

# KIC 010843590

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 010843590-01 | OBS      | 0431.01 | 18.870226     | 140.970943   | 1105.1      | 3.416            | 60.2 | 61.6 | 0.86                        | 5402            | 3.34                   | 35.22                  |
| 010843590-02 | OBS      | 0431.02 | 46.902631     | 154.302795   | 793.8       | 4.179            | 29.5 | 31.9 | 0.86                        | 5402            | 2.78                   | 10.46                  |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments   |
|--------------|----------|------|-------|---|---|---|---|------------|
| 010843590-01 | OBS      | PC   | 1.00  | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010843590-02 | OBS      | PC   | 1.00  | 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.

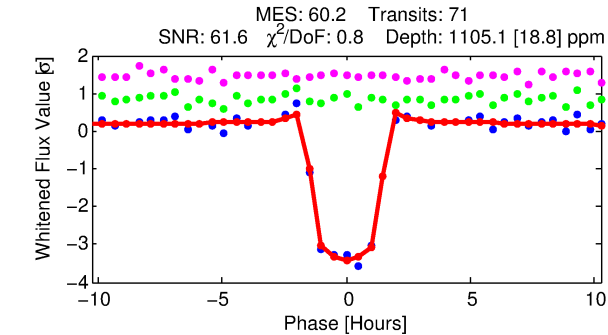
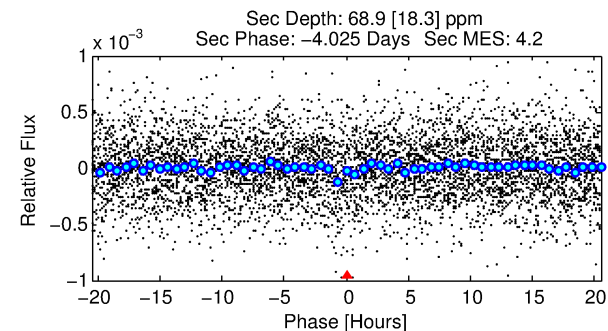
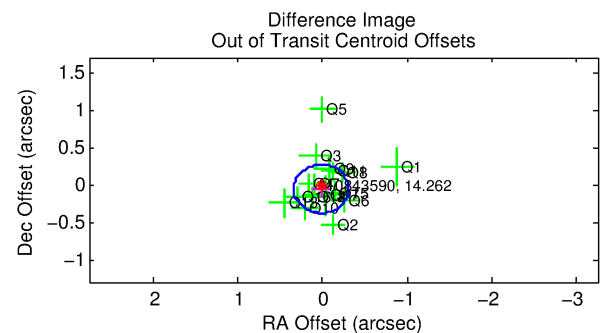
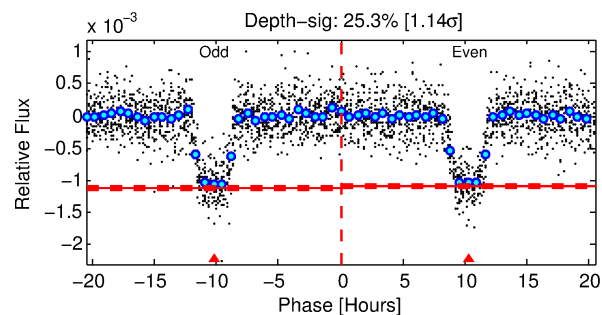
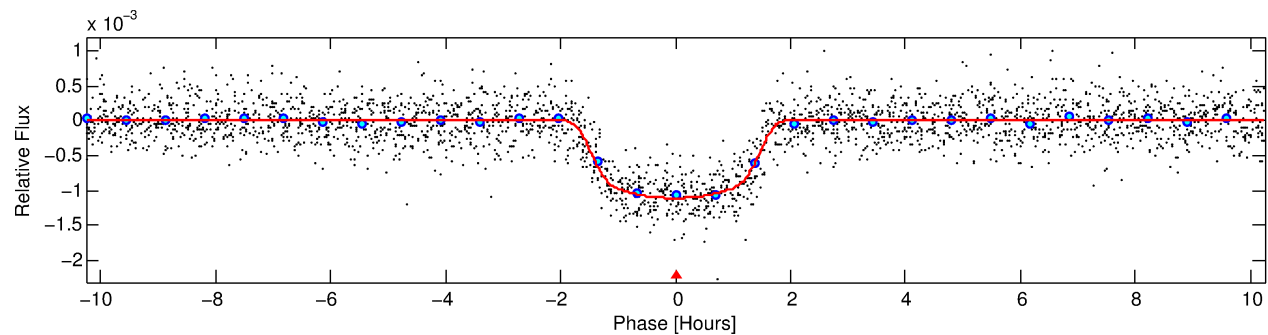
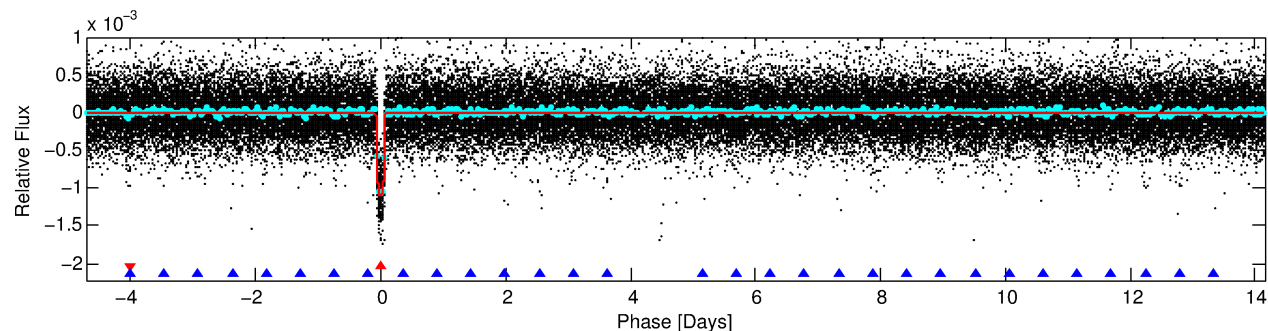
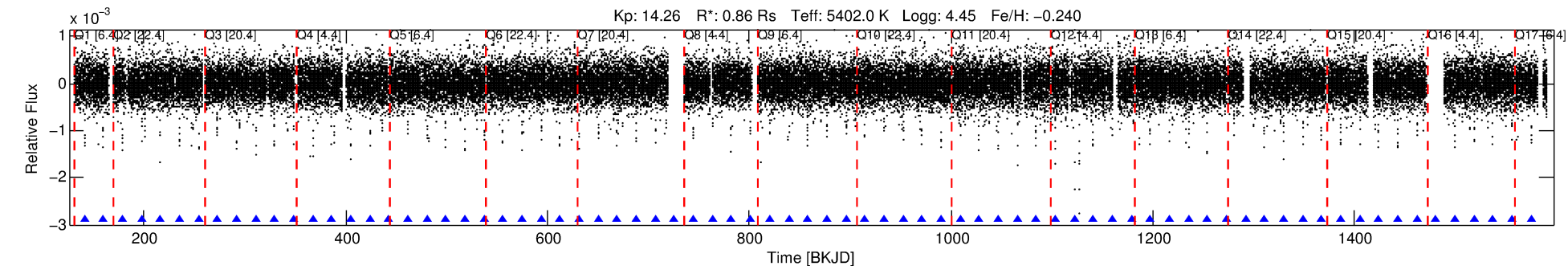
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 010843590-01

No Significant Match Found

# DV One-Page Summary

KIC: 10843590 Candidate: 1 of 2 Period: 18.870 d  
KOI: K00431.01 Name: Kepler-153b Corr: 0.950



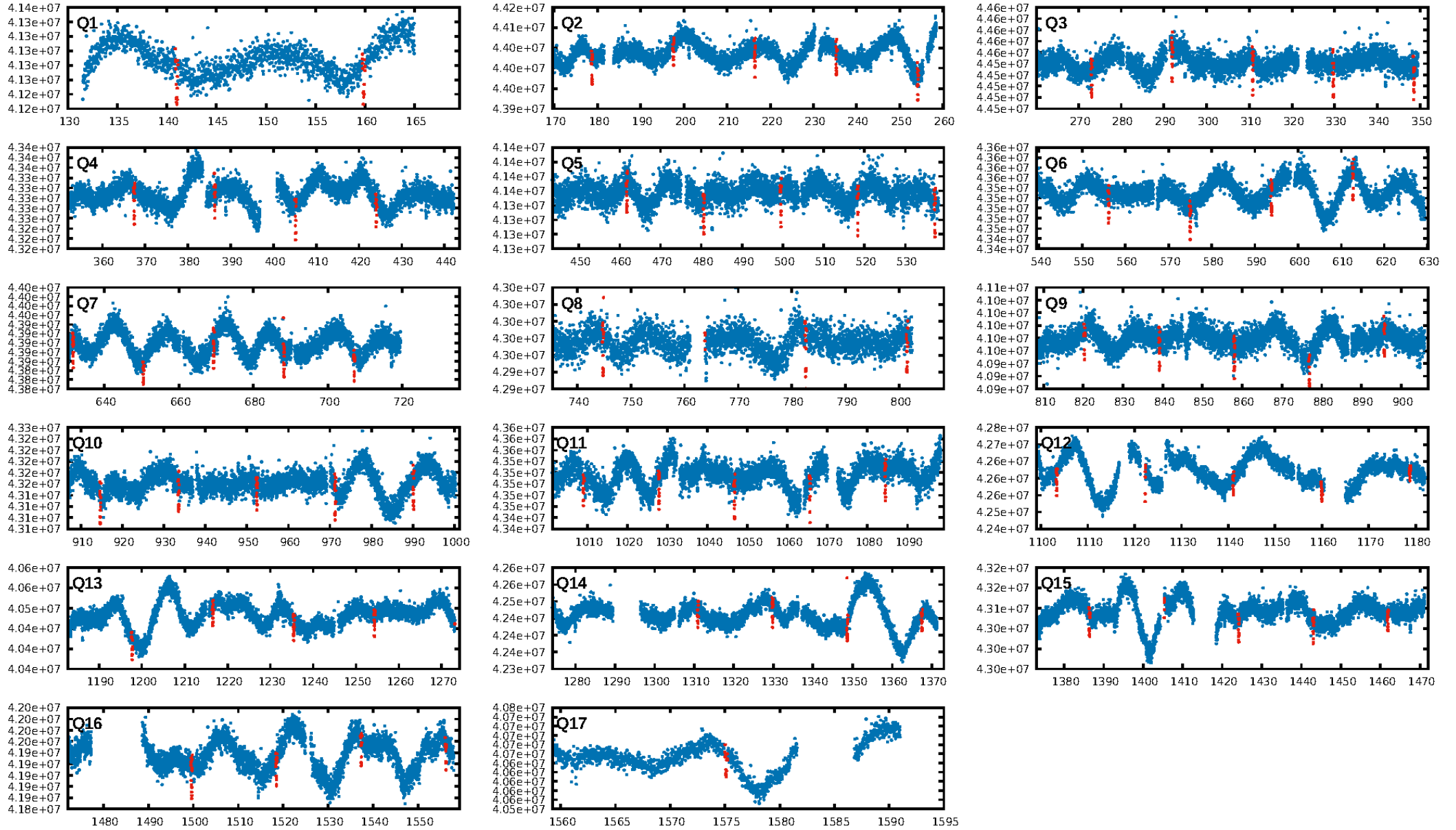
## DV Fit Results:

Period = 18.87023 [0.00003] d  
Epoch = 140.9709 [0.0011] BKJD  
Rp/R\* = 0.0353 [0.0015]  
a/R\* = 24.15 [4.09]  
b = 0.86 [0.05]  
Seff = 35.22 [9.90]  
Teff = 621 [44] K  
Rp = 3.34 [0.65] Re  
a = 0.1273 [0.0211] AU  
Ag = 55.22 [20.68] [2.62 $\sigma$ ]  
Teffp = 2618 [202] K [9.68 $\sigma$ ]

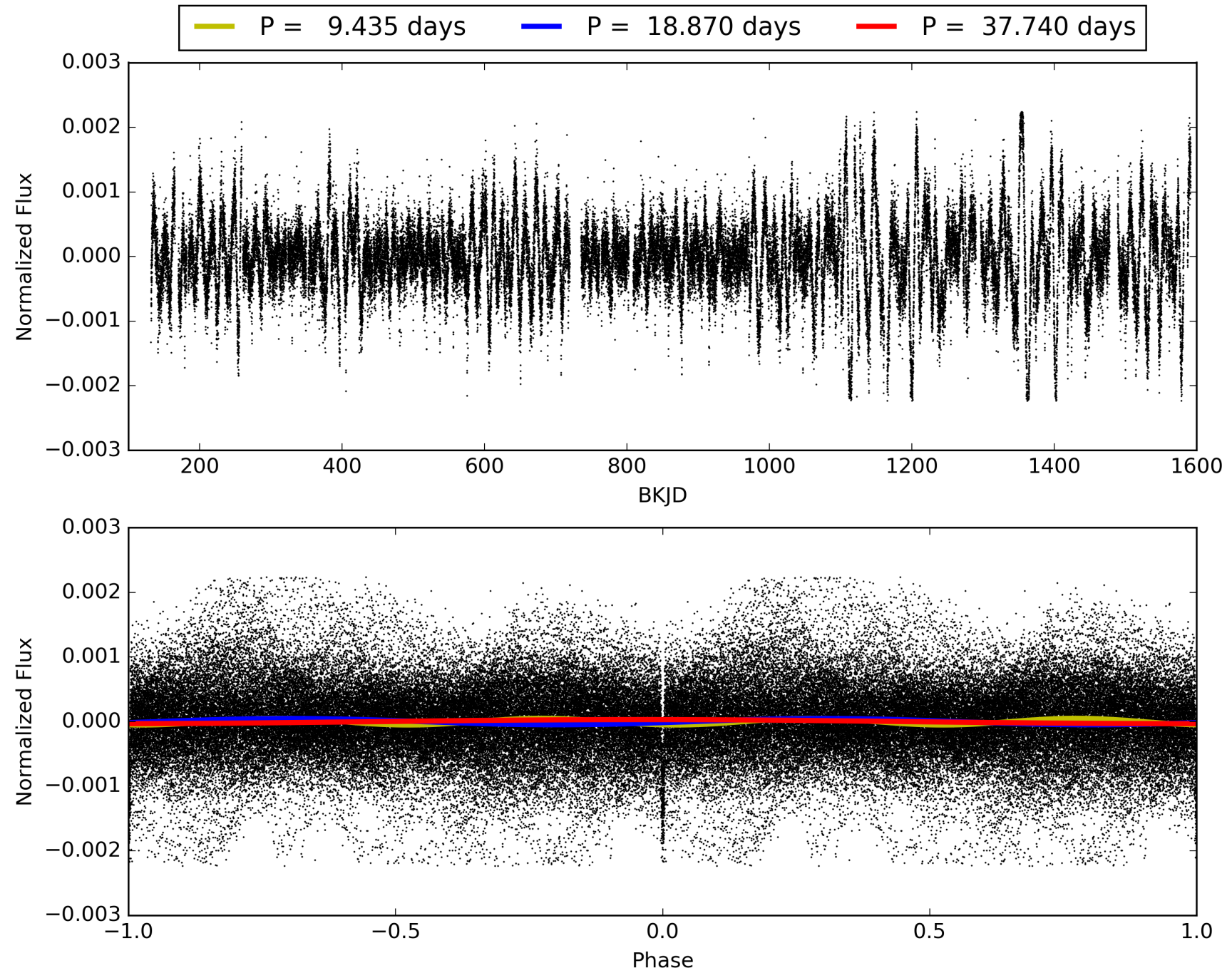
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 100.0% [124.64 $\sigma$ ]  
ModelChiSquare2-sig: 100.0%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 1.00 [68/68]  
GhostDiagnostic-chr: 4.382  
Centroid-sig: 31.2%  
Centroid-so: 0.332 arcsec [1.66 $\sigma$ ]  
OotOffset-rm: 0.058 arcsec [0.54 $\sigma$ ]  
KicOffset-rm: 0.173 arcsec [1.61 $\sigma$ ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 1.00 [17/17]  
DiffImageOverlap-fno: 1.00 [17/17]

