

# KIC 009518318

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
009518318-01	OBS	1978.01	6.511121	131.706436	663.3	1.696	31.3	35.9	1.00	6032	2.97	244.43
009518318-02	OBS	1978.02	23.851639	147.613770	880.5	2.485	23.3	26.2	1.00	6032	3.50	43.28

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009518318-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009518318-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT

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

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

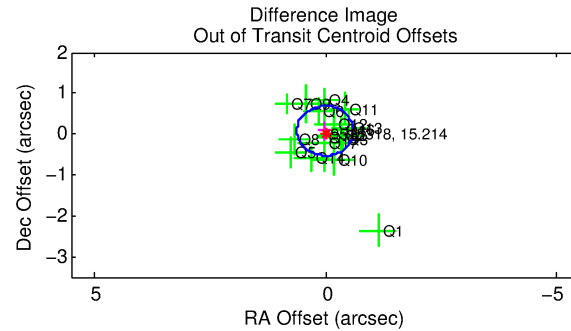
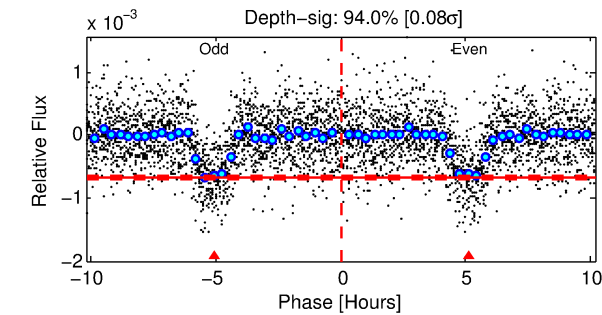
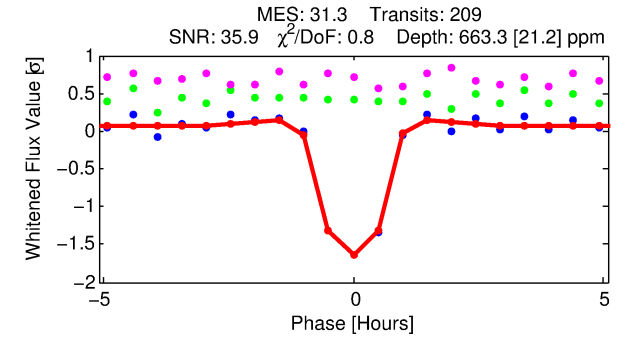
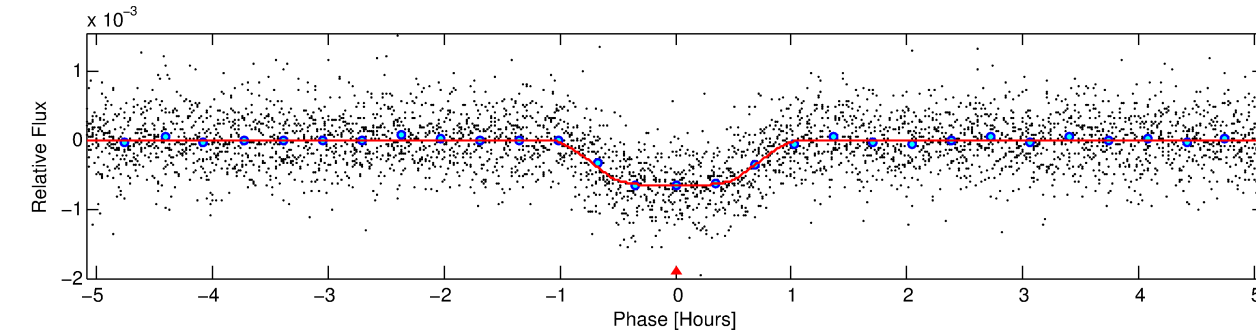
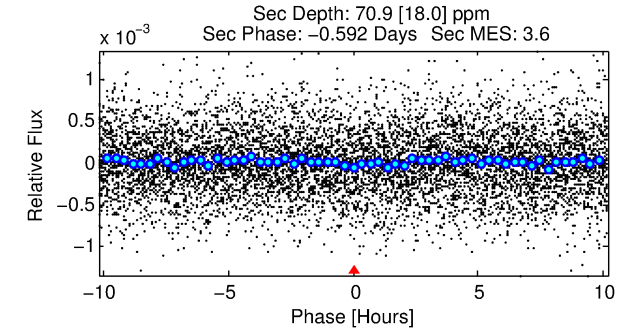
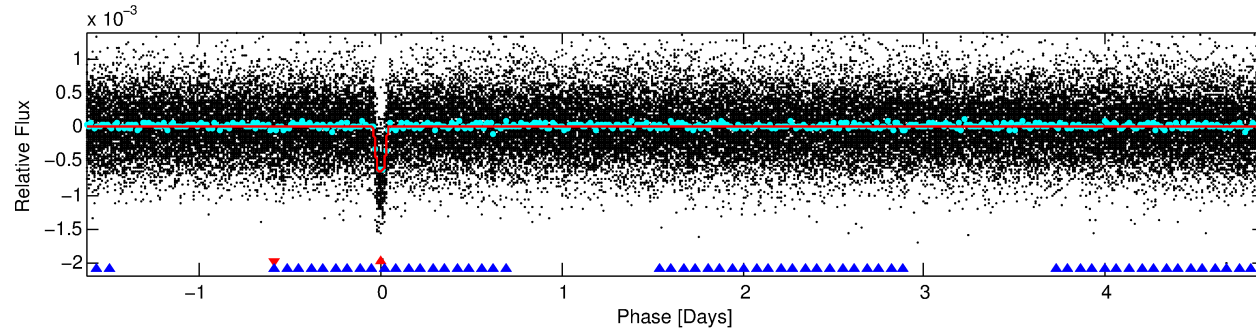
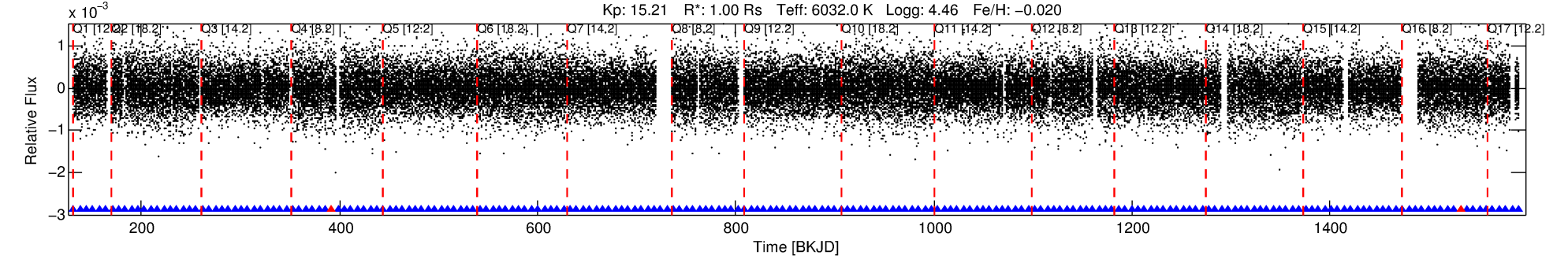
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009518318-01

No Significant Match Found

# DV One-Page Summary

KIC: 9518318 Candidate: 1 of 2 Period: 6.511 d  
KOI: K01978.01 Name: Kepler-346b Corr: 0.968



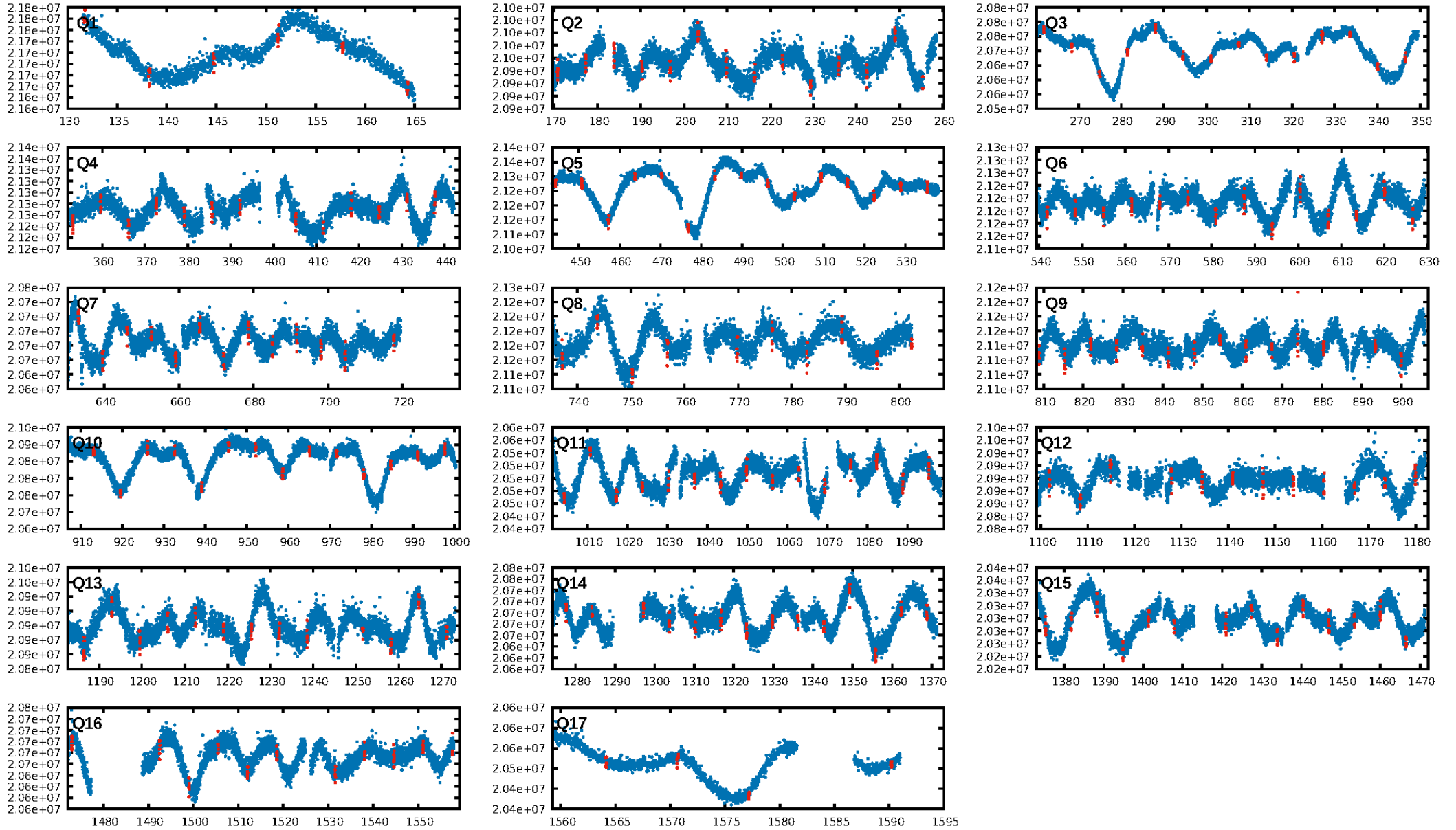
## DV Fit Results:

Period = 6.51112 [0.00001] d  
Epoch = 131.7064 [0.0009] BKJD  
Rp/R\* = 0.0272 [0.0045]  
a/R\* = 16.20 [13.00]  
b = 0.87 [0.24]  
Seff = 244.43 [102.77]  
Teff = 1008 [106] K  
Rp = 2.97 [1.11] Re  
a = 0.0697 [0.0191] AU  
Ag = 21.46 [12.29] [1.66σ]  
Teffp = 3355 [374] K [6.04σ]

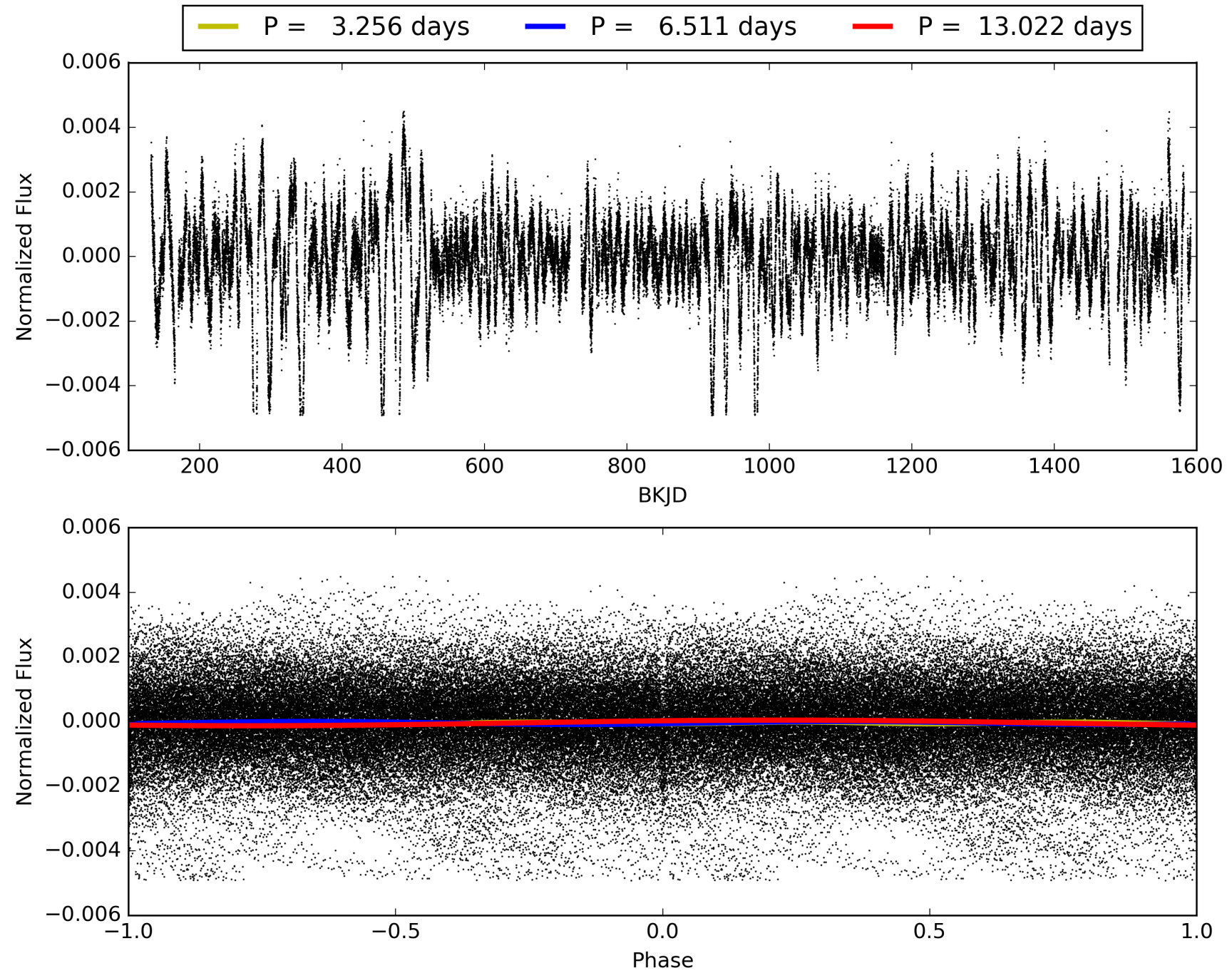
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [138.32σ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 9.33e-206  
RollingBand-fgt: 0.99 [197/199]  
GhostDiagnostic-chr: 6.602  
Centroid-sig: 55.7%  
Centroid-so: 0.328 arcsec [0.87σ]  
OotOffset-rm: 0.079 arcsec [0.39σ]  
KicOffset-rm: 0.145 arcsec [0.82σ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 1.00 [17/17]  
DiffImageOverlap-fno: 1.00 [17/17]

