

# KIC 012010004

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
012010004-01	OBS	No	371.472956	433.778706	1168.5	6.110	18.5	7.3	1.06	6004	3.65	1.34
012010004-02	OBS	No	456.804557	411.808662	356.5	3.119	12.8	2.9	1.06	6004	2.03	1.01

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
012010004-01	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES_MARSHALL—LPP_DV—LPP_ALT—MOD_POS_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—INCONSISTENT_TRANS—CENT_FEW_DIFFS
012010004-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE_TRACKER—LPP_DV—LPP_ALT—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—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.

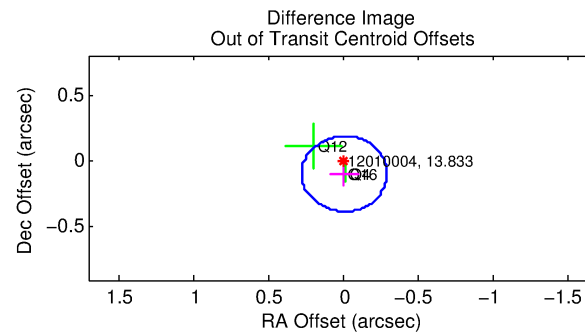
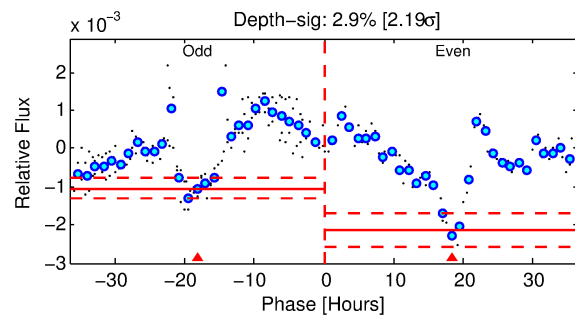
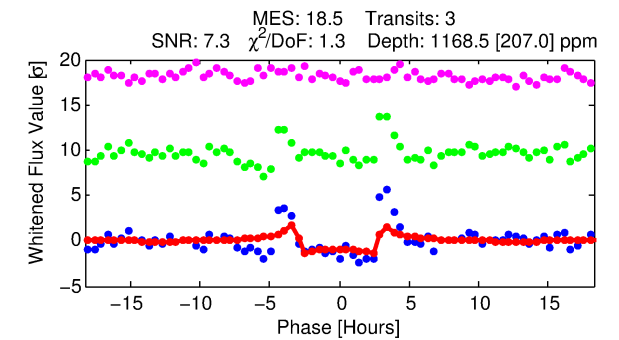
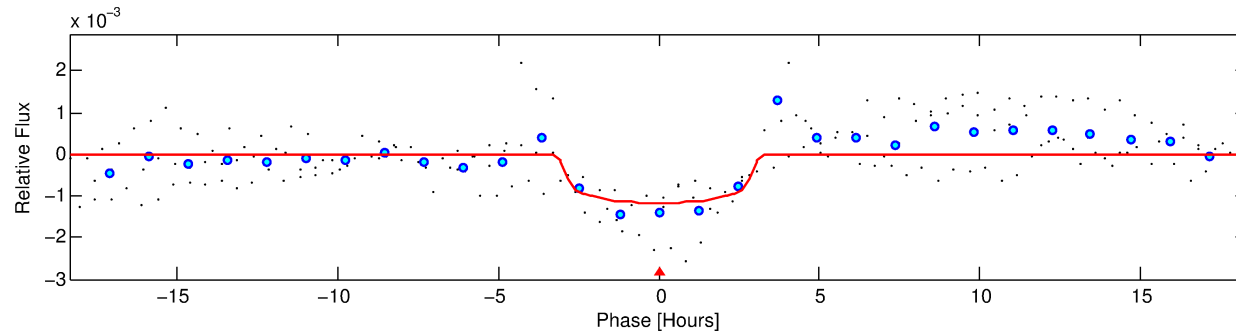
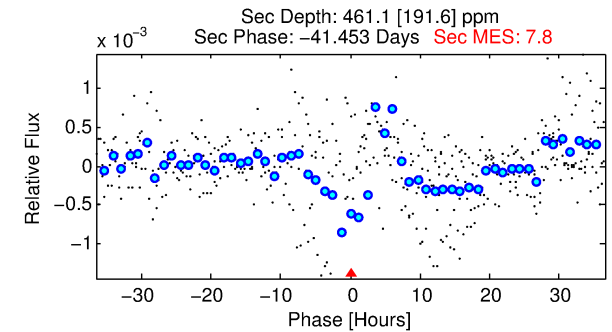
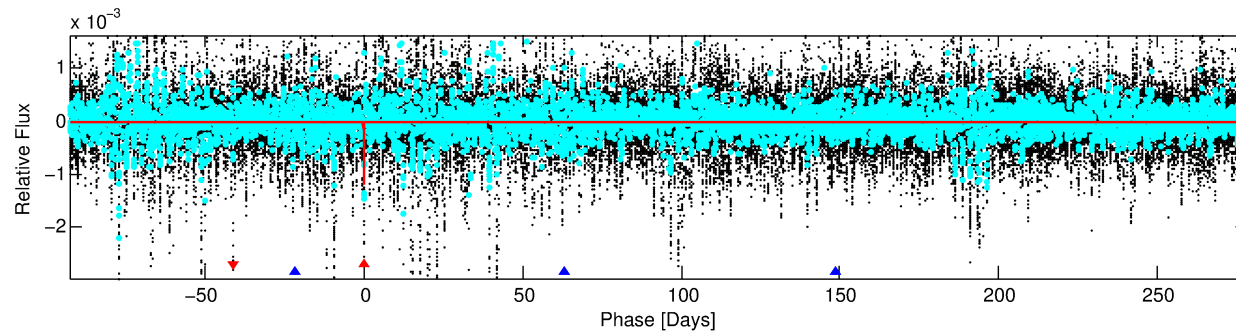
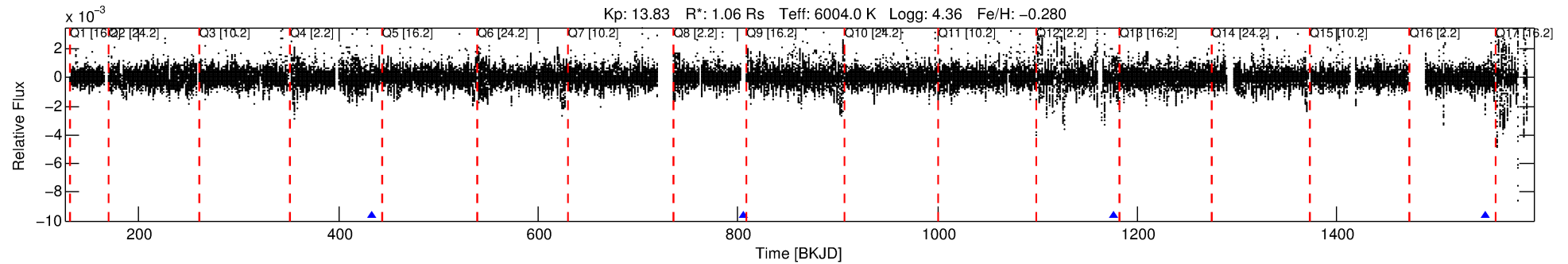
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 012010004-01

No Significant Match Found

# DV One-Page Summary

KIC: 12010004 Candidate: 1 of 2 Period: 371.473 d



## DV Fit Results:

Period = 371.47296 [0.00286] d  
Epoch = 433.7787 [0.0067] BKJD  
Rp/R\* = 0.0315 [0.0903]  
a/R\* = 460.70 [6466.49]  
b = 0.28 [45.93]  
Seff = 1.34 [0.48]  
Teq = 274 [25] K  
Rp = 3.65 [10.53] Re  
a = 0.9910 [0.2380] AU  
Ag = 18647.53 [107310.45] [0.17σ]  
Teffp = 4954 [7116] K [0.66σ]

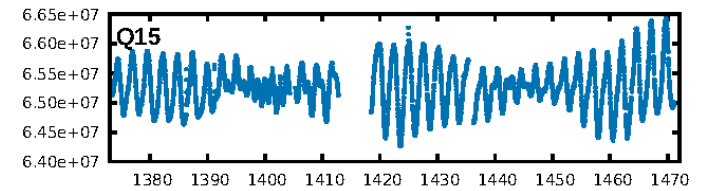
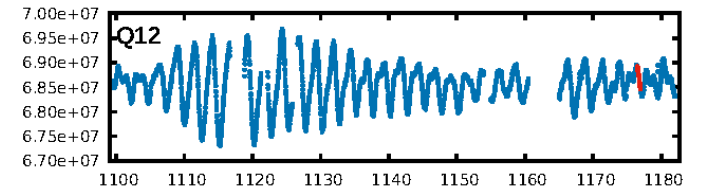
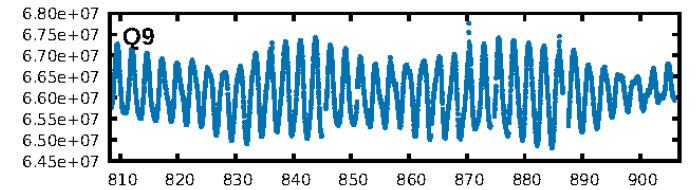
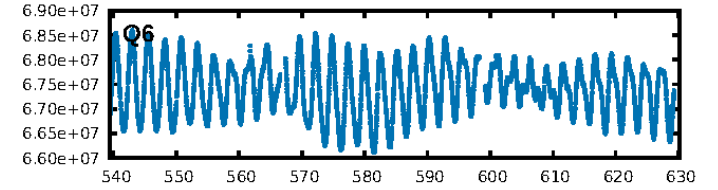
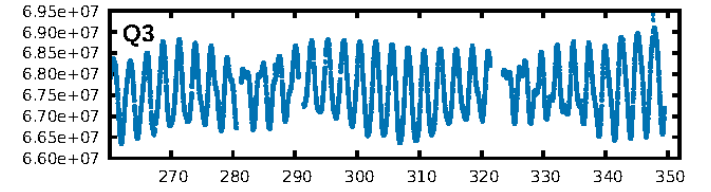
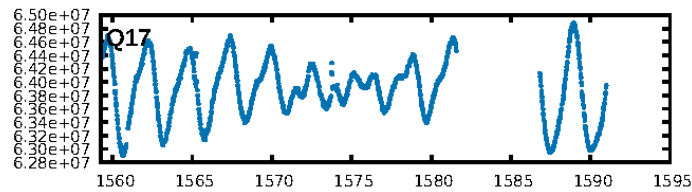
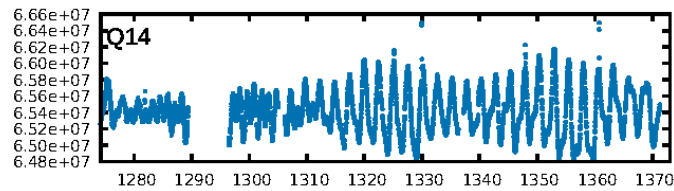
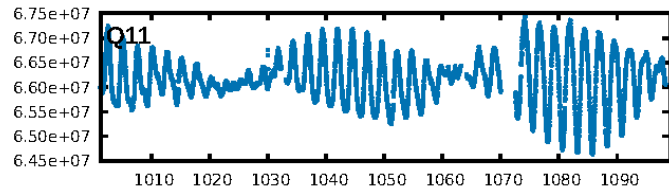
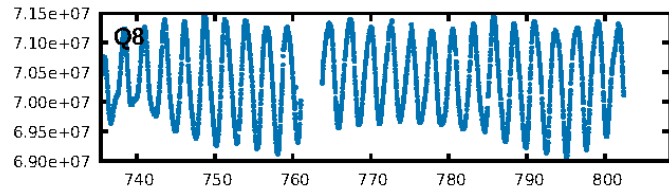
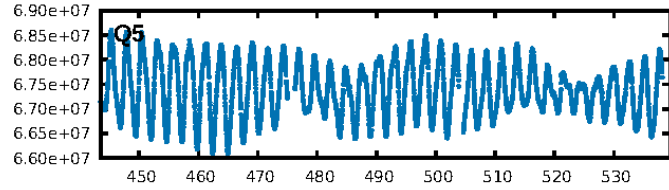
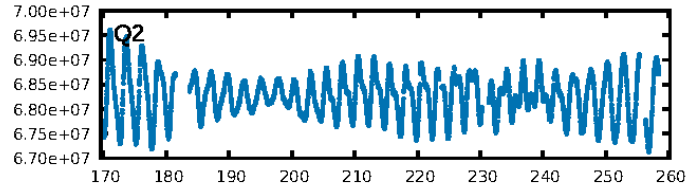
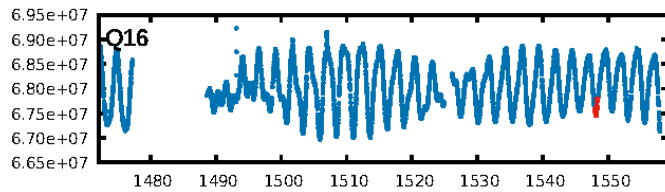
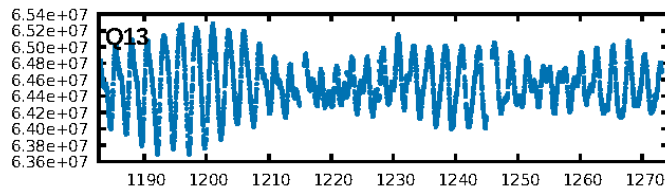
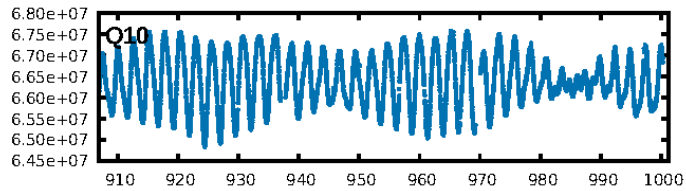
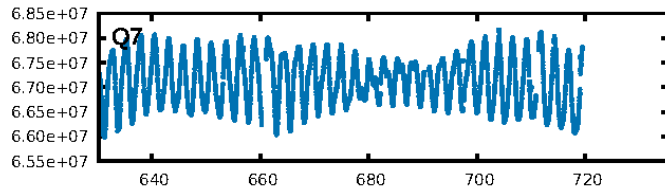
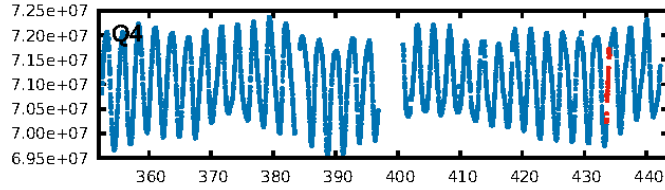
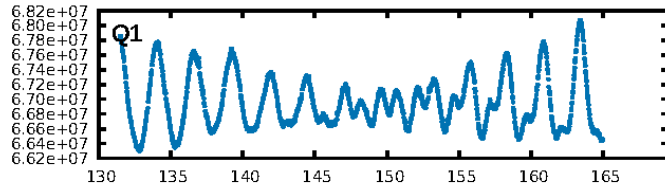
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [298.52σ]  
ModelChiSquare2-sig: 0.3%  
ModelChiSquareGof-sig: 67.3%  
Bootstrap-pfa: 8.05e-20  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: -4.557  
Centroid-sig: 36.8%  
Centroid-so: 0.375 arcsec [0.60σ]  
OotOffset-rm: 0.097 arcsec [1.02σ]  
OotOffset-st: 0/0/3/0 [3]  
KicOffset-rm: 0.168 arcsec [1.81σ]  
KicOffset-st: 0/0/3/0 [3]  
DiffImageQuality-fgm: 0.33 [1/3]  
DiffImageOverlap-fno: 1.00 [3/3]

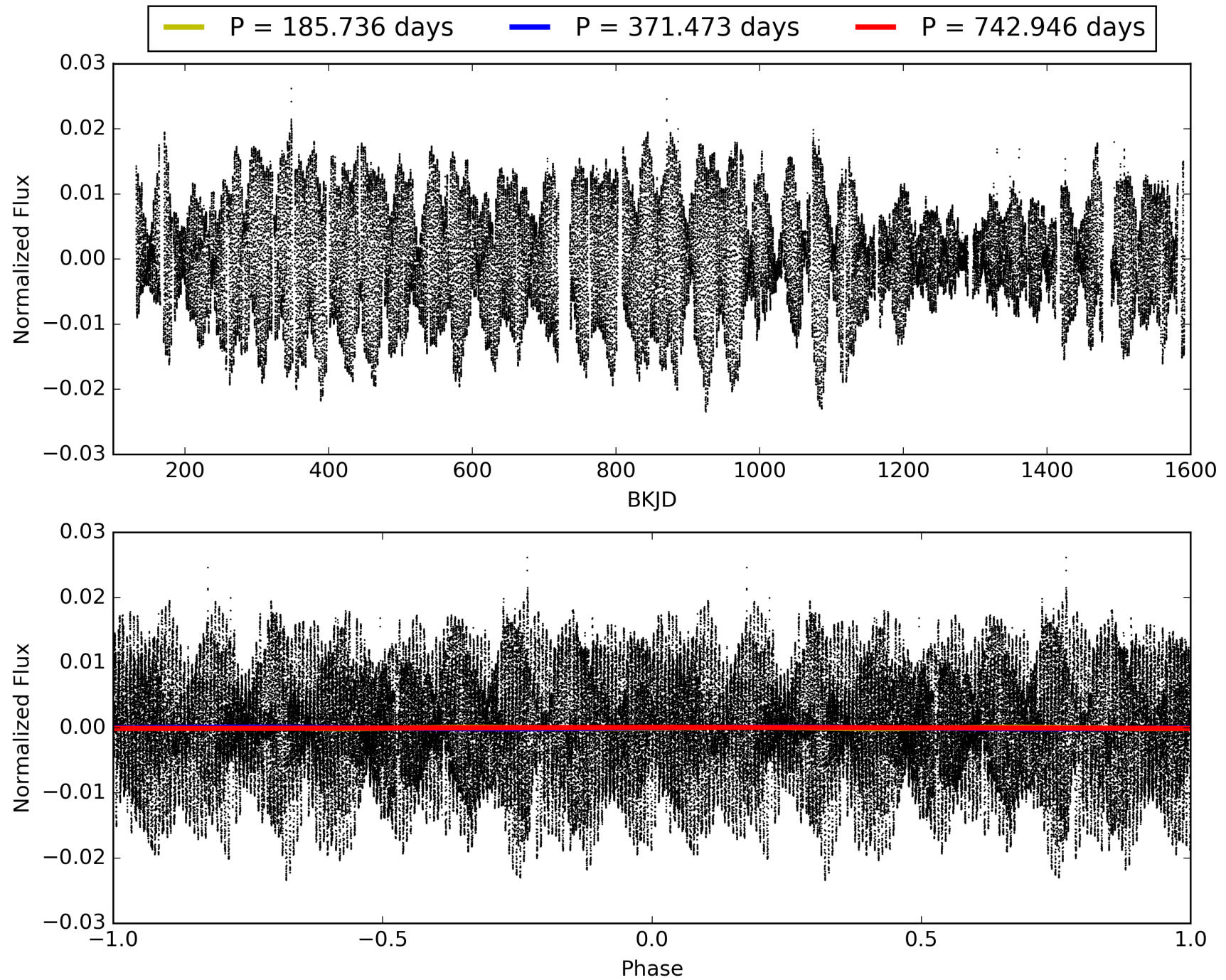
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 07:20:37 Z

