

# KIC 004649305

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|-------|-------|-----------------------------|-----------------|------------------------|------------------------|
| 004649305-01 | OBS      | 0143.01 | 22.651174     | 140.336926   | 2270.1      | 3.704            | 182.1 | 181.8 | 1.33                        | 6968            | 7.60                   | 126.79                 |
| 004649305-02 | OBS      | No      | 22.651222     | 140.432655   | 936.6       | 29.052           | 40.5  | 44.9  | 1.33                        | 6968            | 7.63                   | 126.79                 |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments            |
|--------------|----------|------|-------|---|---|---|---|---------------------|
| 004649305-01 | OBS      | PC   | 0.98  | 0 | 0 | 0 | 0 | NO_COMMENT          |
| 004649305-02 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | LPP_DV—RESIDUAL_TCE |

**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.

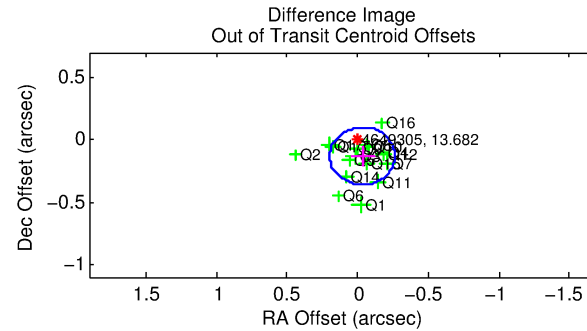
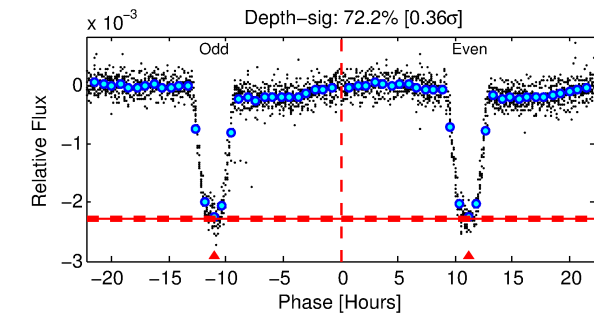
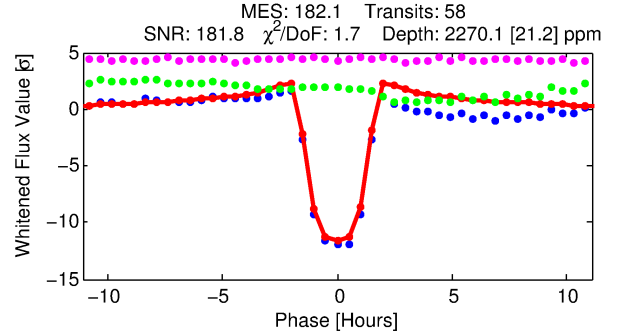
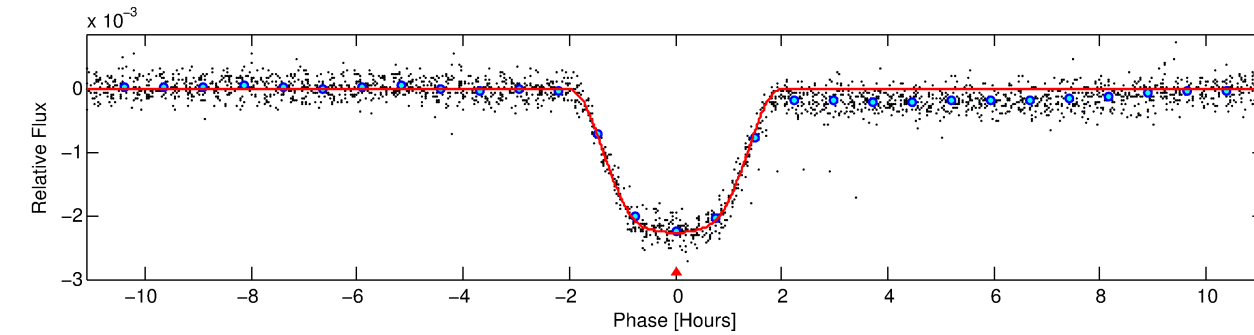
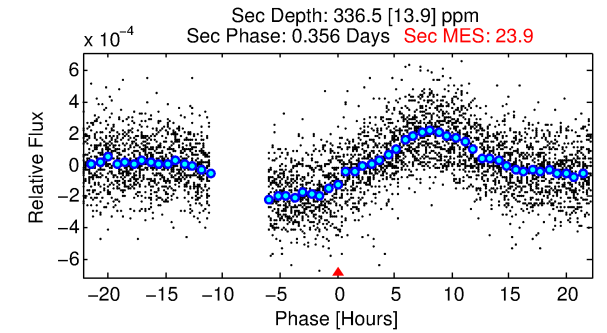
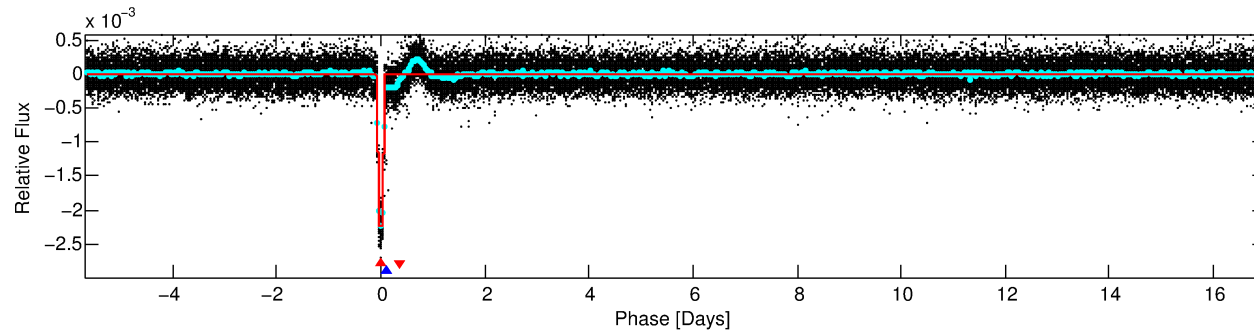
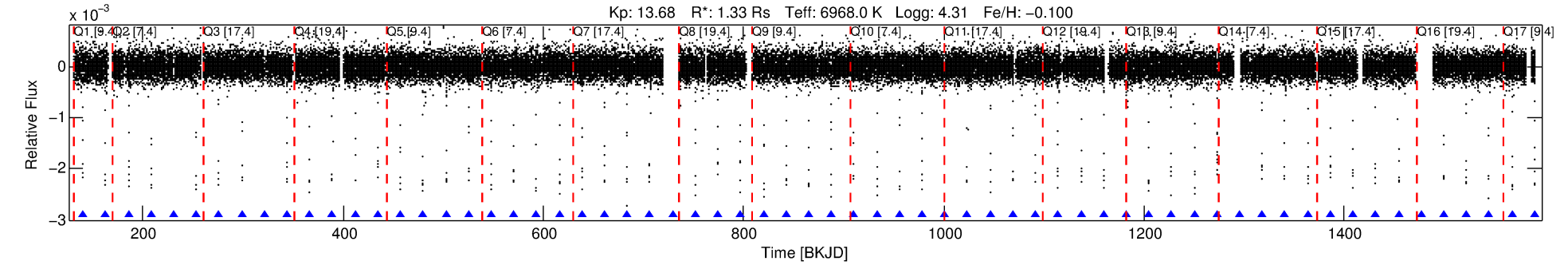
## Ephemeris Match Information For 004649305-01

No Significant Match Found

# DV One-Page Summary

KIC: 4649305 Candidate: 1 of 2 Period: 22.651 d

KOI: K00143.01 Corr: 0.991



## DV Fit Results:

Period = 22.65117 [0.00002] d  
Epoch = 140.3369 [0.0006] BKJD  
Rp/R\* = 0.0522 [0.0004]  
a/R\* = 23.27 [0.43]  
b = 0.93 [0.00]  
Seff = 126.79 [58.95]  
Teq = 856 [99] K  
Rp = 7.60 [2.93] Re  
a = 0.1720 [0.0537] AU  
Ag = 94.86 [41.84] [2.24σ]  
Teffp = 4129 [164] K [17.03σ]

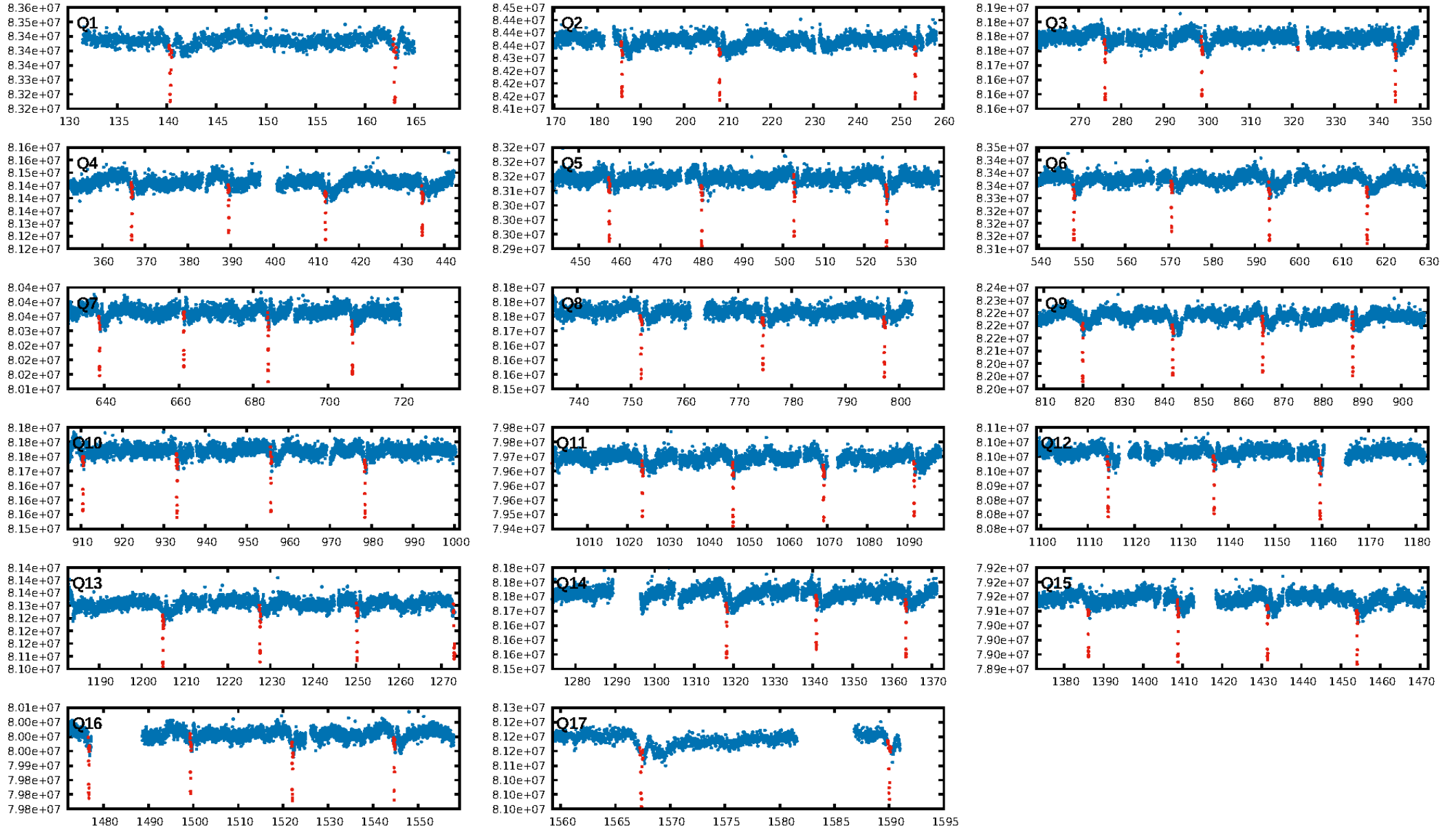
## DV Diagnostic Results:

ShortPeriod-sig: N/A  
LongPeriod-sig: 0.0% [0.00σ]  
ModelChiSquare2-sig: 0.0%  
ModelChiSquareGof-sig: 58.7%  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 1.00 [54/54]  
GhostDiagnostic-chr: 5.176  
Centroid-sig: 8.8%  
Centroid-so: 0.133 arcsec [2.40σ]  
OotOffset-rm: 0.135 arcsec [1.76σ]  
KicOffset-rm: 0.162 arcsec [1.98σ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 1.00 [17/17]  
DiffImageOverlap-fno: 0.00 [0/17]

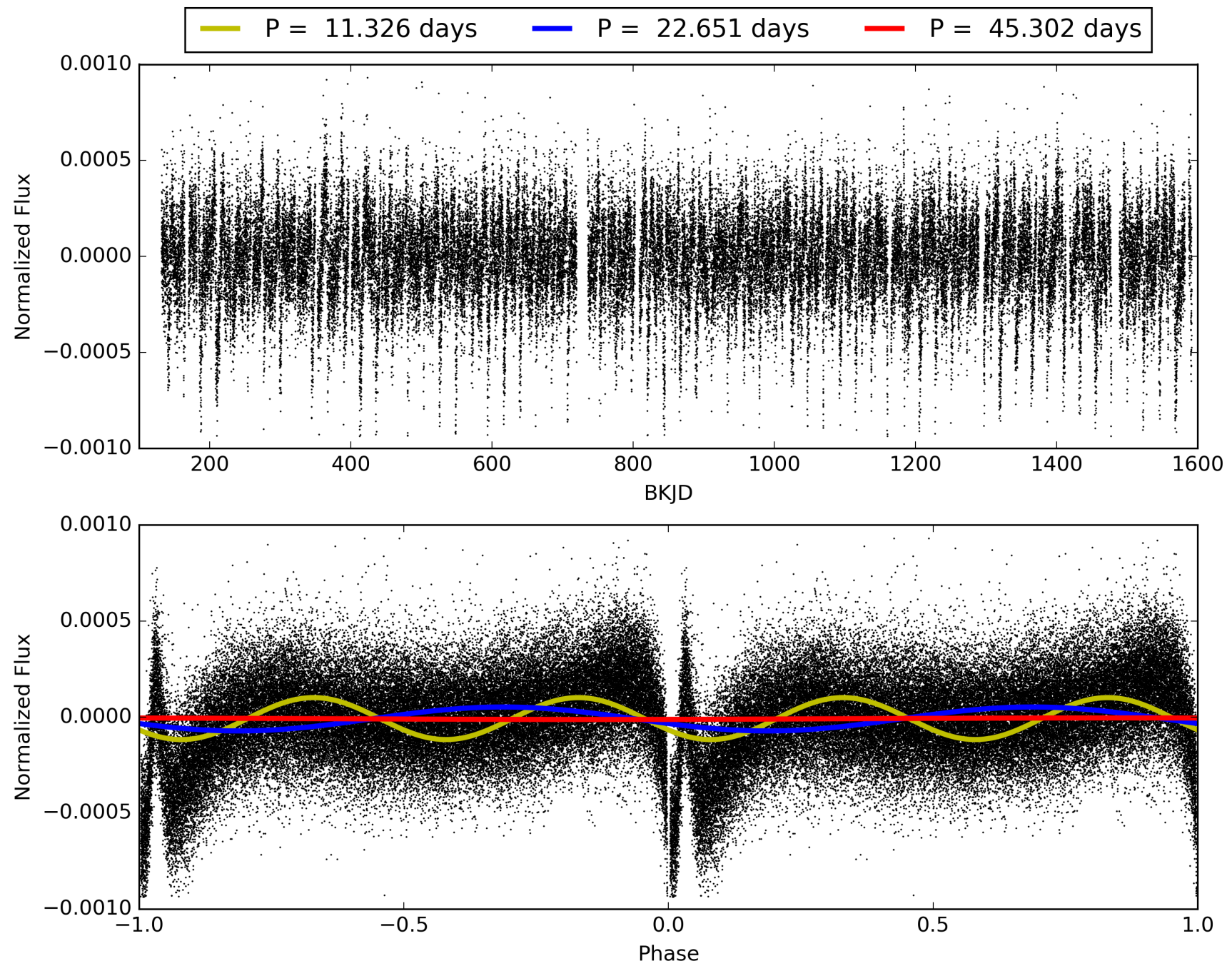
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 20:51:50 Z

