

# KIC 009786877

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 009786877-01 | OBS      | No   | 352.009966    | 425.711251   | 1752.1      | 13.467           | 11.9 | 10.2 | 0.35                        | 3560            | 1.48                   | 0.04                   |
| 009786877-02 | OBS      | No   | 361.765669    | 380.995463   | 920.2       | 15.251           | 9.5  | 5.6  | 0.35                        | 3560            | 1.23                   | 0.04                   |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments  |
|--------------|----------|------|-------|---|---|---|---|---|
| 009786877-01 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | INDIV_TRANS_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS                           |
| 009786877-02 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | INDIV_TRANS_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.

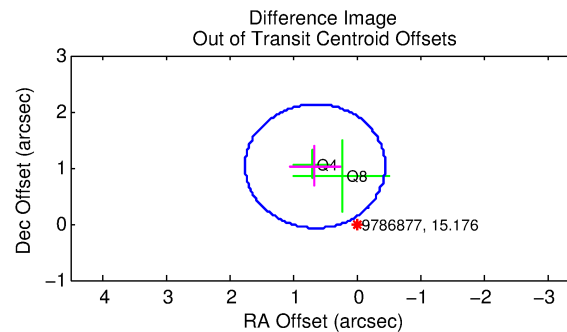
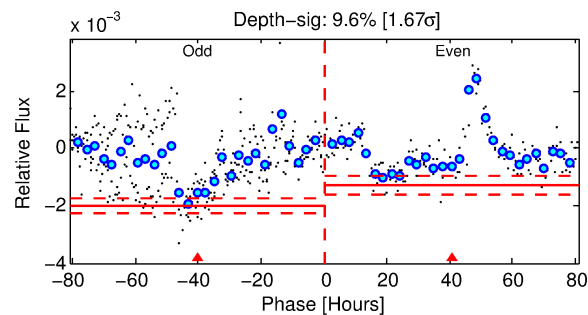
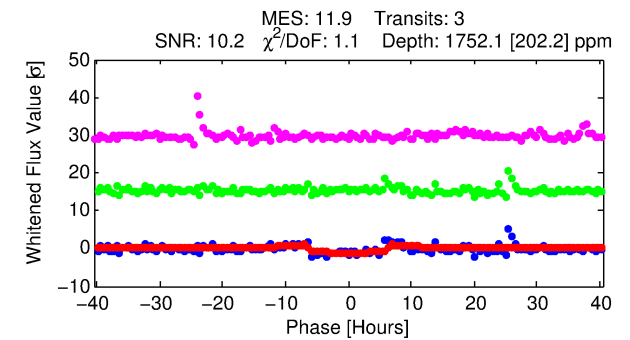
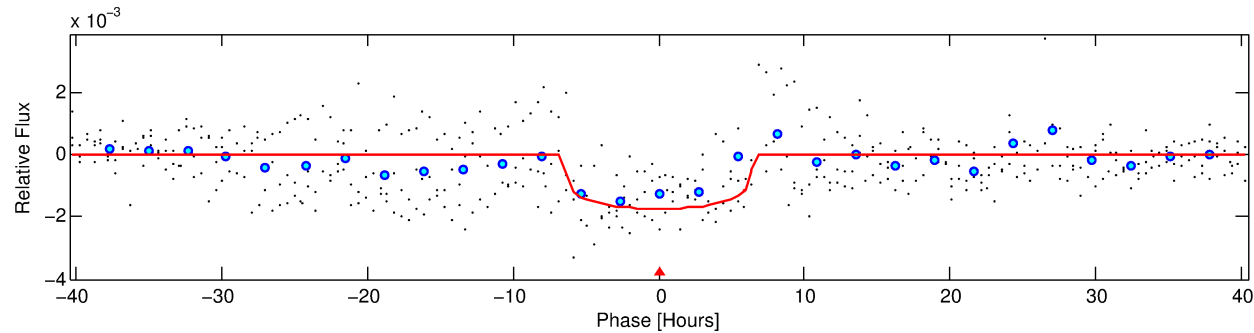
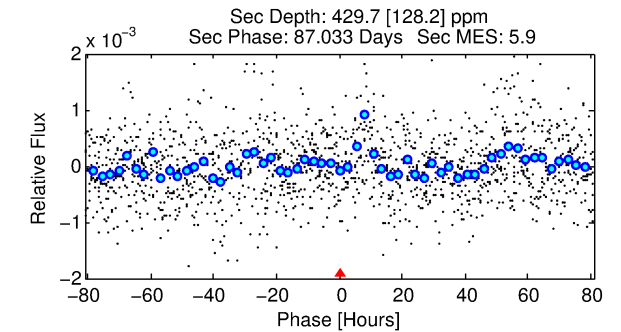
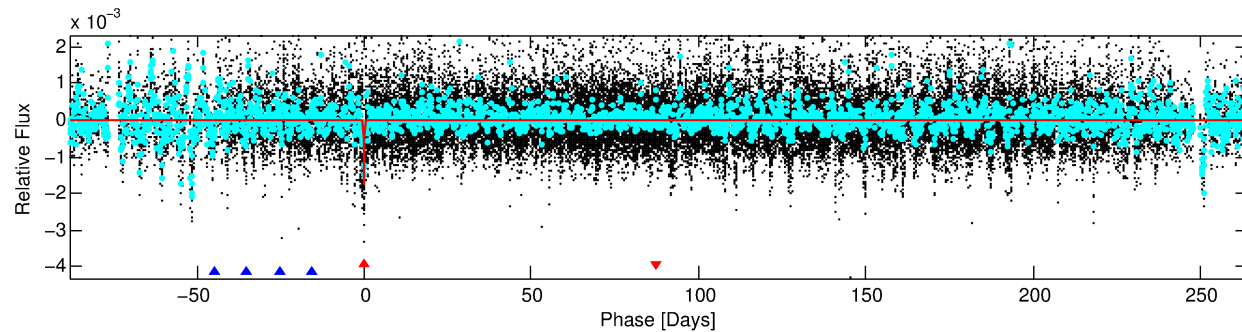
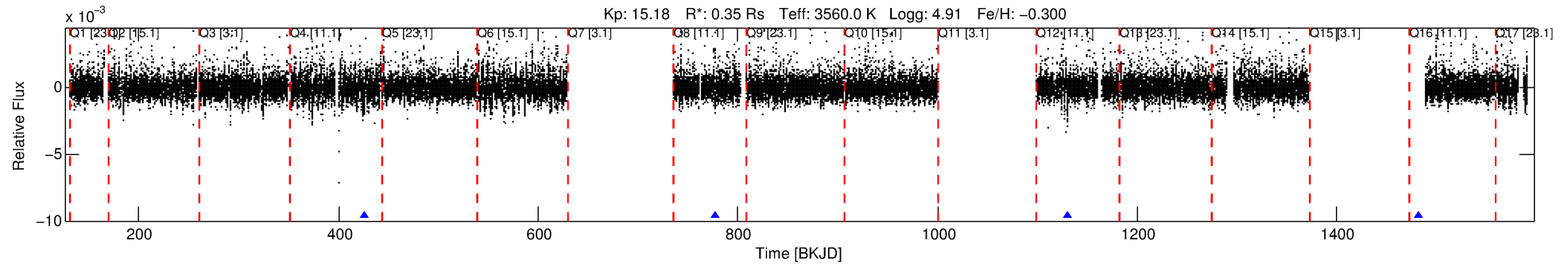
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009786877-01

No Significant Match Found

# DV One-Page Summary

KIC: 9786877 Candidate: 1 of 2 Period: 352.010 d



## DV Fit Results:

Period = 352.00997 [0.00670] d  
Epoch = 425.7113 [0.0092] BKJD  
Rp/R\* = 0.0389 [0.0153]  
a/R\* = 189.39 [341.21]  
b = 0.42 [3.48]  
Seff = 0.04 [0.00]  
Teq = 111 [3] K  
Rp = 1.48 [0.61] Re  
a = 0.6939 [0.0582] AU  
Ag = 51820.51 [43859.40] [1.18 $\sigma$ ]  
Teffp = 2598 [548] K [4.54 $\sigma$ ]

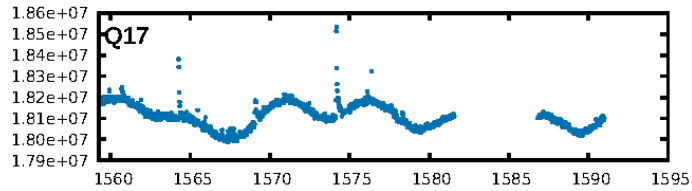
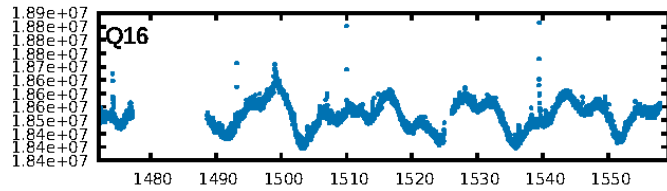
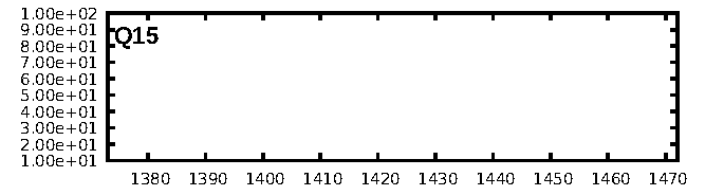
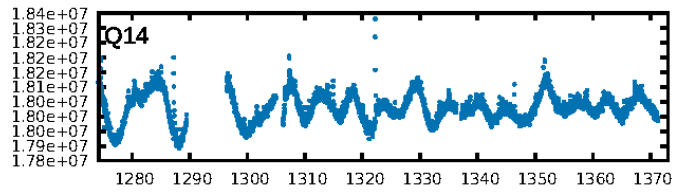
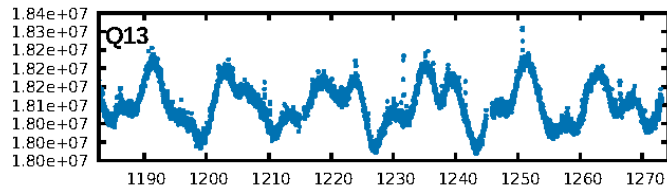
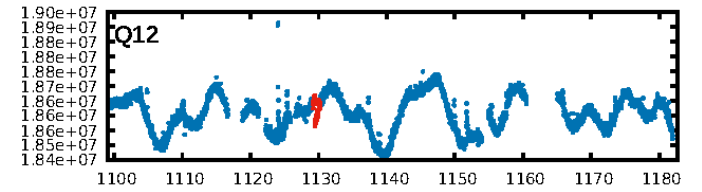
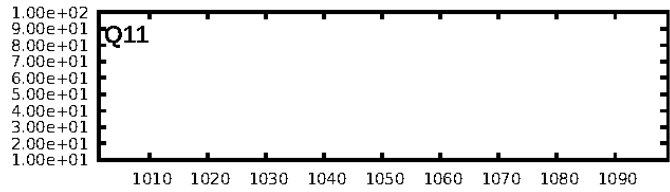
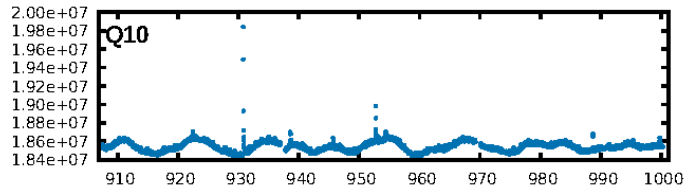
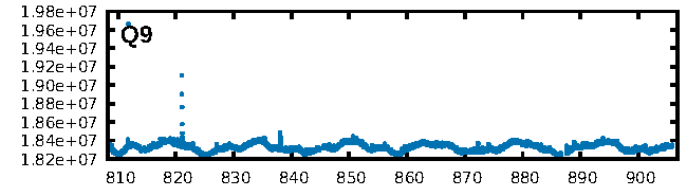
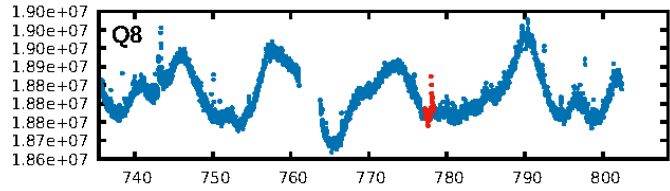
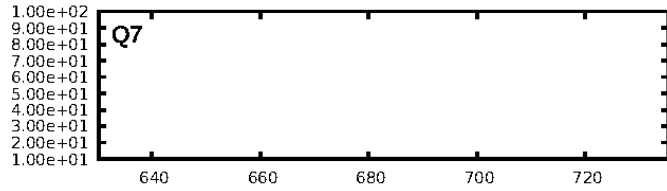
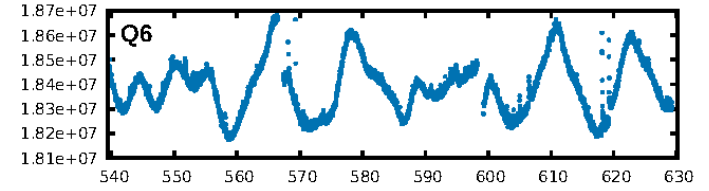
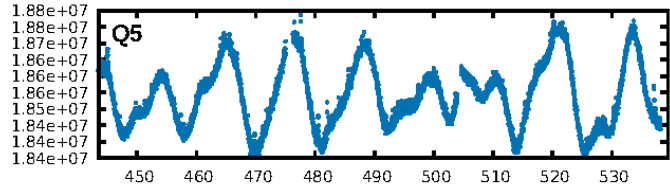
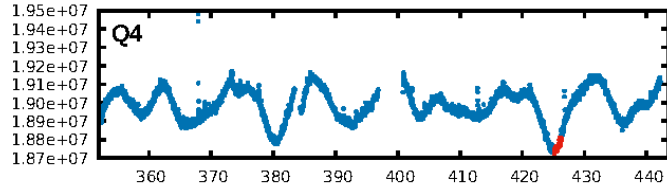
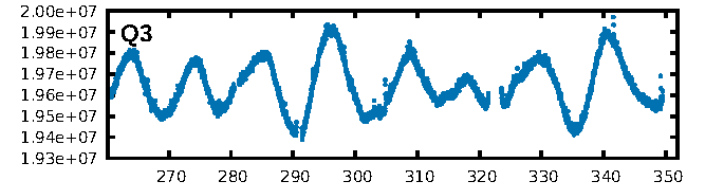
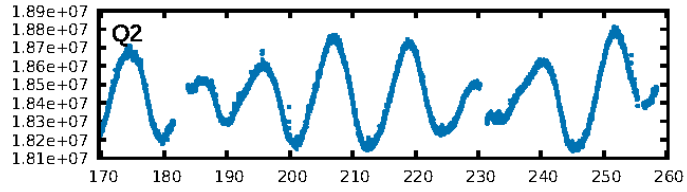
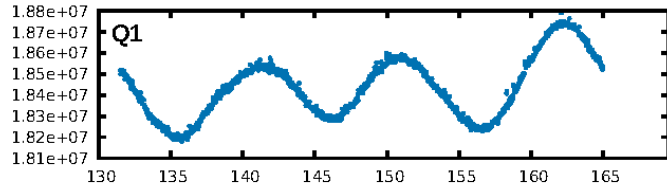
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [11.51 $\sigma$ ]  
ModelChiSquare2-sig: 1.6%  
ModelChiSquareGof-sig: 99.9%  
**Bootstrap-pfa: 9.79e-12**  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: -127.5  
**Centroid-sig: 0.0%**  
Centroid-so: 0.853 arcsec [1.41 $\sigma$ ]  
**OotOffset-rm: 1.213 arcsec [3.31 $\sigma$ ]**  
KicOffset-rm: 0.322 arcsec [0.88 $\sigma$ ]  
OotOffset-st: 0/0/2/0 [2]  
KicOffset-st: 0/0/2/0 [2]  
DiffImageQuality-fgm: 1.00 [2/2]  
DiffImageOverlap-fno: 1.00 [2/2]

