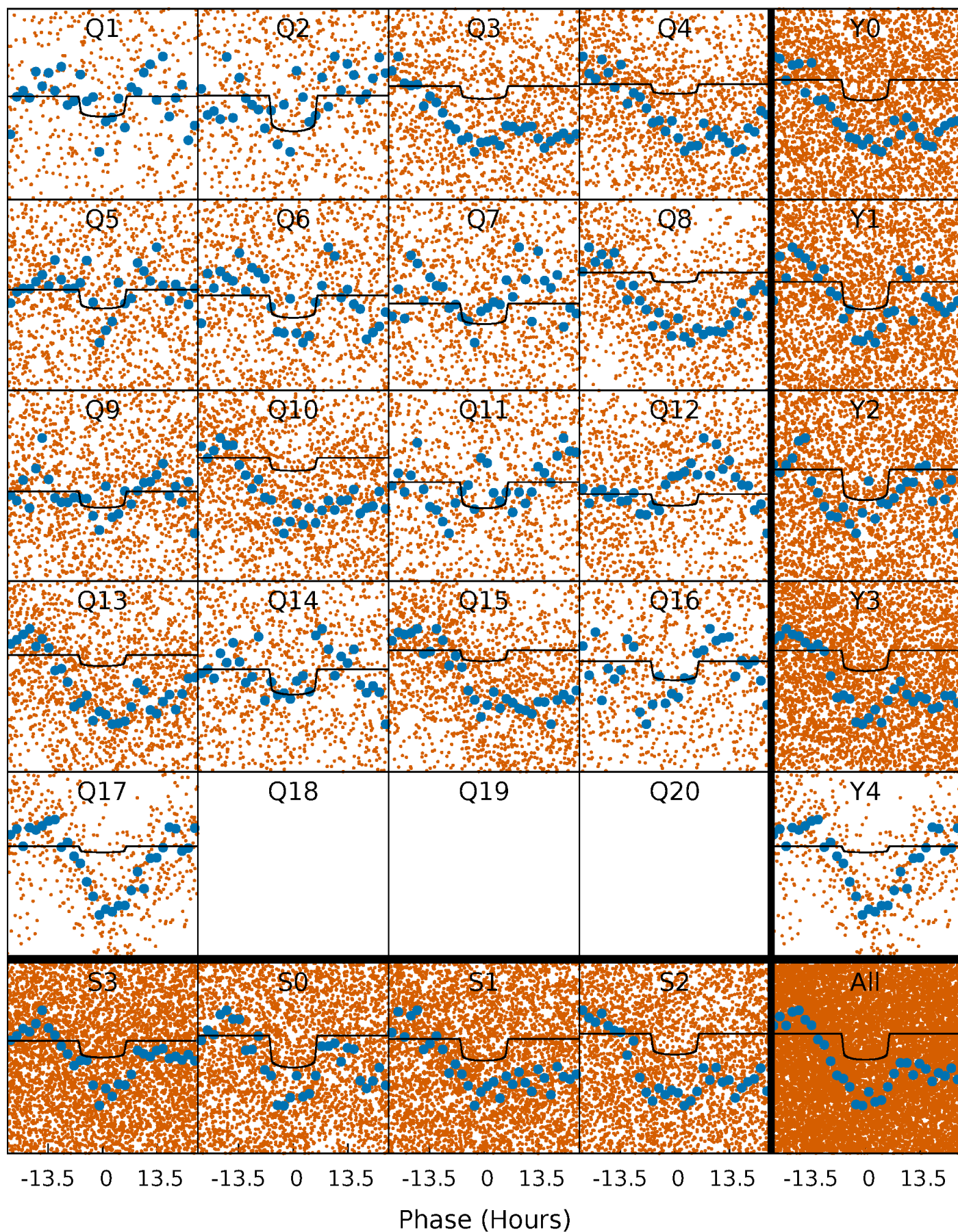
TCE 010516986-01   P= 4.039966 Days    $T_0=131.889210$  (BKJD)





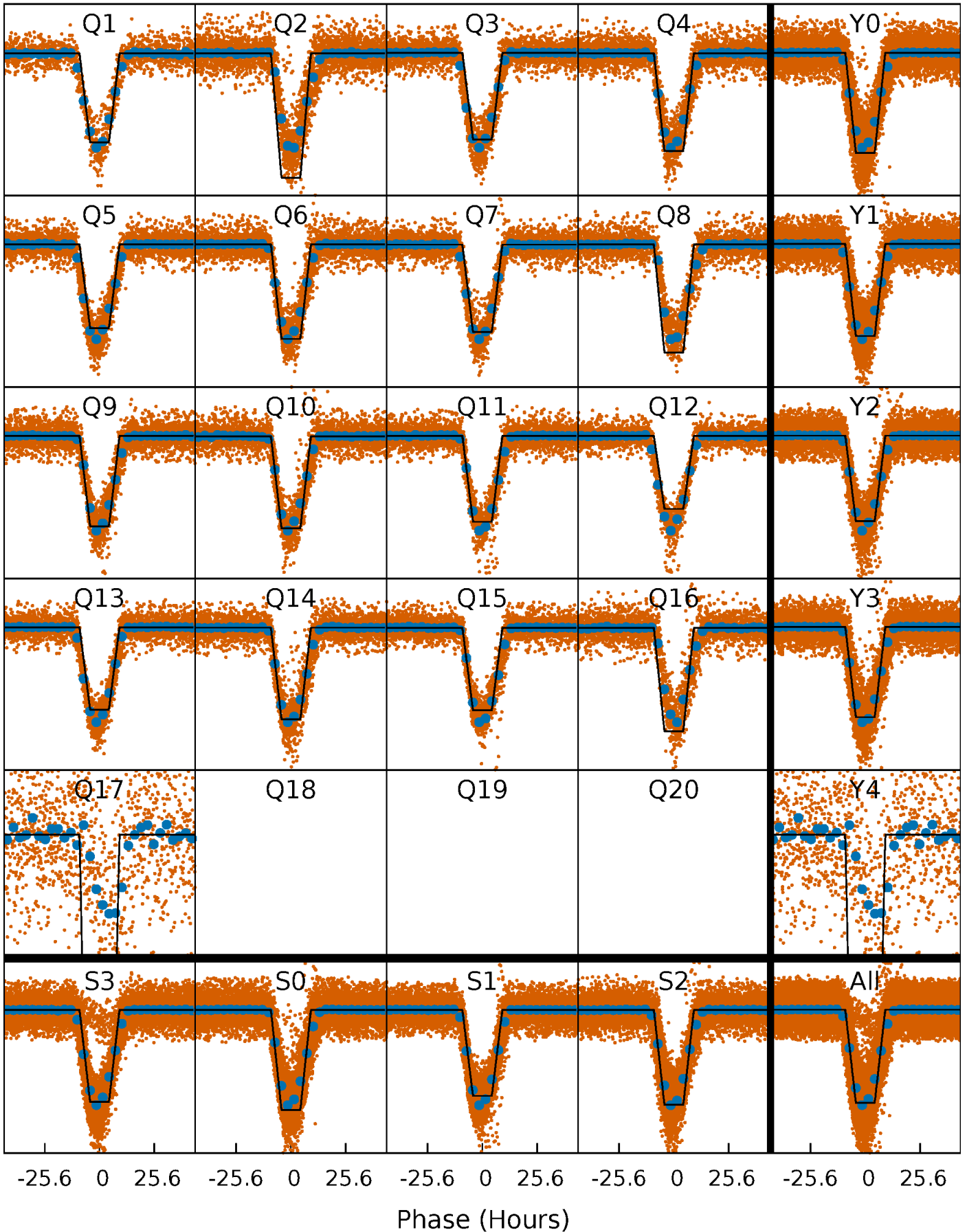
# DV Quarter-Phased Transit Curves

TCE 010516986-01 P= 4.039966 Days  $T_0=131.889210$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

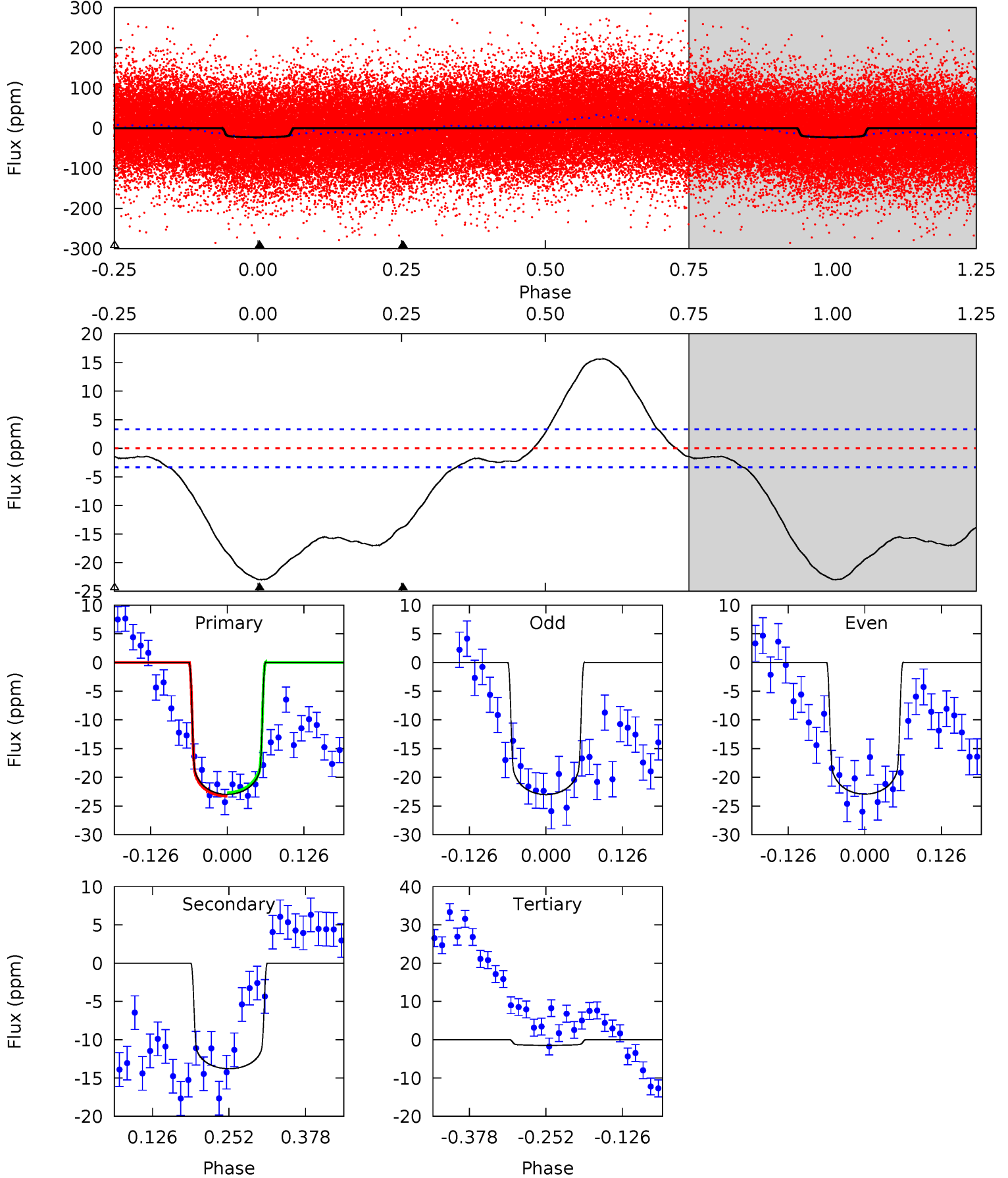
TCE 010516986-01     $P = 4.039777$  Days     $T_0 = 131.563396$  (BKJD)



# DV Model-Shift Uniqueness Test

010516986-01, P = 4.039966 Days, E = 127.849244 Days

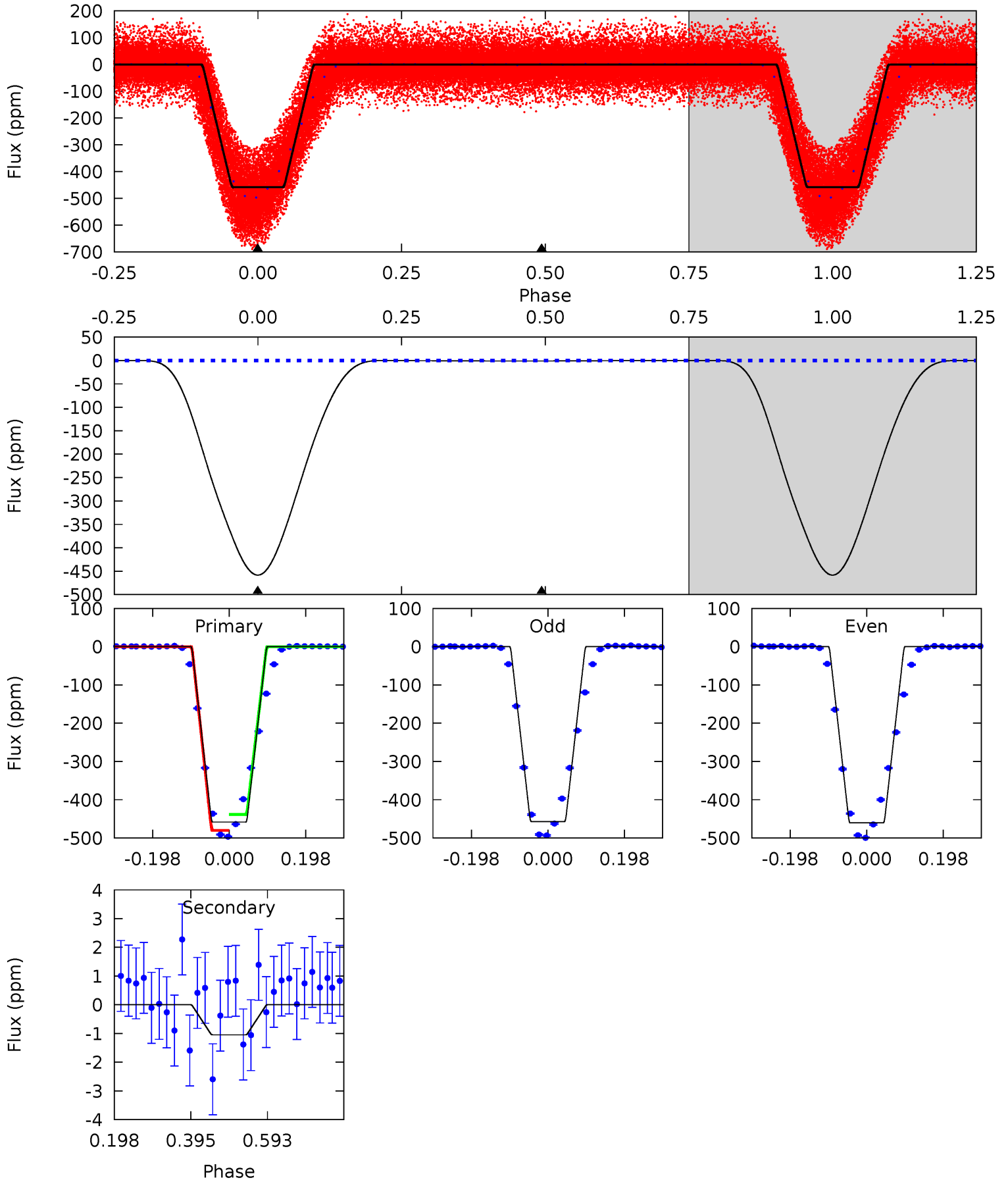
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
31.3	18.8	2.01	0	4.52	1.53	9.08	29.3	31.3	16.8	18.8	0.06	1.27	0.40	0.40