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

# TCE 004649305-01, PDC Light Curves

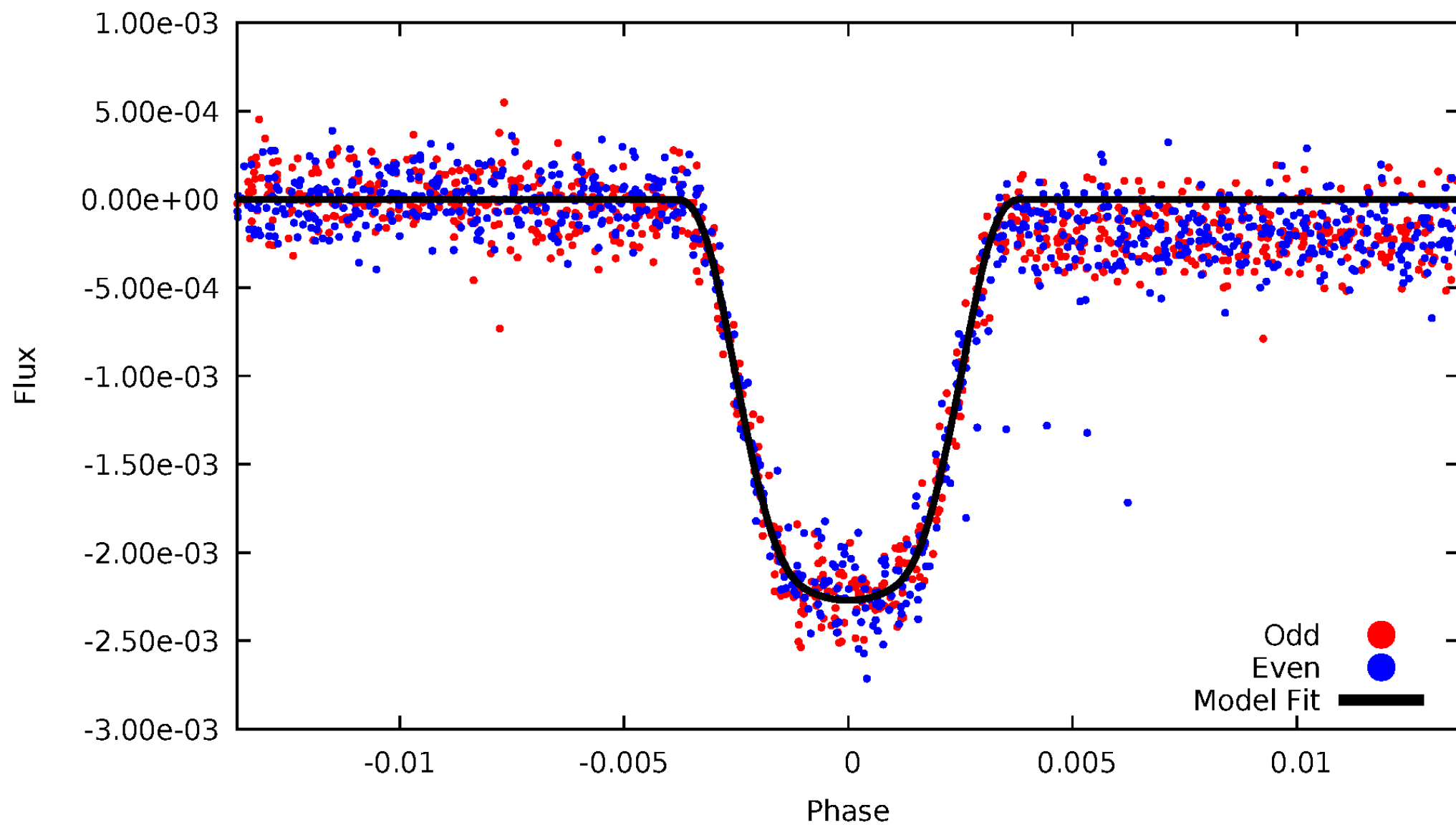


TCE 004649305-01



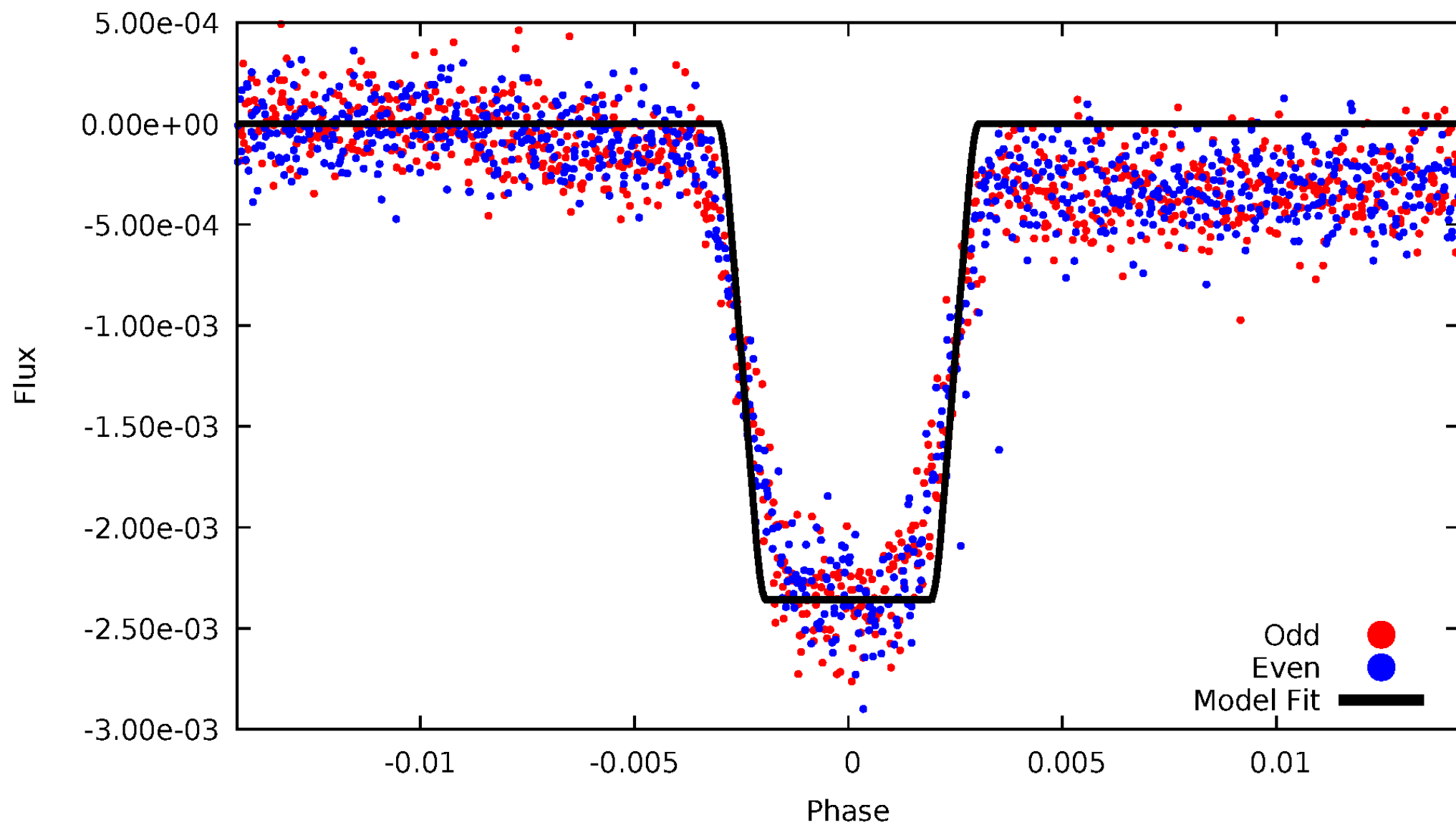
# DV Odd/Even

TCE 004649305-01



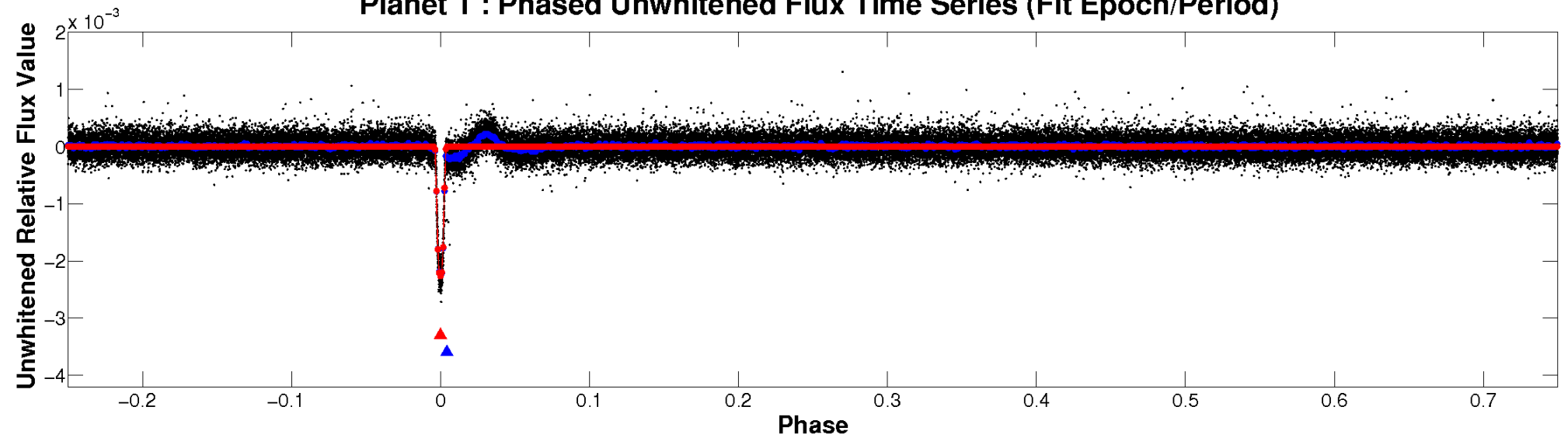
# ALT Odd/Even

TCE 004649305-01

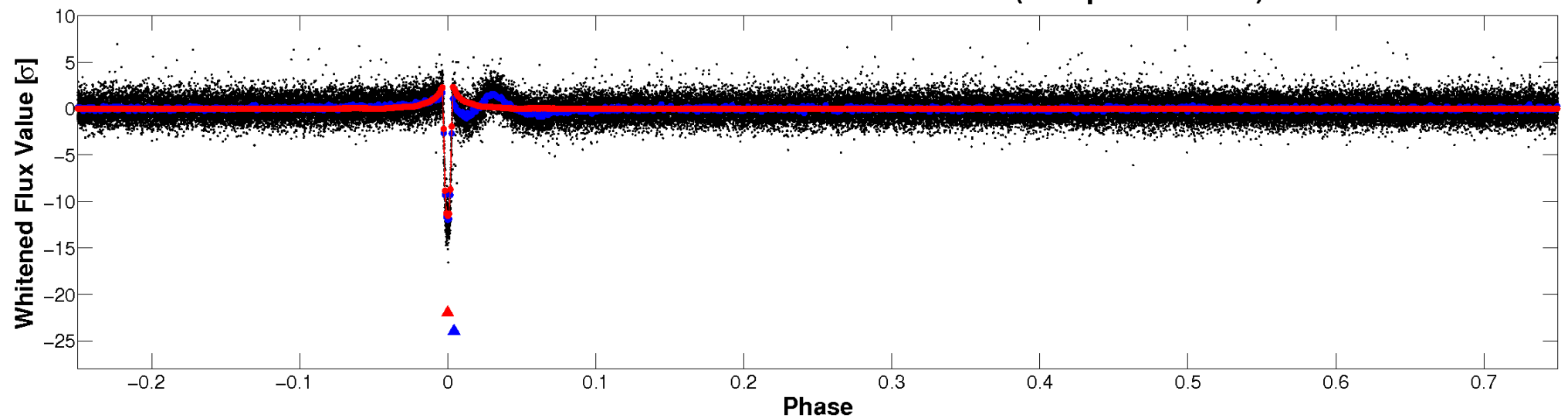


# Non-Whitened Vs. Whitened Light Curve

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



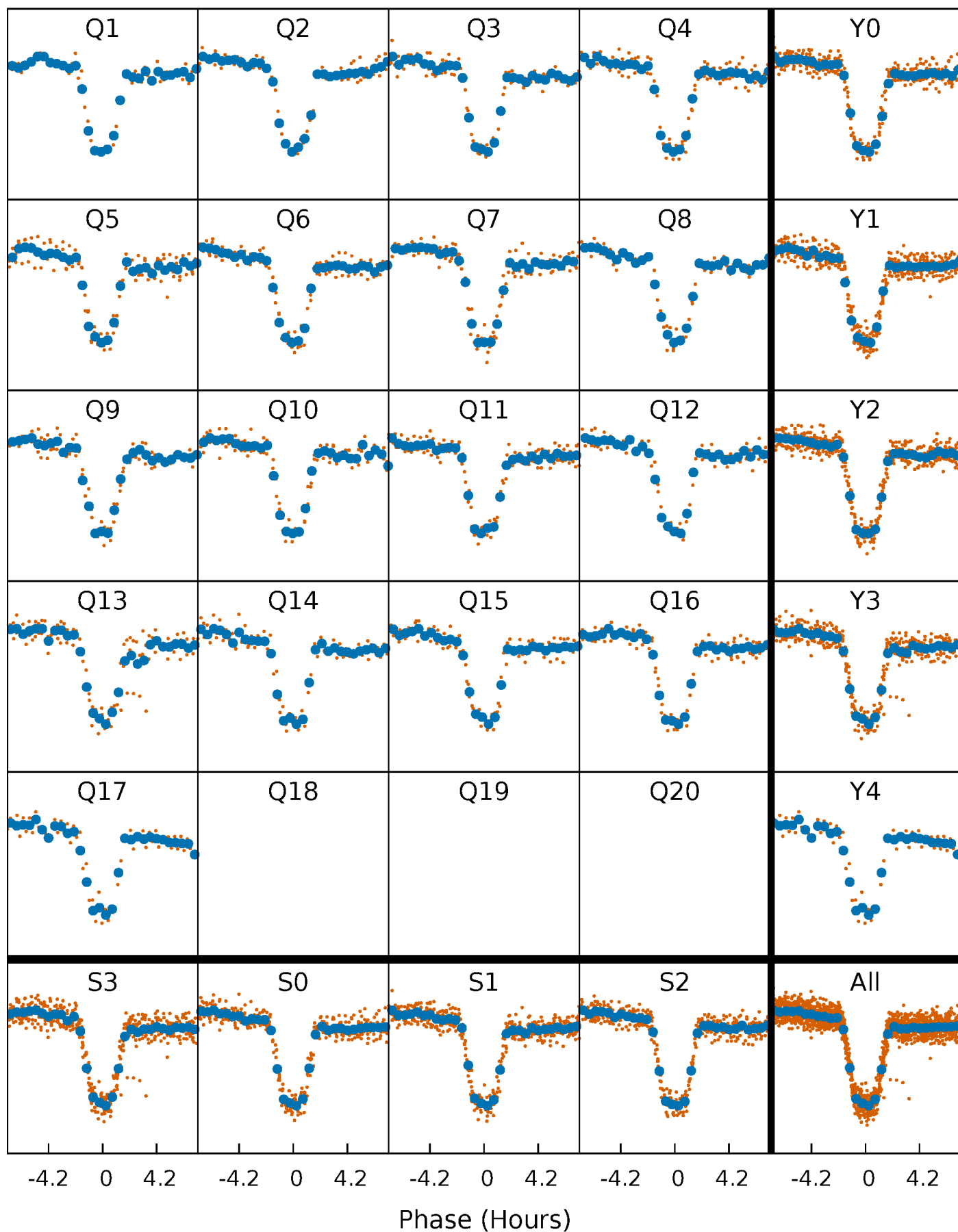
Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)





# PDC Quarter-Phased Transit Curves

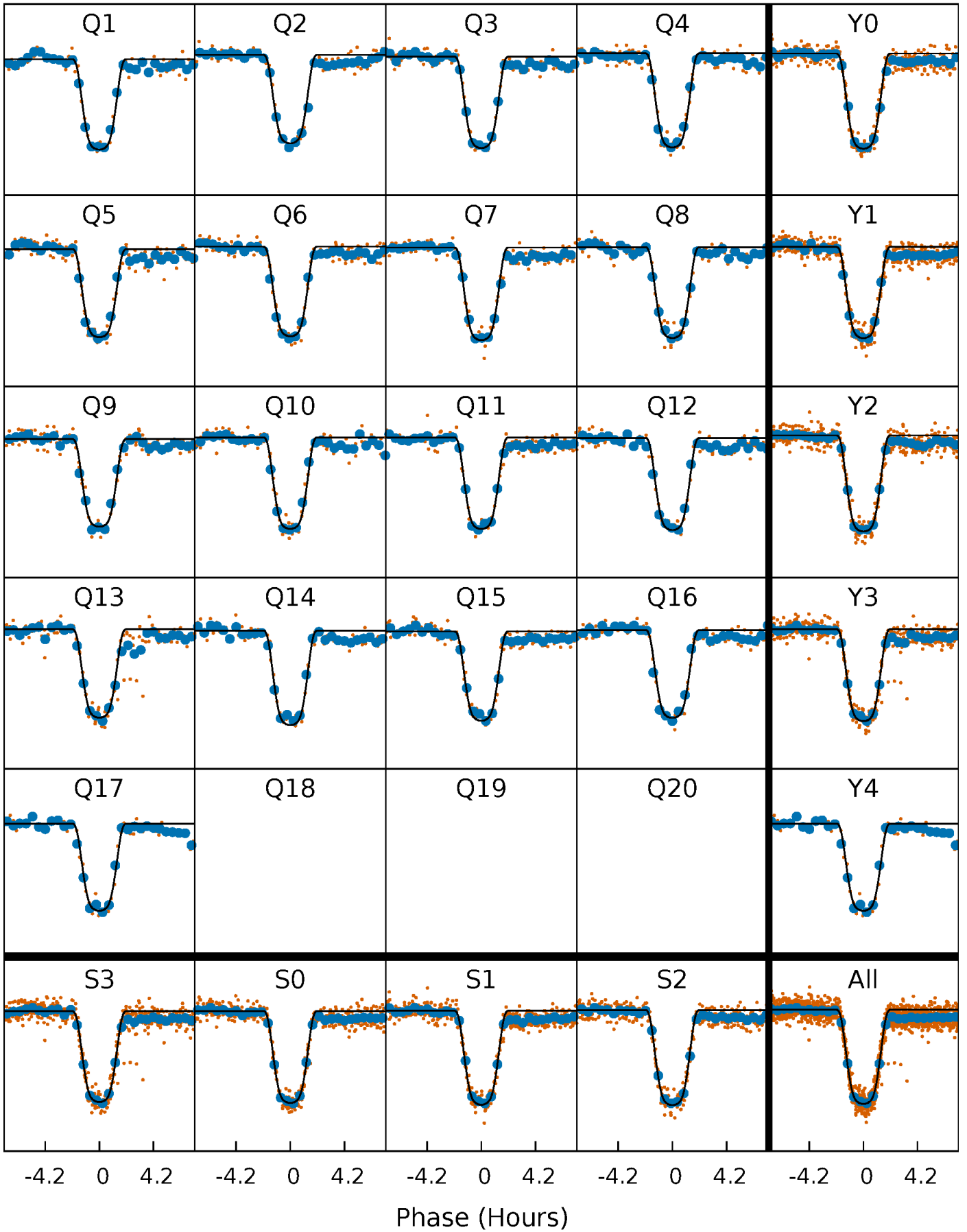
TCE 004649305-01 P= 22.651174 Days  $T_0=140.336926$  (BKJD)





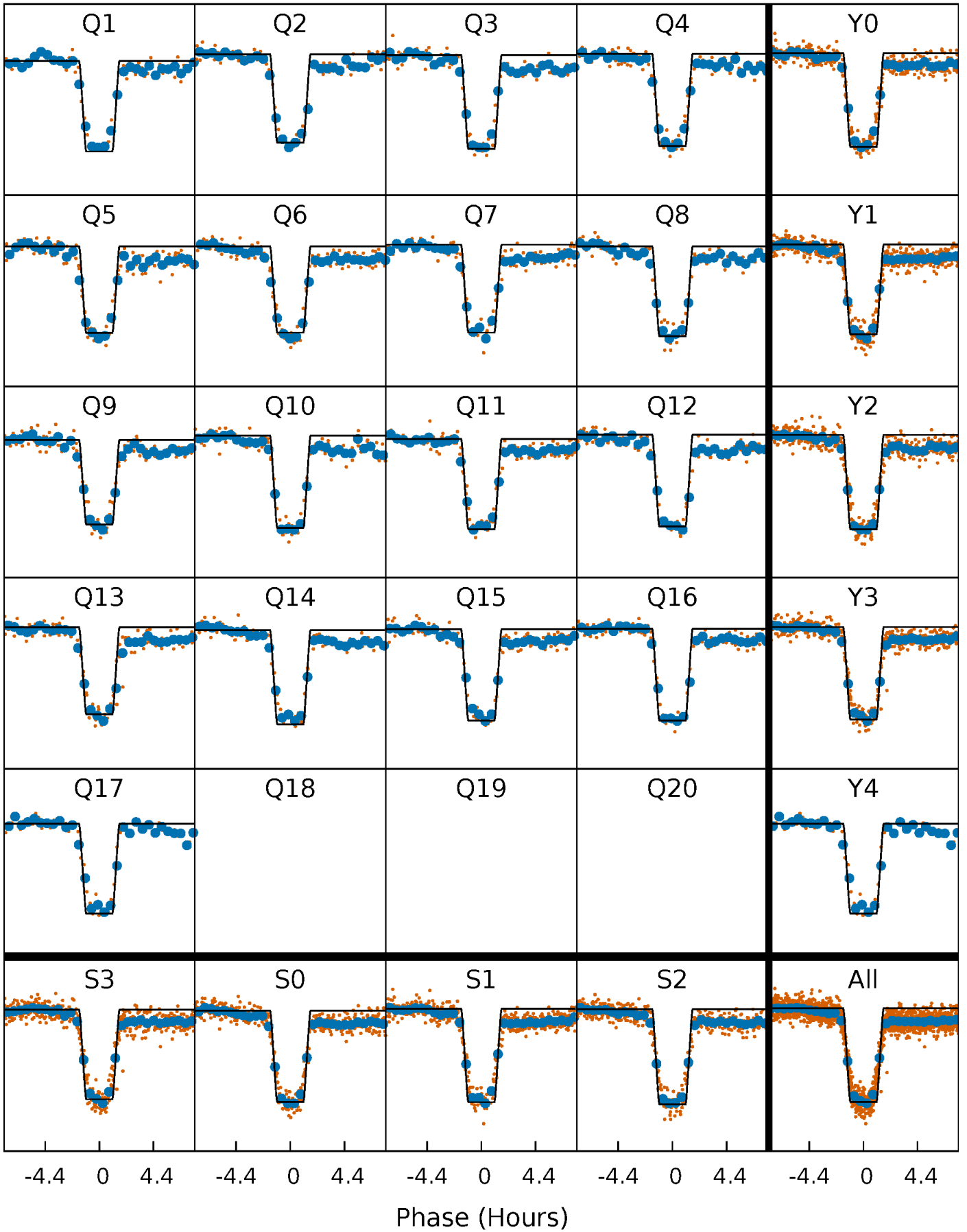
# DV Quarter-Phased Transit Curves

TCE 004649305-01 P= 22.651174 Days  $T_0=140.336926$  (BKJD)



# Alt. Detrend Quarter-Phased Transit Curves

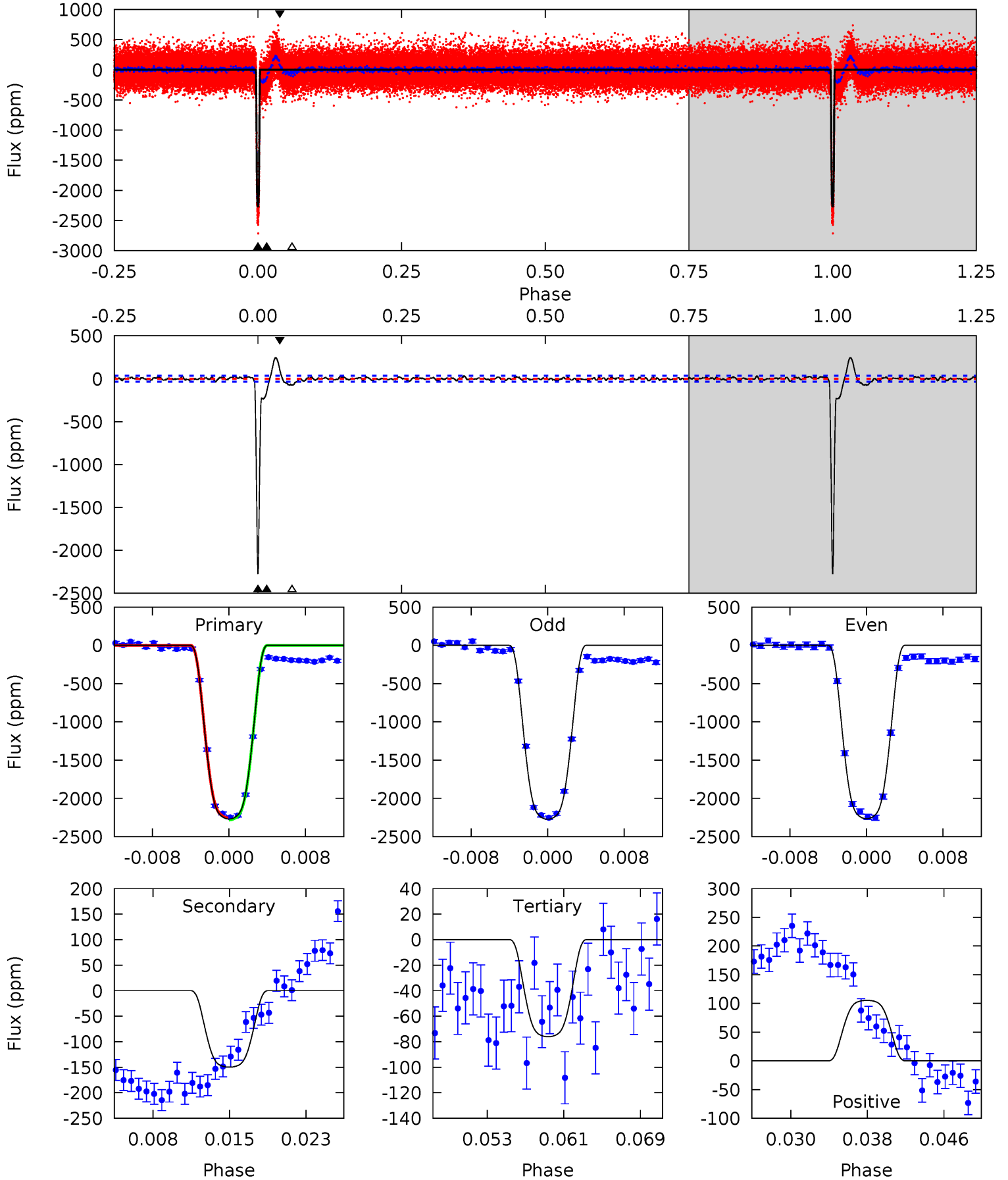
TCE 004649305-01 P= 22.651114 Days  $T_0=140.339907$  (BKJD)