# TCE 009518318-01, PDC Light Curves

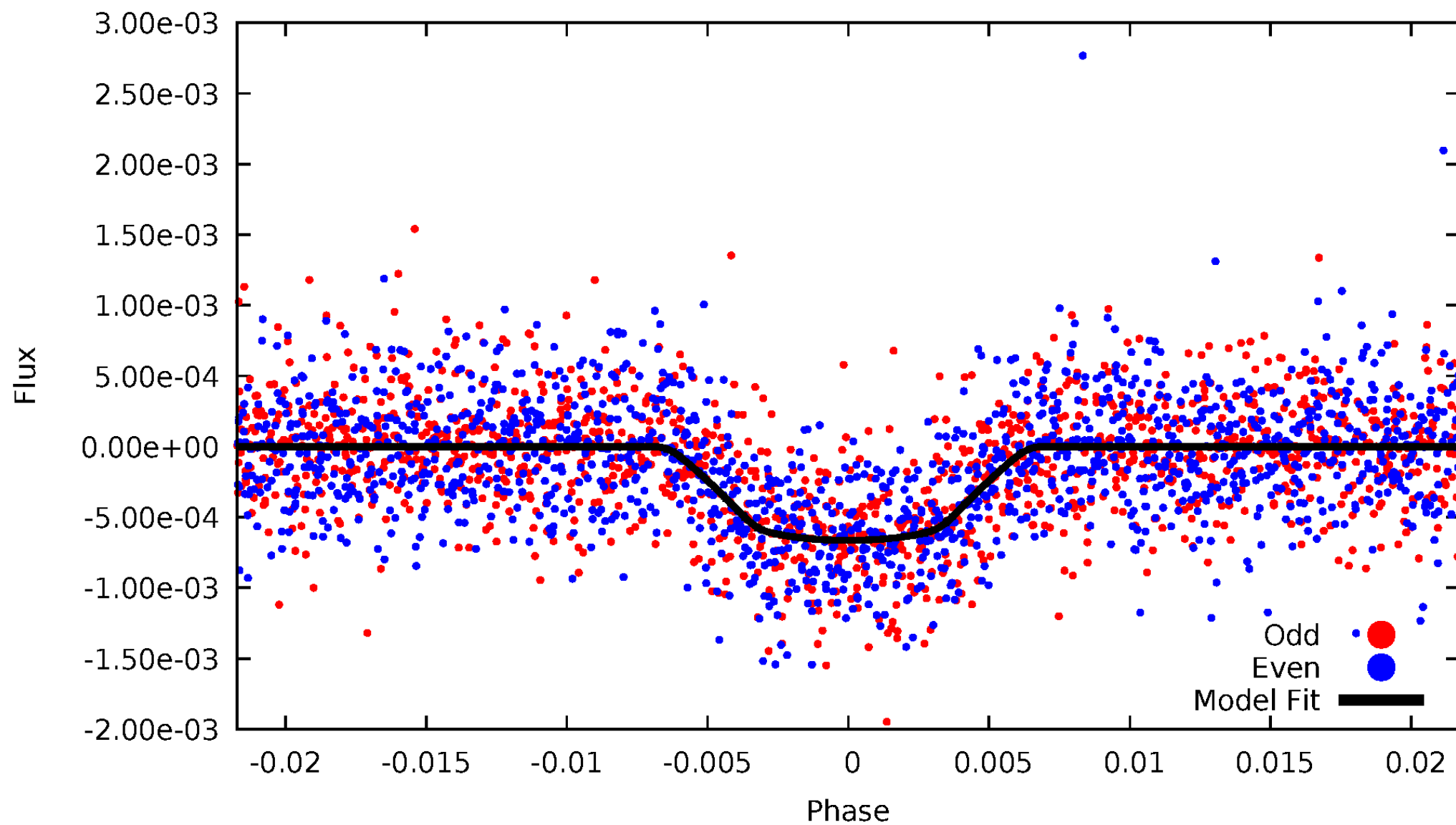


TCE 009518318-01



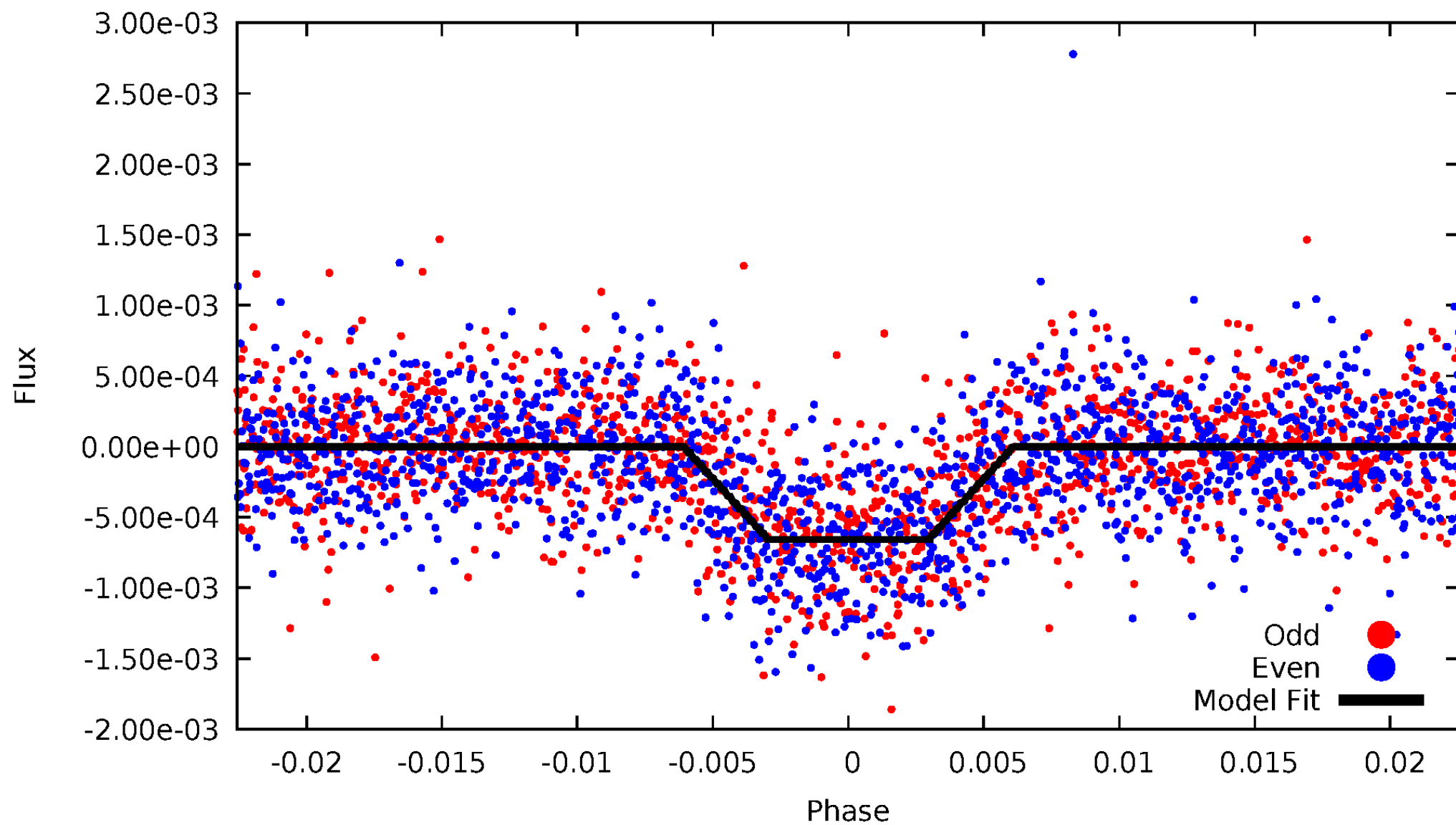
# DV Odd/Even

TCE 009518318-01



# ALT Odd/Even

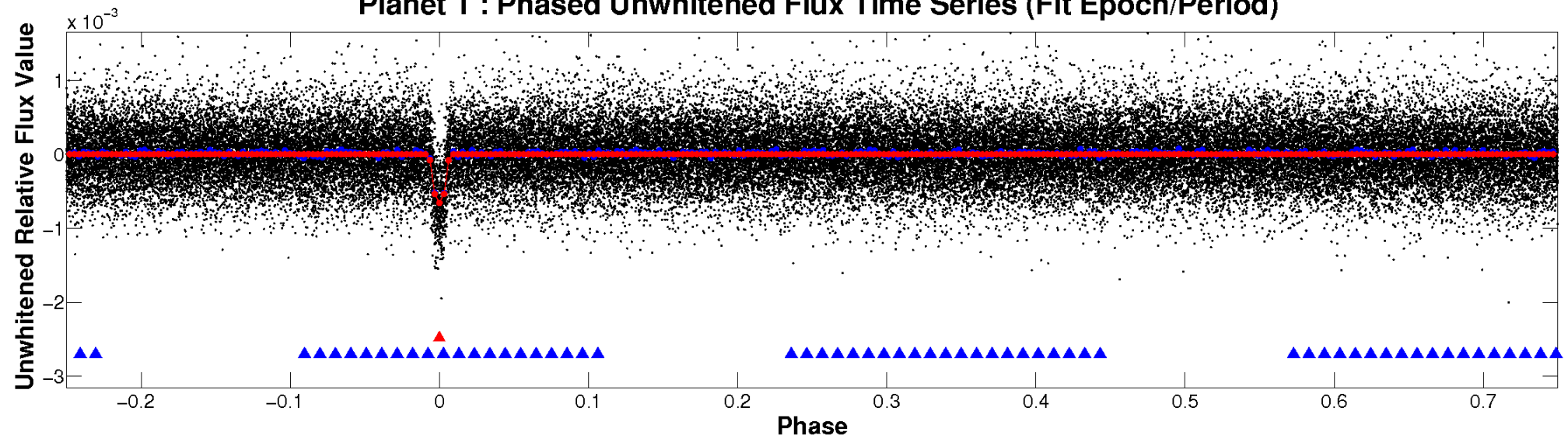
TCE 009518318-01



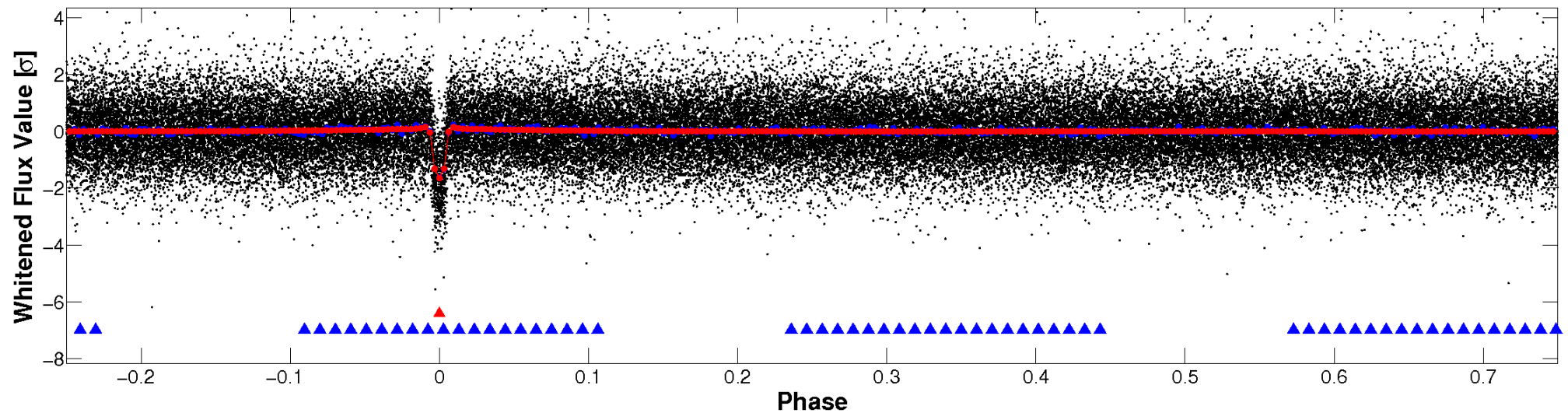


# Non-Whitened Vs. Whitened Light Curve

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

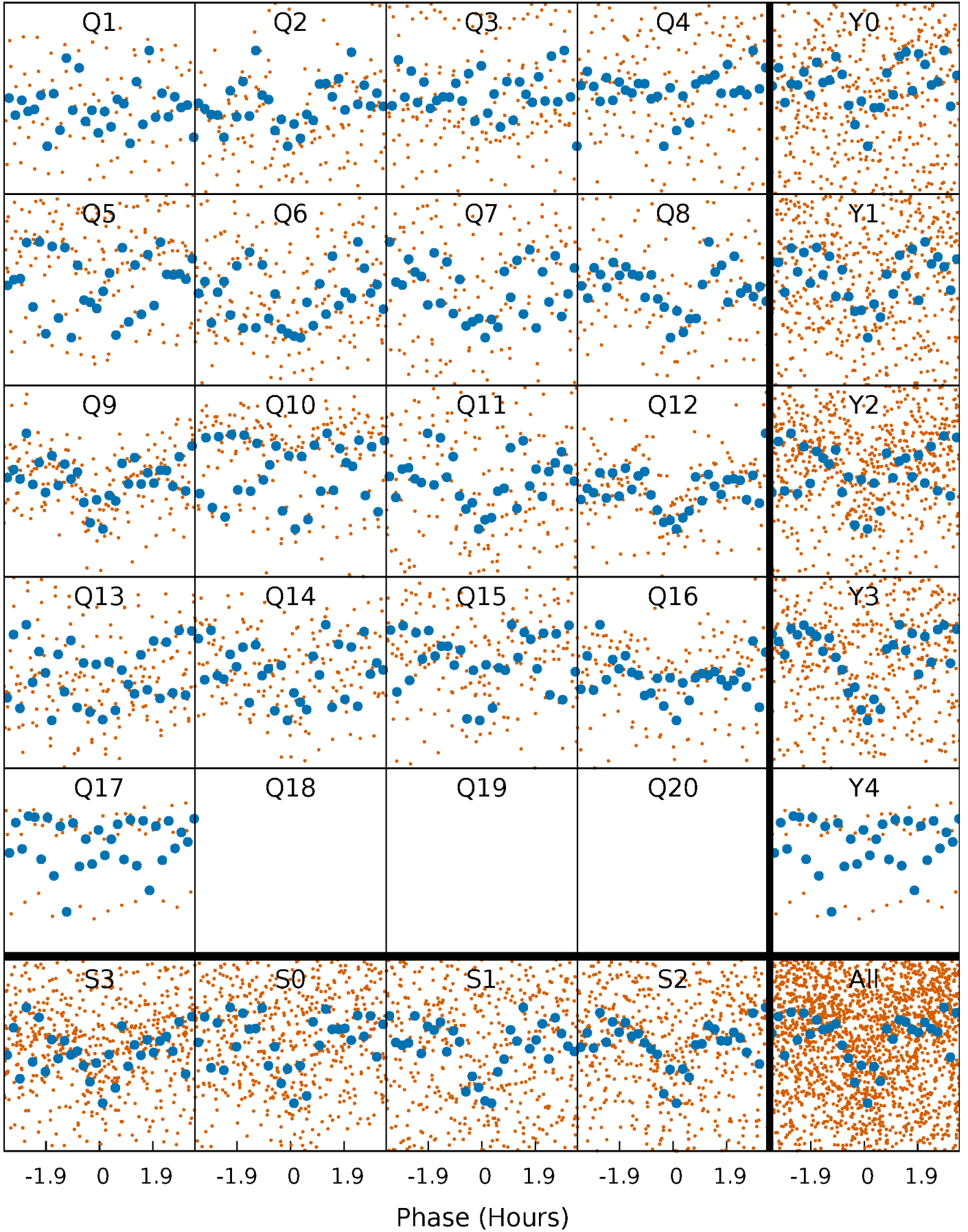


## Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

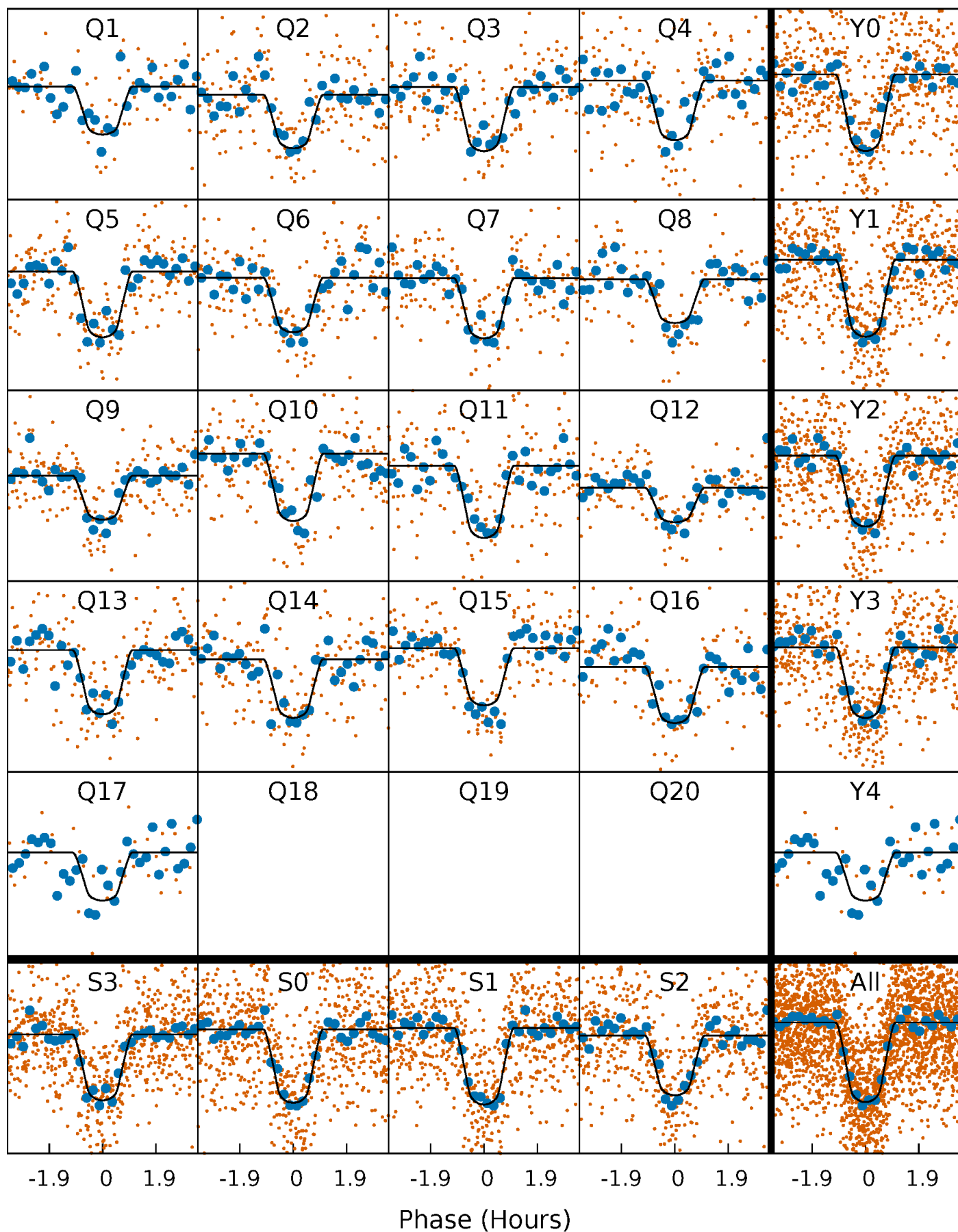
TCE 009518318-01   P= 6.511121 Days    $T_0=131.706436$  (BKJD)





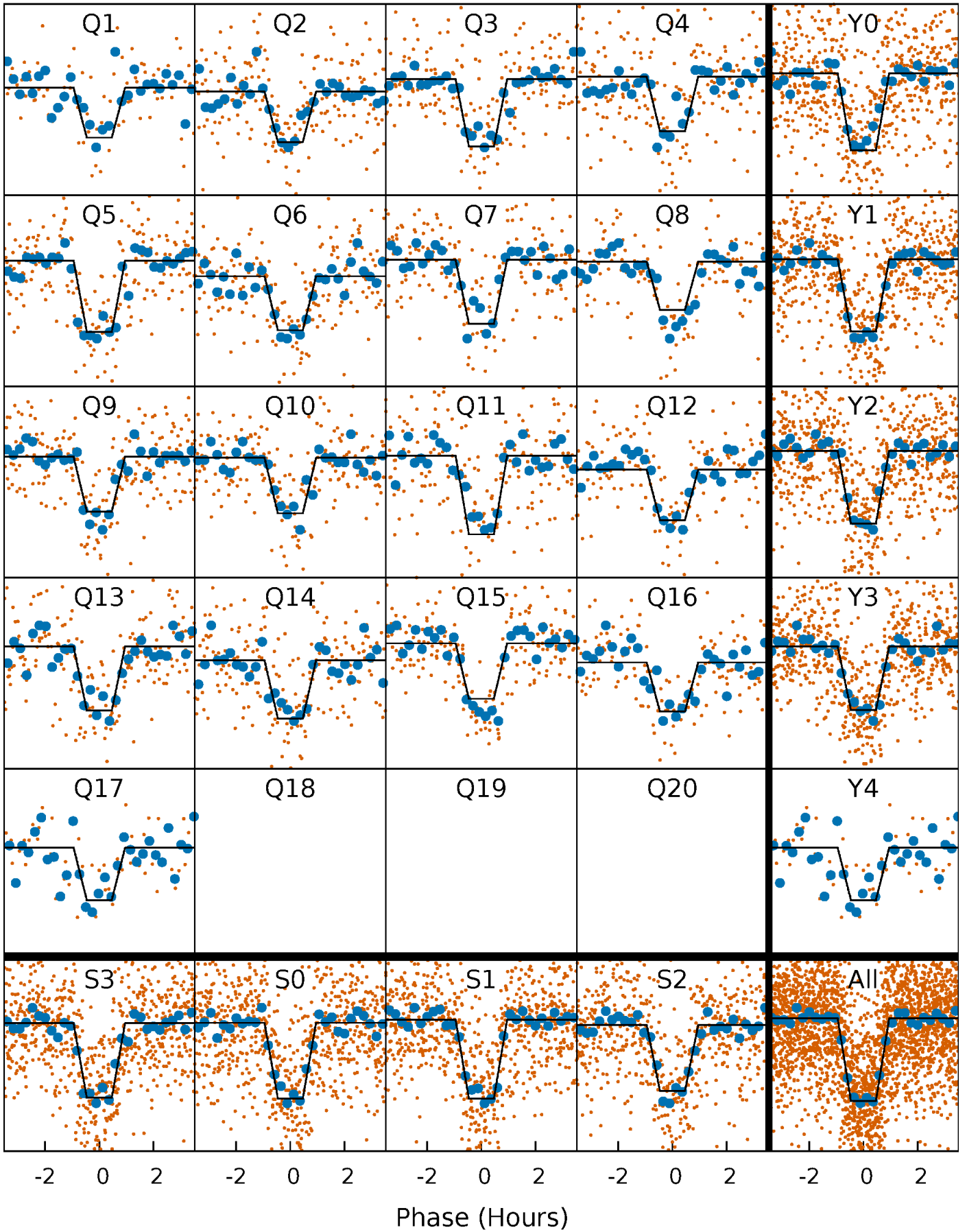
# DV Quarter-Phased Transit Curves

TCE 009518318-01 P= 6.511121 Days  $T_0=131.706436$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

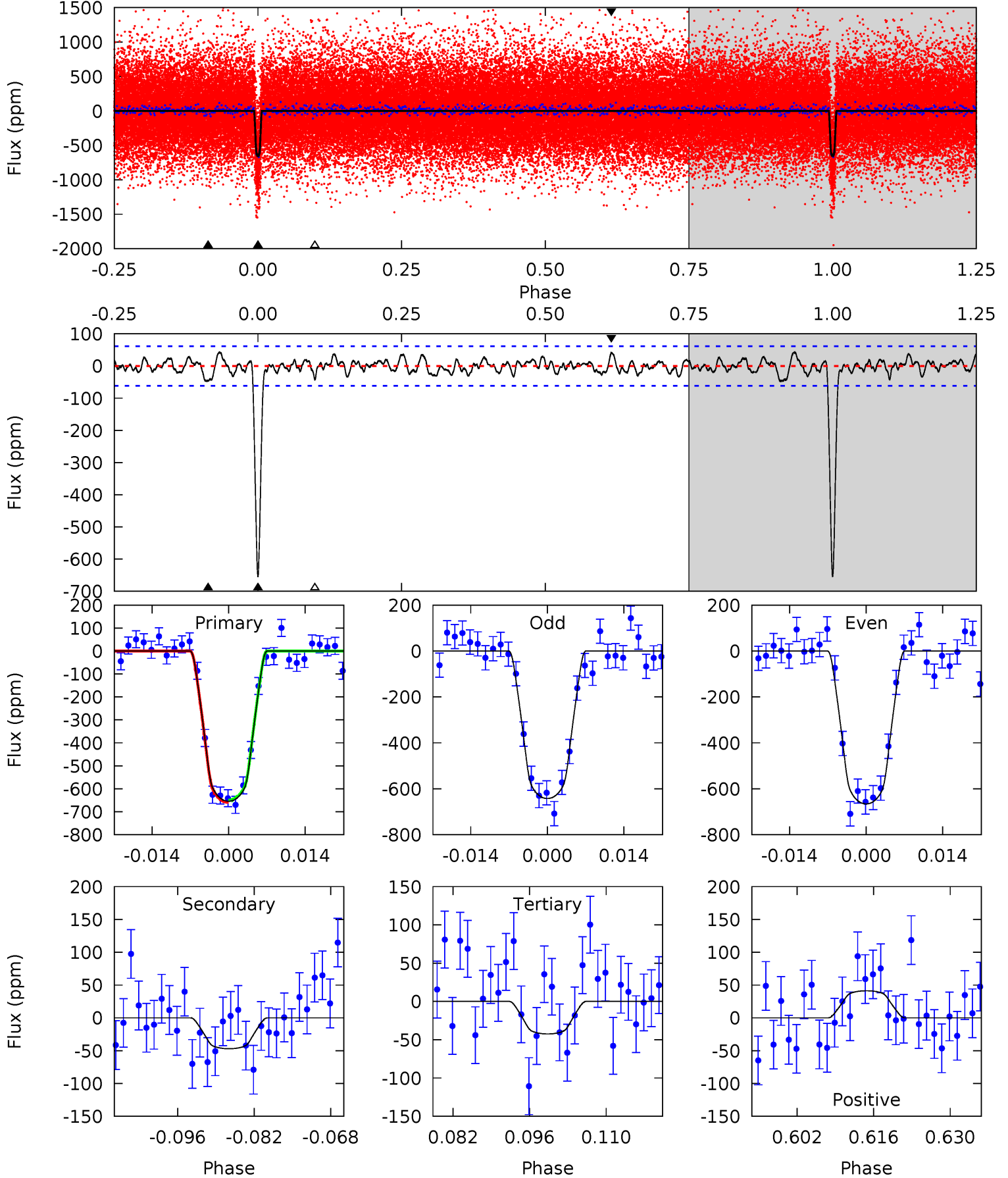
TCE 009518318-01 P= 6.511099 Days  $T_0=131.709250$  (BKJD)



# DV Model-Shift Uniqueness Test

009518318-01, P = 6.511121 Days, E = 125.195315 Days

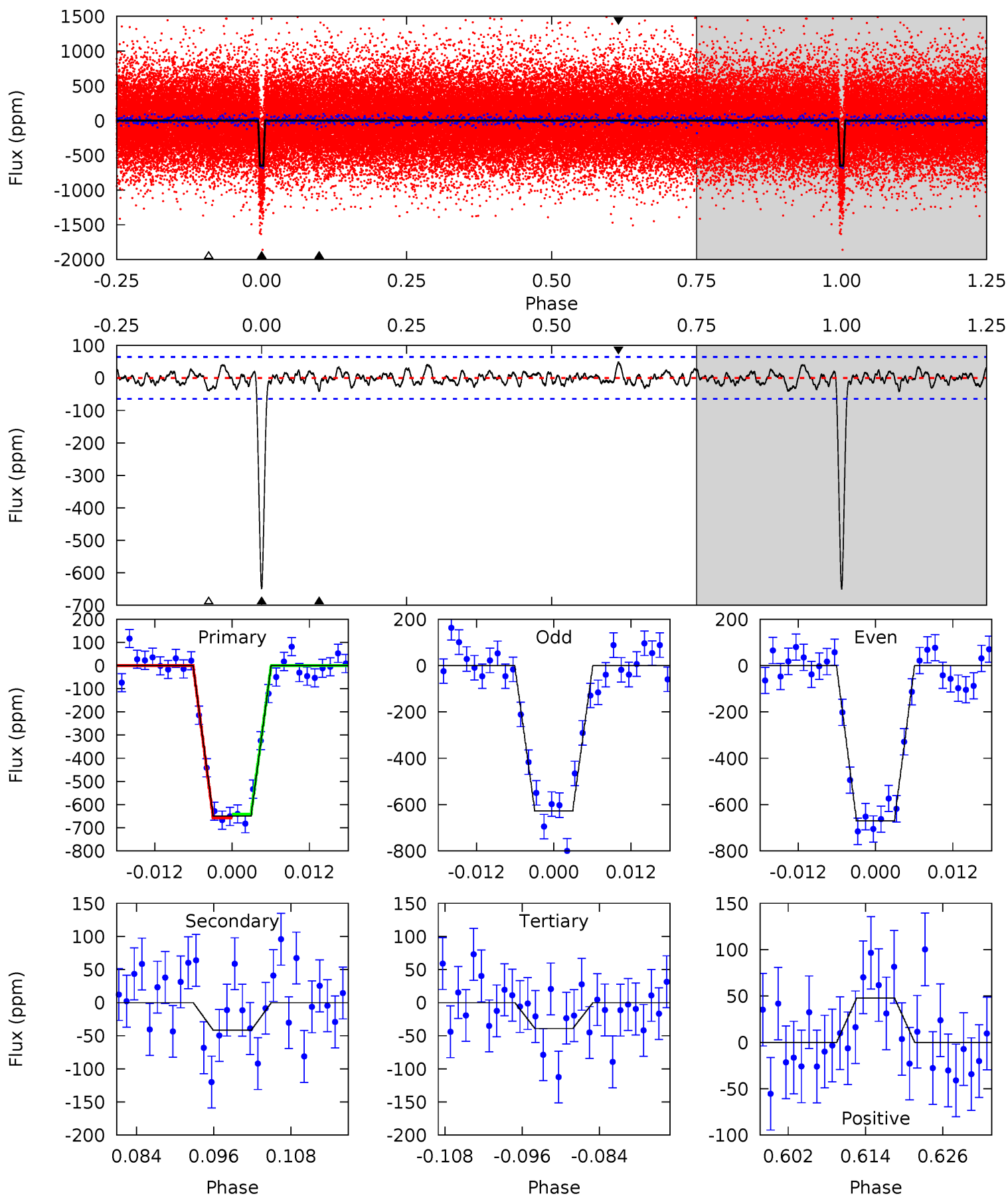
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
52.8	3.80	3.42	3.33	4.97	2.47	1.26	49.4	49.5	0.37	0.47	0.95	1.00	0.06	0.42



# Alt Model-Shift Uniqueness Test

009518318-01, P = 6.511099 Days, E = 125.198151 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
50.3	3.23	3.03	3.70	4.99	2.51	1.17	47.2	46.6	0.21	-0.46	1.64	0.98	0.07	0.68



