

# KIC 002018906

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
002018906-01	OBS	No	0.525149	131.658983	11.9	3.212	15.1	3.7	3.37	5046	1.24	0.00
002018906-04	OBS	No	31.419253	137.819040	334.8	3.524	9.4	8.5	3.37	5046	7.09	196.26
002018906-05	OBS	No	22.245829	137.842474	441.7	2.059	9.2	10.5	3.37	5046	7.50	311.01
002018906-06	OBS	No	44.158582	138.108488	370.8	3.010	9.1	9.2	3.37	5046	7.29	124.67
002018906-07	OBS	No	53.152195	148.596580	587.8	1.755	8.9	9.6	3.37	5046	9.31	97.37
002018906-08	OBS	No	46.663938	154.862044	409.6	2.876	7.8	8.6	3.37	5046	8.08	115.82
002018906-09	OBS	No	53.025159	168.237150	329.6	2.994	8.1	7.9	3.37	5046	7.32	97.68
002018906-10	OBS	No	7.605976	131.528571	187.7	3.276	9.2	10.1	3.37	5046	5.50	1300.86

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
002018906-01	OBS	FP	0.00	1	0	1	0	LPP_DV—CENT_RESOLVED_OFFSET
002018906-04	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-05	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-06	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-07	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-08	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-09	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS
002018906-10	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE_ZUMA—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_CROWDED

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

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

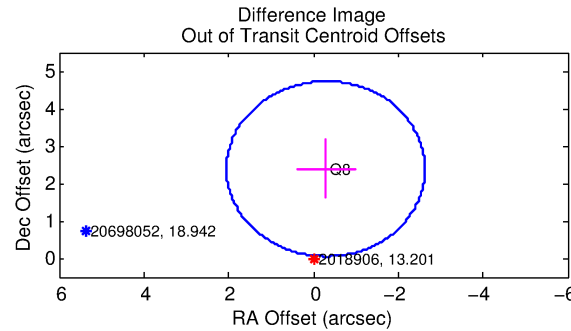
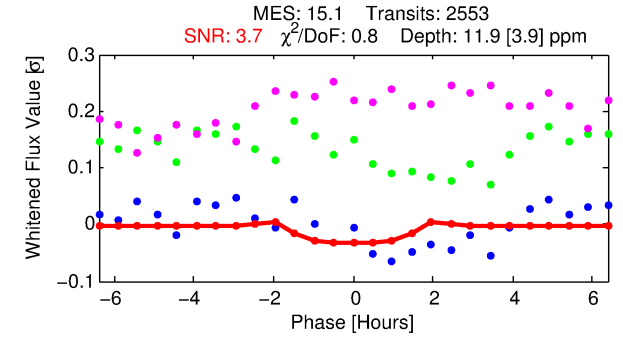
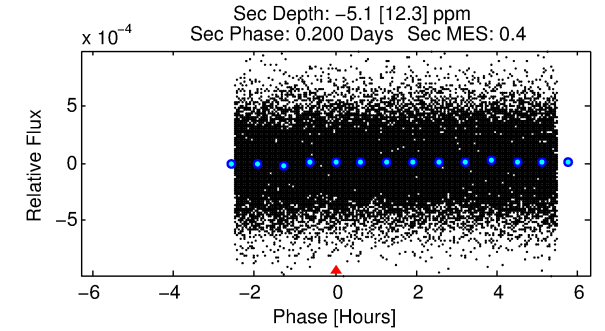
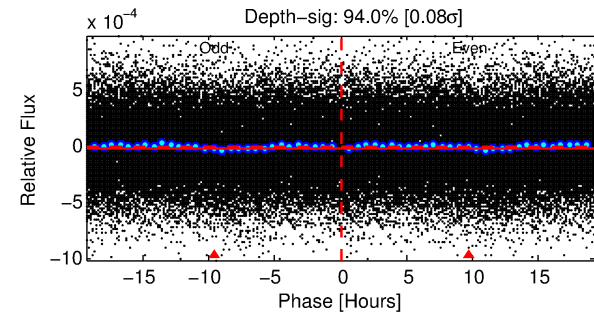
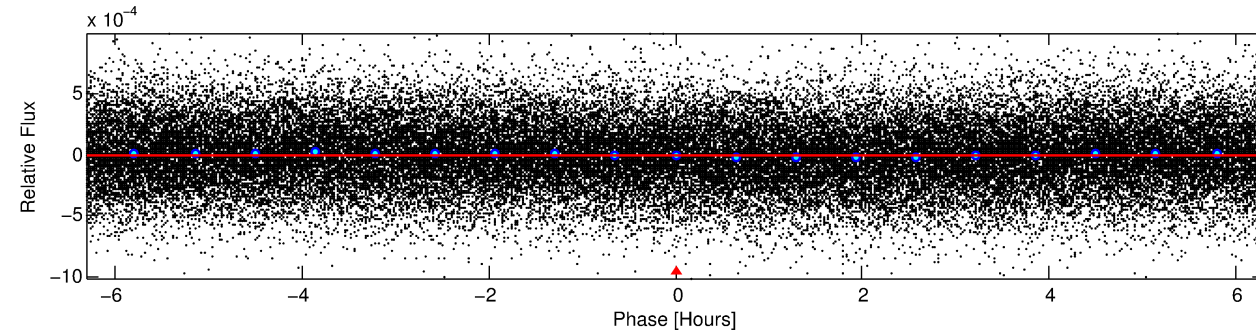
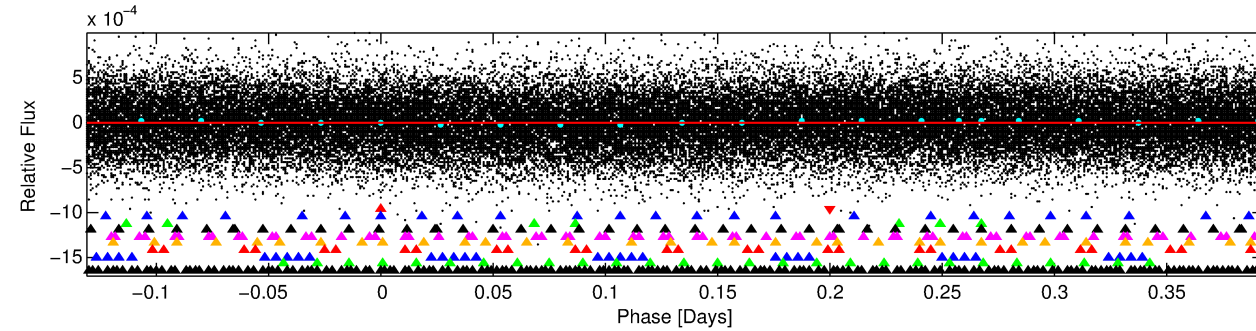
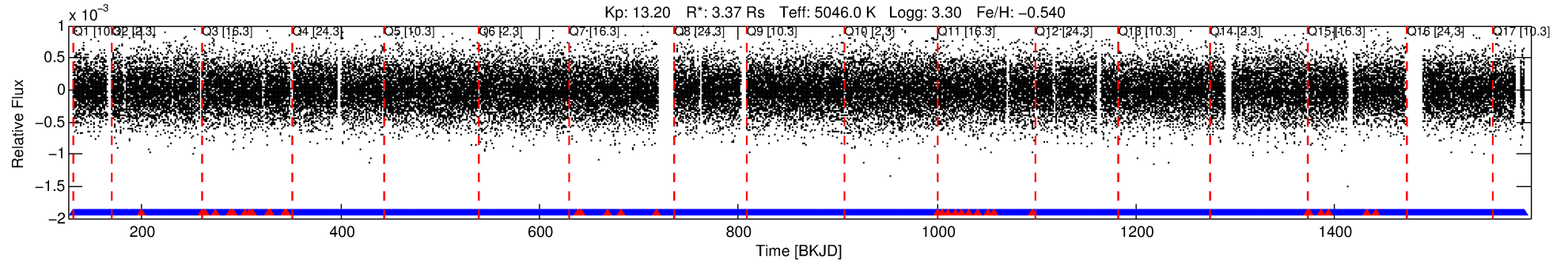
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 002018906-01

No Significant Match Found

# DV One-Page Summary

KIC: 2018906 Candidate: 1 of 10 Period: 0.525 d



## DV Fit Results:

Period = 0.52515 [0.00003] d  
Epoch = 131.6590 [0.0082] BKJD  
Rp/R\* = 0.0034 [0.0034]  
a/R\* = 1.22 [1.56]  
b = 0.70 [2.87]  
Seff = N/A  
Teq = N/A  
Rp = 1.24 [1.43] Re  
a = N/A  
Ag = N/A  
Teffp = N/A

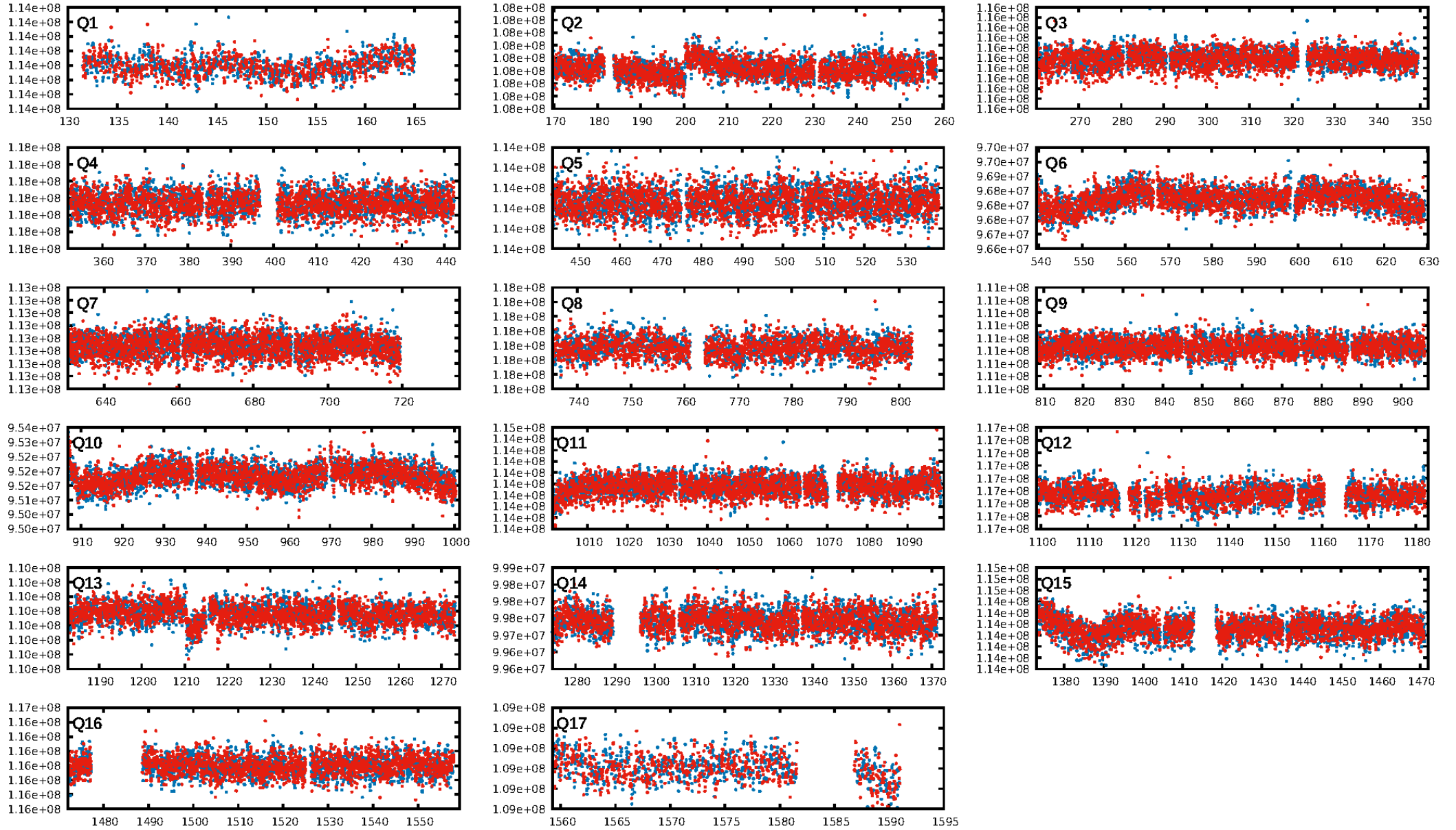
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [37.04 $\sigma$ ]  
ModelChiSquare2-sig: N/A  
ModelChiSquareGof-sig: N/A  
Bootstrap-pfa: 3.92e-36  
RollingBand-fgt: 0.99 [2403/2437]  
GhostDiagnostic-chr: 0.2827  
Centroid-sig: N/A  
Centroid-so: 9.643 arcsec [4.28 $\sigma$ ]  
OotOffset-rm: 2.405 arcsec [3.08 $\sigma$ ]  
KicOffset-rm: 2.234 arcsec [2.87 $\sigma$ ]  
OotOffset-st: 0/0/1/0 [1]  
KicOffset-st: 0/0/1/0 [1]  
DiffImageQuality-fgm: 0.00 [0/1]  
DiffImageOverlap-fno: 1.00 [17/17]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 04:43:01 Z

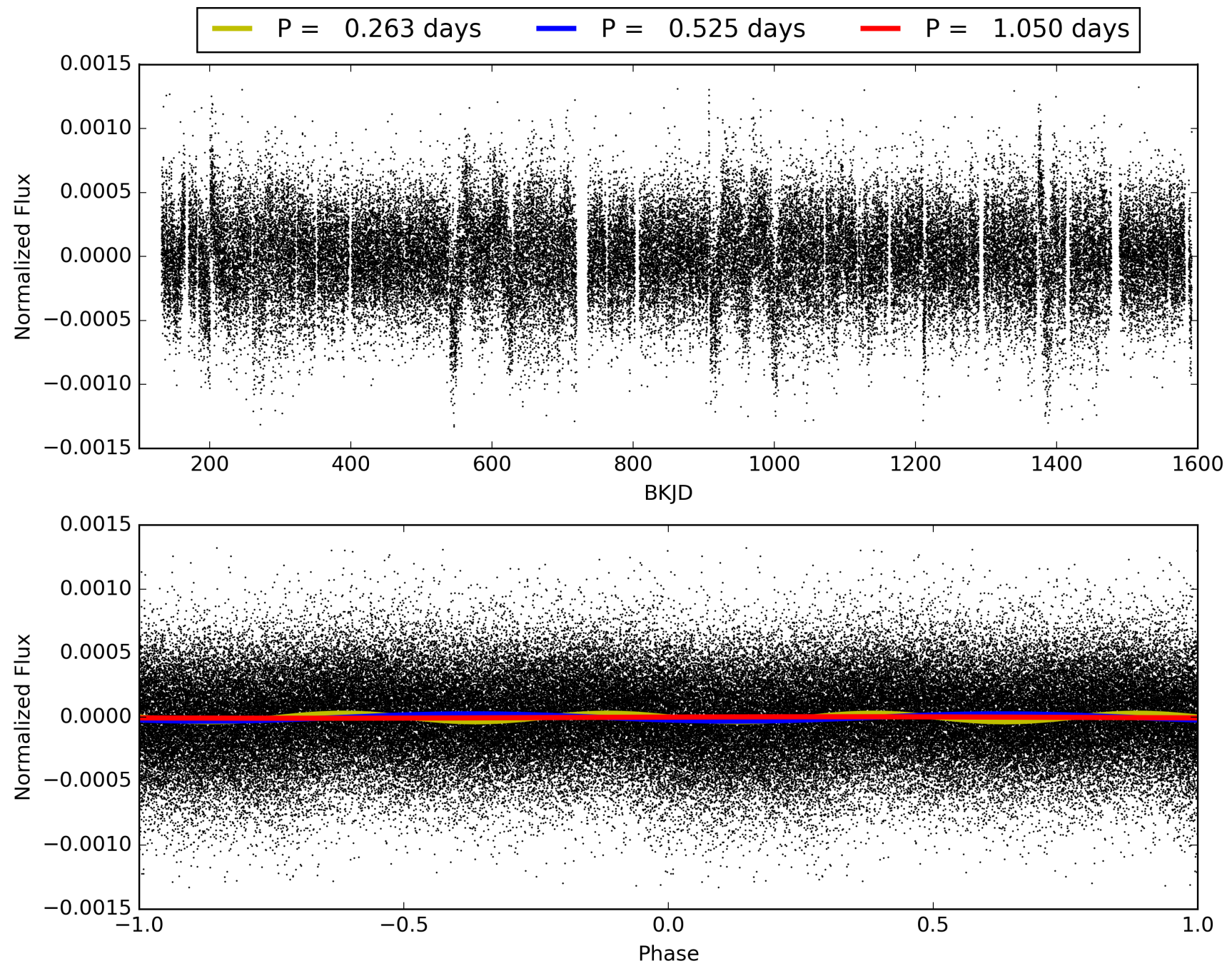
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 002018906-01, PDC Light Curves





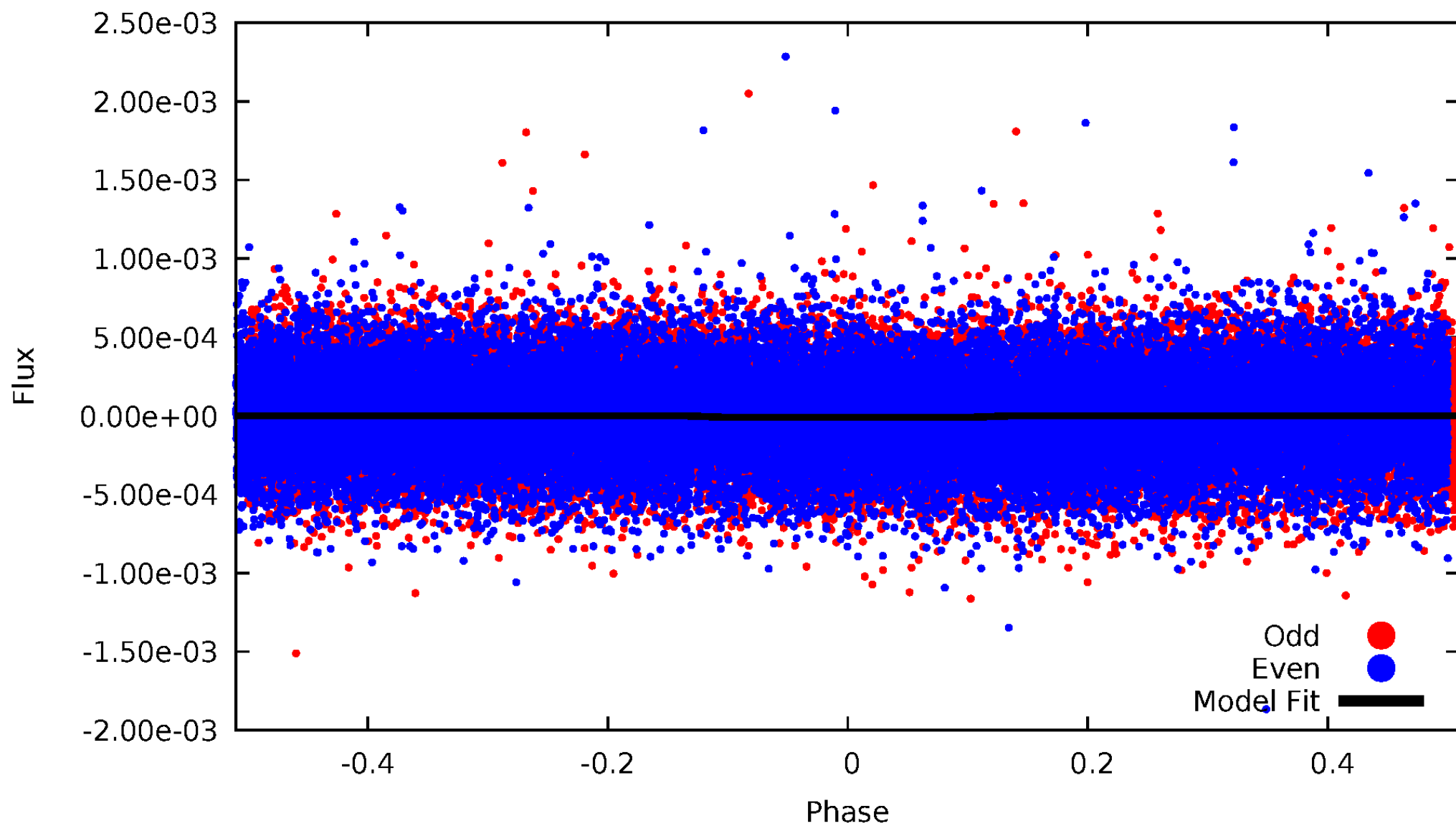
TCE 002018906-01





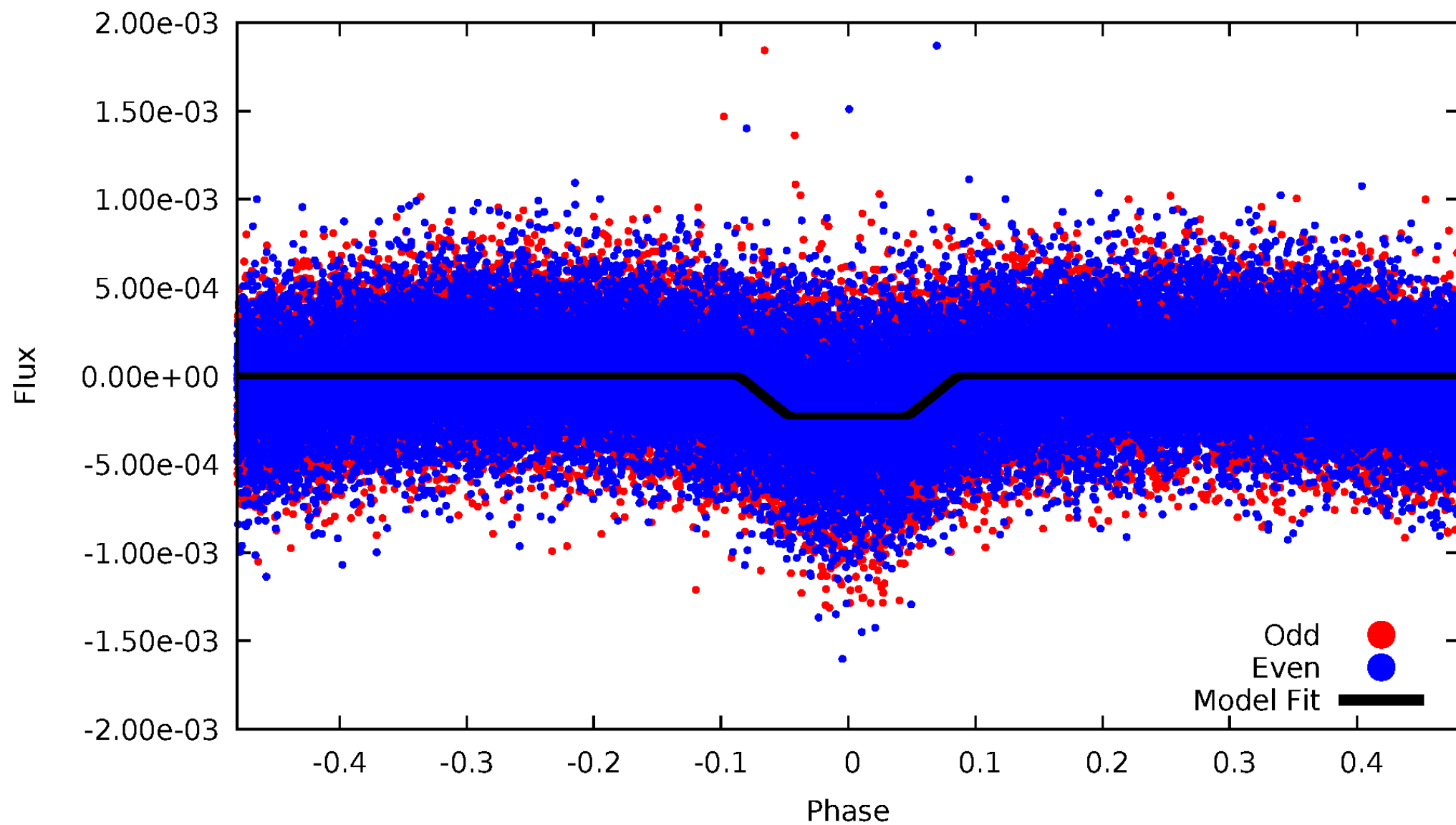
# DV Odd/Even

TCE 002018906-01



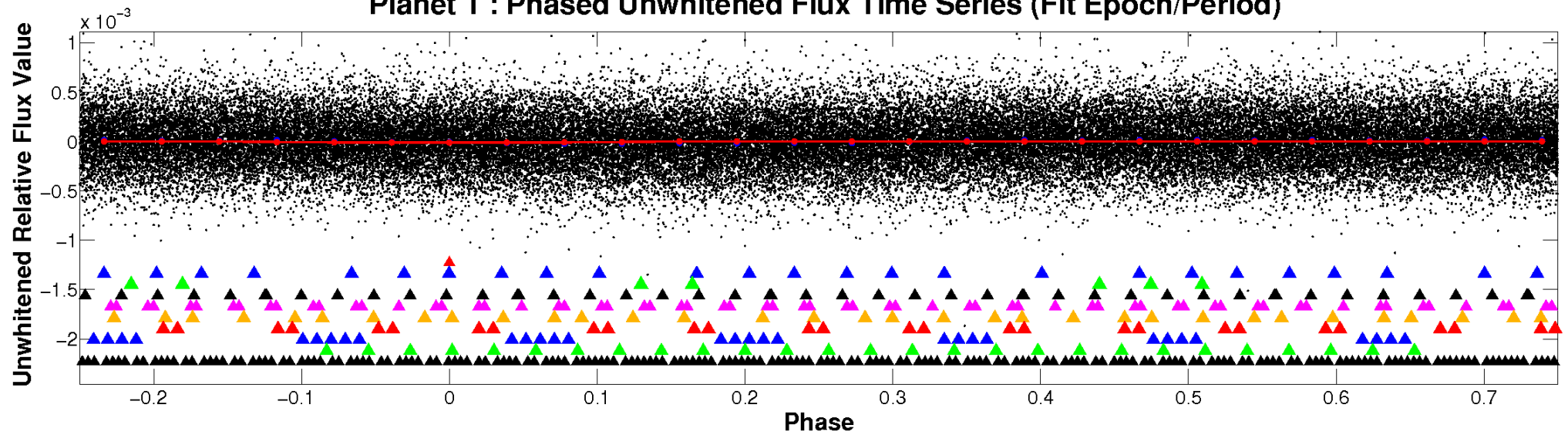
# ALT Odd/Even

TCE 002018906-01

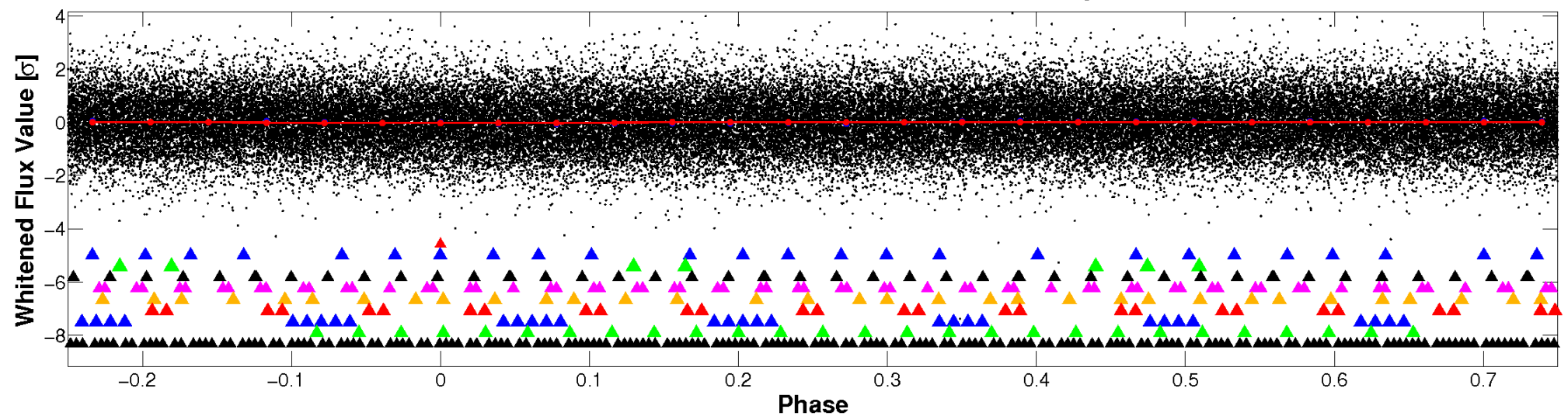


# Non-Whitened Vs. Whitened Light Curve

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



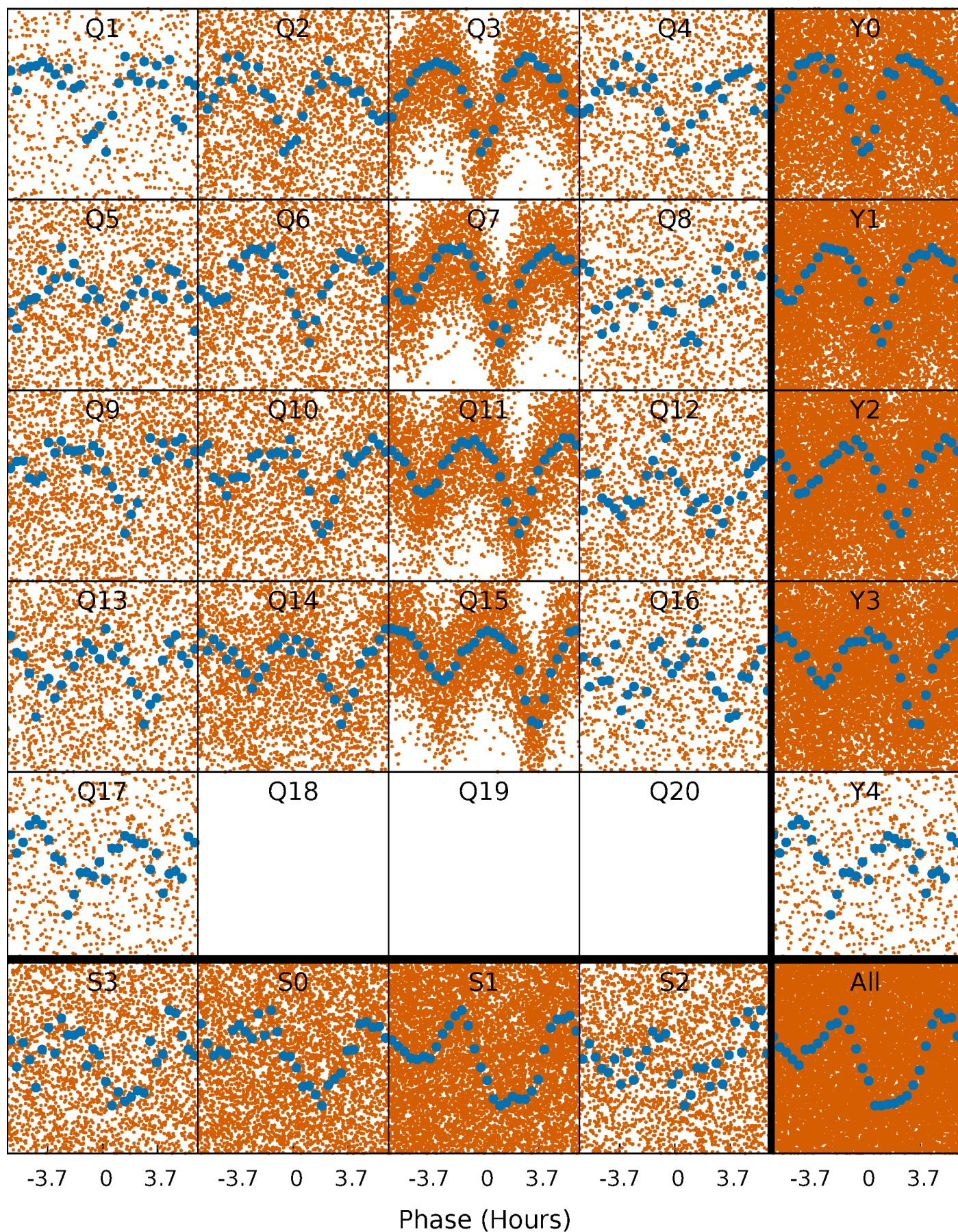
Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)





# PDC Quarter-Phased Transit Curves

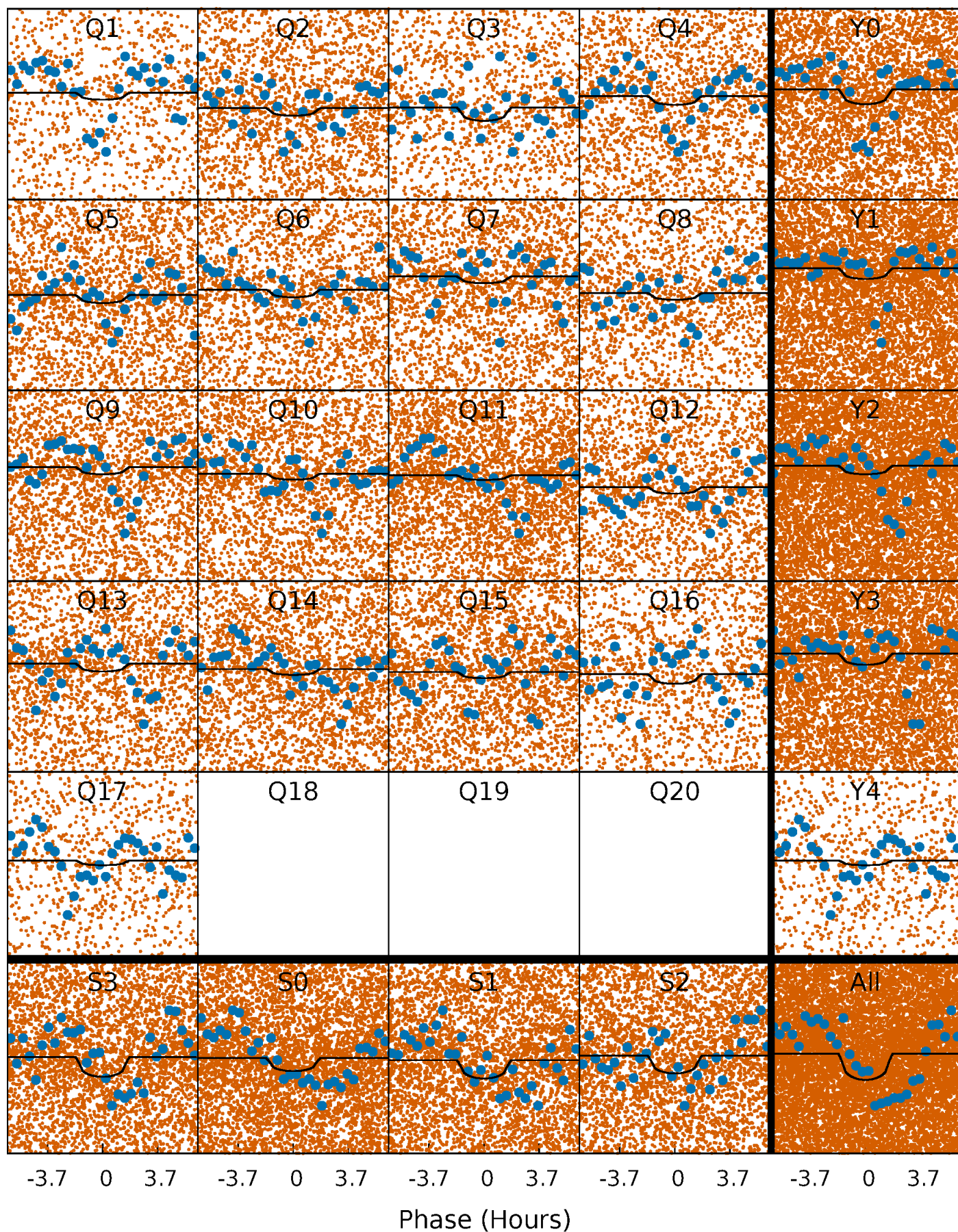
TCE 002018906-01 P= 0.525149 Days  $T_0=131.658983$  (BKJD)





# DV Quarter-Phased Transit Curves

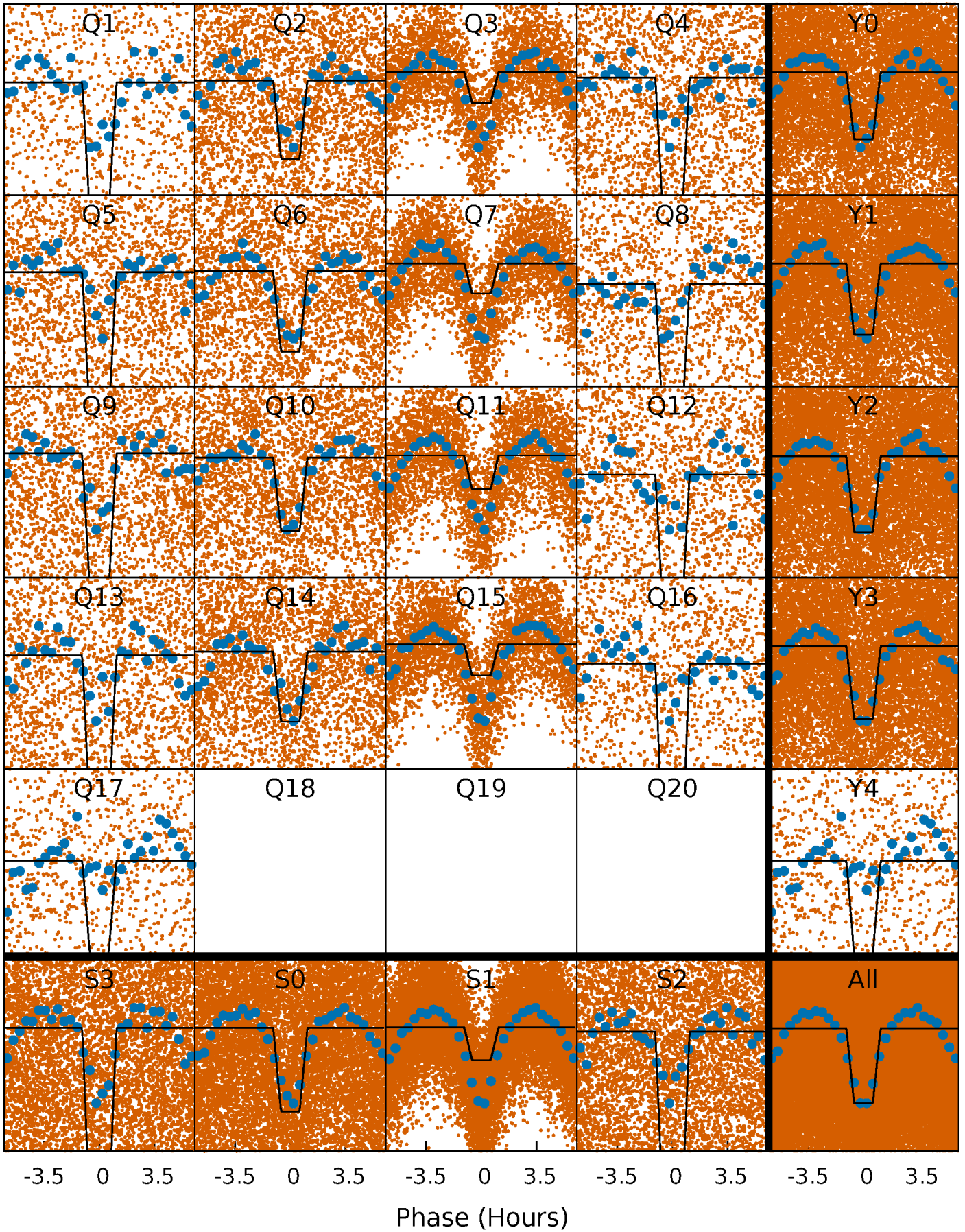
TCE 002018906-01 P= 0.525149 Days  $T_0=131.658983$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

TCE 002018906-01 P= 0.525216 Days  $T_0=131.635916$  (BKJD)

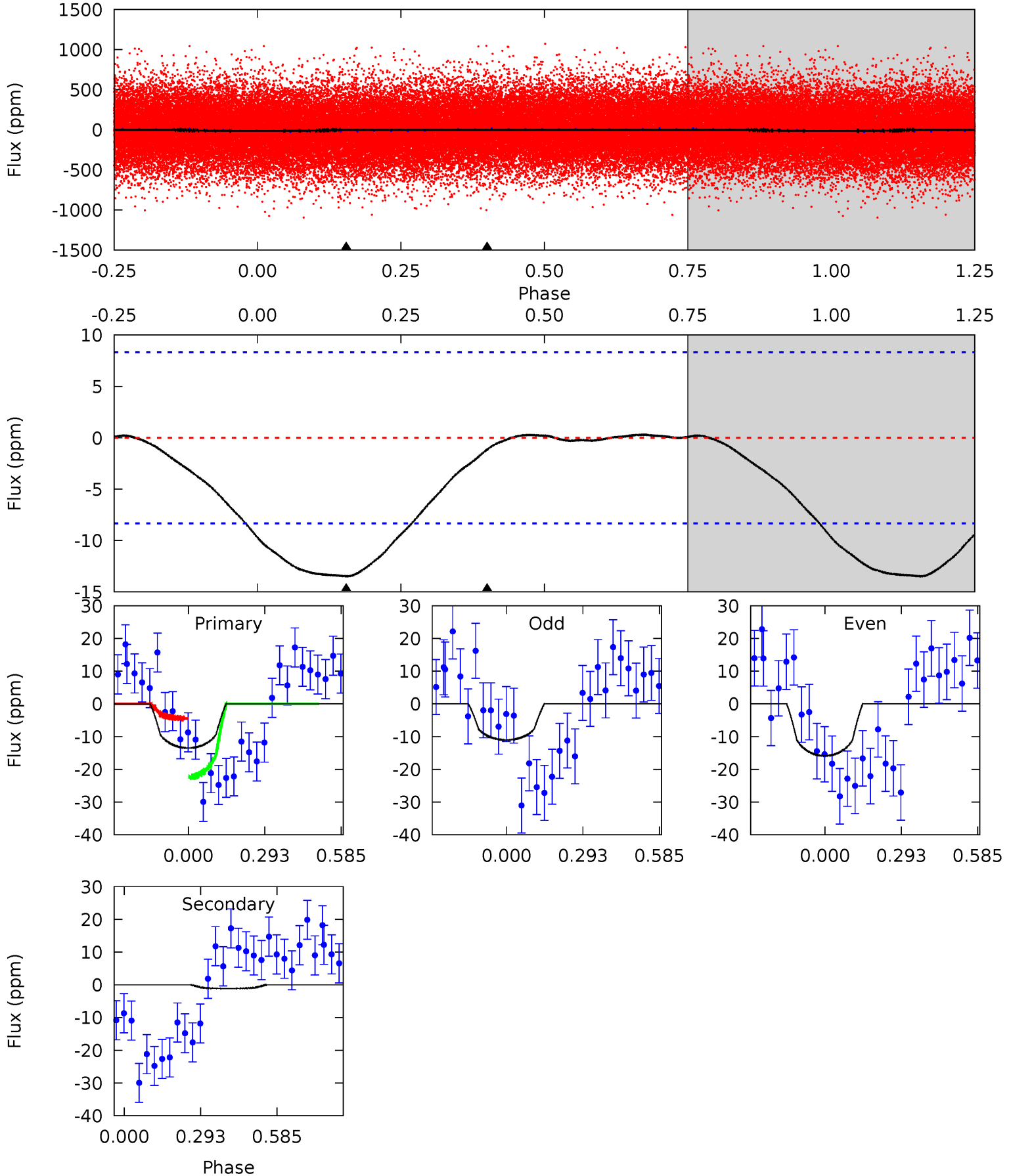




# DV Model-Shift Uniqueness Test

002018906-01, P = 0.525149 Days, E = 131.133834 Days

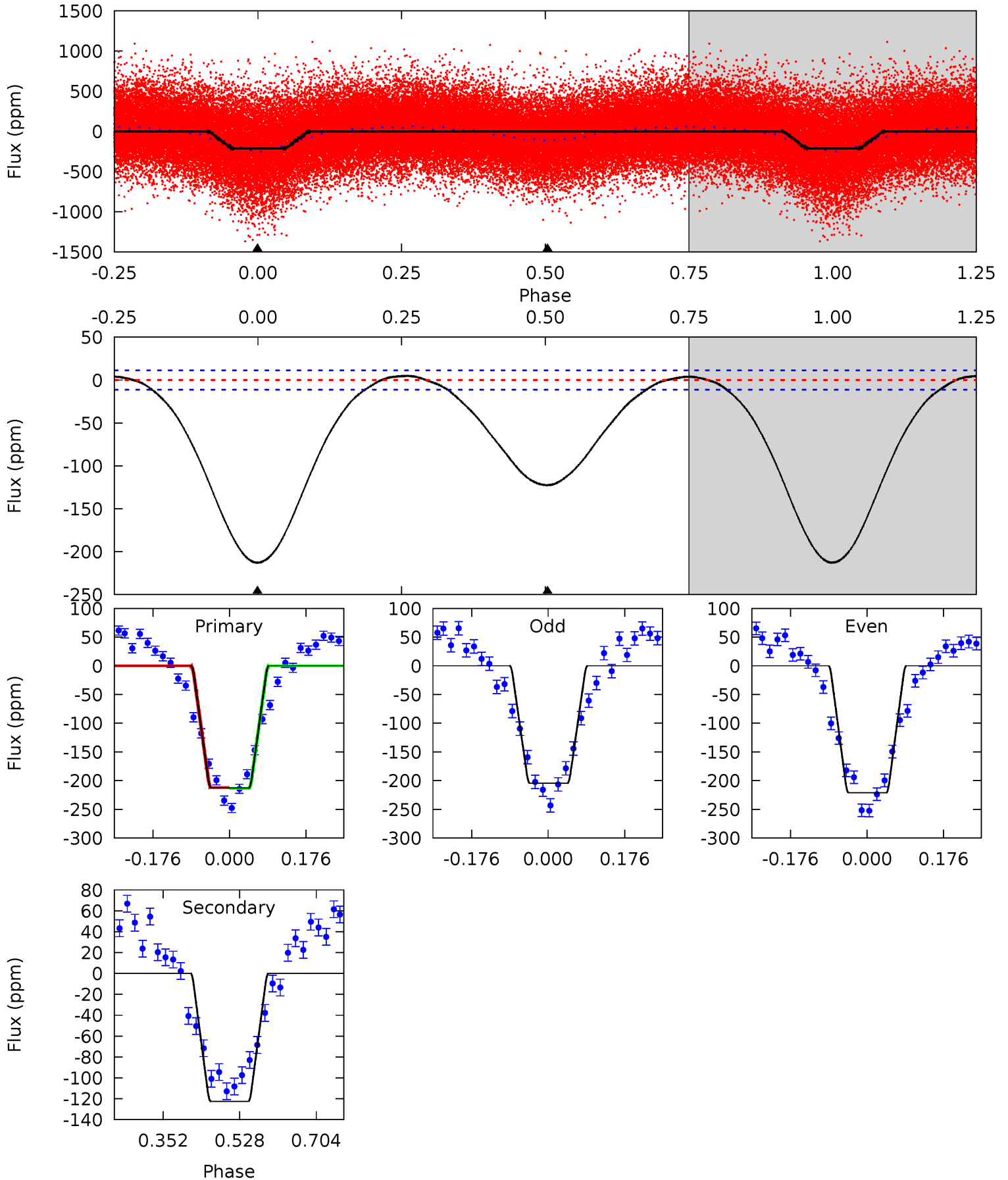
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
7.02	0.60	0	0	4.33	1.05	0.39	7.02	7.02	0.60	0.60	1.28	1.08	0.02	4.66



# Alt Model-Shift Uniqueness Test

002018906-01, P = 0.525216 Days, E = 131.110700 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
84.1	48.4	0	0	4.44	1.35	2.09	84.1	84.1	48.4	48.4	3.29	1.06	0.02	0.30



### Stellar Parameters For KIC 002018906

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5046^{+127}_{-102}$	$3.303^{+0.310}_{-0.310}$	$-0.540^{+0.300}_{-0.250}$	$3.370^{+1.870}_{-1.007}$	$0.832^{+0.283}_{-0.165}$	$0.031^{+0.053}_{-0.022}$
	+3%/-2%	+9%/-9%	+56%/-46%	+55%/-30%	+34%/-20%	+172%/-72%
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 002018906-01 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-1\pm2$	$1.53^{+1.24}_{-0.94}$	$5236^{+683}_{-528}$	$-4321^{+1015}_{-570}$	$0.022^{+0.201}_{-0.053}$
Alt.	$-123\pm3$	$5.51^{+2.17}_{-1.63}$	$5177^{+709}_{-506}$	$2900^{+1407}_{-6932}$	$0.324^{+0.318}_{-0.153}$

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



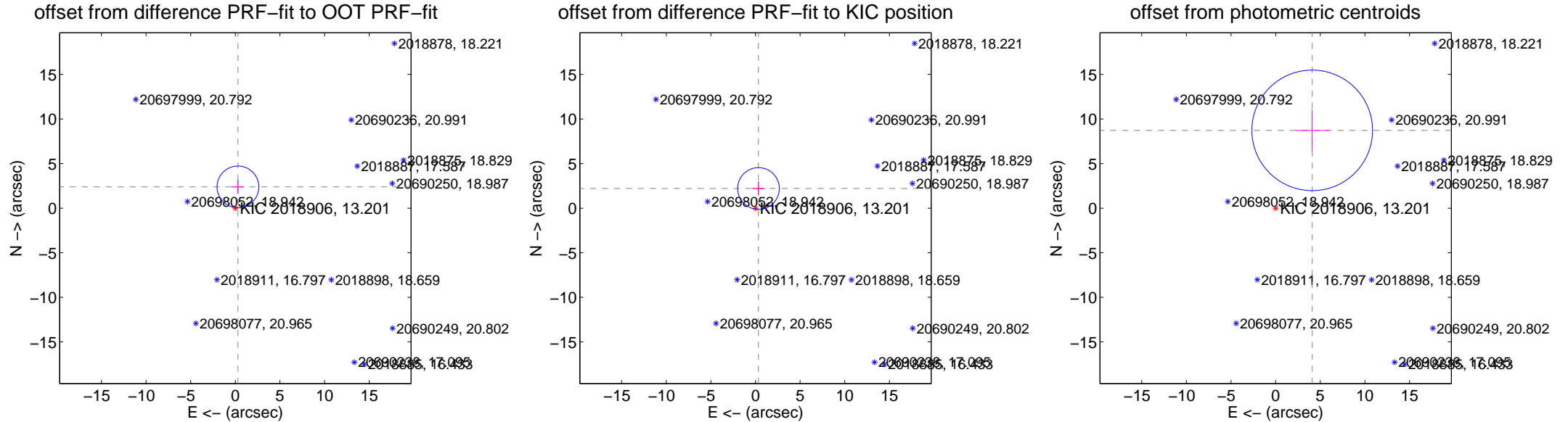
## DV Centroid Data

Supplemental centroid analysis for 002018906-01. Kepler magnitude: 13.20. Transit SNR 3.69

There are 0 quarters with good PRF difference image offsets

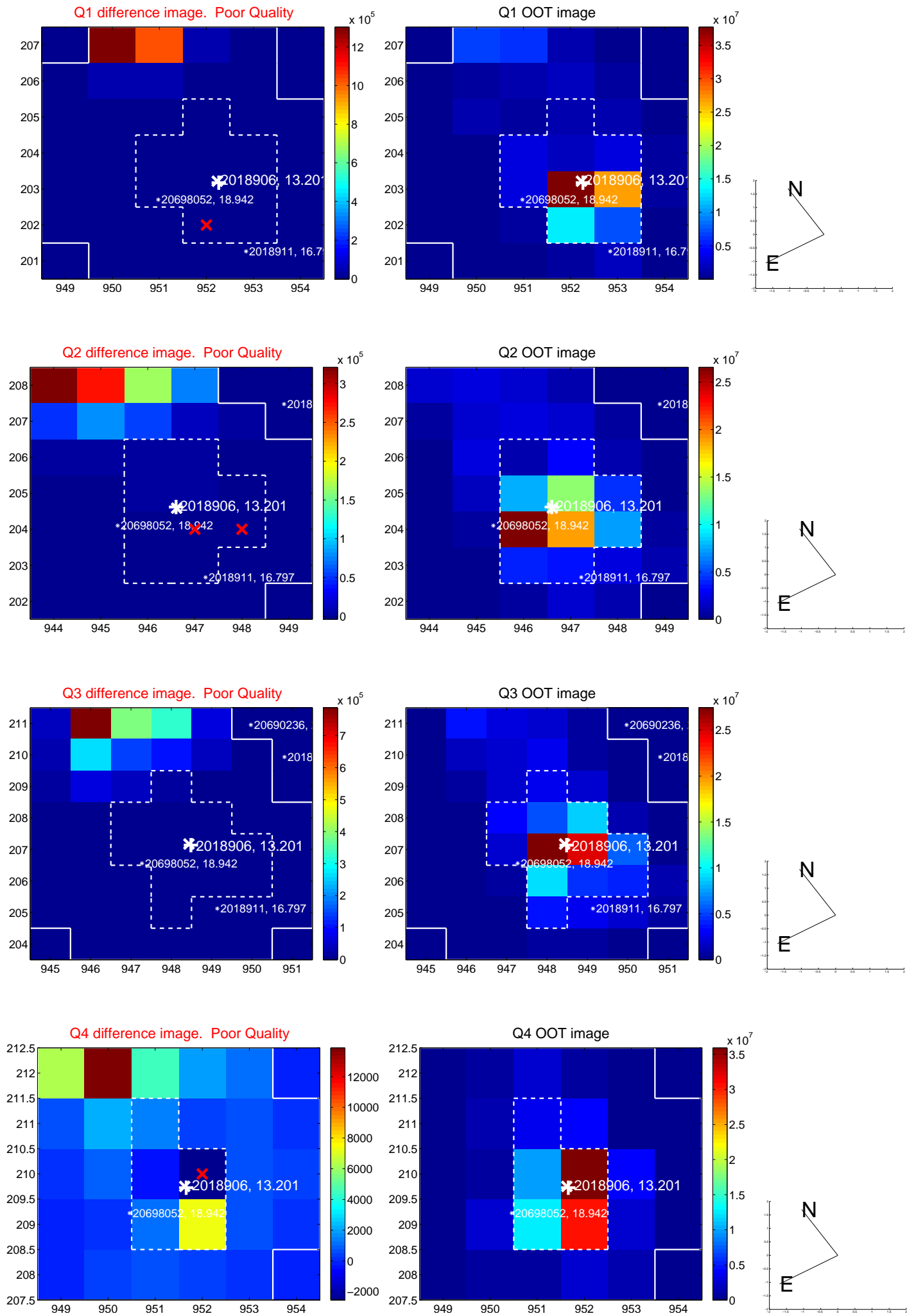
The direct PRF centroid is offset from the target star catalog position by about 0.18 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	2.405 $\pm$ 0.780	3.08	-0.290 $\pm$ 0.680	2.387 $\pm$ 0.781
PRF-fit source offset from KIC position	2.234 $\pm$ 0.779	2.87	-0.335 $\pm$ 0.680	2.208 $\pm$ 0.781
photometric centroid source offset	9.64 $\pm$ 2.25	4.28	-4.10 $\pm$ 1.91	8.73 $\pm$ 2.32

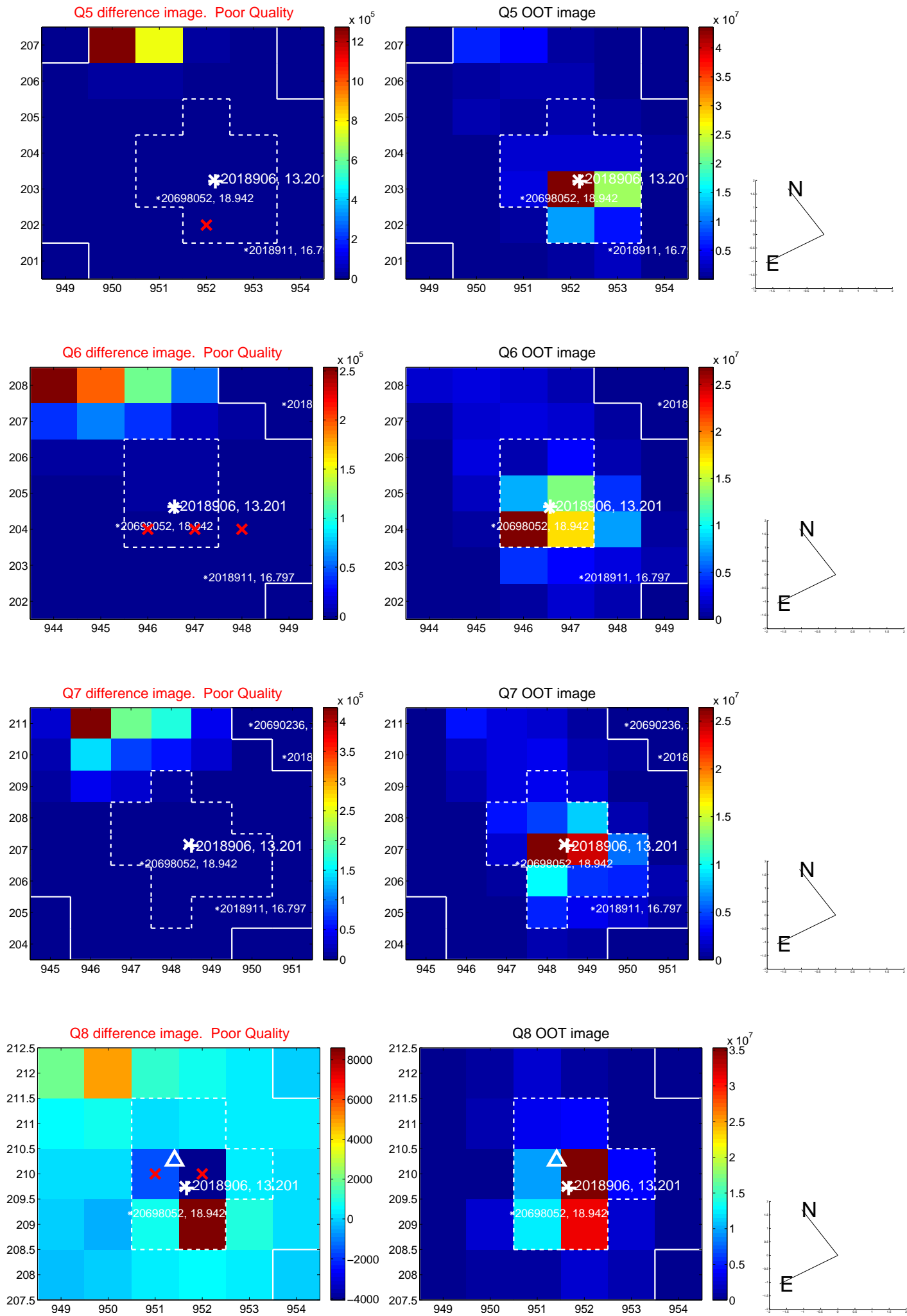


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

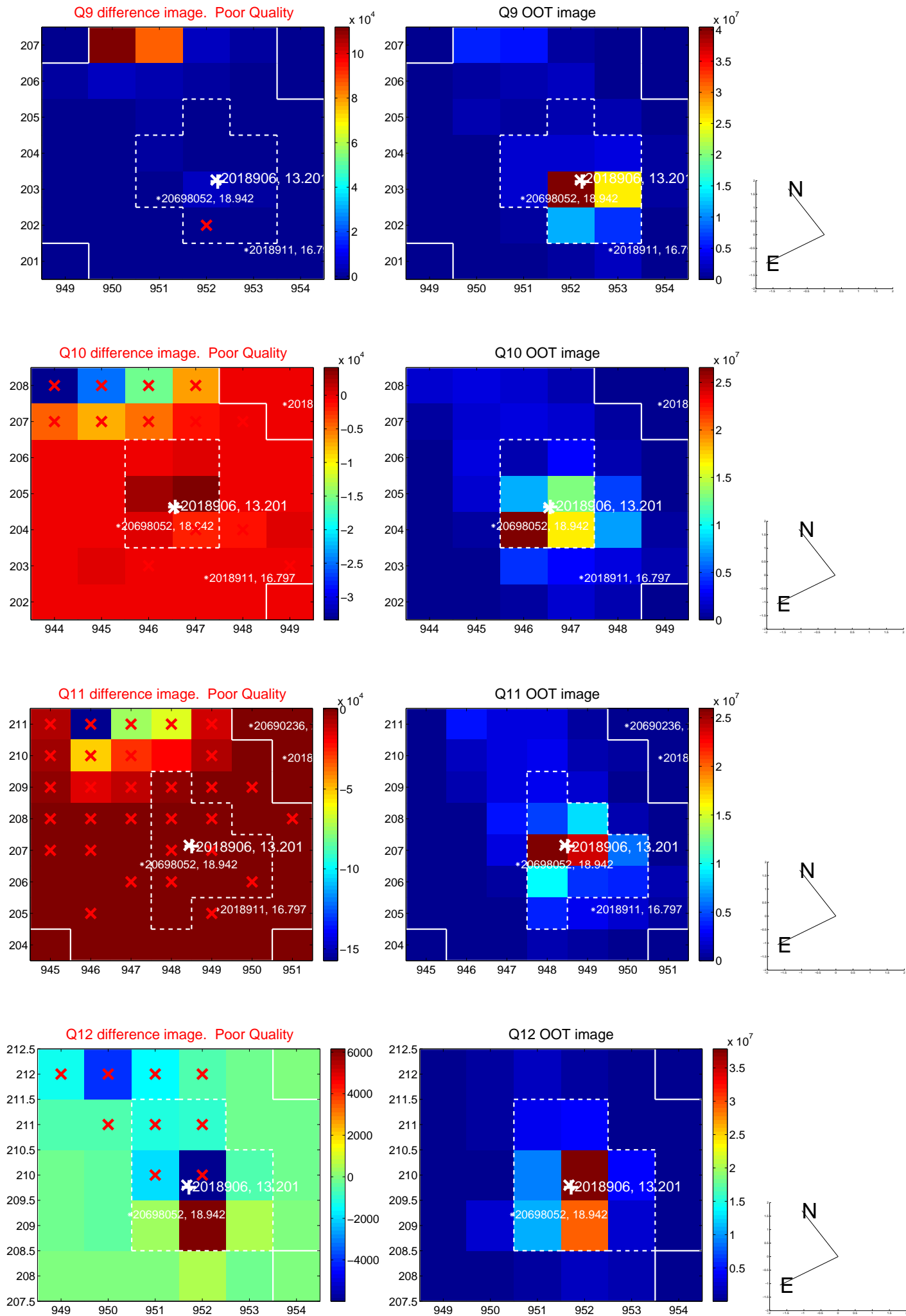


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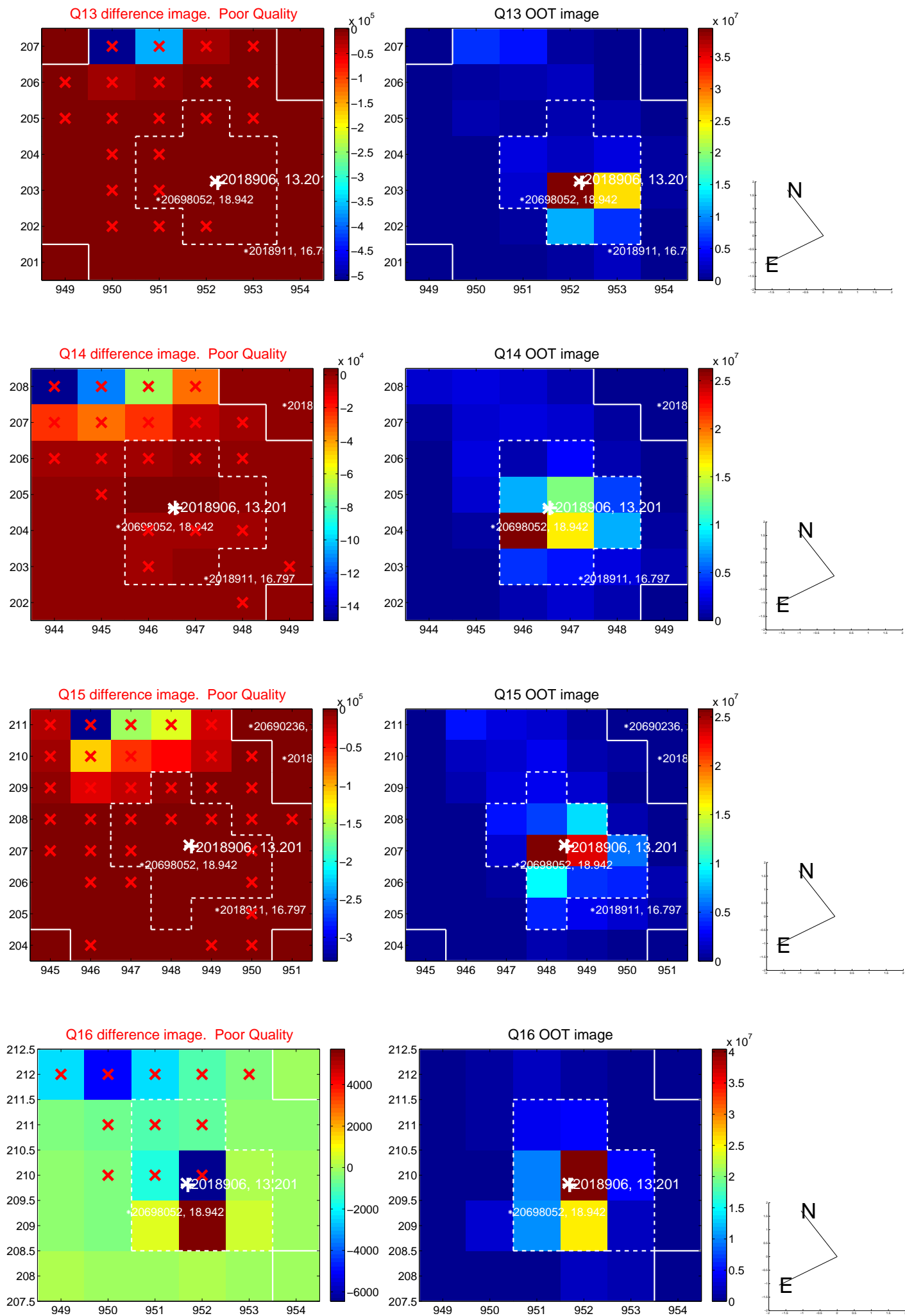




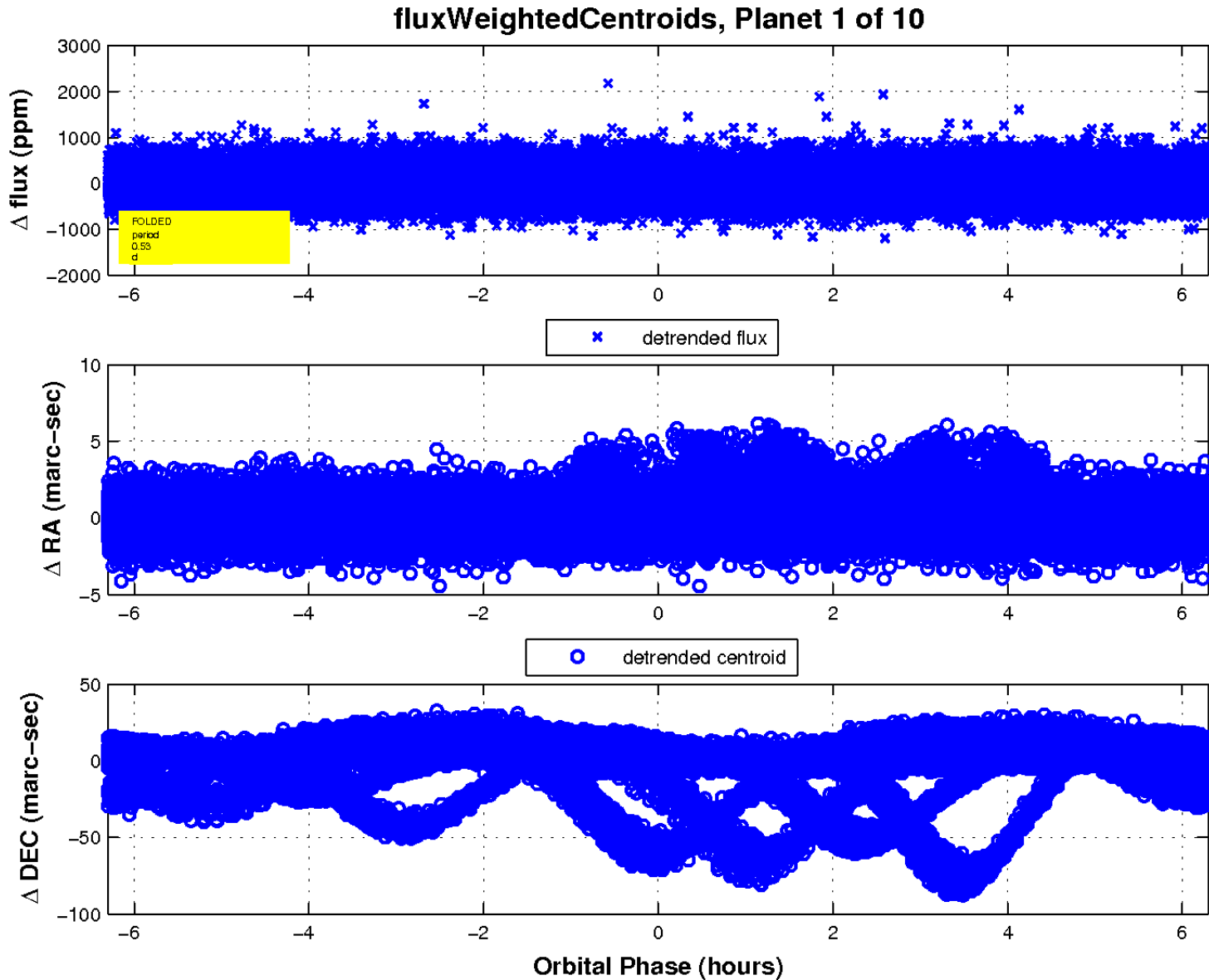
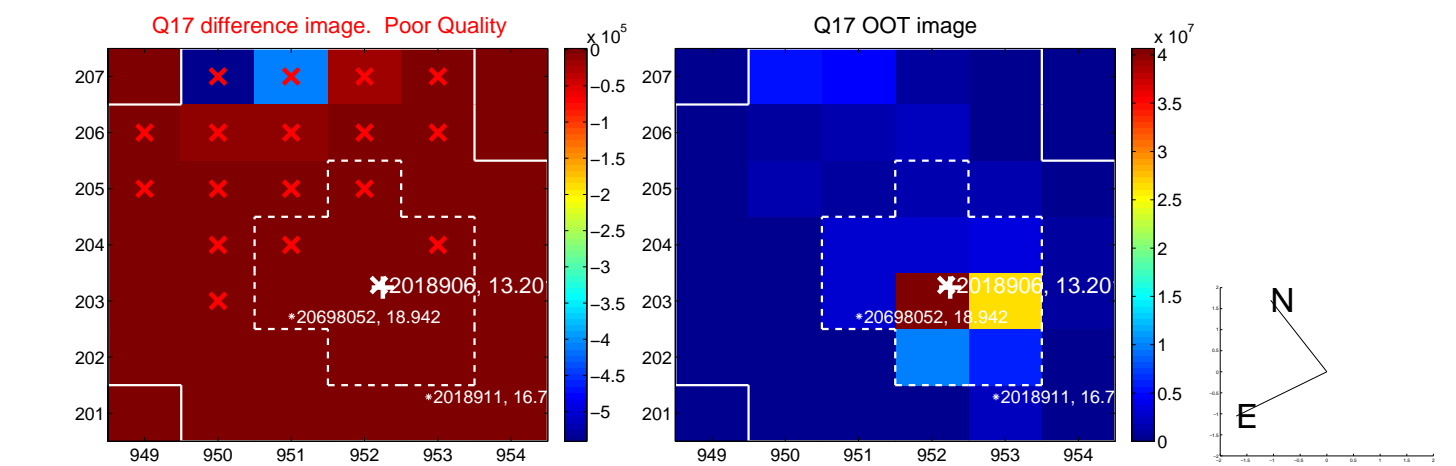
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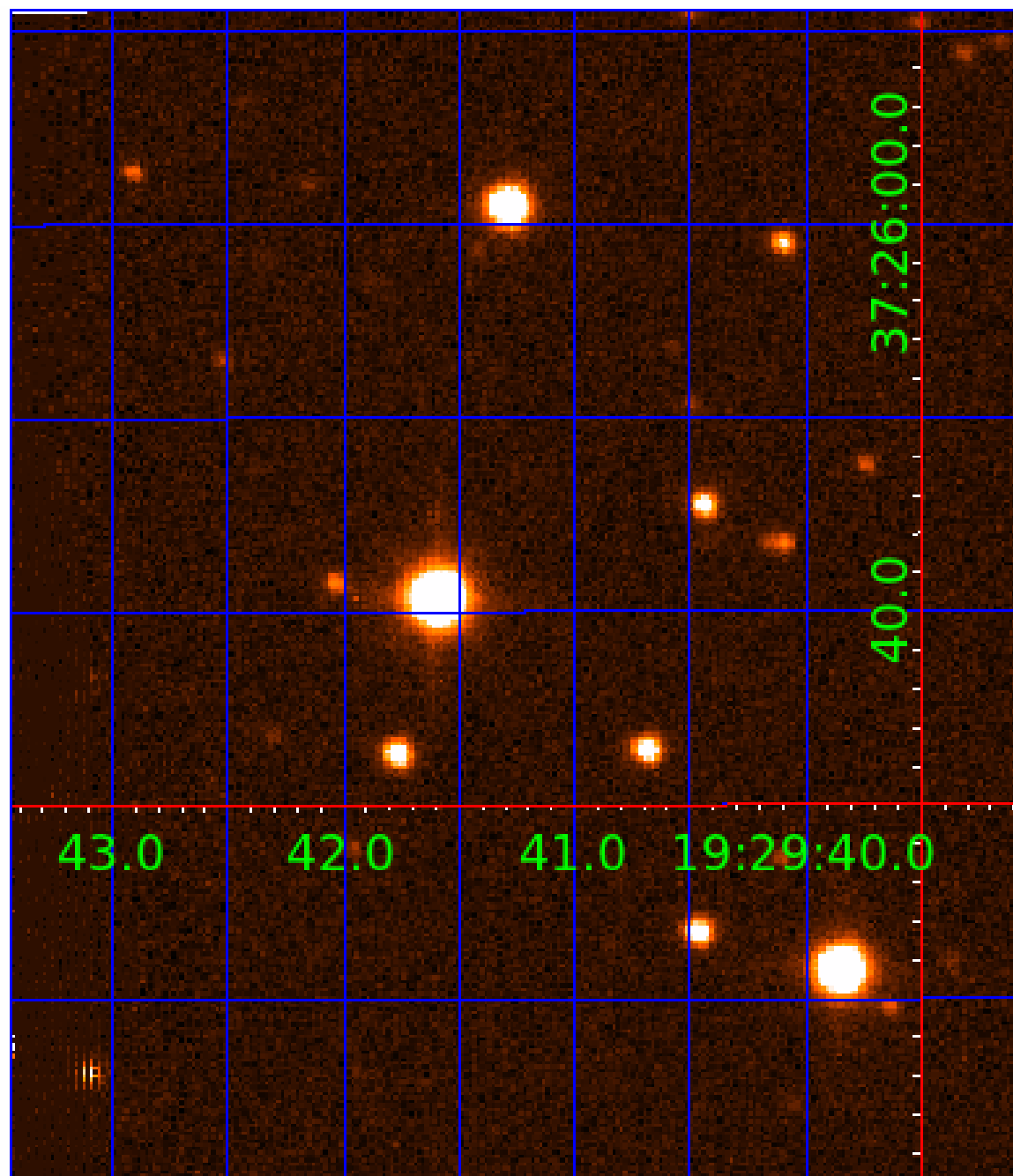


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 002018906

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
002018906-01	OBS	No	0.525149	131.658983	11.9	3.212	15.1	3.7	3.37	5046	1.24	0.00
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## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
002018906-01	OBS	FP	0.00	1	0	1	0	LPP_DV—CENT_RESOLVED_OFFSET
002018906-04	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-05	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-06	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-07	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-08	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-09	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS
002018906-10	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE_ZUMA—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_CROWDED

