

KIC 010227020

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}) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 010227020-01 | OBS | 0730.01 | 14.787584 | 132.428654 | 770.4 | 8.455 | 27.6 | 29.4 | 1.25 | 5814 | 4.93 | 110.60 |
| 010227020-02 | OBS | 0730.03 | 19.723809 | 135.075895 | 503.8 | 9.344 | 17.1 | 17.9 | 1.25 | 5814 | 3.98 | 75.33 |
| 010227020-03 | OBS | 0730.02 | 9.848205 | 138.392875 | 328.4 | 6.003 | 15.4 | 15.5 | 1.25 | 5814 | 2.58 | 190.16 |
| 010227020-04 | OBS | 0730.04 | 7.384377 | 137.477378 | 279.6 | 6.200 | 15.7 | 16.1 | 1.25 | 5814 | 2.71 | 279.16 |

Robovetter Results

| TCE | Run Type | Disp | Score | N | S | C | E | Comments |
|--------------|----------|------|-------|---|---|---|---|------------|
| 010227020-01 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-02 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-03 | OBS | PC | 0.99 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-04 | OBS | PC | 0.99 | 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.

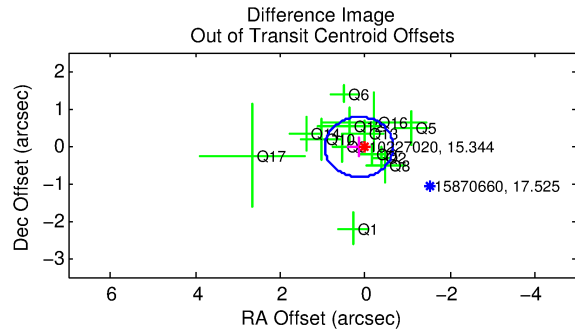
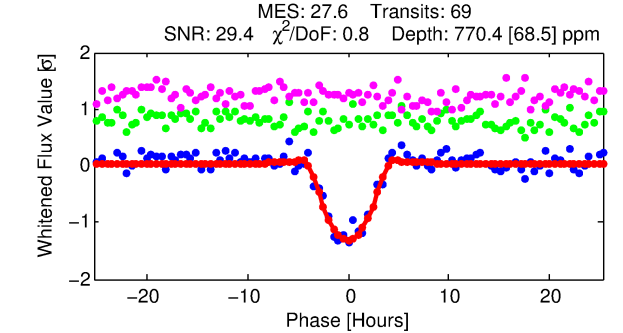
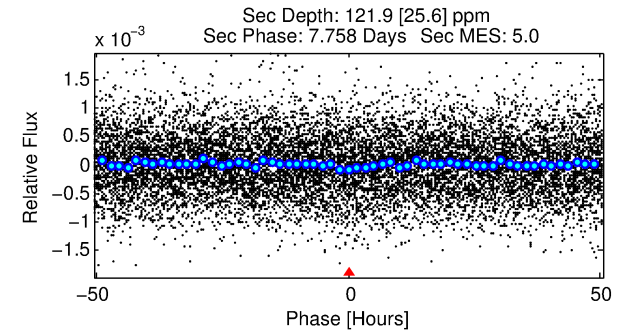
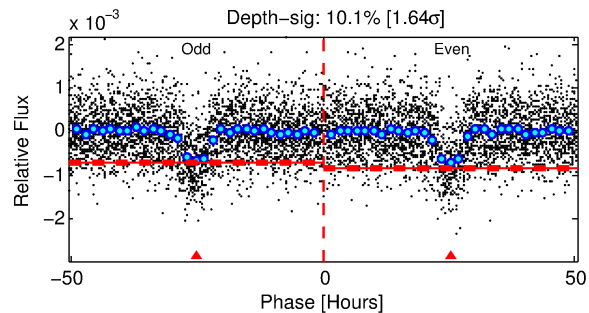
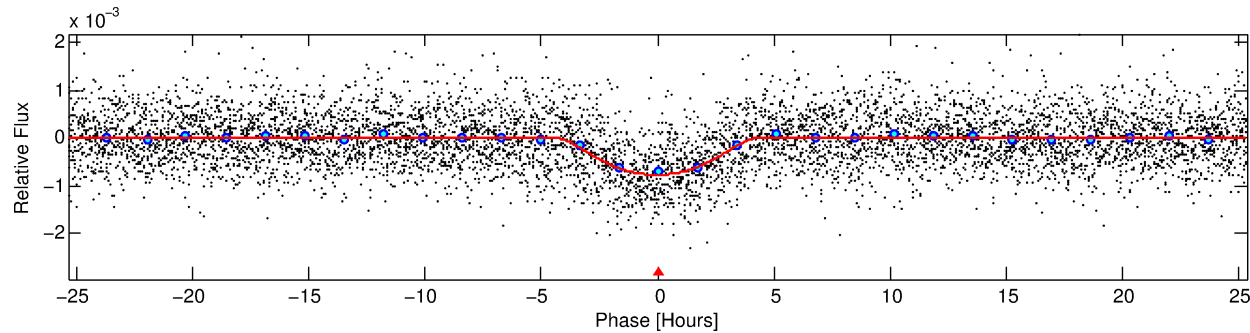
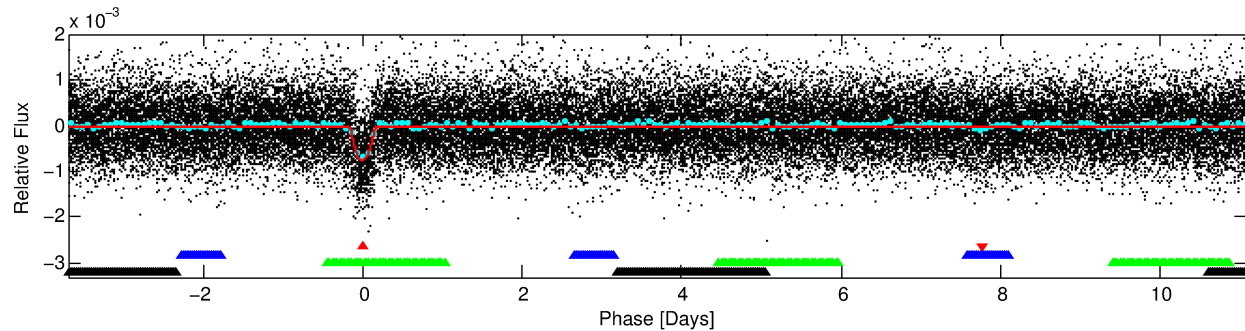
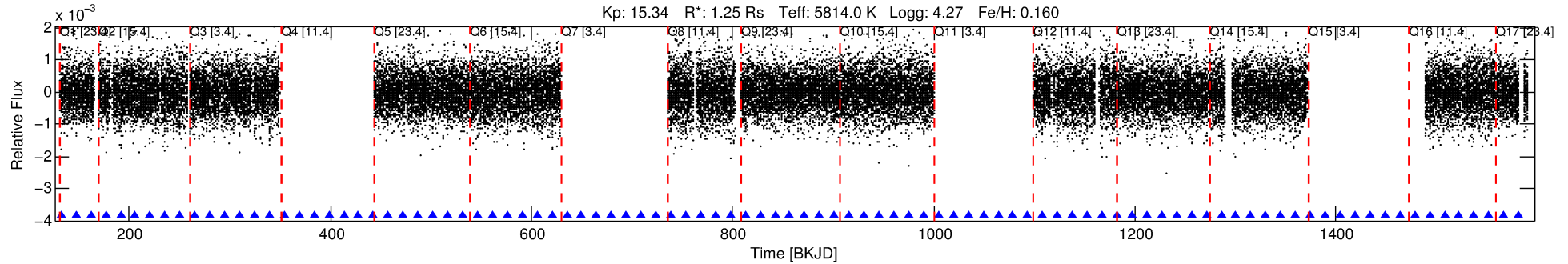
See http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col for comment definitions.

Ephemeris Match Information For 010227020-01

No Significant Match Found

DV One-Page Summary

KIC: 10227020 Candidate: 1 of 4 Period: 14.788 d
KOI: K00730.01 Name: Kepler-223d Corr: 0.938



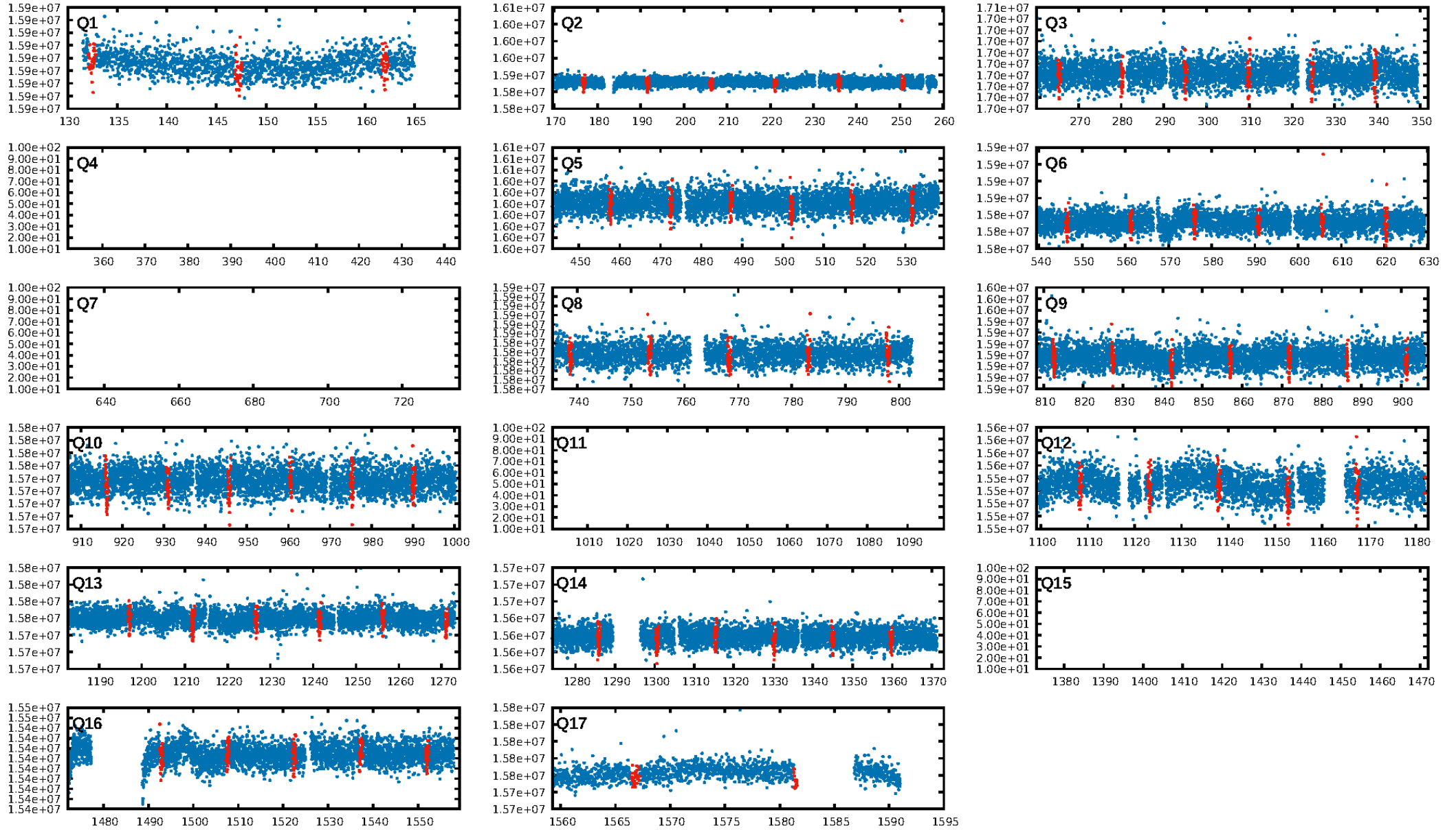
DV Fit Results:

Period = 14.78758 [0.00012] d
Epoch = 132.4287 [0.0062] BKJD
Rp/R* = 0.0362 [0.0083]
a/R* = 4.80 [0.59]
b = 0.97 [0.02]
Seff = 110.60 [26.99]
Teq = 827 [50] K
Rp = 4.93 [1.40] Re
a = 0.1201 [0.0184] AU
Ag = 39.70 [22.19] [1.74 σ]
Teffp = 3209 [408] K [5.79 σ]

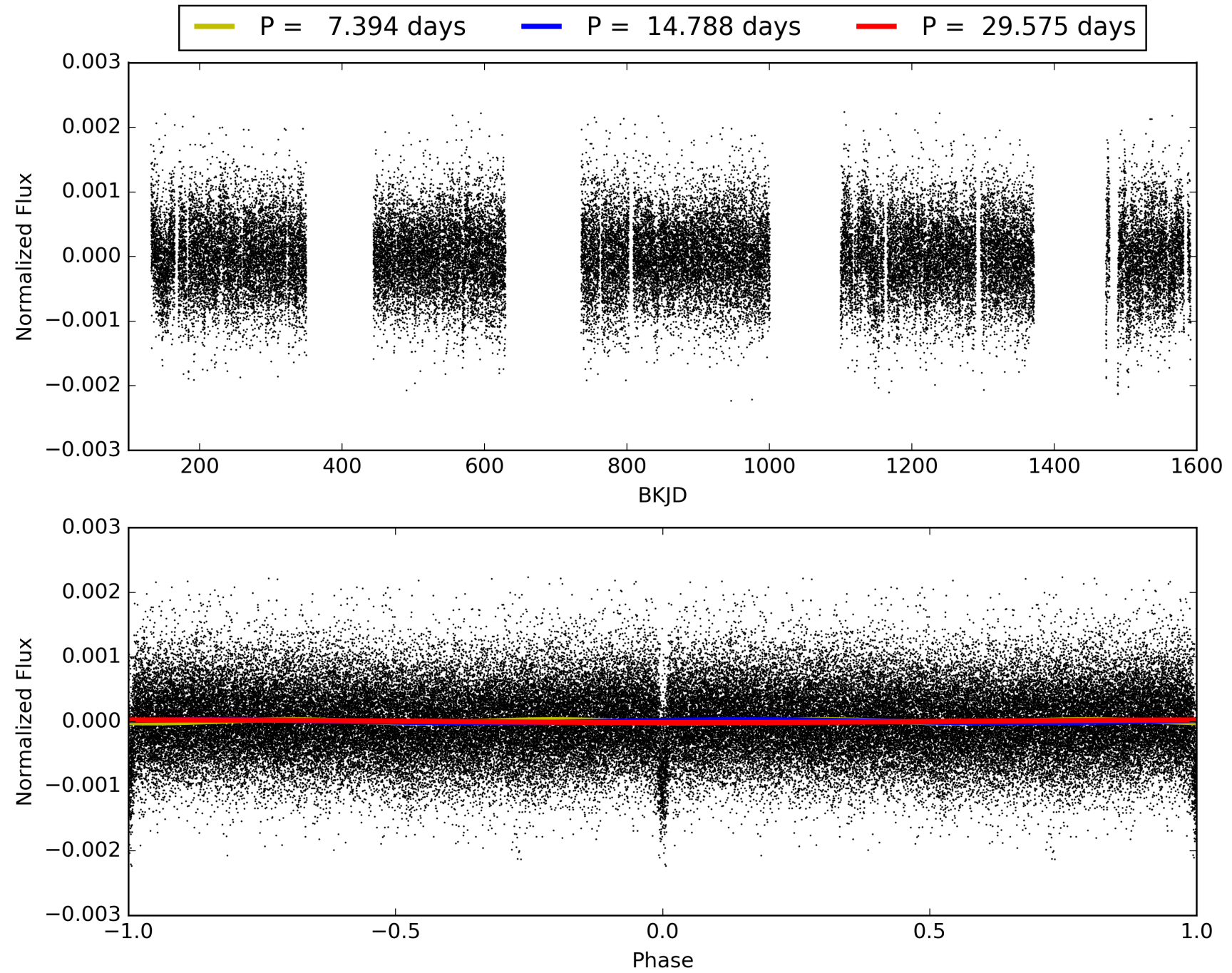
DV Diagnostic Results:

ShortPeriod-sig: 100.0% [11.43 σ]
LongPeriod-sig: 100.0% [9.40 σ]
ModelChiSquare2-sig: 87.2%
ModelChiSquareGof-sig: 100.0%
Bootstrap-pfa: 2.02e-166
RollingBand-fgt: 1.00 [64/64]
GhostDiagnostic-chr: 5.5
Centroid-sig: 25.9%
Centroid-so: 0.252 arcsec [0.59 σ]
OotOffset-rm: 0.143 arcsec [0.53 σ]
KicOffset-rm: 0.278 arcsec [1.03 σ]
OotOffset-st: 4/1/3/5 [13]
KicOffset-st: 4/1/3/5 [13]
DiffImageQuality-fgm: 0.92 [12/13]
DiffImageOverlap-fno: 0.92 [12/13]

TCE 010227020-01, PDC Light Curves

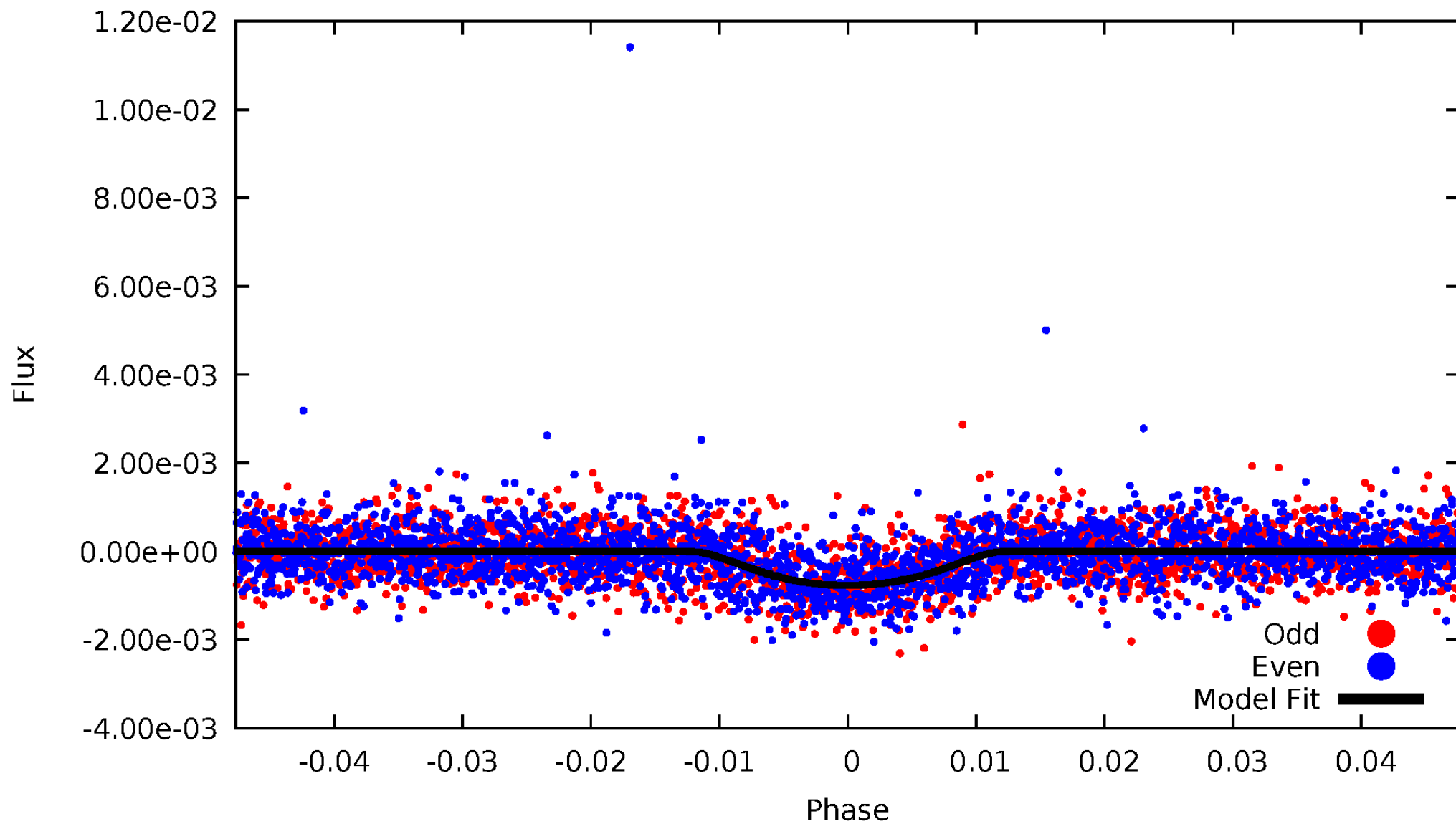


TCE 010227020-01



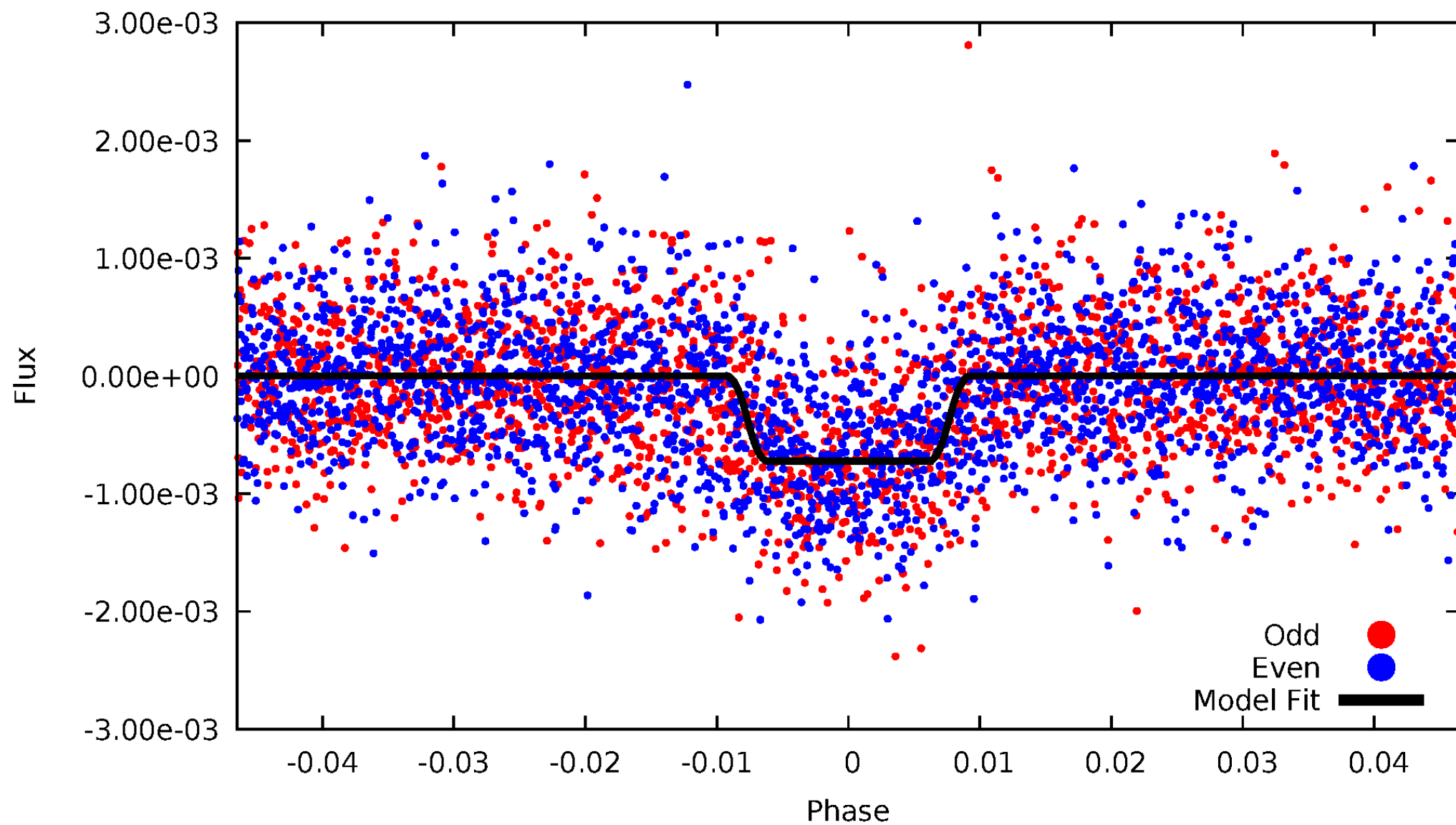
DV Odd/Even

TCE 010227020-01



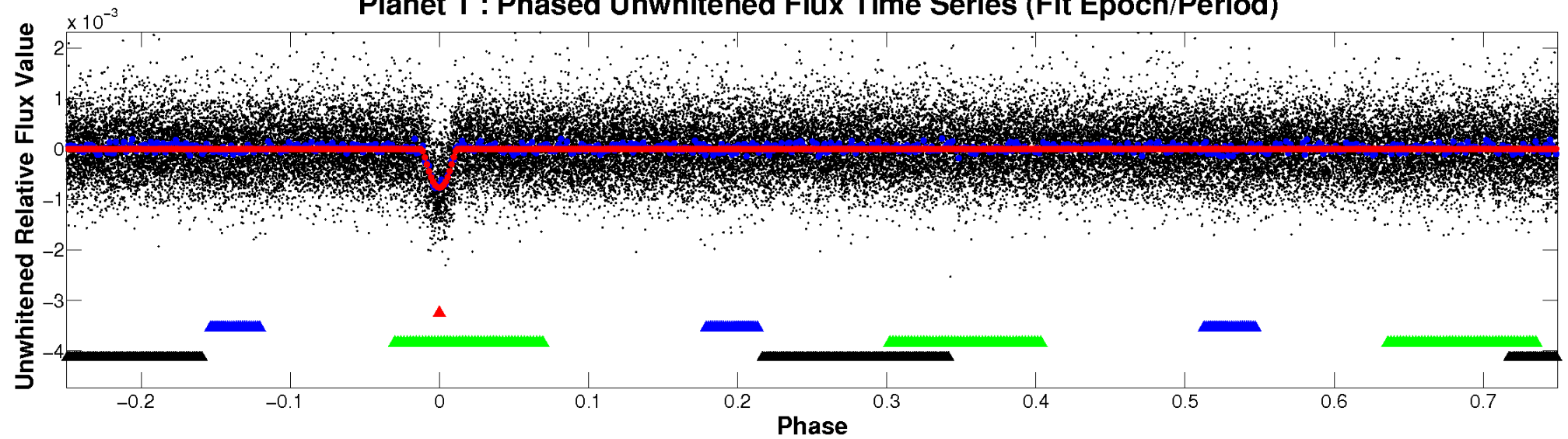
ALT Odd/Even

TCE 010227020-01

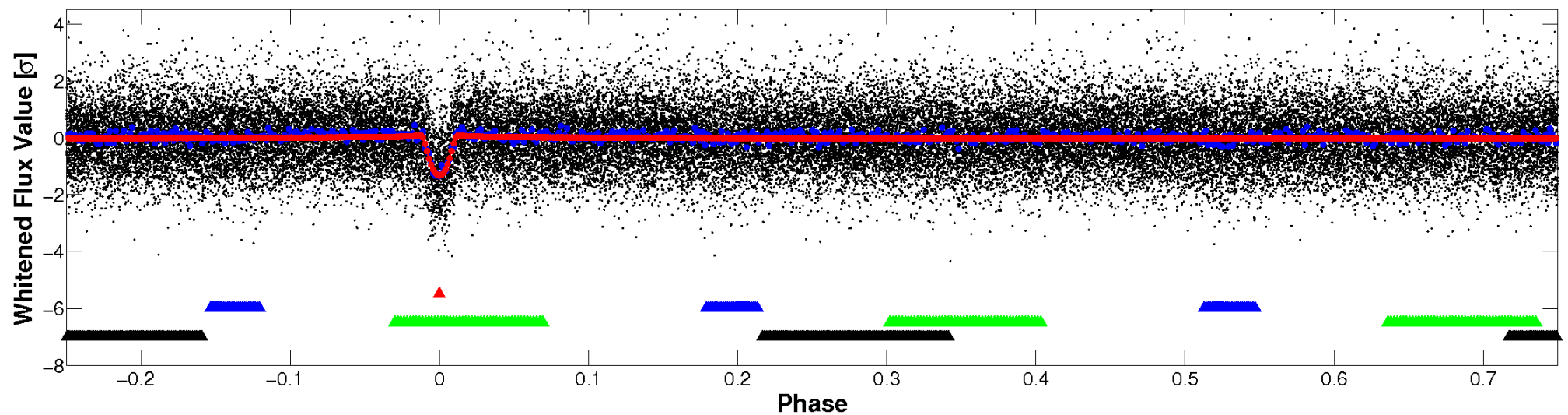


Non-Whitened Vs. Whitened Light Curve

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

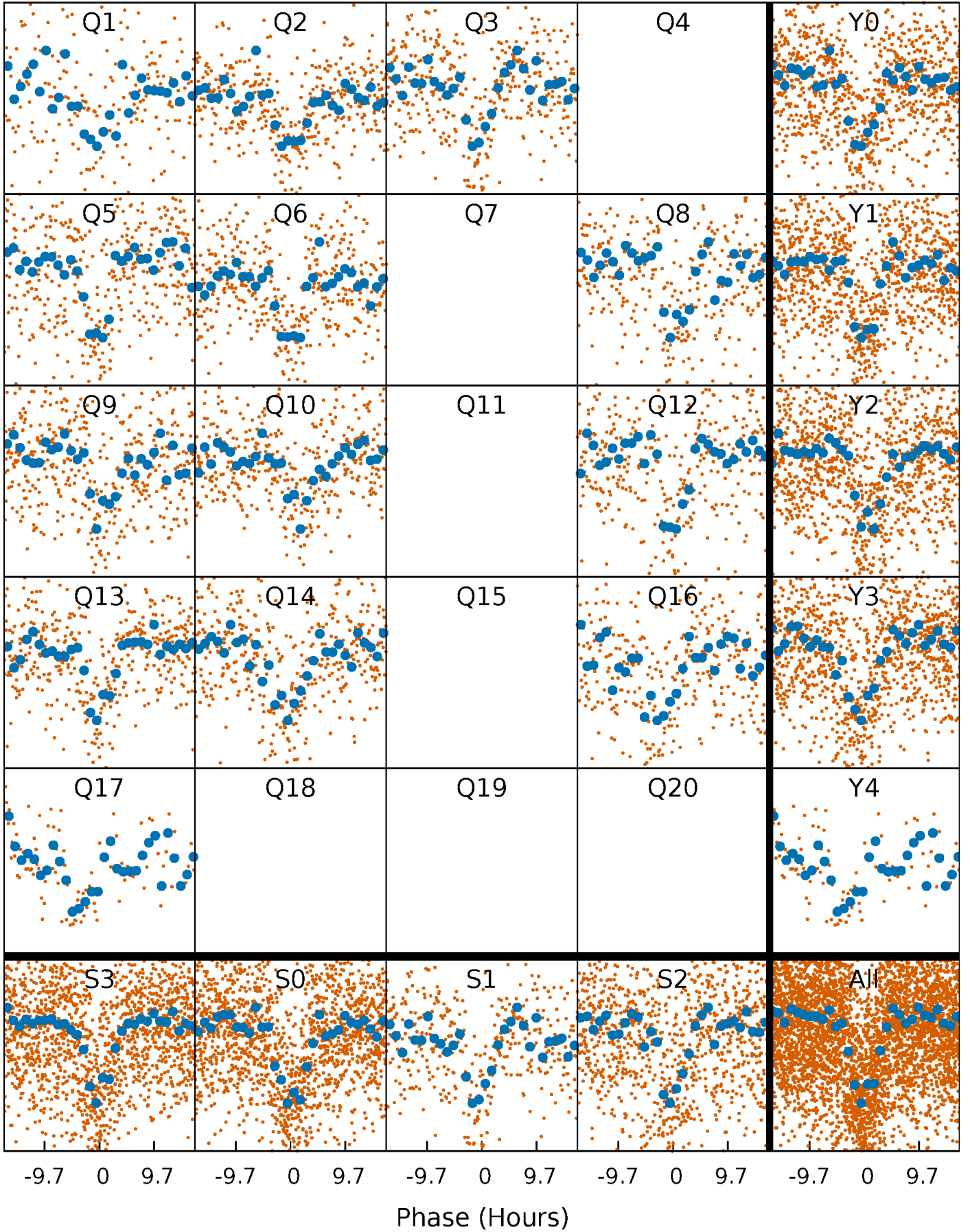


Planet 1 : Phased Whitened Flux Time Series (Fit Epoch/Period)



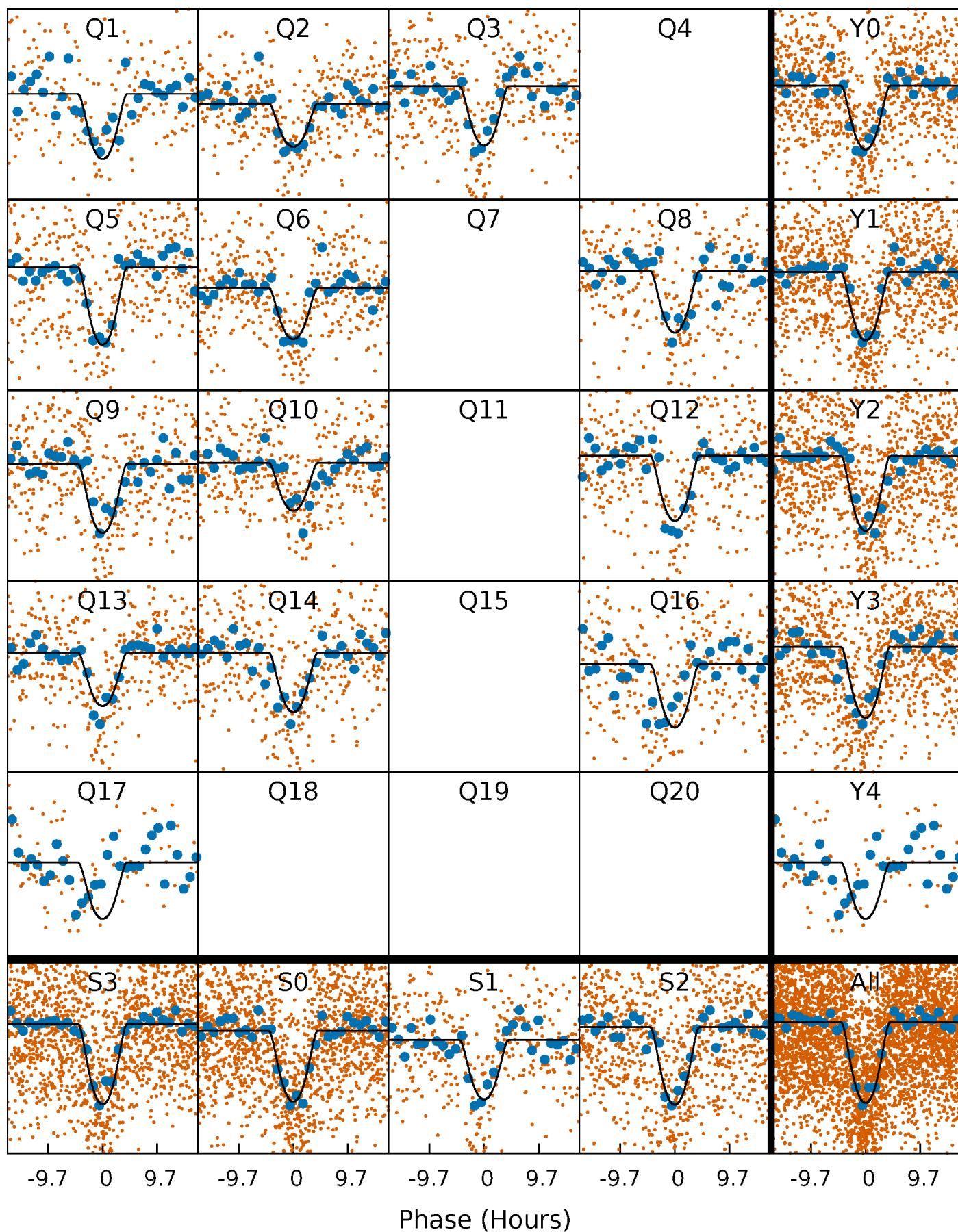
PDC Quarter-Phased Transit Curves

TCE 010227020-01 P= 14.787584 Days $T_0=132.428653$ (BKJD)



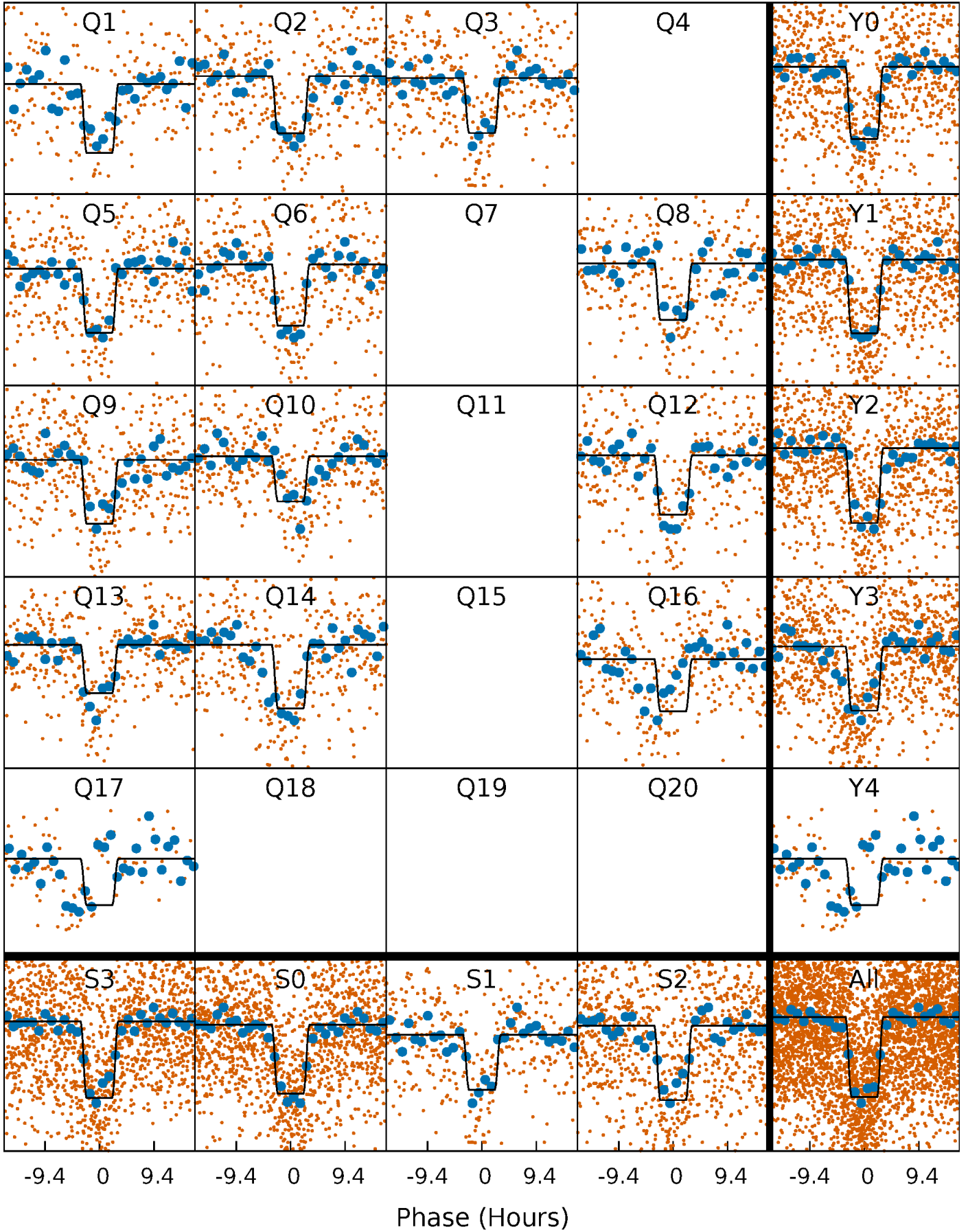
DV Quarter-Phased Transit Curves

TCE 010227020-01 P= 14.787584 Days $T_0=132.428653$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

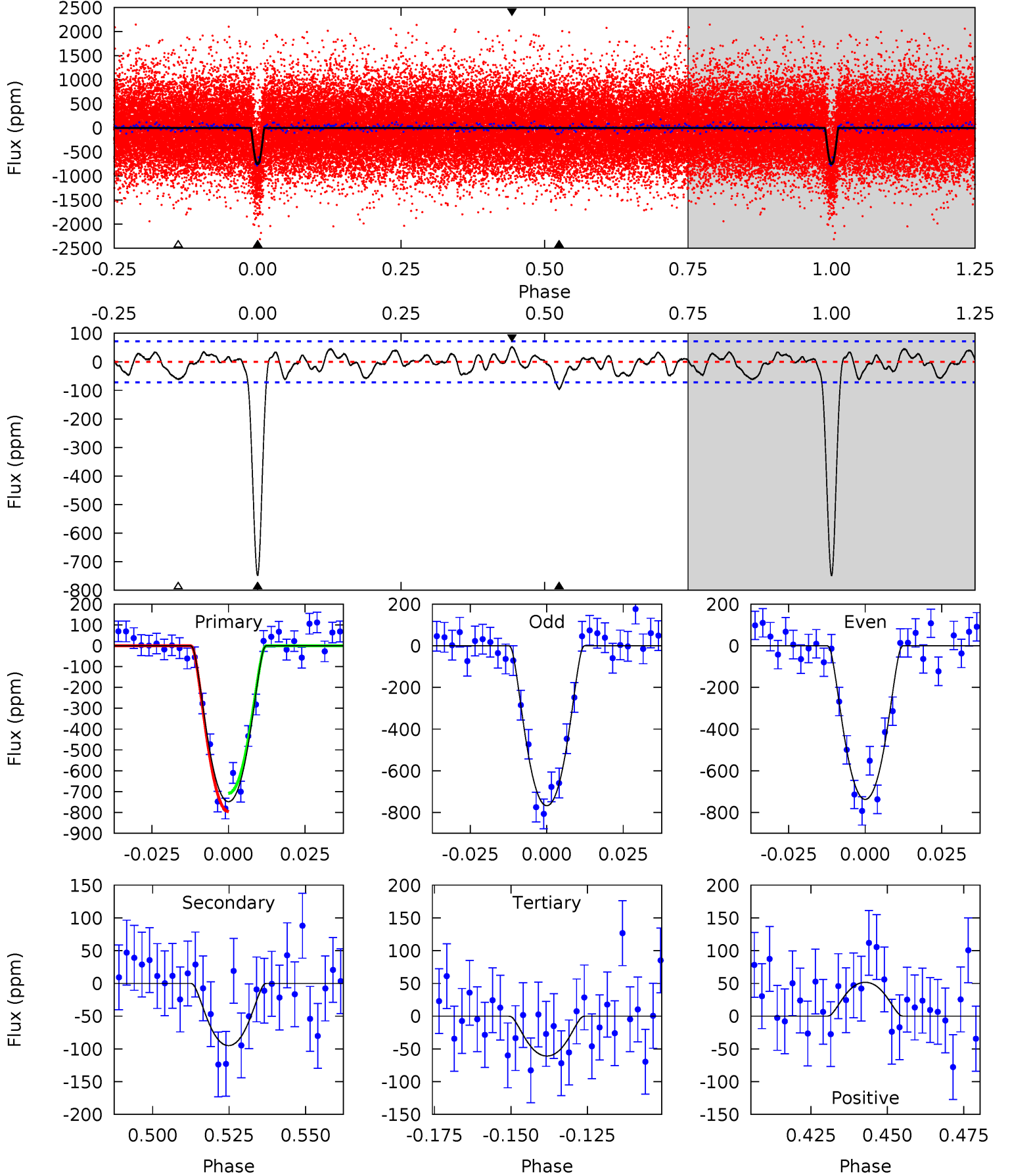
TCE 010227020-01 P= 14.787984 Days $T_0=132.412802$ (BKJD)



DV Model-Shift Uniqueness Test

010227020-01, P = 14.787584 Days, E = 117.641069 Days

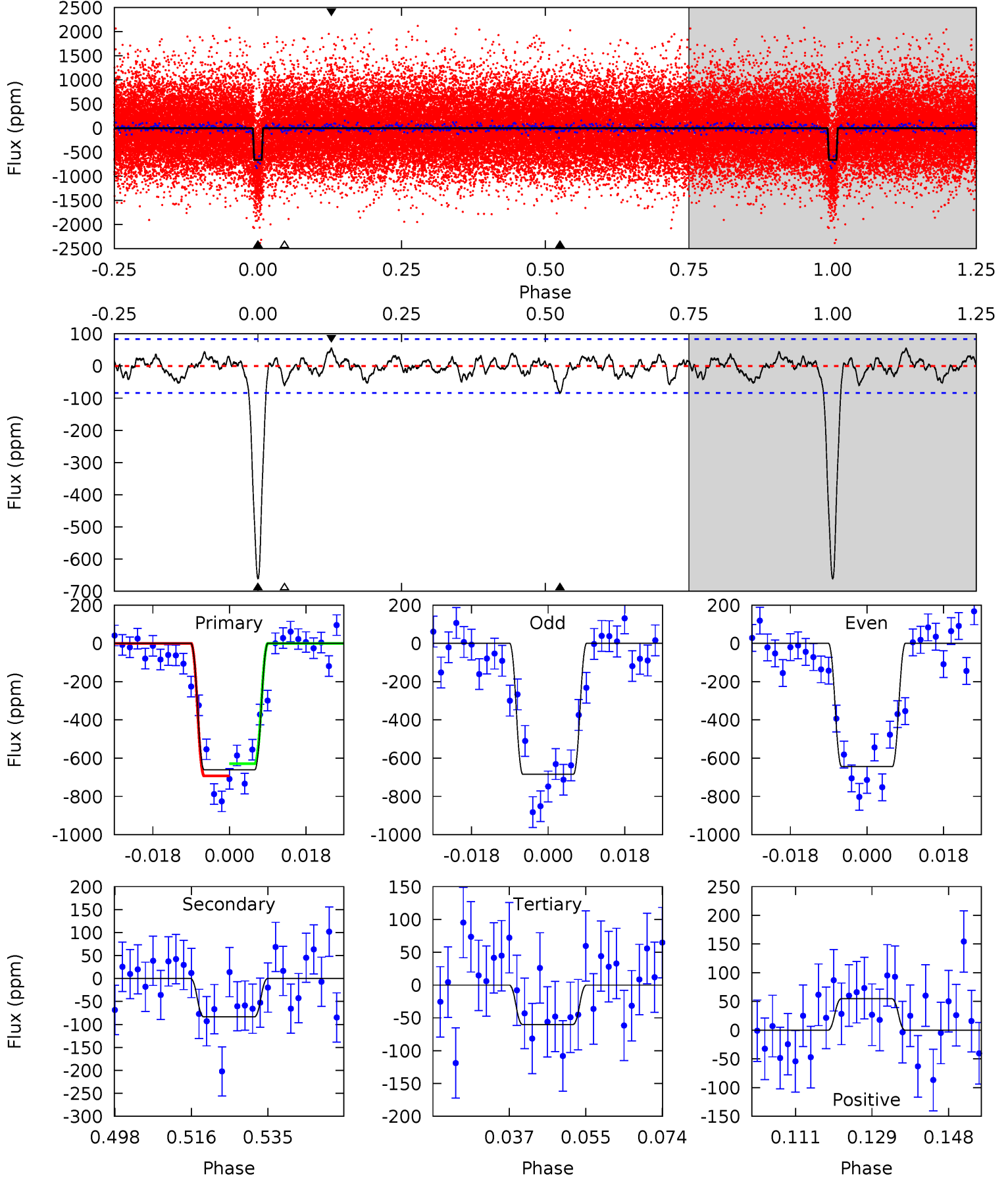
| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 50.7 | 6.44 | 4.13 | 3.50 | 4.85 | 2.24 | 1.68 | 46.6 | 47.2 | 2.31 | 2.94 | 1.02 | 0.97 | 0.06 | 2.97 |



