

# KIC 005106731

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
005106731-01	OBS	No	492.120079	517.569402	1224.1	3.393	17.1	7.9	1.63	5343	5.70	1.44
005106731-02	OBS	No	462.923838	328.868886	993.3	6.671	13.1	5.2	1.63	5343	5.35	1.56
005106731-03	OBS	No	207.838324	304.698473	792.7	2.779	12.9	5.7	1.63	5343	4.96	4.54
005106731-04	OBS	No	388.173766	359.493346	1010.2	3.971	11.2	7.3	1.63	5343	5.51	1.97

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
005106731-01	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES_MARSHALL_ZUMA—LPP_DV—ALL_TRANS_CHASES—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS
005106731-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS
005106731-03	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_CHASES_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS—HALO_GHOST
005106731-04	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_CHASES_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS

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

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

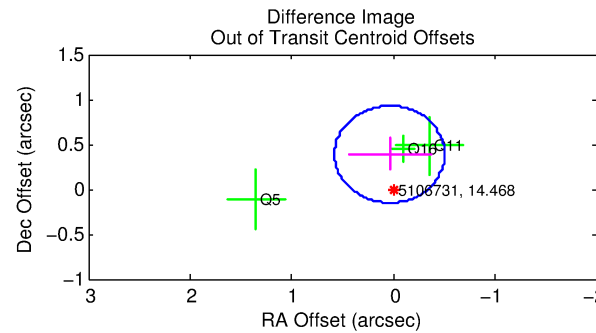
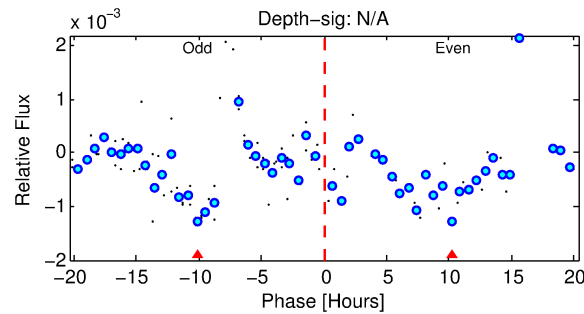
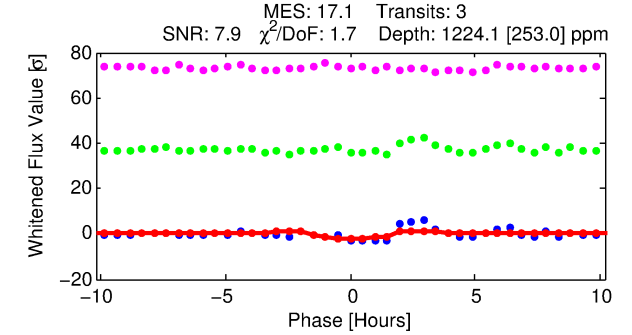
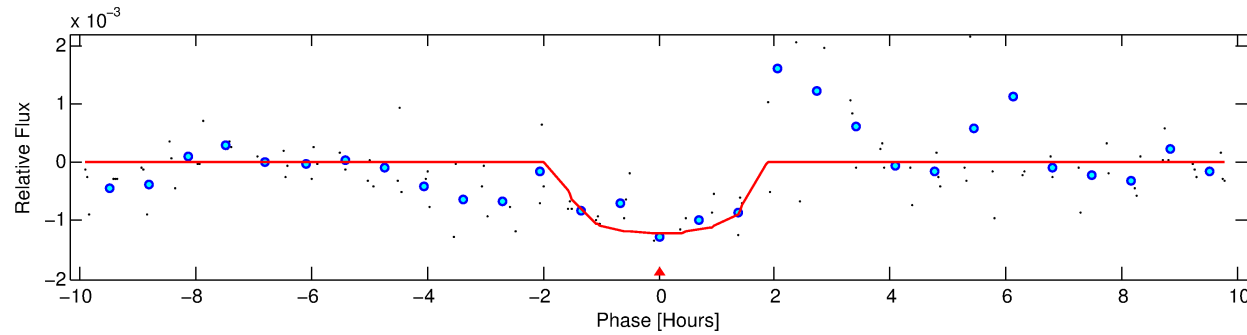
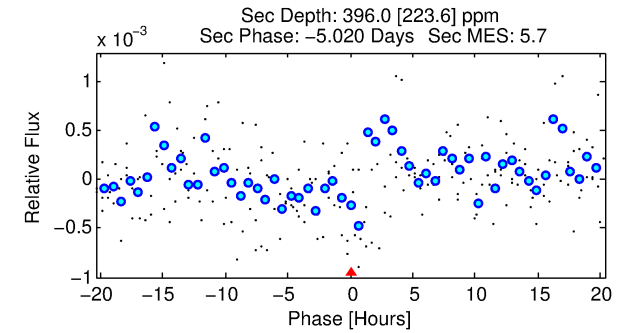
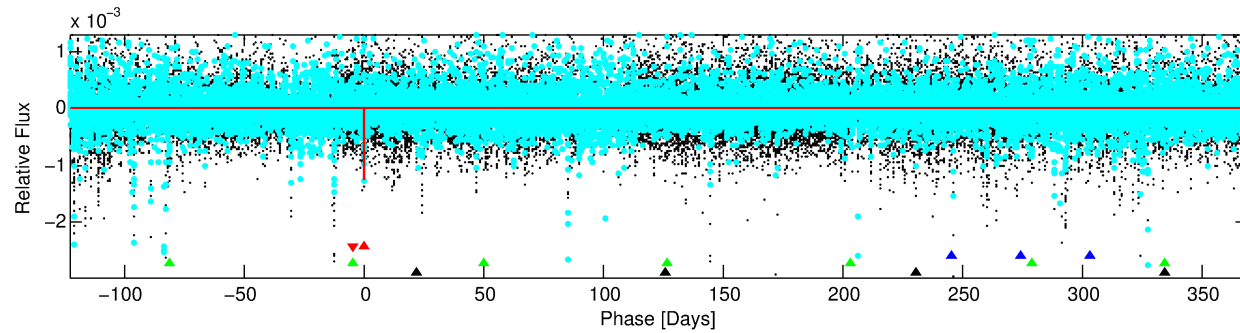
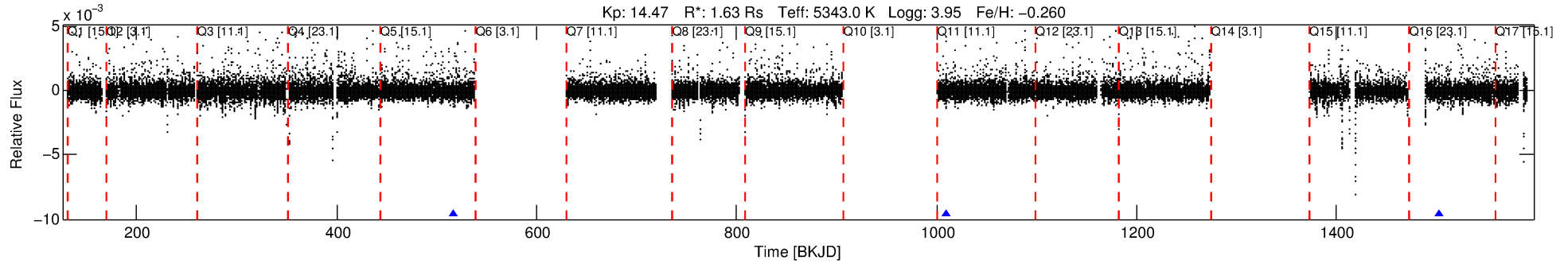
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 005106731-01

No Significant Match Found

# DV One-Page Summary

KIC: 5106731 Candidate: 1 of 4 Period: 492.120 d



## DV Fit Results:

Period = 492.12008 [0.00645] d  
Epoch = 517.5694 [0.0090] BKJD  
Rp/R\* = 0.0320 [0.0817]  
a/R\* = 1071.55 [10736.02]  
b = 0.36 [24.48]  
Seff = 1.44 [1.56]  
Teq = 279 [76] K  
Rp = 5.70 [14.87] Re  
a = 1.1625 [0.7272] AU  
Ag = 9062.58 [47530.45] [0.19 $\sigma$ ]  
Teffp = 4212 [5406] K [0.73 $\sigma$ ]

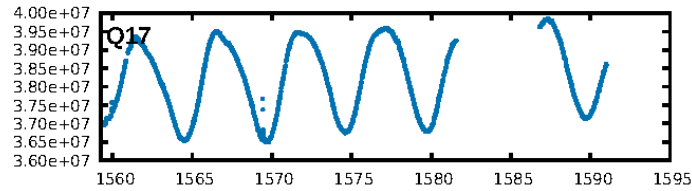
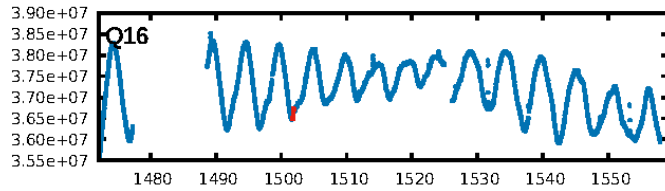
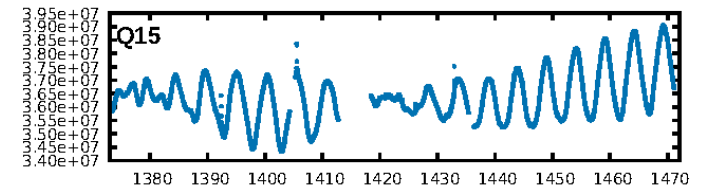
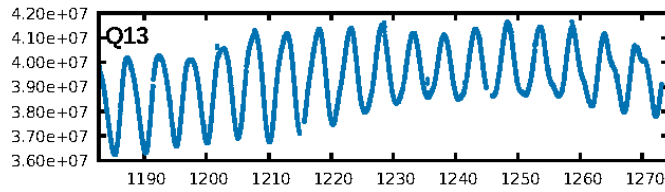
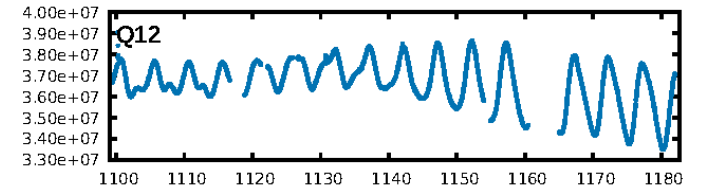
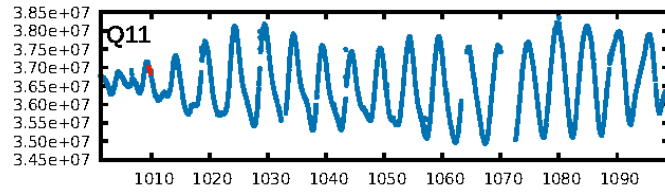
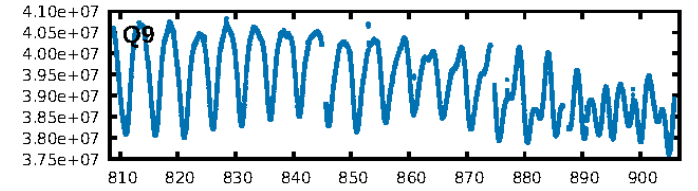
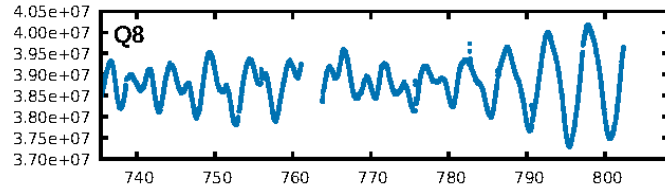
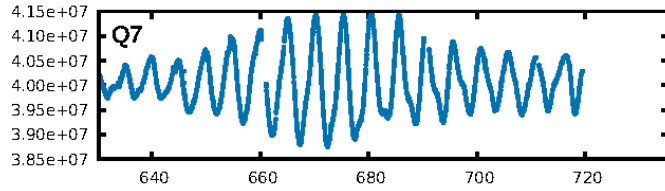
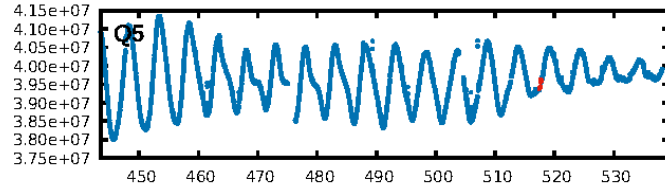
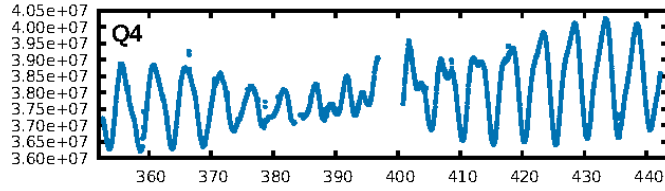
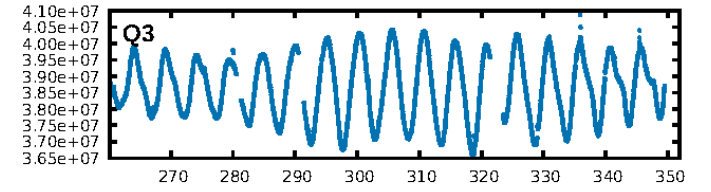
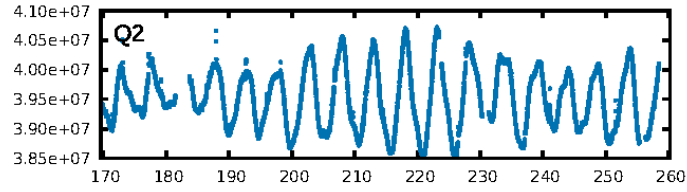
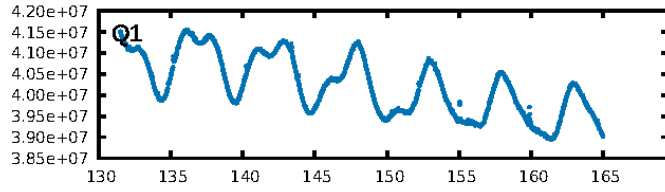
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [93.62 $\sigma$ ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 37.4%  
Bootstrap-pfa: 6.42e-17  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: 0.6342  
Centroid-sig: 16.1%  
Centroid-so: 2.284 arcsec [1.07 $\sigma$ ]  
OotOffset-rm: 0.390 arcsec [2.17 $\sigma$ ]  
OotOffset-st: 0/1/1/1 [3]  
KicOffset-rm: 0.026 arcsec [0.10 $\sigma$ ]  
KicOffset-st: 0/1/1/1 [3]  
DiffImageQuality-fgm: 1.00 [3/3]  
DiffImageOverlap-fno: 1.00 [3/3]

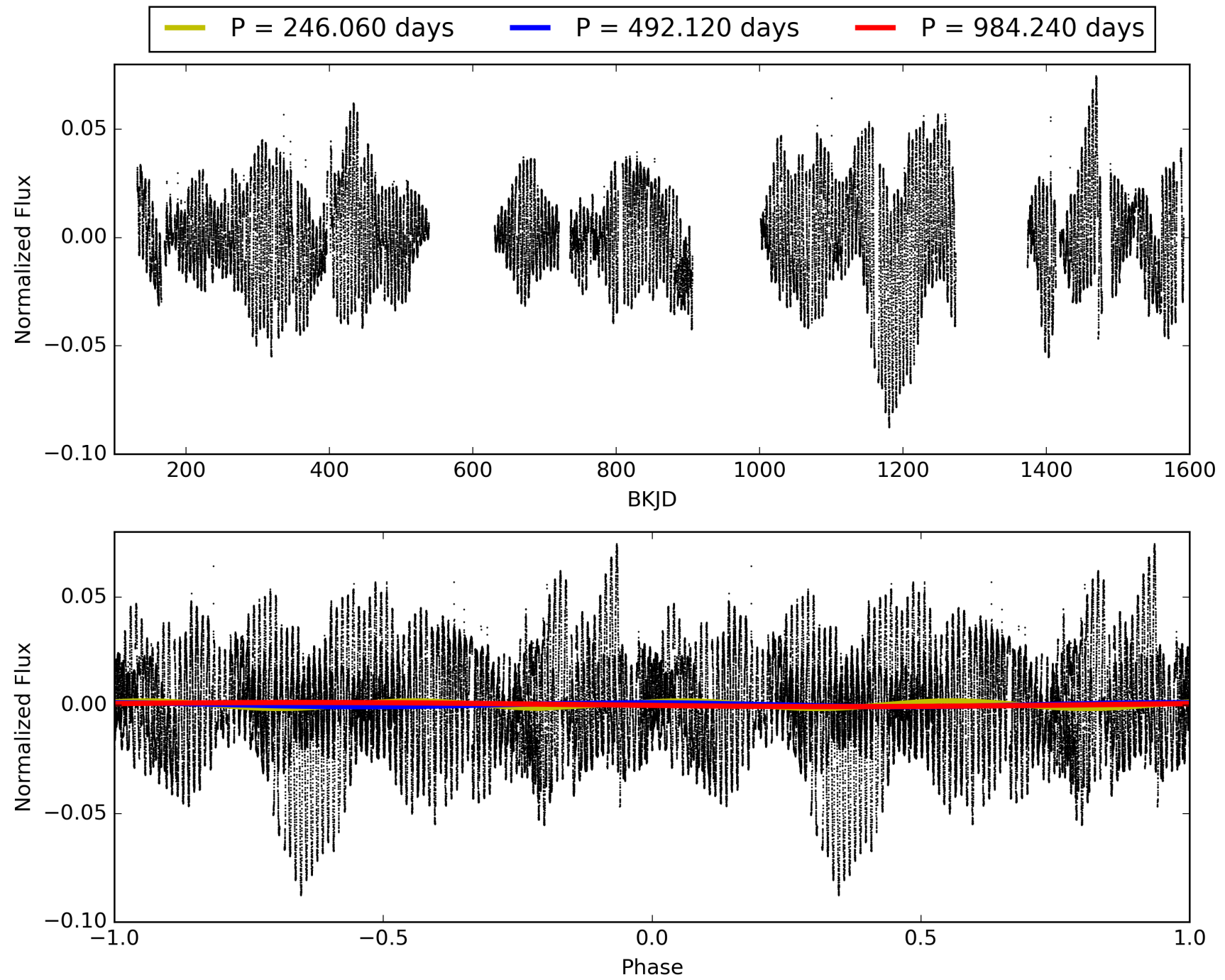
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This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 005106731-01, PDC Light Curves

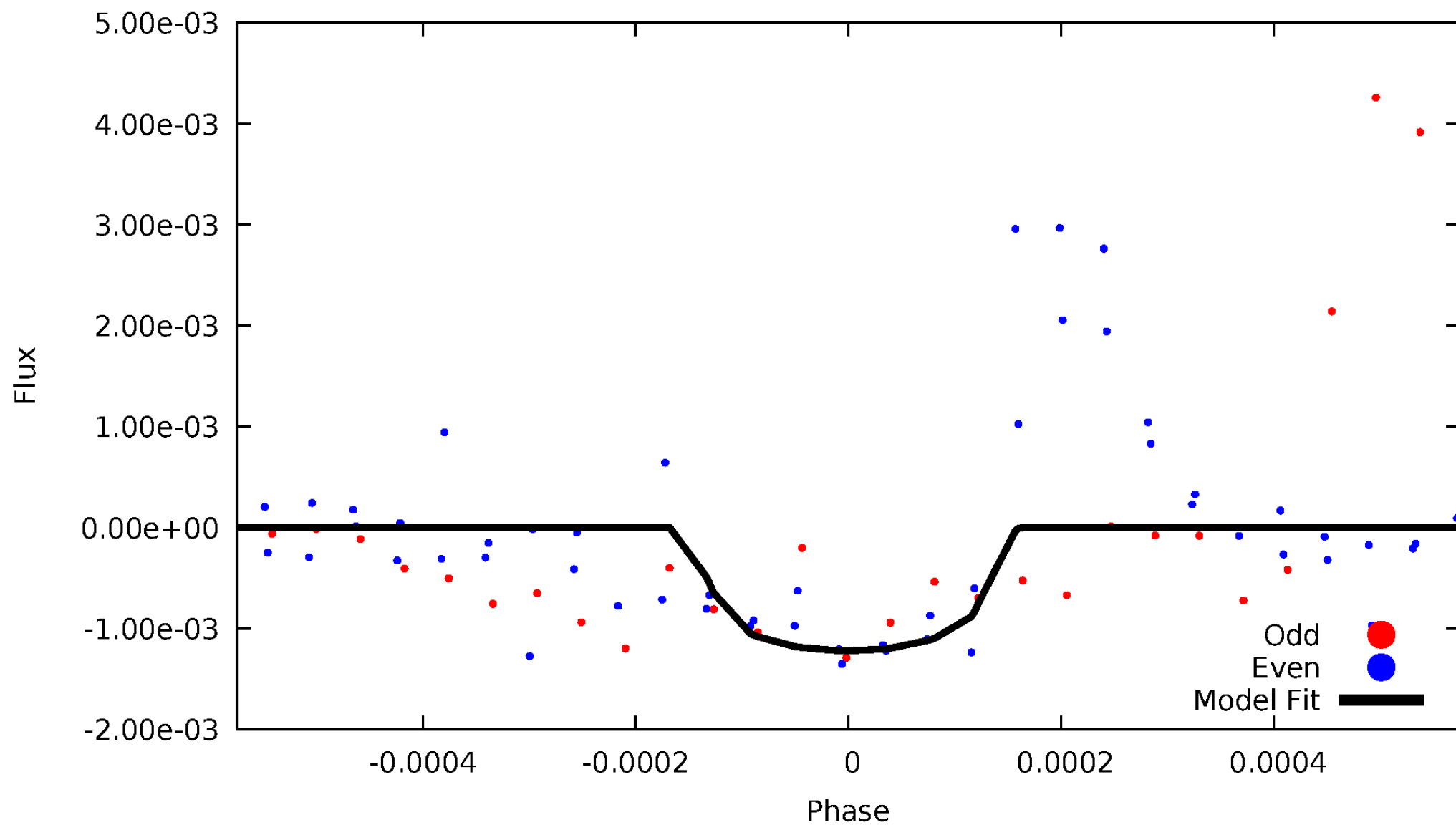


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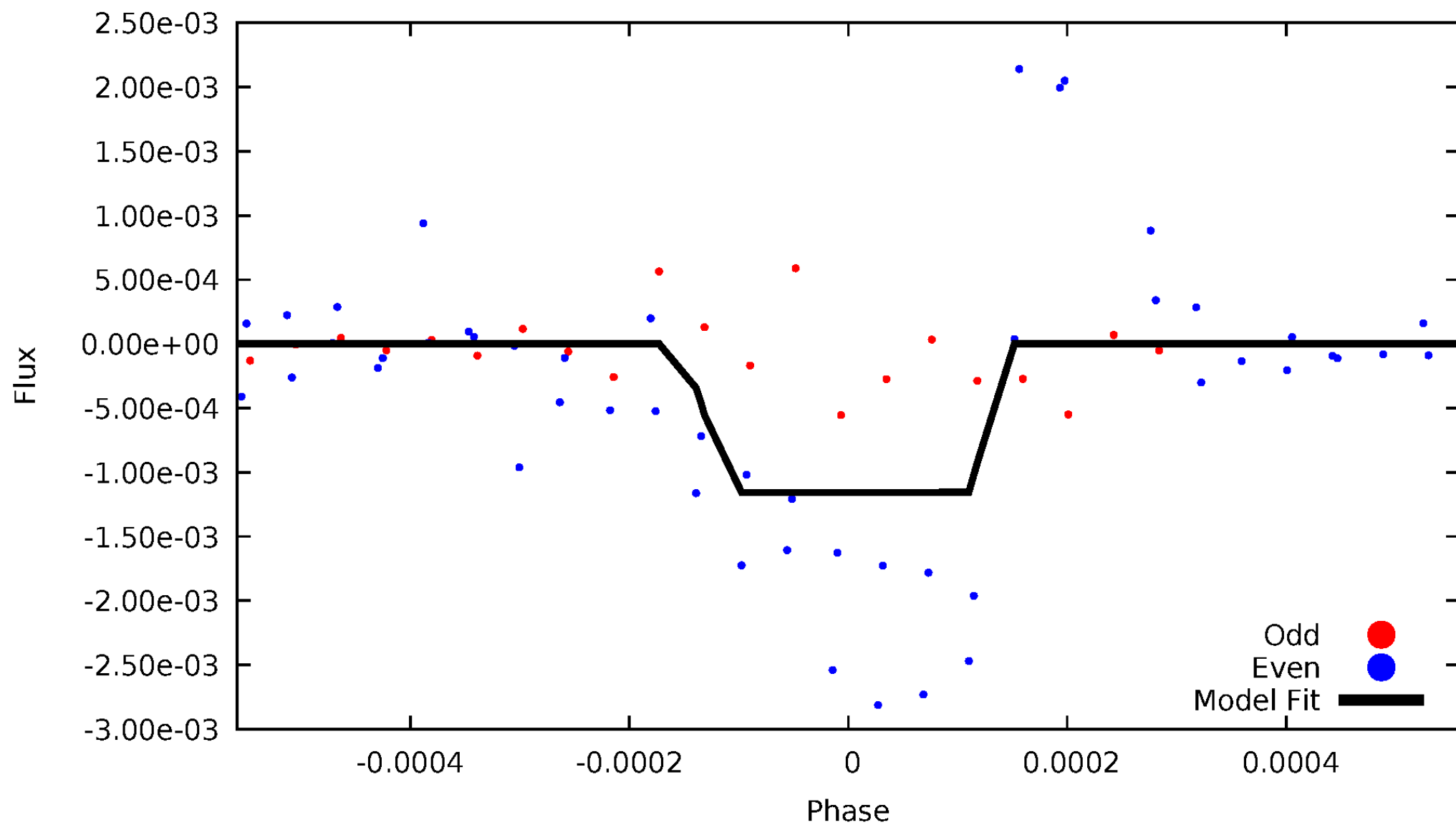
# DV Odd/Even

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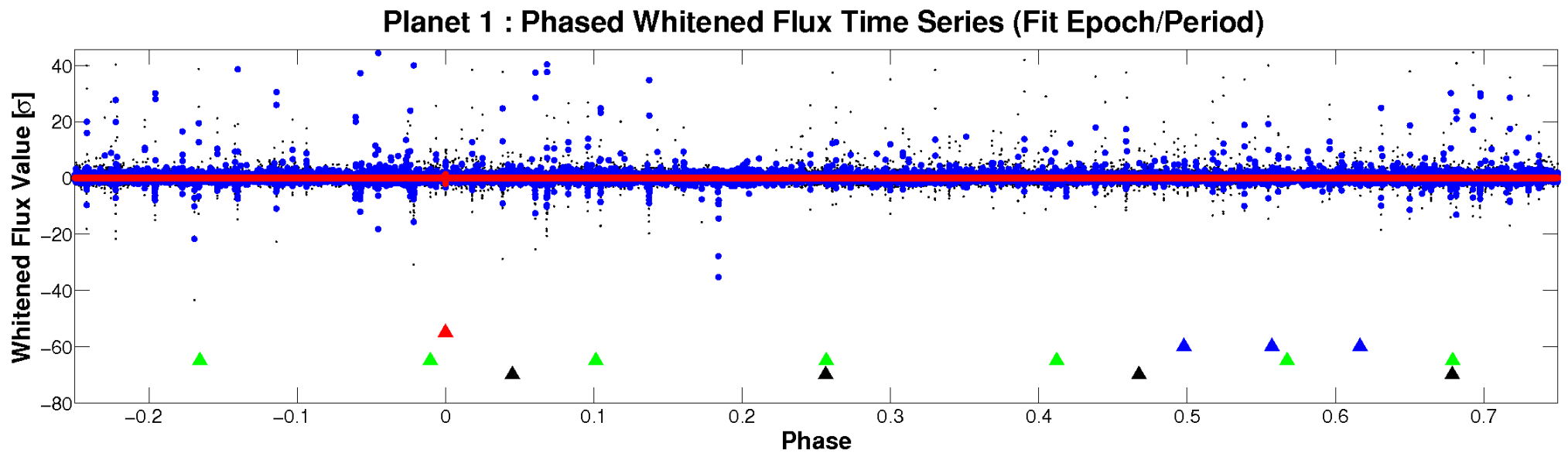
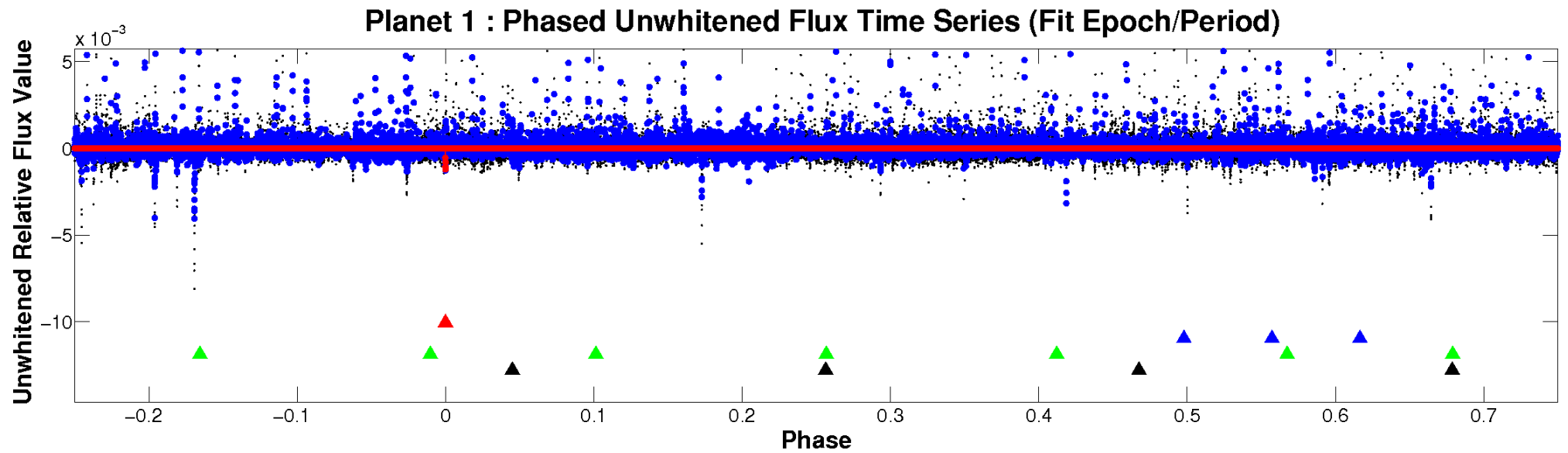


# ALT Odd/Even

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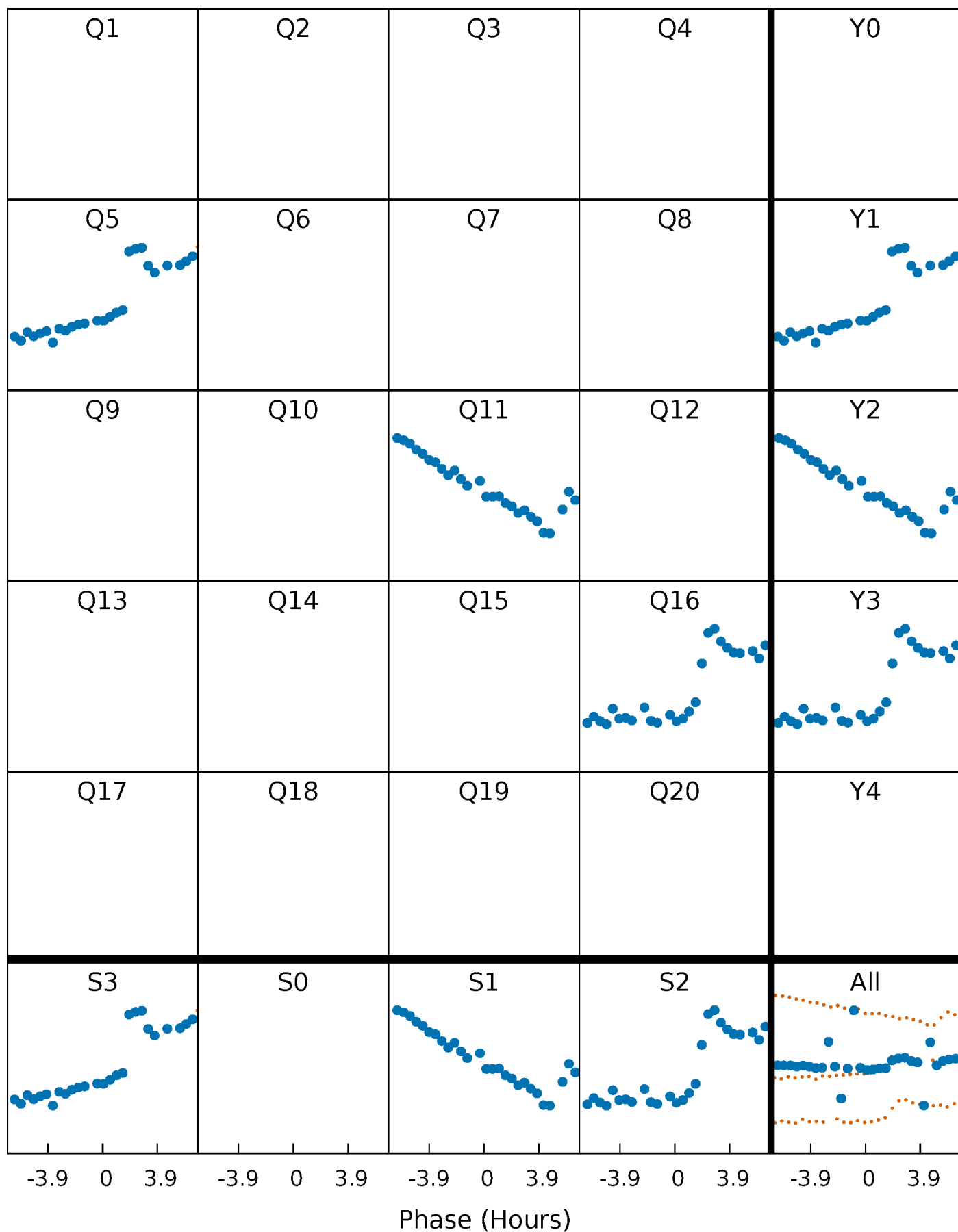


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

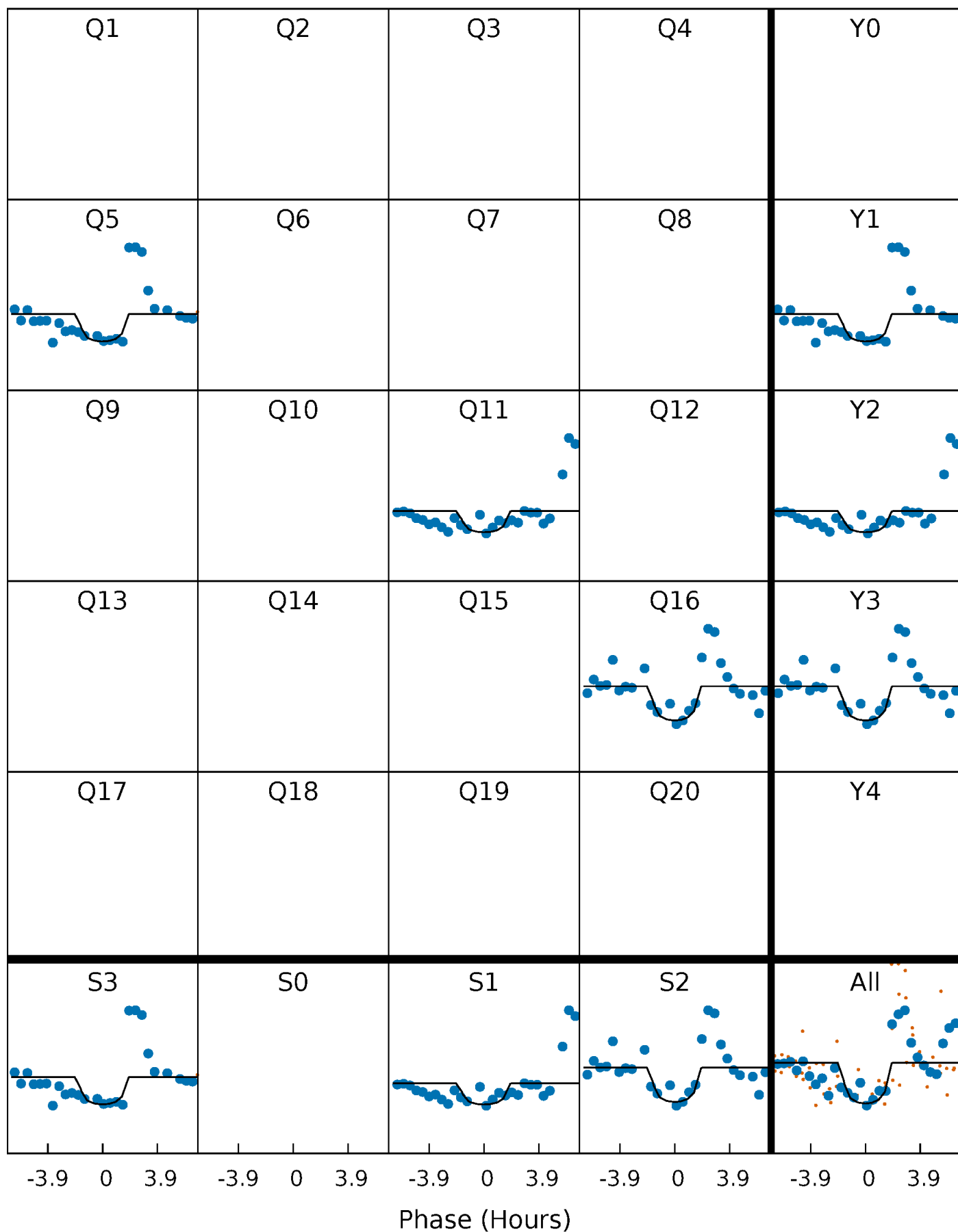
TCE 005106731-01 P=492.120079 Days  $T_0=517.569402$  (BKJD)





