Hare & Hounds

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What went in

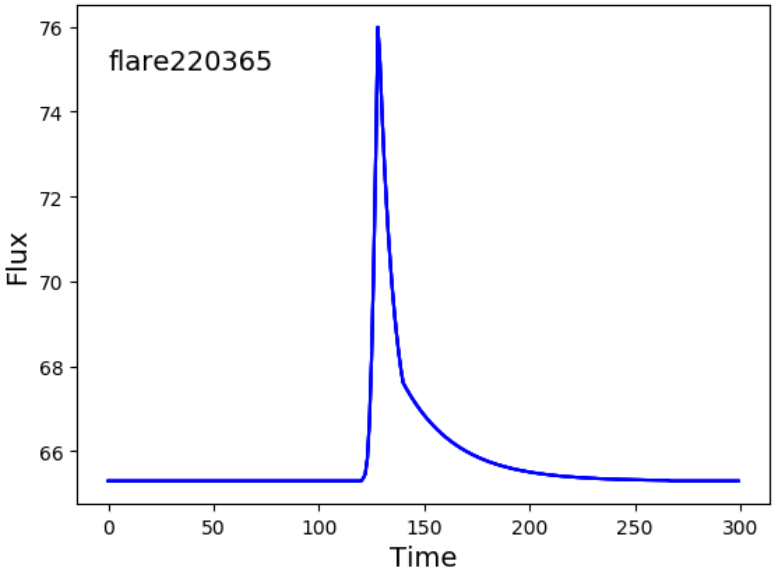
- Each timeseries was 300 data points long with arbitrary cadence of 1.
- Each timeseries contained
  - Flare(s)
  - QPP(s) – not all
  - White noise
  - Red noise

Flares

Time of peak, length of flare, amplitude of peak (min 10), offset allowed to vary randomly.

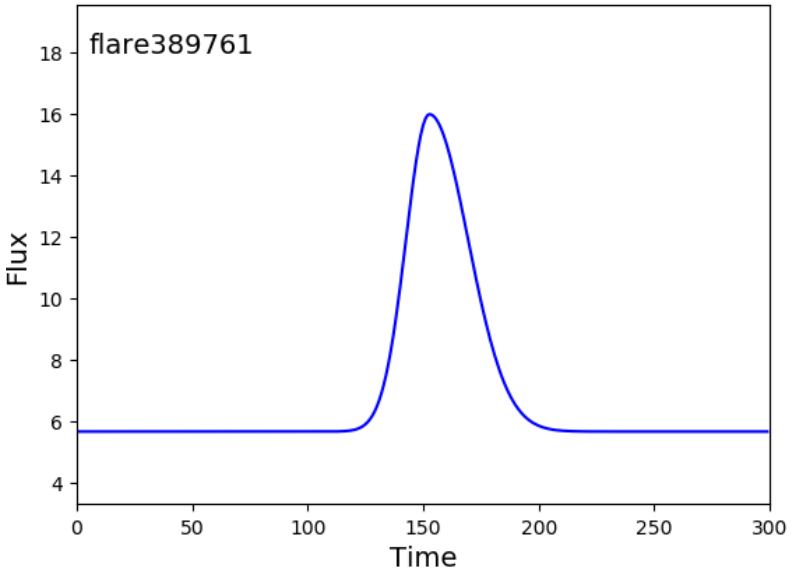
Exponential

- Type 1: Davenport's 2-stage exponential decay



Gaussian

- Different width rising & falling (random)

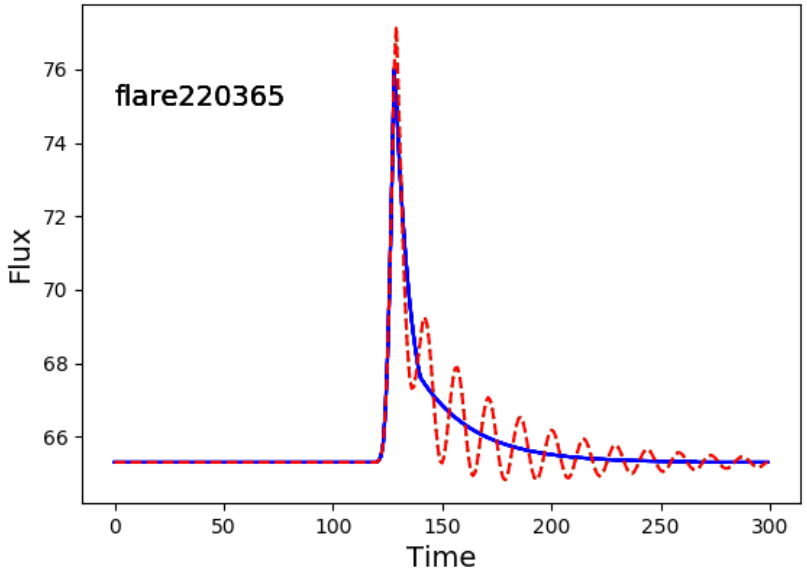


QPPs

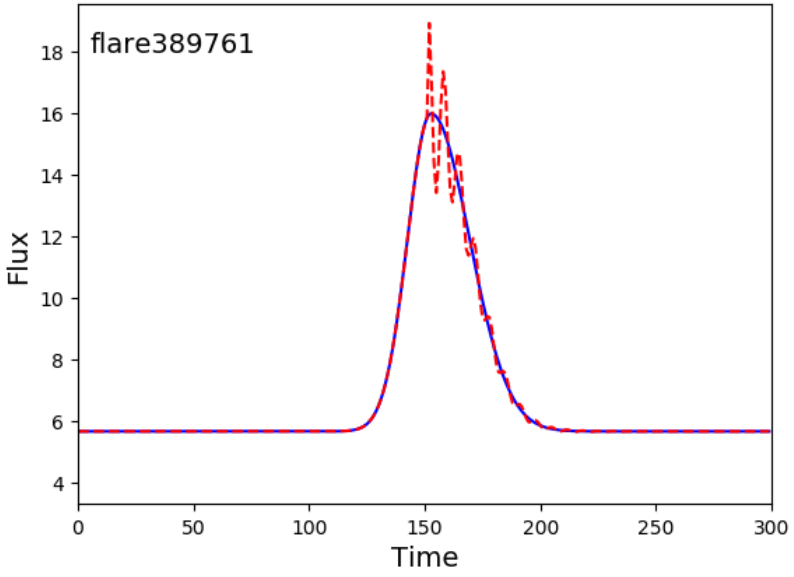
Add QPP signal: $A\exp(-t/t_e)\cos(2\pi t/P+\phi)$

- Systematically varied: A/A_{flare}, P/L_{flare}, t_e*P
- Randomly varied: ϕ [0, 2π]

