

KIC 004545187

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}) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|-------|-----------------------------|-----------------|------------------------|------------------------|
| 004545187-01 | OBS | 0223.01 | 3.177418 | 134.478035 | 1132.5 | 1.629 | 98.4 | 110.1 | 0.71 | 5303 | 2.87 | 234.19 |
| 004545187-02 | OBS | 0223.02 | 41.008061 | 147.033133 | 1001.6 | 4.064 | 33.6 | 36.4 | 0.71 | 5303 | 2.43 | 7.74 |

Robovetter Results

| TCE | Run Type | Disp | Score | N | S | C | E | Comments |
|--------------|----------|------|-------|---|---|---|---|------------|
| 004545187-01 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 004545187-02 | 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.

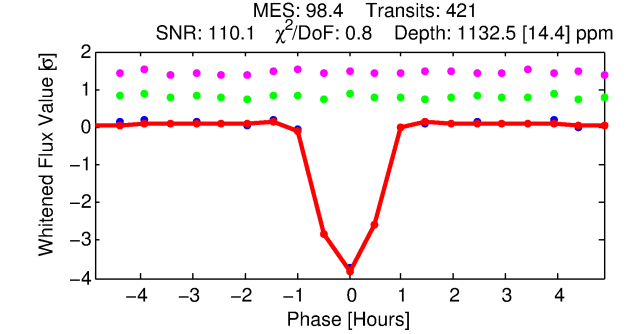
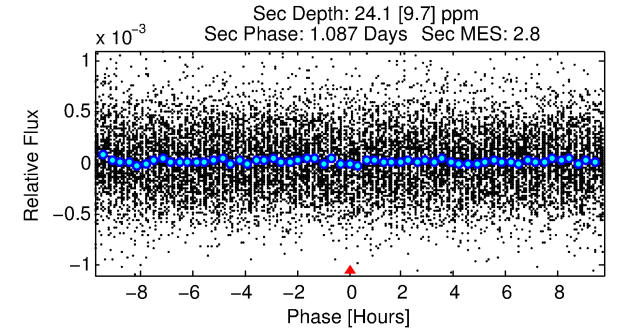
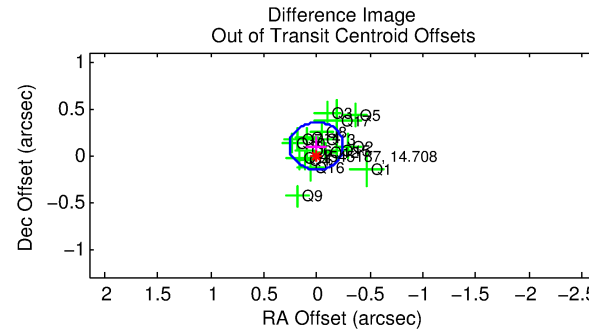
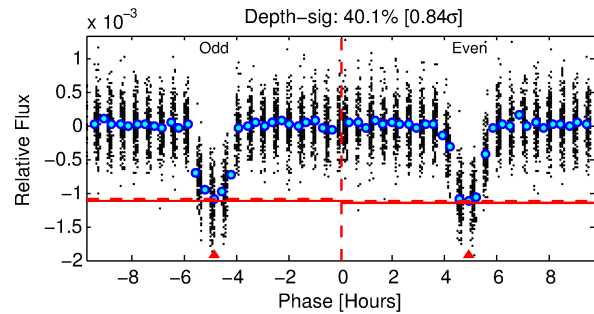
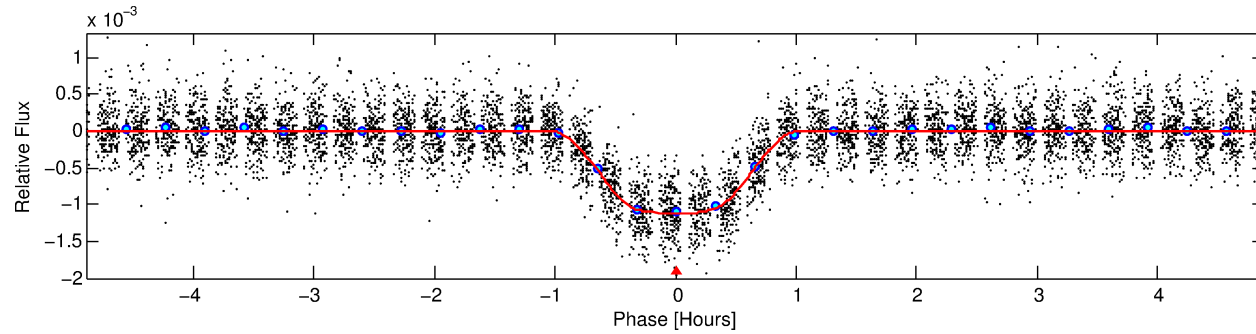
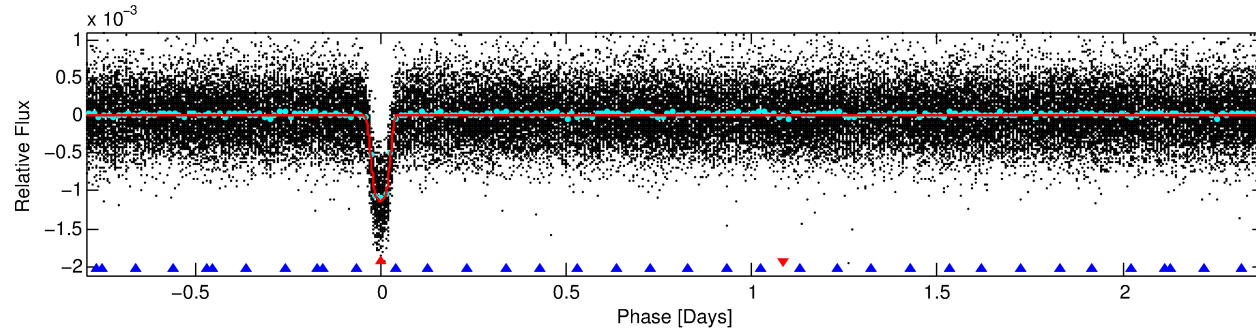
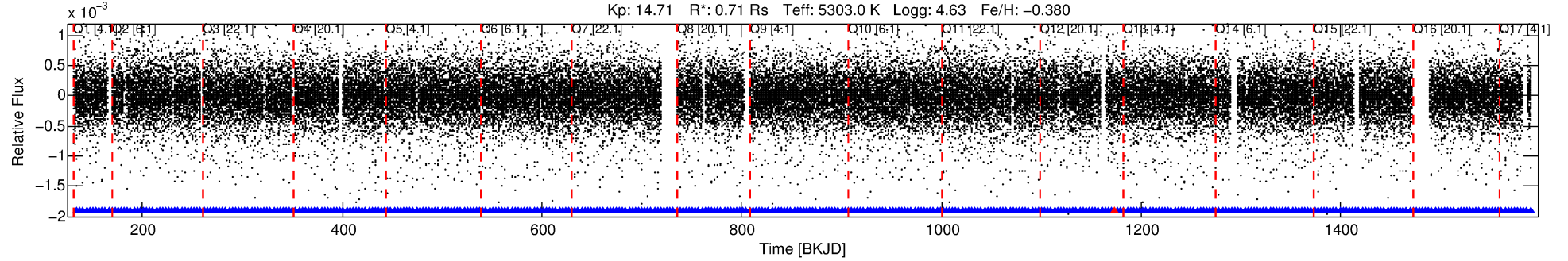
See http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col for comment definitions.

Ephemeris Match Information For 004545187-01

No Significant Match Found

DV One-Page Summary

KIC: 4545187 Candidate: 1 of 2 Period: 3.177 d
KOI: K00223.01 Name: Kepler-121b Corr: 0.948



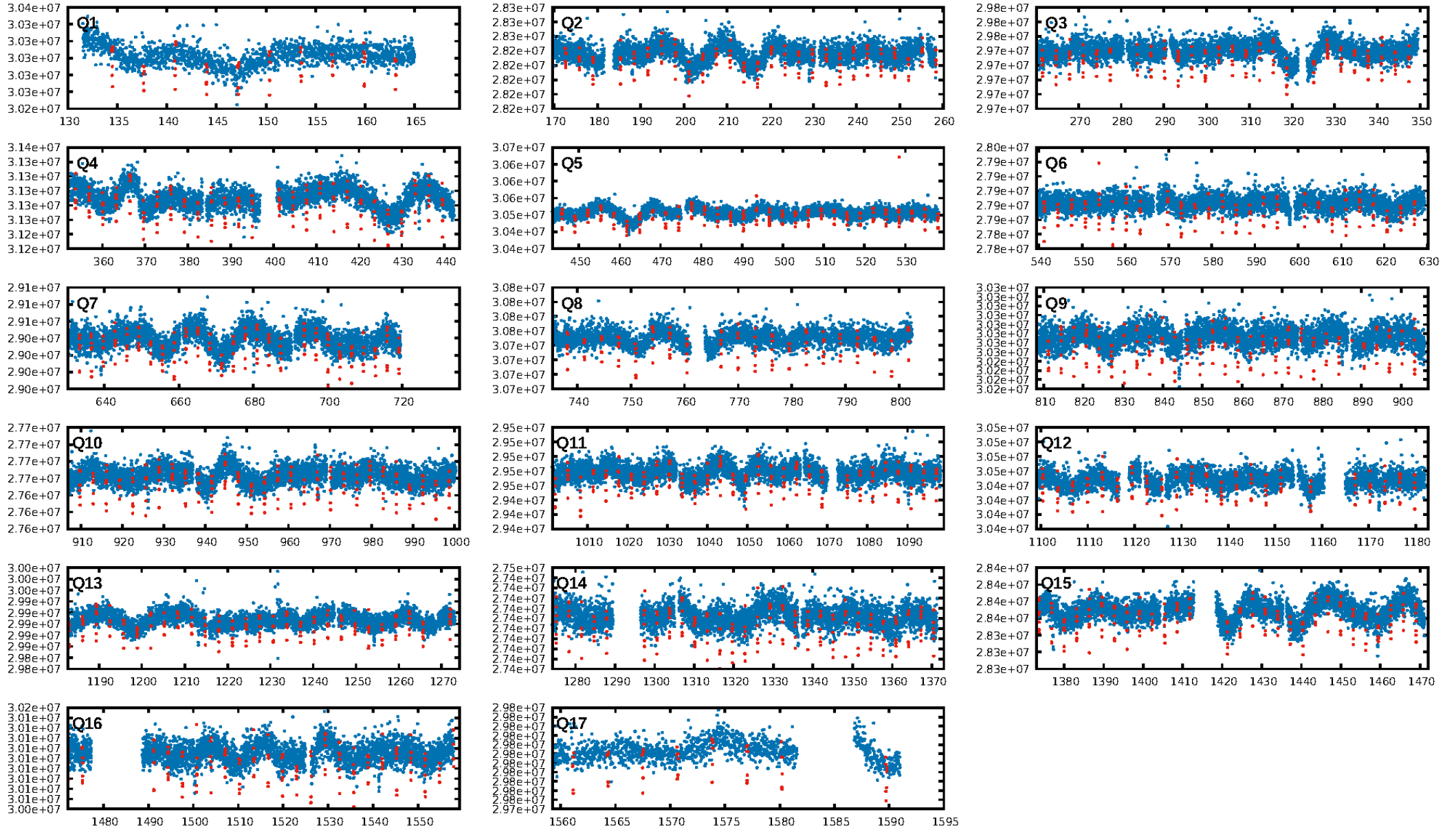
DV Fit Results:

Period = 3.17742 [0.00000] d
Epoch = 134.4780 [0.0003] BKJD
Rp/R* = 0.0372 [0.0013]
a/R* = 7.75 [1.04]
b = 0.90 [0.03]
Seff = 234.19 [51.03]
Teff = 998 [54] K
Rp = 2.87 [0.46] Re
a = 0.0389 [0.0050] AU
Ag = 2.43 [1.09] [1.31 σ]
Teffp = 1926 [205] K [4.37 σ]

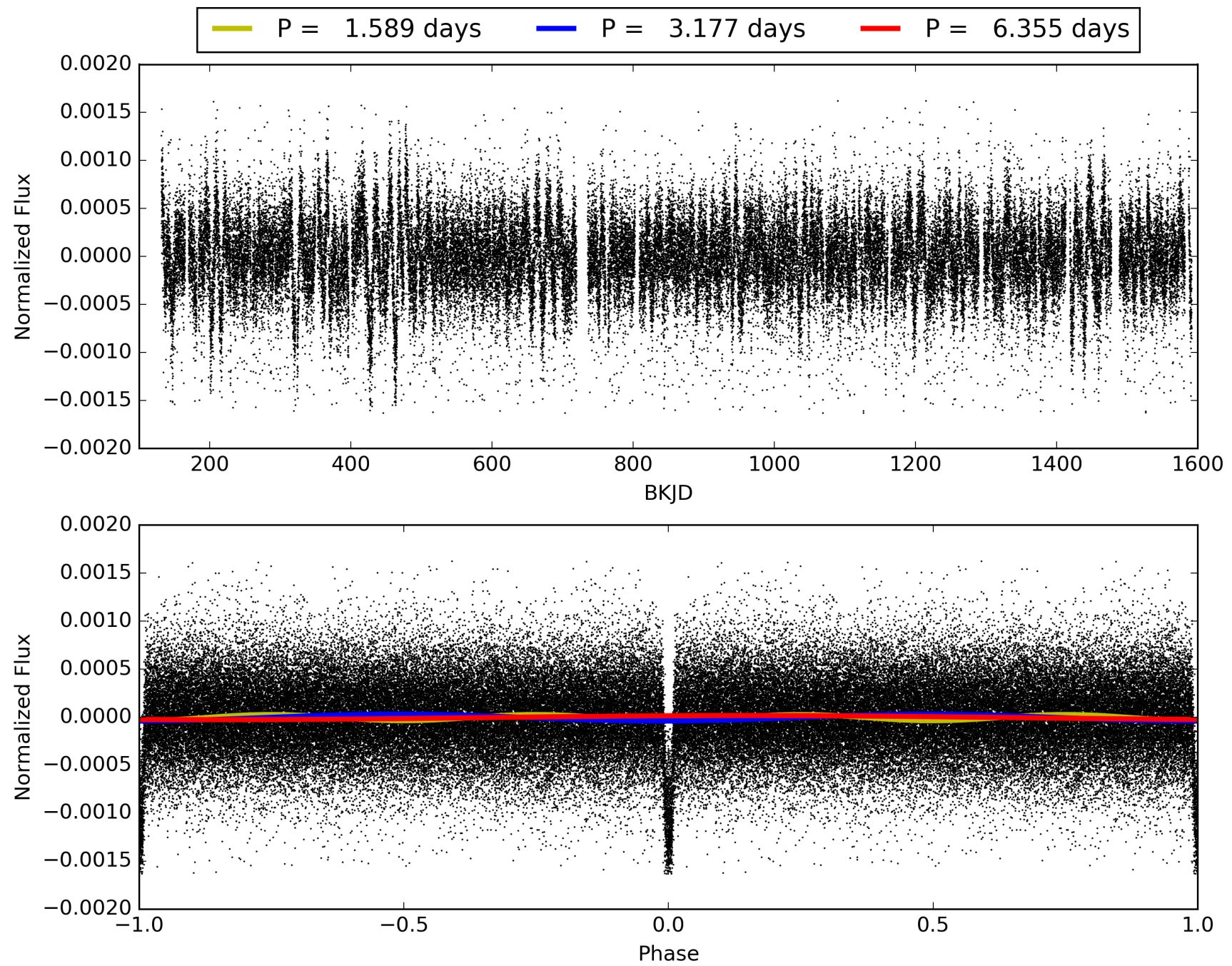
DV Diagnostic Results:

ShortPeriod-sig: N/A
LongPeriod-sig: 100.0% [207.39 σ]
ModelChiSquare2-sig: N/A
ModelChiSquareGof-sig: N/A
Bootstrap-pfa: 0.00e+00
RollingBand-fgt: 1.00 [402/403]
GhostDiagnostic-chr: 4.518
Centroid-sig: 0.6%
Centroid-so: 0.336 arcsec [2.62 σ]
OotOffset-rm: 0.100 arcsec [1.18 σ]
KicOffset-rm: 0.214 arcsec [2.41 σ]
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 004545187-01, PDC Light Curves

