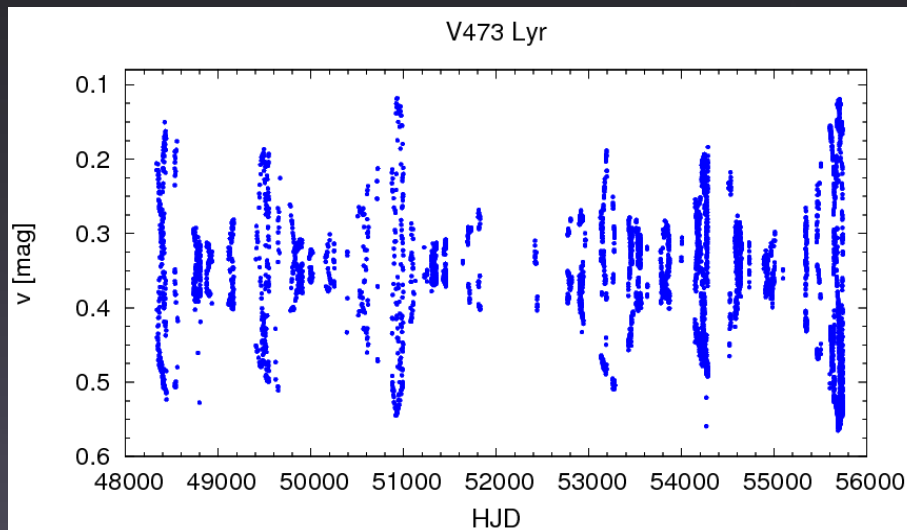


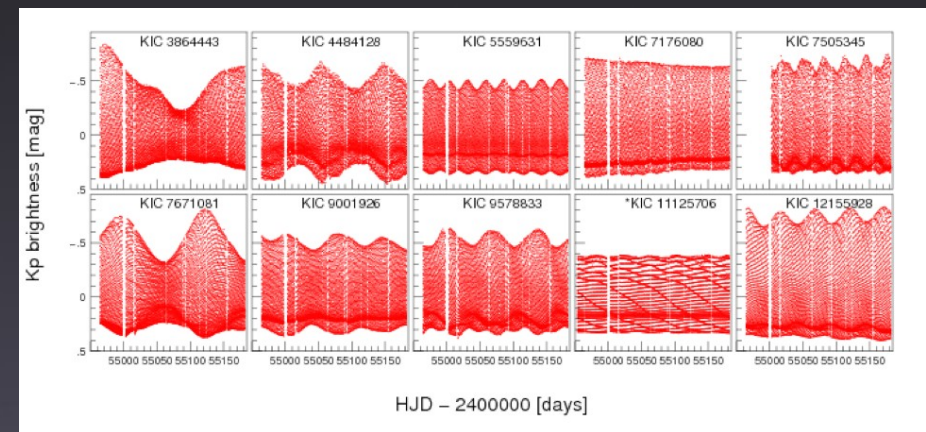
Blazhko-effect in Cepheids too?

First results on V473 Lyr



?

||



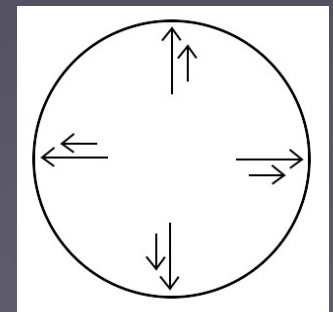
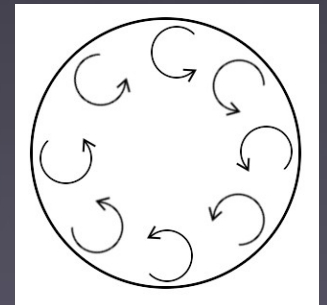
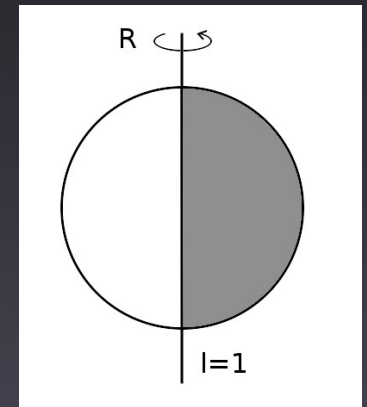
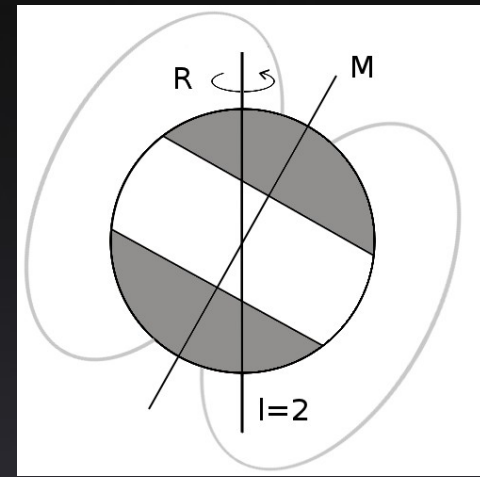
László Molnár

Konkoly Observatory, MTA CSFK

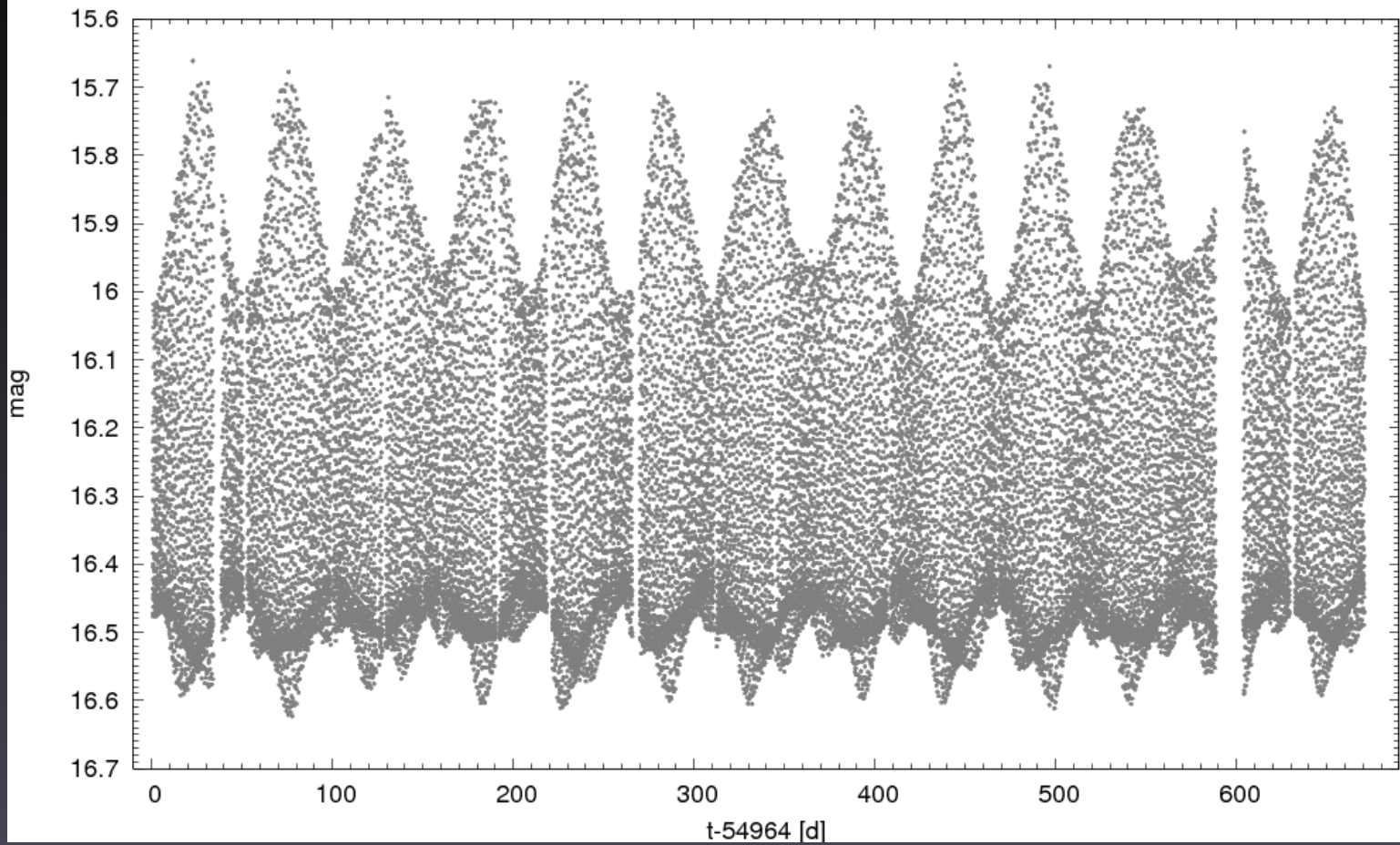
László Szabados, Robert Dukes, Ákos Győrffy et al.

Blazhko-effect recap

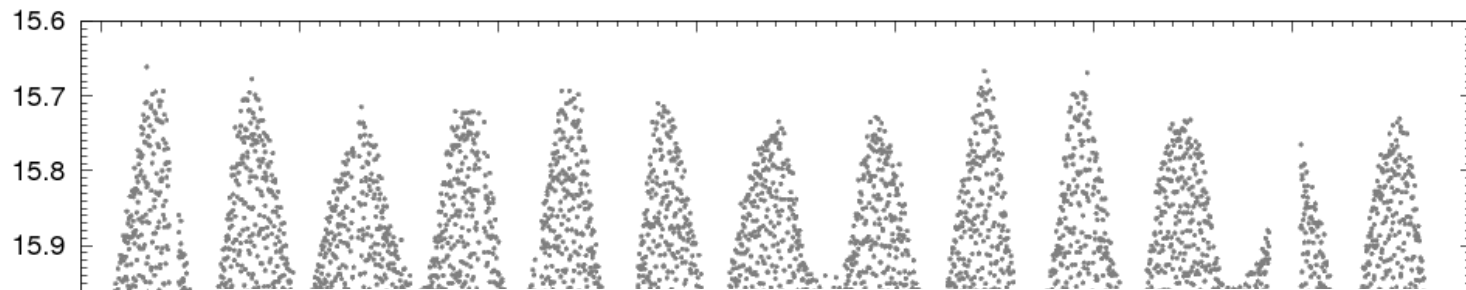
- Seen in RR Lyrae stars
 - Radial pulsators, FM, O1, DM
- Blazhko-effect
 - Amplitude and phase modulation
 - Still unexplained
 - Magnetic oblique rotator?
 - Nonlinear resonant rotator?
 - Convective cycles?
 - Radial resonances?
- Also in double-mode RR Lyrae and Cepheid stars