# DV Model-Shift Uniqueness Test

004649305-01, P = 22.651174 Days, E = 117.685752 Days

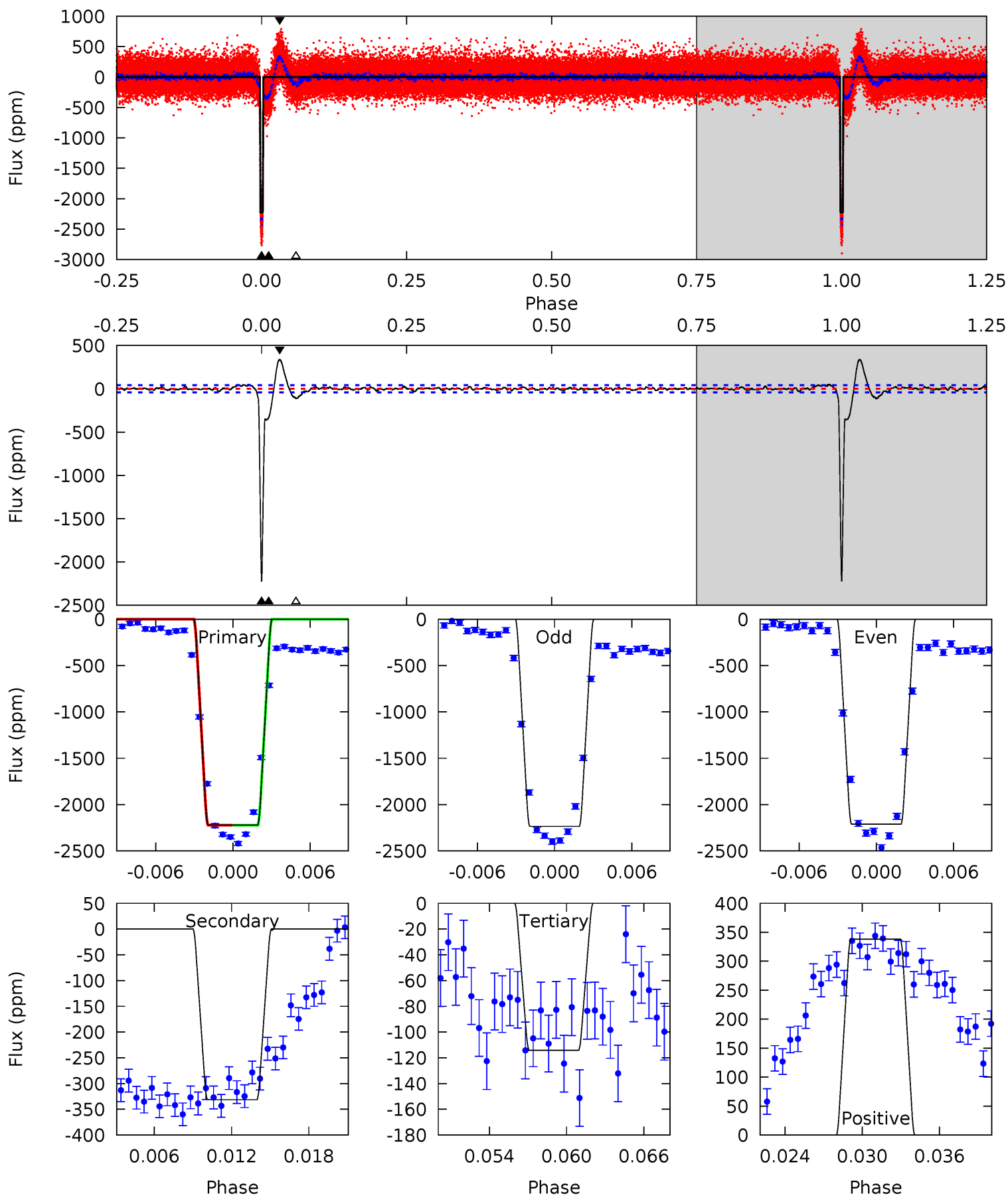
| Pri   | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|-------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 327.8 | 21.6 | 11.0 | 15.2 | 5.08            | 2.67            | 4.02             | 316.8   | 312.6   | 10.7    | 6.41    | 0.47    | 1.00 | 0.10  | 1.79 |



# Alt Model-Shift Uniqueness Test

004649305-01, P = 22.651114 Days, E = 117.688793 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  |
|-------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 277.6 | 41.4 | 14.3 | 42.3 | 5.12            | 2.75            | 5.16             | 263.4   | 235.3   | 27.1    | -0.86   | 1.54    | 1.00 | 0.13  | 0.11 |



### Stellar Parameters For KIC 004649305

|        | $T_{\text{eff}}(K)$  | $\log(g)$                 | [Fe/H]                     | $R (R_{\odot})$           | $M(M_{\odot})$            | $p_{\star} (\text{g}\cdot\text{cm}^{-3})$ |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $6968^{+194}_{-267}$ | $4.310^{+0.058}_{-0.232}$ | $-0.100^{+0.250}_{-0.350}$ | $1.333^{+0.513}_{-0.171}$ | $1.333^{+0.222}_{-0.182}$ | $0.793^{+0.266}_{-0.465}$                 |
|        | +3%/-4%              | +1%/-5%                   | +250%/-350%                | +38%/-13%                 | +17%/-14%                 | +33%/-59%                                 |
| 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 004649305-01 / KOI 0143.01

| Detrend | Depth (ppm)  | $R_p (R_{\oplus})$     | $T_{max} (K)$       | $T_{obs} (K)$       | $A_{obs}$        |
|---------|--------------|------------------------|---------------------|---------------------|------------------|
| DV      | $-150 \pm 7$ | $7.90^{+1.58}_{-0.73}$ | $1225^{+107}_{-66}$ | $3743^{+75}_{-82}$  | $39^{+7}_{-11}$  |
| Alt.    | $-331 \pm 8$ | $7.40^{+1.43}_{-0.71}$ | $1231^{+98}_{-66}$  | $4448^{+87}_{-120}$ | $97^{+18}_{-26}$ |

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

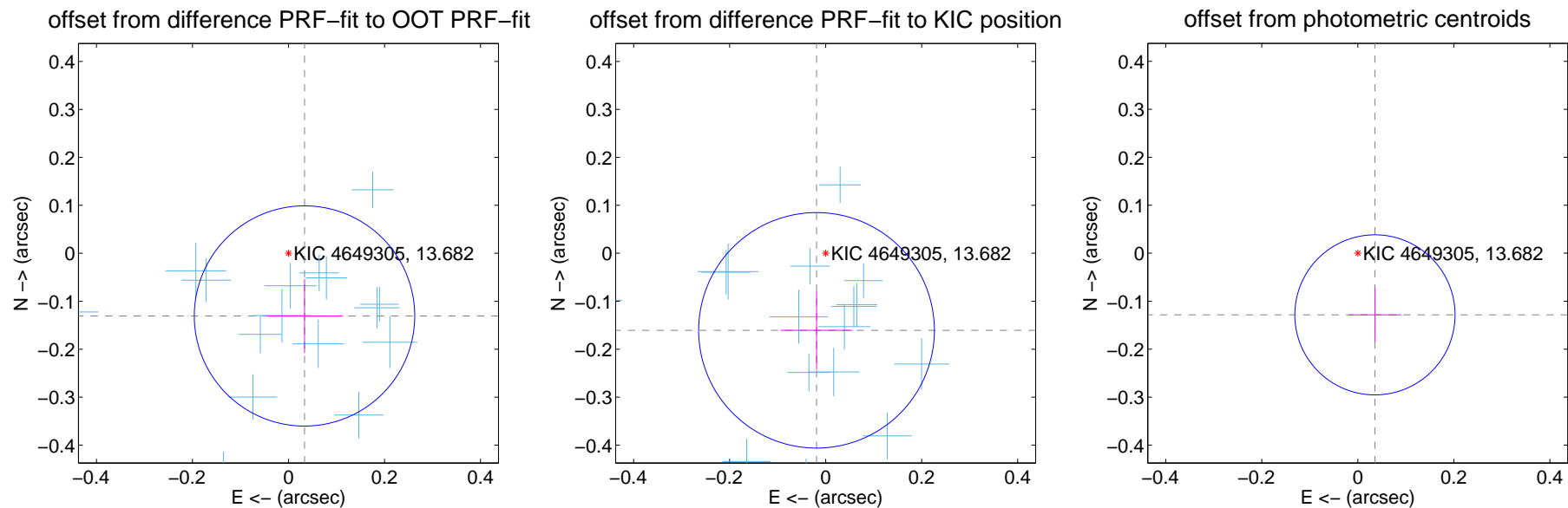
## DV Centroid Data

Supplemental centroid analysis for 004649305-01. Kepler magnitude: 13.68. Transit SNR 181.81

There are 17 quarters with good PRF difference image offsets

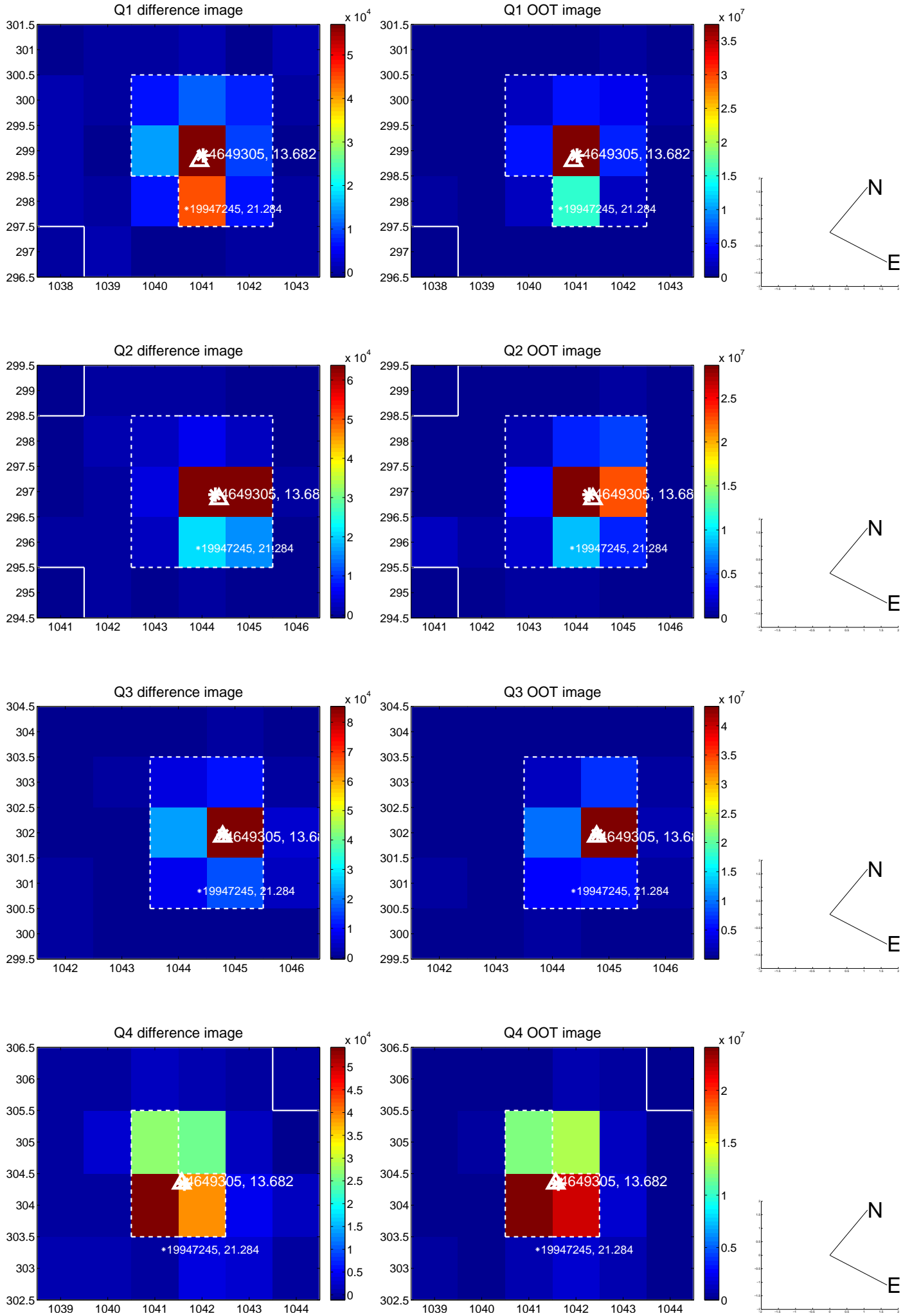
The direct PRF centroid is offset from the target star catalog position by about 0.01 arcsec

|   | Distance in arcsec | Distance / $\sigma$ | $\Delta$ RA        | $\Delta$ Dec       |
|---|--------------------|---------------------|--------------------|--------------------|
| PRF-fit source offset from OOT          | $0.135 \pm 0.077$  | 1.76                | $-0.033 \pm 0.079$ | $-0.131 \pm 0.077$ |
| PRF-fit source offset from KIC position | $0.162 \pm 0.082$  | 1.98                | $0.019 \pm 0.075$  | $-0.161 \pm 0.082$ |
| photometric centroid source offset      | $0.13 \pm 0.06$    | 2.40                | $-0.04 \pm 0.05$   | $-0.13 \pm 0.06$   |



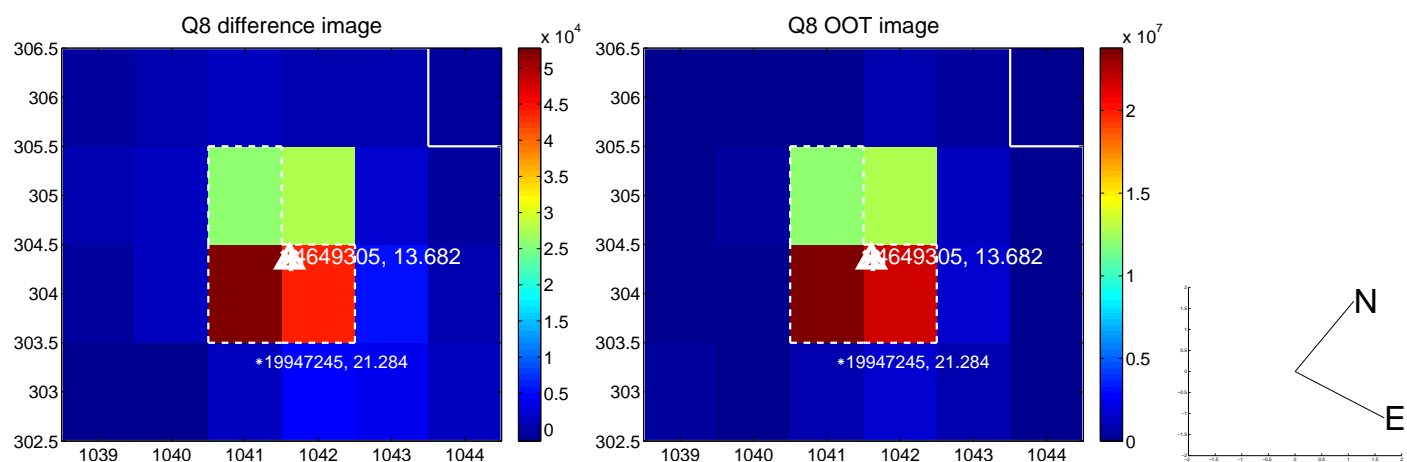
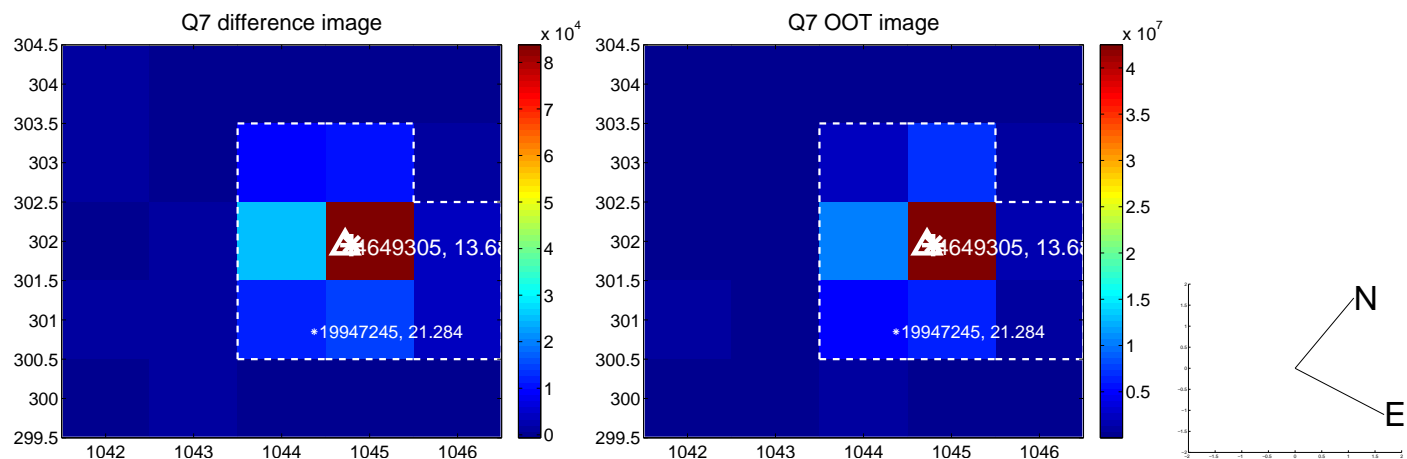
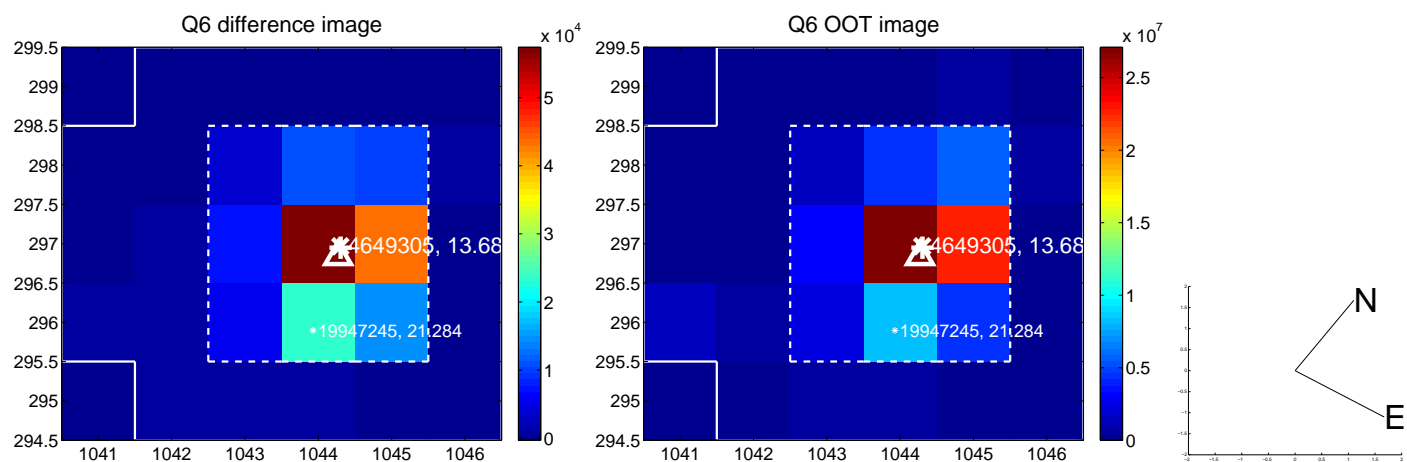
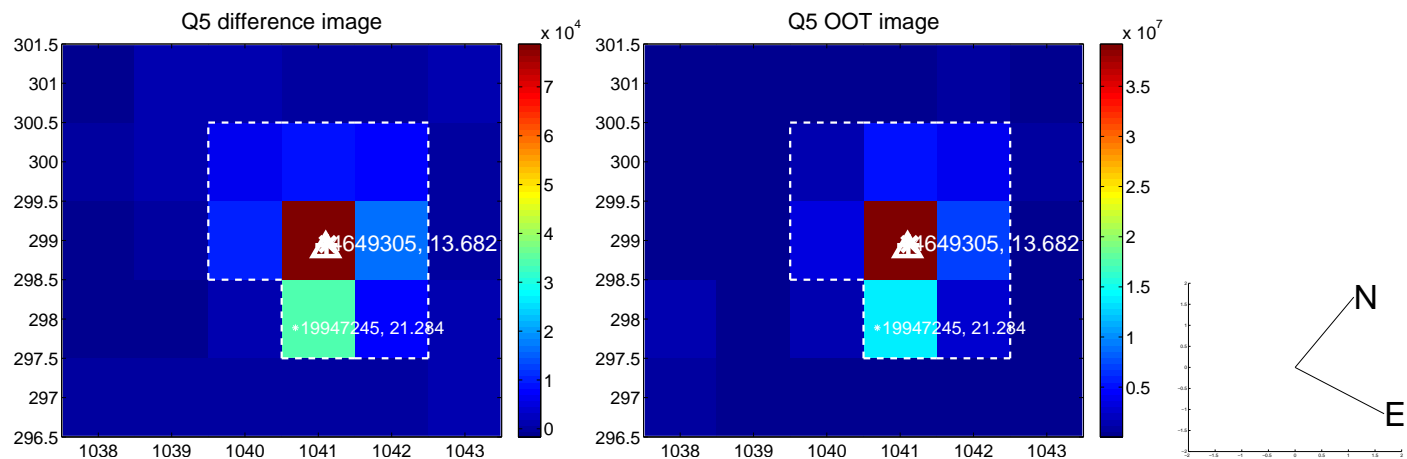
Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