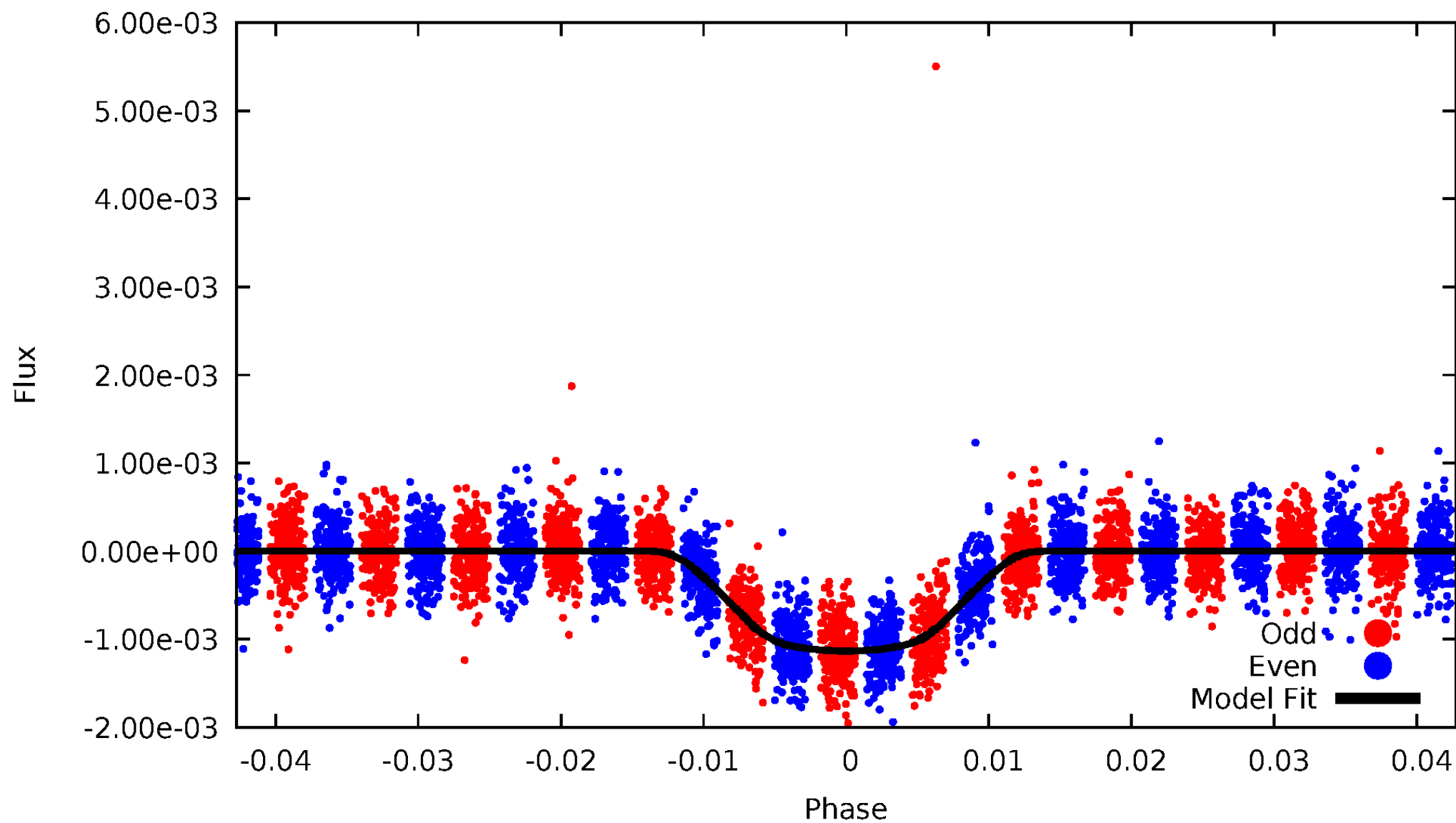


TCE 004545187-01



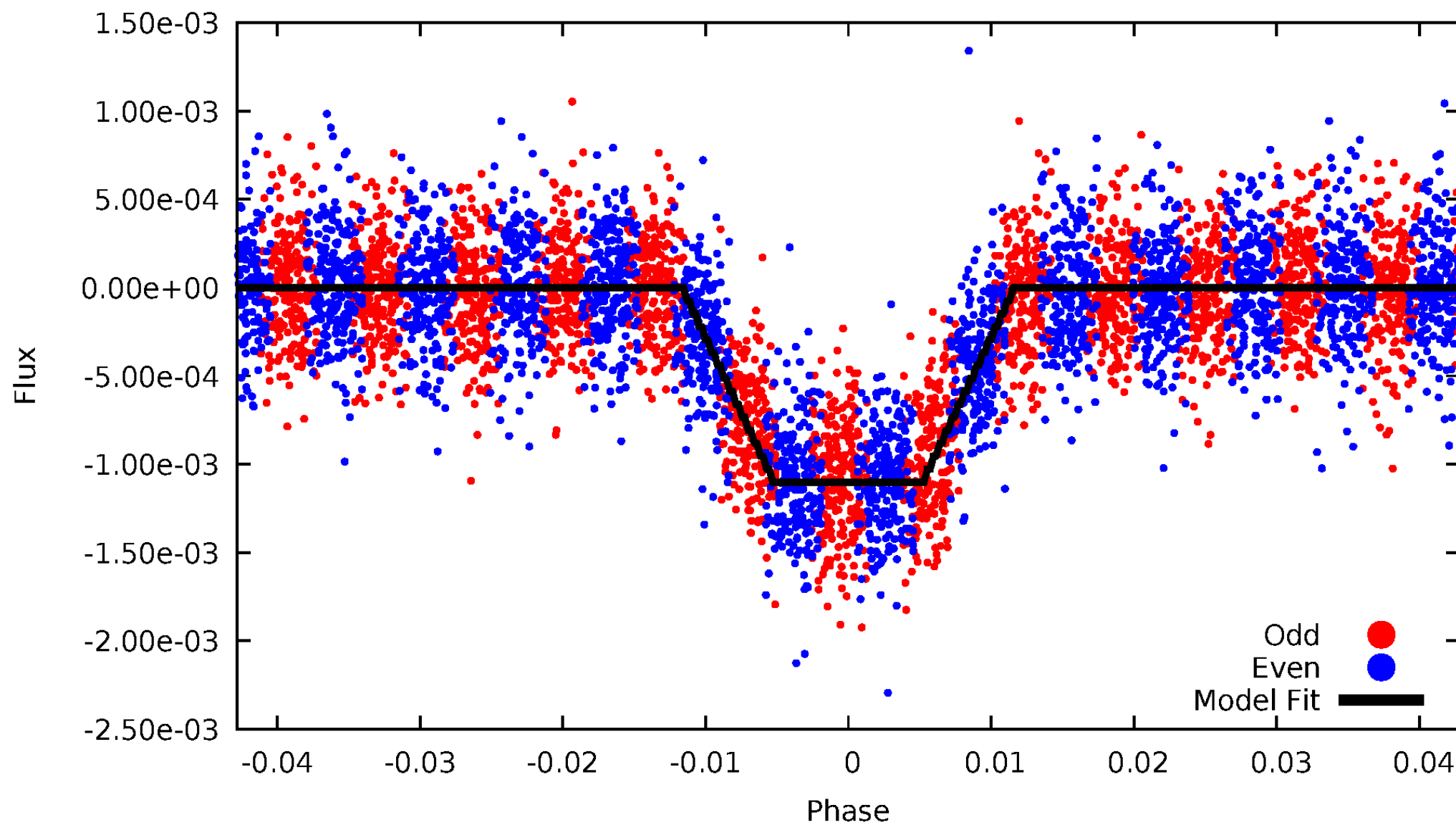
DV Odd/Even

TCE 004545187-01

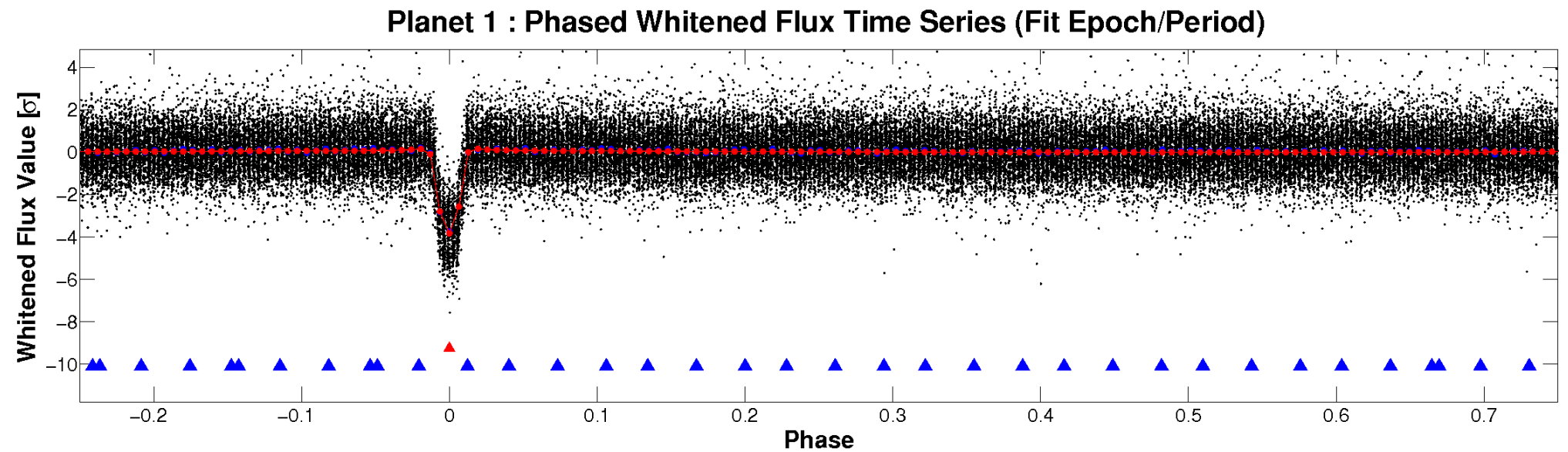
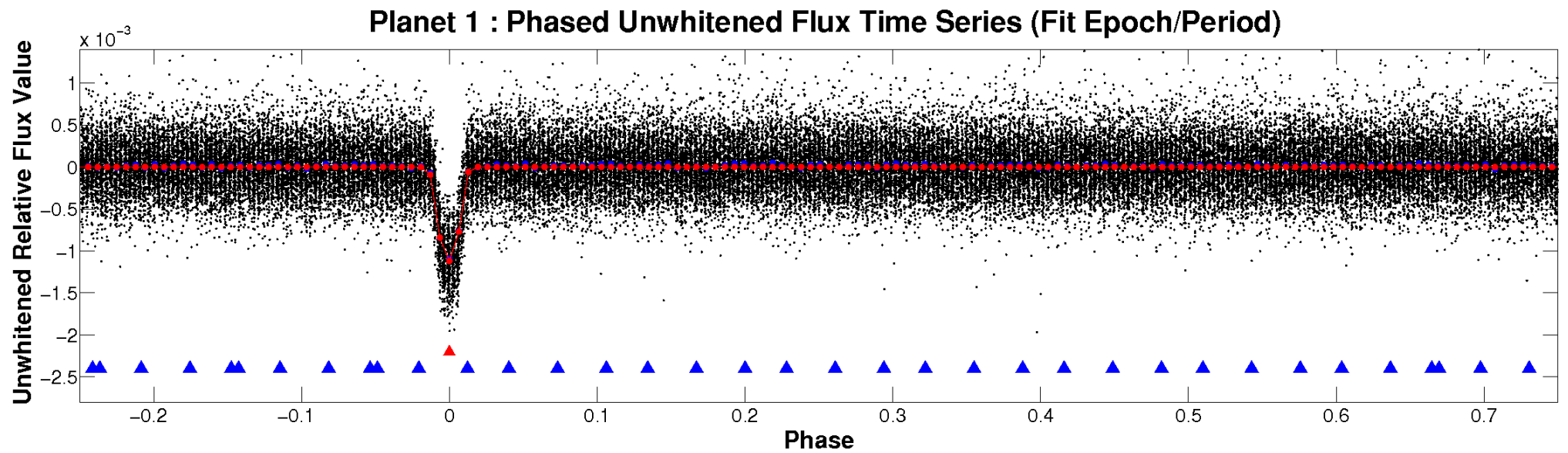


ALT Odd/Even

TCE 004545187-01

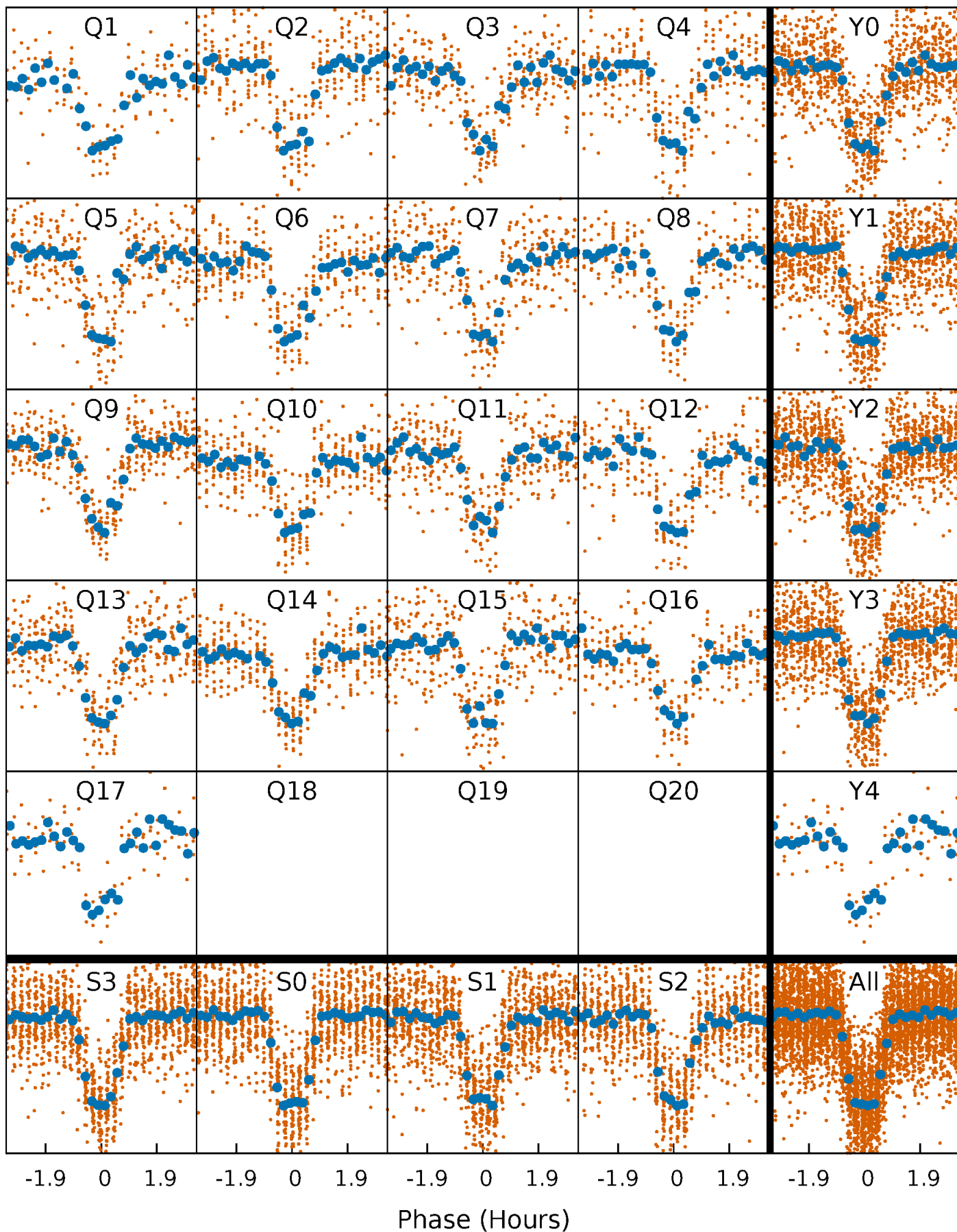


Non-Whitened Vs. Whitened Light Curve



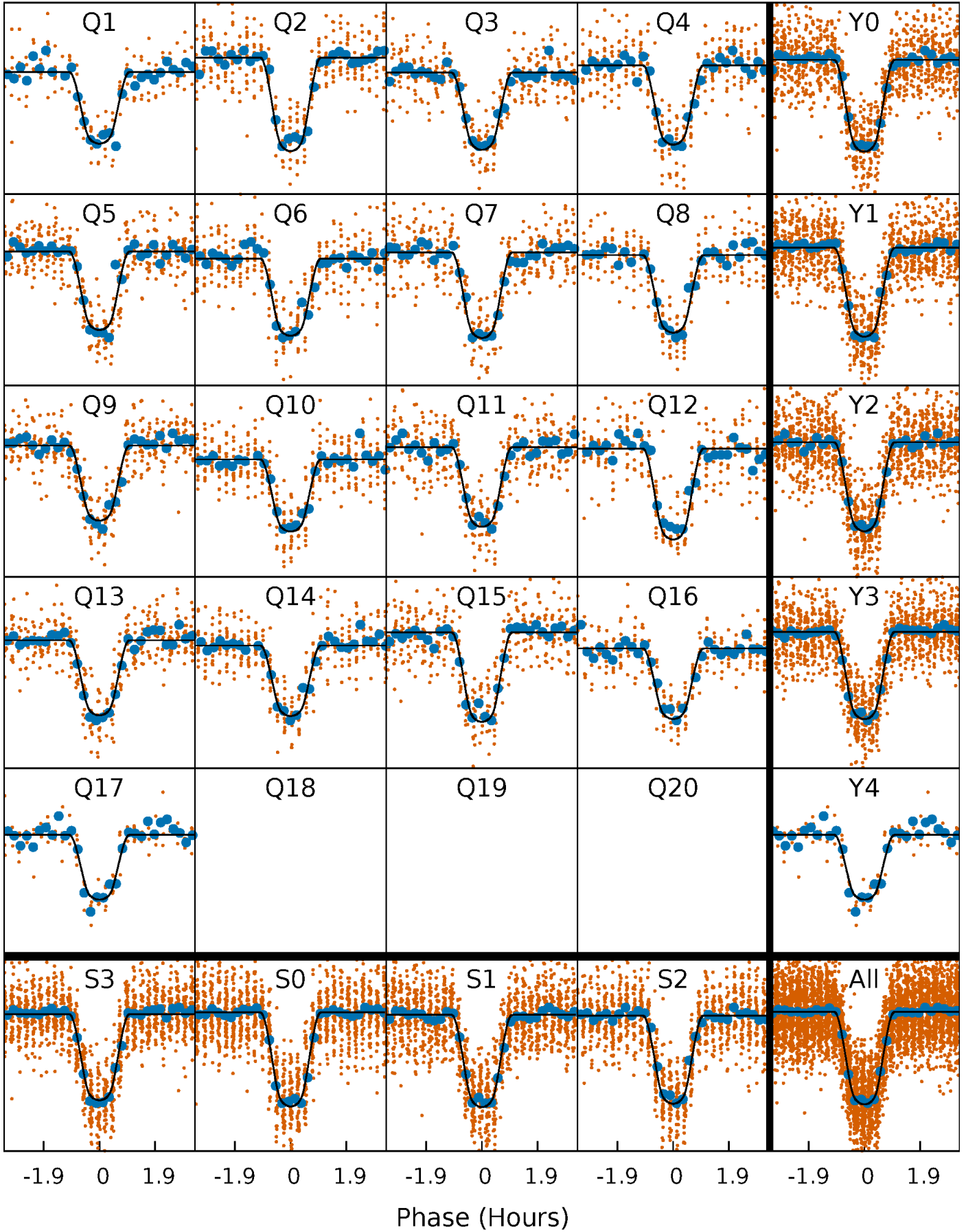
PDC Quarter-Phased Transit Curves

TCE 004545187-01 P= 3.177418 Days $T_0=134.478035$ (BKJD)



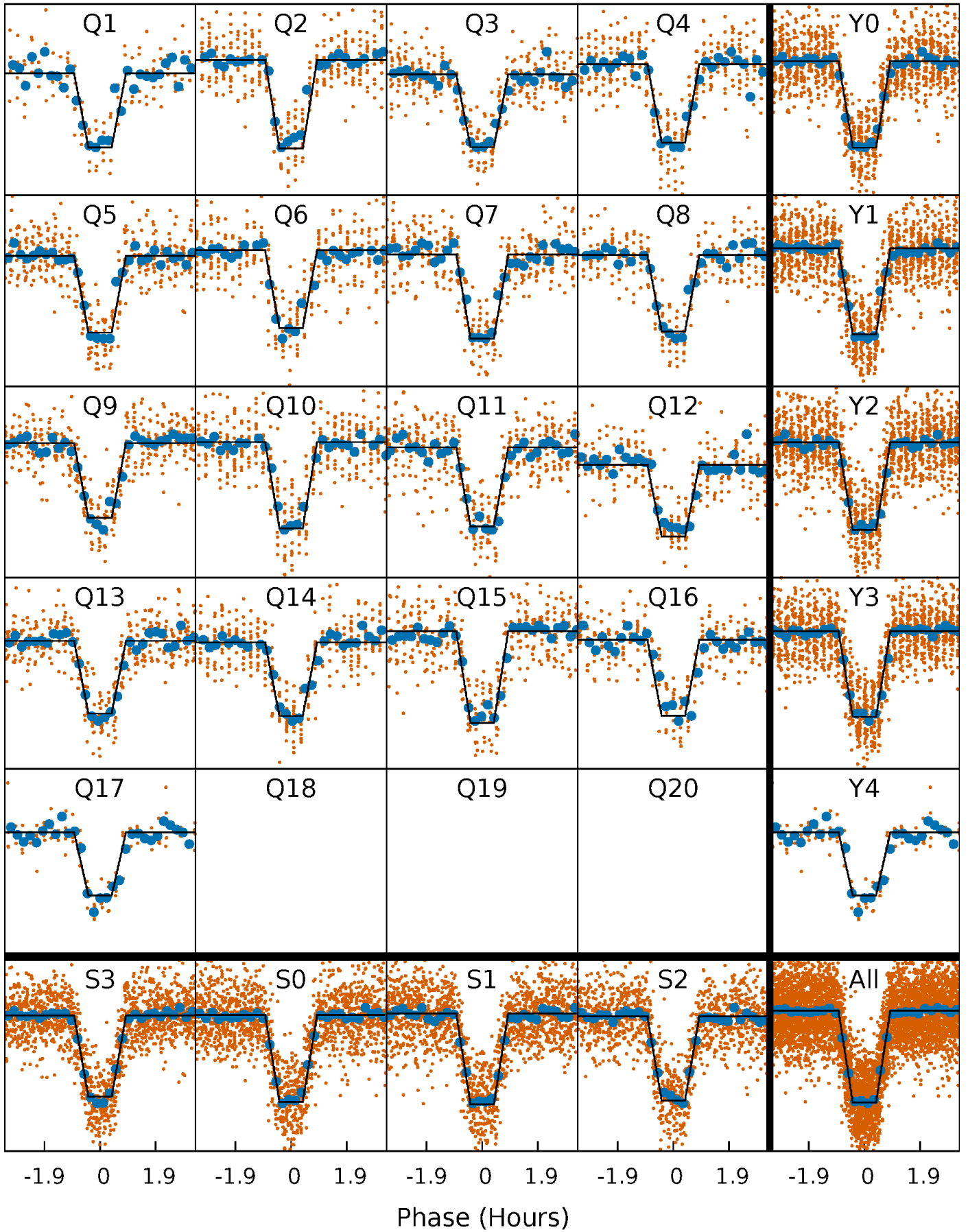
DV Quarter-Phased Transit Curves

TCE 004545187-01 P= 3.177418 Days $T_0=134.478035$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

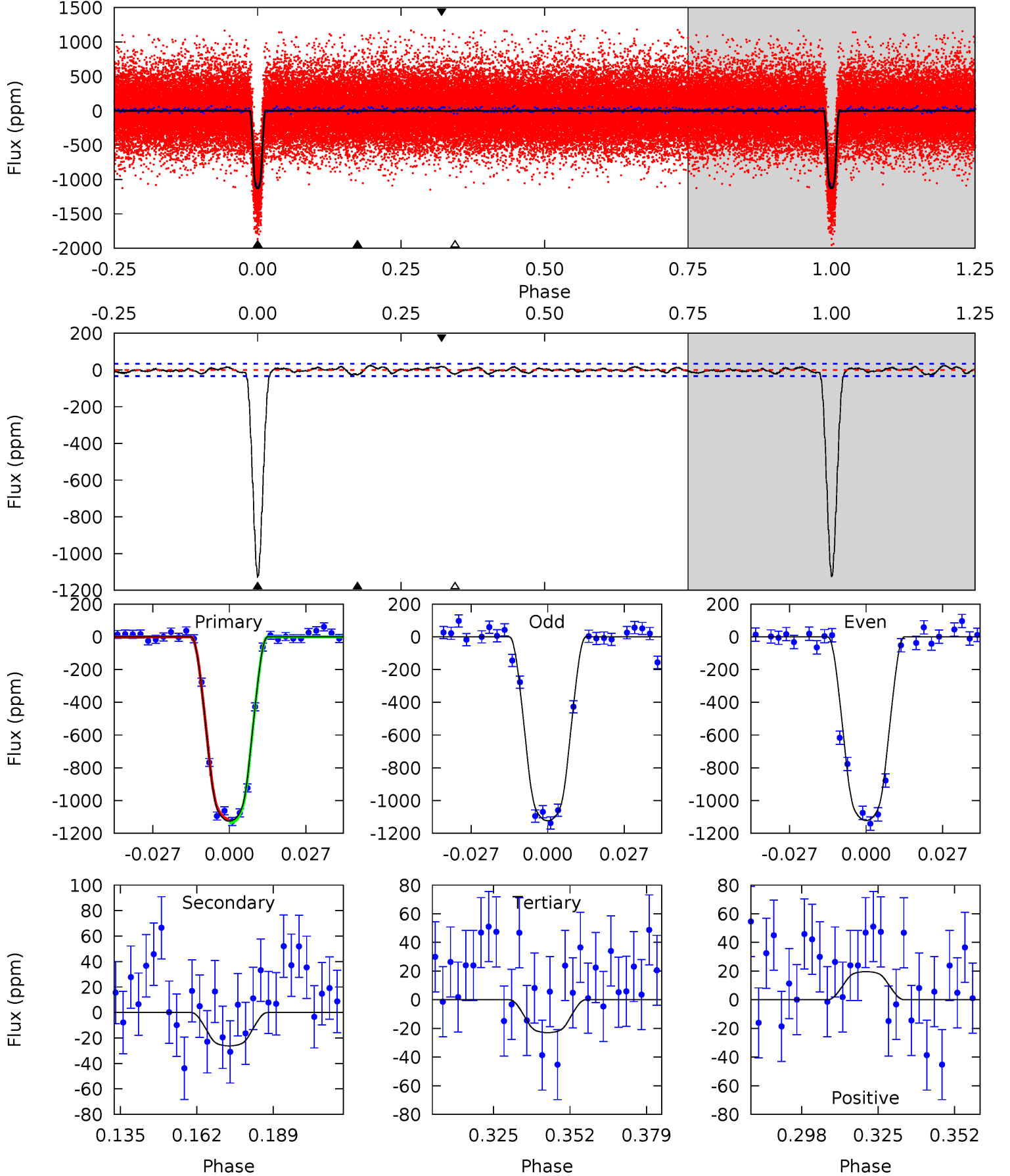
TCE 004545187-01 $P = 3.177402$ Days $T_0 = 134.481794$ (BKJD)



