

# KIC 012406807

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 012406807-01 | OBS      | 3091.01 | 17.067892     | 145.561749   | 261.6       | 5.941            | 11.7 | 12.4 | 1.00                        | 6347            | 1.83                   | 82.75                  |
| 012406807-02 | OBS      | 3091.02 | 7.906947      | 138.427717   | 119.2       | 4.949            | 7.5  | 7.5  | 1.00                        | 6347            | 1.25                   | 230.85                 |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments   |
|--------------|----------|------|-------|---|---|---|---|------------|
| 012406807-01 | OBS      | PC   | 0.93  | 0 | 0 | 0 | 0 | NO_COMMENT |
| 012406807-02 | OBS      | PC   | 0.88  | 0 | 0 | 0 | 0 | NO_COMMENT |

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

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

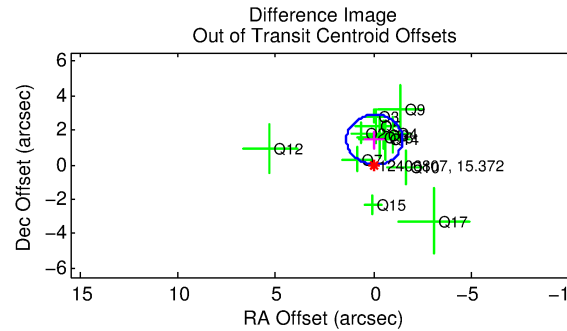
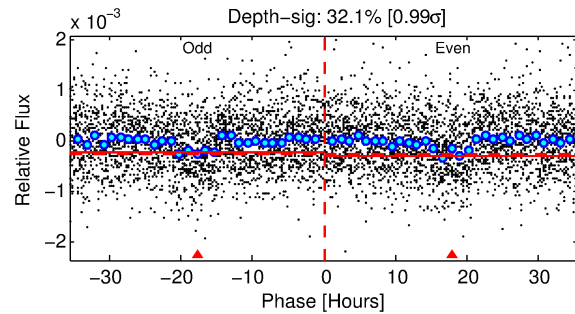
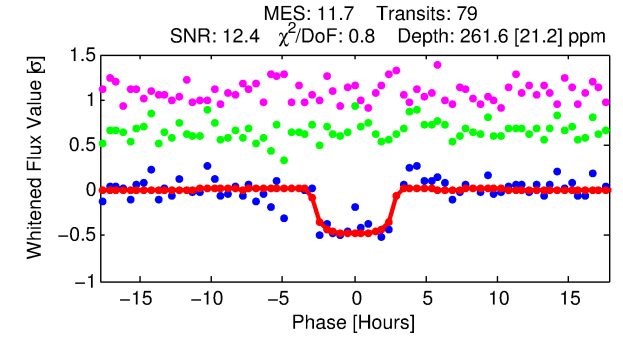
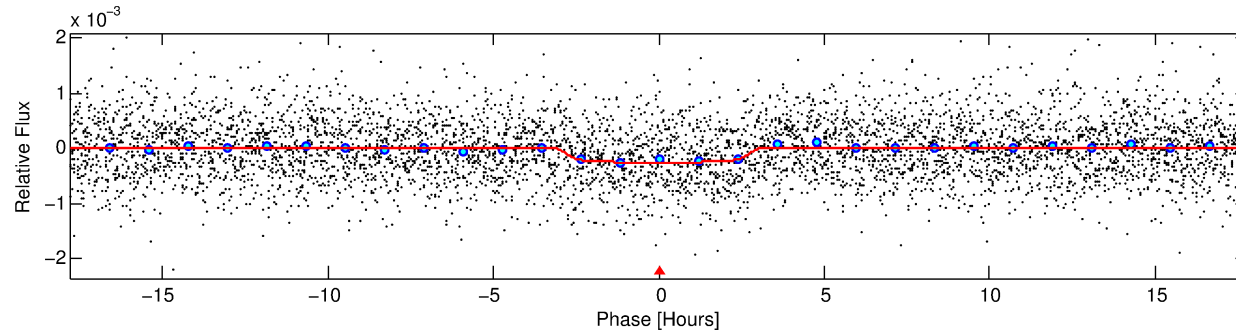
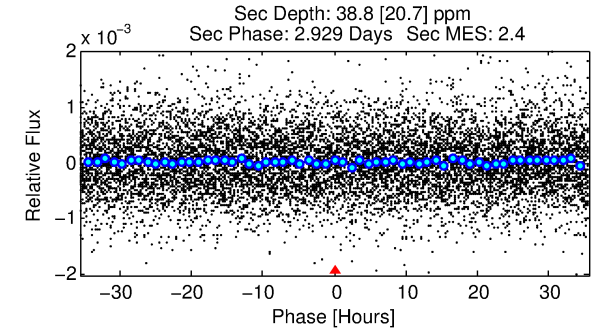
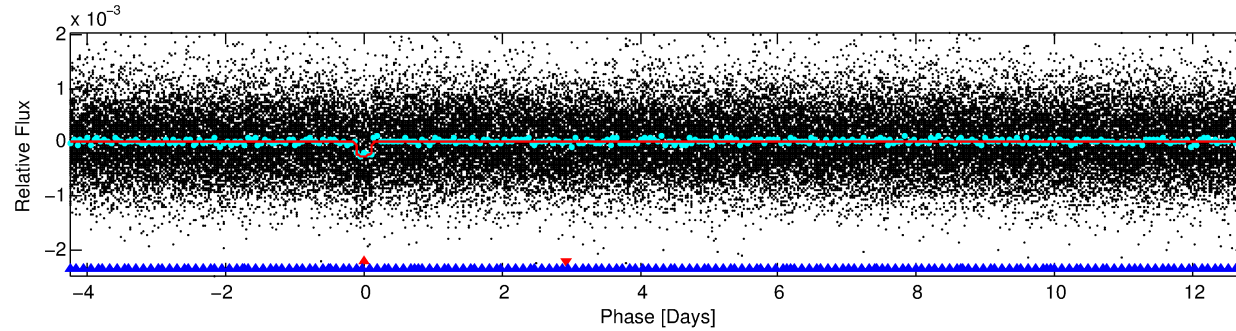
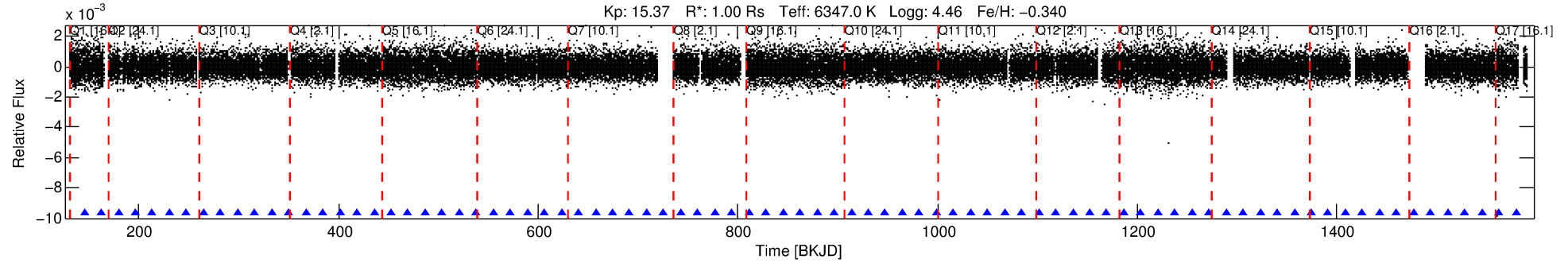
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 012406807-01

No Significant Match Found

# DV One-Page Summary

KIC: 12406807 Candidate: 1 of 2 Period: 17.068 d  
KOI: K03091.01 Corr: 0.970



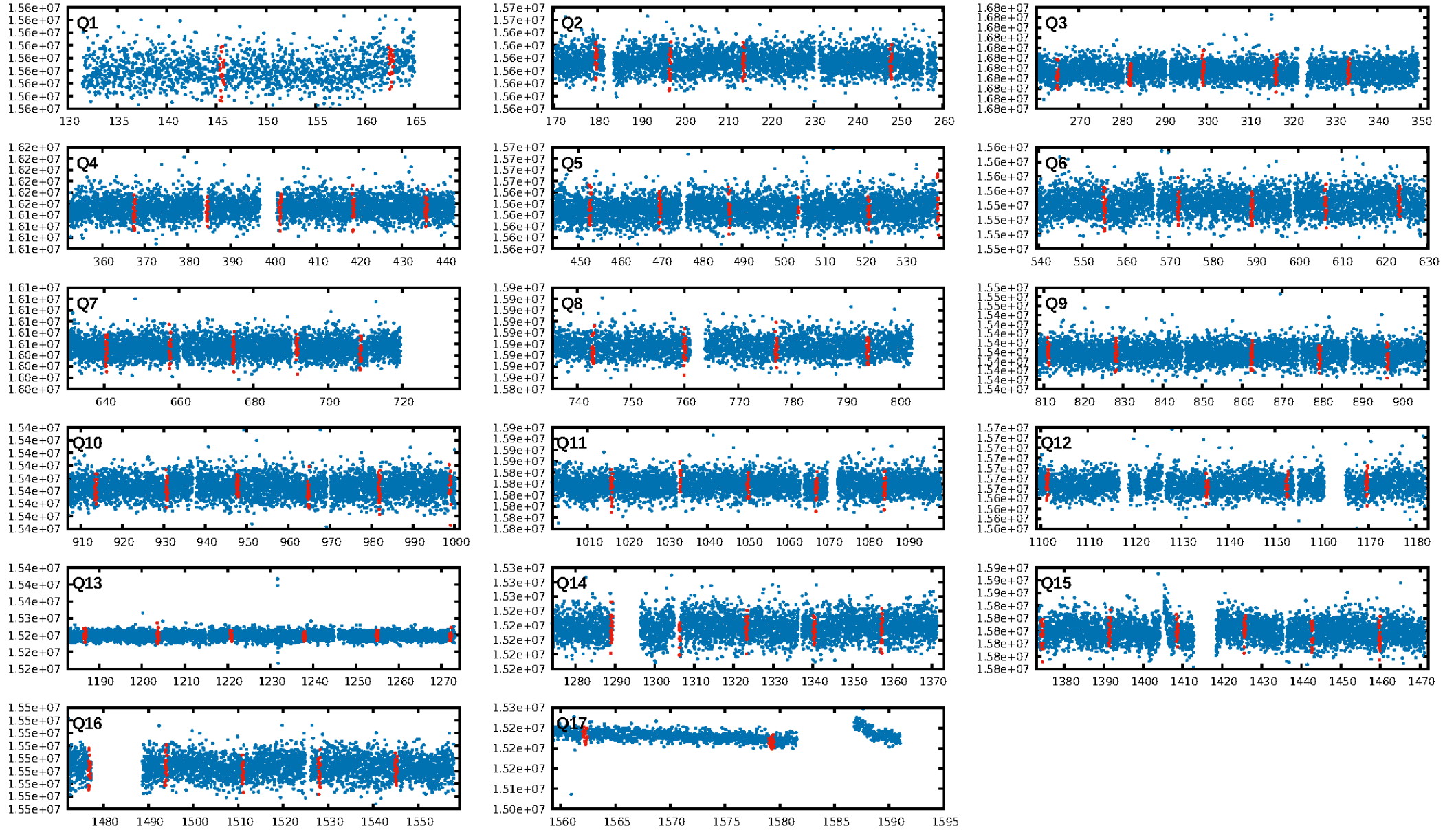
## DV Fit Results:

Period = 17.06789 [0.00019] d  
Epoch = 145.5617 [0.0094] BKJD  
Rp/R\* = 0.0168 [0.0047]  
a/R\* = 12.07 [18.19]  
b = 0.86 [0.48]  
Seff = 82.75 [34.37]  
Teq = 769 [80] K  
Rp = 1.83 [0.77] Re  
a = 0.1320 [0.0357] AU  
Ag = 111.43 [96.40] [1.15σ]  
Teffp = 3863 [754] K [4.08σ]

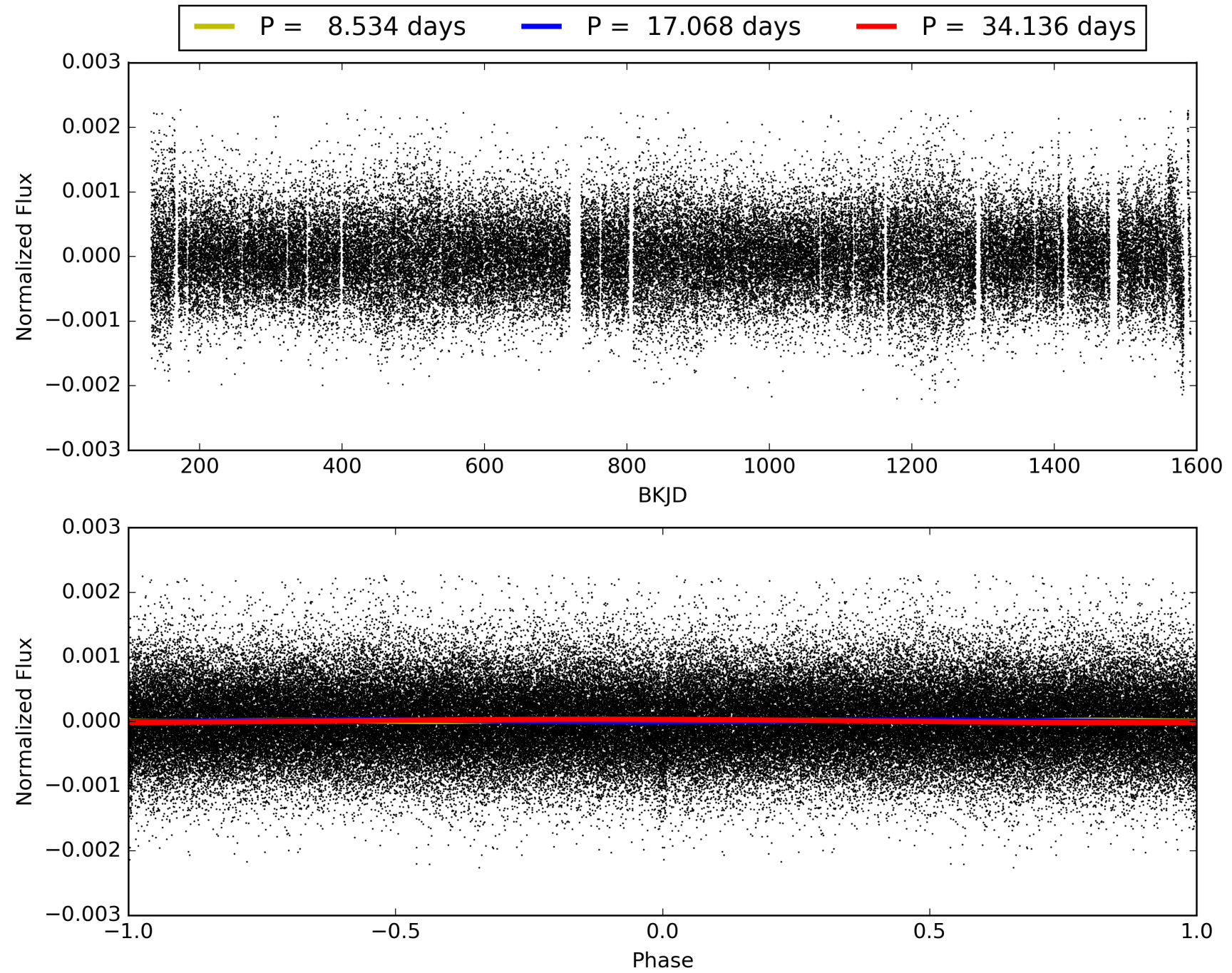
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [28.44σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 99.1%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 6.62e-31  
RollingBand-fgt: 1.00 [75/75]  
GhostDiagnostic-chr: 2.716  
Centroid-sig: 51.5%  
Centroid-so: 0.707 arcsec [0.62σ]  
OotOffset-rm: 1.447 arcsec [3.01σ]  
KicOffset-rm: 1.431 arcsec [2.65σ]  
OotOffset-st: 4/3/3/3 [13]  
KicOffset-st: 4/3/3/3 [13]  
DiffImageQuality-fgm: 0.46 [6/13]  
DiffImageOverlap-fno: 1.00 [17/17]