# TCE 010843590-01, PDC Light Curves

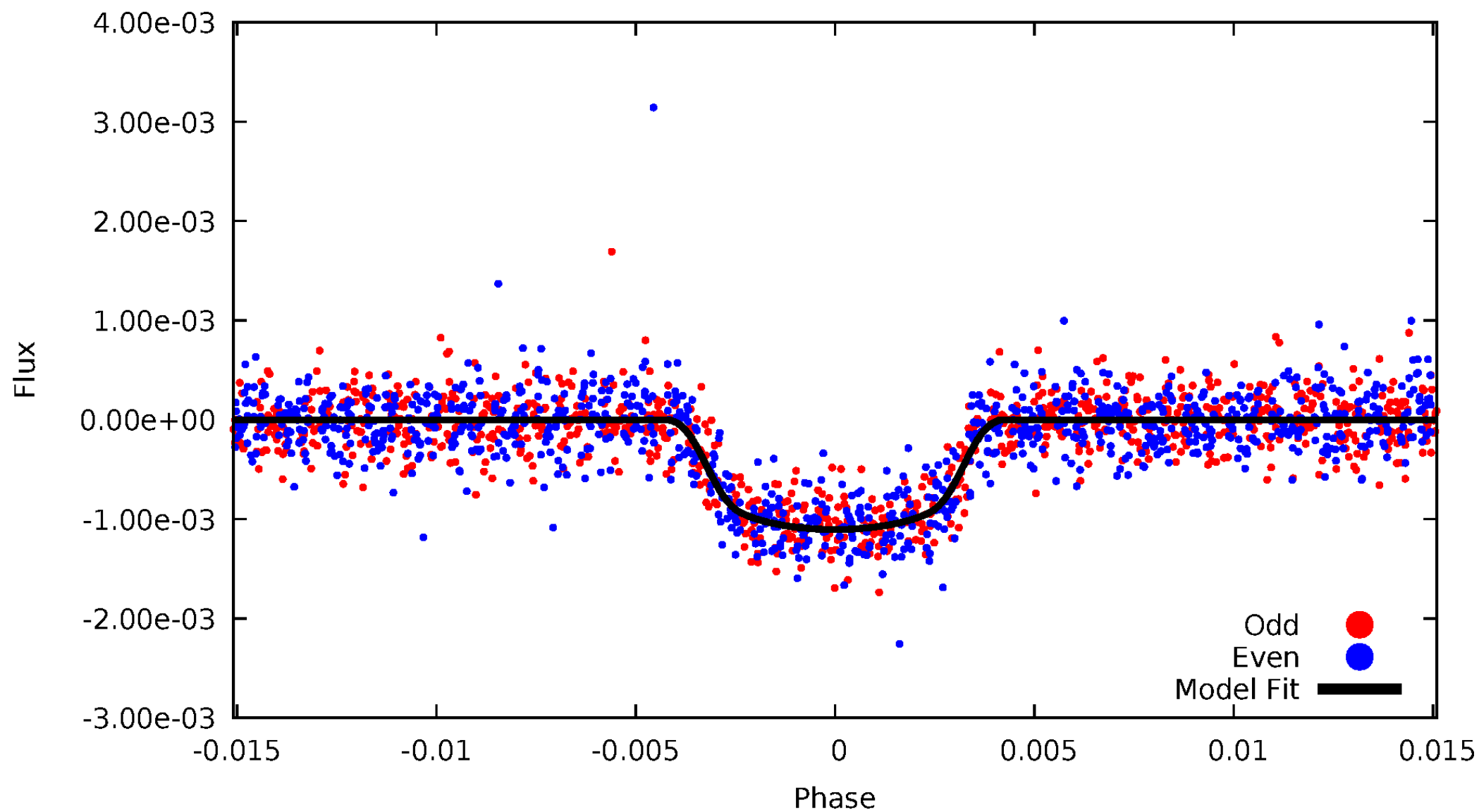


TCE 010843590-01



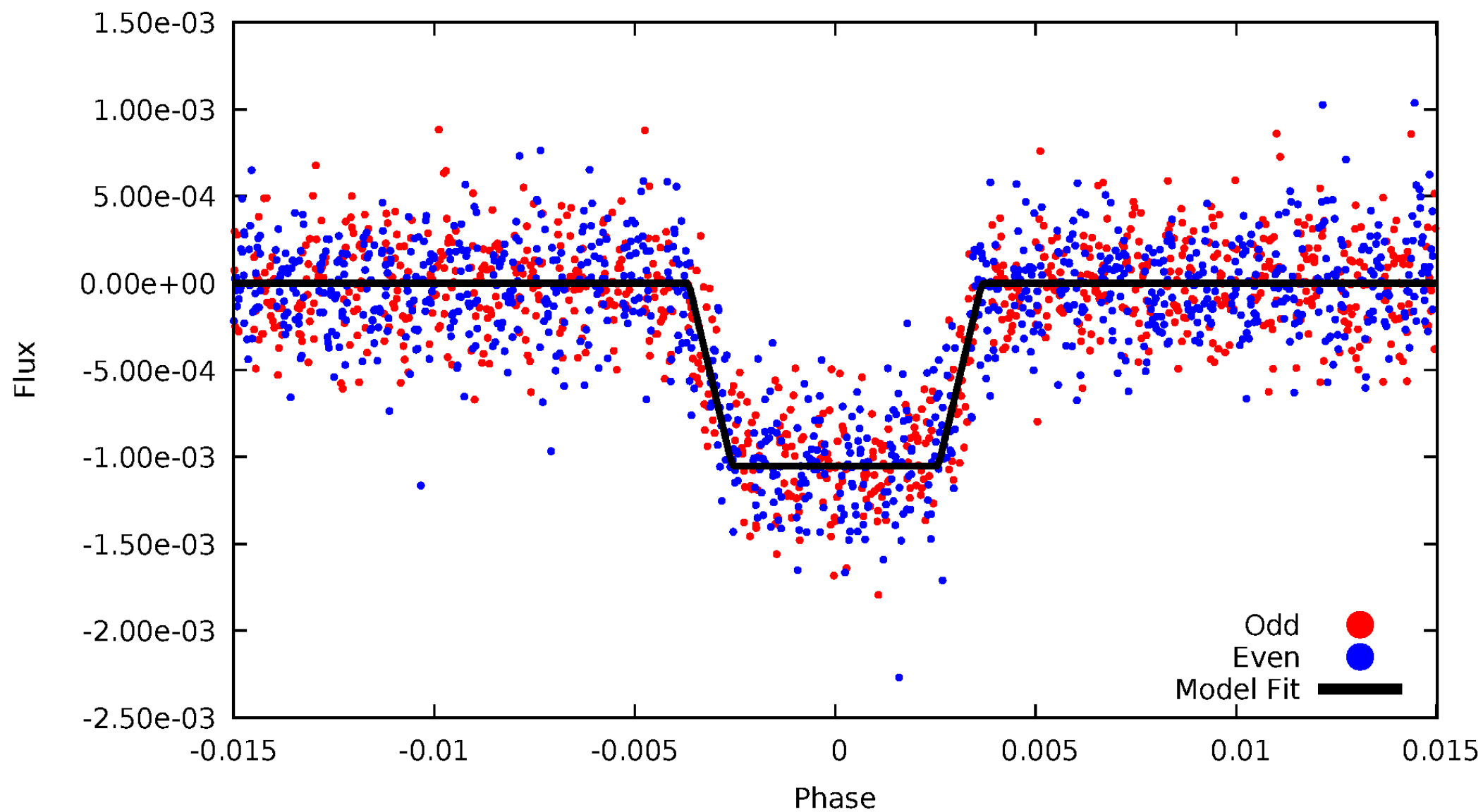
# DV Odd/Even

TCE 010843590-01



# ALT Odd/Even

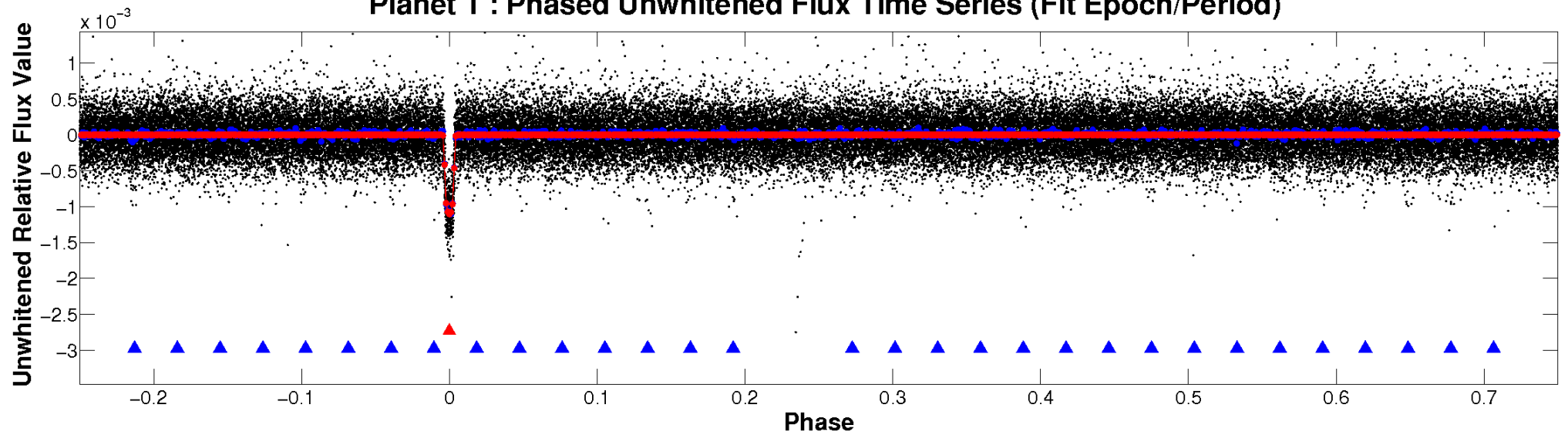
TCE 010843590-01



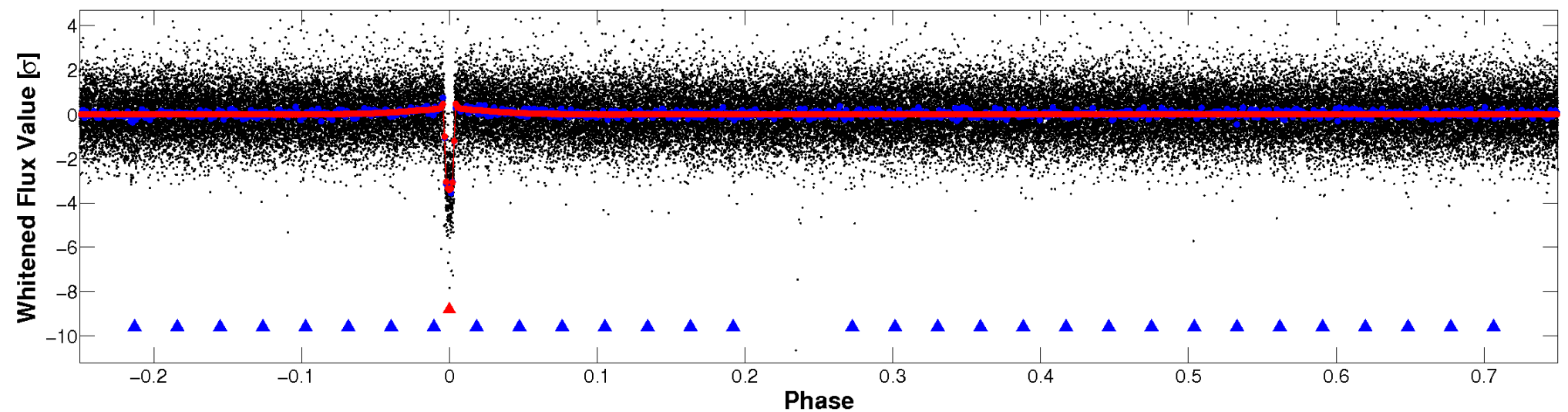


# Non-Whitened Vs. Whitened Light Curve

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

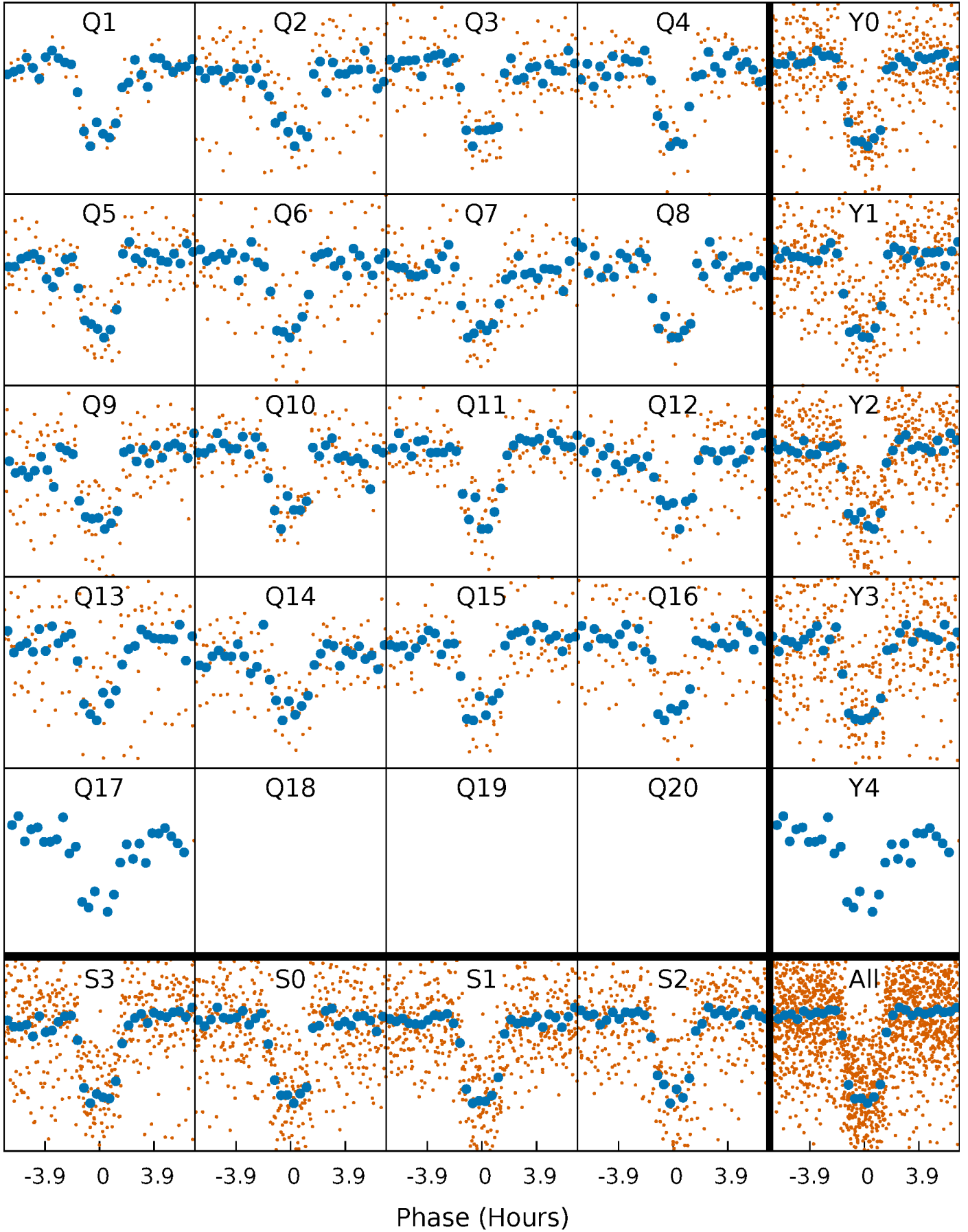


**Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)**



# PDC Quarter-Phased Transit Curves

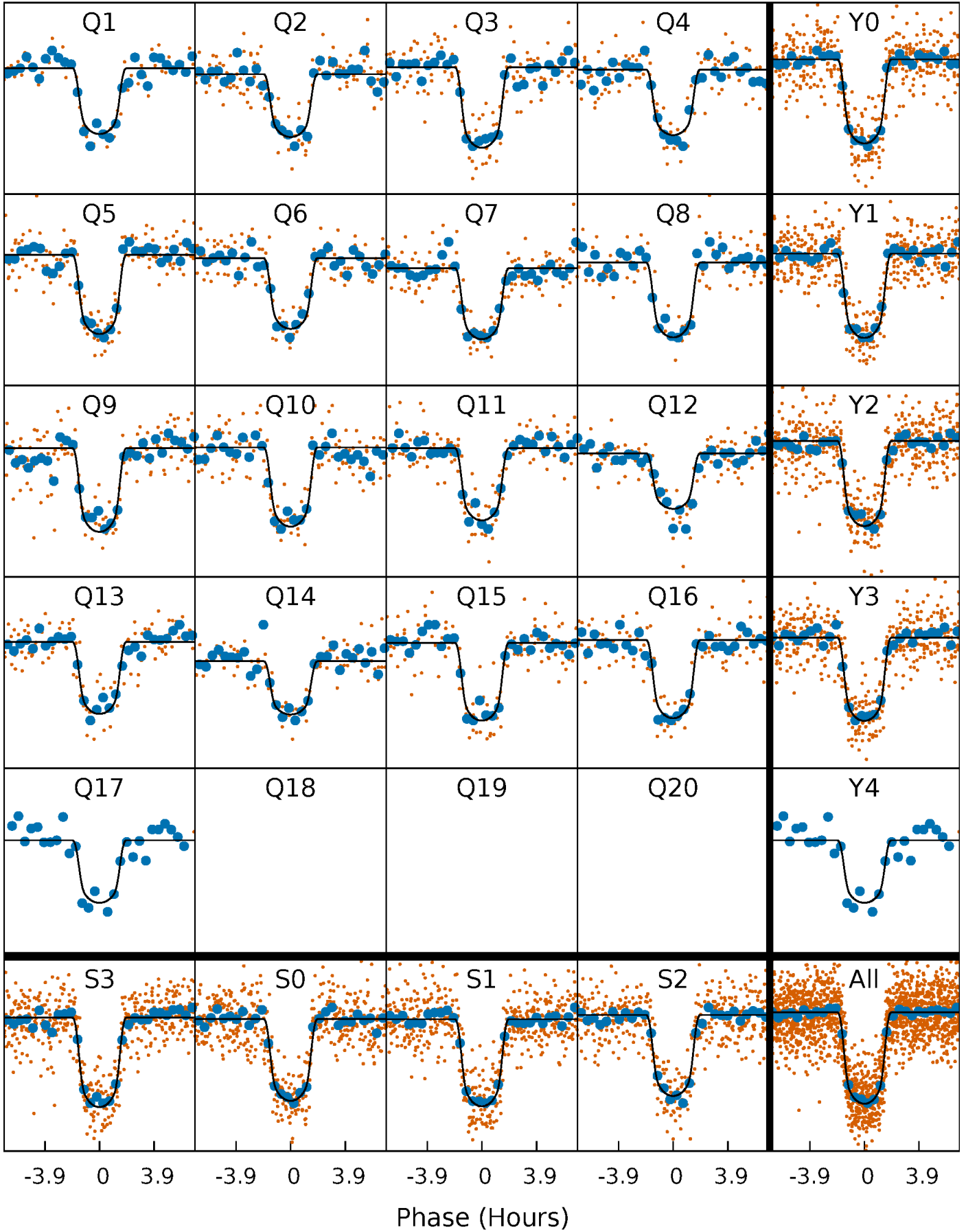
TCE 010843590-01 P= 18.870226 Days  $T_0=140.970943$  (BKJD)





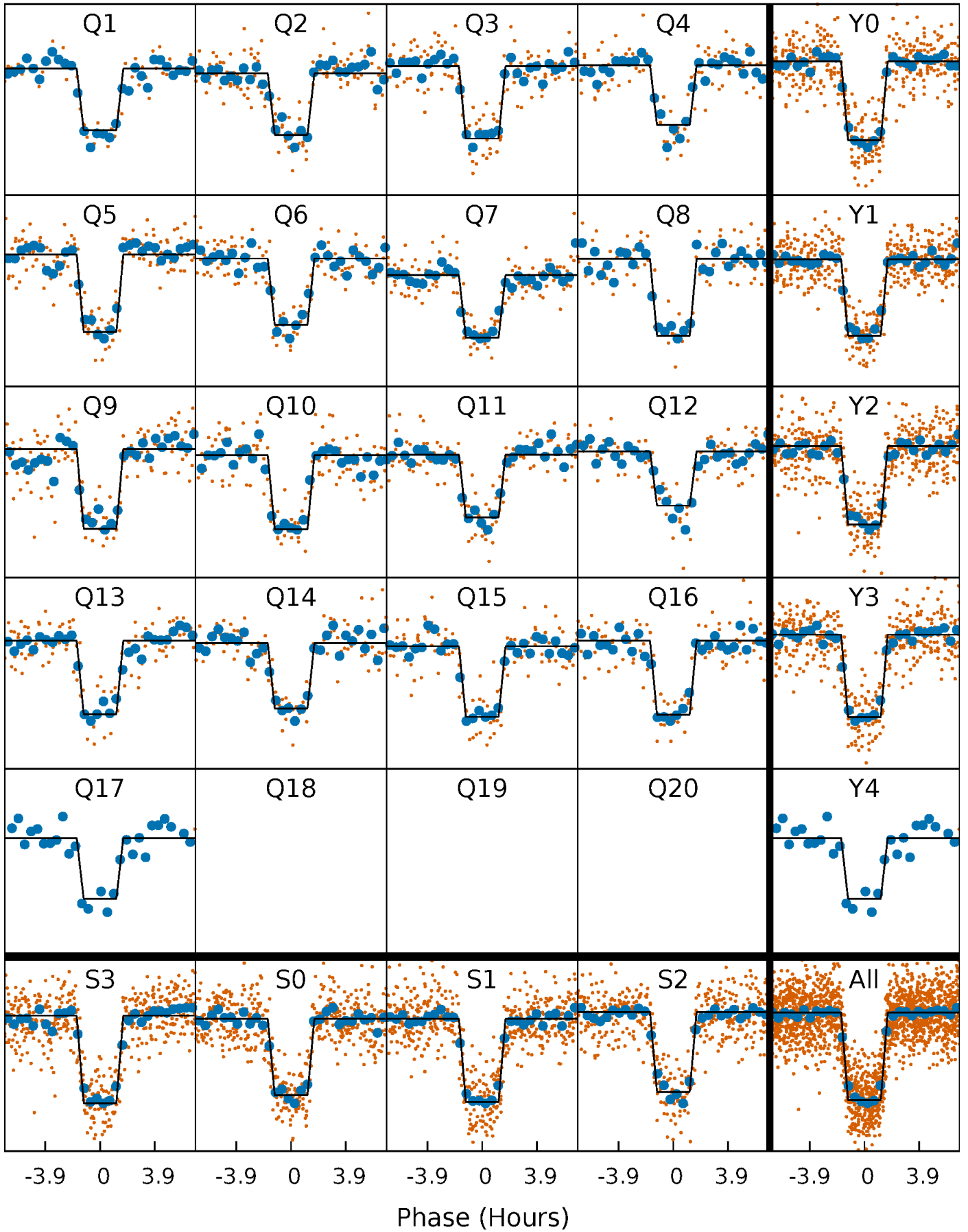
# DV Quarter-Phased Transit Curves

TCE 010843590-01 P= 18.870226 Days  $T_0=140.970943$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