Exponential



Gaussian

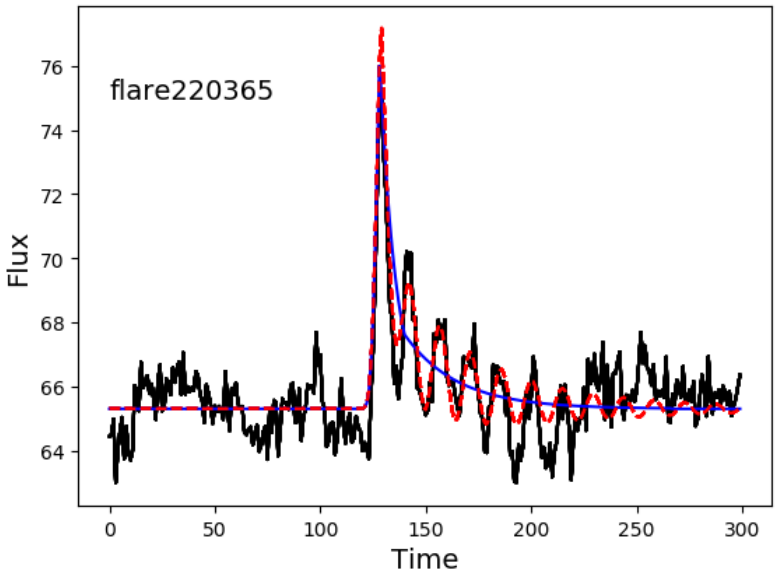


Noise

- White noise: S/N (compared to A_{qpp}) systematic
- Red noise: r [0.81,0.99] & S/N randomly varied
  - $N[i]=r*N[i-1]+((1-r^2)^{0.5})*w[i]$, where w[i]=white noise

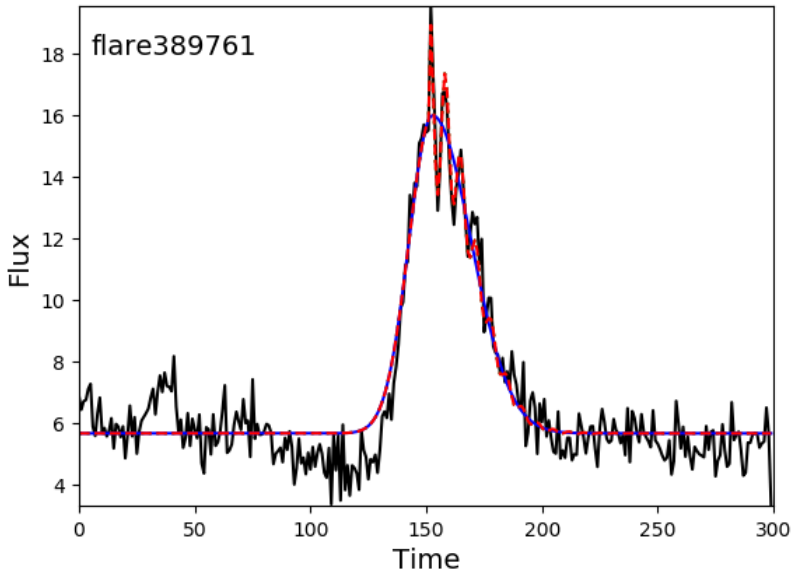
Exponential

- White S/N=5, red S/N=16.6, r=0.84



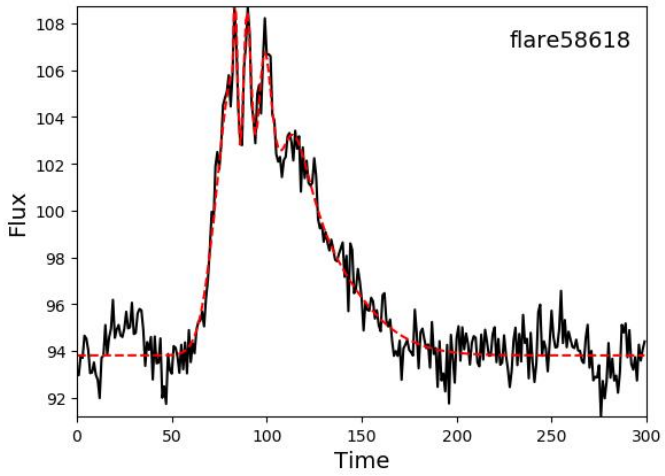
Gaussian

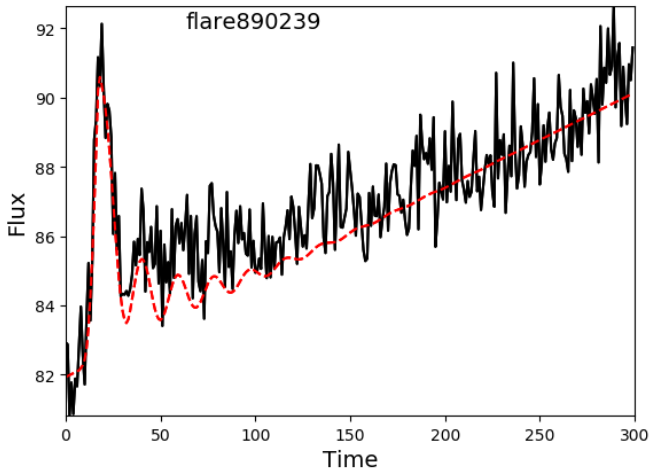
- White S/N=5, red S/N=16.5, r=0.97



Variations

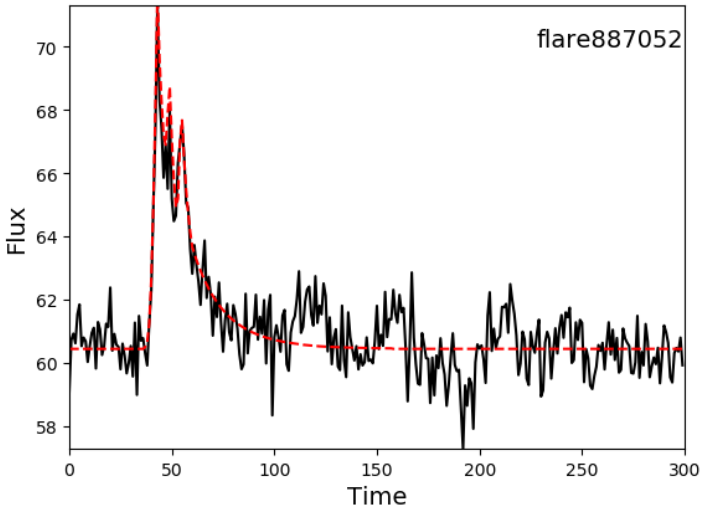
- Single QPP (25 exp, 25 Gauss)
- Varying bgd
  - Linear (1 exp, 2 Gauss), Quadratic (2 exp, 1 Gauss)
- 2 QPPs (2 exp, 2 Gauss)
- Non-stationary QPP (2 exp, 2 Gauss)

