

KIC 009963524

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})
009963524-01	OBS	0720.01	5.690581	134.215842	1359.3	2.684	116.5	116.3	0.81	5244	3.40	129.72
009963524-02	OBS	0720.02	10.041578	137.084642	1110.1	2.699	70.6	70.3	0.81	5244	3.02	60.83
009963524-03	OBS	0720.03	18.369770	131.864411	1025.7	2.245	47.6	47.1	0.81	5244	2.77	27.19
009963524-04	OBS	0720.04	2.795897	132.729403	396.1	2.157	42.5	48.7	0.81	5244	1.85	334.58

Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009963524-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-03	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-04	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 for comment definitions.

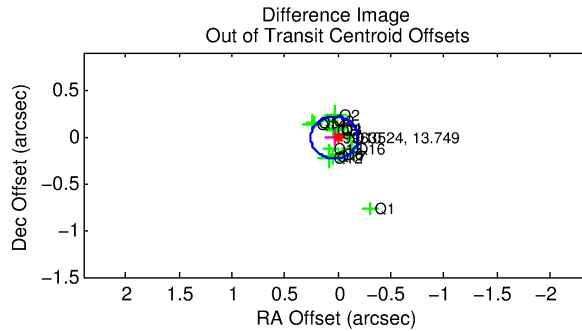
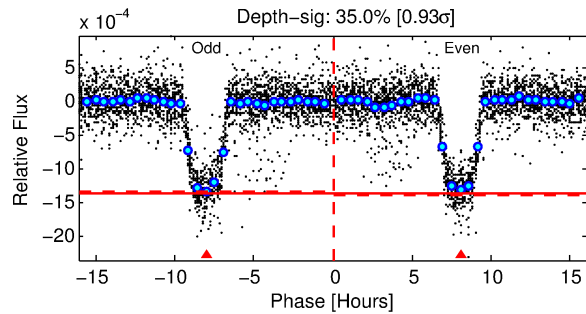
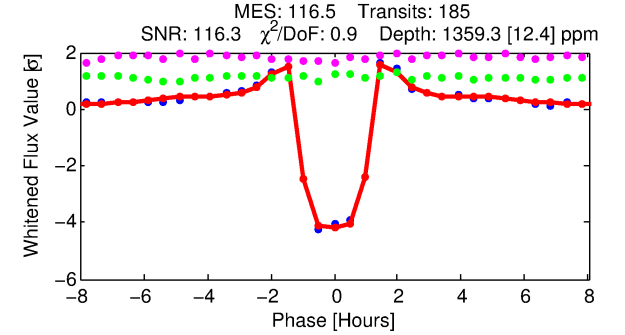
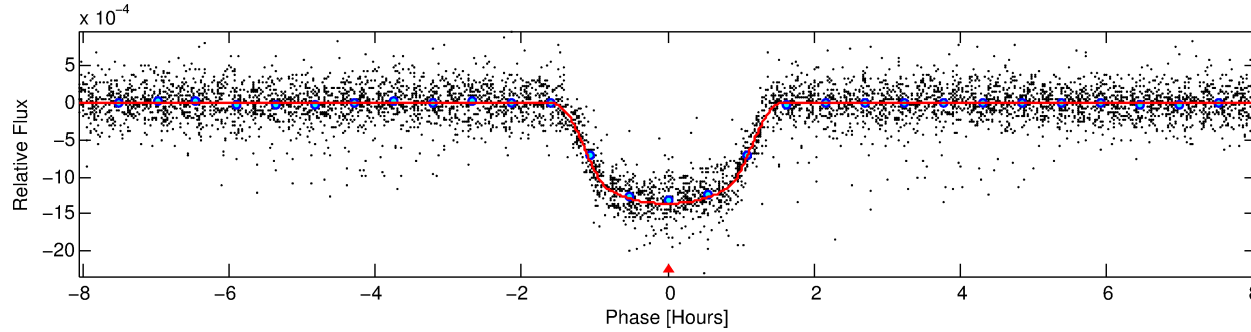
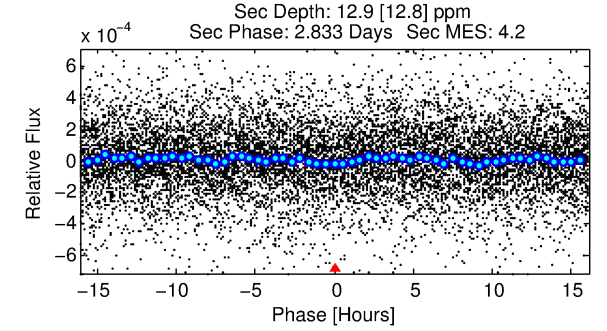
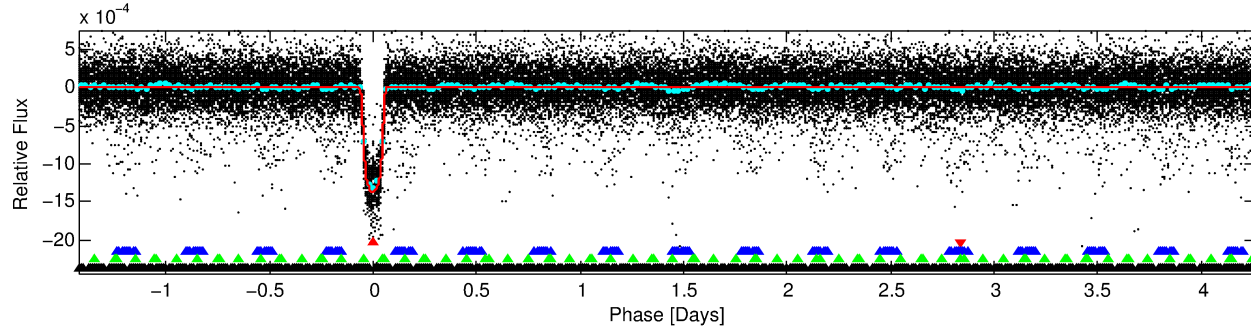
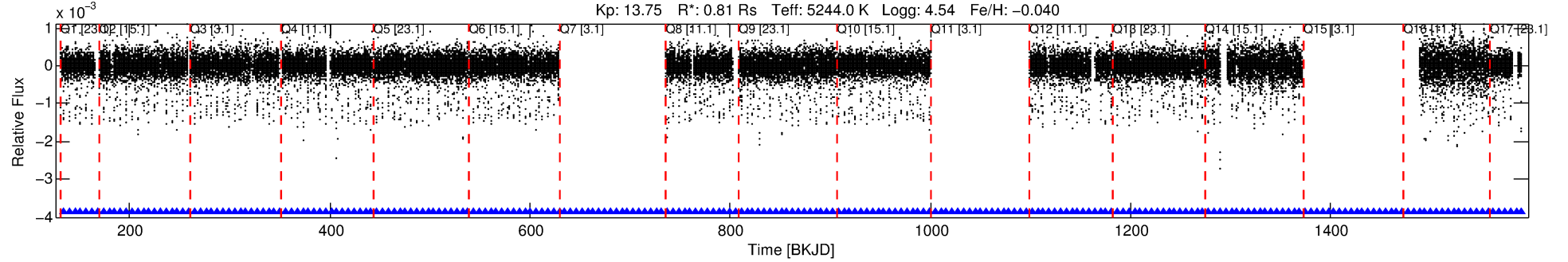
Ephemeris Match Information For 009963524-01

No Significant Match Found

DV One-Page Summary

KIC: 9963524 Candidate: 1 of 4 Period: 5.691 d
KOI: K00720.01 Name: Kepler-221c Corr: 0.966

Kp: 13.75 R*: 0.81 Rs Teff: 5244.0 K Logg: 4.54 Fe/H: -0.040



DV Fit Results:

Period = 5.69058 [0.00000] d
Epoch = 134.2158 [0.0003] BKJD
Rp/R* = 0.0385 [0.0012]
a/R* = 10.15 [1.13]
b = 0.83 [0.04]
Seff = 129.72 [16.40]
Teq = 861 [27] K
Rp = 3.40 [0.27] Re
a = 0.0585 [0.0038] AU
Ag = 2.10 [2.10] [0.53σ]
Teffp = 1602 [399] K [1.86σ]

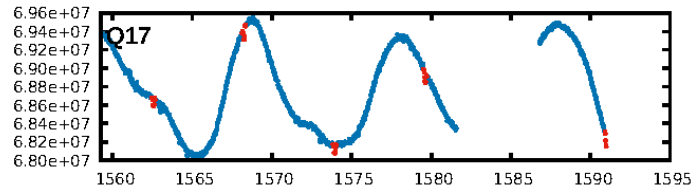
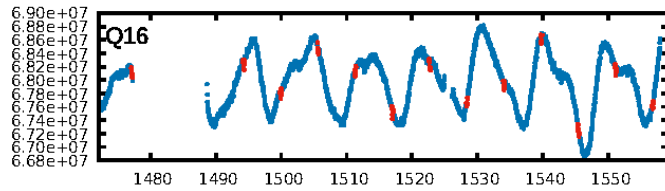
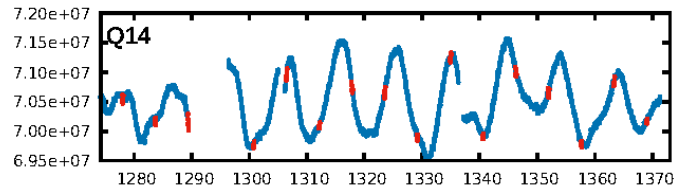
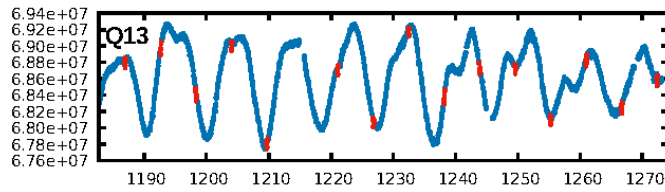
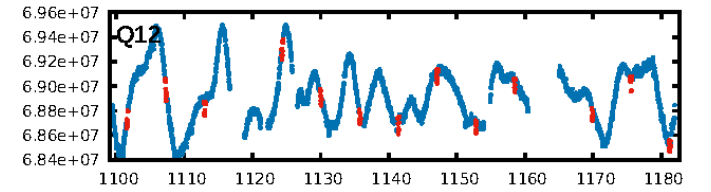
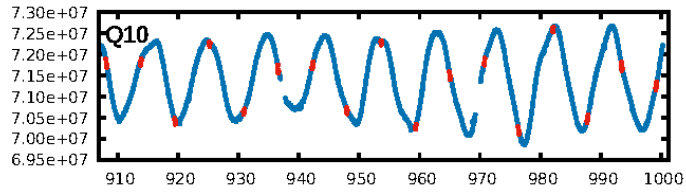
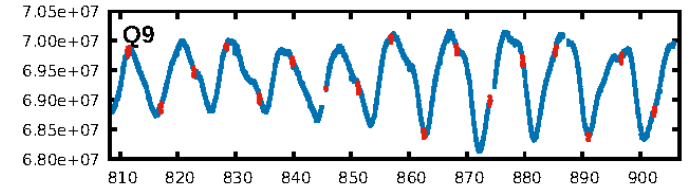
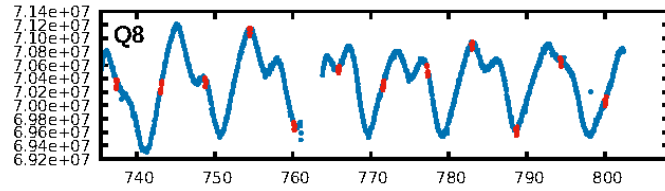
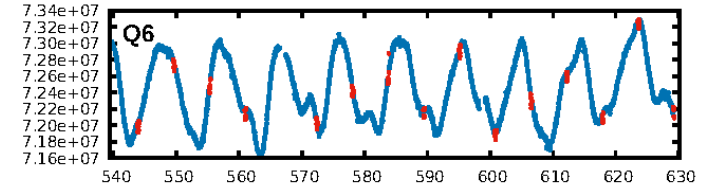
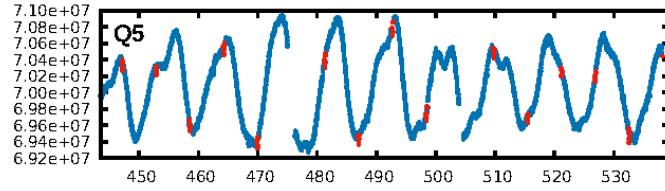
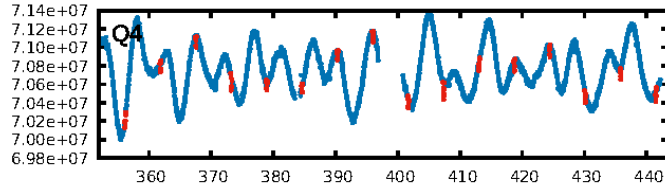
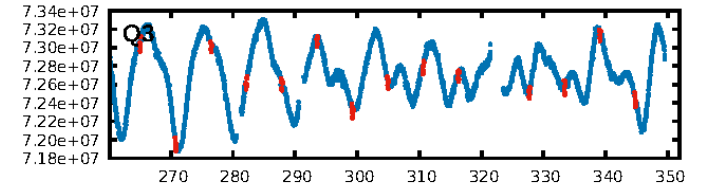
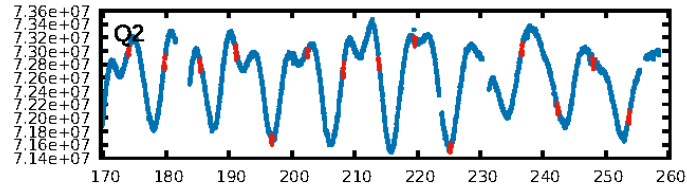
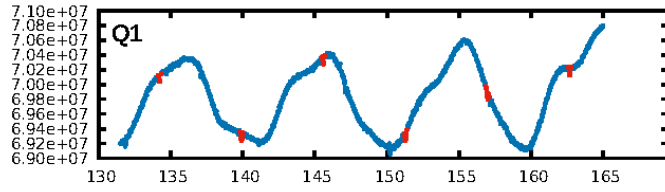
DV Diagnostic Results:

ShortPeriod-sig: 100.0% [20.18σ]
LongPeriod-sig: 100.0% [27.43σ]
ModelChiSquare2-sig: 96.7%
ModelChiSquareGof-sig: 100.0%
Bootstrap-pfa: 0.00e+00
RollingBand-fgt: 1.00 [174/174]
GhostDiagnostic-chr: 2.805
Centroid-sig: 0.0%
Centroid-so: 0.302 arcsec [4.65σ]
OotOffset-rm: 0.035 arcsec [0.47σ]
KicOffset-rm: 0.088 arcsec [1.08σ]
OotOffset-st: 4/1/4/5 [14]
KicOffset-st: 4/1/4/5 [14]
DiffImageQuality-fgm: 1.00 [14/14]
DiffImageOverlap-fno: 1.00 [14/14]

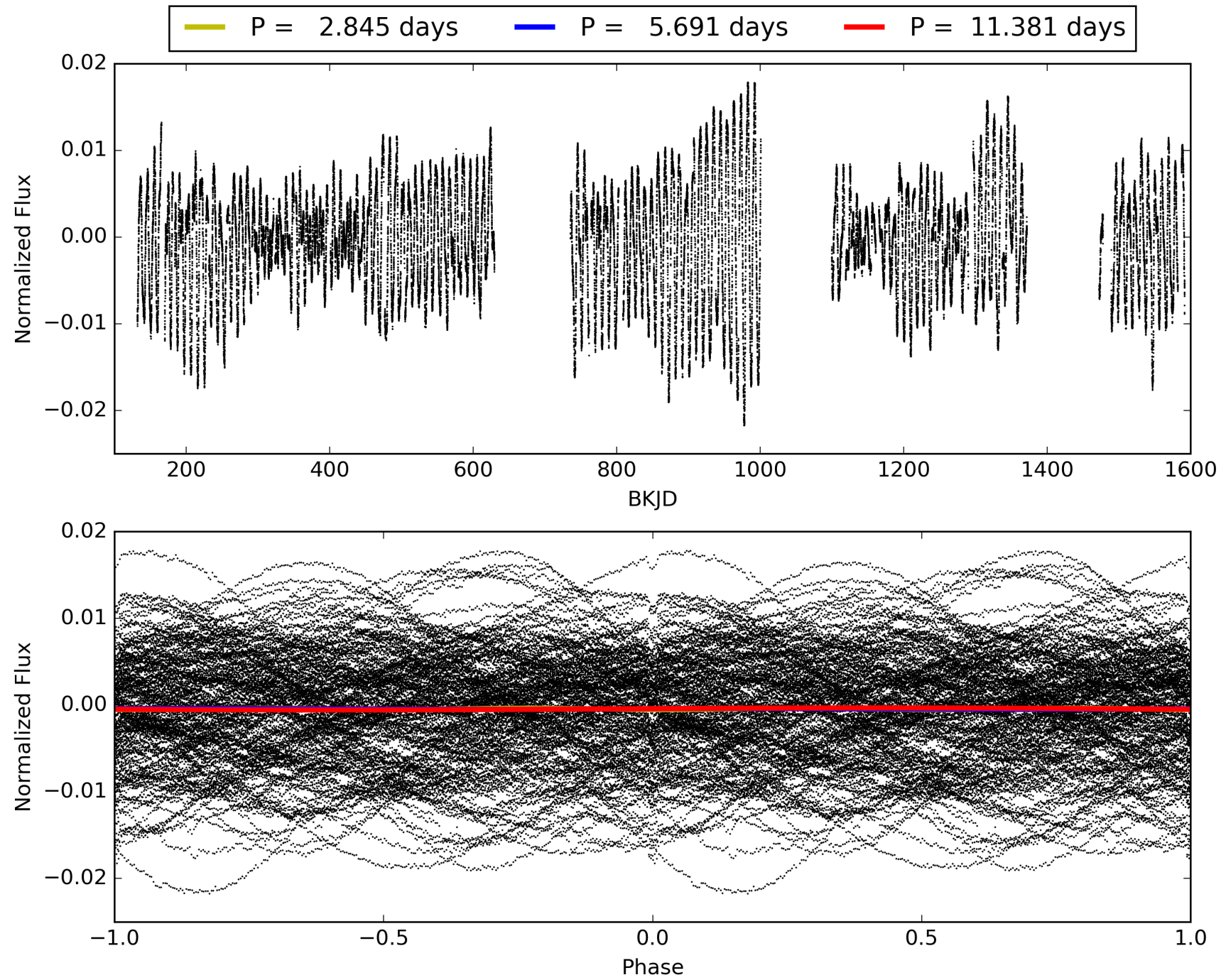
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This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

TCE 009963524-01, PDC Light Curves

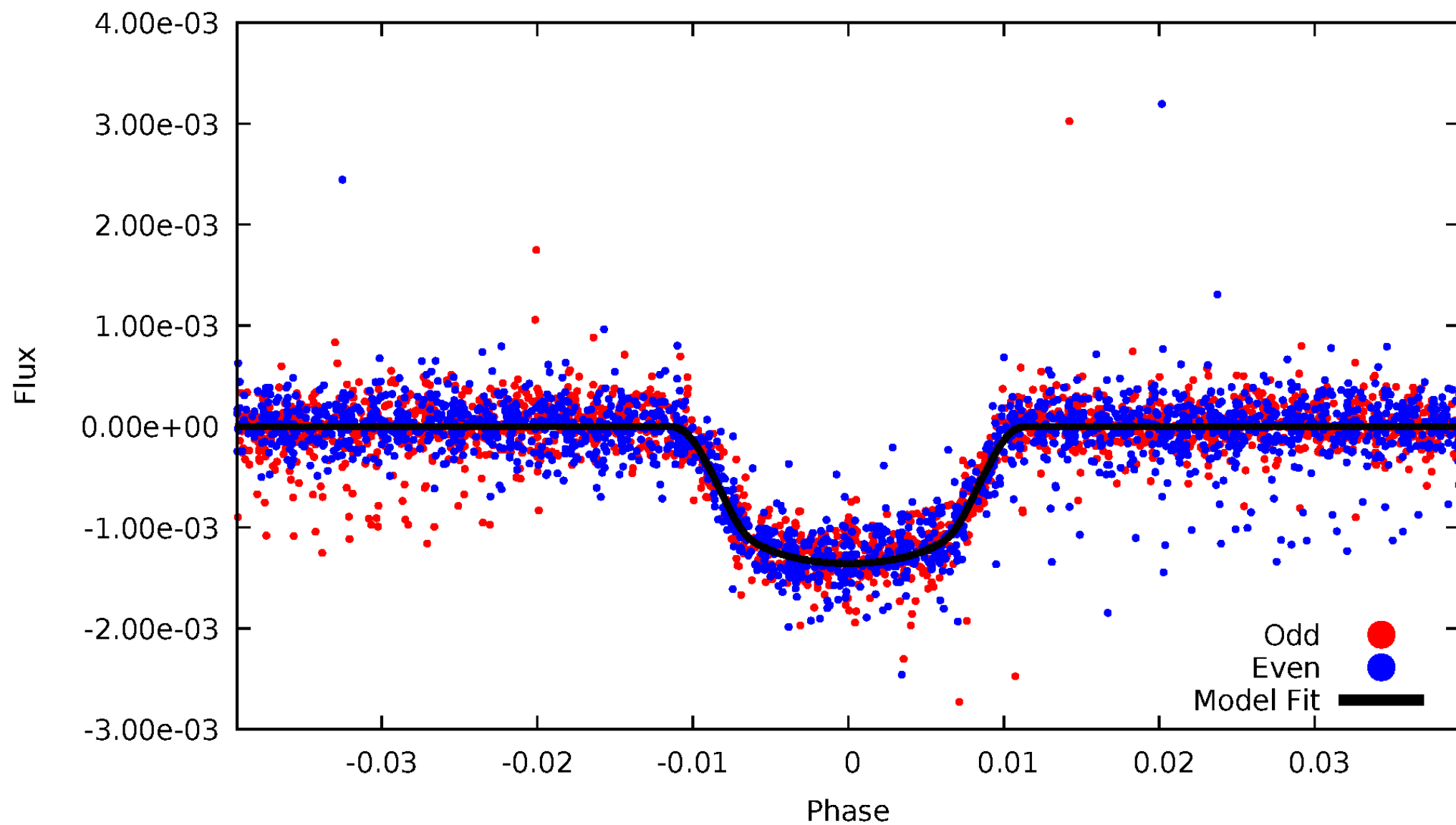


TCE 009963524-01



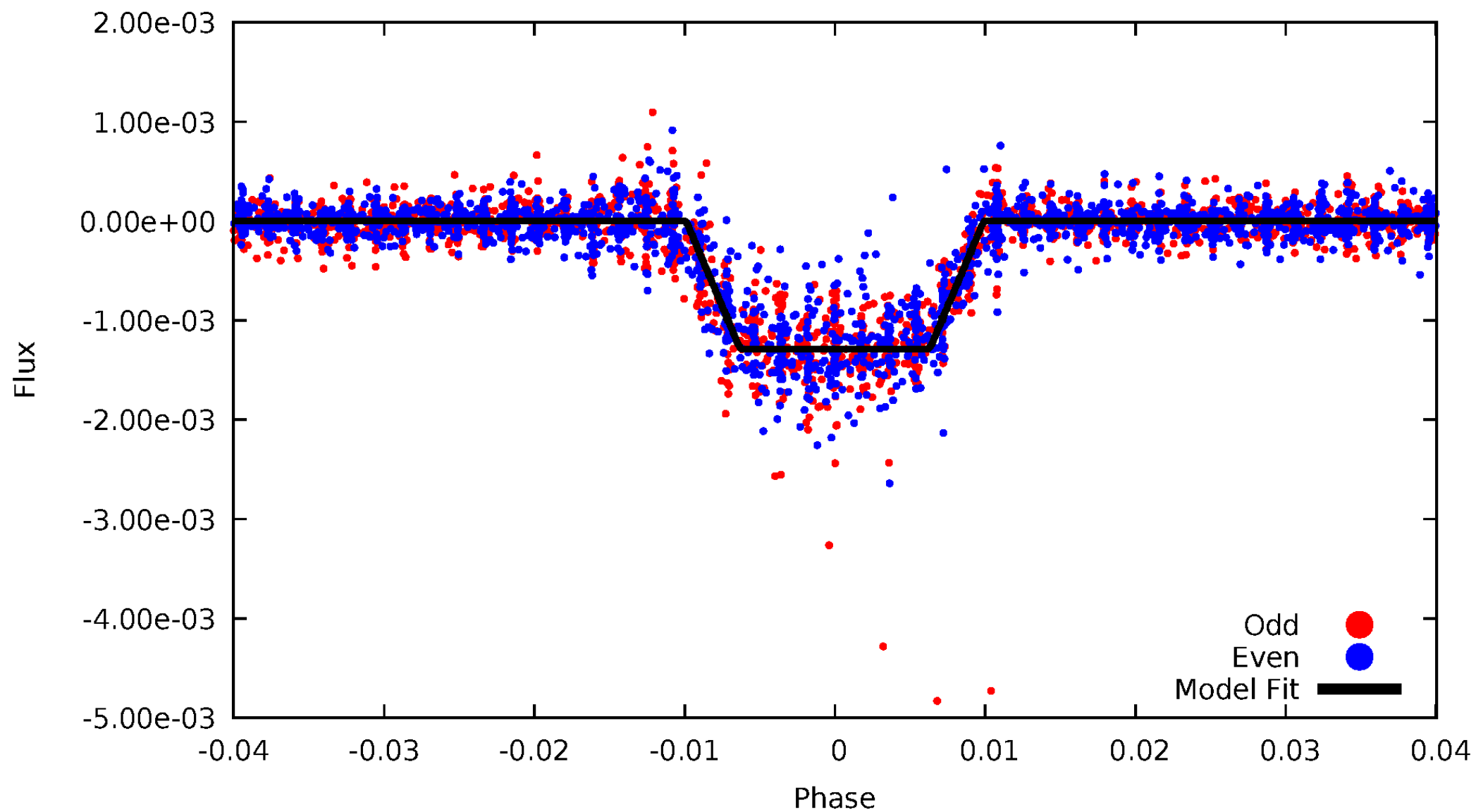
DV Odd/Even

TCE 009963524-01



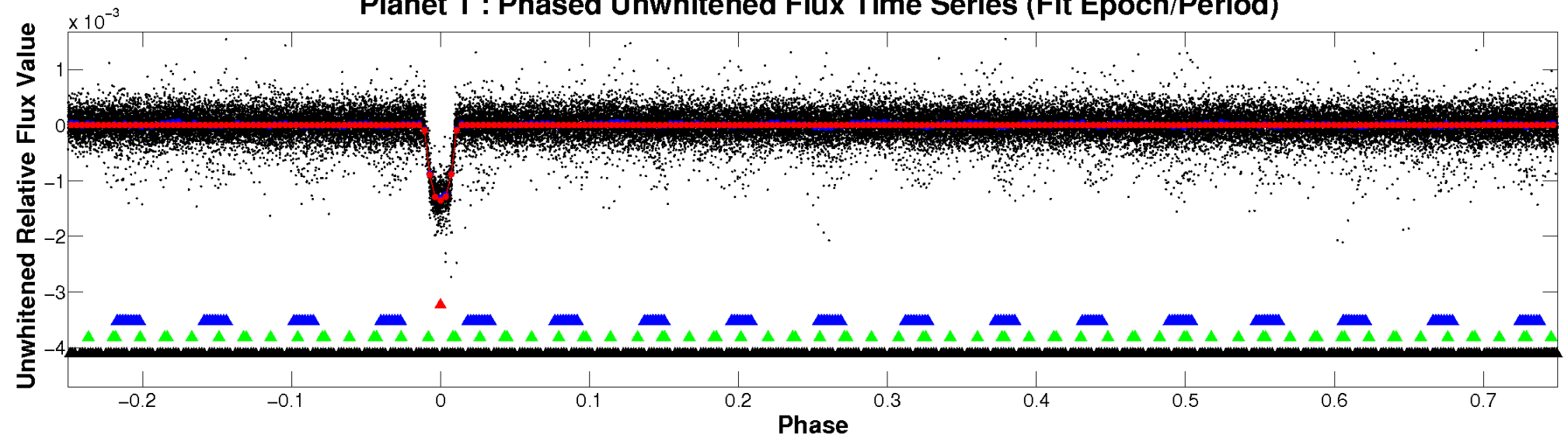
ALT Odd/Even

TCE 009963524-01

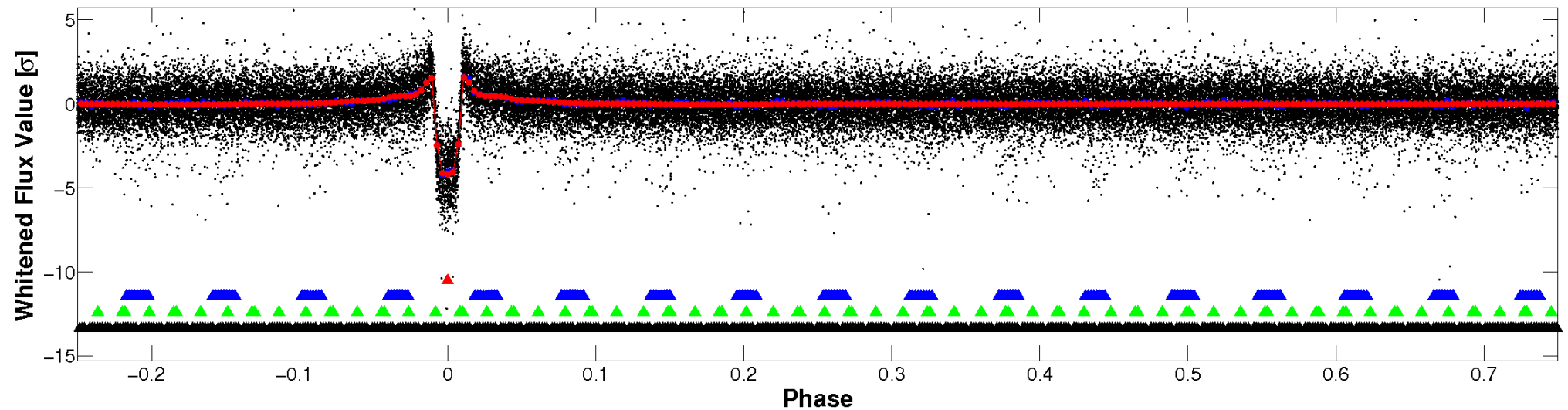


Non-Whitened Vs. Whitened Light Curve

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

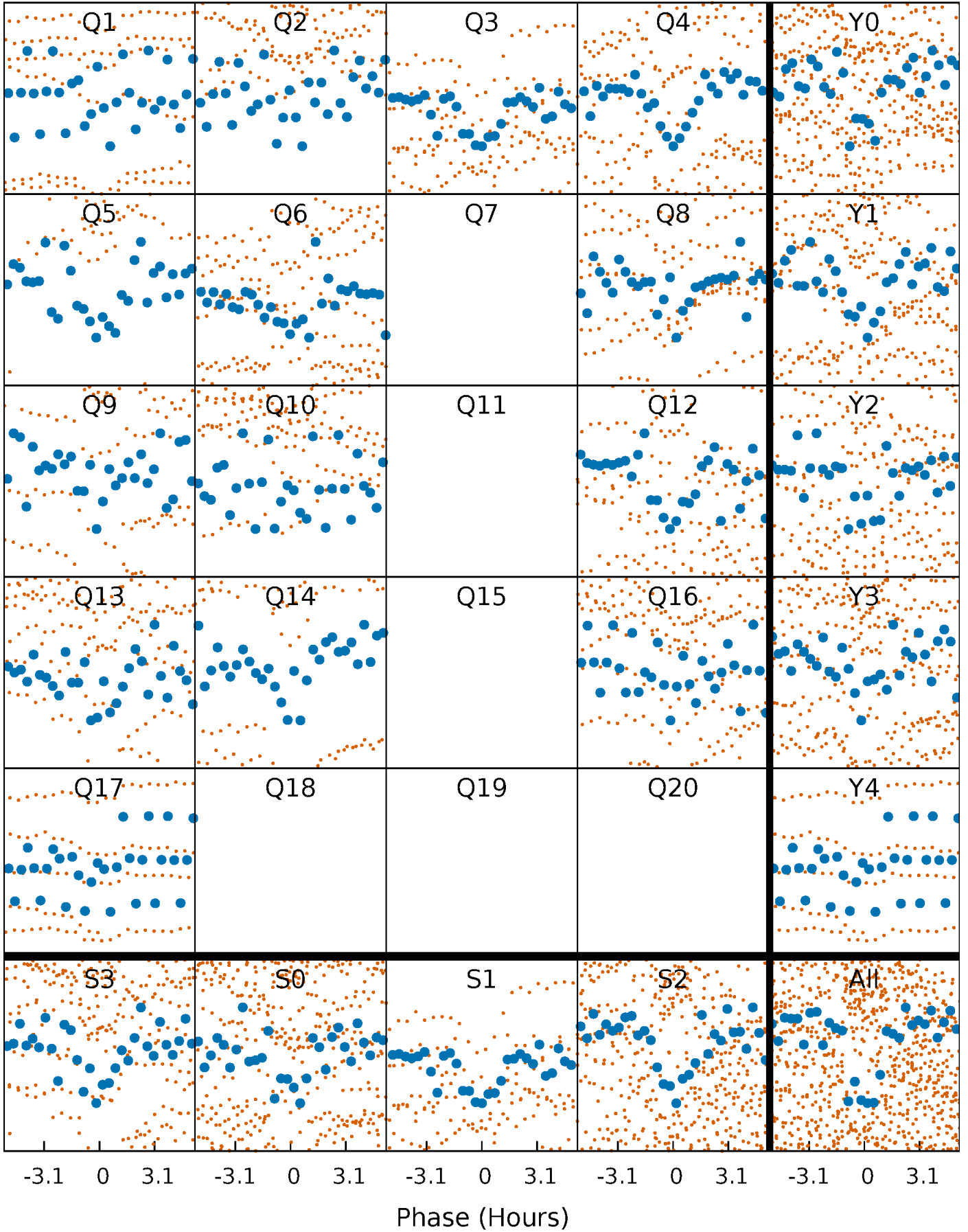


Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)



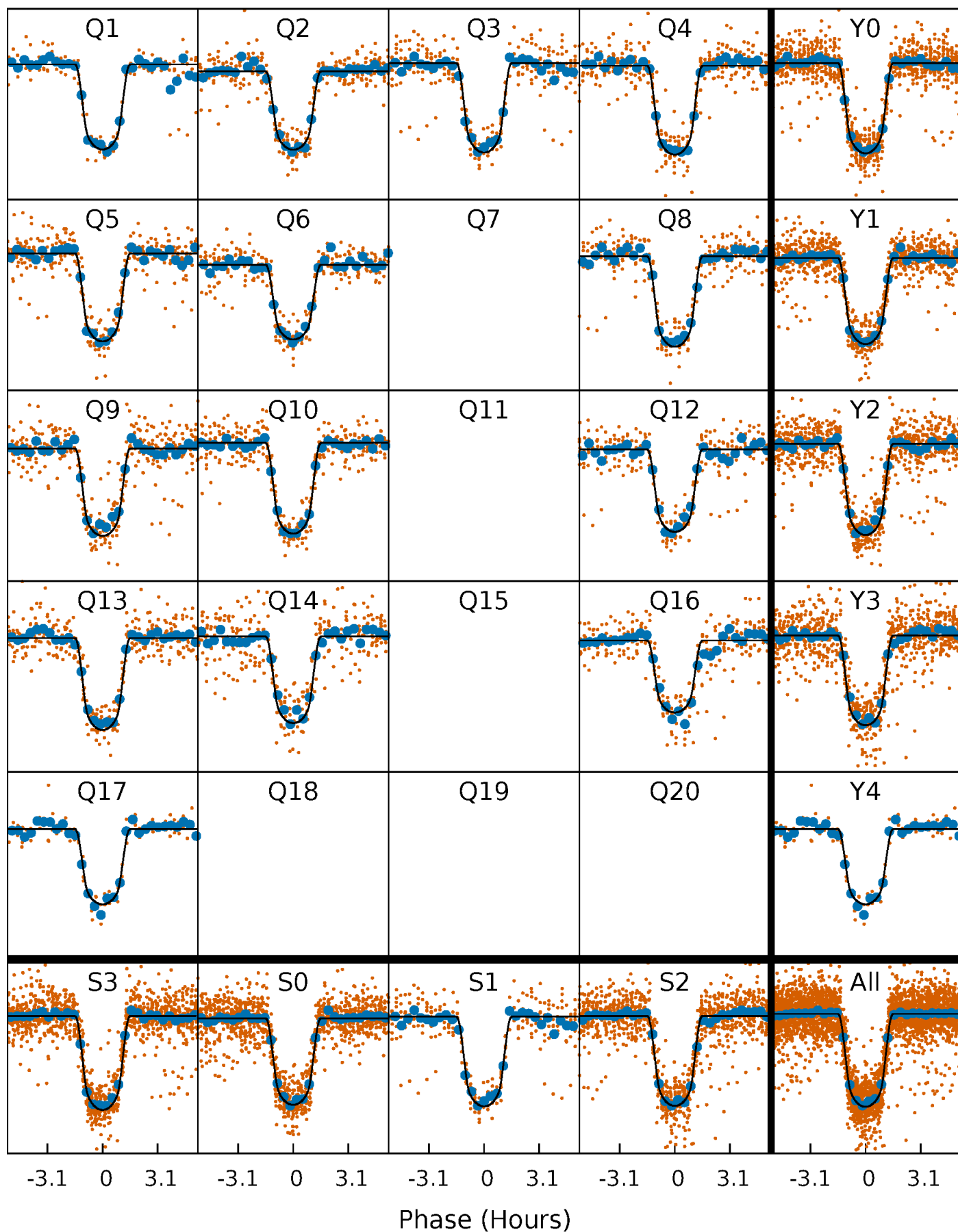
PDC Quarter-Phased Transit Curves

TCE 009963524-01 P= 5.690581 Days $T_0=134.215842$ (BKJD)



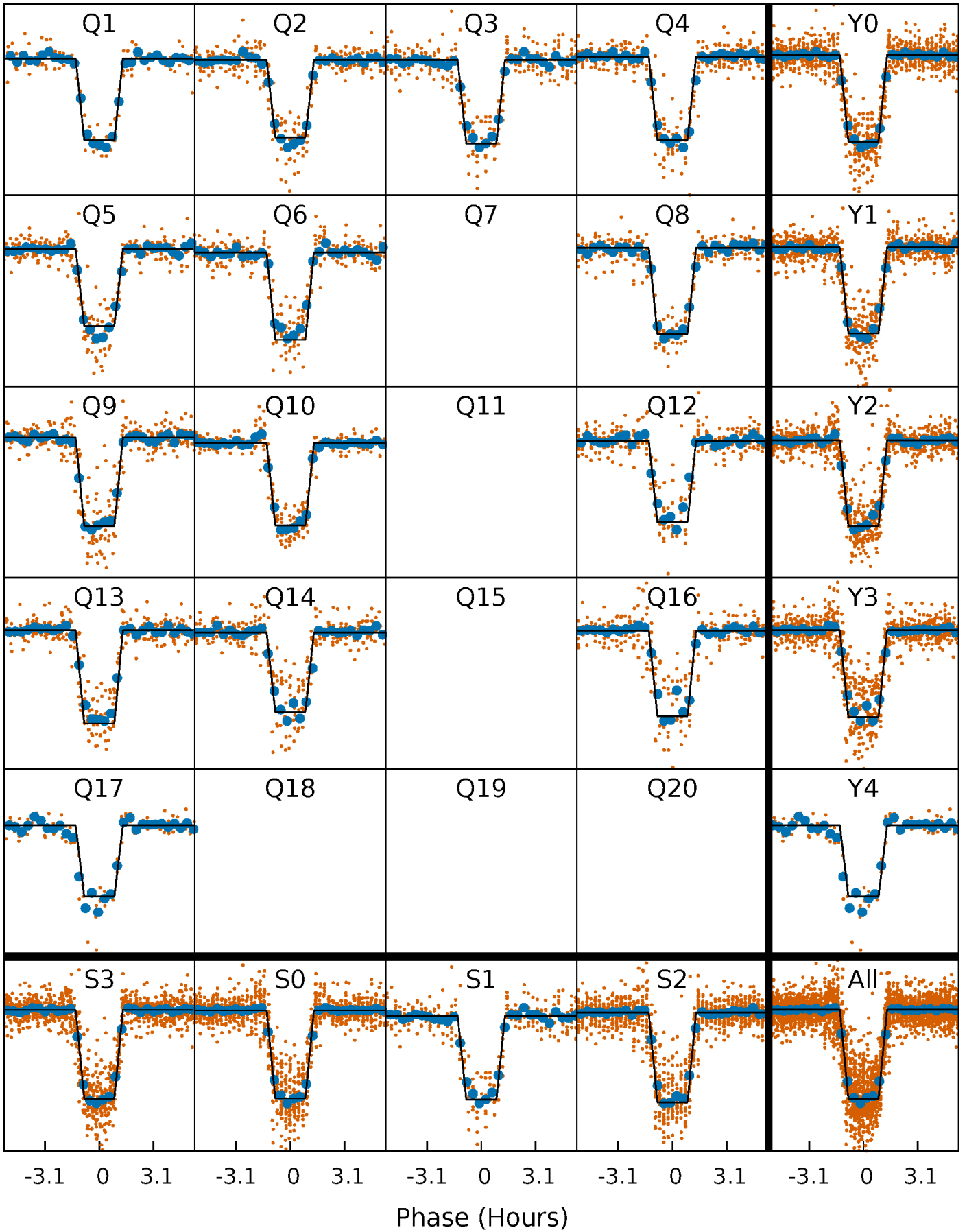
DV Quarter-Phased Transit Curves

TCE 009963524-01 P= 5.690581 Days $T_0=134.215842$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

