

# KIC 002304168

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 002304168-01 | OBS      | No   | 342.324304    | 397.640228   | 631.6       | 3.397            | 15.6 | 7.3  | 3.33                        | 7221            | 9.18                   | 19.19                  |
| 002304168-02 | OBS      | No   | 431.718852    | 219.298211   | 488.4       | 13.219           | 12.2 | 10.3 | 3.33                        | 7221            | 8.77                   | 14.09                  |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments  |
|--------------|----------|------|-------|---|---|---|---|---|
| 002304168-01 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | INDIV_TRANS_TRACKER—LPP_DV—LPP_ALT—ALL_TRANS_CHASES—MOD_TER_DV—MOD_POS_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—INCONSISTENT_TRANS—CENT_FEW_DIFFS |
| 002304168-02 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | INDIV_TRANS_RUBBLE_CHASES—LPP_ALT—ALL_TRANS_CHASES—MOD_TER_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS                                |

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

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

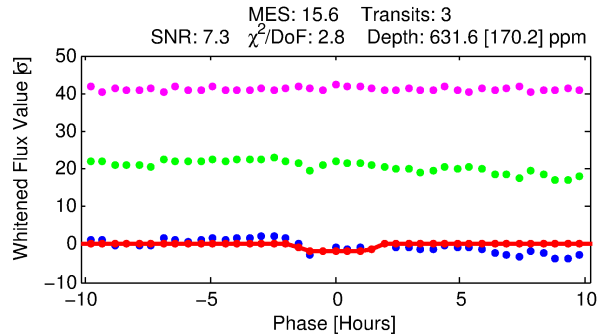
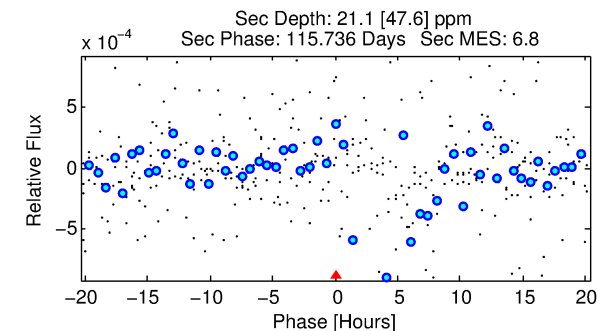
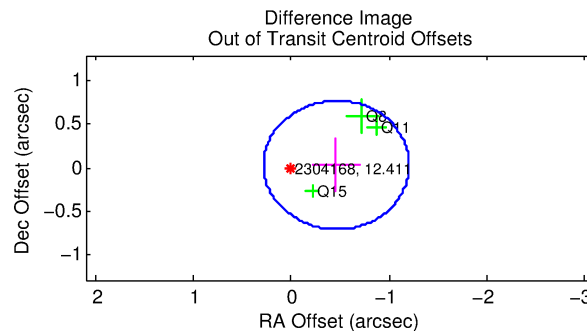
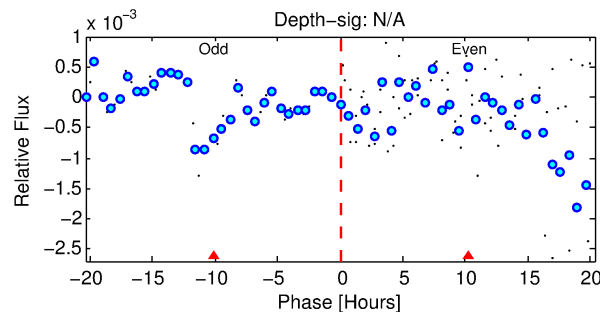
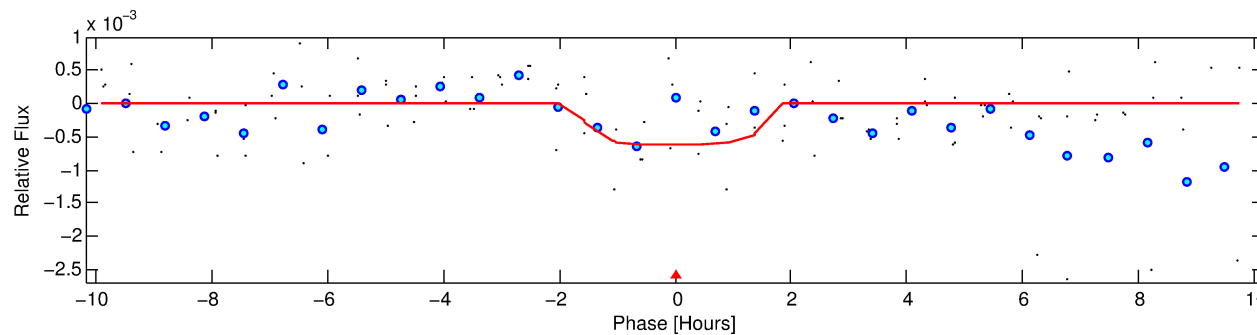
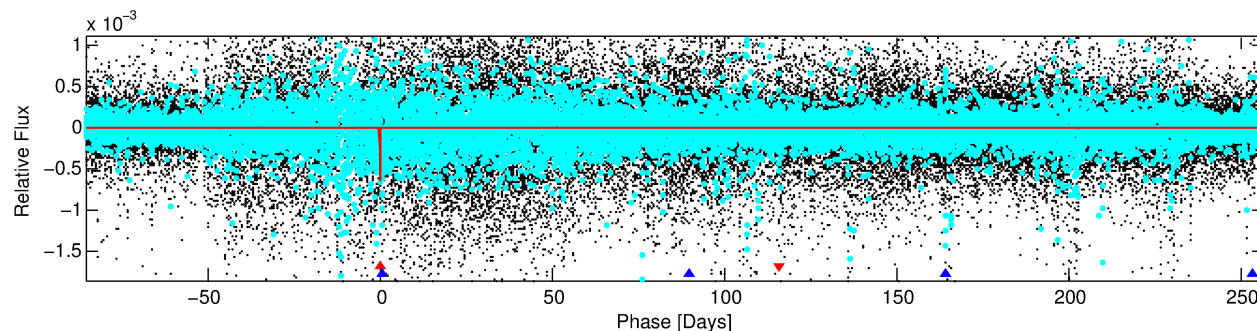
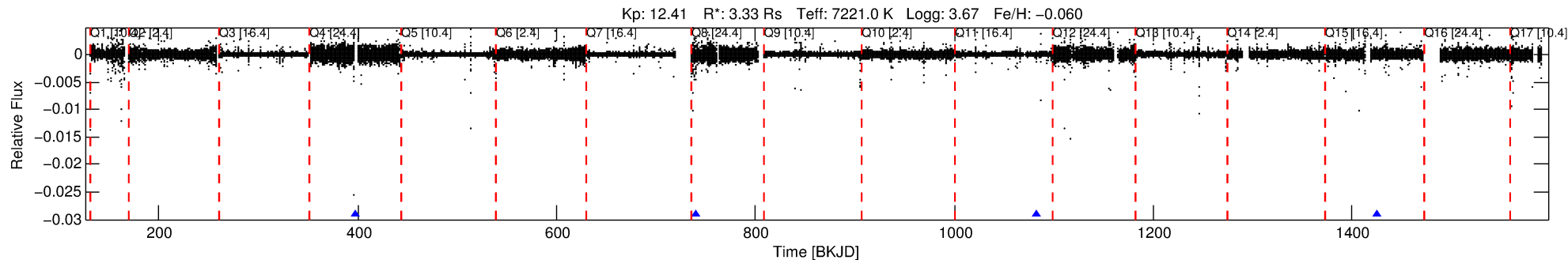
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 002304168-01

No Significant Match Found

# DV One-Page Summary

KIC: 2304168 Candidate: 1 of 2 Period: 342.324 d



## DV Fit Results:

Period = 342.32430 [0.01537] d  
Epoch = 397.6402 [0.0331] BKJD  
Rp/R\* = 0.0253 [0.0408]  
a/R\* = 510.29 [5103.41]  
b = 0.78 [4.98]  
Seff = 19.19 [16.15]  
Teq = 534 [112] K  
Rp = 9.18 [15.56] Re  
a = 1.1870 [0.6021] AU  
Ag = 193.74 [779.99] [0.25σ]  
Teff = 3079 [3037] K [0.84σ]

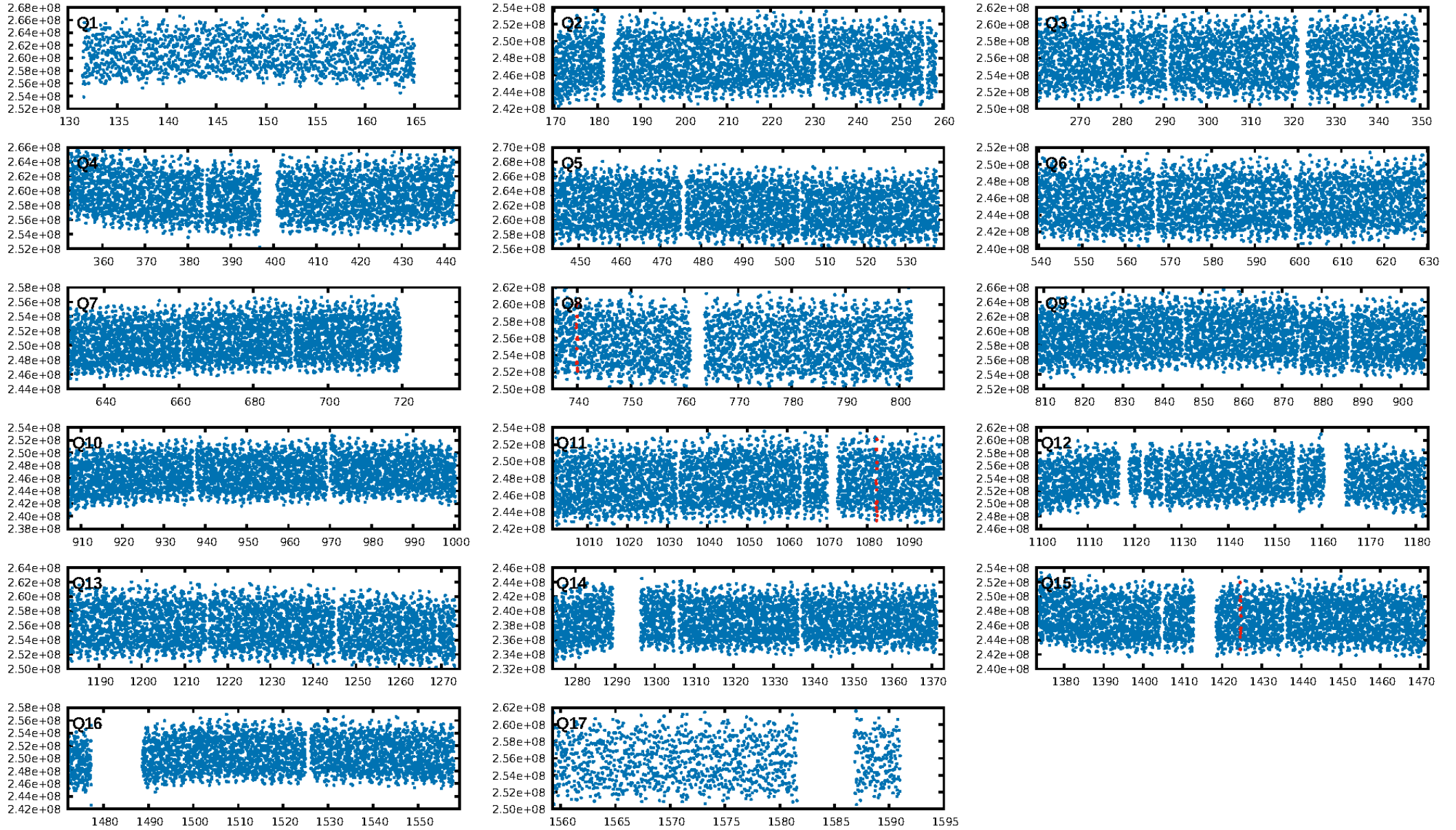
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [157.19σ]  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 8.7%  
Bootstrap-pfa: 8.94e-09  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: 0.9822  
Centroid-sig: 15.1%  
Centroid-so: 1.058 arcsec [1.53σ]  
OotOffset-rm: 0.462 arcsec [1.86σ]  
KicOffset-rm: 0.434 arcsec [1.67σ]  
OotOffset-st: 0.2/1/0 [3]  
KicOffset-st: 0.2/1/0 [3]  
DiffImageQuality-fgm: 0.33 [1/3]  
DiffImageOverlap-fno: 0.67 [2/3]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 01-Feb-2016 17:04:25 Z

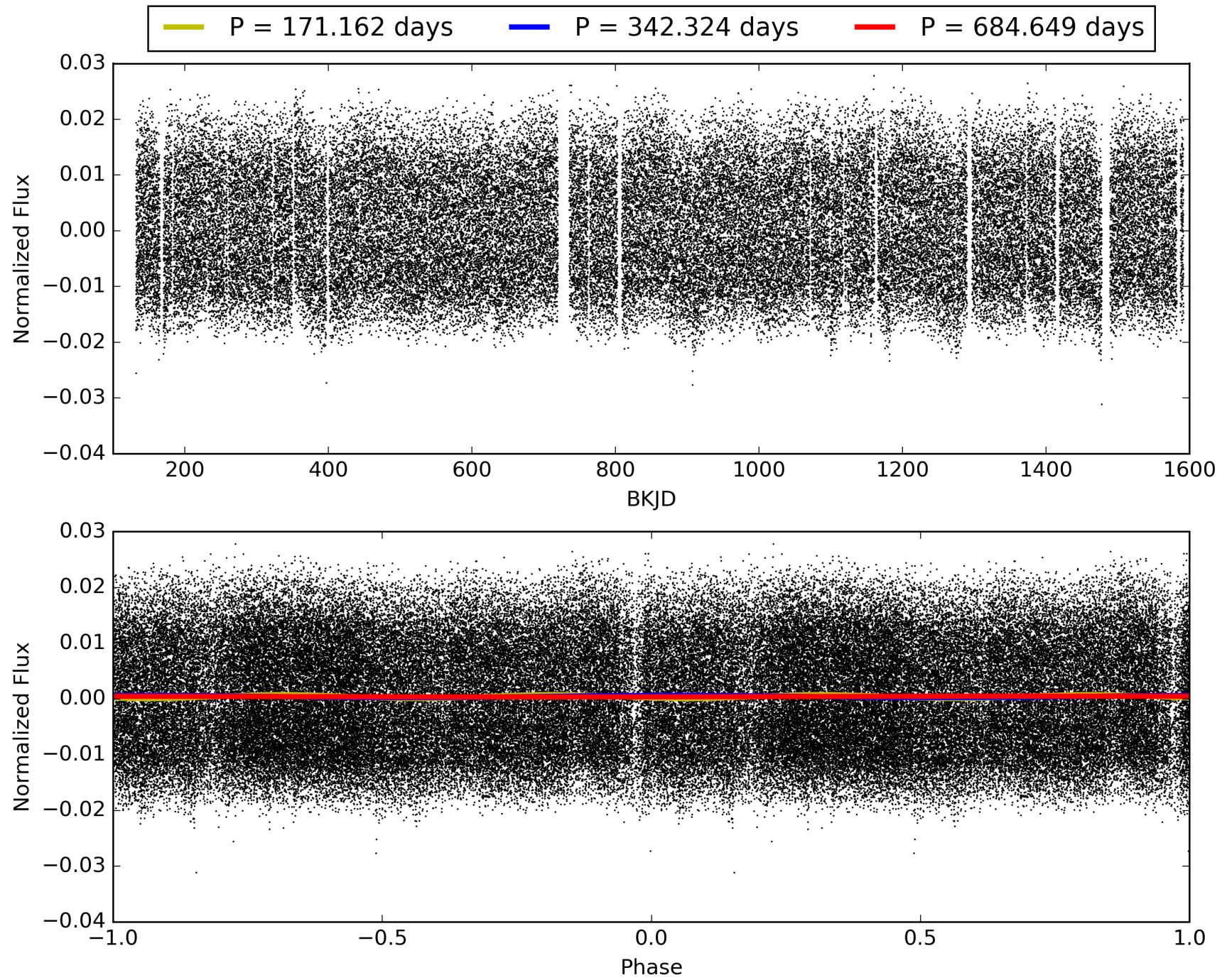
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 002304168-01, PDC Light Curves