### Stellar Parameters For KIC 009518318

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$6032^{+190}_{-232}$	$4.465^{+0.056}_{-0.210}$	$-0.020^{+0.250}_{-0.300}$	$1.001^{+0.333}_{-0.111}$	$1.065^{+0.145}_{-0.145}$	$1.496^{+0.434}_{-0.793}$
	+3%/-4%	+1%/-5%	+1250%/-1500%	+33%/-11%	+14%/-14%	+29%/-53%
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 009518318-01 / KOI 1978.01

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-47 \pm 12$	$3.08^{+0.78}_{-0.54}$	$1435^{+106}_{-74}$	$3472^{+264}_{-219}$	$12^{+8}_{-5}$
Alt.	$-42 \pm 13$	$2.93^{+0.79}_{-0.52}$	$1442^{+116}_{-82}$	$3465^{+297}_{-269}$	$12^{+8}_{-5}$

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



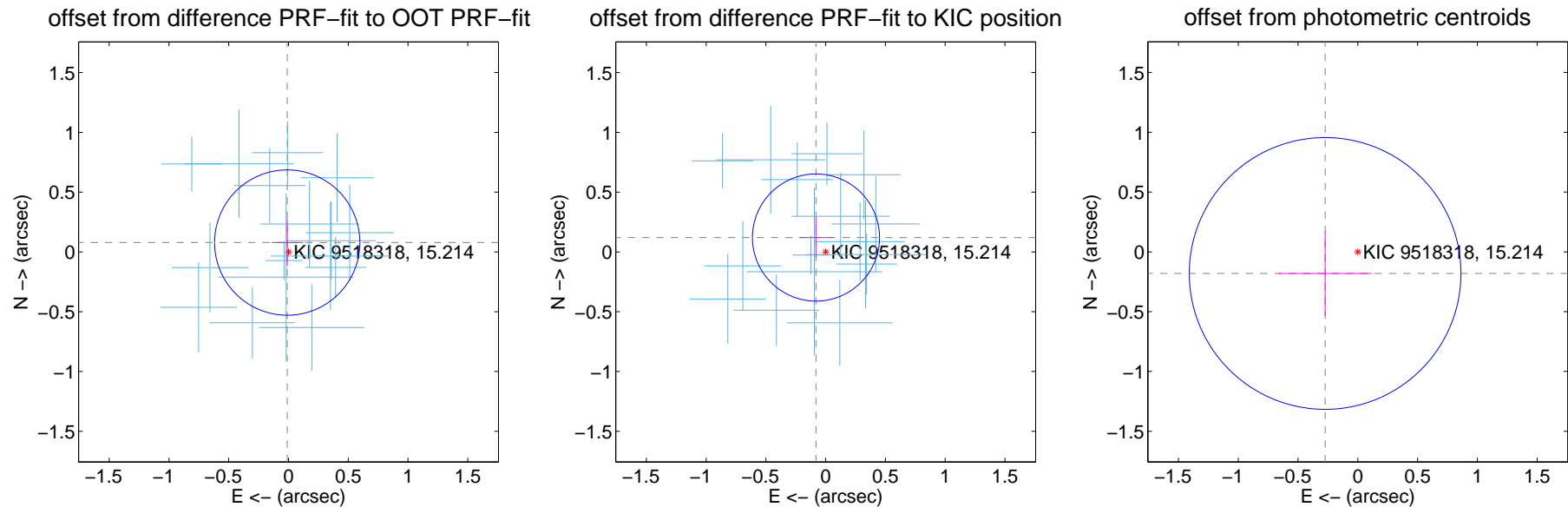
## DV Centroid Data

Supplemental centroid analysis for 009518318-01. Kepler magnitude: 15.21. Transit SNR 35.94

There are 17 quarters with good PRF difference image offsets

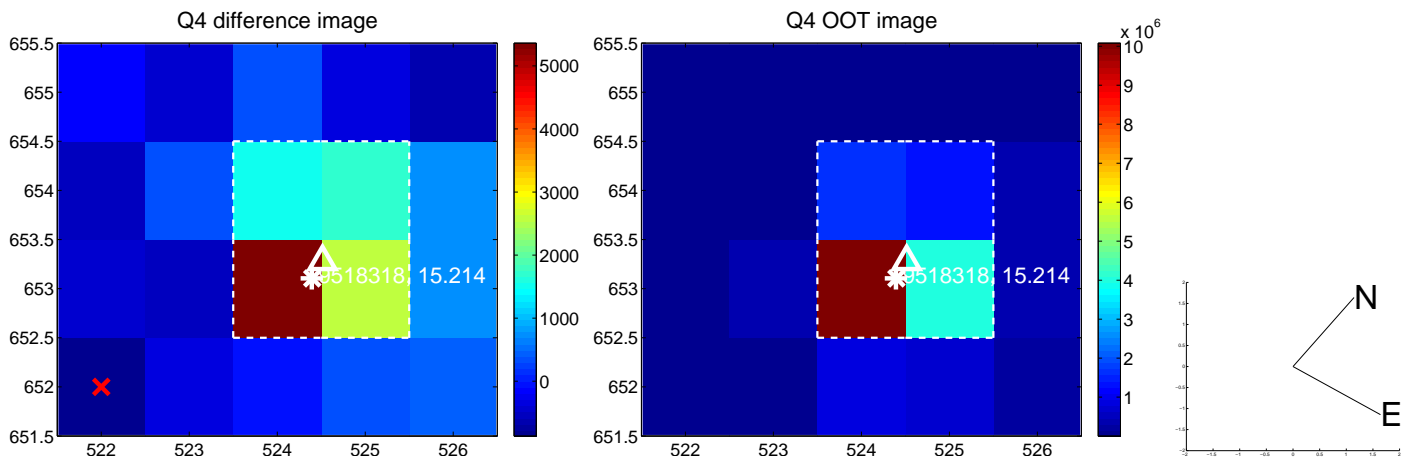
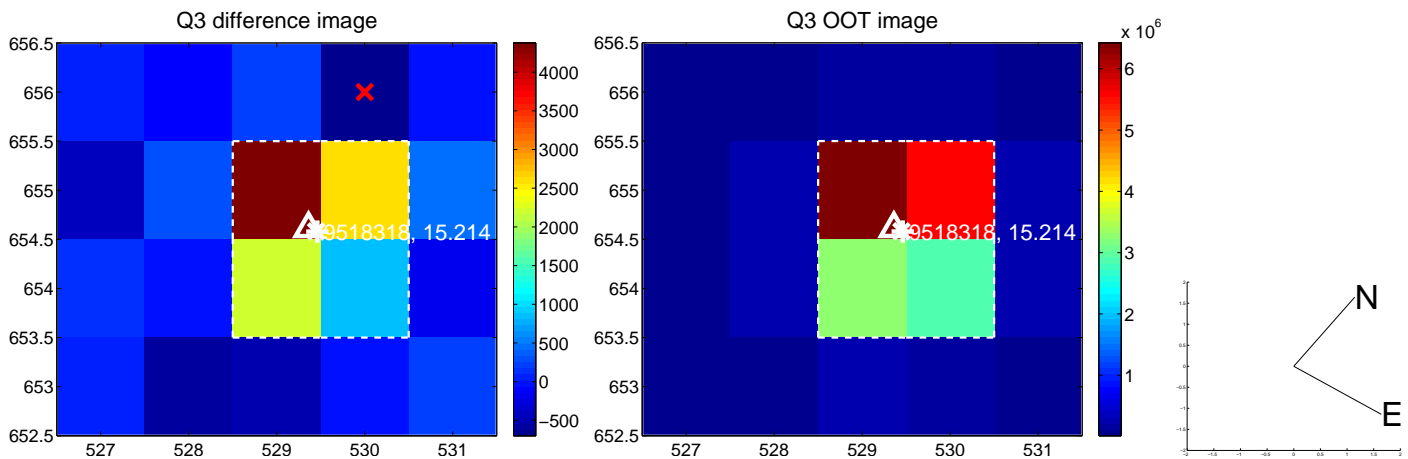
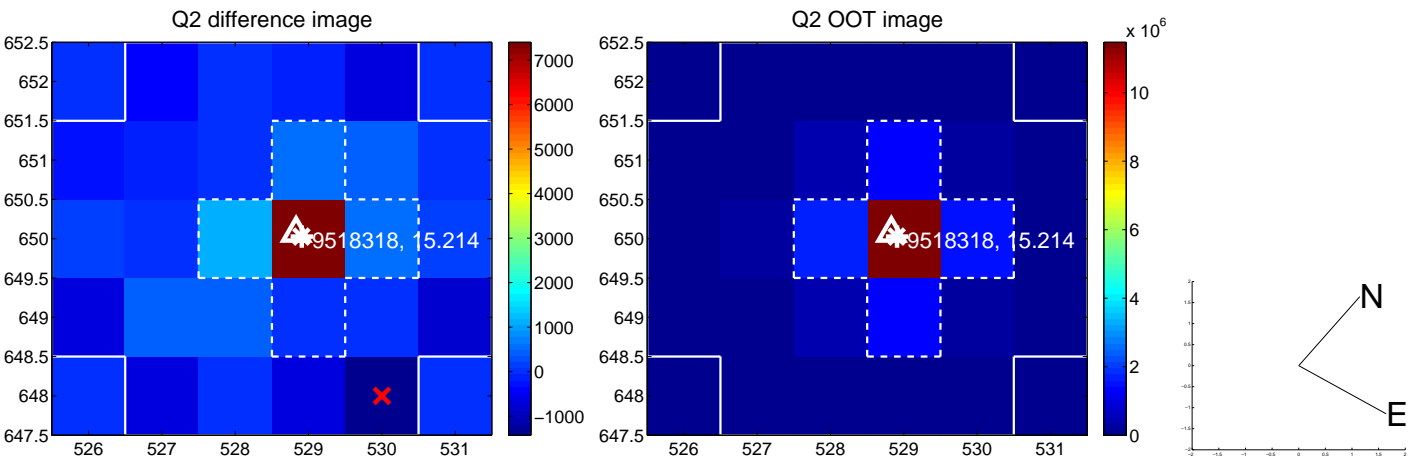
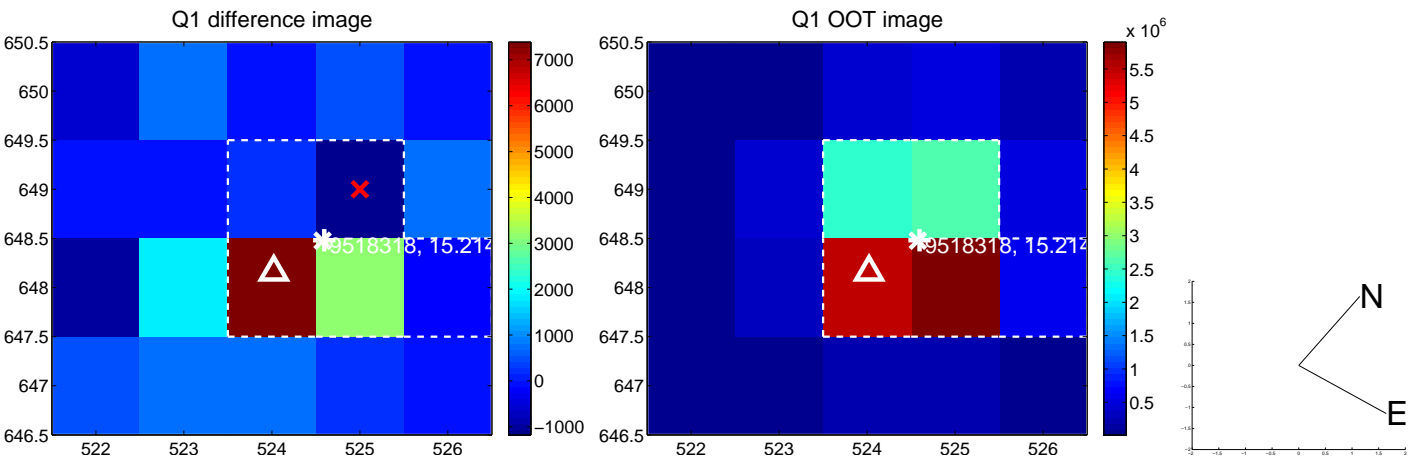
The direct PRF centroid is offset from the target star catalog position by about 0.09 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.079 \pm 0.203$	0.39	$0.010 \pm 0.131$	$0.078 \pm 0.197$
PRF-fit source offset from KIC position	$0.145 \pm 0.177$	0.82	$0.081 \pm 0.138$	$0.120 \pm 0.166$
photometric centroid source offset	$0.33 \pm 0.38$	0.87	$0.27 \pm 0.39$	$-0.18 \pm 0.35$

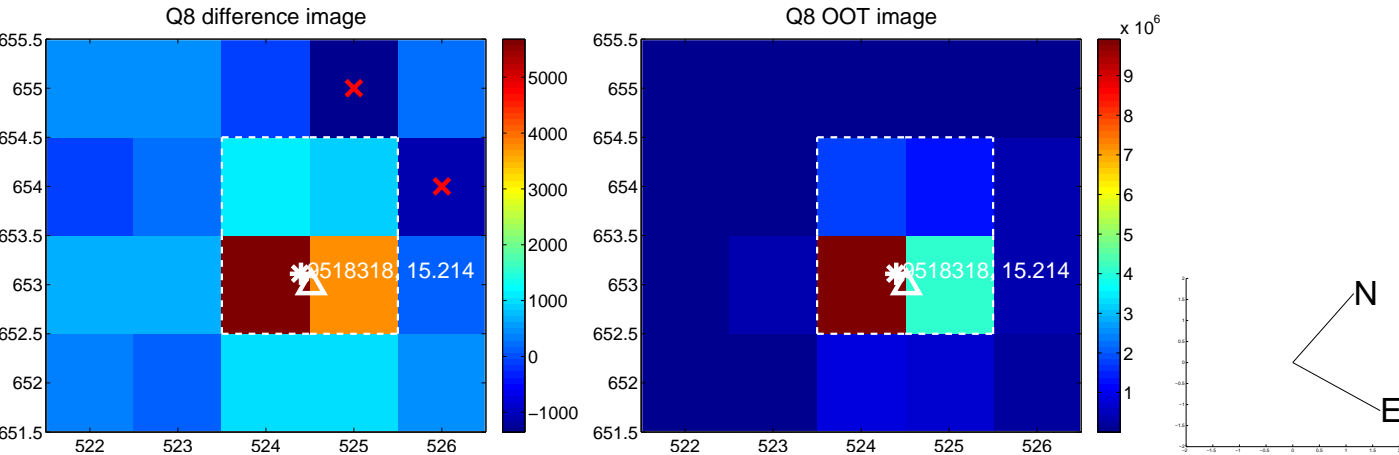
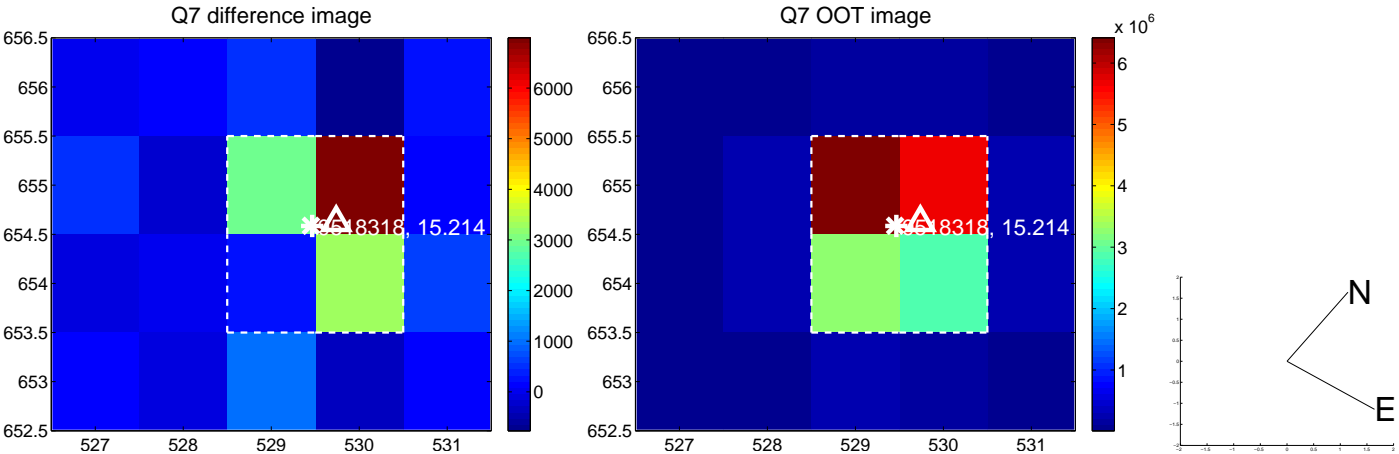
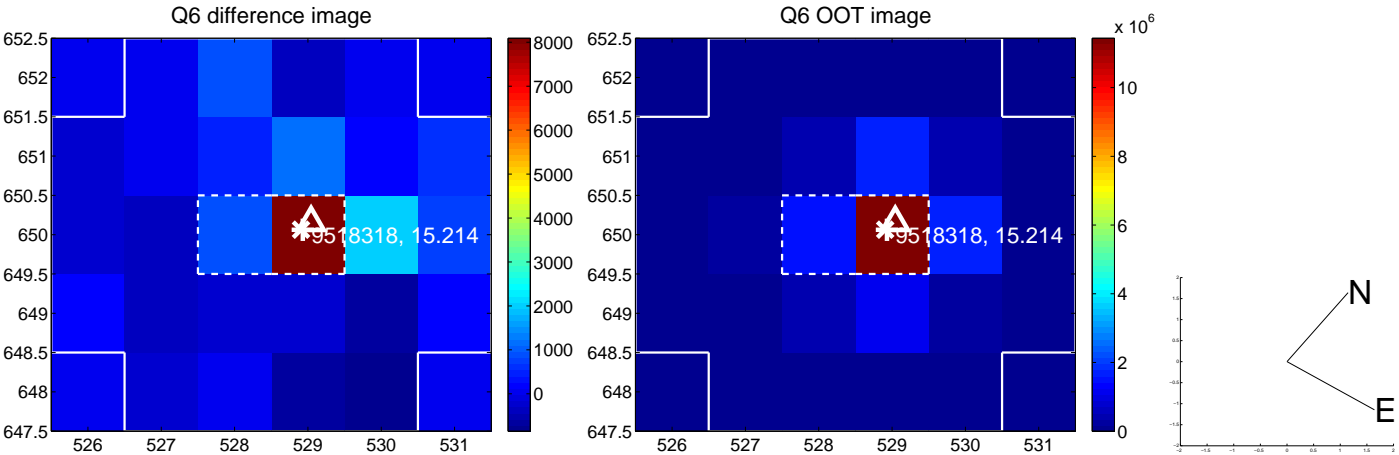
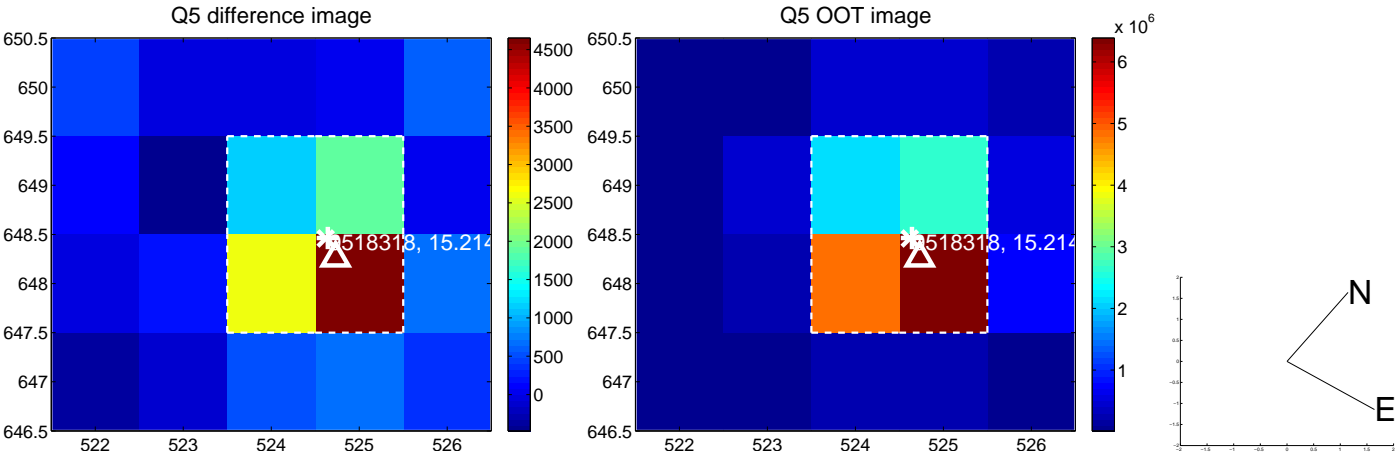