Alt Model-Shift Uniqueness Test

010227020-01, P = 14.787984 Days, E = 117.624818 Days

| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 38.7 | 4.90 | 3.51 | 3.20 | 4.91 | 2.36 | 1.23 | 35.2 | 35.5 | 1.38 | 1.69 | 1.16 | 0.95 | 0.08 | 1.87 |



Stellar Parameters For KIC 010227020

| | $T_{\text{eff}}(K)$ | $\log(g)$ | [Fe/H] | R (R_{\odot}) | $M(M_{\odot})$ | p_{\star} ($\text{g}\cdot\text{cm}^{-3}$) |
|--------|---------------------|---------------------------|---------------------------|---------------------------|---------------------------|---|
| | 5814^{+78}_{-78} | $4.269^{+0.137}_{-0.112}$ | $0.160^{+0.150}_{-0.150}$ | $1.248^{+0.209}_{-0.209}$ | $1.055^{+0.081}_{-0.067}$ | $0.765^{+0.497}_{-0.259}$ |
| | +1%/-1% | +3%/-3% | +94%/-94% | +17%/-17% | +8%/-6% | +65%/-34% |
| Source | SPE90 | SPE90 | SPE90 | DSEP | | |

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

Secondary Eclipse Parameters for KIC 010227020-01 / KOI 0730.01

| Detrend | Depth (ppm) | R_p (R_{\oplus}) | T_{max} (K) | T_{obs} (K) | A_{obs} |
|---------|--------------|------------------------|--------------------|----------------------|------------------|
| DV | -95 ± 15 | $4.90^{+1.22}_{-1.27}$ | 1152^{+54}_{-57} | 3488^{+361}_{-241} | 31^{+26}_{-12} |
| Alt. | -84 ± 17 | $3.66^{+1.30}_{-1.17}$ | 1155^{+55}_{-55} | 3768^{+563}_{-370} | 49^{+62}_{-23} |

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 $A_{obs} \gg 1.0$

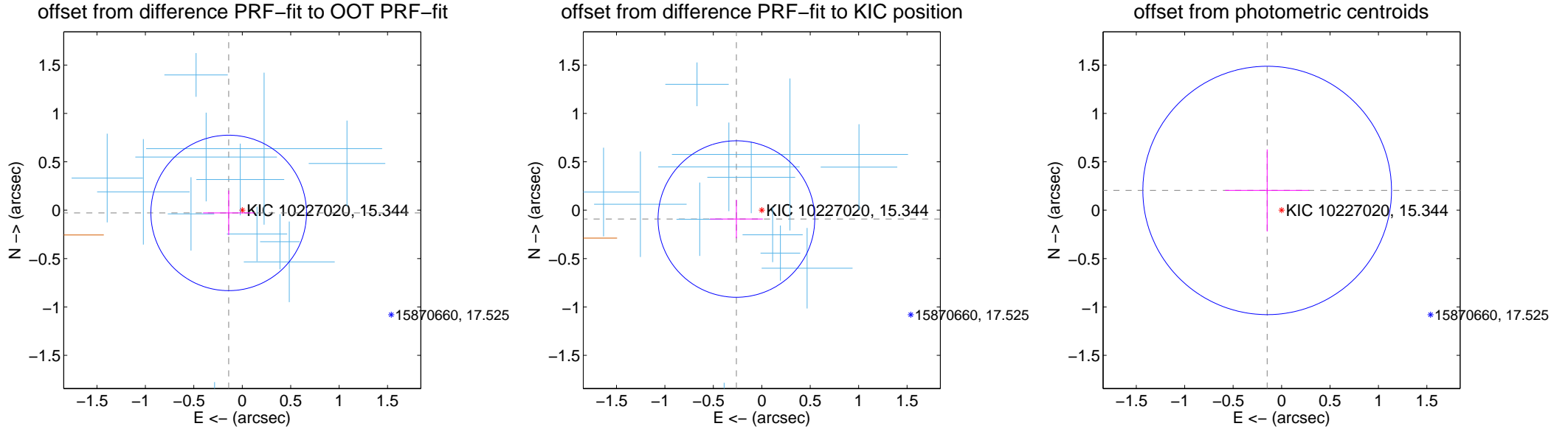
DV Centroid Data

Supplemental centroid analysis for 010227020-01. Kepler magnitude: 15.34. Transit SNR 29.36

There are 12 quarters with good PRF difference image offsets

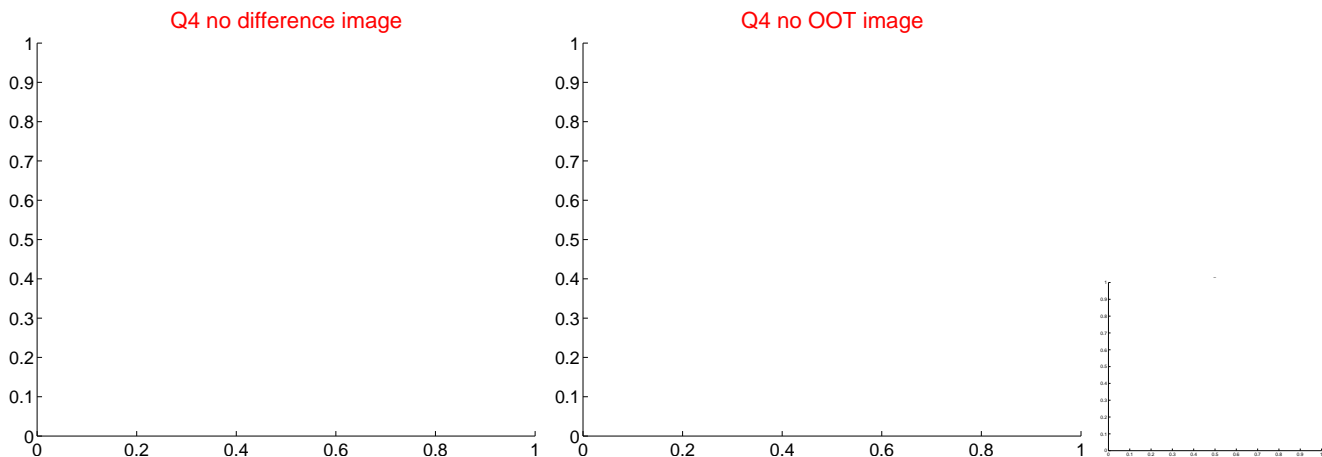
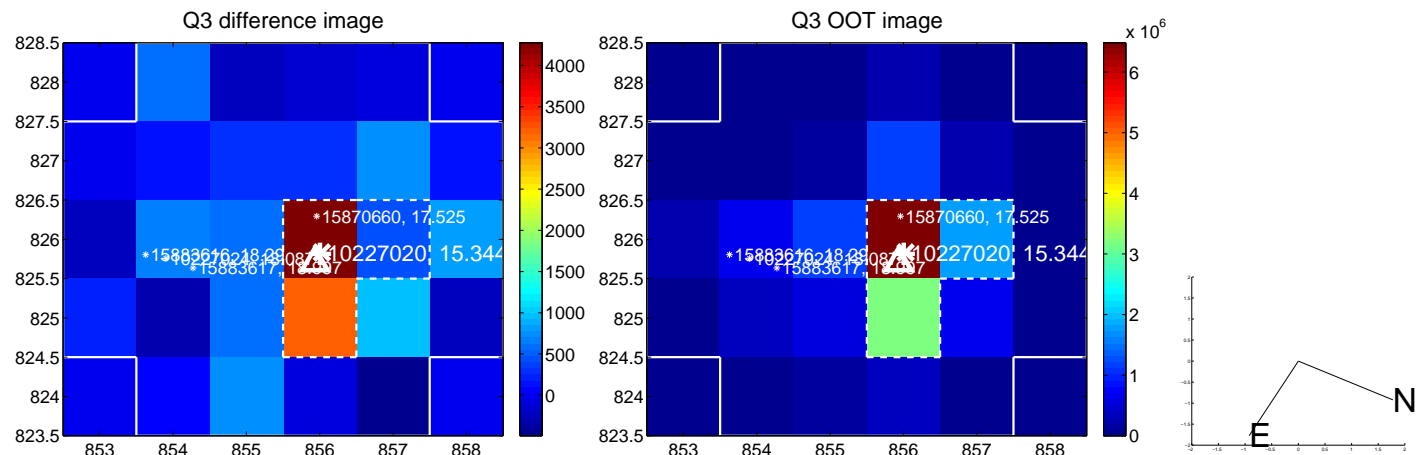
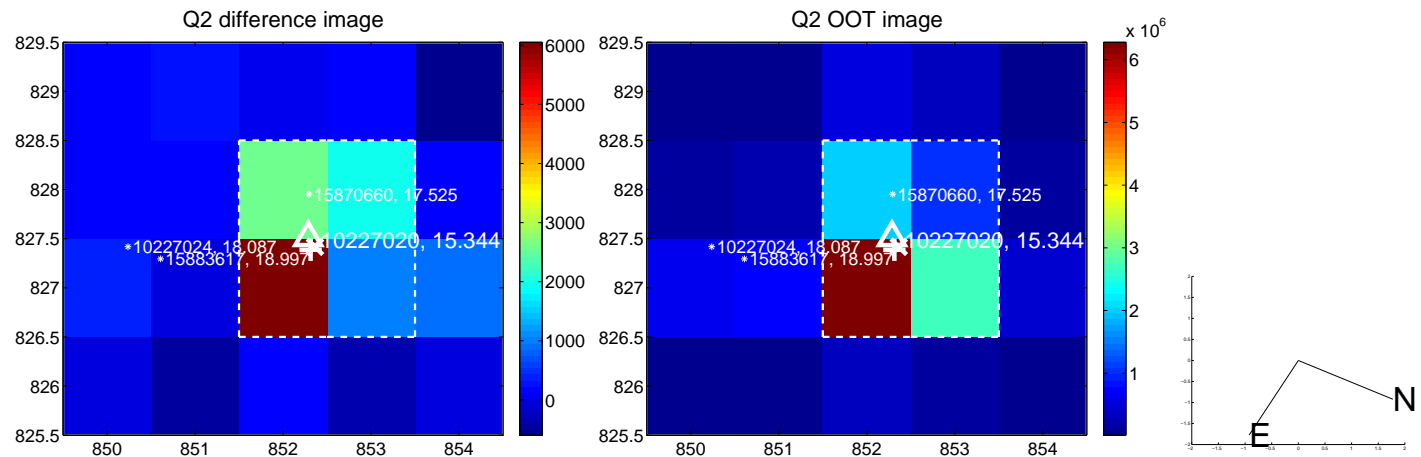
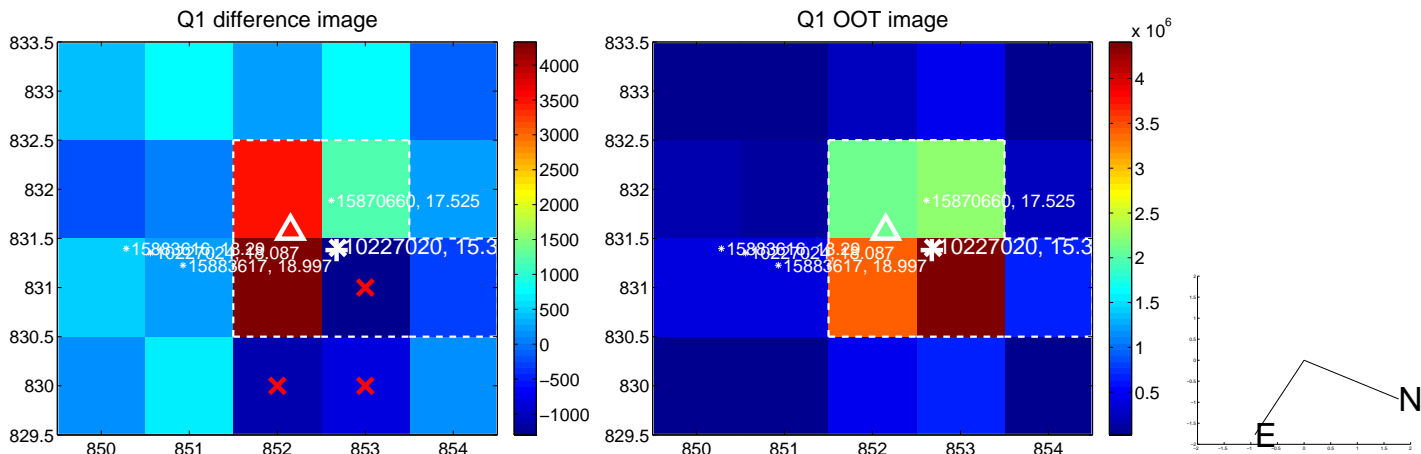
The direct PRF centroid is offset from the target star catalog position by about 0.07 arcsec

| | Distance in arcsec | Distance / σ | Δ RA | Δ Dec |
|---|--------------------|---------------------|-------------------|--------------------|
| PRF-fit source offset from OOT | 0.143 ± 0.268 | 0.53 | 0.140 ± 0.265 | -0.028 ± 0.231 |
| PRF-fit source offset from KIC position | 0.278 ± 0.270 | 1.03 | 0.262 ± 0.273 | -0.091 ± 0.199 |
| photometric centroid source offset | 0.25 ± 0.43 | 0.59 | 0.15 ± 0.43 | 0.20 ± 0.42 |

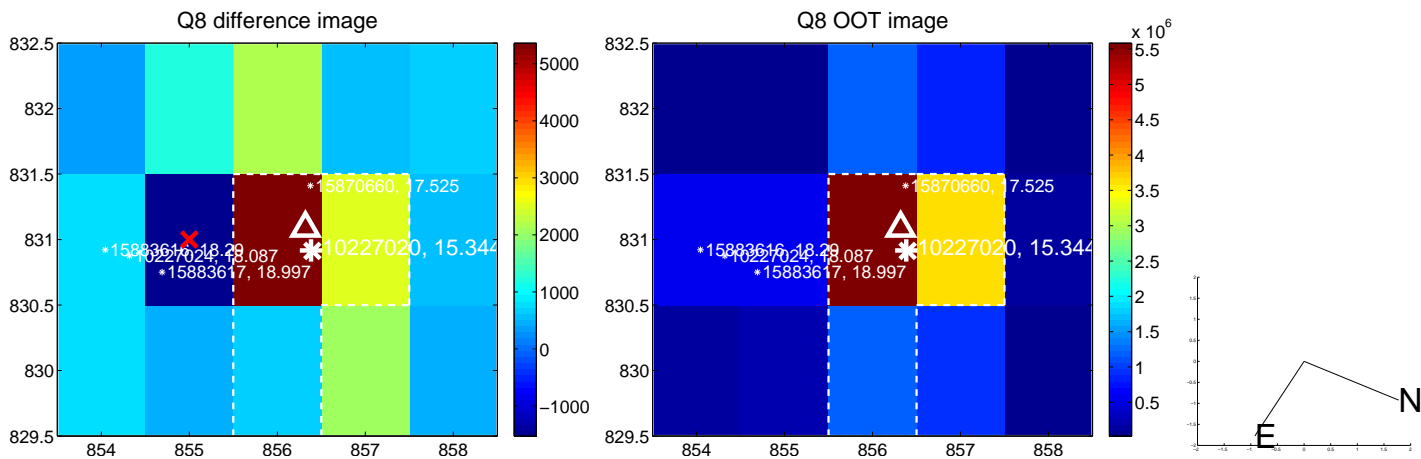
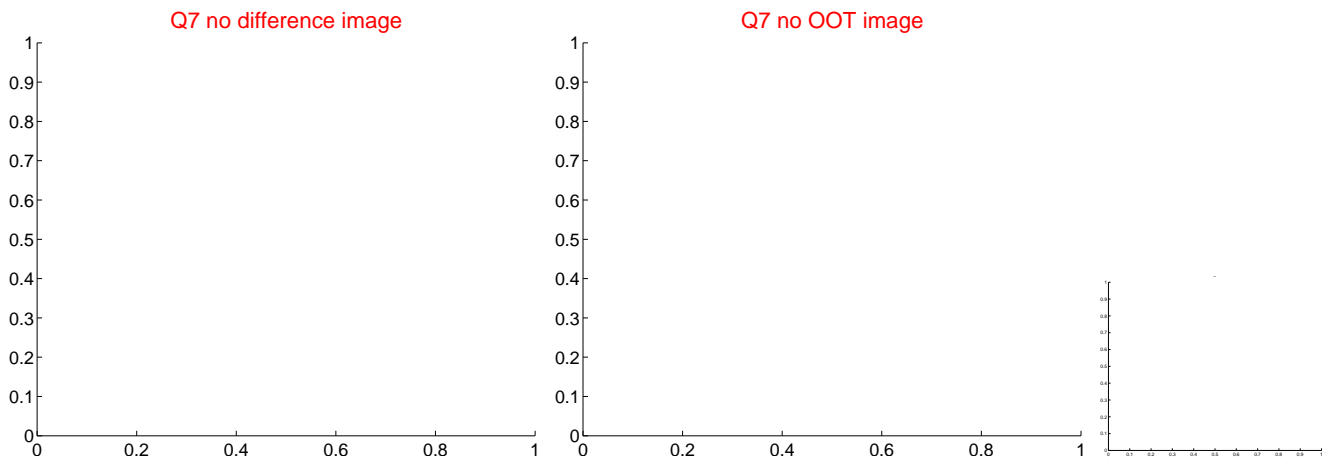
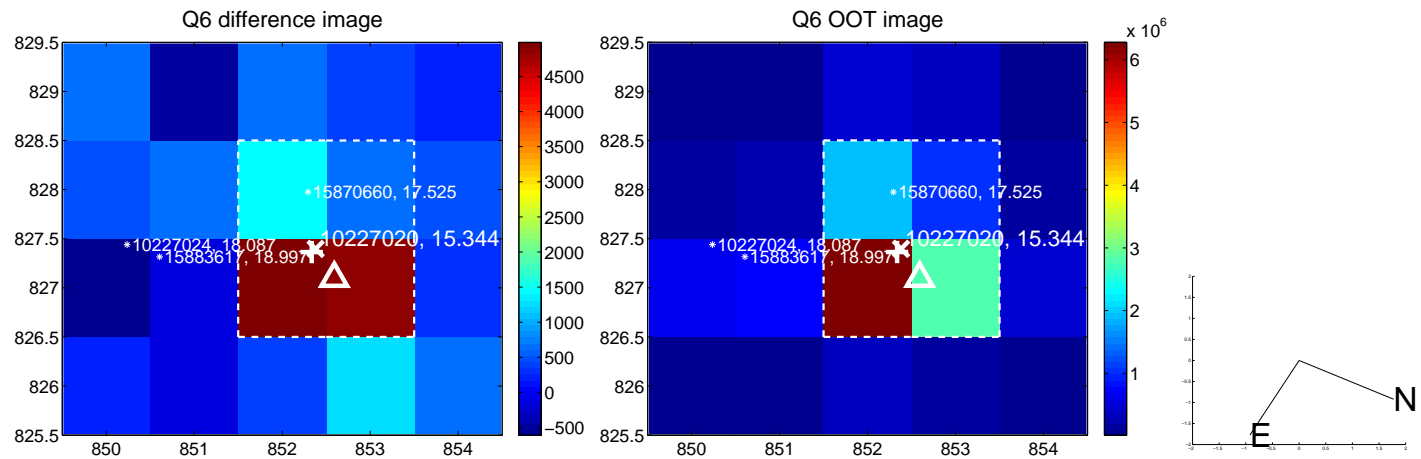
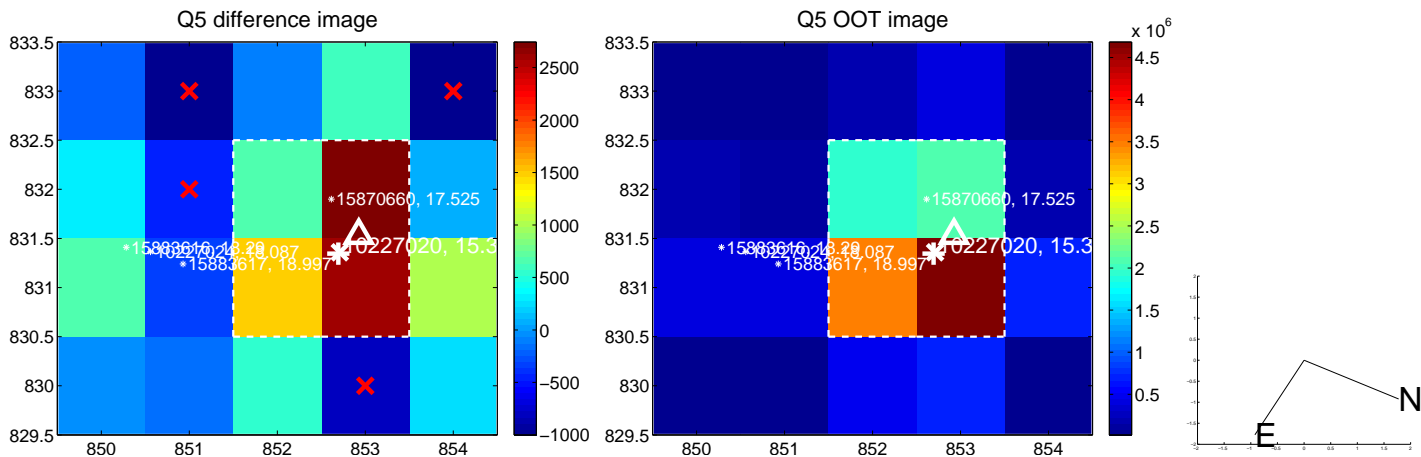


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

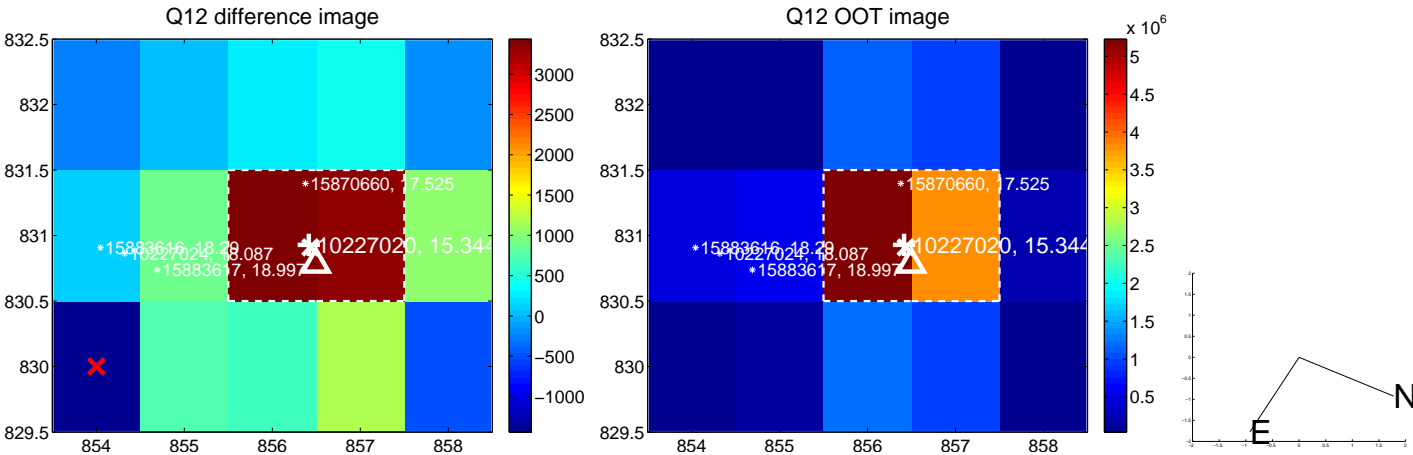
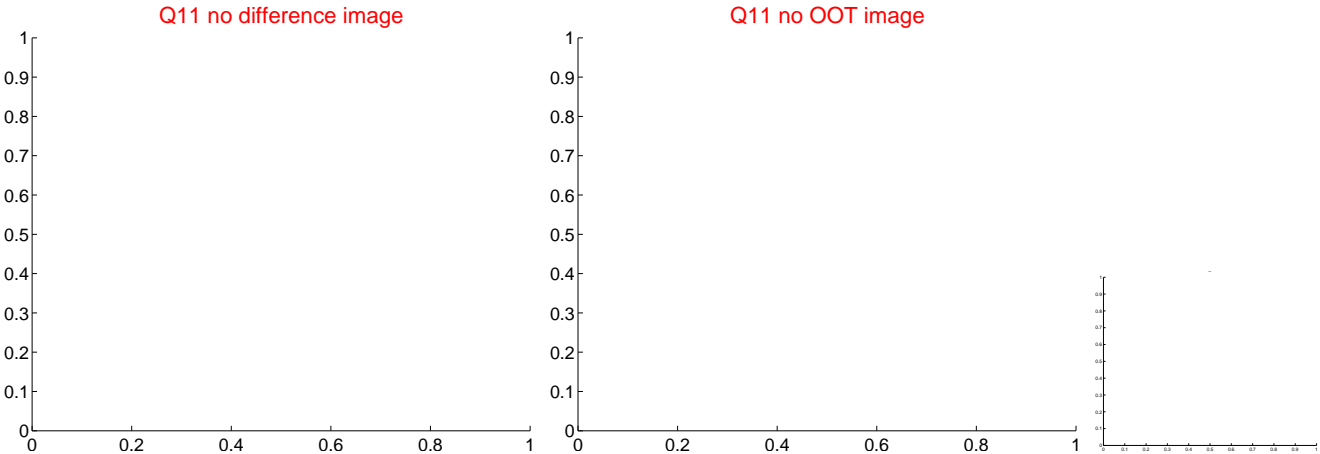
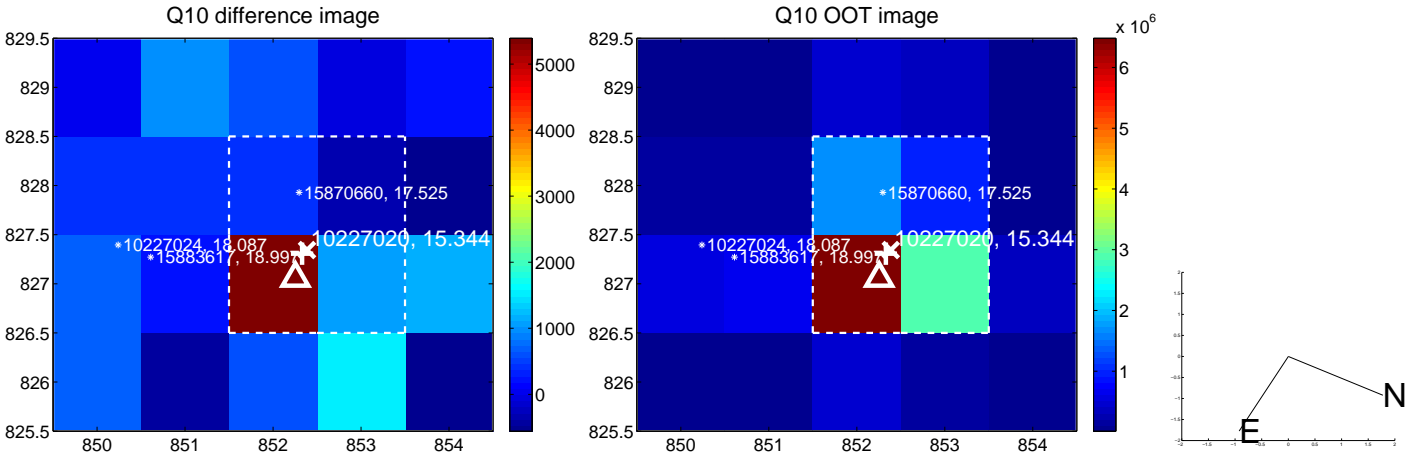
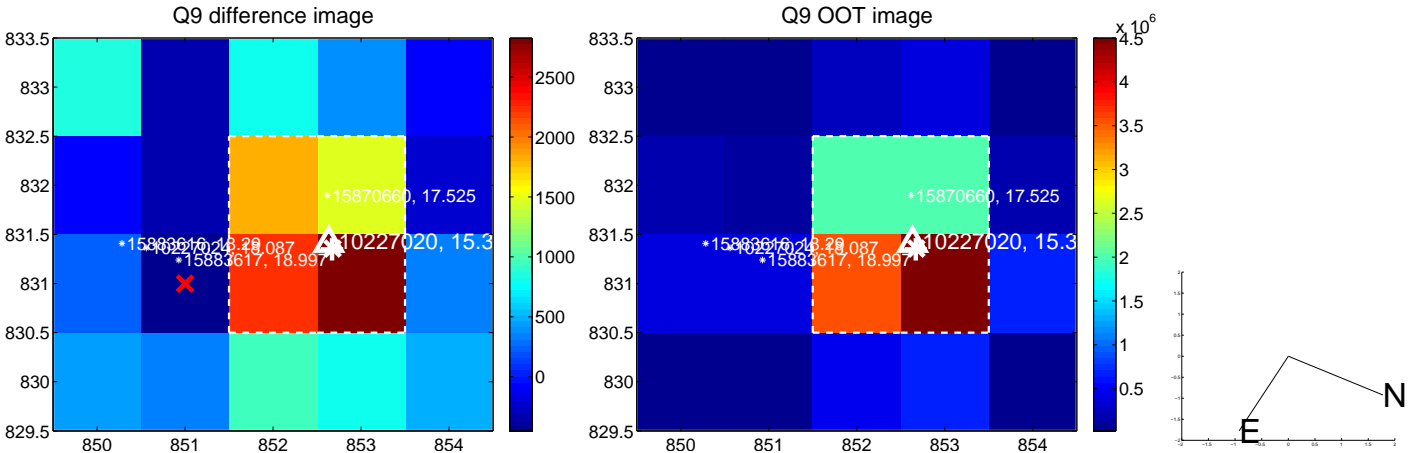
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



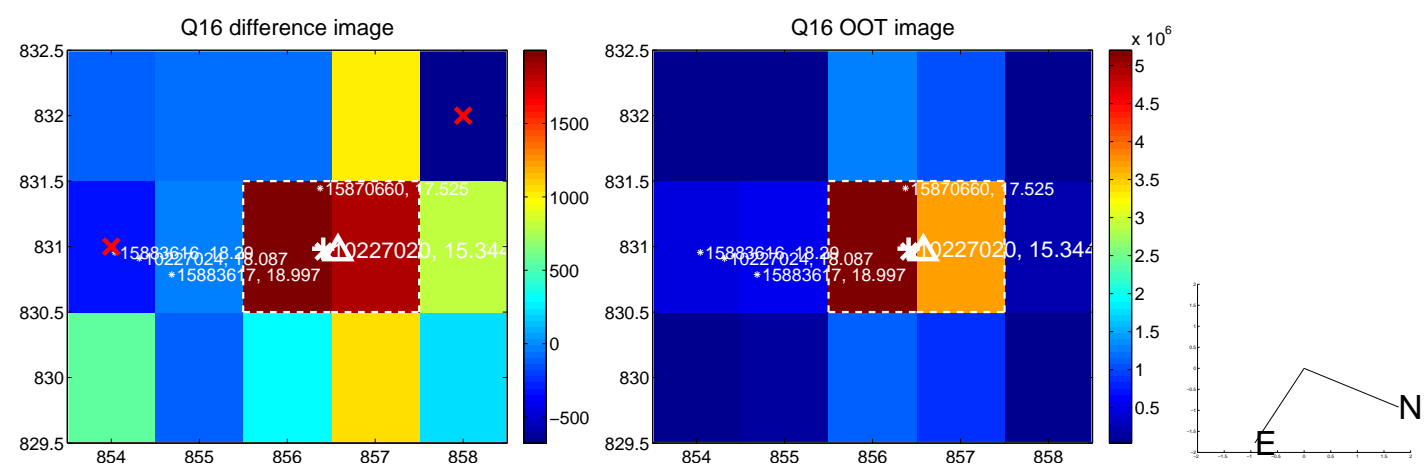
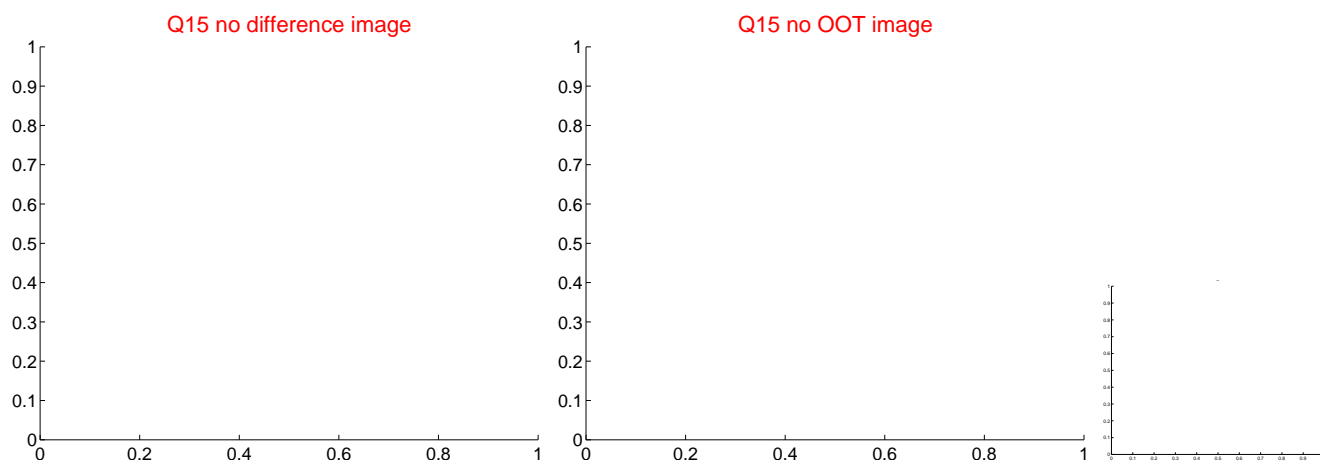
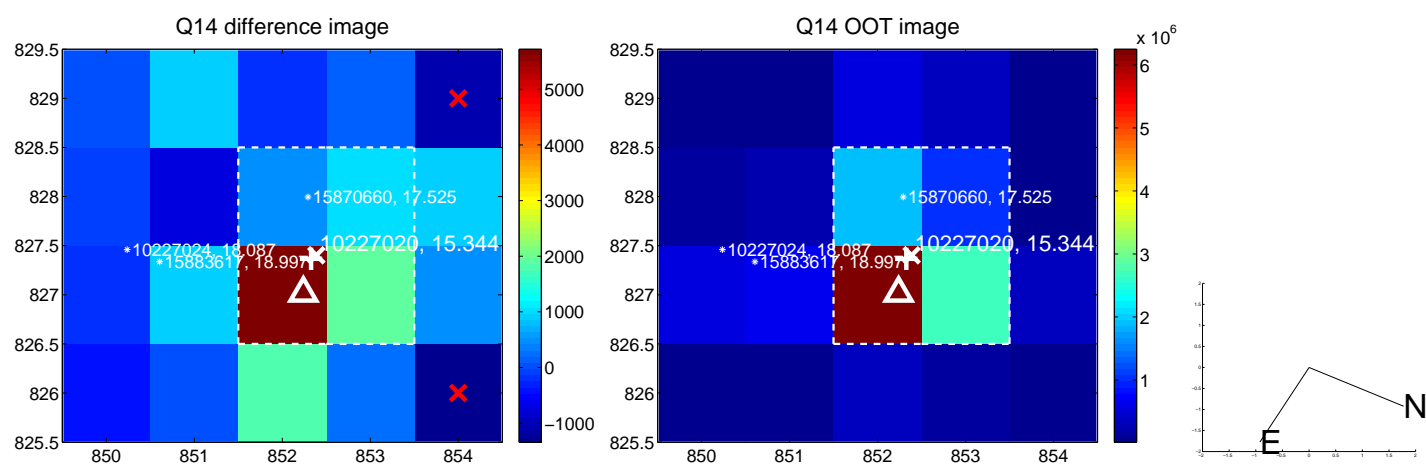
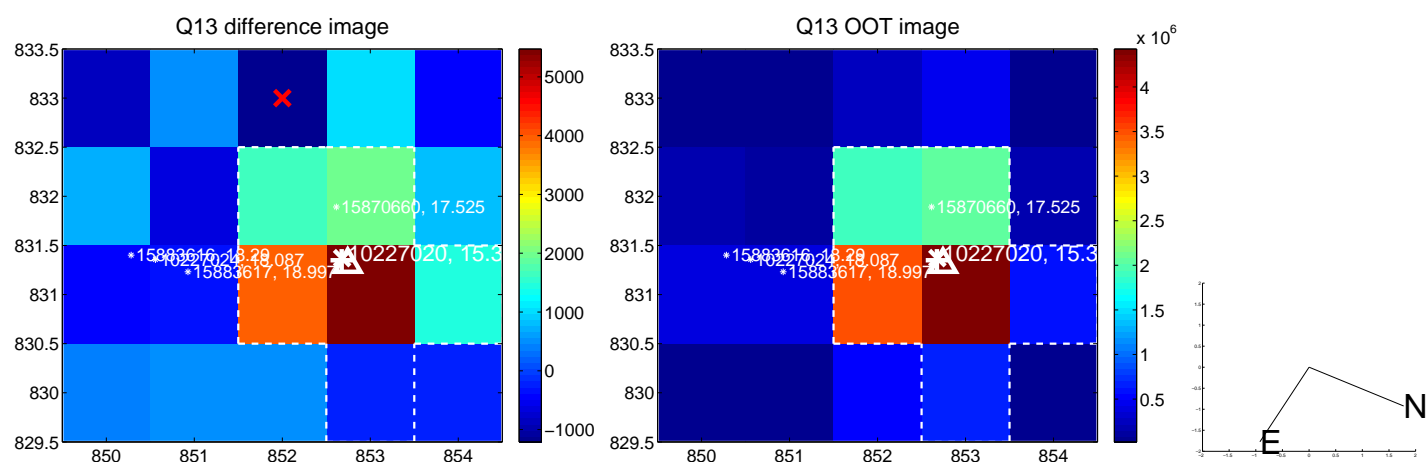
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



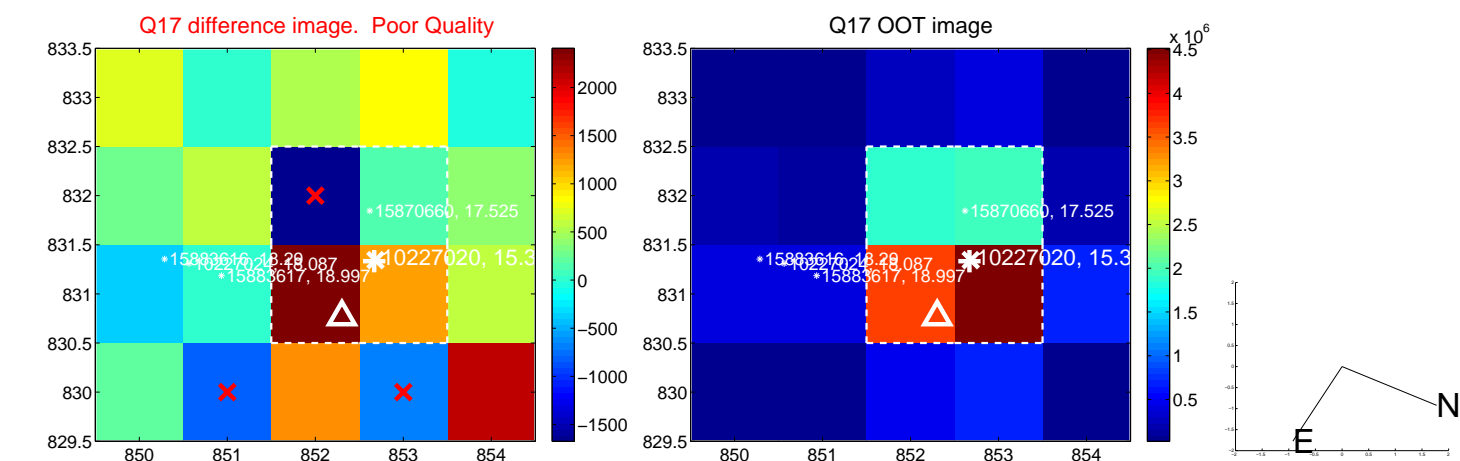
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



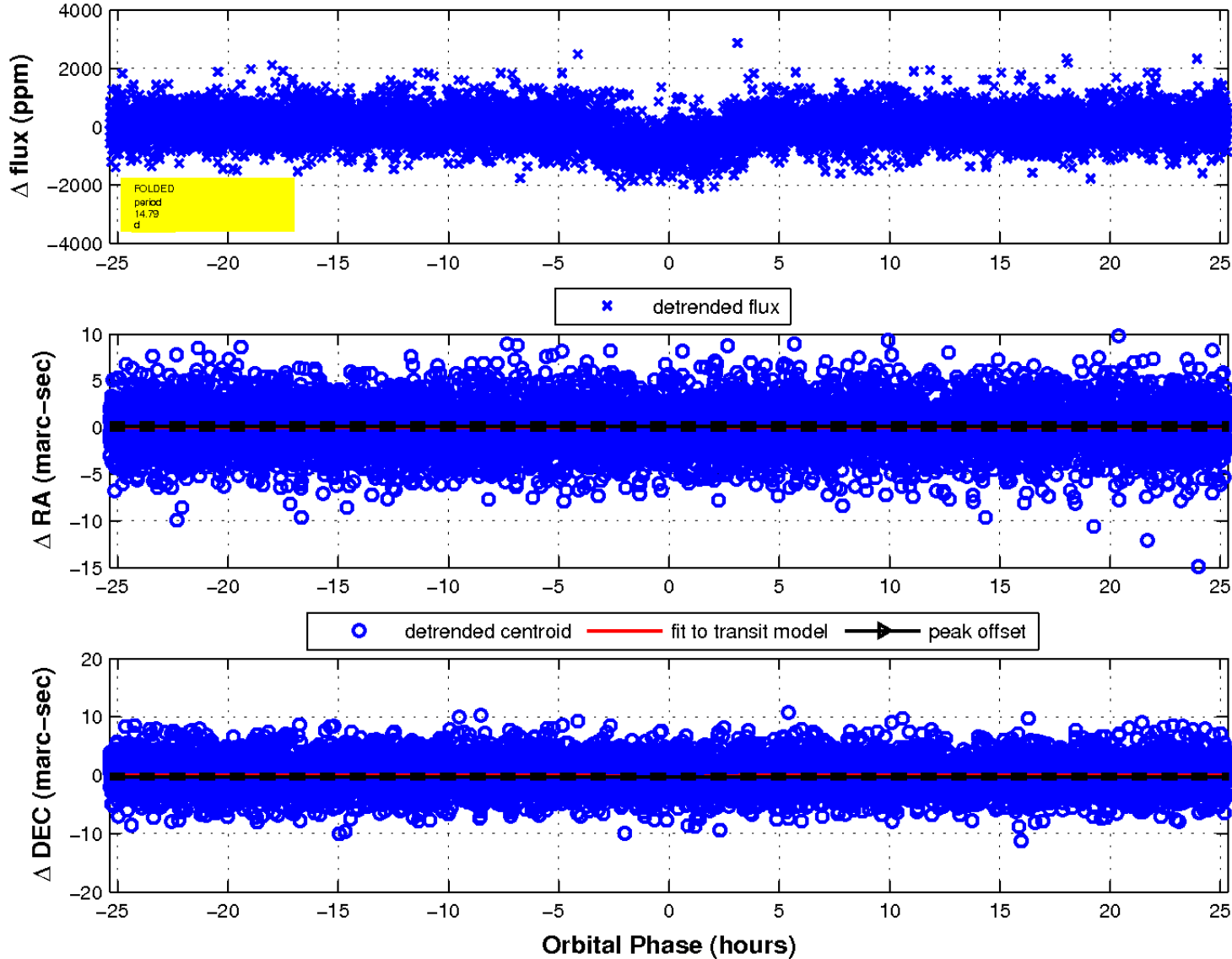
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



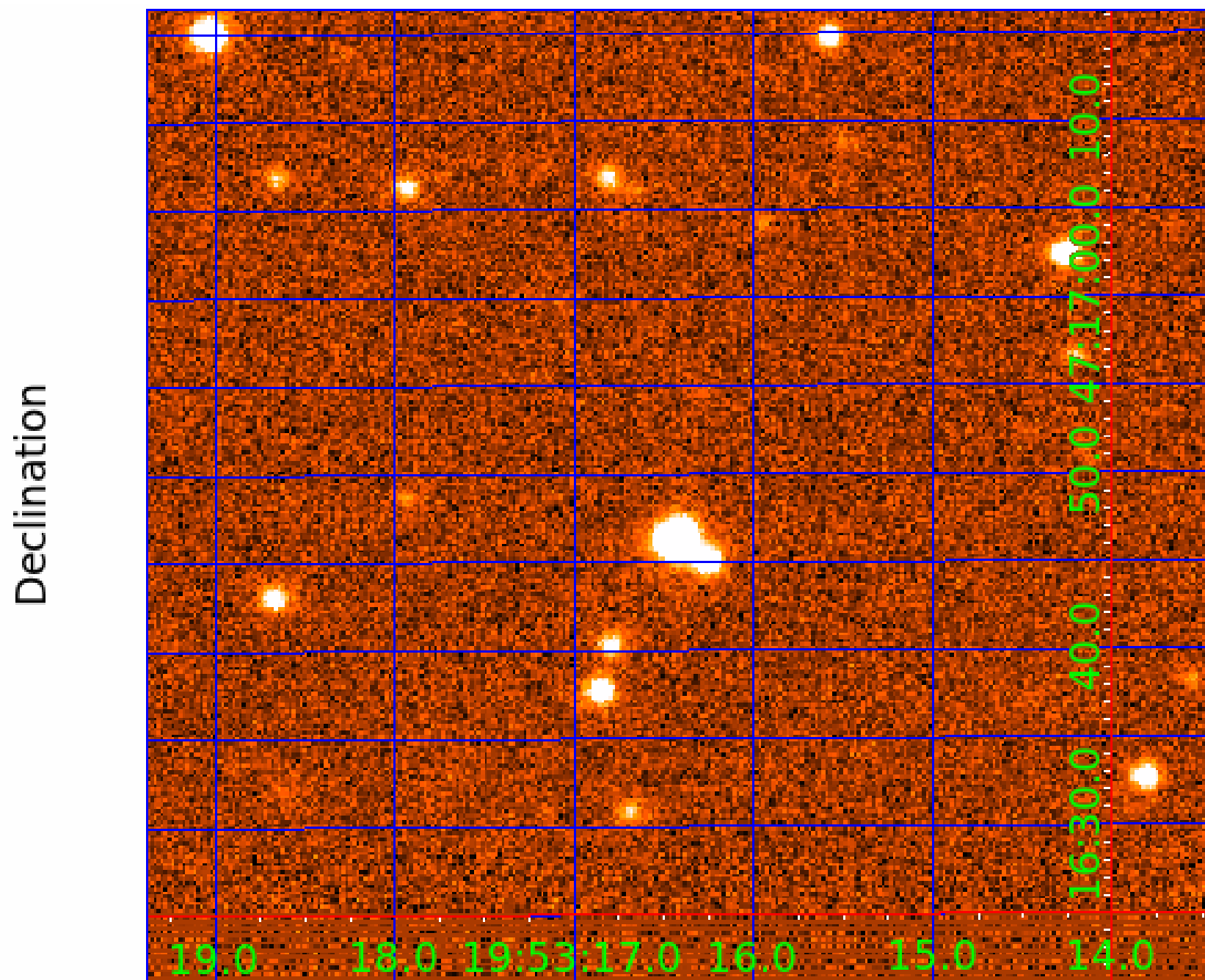
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



fluxWeightedCentroids, Planet 1 of 4



UKIRT Image



KIC 010227020

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}) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 010227020-01 | OBS | 0730.01 | 14.787584 | 132.428654 | 770.4 | 8.455 | 27.6 | 29.4 | 1.25 | 5814 | 4.93 | 110.60 |
| 010227020-02 | OBS | 0730.03 | 19.723809 | 135.075895 | 503.8 | 9.344 | 17.1 | 17.9 | 1.25 | 5814 | 3.98 | 75.33 |
| 010227020-03 | OBS | 0730.02 | 9.848205 | 138.392875 | 328.4 | 6.003 | 15.4 | 15.5 | 1.25 | 5814 | 2.58 | 190.16 |
| 010227020-04 | OBS | 0730.04 | 7.384377 | 137.477378 | 279.6 | 6.200 | 15.7 | 16.1 | 1.25 | 5814 | 2.71 | 279.16 |

Robovetter Results

| TCE | Run Type | Disp | Score | N | S | C | E | Comments |
|--------------|----------|------|-------|---|---|---|---|------------|
| 010227020-01 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-02 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-03 | OBS | PC | 0.99 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-04 | OBS | PC | 0.99 | 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.