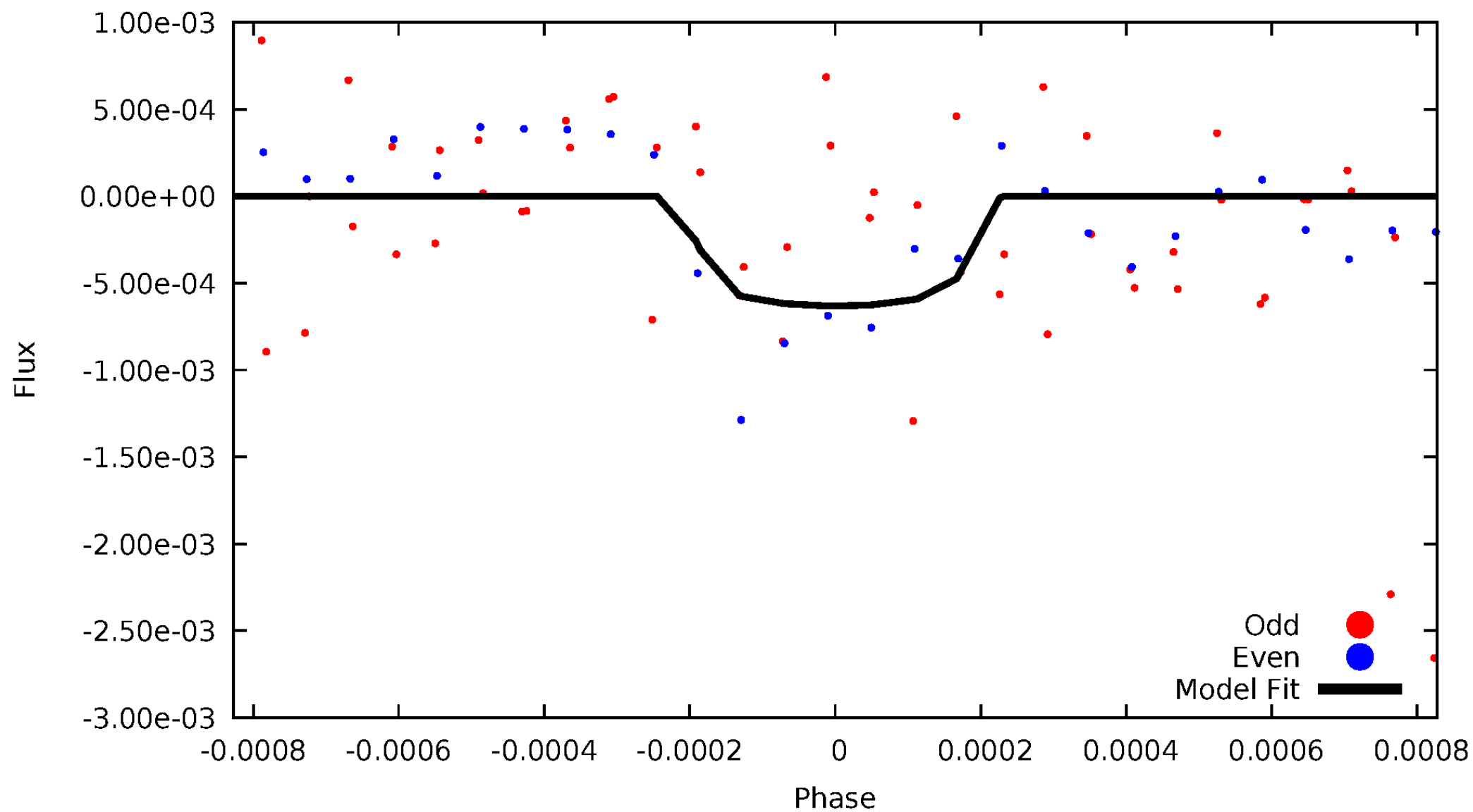


TCE 002304168-01



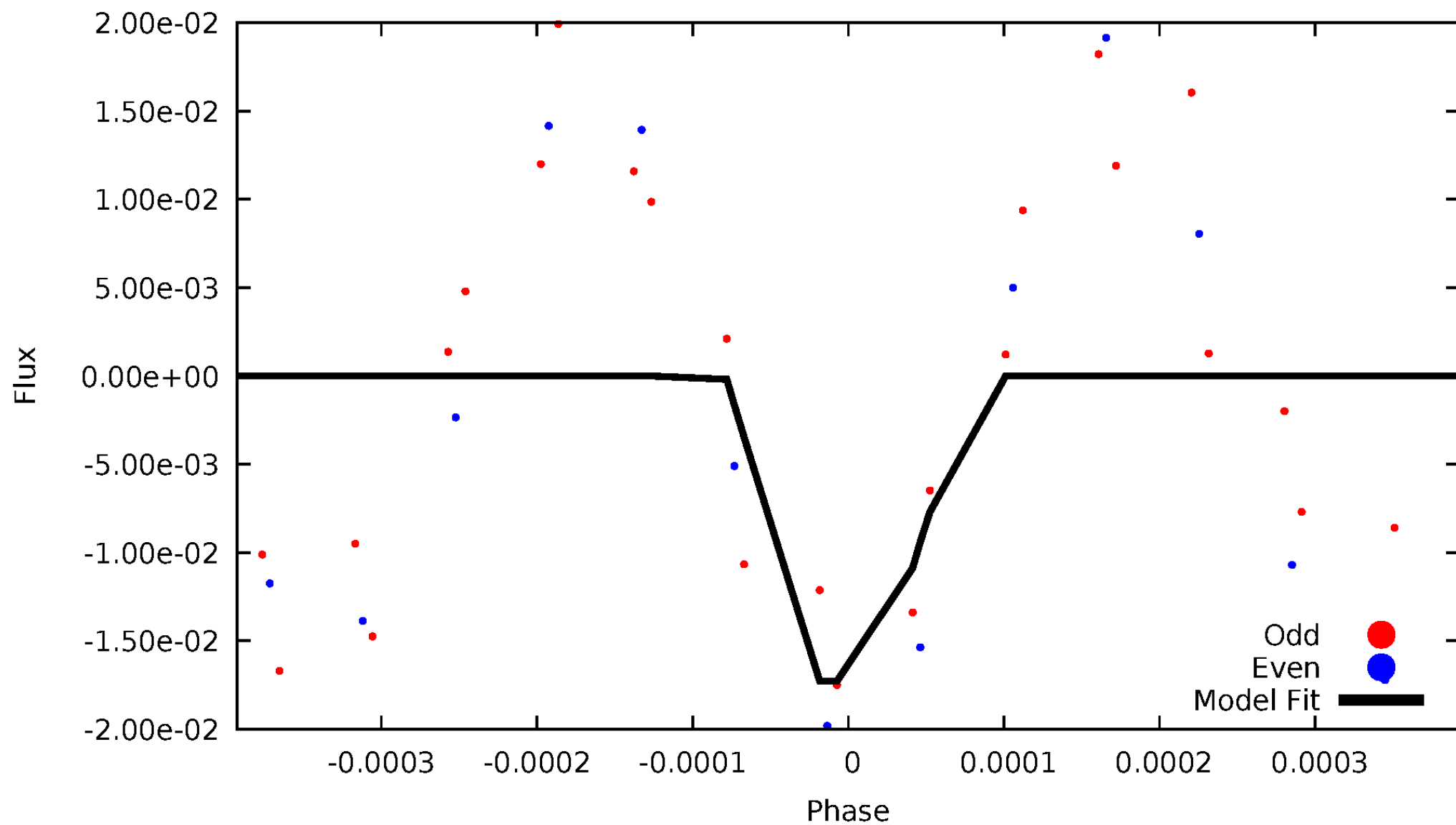
# DV Odd/Even

TCE 002304168-01

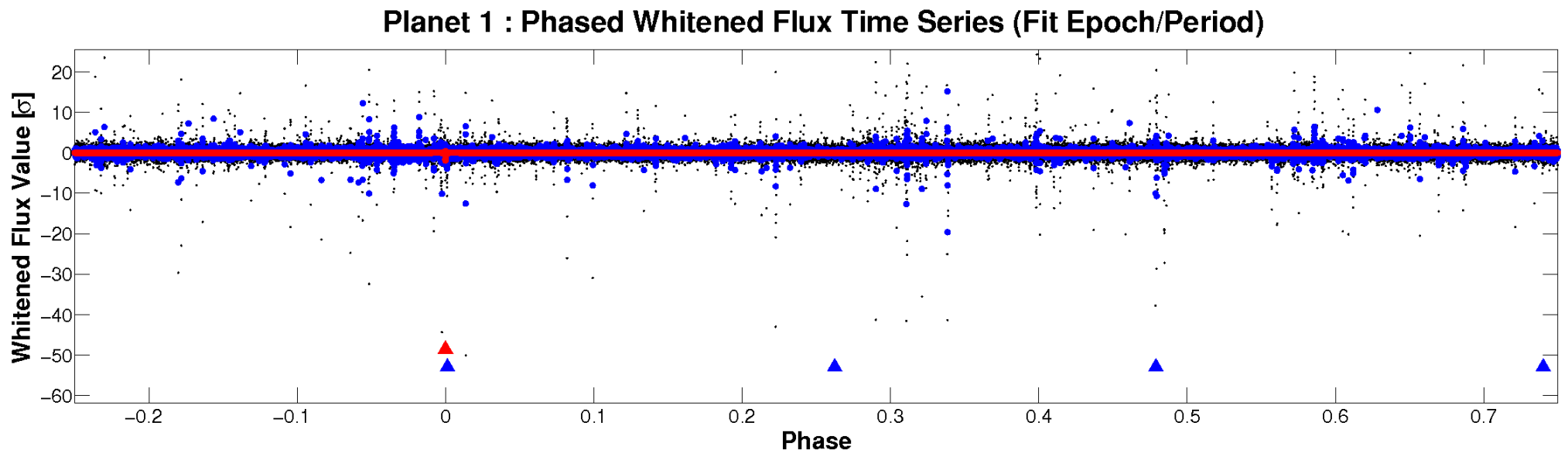
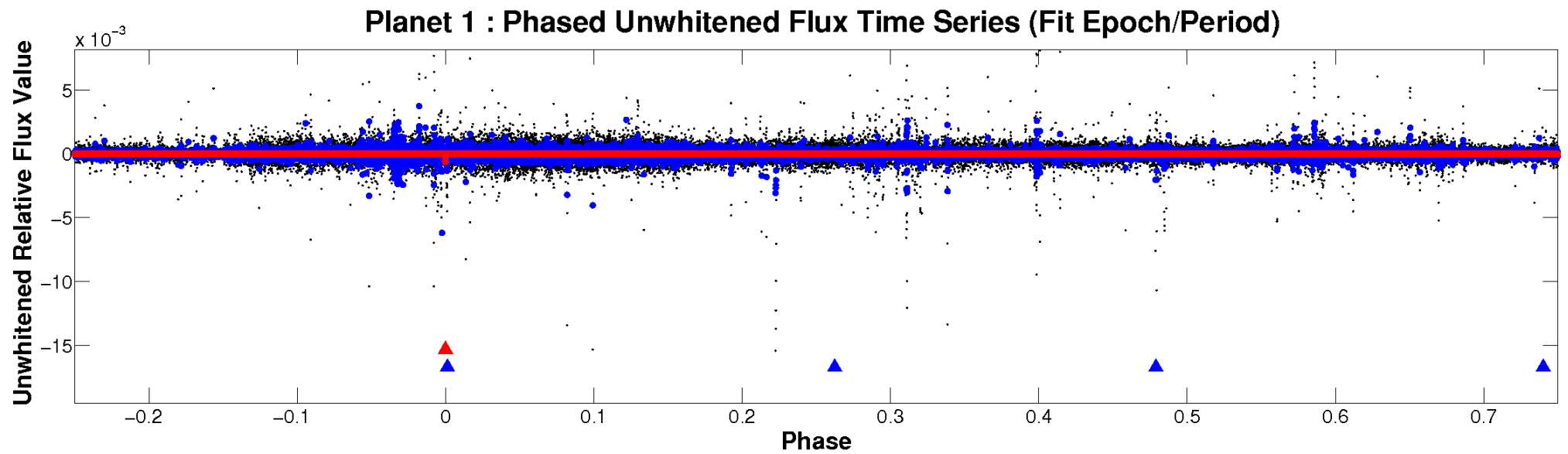


# ALT Odd/Even

TCE 002304168-01

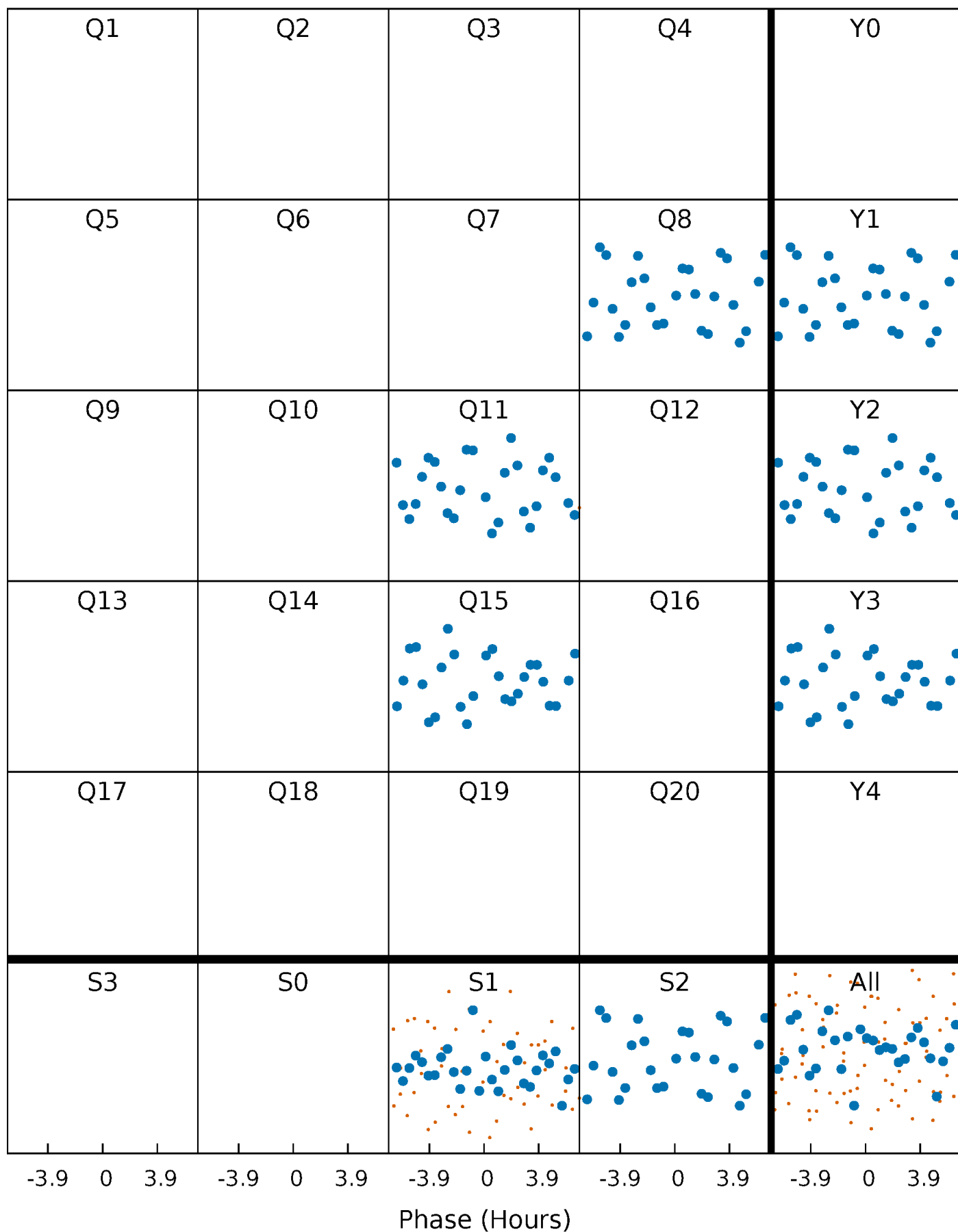


# Non-Whitened Vs. Whitened Light Curve



# PDC Quarter-Phased Transit Curves

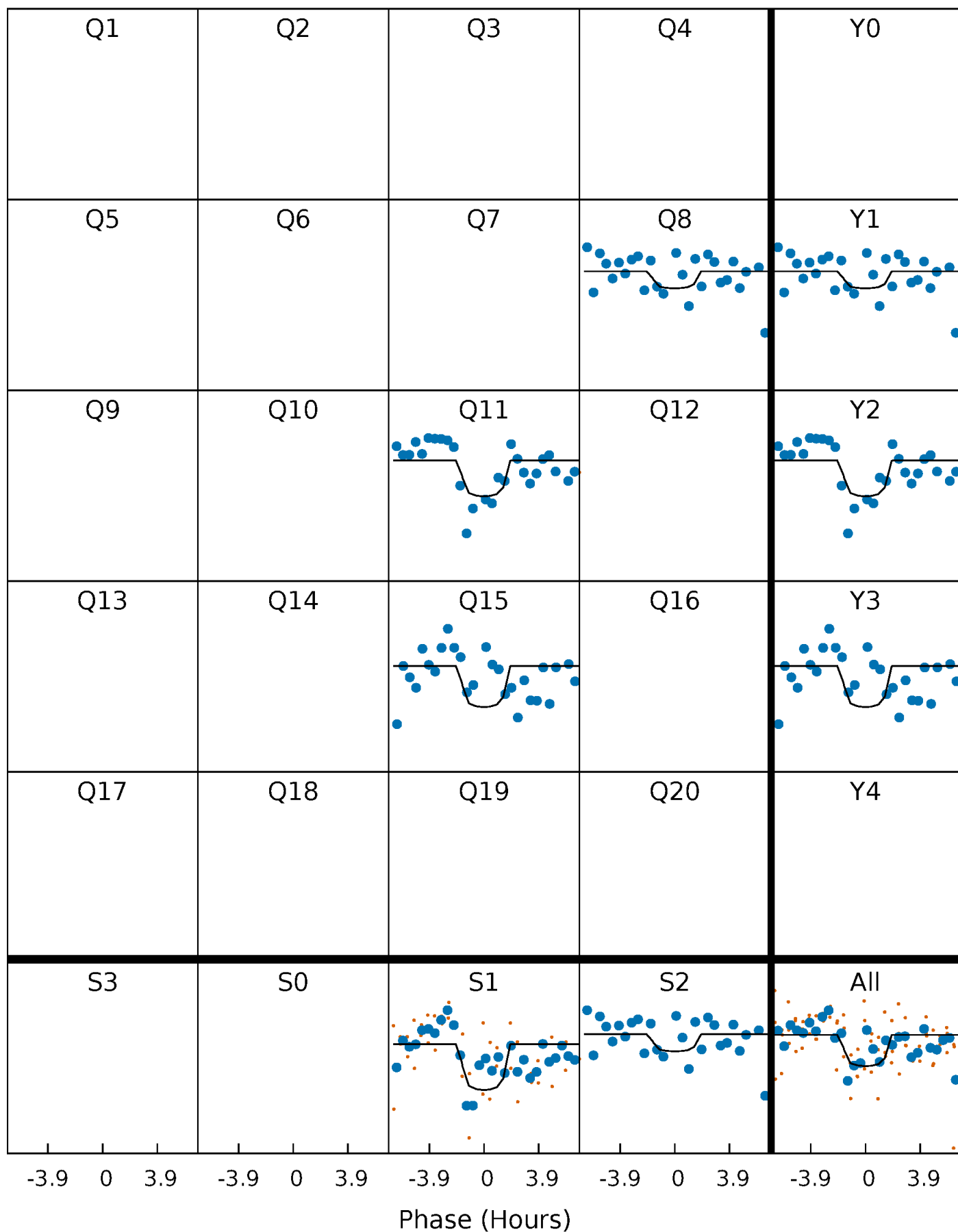
TCE 002304168-01 P=342.324304 Days  $T_0=397.640228$  (BKJD)





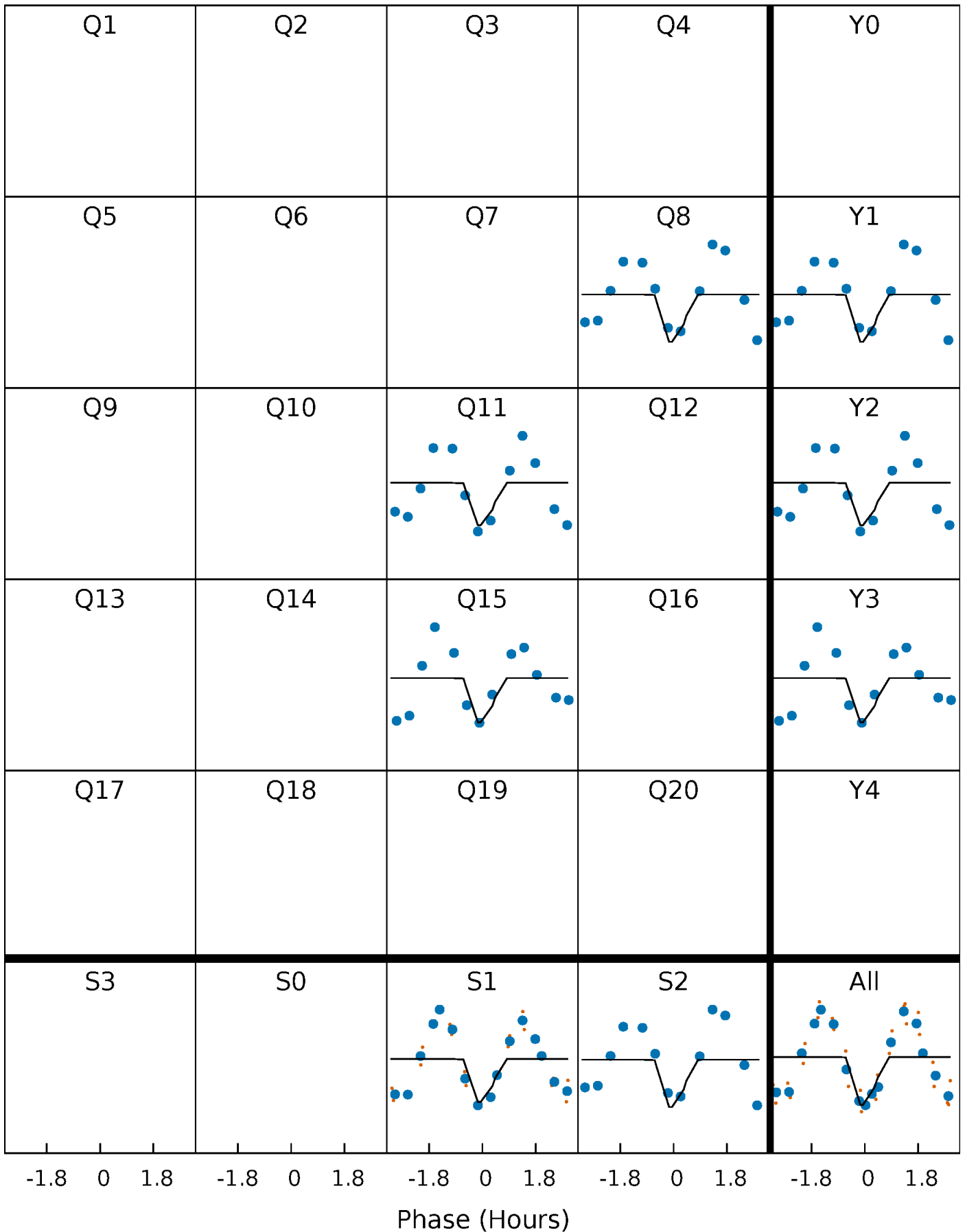
# DV Quarter-Phased Transit Curves

TCE 002304168-01 P=342.324304 Days  $T_0=397.640228$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