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

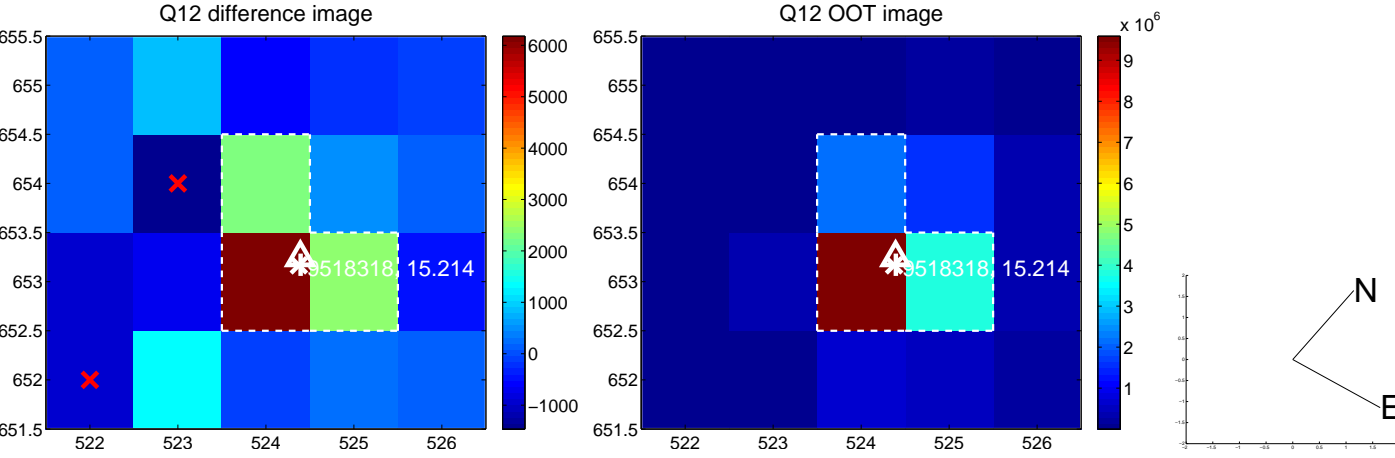
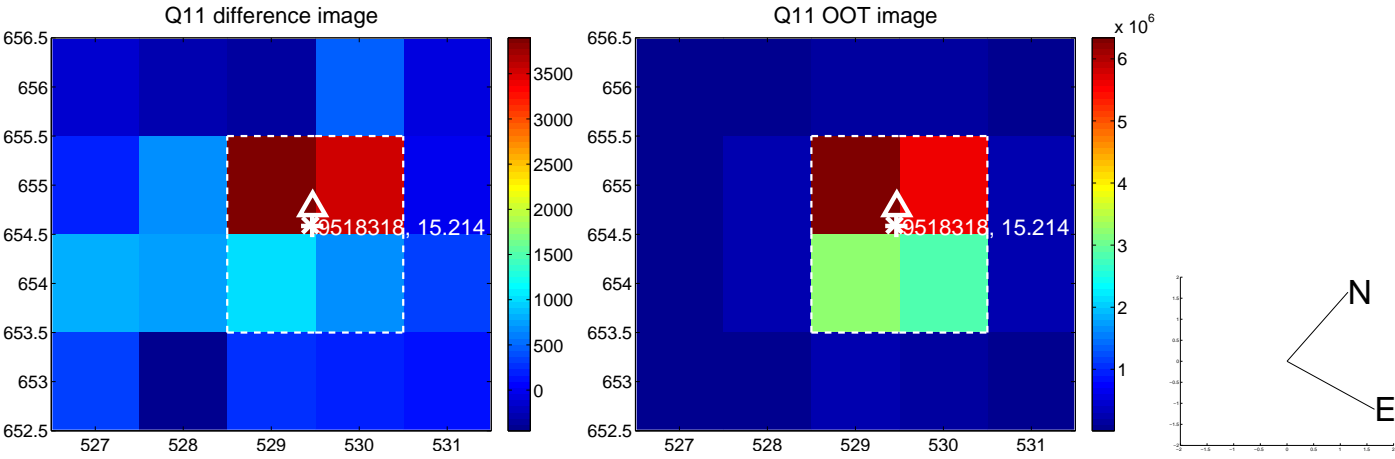
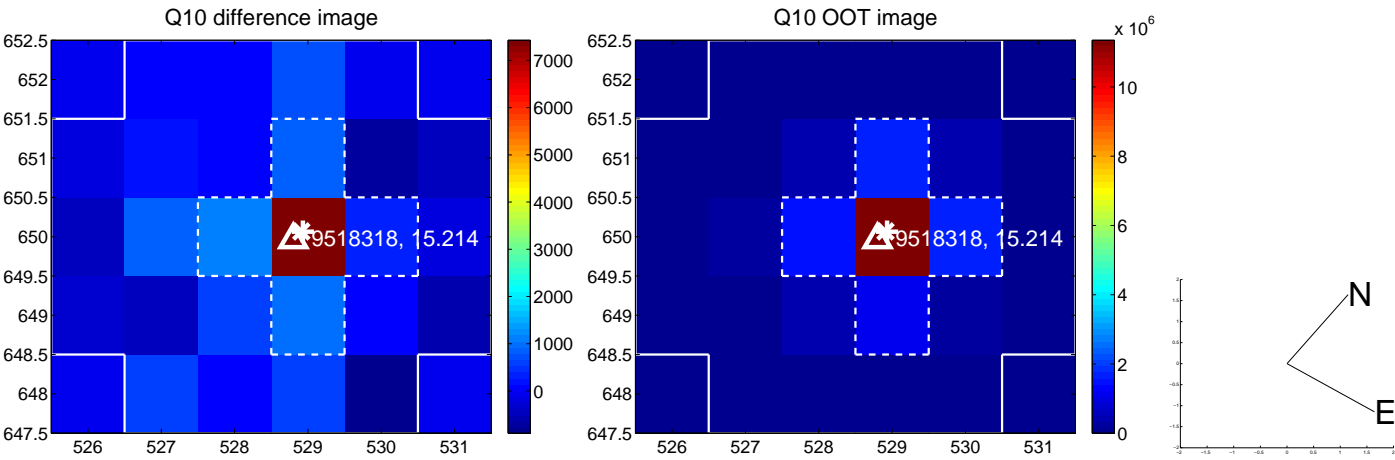
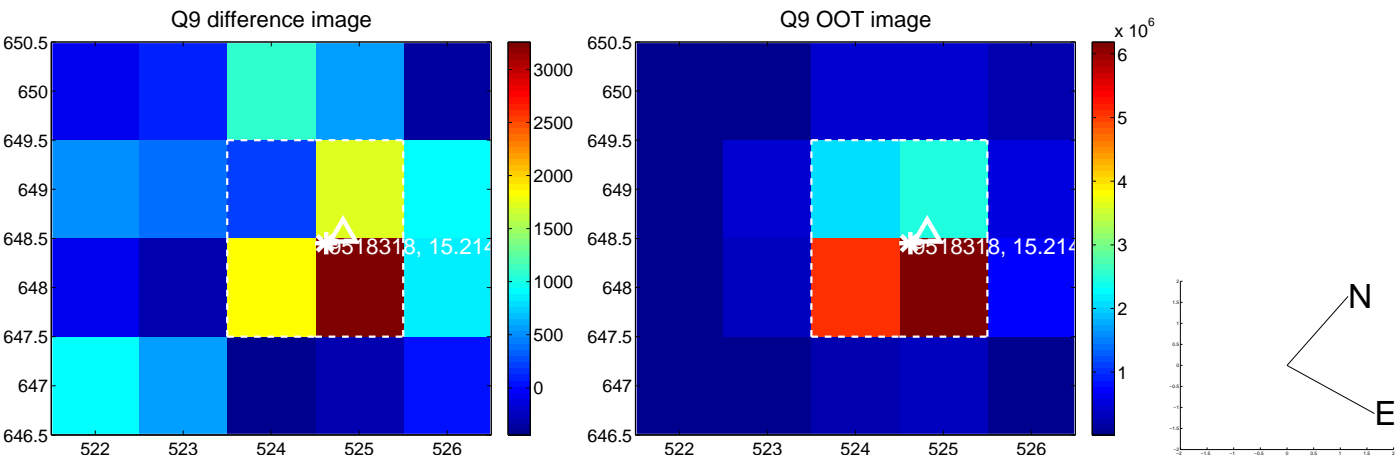
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



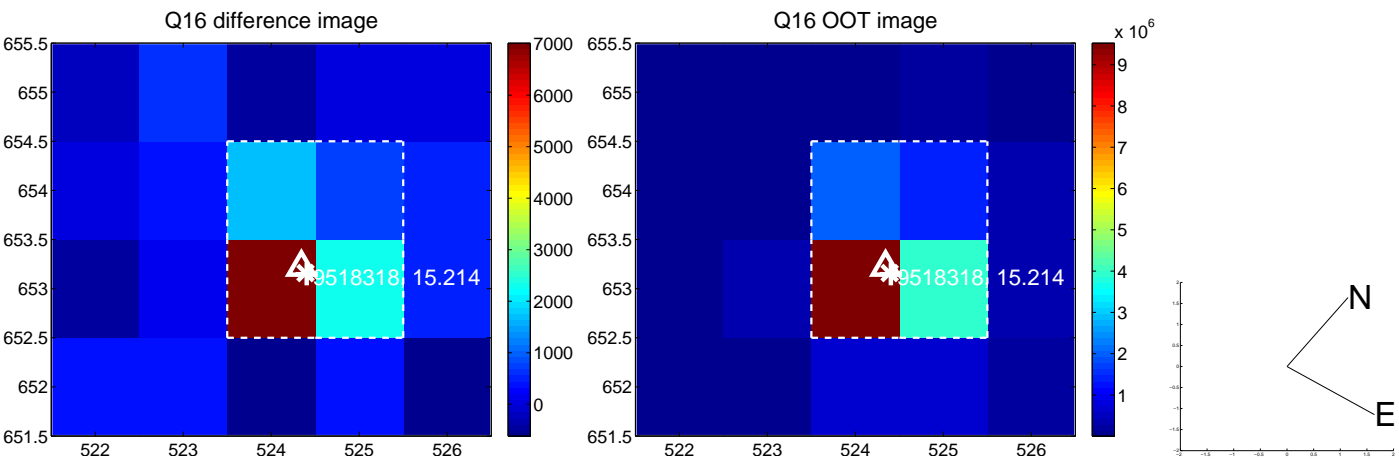
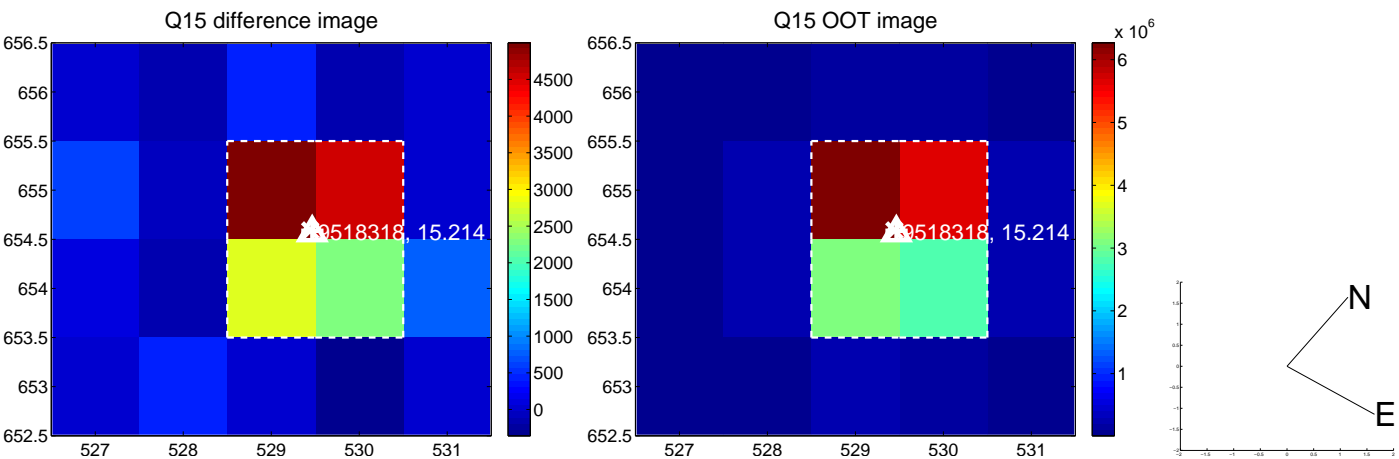
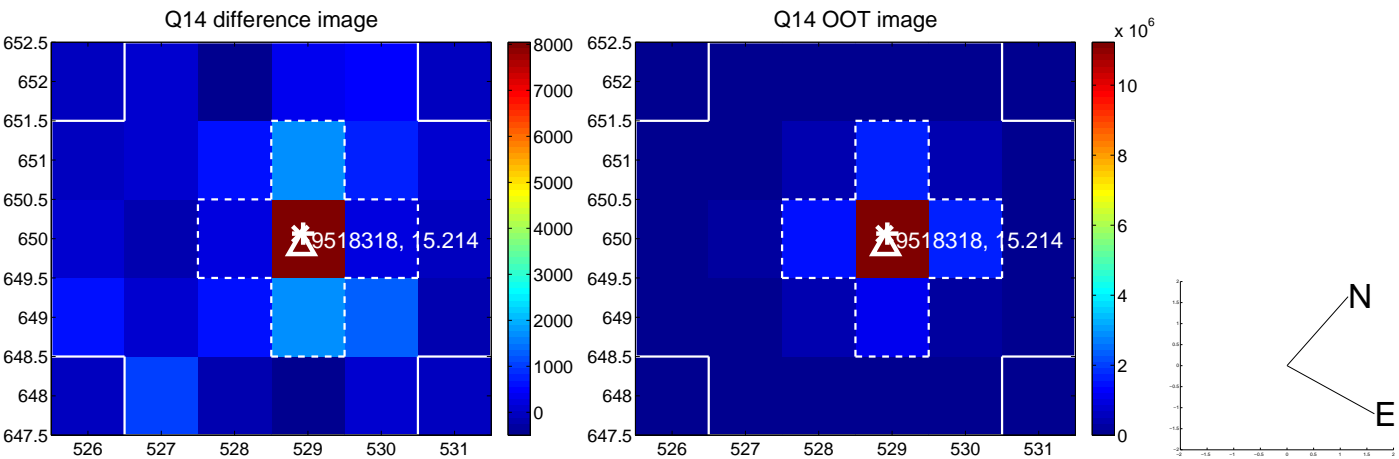
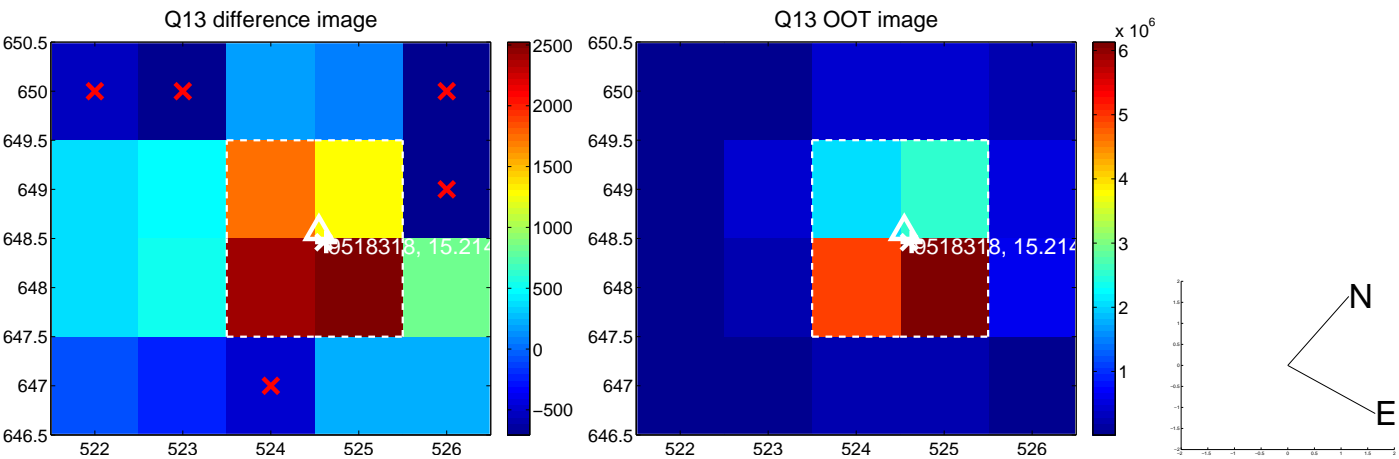
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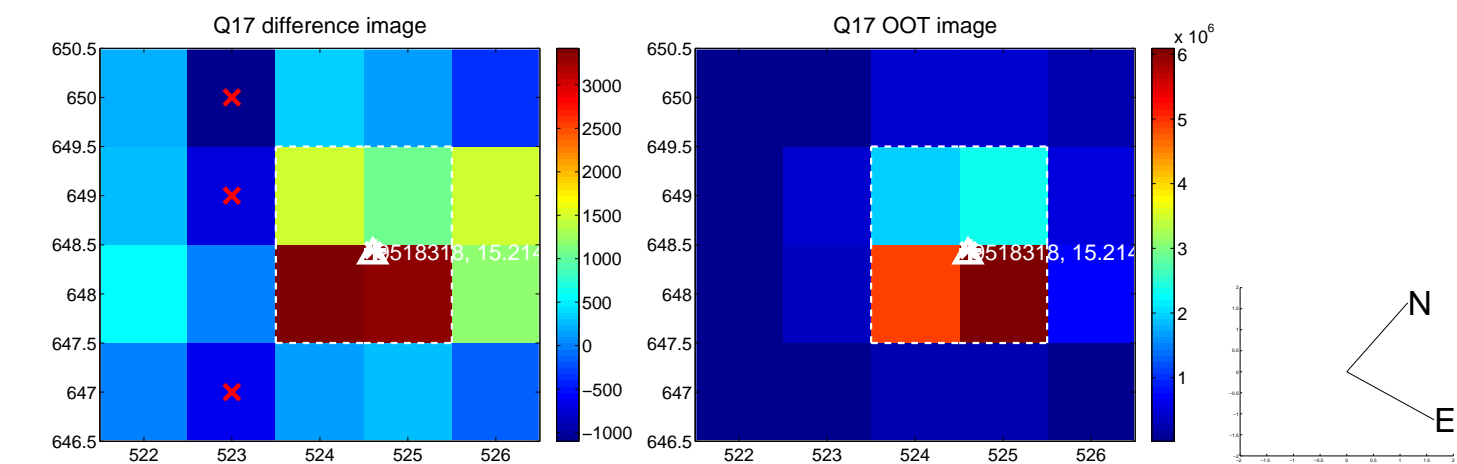


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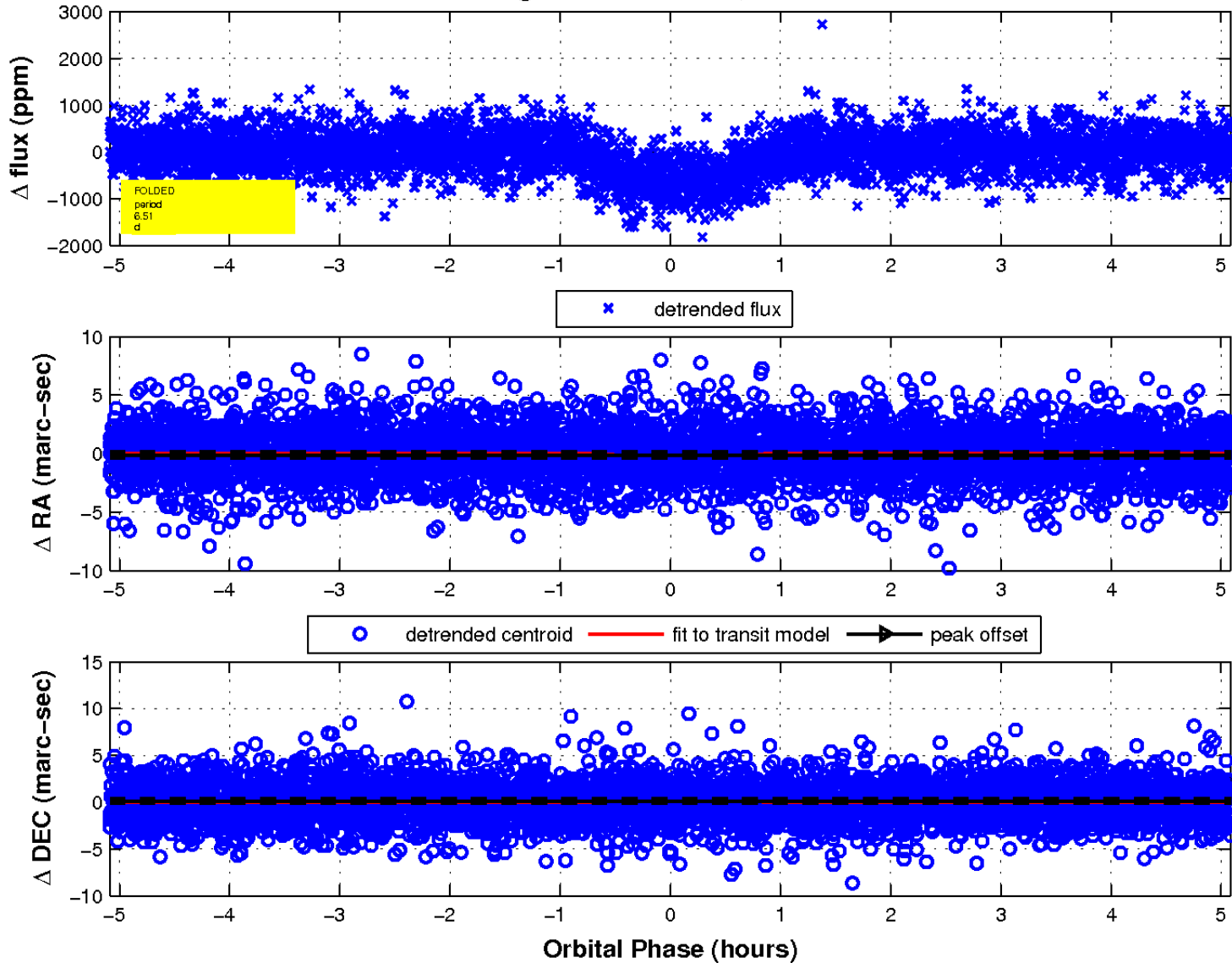




white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

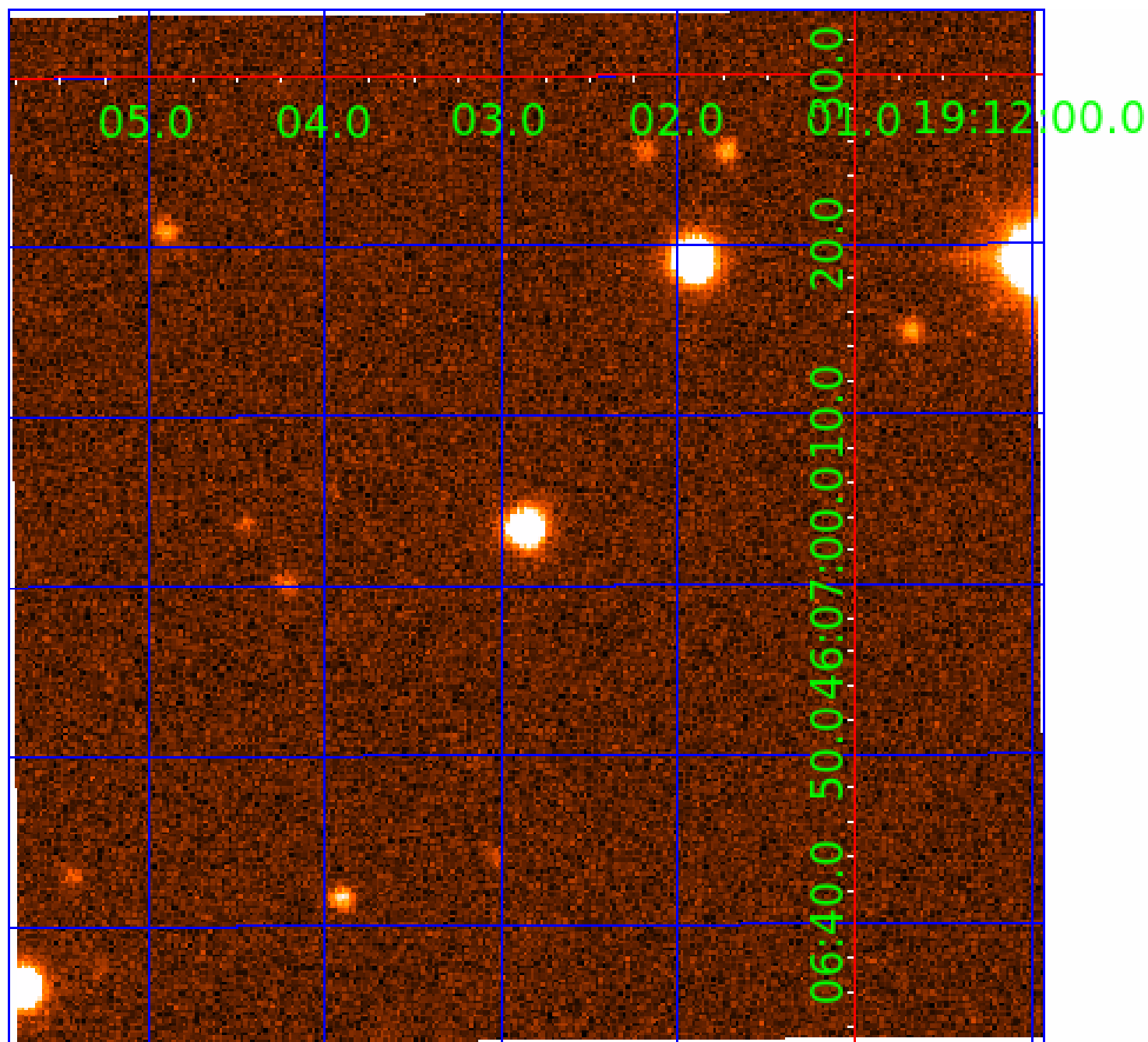


fluxWeightedCentroids, Planet 1 of 2



UKIRT Image

Declination



# KIC 009518318

## 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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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.