# TCE 012406807-01, PDC Light Curves

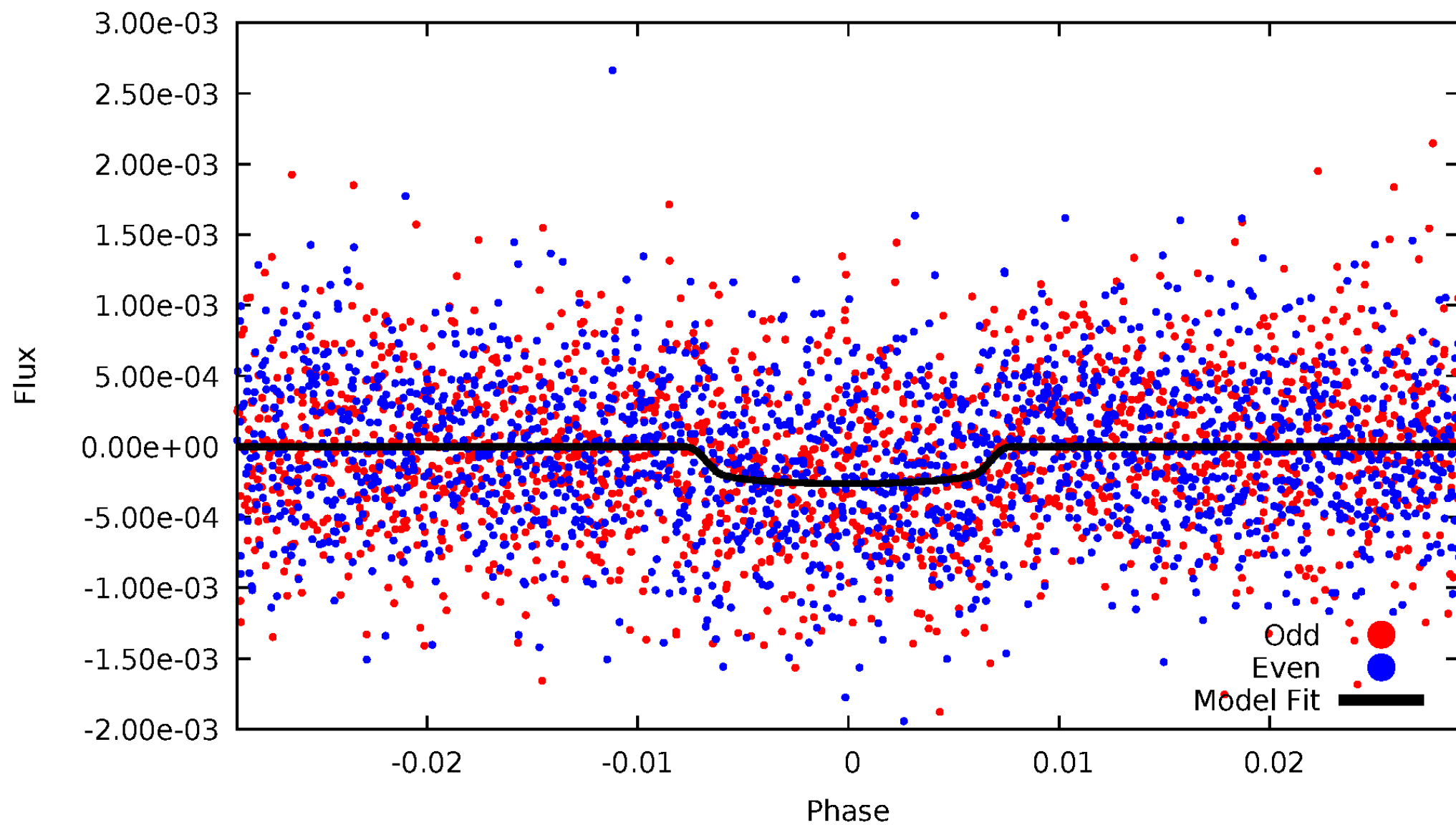


TCE 012406807-01



# DV Odd/Even

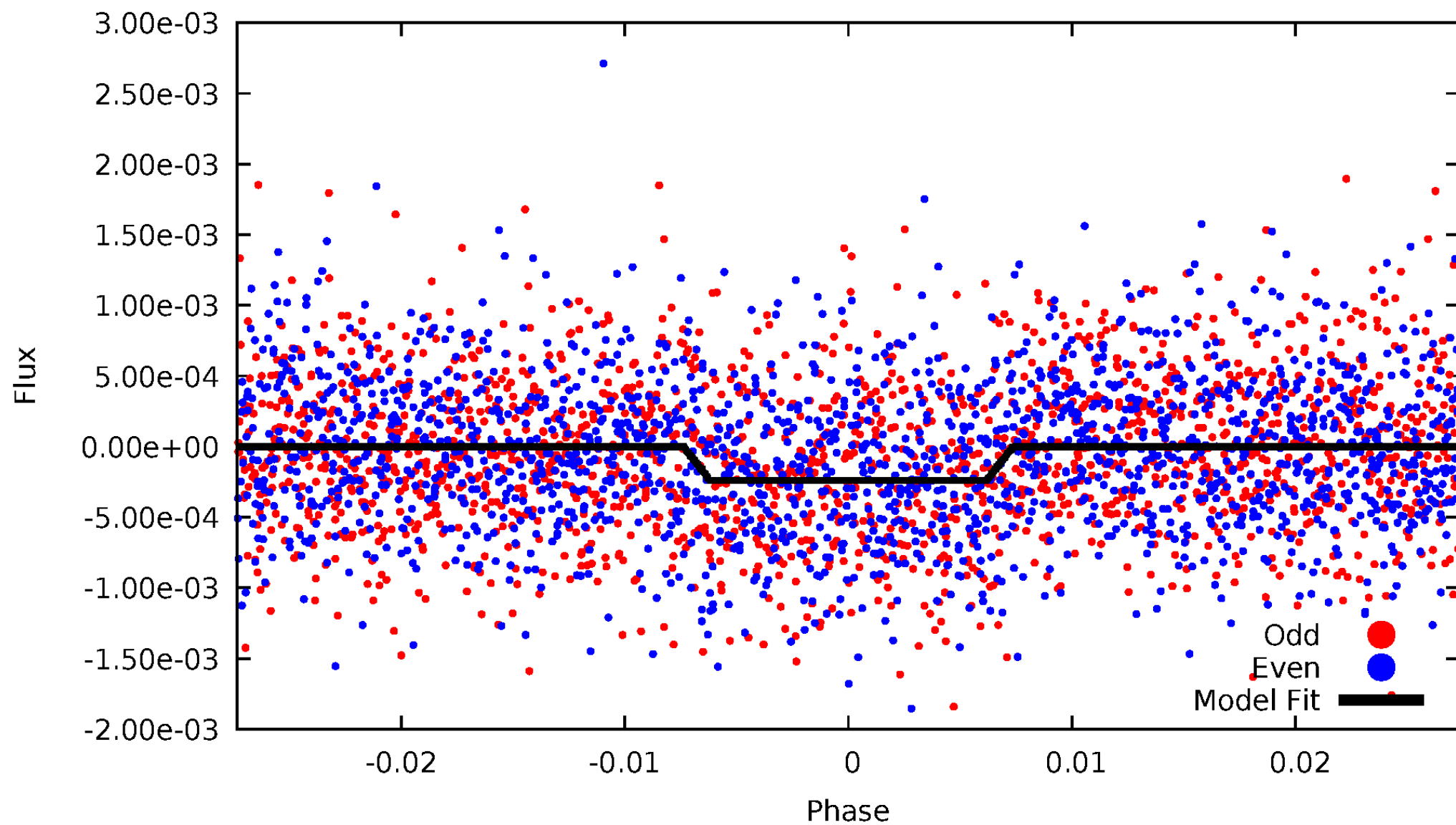
TCE 012406807-01





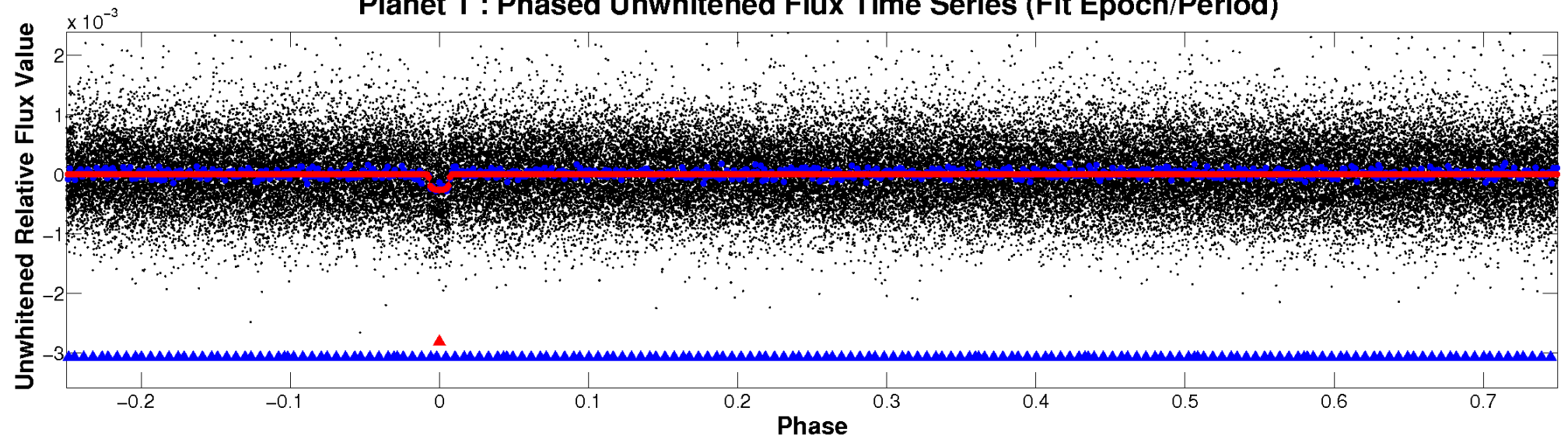
# ALT Odd/Even

TCE 012406807-01

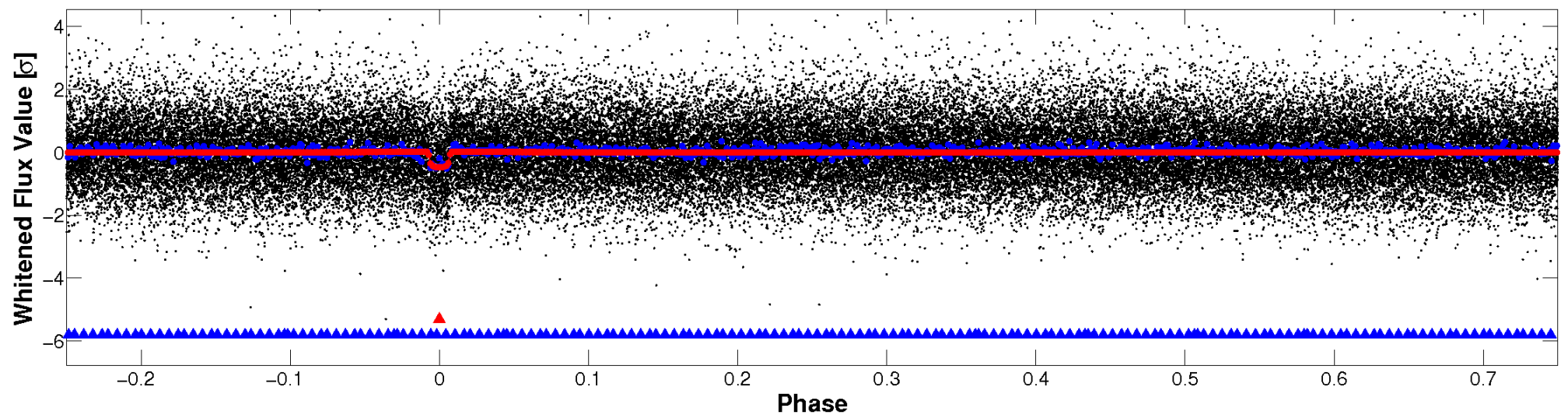


# Non-Whitened Vs. Whitened Light Curve

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

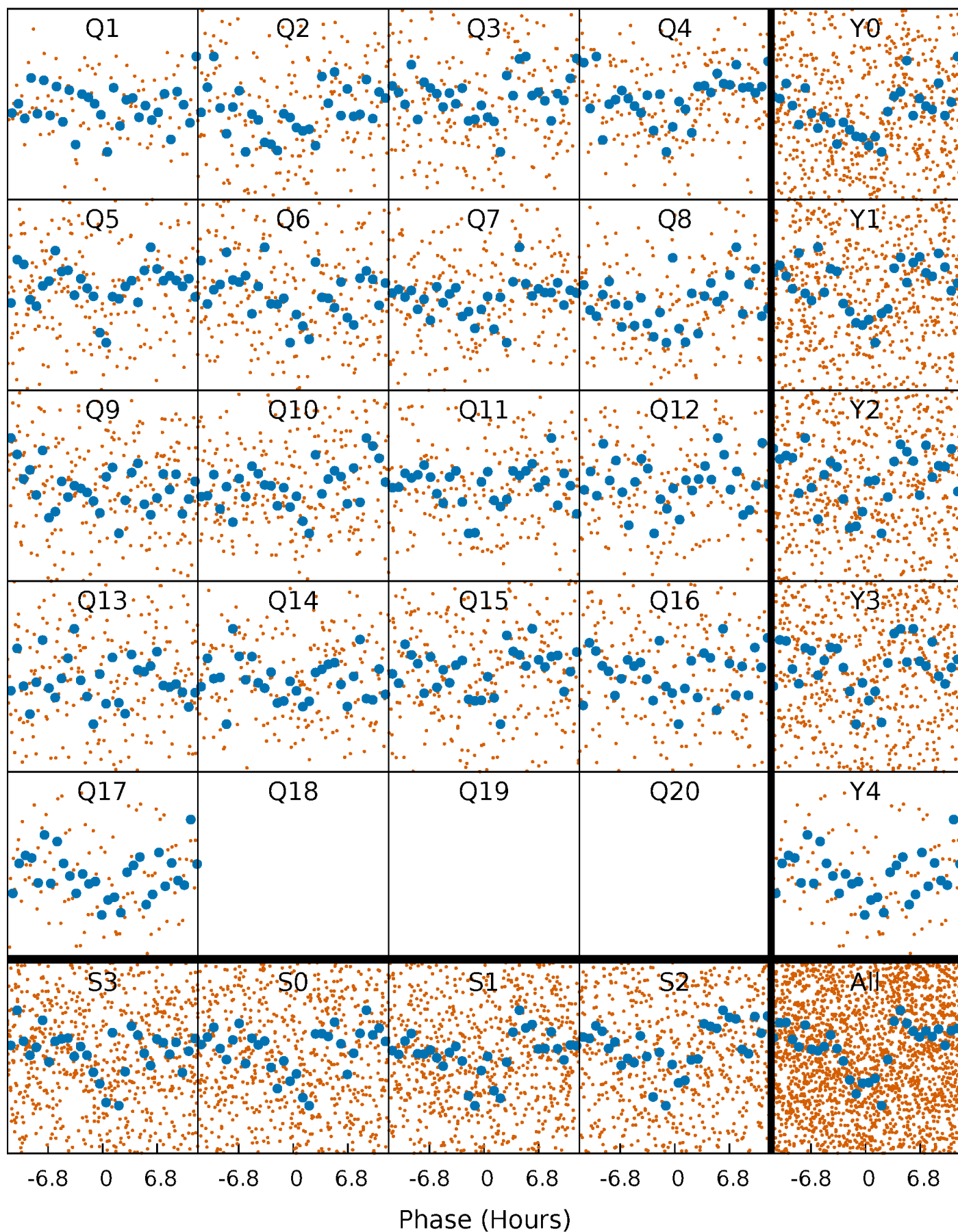


Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)



# PDC Quarter-Phased Transit Curves

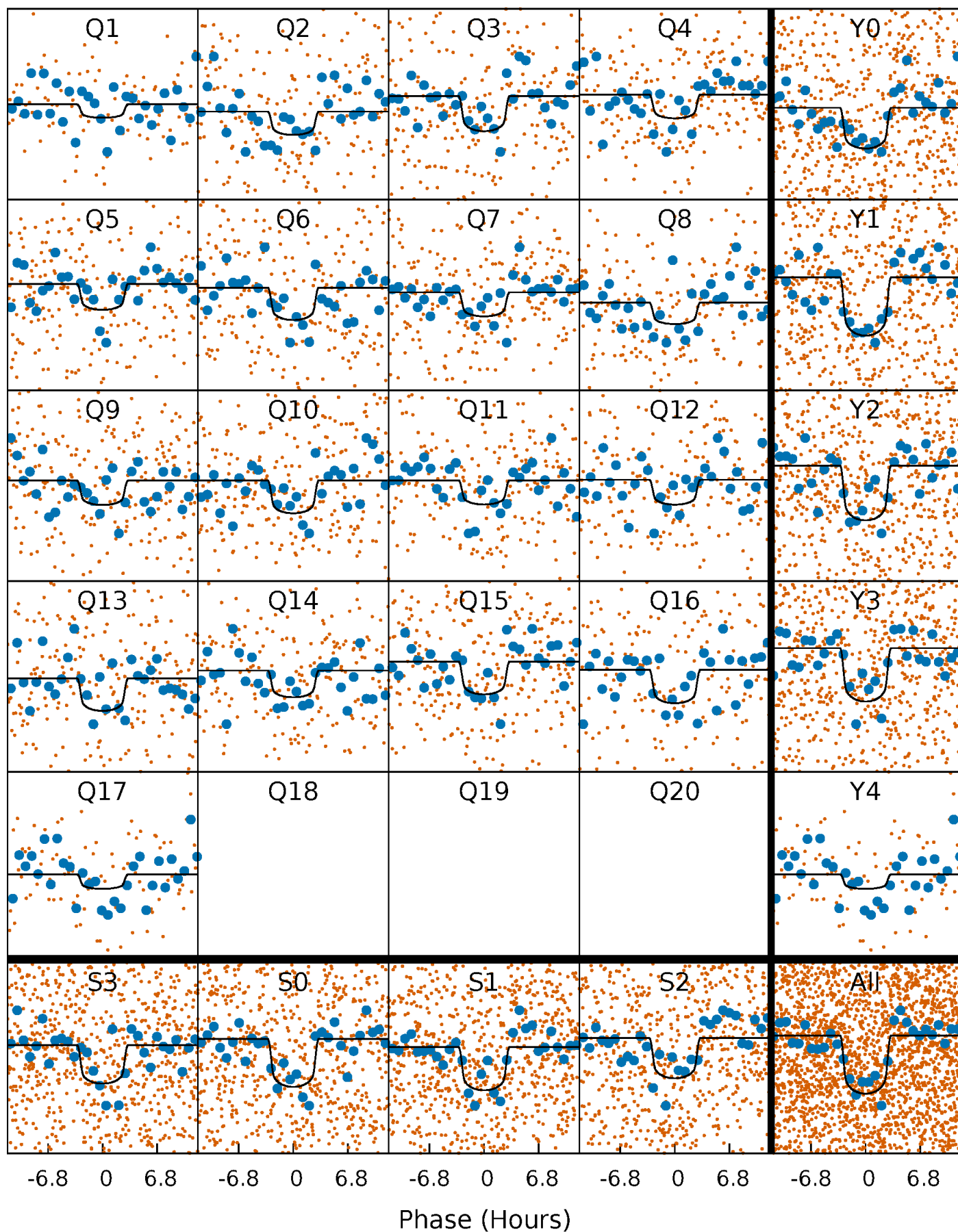
TCE 012406807-01 P= 17.067892 Days  $T_0=145.561749$  (BKJD)





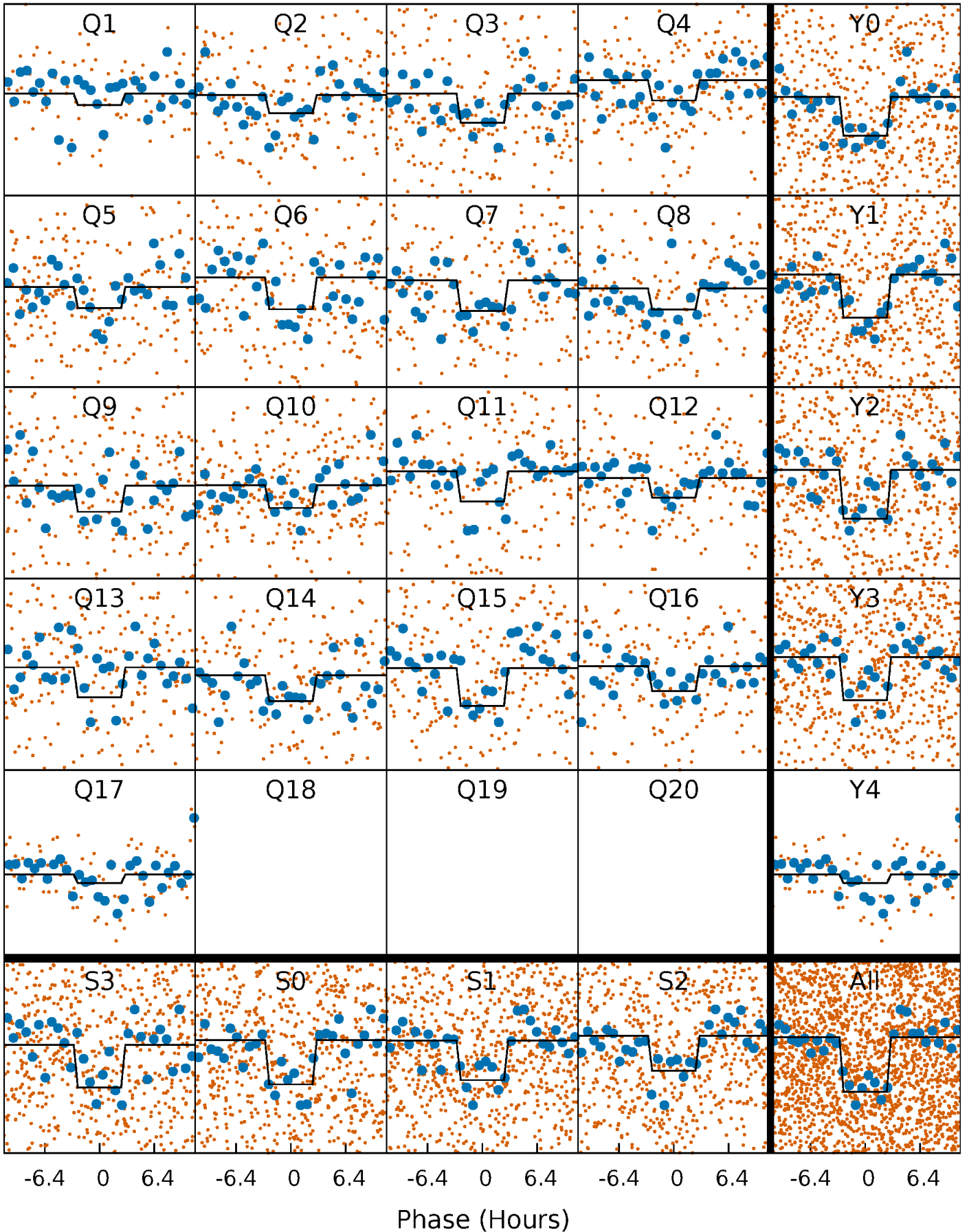
# DV Quarter-Phased Transit Curves

TCE 012406807-01 P= 17.067892 Days  $T_0=145.561749$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

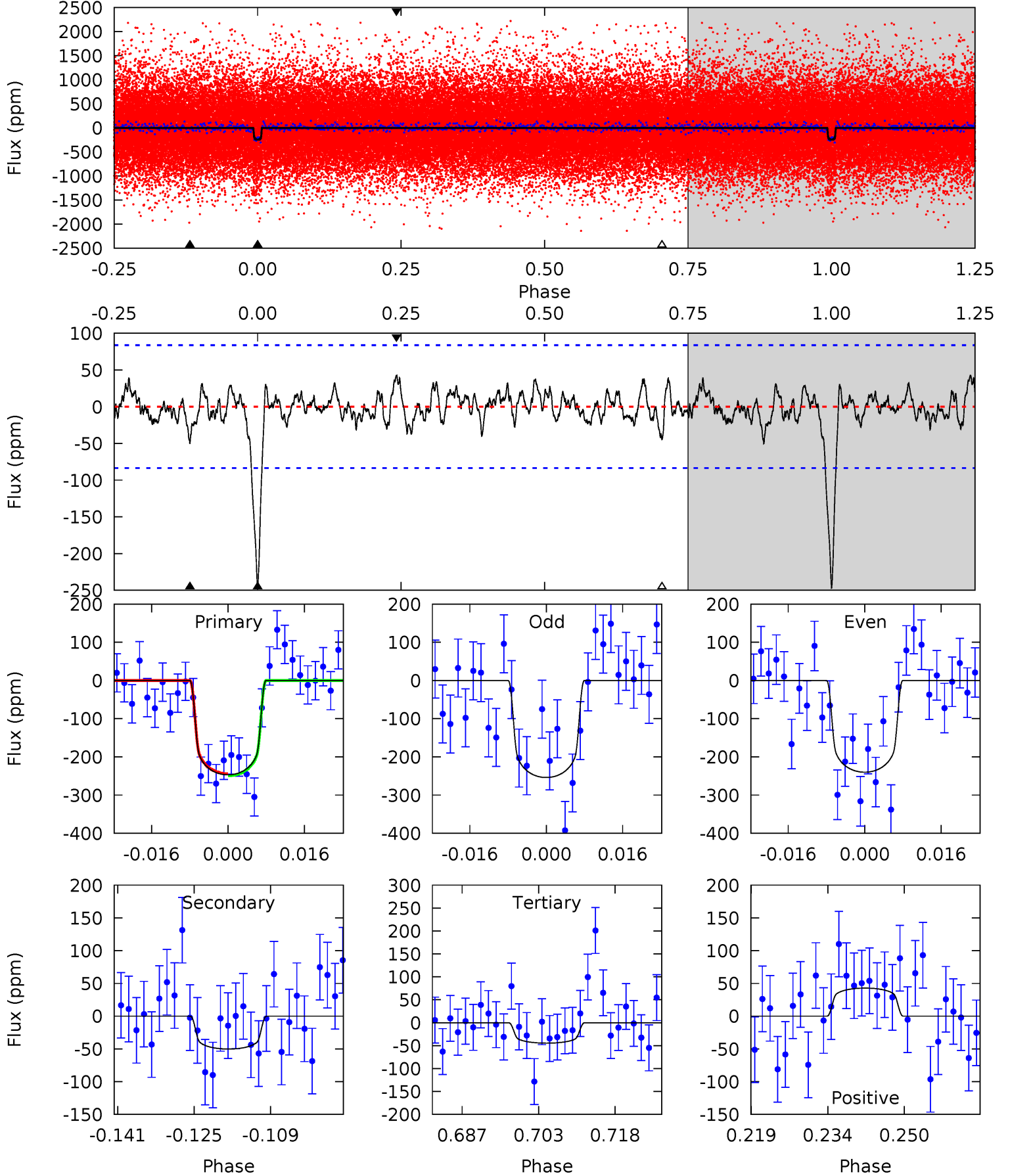
TCE 012406807-01 P= 17.067799 Days  $T_0=145.563235$  (BKJD)