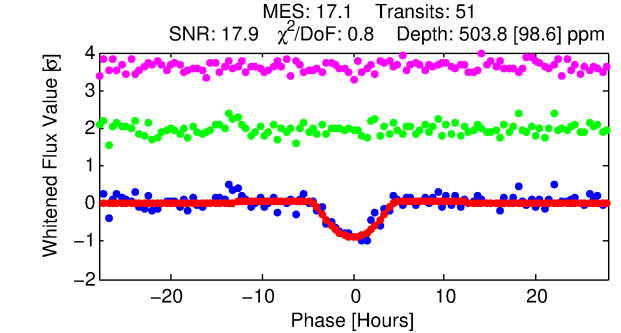
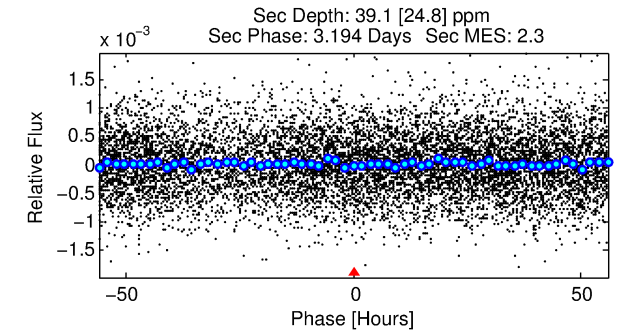
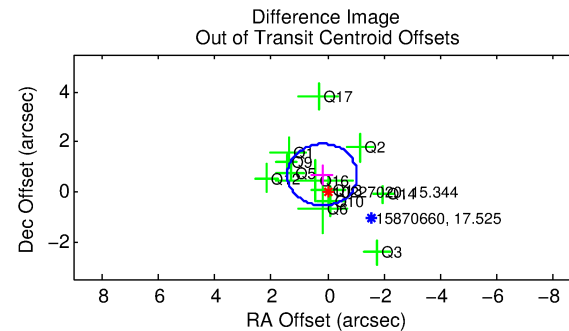
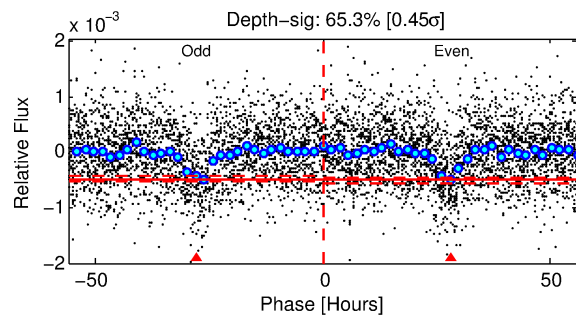
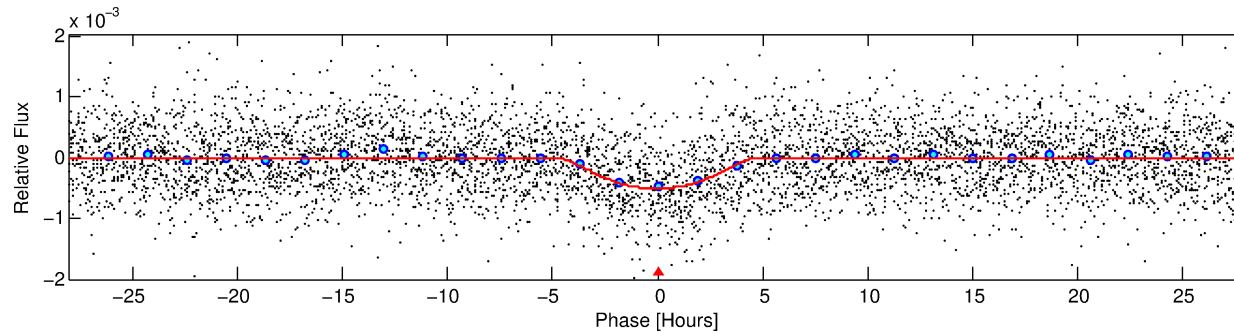
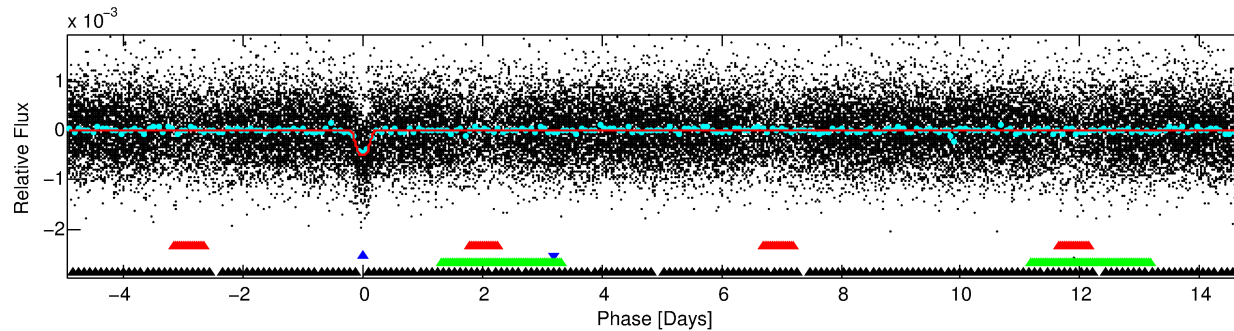
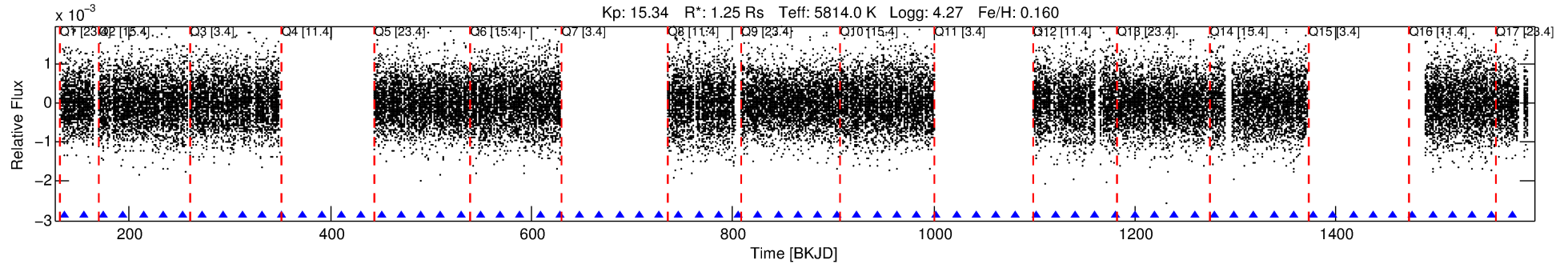
See http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col for comment definitions.

Ephemeris Match Information For 010227020-02

No Significant Match Found

DV One-Page Summary

KIC: 10227020 Candidate: 2 of 4 Period: 19.724 d
KOI: K00730.03 Name: Kepler-223e Corr: 0.984



DV Fit Results:

Period = 19.72381 [0.00027] d
Epoch = 135.0759 [0.0110] BKJD
Rp/R* = 0.0292 [0.0088]
a/R* = 5.27 [0.99]
b = 0.98 [0.02]
Seff = 75.33 [18.39]
Teq = 751 [46] K
Rp = 3.98 [1.37] Re
a = 0.1455 [0.0223] AU
Ag = 28.71 [26.08] [1.06 σ]
Teffp = 2688 [590] K [3.27 σ]

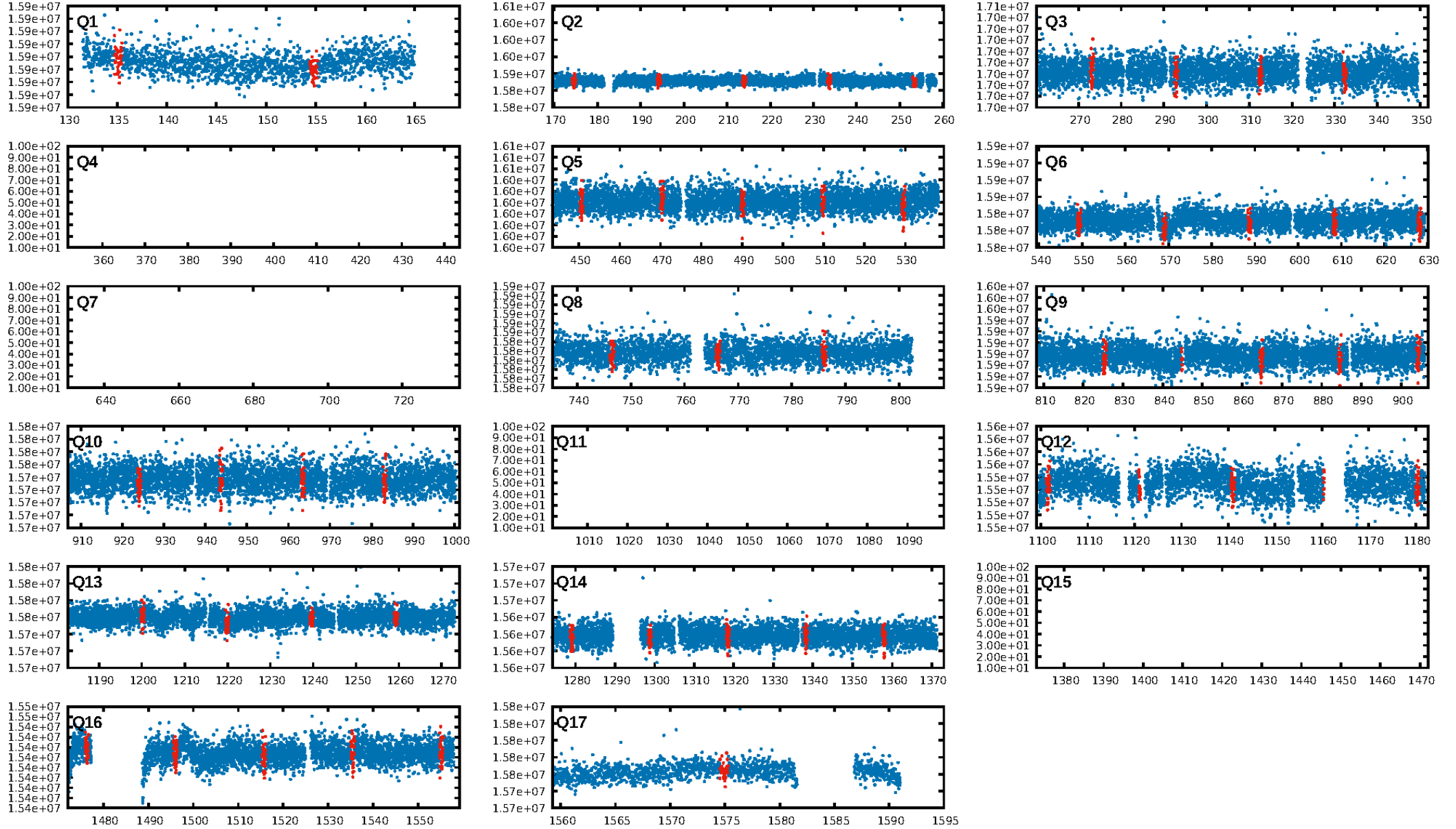
DV Diagnostic Results:

ShortPeriod-sig: 100.0% [9.40 σ]
LongPeriod-sig: N/A
ModelChiSquare2-sig: 99.8%
ModelChiSquareGof-sig: 100.0%
Bootstrap-pfa: 2.65e-67
RollingBand-fgt: 1.00 [48/48]
GhostDiagnostic-chr: 2.216
Centroid-sig: 3.8%
Centroid-so: 1.364 arcsec [1.87 σ]
OotOffset-rm: 0.700 arcsec [1.70 σ]
KicOffset-rm: 0.681 arcsec [1.59 σ]
OotOffset-st: 4/1/2/5 [12]
KicOffset-st: 4/1/2/5 [12]
DiffImageQuality-fgm: 0.92 [11/12]
DiffImageOverlap-fno: 1.00 [13/13]

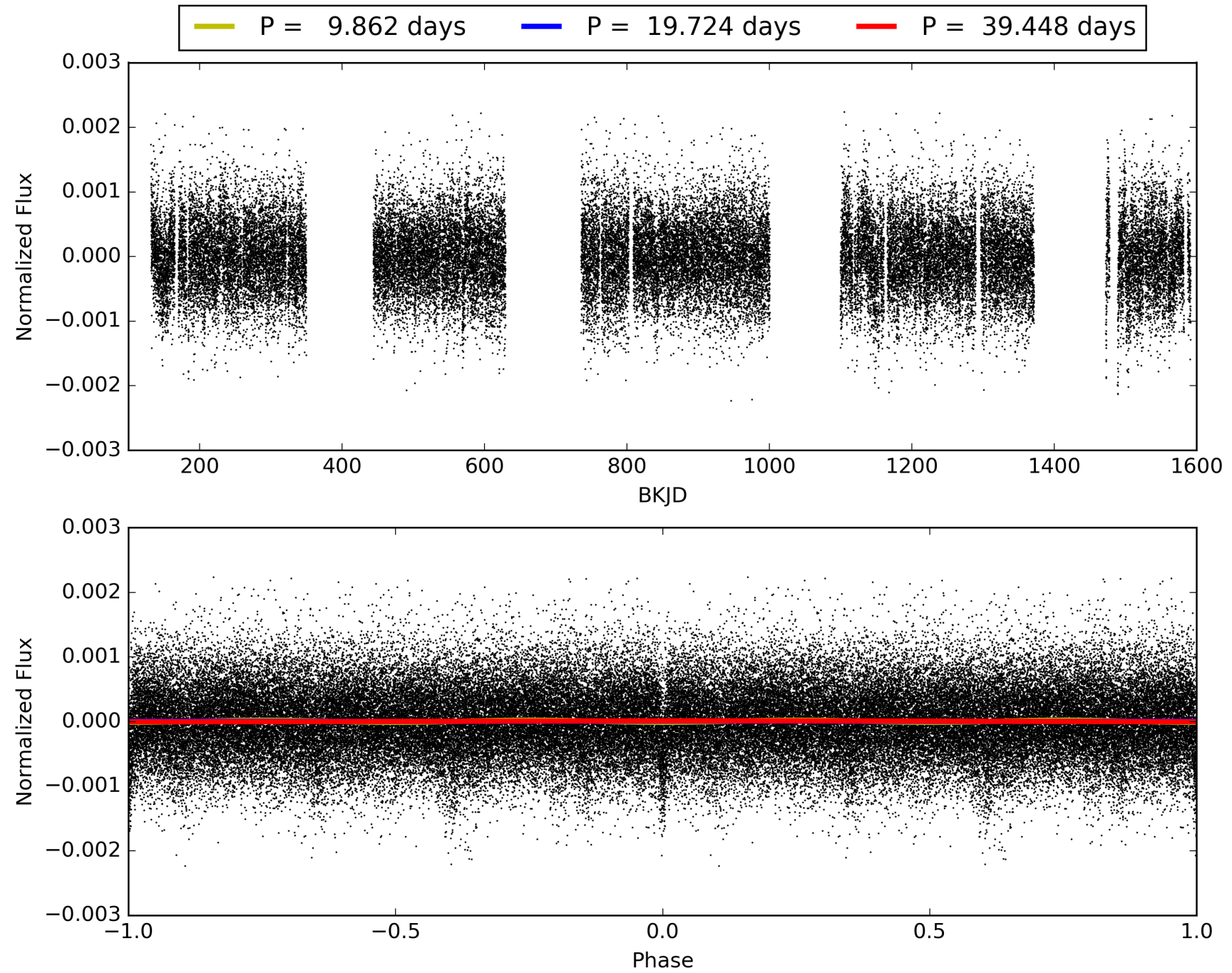
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 22:17:36 Z

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

TCE 010227020-02, PDC Light Curves

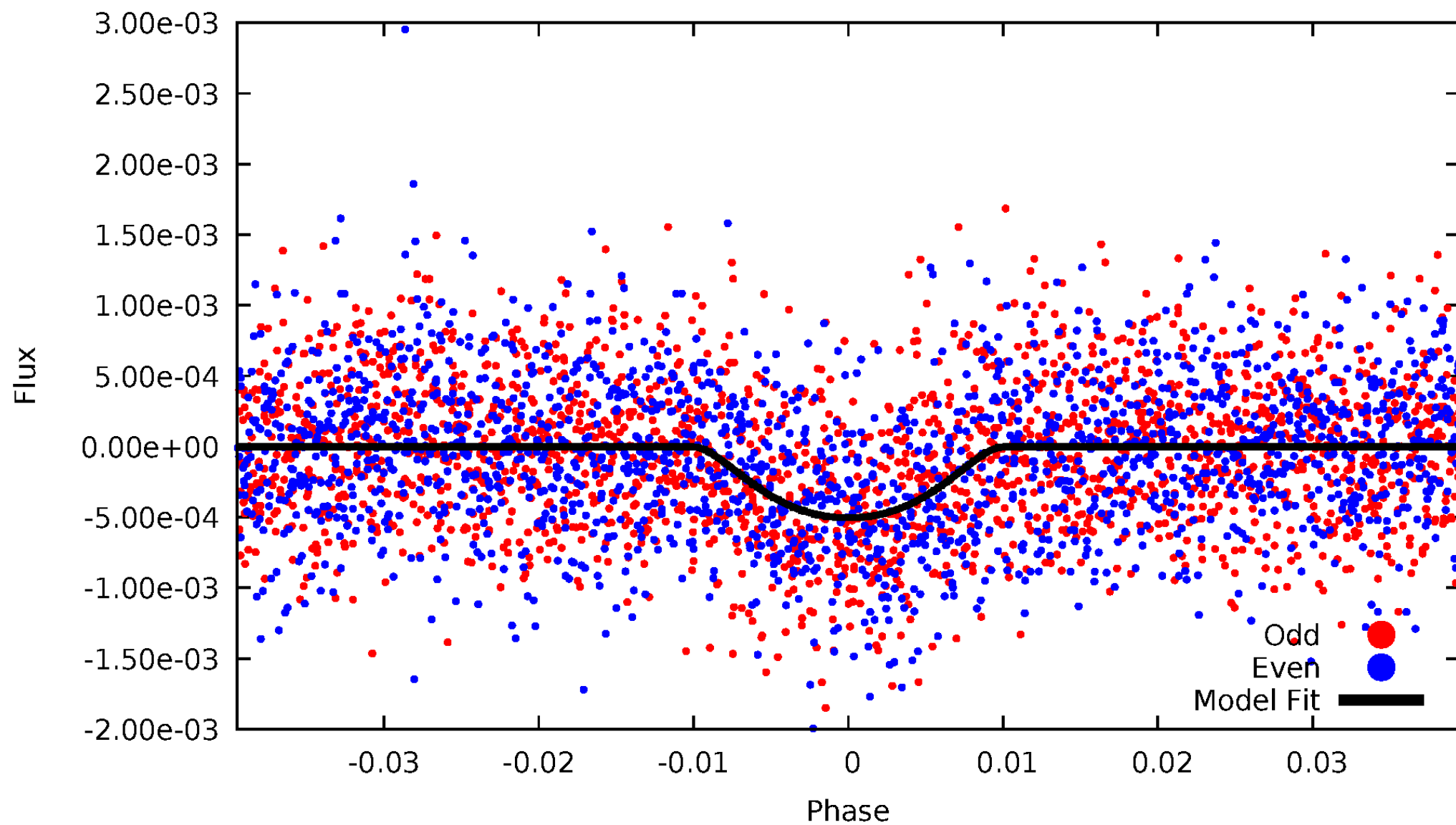


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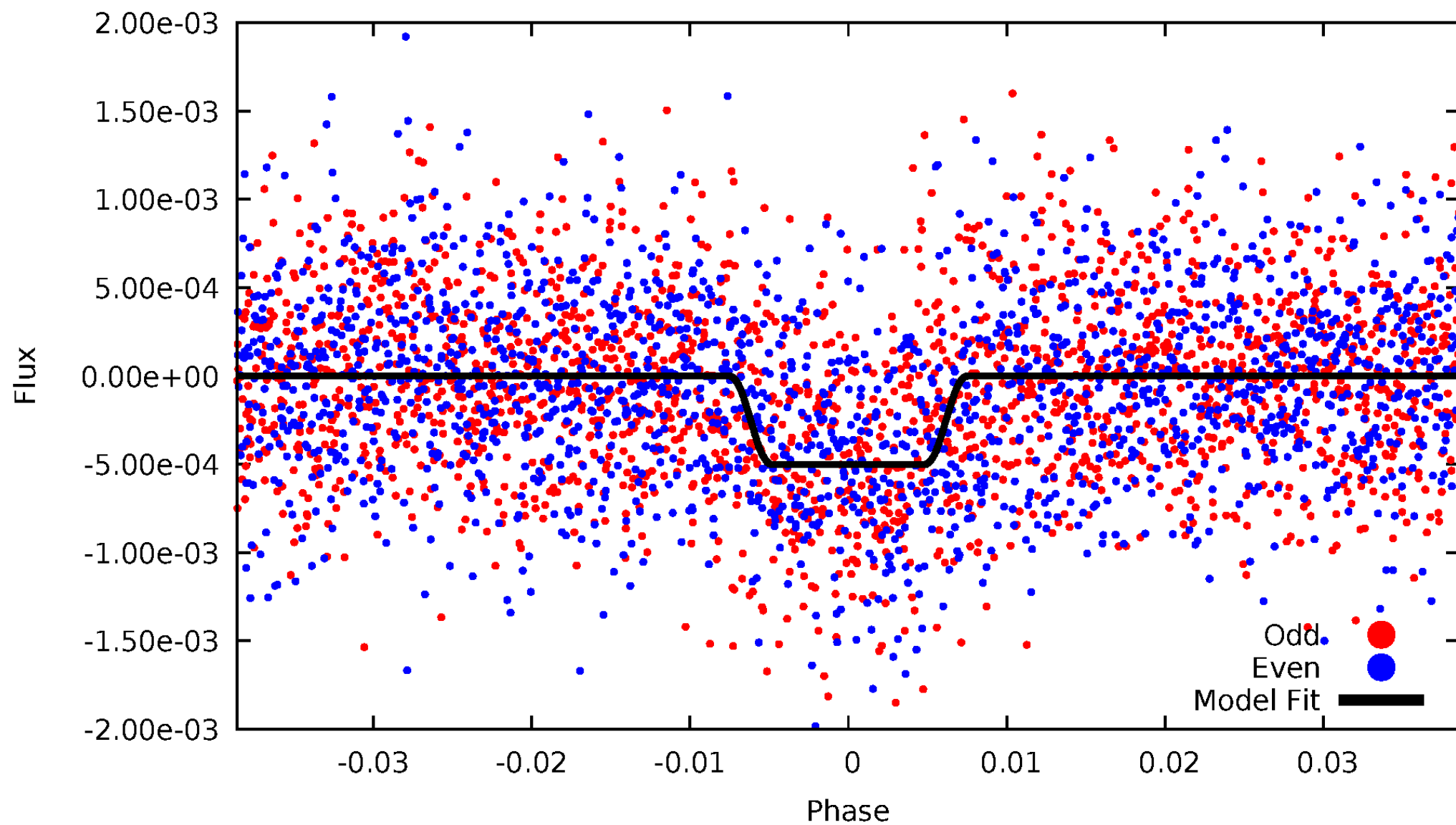
DV Odd/Even

TCE 010227020-02



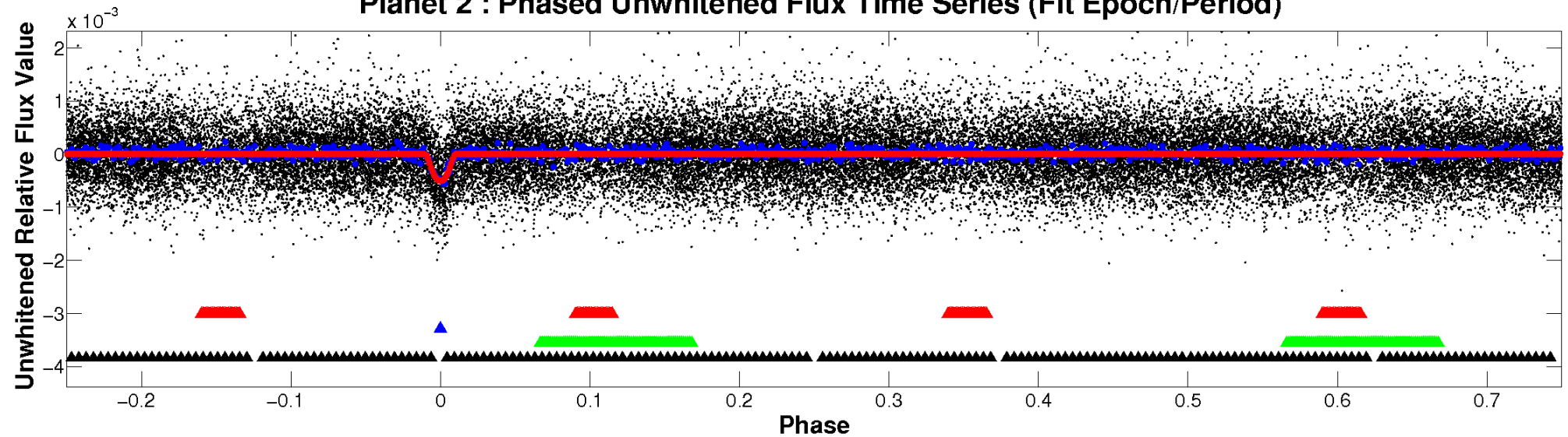
ALT Odd/Even

TCE 010227020-02

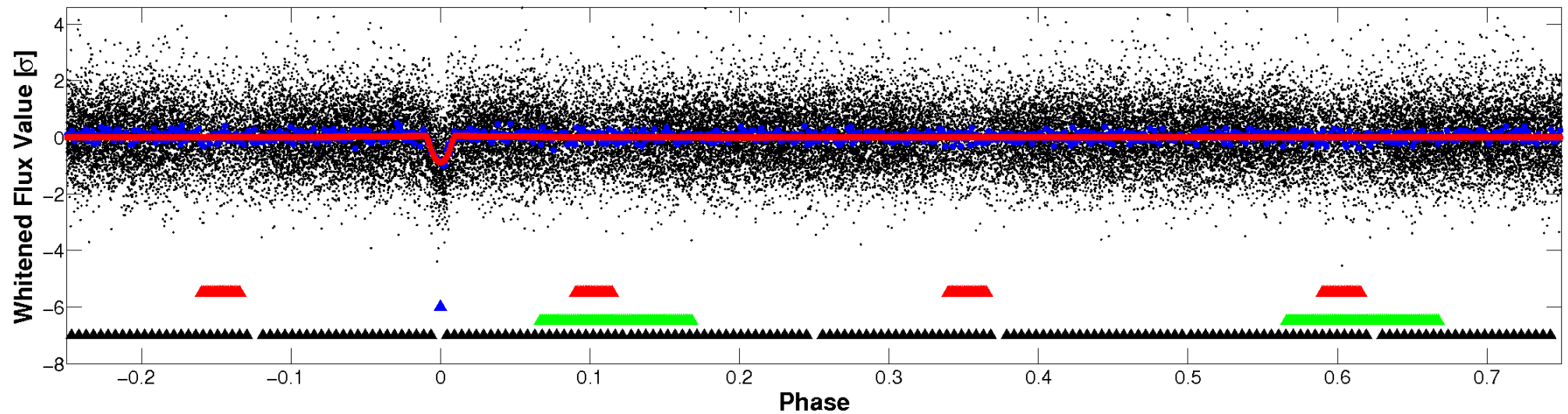


Non-Whitened Vs. Whitened Light Curve

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

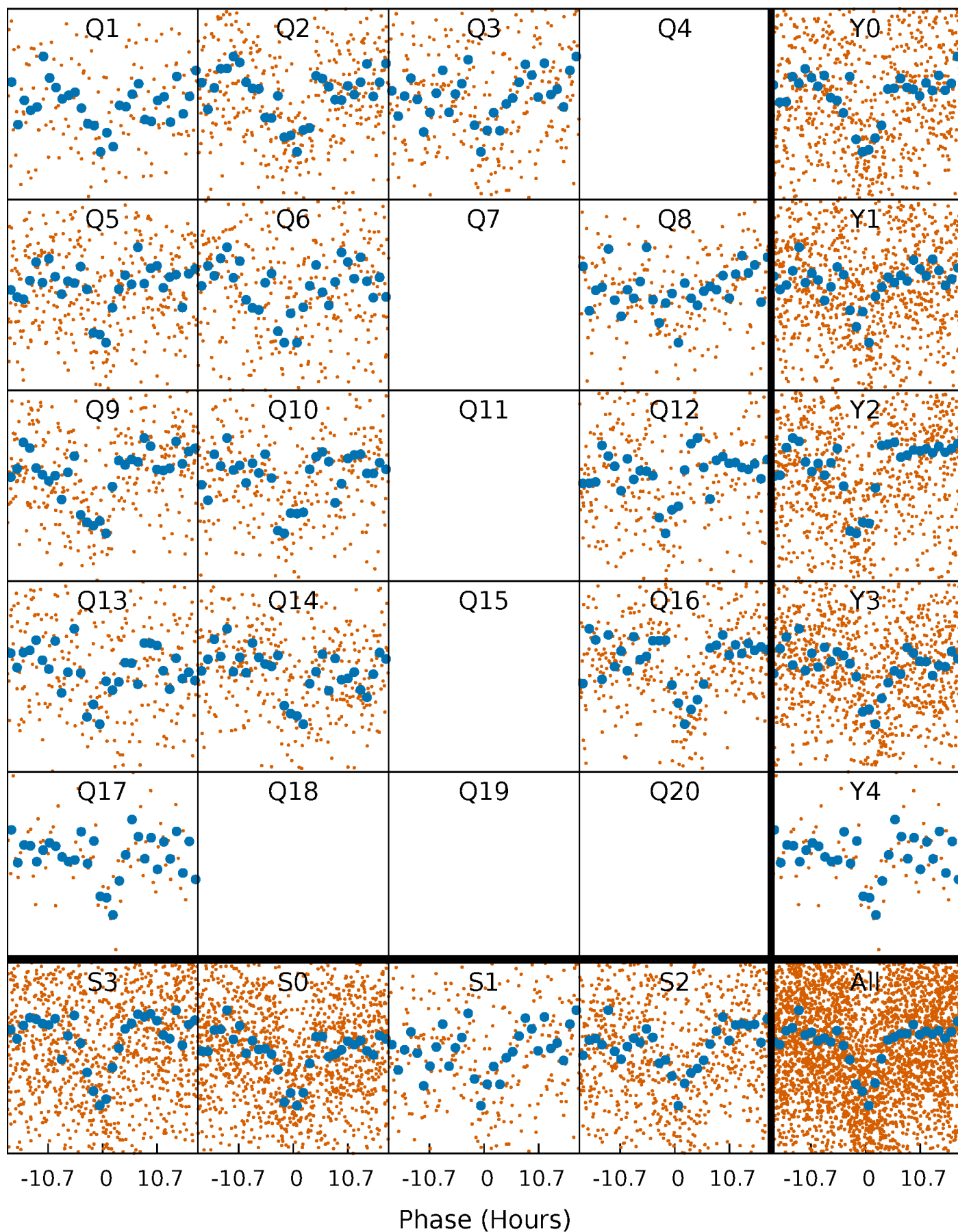


Planet 2 : Phased Whitened Flux Time Series (Fit Epoch/Period)



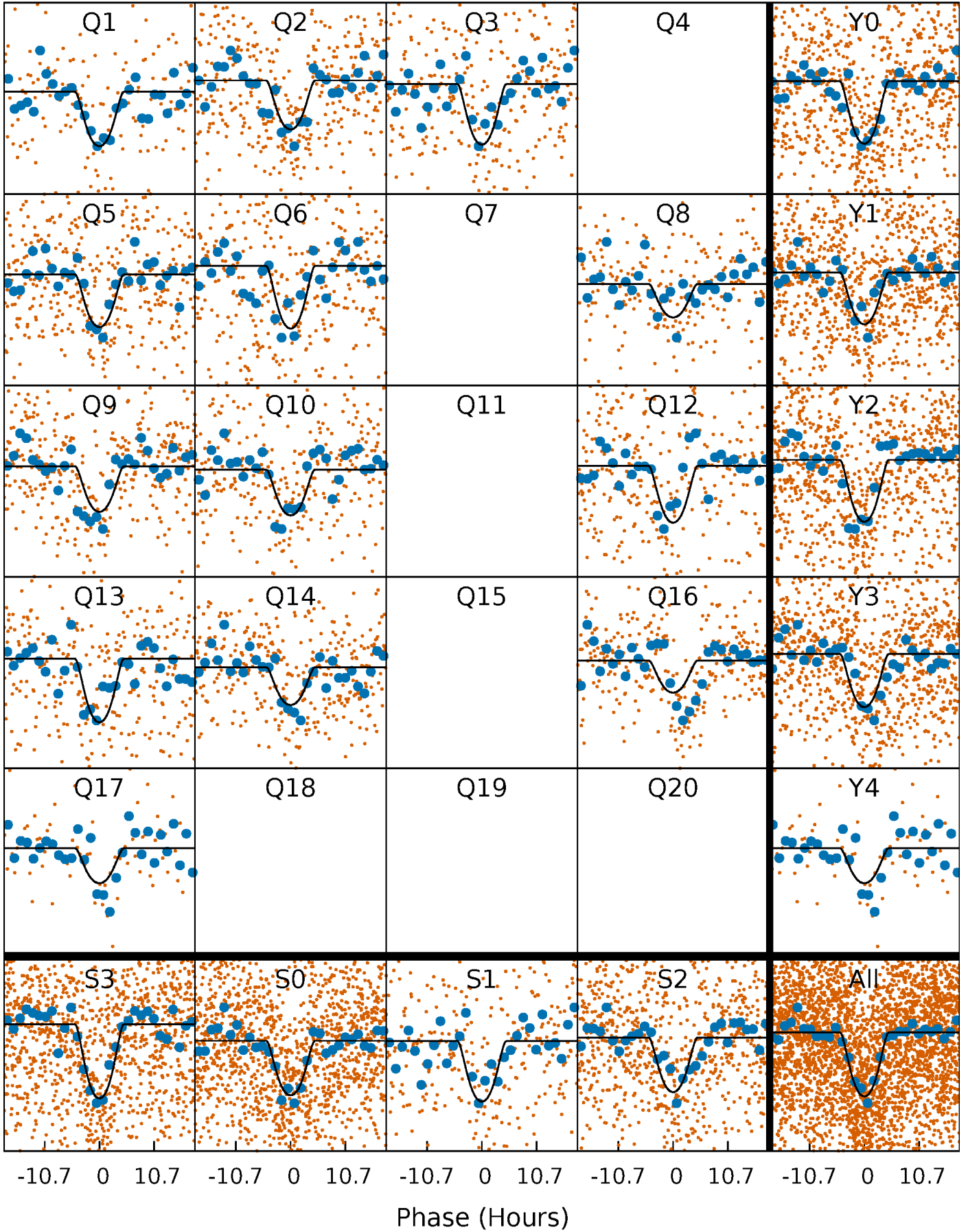
PDC Quarter-Phased Transit Curves

TCE 010227020-02 P= 19.723809 Days $T_0=135.075895$ (BKJD)



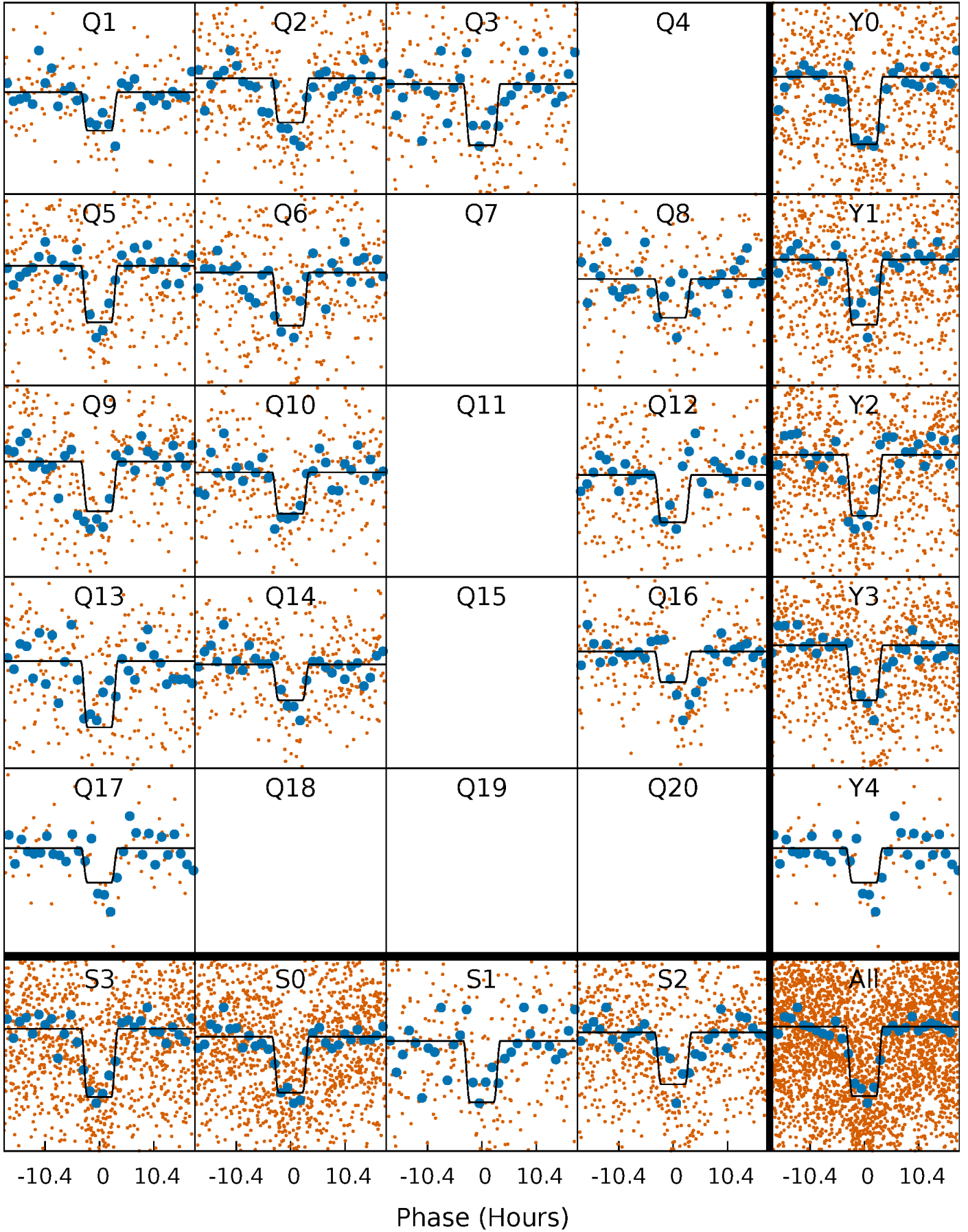
DV Quarter-Phased Transit Curves

TCE 010227020-02 P= 19.723809 Days $T_0=135.075895$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

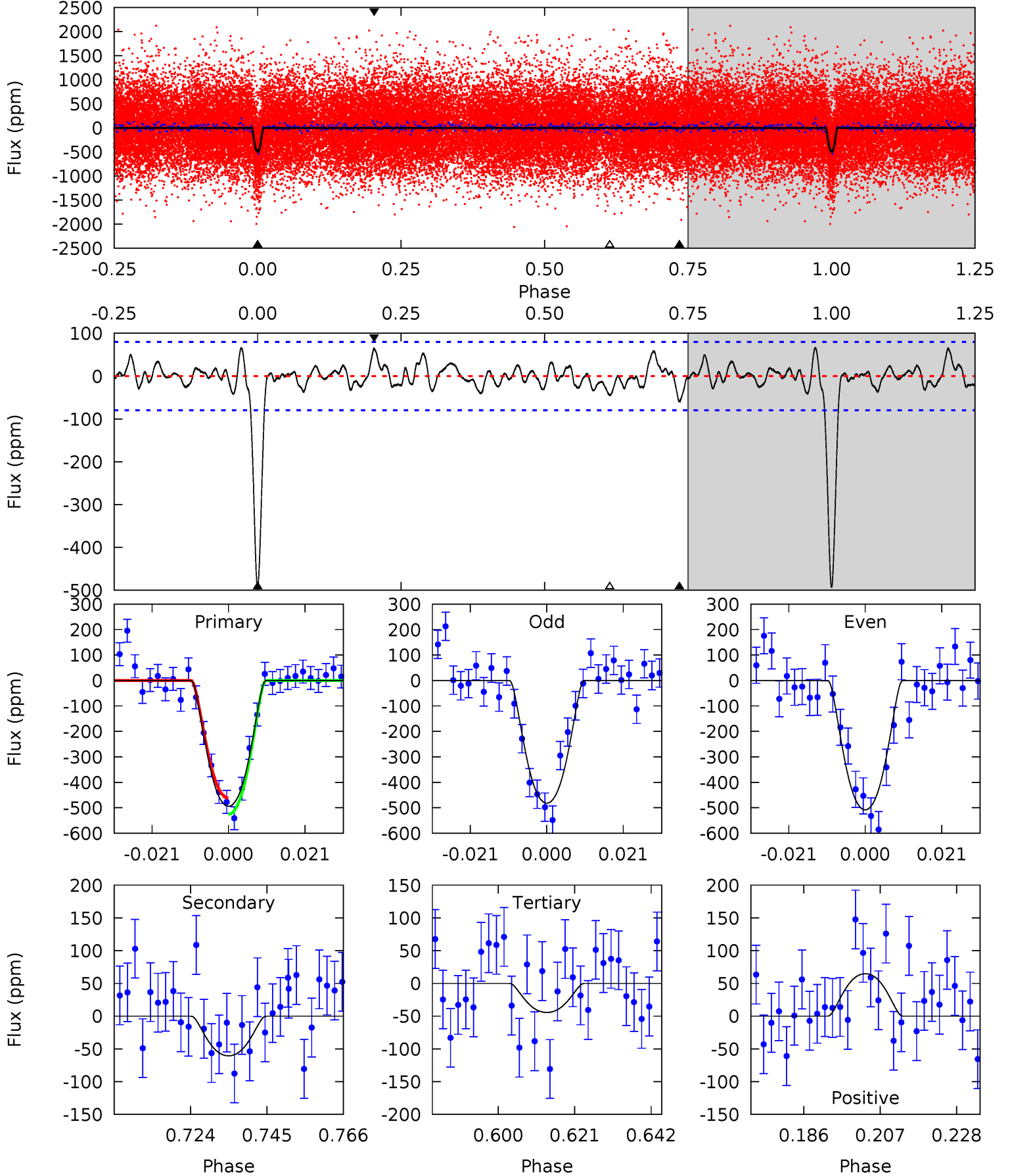
TCE 010227020-02 $P = 19.723824$ Days $T_0 = 135.071850$ (BKJD)



DV Model-Shift Uniqueness Test

010227020-02, P = 19.723809 Days, E = 115.352086 Days

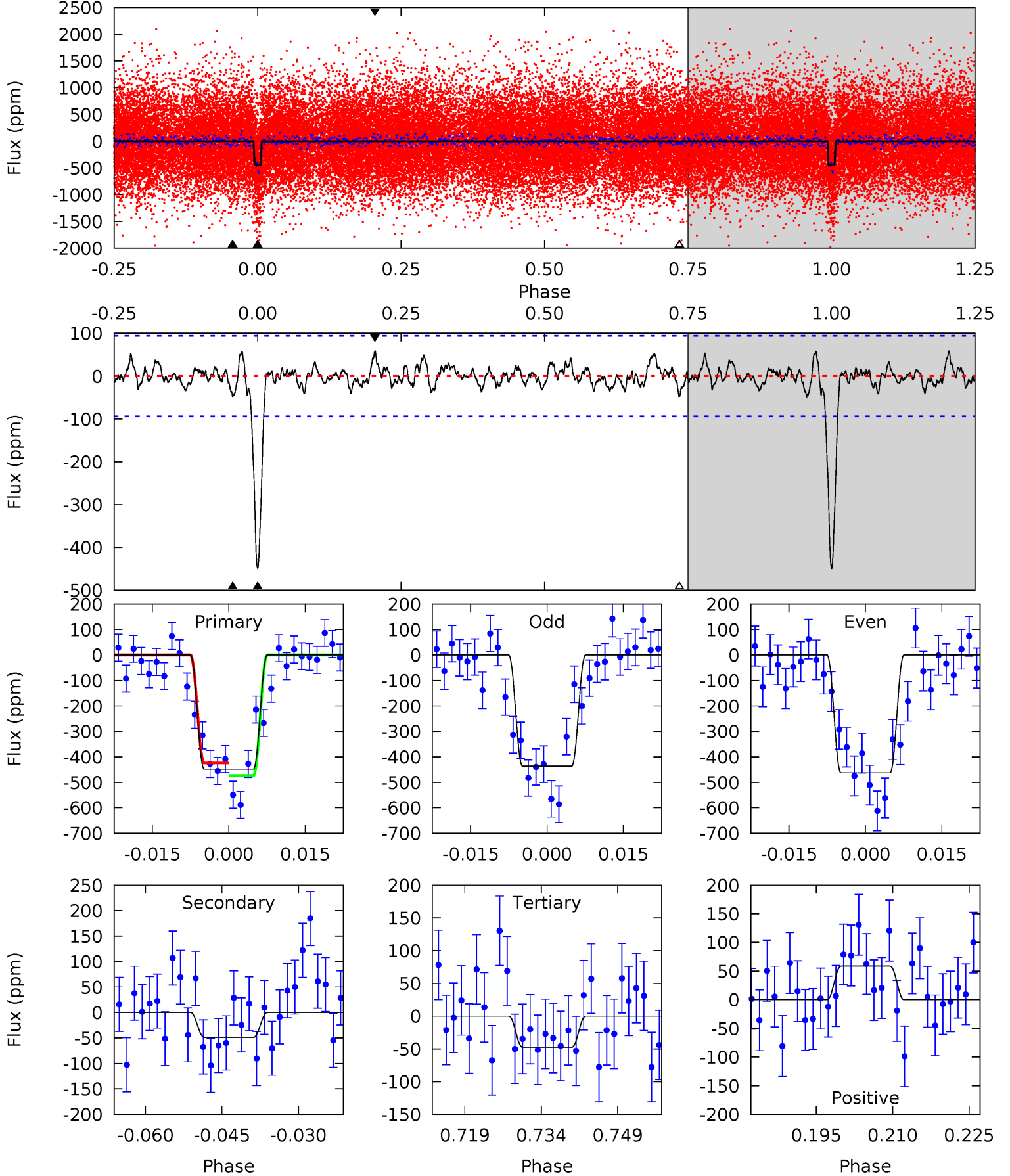
| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 30.2 | 3.70 | 2.72 | 3.96 | 4.88 | 2.31 | 1.29 | 27.5 | 26.2 | 0.99 | -0.25 | 0.80 | 1.00 | 0.12 | 1.94 |