DV Model-Shift Uniqueness Test

004545187-01, P = 3.177418 Days, E = 131.300617 Days

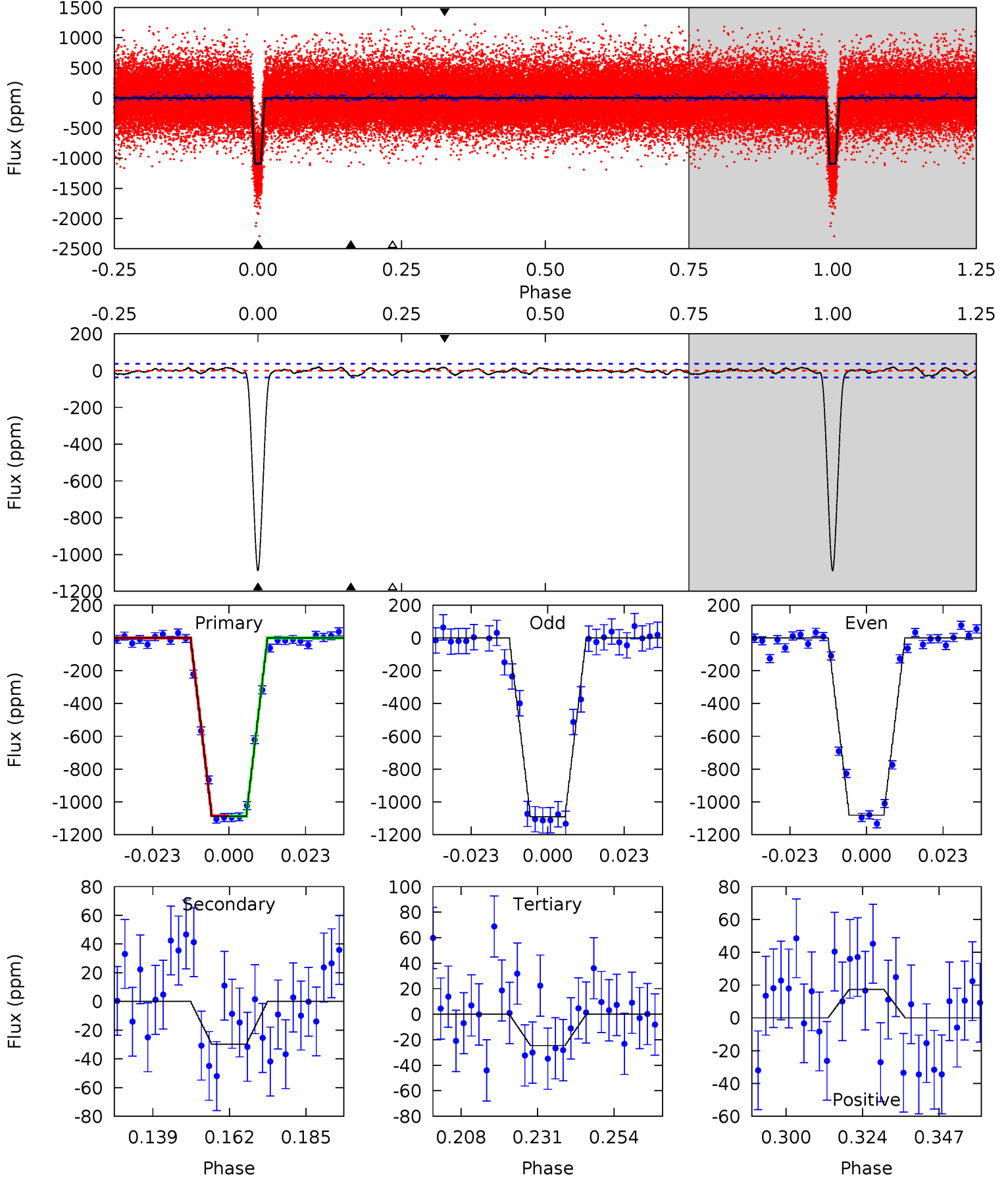
| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|-------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 162.6 | 3.78 | 3.31 | 2.83 | 4.83 | 2.21 | 1.27 | 159.3 | 159.7 | 0.47 | 0.95 | 0.11 | 1.00 | 0.02 | 1.44 |



Alt Model-Shift Uniqueness Test

004545187-01, P = 3.177402 Days, E = 131.304392 Days

| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|-------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 142.0 | 3.89 | 3.21 | 2.27 | 4.86 | 2.27 | 1.17 | 138.8 | 139.8 | 0.68 | 1.63 | 0.65 | 1.00 | 0.02 | 0.16 |



Stellar Parameters For KIC 004545187

| | $T_{\text{eff}}(K)$ | $\log(g)$ | [Fe/H] | R (R_{\odot}) | $M(M_{\odot})$ | p_{\star} ($\text{g}\cdot\text{cm}^{-3}$) |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
| | 5303^{+159}_{-143} | $4.630^{+0.032}_{-0.097}$ | $-0.380^{+0.300}_{-0.300}$ | $0.708^{+0.111}_{-0.051}$ | $0.785^{+0.074}_{-0.082}$ | $3.112^{+0.532}_{-0.957}$ |
| | +3%/-3% | +1%/-2% | +79%/-79% | +16%/-7% | +9%/-10% | +17%/-31% |
| 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 004545187-01 / KOI 0223.01

| Detrend | Depth (ppm) | R_p (R_{\oplus}) | T_{max} (K) | T_{obs} (K) | A_{obs} |
|---------|-------------|------------------------|--------------------|----------------------|---------------------------|
| DV | -26 ± 7 | $2.93^{+0.25}_{-0.19}$ | 1414^{+61}_{-54} | 2684^{+106}_{-131} | $2.504^{+0.729}_{-0.727}$ |
| Alt. | -30 ± 8 | $2.62^{+0.23}_{-0.17}$ | 1418^{+62}_{-52} | 2822^{+115}_{-124} | $3.527^{+1.035}_{-0.930}$ |

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 $A_{obs} \gg 1.0$

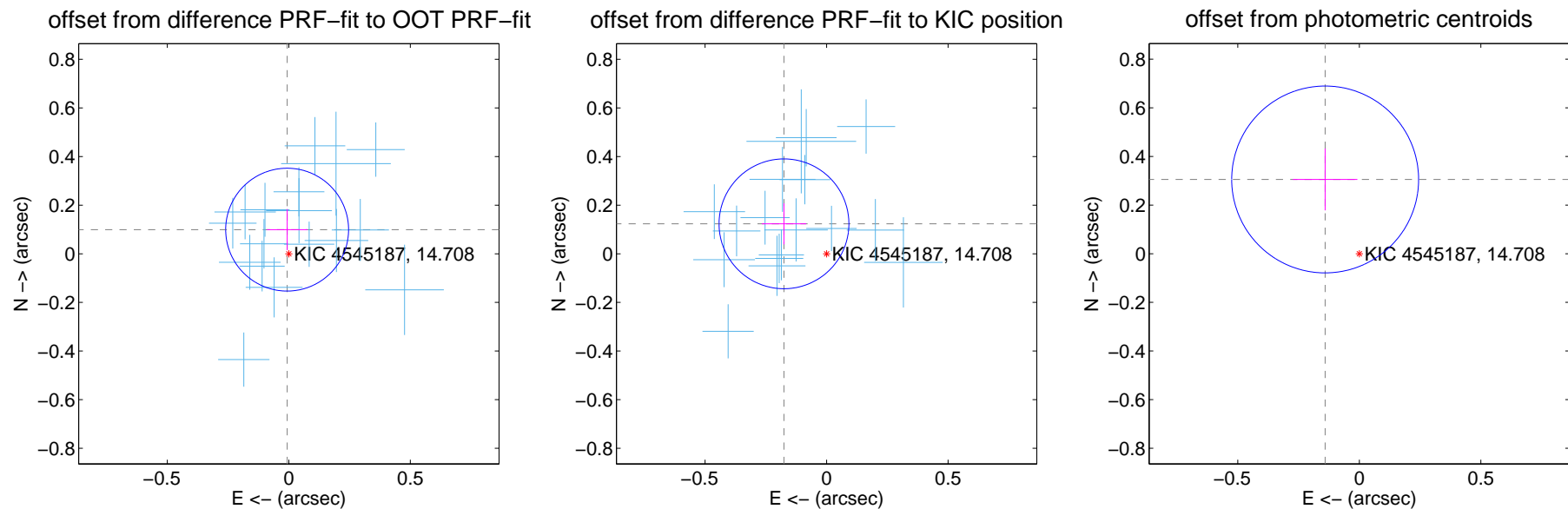
DV Centroid Data

Supplemental centroid analysis for 004545187-01. Kepler magnitude: 14.71. Transit SNR 110.10

There are 17 quarters with good PRF difference image offsets

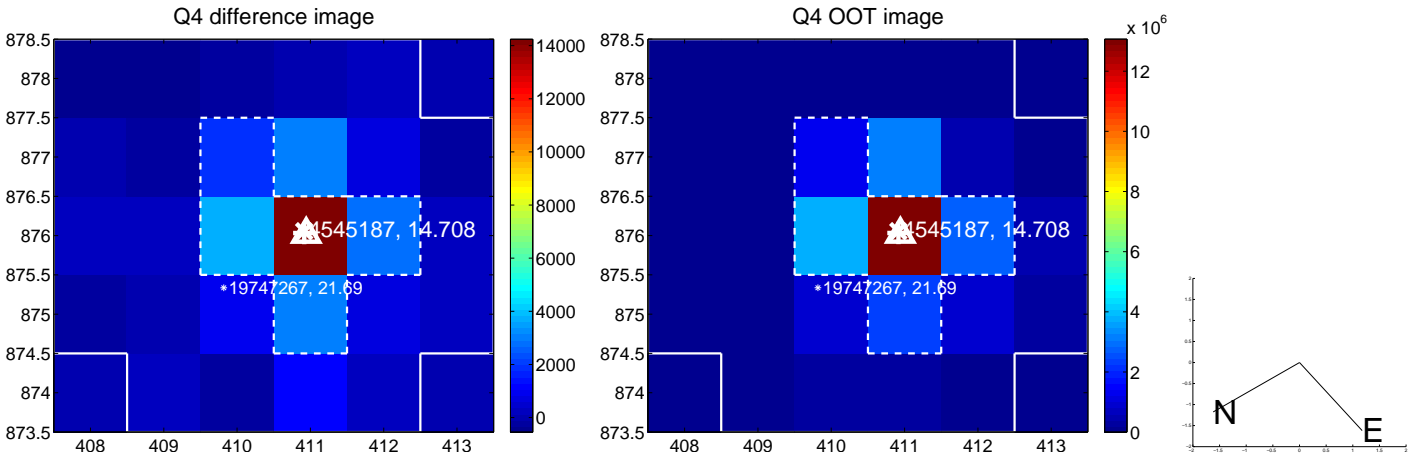
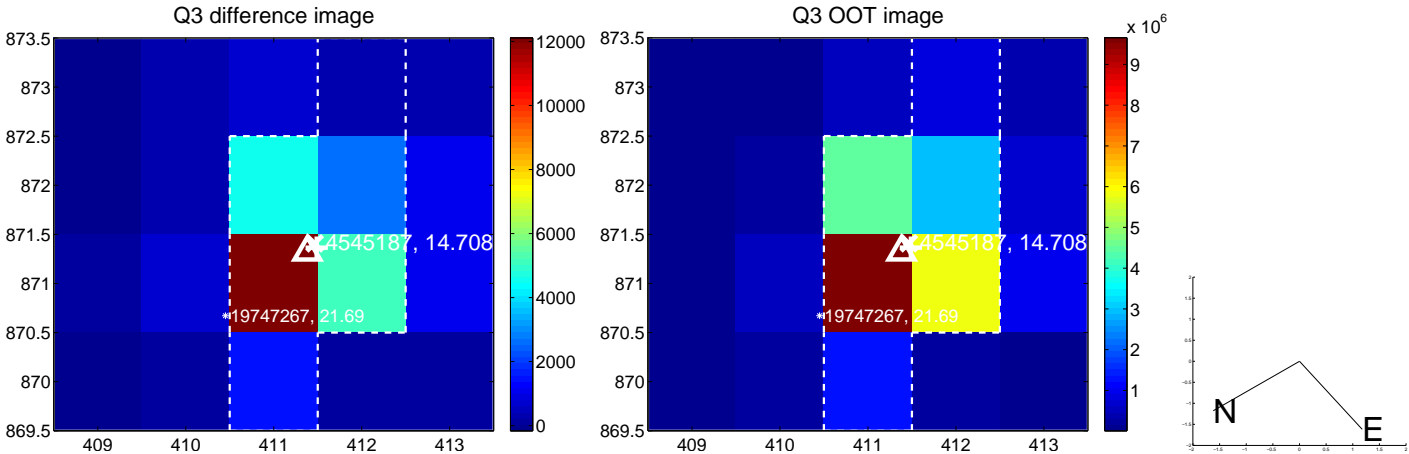
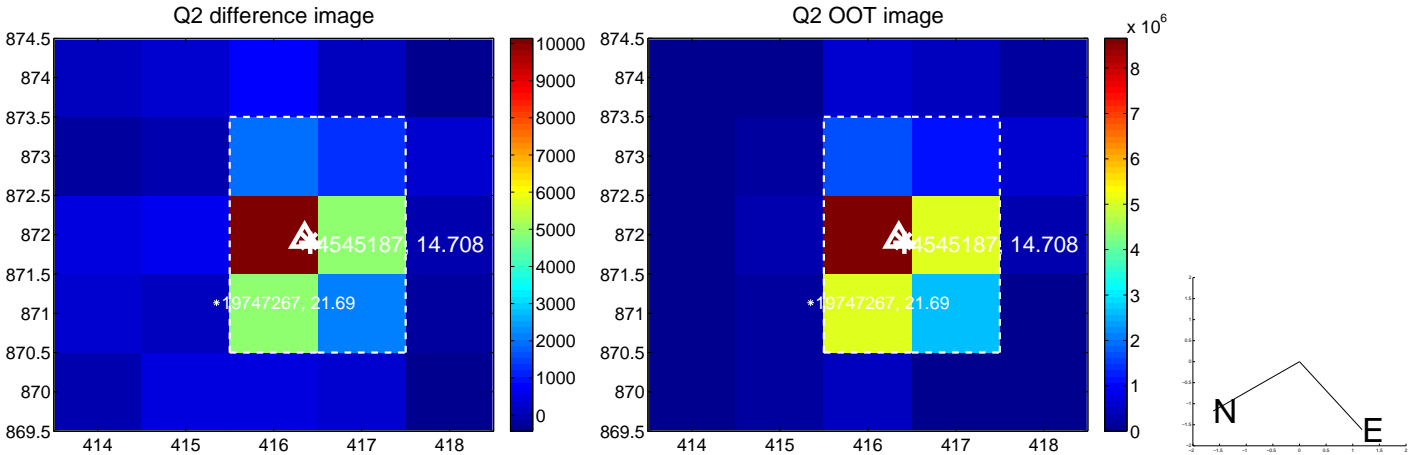
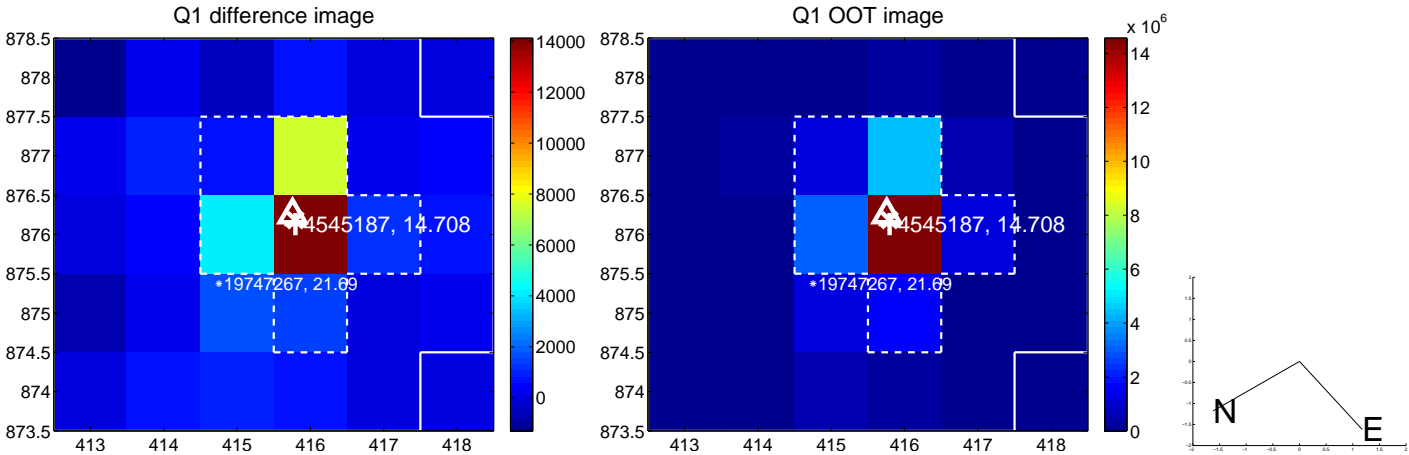
The direct PRF centroid is offset from the target star catalog position by about 0.31 arcsec

| | Distance in arcsec | Distance / σ | Δ RA | Δ Dec |
|---|--------------------|---------------------|-------------------|-------------------|
| PRF-fit source offset from OOT | 0.100 ± 0.084 | 1.18 | 0.007 ± 0.083 | 0.099 ± 0.085 |
| PRF-fit source offset from KIC position | 0.214 ± 0.089 | 2.41 | 0.175 ± 0.091 | 0.123 ± 0.085 |
| photometric centroid source offset | 0.34 ± 0.13 | 2.62 | 0.14 ± 0.13 | 0.31 ± 0.13 |

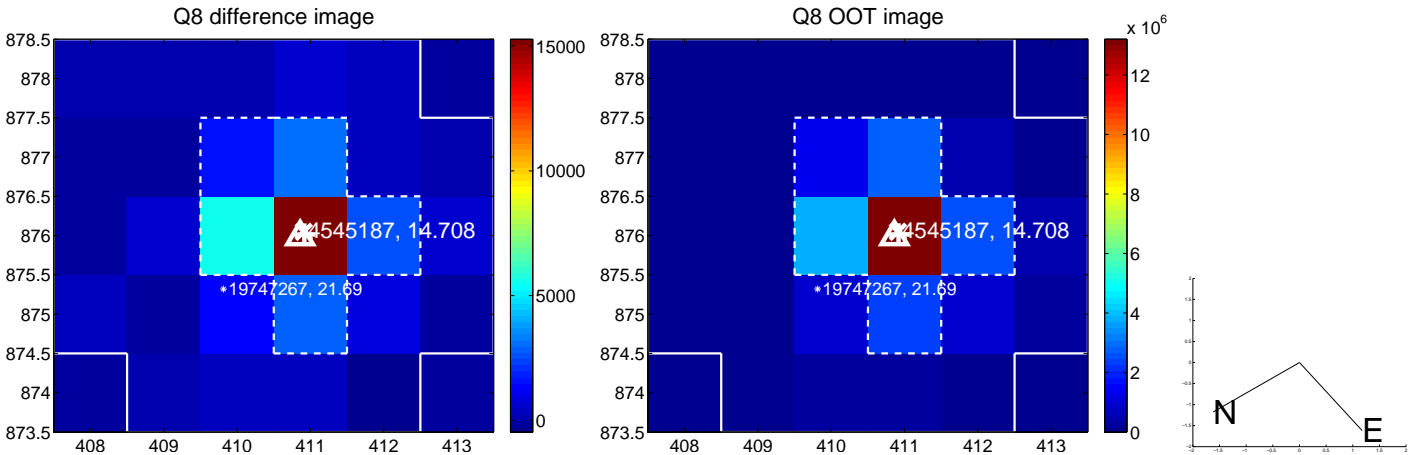
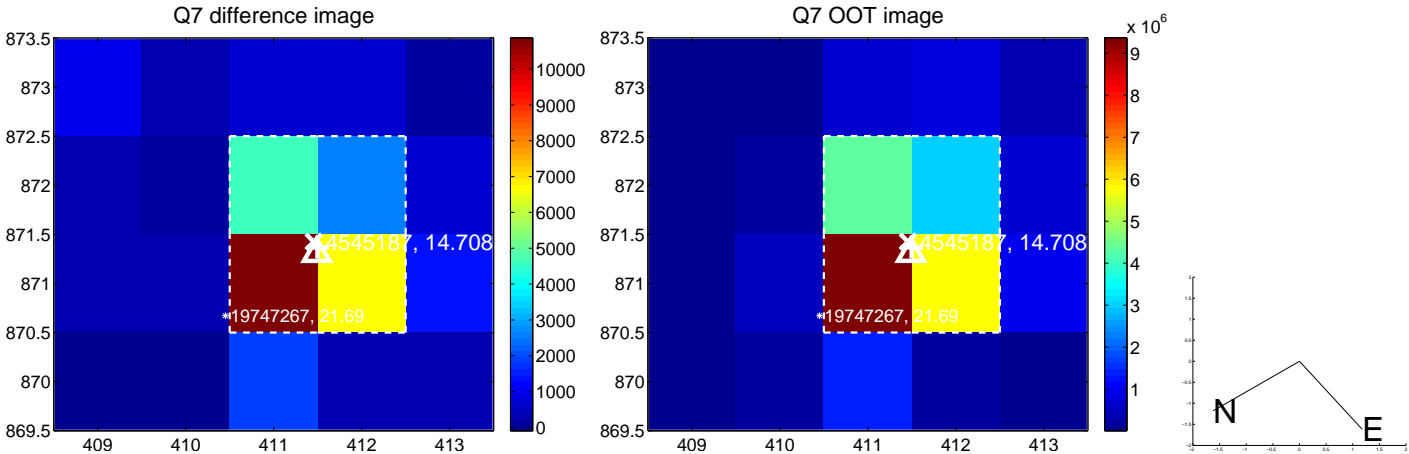
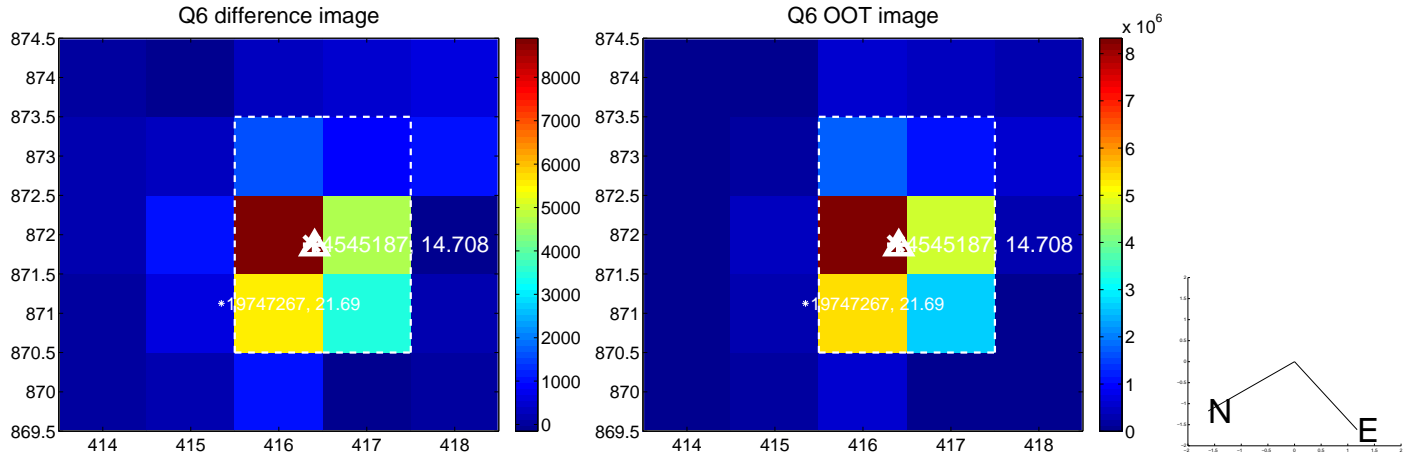
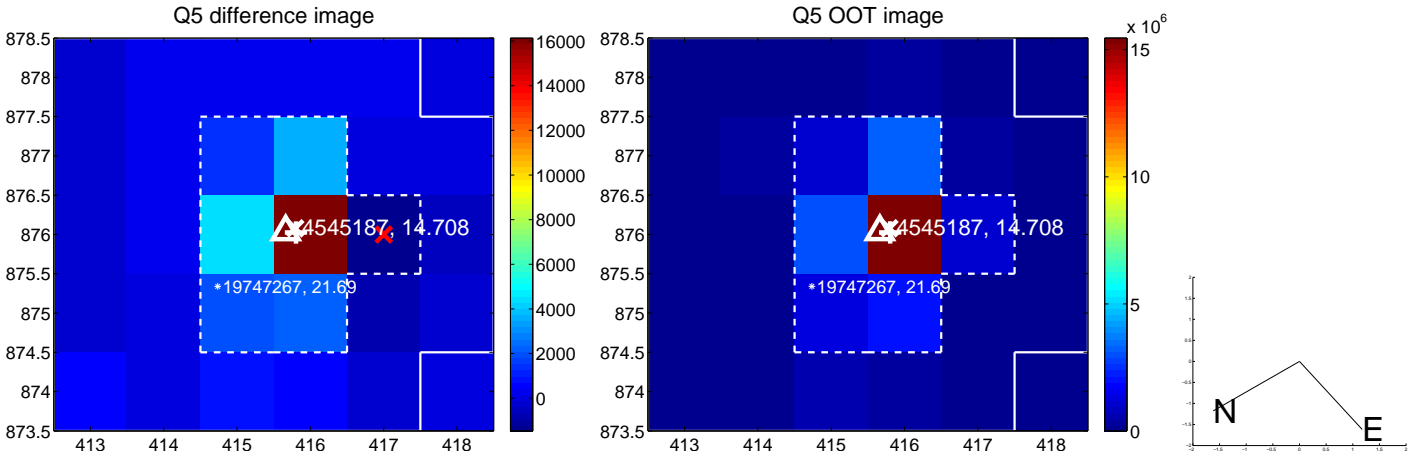