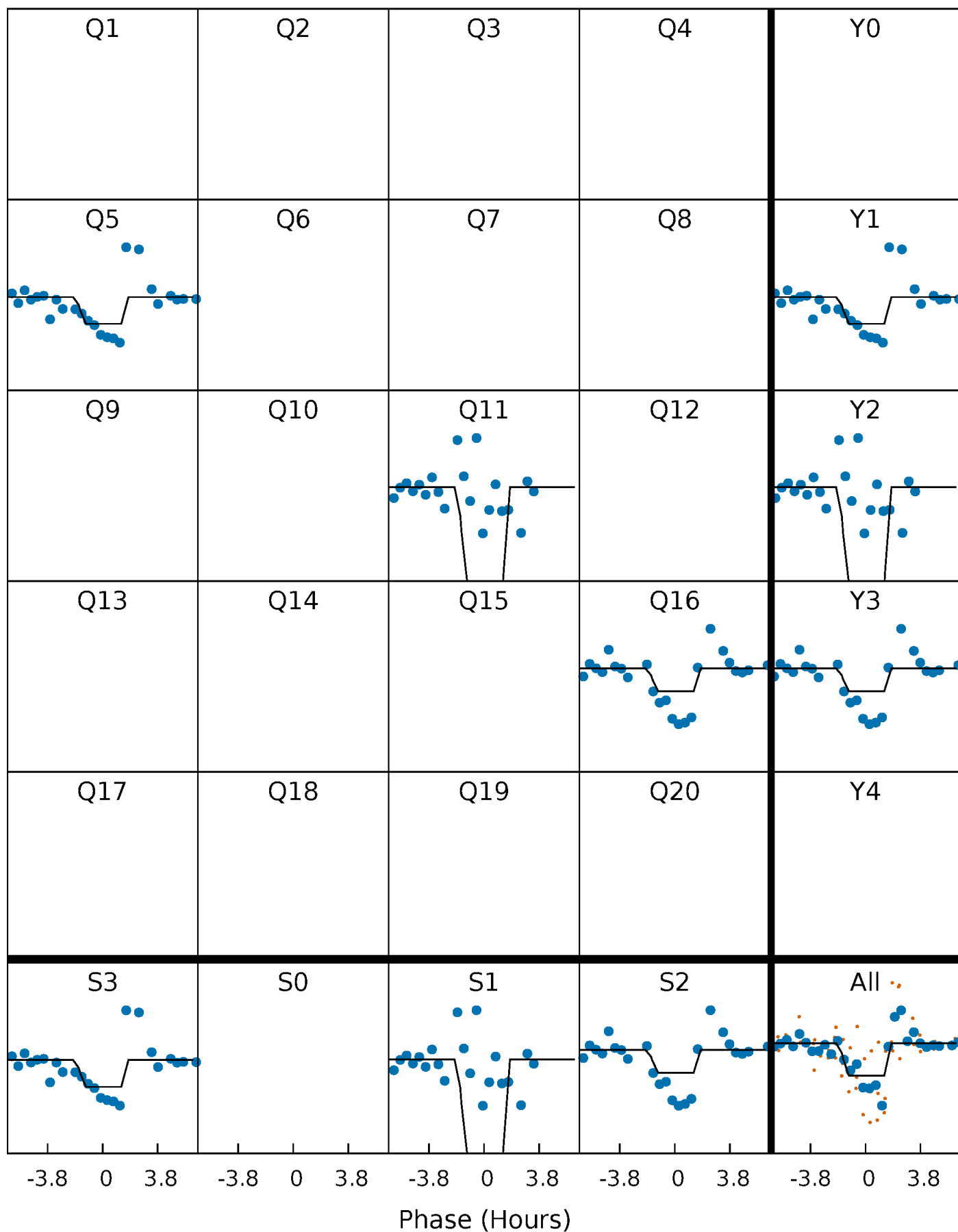
# DV Quarter-Phased Transit Curves

TCE 005106731-01 P=492.120079 Days  $T_0=517.569402$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

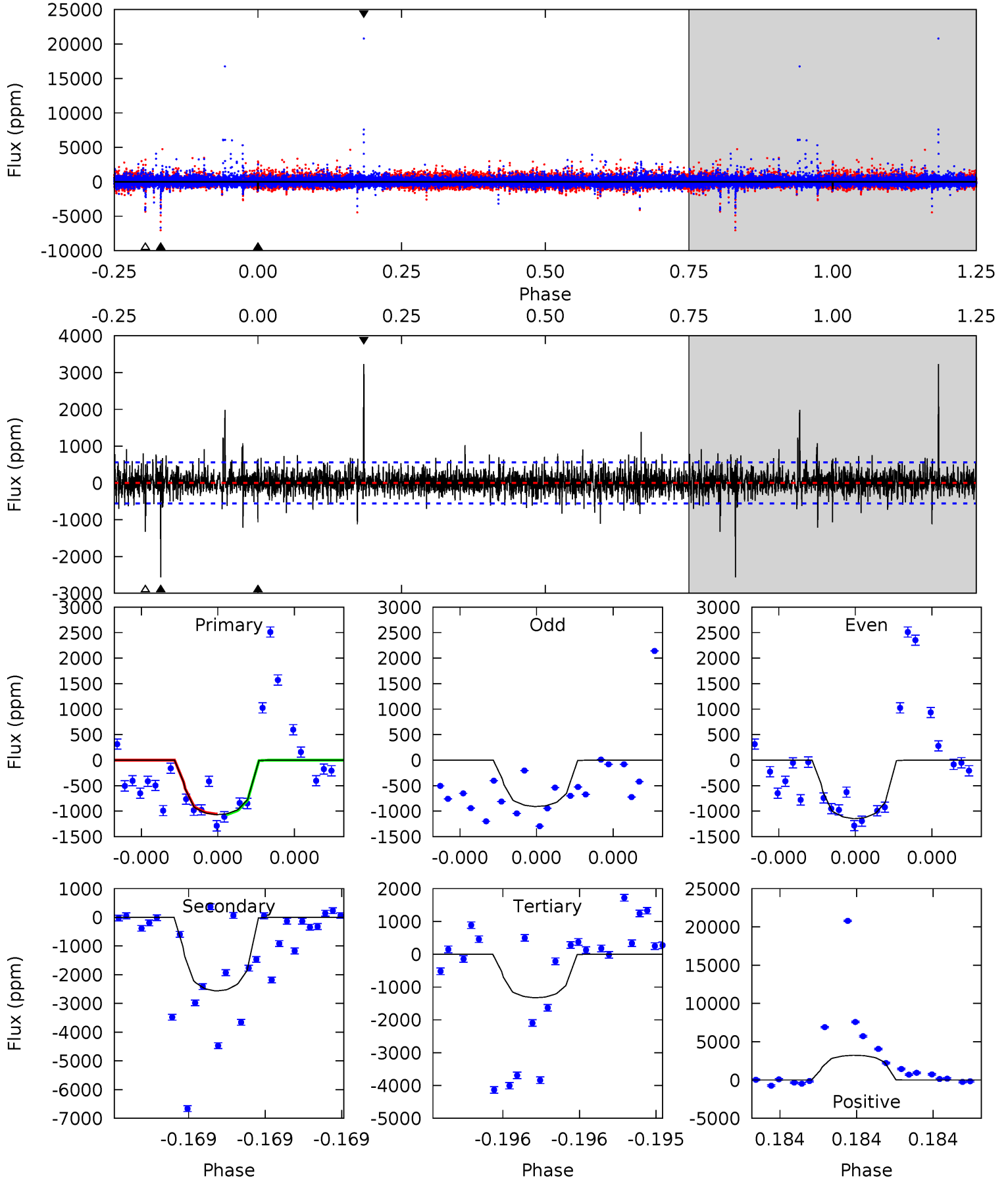
TCE 005106731-01 P=492.121859 Days  $T_0=517.569915$  (BKJD)



# DV Model-Shift Uniqueness Test

005106731-01,  $P = 492.120079$  Days,  $E = 25.449323$  Days

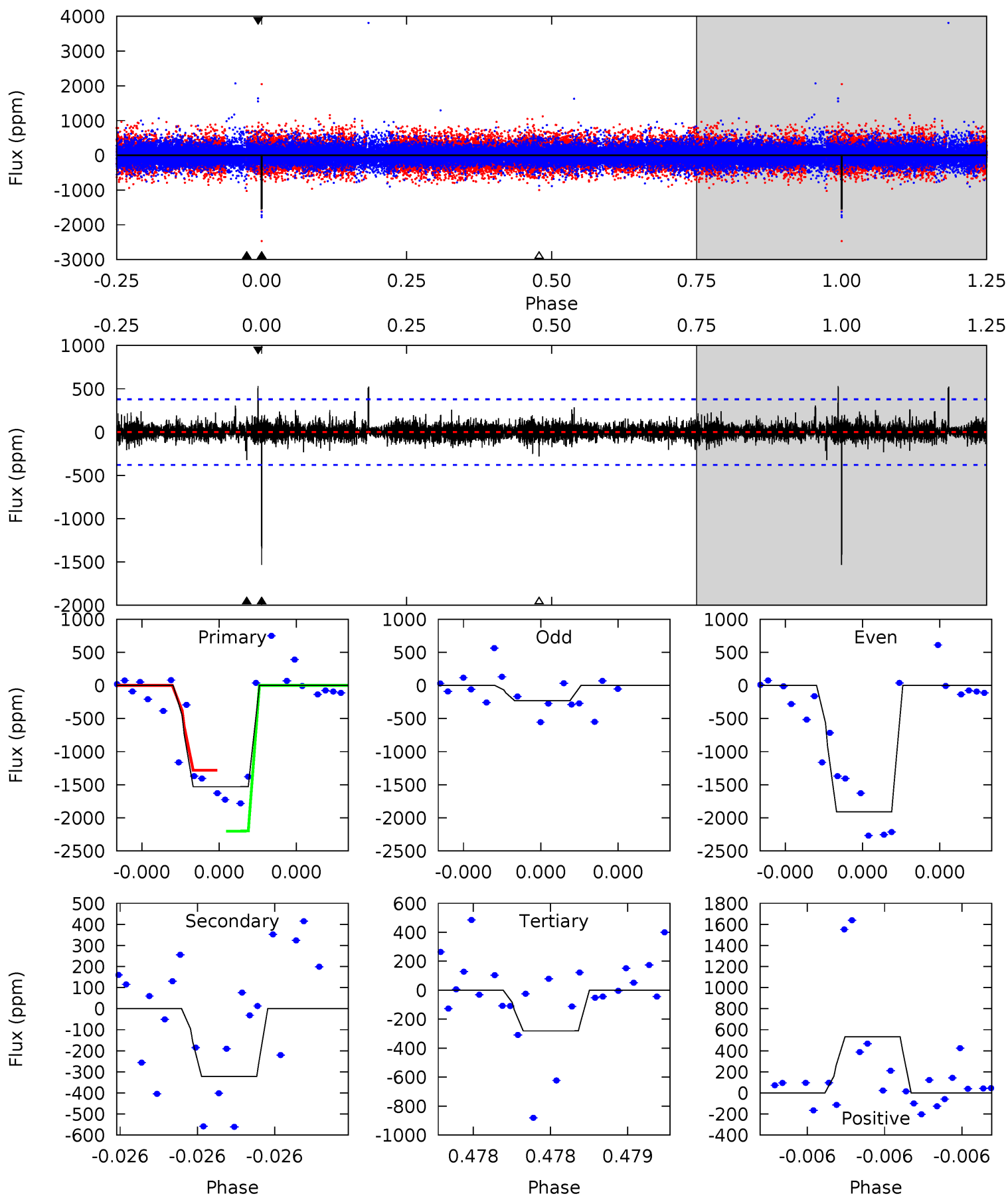
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
10.8	26.0	13.4	32.7	5.66	3.62	2.15	-2.62	-21.9	12.5	-6.73	0.82	1.00	0.56	0.06



# Alt Model-Shift Uniqueness Test

005106731-01, P = 492.121859 Days, E = 25.448056 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
22.9	4.82	4.21	7.98	5.67	3.62	0.73	18.7	15.0	0.61	-3.15	14.9	0.85	0.26	7.33



### Stellar Parameters For KIC 005106731

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5343^{+175}_{-159}$	$3.950^{+0.660}_{-0.264}$	$-0.260^{+0.350}_{-0.250}$	$1.631^{+0.735}_{-0.898}$	$0.867^{+0.084}_{-0.115}$	$0.281^{+2.172}_{-0.162}$
	+3%/-3%	+17%/-7%	+135%/-96%	+45%/-55%	+10%/-13%	+772%/-58%
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 005106731-01 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{\text{max}} (K)$	$T_{\text{obs}} (K)$	$A_{\text{obs}}$
DV	$-2564 \pm 99$	$10.32^{+12.86}_{-6.97}$	$380^{+49}_{-66}$	$4768^{+3207}_{-1082}$	$17662^{+148739}_{-14088}$
Alt.	$-322 \pm 67$	$11.46^{+12.72}_{-8.47}$	$383^{+50}_{-58}$	$3250^{+1746}_{-568}$	$1769^{+26487}_{-1381}$

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

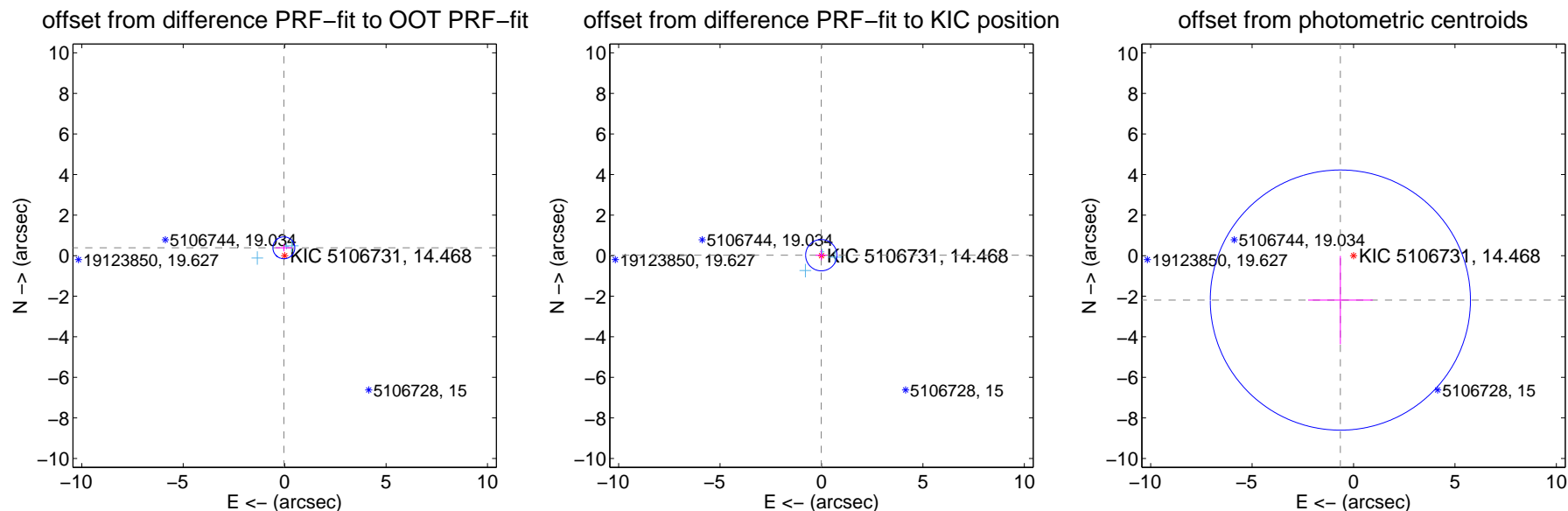
## DV Centroid Data

Supplemental centroid analysis for 005106731-01. Kepler magnitude: 14.47. Transit SNR 7.87

There are 3 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.27 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.390 \pm 0.180$	2.17	$0.038 \pm 0.405$	$0.388 \pm 0.176$
PRF-fit source offset from KIC position	$0.026 \pm 0.257$	0.10	$0.010 \pm 0.277$	$0.024 \pm 0.254$
photometric centroid source offset	$2.28 \pm 2.14$	1.07	$0.65 \pm 1.59$	$-2.19 \pm 2.18$

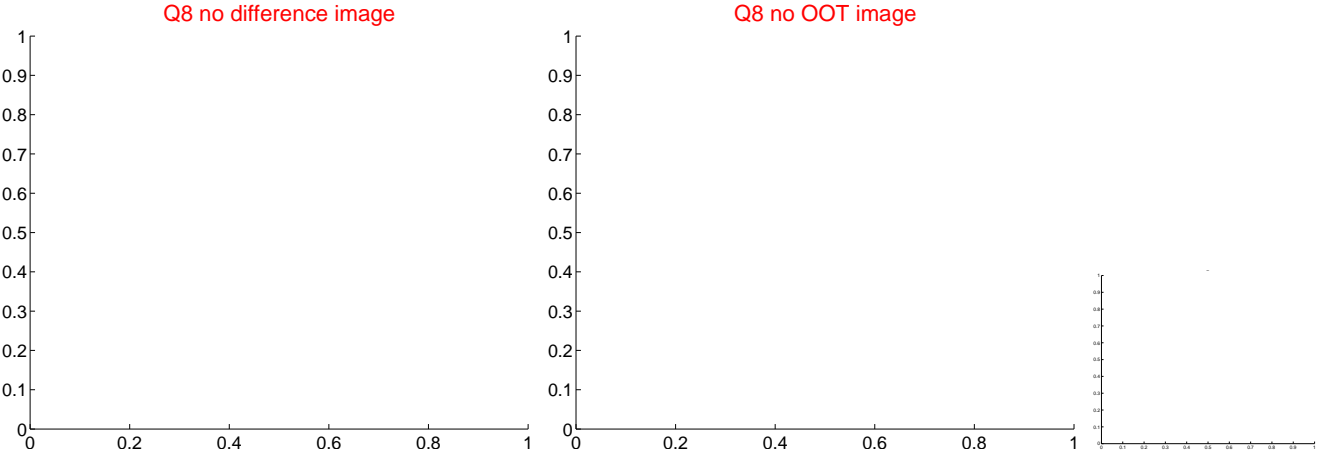
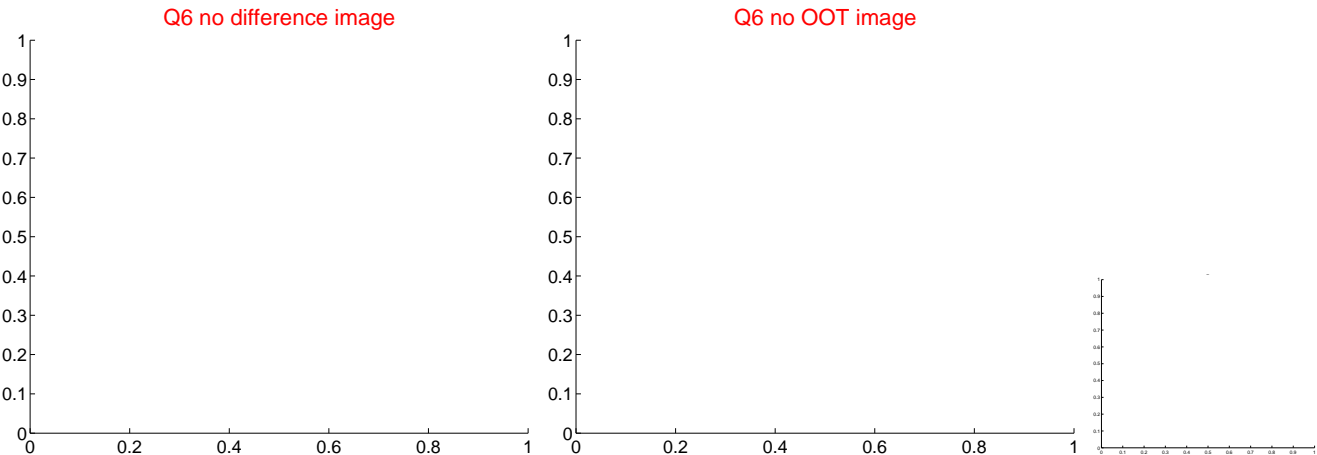
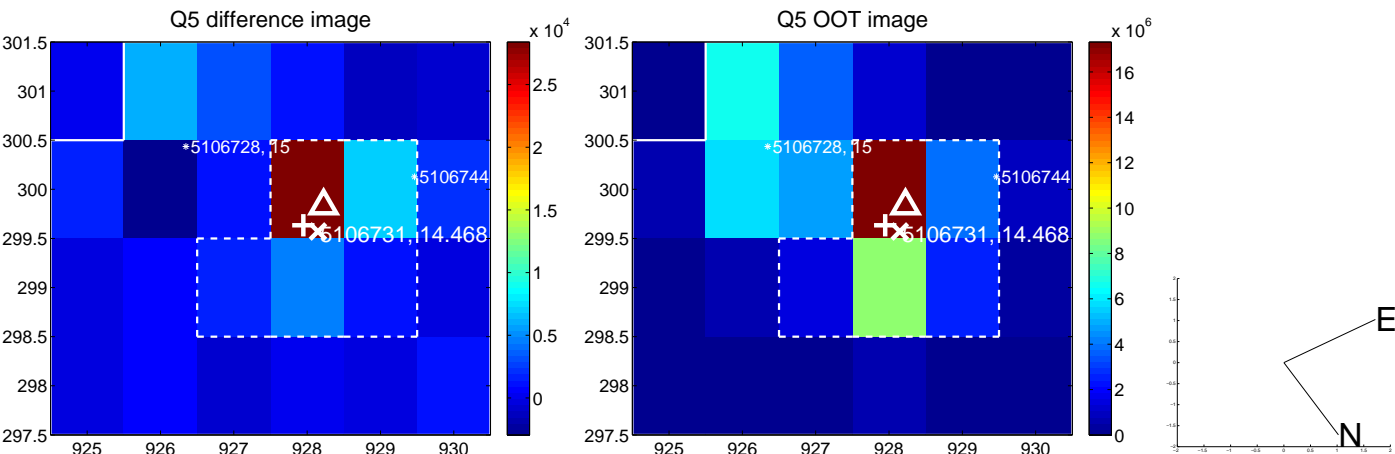


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

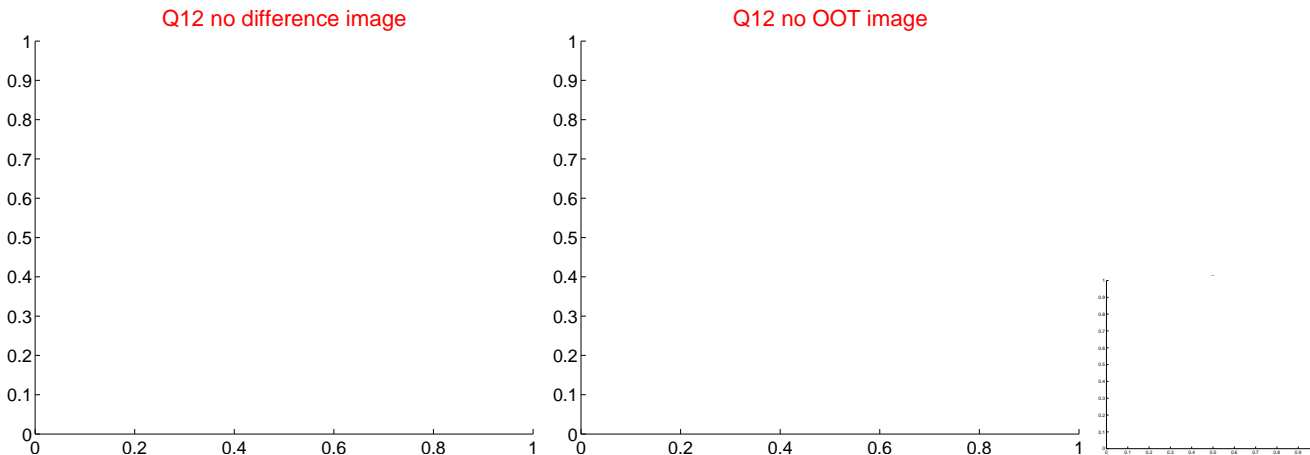
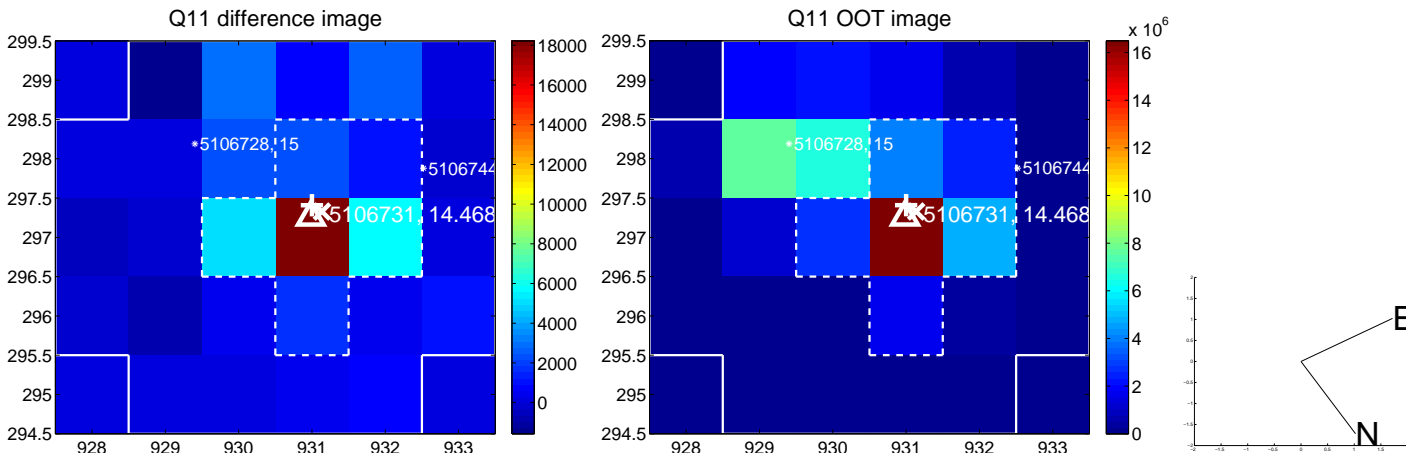
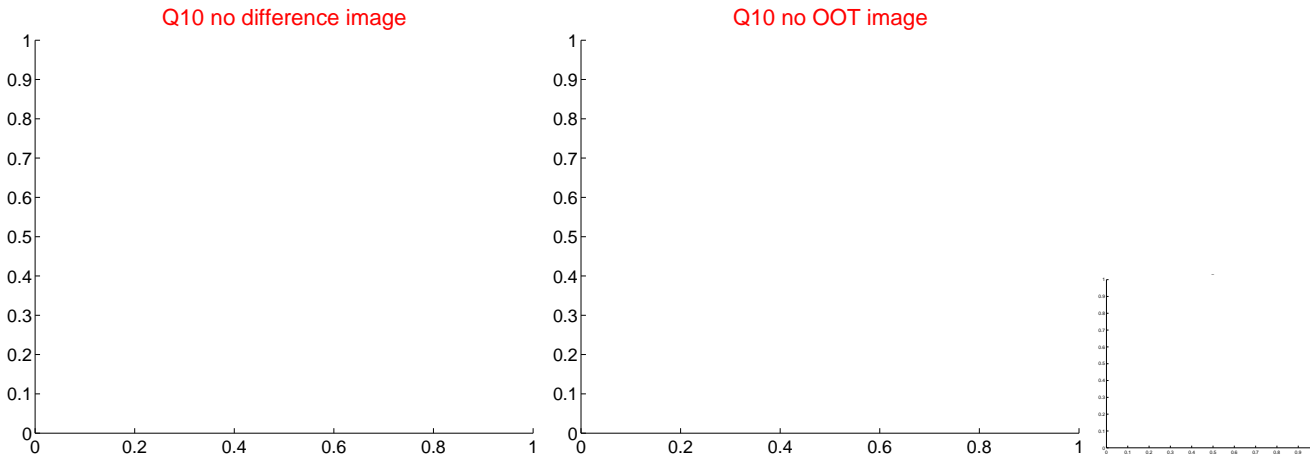
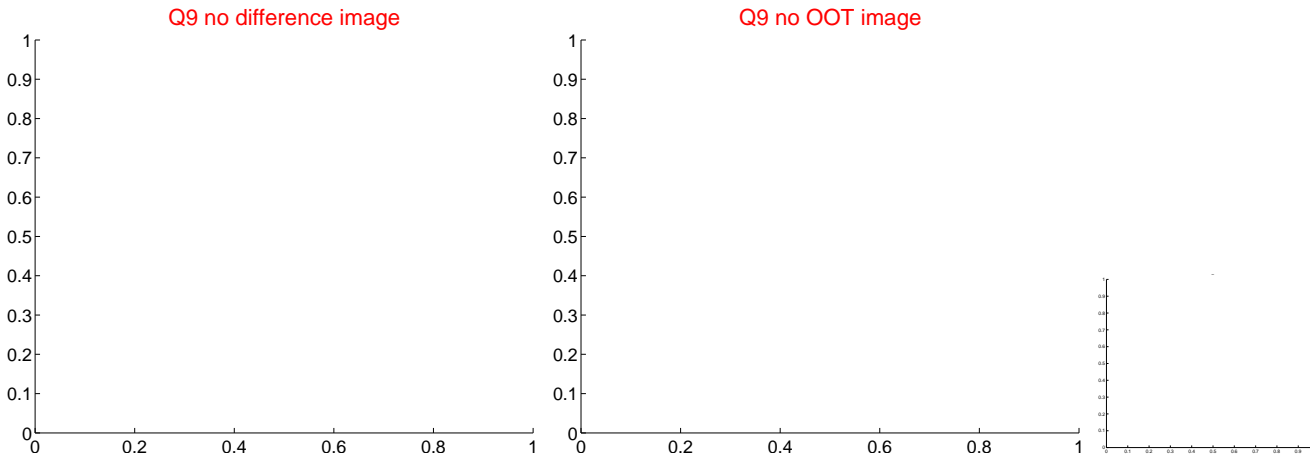


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.