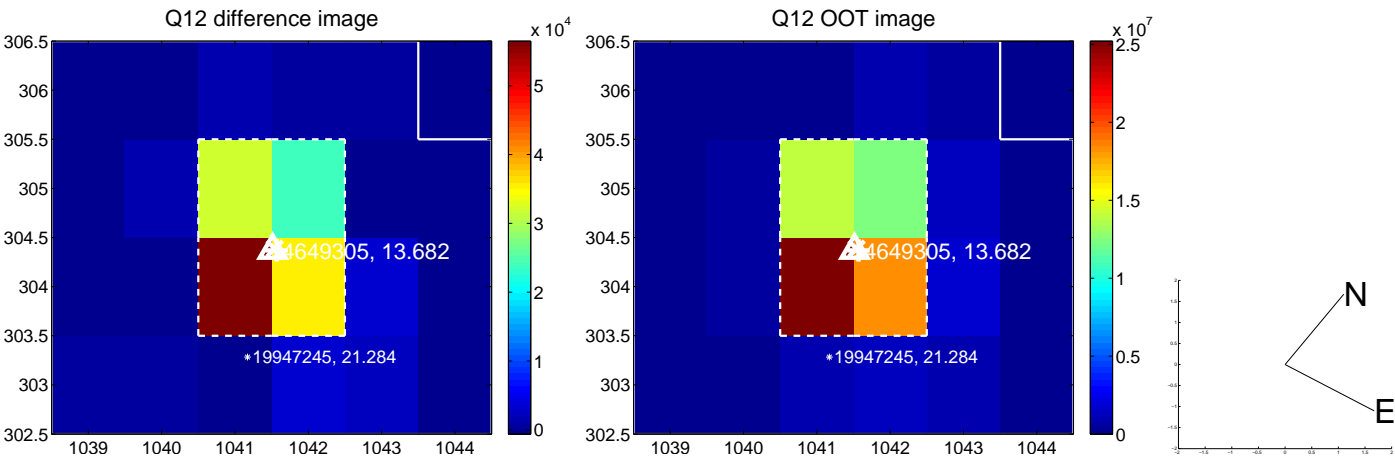
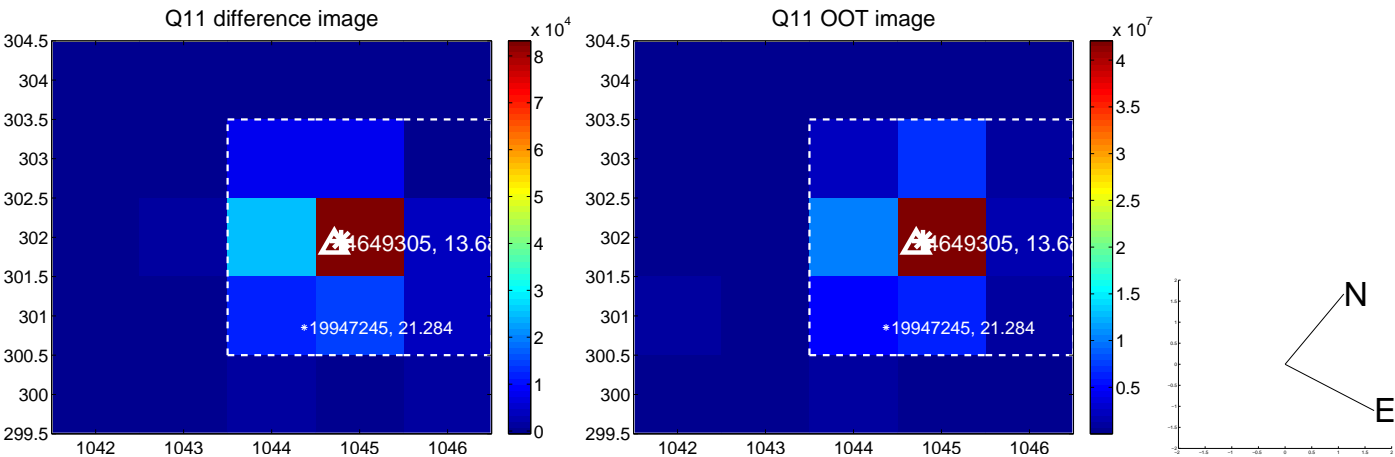
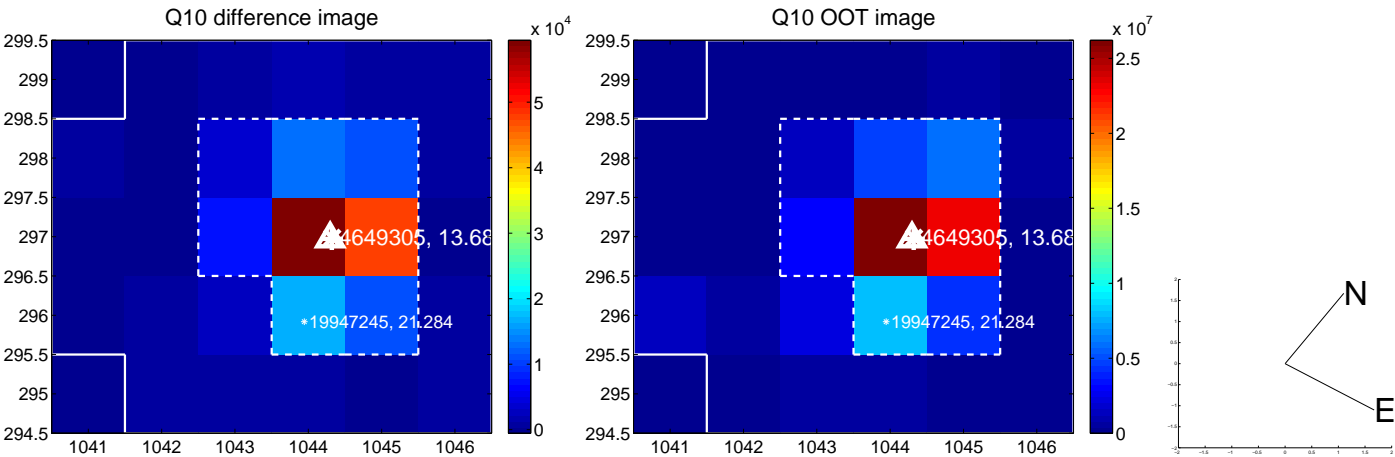
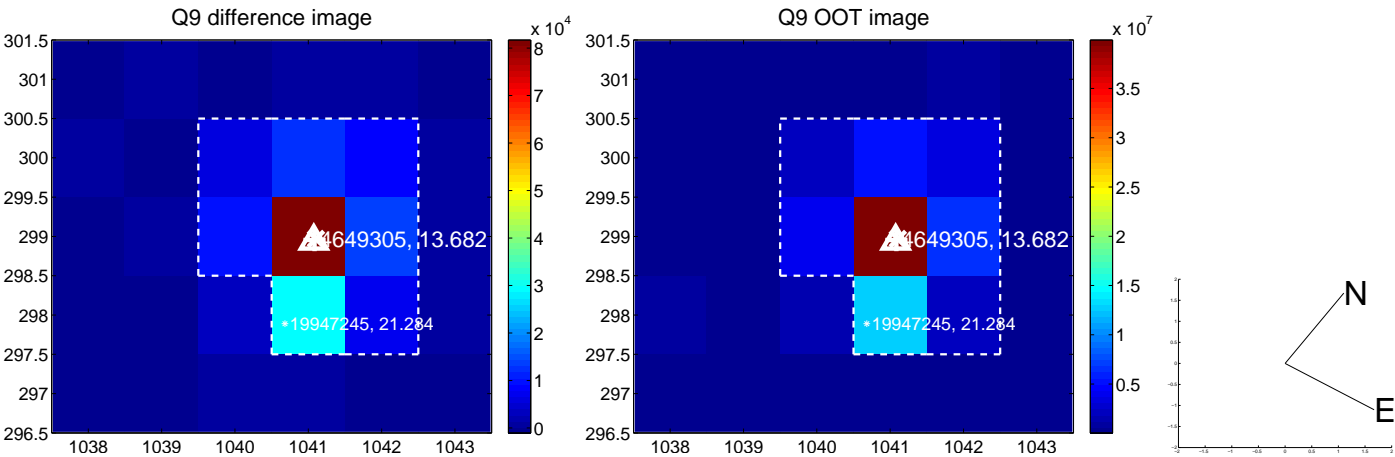




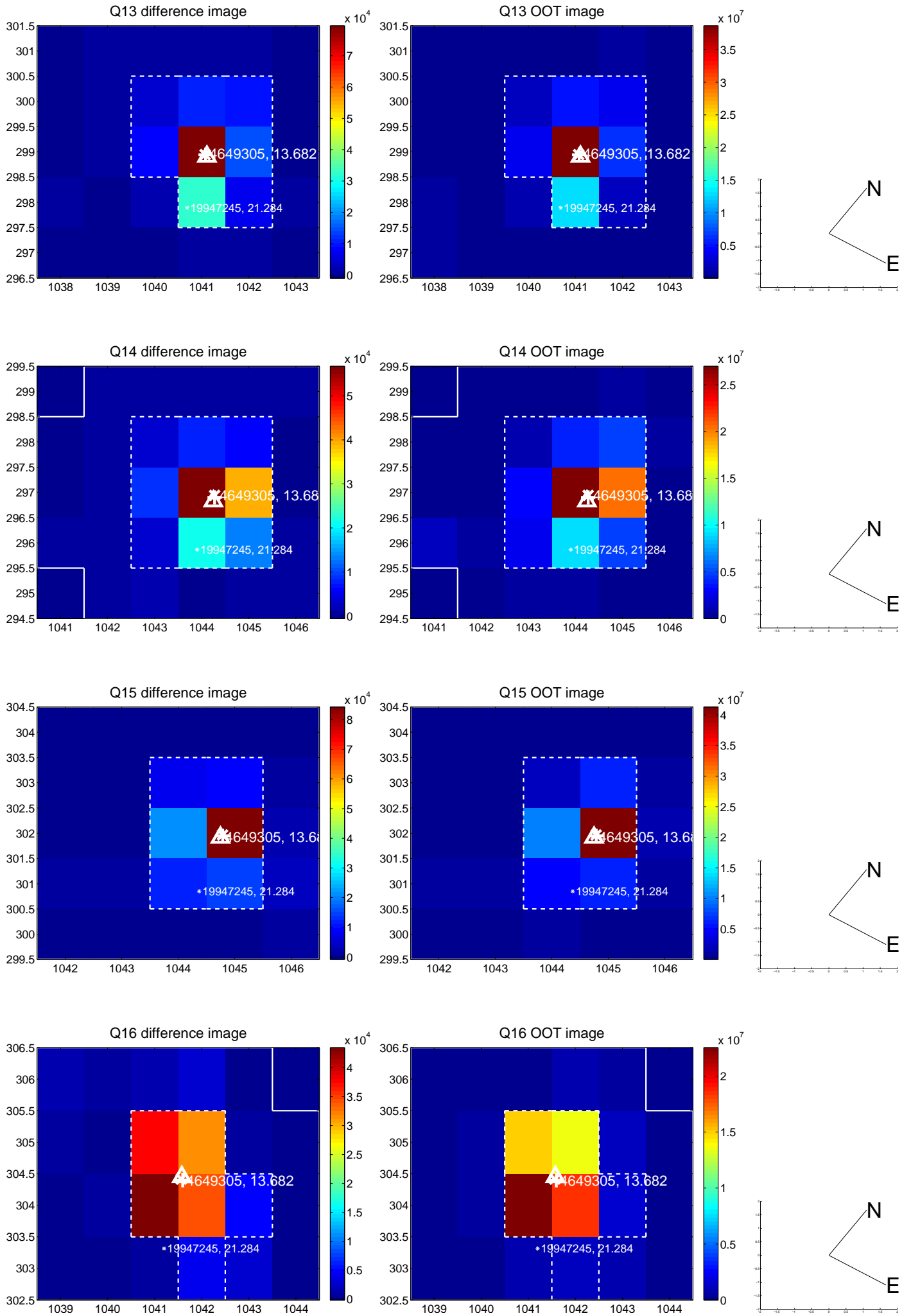
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



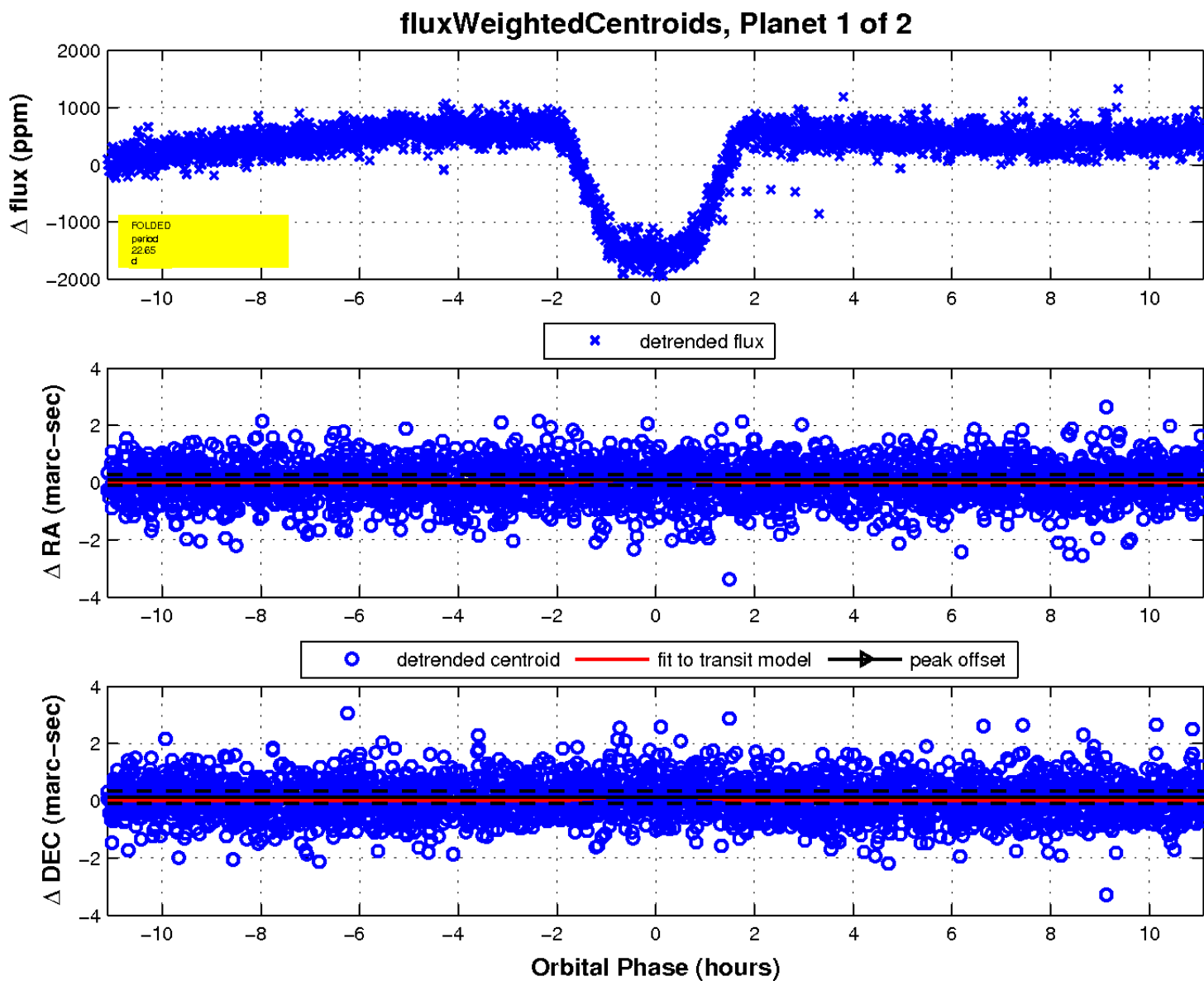
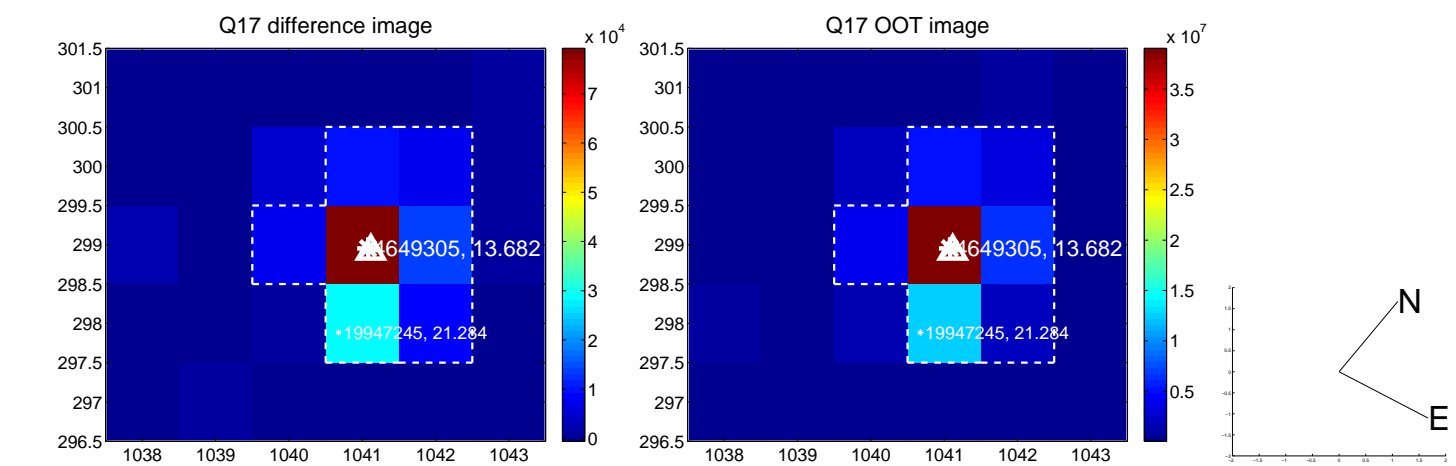
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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

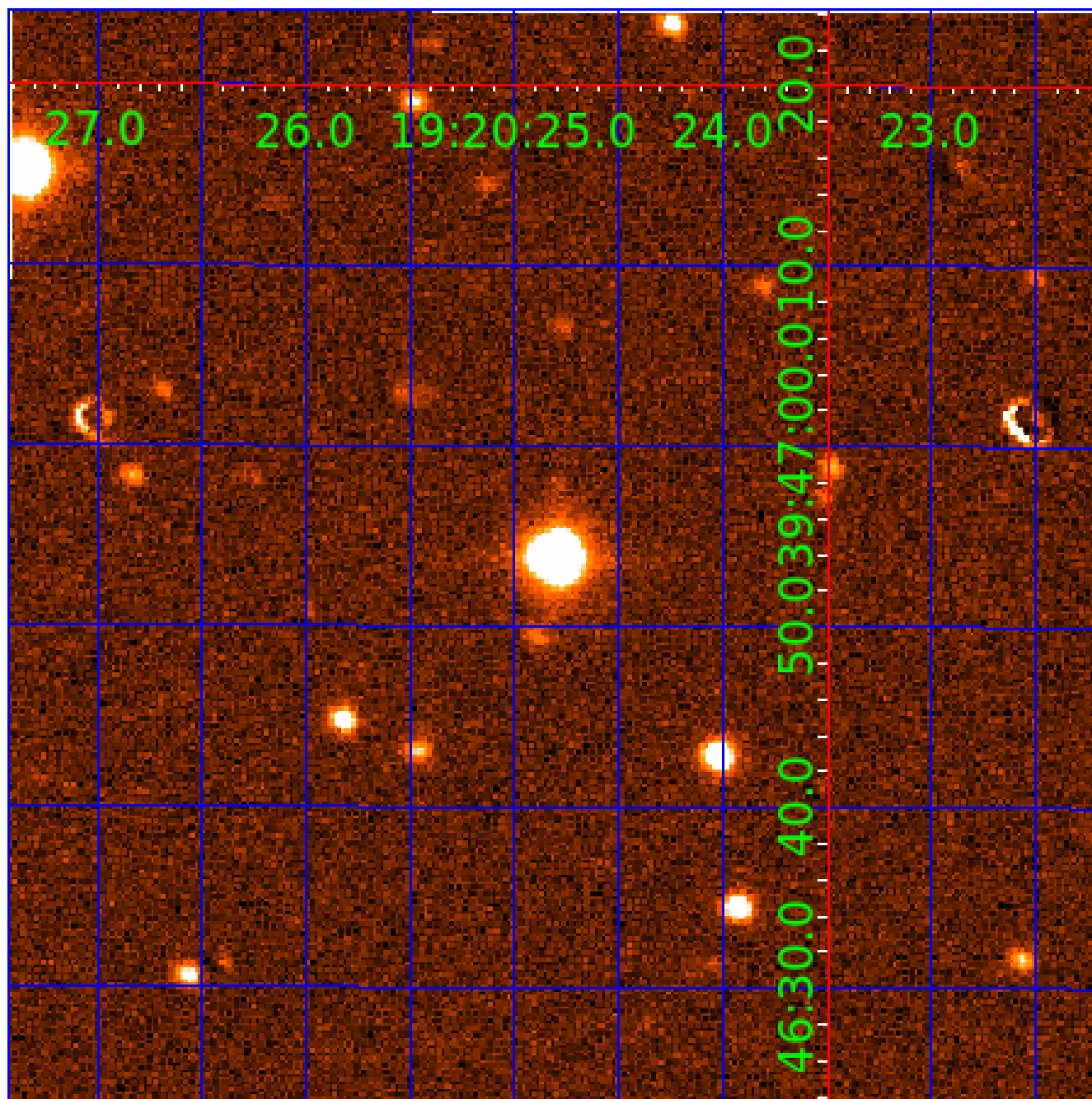


white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



UKIRT Image

Declination



# KIC 004649305

## 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) | $R_p$ ( $R_{\oplus}$ ) | $S_p$ ( $S_{\oplus}$ ) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|-------|-------|-----------------------------|-----------------|------------------------|------------------------|
| 004649305-01 | OBS      | 0143.01 | 22.651174     | 140.336926   | 2270.1      | 3.704            | 182.1 | 181.8 | 1.33                        | 6968            | 7.60                   | 126.79                 |
| 004649305-02 | OBS      | No      | 22.651222     | 140.432655   | 936.6       | 29.052           | 40.5  | 44.9  | 1.33                        | 6968            | 7.63                   | 126.79                 |