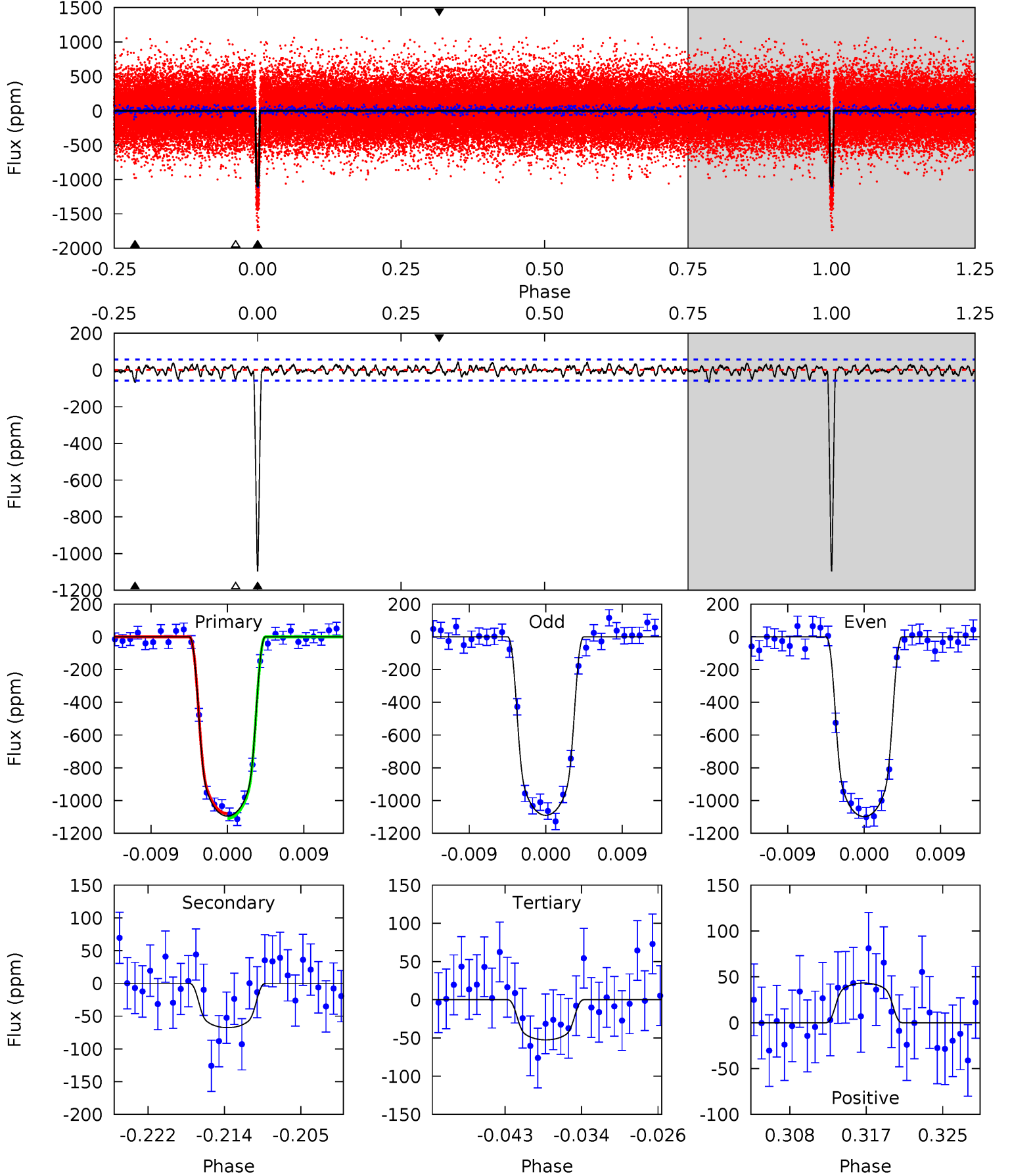
TCE 010843590-01 P= 18.870243 Days  $T_0=140.970608$  (BKJD)



# DV Model-Shift Uniqueness Test

010843590-01,  $P = 18.870226$  Days,  $E = 122.100717$  Days

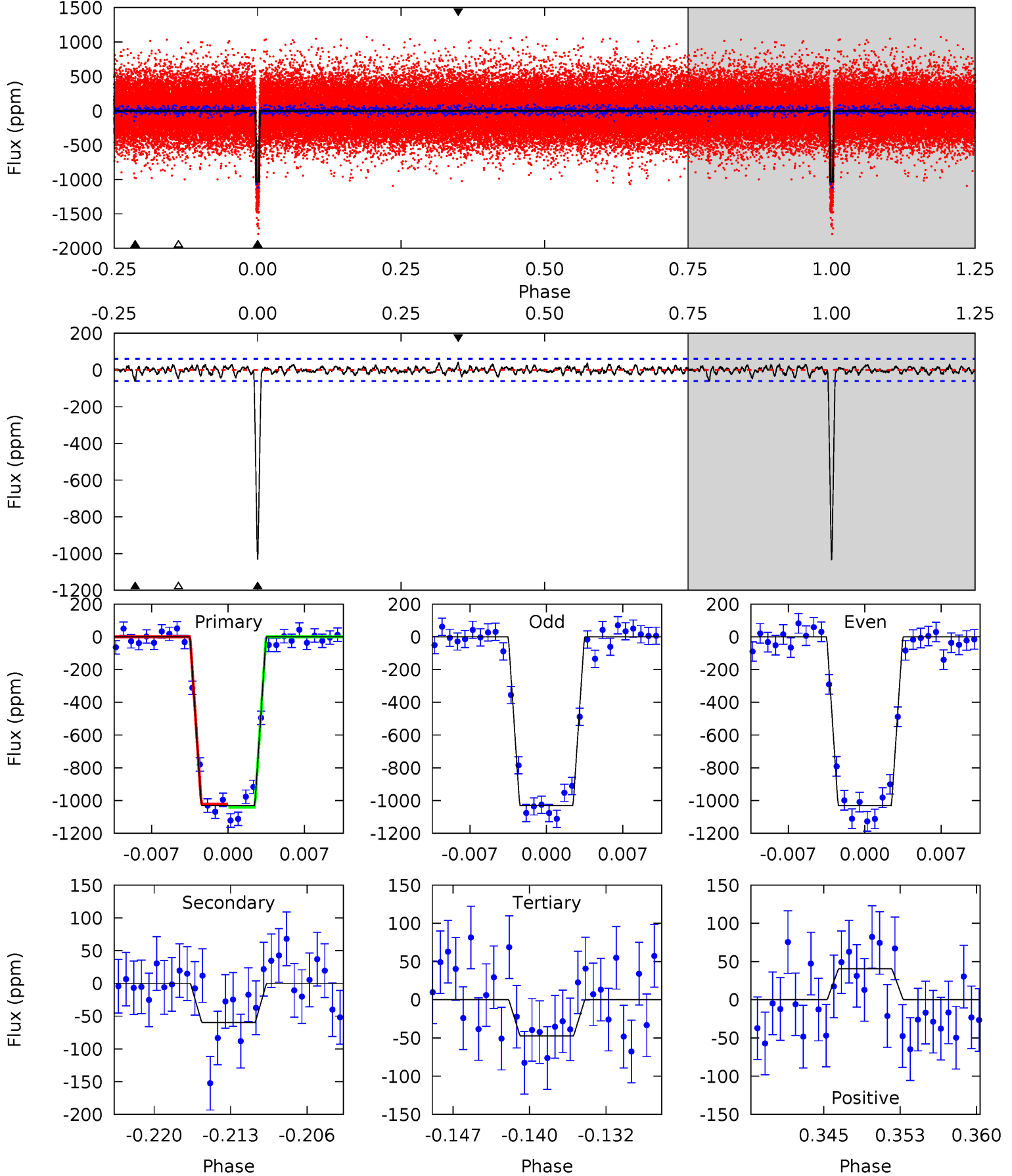
| Pri  | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 96.9 | 5.98 | 4.64 | 3.82 | 5.06            | 2.63            | 1.41             | 92.2    | 93.0    | 1.34    | 2.16    | 0.36    | 1.03 | 0.04  | 1.33 |



# Alt Model-Shift Uniqueness Test

010843590-01,  $P = 18.870243$  Days,  $E = 122.100365$  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  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 86.9 | 5.04 | 4.00 | 3.41 | 5.09            | 2.68            | 1.15             | 82.9    | 83.5    | 1.04    | 1.63    | 0.02    | 1.02 | 0.04  | 0.80 |



### Stellar Parameters For KIC 010843590

|        | $T_{\text{eff}}(K)$  | $\log(g)$                 | [Fe/H]                     | $R (R_{\odot})$           | $M(M_{\odot})$            | $p_{\star} (\text{g}\cdot\text{cm}^{-3})$ |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $5402^{+175}_{-159}$ | $4.452^{+0.126}_{-0.140}$ | $-0.240^{+0.300}_{-0.300}$ | $0.865^{+0.164}_{-0.119}$ | $0.774^{+0.122}_{-0.052}$ | $1.683^{+0.958}_{-0.666}$                 |
|        | +3%/-3%              | +3%/-3%                   | +125%/-125%                | +19%/-14%                 | +16%/-7%                  | +57%/-40%                                 |
| 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 010843590-01 / KOI 0431.01

| Detrend | Depth (ppm)  | $R_p (R_{\oplus})$     | $T_{max} (K)$     | $T_{obs} (K)$        | $A_{obs}$        |
|---------|--------------|------------------------|-------------------|----------------------|------------------|
| DV      | $-68 \pm 11$ | $3.38^{+0.42}_{-0.33}$ | $871^{+52}_{-47}$ | $3185^{+111}_{-111}$ | $53^{+17}_{-13}$ |
| Alt.    | $-60 \pm 12$ | $3.09^{+0.36}_{-0.30}$ | $870^{+51}_{-45}$ | $3203^{+124}_{-118}$ | $55^{+19}_{-14}$ |

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

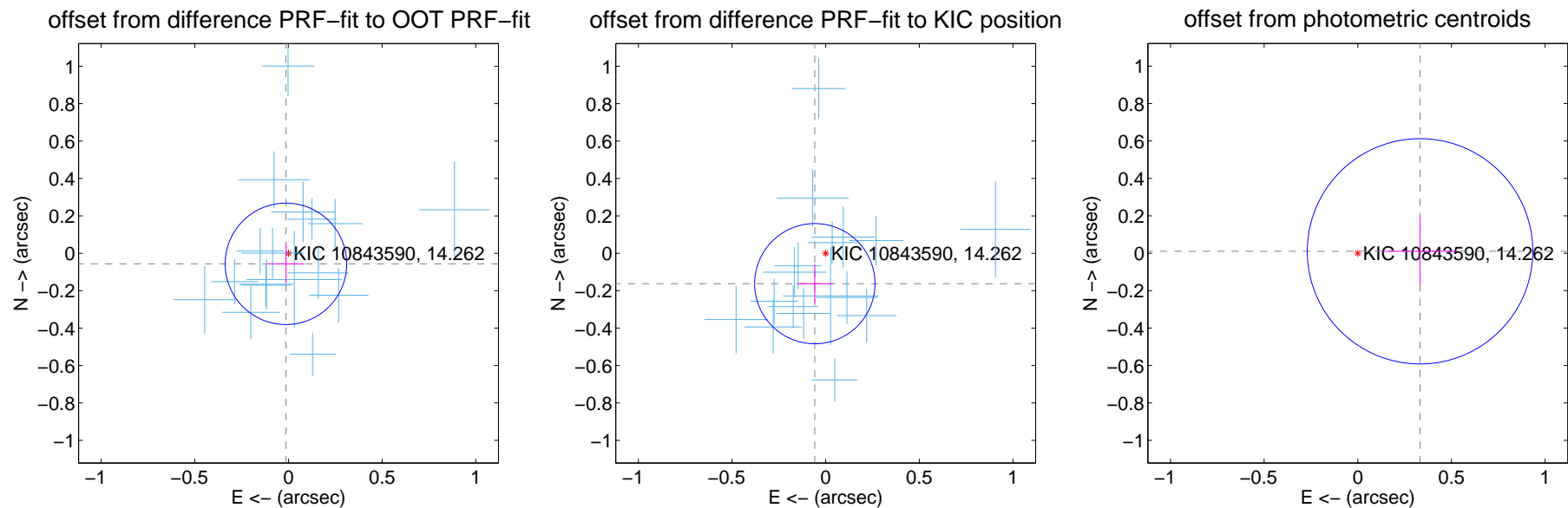
## DV Centroid Data

Supplemental centroid analysis for 010843590-01. Kepler magnitude: 14.26. Transit SNR 61.58

There are 17 quarters with good PRF difference image offsets

The direct PRF centroid is offset from the target star catalog position by about 0.09 arcsec

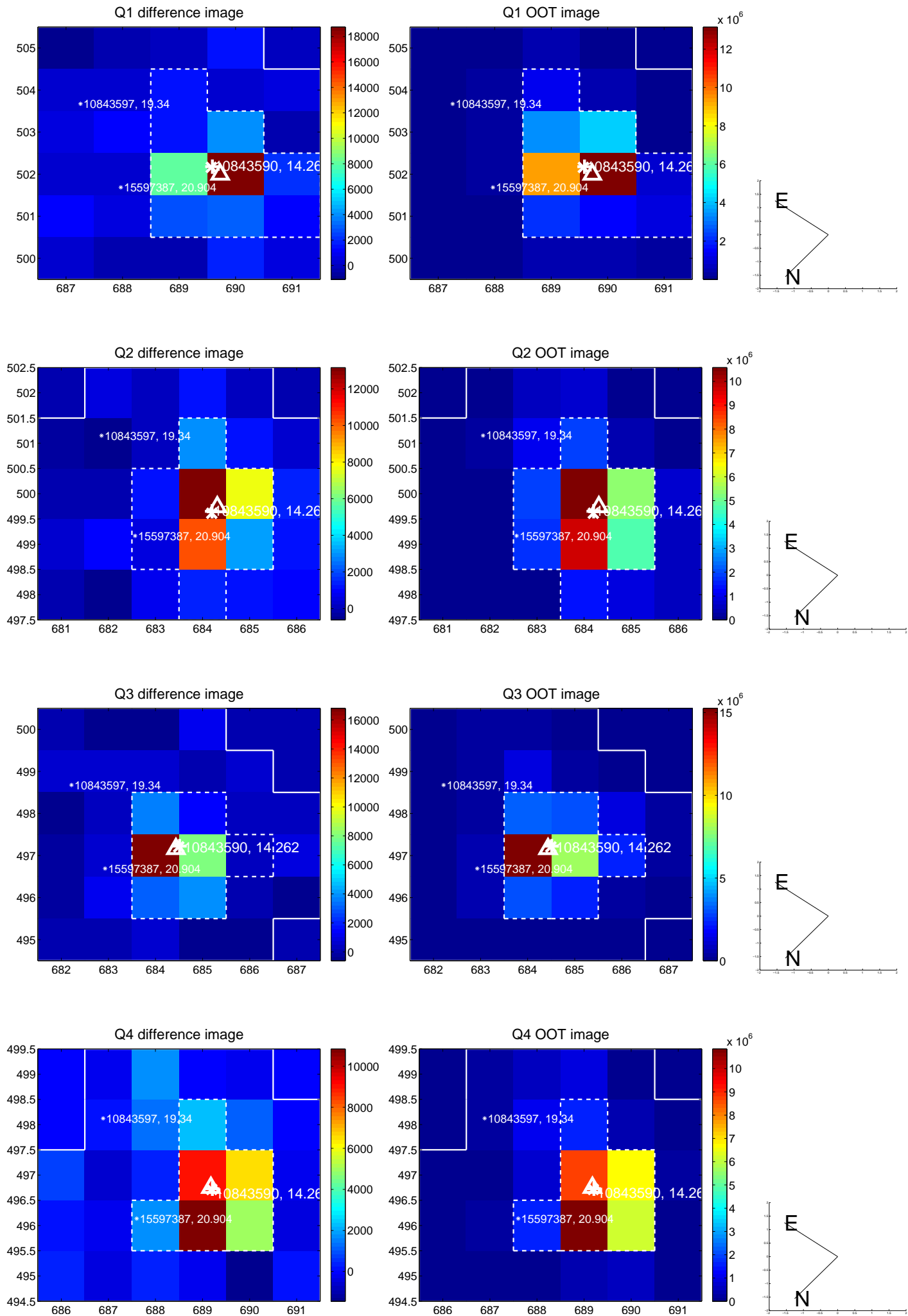
|   | Distance in arcsec | Distance / $\sigma$ | $\Delta$ RA       | $\Delta$ Dec       |
|---|--------------------|---------------------|-------------------|--------------------|
| PRF-fit source offset from OOT          | $0.058 \pm 0.108$  | 0.54                | $0.014 \pm 0.098$ | $-0.056 \pm 0.105$ |
| PRF-fit source offset from KIC position | $0.173 \pm 0.107$  | 1.61                | $0.058 \pm 0.098$ | $-0.162 \pm 0.104$ |
| photometric centroid source offset      | $0.33 \pm 0.20$    | 1.66                | $-0.33 \pm 0.20$  | $0.01 \pm 0.18$    |



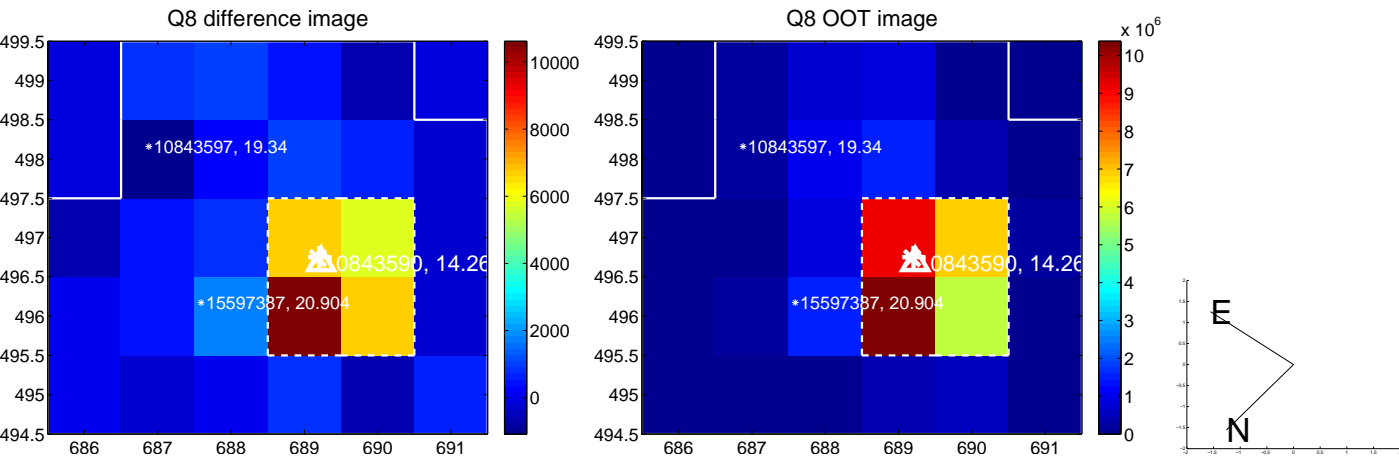
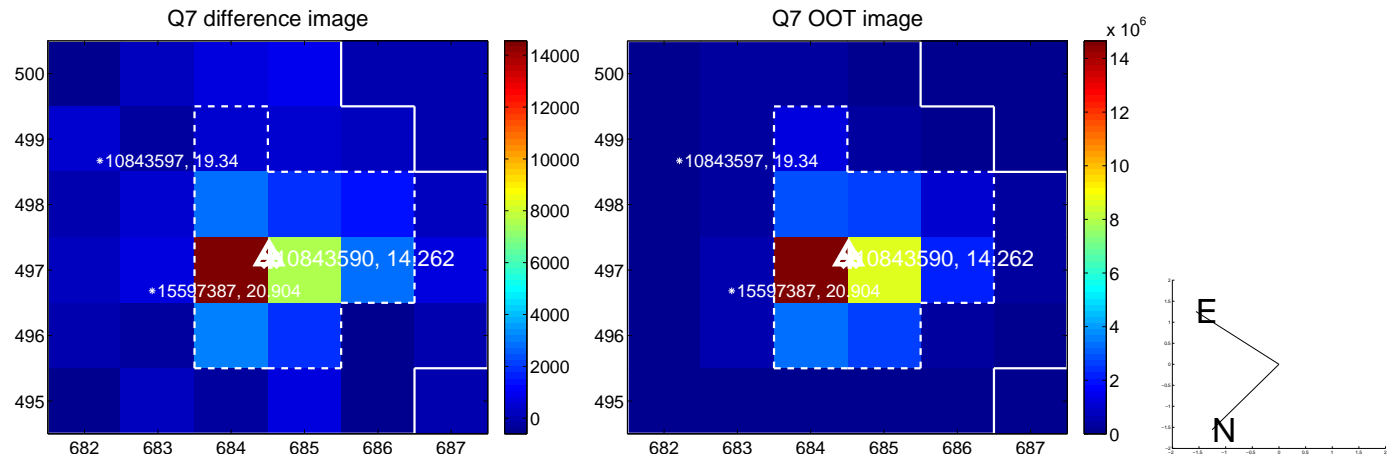
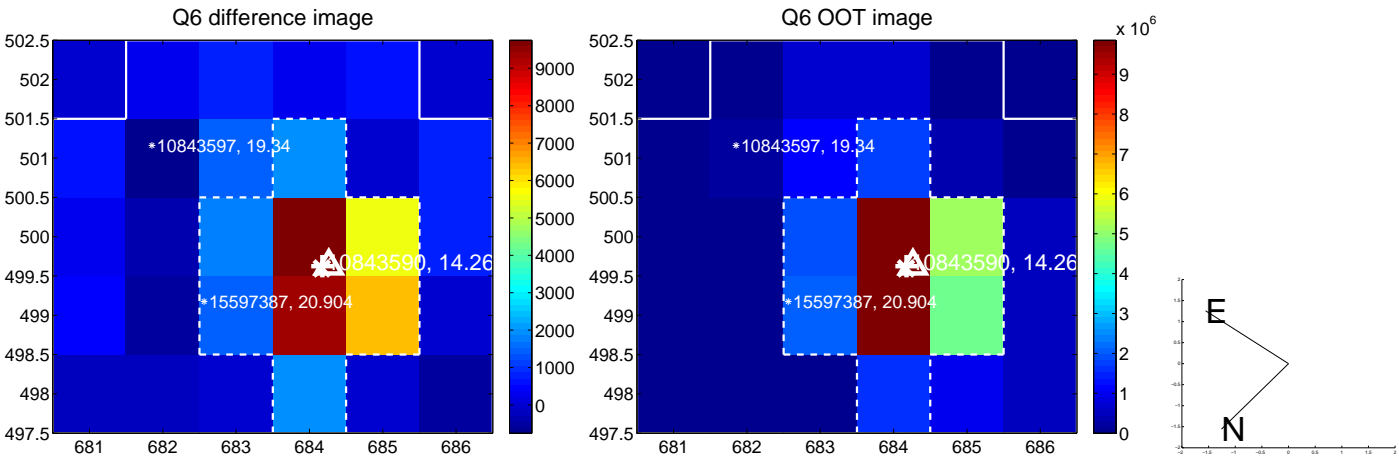
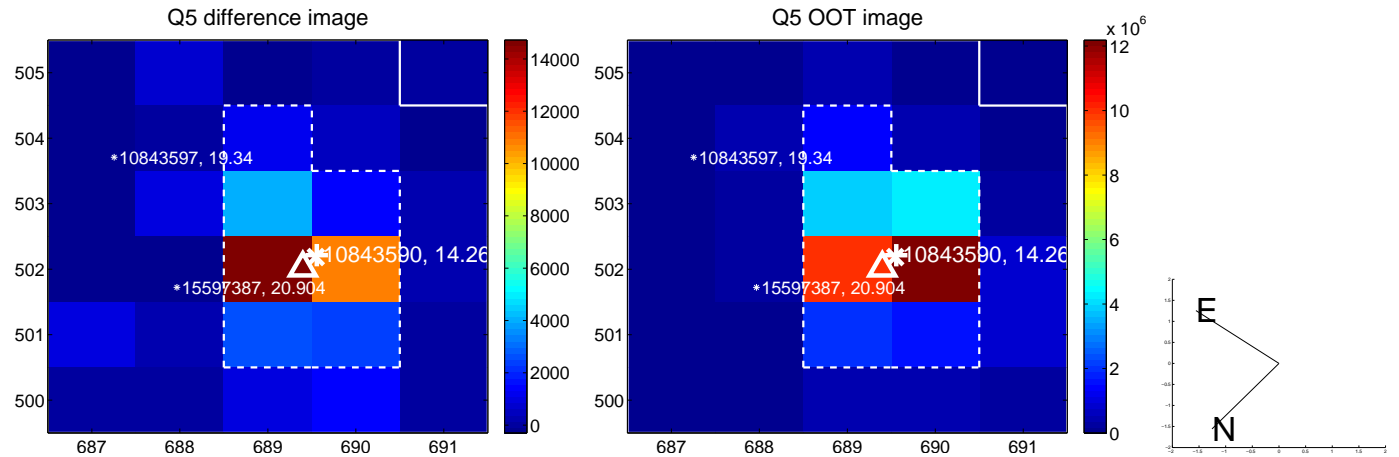
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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