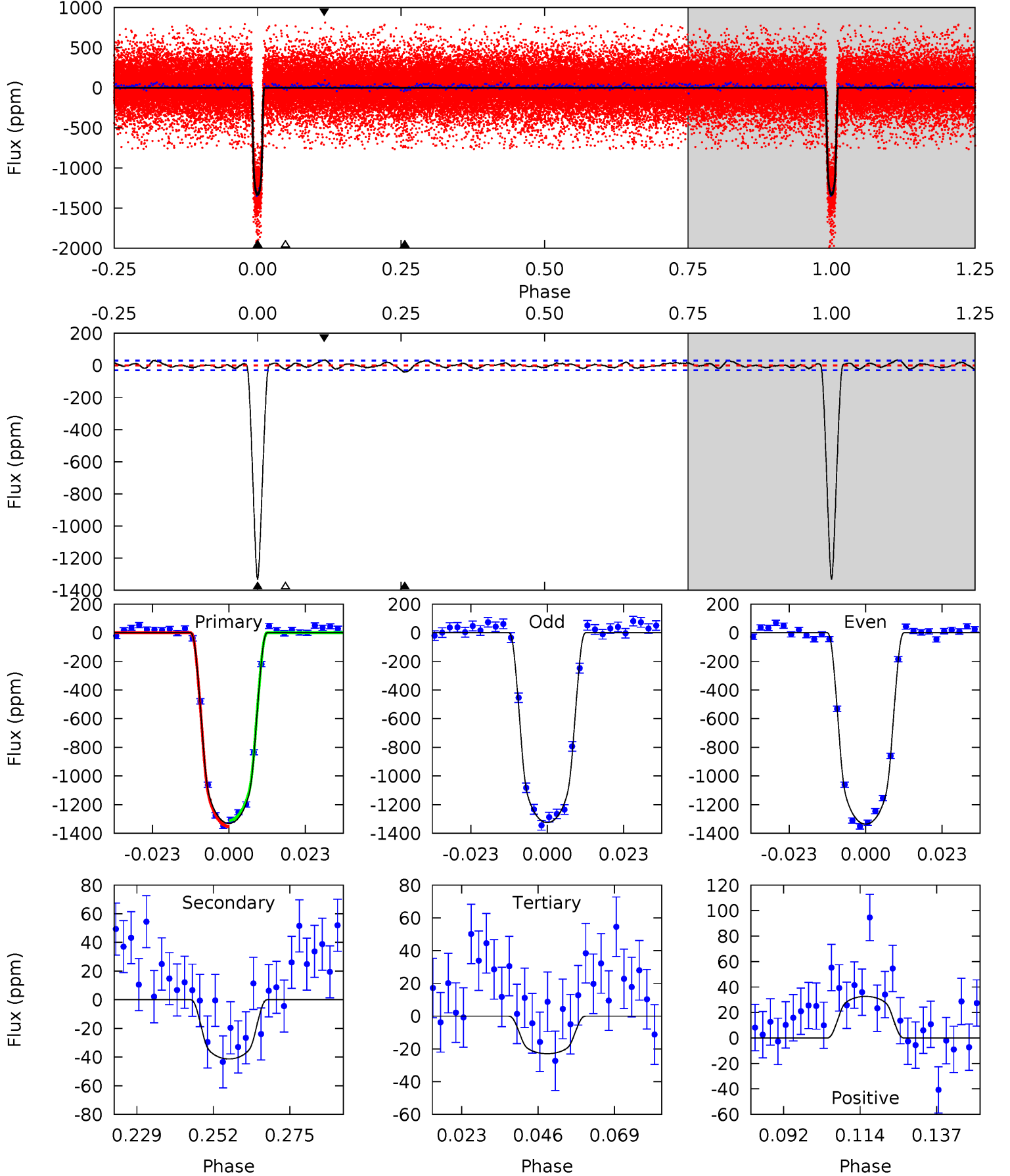
TCE 009963524-01 P= 5.690601 Days $T_0=134.213898$ (BKJD)



DV Model-Shift Uniqueness Test

009963524-01, P = 5.690581 Days, E = 128.525261 Days

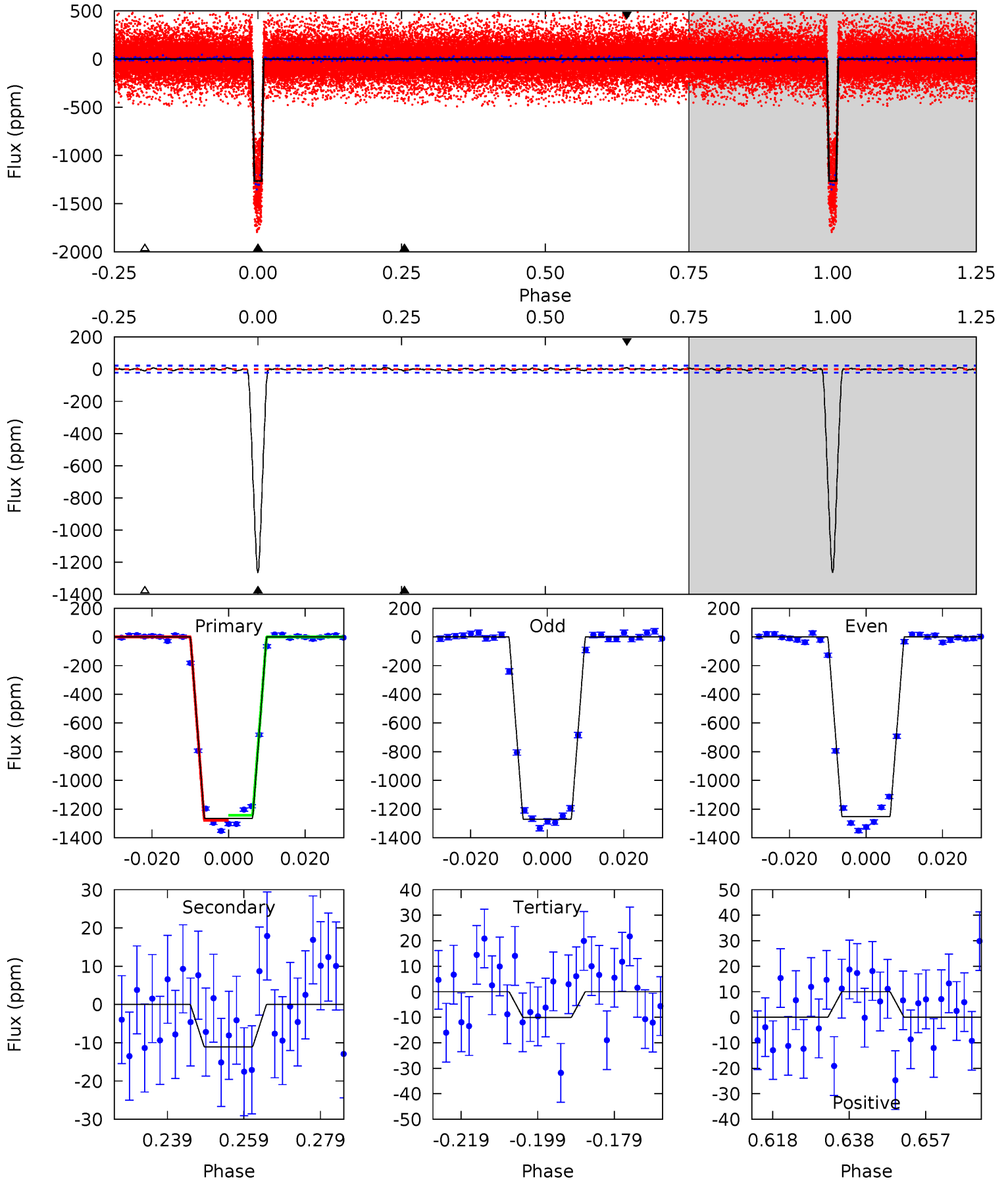
Pri	Sec	Ter	Pos	FA ₁	FA ₂	F _{Red}	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
216.3	6.71	3.73	5.30	4.87	2.28	1.88	212.6	211.0	2.99	1.41	0.89	1.00	0.02	3.38



Alt Model-Shift Uniqueness Test

009963524-01, P = 5.690601 Days, E = 128.523297 Days

Pri	Sec	Ter	Pos	FA ₁	FA ₂	F _{Red}	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
285.4	2.49	2.27	2.25	4.89	2.33	0.85	283.1	283.1	0.23	0.24	2.04	0.99	0.01	4.06



Stellar Parameters For KIC 009963524

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	5244^{+105}_{-105}	$4.538^{+0.045}_{-0.055}$	$-0.040^{+0.150}_{-0.150}$	$0.810^{+0.060}_{-0.044}$	$0.826^{+0.052}_{-0.043}$	$2.191^{+0.351}_{-0.405}$
	+2%/-2%	+1%/-1%	+375%/-375%	+7%/-5%	+6%/-5%	+16%/-18%
Source	SPE58	SPE58	SPE58	DSEP		

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

Secondary Eclipse Parameters for KIC 009963524-01 / KOI 0720.01

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	A_{obs}
DV	-41 ± 6	$3.41^{+0.18}_{-0.16}$	1203^{+32}_{-31}	2832^{+68}_{-73}	$6.711^{+1.209}_{-1.080}$
Alt.	-11 ± 4	$3.18^{+0.17}_{-0.17}$	1205^{+32}_{-30}	2404^{+119}_{-153}	$2.033^{+0.851}_{-0.745}$

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

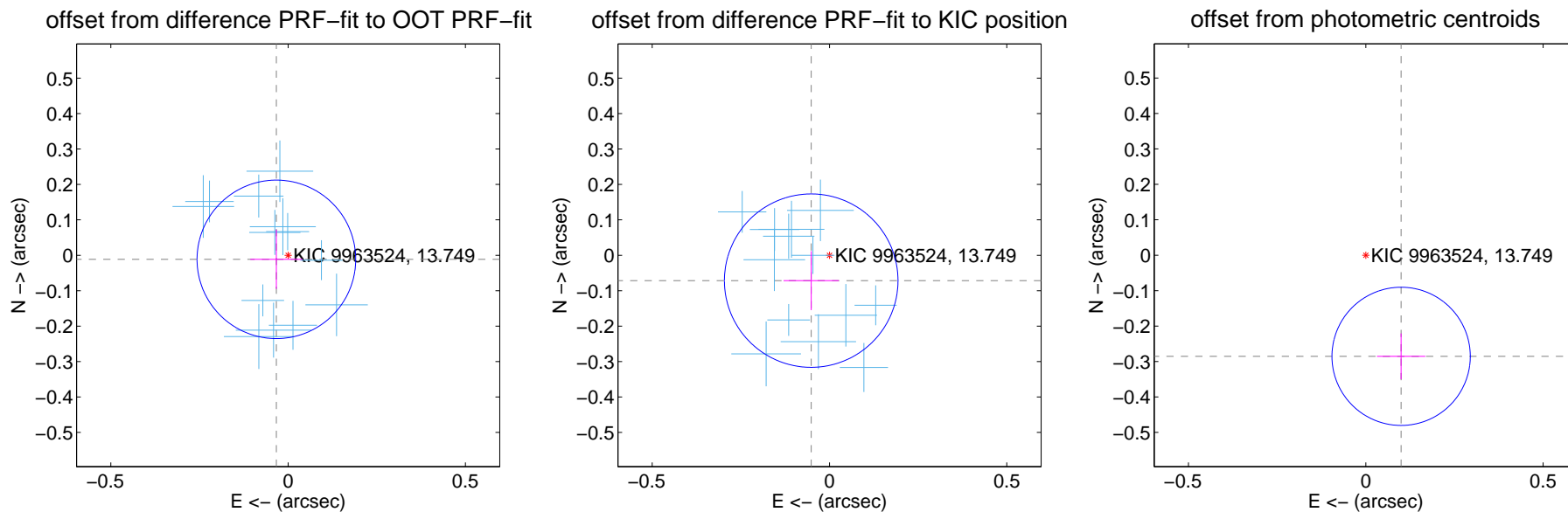
DV Centroid Data

Supplemental centroid analysis for 009963524-01. Kepler magnitude: 13.75. Transit SNR 116.32

There are 14 quarters with good PRF difference image offsets

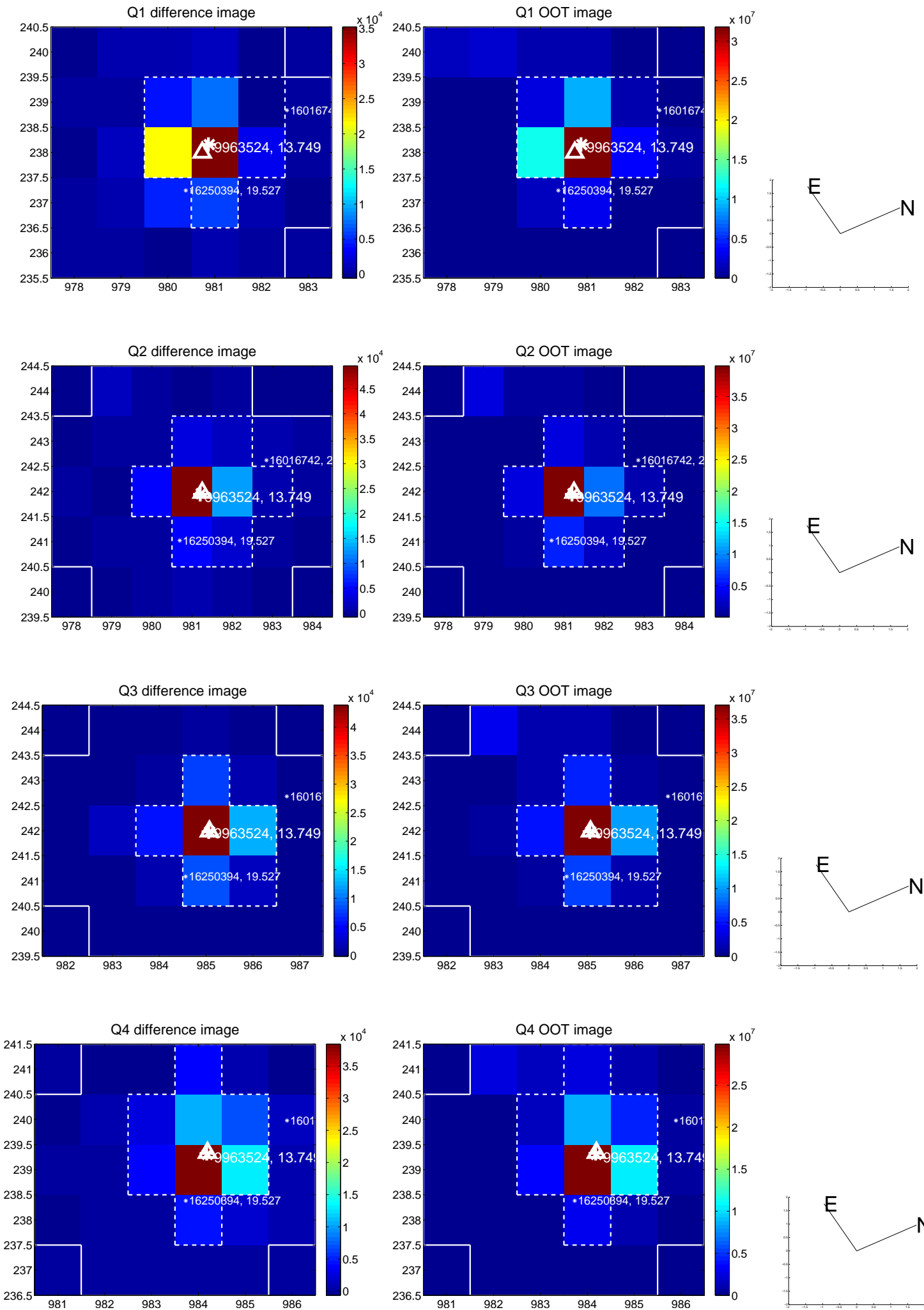
The direct PRF centroid is offset from the target star catalog position by about 0.03 arcsec

	Distance in arcsec	Distance / σ	Δ RA	Δ Dec
PRF-fit source offset from OOT	0.035 ± 0.075	0.47	0.033 ± 0.073	-0.011 ± 0.084
PRF-fit source offset from KIC position	0.088 ± 0.082	1.08	0.052 ± 0.078	-0.072 ± 0.083
photometric centroid source offset	0.30 ± 0.06	4.65	-0.10 ± 0.07	-0.29 ± 0.06

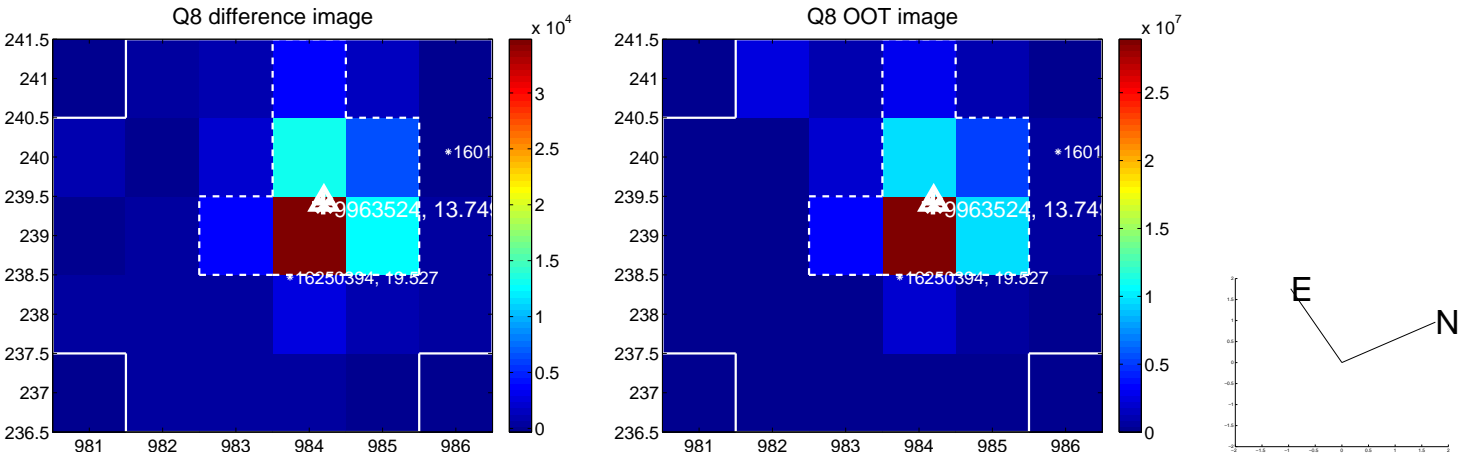
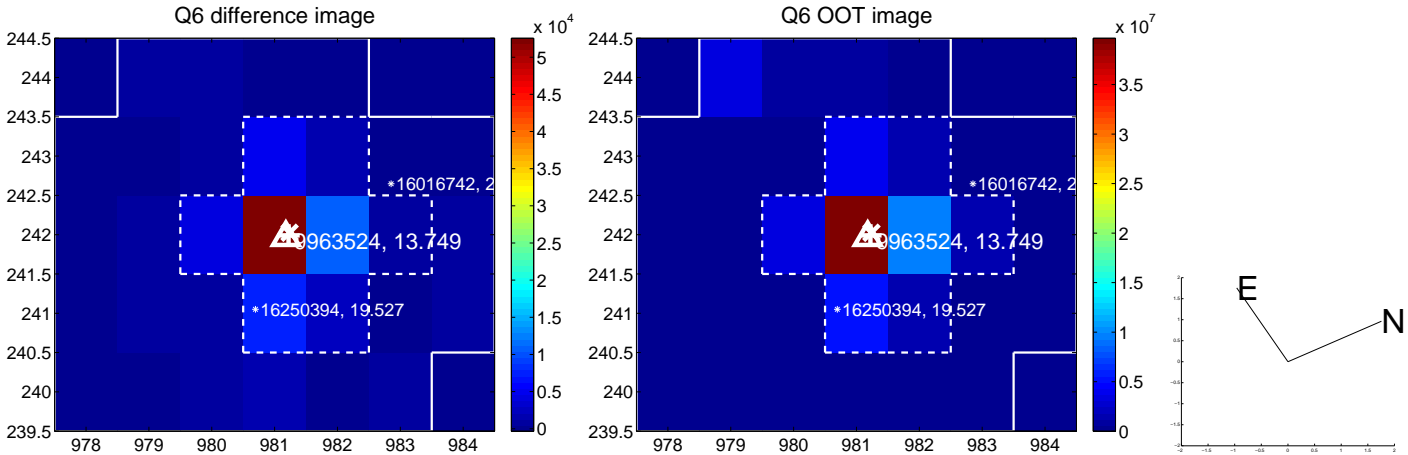
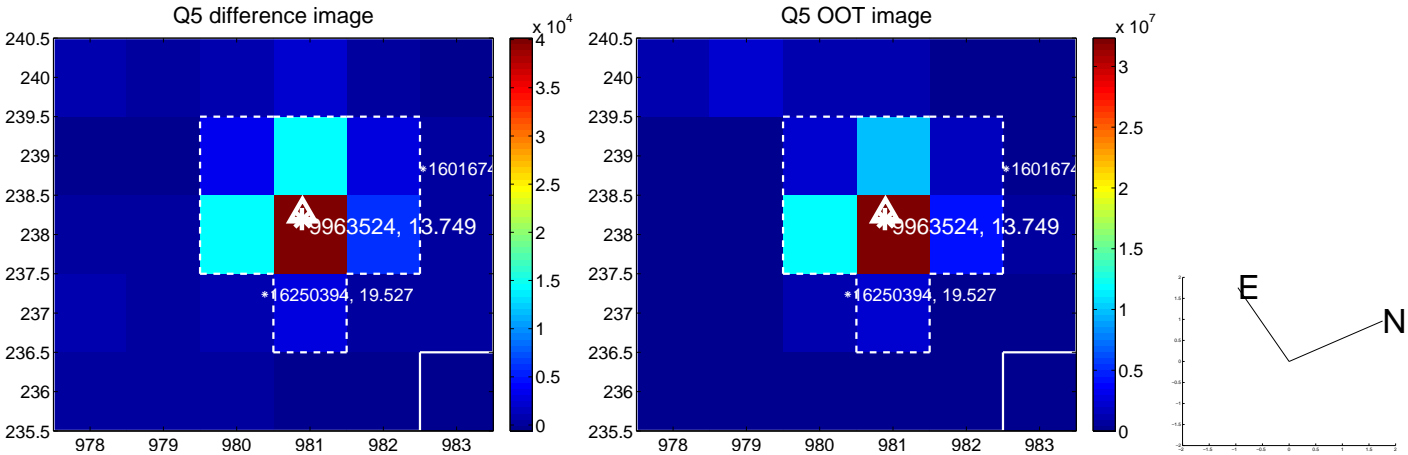


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

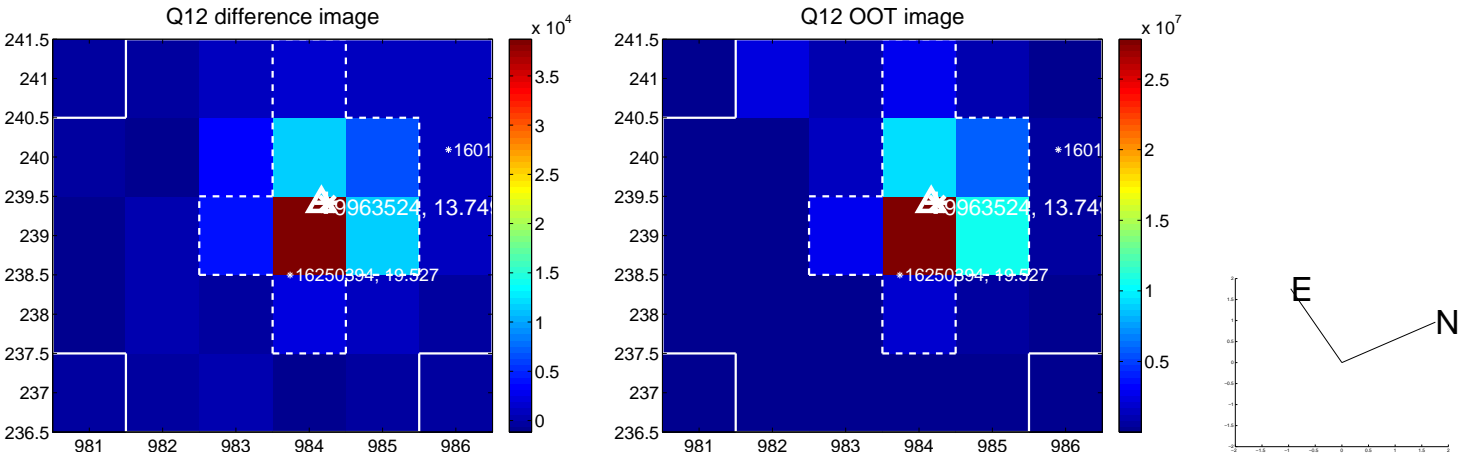
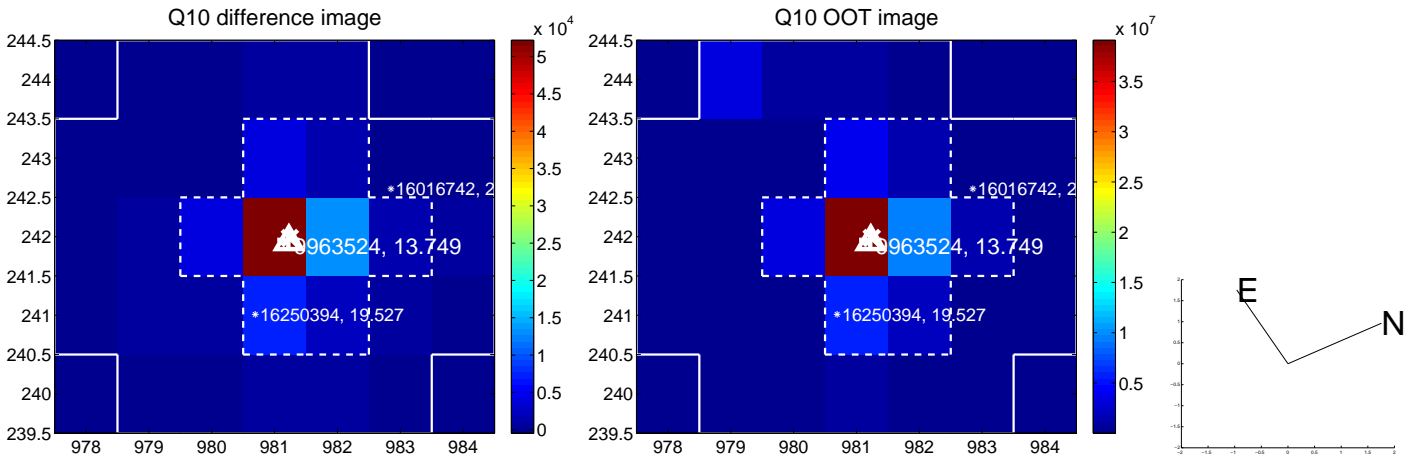
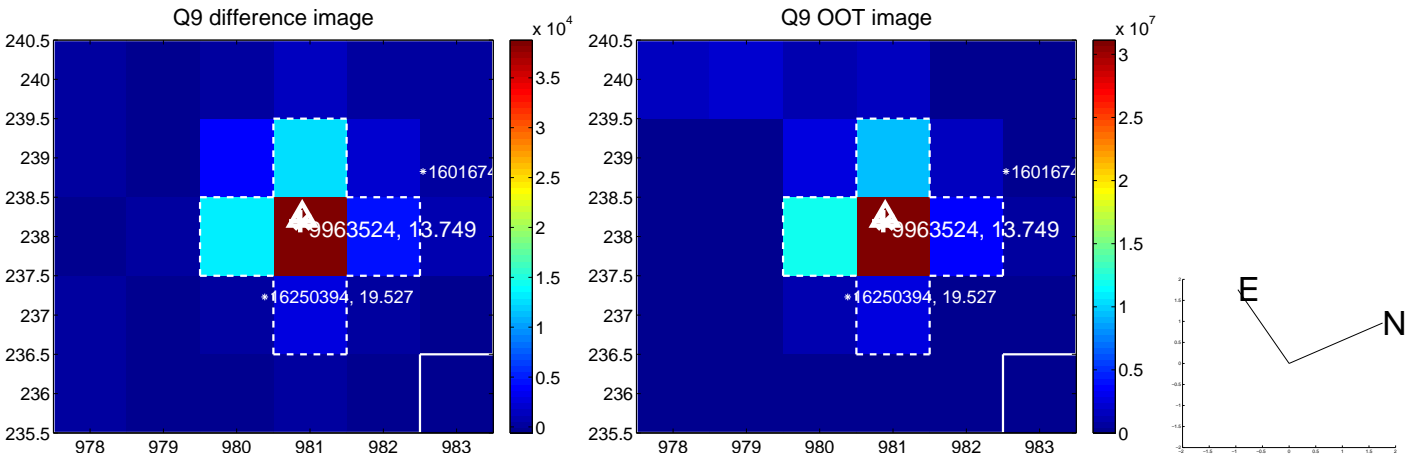
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



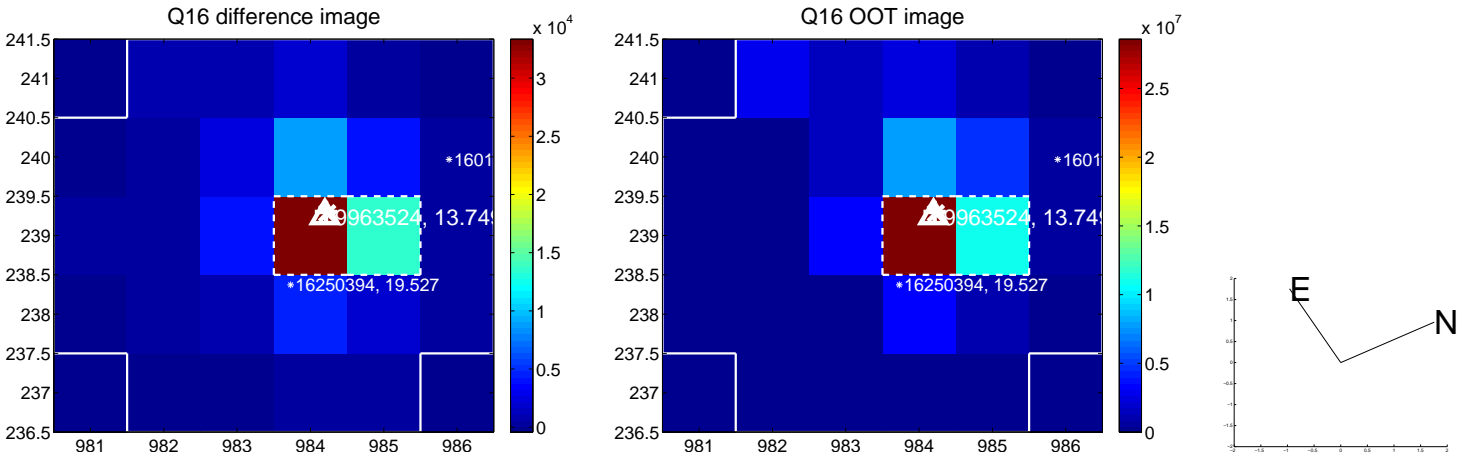
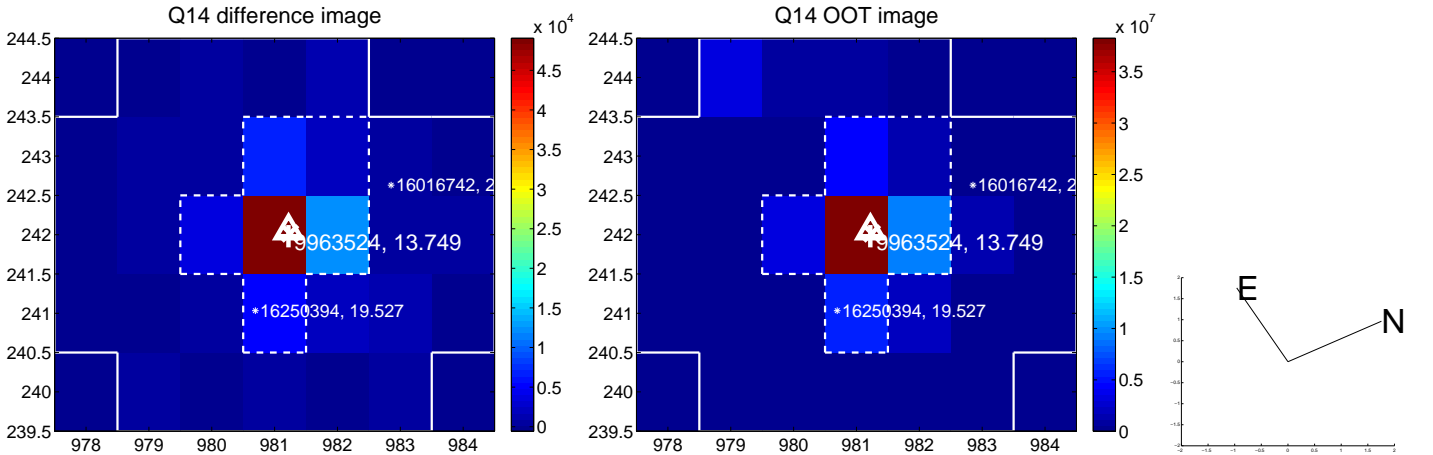
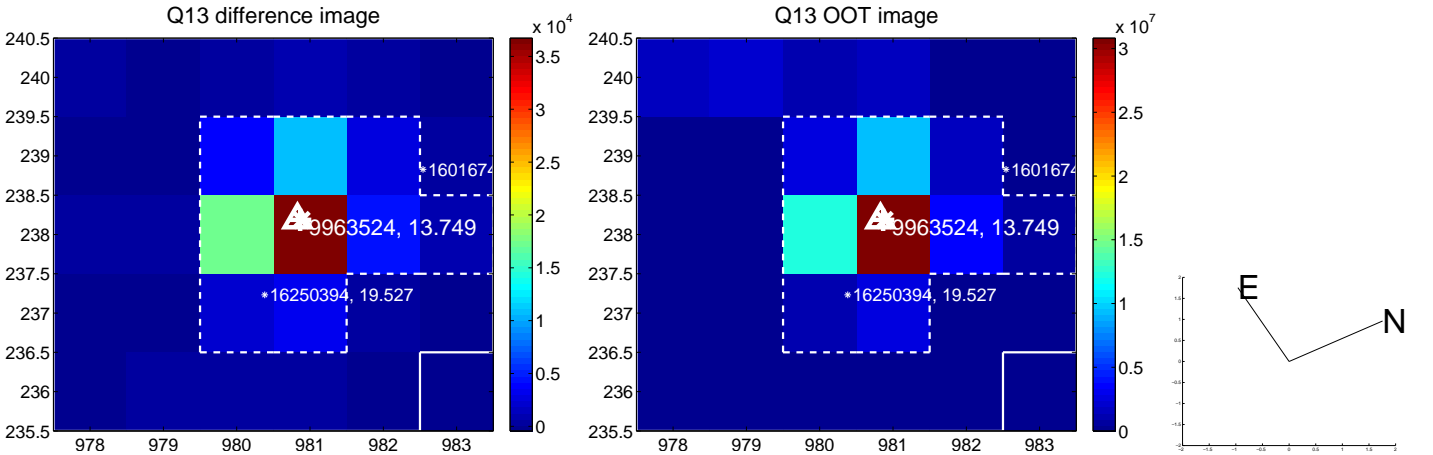
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



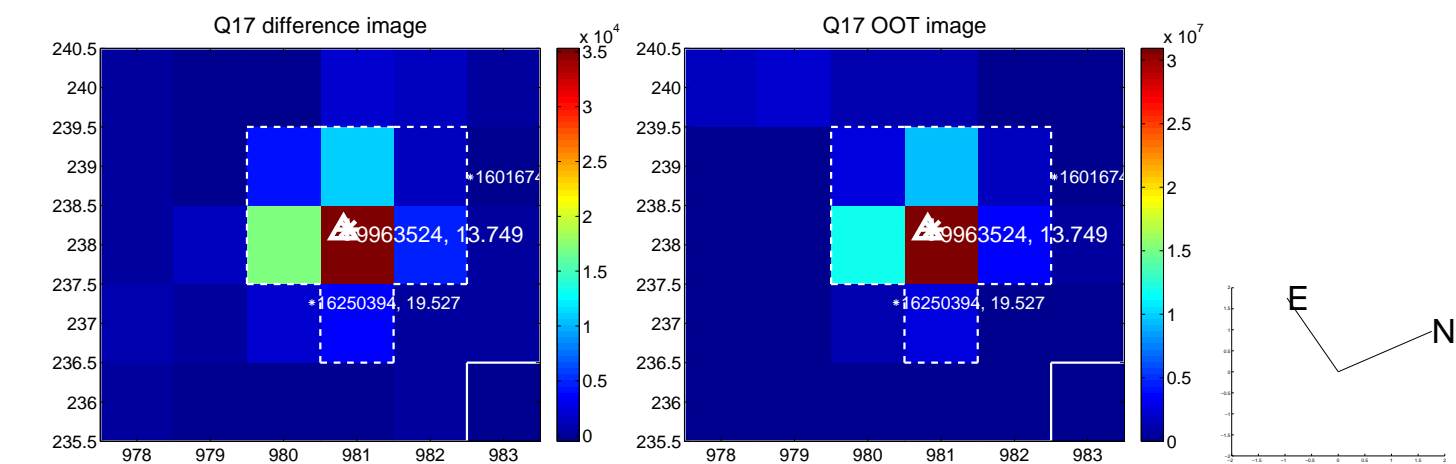
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



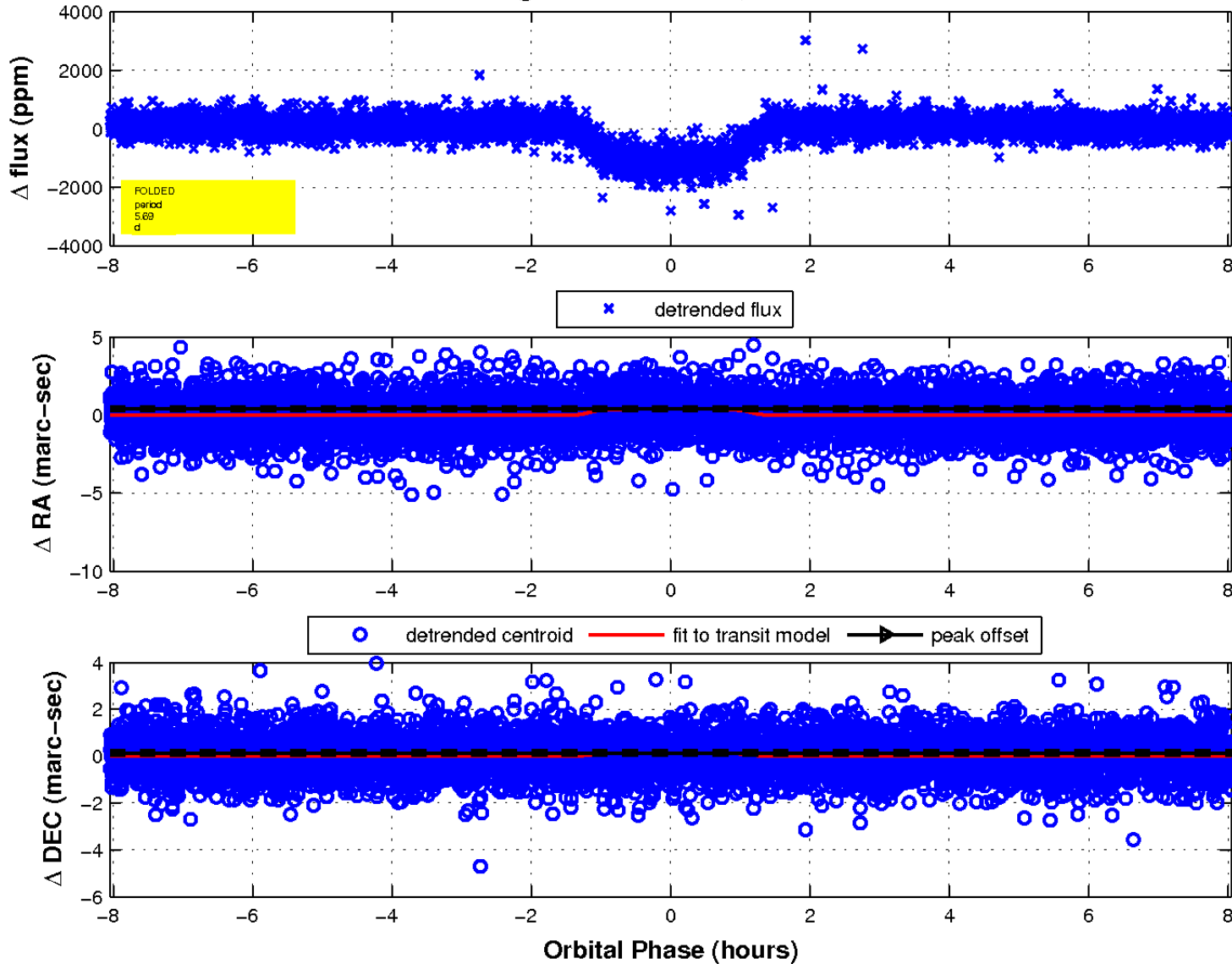
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



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

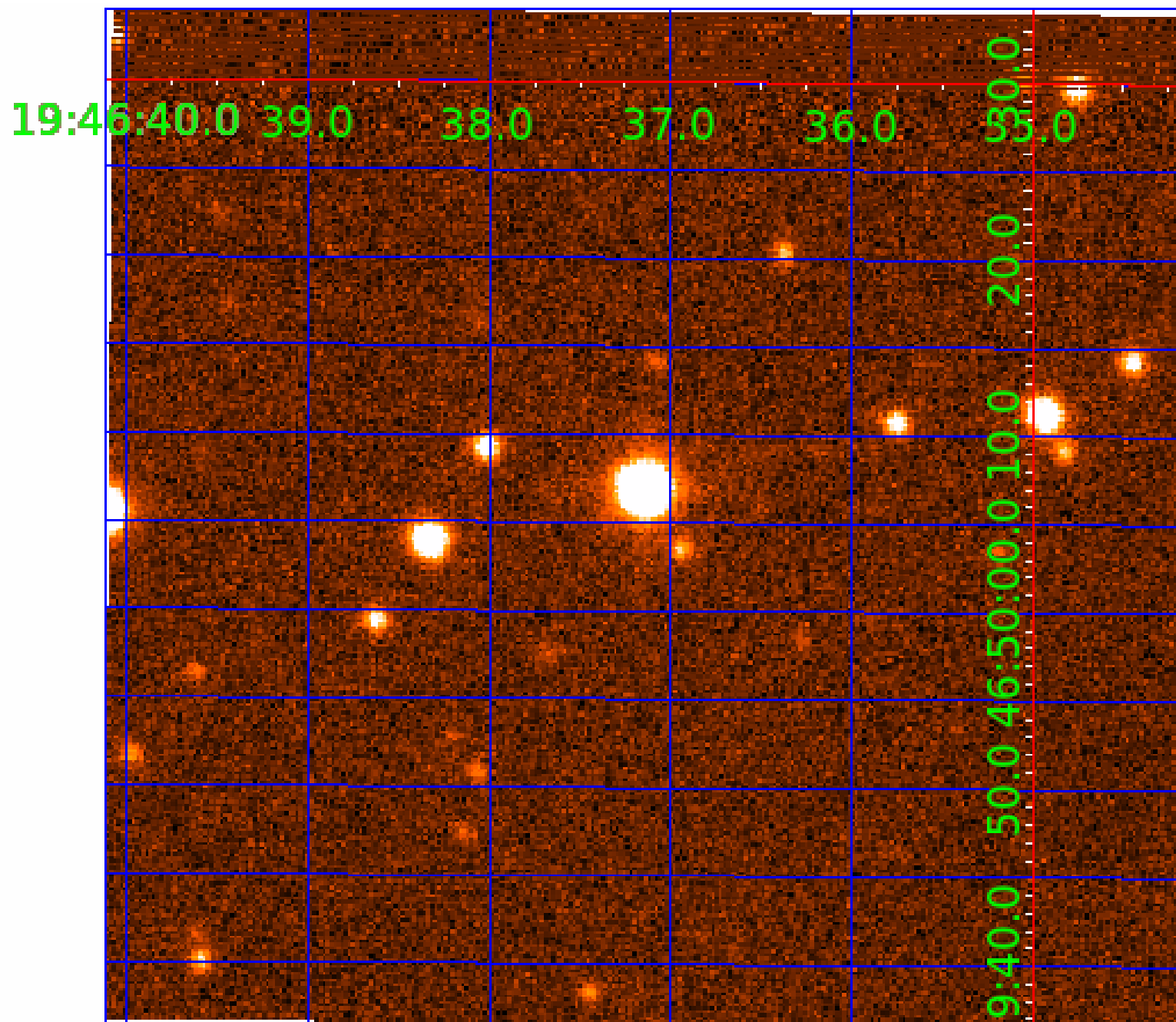


fluxWeightedCentroids, Planet 1 of 4



UKIRT Image

Declination



KIC 009963524

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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Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
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009963524-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-03	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-04	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 for comment definitions.