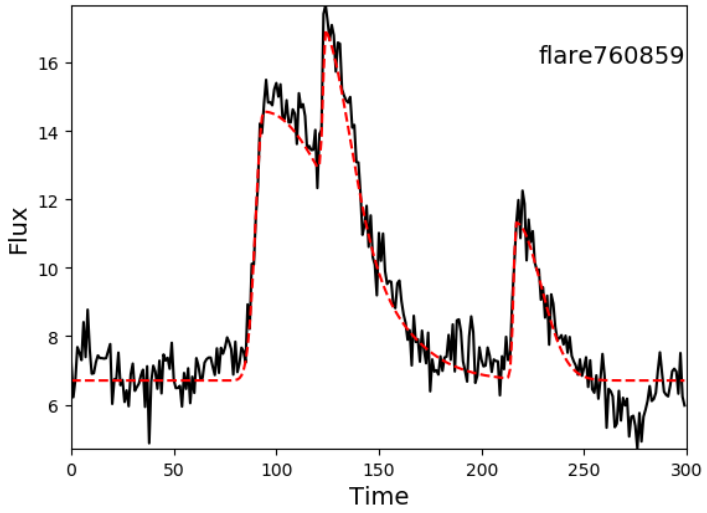




Single & Multiple flares

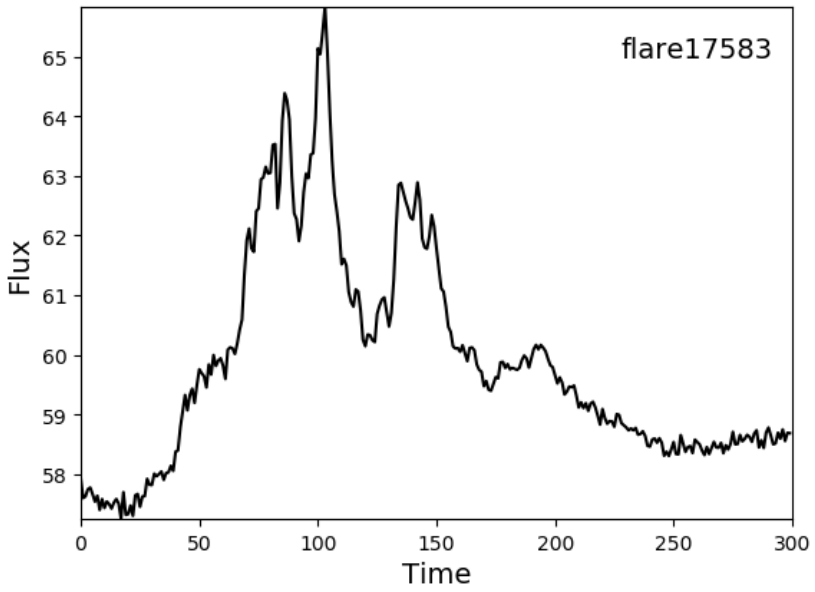
- 1 single exponential flare, 0 single Gauss
- 1 double exponential flare, 0 double Gauss
- Uneven triple exp (3) & Gauss (3) flares
- Evenly spaced exp (4) & Gauss (4) flares

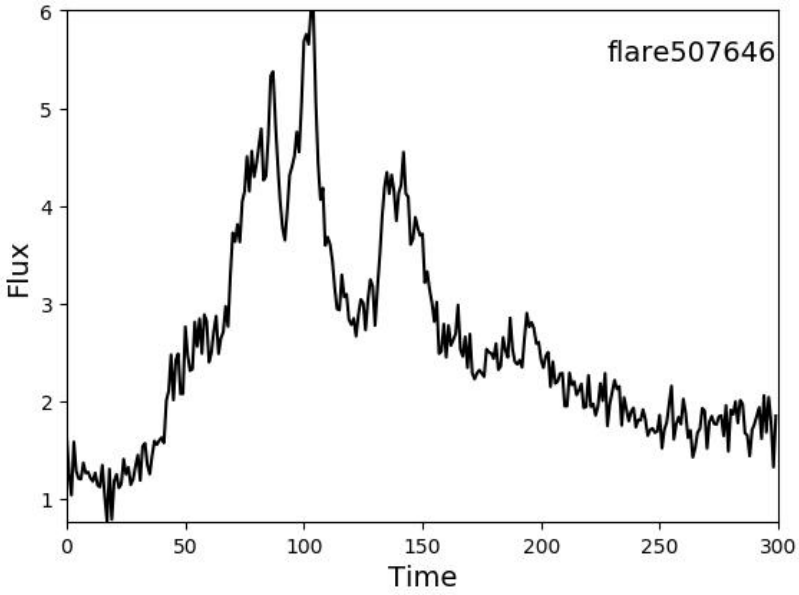




Real solar flares

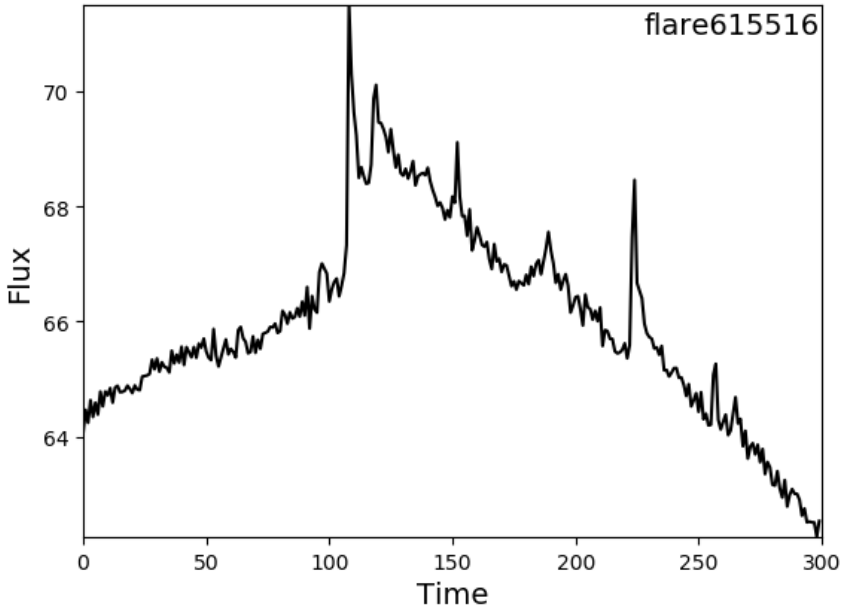
- 3 Solar flares – for each 1=raw, 1=extra noise i.e. 6 in total.
- All from Chloe's paper.

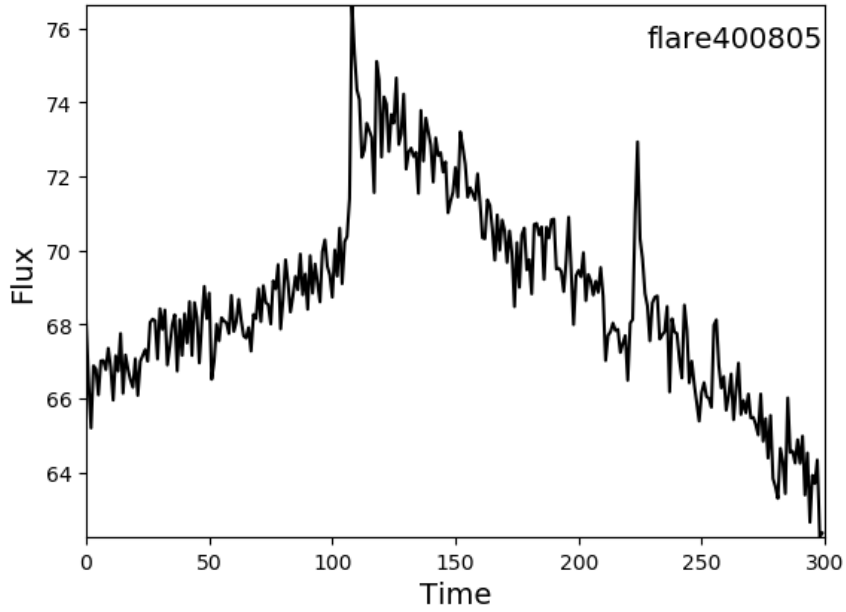




Kepler flares

- 8 flares from 4 stars, different noise levels
- 15 in total
- All from Chloe's paper