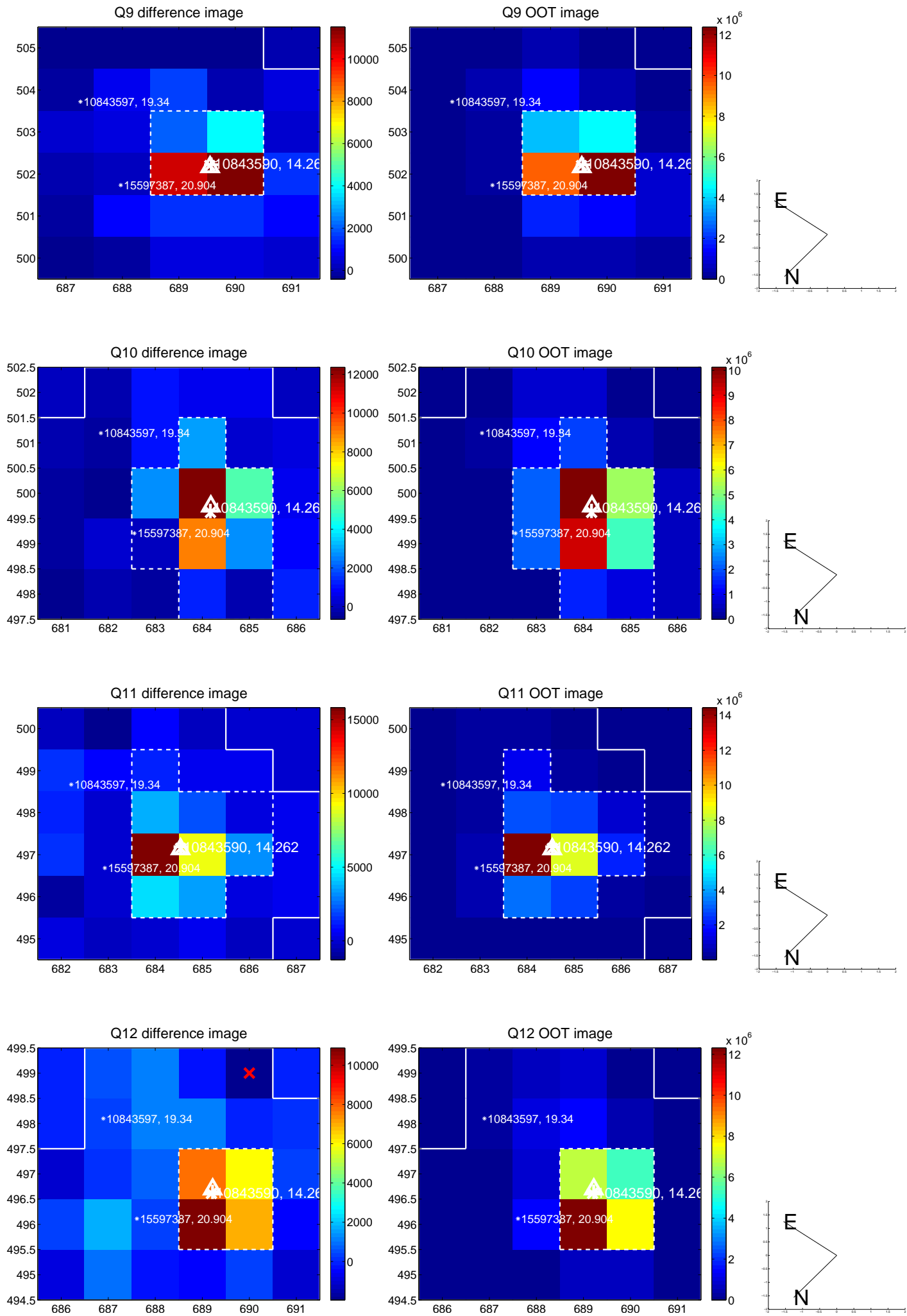
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



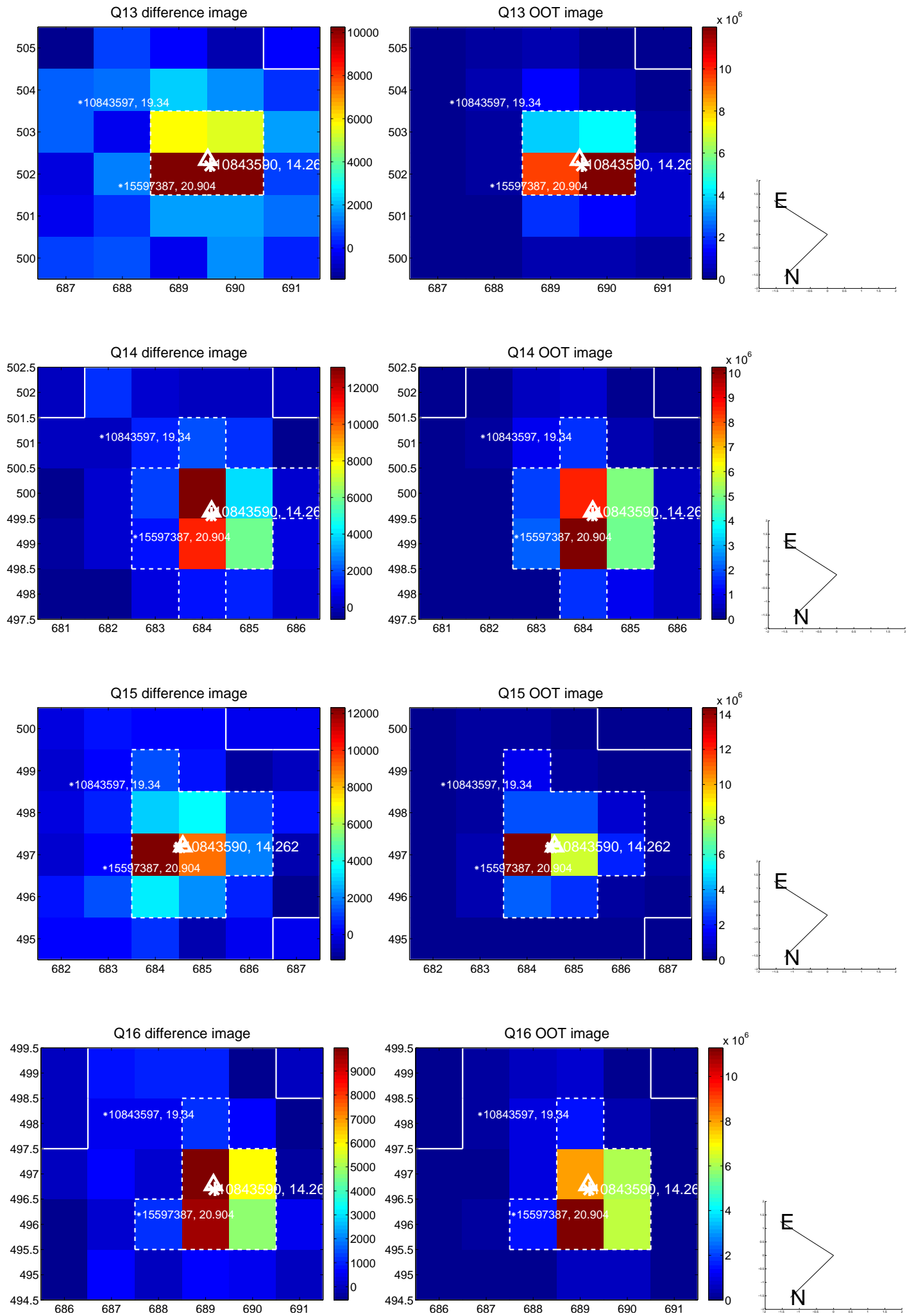
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



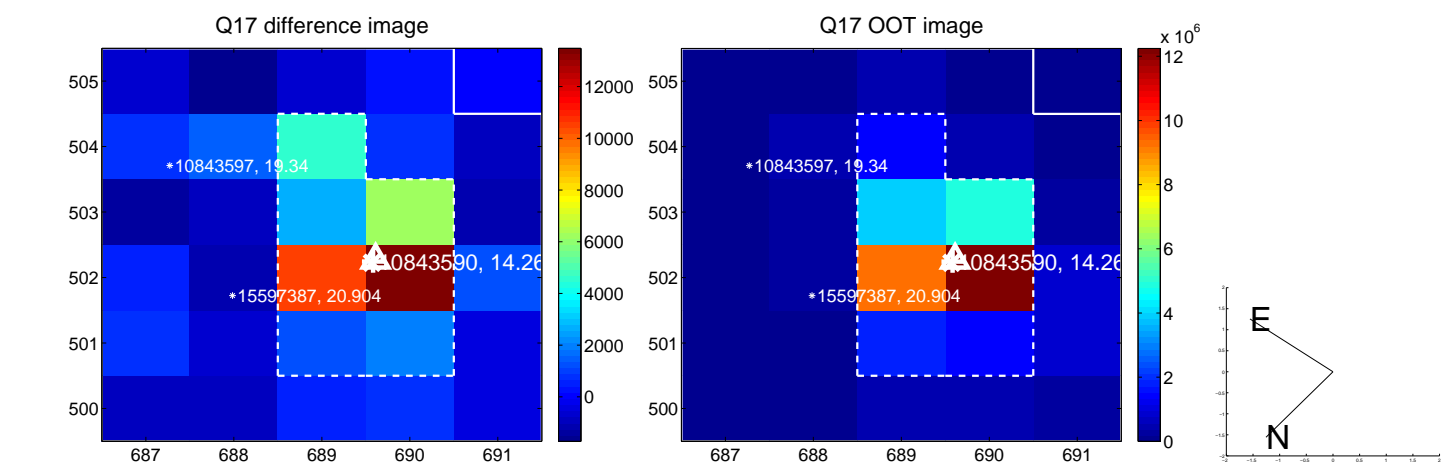
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



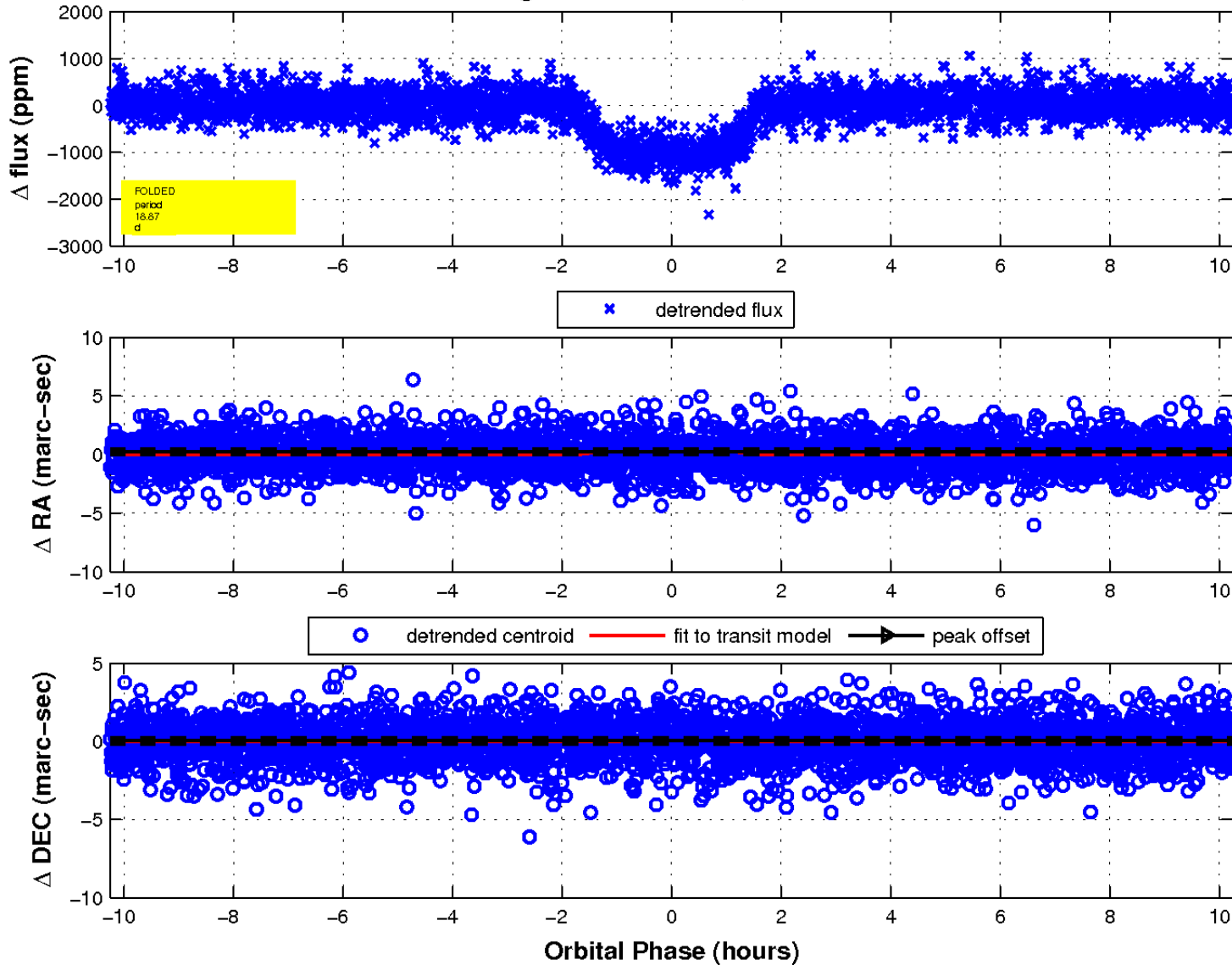
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

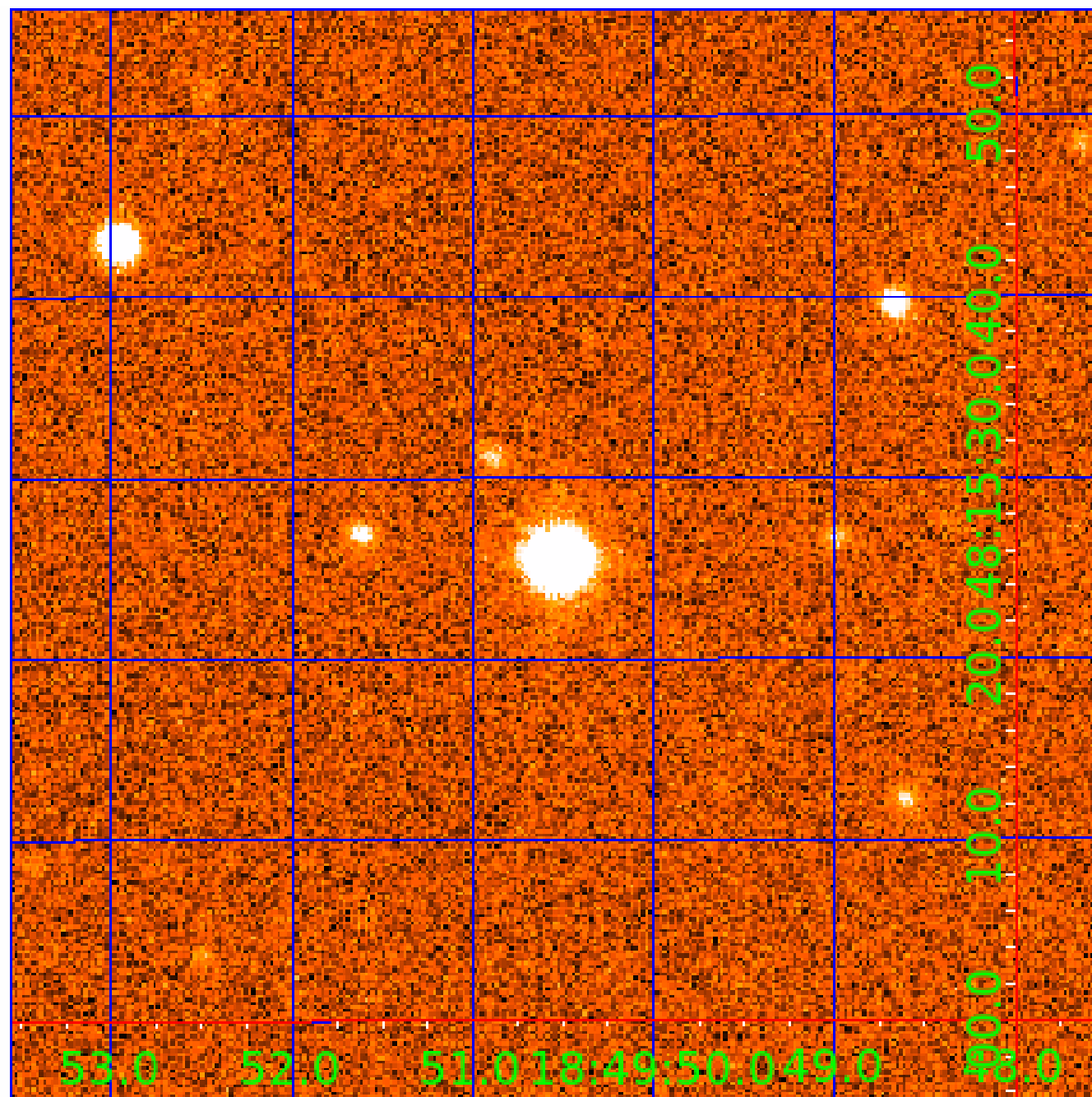


fluxWeightedCentroids, Planet 1 of 2



# UKIRT Image

Declination





# KIC 010843590

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 010843590-01 | OBS      | 0431.01 | 18.870226     | 140.970943   | 1105.1      | 3.416            | 60.2 | 61.6 | 0.86                        | 5402            | 3.34                   | 35.22                  |
| 010843590-02 | OBS      | 0431.02 | 46.902631     | 154.302795   | 793.8       | 4.179            | 29.5 | 31.9 | 0.86                        | 5402            | 2.78                   | 10.46                  |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments   |
|--------------|----------|------|-------|---|---|---|---|------------|
| 010843590-01 | OBS      | PC   | 1.00  | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010843590-02 | OBS      | PC   | 1.00  | 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.