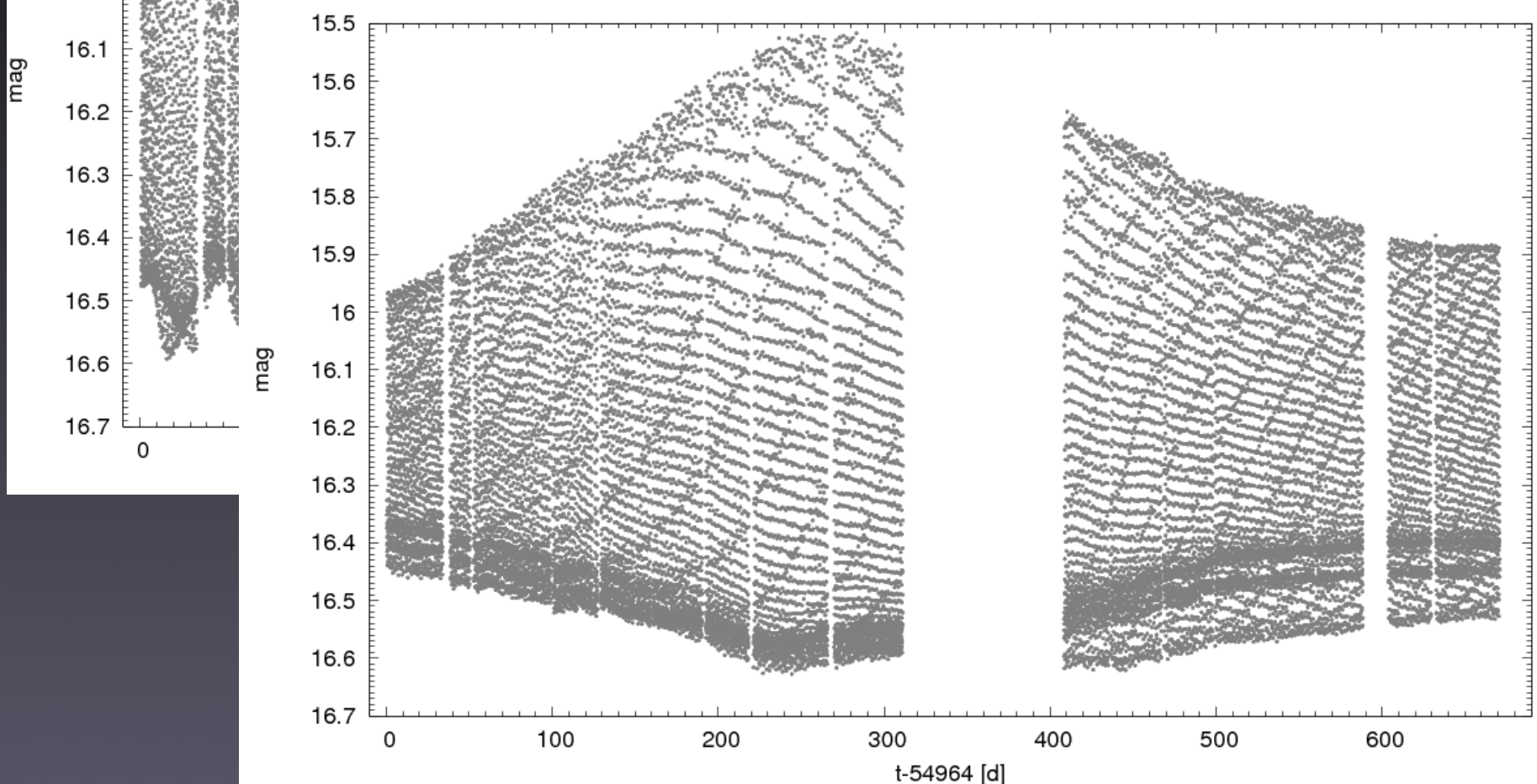
KIC 9697825



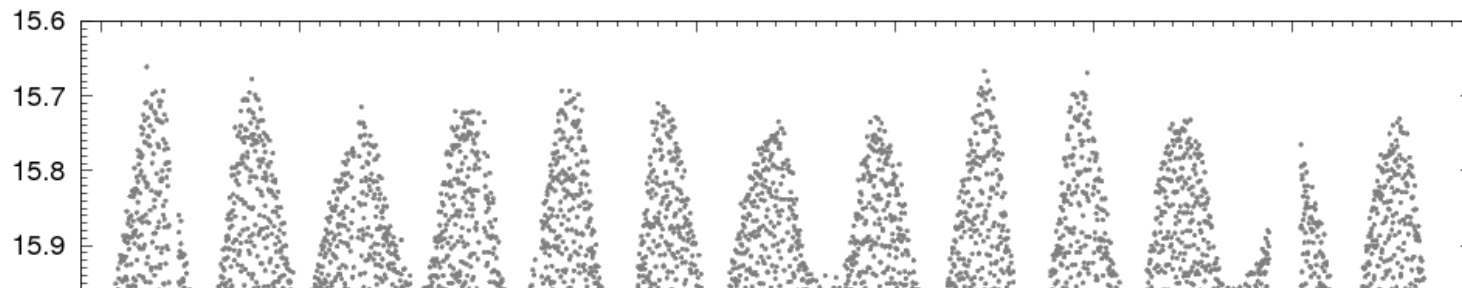
KIC 9697825



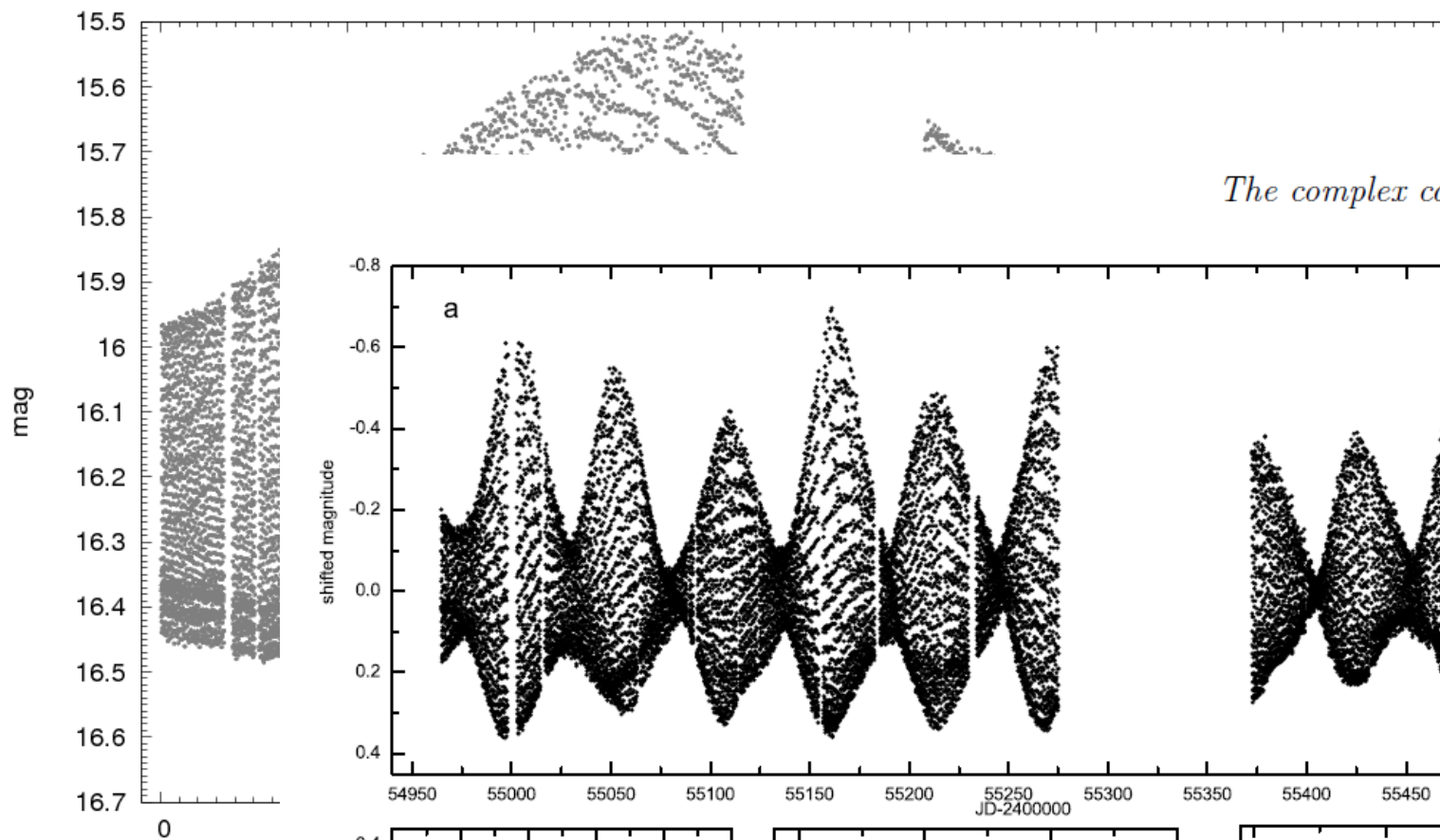
KIC 6186029



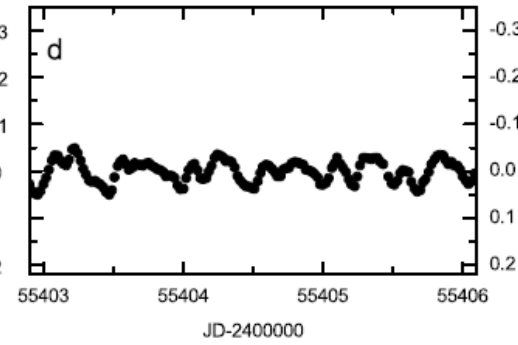
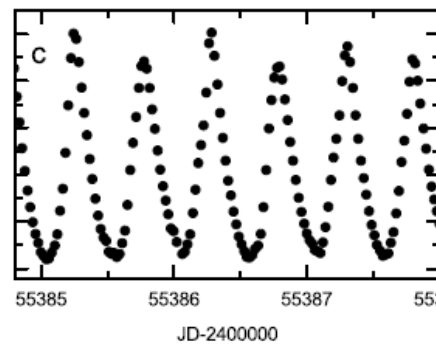
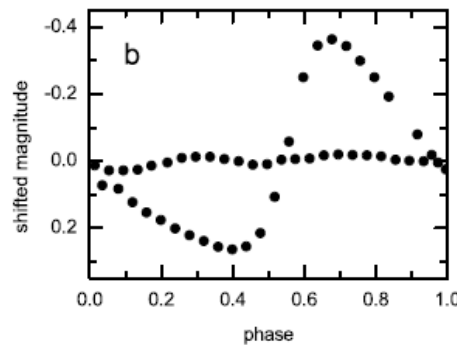
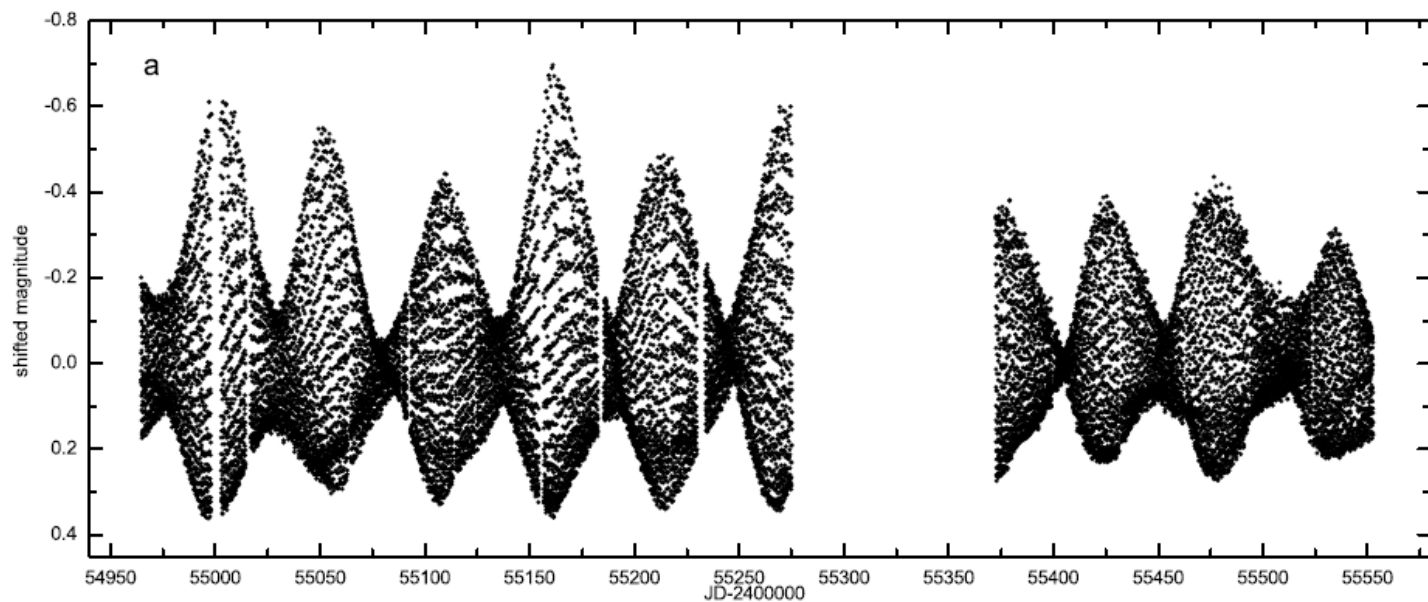
KIC 9697825



KIC 6186029

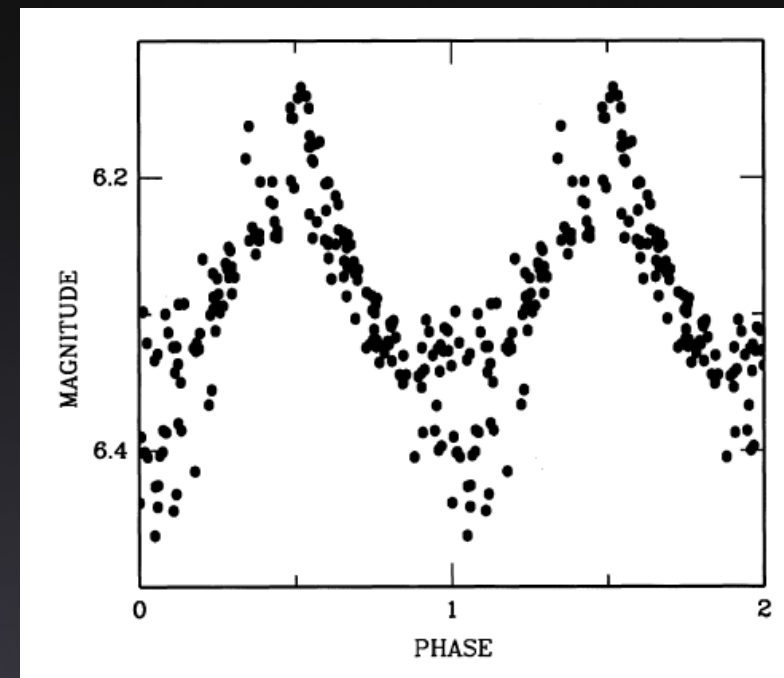


The complex case of V445 Lyr



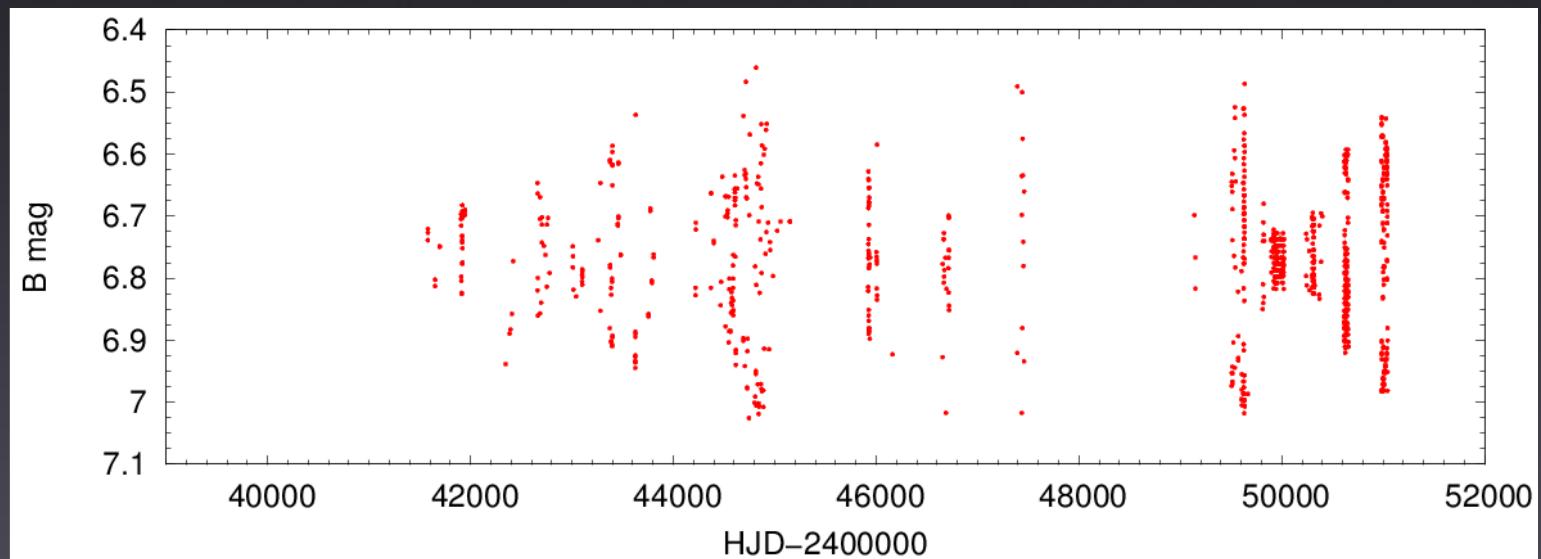
V473 Lyrae

- Discovered in 1969
- Shortest period Cepheid
- $P=1.4909$ days
 - 1st or 2nd overtone
- Very strong amplitude variations
- Koen (2001), HIPPARCOS data
 - No sign of phase modulation (period change)
 - Modulation period ~ 1200 days
 - ! Data span is 1150 days !
- Blazhko-effect or something else?

