Characteristics of a new Blazhko effect population in the SuperWASP archive

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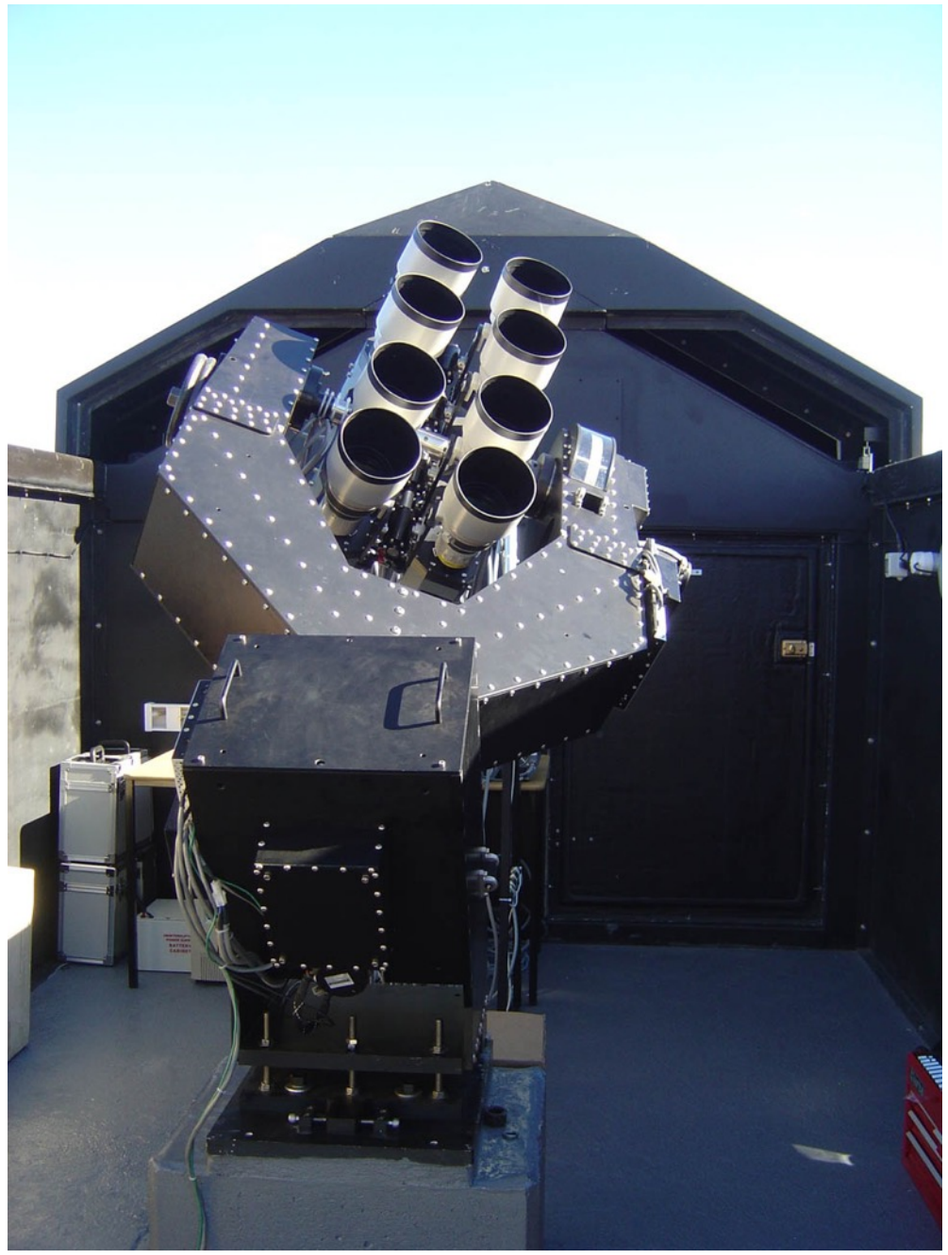
Outline

- Phase folding routine
- Results using the CLEAN algorithm
- Analysis of phase folded light curves
- Correlation of characteristic parameters



Phase folding SuperWASP light curves

- Initial catalogue of 8556 candidate RRab objects from Payne (2013), categorised using a machine learning technique run on SWASP archive.