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

# TCE 012010004-01, PDC Light Curves

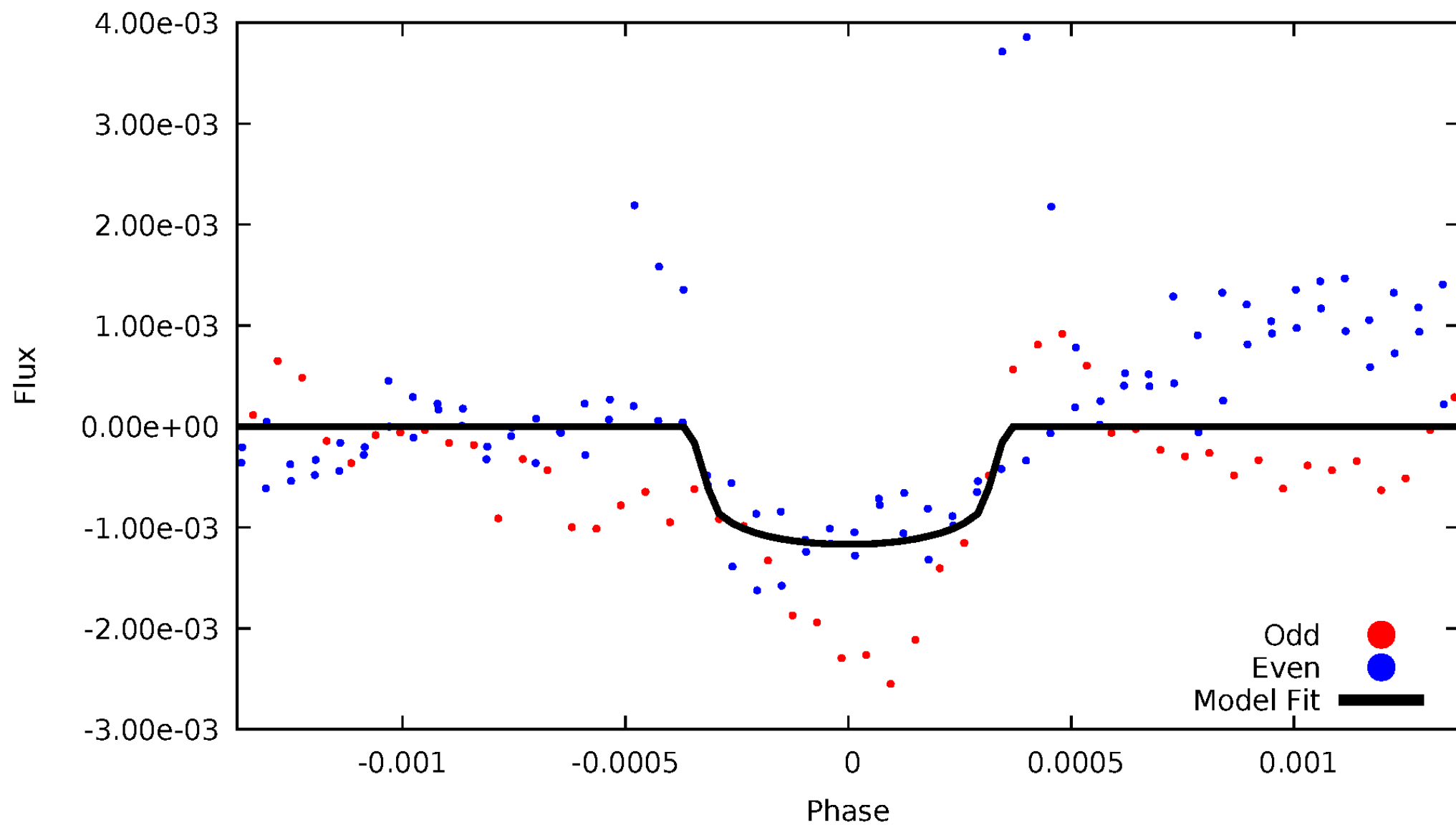


TCE 012010004-01



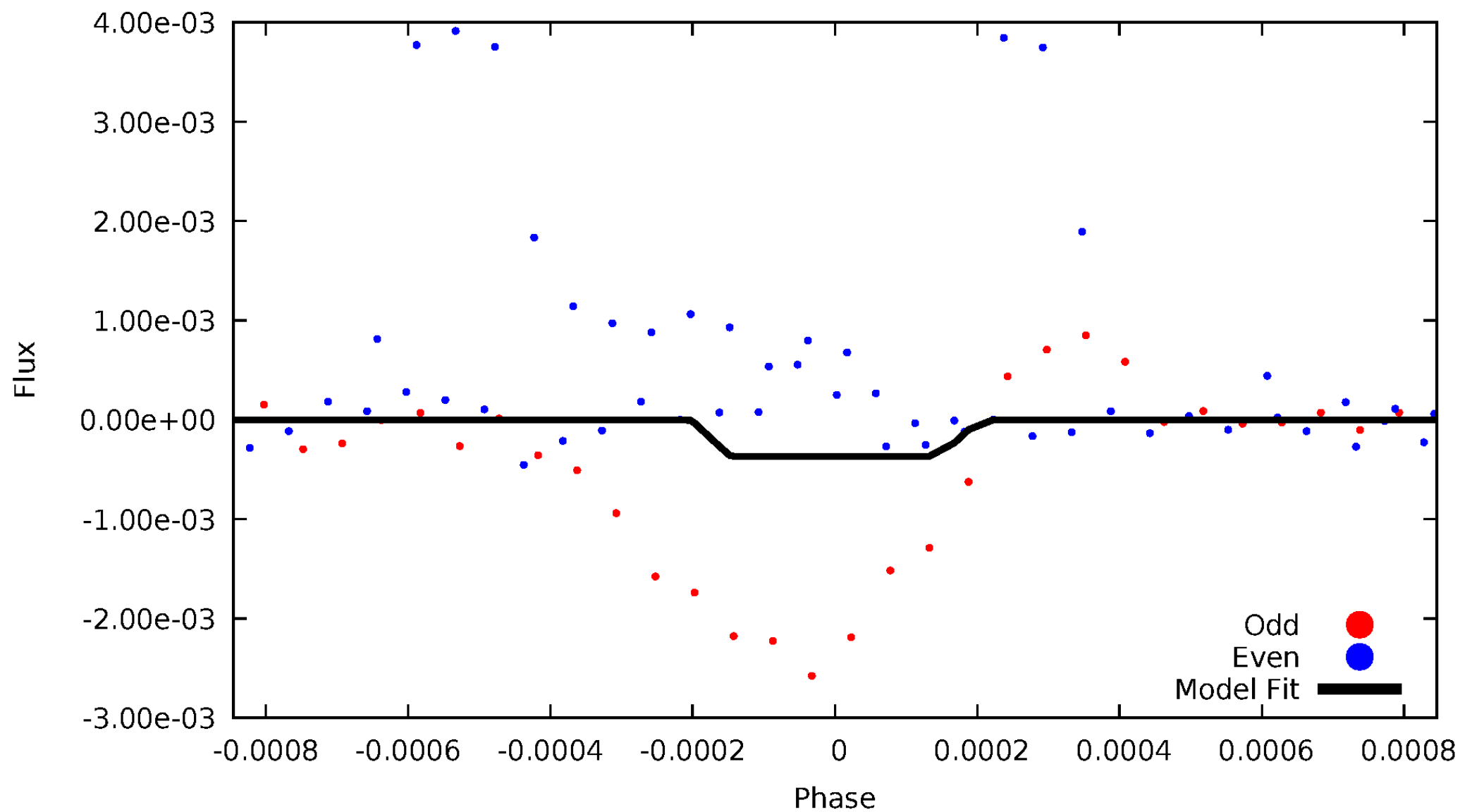
# DV Odd/Even

TCE 012010004-01



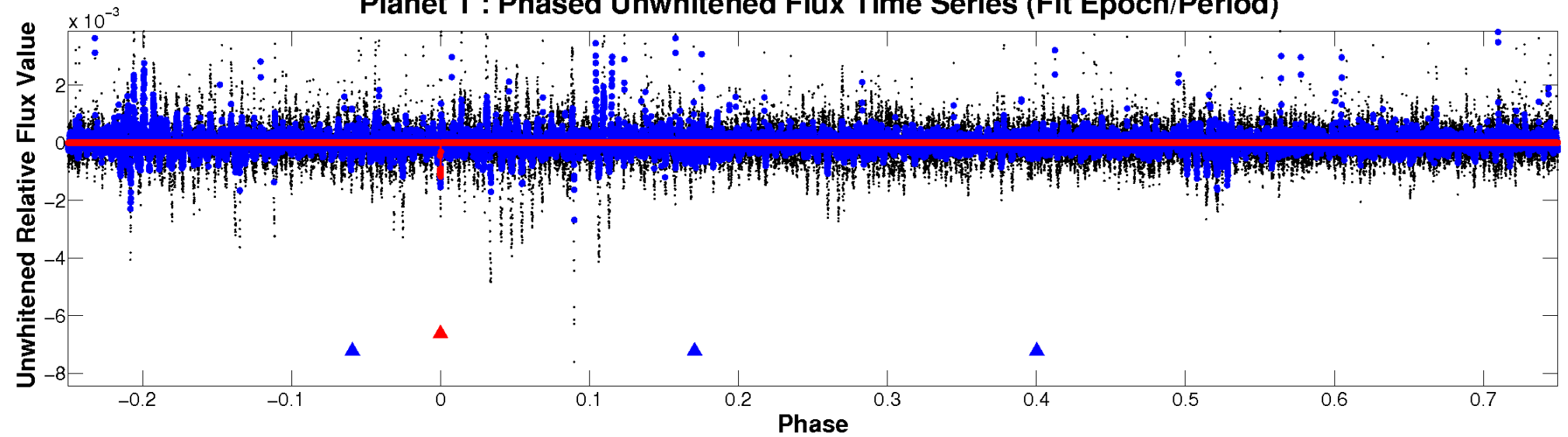
# ALT Odd/Even

TCE 012010004-01

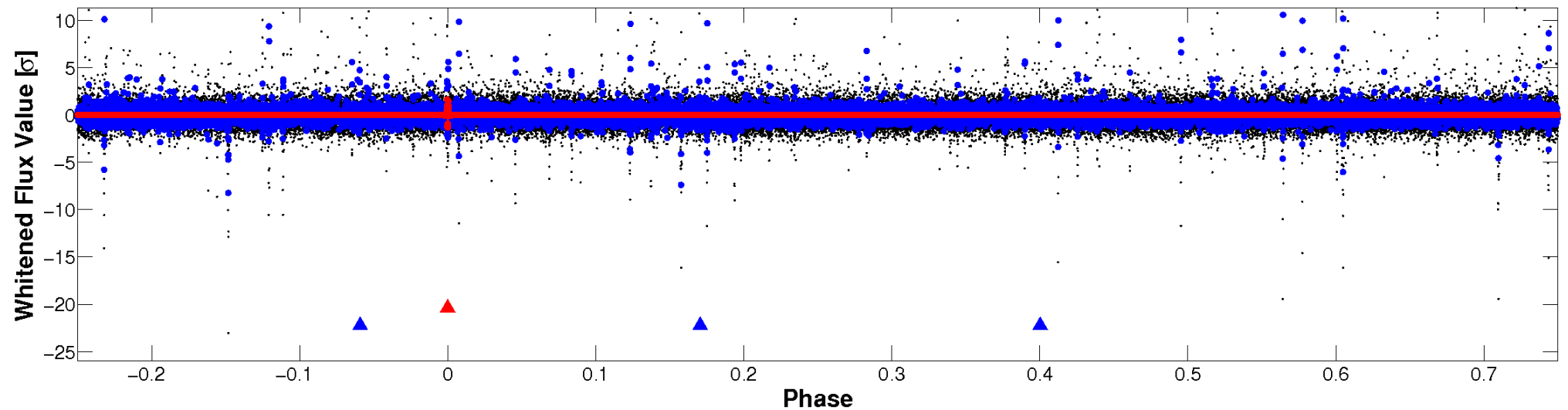


# Non-Whitened Vs. Whitened Light Curve

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



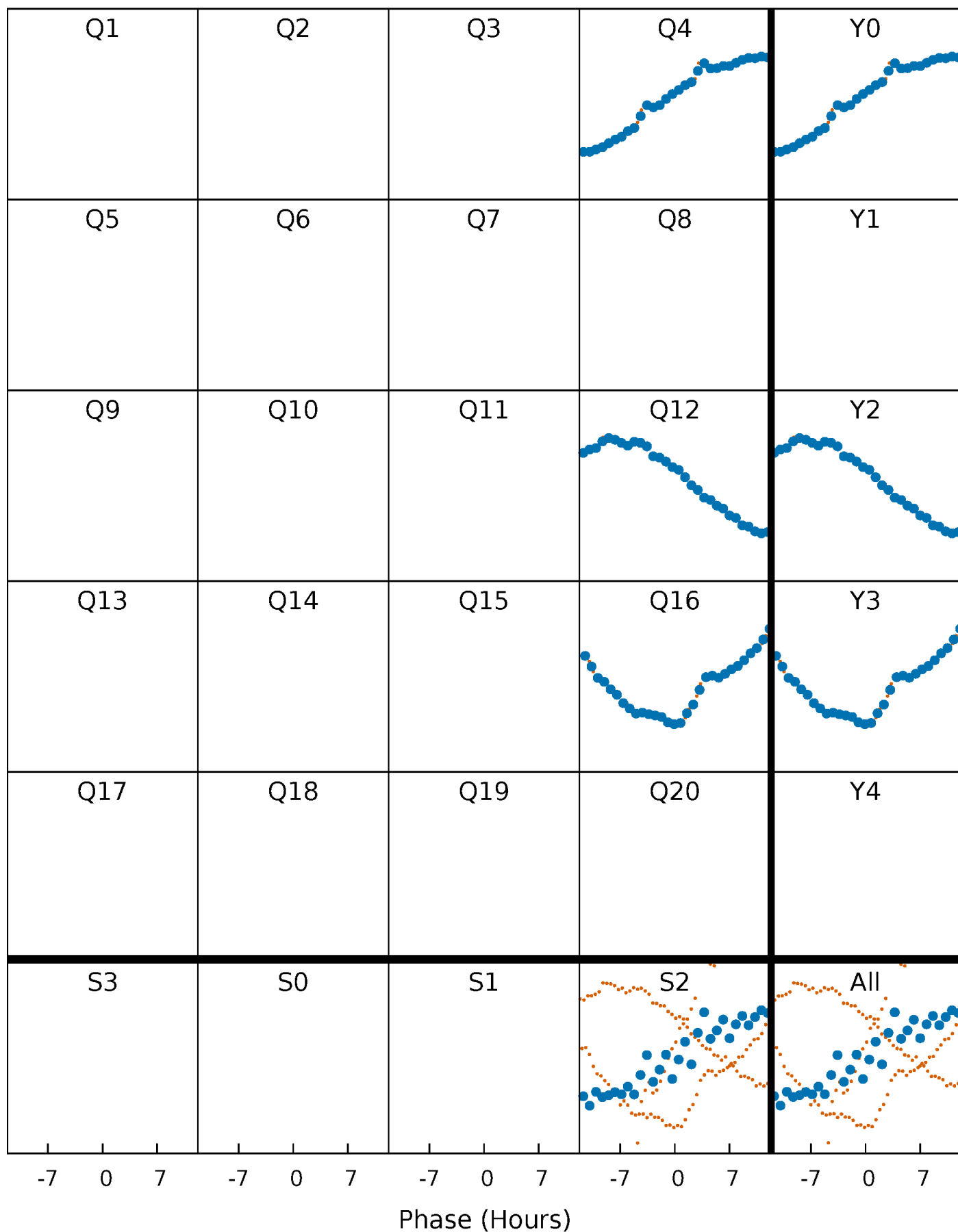
**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**