# Alt Model-Shift Uniqueness Test

010516986-01, P = 4.039777 Days, E = 127.523619 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
1149	2.63	0	0	4.42	1.29	0.53	1149	1149	2.63	2.63	4.12	0.98	0.00	51.6



### Stellar Parameters For KIC 010516986

	$T_{\text{eff}}(K)$	$\log(g)$	$[\text{Fe}/\text{H}]$	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$9734^{+306}_{-409}$	$3.717^{+0.448}_{-0.140}$	$0.070^{+0.200}_{-0.650}$	$3.935^{+0.834}_{-1.945}$	$2.939^{+0.254}_{-1.018}$	$0.068^{+0.298}_{-0.027}$
	+3%/-4%	+12%/-4%	+286%/-929%	+21%/-49%	+9%/-35%	+438%/-40%
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 010516986-01 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-14 \pm 1$	$1.35^{+0.28}_{-0.33}$	$4375^{+335}_{-529}$	$10420^{+1157}_{-830}$	$21^{+14}_{-6}$
Alt.	$-1 \pm 0$	$9.14^{+1.47}_{-2.29}$	$4371^{+361}_{-521}$	$-3659^{+309}_{-204}$	$0.036^{+0.025}_{-0.016}$

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



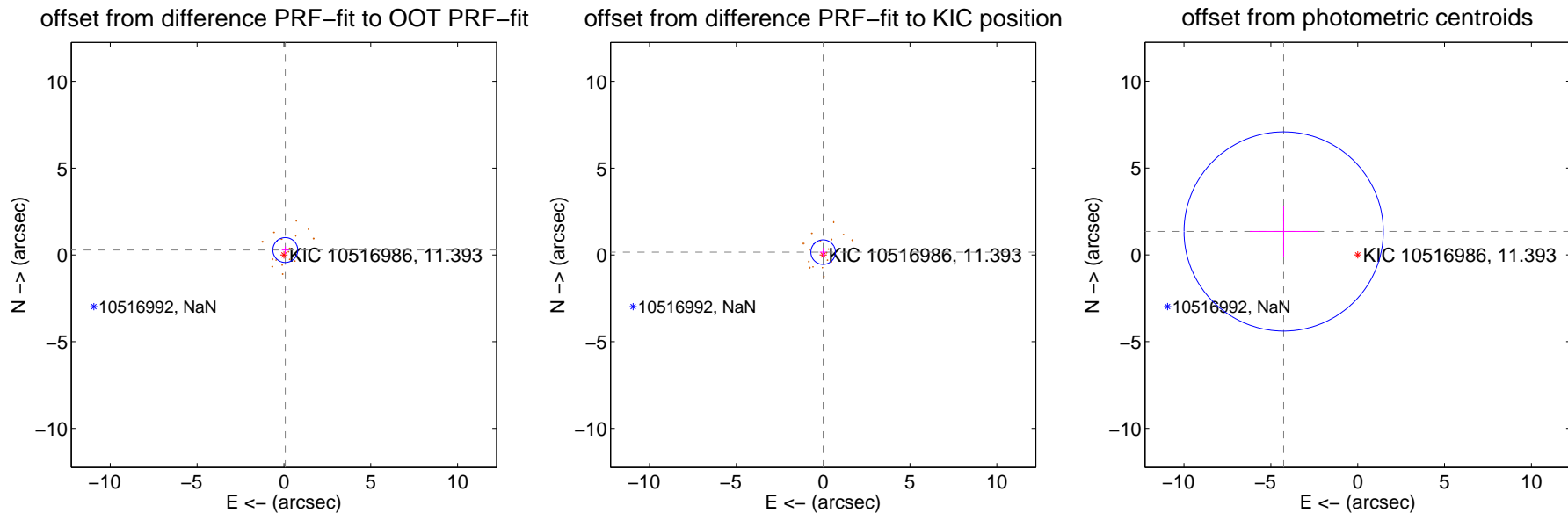
## DV Centroid Data

Supplemental centroid analysis for 010516986-01. **Kepler magnitude: 11.39.** Transit SNR 6.71

**There are 0 quarters with good PRF difference image offsets**

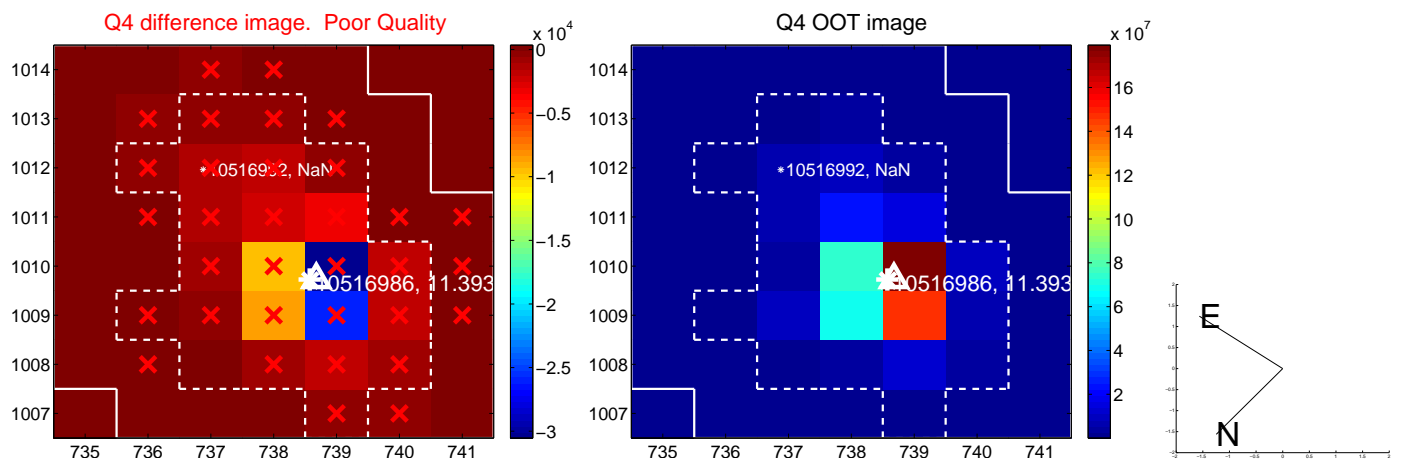
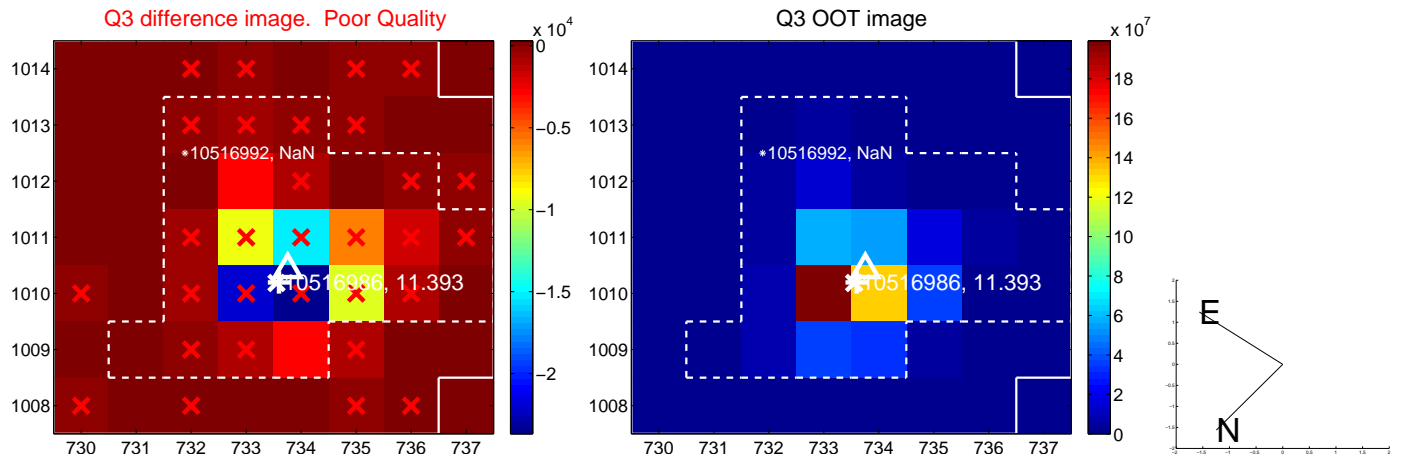
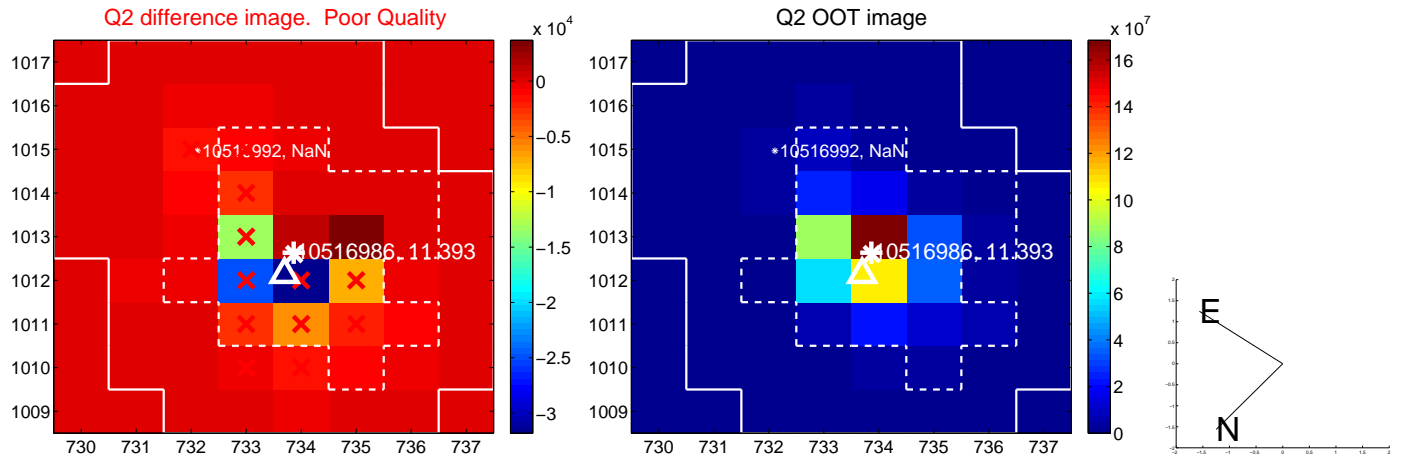
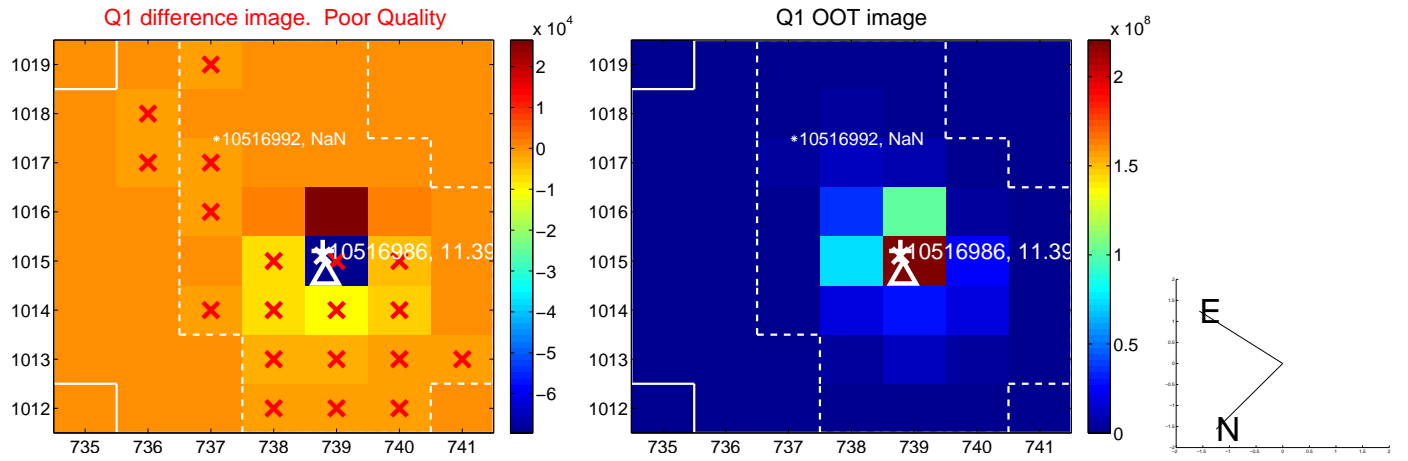
The direct PRF centroid is offset from the target star catalog position by about 0.22 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.291 \pm 0.239$	1.22	$-0.079 \pm 0.200$	$0.280 \pm 0.221$
PRF-fit source offset from KIC position	$0.160 \pm 0.236$	0.68	$0.002 \pm 0.193$	$0.160 \pm 0.236$
photometric centroid source offset	$4.47 \pm 1.91$	2.34	$4.26 \pm 1.95$	$1.35 \pm 1.48$