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

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

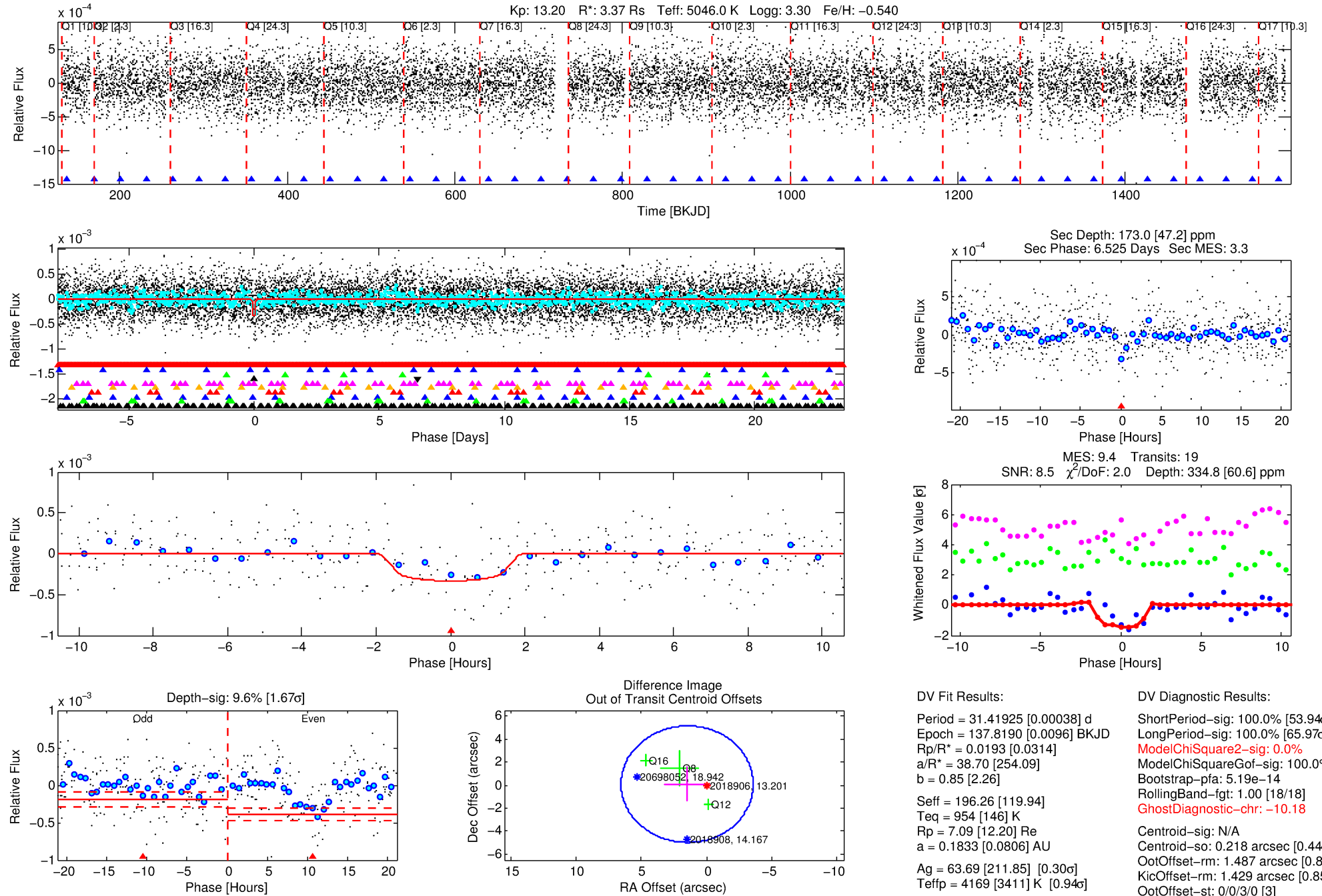
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 002018906-04

No Significant Match Found

# DV One-Page Summary

KIC: 2018906 Candidate: 4 of 10 Period: 31.419 d



## DV Fit Results:

Period = 31.41925 [0.00038] d  
Epoch = 137.8190 [0.0096] BKJD  
Rp/R\* = 0.0193 [0.0314]  
a/R\* = 38.70 [254.09]  
b = 0.85 [2.26]  
Seff = 196.26 [119.94]  
Teff = 954 [146] K  
Rp = 7.09 [12.20] Re  
a = 0.1833 [0.0806] AU  
Ag = 63.69 [211.85] [0.30 $\sigma$ ]  
Teffp = 4169 [3411] K [0.94 $\sigma$ ]

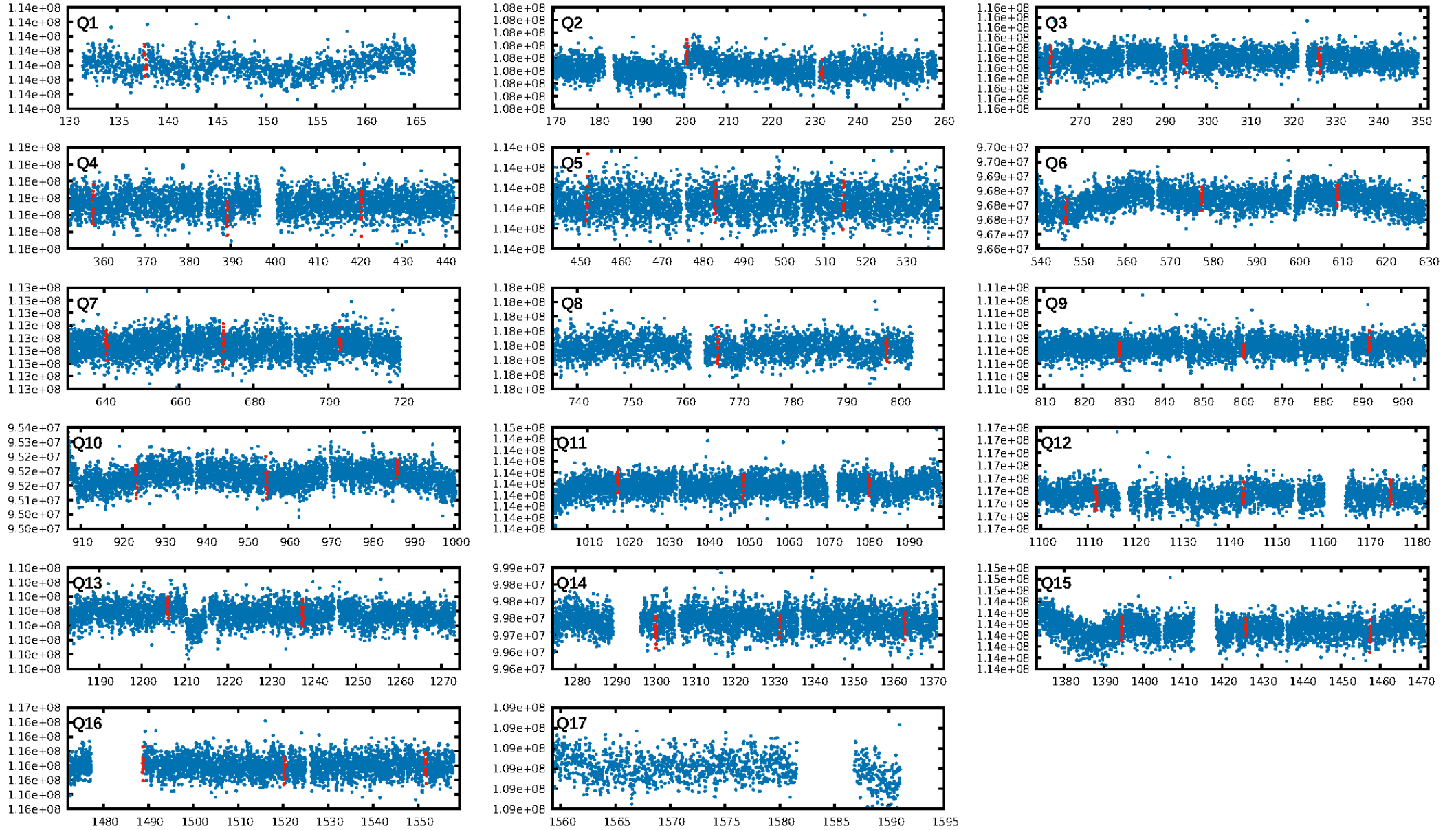
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [53.94 $\sigma$ ]  
LongPeriod-sig: 100.0% [65.97 $\sigma$ ]  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 5.19e-14  
RollingBand-fgt: 1.00 [18/18]  
GhostDiagnostic-chr: -10.18  
Centroid-sig: N/A  
Centroid-so: 0.218 arcsec [0.44 $\sigma$ ]  
OotOffset-rm: 1.487 arcsec [0.88 $\sigma$ ]  
KicOffset-rm: 1.429 arcsec [0.85 $\sigma$ ]  
OotOffset-st: 0/0/3/0 [3]  
KicOffset-st: 0/0/3/0 [3]  
DiffImageQuality-fgm: 0.33 [1/3]  
DiffImageOverlap-fno: 0.00 [0/16]

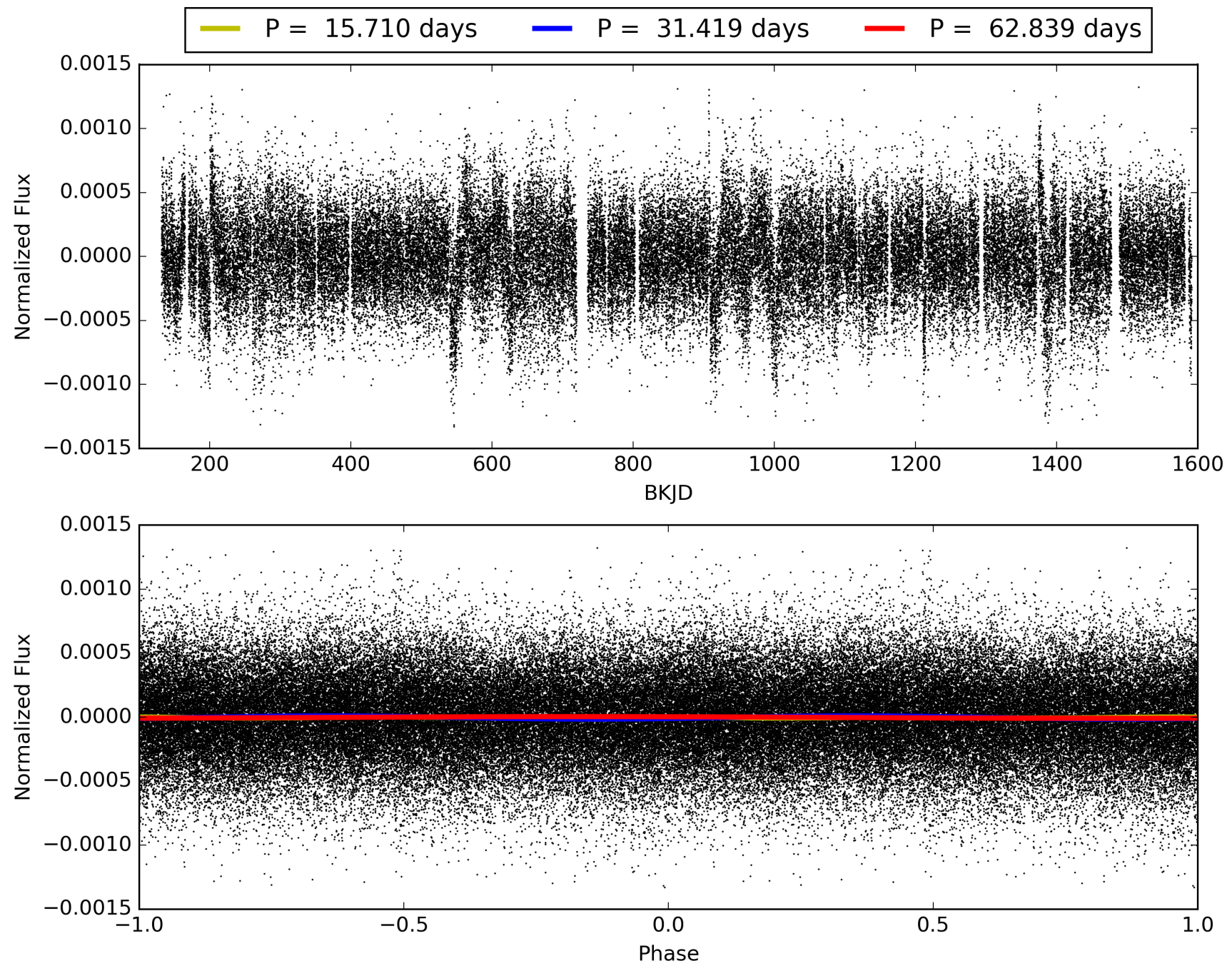
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 04:43:20 Z

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

# TCE 002018906-04, PDC Light Curves



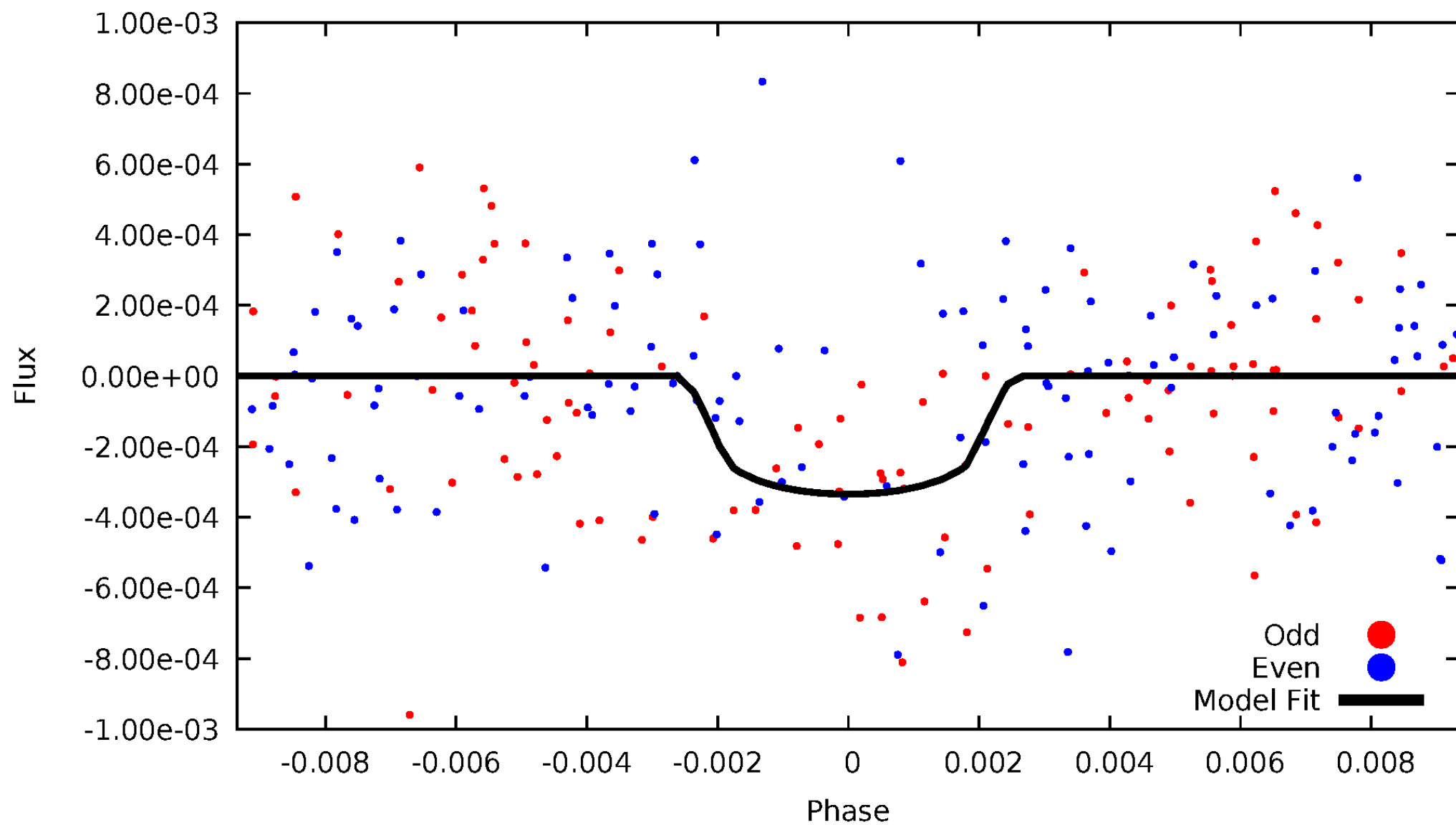
TCE 002018906-04





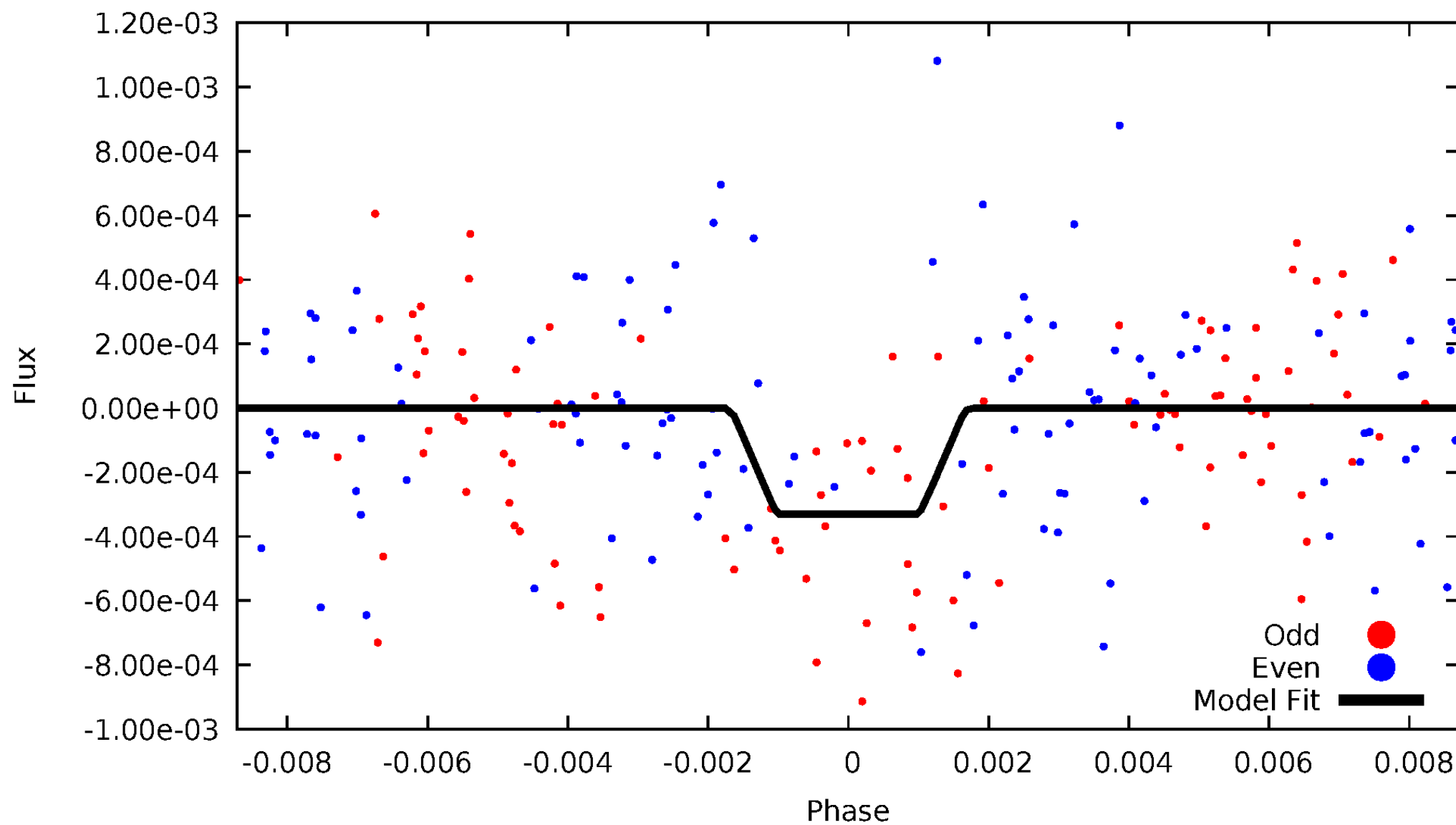
# DV Odd/Even

TCE 002018906-04



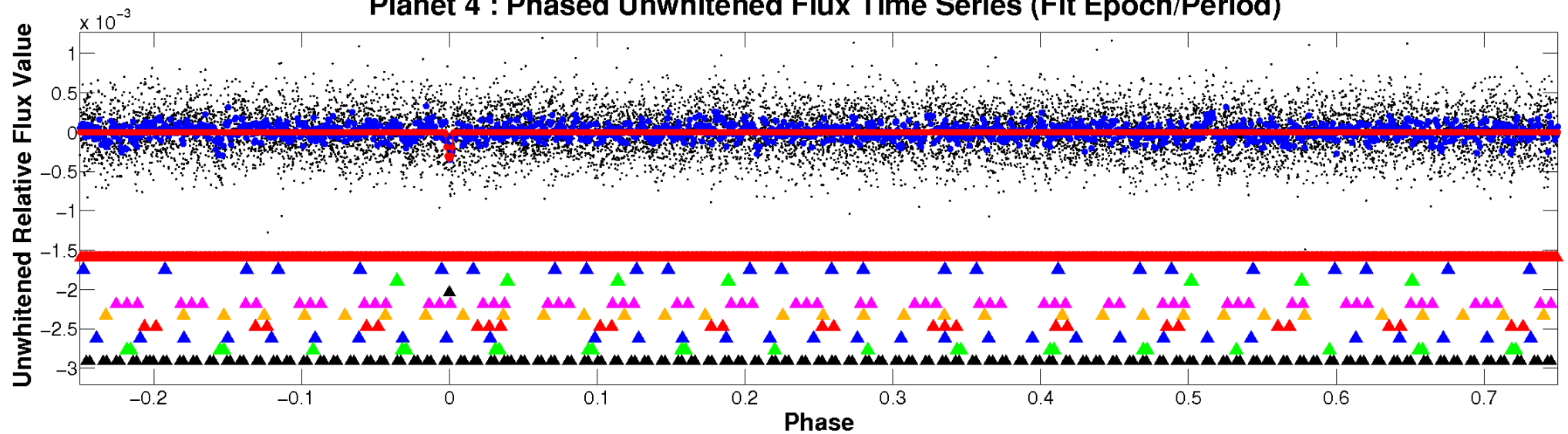
# ALT Odd/Even

TCE 002018906-04

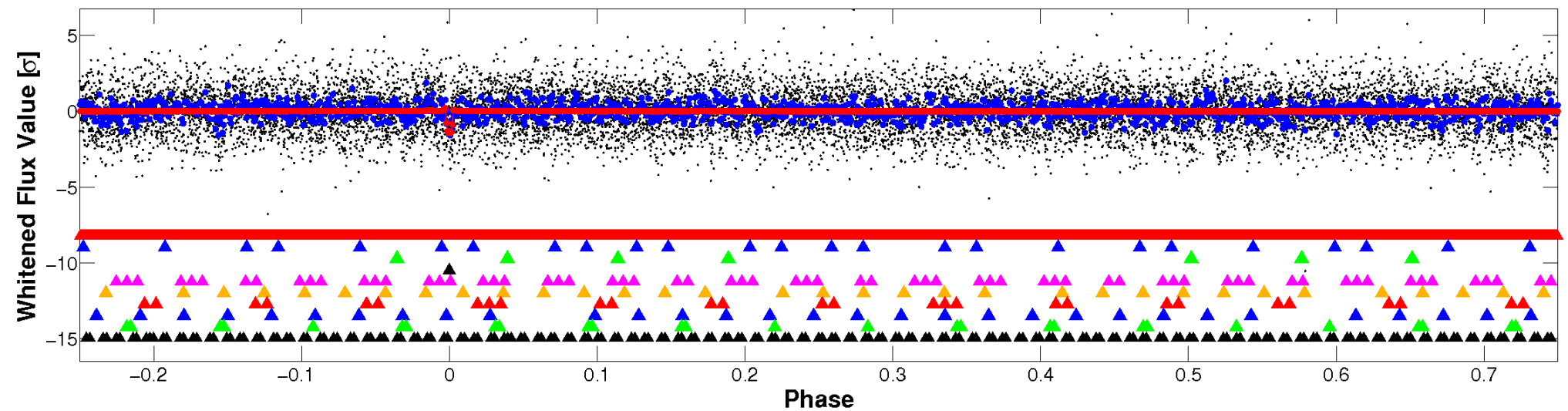


# Non-Whitened Vs. Whitened Light Curve

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

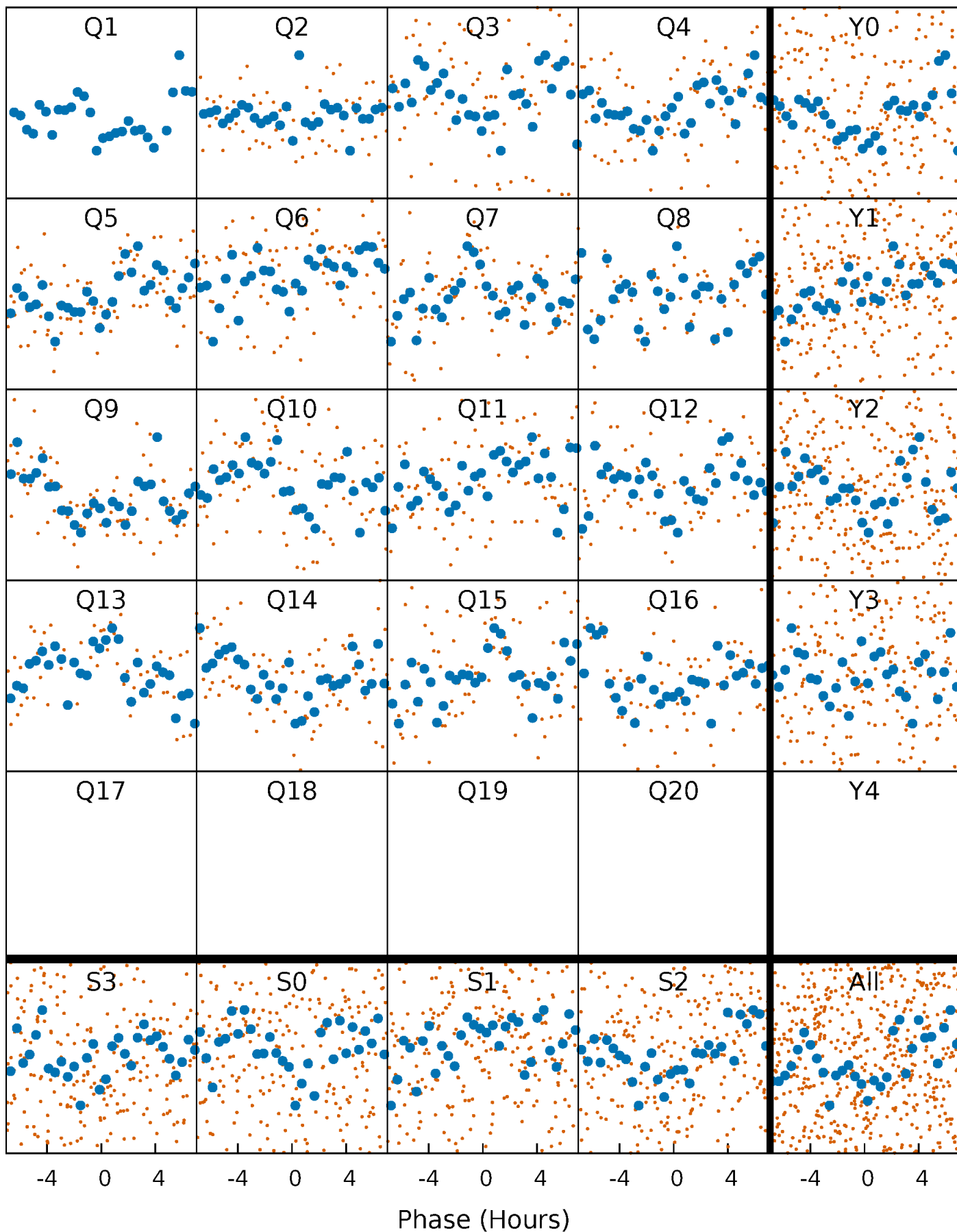


## Planet 4 : Phased Whitened Flux Time Series (Fit Epoch/Period)



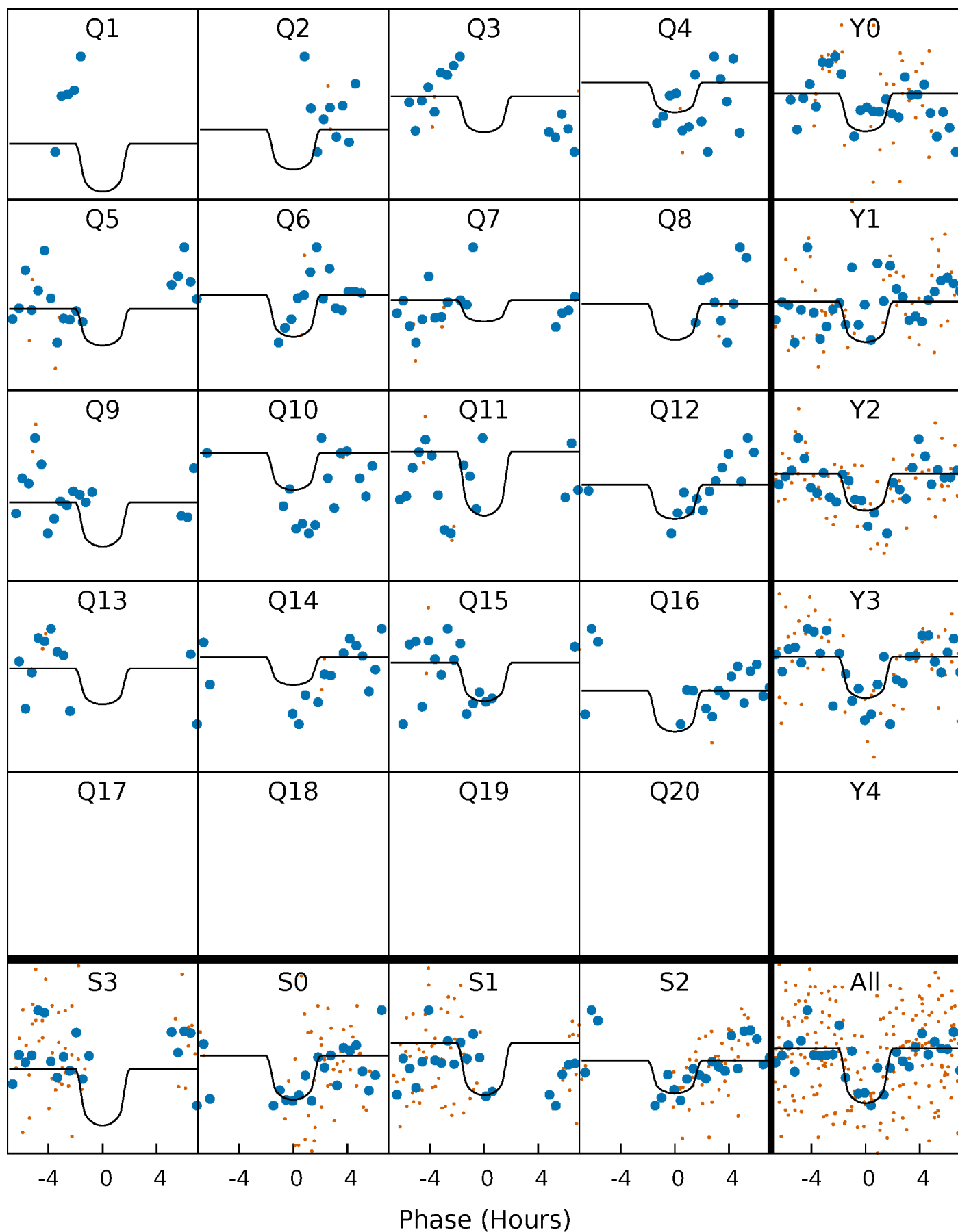
# PDC Quarter-Phased Transit Curves

TCE 002018906-04   P= 31.419253 Days    $T_0=137.819040$  (BKJD)



# DV Quarter-Phased Transit Curves

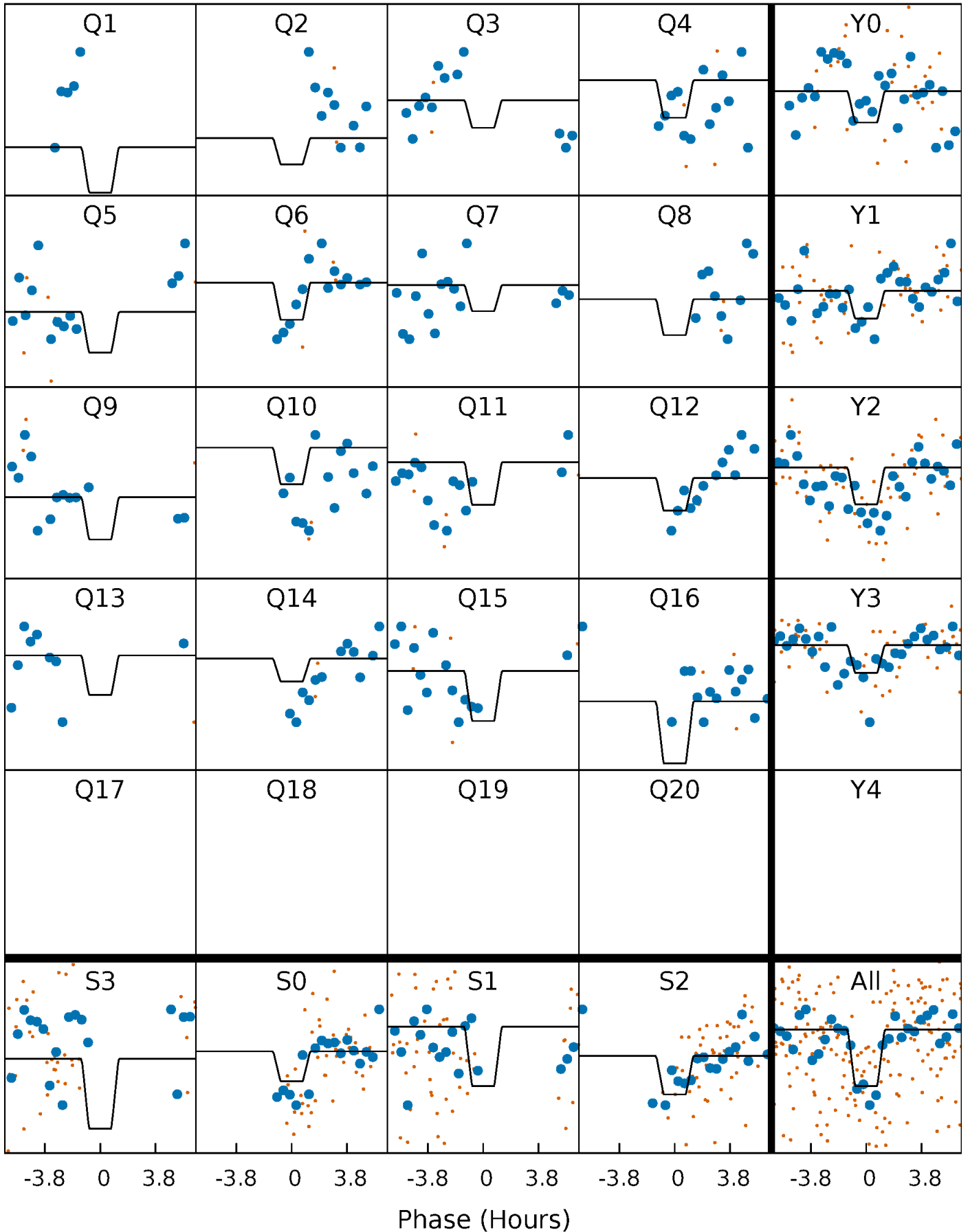
TCE 002018906-04     $P = 31.419253$  Days     $T_0 = 137.819040$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

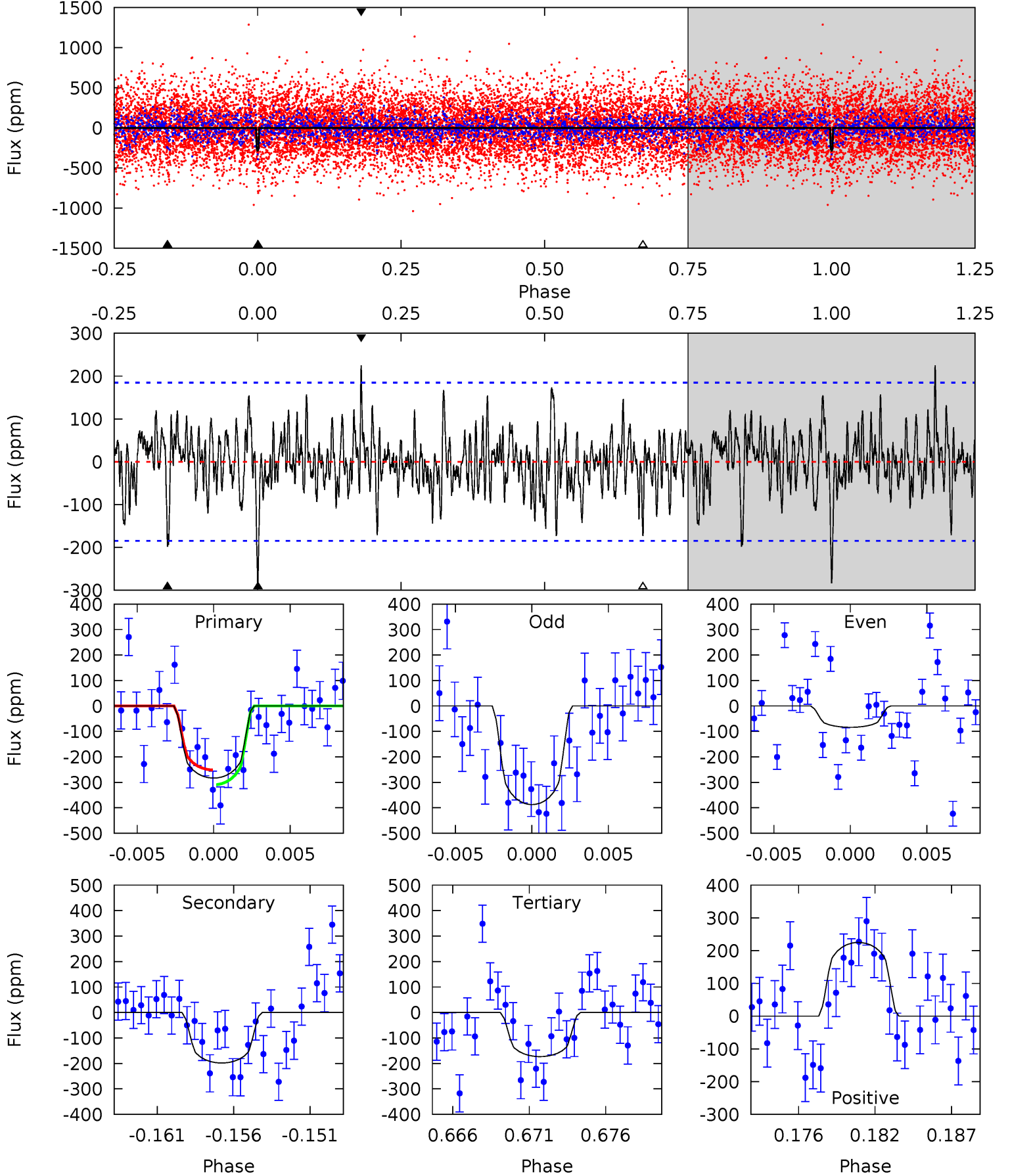
TCE 002018906-04 P= 31.420240 Days  $T_0=137.802260$  (BKJD)



# DV Model-Shift Uniqueness Test

002018906-04, P = 31.419253 Days, E = 106.399787 Days

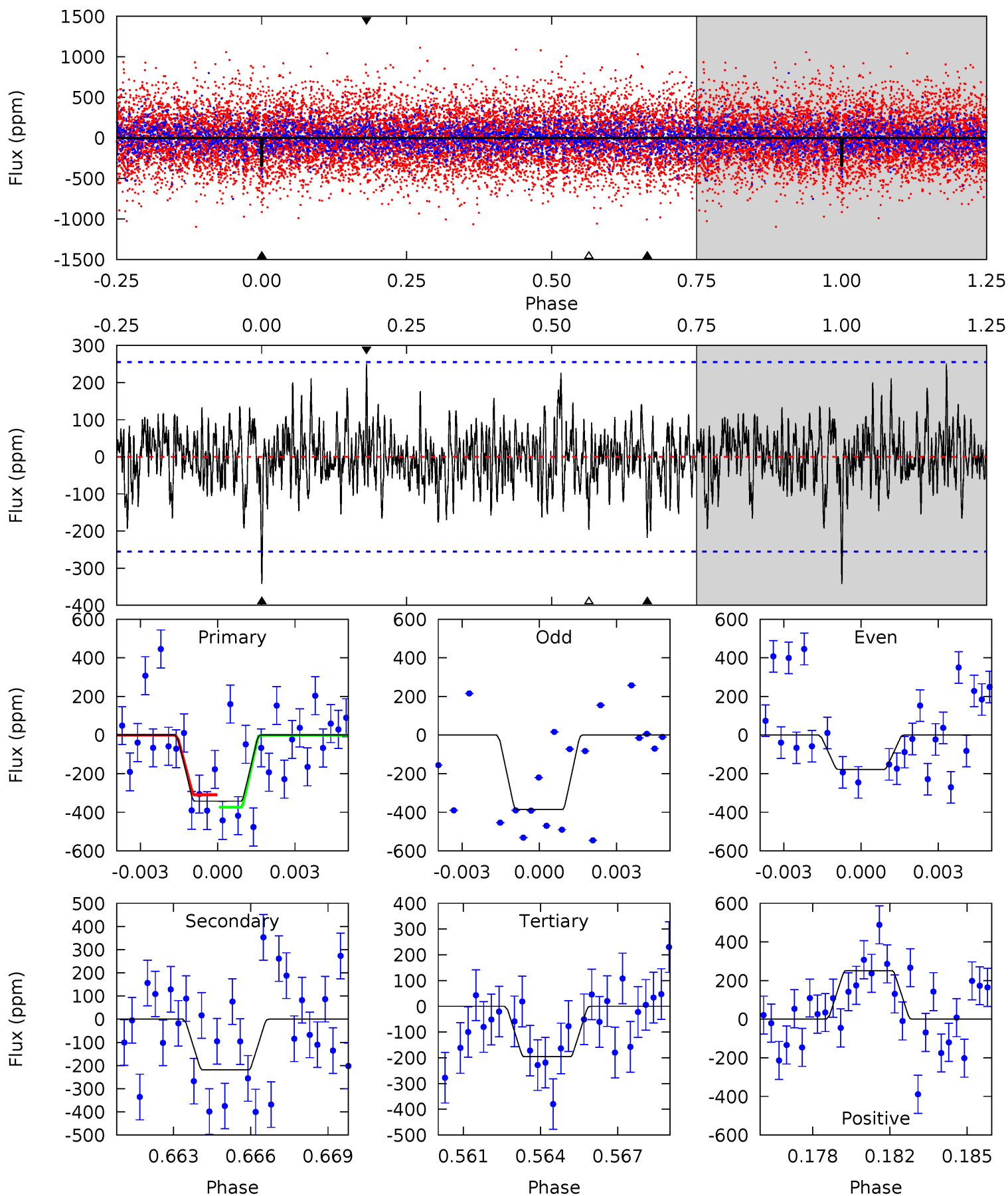
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
7.90	5.53	4.83	6.28	5.16	2.80	1.58	3.07	1.62	0.70	-0.75	4.27	0.77	0.44	0.80



# Alt Model-Shift Uniqueness Test

002018906-04, P = 31.420240 Days, E = 106.382020 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
7.03	4.48	4.02	5.16	5.24	2.95	1.32	3.01	1.86	0.46	-0.68	1.90	1.11	0.42	0.66



### Stellar Parameters For KIC 002018906

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5046^{+127}_{-102}$	$3.303^{+0.310}_{-0.310}$	$-0.540^{+0.300}_{-0.250}$	$3.370^{+1.870}_{-1.007}$	$0.832^{+0.283}_{-0.165}$	$0.031^{+0.053}_{-0.022}$
	+3%/-2%	+9%/-9%	+56%/-46%	+55%/-30%	+34%/-20%	+172%/-72%
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 002018906-04 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-198 \pm 36$	$11.26^{+10.51}_{-7.47}$	$1340^{+169}_{-133}$	$3753^{+2144}_{-687}$	$29^{+217}_{-21}$
Alt.	$-218 \pm 49$	$11.02^{+9.77}_{-7.15}$	$1325^{+179}_{-124}$	$3892^{+1817}_{-781}$	$34^{+224}_{-25}$

$T_{\text{max}}$  = 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

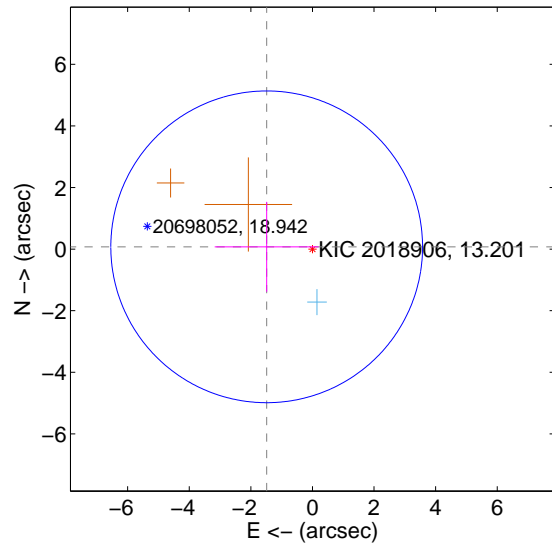
Supplemental centroid analysis for 002018906-04. Kepler magnitude: 13.20. Transit SNR 8.50

There are 1 quarters with good PRF difference image offsets

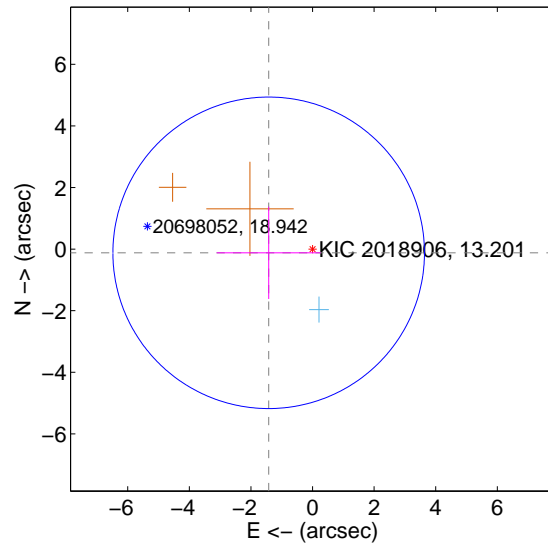
The direct PRF centroid is offset from the target star catalog position by about 0.15 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.487 \pm 1.687$	0.88	$1.486 \pm 1.688$	$0.074 \pm 1.460$
PRF-fit source offset from KIC position	$1.429 \pm 1.686$	0.85	$1.424 \pm 1.687$	$-0.121 \pm 1.500$
photometric centroid source offset	$0.22 \pm 0.50$	0.44	$-0.22 \pm 0.50$	$0.02 \pm 0.57$

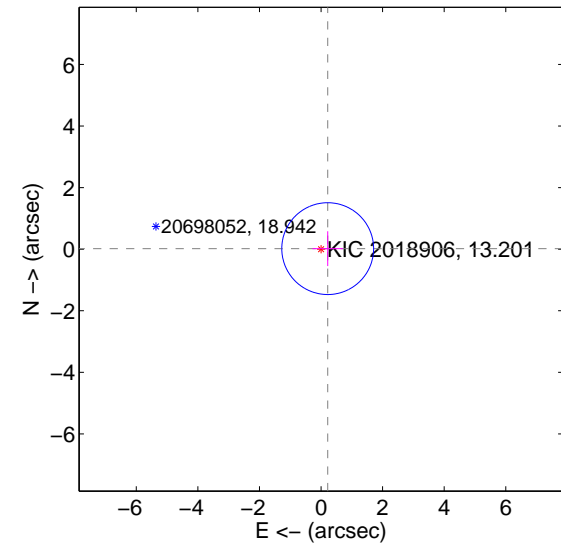
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position



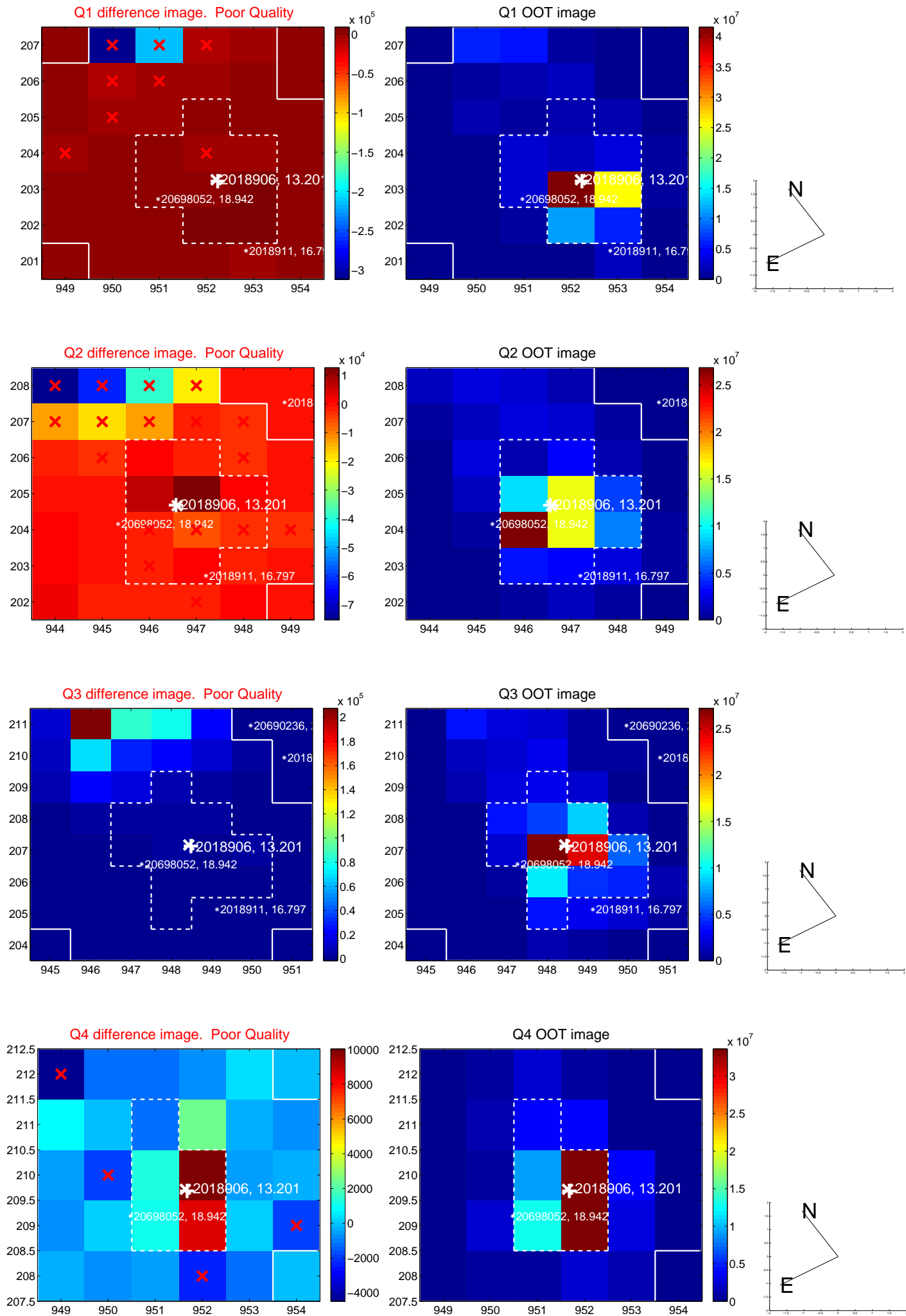
offset from photometric centroids



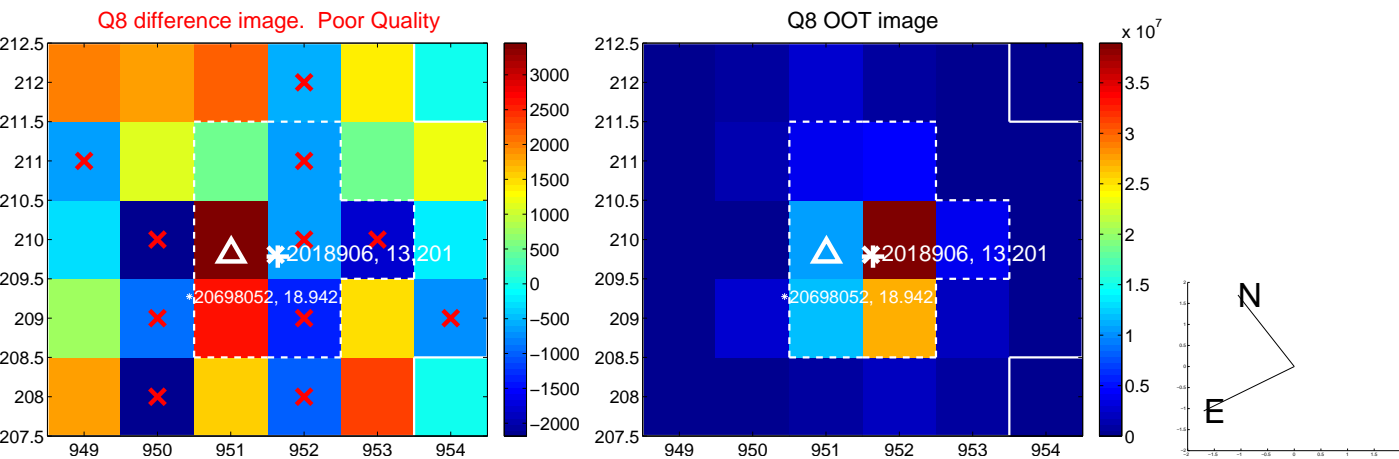
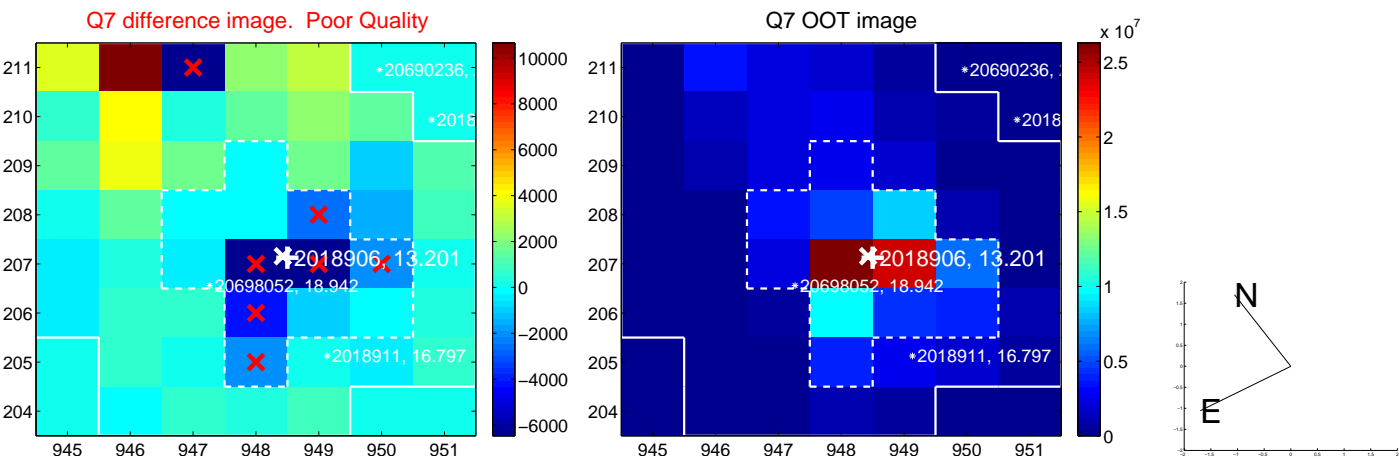
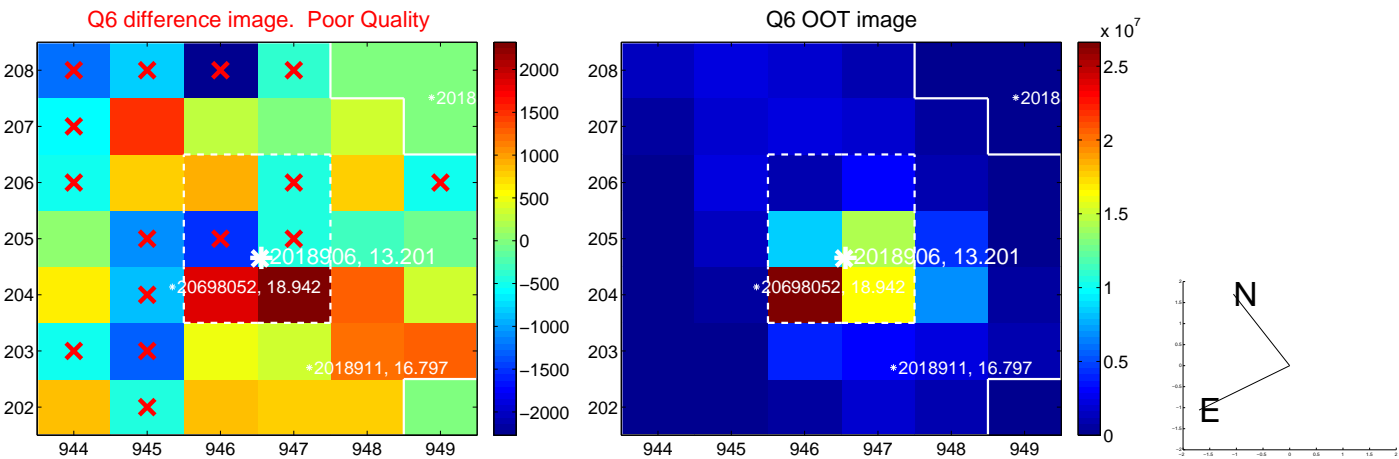
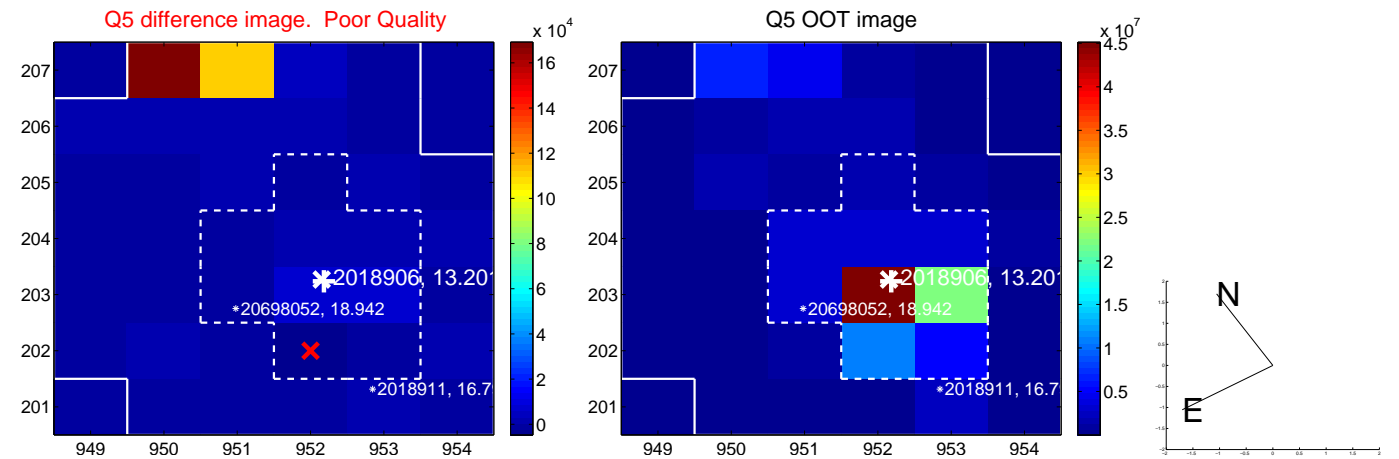
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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



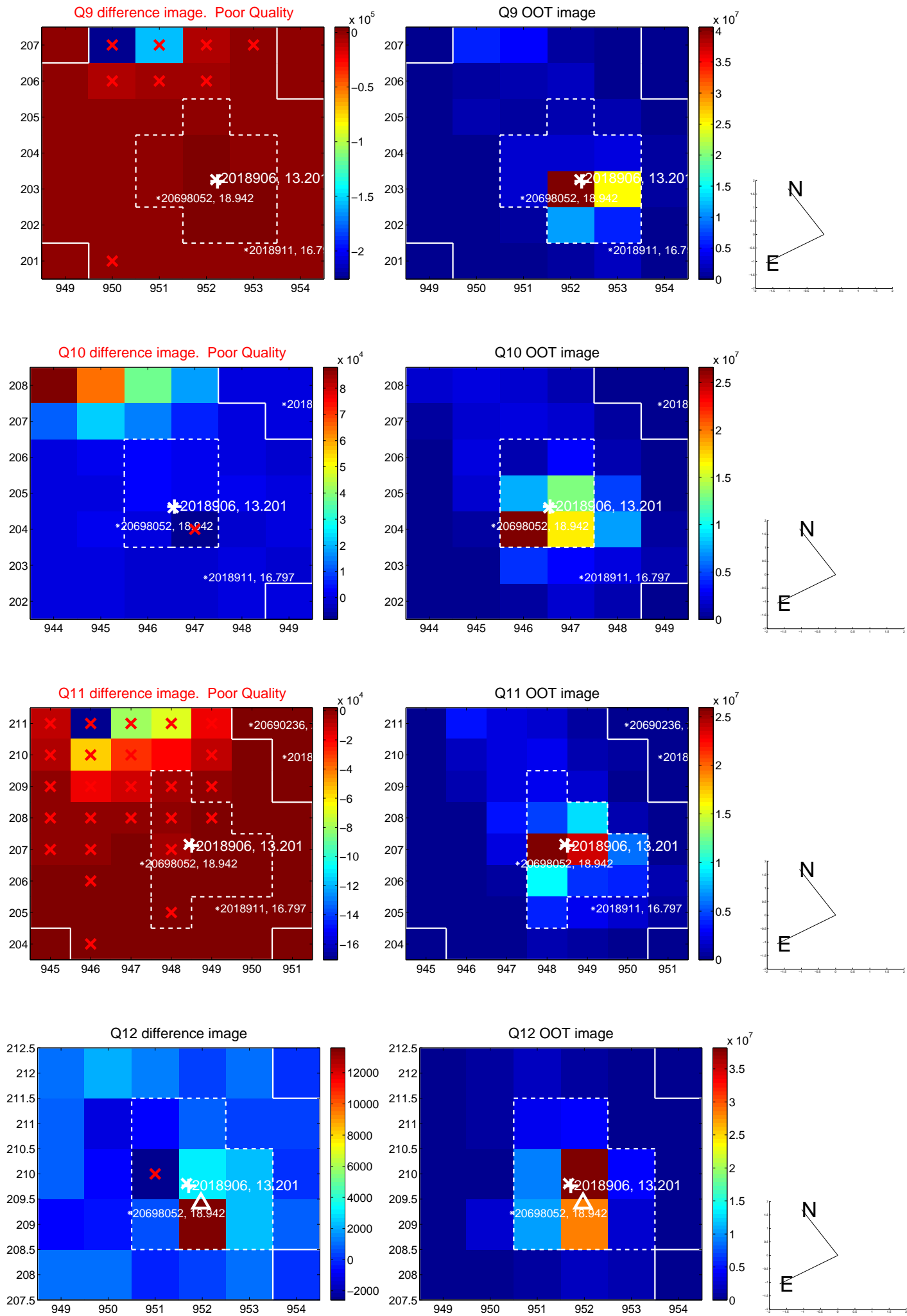
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



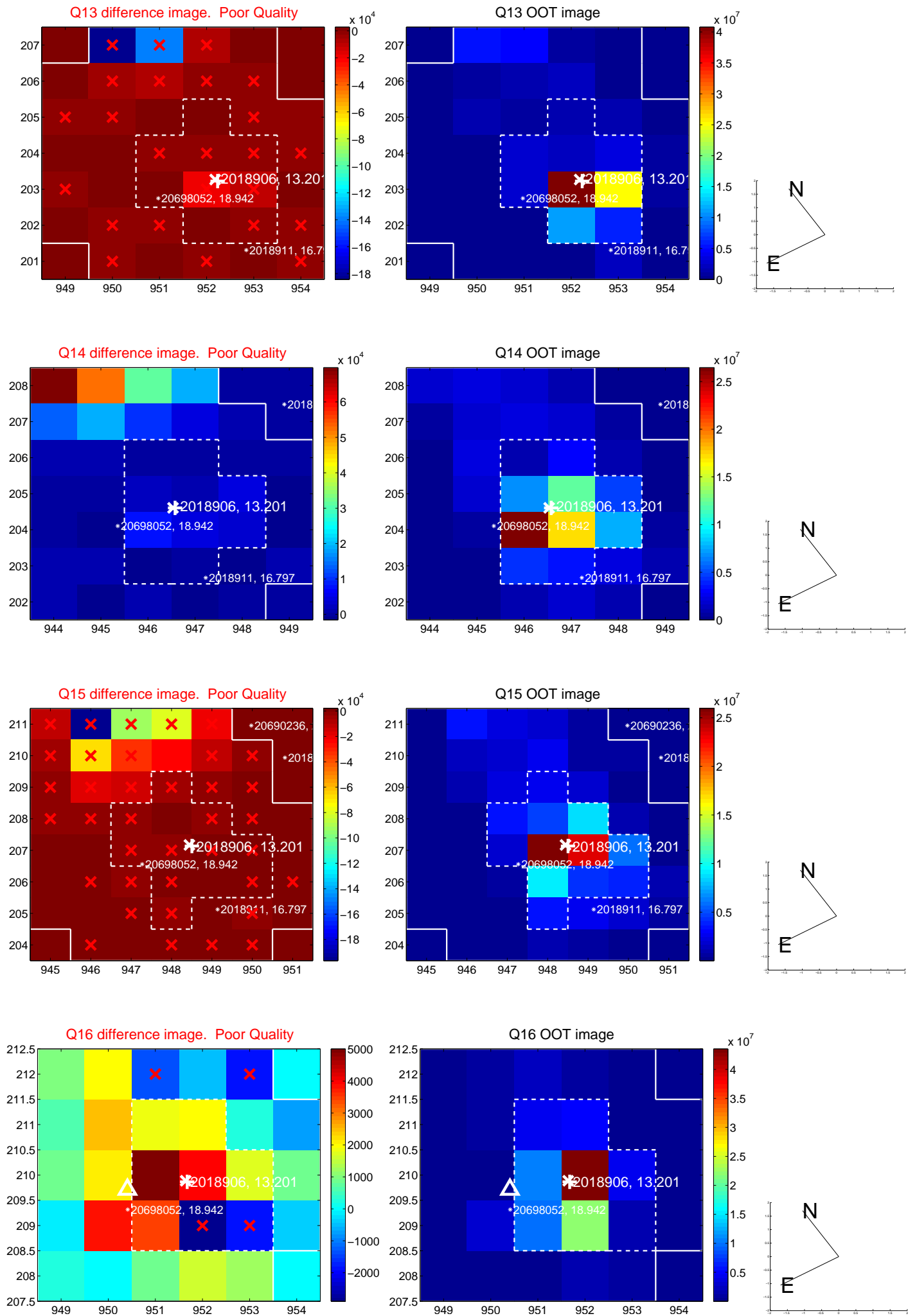
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



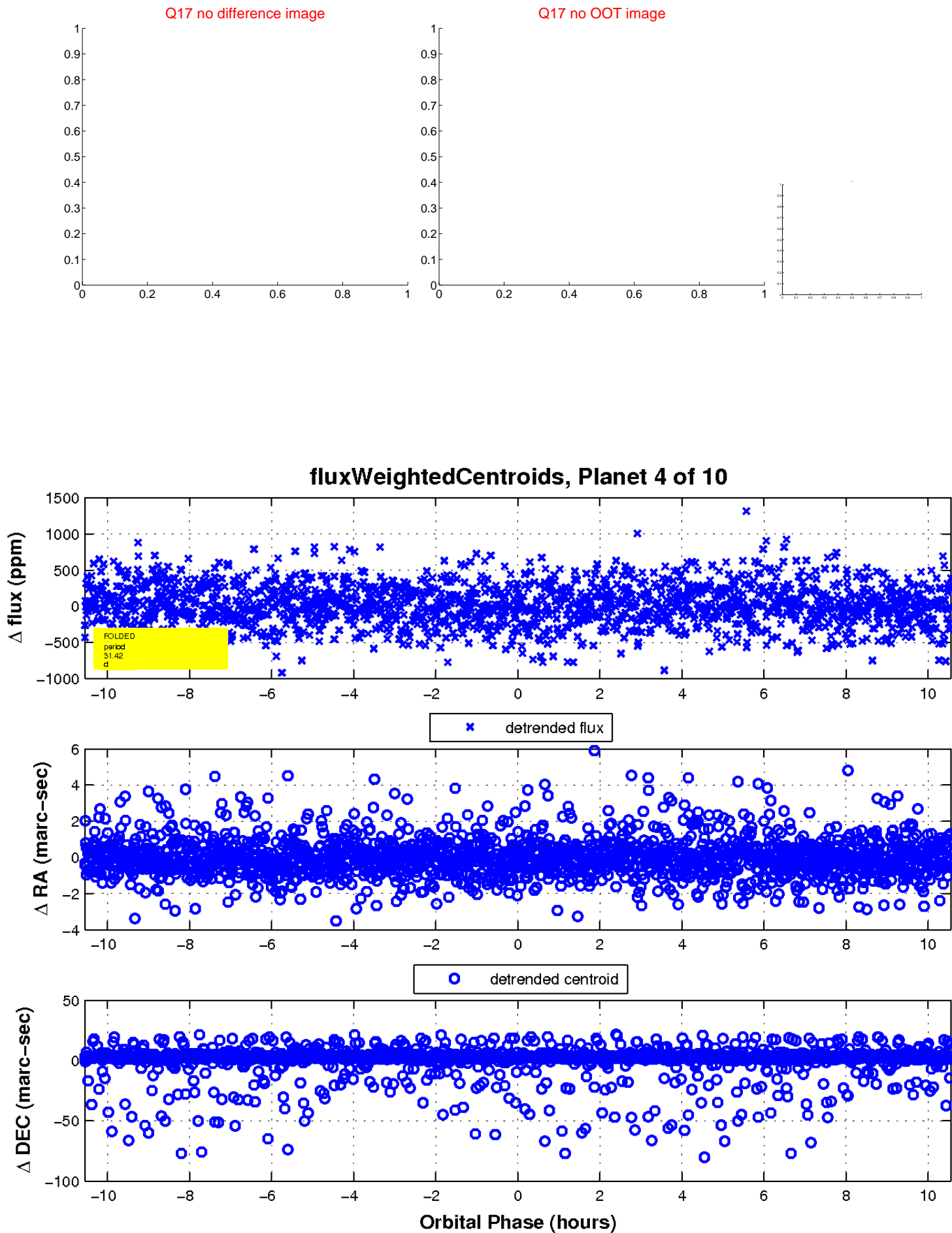
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



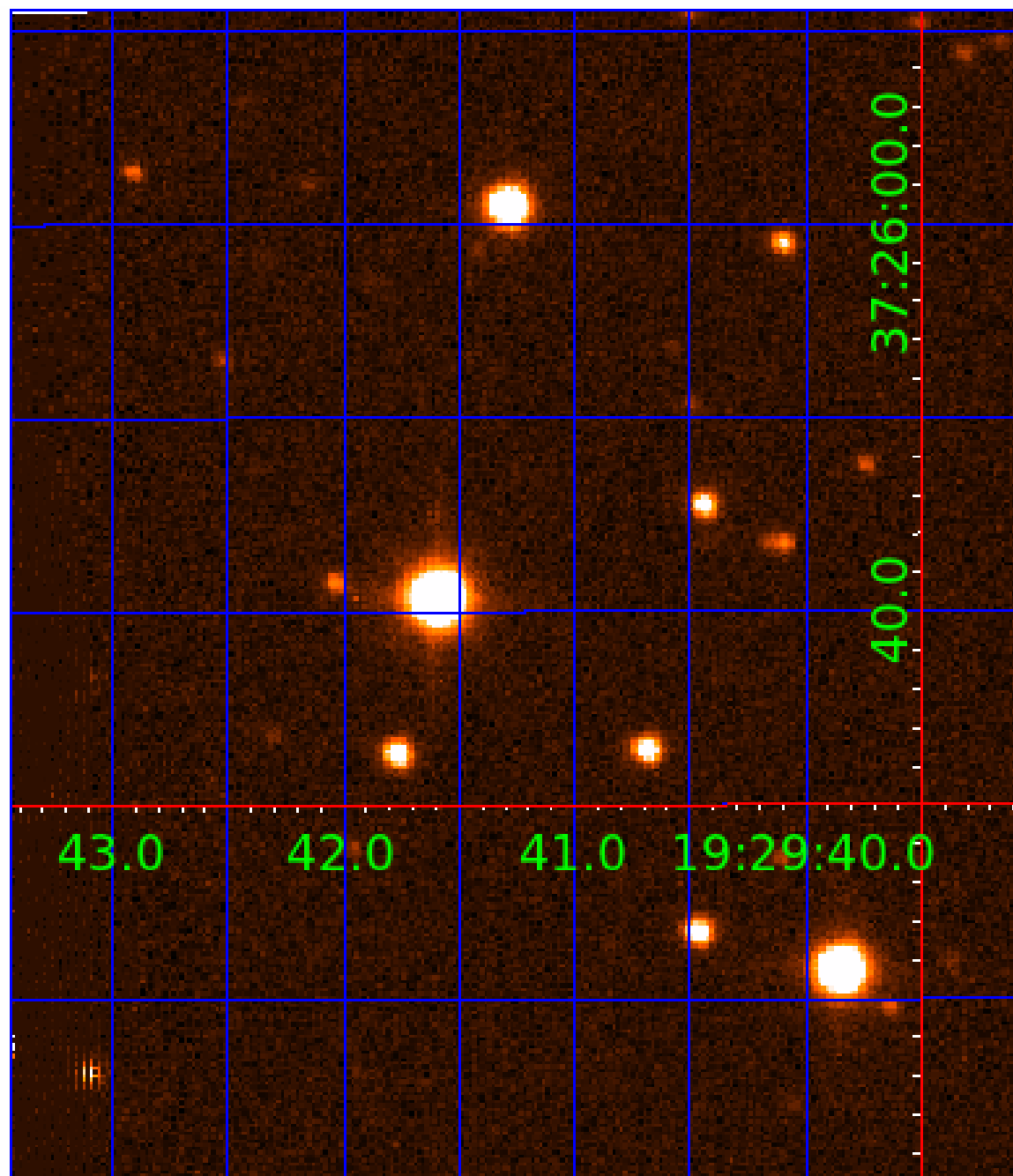
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.