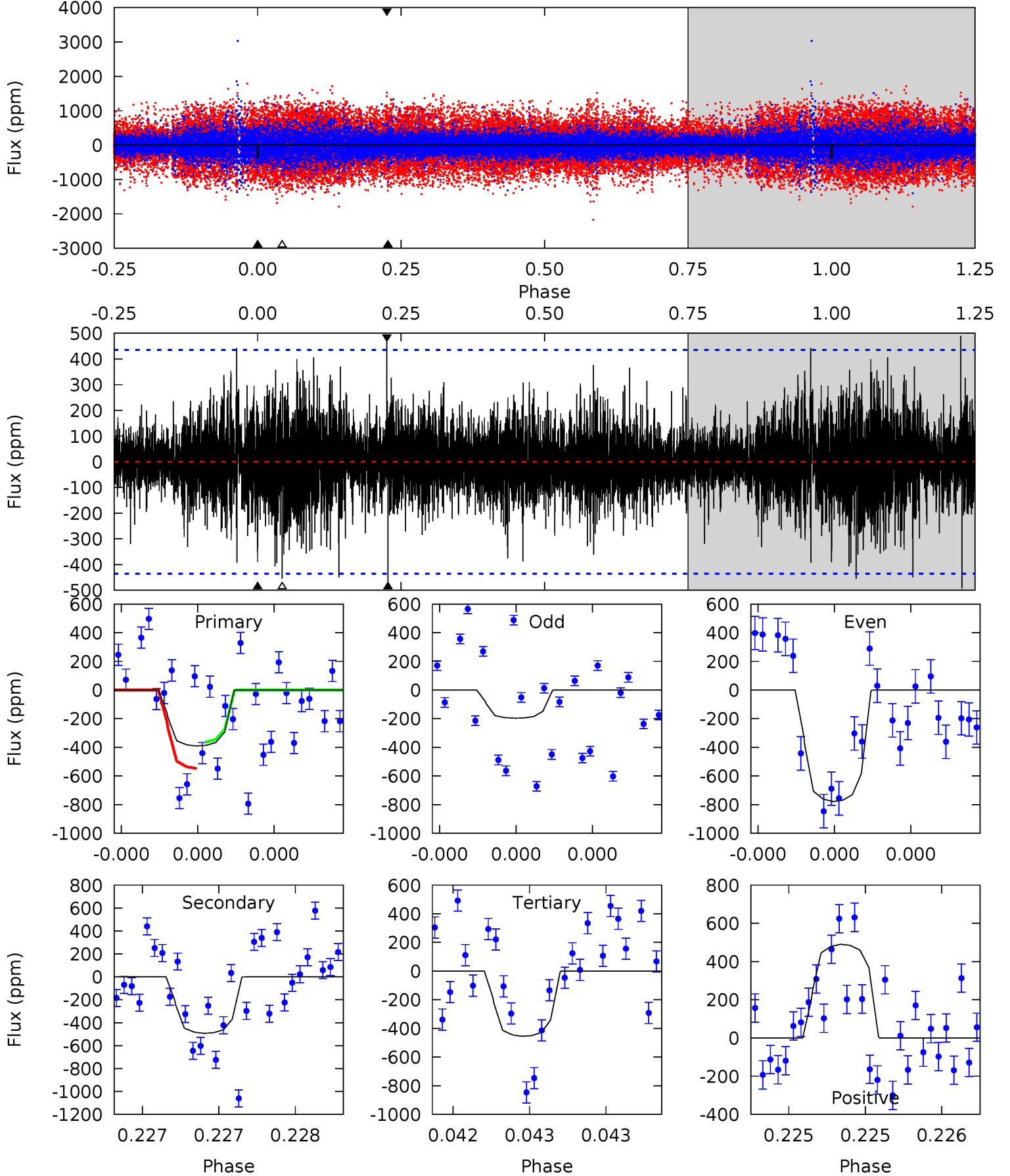
TCE 002304168-01 P=342.262130 Days  $T_0=397.786166$  (BKJD)



# DV Model-Shift Uniqueness Test

002304168-01,  $P = 342.324304$  Days,  $E = 55.315924$  Days

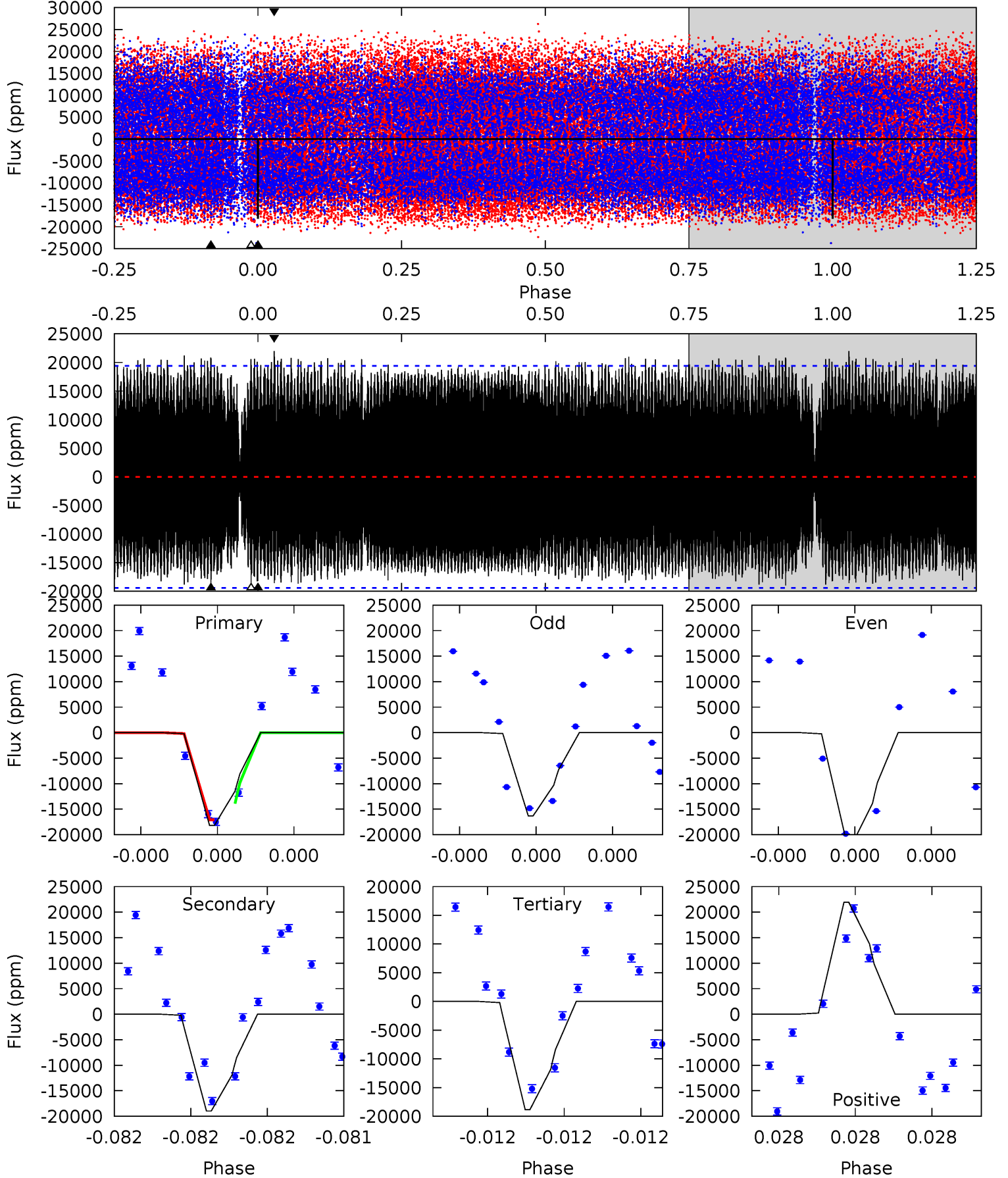
| Pri  | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 5.01 | 6.32 | 5.83 | 6.28 | 5.58            | 3.49            | 1.20             | -0.83   | -1.27   | 0.48    | 0.04    | 3.52    | 1.41 | 0.50  | 1.17 |



# Alt Model-Shift Uniqueness Test

002304168-01, P = 342.262130 Days, E = 55.524036 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  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 5.39 | 5.62 | 5.58 | 6.50 | 5.75            | 3.75            | 2.81             | -0.19   | -1.11   | 0.04    | -0.89   | 0.81    | 1.01 | 0.54  | 0.45 |



### Stellar Parameters For KIC 002304168

|        | $T_{\text{eff}}(K)$  | $\log(g)$                 | [Fe/H]                     | $R$ ( $R_{\odot}$ )       | $M(M_{\odot})$            | $p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ ) |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $7221^{+226}_{-327}$ | $3.672^{+0.486}_{-0.054}$ | $-0.060^{+0.250}_{-0.350}$ | $3.332^{+0.404}_{-1.718}$ | $1.904^{+0.124}_{-0.495}$ | $0.072^{+0.358}_{-0.013}$                     |
|        | +3%/-5%              | +13%/-1%                  | +417%/-583%                | +12%/-52%                 | +7%/-26%                  | +494%/-17%                                    |
| Source | KIC0                 | 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 002304168-01 / KOI

| Detrend | Depth (ppm)       | $R_p$ ( $R_{\oplus}$ )    | $T_{max}$ (K)     | $T_{obs}$ (K)          | $A_{obs}$               |
|---------|-------------------|---------------------------|-------------------|------------------------|-------------------------|
| DV      | $-493 \pm 78$     | $12.18^{+12.07}_{-7.59}$  | $707^{+56}_{-86}$ | $5283^{+3894}_{-1190}$ | $2513^{+15120}_{-1898}$ |
| Alt.    | $-18956 \pm 3375$ | $40.95^{+17.85}_{-14.73}$ | $714^{+52}_{-93}$ | $7445^{+1907}_{-1161}$ | $8415^{+12296}_{-4288}$ |

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

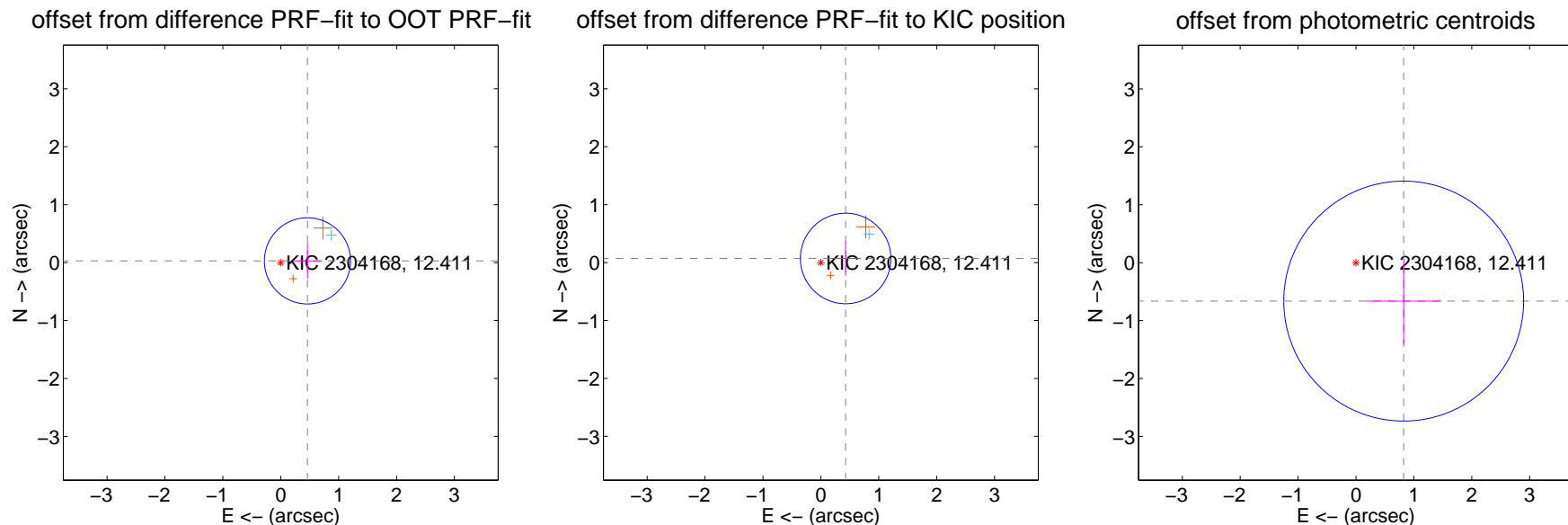
## DV Centroid Data

Supplemental centroid analysis for 002304168-01. Kepler magnitude: 12.41. Transit SNR 7.34

There are 1 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.07 arcsec

|   | Distance in arcsec | Distance / $\sigma$ | $\Delta$ RA        | $\Delta$ Dec      |
|---|--------------------|---------------------|--------------------|-------------------|
| PRF-fit source offset from OOT          | $0.462 \pm 0.248$  | 1.86                | $-0.461 \pm 0.248$ | $0.030 \pm 0.309$ |
| PRF-fit source offset from KIC position | $0.434 \pm 0.261$  | 1.67                | $-0.428 \pm 0.259$ | $0.071 \pm 0.296$ |
| photometric centroid source offset      | $1.06 \pm 0.69$    | 1.53                | $-0.82 \pm 0.65$   | $-0.66 \pm 0.75$  |



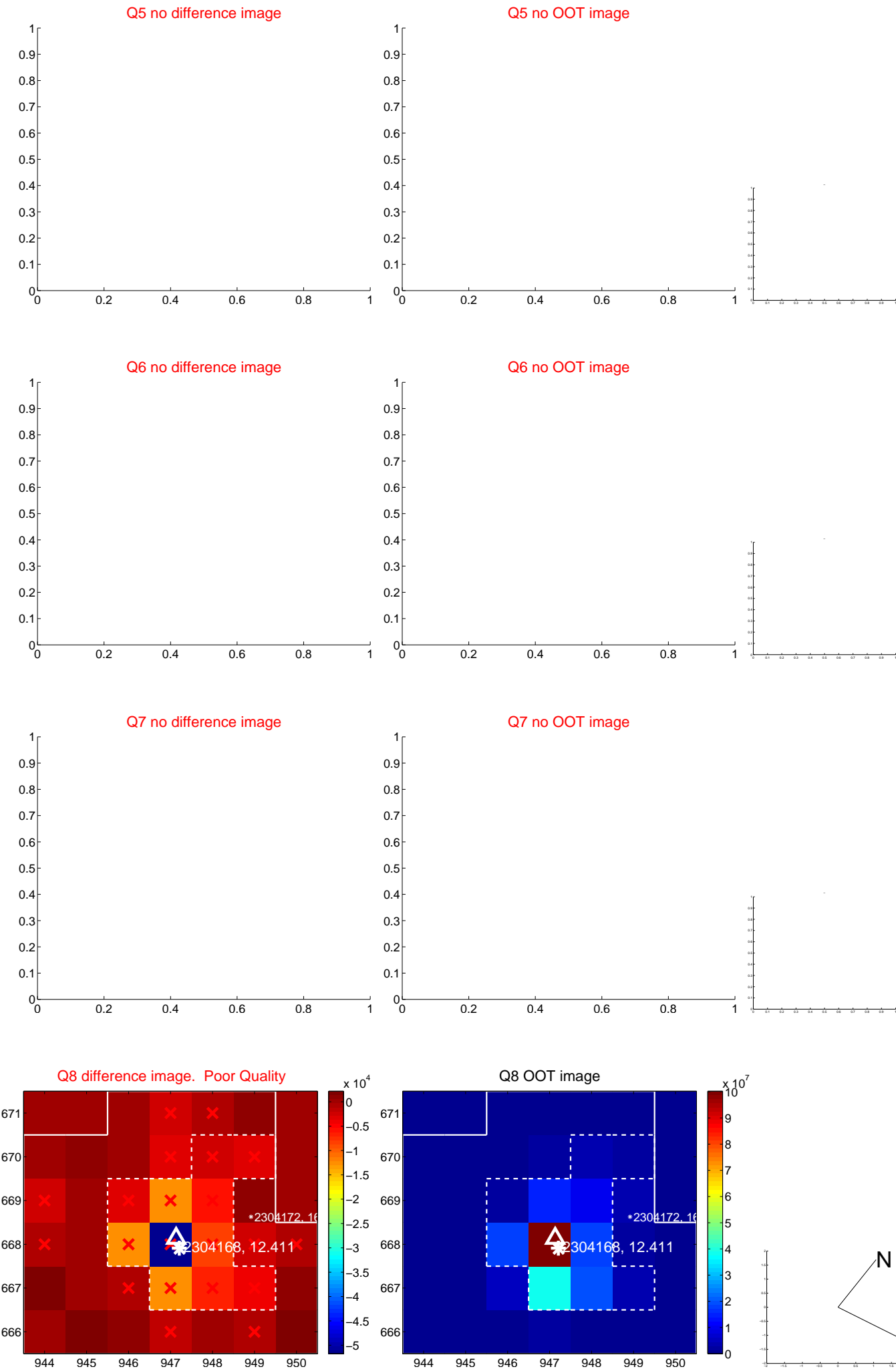
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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