# DV Model-Shift Uniqueness Test

012406807-01,  $P = 17.067892$  Days,  $E = 128.493857$  Days

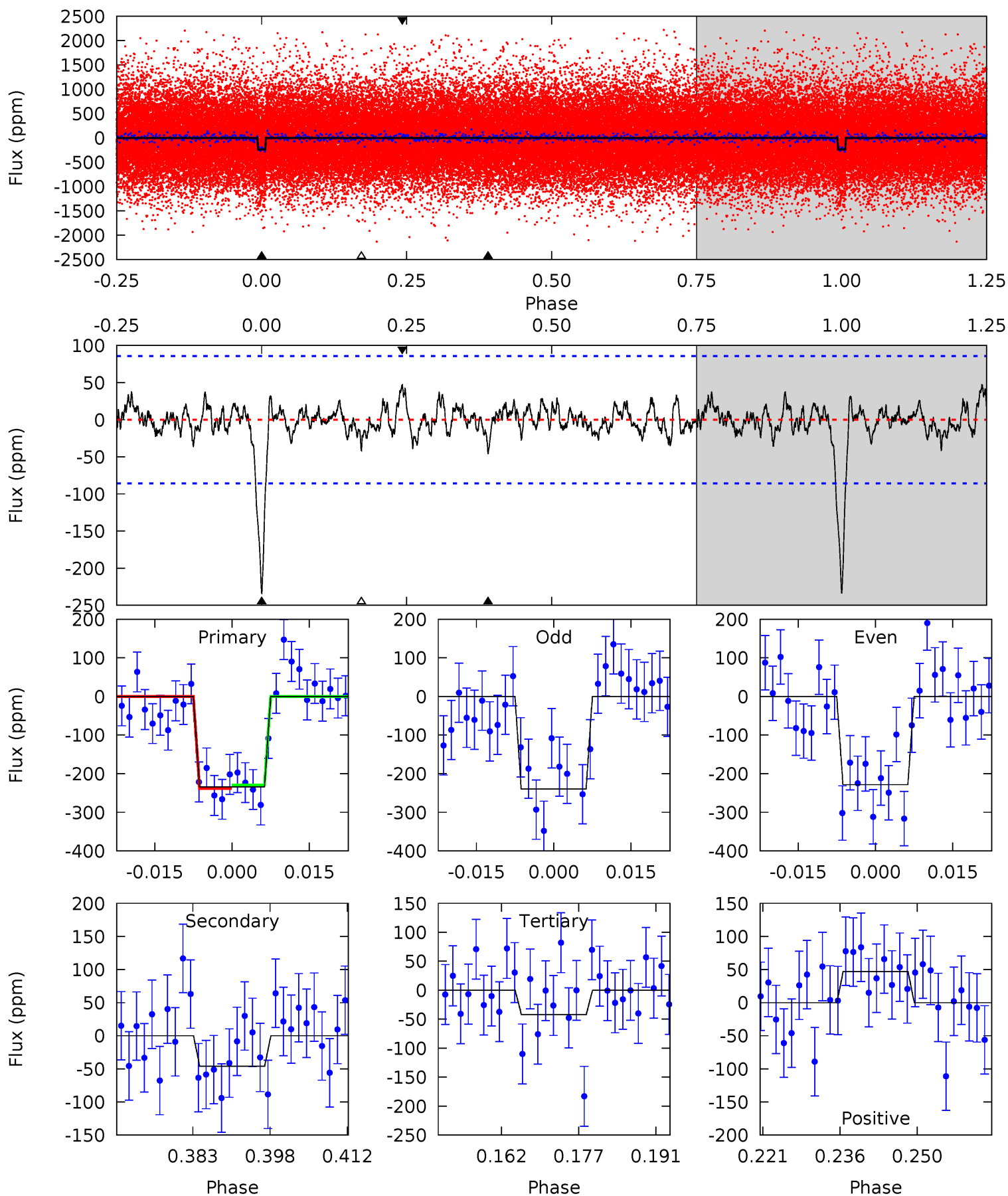
| Pri  | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 14.6 | 2.97 | 2.63 | 2.53 | 4.94            | 2.42            | 0.93             | 11.9    | 12.1    | 0.33    | 0.44    | 0.41    | 0.98 | 0.15  | 0.15 |



# Alt Model-Shift Uniqueness Test

012406807-01,  $P = 17.067799$  Days,  $E = 128.495436$  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  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 13.5 | 2.66 | 2.42 | 2.71 | 4.95            | 2.44            | 0.85             | 11.1    | 10.8    | 0.24    | -0.05   | 0.33    | 0.89 | 0.17  | 0.26 |



### Stellar Parameters For KIC 012406807

|        | $T_{\text{eff}} (K)$ | $\log(g)$                 | $[\text{Fe}/\text{H}]$     | $R (R_{\odot})$           | $M (M_{\odot})$           | $p_{\star} (\text{g}\cdot\text{cm}^{-3})$ |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $6347^{+170}_{-207}$ | $4.464^{+0.054}_{-0.216}$ | $-0.340^{+0.250}_{-0.300}$ | $0.996^{+0.319}_{-0.106}$ | $1.053^{+0.146}_{-0.146}$ | $1.501^{+0.412}_{-0.768}$                 |
|        | +3%/-3%              | +1%/-5%                   | +74%/-88%                  | +32%/-11%                 | +14%/-14%                 | +27%/-51%                                 |
| 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 012406807-01 / KOI 3091.01

| Detrend | Depth (ppm)  | $R_p (R_{\oplus})$     | $T_{\text{max}} (K)$ | $T_{\text{obs}} (K)$ | $A_{\text{obs}}$   |
|---------|--------------|------------------------|----------------------|----------------------|--------------------|
| DV      | $-50 \pm 17$ | $1.99^{+0.59}_{-0.61}$ | $1098^{+84}_{-53}$   | $4274^{+638}_{-442}$ | $119^{+117}_{-58}$ |
| Alt.    | $-46 \pm 17$ | $1.72^{+0.65}_{-0.52}$ | $1097^{+78}_{-52}$   | $4380^{+744}_{-520}$ | $135^{+164}_{-71}$ |

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



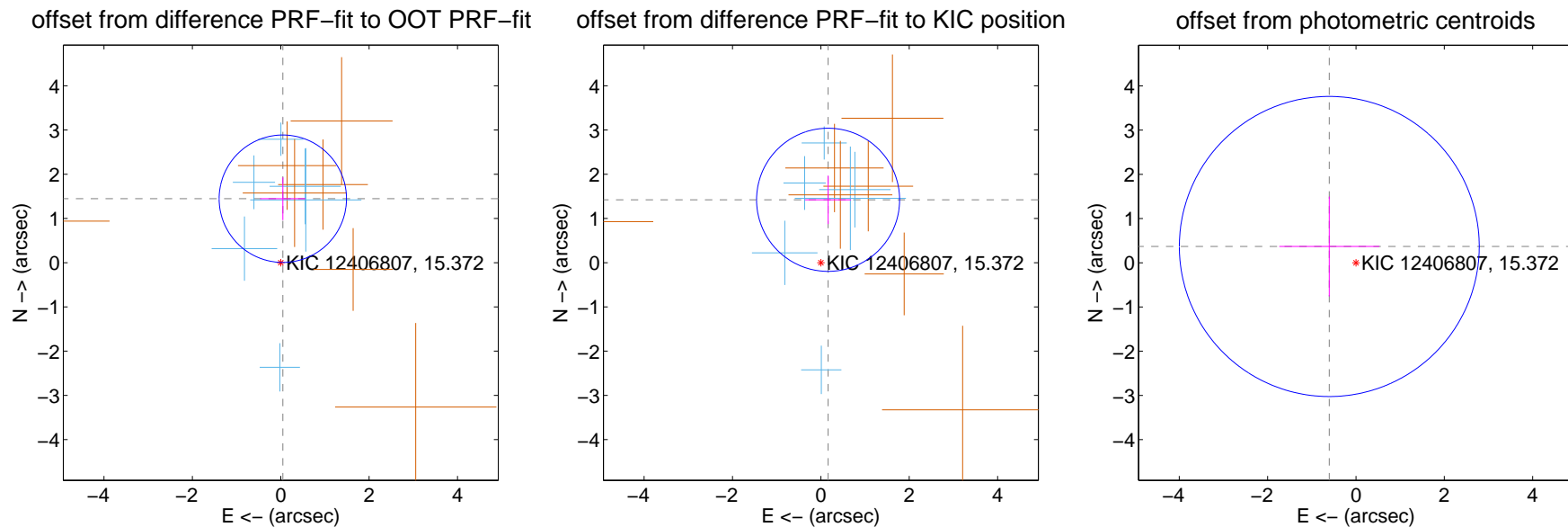
## DV Centroid Data

Supplemental centroid analysis for 012406807-01. Kepler magnitude: 15.37. Transit SNR 12.37

There are 6 quarters with good PRF difference image offsets

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

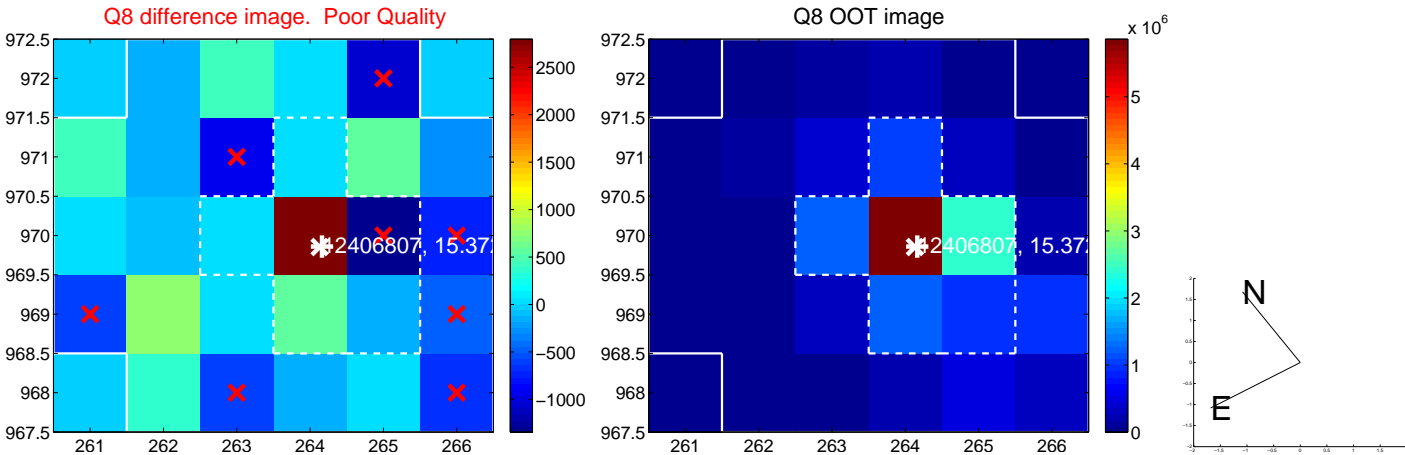
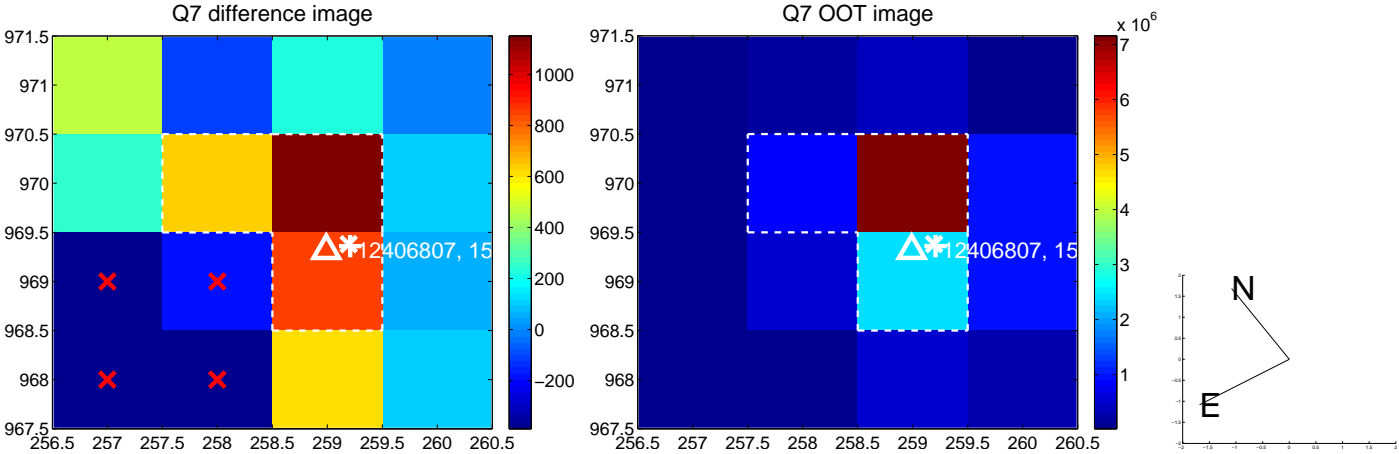
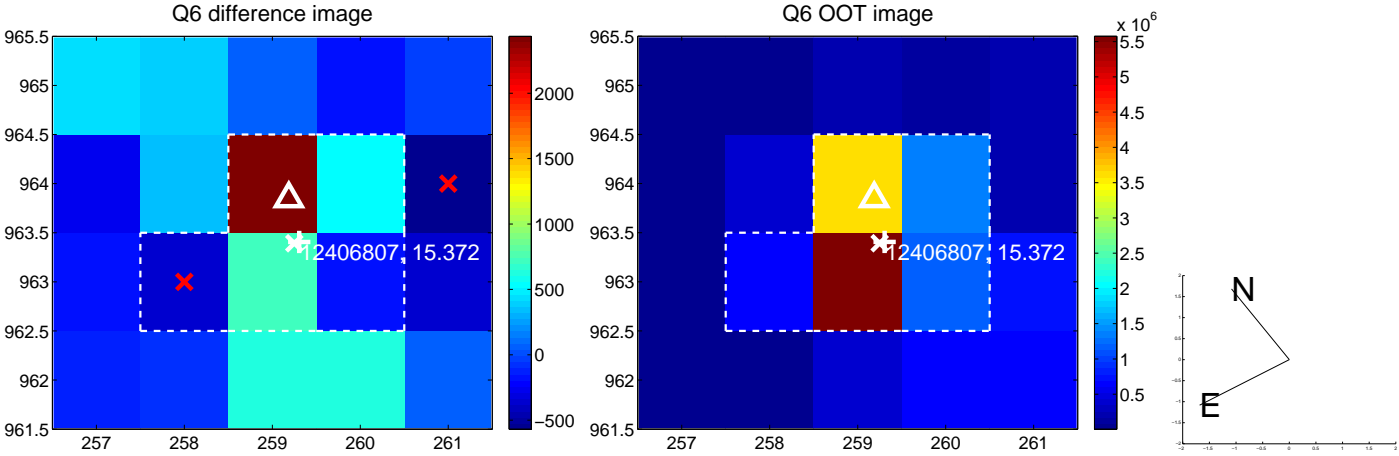
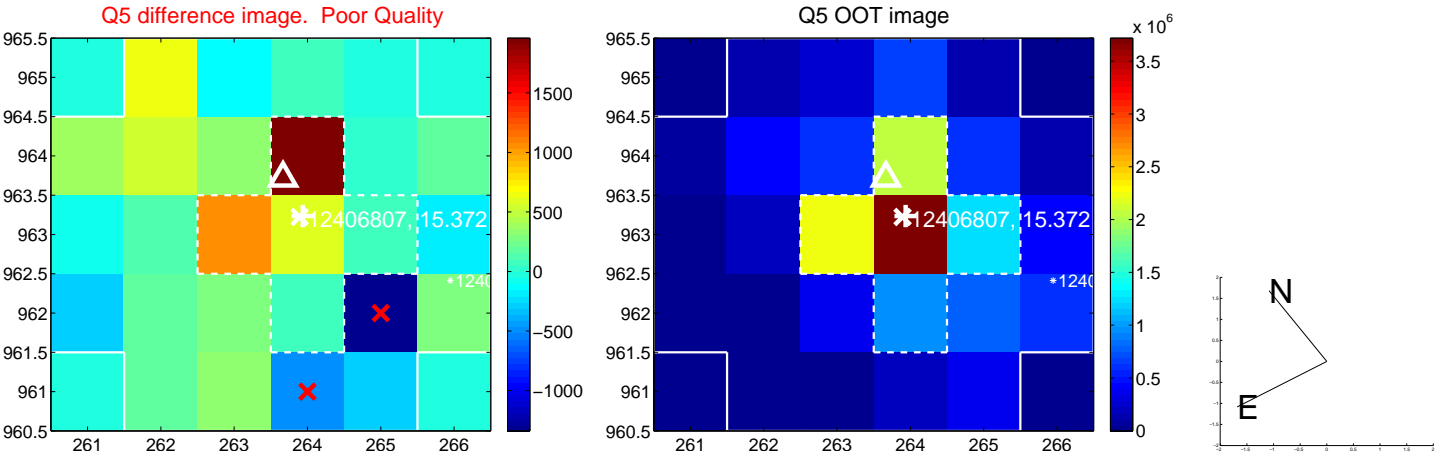
|   | Distance in arcsec | Distance / $\sigma$ | $\Delta$ RA        | $\Delta$ Dec      |
|---|--------------------|---------------------|--------------------|-------------------|
| PRF-fit source offset from OOT          | $1.447 \pm 0.480$  | <b>3.01</b>         | $-0.047 \pm 0.512$ | $1.446 \pm 0.483$ |
| PRF-fit source offset from KIC position | $1.431 \pm 0.539$  | 2.65                | $-0.163 \pm 0.520$ | $1.422 \pm 0.547$ |
| photometric centroid source offset      | $0.71 \pm 1.13$    | 0.62                | $0.60 \pm 1.13$    | $0.37 \pm 1.13$   |



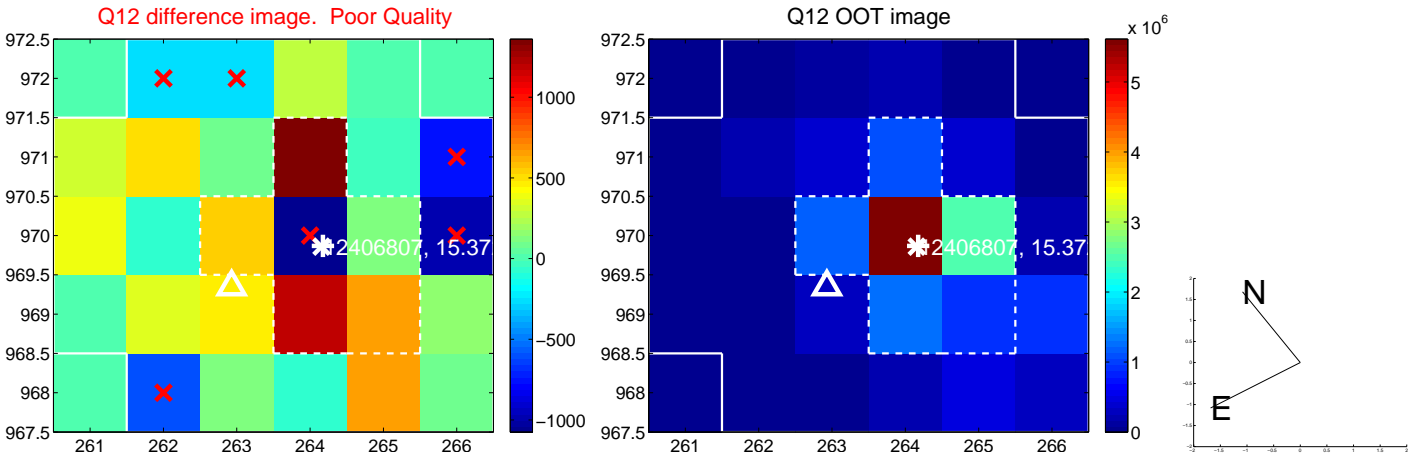
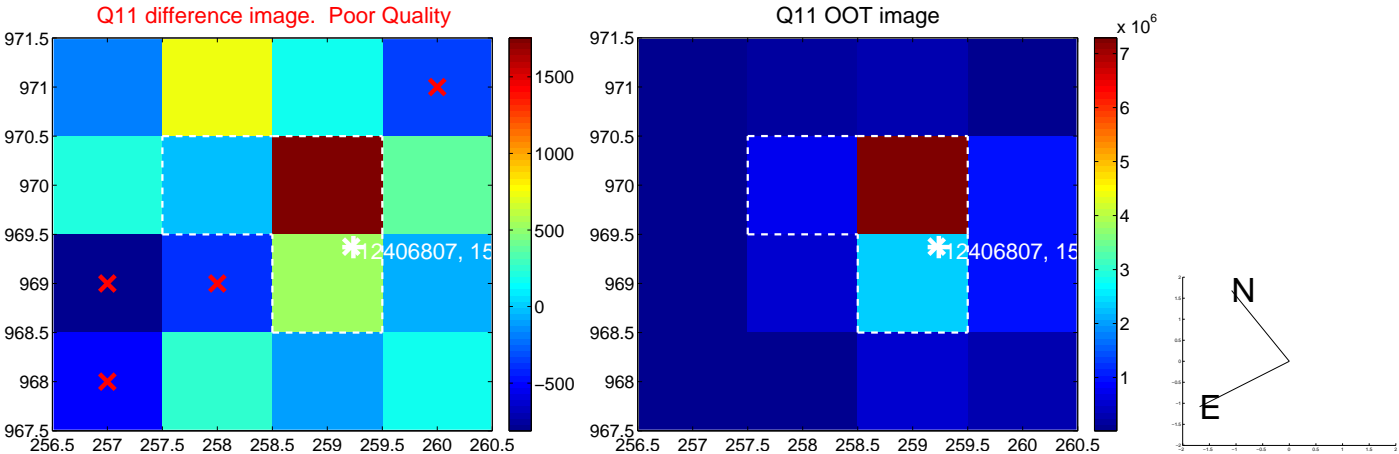
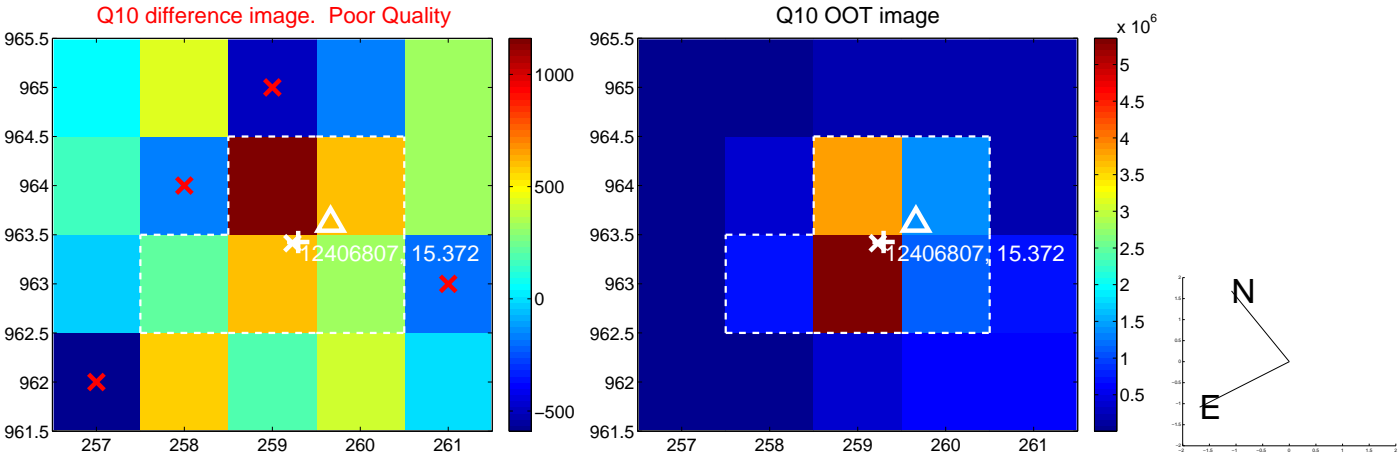
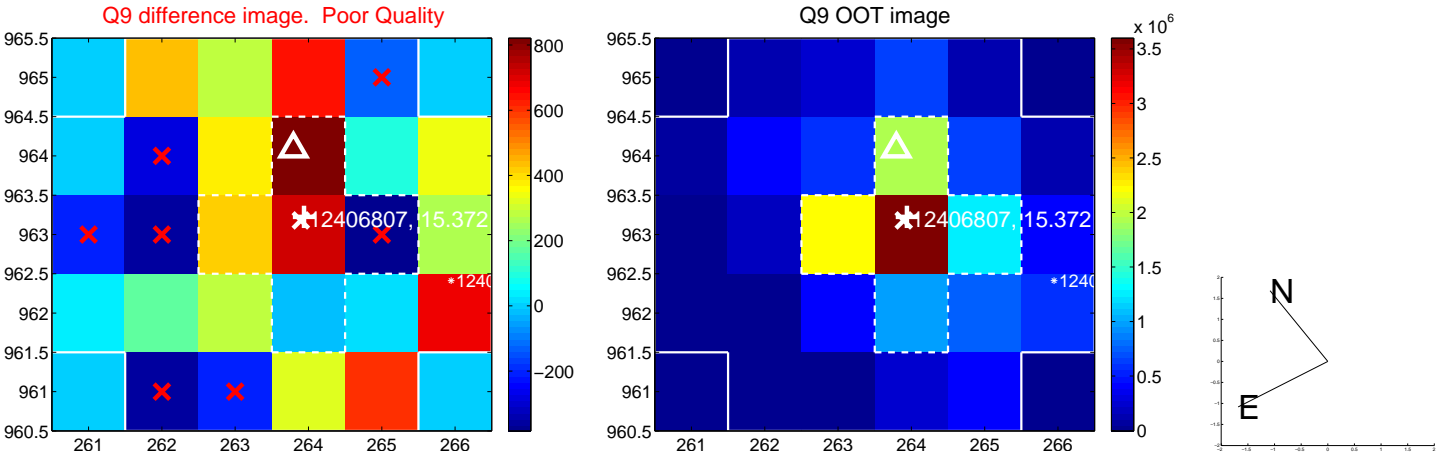
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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