UKIRT Image

Declination



# KIC 002018906

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
002018906-01	OBS	No	0.525149	131.658983	11.9	3.212	15.1	3.7	3.37	5046	1.24	0.00
002018906-04	OBS	No	31.419253	137.819040	334.8	3.524	9.4	8.5	3.37	5046	7.09	196.26
002018906-05	OBS	No	22.245829	137.842474	441.7	2.059	9.2	10.5	3.37	5046	7.50	311.01
002018906-06	OBS	No	44.158582	138.108488	370.8	3.010	9.1	9.2	3.37	5046	7.29	124.67
002018906-07	OBS	No	53.152195	148.596580	587.8	1.755	8.9	9.6	3.37	5046	9.31	97.37
002018906-08	OBS	No	46.663938	154.862044	409.6	2.876	7.8	8.6	3.37	5046	8.08	115.82
002018906-09	OBS	No	53.025159	168.237150	329.6	2.994	8.1	7.9	3.37	5046	7.32	97.68
002018906-10	OBS	No	7.605976	131.528571	187.7	3.276	9.2	10.1	3.37	5046	5.50	1300.86

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
002018906-01	OBS	FP	0.00	1	0	1	0	LPP_DV—CENT_RESOLVED_OFFSET
002018906-04	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-05	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-06	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-07	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-08	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-09	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS
002018906-10	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE_ZUMA—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_CROWDED

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

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

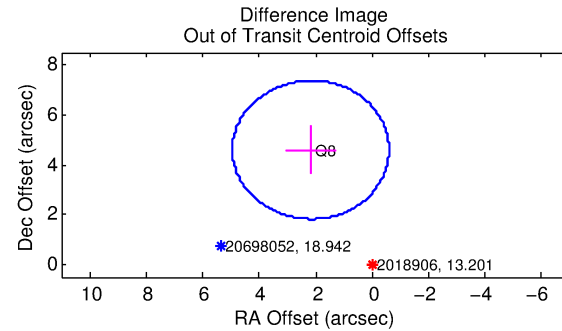
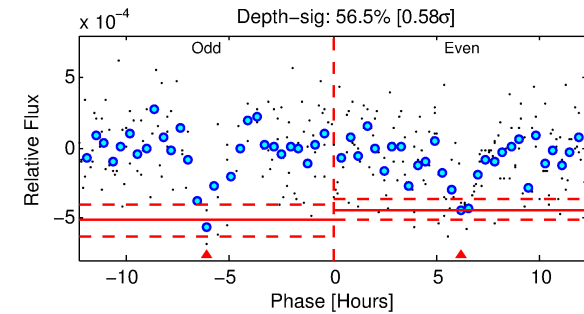
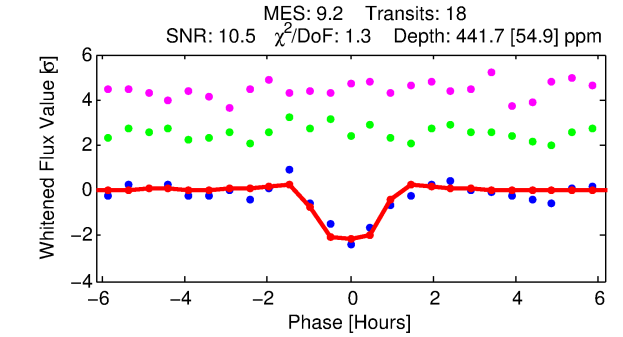
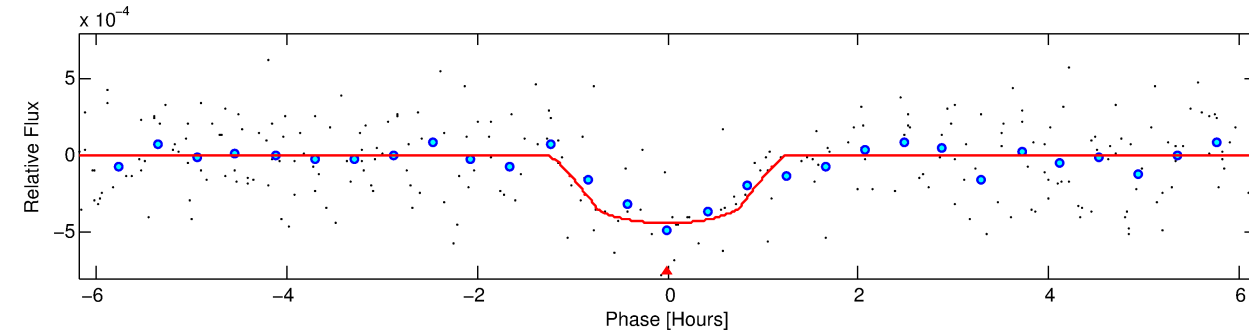
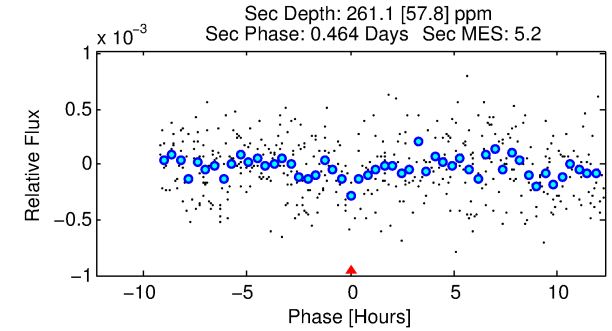
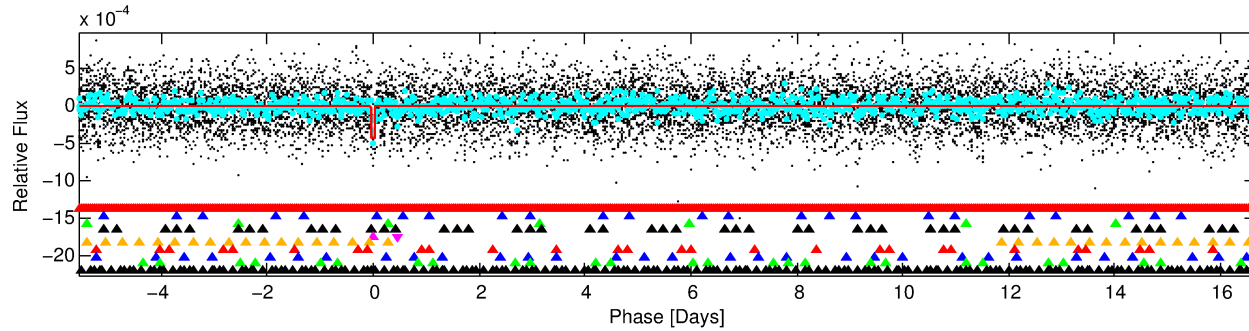
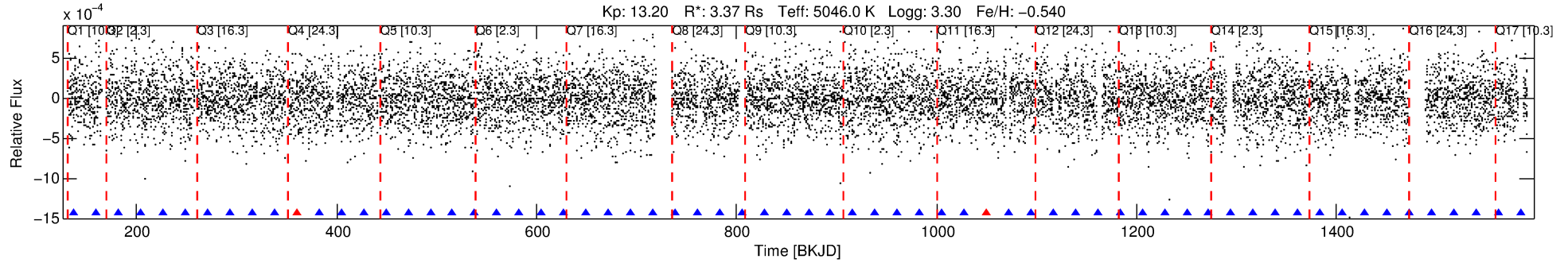
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 002018906-05

No Significant Match Found

# DV One-Page Summary

KIC: 2018906 Candidate: 5 of 10 Period: 22.246 d



## DV Fit Results:

Period = 22.24583 [0.00016] d  
Epoch = 137.8425 [0.0064] BKJD  
Rp/R\* = 0.0204 [0.0368]  
a/R\* = 63.37 [435.34]  
b = 0.67 [5.72]  
Seff = 311.01 [190.05]  
Teq = 1071 [164] K  
Rp = 7.50 [14.17] Re  
a = 0.1456 [0.0641] AU  
Ag = 54.18 [198.82] [0.27σ]  
Teffp = 4492 [4066] K [0.84σ]

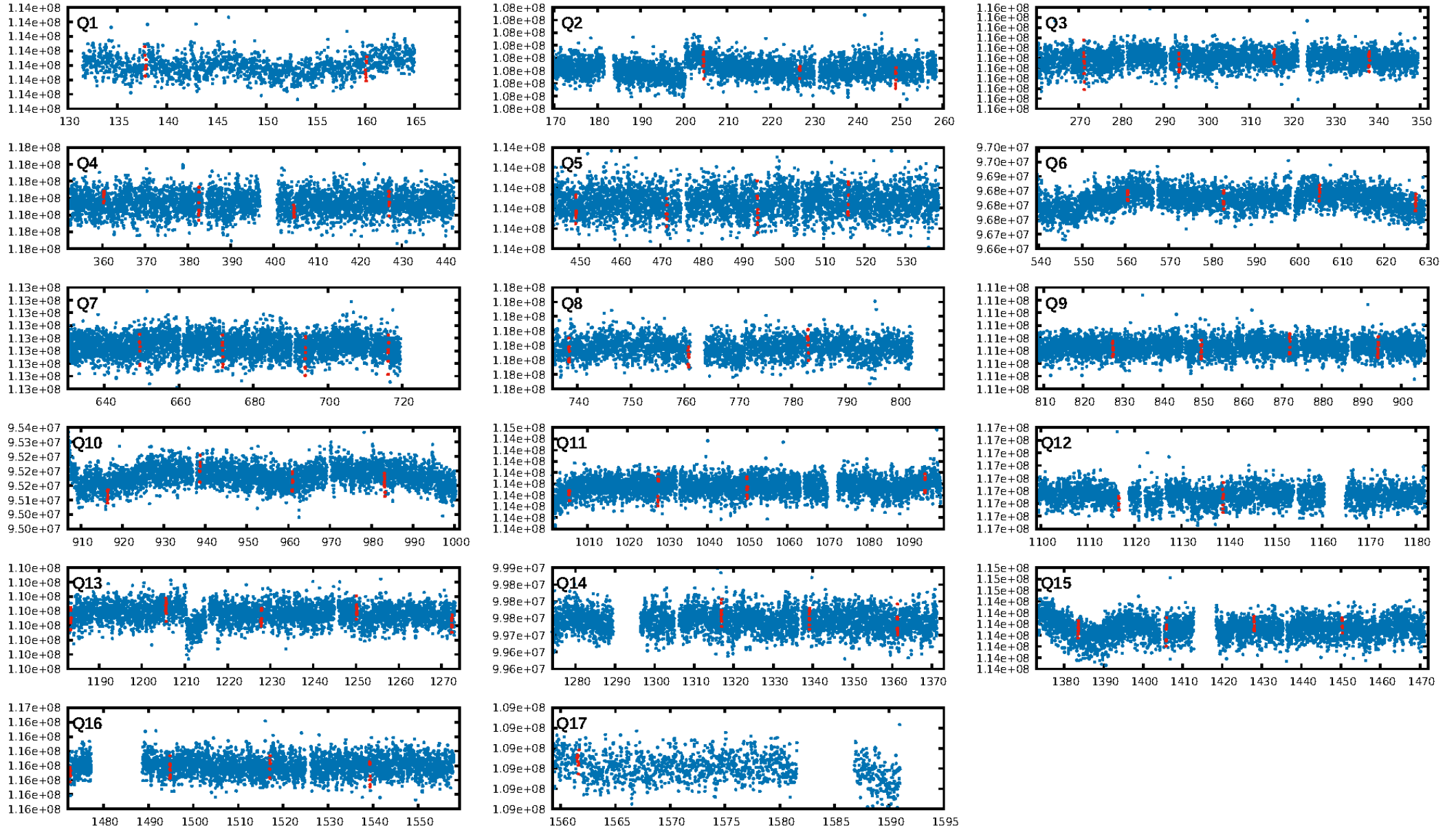
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [90.79σ]  
LongPeriod-sig: 100.0% [53.94σ]  
ModelChiSquare2-sig: 30.7%  
ModelChiSquareGof-sig: 100.0%  
**Bootstrap-pfa: 8.00e-11**  
RollingBand-fgt: 0.89 [16/18]  
GhostDiagnostic-chr: -1.542  
Centroid-sig: N/A  
Centroid-so: 0.921 arcsec [2.00σ]  
**OotOffset-rm: 5.081 arcsec [5.50σ]**  
**KicOffset-rm: 4.933 arcsec [5.34σ]**  
OotOffset-st: 0/0/1/0 [1]  
KicOffset-st: 0/0/1/0 [1]  
DiffImageQuality-fgm: 0.00 [0/1]  
DiffImageOverlap-fno: 0.00 [0/17]

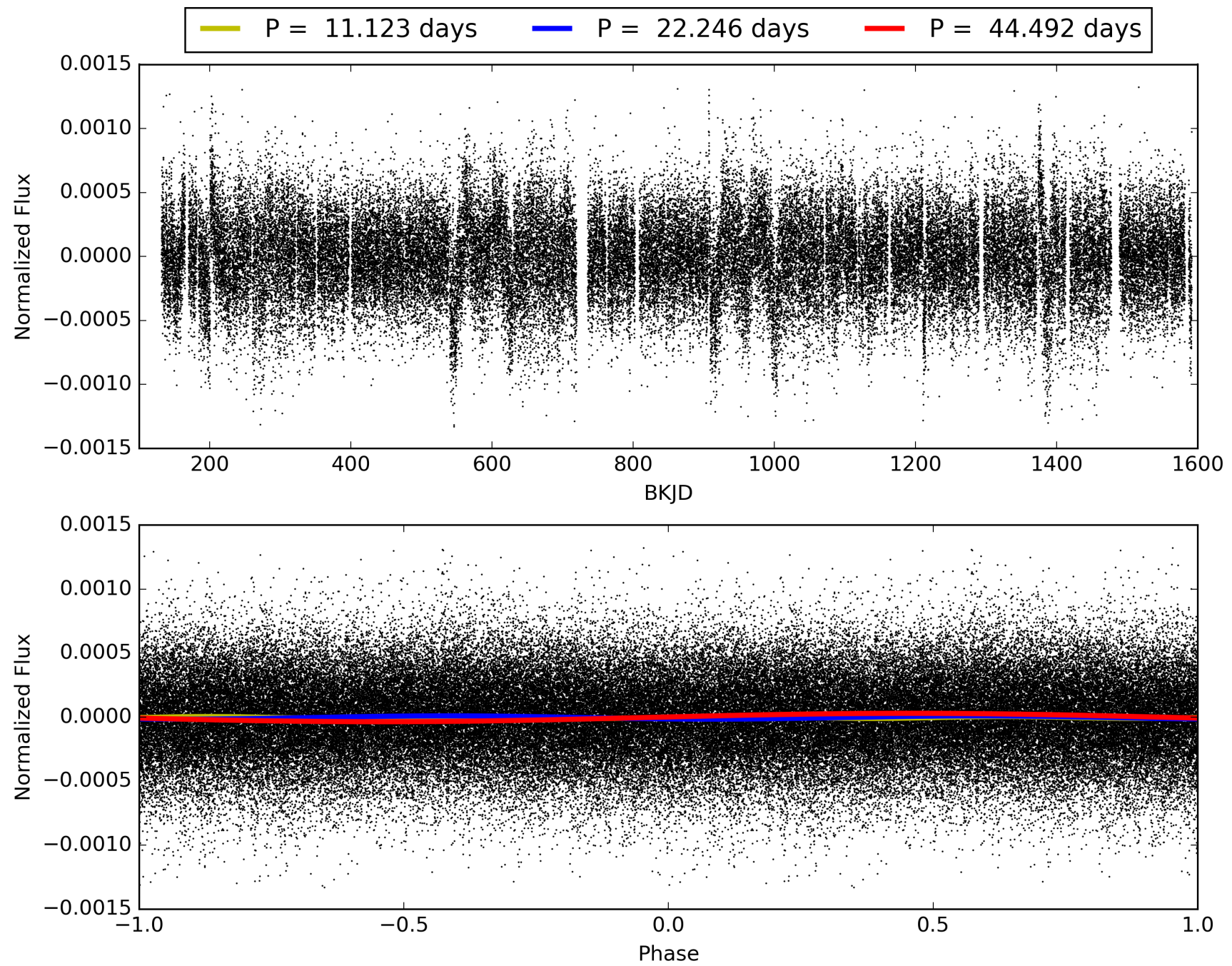
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 04:43:24 Z

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

# TCE 002018906-05, PDC Light Curves



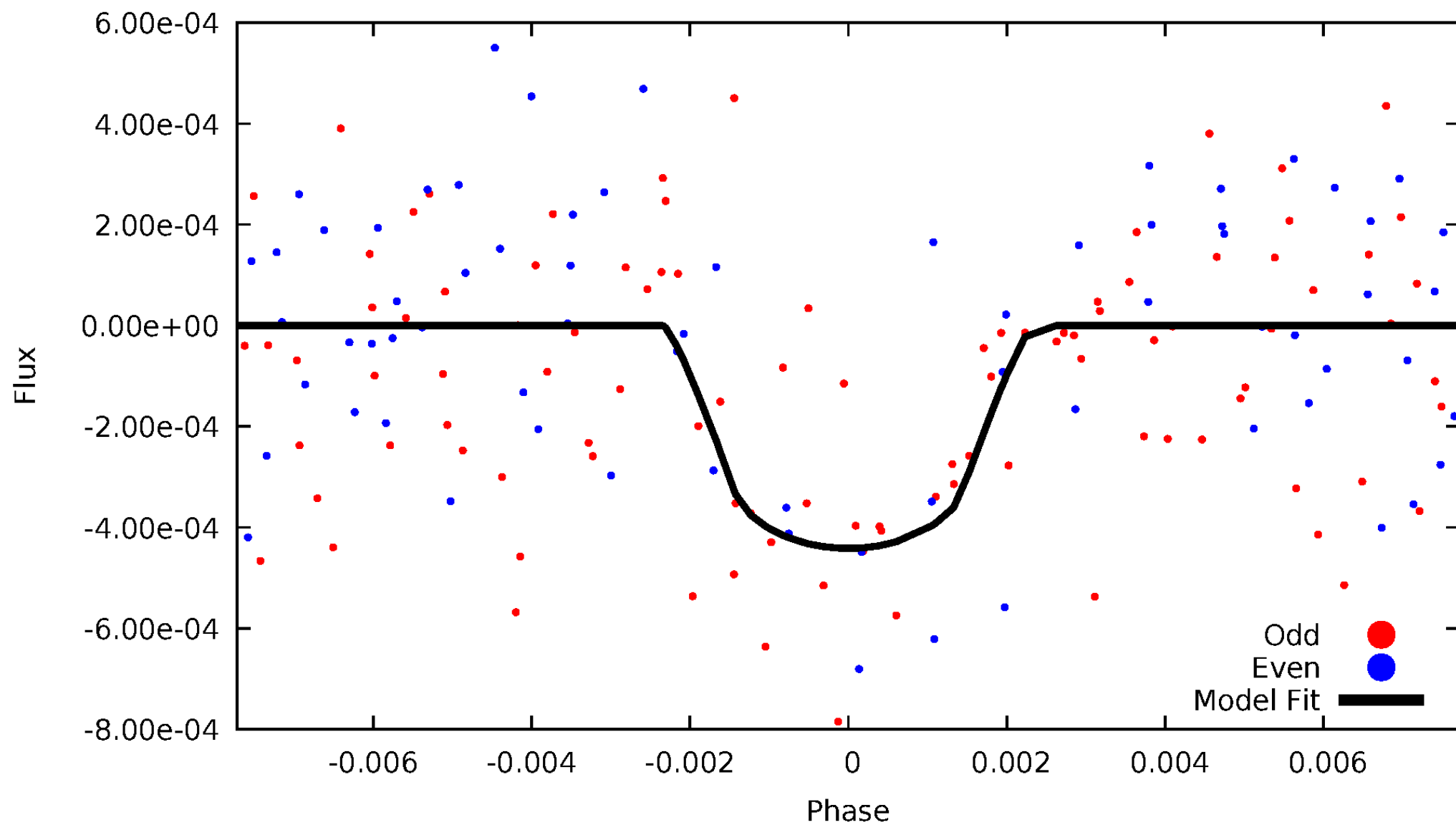
TCE 002018906-05





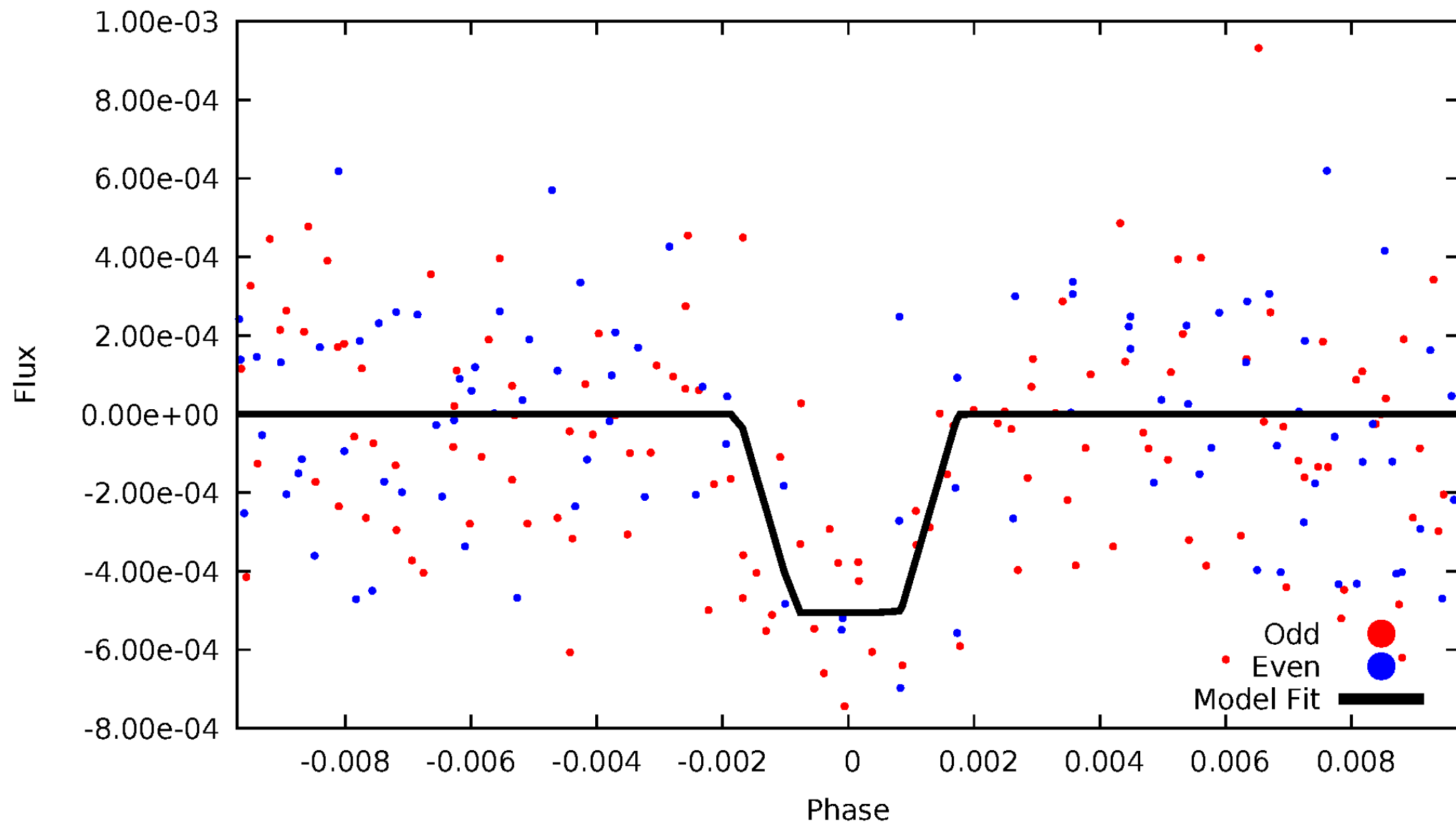
# DV Odd/Even

TCE 002018906-05



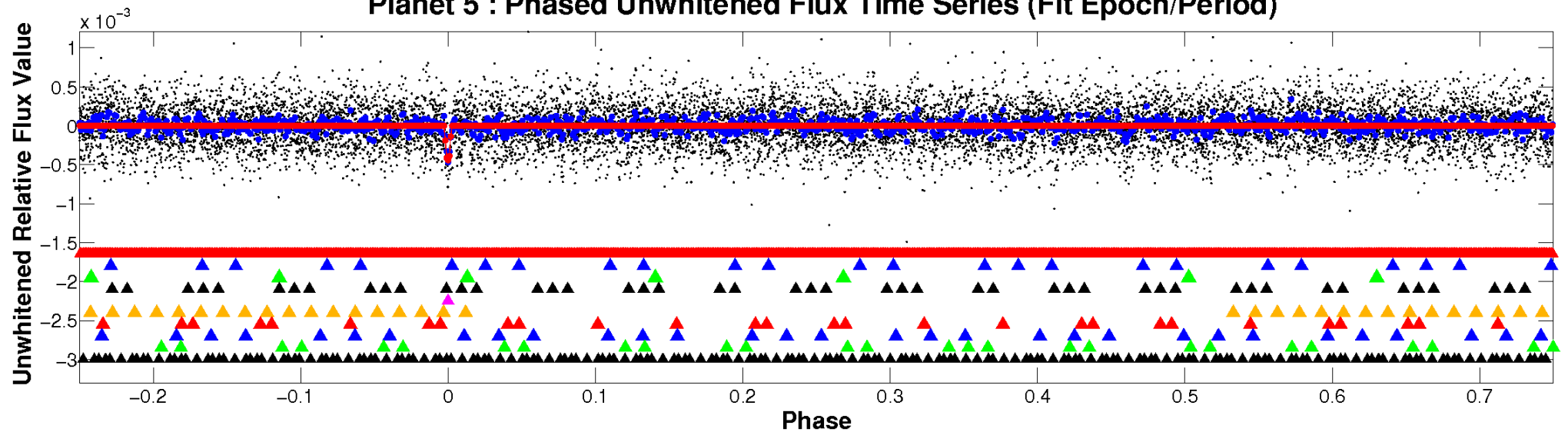
# ALT Odd/Even

TCE 002018906-05

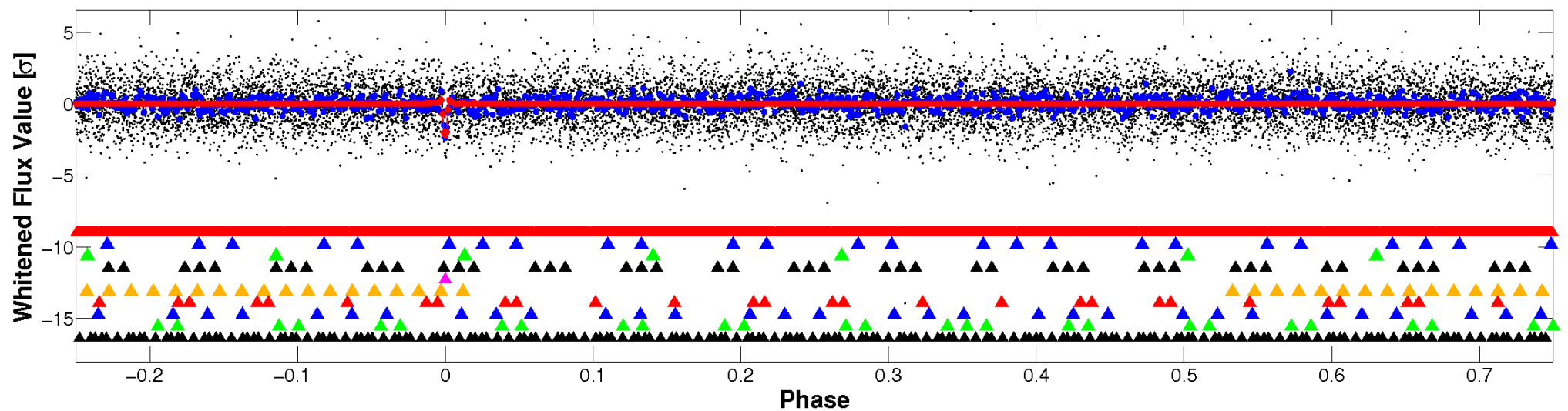


# Non-Whitened Vs. Whitened Light Curve

## Planet 5 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

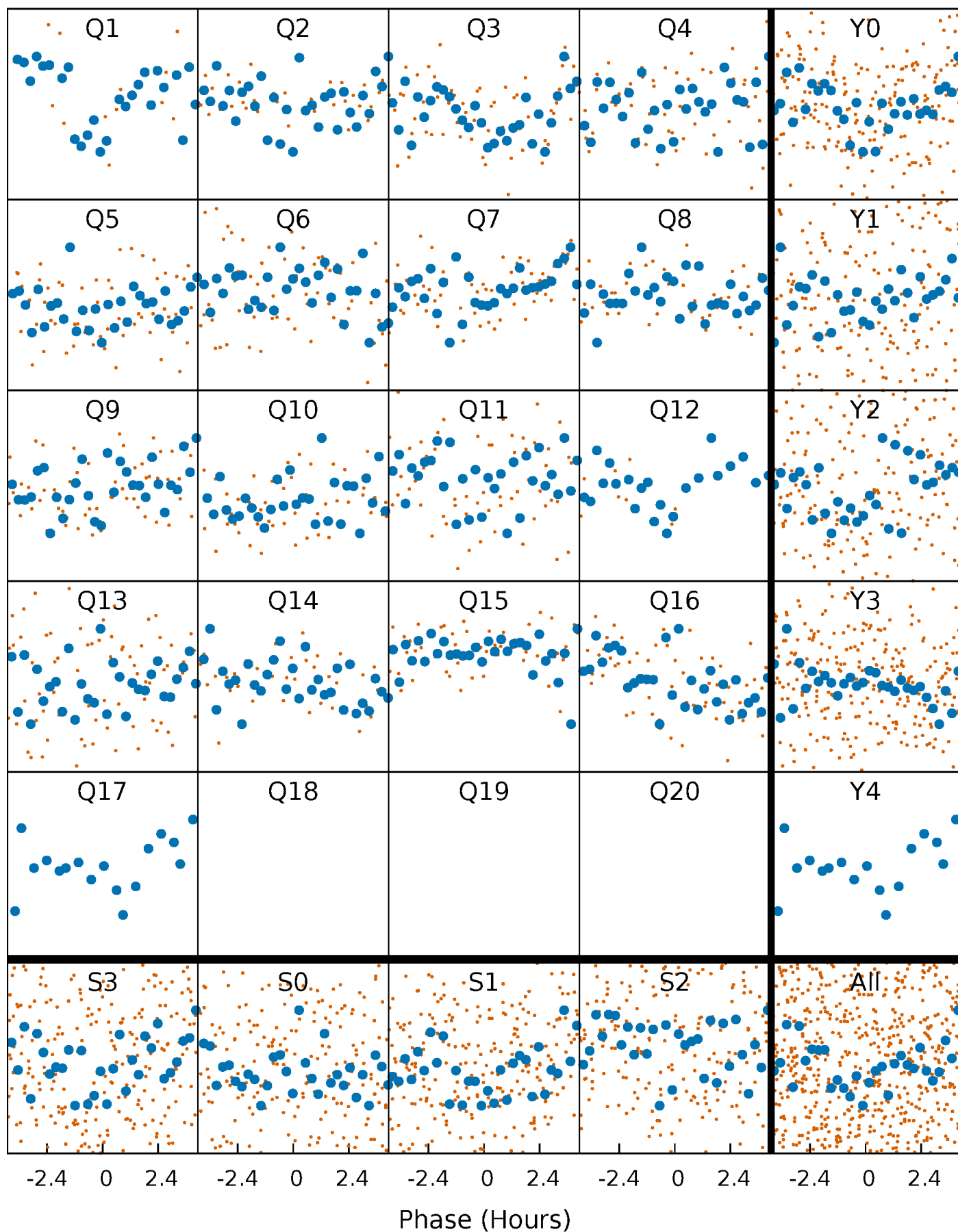


## Planet 5 : Phased Whitened Flux Time Series (Fit Epoch/Period)



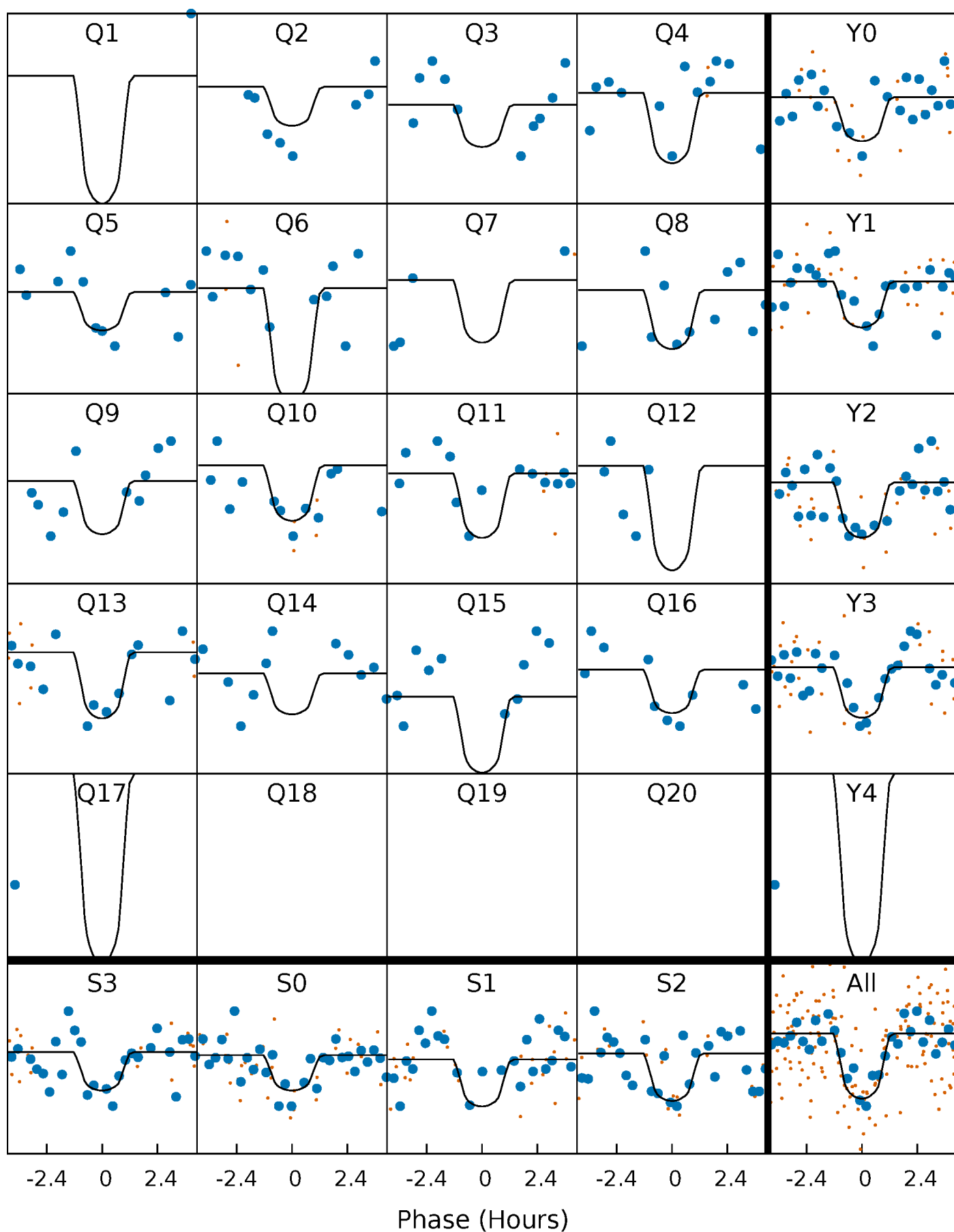
# PDC Quarter-Phased Transit Curves

TCE 002018906-05     $P = 22.245829$  Days     $T_0 = 137.842474$  (BKJD)



# DV Quarter-Phased Transit Curves

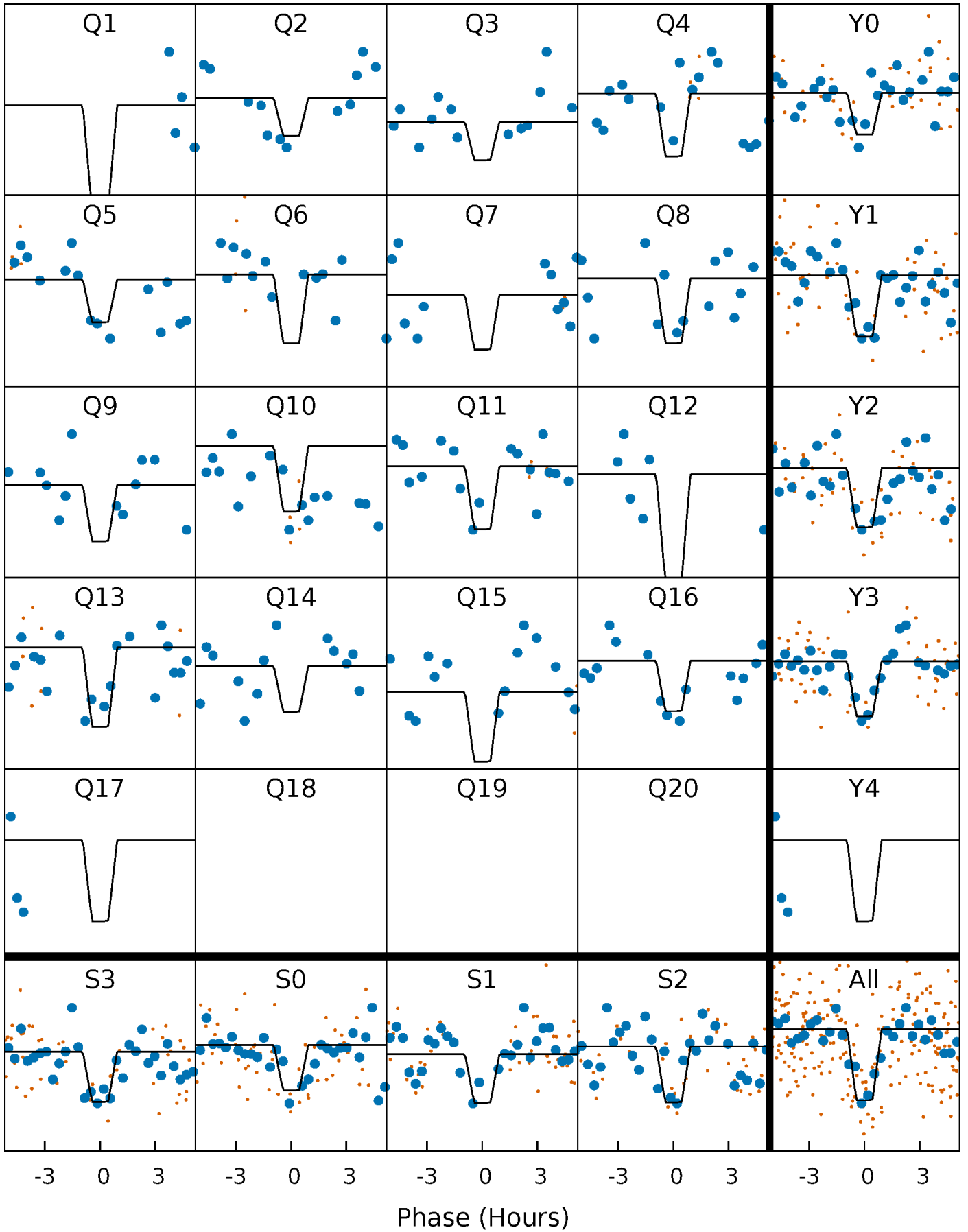
TCE 002018906-05     $P = 22.245829$  Days     $T_0 = 137.842474$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

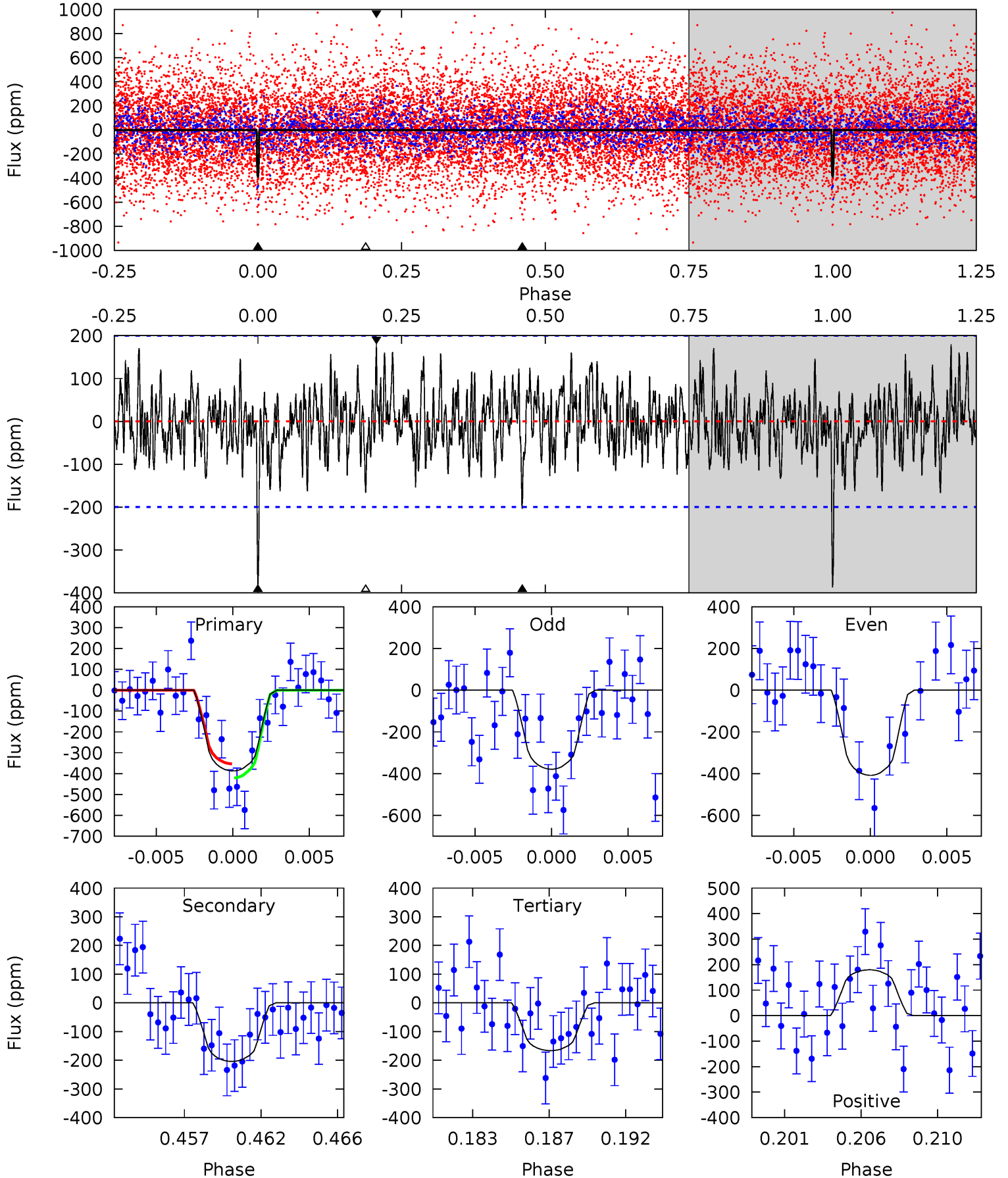
TCE 002018906-05     $P = 22.245816$  Days     $T_0 = 137.848367$  (BKJD)



# DV Model-Shift Uniqueness Test

002018906-05,  $P = 22.245829$  Days,  $E = 115.596645$  Days

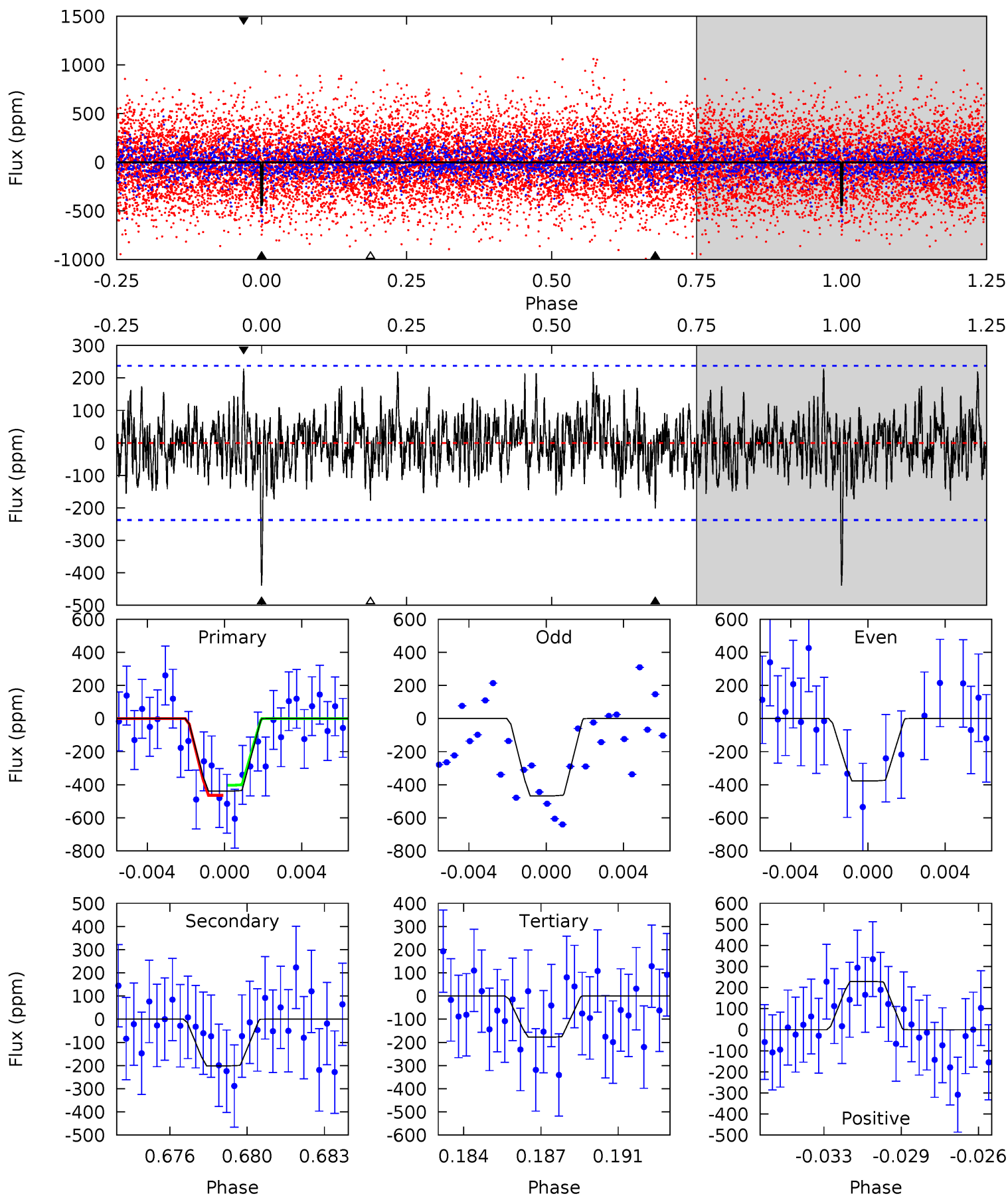
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
10.0	5.29	4.31	4.65	5.17	2.84	1.54	5.71	5.37	0.98	0.64	0.36	0.88	0.32	0.87



# Alt Model-Shift Uniqueness Test

002018906-05,  $P = 22.245816$  Days,  $E = 115.602551$  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
9.63	4.42	3.89	5.02	5.22	2.90	1.45	5.74	4.61	0.52	-0.61	0.91	1.02	0.34	0.67



### Stellar Parameters For KIC 002018906

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5046^{+127}_{-102}$	$3.303^{+0.310}_{-0.310}$	$-0.540^{+0.300}_{-0.250}$	$3.370^{+1.870}_{-1.007}$	$0.832^{+0.283}_{-0.165}$	$0.031^{+0.053}_{-0.022}$
	+3%/-2%	+9%/-9%	+56%/-46%	+55%/-30%	+34%/-20%	+172%/-72%
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 002018906-05 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-204 \pm 39$	$12.75^{+12.96}_{-7.81}$	$1486^{+233}_{-135}$	$3585^{+1556}_{-634}$	$14^{+83}_{-10}$
Alt.	$-201 \pm 46$	$12.76^{+12.75}_{-8.28}$	$1502^{+184}_{-151}$	$3559^{+1796}_{-656}$	$14^{+109}_{-11}$

$T_{max}$  = 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

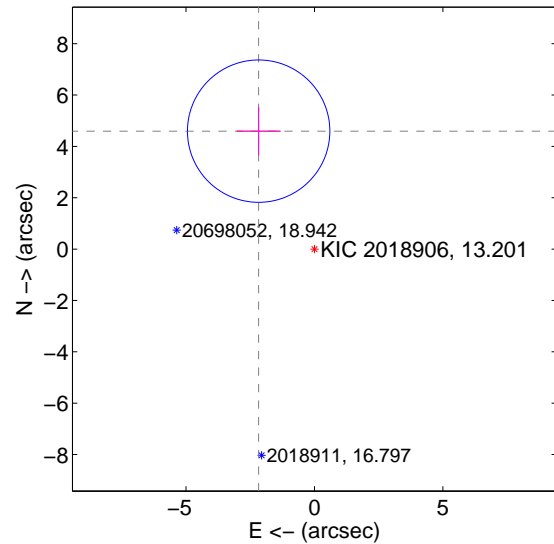
Supplemental centroid analysis for 002018906-05. Kepler magnitude: 13.20. Transit SNR 10.52

There are 0 quarters with good PRF difference image offsets

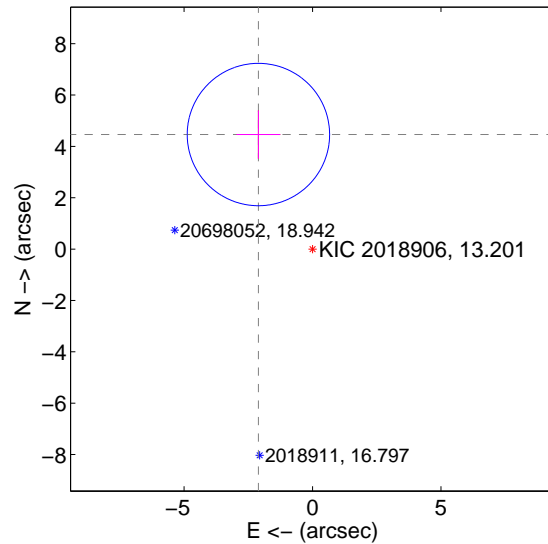
The direct PRF centroid is offset from the target star catalog position by about 0.15 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$5.081 \pm 0.924$	5.50	$2.172 \pm 0.853$	$4.593 \pm 0.939$
PRF-fit source offset from KIC position	$4.933 \pm 0.924$	5.34	$2.107 \pm 0.853$	$4.461 \pm 0.939$
photometric centroid source offset	$0.92 \pm 0.46$	2.00	$-0.52 \pm 0.42$	$-0.76 \pm 0.48$

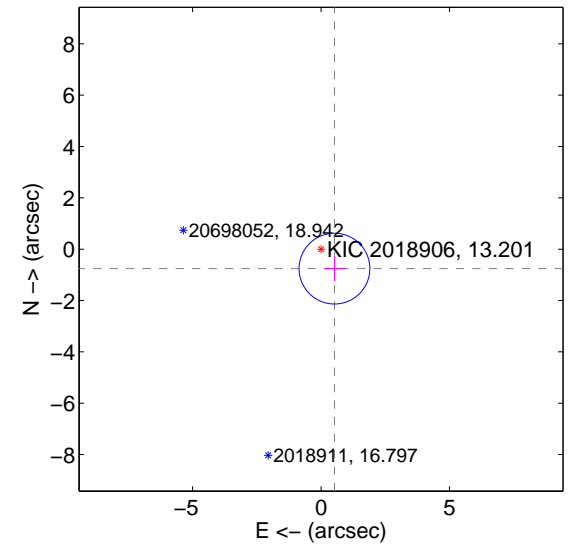
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

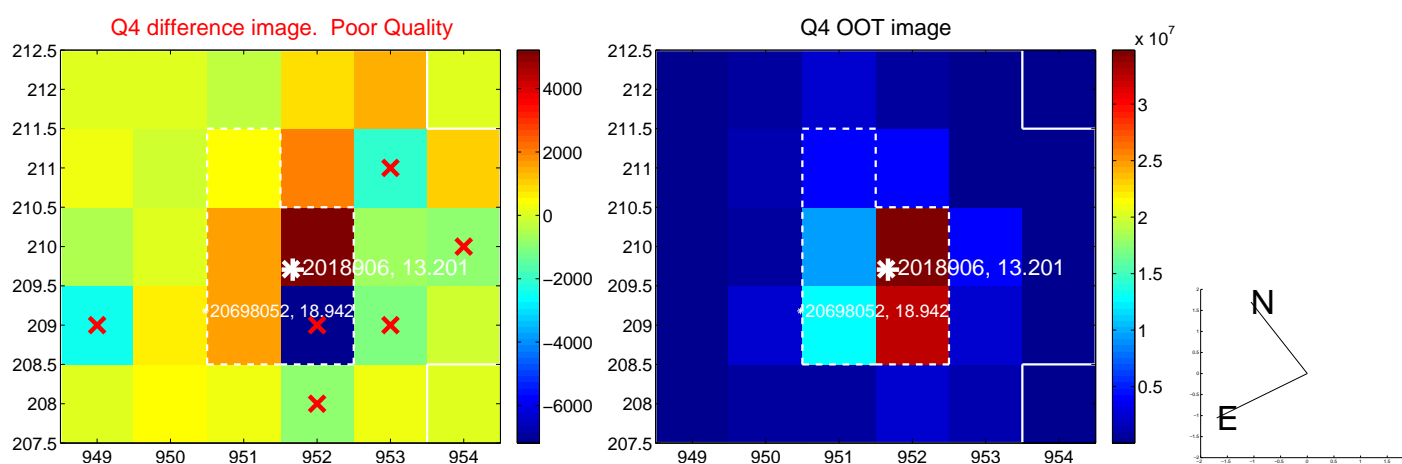
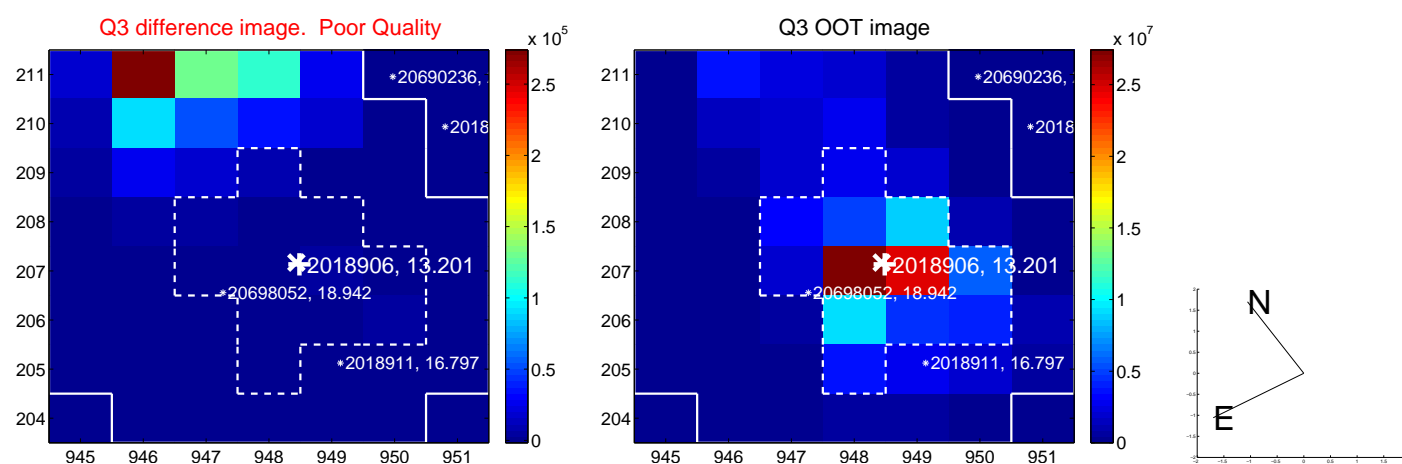
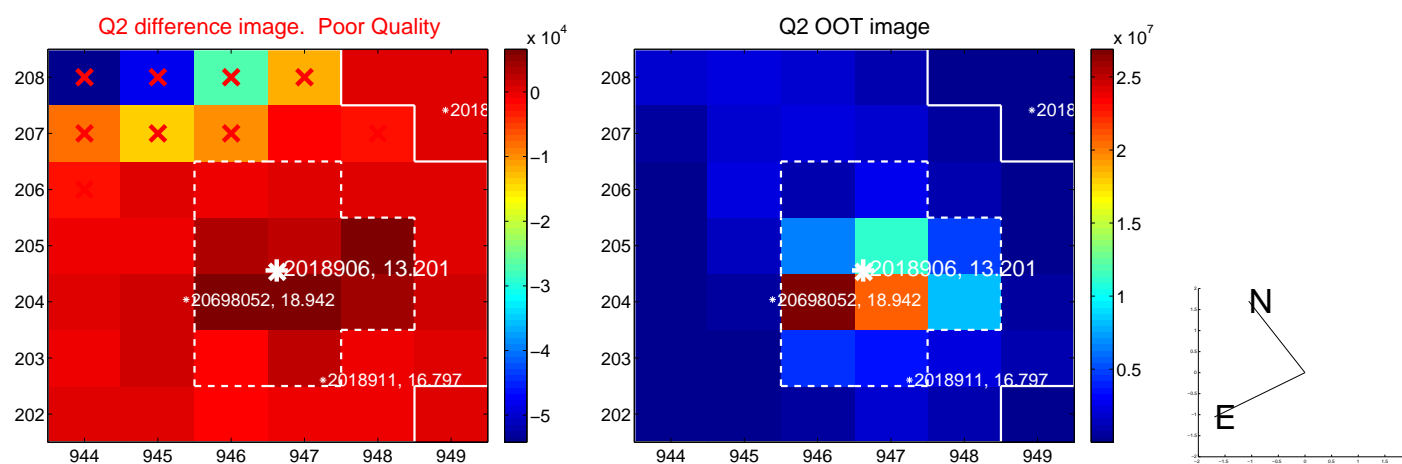
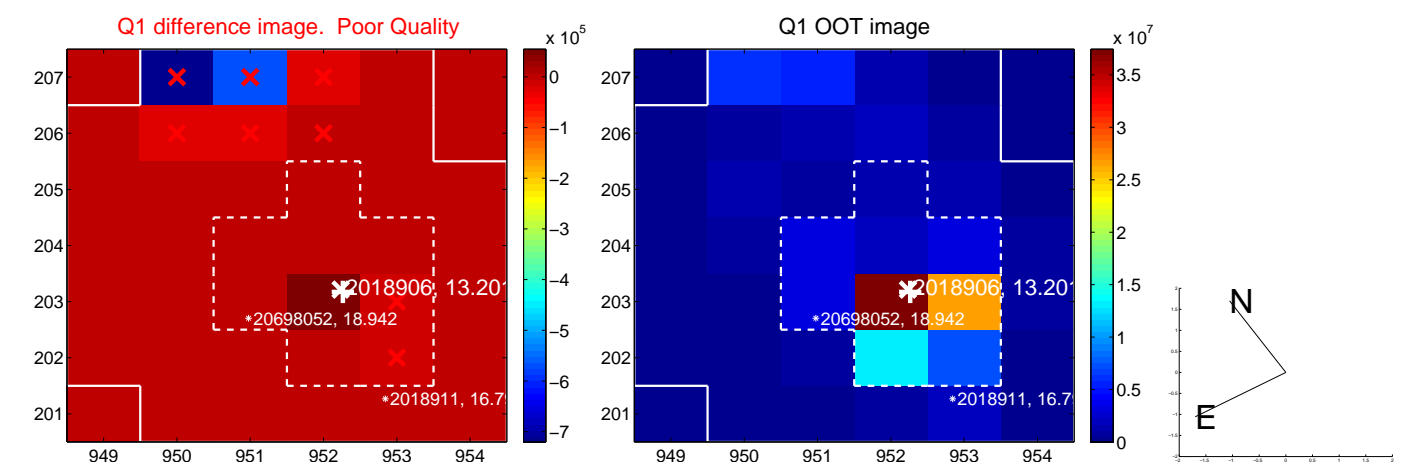


offset from photometric centroids



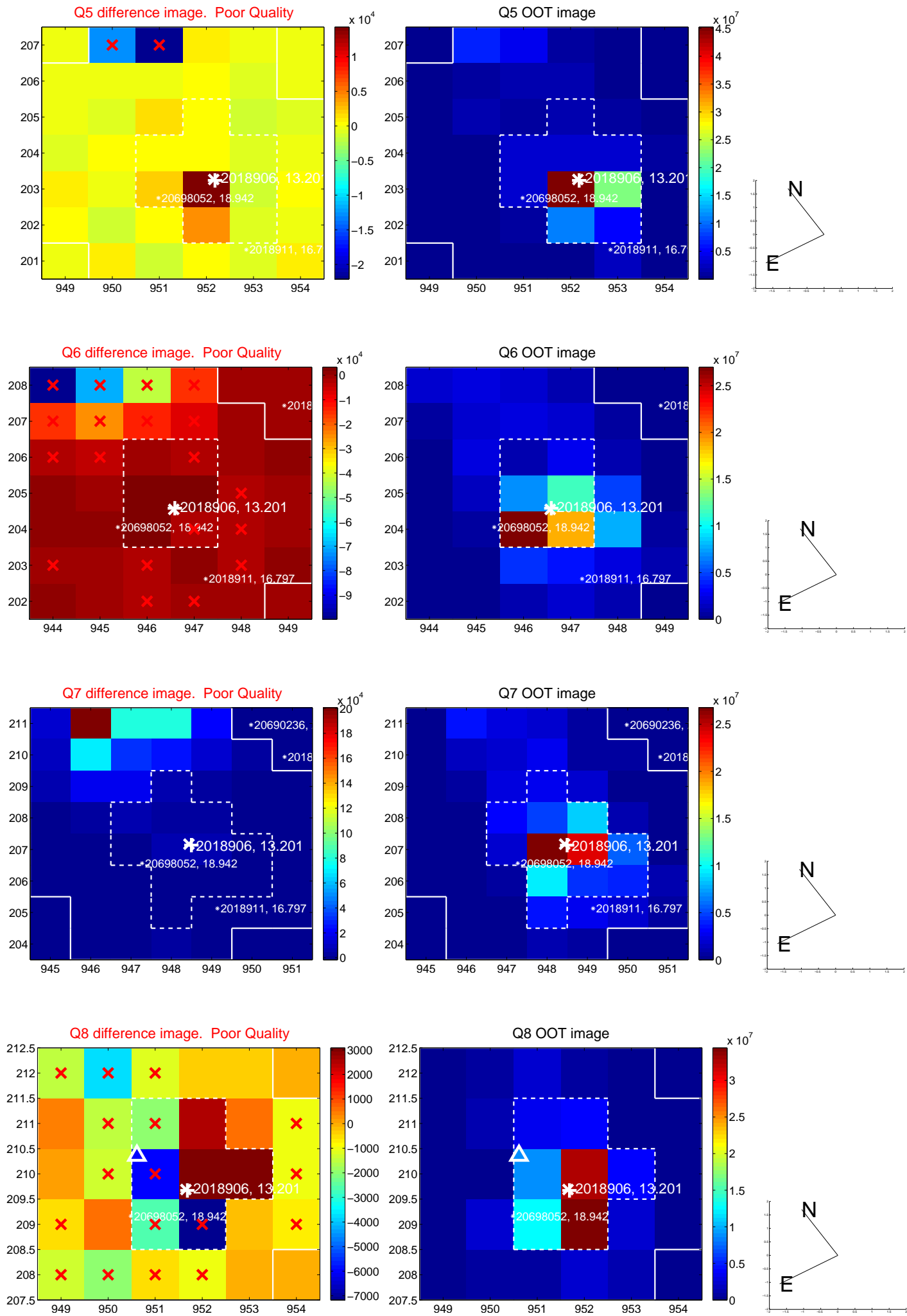
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

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

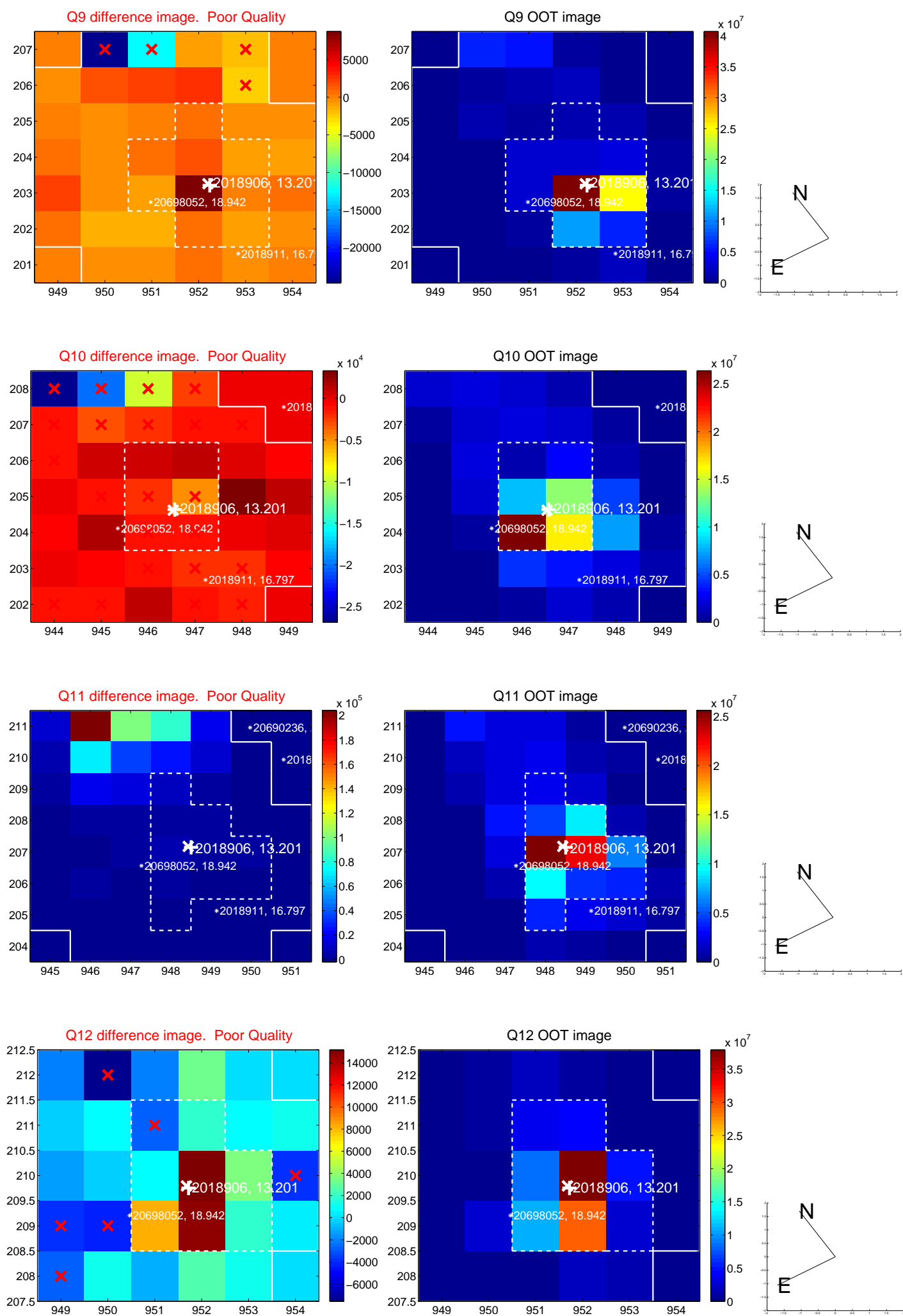




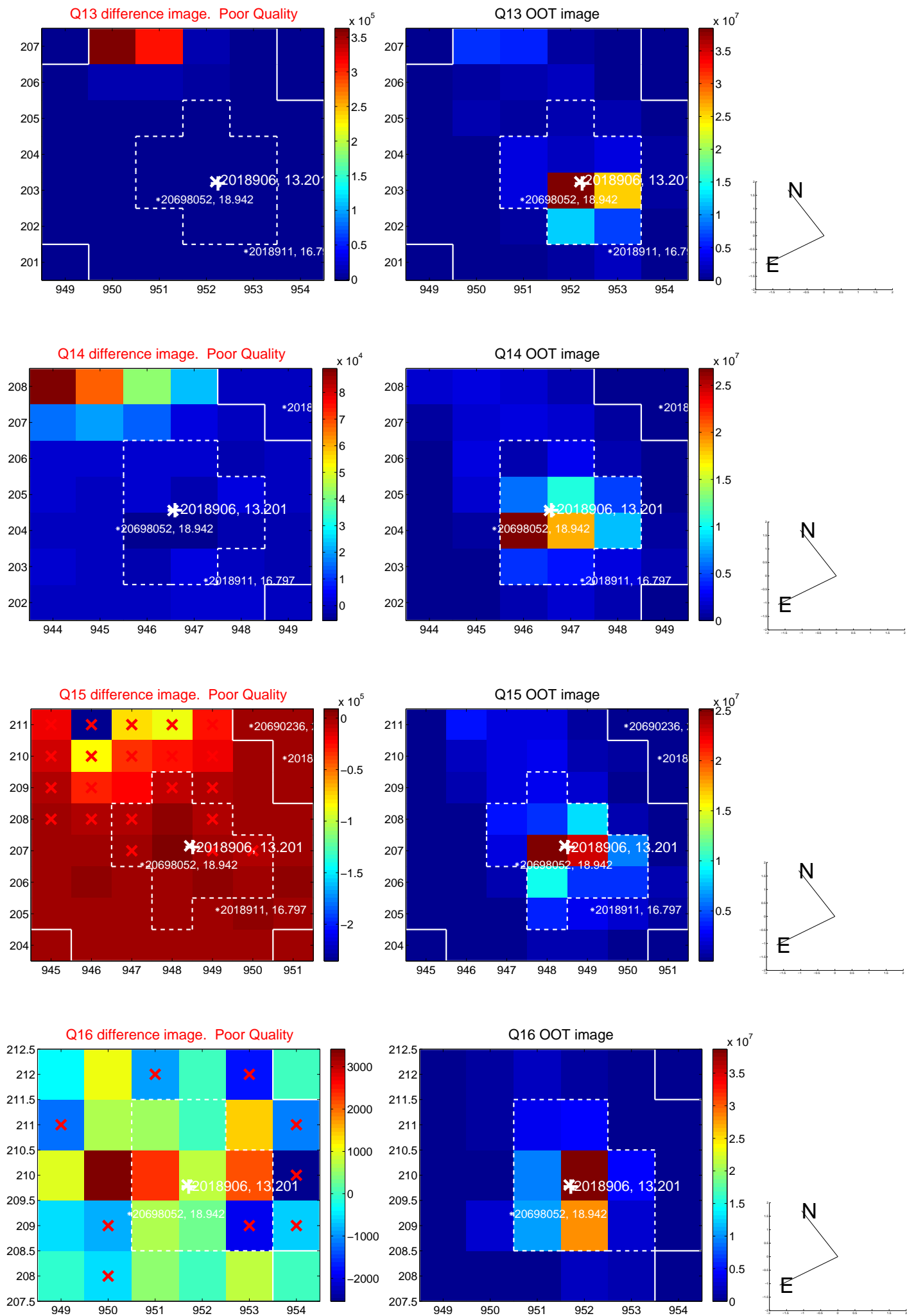
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



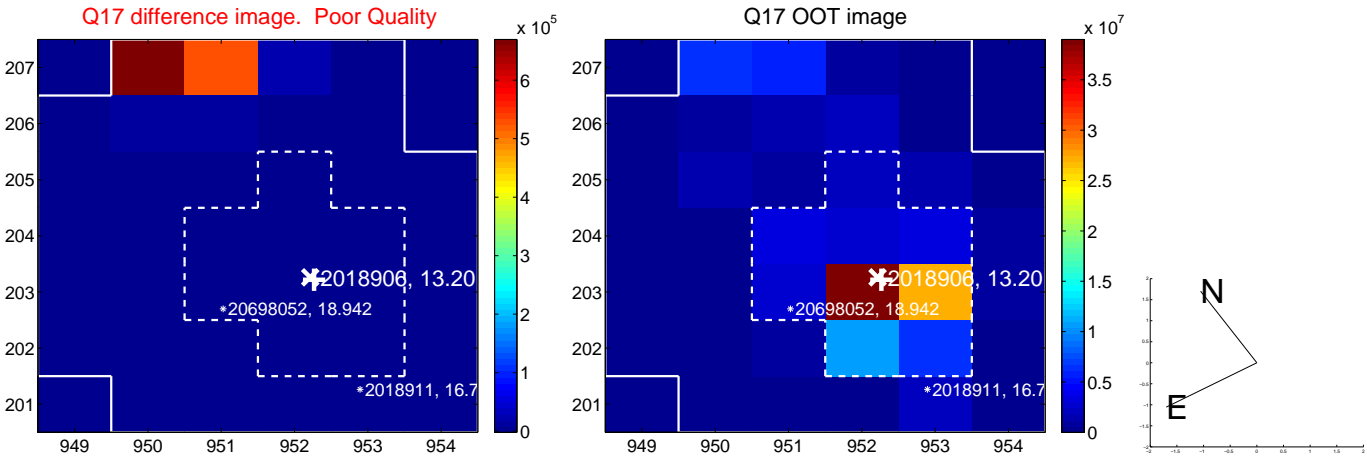
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



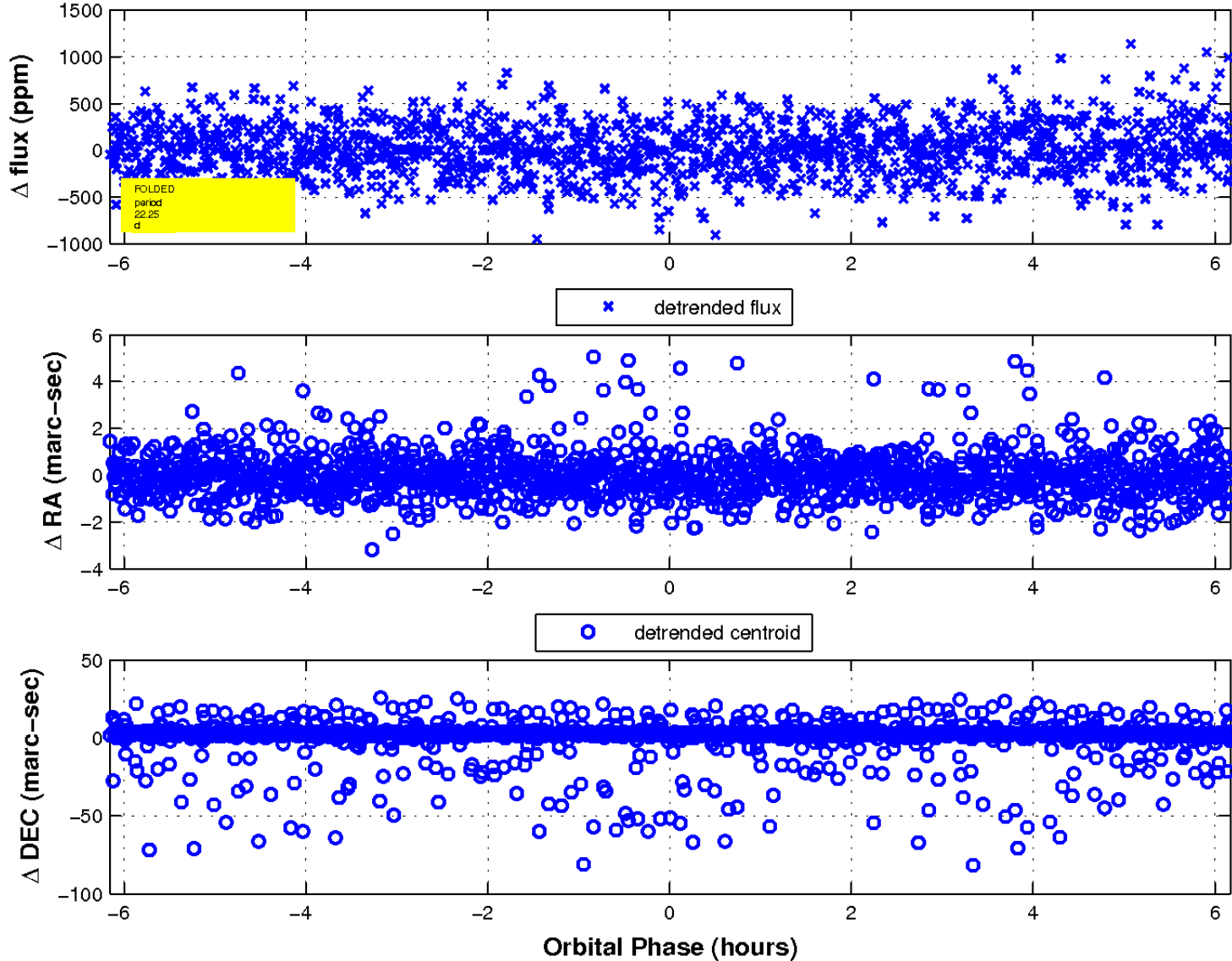
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