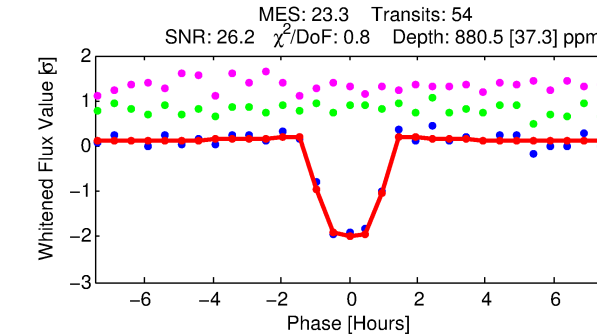
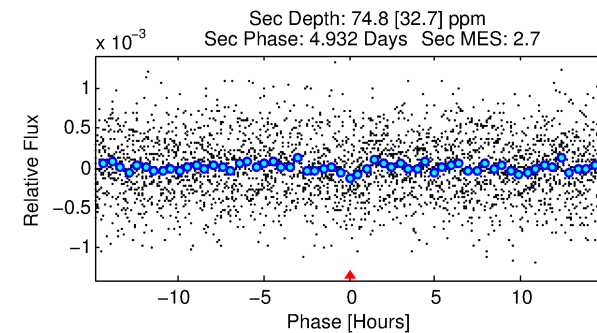
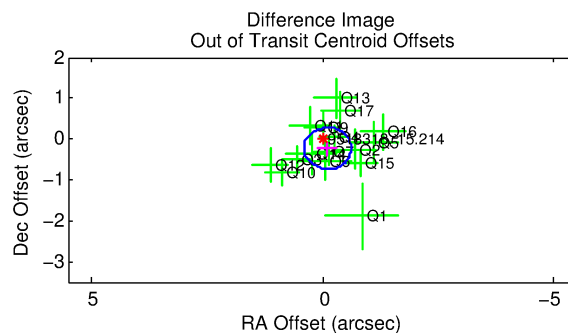
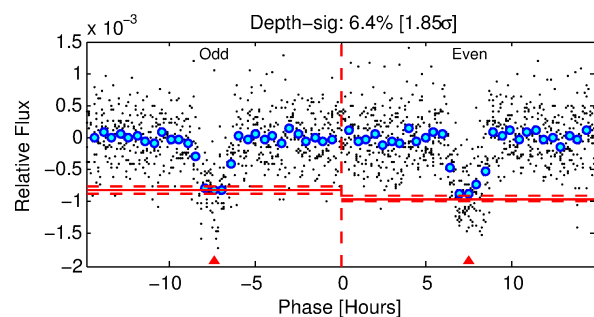
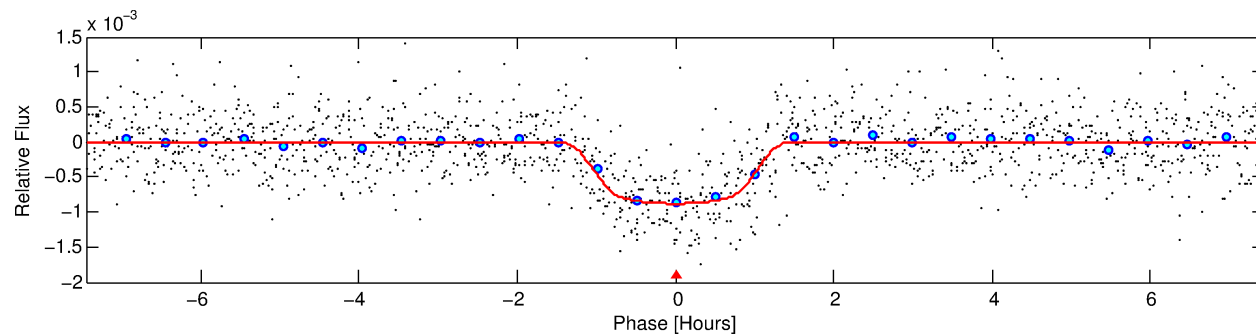
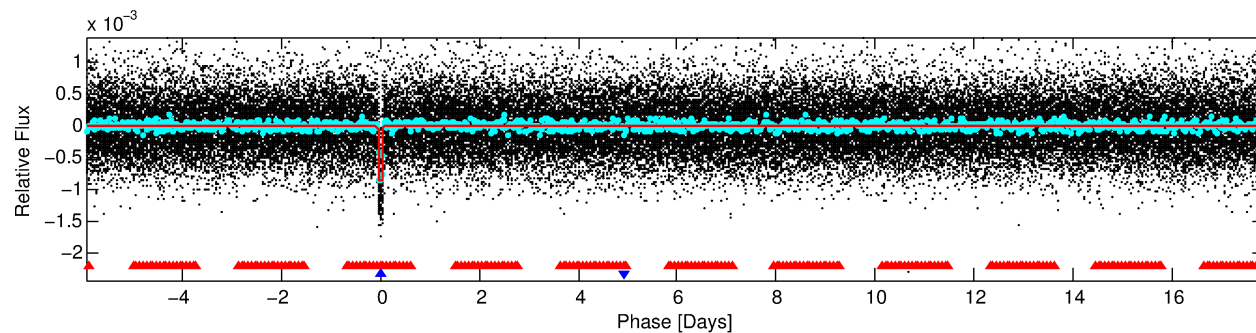
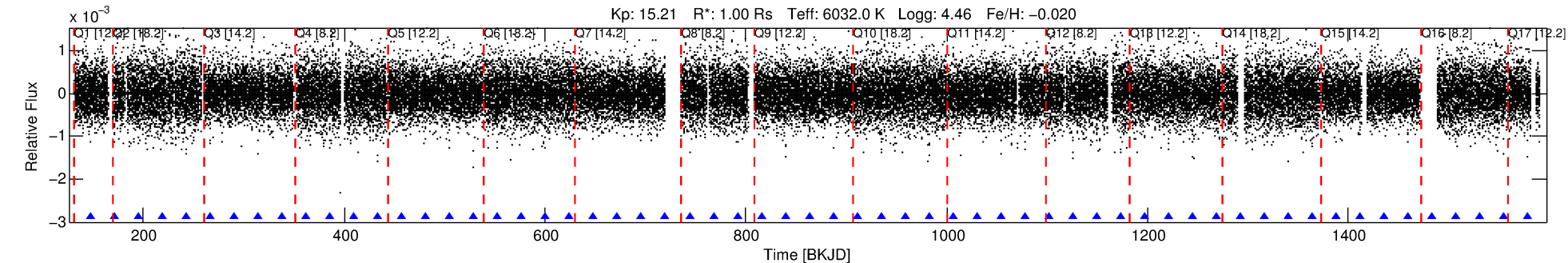
## Ephemeris Match Information For 009518318-02

No Significant Match Found

# DV One-Page Summary

KIC: 9518318 Candidate: 2 of 2 Period: 23.852 d  
KOI: K01978.02 Name: Kepler-346c Corr: 0.989

Kp: 15.21 R\*: 1.00 Rs Teff: 6032.0 K Logg: 4.46 Fe/H: -0.020



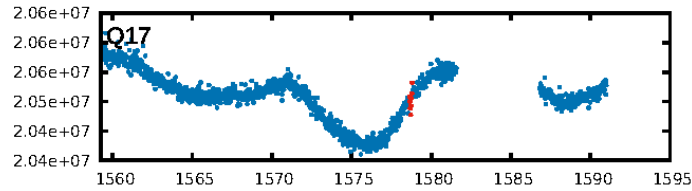
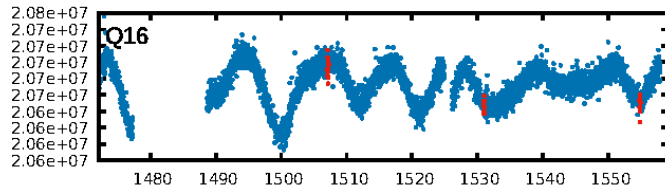
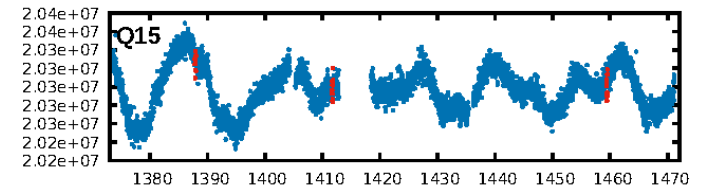
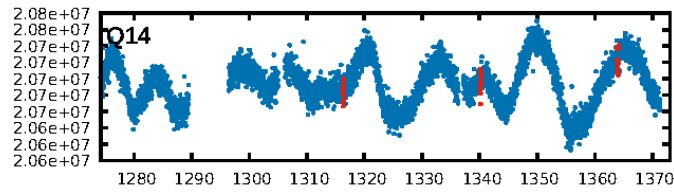
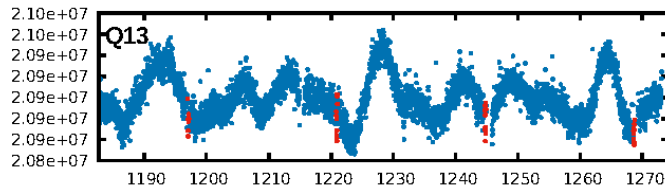
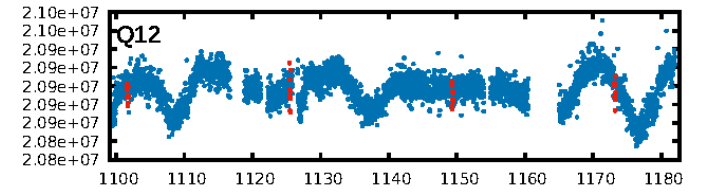
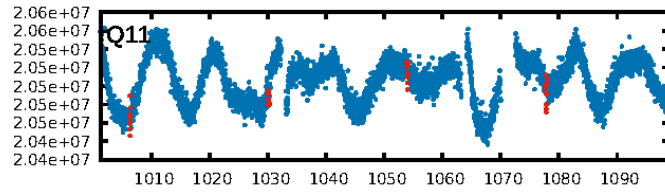
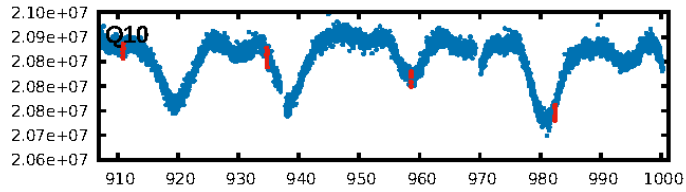
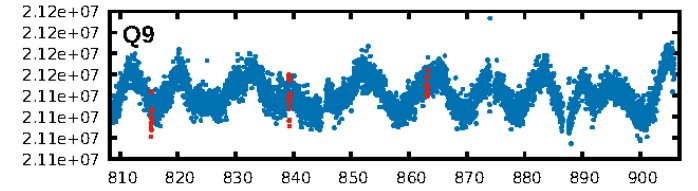
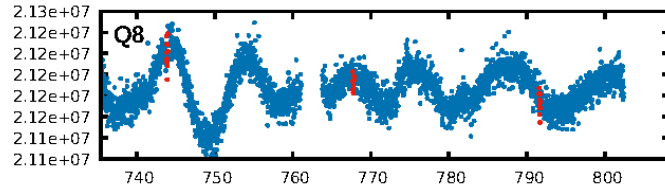
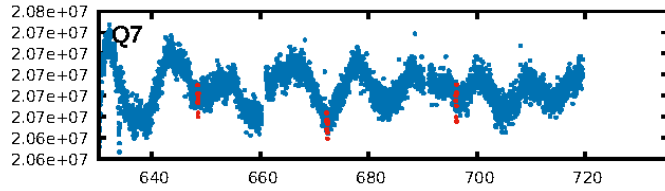
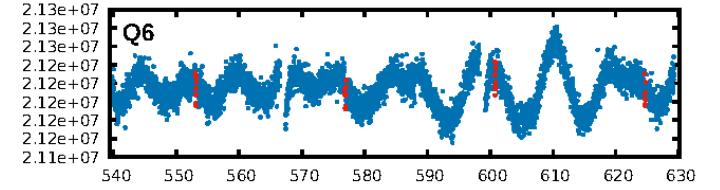
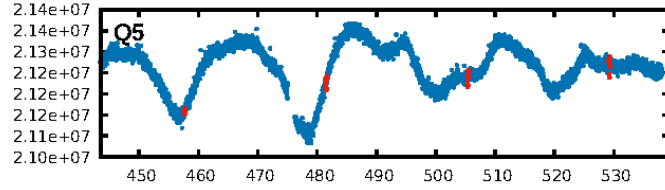
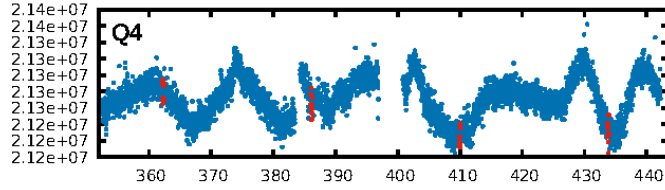
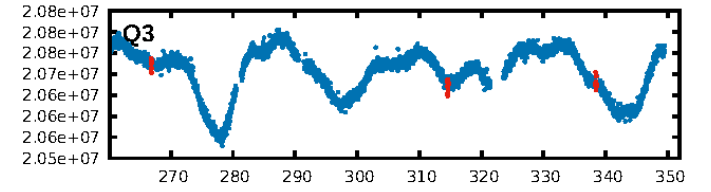
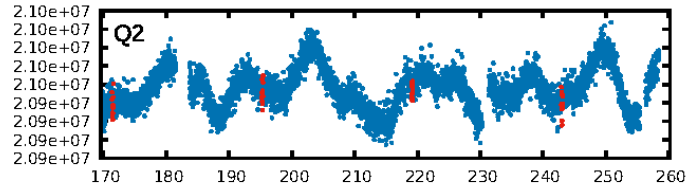
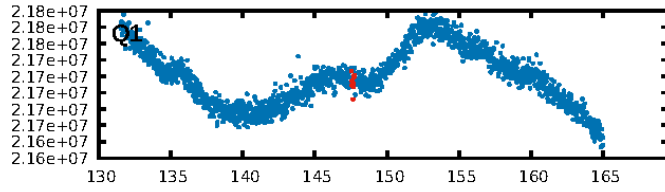
## DV Fit Results:

Period = 23.85164 [0.00006] d  
Epoch = 147.6138 [0.0022] BKJD  
Rp/R\* = 0.0320 [0.0032]  
a/R\* = 37.81 [17.14]  
b = 0.89 [0.10]  
Seff = 43.29 [18.20]  
Teff = 654 [69] K  
Rp = 3.49 [1.21] Re  
a = 0.1657 [0.0454] AU  
Ag = 92.55 [57.23] [1.60σ]  
Teffp = 3137 [394] K [6.20σ]

## DV Diagnostic Results:

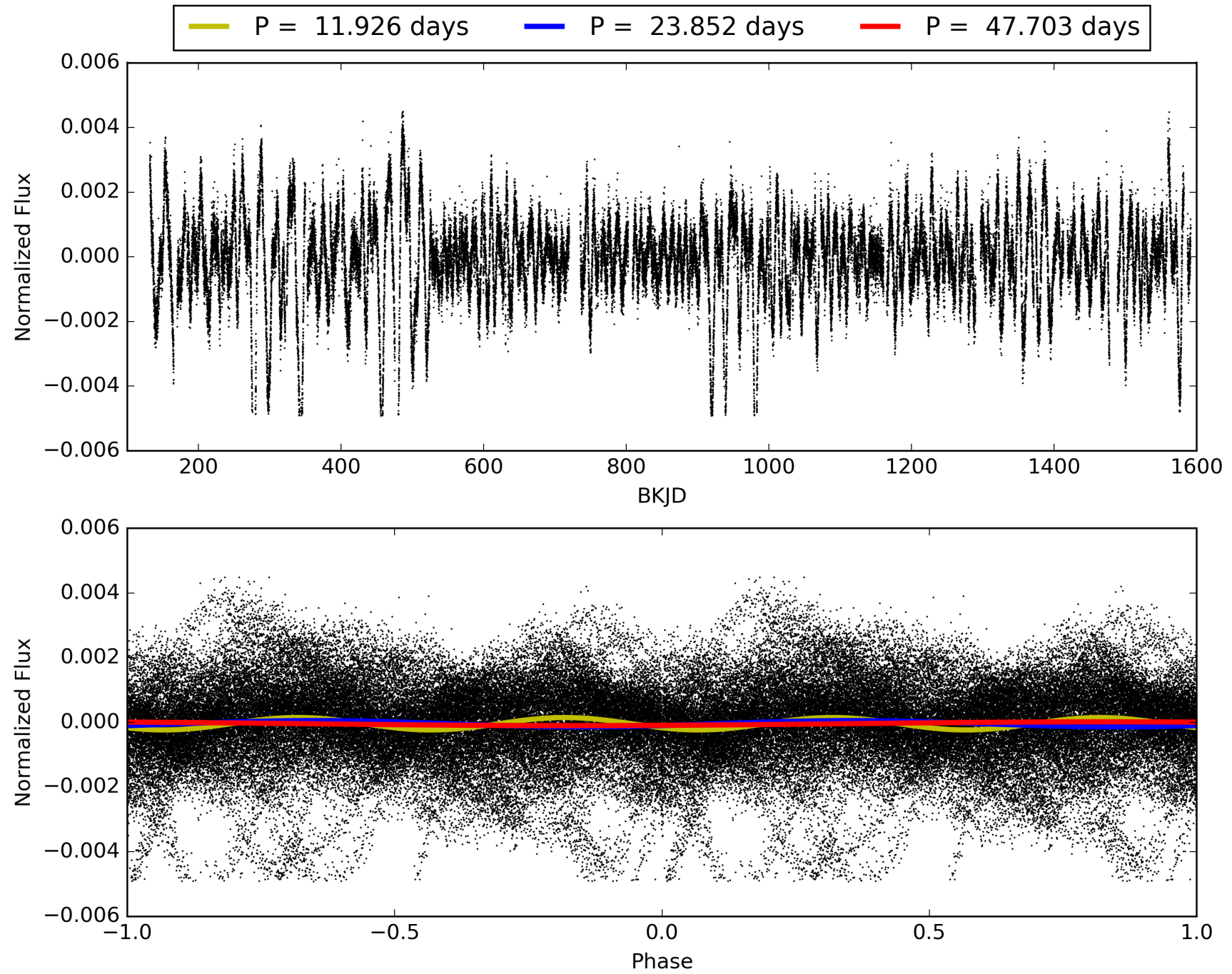
ShortPeriod-sig: 100.0% [138.32σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 91.9%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 1.20e-111  
RollingBand-fgt: 1.00 [52/52]  
GhostDiagnostic-chr: 2.487  
Centroid-sig: 0.4%  
Centroid-so: 1.180 arcsec [2.51σ]  
OotOffset-rm: 0.255 arcsec [1.51σ]  
KicOffset-rm: 0.205 arcsec [1.18σ]  
OotOffset-st: 4/4/3/5 [16]  
KicOffset-st: 4/4/3/5 [16]  
DiffImageQuality-fgm: 1.00 [16/16]  
DiffImageOverlap-fno: 1.00 [17/17]