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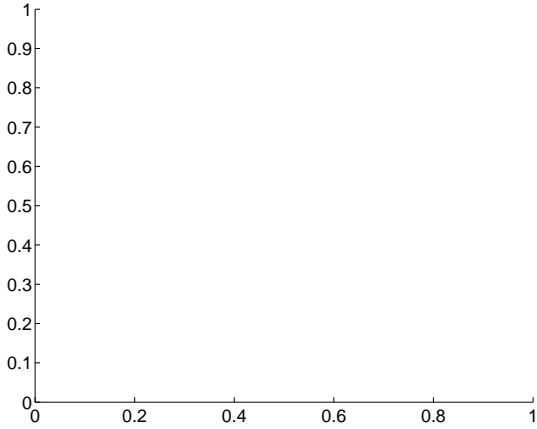
Q13 no difference image



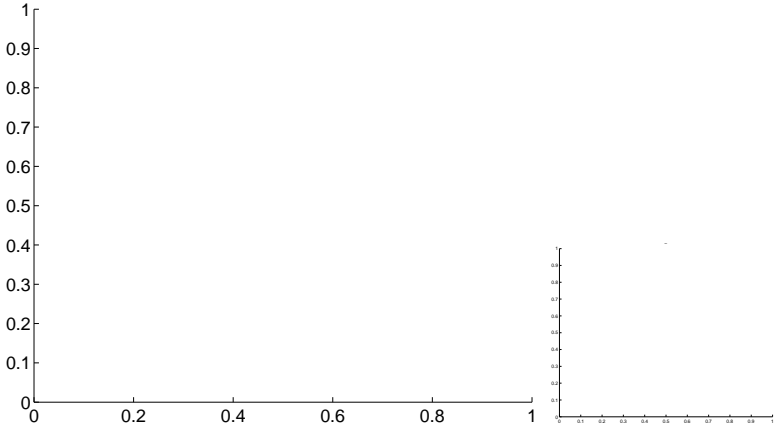
Q13 no OOT image



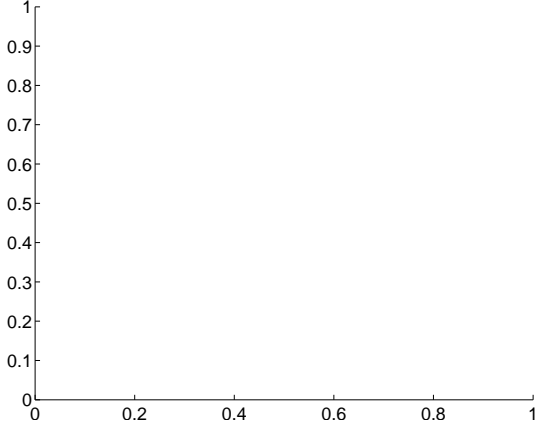
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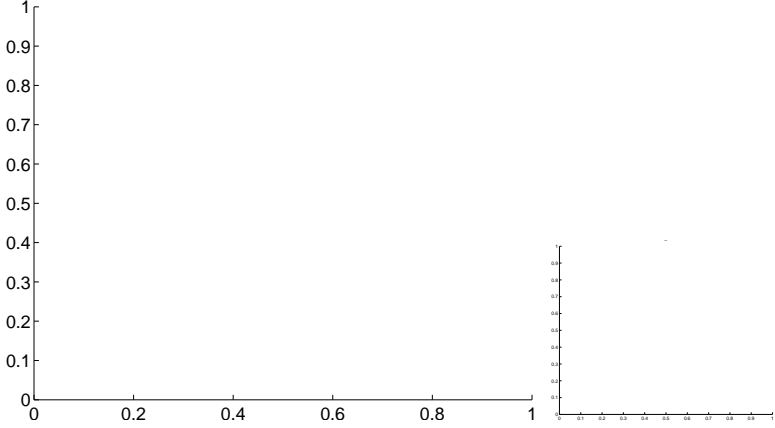
Q14 no OOT image



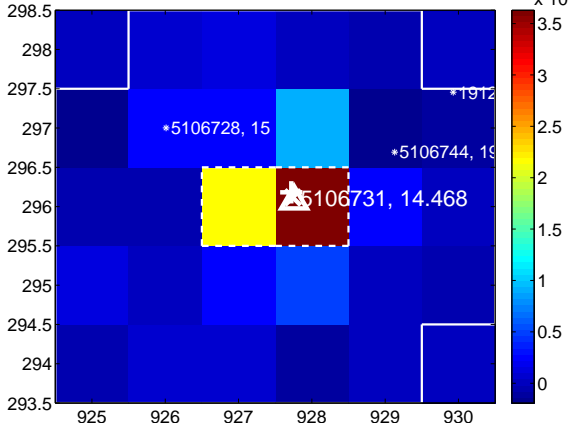
Q15 no difference image



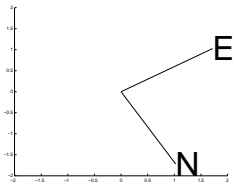
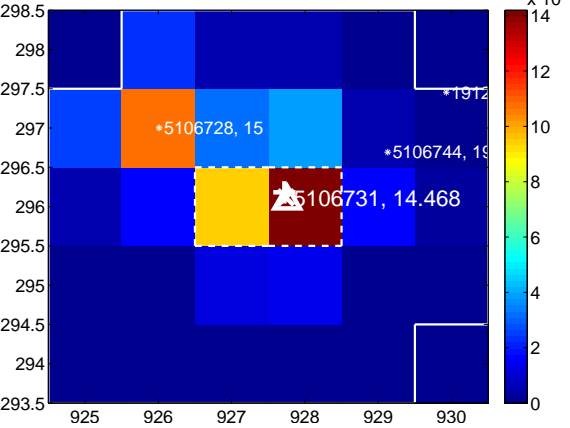
Q15 no OOT image



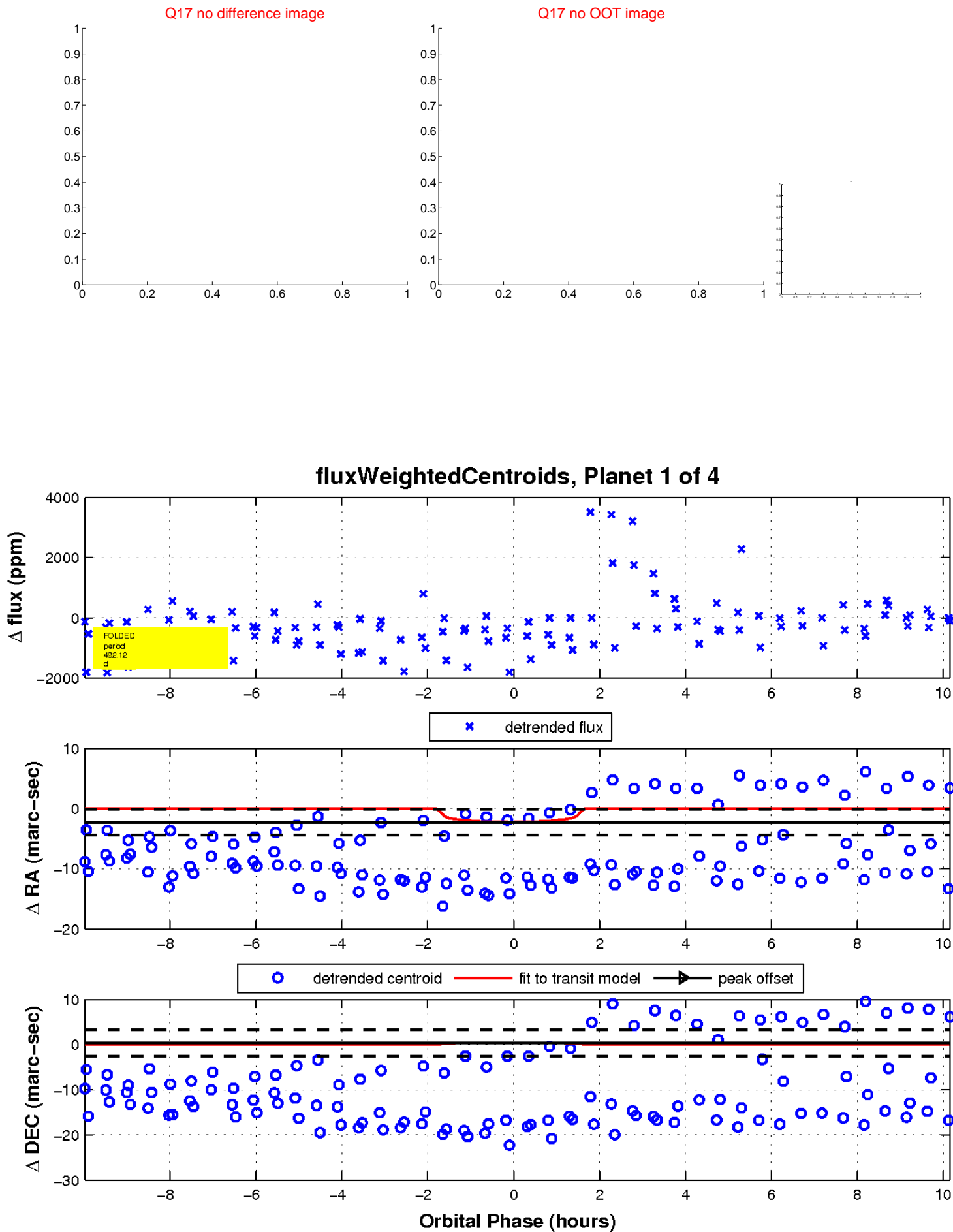
Q16 difference image



Q16 OOT image

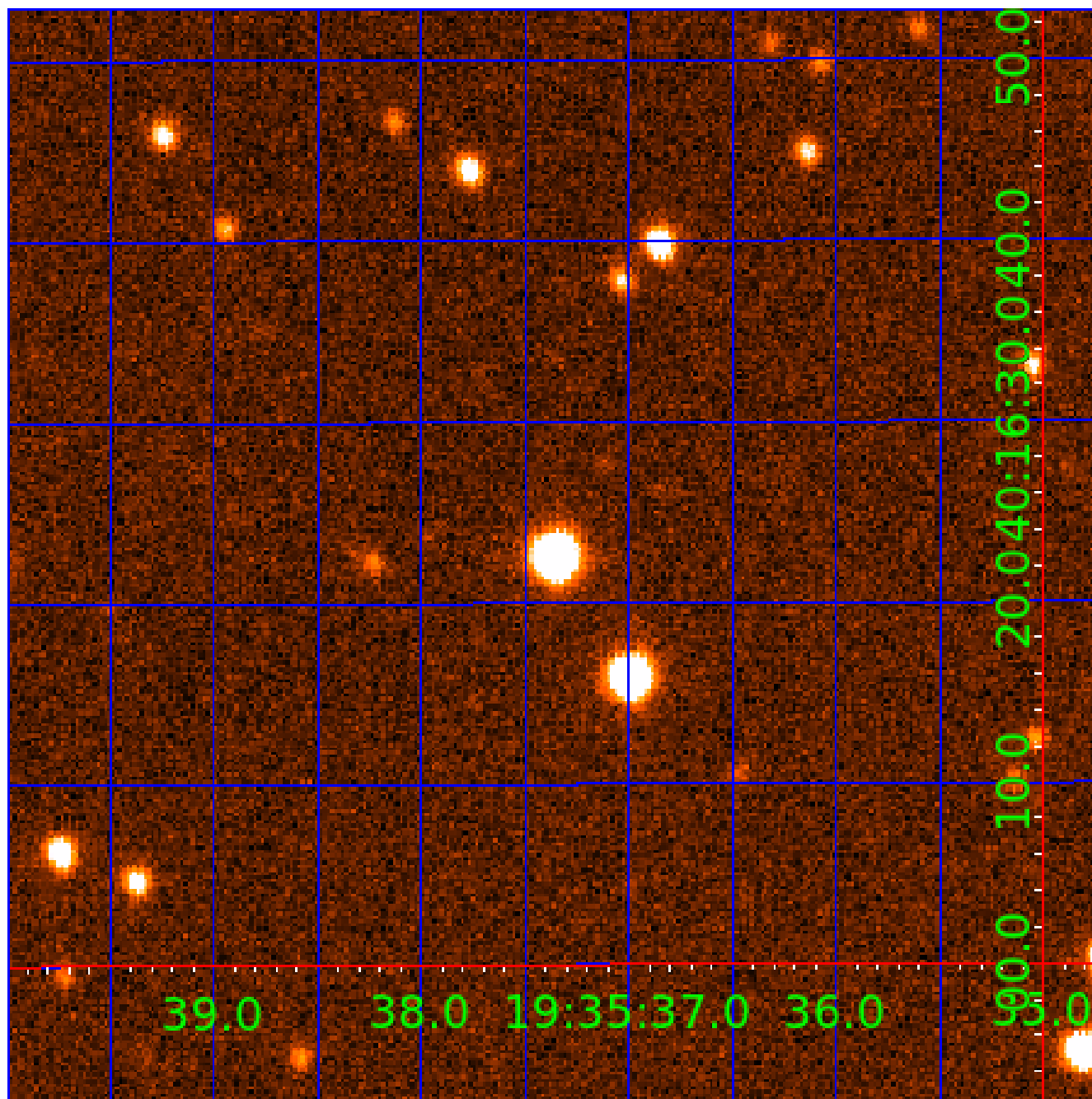


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UKIRT Image

Declination



# KIC 005106731

## Q1-17 DR25 TCE Parameters

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005106731-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS
005106731-03	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_CHASES_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS—HALO_GHOST
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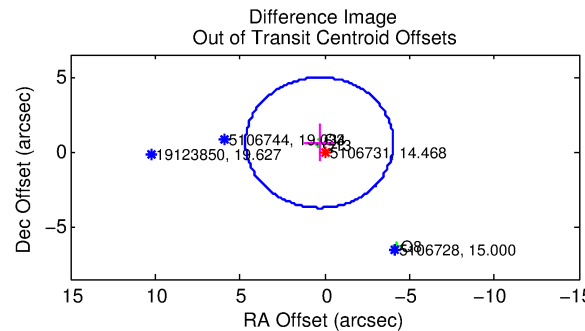
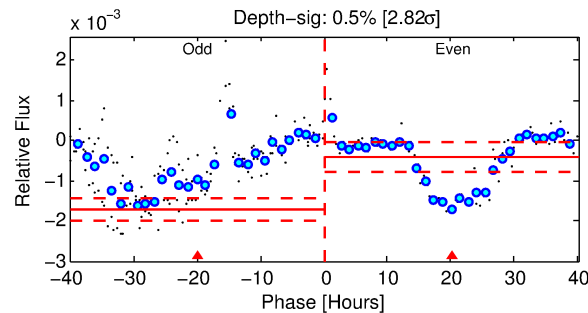
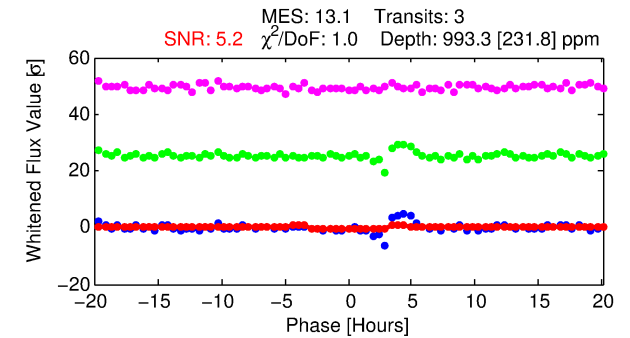
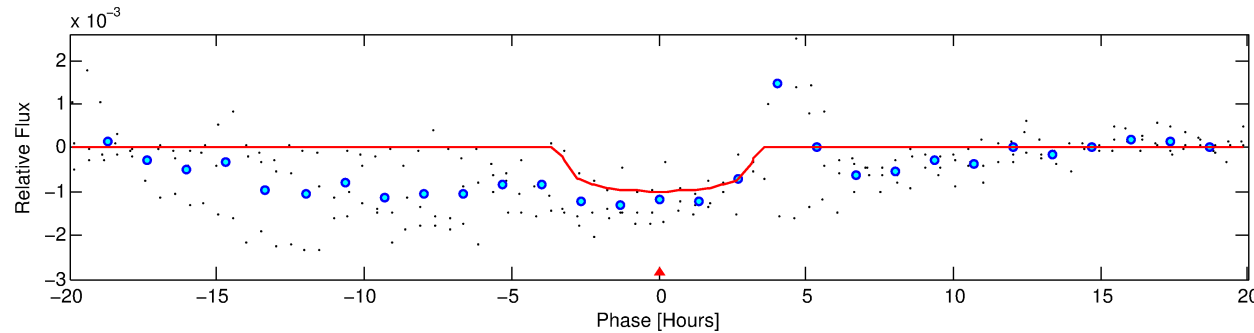
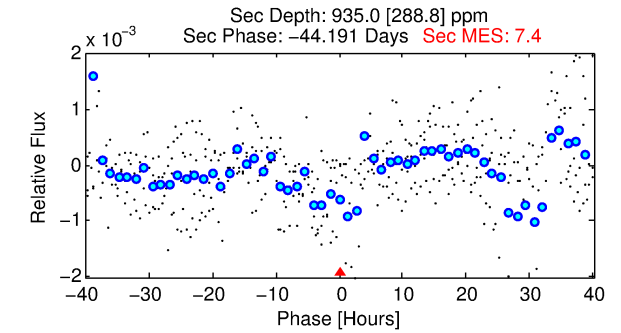
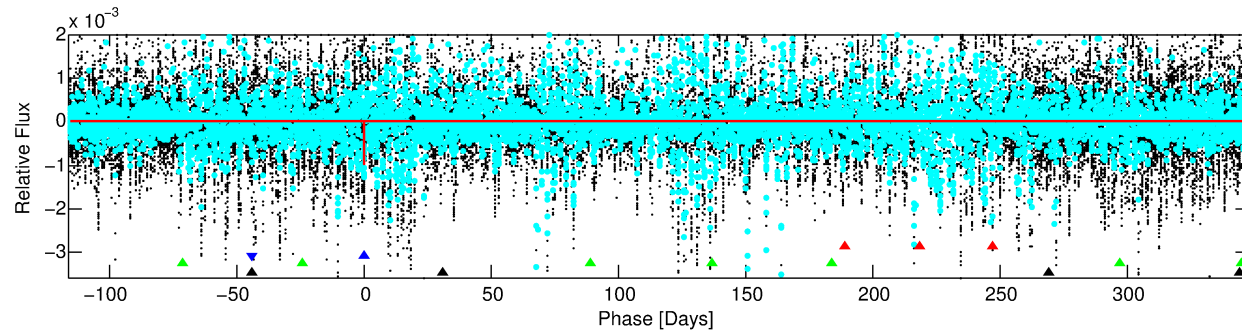
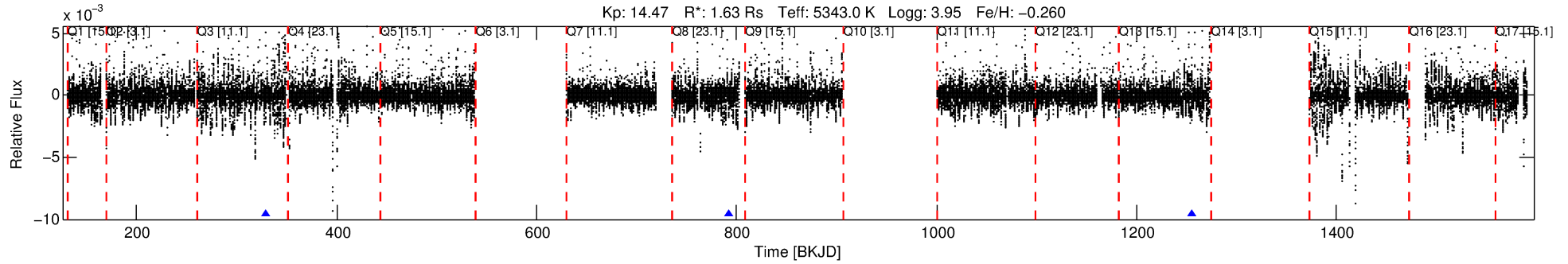
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 005106731-02

No Significant Match Found

# DV One-Page Summary

KIC: 5106731 Candidate: 2 of 4 Period: 462.924 d



## DV Fit Results:

Period = 462.92384 [0.00691] d  
Epoch = 328.8689 [0.0104] BKJD  
Rp/R\* = 0.0301 [0.0570]  
a/R\* = 438.66 [3365.71]  
b = 0.61 [7.91]  
Seff = 1.56 [1.69]  
Teq = 285 [77] K  
Rp = 5.35 [10.56] Re  
a = 1.1160 [0.6982] AU  
Ag = 22380.97 [88455.63] [0.25 $\sigma$ ]  
Teffp = 5389 [5126] K [1.00 $\sigma$ ]

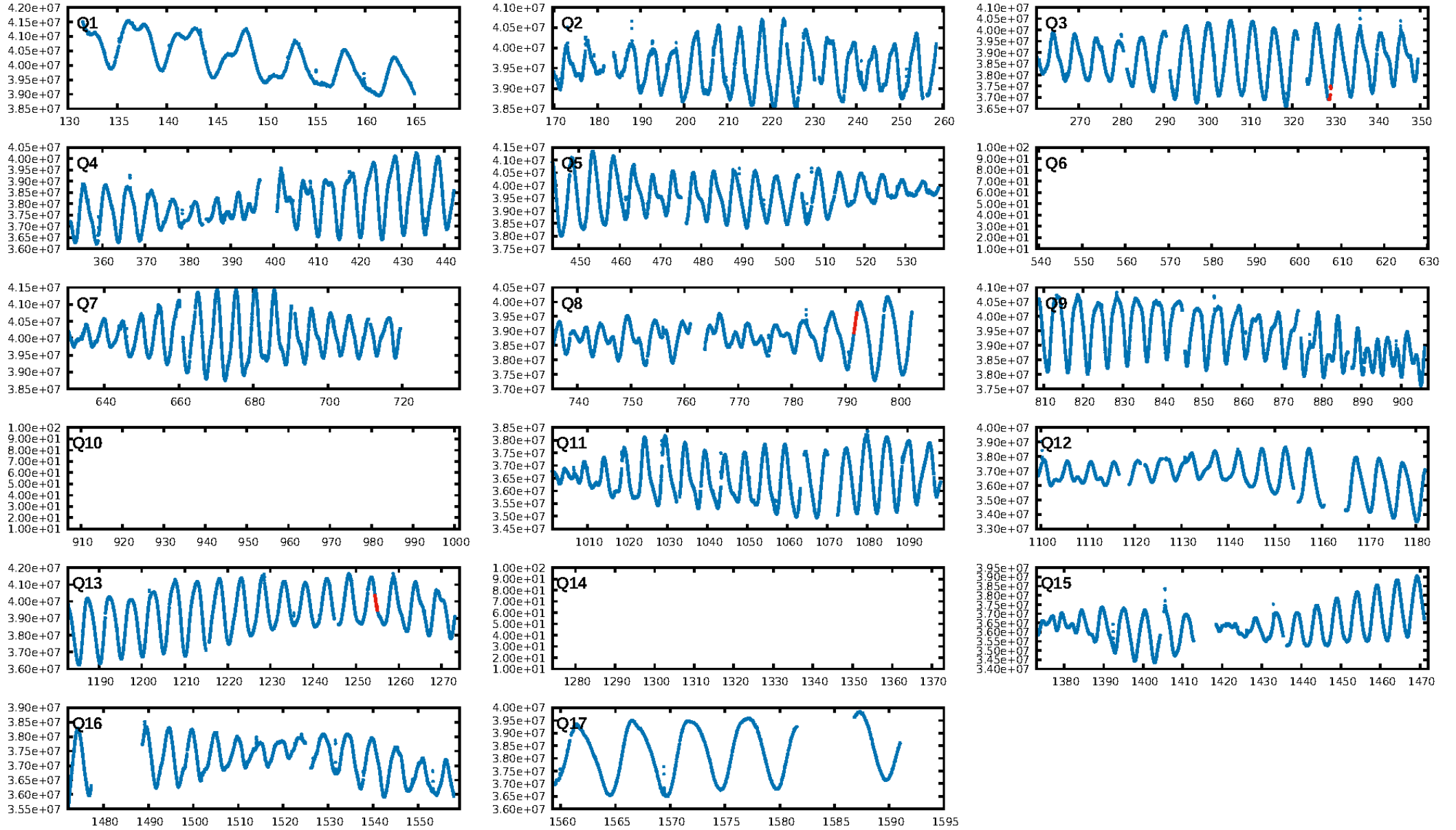
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [231.07 $\sigma$ ]  
LongPeriod-sig: 100.0% [93.62 $\sigma$ ]  
ModelChiSquare2-sig: 0.5%  
ModelChiSquareGof-sig: 98.2%  
**Bootstrap-pfa: 1.56e-11**  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: 0.7368  
Centroid-sig: 26.6%  
Centroid-so: 1.451 arcsec [0.35 $\sigma$ ]  
OotOffset-rm: 0.674 arcsec [0.46 $\sigma$ ]  
KicOffset-rm: 0.023 arcsec [0.02 $\sigma$ ]  
OotOffset-st: 0/1/1/1 [3]  
KicOffset-st: 0/1/1/1 [3]  
DiffImageQuality-fgm: 0.67 [2/3]  
DiffImageOverlap-fno: 1.00 [3/3]

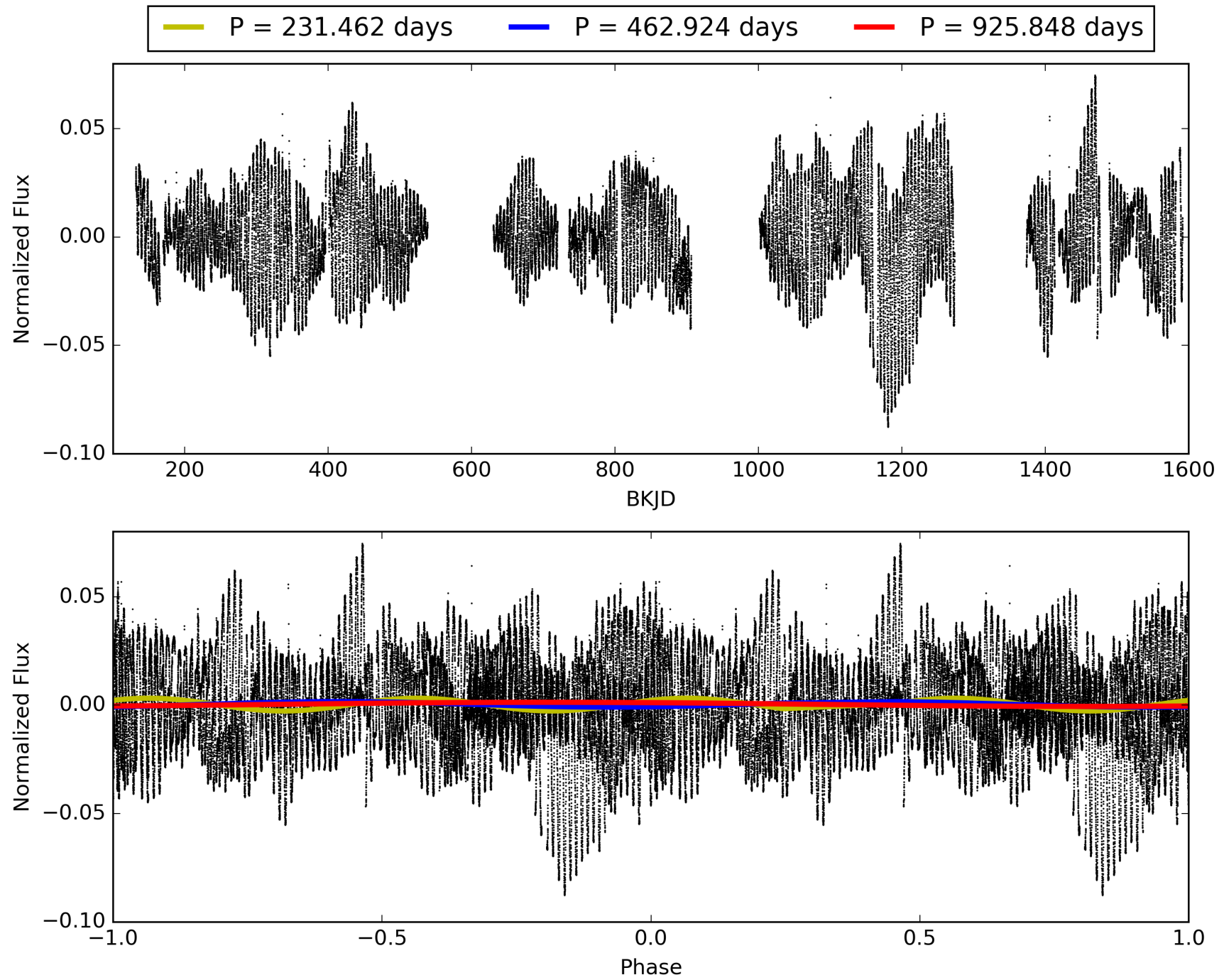
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 01-Feb-2016 05:51:12 Z