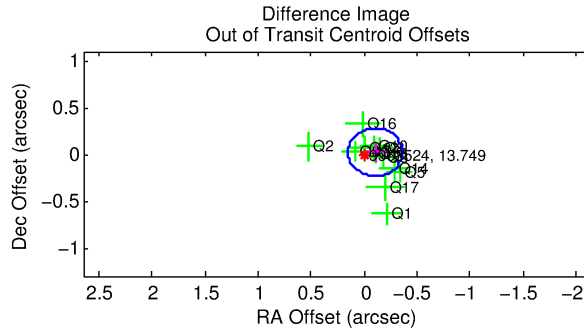
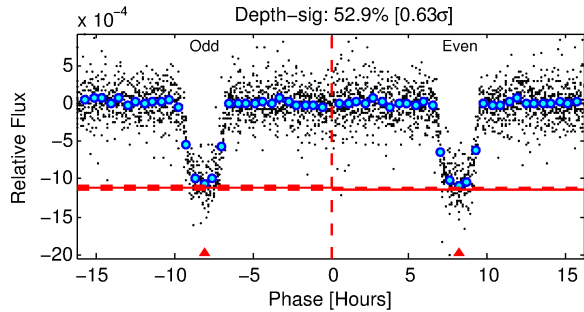
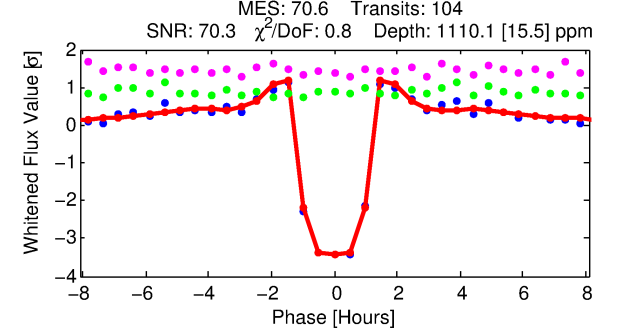
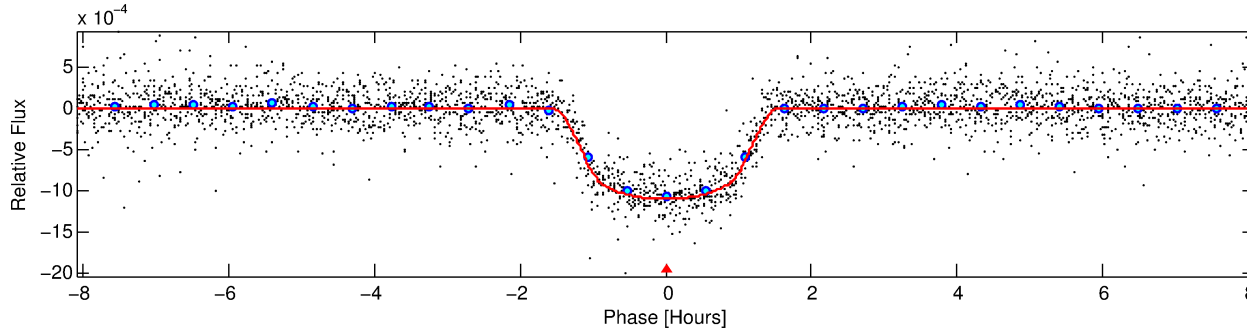
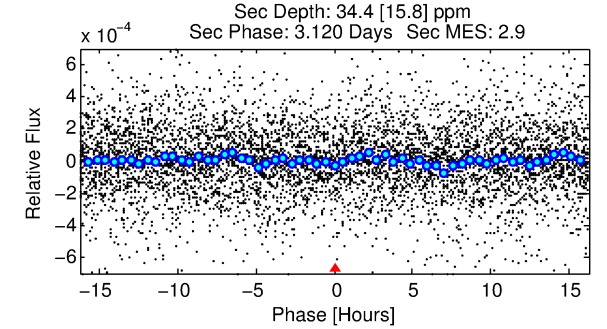
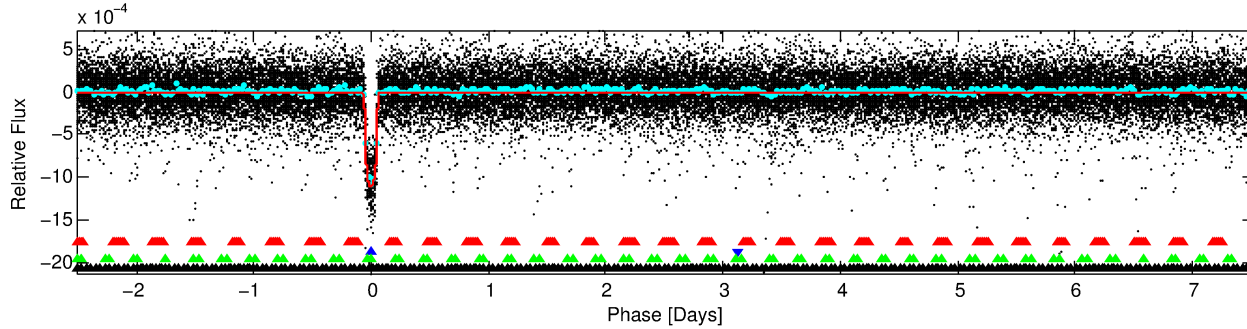
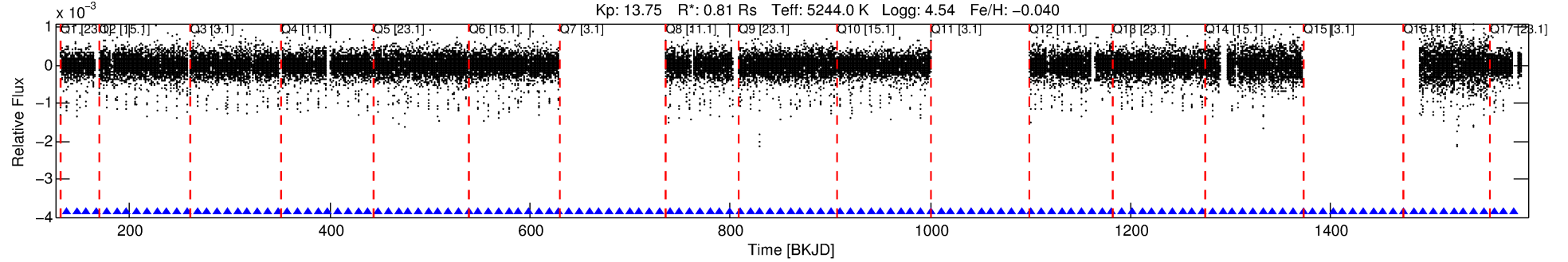
Ephemeris Match Information For 009963524-02

No Significant Match Found

DV One-Page Summary

KIC: 9963524 Candidate: 2 of 4 Period: 10.042 d
KOI: K00720.02 Name: Kepler-221d Corr: 0.973

Kp: 13.75 R*: 0.81 Rs Teff: 5244.0 K Logg: 4.54 Fe/H: -0.040



DV Fit Results:

Period = 10.04158 [0.00001] d
Epoch = 137.0846 [0.0006] BKJD
Rp/R* = 0.0342 [0.0026]
a/R* = 18.54 [5.19]
b = 0.80 [0.13]
Seff = 60.83 [7.69]
Teq = 712 [23] K
Rp = 3.02 [0.32] Re
a = 0.0855 [0.0056] AU
Ag = 15.13 [7.47] [1.89σ]
Teffp = 2171 [266] K [5.46σ]

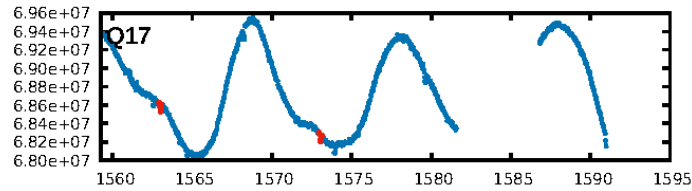
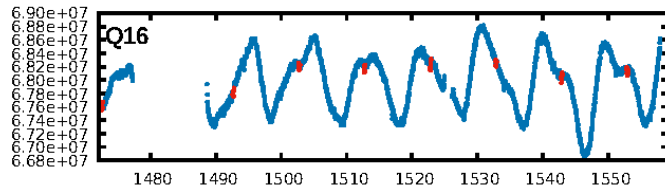
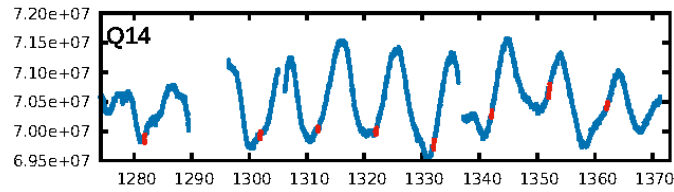
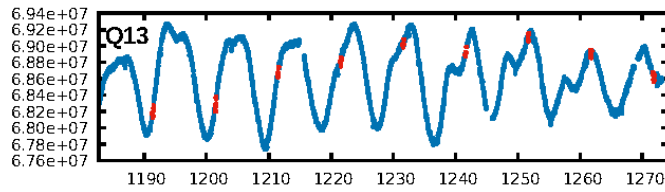
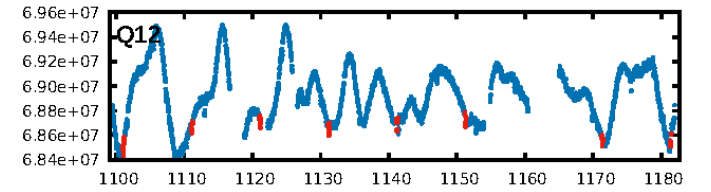
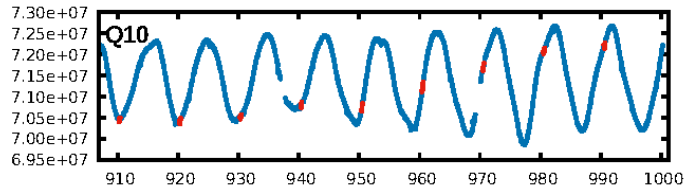
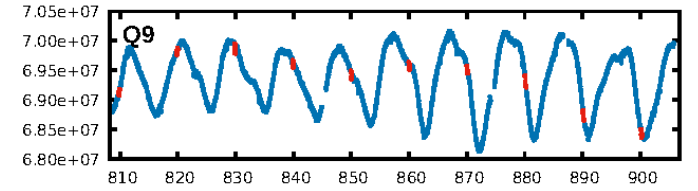
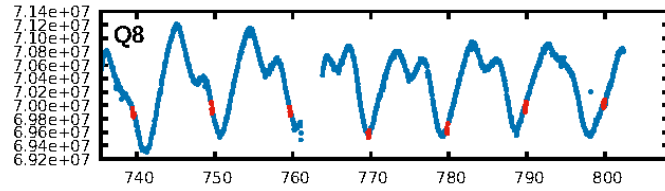
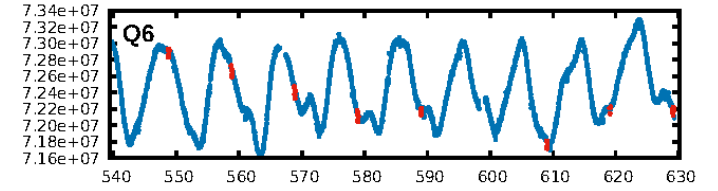
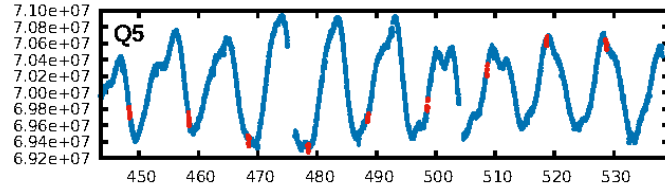
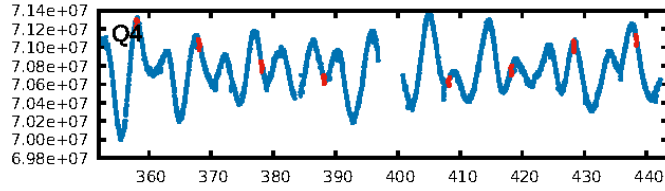
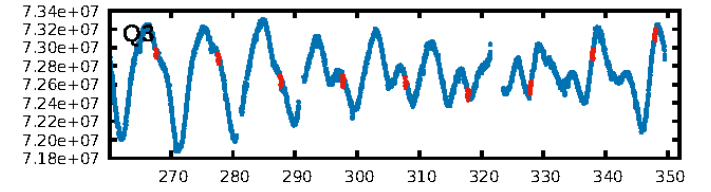
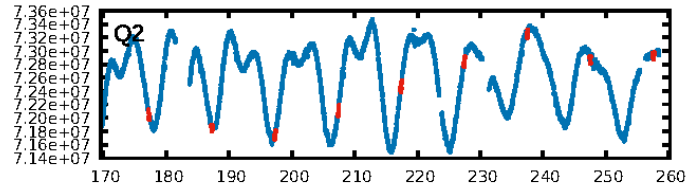
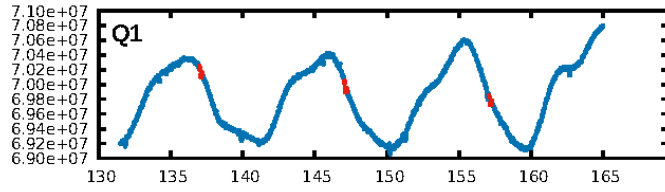
DV Diagnostic Results:

ShortPeriod-sig: 100.0% [27.43σ]
LongPeriod-sig: 100.0% [56.93σ]
ModelChiSquare2-sig: 100.0%
ModelChiSquareGof-sig: 100.0%
Bootstrap-pfa: 0.00e+00
RollingBand-fgt: 1.00 [99/99]
GhostDiagnostic-chr: 2.078
Centroid-sig: 0.0%
Centroid-so: 0.264 arcsec [2.49σ]
OotOffset-rm: 0.106 arcsec [1.24σ]
KicOffset-rm: 0.093 arcsec [0.96σ]
OotOffset-st: 4/1/4/5 [14]
KicOffset-st: 4/1/4/5 [14]
DiffImageQuality-fgm: 1.00 [14/14]
DiffImageOverlap-fno: 1.00 [14/14]

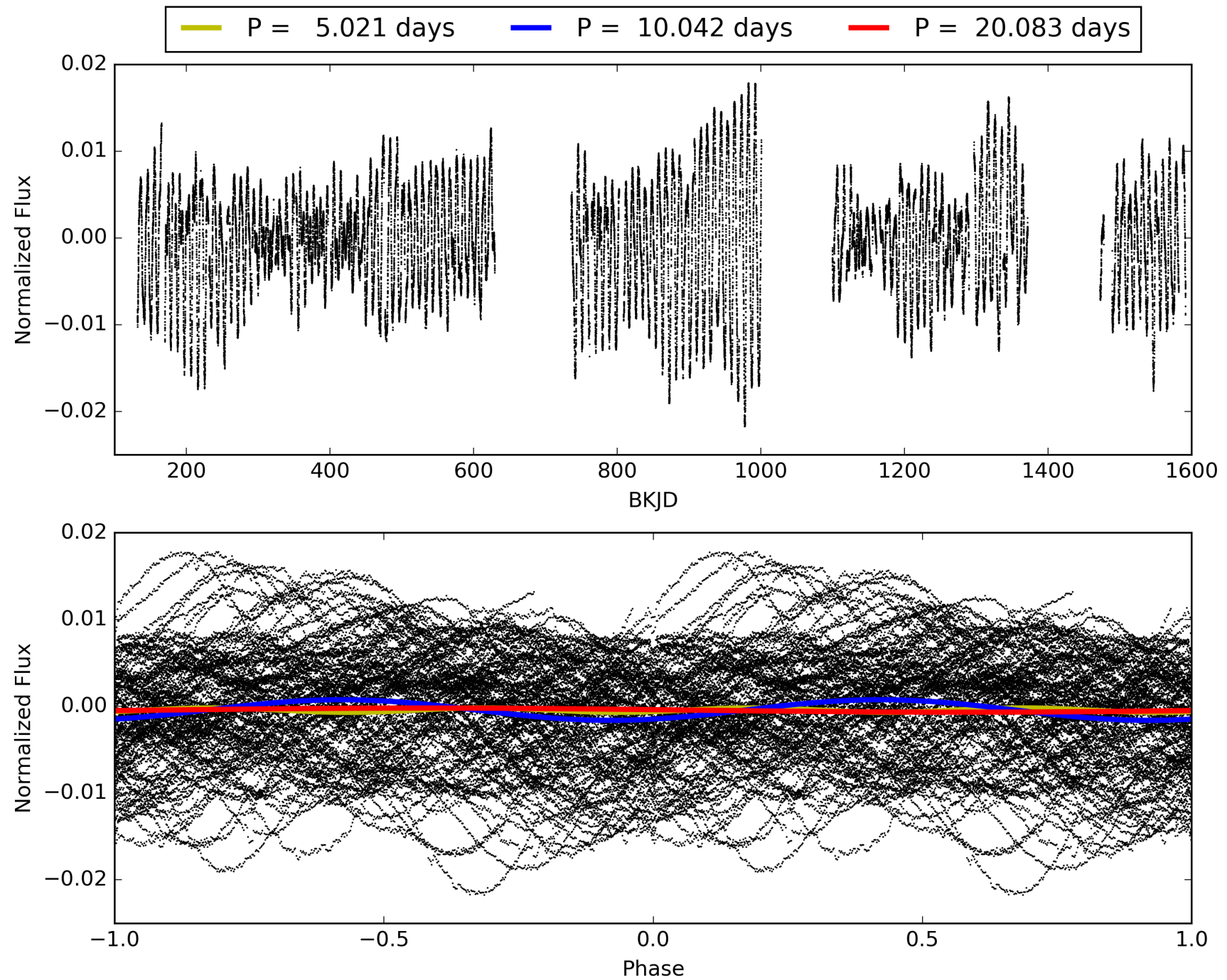
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 01-Feb-2016 12:07:08 Z

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

TCE 009963524-02, PDC Light Curves

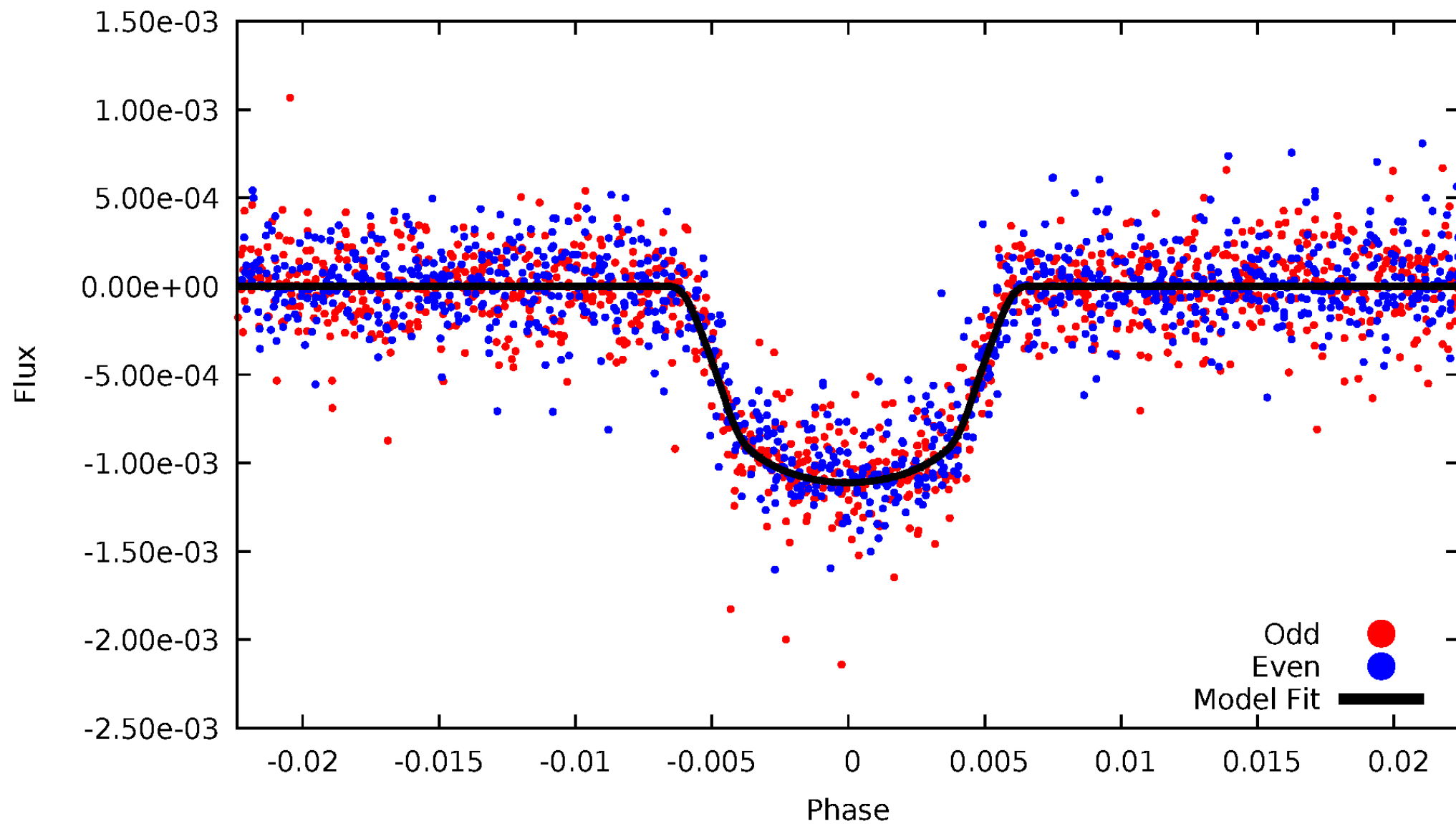


TCE 009963524-02



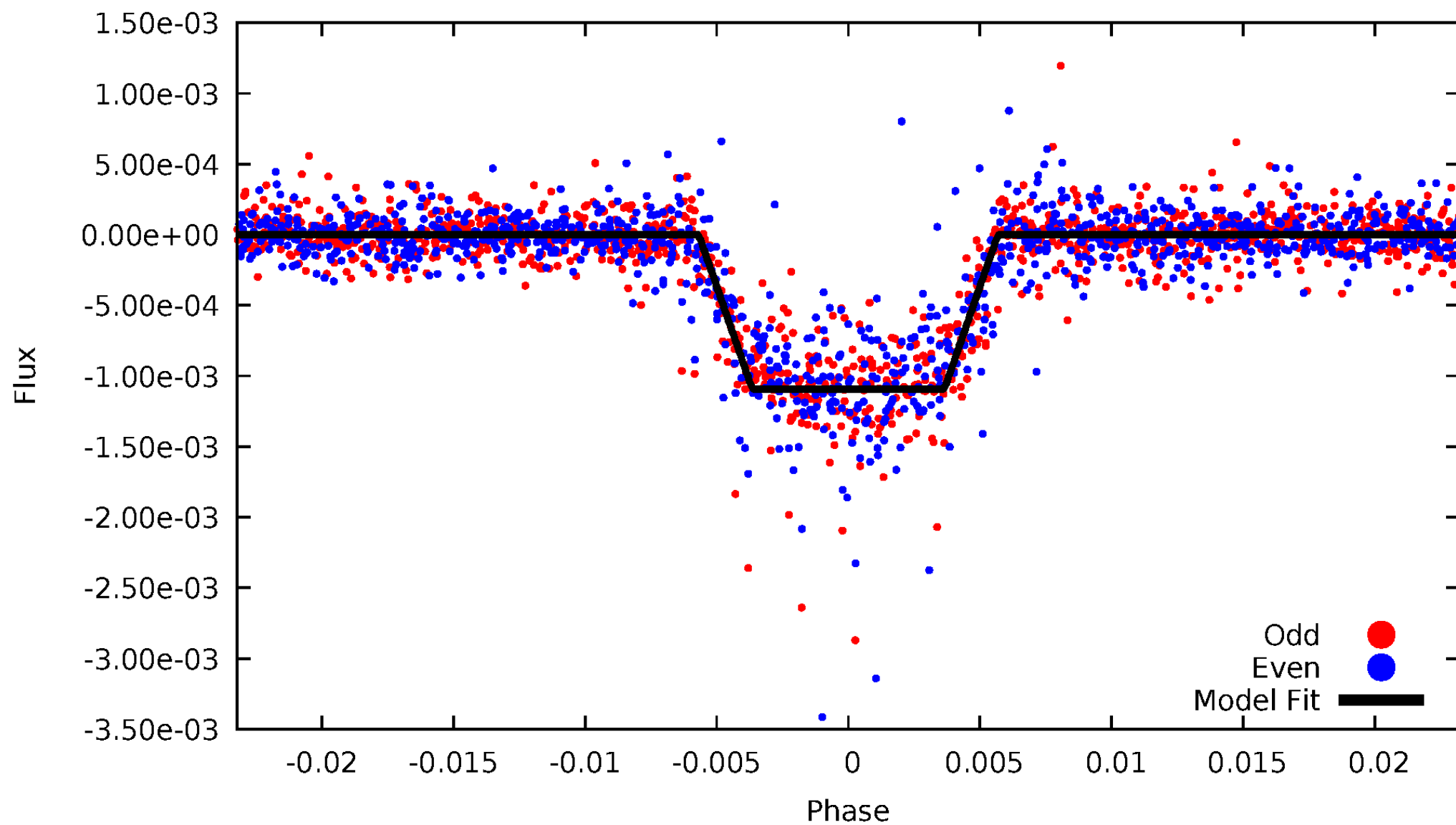
DV Odd/Even

TCE 009963524-02



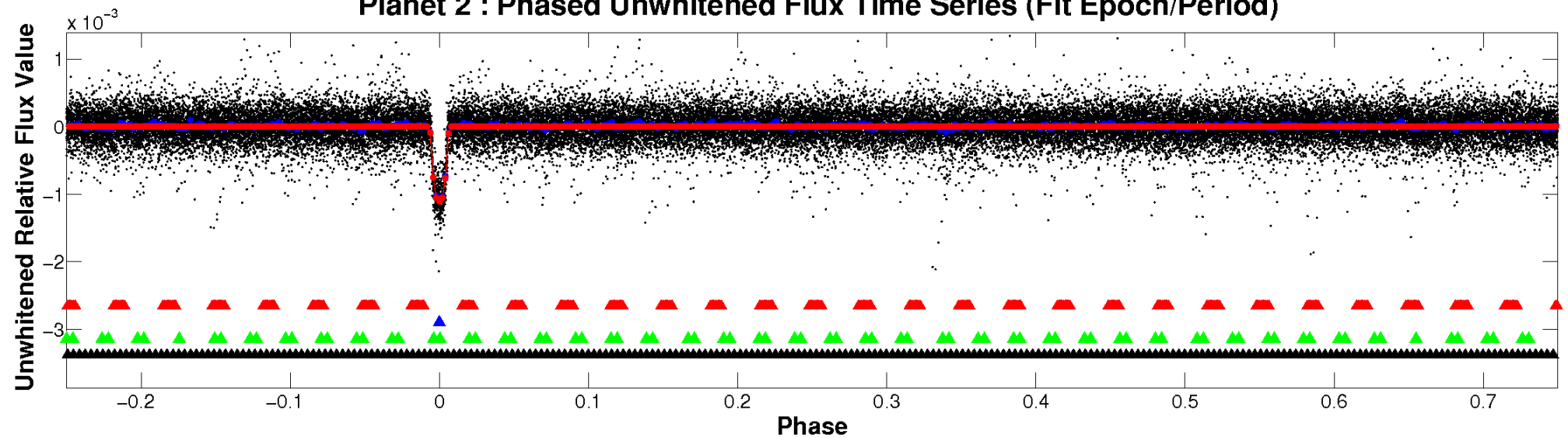
ALT Odd/Even

TCE 009963524-02

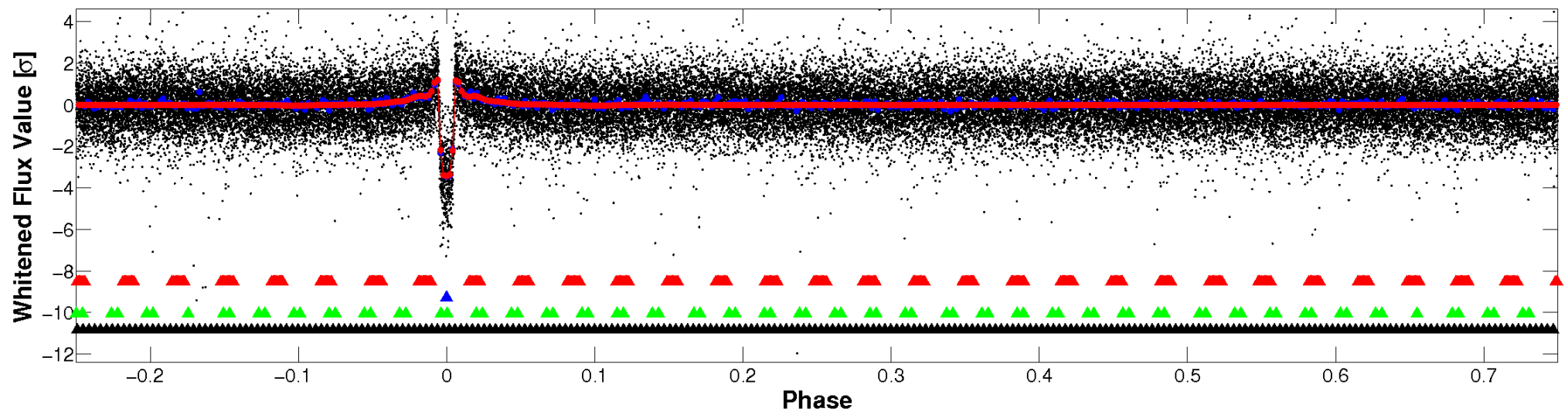


Non-Whitened Vs. Whitened Light Curve

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

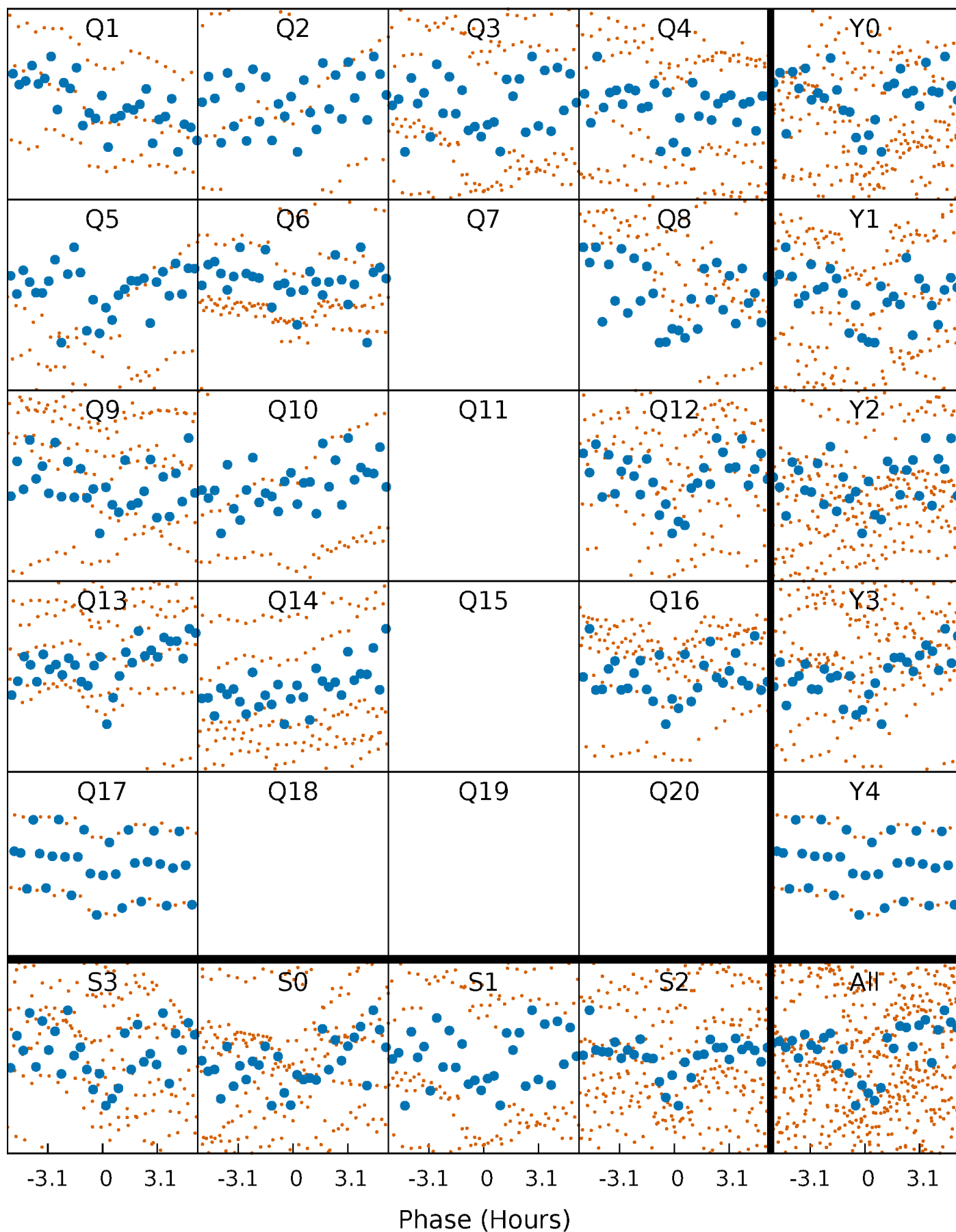


Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



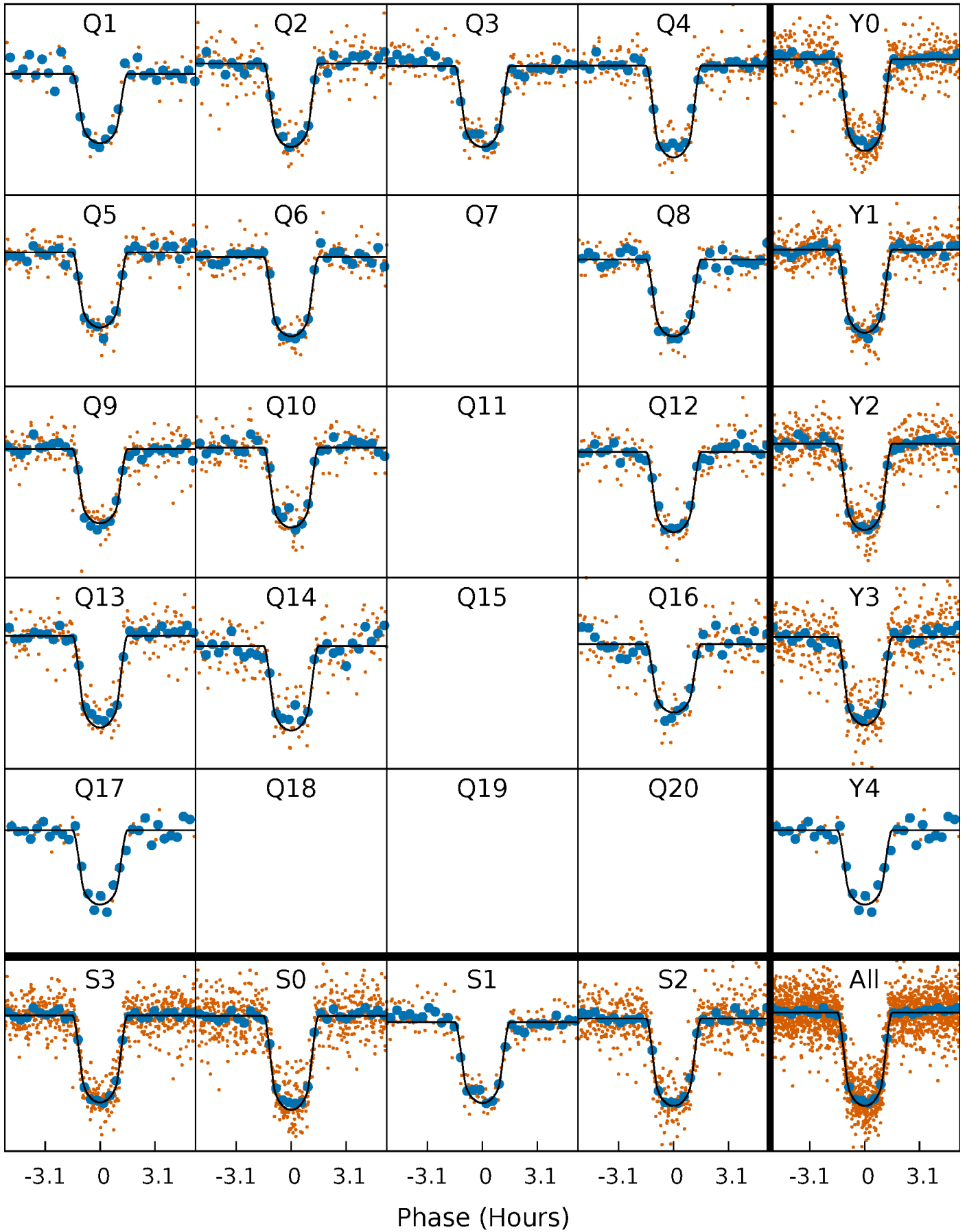
PDC Quarter-Phased Transit Curves

TCE 009963524-02 P= 10.041578 Days $T_0=137.084642$ (BKJD)