# TCE 009518318-02, PDC Light Curves



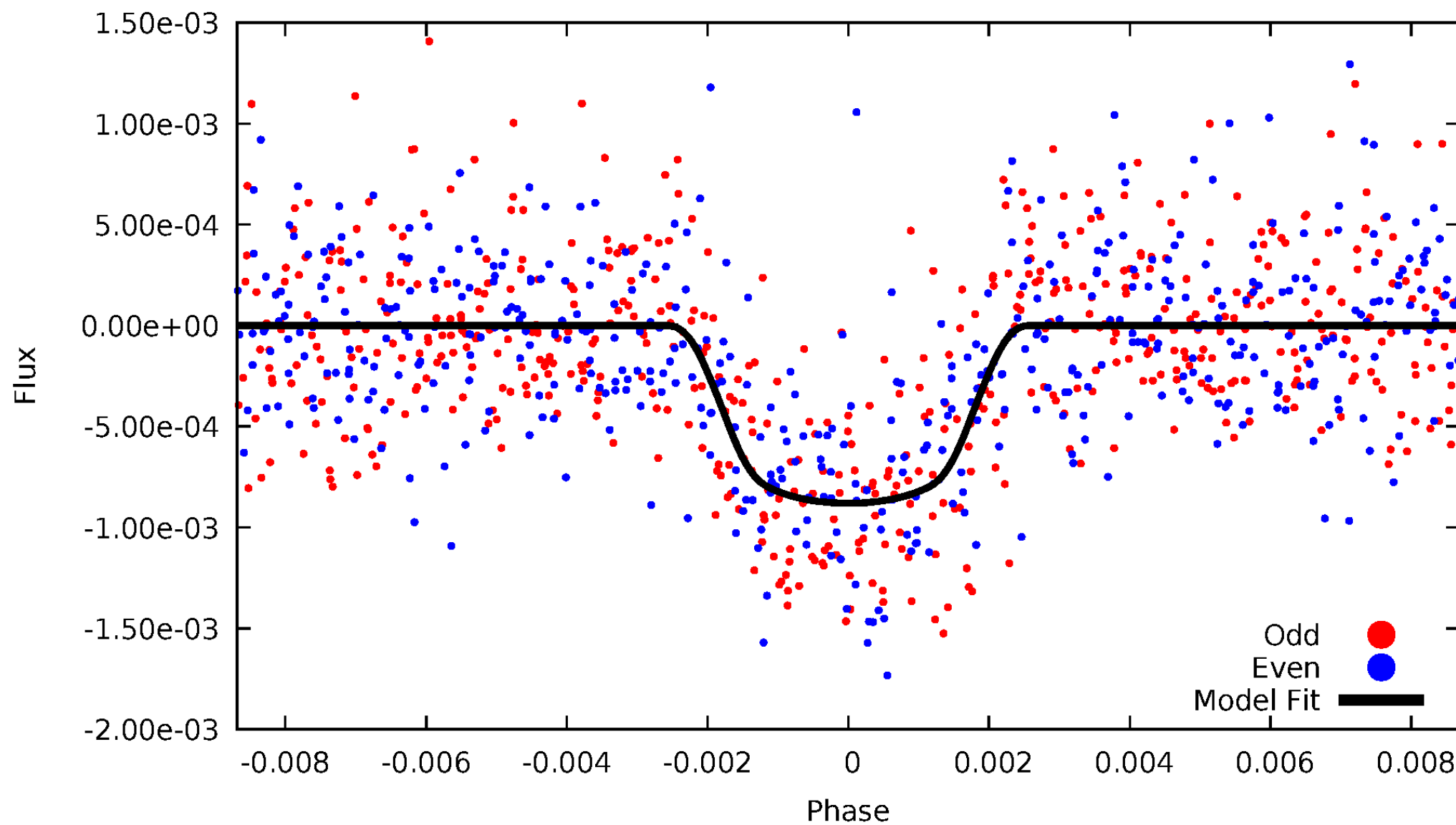


TCE 009518318-02



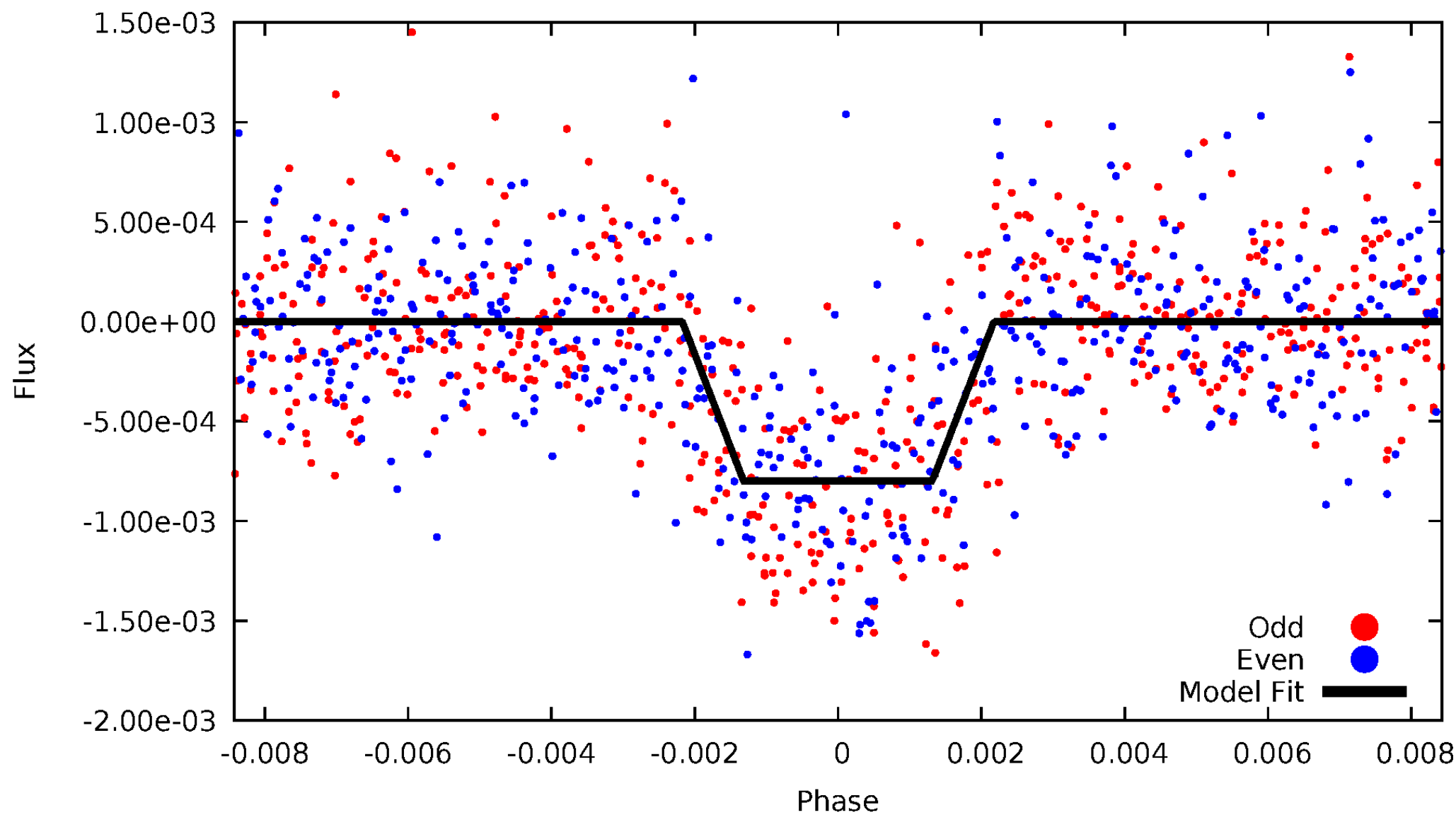
# DV Odd/Even

TCE 009518318-02



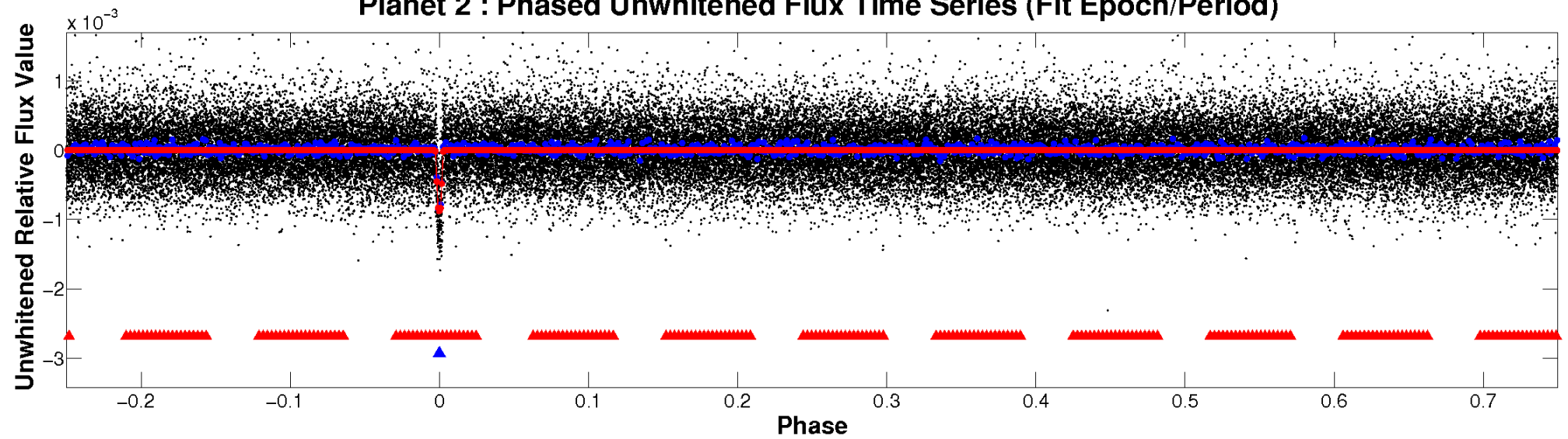
# ALT Odd/Even

TCE 009518318-02

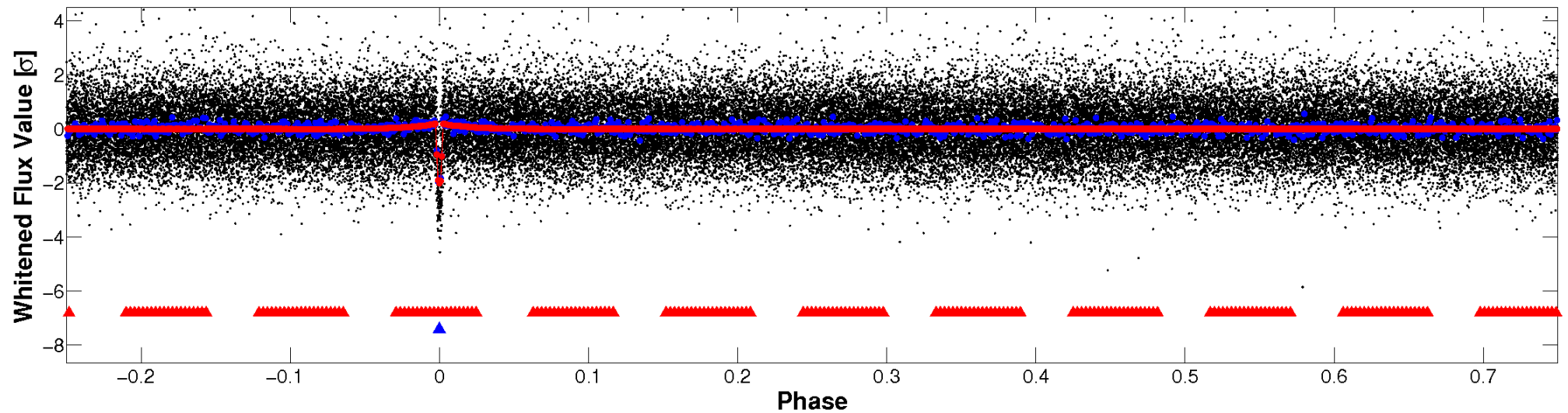


# Non-Whitened Vs. Whitened Light Curve

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

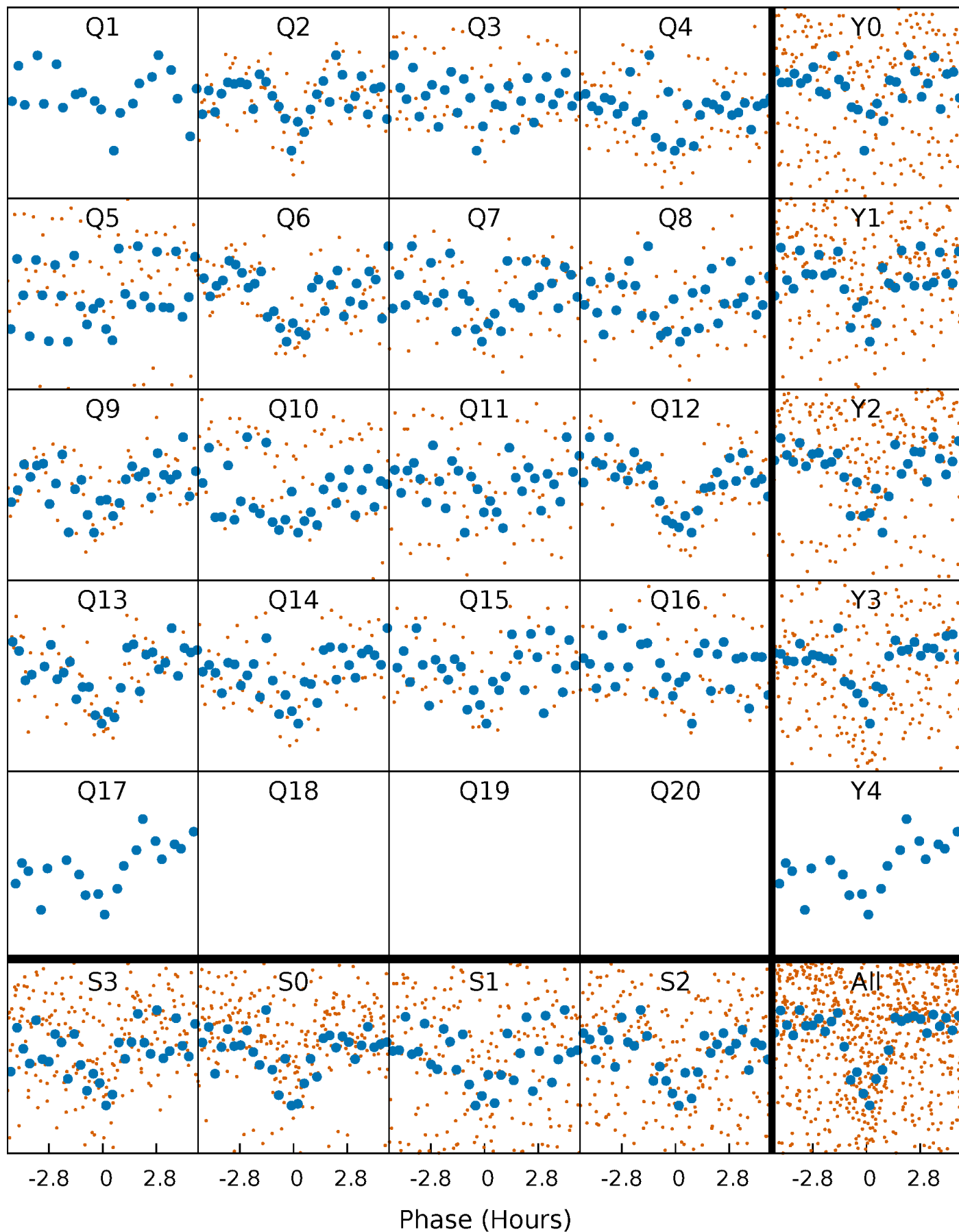


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

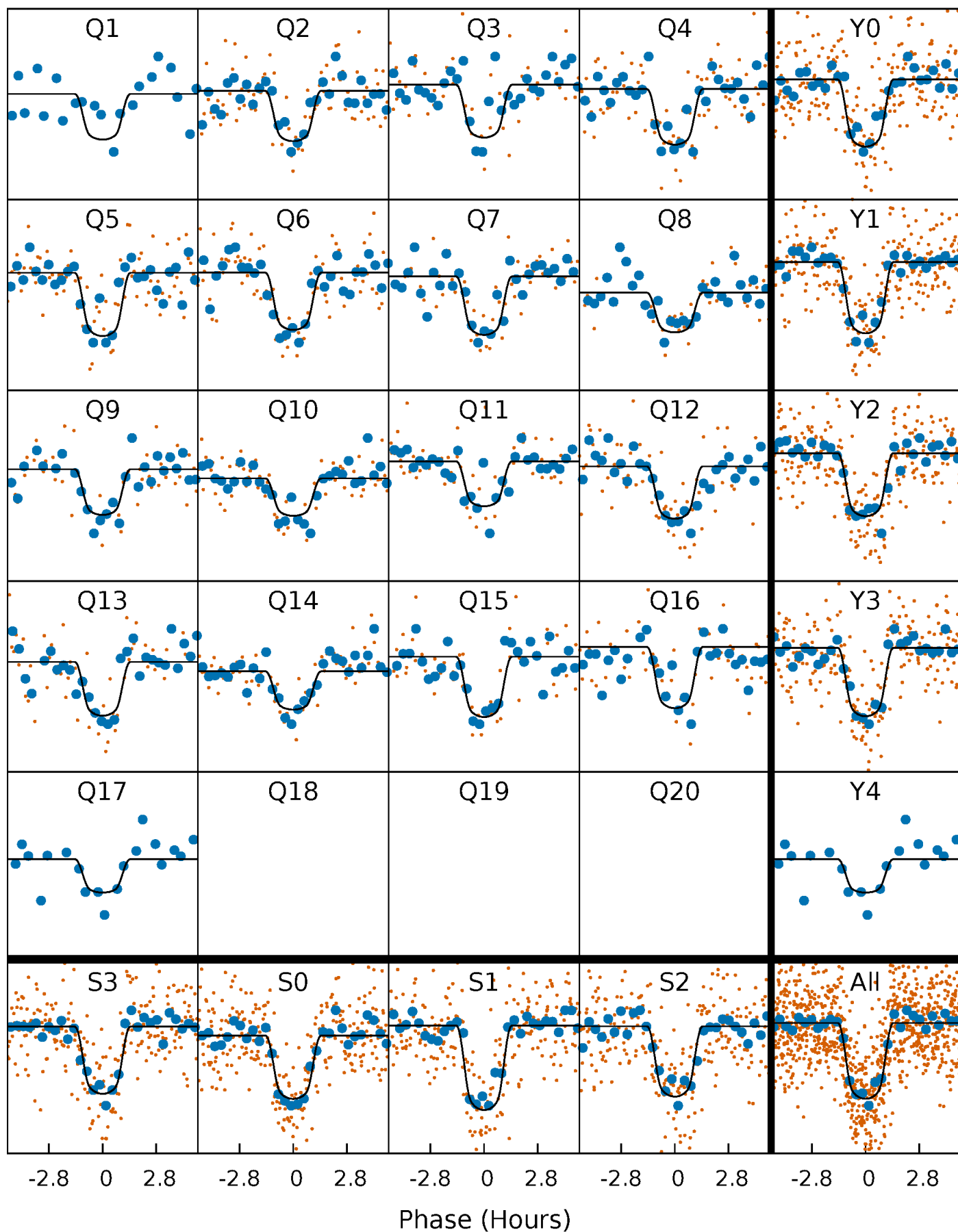
TCE 009518318-02 P= 23.851639 Days  $T_0=147.613770$  (BKJD)





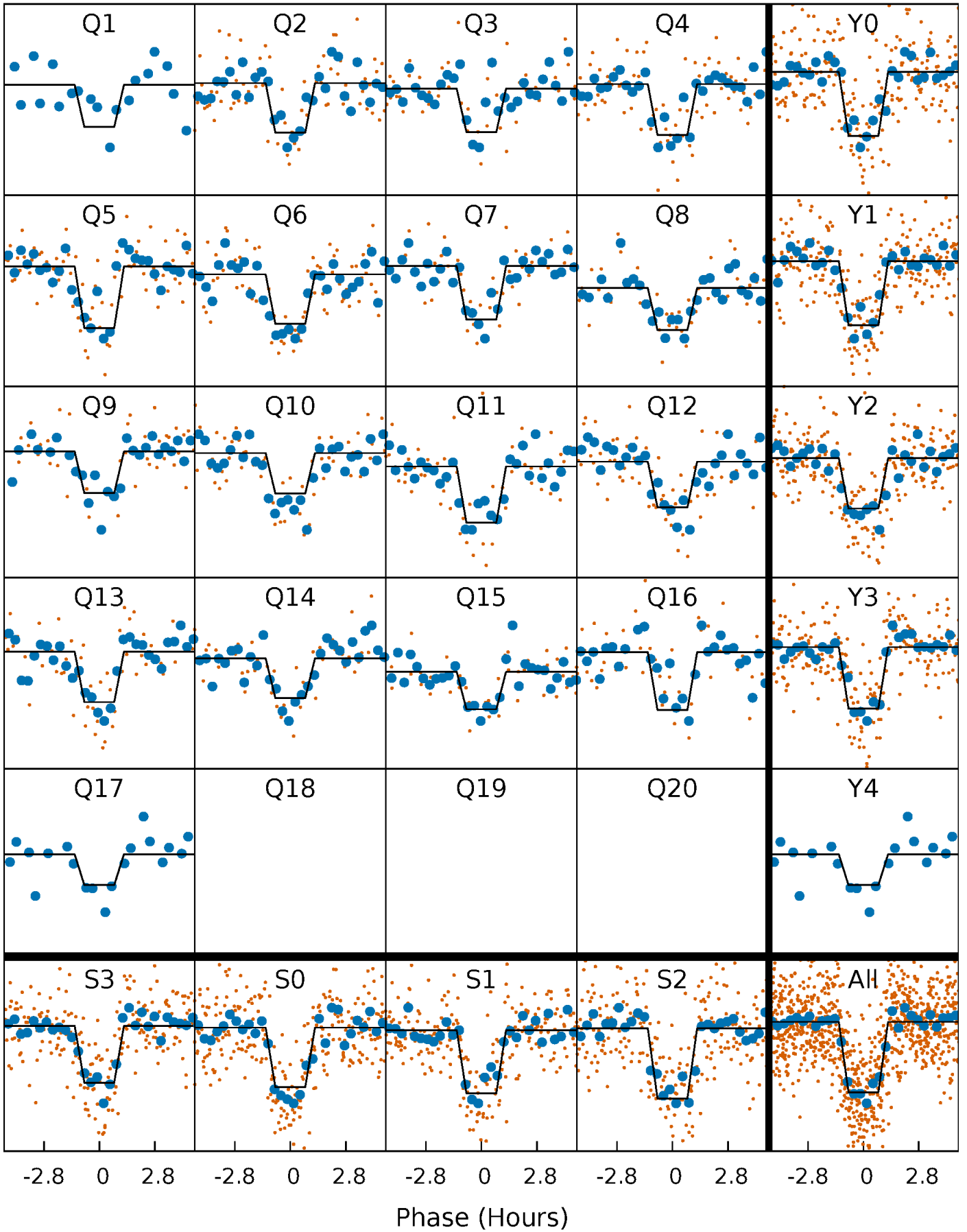
# DV Quarter-Phased Transit Curves

TCE 009518318-02 P= 23.851639 Days  $T_0=147.613770$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

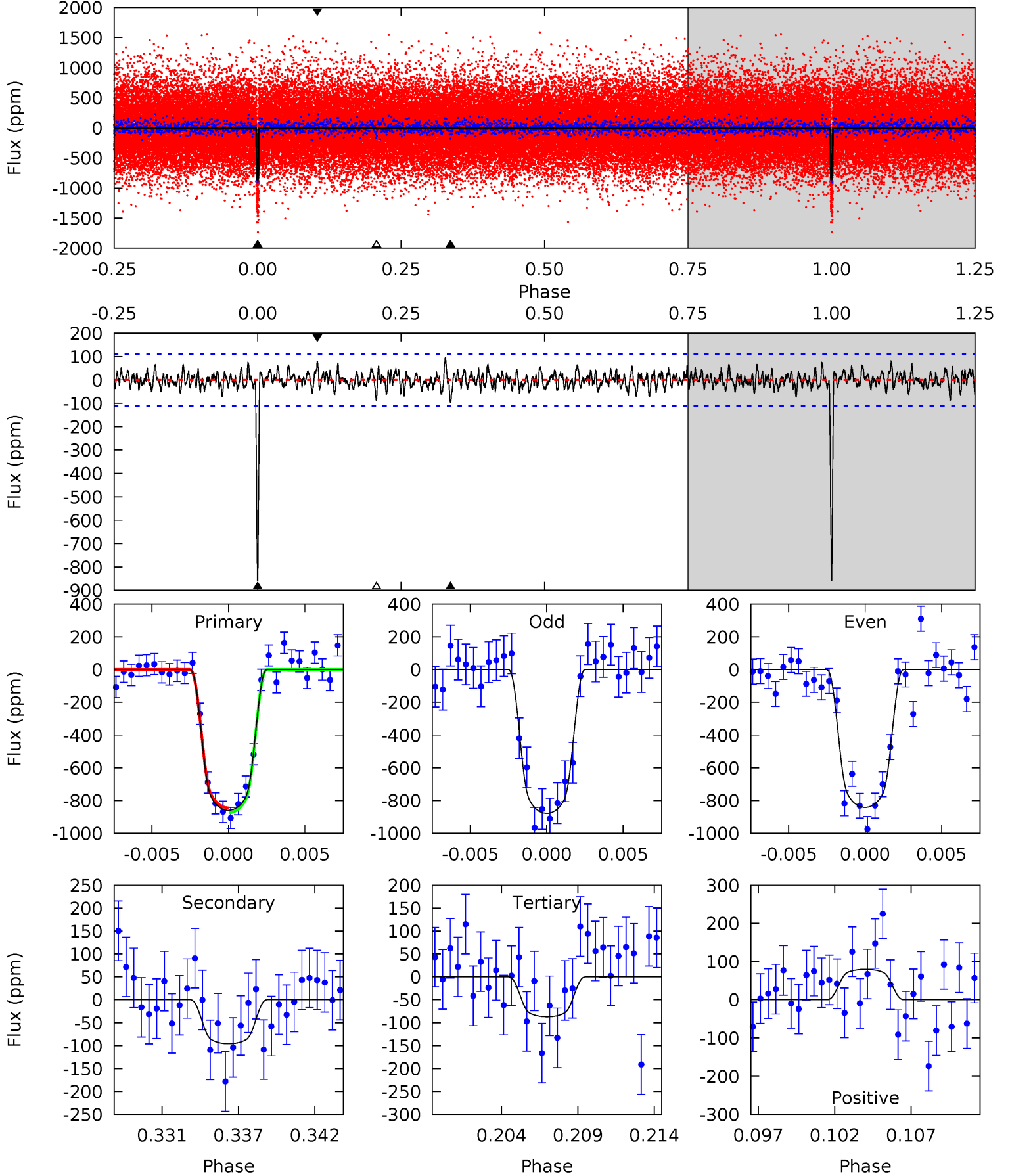
TCE 009518318-02 P= 23.851588 Days  $T_0=147.615784$  (BKJD)