## Robovetter Results

| TCE          | Run Type | Disp | Score | N | S | C | E | Comments            |
|--------------|----------|------|-------|---|---|---|---|---------------------|
| 004649305-01 | OBS      | PC   | 0.98  | 0 | 0 | 0 | 0 | NO_COMMENT          |
| 004649305-02 | OBS      | FP   | 0.00  | 1 | 0 | 0 | 0 | LPP_DV—RESIDUAL_TCE |

**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.

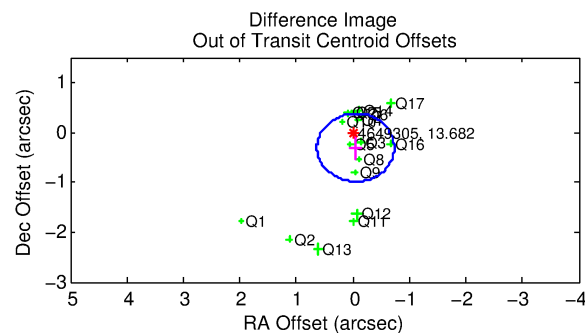
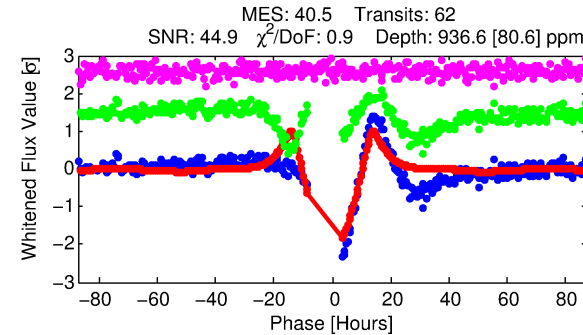
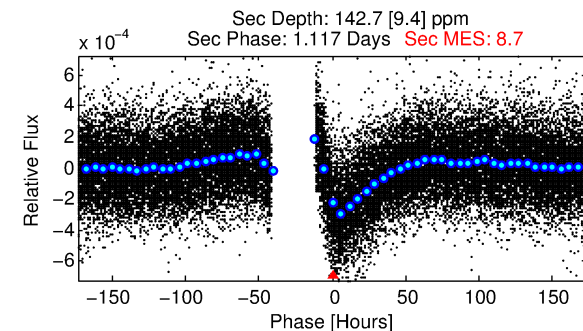
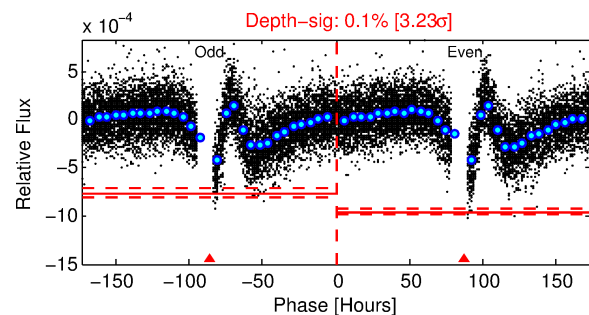
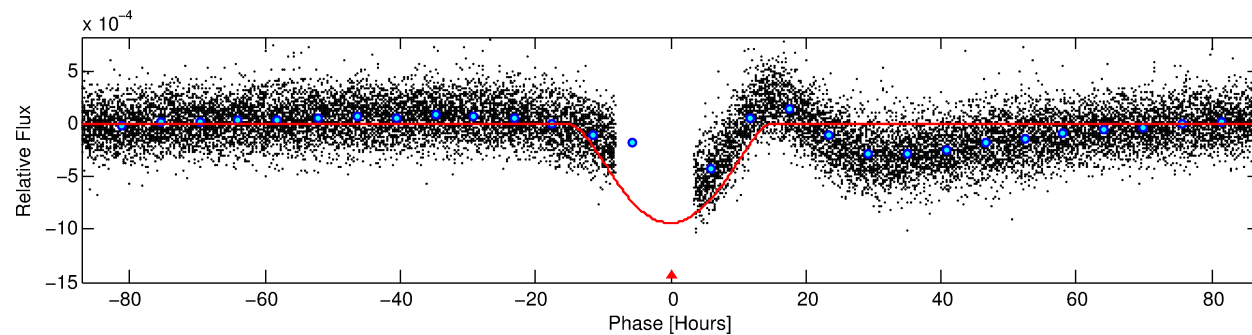
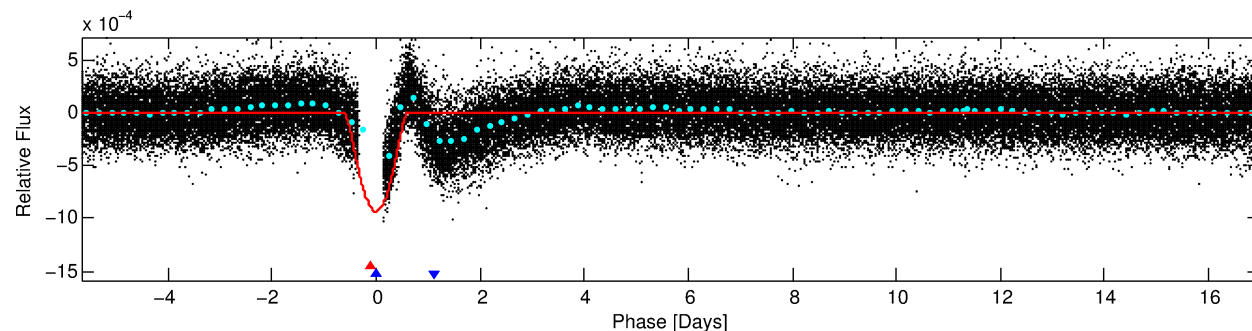
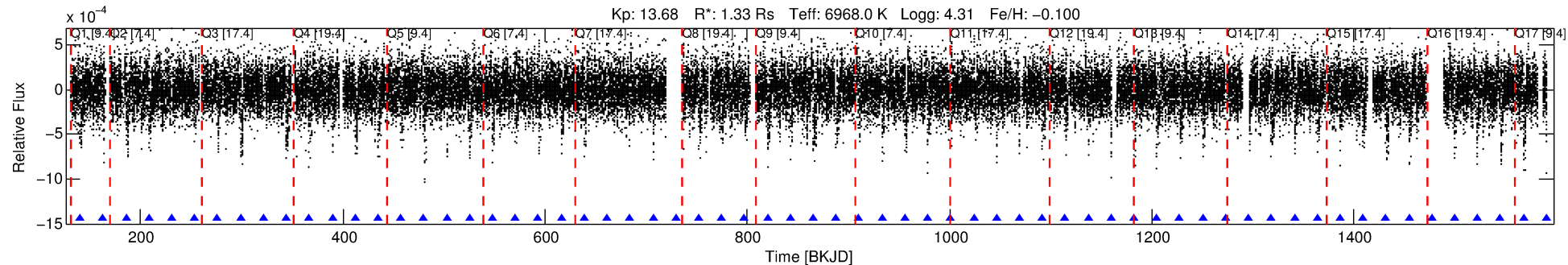
## Ephemeris Match Information For 004649305-02

No Significant Match Found

# DV One-Page Summary

KIC: 4649305 Candidate: 2 of 2 Period: 22.651 d  
KOI: K00143 Corr: No Ephemeris Match

Kp: 13.68 R\*: 1.33 Rs Teff: 6968.0 K Logg: 4.31 Fe/H: -0.100



## DV Fit Results:

Period = 22.65122 [0.00018] d  
Epoch = 140.4327 [0.0066] BKJD  
Rp/R\* = 0.0524 [0.0185]  
a/R\* = 2.20 [0.12]  
b = 1.00 [0.03]  
Seff = 126.79 [58.95]  
Teq = 856 [99] K  
Rp = 7.63 [3.98] Re  
a = 0.1720 [0.0537] AU  
Ag = 39.95 [33.33] [1.17σ]  
Teffp = 3326 [604] K [4.04σ]

## DV Diagnostic Results:

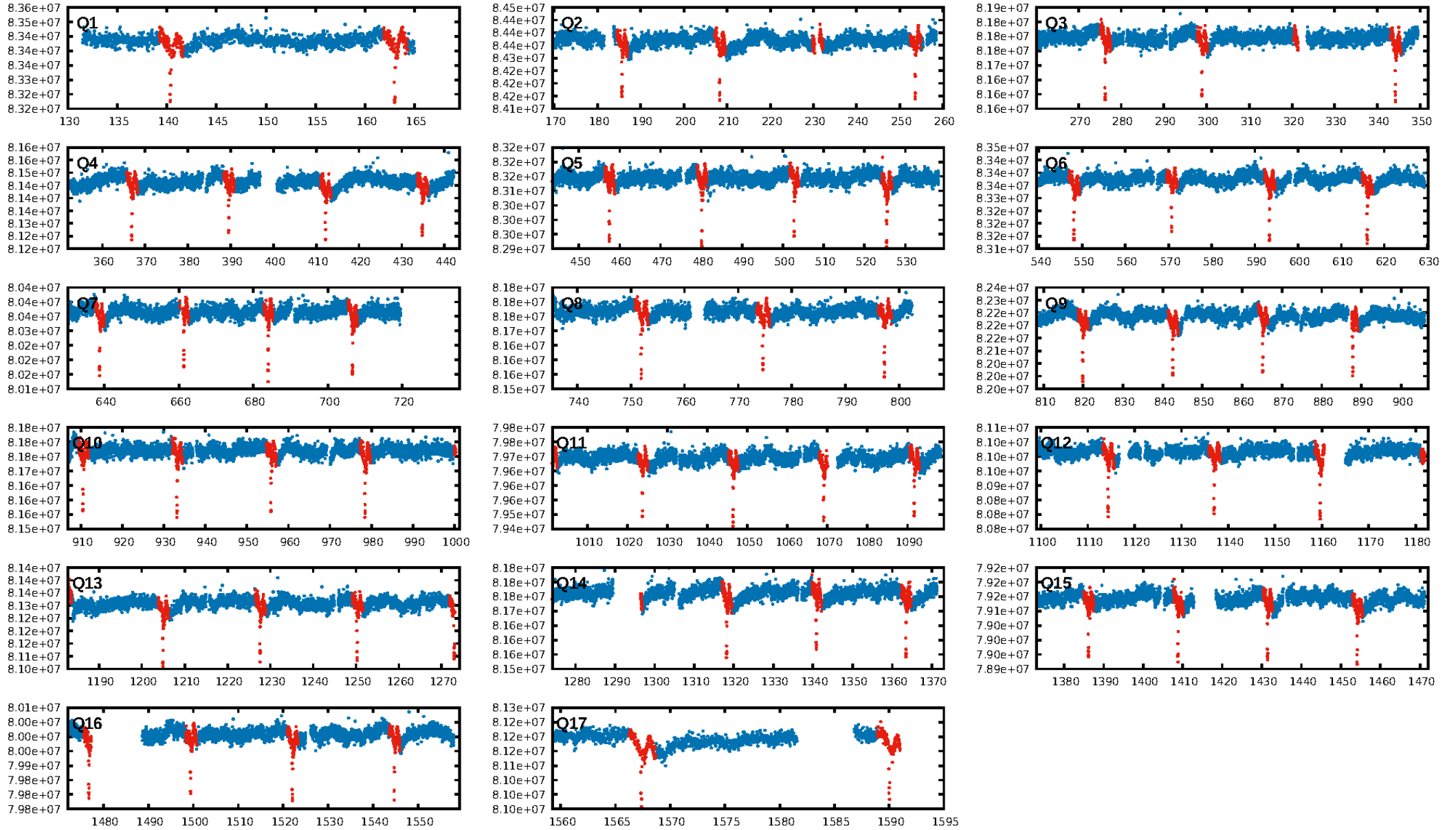
ShortPeriod-sig: 0.0% [0.00σ]  
LongPeriod-sig: N/A  
ModelChiSquare2-sig: 2.2%  
ModelChiSquareGof-sig: 100.0%  
Bootstrap-pfa: 0.00e+00  
RollingBand-fgt: 1.00 [58/58]  
GhostDiagnostic-chr: 2.088  
Centroid-sig: 3.5%  
Centroid-so: 0.020 arcsec [0.31σ]  
OotOffset-rm: 0.311 arcsec [1.37σ]  
OotOffset-st: 4/4/4/5 [17]  
KicOffset-rm: 0.342 arcsec [1.43σ]  
KicOffset-st: 4/4/4/5 [17]  
DiffImageQuality-fgm: 1.00 [17/17]  
DiffImageOverlap-fno: 0.00 [0/17]

Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 20:51:57 Z

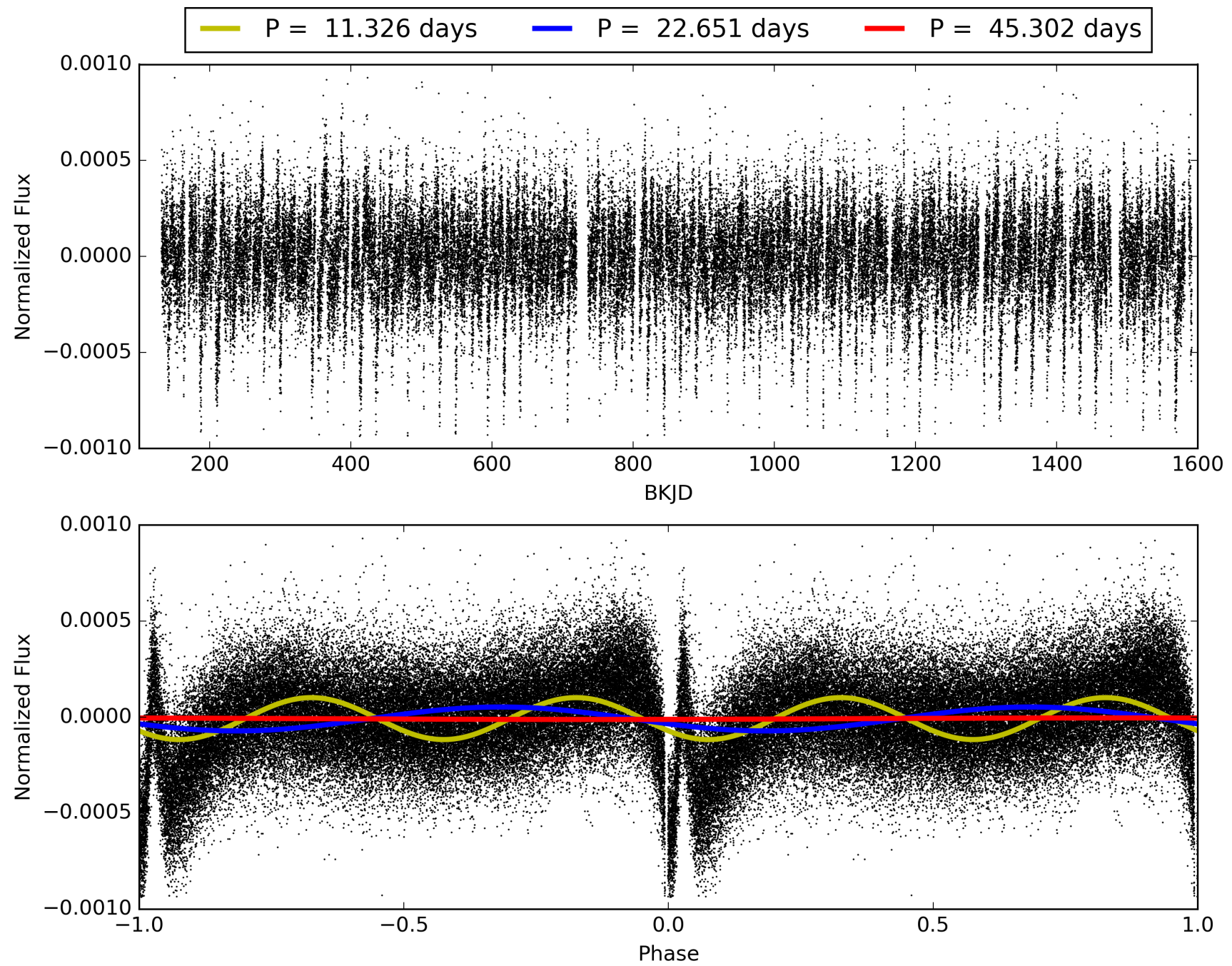
This Data Validation Report Summary was produced in the Kepler Science Operations Center Pipeline at NASA Ames Research Center