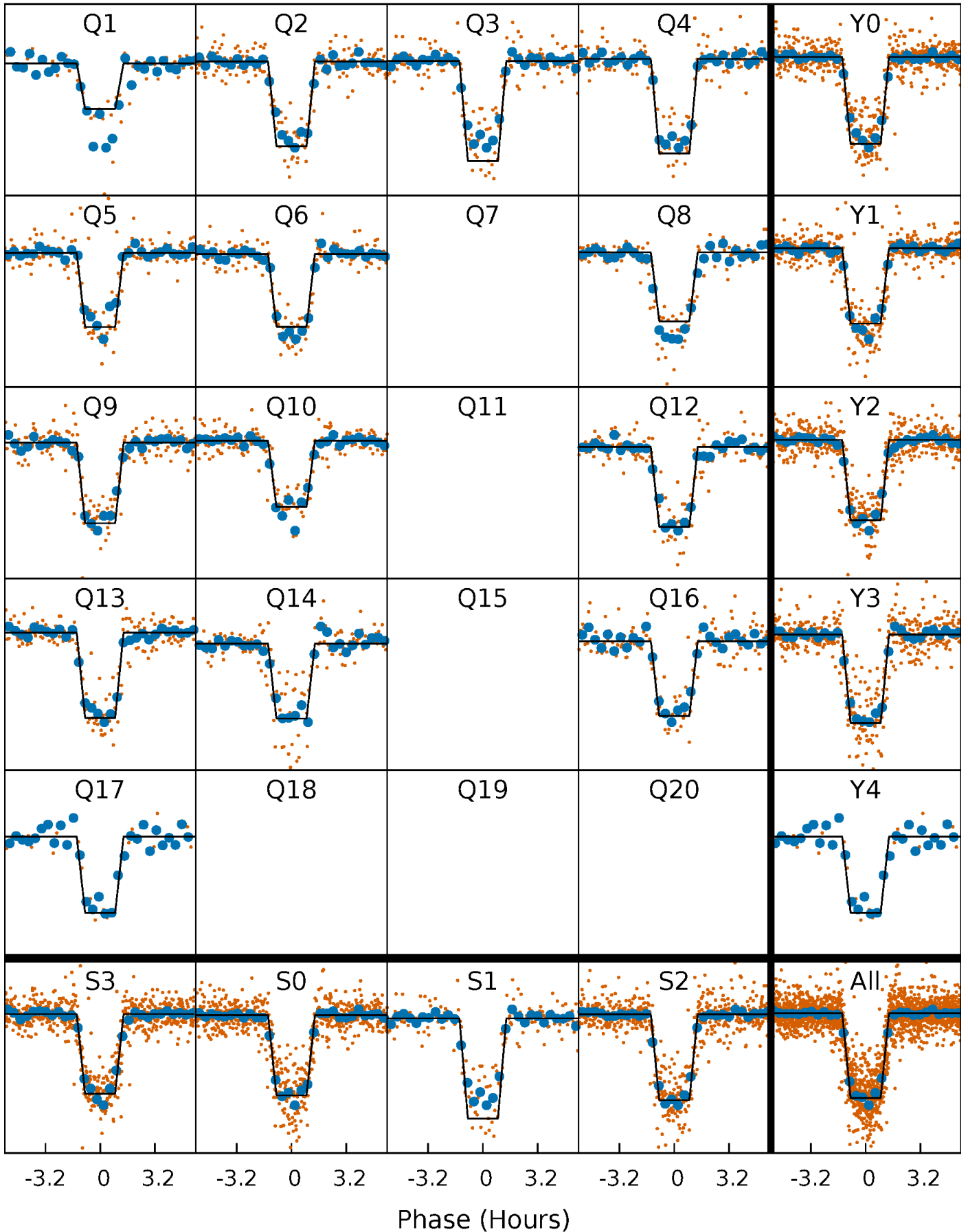
DV Quarter-Phased Transit Curves

TCE 009963524-02 P= 10.041578 Days $T_0=137.084642$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

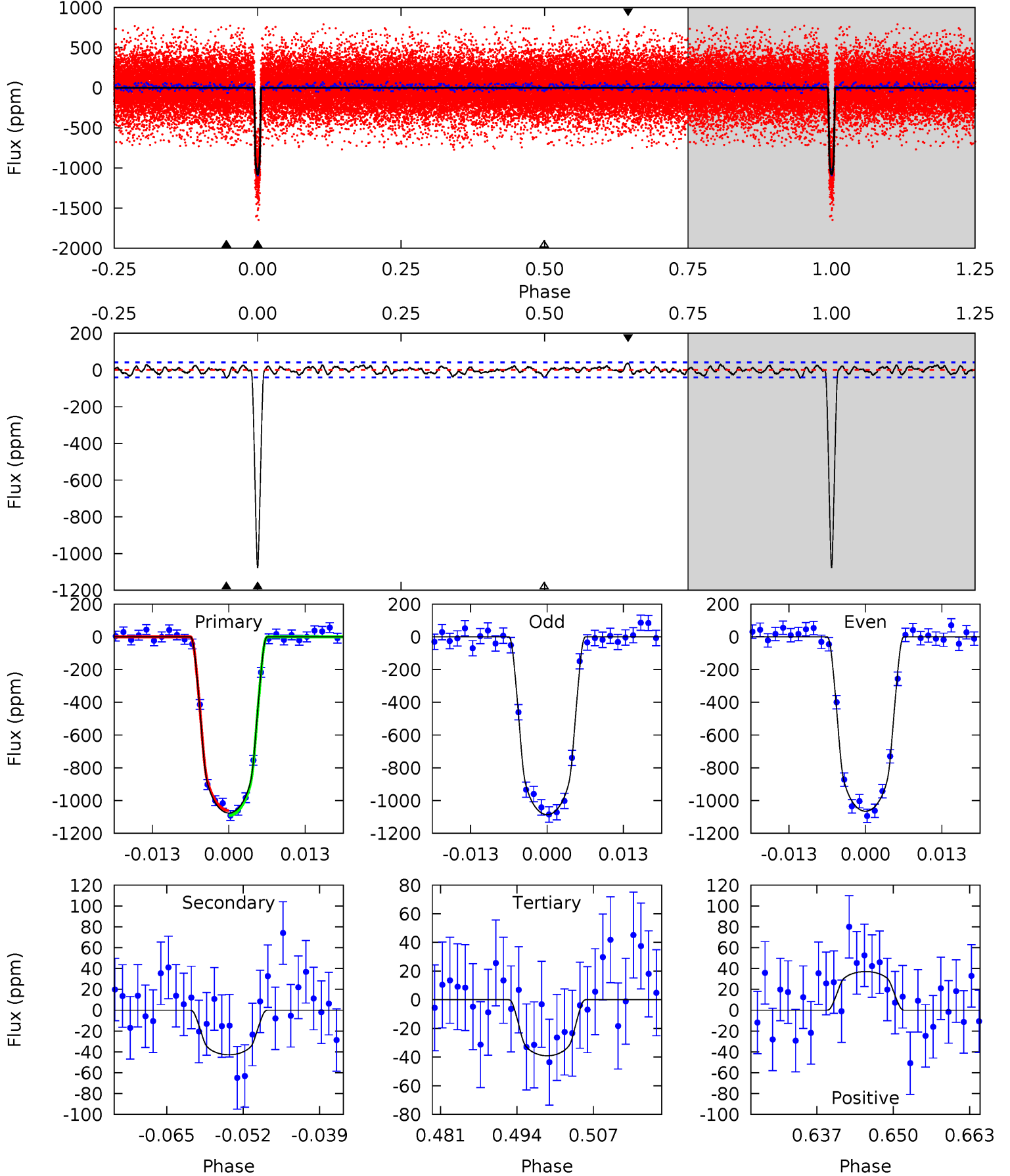
TCE 009963524-02 P= 10.041587 Days $T_0=137.083777$ (BKJD)



DV Model-Shift Uniqueness Test

009963524-02, P = 10.041578 Days, E = 127.043064 Days

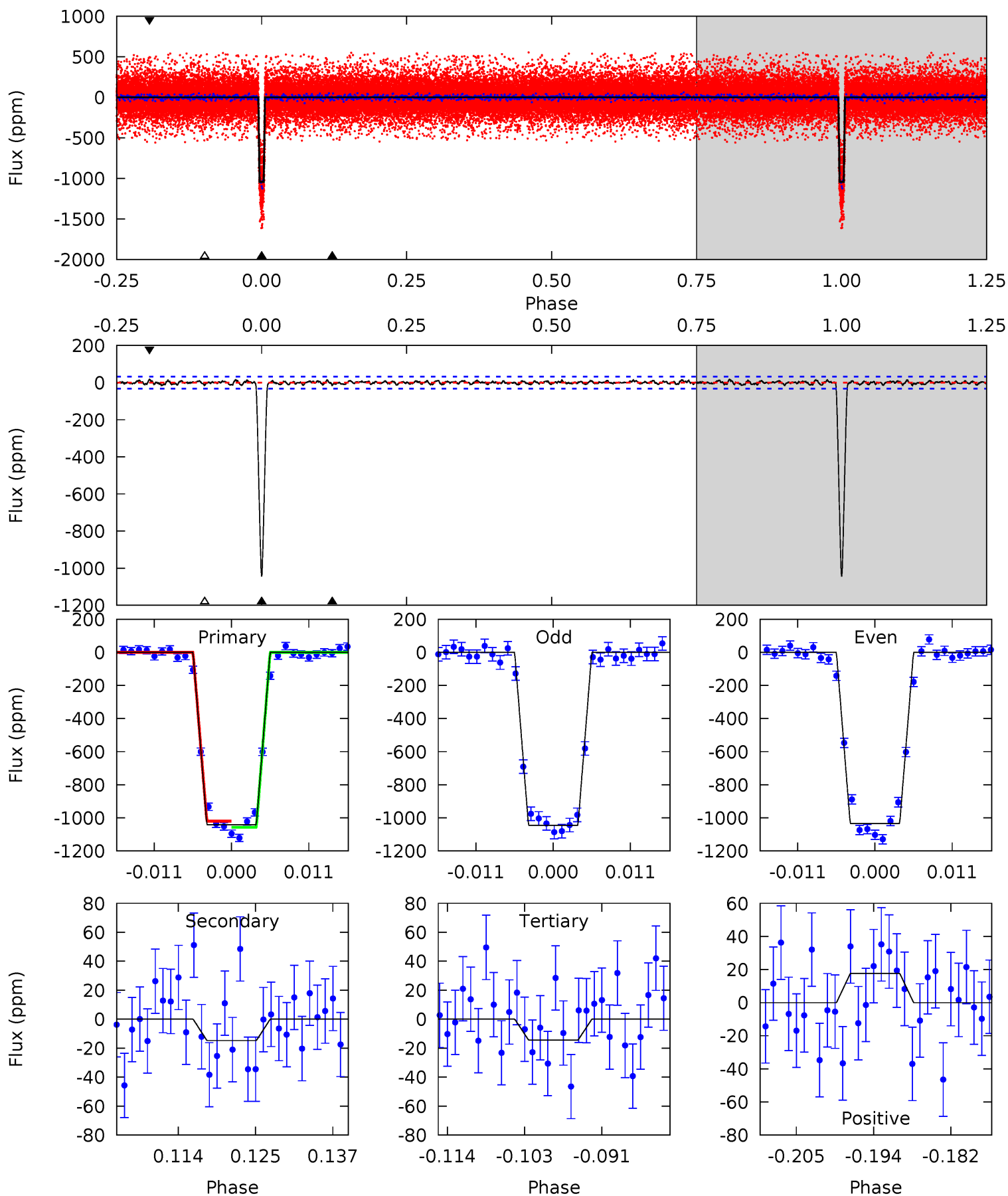
Pri	Sec	Ter	Pos	FA ₁	FA ₂	F _{Red}	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
130.6	5.19	4.75	4.50	4.98	2.48	1.62	125.9	126.1	0.45	0.70	1.28	1.01	0.03	1.87



Alt Model-Shift Uniqueness Test

009963524-02, P = 10.041587 Days, E = 127.042190 Days

Pri	Sec	Ter	Pos	FA ₁	FA ₂	F _{Red}	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
161.4	2.28	2.24	2.73	5.00	2.53	0.89	159.2	158.7	0.05	-0.45	0.84	1.00	0.02	2.94



Stellar Parameters For KIC 009963524

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	5244^{+105}_{-105}	$4.538^{+0.045}_{-0.055}$	$-0.040^{+0.150}_{-0.150}$	$0.810^{+0.060}_{-0.044}$	$0.826^{+0.052}_{-0.043}$	$2.191^{+0.351}_{-0.405}$
	+2%/-2%	+1%/-1%	+375%/-375%	+7%/-5%	+6%/-5%	+16%/-18%
Source	SPE58	SPE58	SPE58	DSEP		

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

Secondary Eclipse Parameters for KIC 009963524-02 / KOI 0720.02

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	A_{obs}
DV	-43 ± 8	$3.04^{+0.25}_{-0.25}$	996^{+29}_{-26}	2950^{+106}_{-111}	19^{+5}_{-4}
Alt.	-15 ± 6	$2.93^{+0.25}_{-0.26}$	997^{+27}_{-27}	2578^{+140}_{-196}	$6.974^{+3.292}_{-3.276}$

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

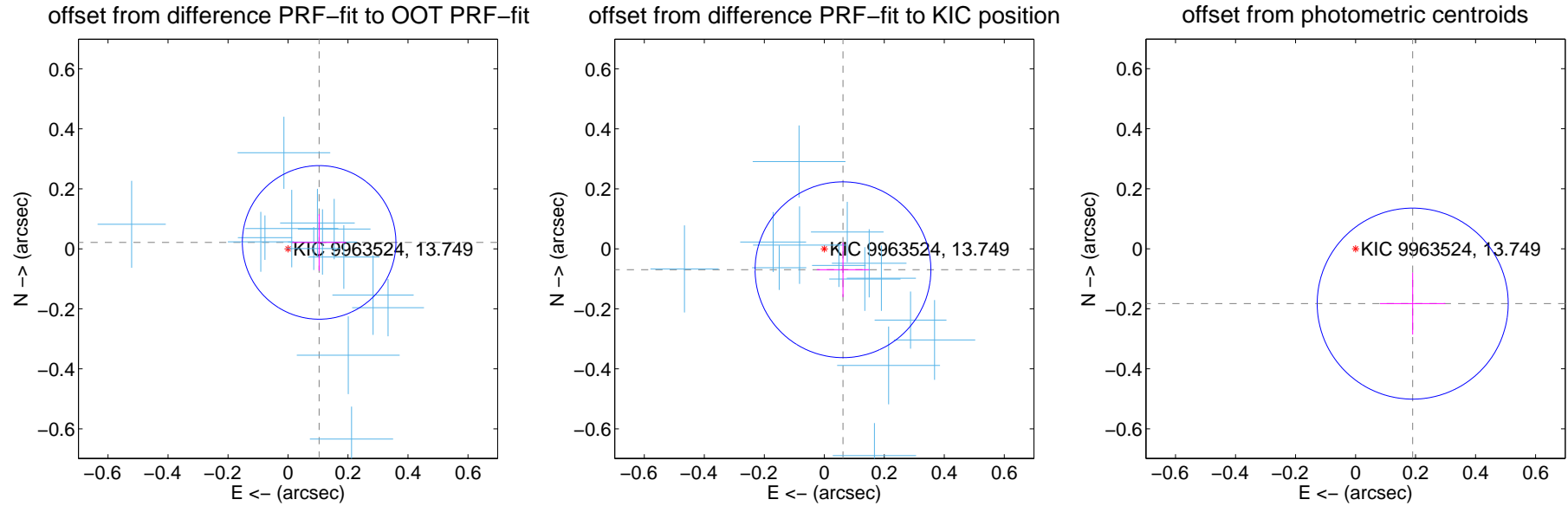
DV Centroid Data

Supplemental centroid analysis for 009963524-02. Kepler magnitude: 13.75. Transit SNR 70.28

There are 14 quarters with good PRF difference image offsets

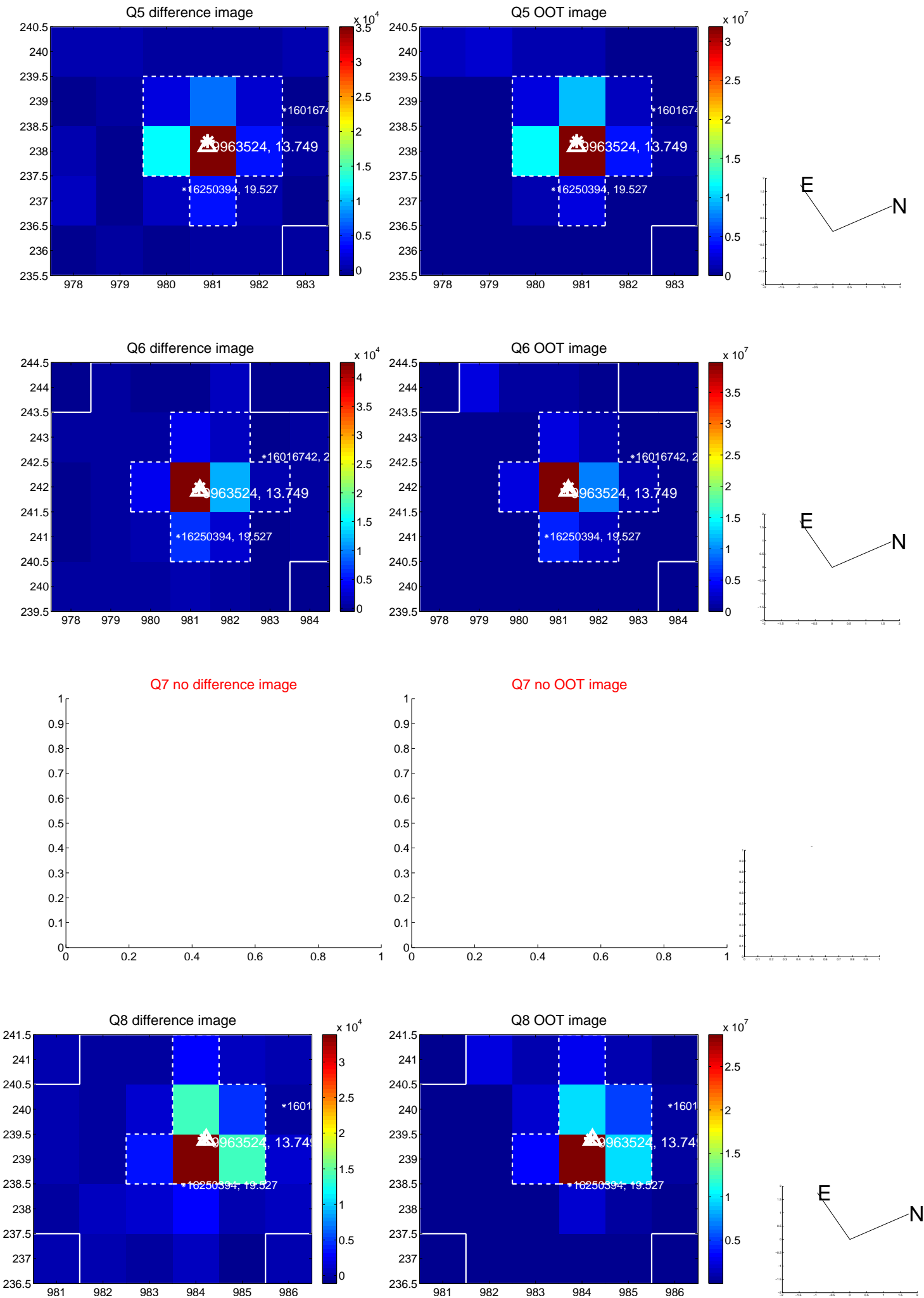
The direct PRF centroid is offset from the target star catalog position by about 0.04 arcsec

	Distance in arcsec	Distance / σ	Δ RA	Δ Dec
PRF-fit source offset from OOT	0.106 ± 0.085	1.24	-0.104 ± 0.090	0.021 ± 0.094
PRF-fit source offset from KIC position	0.093 ± 0.098	0.96	-0.062 ± 0.087	-0.070 ± 0.091
photometric centroid source offset	0.26 ± 0.11	2.49	-0.19 ± 0.11	-0.18 ± 0.10

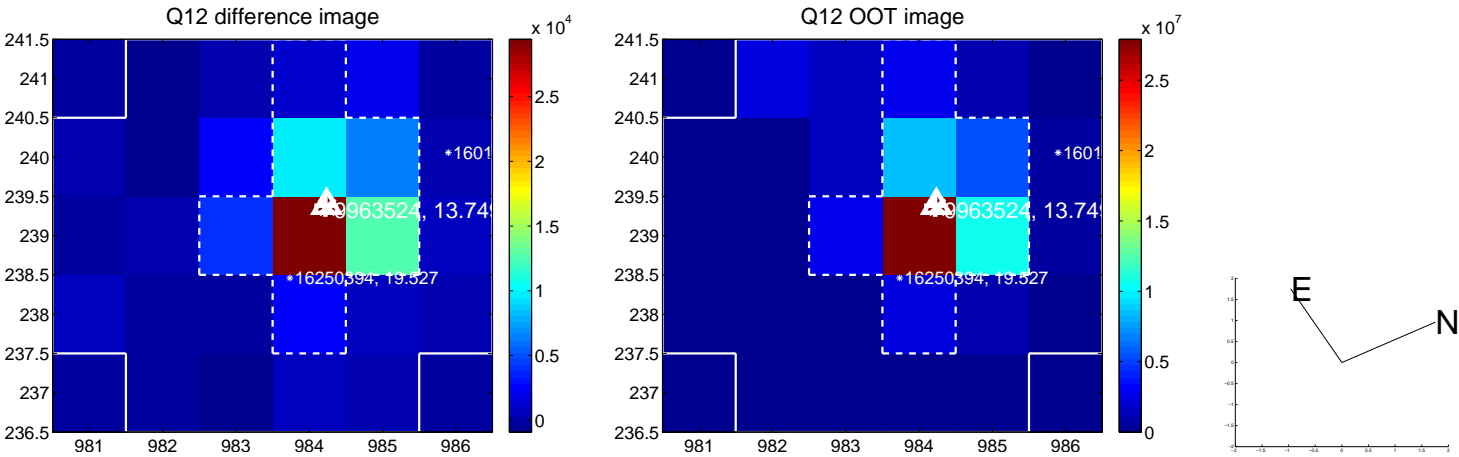
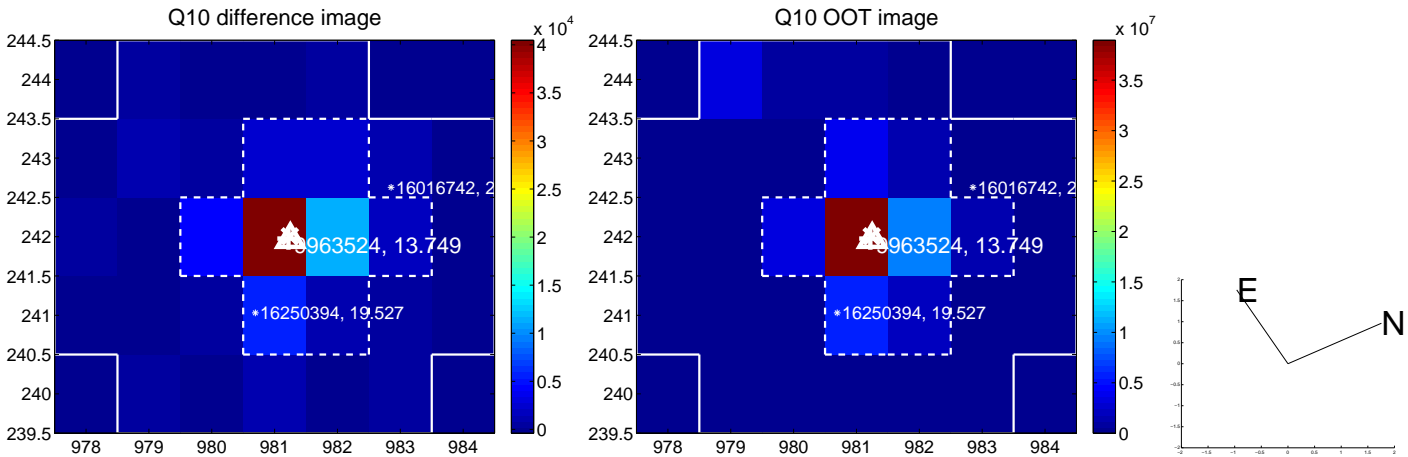
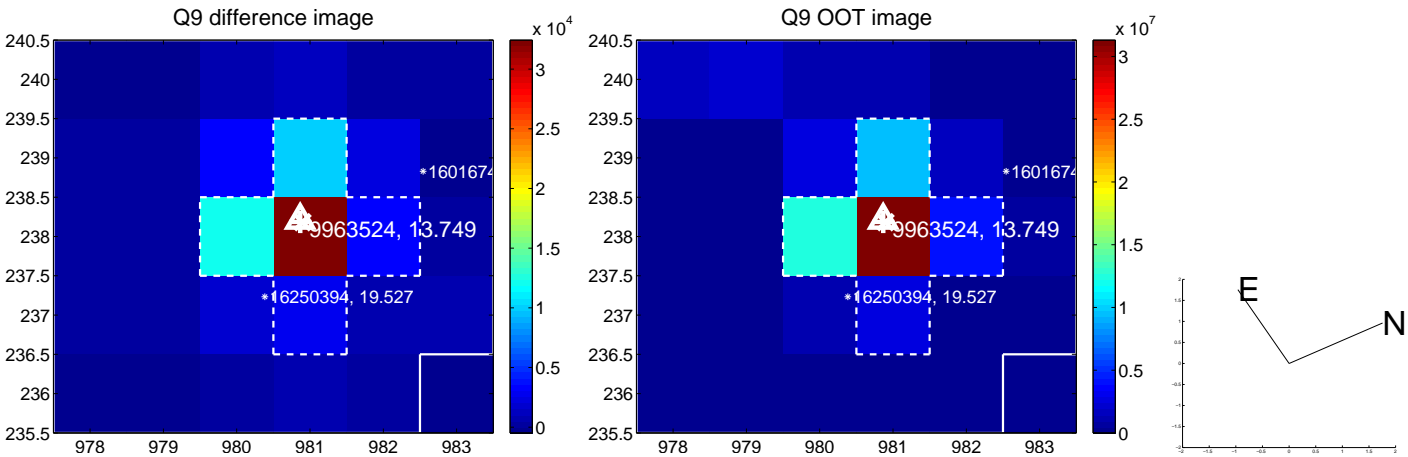


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

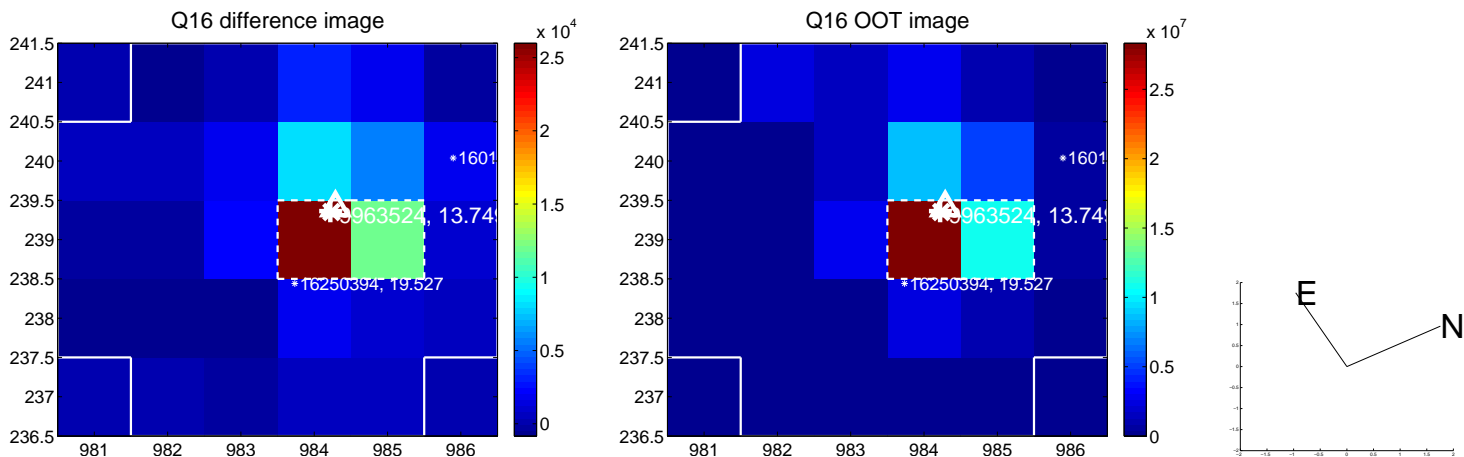
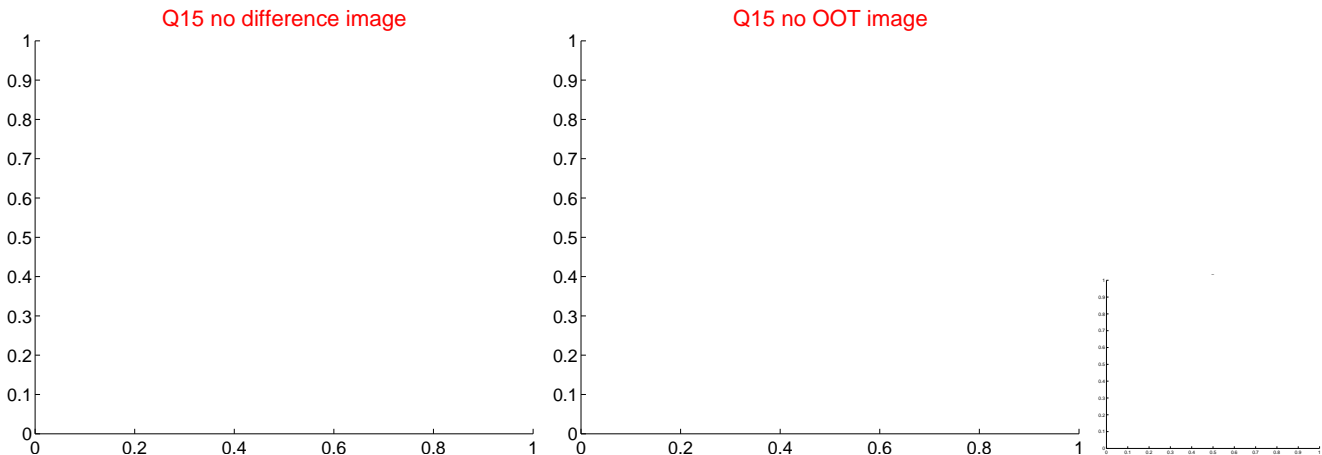
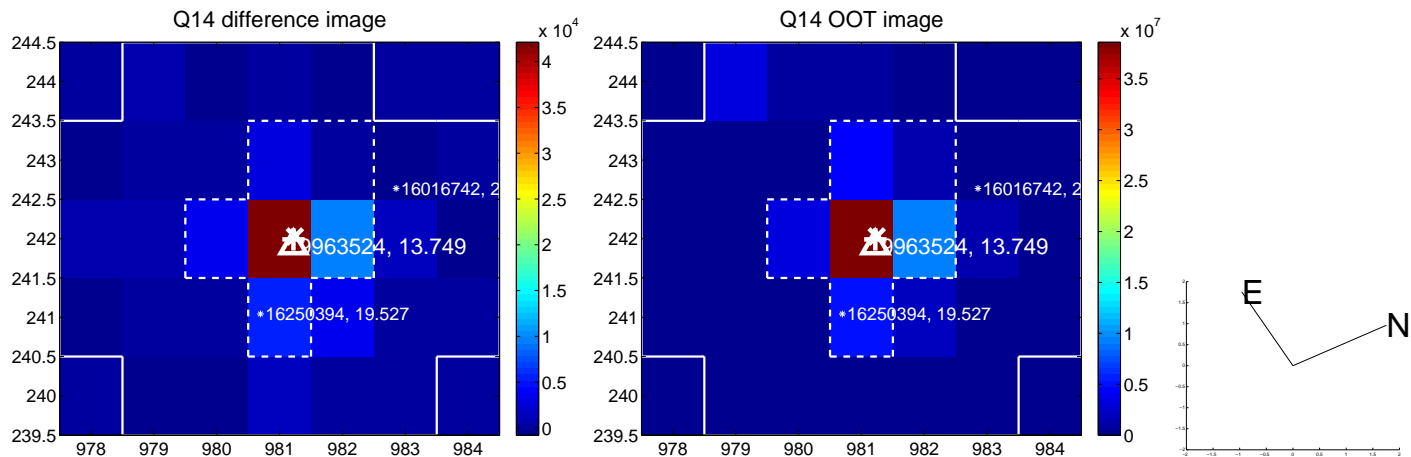
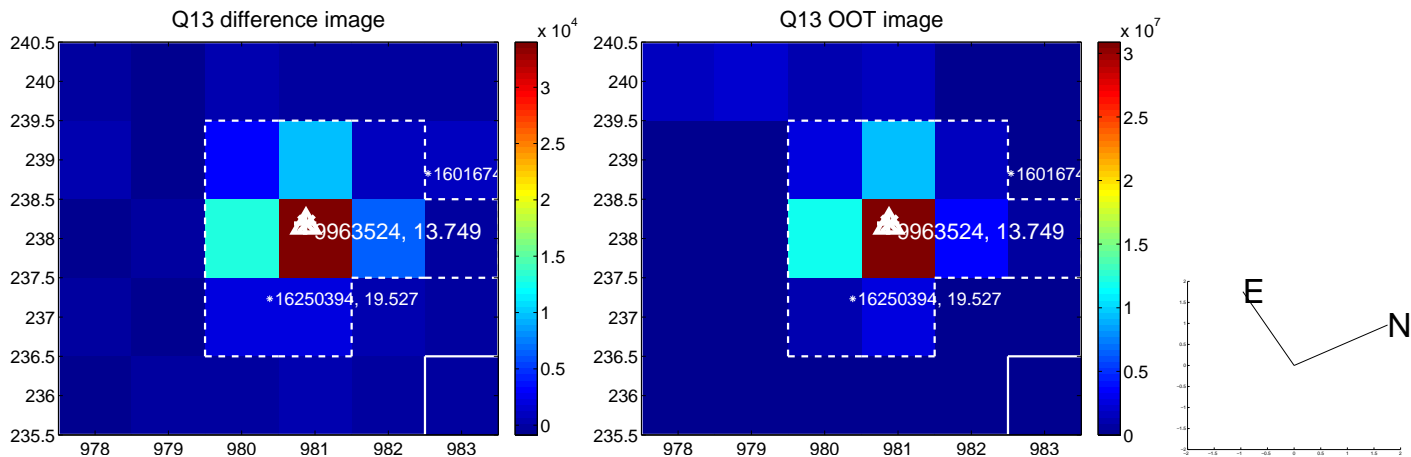
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



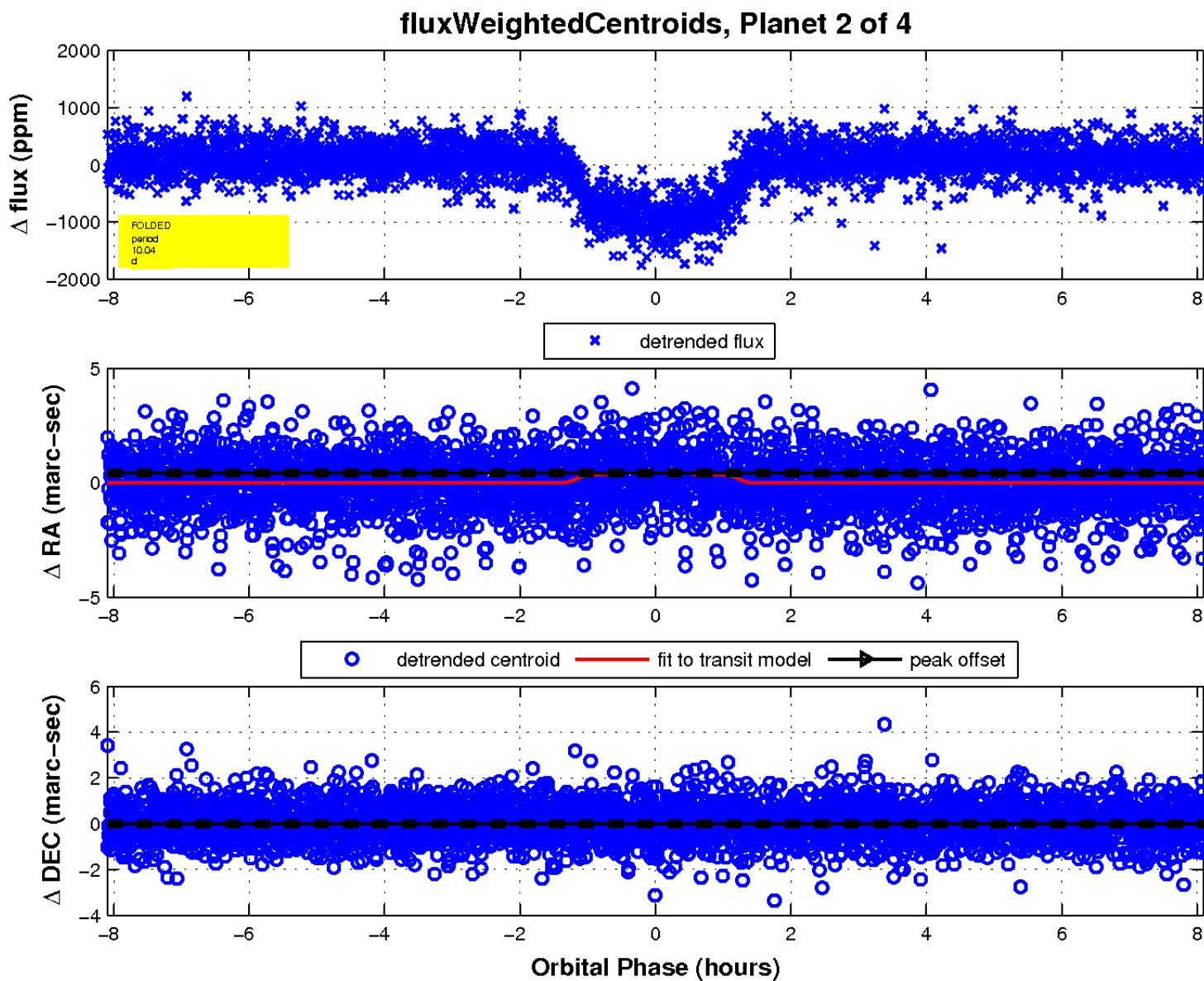
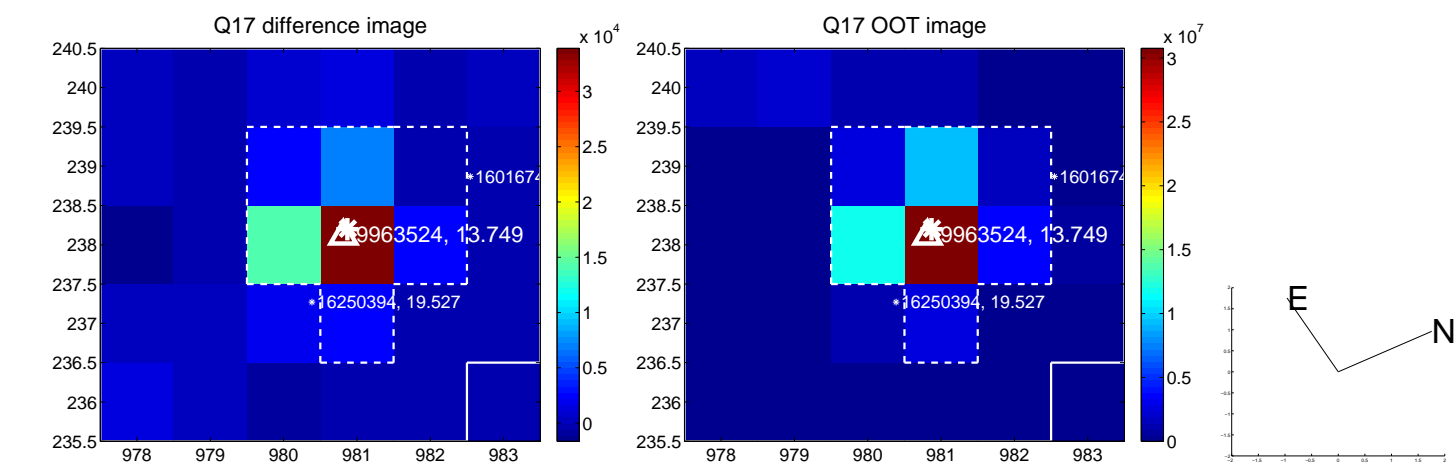
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



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

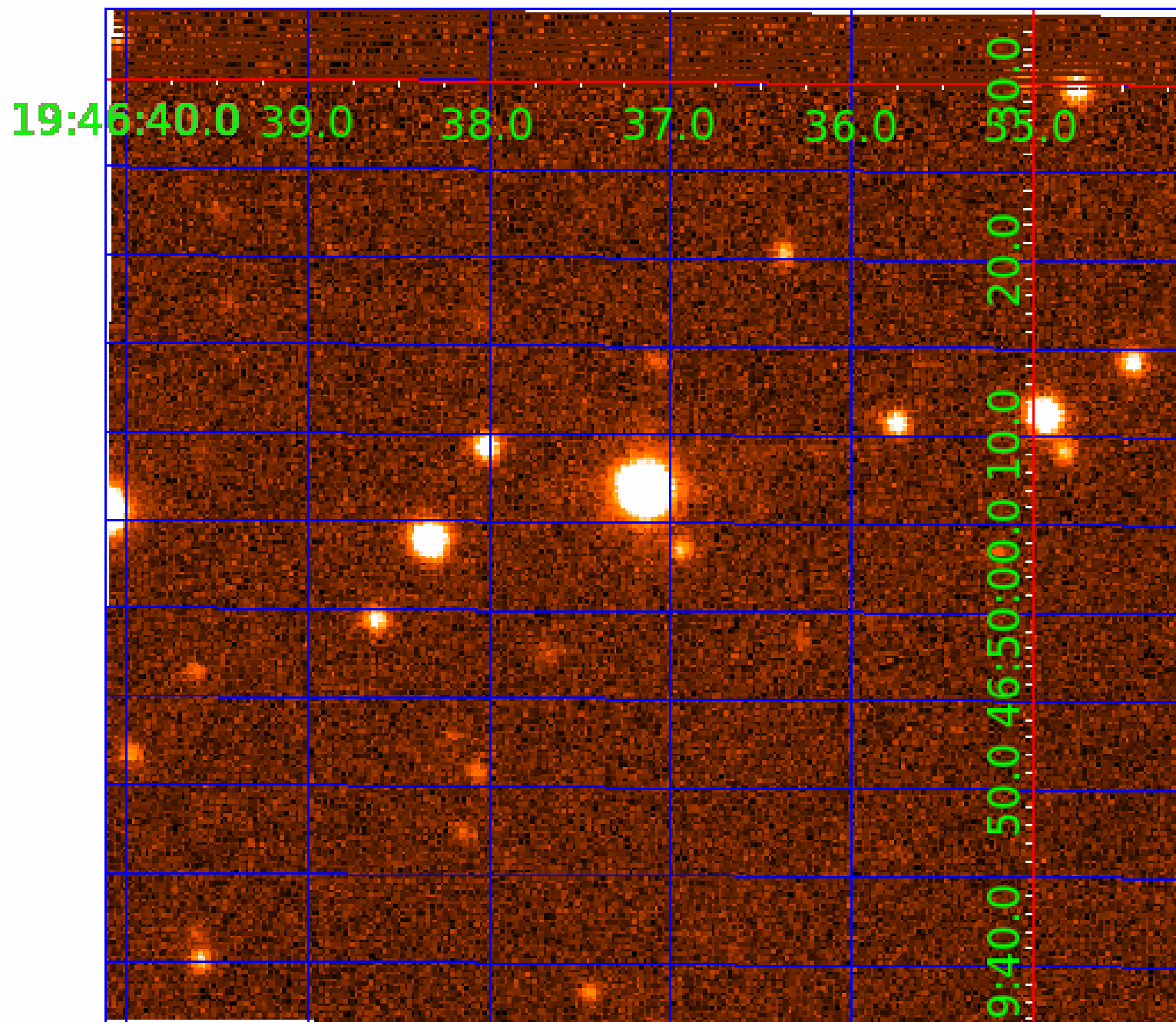


white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



UKIRT Image

Declination



KIC 009963524

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})
009963524-01	OBS	0720.01	5.690581	134.215842	1359.3	2.684	116.5	116.3	0.81	5244	3.40	129.72
009963524-02	OBS	0720.02	10.041578	137.084642	1110.1	2.699	70.6	70.3	0.81	5244	3.02	60.83
009963524-03	OBS	0720.03	18.369770	131.864411	1025.7	2.245	47.6	47.1	0.81	5244	2.77	27.19
009963524-04	OBS	0720.04	2.795897	132.729403	396.1	2.157	42.5	48.7	0.81	5244	1.85	334.58

Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009963524-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-03	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-04	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.