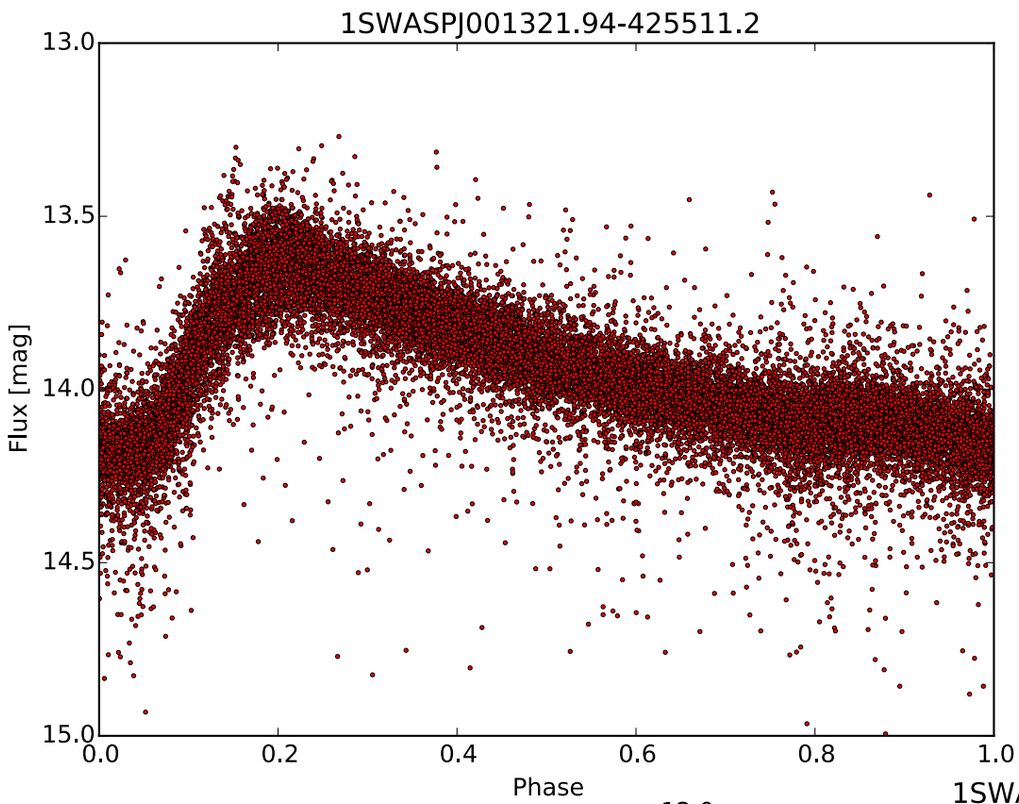
- Used the SysRem detrended data (Tamuz et al., 2005) from the 3.5 pixel aperture.

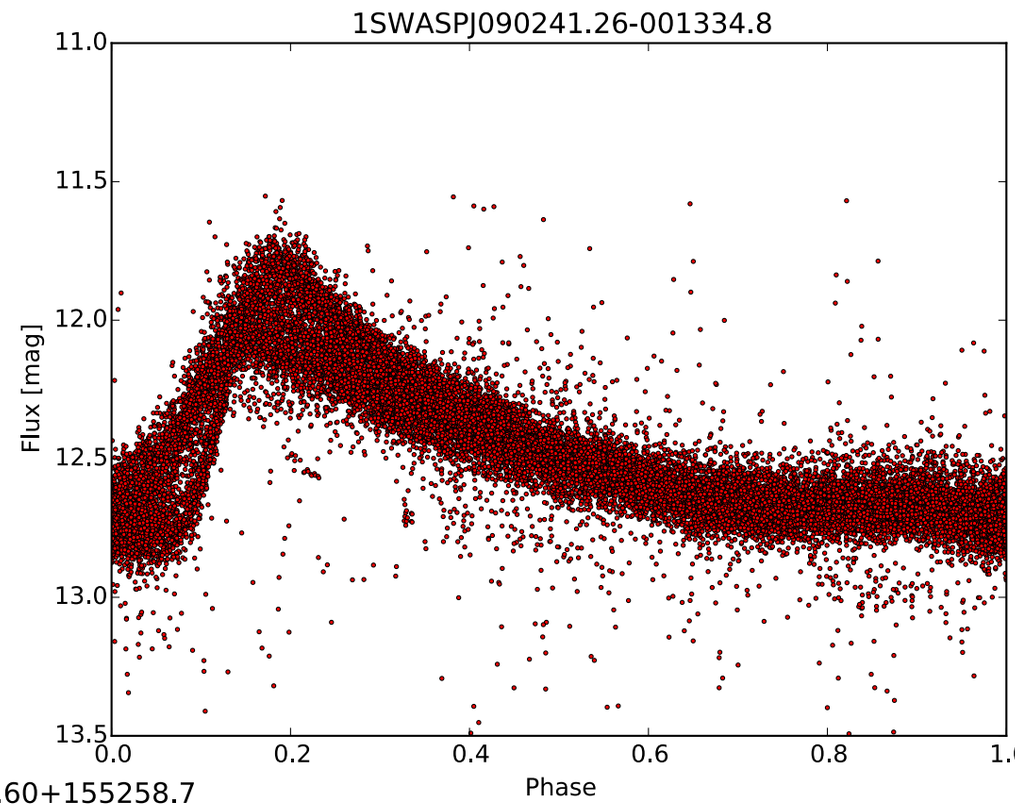
- Outliers removed using 5 iterations of a 5 sigma clip.