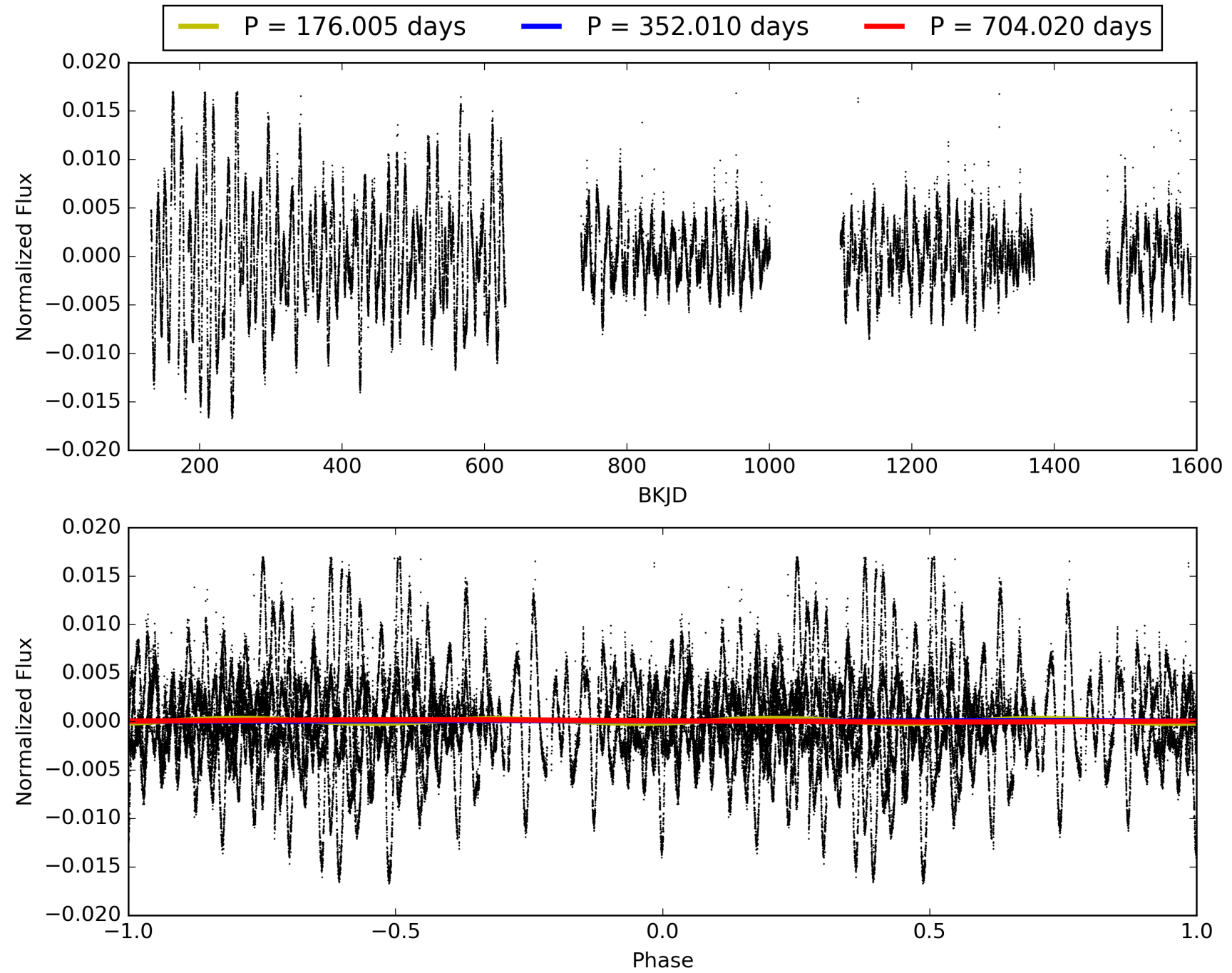
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This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