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

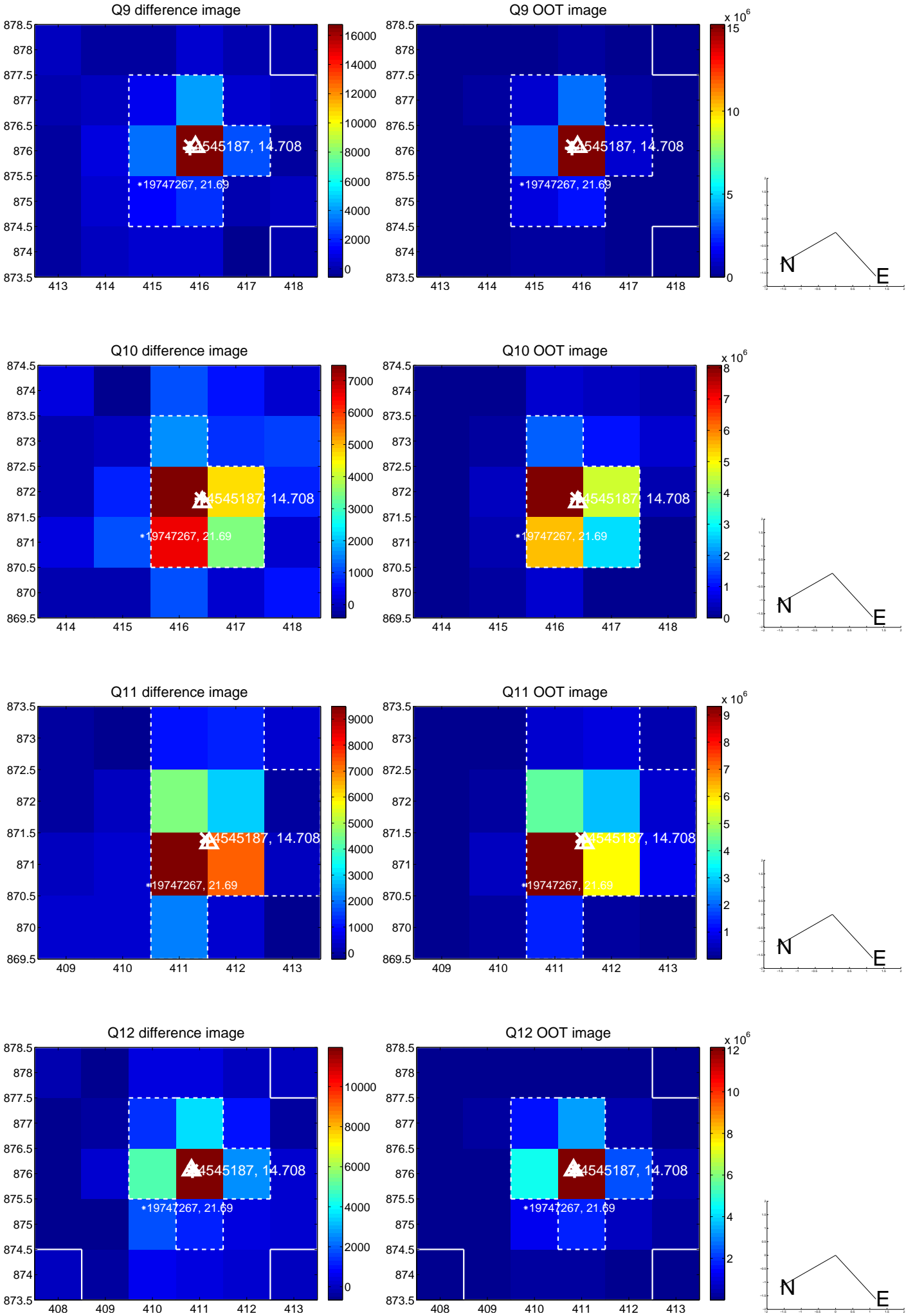
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



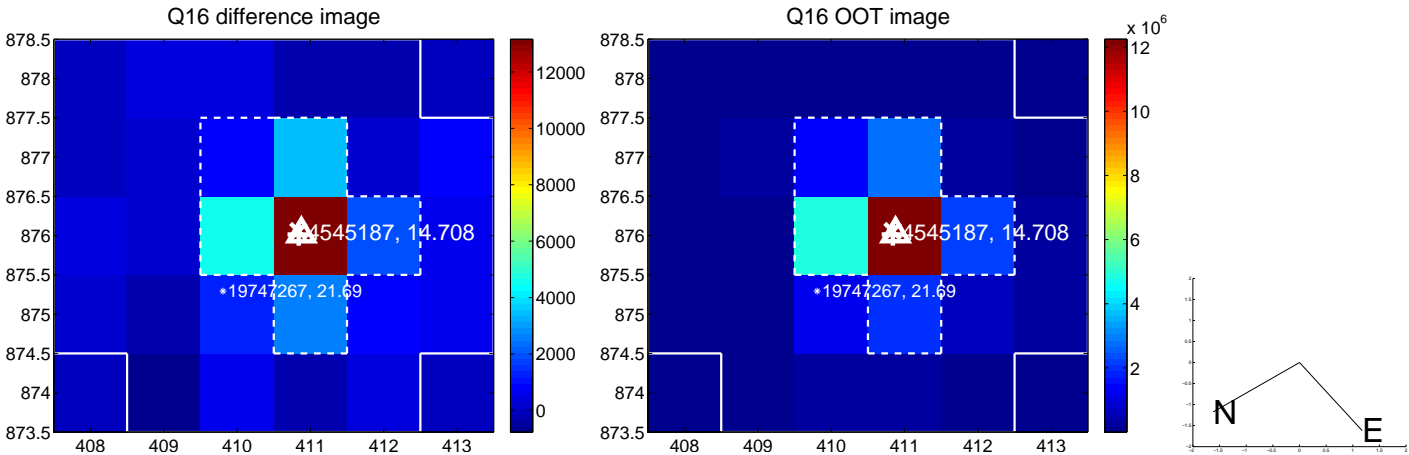
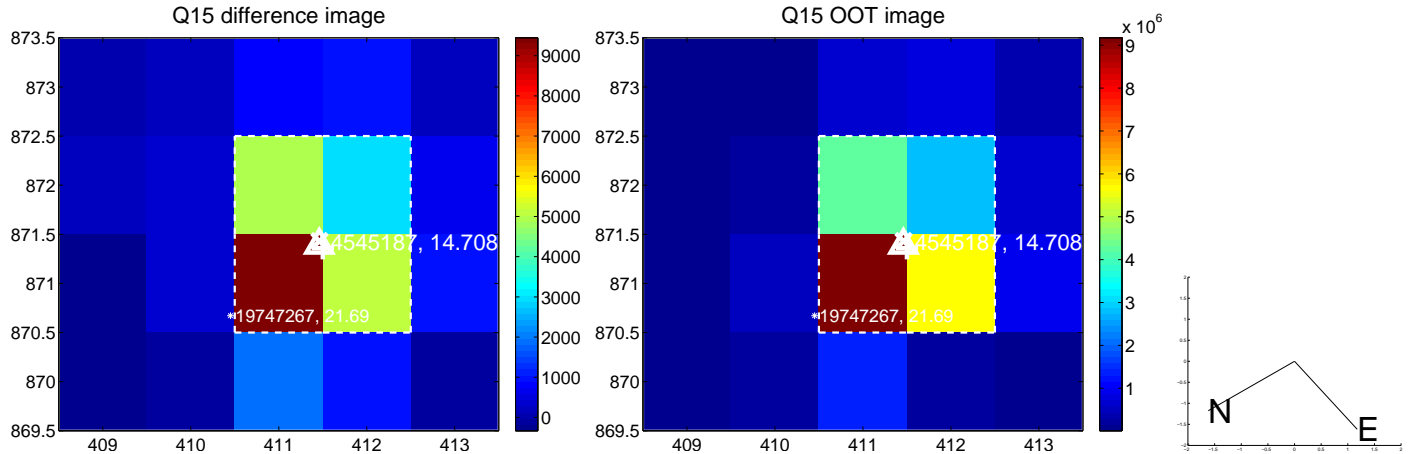
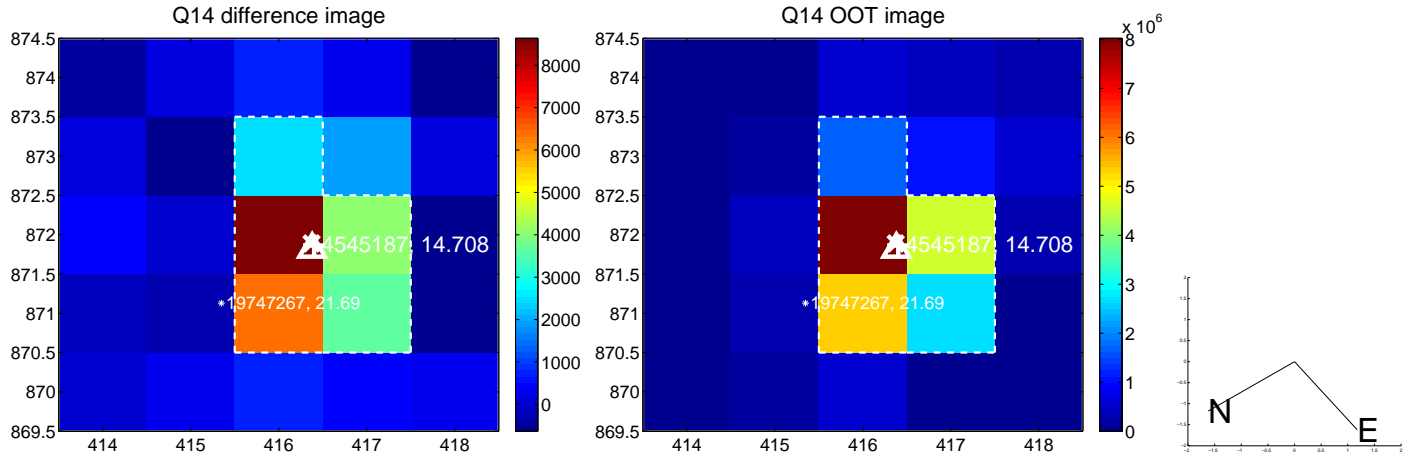
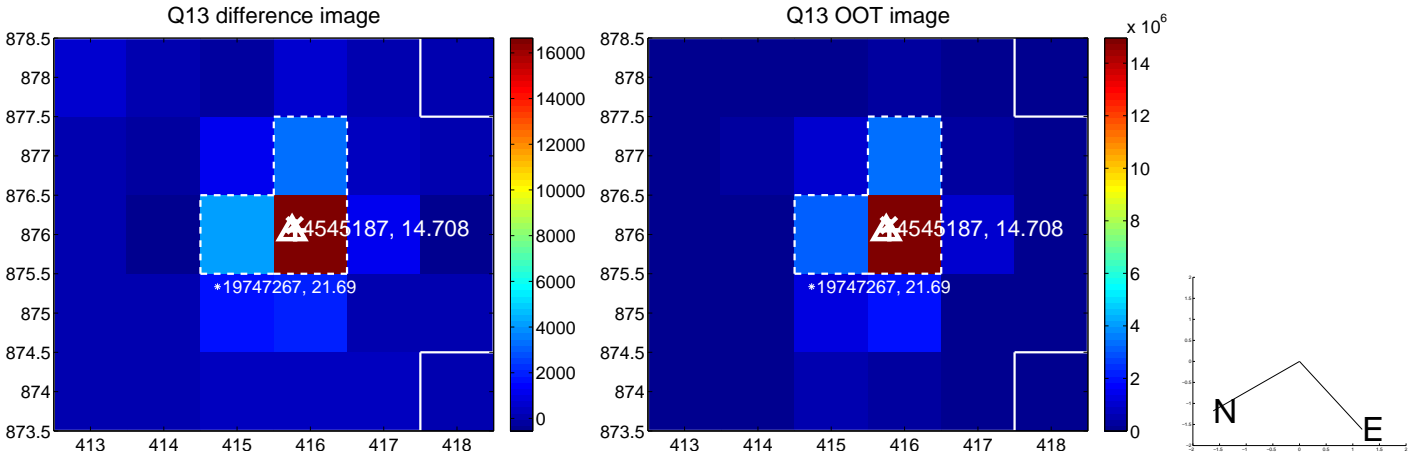
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



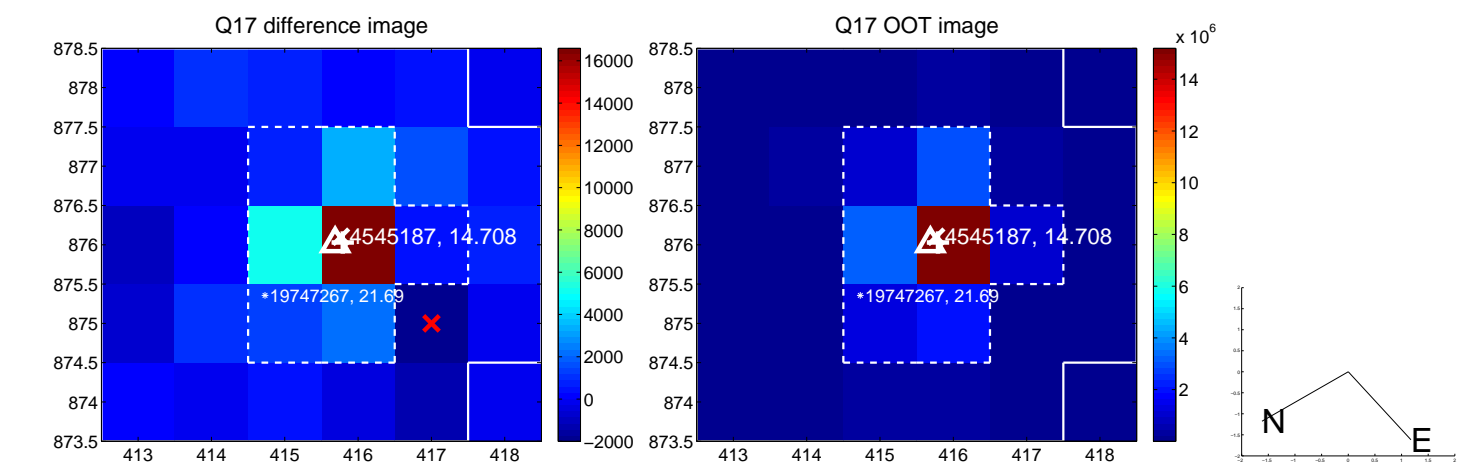
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



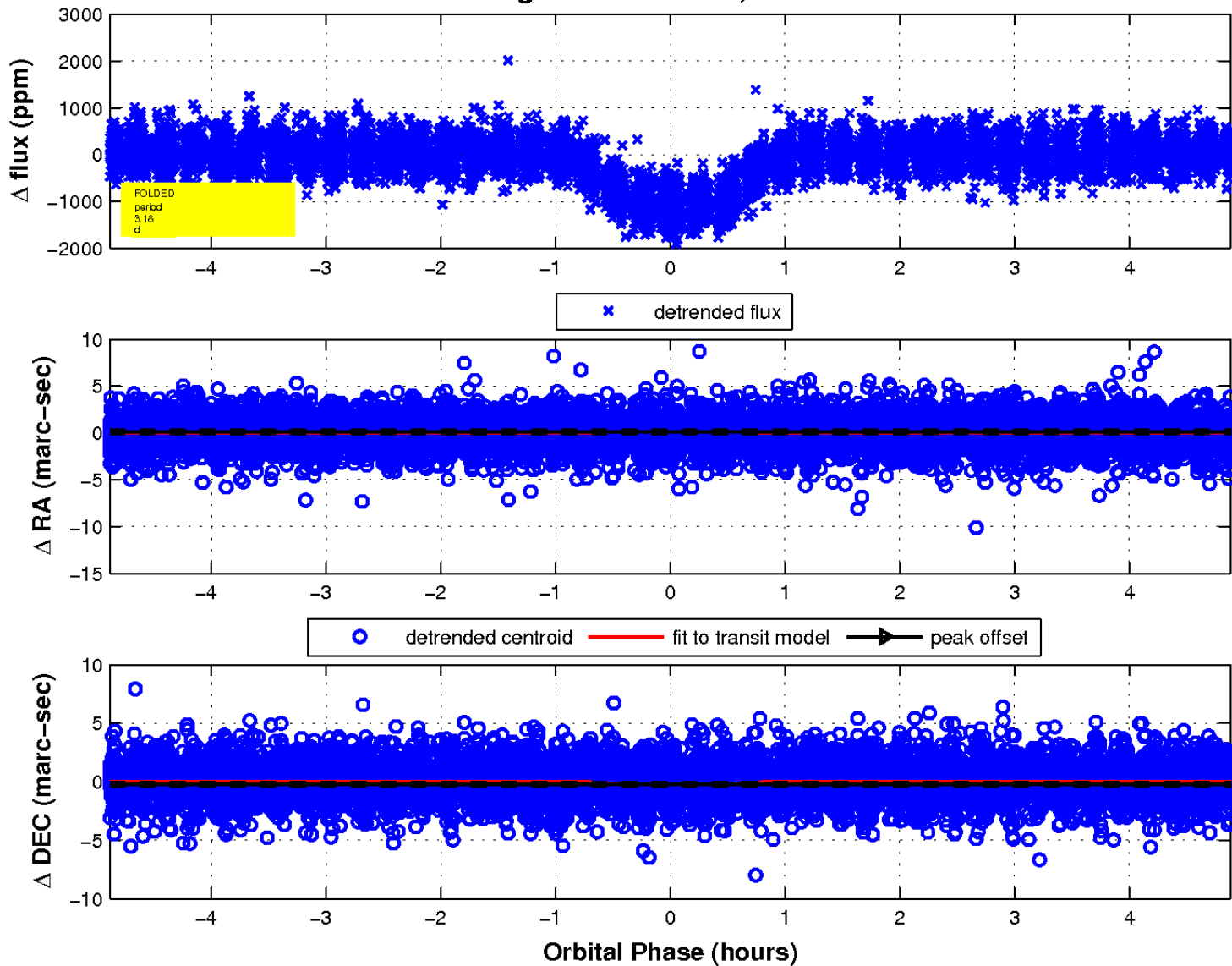
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