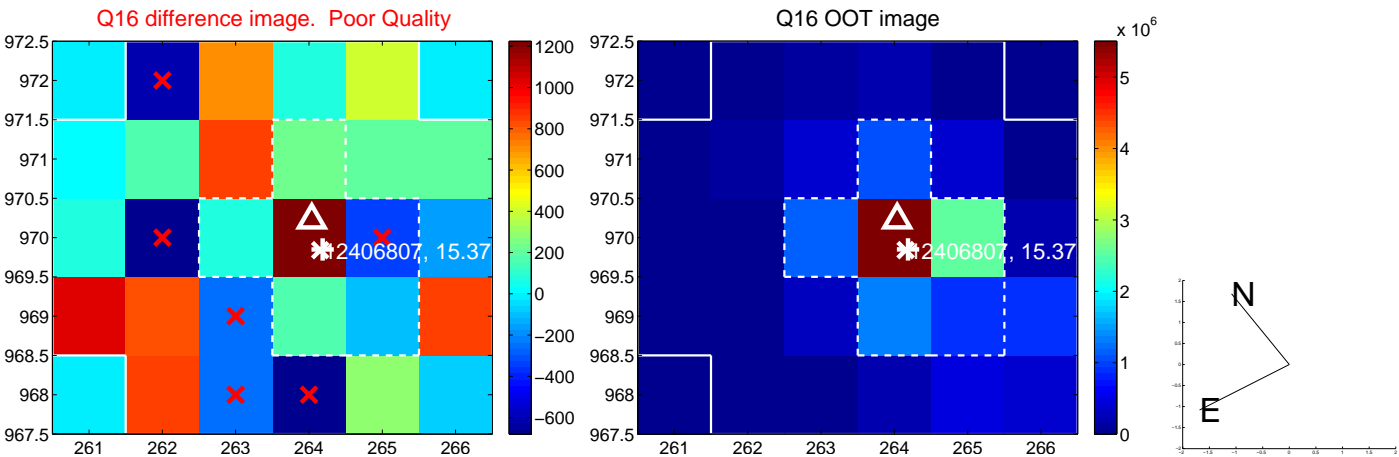
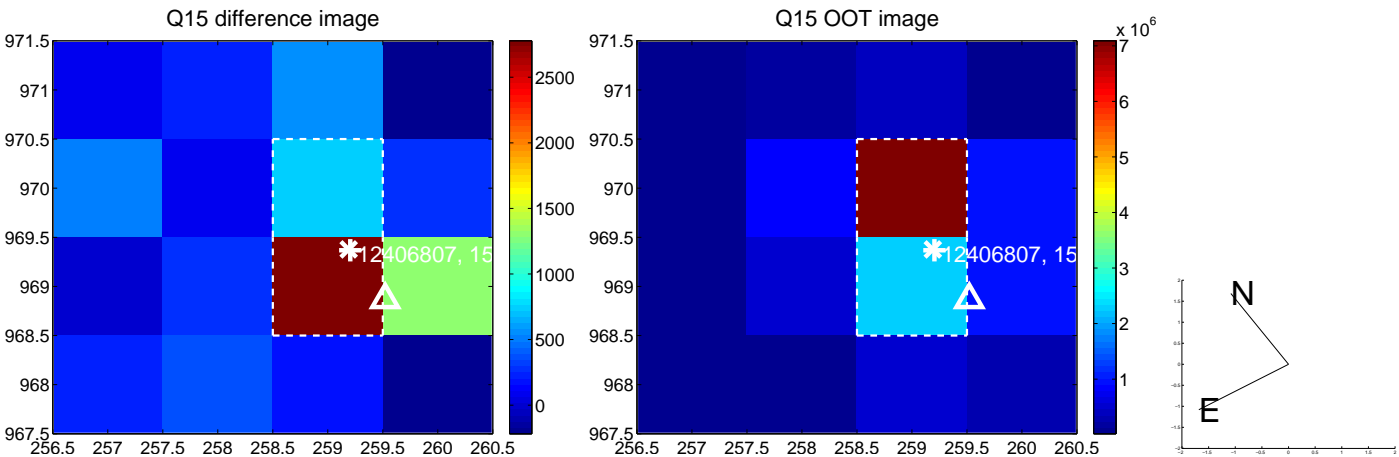
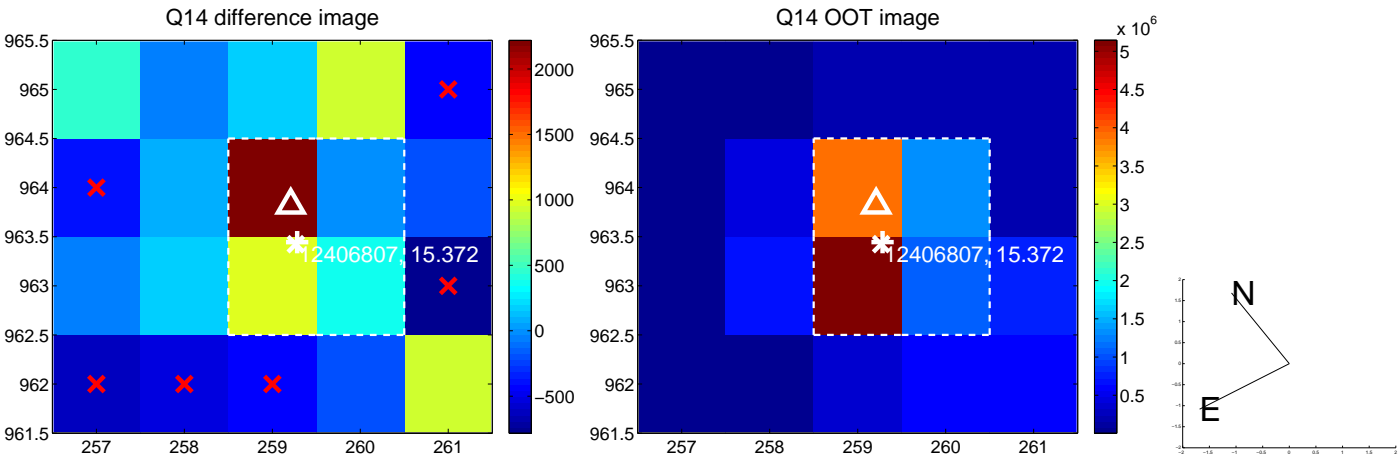
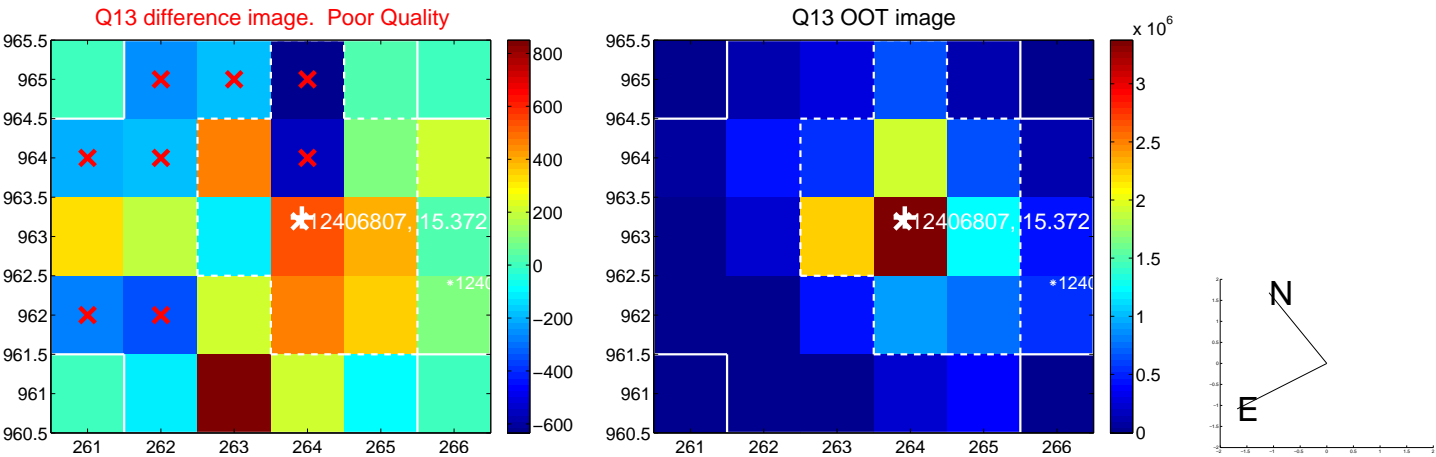
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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.

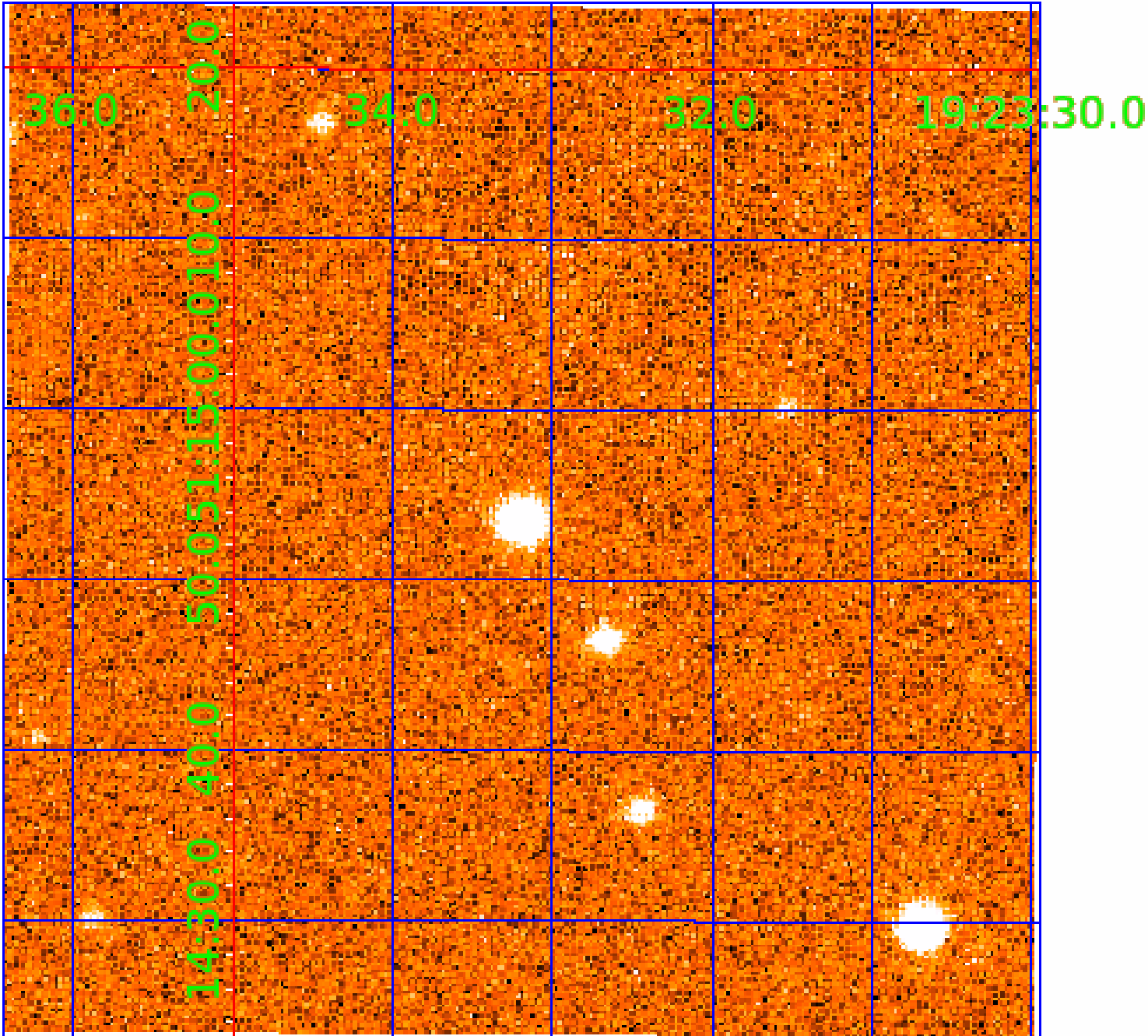






UKIRT Image

Declination



# KIC 012406807

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 012406807-01 | OBS      | 3091.01 | 17.067892     | 145.561749   | 261.6       | 5.941            | 11.7 | 12.4 | 1.00                        | 6347            | 1.83                   | 82.75                  |
| 012406807-02 | OBS      | 3091.02 | 7.906947      | 138.427717   | 119.2       | 4.949            | 7.5  | 7.5  | 1.00                        | 6347            | 1.25                   | 230.85                 |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments   |
|--------------|----------|------|-------|---|---|---|---|------------|
| 012406807-01 | OBS      | PC   | 0.93  | 0 | 0 | 0 | 0 | NO_COMMENT |
| 012406807-02 | OBS      | PC   | 0.88  | 0 | 0 | 0 | 0 | NO_COMMENT |

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

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

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

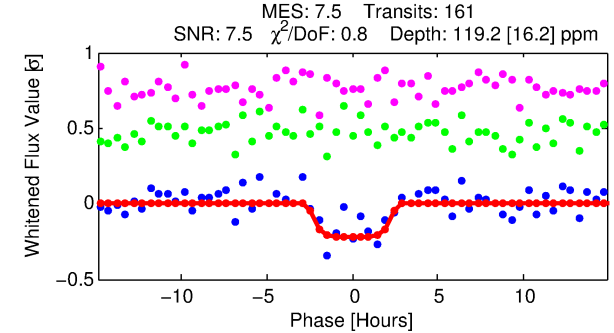
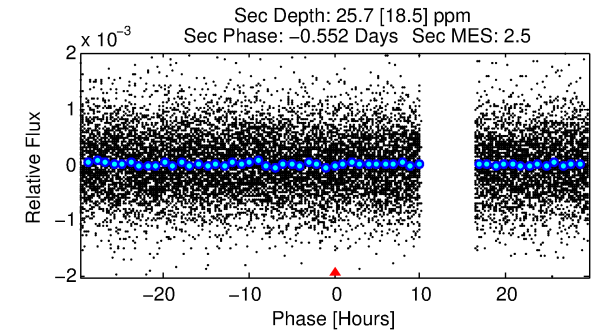
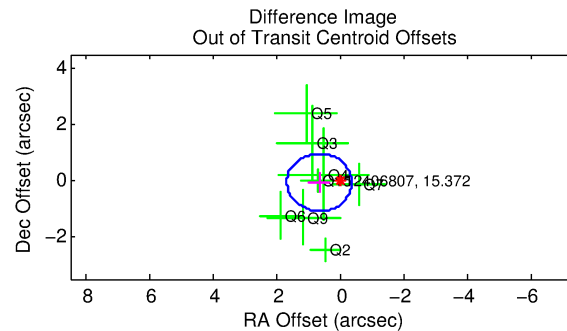
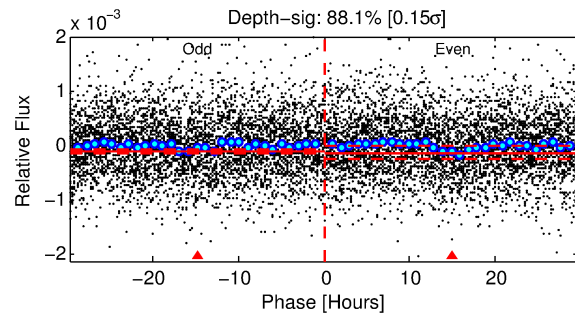
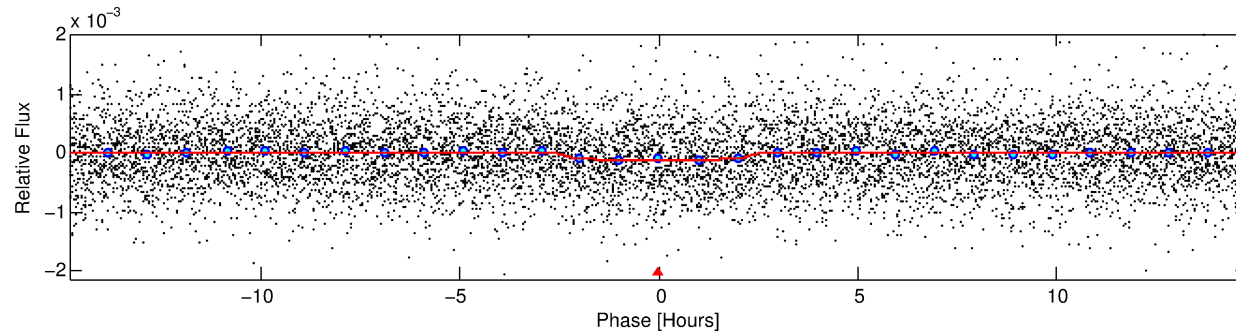
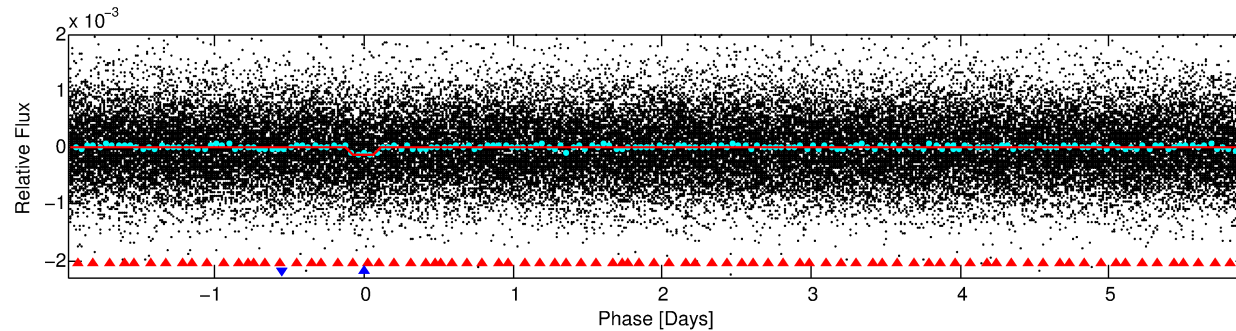
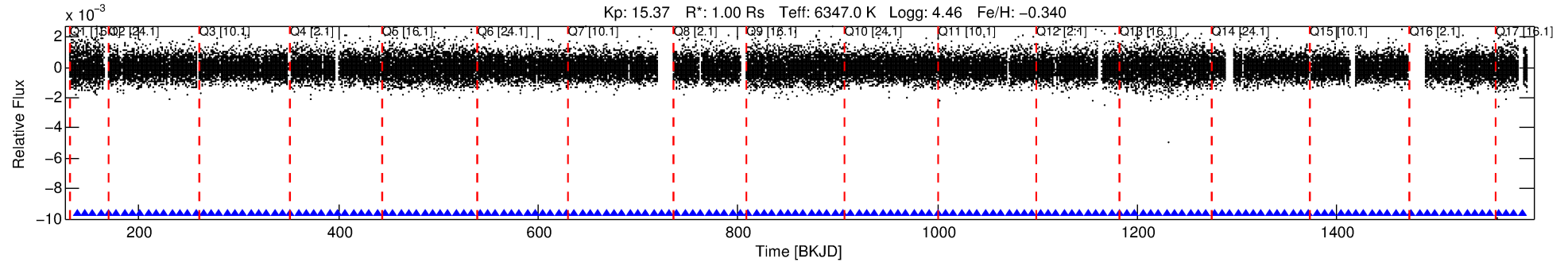
## Ephemeris Match Information For 012406807-02