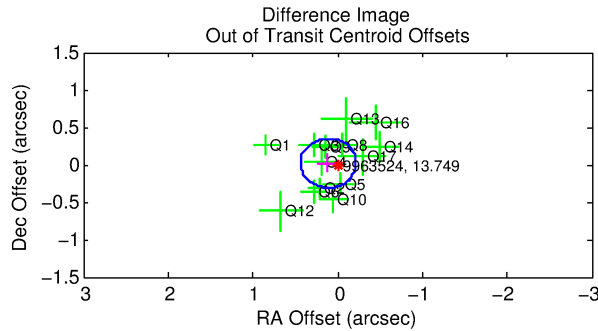
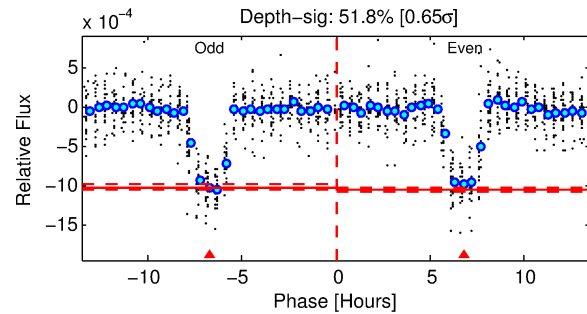
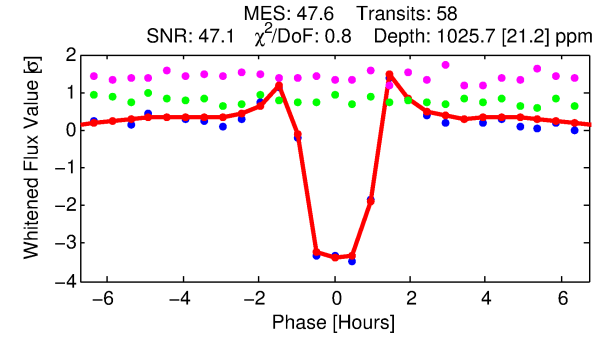
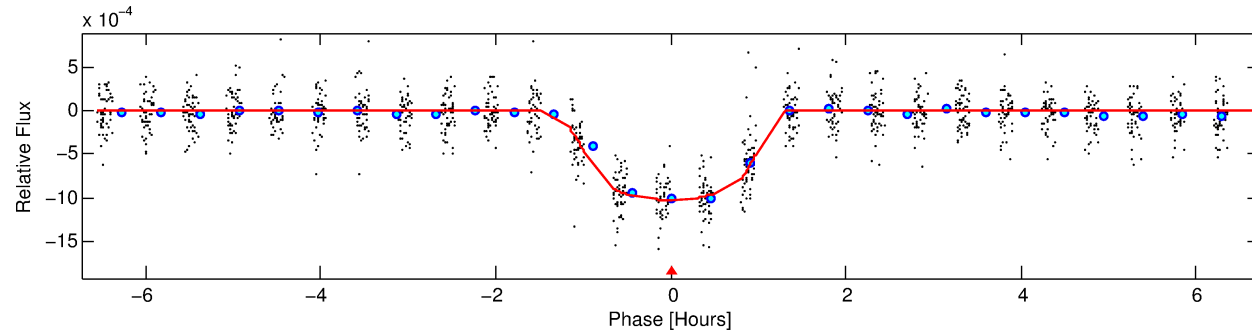
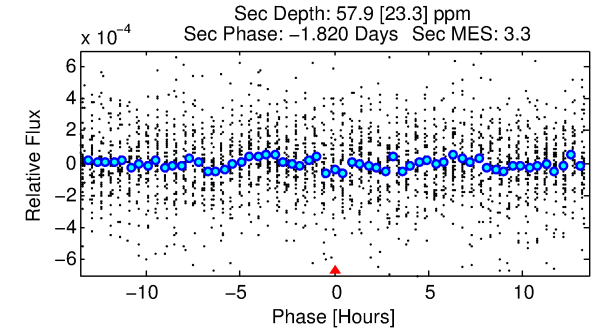
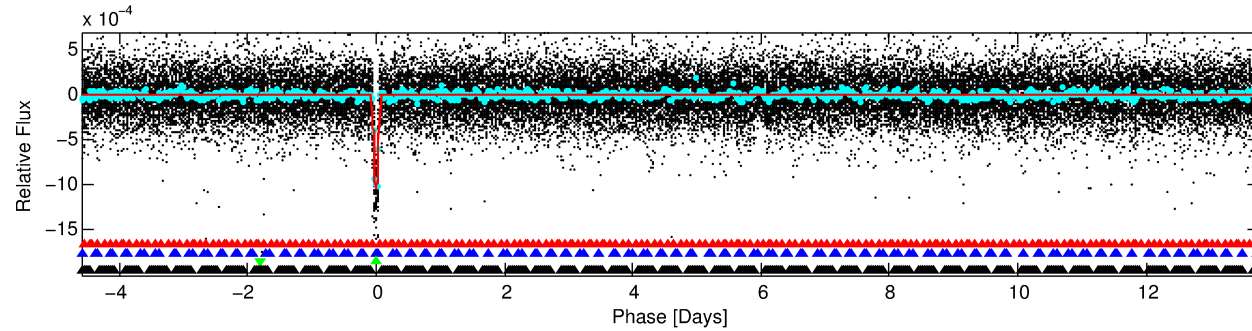
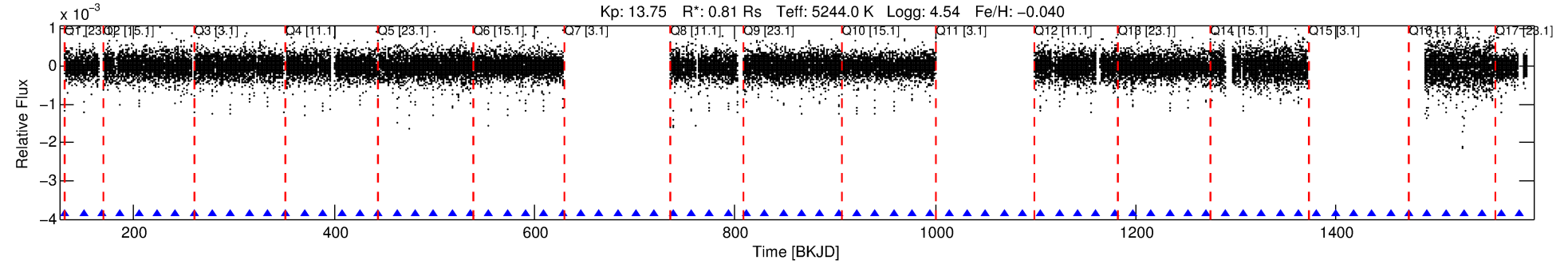
See http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col for comment definitions.

Ephemeris Match Information For 009963524-03

No Significant Match Found

DV One-Page Summary

KIC: 9963524 Candidate: 3 of 4 Period: 18.370 d
KOI: K00720.03 Name: Kepler-221e Corr: 0.989



DV Fit Results:

Period = 18.36977 [0.00002] d
Epoch = 131.8644 [0.0009] BKJD
Rp/R* = 0.0313 [0.0072]
a/R* = 47.57 [40.24]
b = 0.70 [0.64]
Seff = 27.19 [3.44]
Teq = 582 [18] K
Rp = 2.77 [0.67] Re
a = 0.1279 [0.0083] AU
Ag = 67.93 [41.88] [1.60σ]
Teffp = 2585 [397] K [5.04σ]

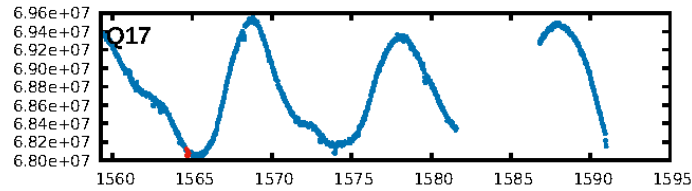
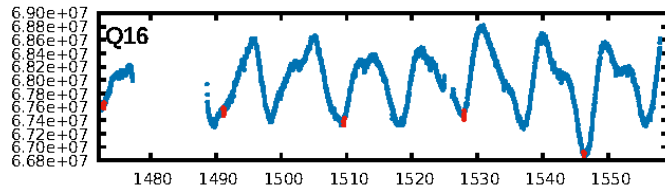
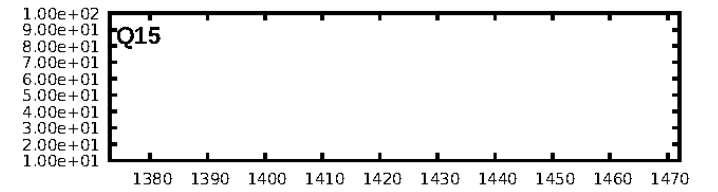
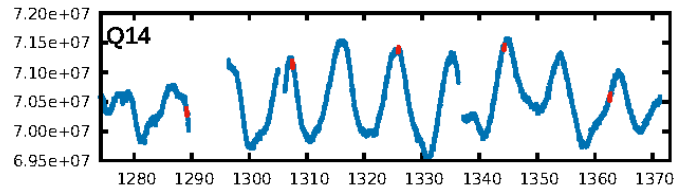
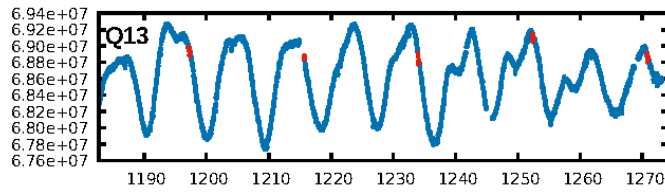
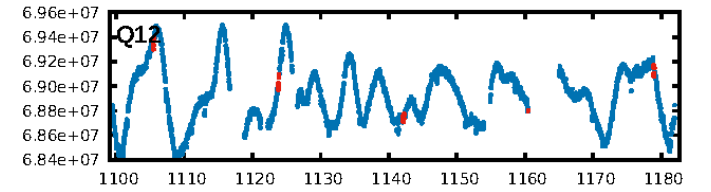
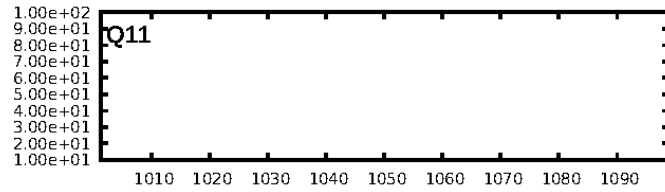
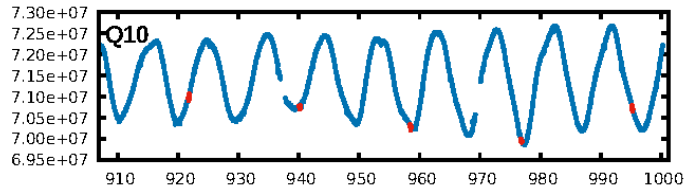
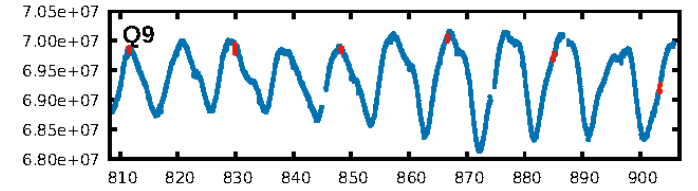
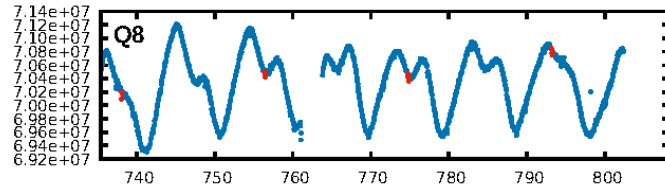
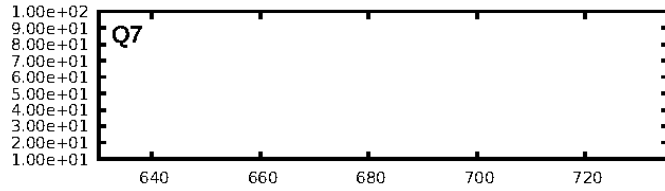
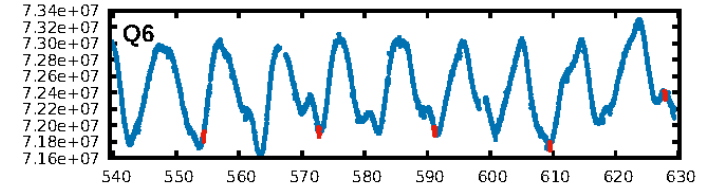
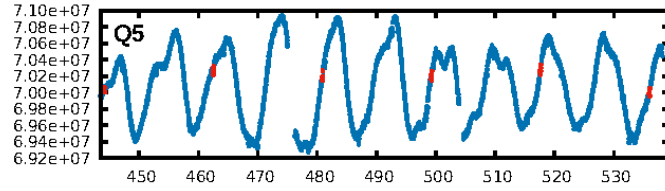
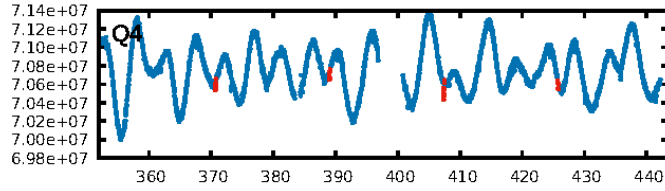
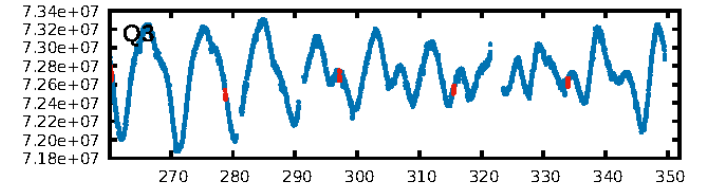
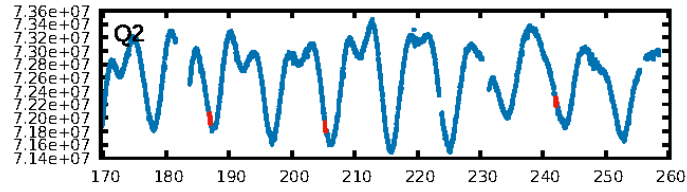
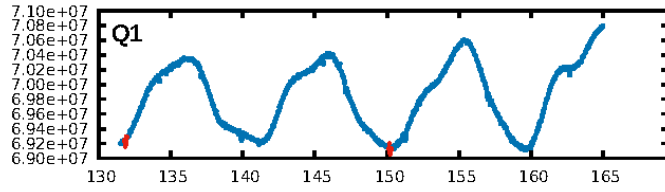
DV Diagnostic Results:

ShortPeriod-sig: 100.0% [56.93σ]
LongPeriod-sig: N/A
ModelChiSquare2-sig: 92.5%
ModelChiSquareGof-sig: 100.0%
Bootstrap-pfa: 0.00e+00
RollingBand-fgt: 1.00 [55/55]
GhostDiagnostic-chr: 5.066
Centroid-sig: 0.3%
Centroid-so: 0.084 arcsec [0.52σ]
OotOffset-rm: 0.113 arcsec [1.03σ]
KicOffset-rm: 0.131 arcsec [1.02σ]
OotOffset-st: 4/1/4/5 [14]
KicOffset-st: 4/1/4/5 [14]
DiffImageQuality-fgm: 1.00 [14/14]
DiffImageOverlap-fno: 0.93 [13/14]

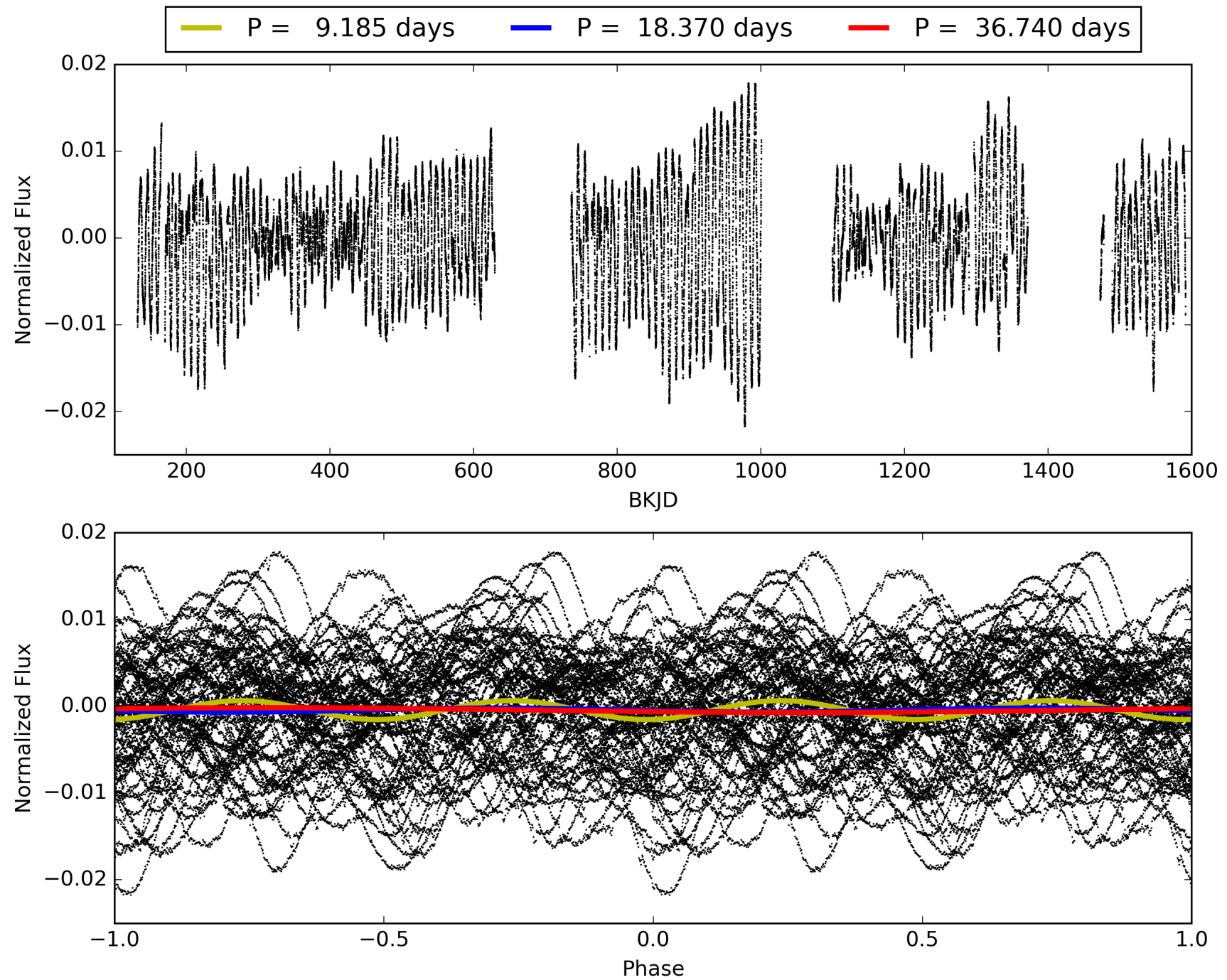
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 01-Feb-2016 12:07:13 Z

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

TCE 009963524-03, PDC Light Curves

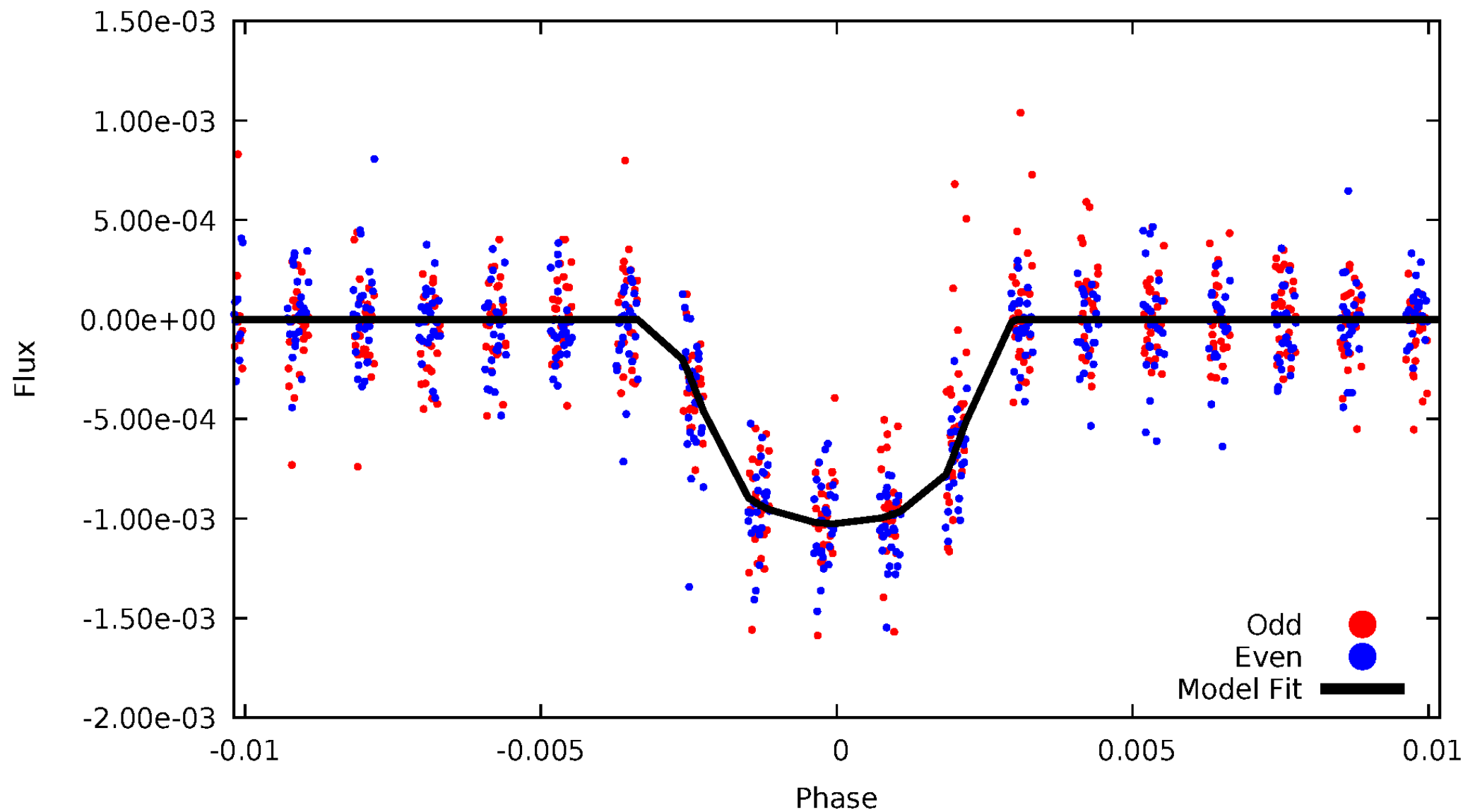


TCE 009963524-03



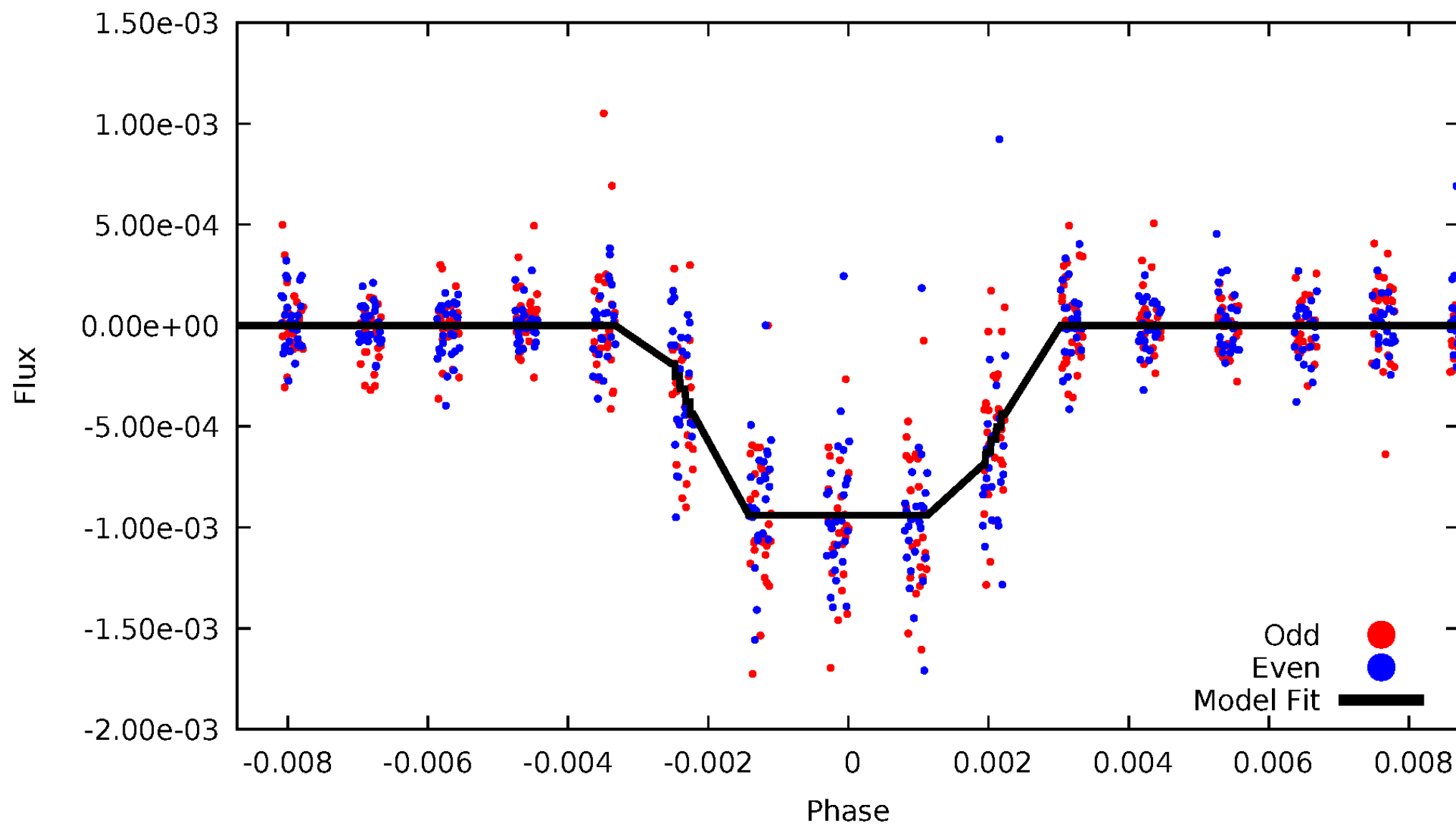
DV Odd/Even

TCE 009963524-03



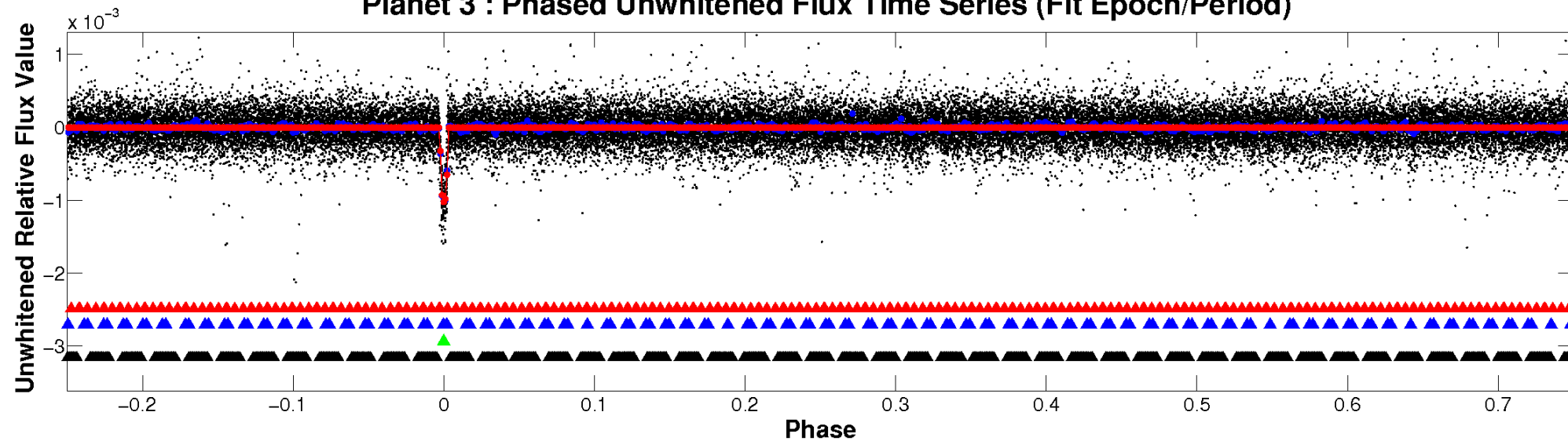
ALT Odd/Even

TCE 009963524-03

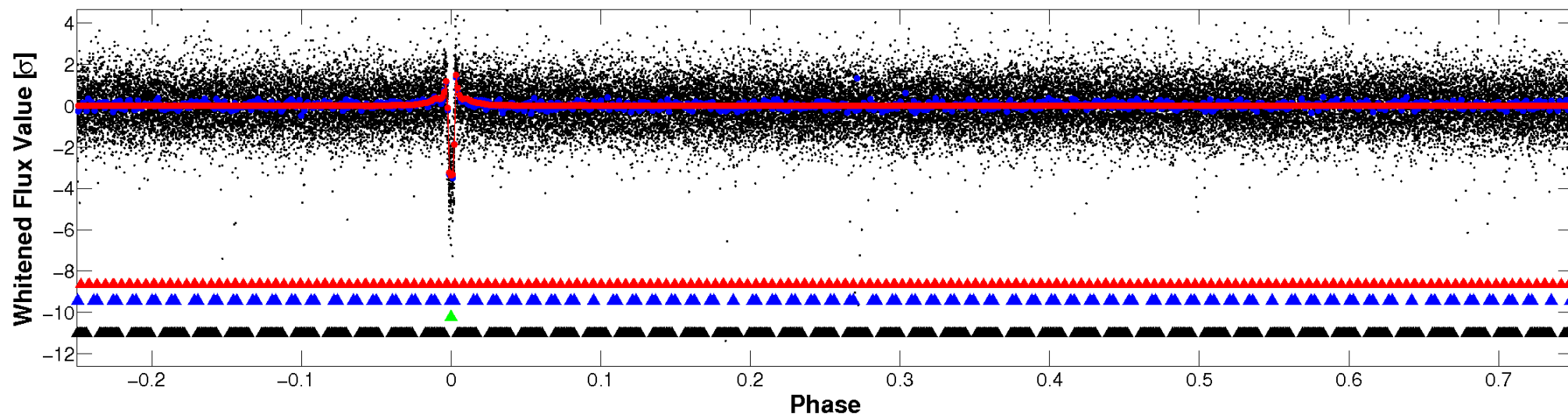


Non-Whitened Vs. Whitened Light Curve

Planet 3 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

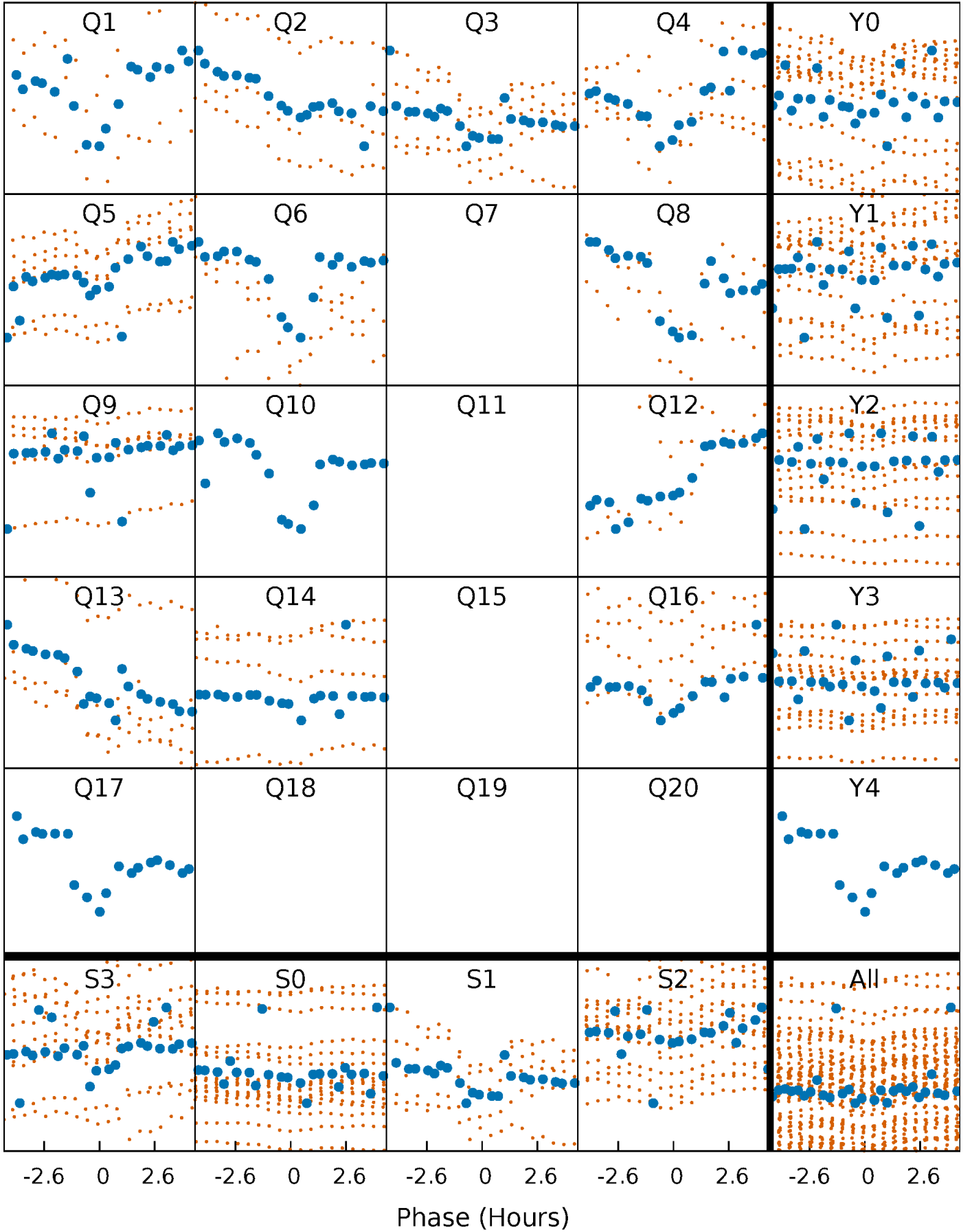


Planet 3 : Phased Whitened Flux Time Series (Fit Epoch/Period)



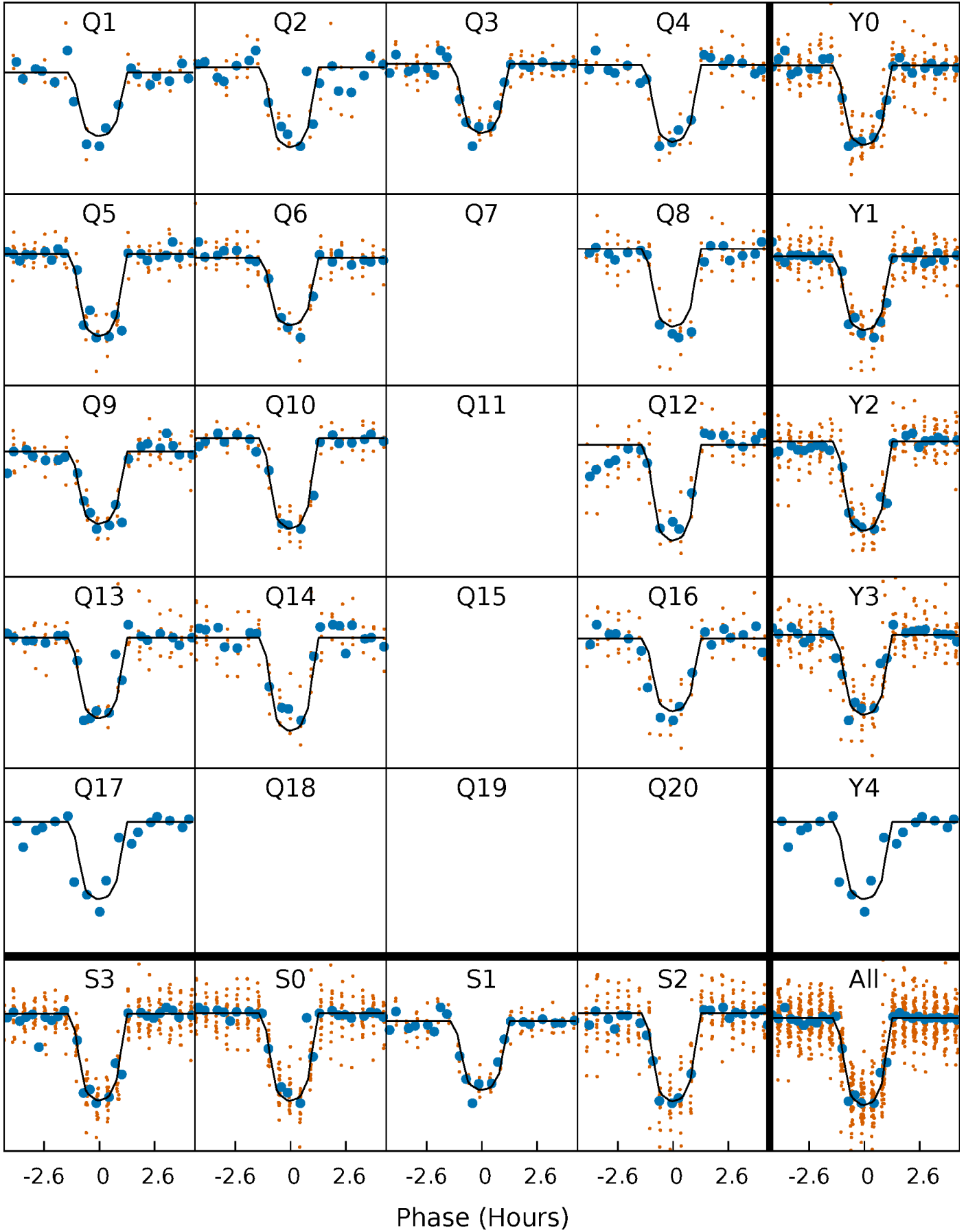
PDC Quarter-Phased Transit Curves

TCE 009963524-03 P= 18.369770 Days $T_0=131.864411$ (BKJD)