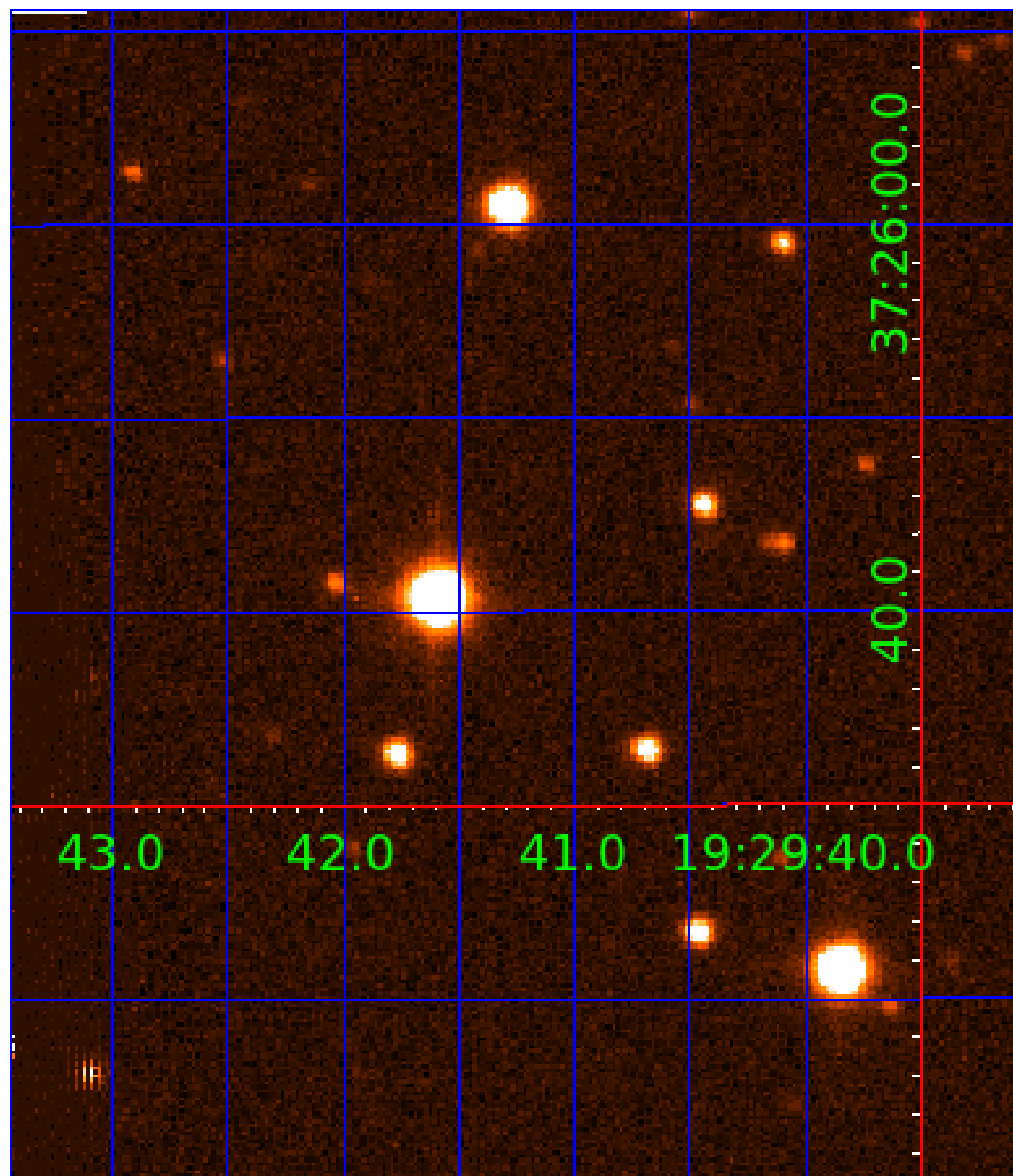


fluxWeightedCentroids, Planet 5 of 10



UKIRT Image

Declination



# KIC 002018906

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
002018906-01	OBS	No	0.525149	131.658983	11.9	3.212	15.1	3.7	3.37	5046	1.24	0.00
002018906-04	OBS	No	31.419253	137.819040	334.8	3.524	9.4	8.5	3.37	5046	7.09	196.26
002018906-05	OBS	No	22.245829	137.842474	441.7	2.059	9.2	10.5	3.37	5046	7.50	311.01
002018906-06	OBS	No	44.158582	138.108488	370.8	3.010	9.1	9.2	3.37	5046	7.29	124.67
002018906-07	OBS	No	53.152195	148.596580	587.8	1.755	8.9	9.6	3.37	5046	9.31	97.37
002018906-08	OBS	No	46.663938	154.862044	409.6	2.876	7.8	8.6	3.37	5046	8.08	115.82
002018906-09	OBS	No	53.025159	168.237150	329.6	2.994	8.1	7.9	3.37	5046	7.32	97.68
002018906-10	OBS	No	7.605976	131.528571	187.7	3.276	9.2	10.1	3.37	5046	5.50	1300.86

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
002018906-01	OBS	FP	0.00	1	0	1	0	LPP_DV—CENT_RESOLVED_OFFSET
002018906-04	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-05	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-06	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-07	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-08	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-09	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS
002018906-10	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE_ZUMA—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_CROWDED

**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.

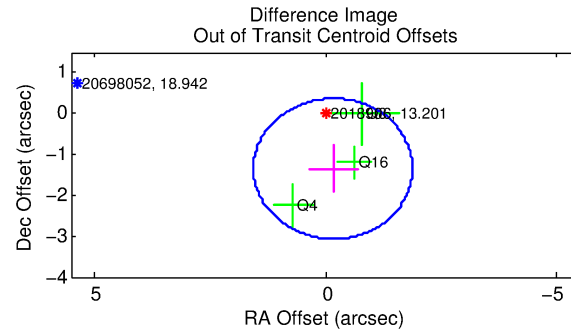
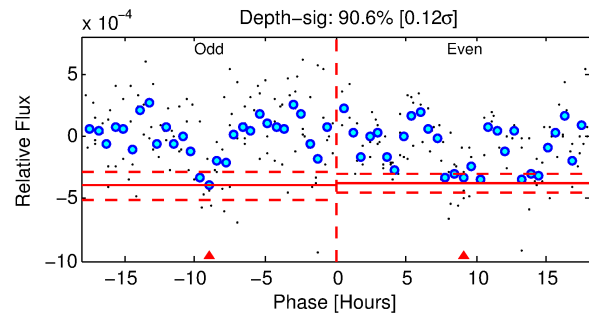
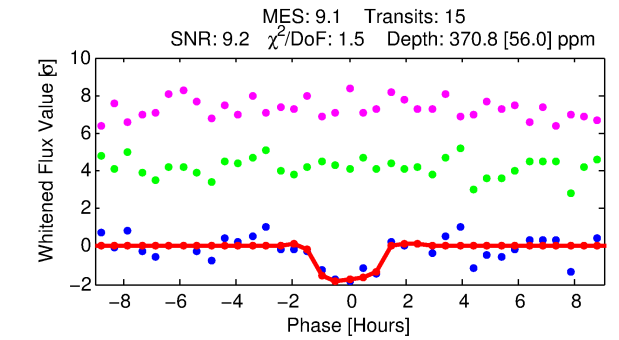
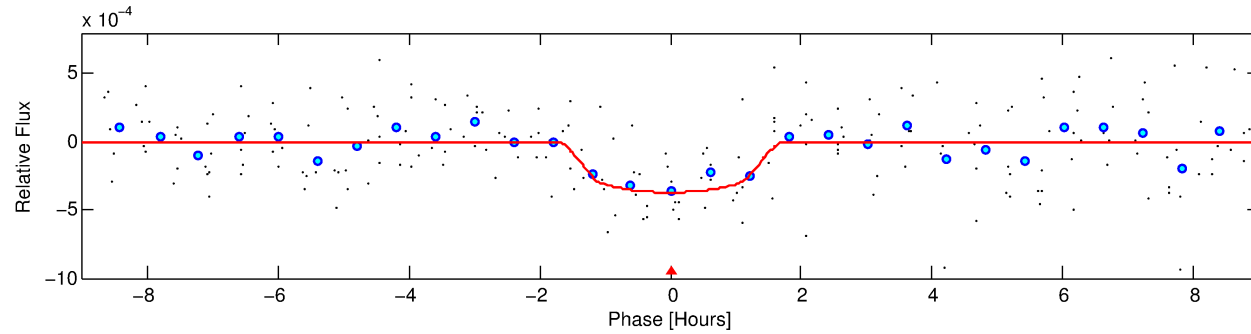
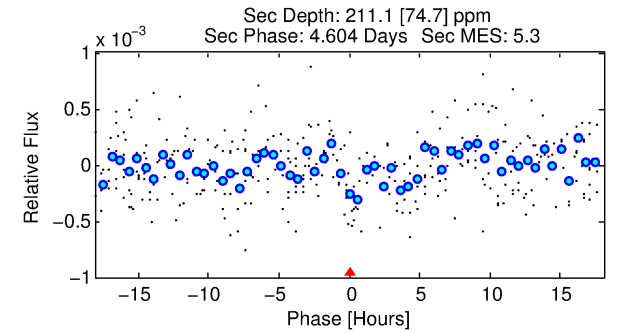
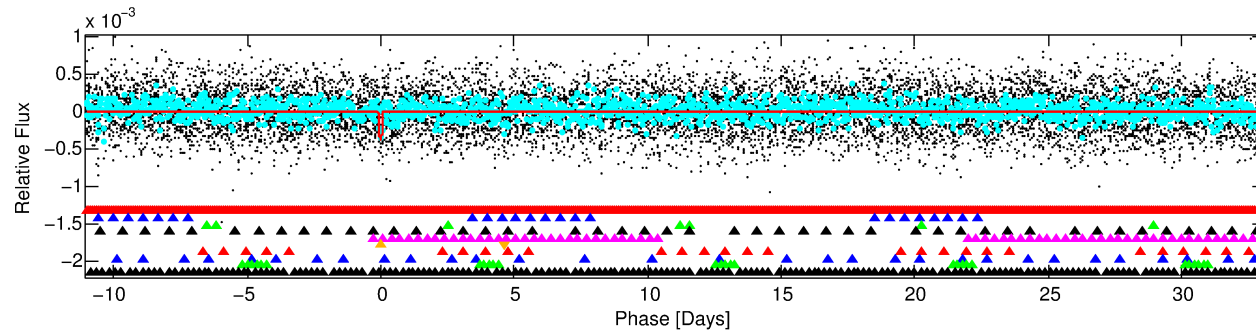
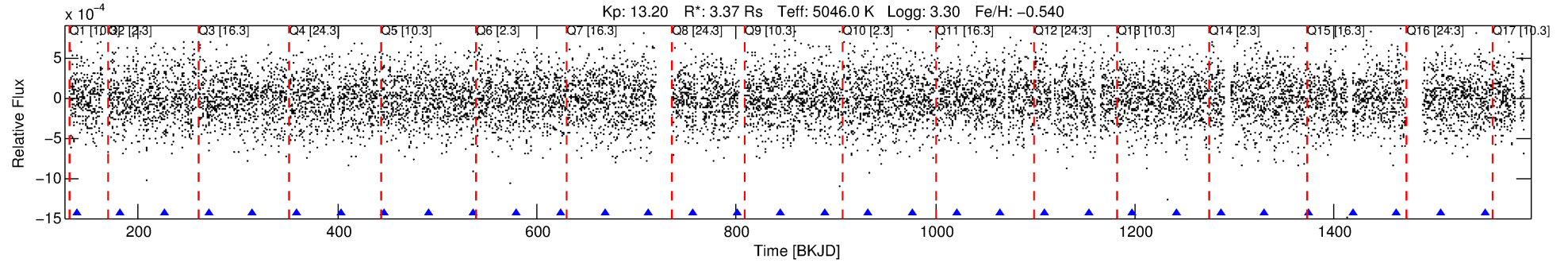
Ephemeris Match Information For 002018906-06

No Significant Match Found



# DV One-Page Summary

KIC: 2018906 Candidate: 6 of 10 Period: 44.159 d



## DV Fit Results:

Period = 44.15858 [0.00059] d  
Epoch = 138.1085 [0.0096] BKJD  
Rp/R\* = 0.0198 [0.0357]  
a/R\* = 69.13 [496.14]  
b = 0.81 [3.08]  
Seff = 124.67 [76.18]  
Teff = 852 [130] K  
Rp = 7.29 [13.72] Re  
a = 0.2300 [0.1012] AU  
Ag = 115.54 [423.16] [0.27 $\sigma$ ]  
Teffp = 4319 [3902] K [0.89 $\sigma$ ]

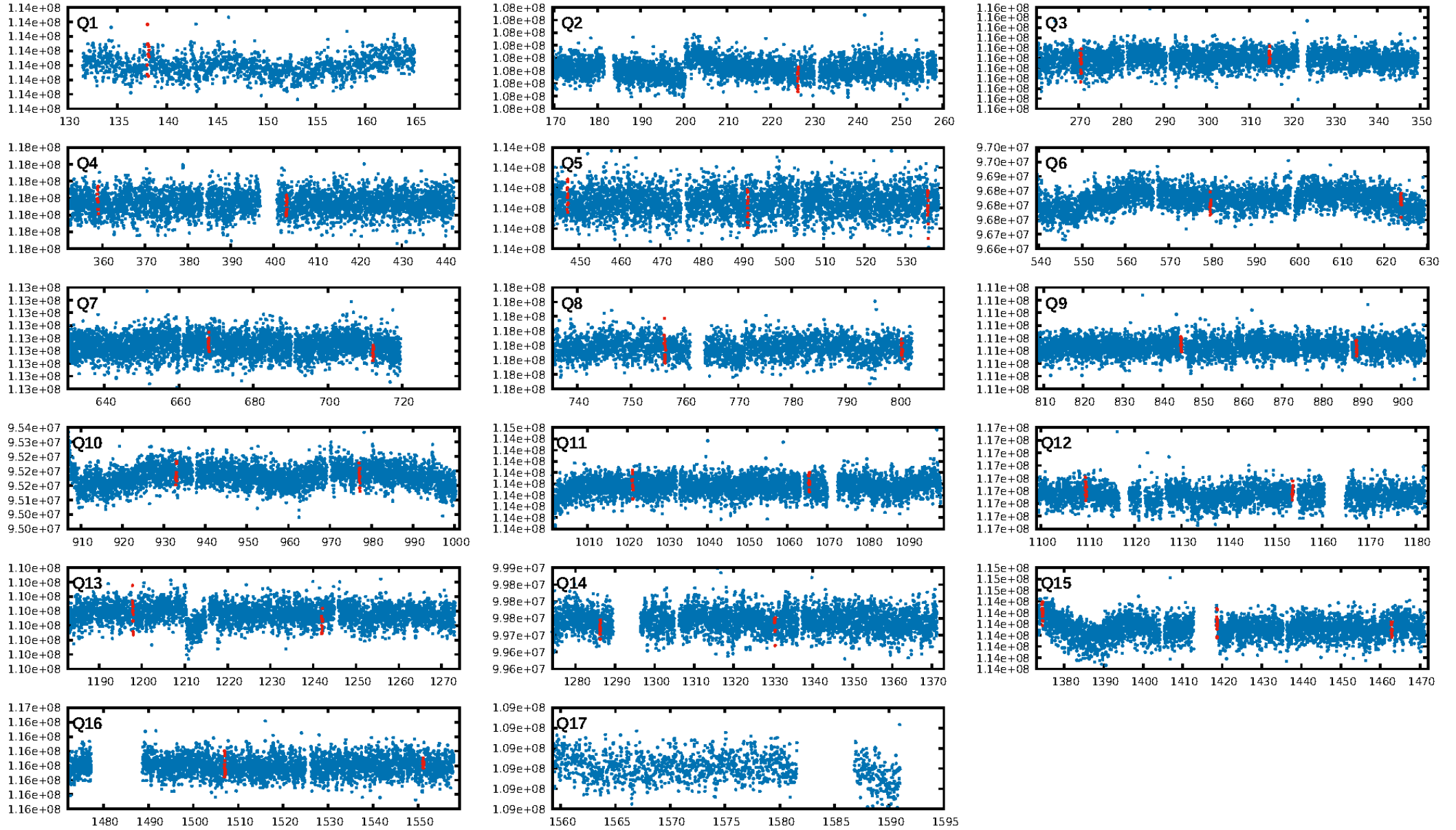
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [65.97 $\sigma$ ]  
LongPeriod-sig: 100.0% [14.44 $\sigma$ ]  
ModelChiSquare2-sig: 1.2%  
ModelChiSquareGof-sig: 100.0%  
**Bootstrap-pfa: 1.83e-11**  
RollingBand-fgt: 1.00 [14/14]  
GhostDiagnostic-chr: -1.766  
Centroid-sig: N/A  
Centroid-so: 0.952 arcsec [1.52 $\sigma$ ]  
OotOffset-rm: 1.360 arcsec [2.37 $\sigma$ ]  
KicOffset-rm: 1.519 arcsec [2.79 $\sigma$ ]  
OotOffset-st: 0/0/3/0 [3]  
KicOffset-st: 0/0/3/0 [3]  
DiffImageQuality-fgm: 0.33 [1/3]  
DiffImageOverlap-fno: 0.00 [0/16]

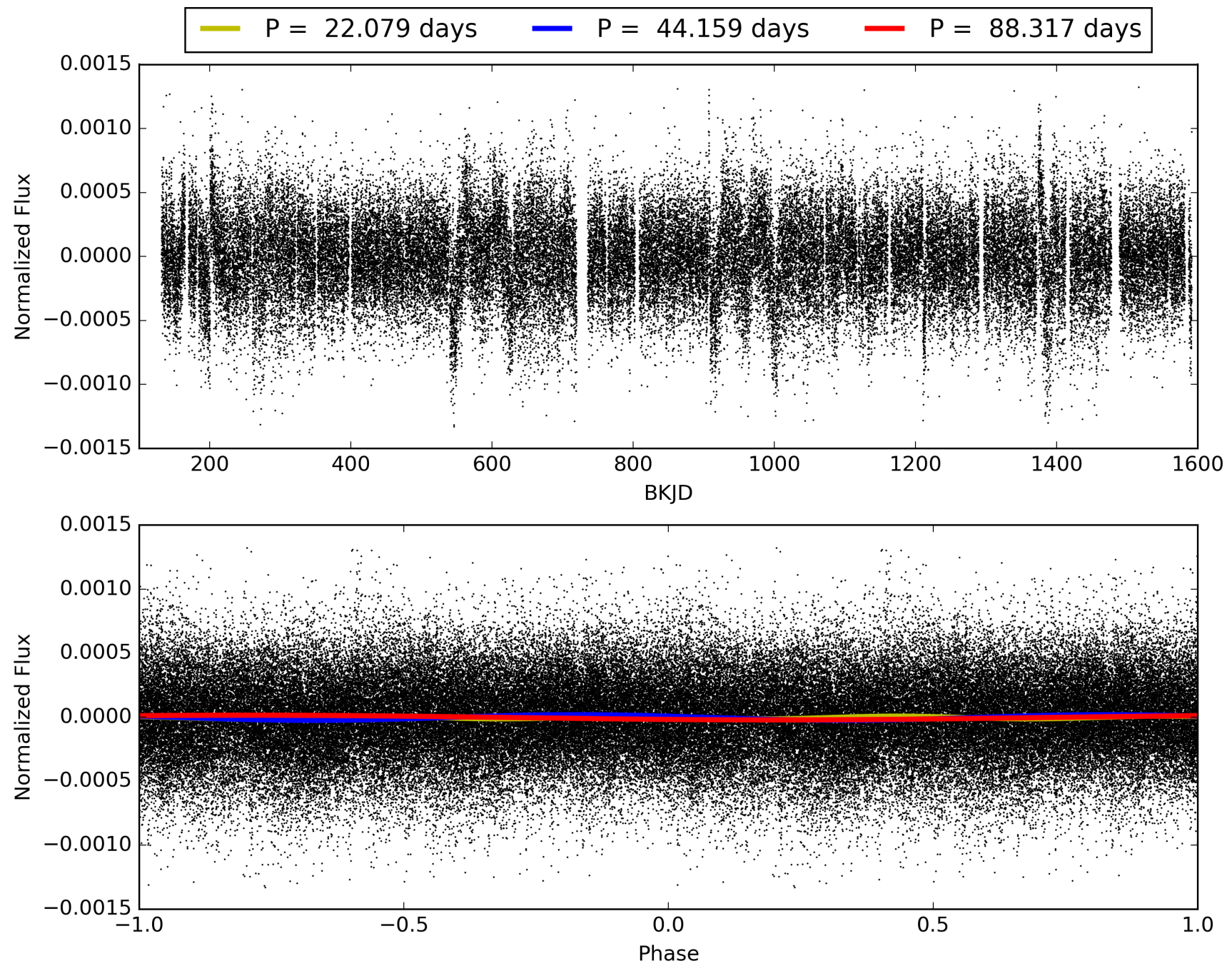
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 04:43:28 Z

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

# TCE 002018906-06, PDC Light Curves

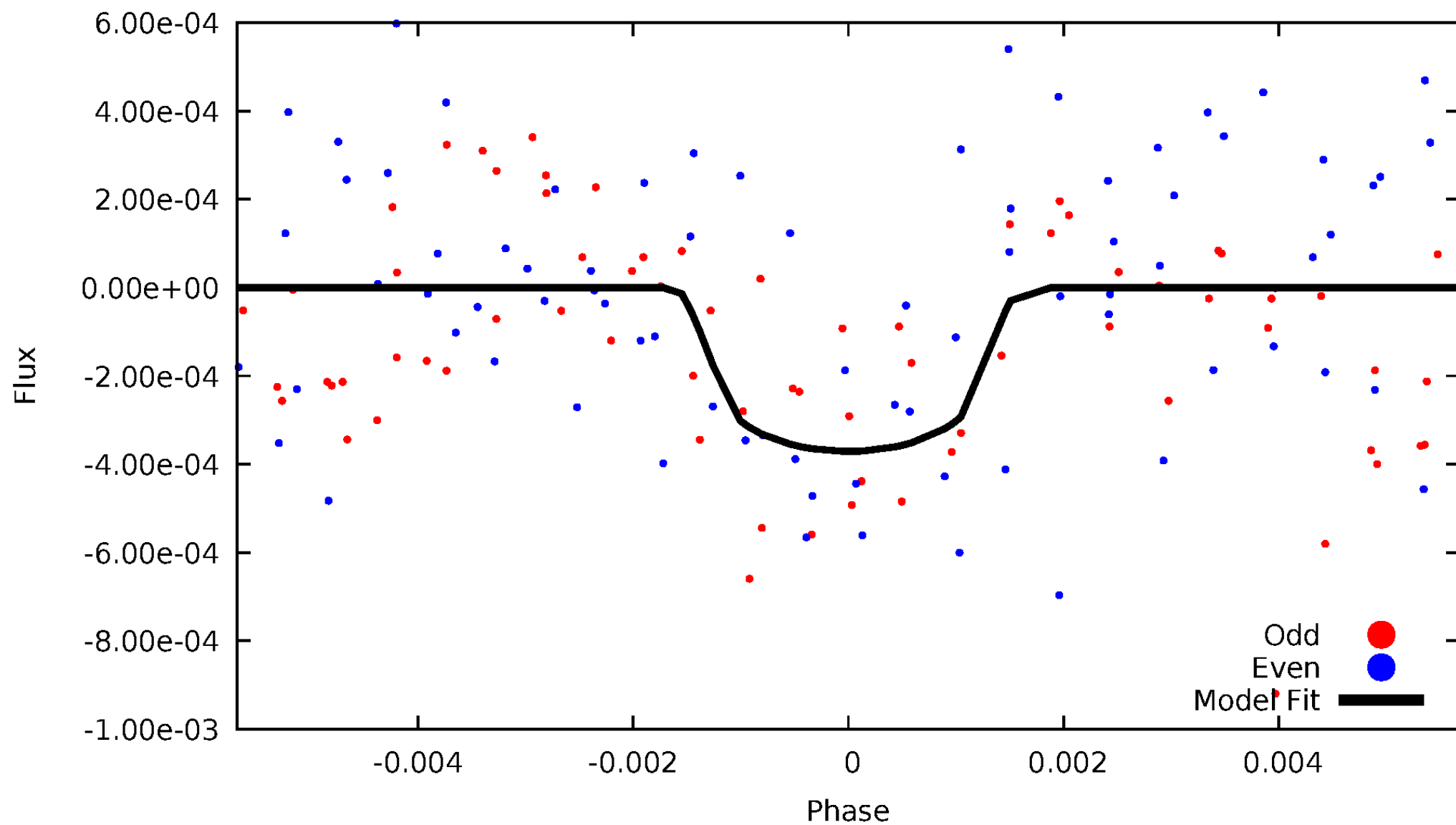


TCE 002018906-06



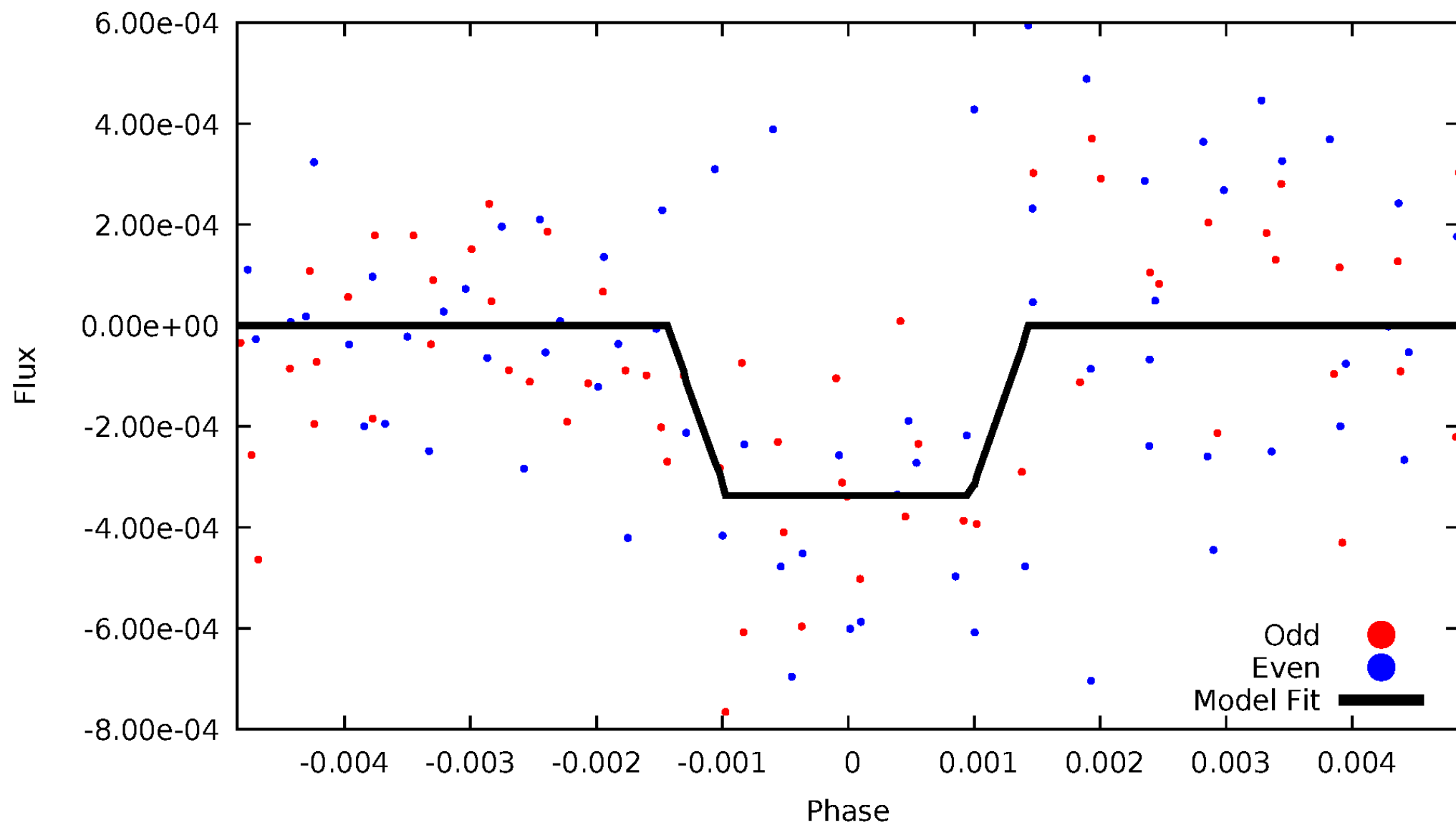
# DV Odd/Even

TCE 002018906-06



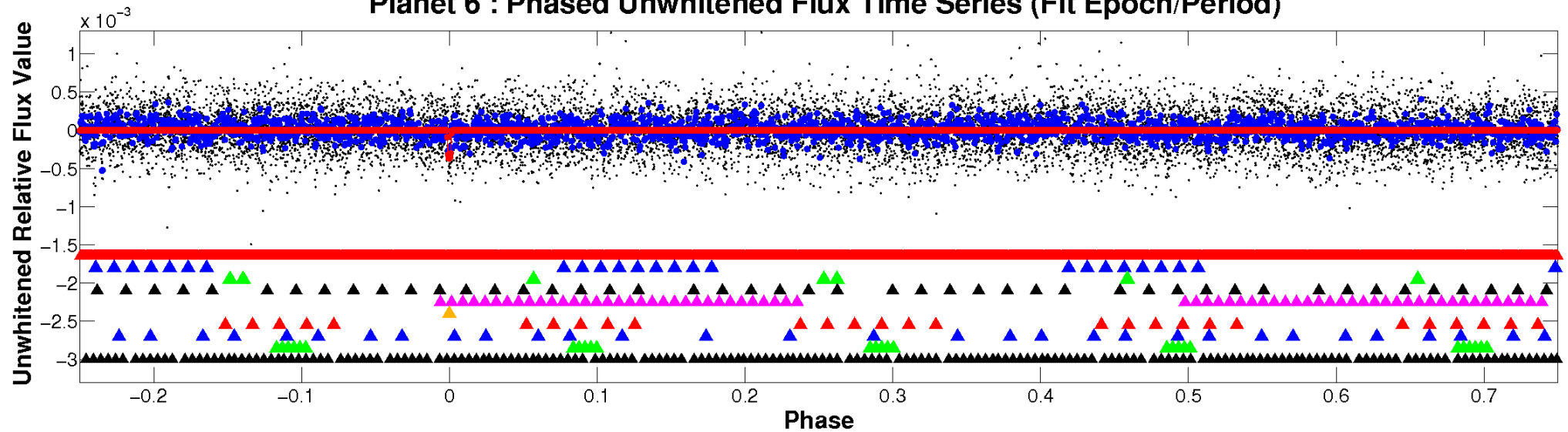
# ALT Odd/Even

TCE 002018906-06

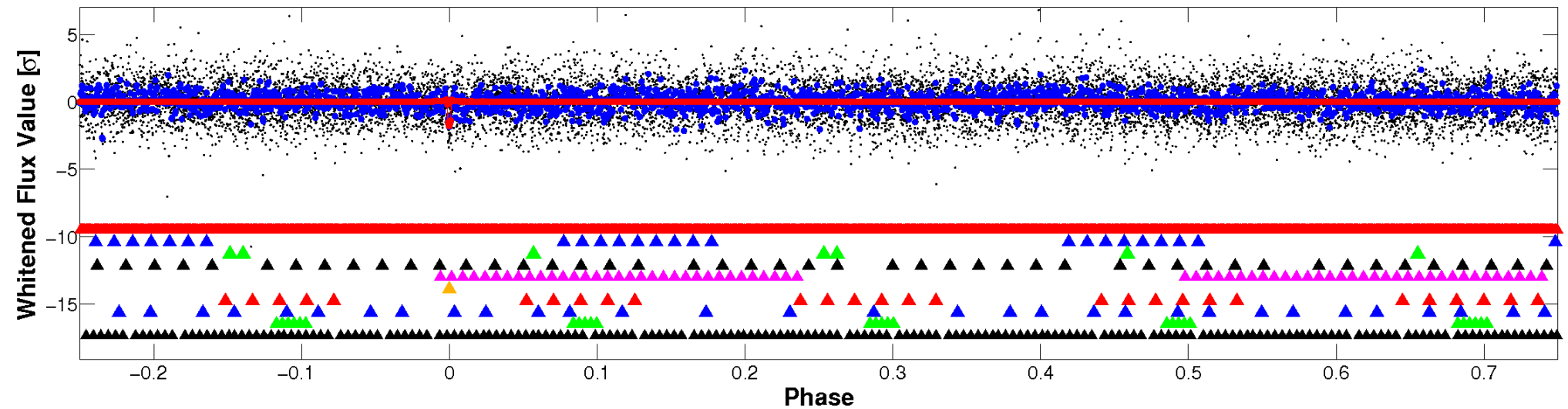


# Non-Whitened Vs. Whitened Light Curve

## Planet 6 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)



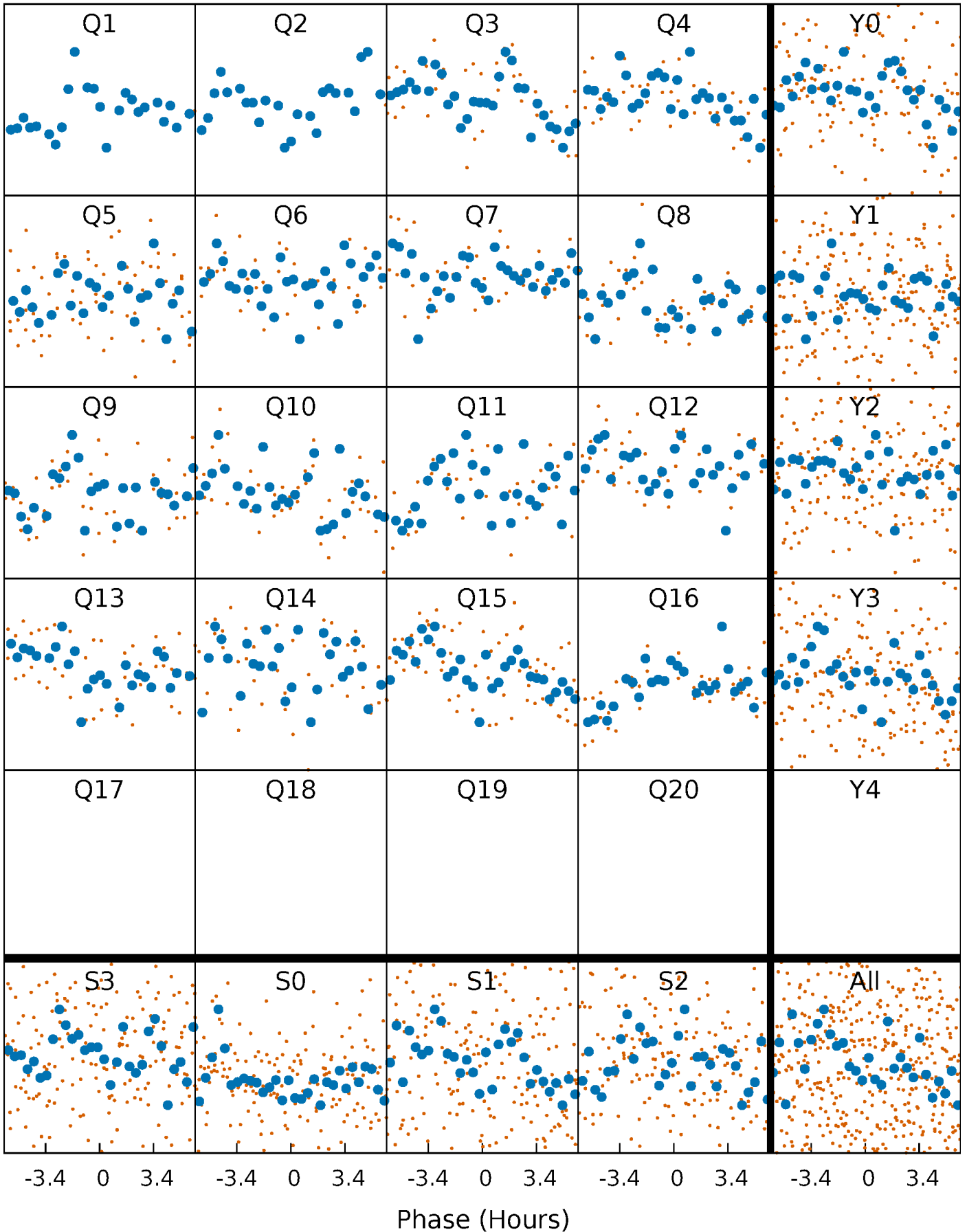
## Planet 6 : Phased Whitened Flux Time Series (Fit Epoch/Period)





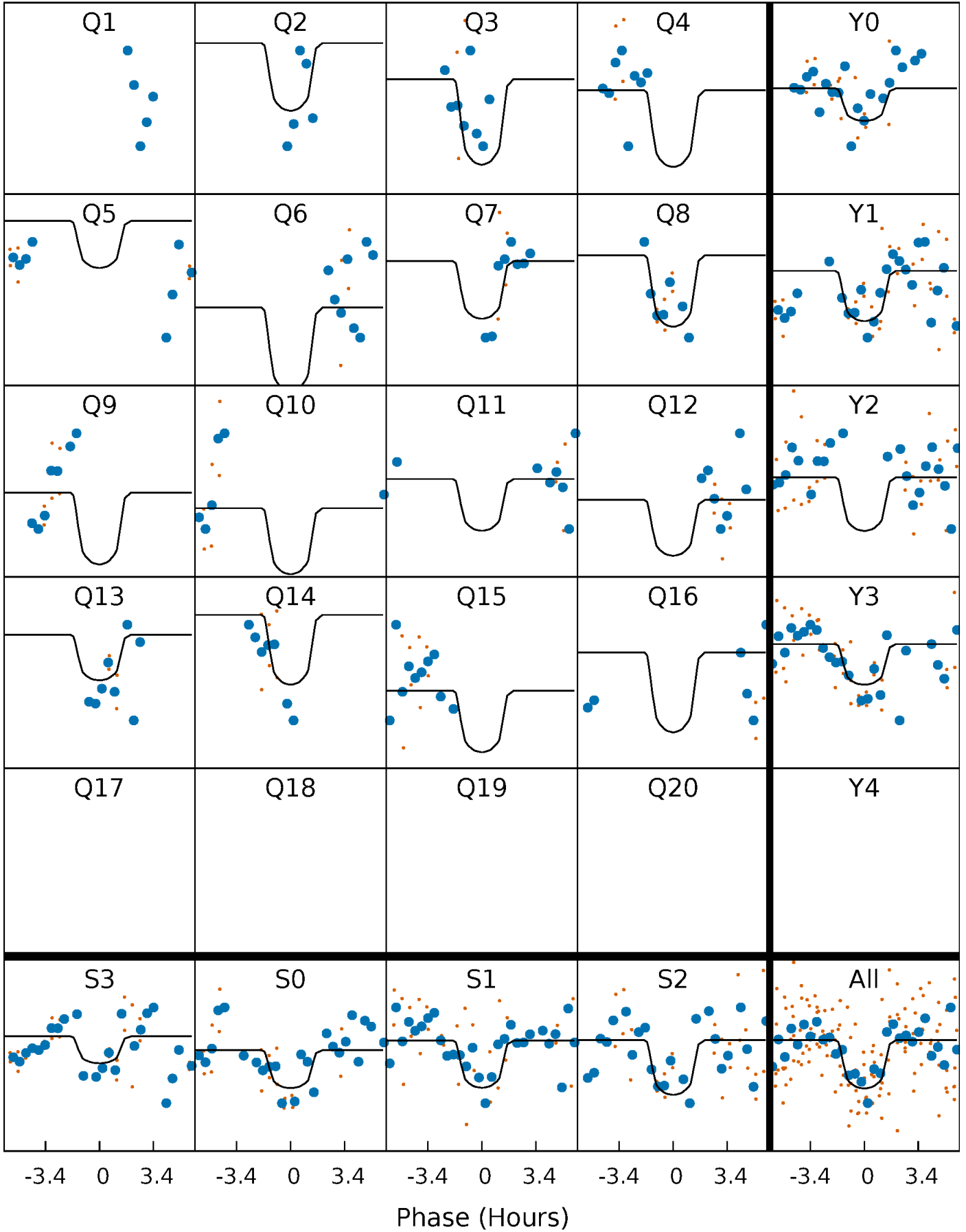
# PDC Quarter-Phased Transit Curves

TCE 002018906-06 P= 44.158582 Days  $T_0=138.108488$  (BKJD)



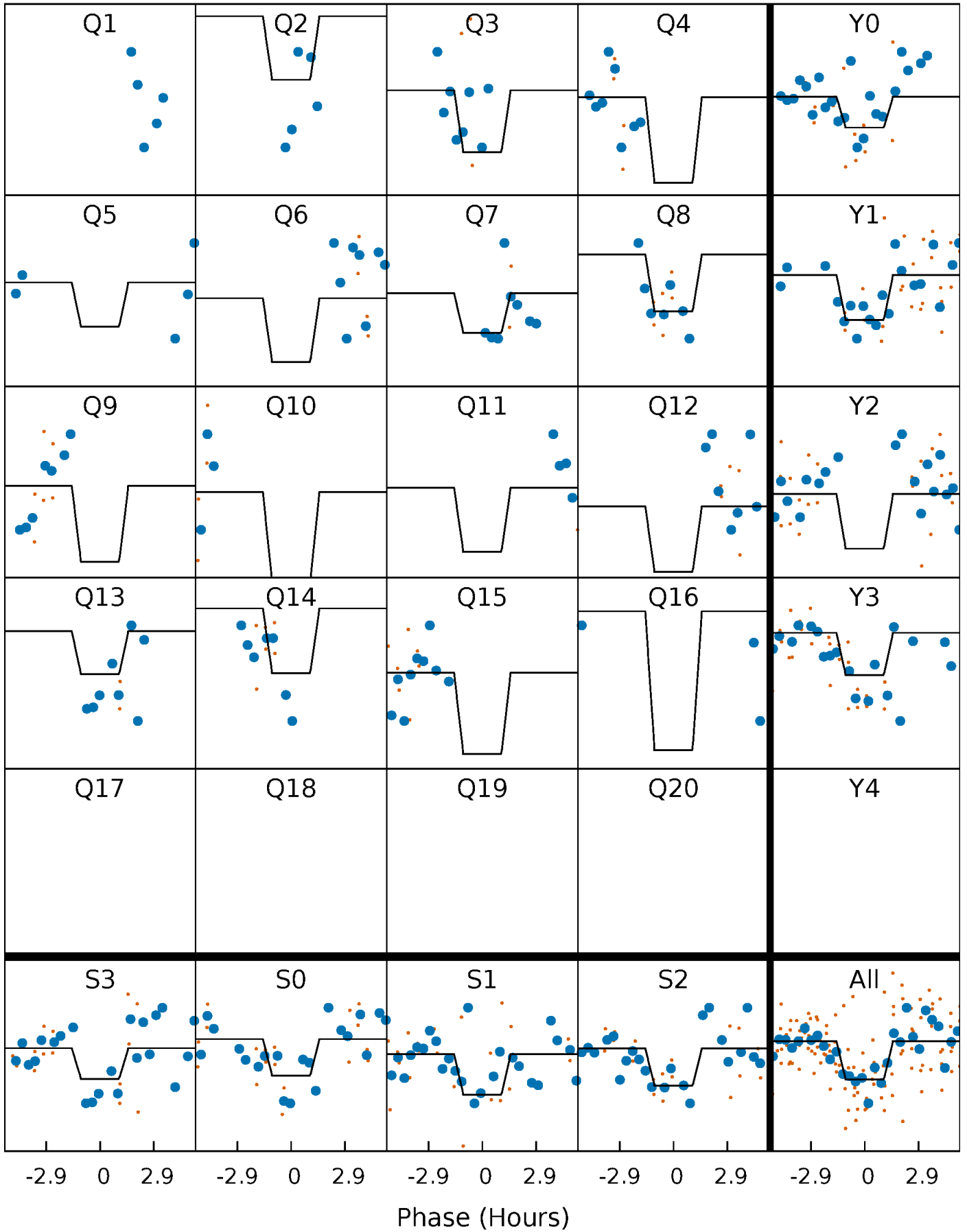
# DV Quarter-Phased Transit Curves

TCE 002018906-06   P= 44.158582 Days    $T_0=138.108488$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

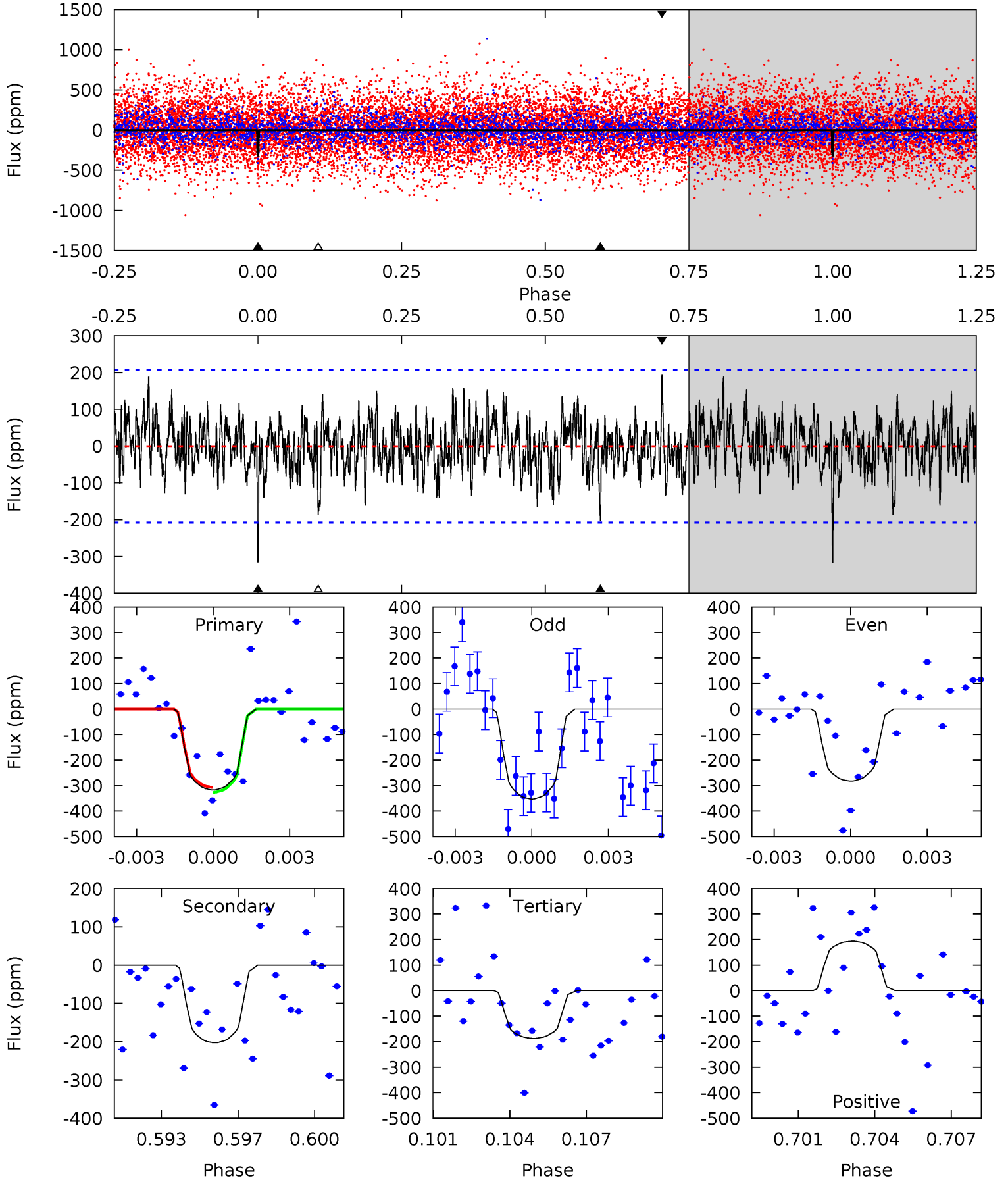
TCE 002018906-06   P= 44.158528 Days    $T_0=138.111175$  (BKJD)



# DV Model-Shift Uniqueness Test

002018906-06, P = 44.158582 Days, E = 93.949906 Days

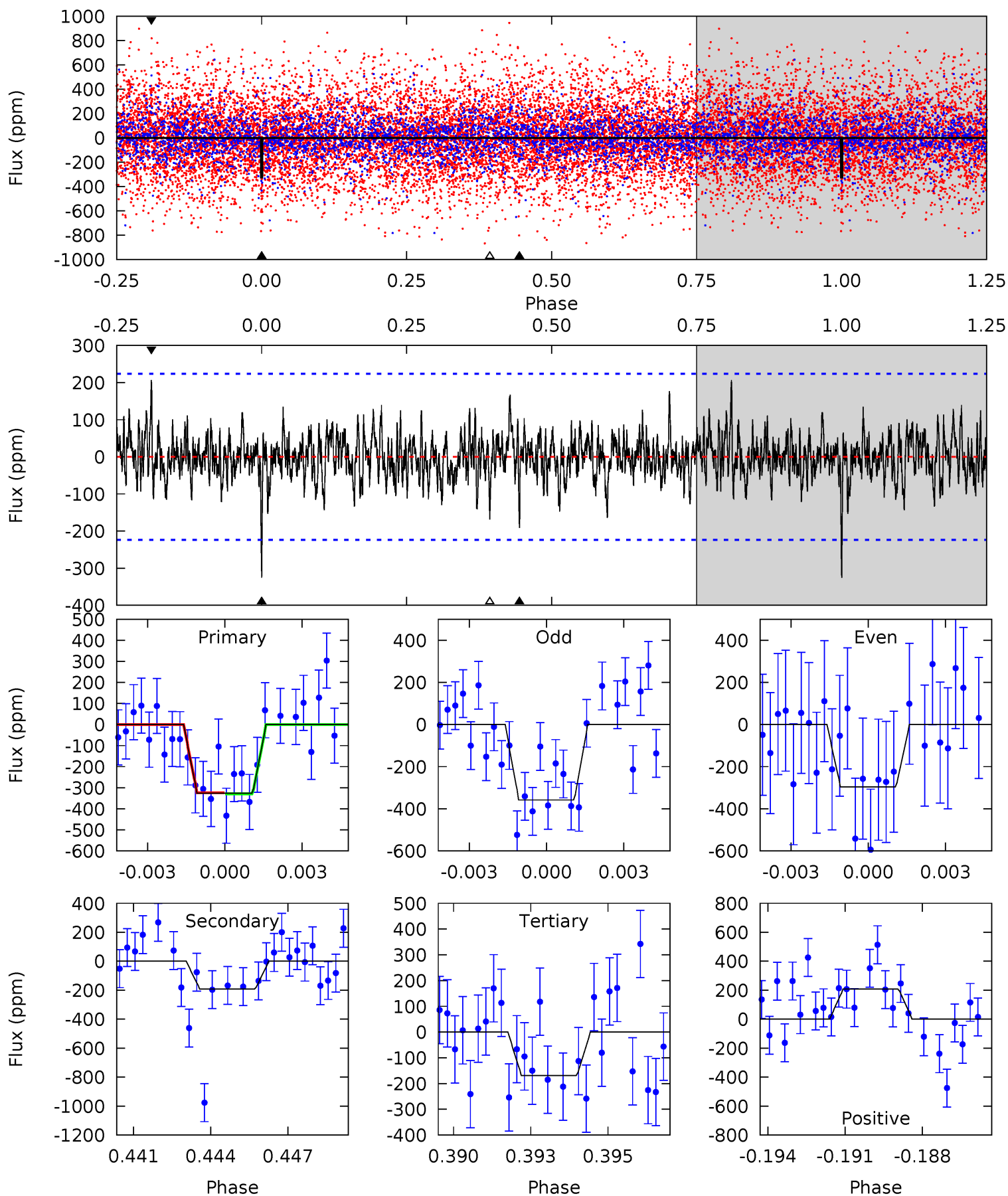
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
7.98	5.11	4.70	4.89	5.23	2.93	1.47	3.27	3.09	0.41	0.22	0.89	0.67	0.38	0.24



# Alt Model-Shift Uniqueness Test

002018906-06, P = 44.158528 Days, E = 93.952647 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
7.68	4.51	3.98	4.88	5.27	3.00	1.16	3.71	2.80	0.53	-0.37	0.75	0.73	0.39	0.05



### Stellar Parameters For KIC 002018906

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5046^{+127}_{-102}$	$3.303^{+0.310}_{-0.310}$	$-0.540^{+0.300}_{-0.250}$	$3.370^{+1.870}_{-1.007}$	$0.832^{+0.283}_{-0.165}$	$0.031^{+0.053}_{-0.022}$
	+3%/-2%	+9%/-9%	+56%/-46%	+55%/-30%	+34%/-20%	+172%/-72%
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 002018906-06 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-203 \pm 40$	$11.89^{+11.70}_{-8.06}$	$1188^{+153}_{-114}$	$3681^{+2199}_{-688}$	$43^{+347}_{-33}$
Alt.	$-191 \pm 42$	$11.81^{+11.80}_{-7.88}$	$1191^{+153}_{-119}$	$3677^{+1833}_{-686}$	$41^{+306}_{-31}$

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



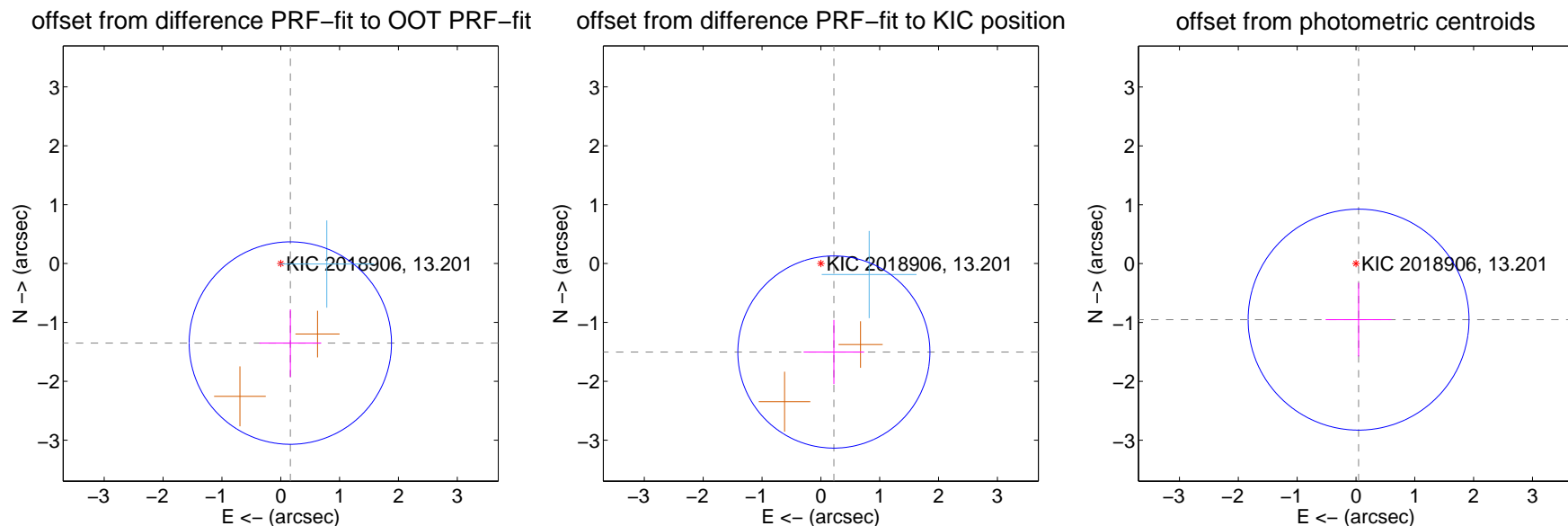
## DV Centroid Data

Supplemental centroid analysis for 002018906-06. Kepler magnitude: 13.20. Transit SNR 9.20

There are 1 quarters with good PRF difference image offsets

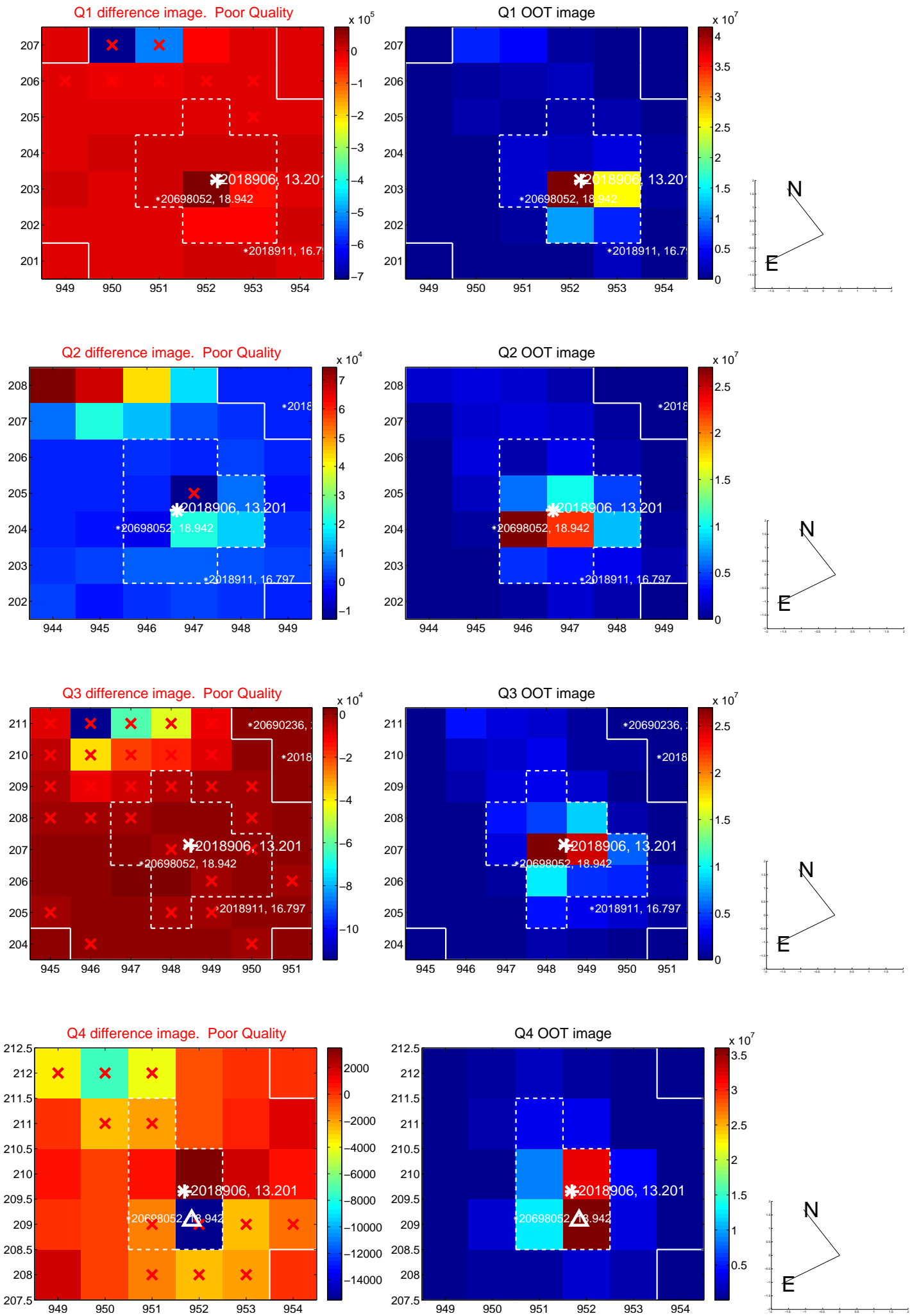
The direct PRF centroid is offset from the target star catalog position by about 0.18 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.360 \pm 0.573$	2.37	$-0.163 \pm 0.525$	$-1.350 \pm 0.574$
PRF-fit source offset from KIC position	$1.519 \pm 0.544$	2.79	$-0.221 \pm 0.514$	$-1.502 \pm 0.544$
photometric centroid source offset	$0.95 \pm 0.63$	1.52	$-0.04 \pm 0.56$	$-0.95 \pm 0.63$

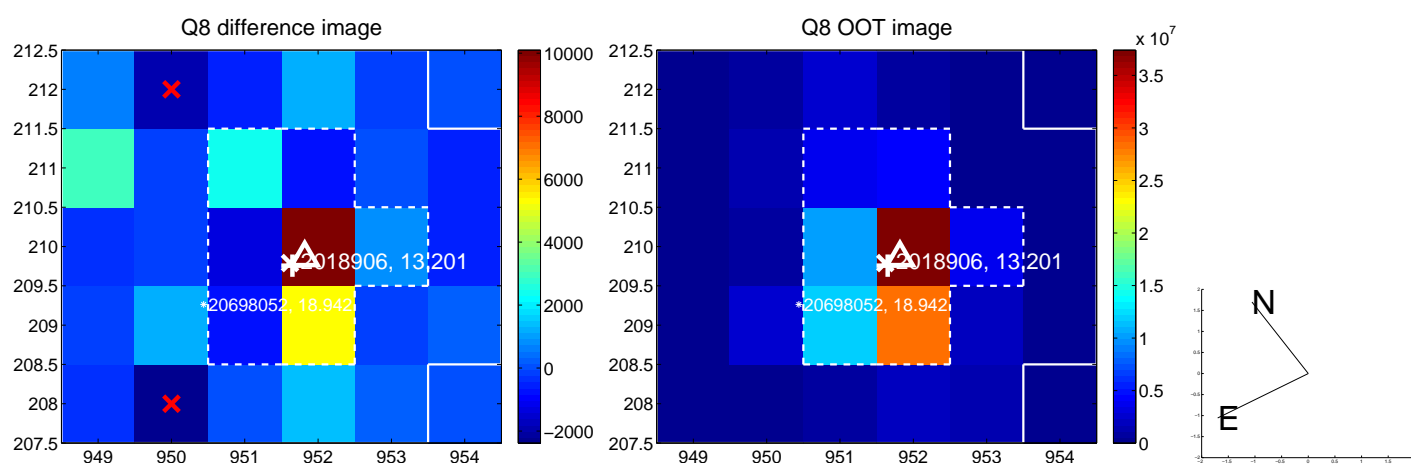
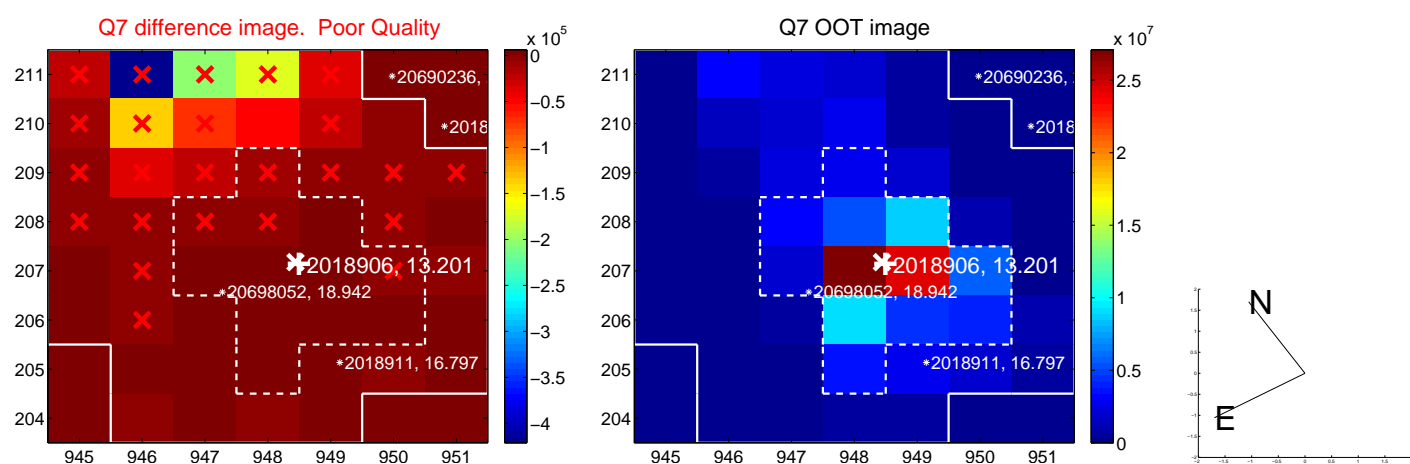
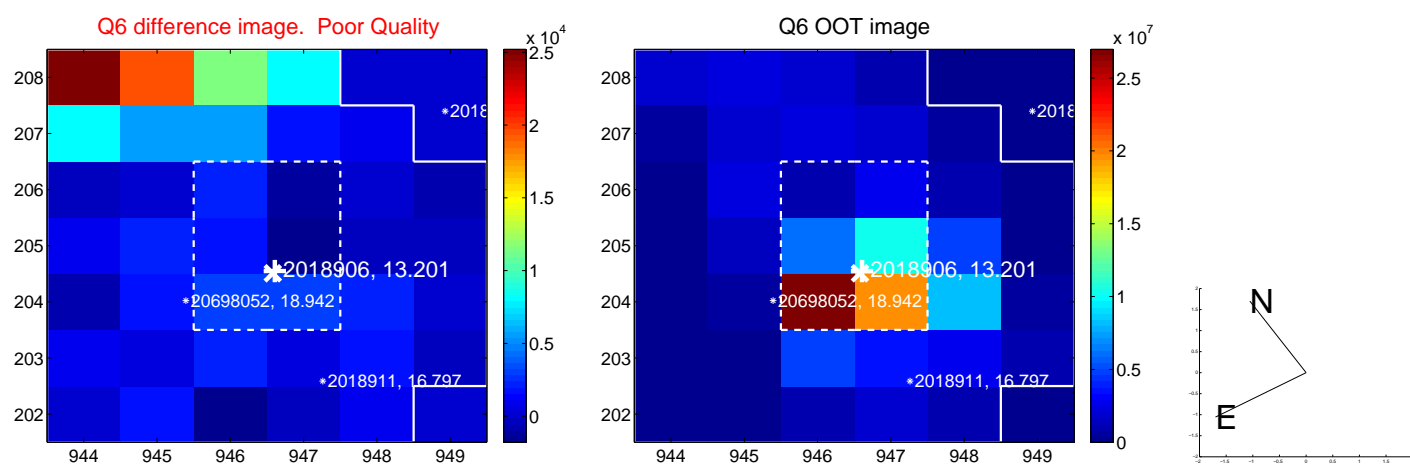
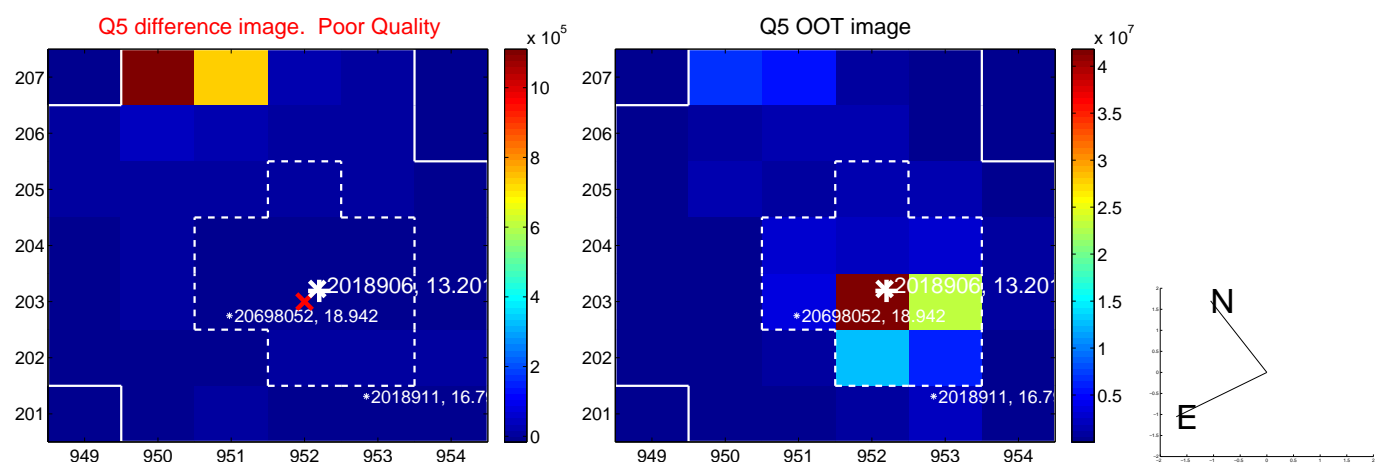


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

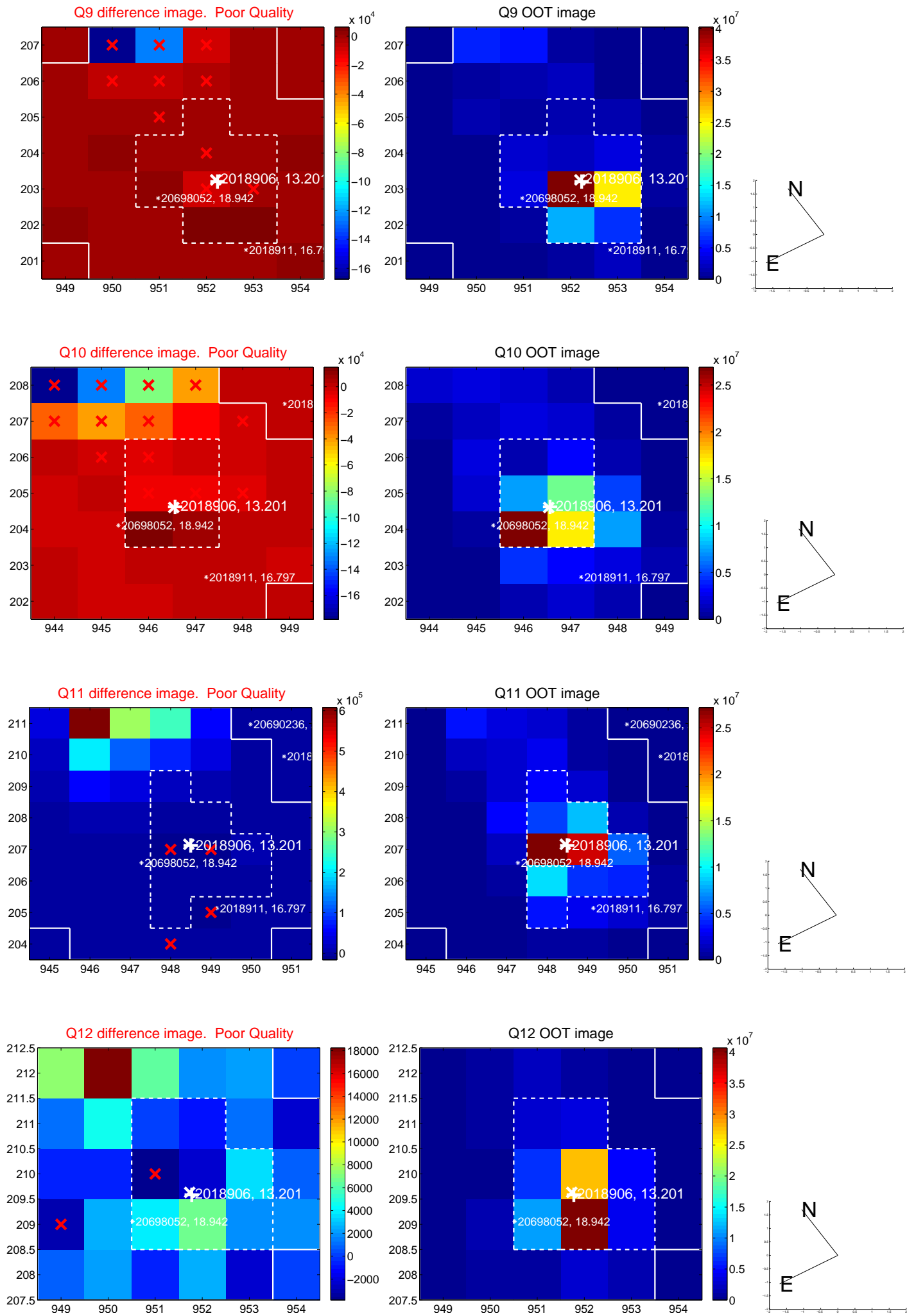
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



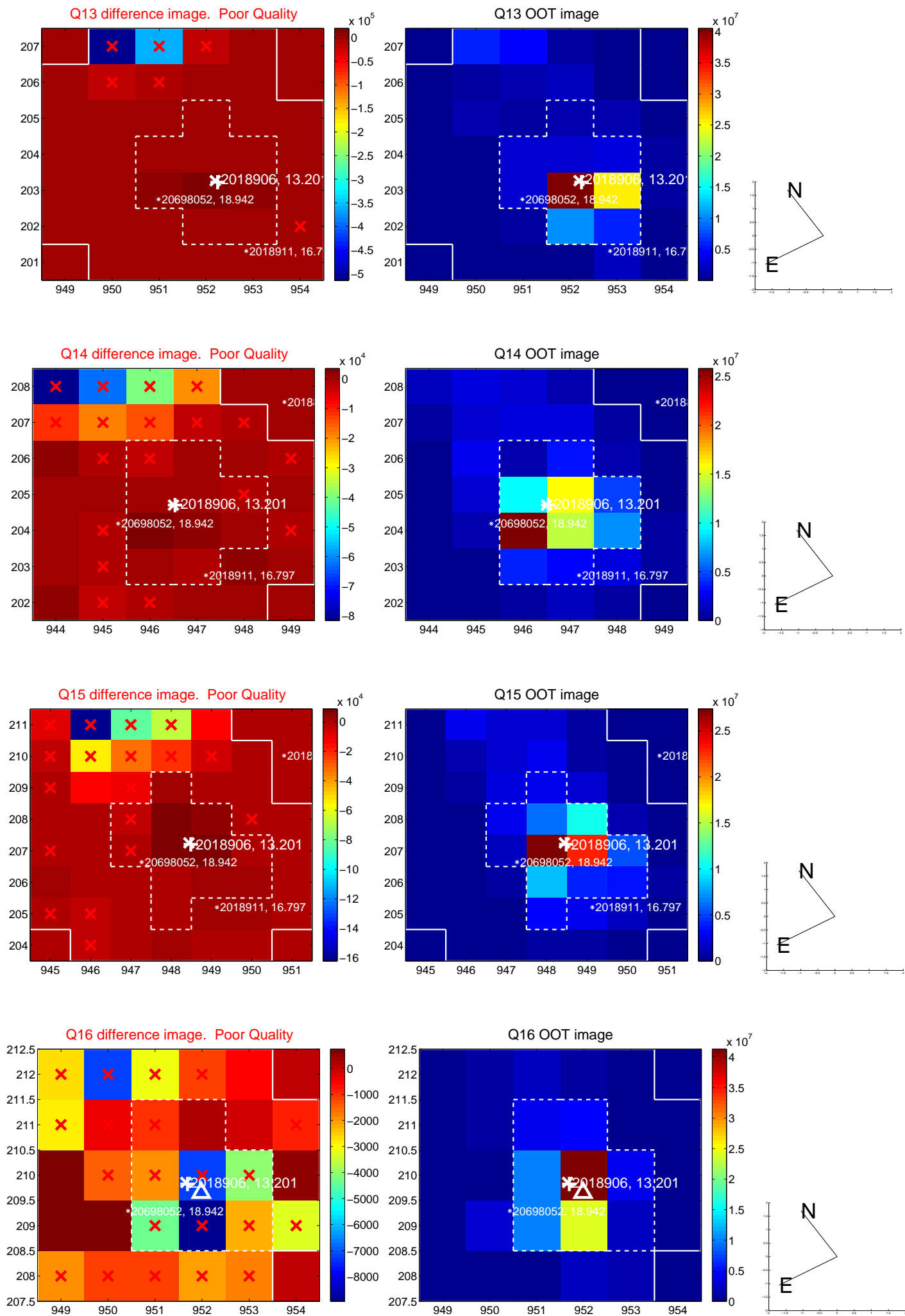
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



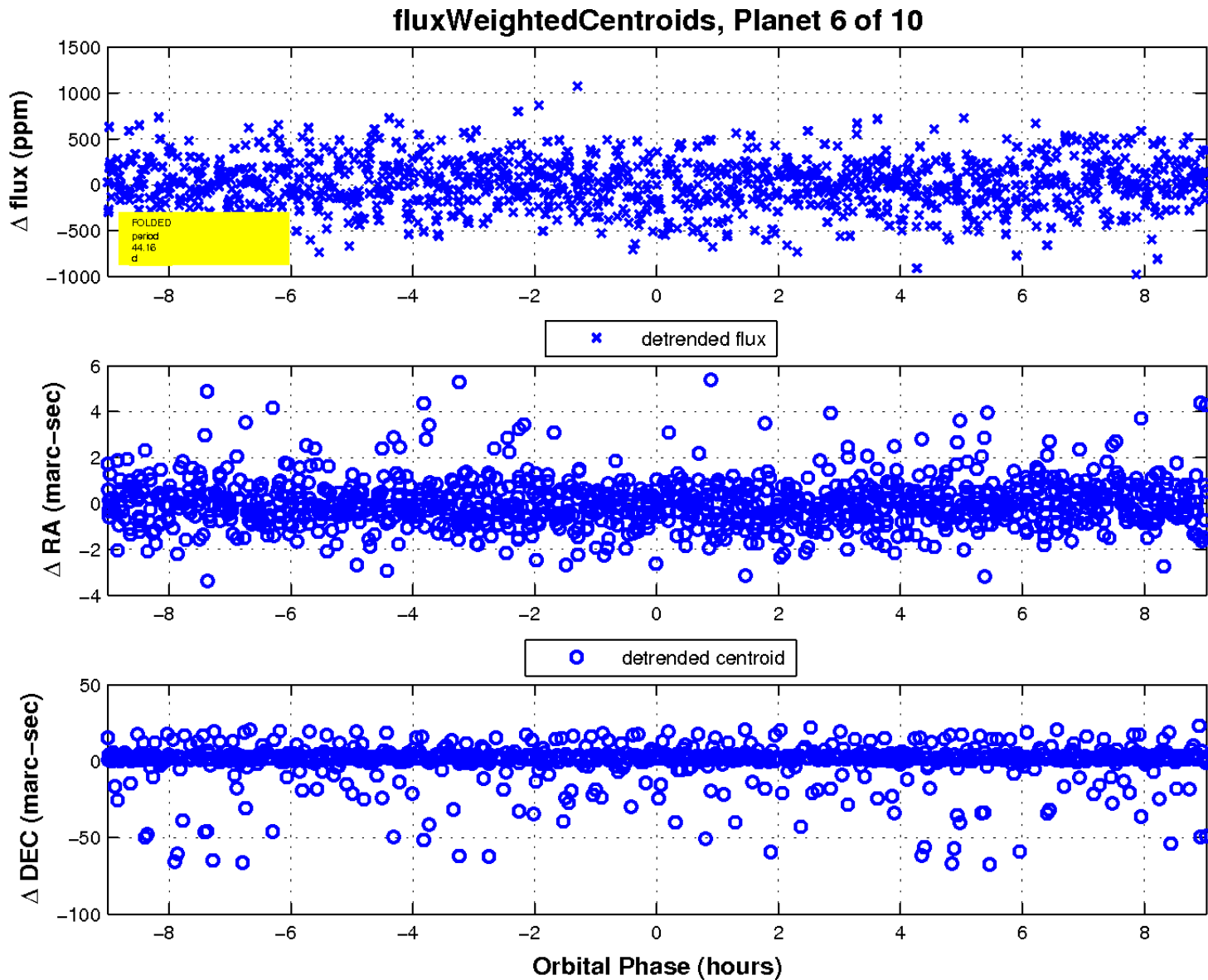
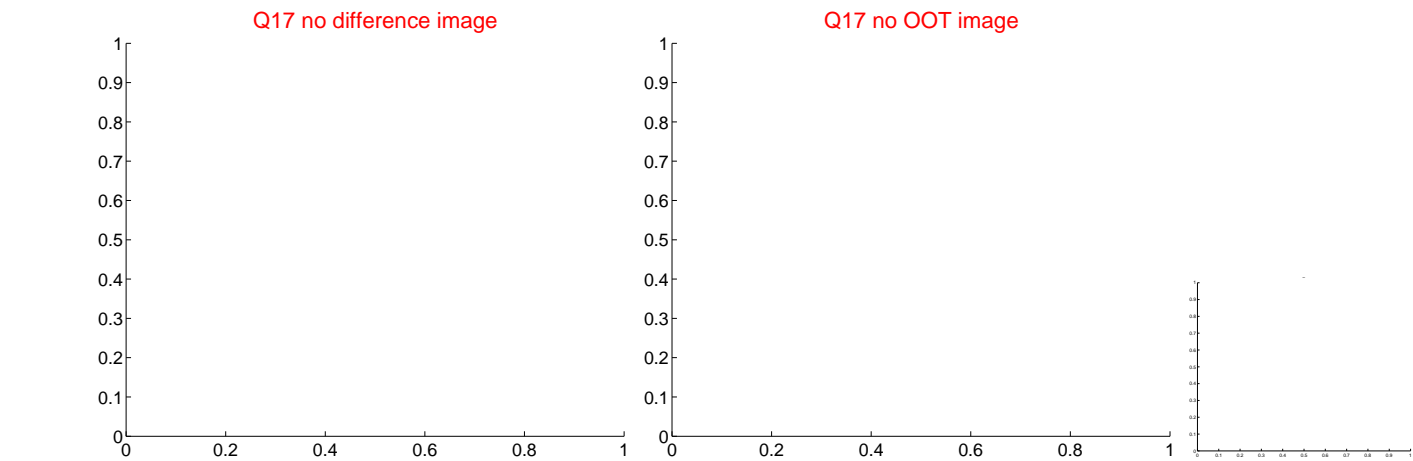
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



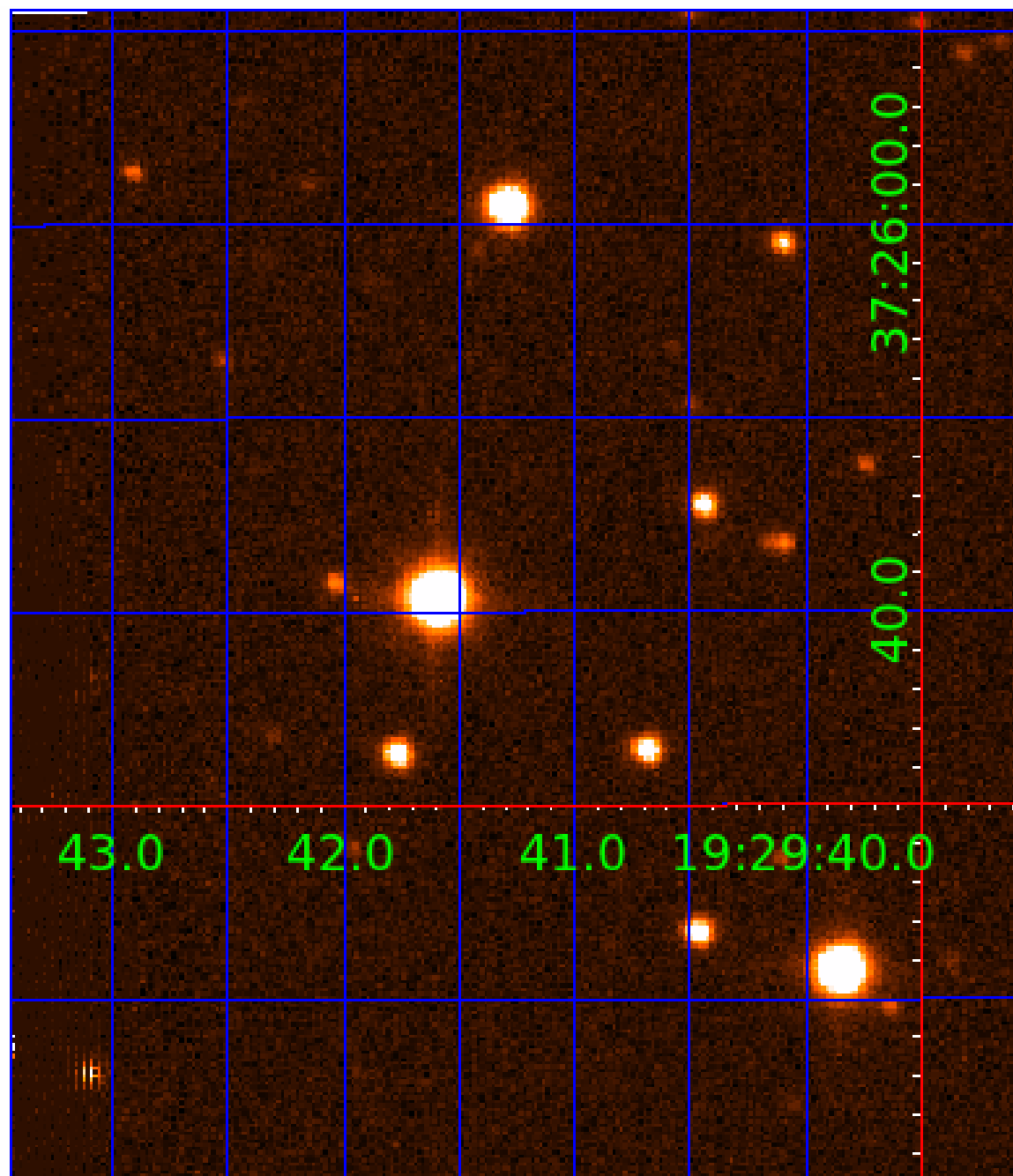
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.