Alt Model-Shift Uniqueness Test

010227020-02, P = 19.723824 Days, E = 115.348026 Days

| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 23.6 | 2.57 | 2.50 | 3.08 | 4.95 | 2.43 | 0.98 | 21.1 | 20.5 | 0.07 | -0.51 | 0.68 | 0.96 | 0.12 | 1.31 |



Stellar Parameters For KIC 010227020

| | $T_{\text{eff}}(K)$ | $\log(g)$ | [Fe/H] | R (R_{\odot}) | $M(M_{\odot})$ | p_{\star} ($\text{g}\cdot\text{cm}^{-3}$) |
|--------|---------------------|---------------------------|---------------------------|---------------------------|---------------------------|---|
| | 5814^{+78}_{-78} | $4.269^{+0.137}_{-0.112}$ | $0.160^{+0.150}_{-0.150}$ | $1.248^{+0.209}_{-0.209}$ | $1.055^{+0.081}_{-0.067}$ | $0.765^{+0.497}_{-0.259}$ |
| | +1%/-1% | +3%/-3% | +94%/-94% | +17%/-17% | +8%/-6% | +65%/-34% |
| Source | SPE90 | SPE90 | SPE90 | DSEP | | |

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

Secondary Eclipse Parameters for KIC 010227020-02 / KOI 0730.03

| Detrend | Depth (ppm) | R_p (R_{\oplus}) | T_{max} (K) | T_{obs} (K) | A_{obs} |
|---------|--------------|------------------------|--------------------|----------------------|-------------------|
| DV | -61 ± 16 | $3.91^{+1.26}_{-1.26}$ | 1046^{+48}_{-47} | 3485^{+510}_{-321} | 46^{+59}_{-23} |
| Alt. | -49 ± 19 | $2.97^{+1.35}_{-1.17}$ | 1050^{+46}_{-50} | 3688^{+753}_{-466} | 64^{+115}_{-36} |

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 $A_{obs} \gg 1.0$

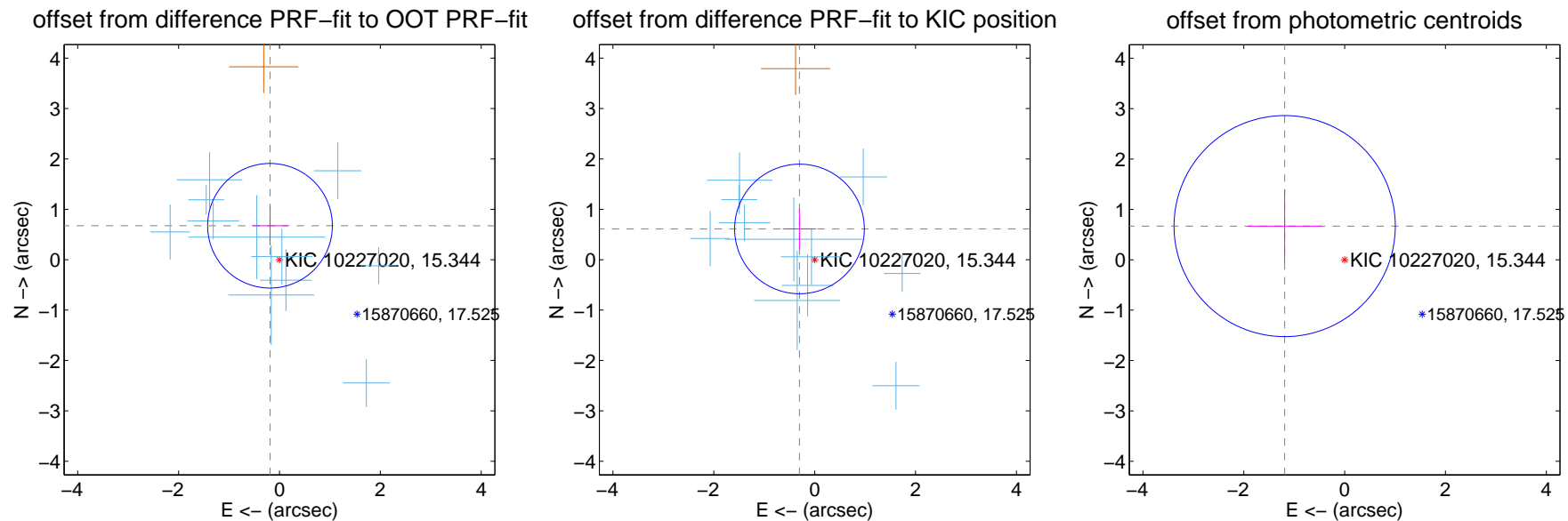
DV Centroid Data

Supplemental centroid analysis for 010227020-02. Kepler magnitude: 15.34. Transit SNR 17.93

There are 11 quarters with good PRF difference image offsets

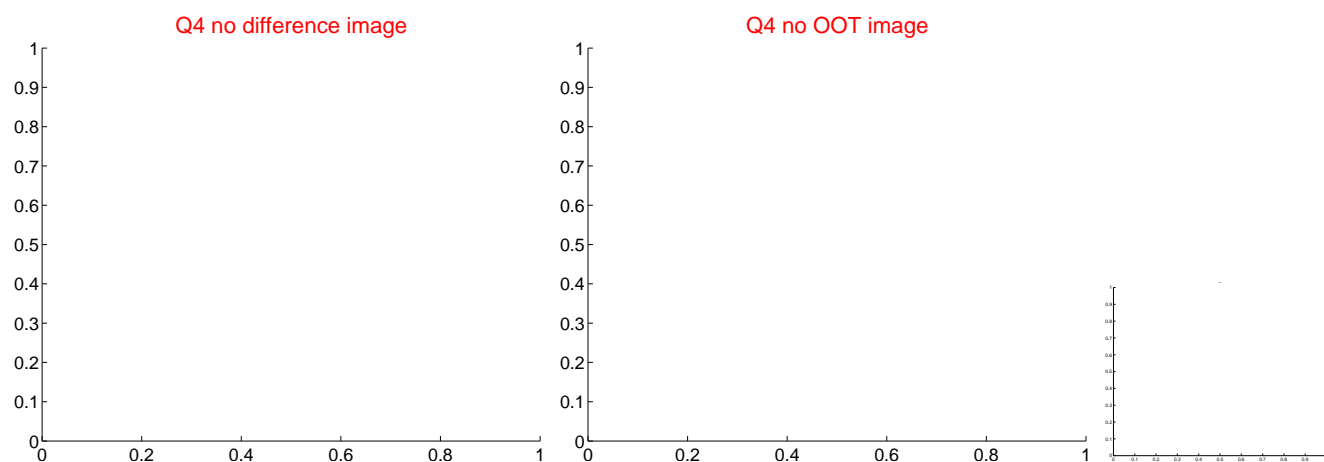
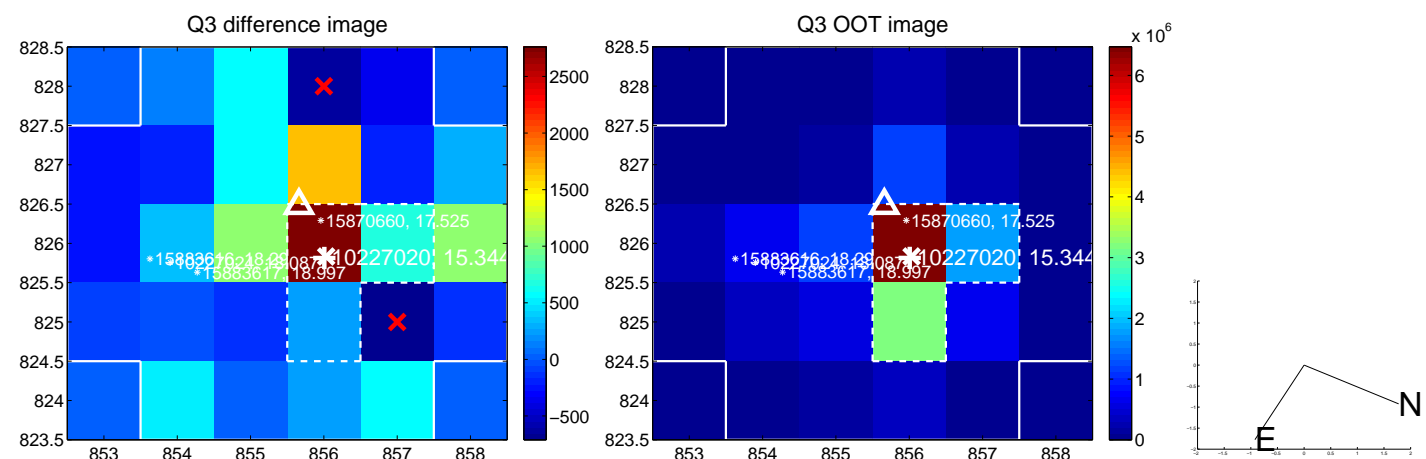
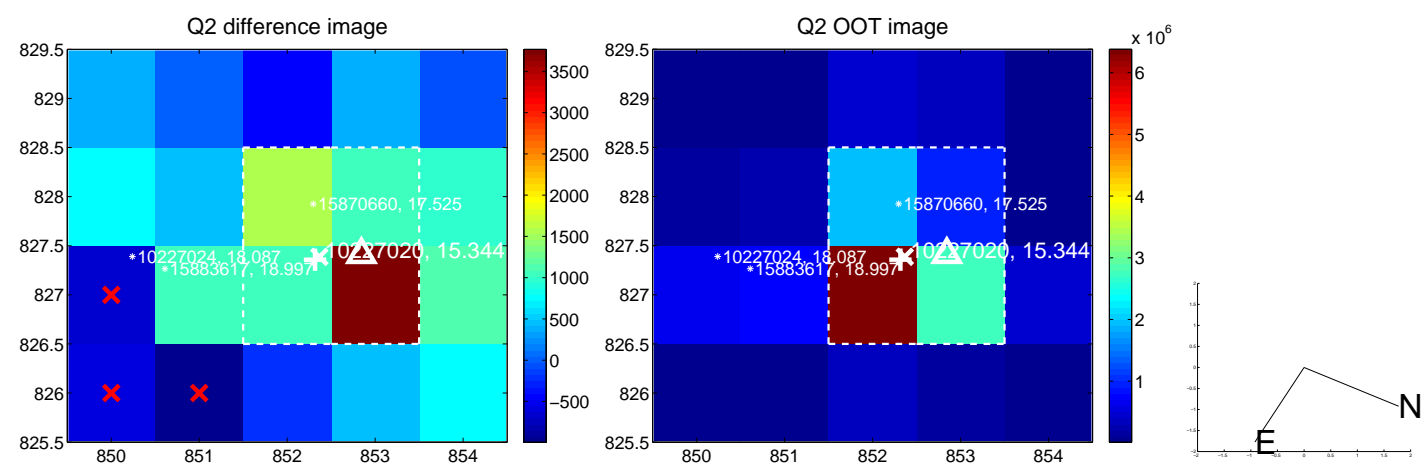
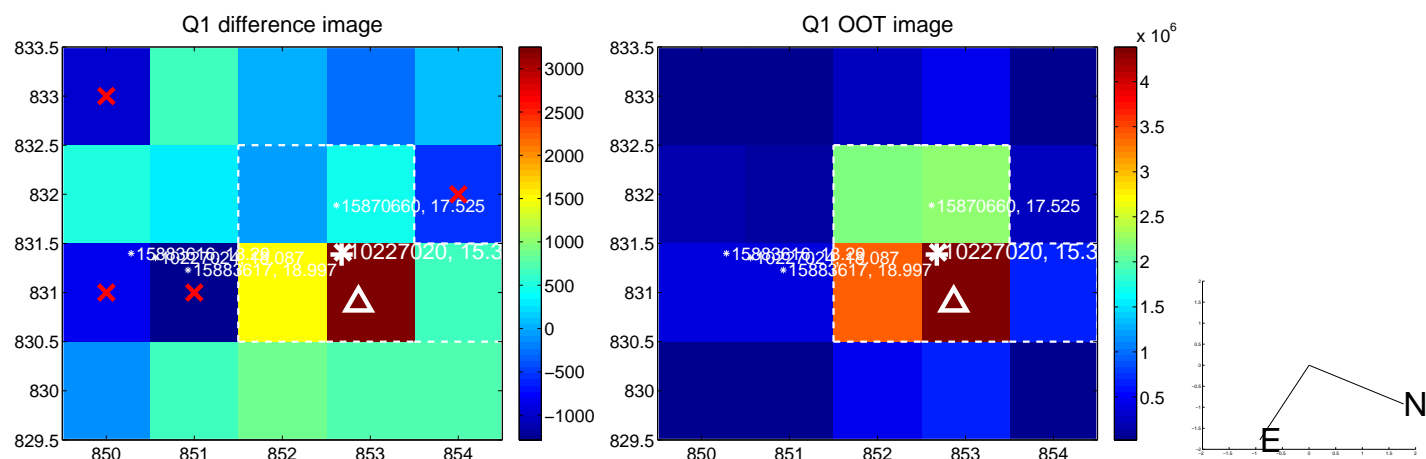
The direct PRF centroid is offset from the target star catalog position by about 0.08 arcsec

| | Distance in arcsec | Distance / σ | Δ RA | Δ Dec |
|---|--------------------|---------------------|-------------------|-------------------|
| PRF-fit source offset from OOT | 0.700 ± 0.412 | 1.70 | 0.188 ± 0.354 | 0.674 ± 0.388 |
| PRF-fit source offset from KIC position | 0.681 ± 0.429 | 1.59 | 0.301 ± 0.329 | 0.610 ± 0.396 |
| photometric centroid source offset | 1.36 ± 0.73 | 1.87 | 1.19 ± 0.73 | 0.67 ± 0.72 |

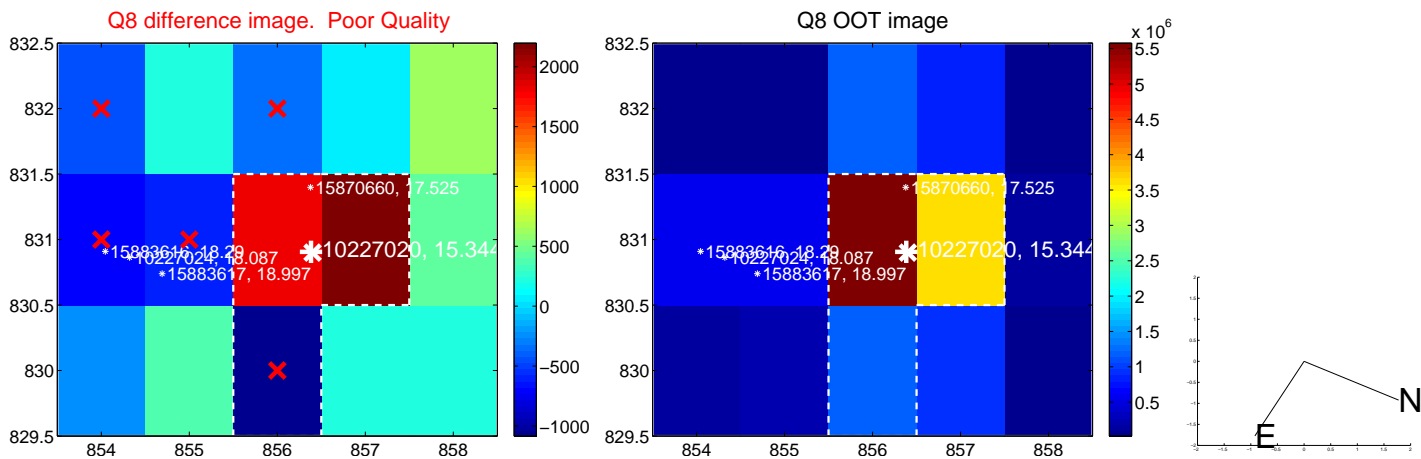
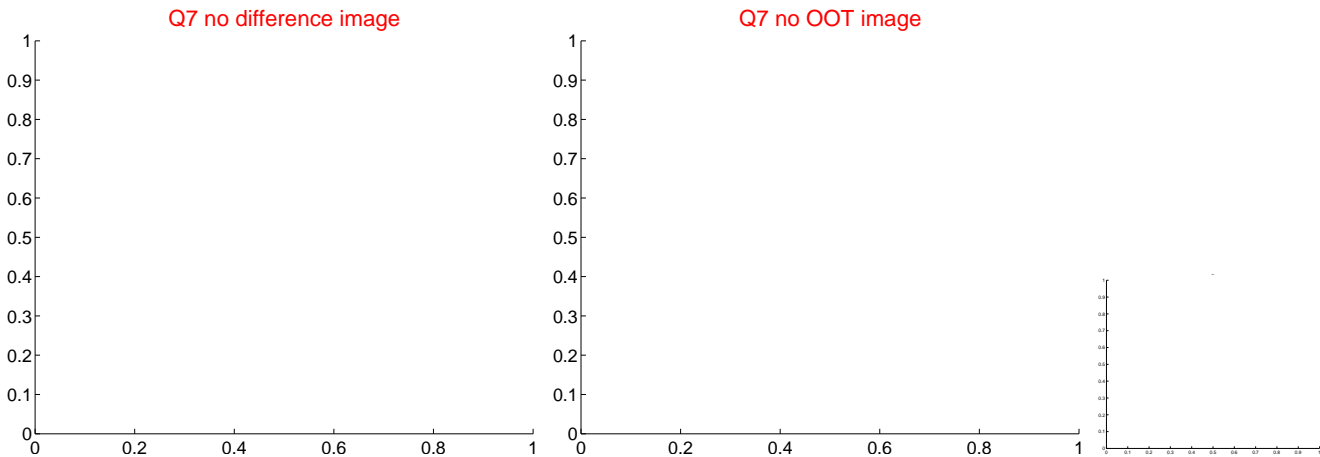
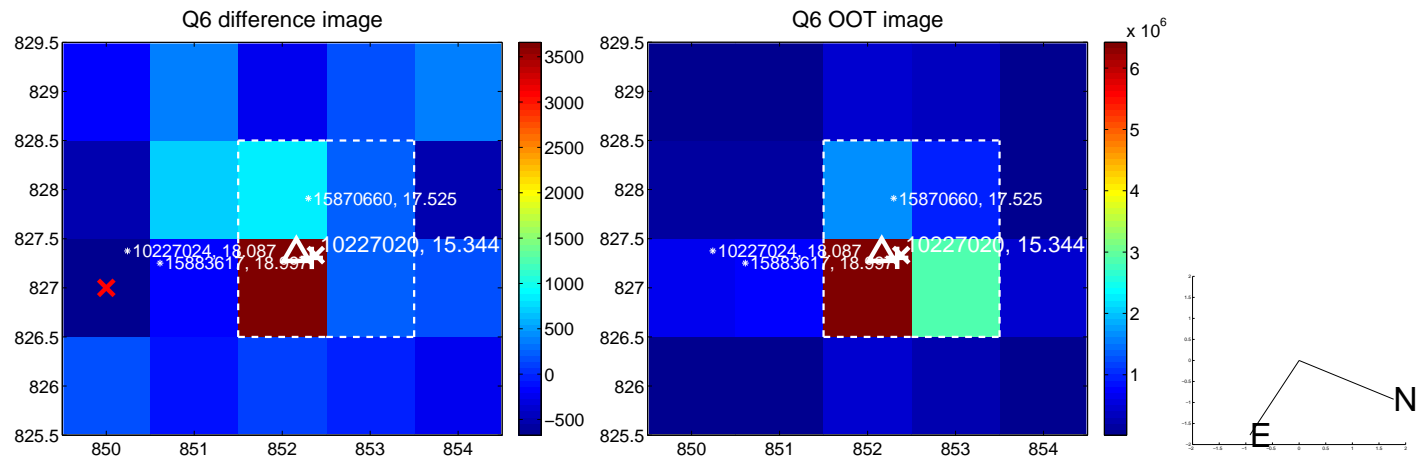
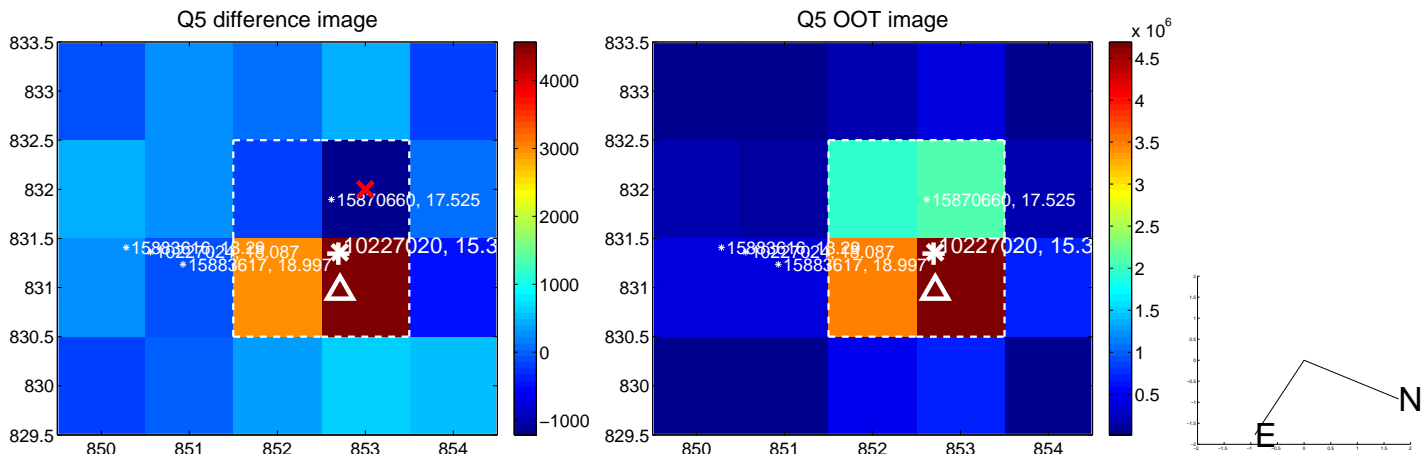


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

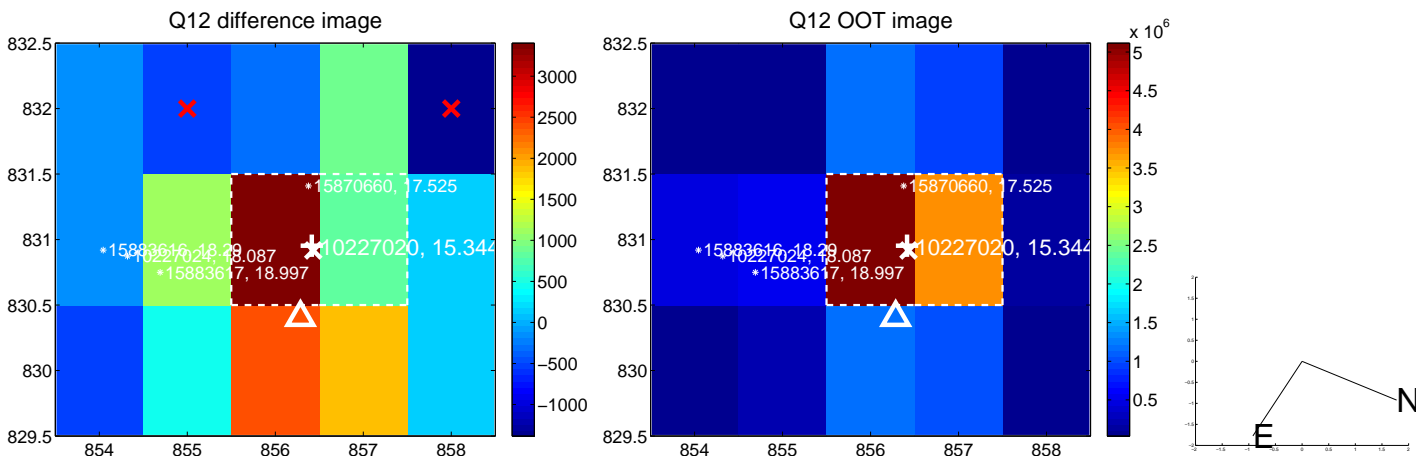
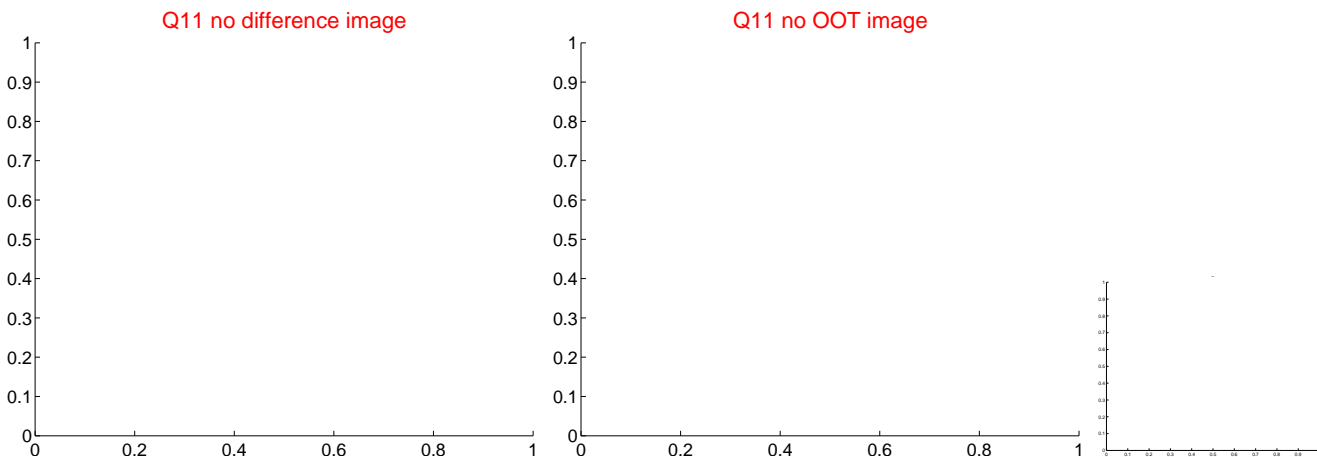
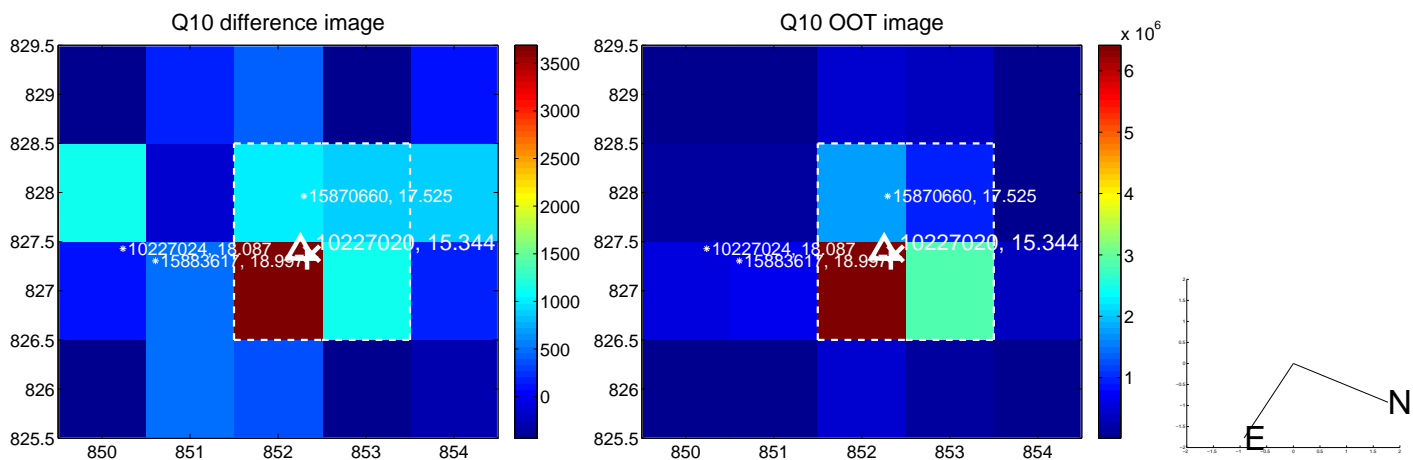
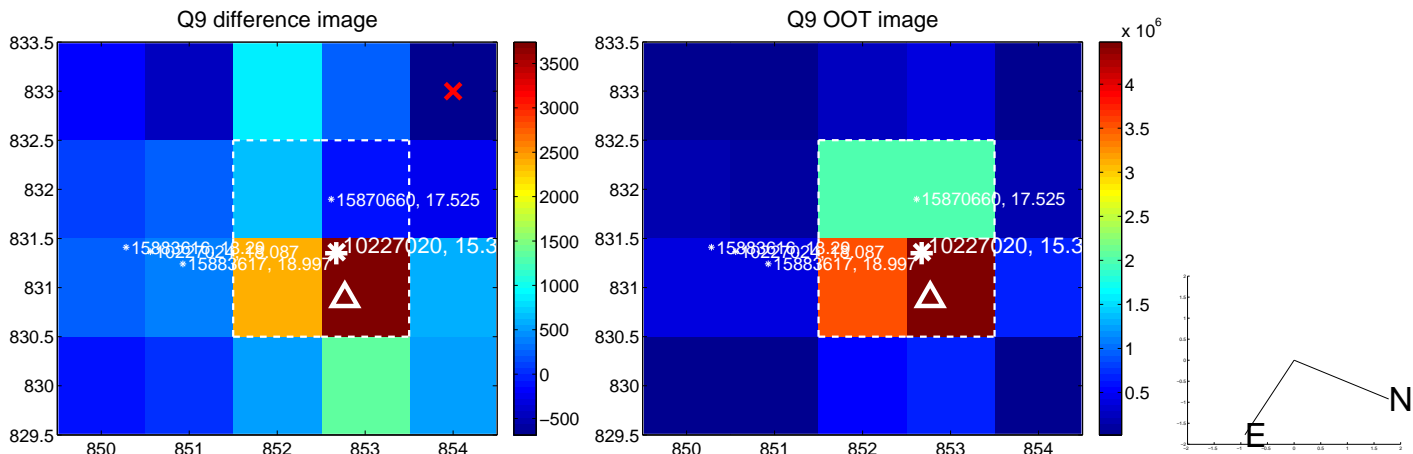
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



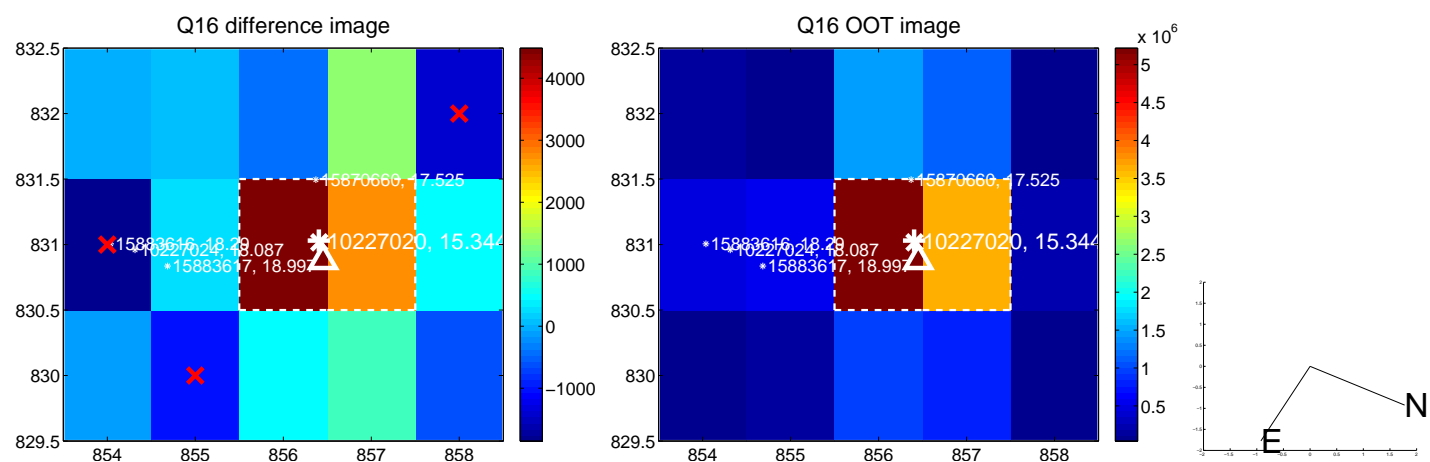
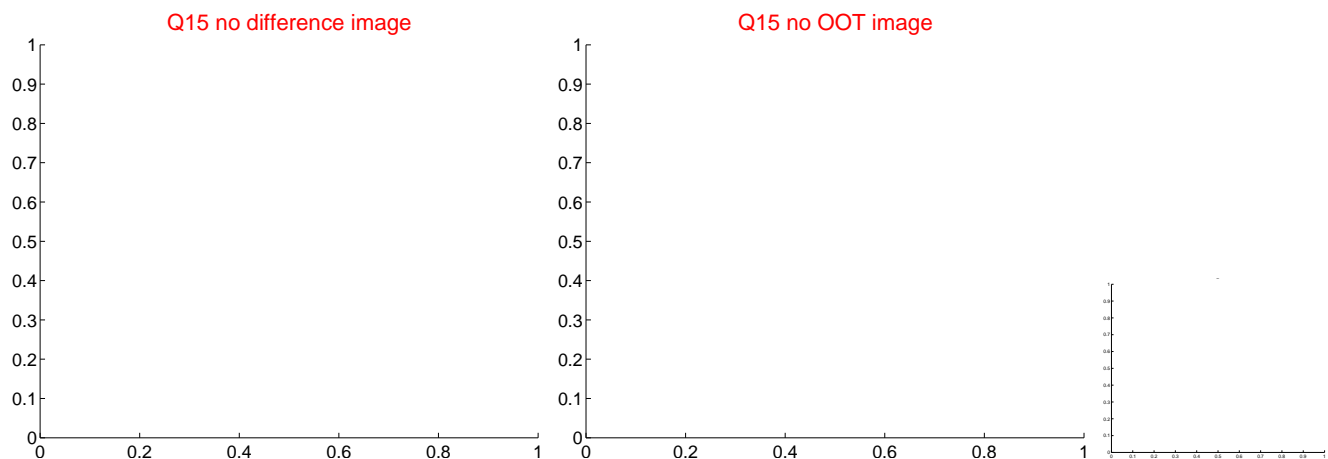
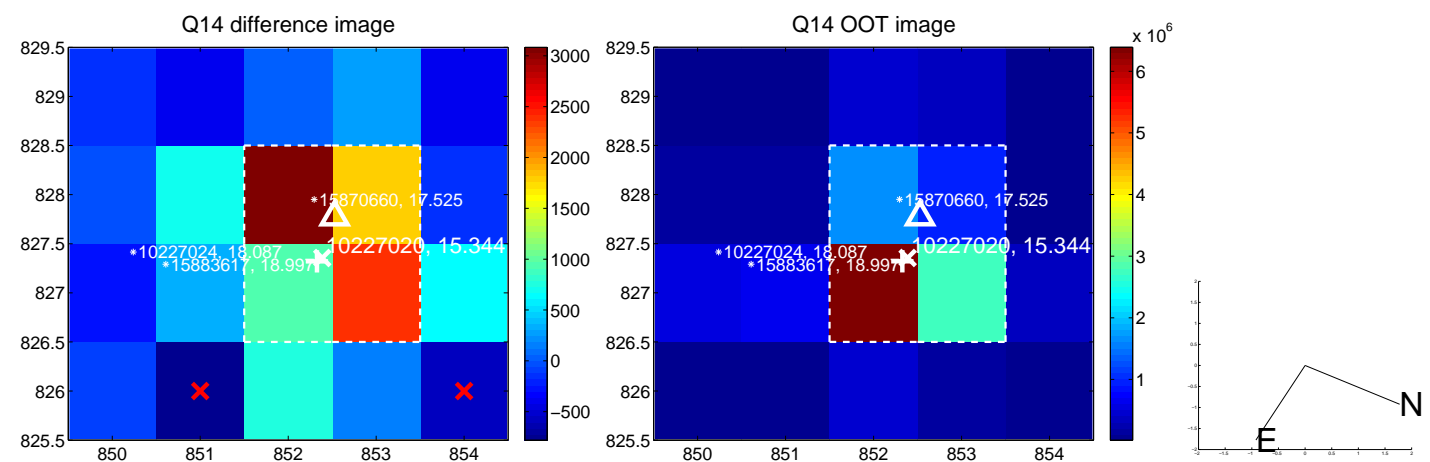
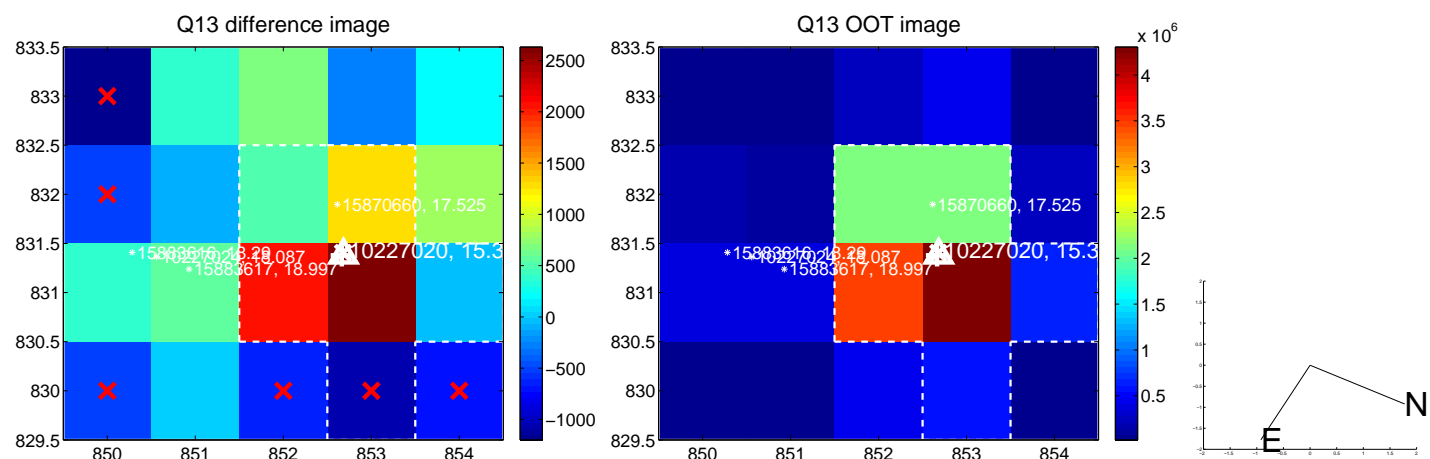
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



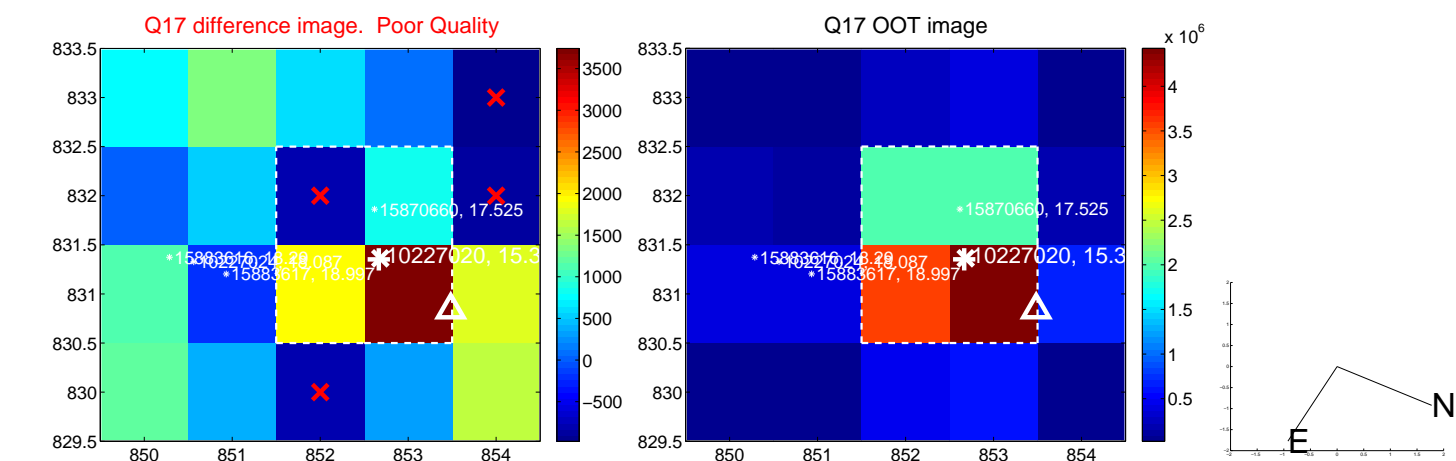
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



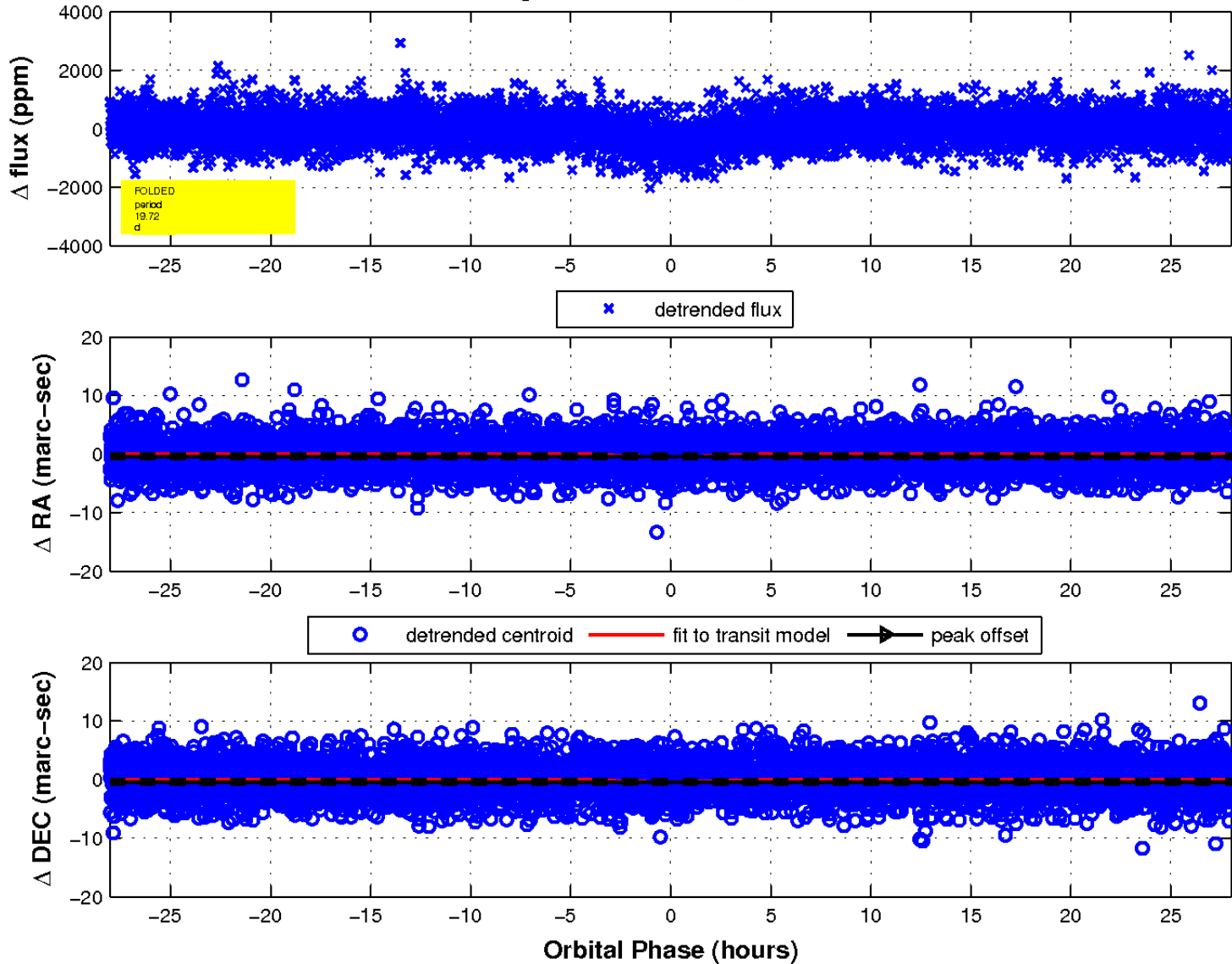
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



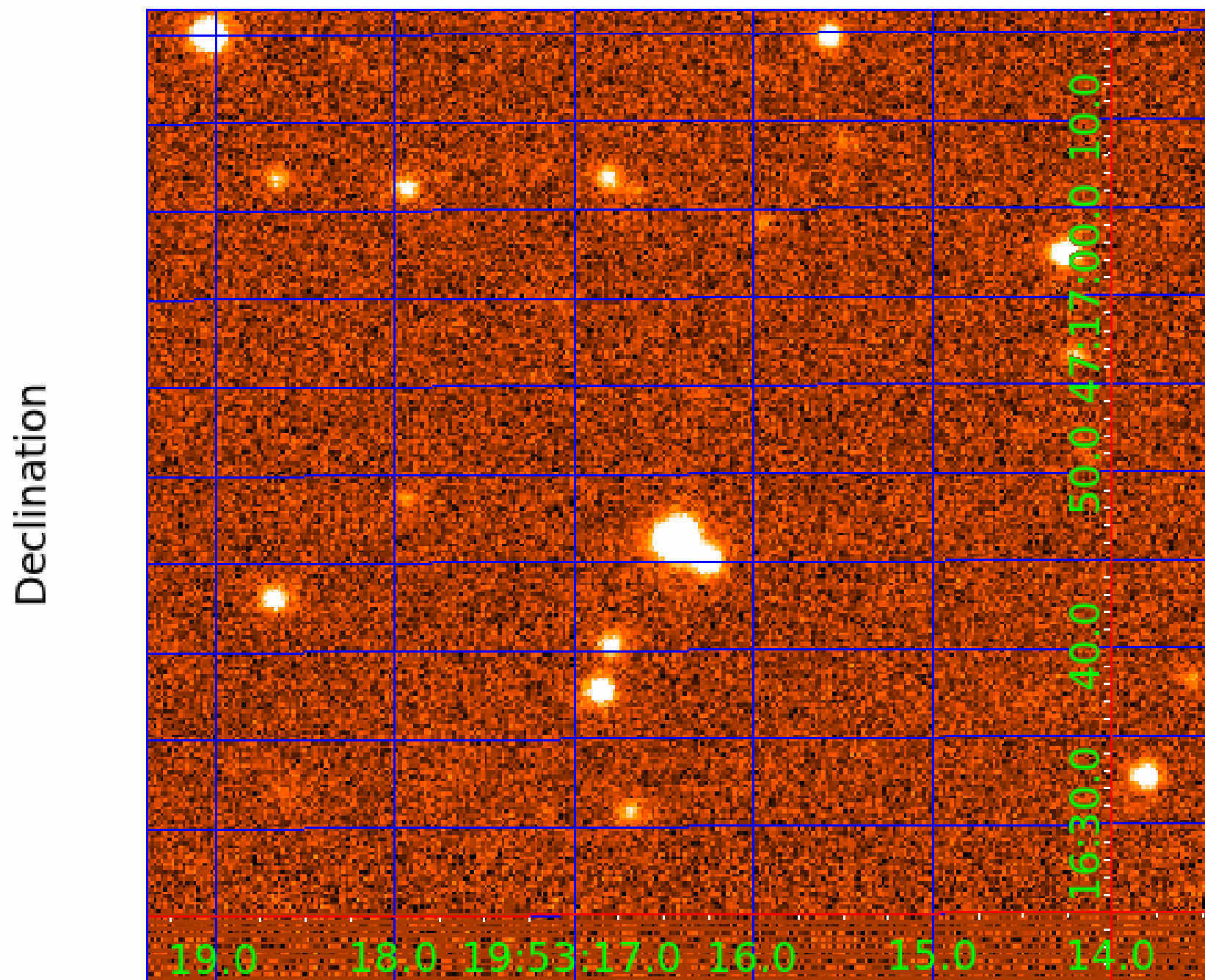
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



fluxWeightedCentroids, Planet 2 of 4



UKIRT Image



KIC 010227020

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}) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 010227020-01 | OBS | 0730.01 | 14.787584 | 132.428654 | 770.4 | 8.455 | 27.6 | 29.4 | 1.25 | 5814 | 4.93 | 110.60 |
| 010227020-02 | OBS | 0730.03 | 19.723809 | 135.075895 | 503.8 | 9.344 | 17.1 | 17.9 | 1.25 | 5814 | 3.98 | 75.33 |
| 010227020-03 | OBS | 0730.02 | 9.848205 | 138.392875 | 328.4 | 6.003 | 15.4 | 15.5 | 1.25 | 5814 | 2.58 | 190.16 |
| 010227020-04 | OBS | 0730.04 | 7.384377 | 137.477378 | 279.6 | 6.200 | 15.7 | 16.1 | 1.25 | 5814 | 2.71 | 279.16 |

Robovetter Results

| TCE | Run Type | Disp | Score | N | S | C | E | Comments |
|--------------|----------|------|-------|---|---|---|---|------------|
| 010227020-01 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-02 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-03 | OBS | PC | 0.99 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-04 | OBS | PC | 0.99 | 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.