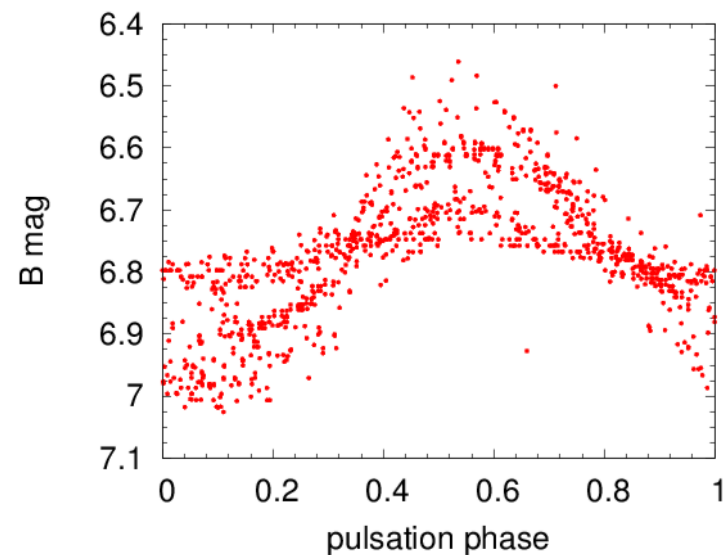
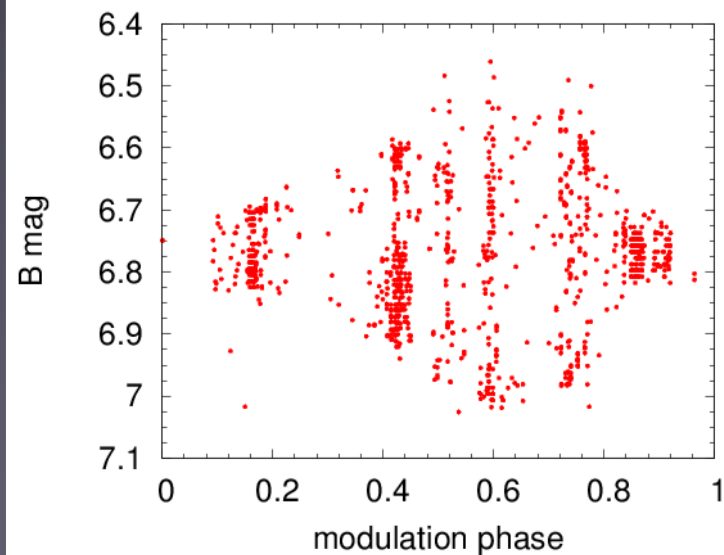