UKIRT Image

Declination



# KIC 002018906

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
002018906-01	OBS	No	0.525149	131.658983	11.9	3.212	15.1	3.7	3.37	5046	1.24	0.00
002018906-04	OBS	No	31.419253	137.819040	334.8	3.524	9.4	8.5	3.37	5046	7.09	196.26
002018906-05	OBS	No	22.245829	137.842474	441.7	2.059	9.2	10.5	3.37	5046	7.50	311.01
002018906-06	OBS	No	44.158582	138.108488	370.8	3.010	9.1	9.2	3.37	5046	7.29	124.67
002018906-07	OBS	No	53.152195	148.596580	587.8	1.755	8.9	9.6	3.37	5046	9.31	97.37
002018906-08	OBS	No	46.663938	154.862044	409.6	2.876	7.8	8.6	3.37	5046	8.08	115.82
002018906-09	OBS	No	53.025159	168.237150	329.6	2.994	8.1	7.9	3.37	5046	7.32	97.68
002018906-10	OBS	No	7.605976	131.528571	187.7	3.276	9.2	10.1	3.37	5046	5.50	1300.86

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
002018906-01	OBS	FP	0.00	1	0	1	0	LPP_DV—CENT_RESOLVED_OFFSET
002018906-04	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-05	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-06	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-07	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-08	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-09	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS
002018906-10	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE_ZUMA—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_CROWDED

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

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

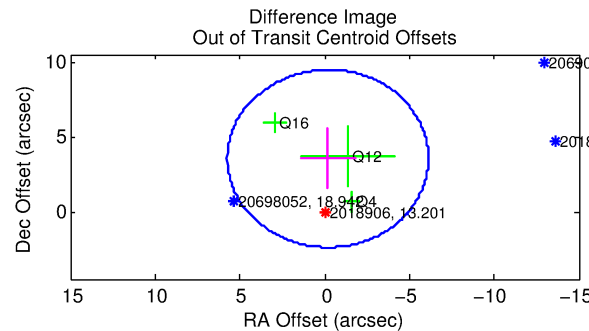
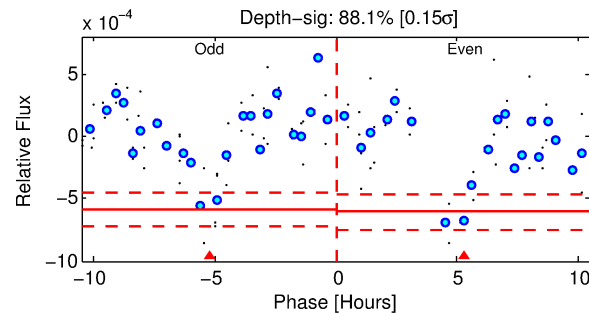
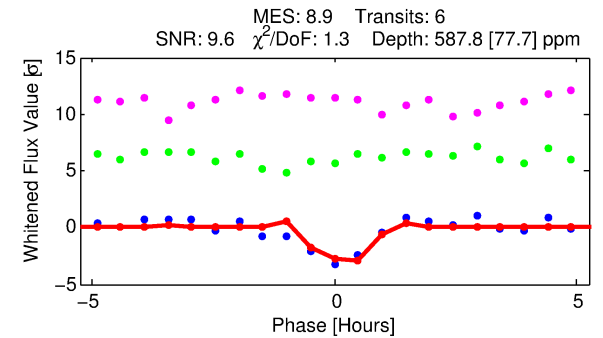
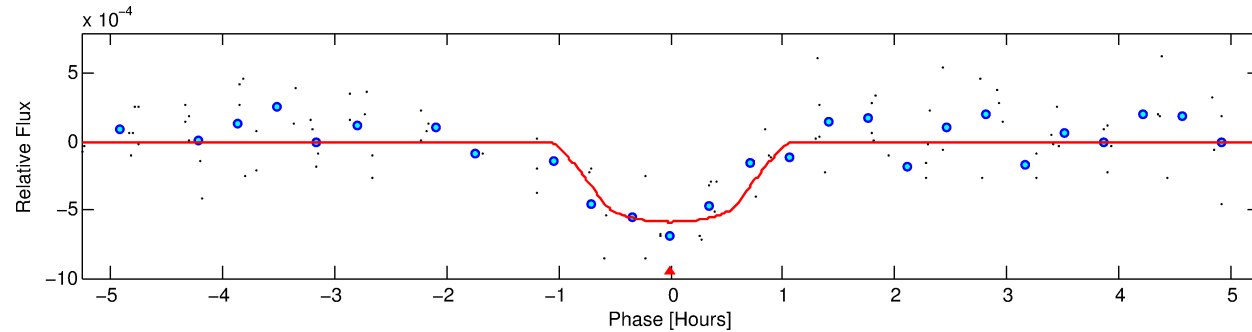
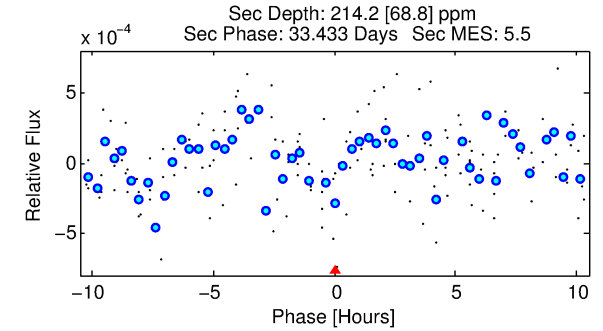
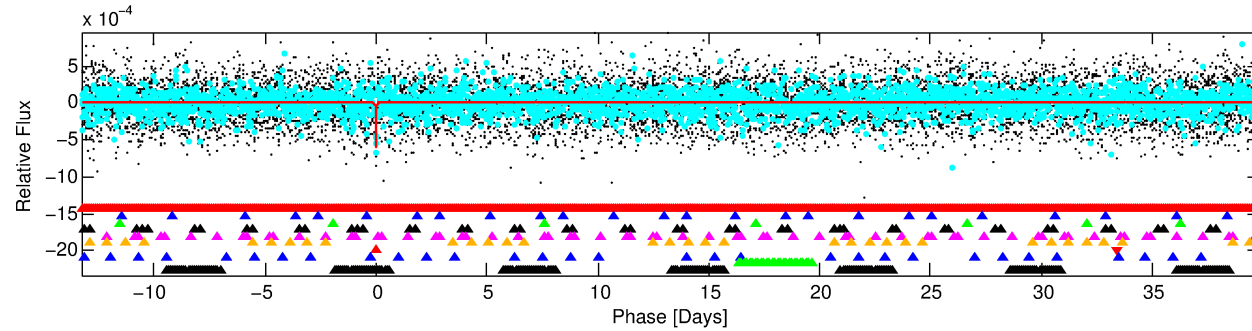
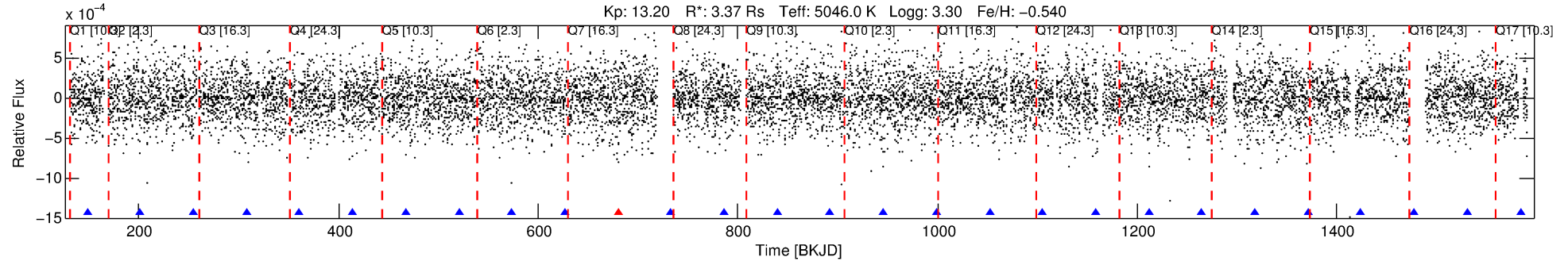
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 002018906-07

No Significant Match Found

# DV One-Page Summary

KIC: 2018906 Candidate: 7 of 10 Period: 53.152 d



## DV Fit Results:

Period = 53.15220 [0.00034] d  
Epoch = 148.5966 [0.0052] BKJD  
Rp/R\* = 0.0253 [0.0518]  
a/R\* = 139.27 [1146.40]  
b = 0.83 [3.13]  
Seff = 97.37 [59.50]  
Teq = 801 [122] K  
Rp = 9.31 [19.74] Re  
a = 0.2603 [0.1145] AU  
Ag = 92.06 [381.79] [0.24σ]  
Teffp = 3836 [3936] K [0.77σ]

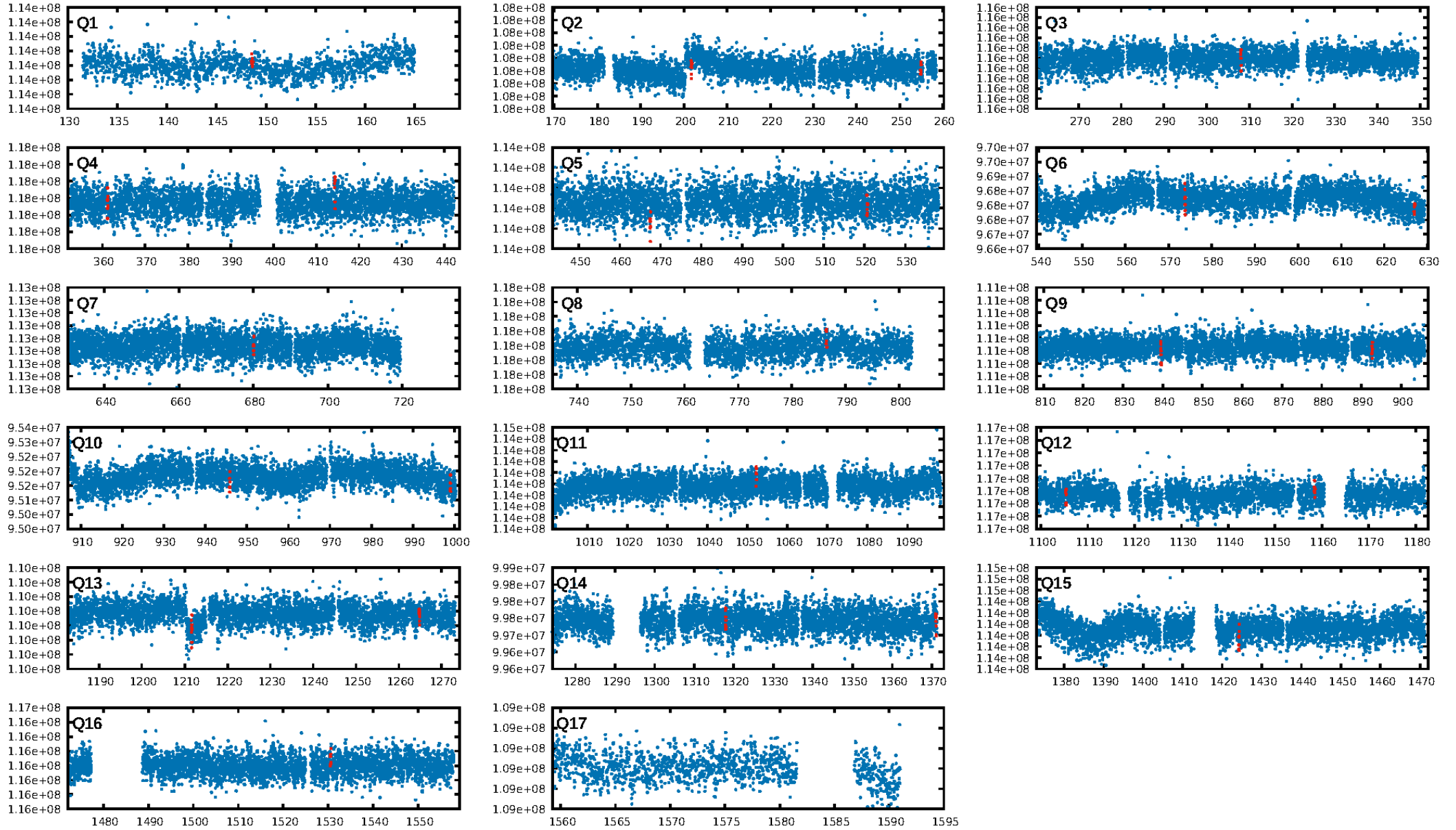
## DV Diagnostic Results:

ShortPeriod-sig: 62.0% [0.88σ]  
LongPeriod-sig: 100.0% [35.44σ]  
ModelChiSquare2-sig: 58.8%  
ModelChiSquareGof-sig: 90.5%  
**Bootstrap-pfa: 4.27e-10**  
RollingBand-fgt: 0.83 [5/6]  
**GhostDiagnostic-chr: -0.3077**  
Centroid-sig: N/A  
**Centroid-so: 1.847 arcsec [3.20σ]**  
OotOffset-rm: 3.544 arcsec [1.79σ]  
KicOffset-rm: 3.451 arcsec [1.79σ]  
OotOffset-st: 0/0/3/0 [3]  
KicOffset-st: 0/0/3/0 [3]  
DiffImageQuality-fgm: 0.00 [0/3]  
DiffImageOverlap-fno: 0.00 [0/16]

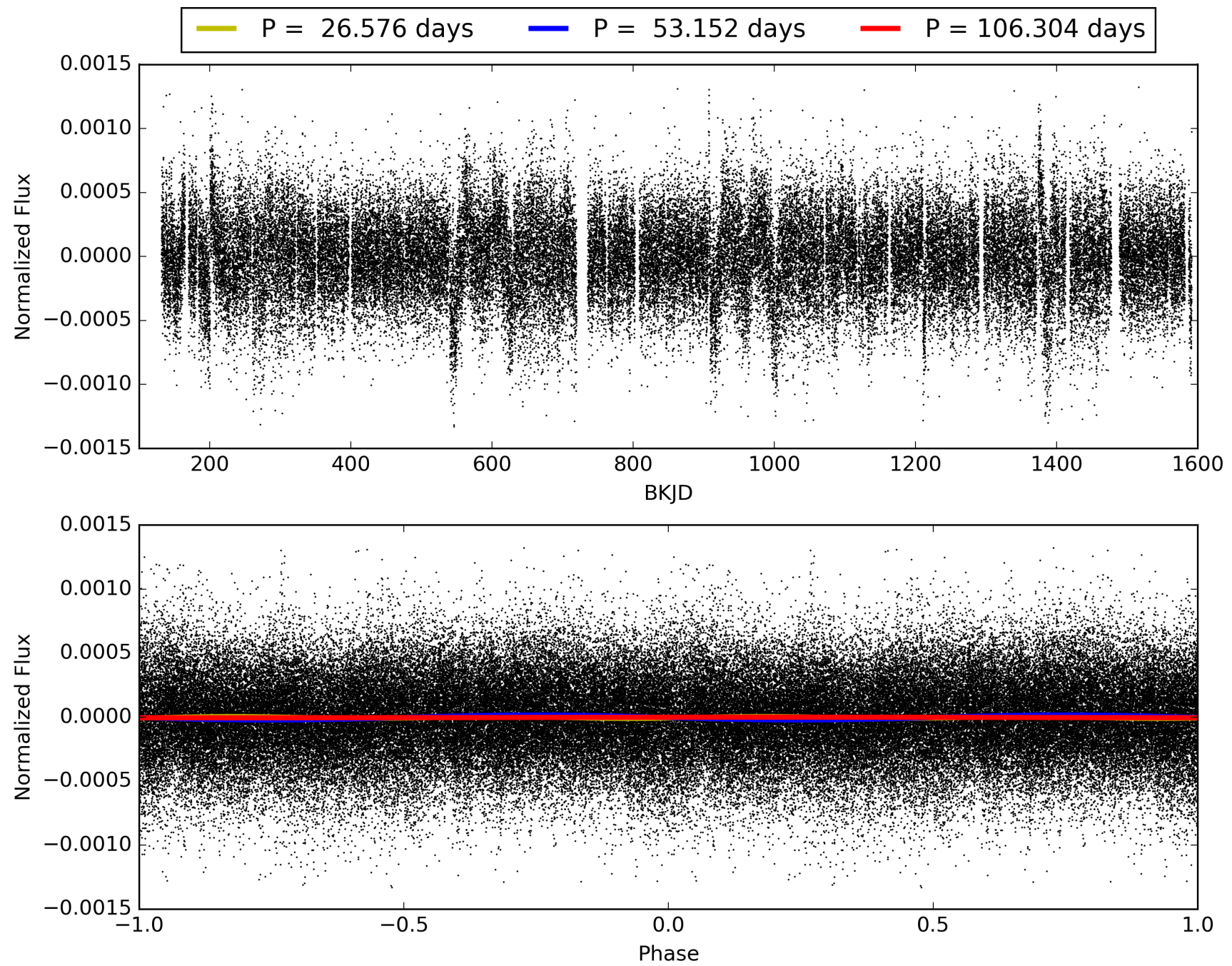
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 04:43:32 Z

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

# TCE 002018906-07, PDC Light Curves

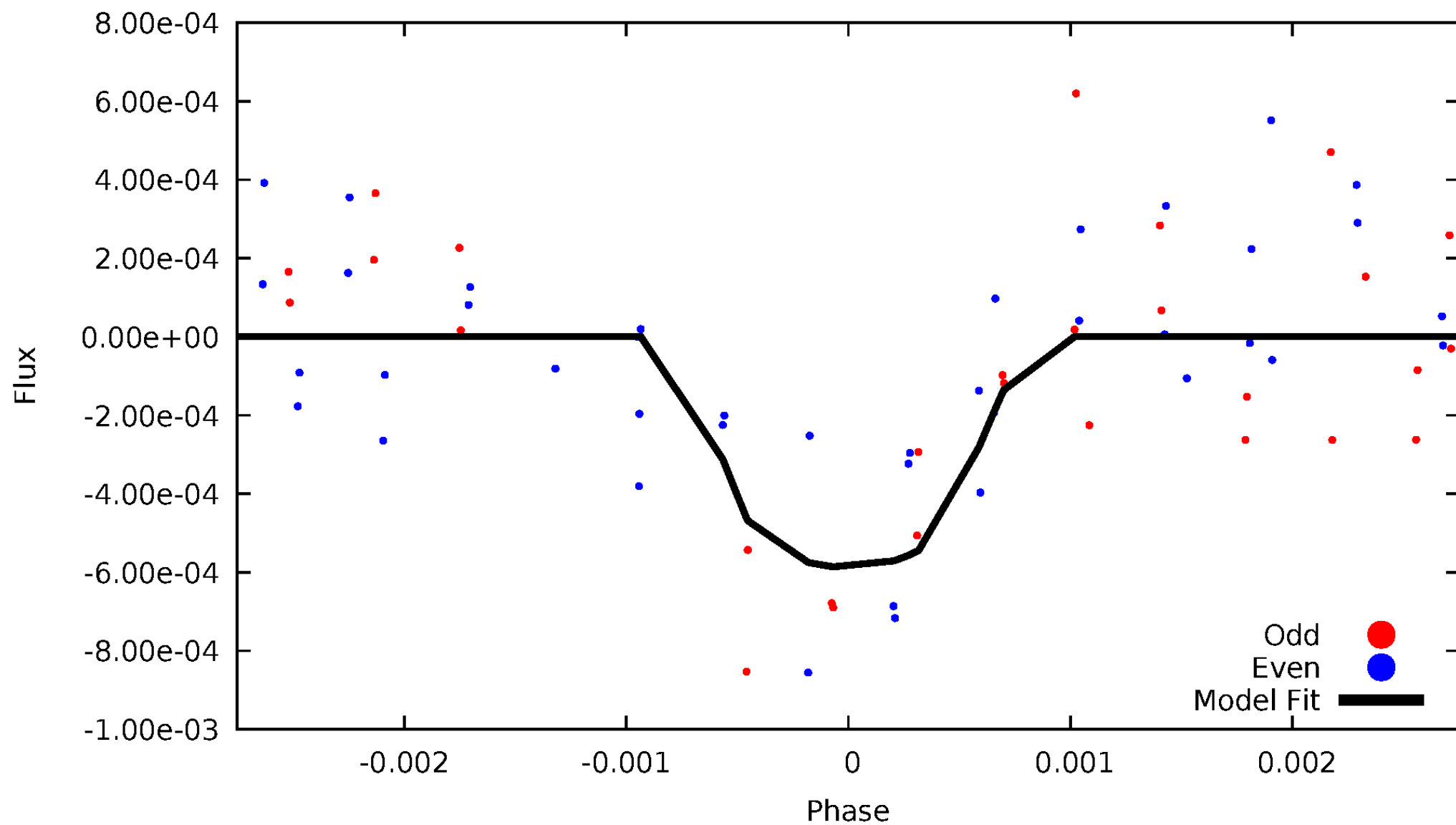


TCE 002018906-07



# DV Odd/Even

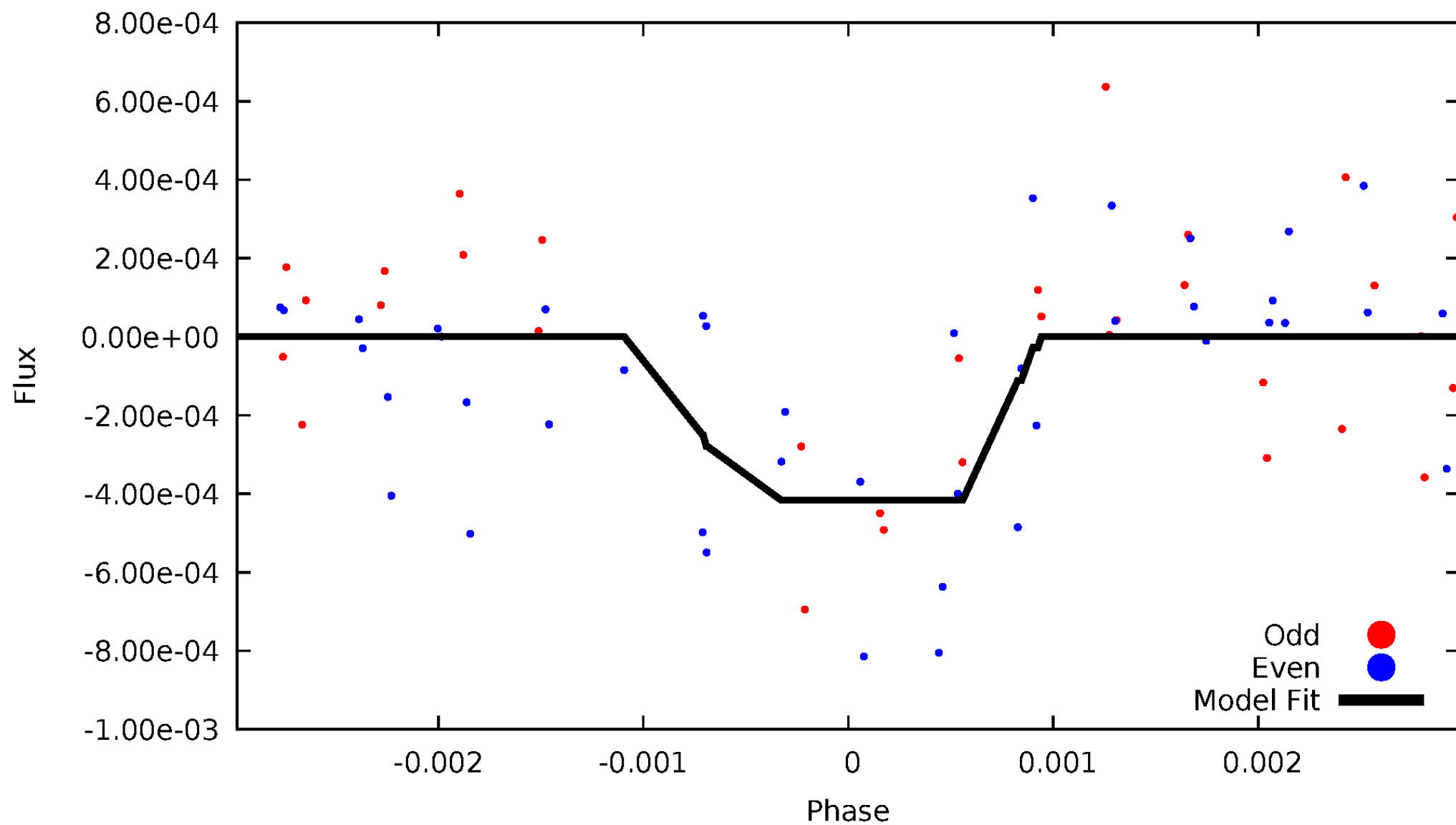
TCE 002018906-07





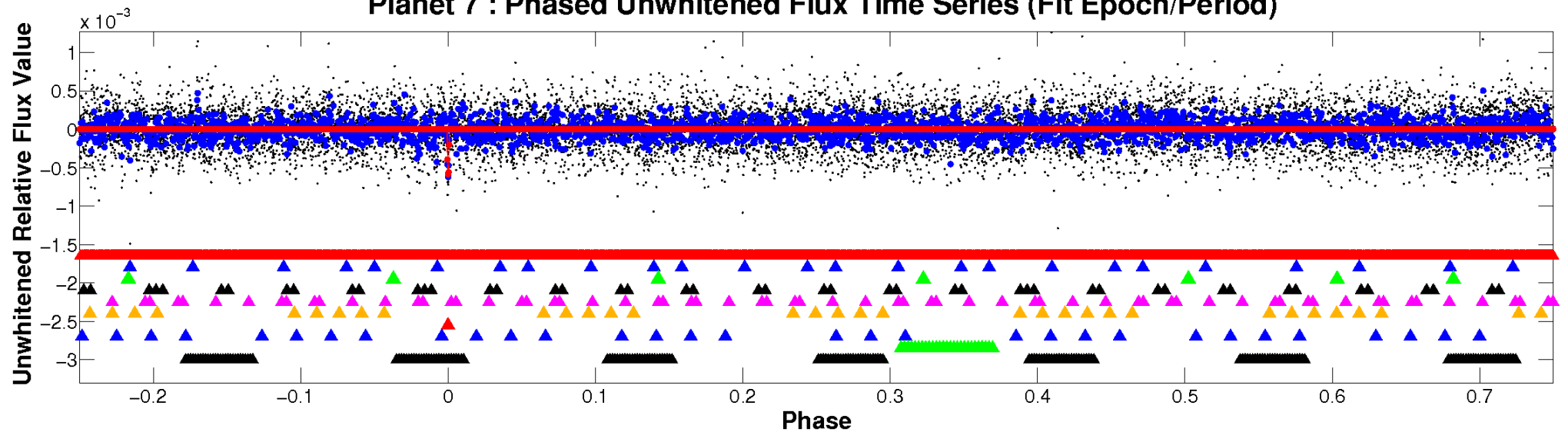
# ALT Odd/Even

TCE 002018906-07

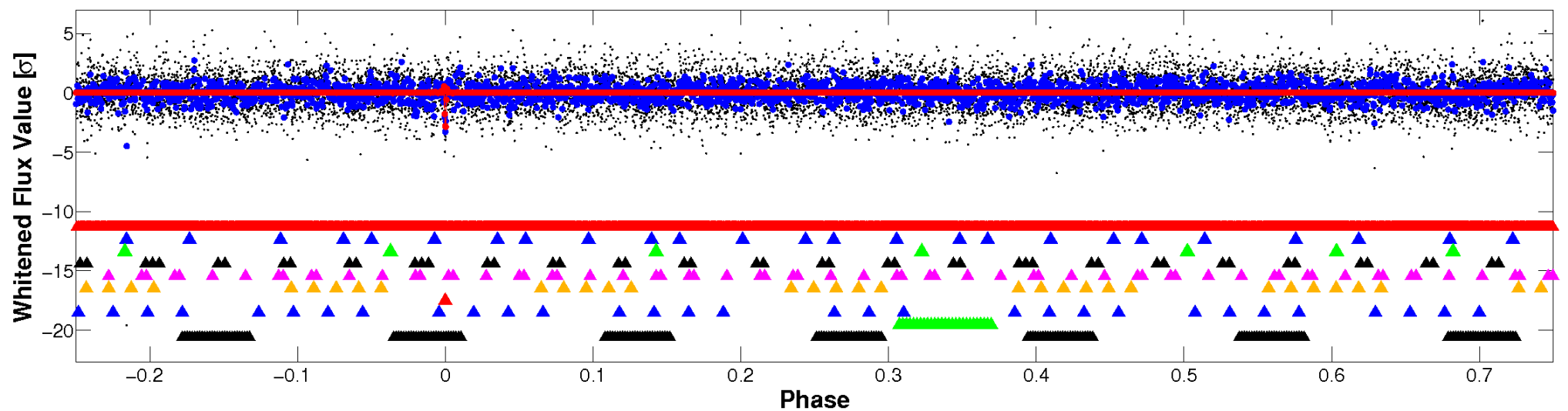


# Non-Whitened Vs. Whitened Light Curve

## Planet 7 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

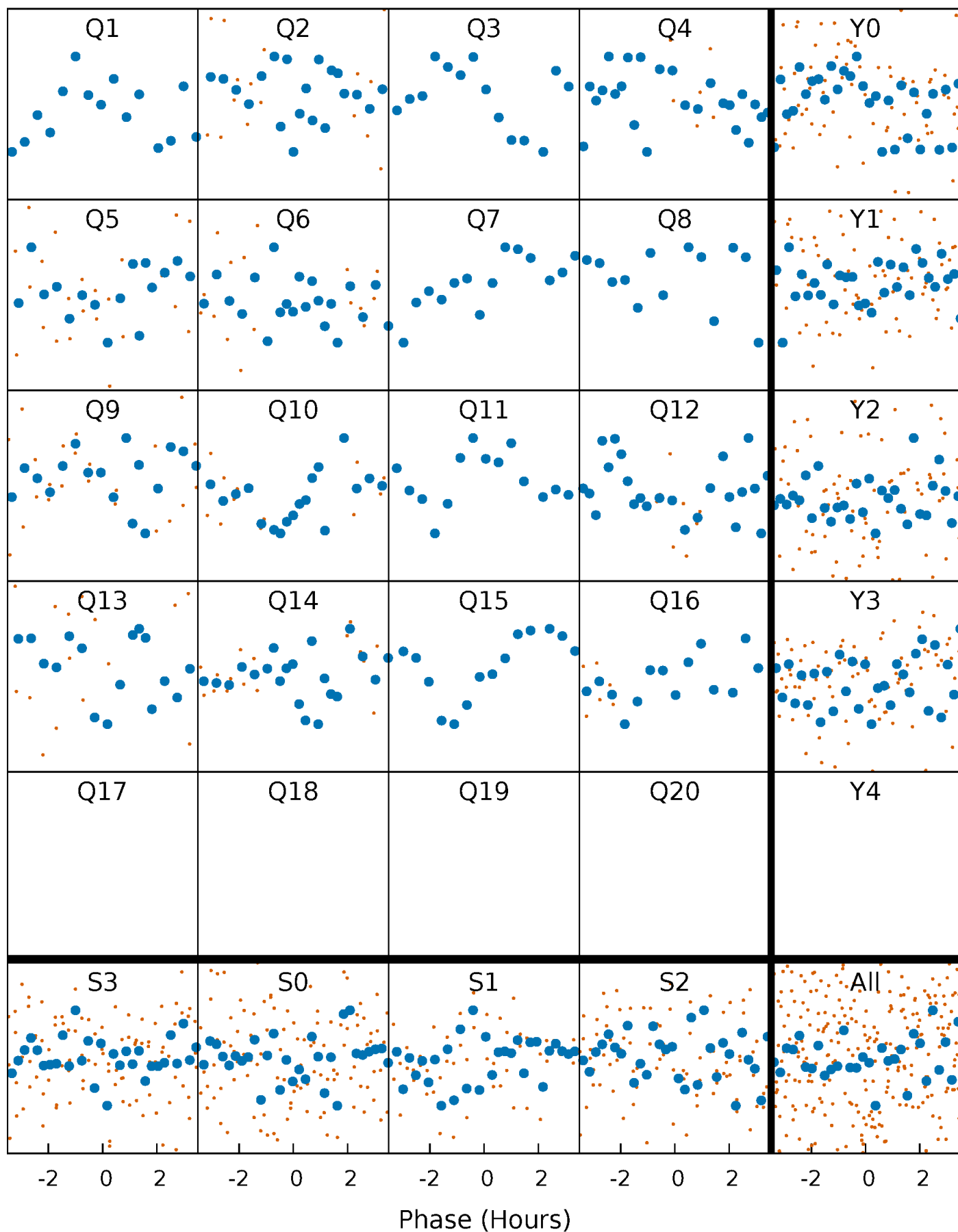


## Planet 7 : Phased Whitened Flux Time Series (Fit Epoch/Period)



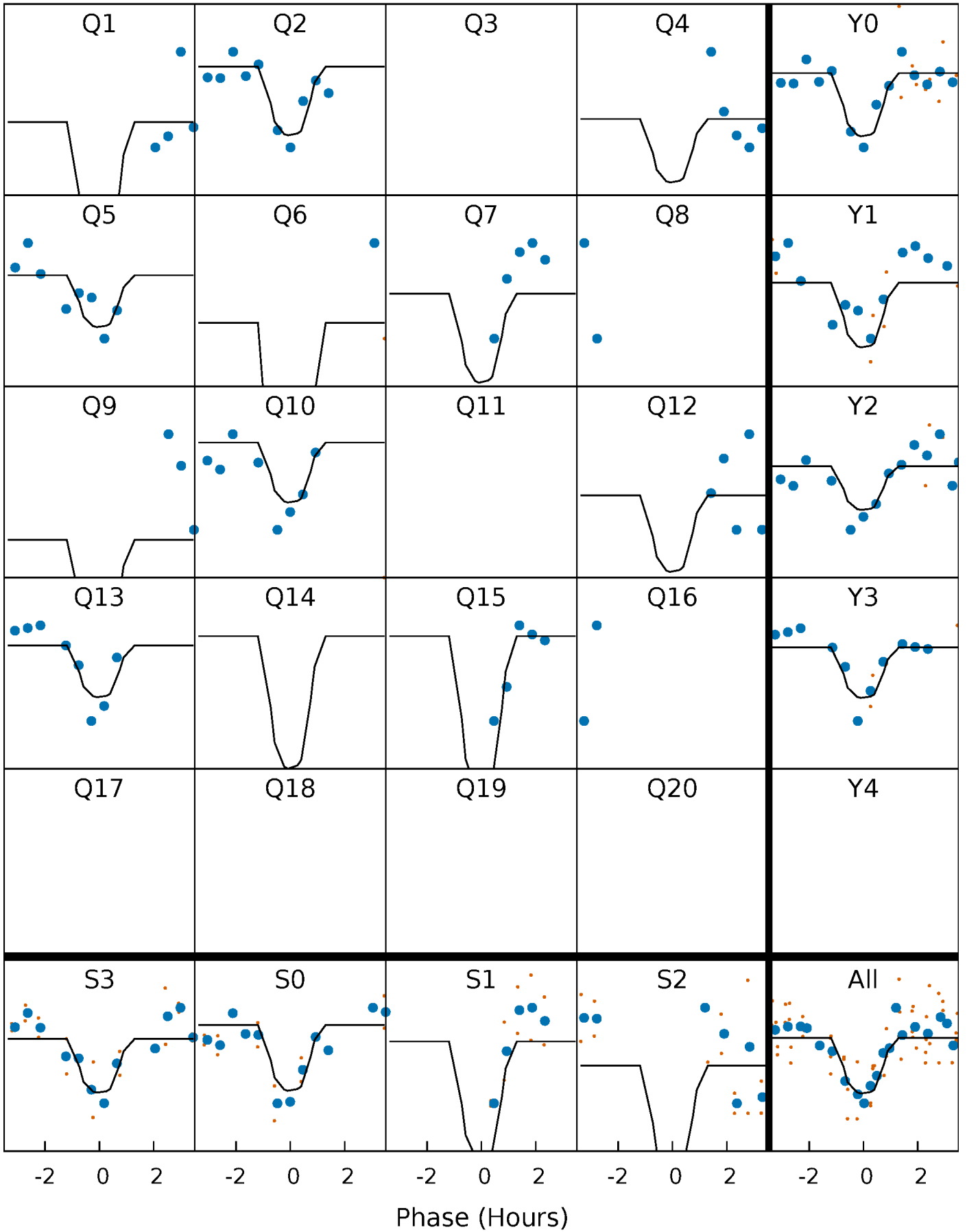
# PDC Quarter-Phased Transit Curves

TCE 002018906-07     $P = 53.152195$  Days     $T_0 = 148.596580$  (BKJD)



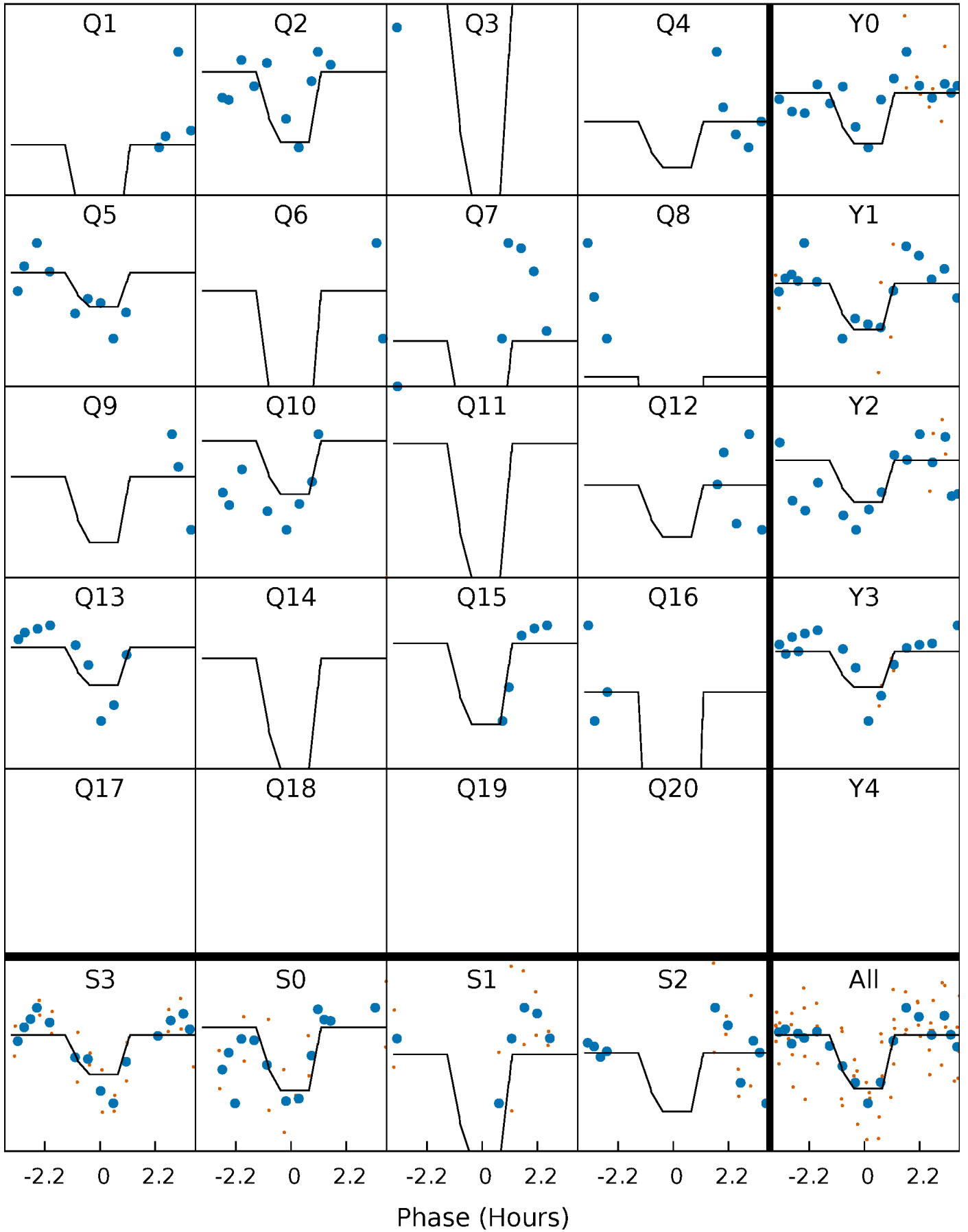
# DV Quarter-Phased Transit Curves

TCE 002018906-07   P= 53.152195 Days    $T_0=148.596580$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

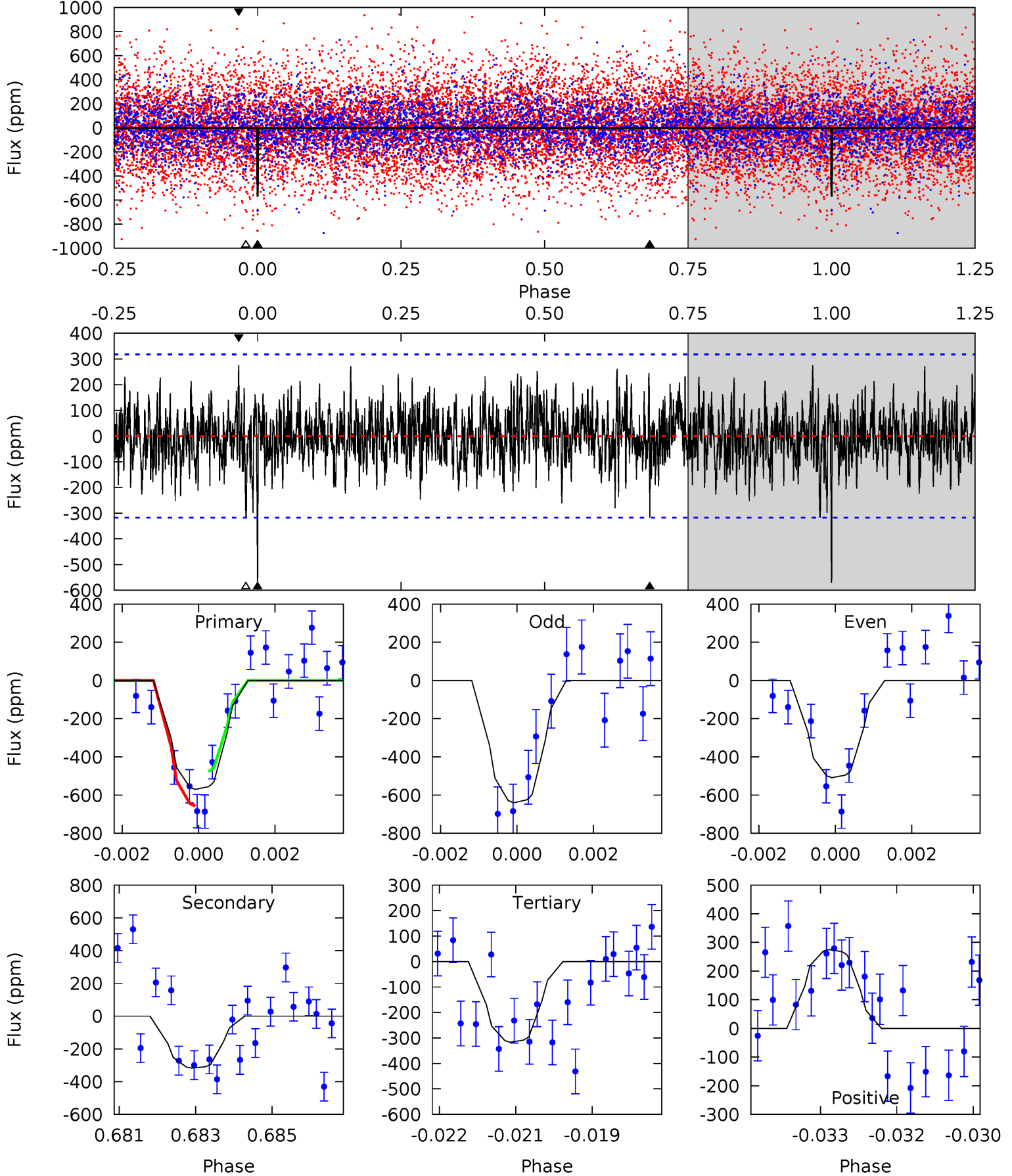
TCE 002018906-07   P= 53.152103 Days    $T_0=148.584788$  (BKJD)



# DV Model-Shift Uniqueness Test

002018906-07, P = 53.152195 Days, E = 95.444385 Days

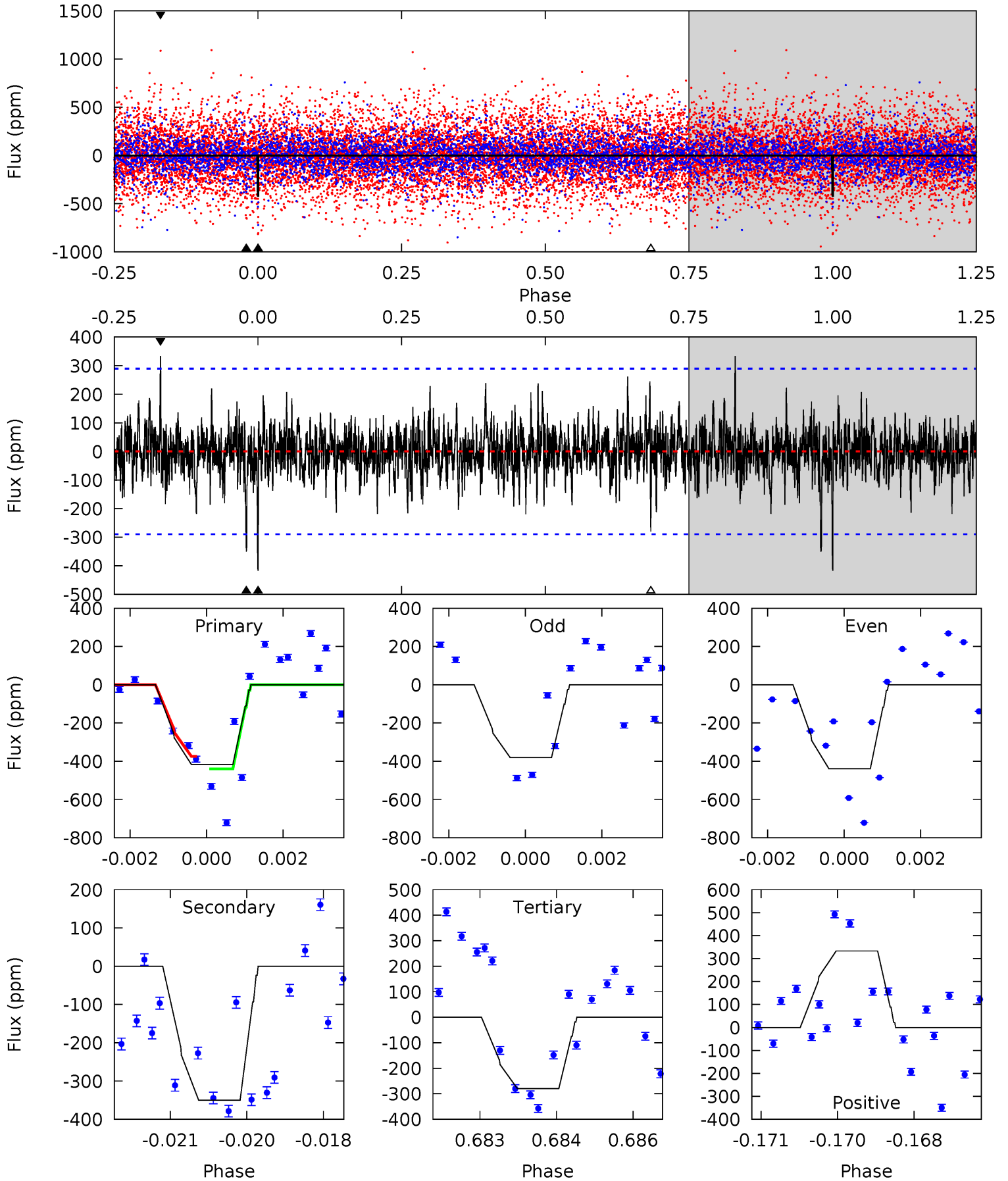
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
9.64	5.36	5.35	4.65	5.37	3.16	1.48	4.29	4.99	0.01	0.71	1.11	0.97	0.33	1.44



# Alt Model-Shift Uniqueness Test

002018906-07, P = 53.152103 Days, E = 95.432685 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
7.73	6.50	5.19	6.18	5.36	3.15	1.24	2.54	1.54	1.31	0.31	0.50	0.82	0.44	0.56





### Stellar Parameters For KIC 002018906

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5046^{+127}_{-102}$	$3.303^{+0.310}_{-0.310}$	$-0.540^{+0.300}_{-0.250}$	$3.370^{+1.870}_{-1.007}$	$0.832^{+0.283}_{-0.165}$	$0.031^{+0.053}_{-0.022}$
	+3%/-2%	+9%/-9%	+56%/-46%	+55%/-30%	+34%/-20%	+172%/-72%
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 002018906-07 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-317 \pm 59$	$17.29^{+16.75}_{-11.70}$	$1111^{+147}_{-101}$	$3519^{+1839}_{-656}$	$40^{+277}_{-30}$
Alt.	$-350 \pm 54$	$16.15^{+17.92}_{-10.37}$	$1117^{+137}_{-107}$	$3644^{+1962}_{-722}$	$50^{+359}_{-38}$

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

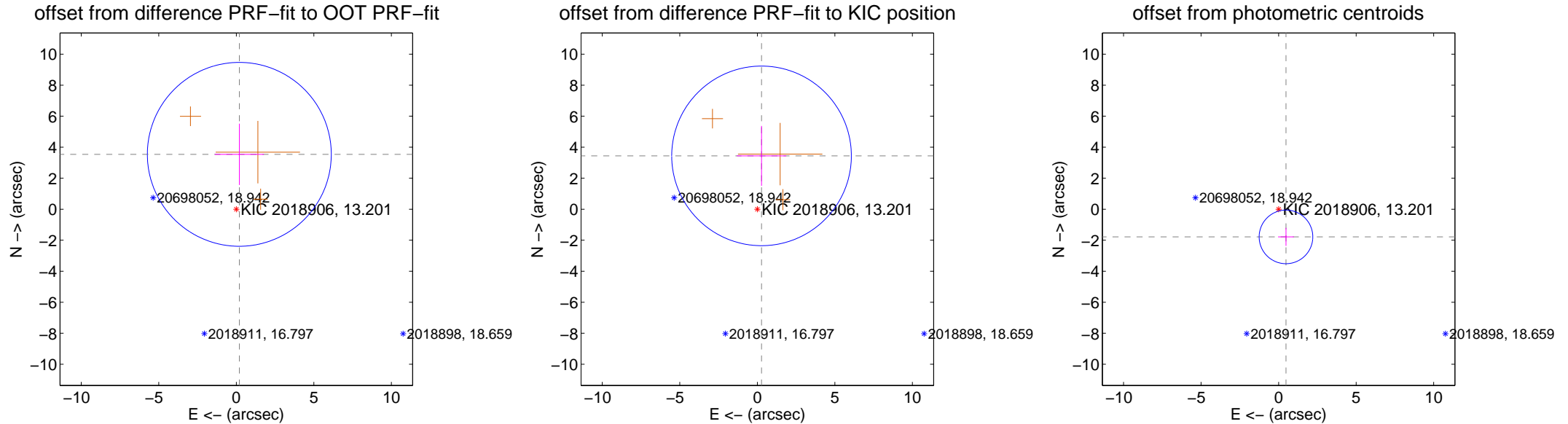
## DV Centroid Data

Supplemental centroid analysis for 002018906-07. Kepler magnitude: 13.20. Transit SNR 9.63

There are 0 quarters with good PRF difference image offsets

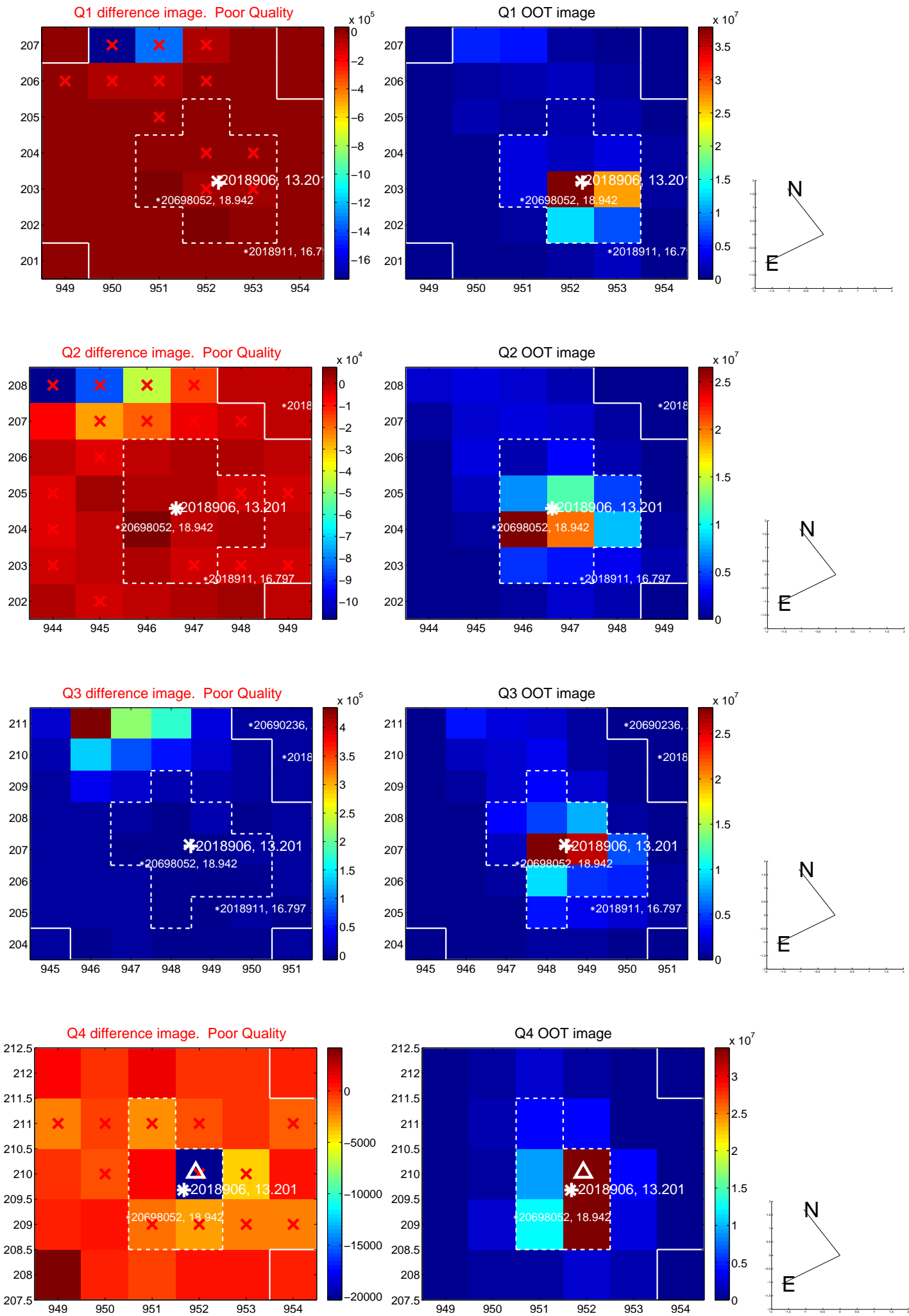
The direct PRF centroid is offset from the target star catalog position by about 0.17 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$3.544 \pm 1.977$	1.79	$-0.194 \pm 1.587$	$3.539 \pm 1.978$
PRF-fit source offset from KIC position	$3.451 \pm 1.931$	1.79	$-0.271 \pm 1.594$	$3.440 \pm 1.933$
photometric centroid source offset	$1.85 \pm 0.58$	3.20	$-0.48 \pm 0.51$	$-1.79 \pm 0.58$

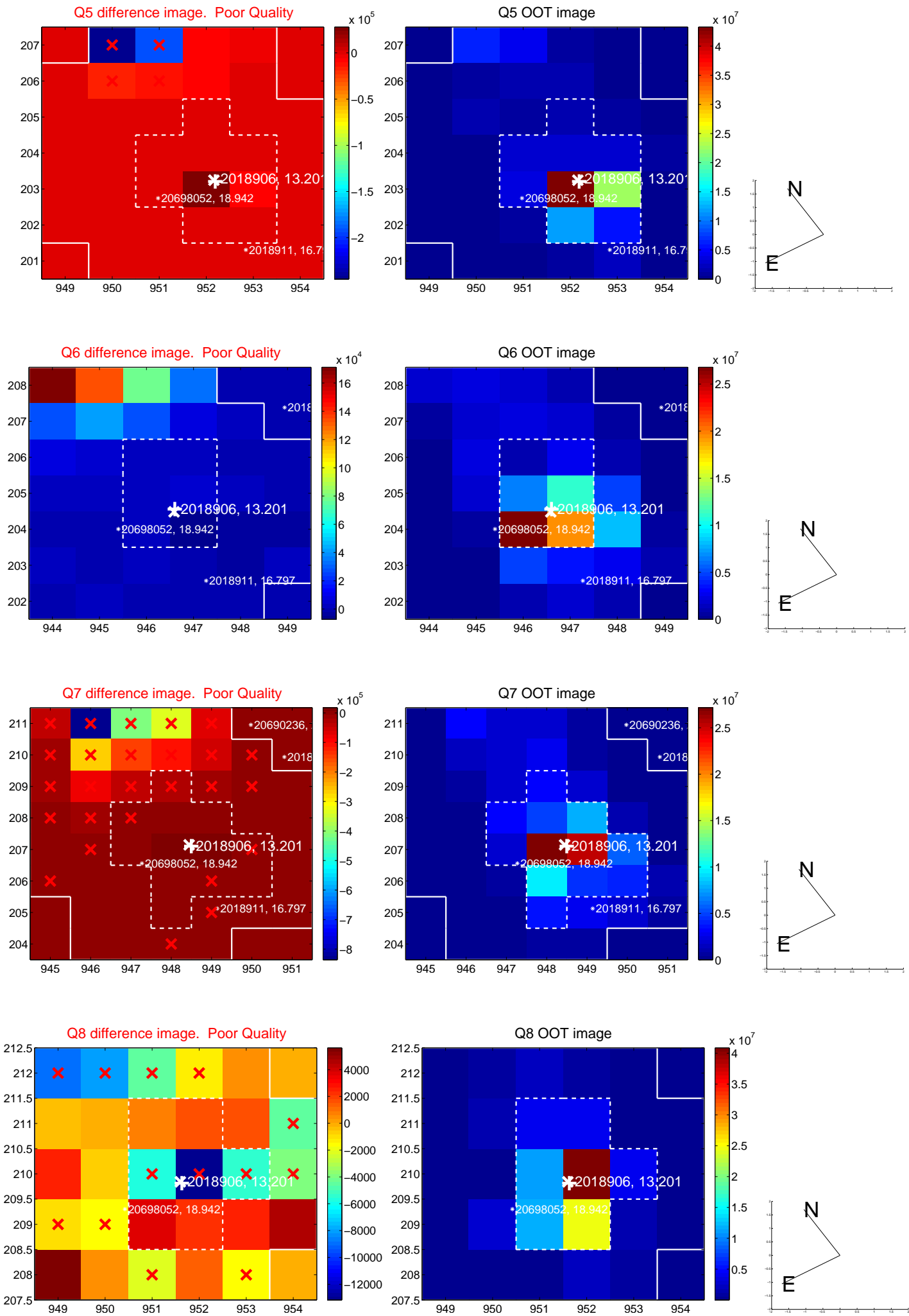


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

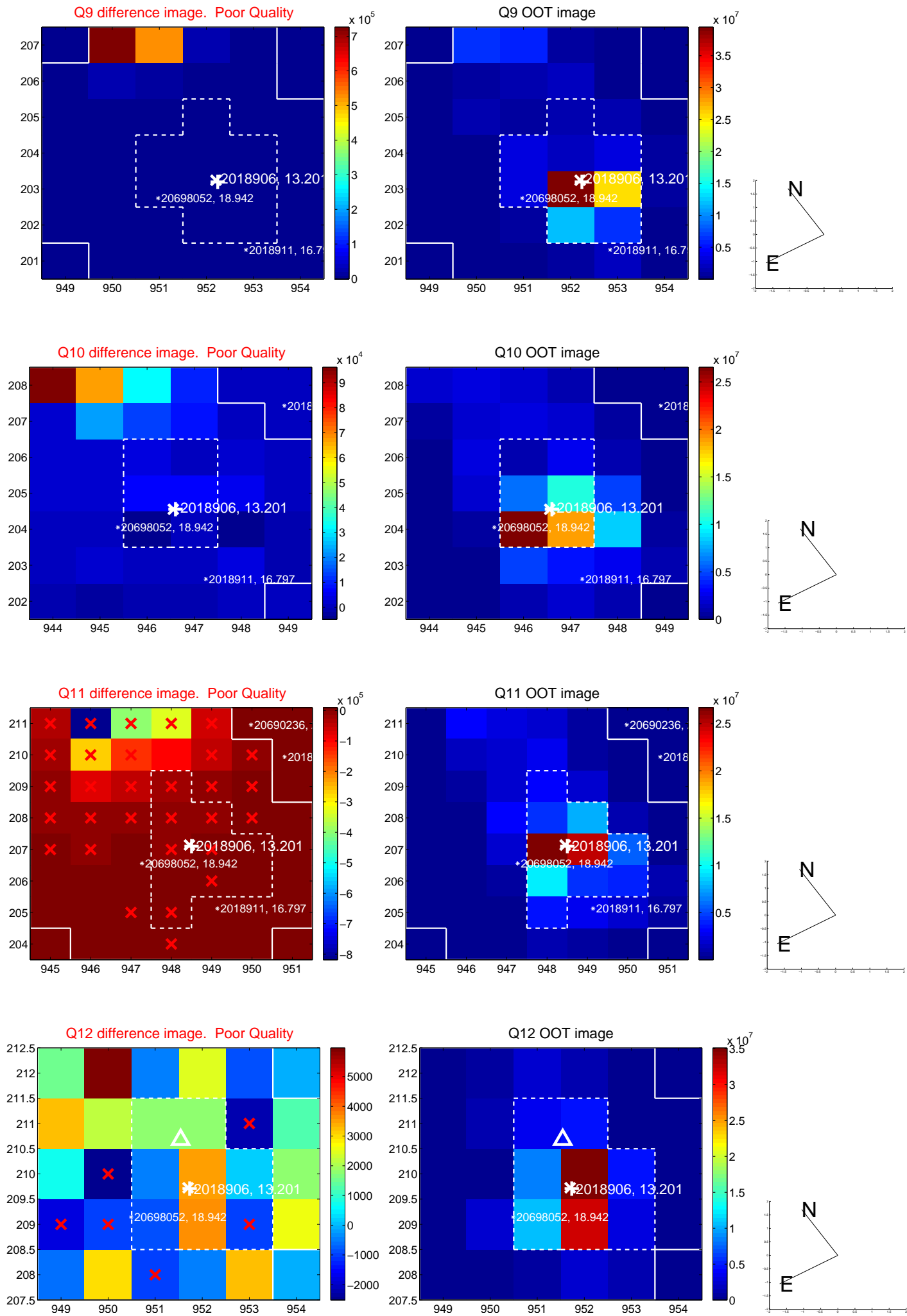
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



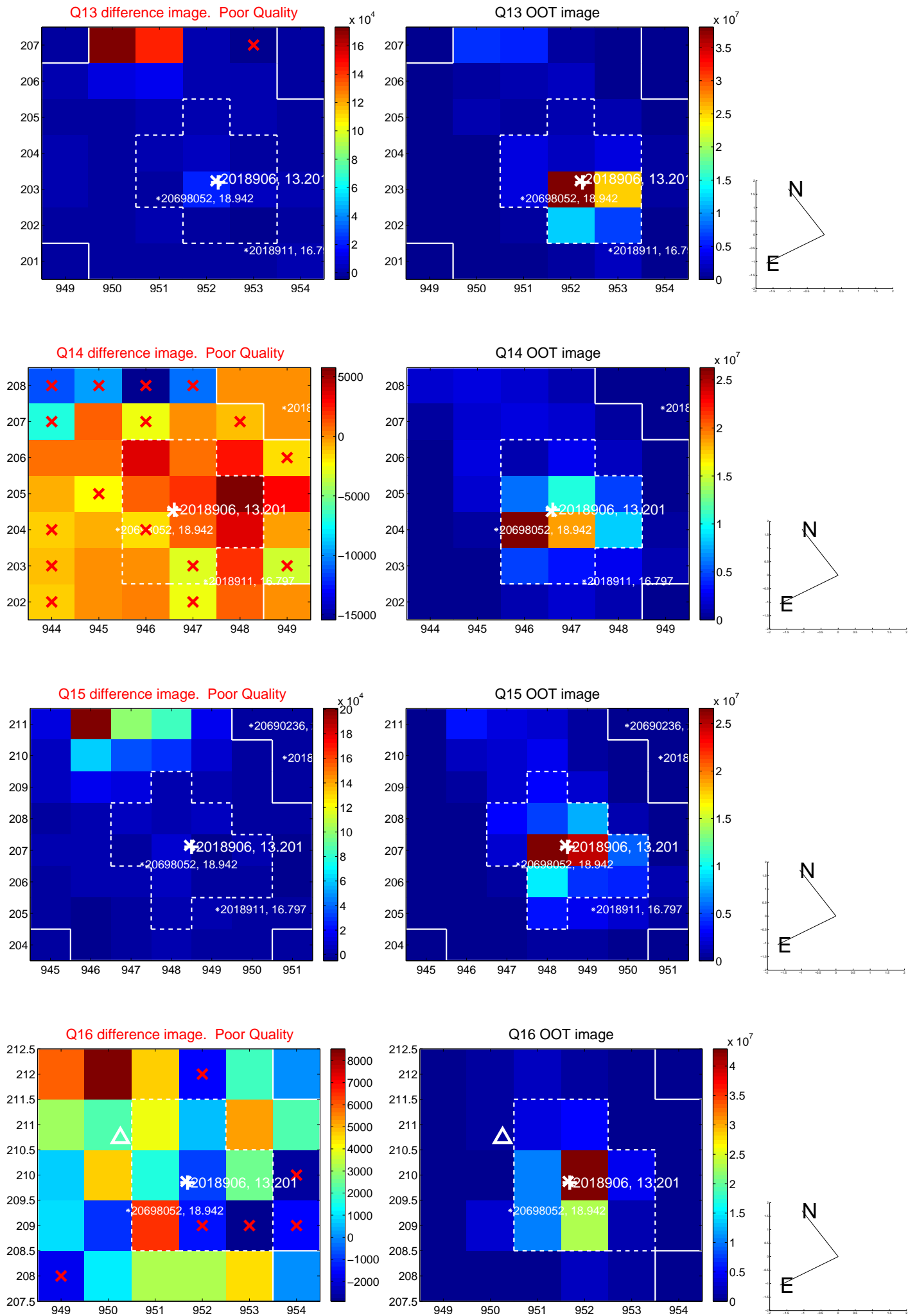
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



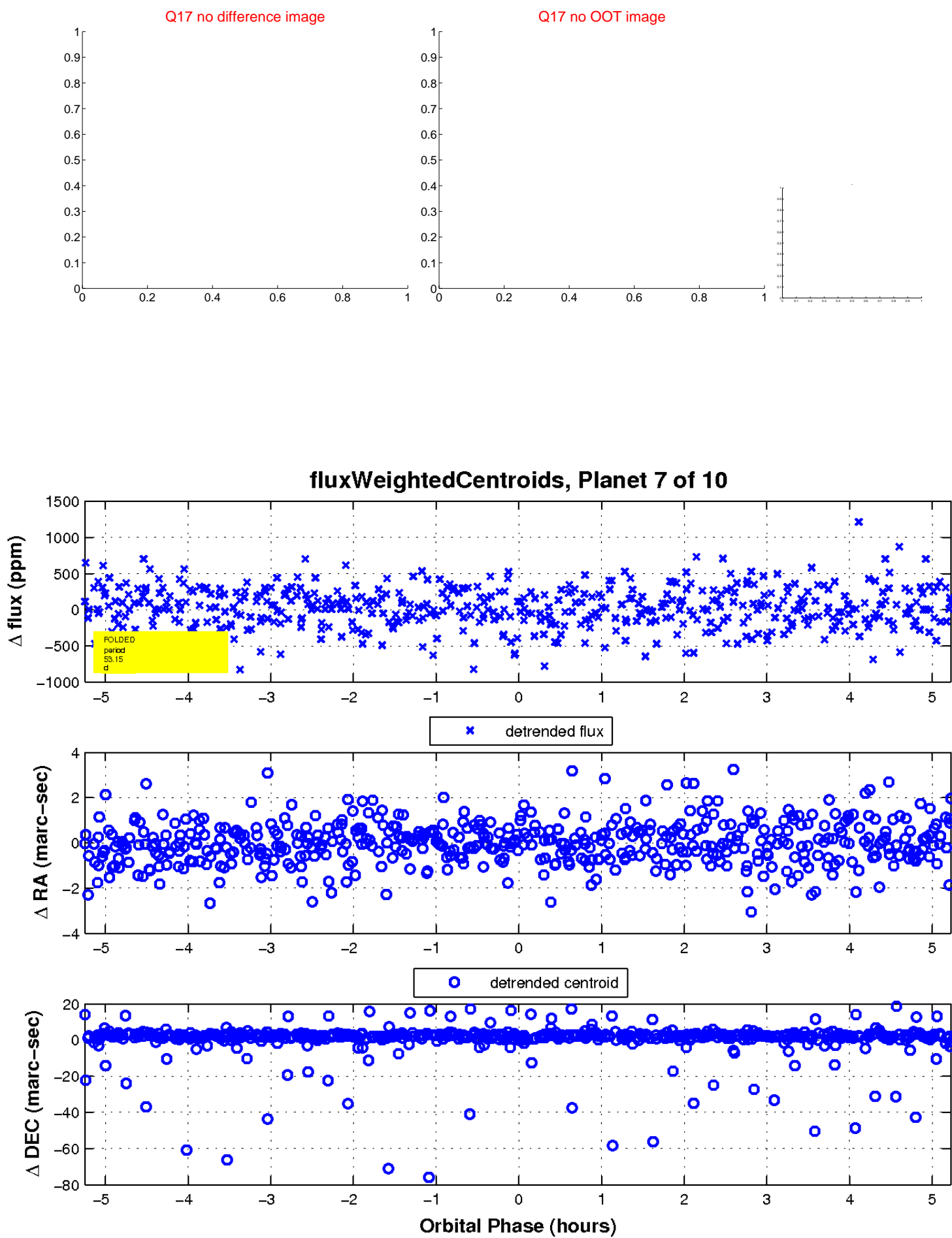
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



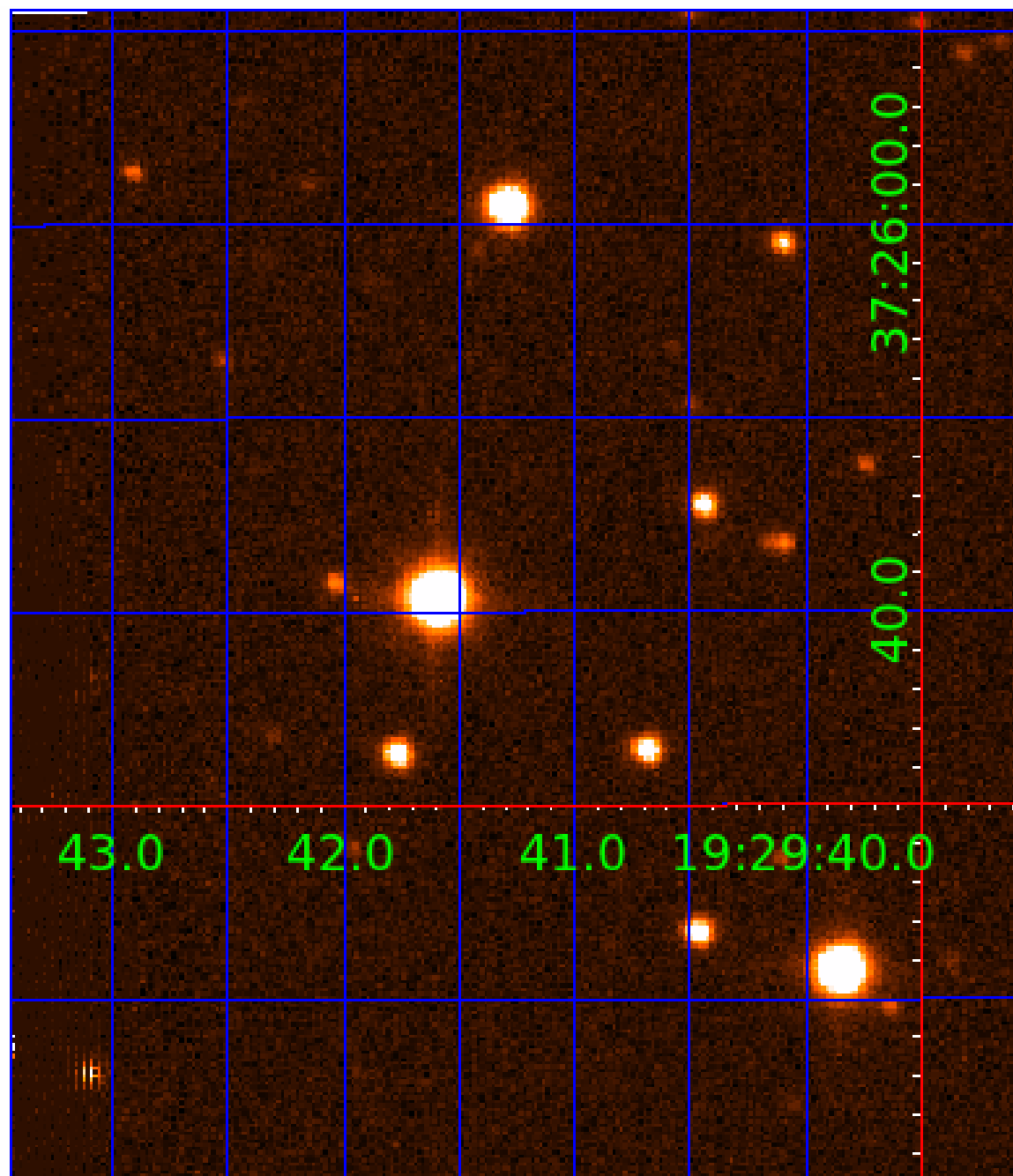
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.