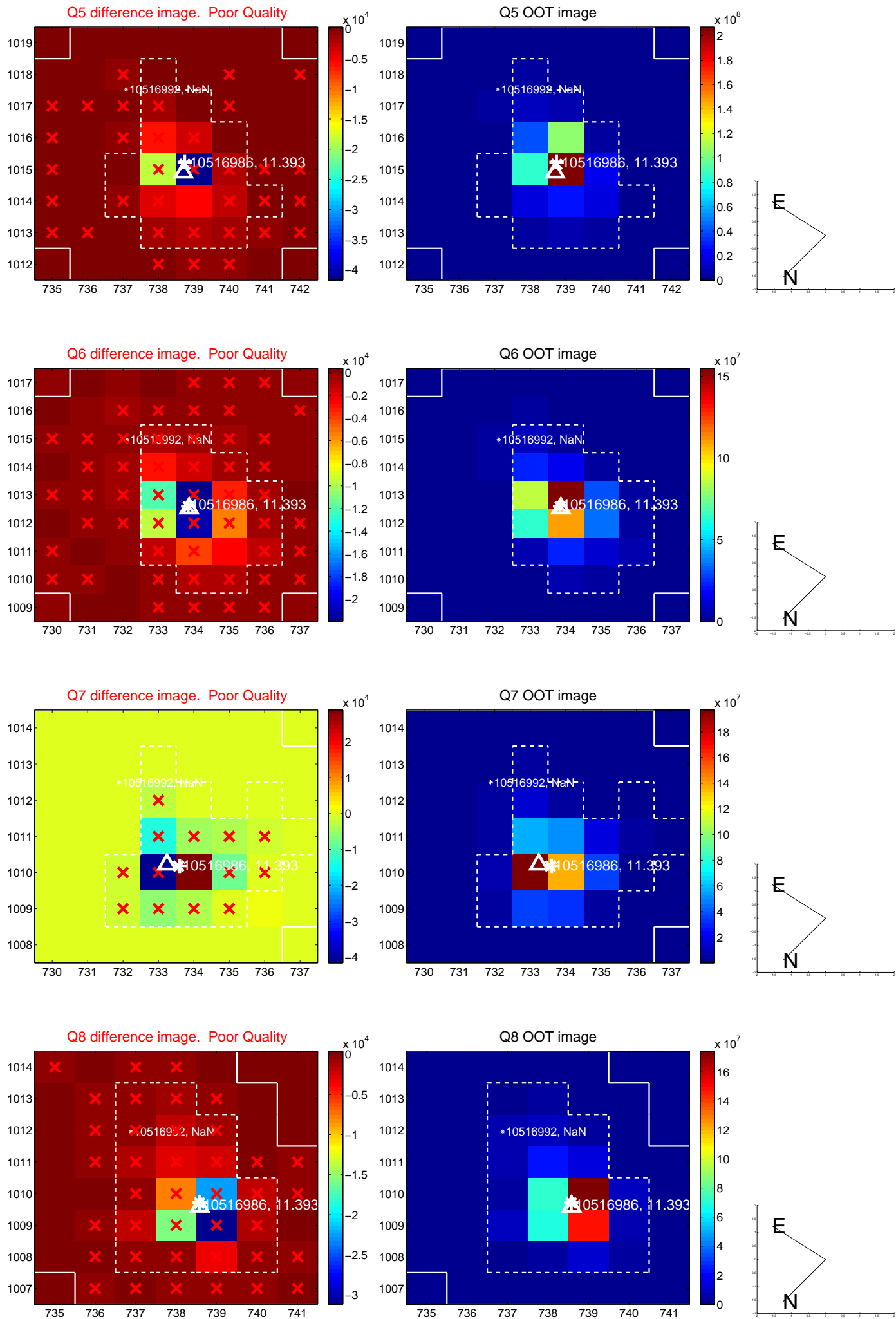


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets;** magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

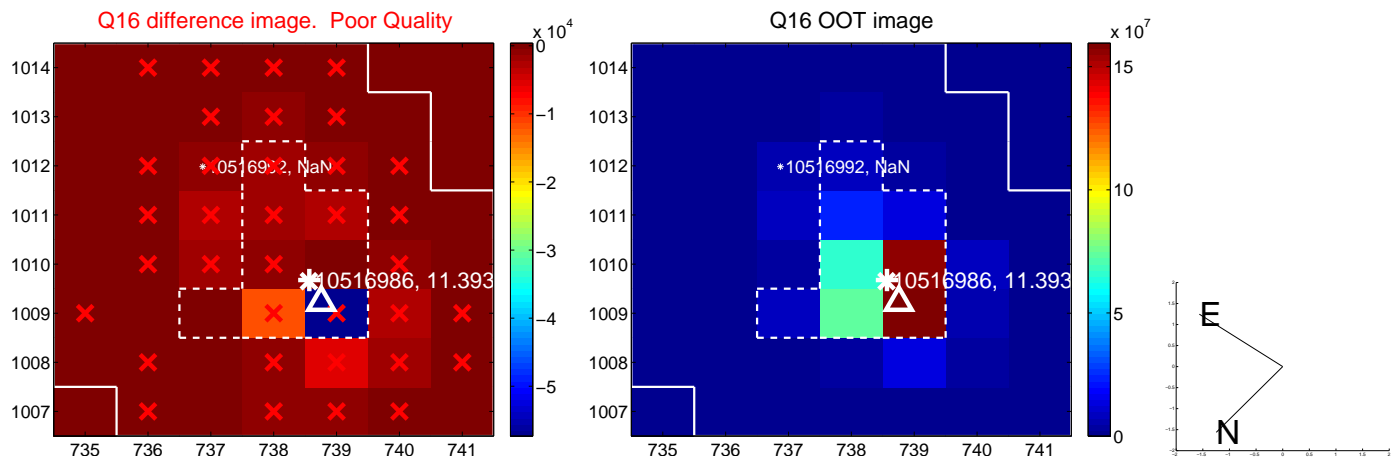
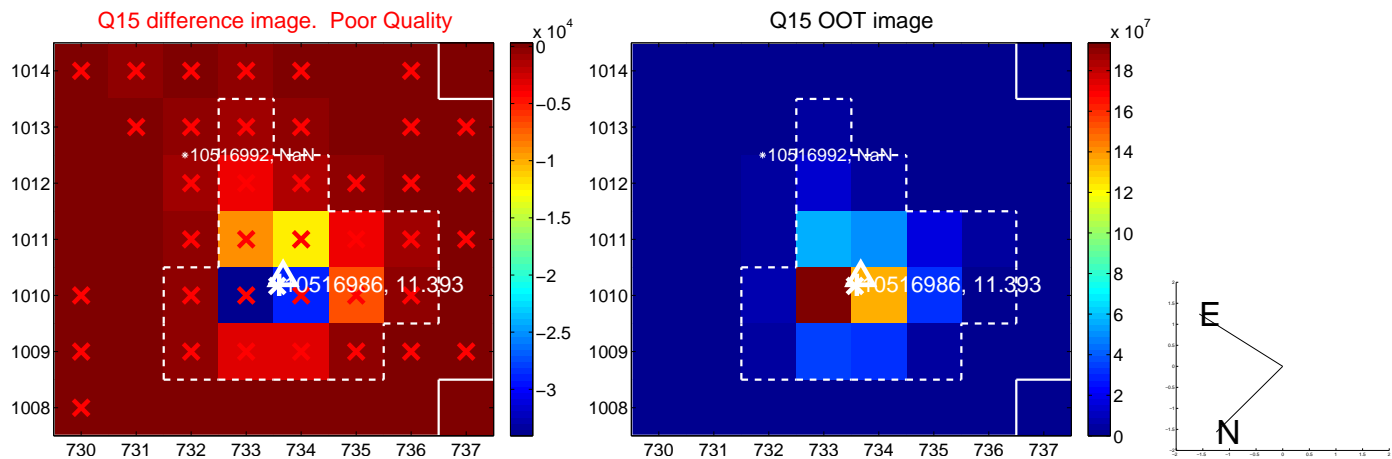
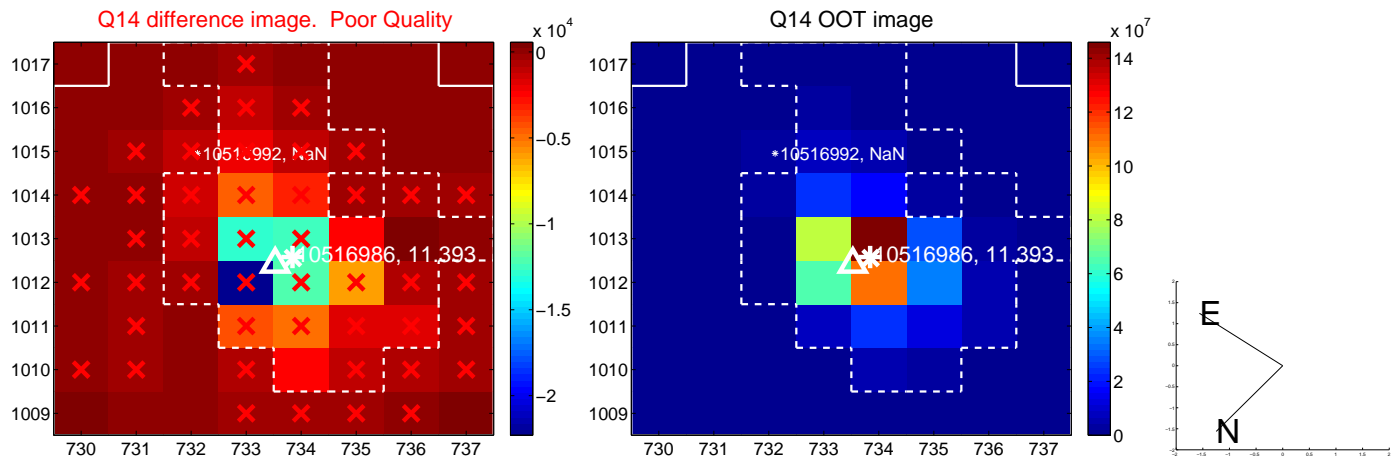
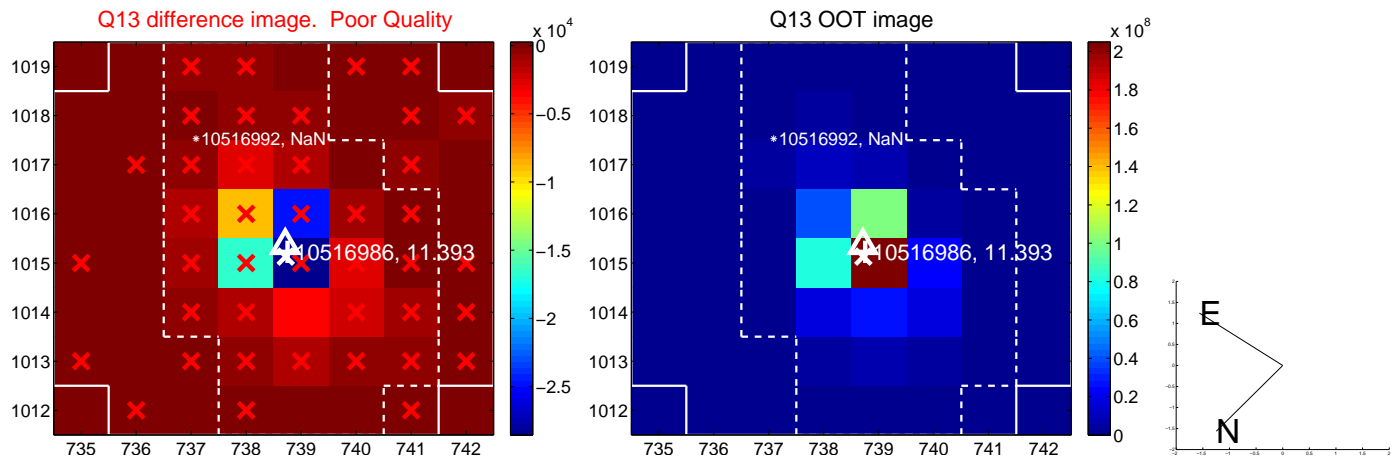


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



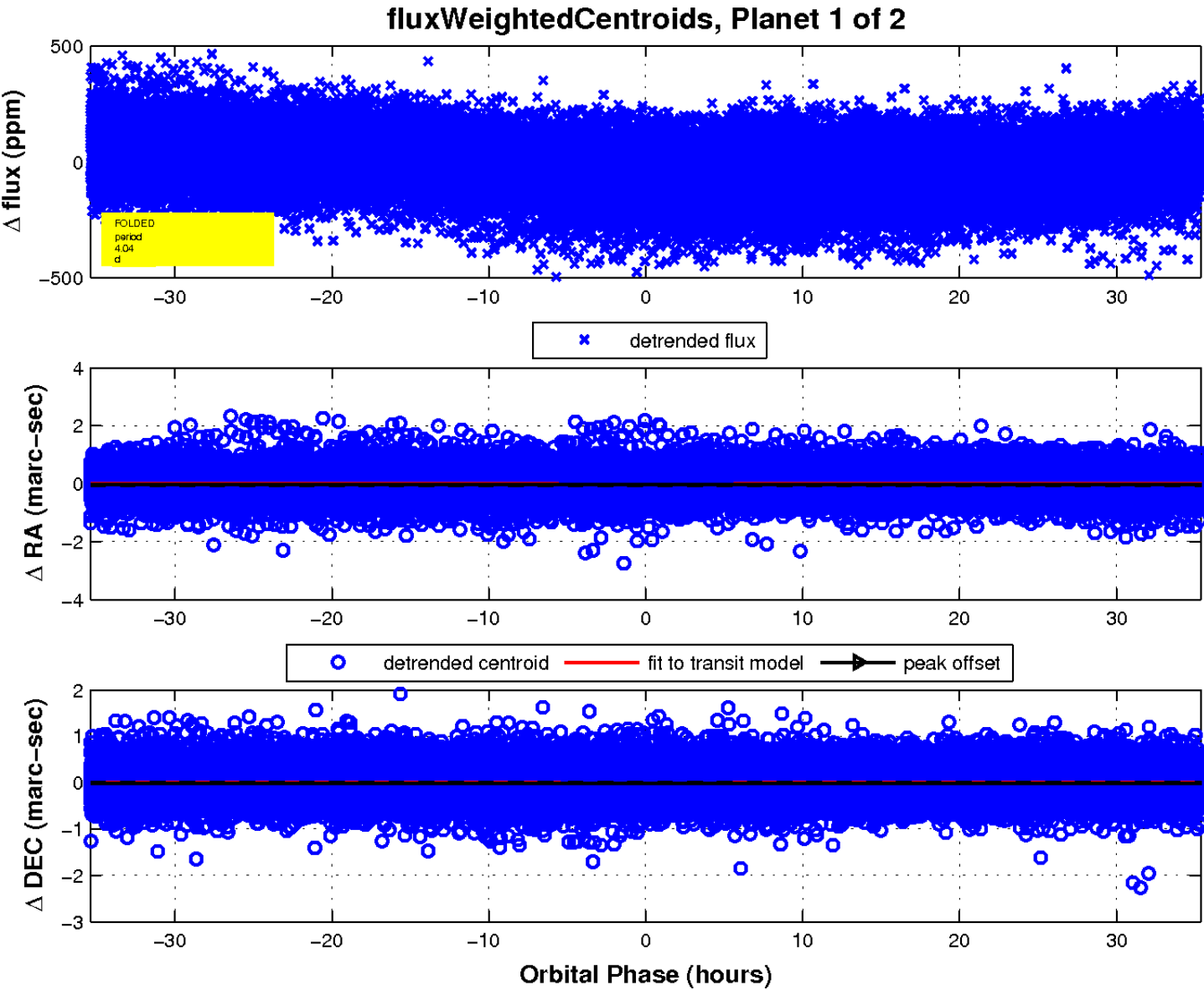
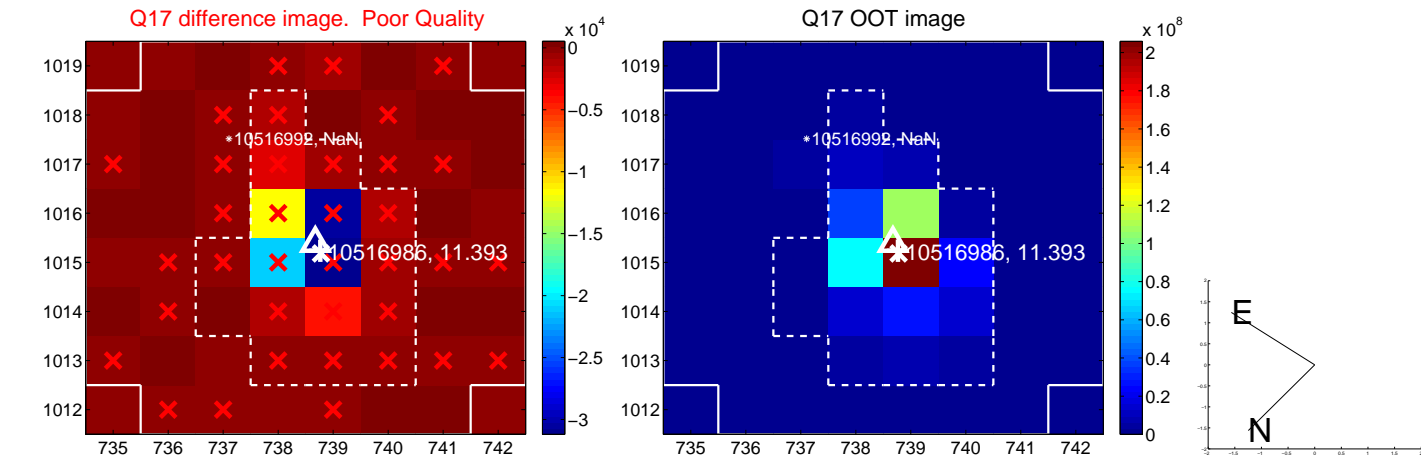