# PDC Quarter-Phased Transit Curves

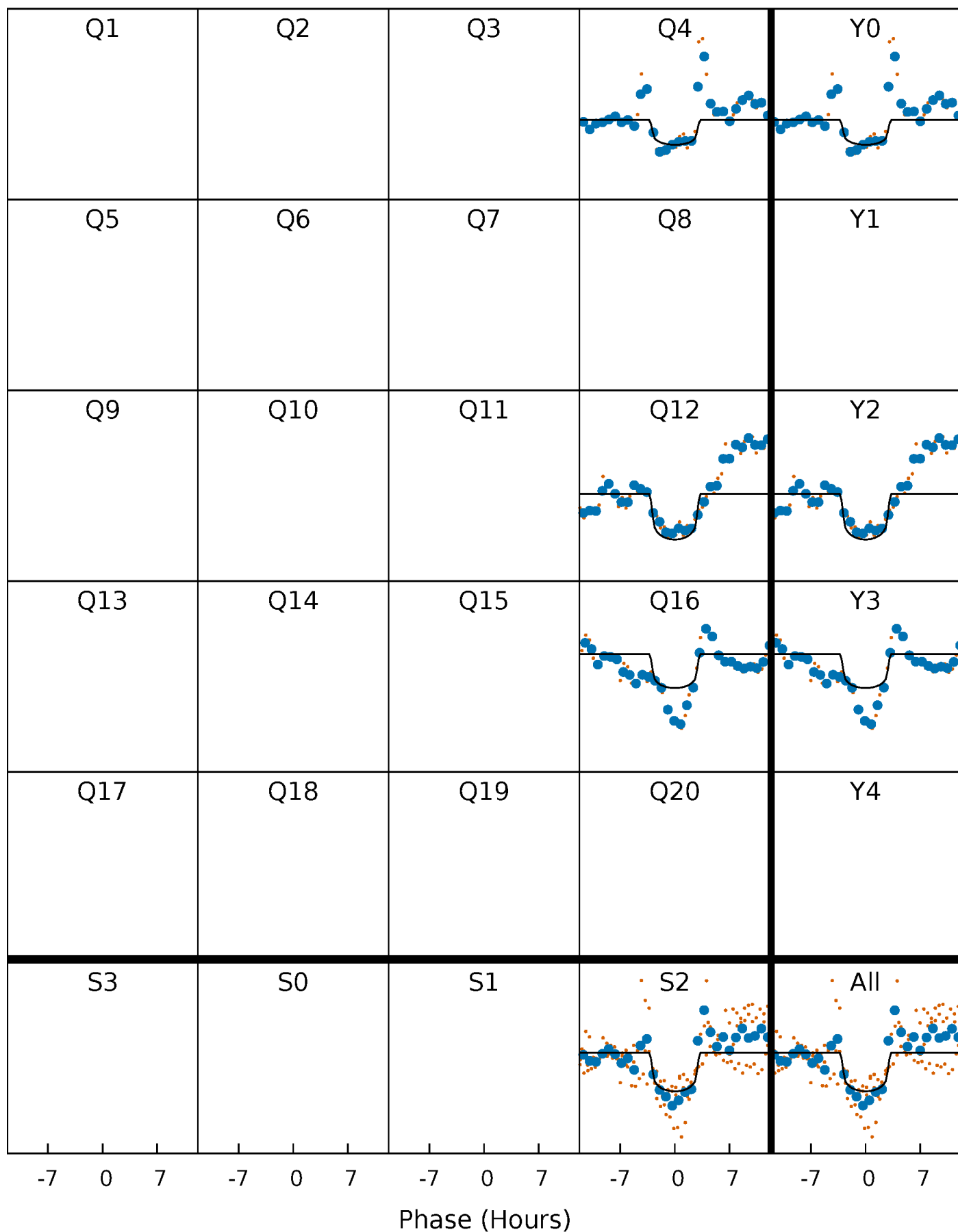
TCE 012010004-01 P=371.472956 Days  $T_0=433.778706$  (BKJD)





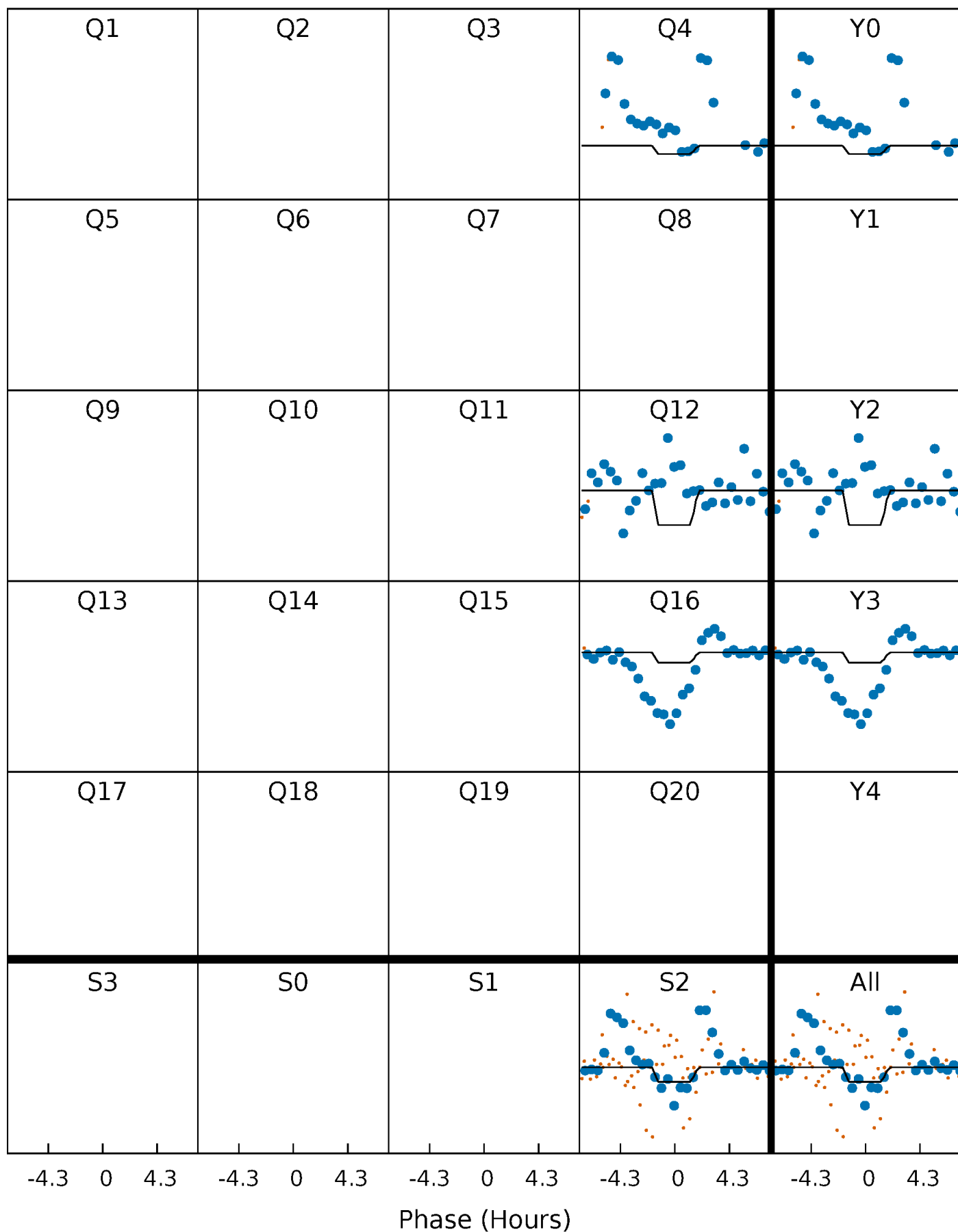
# DV Quarter-Phased Transit Curves

TCE 012010004-01 P=371.472956 Days  $T_0=433.778706$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

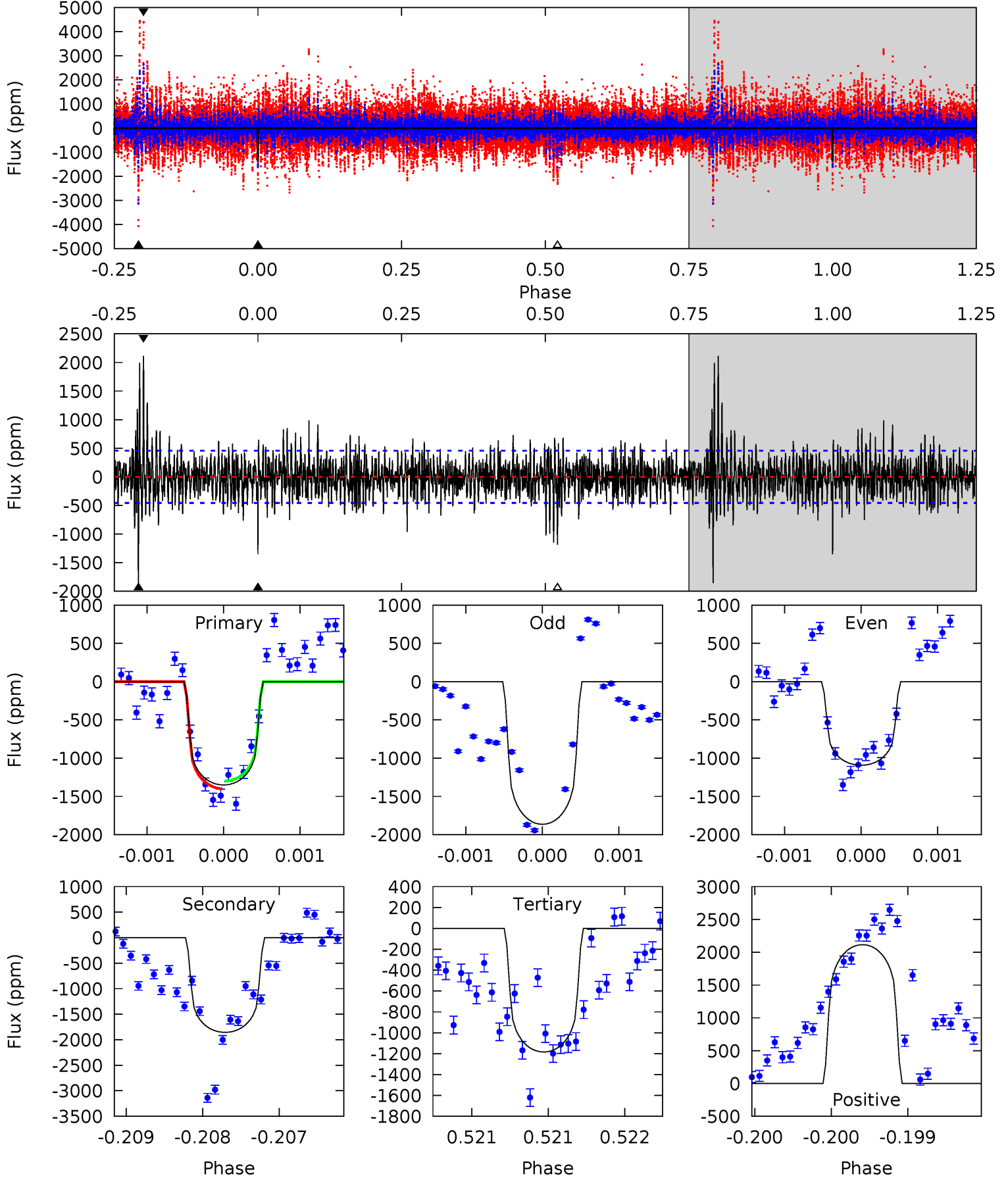
TCE 012010004-01 P=371.475310 Days  $T_0=433.818963$  (BKJD)



# DV Model-Shift Uniqueness Test

012010004-01, P = 371.472956 Days, E = 62.305750 Days

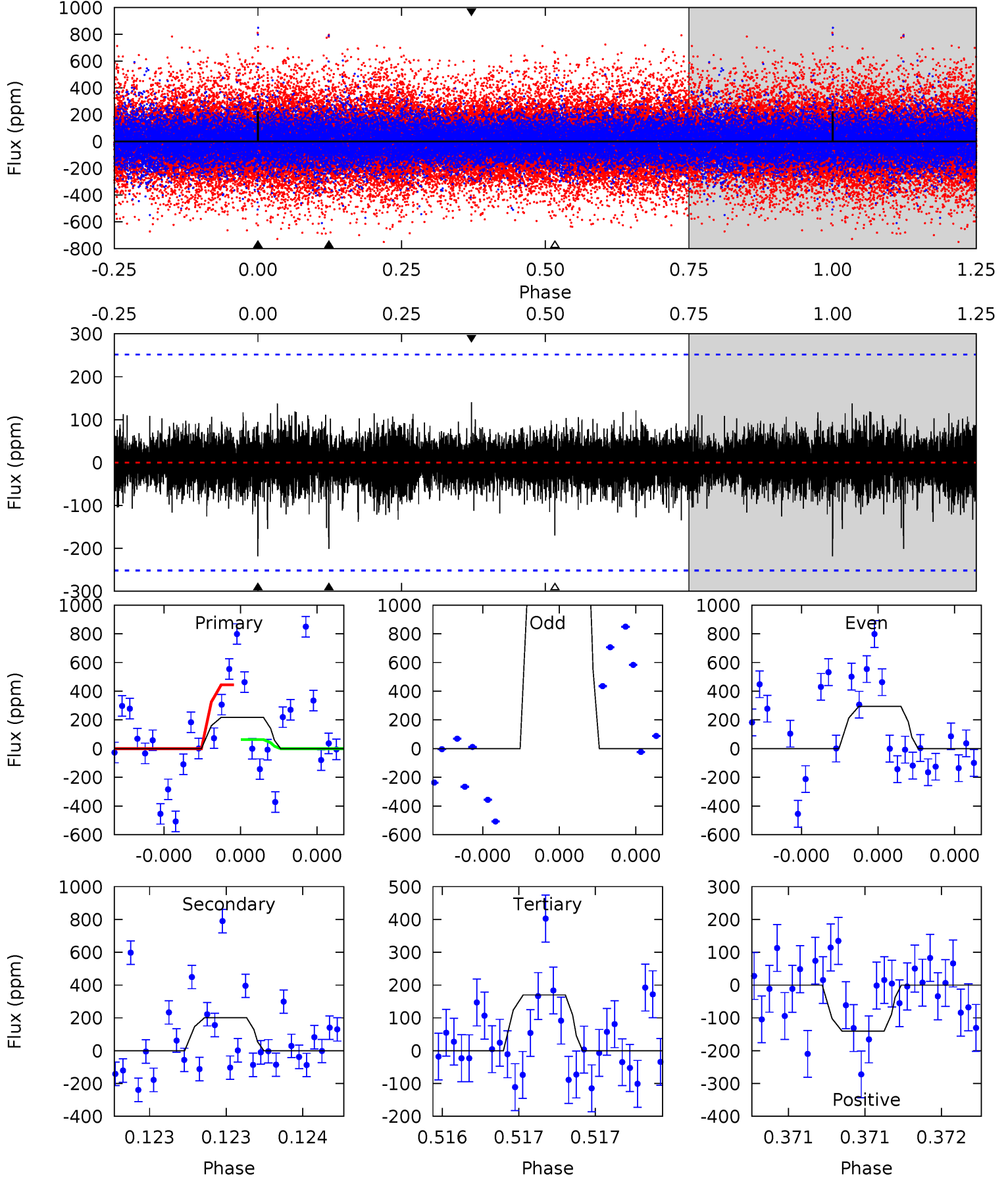
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
16.3	22.4	14.3	25.5	5.51	3.38	3.14	2.00	-9.23	8.10	-3.14	3.75	1.13	0.53	0.61



# Alt Model-Shift Uniqueness Test

012010004-01, P = 371.475310 Days, E = 62.343653 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
4.86	4.47	3.78	3.12	5.60	3.52	0.69	1.08	1.74	0.69	1.35	23.1	-2.45	0.39	0



### Stellar Parameters For KIC 012010004

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6004^{+163}_{-181}$	$4.359^{+0.148}_{-0.181}$	$-0.280^{+0.300}_{-0.300}$	$1.062^{+0.312}_{-0.192}$	$0.940^{+0.132}_{-0.096}$	$1.107^{+0.757}_{-0.517}$
	+3%/-3%	+3%/-4%	+107%/-107%	+29%/-18%	+14%/-10%	+68%/-47%
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 012010004-01 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-1855 \pm 83$	$8.28^{+8.25}_{-5.72}$	$384^{+30}_{-23}$	$4819^{+3893}_{-1101}$	$14923^{+135083}_{-11258}$
Alt.	$-201 \pm 45$	$8.10^{+8.56}_{-5.82}$	$385^{+29}_{-24}$	$3273^{+1981}_{-580}$	$1602^{+18815}_{-1206}$

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

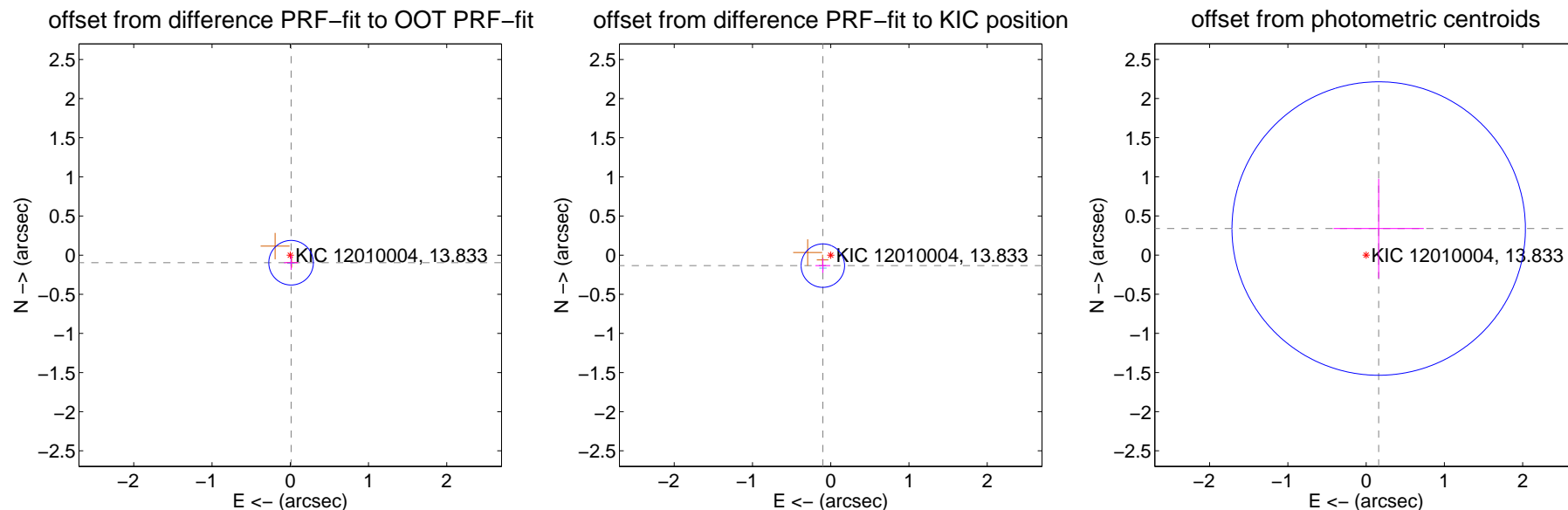
## DV Centroid Data

Supplemental centroid analysis for 012010004-01. Kepler magnitude: 13.83. Transit SNR 7.27