No Significant Match Found

# DV One-Page Summary

KIC: 12406807 Candidate: 2 of 2 Period: 7.907 d

KOI: K03091 Corr: No Ephemeris Match



## DV Fit Results:

Period = 7.90695 [0.00012] d  
Epoch = 138.4277 [0.0117] BKJD  
Rp/R\* = 0.0115 [0.0071]  
a/R\* = 6.18 [20.81]  
b = 0.88 [0.91]  
Seff = 230.85 [95.89]  
Teq = 994 [103] K  
Rp = 1.25 [0.87] Re  
a = 0.0790 [0.0214] AU  
Ag = 56.30 [83.31] [0.66 $\sigma$ ]  
Teffp = 4209 [1507] K [2.13 $\sigma$ ]

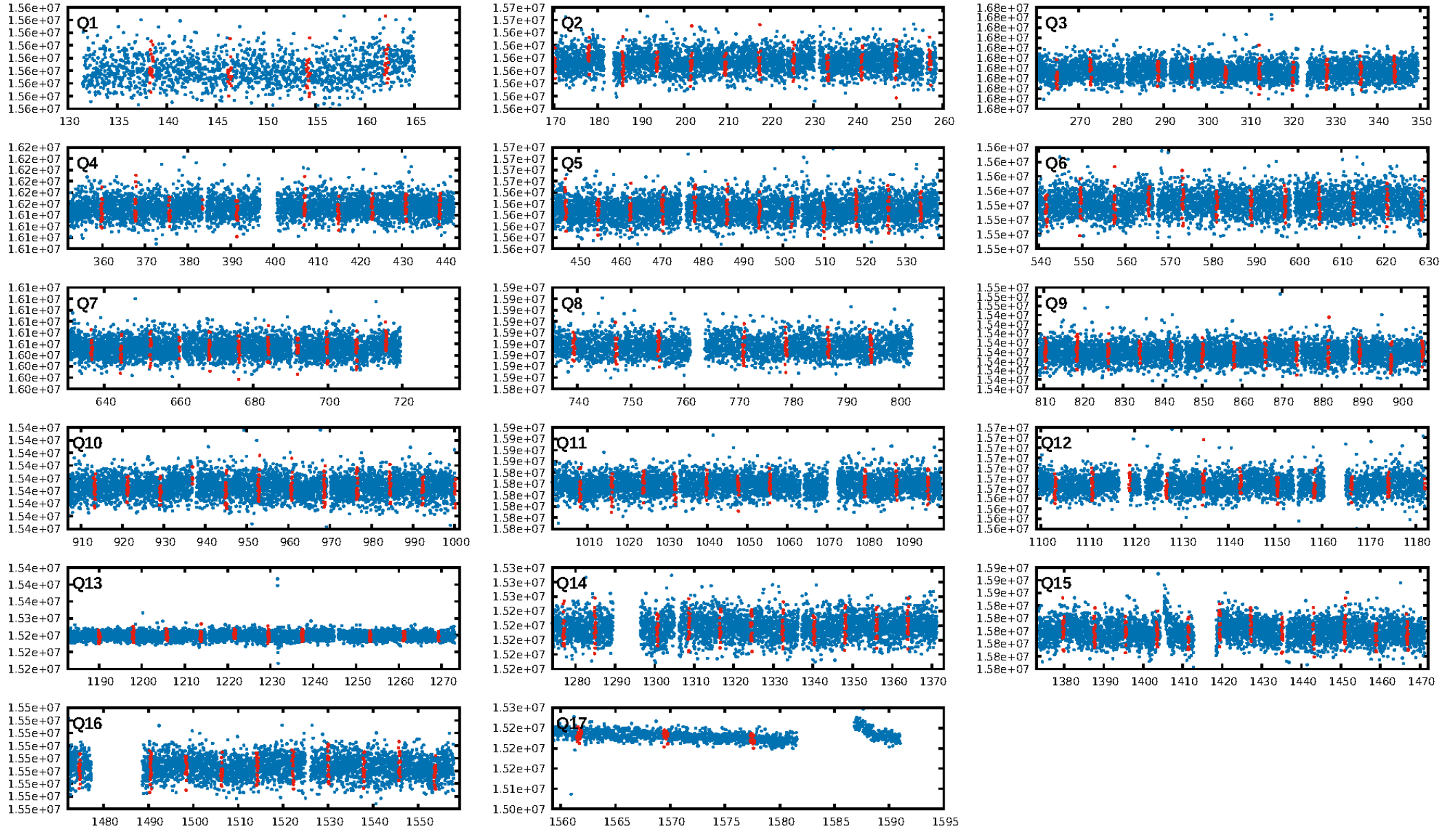
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [28.44 $\sigma$ ]  
ModelChiSquare2-sig: 100.0%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 7.48e-14  
RollingBand-fgt: 1.00 [154/154]  
GhostDiagnostic-chr: 56.1  
Centroid-sig: 89.1%  
Centroid-so: 0.491 arcsec [0.27 $\sigma$ ]  
OotOffset-rm: 0.672 arcsec [1.98 $\sigma$ ]  
KicOffset-rm: 0.534 arcsec [1.57 $\sigma$ ]  
OotOffset-st: 2/3/1/2 [8]  
KicOffset-st: 2/3/1/2 [8]  
DiffImageQuality-fgm: 0.62 [5/8]  
DiffImageOverlap-fno: 1.00 [17/17]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 29-Jan-2016 01:44:45 Z

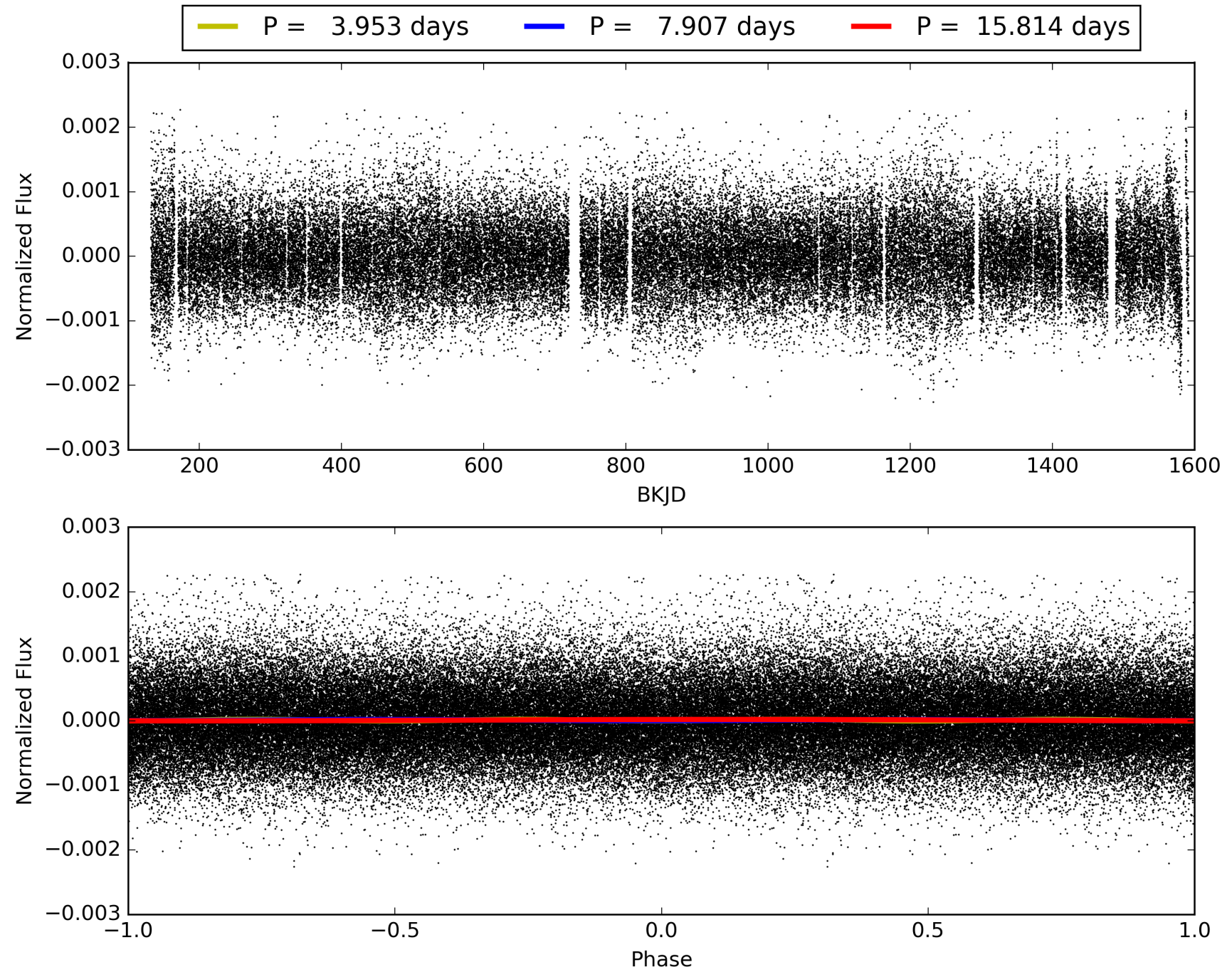
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center