Data set No. 1

- Published B, V, R, v_{rad} data from various observers

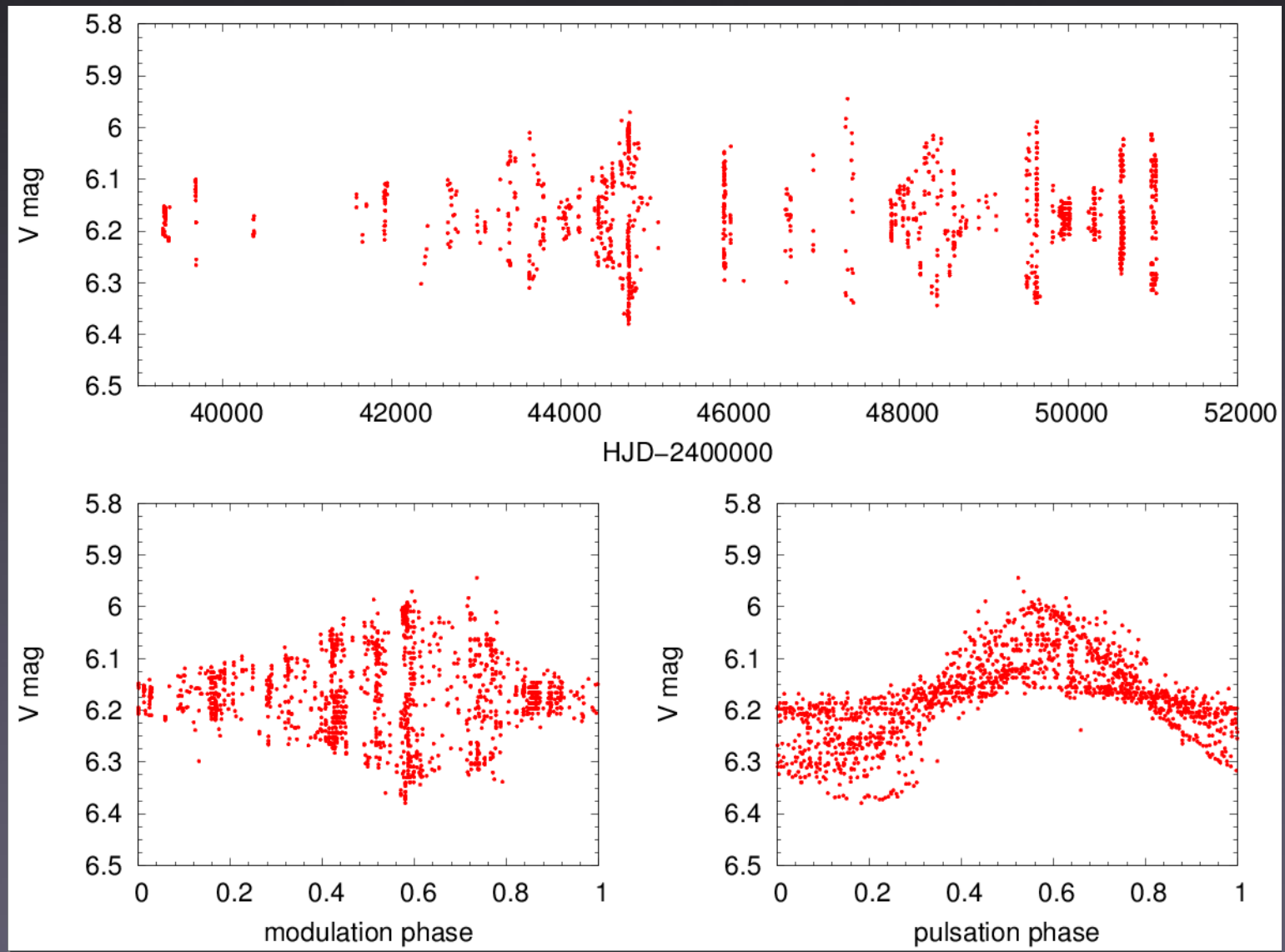


1029
points



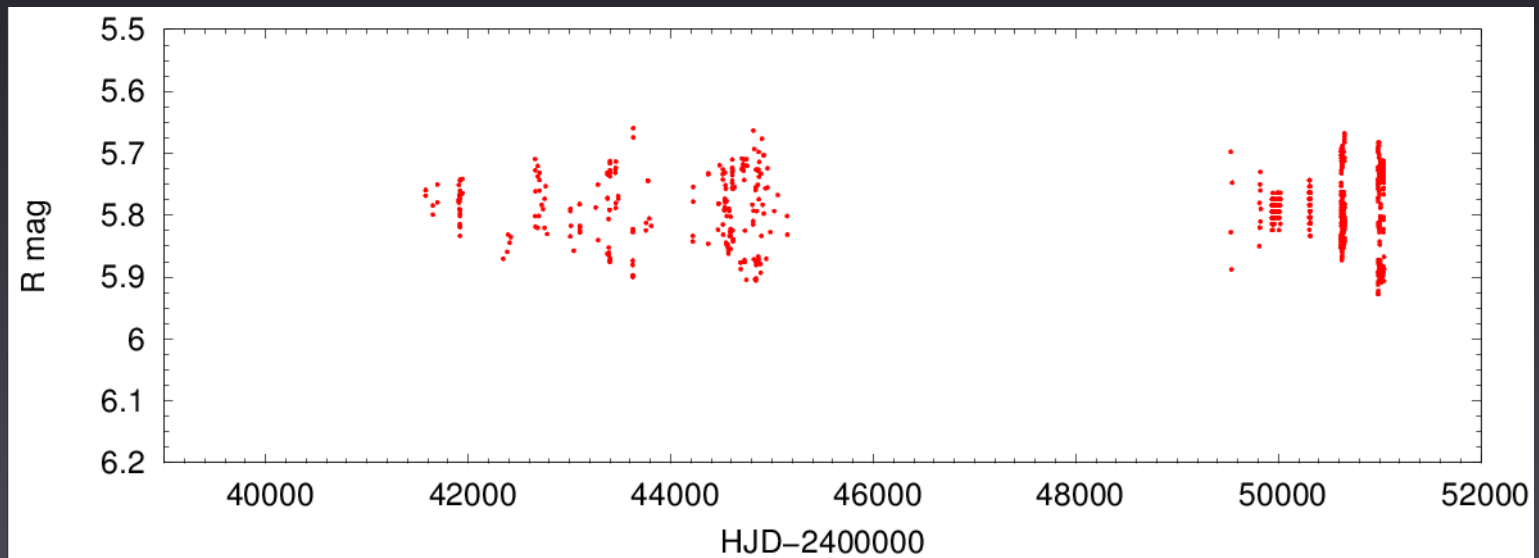
Data set No. 1

- Published B, V, R, v_{rad} data from various observers

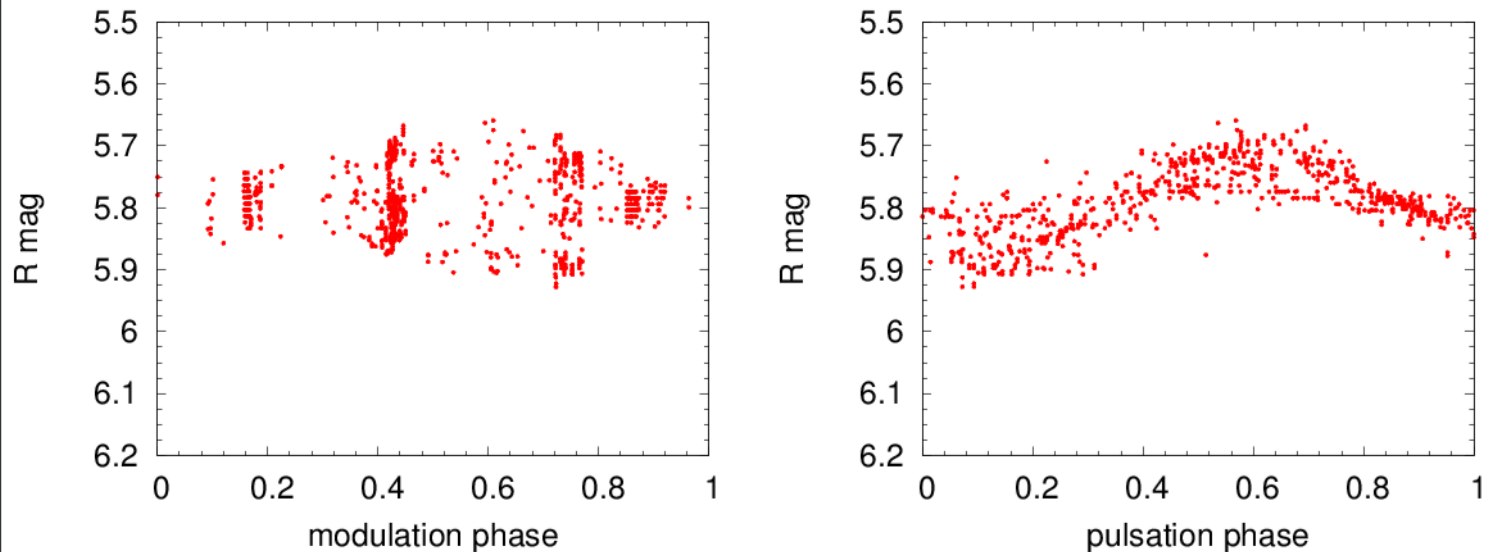


Data set No. 1

- Published B, V, R, v_{rad} data from various observers

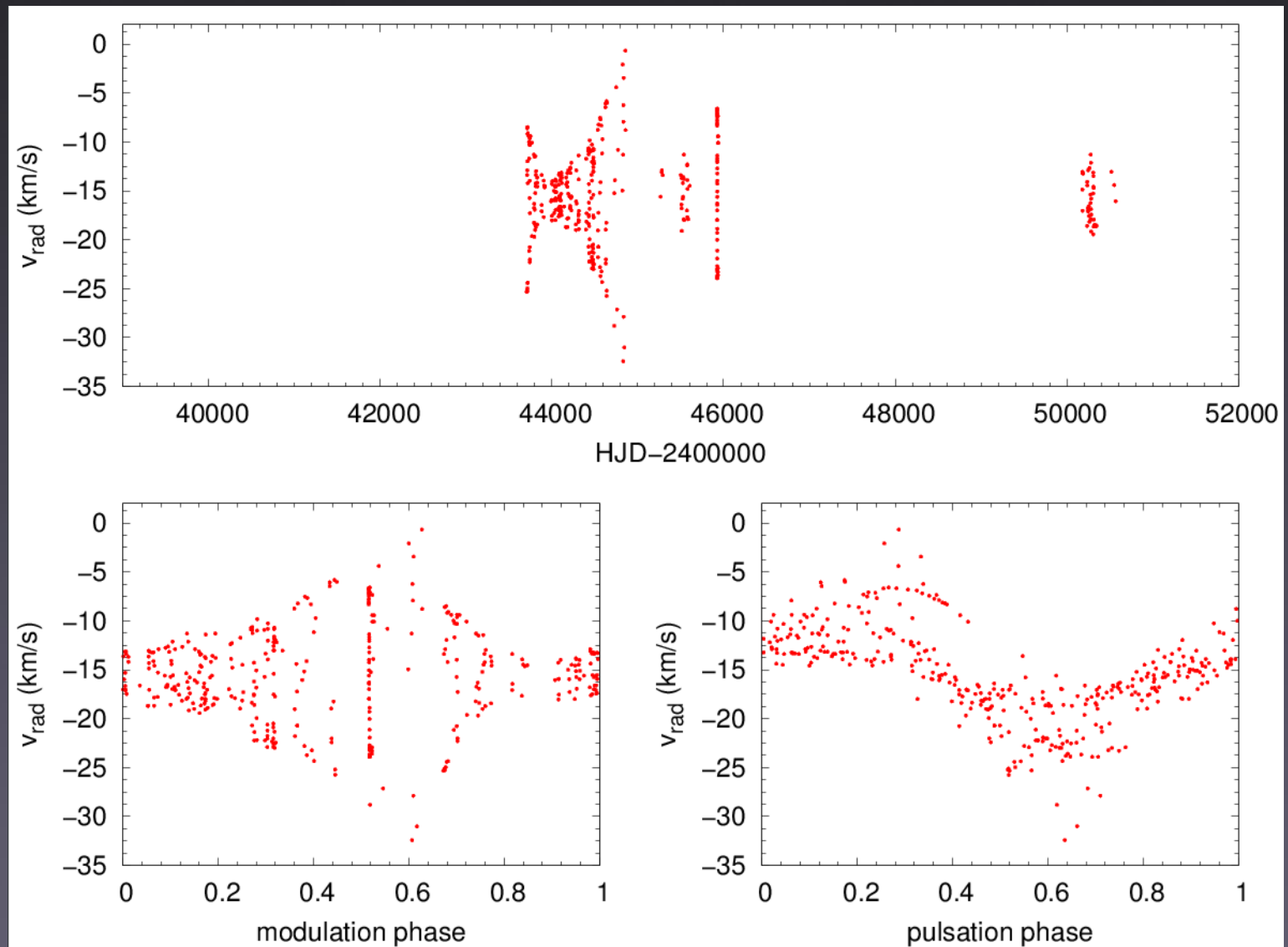


690
points



Data set No. 1