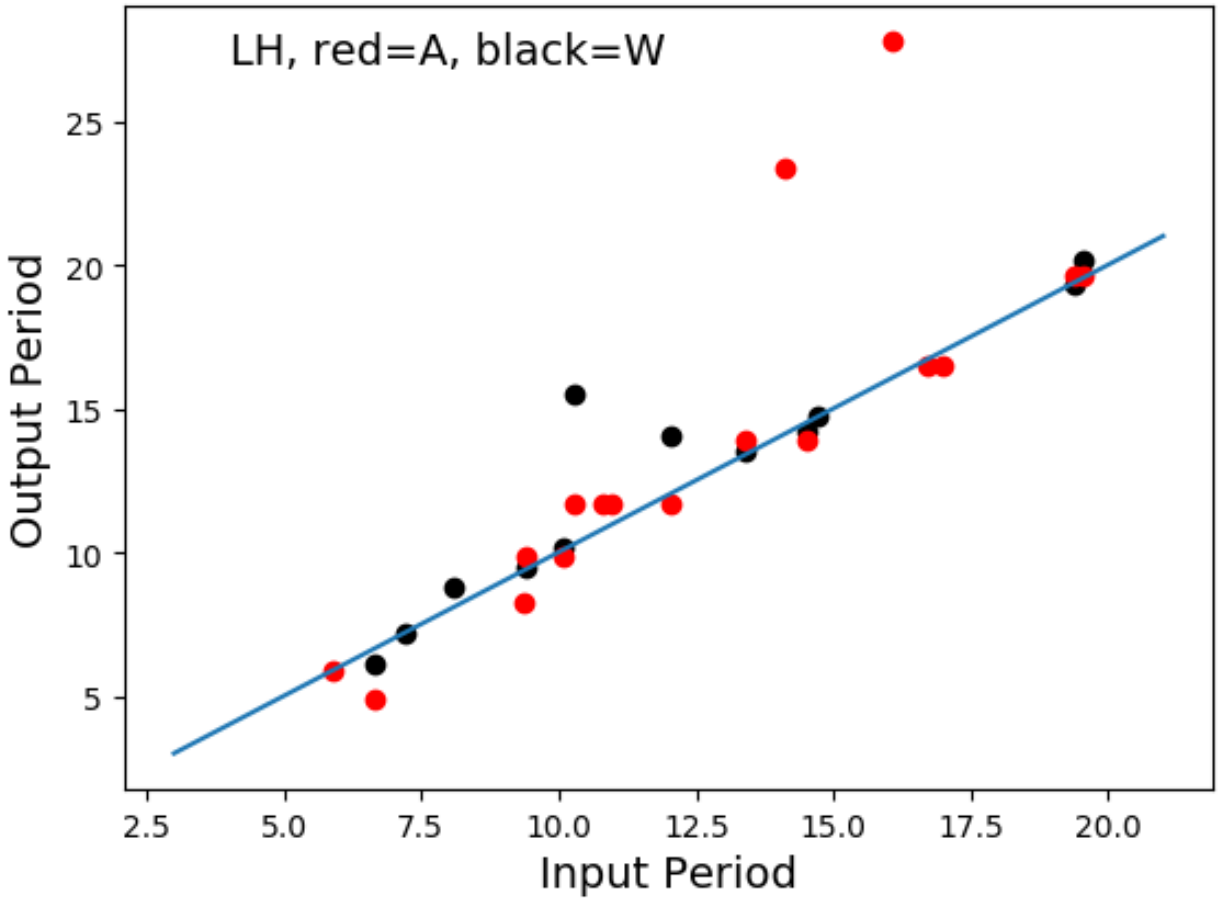




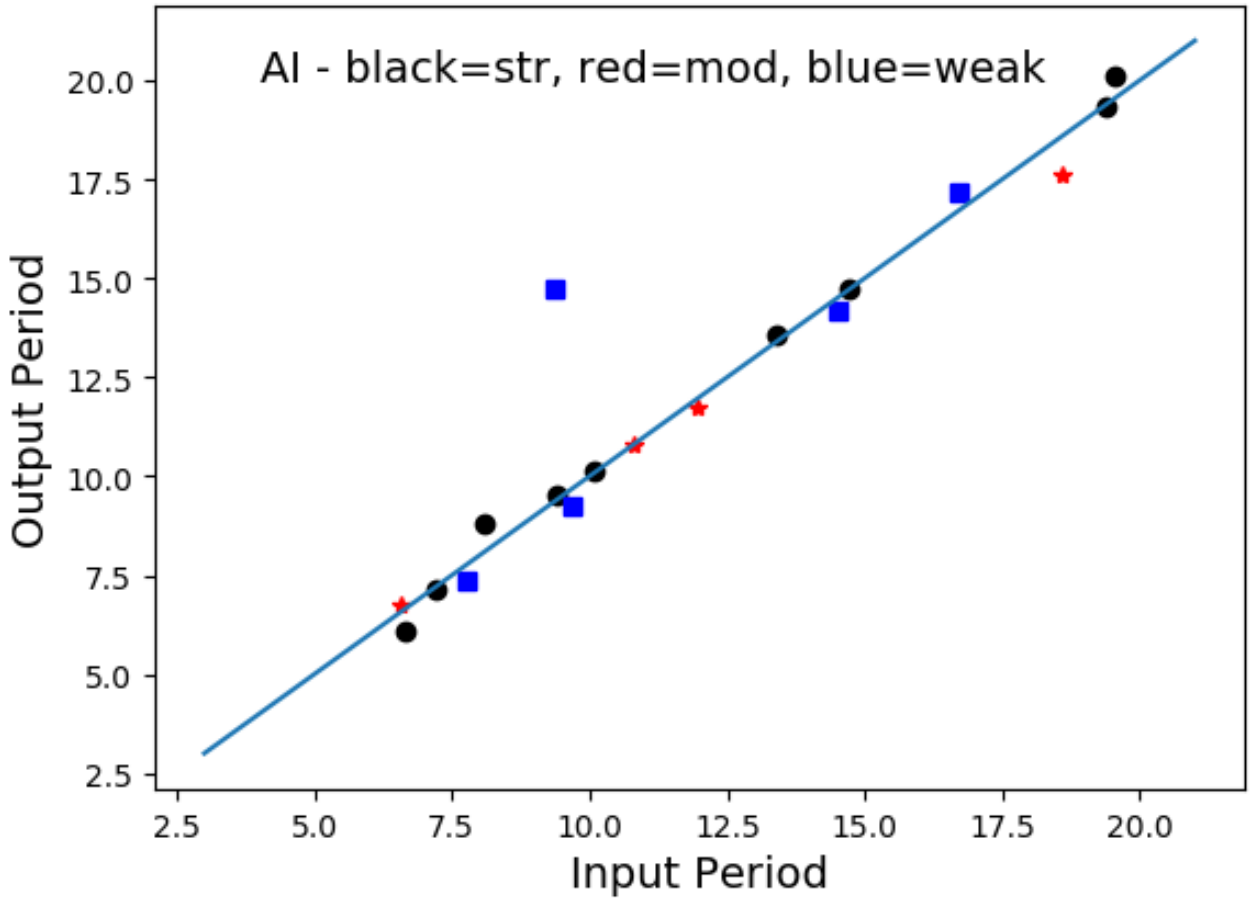
Distribution of detections

- 5 detected by 5 methods (LH - both, CEP, TvD, AI)
- 14 detected by 4 methods
- 16 detected by 3 methods
- 19 detected by 2 methods
- 37 detected by 1 method
- 6 detected by none.
- Total detections: LH – A=26, AI= 21, LH – W=13, CEP=46, TvD=30, JM=28.
- Total decaying qpp: LH – A=17, AI= 18, LH – W=12, CEP=36, TvD=21, JM=19.