# DV Model-Shift Uniqueness Test

009518318-02,  $P = 23.851639$  Days,  $E = 123.762131$  Days

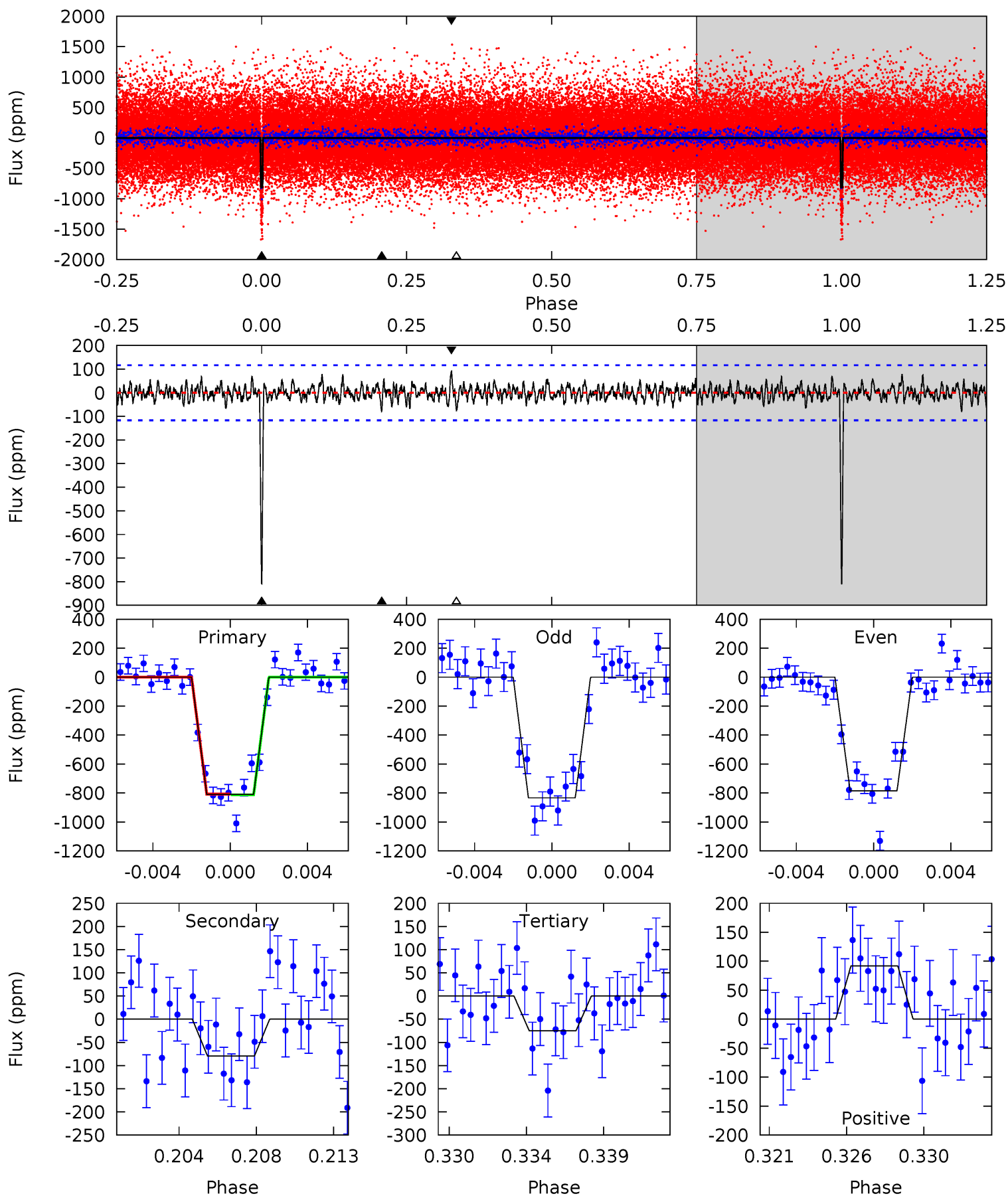
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
40.3	4.50	4.09	3.74	5.15	2.80	1.24	36.2	36.5	0.41	0.76	0.86	1.02	0.10	0.70



# Alt Model-Shift Uniqueness Test

009518318-02,  $P = 23.851588$  Days,  $E = 123.764196$  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
36.0	3.54	3.32	4.08	5.18	2.85	1.07	32.7	31.9	0.21	-0.54	1.07	1.01	0.10	0.11



### Stellar Parameters For KIC 009518318

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$6032^{+190}_{-232}$	$4.465^{+0.056}_{-0.210}$	$-0.020^{+0.250}_{-0.300}$	$1.001^{+0.333}_{-0.111}$	$1.065^{+0.145}_{-0.145}$	$1.496^{+0.434}_{-0.793}$
	+3%/-4%	+1%/-5%	+1250%/-1500%	+33%/-11%	+14%/-14%	+29%/-53%
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 009518318-02 / KOI 1978.02

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-96 \pm 21$	$3.63^{+0.63}_{-0.49}$	$931^{+72}_{-45}$	$3731^{+209}_{-194}$	$105^{+48}_{-32}$
Alt.	$-80 \pm 23$	$3.19^{+0.63}_{-0.48}$	$936^{+69}_{-54}$	$3772^{+266}_{-246}$	$113^{+56}_{-42}$

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

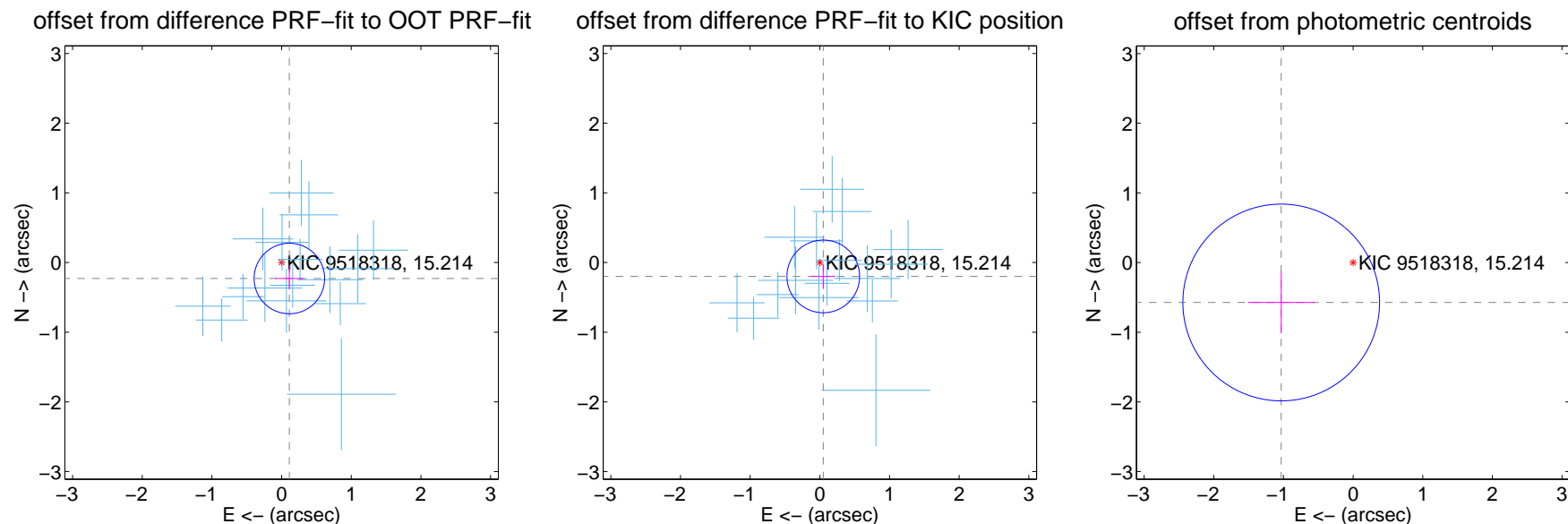
## DV Centroid Data

Supplemental centroid analysis for 009518318-02. Kepler magnitude: 15.21. Transit SNR 26.24

There are 16 quarters with good PRF difference image offsets

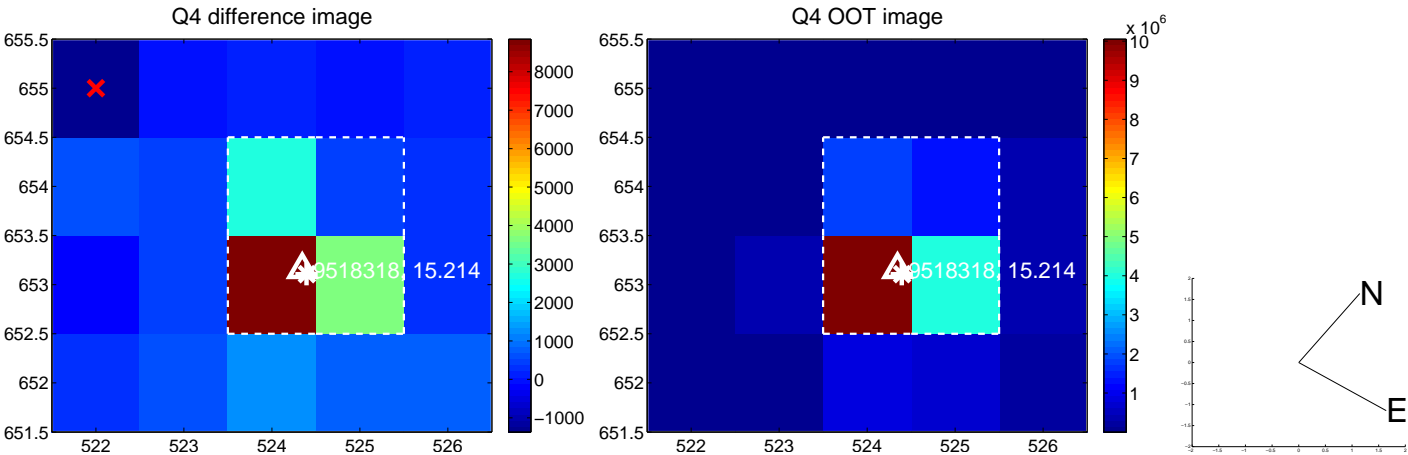
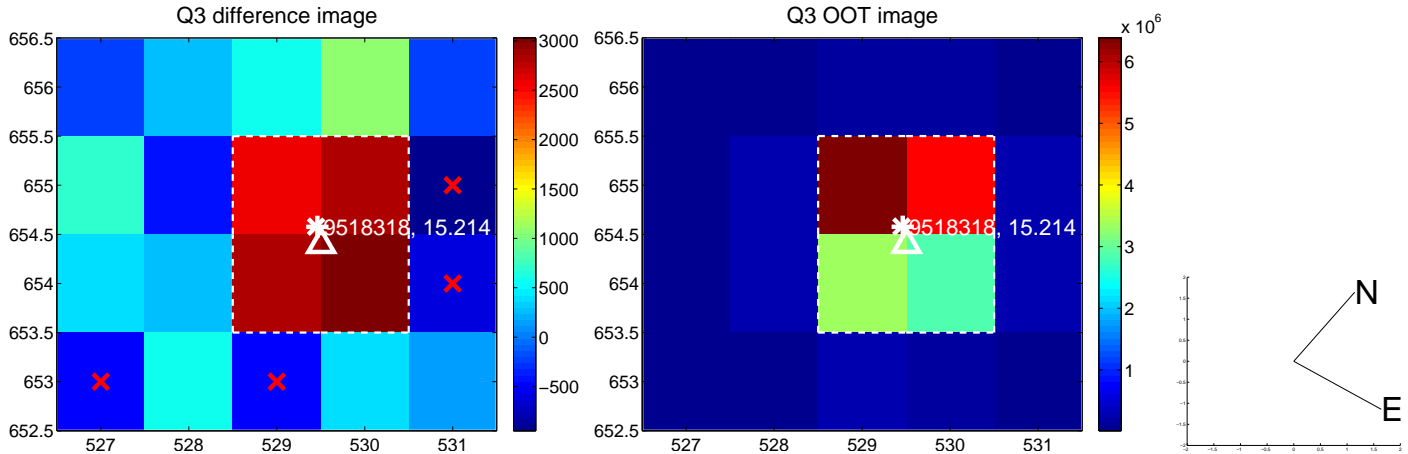
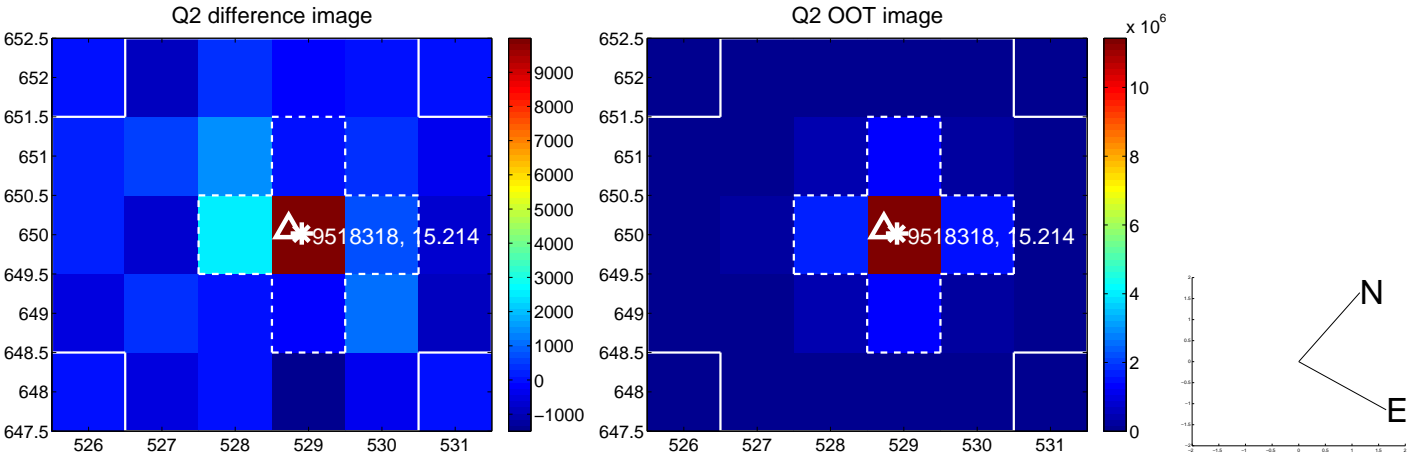
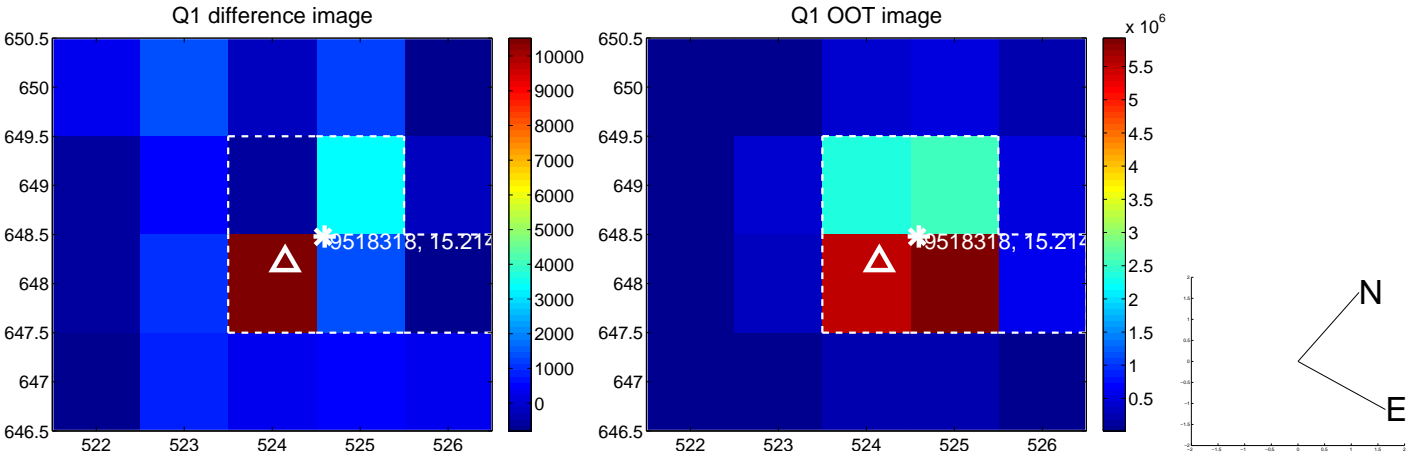
The direct PRF centroid is offset from the target star catalog position by about 0.09 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.255 \pm 0.169$	1.51	$-0.112 \pm 0.200$	$-0.229 \pm 0.160$
PRF-fit source offset from KIC position	$0.205 \pm 0.174$	1.18	$-0.049 \pm 0.175$	$-0.199 \pm 0.180$
photometric centroid source offset	$1.18 \pm 0.47$	2.51	$1.03 \pm 0.48$	$-0.57 \pm 0.44$



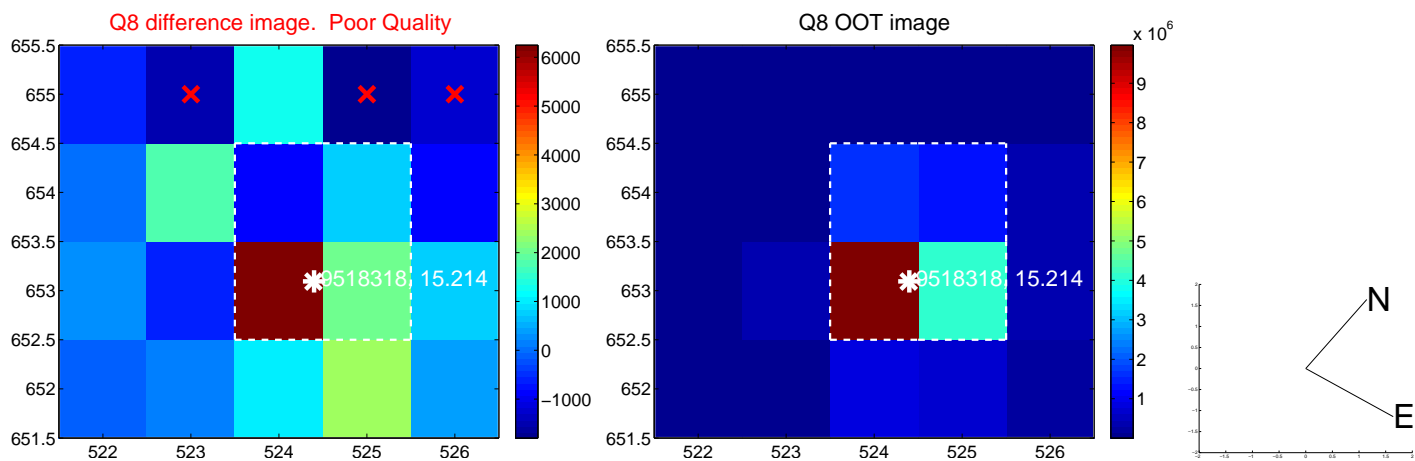
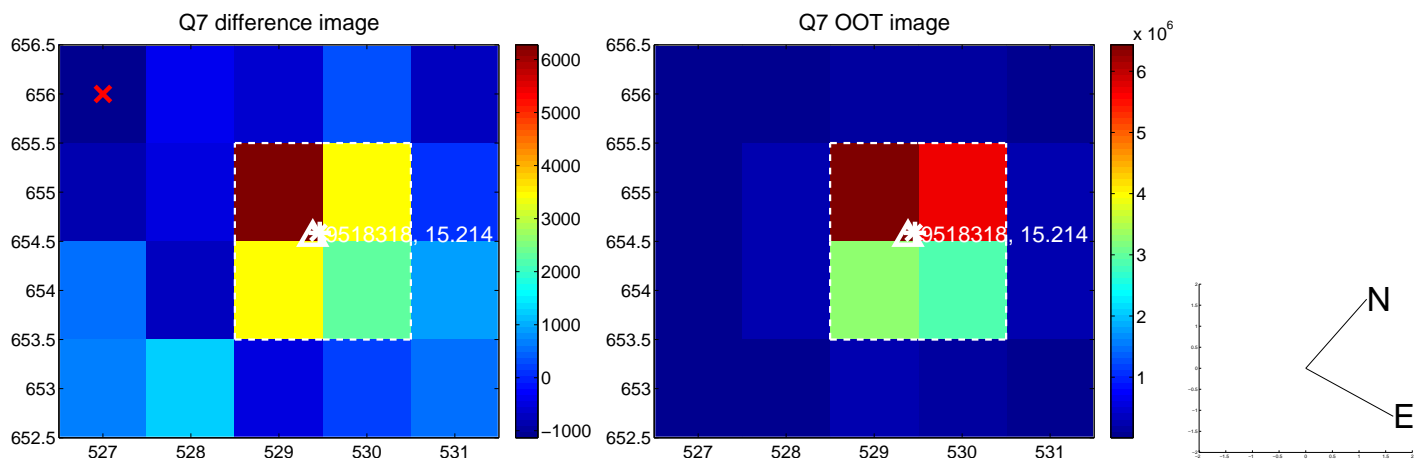
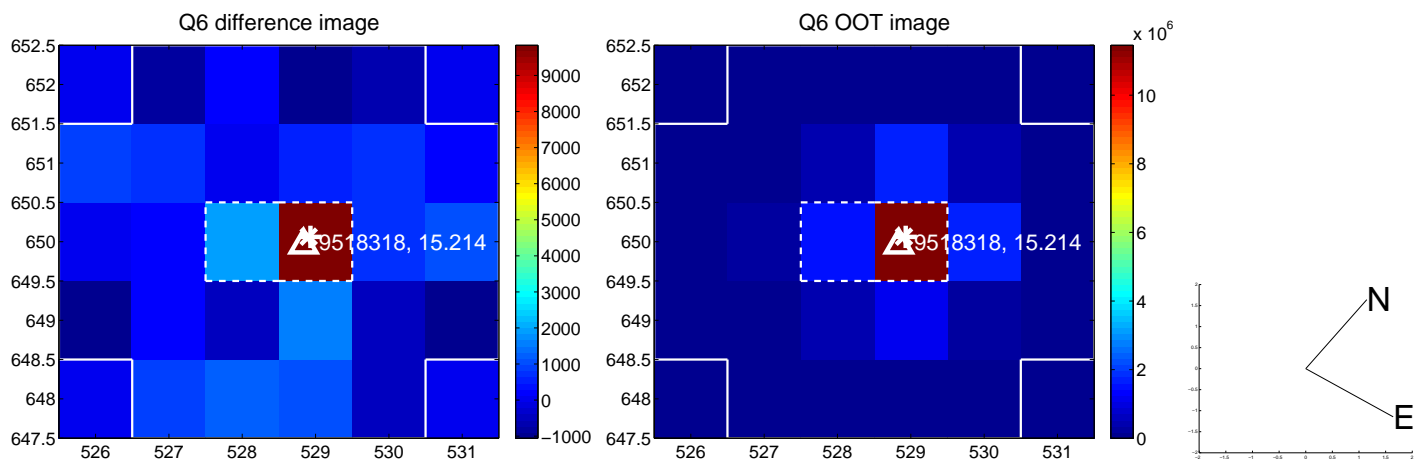
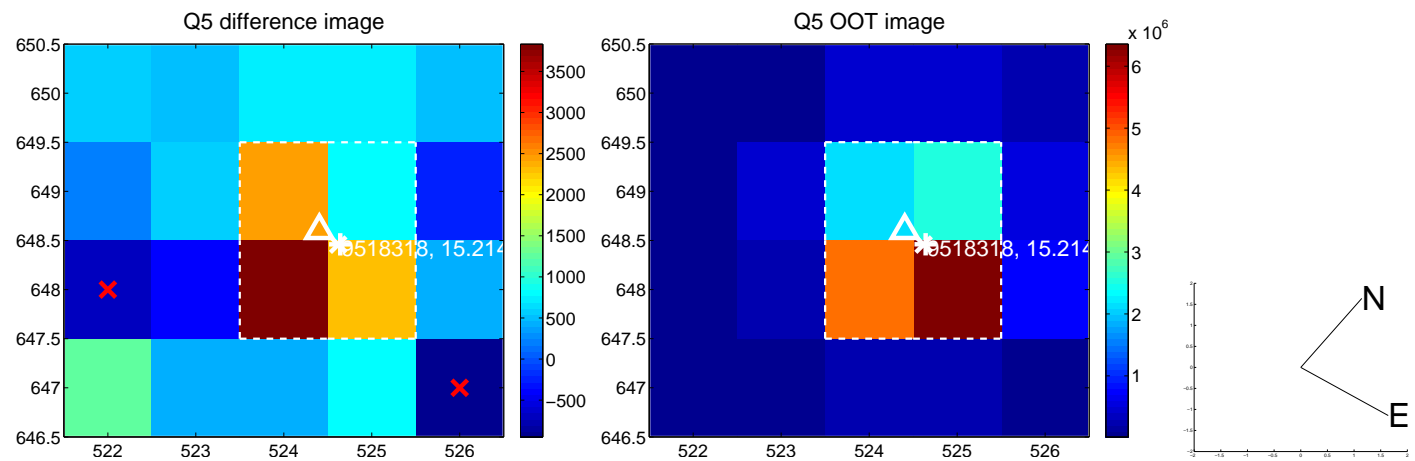
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