## TCE 009786877-01, PDC Light Curves

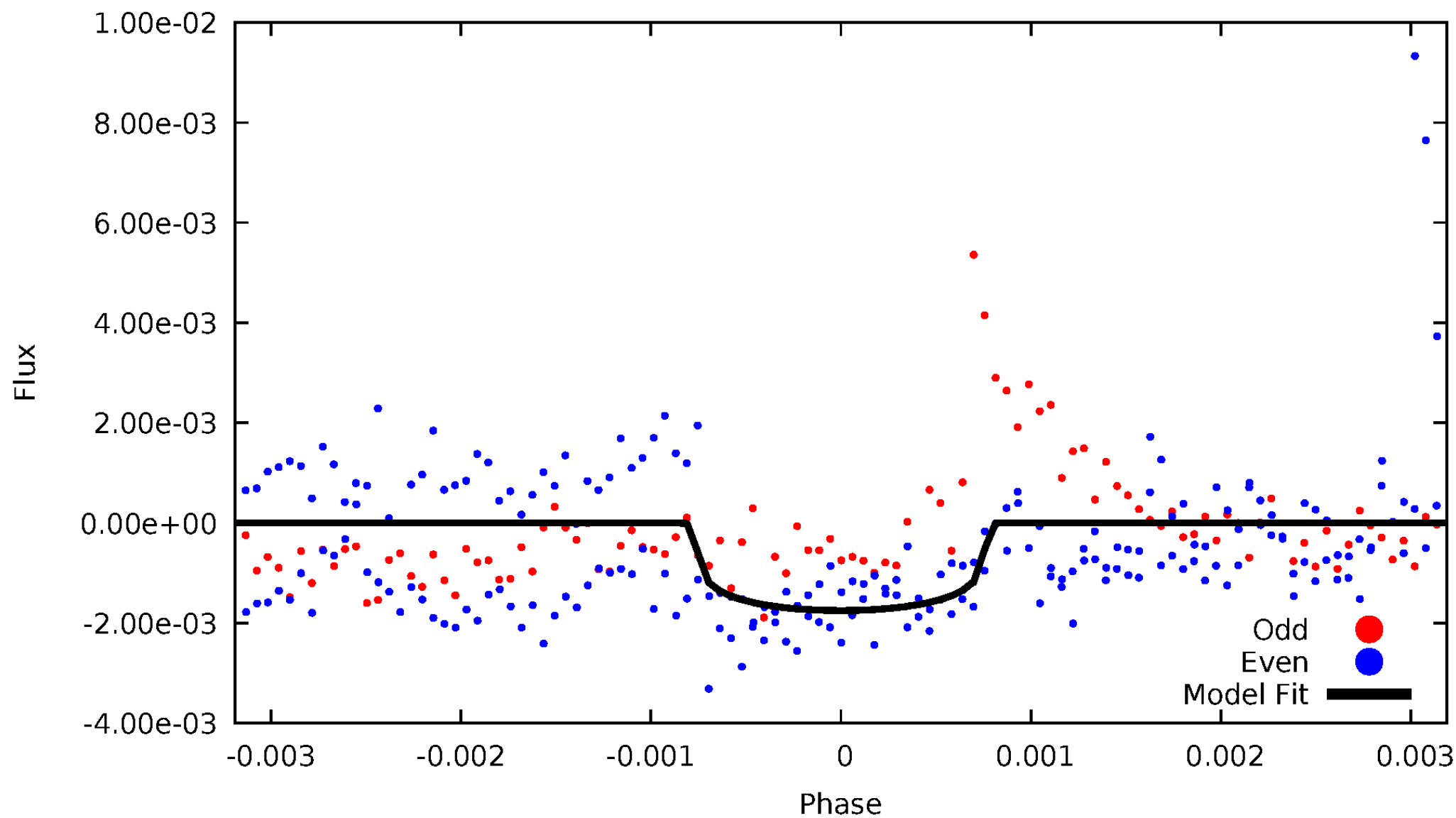


TCE 009786877-01



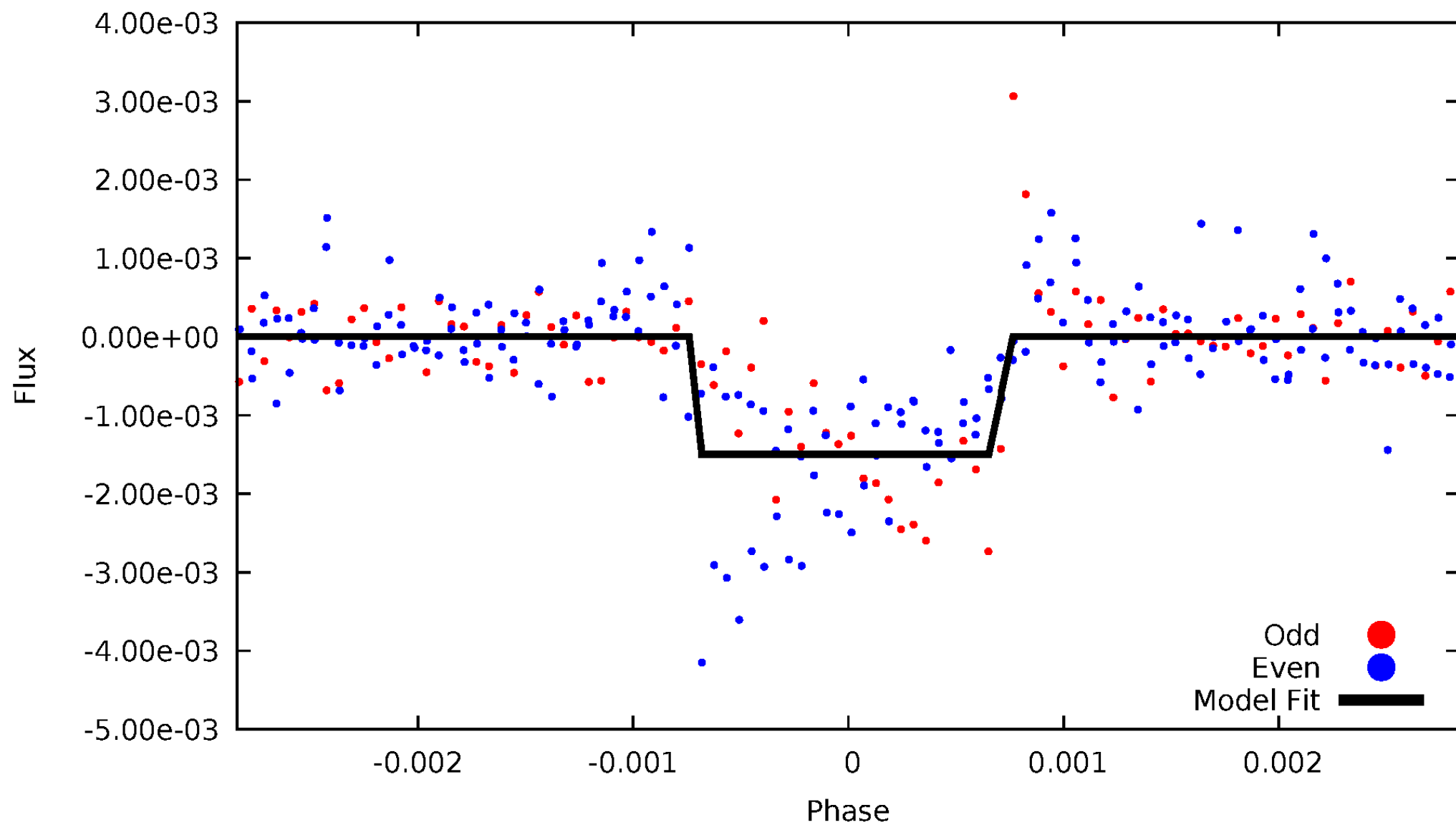
# DV Odd/Even

TCE 009786877-01



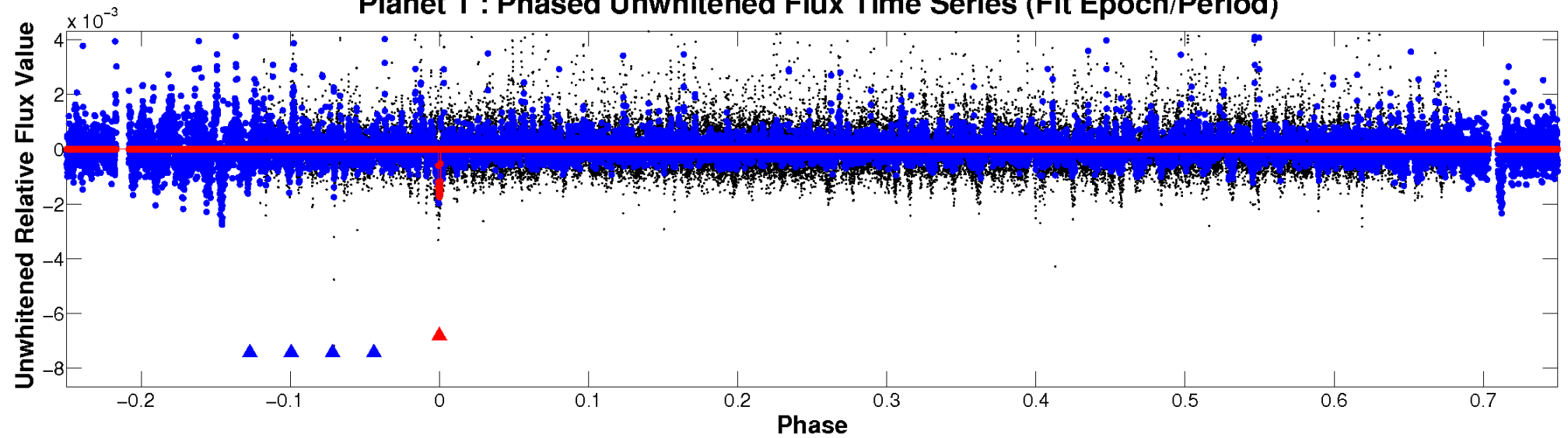
# ALT Odd/Even

TCE 009786877-01

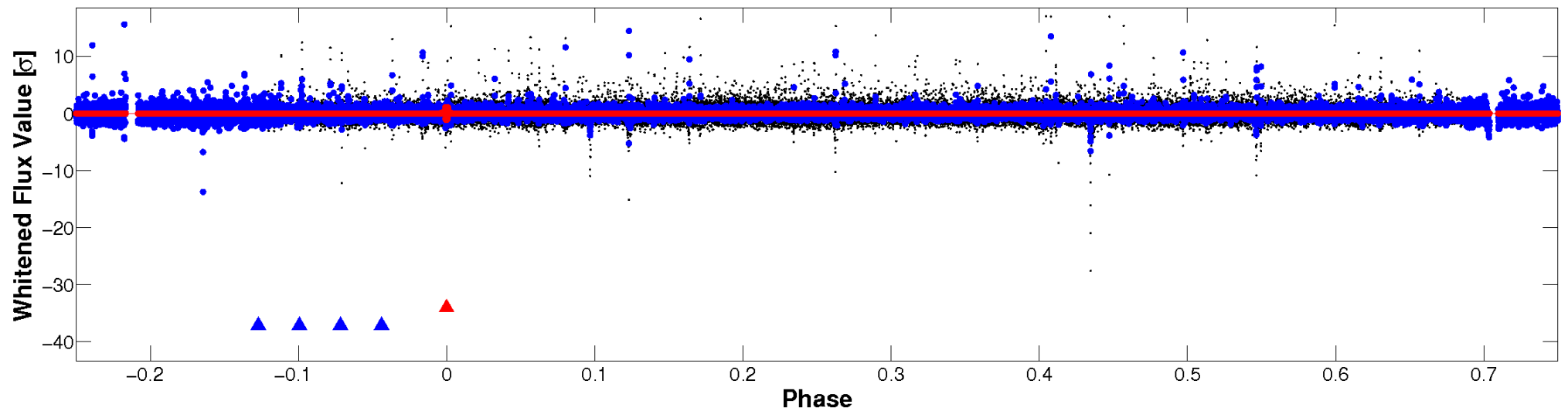


# Non-Whitened Vs. Whitened Light Curve

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

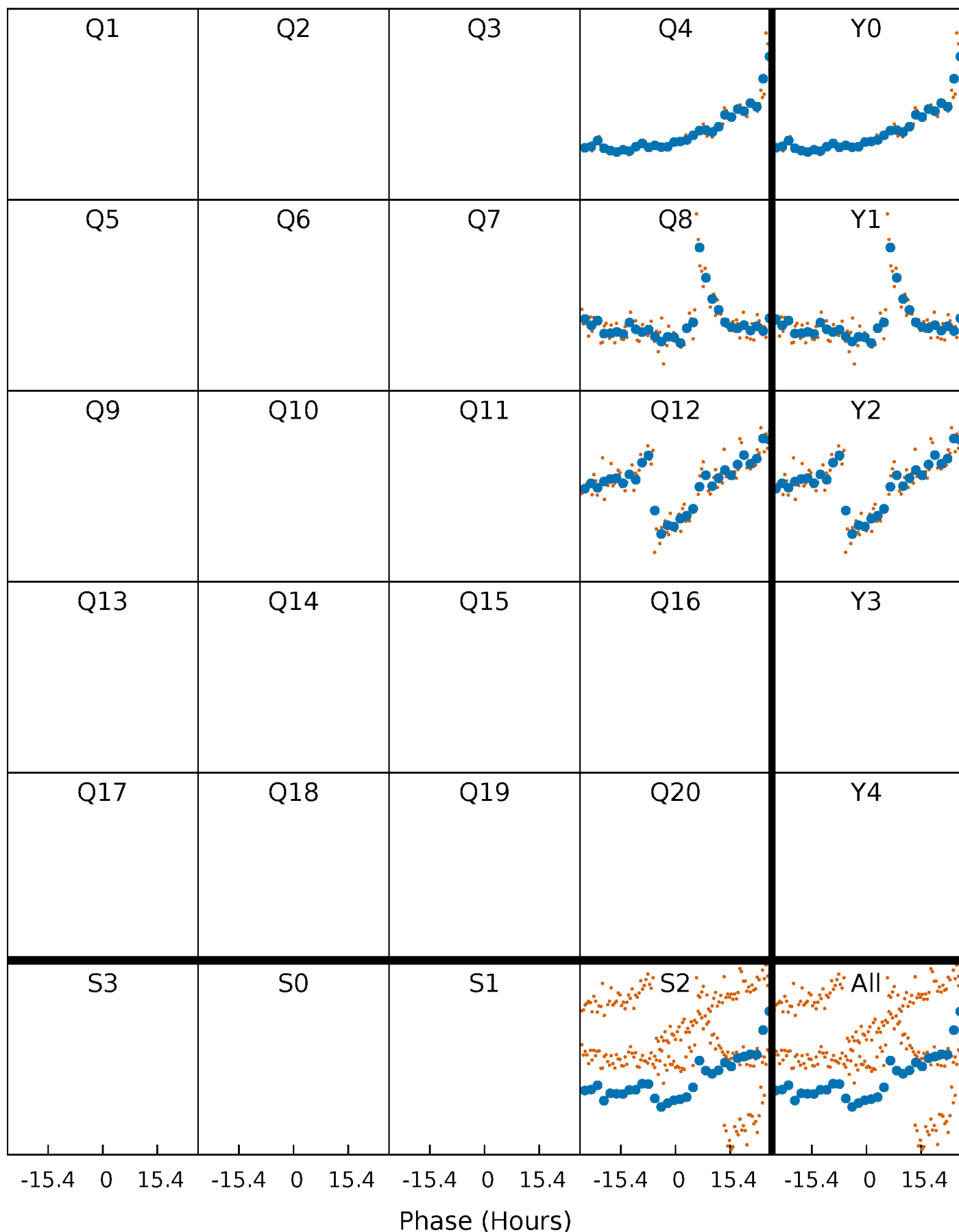


**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**



# PDC Quarter-Phased Transit Curves

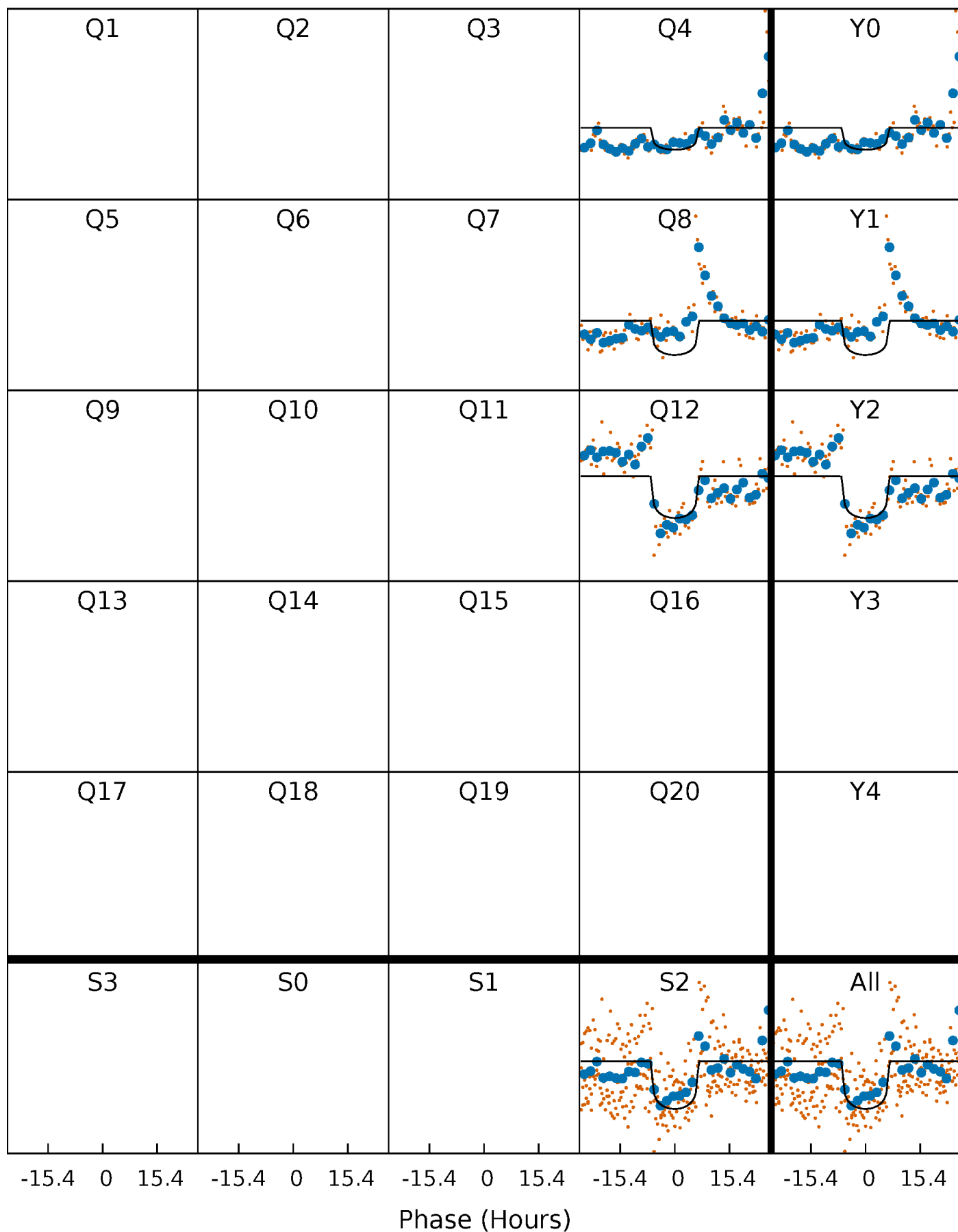
TCE 009786877-01 P=352.009966 Days  $T_0=425.711251$  (BKJD)





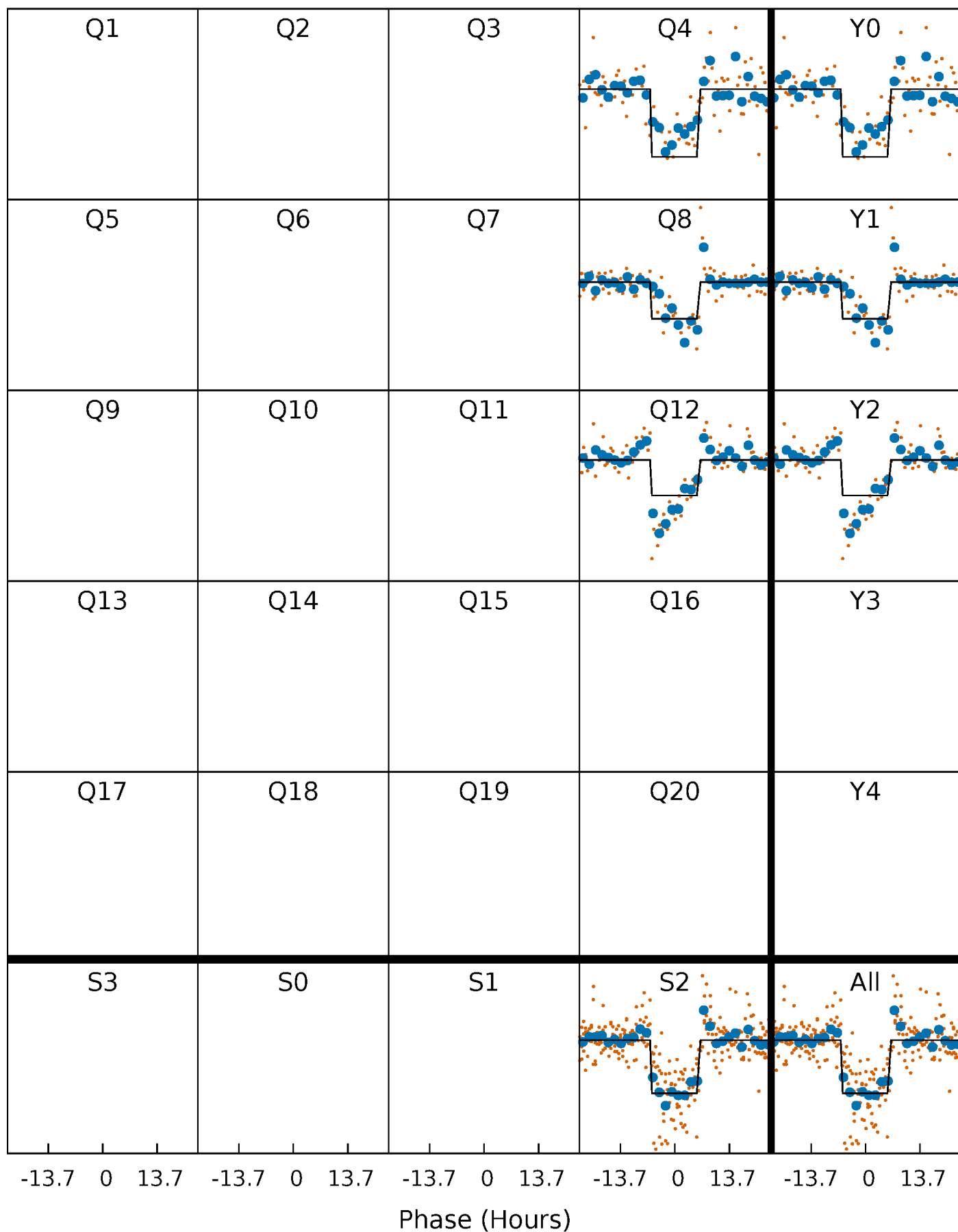
# DV Quarter-Phased Transit Curves

TCE 009786877-01 P=352.009966 Days  $T_0=425.711251$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

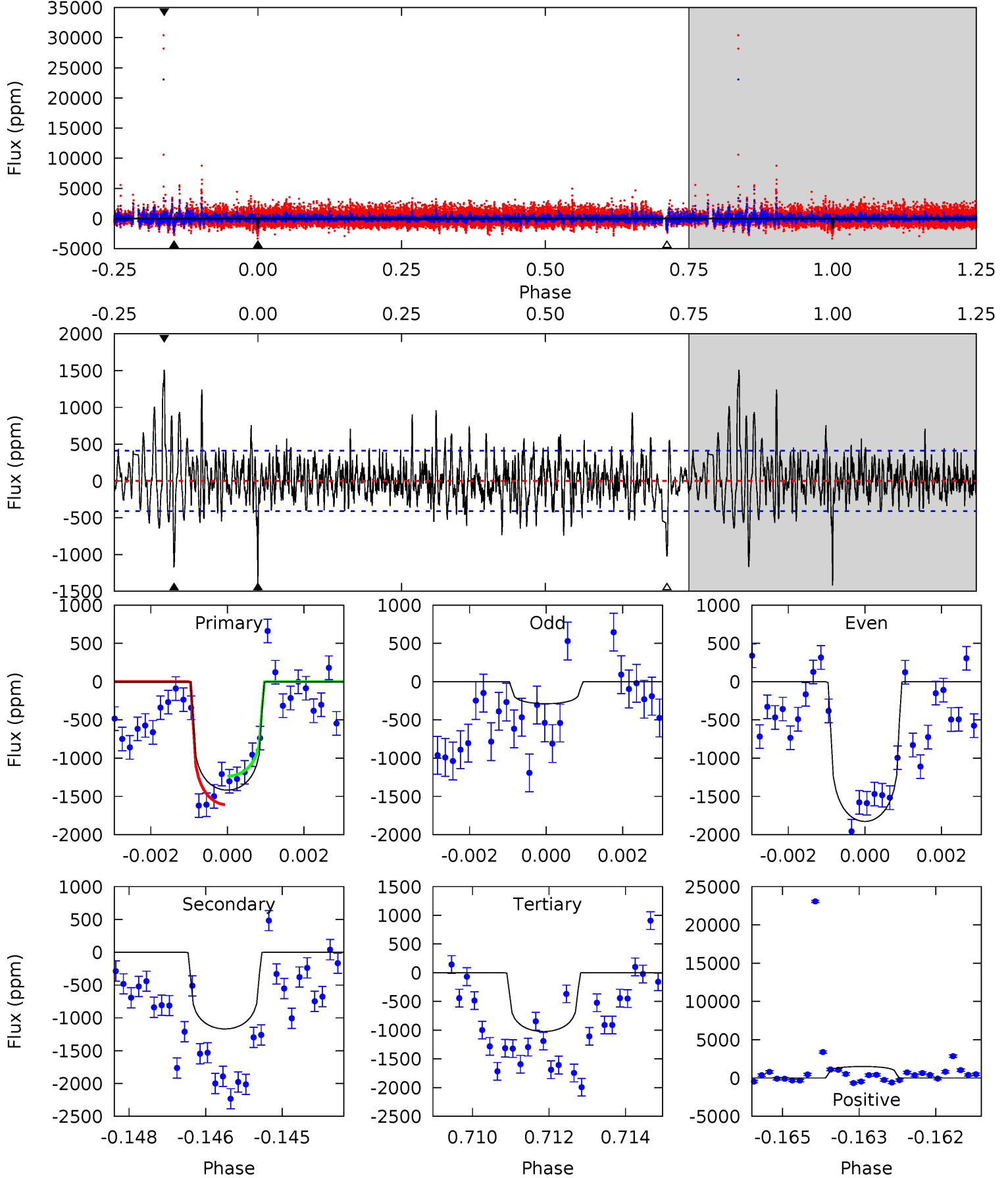
TCE 009786877-01 P=352.029372 Days  $T_0=425.667649$  (BKJD)



# DV Model-Shift Uniqueness Test

009786877-01, P = 352.009966 Days, E = 73.701285 Days

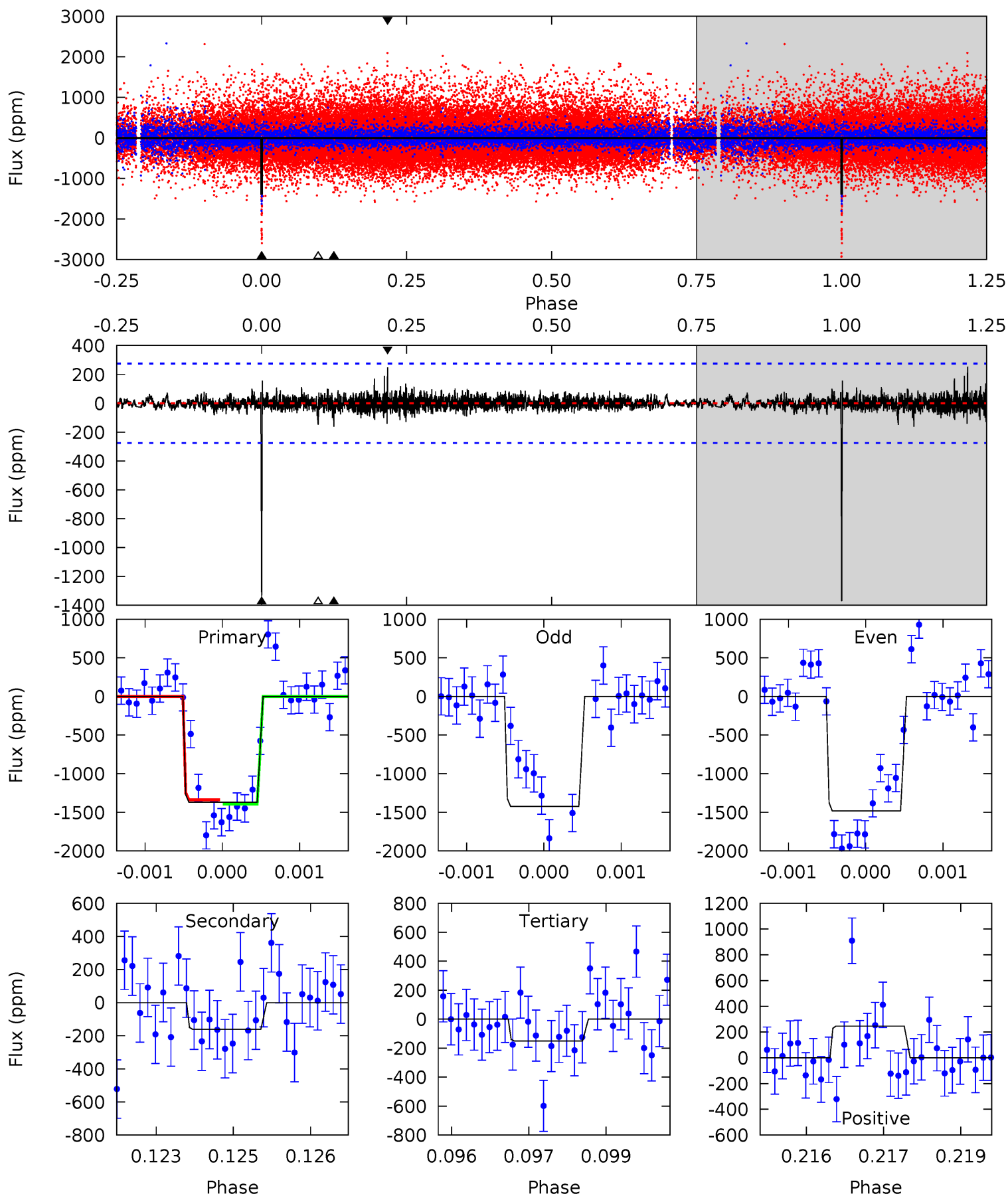
| Pri  | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 18.5 | 15.2 | 13.3 | 19.7 | 5.36            | 3.14            | 3.21             | 5.13    | -1.22   | 1.89    | -4.46   | 8.81    | 0.89 | 0.52  | 2.37 |