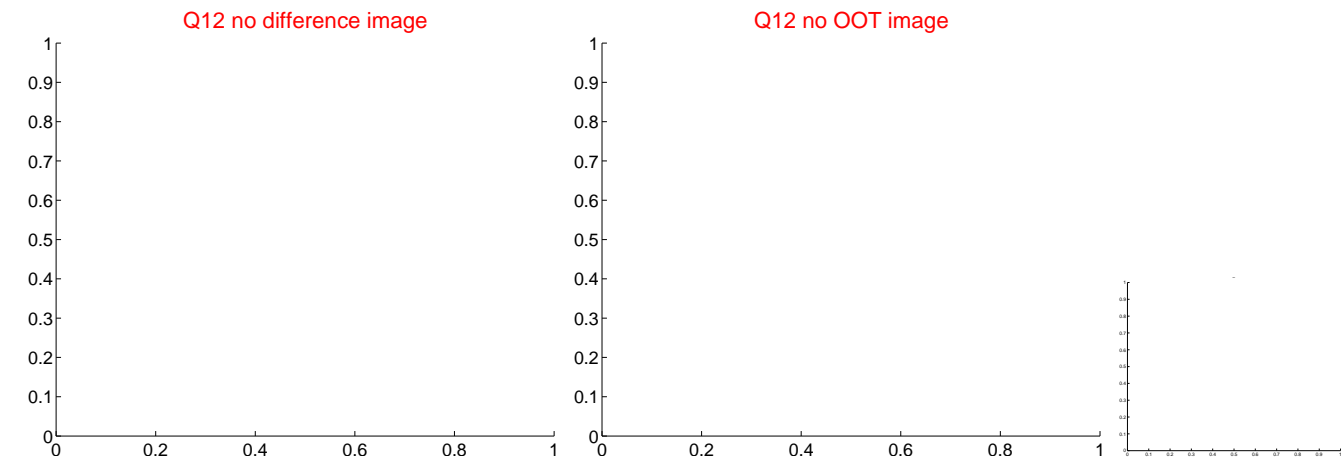
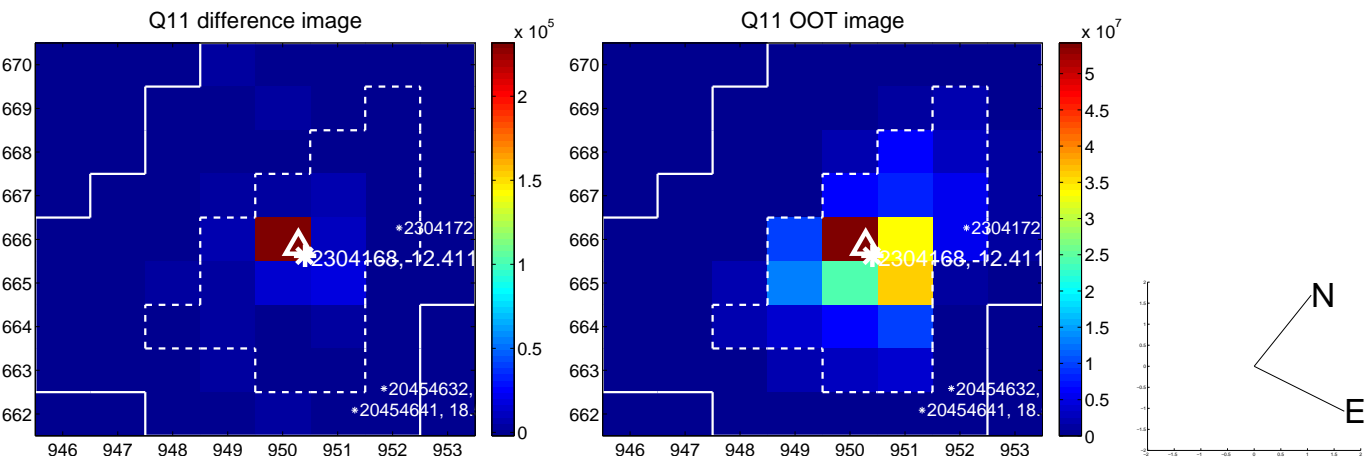
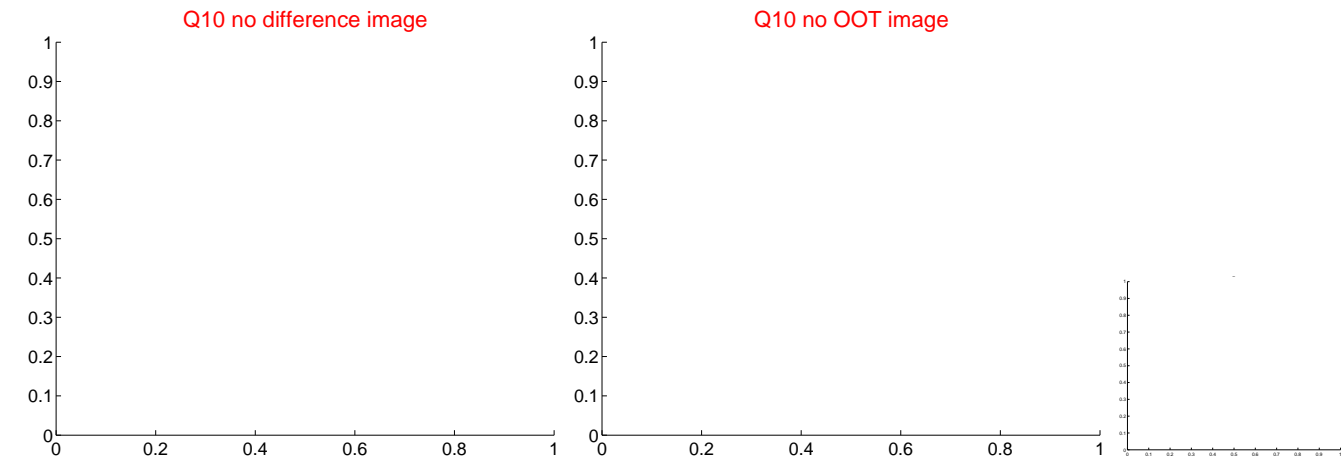
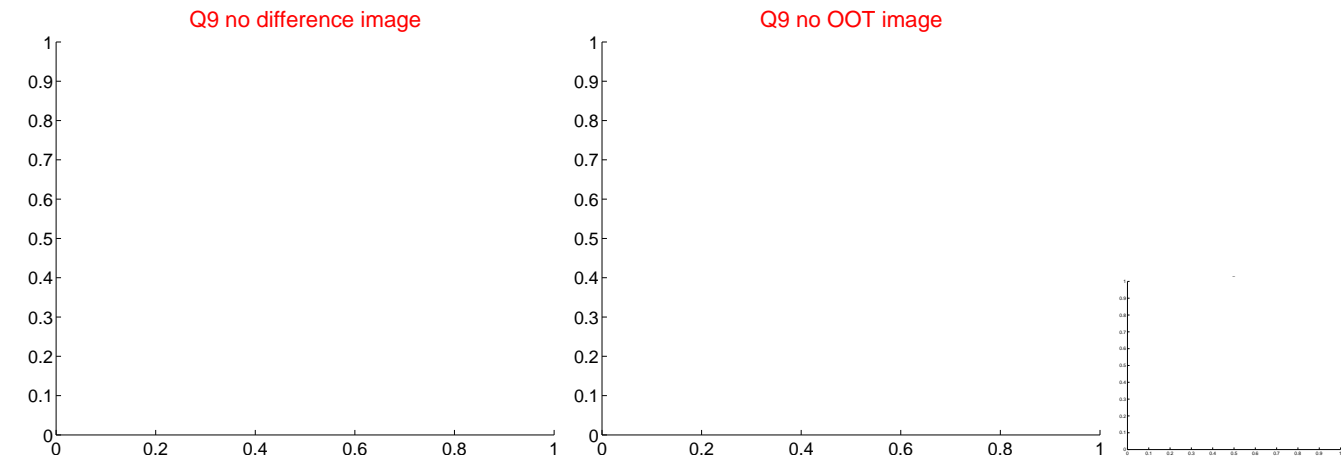
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



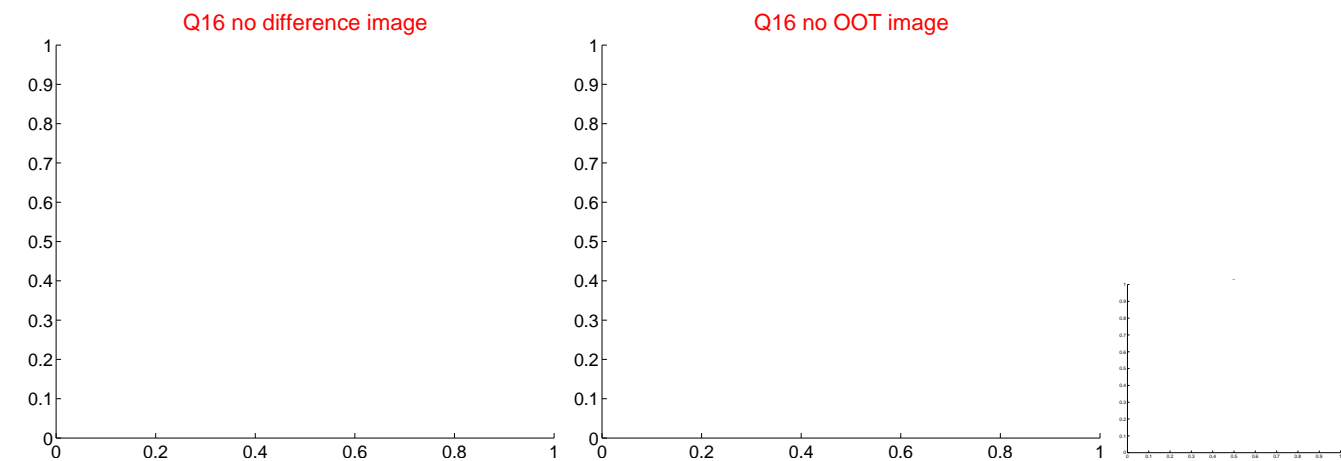
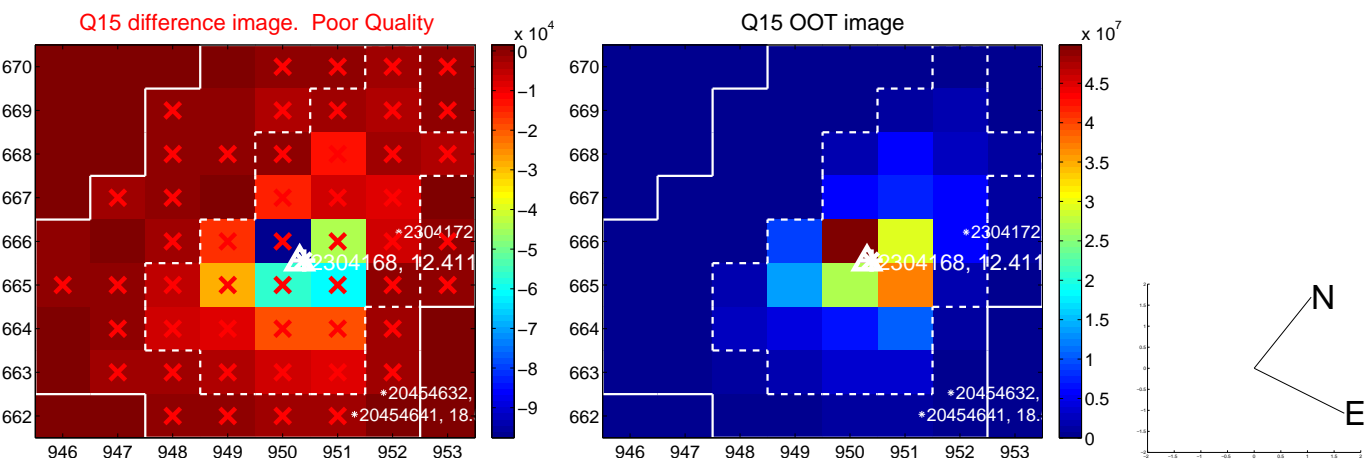
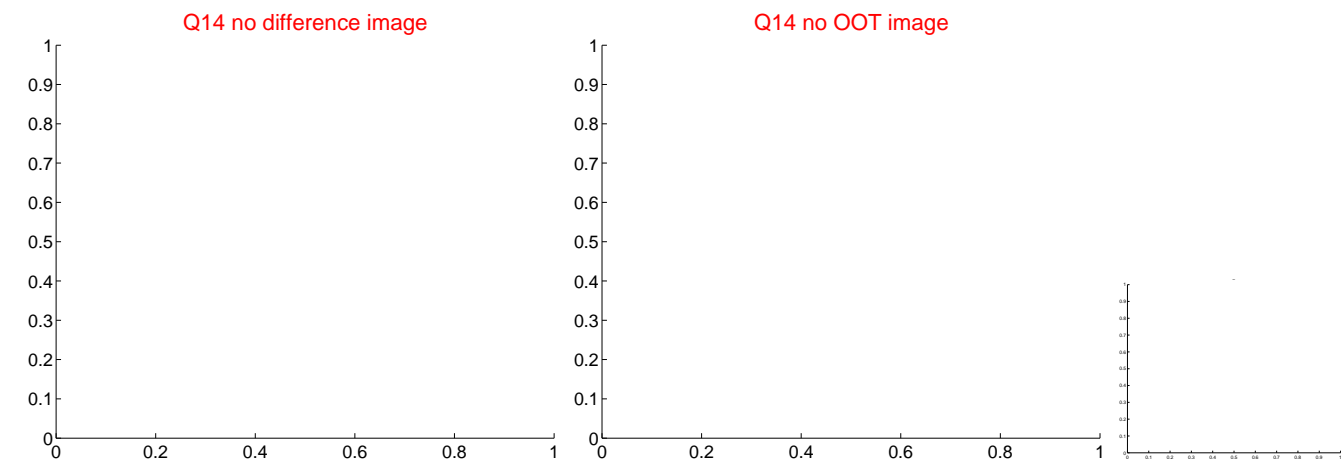
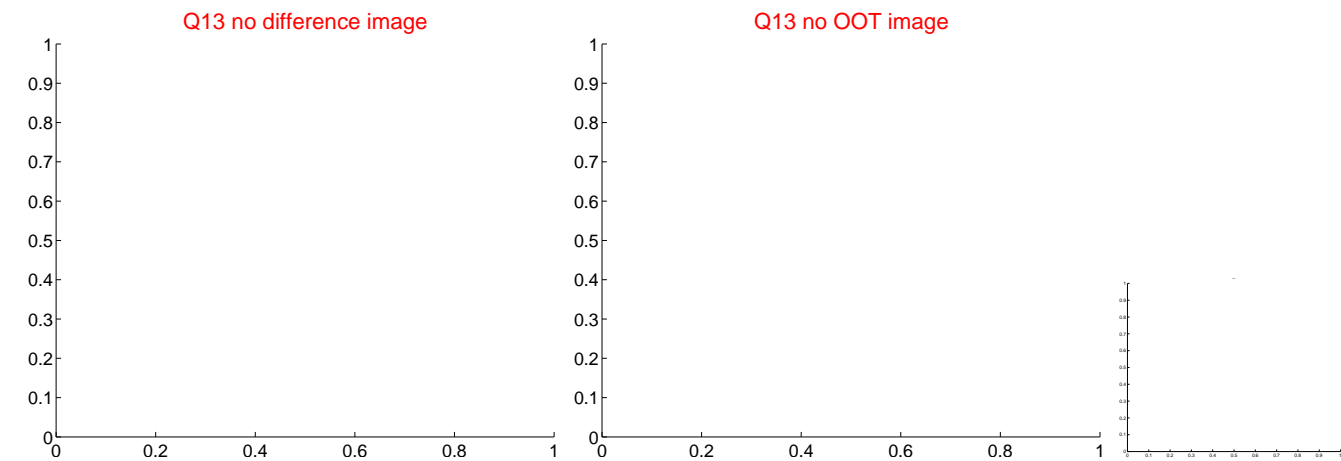
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



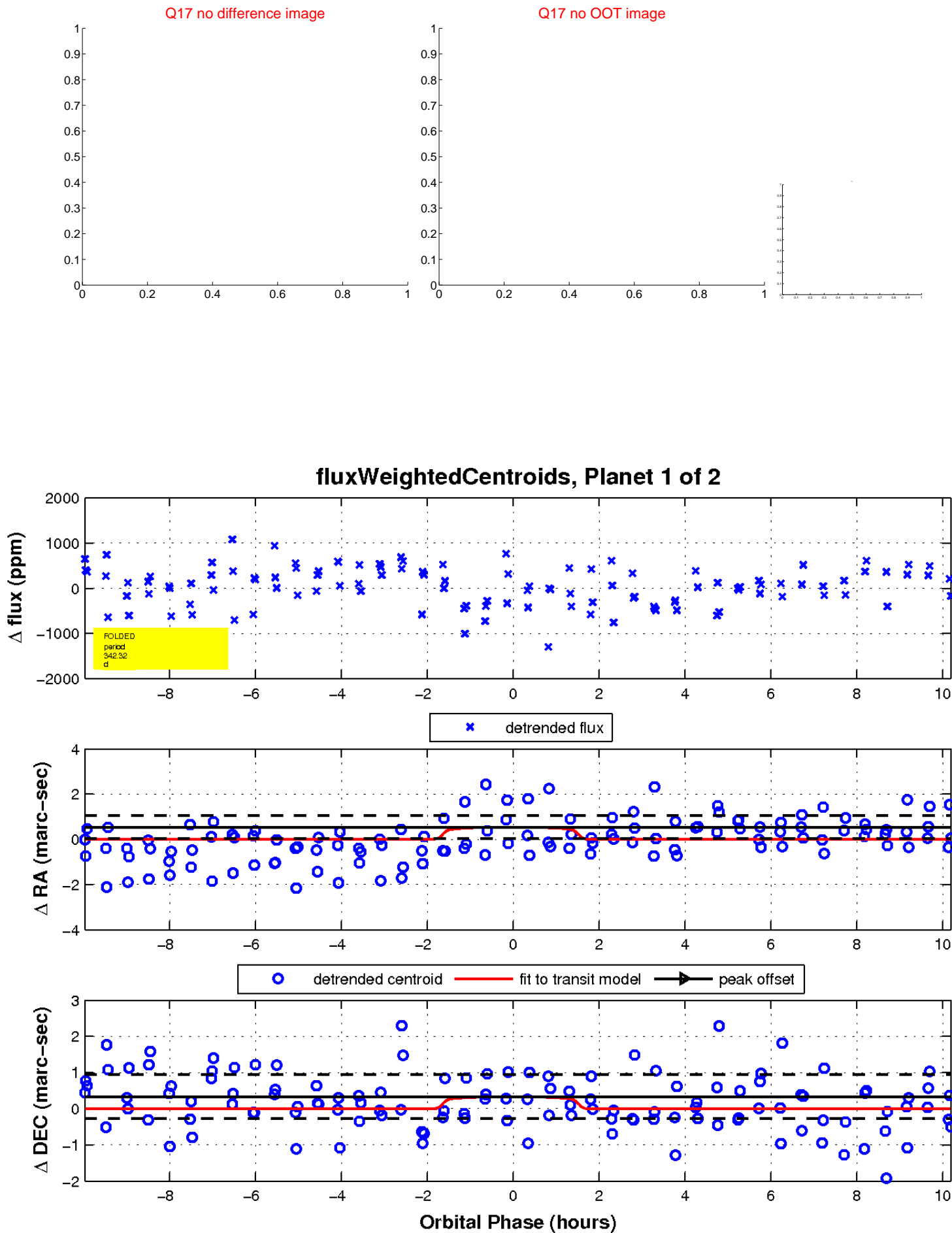
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