There are 1 quarters with good PRF difference image offsets

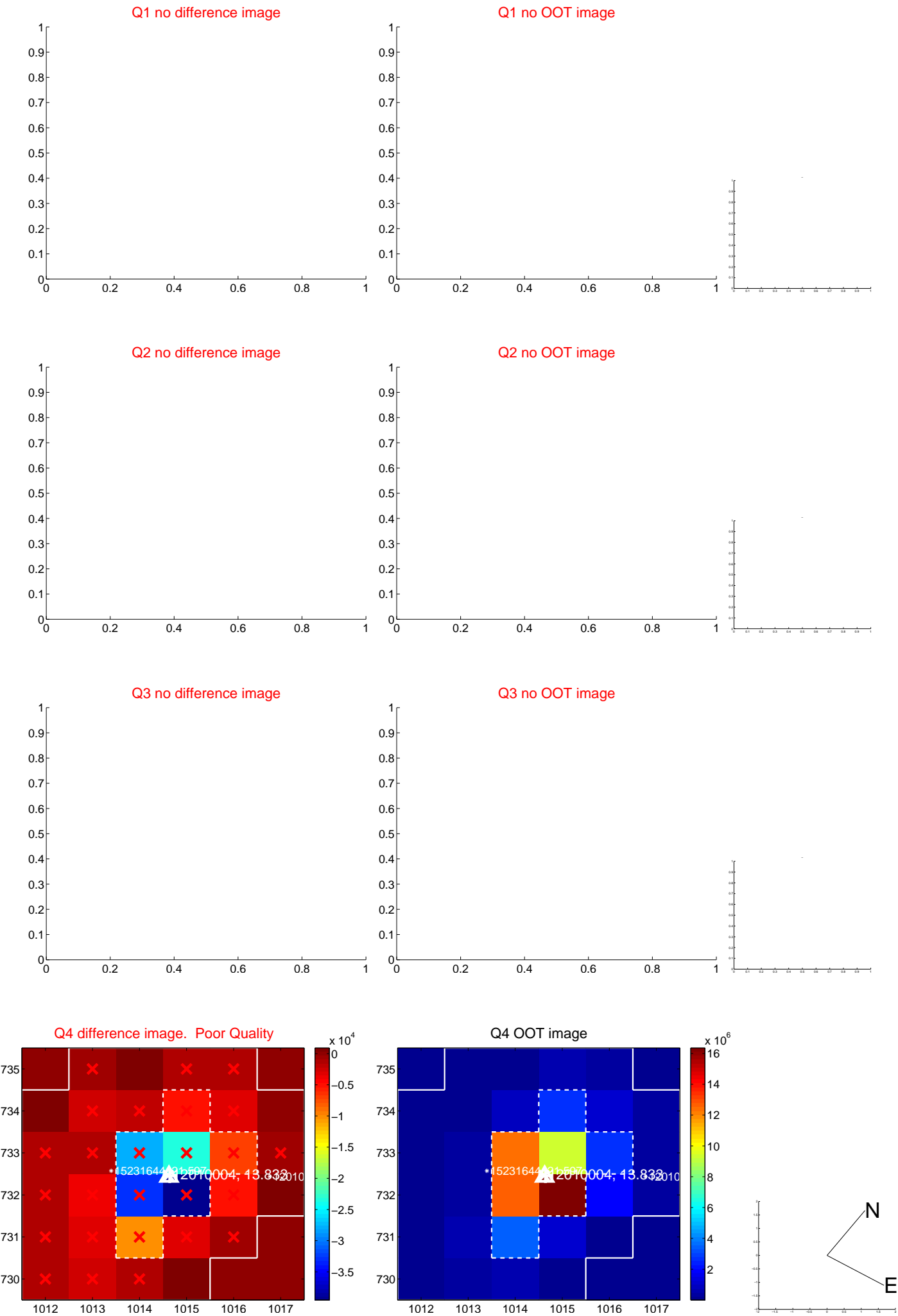
The direct PRF centroid is offset from the target star catalog position by about 0.12 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.097 \pm 0.095$	1.02	$-0.011 \pm 0.090$	$-0.097 \pm 0.091$
PRF-fit source offset from KIC position	$0.168 \pm 0.093$	1.81	$0.101 \pm 0.095$	$-0.134 \pm 0.091$
photometric centroid source offset	$0.38 \pm 0.62$	0.60	$-0.16 \pm 0.58$	$0.34 \pm 0.64$



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.

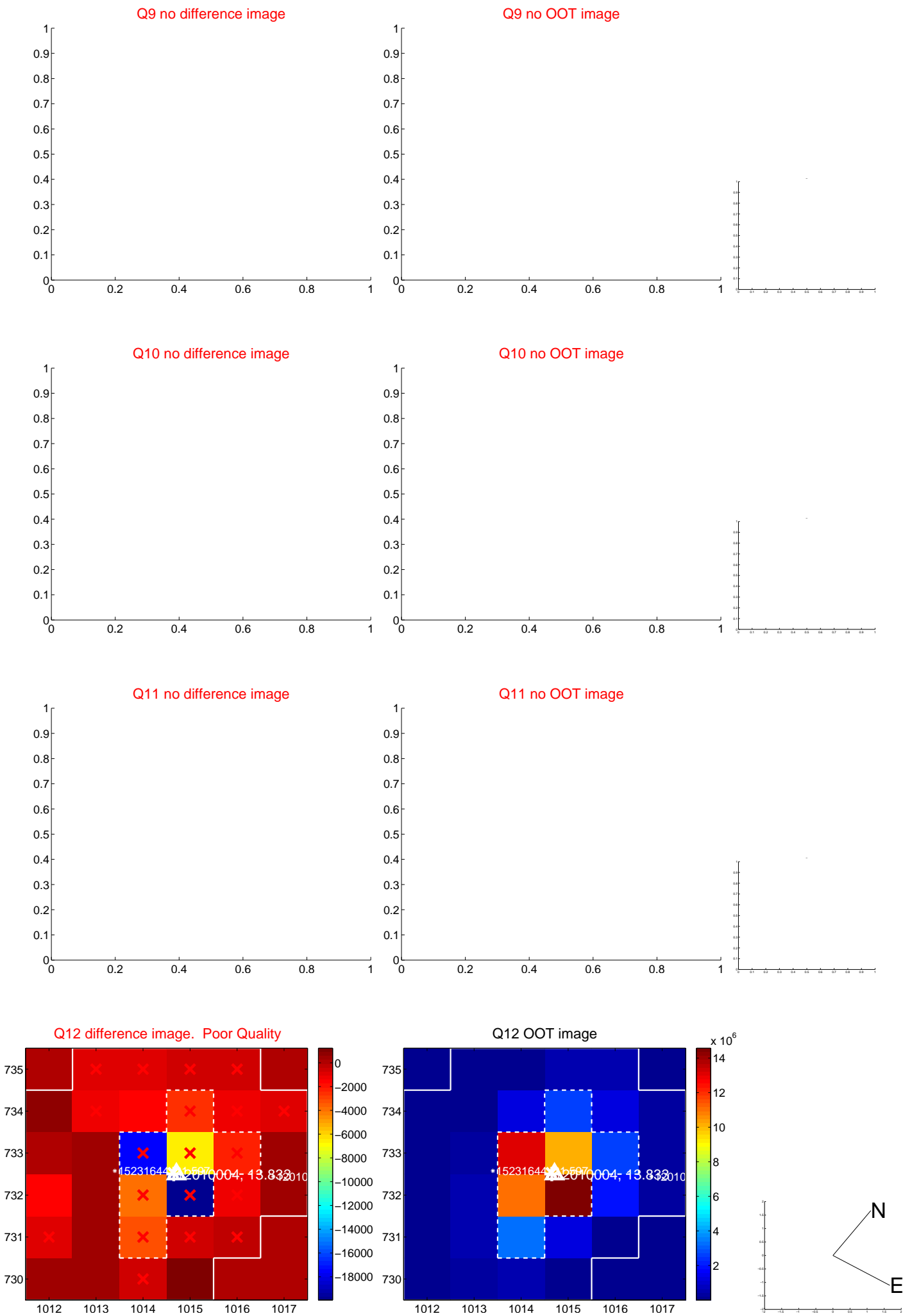




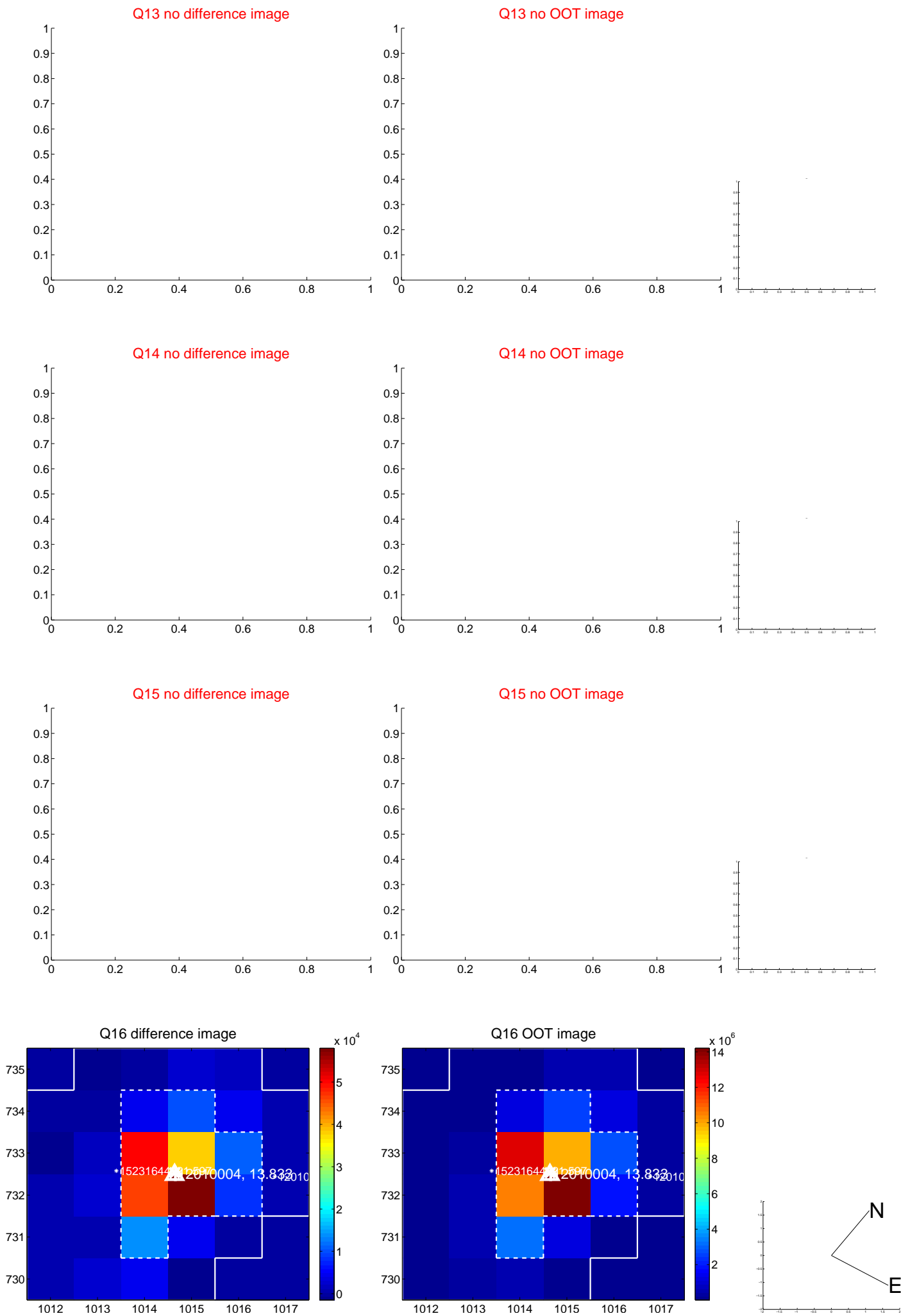
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



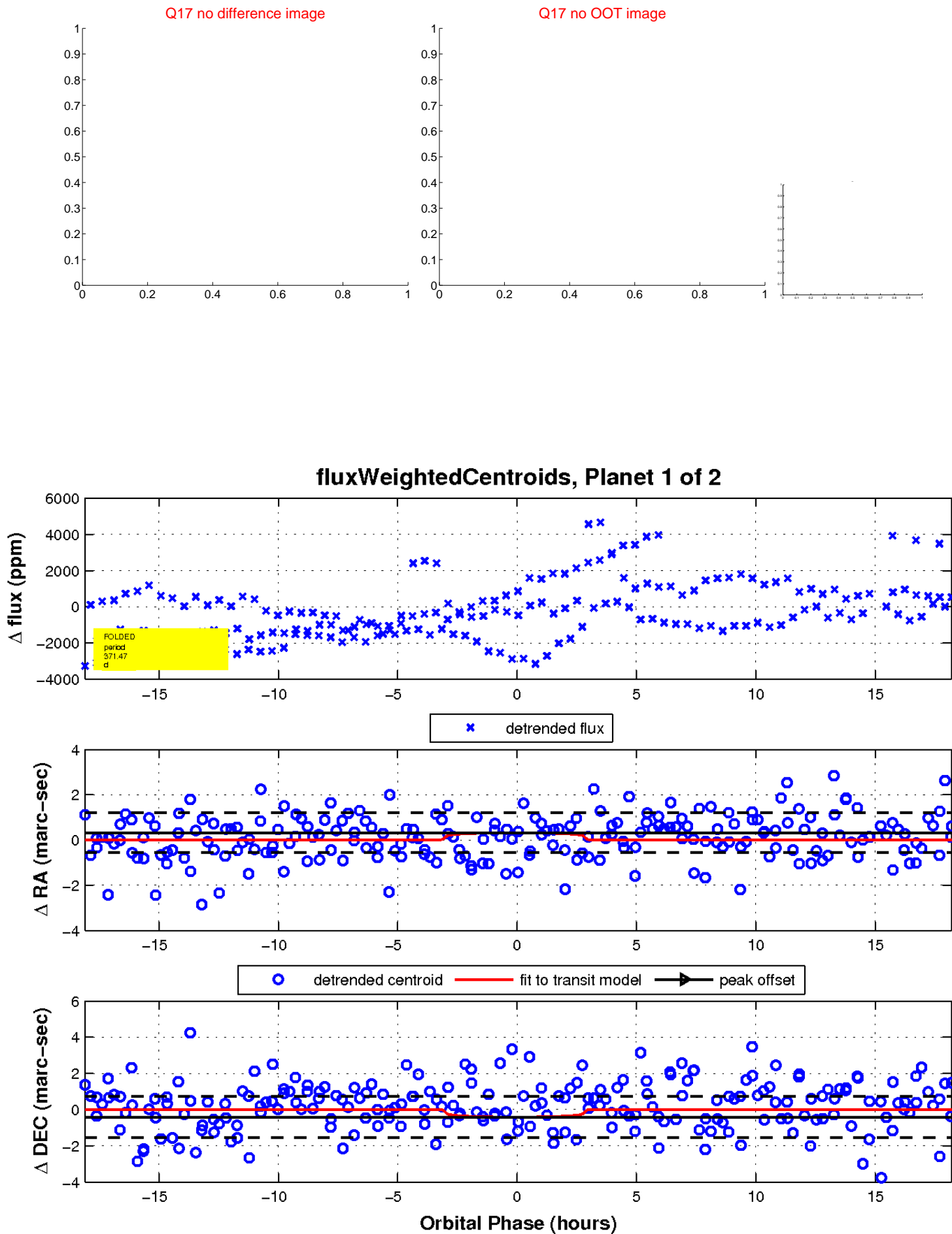
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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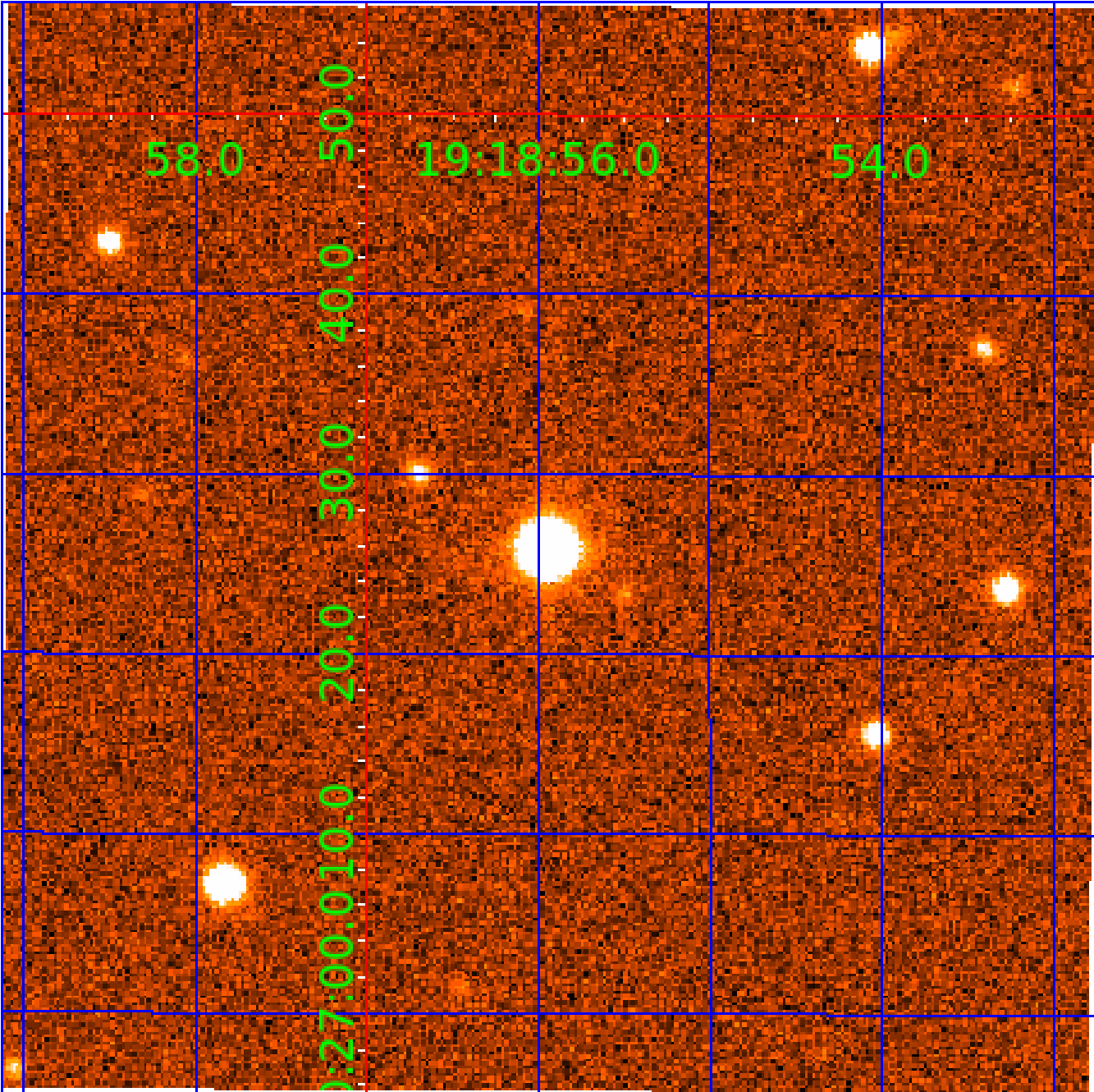


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 012010004

## 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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012010004-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_MARSHALL_SKYE_TRACKER—LPP_DV—LPP_ALT—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—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.