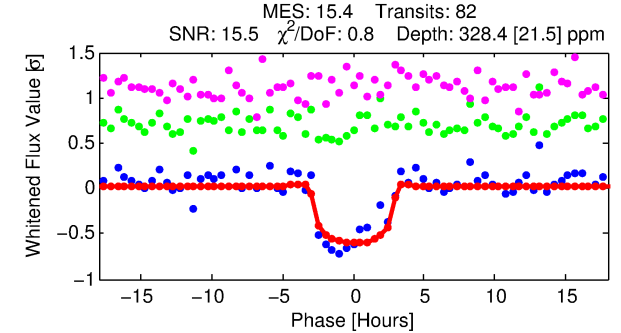
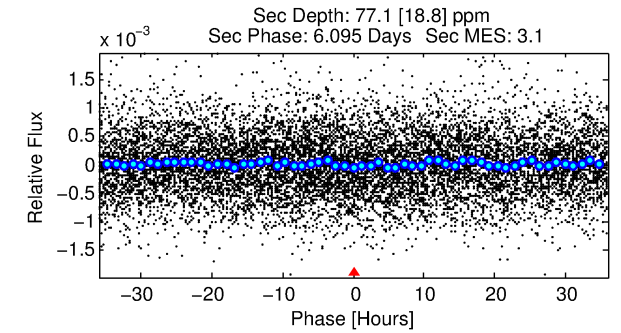
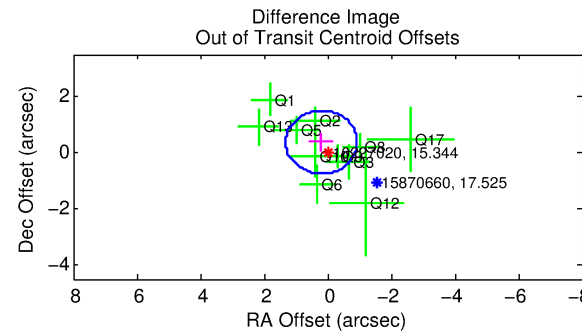
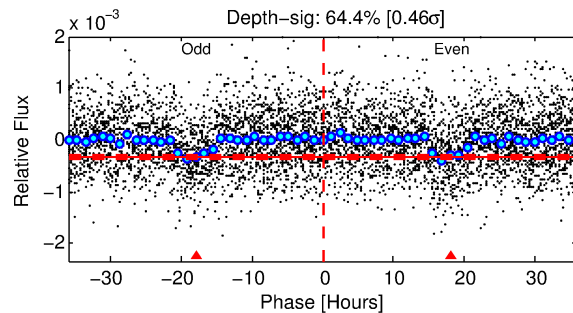
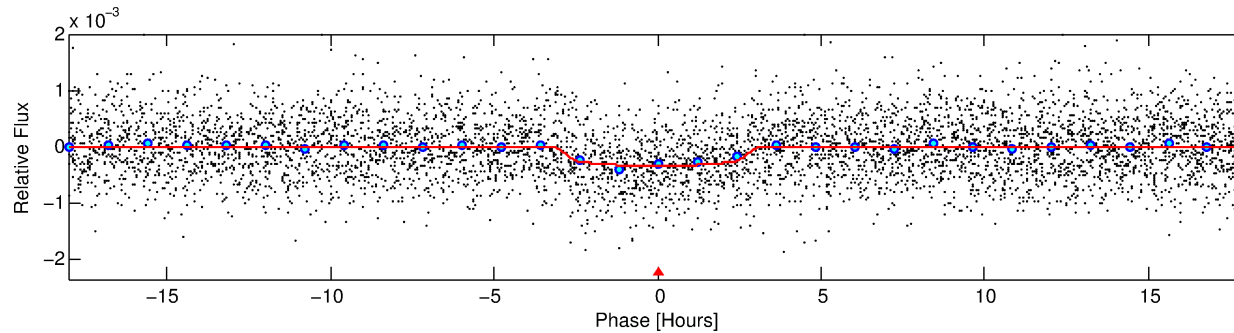
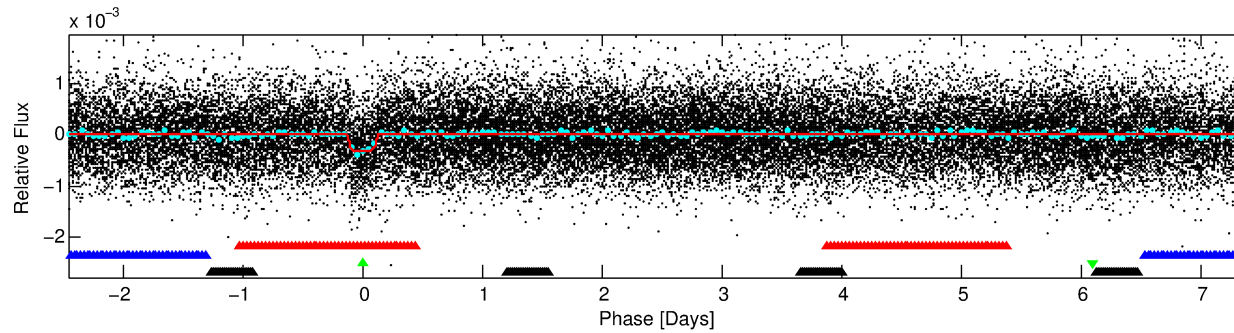
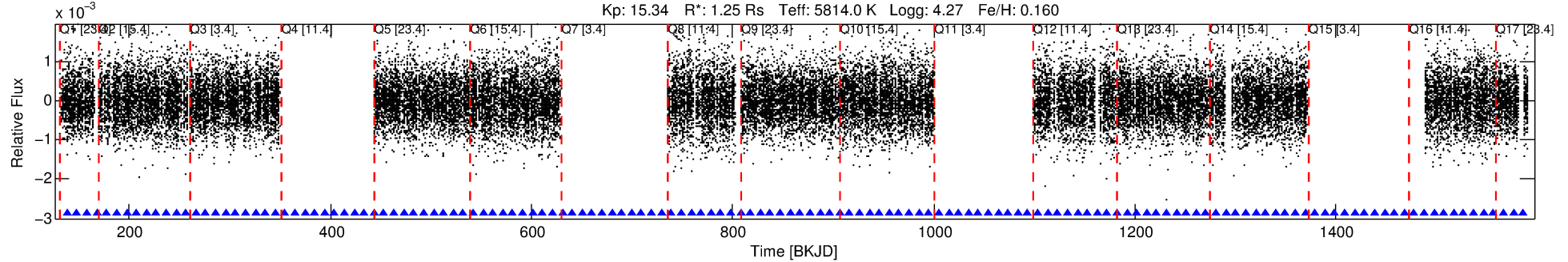
Ephemeris Match Information For 010227020-03

No Significant Match Found

DV One-Page Summary

KIC: 10227020 Candidate: 3 of 4 Period: 9.848 d
KOI: K00730.02 Name: Kepler-223c Corr: 0.907

Kp: 15.34 R*: 1.25 Rs Teff: 5814.0 K Logg: 4.27 Fe/H: 0.160



DV Fit Results:

Period = 9.84821 [0.00009] d
Epoch = 138.3929 [0.0064] BKJD
Rp/R* = 0.0189 [0.0054]
a/R* = 7.20 [9.08]
b = 0.84 [0.44]
Seff = 190.16 [46.41]
Teq = 947 [58] K
Rp = 2.57 [0.85] Re
a = 0.0916 [0.0140] AU
Ag = 53.63 [35.52] [1.48σ]
Teffp = 3962 [614] K [4.89σ]

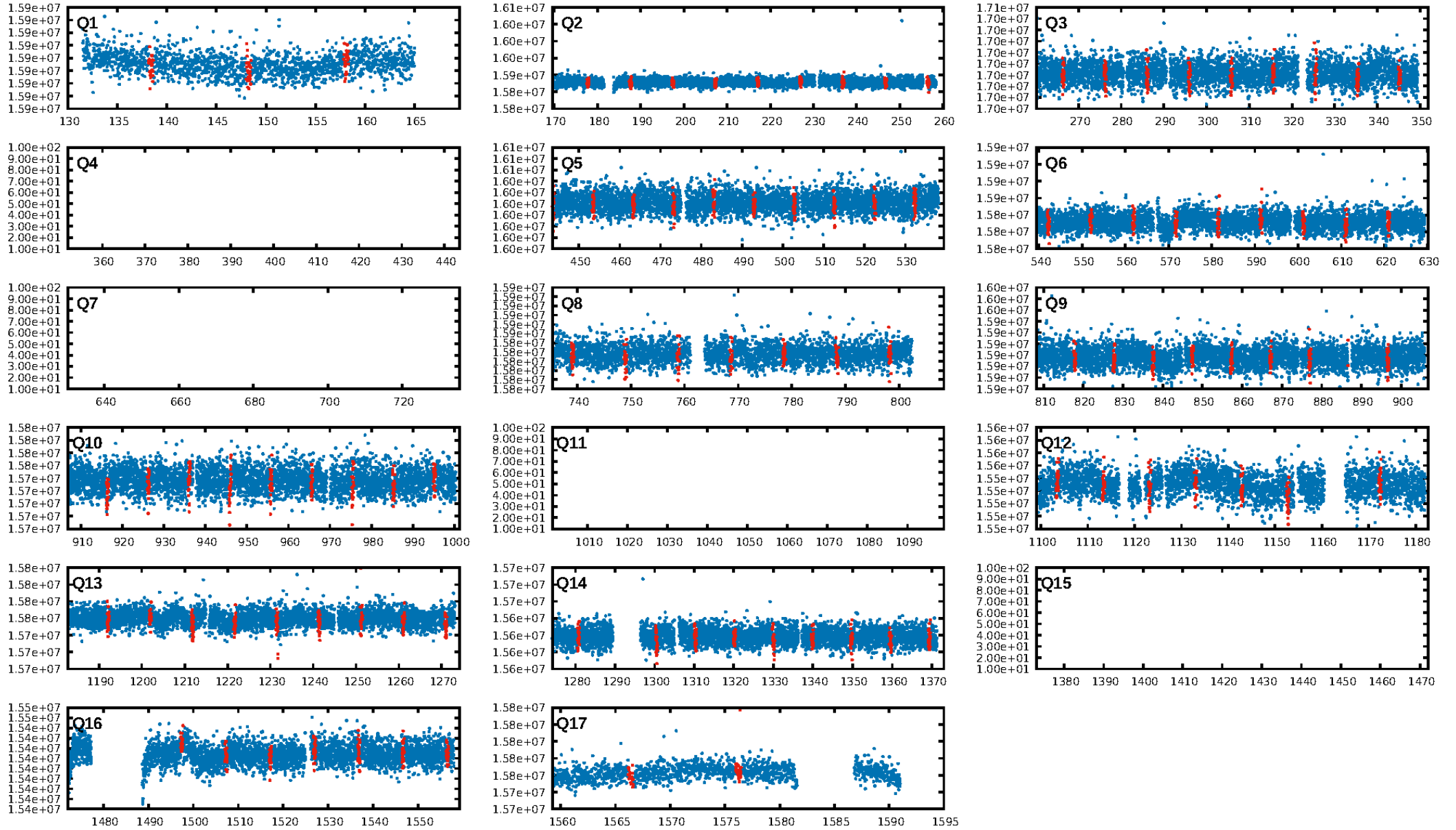
DV Diagnostic Results:

ShortPeriod-sig: 100.0% [6.85σ]
LongPeriod-sig: 100.0% [11.43σ]
ModelChiSquare2-sig: 99.8%
ModelChiSquareGof-sig: 100.0%
Bootstrap-pfa: 4.91e-55
RollingBand-fgt: 1.00 [77/77]
GhostDiagnostic-chr: 7.817
Centroid-sig: 50.3%
Centroid-so: 0.592 arcsec [0.75σ]
OotOffset-rm: 0.421 arcsec [1.12σ]
KicOffset-rm: 0.449 arcsec [1.02σ]
OotOffset-st: 3/1/2/5 [11]
KicOffset-st: 3/1/2/5 [11]
DiffImageQuality-fgm: 0.82 [9/11]
DiffImageOverlap-fno: 1.00 [13/13]

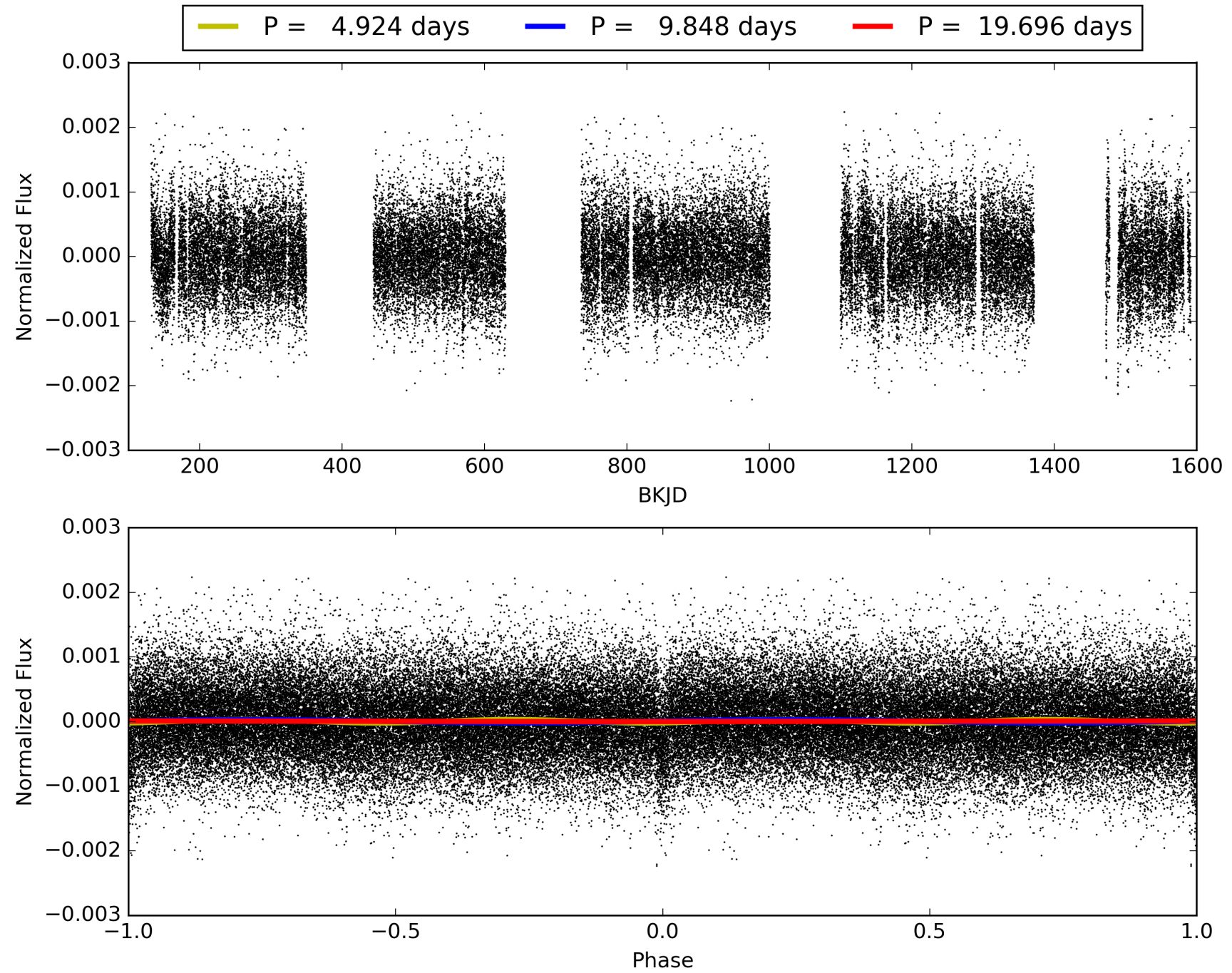
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 22:17:42 Z

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

TCE 010227020-03, PDC Light Curves

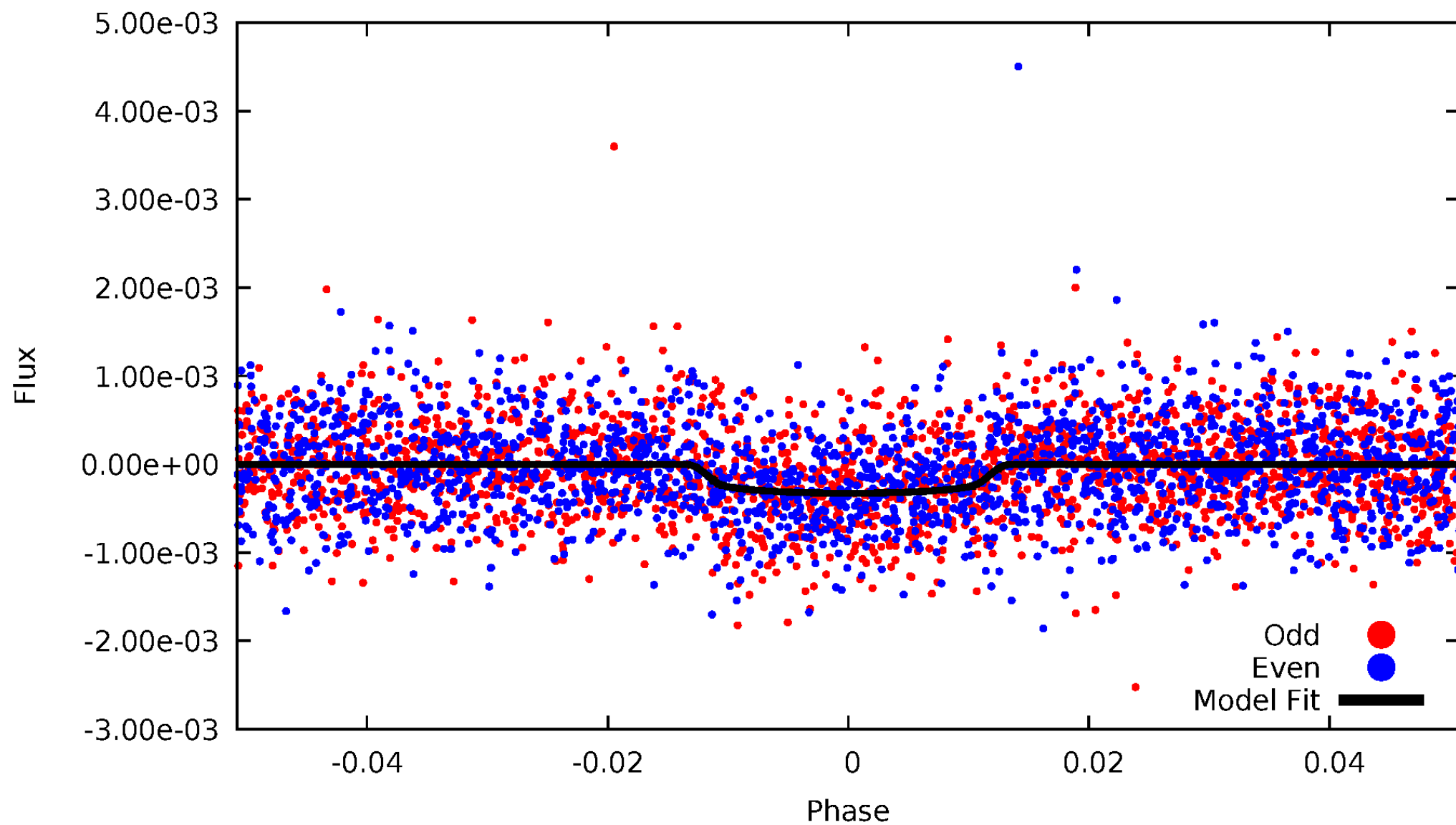


TCE 010227020-03



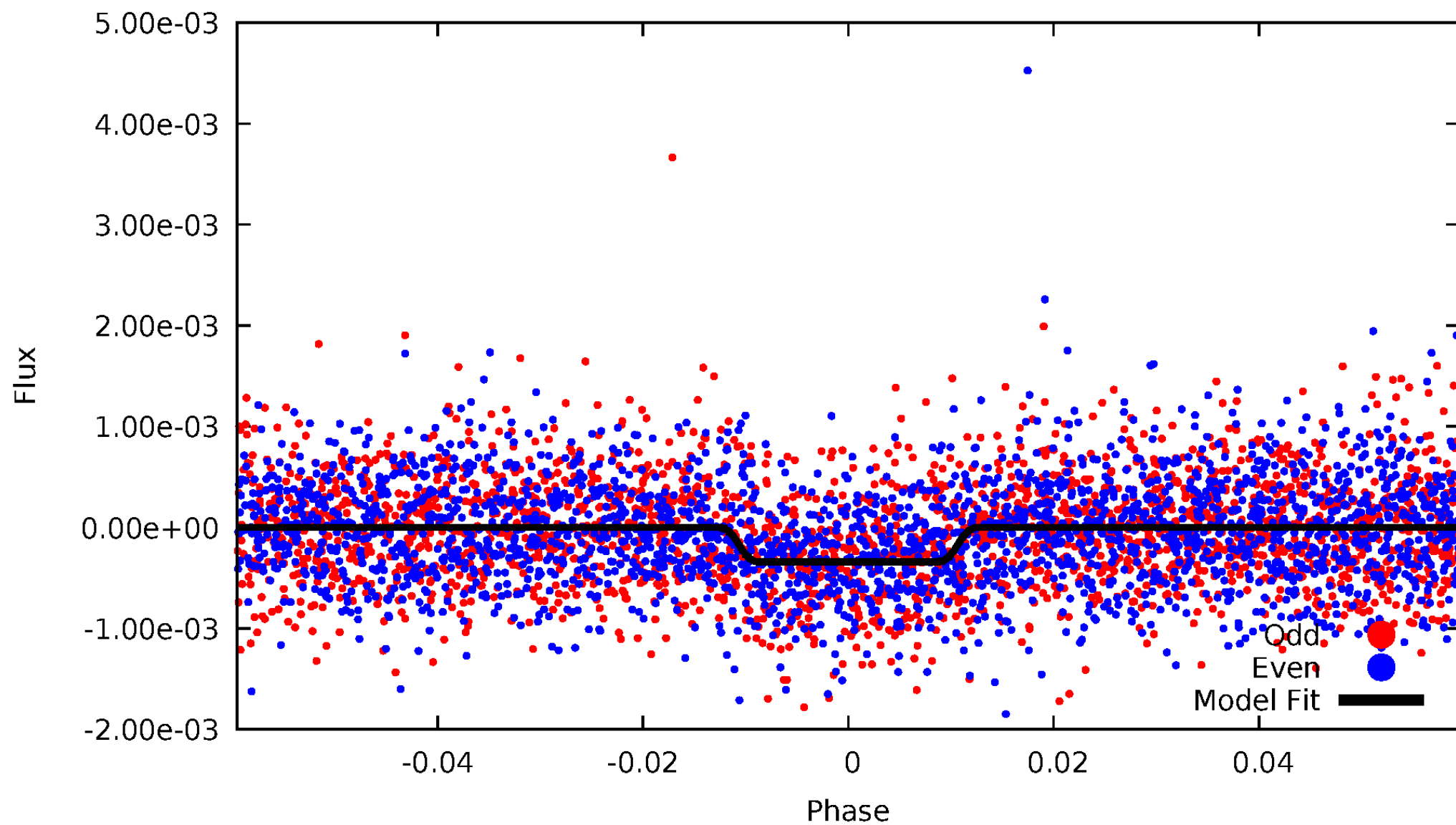
DV Odd/Even

TCE 010227020-03



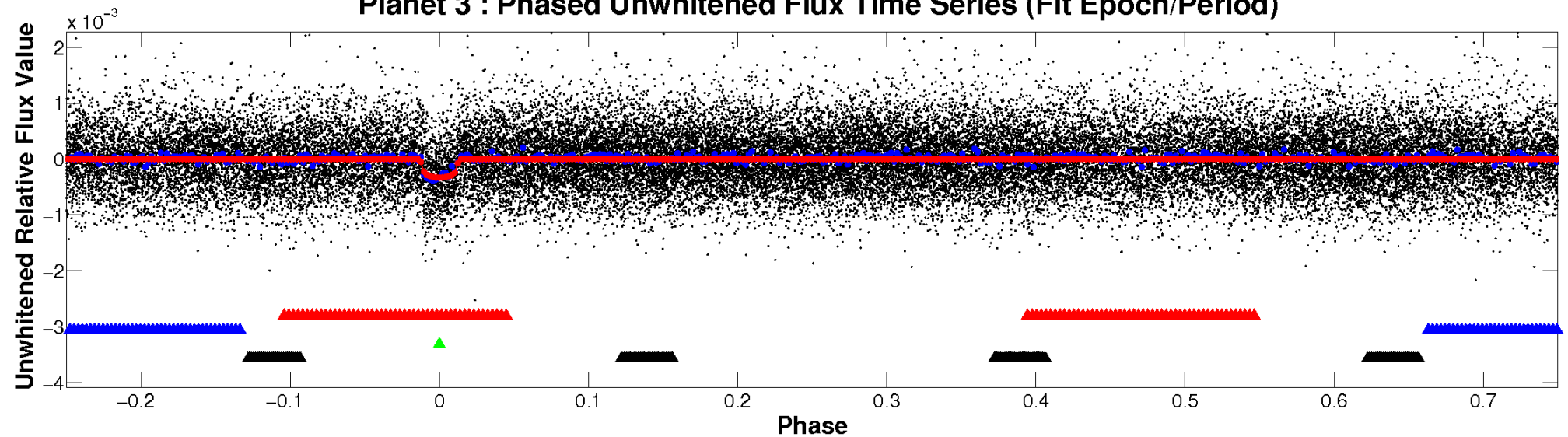
ALT Odd/Even

TCE 010227020-03

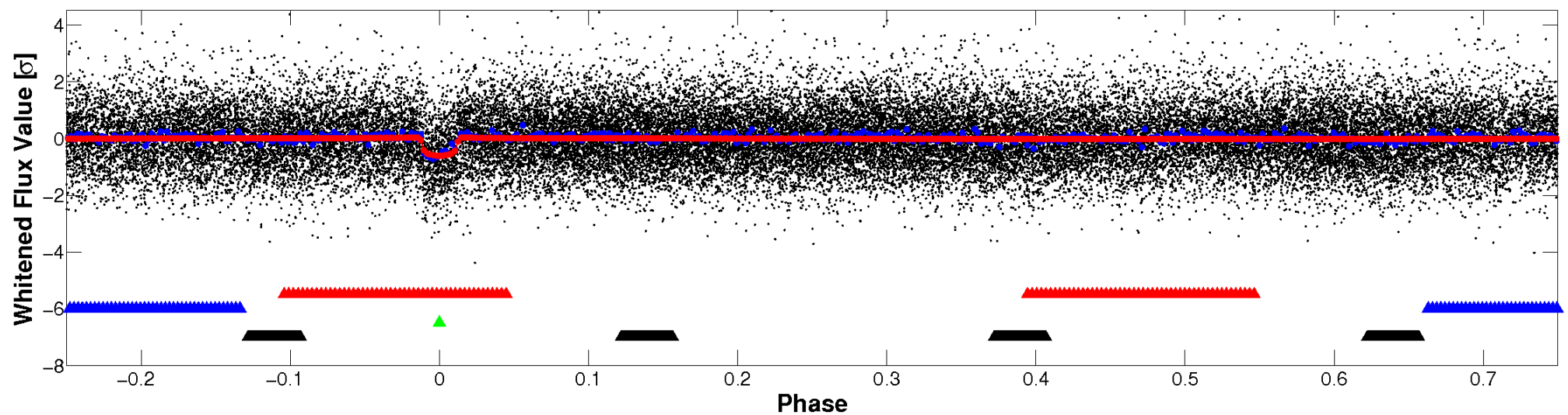


Non-Whitened Vs. Whitened Light Curve

Planet 3 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

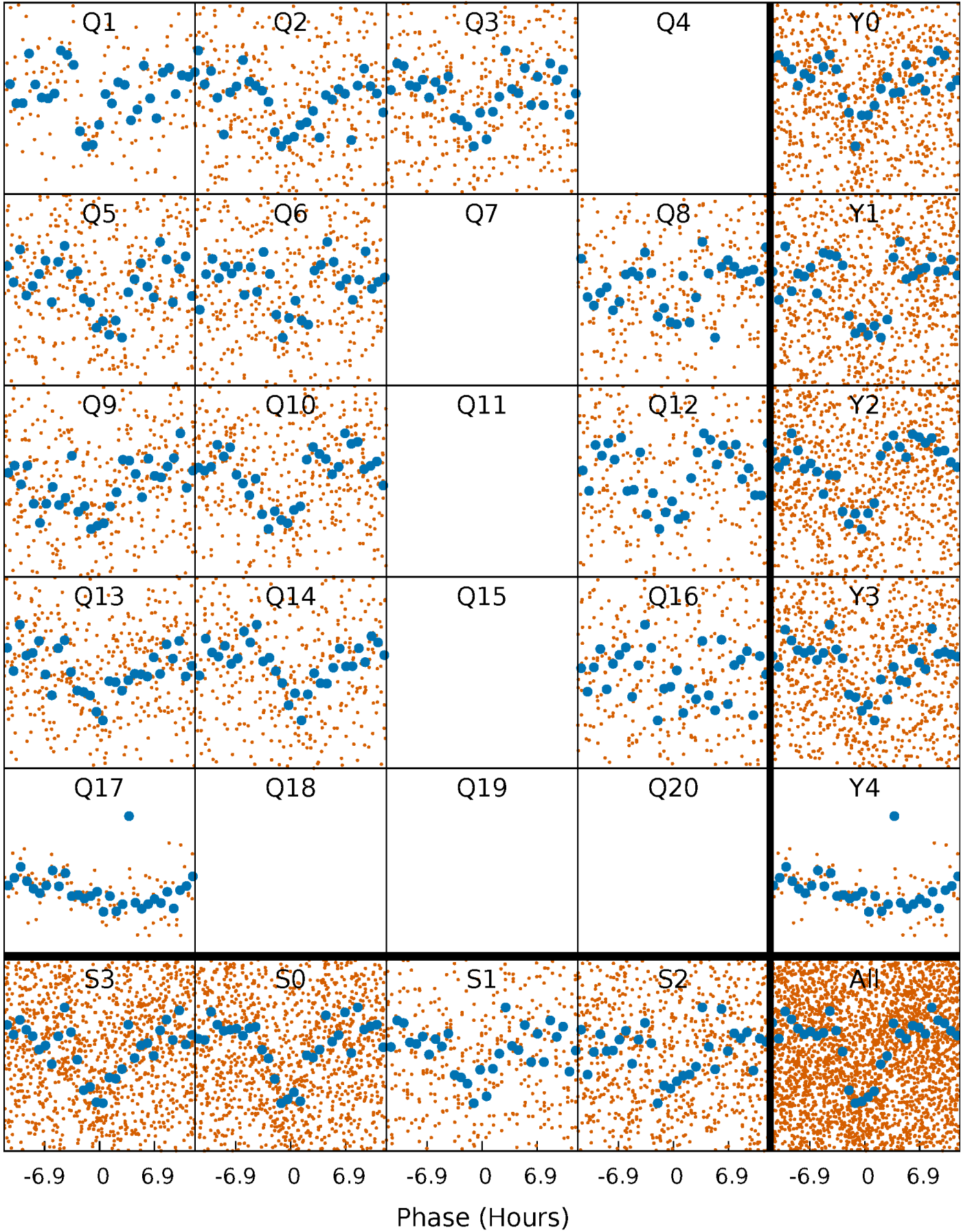


Planet 3 : Phased Whitened Flux Time Series (Fit Epoch/Period)



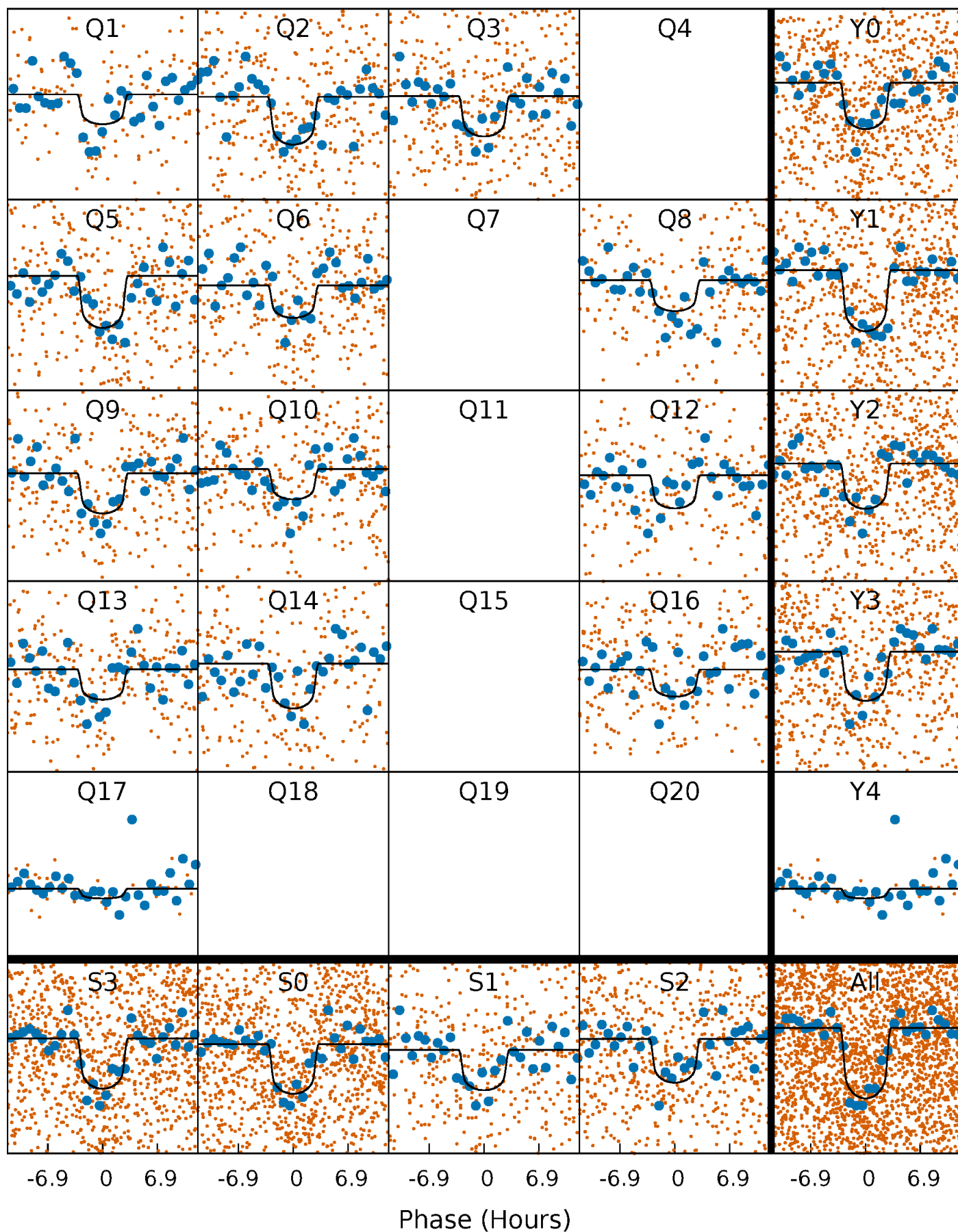
PDC Quarter-Phased Transit Curves

TCE 010227020-03 P= 9.848205 Days $T_0=138.392875$ (BKJD)



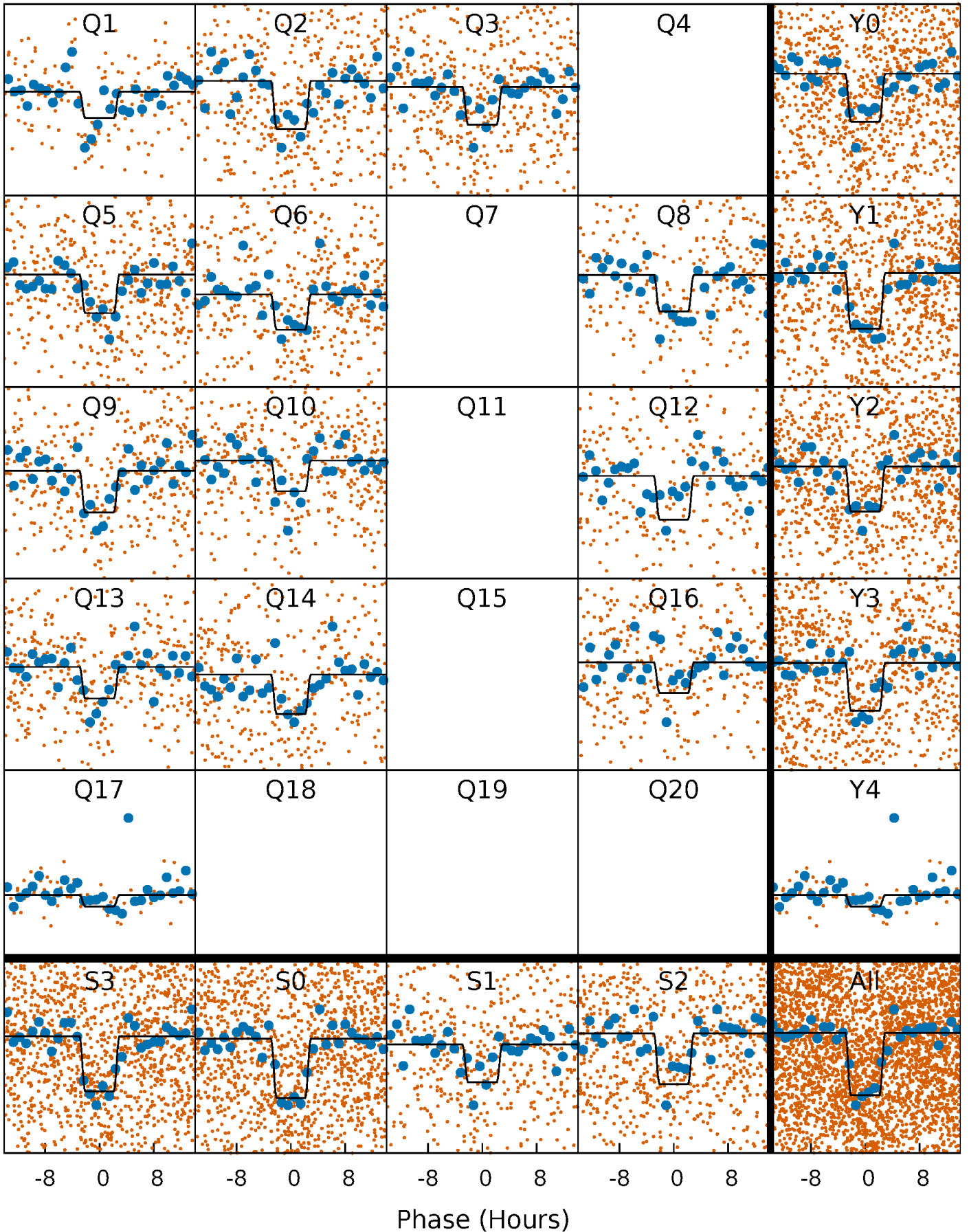
DV Quarter-Phased Transit Curves

TCE 010227020-03 P= 9.848205 Days $T_0=138.392875$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

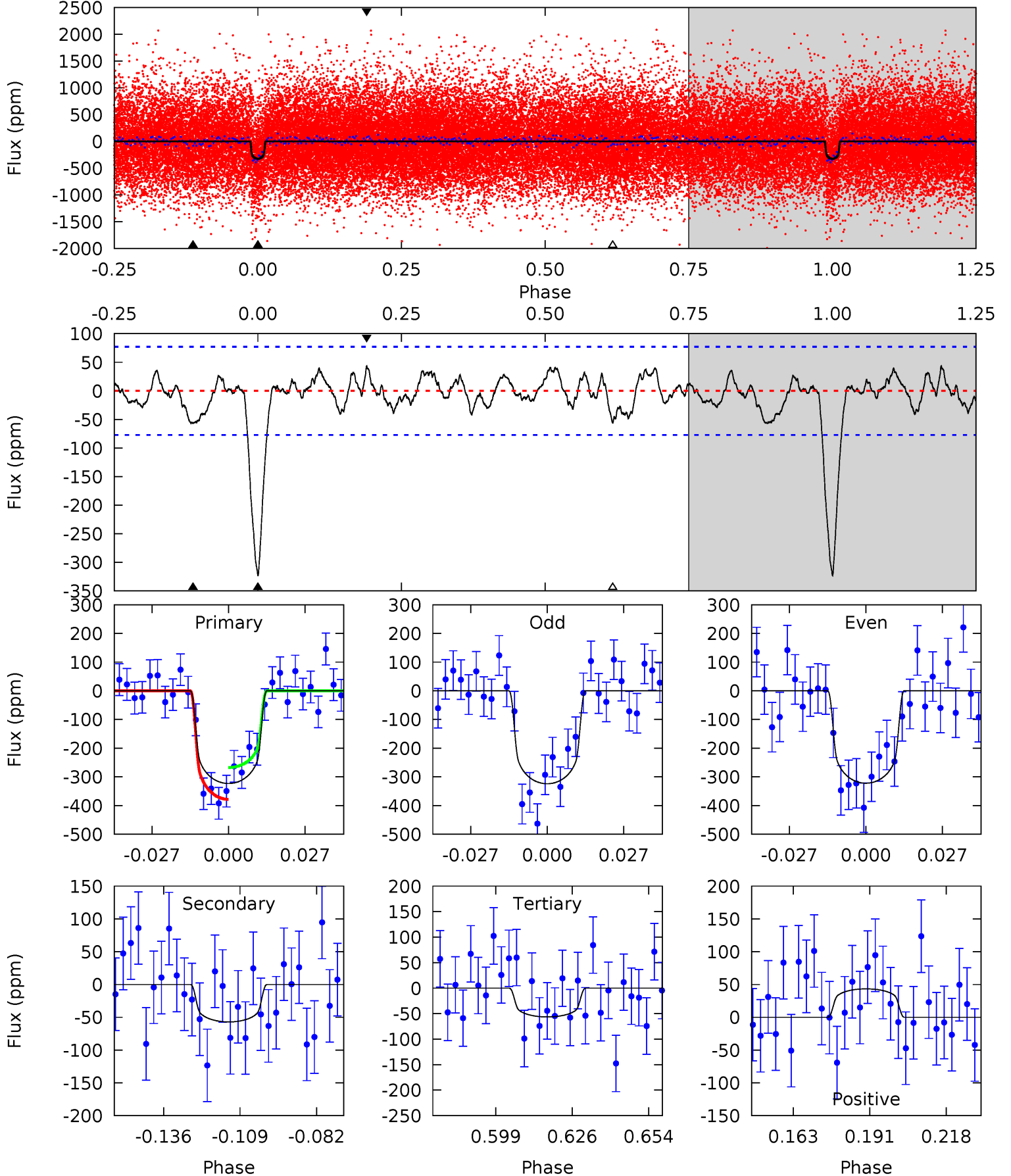
TCE 010227020-03 P= 9.847895 Days $T_0=138.405136$ (BKJD)