# TCE 004649305-02, PDC Light Curves

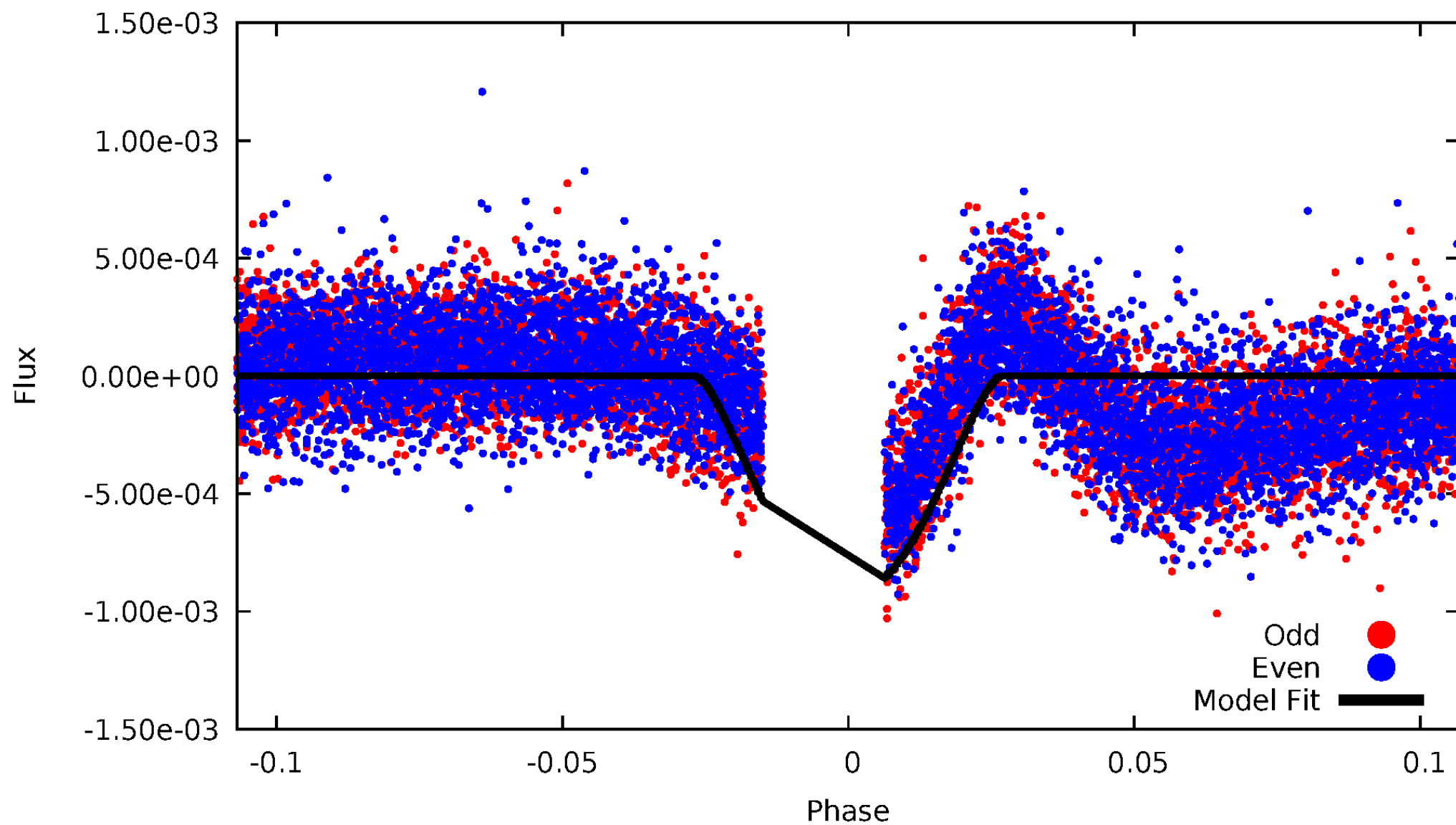


TCE 004649305-02



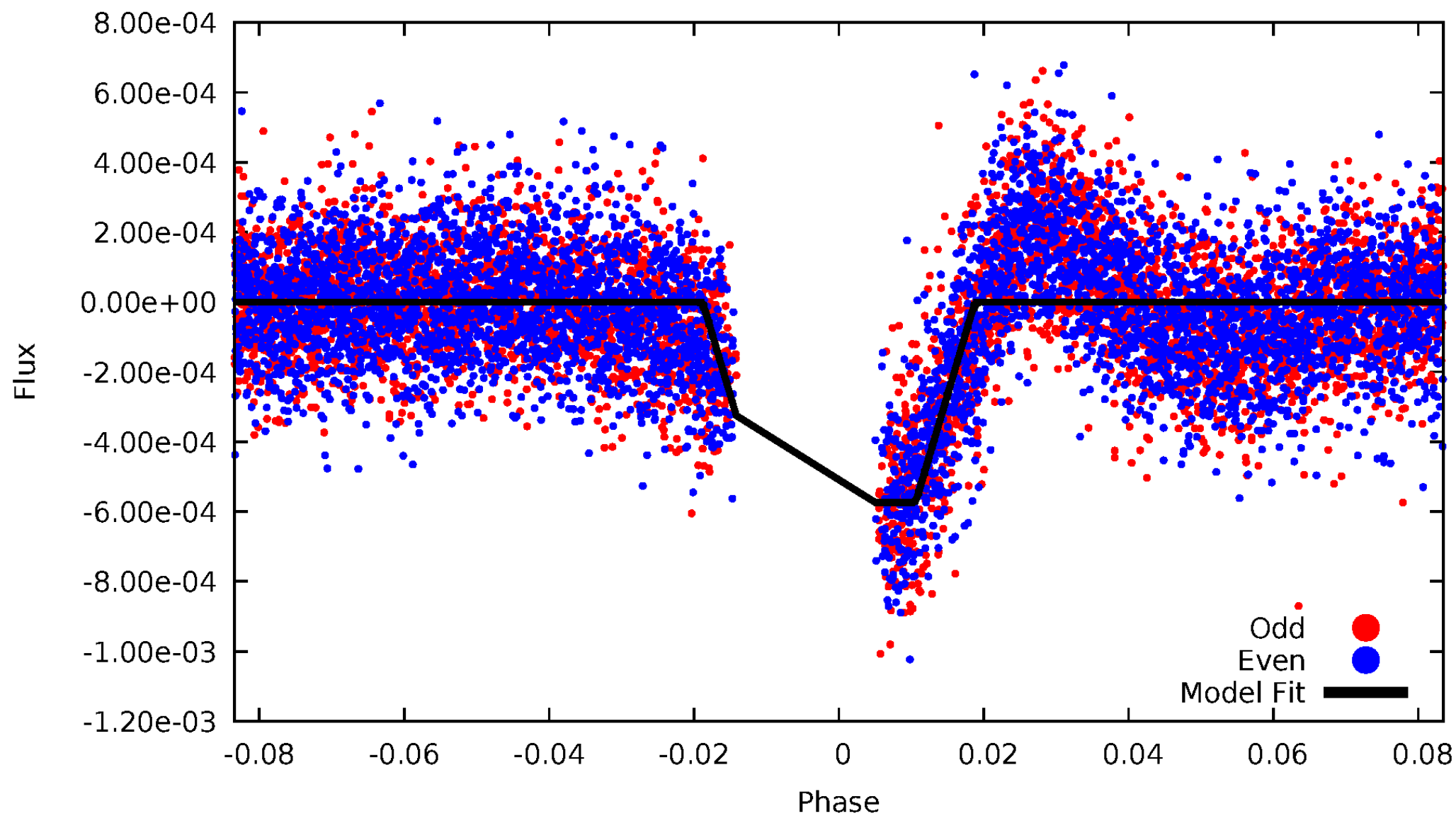
DV Odd/Even

TCE 004649305-02



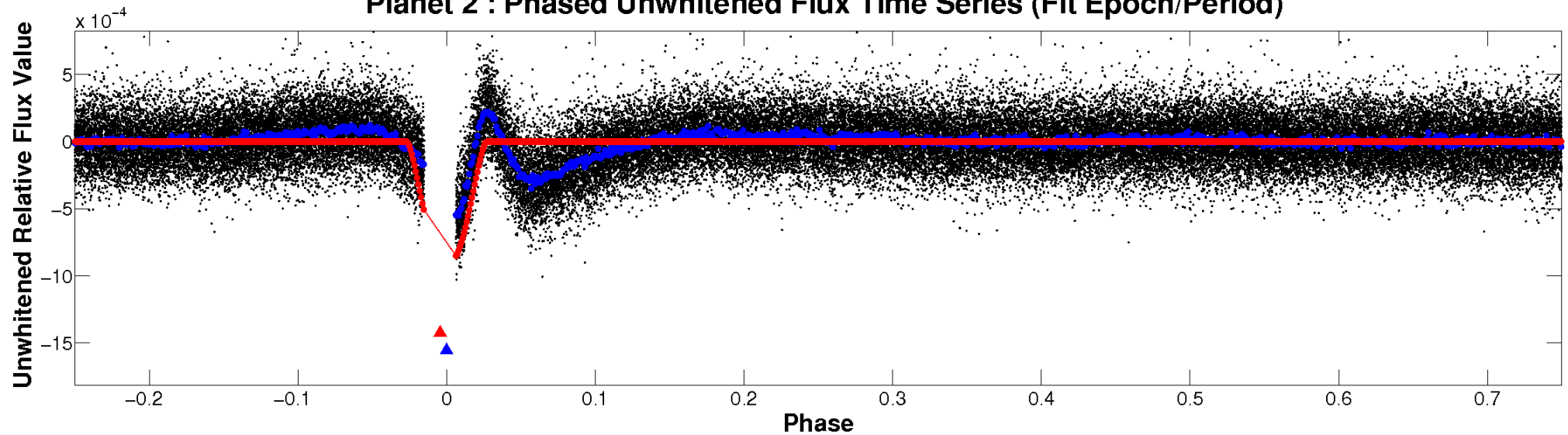
# ALT Odd/Even

TCE 004649305-02

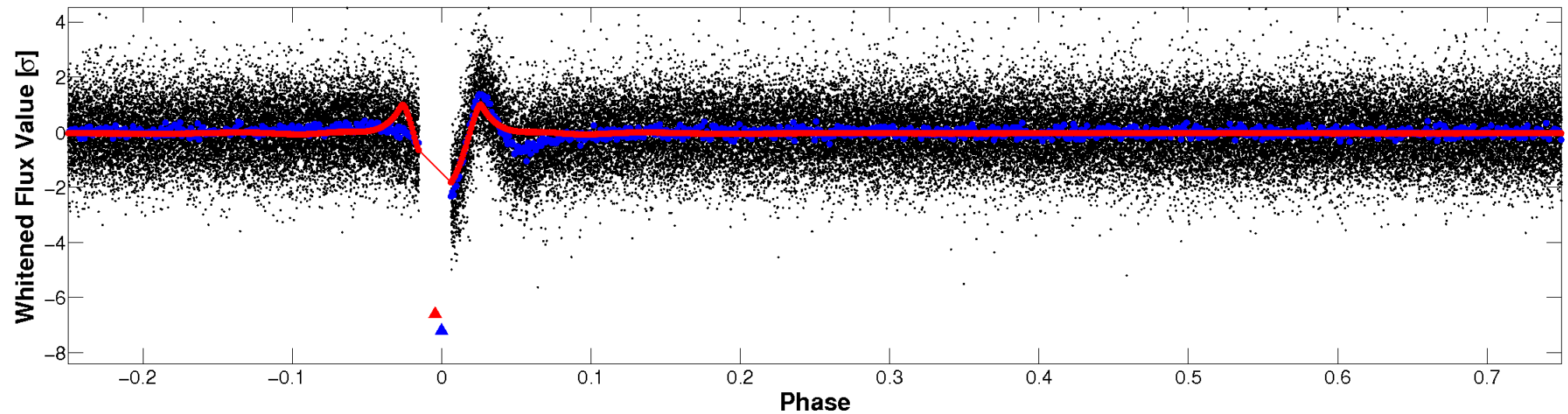


# Non-Whitened Vs. Whitened Light Curve

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



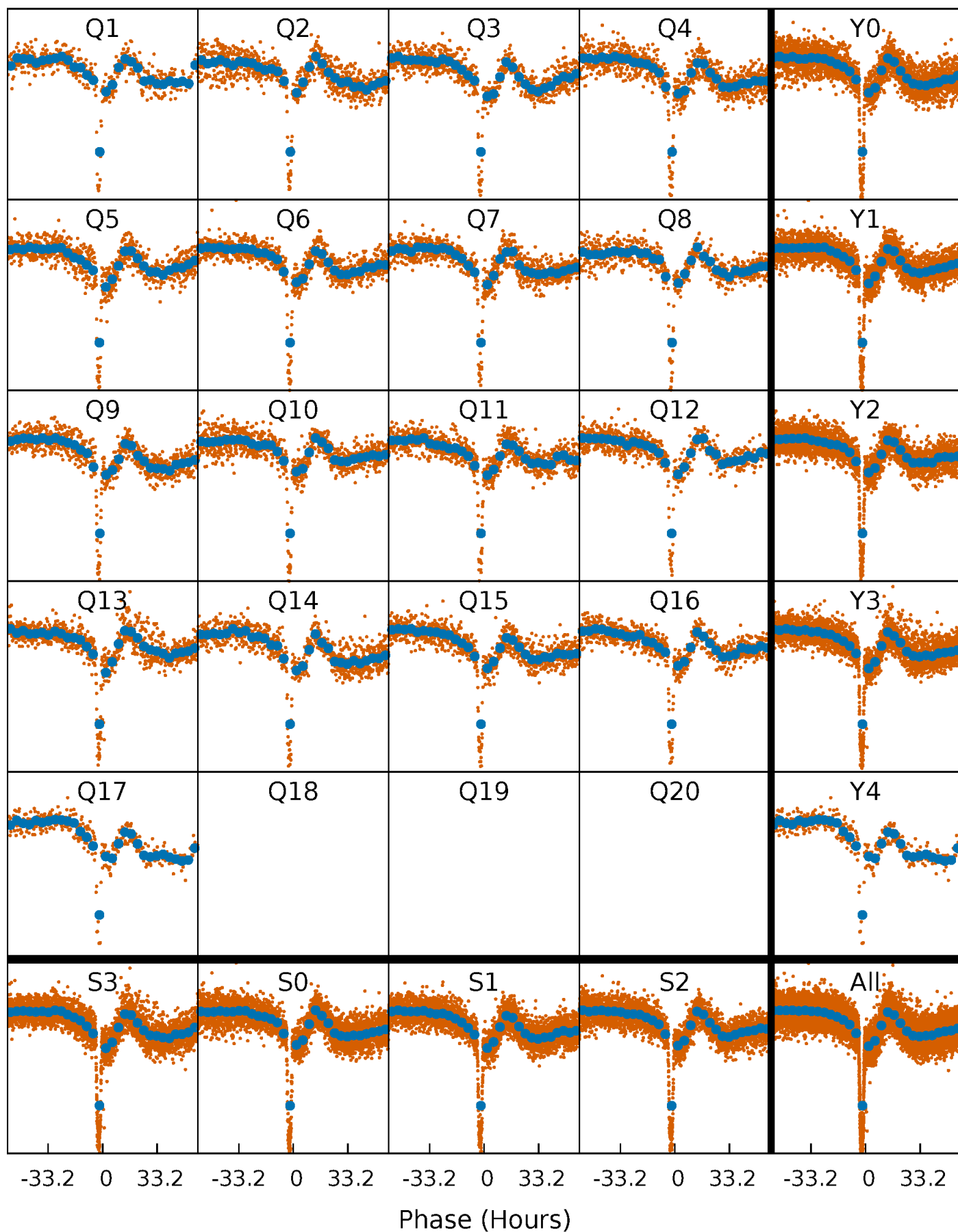
## Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)





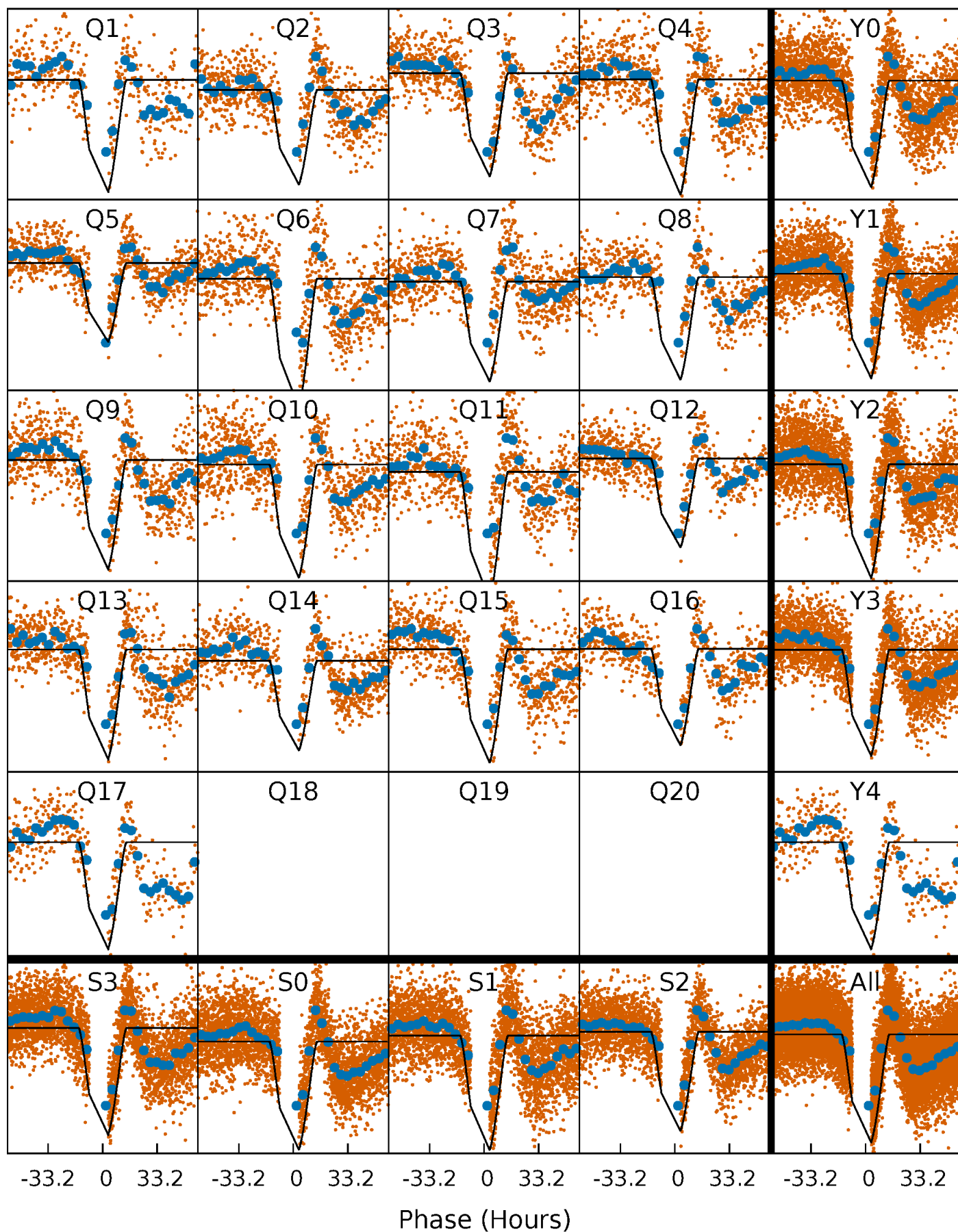
# PDC Quarter-Phased Transit Curves

TCE 004649305-02   P= 22.651222 Days    $T_0=140.432655$  (BKJD)



# DV Quarter-Phased Transit Curves

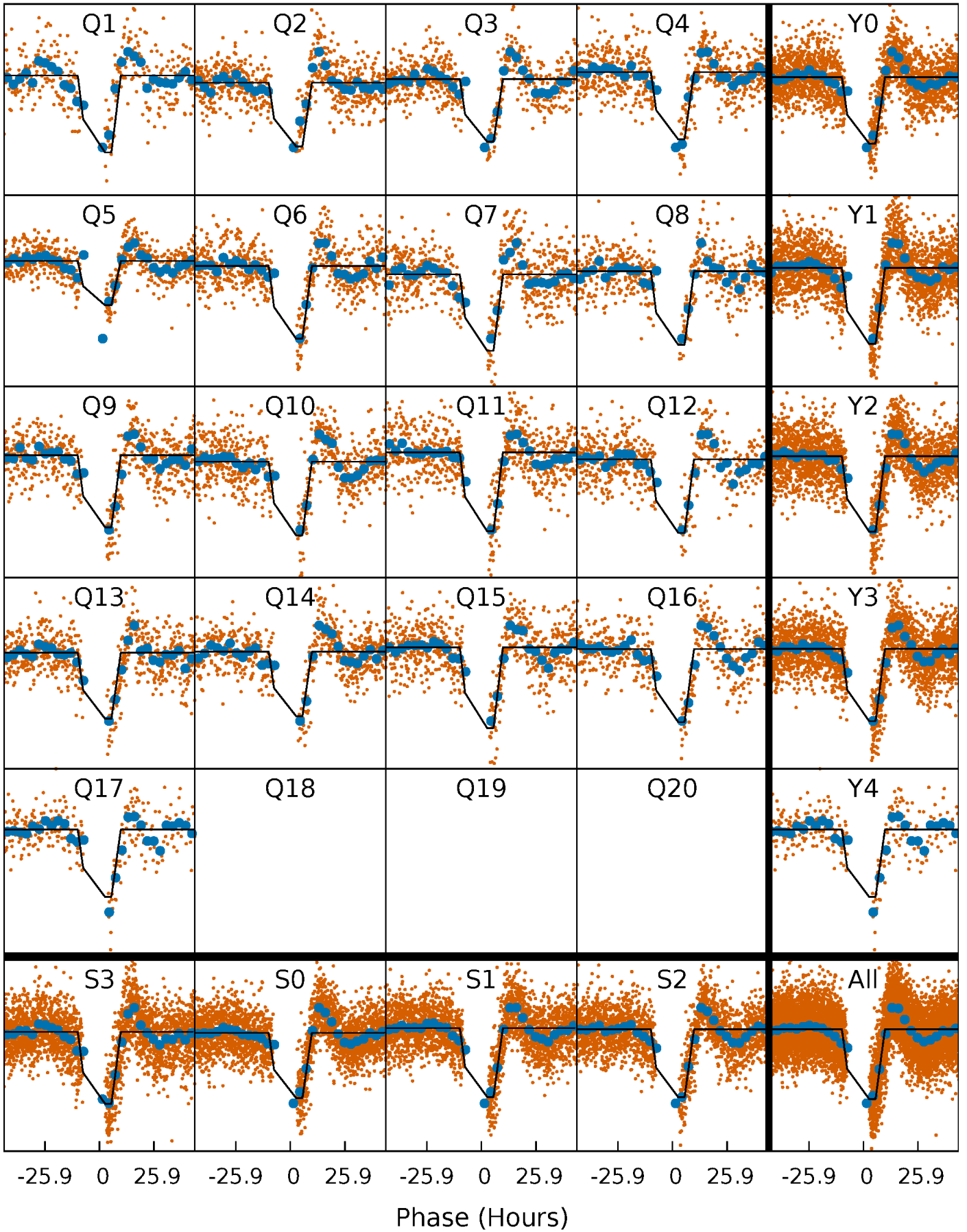
TCE 004649305-02   P= 22.651222 Days    $T_0=140.432655$  (BKJD)