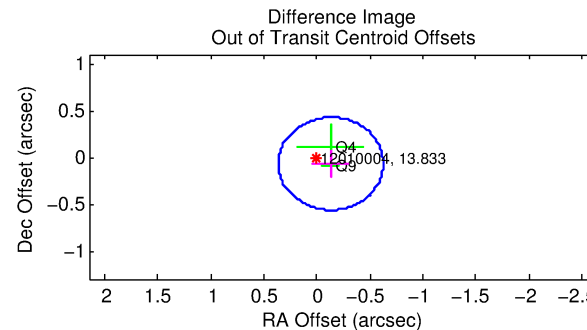
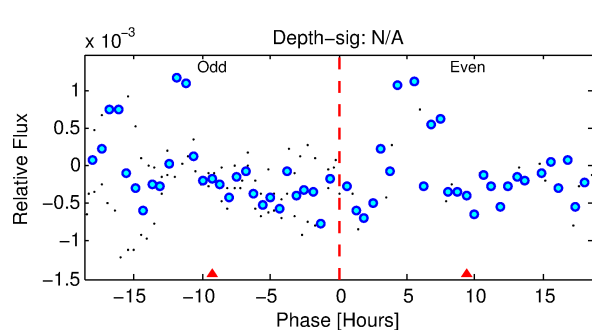
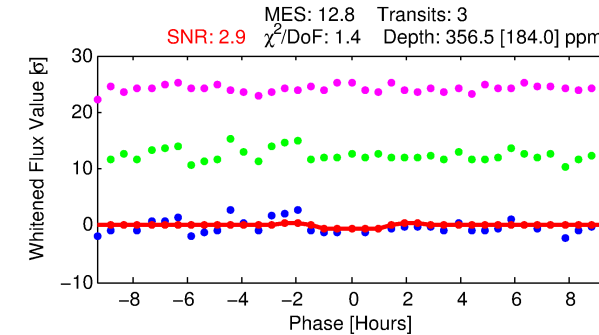
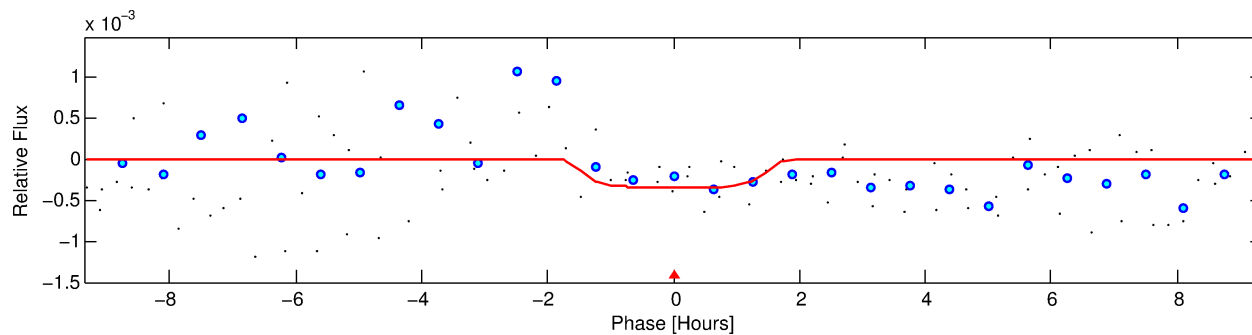
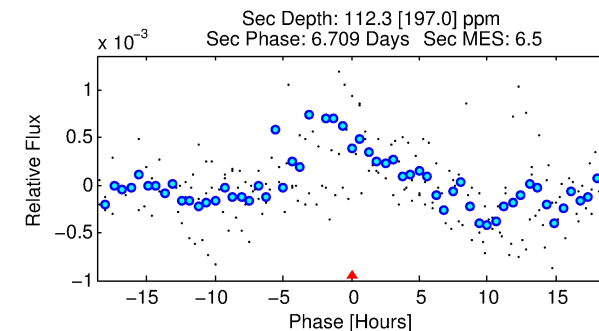
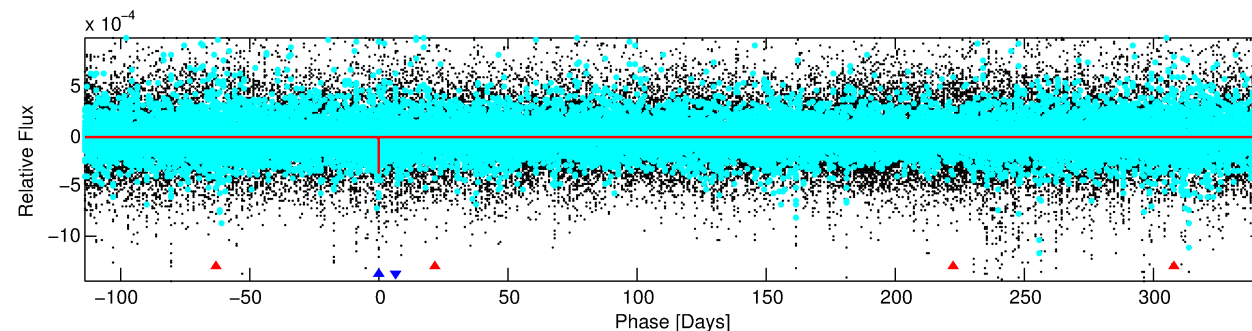
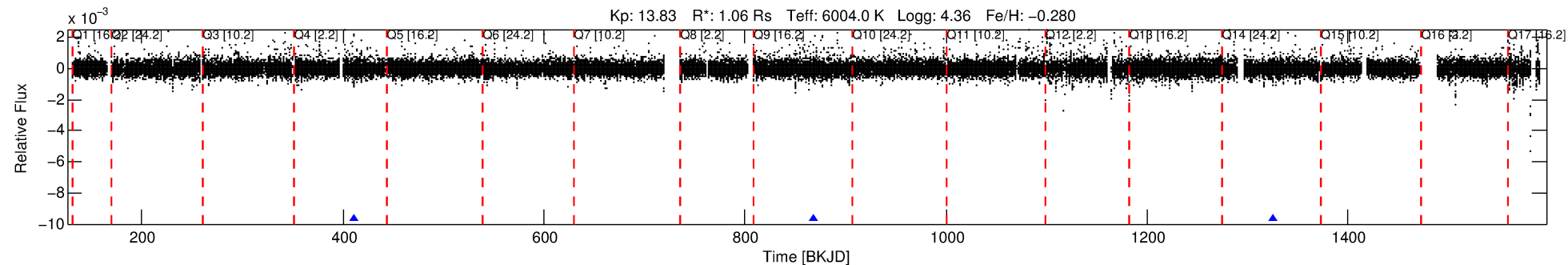
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 012010004-02

No Significant Match Found

# DV One-Page Summary

KIC: 12010004 Candidate: 2 of 2 Period: 456.805 d



## DV Fit Results:

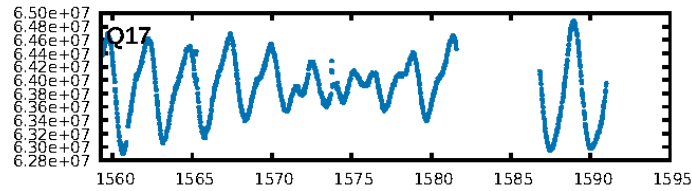
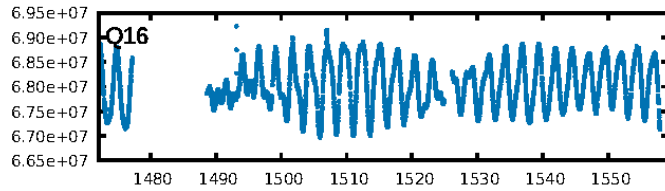
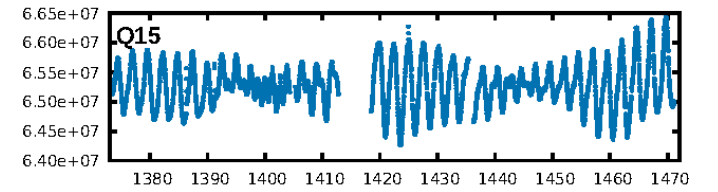
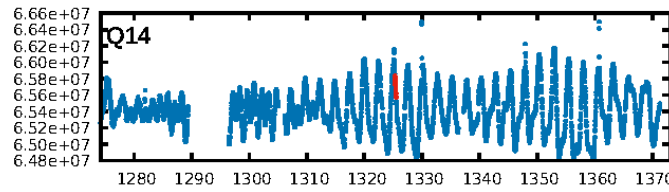
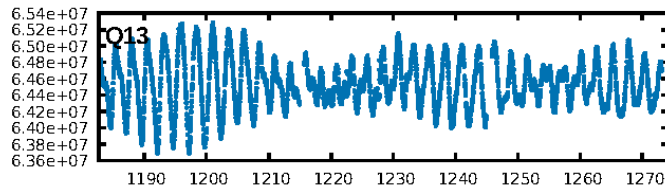
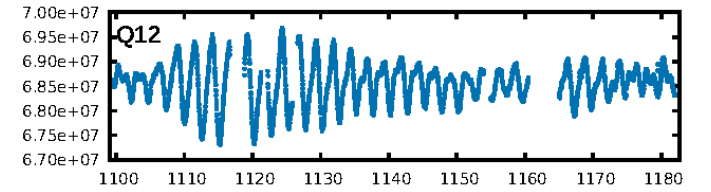
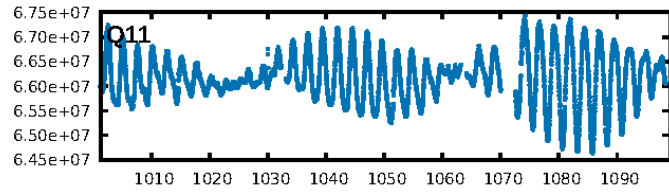
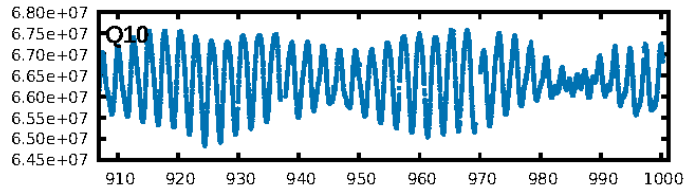
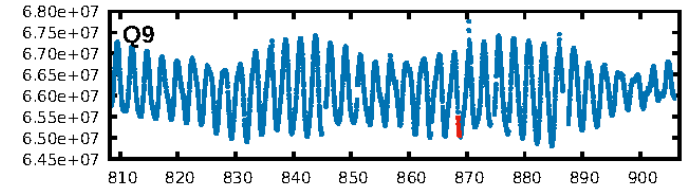
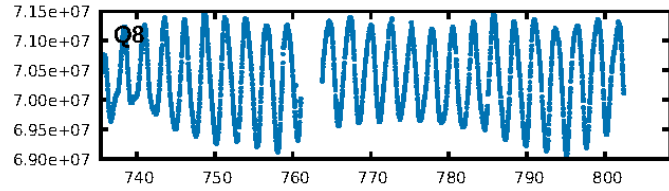
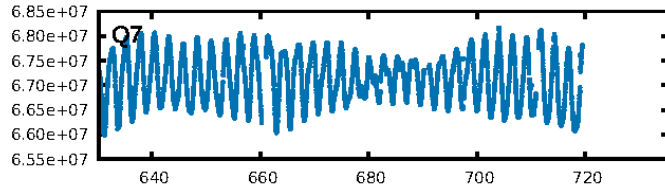
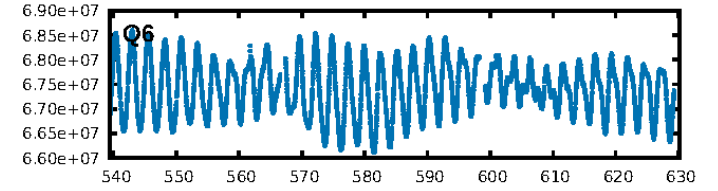
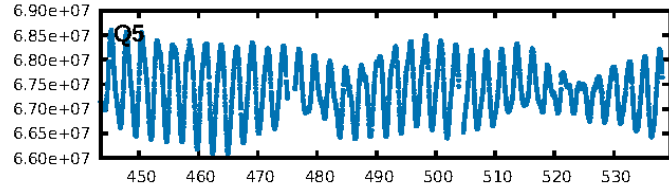
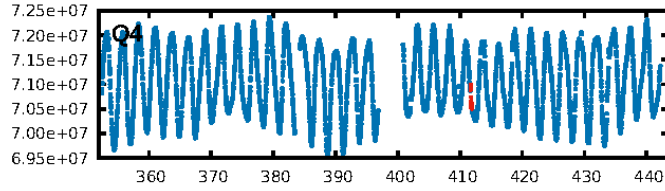
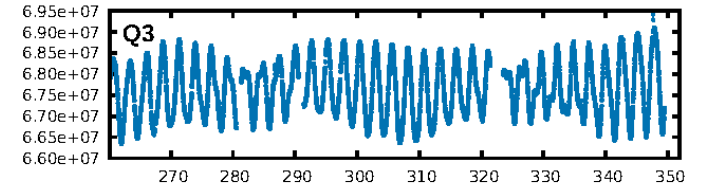
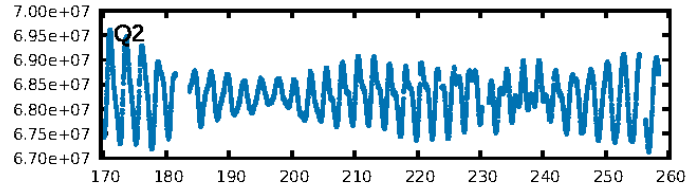
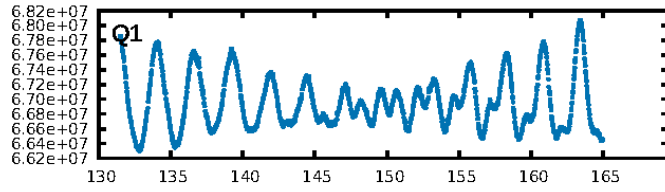
Period = 456.80456 [0.01499] d  
Epoch = 411.8087 [0.0199] BKJD  
Rp/R\* = 0.0175 [0.1093]  
a/R\* = 1078.99 [33217.25]  
b = 0.32 [85.24]  
Seff = 1.01 [0.37]  
Teff = 256 [23] K  
Rp = 2.03 [12.68] Re  
a = 1.1375 [0.2731] AU  
Ag = 19477.75 [245988.00] [0.08σ]  
Teffp = 4675 [14755] K [0.30σ]