# TCE 012406807-02, PDC Light Curves



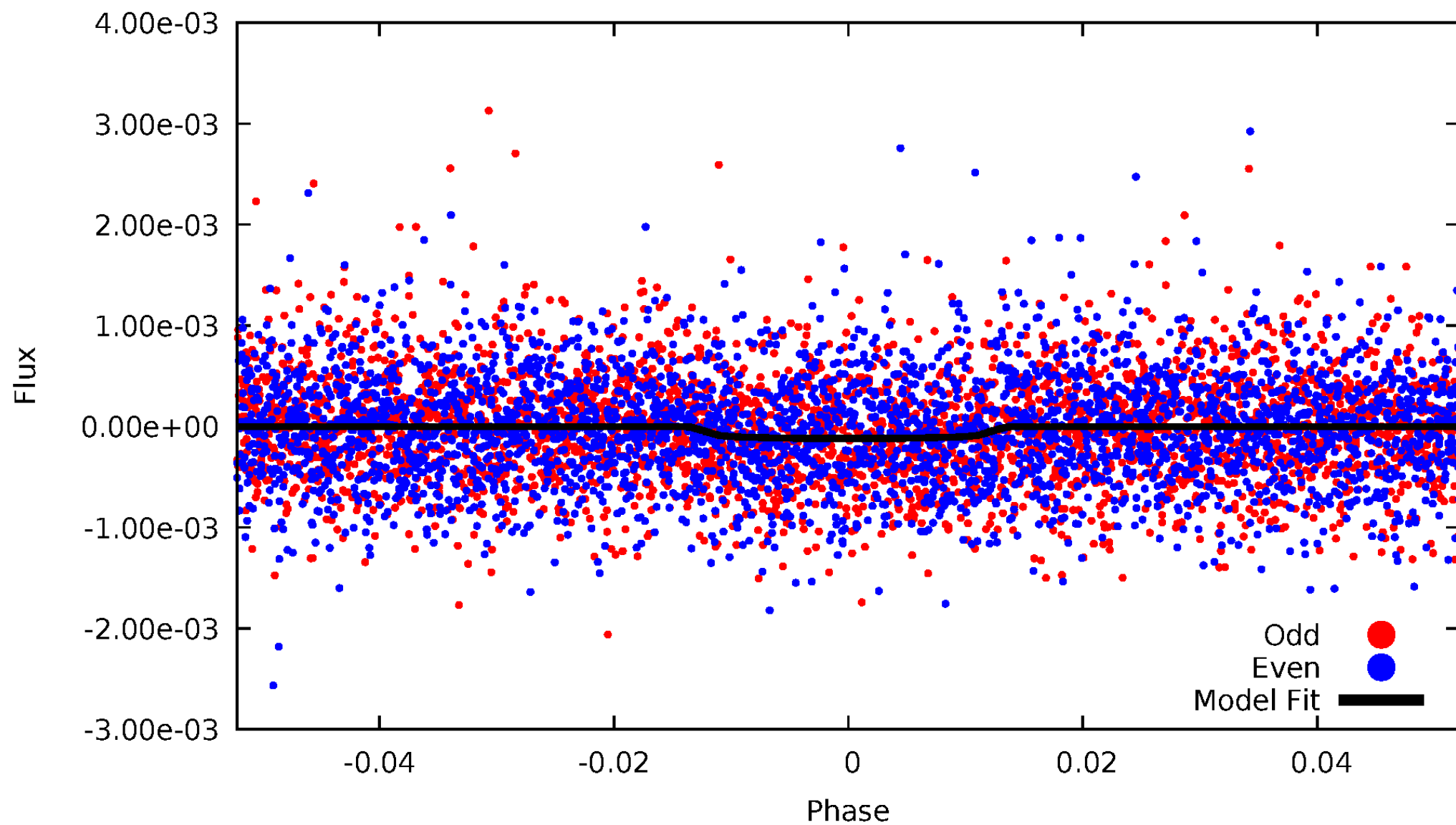


# TCE 012406807-02



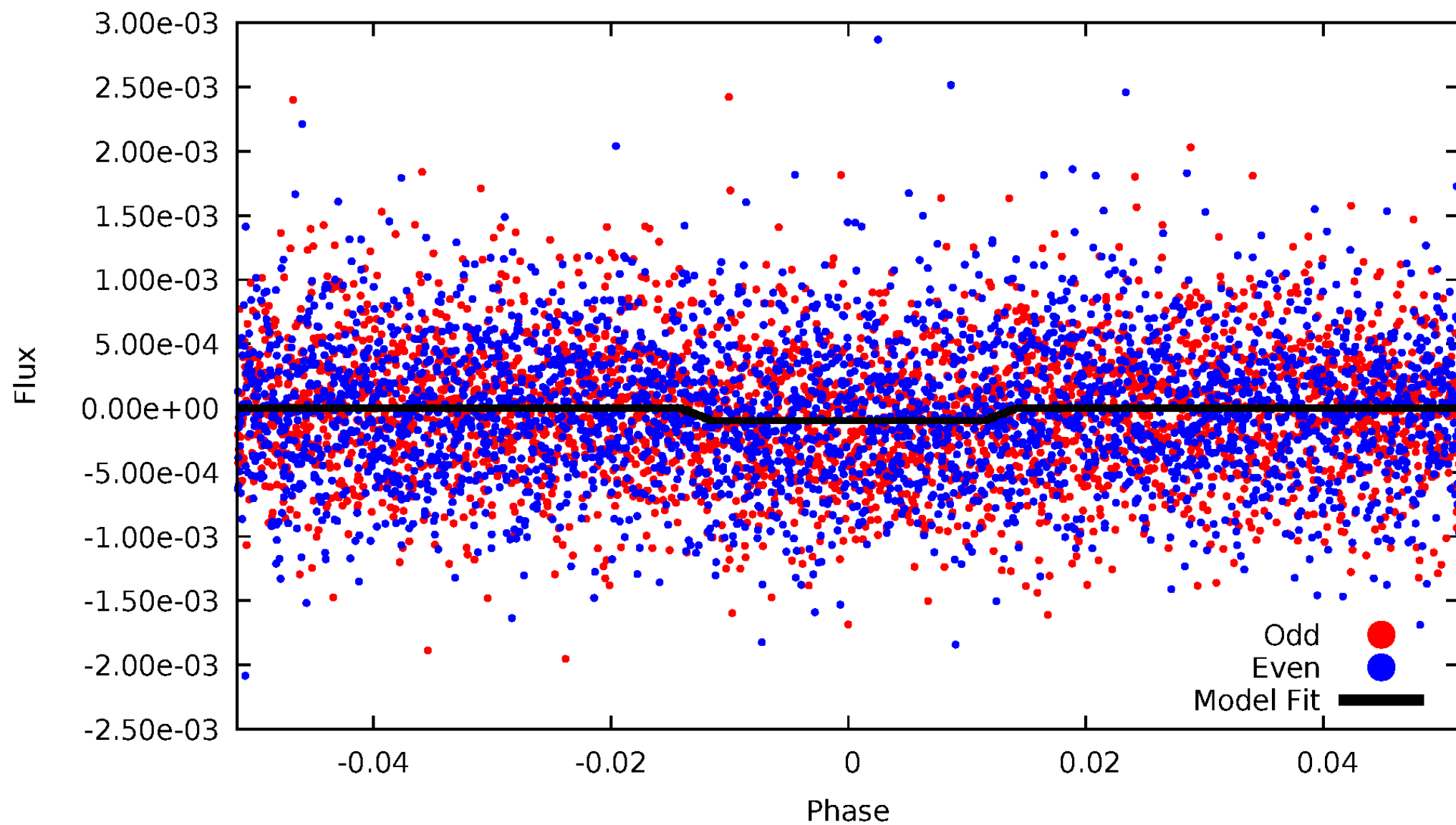
# DV Odd/Even

TCE 012406807-02



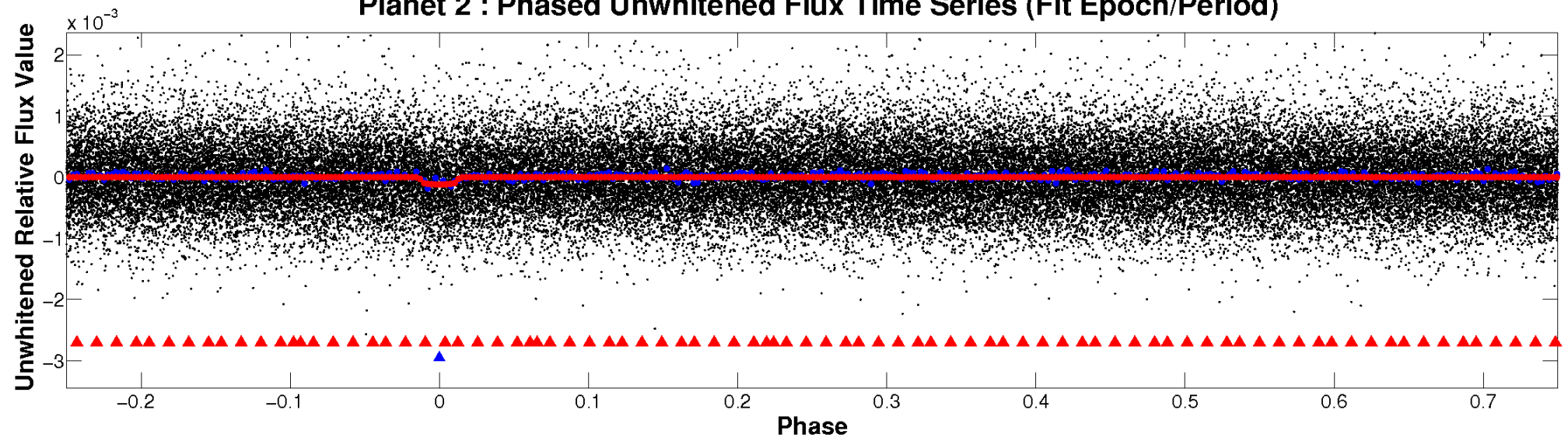
# ALT Odd/Even

TCE 012406807-02

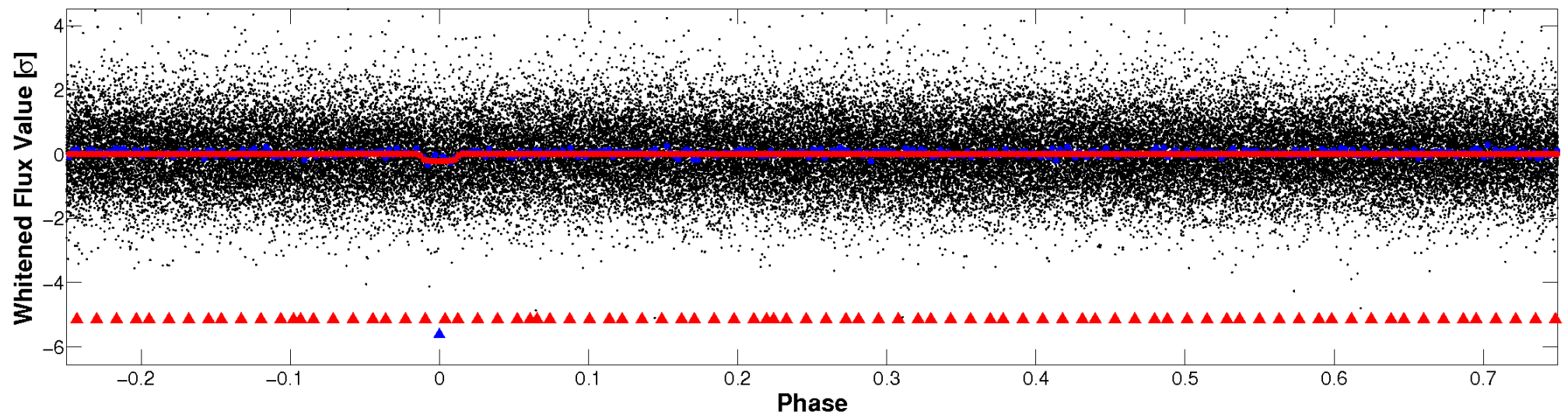


# Non-Whitened Vs. Whitened Light Curve

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



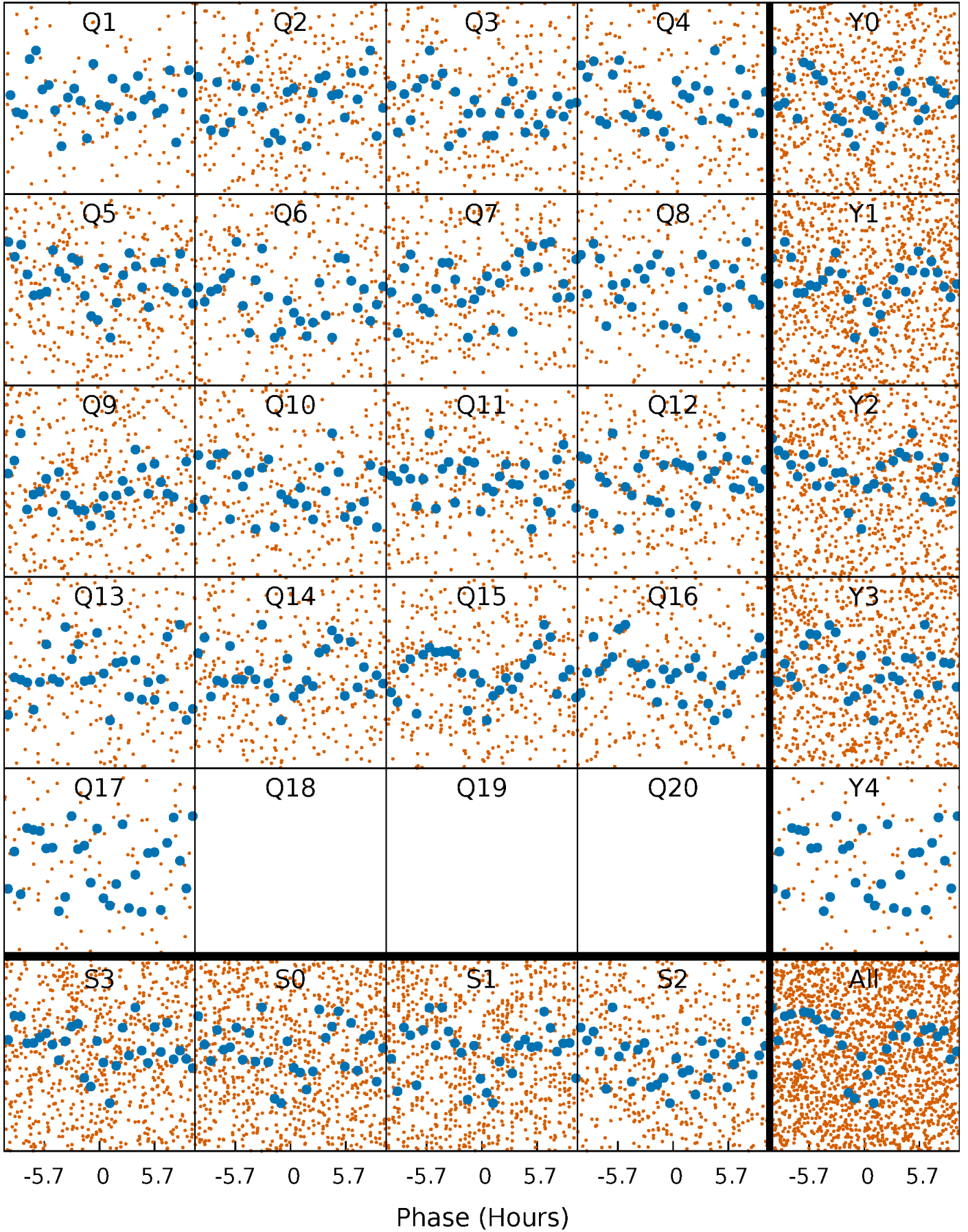
## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)





# PDC Quarter-Phased Transit Curves

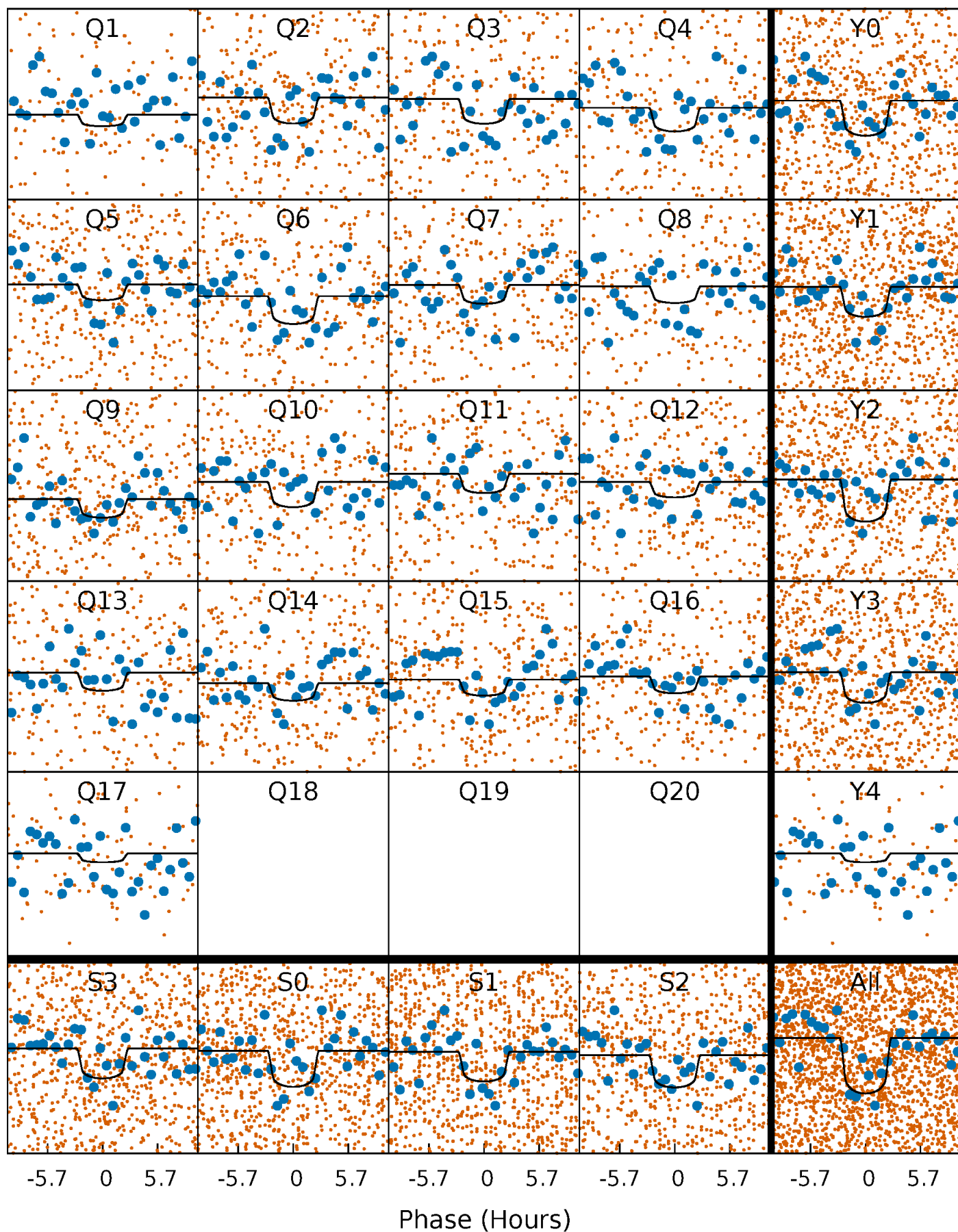
TCE 012406807-02    P= 7.906947 Days     $T_0=138.427717$  (BKJD)





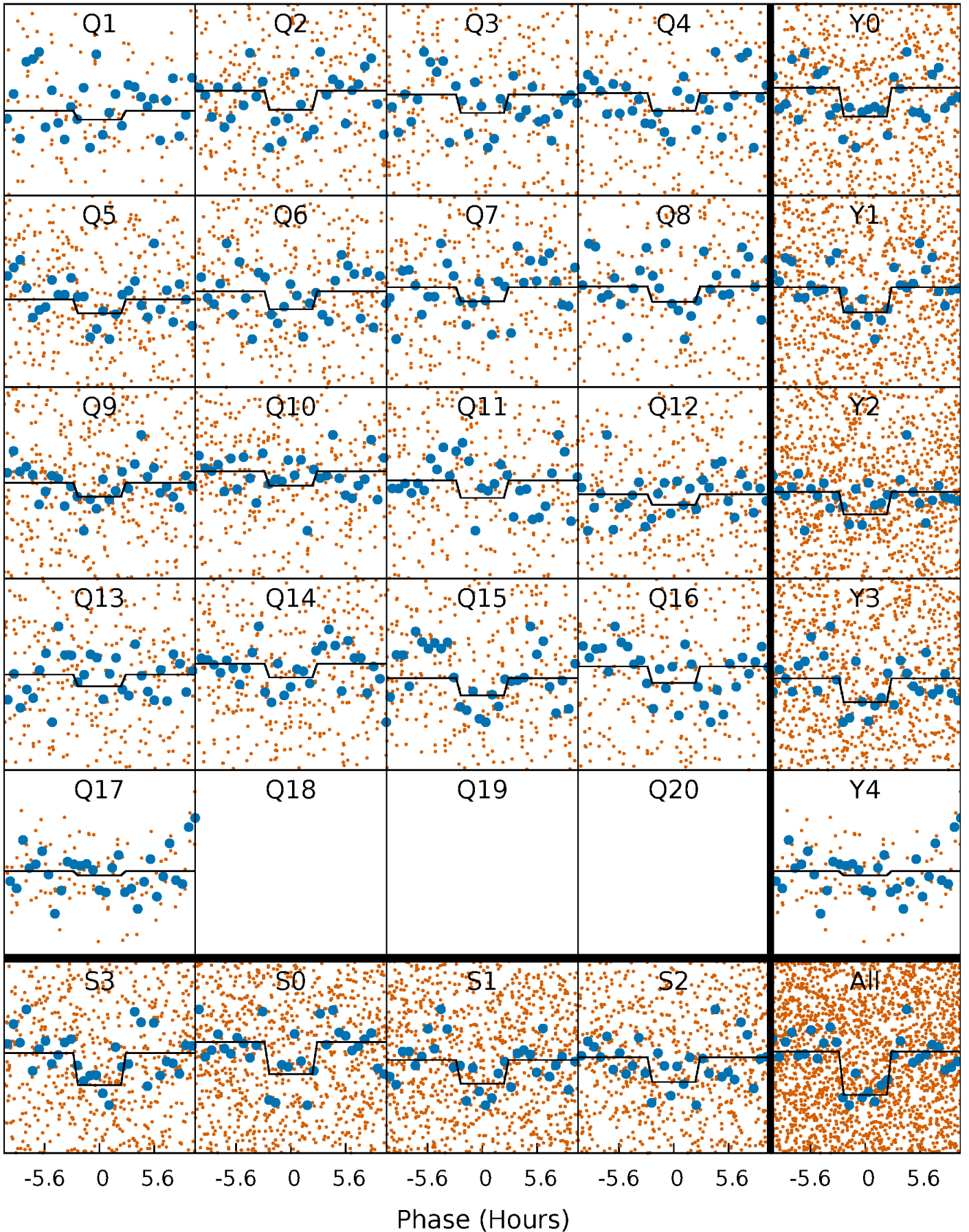
# DV Quarter-Phased Transit Curves

TCE 012406807-02   P= 7.906947 Days    $T_0=138.427717$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

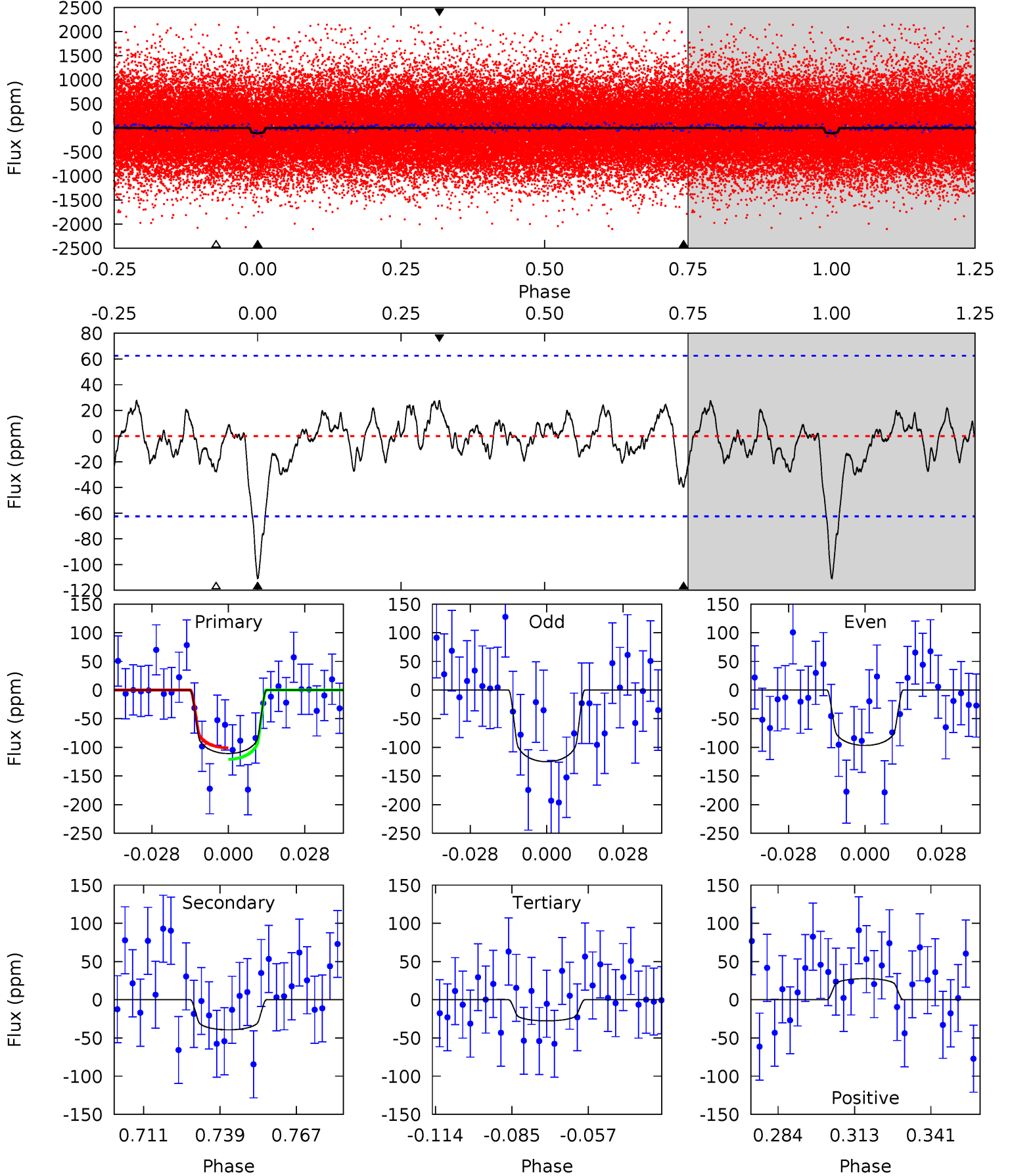
TCE 012406807-02 P= 7.907138 Days  $T_0=138.419218$  (BKJD)



# DV Model-Shift Uniqueness Test

012406807-02, P = 7.906947 Days, E = 130.520770 Days

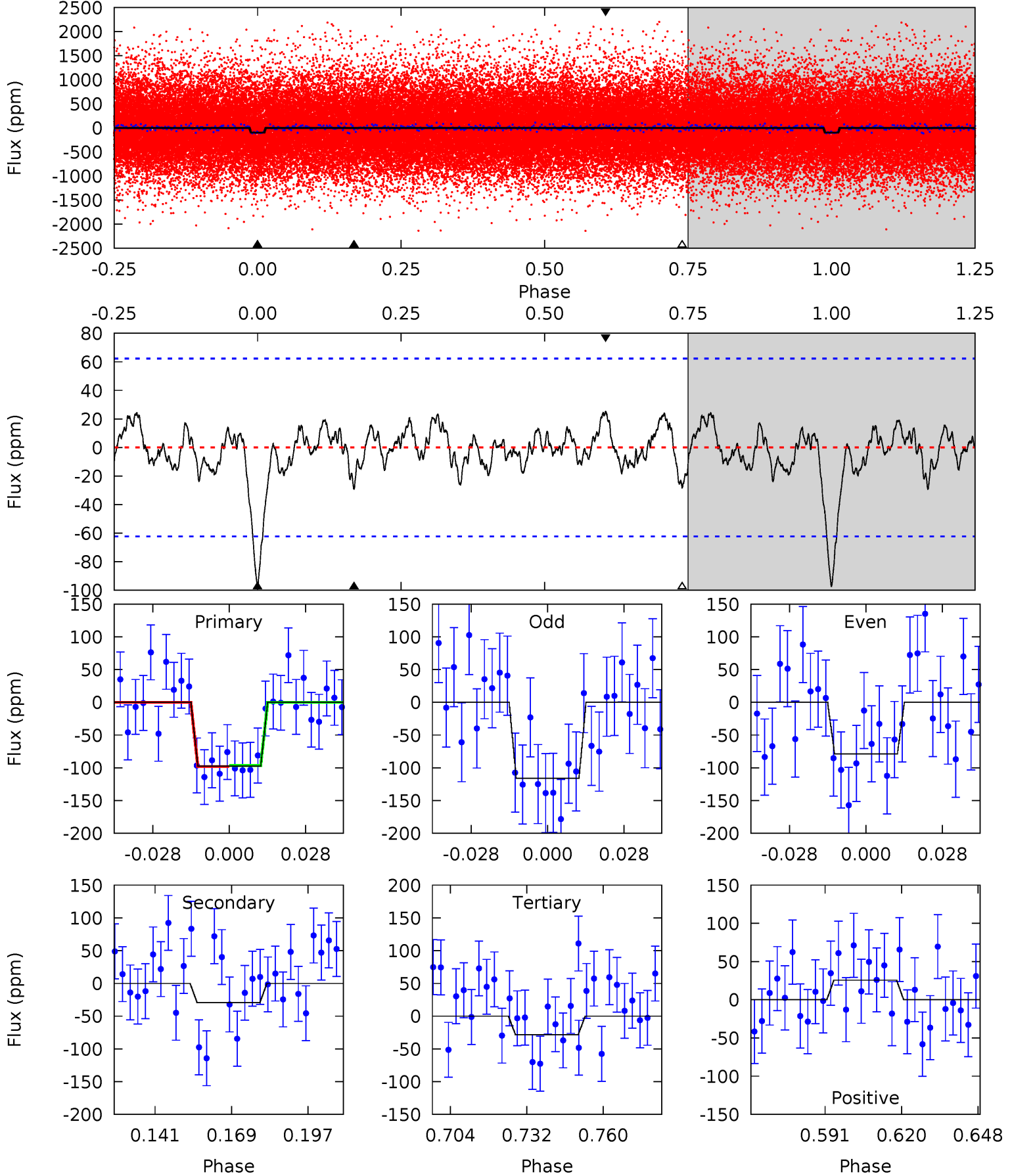
| Pri  | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 8.55 | 3.03 | 2.13 | 2.13 | 4.82            | 2.19            | 0.96             | 6.42    | 6.41    | 0.91    | 0.90    | 1.10    | 1.03 | 0.20  | 0.77 |



# Alt Model-Shift Uniqueness Test

012406807-02, P = 7.907138 Days, E = 130.512080 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  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 7.54 | 2.27 | 2.18 | 1.98 | 4.82            | 2.19            | 0.87             | 5.36    | 5.56    | 0.09    | 0.29    | 1.44    | 0.93 | 0.21  | 0.07 |



### Stellar Parameters For KIC 012406807

|        | $T_{\text{eff}} (K)$ | $\log(g)$                 | $[\text{Fe}/\text{H}]$     | $R (R_{\odot})$           | $M (M_{\odot})$           | $p_{\star} (\text{g}\cdot\text{cm}^{-3})$ |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $6347^{+170}_{-207}$ | $4.464^{+0.054}_{-0.216}$ | $-0.340^{+0.250}_{-0.300}$ | $0.996^{+0.319}_{-0.106}$ | $1.053^{+0.146}_{-0.146}$ | $1.501^{+0.412}_{-0.768}$                 |
|        | +3%/-3%              | +1%/-5%                   | +74%/-88%                  | +32%/-11%                 | +14%/-14%                 | +27%/-51%                                 |
| 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 012406807-02 / KOI 3091.02

| Detrend | Depth (ppm)  | $R_p (R_{\oplus})$     | $T_{\text{max}} (K)$ | $T_{\text{obs}} (K)$  | $A_{\text{obs}}$  |
|---------|--------------|------------------------|----------------------|-----------------------|-------------------|
| DV      | $-39 \pm 13$ | $1.37^{+0.82}_{-0.77}$ | $1422^{+108}_{-75}$  | $4753^{+2135}_{-839}$ | $73^{+288}_{-49}$ |
| Alt.    | $-29 \pm 13$ | $1.24^{+0.82}_{-0.71}$ | $1419^{+106}_{-73}$  | $4559^{+2375}_{-876}$ | $60^{+317}_{-42}$ |