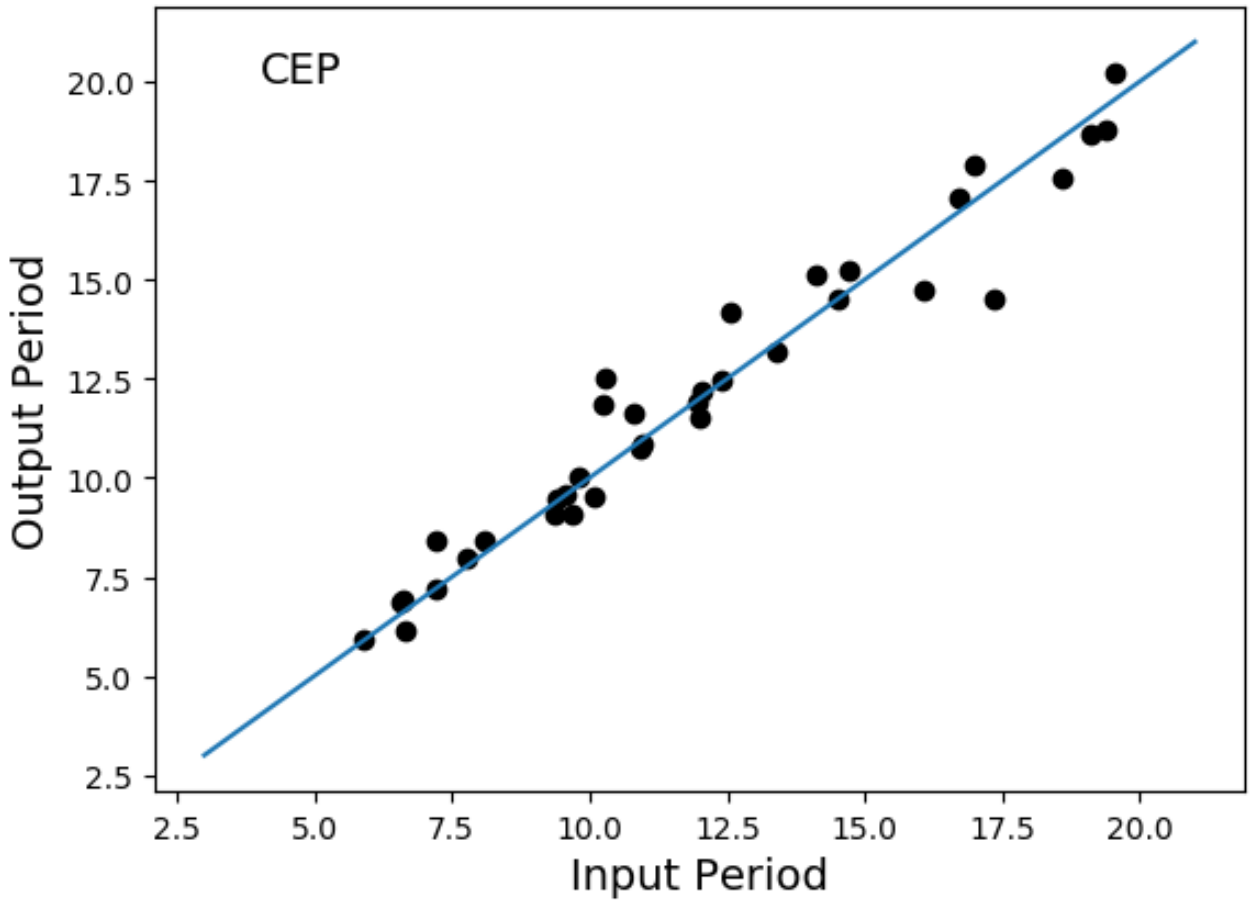
Results – Decaying QPP - LH



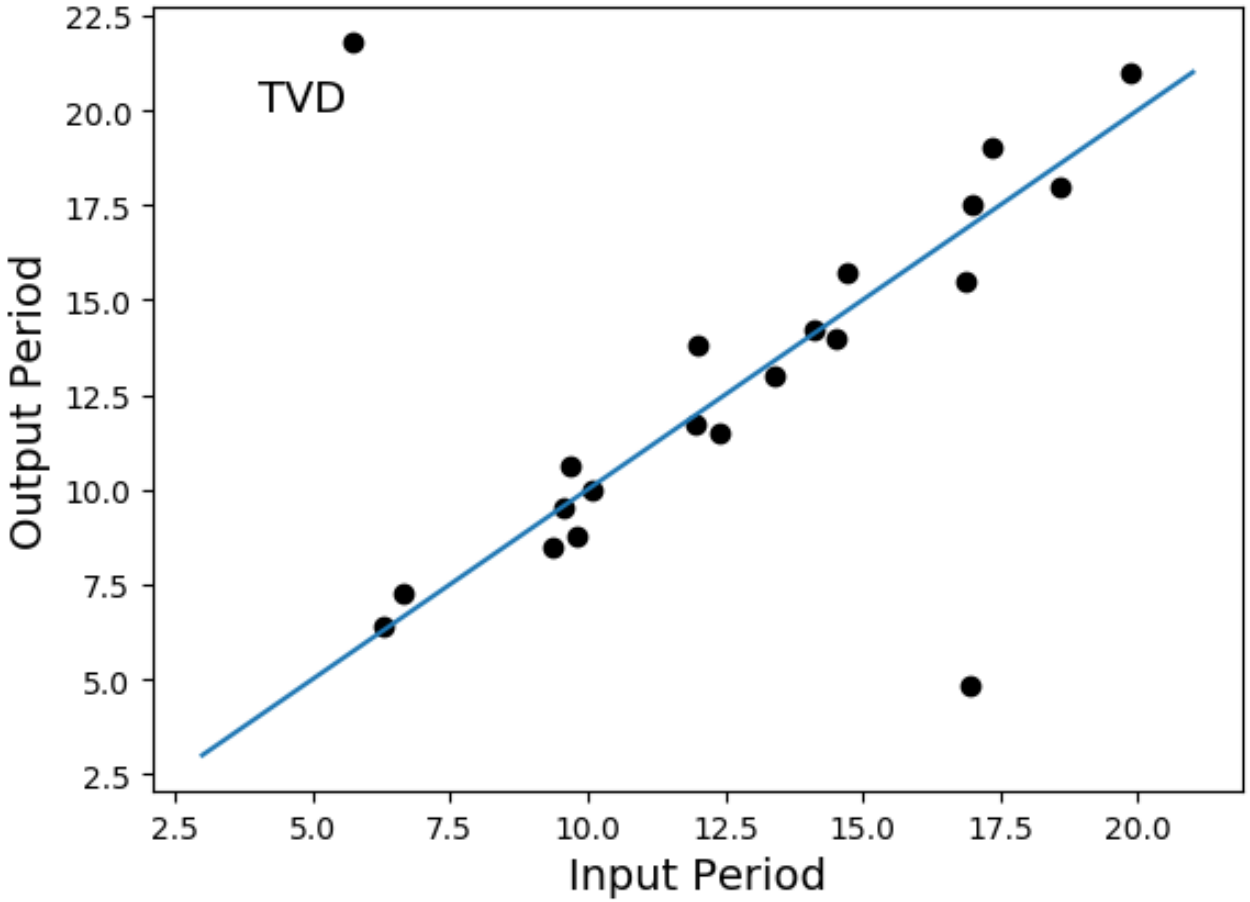
Results – Decaying QPP - AI



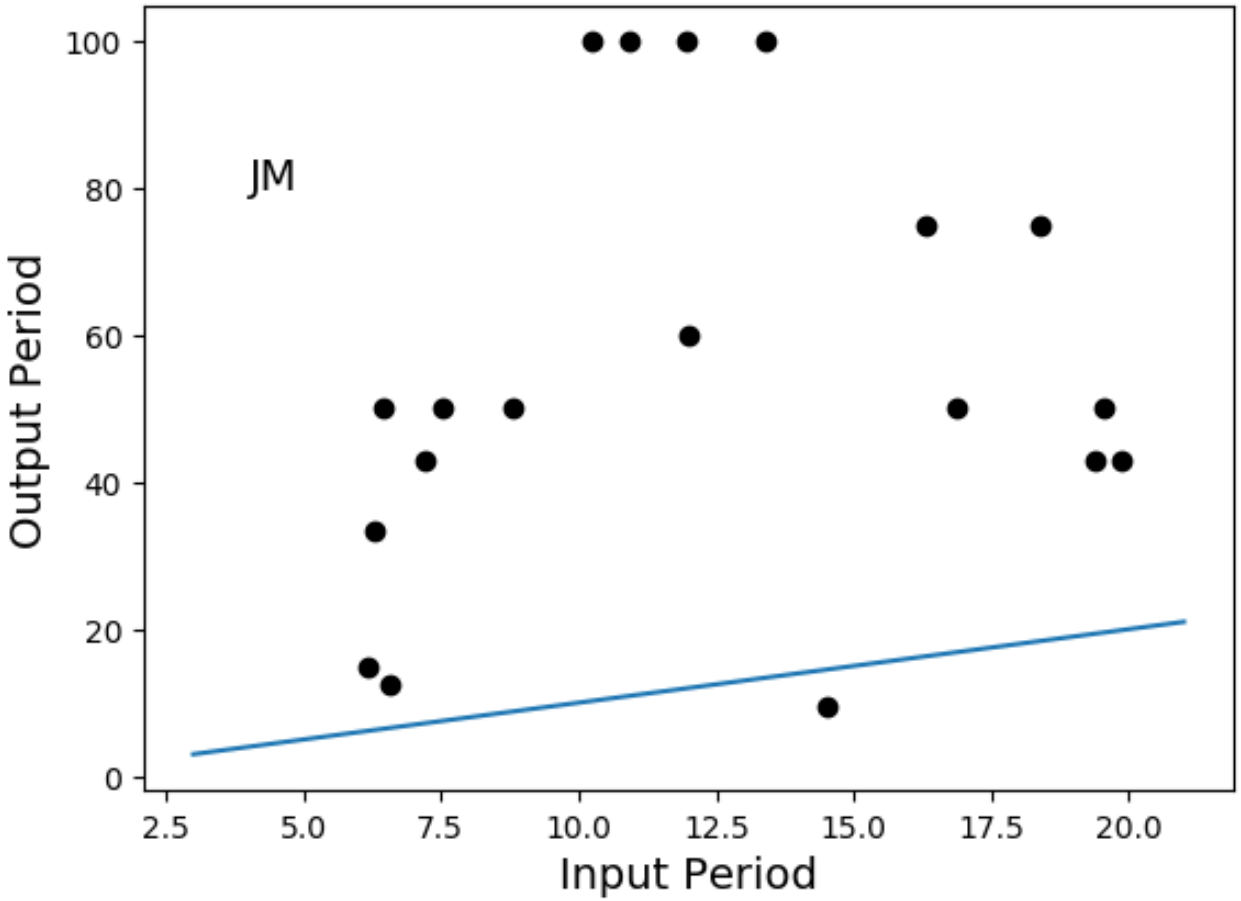
Results – Decaying QPP - CEP



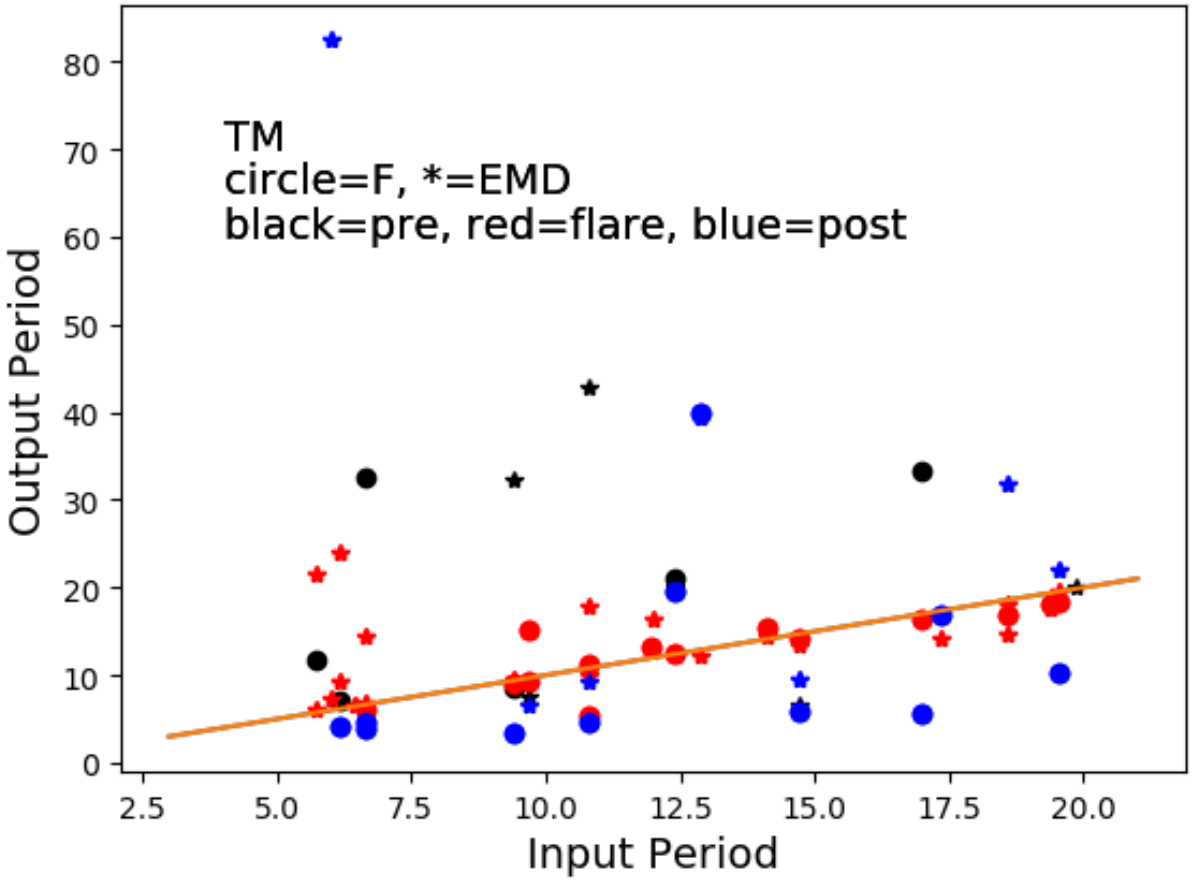
Results – Decaying QPP - TvD