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

# TCE 005106731-02, PDC Light Curves



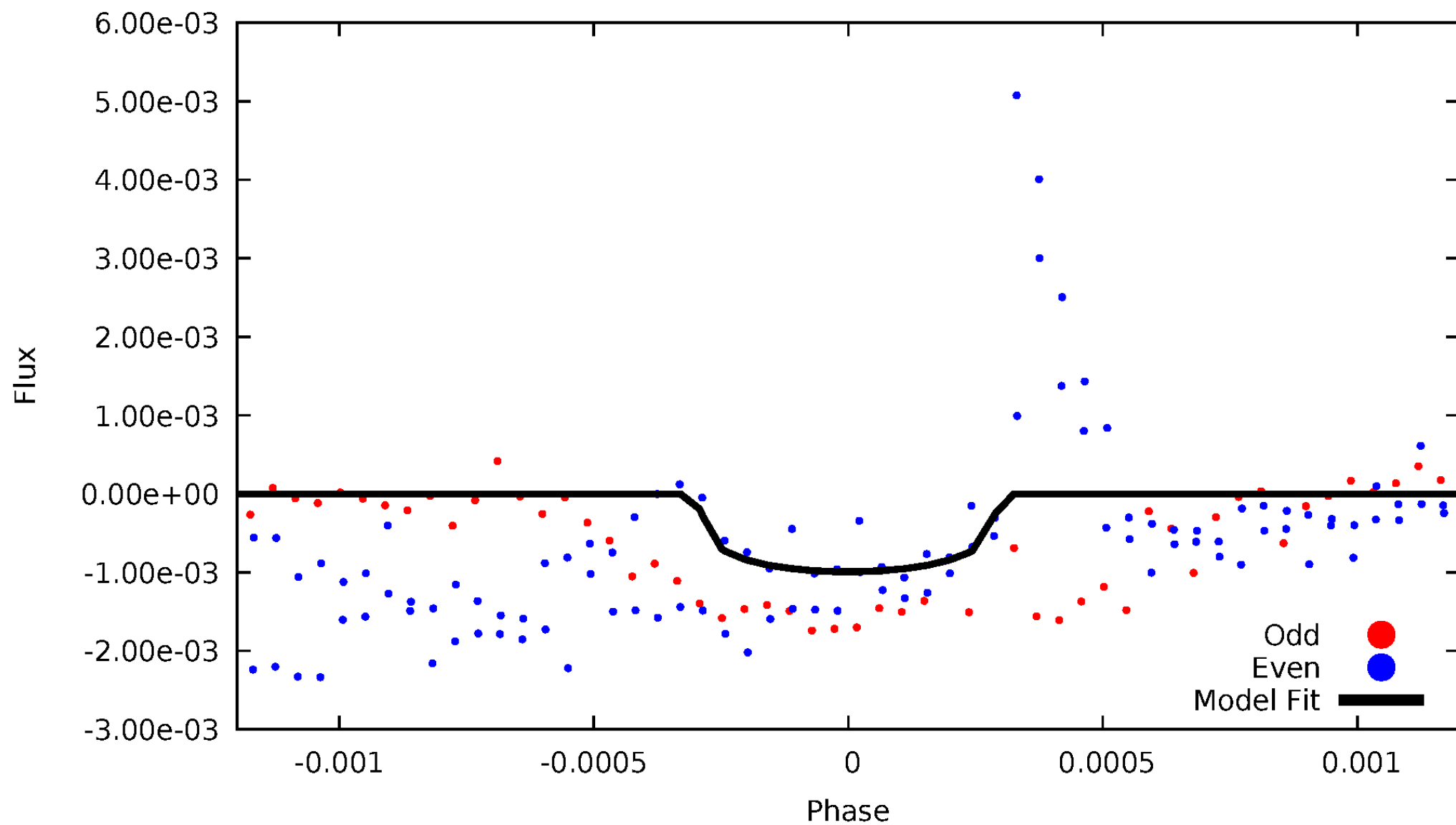
TCE 005106731-02





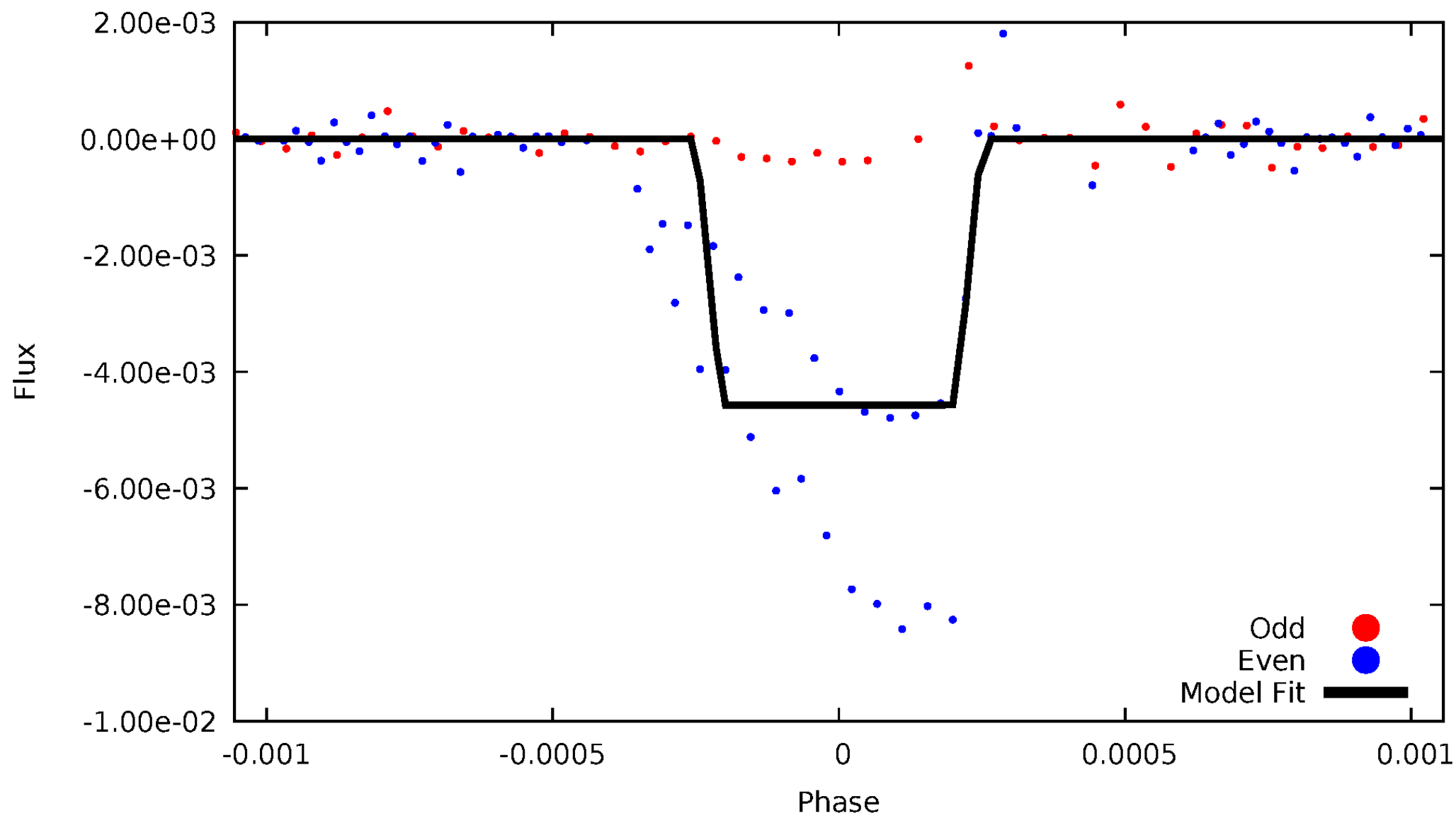
# DV Odd/Even

TCE 005106731-02



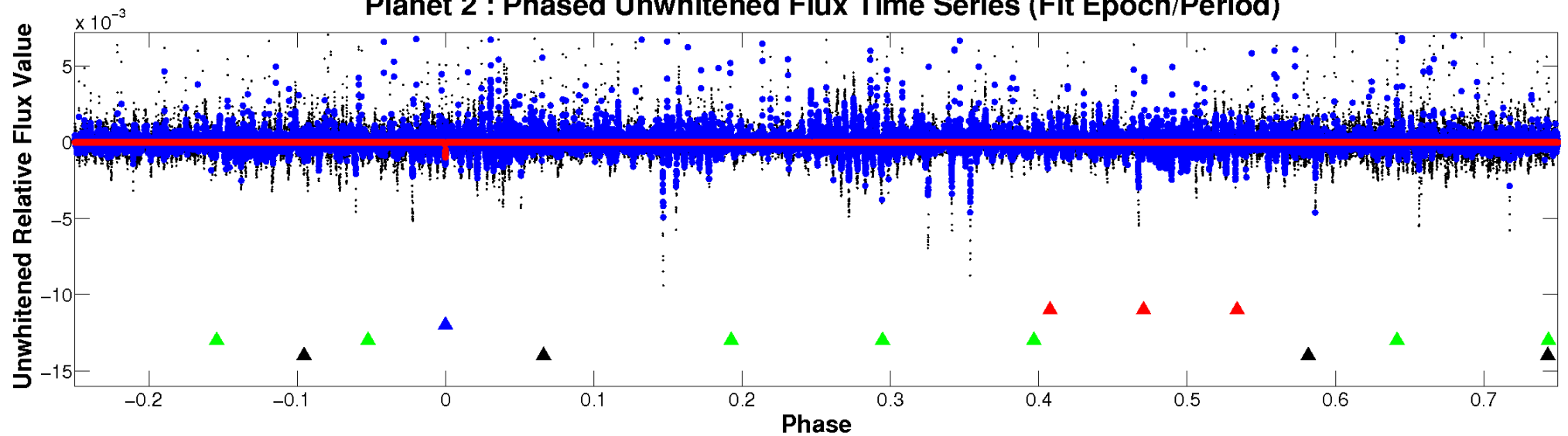
# ALT Odd/Even

TCE 005106731-02

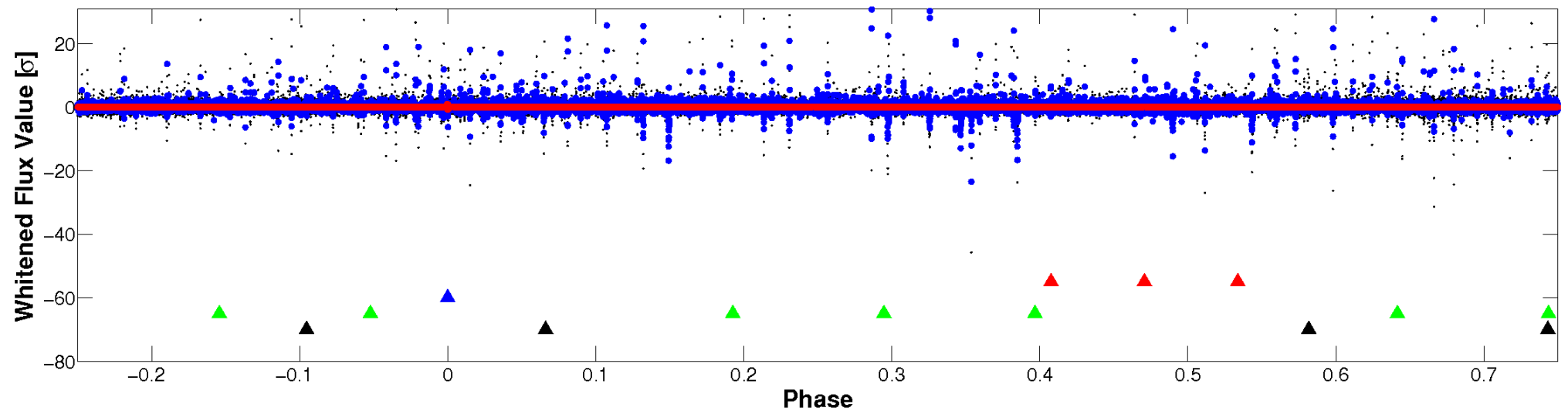


# Non-Whitened Vs. Whitened Light Curve

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

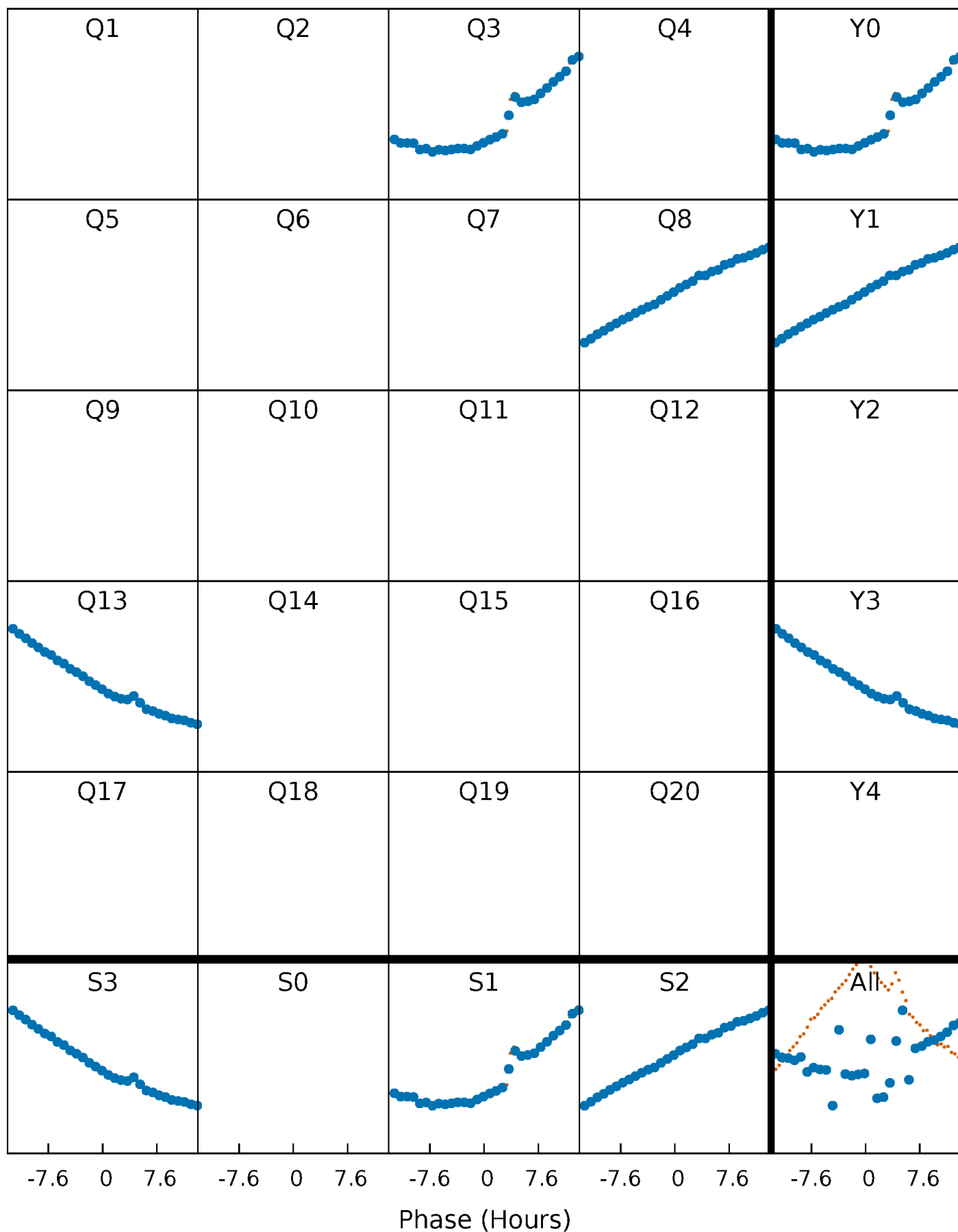


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



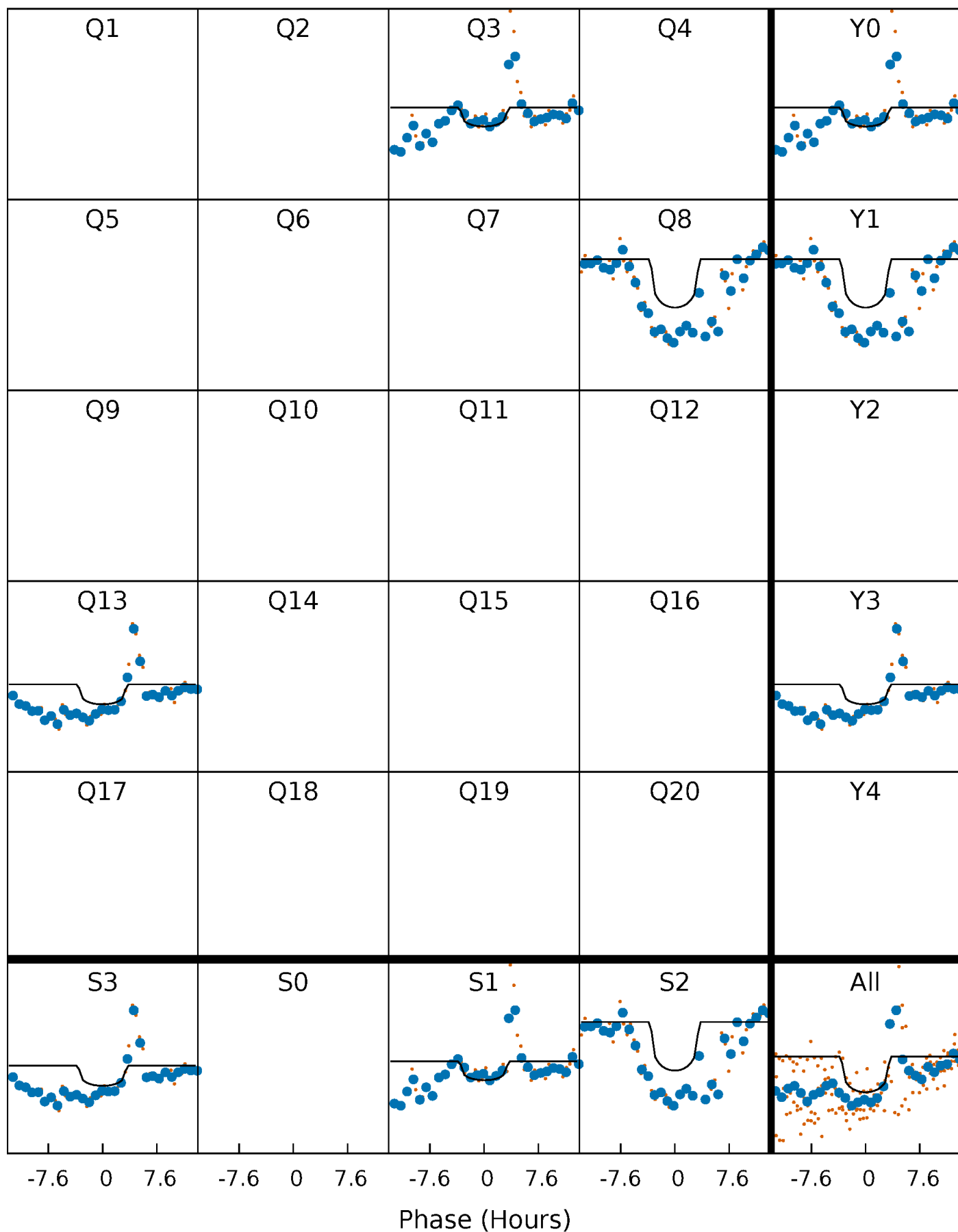
# PDC Quarter-Phased Transit Curves

TCE 005106731-02 P=462.923838 Days  $T_0=328.868886$  (BKJD)



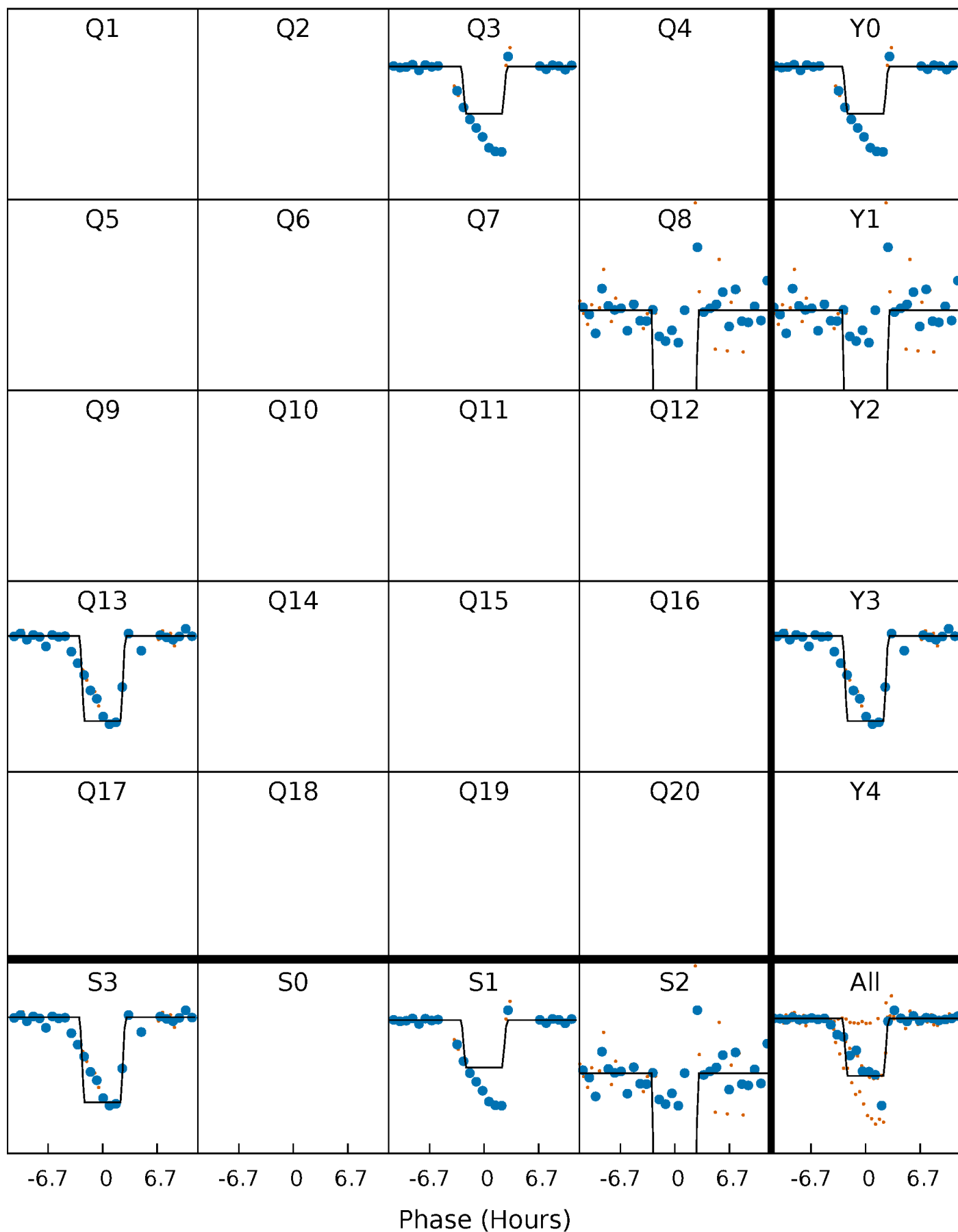
# DV Quarter-Phased Transit Curves

TCE 005106731-02     $P=462.923838$  Days     $T_0=328.868886$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

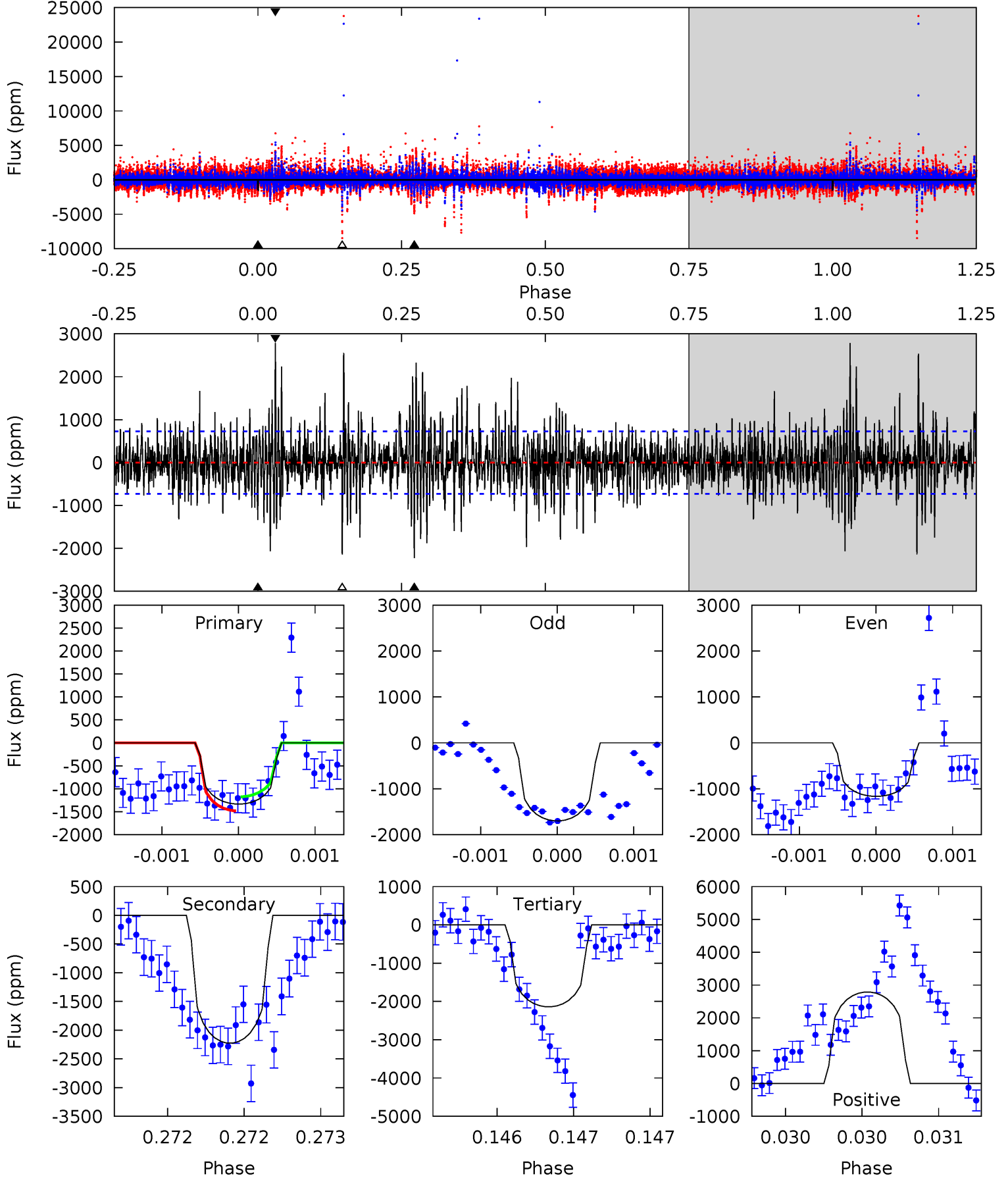
TCE 005106731-02 P=462.929113 Days  $T_0=328.909302$  (BKJD)



# DV Model-Shift Uniqueness Test

005106731-02, P = 462.923838 Days, E = 328.868886 Days

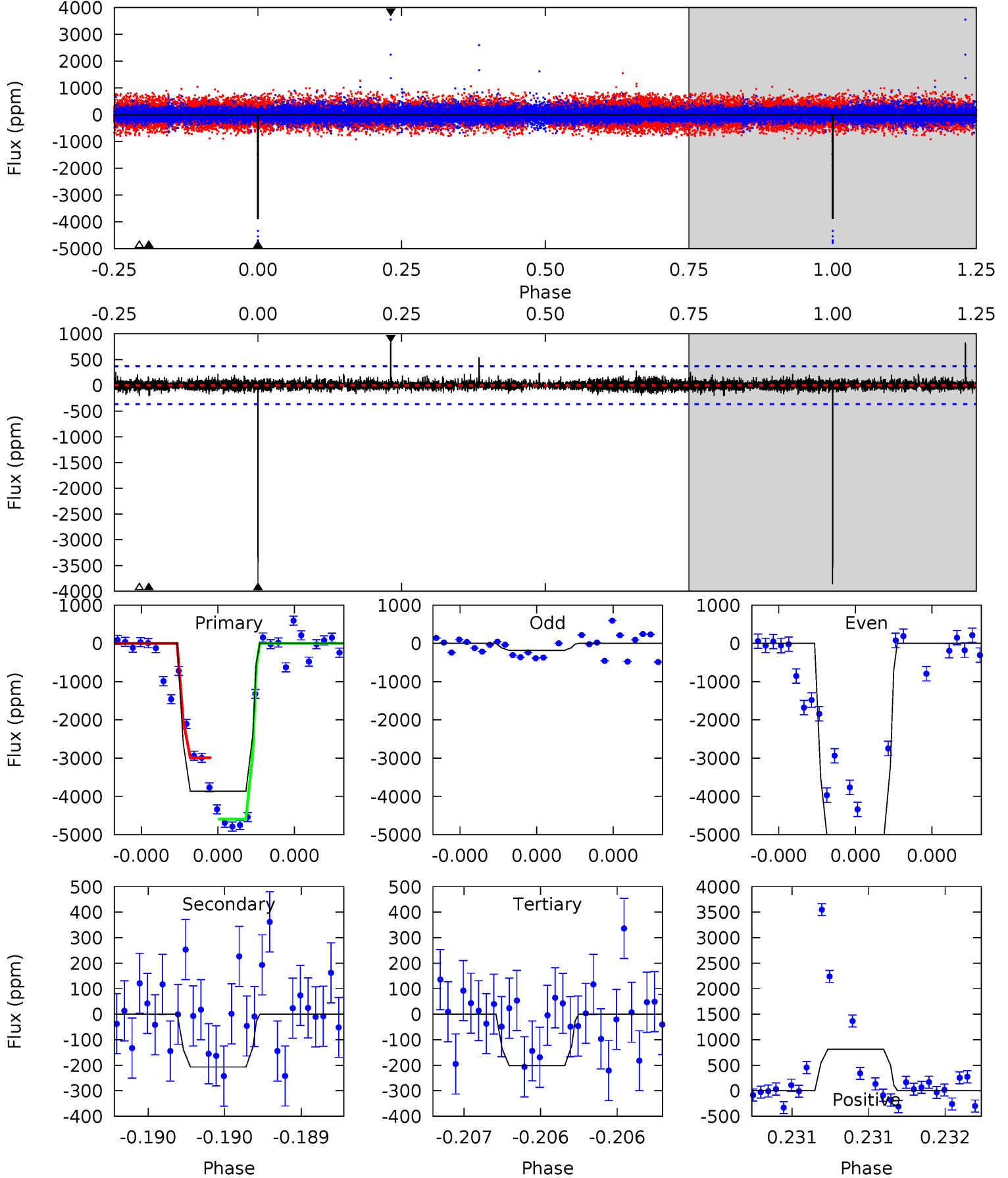
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
10.1	16.9	16.3	21.2	5.55	3.44	3.59	-6.13	-11.1	0.66	-4.27	1.65	0.89	0.56	1.14



# Alt Model-Shift Uniqueness Test

005106731-02, P = 462.929113 Days, E = 328.909302 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
58.8	3.14	3.06	12.4	5.58	3.49	0.72	55.7	46.4	0.09	-9.25	53.2	0.94	0.17	0





### Stellar Parameters For KIC 005106731

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5343^{+175}_{-159}$	$3.950^{+0.660}_{-0.264}$	$-0.260^{+0.350}_{-0.250}$	$1.631^{+0.735}_{-0.898}$	$0.867^{+0.084}_{-0.115}$	$0.281^{+2.172}_{-0.162}$
	+3%/-3%	+17%/-7%	+135%/-96%	+45%/-55%	+10%/-13%	+772%/-58%
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 005106731-02 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-2225 \pm 131$	$8.43^{+8.64}_{-5.92}$	$391^{+51}_{-57}$	$5179^{+4655}_{-1231}$	$21498^{+214105}_{-16330}$
Alt.	$-207 \pm 66$	$11.65^{+11.18}_{-7.19}$	$393^{+52}_{-66}$	$2994^{+1075}_{-434}$	$1011^{+6553}_{-752}$

$T_{max}$  = 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

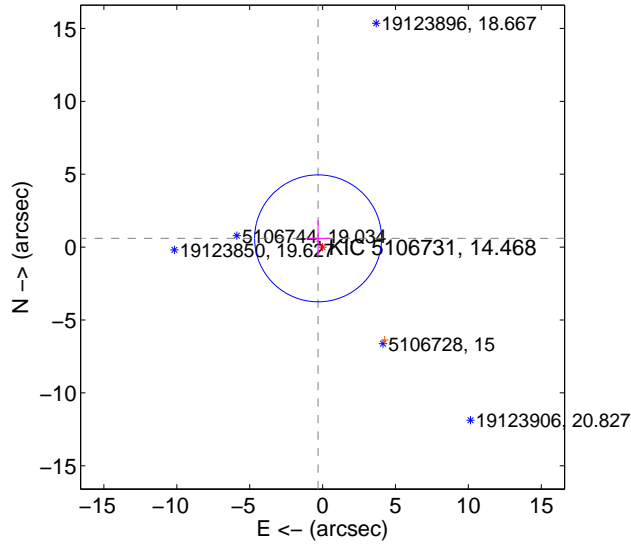
Supplemental centroid analysis for 005106731-02. Kepler magnitude: 14.47. Transit SNR 5.23

There are 2 quarters with good PRF difference image offsets

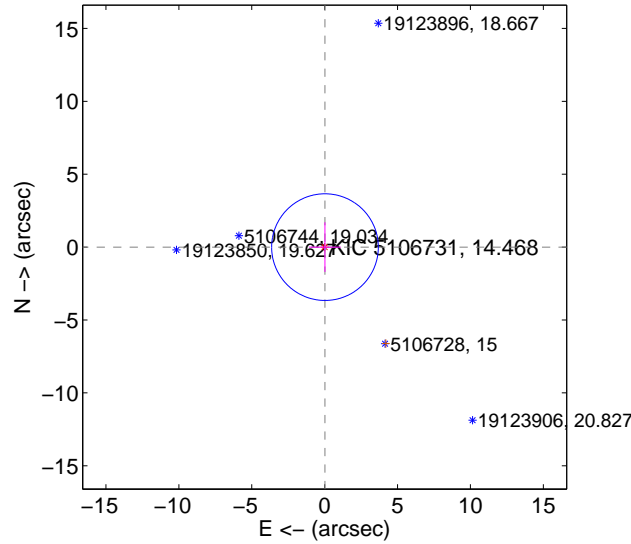
The direct PRF centroid is offset from the target star catalog position by about 0.67 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.674 \pm 1.451$	0.46	$0.307 \pm 0.813$	$0.600 \pm 1.217$
PRF-fit source offset from KIC position	$0.023 \pm 1.219$	0.02	$-0.023 \pm 1.086$	$-0.002 \pm 1.701$
photometric centroid source offset	$1.45 \pm 4.13$	0.35	$0.42 \pm 2.75$	$1.39 \pm 4.23$

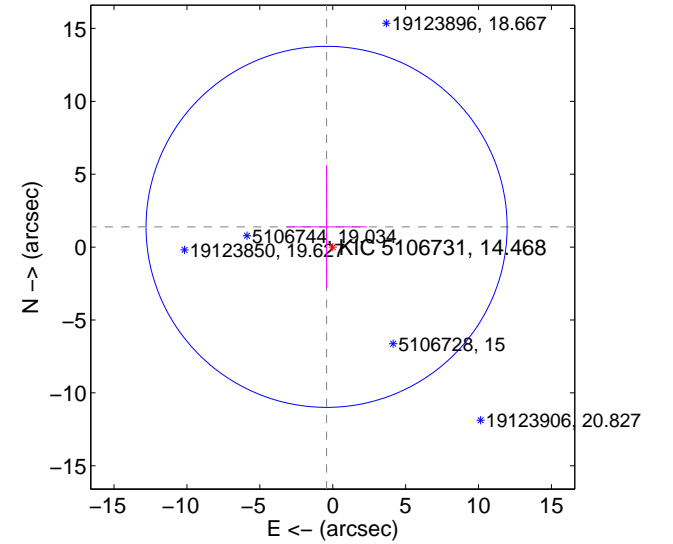
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

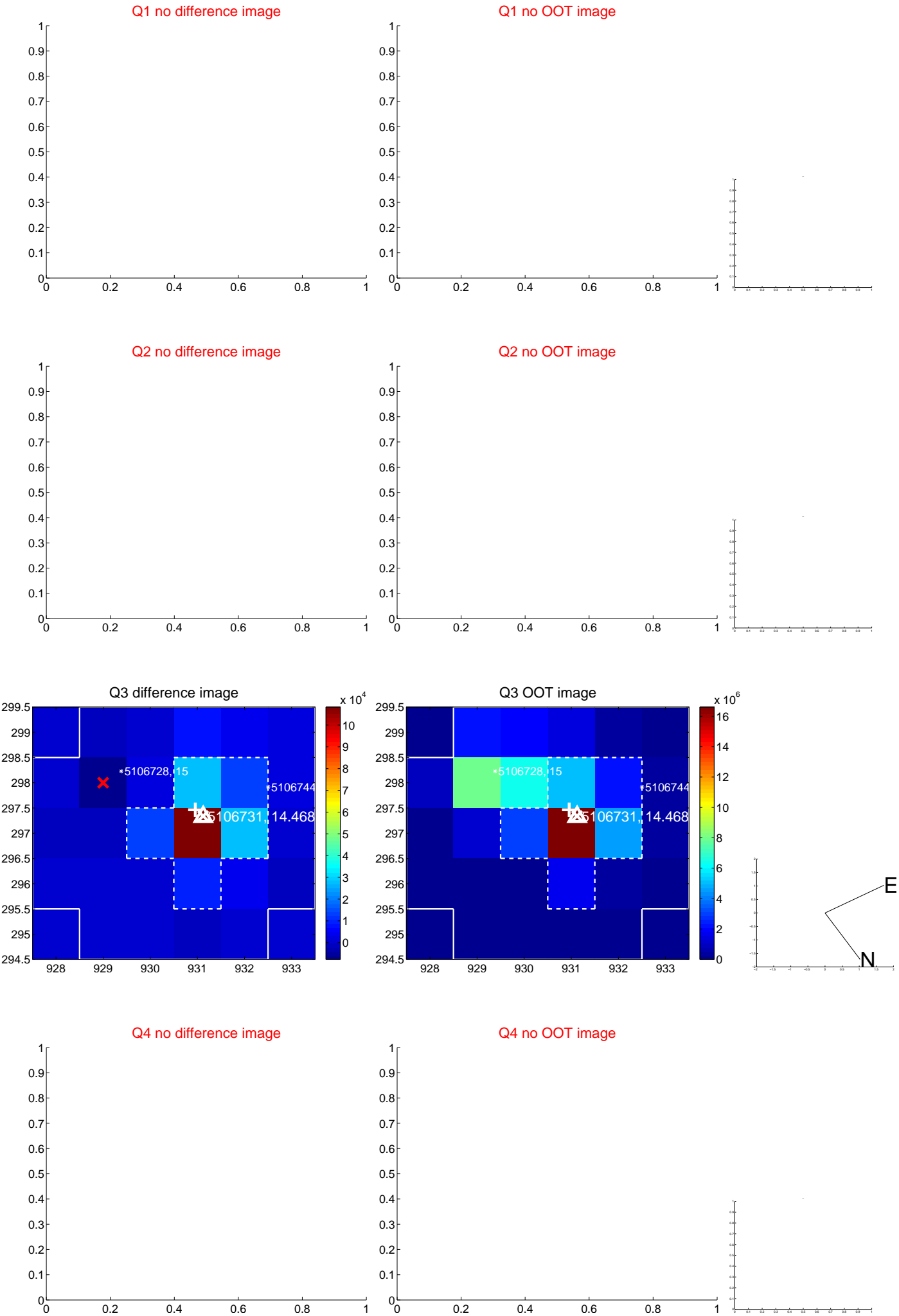


offset from photometric centroids



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

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



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

Q5 no difference image



Q5 no OOT image



Q6 no difference image



Q6 no OOT image



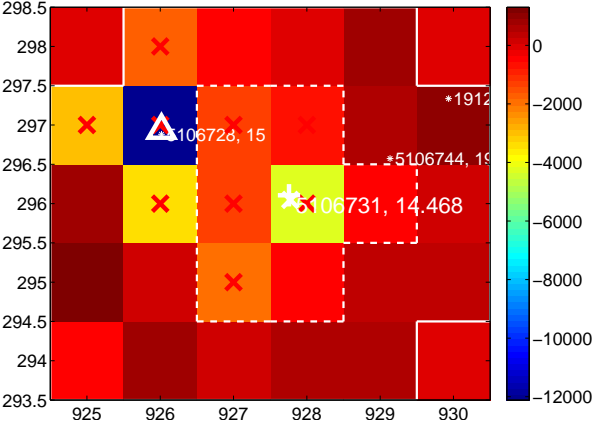
Q7 no difference image



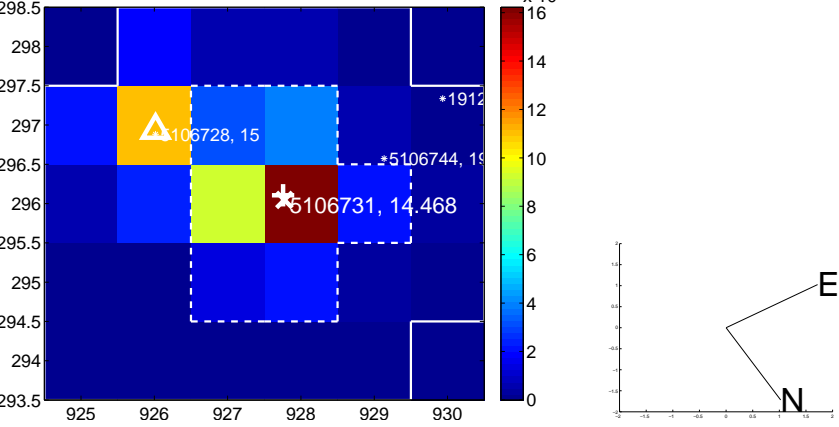
Q7 no OOT image



Q8 difference image. Poor Quality



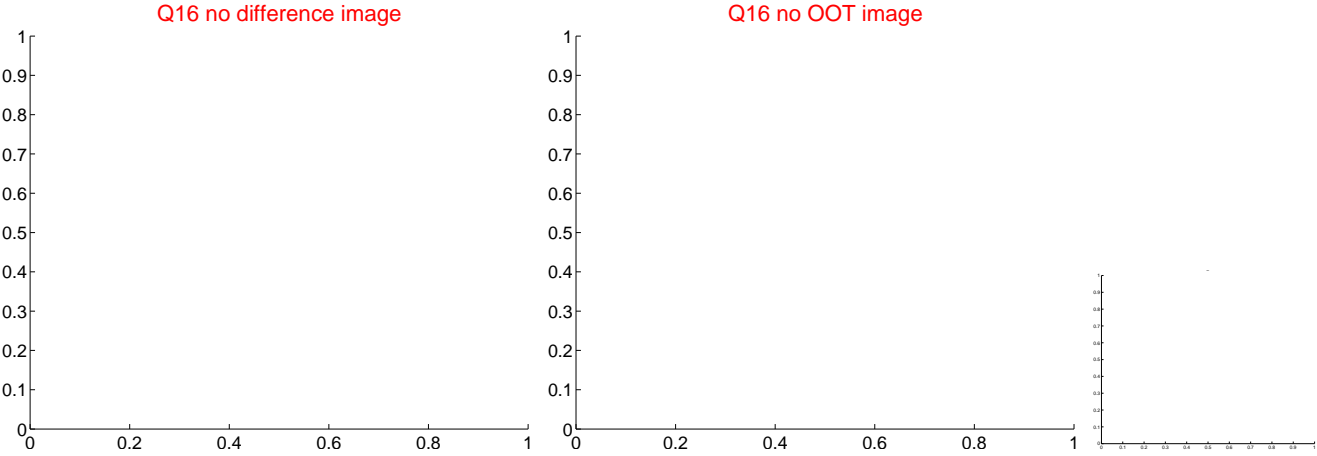
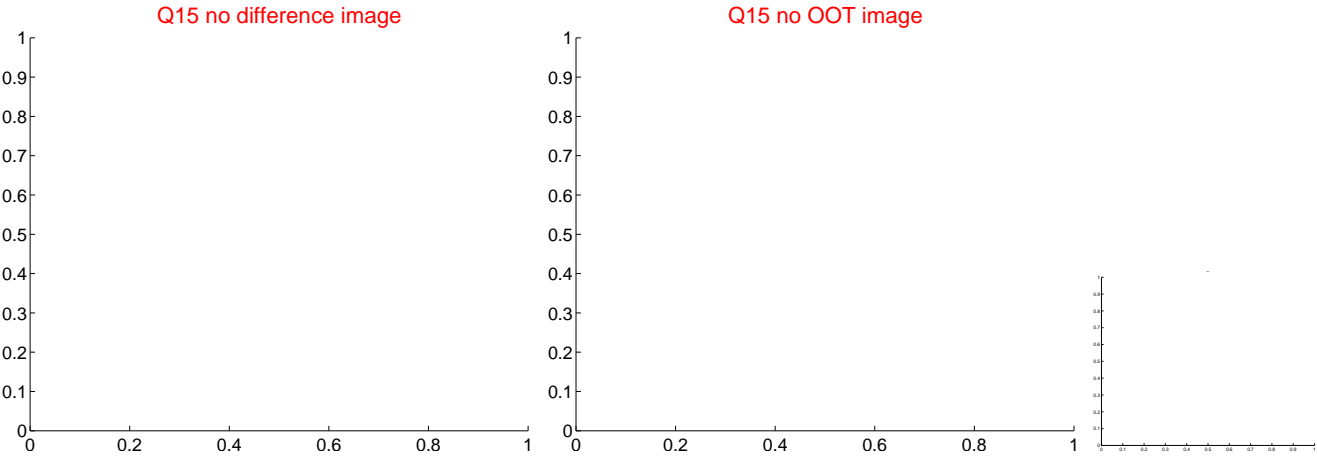
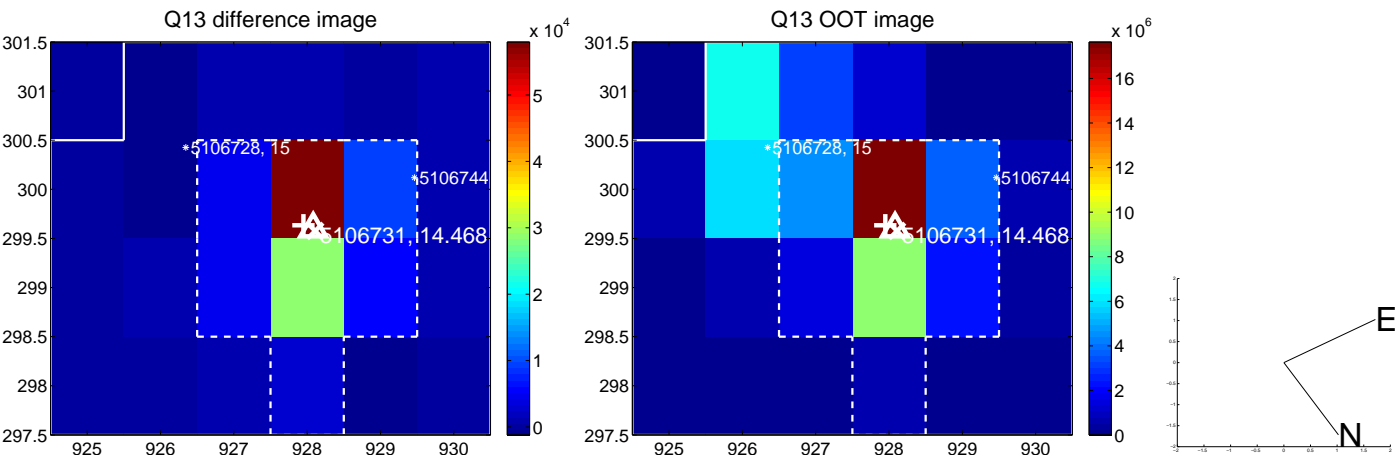
Q8 OOT image