DV Model-Shift Uniqueness Test

010227020-03, P = 9.848205 Days, E = 128.544670 Days

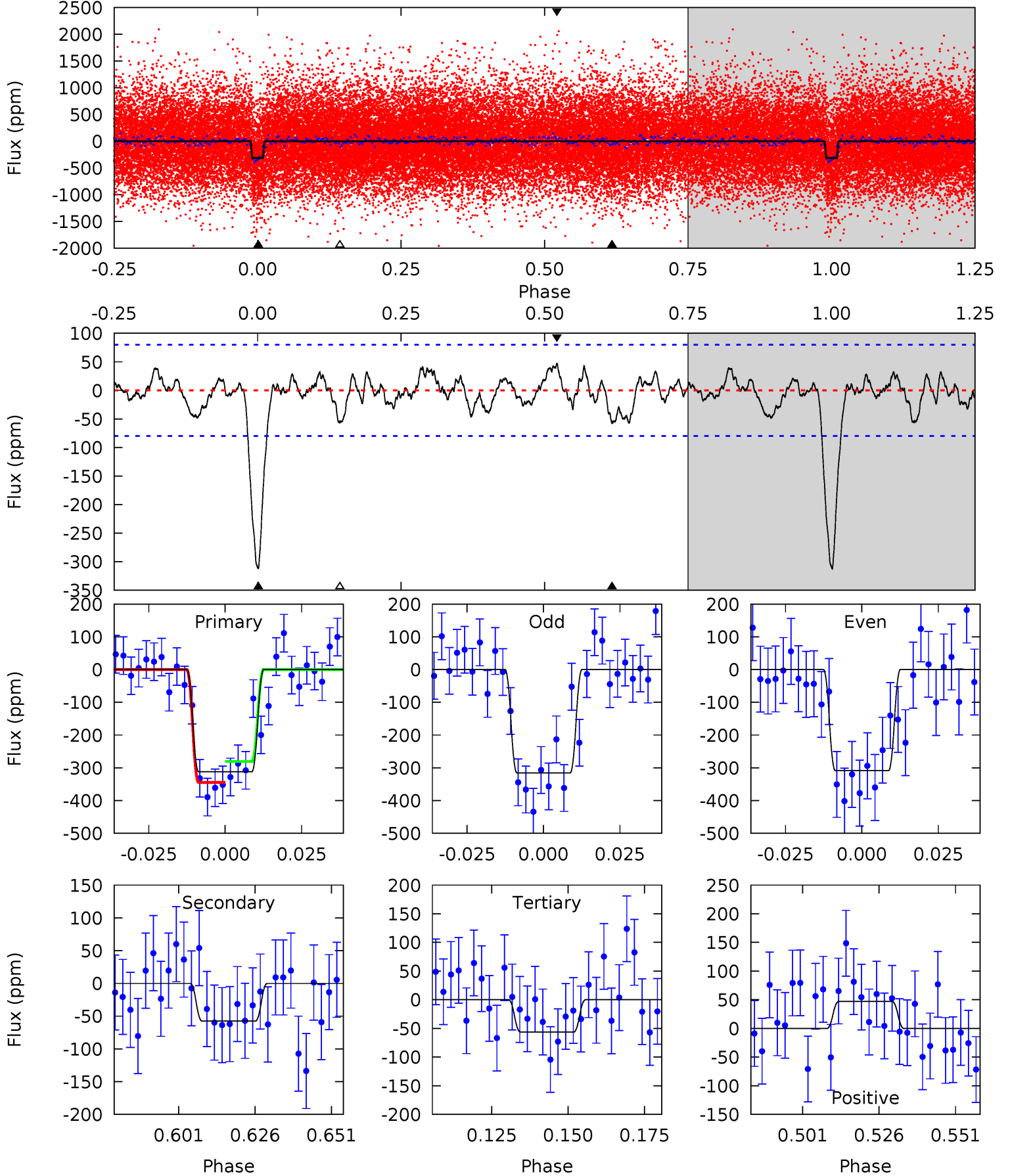
| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 20.2 | 3.57 | 3.53 | 2.71 | 4.83 | 2.21 | 1.28 | 16.7 | 17.5 | 0.04 | 0.86 | 0.06 | 0.94 | 0.12 | 3.48 |



Alt Model-Shift Uniqueness Test

010227020-03, P = 9.847895 Days, E = 128.557241 Days

| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 18.9 | 3.49 | 3.41 | 2.87 | 4.85 | 2.24 | 1.24 | 15.5 | 16.1 | 0.08 | 0.62 | 0.21 | 0.90 | 0.13 | 1.94 |



Stellar Parameters For KIC 010227020

| | $T_{\text{eff}}(K)$ | $\log(g)$ | [Fe/H] | R (R_{\odot}) | $M(M_{\odot})$ | p_{\star} ($\text{g}\cdot\text{cm}^{-3}$) |
|--------|---------------------|---------------------------|---------------------------|---------------------------|---------------------------|---|
| | 5814^{+78}_{-78} | $4.269^{+0.137}_{-0.112}$ | $0.160^{+0.150}_{-0.150}$ | $1.248^{+0.209}_{-0.209}$ | $1.055^{+0.081}_{-0.067}$ | $0.765^{+0.497}_{-0.259}$ |
| | +1%/-1% | +3%/-3% | +94%/-94% | +17%/-17% | +8%/-6% | +65%/-34% |
| Source | SPE90 | SPE90 | SPE90 | DSEP | | |

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

Secondary Eclipse Parameters for KIC 010227020-03 / KOI 0730.02

| Detrend | Depth (ppm) | R_p (R_{\oplus}) | T_{max} (K) | T_{obs} (K) | A_{obs} |
|---------|--------------|------------------------|--------------------|----------------------|------------------|
| DV | -57 ± 16 | $2.54^{+0.84}_{-0.75}$ | 1326^{+57}_{-66} | 3999^{+591}_{-411} | 40^{+46}_{-18} |
| Alt. | -58 ± 16 | $2.49^{+0.80}_{-0.71}$ | 1326^{+58}_{-62} | 4010^{+543}_{-375} | 41^{+41}_{-18} |

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 $A_{obs} \gg 1.0$

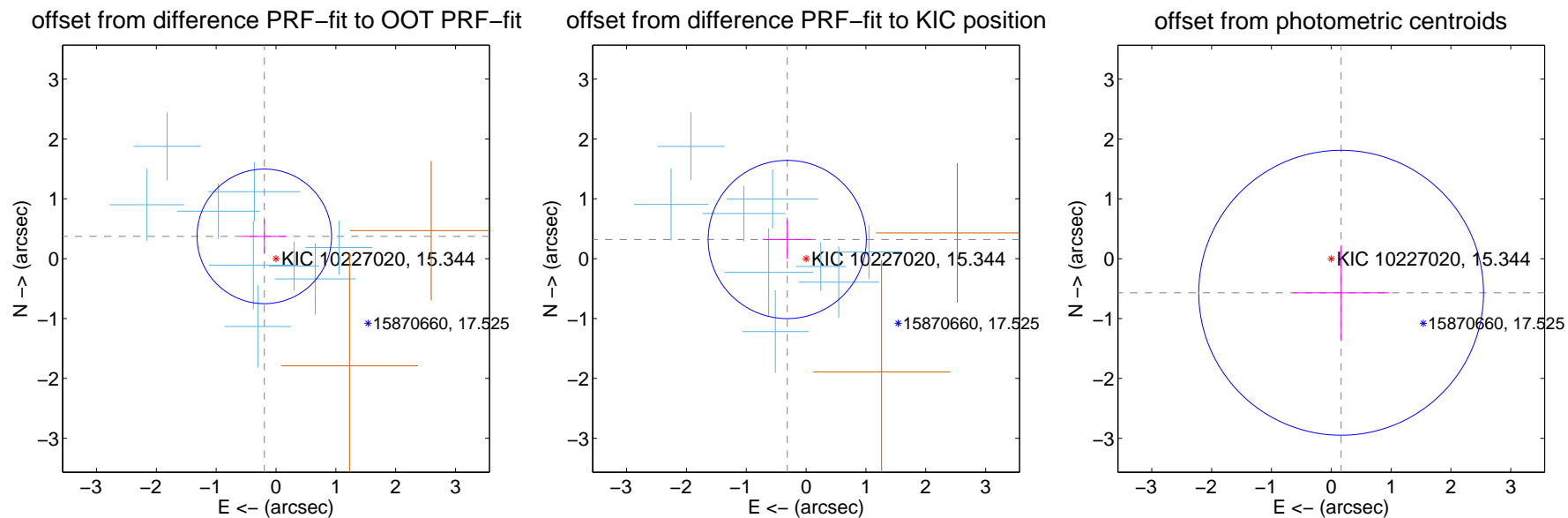
DV Centroid Data

Supplemental centroid analysis for 010227020-03. Kepler magnitude: 15.34. Transit SNR 15.51

There are 9 quarters with good PRF difference image offsets

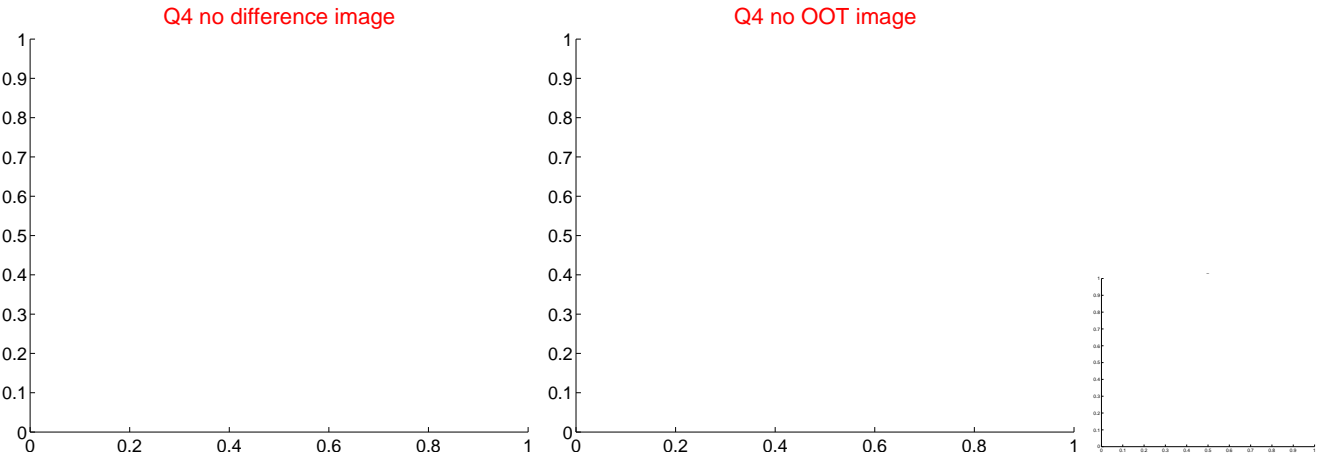
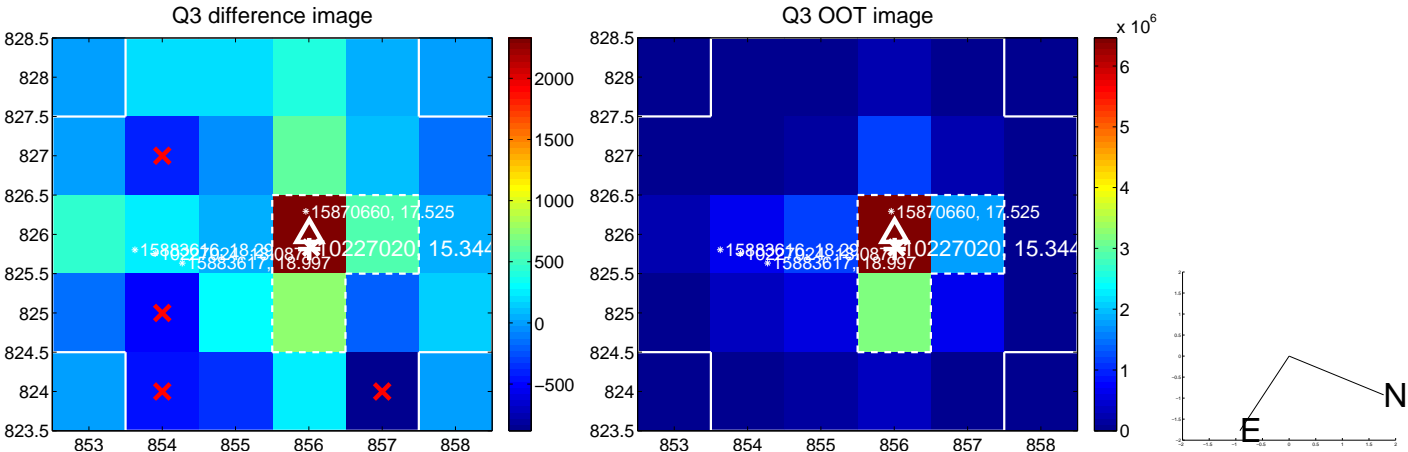
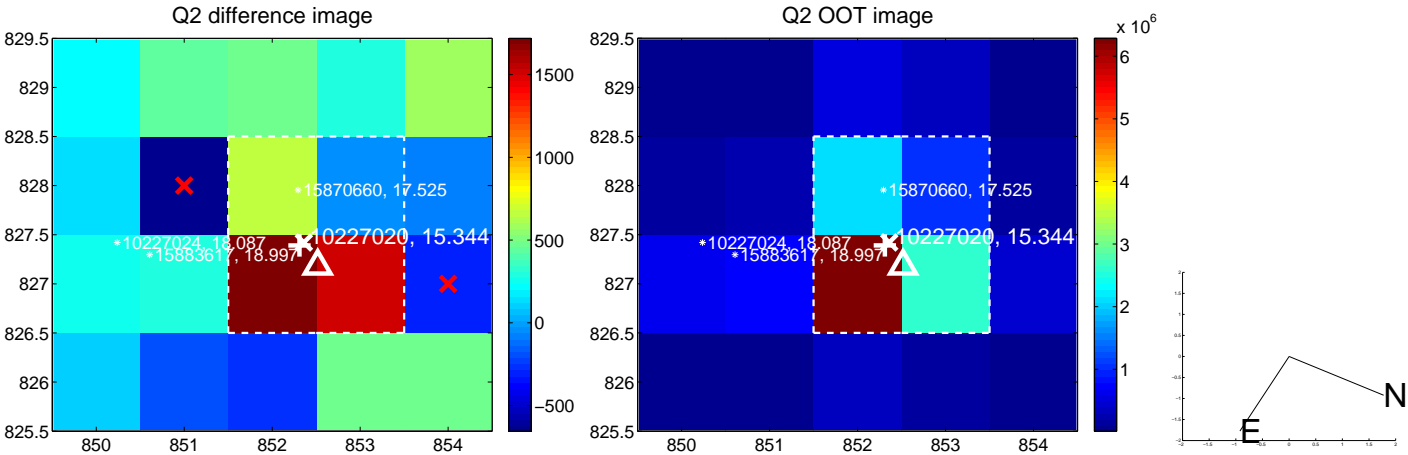
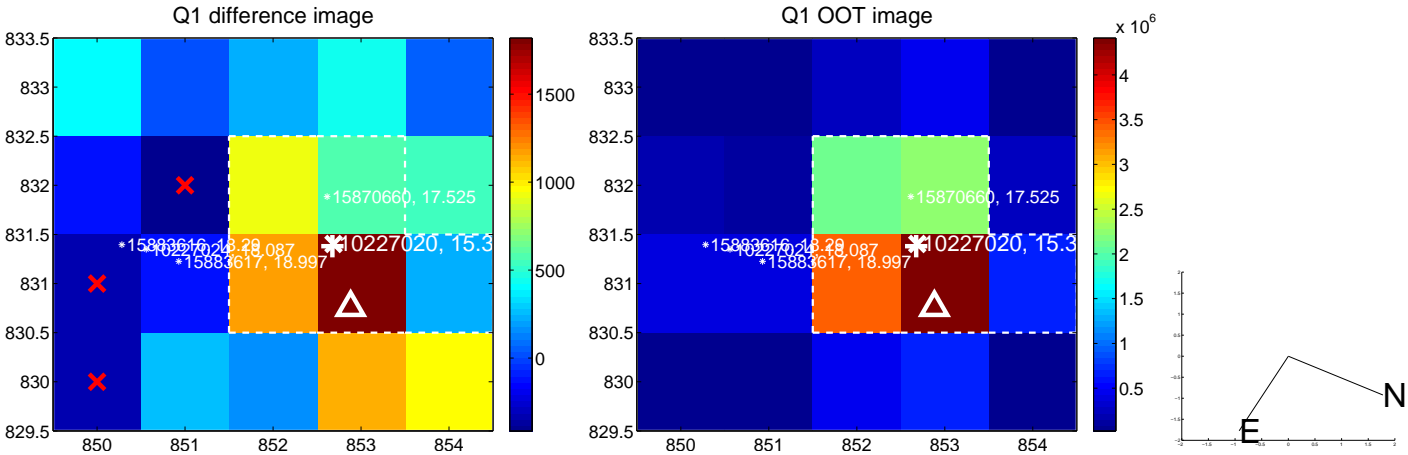
The direct PRF centroid is offset from the target star catalog position by about 0.08 arcsec

| | Distance in arcsec | Distance / σ | Δ RA | Δ Dec |
|---|--------------------|---------------------|-------------------|-------------------|
| PRF-fit source offset from OOT | 0.421 ± 0.375 | 1.12 | 0.196 ± 0.372 | 0.372 ± 0.283 |
| PRF-fit source offset from KIC position | 0.449 ± 0.440 | 1.02 | 0.315 ± 0.410 | 0.320 ± 0.326 |
| photometric centroid source offset | 0.59 ± 0.79 | 0.75 | -0.16 ± 0.80 | -0.57 ± 0.79 |

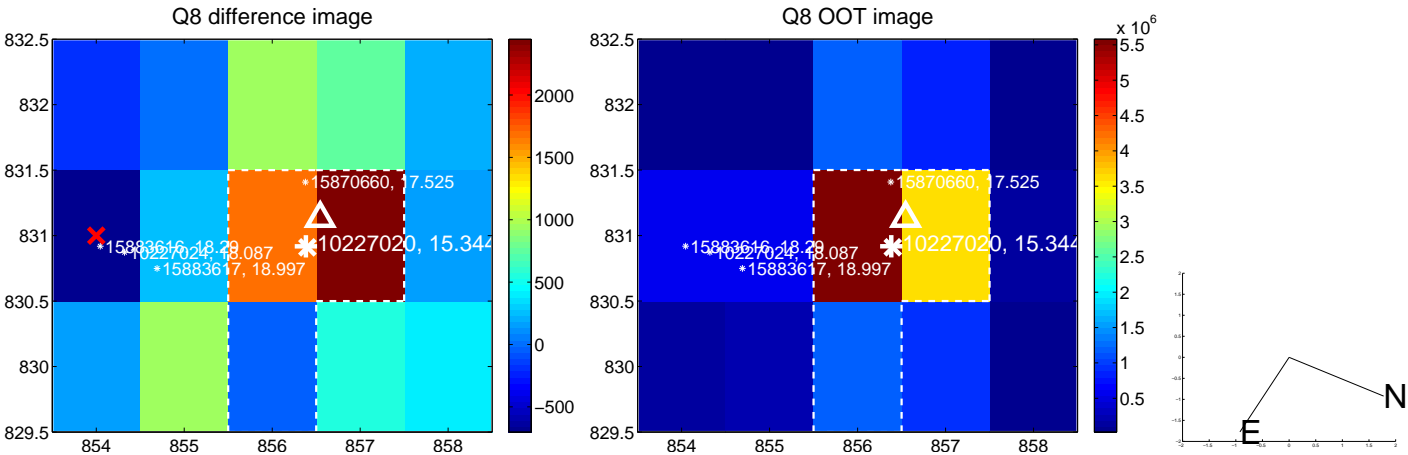
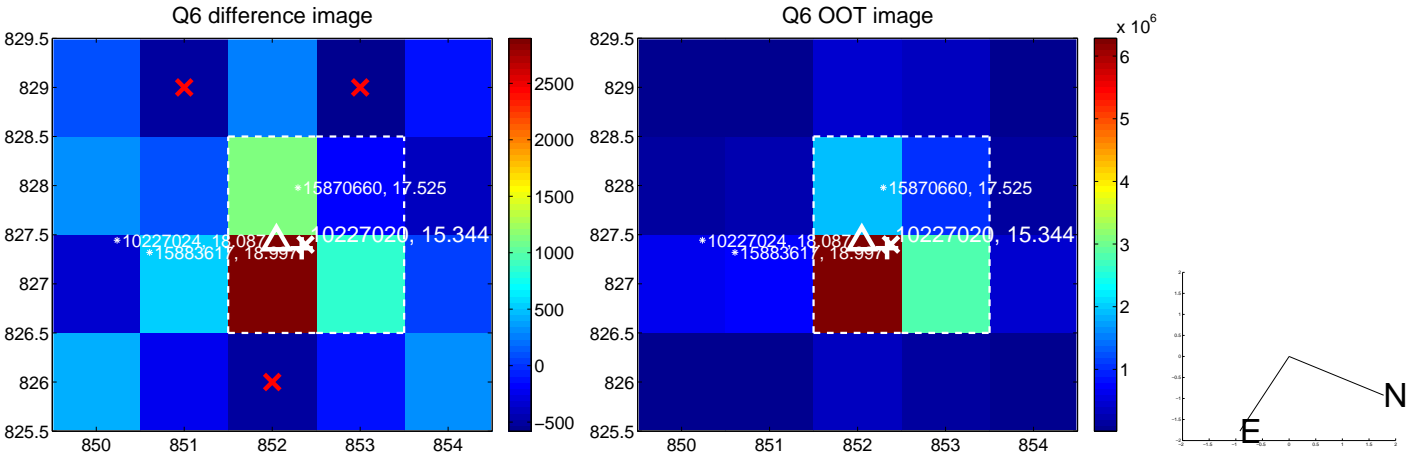
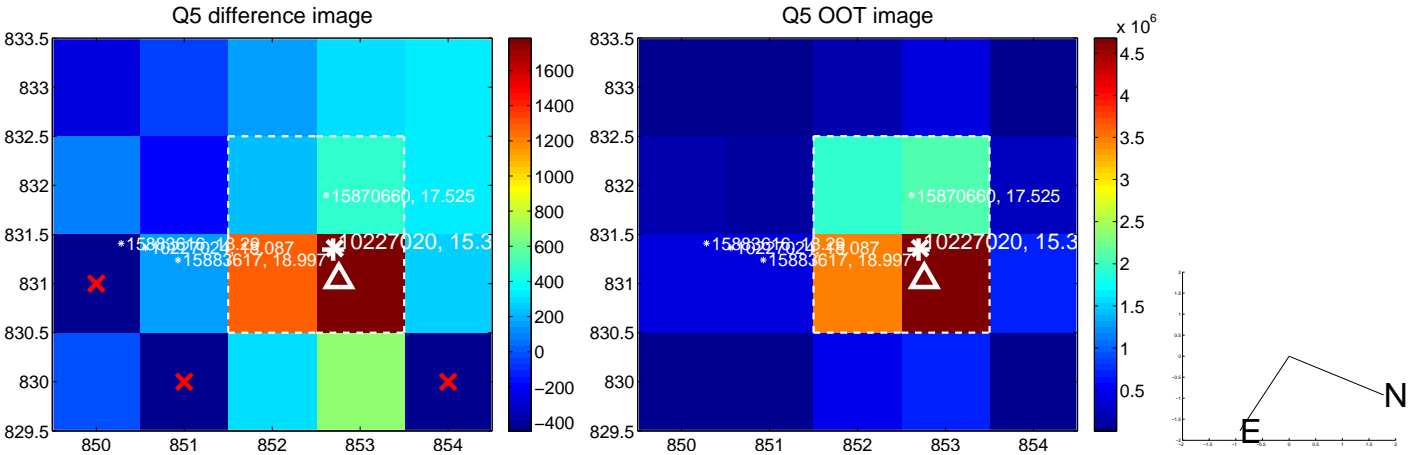


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses: good quarterly centroid offsets; Vermillion crosses: bad quarterly centroid offsets**; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

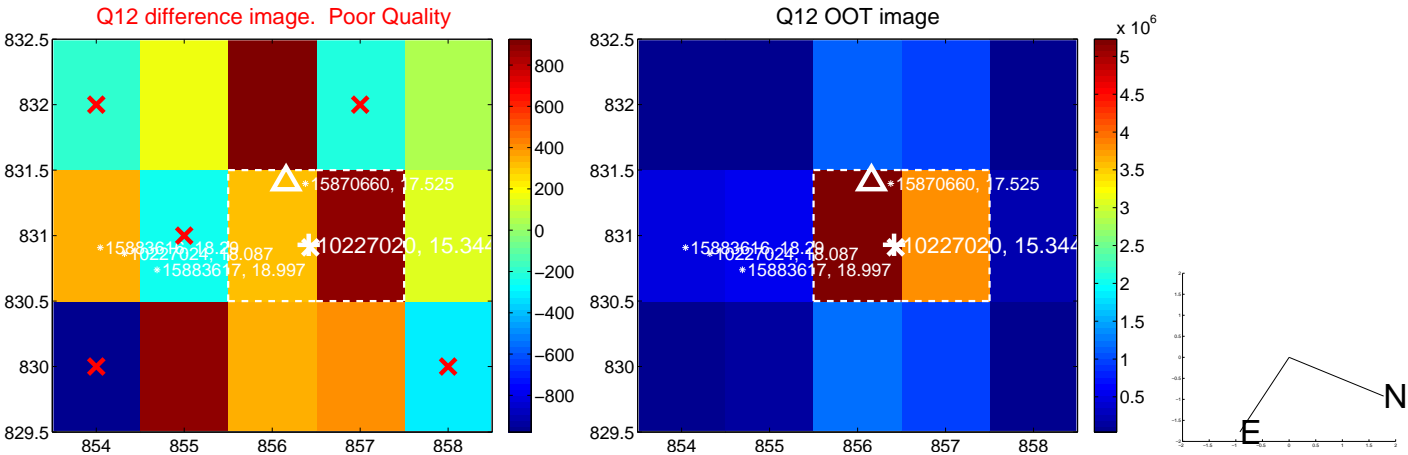
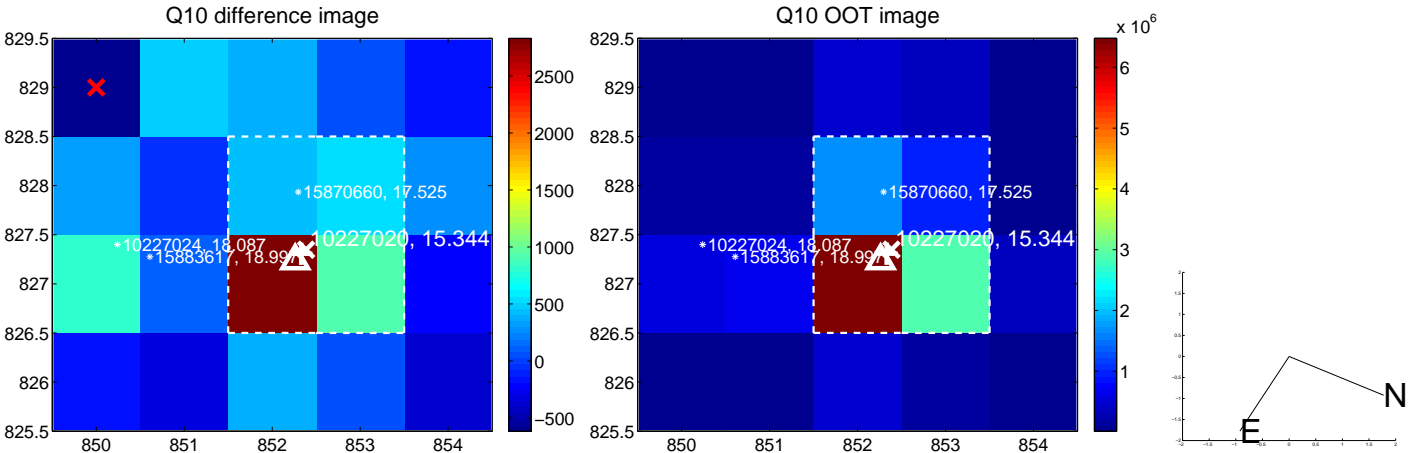
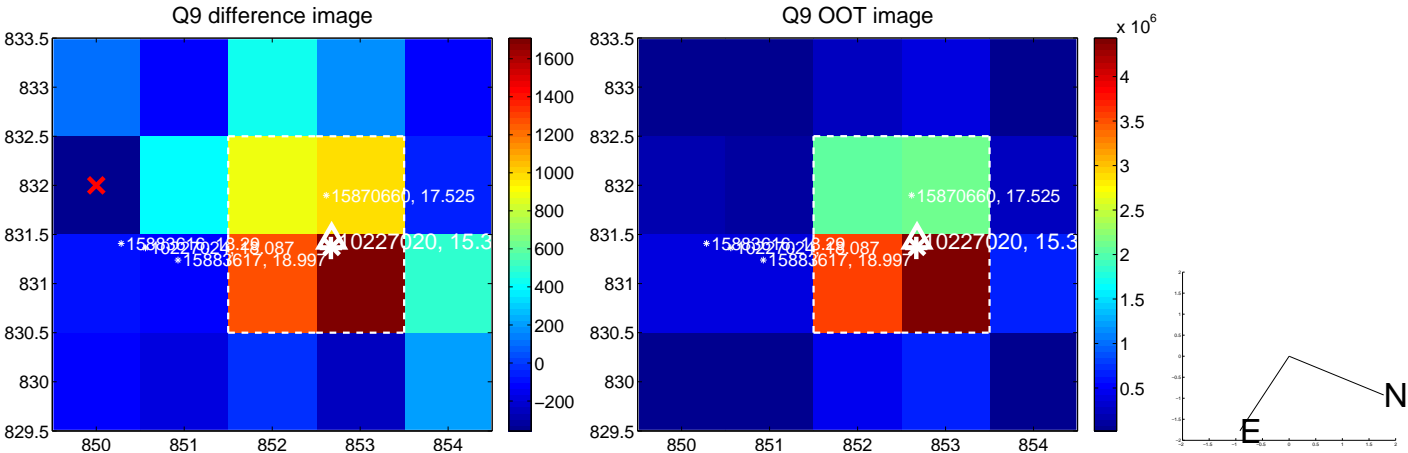
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



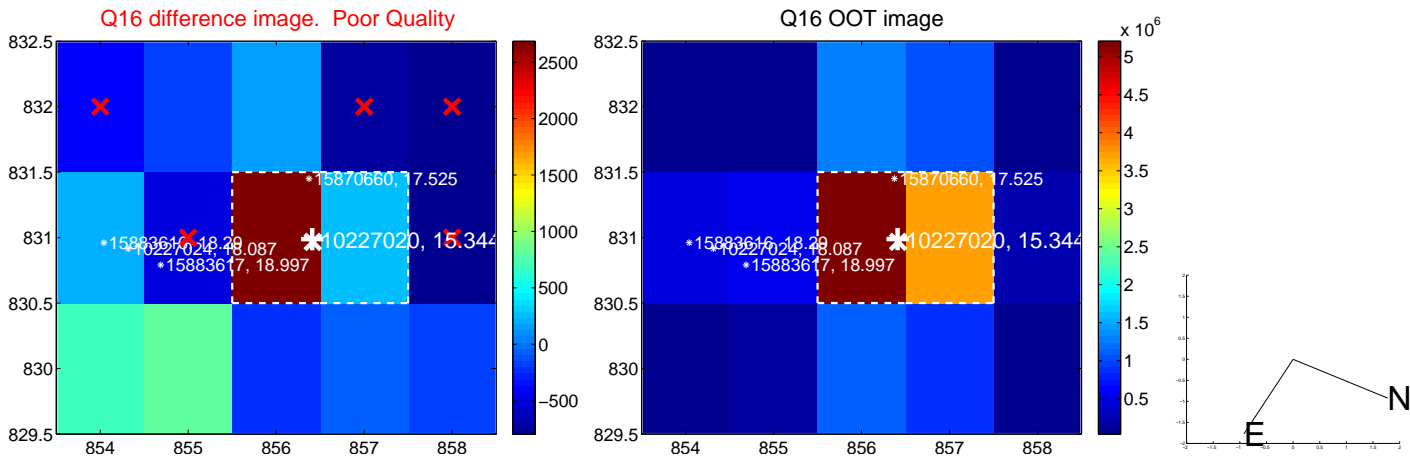
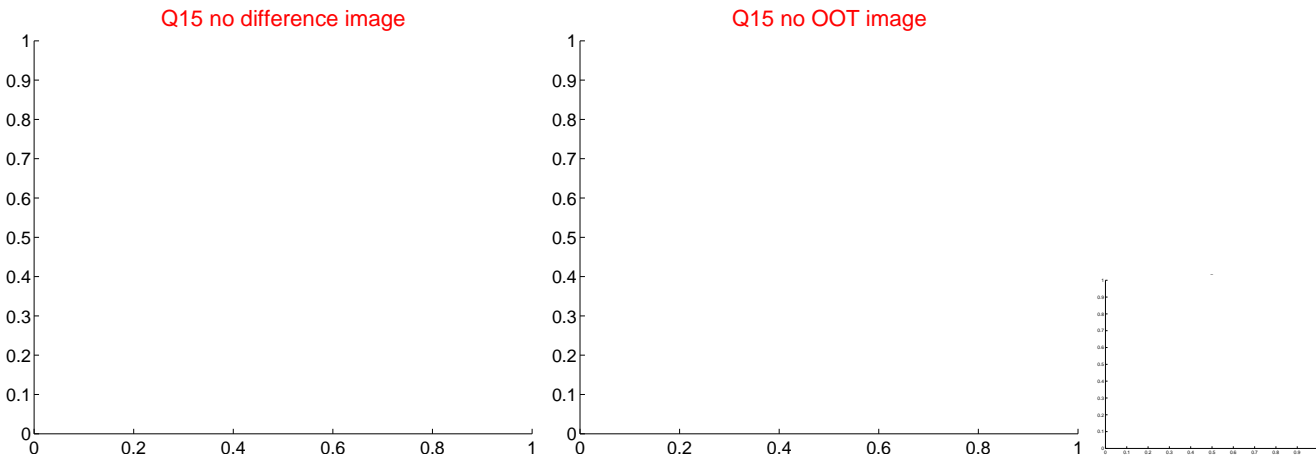
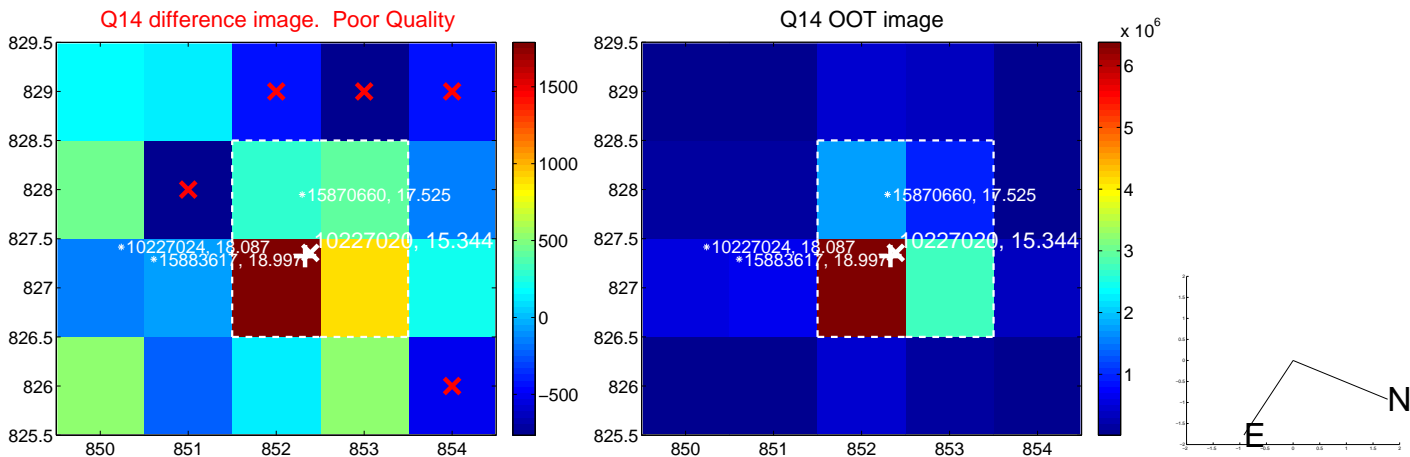
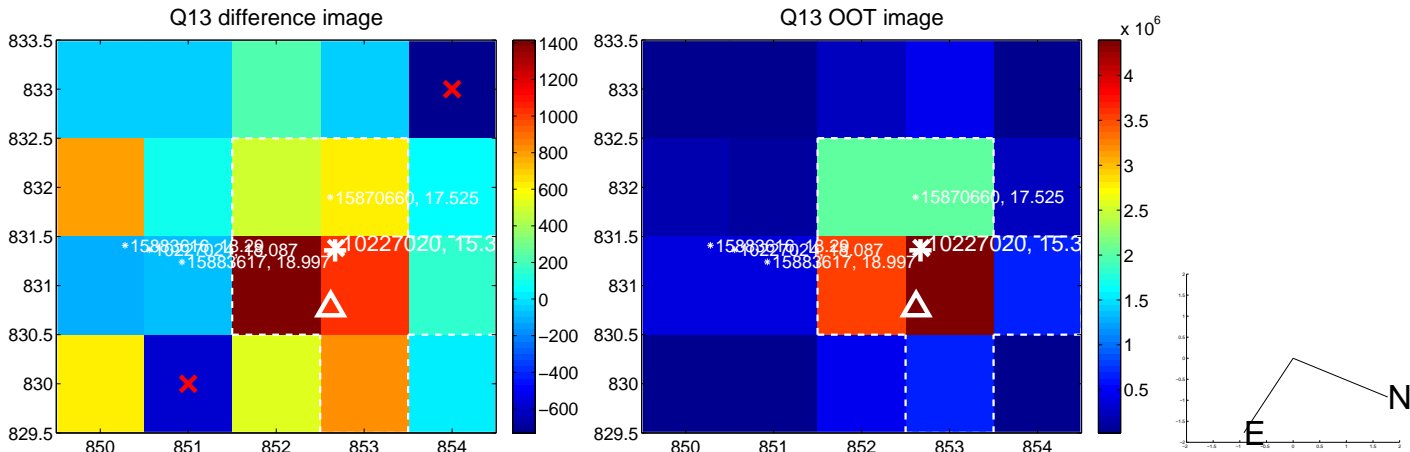
white ×: KIC target position; +: OOT centroid; △: difference centroid. red ×: large negative pixel value.



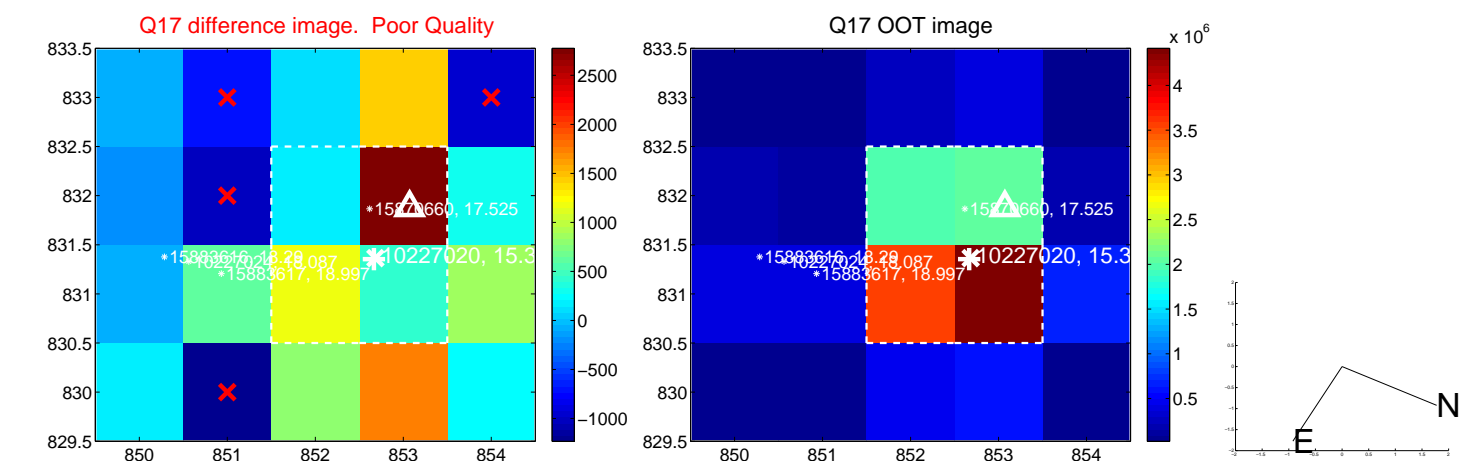
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



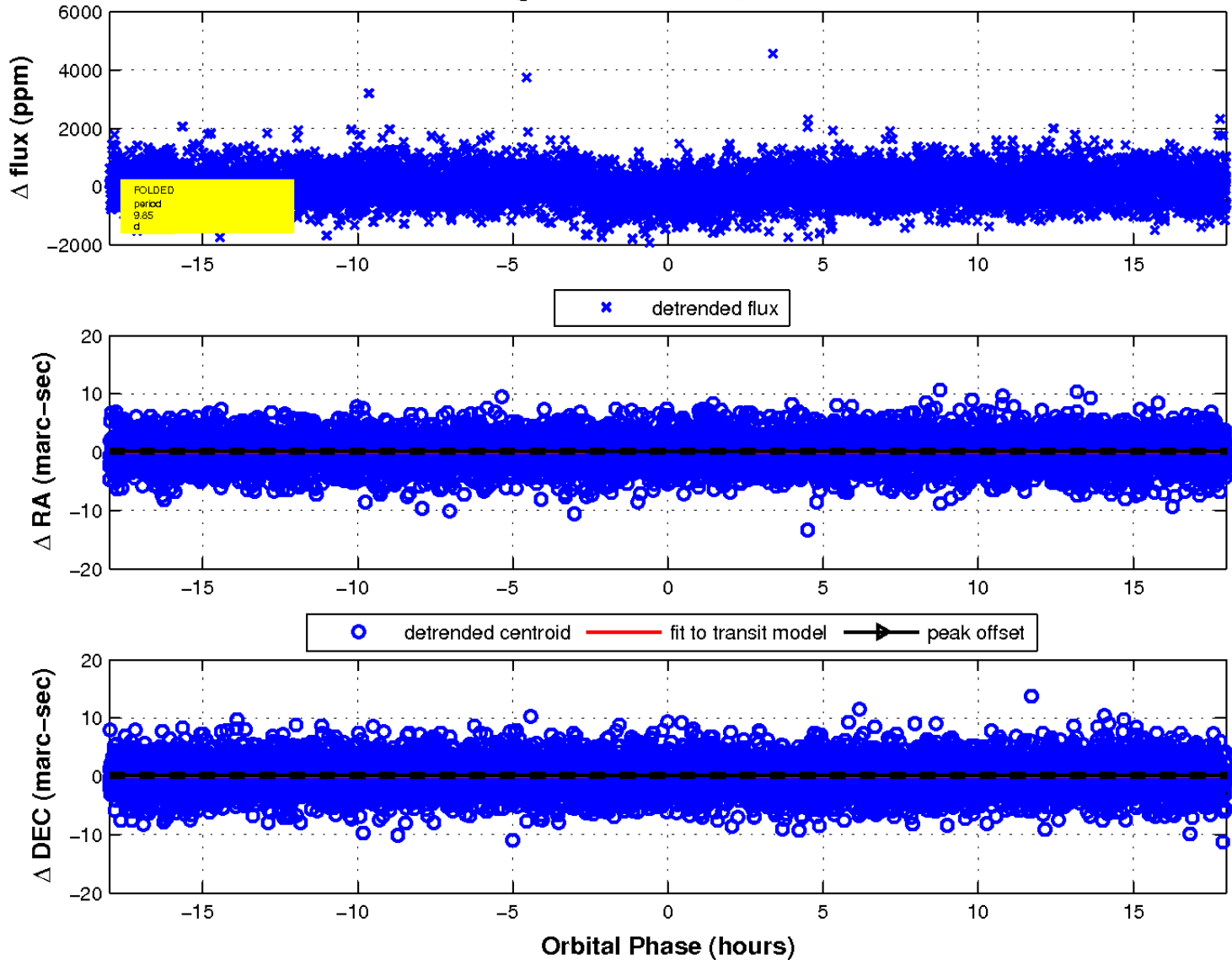
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



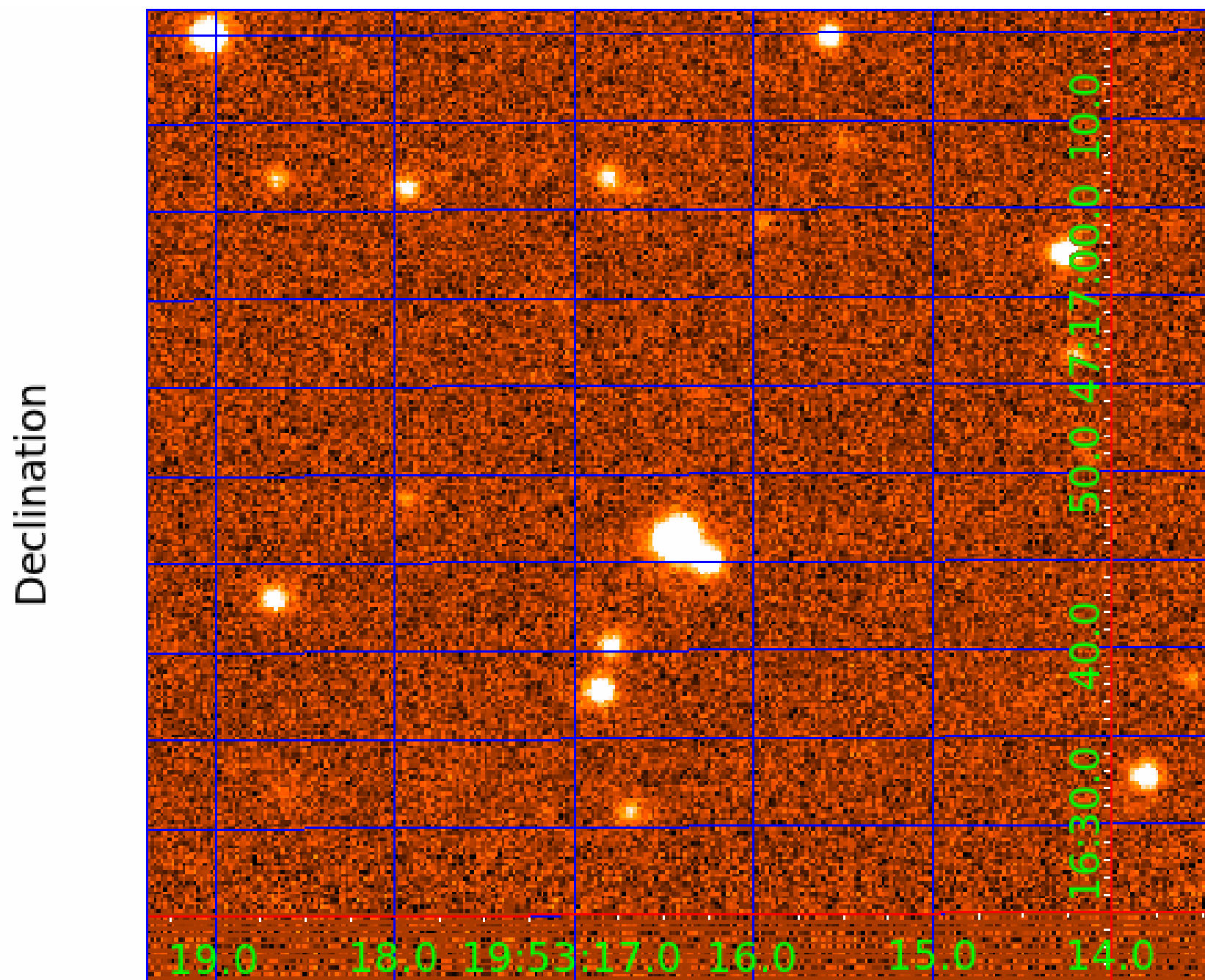
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



fluxWeightedCentroids, Planet 3 of 4



UKIRT Image



KIC 010227020

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}) |
|--------------|----------|---------|---------------|--------------|-------------|------------------|------|------|-----------------------------|-----------------|------------------------|------------------------|
| 010227020-01 | OBS | 0730.01 | 14.787584 | 132.428654 | 770.4 | 8.455 | 27.6 | 29.4 | 1.25 | 5814 | 4.93 | 110.60 |
| 010227020-02 | OBS | 0730.03 | 19.723809 | 135.075895 | 503.8 | 9.344 | 17.1 | 17.9 | 1.25 | 5814 | 3.98 | 75.33 |
| 010227020-03 | OBS | 0730.02 | 9.848205 | 138.392875 | 328.4 | 6.003 | 15.4 | 15.5 | 1.25 | 5814 | 2.58 | 190.16 |
| 010227020-04 | OBS | 0730.04 | 7.384377 | 137.477378 | 279.6 | 6.200 | 15.7 | 16.1 | 1.25 | 5814 | 2.71 | 279.16 |

Robovetter Results

| TCE | Run Type | Disp | Score | N | S | C | E | Comments |
|--------------|----------|------|-------|---|---|---|---|------------|
| 010227020-01 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-02 | OBS | PC | 1.00 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-03 | OBS | PC | 0.99 | 0 | 0 | 0 | 0 | NO_COMMENT |
| 010227020-04 | OBS | PC | 0.99 | 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.