# Alt. Detrend Quarter-Phased Transit Curves

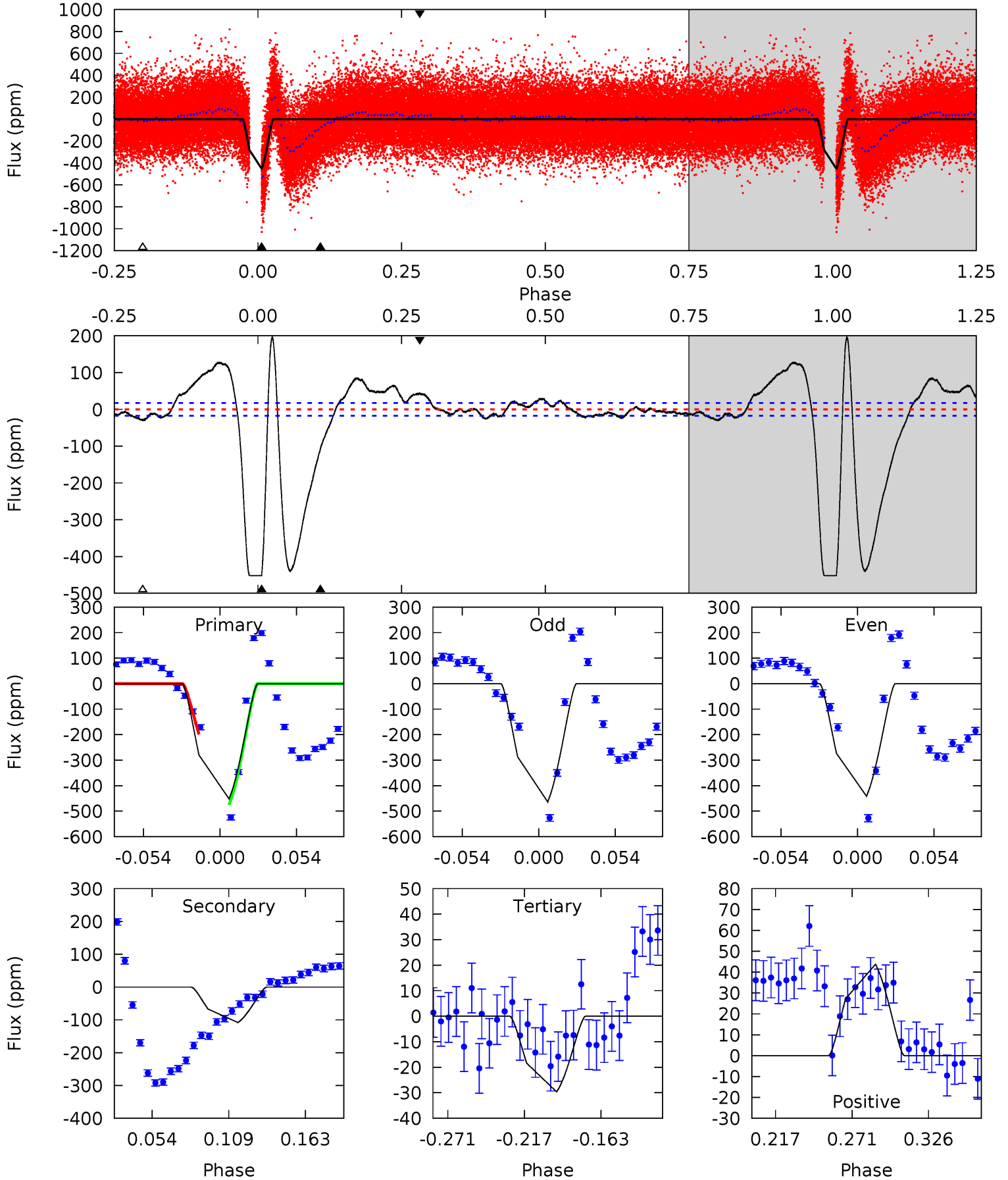
TCE 004649305-02 P= 22.650207 Days  $T_0=140.471287$  (BKJD)



# DV Model-Shift Uniqueness Test

004649305-02, P = 22.651222 Days, E = 117.781433 Days

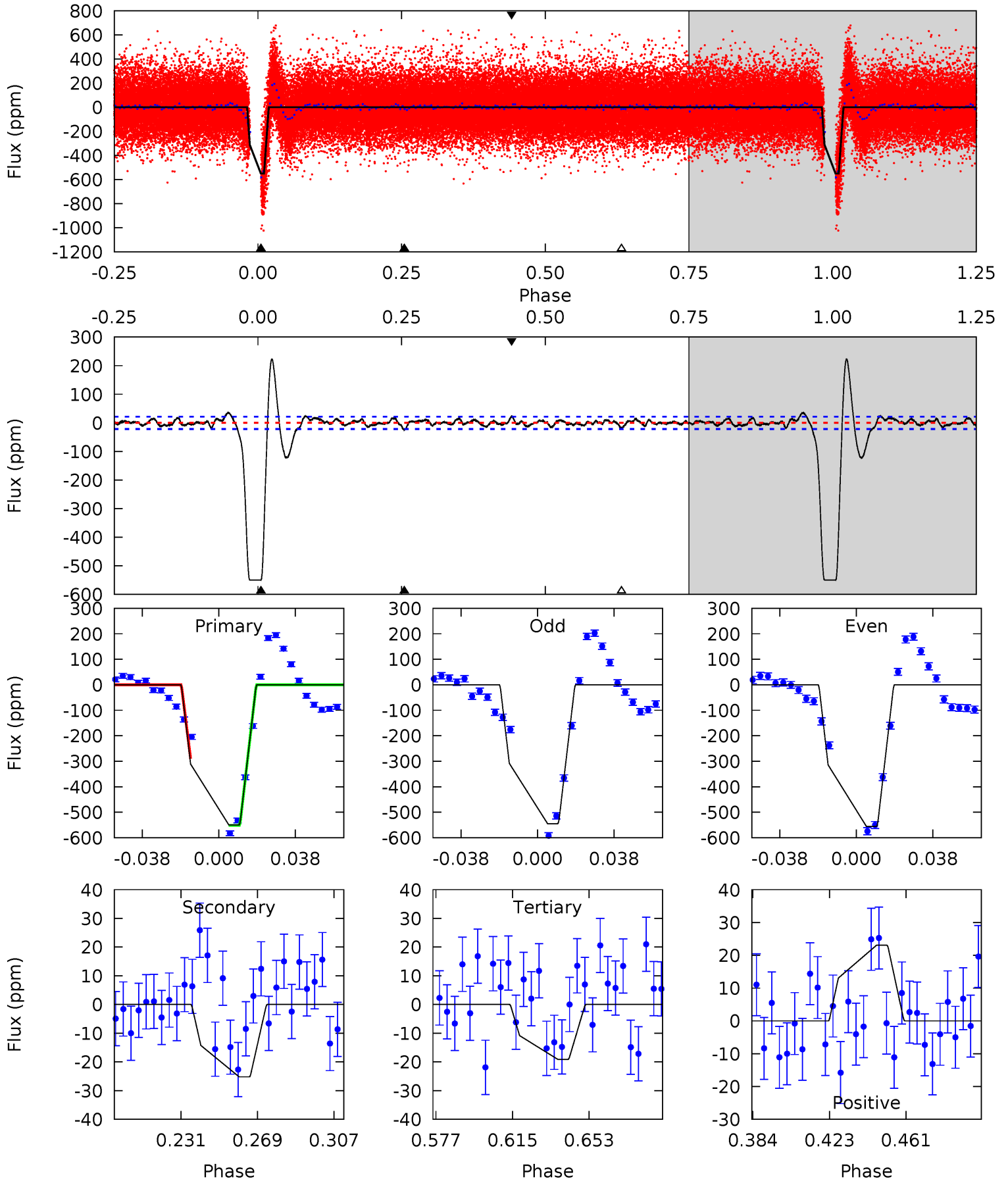
| Pri   | Sec  | Ter  | Pos  | FA <sub>1</sub> | FA <sub>2</sub> | F <sub>Red</sub> | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM  | Shape | TAT  |
|-------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 121.5 | 29.1 | 7.98 | 11.8 | 4.69            | 1.92            | 10.1             | 113.5   | 109.7   | 21.1    | 17.3    | 3.00    | 0.95 | 0.30  | 34.8 |



# Alt Model-Shift Uniqueness Test

004649305-02, P = 22.650207 Days, E = 117.821080 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  |
|-------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 120.7 | 5.54 | 4.20 | 5.07 | 4.76            | 2.07            | 3.81             | 116.5   | 115.7   | 1.34    | 0.47    | 1.18    | 0.97 | 0.29  | 24.1 |



### Stellar Parameters For KIC 004649305

|        | $T_{\text{eff}}(K)$  | $\log(g)$                 | [Fe/H]                     | $R (R_{\odot})$           | $M(M_{\odot})$            | $p_{\star} (\text{g}\cdot\text{cm}^{-3})$ |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
|        | $6968^{+194}_{-267}$ | $4.310^{+0.058}_{-0.232}$ | $-0.100^{+0.250}_{-0.350}$ | $1.333^{+0.513}_{-0.171}$ | $1.333^{+0.222}_{-0.182}$ | $0.793^{+0.266}_{-0.465}$                 |
|        | +3%/-4%              | +1%/-5%                   | +250%/-350%                | +38%/-13%                 | +17%/-14%                 | +33%/-59%                                 |
| 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 004649305-02 / KOI

| Detrend | Depth (ppm)  | $R_p (R_{\oplus})$     | $T_{\text{max}} (K)$ | $T_{\text{obs}} (K)$  | $A_{\text{obs}}$  |
|---------|--------------|------------------------|----------------------|-----------------------|-------------------|
| DV      | $-108 \pm 4$ | $7.97^{+3.46}_{-2.66}$ | $1221^{+97}_{-69}$   | $3548^{+507}_{-335}$  | $28^{+33}_{-14}$  |
| Alt.    | $-25 \pm 5$  | $4.05^{+2.87}_{-2.35}$ | $1219^{+91}_{-59}$   | $3482^{+1319}_{-532}$ | $24^{+114}_{-16}$ |

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

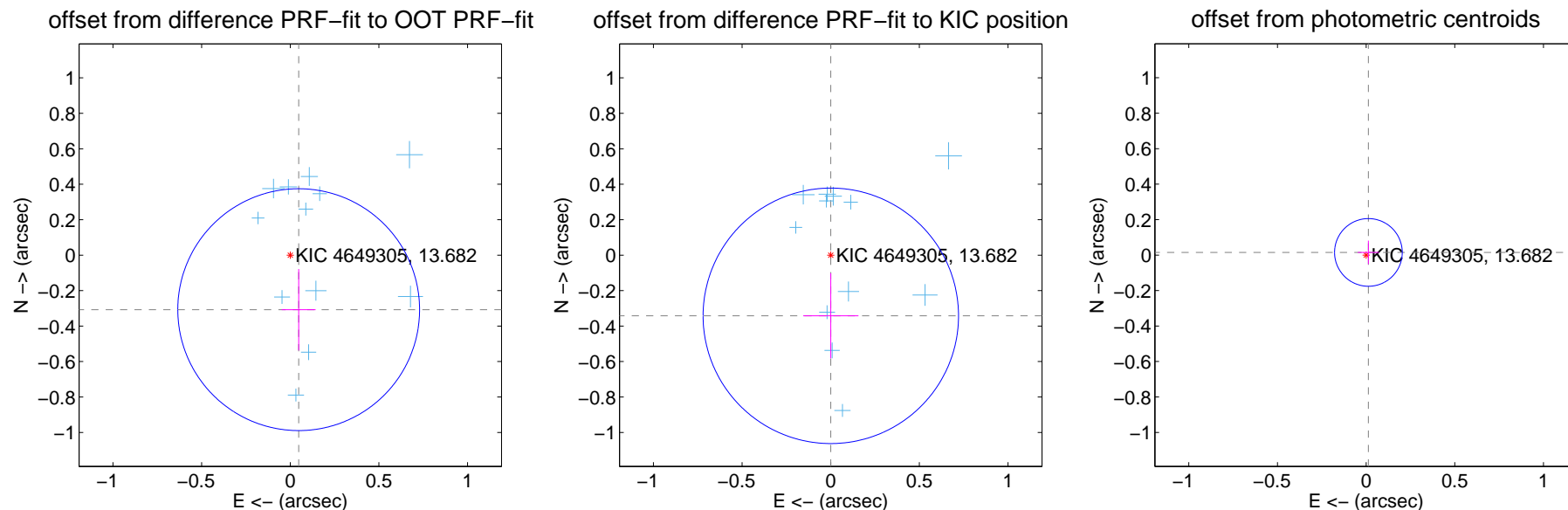
## DV Centroid Data

Supplemental centroid analysis for 004649305-02. Kepler magnitude: 13.68. Transit SNR 44.91

There are 17 quarters with good PRF difference image offsets

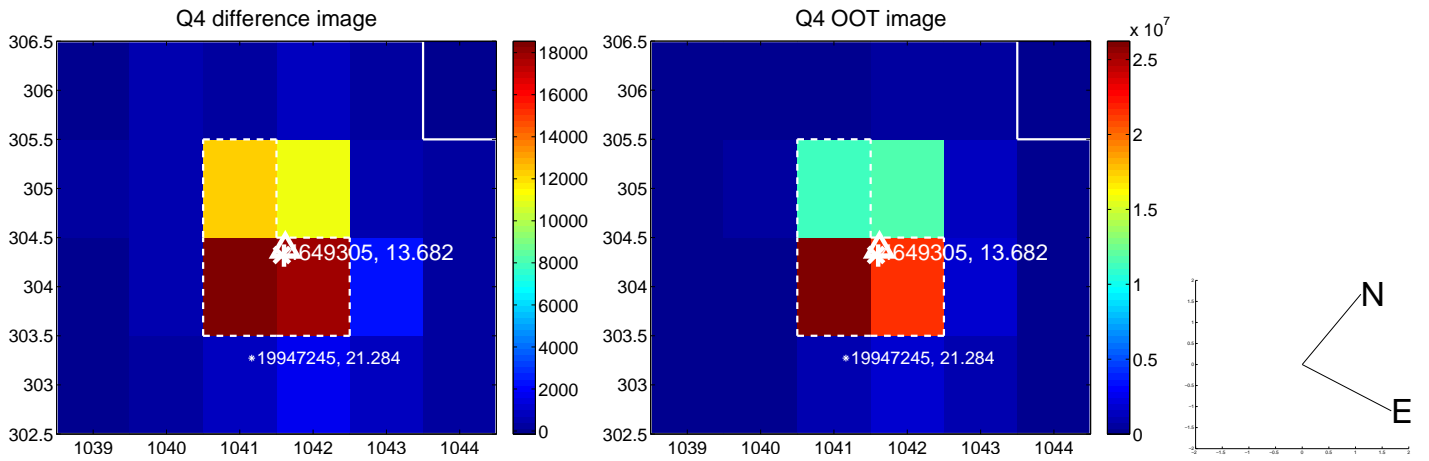
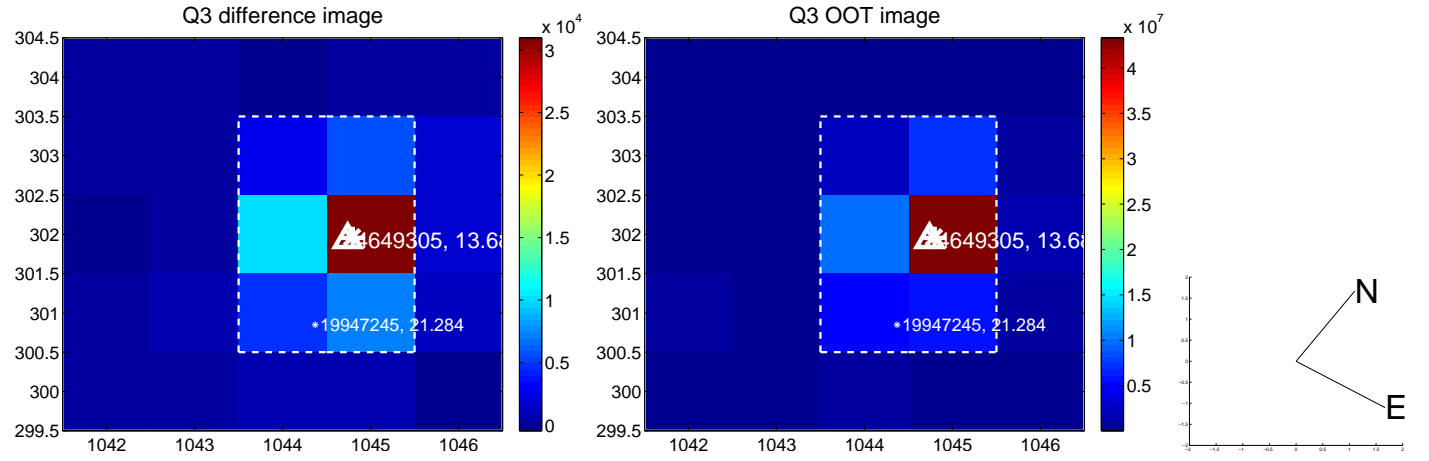
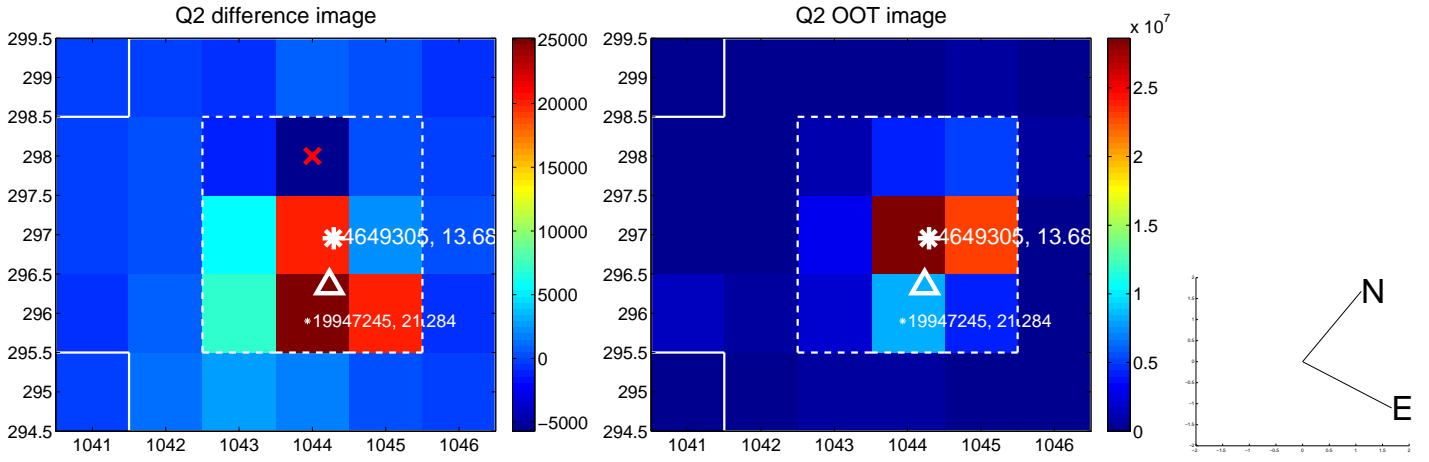
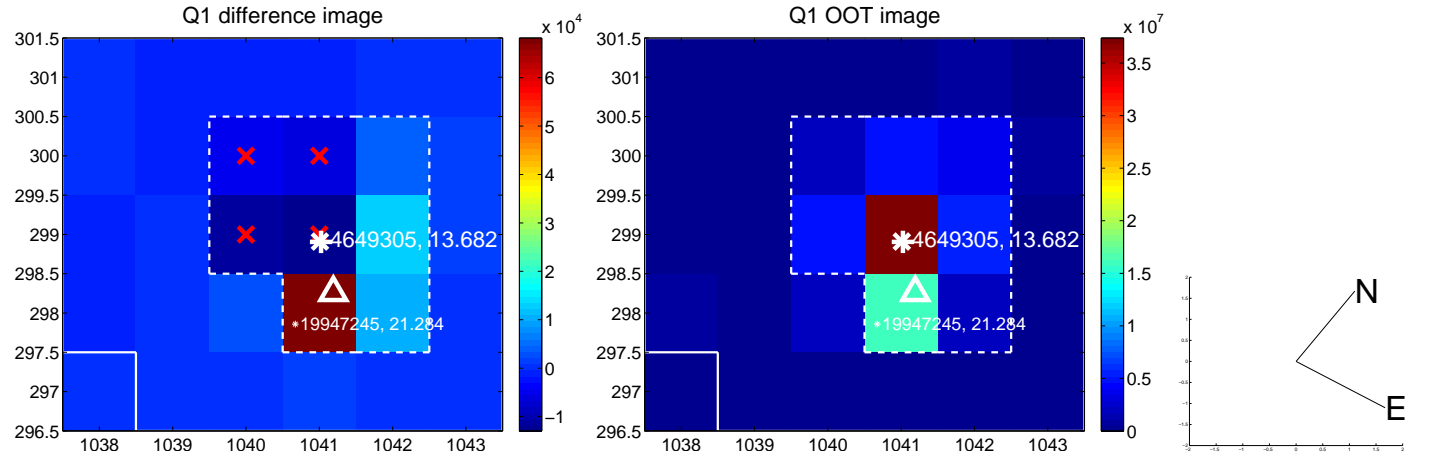
The direct PRF centroid is offset from the target star catalog position by about 0.01 arcsec

|   | Distance in arcsec | Distance / $\sigma$ | $\Delta$ RA        | $\Delta$ Dec       |
|---|--------------------|---------------------|--------------------|--------------------|
| PRF-fit source offset from OOT          | $0.311 \pm 0.227$  | 1.37                | $-0.047 \pm 0.096$ | $-0.307 \pm 0.230$ |
| PRF-fit source offset from KIC position | $0.342 \pm 0.240$  | 1.43                | $-0.000 \pm 0.156$ | $-0.342 \pm 0.240$ |
| photometric centroid source offset      | $0.02 \pm 0.06$    | 0.31                | $-0.01 \pm 0.06$   | $0.01 \pm 0.07$    |