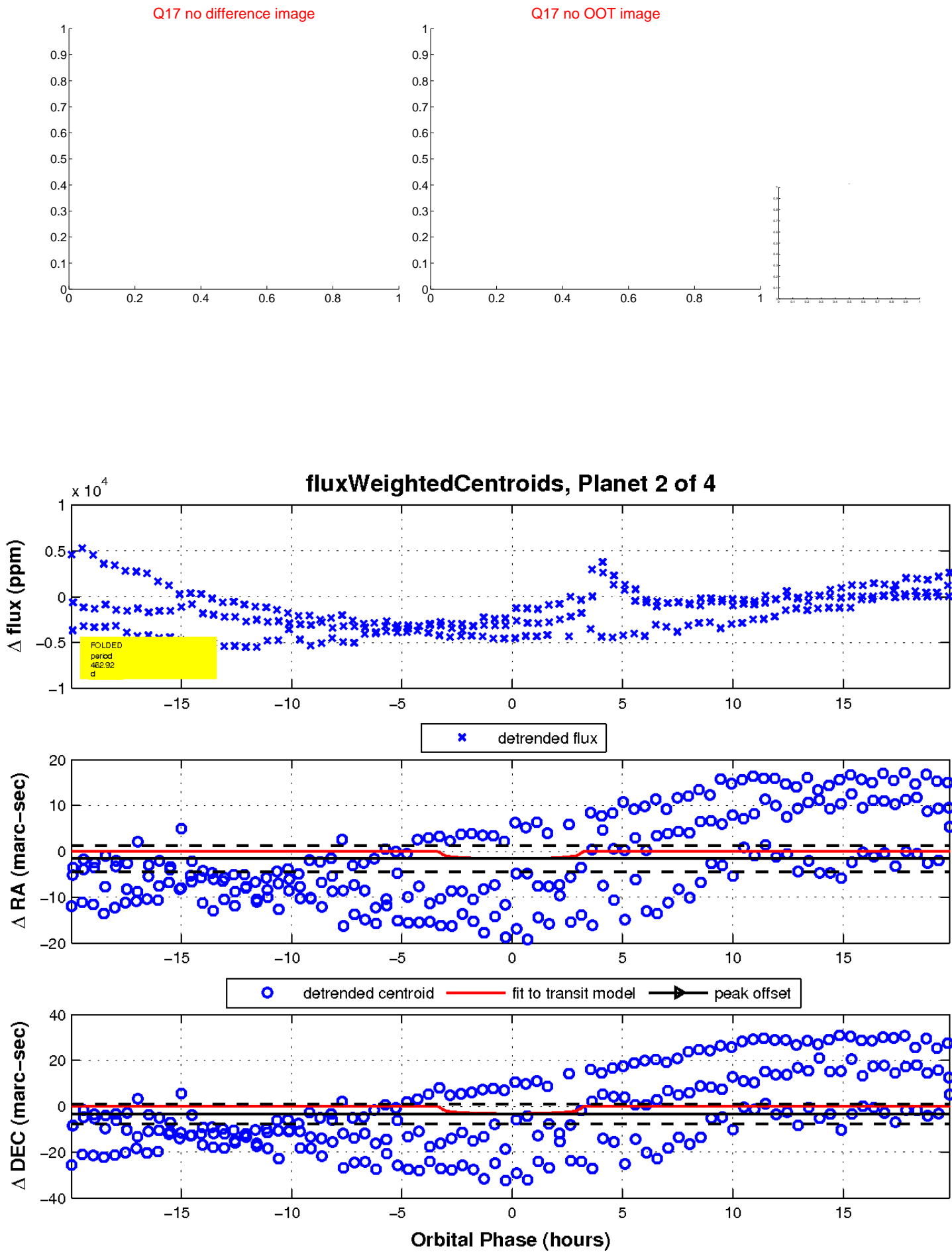
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

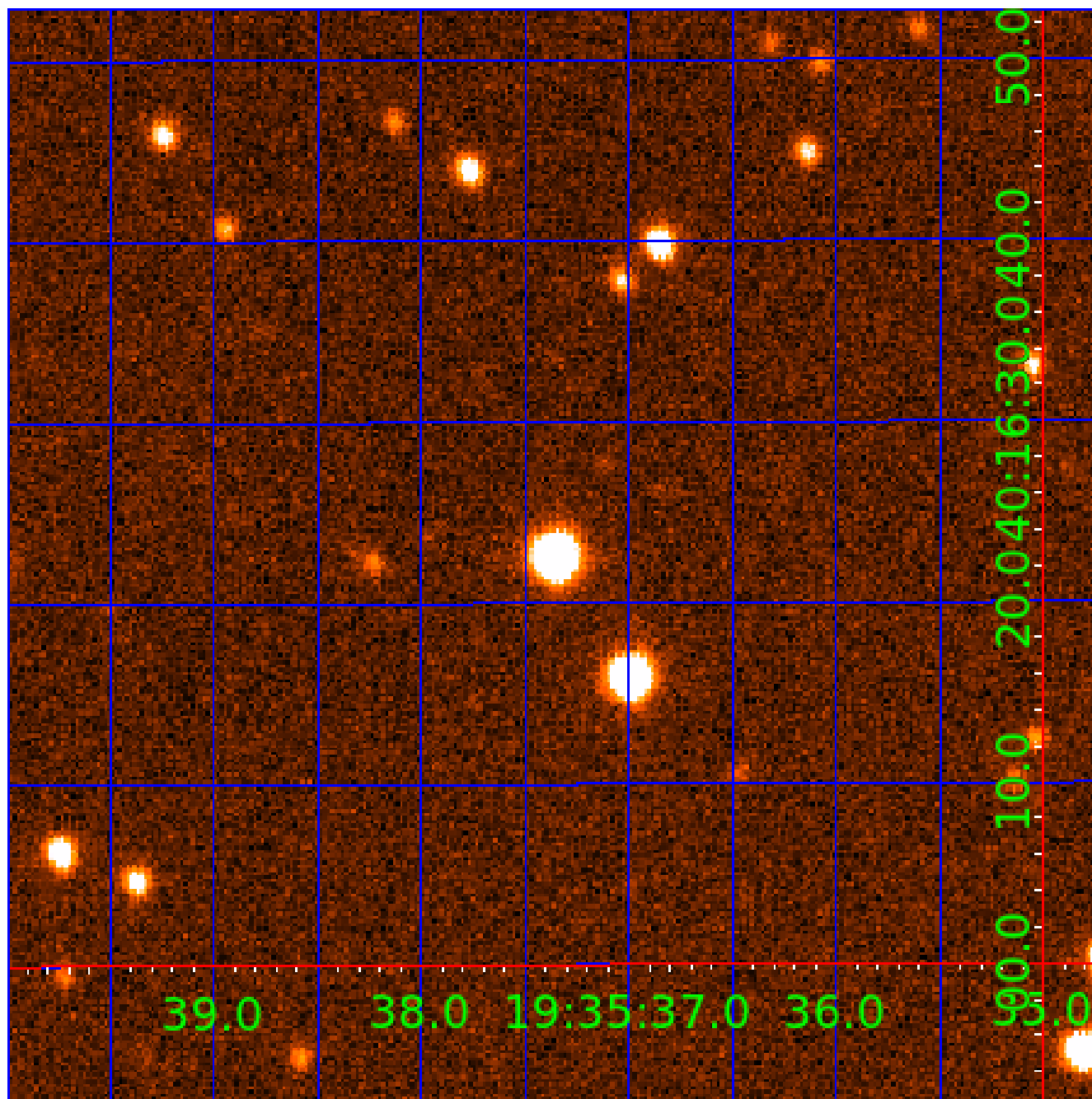


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 005106731

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
005106731-01	OBS	No	492.120079	517.569402	1224.1	3.393	17.1	7.9	1.63	5343	5.70	1.44
005106731-02	OBS	No	462.923838	328.868886	993.3	6.671	13.1	5.2	1.63	5343	5.35	1.56
005106731-03	OBS	No	207.838324	304.698473	792.7	2.779	12.9	5.7	1.63	5343	4.96	4.54
005106731-04	OBS	No	388.173766	359.493346	1010.2	3.971	11.2	7.3	1.63	5343	5.51	1.97

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
005106731-01	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES_MARSHALL_ZUMA—LPP_DV—ALL_TRANS_CHASES—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS
005106731-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS
005106731-03	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_CHASES_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS—HALO_GHOST
005106731-04	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_CHASES_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS

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

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

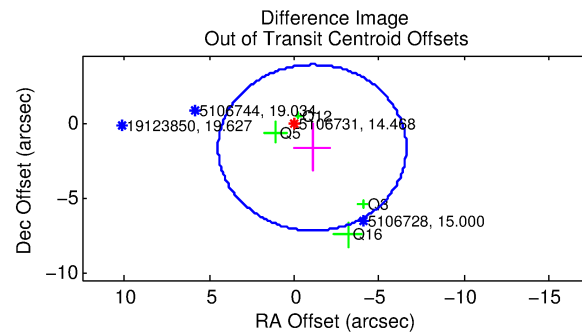
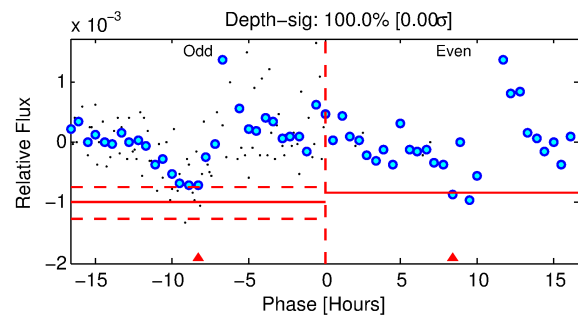
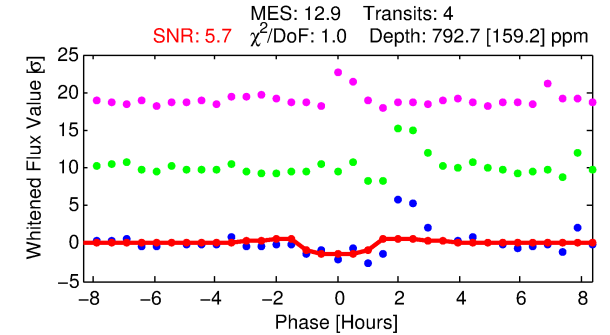
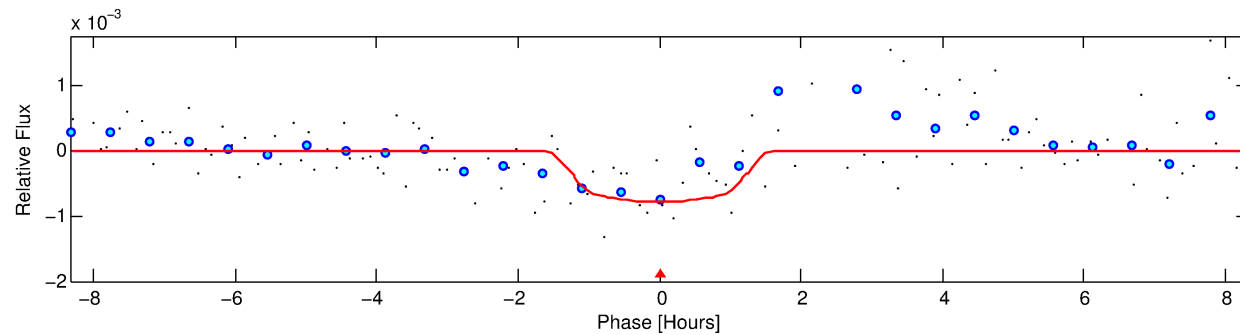
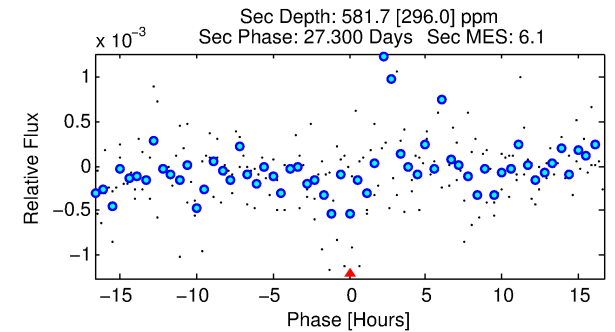
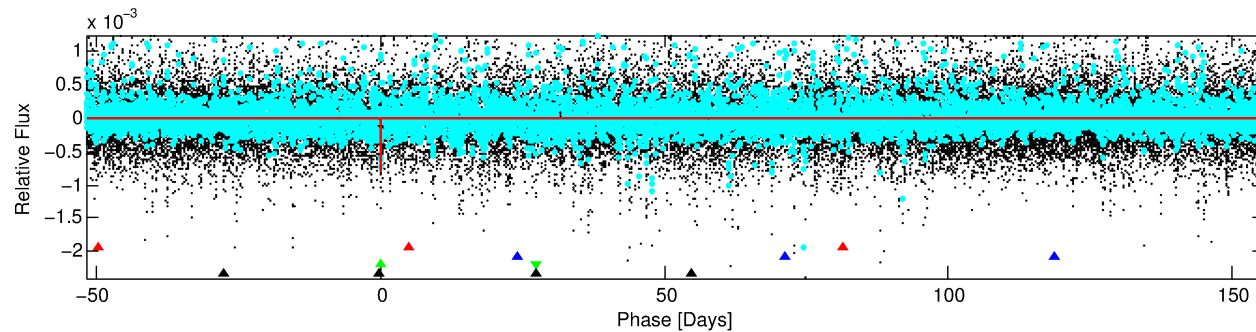
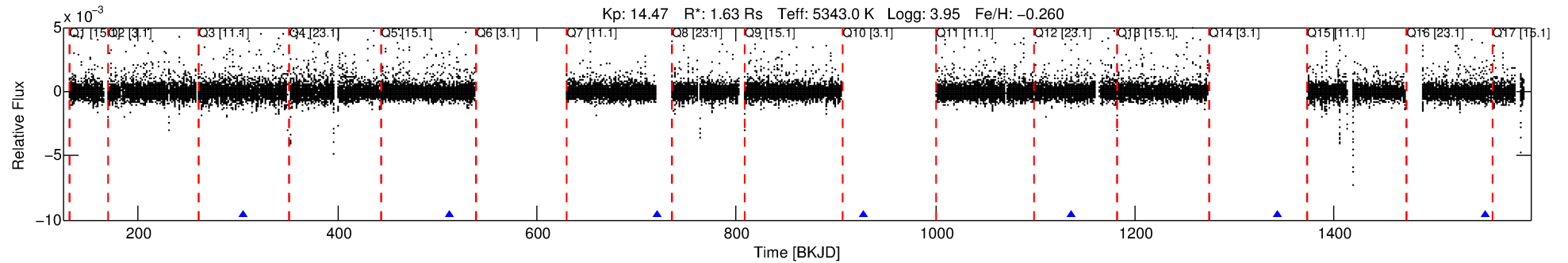
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 005106731-03

No Significant Match Found

# DV One-Page Summary

KIC: 5106731 Candidate: 3 of 4 Period: 207.838 d



## DV Fit Results:

Period = 207.83832 [0.00296] d  
Epoch = 304.6985 [0.0083] BKJD  
Rp/R\* = 0.0279 [0.0563]  
a/R\* = 412.77 [3313.96]  
b = 0.73 [5.22]  
Seff = 4.54 [4.92]  
Teq = 372 [101] K  
Rp = 4.96 [10.38] Re  
a = 0.6544 [0.4093] AU  
Ag = 5568.94 [23452.43] [0.24σ]  
Teff = 4970 [5061] K [0.91σ]

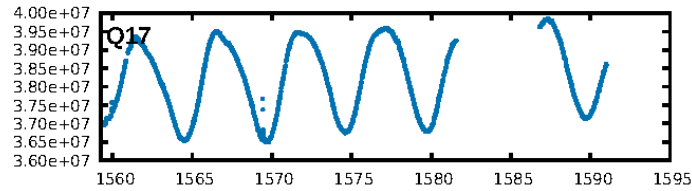
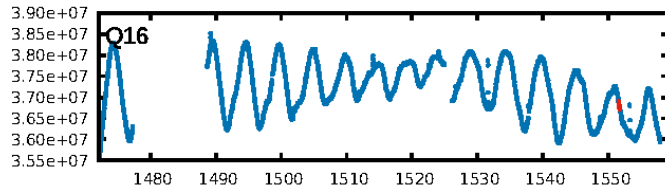
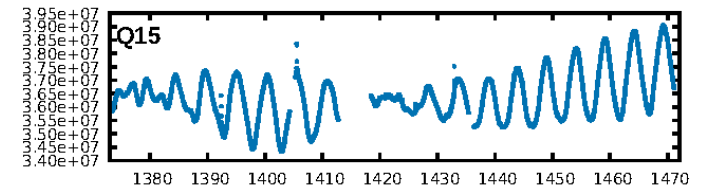
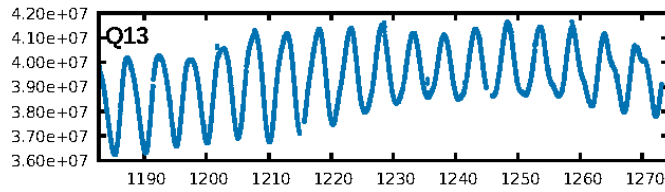
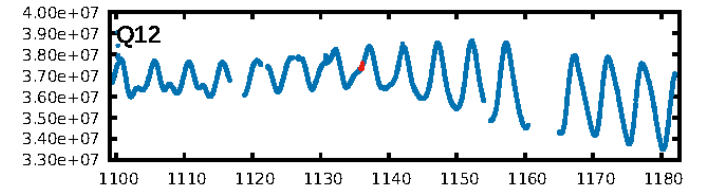
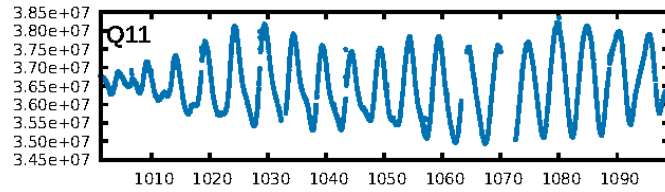
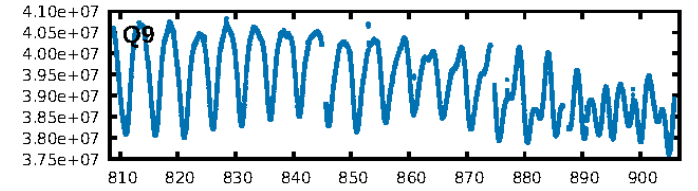
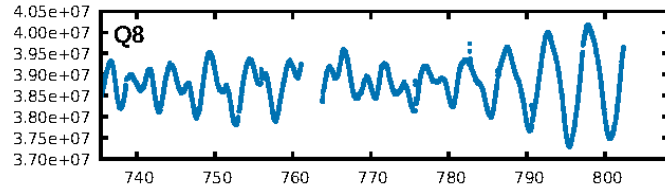
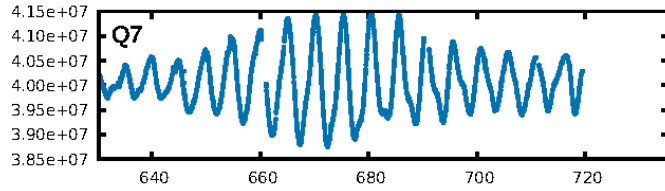
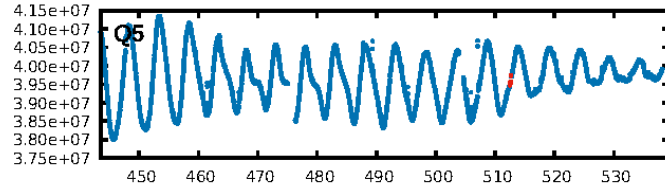
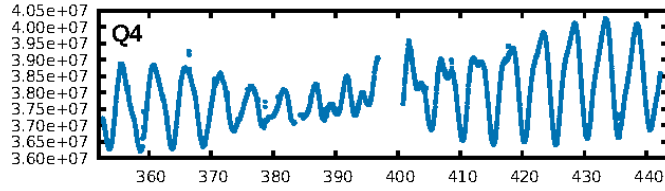
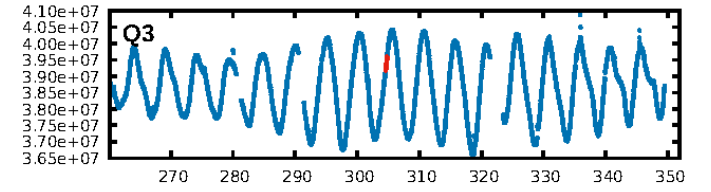
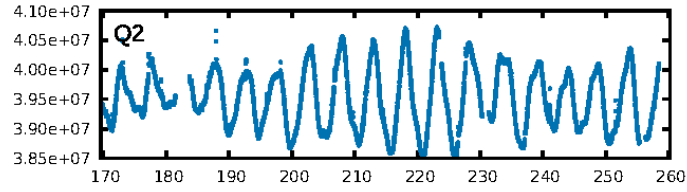
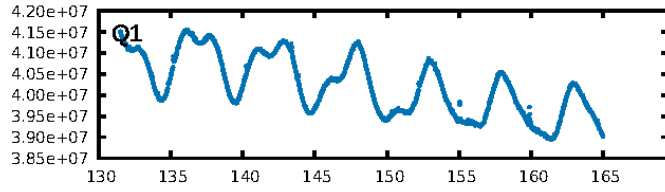
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [893.02σ]  
ModelChiSquare2-sig: 15.4%  
ModelChiSquareGof-sig: 96.2%  
Bootstrap-pfa: 2.08e-13  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: -0.206  
Centroid-sig: 68.5%  
Centroid-so: 1.857 arcsec [0.59σ]  
OotOffset-rm: 1.984 arcsec [1.07σ]  
KicOffset-rm: 2.324 arcsec [0.94σ]  
OotOffset-st: 0/1/2/1 [4]  
KicOffset-st: 0/1/2/1 [4]  
DiffImageQuality-fgm: 0.50 [2/4]  
DiffImageOverlap-fno: 0.75 [3/4]

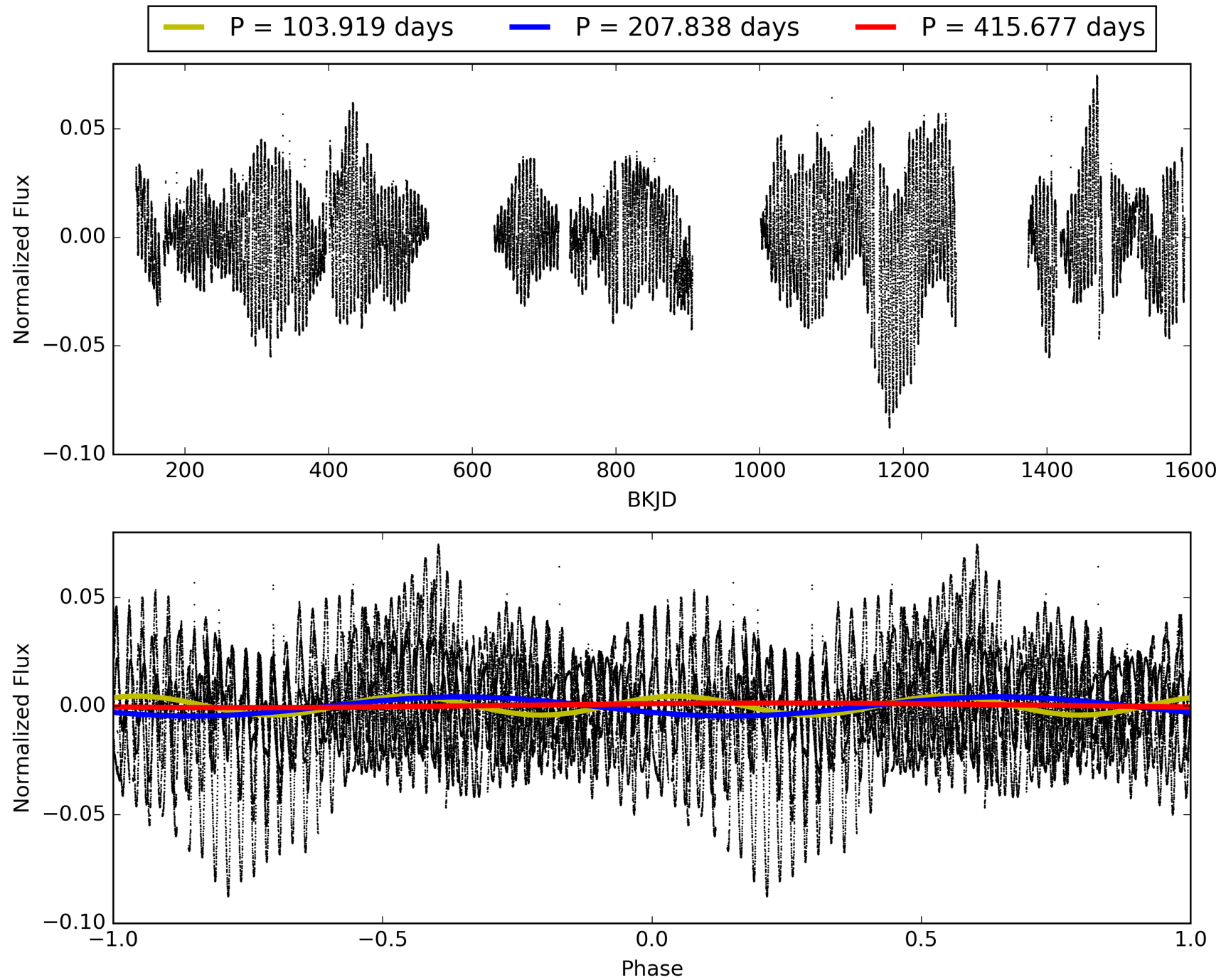
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 01-Feb-2016 05:51:23 Z