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

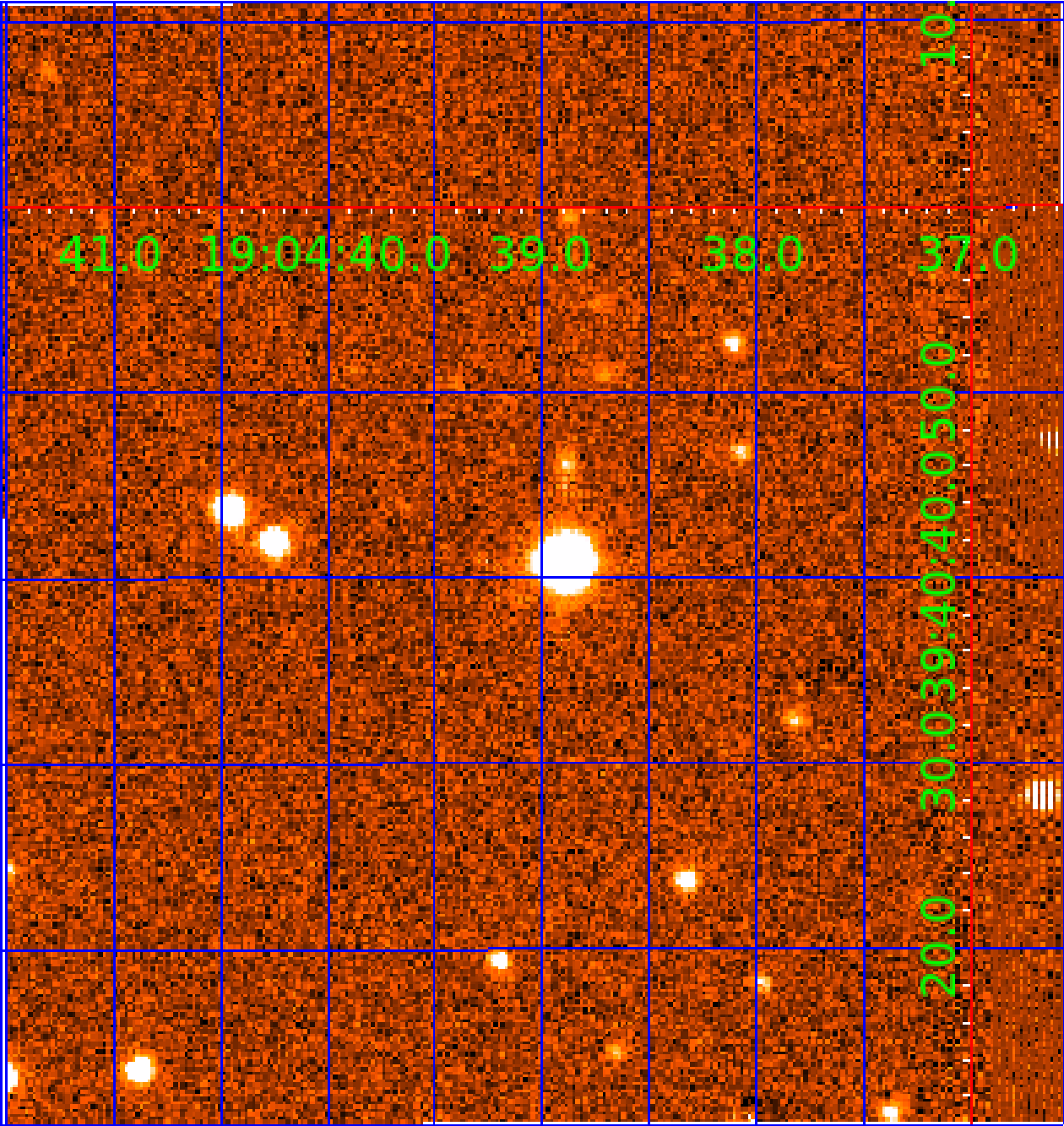


fluxWeightedCentroids, Planet 1 of 2



UKIRT Image

Declination



KIC 004545187

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}) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|-------|-----------------------------|-----------------|------------------------|------------------------|
| 004545187-01 | OBS | 0223.01 | 3.177418 | 134.478035 | 1132.5 | 1.629 | 98.4 | 110.1 | 0.71 | 5303 | 2.87 | 234.19 |
| 004545187-02 | OBS | 0223.02 | 41.008061 | 147.033133 | 1001.6 | 4.064 | 33.6 | 36.4 | 0.71 | 5303 | 2.43 | 7.74 |

Robovetter Results

| TCE | Run Type | Disp | Score | N | S | C | E | Comments |
|--------------|----------|------|-------|---|---|---|---|------------|
| 004545187-01 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 004545187-02 | 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 for comment definitions.

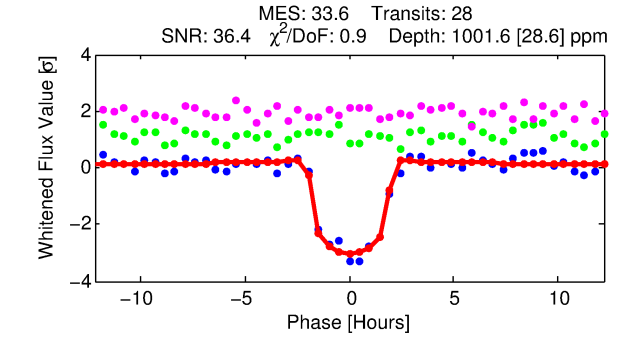
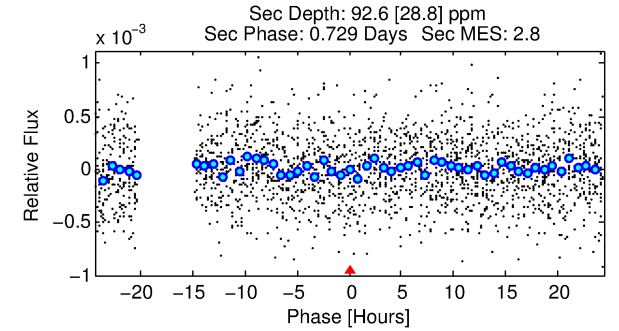
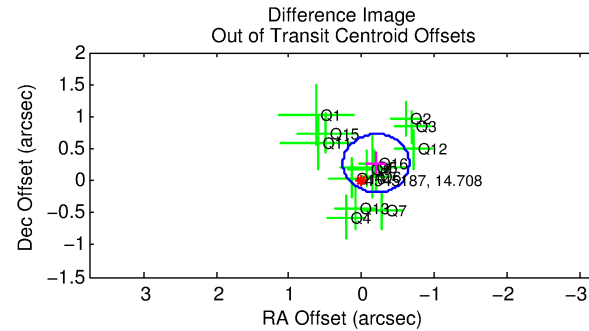
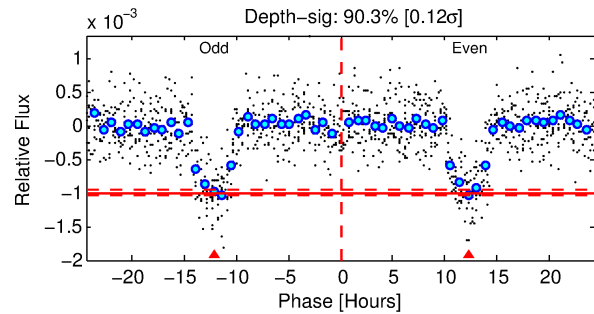
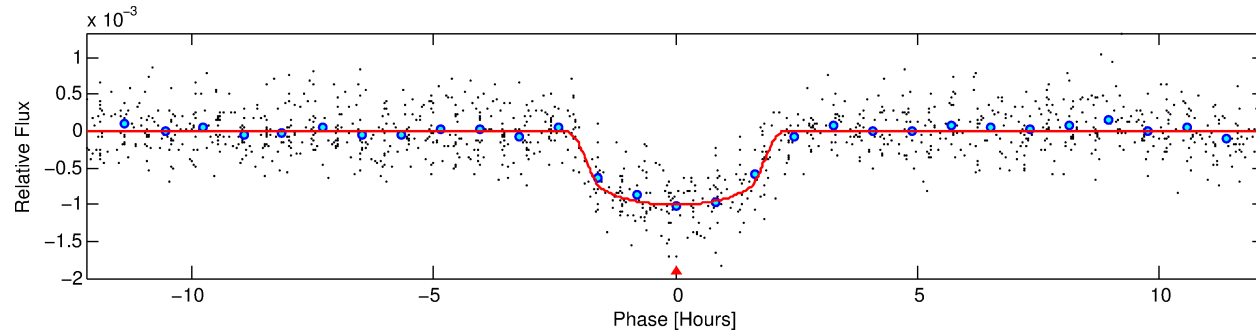
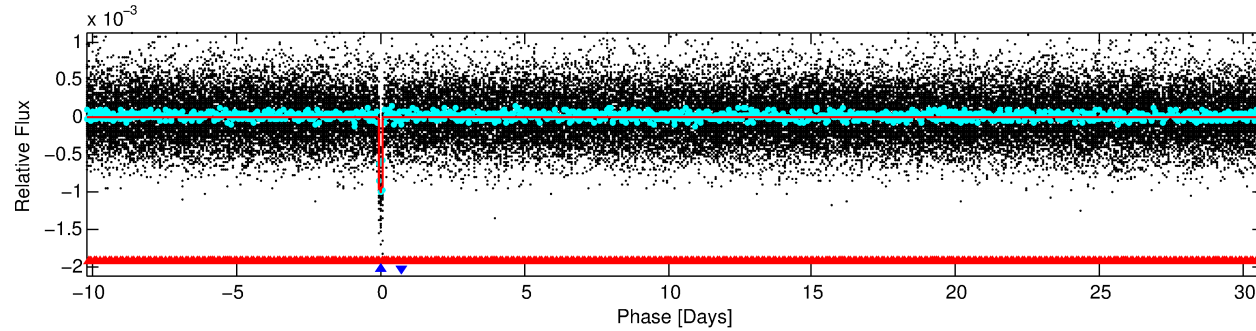
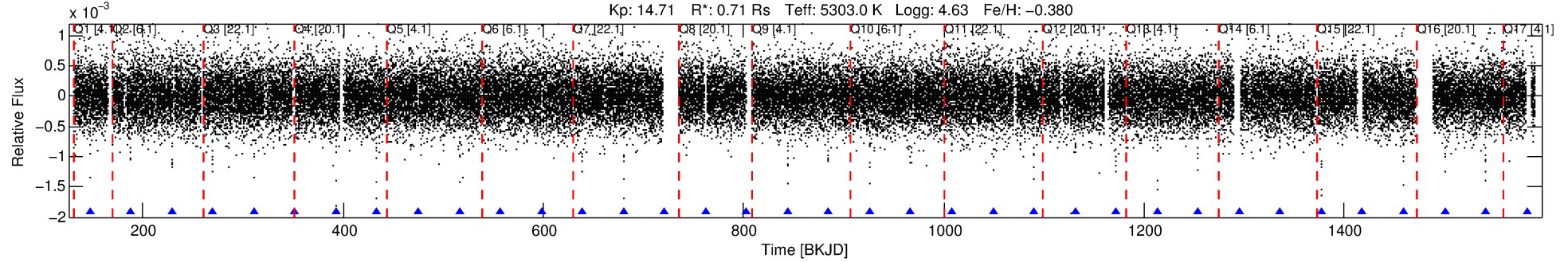
Ephemeris Match Information For 004545187-02

No Significant Match Found

DV One-Page Summary

KIC: 4545187 Candidate: 2 of 2 Period: 41.008 d
KOI: K00223.02 Name: Kepler-121c Corr: 0.962

Kp: 14.71 R*: 0.71 Rs Teff: 5303.0 K Logg: 4.63 Fe/H: -0.380



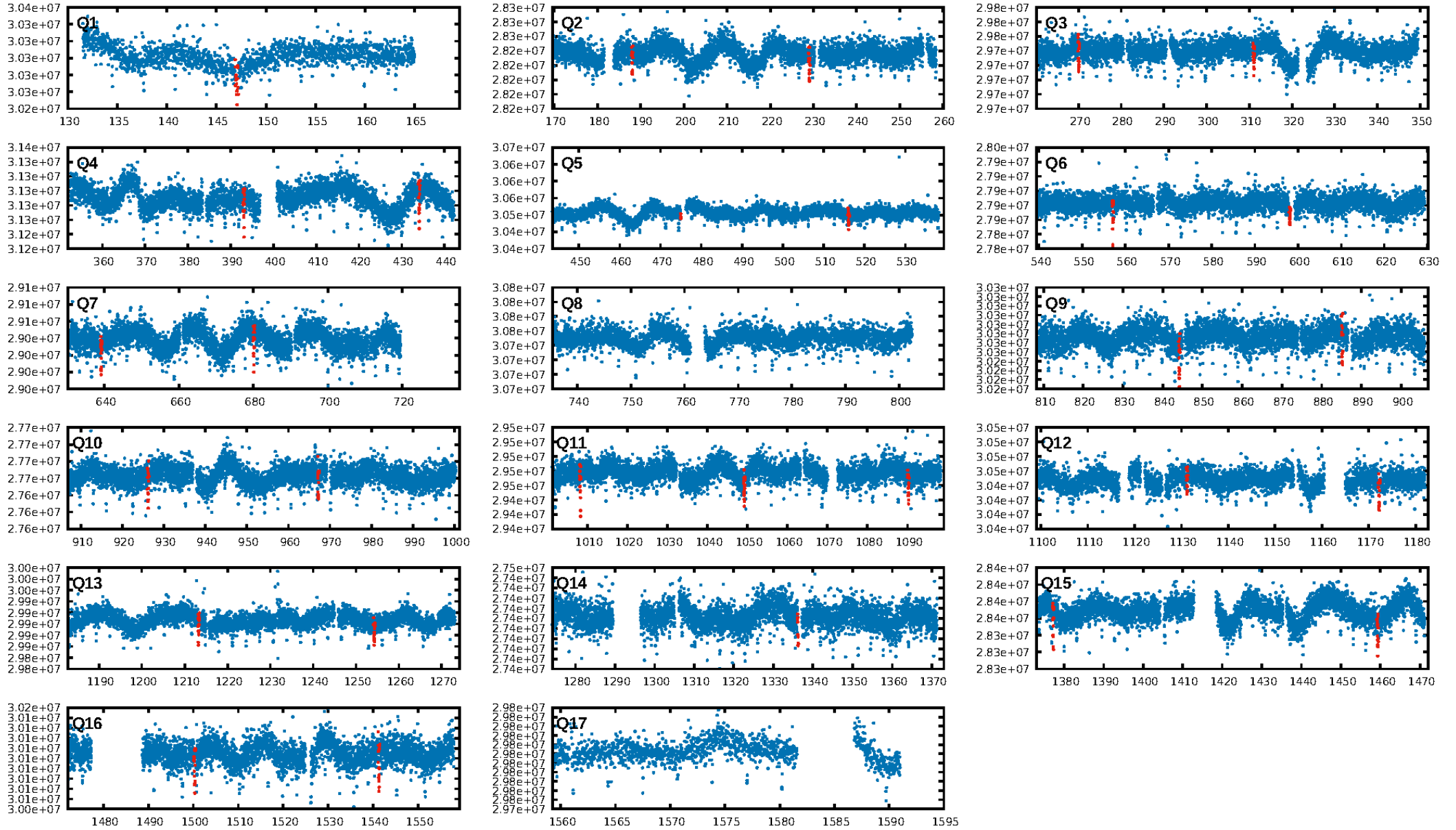
DV Fit Results:

Period = 41.00806 [0.00012] d
Epoch = 147.0331 [0.0024] BKJD
Rp/R* = 0.0315 [0.0061]
a/R* = 55.00 [42.42]
b = 0.75 [0.47]
Seff = 7.74 [1.69]
Teff = 425 [23] K
Rp = 2.43 [0.61] Re
a = 0.2143 [0.0275] AU
Ag = 395.45 [209.59] [1.88σ]
Teffp = 2932 [375] K [6.67σ]

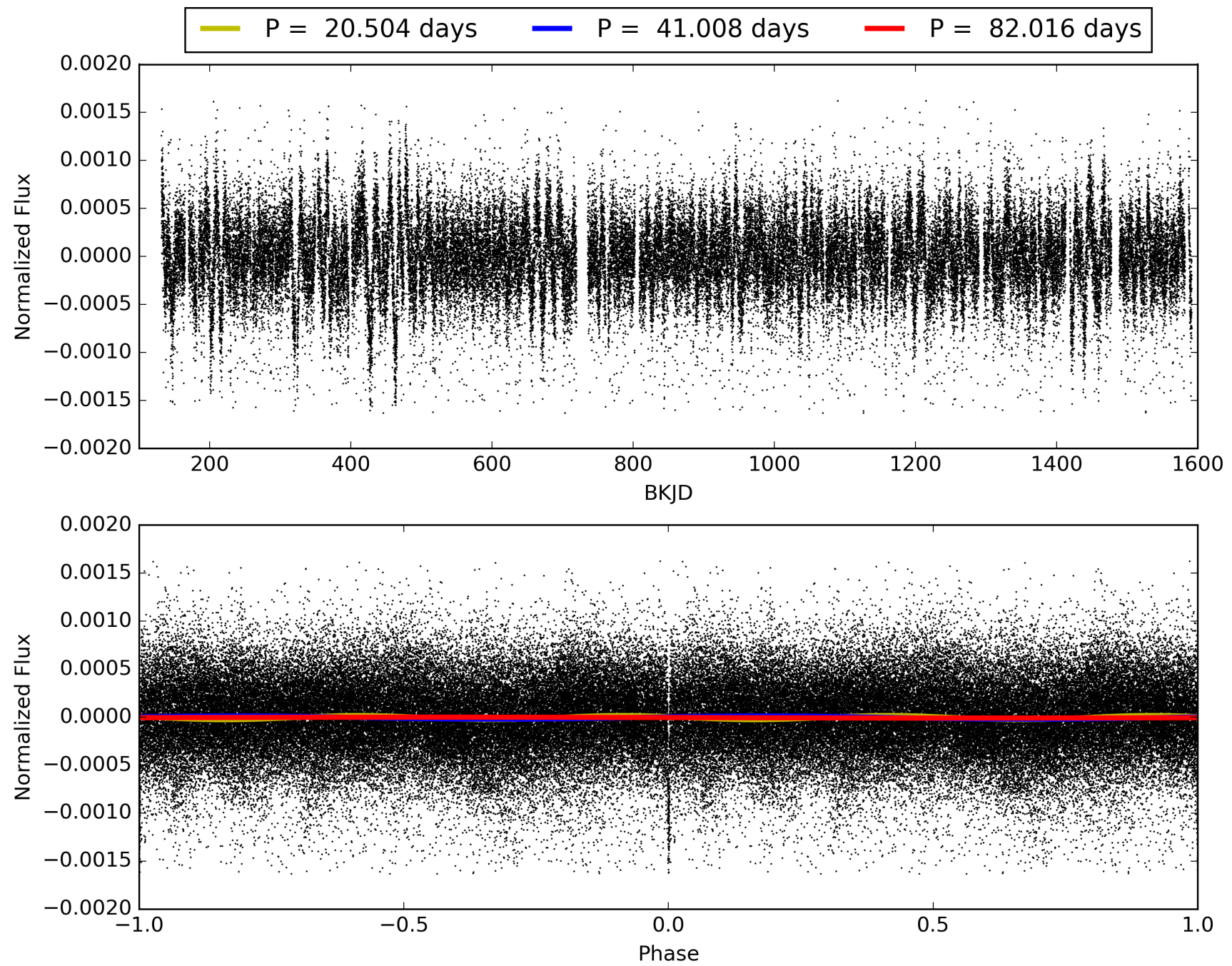
DV Diagnostic Results:

ShortPeriod-sig: 100.0% [207.39σ]
LongPeriod-sig: N/A
ModelChiSquare2-sig: 7.1%
ModelChiSquareGof-sig: 100.0%
Bootstrap-pfa: 6.91e-240
RollingBand-fgt: 1.00 [27/27]
GhostDiagnostic-chr: 3.132
Centroid-sig: 3.4%
Centroid-so: 0.323 arcsec [0.95σ]
OotOffset-rm: 0.337 arcsec [2.22σ]
KicOffset-rm: 0.308 arcsec [1.88σ]
OotOffset-st: 3/4/3/4 [14]
KicOffset-st: 3/4/3/4 [14]
DiffImageQuality-fgm: 1.00 [14/14]
DiffImageOverlap-fno: 0.79 [11/14]