UKIRT Image

Declination



# KIC 002018906

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
002018906-01	OBS	No	0.525149	131.658983	11.9	3.212	15.1	3.7	3.37	5046	1.24	0.00
002018906-04	OBS	No	31.419253	137.819040	334.8	3.524	9.4	8.5	3.37	5046	7.09	196.26
002018906-05	OBS	No	22.245829	137.842474	441.7	2.059	9.2	10.5	3.37	5046	7.50	311.01
002018906-06	OBS	No	44.158582	138.108488	370.8	3.010	9.1	9.2	3.37	5046	7.29	124.67
002018906-07	OBS	No	53.152195	148.596580	587.8	1.755	8.9	9.6	3.37	5046	9.31	97.37
002018906-08	OBS	No	46.663938	154.862044	409.6	2.876	7.8	8.6	3.37	5046	8.08	115.82
002018906-09	OBS	No	53.025159	168.237150	329.6	2.994	8.1	7.9	3.37	5046	7.32	97.68
002018906-10	OBS	No	7.605976	131.528571	187.7	3.276	9.2	10.1	3.37	5046	5.50	1300.86

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
002018906-01	OBS	FP	0.00	1	0	1	0	LPP_DV—CENT_RESOLVED_OFFSET
002018906-04	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-05	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-06	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-07	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-08	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-09	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS
002018906-10	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE_ZUMA—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_CROWDED

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

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

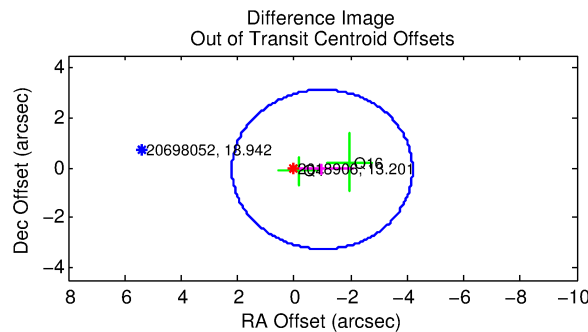
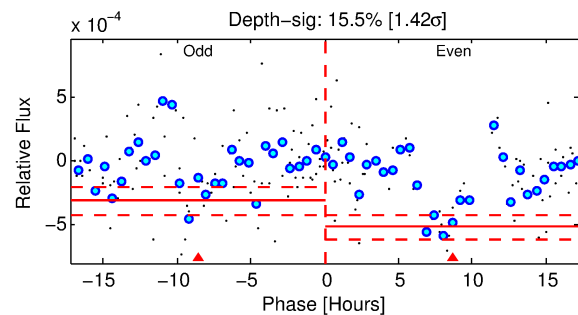
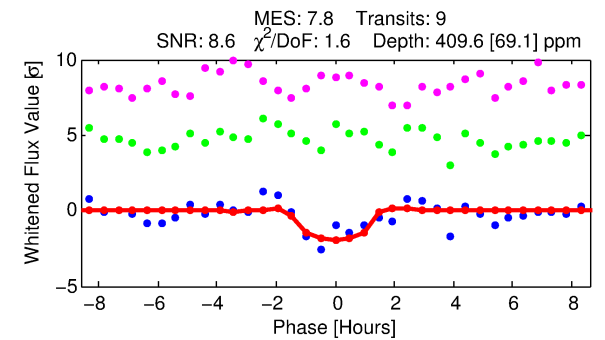
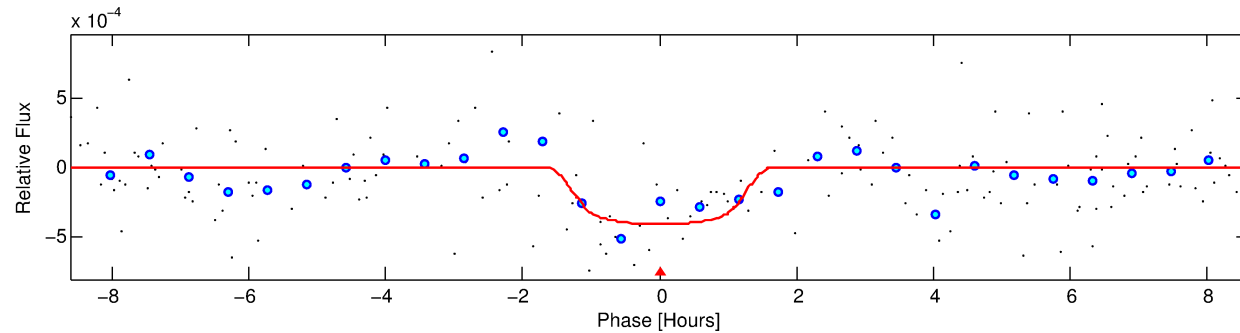
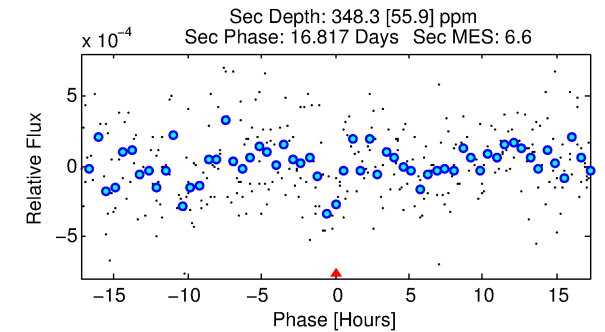
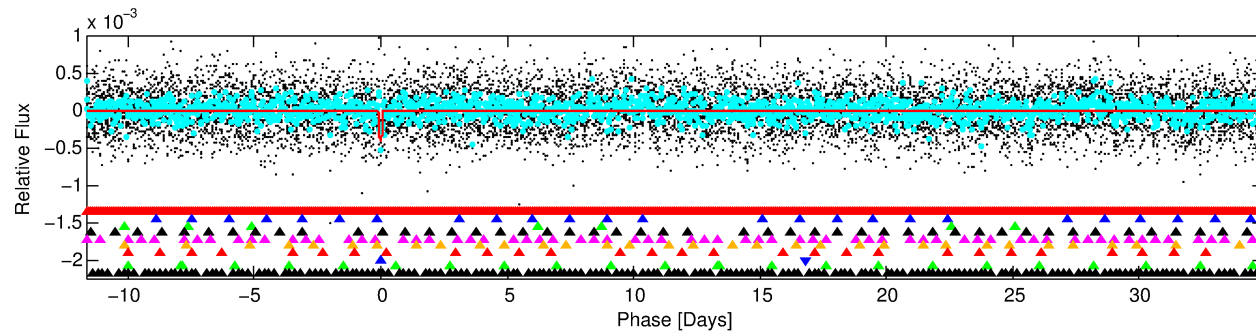
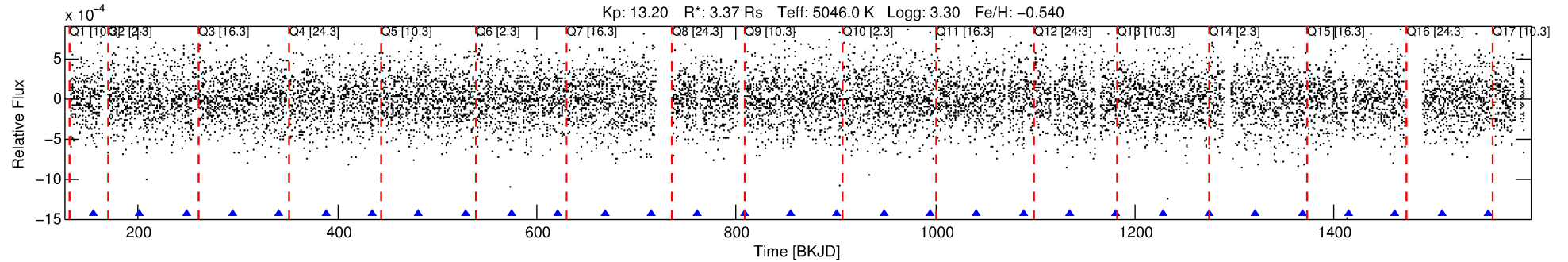
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 002018906-08

No Significant Match Found

# DV One-Page Summary

KIC: 2018906 Candidate: 8 of 10 Period: 46.664 d



## DV Fit Results:

Period = 46.66394 [0.00077] d  
Epoch = 154.8620 [0.0125] BKJD  
Rp/R\* = 0.0220 [0.0282]  
a/R\* = 64.05 [338.77]  
b = 0.88 [1.36]  
Seff = 115.82 [70.78]  
Teff = 837 [128] K  
Rp = 8.08 [11.28] Re  
a = 0.2387 [0.1050] AU  
Ag = 167.27 [441.37] [0.38 $\sigma$ ]  
Teffp = 4651 [2989] K [1.27 $\sigma$ ]

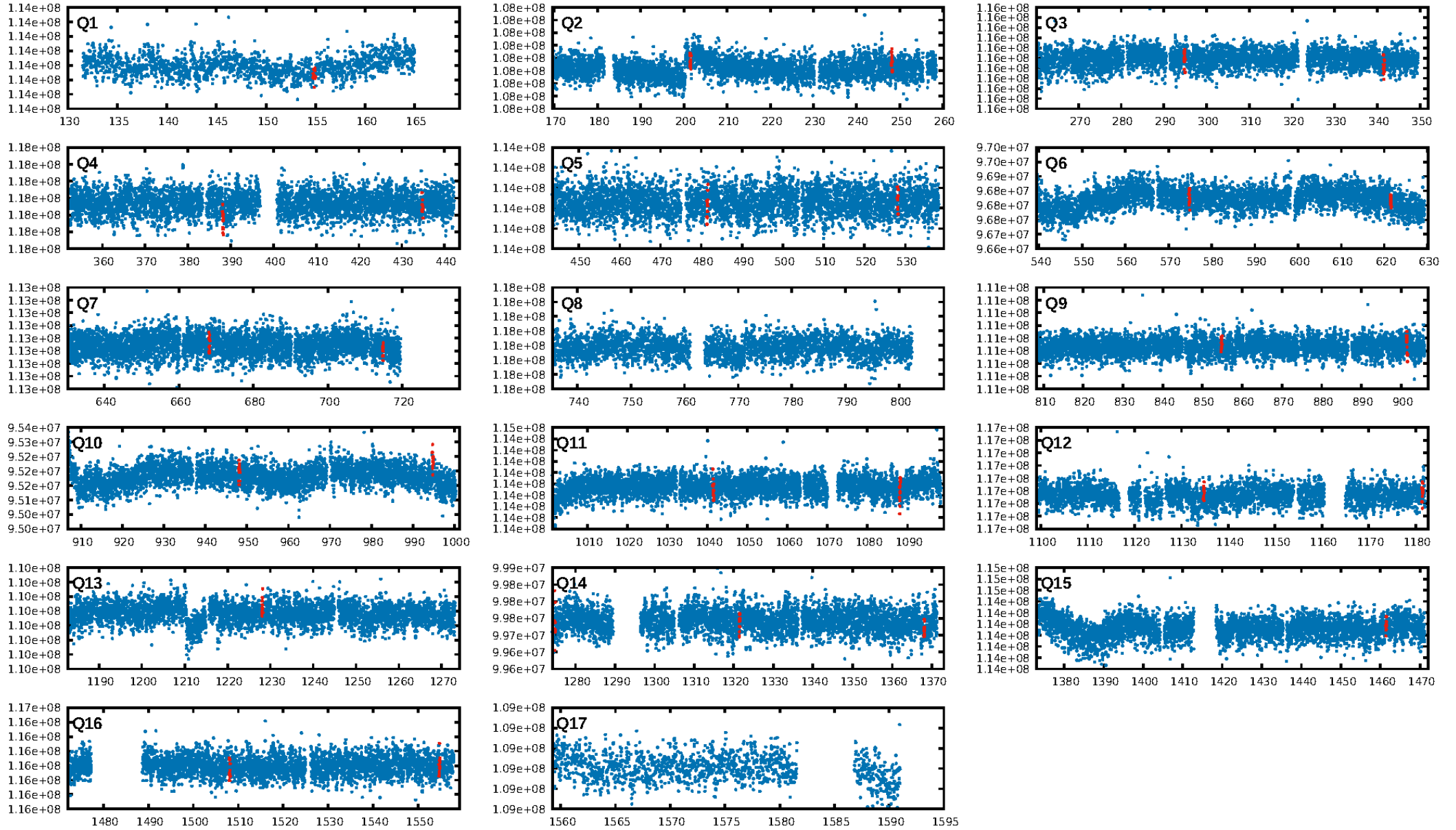
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [14.44 $\sigma$ ]  
LongPeriod-sig: 100.0% [36.78 $\sigma$ ]  
ModelChiSquare2-sig: 22.0%  
ModelChiSquareGof-sig: 100.0%  
**Bootstrap-pfa: 1.55e-08**  
RollingBand-fgt: 1.00 [9/9]  
GhostDiagnostic-chr: -2.444  
Centroid-sig: N/A  
Centroid-so: 1.021 arcsec [1.60 $\sigma$ ]  
OotOffset-rm: 0.998 arcsec [0.94 $\sigma$ ]  
KicOffset-rm: 1.081 arcsec [1.04 $\sigma$ ]  
OotOffset-st: 0/0/2/0 [2]  
KicOffset-st: 0/0/2/0 [2]  
DiffImageQuality-fgm: 0.50 [1/2]  
DiffImageOverlap-fno: 0.00 [0/15]

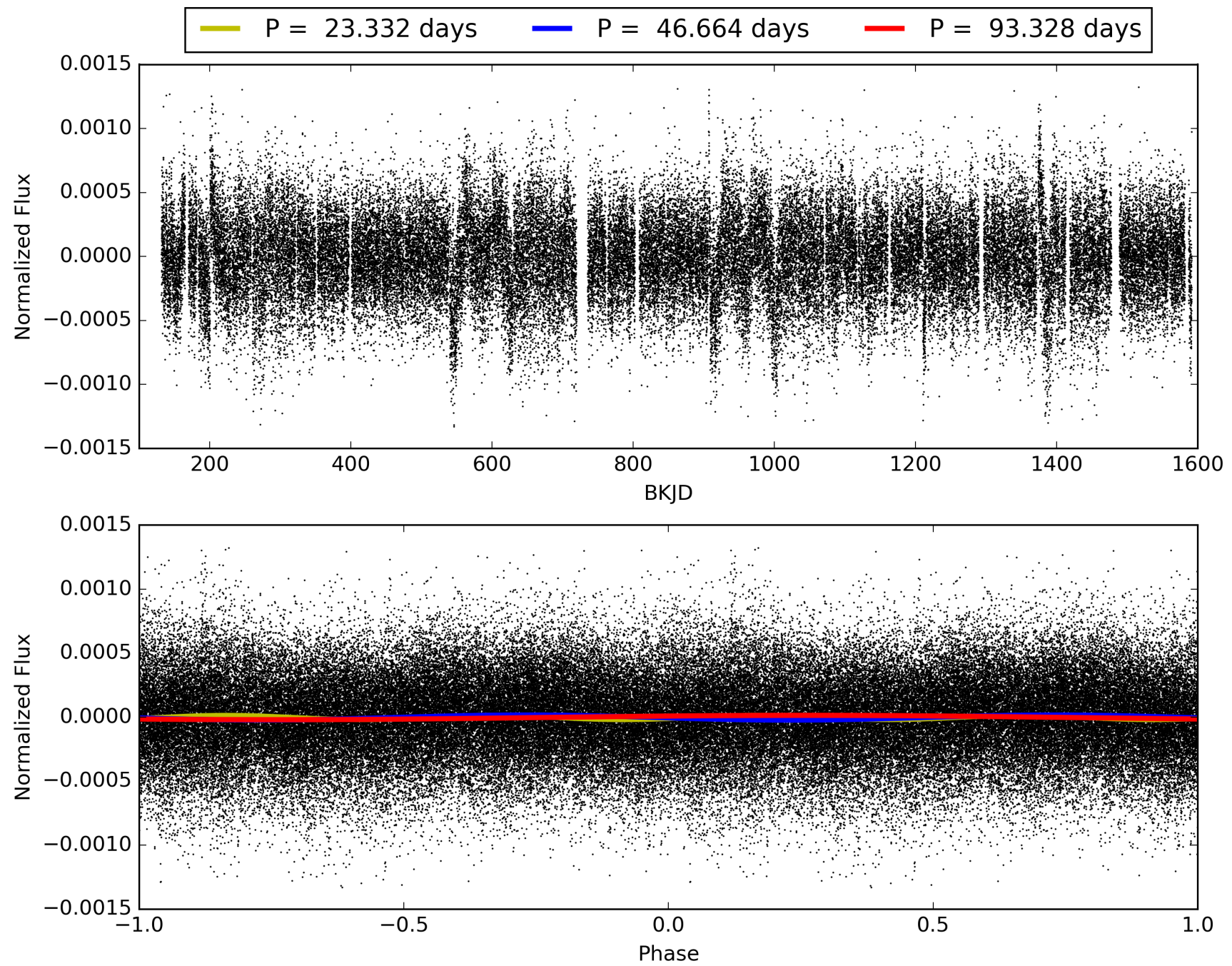
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 04:43:35 Z

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

# TCE 002018906-08, PDC Light Curves

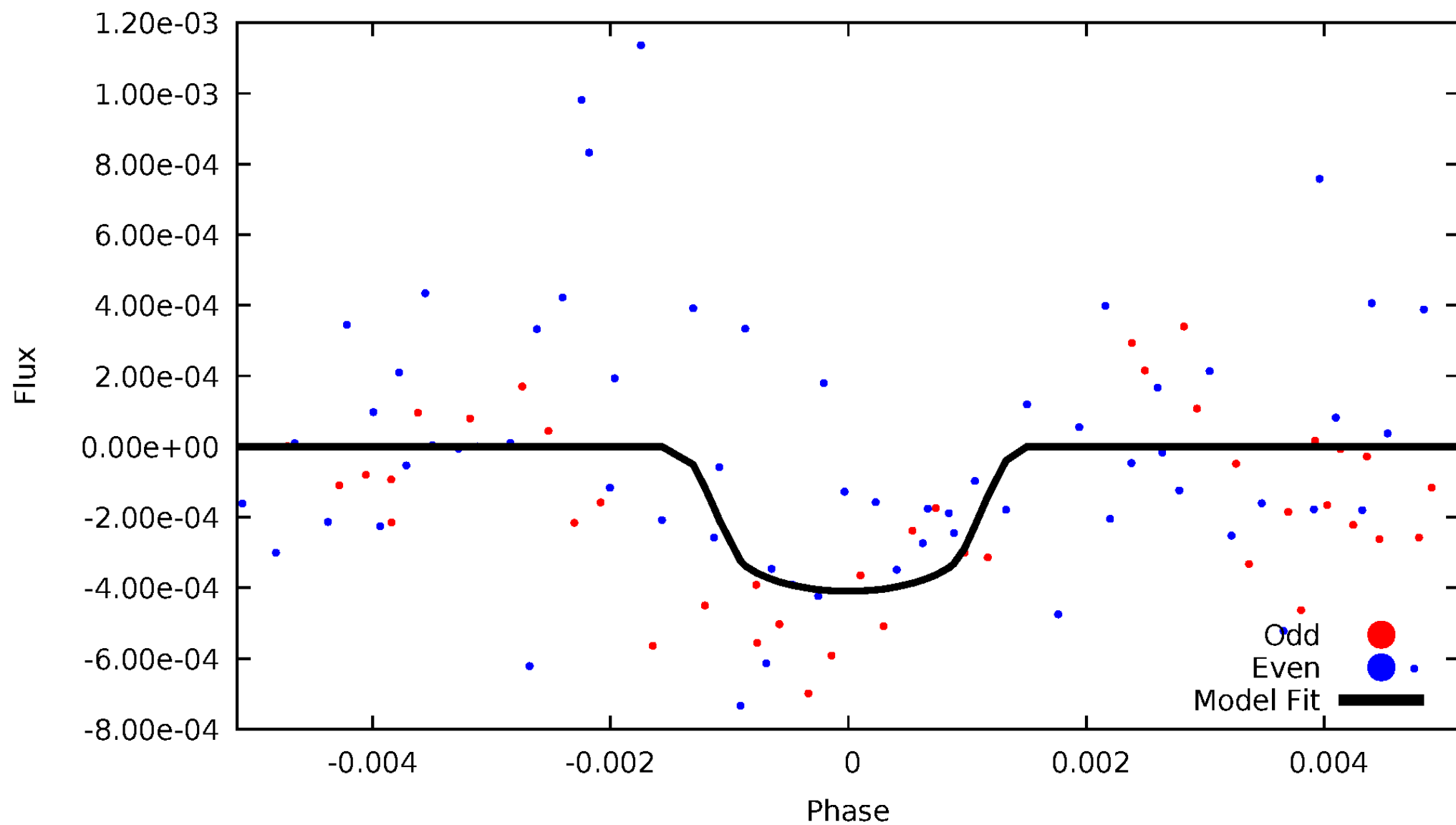


TCE 002018906-08



# DV Odd/Even

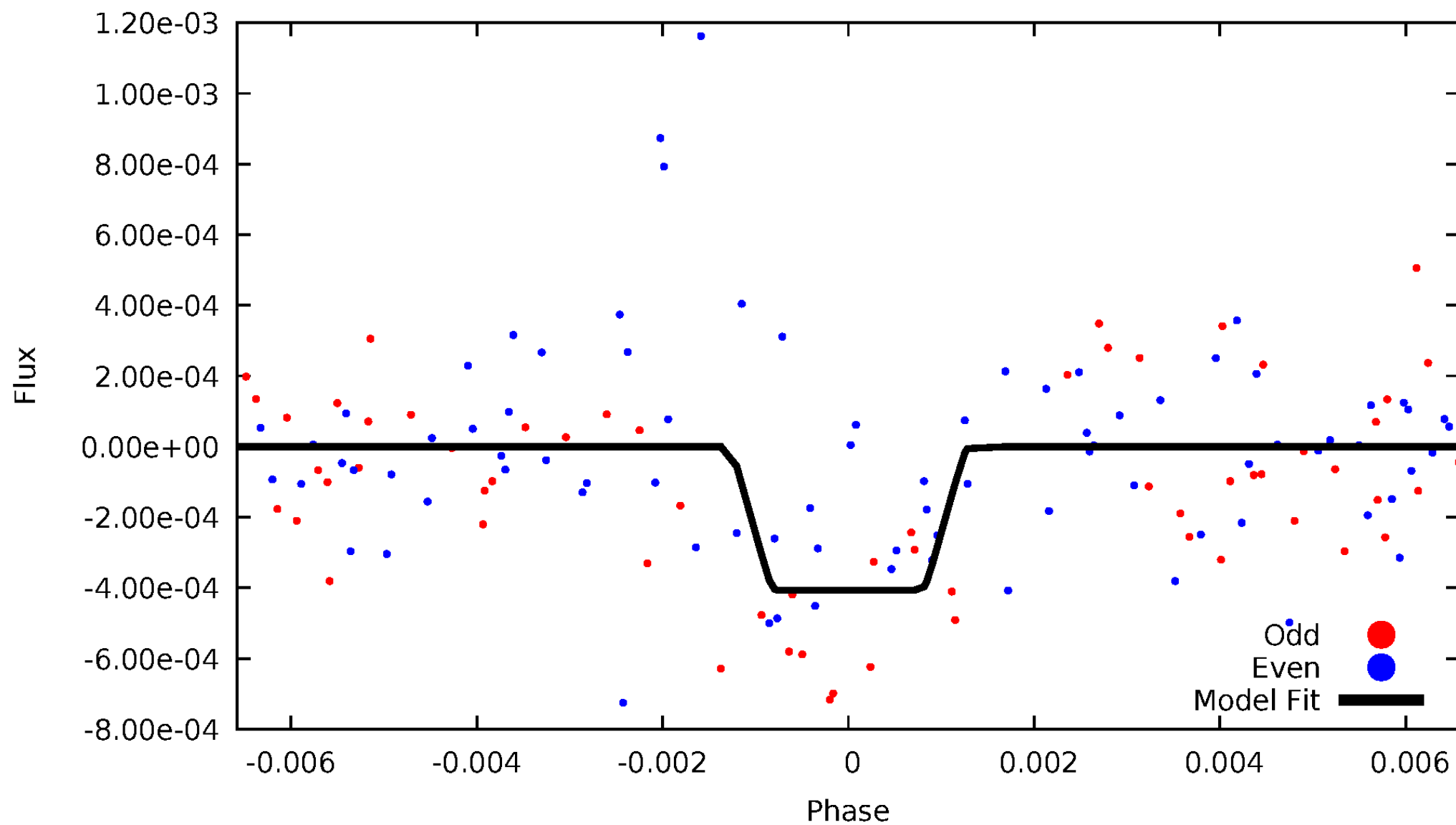
TCE 002018906-08





# ALT Odd/Even

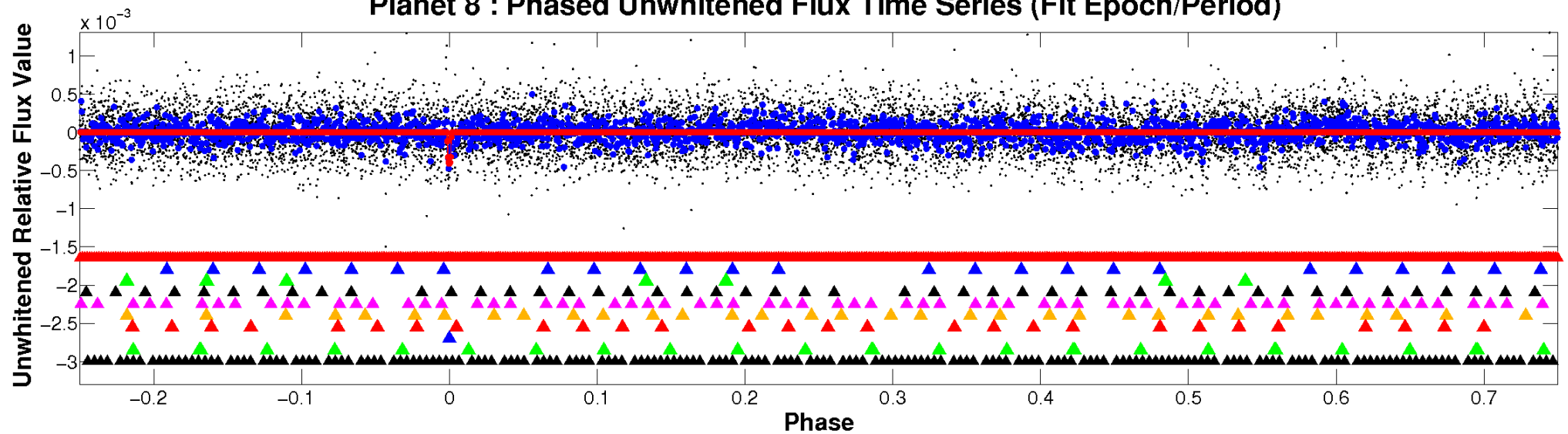
TCE 002018906-08



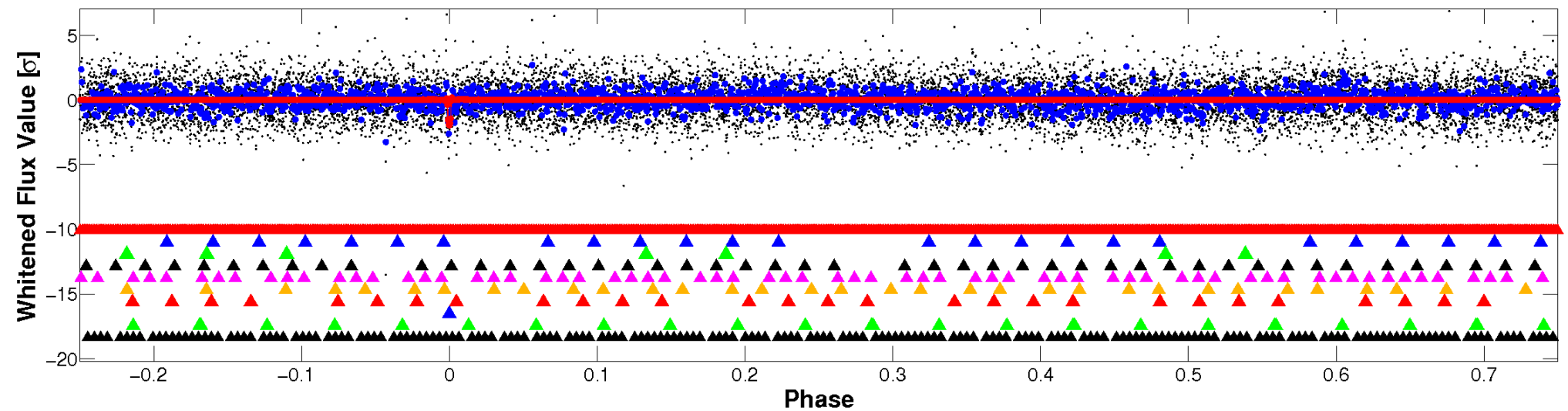


# Non-Whitened Vs. Whitened Light Curve

## Planet 8 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

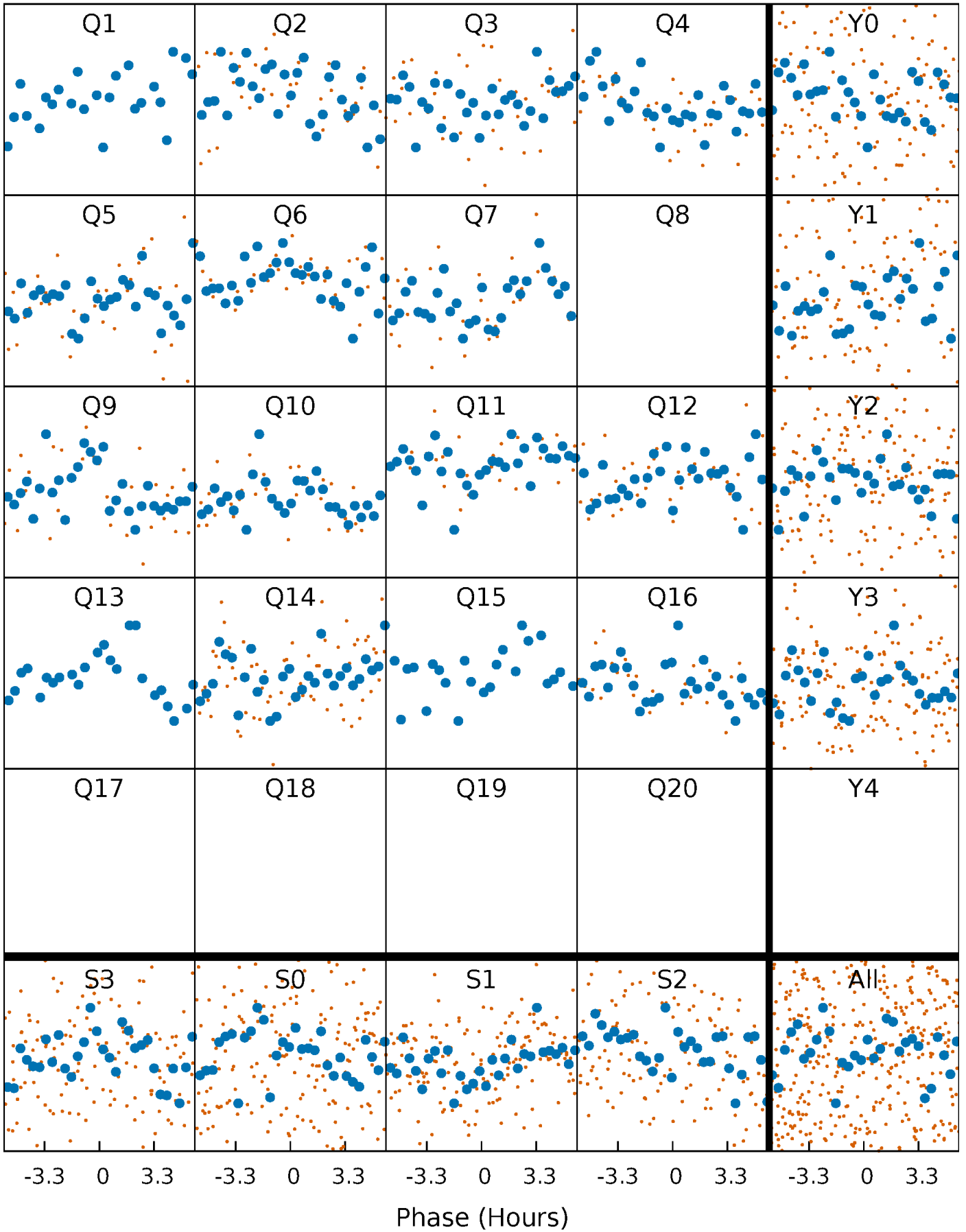


## Planet 8 : Phased Whitened Flux Time Series (Fit Epoch/Period)



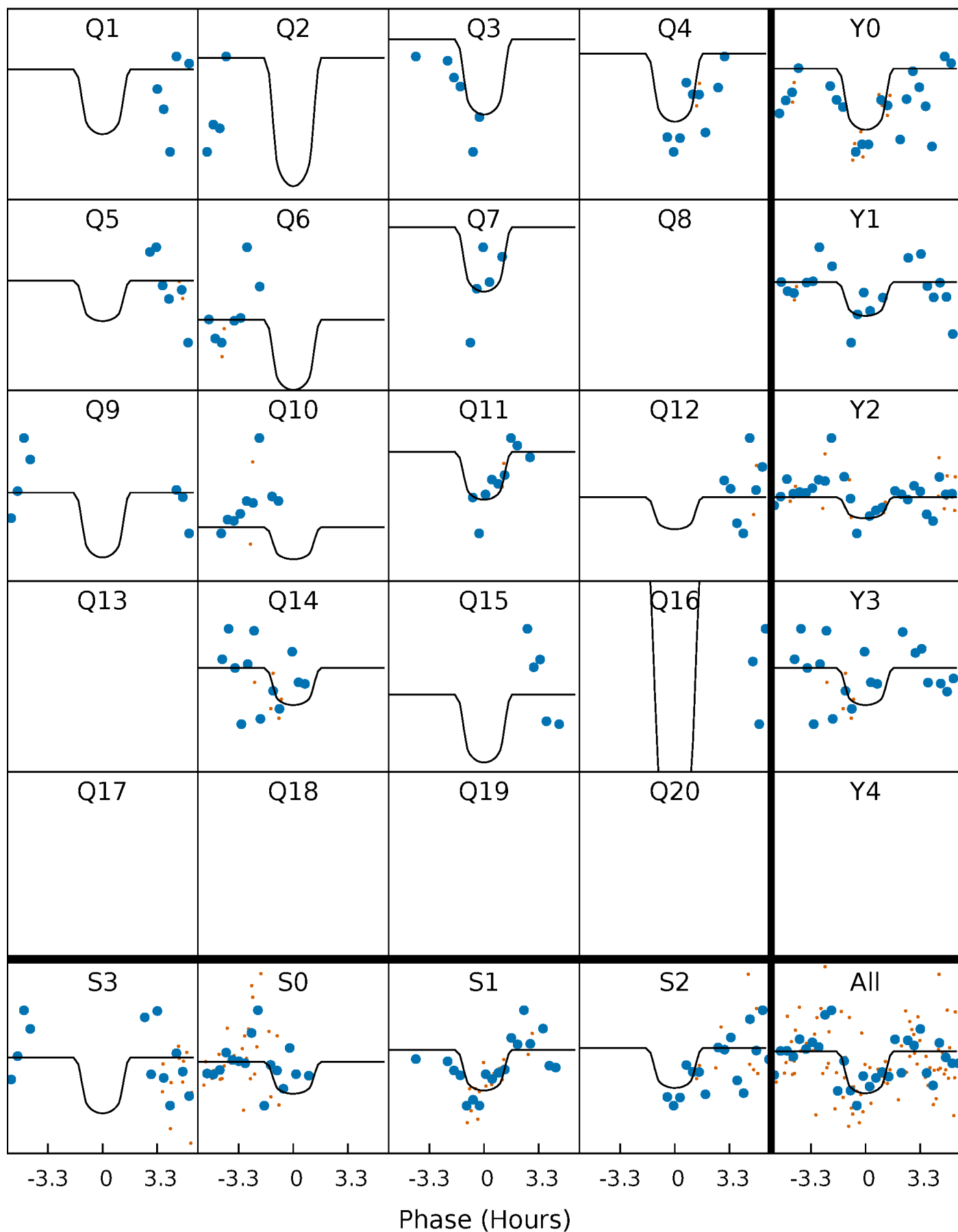
# PDC Quarter-Phased Transit Curves

TCE 002018906-08     $P = 46.663938$  Days     $T_0 = 154.862044$  (BKJD)



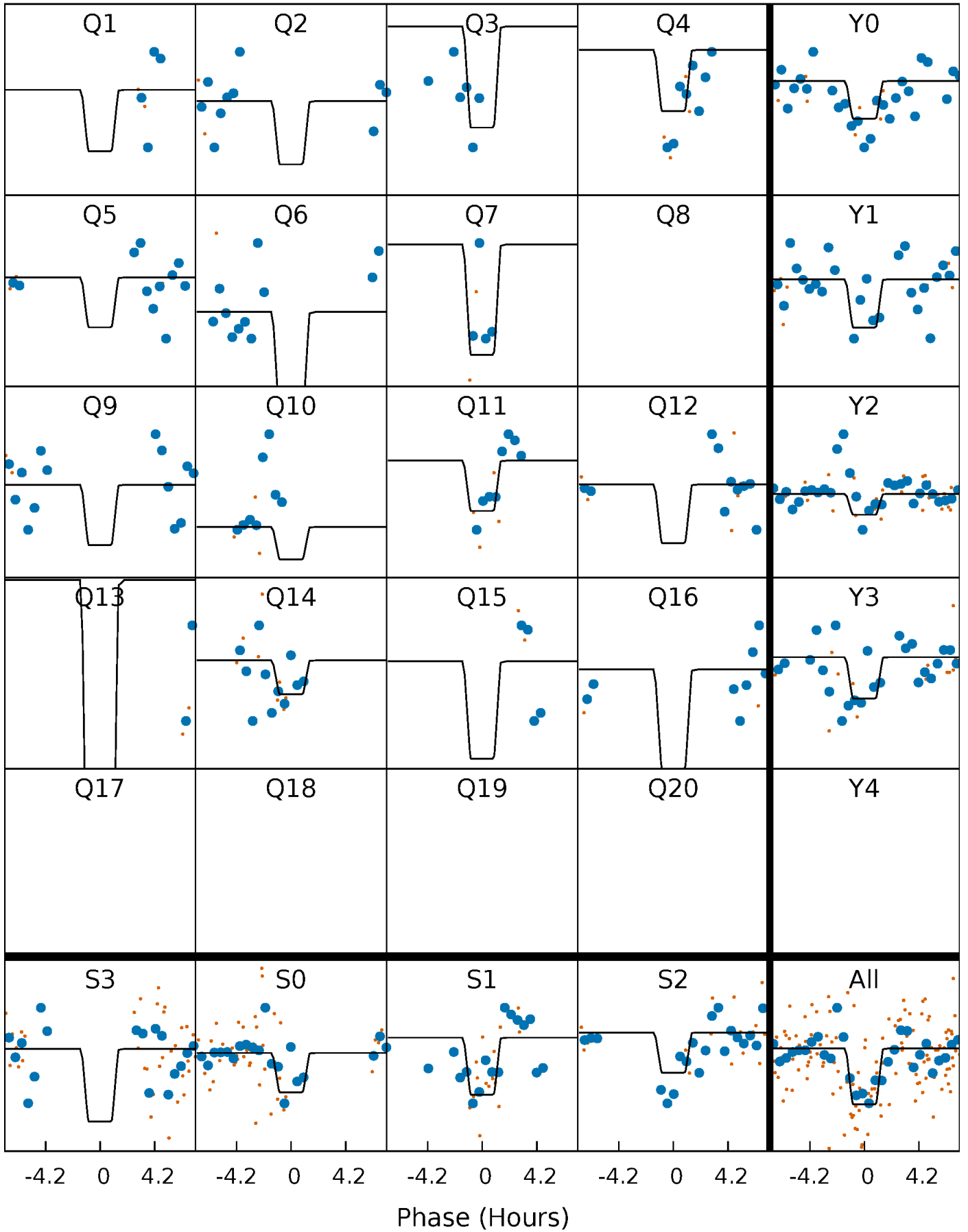
# DV Quarter-Phased Transit Curves

TCE 002018906-08     $P = 46.663938$  Days     $T_0 = 154.862044$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

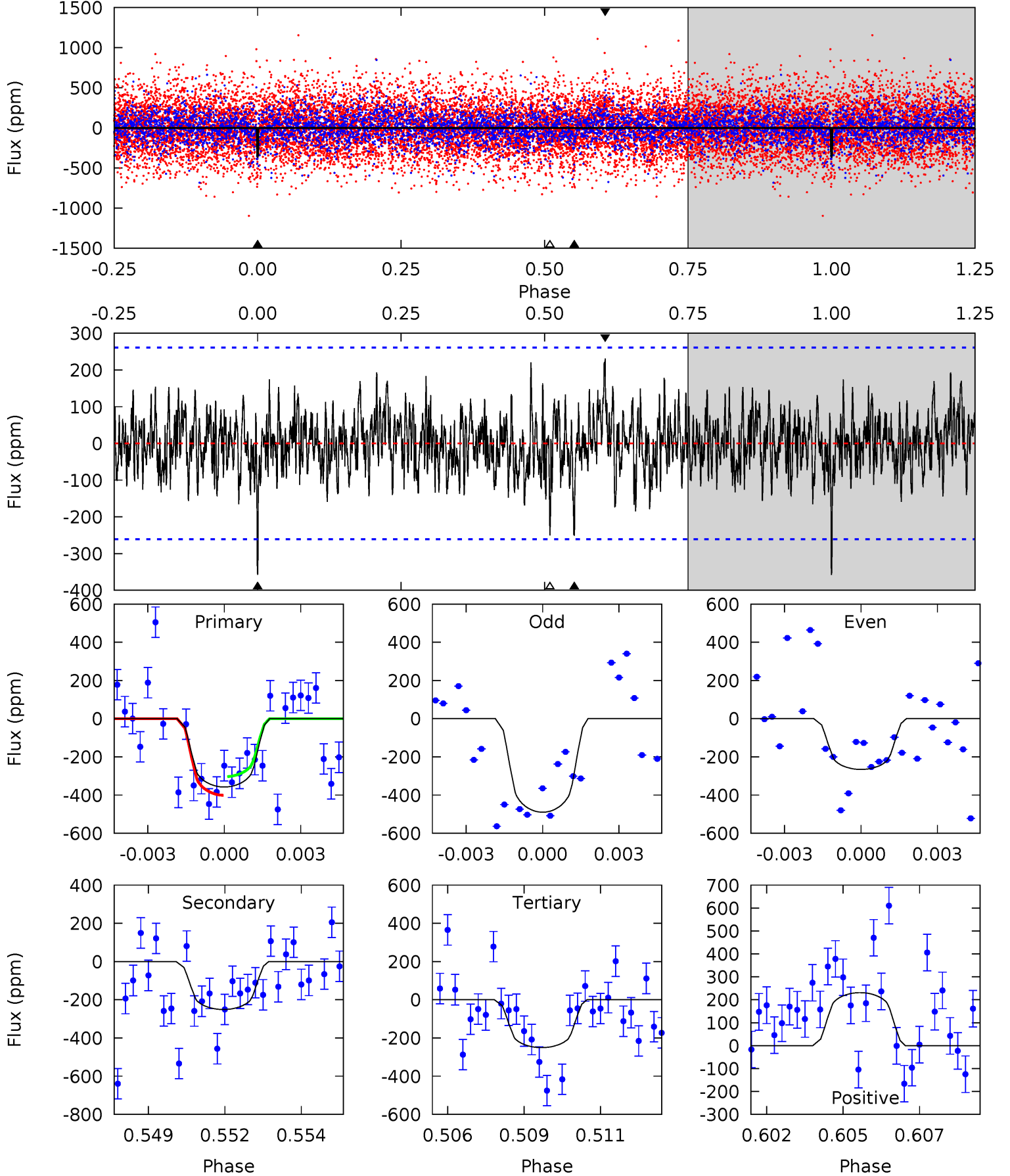
TCE 002018906-08 P= 46.663167 Days  $T_0=154.868621$  (BKJD)



# DV Model-Shift Uniqueness Test

002018906-08, P = 46.663938 Days, E = 108.198106 Days

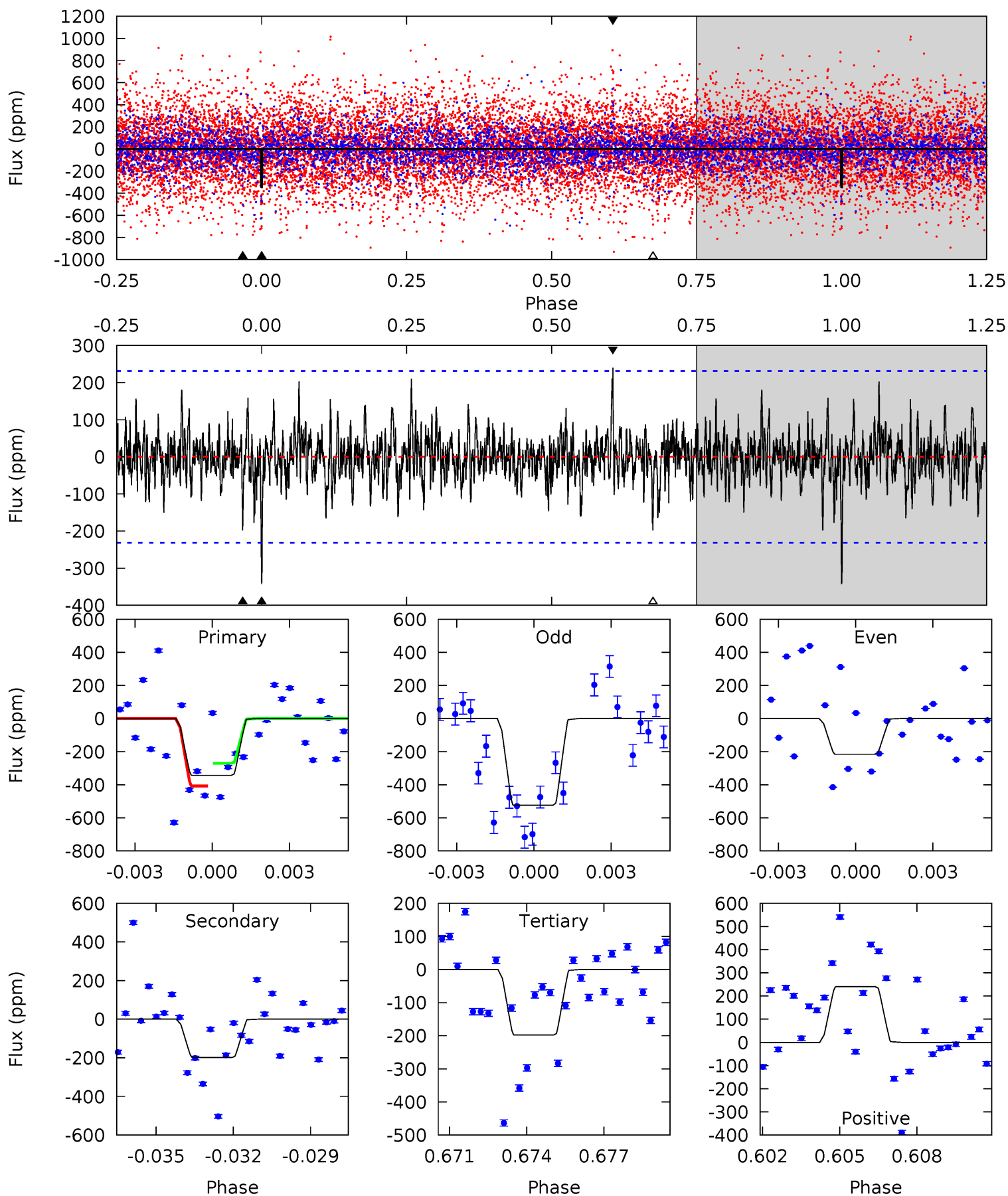
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
7.24	5.08	5.07	4.68	5.28	3.02	1.35	2.17	2.57	0.01	0.40	2.21	0.83	0.39	0.99



# Alt Model-Shift Uniqueness Test

002018906-08, P = 46.663167 Days, E = 108.205454 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
7.80	4.50	4.50	5.45	5.26	2.98	1.20	3.30	2.34	0.00	-0.95	3.44	0.99	0.41	1.56



### Stellar Parameters For KIC 002018906

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5046^{+127}_{-102}$	$3.303^{+0.310}_{-0.310}$	$-0.540^{+0.300}_{-0.250}$	$3.370^{+1.870}_{-1.007}$	$0.832^{+0.283}_{-0.165}$	$0.031^{+0.053}_{-0.022}$
	+3%/-2%	+9%/-9%	+56%/-46%	+55%/-30%	+34%/-20%	+172%/-72%
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 002018906-08 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{\text{max}}$ (K)	$T_{\text{obs}}$ (K)	$A_{\text{obs}}$
DV	$-251 \pm 49$	$10.08^{+10.81}_{-6.93}$	$1173^{+148}_{-121}$	$4061^{+3029}_{-788}$	$76^{+719}_{-57}$
Alt.	$-198 \pm 44$	$11.06^{+9.66}_{-6.98}$	$1166^{+161}_{-110}$	$3756^{+1871}_{-586}$	$50^{+327}_{-36}$

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



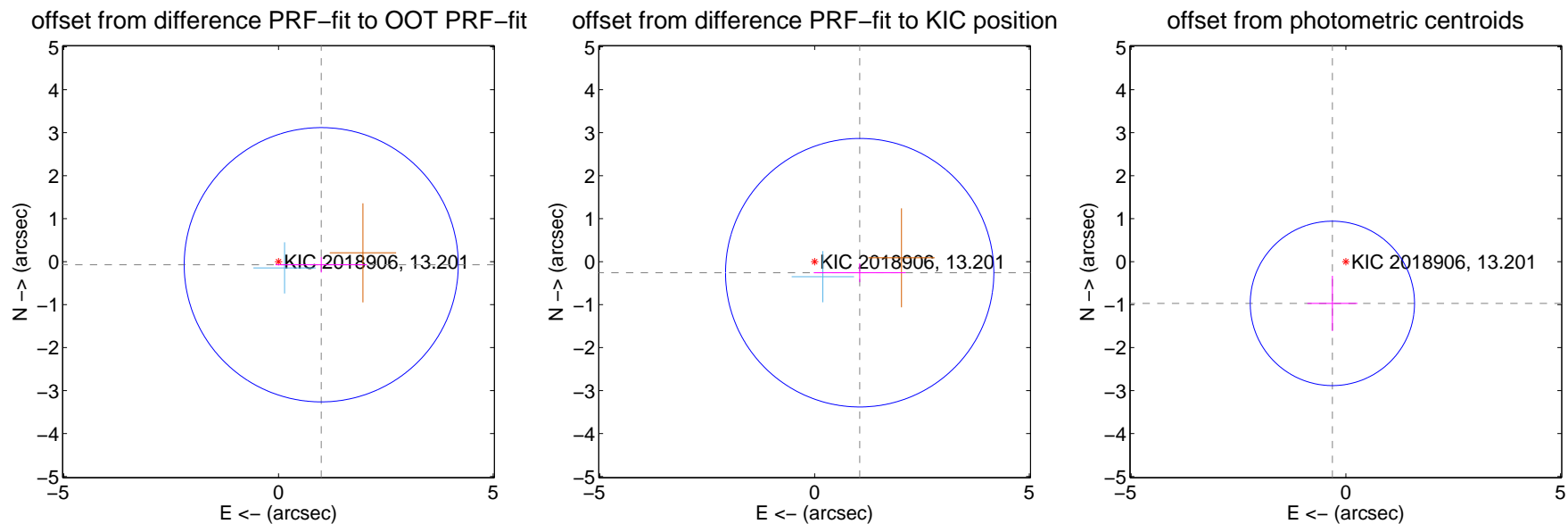
## DV Centroid Data

Supplemental centroid analysis for 002018906-08. Kepler magnitude: 13.20. Transit SNR 8.58

There are 1 quarters with good PRF difference image offsets

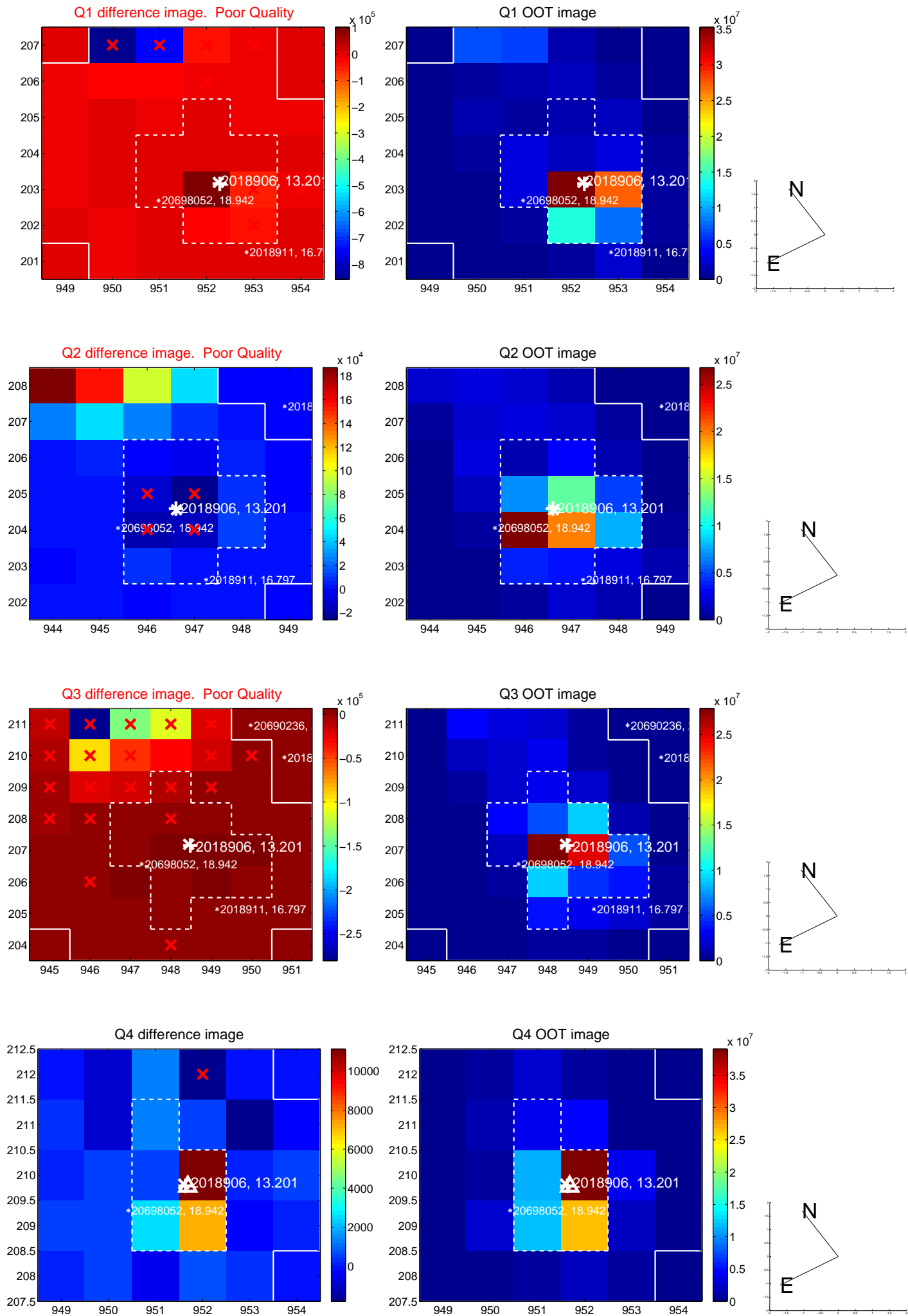
The direct PRF centroid is offset from the target star catalog position by about 0.13 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.998 \pm 1.064$	0.94	$-0.995 \pm 1.066$	$-0.072 \pm 0.180$
PRF-fit source offset from KIC position	$1.081 \pm 1.041$	1.04	$-1.050 \pm 1.071$	$-0.257 \pm 0.220$
photometric centroid source offset	$1.02 \pm 0.64$	1.60	$0.31 \pm 0.58$	$-0.97 \pm 0.64$

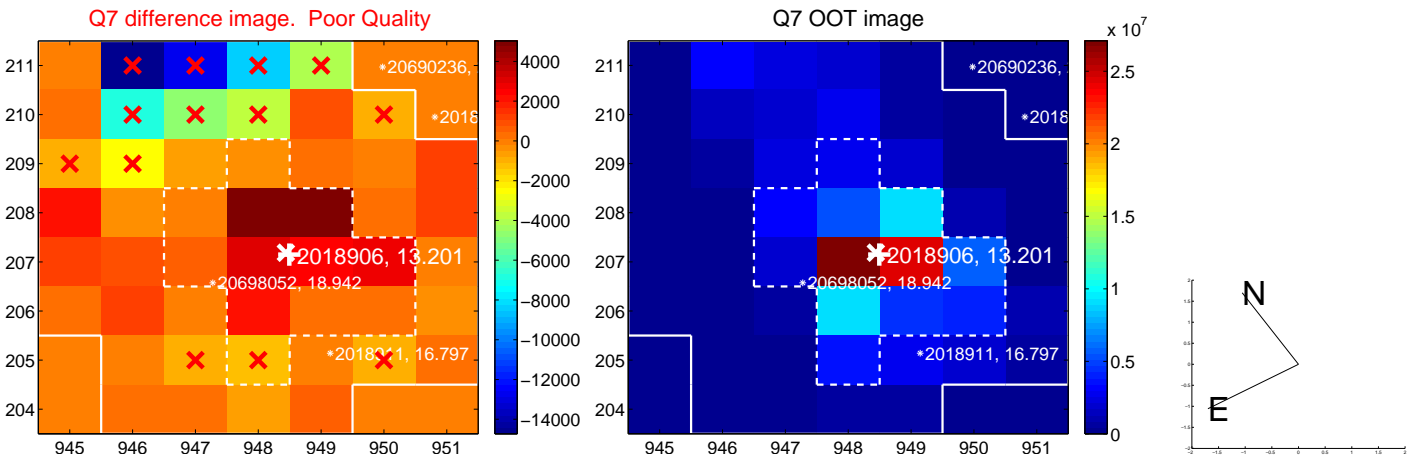
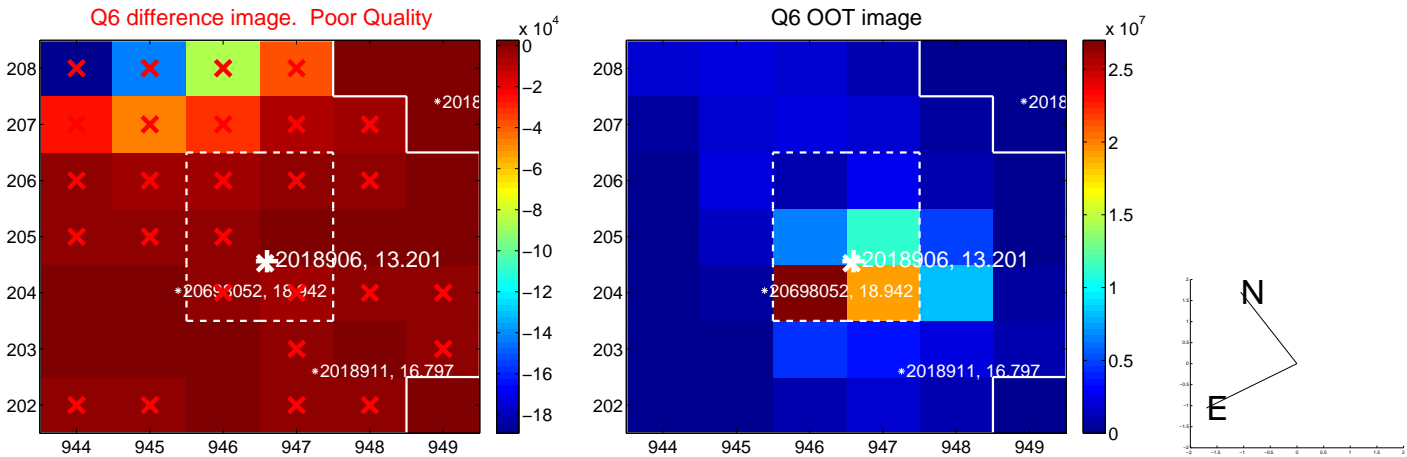
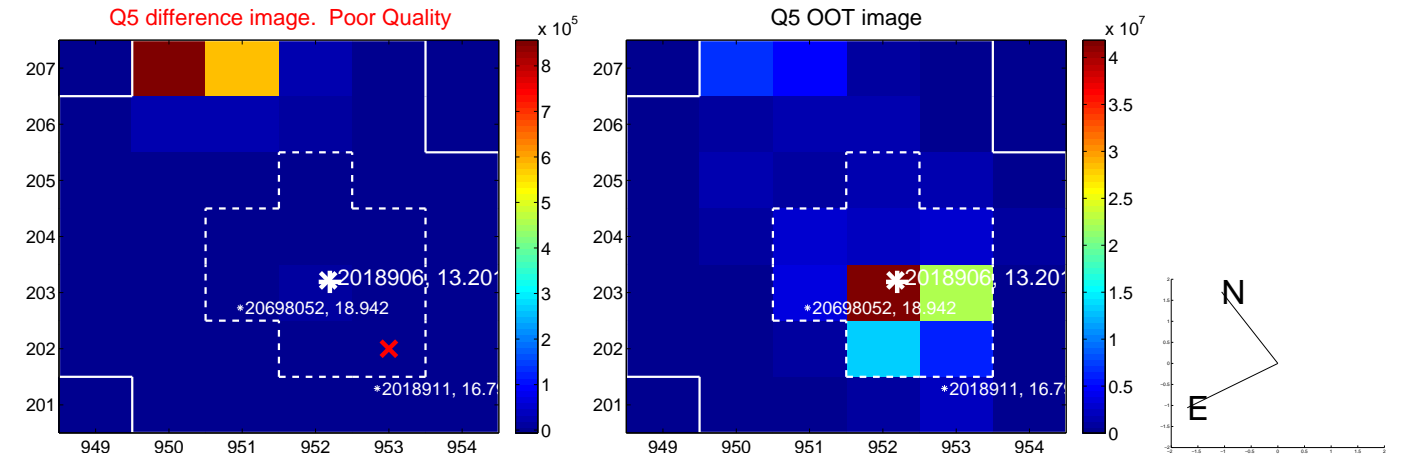


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

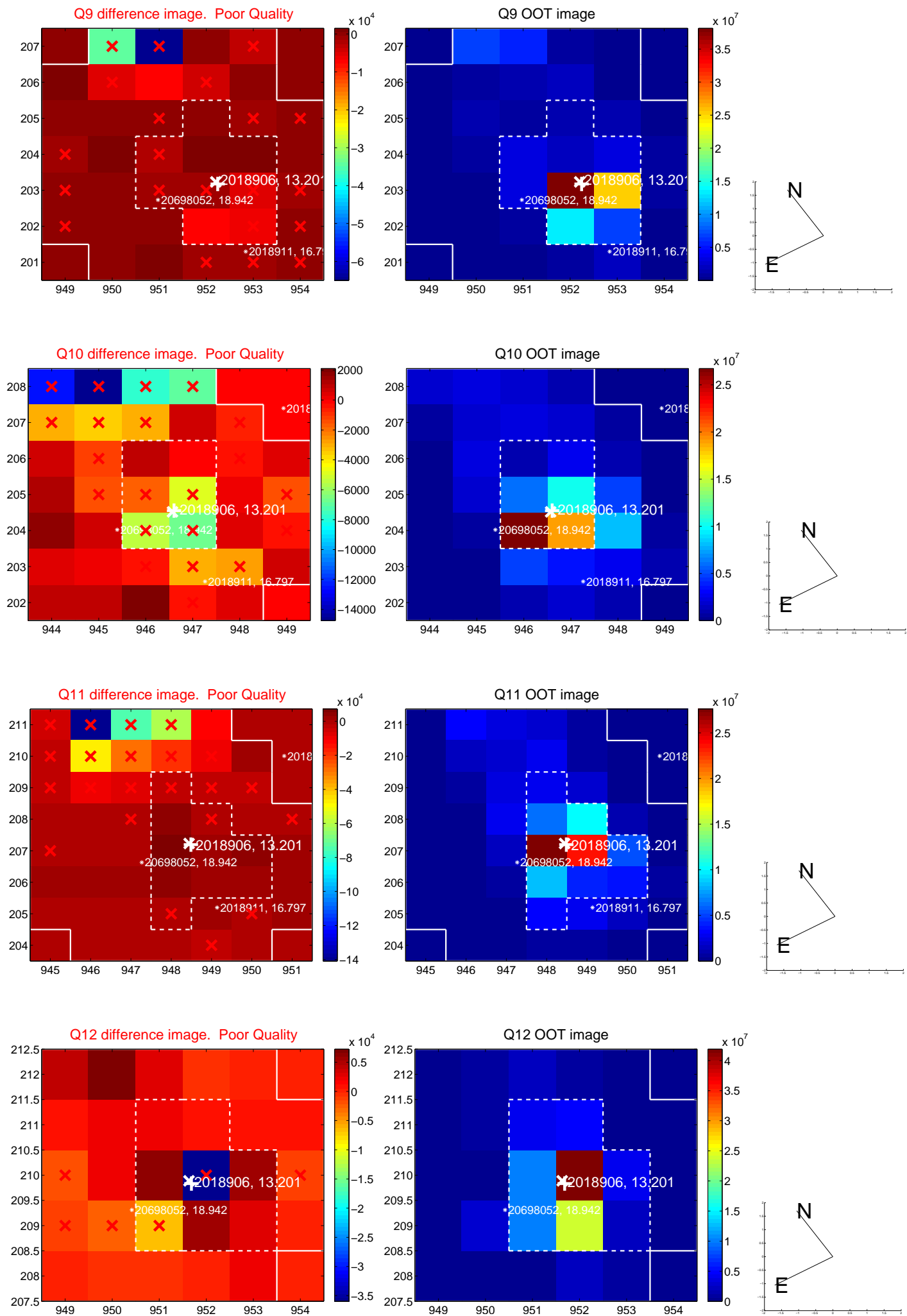
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



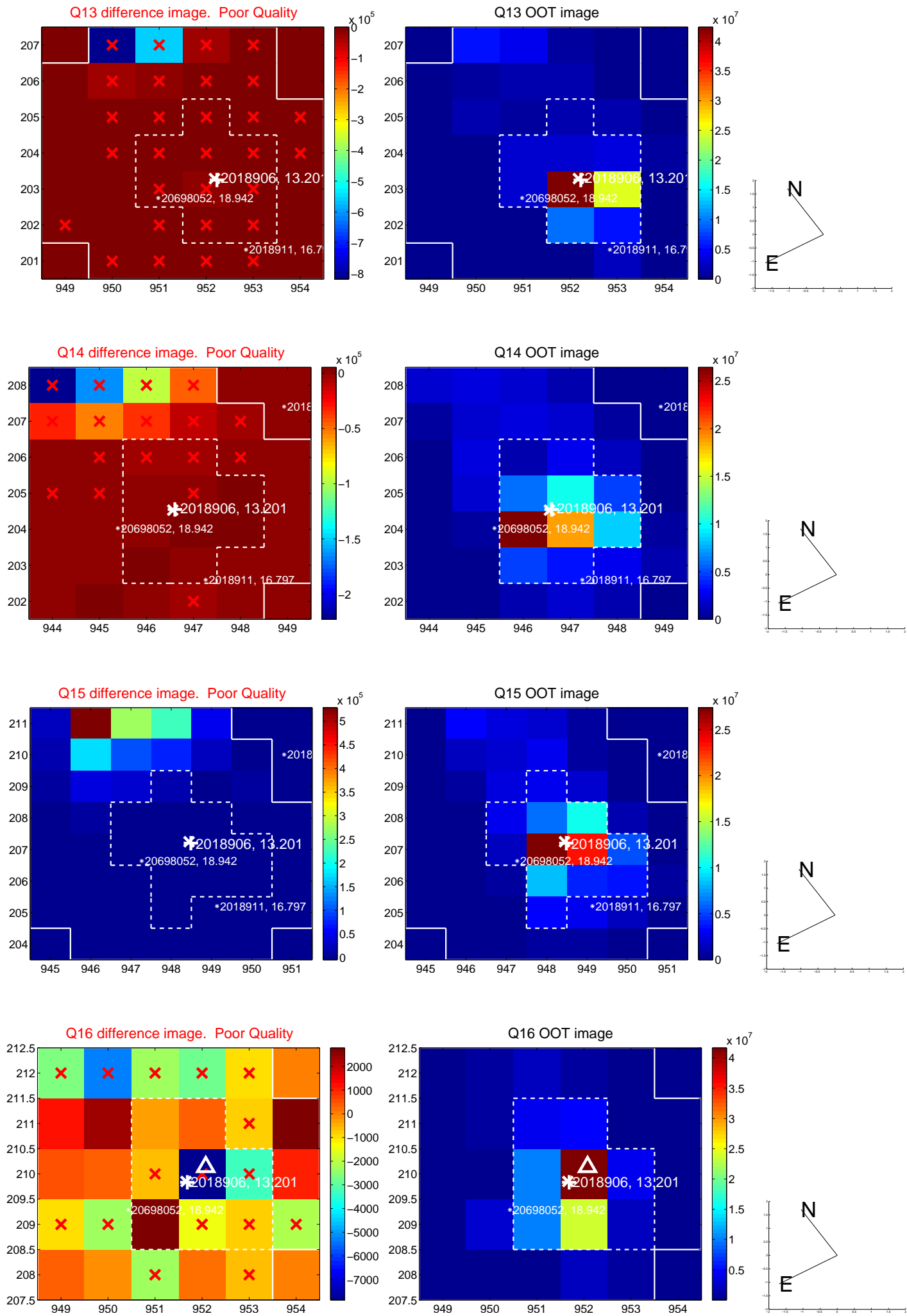
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