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

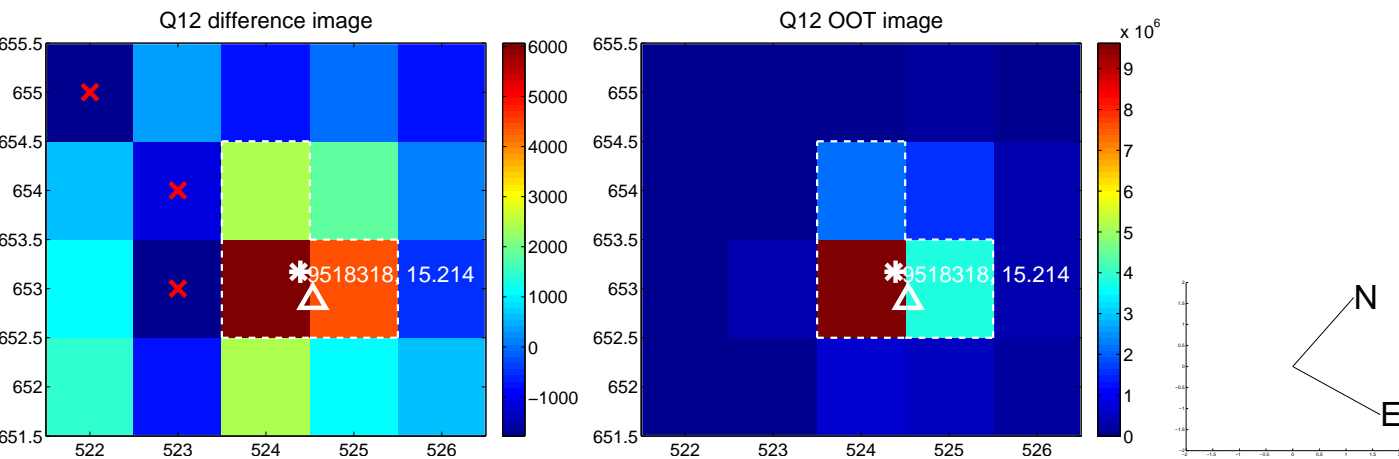
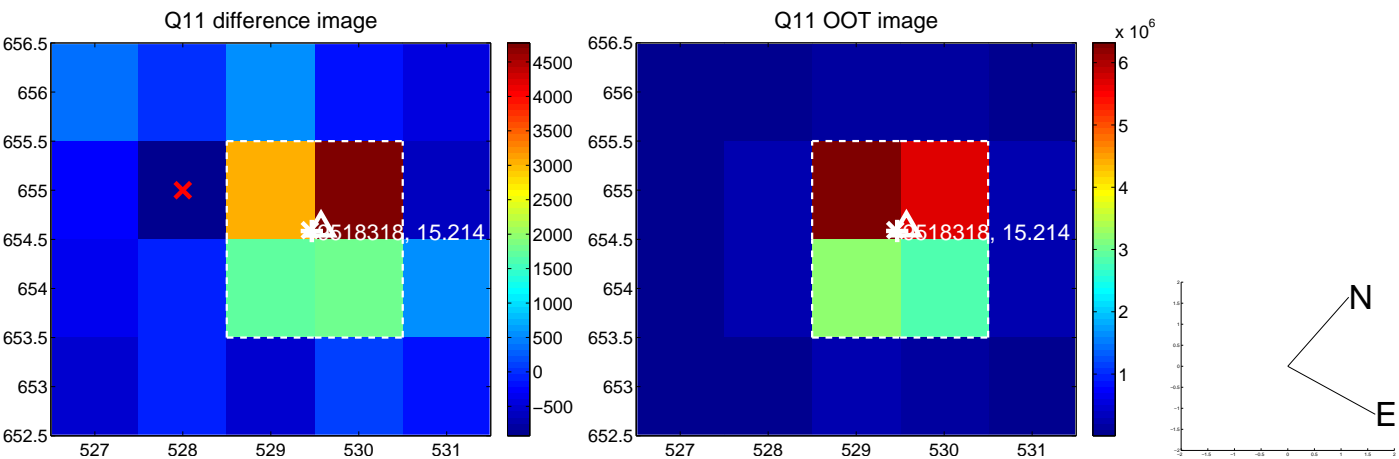
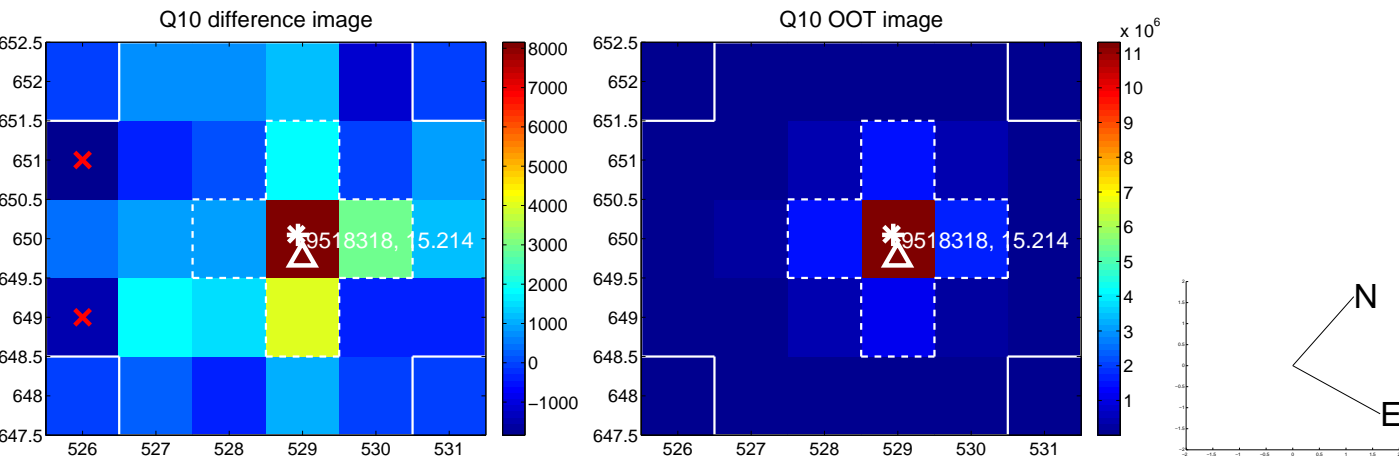
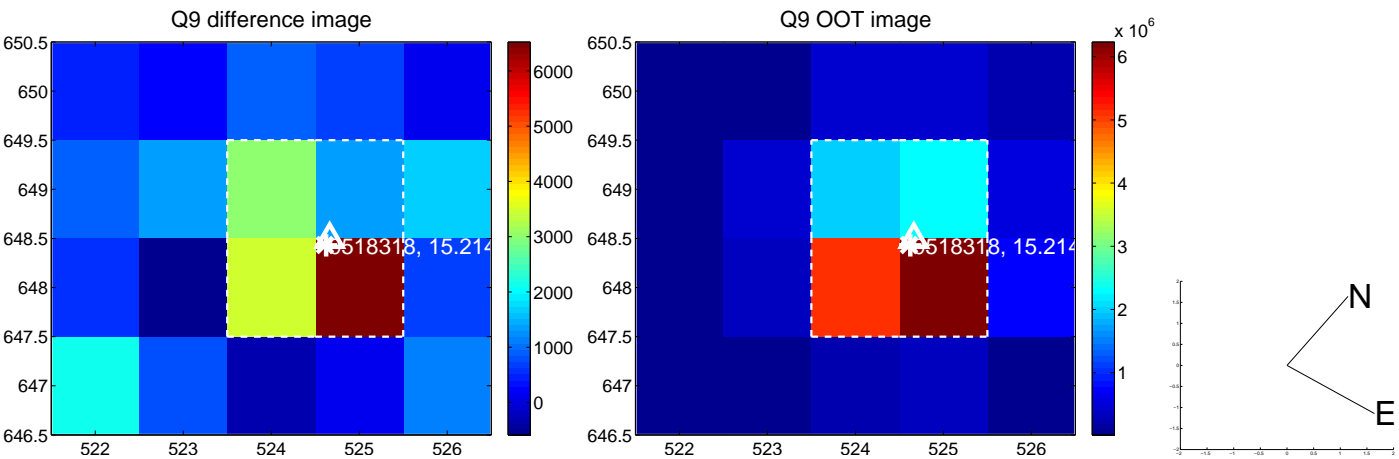




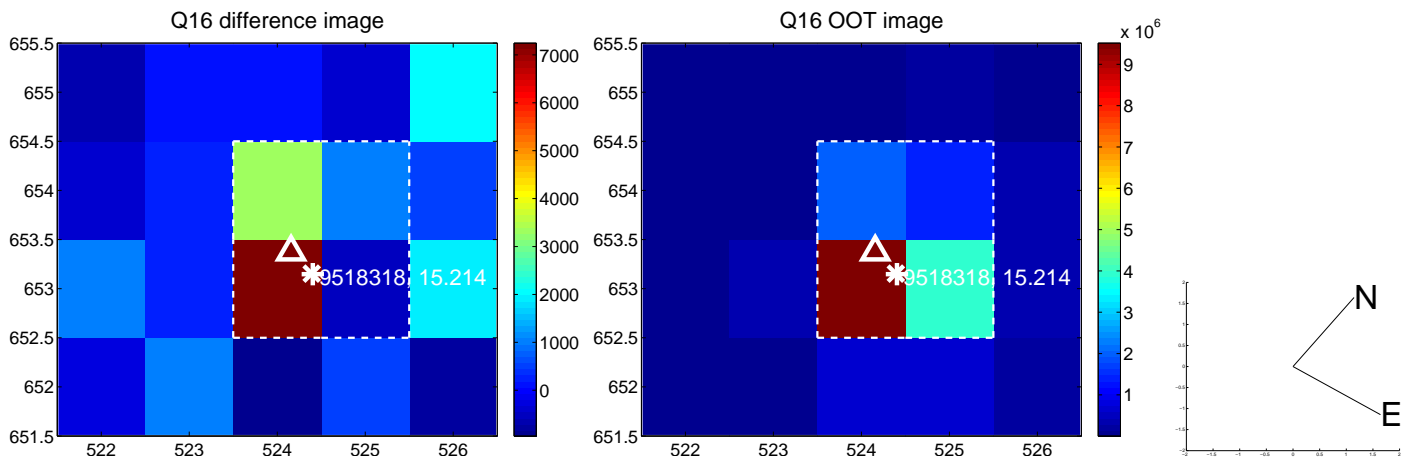
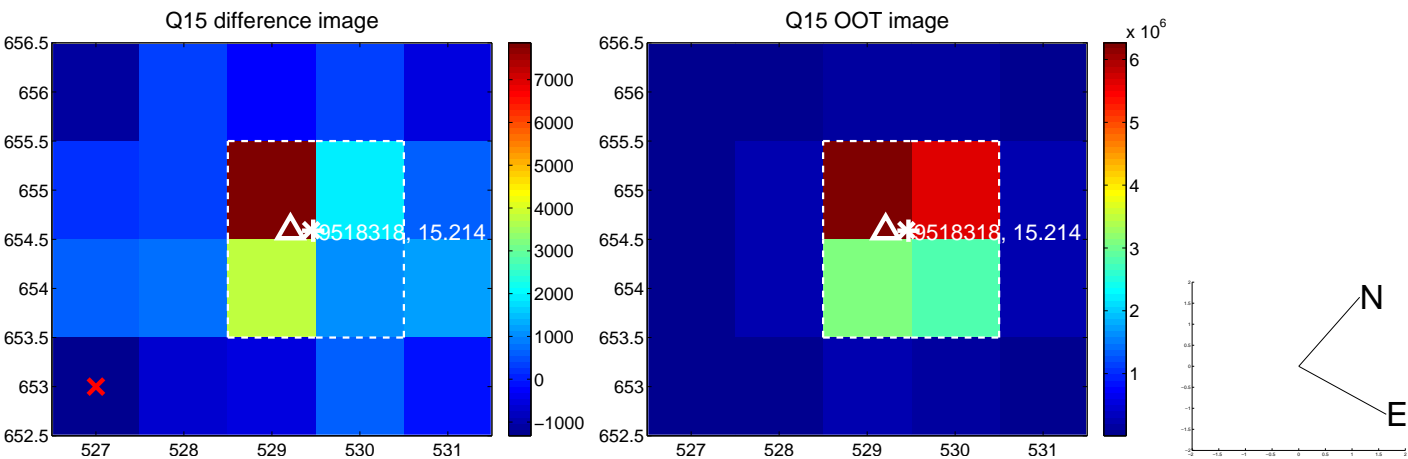
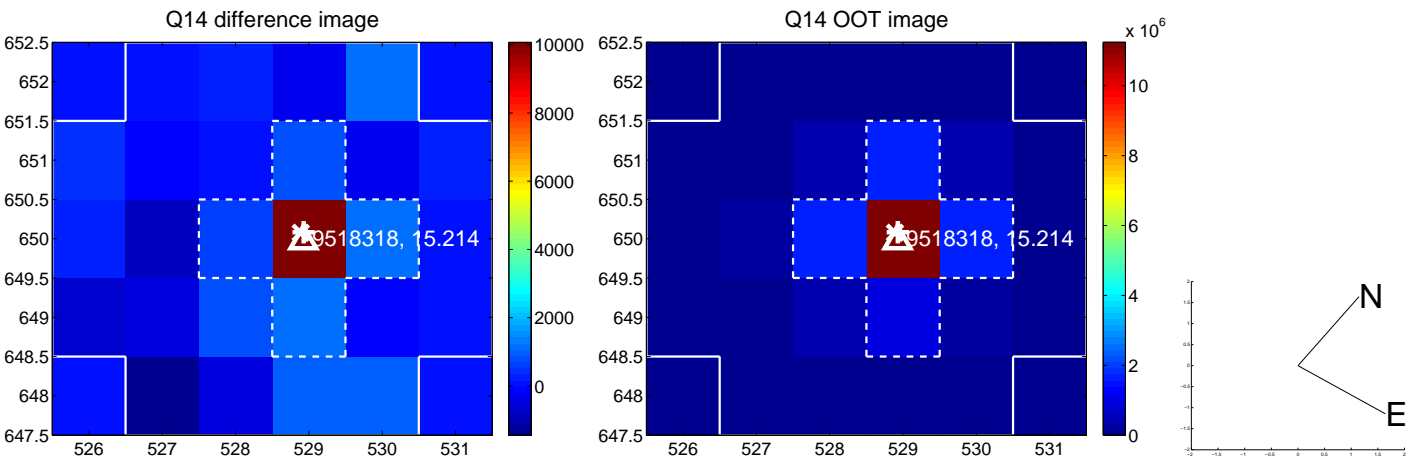
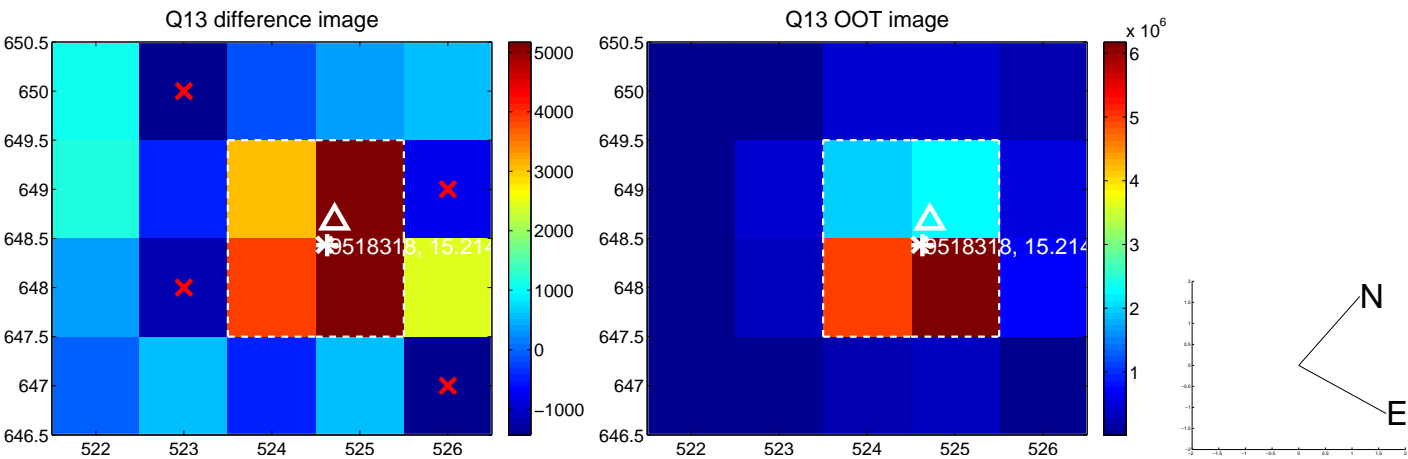
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



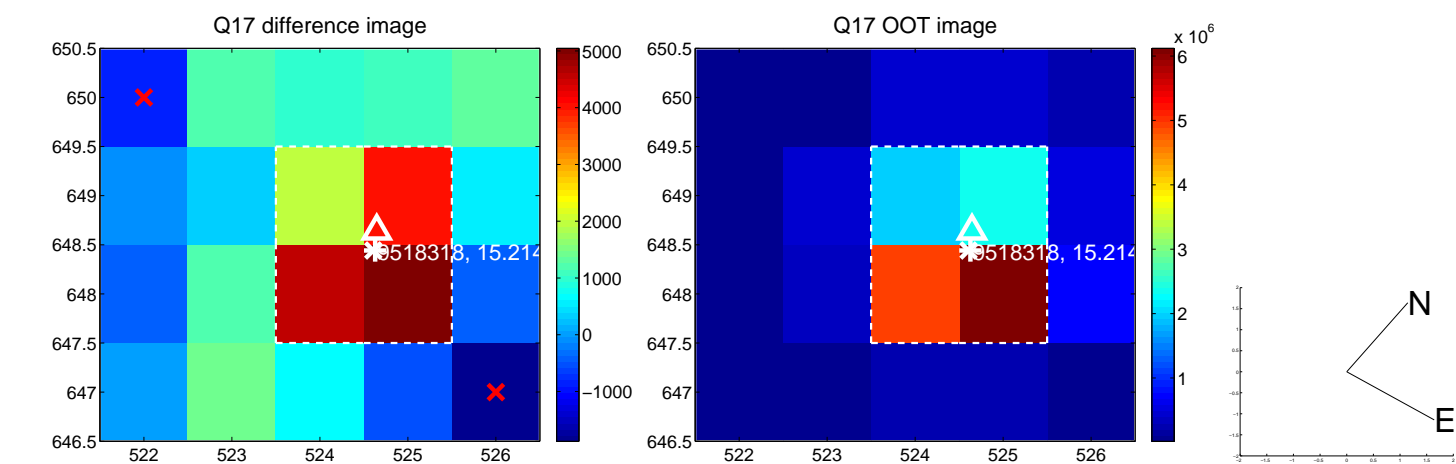
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



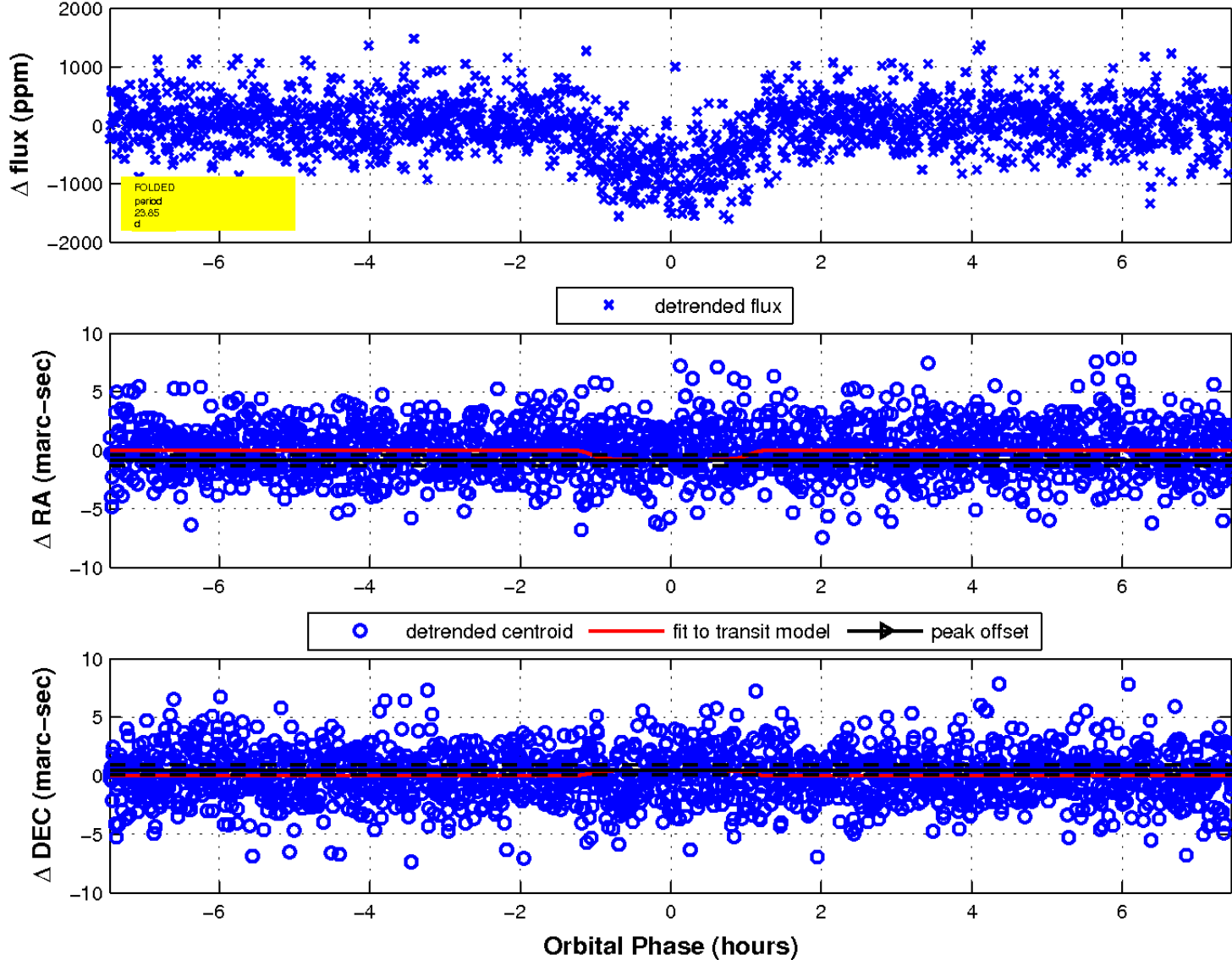
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

Declination