TCE 004545187-02, PDC Light Curves

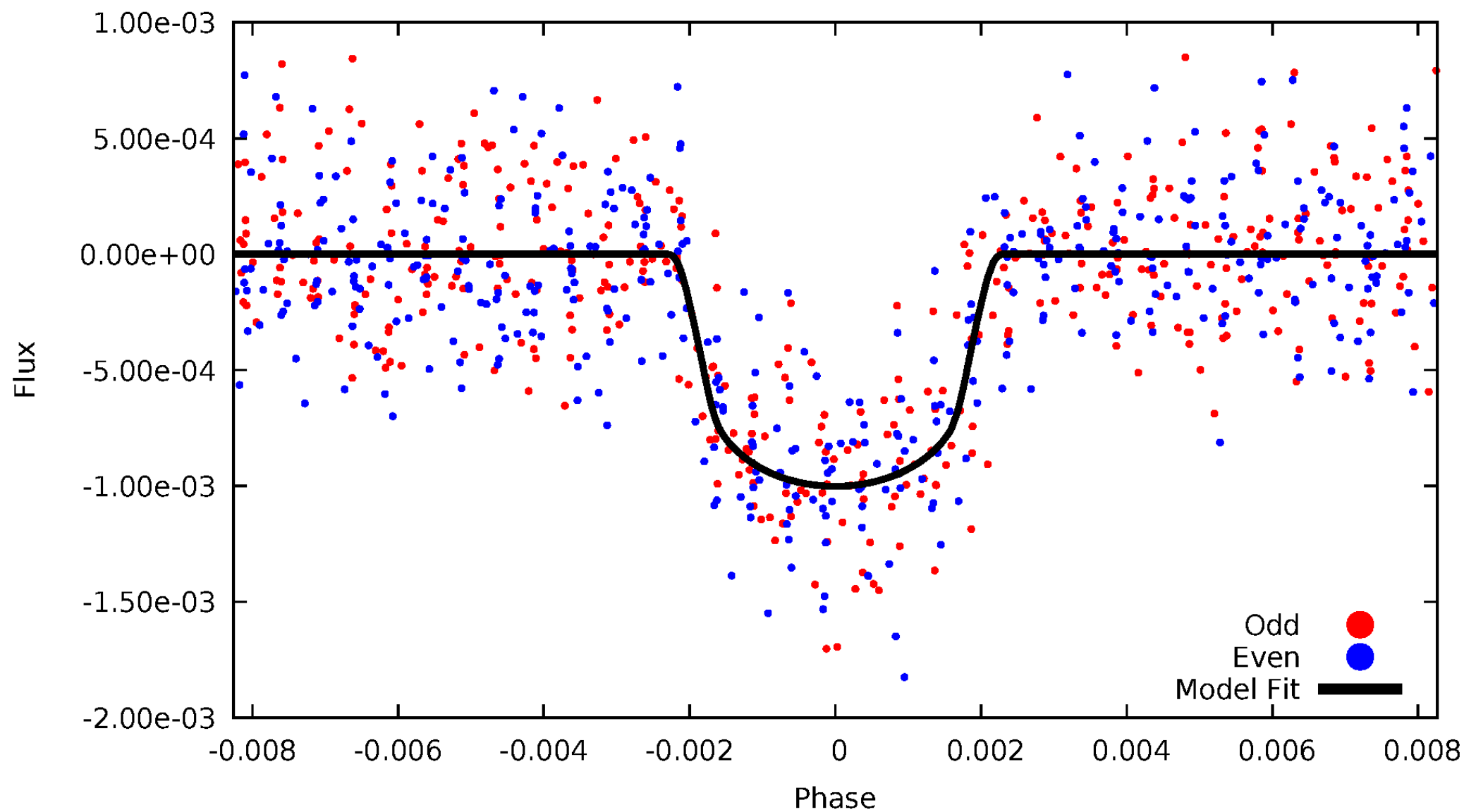


TCE 004545187-02



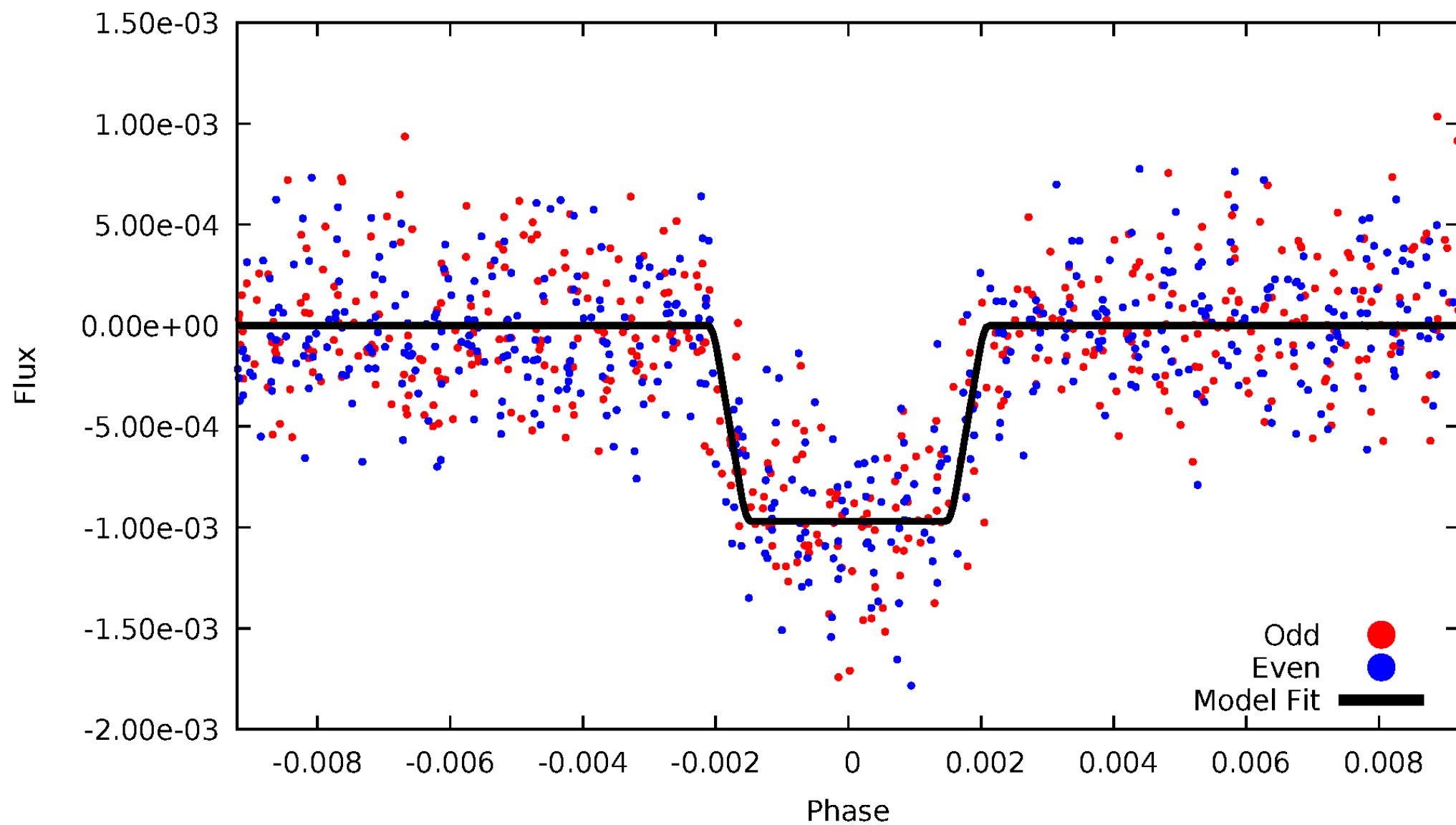
DV Odd/Even

TCE 004545187-02



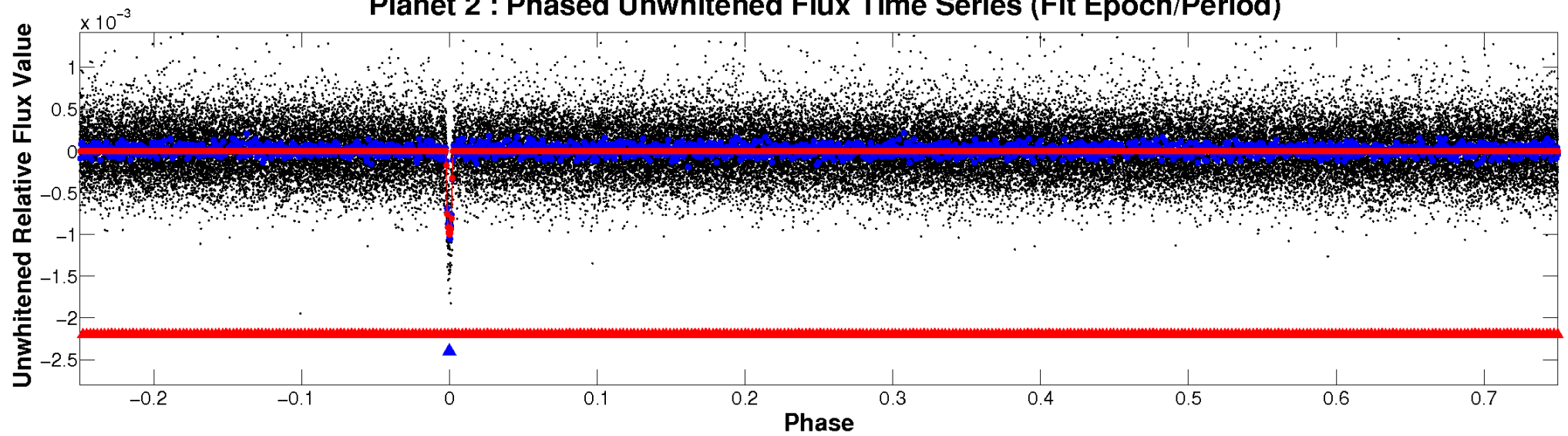
ALT Odd/Even

TCE 004545187-02

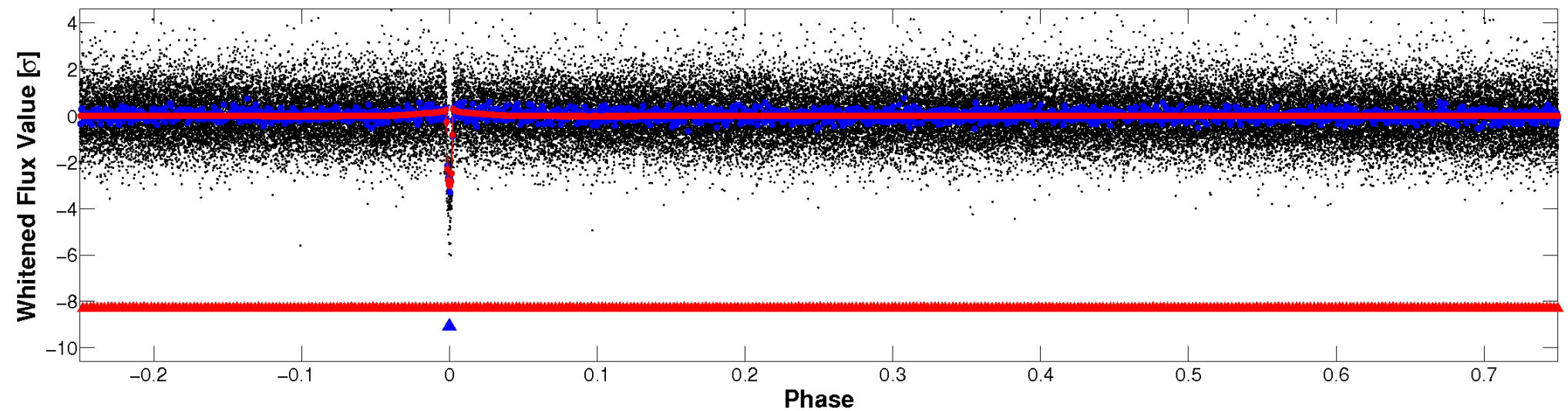


Non-Whitened Vs. Whitened Light Curve

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

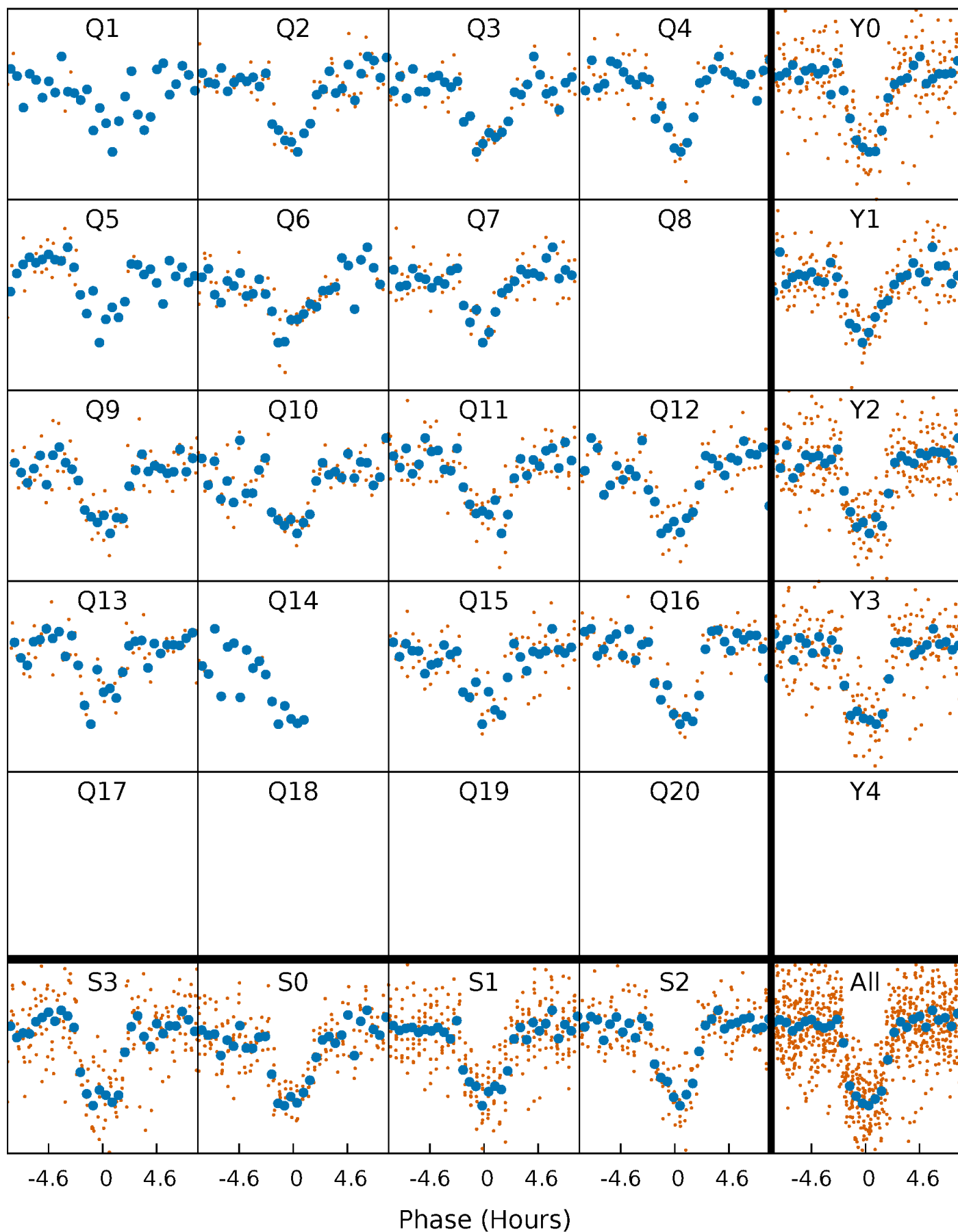


Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



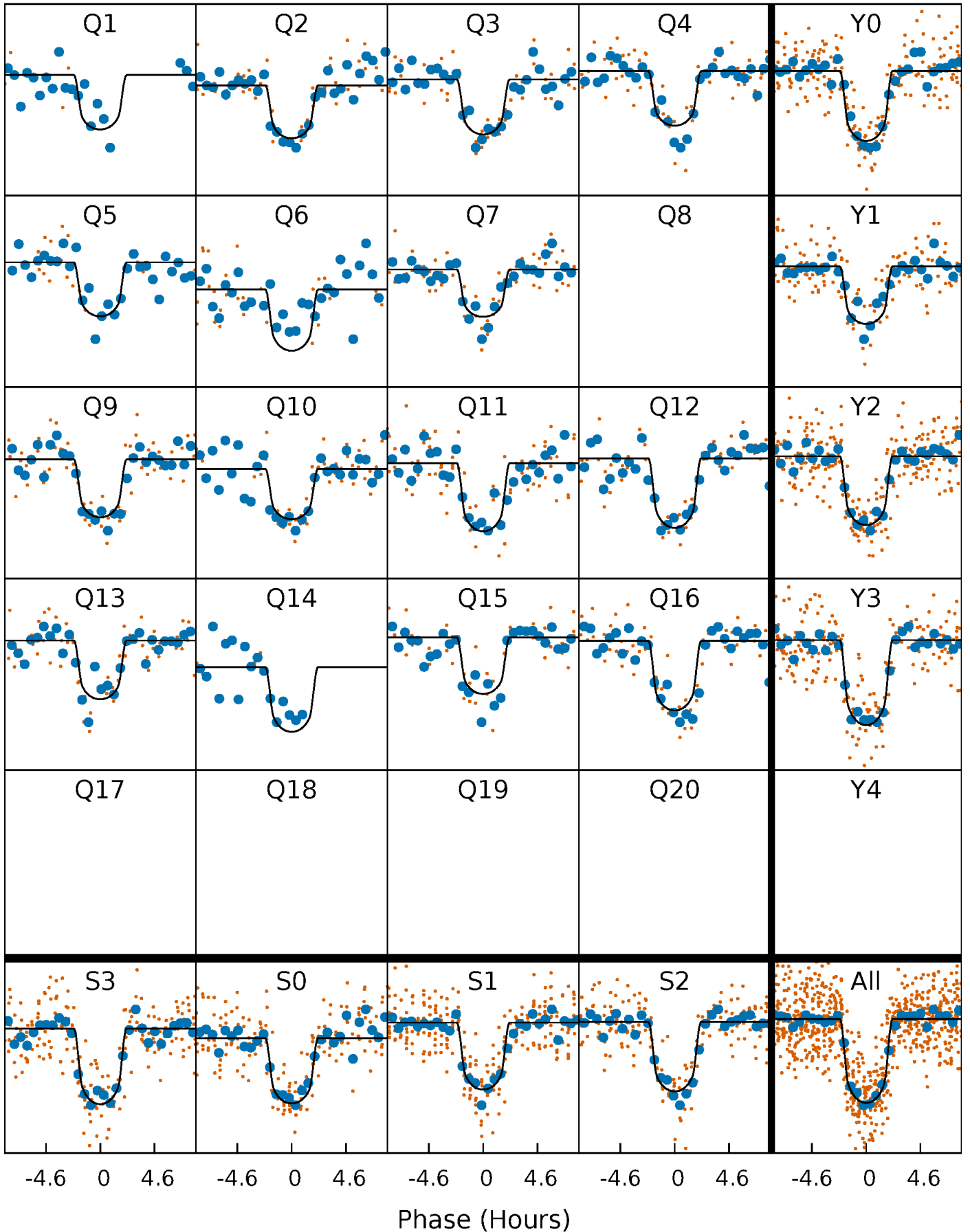
PDC Quarter-Phased Transit Curves

TCE 004545187-02 P= 41.008061 Days $T_0=147.033133$ (BKJD)



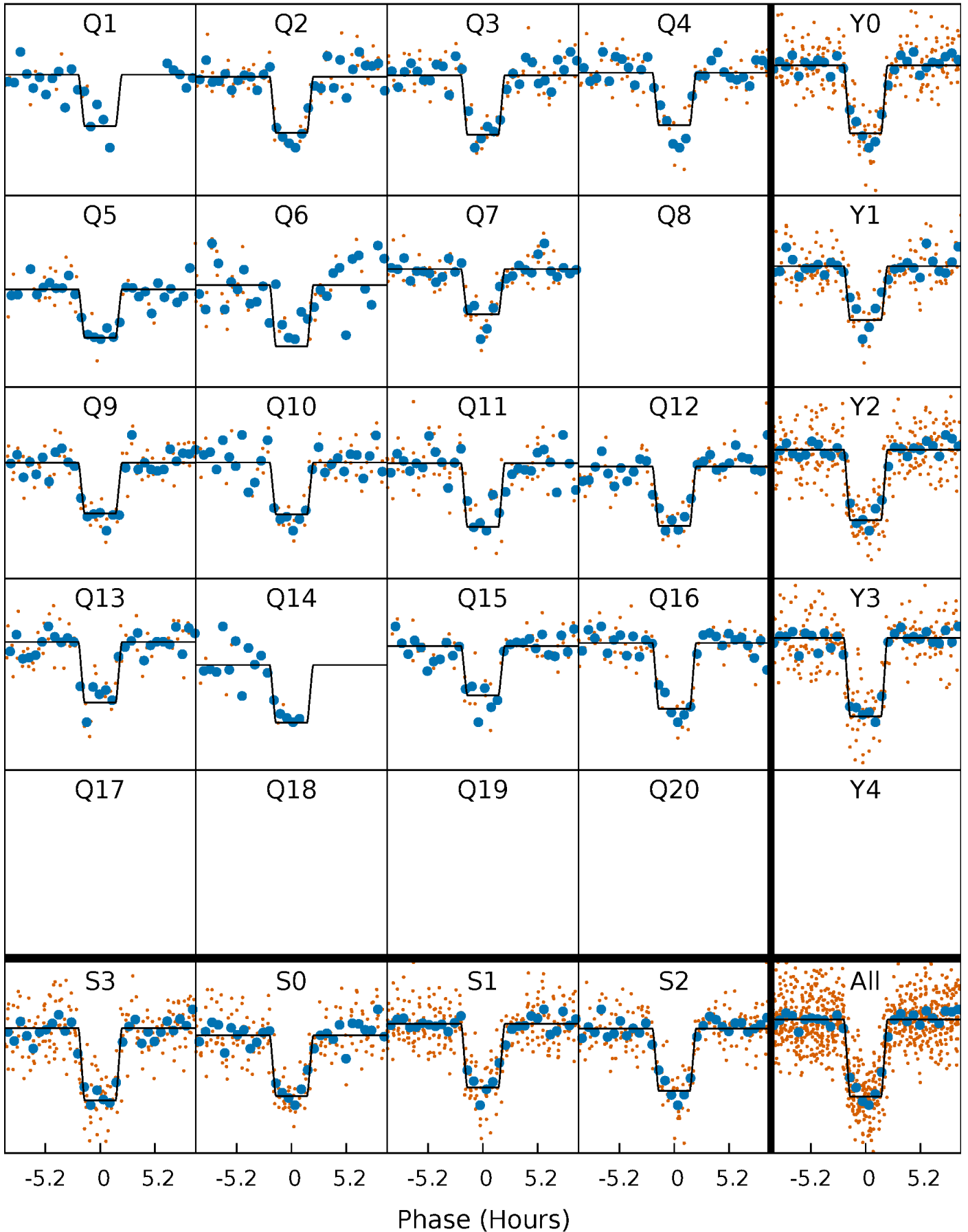
DV Quarter-Phased Transit Curves

TCE 004545187-02 P= 41.008061 Days $T_0=147.033133$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