# Alt Model-Shift Uniqueness Test

009786877-01,  $P = 352.029372$  Days,  $E = 73.638277$  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  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 26.8 | 3.15 | 2.94 | 4.83 | 5.38            | 3.18            | 0.59             | 23.9    | 22.0    | 0.21    | -1.67   | 0.55    | 1.05 | 0.15  | 0.56 |



### Stellar Parameters For KIC 009786877

|        | $T_{\text{eff}} (K)$ | $\log(g)$                 | $[\text{Fe}/\text{H}]$     | $R (R_{\odot})$           | $M (M_{\odot})$           | $p_{\star} (\text{g}\cdot\text{cm}^{-3})$ |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $3560^{+63}_{-63}$   | $4.908^{+0.045}_{-0.040}$ | $-0.300^{+0.100}_{-0.100}$ | $0.349^{+0.036}_{-0.040}$ | $0.360^{+0.044}_{-0.049}$ | $11.940^{+3.084}_{-2.050}$                |
|        | +2%/-2%              | +1%/-1%                   | +33%/-33%                  | +10%/-11%                 | +12%/-14%                 | +26%/-17%                                 |
| Source | PHO2                 | PHO2                      | PHO2                       | DSEP                      |                           |   |

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

### Secondary Eclipse Parameters for KIC 009786877-01 / KOI

| Detrend | Depth (ppm)    | $R_p (R_{\oplus})$     | $T_{\text{max}} (K)$ | $T_{\text{obs}} (K)$ | $A_{\text{obs}}$            |
|---------|----------------|------------------------|----------------------|----------------------|-----------------------------|
| DV      | $-1169 \pm 77$ | $1.52^{+0.56}_{-0.61}$ | $156^{+4}_{-4}$      | $3402^{+590}_{-310}$ | $137280^{+240446}_{-63040}$ |
| Alt.    | $-161 \pm 51$  | $1.45^{+0.61}_{-0.56}$ | $155^{+4}_{-4}$      | $2596^{+374}_{-229}$ | $20202^{+34062}_{-11006}$   |

$T_{\text{max}}$  = 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

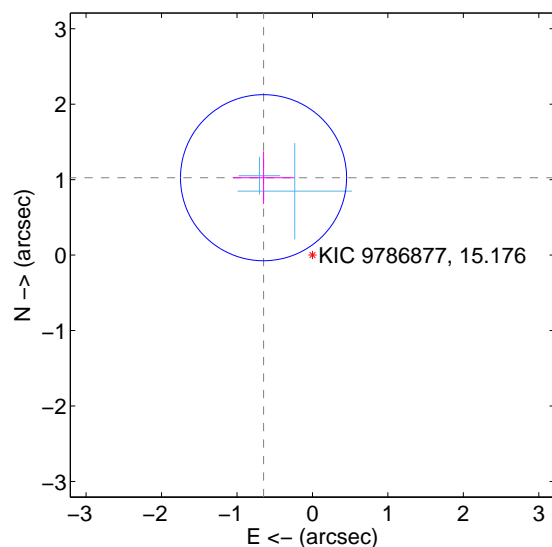
Supplemental centroid analysis for 009786877-01. Kepler magnitude: 15.18. Transit SNR 10.25

There are 2 quarters with good PRF difference image offsets

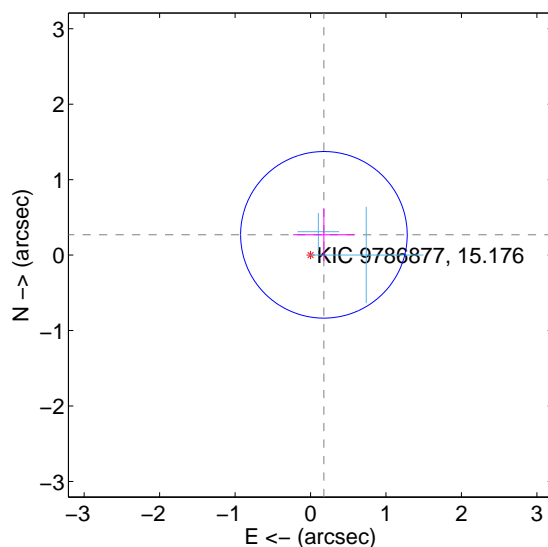
The direct PRF centroid is offset from the target star catalog position by about 1.29 arcsec

|   | Distance in arcsec                  | Distance / $\sigma$ | $\Delta$ RA        | $\Delta$ Dec      |
|---|-------------------------------------|---------------------|--------------------|-------------------|
| PRF-fit source offset from OOT          | <b><math>1.213 \pm 0.367</math></b> | <b>3.31</b>         | $0.648 \pm 0.408$  | $1.026 \pm 0.349$ |
| PRF-fit source offset from KIC position | $0.322 \pm 0.368$                   | 0.88                | $-0.177 \pm 0.408$ | $0.269 \pm 0.349$ |
| photometric centroid source offset      | $0.85 \pm 0.61$                     | 1.41                | $0.72 \pm 0.59$    | $0.45 \pm 0.65$   |

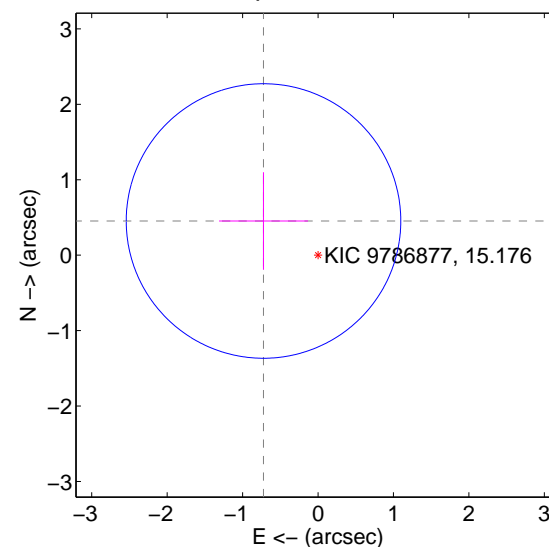
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

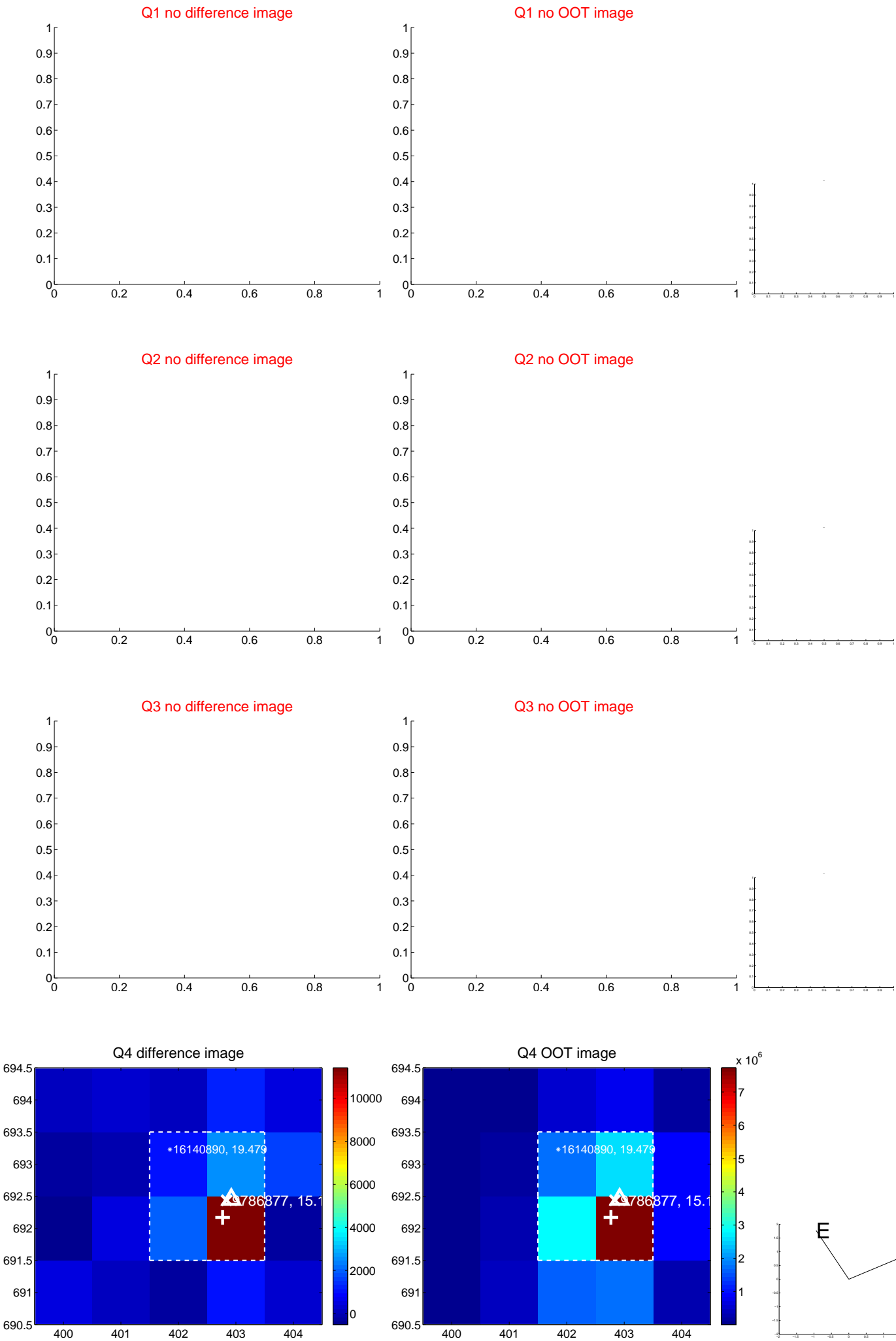


offset from photometric centroids

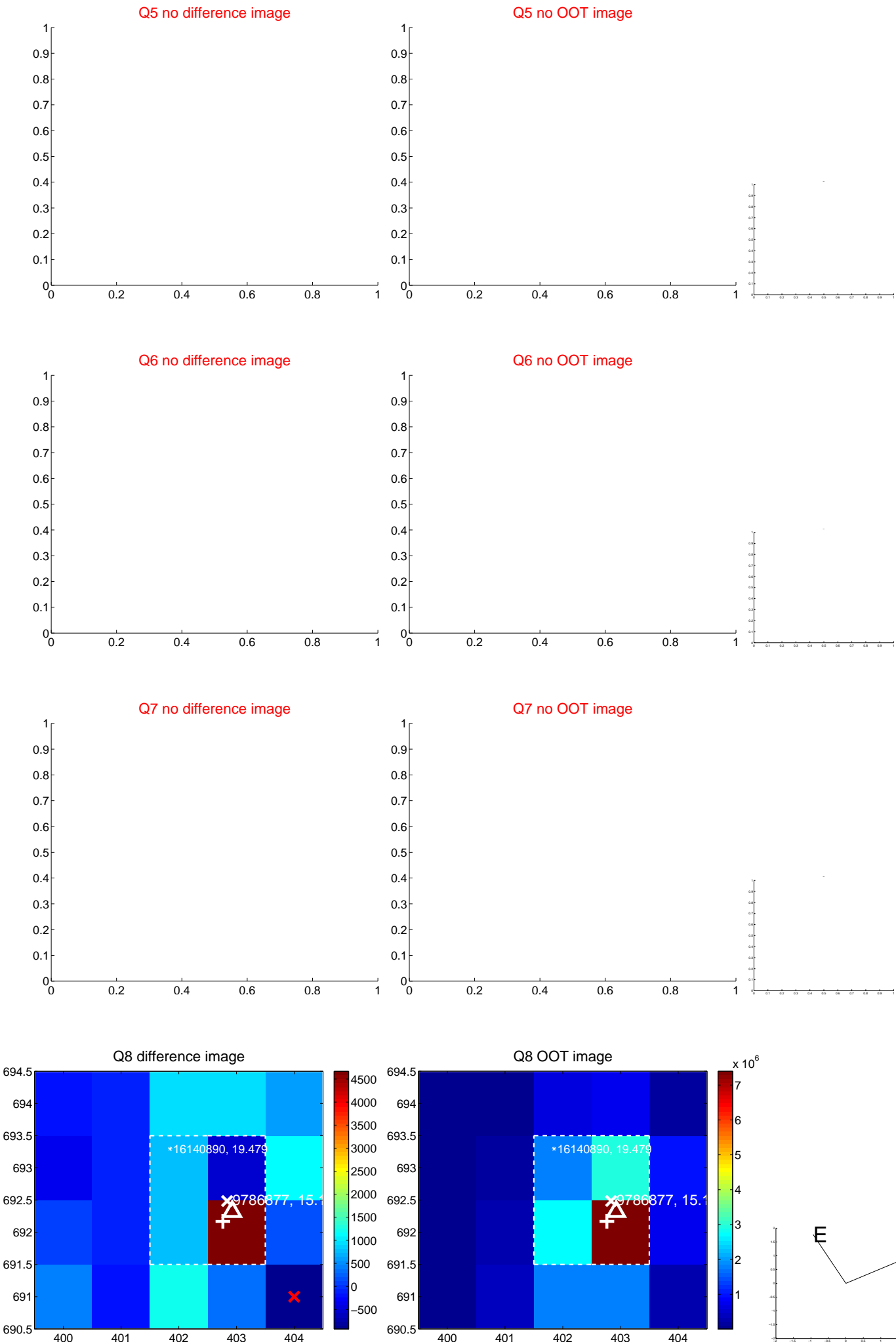


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: three-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

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



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





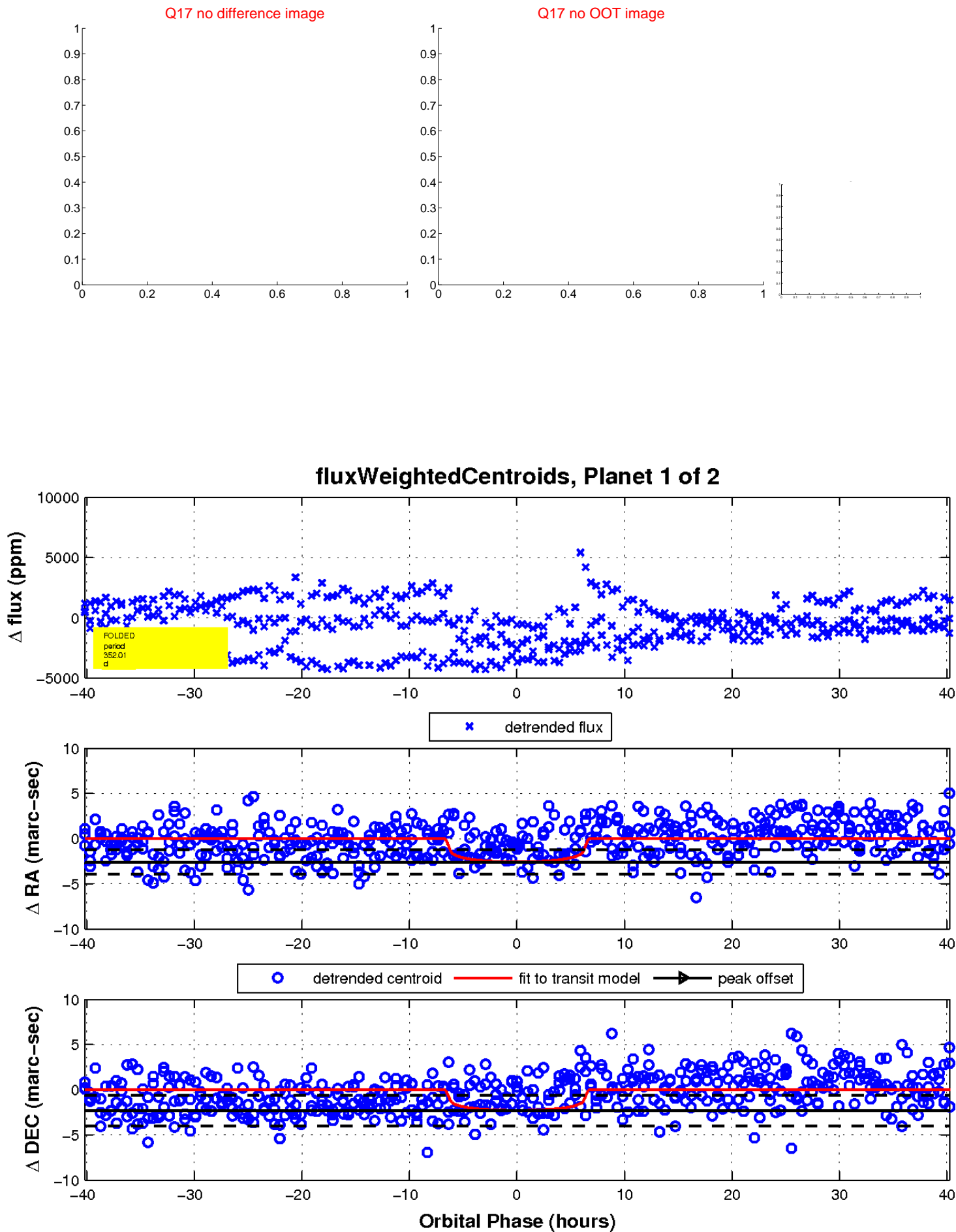
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