$T_{\text{max}}$  = 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

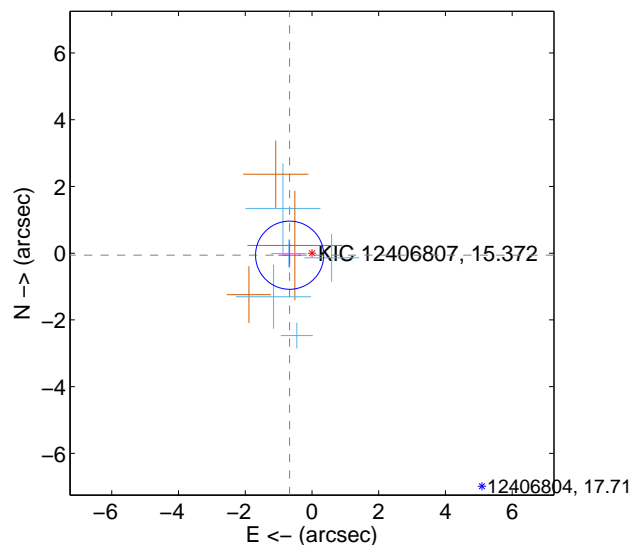
Supplemental centroid analysis for 012406807-02. Kepler magnitude: 15.37. Transit SNR 7.49

There are 5 quarters with good PRF difference image offsets

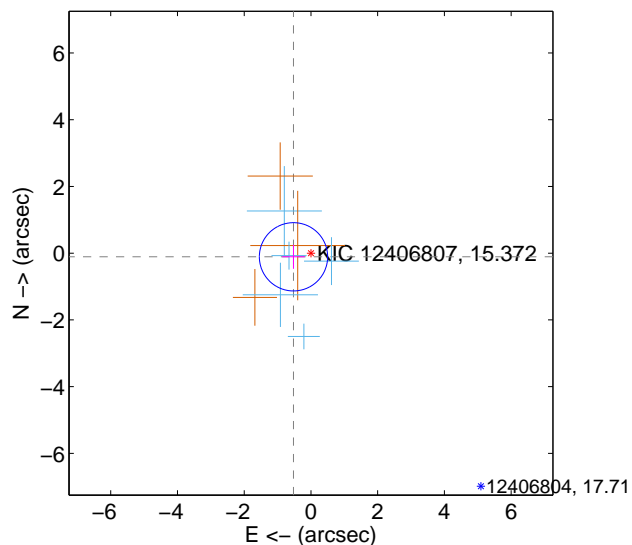
The direct PRF centroid is offset from the target star catalog position by about 0.07 arcsec

|   | Distance in arcsec | Distance / $\sigma$ | $\Delta$ RA       | $\Delta$ Dec       |
|---|--------------------|---------------------|-------------------|--------------------|
| PRF-fit source offset from OOT          | $0.672 \pm 0.340$  | 1.98                | $0.669 \pm 0.340$ | $-0.061 \pm 0.360$ |
| PRF-fit source offset from KIC position | $0.534 \pm 0.341$  | 1.57                | $0.523 \pm 0.340$ | $-0.109 \pm 0.360$ |
| photometric centroid source offset      | $0.49 \pm 1.85$    | 0.27                | $0.15 \pm 1.87$   | $-0.47 \pm 1.85$   |

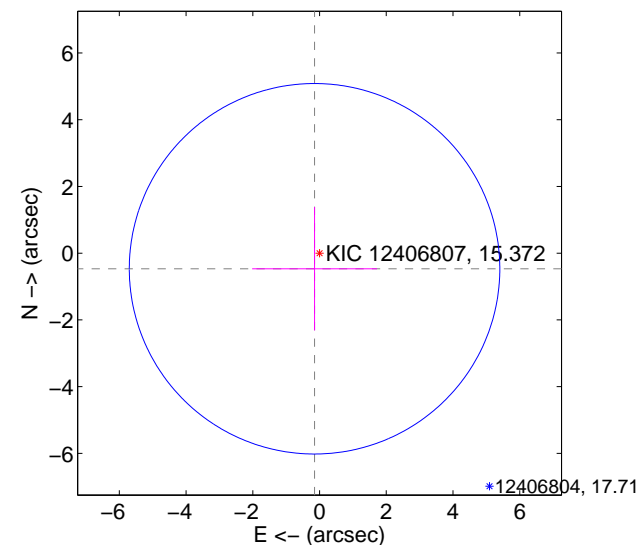
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position



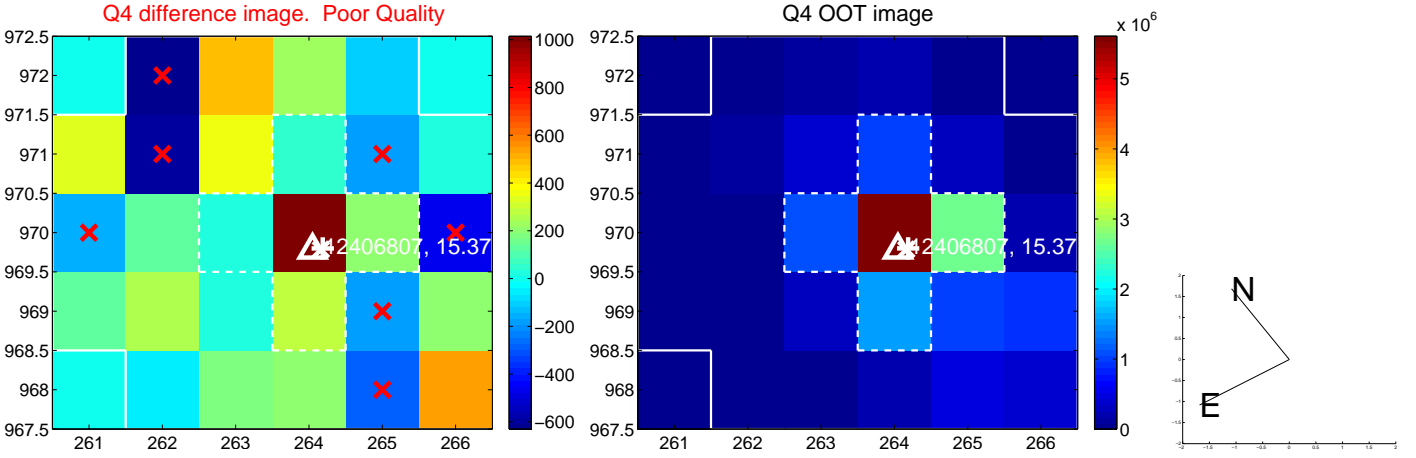
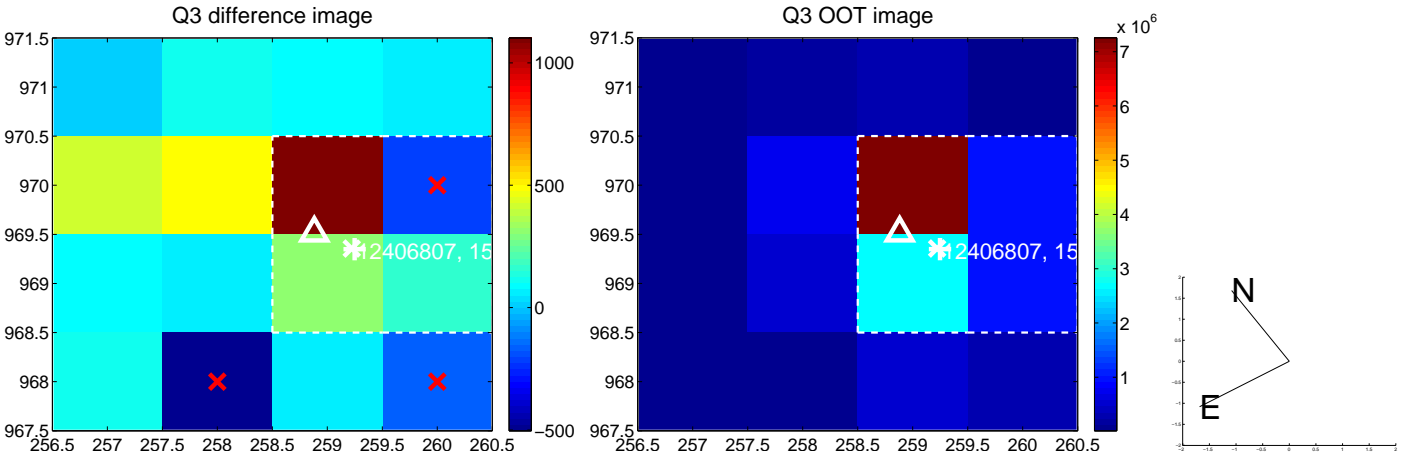
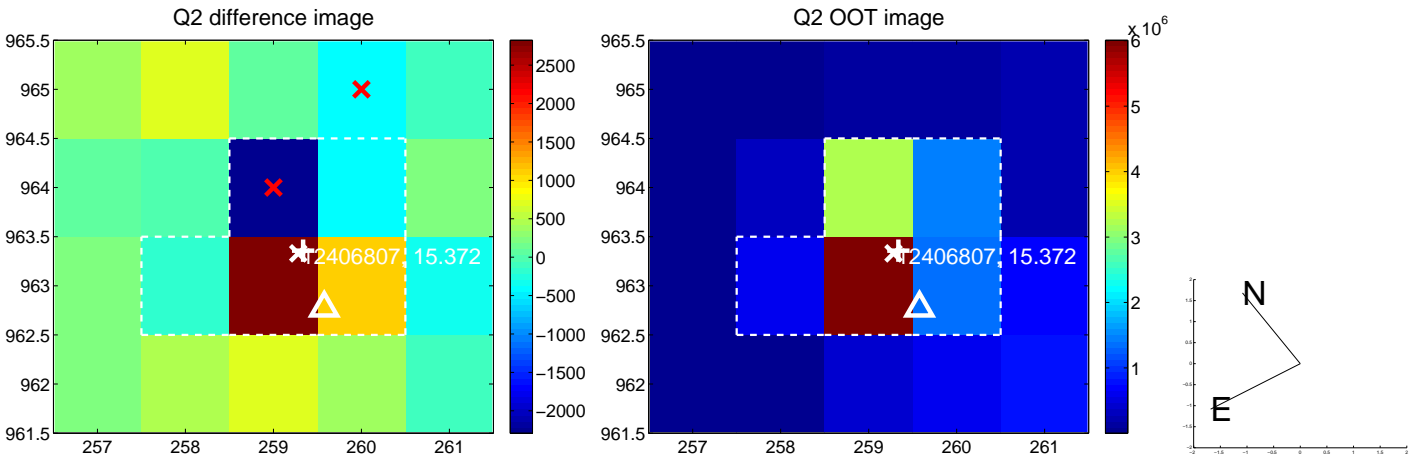
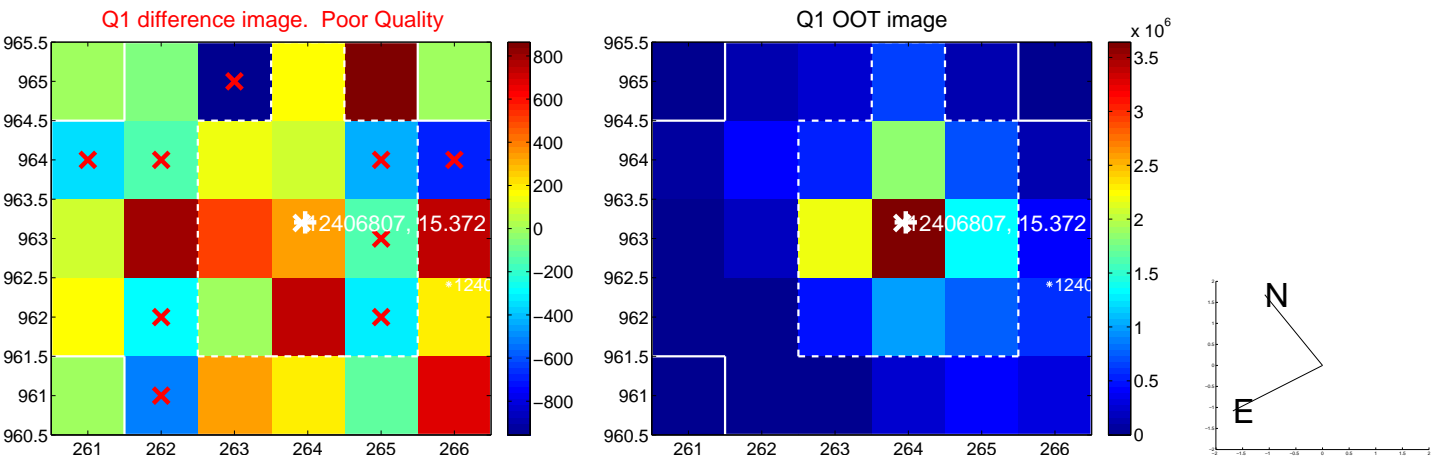
offset from photometric centroids



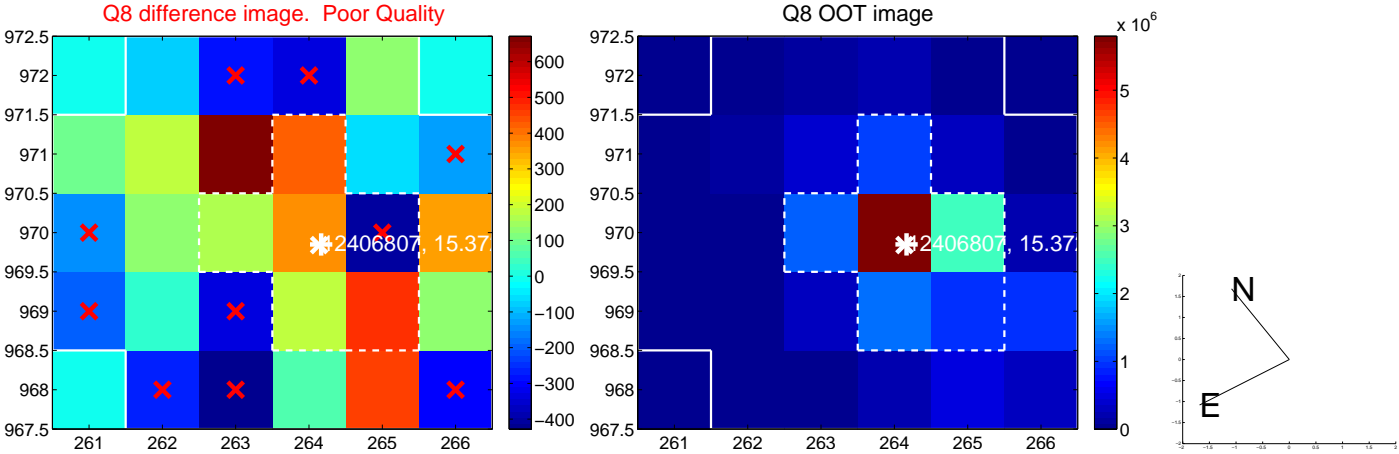
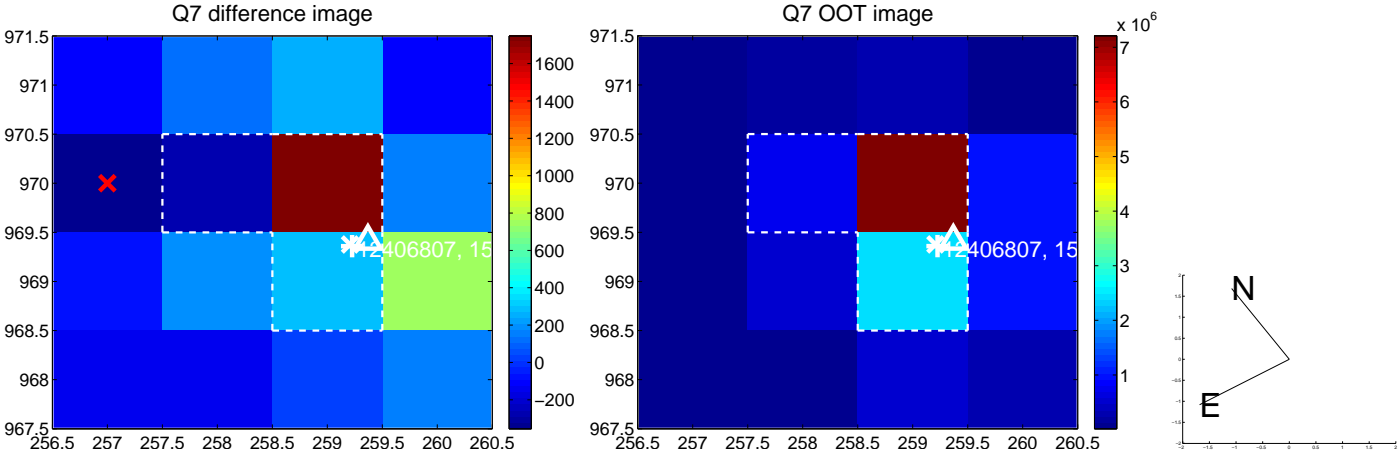
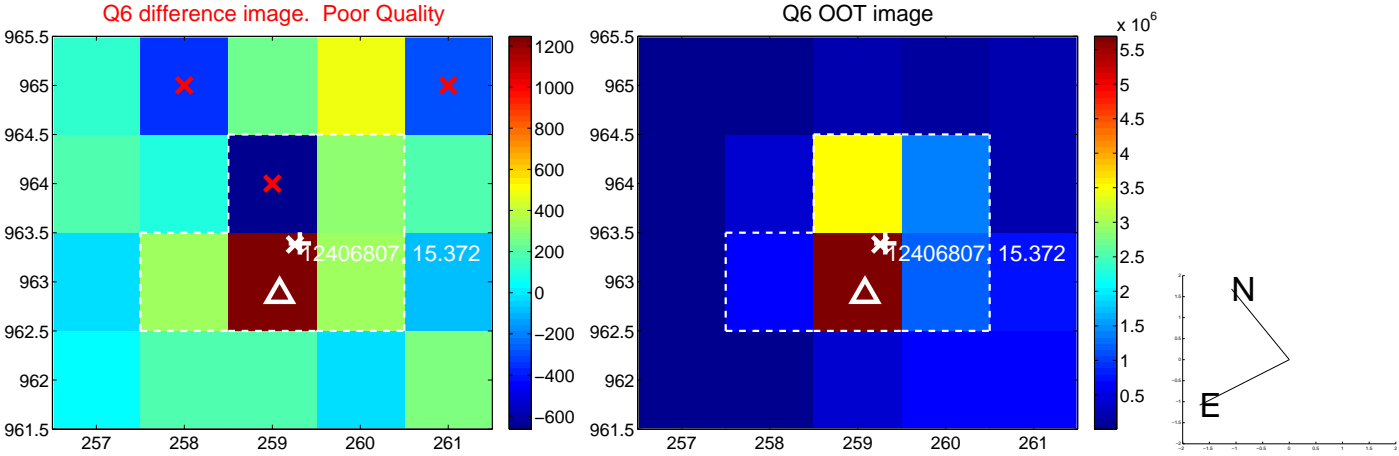
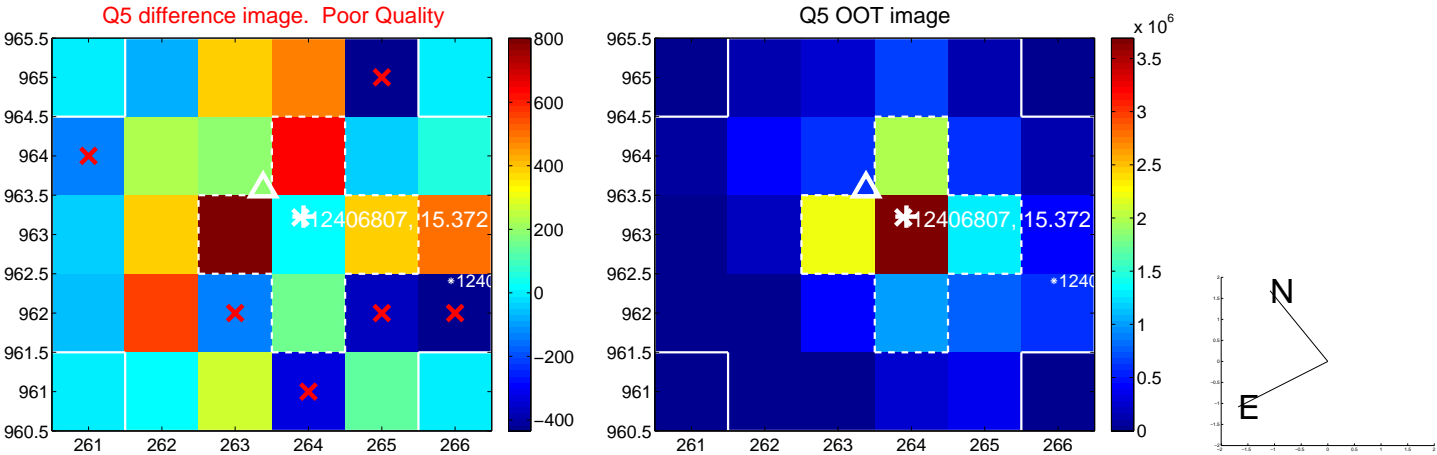
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets**; **Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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