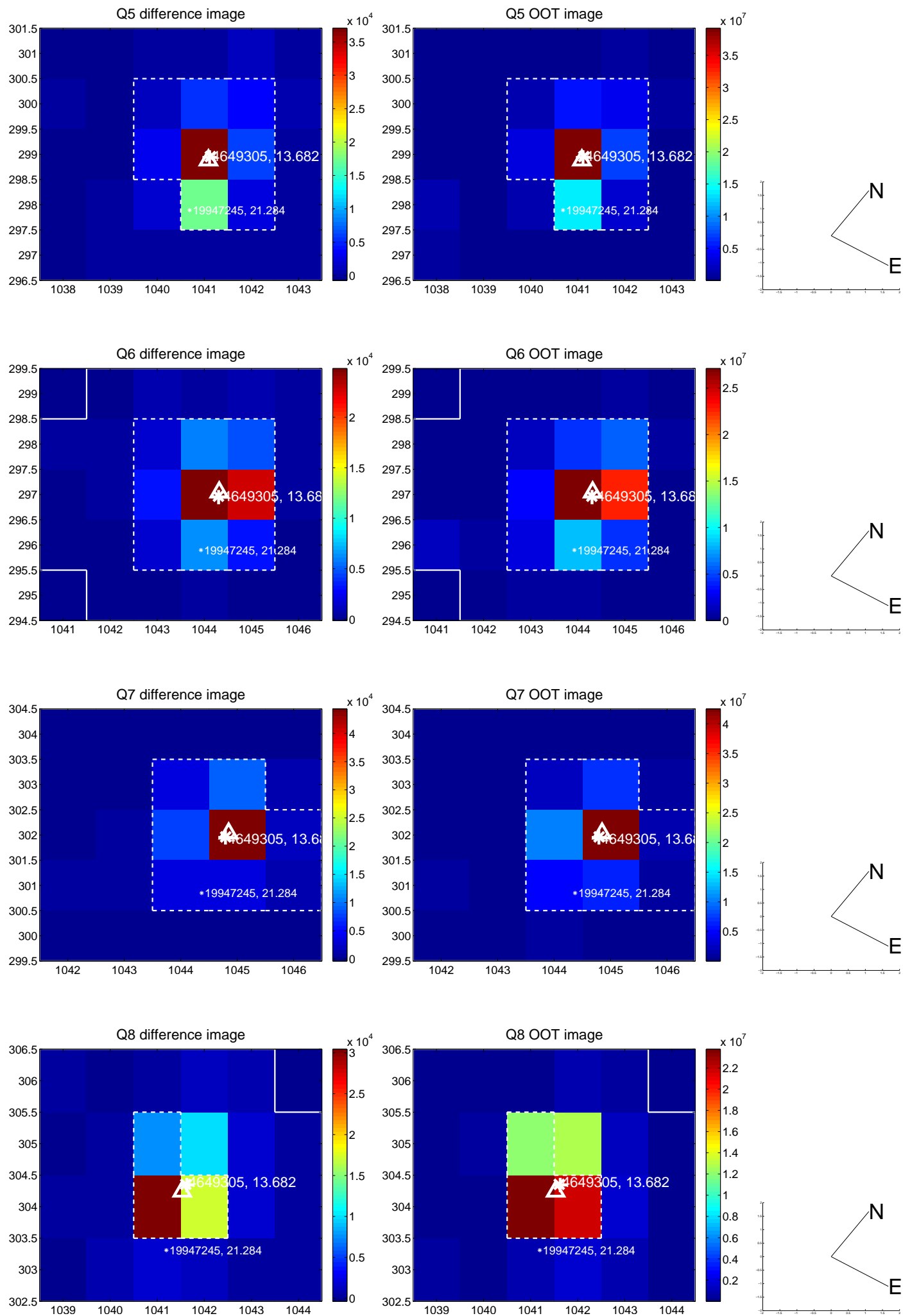


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- $\sigma$  uncertainty. Blue circle: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

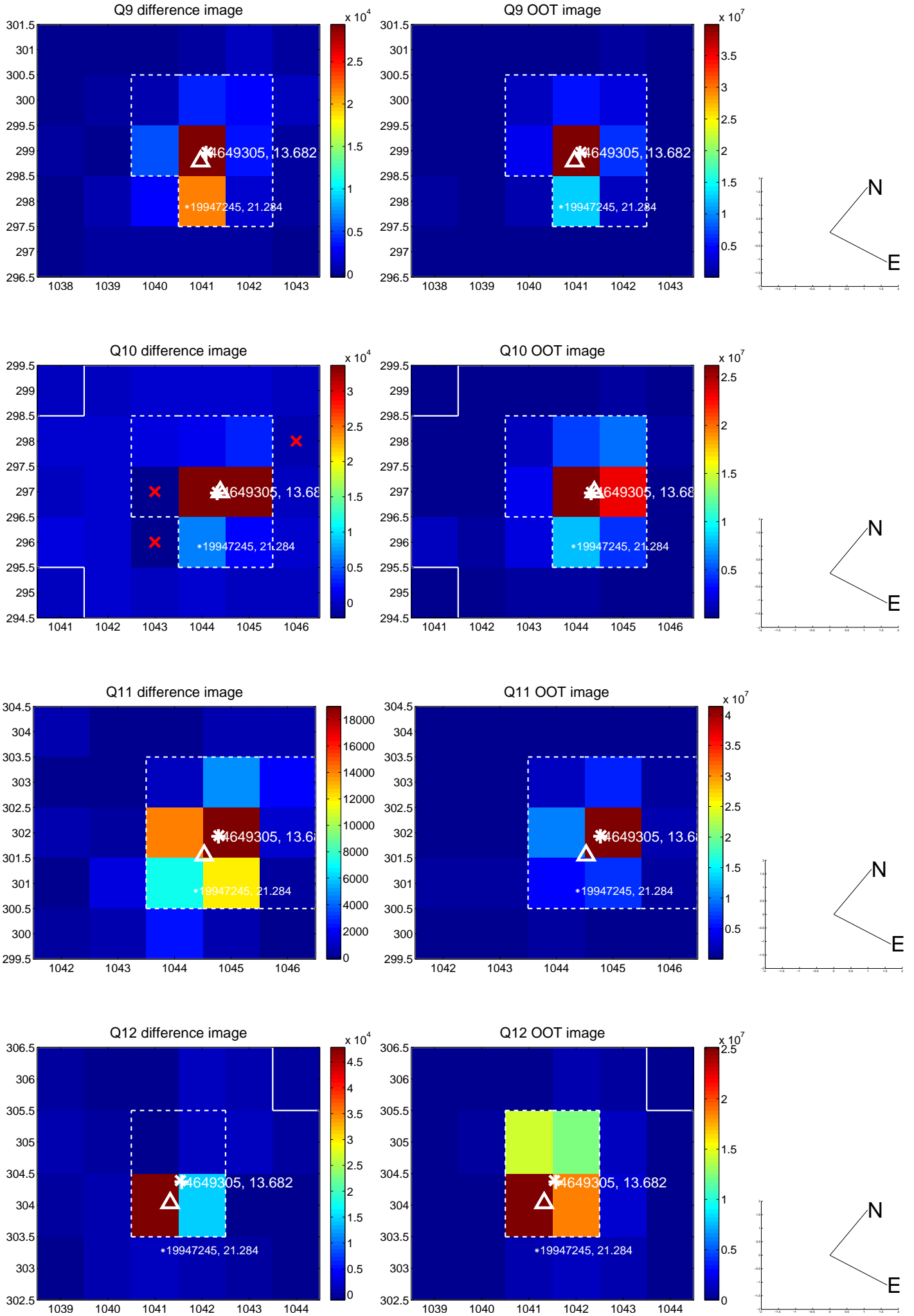


white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.

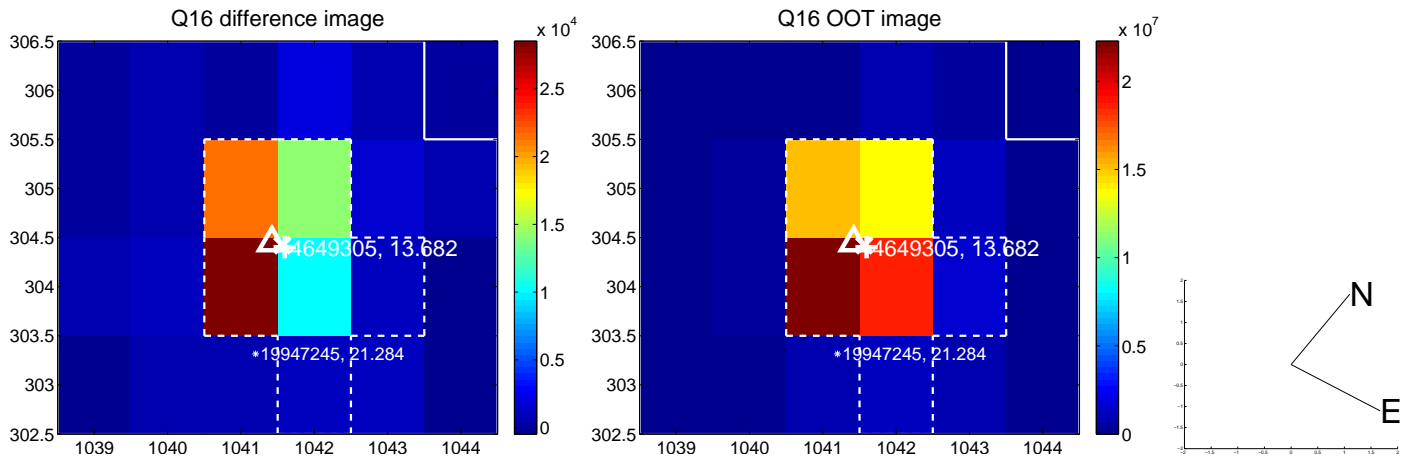
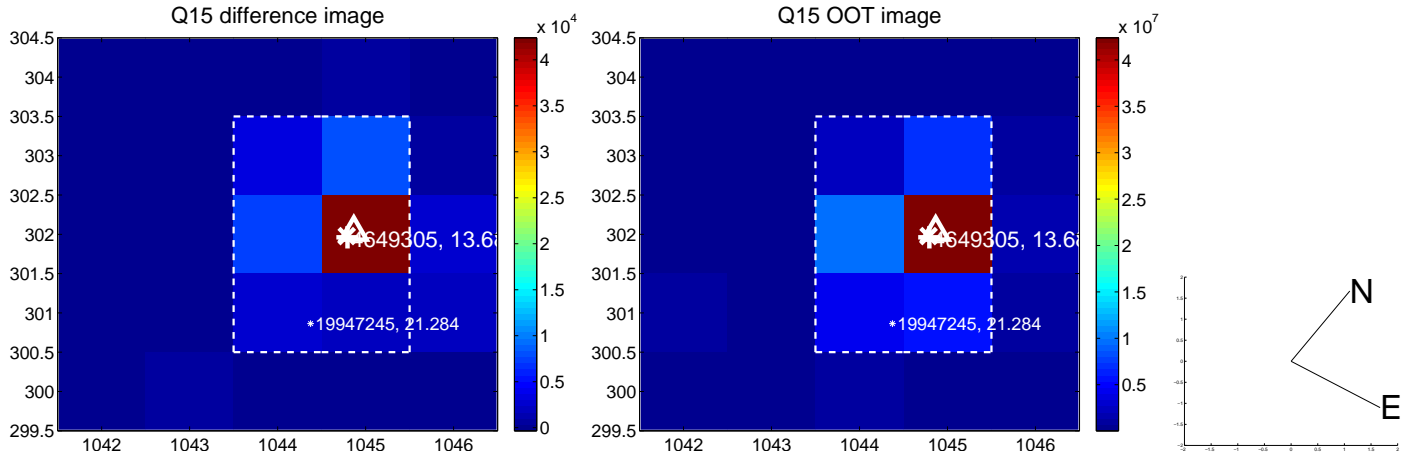
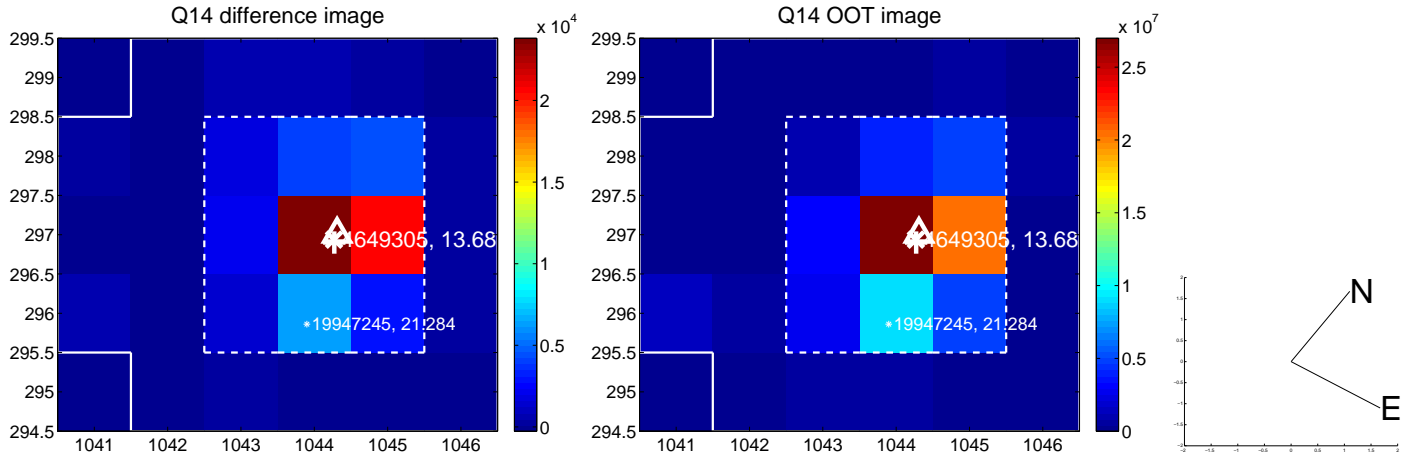
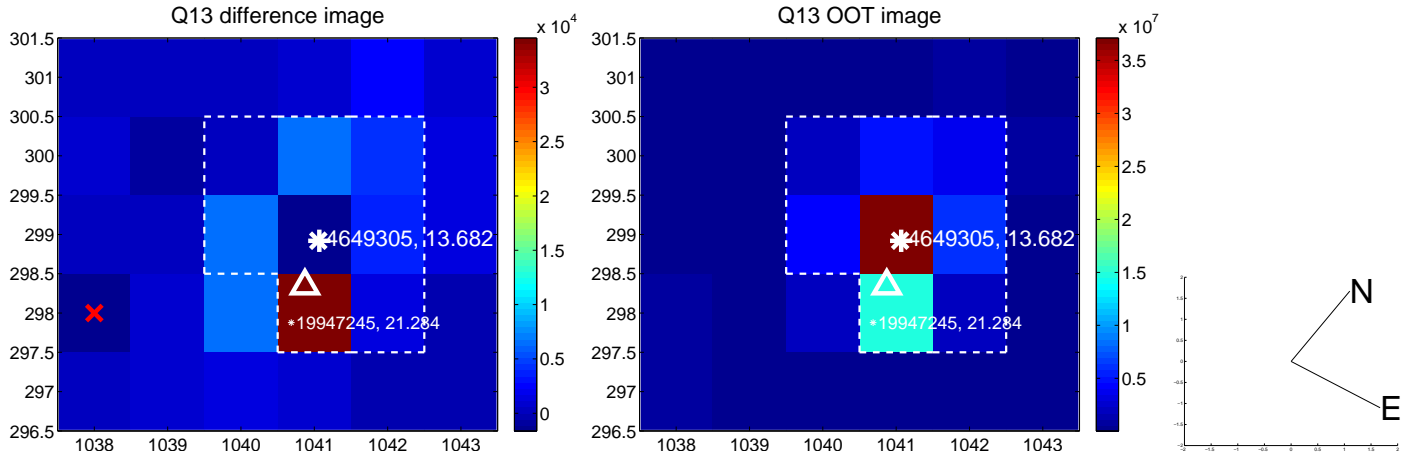




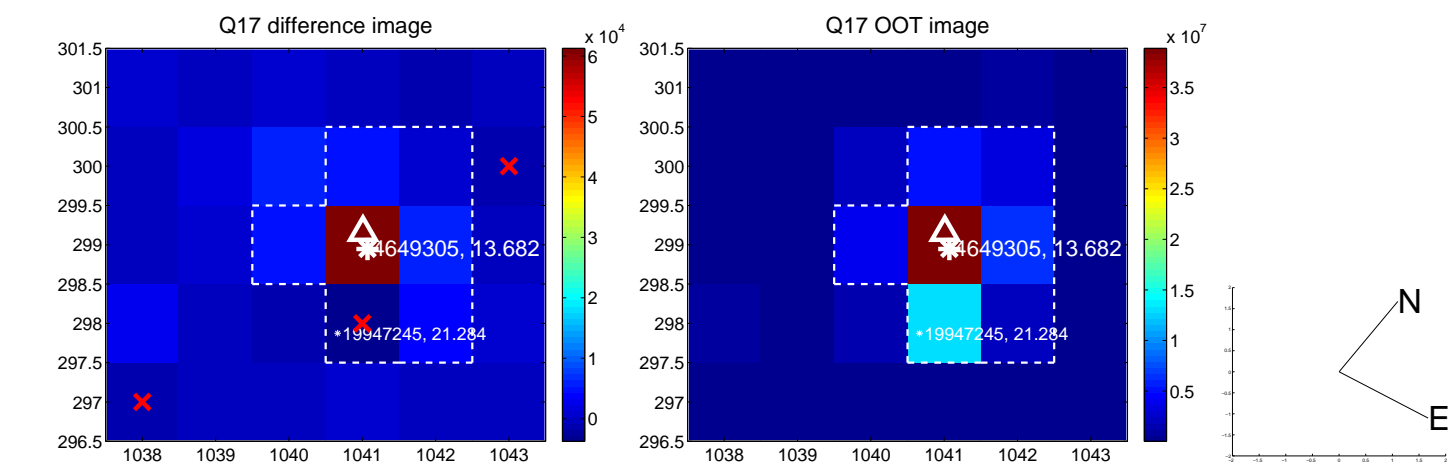
white  $\times$ : KIC target position; +: OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



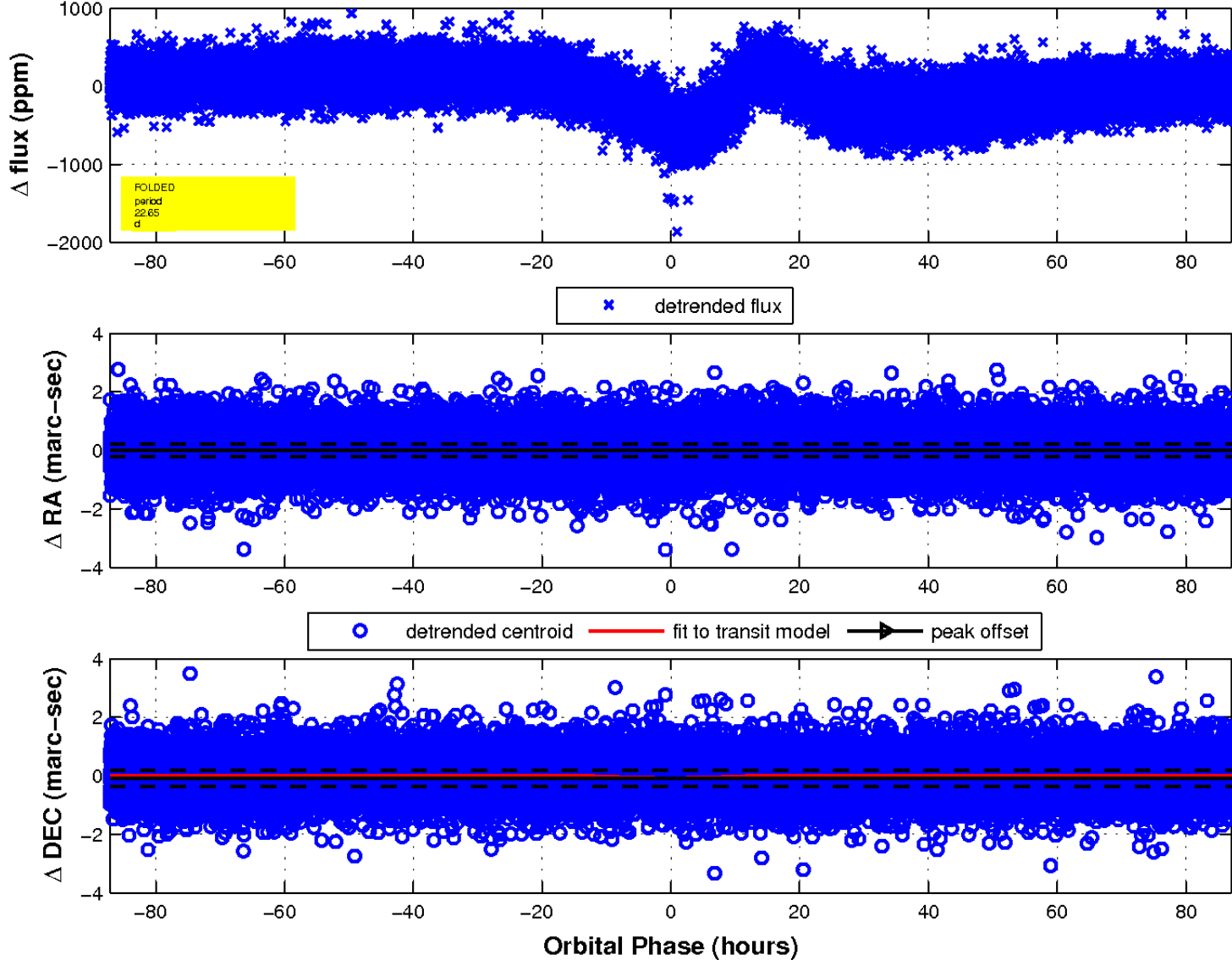
white  $\times$ : KIC target position;  $+$ : OOT centroid;  $\triangle$ : difference centroid. red  $\times$ : large negative pixel value.



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



fluxWeightedCentroids, Planet 2 of 2



UKIRT Image

Declination