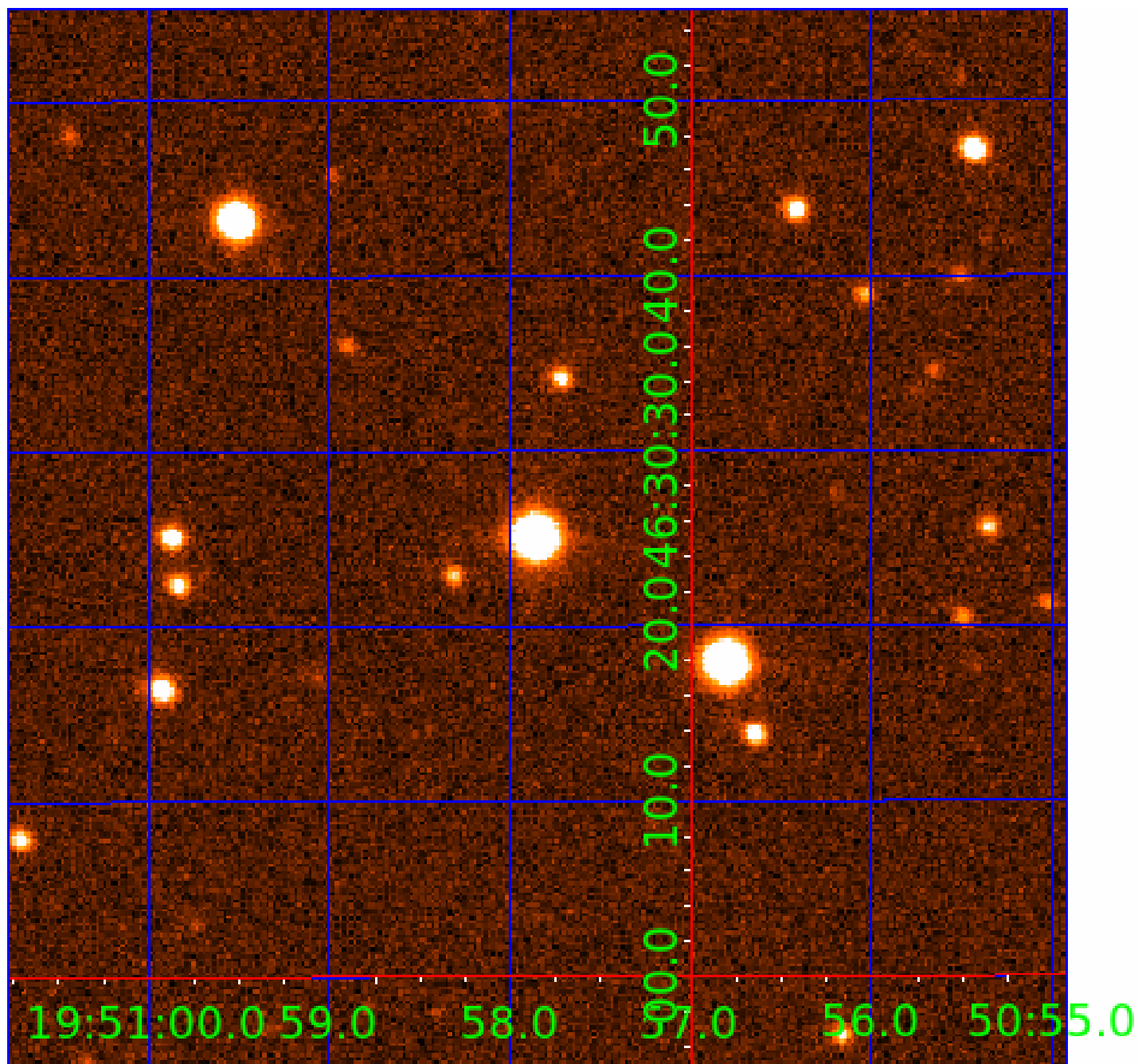


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 009786877

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 009786877-01 | OBS      | No   | 352.009966    | 425.711251   | 1752.1      | 13.467           | 11.9 | 10.2 | 0.35                        | 3560            | 1.48                   | 0.04                   |
| 009786877-02 | OBS      | No   | 361.765669    | 380.995463   | 920.2       | 15.251           | 9.5  | 5.6  | 0.35                        | 3560            | 1.23                   | 0.04                   |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments  |
|--------------|----------|------|-------|---|---|---|---|---|
| 009786877-01 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | INDIV_TRANS_MARSHALL—LPP_DV—ALL_TRANS_CHASES—MOD_POS_DV—INCONSISTENT_TRANS—CENT_FEW_DIFFS                           |
| 009786877-02 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | INDIV_TRANS_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.

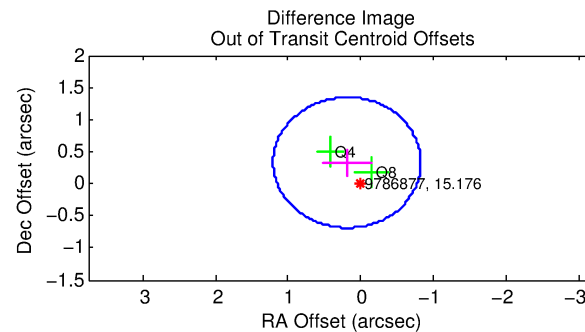
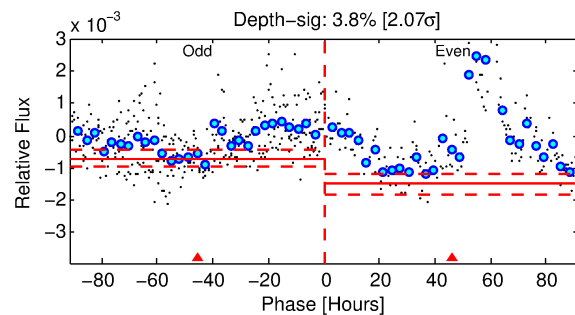
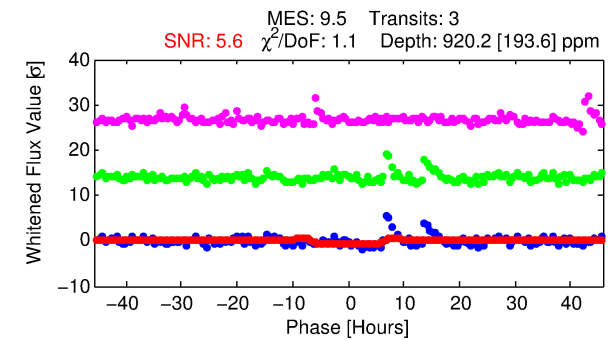
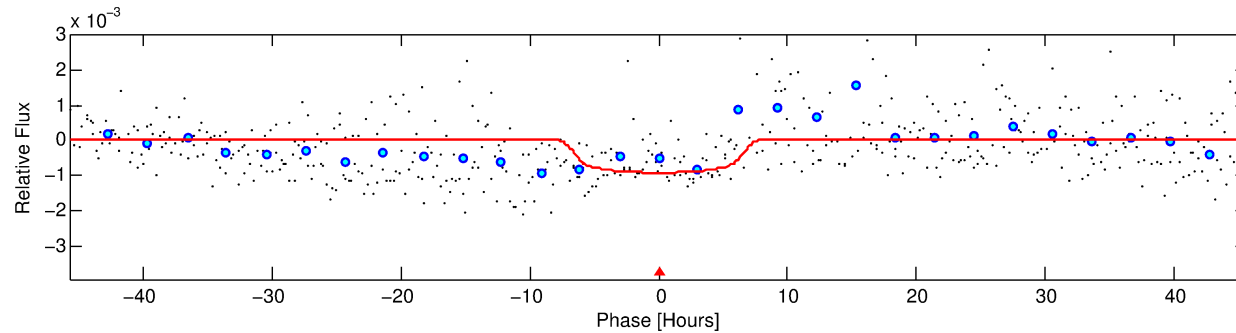
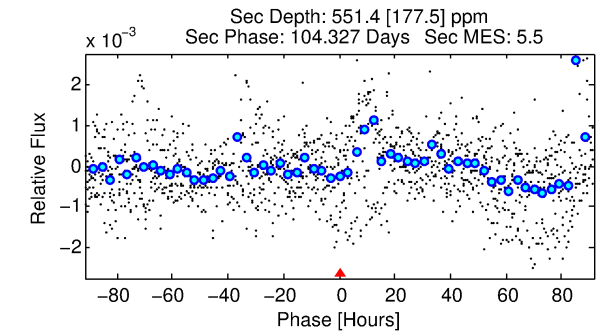
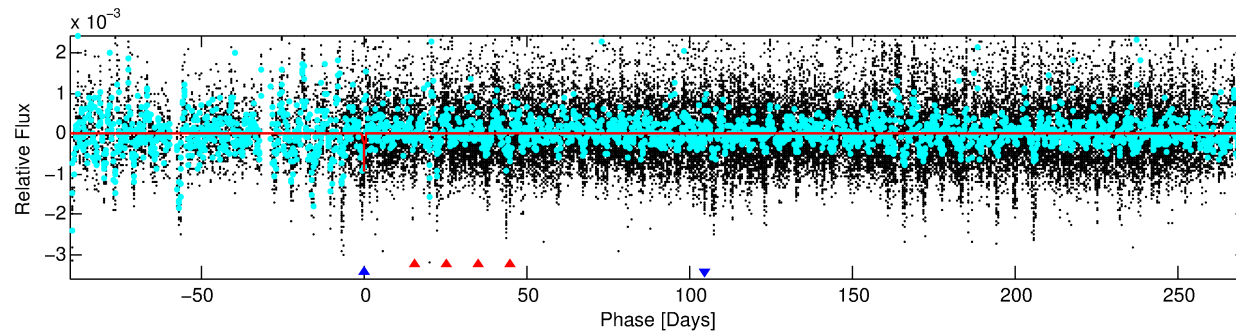
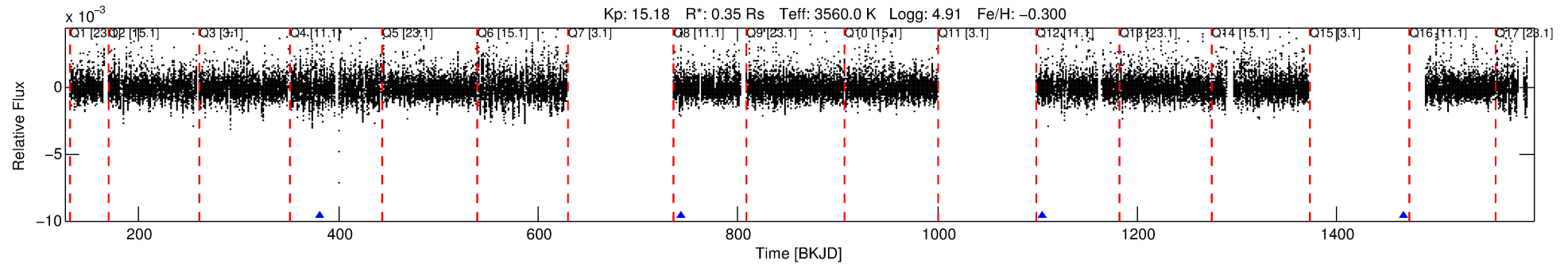
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 009786877-02

No Significant Match Found

# DV One-Page Summary

KIC: 9786877 Candidate: 2 of 2 Period: 361.766 d



## DV Fit Results:

Period = 361.76567 [0.02283] d  
Epoch = 380.9955 [0.0317] BKJD  
Rp/R\* = 0.0322 [0.0051]  
a/R\* = 98.77 [47.85]  
b = 0.88 [0.13]  
Seff = 0.04 [0.00]  
Teq = 110 [3] K  
Rp = 1.23 [0.24] Re  
a = 0.7066 [0.0593] AU  
Ag = 100897.24 [46833.01] [2.15 $\sigma$ ]  
Teffp = 3041 [348] K [8.41 $\sigma$ ]

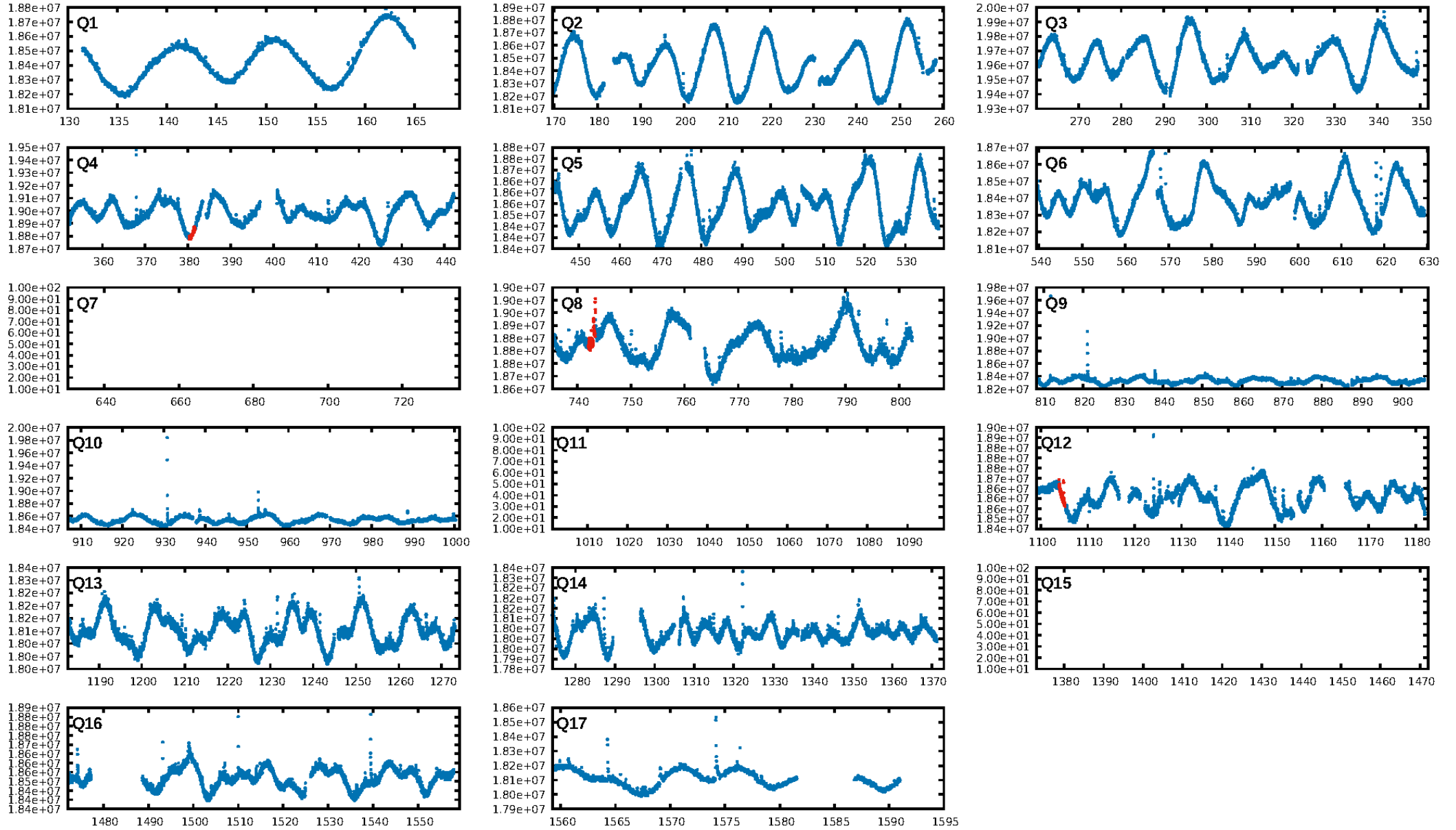
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [11.51 $\sigma$ ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 8.7%  
ModelChiSquareGof-sig: 99.8%  
Bootstrap-pfa: 4.22e-09  
RollingBand-fgt: 1.00 [3/3]  
GhostDiagnostic-chr: -10.99  
Centroid-sig: 1.0%  
Centroid-so: 2.267 arcsec [1.92 $\sigma$ ]  
OotOffset-rm: 0.379 arcsec [1.12 $\sigma$ ]  
OotOffset-st: 0/0/2/0 [2]  
KicOffset-rm: 0.329 arcsec [1.06 $\sigma$ ]  
KicOffset-st: 0/0/2/0 [2]  
DiffImageQuality-fgm: 1.00 [2/2]  
DiffImageOverlap-fno: 1.00 [2/2]