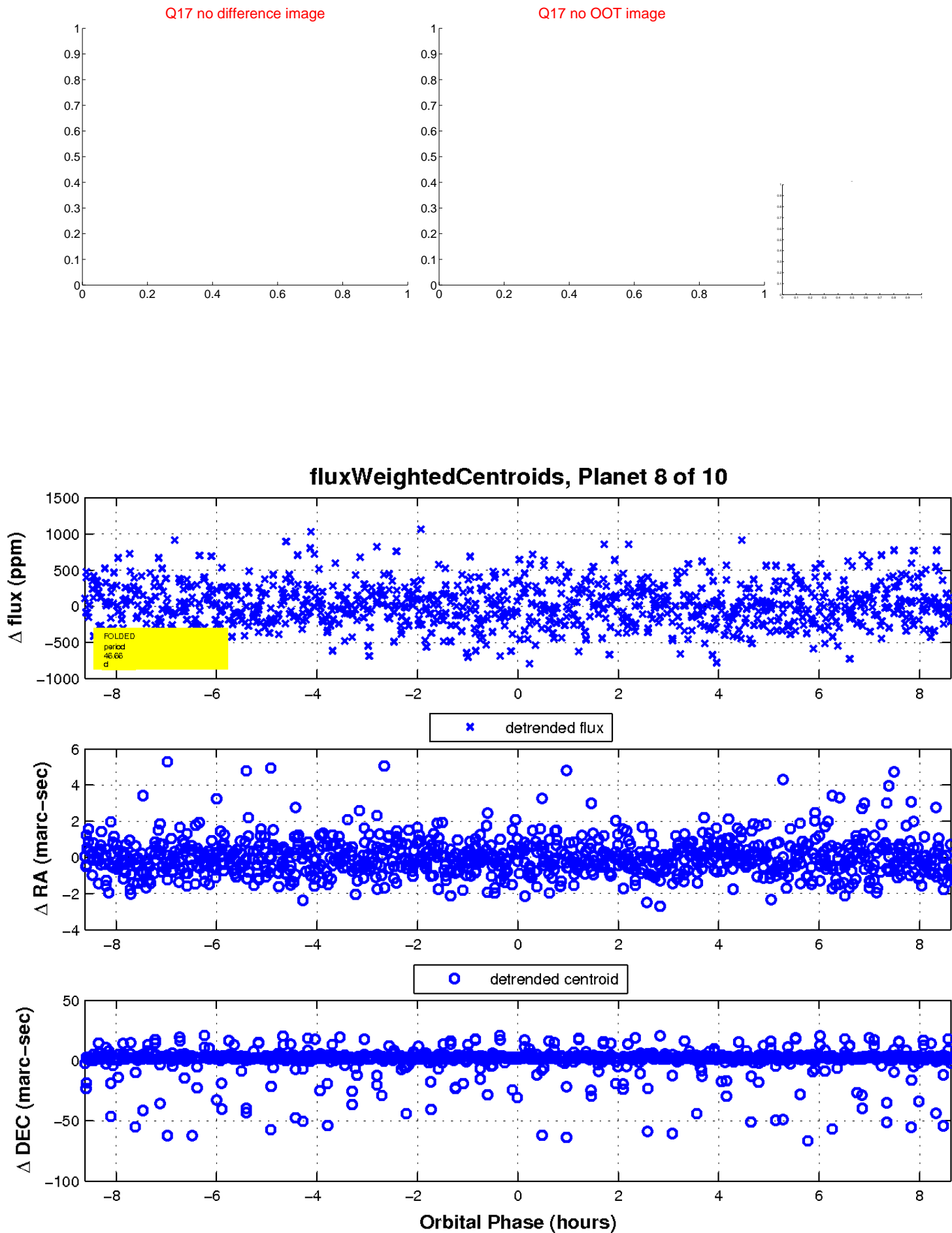
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

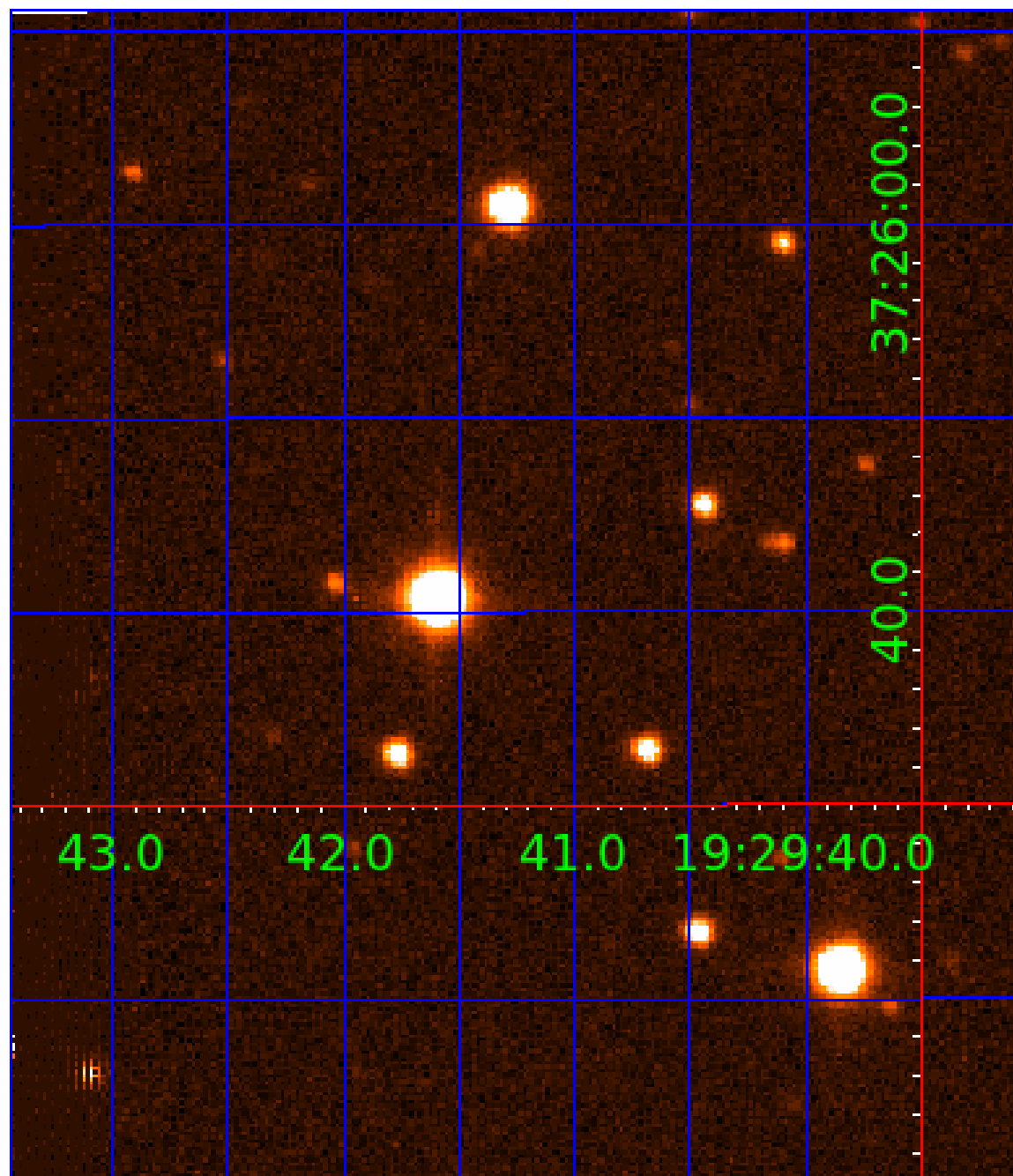


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 002018906

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
002018906-01	OBS	No	0.525149	131.658983	11.9	3.212	15.1	3.7	3.37	5046	1.24	0.00
002018906-04	OBS	No	31.419253	137.819040	334.8	3.524	9.4	8.5	3.37	5046	7.09	196.26
002018906-05	OBS	No	22.245829	137.842474	441.7	2.059	9.2	10.5	3.37	5046	7.50	311.01
002018906-06	OBS	No	44.158582	138.108488	370.8	3.010	9.1	9.2	3.37	5046	7.29	124.67
002018906-07	OBS	No	53.152195	148.596580	587.8	1.755	8.9	9.6	3.37	5046	9.31	97.37
002018906-08	OBS	No	46.663938	154.862044	409.6	2.876	7.8	8.6	3.37	5046	8.08	115.82
002018906-09	OBS	No	53.025159	168.237150	329.6	2.994	8.1	7.9	3.37	5046	7.32	97.68
002018906-10	OBS	No	7.605976	131.528571	187.7	3.276	9.2	10.1	3.37	5046	5.50	1300.86

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
002018906-01	OBS	FP	0.00	1	0	1	0	LPP_DV—CENT_RESOLVED_OFFSET
002018906-04	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-05	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-06	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-07	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-08	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-09	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS
002018906-10	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE_ZUMA—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_CROWDED

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

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

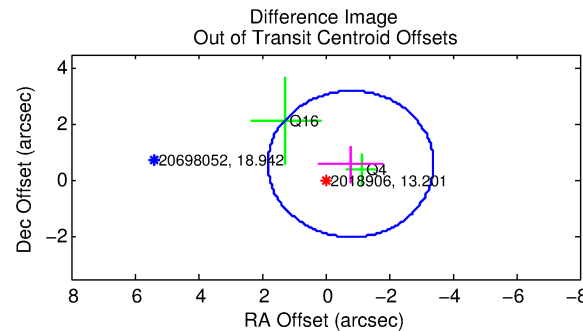
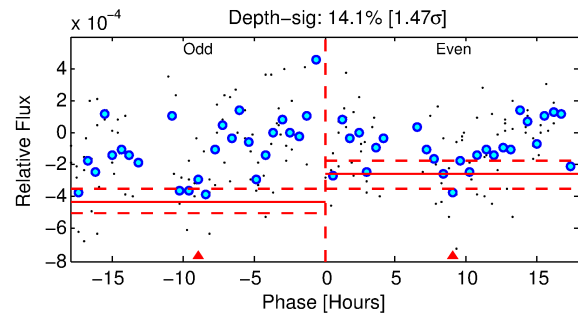
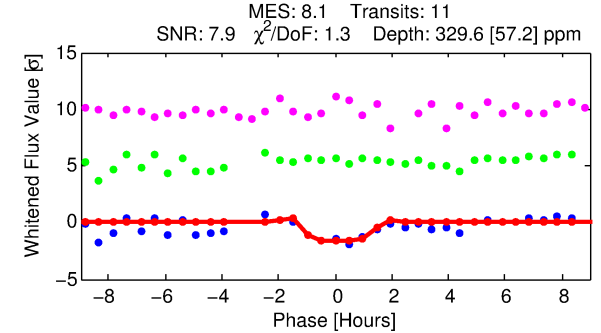
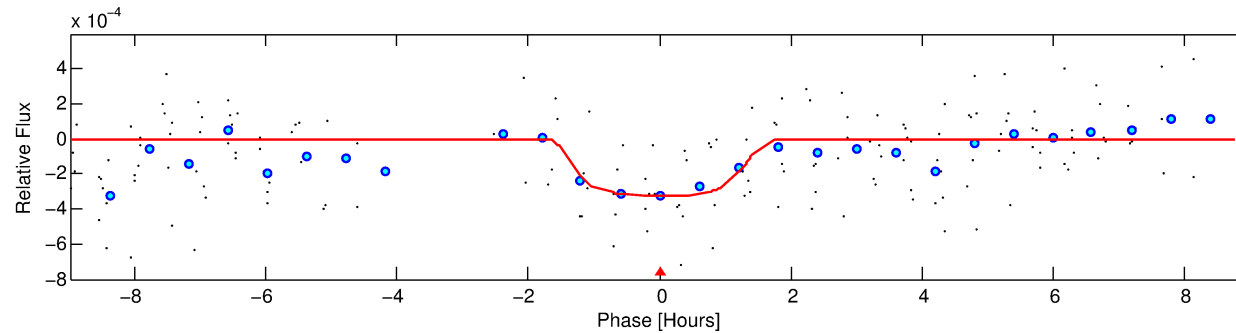
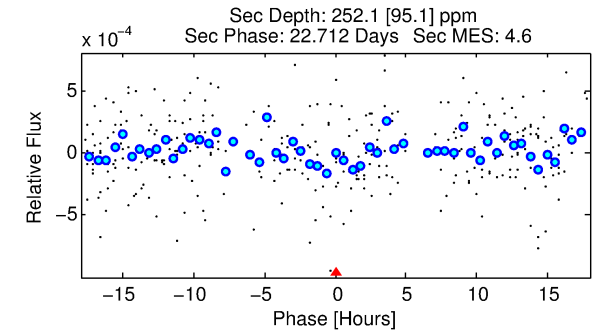
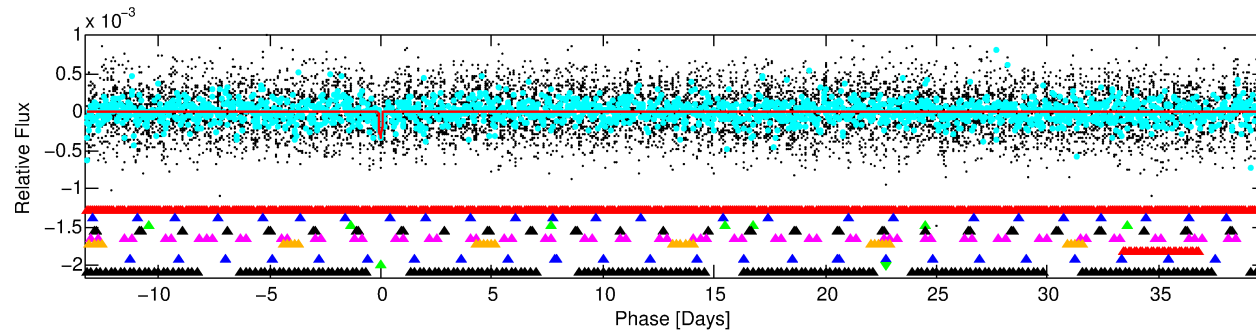
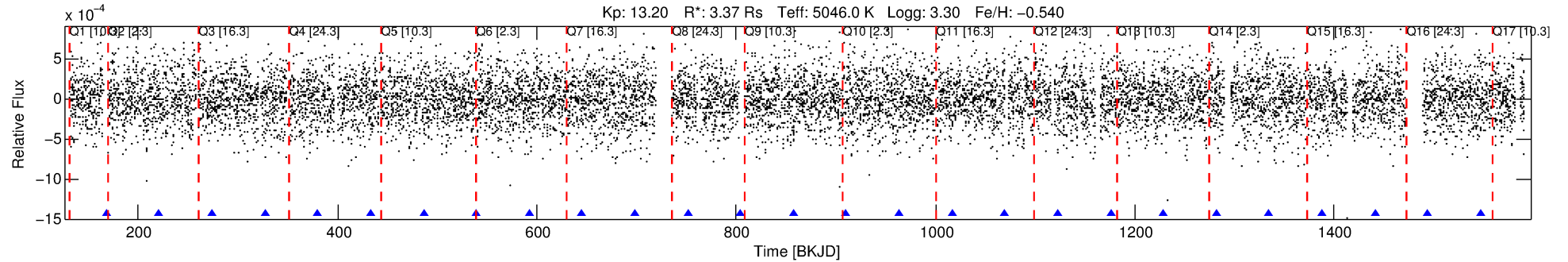
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 002018906-09

No Significant Match Found

# DV One-Page Summary

KIC: 2018906 Candidate: 9 of 10 Period: 53.025 d



## DV Fit Results:

Period = 53.02516 [0.00279] d  
Epoch = 168.2372 [0.0171] BKJD  
Rp/R\* = 0.0199 [0.0159]  
a/R\* = 66.78 [220.84]  
b = 0.89 [0.78]  
Seff = 97.68 [59.69]  
Teff = 802 [122] K  
Rp = 7.32 [7.12] Re  
a = 0.2599 [0.1143] AU  
Ag = 174.62 [305.36] [0.57σ]  
Teffp = 4505 [1852] K [2.00σ]

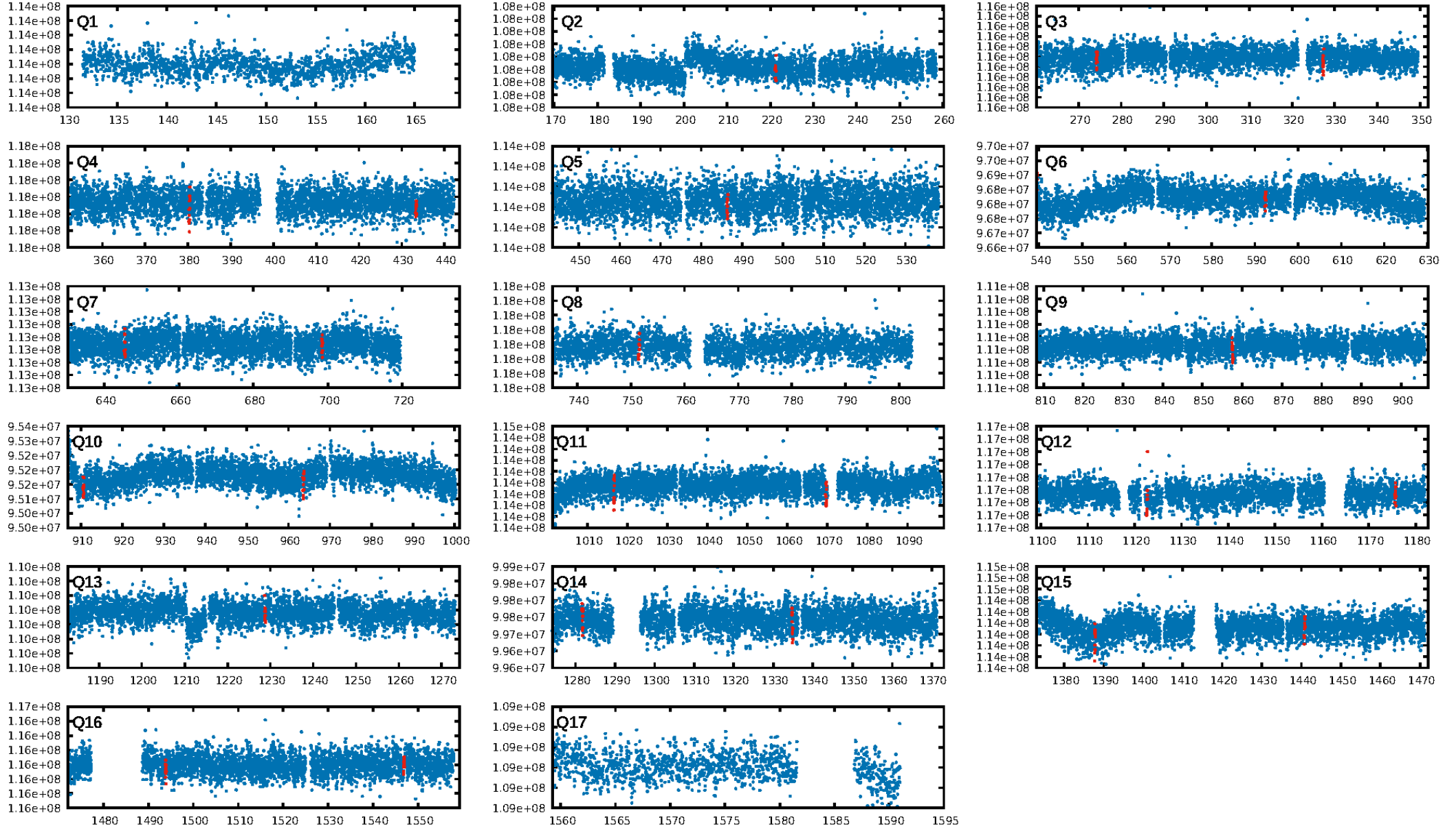
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [36.78σ]  
LongPeriod-sig: 62.0% [0.88σ]  
ModelChiSquare2-sig: 2.8%  
ModelChiSquareGof-sig: 100.0%  
**Bootstrap-pfa: 4.94e-09**  
RollingBand-fgt: 1.00 [11/11]  
GhostDiagnostic-chr: 3.047  
Centroid-sig: N/A  
Centroid-so: 0.857 arcsec [1.04σ]  
OotOffset-rm: 0.992 arcsec [1.14σ]  
KicOffset-rm: 0.954 arcsec [1.04σ]  
OotOffset-st: 0/0/2/0 [2]  
KicOffset-st: 0/0/2/0 [2]  
DiffImageQuality-fgm: 0.50 [1/2]  
DiffImageOverlap-fno: 0.00 [0/14]

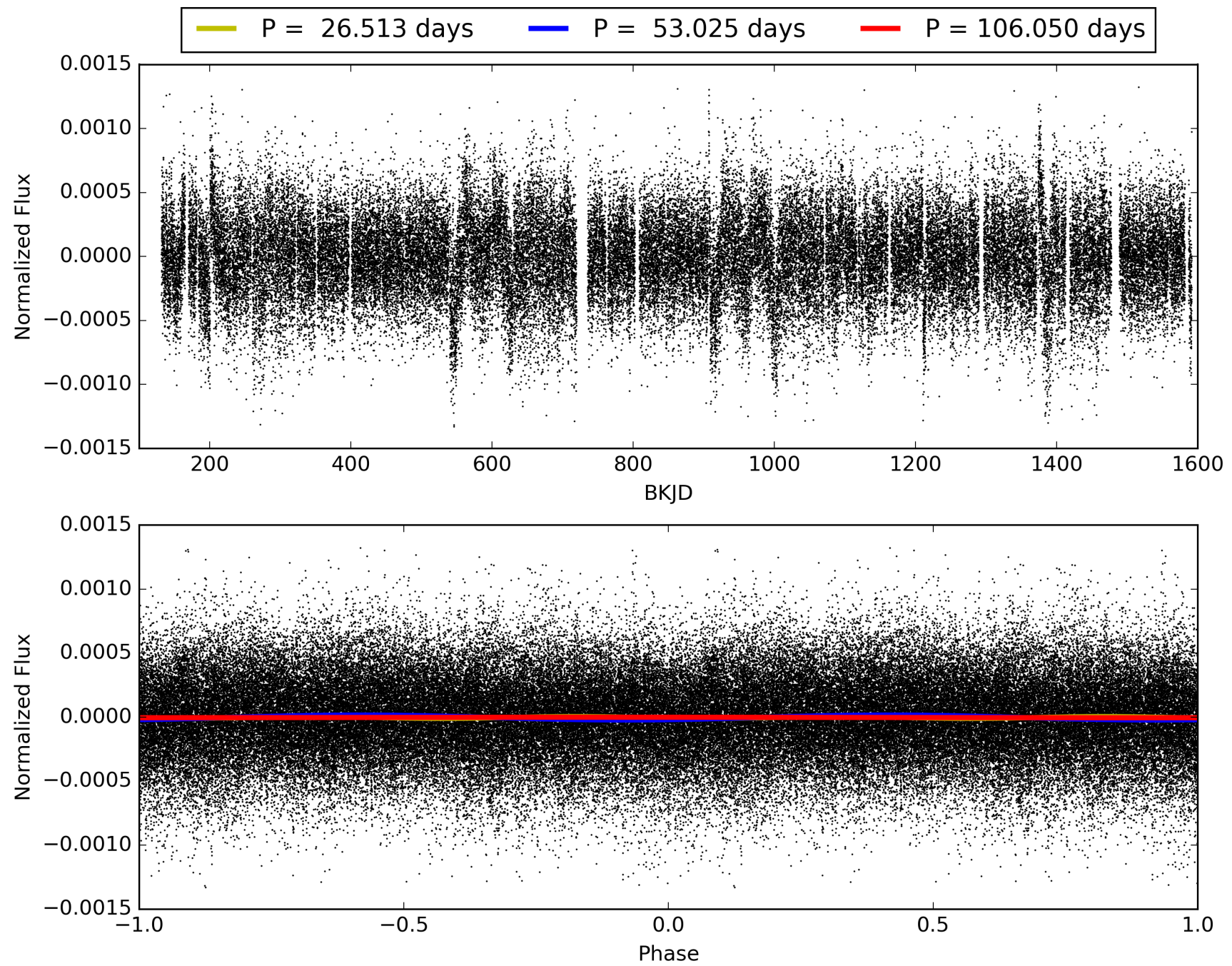
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 04:43:39 Z

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

# TCE 002018906-09, PDC Light Curves

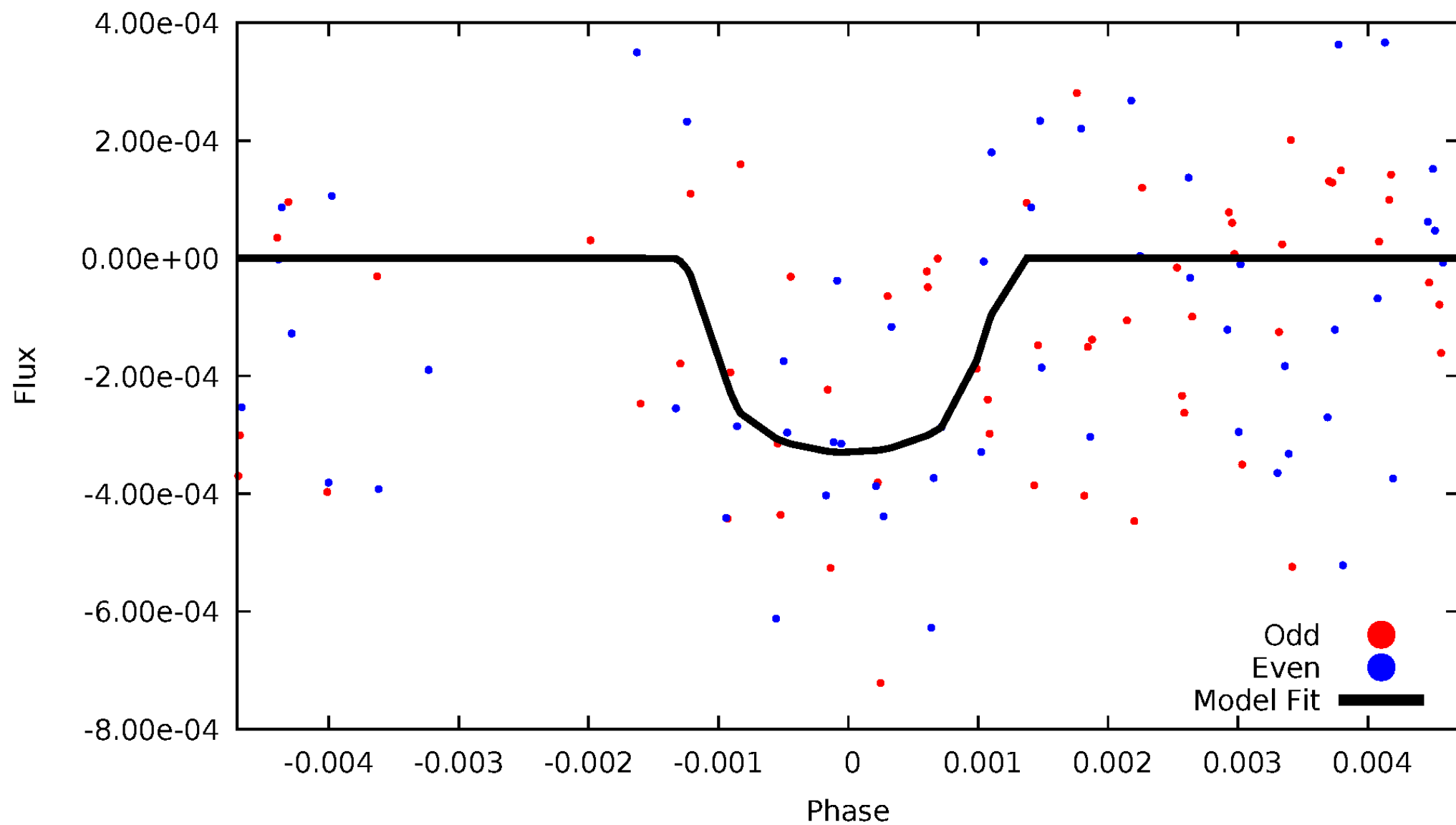


TCE 002018906-09



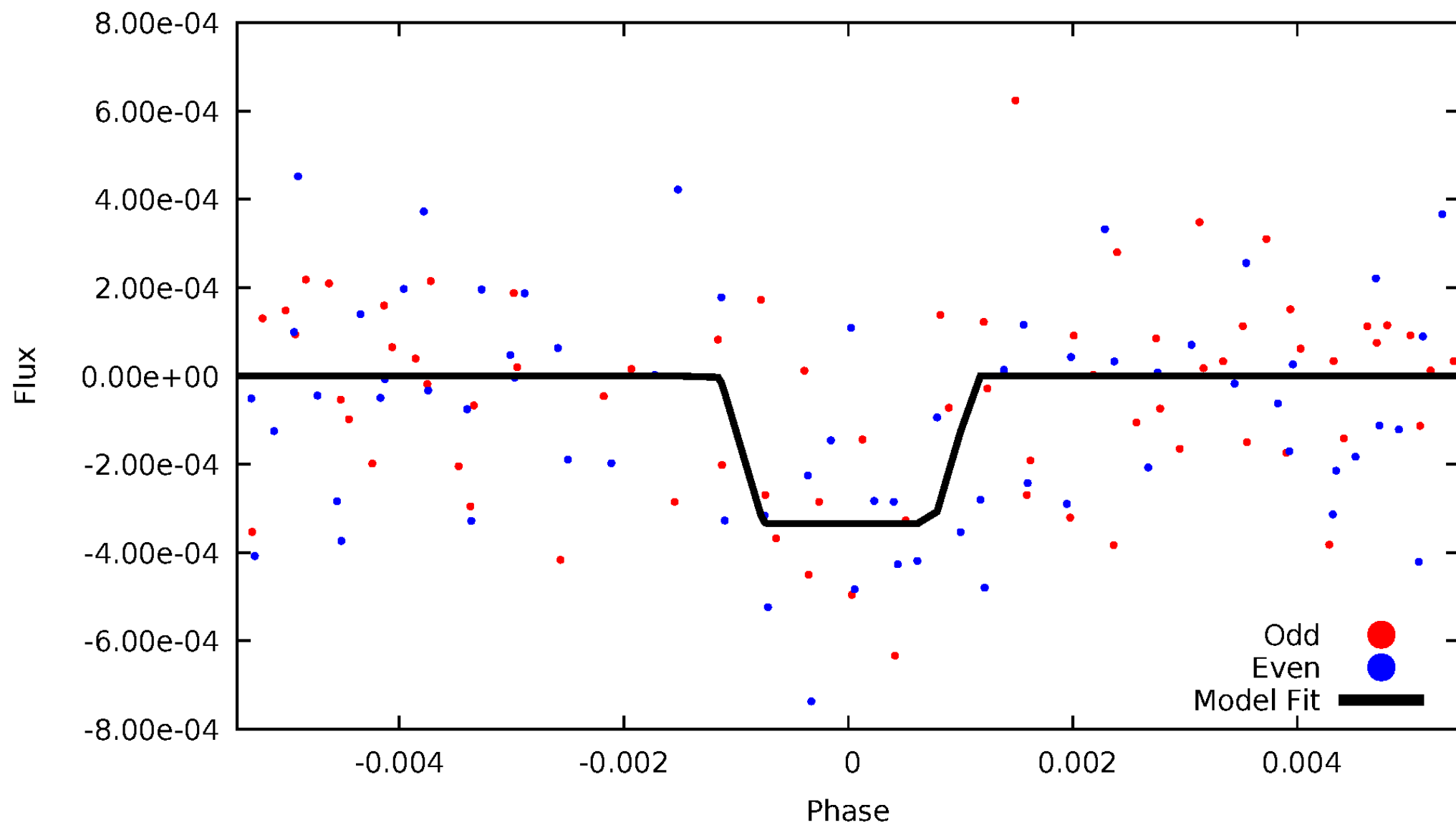
# DV Odd/Even

TCE 002018906-09



# ALT Odd/Even

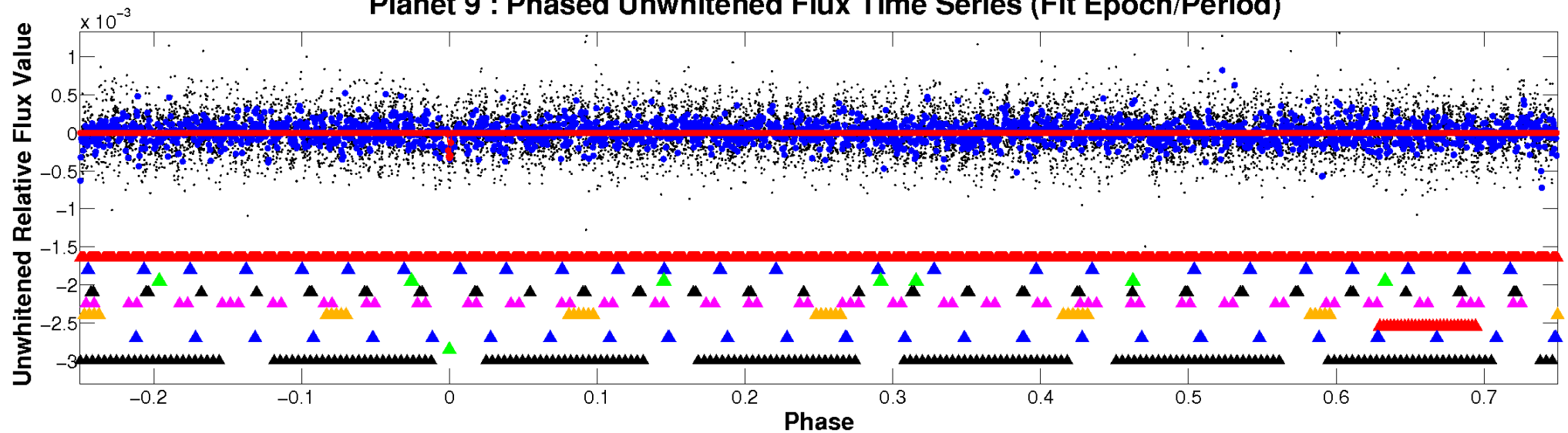
TCE 002018906-09



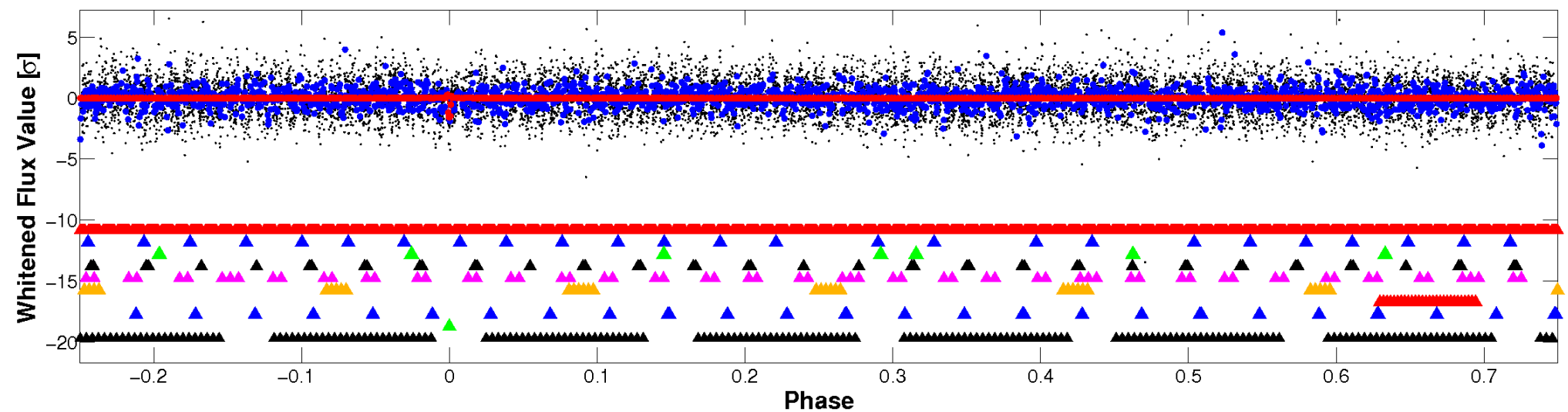


# Non-Whitened Vs. Whitened Light Curve

## Planet 9 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)



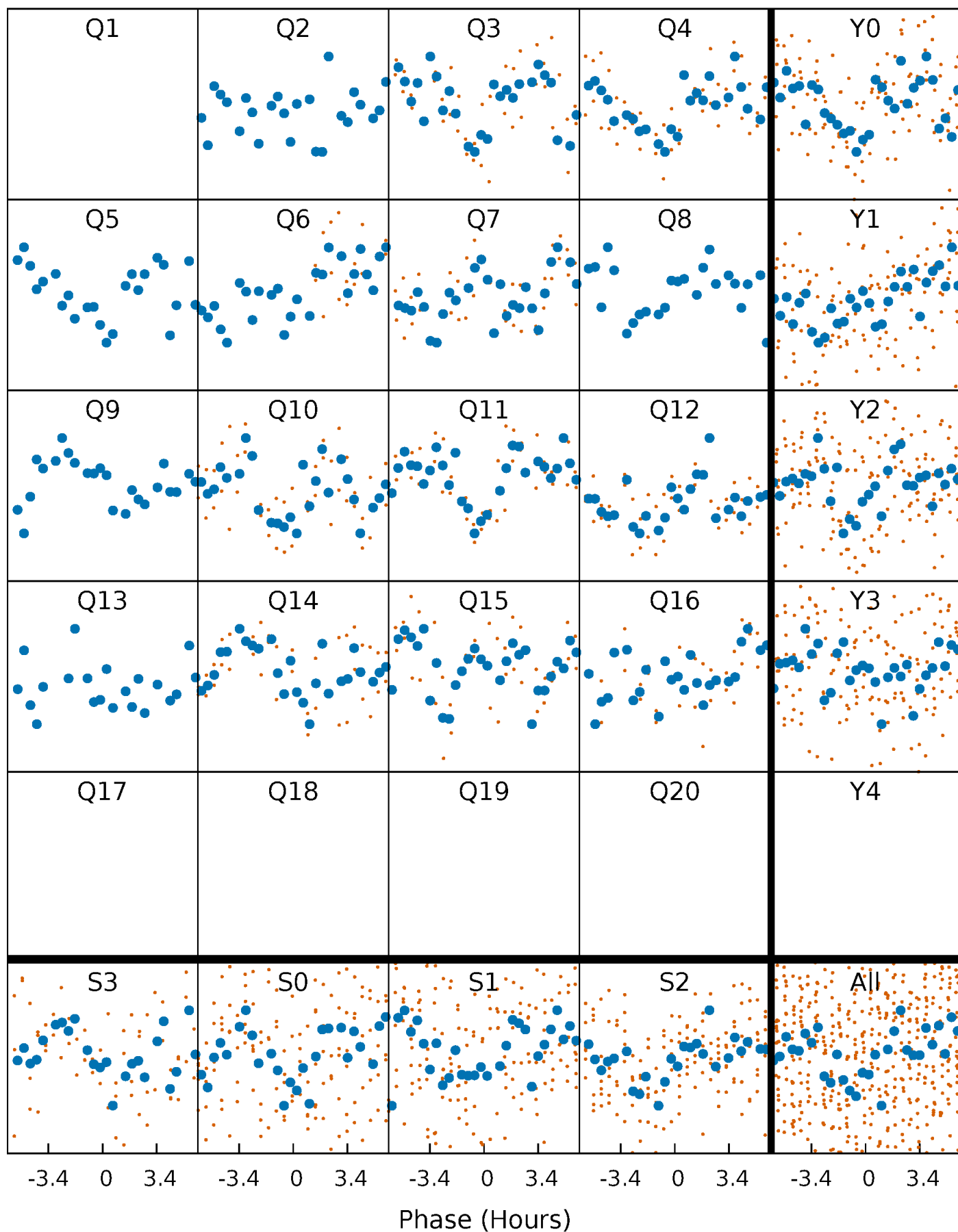
## Planet 9 : Phased Whitened Flux Time Series (Fit Epoch/Period)





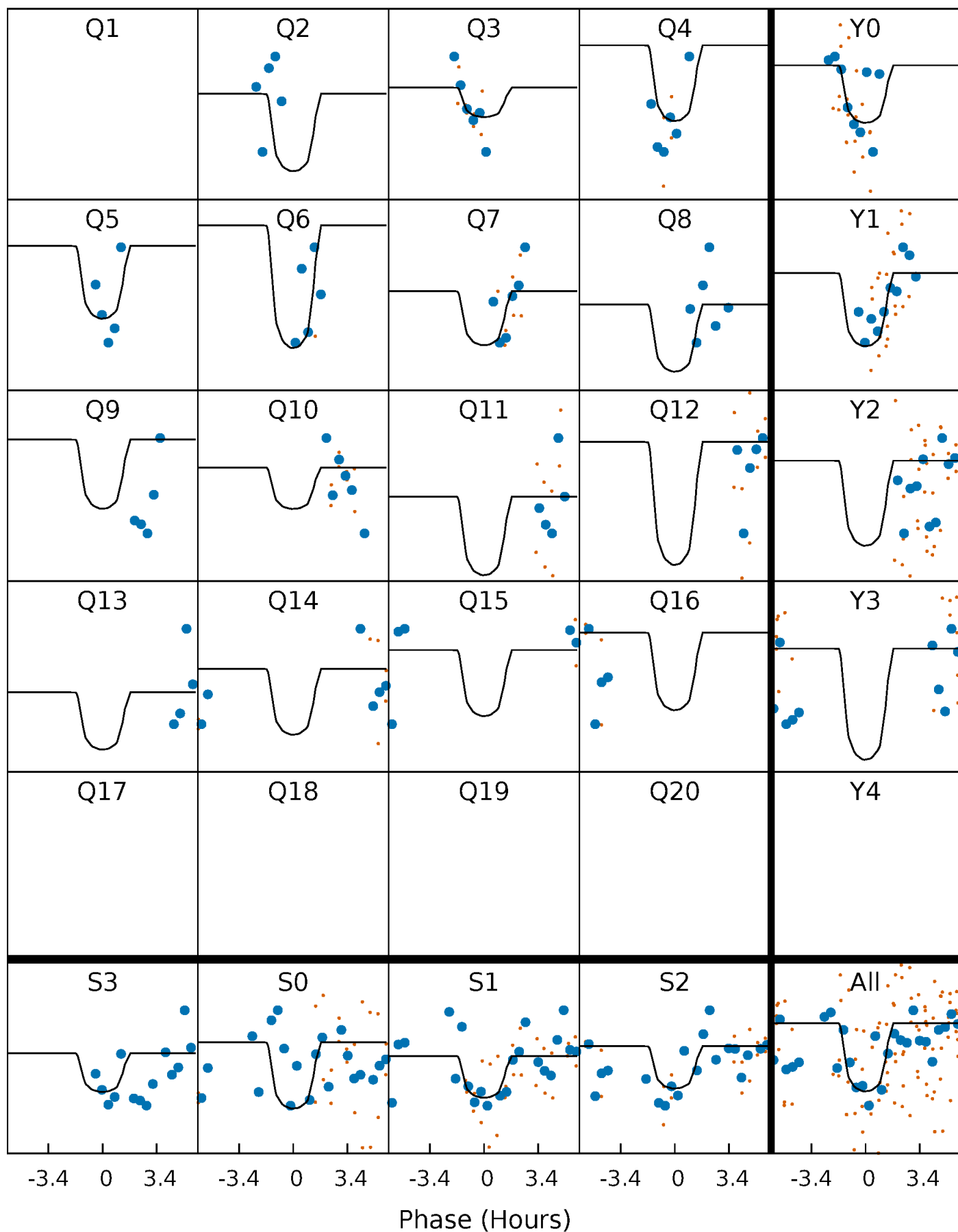
# PDC Quarter-Phased Transit Curves

TCE 002018906-09 P= 53.025159 Days  $T_0=168.237150$  (BKJD)



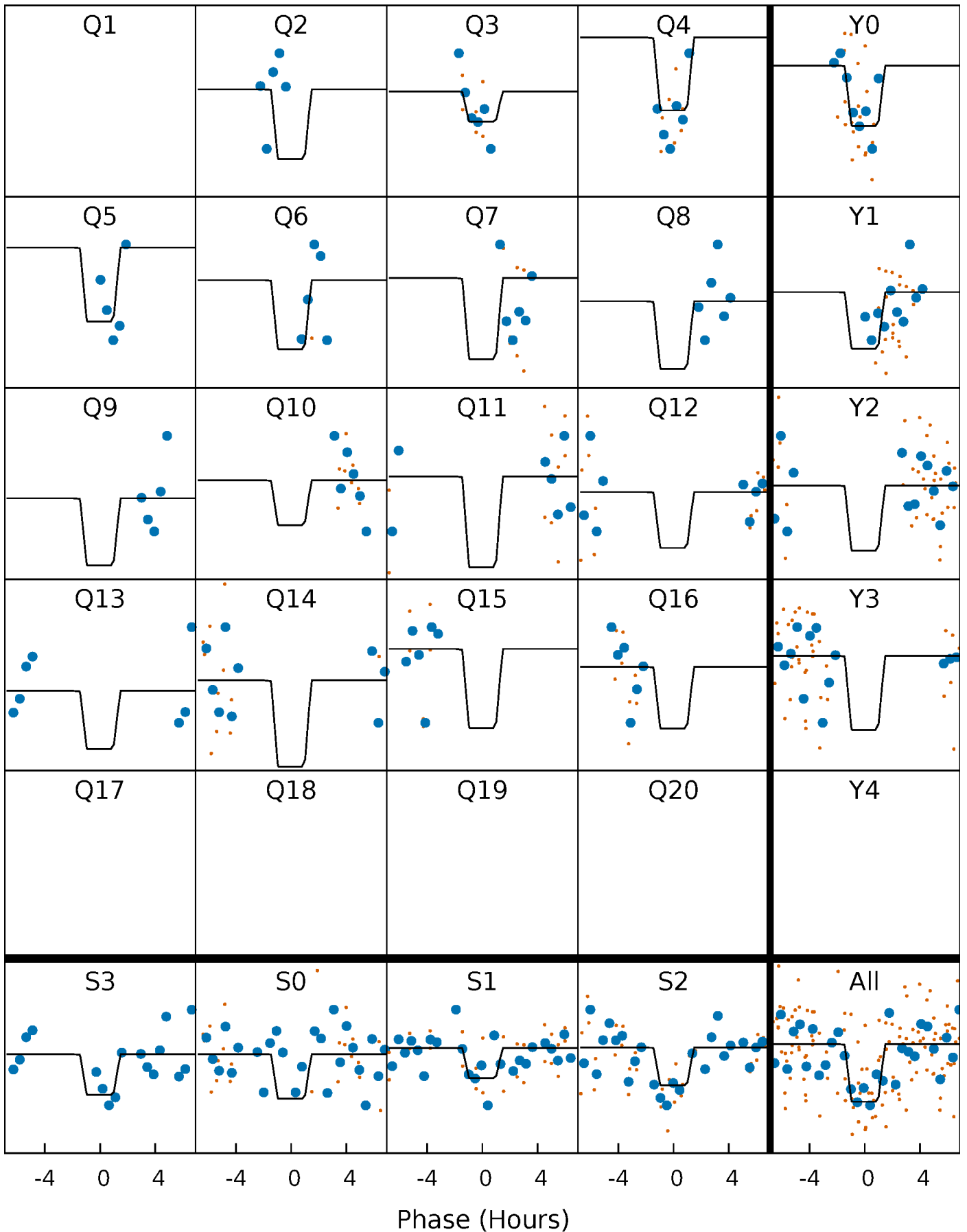
# DV Quarter-Phased Transit Curves

TCE 002018906-09   P= 53.025159 Days    $T_0=168.237150$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

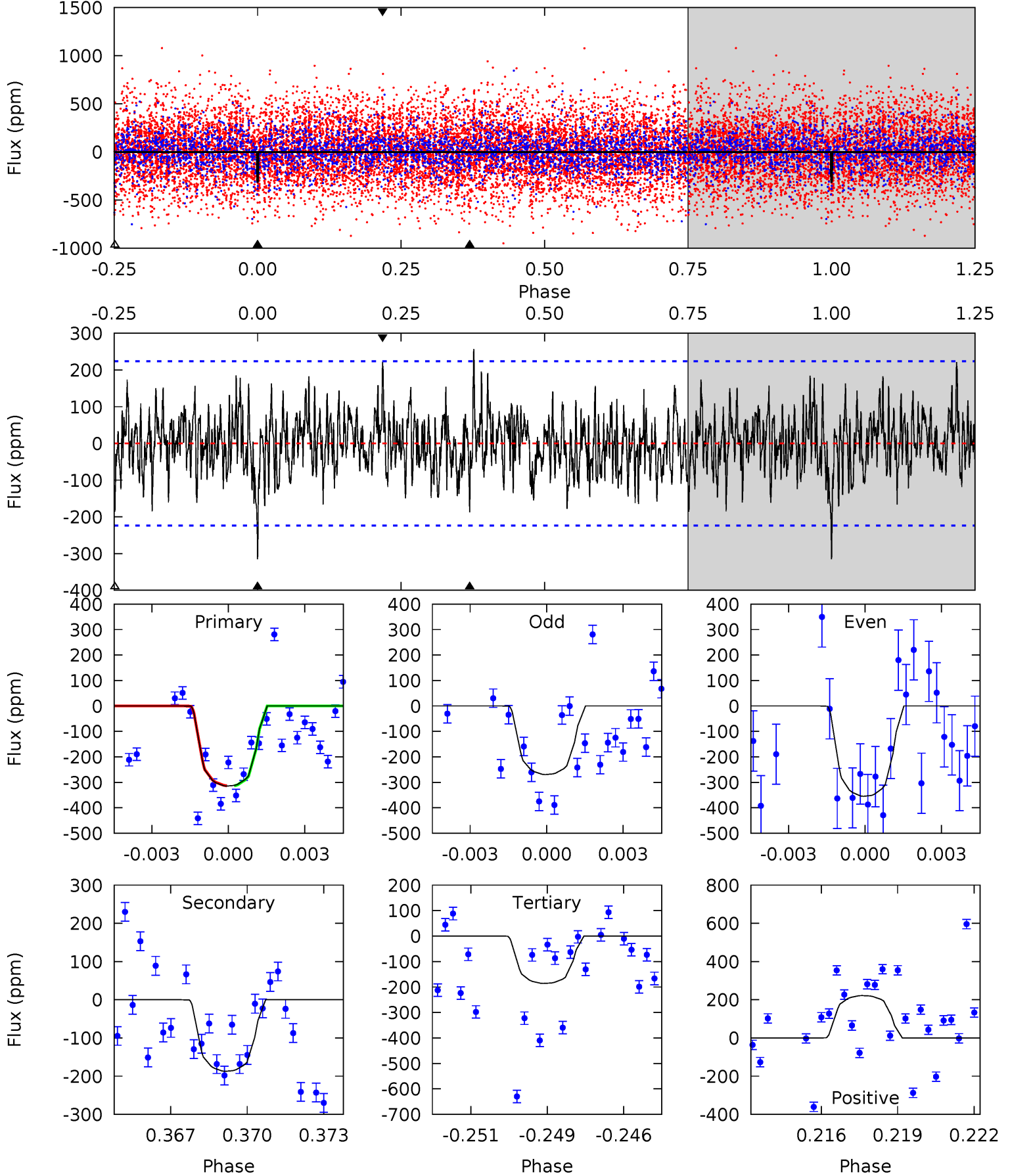
TCE 002018906-09     $P = 53.022075$  Days     $T_0 = 168.237469$  (BKJD)



# DV Model-Shift Uniqueness Test

002018906-09, P = 53.025159 Days, E = 115.211991 Days

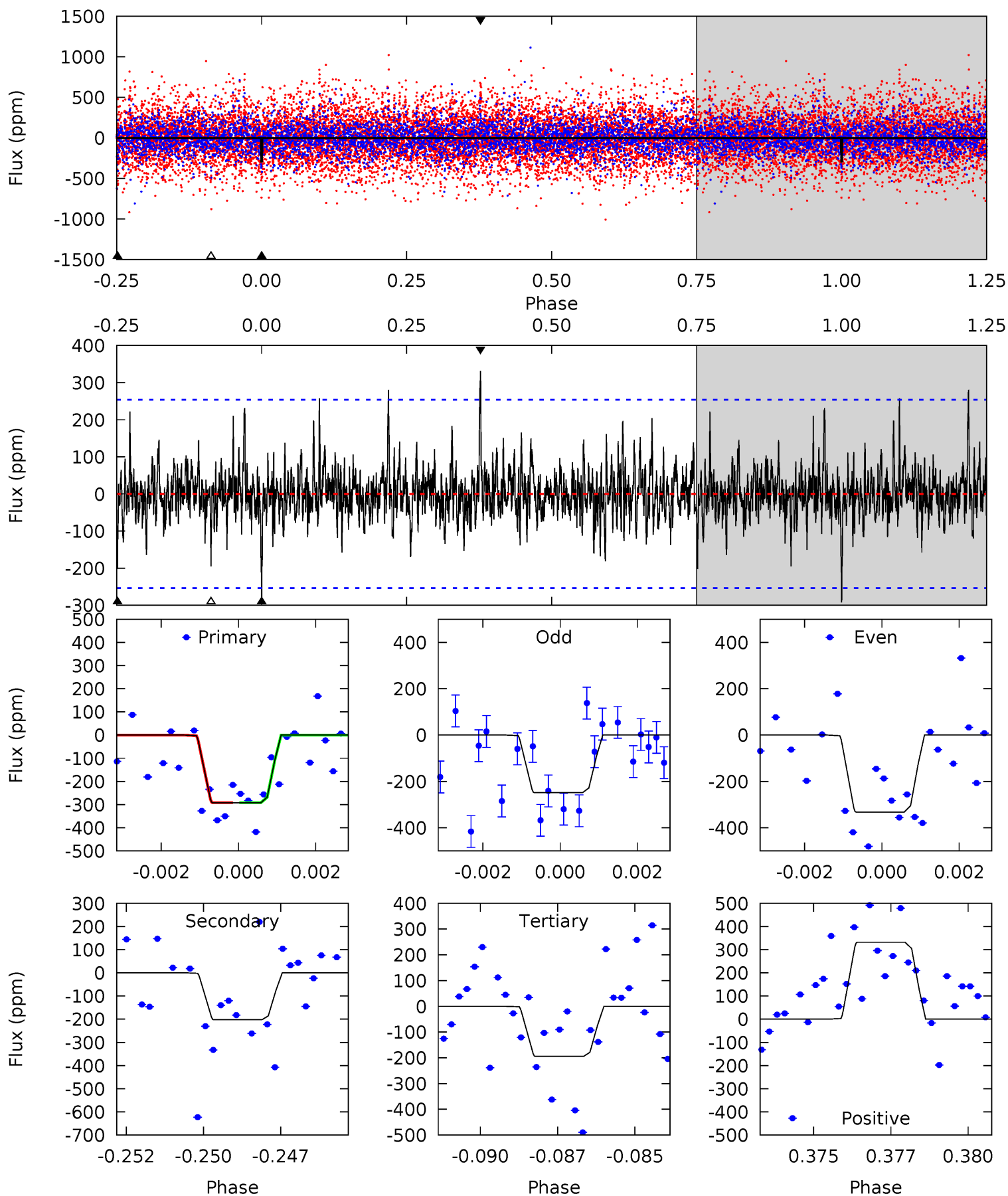
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
7.41	4.41	4.38	5.23	5.27	3.00	1.59	3.03	2.19	0.03	-0.82	1.02	1.12	0.45	0.01



# Alt Model-Shift Uniqueness Test

002018906-09, P = 53.022075 Days, E = 115.215394 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
6.12	4.24	4.08	6.95	5.32	3.07	1.21	2.05	-0.82	0.17	-2.70	0.88	0.99	0.53	0.00



### Stellar Parameters For KIC 002018906

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5046^{+127}_{-102}$	$3.303^{+0.310}_{-0.310}$	$-0.540^{+0.300}_{-0.250}$	$3.370^{+1.870}_{-1.007}$	$0.832^{+0.283}_{-0.165}$	$0.031^{+0.053}_{-0.022}$
	+3%/-2%	+9%/-9%	+56%/-46%	+55%/-30%	+34%/-20%	+172%/-72%
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 002018906-09 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-187 \pm 42$	$7.66^{+7.00}_{-4.52}$	$1116^{+140}_{-108}$	$4220^{+1909}_{-738}$	$118^{+582}_{-86}$
Alt.	$-203 \pm 48$	$7.68^{+6.29}_{-4.66}$	$1119^{+160}_{-97}$	$4312^{+2080}_{-790}$	$125^{+637}_{-87}$

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

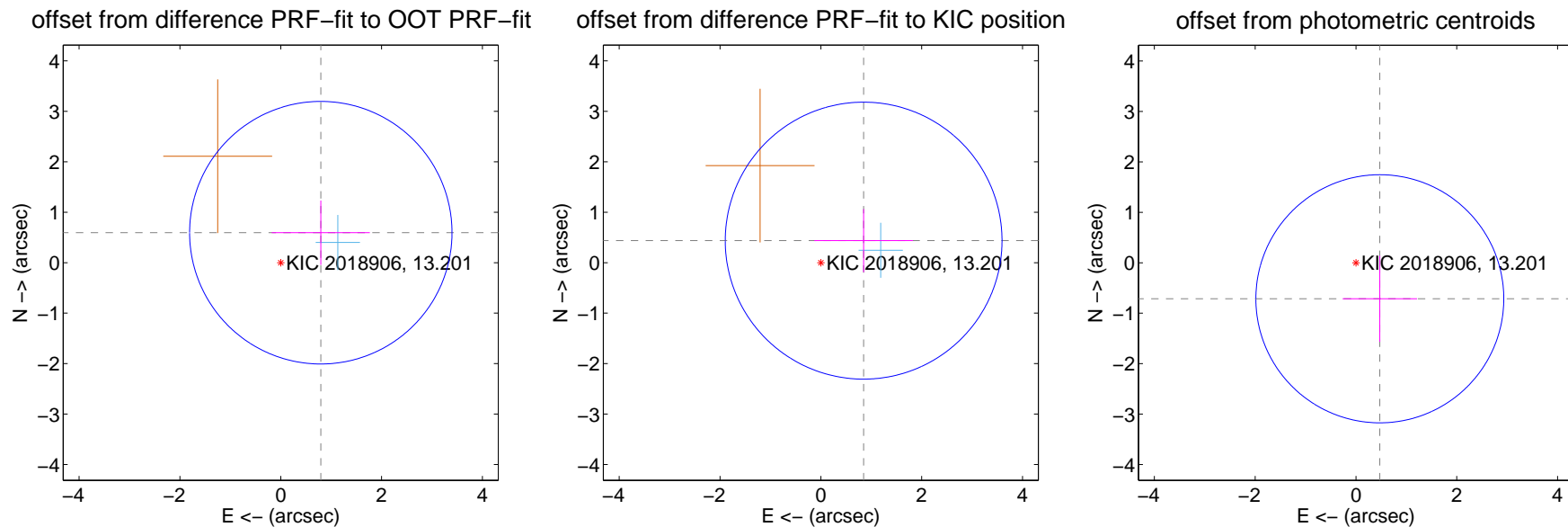
## DV Centroid Data

Supplemental centroid analysis for 002018906-09. Kepler magnitude: 13.20. Transit SNR 7.86

There are 1 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.19 arcsec

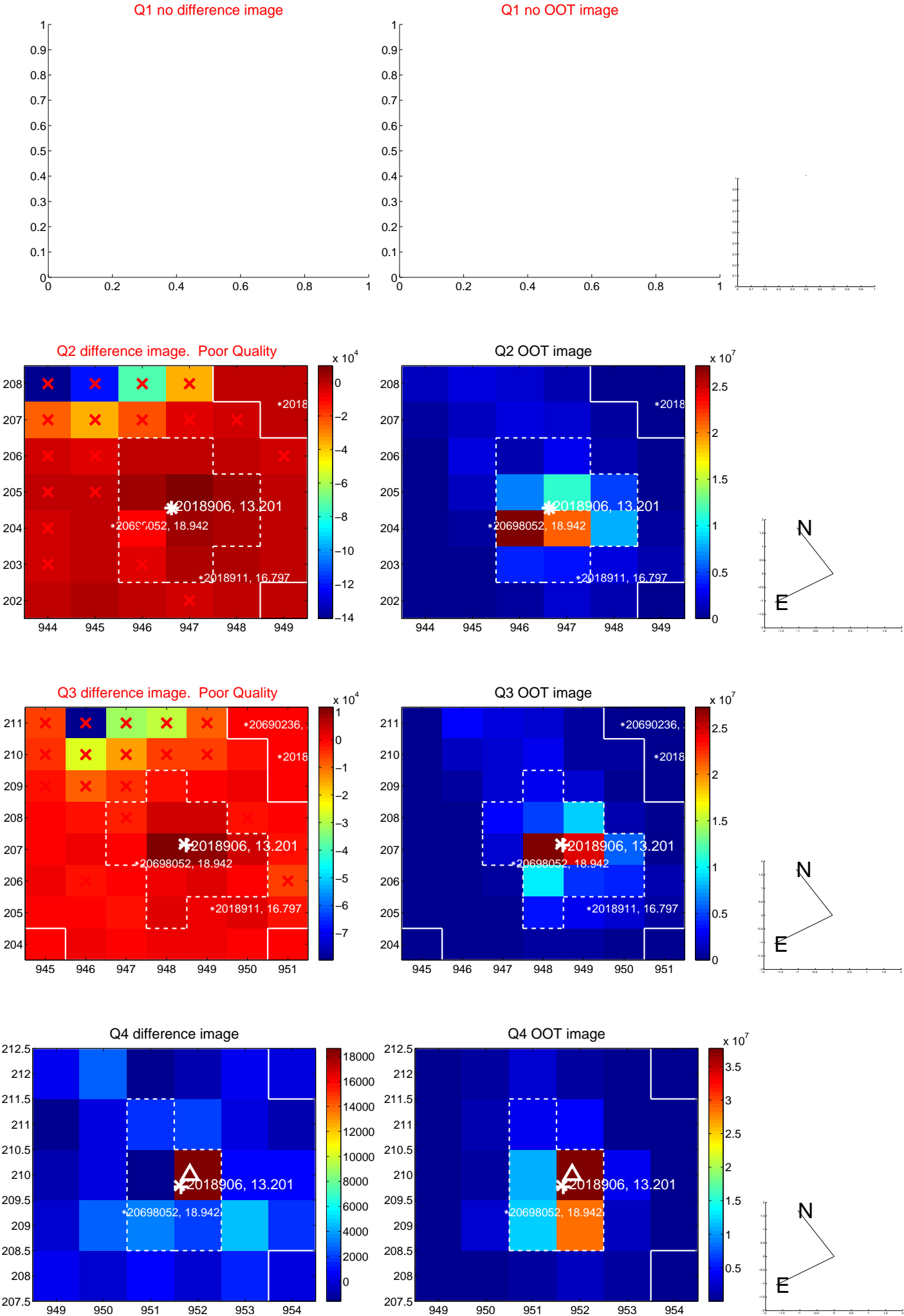
	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.992 \pm 0.867$	1.14	$-0.795 \pm 0.973$	$0.595 \pm 0.638$
PRF-fit source offset from KIC position	$0.954 \pm 0.915$	1.04	$-0.848 \pm 0.977$	$0.437 \pm 0.626$
photometric centroid source offset	$0.86 \pm 0.82$	1.04	$-0.47 \pm 0.74$	$-0.71 \pm 0.85$



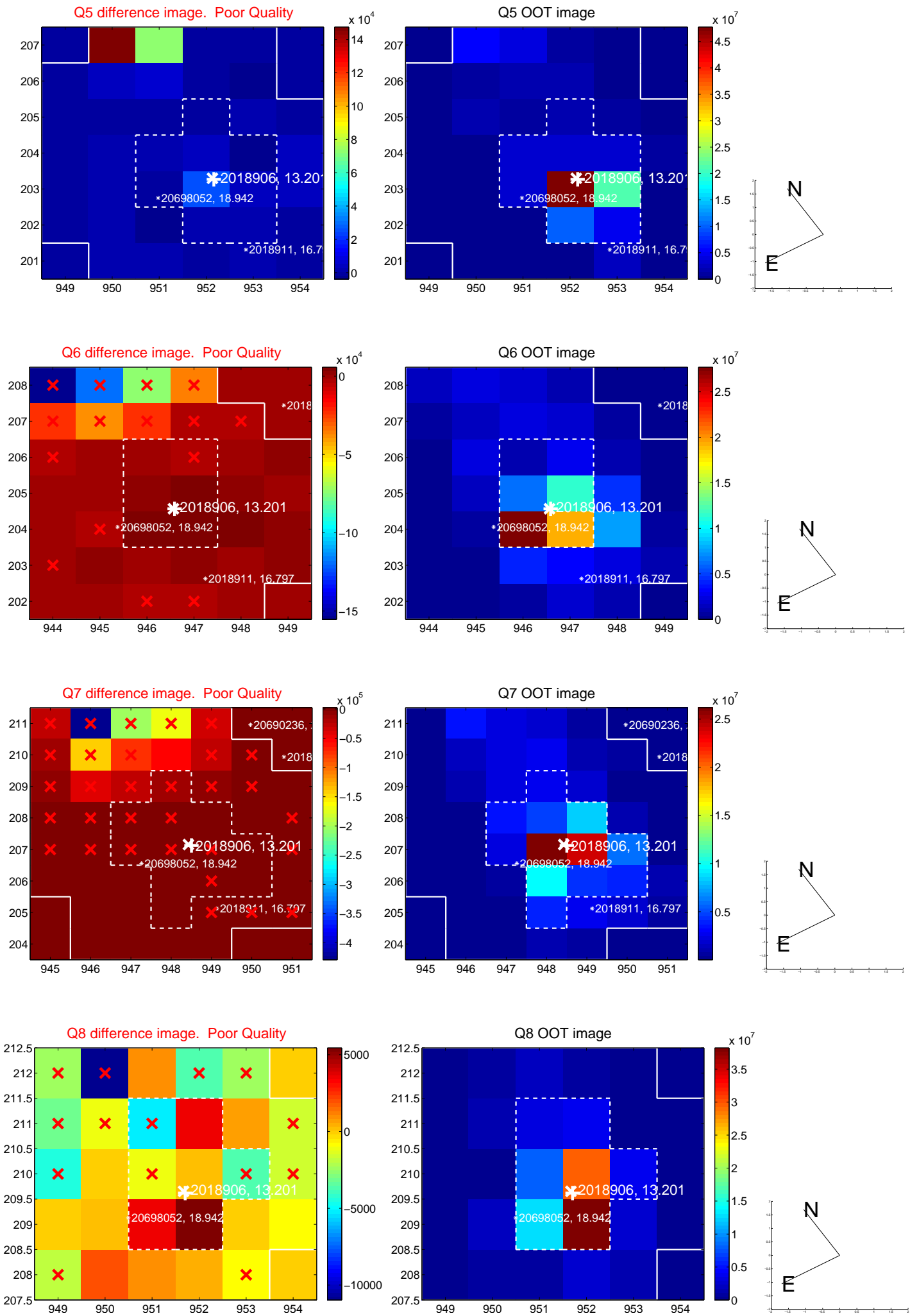
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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



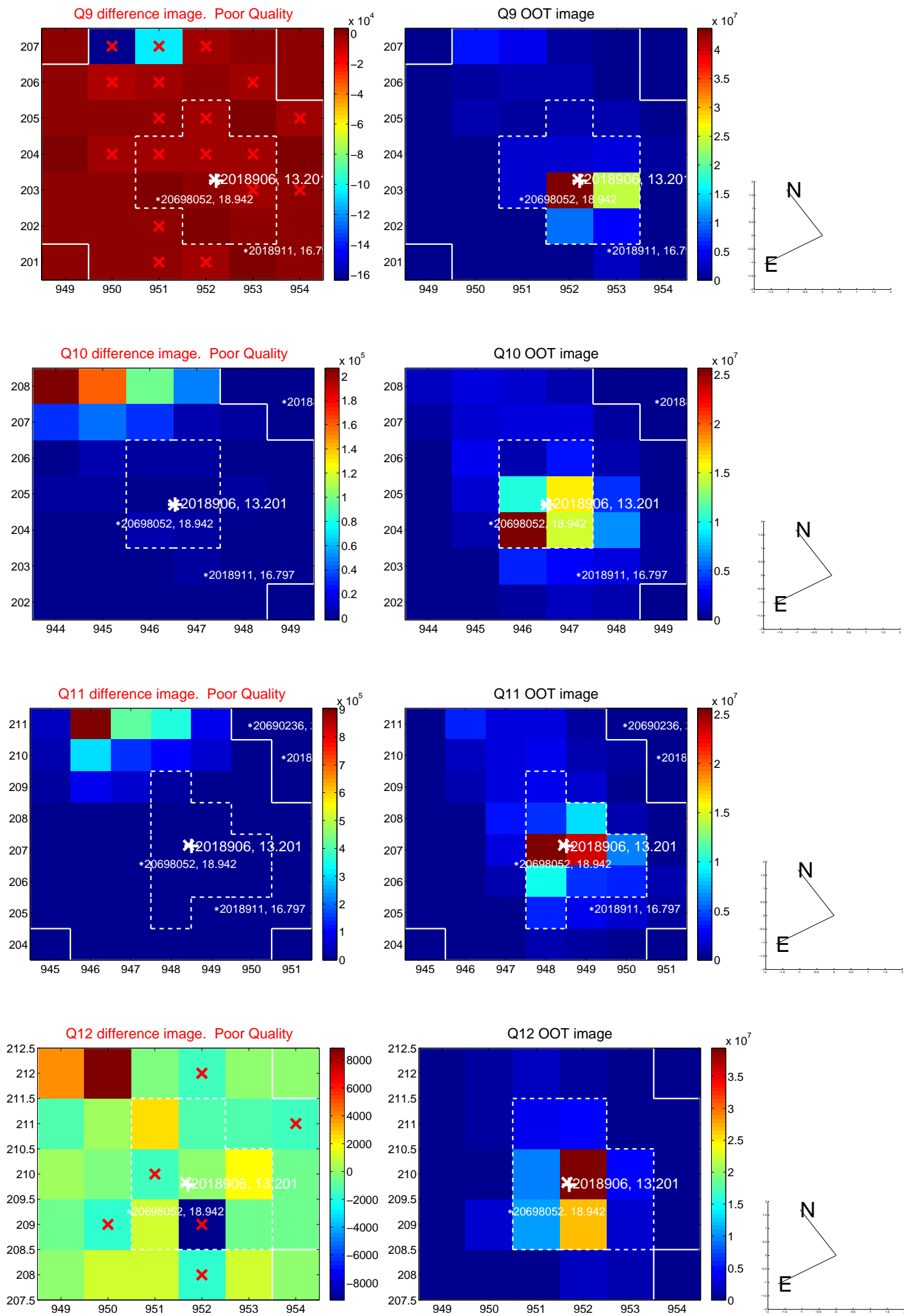
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



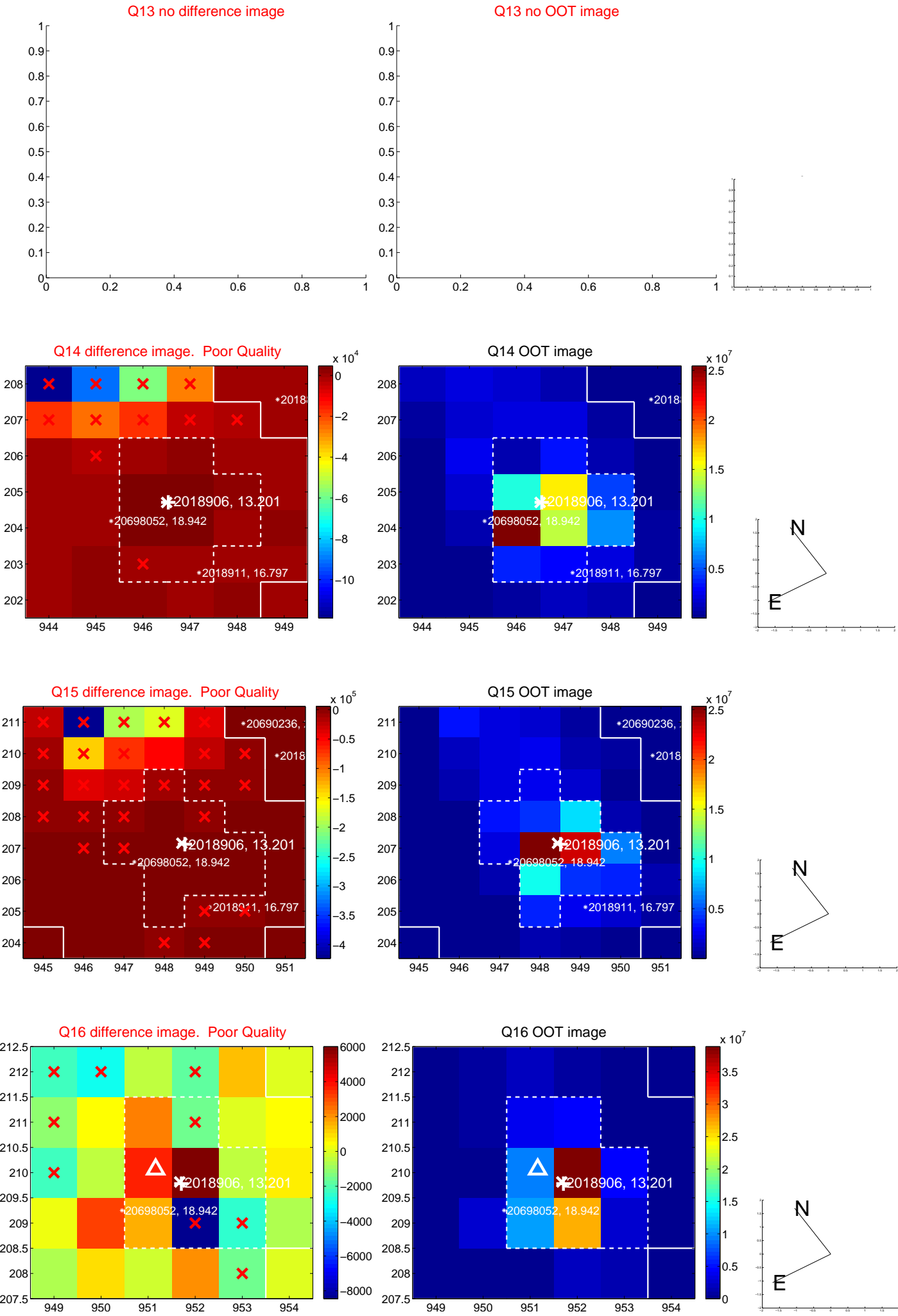
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



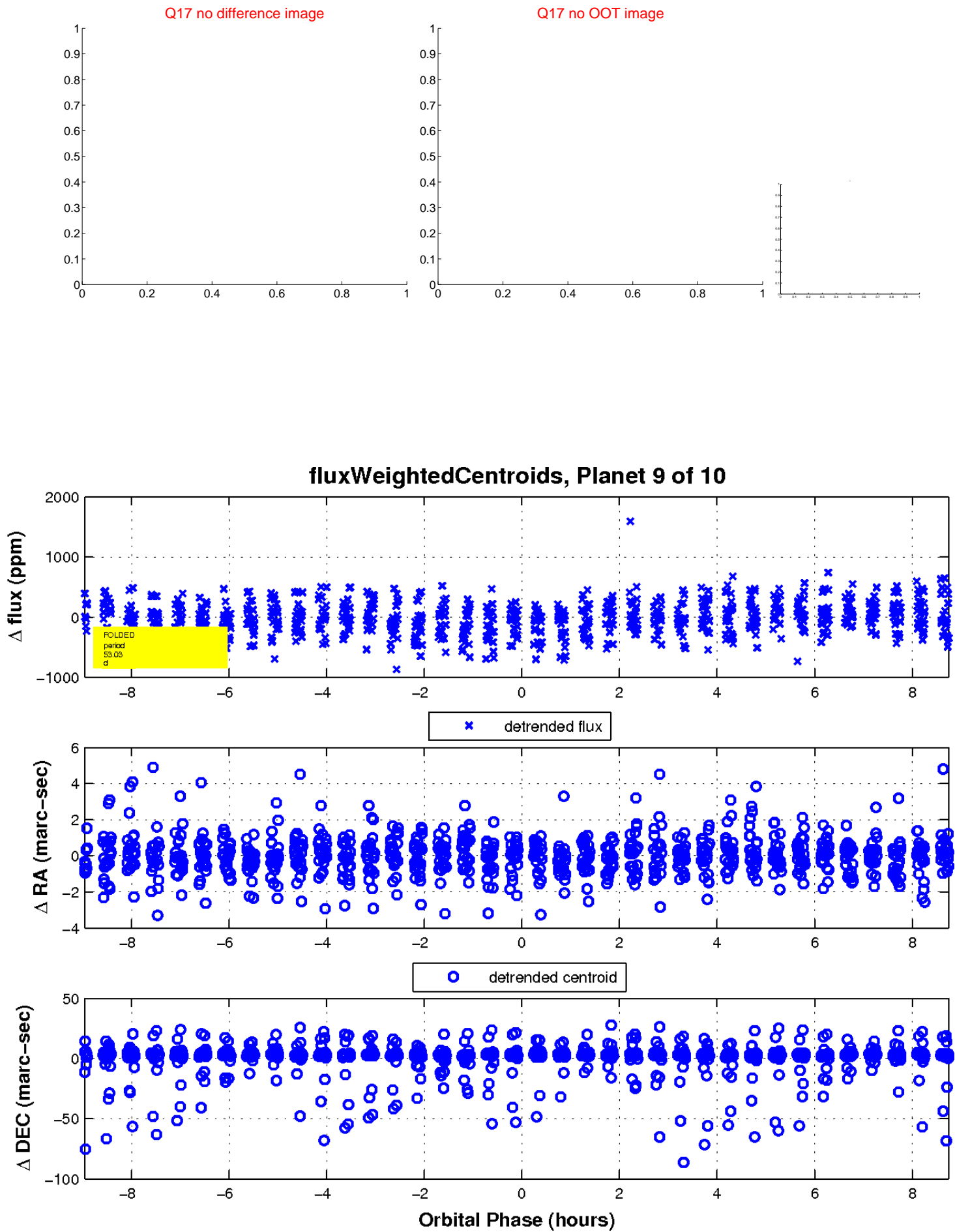
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