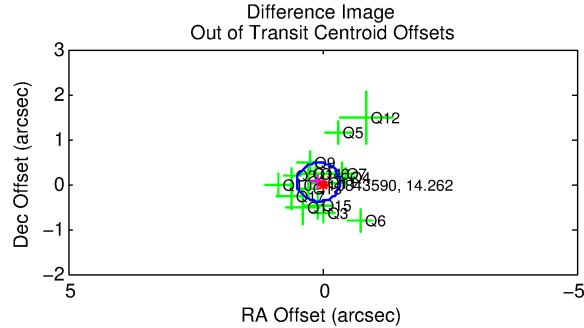
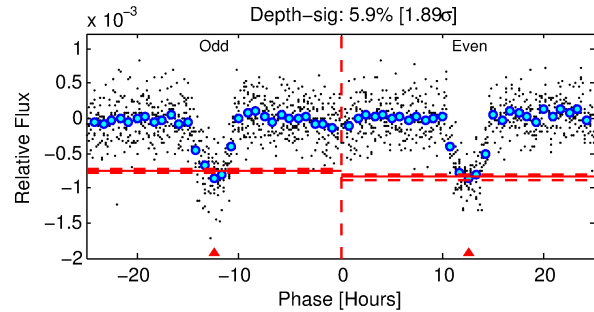
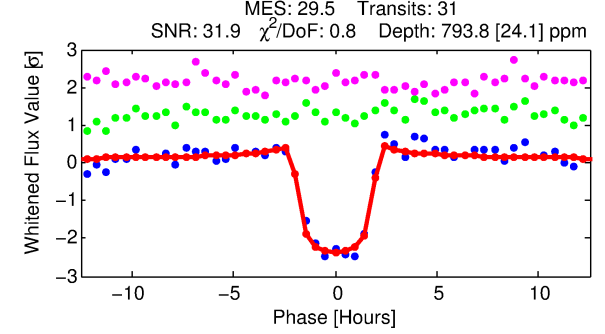
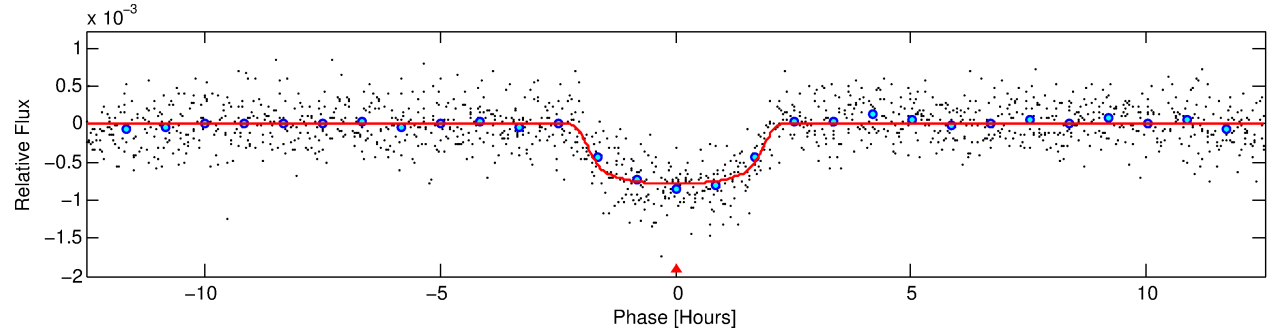
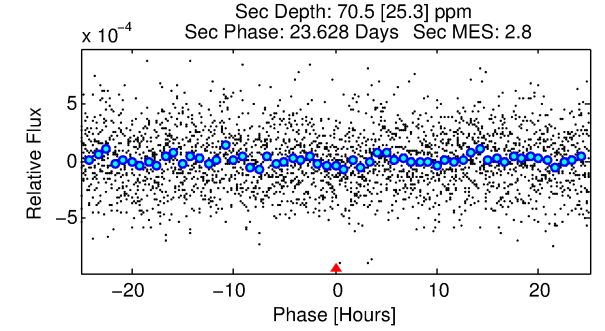
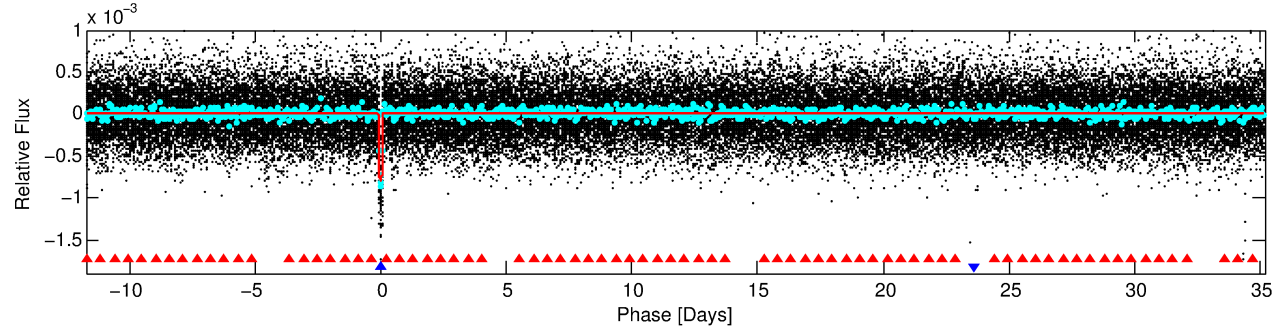
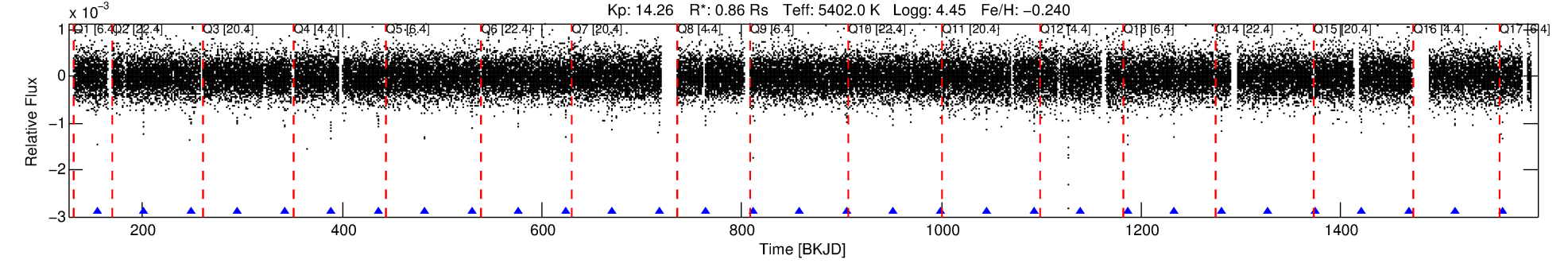
See [http://exoplanetarchive.ipac.caltech.edu/docs/API\\_kepcandidate\\_columns.html#proj\\_disp\\_col](http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col) for comment definitions.

## Ephemeris Match Information For 010843590-02

No Significant Match Found

# DV One-Page Summary

KIC: 10843590 Candidate: 2 of 2 Period: 46.903 d  
KOI: K00431.02 Name: Kepler-153c Corr: 0.971



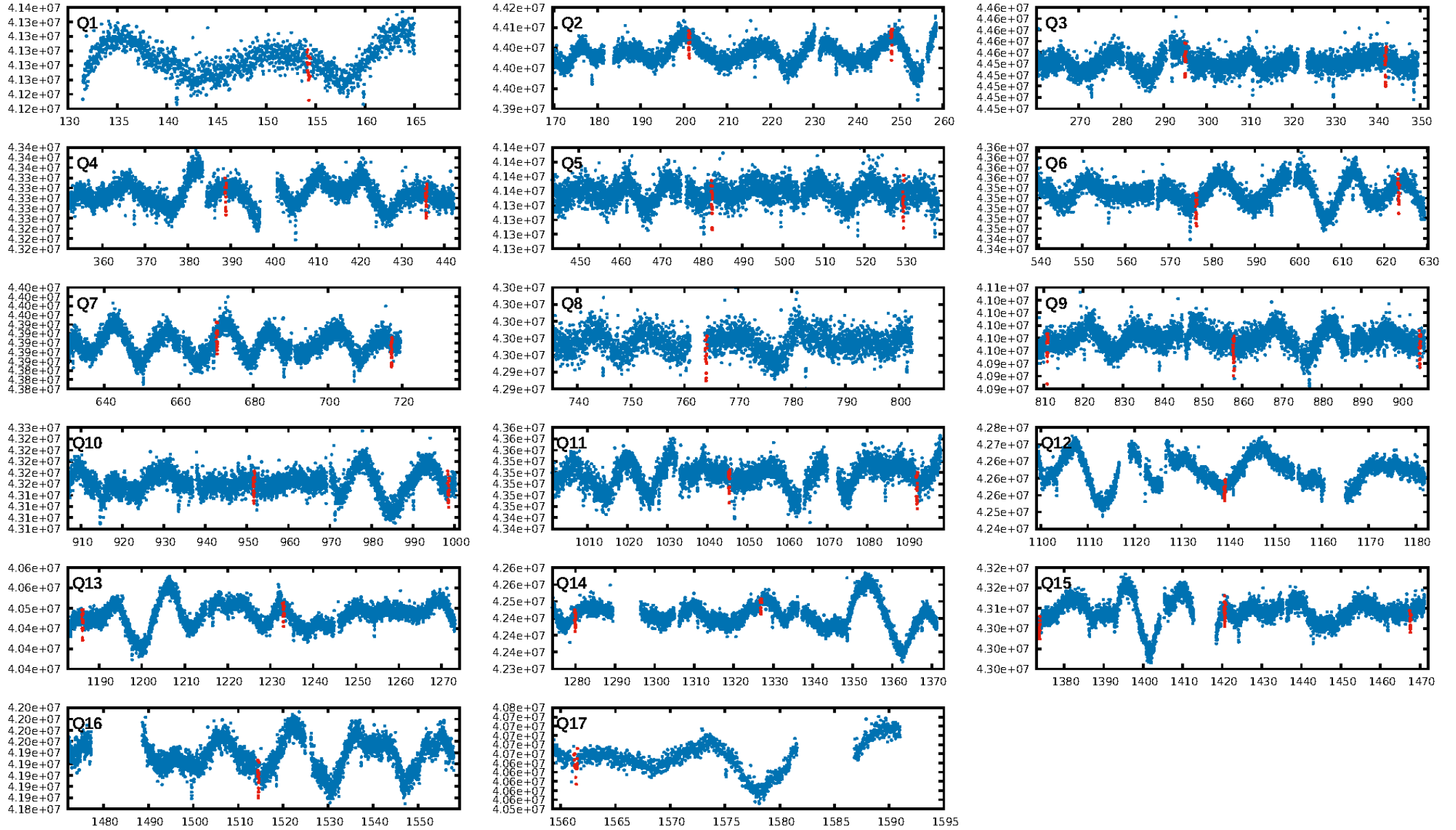
## DV Fit Results:

Period = 46.90263 [0.00013] d  
Epoch = 154.3028 [0.0023] BKJD  
Rp/R\* = 0.0294 [0.0031]  
a/R\* = 51.12 [22.29]  
b = 0.84 [0.16]  
Seff = 10.46 [2.94]  
Teq = 459 [32] K  
Rp = 2.78 [0.60] Re  
a = 0.2336 [0.0388] AU  
Ag = 274.40 [133.51] [2.05σ]  
Teffp = 2886 [316] K [7.65σ]

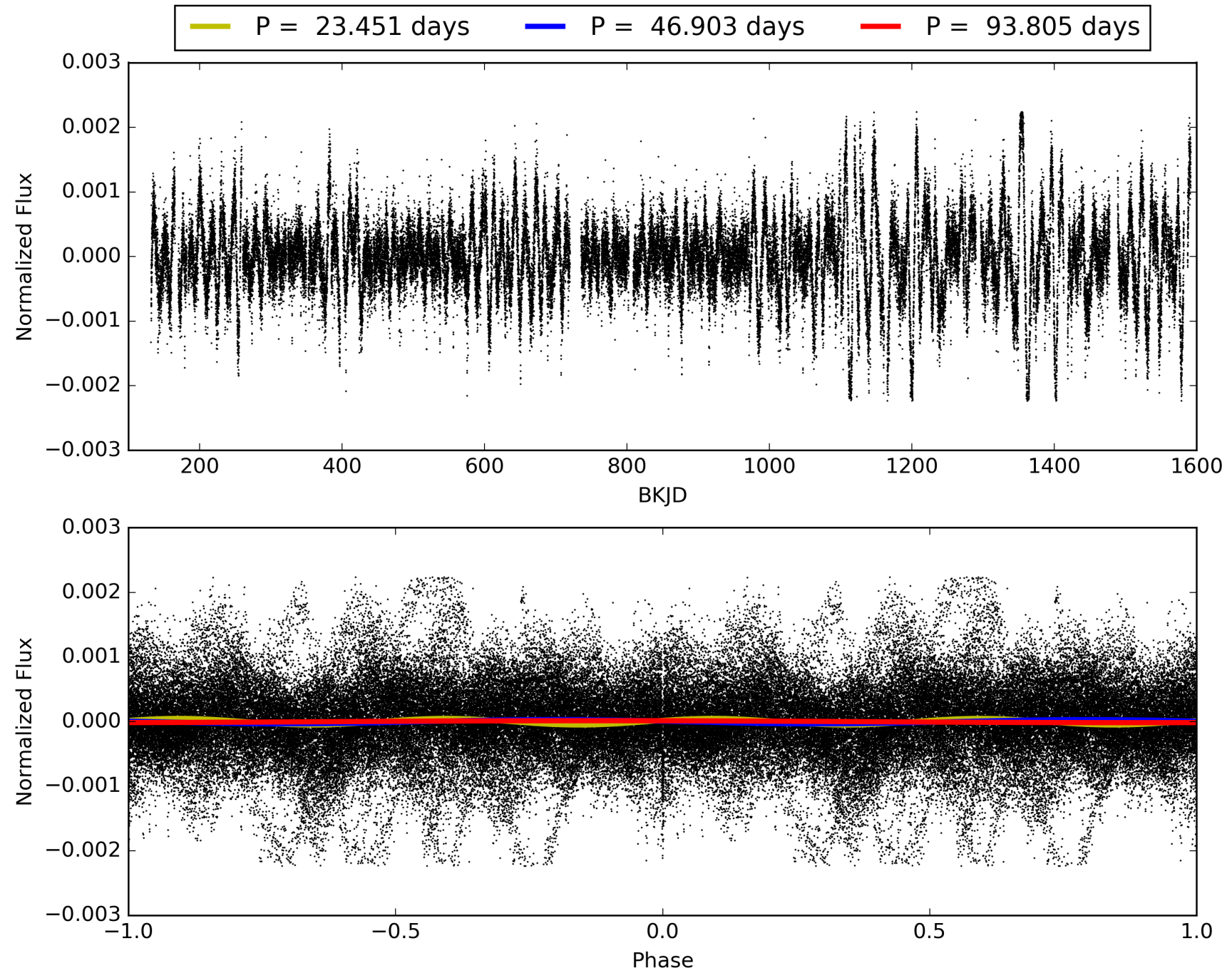
## DV Diagnostic Results:

ShortPeriod-sig: 100.0% [124.64σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 99.2%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 2.08e-179  
RollingBand-fgt: 1.00 [29/29]  
GhostDiagnostic-chr: 3.783  
Centroid-sig: 0.6%  
Centroid-so: 0.916 arcsec [2.51σ]  
OotOffset-rm: 0.097 arcsec [0.68σ]  
KicOffset-rm: 0.119 arcsec [0.78σ]  
OotOffset-st: 4/4/3/5 [16]  
KicOffset-st: 4/4/3/5 [16]  
DiffImageQuality-fgm: 1.00 [16/16]  
DiffImageOverlap-fno: 1.00 [16/16]