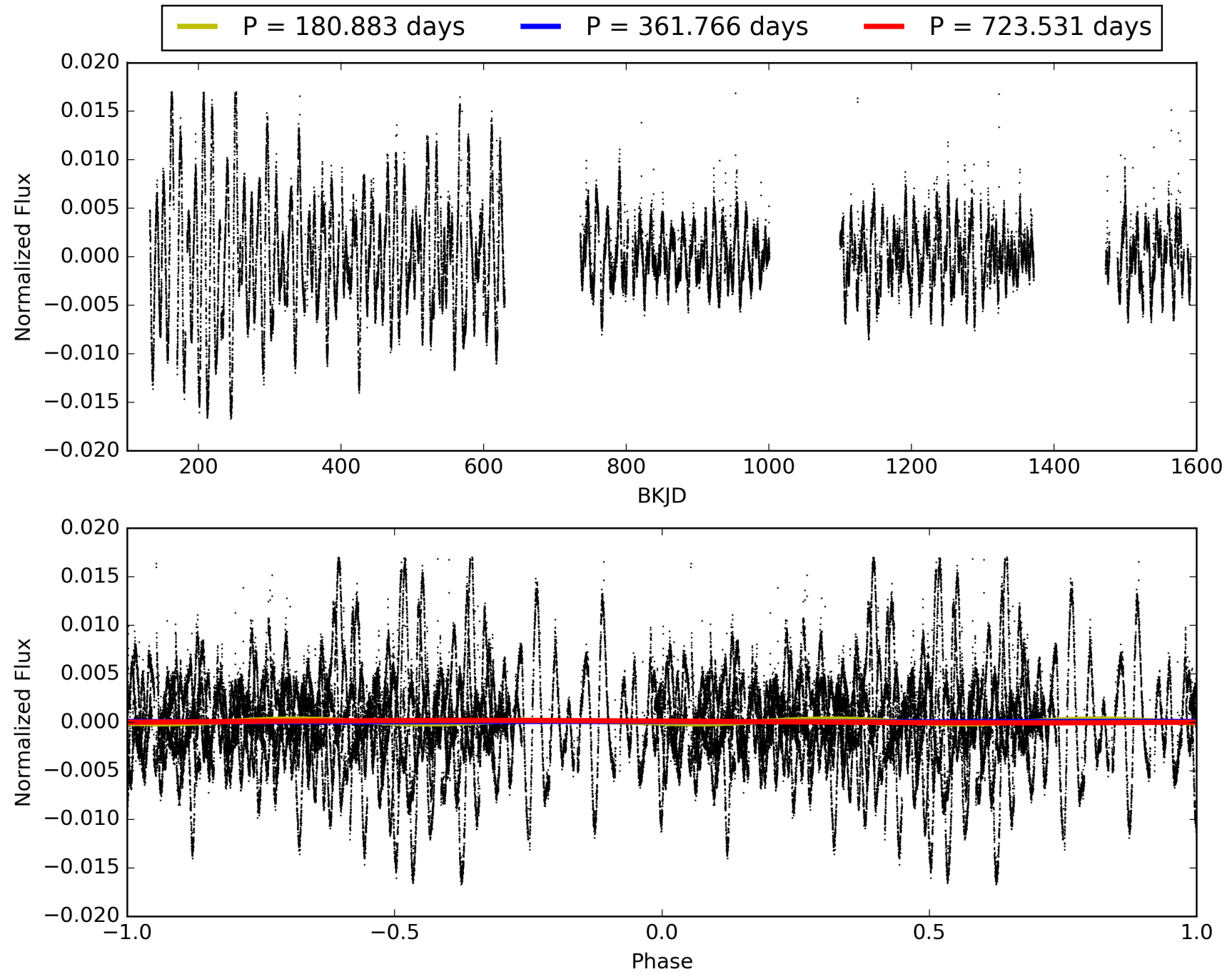
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 13:30:27 Z