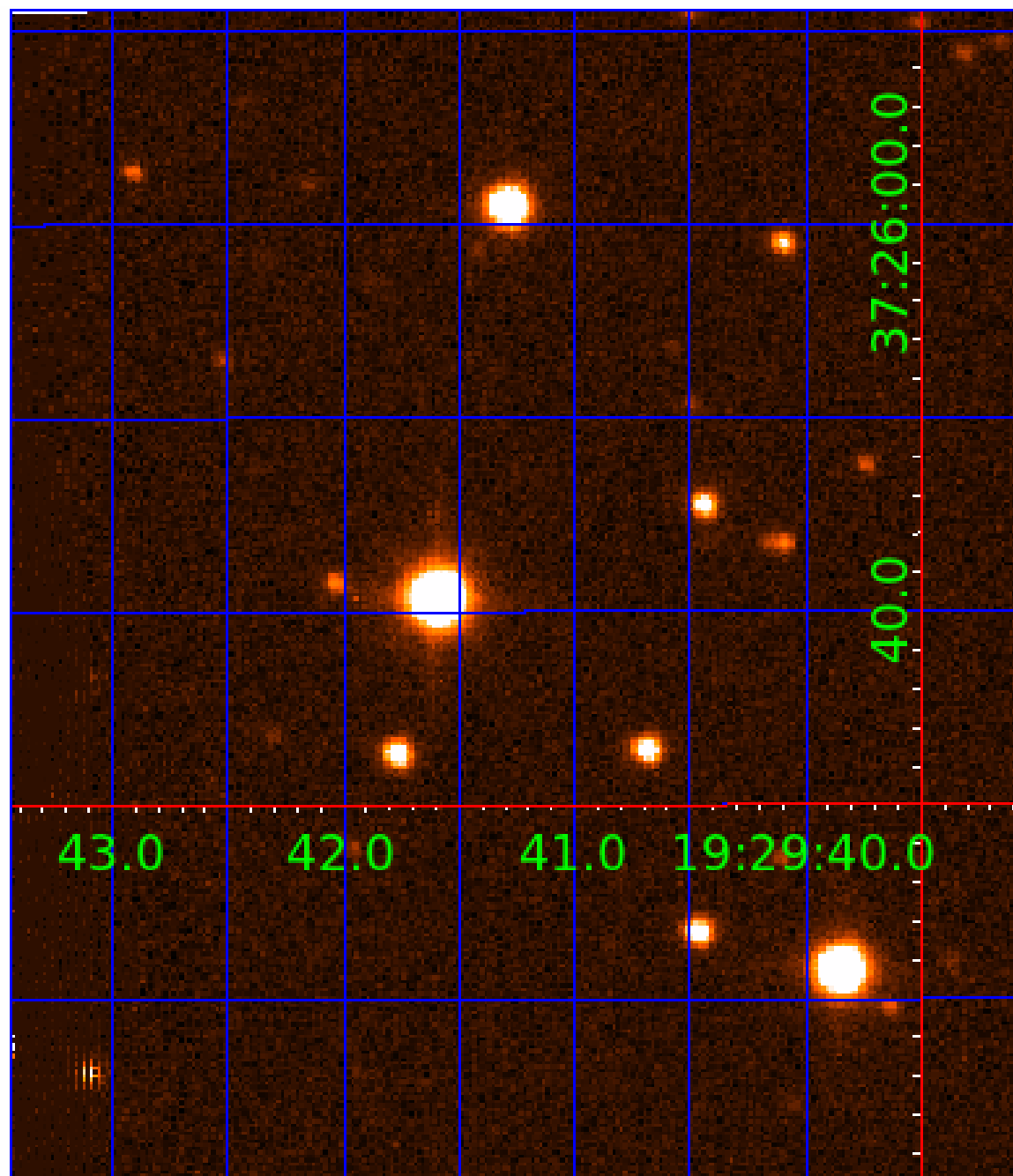


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 002018906

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
002018906-01	OBS	No	0.525149	131.658983	11.9	3.212	15.1	3.7	3.37	5046	1.24	0.00
002018906-04	OBS	No	31.419253	137.819040	334.8	3.524	9.4	8.5	3.37	5046	7.09	196.26
002018906-05	OBS	No	22.245829	137.842474	441.7	2.059	9.2	10.5	3.37	5046	7.50	311.01
002018906-06	OBS	No	44.158582	138.108488	370.8	3.010	9.1	9.2	3.37	5046	7.29	124.67
002018906-07	OBS	No	53.152195	148.596580	587.8	1.755	8.9	9.6	3.37	5046	9.31	97.37
002018906-08	OBS	No	46.663938	154.862044	409.6	2.876	7.8	8.6	3.37	5046	8.08	115.82
002018906-09	OBS	No	53.025159	168.237150	329.6	2.994	8.1	7.9	3.37	5046	7.32	97.68
002018906-10	OBS	No	7.605976	131.528571	187.7	3.276	9.2	10.1	3.37	5046	5.50	1300.86

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
002018906-01	OBS	FP	0.00	1	0	1	0	LPP_DV—CENT_RESOLVED_OFFSET
002018906-04	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-05	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-06	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-07	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—MOD_NONUNIQ_ALT—MOD_POS_ALT—CENT_RESOLVED_OFFSET
002018906-08	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_RESOLVED_OFFSET
002018906-09	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE—TRANS_GAPPED—LPP_DV—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS
002018906-10	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_SKYE_ZUMA—TRANS_GAPPED—MOD_NONUNIQ_DV—MOD_NONUNIQ_ALT—CENT_CROWDED

**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.

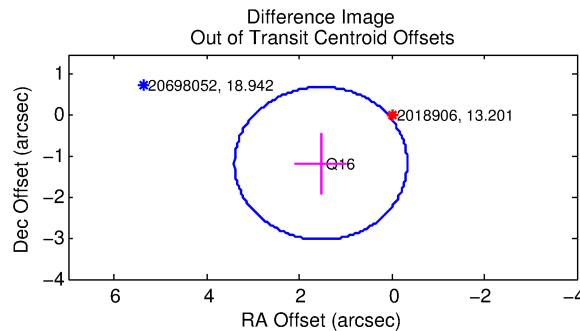
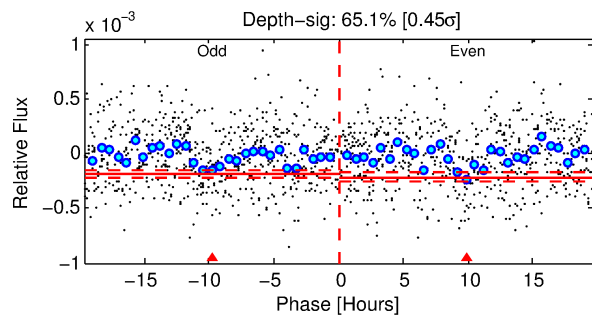
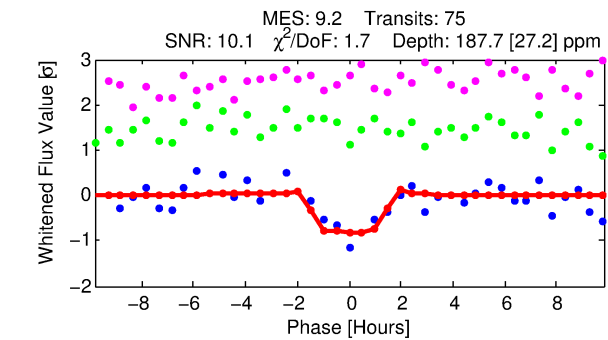
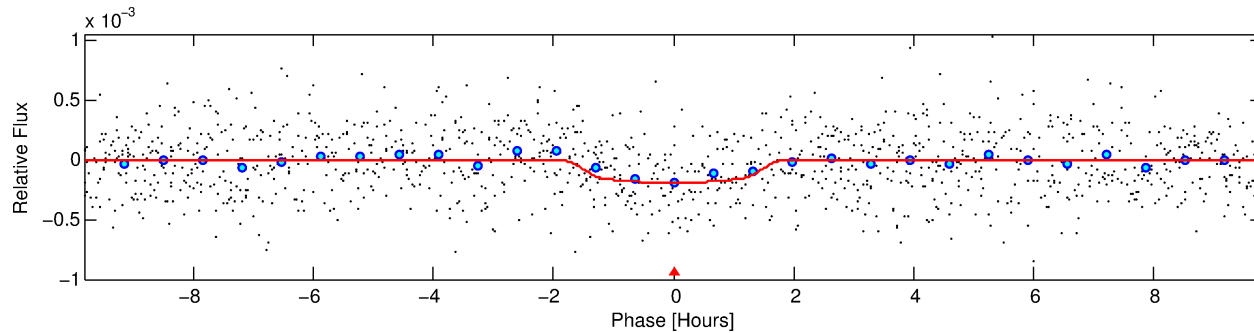
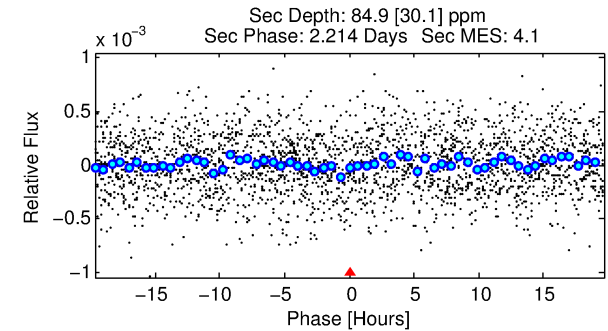
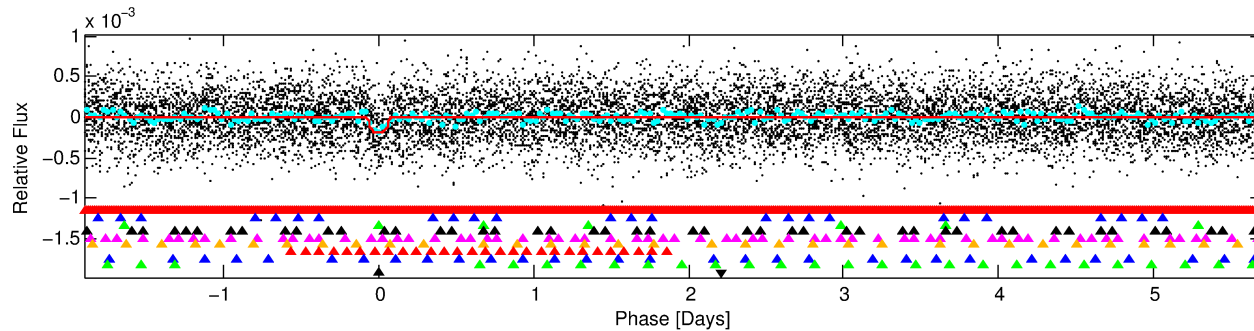
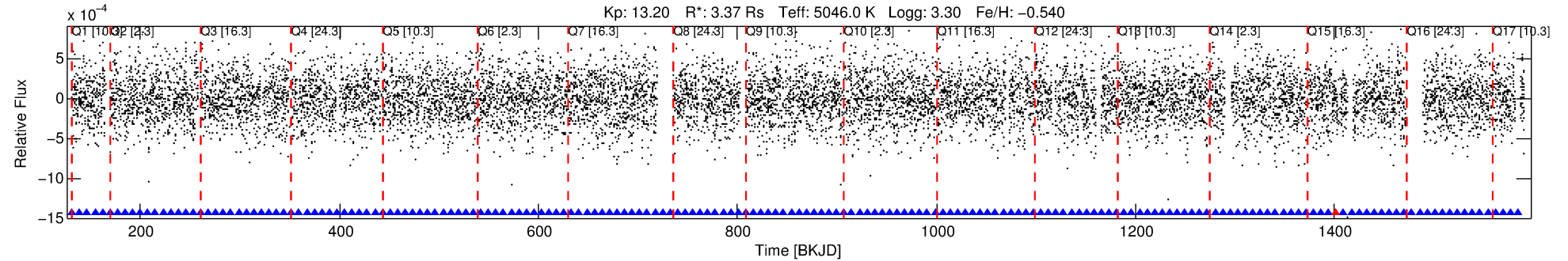
Ephemeris Match Information For 002018906-10

No Significant Match Found



# DV One-Page Summary

KIC: 2018906 Candidate: 10 of 10 Period: 7.606 d



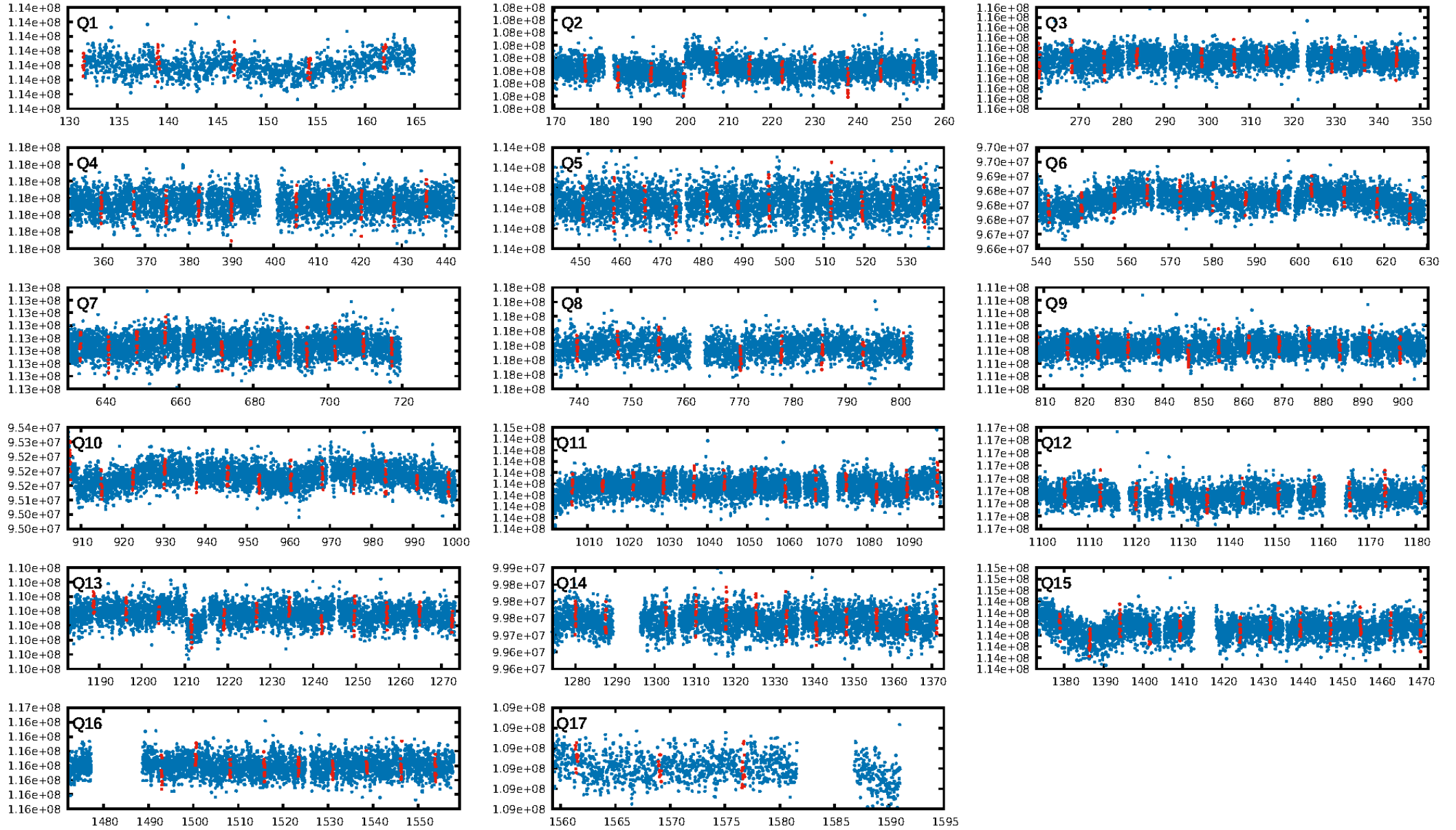
## DV Fit Results:

Period = 7.60598 [0.00008] d  
Epoch = 131.5286 [0.0076] BKJD  
Rp/R\* = 0.0150 [0.0113]  
a/R\* = 8.74 [27.44]  
b = 0.89 [0.77]  
Seff = 1300.86 [794.94]  
Teq = 1531 [234] K  
Rp = 5.50 [5.16] Re  
a = 0.0712 [0.0313] AU  
Ag = 7.83 [13.05] [0.52σ]  
Teffp = 3960 [1543] K [1.56σ]

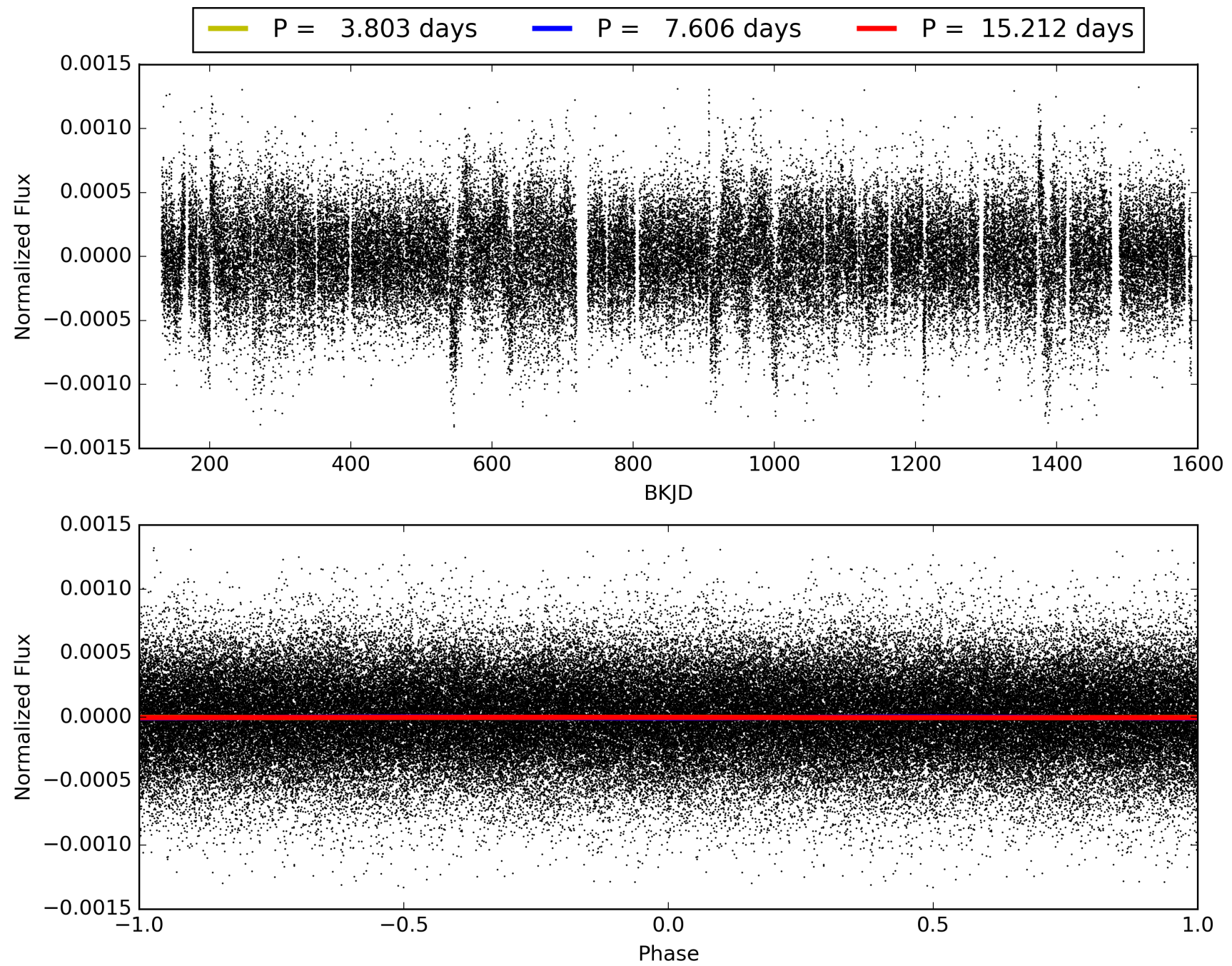
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [37.04σ]  
LongPeriod-sig: 100.0% [90.79σ]  
ModelChiSquare2-sig: 1.2%  
ModelChiSquareGof-sig: 100.0%  
**Bootstrap-pfa: 1.63e-11**  
RollingBand-fgt: 0.99 [70/71]  
GhostDiagnostic-chr: 1.125  
Centroid-sig: N/A  
Centroid-so: 0.408 arcsec [0.81σ]  
**OotOffset-rm: 1.929 arcsec [3.10σ]**  
**KicOffset-rm: 2.005 arcsec [3.15σ]**  
OotOffset-st: 0/0/1/0 [1]  
KicOffset-st: 0/0/1/0 [1]  
DiffImageQuality-fgm: 0.00 [0/1]  
DiffImageOverlap-fno: 0.00 [0/17]

# TCE 002018906-10, PDC Light Curves

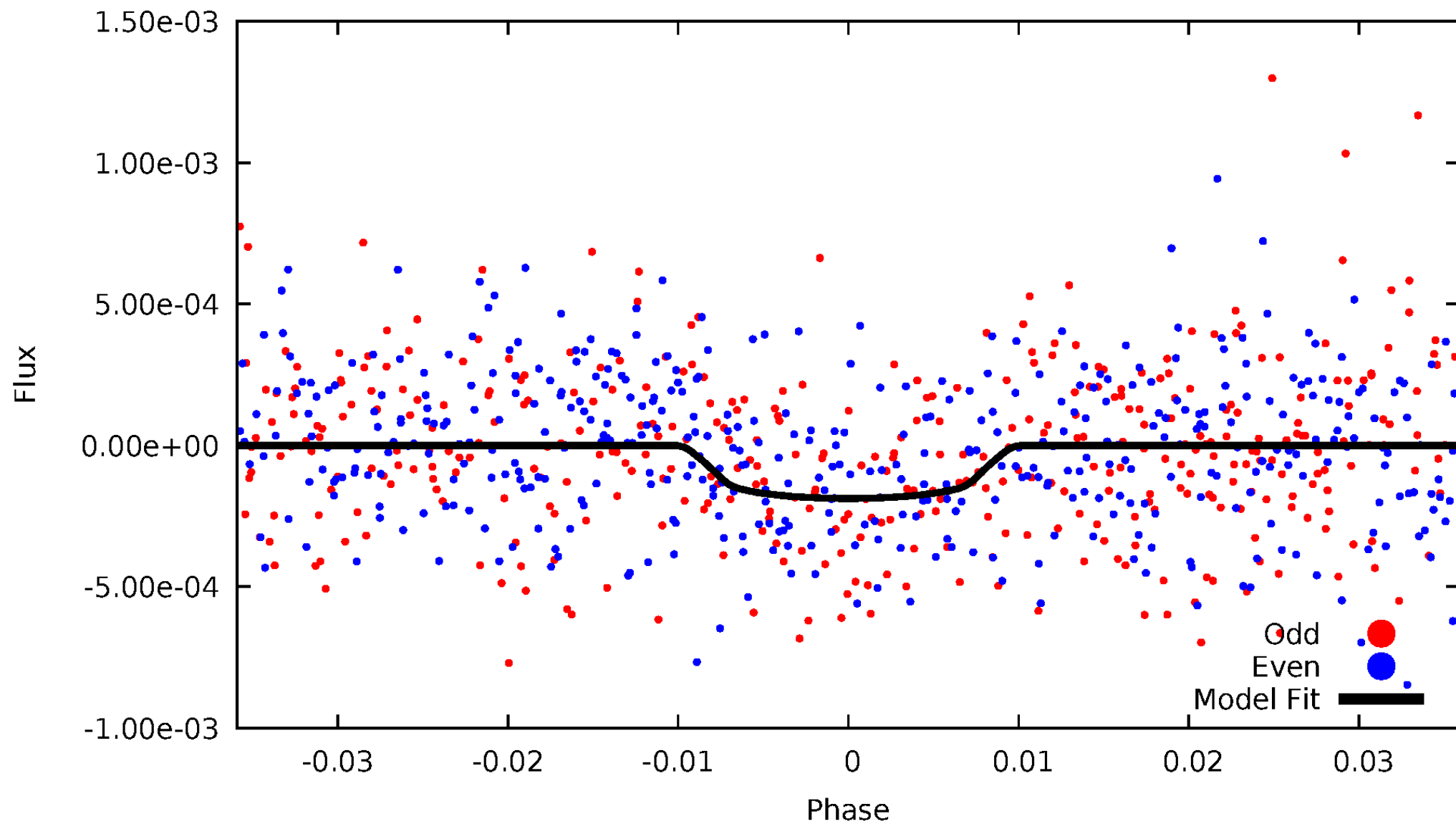


TCE 002018906-10



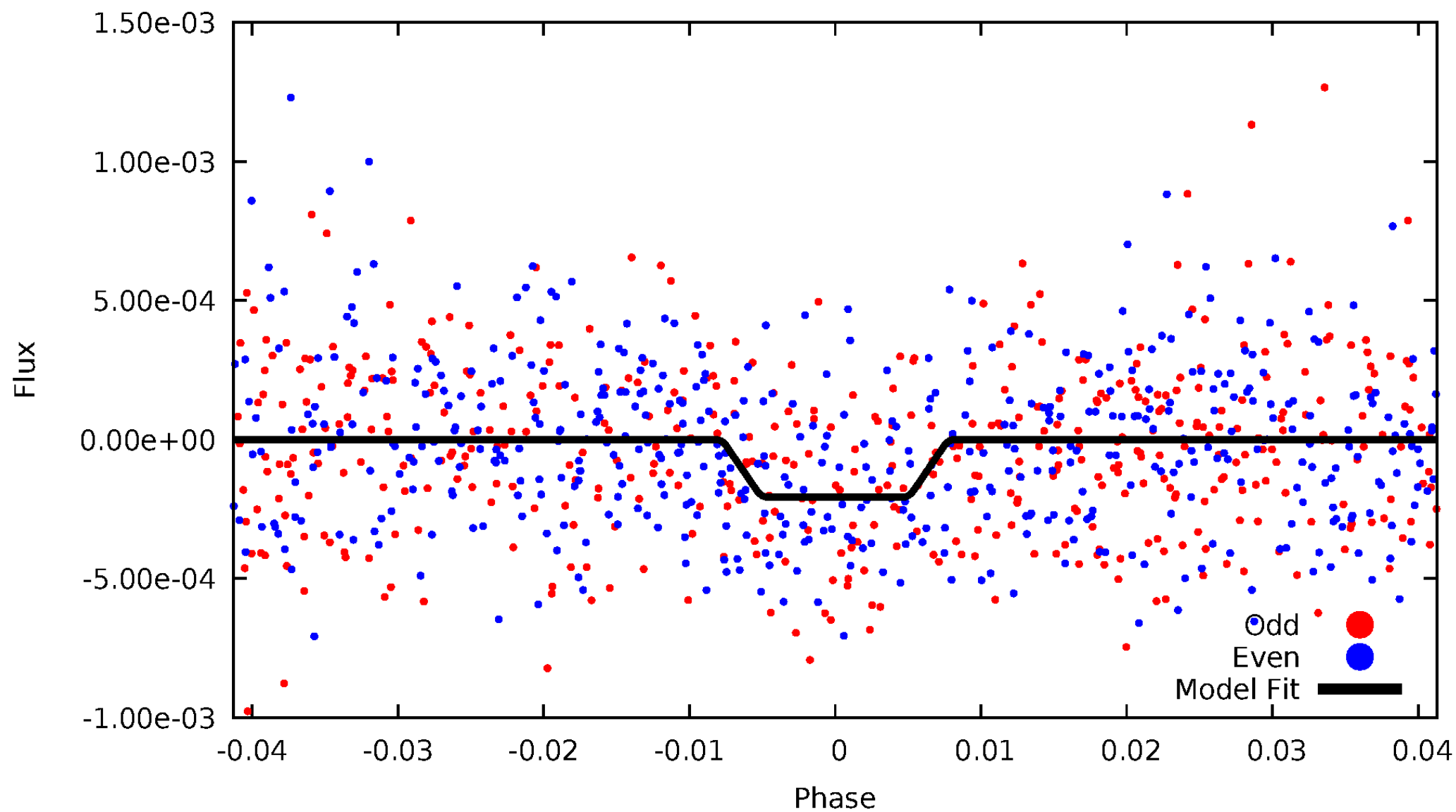
# DV Odd/Even

TCE 002018906-10



# ALT Odd/Even

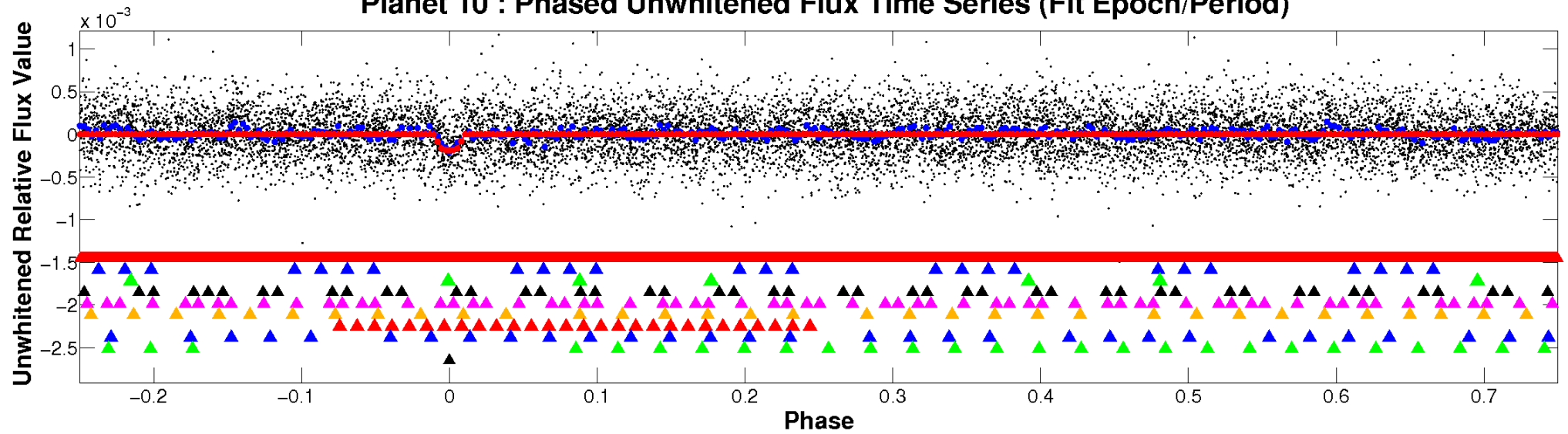
TCE 002018906-10



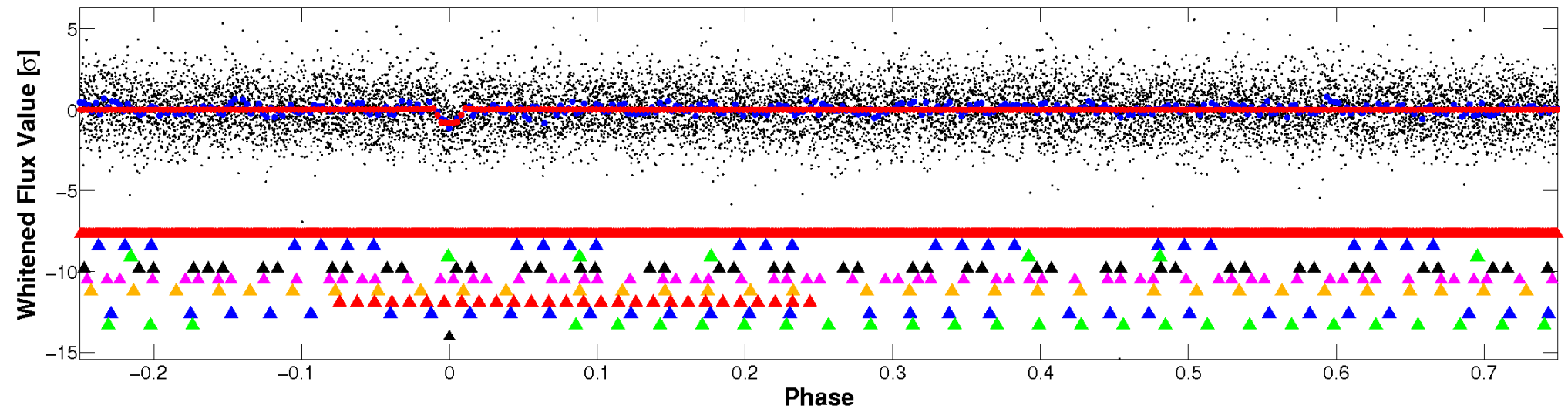


# Non-Whitened Vs. Whitened Light Curve

## Planet 10 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

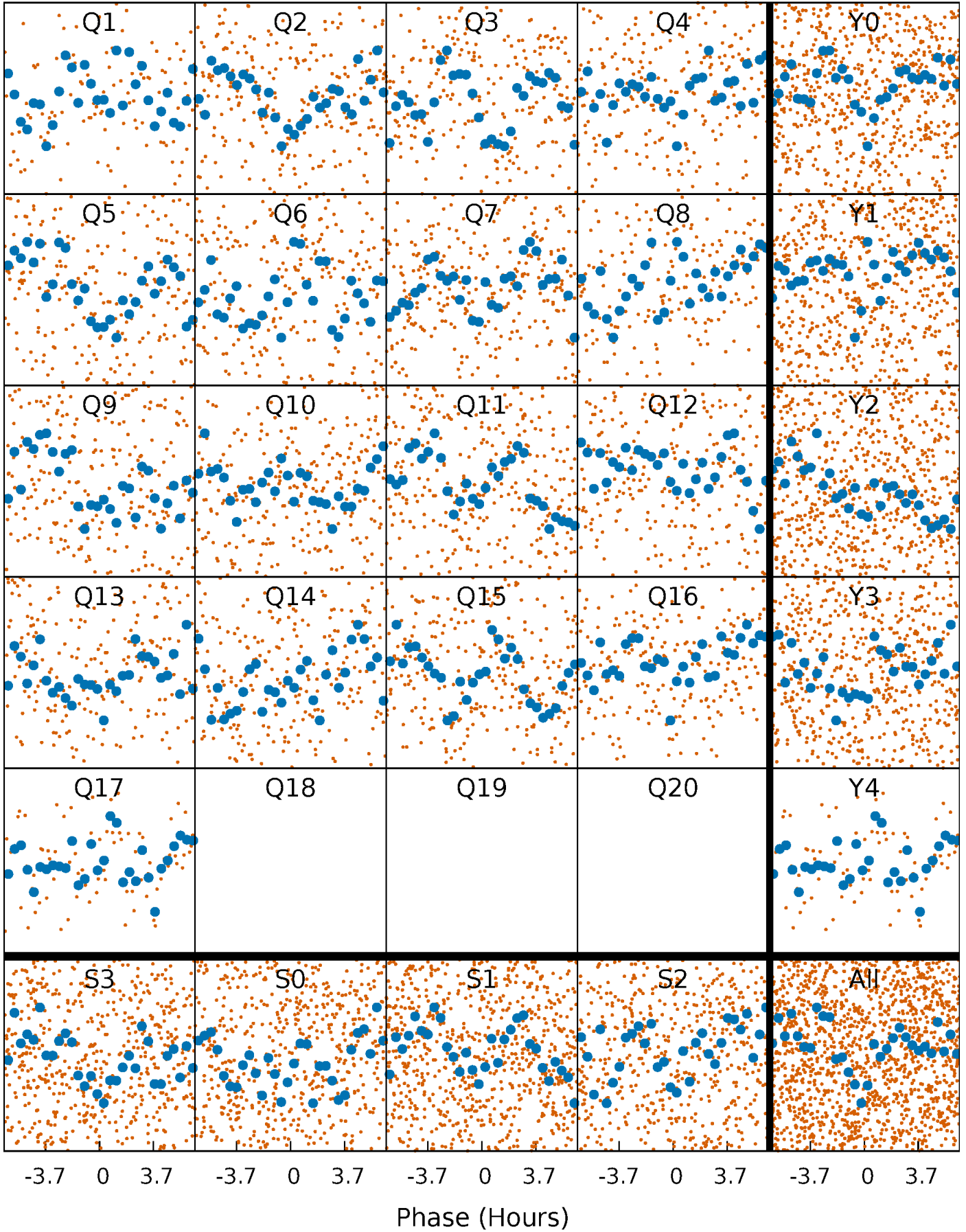


## Planet 10 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

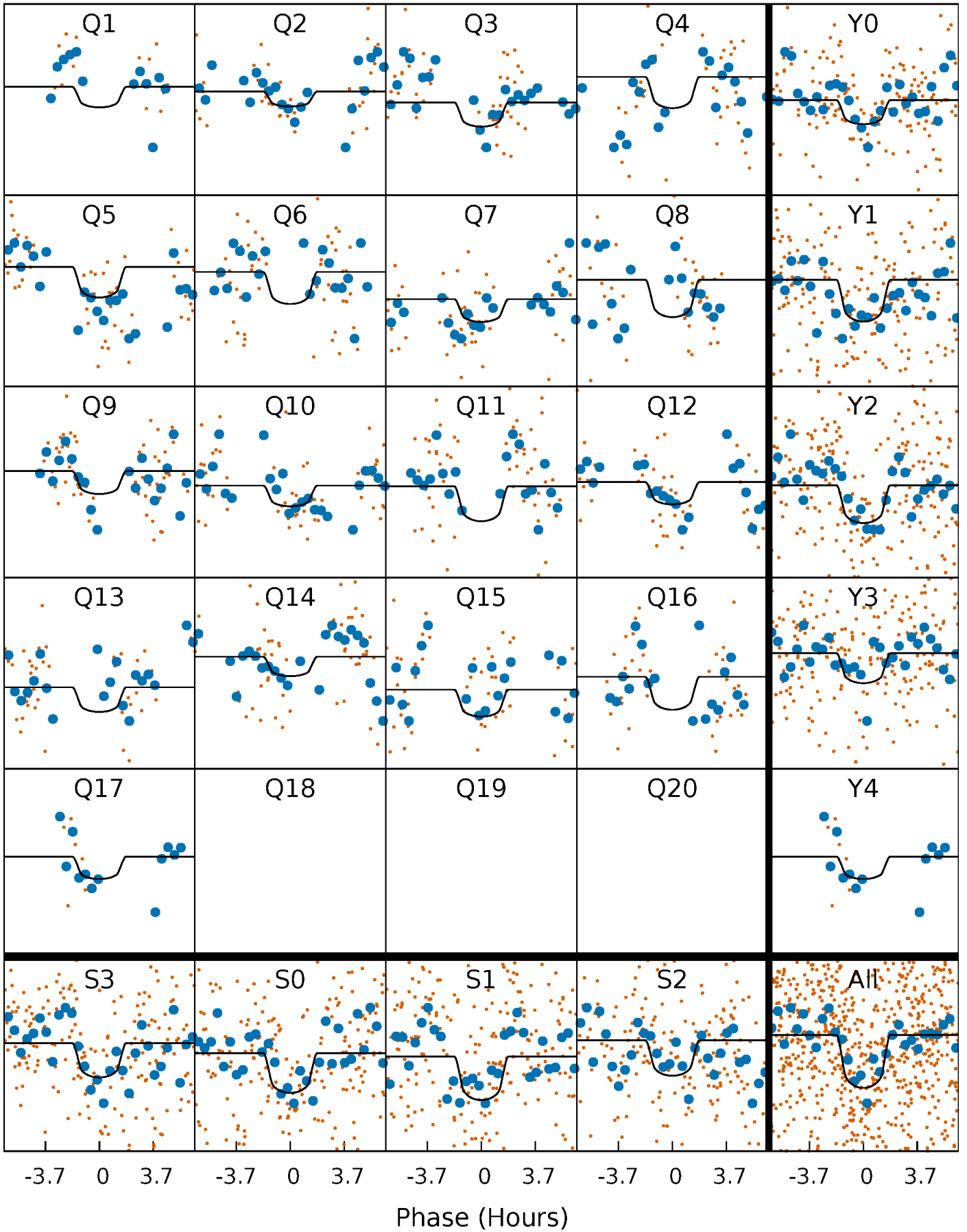
TCE 002018906-10   P= 7.605976 Days    $T_0=131.528571$  (BKJD)





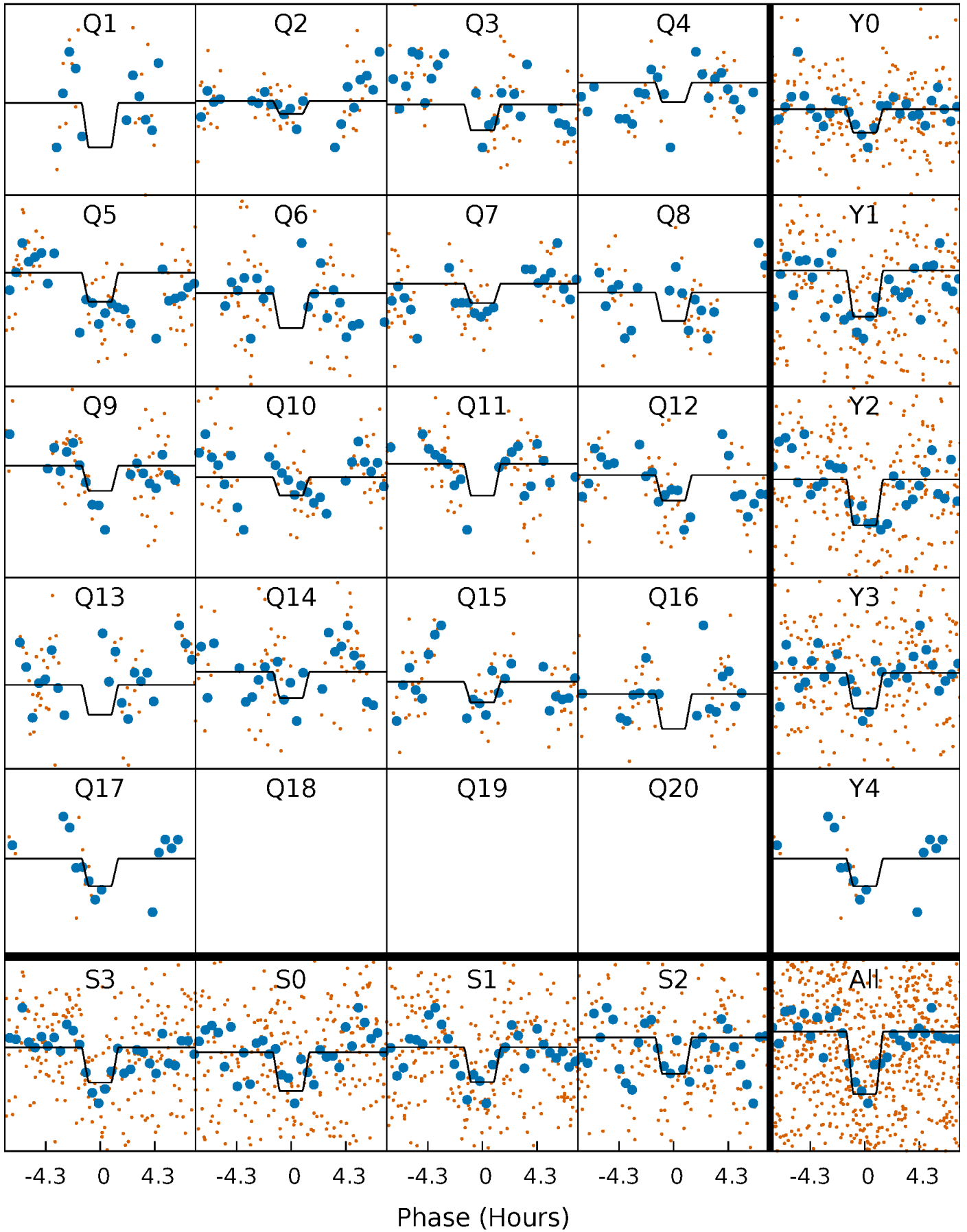
# DV Quarter-Phased Transit Curves

TCE 002018906-10   P= 7.605976 Days    $T_0=131.528571$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

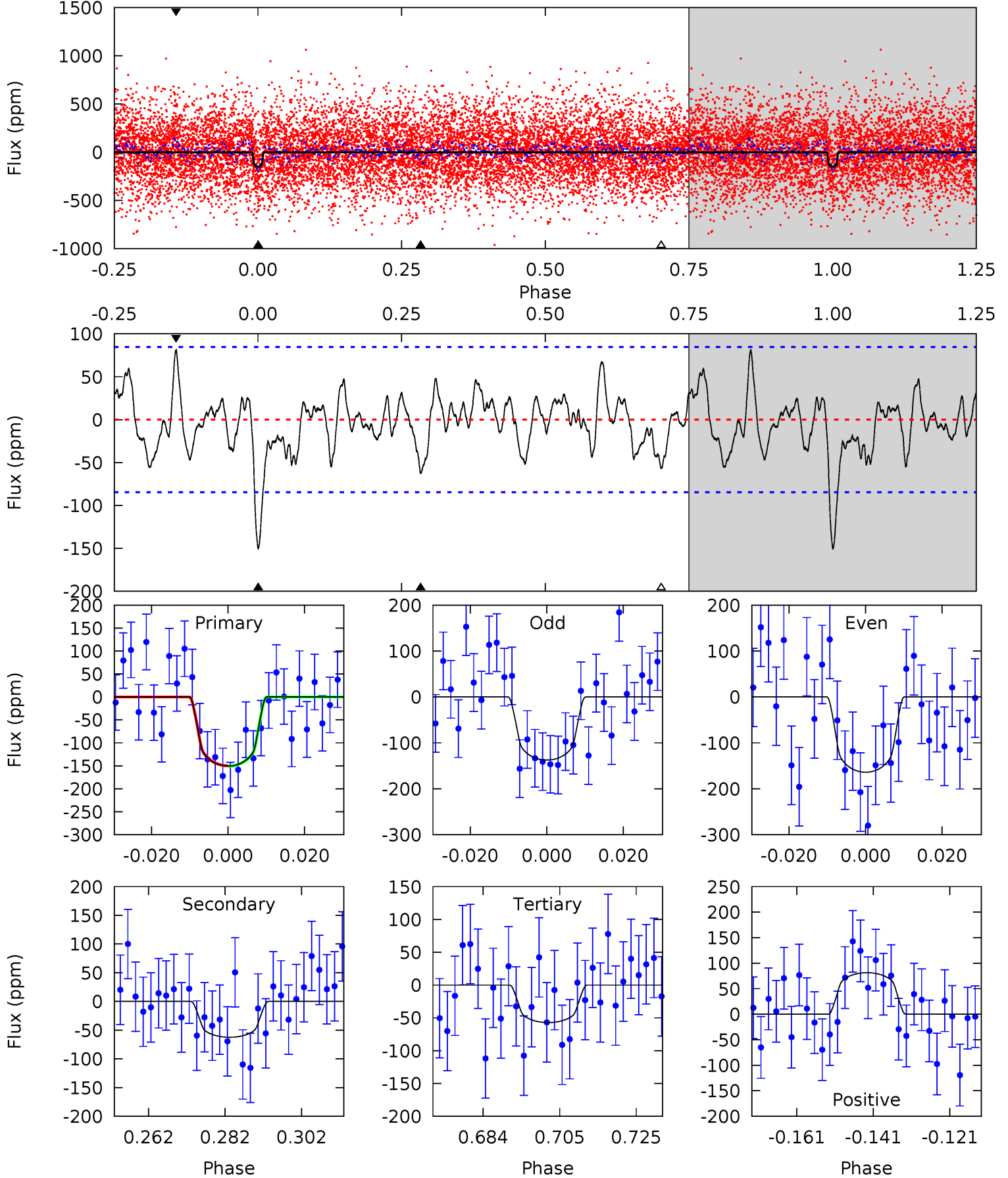
TCE 002018906-10   P= 7.605882 Days    $T_0=131.534946$  (BKJD)



# DV Model-Shift Uniqueness Test

002018906-10, P = 7.605976 Days, E = 131.528571 Days

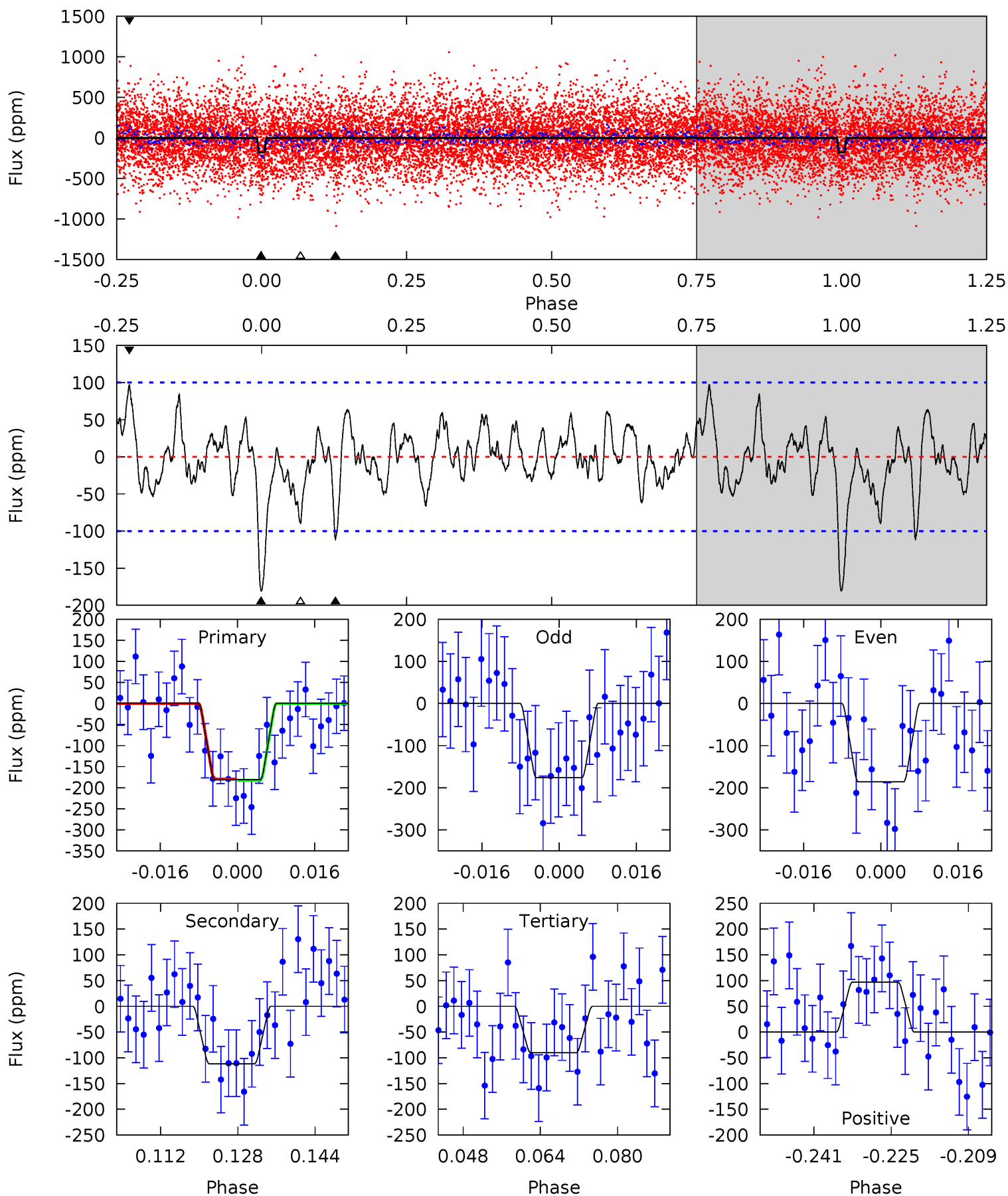
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
8.69	3.61	3.30	4.70	4.89	2.32	1.49	5.39	3.99	0.30	-1.10	0.77	0.90	0.35	0.03



# Alt Model-Shift Uniqueness Test

002018906-10, P = 7.605882 Days, E = 131.534946 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
8.92	5.50	4.45	4.79	4.93	2.41	1.50	4.47	4.13	1.05	0.71	0.24	0.95	0.35	0.07



### Stellar Parameters For KIC 002018906

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R$ ( $R_{\odot}$ )	$M(M_{\odot})$	$p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ )
	$5046^{+127}_{-102}$	$3.303^{+0.310}_{-0.310}$	$-0.540^{+0.300}_{-0.250}$	$3.370^{+1.870}_{-1.007}$	$0.832^{+0.283}_{-0.165}$	$0.031^{+0.053}_{-0.022}$
	+3%/-2%	+9%/-9%	+56%/-46%	+55%/-30%	+34%/-20%	+172%/-72%
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 002018906-10 / KOI

Detrend	Depth (ppm)	$R_p$ ( $R_{\oplus}$ )	$T_{max}$ (K)	$T_{obs}$ (K)	$A_{obs}$
DV	$-62 \pm 17$	$6.14^{+4.70}_{-3.65}$	$2140^{+274}_{-198}$	$3724^{+1464}_{-620}$	$4.475^{+21.647}_{-3.085}$
Alt.	$-111 \pm 20$	$5.75^{+4.29}_{-3.40}$	$2132^{+277}_{-215}$	$4269^{+1898}_{-727}$	$9.561^{+47.443}_{-6.463}$

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

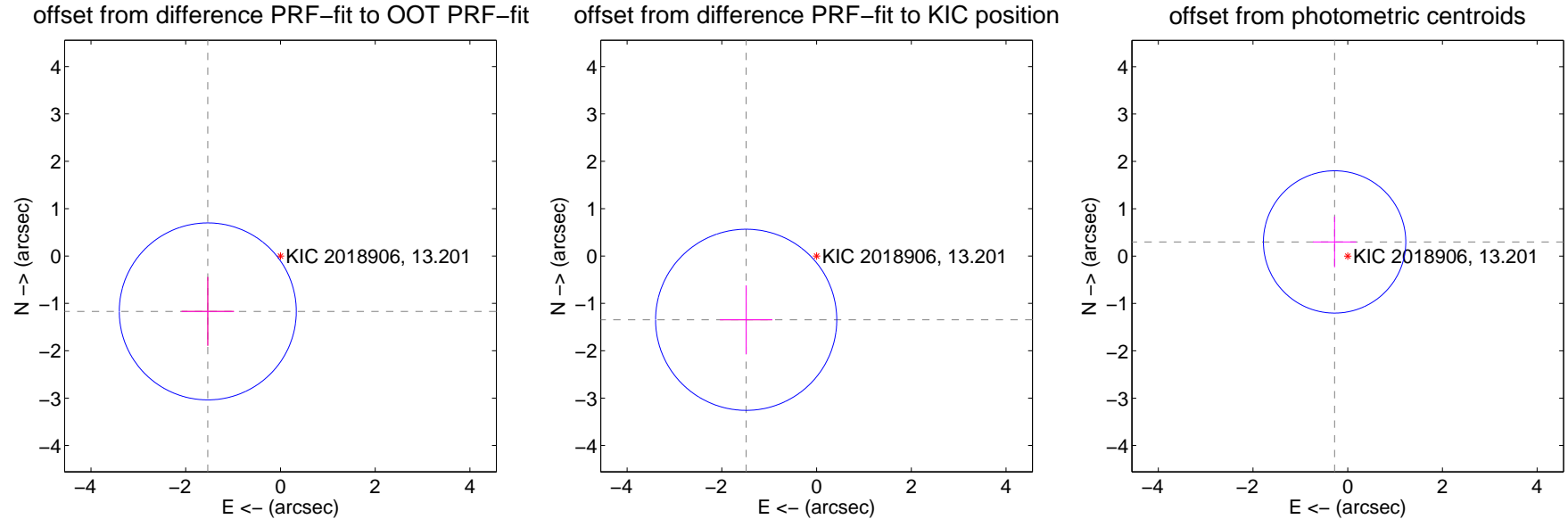
## DV Centroid Data

Supplemental centroid analysis for 002018906-10. Kepler magnitude: 13.20. Transit SNR 10.15

There are 0 quarters with good PRF difference image offsets

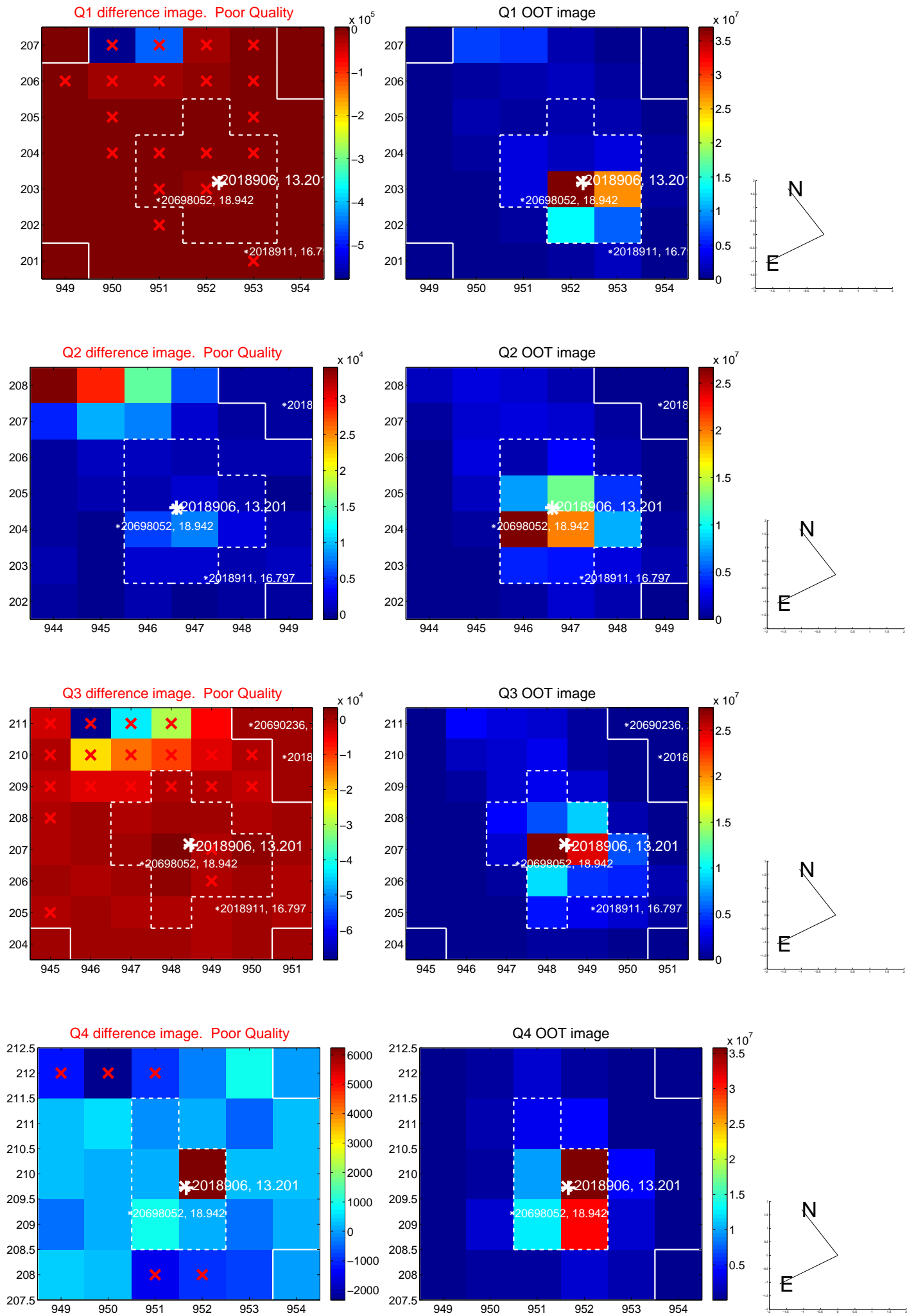
The direct PRF centroid is offset from the target star catalog position by about 0.18 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.929 \pm 0.623$	3.10	$1.534 \pm 0.554$	$-1.169 \pm 0.726$
PRF-fit source offset from KIC position	$2.005 \pm 0.637$	3.15	$1.486 \pm 0.554$	$-1.347 \pm 0.726$
photometric centroid source offset	$0.41 \pm 0.50$	0.81	$0.28 \pm 0.46$	$0.30 \pm 0.54$



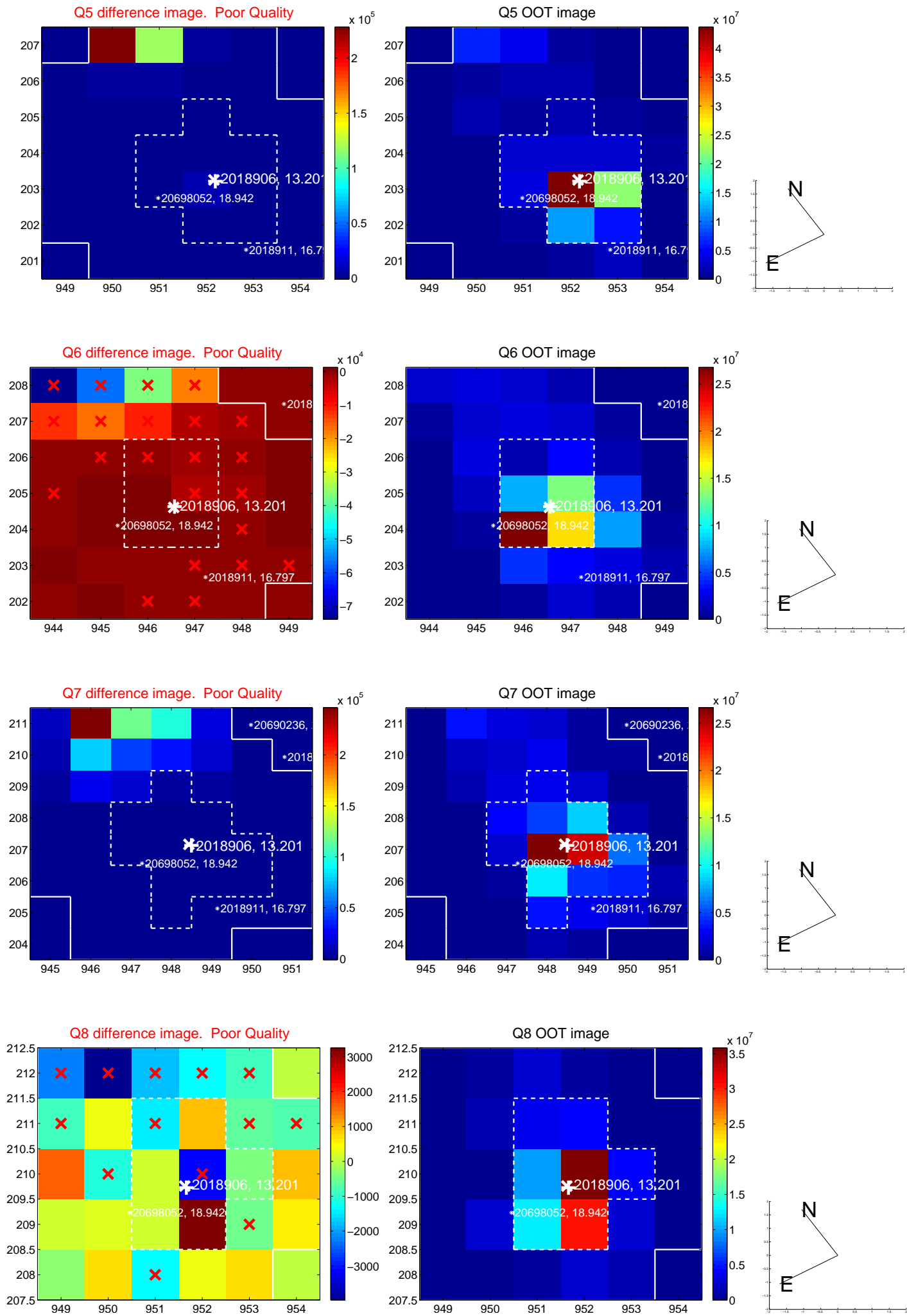
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

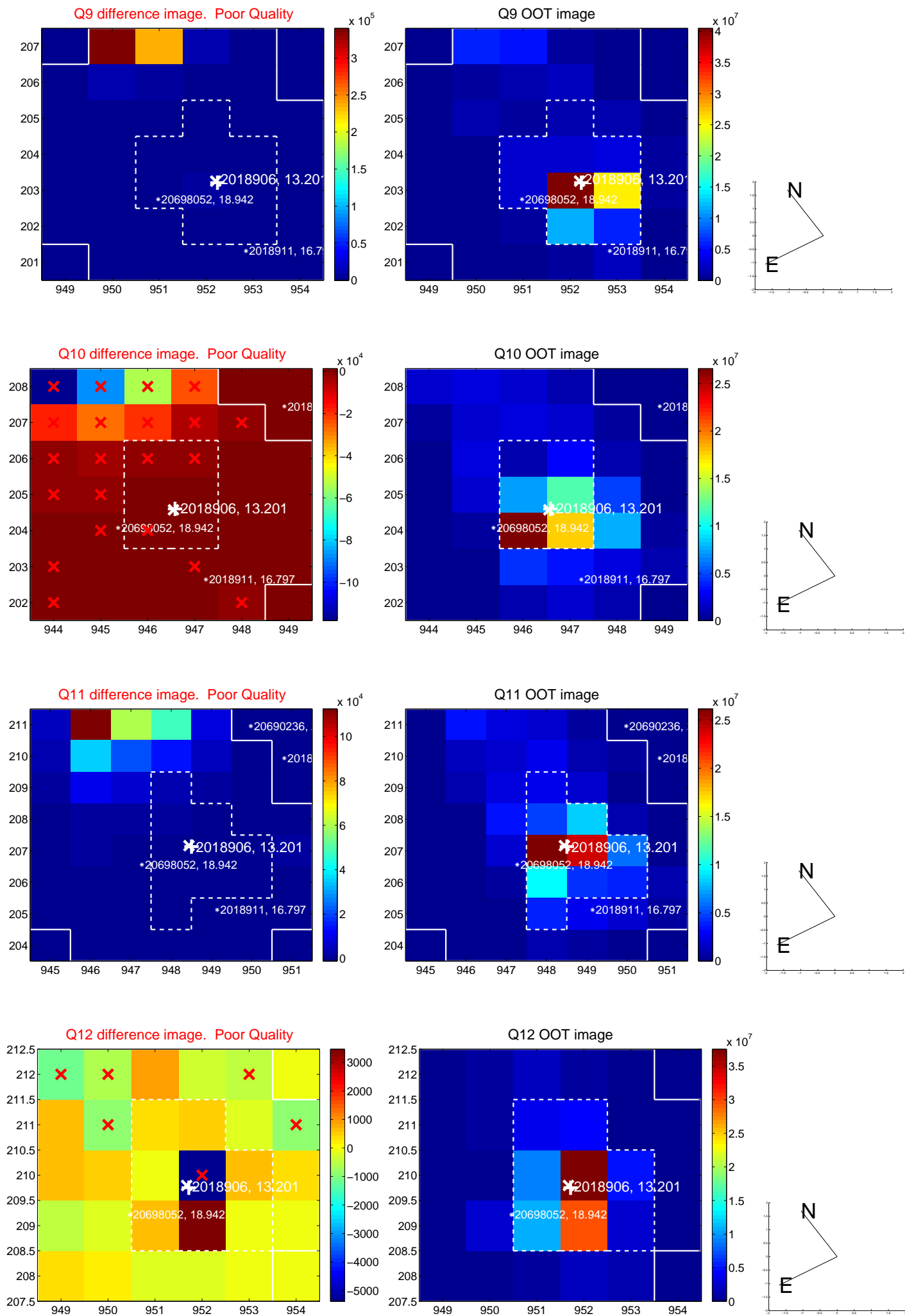




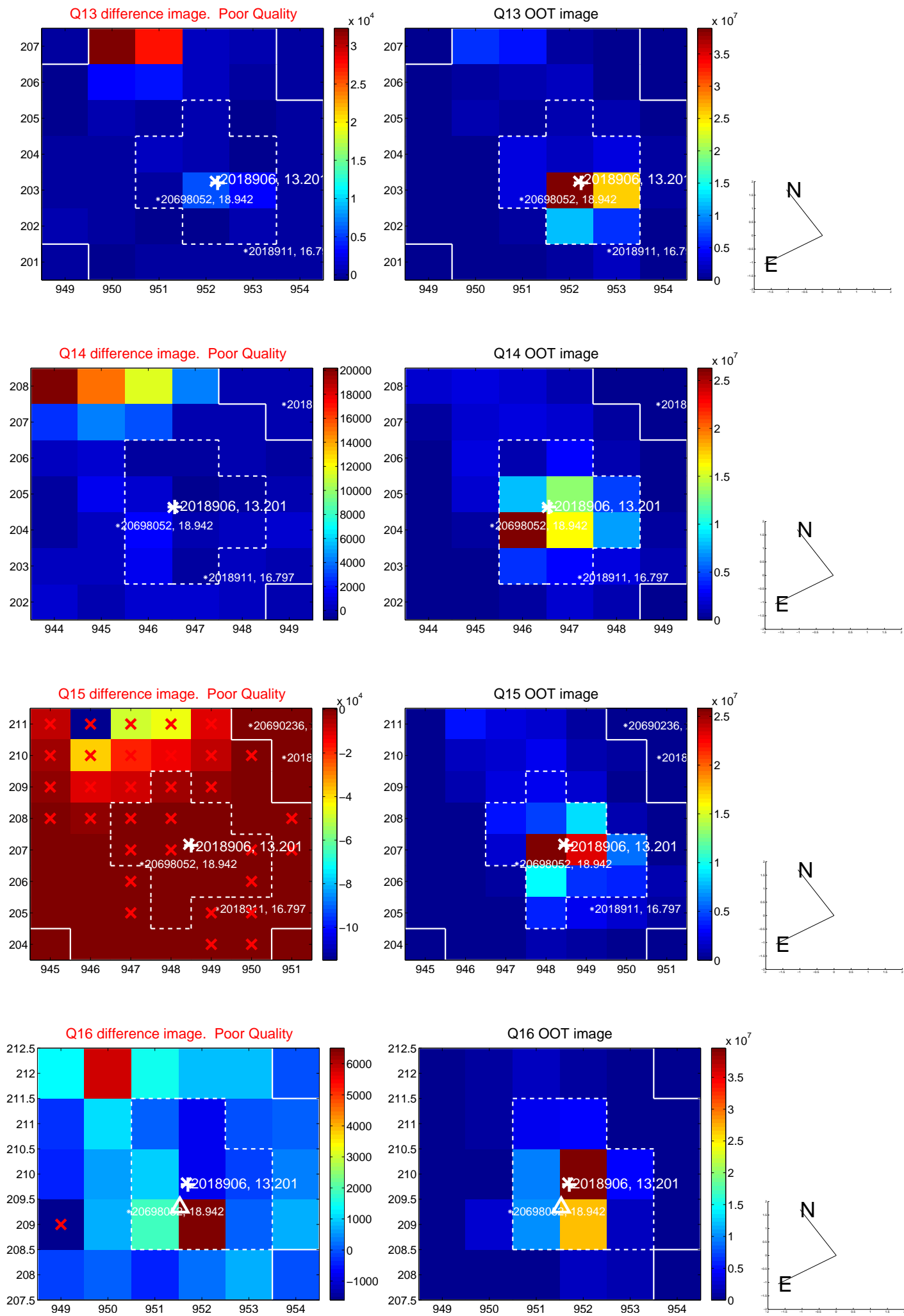
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



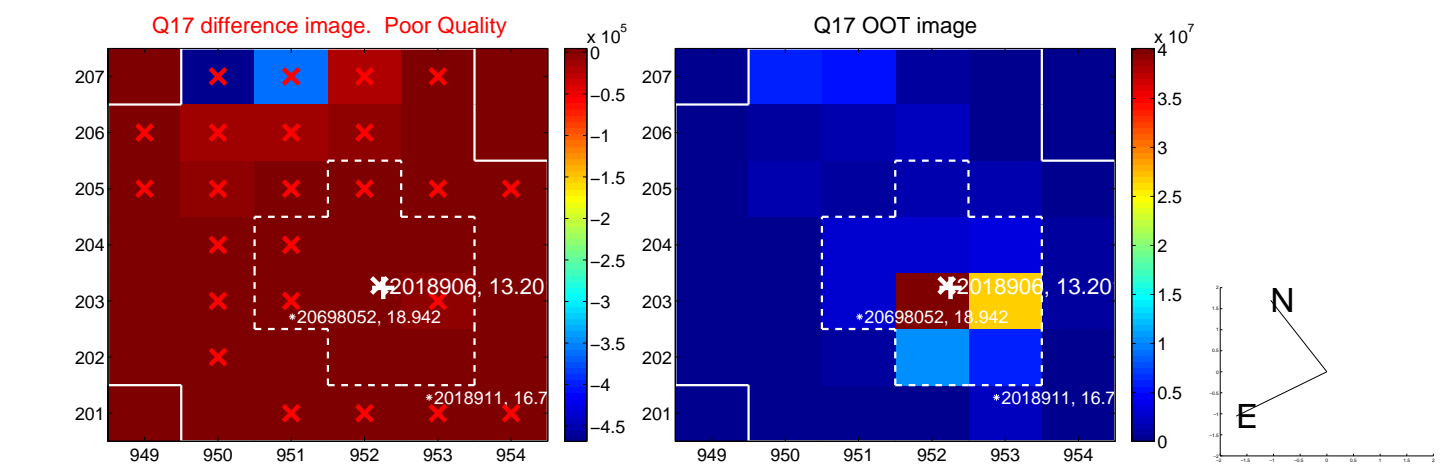
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



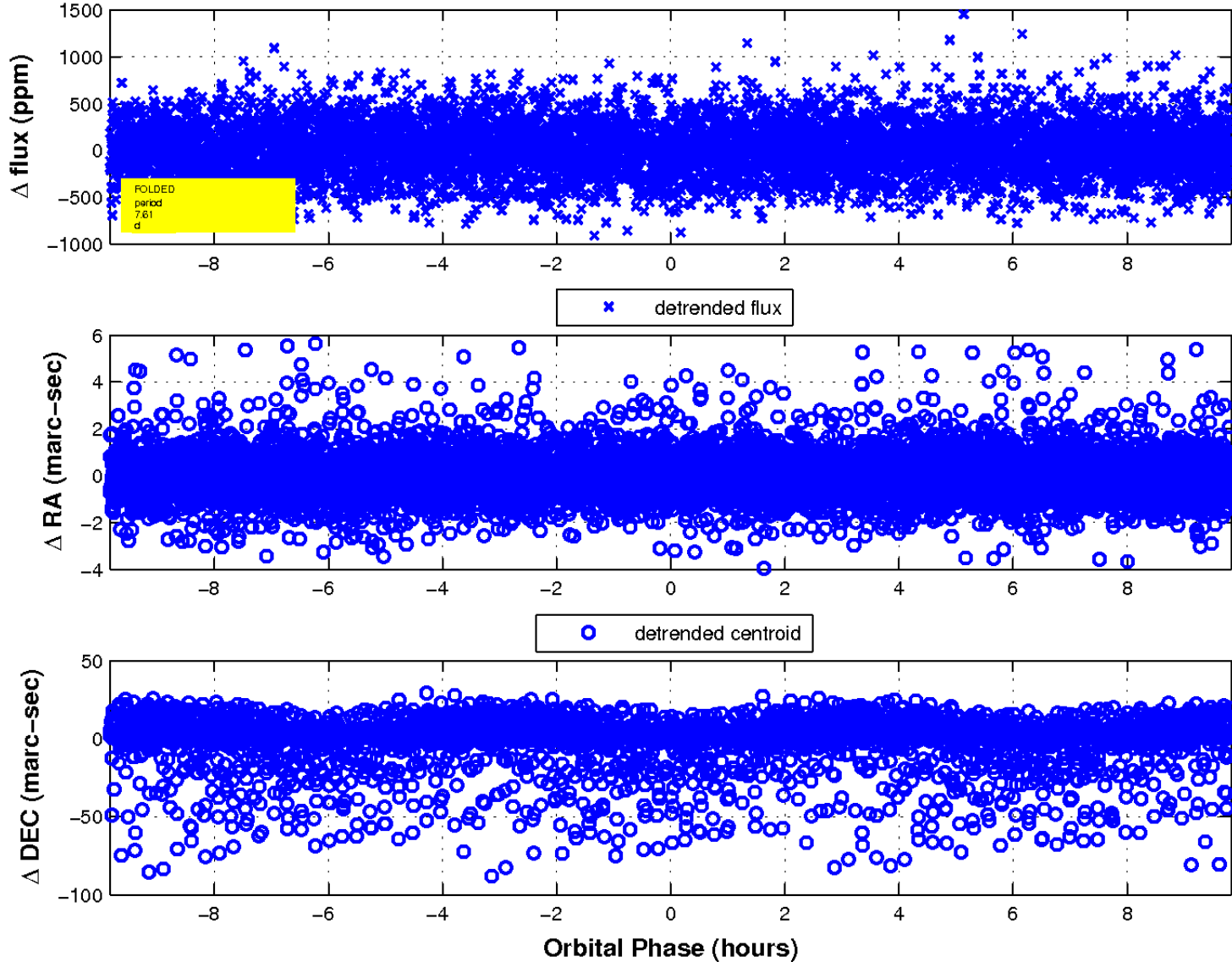
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 10 of 10



UKIRT Image

Declination