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

# TCE 005106731-03, PDC Light Curves

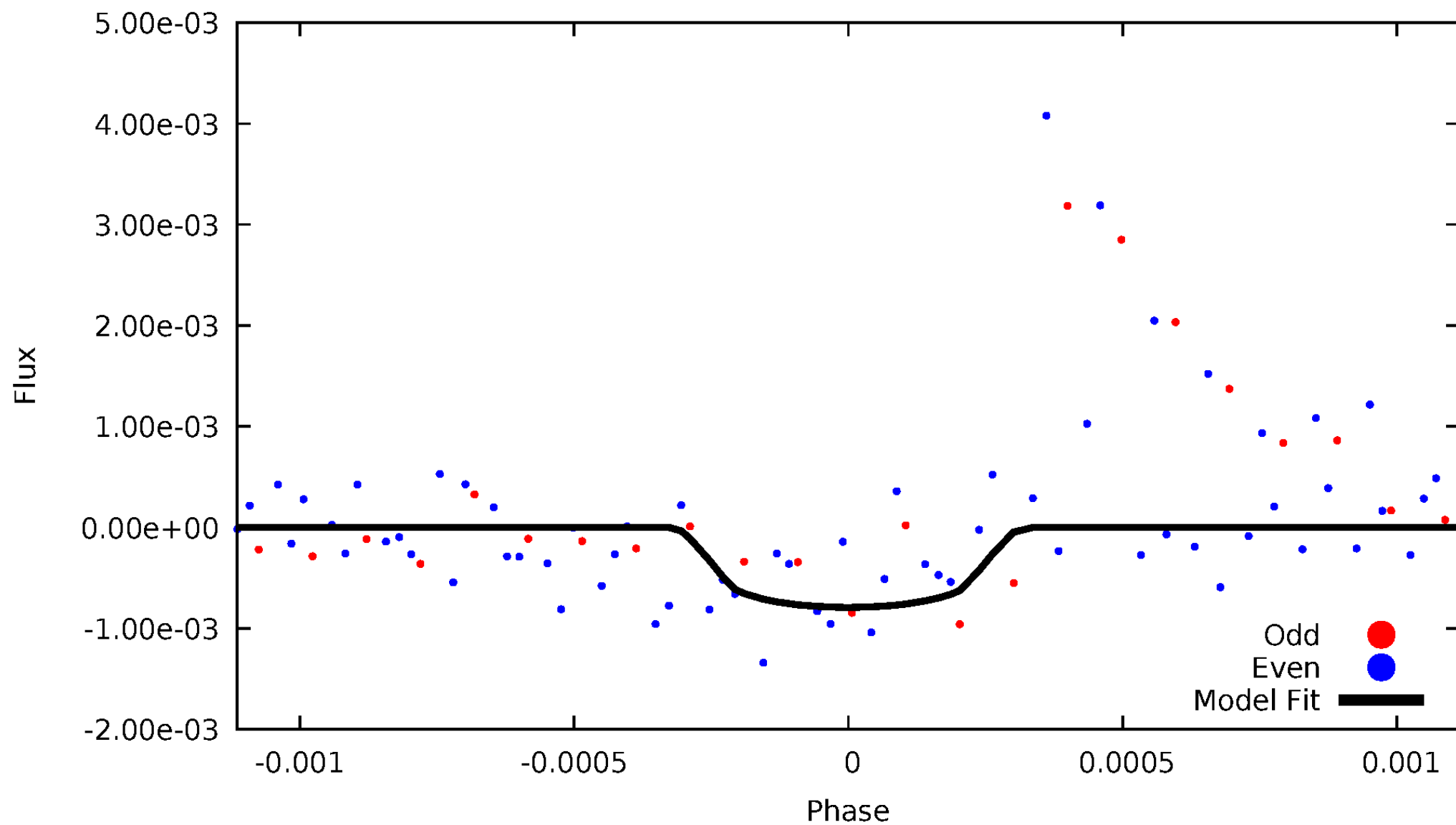


TCE 005106731-03



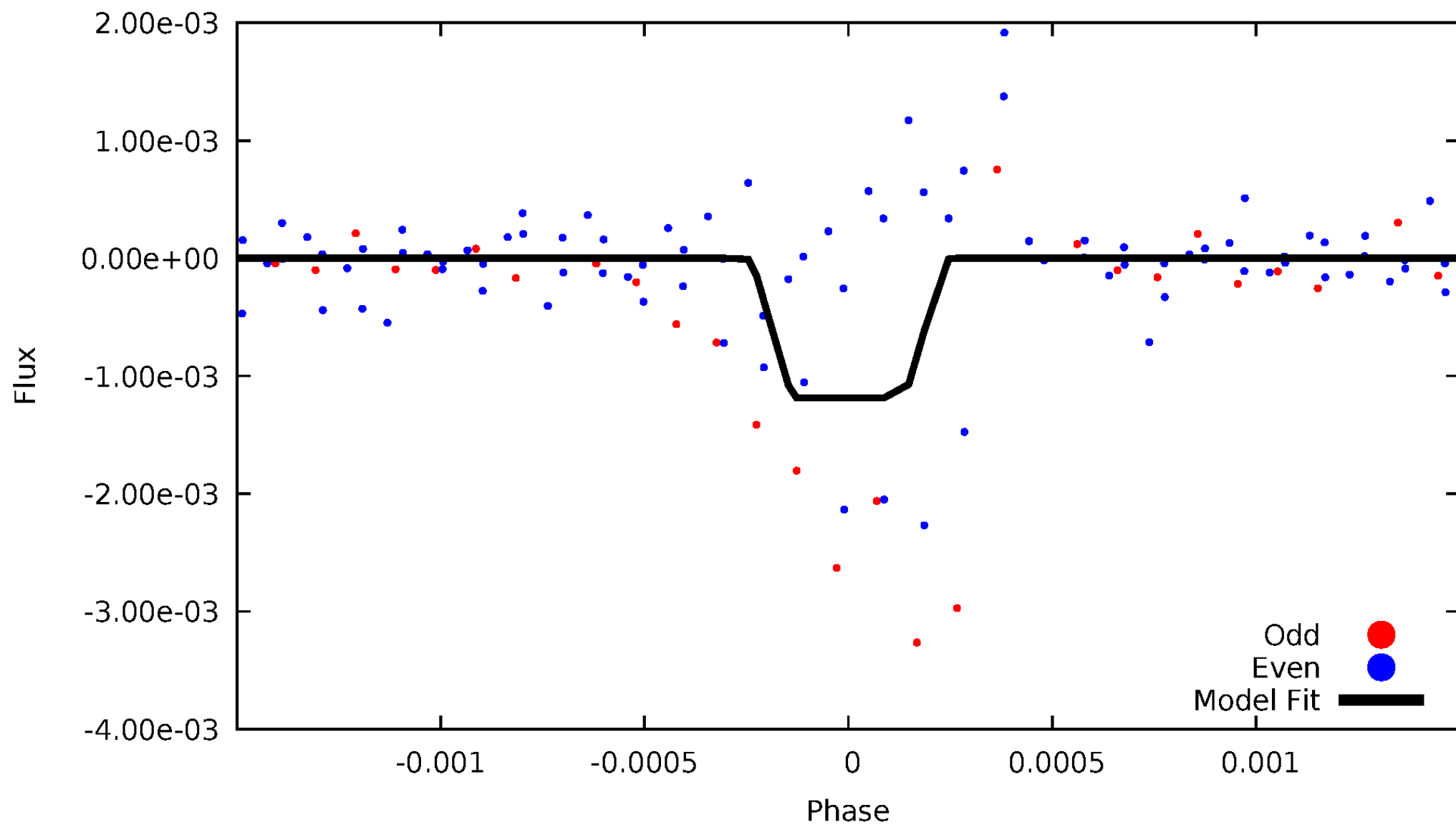
# DV Odd/Even

TCE 005106731-03



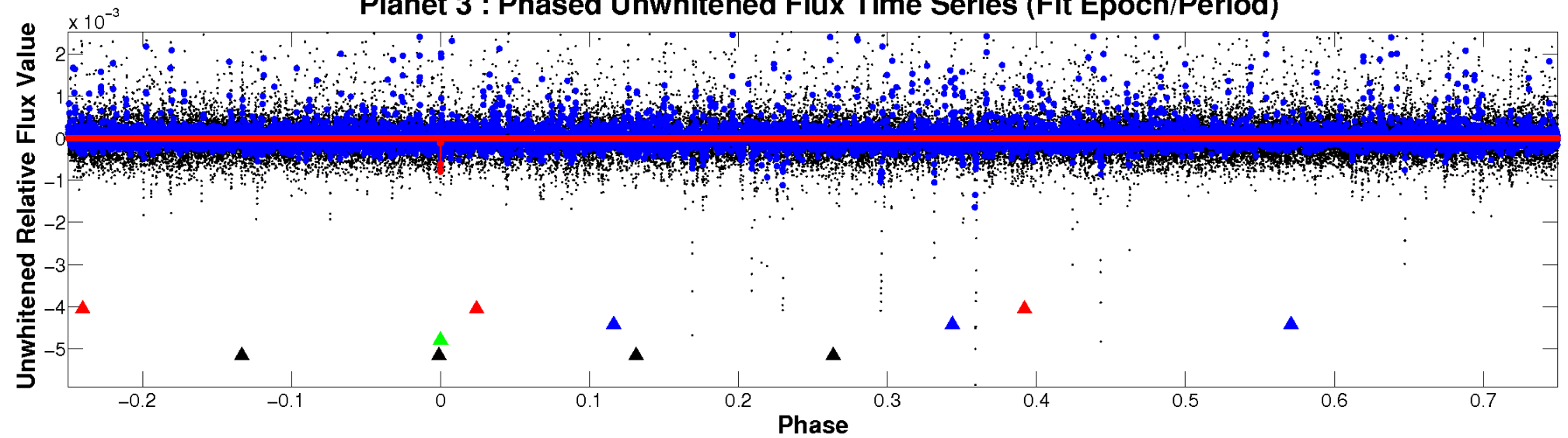
# ALT Odd/Even

TCE 005106731-03

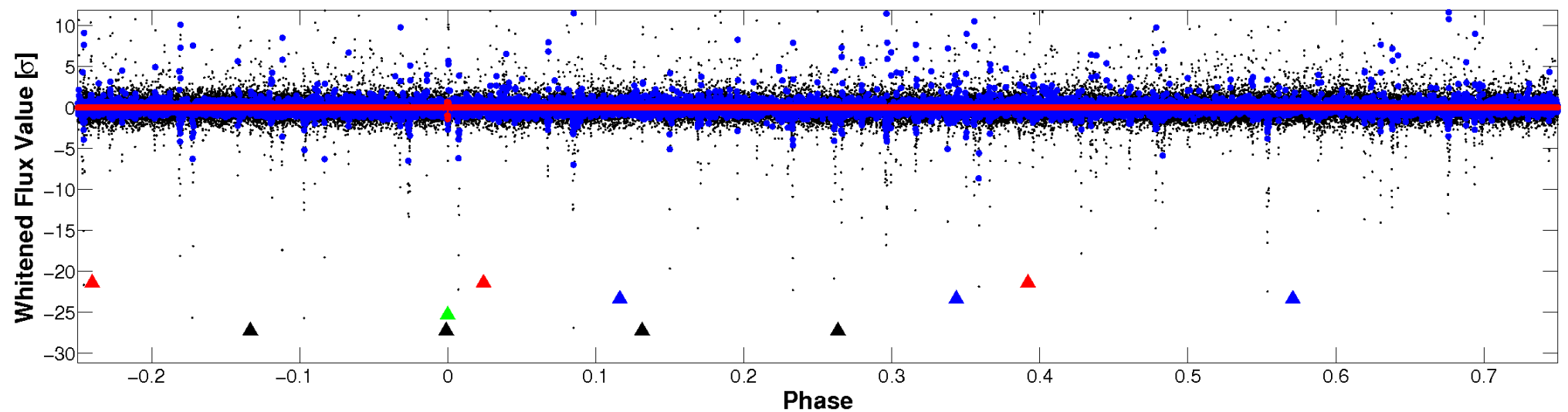


# Non-Whitened Vs. Whitened Light Curve

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

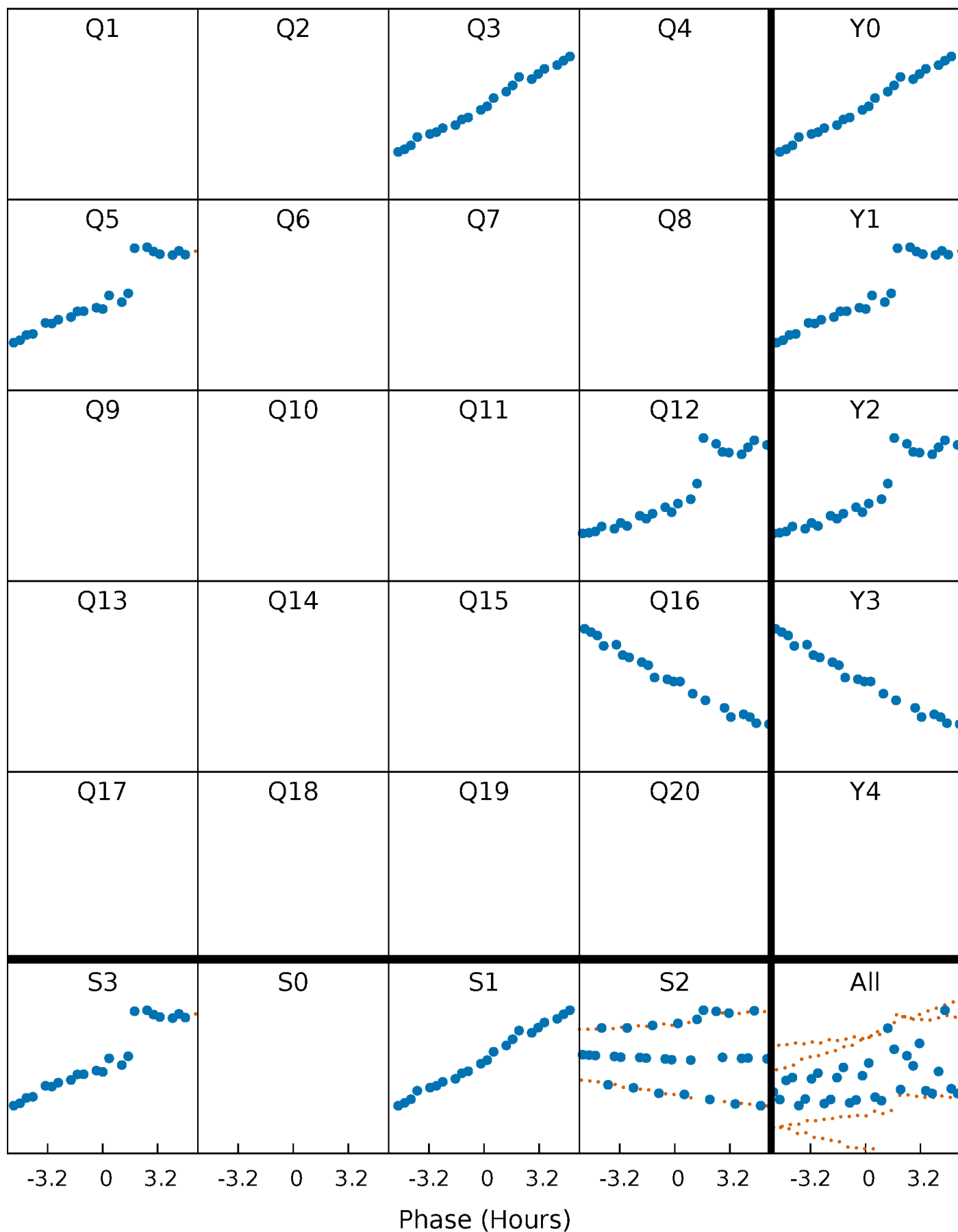


Planet 3 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

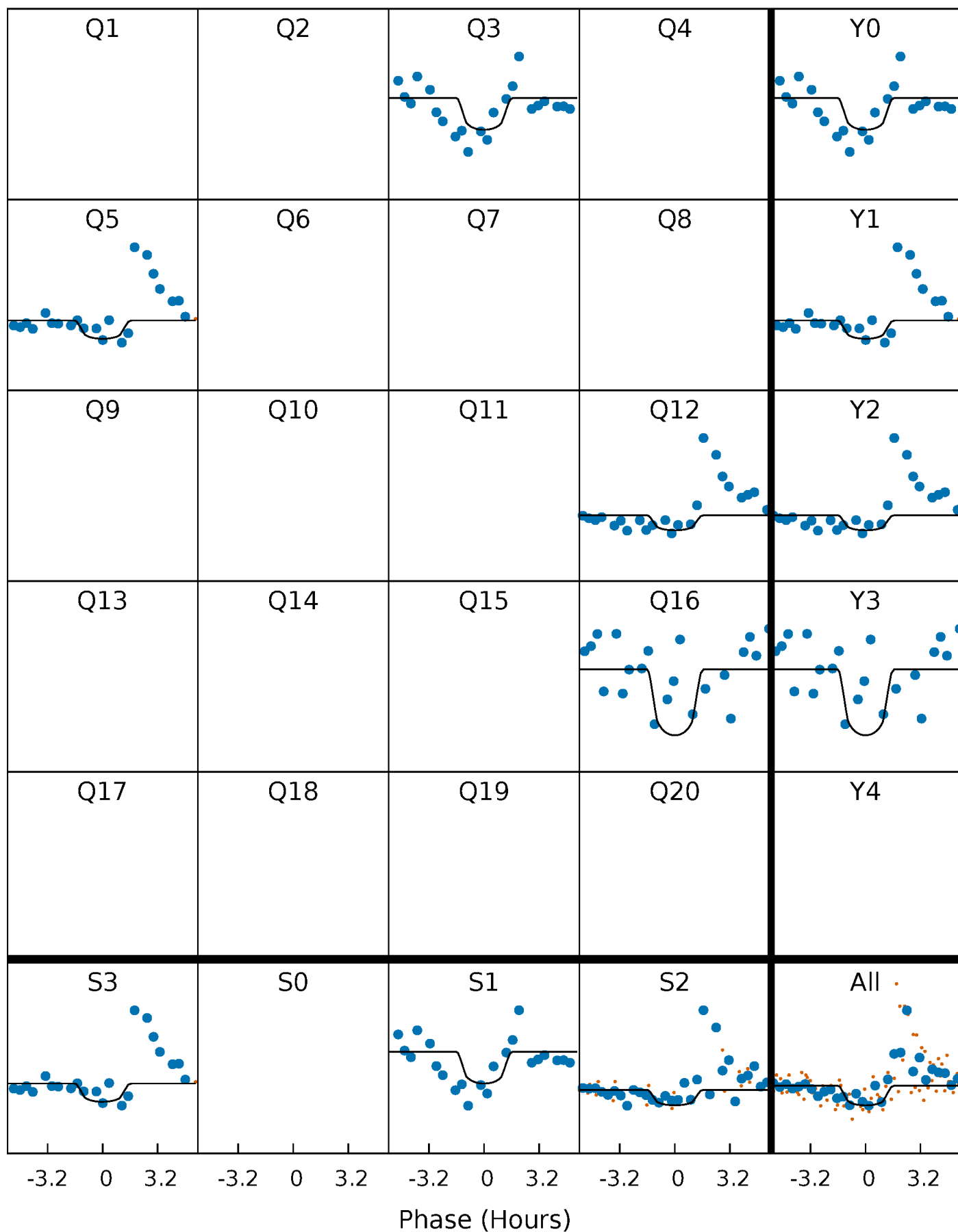
TCE 005106731-03     $P=207.838324$  Days     $T_0=304.698473$  (BKJD)





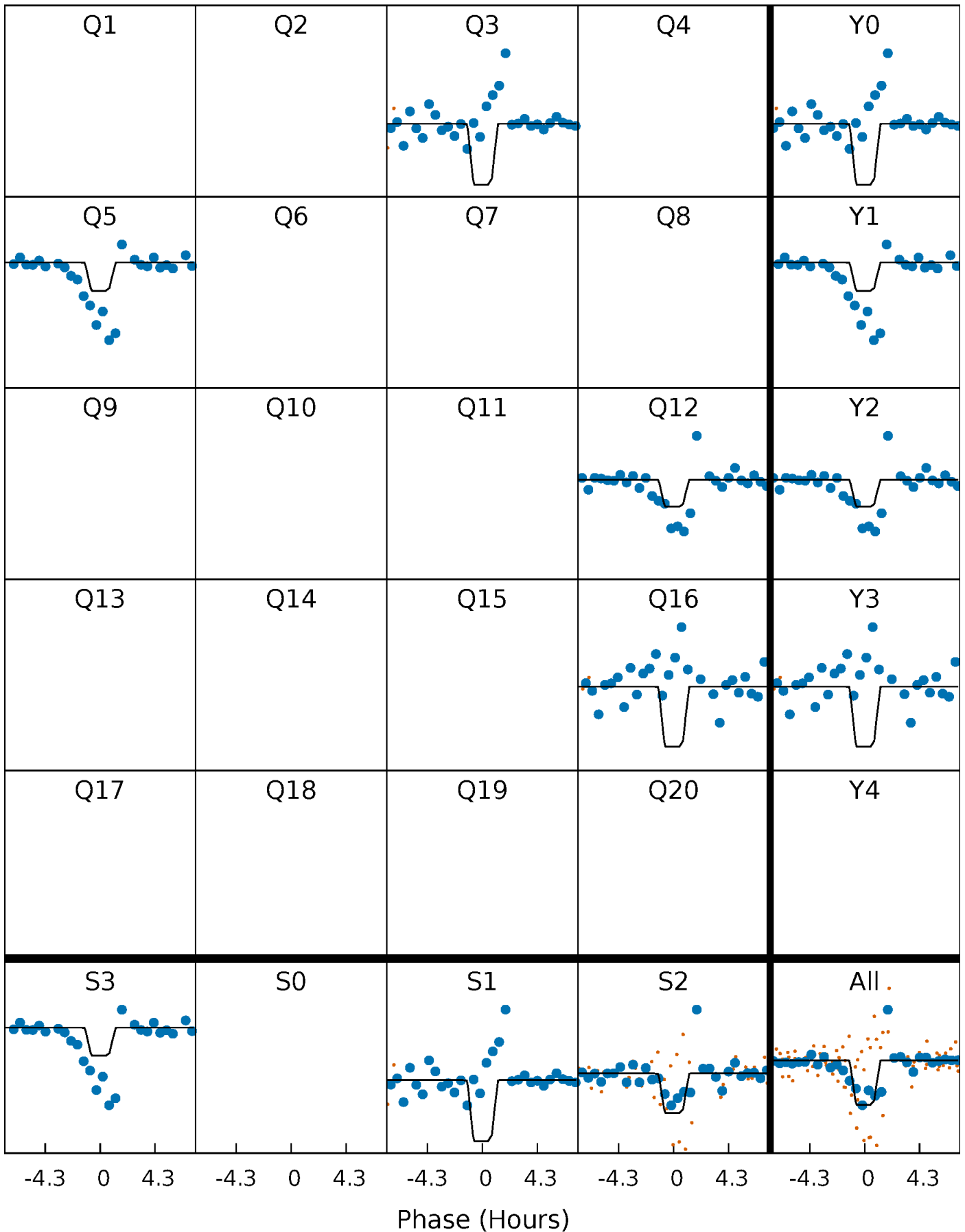
# DV Quarter-Phased Transit Curves

TCE 005106731-03     $P=207.838324$  Days     $T_0=304.698473$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

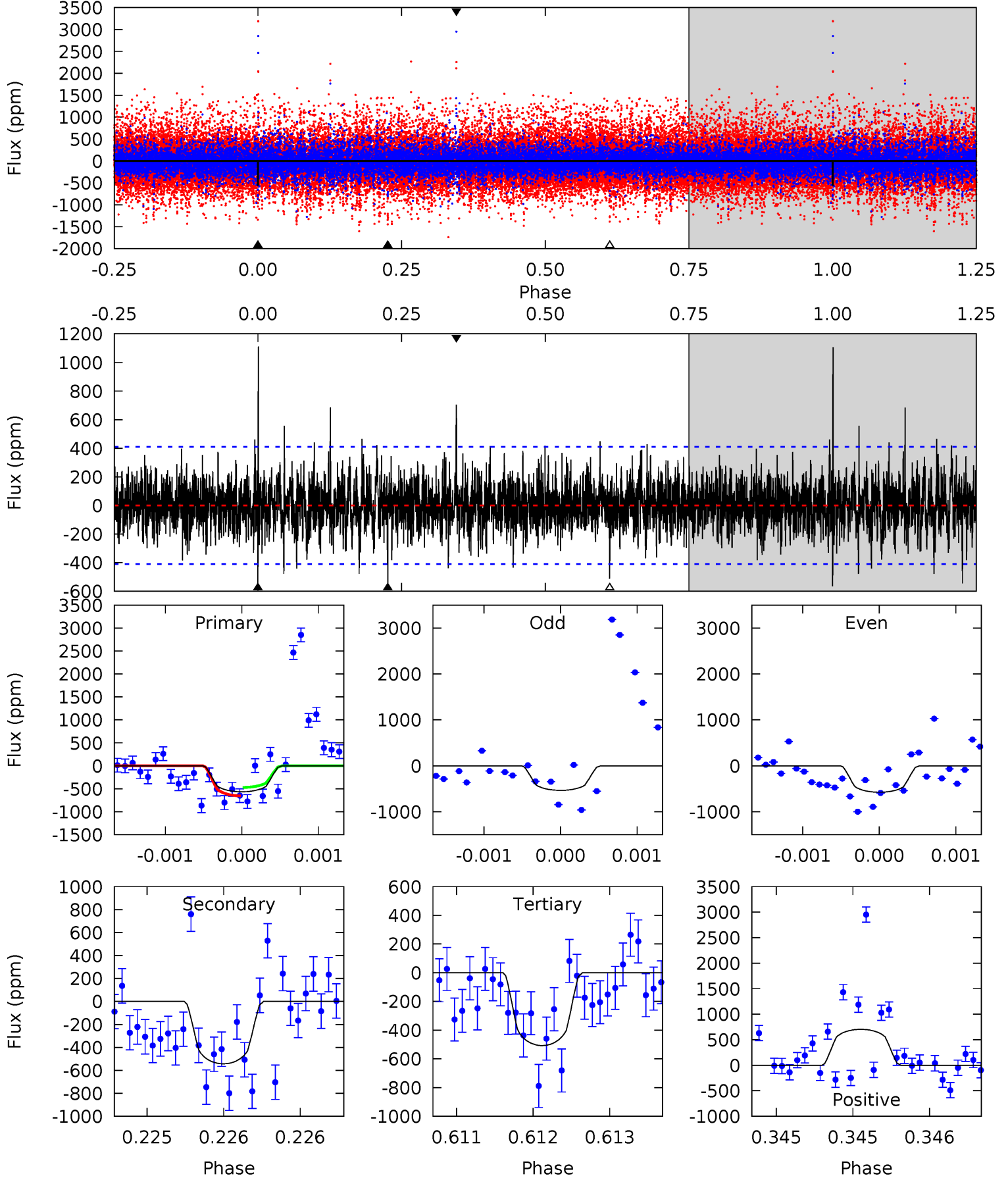
TCE 005106731-03     $P=207.834399$  Days     $T_0=304.709653$  (BKJD)



# DV Model-Shift Uniqueness Test

005106731-03, P = 207.838324 Days, E = 96.860149 Days

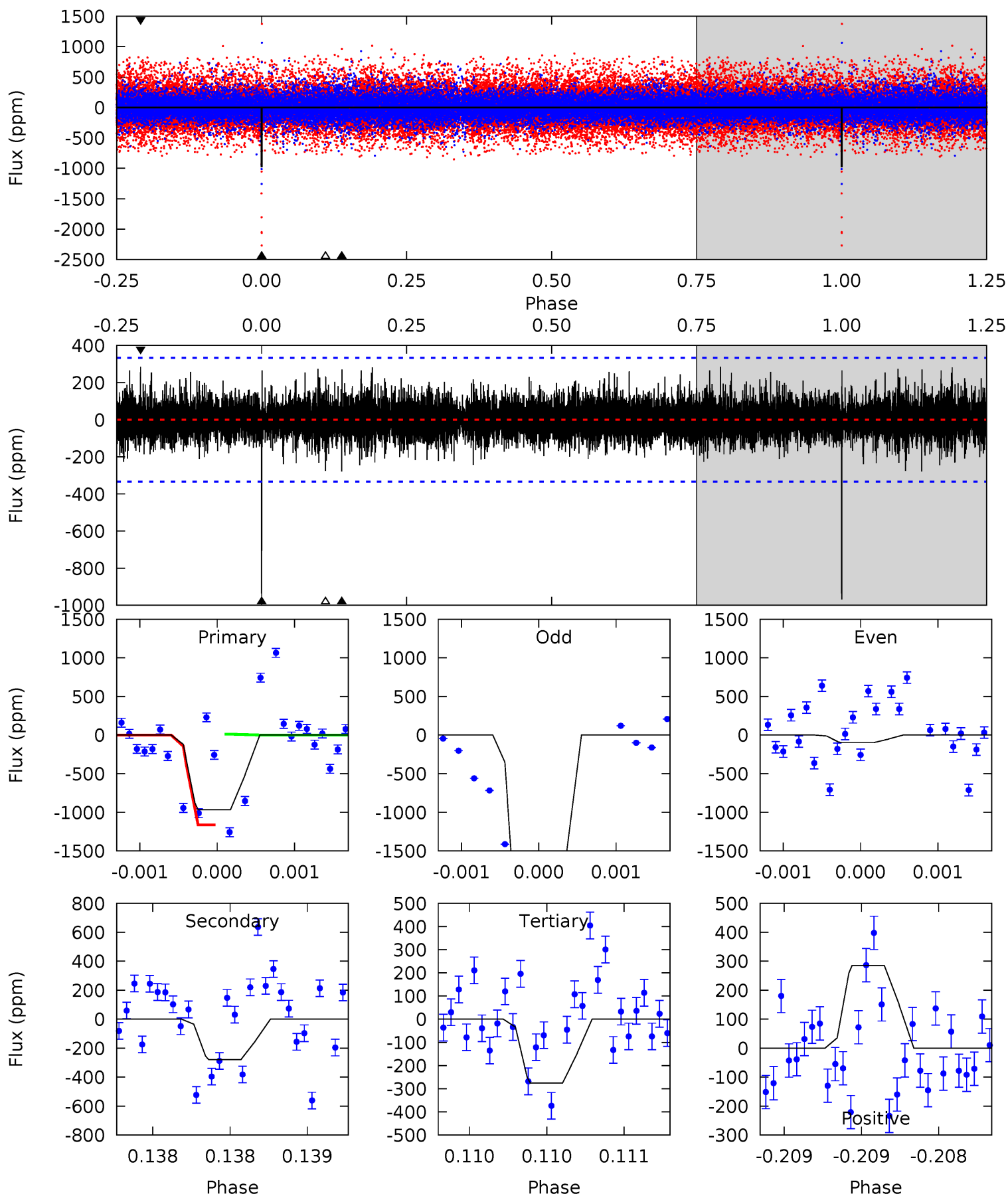
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
7.63	7.33	6.85	9.50	5.53	3.41	1.70	0.78	-1.87	0.48	-2.17	0.21	1.04	0.66	1.25



# Alt Model-Shift Uniqueness Test

005106731-03, P = 207.834399 Days, E = 96.875254 Days

Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
16.2	4.66	4.60	4.76	5.57	3.47	1.08	11.6	11.4	0.06	-0.10	21.7	1.04	0.23	0



### Stellar Parameters For KIC 005106731

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5343^{+175}_{-159}$	$3.950^{+0.660}_{-0.264}$	$-0.260^{+0.350}_{-0.250}$	$1.631^{+0.735}_{-0.898}$	$0.867^{+0.084}_{-0.115}$	$0.281^{+2.172}_{-0.162}$
	+3%/-3%	+17%/-7%	+135%/-96%	+45%/-55%	+10%/-13%	+772%/-58%
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 005106731-03 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-543 \pm 74$	$8.13^{+9.08}_{-5.71}$	$508^{+68}_{-79}$	$3928^{+2648}_{-753}$	$1985^{+19252}_{-1554}$
Alt.	$-279 \pm 60$	$8.92^{+9.48}_{-6.15}$	$511^{+64}_{-79}$	$3394^{+1617}_{-578}$	$781^{+7728}_{-601}$

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

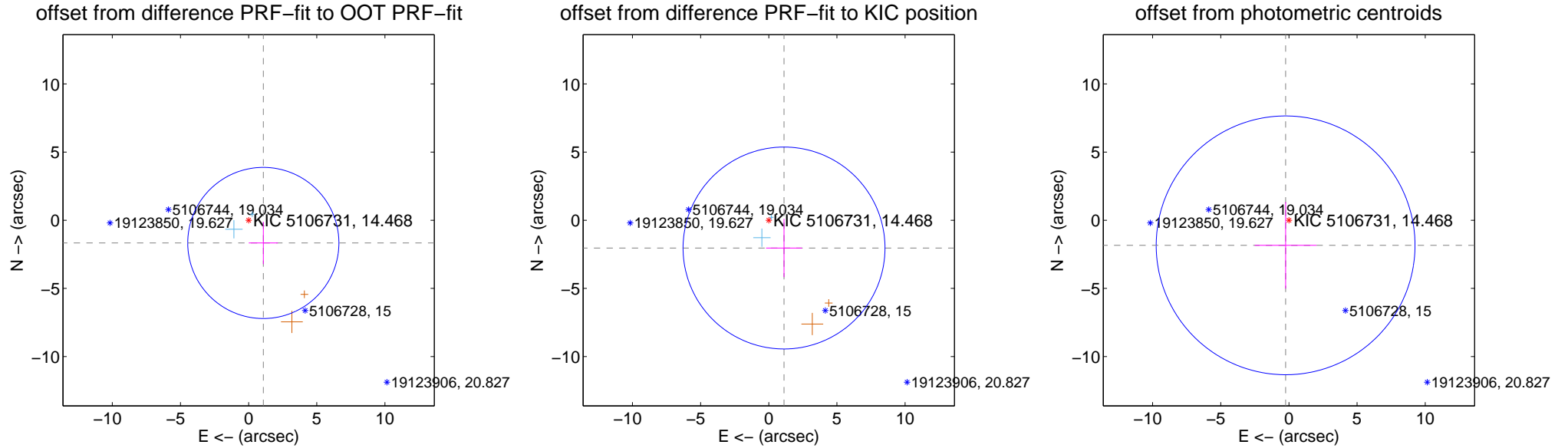
## DV Centroid Data

Supplemental centroid analysis for 005106731-03. Kepler magnitude: 14.47. Transit SNR 5.73

There are 2 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.16 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$1.984 \pm 1.847$	1.07	$-1.078 \pm 1.070$	$-1.666 \pm 1.551$
PRF-fit source offset from KIC position	$2.324 \pm 2.468$	0.94	$-1.118 \pm 1.318$	$-2.037 \pm 2.137$
photometric centroid source offset	$1.86 \pm 3.16$	0.59	$0.24 \pm 2.26$	$-1.84 \pm 3.18$



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.

Q1 no difference image



Q1 no OOT image



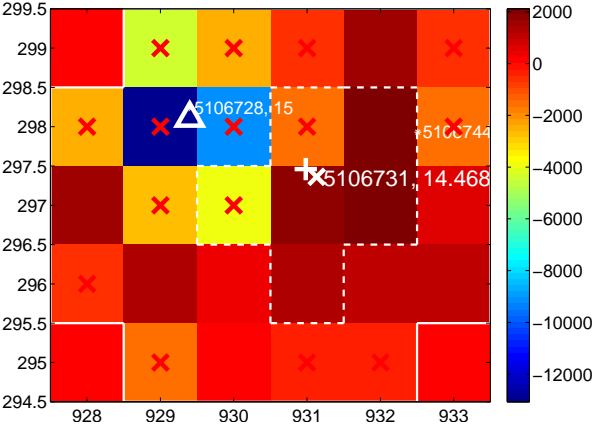
Q2 no difference image



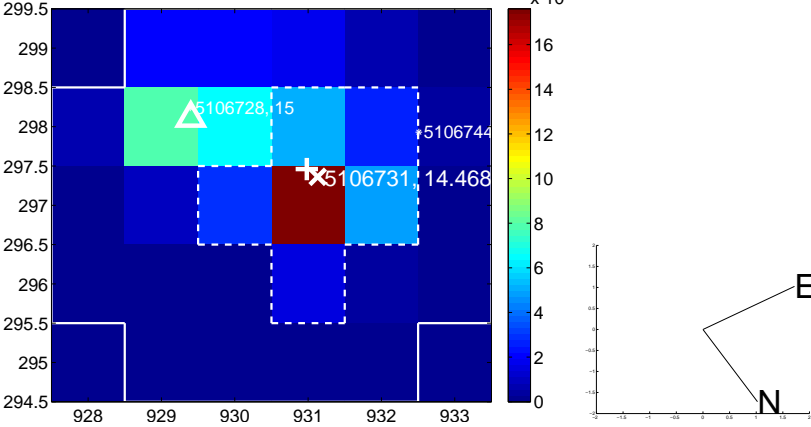
Q2 no OOT image



Q3 difference image. Poor Quality



Q3 OOT image



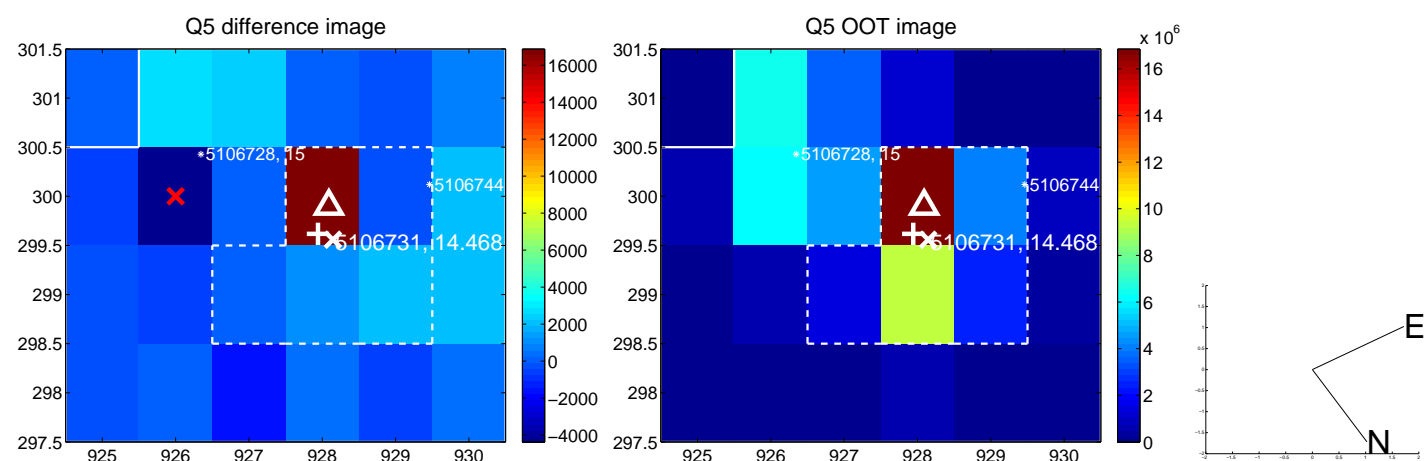
Q4 no difference image



Q4 no OOT image



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





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

Q9 no difference image



Q9 no OOT image



Q10 no difference image



Q10 no OOT image



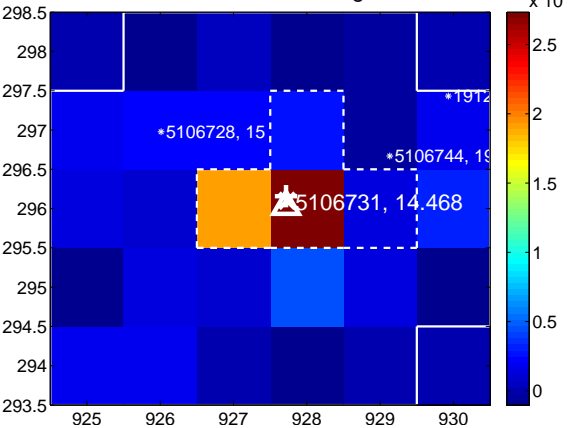
Q11 no difference image



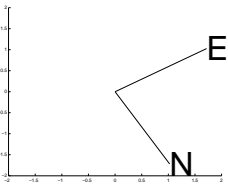
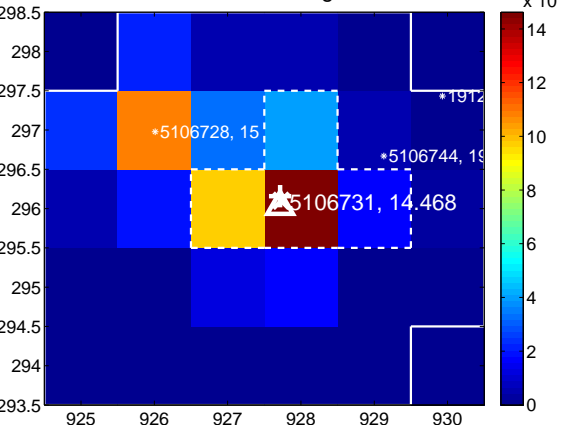
Q11 no OOT image



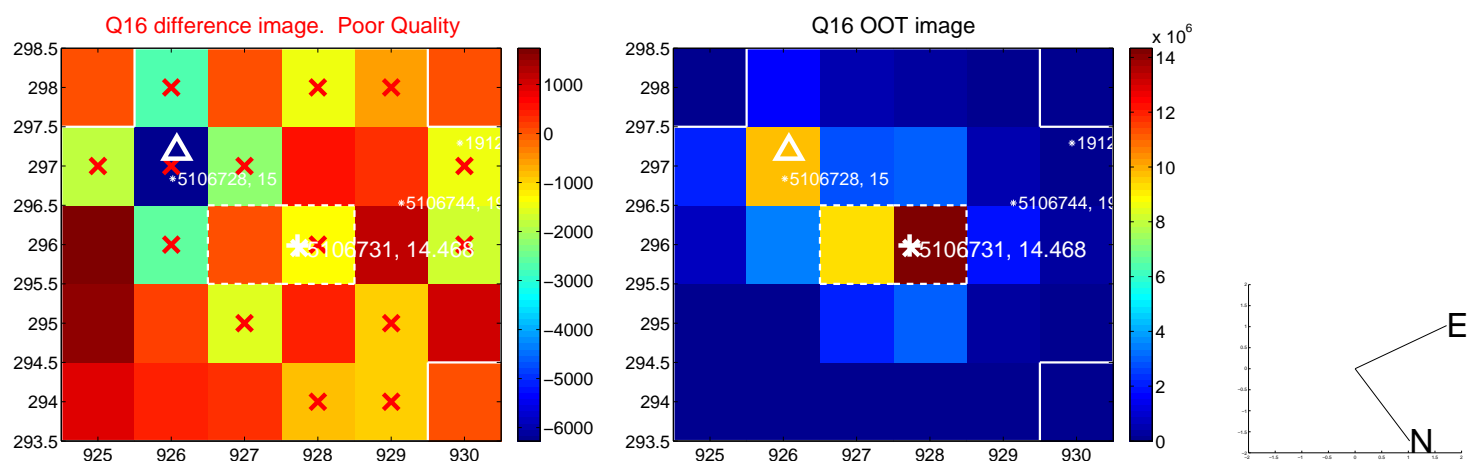
Q12 difference image



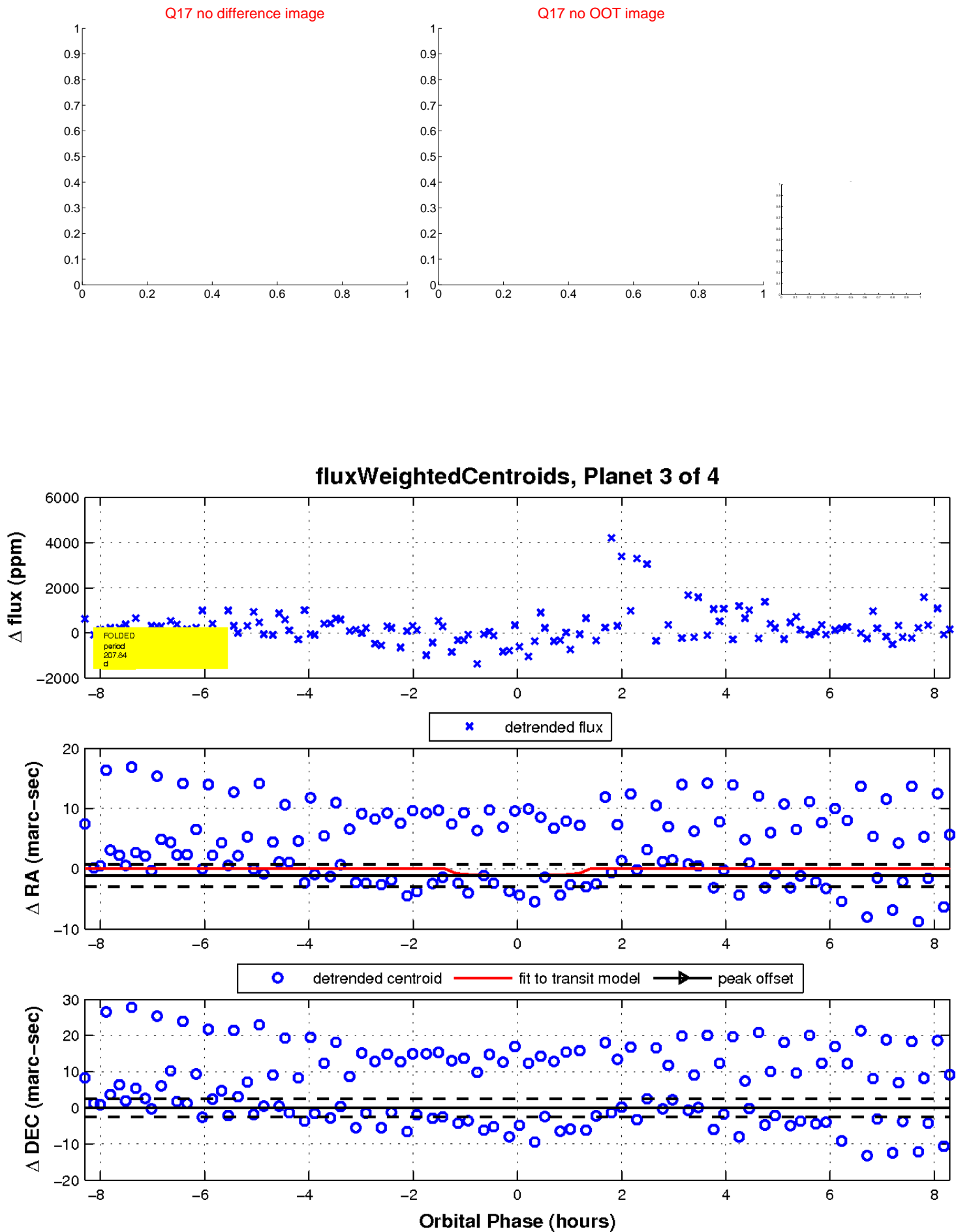
Q12 OOT image



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

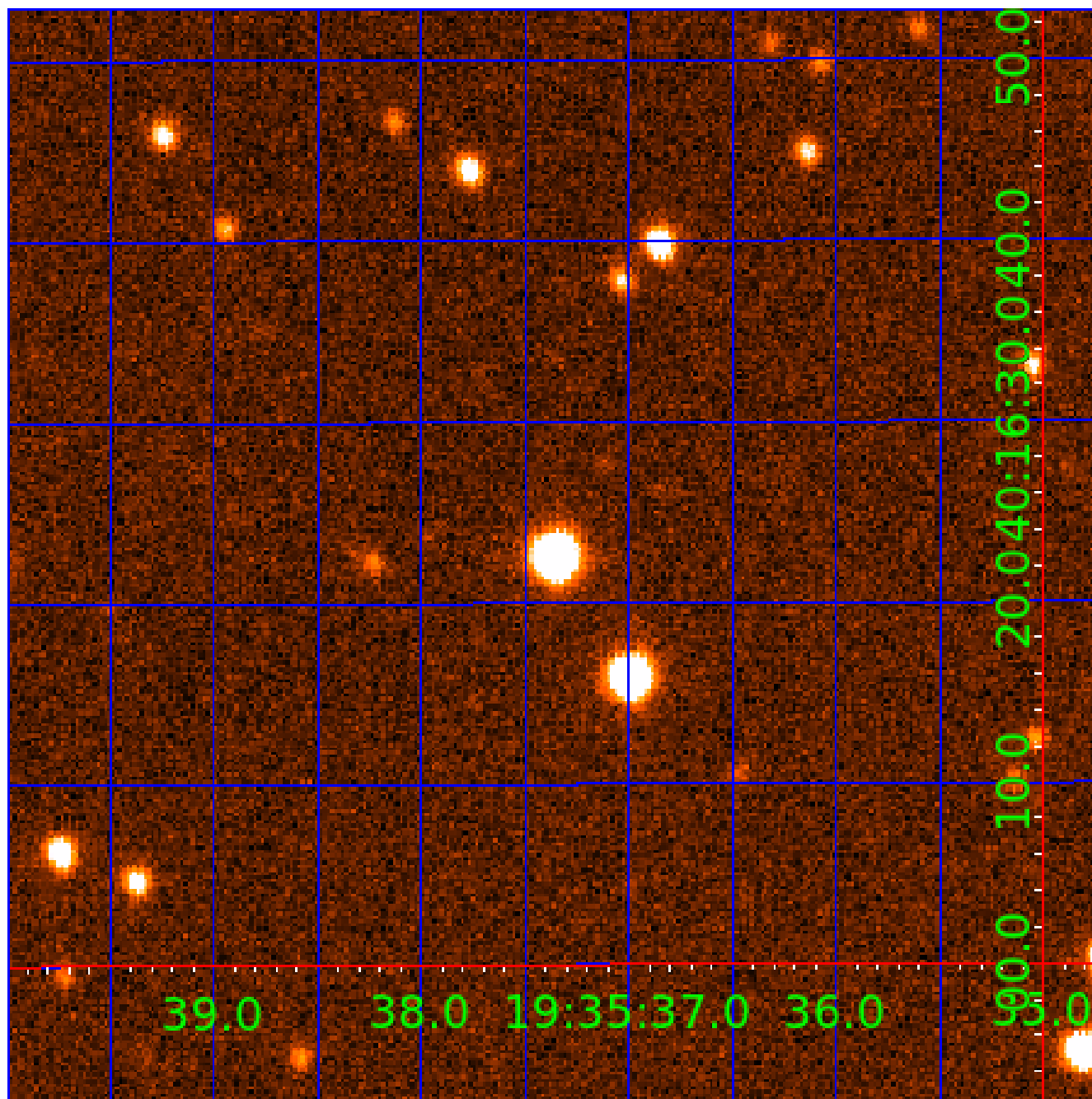


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 005106731

## 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)	$R_p$ ( $R_{\oplus}$ )	$S_p$ ( $S_{\oplus}$ )
005106731-01	OBS	No	492.120079	517.569402	1224.1	3.393	17.1	7.9	1.63	5343	5.70	1.44
005106731-02	OBS	No	462.923838	328.868886	993.3	6.671	13.1	5.2	1.63	5343	5.35	1.56
005106731-03	OBS	No	207.838324	304.698473	792.7	2.779	12.9	5.7	1.63	5343	4.96	4.54
005106731-04	OBS	No	388.173766	359.493346	1010.2	3.971	11.2	7.3	1.63	5343	5.51	1.97