# TCE 010843590-02, PDC Light Curves

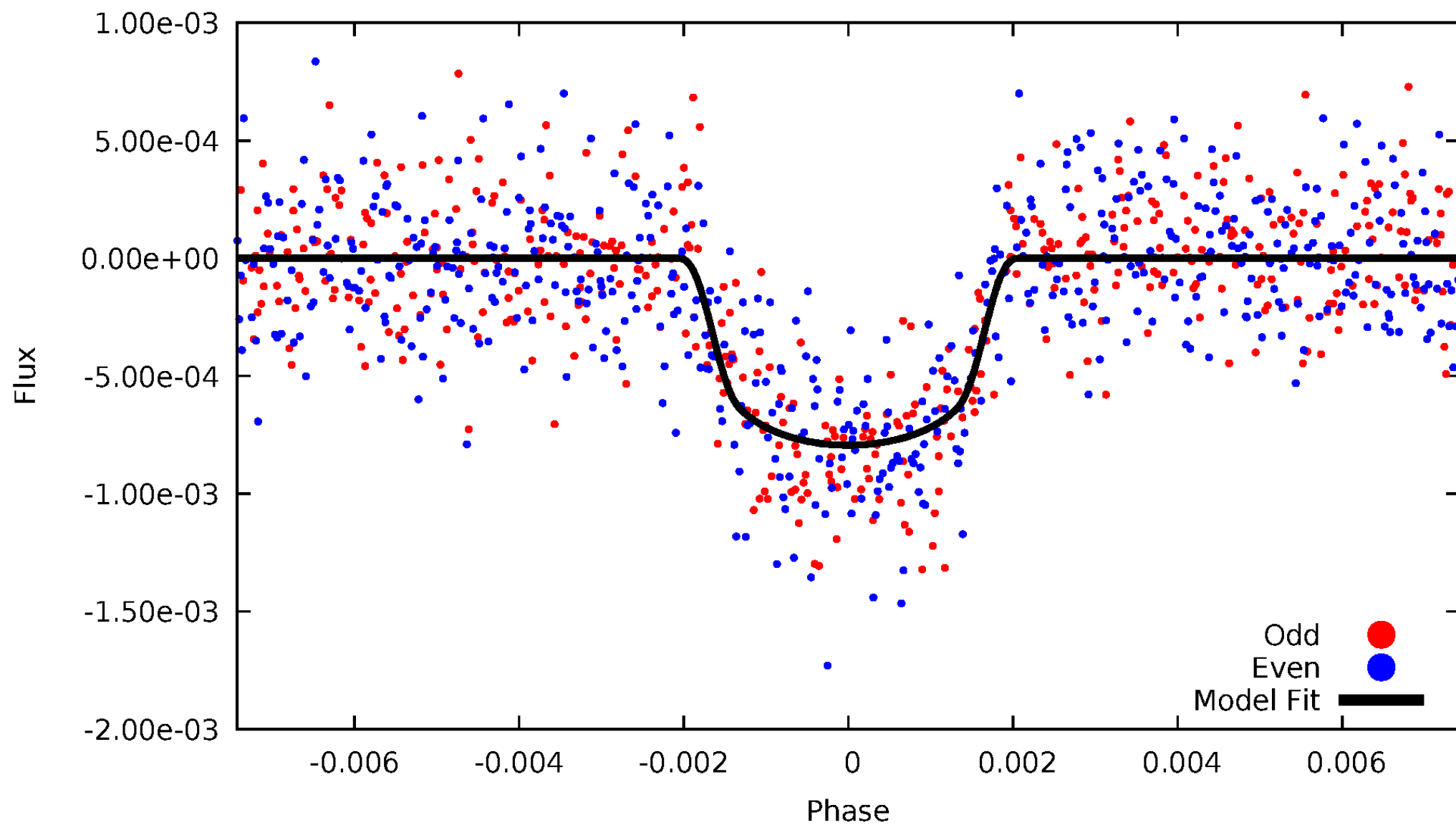


TCE 010843590-02



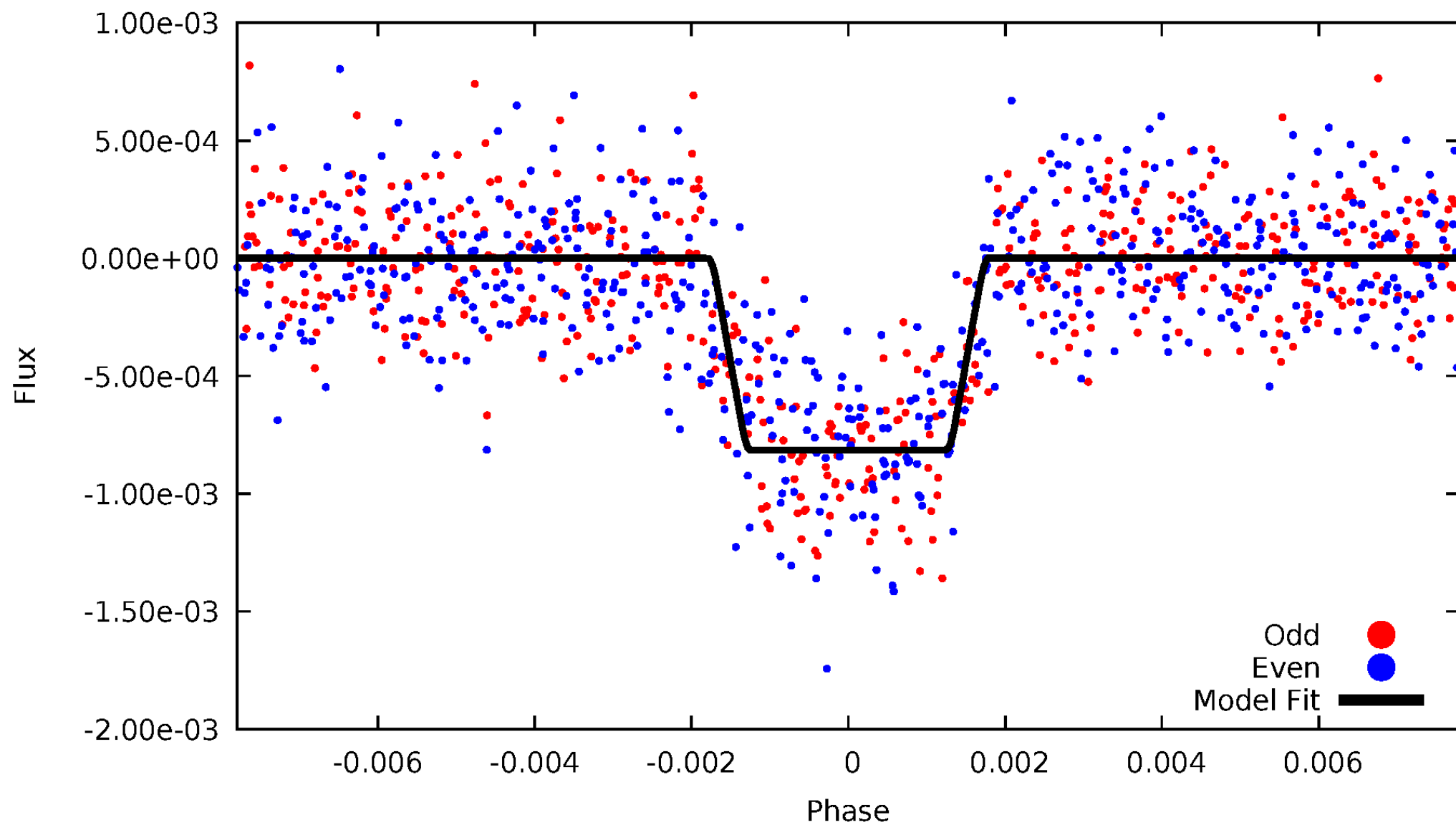
# DV Odd/Even

TCE 010843590-02



# ALT Odd/Even

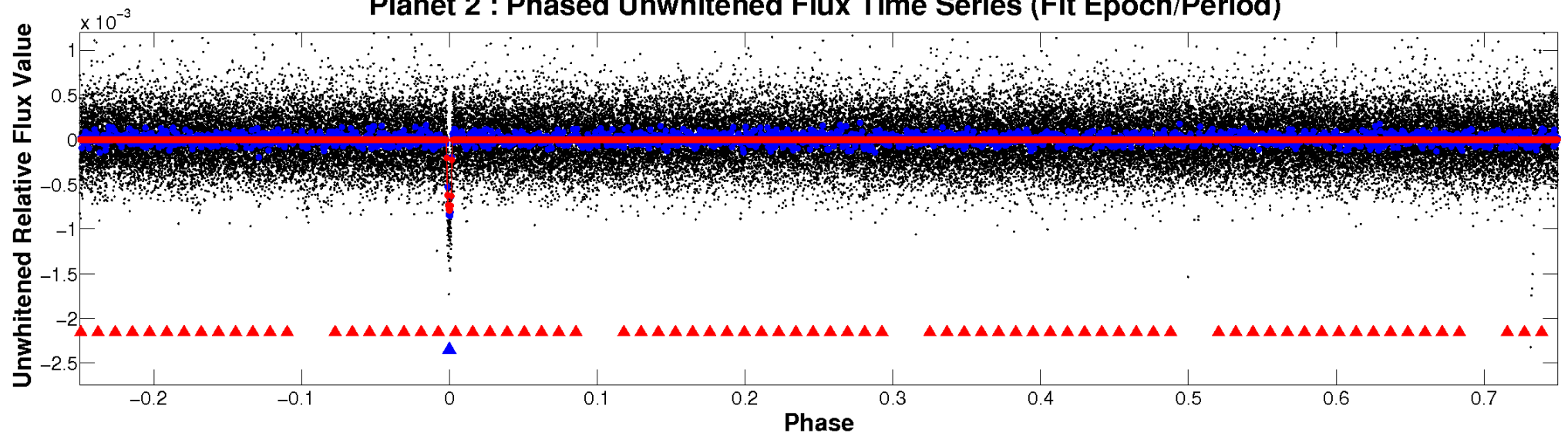
TCE 010843590-02



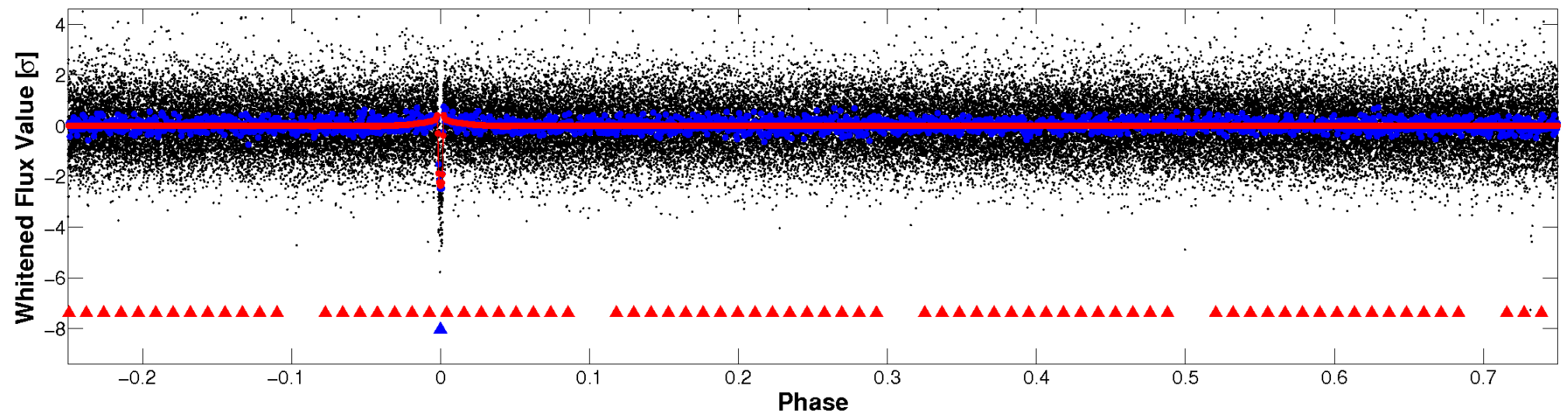


# Non-Whitened Vs. Whitened Light Curve

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

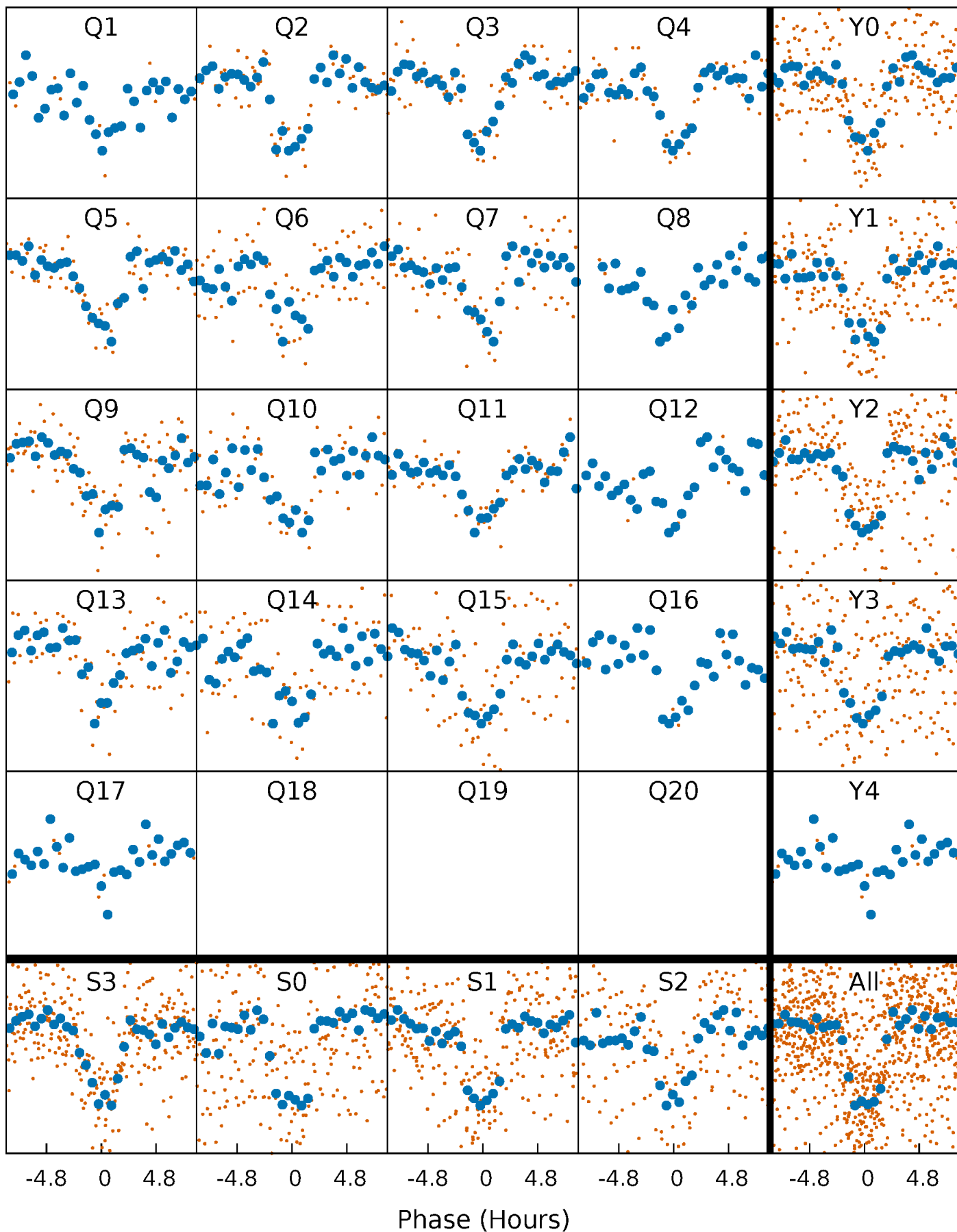


## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



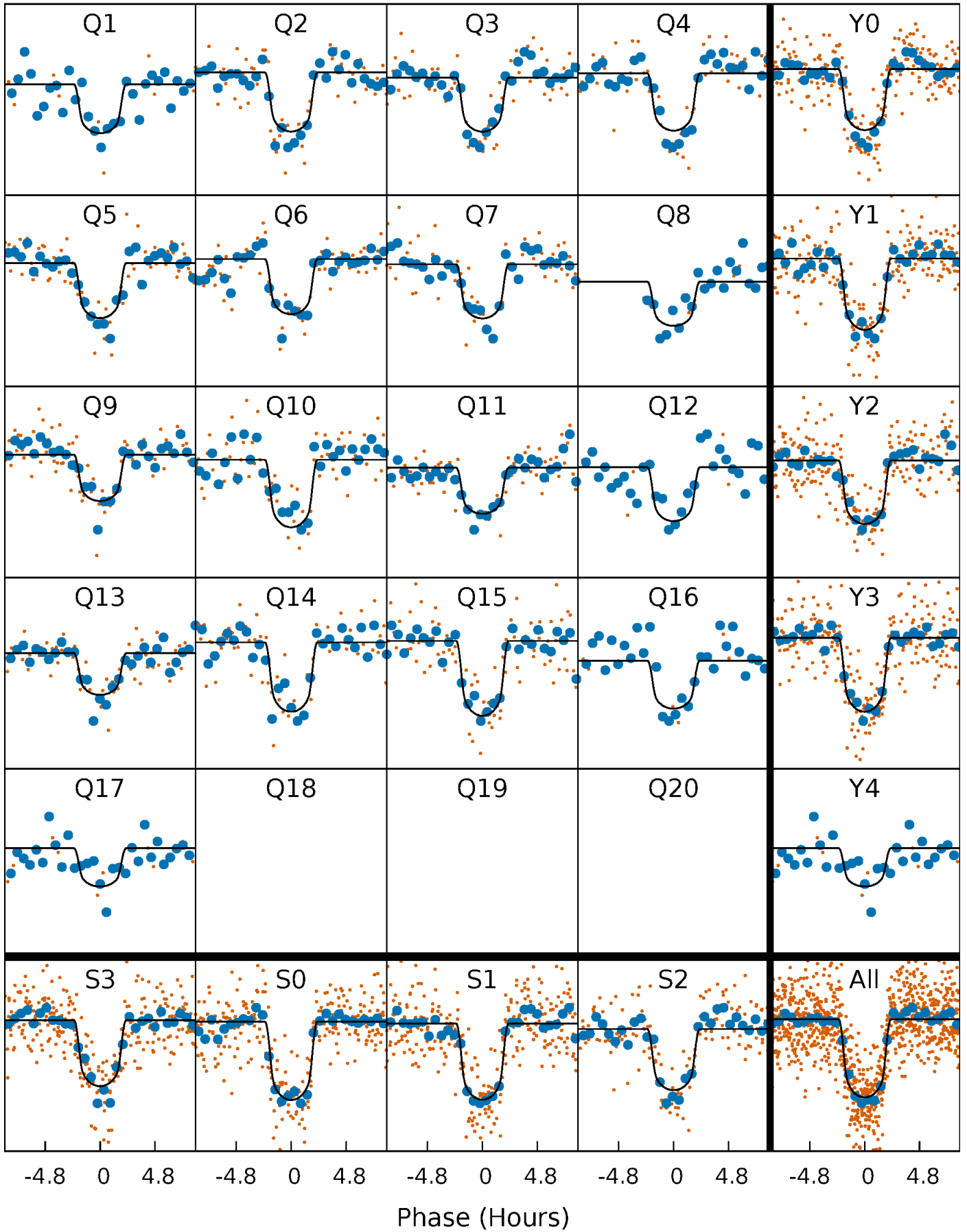
# PDC Quarter-Phased Transit Curves

TCE 010843590-02   P= 46.902631 Days    $T_0=154.302795$  (BKJD)



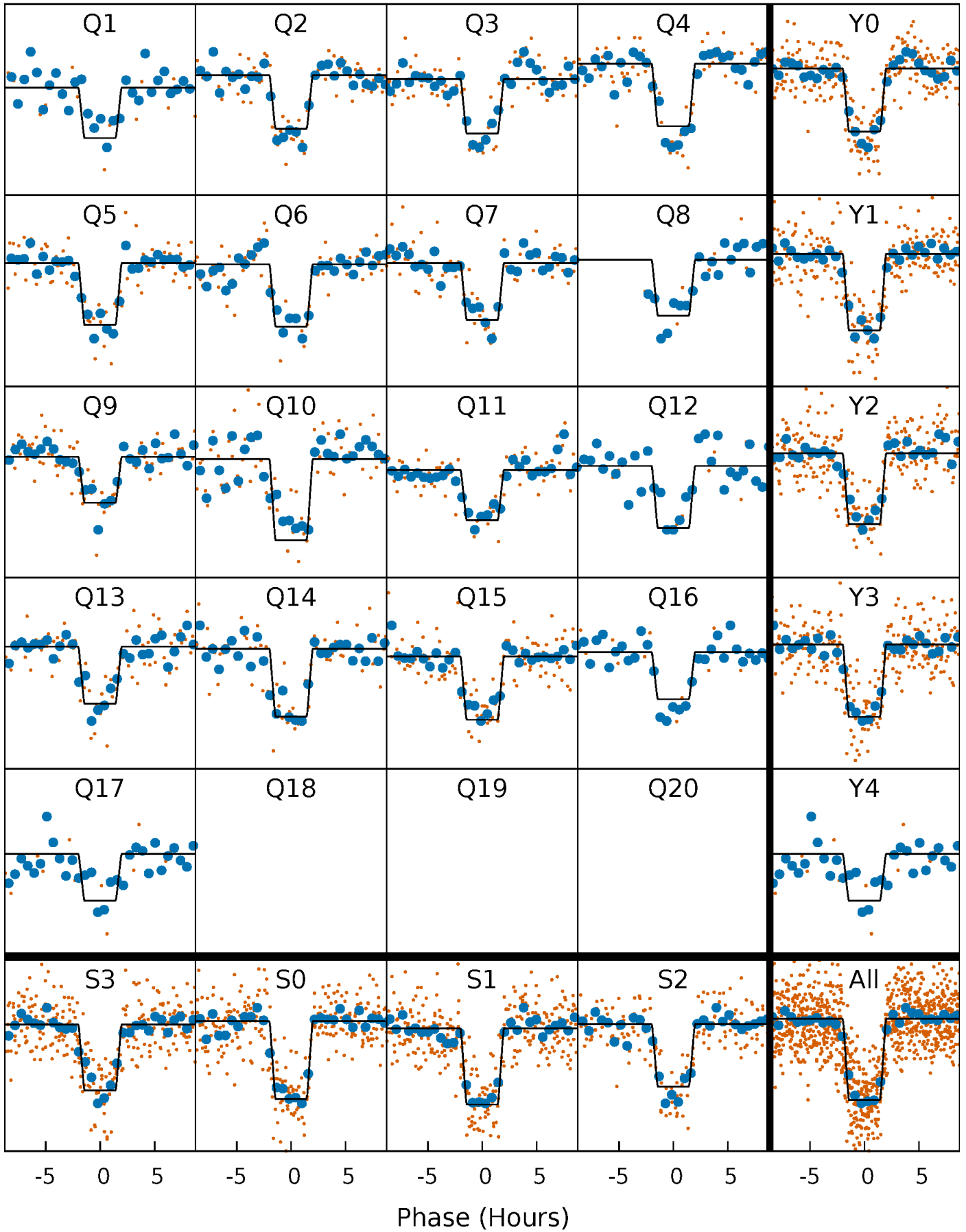
# DV Quarter-Phased Transit Curves

TCE 010843590-02   P= 46.902631 Days    $T_0=154.302795$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