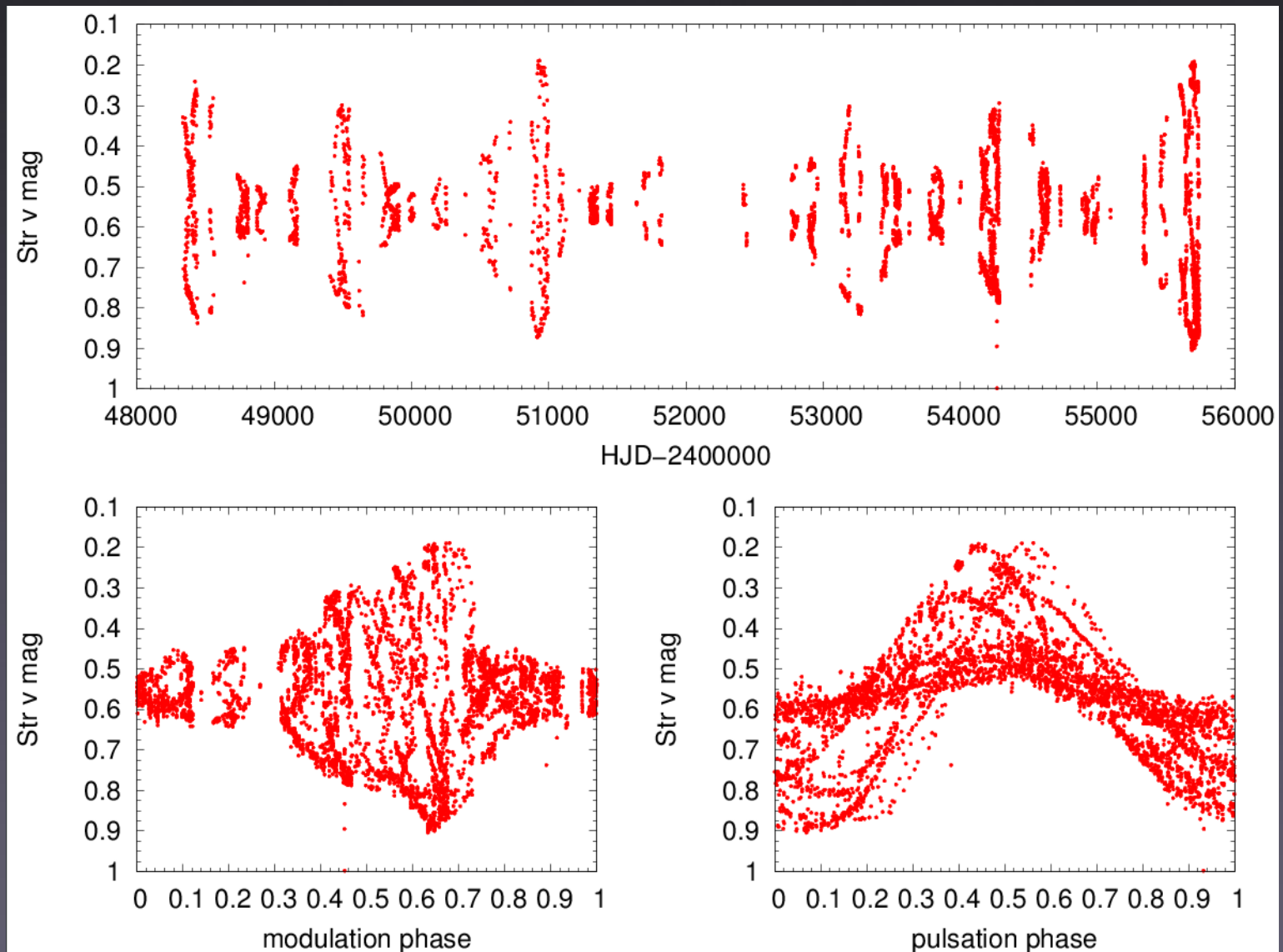
- Published B, V, R, v_{rad} data from various observers



377
points

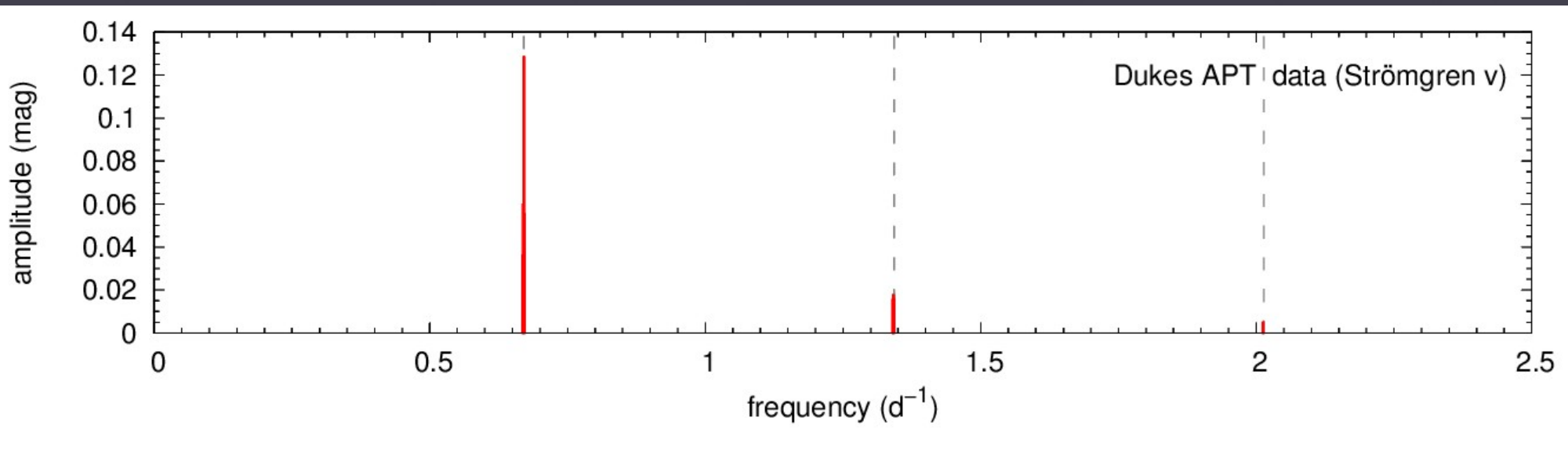
Data set No. 2

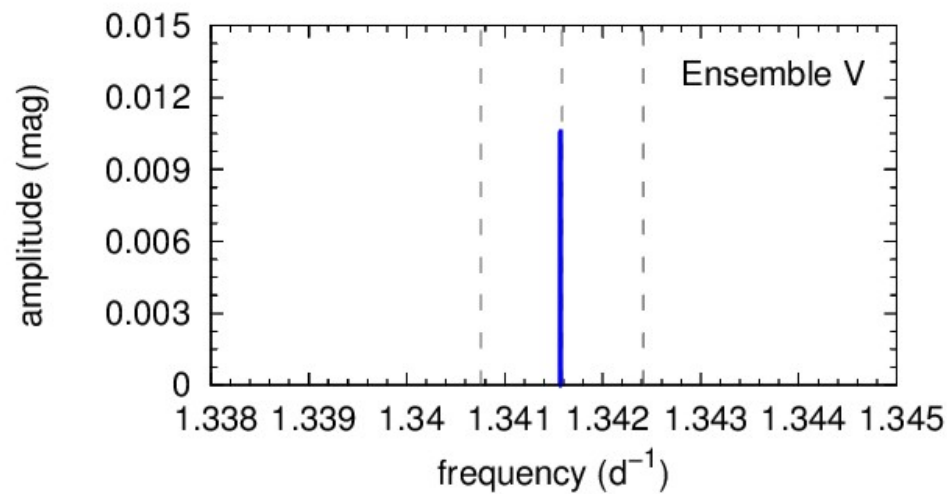
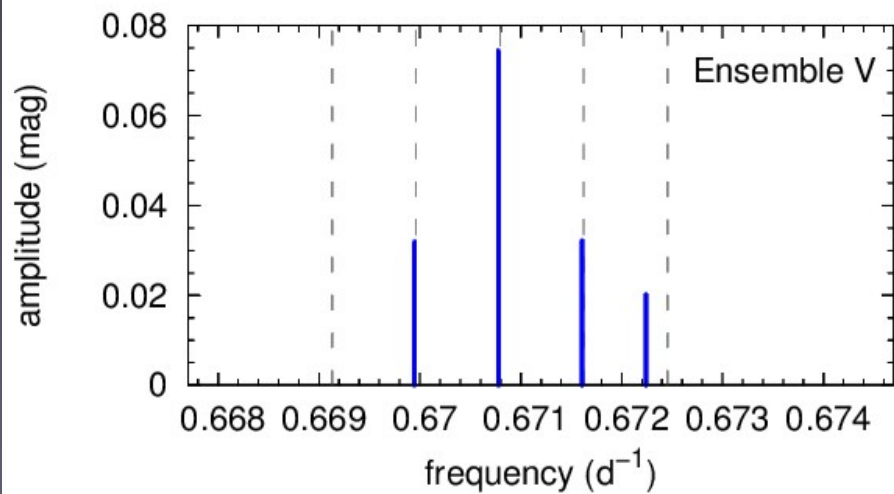
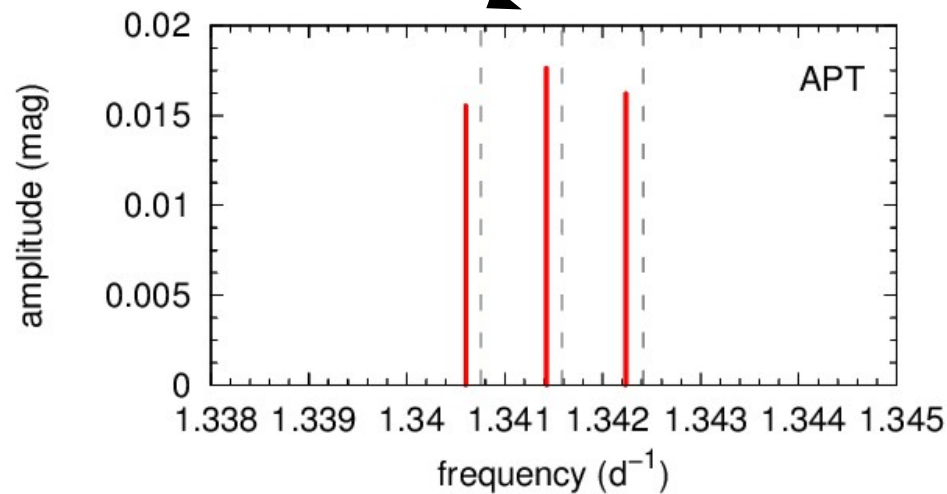
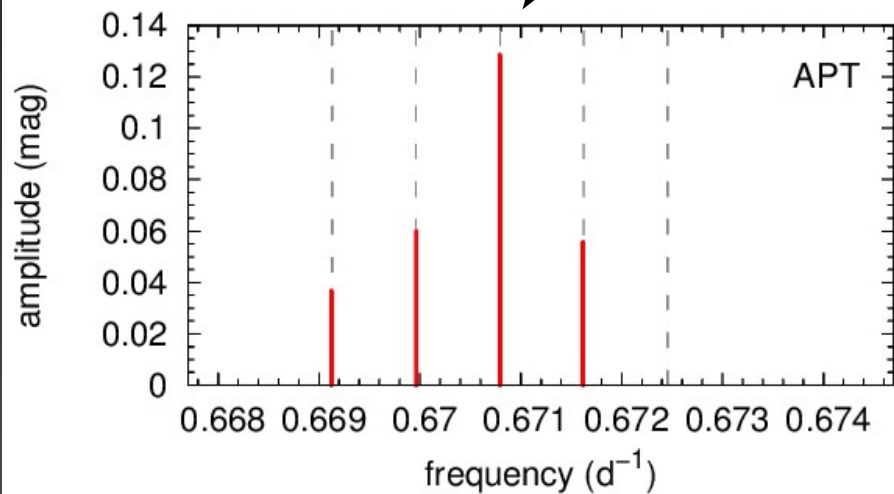
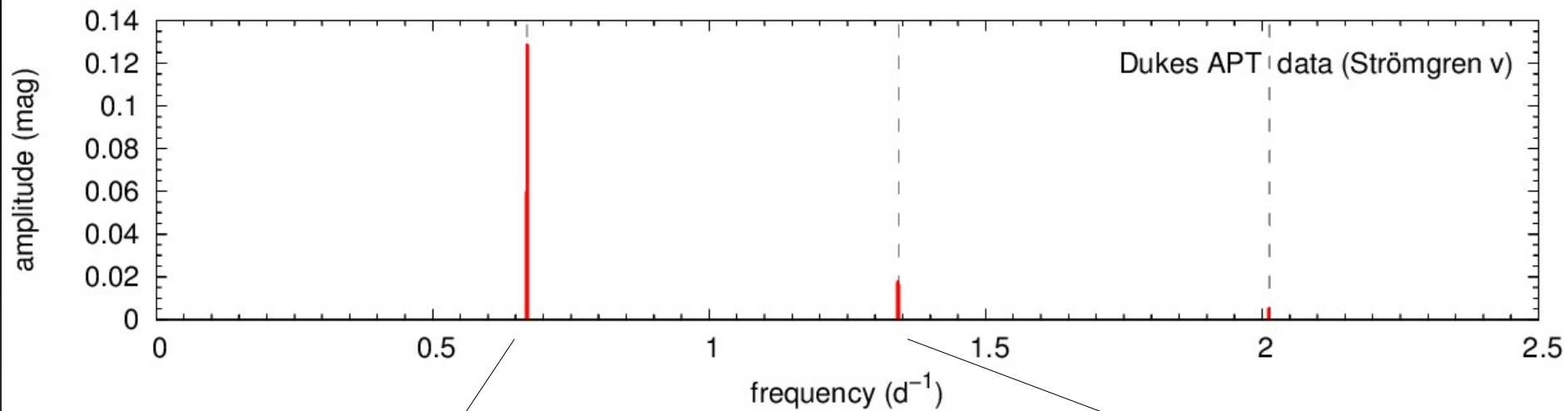
- Strömgren v data by Robert Dukes – 4623 pts