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



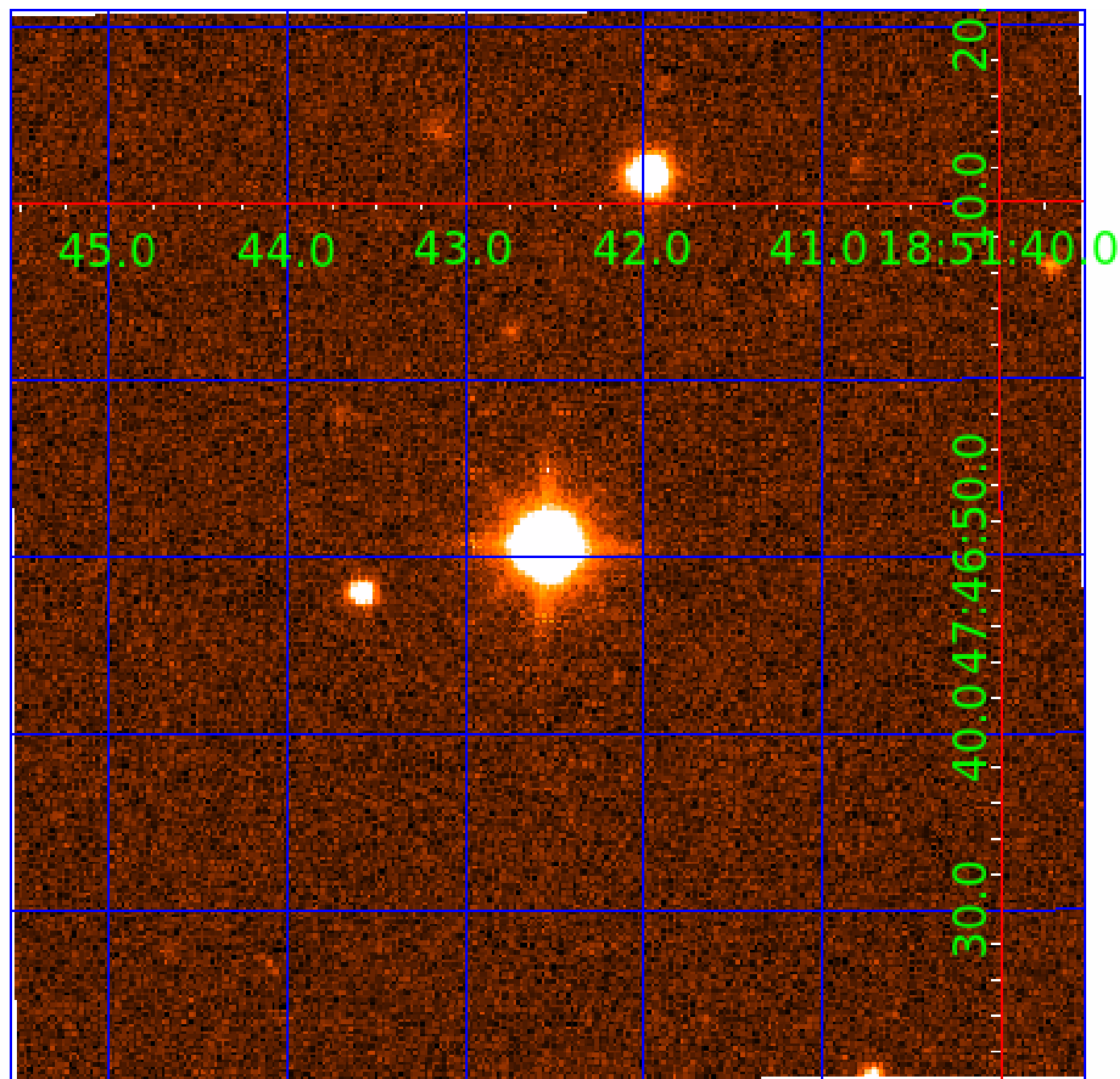


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 010516986

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
010516986-01	OBS	No	4.039966	131.889210	8.9	11.794	8.9	6.7	3.94	9734	1.42	24595.33
010516986-02	OBS	No	387.930063	276.341989	104.5	9.473	24.1	6.5	3.94	9734	4.66	55.94

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
010516986-01	OBS	FP	0.00	1	0	0	0	SWEET_NTL—LPP_DV—MOD_NONUNIQ_DV—CENT_SATURATED
010516986-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_MARSHALL—LPP_DV—ALL_TRANS_CHASES—INCONSISTENT_TRANS—CENT_SATURATED

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

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

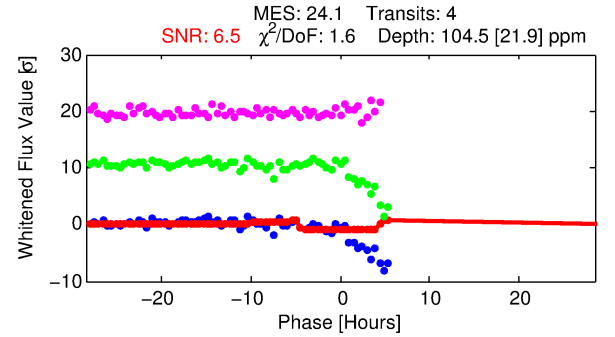
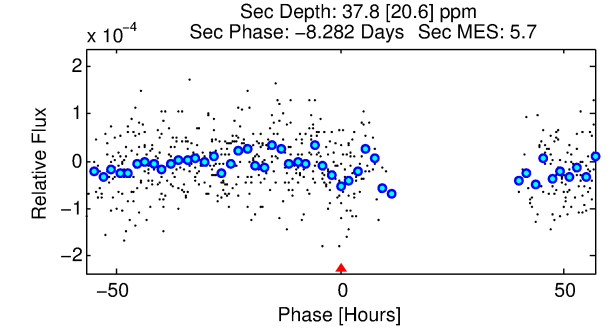
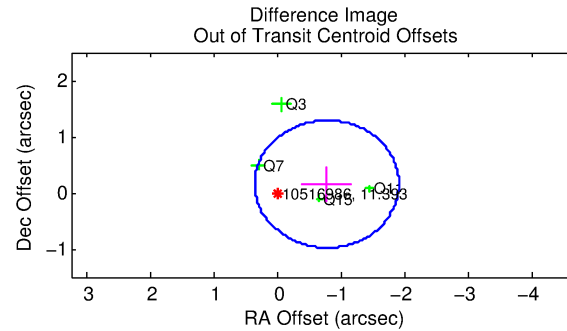
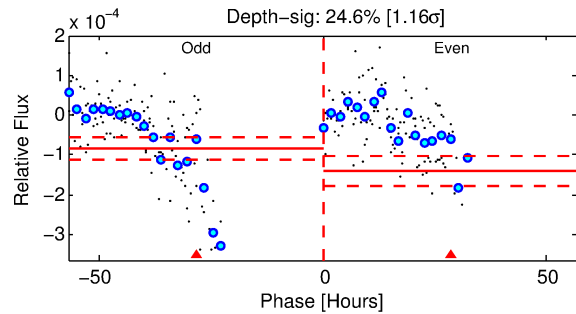
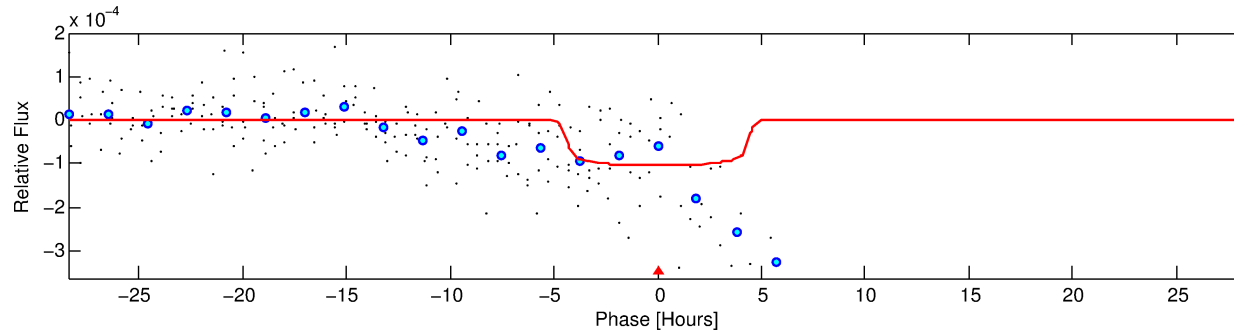
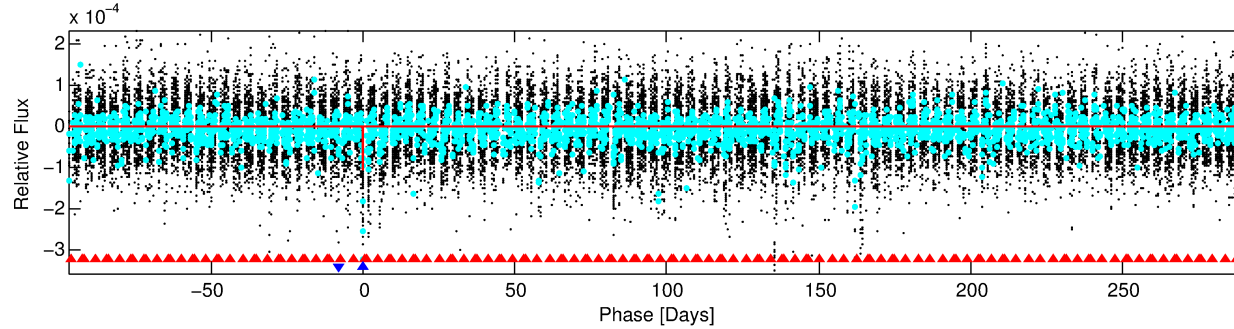
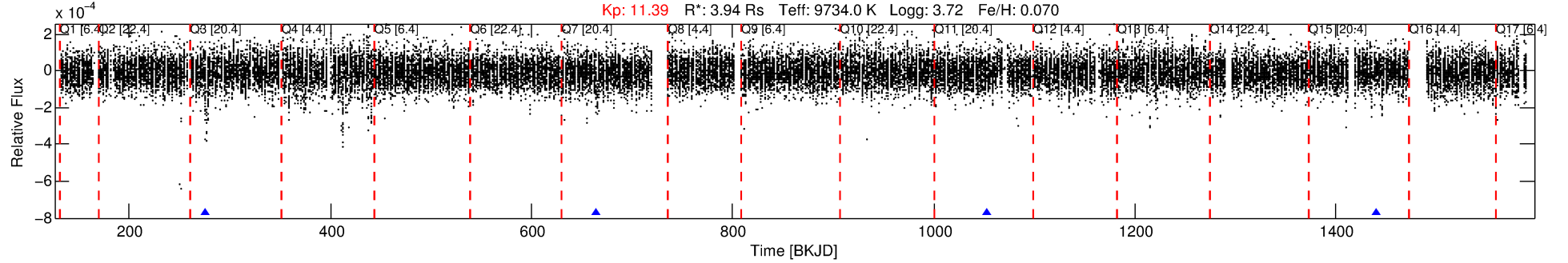
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 010516986-02

No Significant Match Found

# DV One-Page Summary

KIC: 10516986 Candidate: 2 of 2 Period: 387.930 d



## DV Fit Results:

Period = 387.93006 [0.01049] d  
Epoch = 276.3420 [0.0163] BKJD  
 $R_p/R^*$  = 0.0109 [0.0020]  
 $a/R^*$  = 135.06 [146.42]  
 $b$  = 0.91 [0.20]  
 $\text{Seff}$  = 55.94 [43.68]  
 $T_{\text{eq}}$  = 697 [136] K  
 $R_p$  = 4.66 [2.46]  $R_e$   
 $a$  = 1.4922 [0.7107] AU  
 $A_g$  = 2132.89 [2143.88] [0.99 $\sigma$ ]  
 $T_{\text{eff}}$  = 7327 [1238] K [5.32 $\sigma$ ]