## Robovetter Results

TCE	Run Type	Disp	Score	N	S	C	E	Comments
005106731-01	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES_MARSHALL_ZUMA—LPP_DV—ALL_TRANS_CHASES—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS
005106731-02	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_CHASES—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS
005106731-03	OBS	FP	0.00	1	0	1	0	INDIV_TRANS_CHASES_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS—HALO_GHOST
005106731-04	OBS	FP	0.00	1	0	0	0	INDIV_TRANS_RUBBLE_CHASES_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_NONUNIQ_DV—MOD_TER_DV—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS

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

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

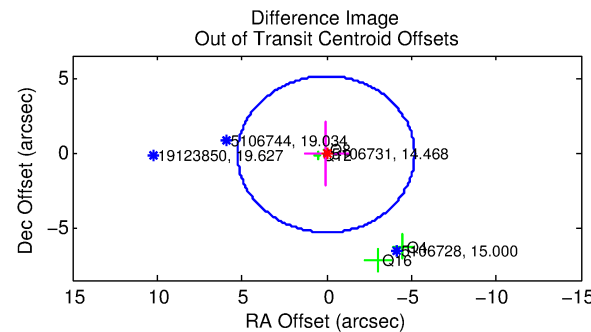
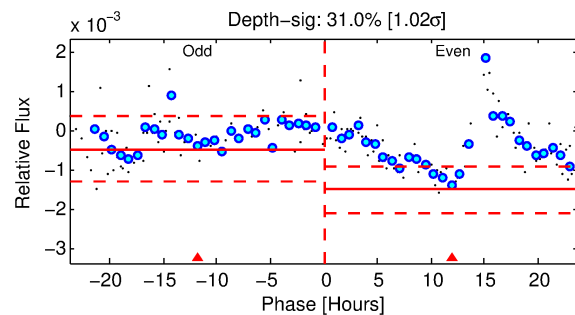
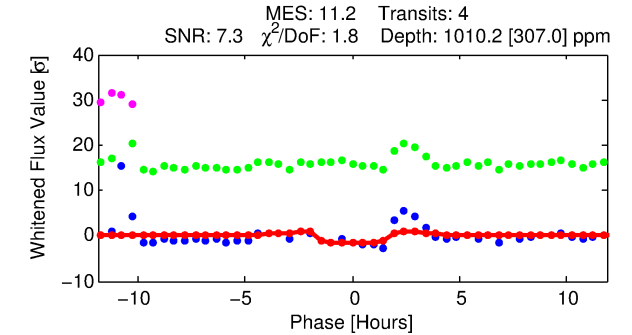
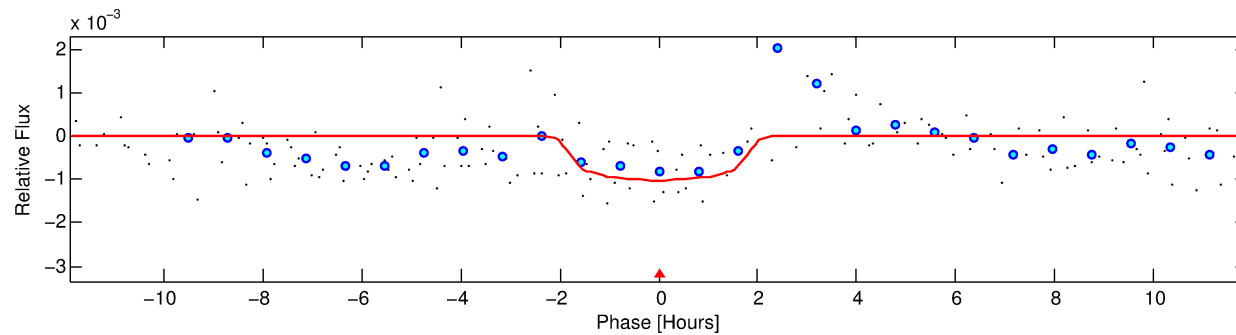
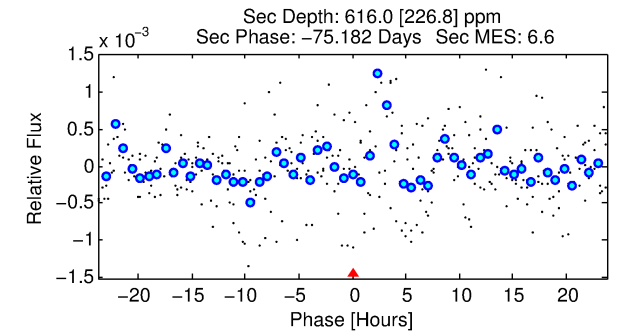
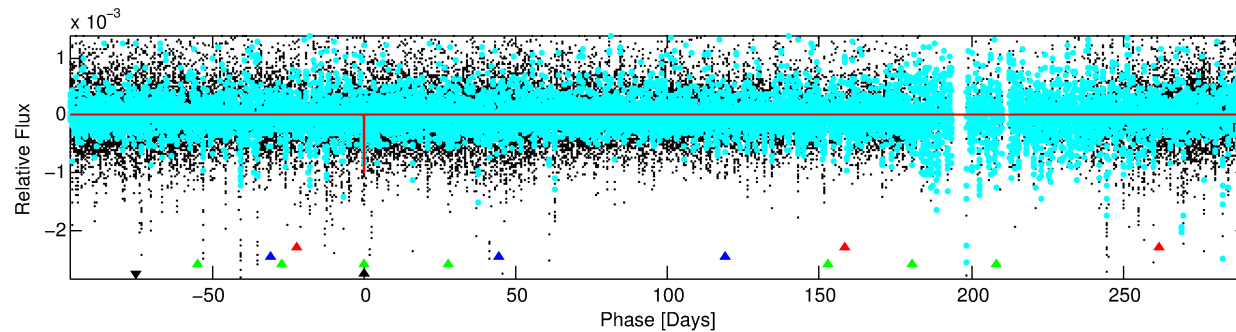
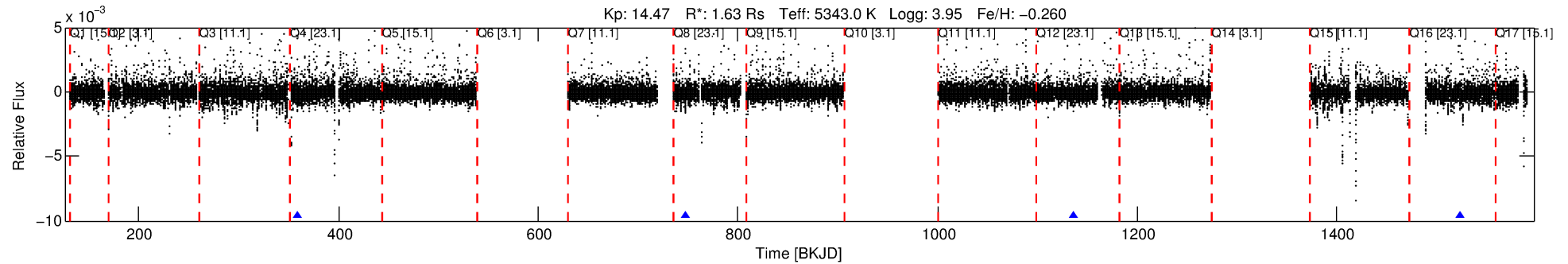
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

Ephemeris Match Information For 005106731-04

No Significant Match Found

# DV One-Page Summary

KIC: 5106731 Candidate: 4 of 4 Period: 388.174 d



## DV Fit Results:

Period = 388.17377 [0.00780] d  
Epoch = 359.4933 [0.0148] BKJD  
Rp/R\* = 0.0310 [0.0726]  
a/R\* = 571.65 [5274.67]  
b = 0.69 [7.12]  
Seff = 1.97 [2.14]  
Teq = 302 [82] K  
Rp = 5.52 [13.27] Re  
a = 0.9924 [0.6208] AU  
Ag = 10971.51 [52874.83] [0.21 $\sigma$ ]  
Teffp = 4782 [5617] K [0.80 $\sigma$ ]

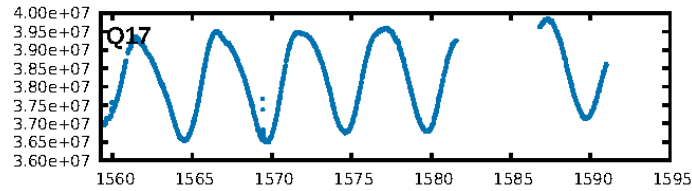
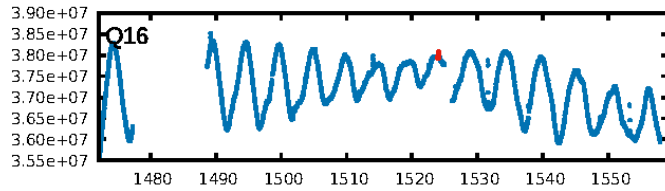
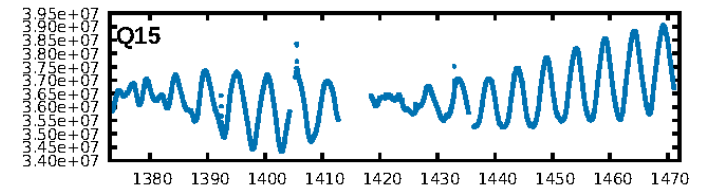
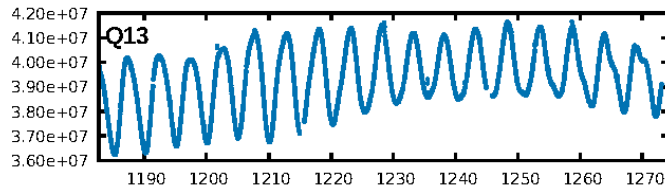
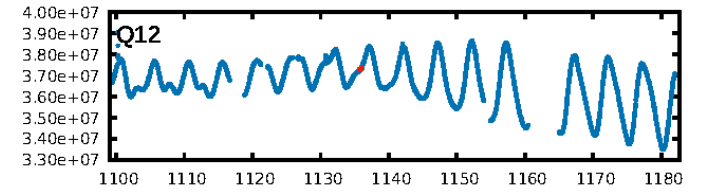
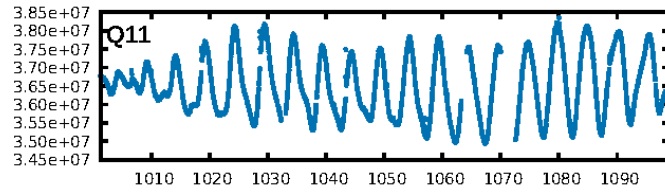
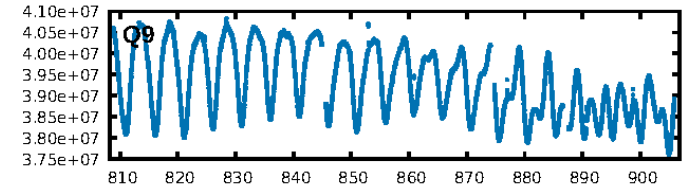
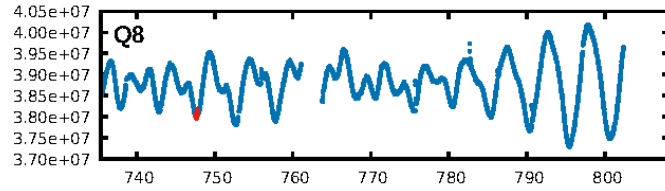
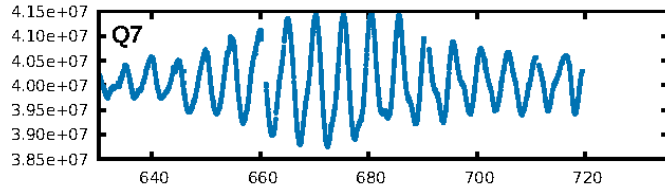
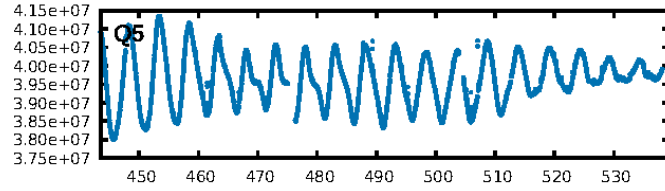
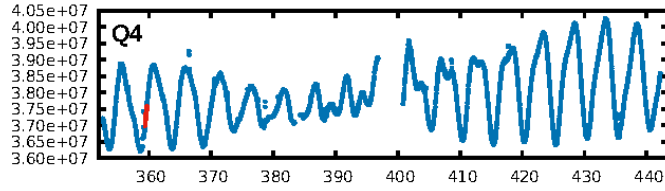
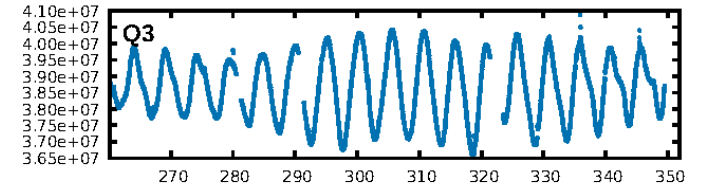
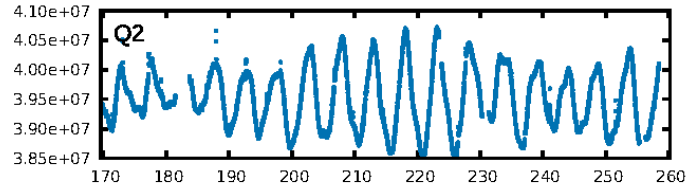
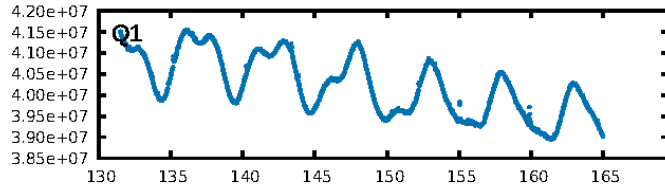
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [893.02 $\sigma$ ]  
LongPeriod-sig: 100.0% [231.07 $\sigma$ ]  
ModelChiSquare2-sig: 0.1%  
ModelChiSquareGof-sig: 44.2%  
Bootstrap-pfa: 4.30e-10  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: -0.5211  
Centroid-sig: 1.2%  
Centroid-so: 2.563 arcsec [0.98 $\sigma$ ]  
OotOffset-rm: 0.114 arcsec [0.07 $\sigma$ ]  
OotOffset-st: 0/0/4/0 [4]  
KicOffset-rm: 0.304 arcsec [0.17 $\sigma$ ]  
KicOffset-st: 0/0/4/0 [4]  
DiffImageQuality-fgm: 0.75 [3/4]  
DiffImageOverlap-fno: 0.75 [3/4]

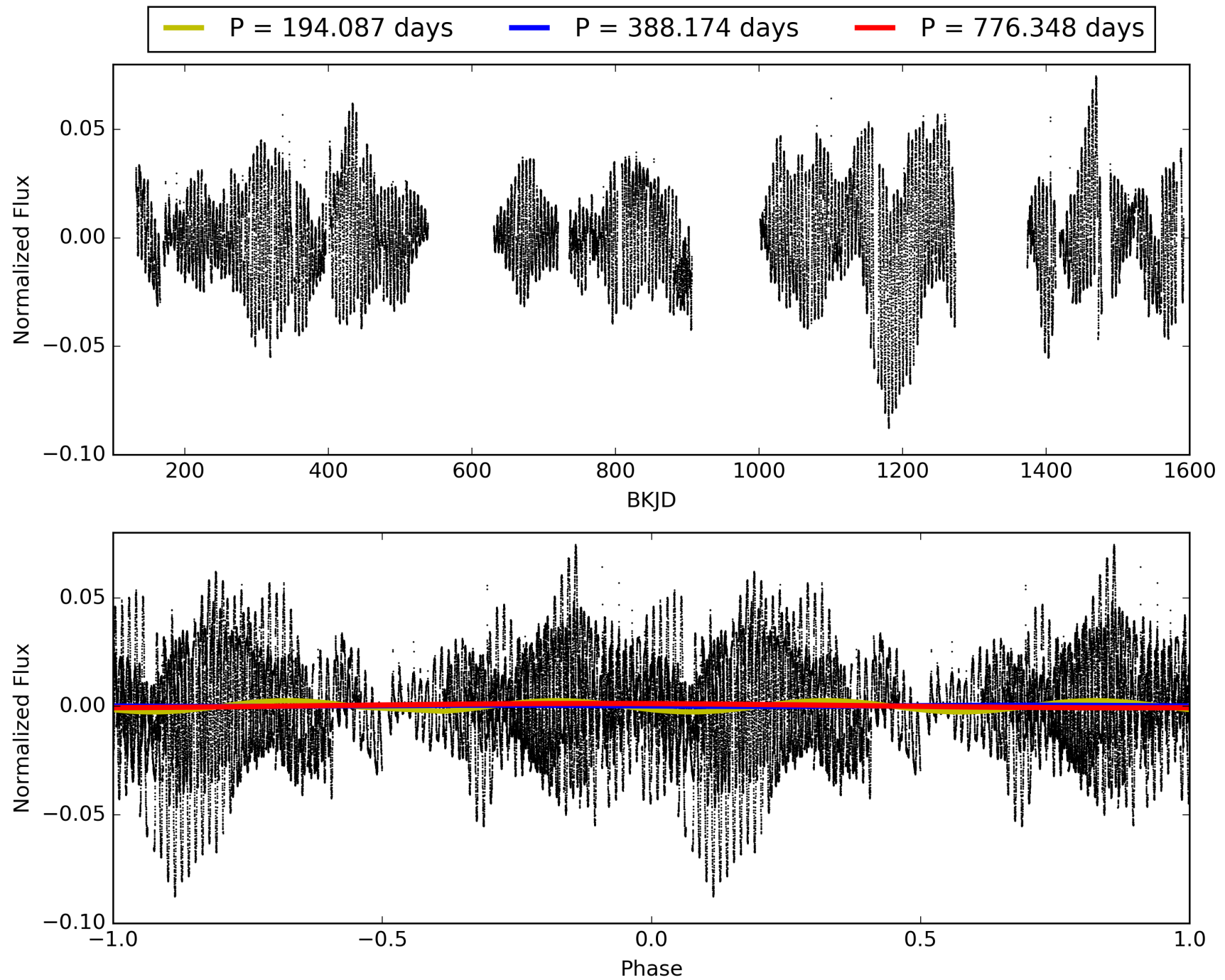
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 01-Feb-2016 05:51:39 Z

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

# TCE 005106731-04, PDC Light Curves



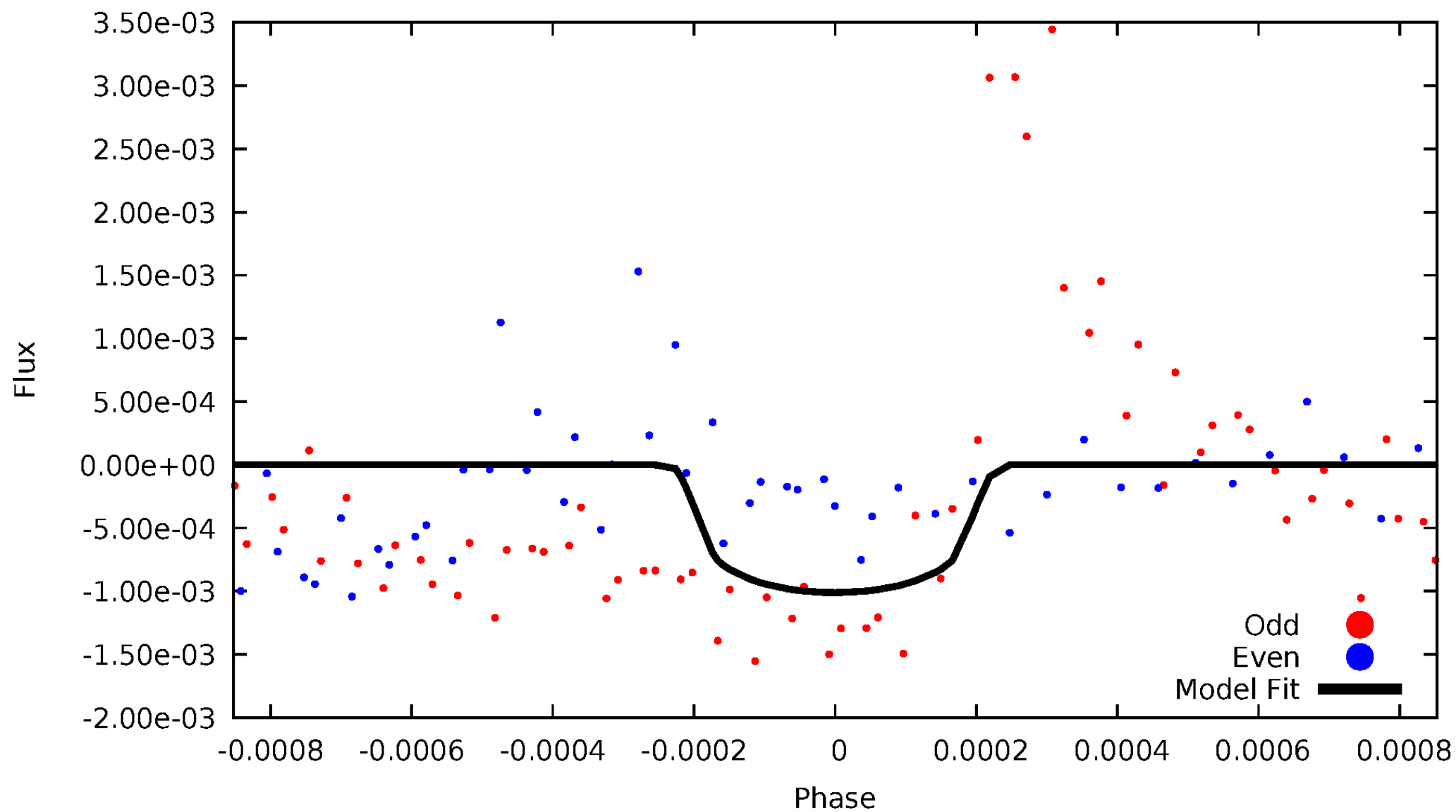
TCE 005106731-04





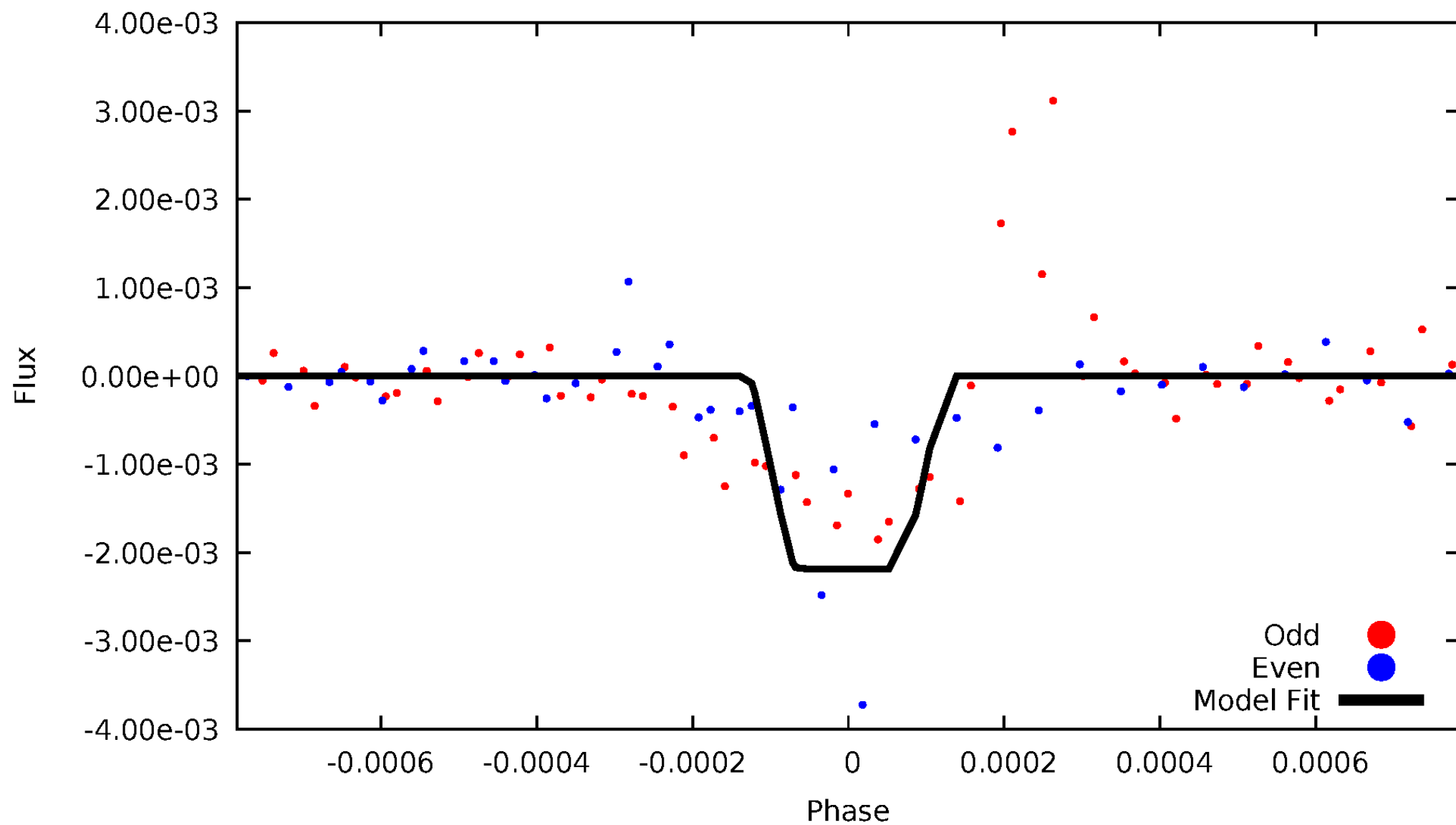
# DV Odd/Even

TCE 005106731-04



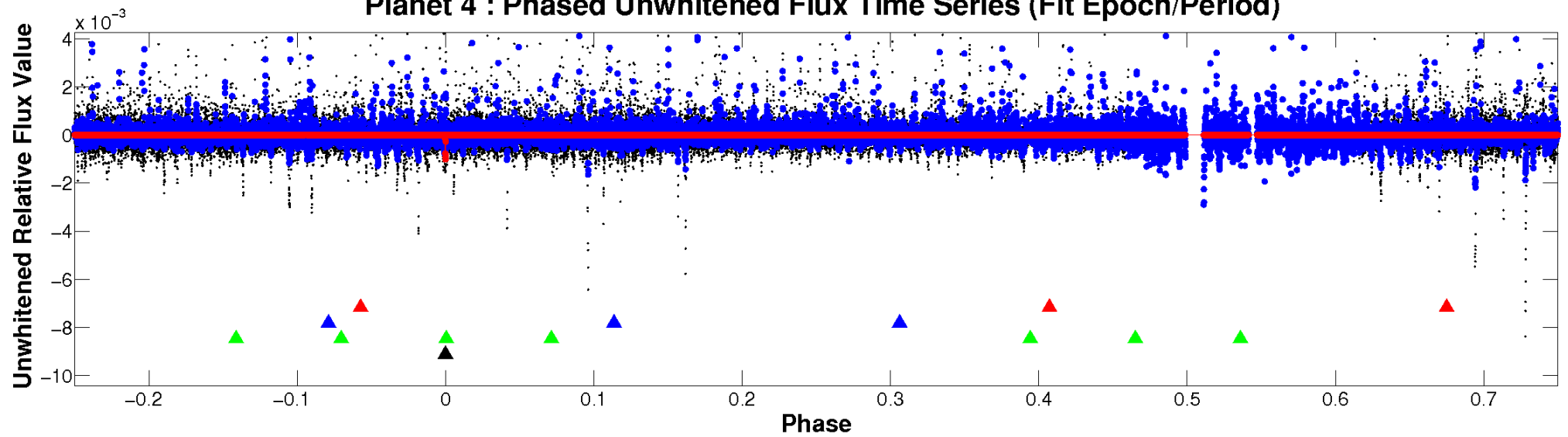
# ALT Odd/Even

TCE 005106731-04

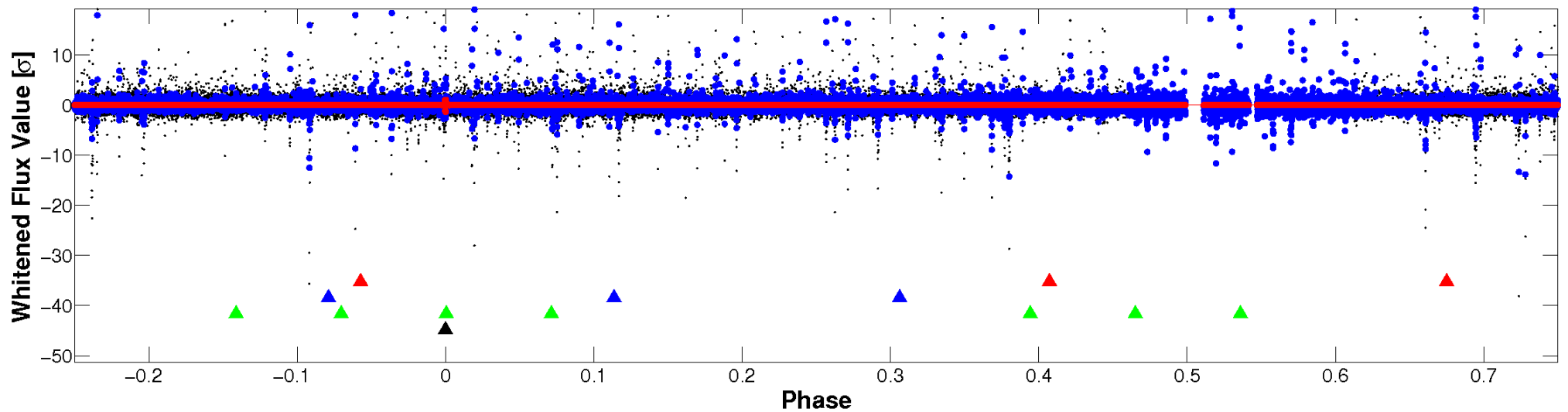


# Non-Whitened Vs. Whitened Light Curve

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

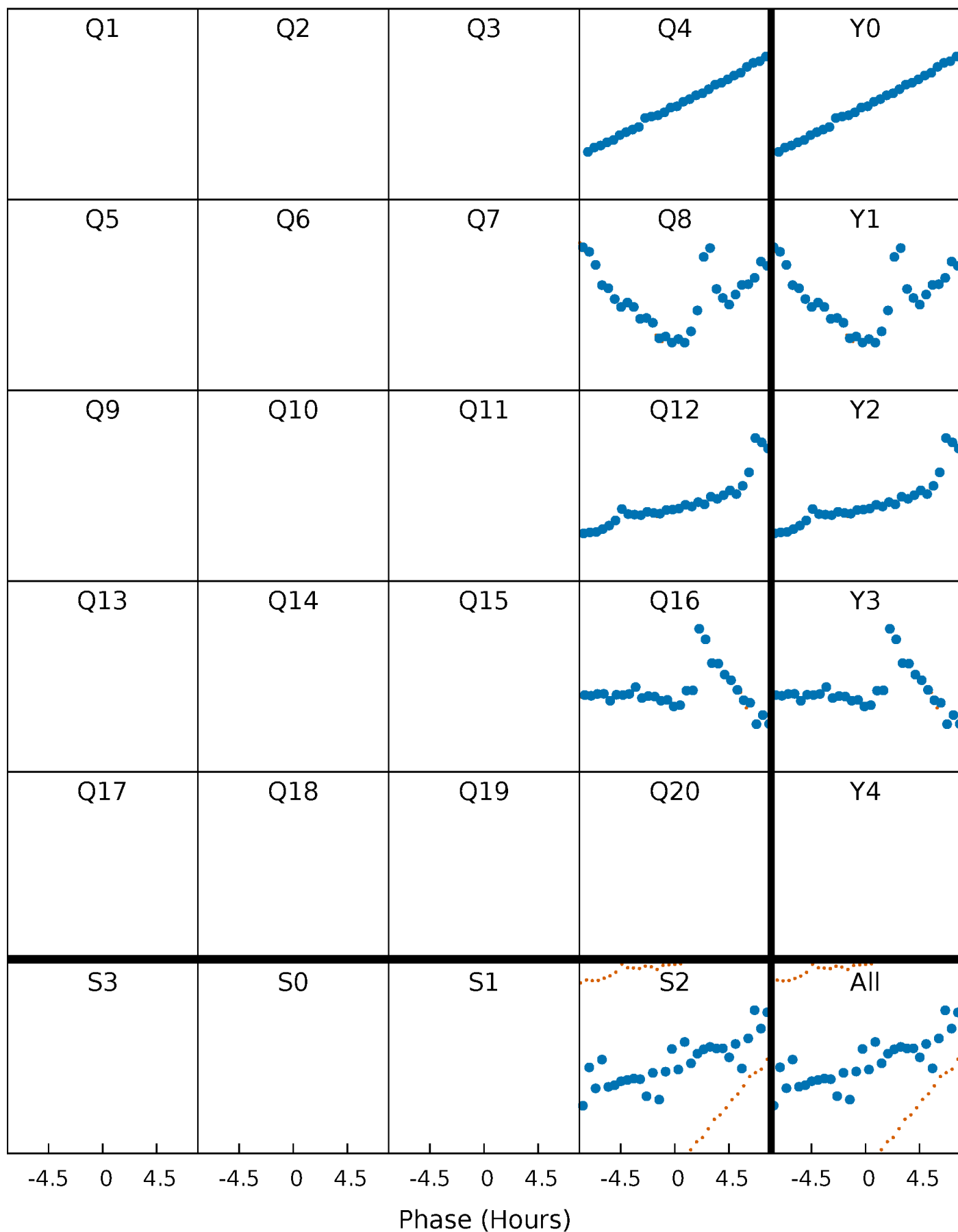


## Planet 4 : Phased Whitened Flux Time Series (Fit Epoch/Period)



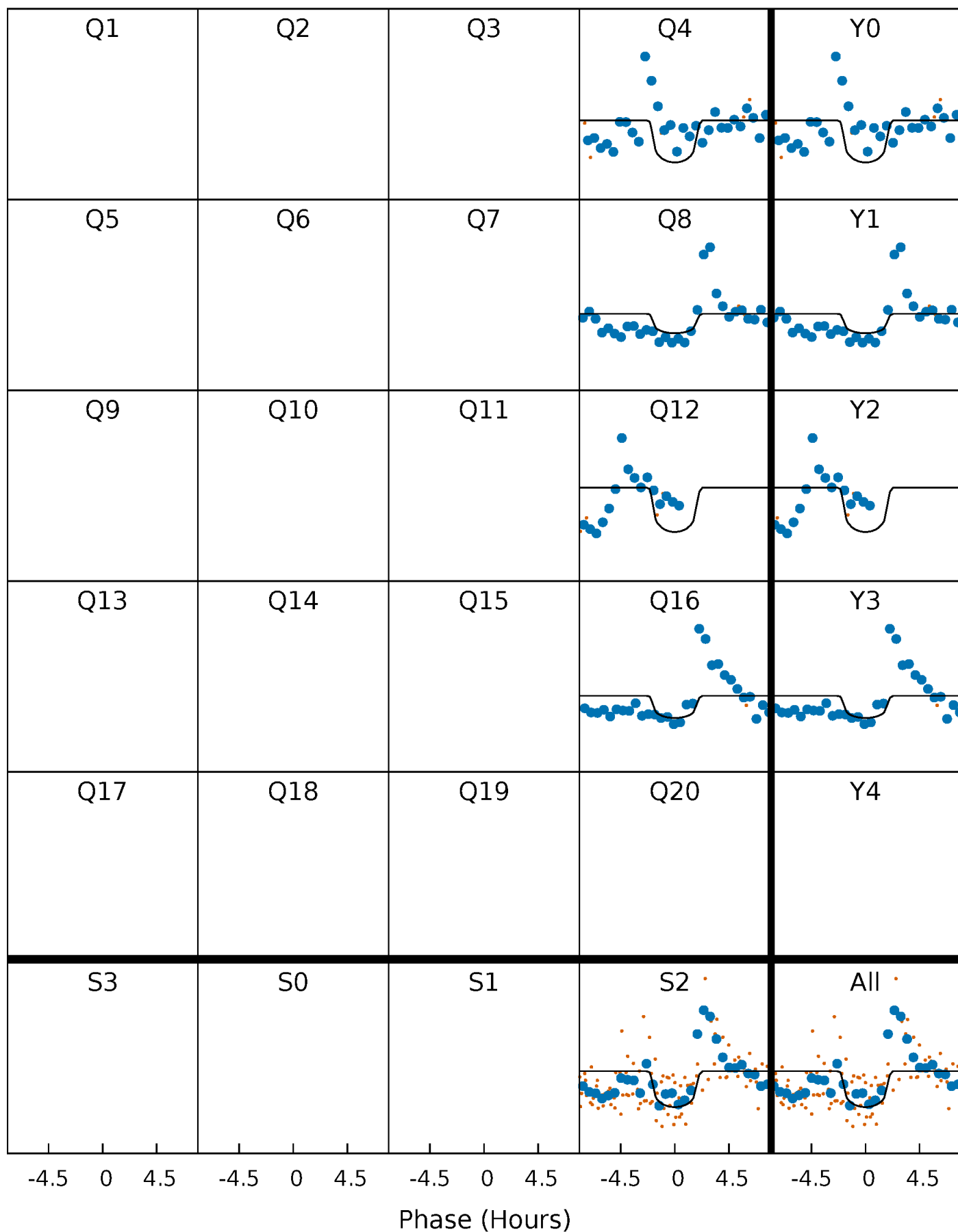
# PDC Quarter-Phased Transit Curves

TCE 005106731-04     $P=388.173766$  Days     $T_0=359.493346$  (BKJD)