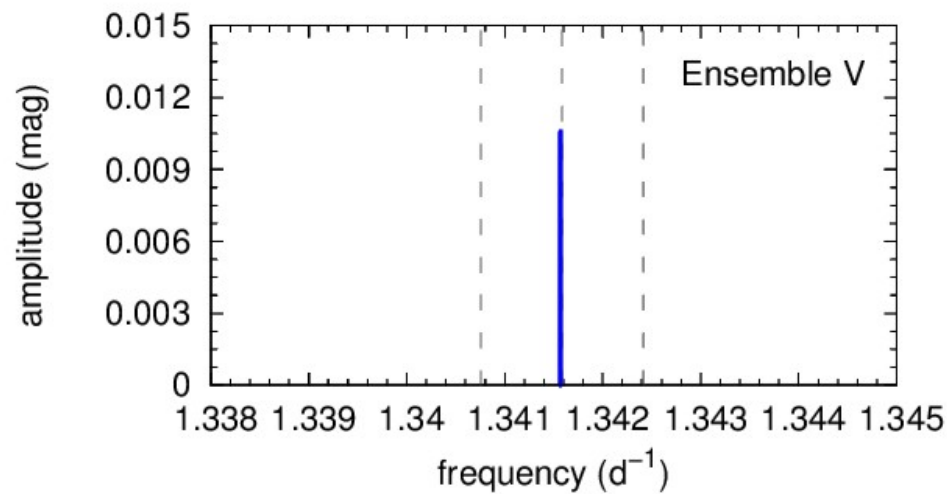
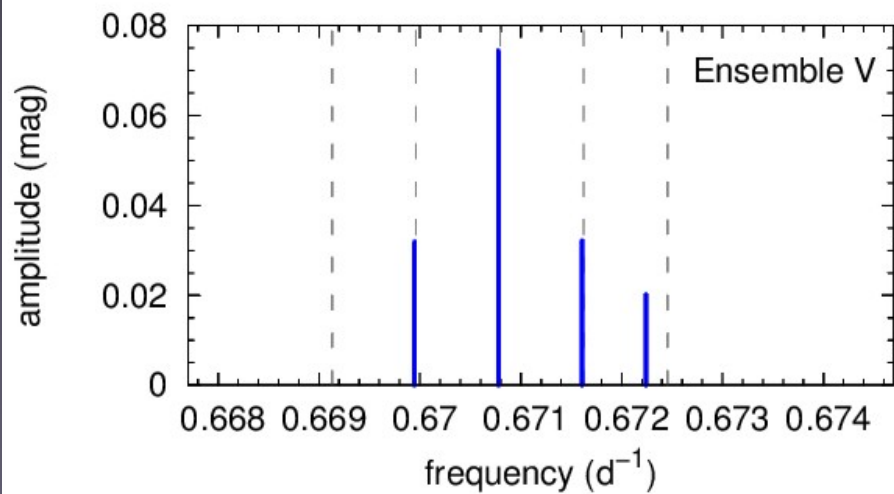
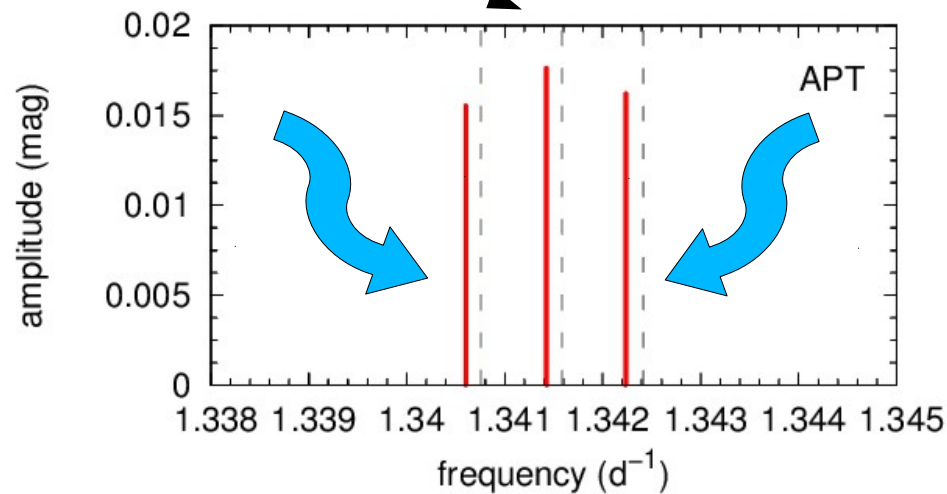
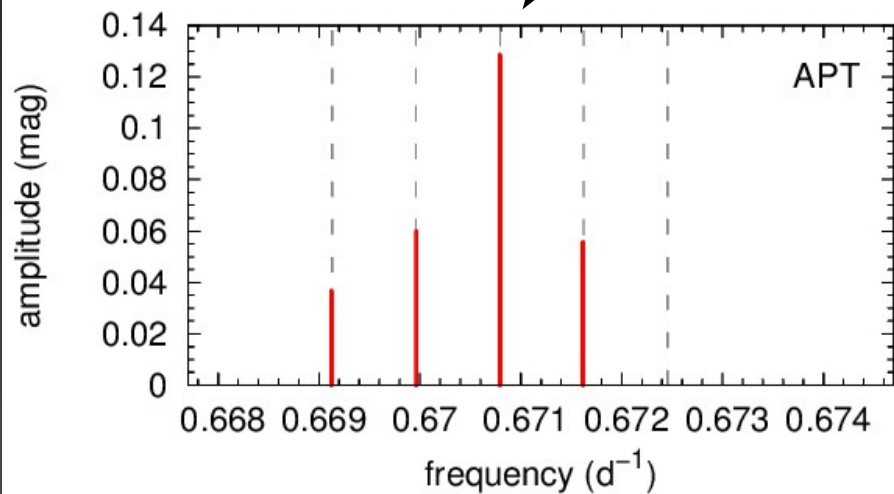
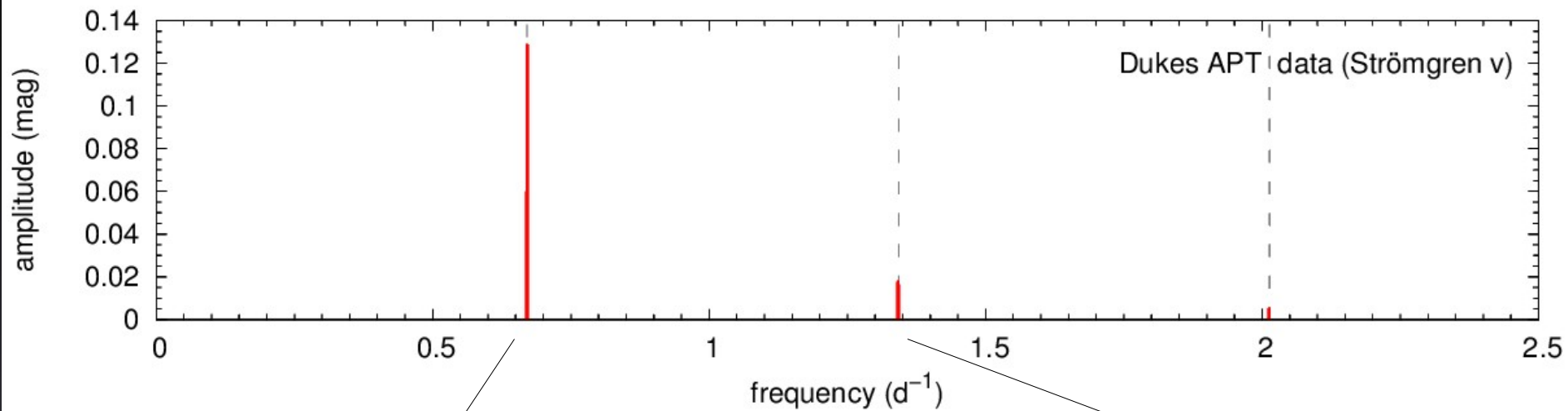


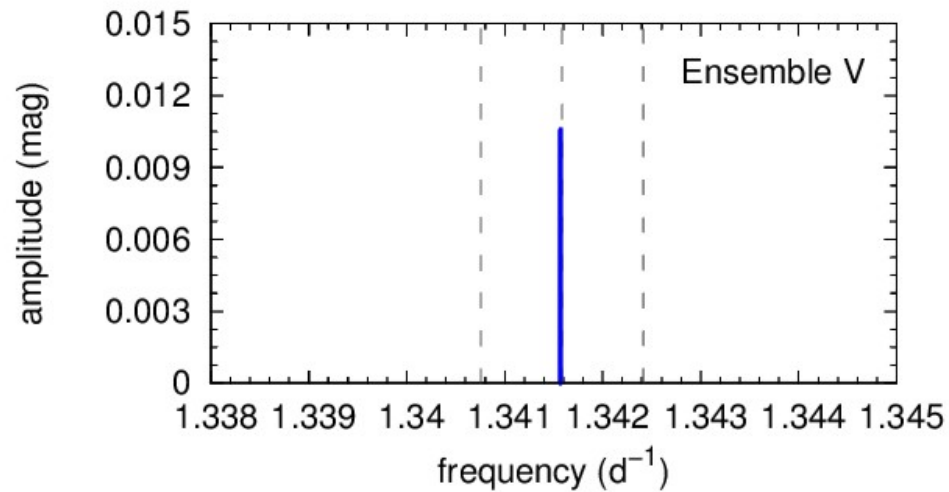
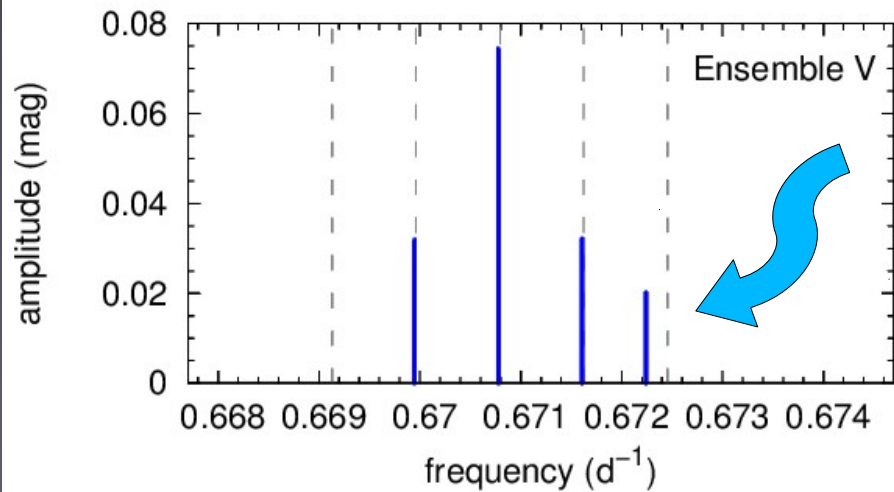
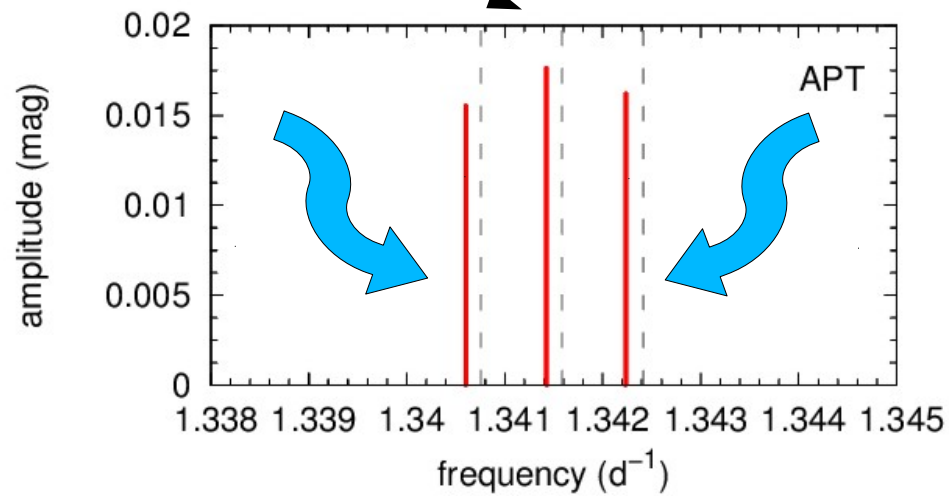
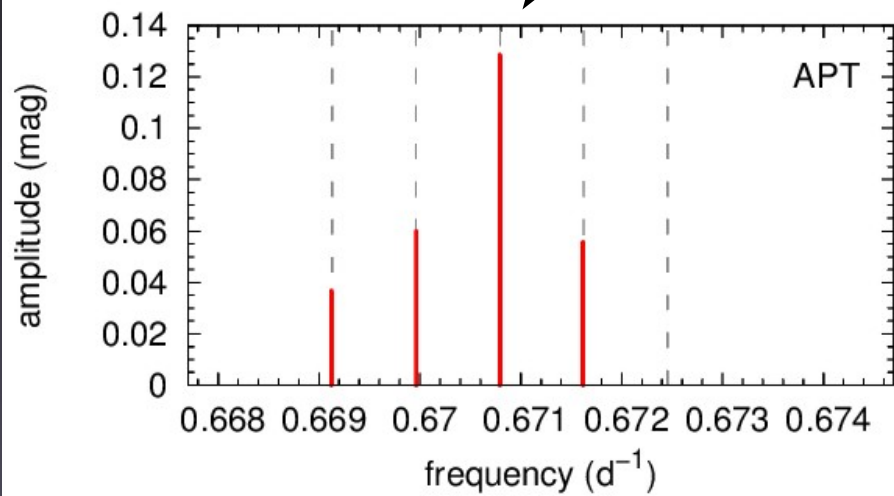
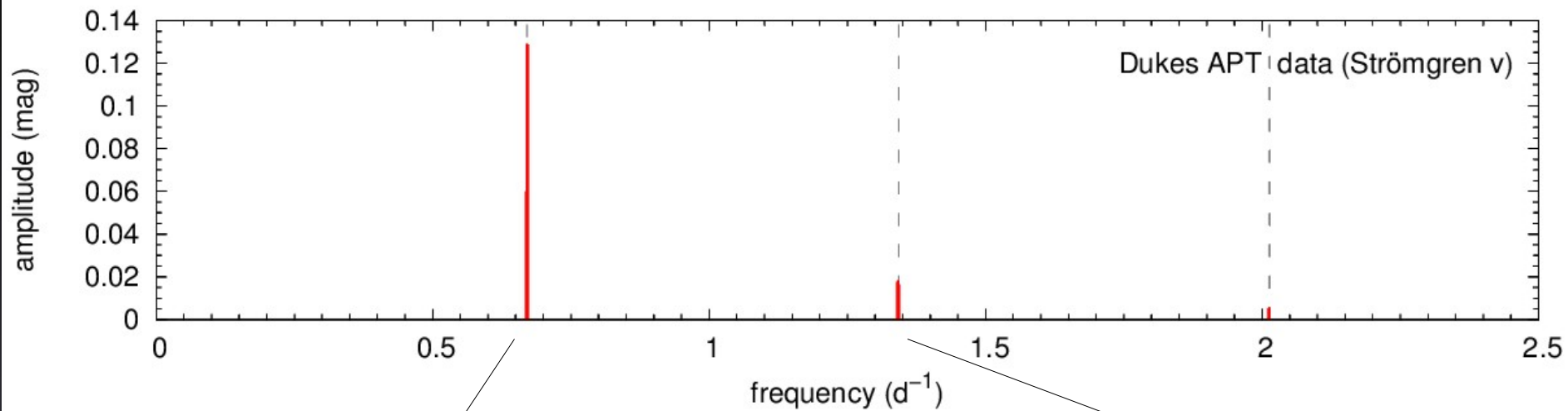
Pulsation/modulation properties