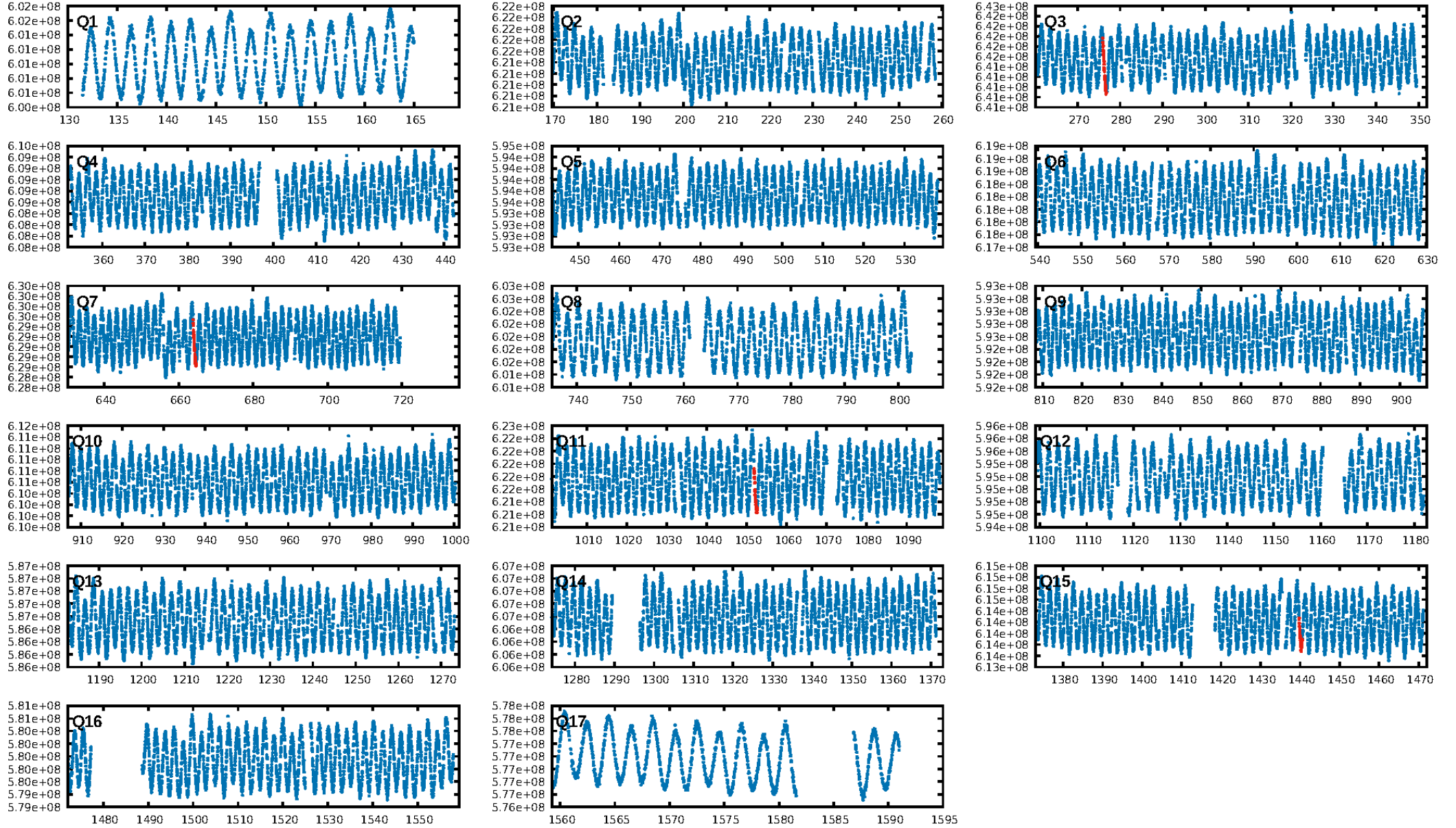
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [609.06 $\sigma$ ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 39.6%  
Bootstrap-pfa: 7.20e-52  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: 8.124  
Centroid-sig: 63.6%  
Centroid-so: 1.061 arcsec [0.70 $\sigma$ ]  
OotOffset-rm: 0.785 arcsec [2.08 $\sigma$ ]  
KicOffset-rm: 0.814 arcsec [2.11 $\sigma$ ]  
OotOffset-st: 0/4/0/0 [4]  
KicOffset-st: 0/4/0/0 [4]  
DiffImageQuality-fgm: 1.00 [4/4]  
DiffImageOverlap-fno: 0.25 [1/4]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 01-Feb-2016 09:37:24 Z

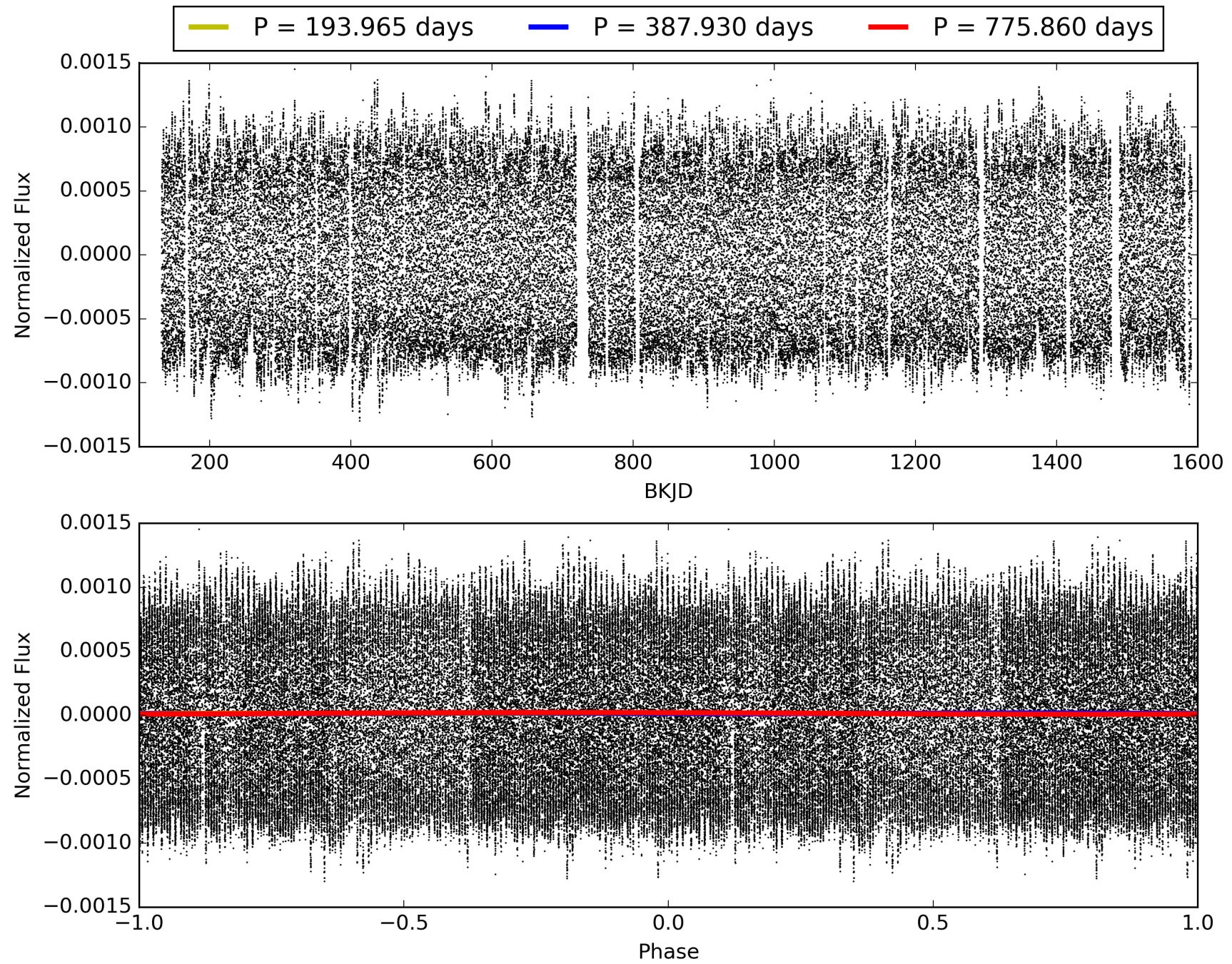
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 010516986-02, PDC Light Curves