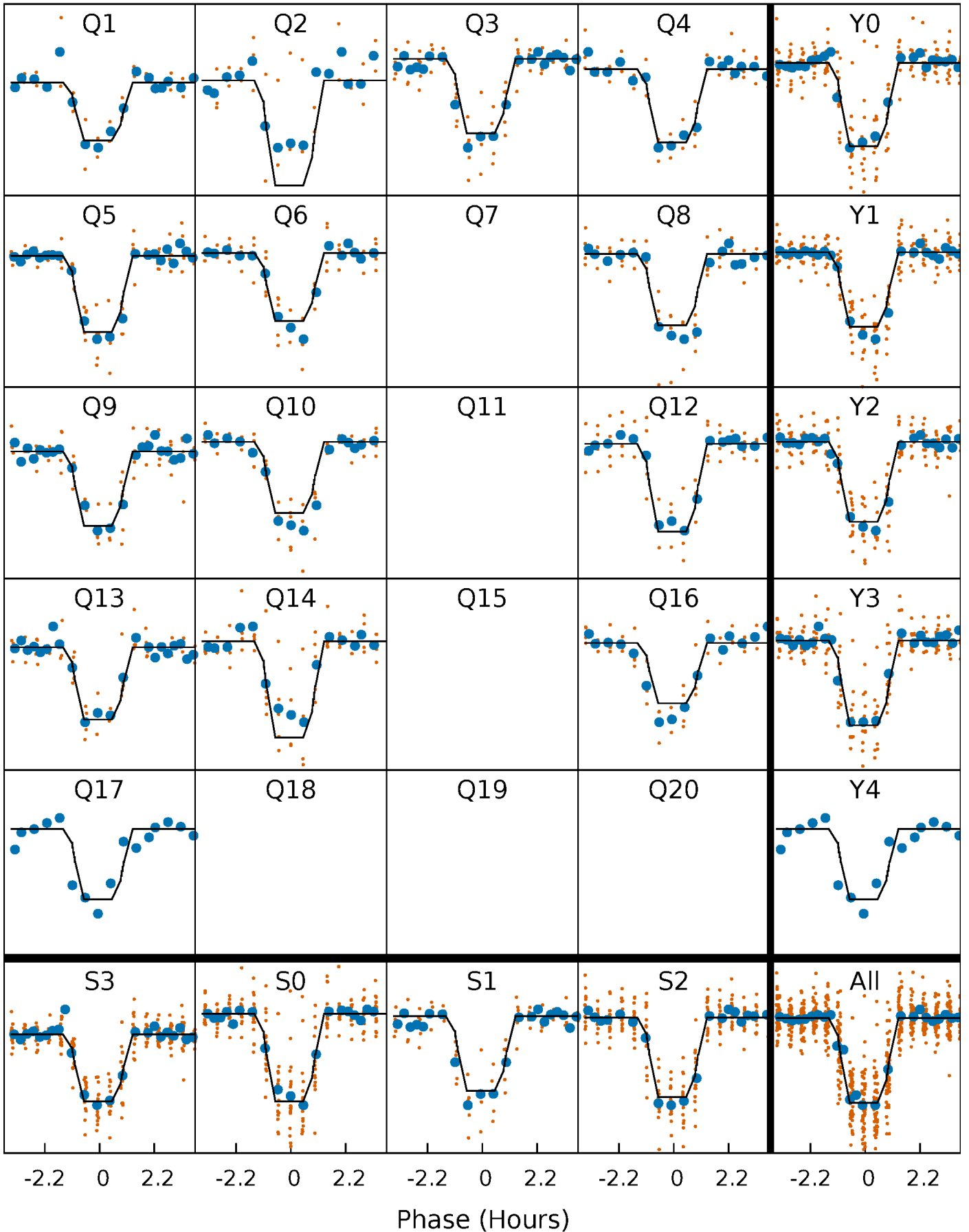
DV Quarter-Phased Transit Curves

TCE 009963524-03 P= 18.369770 Days $T_0=131.864411$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

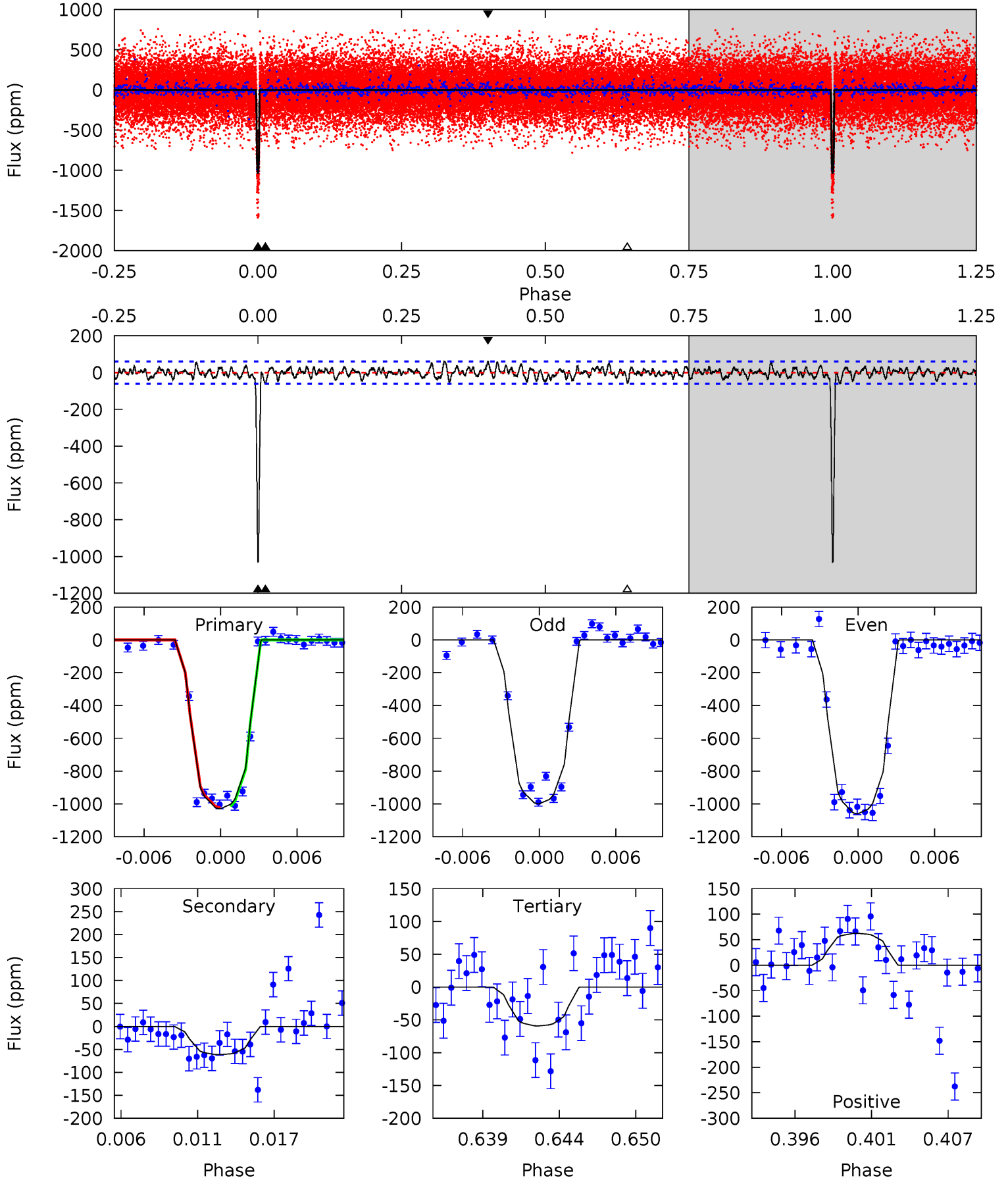
TCE 009963524-03 P= 18.369783 Days $T_0=131.862770$ (BKJD)



DV Model-Shift Uniqueness Test

009963524-03, P = 18.369770 Days, E = 113.494641 Days

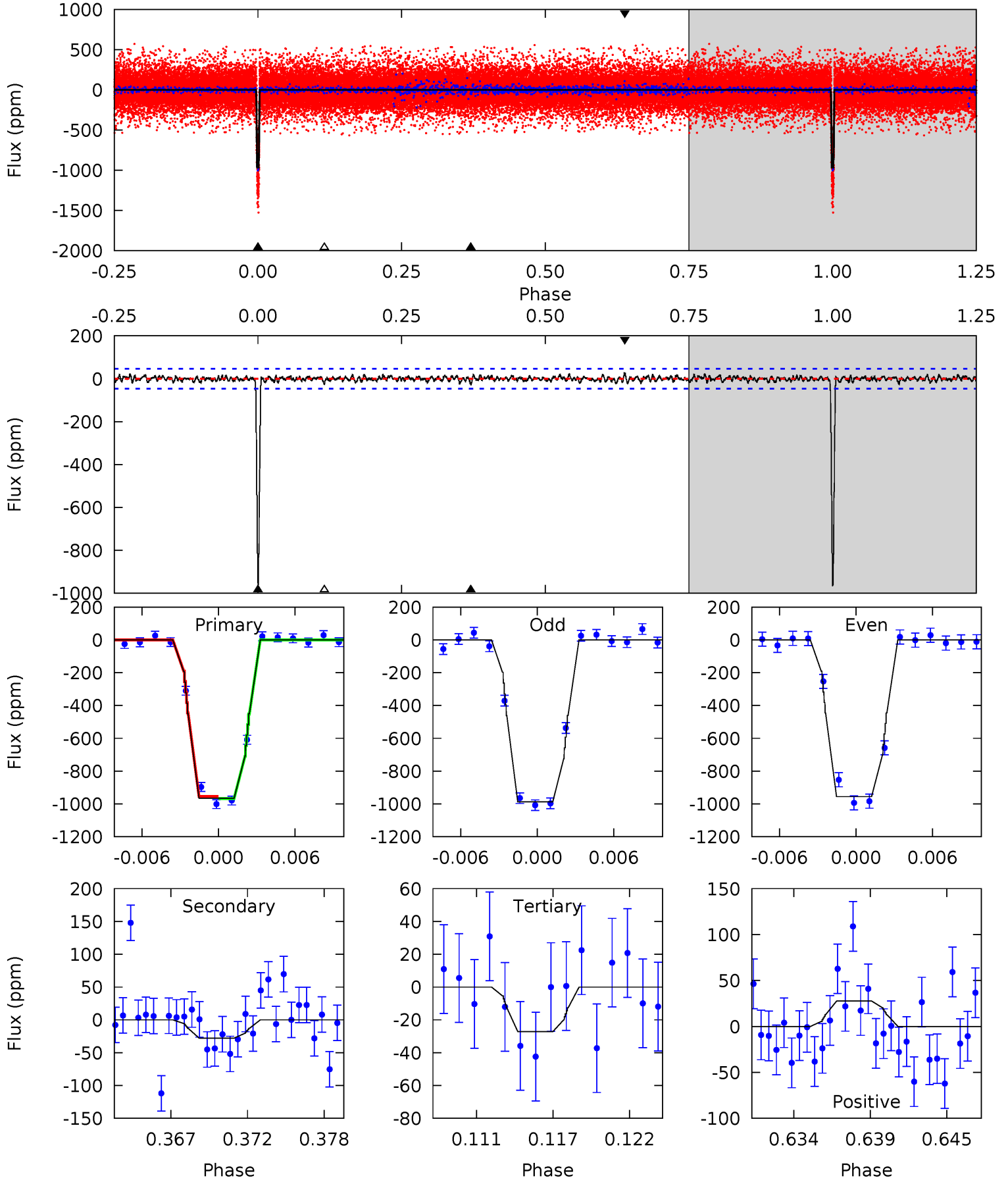
Pri	Sec	Ter	Pos	FA ₁	FA ₂	F _{Red}	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
87.1	5.19	5.01	5.28	5.13	2.77	1.68	82.0	81.8	0.18	-0.09	2.59	1.00	0.06	0.36



Alt Model-Shift Uniqueness Test

009963524-03, P = 18.369783 Days, E = 113.492987 Days

Pri	Sec	Ter	Pos	FA ₁	FA ₂	F _{Red}	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
106.4	3.06	2.99	3.04	5.14	2.77	0.89	103.4	103.3	0.07	0.03	1.78	1.02	0.03	0.74



Stellar Parameters For KIC 009963524

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	5244^{+105}_{-105}	$4.538^{+0.045}_{-0.055}$	$-0.040^{+0.150}_{-0.150}$	$0.810^{+0.060}_{-0.044}$	$0.826^{+0.052}_{-0.043}$	$2.191^{+0.351}_{-0.405}$
	+2%/-2%	+1%/-1%	+375%/-375%	+7%/-5%	+6%/-5%	+16%/-18%
Source	SPE58	SPE58	SPE58	DSEP		

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

Secondary Eclipse Parameters for KIC 009963524-03 / KOI 0720.03

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	A_{obs}
DV	-61 ± 12	$2.76^{+0.68}_{-0.64}$	814^{+23}_{-21}	3194^{+265}_{-209}	72^{+52}_{-27}
Alt.	-28 ± 9	$2.74^{+0.65}_{-0.63}$	815^{+23}_{-19}	2875^{+254}_{-229}	34^{+28}_{-15}

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 $A_{obs} \gg 1.0$

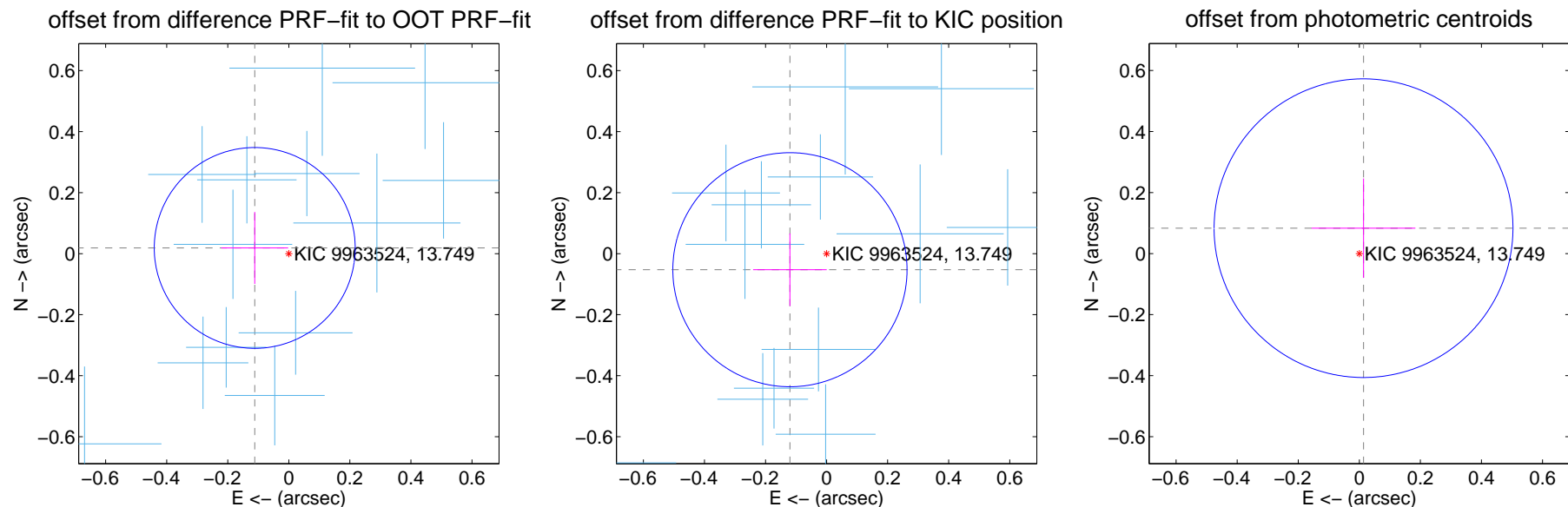
DV Centroid Data

Supplemental centroid analysis for 009963524-03. Kepler magnitude: 13.75. Transit SNR 47.08

There are 14 quarters with good PRF difference image offsets

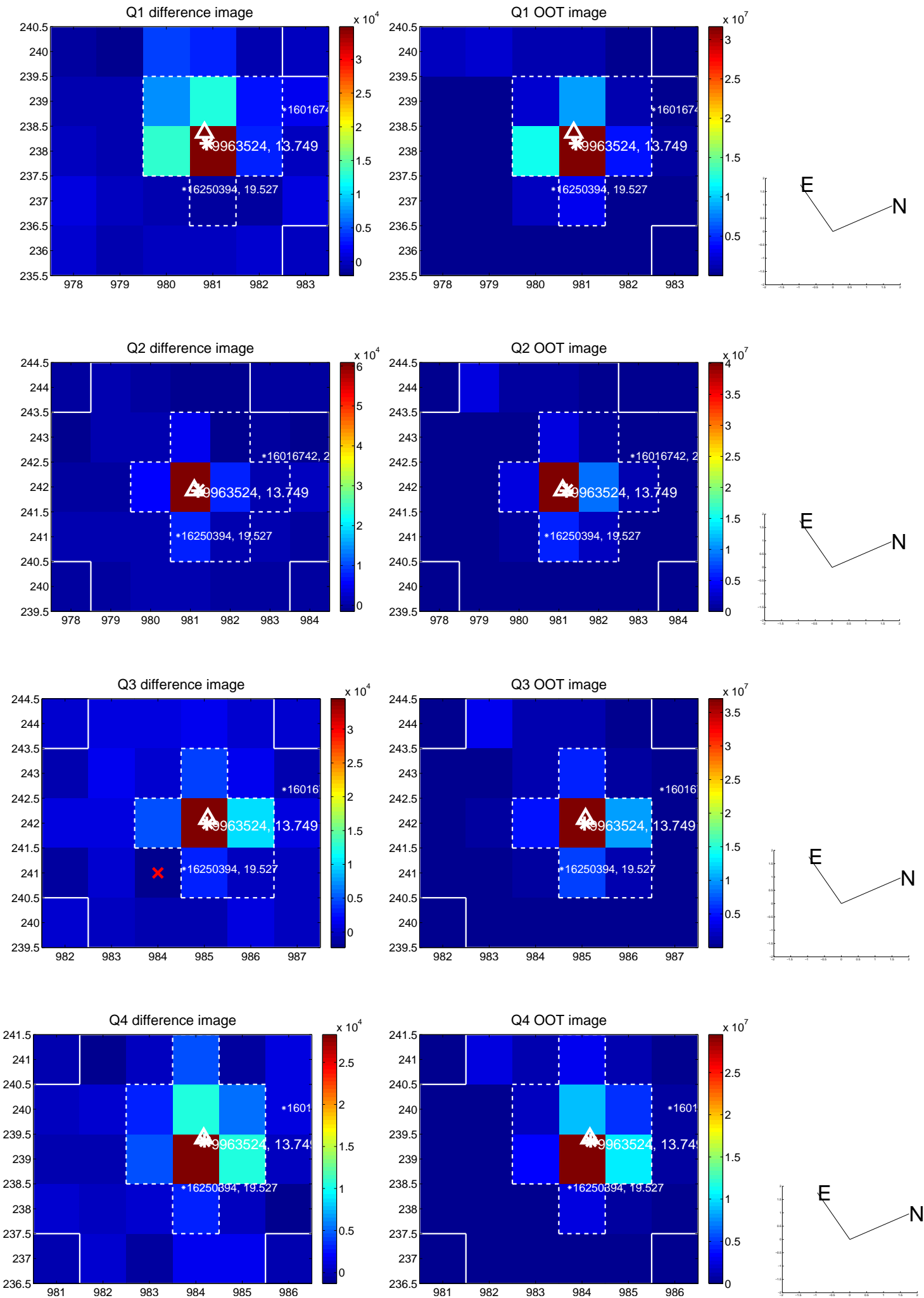
The direct PRF centroid is offset from the target star catalog position by about 0.04 arcsec

	Distance in arcsec	Distance / σ	Δ RA	Δ Dec
PRF-fit source offset from OOT	0.113 ± 0.110	1.03	0.112 ± 0.109	0.019 ± 0.118
PRF-fit source offset from KIC position	0.131 ± 0.128	1.02	0.120 ± 0.120	-0.053 ± 0.119
photometric centroid source offset	0.08 ± 0.16	0.52	-0.01 ± 0.17	0.08 ± 0.16

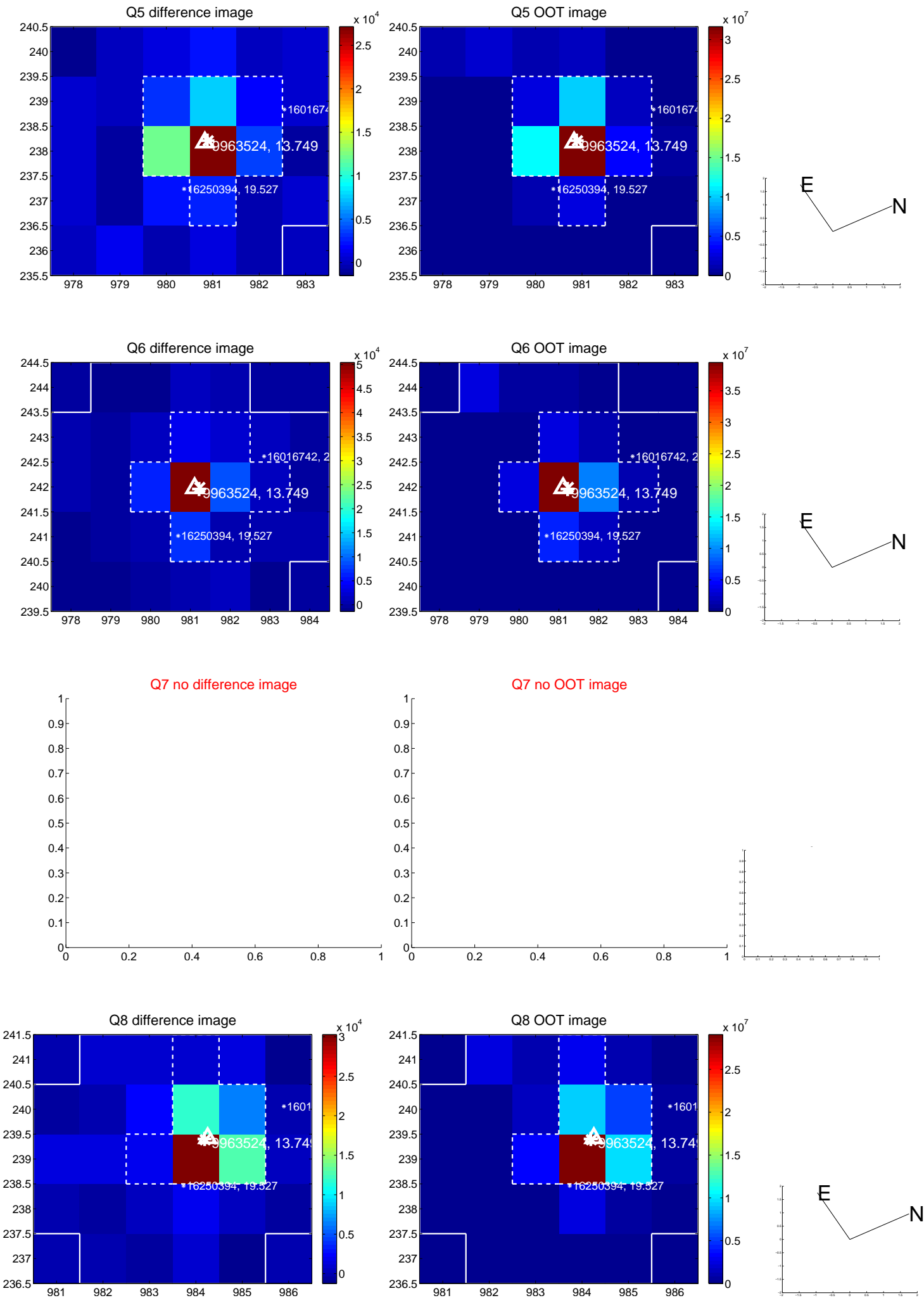


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

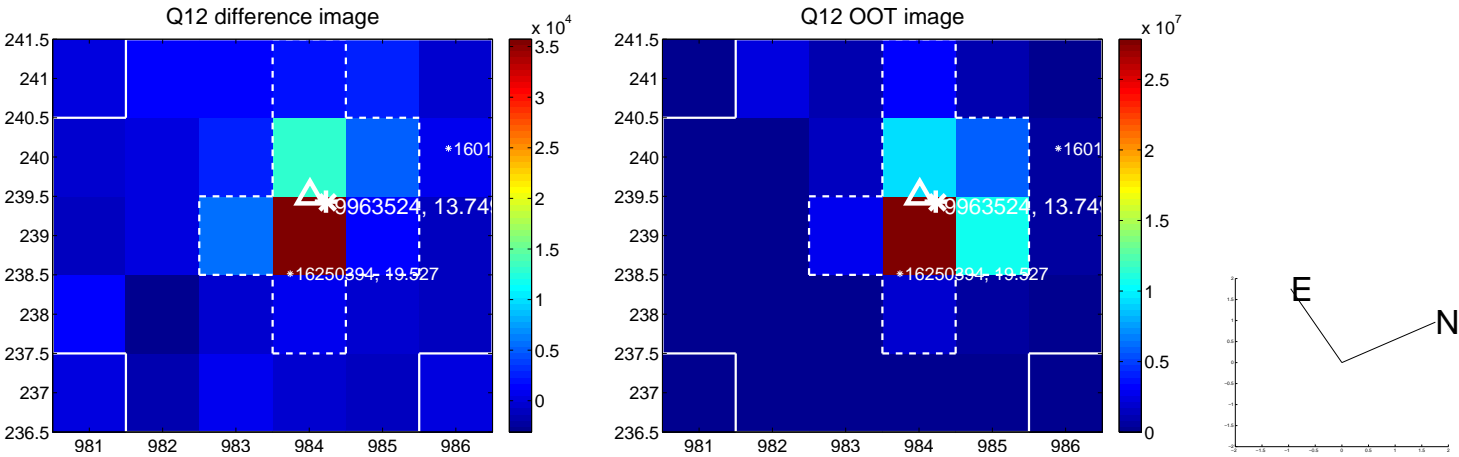
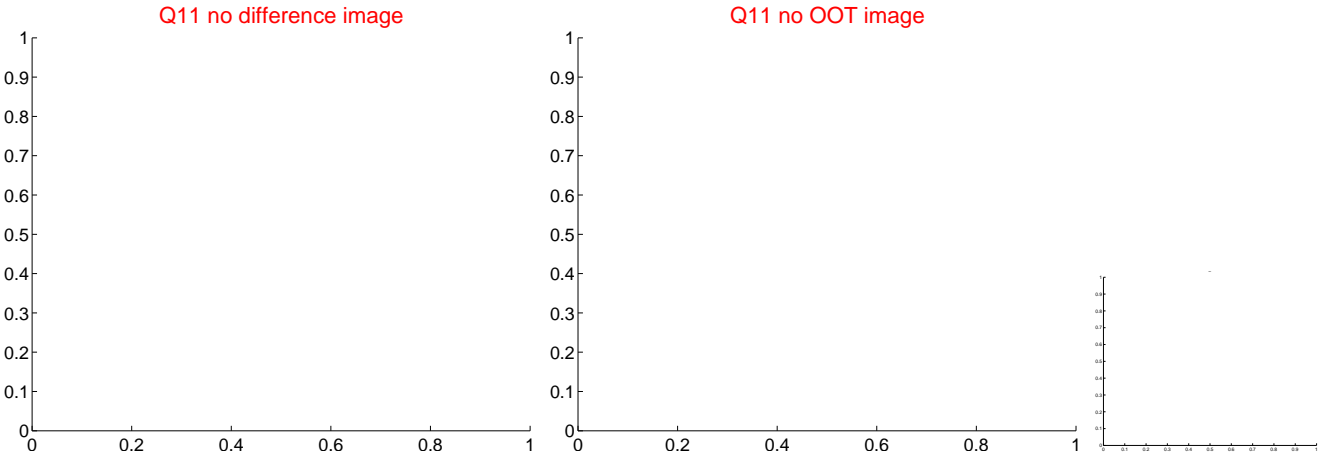
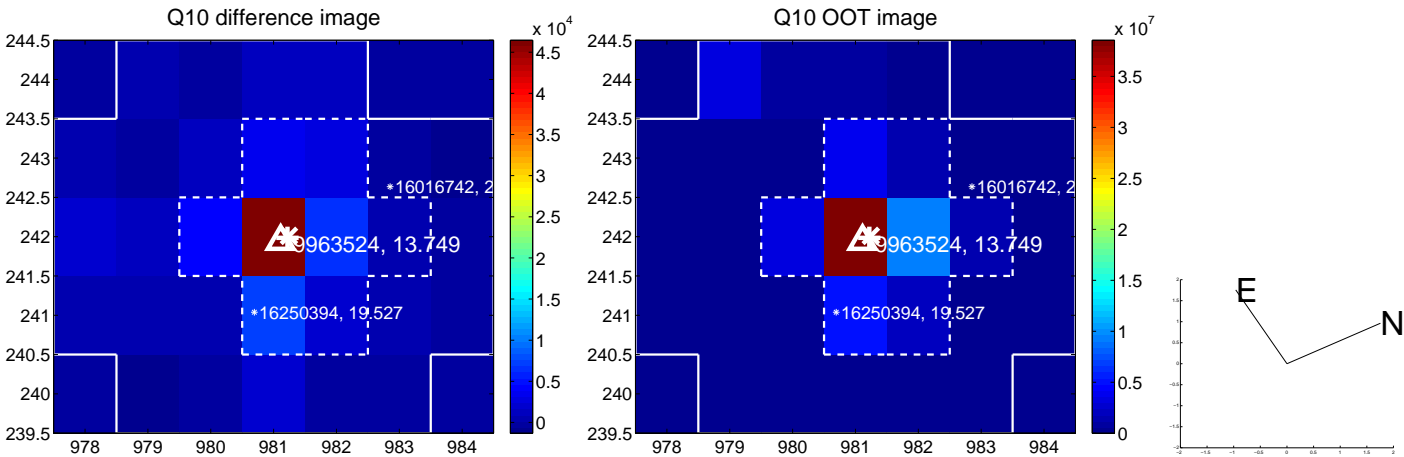
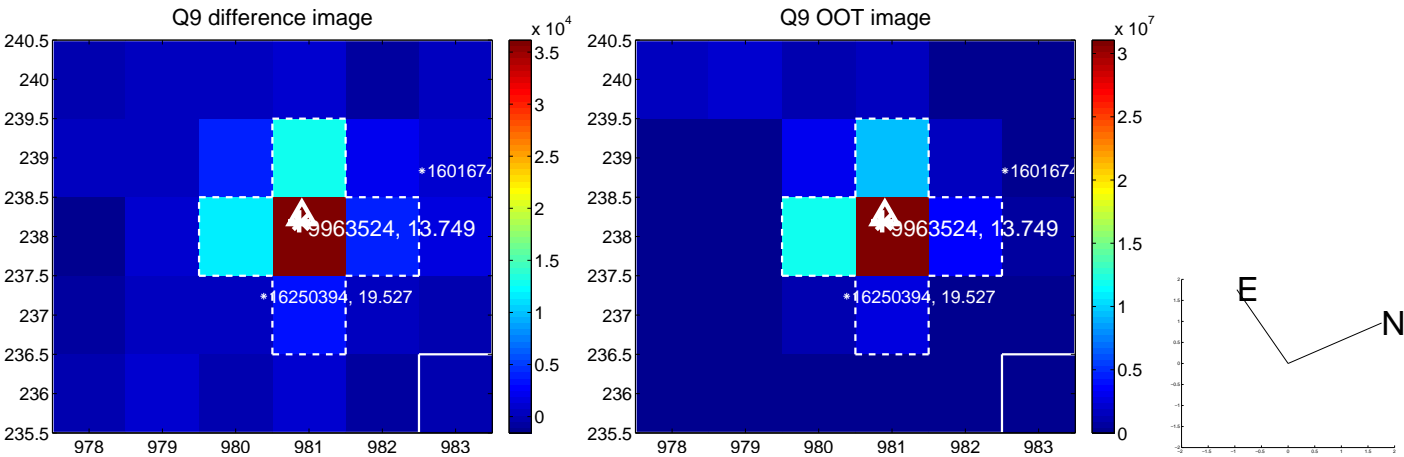
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



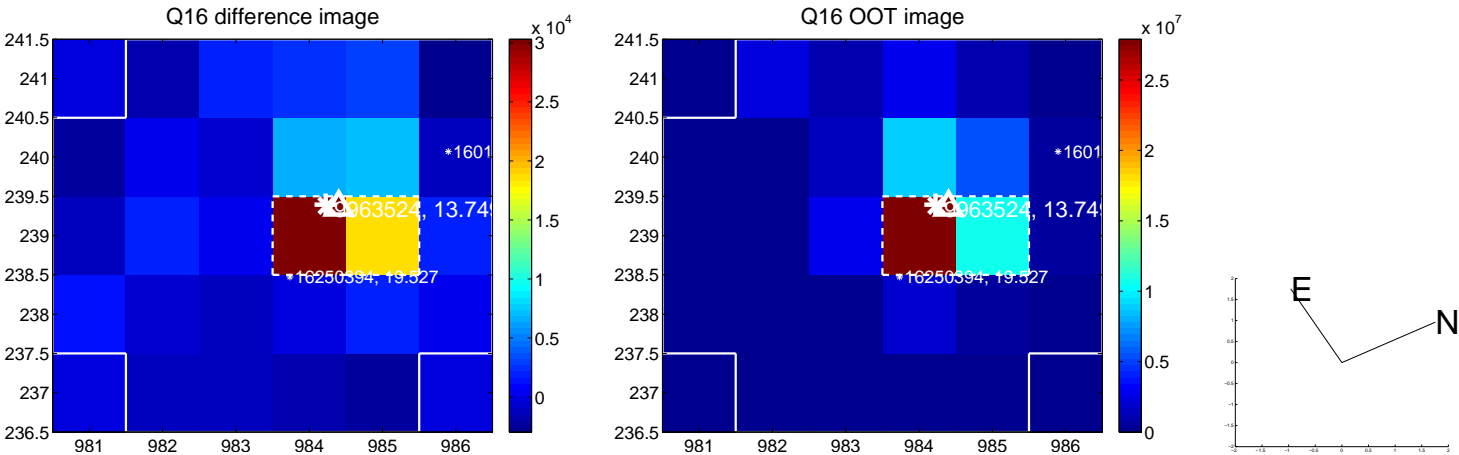
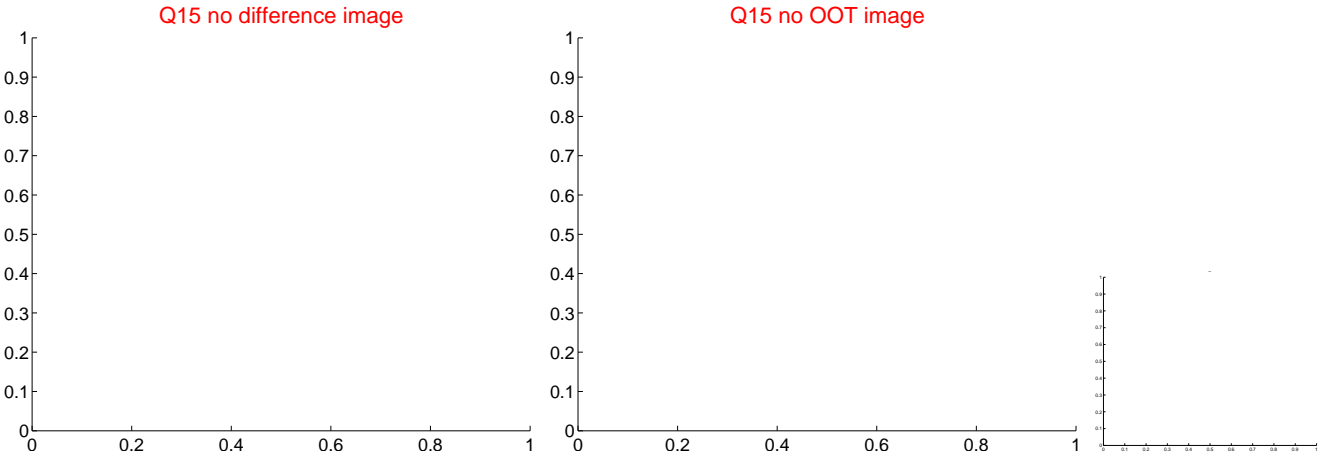
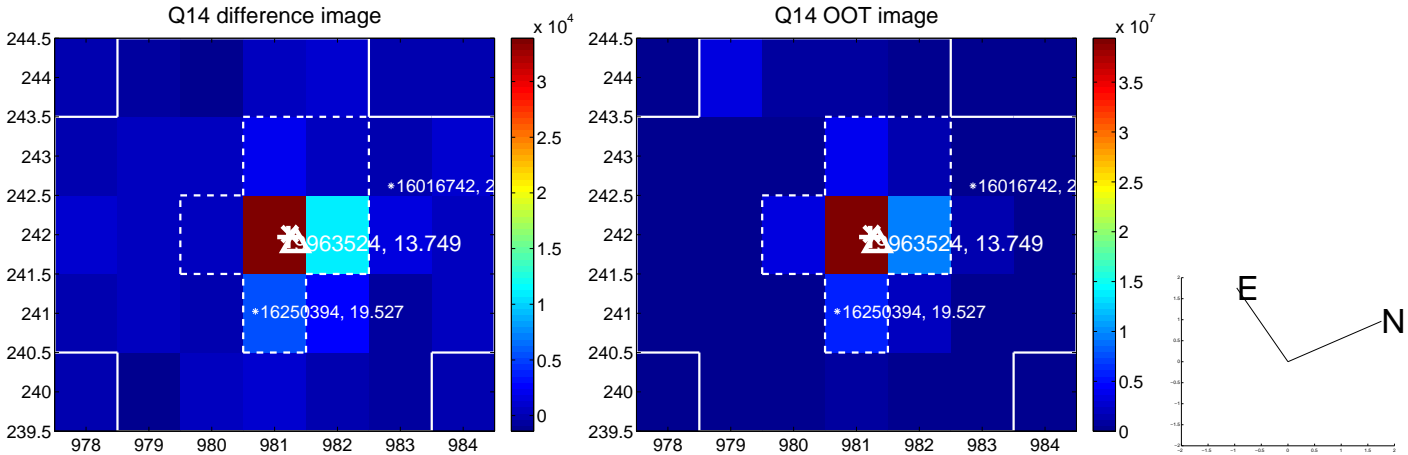
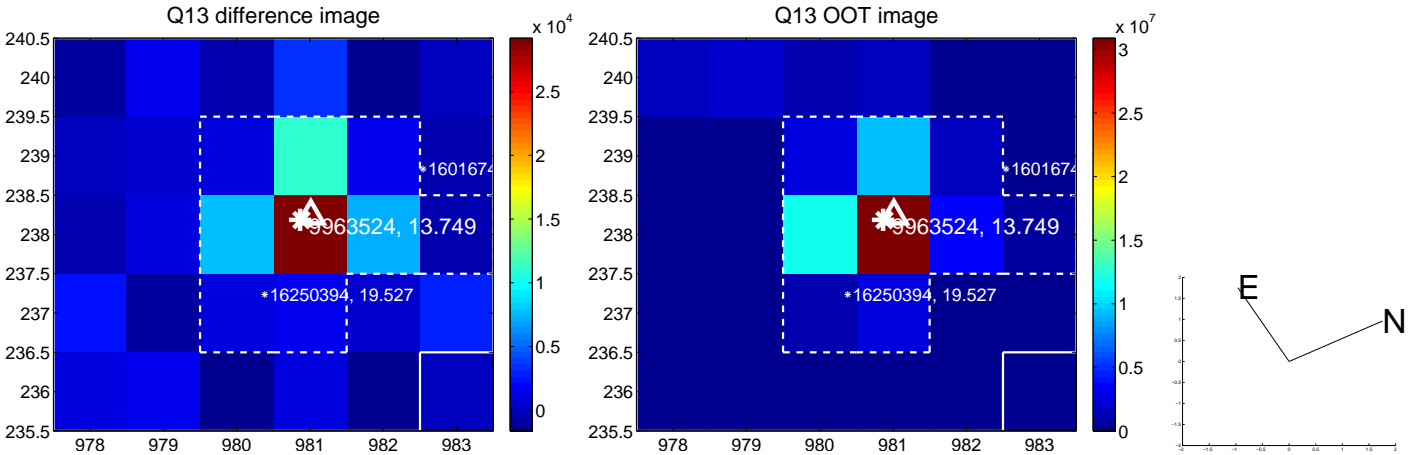
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



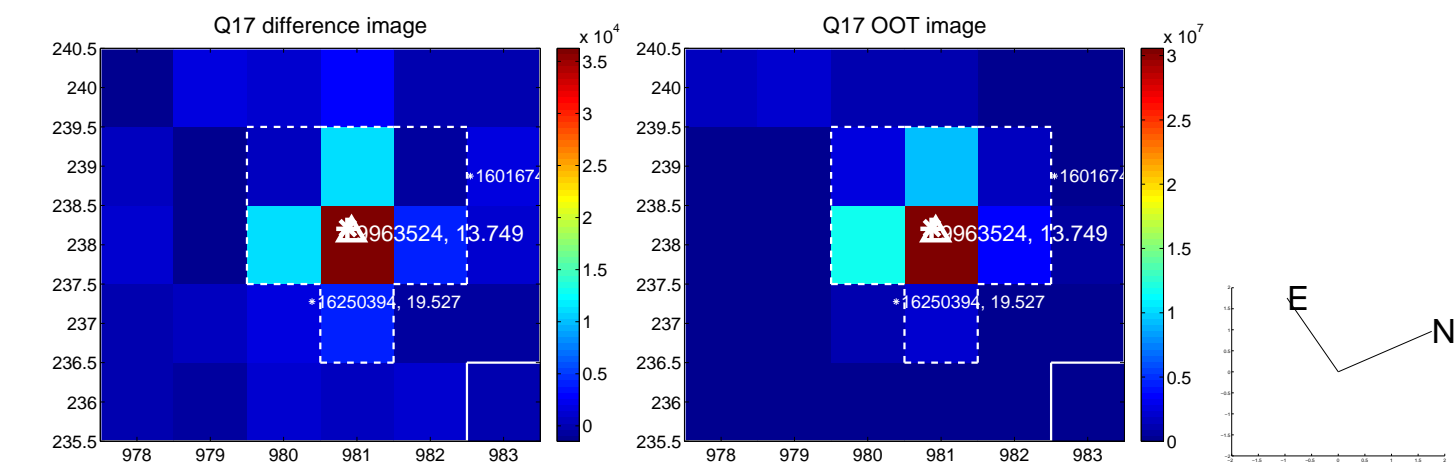
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