## DV Diagnostic Results:

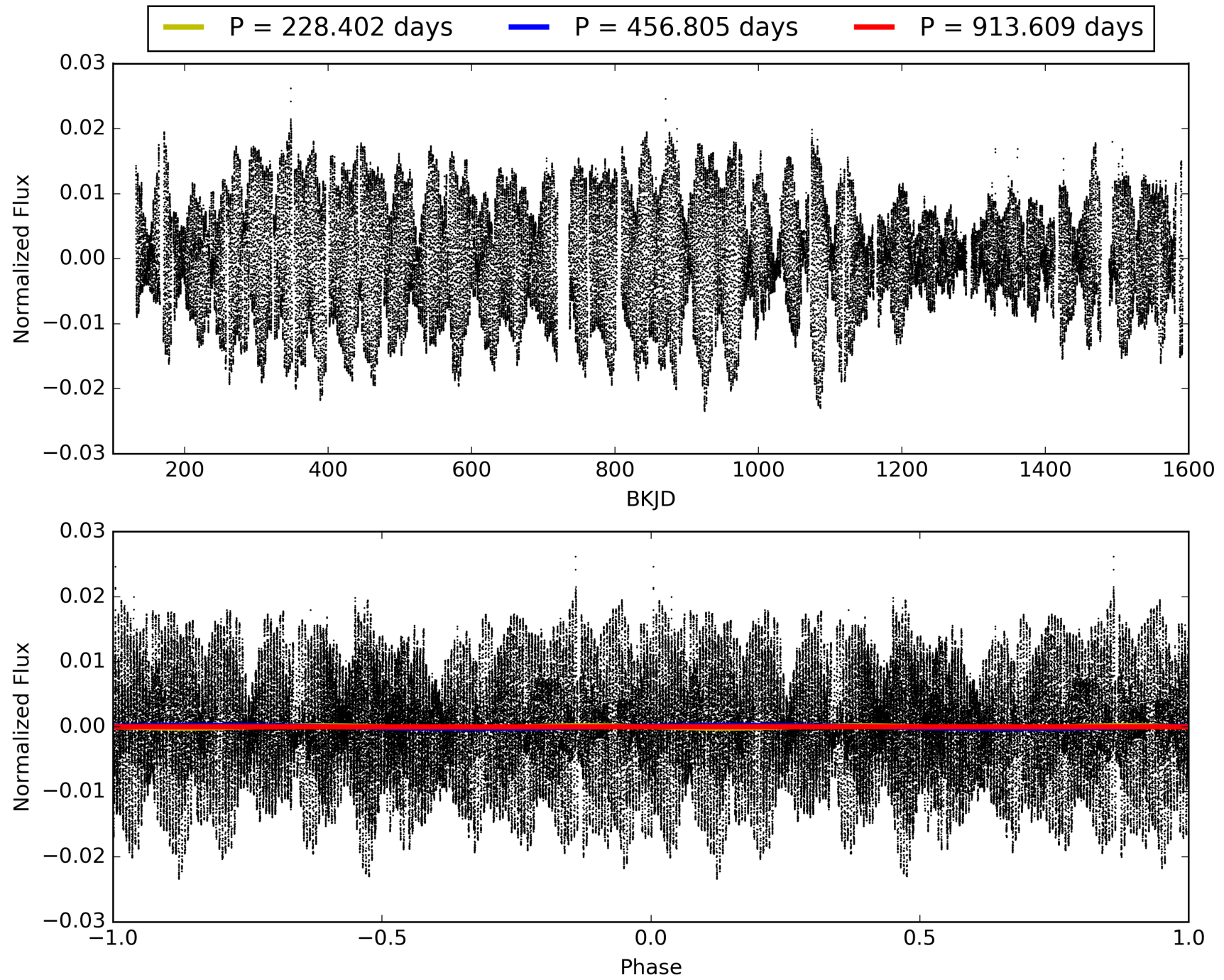
ShortPeriod-sig: 100.0% [298.52σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 9.2%  
ModelChiSquareGof-sig: 94.5%  
**Bootstrap-pfa: 1.86e-10**  
RollingBand-fgt: 1.00 [3/3]  
**GhostDiagnostic-chr: 0.9359**  
Centroid-sig: 70.1%  
Centroid-so: 1.187 arcsec [0.53σ]  
OotOffset-rm: 0.147 arcsec [0.89σ]  
KicOffset-rm: 0.154 arcsec [1.03σ]  
OotOffset-st: 0/0/1/1 [2]  
KicOffset-st: 0/0/1/1 [2]  
DiffImageQuality-fgm: 1.00 [2/2]  
DiffImageOverlap-fno: 1.00 [3/3]