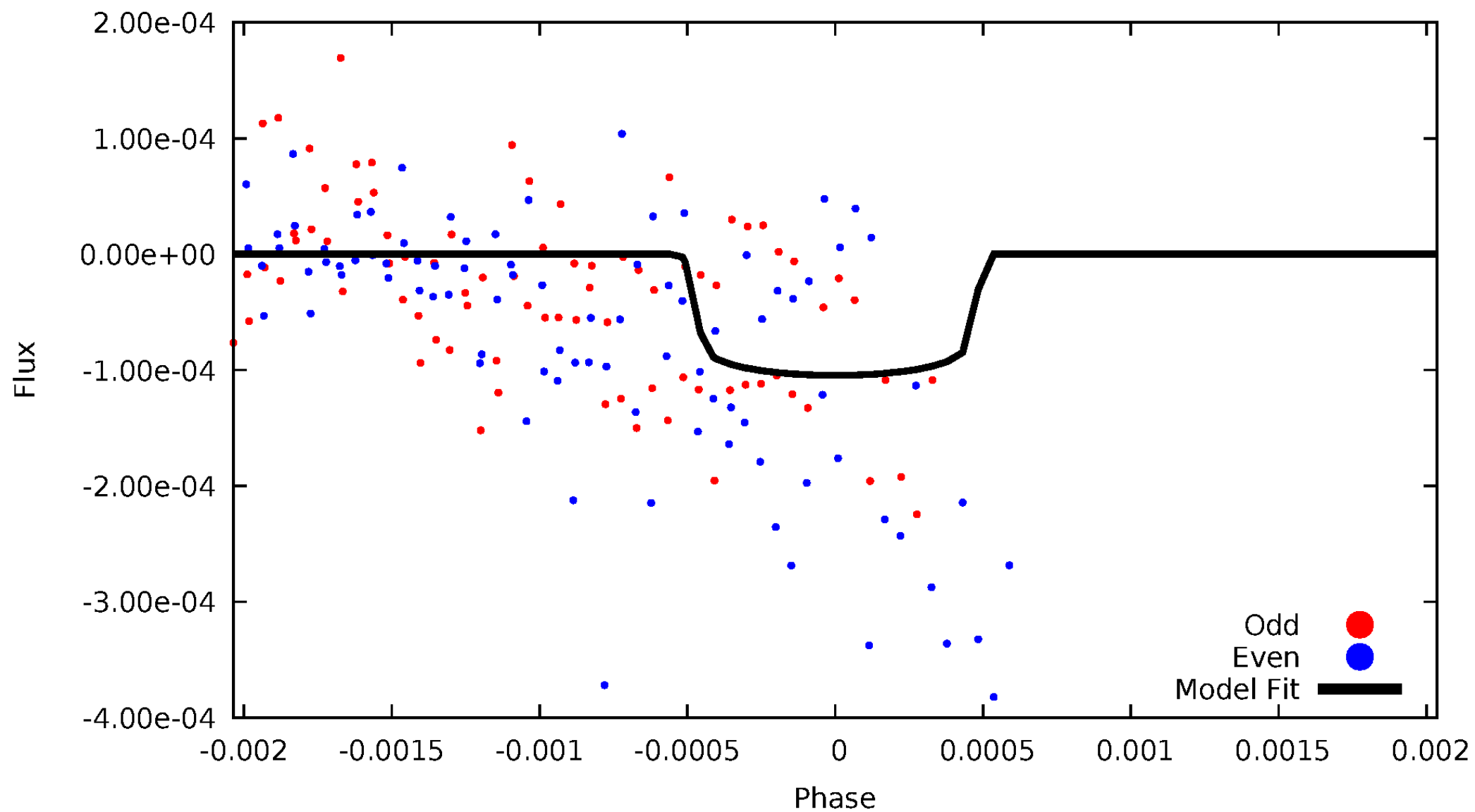


# TCE 010516986-02



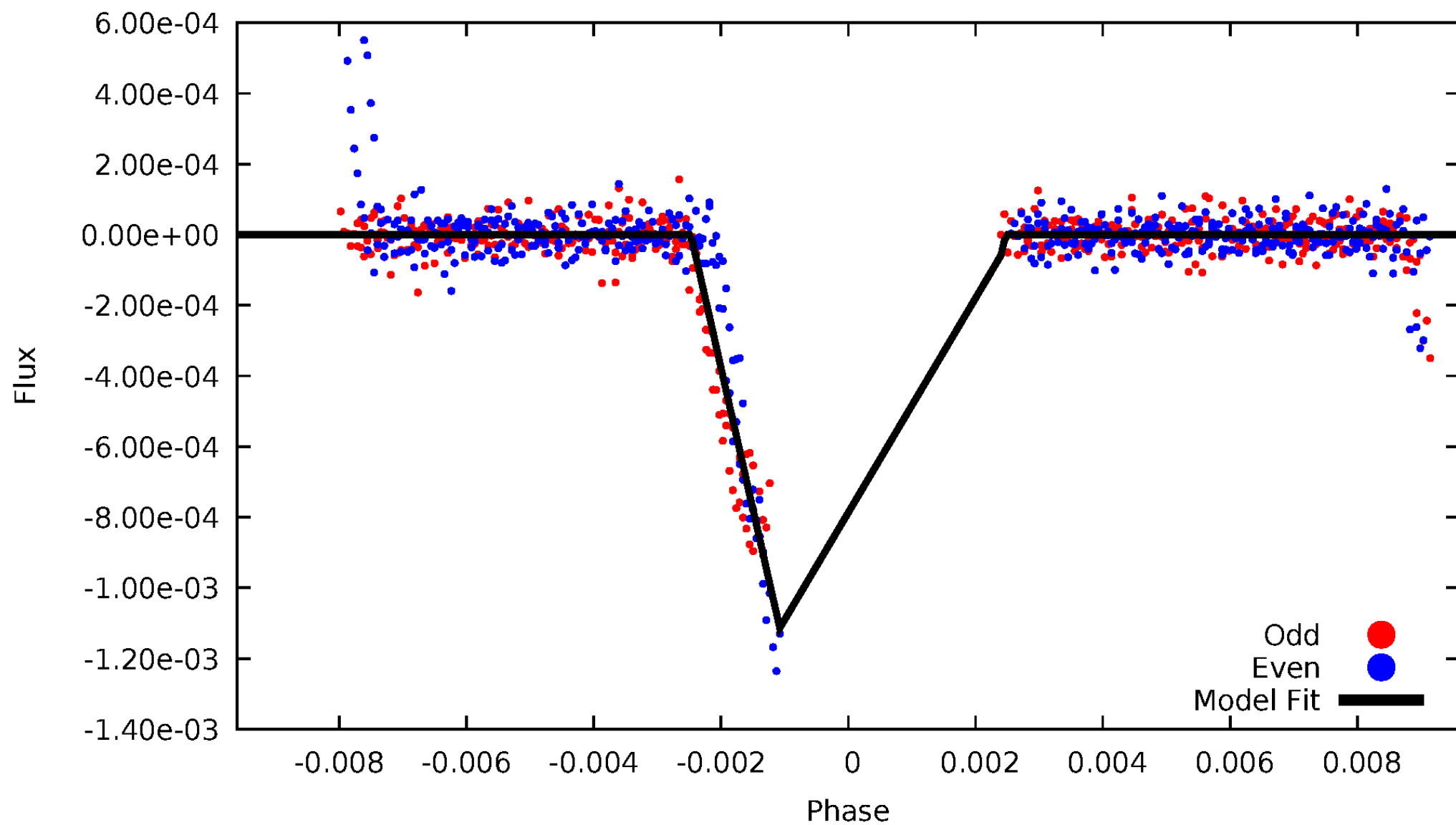
# DV Odd/Even

TCE 010516986-02



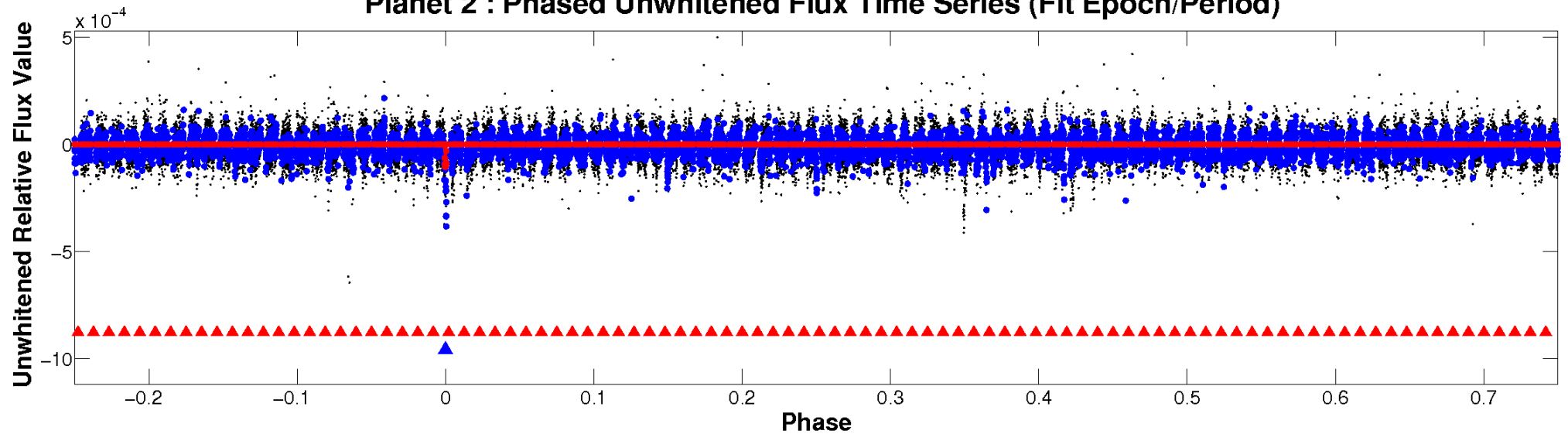
# ALT Odd/Even

TCE 010516986-02

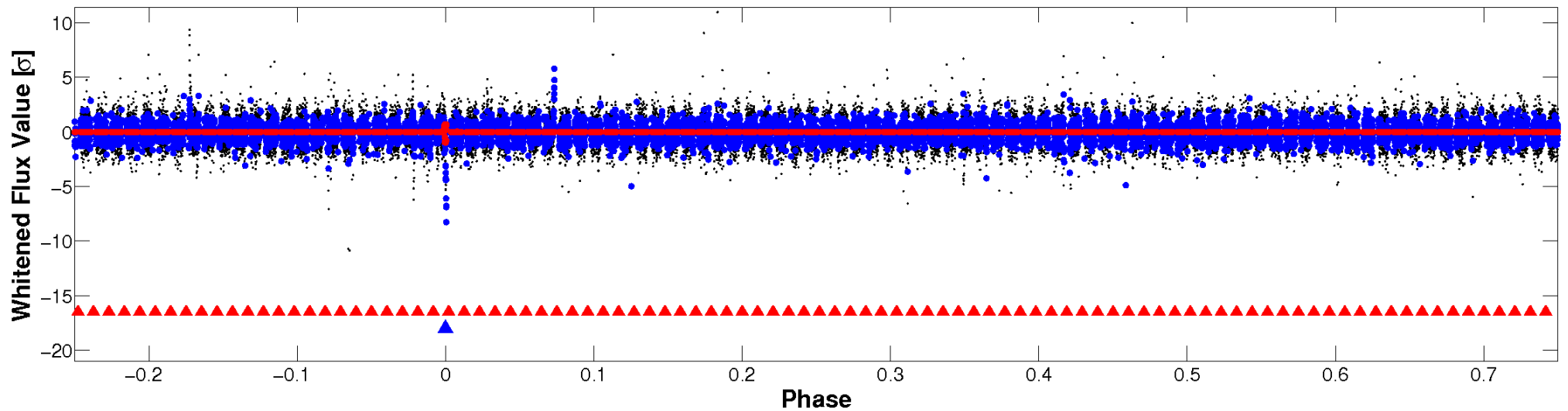


# Non-Whitened Vs. Whitened Light Curve

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

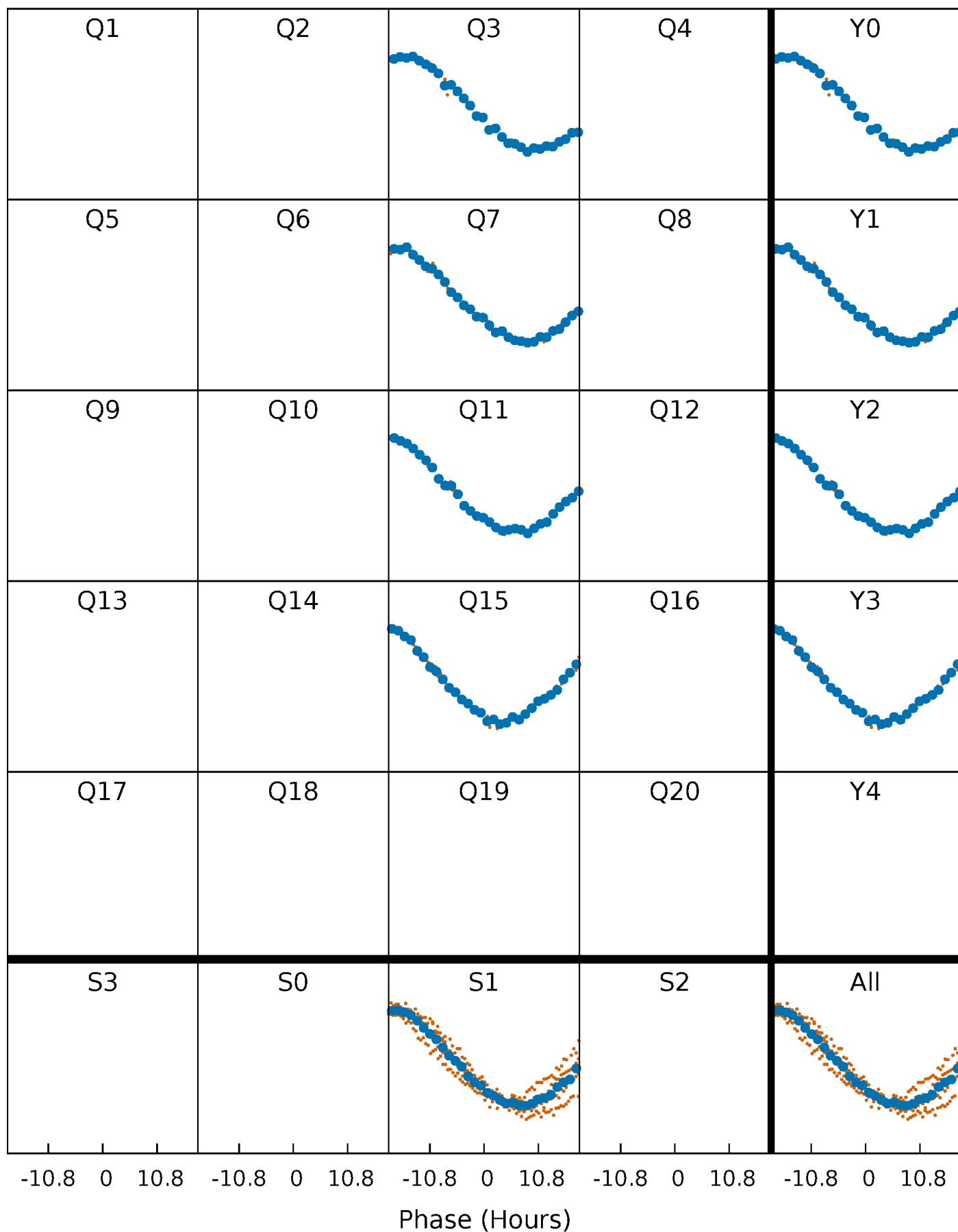


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

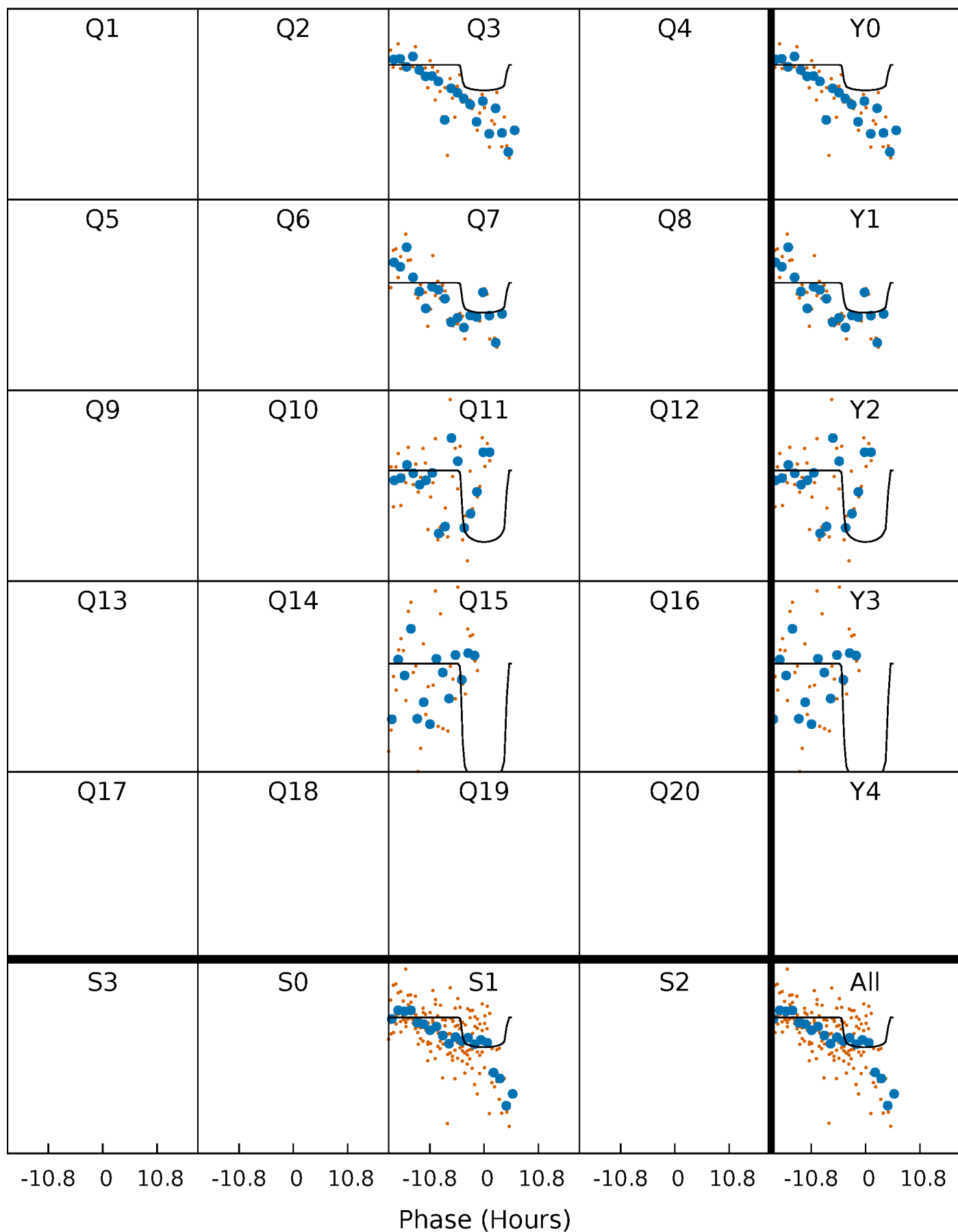
TCE 010516986-02   P=387.930063 Days    $T_0=276.341989$  (BKJD)





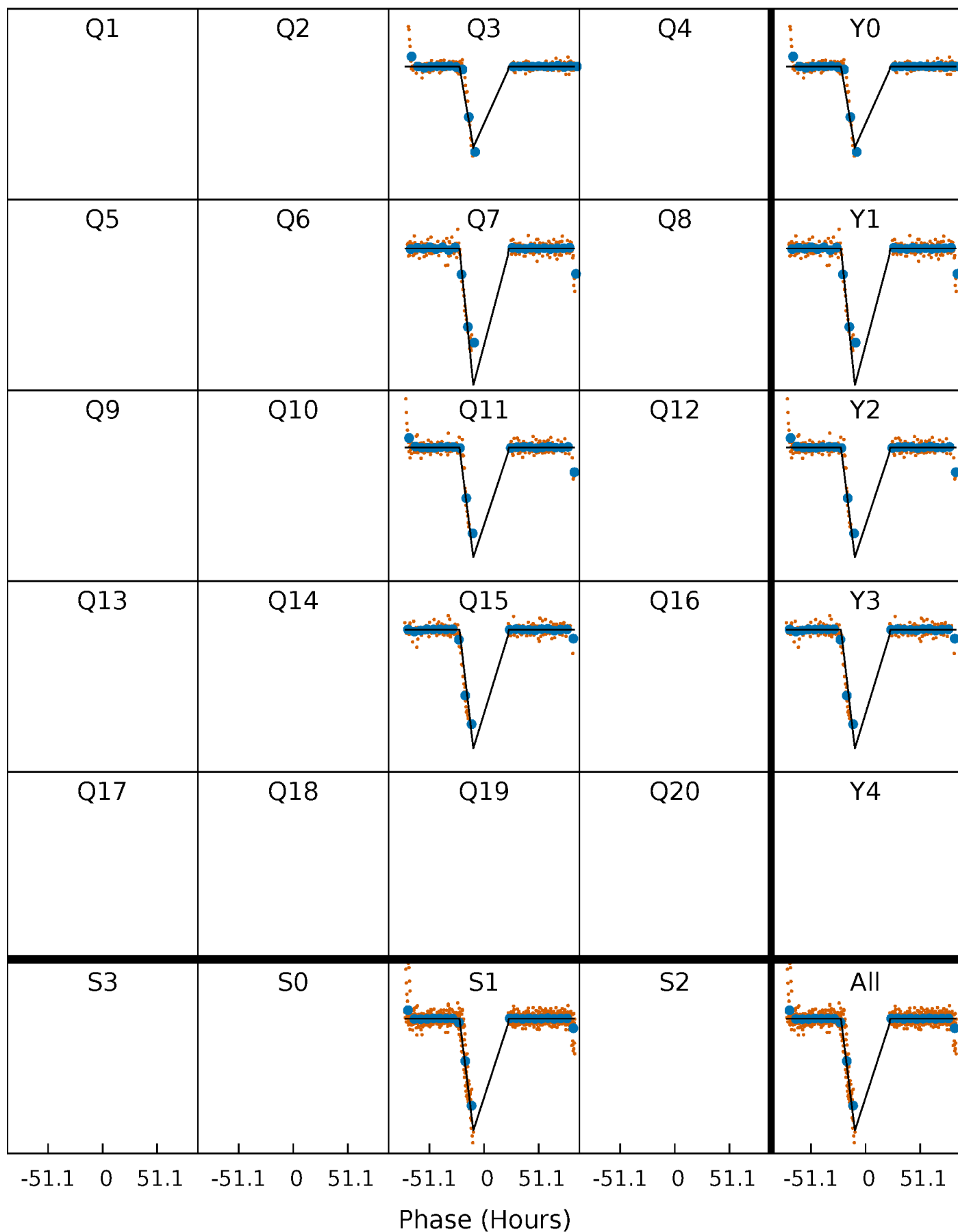
# DV Quarter-Phased Transit Curves

TCE 010516986-02     $P=387.930063$  Days     $T_0=276.341989$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