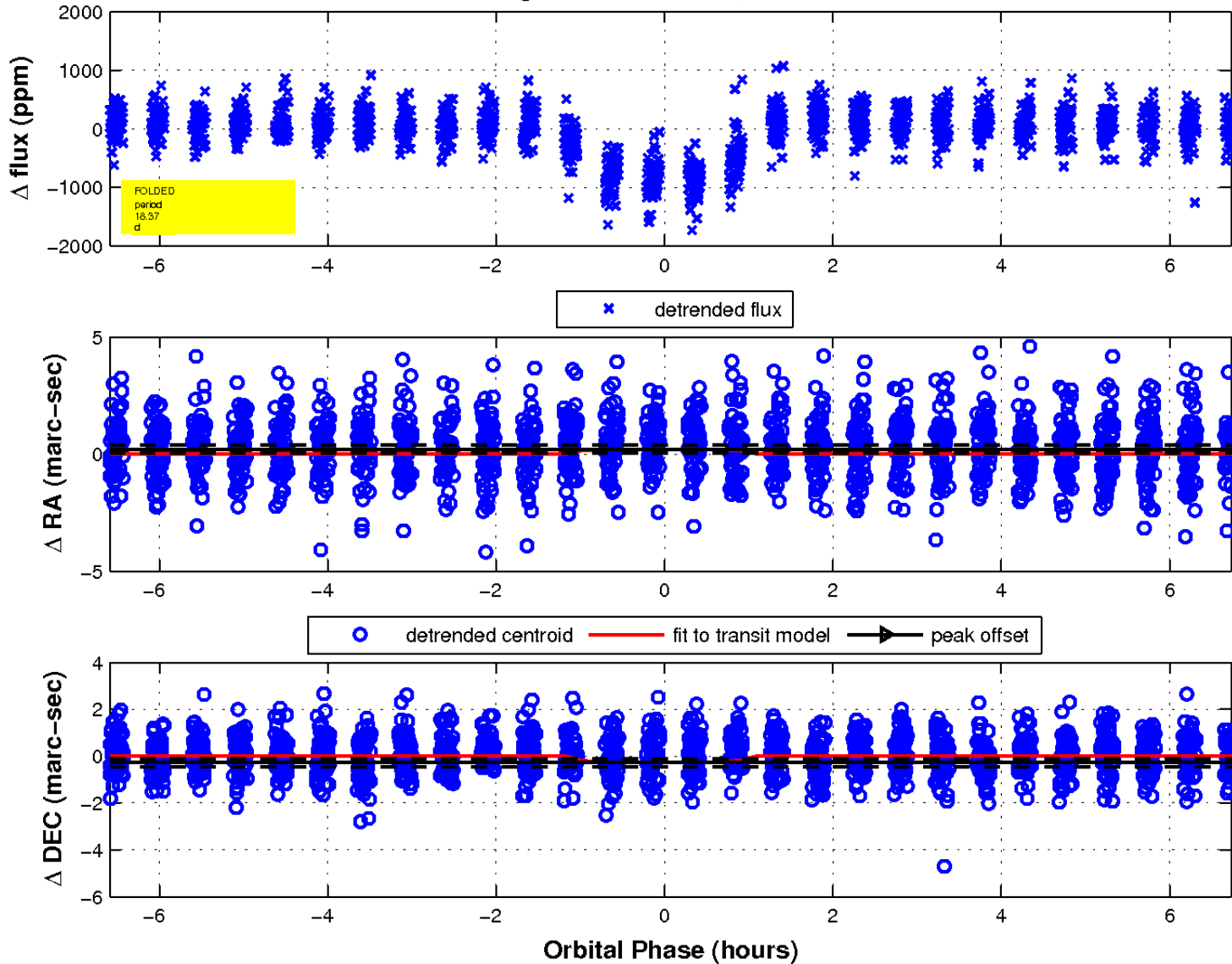
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



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

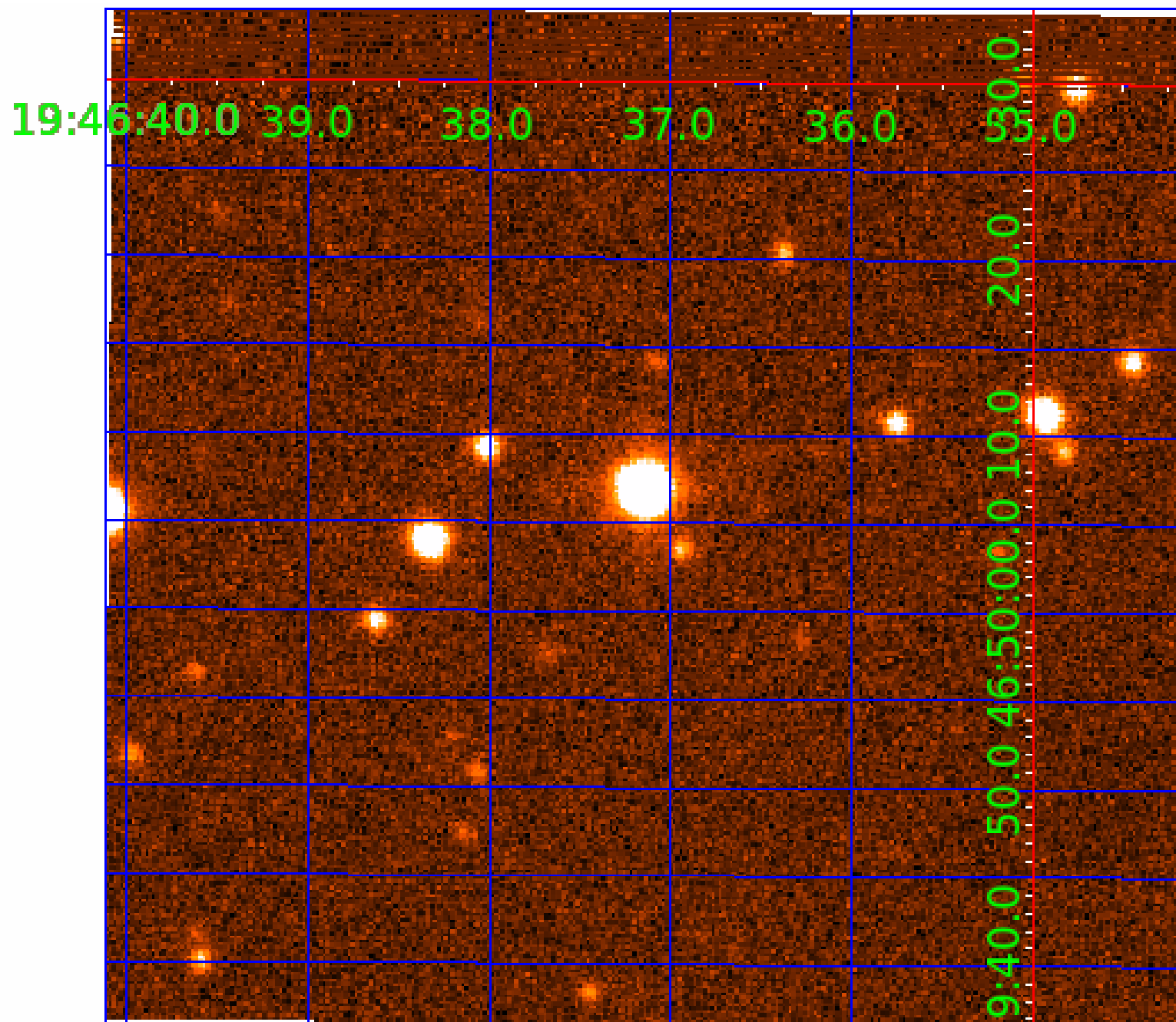


fluxWeightedCentroids, Planet 3 of 4



UKIRT Image

Declination



KIC 009963524

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})
009963524-01	OBS	0720.01	5.690581	134.215842	1359.3	2.684	116.5	116.3	0.81	5244	3.40	129.72
009963524-02	OBS	0720.02	10.041578	137.084642	1110.1	2.699	70.6	70.3	0.81	5244	3.02	60.83
009963524-03	OBS	0720.03	18.369770	131.864411	1025.7	2.245	47.6	47.1	0.81	5244	2.77	27.19
009963524-04	OBS	0720.04	2.795897	132.729403	396.1	2.157	42.5	48.7	0.81	5244	1.85	334.58

Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
009963524-01	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-02	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-03	OBS	PC	1.00	0	0	0	0	NO_COMMENT
009963524-04	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 for comment definitions.

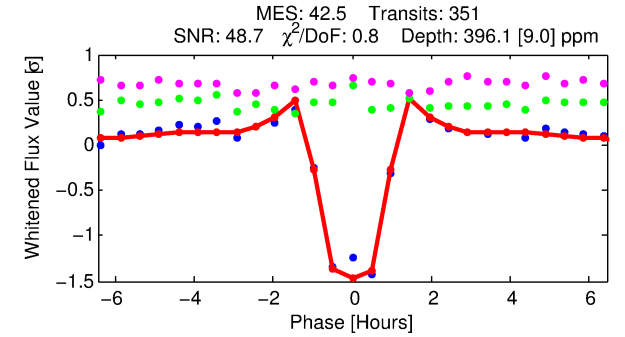
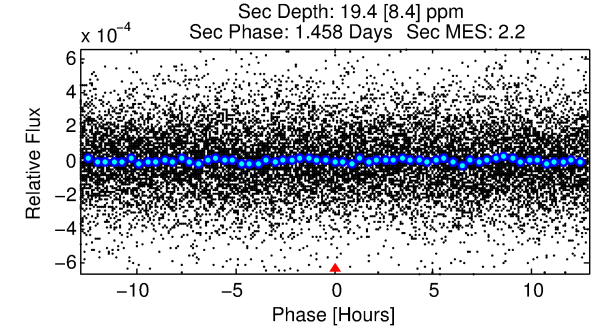
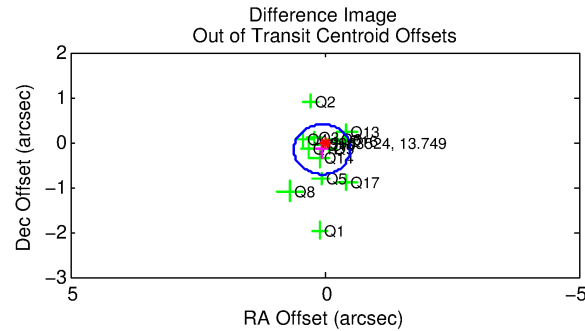
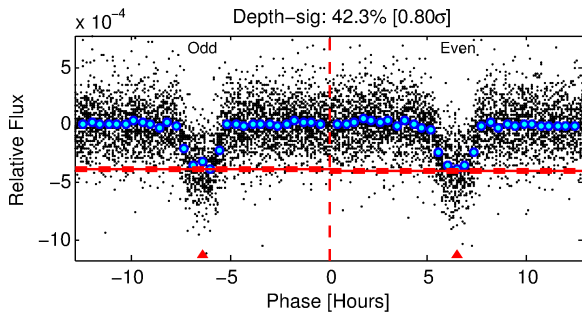
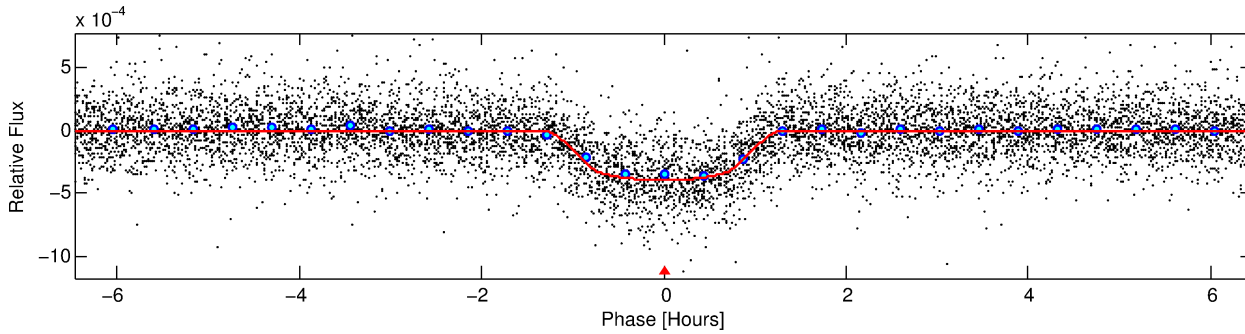
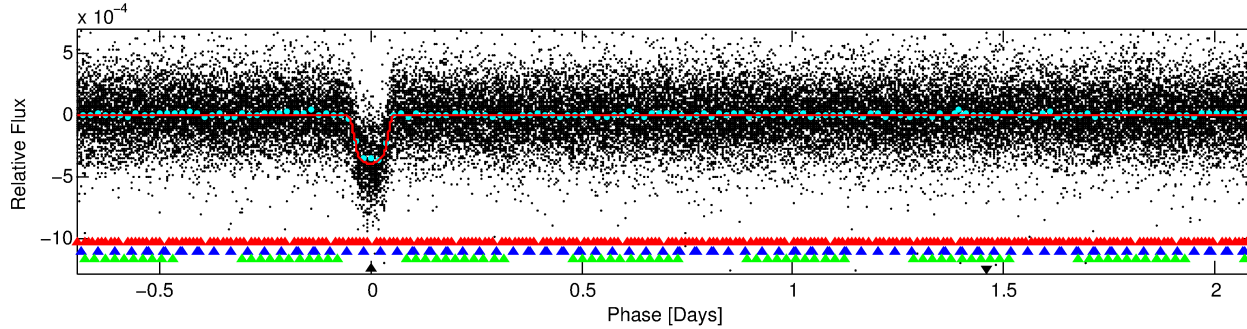
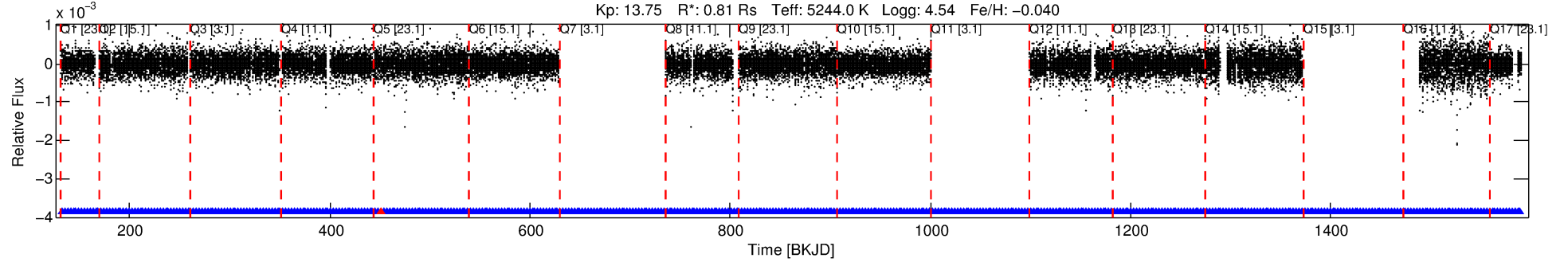
Ephemeris Match Information For 009963524-04

No Significant Match Found

DV One-Page Summary

KIC: 9963524 Candidate: 4 of 4 Period: 2.796 d
KOI: K00720.04 Name: Kepler-221b Corr: 0.972

Kp: 13.75 R*: 0.81 Rs Teff: 5244.0 K Logg: 4.54 Fe/H: -0.040



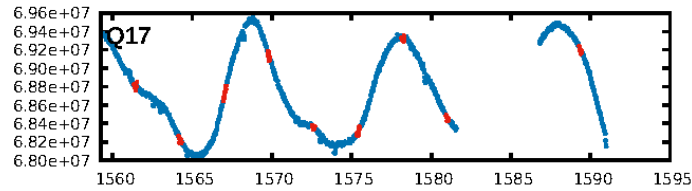
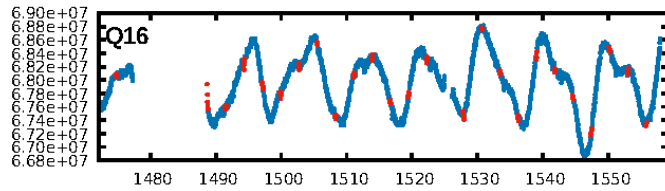
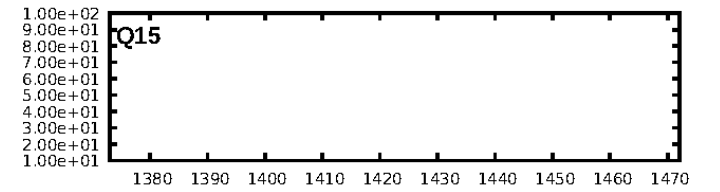
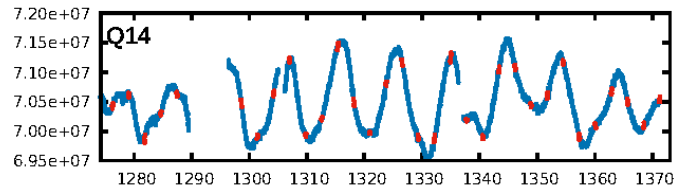
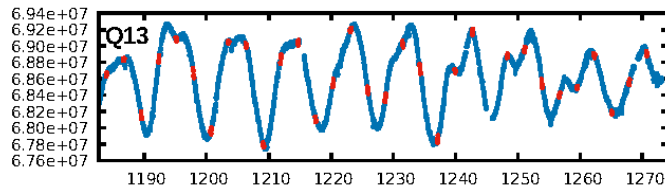
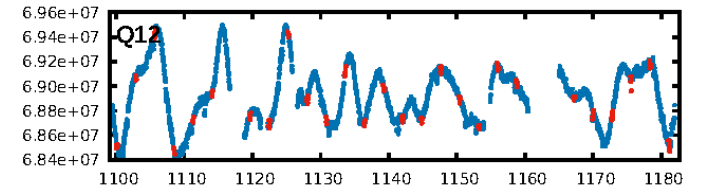
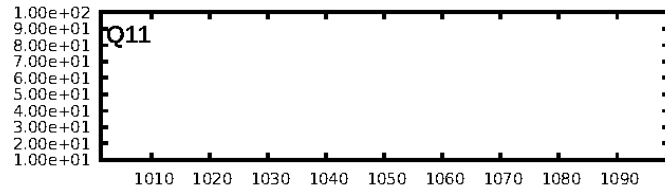
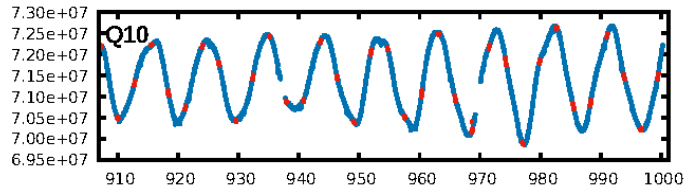
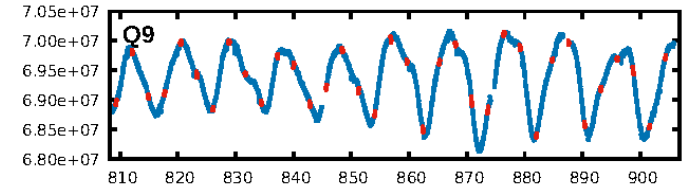
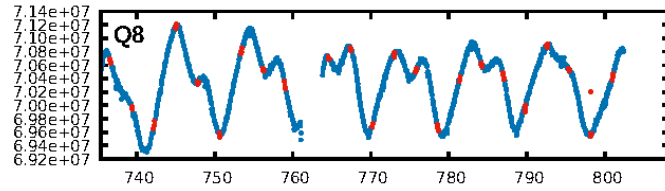
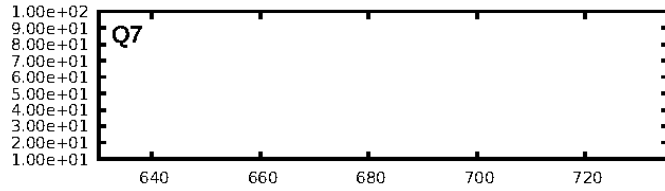
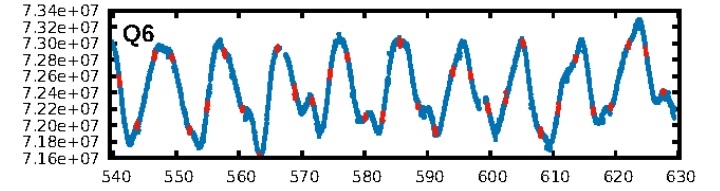
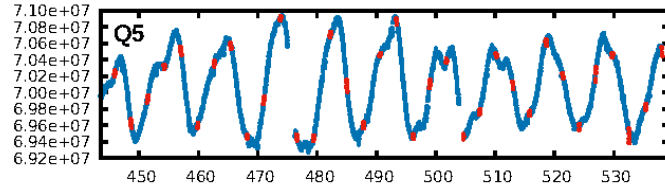
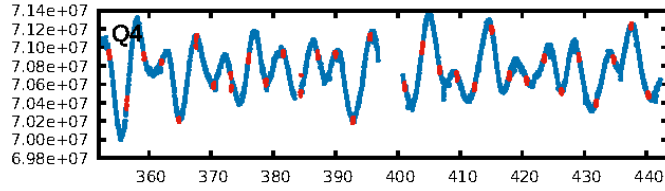
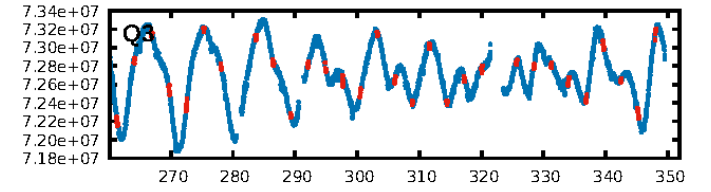
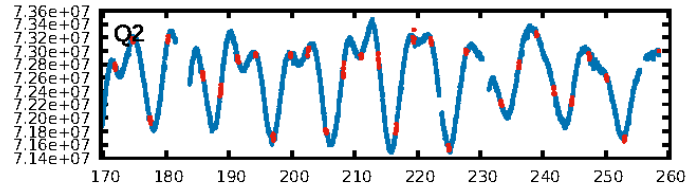
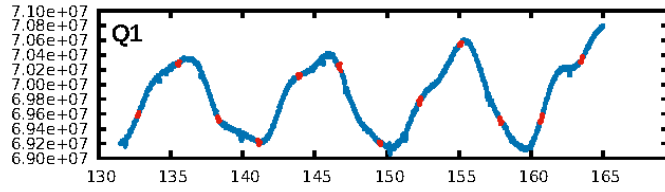
DV Fit Results:

Period = 2.79590 [0.00000] d
Epoch = 132.7294 [0.0005] BKJD
Rp/R* = 0.0210 [0.0033]
a/R* = 5.76 [3.41]
b = 0.84 [0.21]
Seff = 334.59 [42.30]
Teq = 1091 [34] K
Rp = 1.86 [0.32] Re
a = 0.0365 [0.0024] AU
Ag = 4.11 [2.22] [1.40σ]
Teffp = 2401 [322] K [4.04σ]

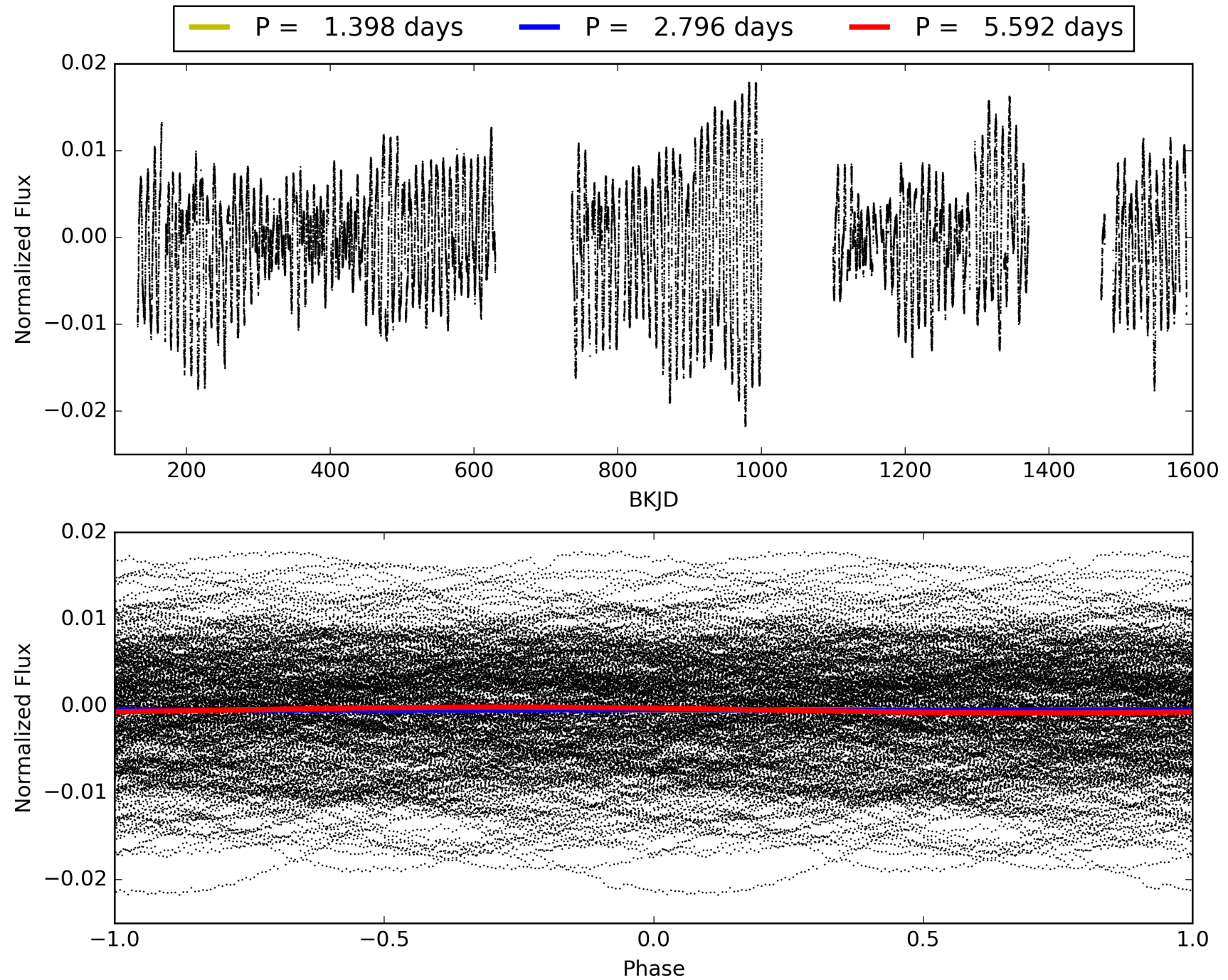
DV Diagnostic Results:

ShortPeriod-sig: N/A
LongPeriod-sig: 100.0% [20.18σ]
ModelChiSquare2-sig: N/A
ModelChiSquareGof-sig: N/A
Bootstrap-pfa: 0.00e+00
RollingBand-fgt: 1.00 [329/330]
GhostDiagnostic-chr: 2.805
Centroid-sig: 0.0%
Centroid-so: 0.540 arcsec [3.14σ]
OotOffset-rm: 0.167 arcsec [0.91σ]
KicOffset-rm: 0.252 arcsec [1.30σ]
OotOffset-st: 4/1/4/5 [14]
KicOffset-st: 4/1/4/5 [14]
DiffImageQuality-fgm: 1.00 [14/14]
DiffImageOverlap-fno: 1.00 [14/14]

TCE 009963524-04, PDC Light Curves

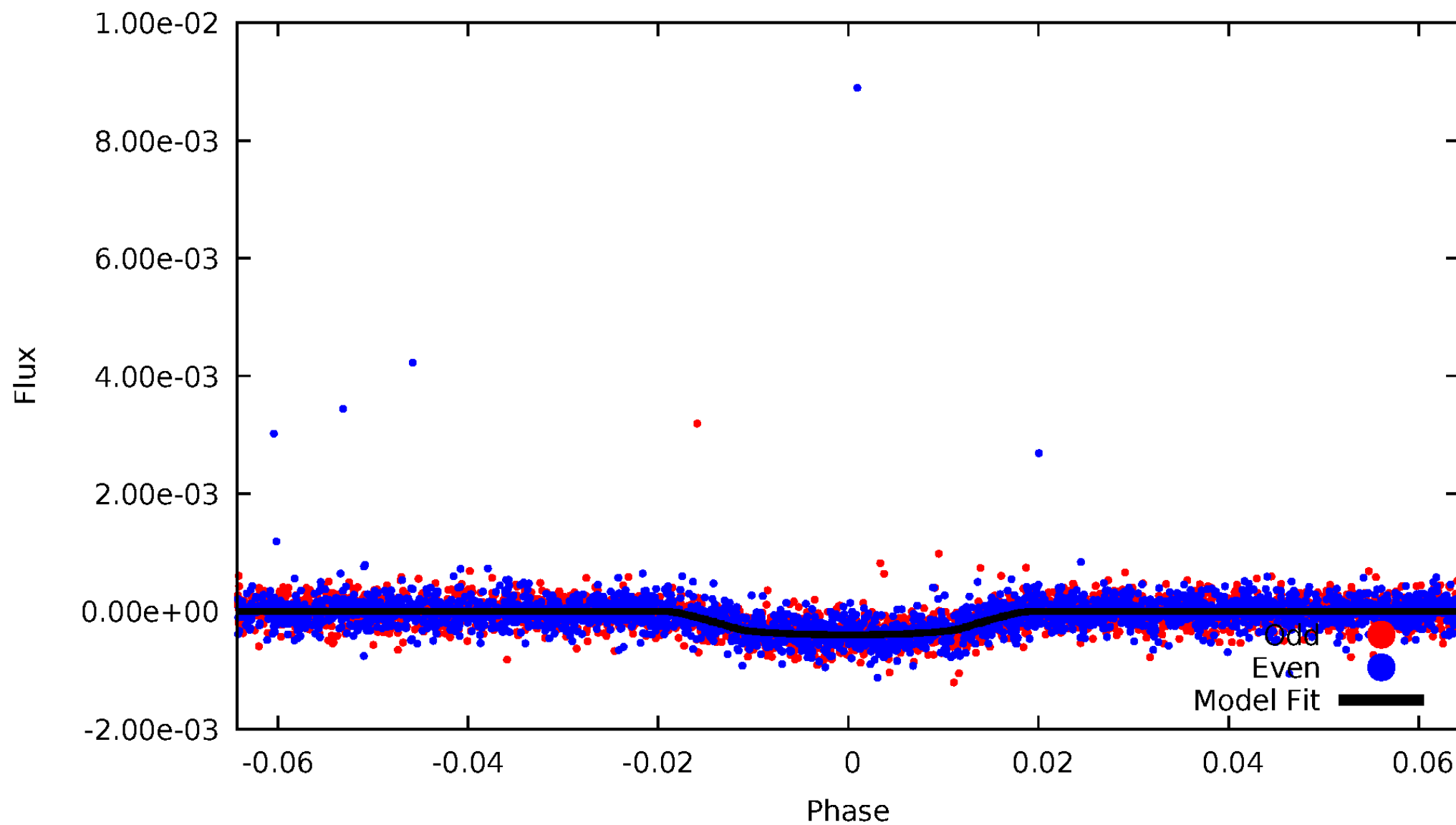


TCE 009963524-04



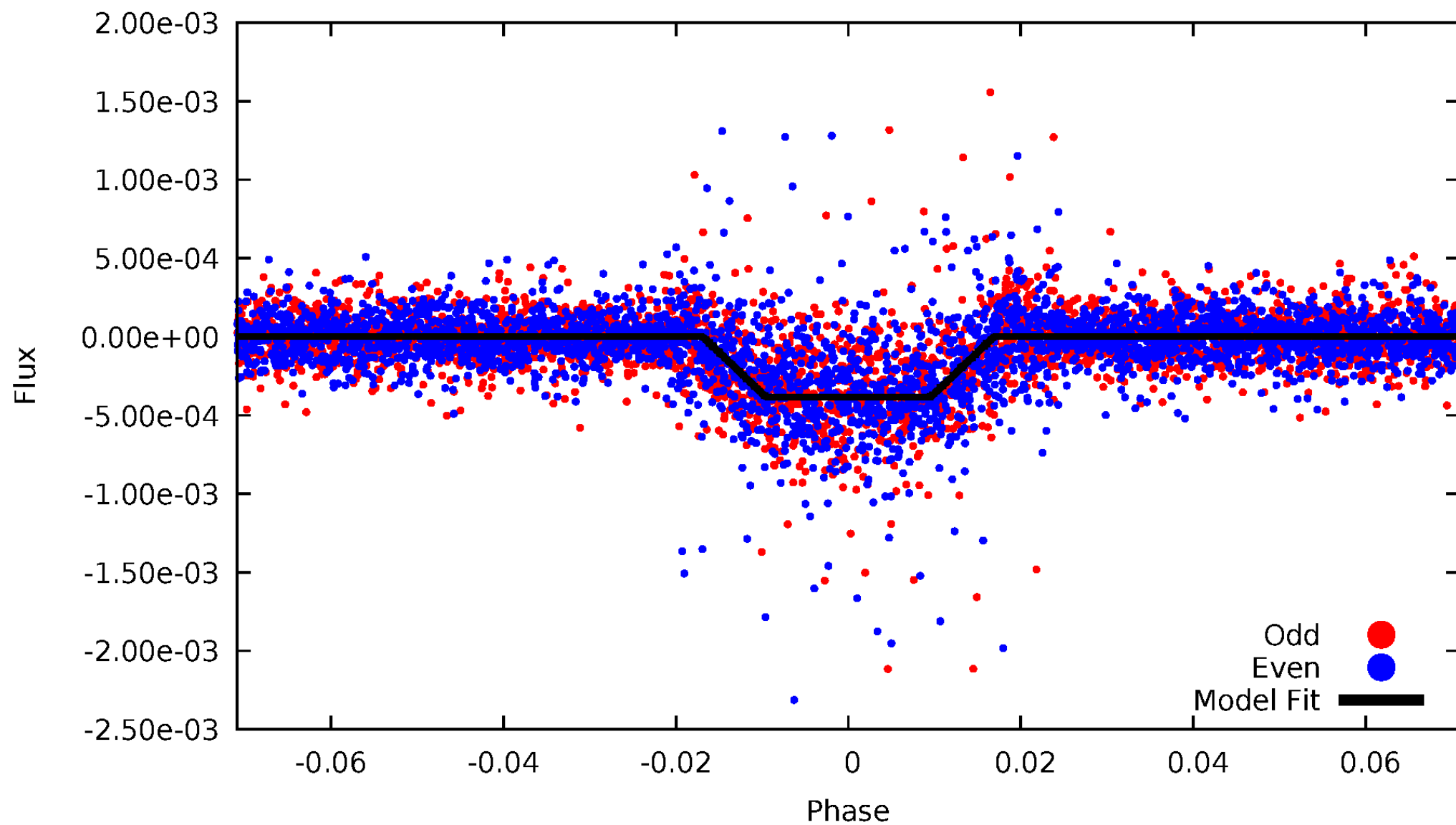
DV Odd/Even

TCE 009963524-04



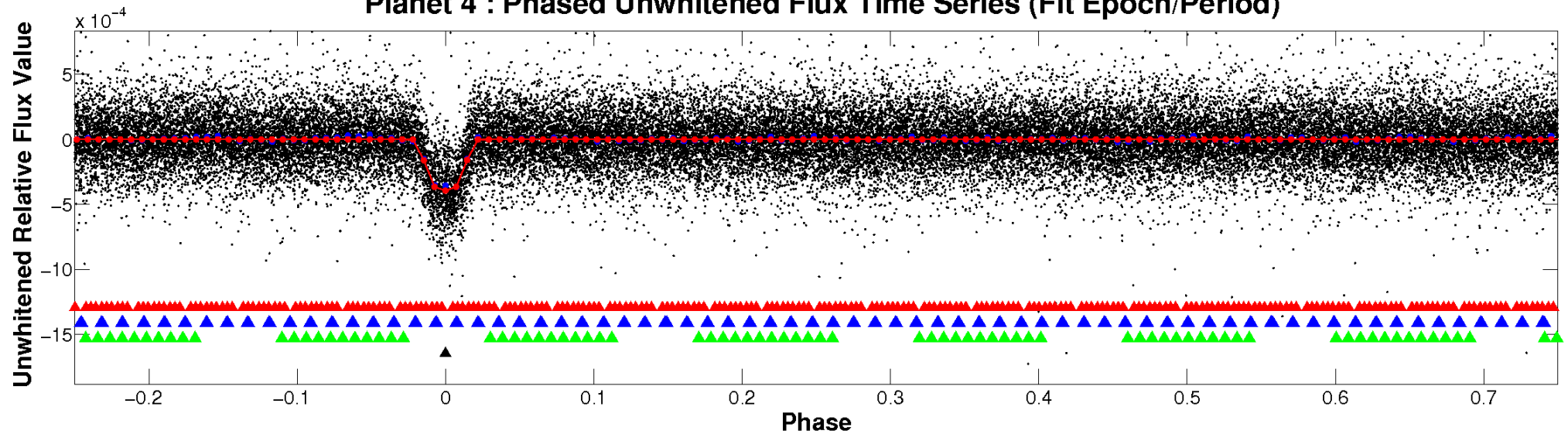
ALT Odd/Even

TCE 009963524-04

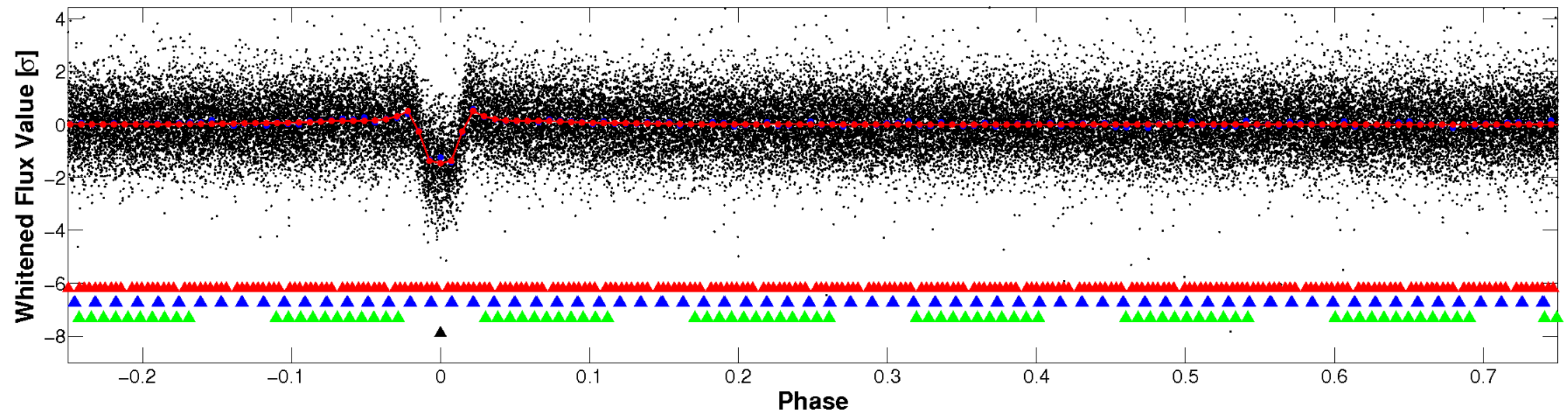


Non-Whitened Vs. Whitened Light Curve

Planet 4 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

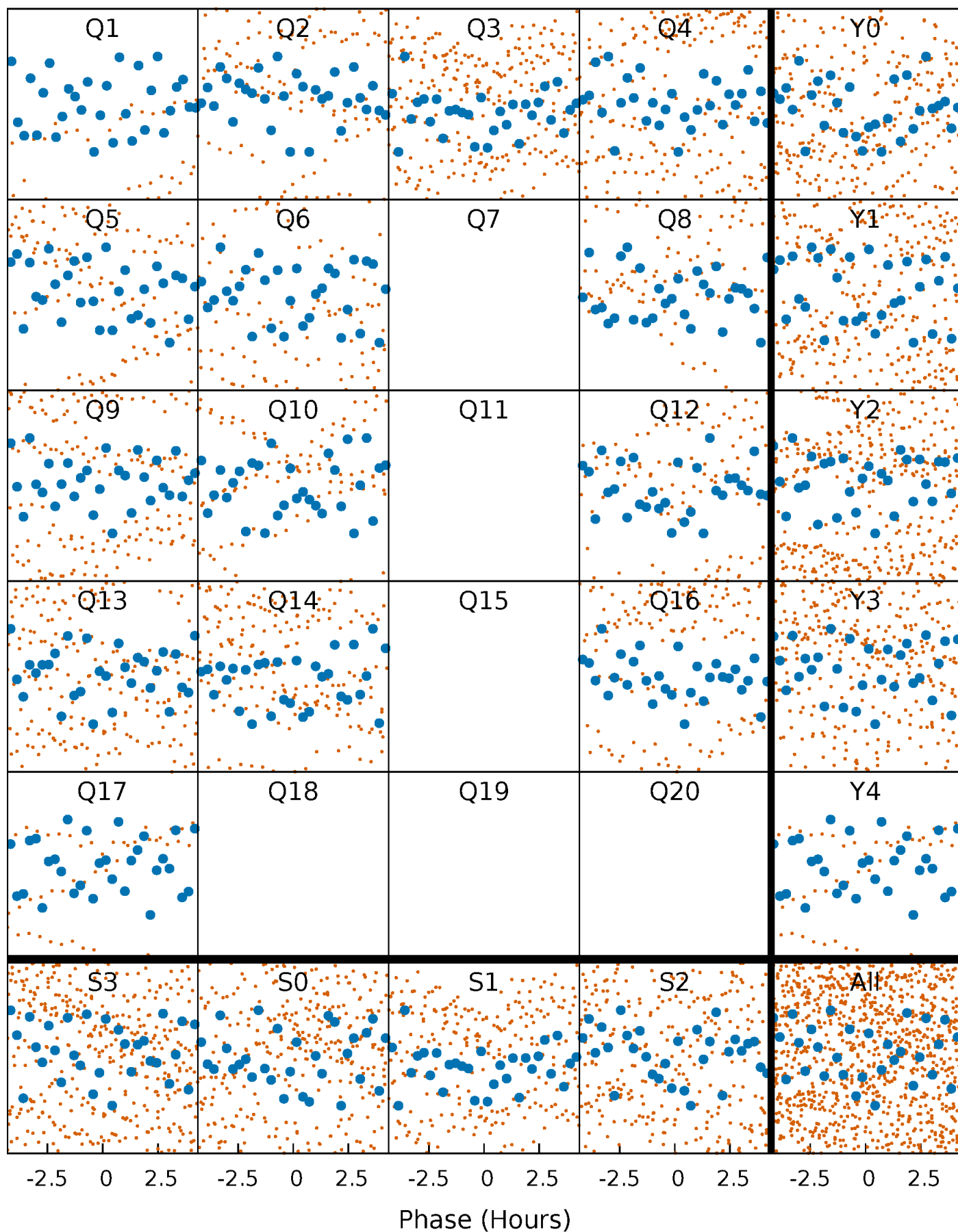


Planet 4 : Phased Whitened Flux Time Series (Fit Epoch/Period)