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

# TCE 009786877-02, PDC Light Curves



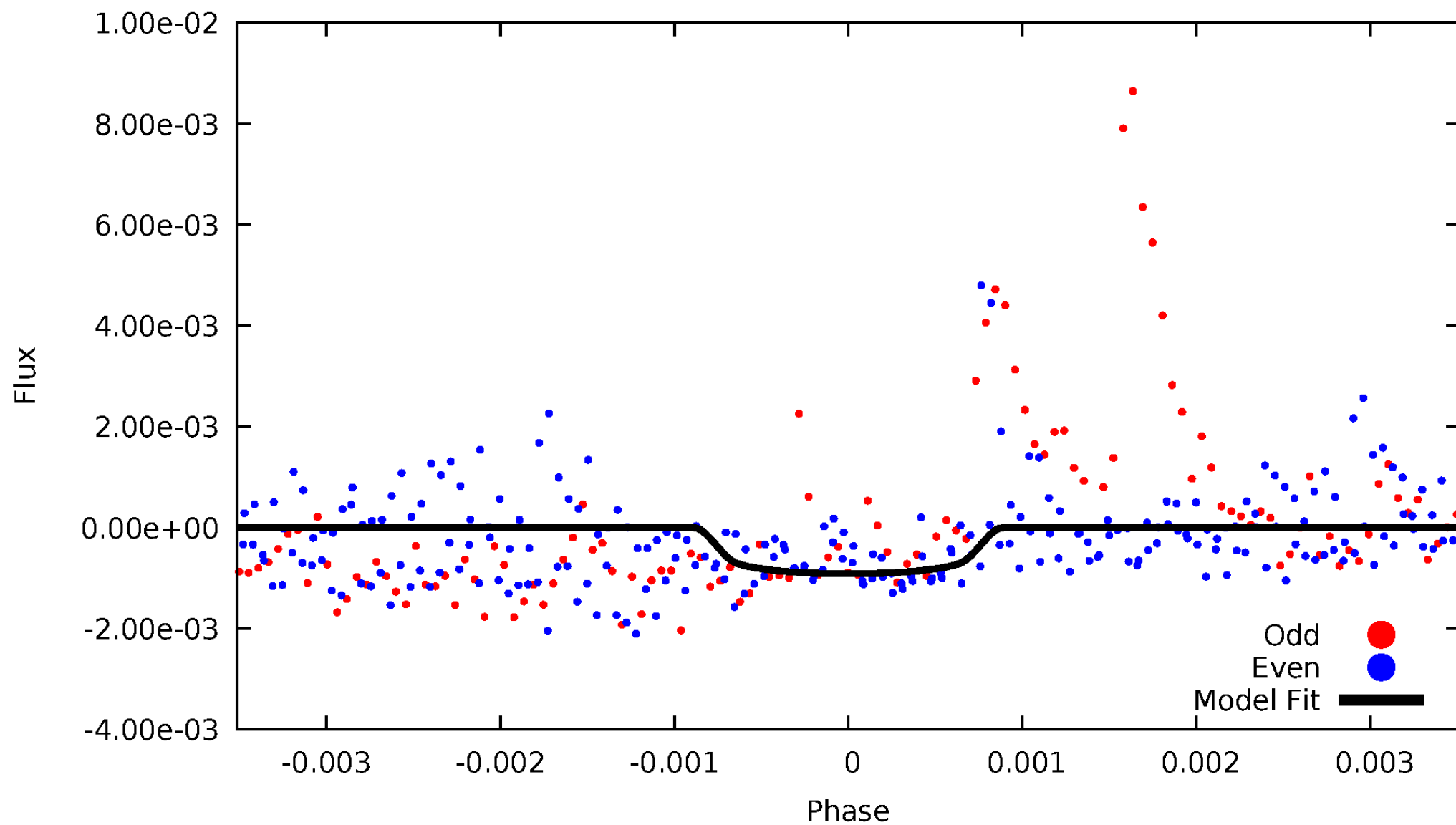
TCE 009786877-02





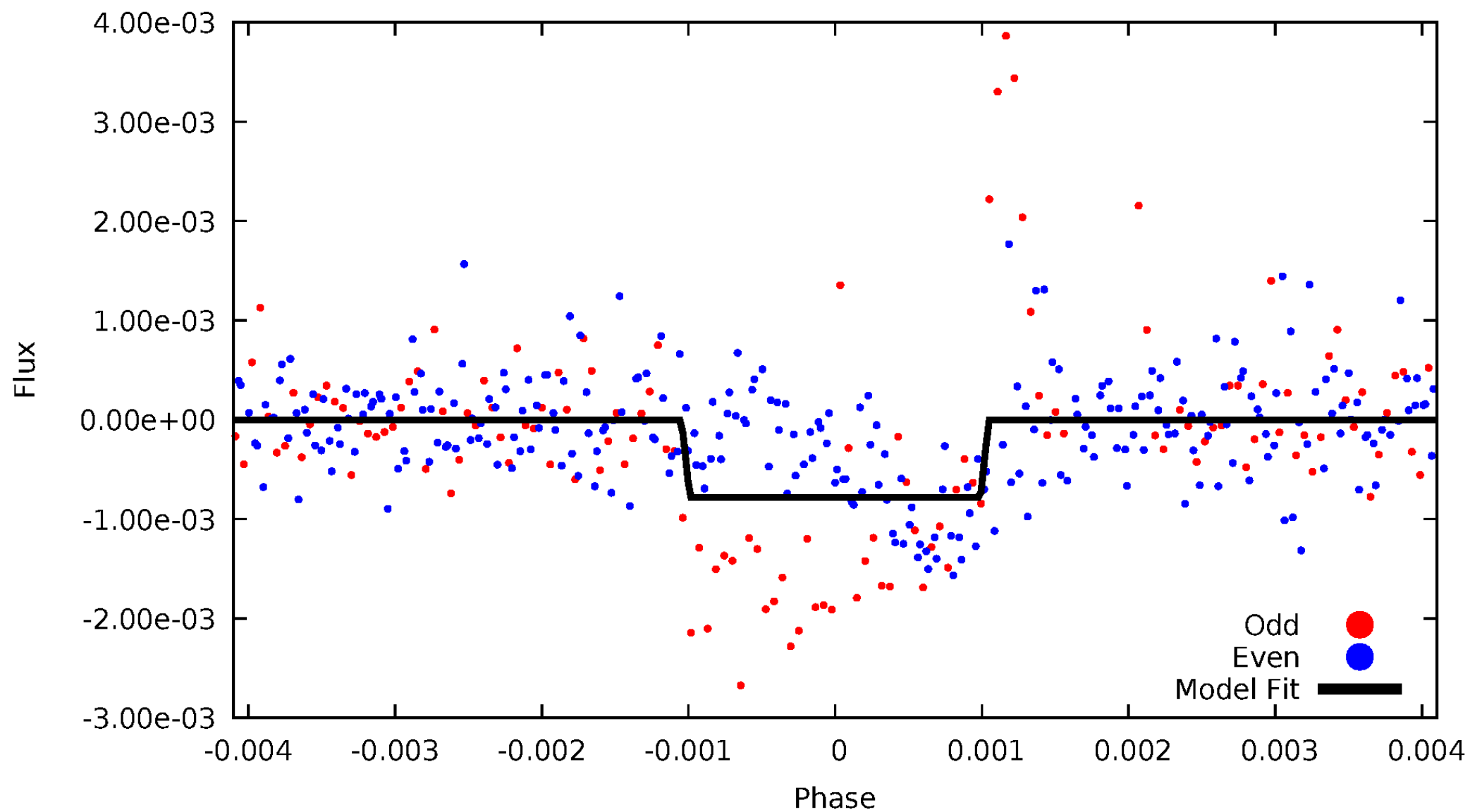
# DV Odd/Even

TCE 009786877-02



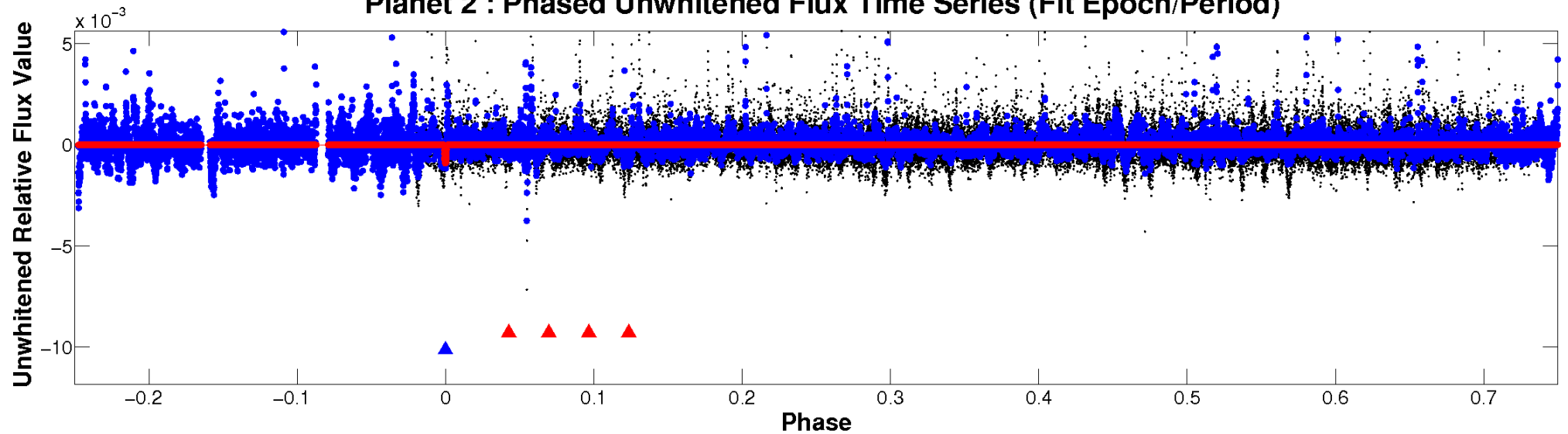
# ALT Odd/Even

TCE 009786877-02

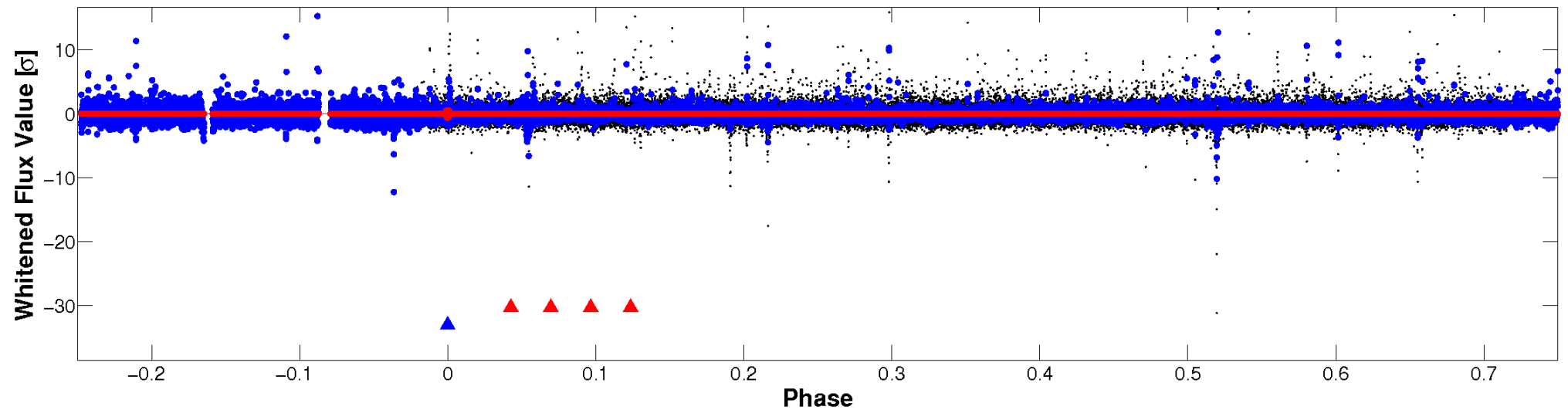


# Non-Whitened Vs. Whitened Light Curve

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



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



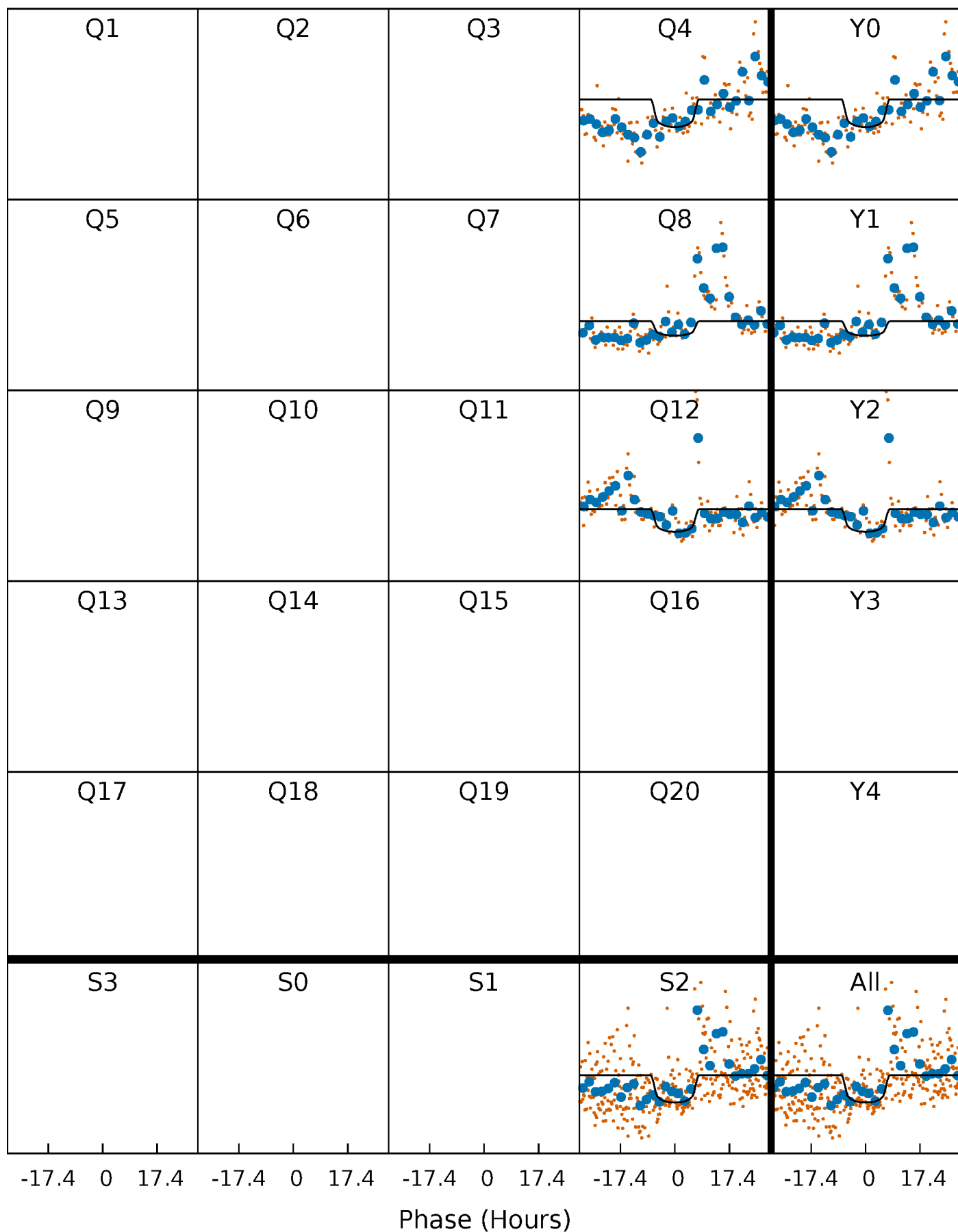
# PDC Quarter-Phased Transit Curves

TCE 009786877-02 P=361.765669 Days  $T_0=380.995463$  (BKJD)



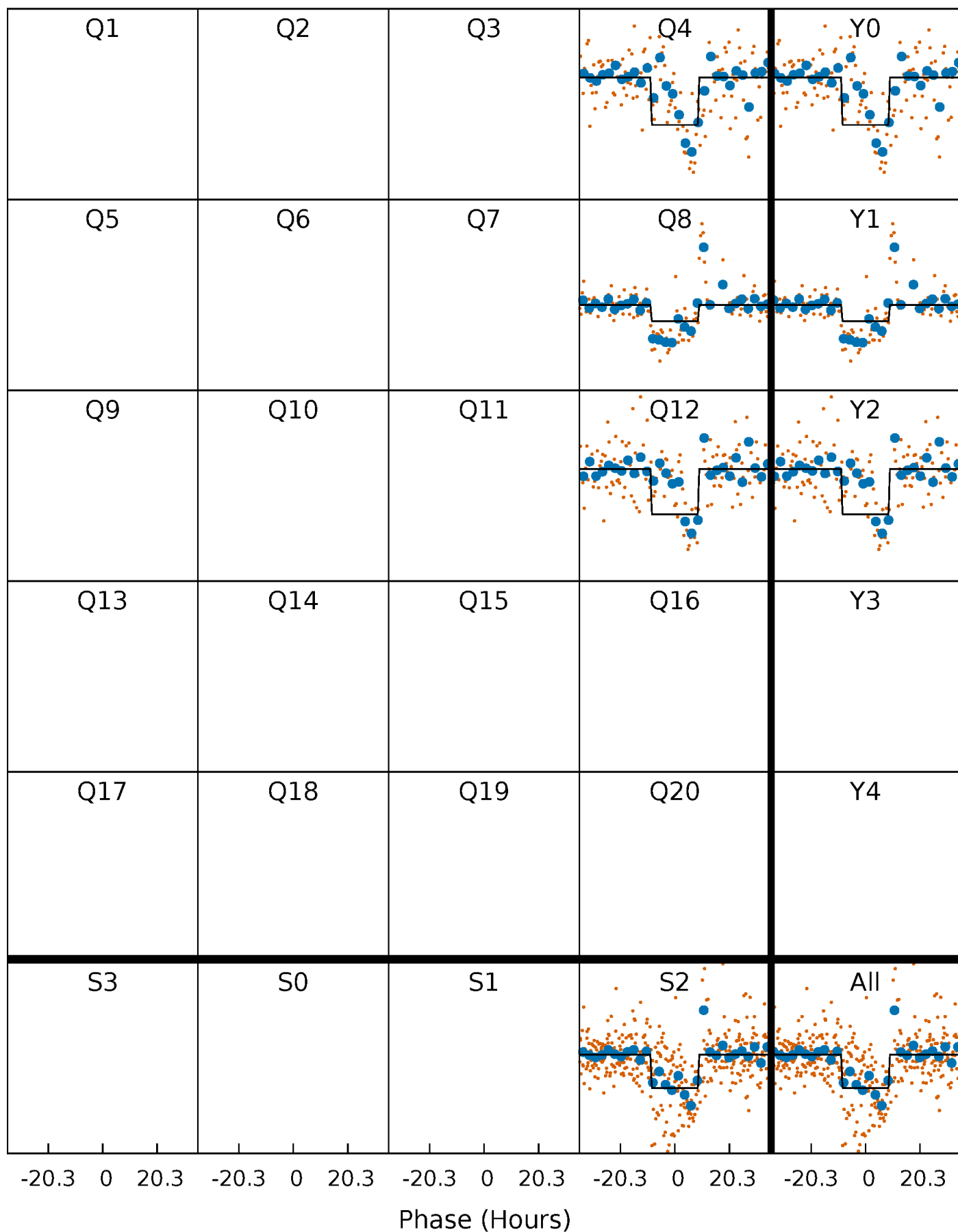
# DV Quarter-Phased Transit Curves

TCE 009786877-02     $P=361.765669$  Days     $T_0=380.995463$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

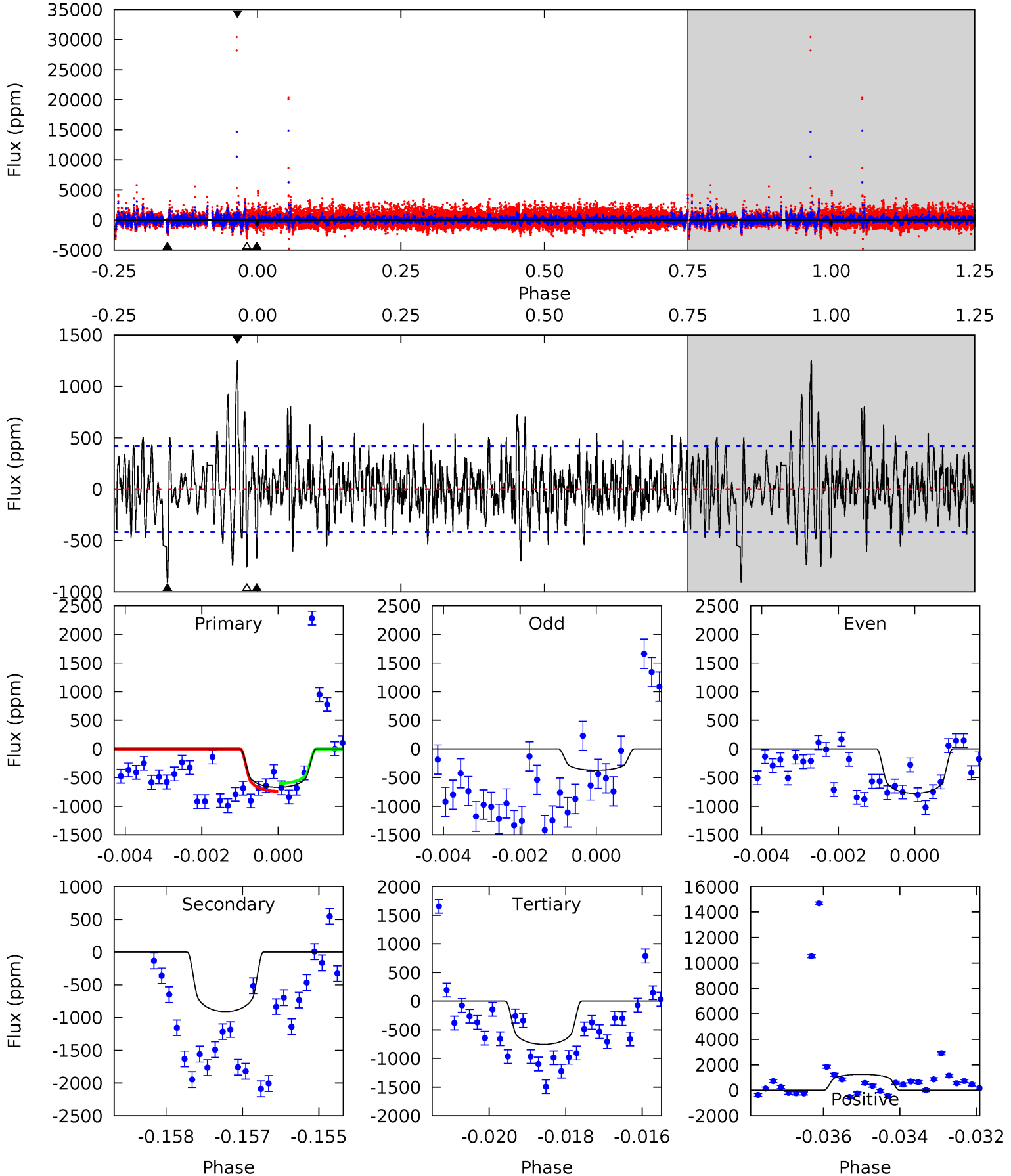
TCE 009786877-02 P=361.769369 Days  $T_0=380.876337$  (BKJD)



# DV Model-Shift Uniqueness Test

009786877-02, P = 361.765669 Days, E = 19.229794 Days

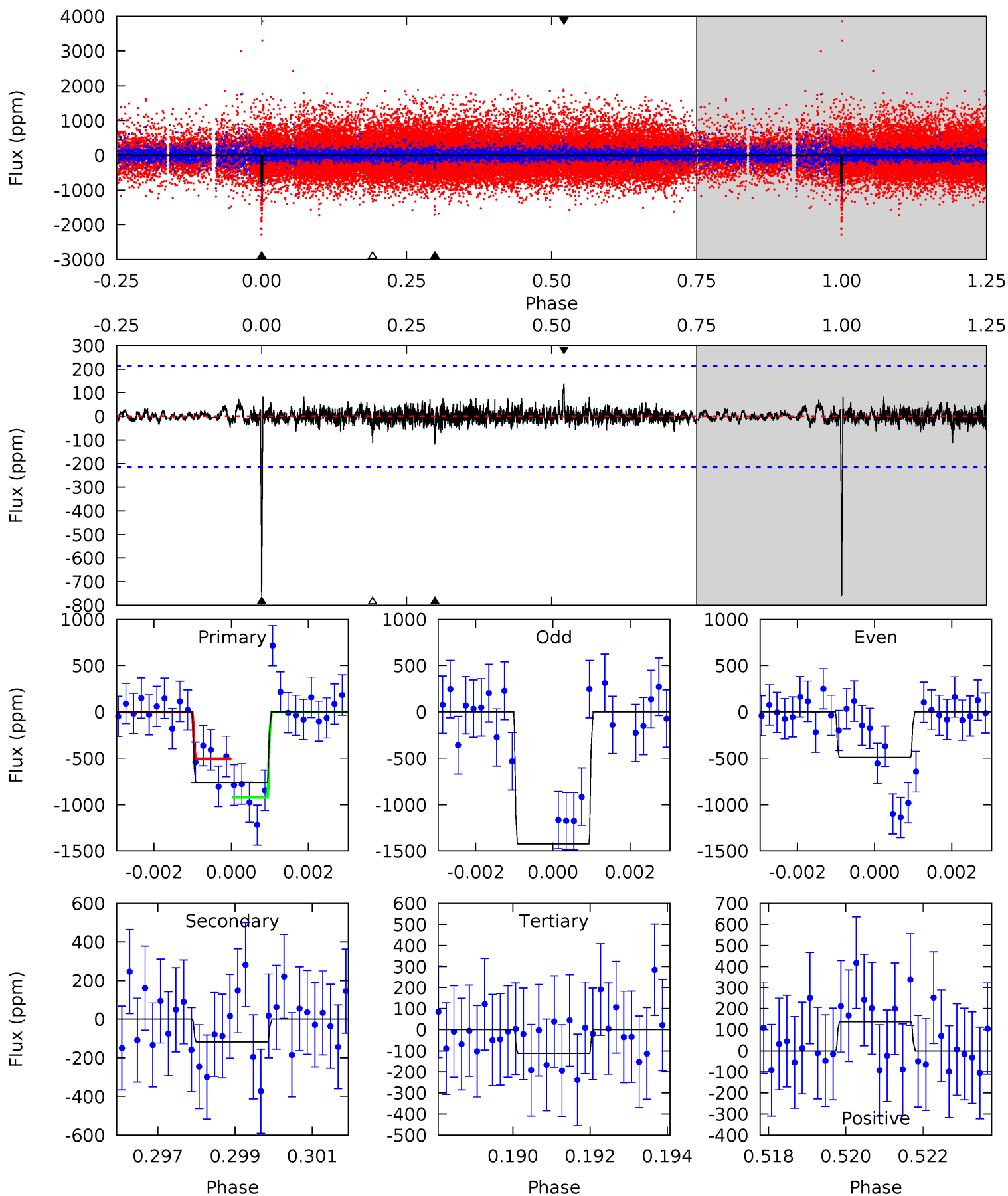
| Pri  | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 8.58 | 11.6 | 9.64 | 16.0 | 5.35            | 3.12            | 2.70             | -1.06   | -7.39   | 1.98    | -4.35   | 2.38    | 1.05 | 0.58  | 0.87 |



# Alt Model-Shift Uniqueness Test

009786877-02, P = 361.769369 Days, E = 19.106968 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  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 18.9 | 2.92 | 2.77 | 3.41 | 5.32            | 3.08            | 0.51             | 16.1    | 15.4    | 0.14    | -0.49   | 10.8    | 1.50 | 0.15  | 5.12 |





### Stellar Parameters For KIC 009786877

|        | $T_{\text{eff}} (K)$ | $\log(g)$                 | $[\text{Fe}/\text{H}]$     | $R (R_{\odot})$           | $M (M_{\odot})$           | $p_{\star} (\text{g}\cdot\text{cm}^{-3})$ |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $3560^{+63}_{-63}$   | $4.908^{+0.045}_{-0.040}$ | $-0.300^{+0.100}_{-0.100}$ | $0.349^{+0.036}_{-0.040}$ | $0.360^{+0.044}_{-0.049}$ | $11.940^{+3.084}_{-2.050}$                |
|        | +2%/-2%              | +1%/-1%                   | +33%/-33%                  | +10%/-11%                 | +12%/-14%                 | +26%/-17%                                 |
| Source | PHO2                 | PHO2                      | PHO2                       | DSEP                      |                           |   |

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

### Secondary Eclipse Parameters for KIC 009786877-02 / KOI

| Detrend | Depth (ppm)   | $R_p (R_{\oplus})$     | $T_{\text{max}} (K)$ | $T_{\text{obs}} (K)$ | $A_{\text{obs}}$           |
|---------|---------------|------------------------|----------------------|----------------------|----------------------------|
| DV      | $-909 \pm 78$ | $1.23^{+0.21}_{-0.21}$ | $154^{+4}_{-4}$      | $3483^{+246}_{-166}$ | $168178^{+75580}_{-45386}$ |
| Alt.    | $-118 \pm 40$ | $1.05^{+0.21}_{-0.20}$ | $154^{+4}_{-4}$      | $2707^{+175}_{-187}$ | $28109^{+18621}_{-11778}$  |