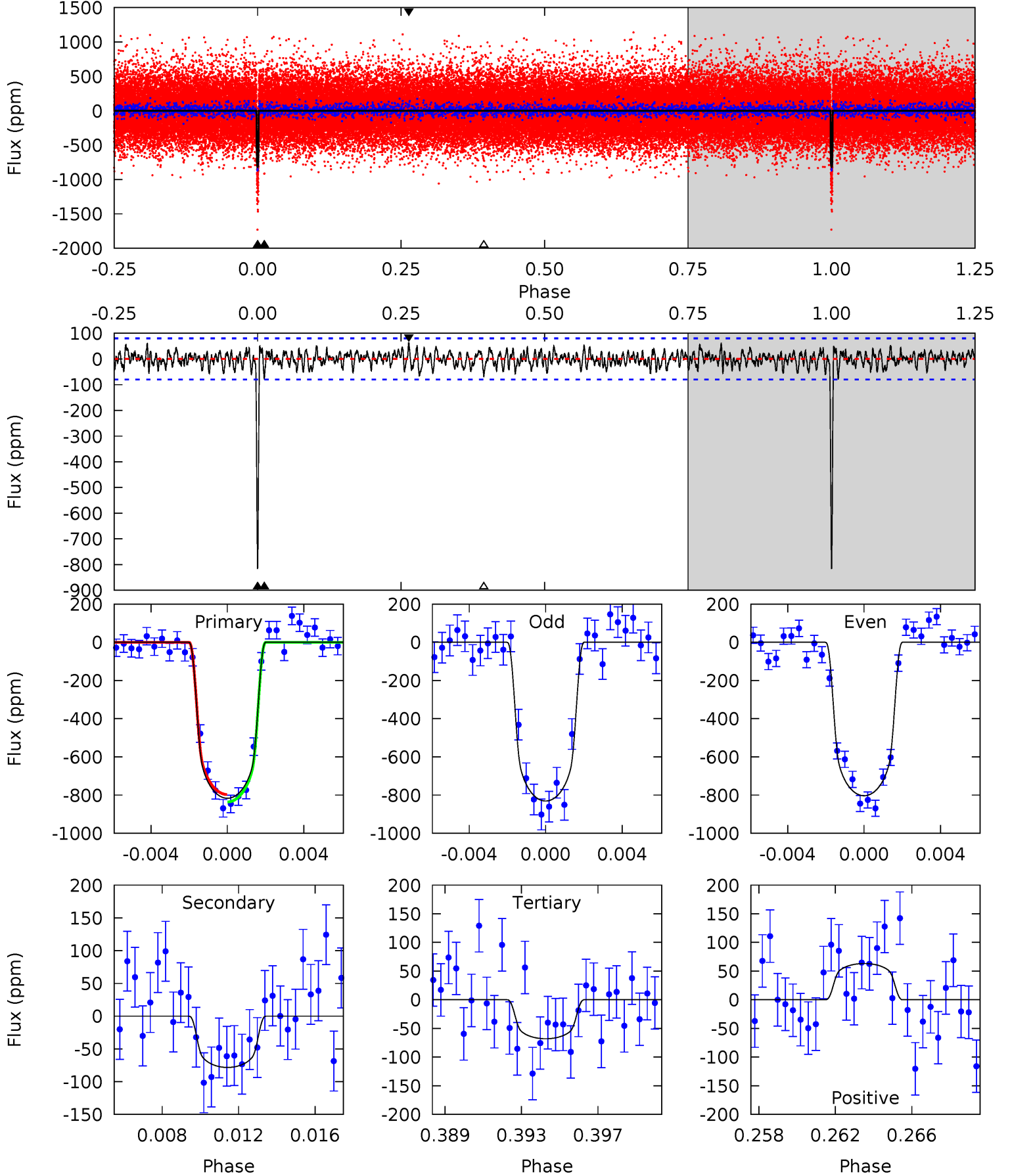
TCE 010843590-02   P= 46.902881 Days    $T_0=154.300296$  (BKJD)



# DV Model-Shift Uniqueness Test

010843590-02, P = 46.902631 Days, E = 107.400164 Days

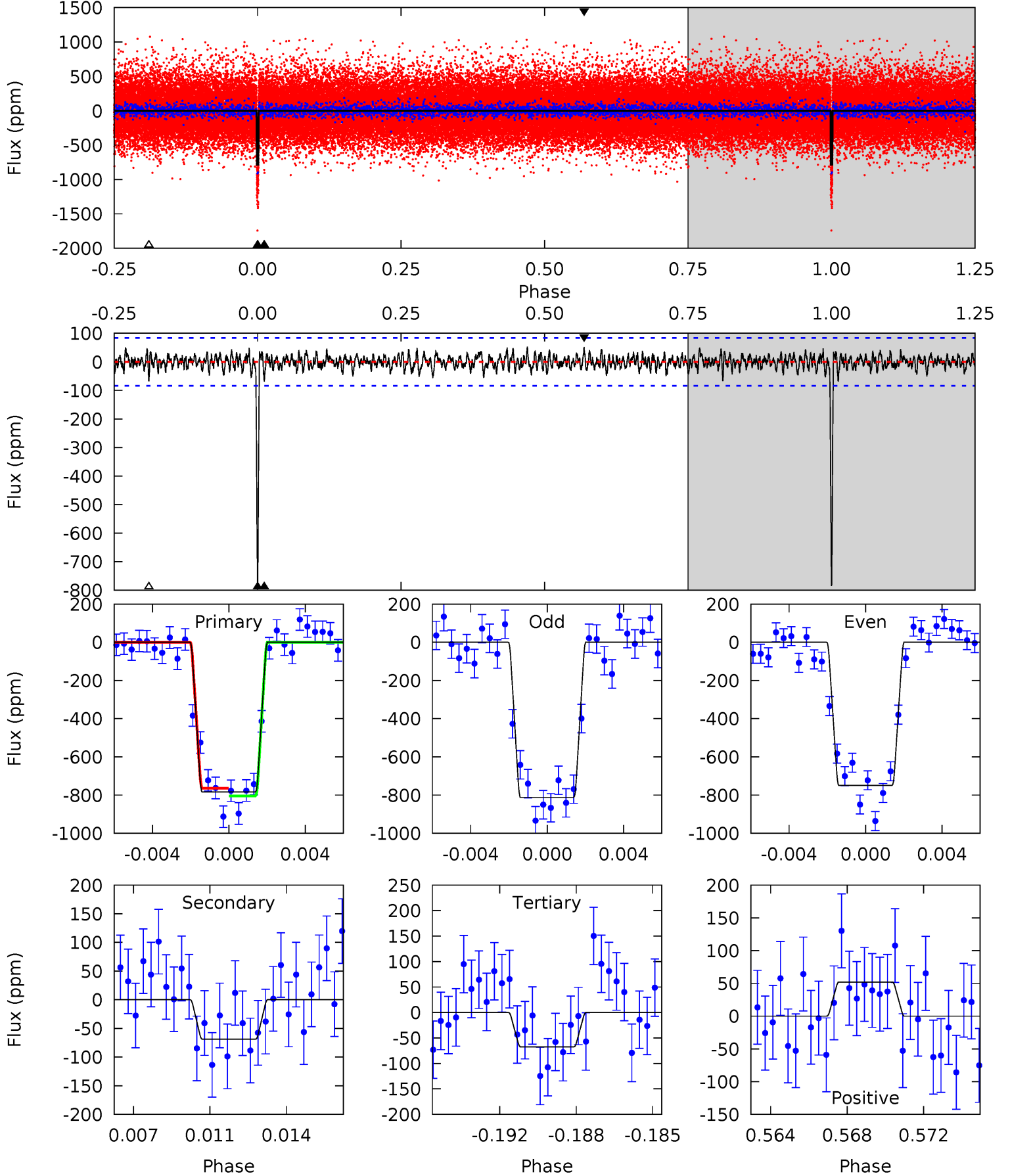
| Pri  | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 53.0 | 5.08 | 4.41 | 4.10 | 5.20            | 2.87            | 1.48             | 48.6    | 48.9    | 0.67    | 0.98    | 0.90    | 1.01 | 0.07  | 1.27 |



# Alt Model-Shift Uniqueness Test

010843590-02, P = 46.902881 Days, E = 107.397415 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  |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 48.9 | 4.29 | 4.21 | 3.25 | 5.22            | 2.92            | 1.16             | 44.7    | 45.7    | 0.07    | 1.03    | 1.96    | 1.01 | 0.06  | 1.25 |





### Stellar Parameters For KIC 010843590

|        | $T_{\text{eff}}(K)$  | $\log(g)$                 | [Fe/H]                     | $R (R_{\odot})$           | $M(M_{\odot})$            | $p_{\star} (\text{g}\cdot\text{cm}^{-3})$ |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $5402^{+175}_{-159}$ | $4.452^{+0.126}_{-0.140}$ | $-0.240^{+0.300}_{-0.300}$ | $0.865^{+0.164}_{-0.119}$ | $0.774^{+0.122}_{-0.052}$ | $1.683^{+0.958}_{-0.666}$                 |
|        | +3%/-3%              | +3%/-3%                   | +125%/-125%                | +19%/-14%                 | +16%/-7%                  | +57%/-40%                                 |
| 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 010843590-02 / KOI 0431.02

| Detrend | Depth (ppm)  | $R_p (R_{\oplus})$     | $T_{max} (K)$     | $T_{obs} (K)$        | $A_{obs}$          |
|---------|--------------|------------------------|-------------------|----------------------|--------------------|
| DV      | $-78 \pm 15$ | $2.80^{+0.43}_{-0.37}$ | $644^{+35}_{-37}$ | $3457^{+174}_{-173}$ | $299^{+129}_{-85}$ |
| Alt.    | $-69 \pm 16$ | $2.75^{+0.44}_{-0.37}$ | $646^{+38}_{-36}$ | $3397^{+196}_{-177}$ | $273^{+111}_{-93}$ |

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

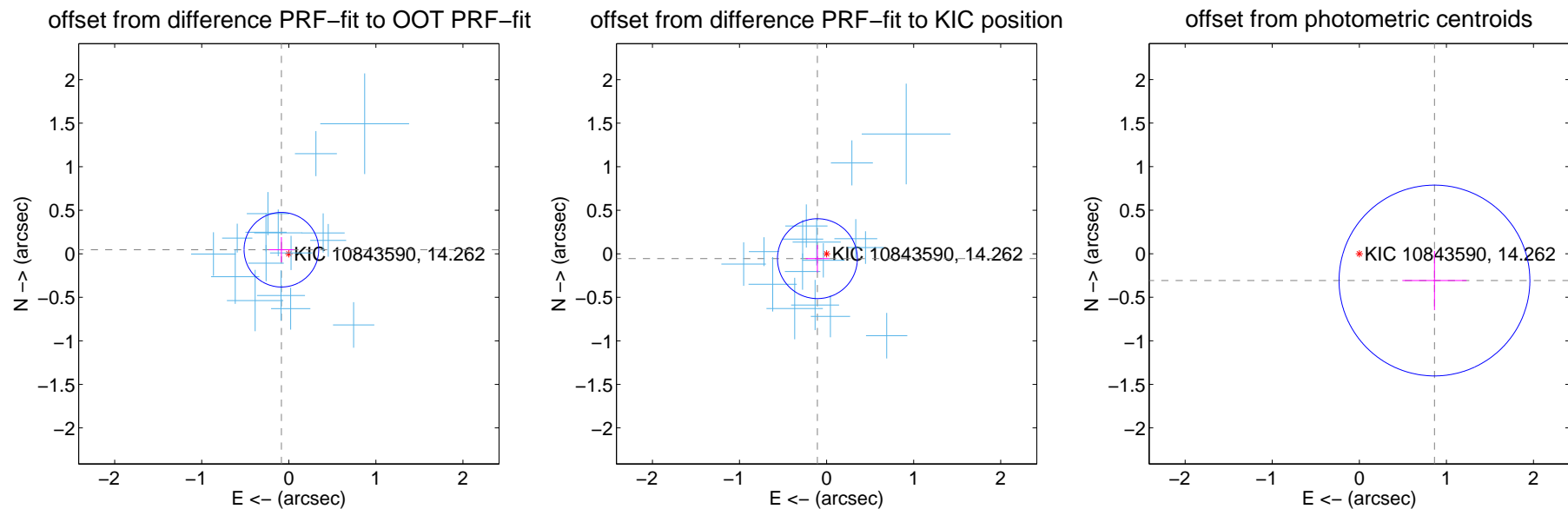
## DV Centroid Data

Supplemental centroid analysis for 010843590-02. Kepler magnitude: 14.26. Transit SNR 31.91

There are 16 quarters with good PRF difference image offsets

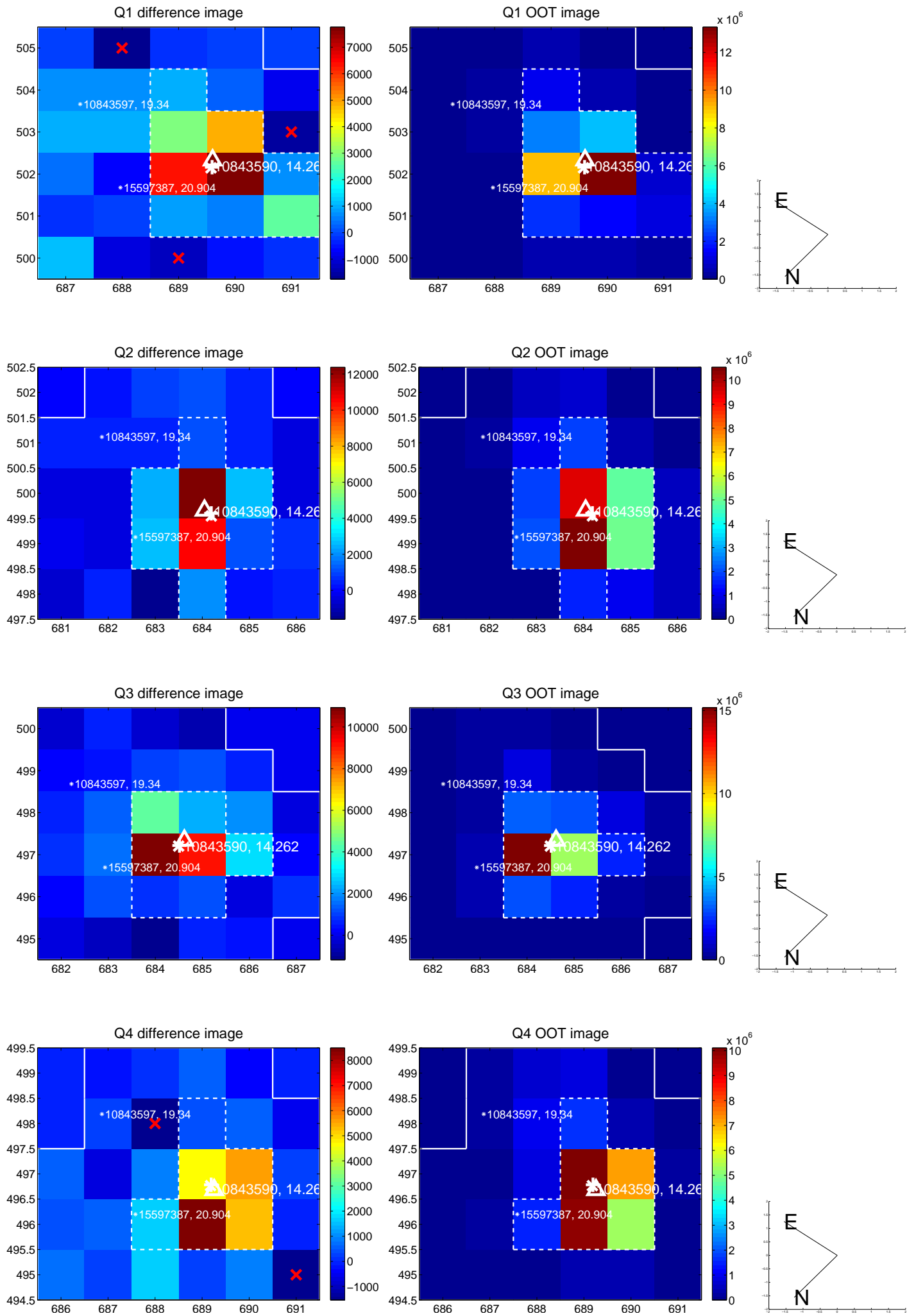
The direct PRF centroid is offset from the target star catalog position by about 0.09 arcsec

|   | Distance in arcsec | Distance / $\sigma$ | $\Delta$ RA       | $\Delta$ Dec       |
|---|--------------------|---------------------|-------------------|--------------------|
| PRF-fit source offset from OOT          | $0.097 \pm 0.143$  | 0.68                | $0.085 \pm 0.142$ | $0.047 \pm 0.145$  |
| PRF-fit source offset from KIC position | $0.119 \pm 0.153$  | 0.78                | $0.105 \pm 0.134$ | $-0.056 \pm 0.157$ |
| photometric centroid source offset      | $0.92 \pm 0.37$    | 2.51                | $-0.86 \pm 0.37$  | $-0.31 \pm 0.34$   |

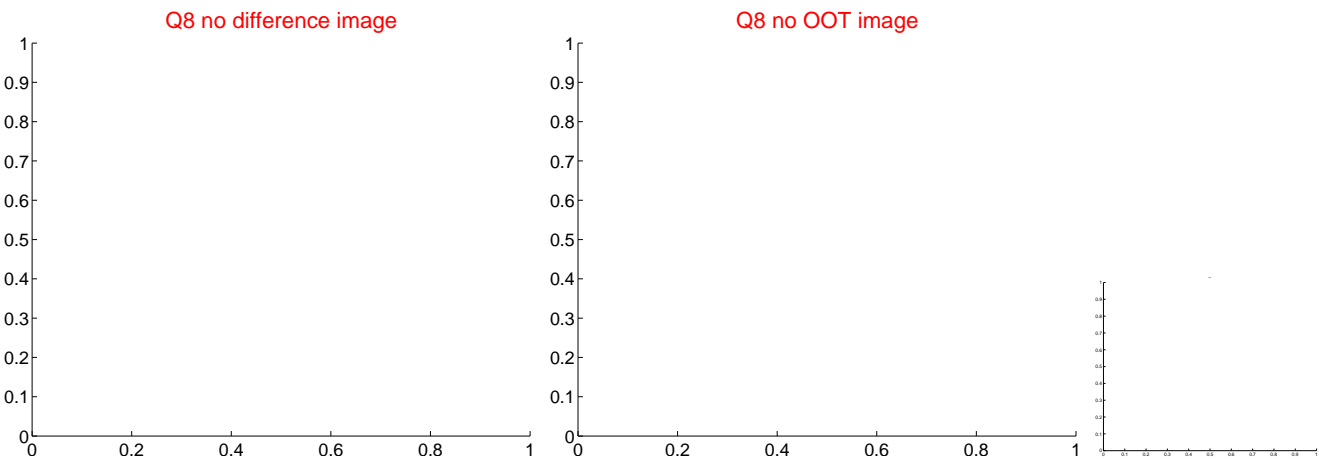
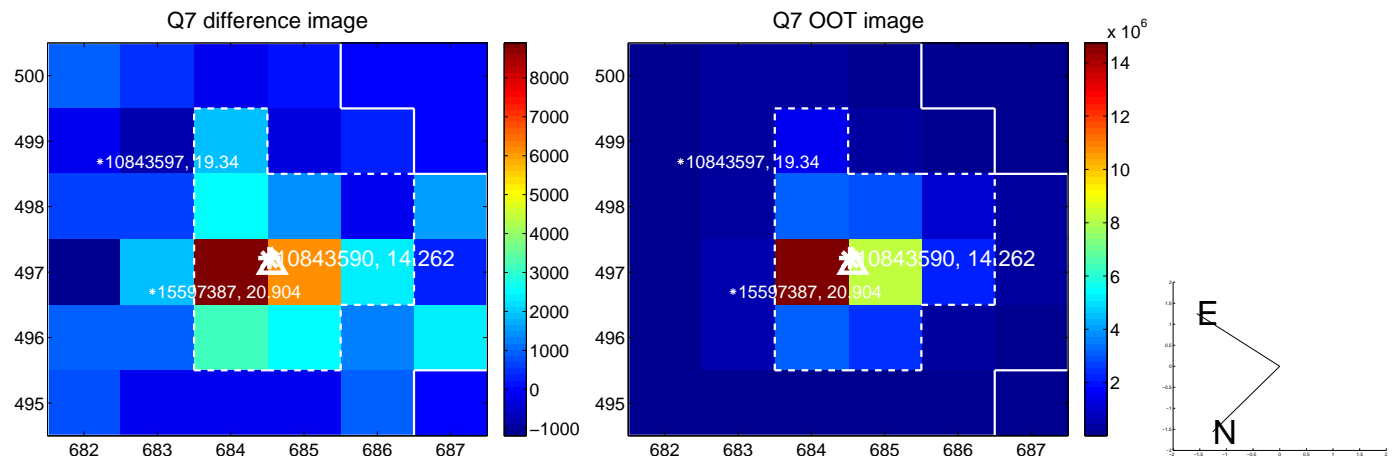
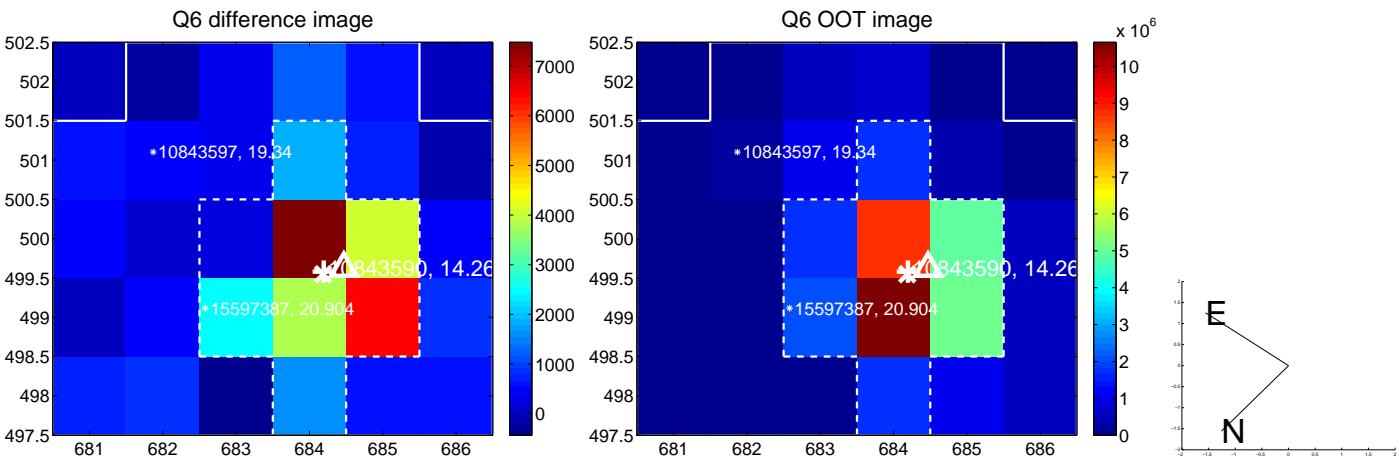
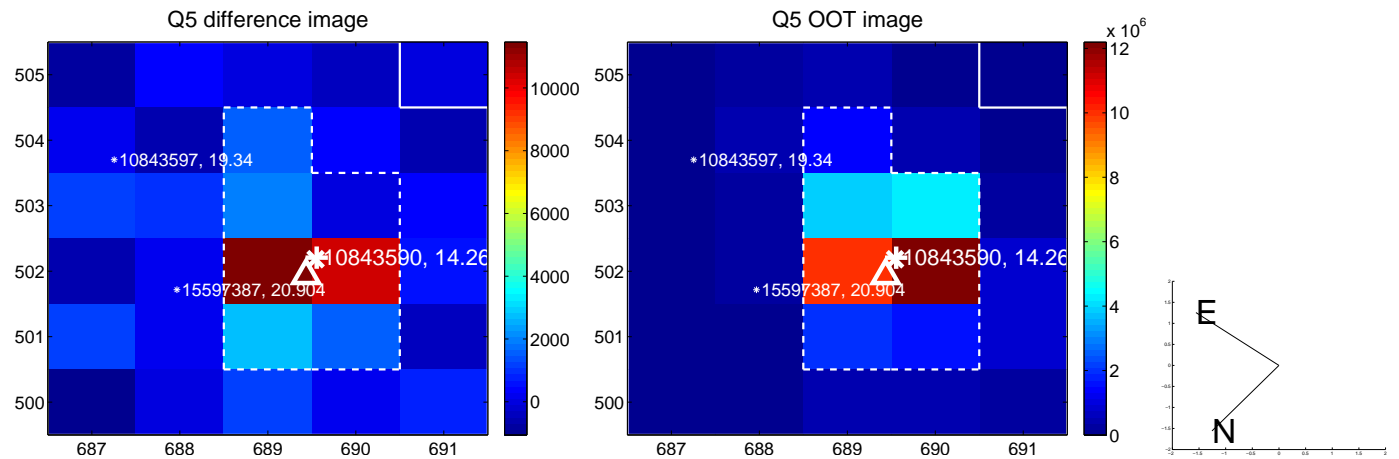