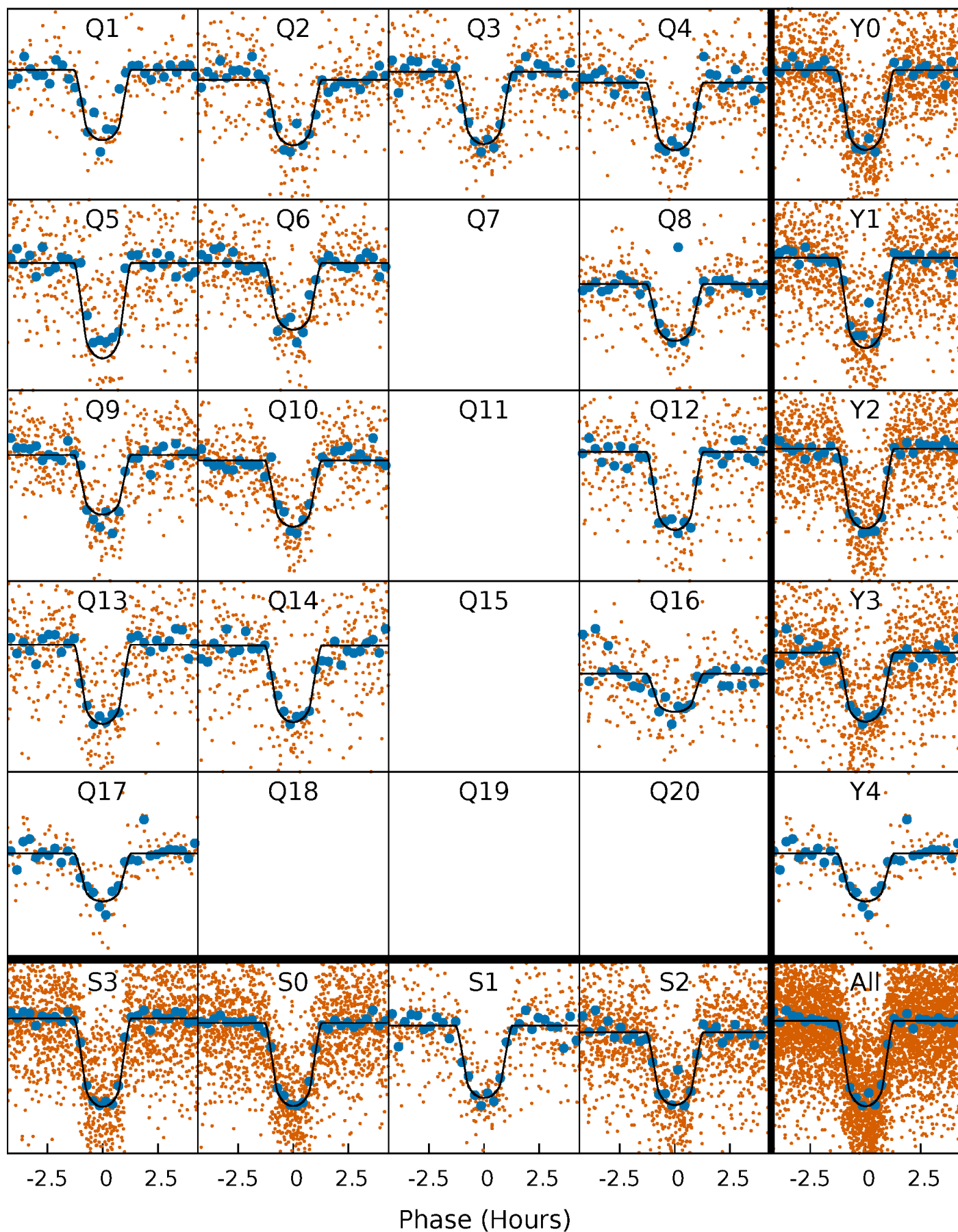
PDC Quarter-Phased Transit Curves

TCE 009963524-04 P= 2.795897 Days $T_0=132.729403$ (BKJD)



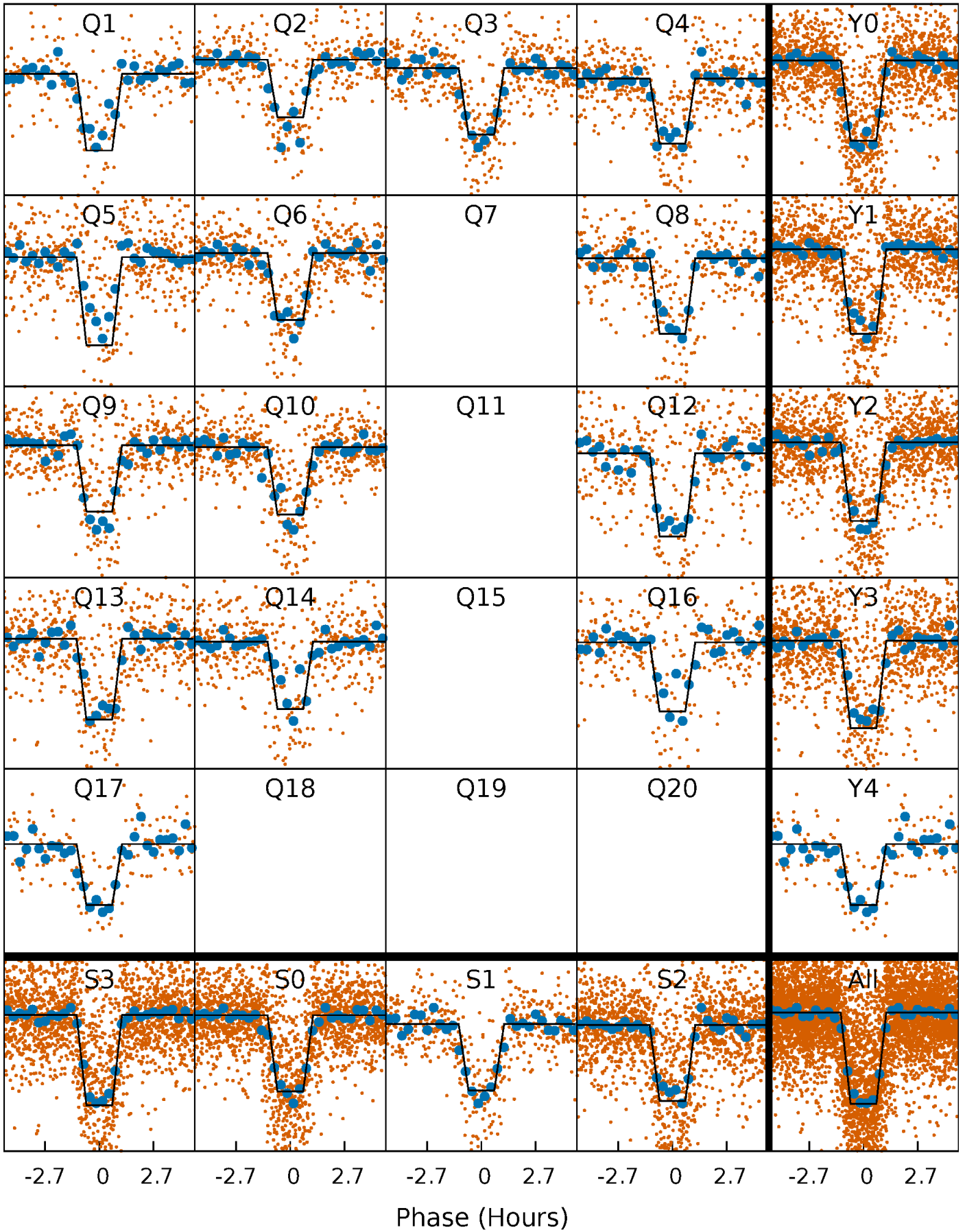
DV Quarter-Phased Transit Curves

TCE 009963524-04 P= 2.795897 Days $T_0=132.729403$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

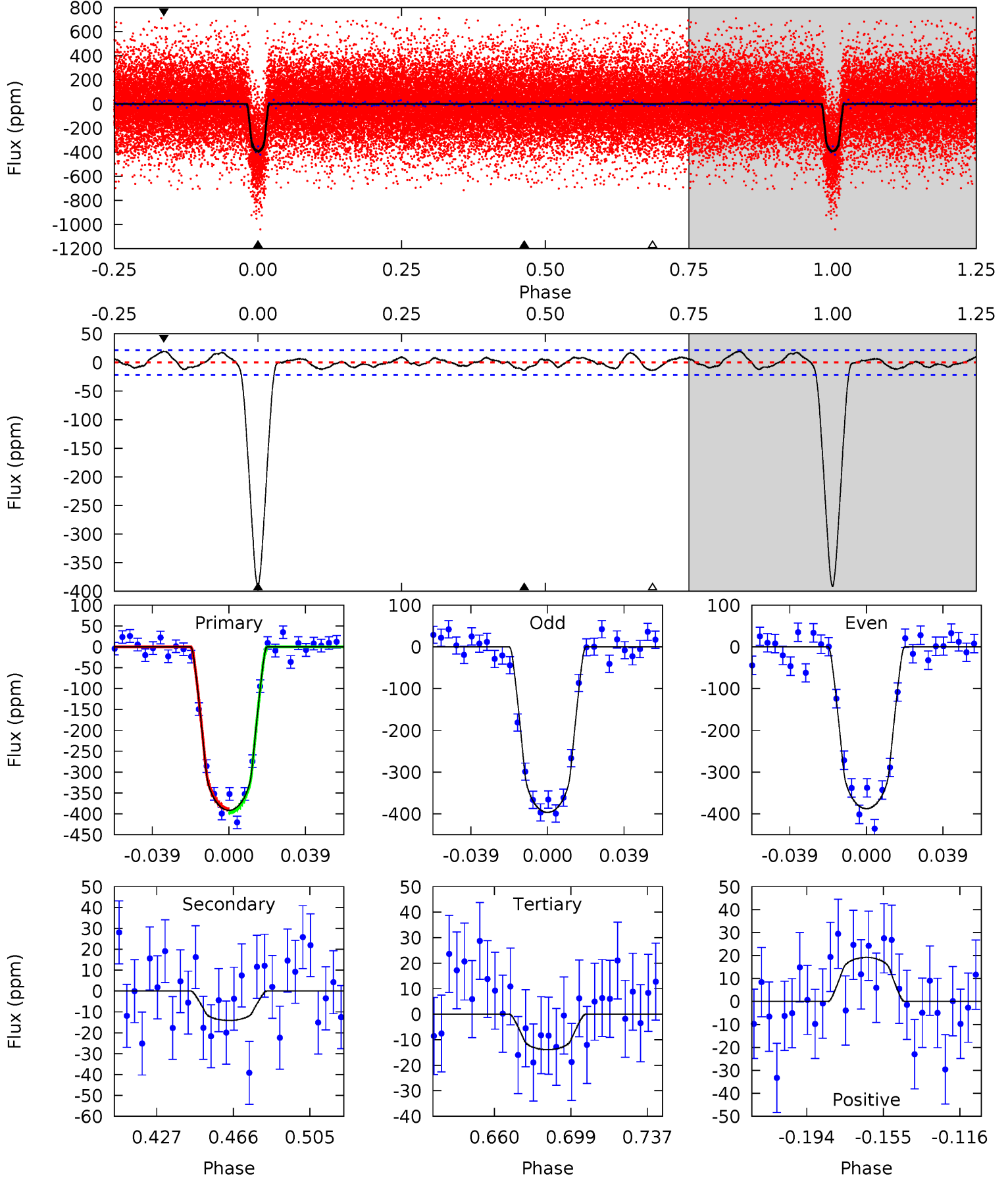
TCE 009963524-04 P= 2.795886 Days $T_0=132.731592$ (BKJD)



DV Model-Shift Uniqueness Test

009963524-04, P = 2.795897 Days, E = 129.933506 Days

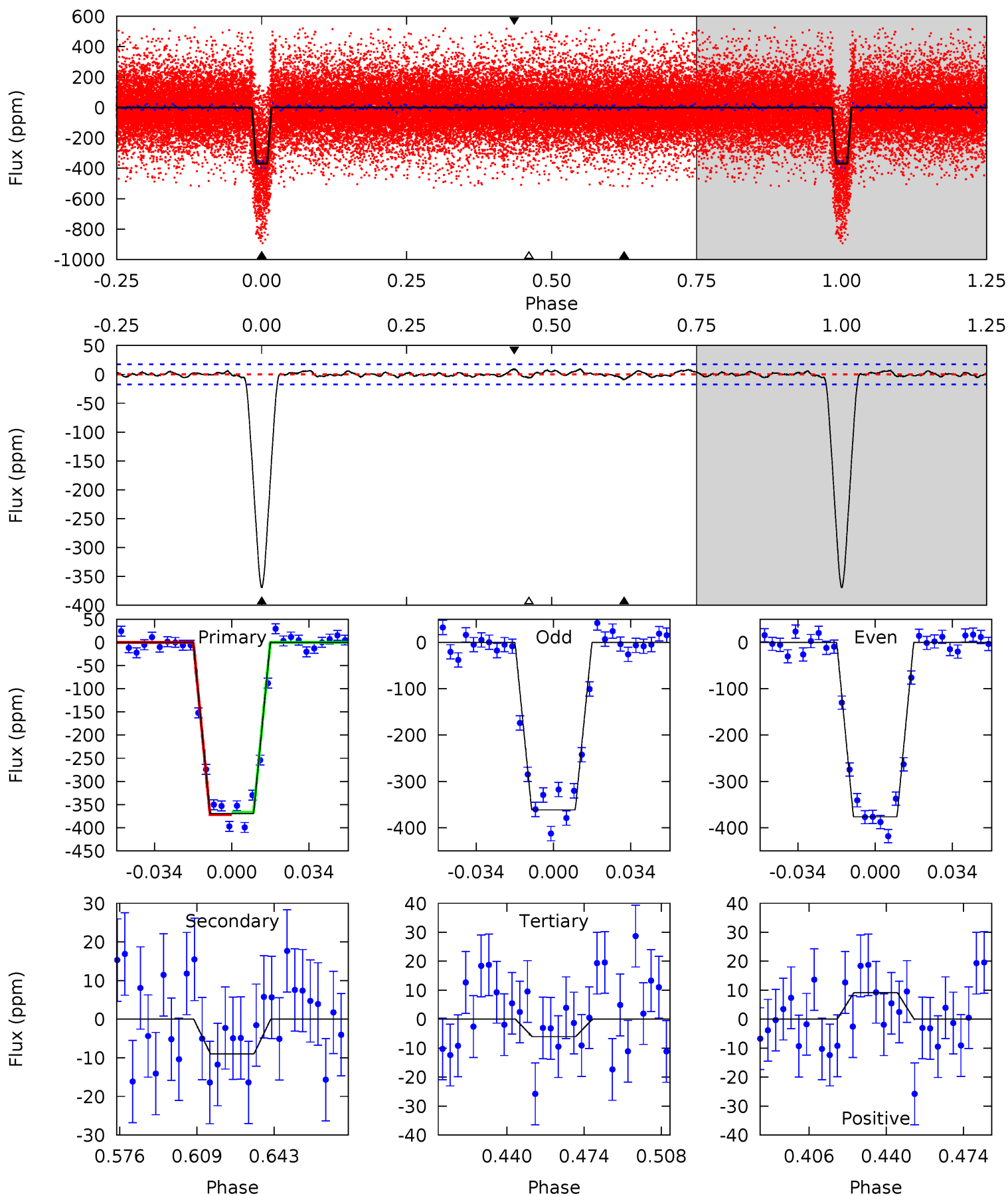
Pri	Sec	Ter	Pos	FA ₁	FA ₂	F _{Red}	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
86.2	3.10	3.05	4.22	4.76	2.07	1.61	83.1	81.9	0.05	-1.12	1.01	0.98	0.05	0.94



Alt Model-Shift Uniqueness Test

009963524-04, P = 2.795886 Days, E = 129.935706 Days

Pri	Sec	Ter	Pos	FA ₁	FA ₂	F _{Red}	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
100.9	2.45	1.65	2.49	4.79	2.12	0.87	99.3	98.4	0.80	-0.04	2.04	0.97	0.02	0



Stellar Parameters For KIC 009963524

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	5244^{+105}_{-105}	$4.538^{+0.045}_{-0.055}$	$-0.040^{+0.150}_{-0.150}$	$0.810^{+0.060}_{-0.044}$	$0.826^{+0.052}_{-0.043}$	$2.191^{+0.351}_{-0.405}$
	+2%/-2%	+1%/-1%	+375%/-375%	+7%/-5%	+6%/-5%	+16%/-18%
Source	SPE58	SPE58	SPE58	DSEP		

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

Secondary Eclipse Parameters for KIC 009963524-04 / KOI 0720.04

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	A_{obs}
DV	-14 ± 5	$1.88^{+0.30}_{-0.31}$	1525^{+42}_{-41}	2858^{+188}_{-218}	$2.945^{+1.584}_{-1.185}$
Alt.	-9 ± 4	$1.74^{+0.28}_{-0.29}$	1529^{+42}_{-40}	2733^{+224}_{-248}	$2.166^{+1.469}_{-0.990}$

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

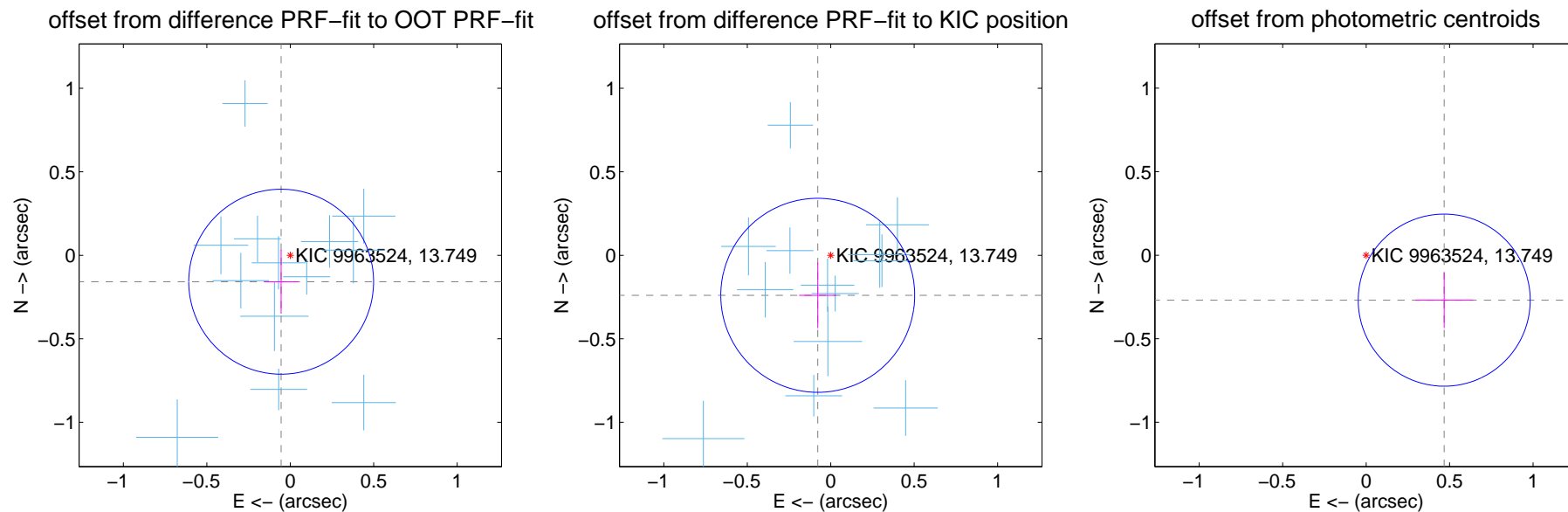
DV Centroid Data

Supplemental centroid analysis for 009963524-04. Kepler magnitude: 13.75. Transit SNR 48.68

There are 14 quarters with good PRF difference image offsets

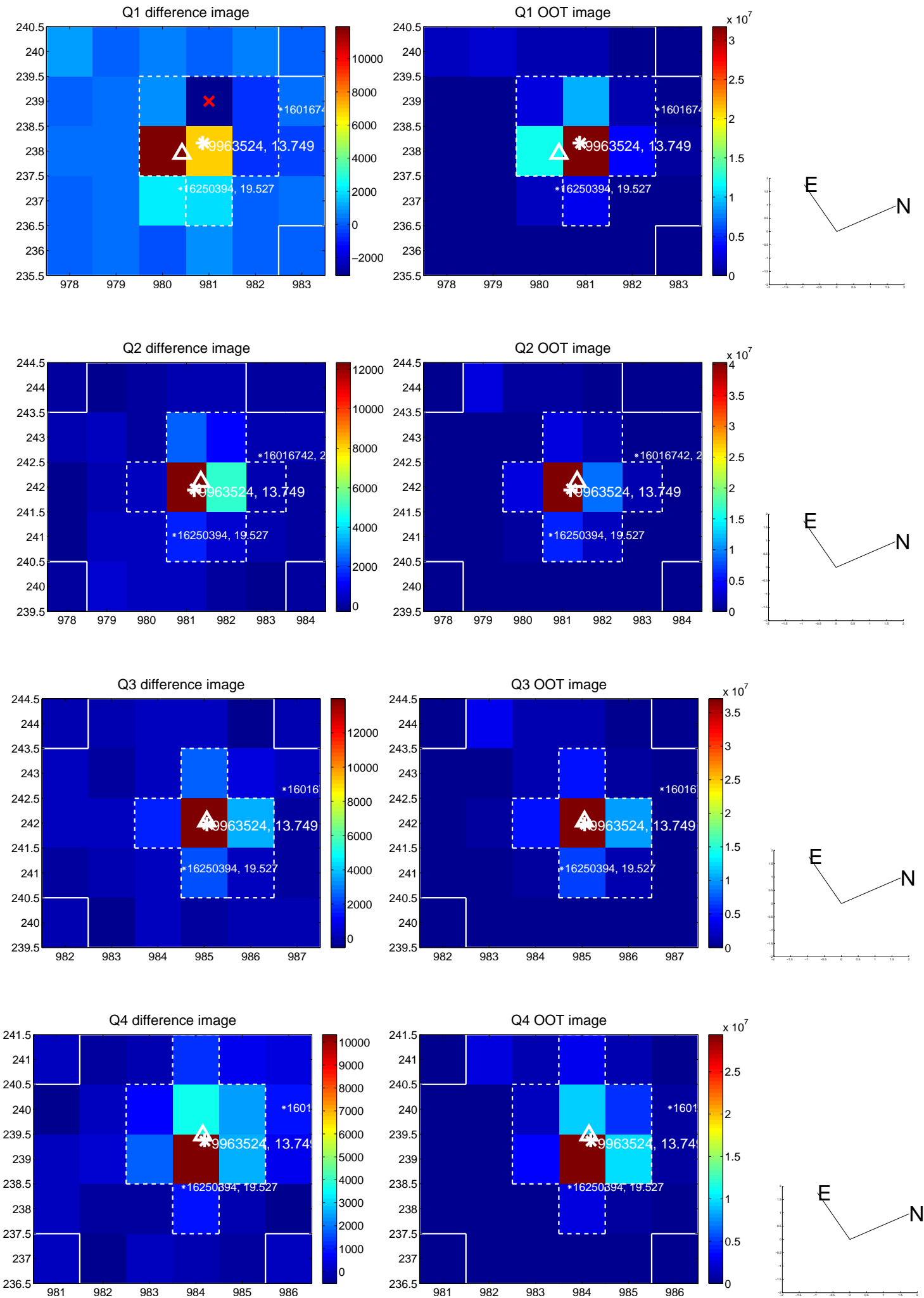
The direct PRF centroid is offset from the target star catalog position by about 0.03 arcsec

	Distance in arcsec	Distance / σ	Δ RA	Δ Dec
PRF-fit source offset from OOT	0.167 ± 0.185	0.91	0.055 ± 0.103	-0.158 ± 0.191
PRF-fit source offset from KIC position	0.252 ± 0.194	1.30	0.078 ± 0.112	-0.240 ± 0.196
photometric centroid source offset	0.54 ± 0.17	3.14	-0.47 ± 0.17	-0.27 ± 0.17

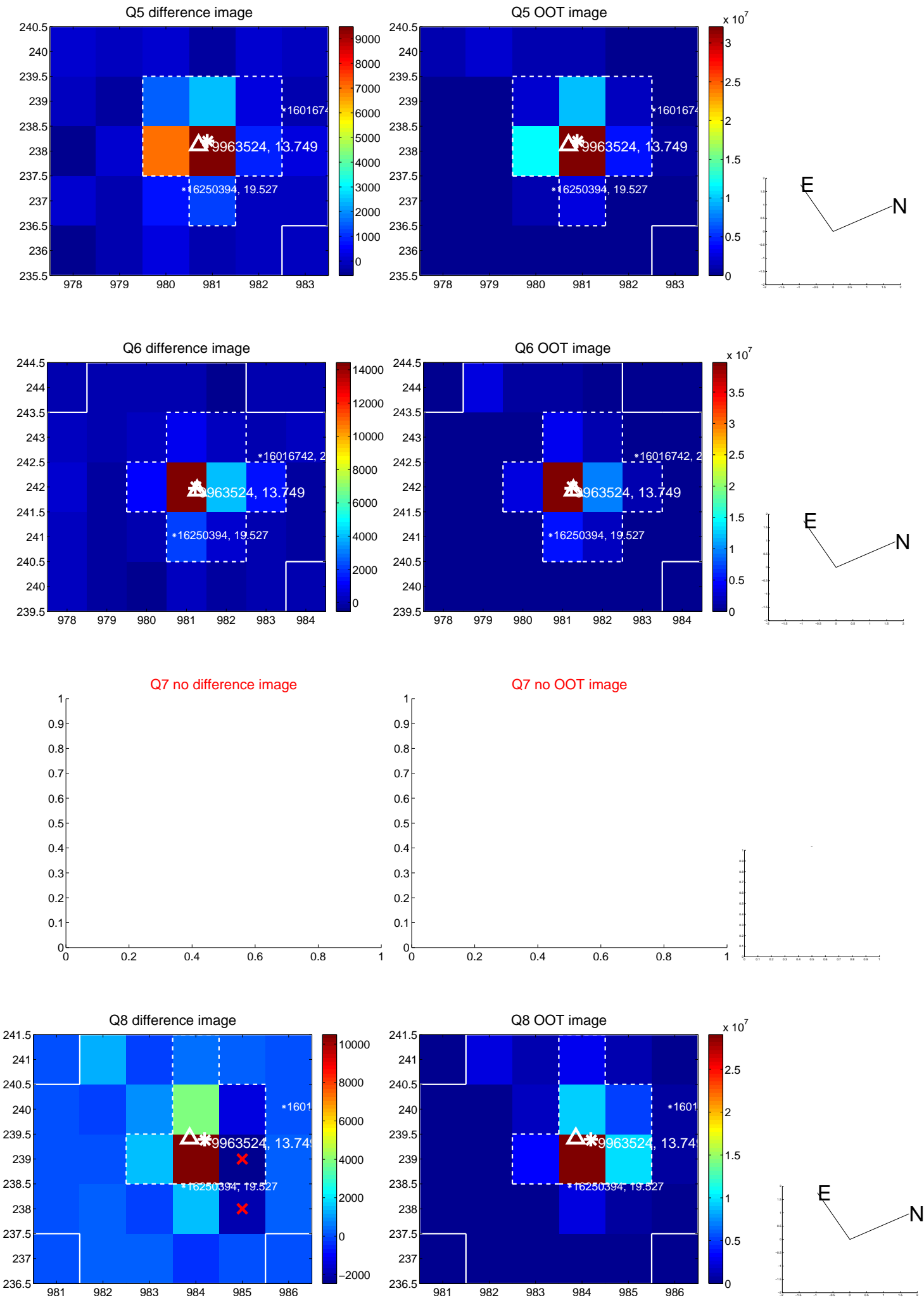


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

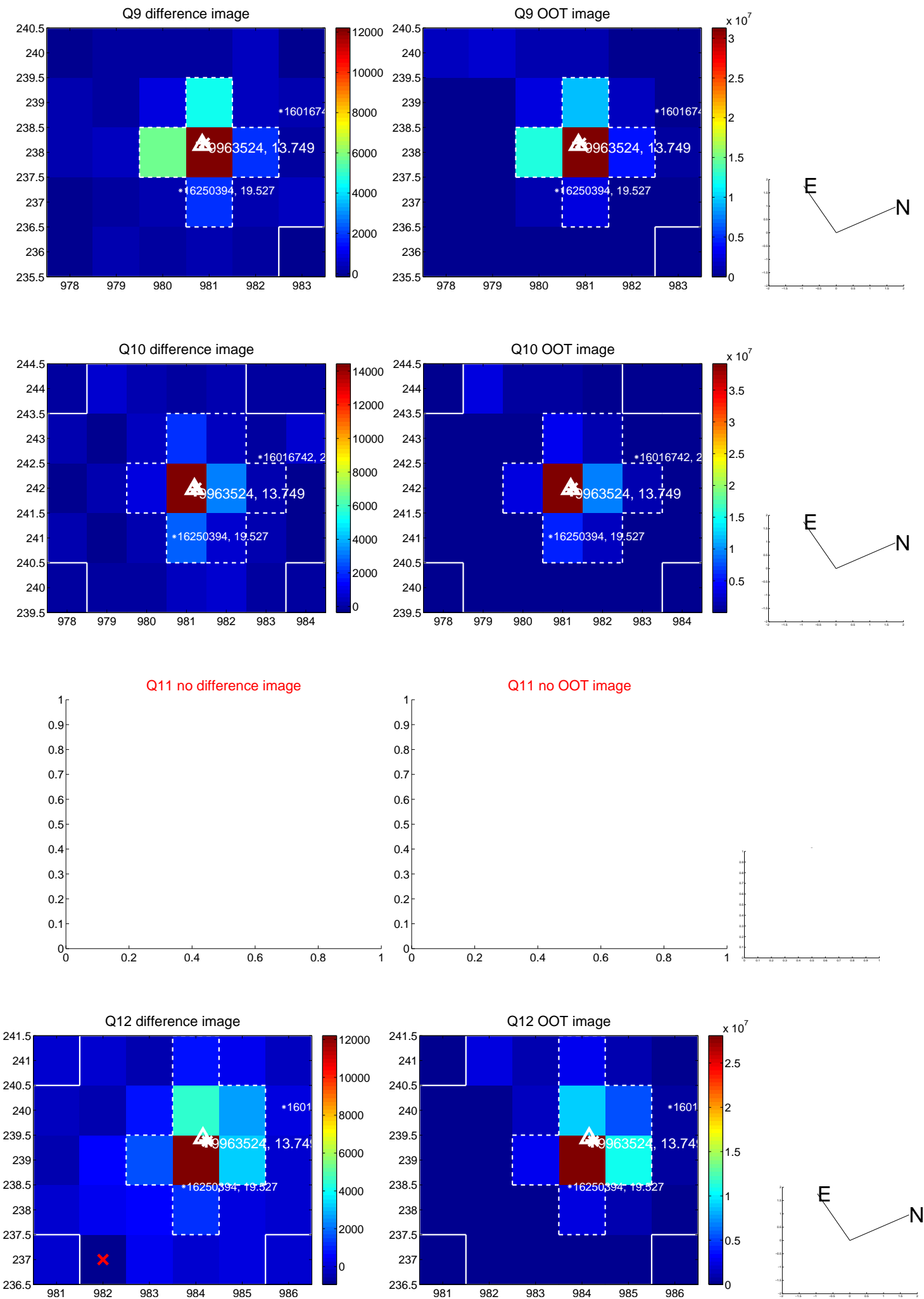
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



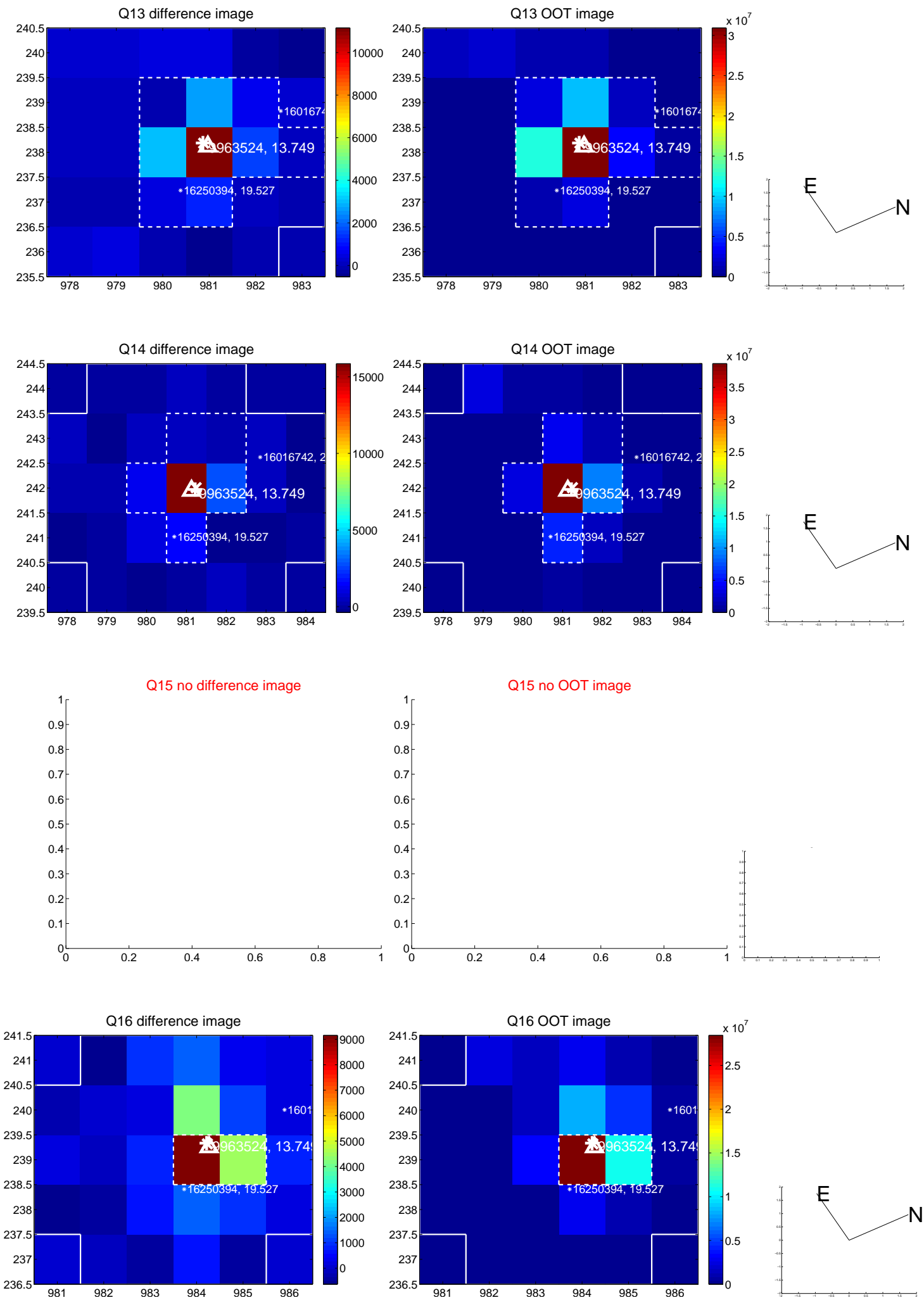
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



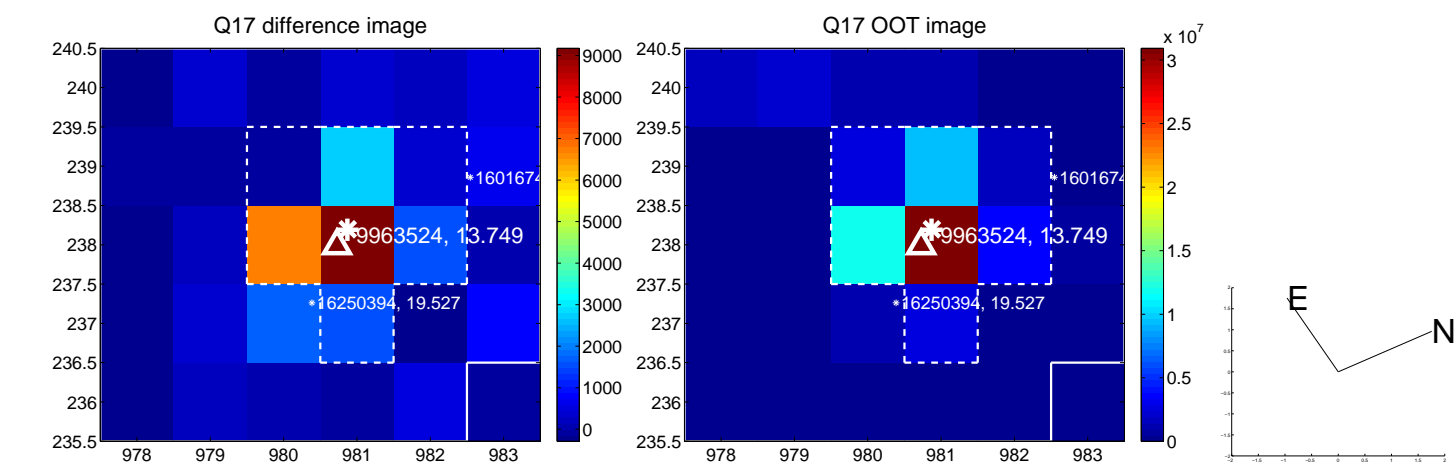
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



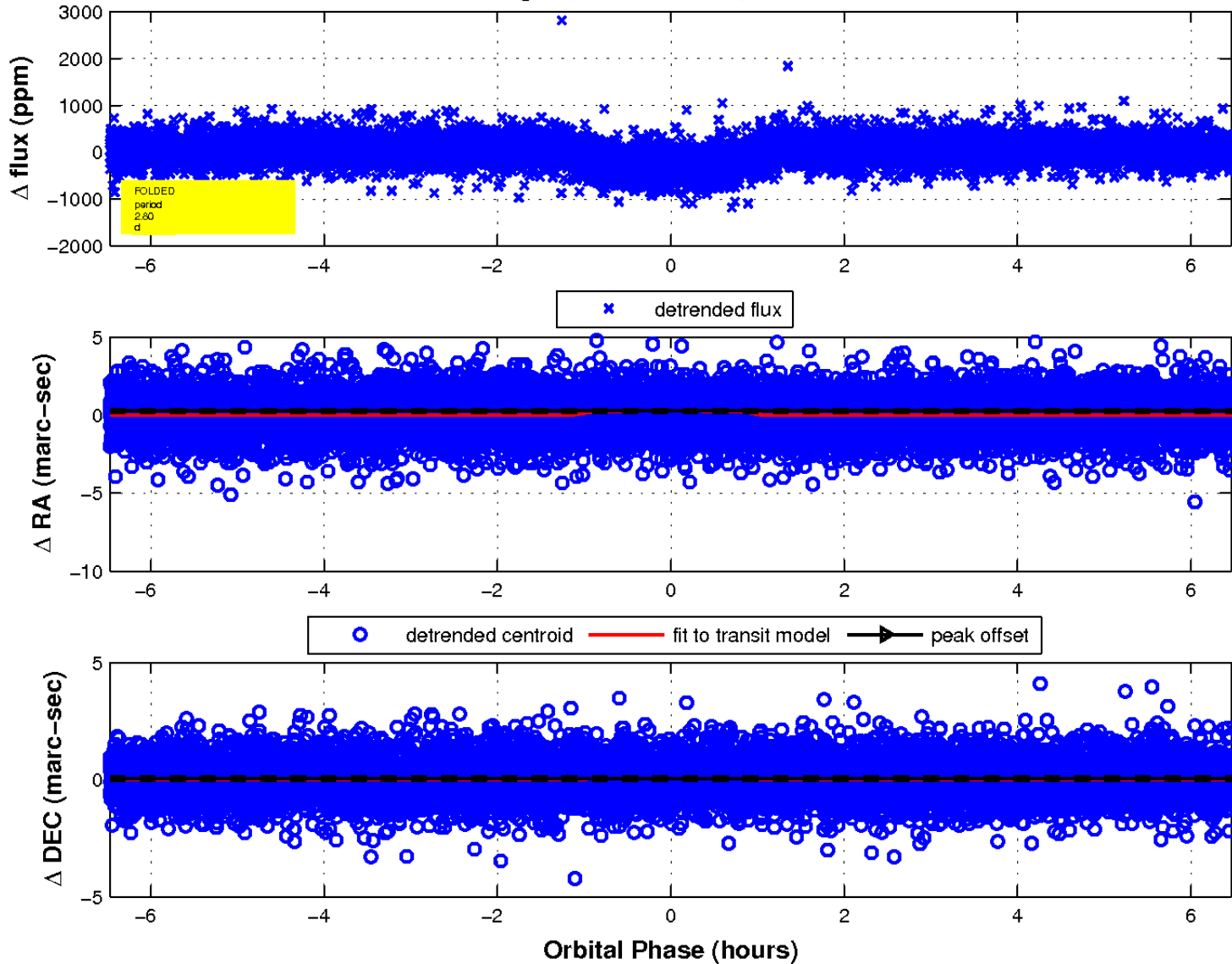
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



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



fluxWeightedCentroids, Planet 4 of 4



UKIRT Image

Declination