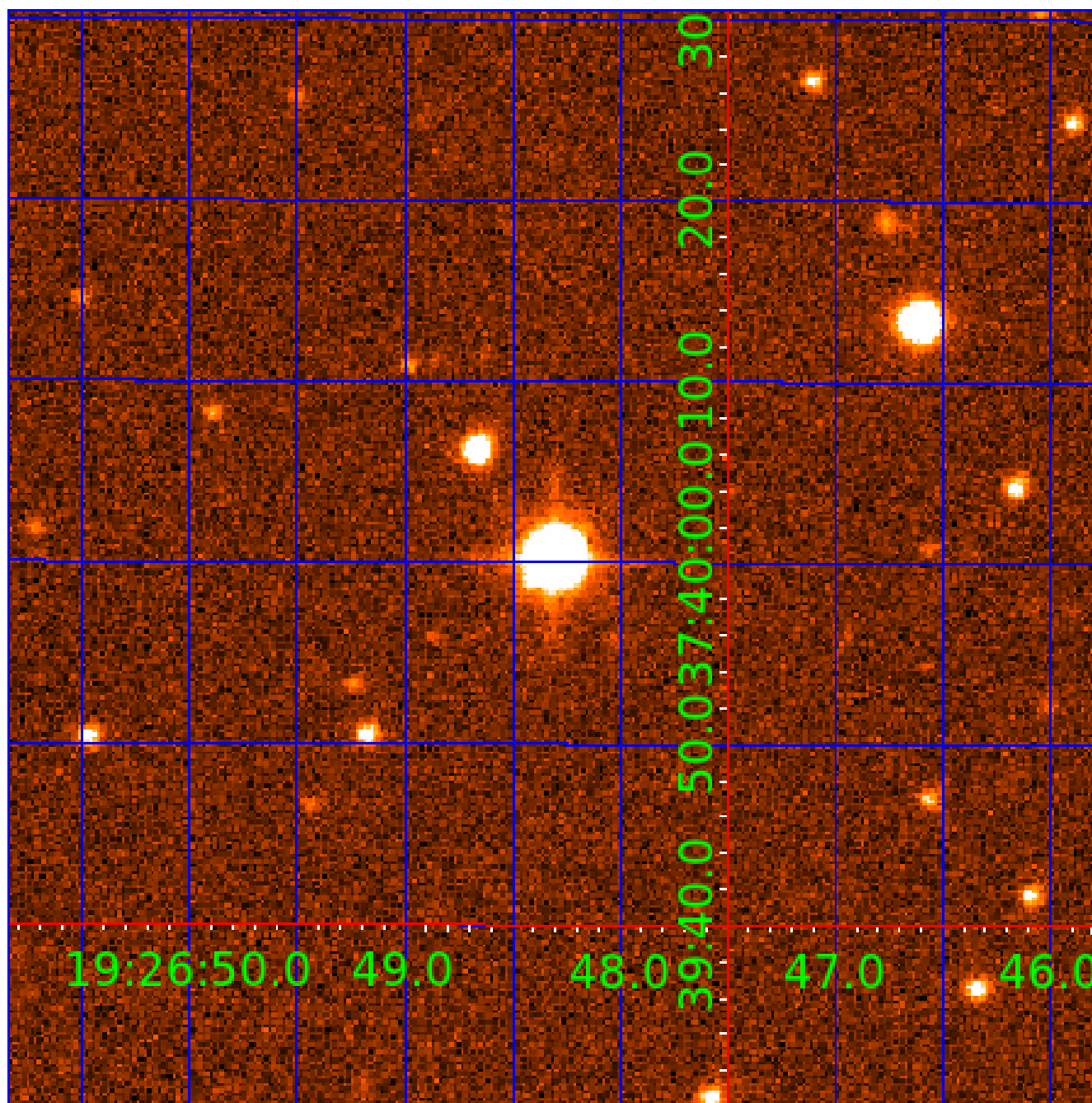


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination





# KIC 002304168

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 002304168-01 | OBS      | No   | 342.324304    | 397.640228   | 631.6       | 3.397            | 15.6 | 7.3  | 3.33                        | 7221            | 9.18                   | 19.19                  |
| 002304168-02 | OBS      | No   | 431.718852    | 219.298211   | 488.4       | 13.219           | 12.2 | 10.3 | 3.33                        | 7221            | 8.77                   | 14.09                  |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments  |
|--------------|----------|------|-------|---|---|---|---|---|
| 002304168-01 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | INDIV_TRANS_TRACKER—LPP_DV—LPP_ALT—ALL_TRANS_CHASES—MOD_TER_DV—MOD_POS_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—INCONSISTENT_TRANS—CENT_FEW_DIFFS |
| 002304168-02 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | INDIV_TRANS_RUBBLE_CHASES—LPP_ALT—ALL_TRANS_CHASES—MOD_TER_DV—MOD_NONUNIQ_ALT—MOD_TER_ALT—MOD_POS_ALT—CENT_FEW_DIFFS                                |

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

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

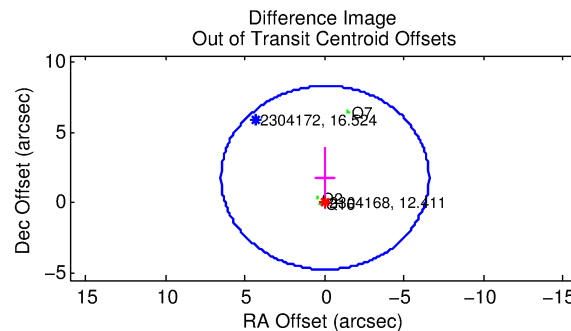
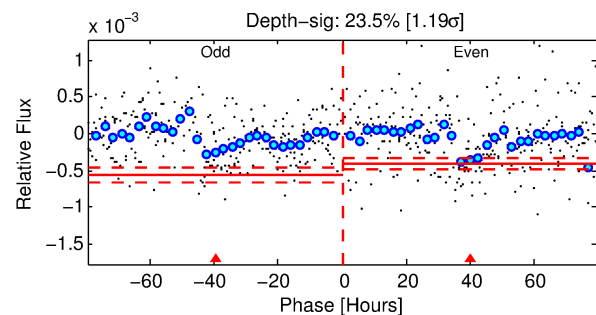
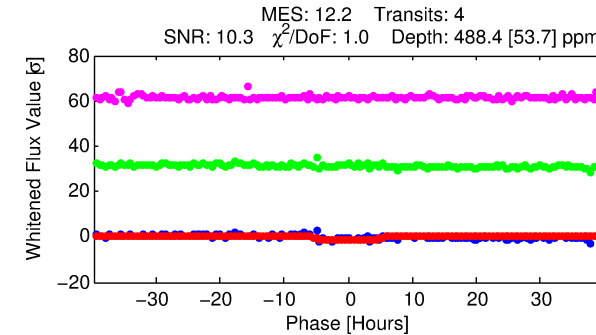
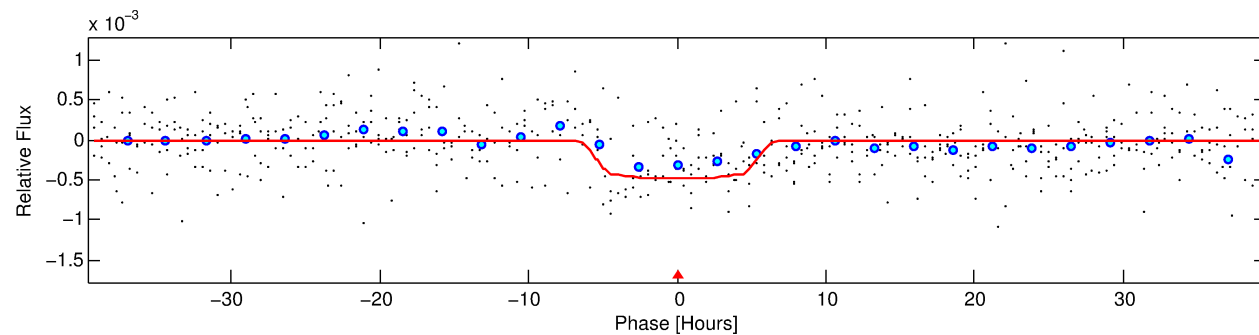
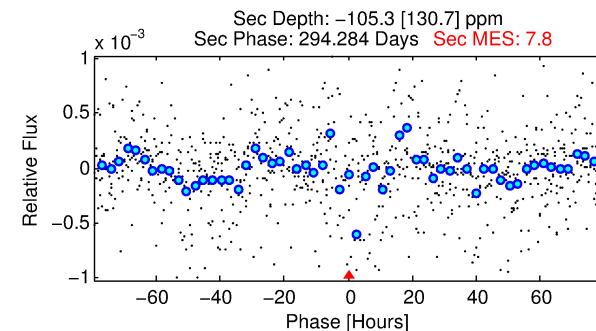
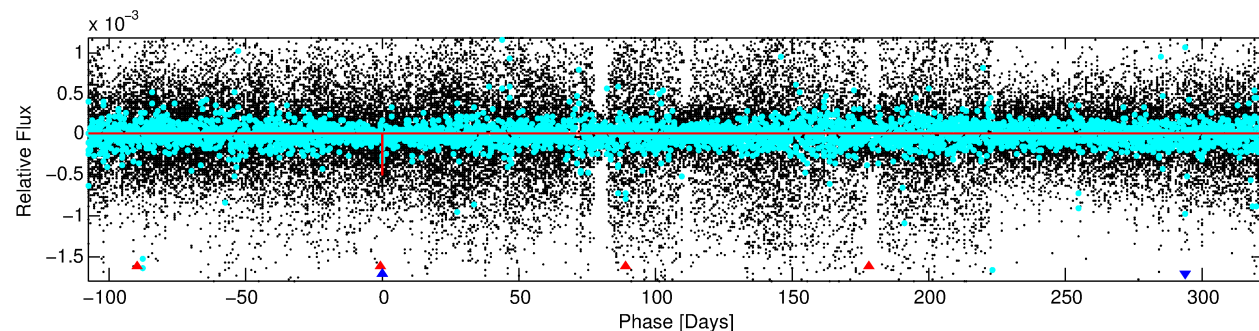
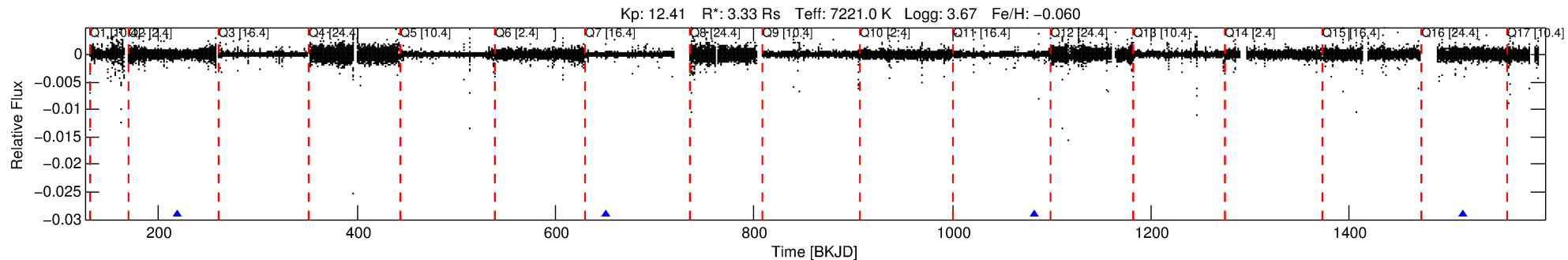
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 002304168-02

No Significant Match Found

# DV One-Page Summary

KIC: 2304168 Candidate: 2 of 2 Period: 431.719 d



## DV Fit Results:

Period = 431.71885 [0.01180] d  
Epoch = 219.2982 [0.0184] BKJD  
Rp/R\* = 0.0241 [0.0018]  
a/R\* = 106.55 [28.49]  
b = 0.93 [0.04]  
Seff = 14.09 [11.85]  
Teq = 494 [104] K  
Rp = 8.77 [4.57] Re  
a = 1.3856 [0.7028] AU  
Ag = N/A  
Teffp = N/A

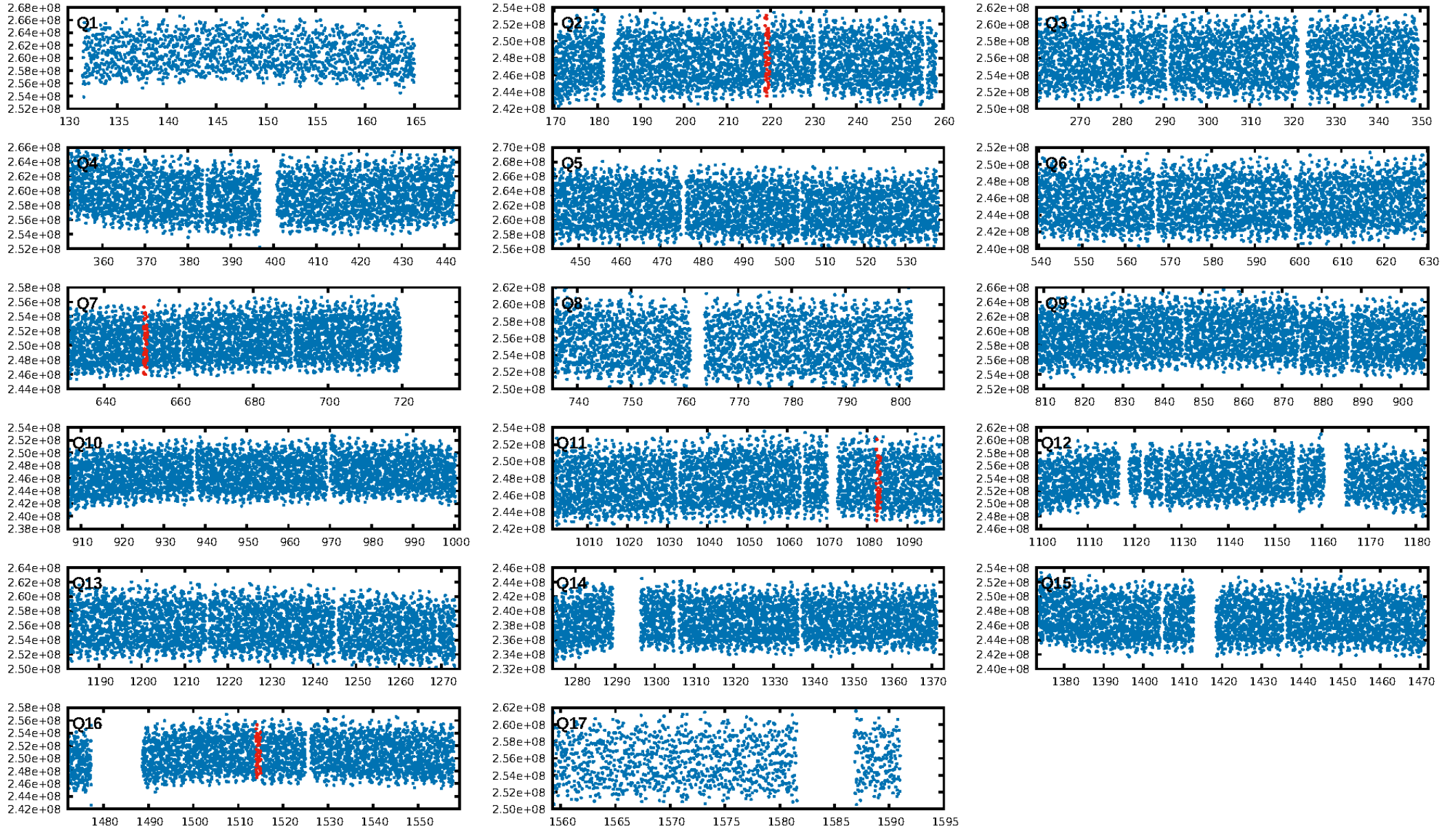
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [157.19σ]  
LongPeriod-sig: N/A  
**ModelChiSquare2-sig: 0.1%**  
ModelChiSquareGof-sig: 99.6%  
**Bootstrap-pfa: 9.03e-07**  
RollingBand-fgt: 1.00 [4/4]  
GhostDiagnostic-chr: 1.168  
Centroid-sig: 8.0%  
Centroid-so: 0.801 arcsec [1.51σ]  
OotOffset-rm: 1.778 arcsec [0.82σ]  
KicOffset-rm: 1.728 arcsec [0.80σ]  
OotOffset-st: 1/1/1/0 [3]  
KicOffset-st: 1/1/1/0 [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 17:04:35 Z

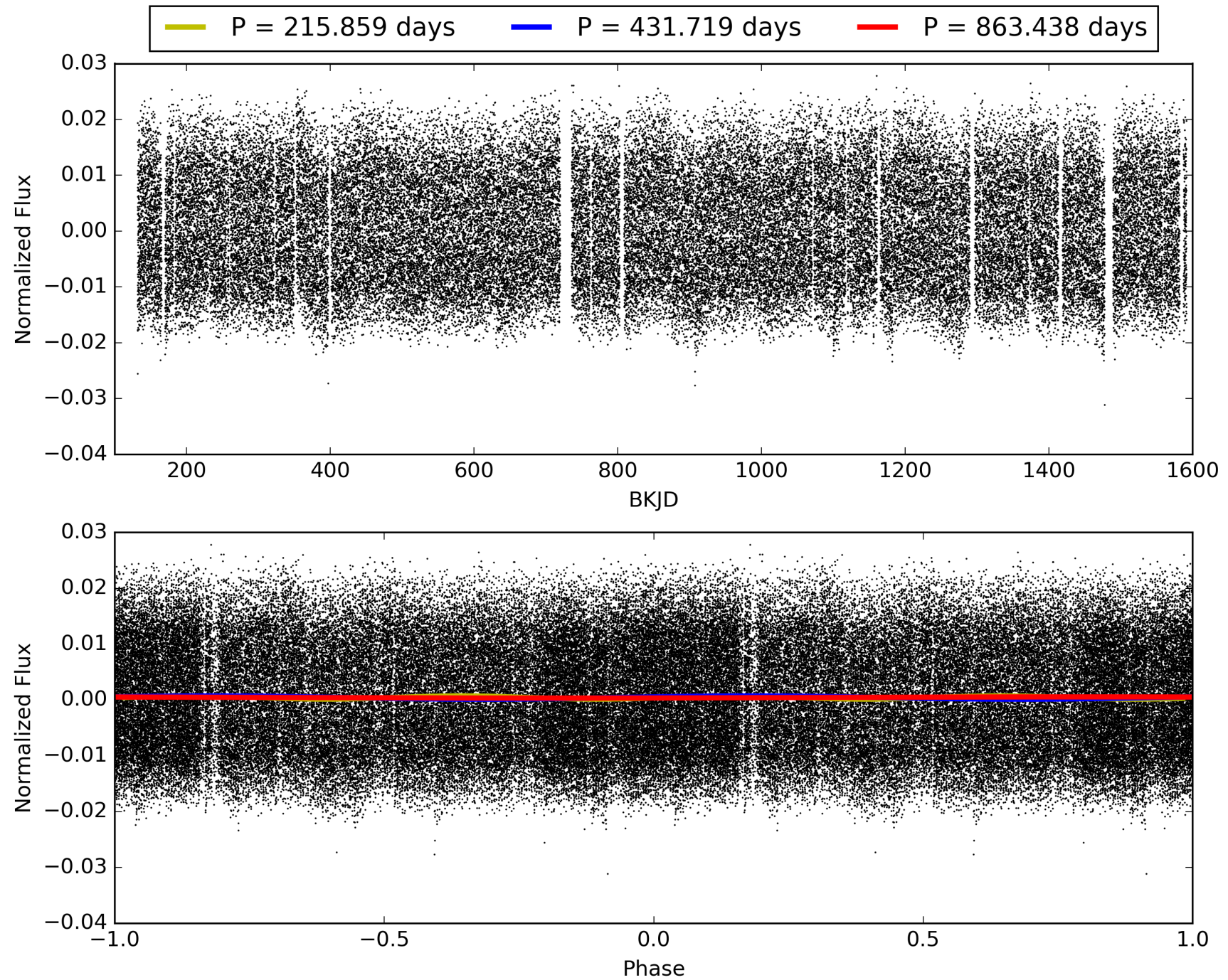
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 002304168-02, PDC Light Curves