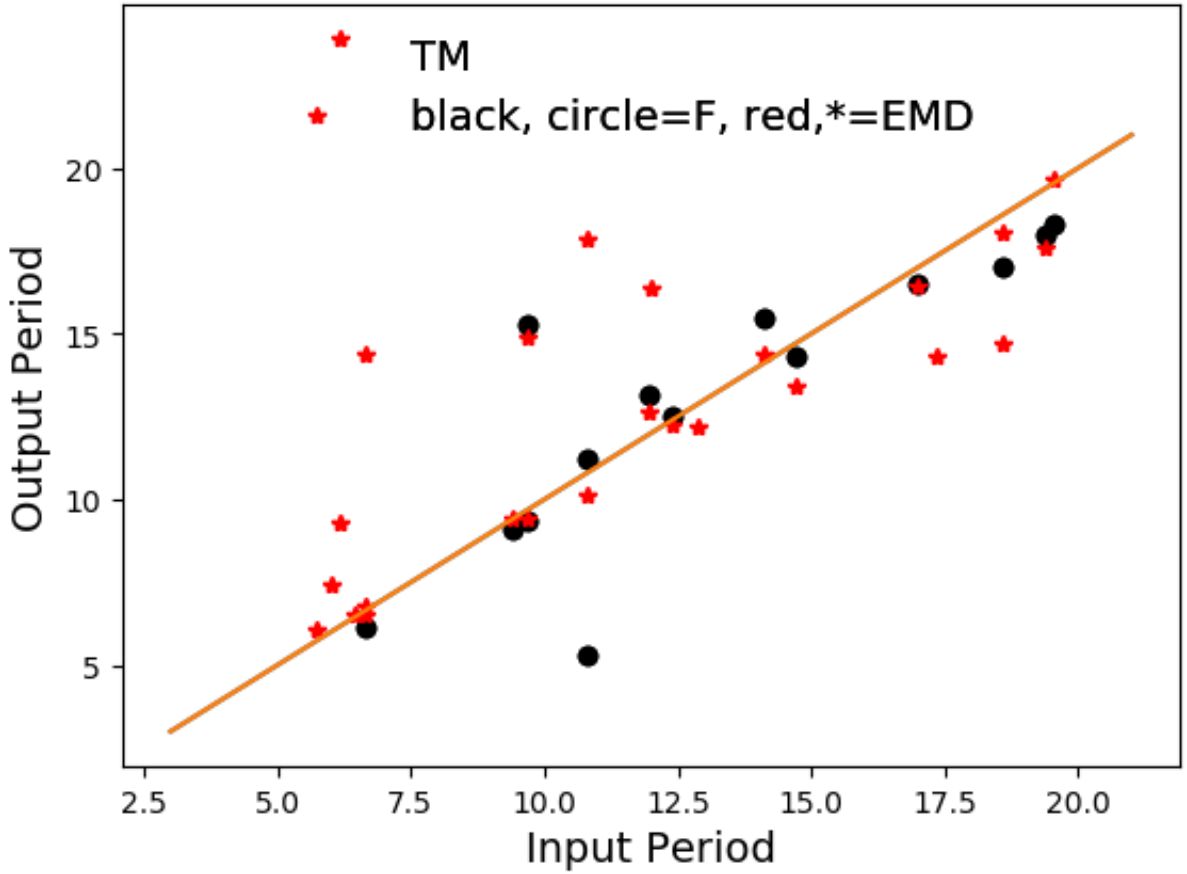
Results – Decaying QPP - JM



Results – Decaying QPP - TM

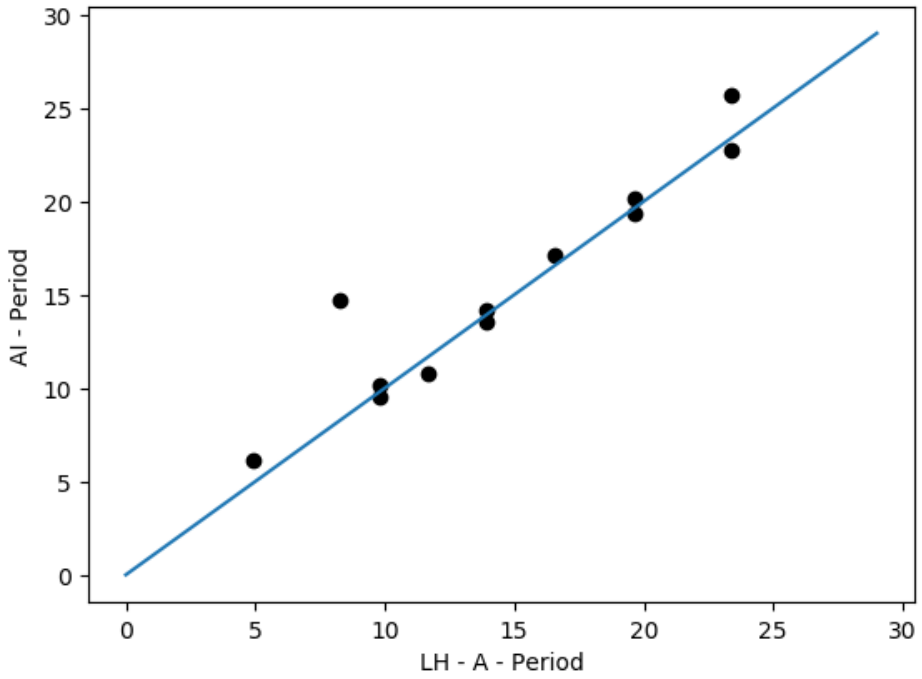


Results – Decaying QPP - TM

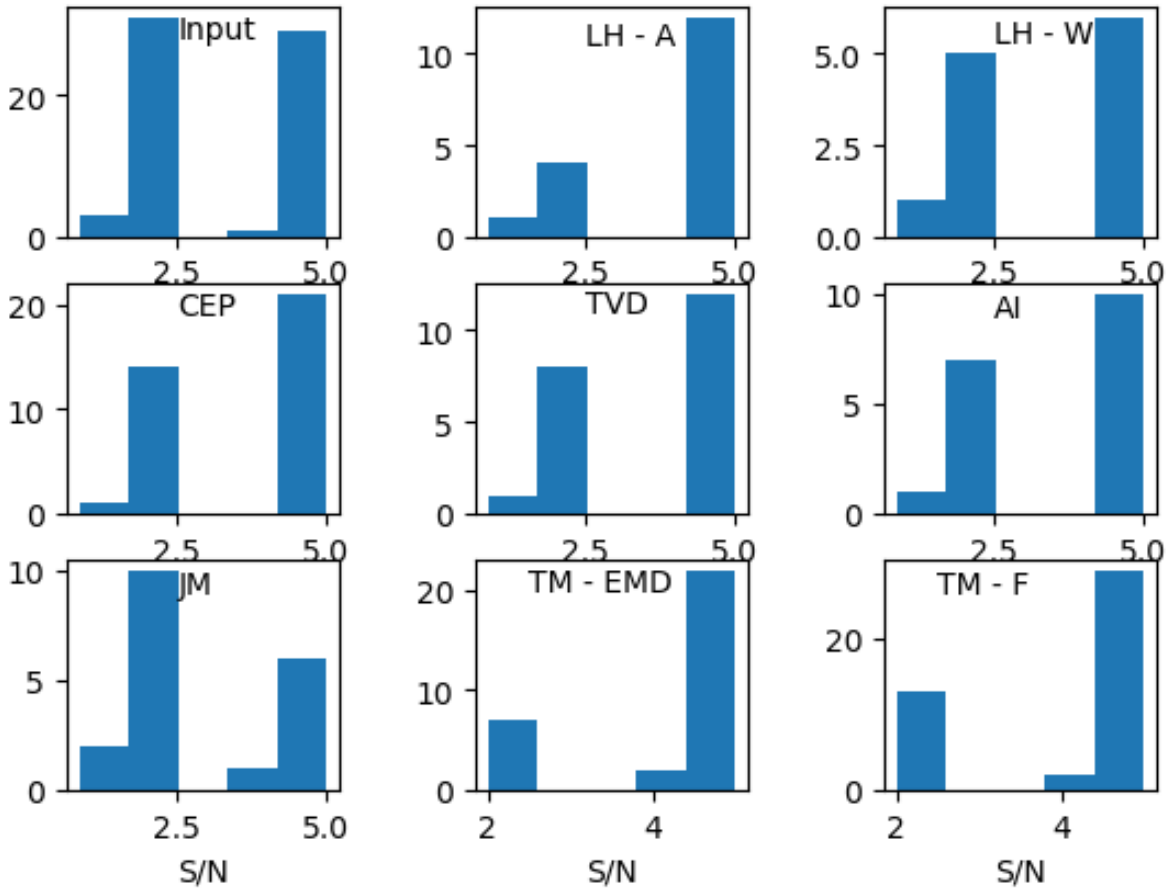


AFINO comparison

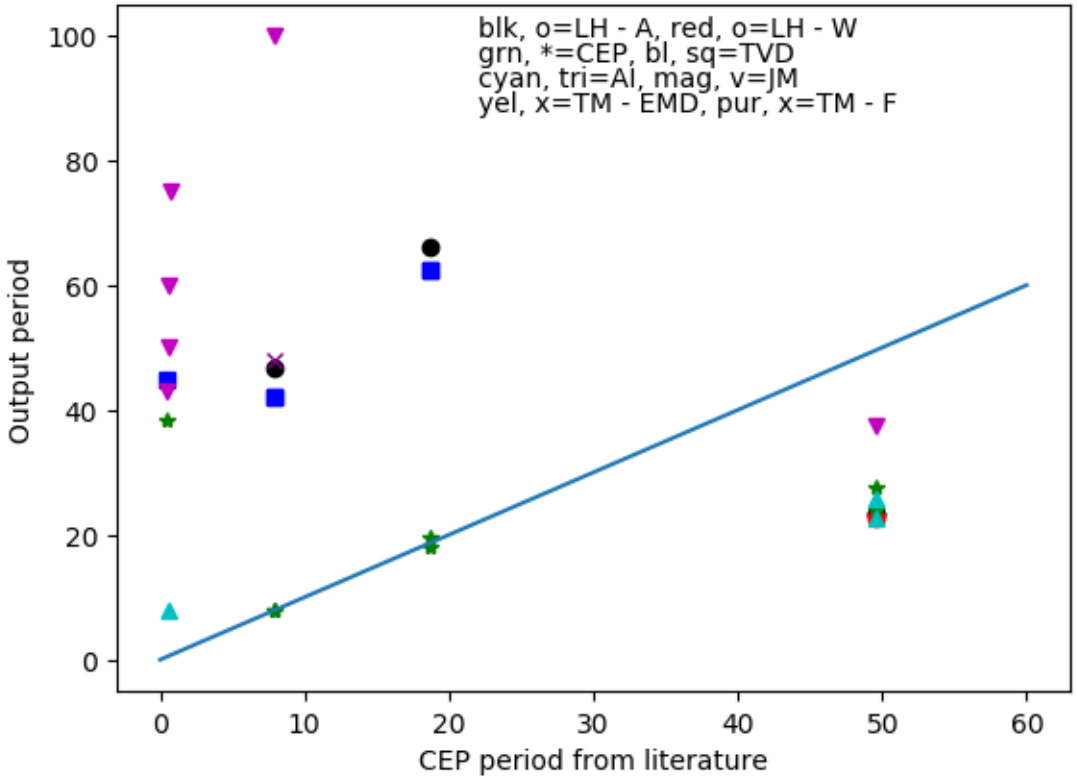
- 12 detected by both methods