- Main period is 1.4909 days
- Modulation period: 1203 ± 6 days
 - Based on the sidelobes/aliases in the FT



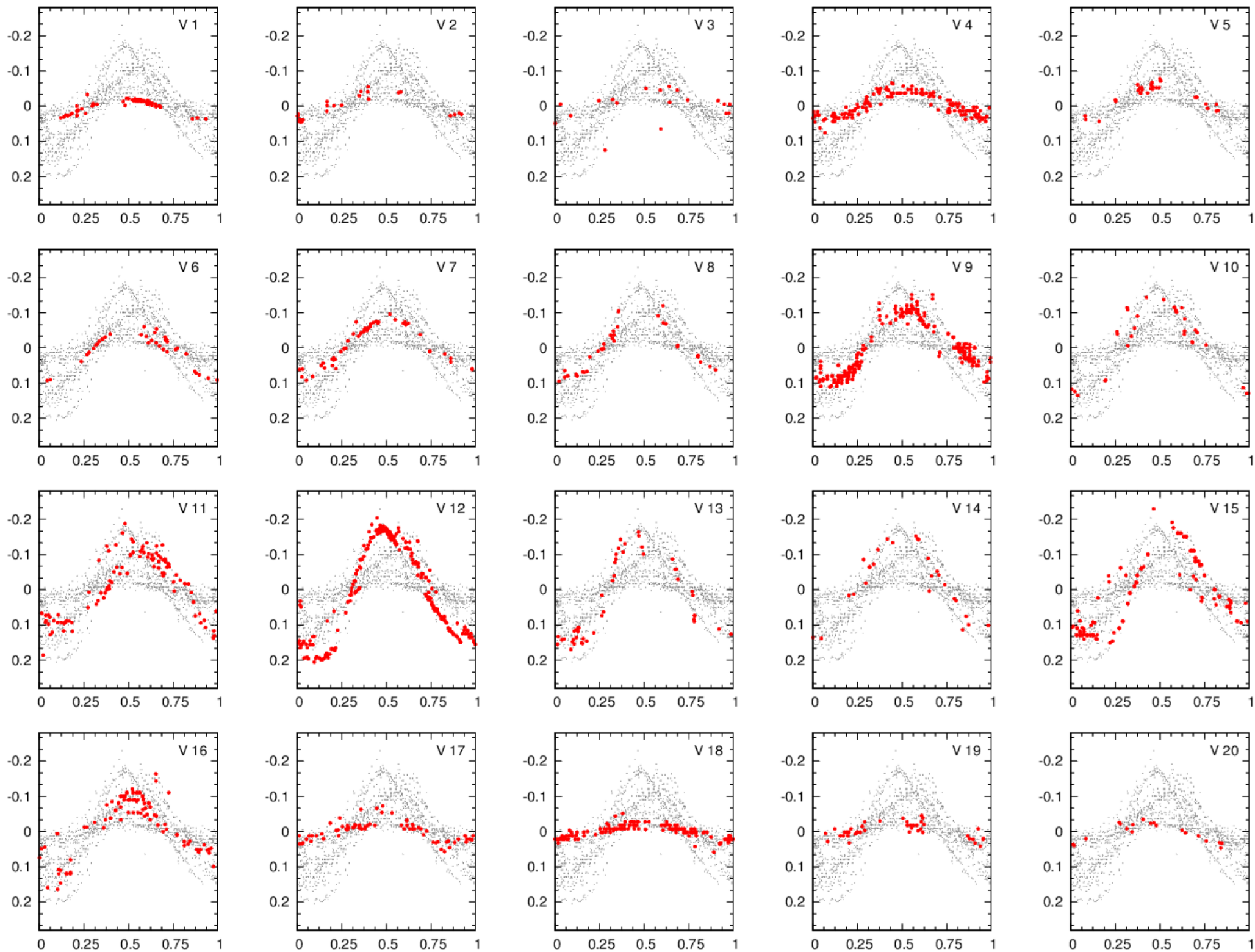


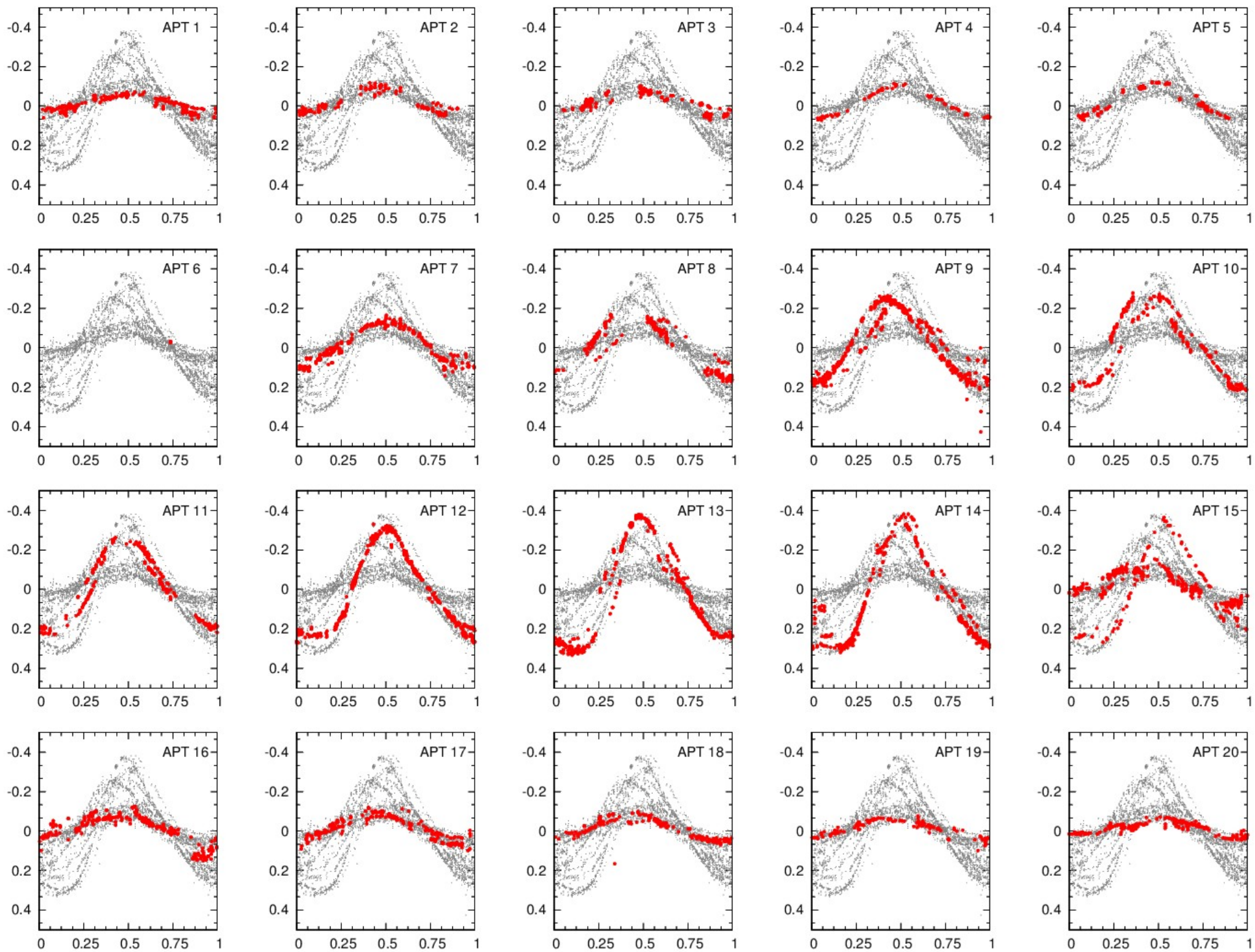


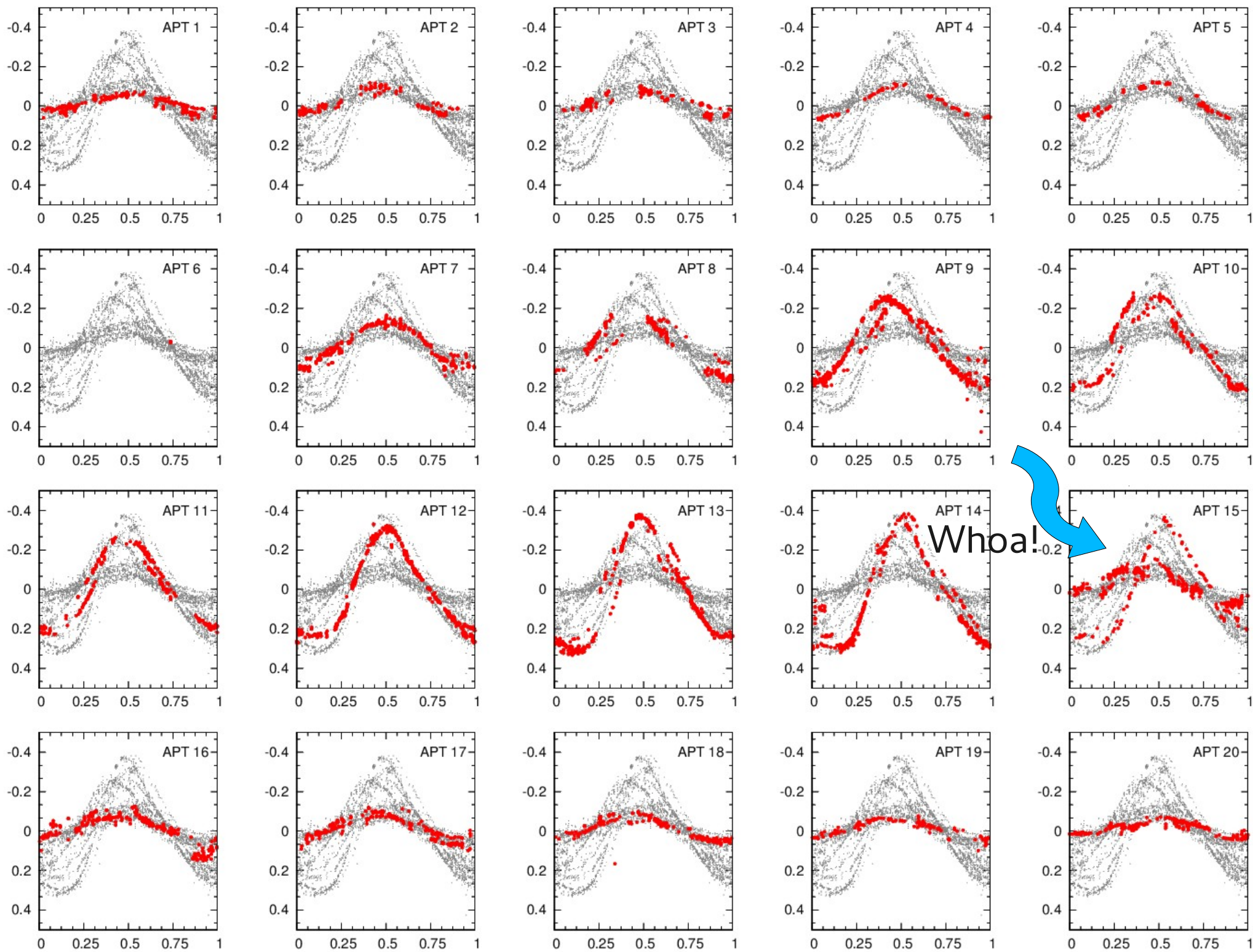


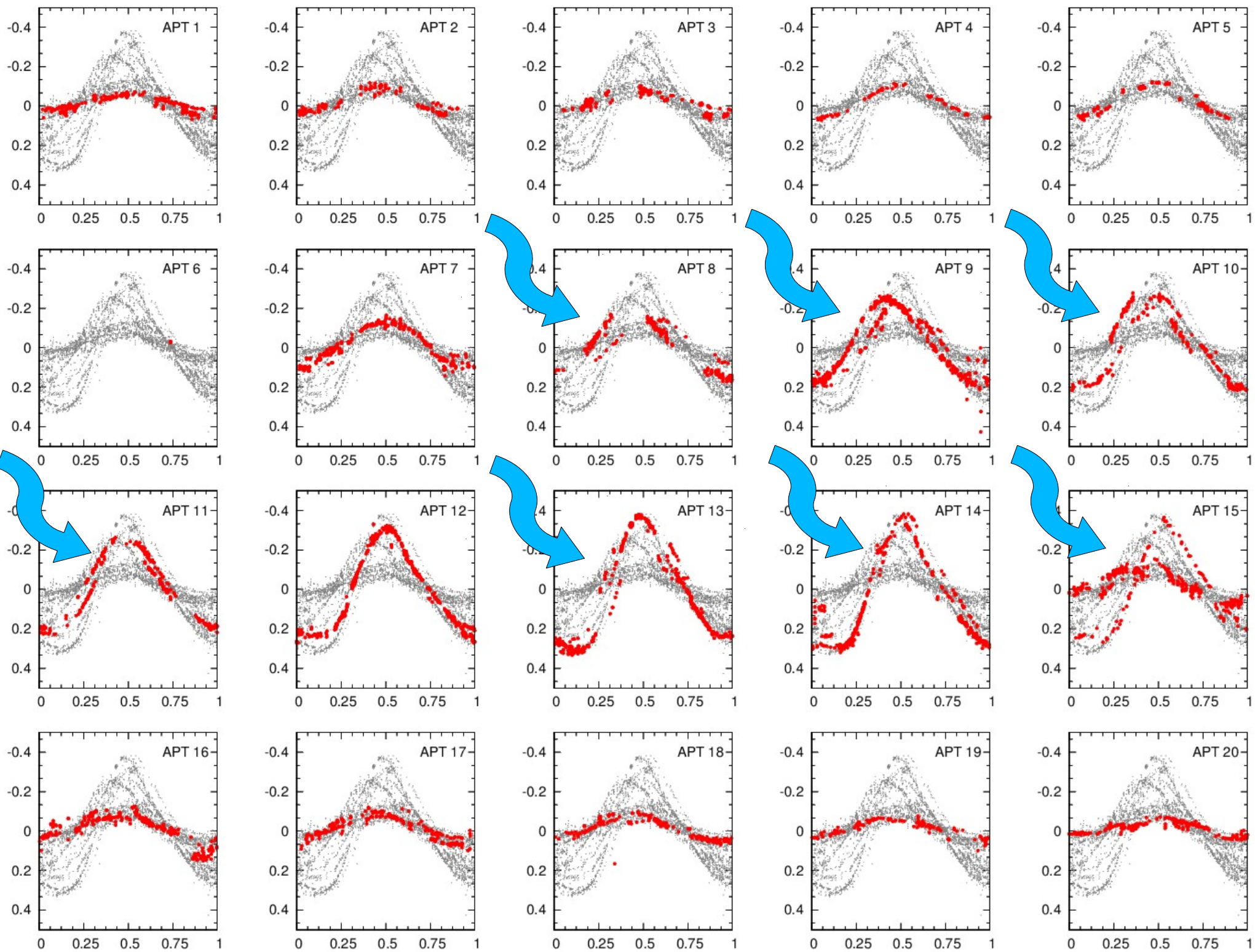
Pulsation/modulation properties

- Modulation period: 1203 ± 6 days (~ 802 pulsation cycles) \rightarrow slow
- But: irregularities in the Fourier-transforms
 - Variable modulation?
 - Additional modes?
 - Both exist in Blazhko RR Lyrae stars
- Sparse coverage \rightarrow binning into 10/20 bins/modulation cycle



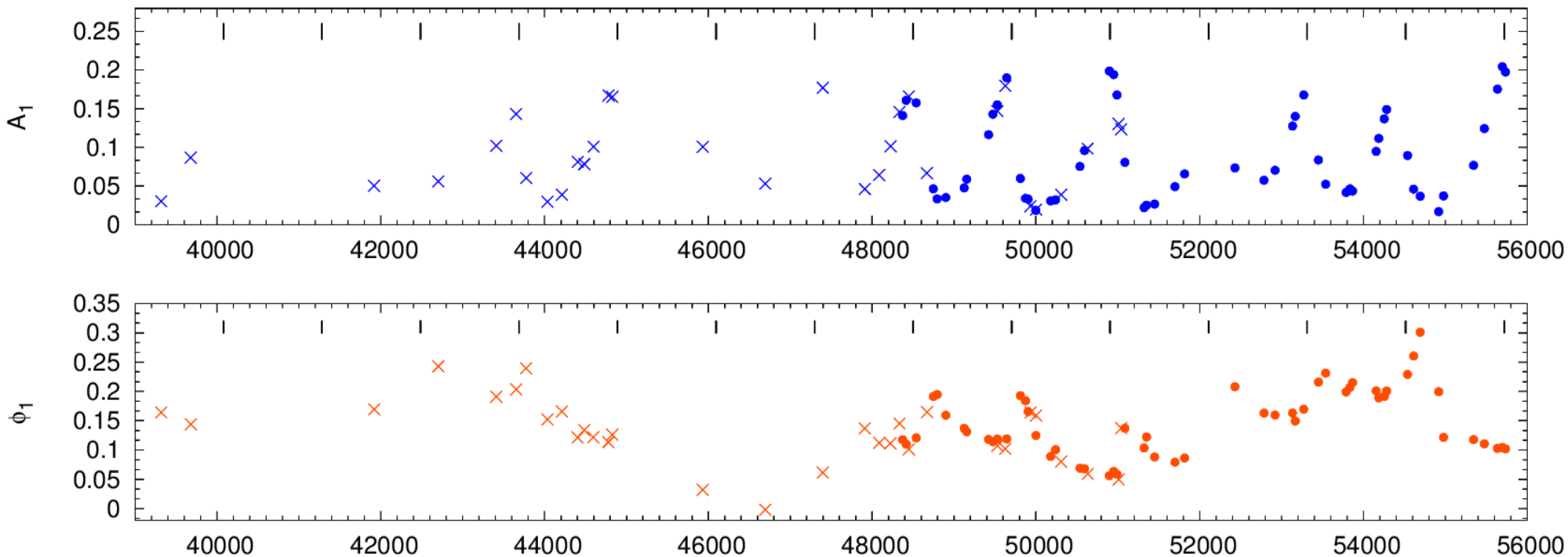




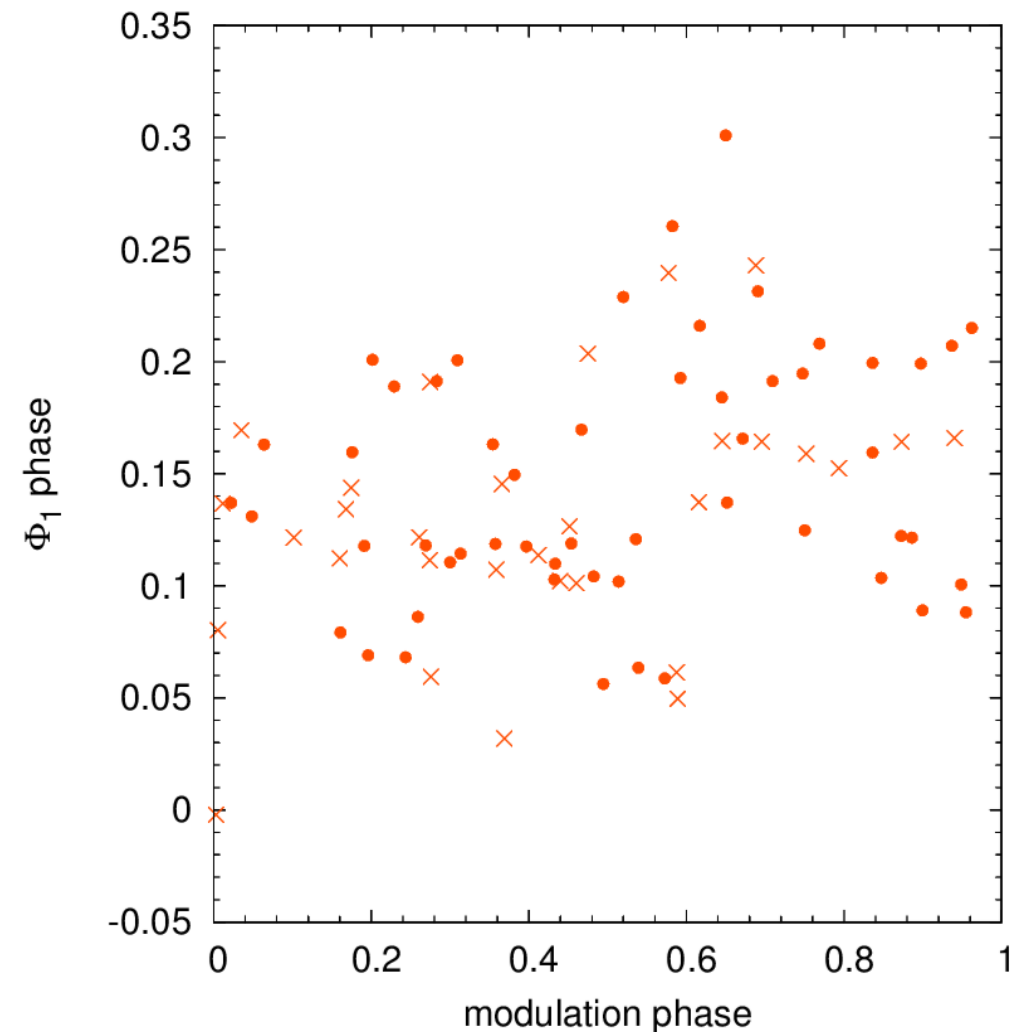
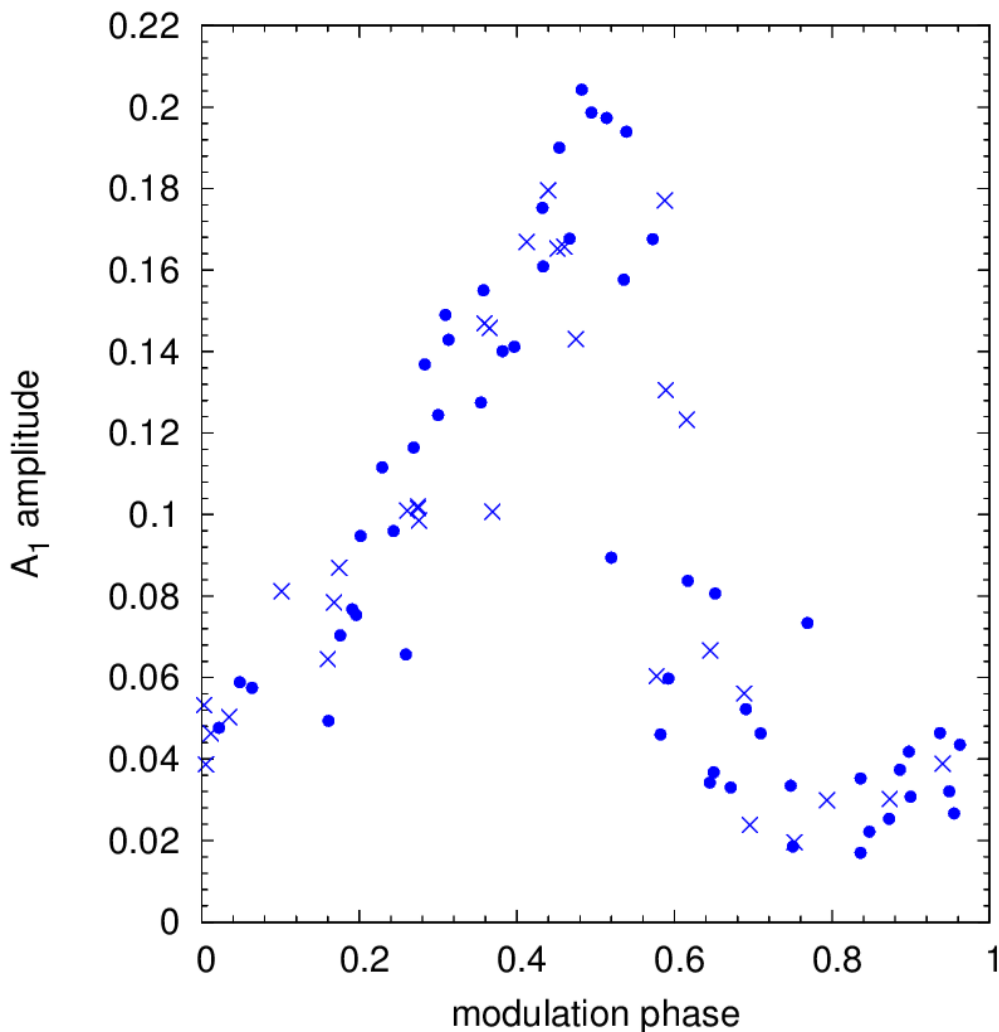