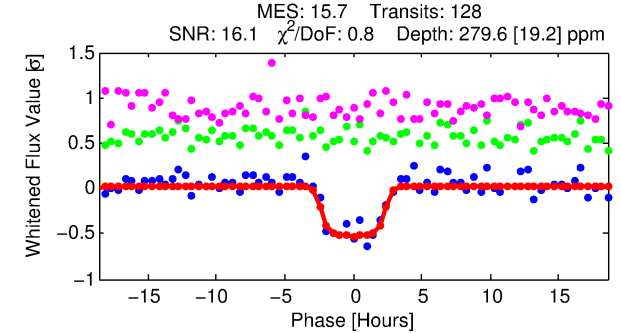
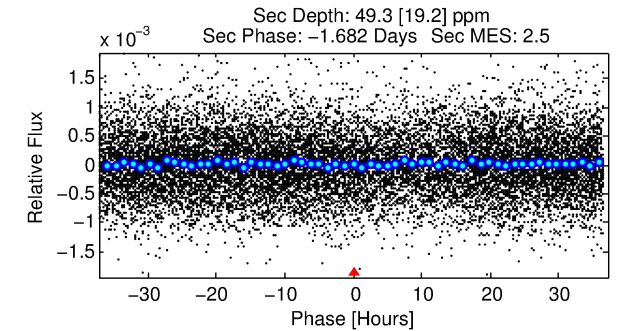
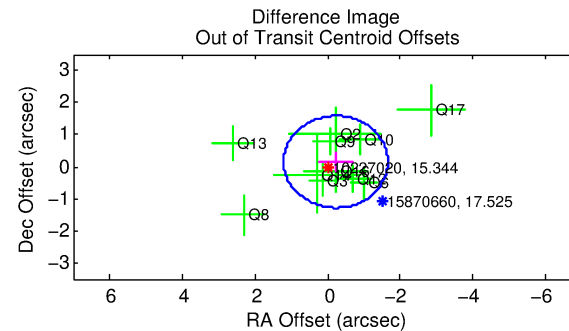
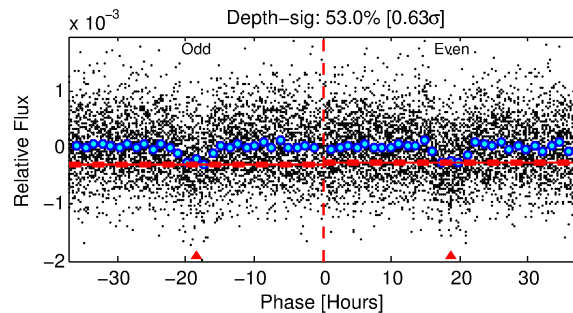
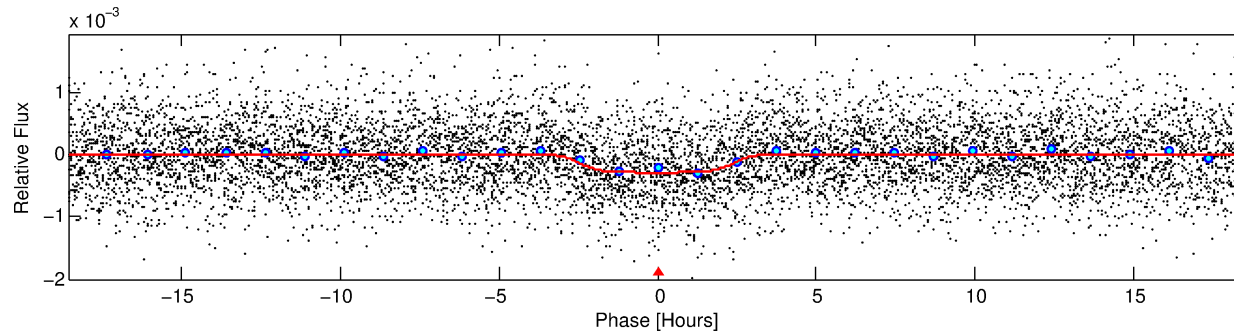
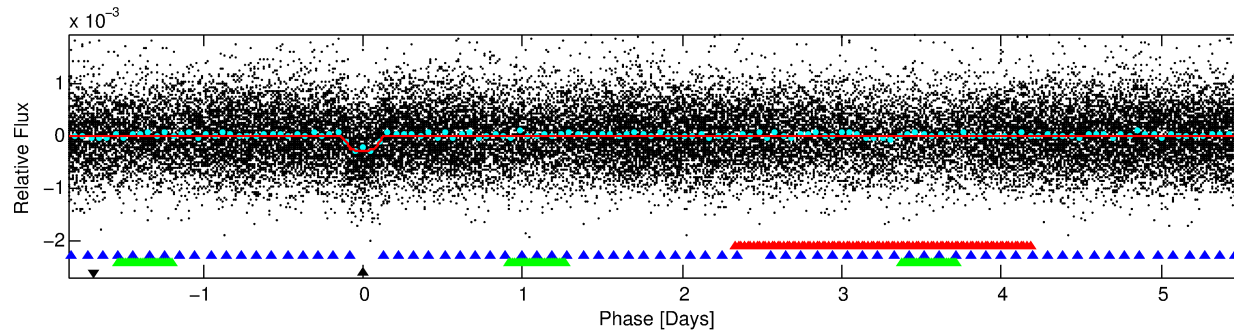
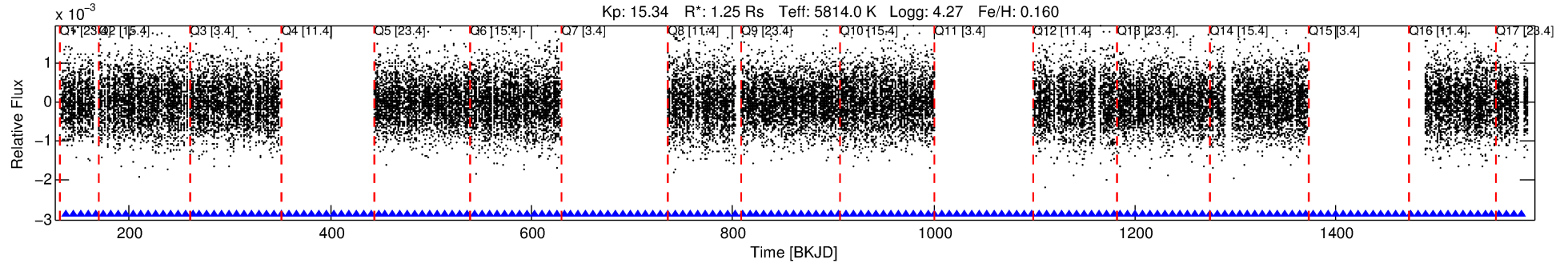
See http://exoplanetarchive.ipac.caltech.edu/docs/API_kepcandidate_columns.html#proj_disp_col for comment definitions.

Ephemeris Match Information For 010227020-04

No Significant Match Found

DV One-Page Summary

KIC: 10227020 Candidate: 4 of 4 Period: 7.384 d
KOI: K00730.04 Name: Kepler-223b Corr: 0.922



DV Fit Results:

Period = 7.38438 [0.00008] d
Epoch = 137.4774 [0.0082] BKJD
Rp/R* = 0.0199 [0.0012]
a/R* = 3.28 [0.67]
b = 0.96 [0.02]
Seff = 279.16 [68.14]
Teq = 1042 [64] K
Rp = 2.71 [0.48] Re
a = 0.0756 [0.0116] AU
Ag = 21.09 [9.97] [2.02 σ]
Teffp = 3453 [355] K [6.68 σ]

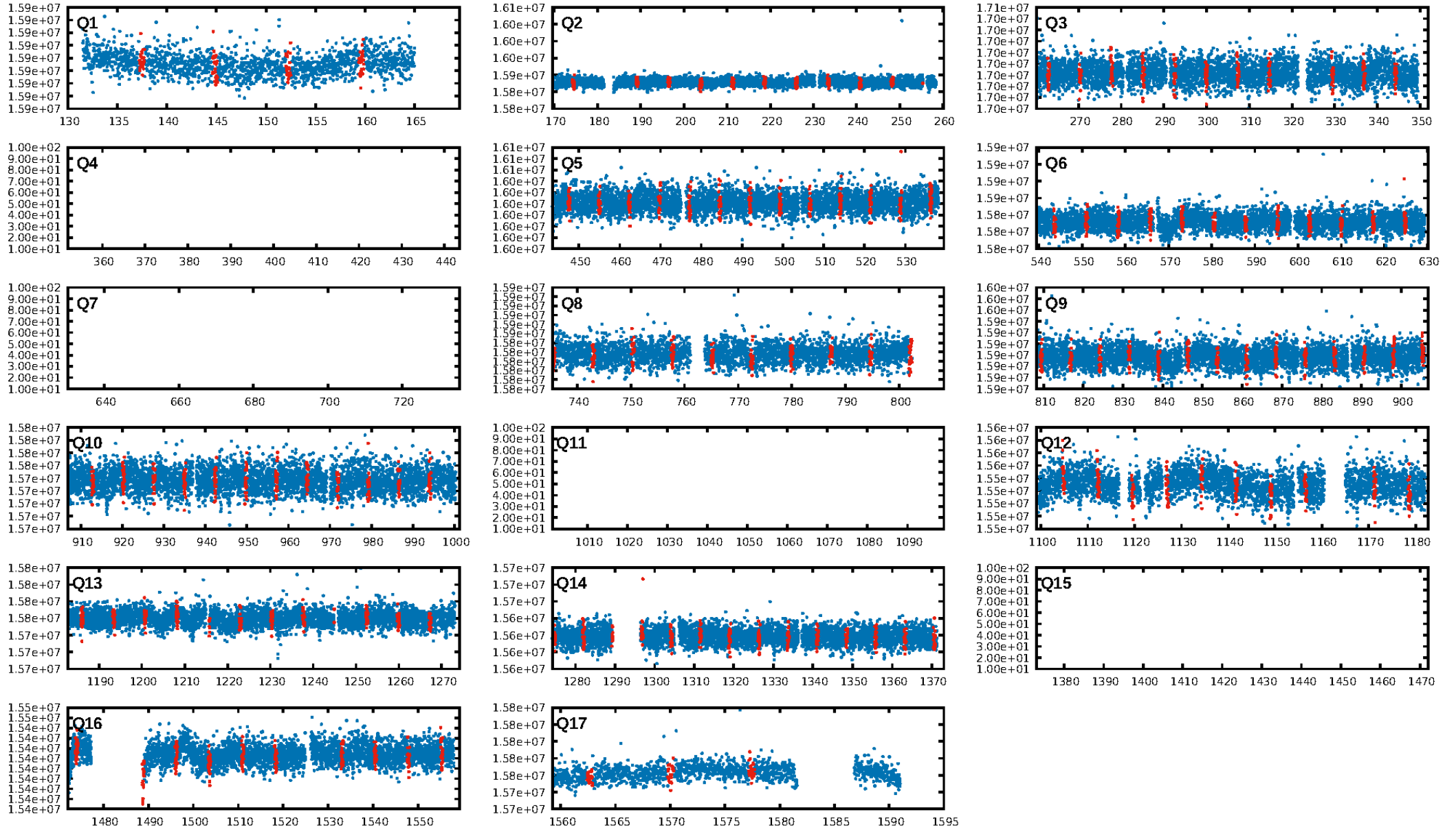
DV Diagnostic Results:

ShortPeriod-sig: N/A
LongPeriod-sig: 100.0% [6.85 σ]
ModelChiSquare2-sig: 100.0%
ModelChiSquareGof-sig: 100.0%
Bootstrap-pfa: 9.02e-57
RollingBand-fgt: 1.00 [121/121]
GhostDiagnostic-chr: 2.029
Centroid-sig: 96.3%
Centroid-so: 0.184 arcsec [0.22 σ]
OotOffset-rm: 0.270 arcsec [0.56 σ]
KicOffset-rm: 0.138 arcsec [0.32 σ]
OotOffset-st: 4/1/3/3 [11]
KicOffset-st: 4/1/3/3 [11]
DiffImageQuality-fgm: 0.91 [10/11]
DiffImageOverlap-fno: 1.00 [13/13]

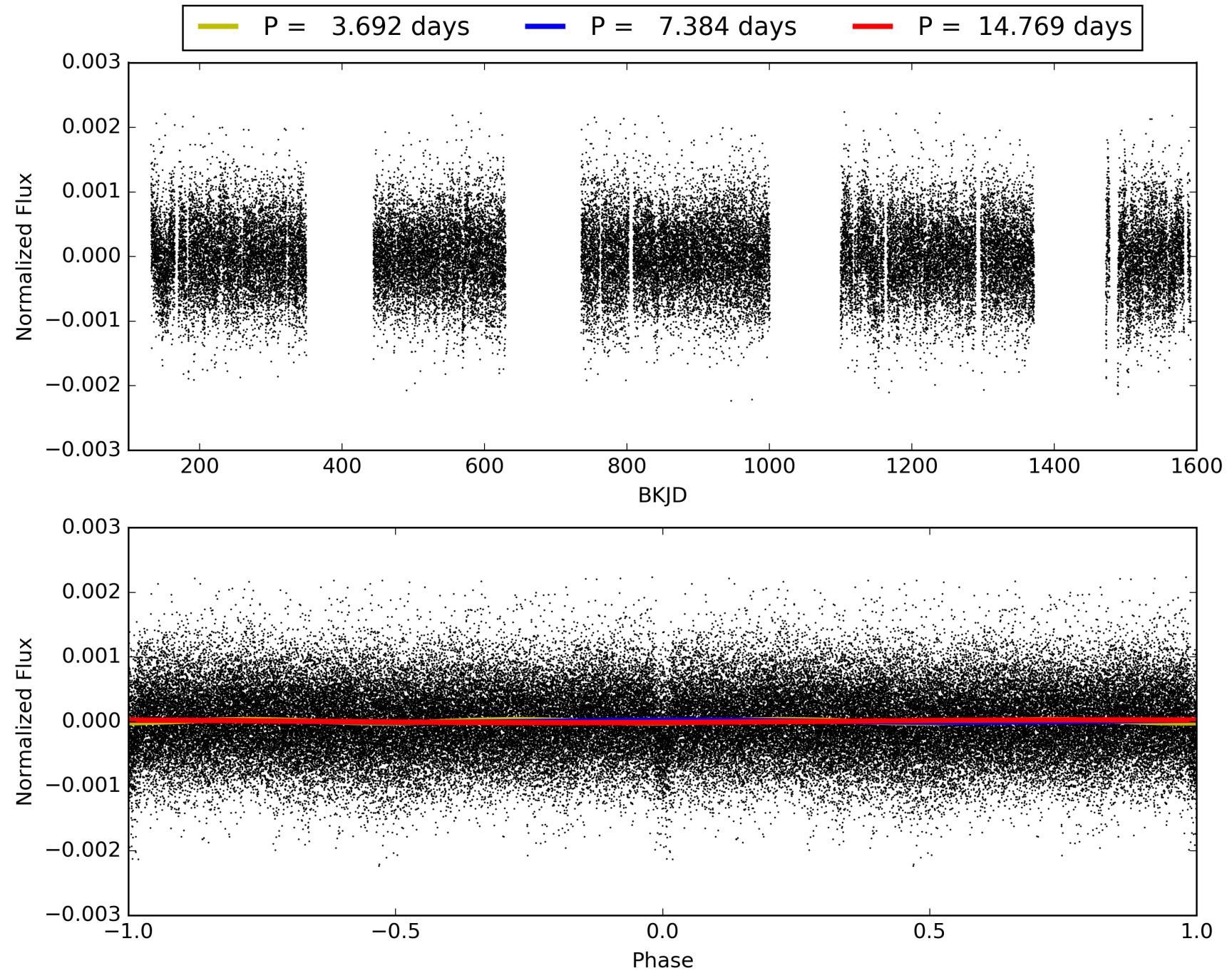
Software Revision: svn+ssh://murzim/repo/soc/tags/release/9.3.42@60958 -- Date Generated: 31-Jan-2016 22:17:48 Z

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

TCE 010227020-04, PDC Light Curves

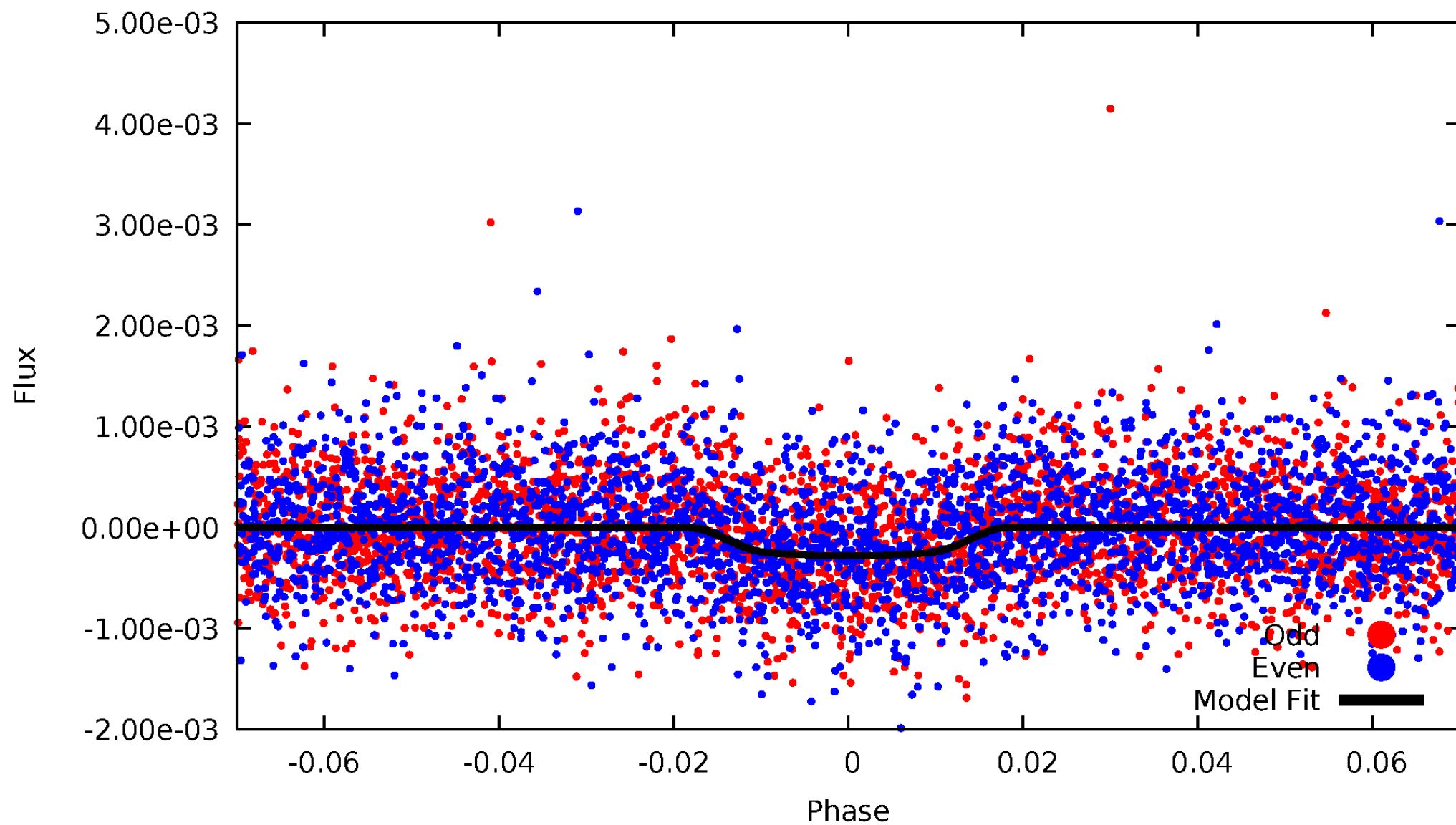


TCE 010227020-04



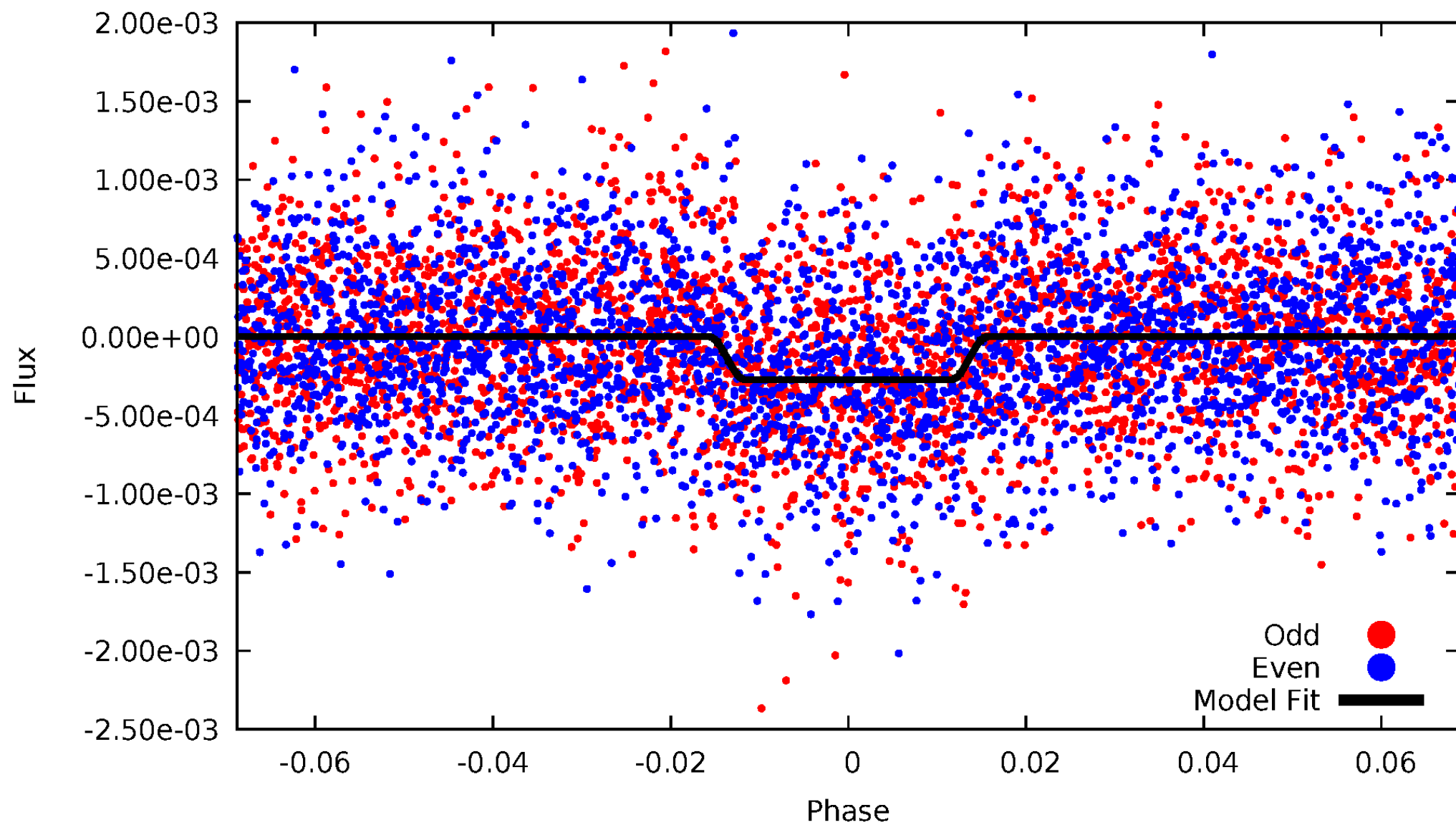
DV Odd/Even

TCE 010227020-04



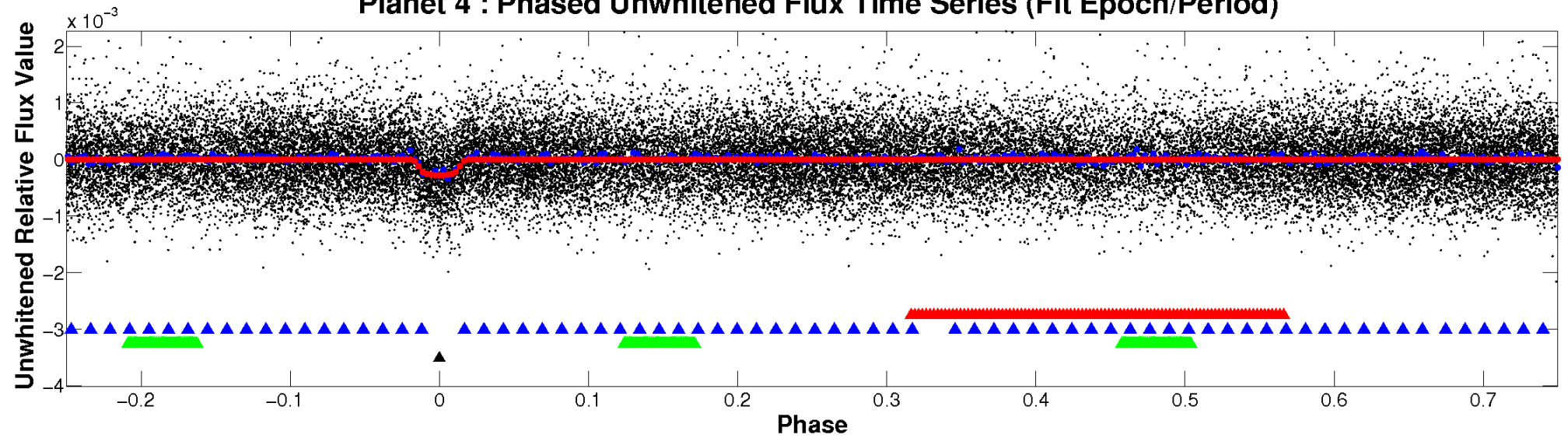
ALT Odd/Even

TCE 010227020-04

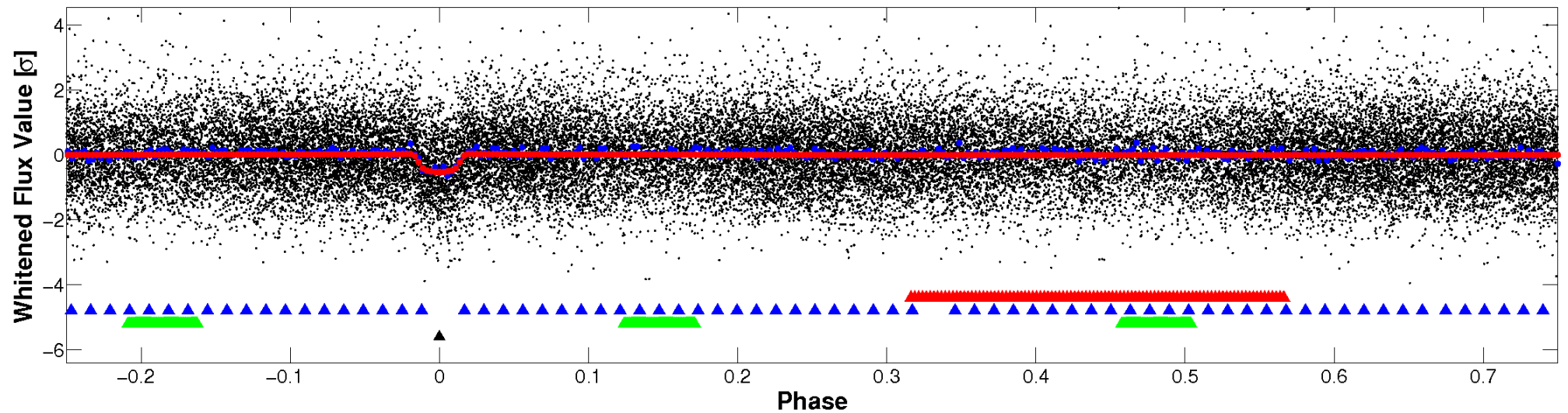


Non-Whitened Vs. Whitened Light Curve

Planet 4 : Phased Unwhitened Flux Time Series (Fit Epoch/Period)

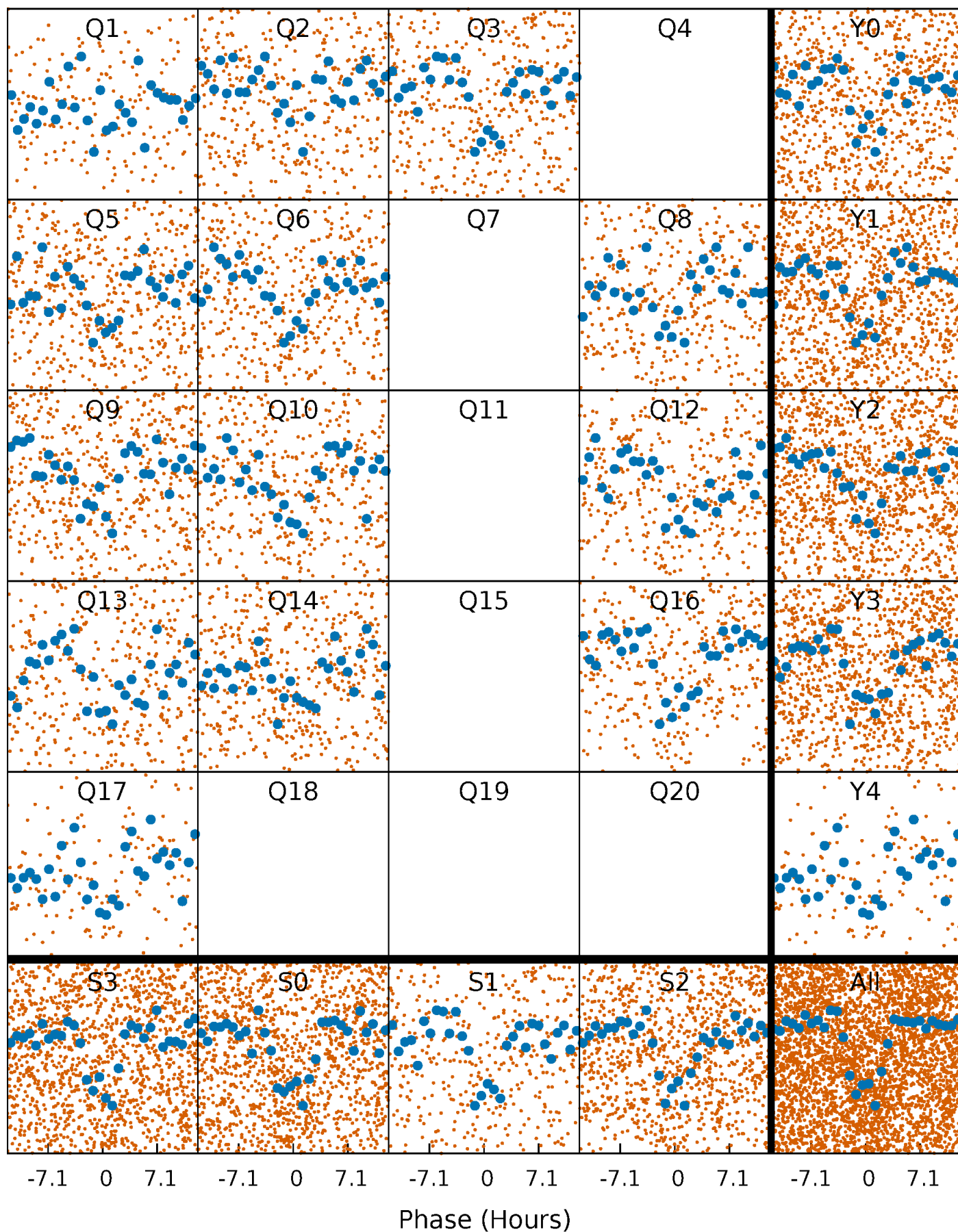


Planet 4 : Phased Whitened Flux Time Series (Fit Epoch/Period)



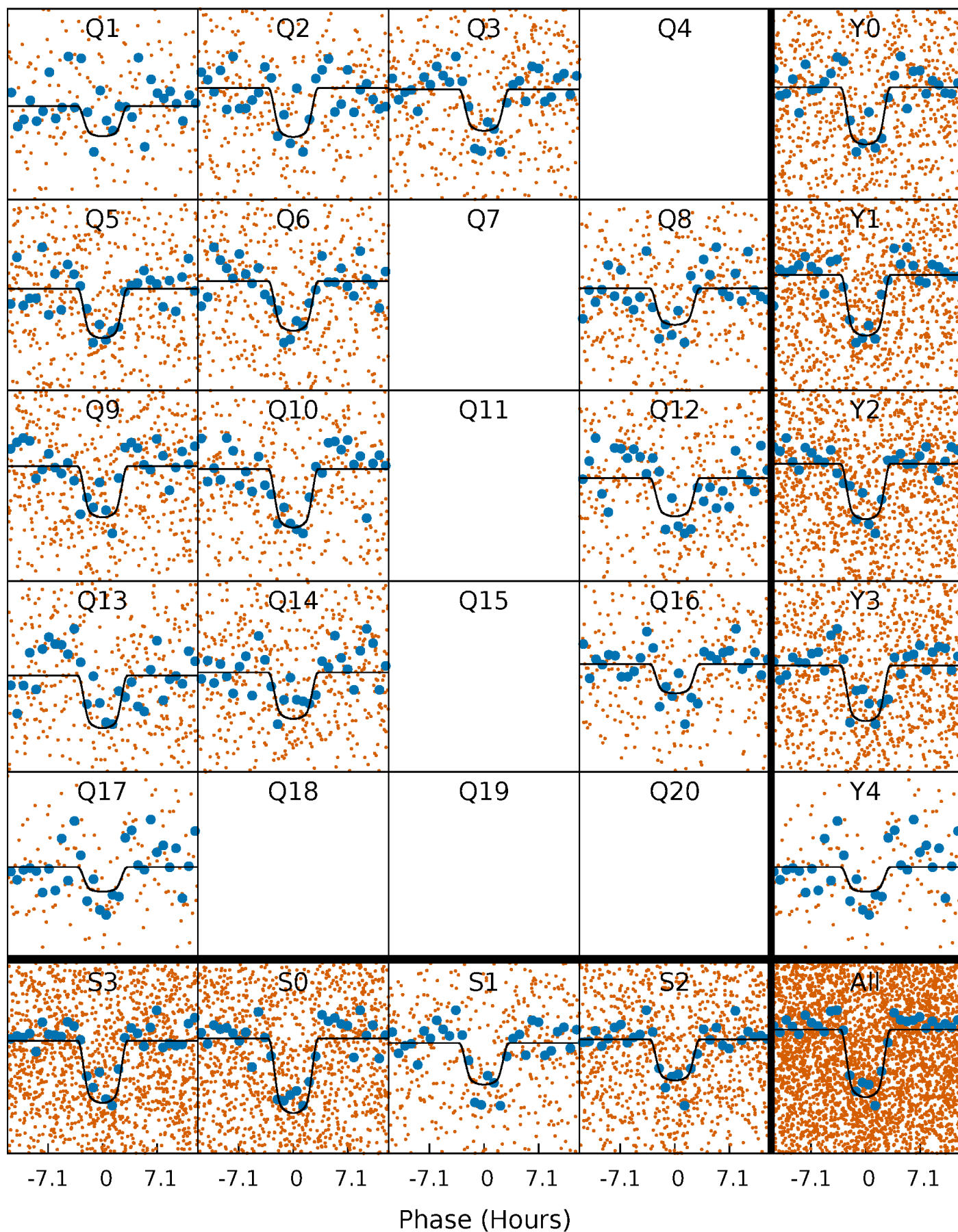
PDC Quarter-Phased Transit Curves

TCE 010227020-04 $P = 7.384377$ Days $T_0 = 137.477378$ (BKJD)



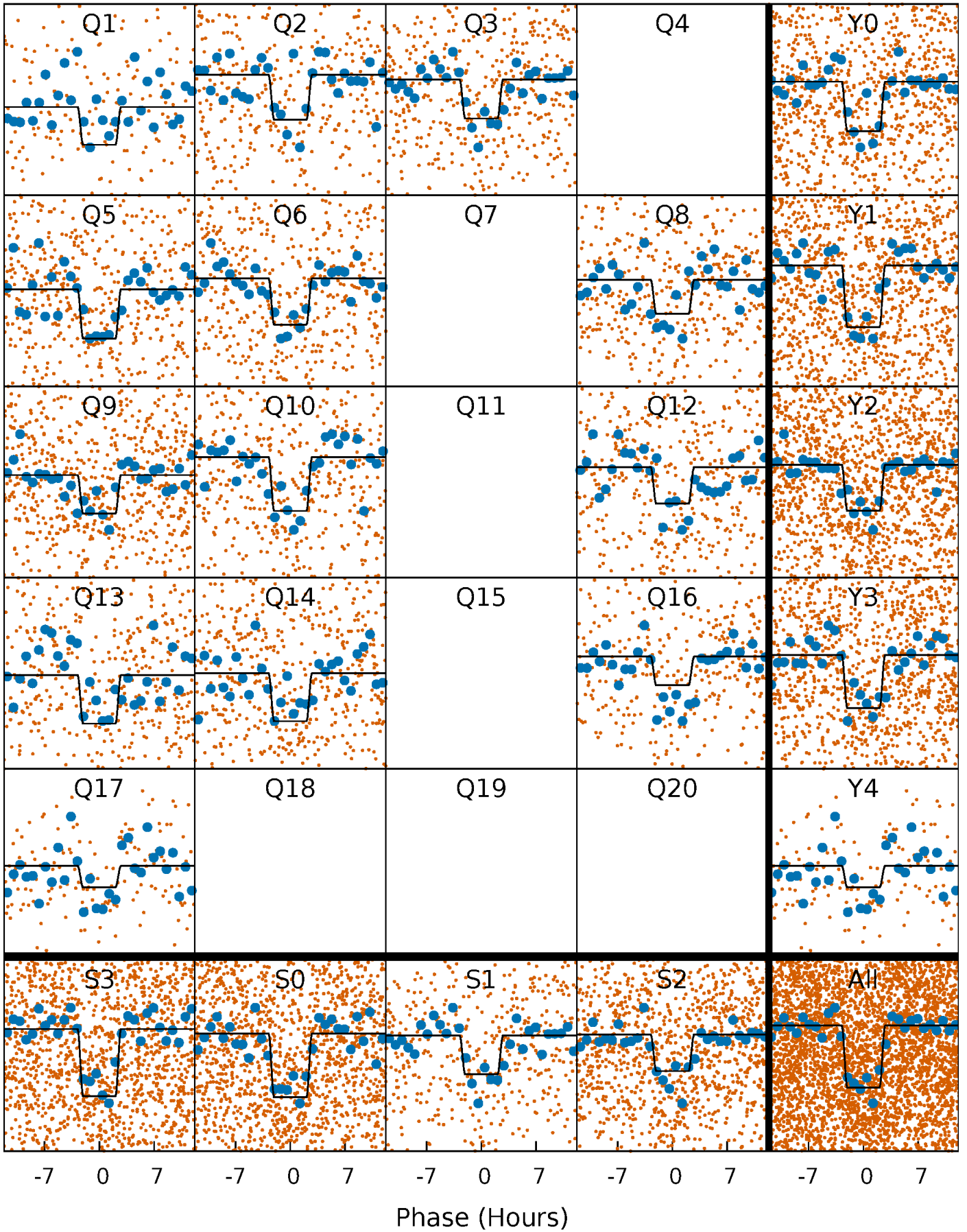
DV Quarter-Phased Transit Curves

TCE 010227020-04 P= 7.384377 Days $T_0=137.477378$ (BKJD)



Alt. Detrend Quarter-Phased Transit Curves

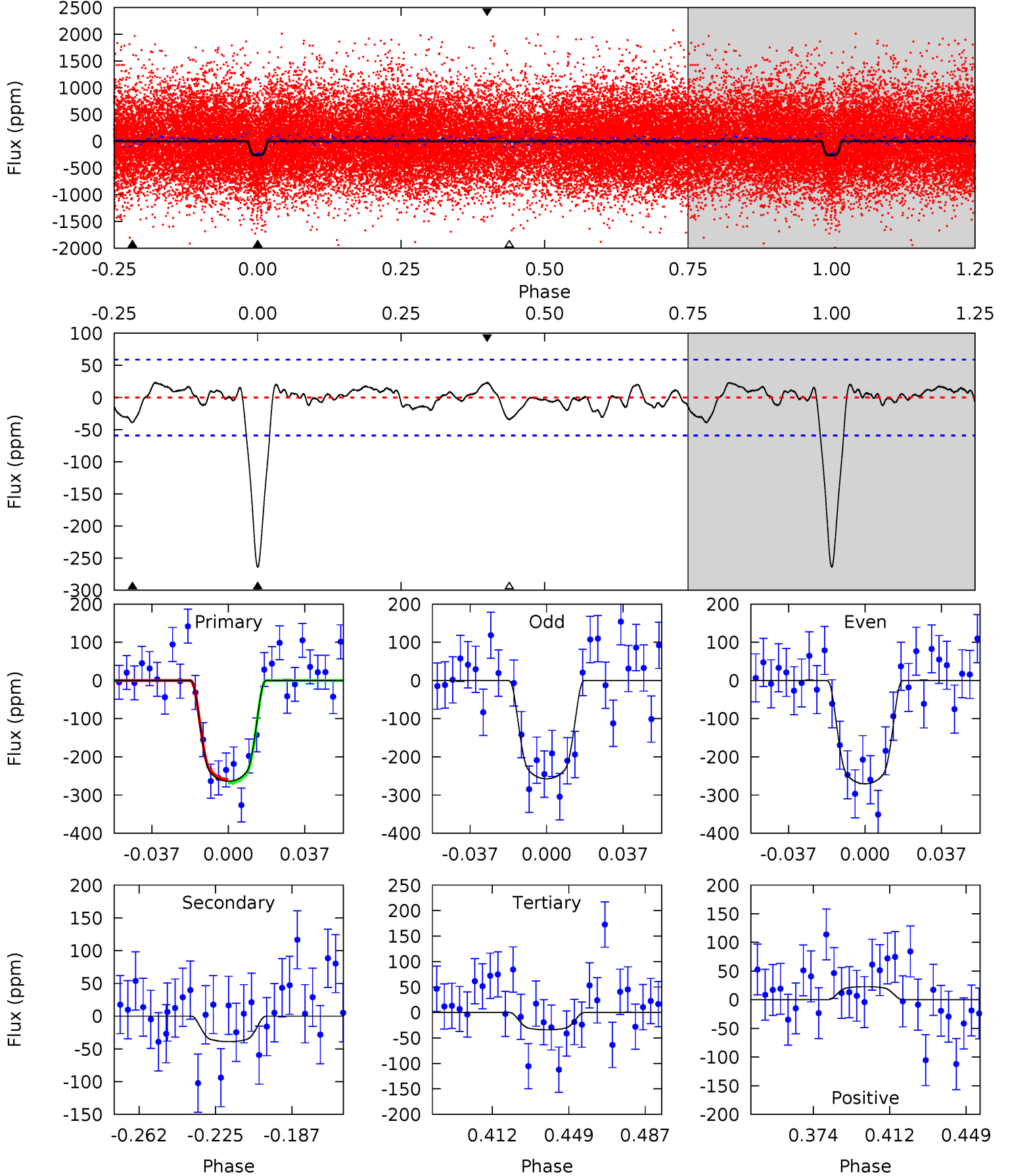
TCE 010227020-04 $P = 7.384419$ Days $T_0 = 137.473702$ (BKJD)



DV Model-Shift Uniqueness Test

010227020-04, P = 7.384377 Days, E = 130.093001 Days

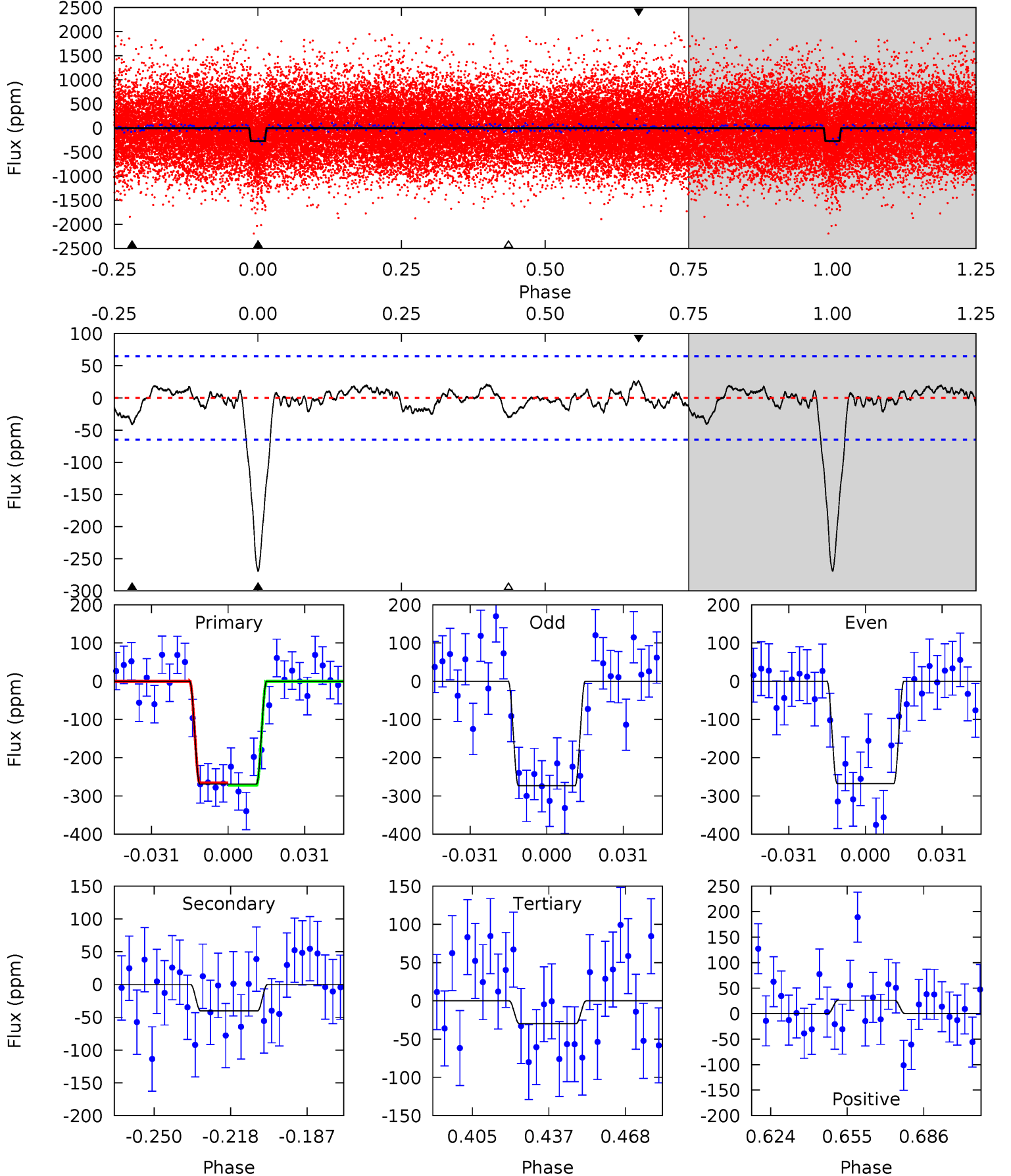
| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 21.3 | 3.14 | 2.74 | 1.84 | 4.77 | 2.08 | 0.95 | 18.5 | 19.4 | 0.40 | 1.30 | 0.54 | 1.04 | 0.08 | 0.38 |