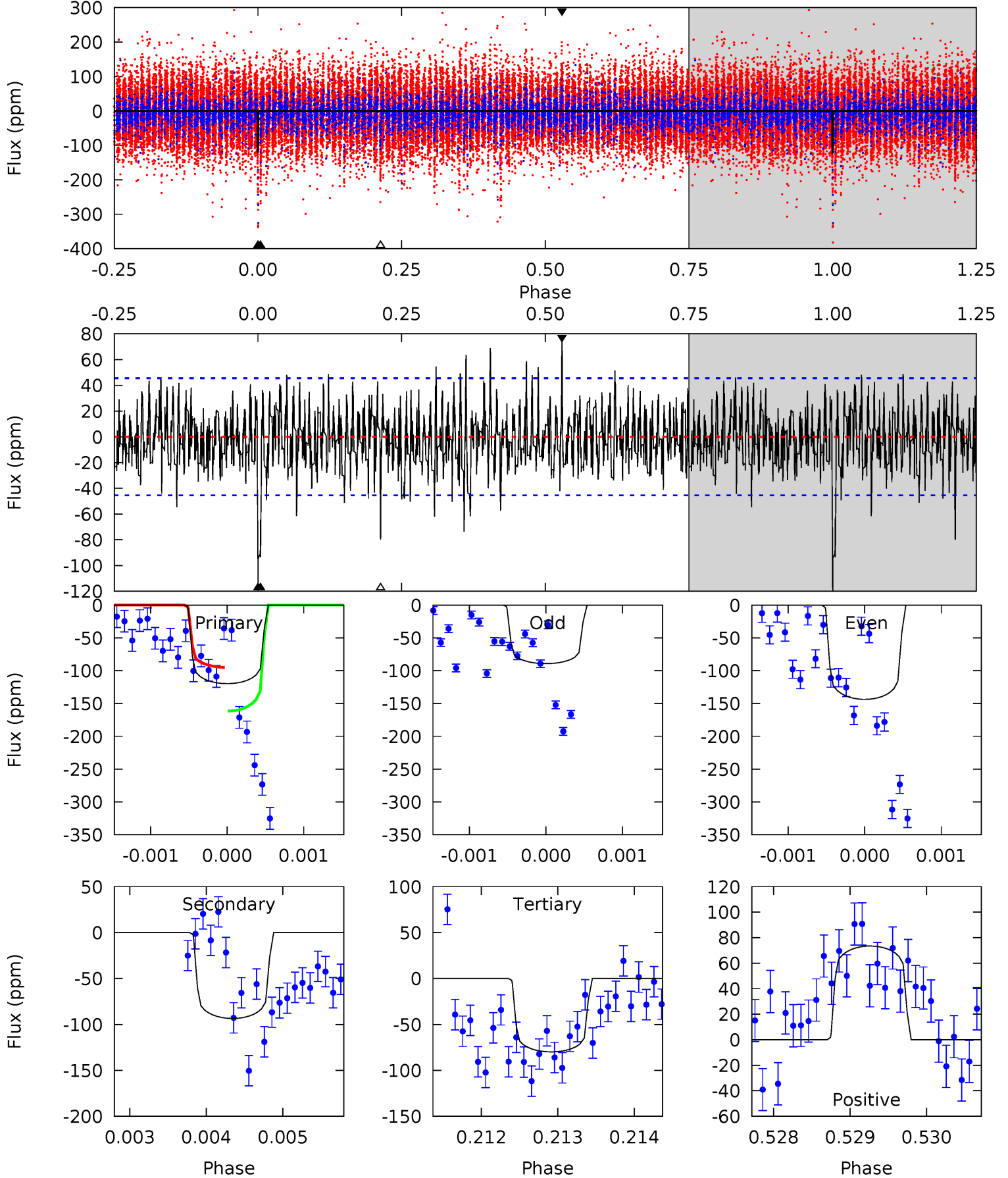
TCE 010516986-02 P=387.890269 Days  $T_0=276.988439$  (BKJD)



# DV Model-Shift Uniqueness Test

010516986-02, P = 387.930063 Days, E = 276.341989 Days

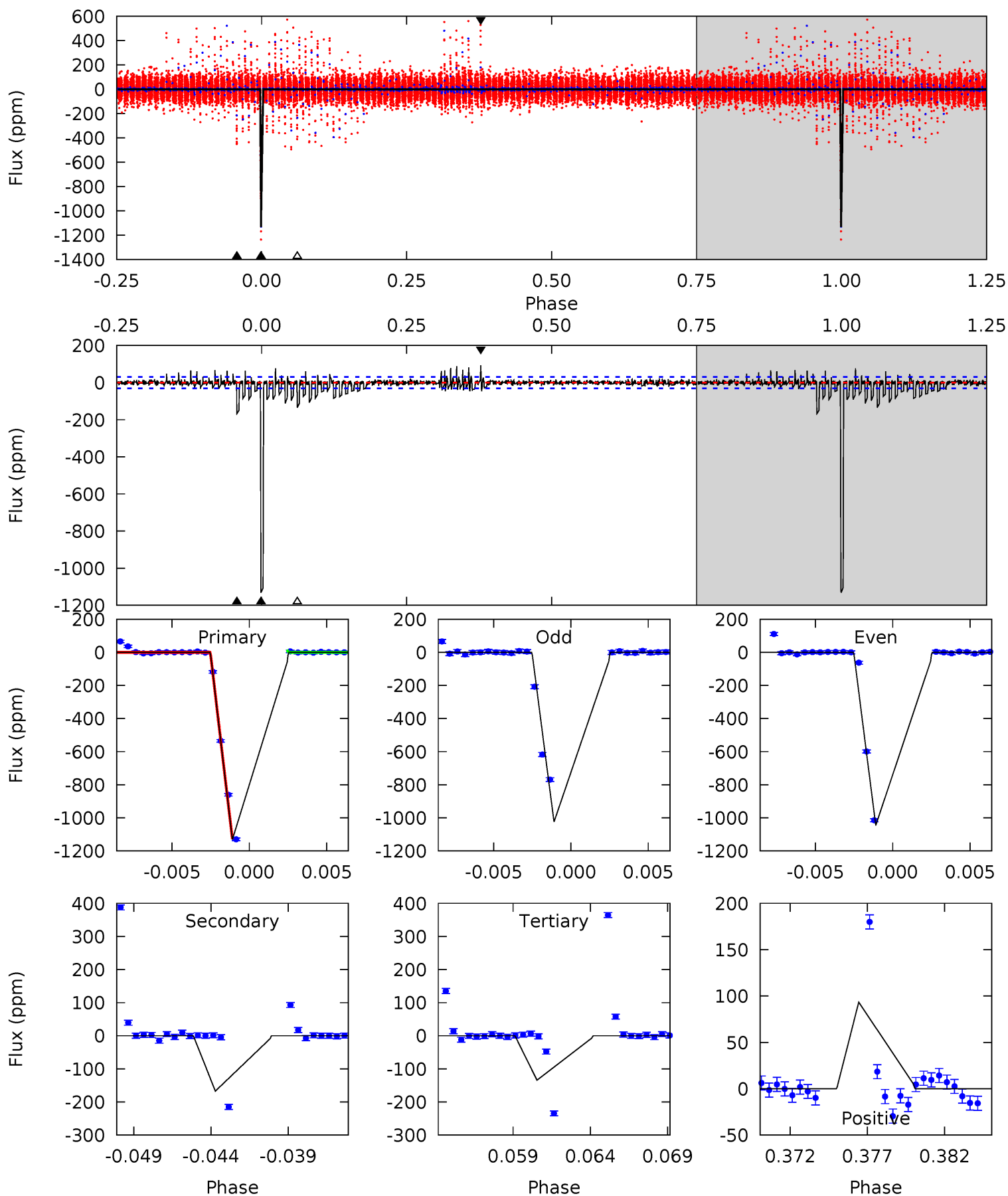
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
14.3	11.2	9.57	8.80	5.45	3.29	2.25	4.77	5.54	1.63	2.40	3.25	1.23	0.38	3.71



# Alt Model-Shift Uniqueness Test

010516986-02, P = 387.890269 Days, E = 276.988439 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
187.3	27.7	22.2	15.5	5.16	2.81	1.99	165.1	171.9	5.47	12.2	1.80	1.08	0.08	19.5



### Stellar Parameters For KIC 010516986

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$9734^{+306}_{-409}$	$3.717^{+0.448}_{-0.140}$	$0.070^{+0.200}_{-0.650}$	$3.935^{+0.834}_{-1.945}$	$2.939^{+0.254}_{-1.018}$	$0.068^{+0.298}_{-0.027}$
	+3%/-4%	+12%/-4%	+286%/-929%	+21%/-49%	+9%/-35%	+438%/-40%
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 010516986-02 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-93 \pm 8$	$4.31^{+1.34}_{-1.35}$	$945^{+86}_{-116}$	$8870^{+1558}_{-981}$	$5983^{+6074}_{-2416}$
Alt.	$-167 \pm 6$	$17.11^{+3.05}_{-4.76}$	$947^{+87}_{-124}$	$5090^{+174}_{-171}$	$687^{+502}_{-178}$

$T_{max}$  = 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

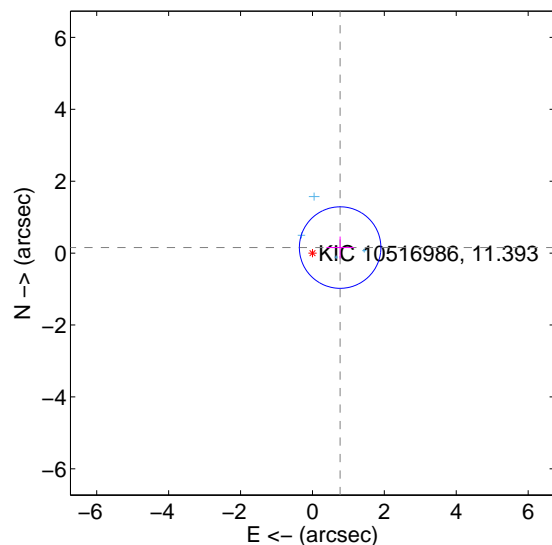
Supplemental centroid analysis for 010516986-02. **Kepler magnitude: 11.39.** Transit SNR 6.47

There are 4 quarters with good PRF difference image offsets

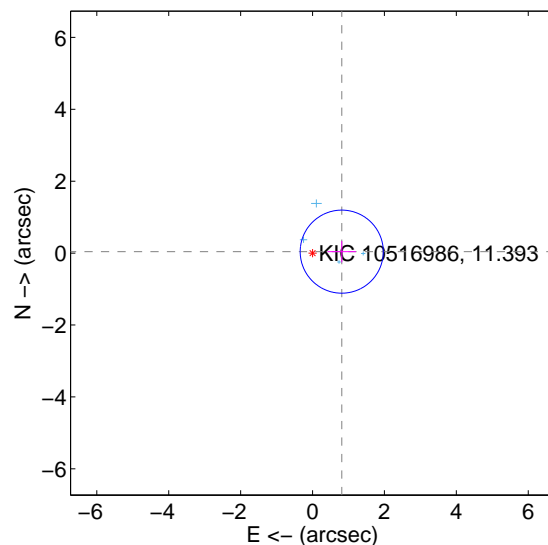
The direct PRF centroid is offset from the target star catalog position by about 0.15 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.785 \pm 0.378$	2.08	$-0.770 \pm 0.380$	$0.154 \pm 0.308$
PRF-fit source offset from KIC position	$0.814 \pm 0.385$	2.11	$-0.813 \pm 0.396$	$0.040 \pm 0.297$
photometric centroid source offset	$1.06 \pm 1.52$	0.70	$1.01 \pm 1.55$	$-0.34 \pm 1.21$

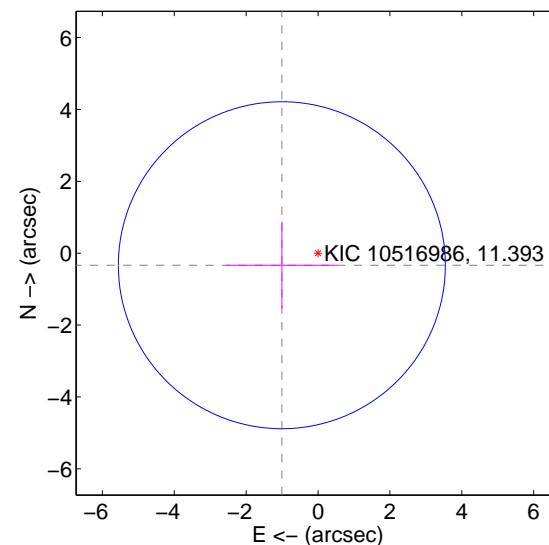
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position