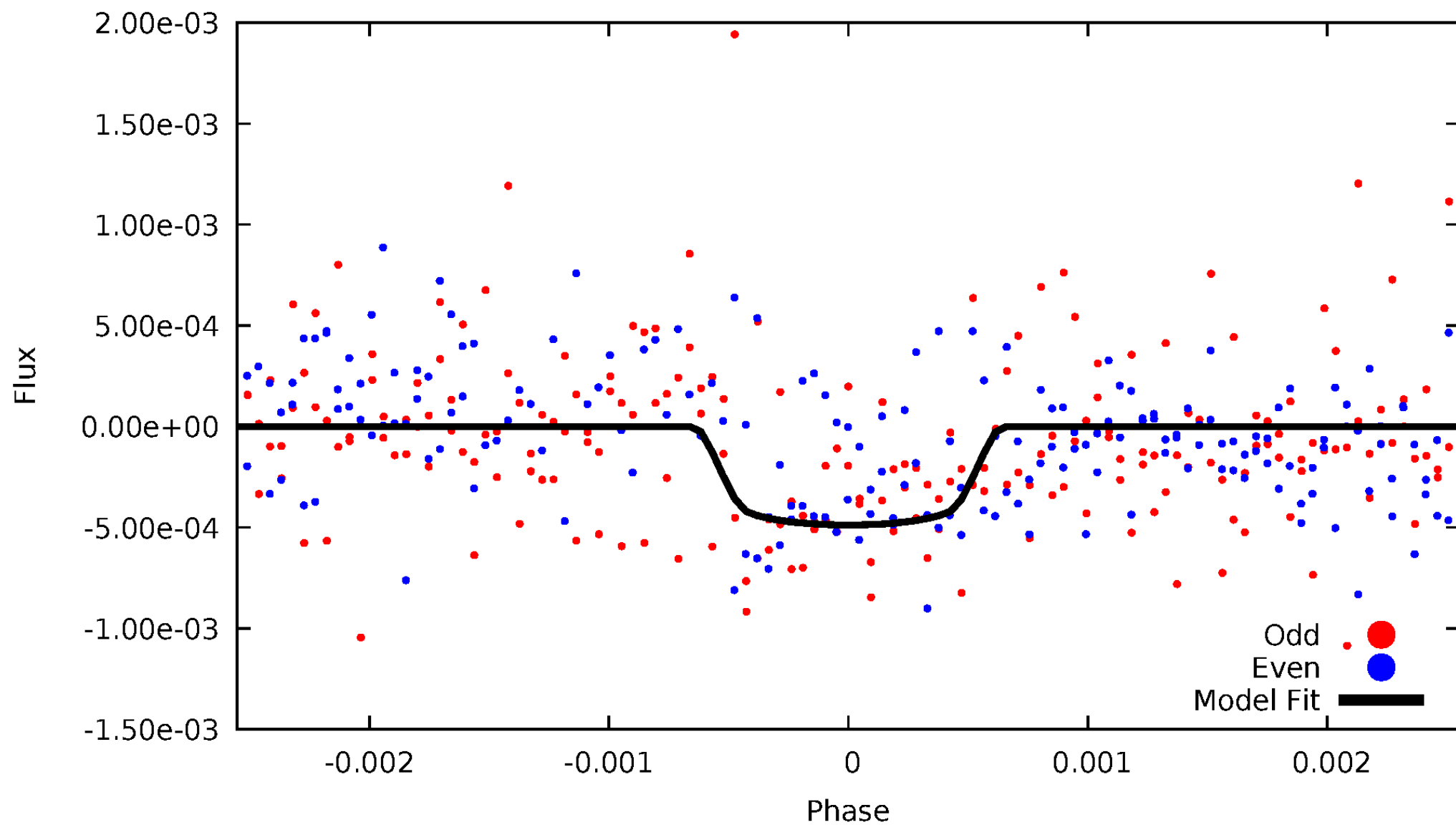


TCE 002304168-02



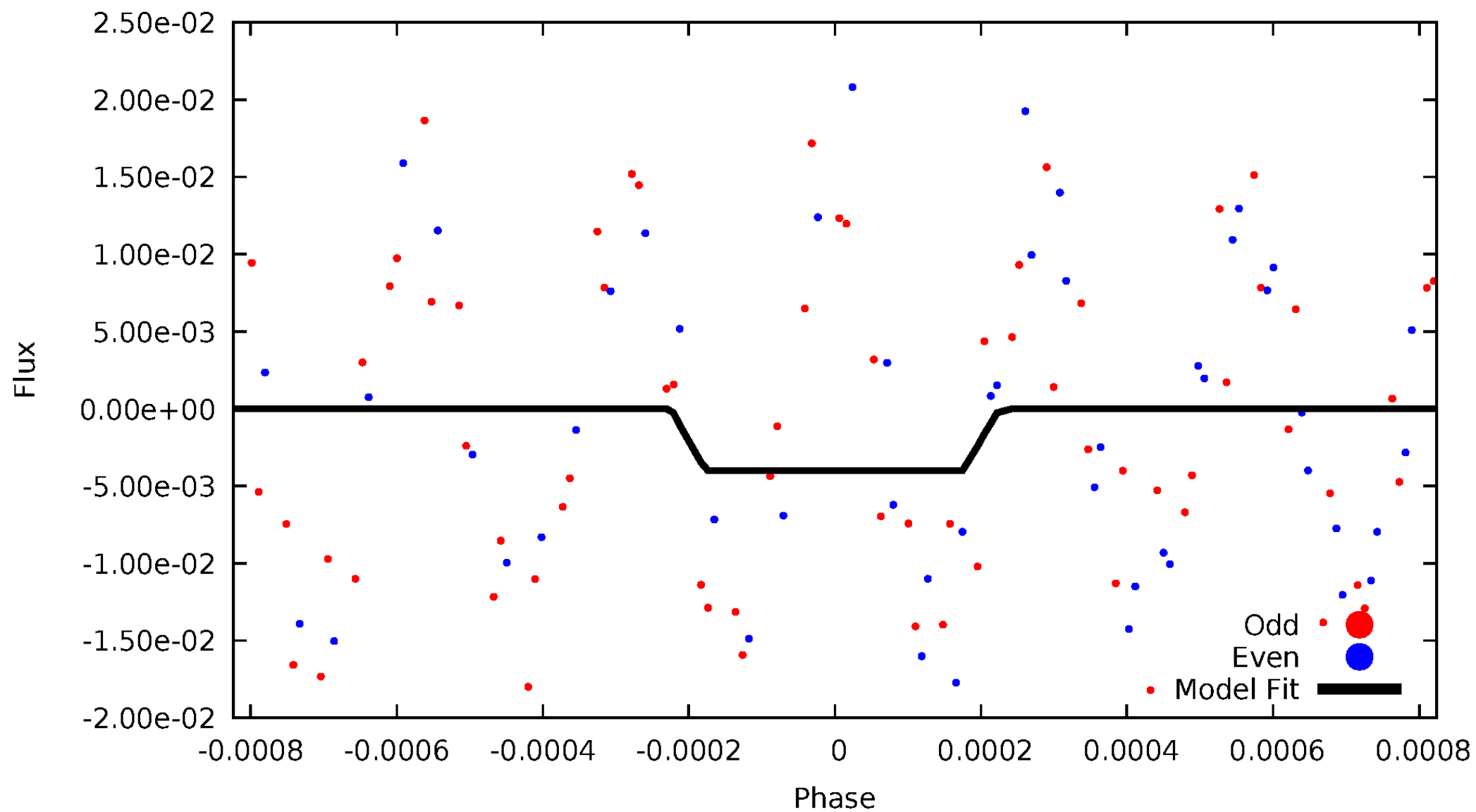
# DV Odd/Even

TCE 002304168-02



# ALT Odd/Even

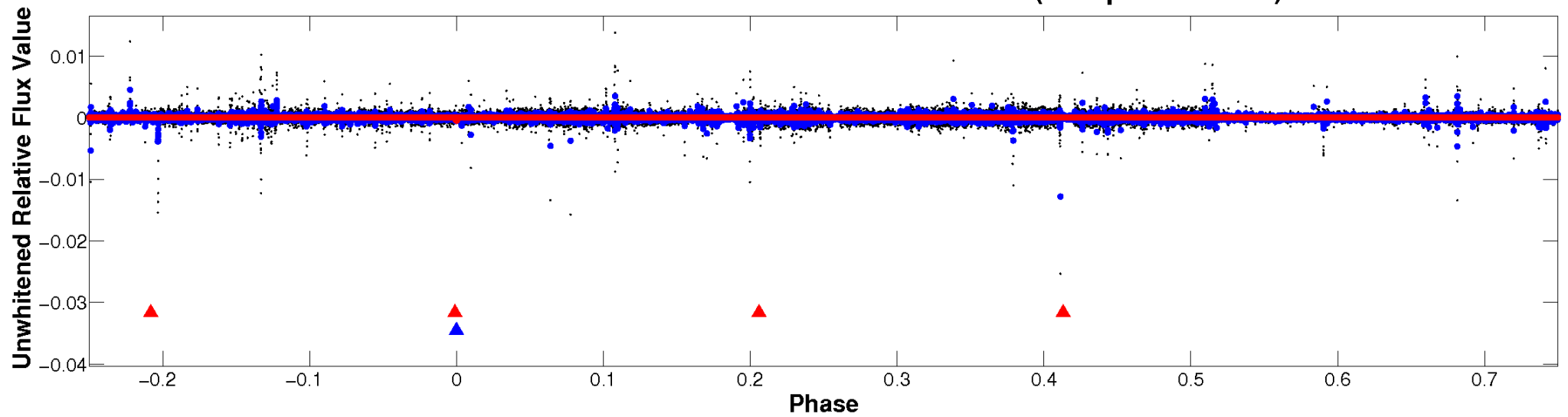
TCE 002304168-02



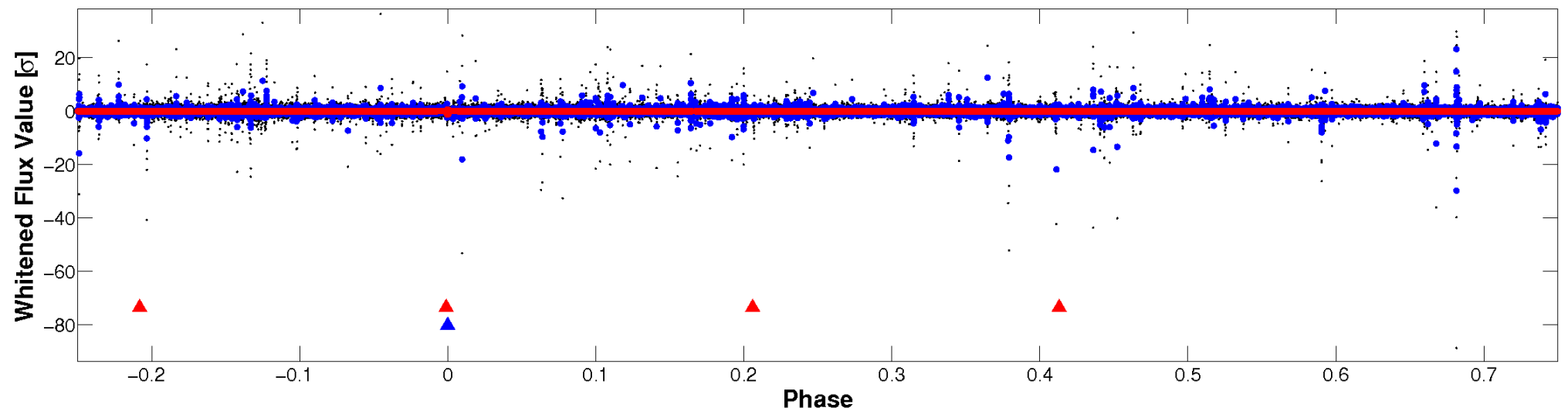


# Non-Whitened Vs. Whitened Light Curve

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

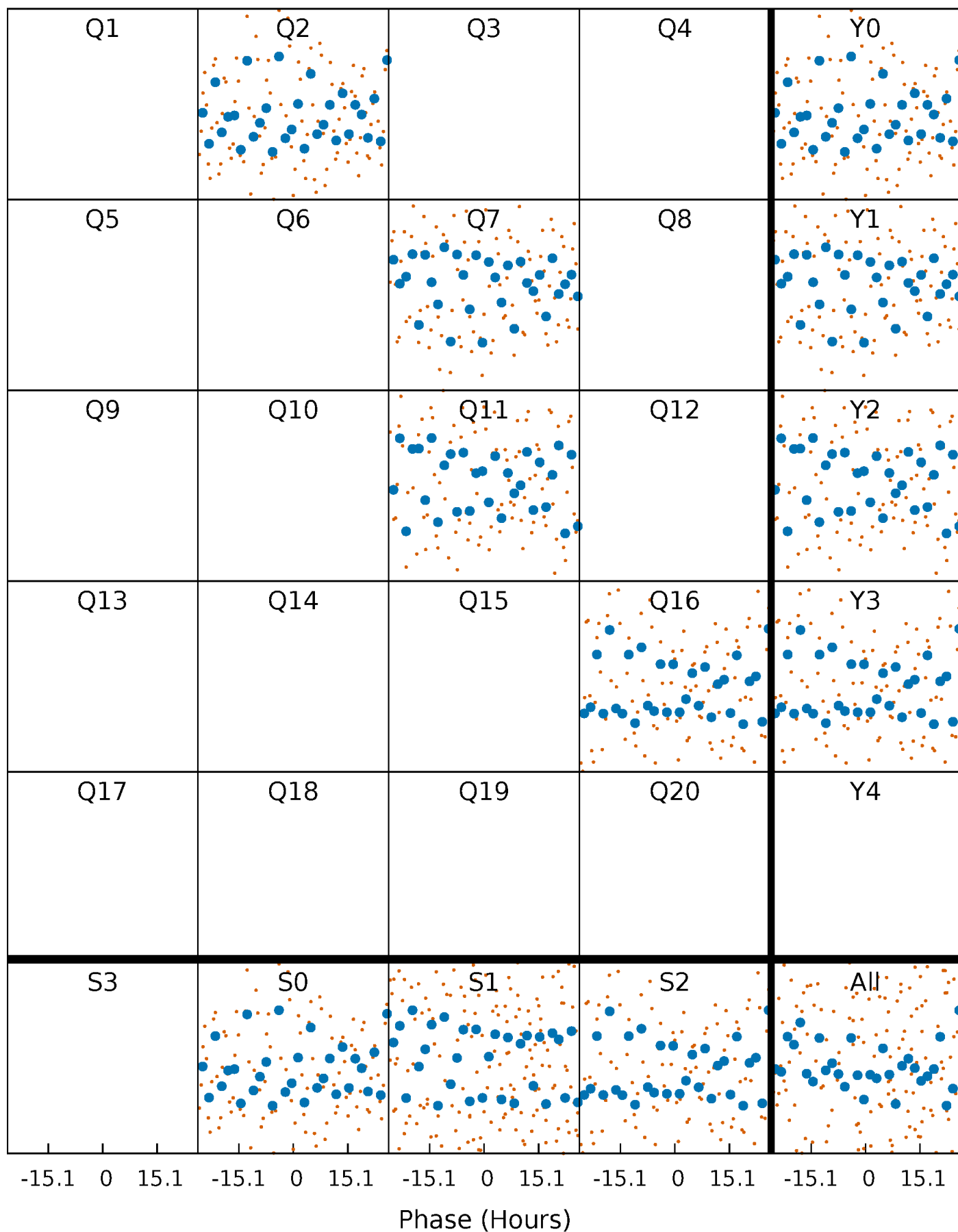


**Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)**



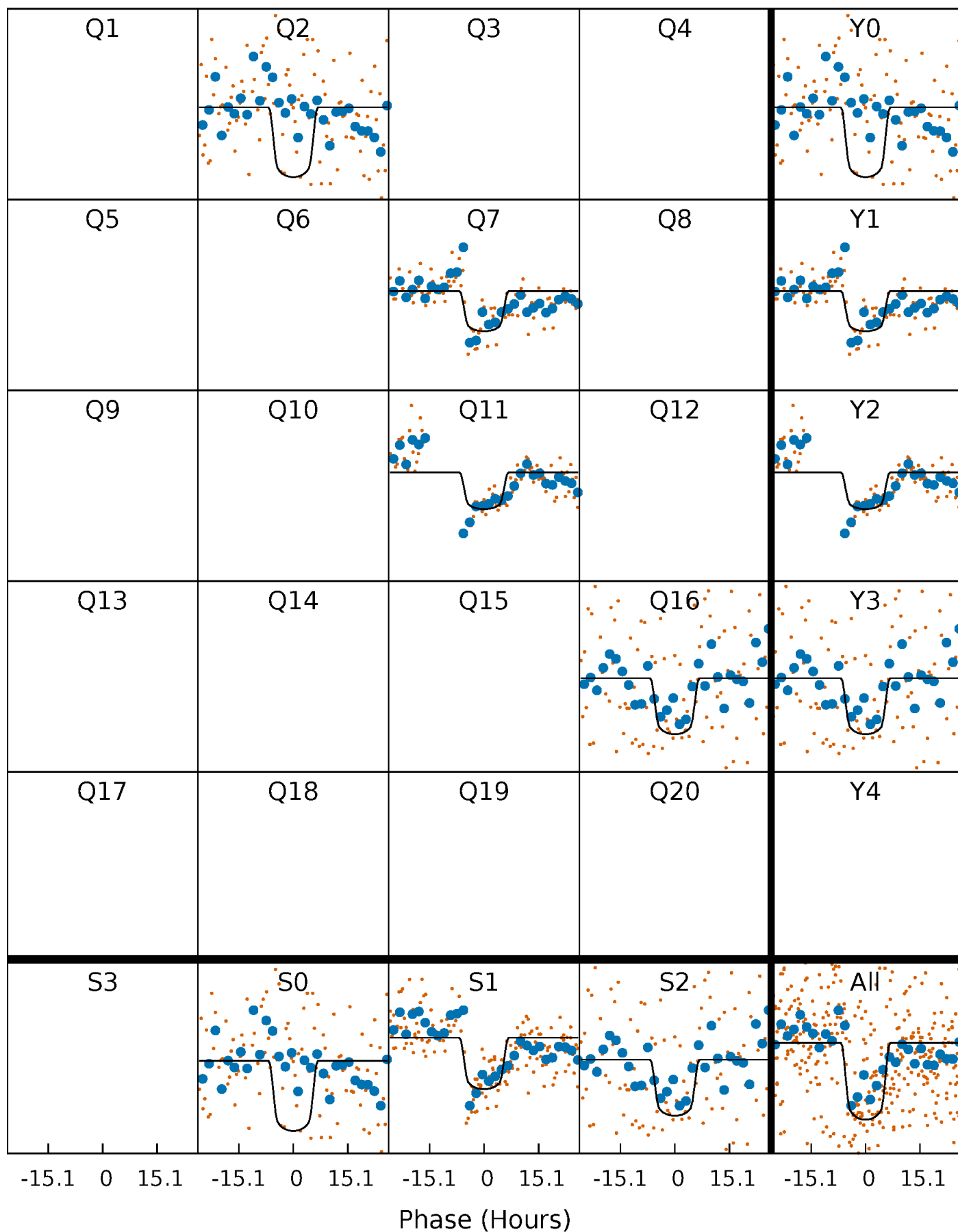
# PDC Quarter-Phased Transit Curves

TCE 002304168-02     $P=431.718852$  Days     $T_0=219.298211$  (BKJD)