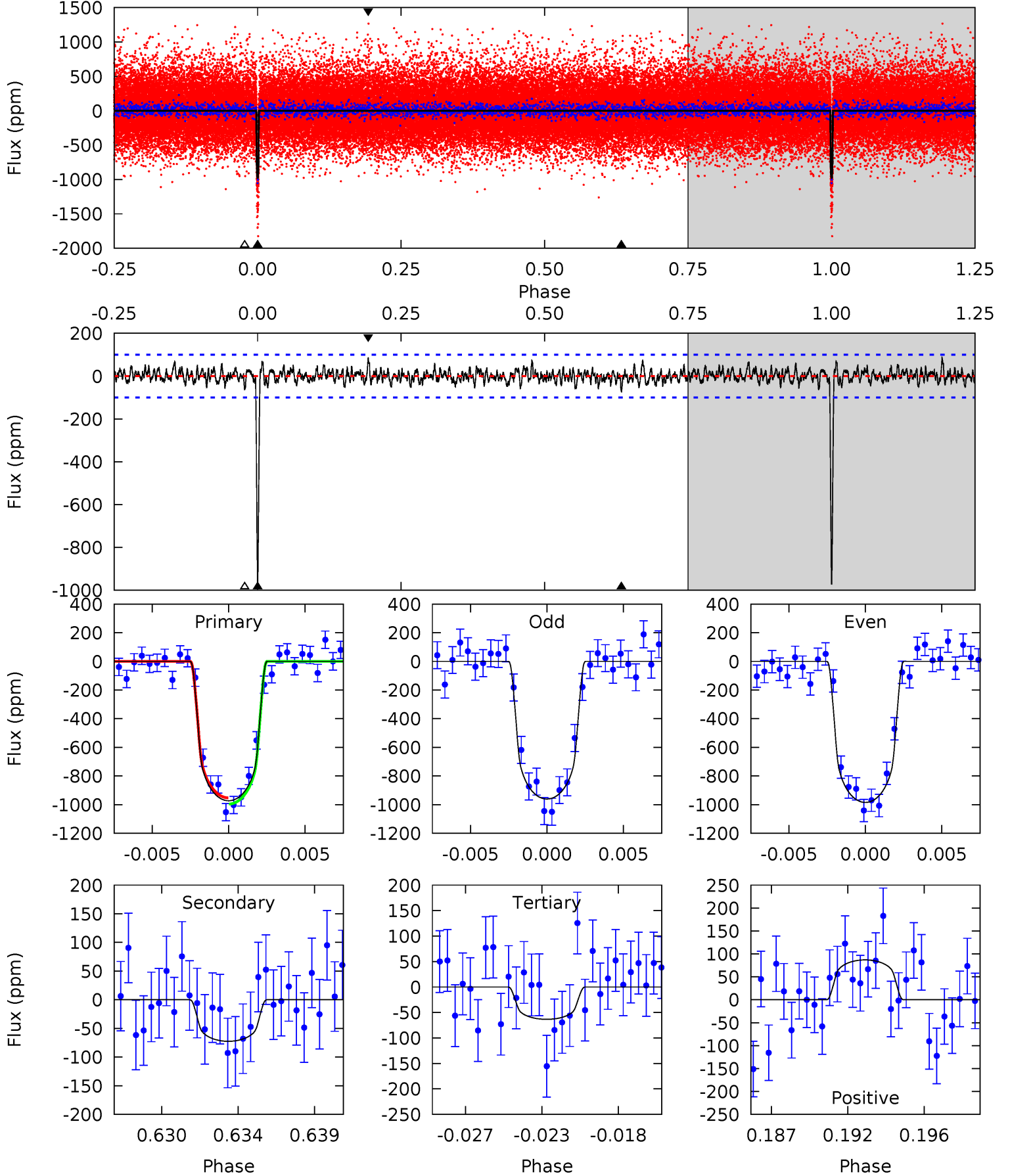
TCE 004545187-02 P= 41.008218 Days $T_0=147.032182$ (BKJD)



DV Model-Shift Uniqueness Test

004545187-02, P = 41.008061 Days, E = 106.025072 Days

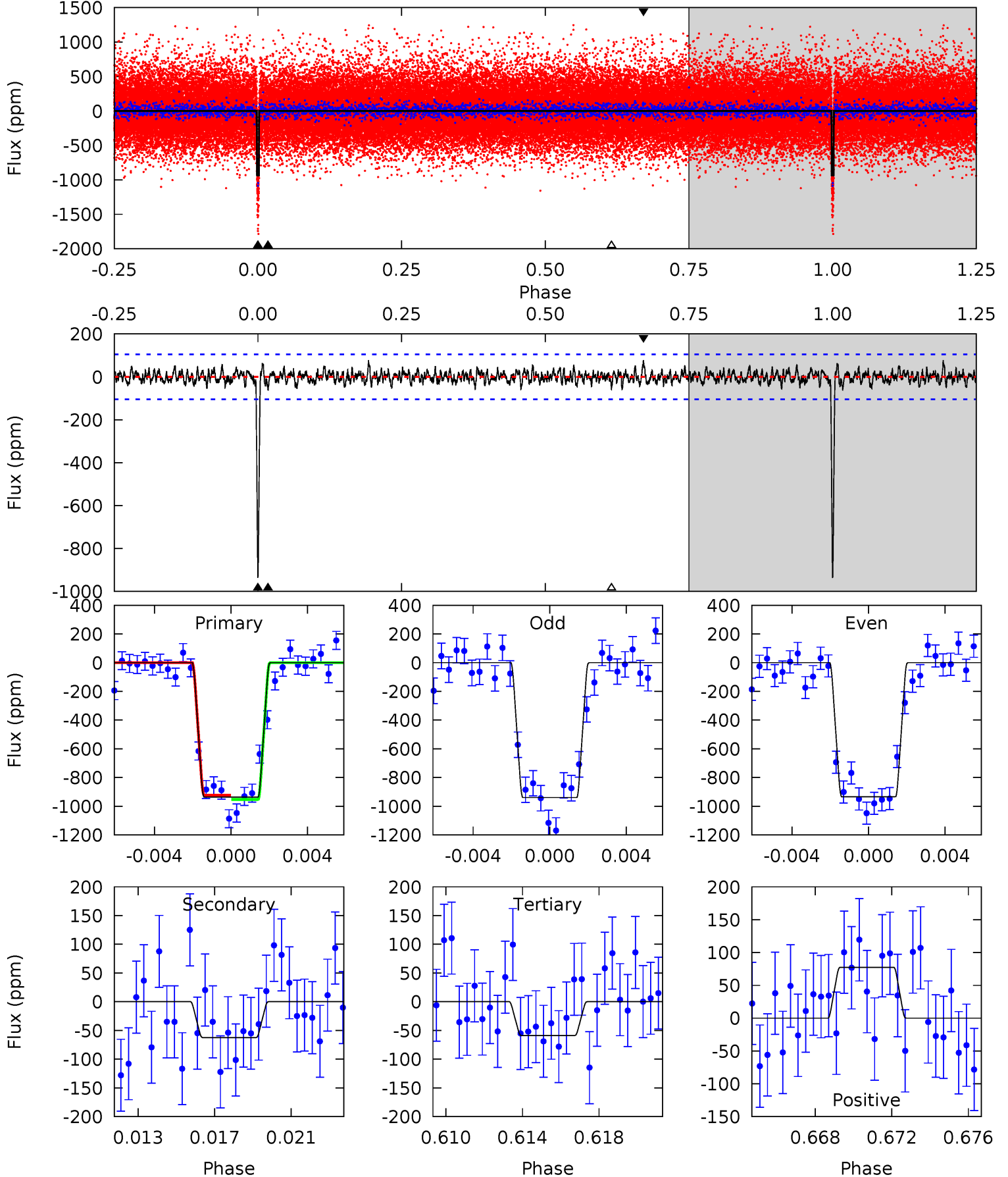
| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 50.4 | 3.75 | 3.29 | 4.50 | 5.17 | 2.84 | 1.17 | 47.1 | 45.9 | 0.47 | -0.75 | 0.62 | 1.00 | 0.08 | 1.12 |



Alt Model-Shift Uniqueness Test

004545187-02, $P = 41.008218$ Days, $E = 106.023964$ Days

| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 46.4 | 3.09 | 2.91 | 3.83 | 5.19 | 2.86 | 1.02 | 43.5 | 42.6 | 0.18 | -0.74 | 0.15 | 1.00 | 0.08 | 0.75 |



Stellar Parameters For KIC 004545187

| | $T_{\text{eff}}(K)$ | $\log(g)$ | [Fe/H] | R (R_{\odot}) | M (M_{\odot}) | p_{\star} ($\text{g}\cdot\text{cm}^{-3}$) |
|--------|----------------------|---------------------------|----------------------------|---------------------------|---------------------------|---|
| | 5303^{+159}_{-143} | $4.630^{+0.032}_{-0.097}$ | $-0.380^{+0.300}_{-0.300}$ | $0.708^{+0.111}_{-0.051}$ | $0.785^{+0.074}_{-0.082}$ | $3.112^{+0.532}_{-0.957}$ |
| | +3%/-3% | +1%/-2% | +79%/-79% | +16%/-7% | +9%/-10% | +17%/-31% |
| 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 004545187-02 / KOI 0223.02

| Detrend | Depth (ppm) | R_p (R_{\oplus}) | T_{max} (K) | T_{obs} (K) | A_{obs} |
|---------|--------------|------------------------|-------------------|----------------------|---------------------|
| DV | -72 ± 19 | $2.49^{+0.53}_{-0.49}$ | 602^{+27}_{-21} | 3285^{+278}_{-222} | 291^{+183}_{-116} |
| Alt. | -62 ± 20 | $2.46^{+0.53}_{-0.51}$ | 601^{+26}_{-22} | 3242^{+260}_{-244} | 264^{+165}_{-109} |

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 $A_{obs} \gg 1.0$

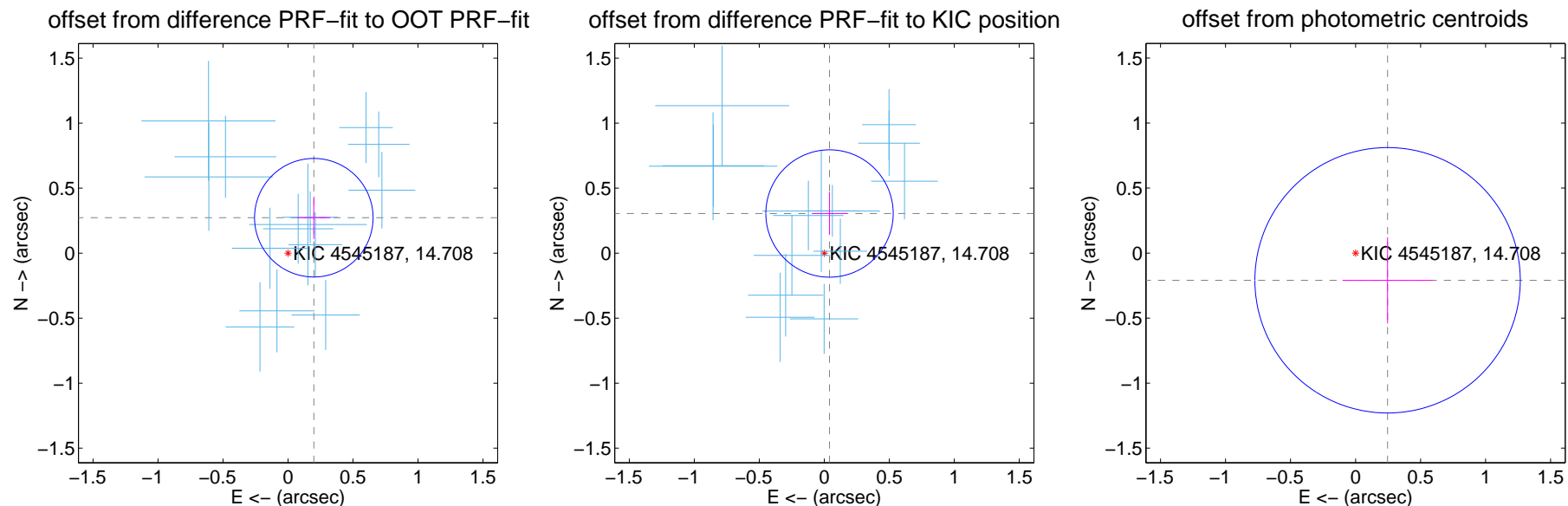
DV Centroid Data

Supplemental centroid analysis for 004545187-02. Kepler magnitude: 14.71. Transit SNR 36.39

There are 14 quarters with good PRF difference image offsets

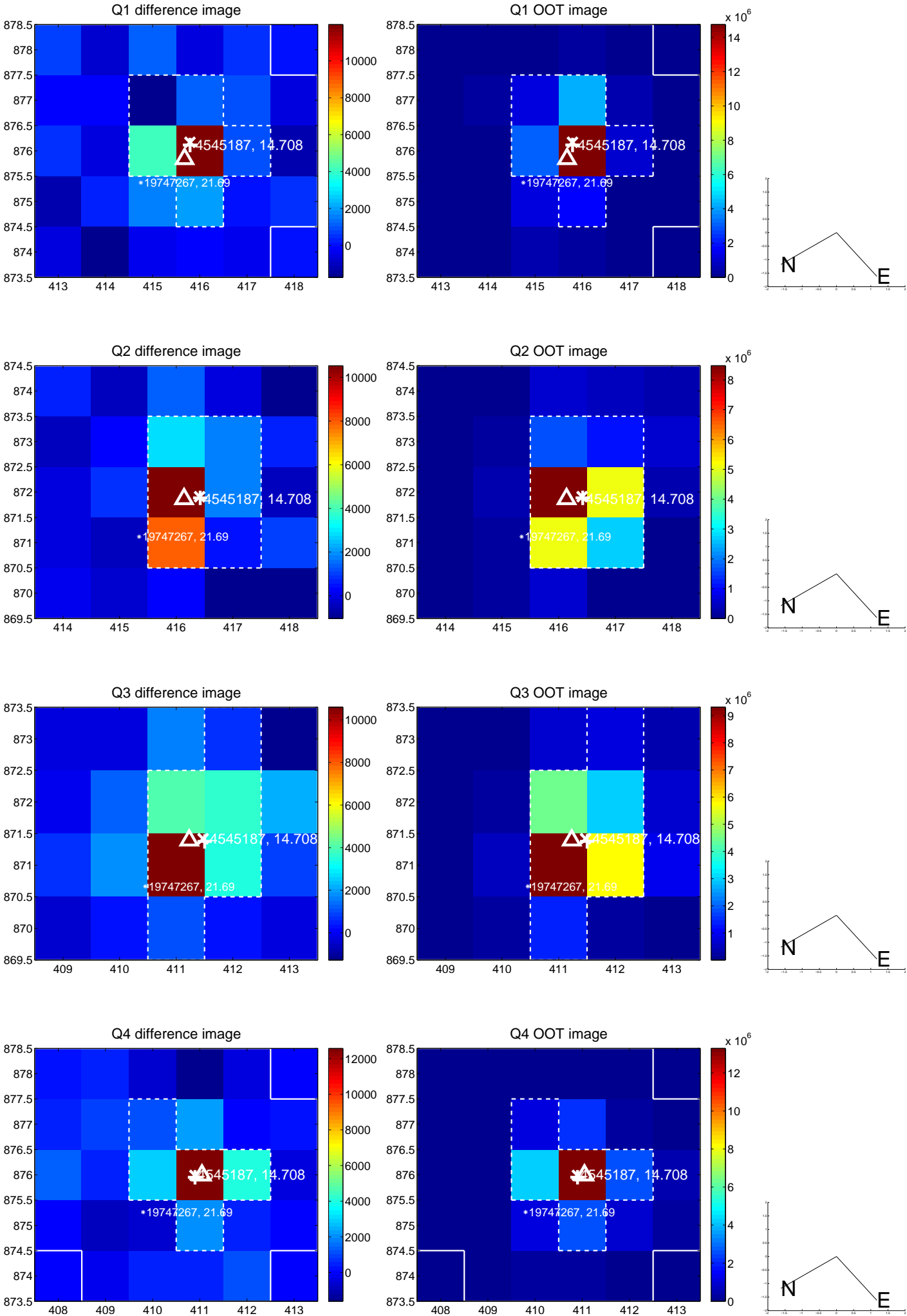
The direct PRF centroid is offset from the target star catalog position by about 0.12 arcsec

| | Distance in arcsec | Distance / σ | Δ RA | Δ Dec |
|---|--------------------|---------------------|--------------------|-------------------|
| PRF-fit source offset from OOT | 0.337 ± 0.152 | 2.22 | -0.198 ± 0.128 | 0.273 ± 0.163 |
| PRF-fit source offset from KIC position | 0.308 ± 0.163 | 1.88 | -0.040 ± 0.137 | 0.305 ± 0.164 |
| photometric centroid source offset | 0.32 ± 0.34 | 0.95 | -0.25 ± 0.35 | -0.21 ± 0.33 |

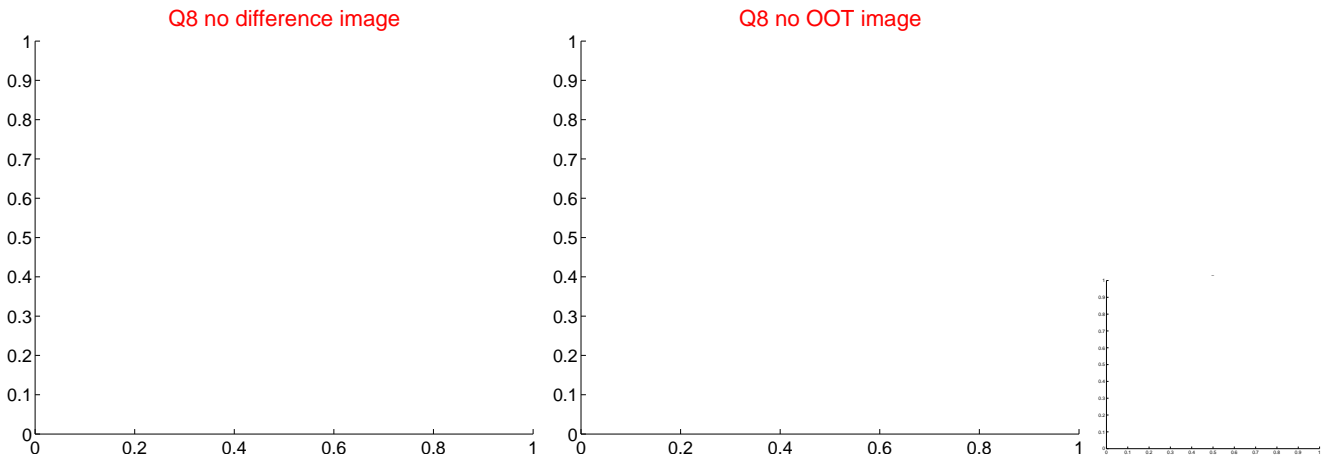
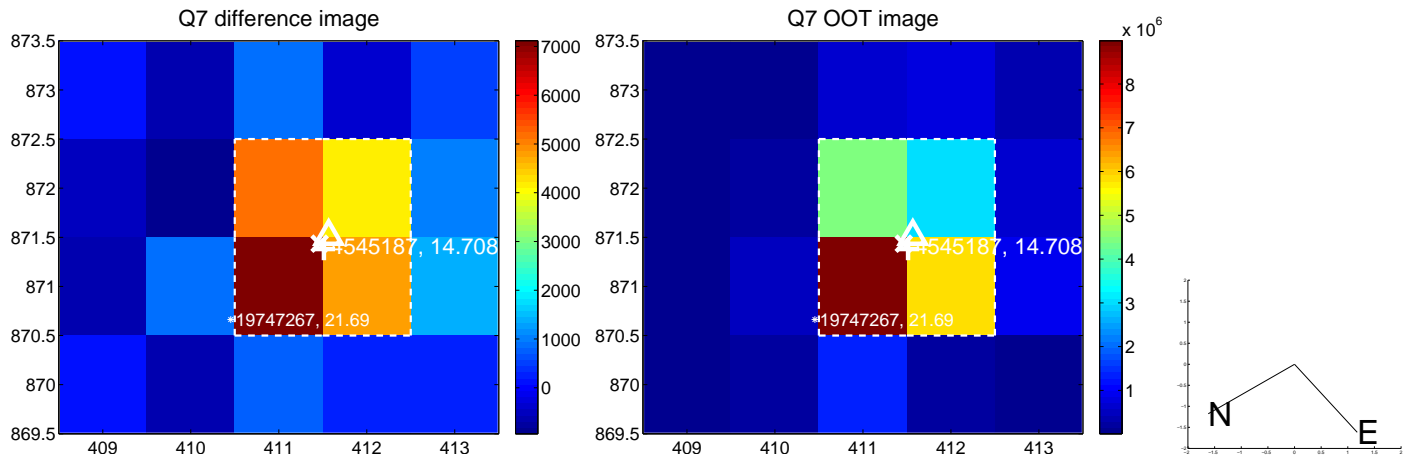
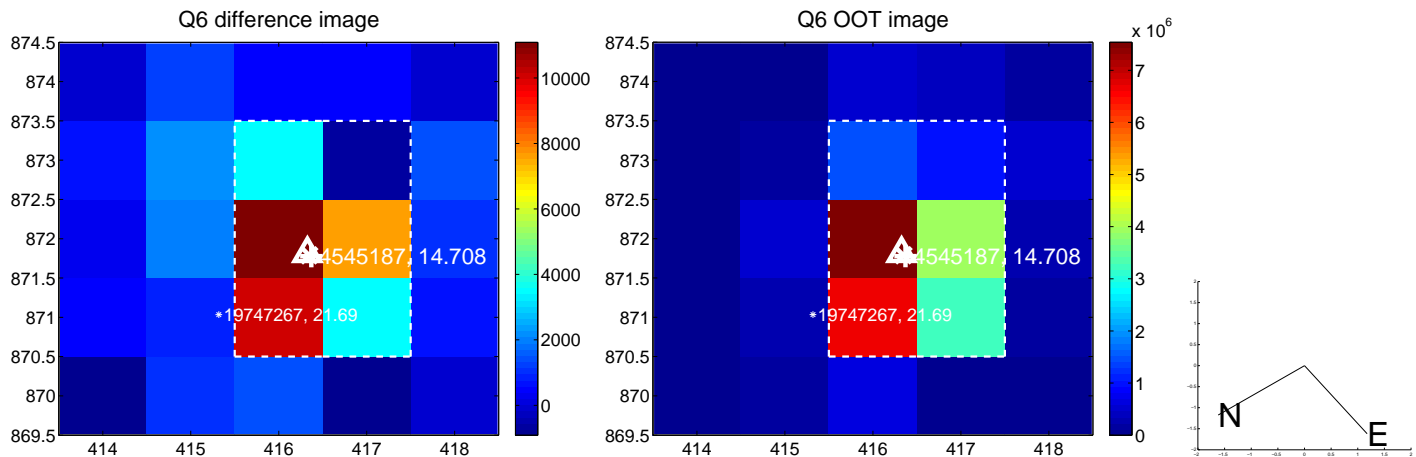
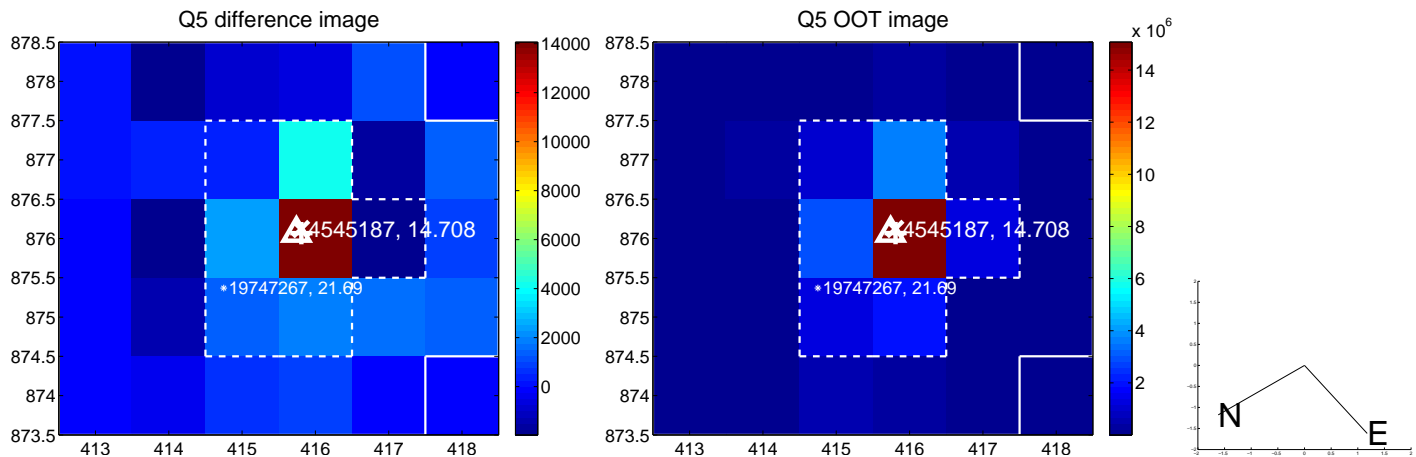