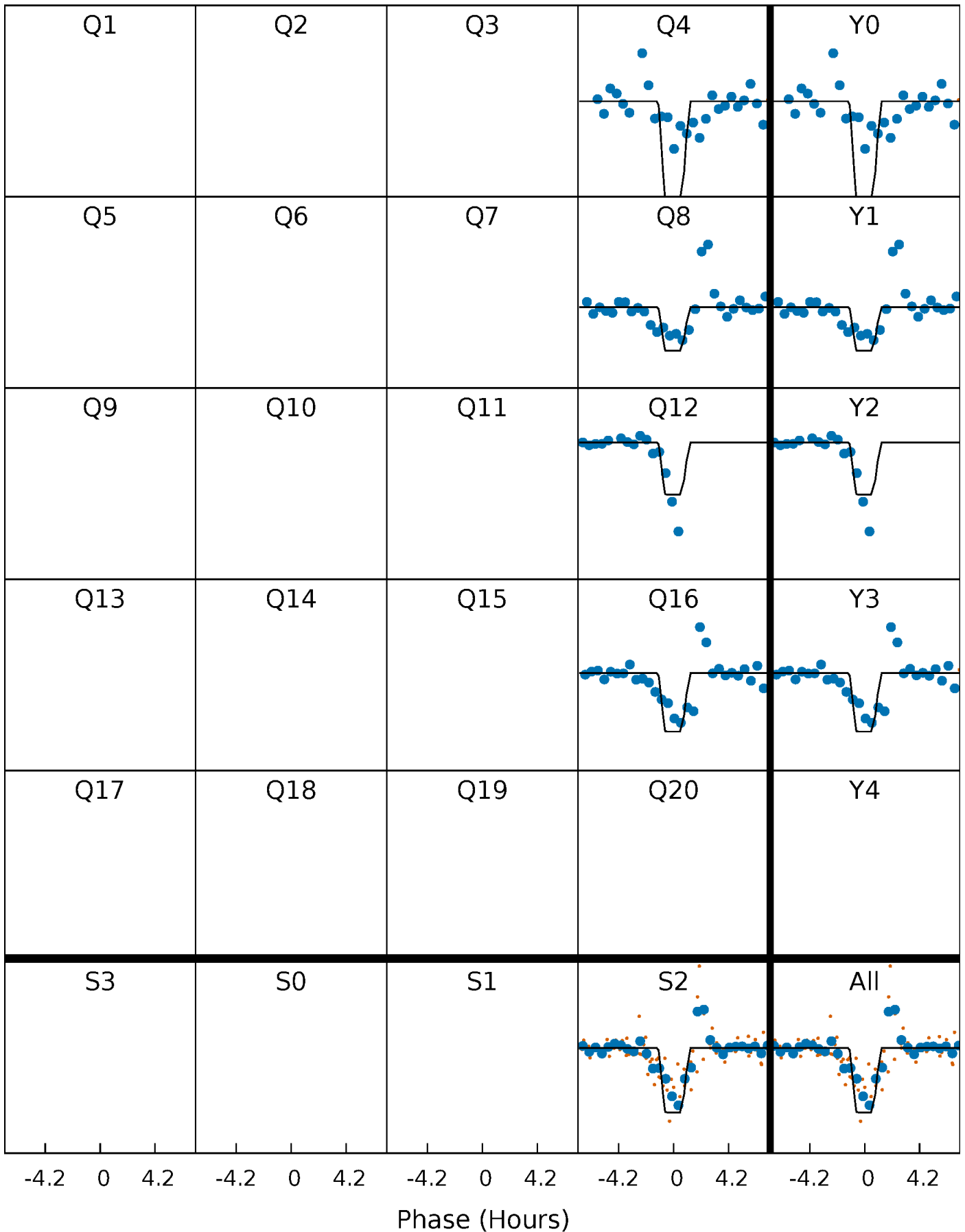
# DV Quarter-Phased Transit Curves

TCE 005106731-04 P=388.173766 Days  $T_0=359.493346$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

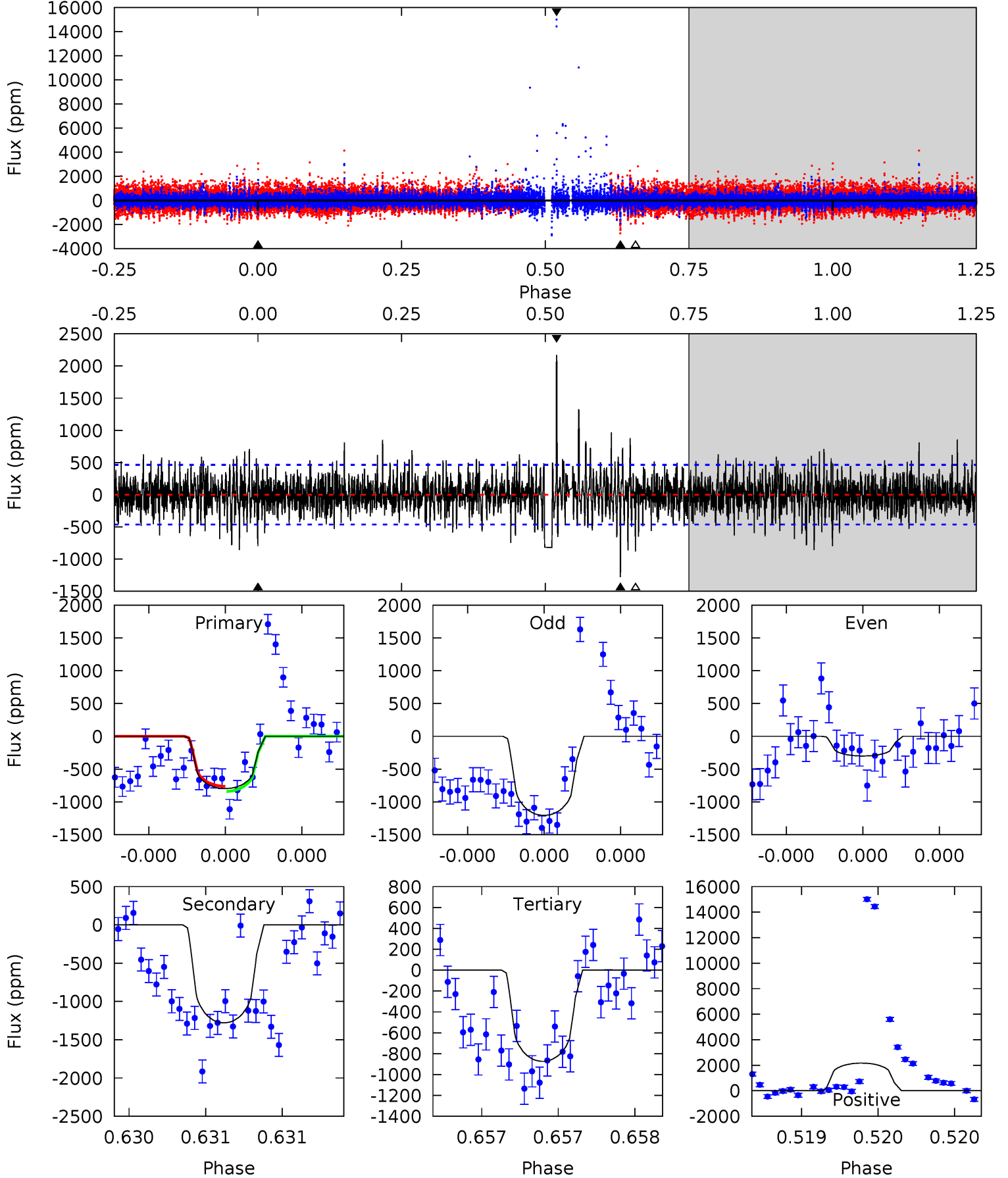
TCE 005106731-04 P=388.169528 Days  $T_0=359.514952$  (BKJD)



# DV Model-Shift Uniqueness Test

005106731-04, P = 388.173766 Days, E = 359.493346 Days

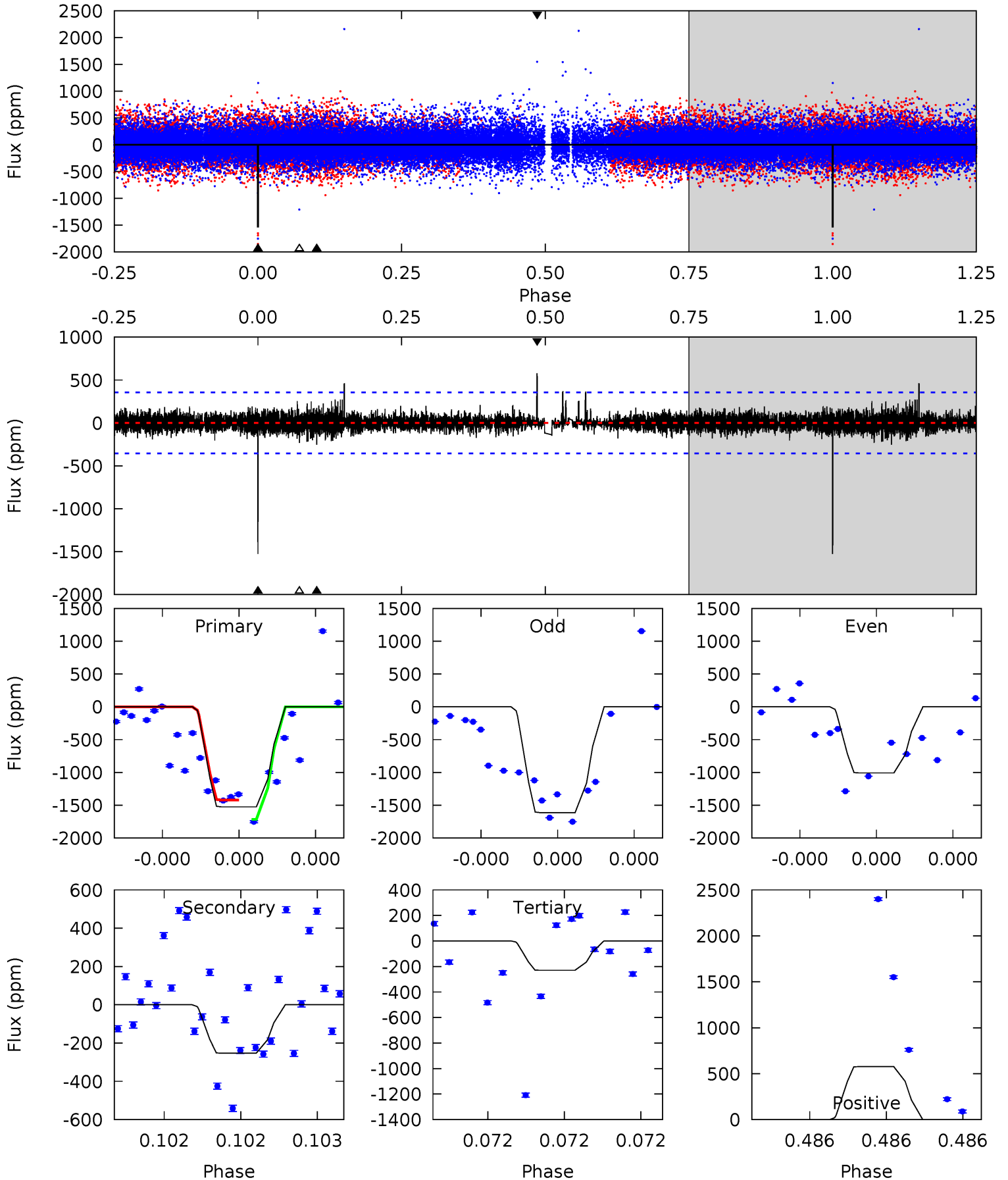
Pri	Sec	Ter	Pos	FA <sub>1</sub>	FA <sub>2</sub>	F <sub>Red</sub>	Pri-Ter	Pri-Pos	Sec-Ter	Sec-Pos	Odd-Evn	DMM	Shape	TAT
9.60	15.4	10.5	26.1	5.58	3.50	2.47	-0.92	-16.5	4.89	-10.7	4.32	1.14	0.63	0.48



# Alt Model-Shift Uniqueness Test

005106731-04, P = 388.169528 Days, E = 359.514952 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
24.5	4.06	3.69	9.27	5.71	3.68	0.85	20.8	15.2	0.37	-5.21	4.64	1.05	0.27	2.22





### Stellar Parameters For KIC 005106731

	$T_{\text{eff}}(K)$	$\log(g)$	[Fe/H]	$R (R_{\odot})$	$M(M_{\odot})$	$p_{\star} (\text{g}\cdot\text{cm}^{-3})$
	$5343^{+175}_{-159}$	$3.950^{+0.660}_{-0.264}$	$-0.260^{+0.350}_{-0.250}$	$1.631^{+0.735}_{-0.898}$	$0.867^{+0.084}_{-0.115}$	$0.281^{+2.172}_{-0.162}$
	+3%/-3%	+17%/-7%	+135%/-96%	+45%/-55%	+10%/-13%	+772%/-58%
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 005106731-04 / KOI

Detrend	Depth (ppm)	$R_p (R_{\oplus})$	$T_{max} (K)$	$T_{obs} (K)$	$A_{obs}$
DV	$-1280 \pm 83$	$9.82^{+10.61}_{-6.96}$	$417^{+50}_{-66}$	$4292^{+3552}_{-837}$	$7319^{+77638}_{-5641}$
Alt.	$-253 \pm 62$	$11.47^{+12.45}_{-7.48}$	$415^{+56}_{-67}$	$3103^{+1344}_{-491}$	$1022^{+7933}_{-790}$

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

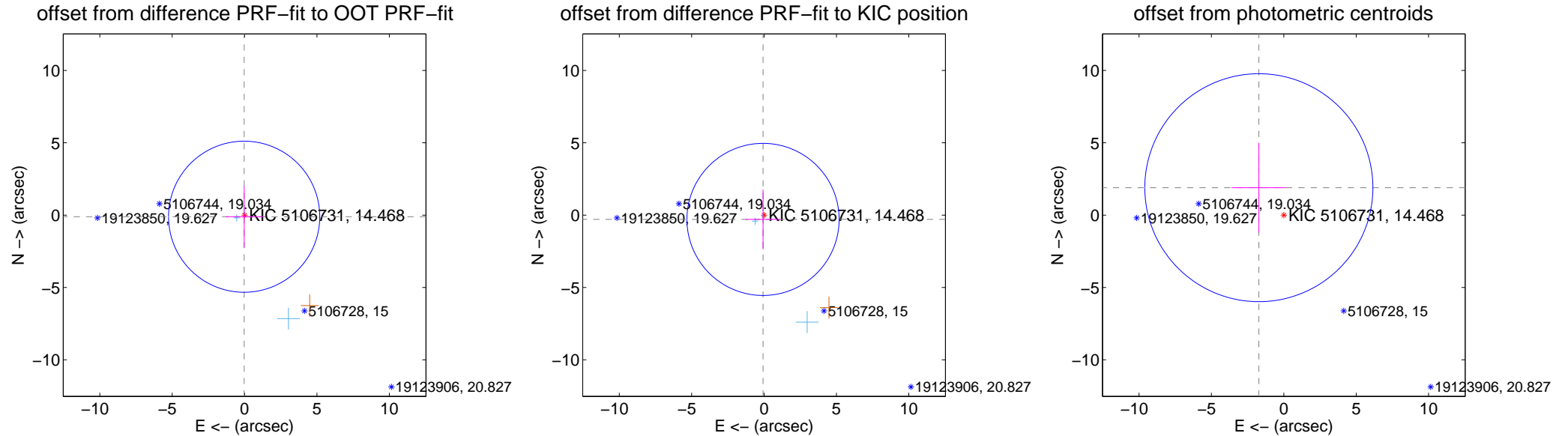
## DV Centroid Data

Supplemental centroid analysis for 005106731-04. Kepler magnitude: 14.47. Transit SNR 7.30

There are 3 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.25 arcsec

	Distance in arcsec	Distance / $\sigma$	$\Delta$ RA	$\Delta$ Dec
PRF-fit source offset from OOT	$0.114 \pm 1.741$	0.07	$0.029 \pm 1.287$	$-0.110 \pm 2.123$
PRF-fit source offset from KIC position	$0.304 \pm 1.753$	0.17	$0.070 \pm 1.206$	$-0.296 \pm 2.063$
photometric centroid source offset	$2.56 \pm 2.63$	0.98	$1.72 \pm 1.89$	$1.90 \pm 3.11$



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.

Q1 no difference image



Q1 no OOT image



Q2 no difference image



Q2 no OOT image



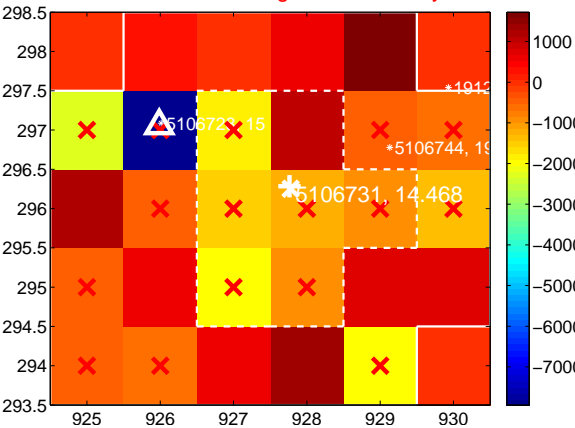
Q3 no difference image



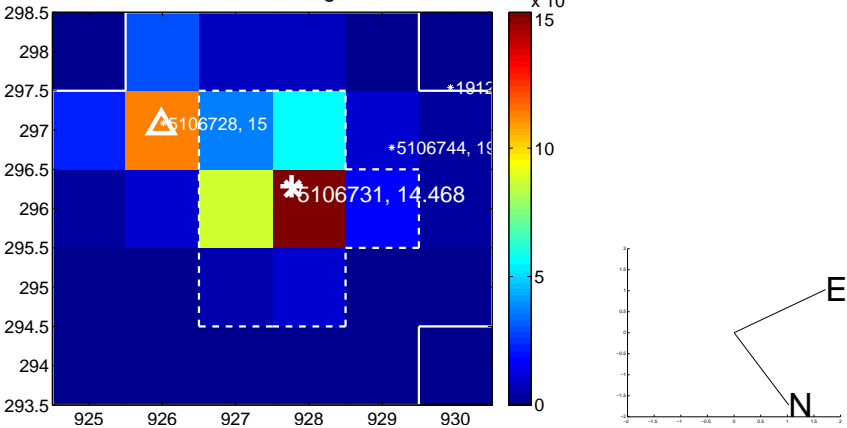
Q3 no OOT image



Q4 difference image. Poor Quality



Q4 OOT image

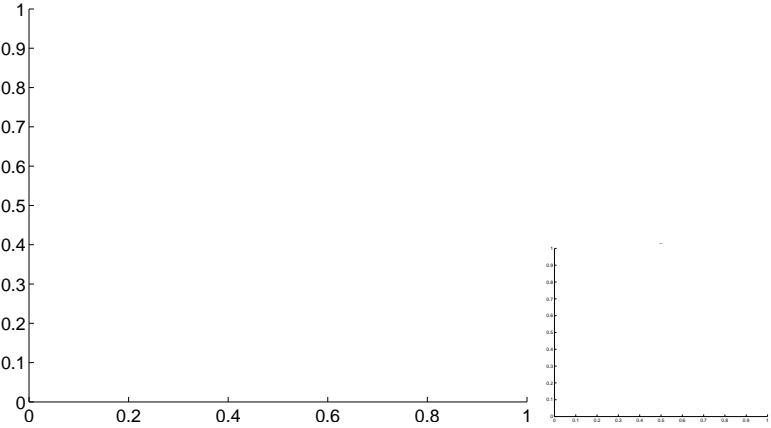


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

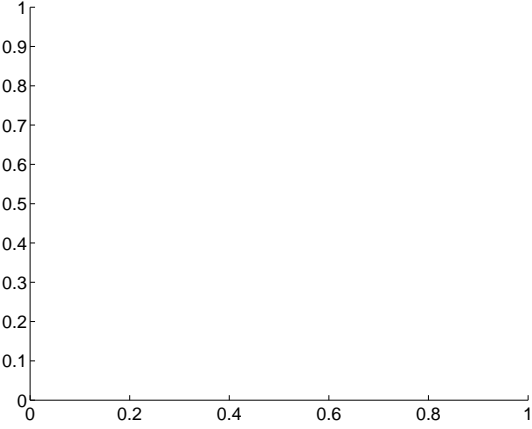
Q5 no difference image



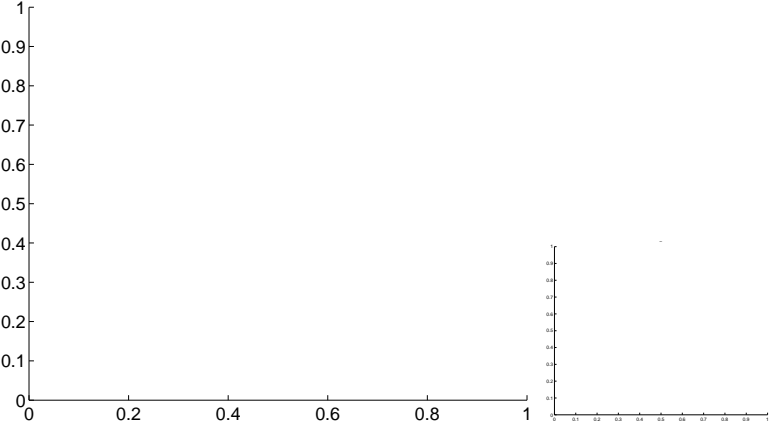
Q5 no OOT image



Q6 no difference image



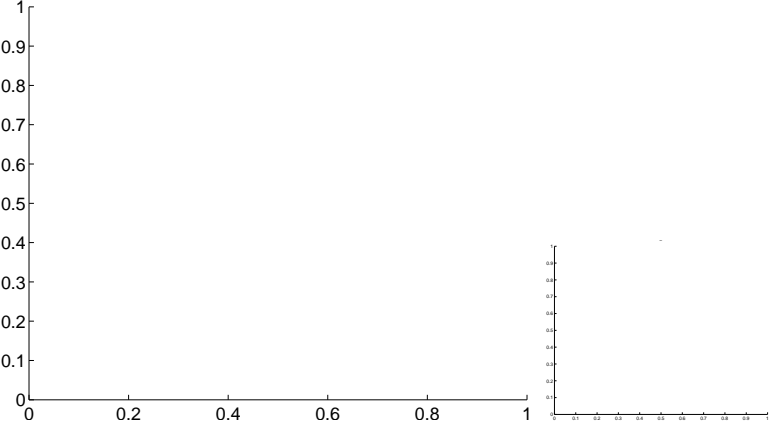
Q6 no OOT image



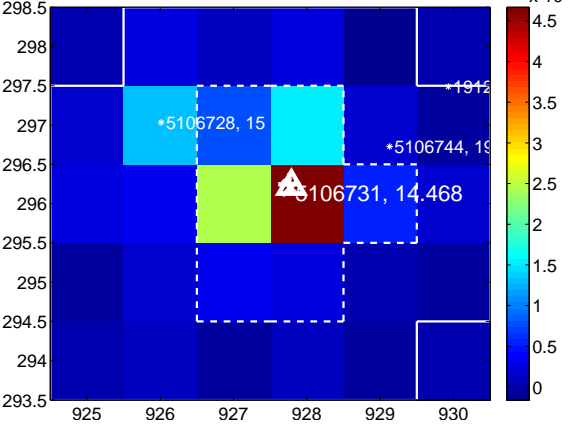
Q7 no difference image



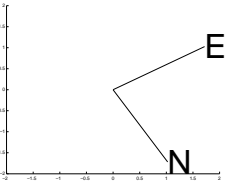
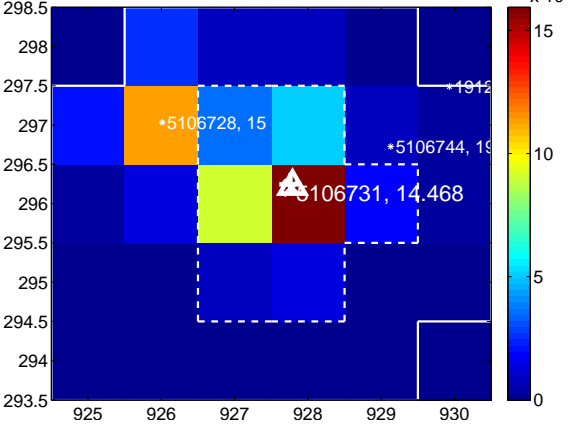
Q7 no OOT image



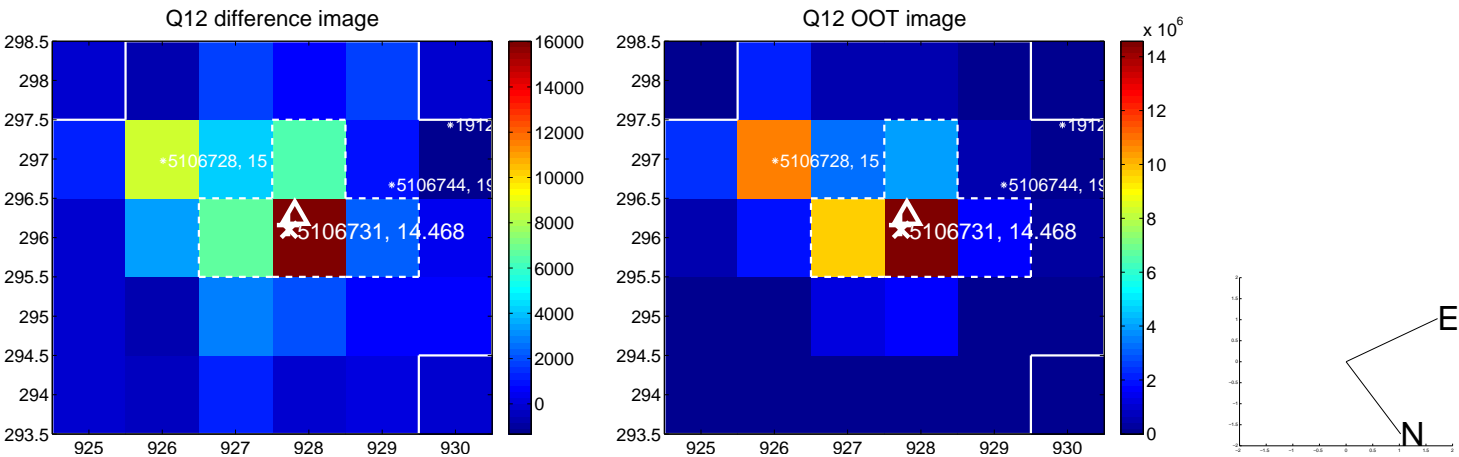
Q8 difference image



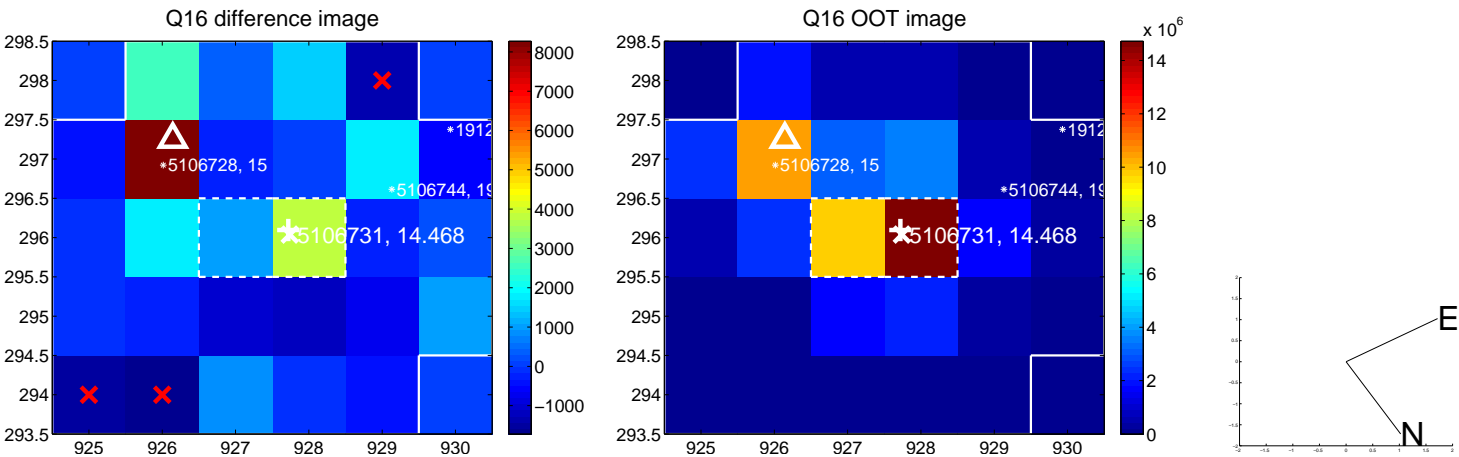
Q8 OOT image



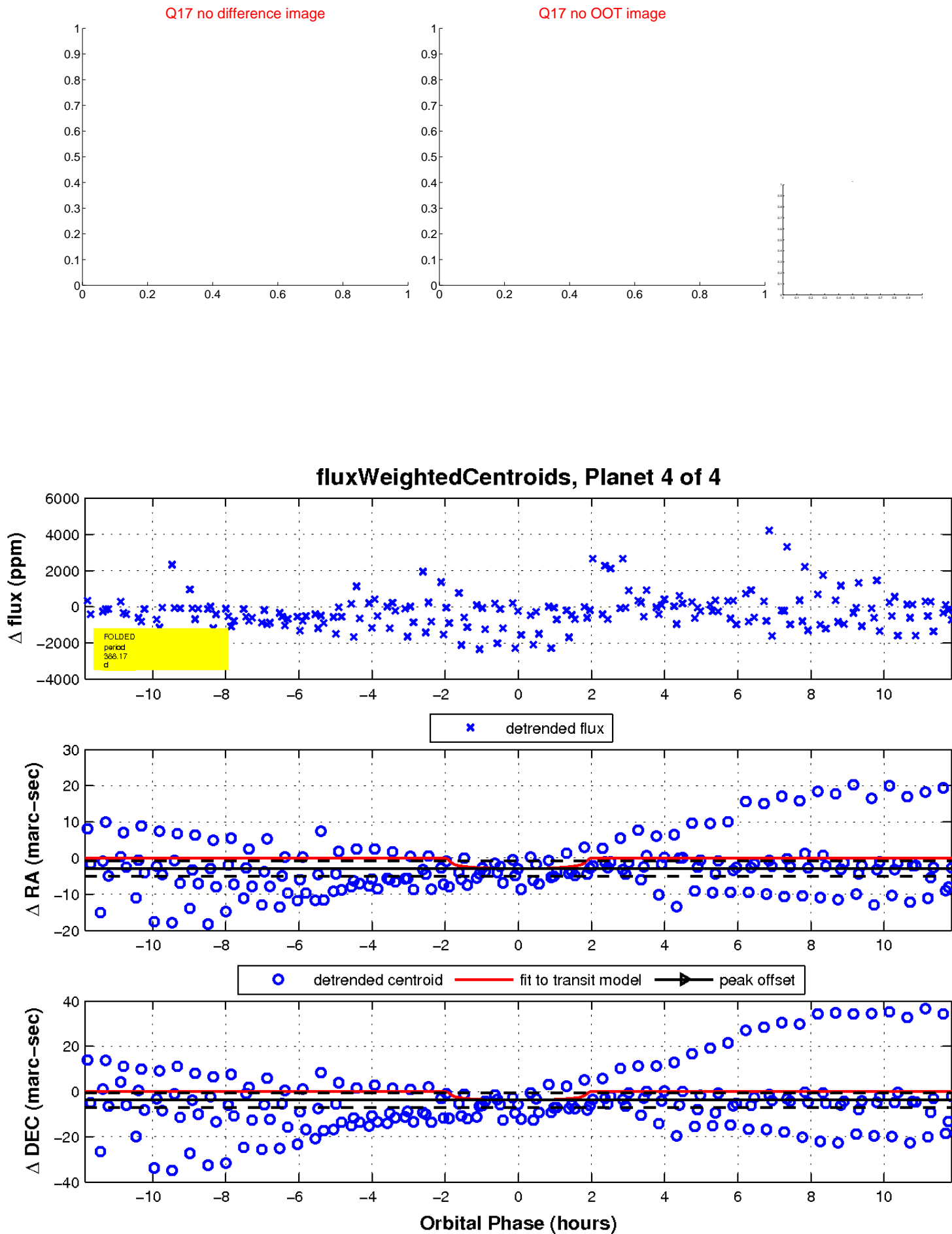
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



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



UKIRT Image

Declination