Modulation properties

- Phase diagrams suggest variable modulation
- Amplitude, phase of f_1 freq. peak in each bin

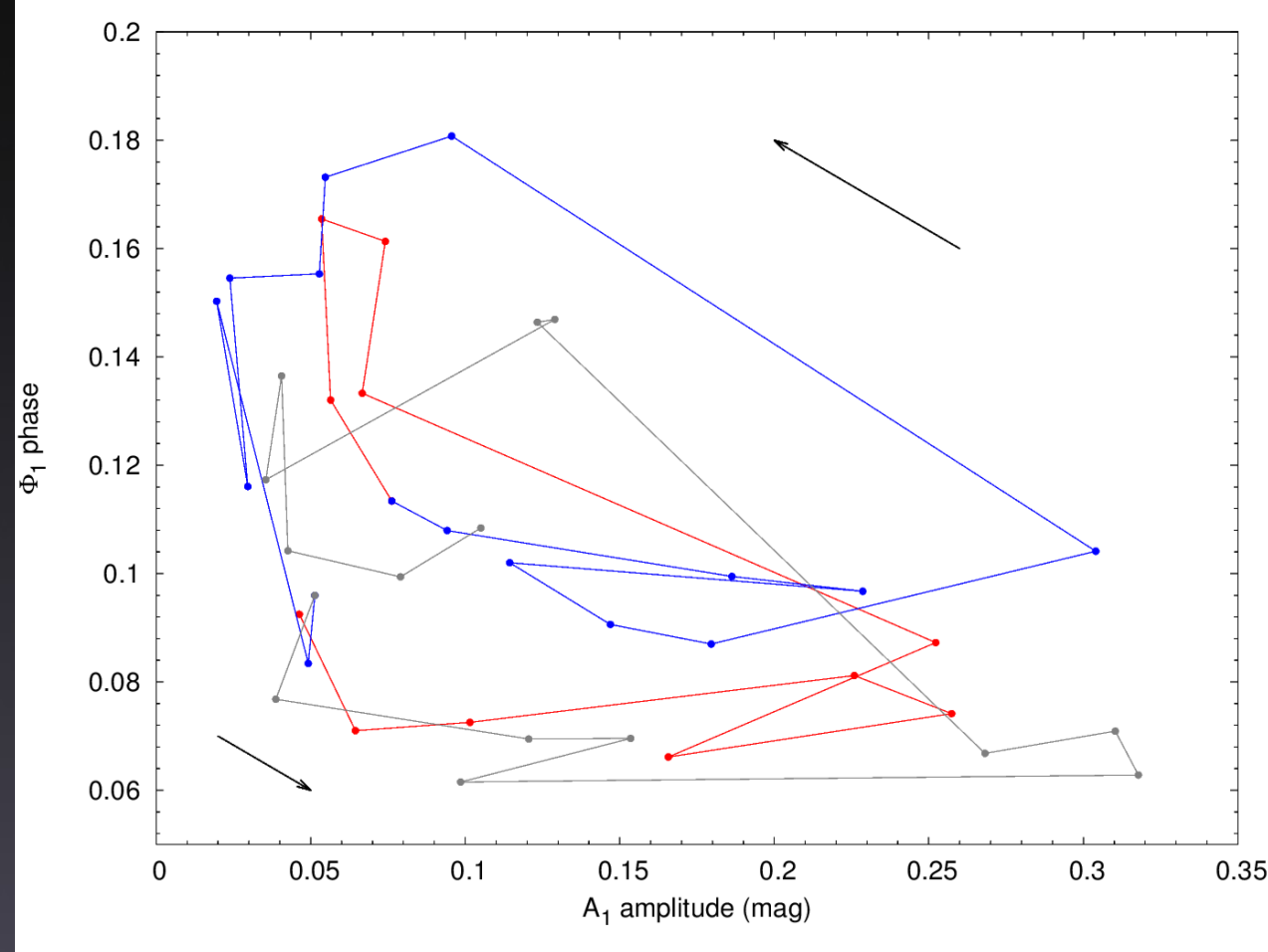


- Amplitude modulation is more consistent
- Phase modulation shows trends, jumps
 - Another sign of changing modulation period



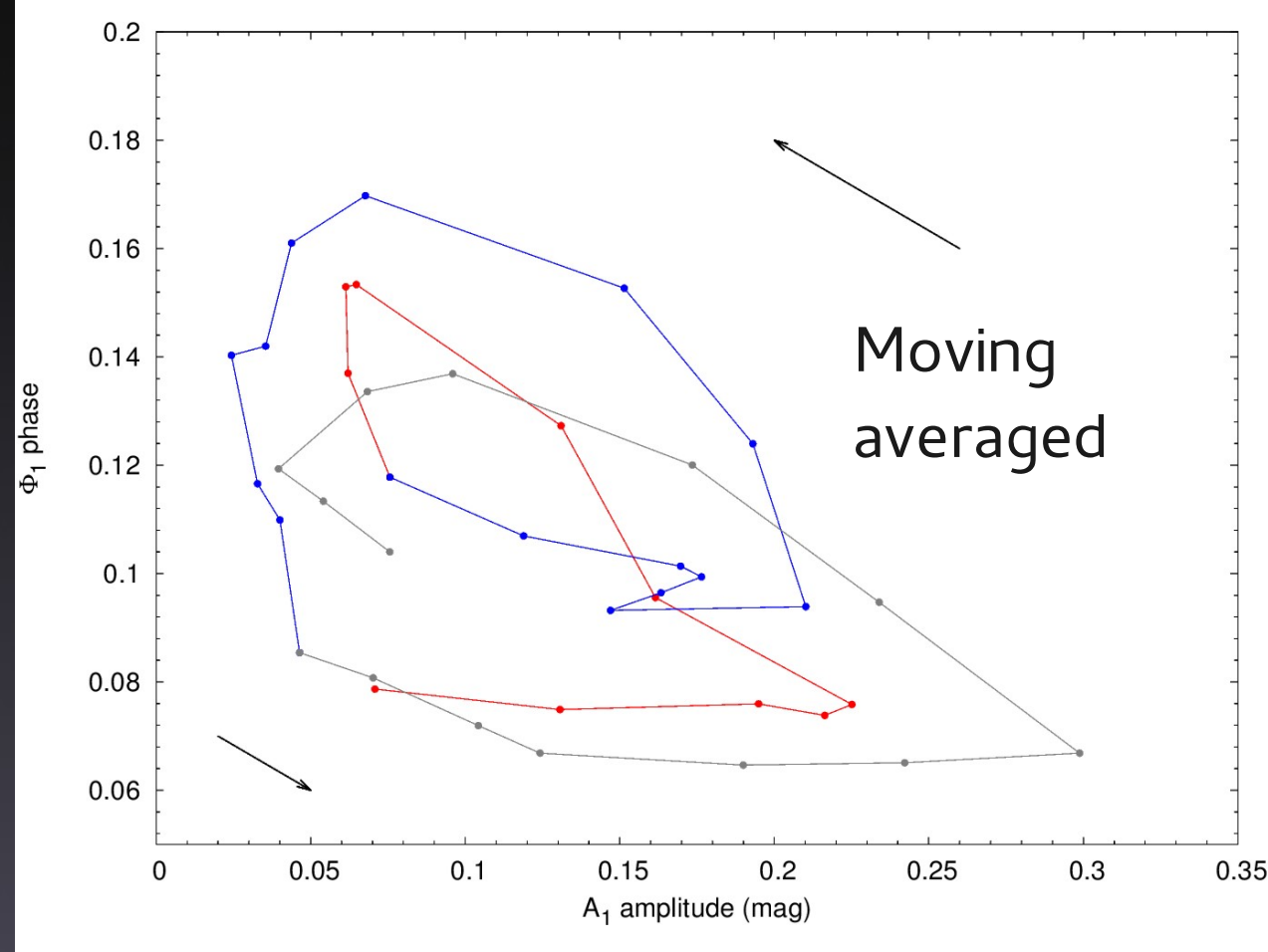
Loop diagram

- Counter-clockwise: similar to many Blazhko RR Lyrae stars
- Strong cycle-to-cycle variations



Loop diagram

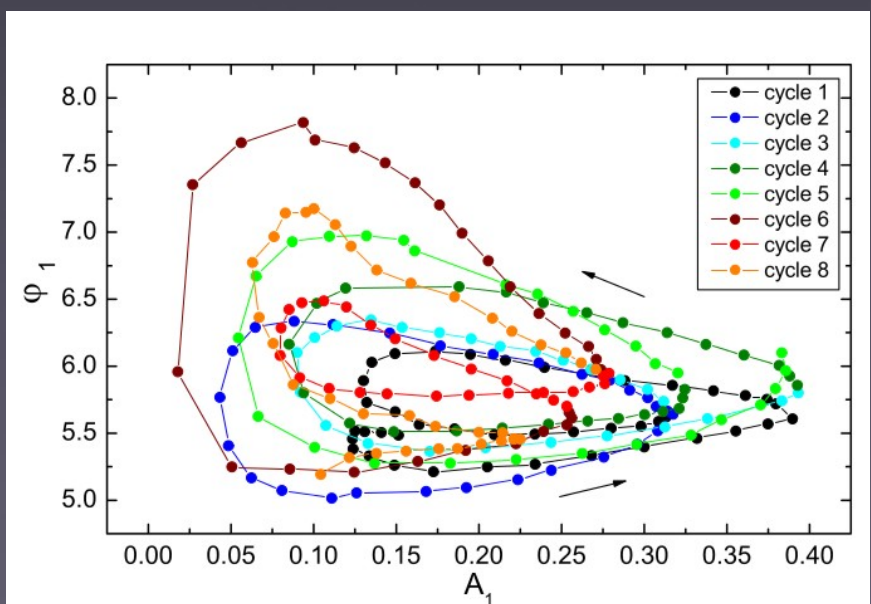
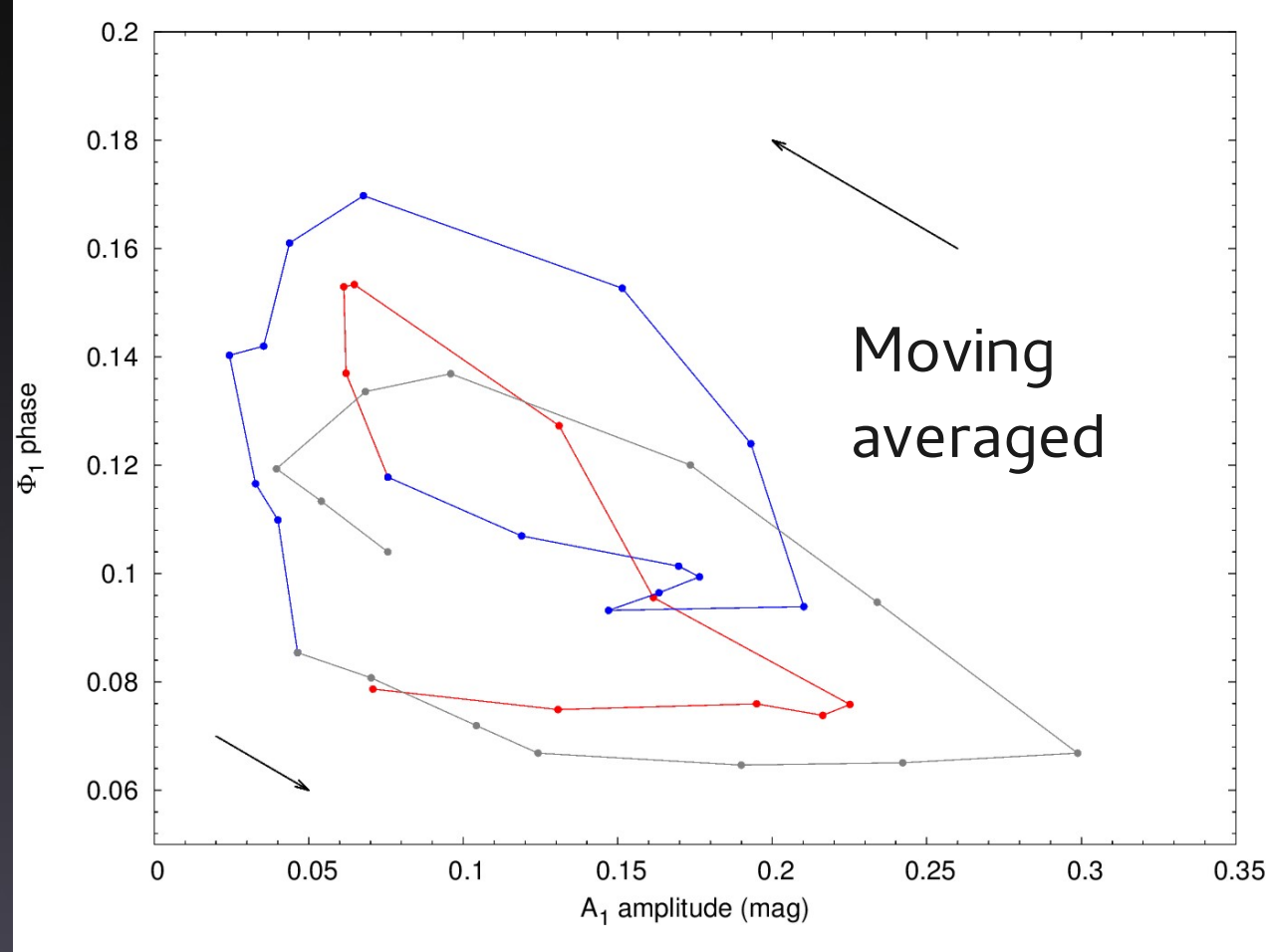
- Counter-clockwise: similar to many Blazhko RR Lyrae stars
- Strong cycle-to-cycle variations



Loop diagram

- Counter-clockwise: similar to many Blazhko RR Lyrae stars
- Strong cycle-to-cycle variations
- Seen in RR Lyrae stars too

V445 Lyr, Guggenberger et al. 2012



First results

- V473 Lyr shows strong modulation with a period of 1203 d
- Modulation period and amplitude are not constant
- Looks similar to the Blazhko-effect
- Light-curve shape changes less dramatically

Future work

- Combine the datasets
- Color, radial velocity information
- Compare various parameters to RR Lyrae stars
- Possible alternatives for the Blazhko-effect?