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

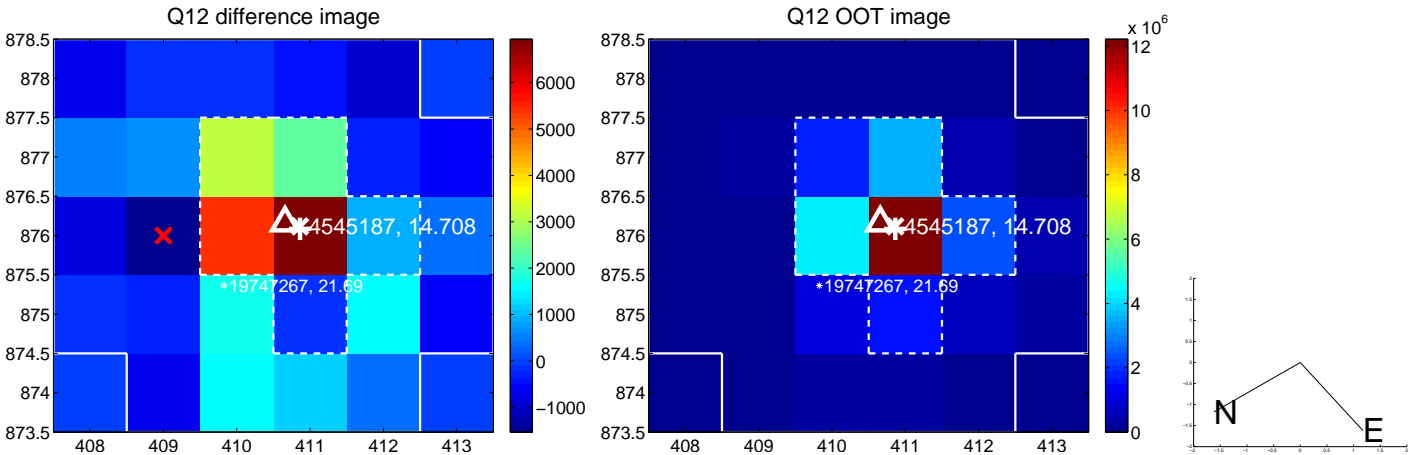
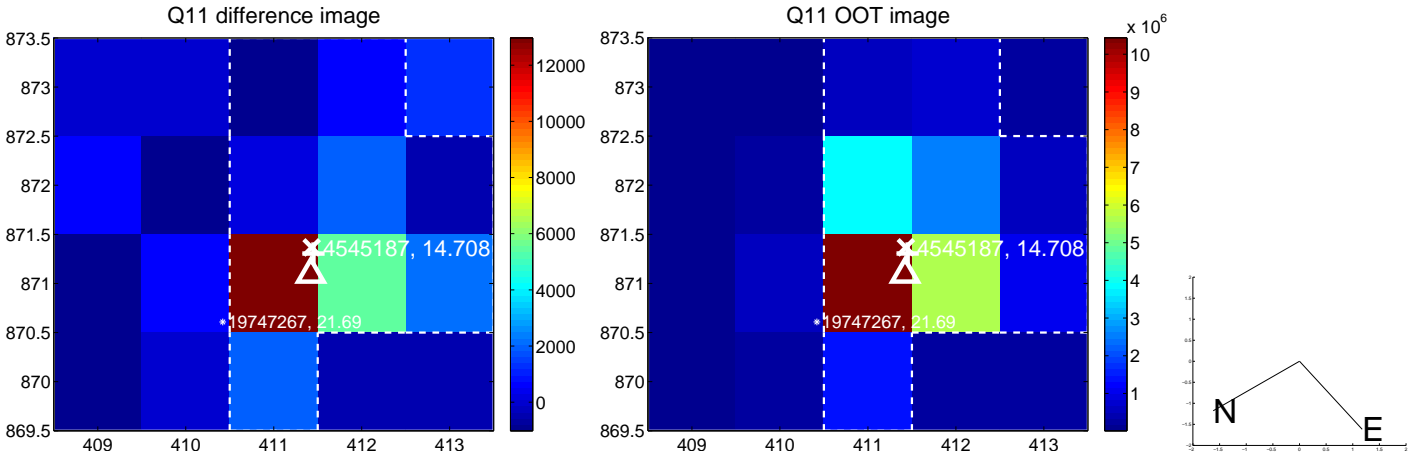
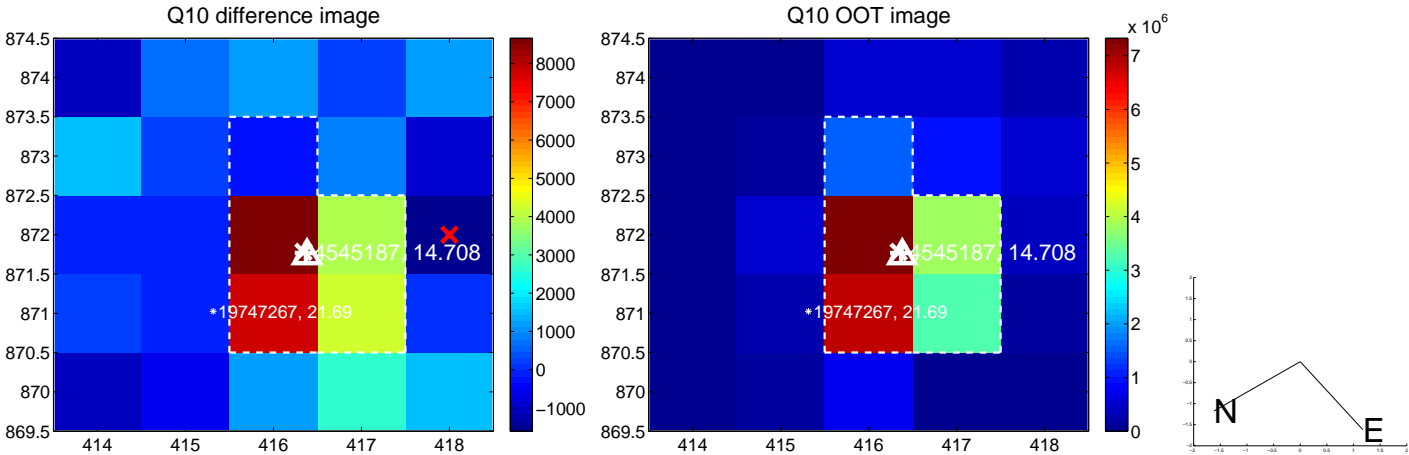
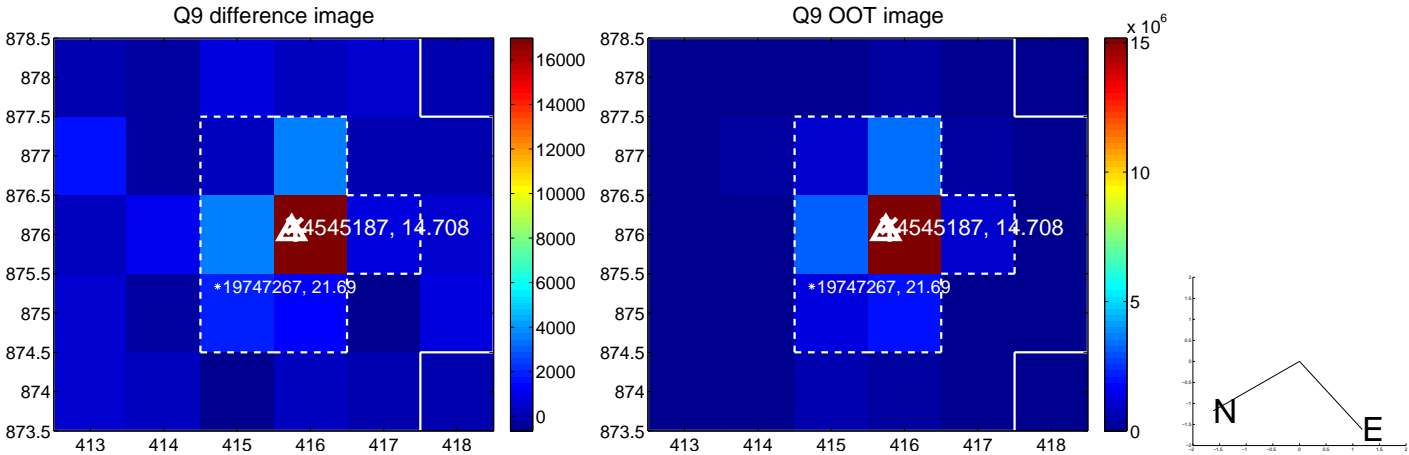
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



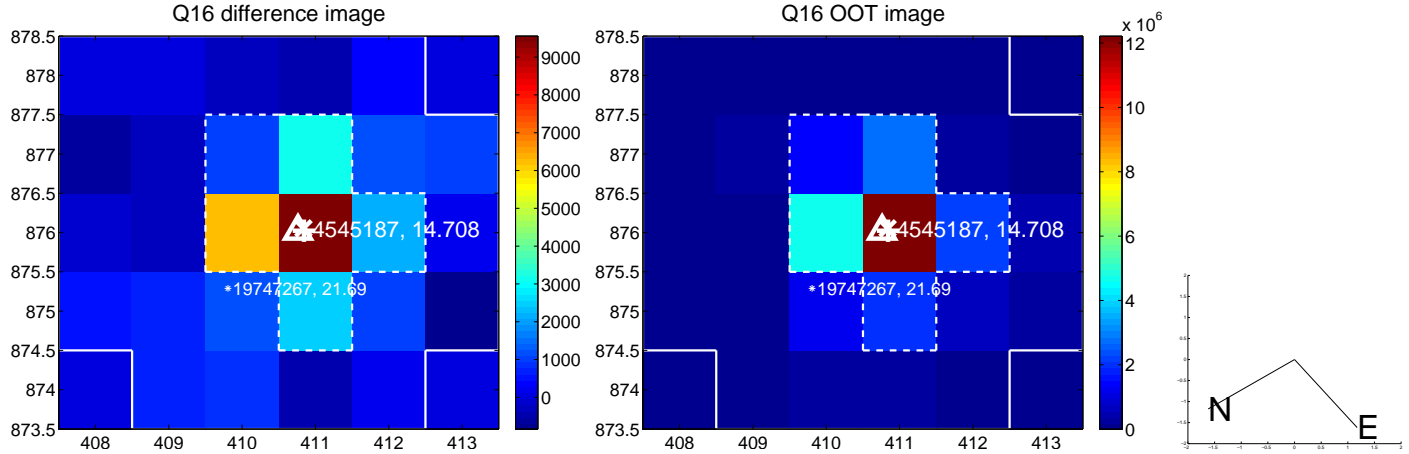
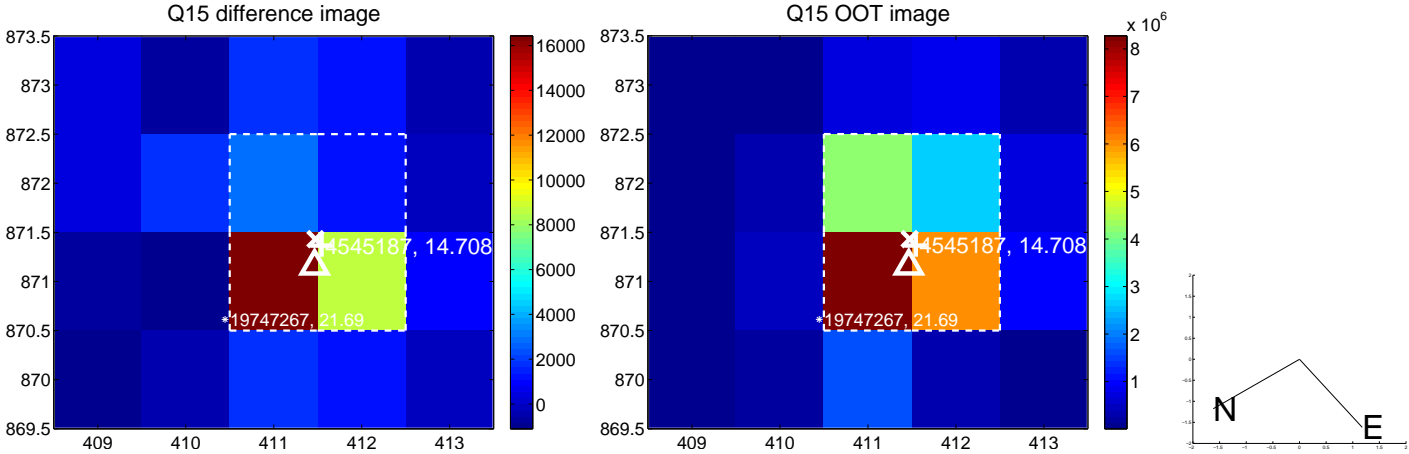
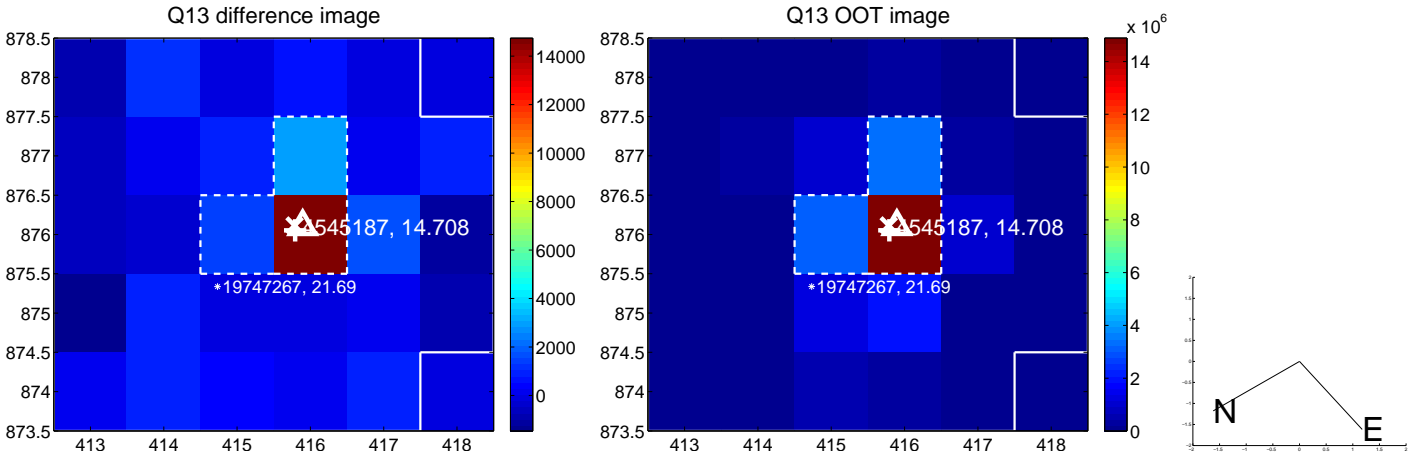
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



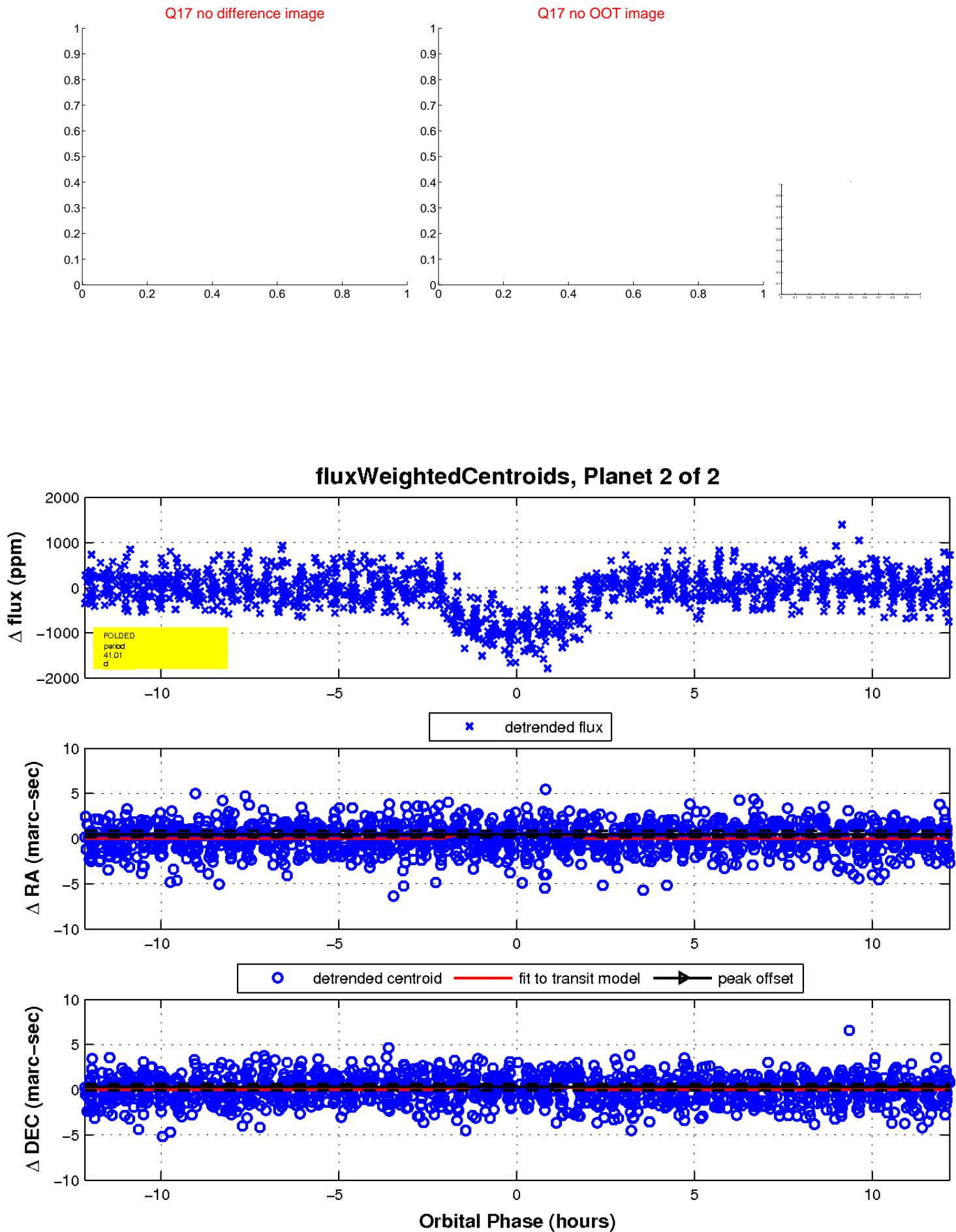
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



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