$T_{\text{max}}$  = 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

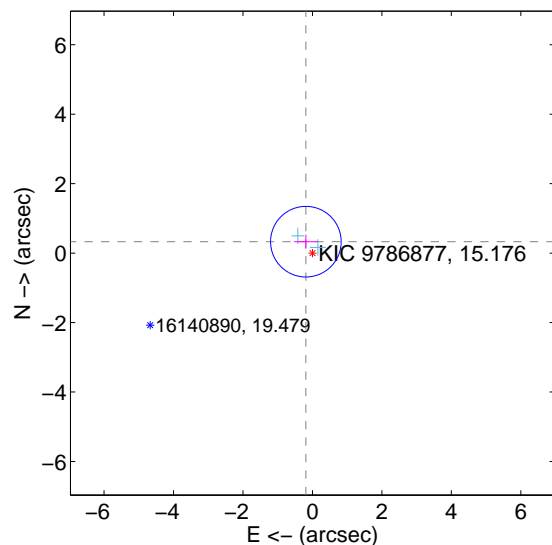
Supplemental centroid analysis for 009786877-02. Kepler magnitude: 15.18. Transit SNR 5.60

There are 2 quarters with good PRF difference image offsets

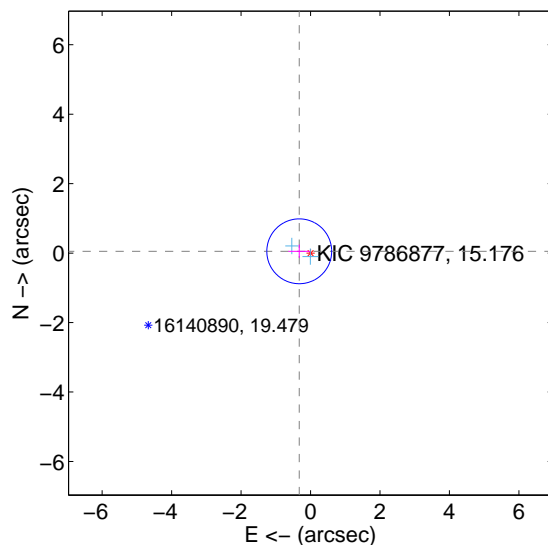
The direct PRF centroid is offset from the target star catalog position by about 0.31 arcsec

|   | Distance in arcsec | Distance / $\sigma$ | $\Delta$ RA       | $\Delta$ Dec      |
|---|--------------------|---------------------|-------------------|-------------------|
| PRF-fit source offset from OOT          | $0.379 \pm 0.339$  | 1.12                | $0.189 \pm 0.340$ | $0.329 \pm 0.203$ |
| PRF-fit source offset from KIC position | $0.329 \pm 0.311$  | 1.06                | $0.325 \pm 0.314$ | $0.052 \pm 0.190$ |
| photometric centroid source offset      | $2.27 \pm 1.18$    | 1.92                | $1.52 \pm 1.11$   | $-1.68 \pm 1.24$  |

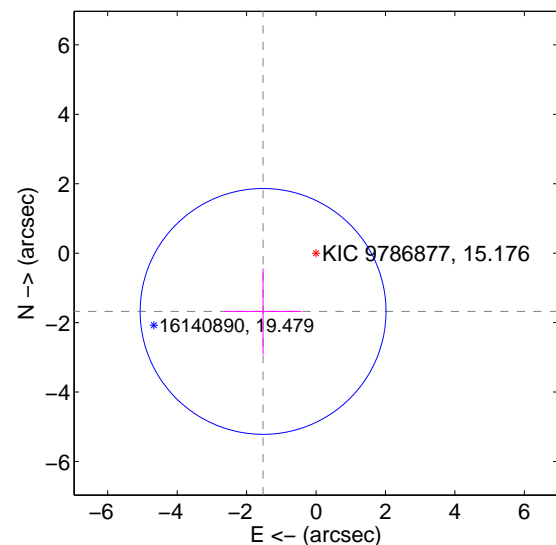
offset from difference PRF-fit to OOT PRF-fit



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.

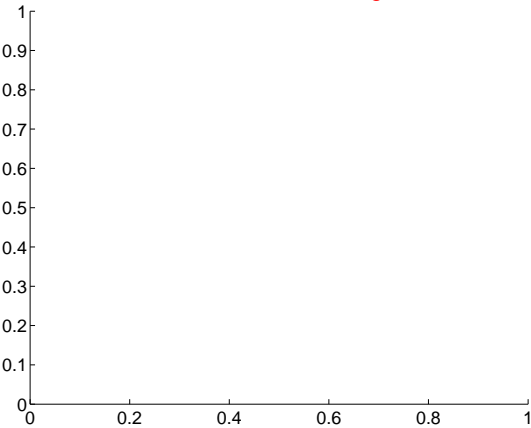
Q1 no difference image



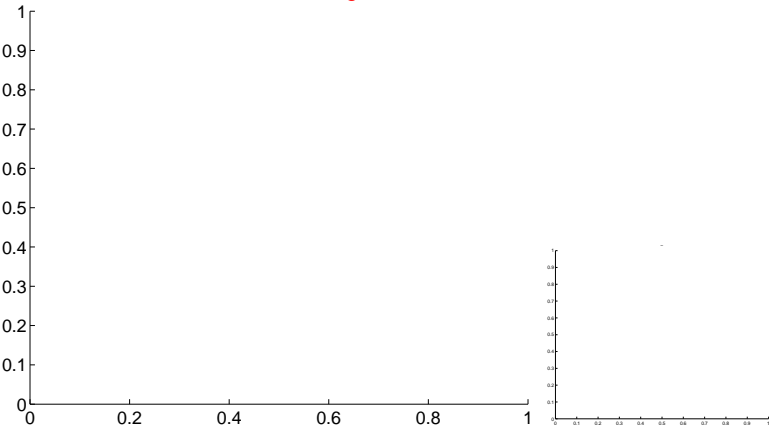
Q1 no OOT image



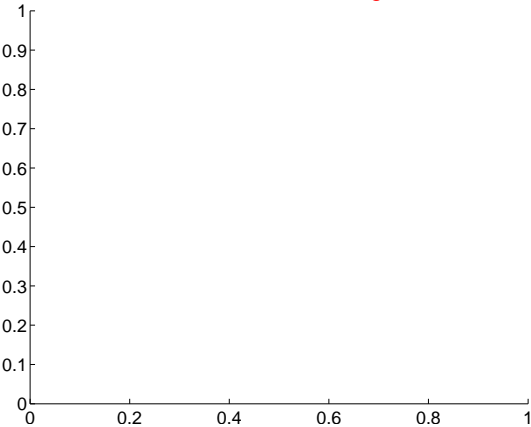
Q2 no difference image



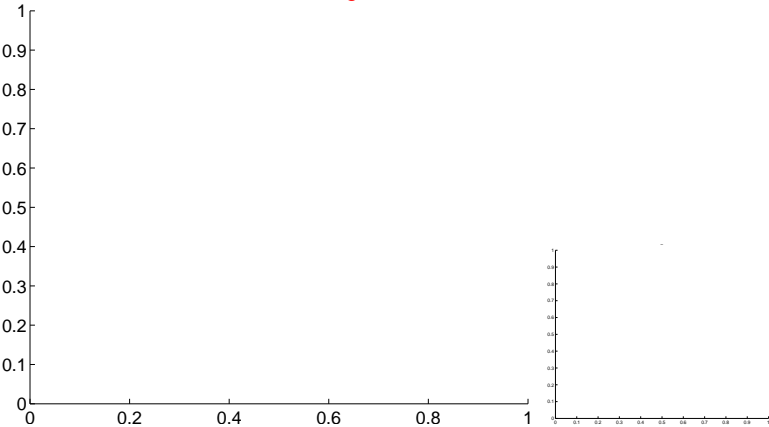
Q2 no OOT image



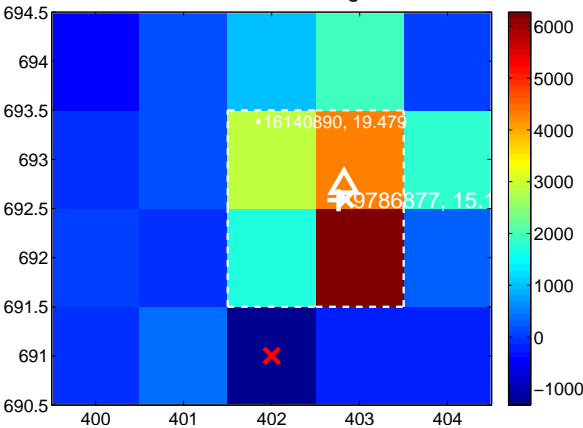
Q3 no difference image



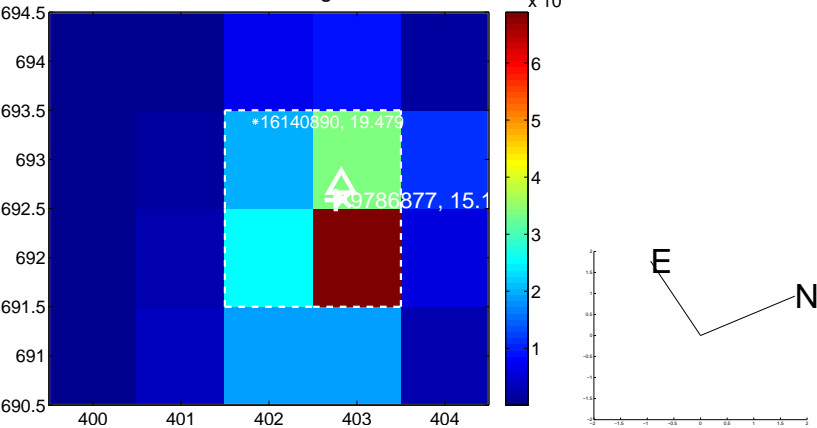
Q3 no OOT image



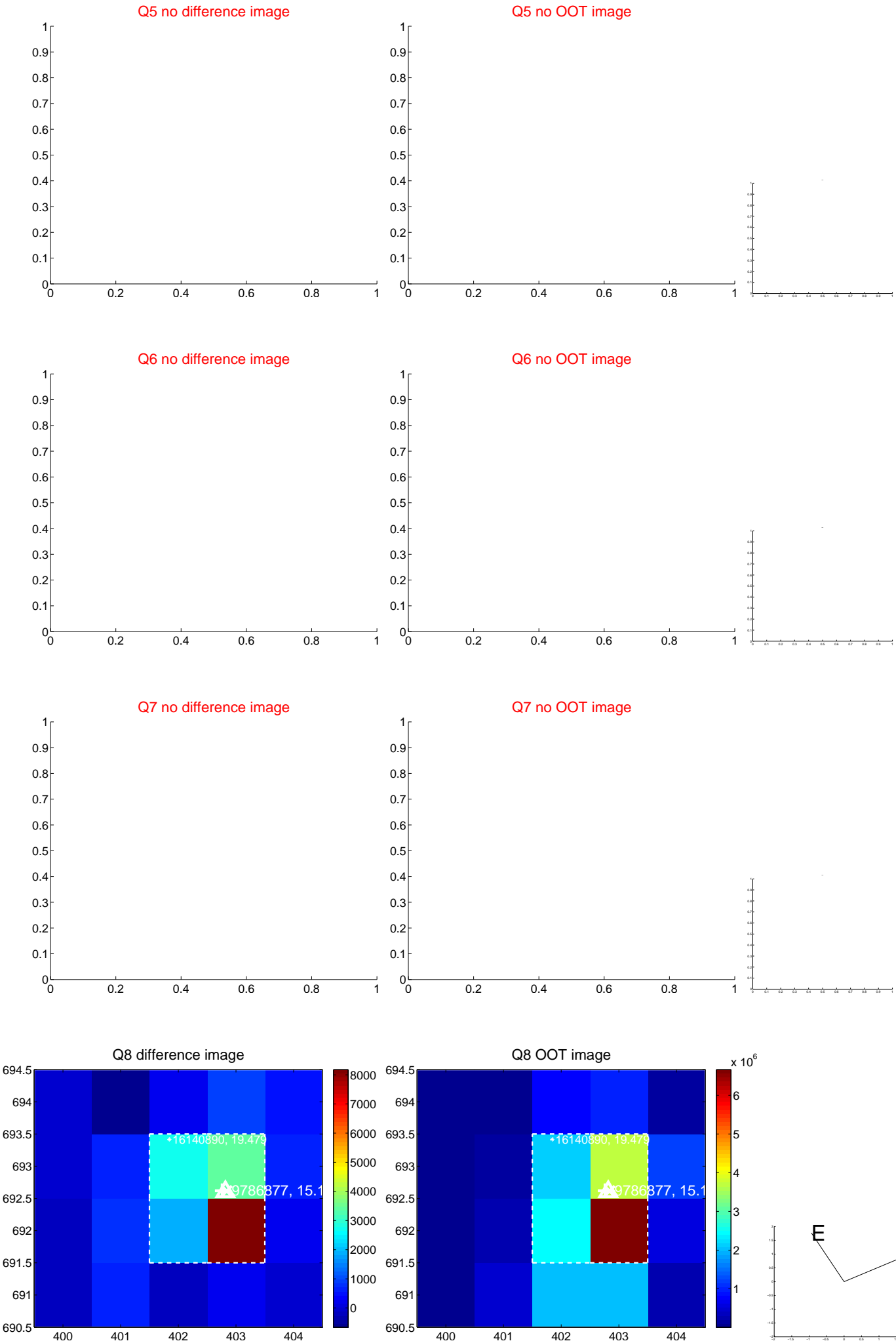
Q4 difference image



Q4 OOT image



white ×: KIC target position; +: OOT centroid; △: difference centroid. red ✕: large negative pixel value.



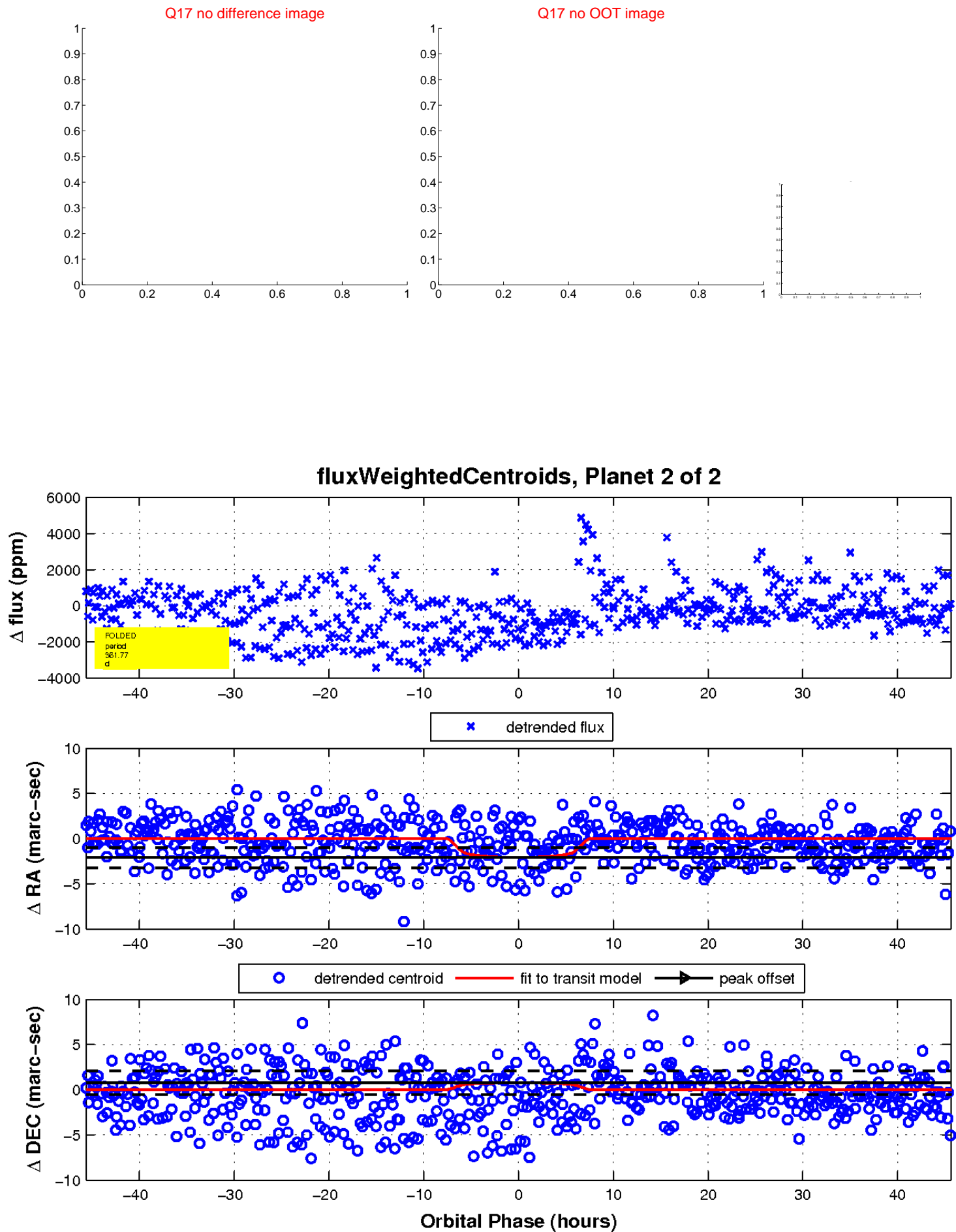
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