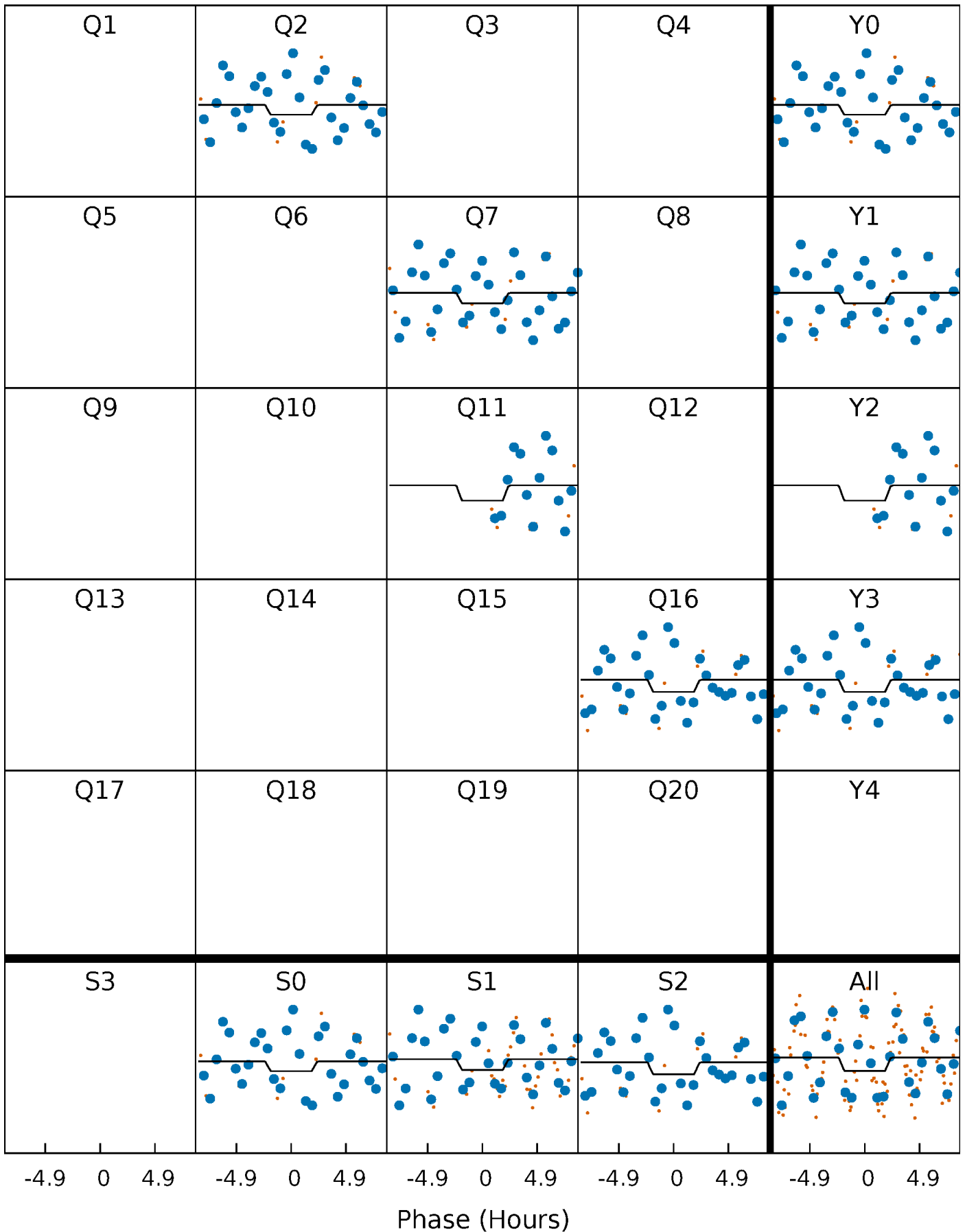
# DV Quarter-Phased Transit Curves

TCE 002304168-02 P=431.718852 Days  $T_0=219.298211$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

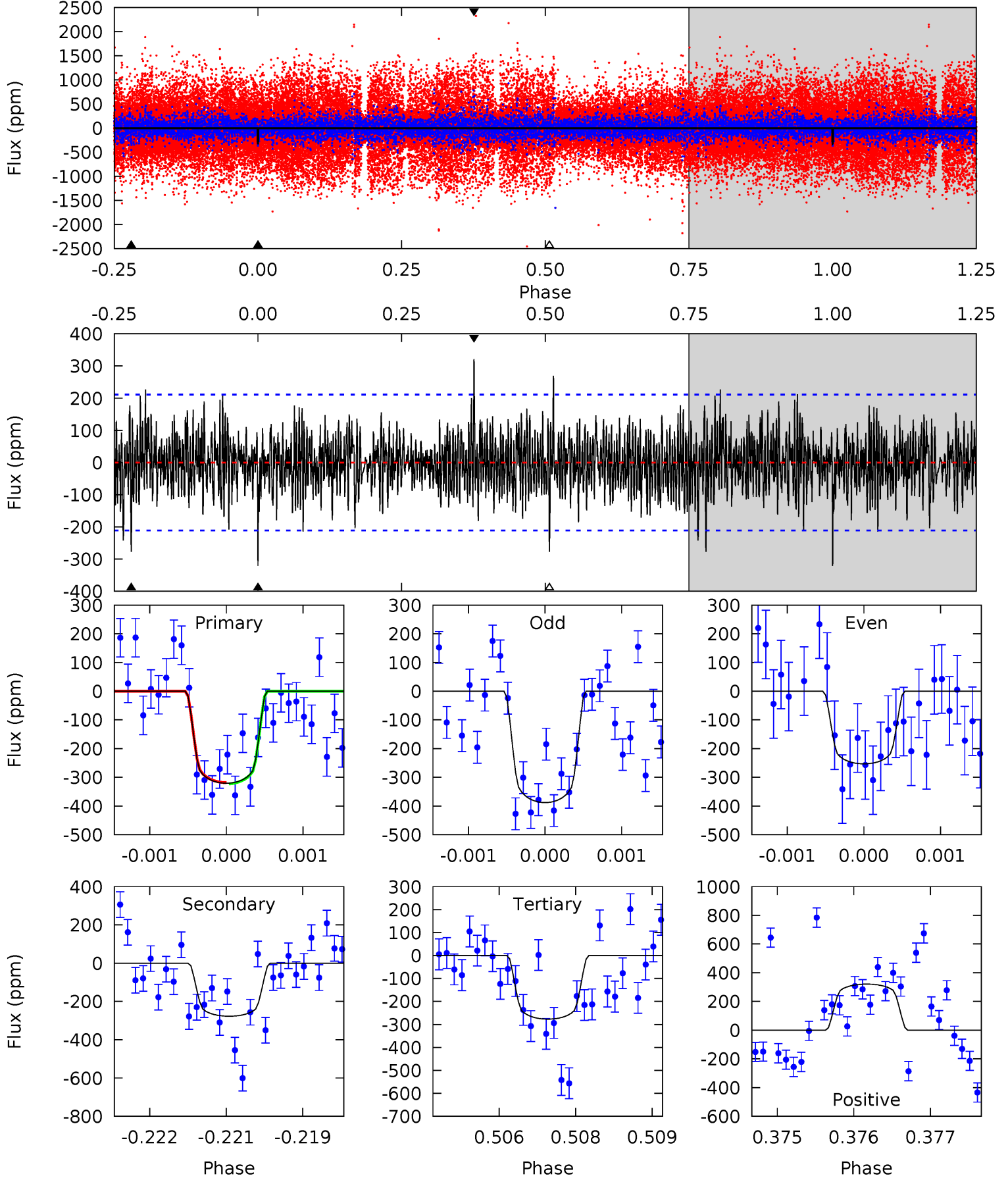
TCE 002304168-02 P=431.686200 Days  $T_0=219.123718$  (BKJD)



# DV Model-Shift Uniqueness Test

002304168-02, P = 431.718852 Days, E = 219.298211 Days

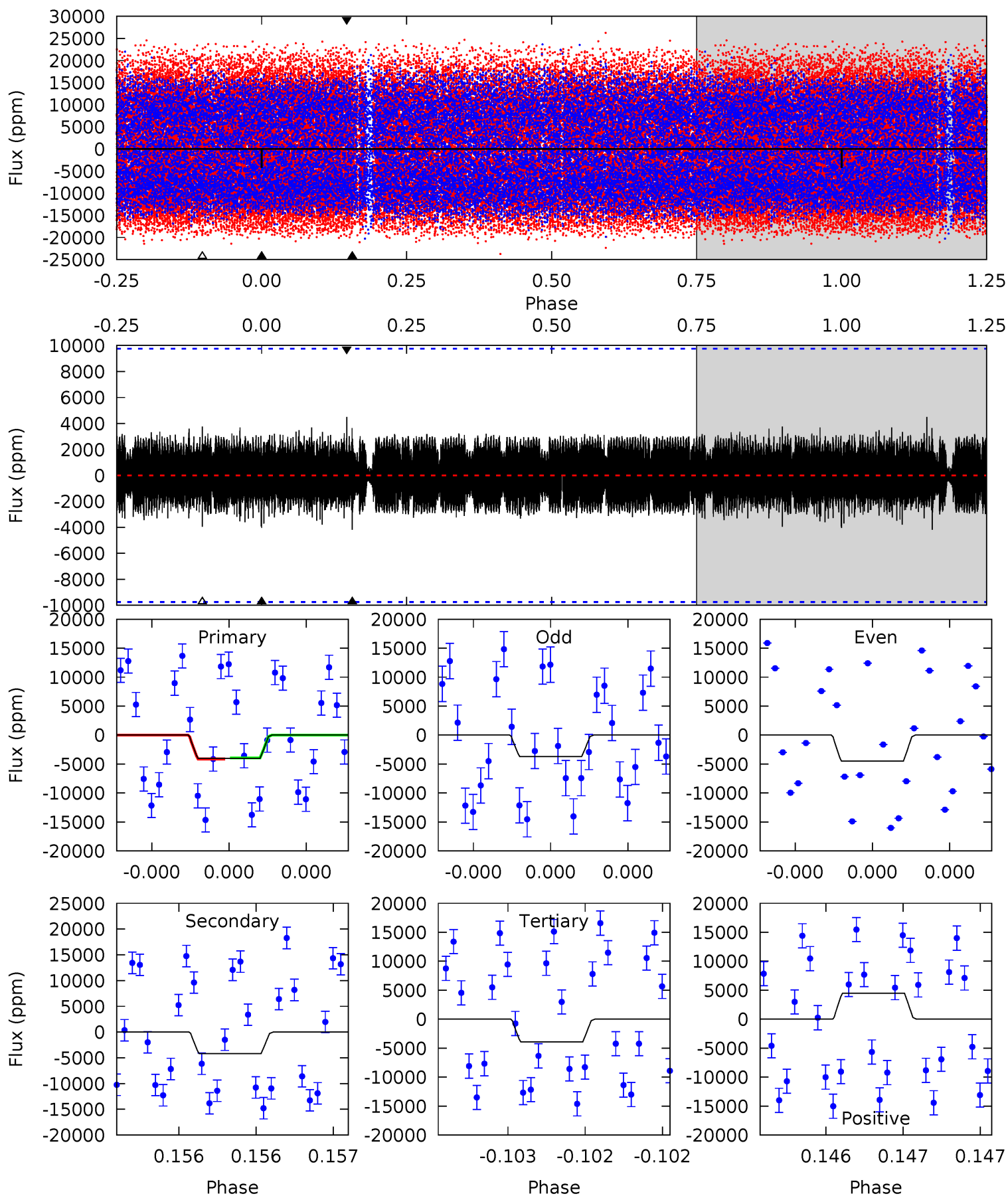
| Pri  | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 8.23 | 7.11 | 7.11 | 8.23 | 5.41            | 3.23            | 1.80             | 1.12    | -0.01   | 0.01    | -1.12   | 1.68    | 0.87 | 0.50  | 0.05 |



# Alt Model-Shift Uniqueness Test

002304168-02, P = 431.686200 Days, E = 219.123718 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  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 2.31 | 2.40 | 2.26 | 2.58 | 5.60            | 3.52            | 0.84             | 0.06    | -0.27   | 0.14    | -0.18   | 0.23    | 1.27 | 0.52  | 0.05 |





### Stellar Parameters For KIC 002304168

|        | $T_{\text{eff}}(K)$  | $\log(g)$                 | [Fe/H]                     | $R$ ( $R_{\odot}$ )       | $M(M_{\odot})$            | $p_{\star}$ ( $\text{g}\cdot\text{cm}^{-3}$ ) |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $7221^{+226}_{-327}$ | $3.672^{+0.486}_{-0.054}$ | $-0.060^{+0.250}_{-0.350}$ | $3.332^{+0.404}_{-1.718}$ | $1.904^{+0.124}_{-0.495}$ | $0.072^{+0.358}_{-0.013}$                     |
|        | +3%/-5%              | +13%/-1%                  | +417%/-583%                | +12%/-52%                 | +7%/-26%                  | +494%/-17%                                    |
| Source | KIC0                 | 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 002304168-02 / KOI

| Detrend | Depth (ppm)      | $R_p$ ( $R_{\oplus}$ )  | $T_{\text{max}}$ (K) | $T_{\text{obs}}$ (K) | $A_{\text{obs}}$        |
|---------|------------------|-------------------------|----------------------|----------------------|-------------------------|
| DV      | $-277 \pm 39$    | $7.91^{+1.52}_{-1.92}$  | $658^{+49}_{-84}$    | $5907^{+361}_{-358}$ | $4609^{+3453}_{-1376}$  |
| Alt.    | $-4181 \pm 1742$ | $21.15^{+2.97}_{-5.36}$ | $653^{+53}_{-78}$    | $7233^{+863}_{-944}$ | $10445^{+7538}_{-4653}$ |

$T_{\text{max}}$  = 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

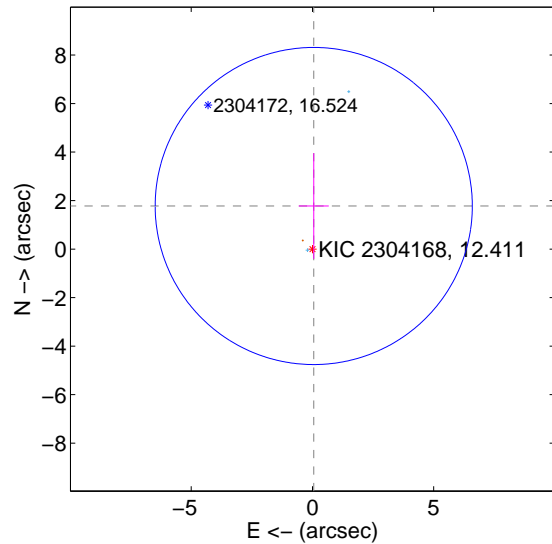
Supplemental centroid analysis for 002304168-02. Kepler magnitude: 12.41. Transit SNR 10.32

There are 2 quarters with good PRF difference image offsets

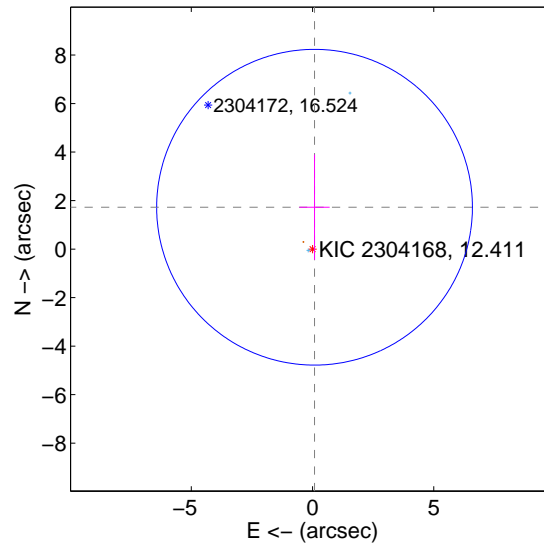
The direct PRF centroid is offset from the target star catalog position by about 0.03 arcsec

|   | Distance in arcsec | Distance / $\sigma$ | $\Delta$ RA        | $\Delta$ Dec      |
|---|--------------------|---------------------|--------------------|-------------------|
| PRF-fit source offset from OOT          | $1.778 \pm 2.179$  | 0.82                | $-0.054 \pm 0.617$ | $1.777 \pm 2.180$ |
| PRF-fit source offset from KIC position | $1.728 \pm 2.170$  | 0.80                | $-0.083 \pm 0.625$ | $1.726 \pm 2.172$ |
| photometric centroid source offset      | $0.80 \pm 0.53$    | 1.51                | $-0.58 \pm 0.51$   | $-0.55 \pm 0.55$  |

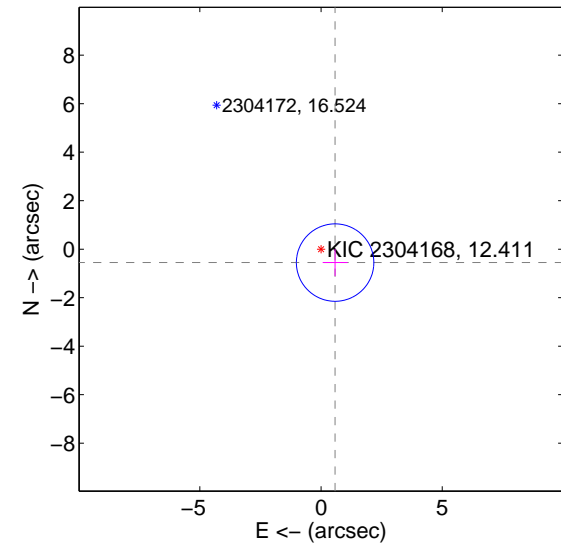
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

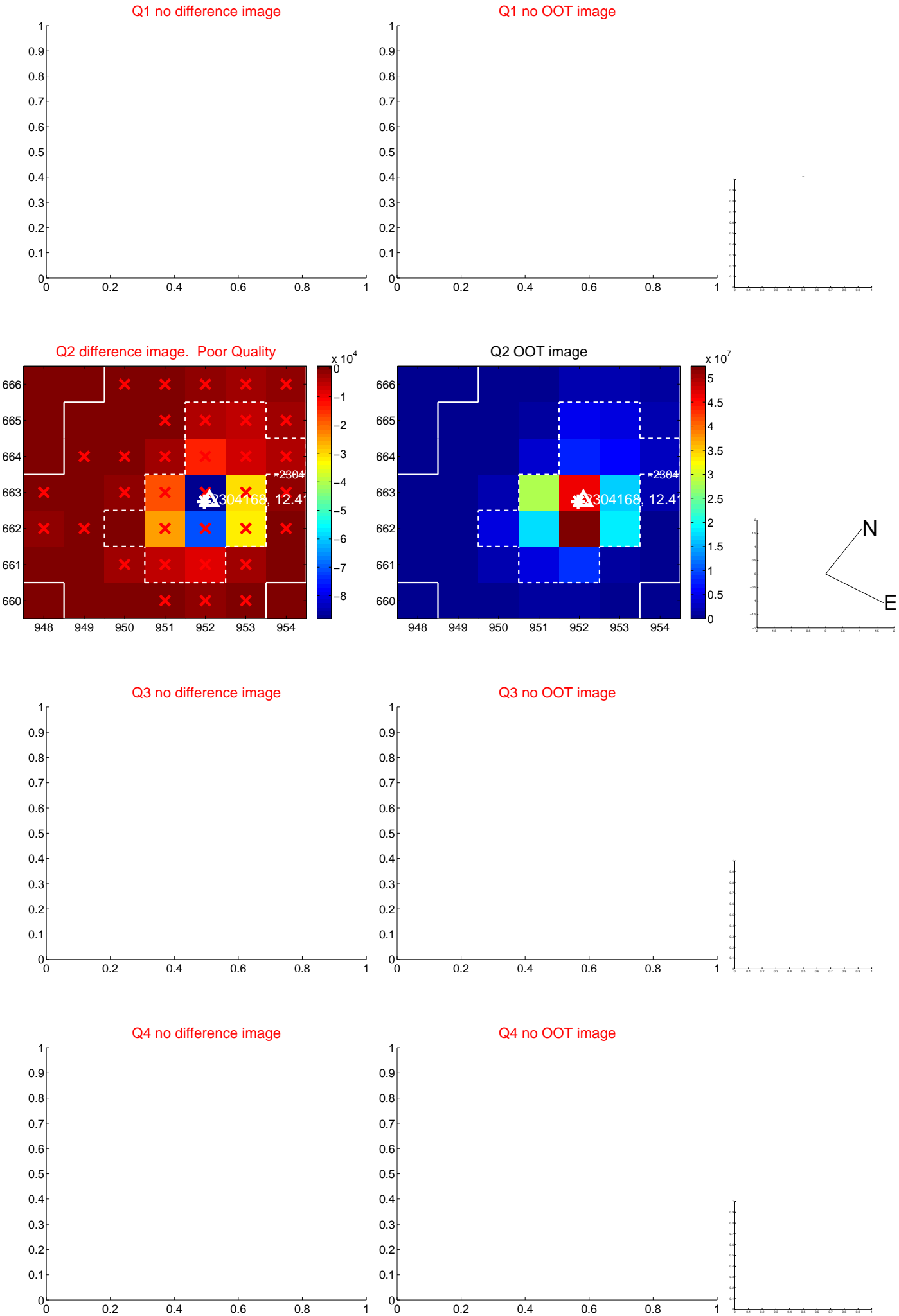


offset from photometric centroids



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.