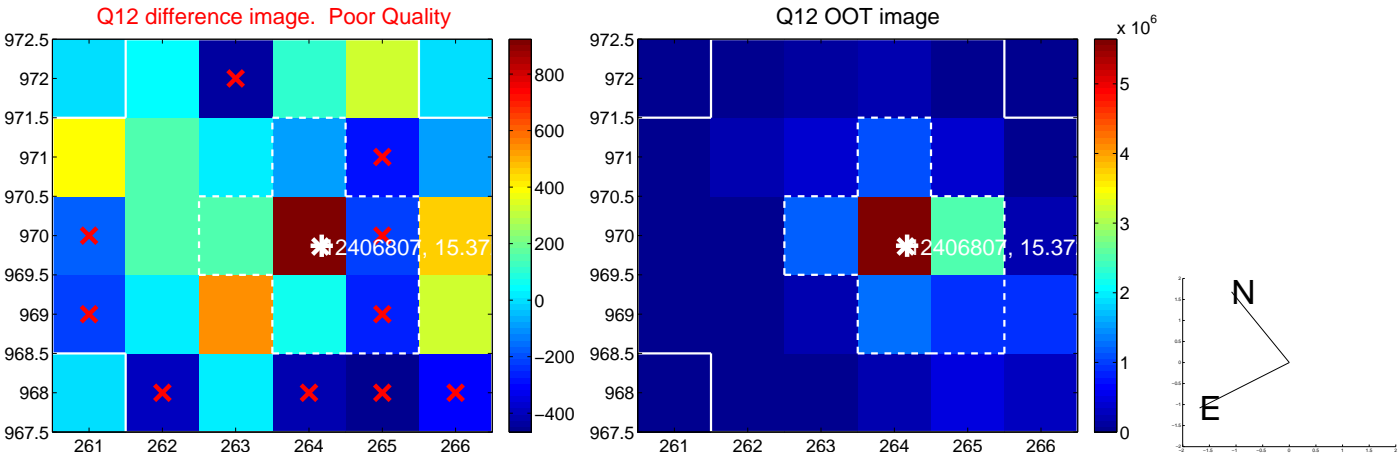
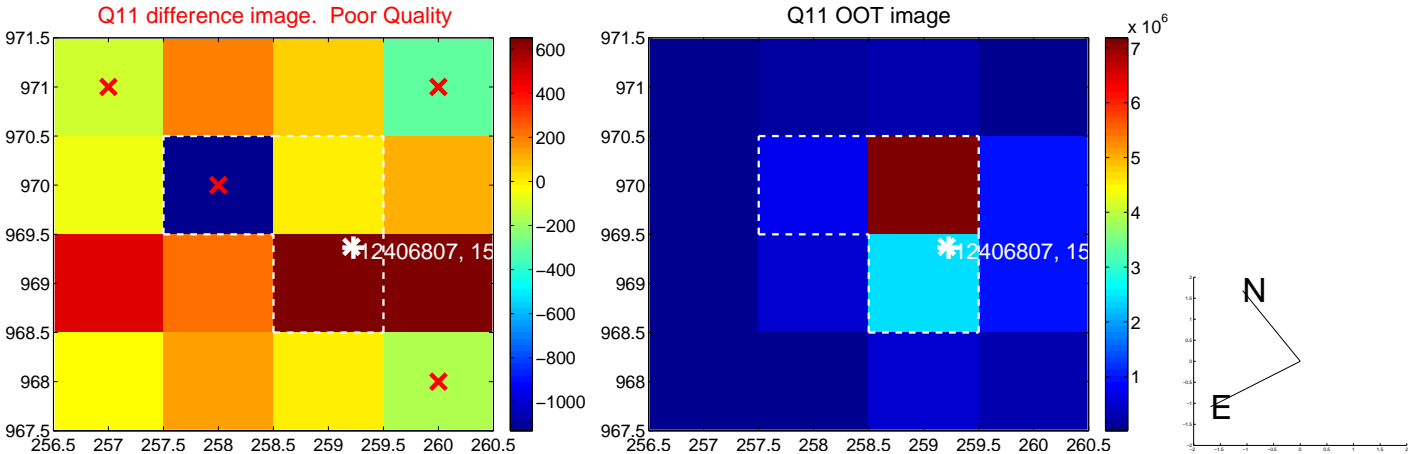
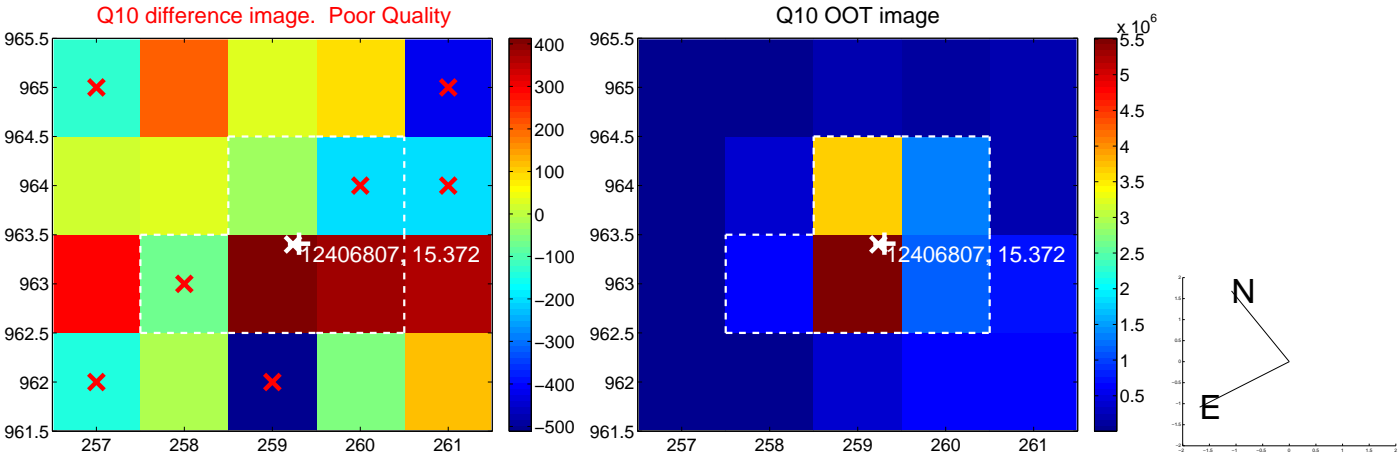
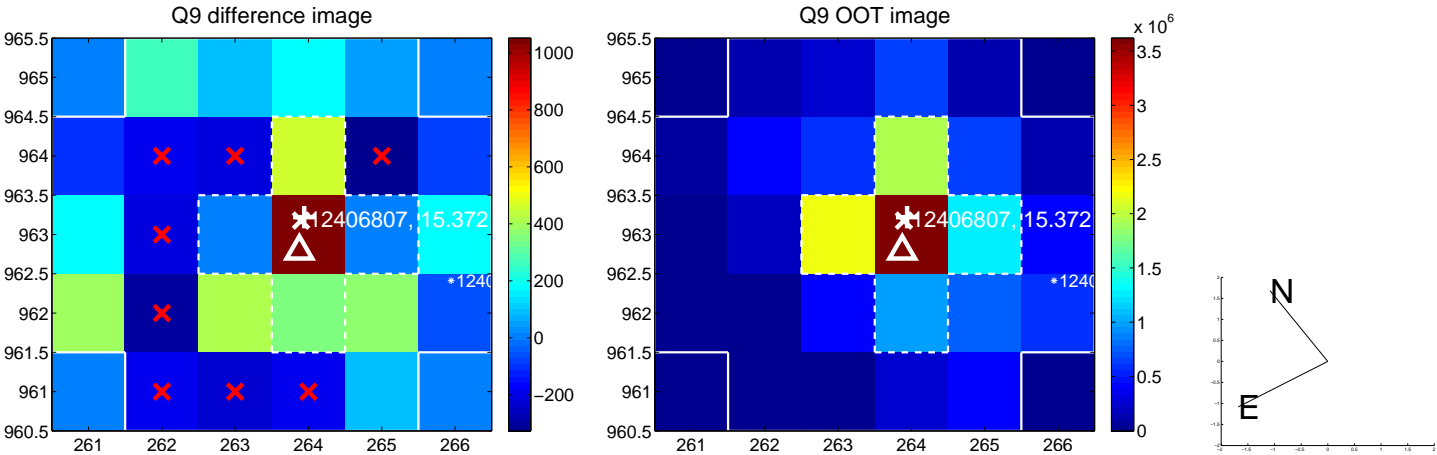
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



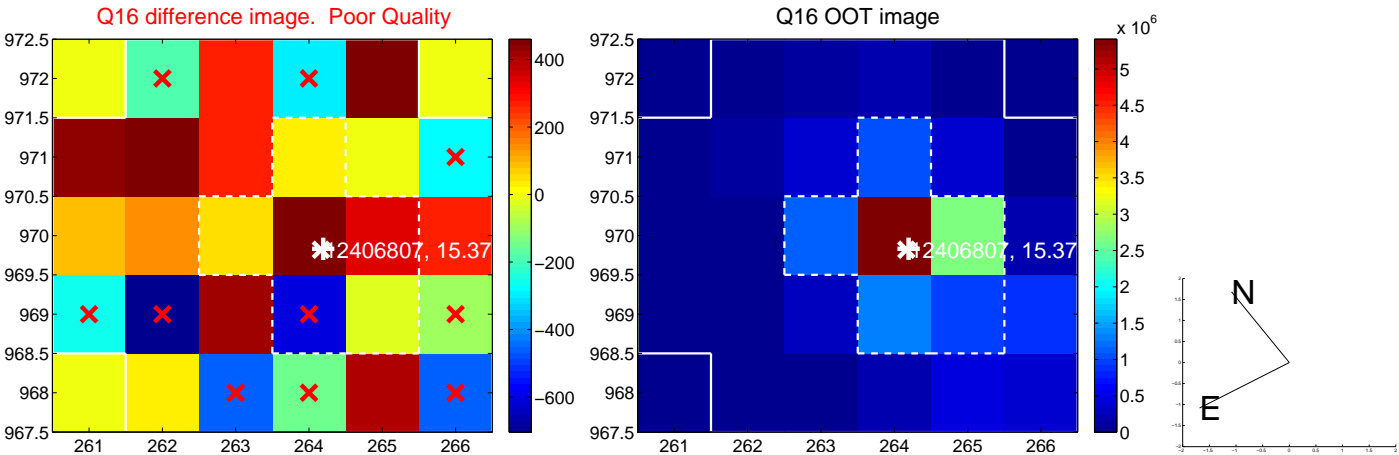
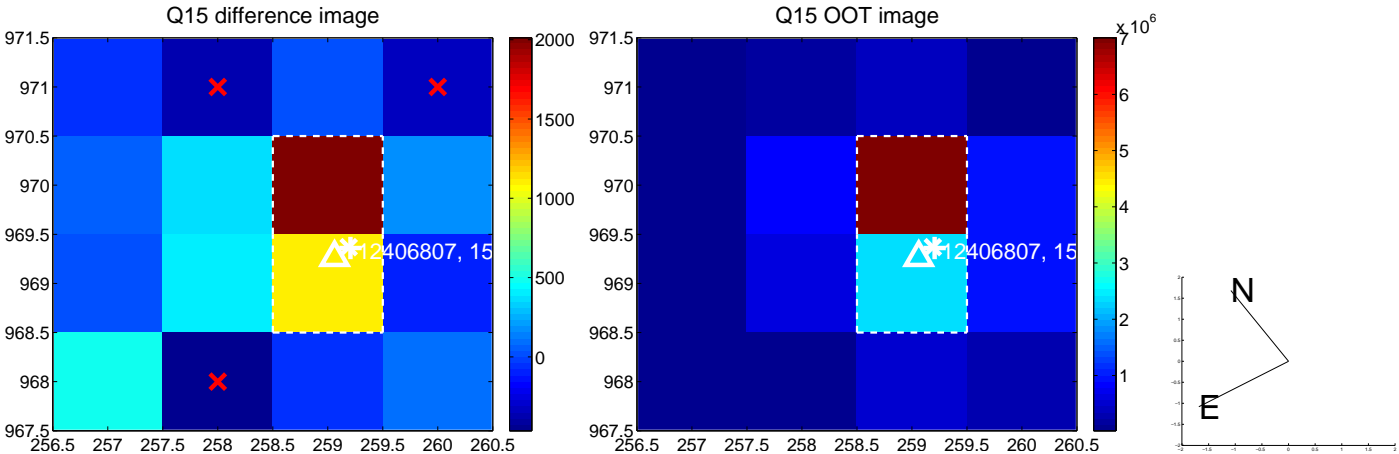
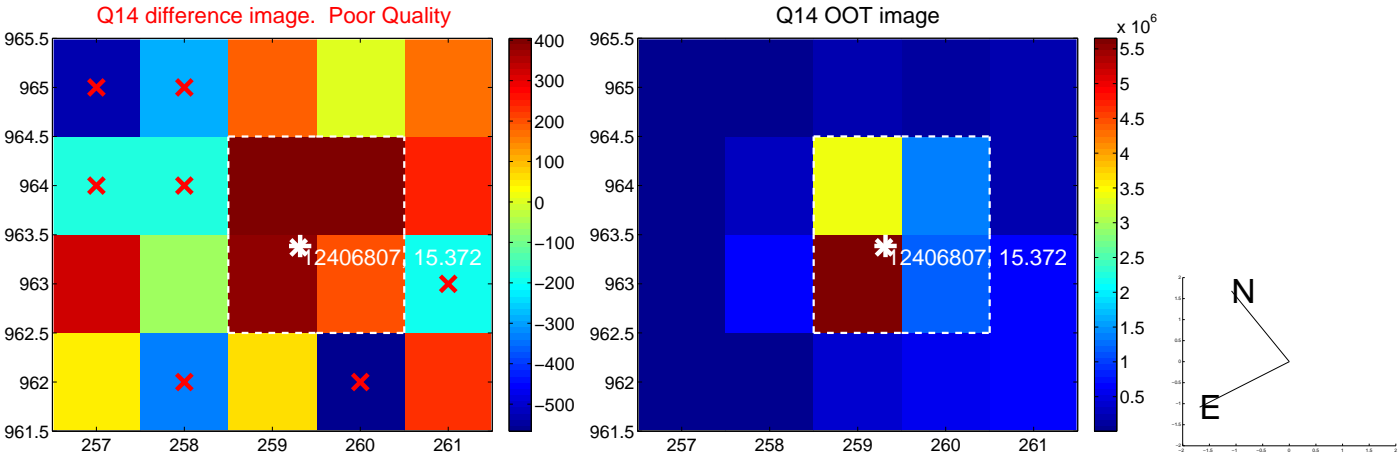
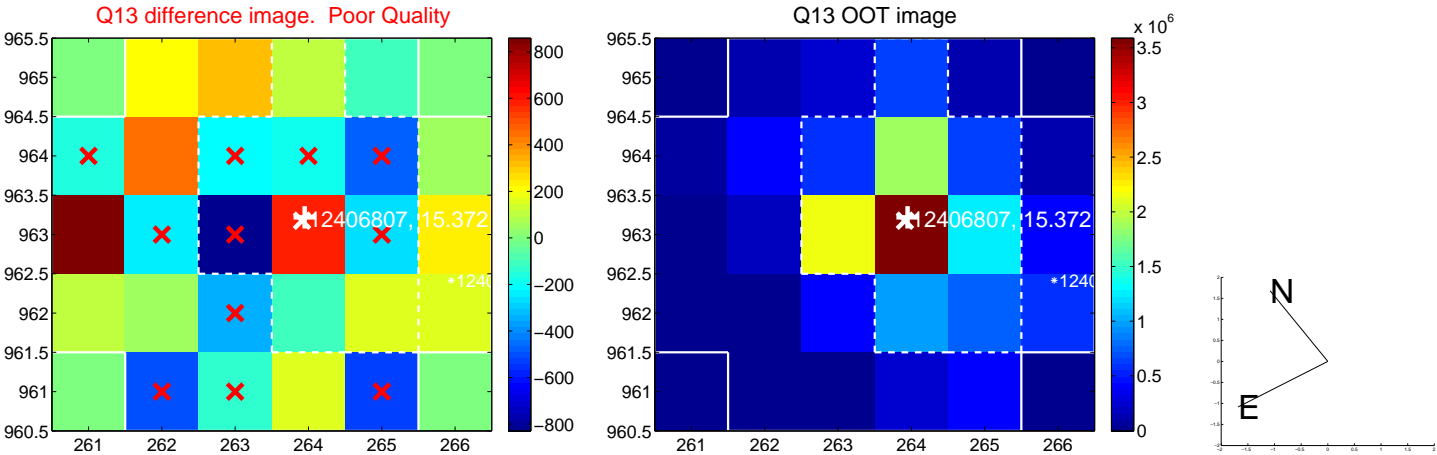
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



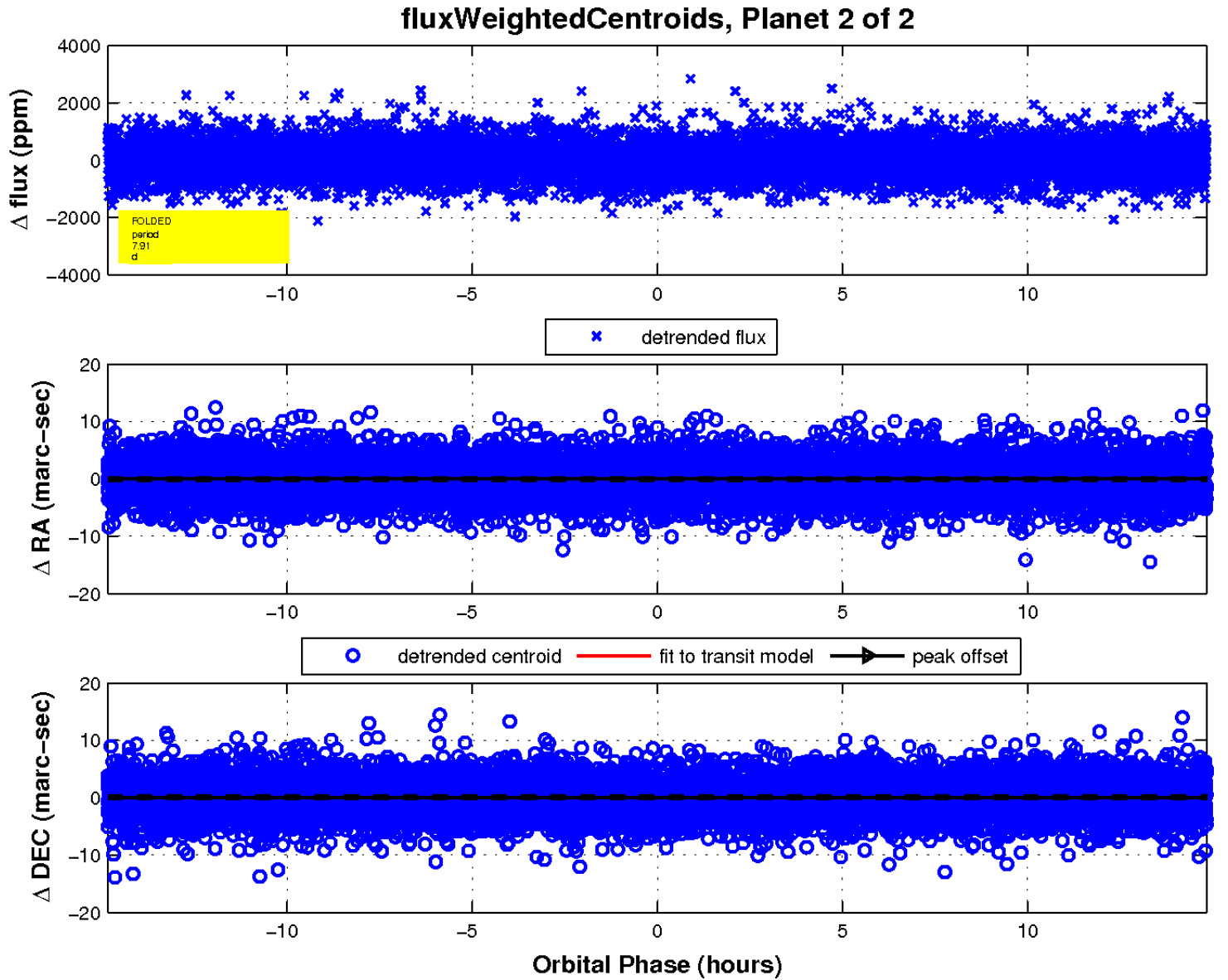
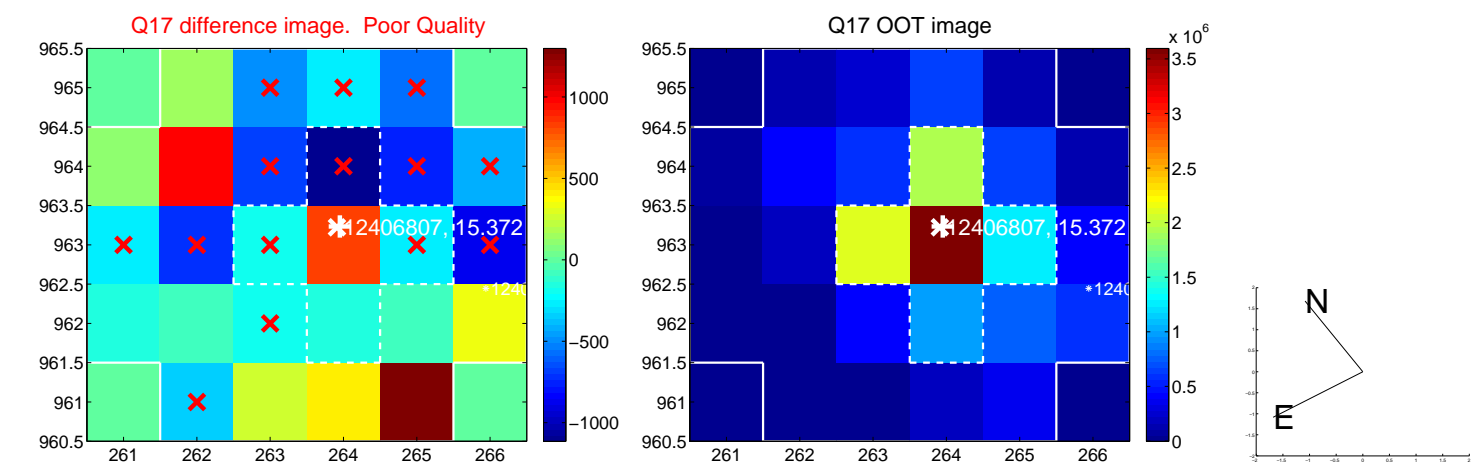
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