# TCE 012010004-02, PDC Light Curves

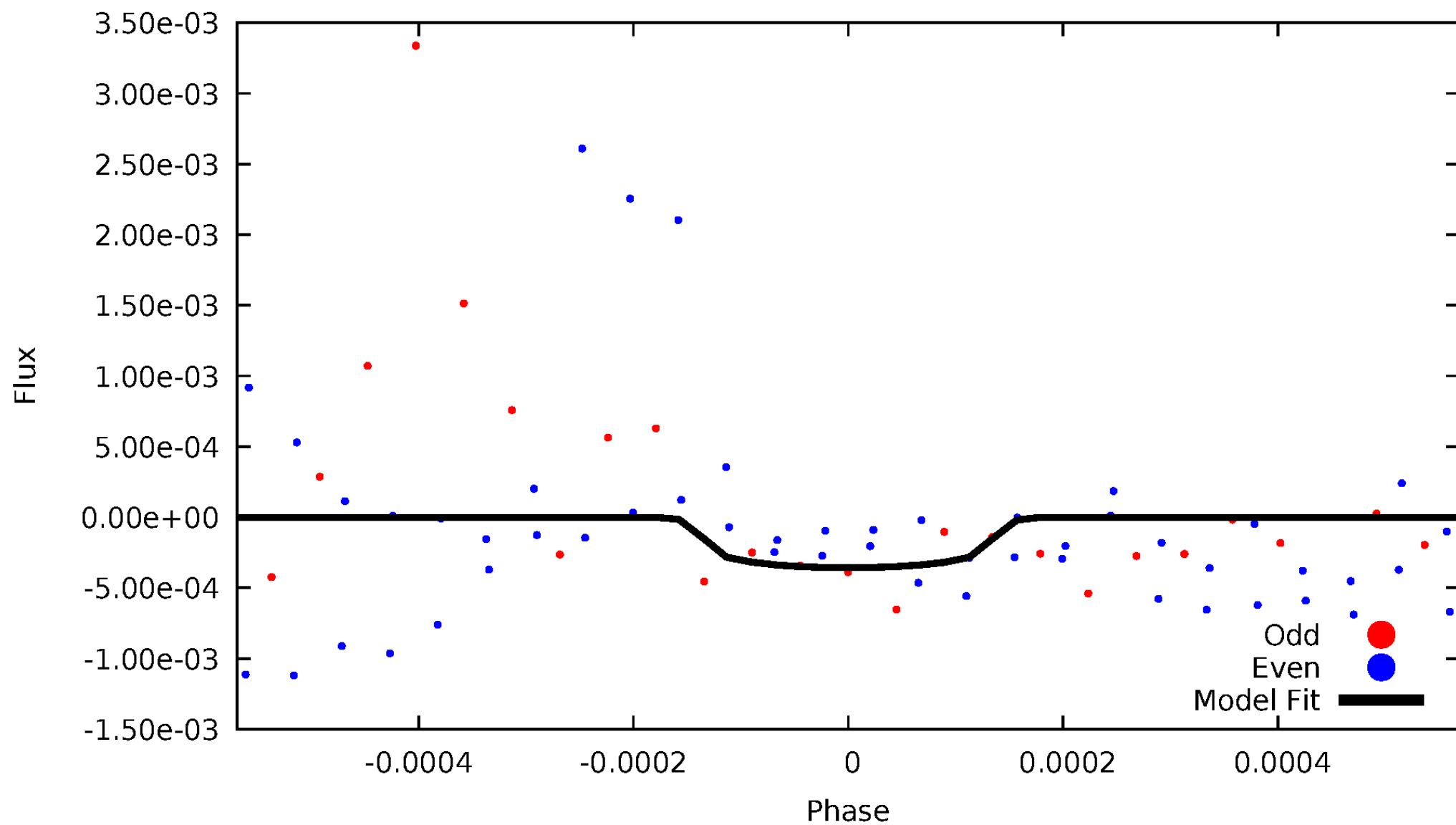


# TCE 012010004-02



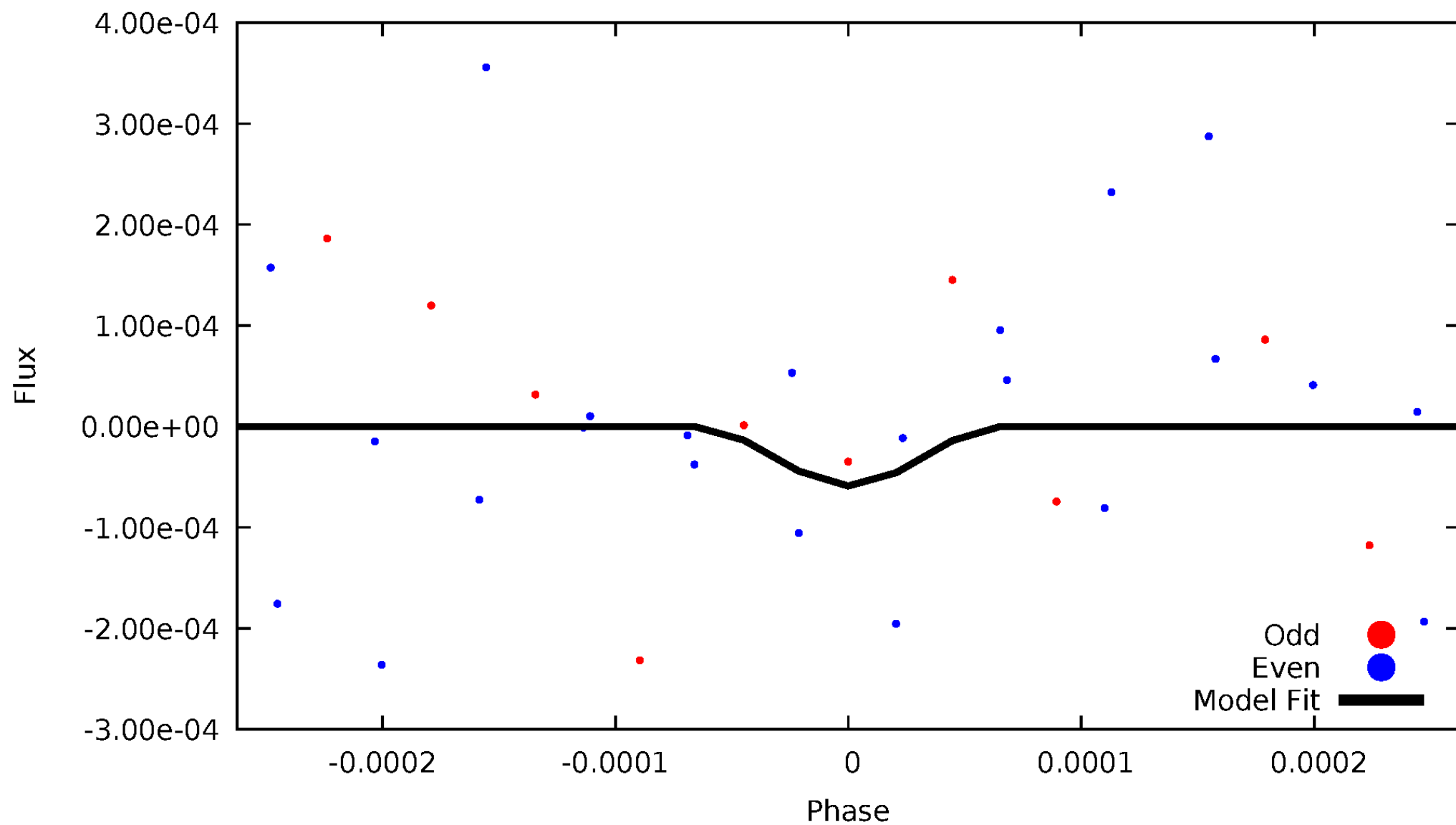
# DV Odd/Even

TCE 012010004-02



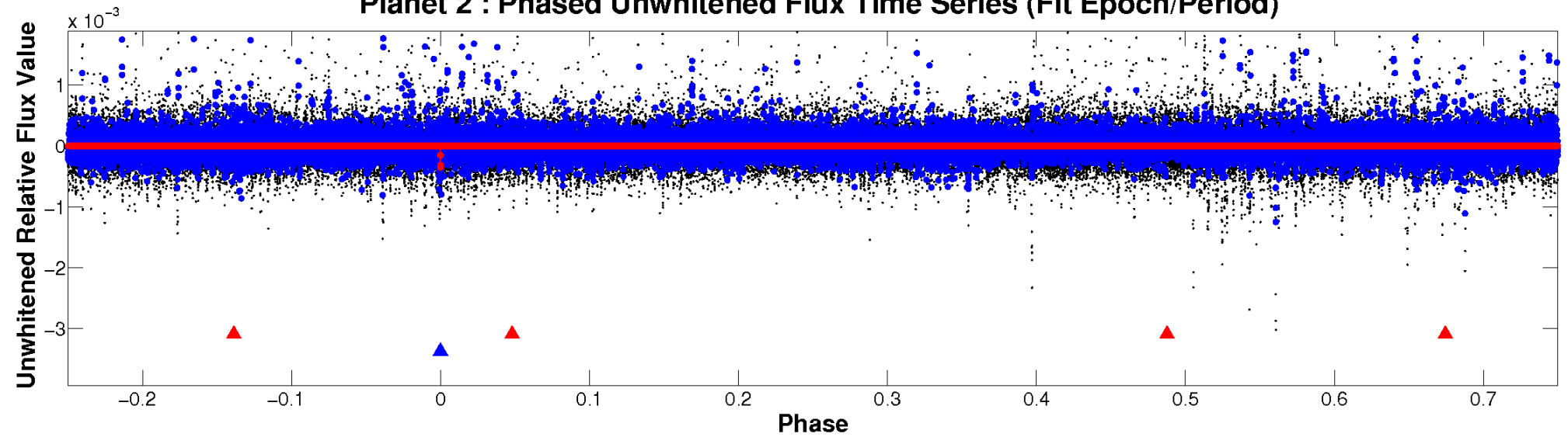
# ALT Odd/Even

TCE 012010004-02

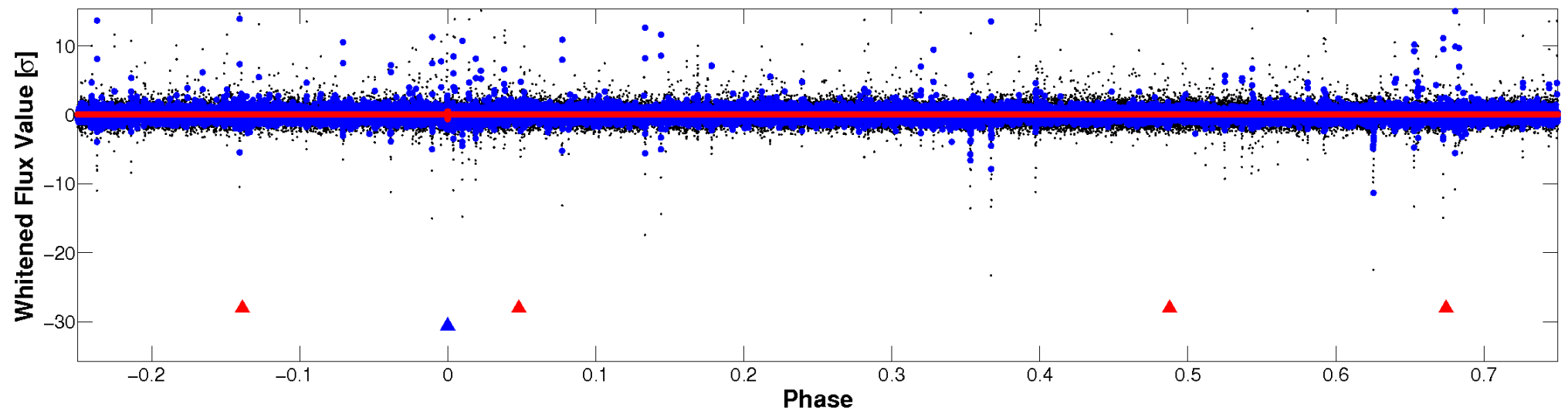


# Non-Whitened Vs. Whitened Light Curve

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

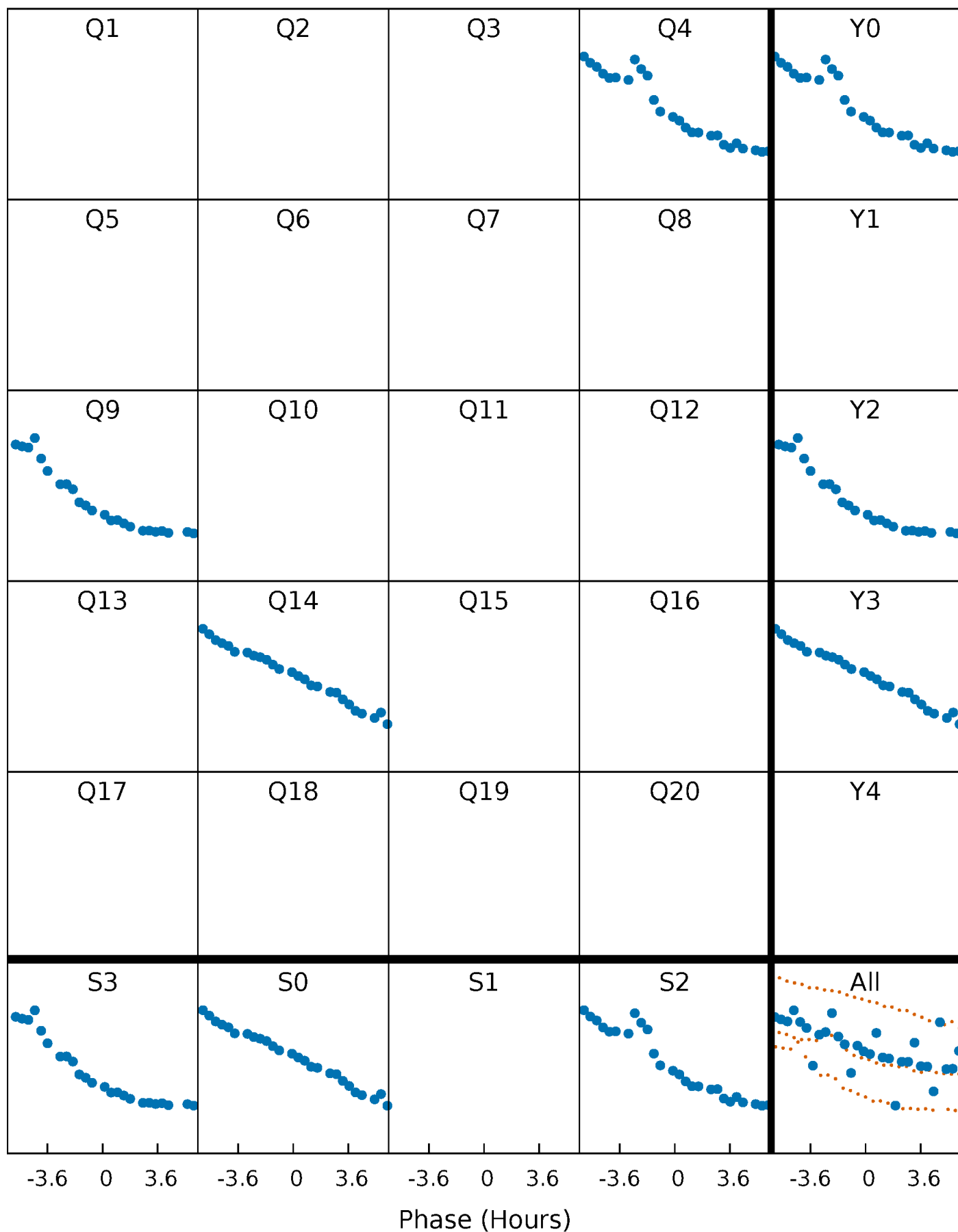


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



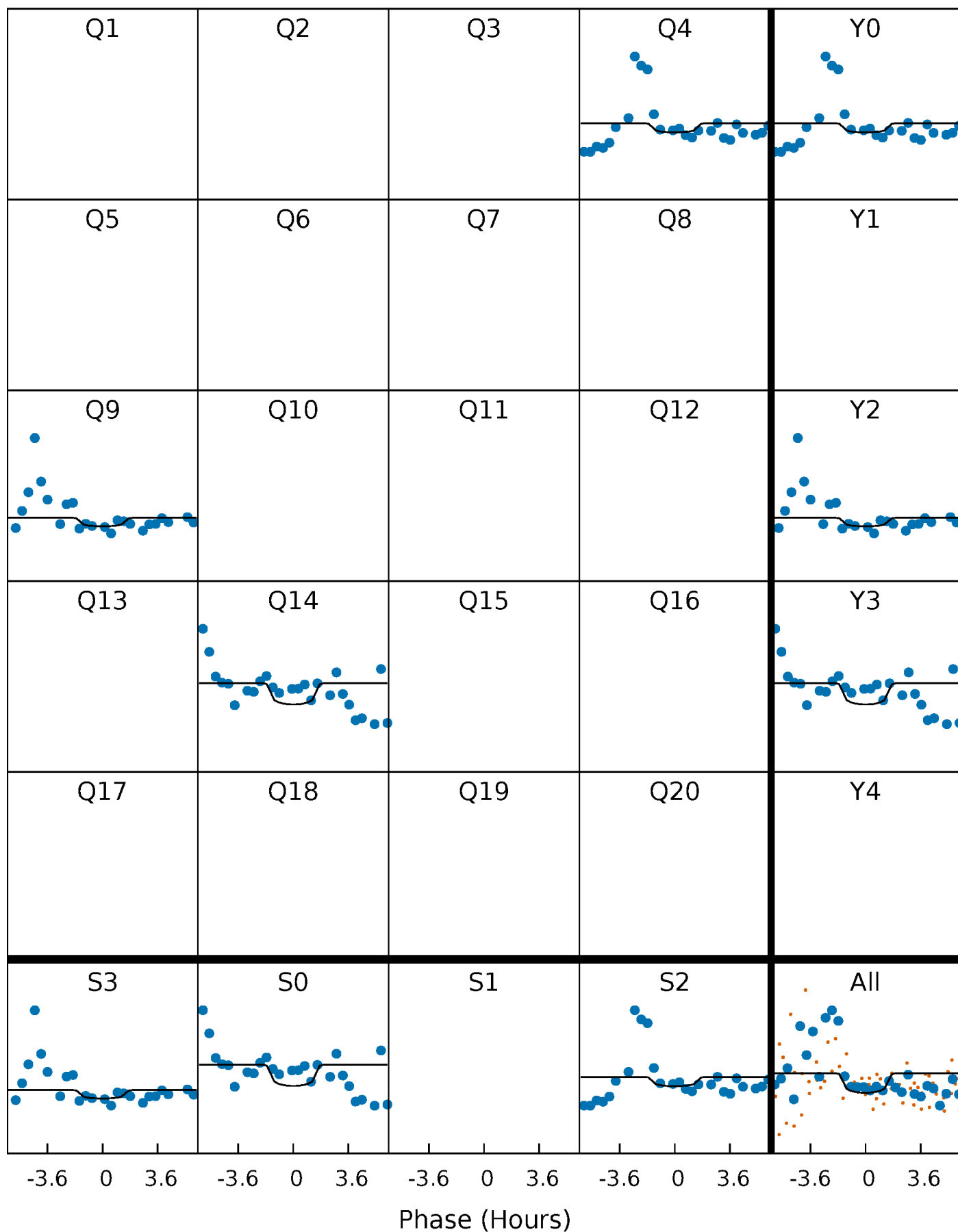
# PDC Quarter-Phased Transit Curves

TCE 012010004-02     $P=456.804557$  Days     $T_0=411.808662$  (BKJD)



# DV Quarter-Phased Transit Curves

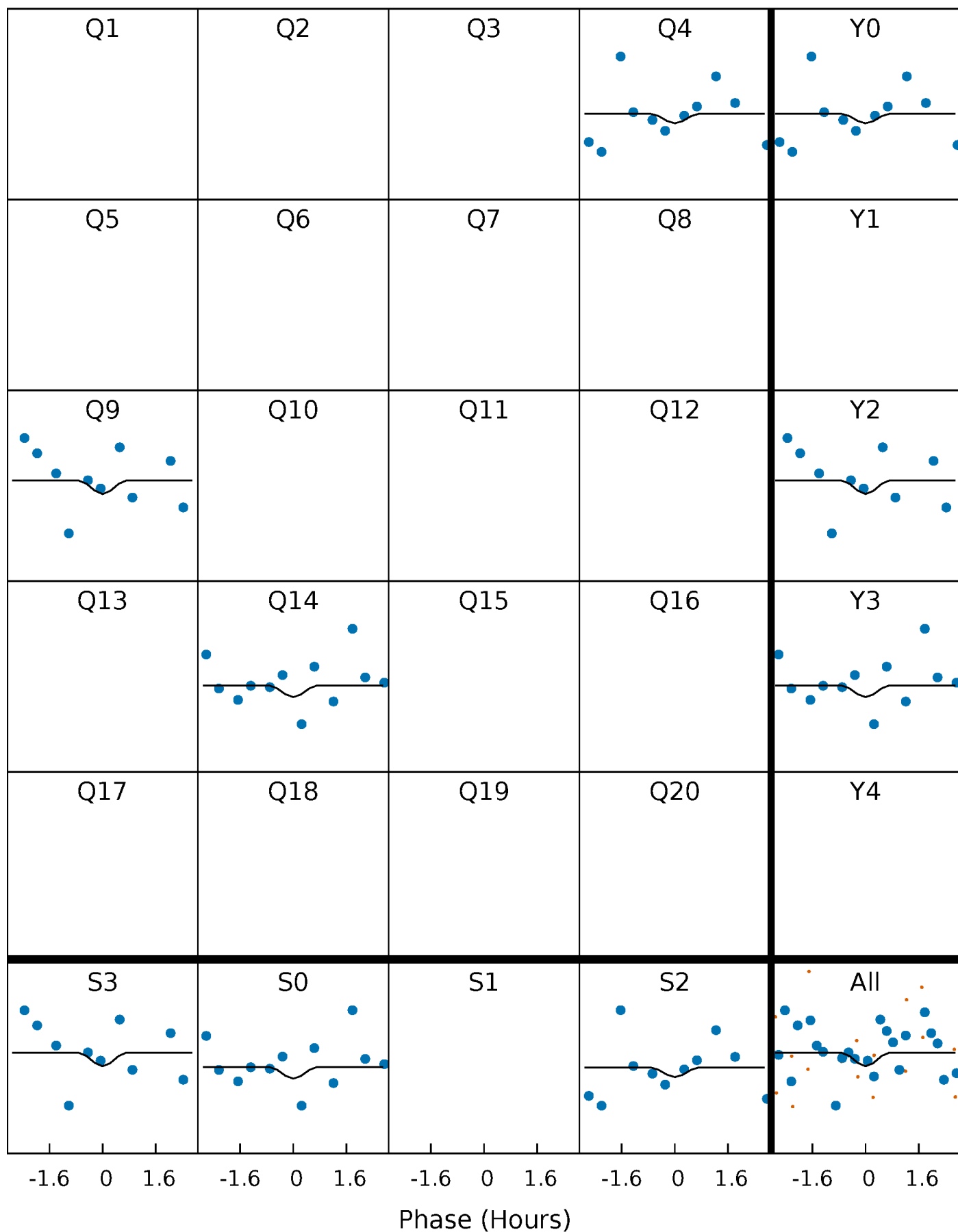
TCE 012010004-02 P=456.804557 Days  $T_0=411.808662$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

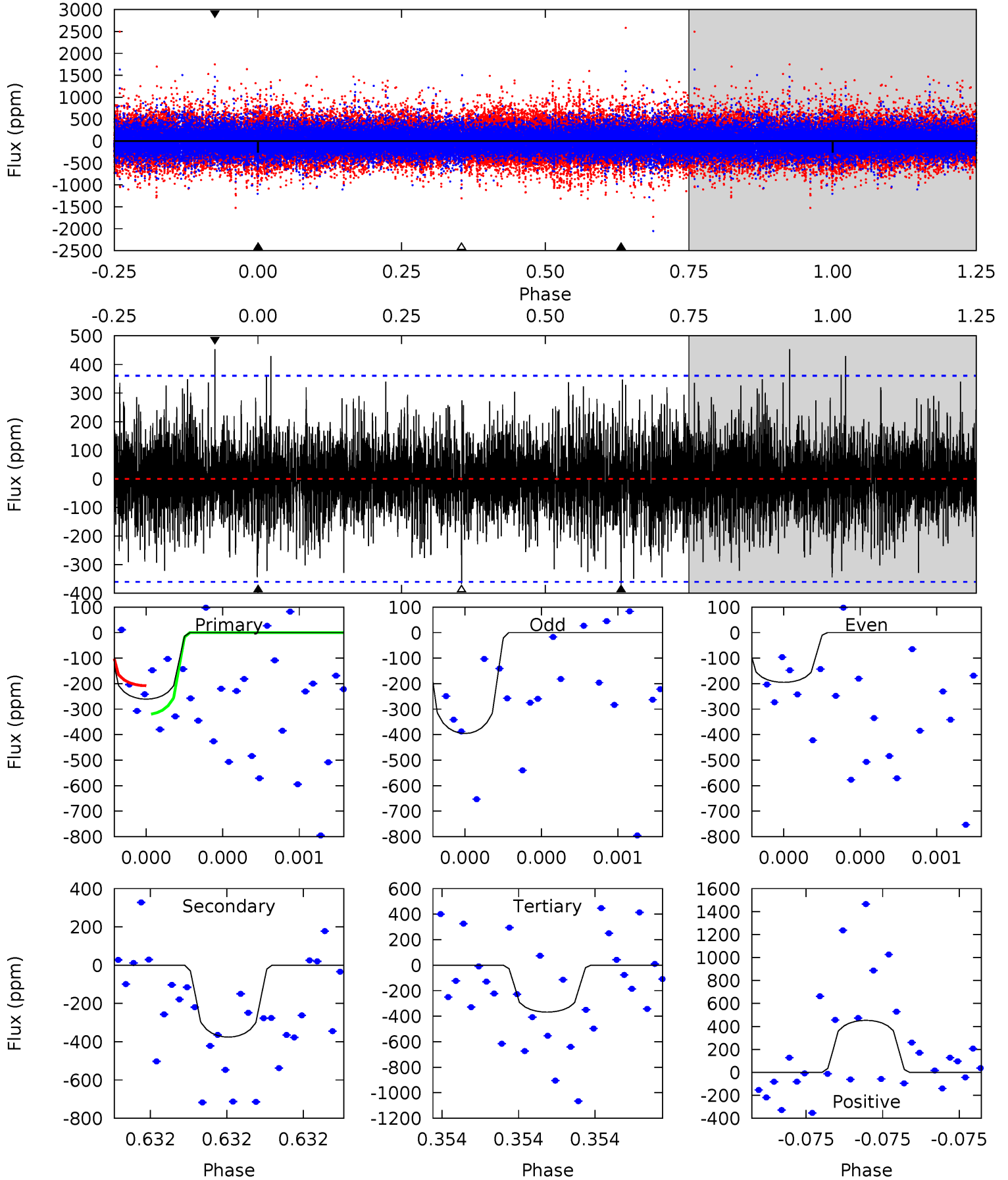
TCE 012010004-02 P=456.703688 Days  $T_0=412.052522$  (BKJD)



# DV Model-Shift Uniqueness Test

012010004-02, P = 456.804557 Days, E = 411.808662 Days

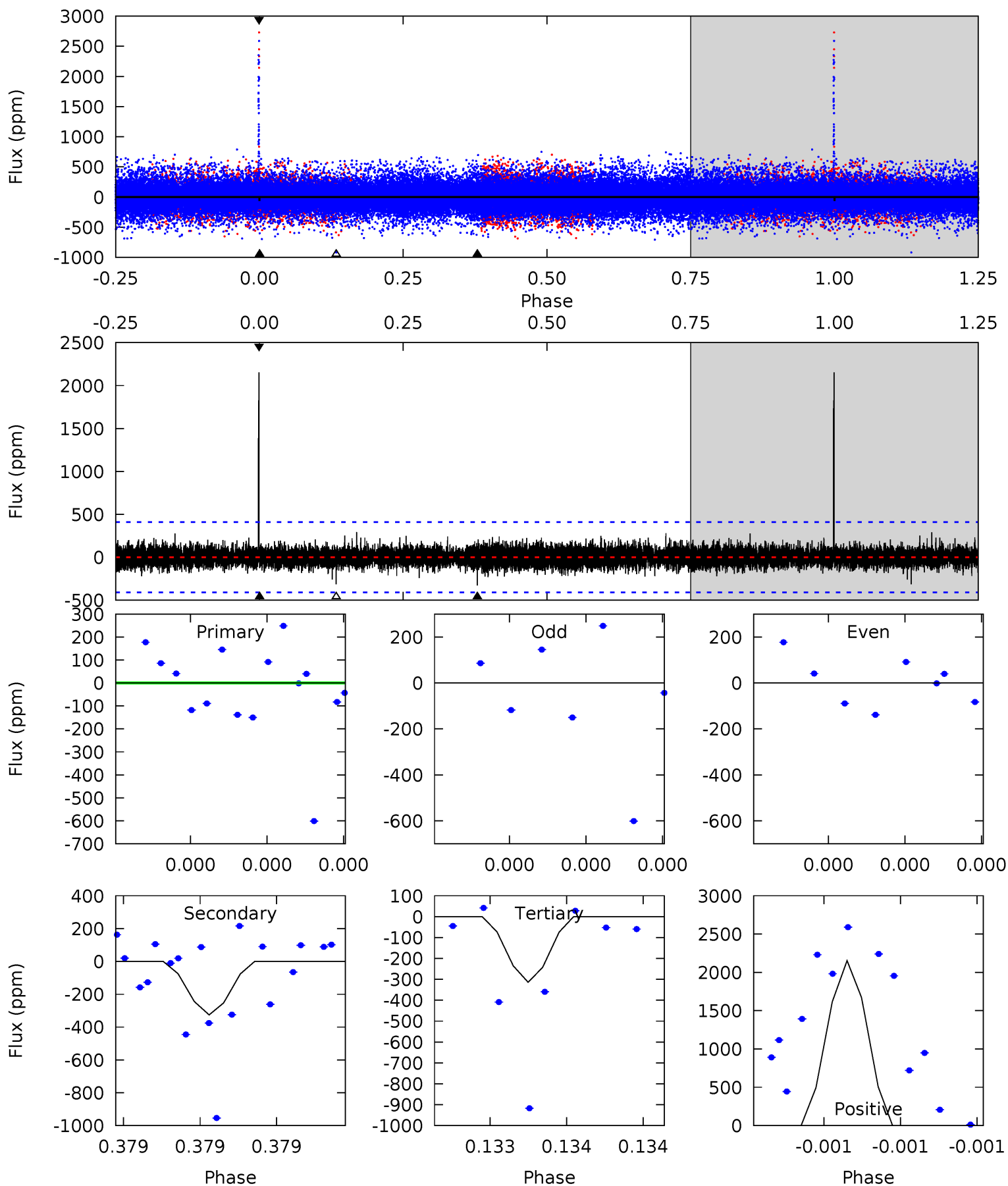
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
4.10	5.90	5.78	7.12	5.65	3.60	1.46	-1.68	-3.02	0.12	-1.22	1.19	1.03	0.55	0.88



# Alt Model-Shift Uniqueness Test

012010004-02, P = 456.703688 Days, E = 412.052522 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
0.89	4.64	4.47	30.6	5.83	3.87	0.97	-3.58	-29.7	0.17	-26.0	0.47	0.77	0.87	0.33



### Stellar Parameters For KIC 012010004

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$6004^{+163}_{-181}$	$4.359^{+0.148}_{-0.181}$	$-0.280^{+0.300}_{-0.300}$	$1.062^{+0.312}_{-0.192}$	$0.940^{+0.132}_{-0.096}$	$1.107^{+0.757}_{-0.517}$
	+3%/-3%	+3%/-4%	+107%/-107%	+29%/-18%	+14%/-10%	+68%/-47%
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 012010004-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-376 \pm 64$	$9.06^{+10.60}_{-6.00}$	$359^{+24}_{-22}$	$3486^{+1882}_{-702}$	$3256^{+24846}_{-2556}$
Alt.	$-326 \pm 70$	$9.71^{+9.89}_{-7.05}$	$358^{+25}_{-21}$	$3344^{+2035}_{-610}$	$2425^{+28516}_{-1821}$