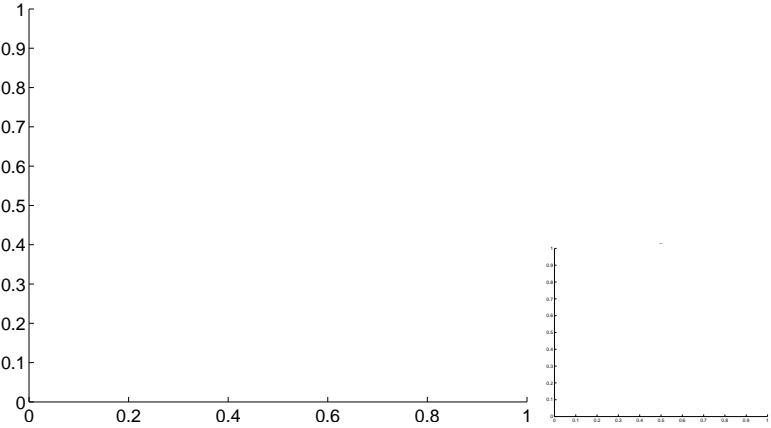


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

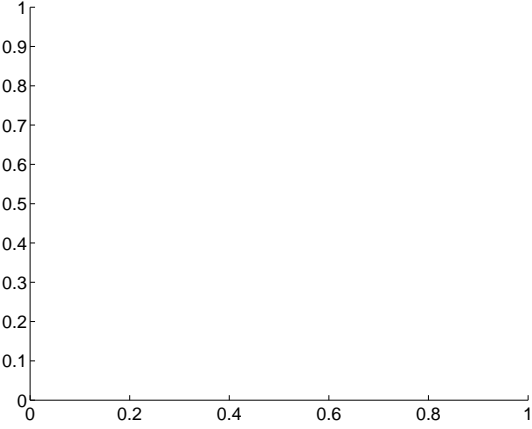
Q5 no difference image



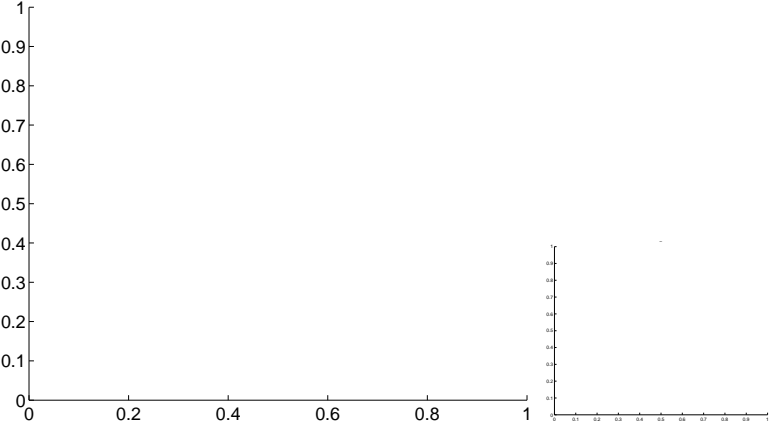
Q5 no OOT image



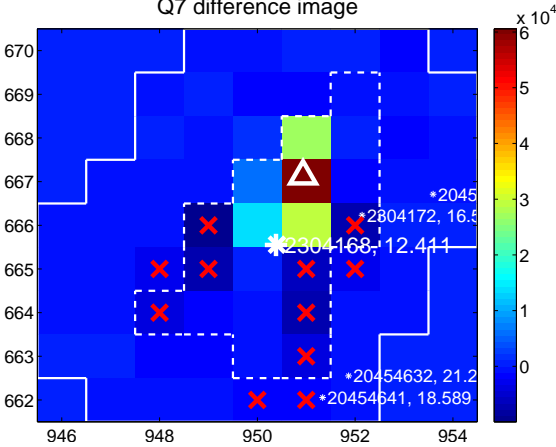
Q6 no difference image



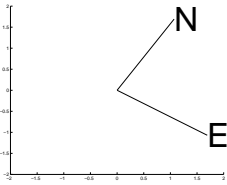
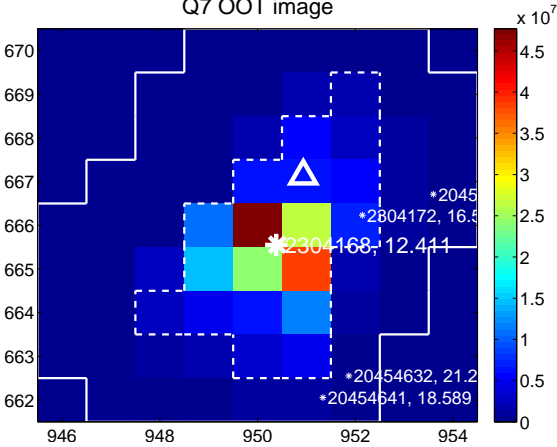
Q6 no OOT image



Q7 difference image



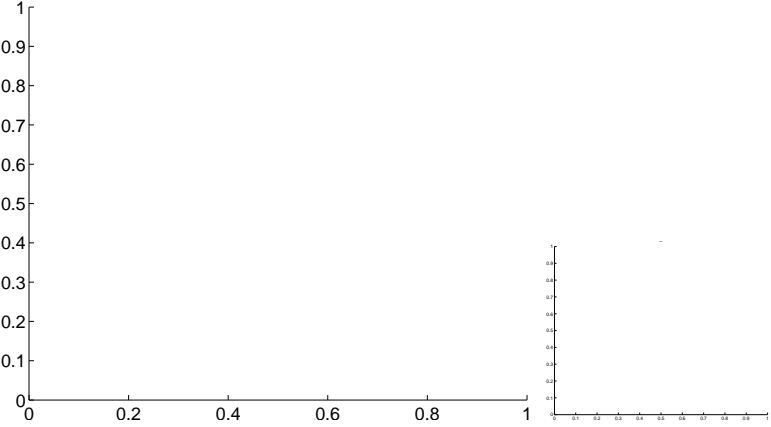
Q7 OOT image



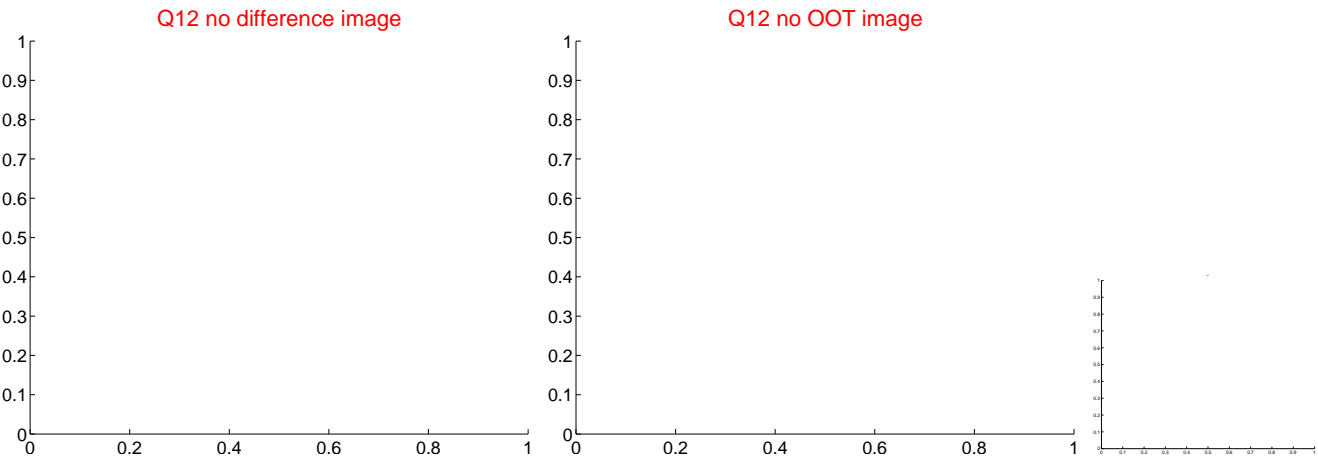
Q8 no difference image



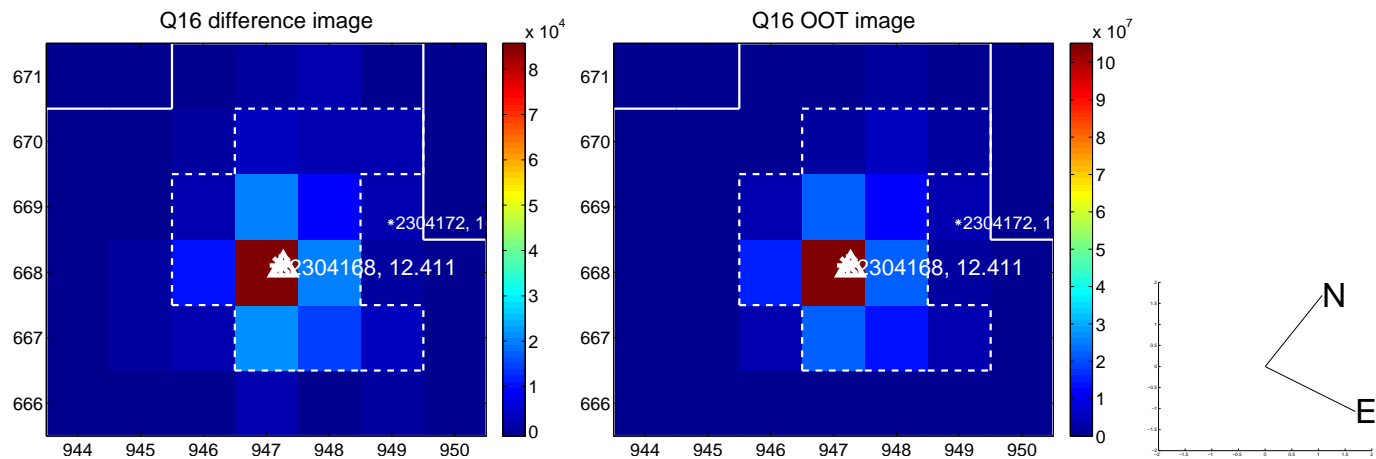
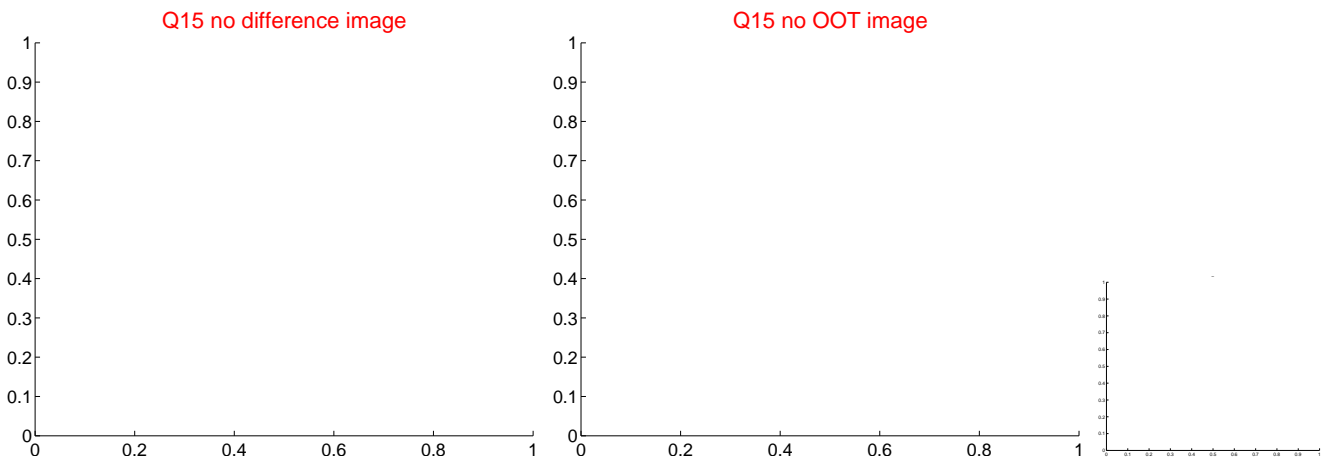
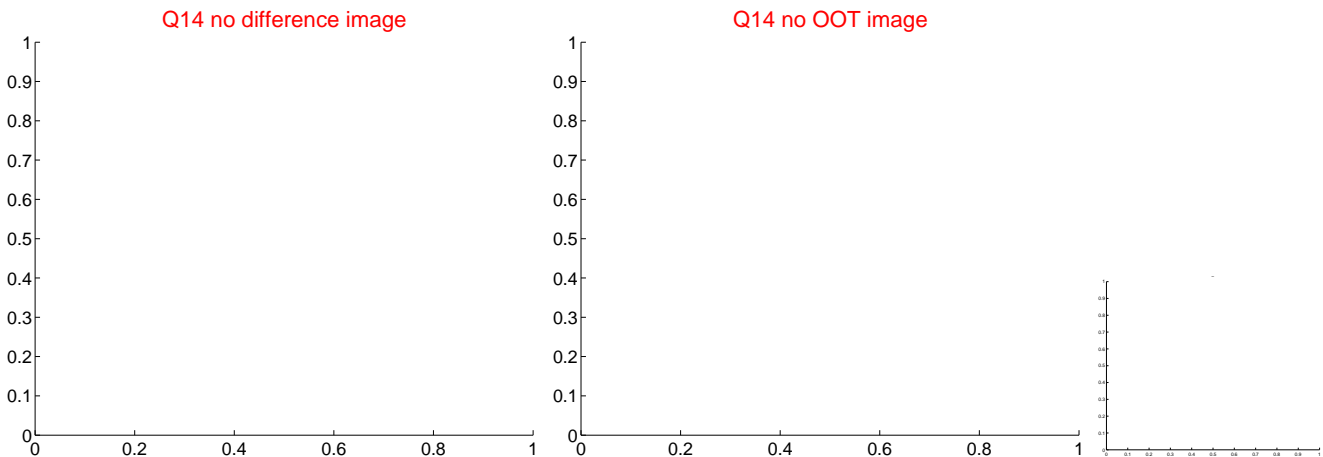
Q8 no OOT image



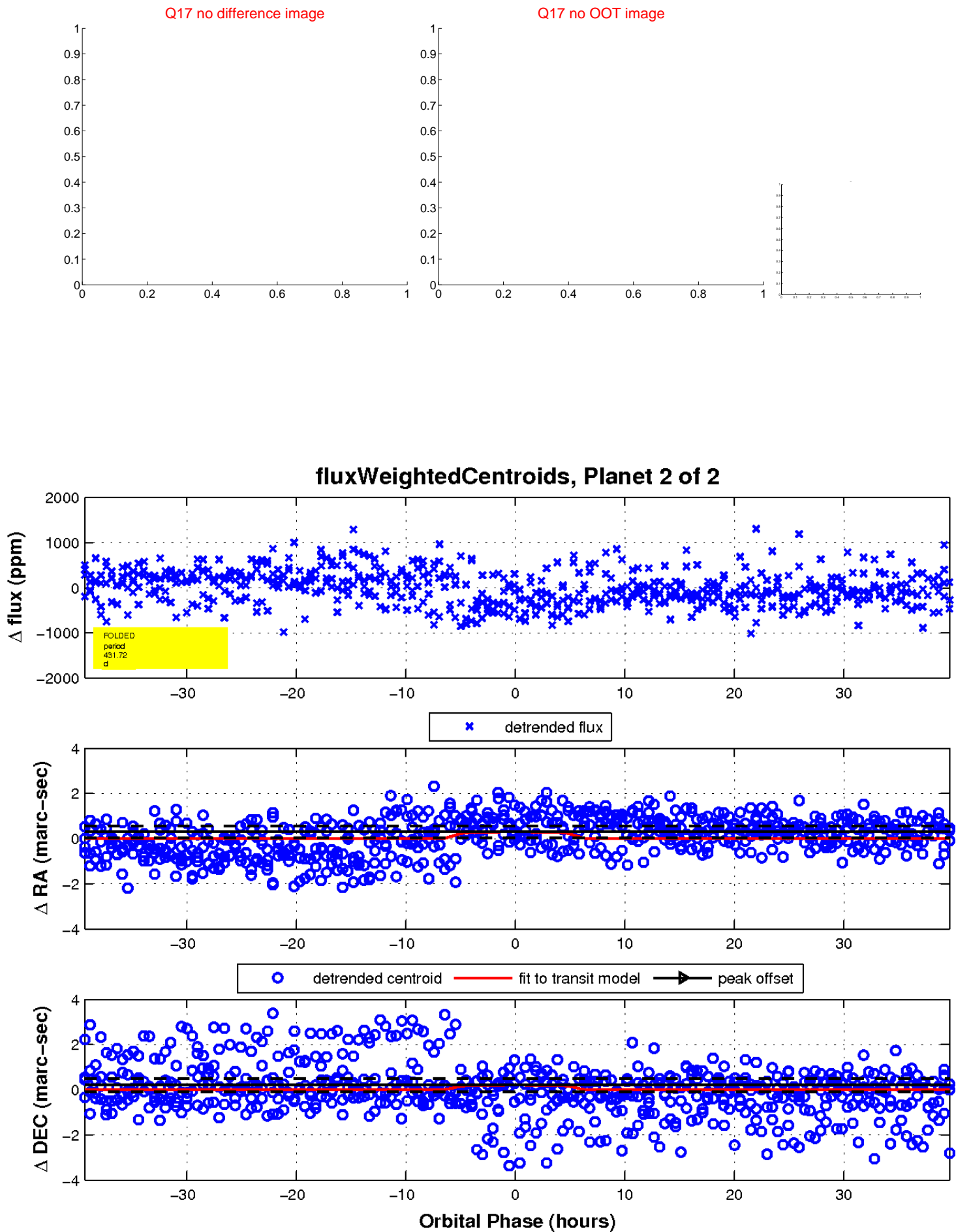
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



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



UKIRT Image

Declination