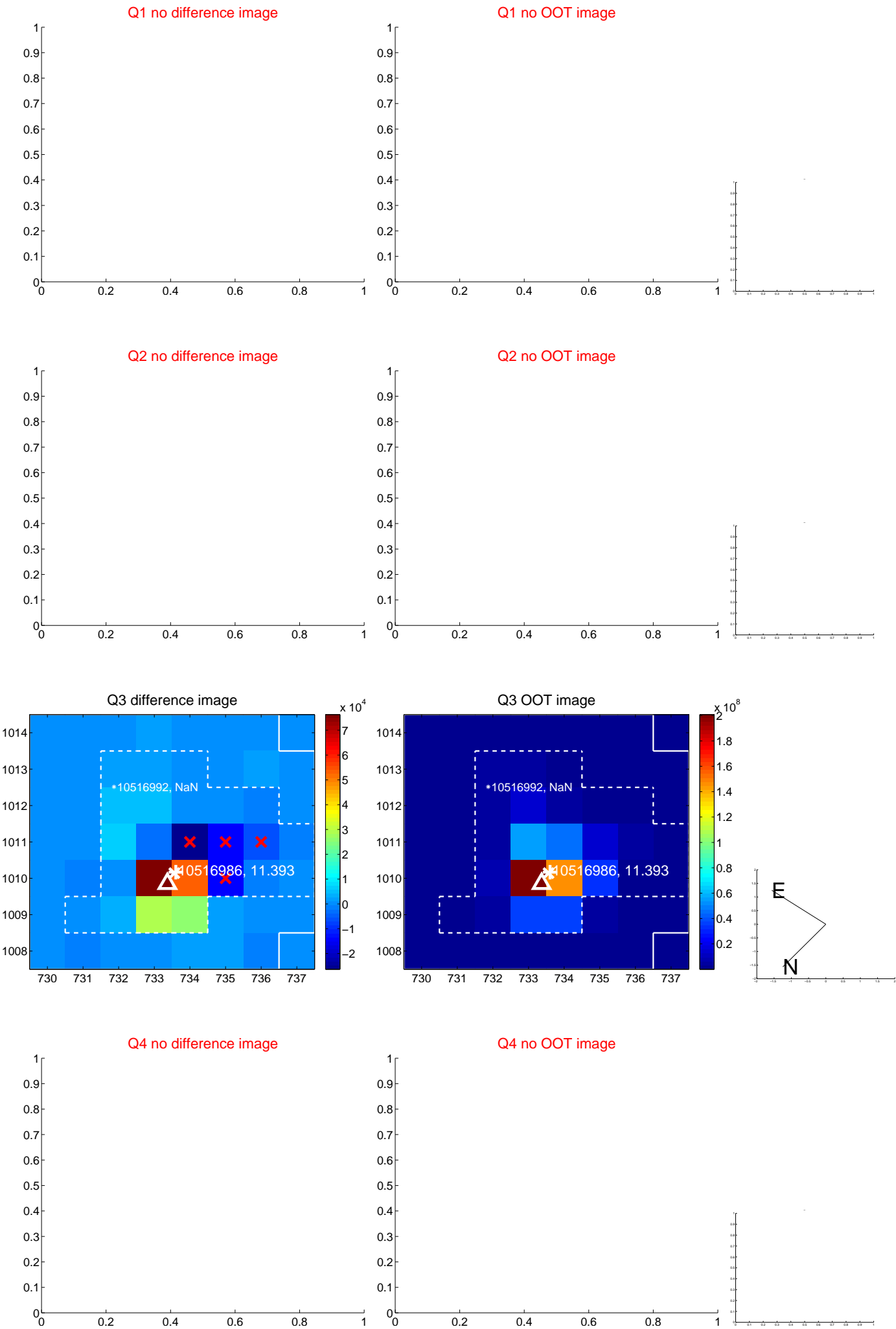
offset from photometric centroids



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.

Q5 no difference image



Q5 no OOT image



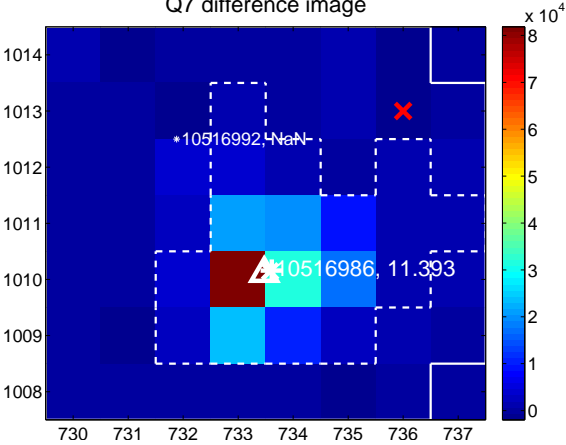
Q6 no difference image



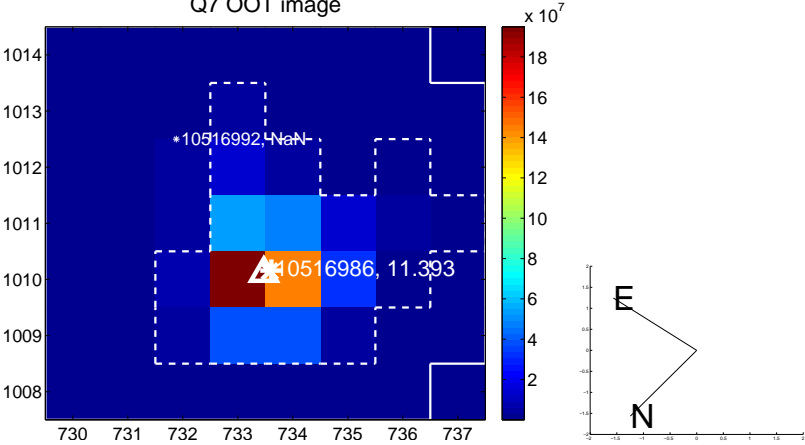
Q6 no OOT image



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.

Q9 no difference image



Q9 no OOT image



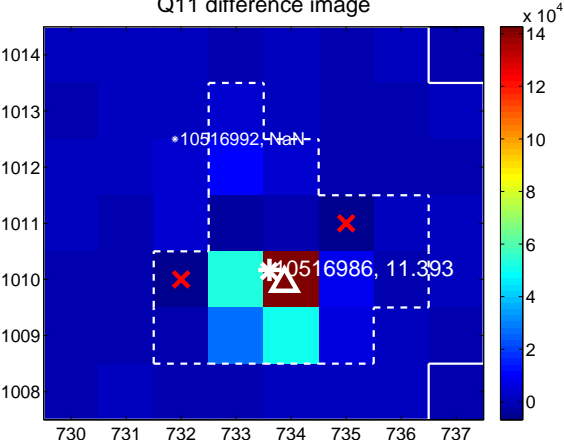
Q10 no difference image



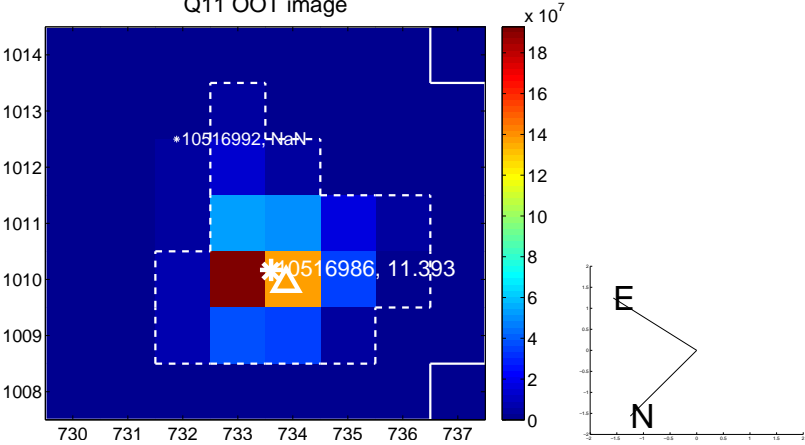
Q10 no OOT image



Q11 difference image



Q11 OOT image



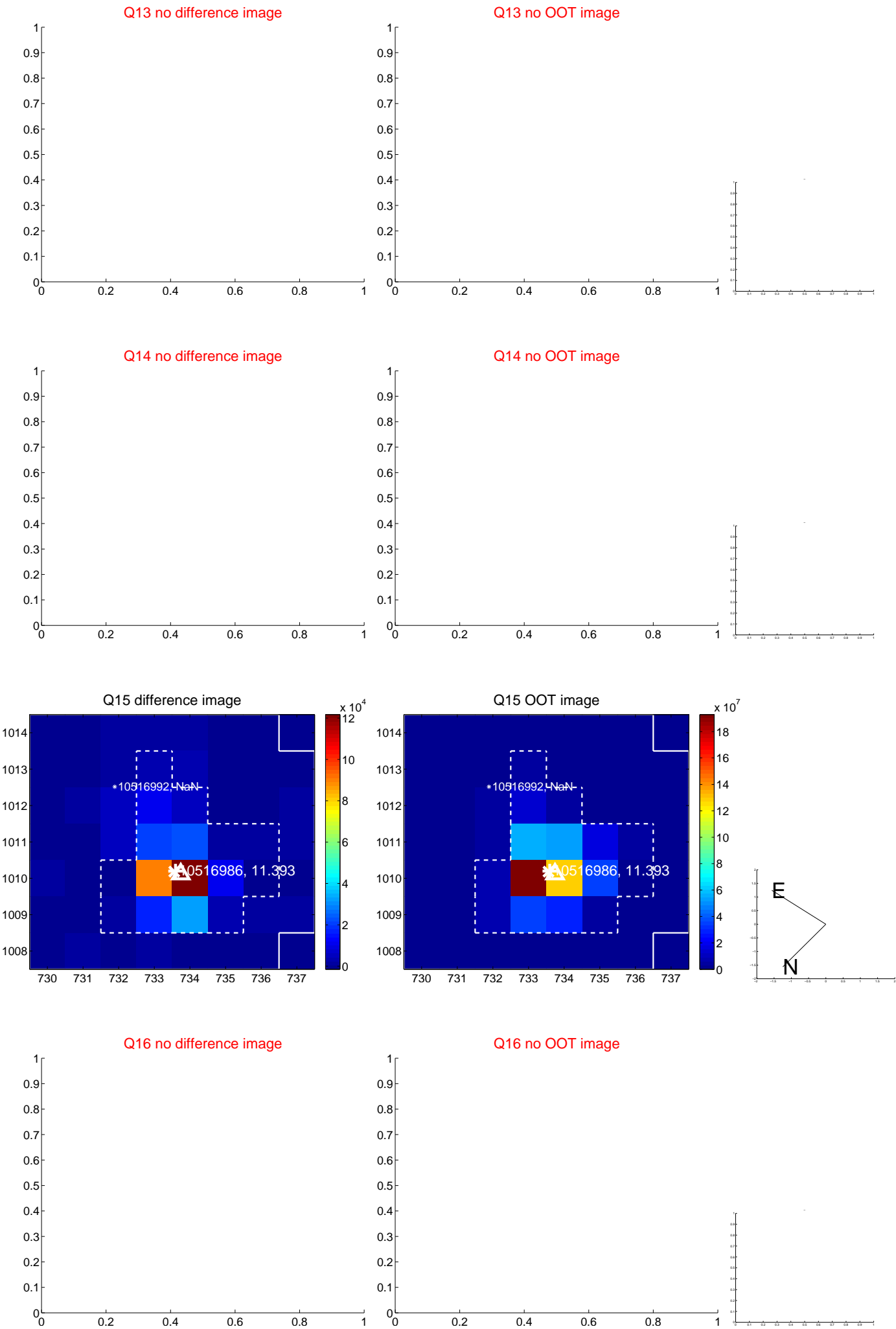
Q12 no difference image



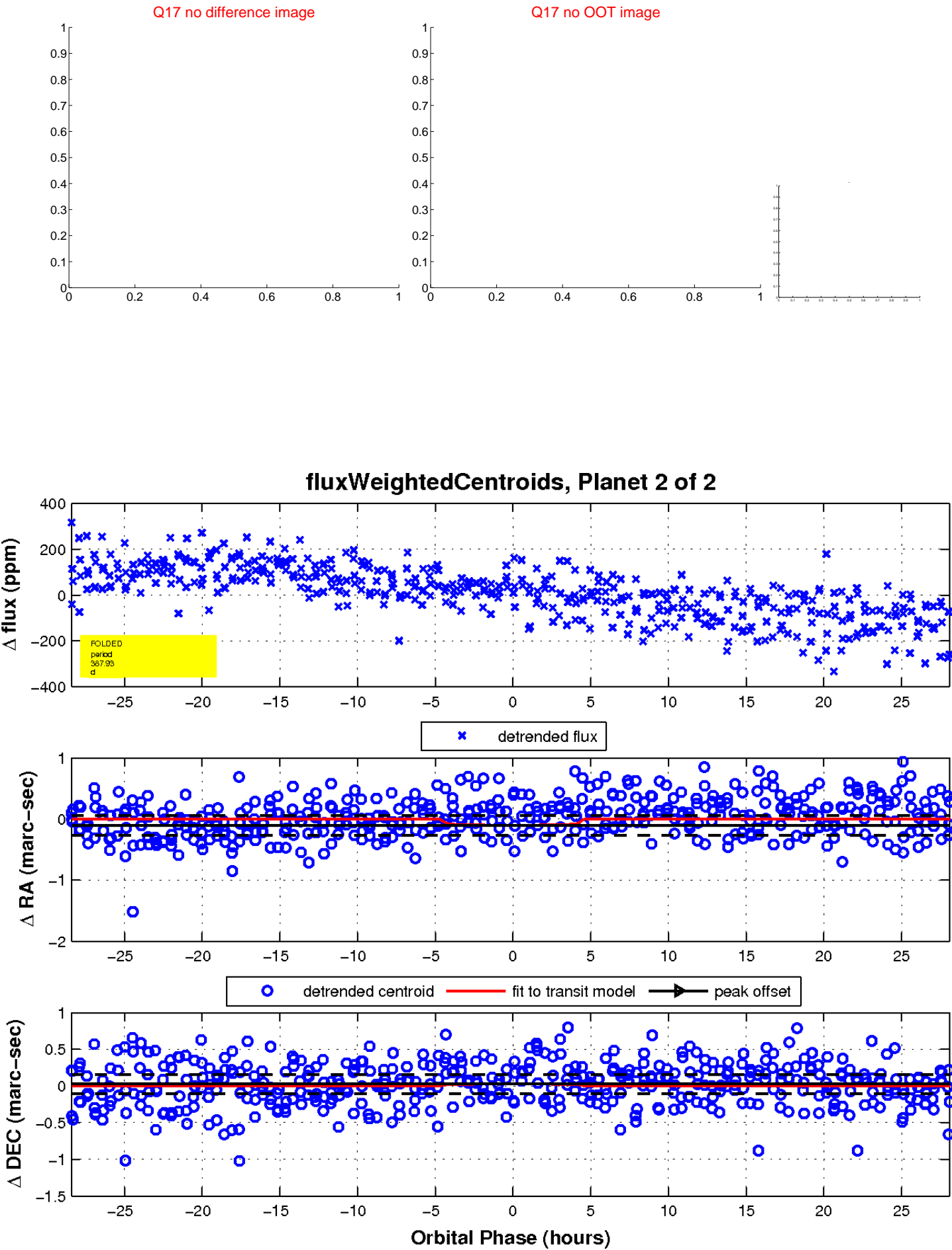
Q12 no OOT image



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.



UKIRT Image

Declination