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

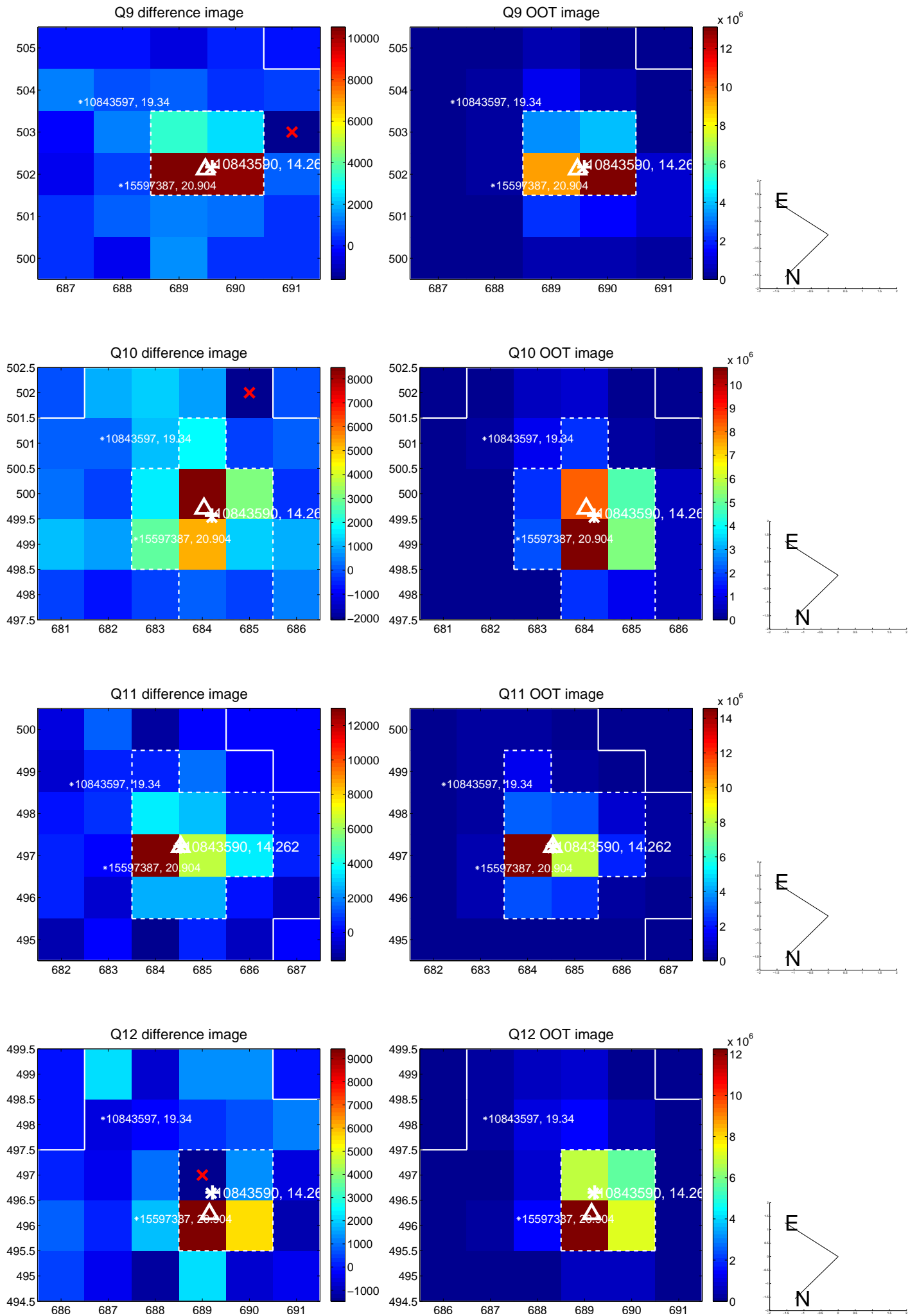
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



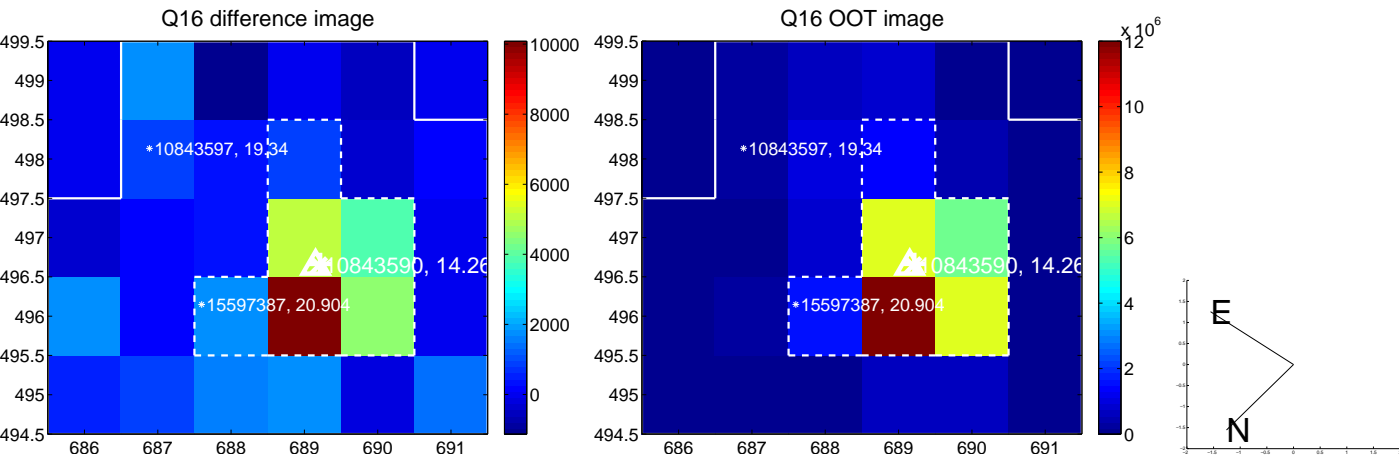
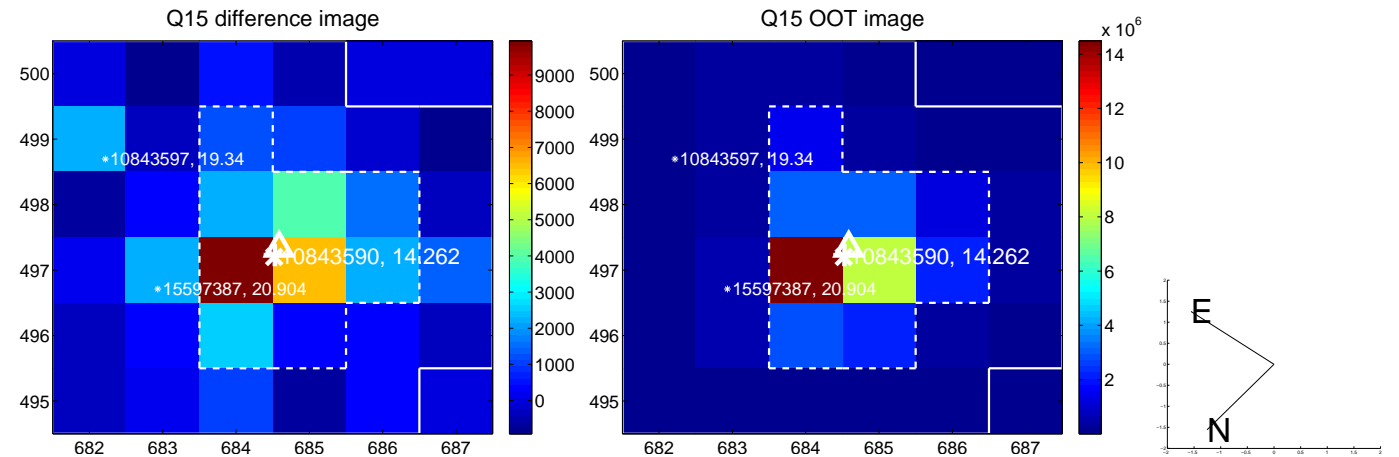
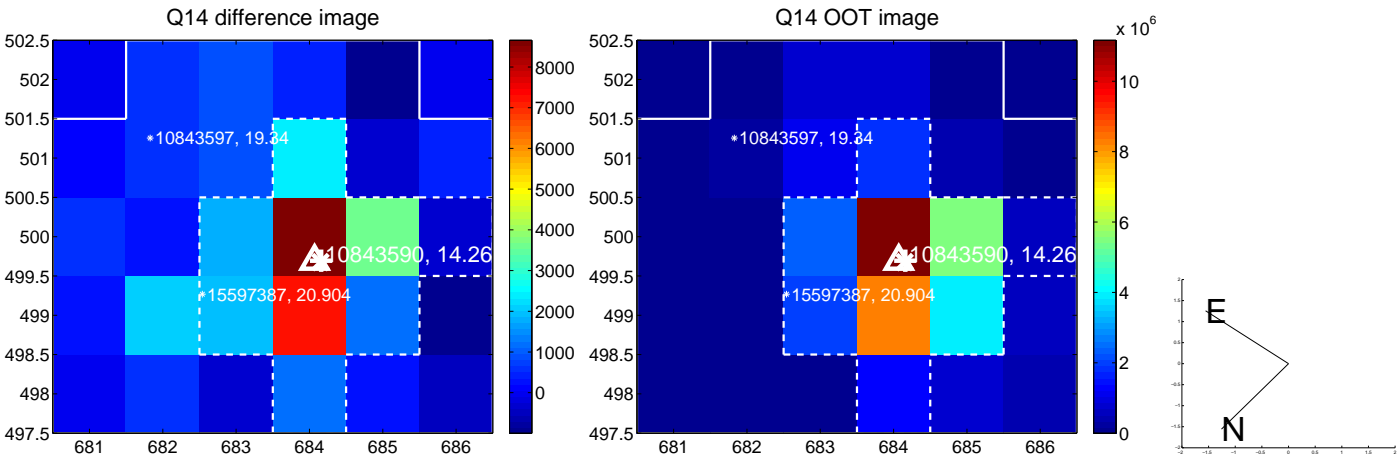
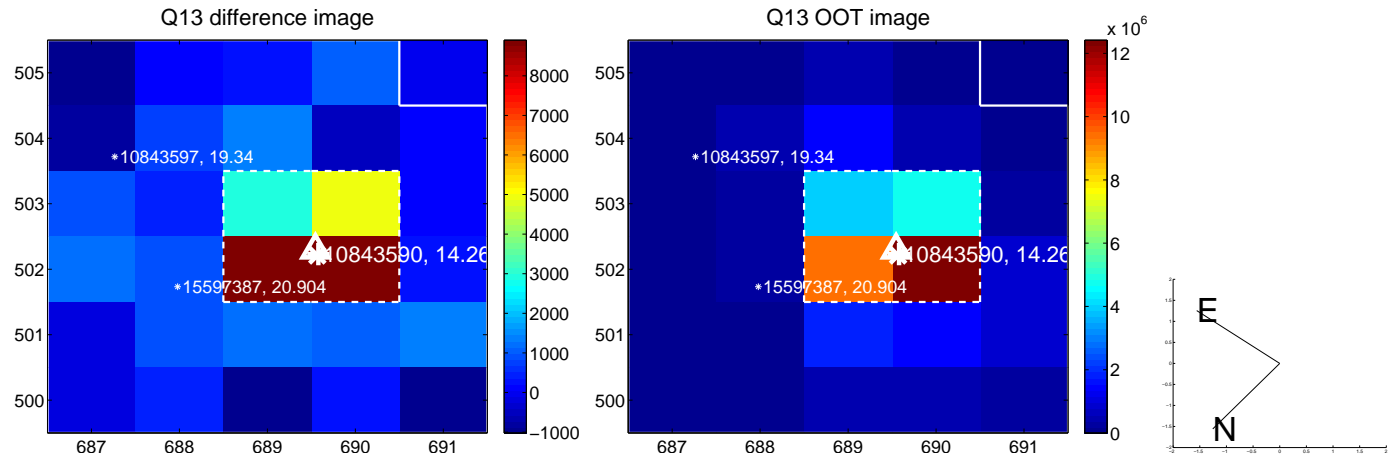
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



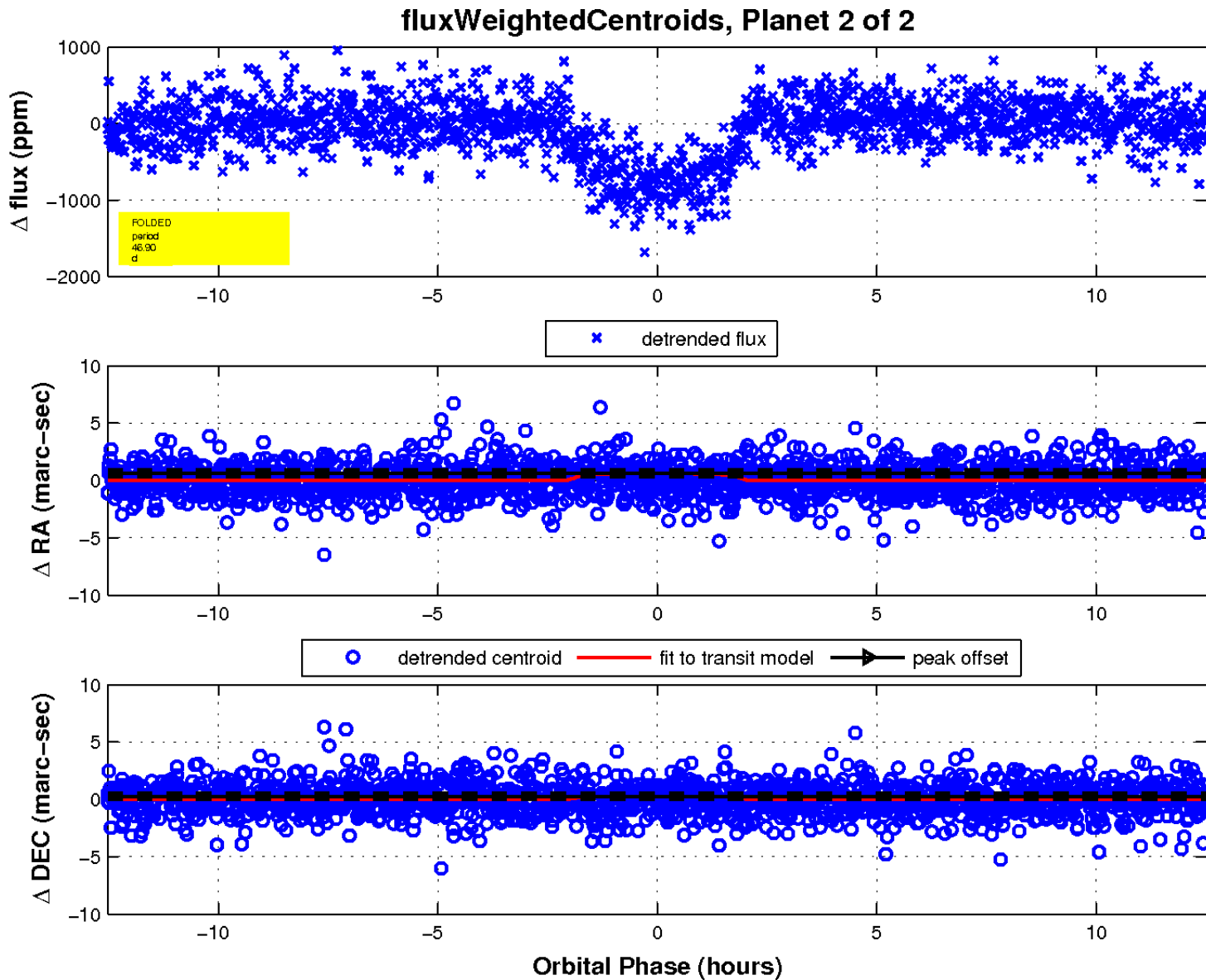
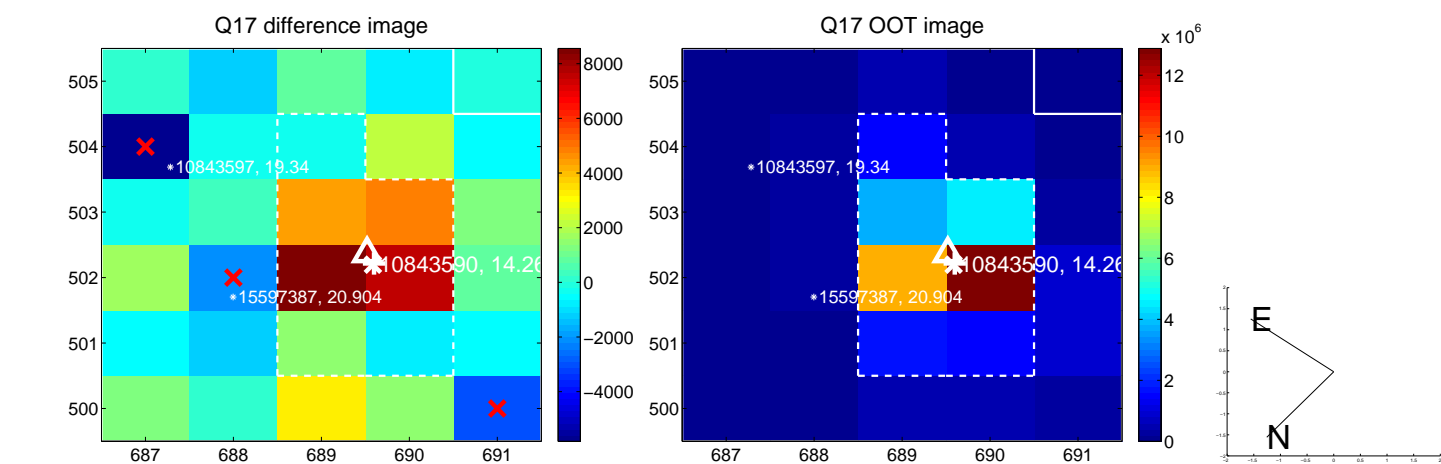
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