$T_{\text{max}}$  = 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

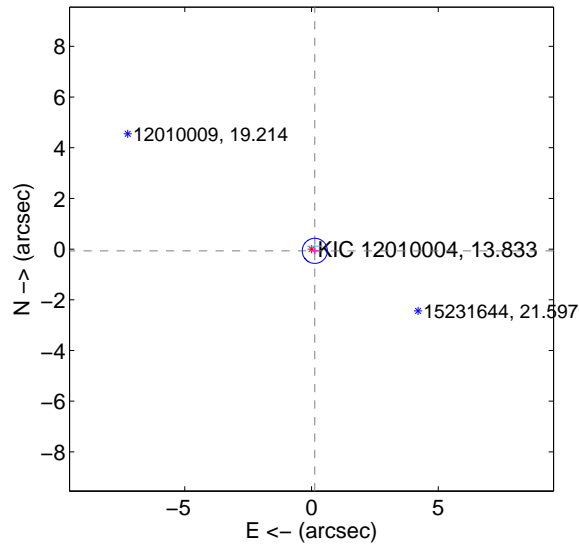
Supplemental centroid analysis for 012010004-02. Kepler magnitude: 13.83. Transit SNR 2.89

There are 2 quarters with good PRF difference image offsets

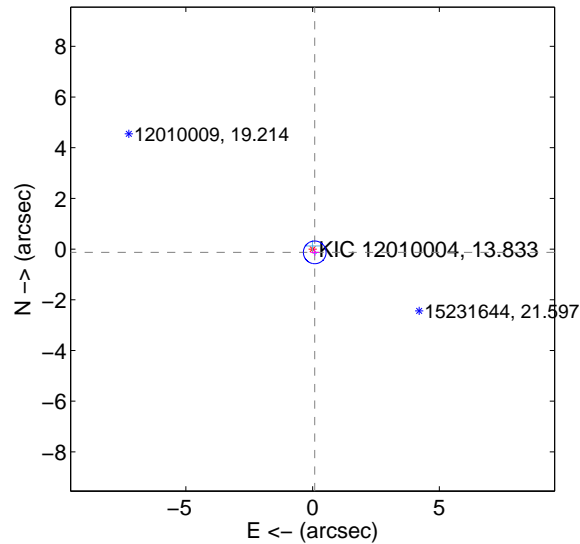
The direct PRF centroid is offset from the target star catalog position by about 0.08 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.147 \pm 0.165$	0.89	$-0.130 \pm 0.172$	$-0.069 \pm 0.139$
PRF-fit source offset from KIC position	$0.154 \pm 0.149$	1.03	$-0.084 \pm 0.172$	$-0.129 \pm 0.139$
photometric centroid source offset	$1.19 \pm 2.26$	0.53	$-1.14 \pm 2.25$	$0.34 \pm 2.34$

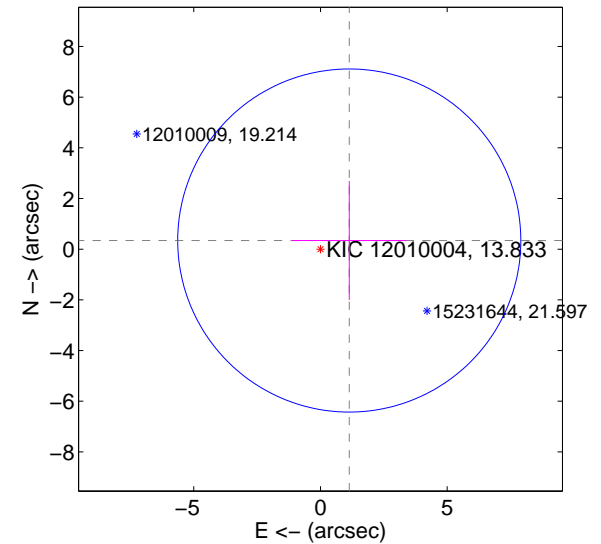
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

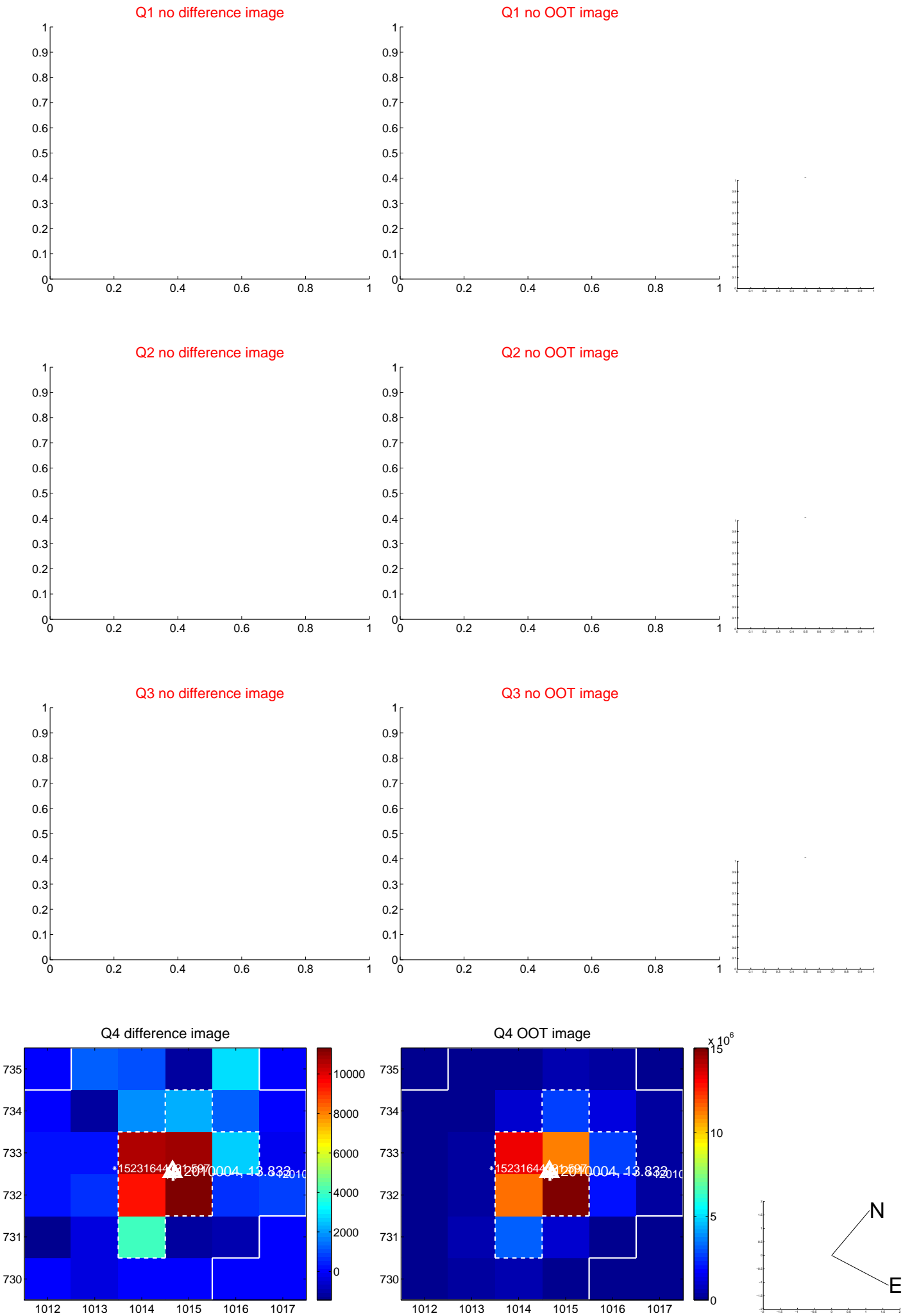


offset from photometric centroids



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

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

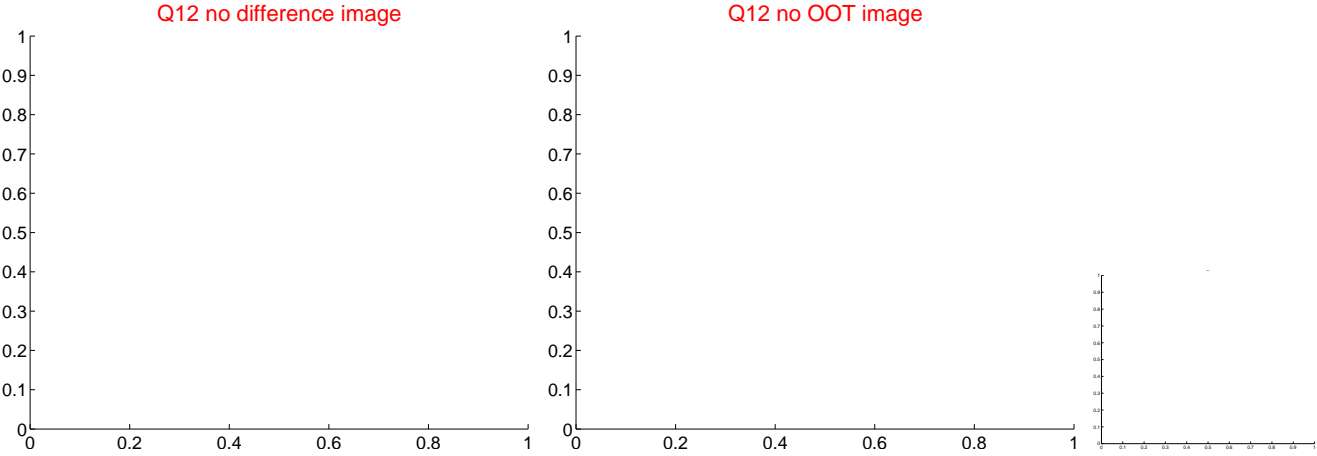
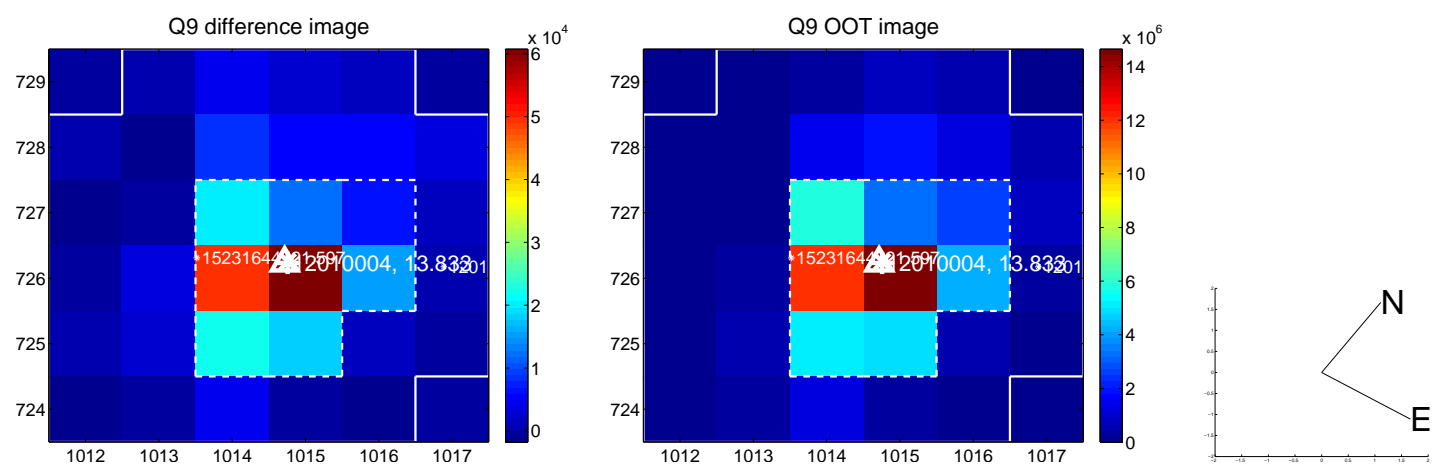


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

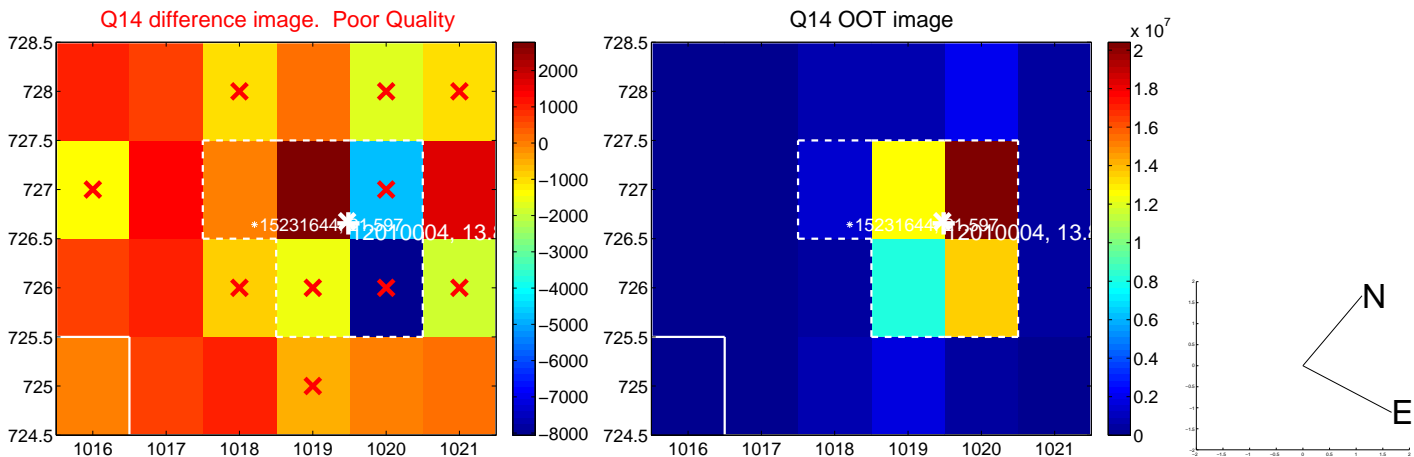




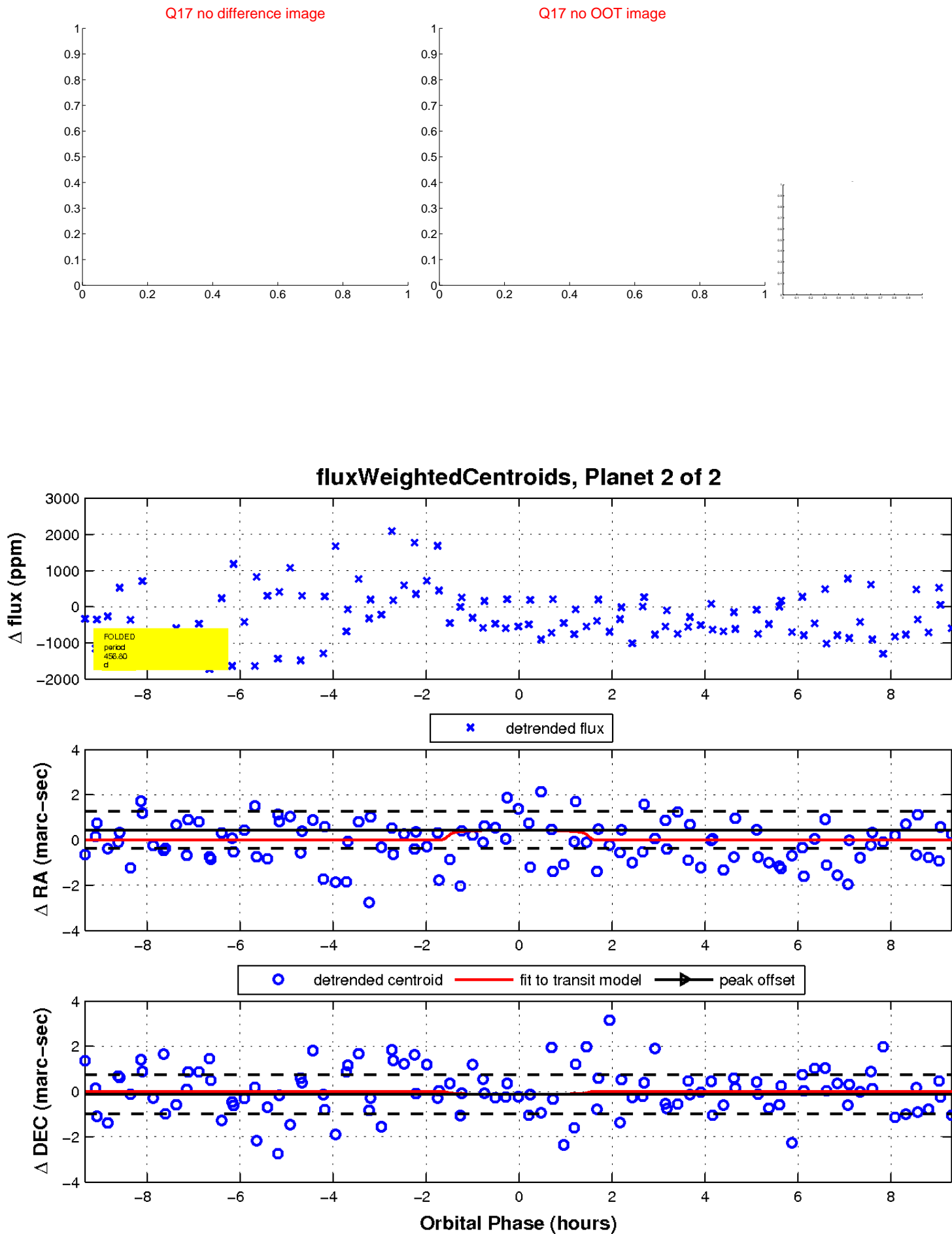
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



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



UKIRT Image

Declination