- 14 only detected by LH, 9 only detected by AI



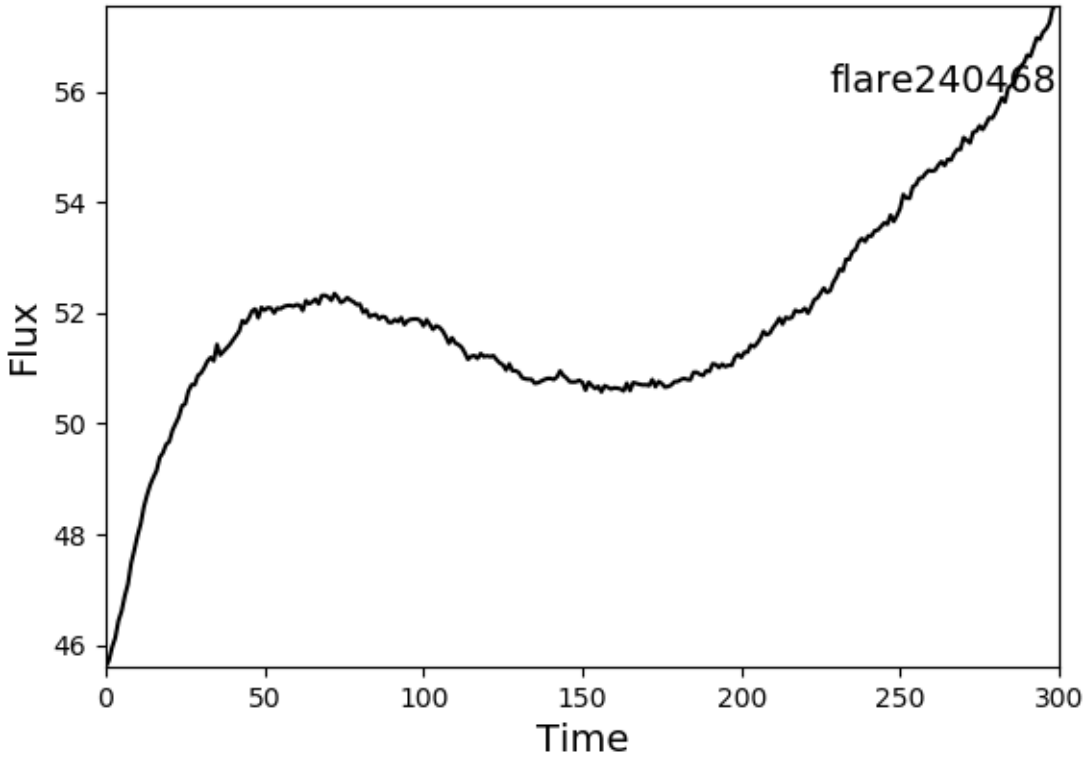
S/N distributions



Real Flares


blk, o=LH - A, red, o=LH - W
grn, *=CEP, bl, sq=TVD
cyan, tri=Al, mag, v=JM
yel, x=TM - EMD, pur, x=TM - F
Output period
CEP period from literature
0
20
40
60
80
100
0
10
20
30
40
50
60

Goes flare



Multiflares

- LH – A – 1x3 regularly split, 2x3 irregularly split
- AI - none
- LH – W – none
- CEP – 1x 3 regularly split
- TvD – 1x 3 regularly split, 1x 3 irregularly split
- JM – 1x2 flares, 1x3 irregular, 1x 3 regular
- TM – EMD – 3x3 regular
- TM – F – 3x3 regular