Alt Model-Shift Uniqueness Test

010227020-04, P = 7.384419 Days, E = 130.089283 Days

| Pri | Sec | Ter | Pos | FA ₁ | FA ₂ | F _{Red} | Pri-Ter | Pri-Pos | Sec-Ter | Sec-Pos | Odd-Evn | DMM | Shape | TAT |
|------|------|------|------|-----------------|-----------------|------------------|---------|---------|---------|---------|---------|------|-------|------|
| 20.0 | 3.00 | 2.21 | 1.94 | 4.80 | 2.15 | 0.83 | 17.8 | 18.0 | 0.79 | 1.06 | 0.22 | 1.07 | 0.09 | 0.24 |



Stellar Parameters For KIC 010227020

| | $T_{\text{eff}}(K)$ | $\log(g)$ | [Fe/H] | R (R_{\odot}) | $M(M_{\odot})$ | p_{\star} ($\text{g}\cdot\text{cm}^{-3}$) |
|--------|---------------------|---------------------------|---------------------------|---------------------------|---------------------------|---|
| | 5814^{+78}_{-78} | $4.269^{+0.137}_{-0.112}$ | $0.160^{+0.150}_{-0.150}$ | $1.248^{+0.209}_{-0.209}$ | $1.055^{+0.081}_{-0.067}$ | $0.765^{+0.497}_{-0.259}$ |
| | +1%/-1% | +3%/-3% | +94%/-94% | +17%/-17% | +8%/-6% | +65%/-34% |
| Source | SPE90 | SPE90 | SPE90 | DSEP | | |

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

Secondary Eclipse Parameters for KIC 010227020-04 / KOI 0730.04

| Detrend | Depth (ppm) | R_p (R_{\oplus}) | T_{max} (K) | T_{obs} (K) | A_{obs} |
|---------|--------------|------------------------|--------------------|----------------------|-----------------|
| DV | -39 ± 12 | $2.70^{+0.30}_{-0.31}$ | 1460^{+62}_{-66} | 3684^{+186}_{-214} | 17^{+7}_{-6} |
| Alt. | -40 ± 13 | $2.25^{+0.28}_{-0.28}$ | 1455^{+70}_{-68} | 3924^{+242}_{-296} | 24^{+12}_{-9} |

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

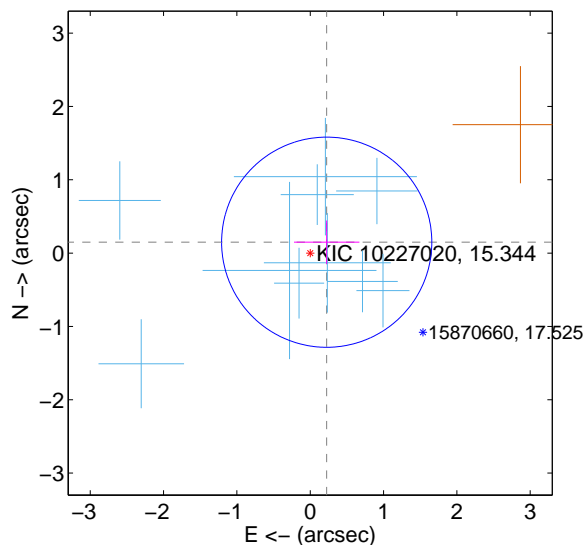
Supplemental centroid analysis for 010227020-04. Kepler magnitude: 15.34. Transit SNR 16.09

There are 10 quarters with good PRF difference image offsets

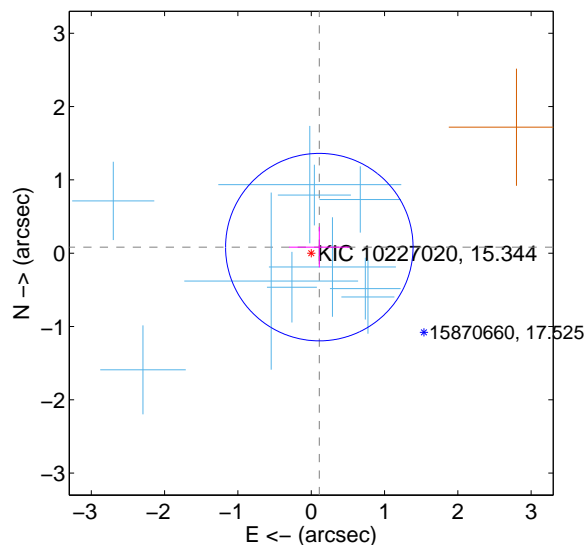
The direct PRF centroid is offset from the target star catalog position by about 0.07 arcsec

| | Distance in arcsec | Distance / σ | Δ RA | Δ Dec |
|---|--------------------|---------------------|--------------------|-------------------|
| PRF-fit source offset from OOT | 0.270 ± 0.478 | 0.56 | -0.225 ± 0.446 | 0.148 ± 0.296 |
| PRF-fit source offset from KIC position | 0.138 ± 0.426 | 0.32 | -0.110 ± 0.412 | 0.083 ± 0.277 |
| photometric centroid source offset | 0.18 ± 0.86 | 0.22 | 0.13 ± 0.86 | -0.13 ± 0.85 |

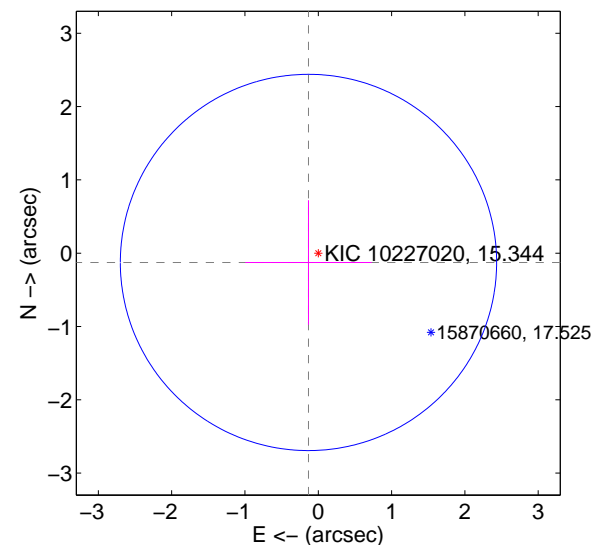
offset from difference PRF-fit to OOT PRF-fit



offset from difference PRF-fit to KIC position

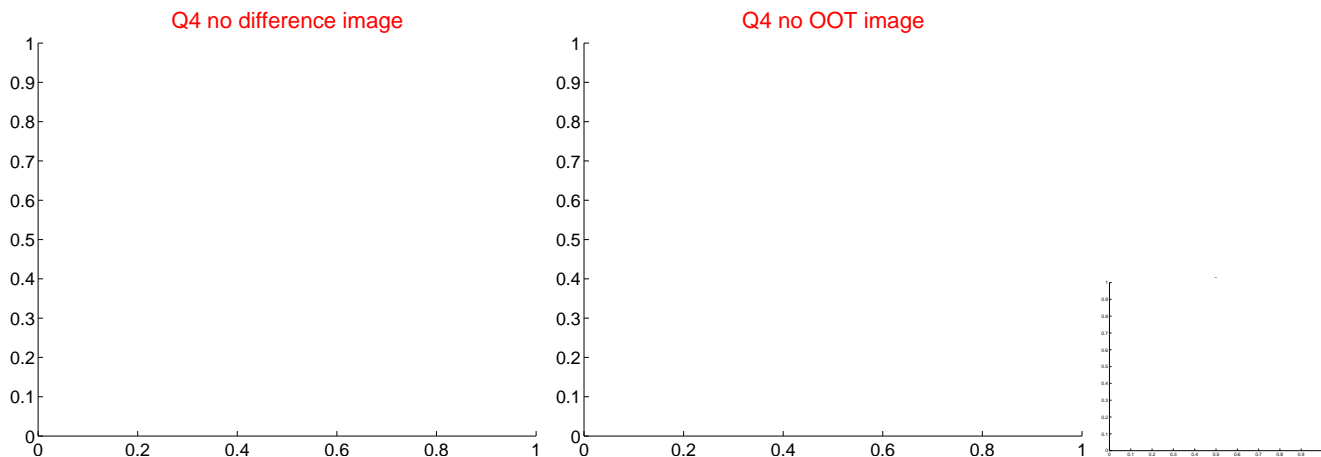
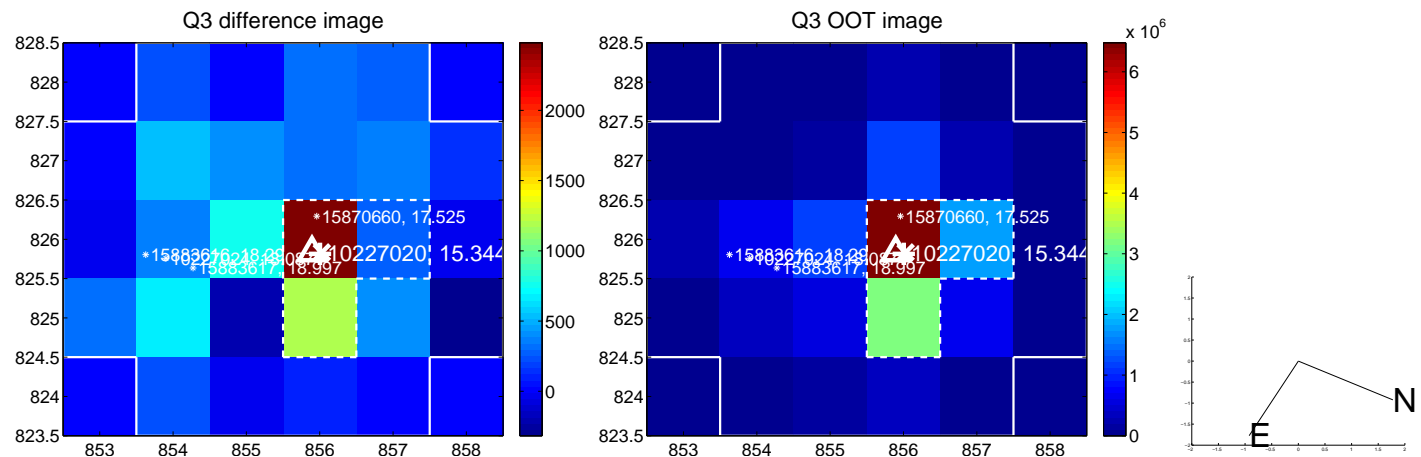
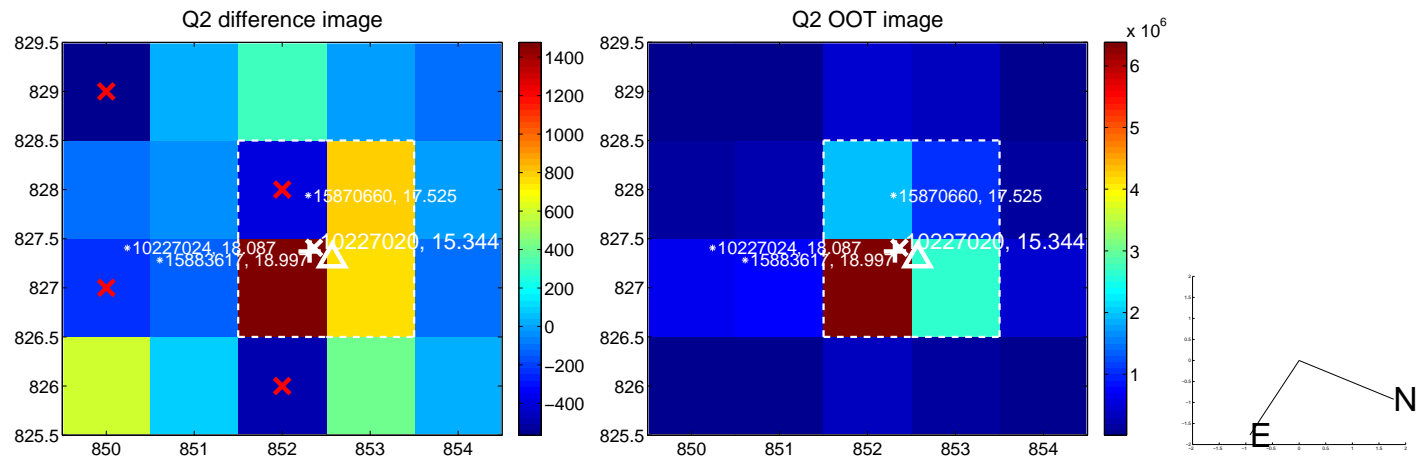
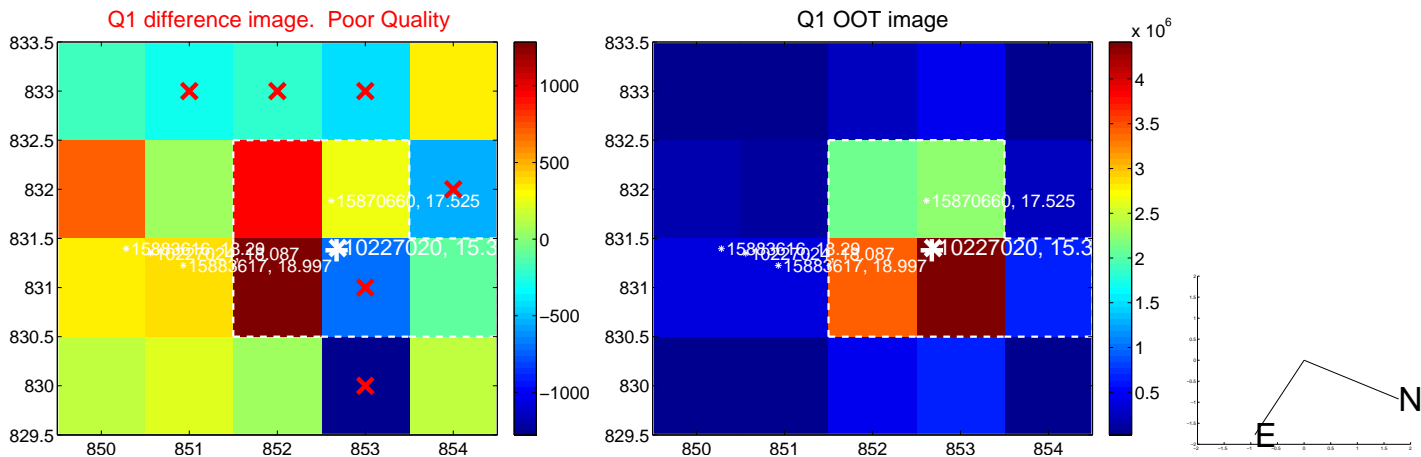


offset from photometric centroids

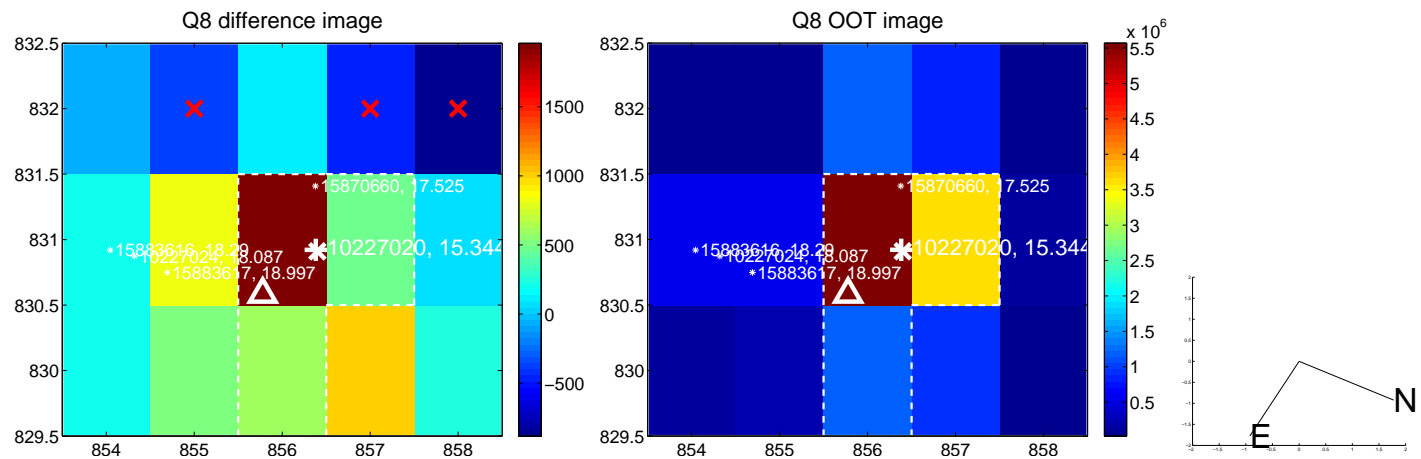
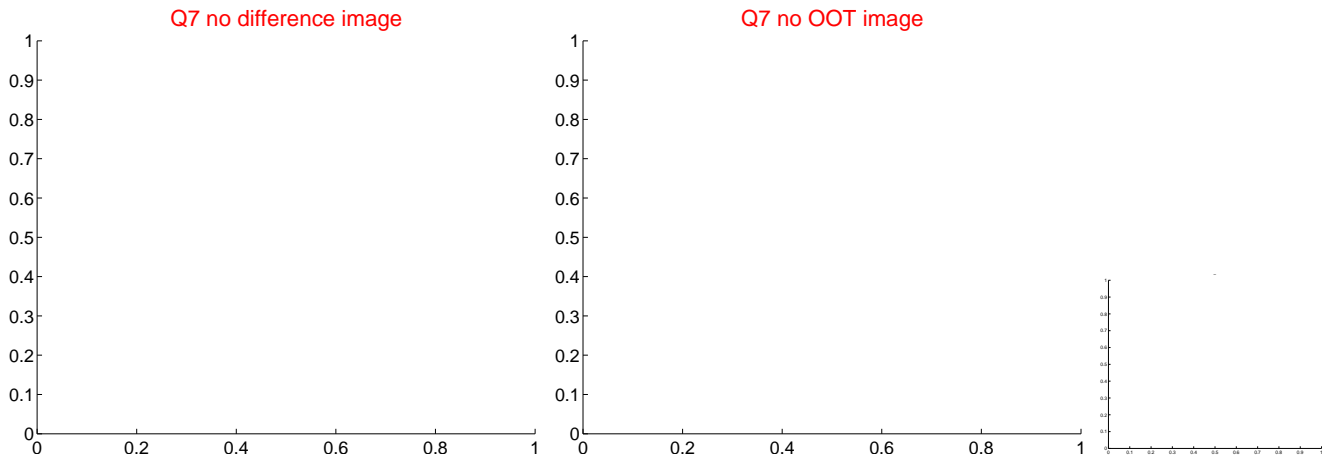
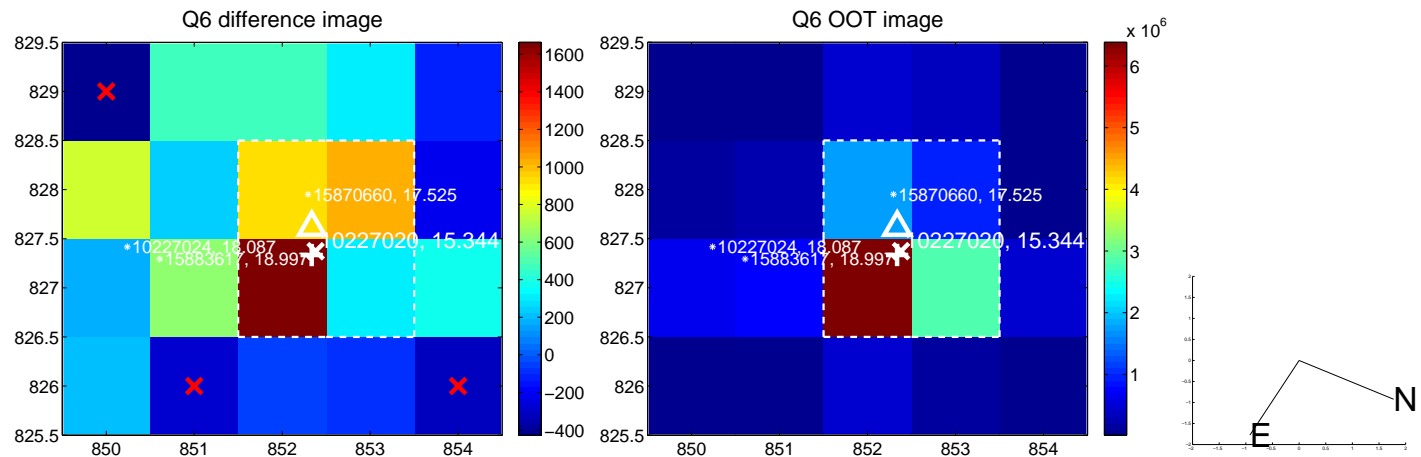
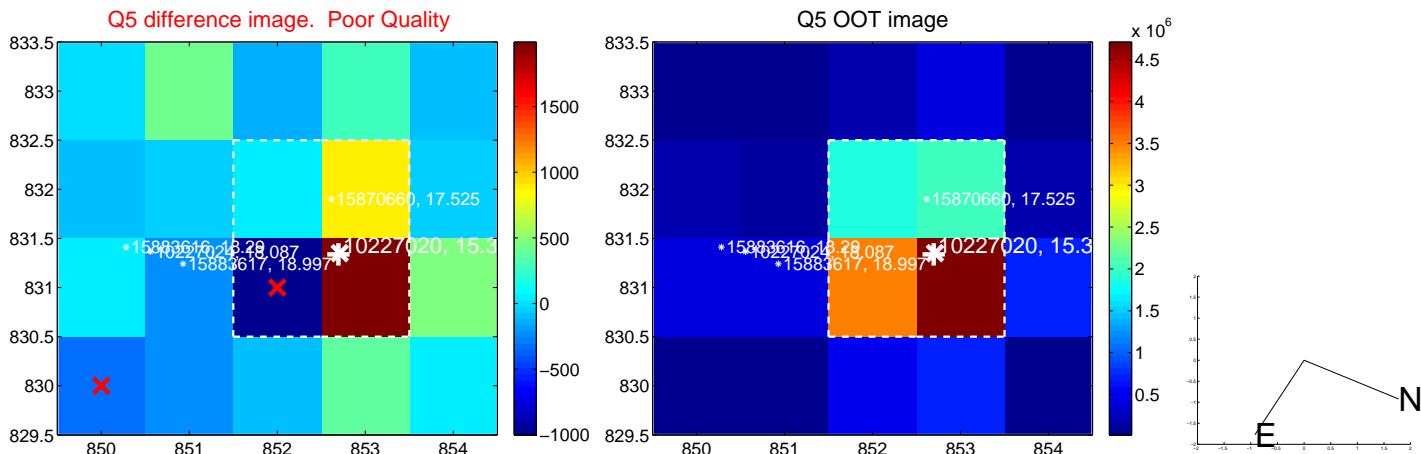


Centroid source offsets from the target star reconstructed from PRF and photometric centroids. **Sky blue crosses:** good quarterly centroid offsets; **Vermillion crosses:** bad quarterly centroid offsets; magenta cross: average over quarters. Length of the crosses: one- σ uncertainty. Blue circle: three-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

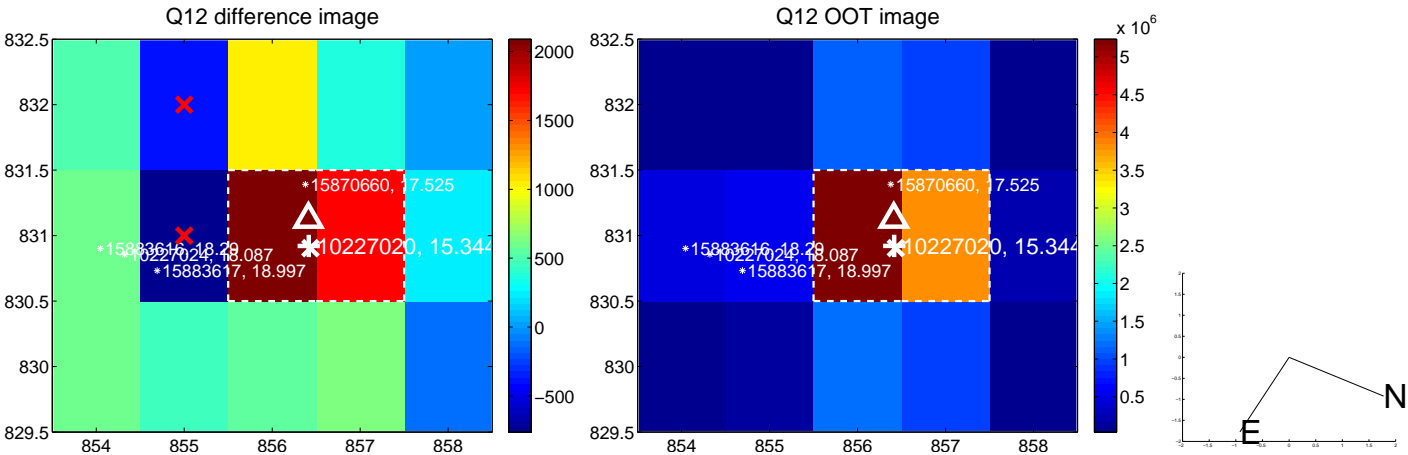
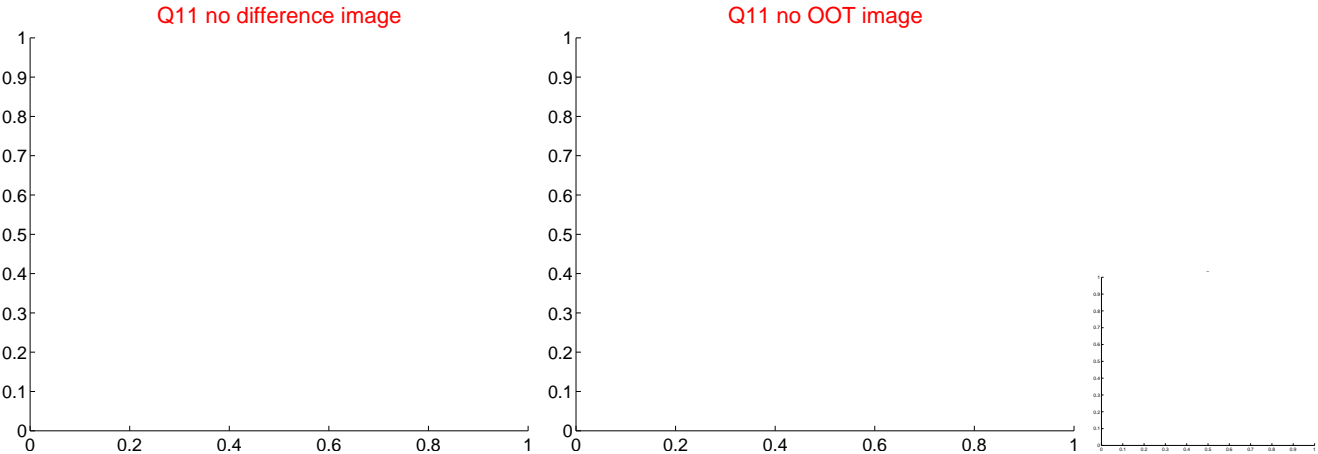
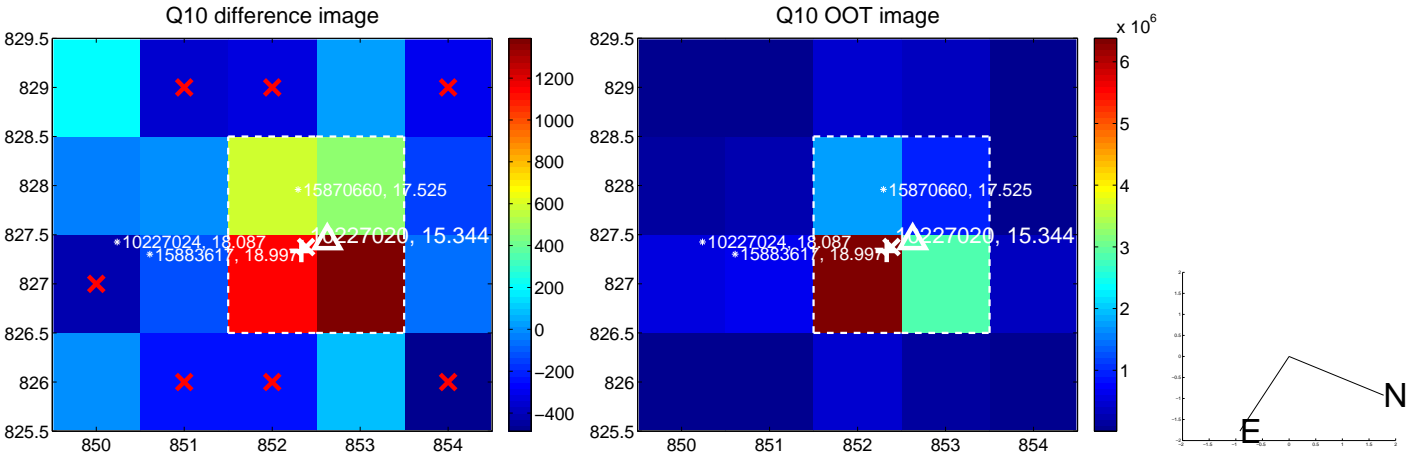
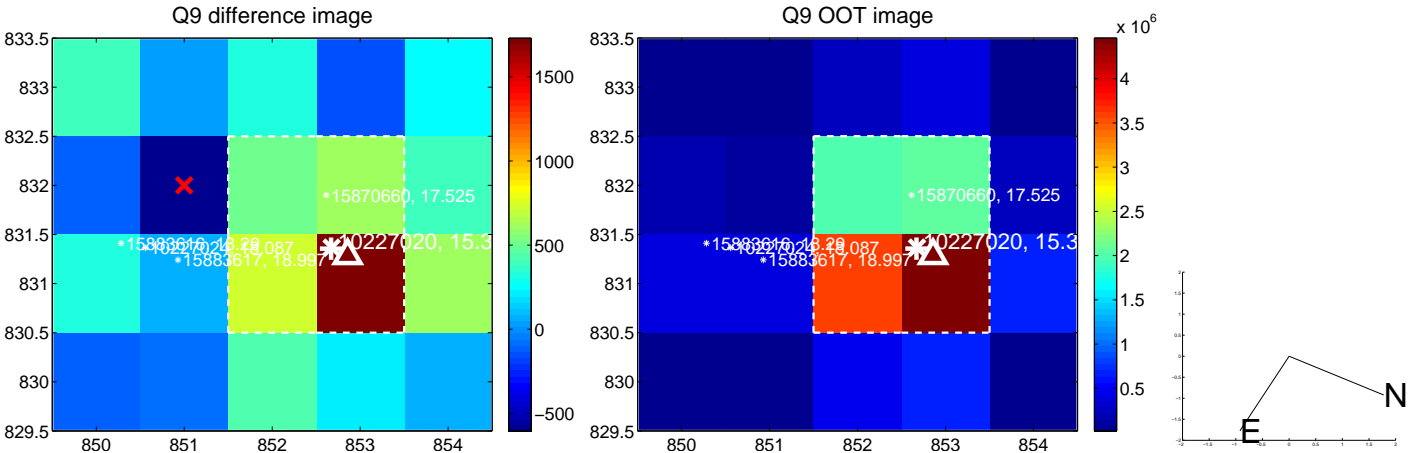
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



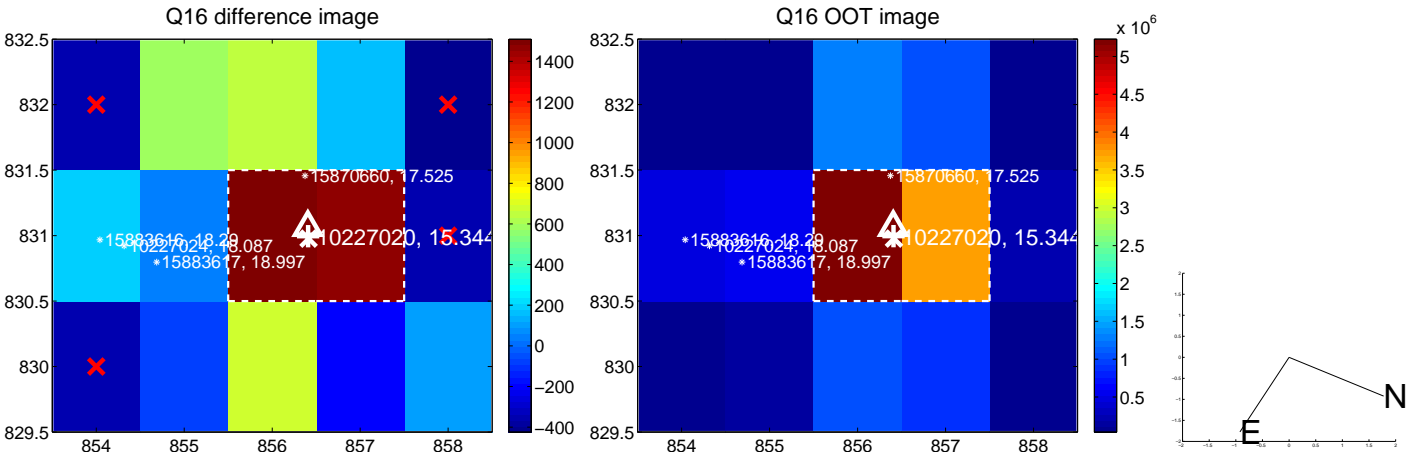
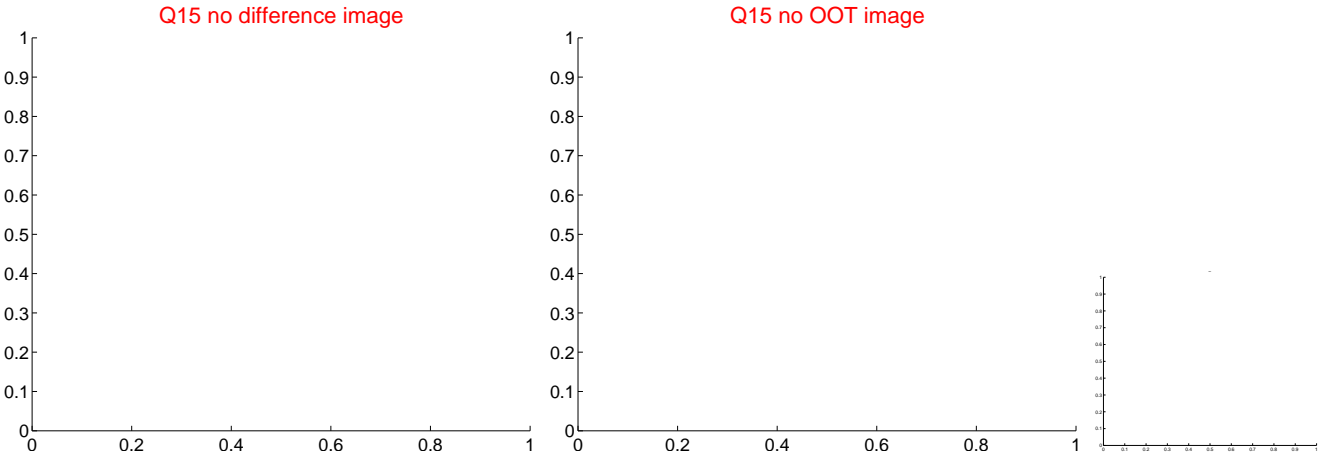
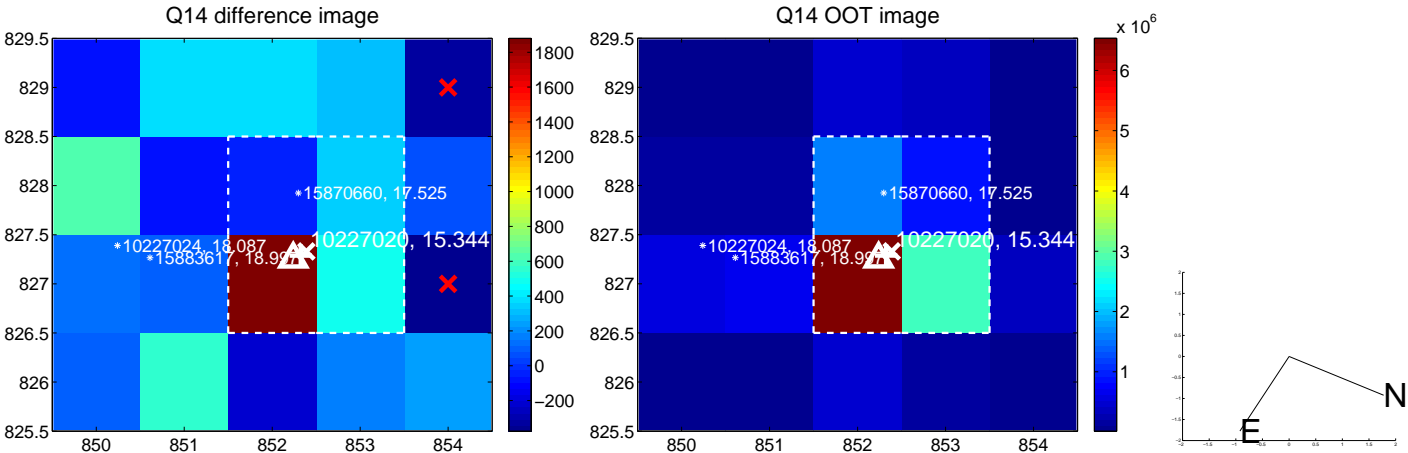
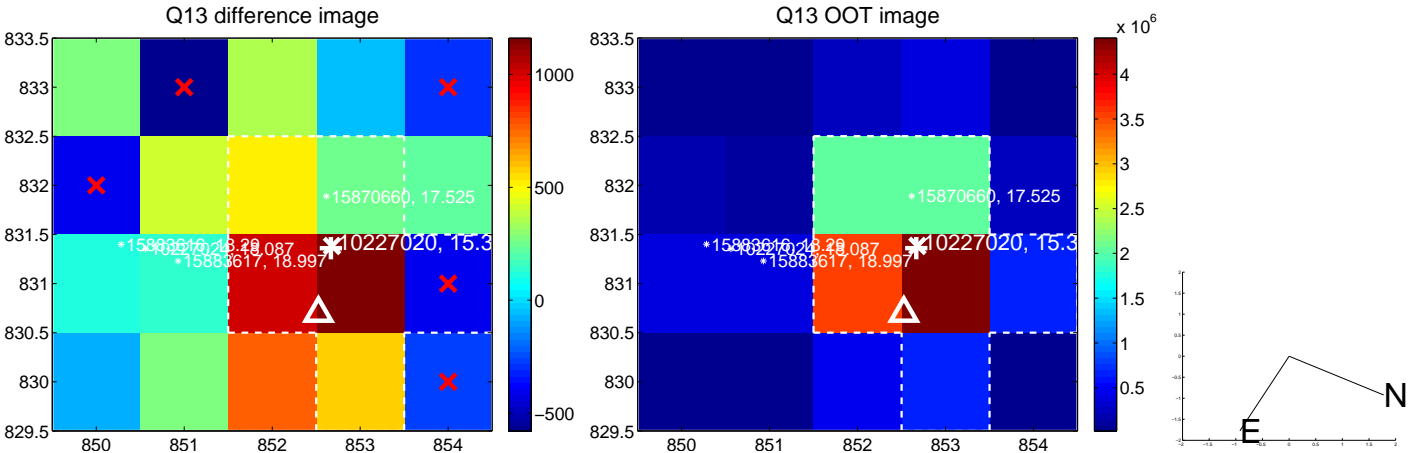
white \times : KIC target position; $+$: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



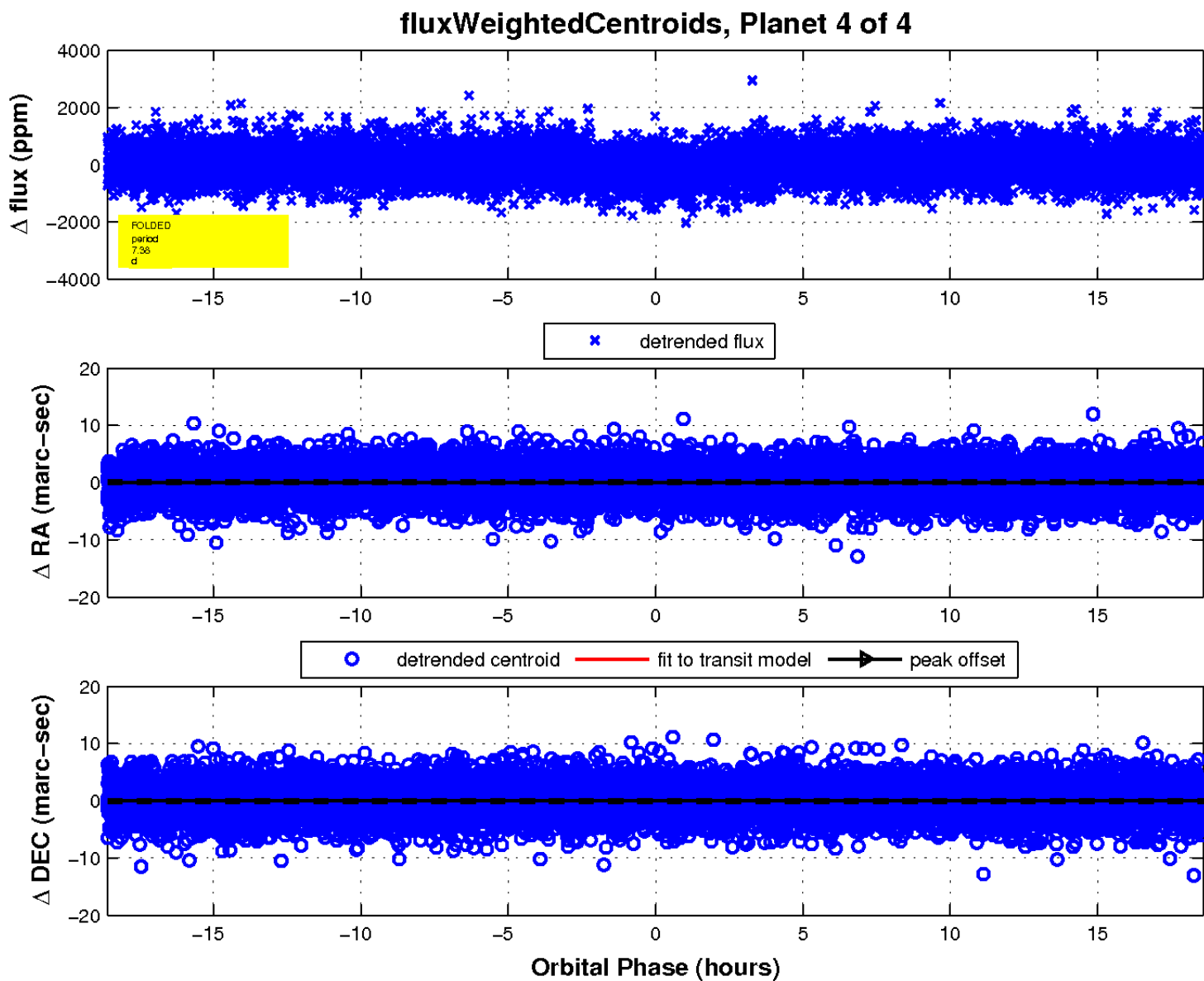
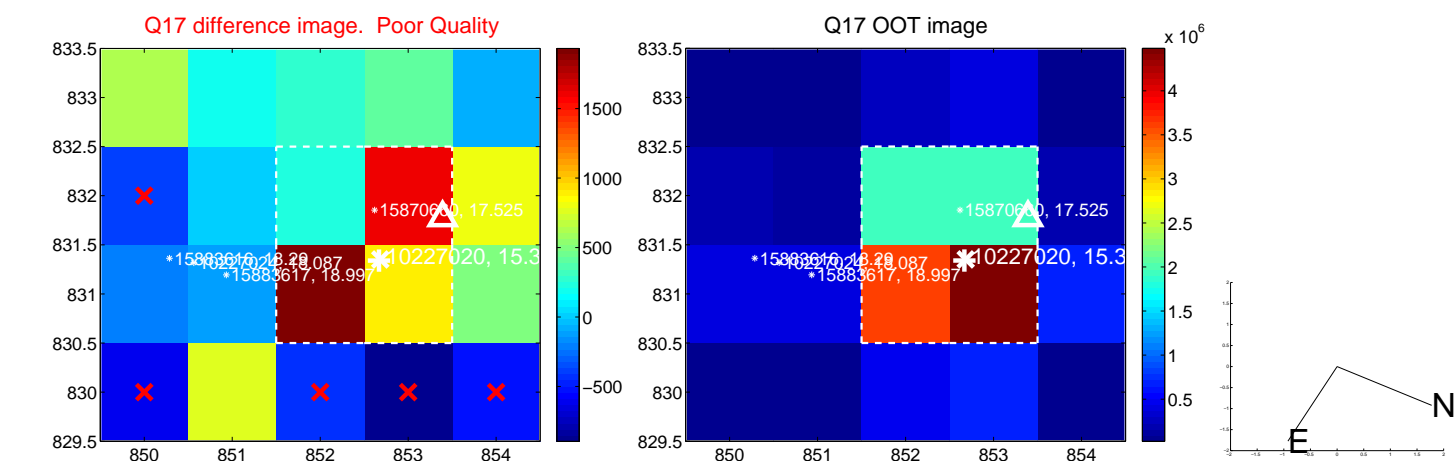
white \times : KIC target position; +: OOT centroid; \triangle : difference centroid. red \times : large negative pixel value.



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