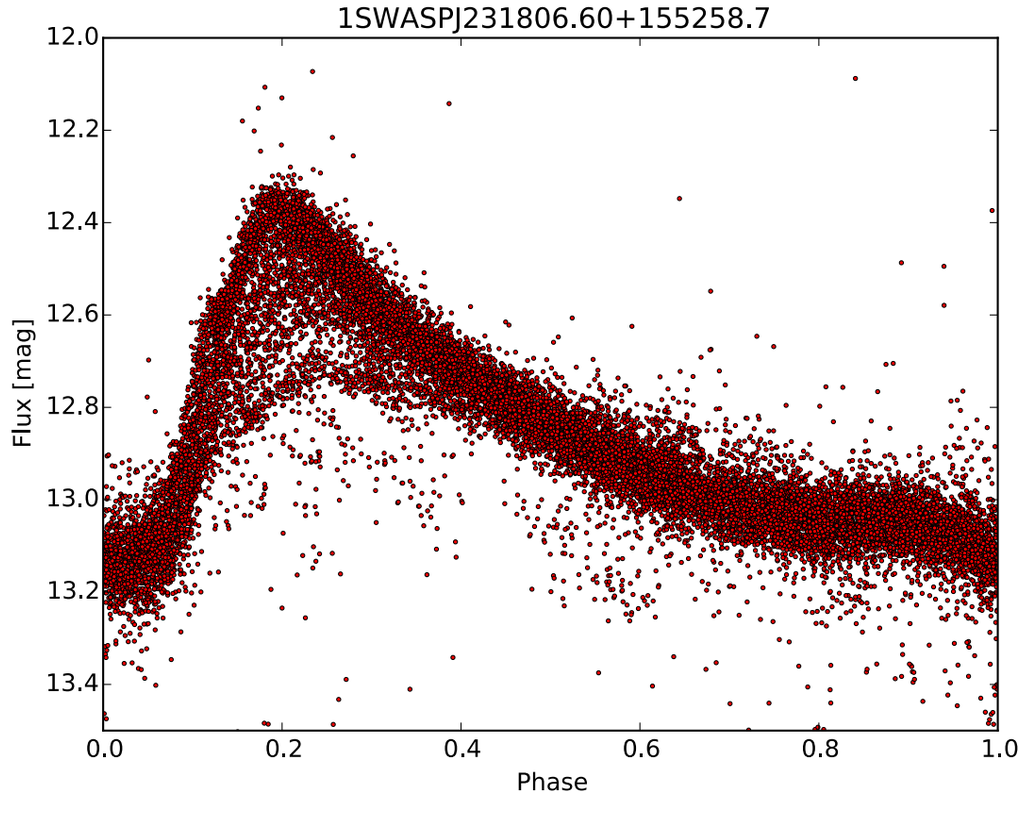
- After visual checks and removal of duplicates, 4986 objects remained with average duration of 5.5 years and ~30k data points per object.

- Phase folded using a phase dispersion minimisation and epoch folding combination (Davies, 1990).

Sample phase folded light curves



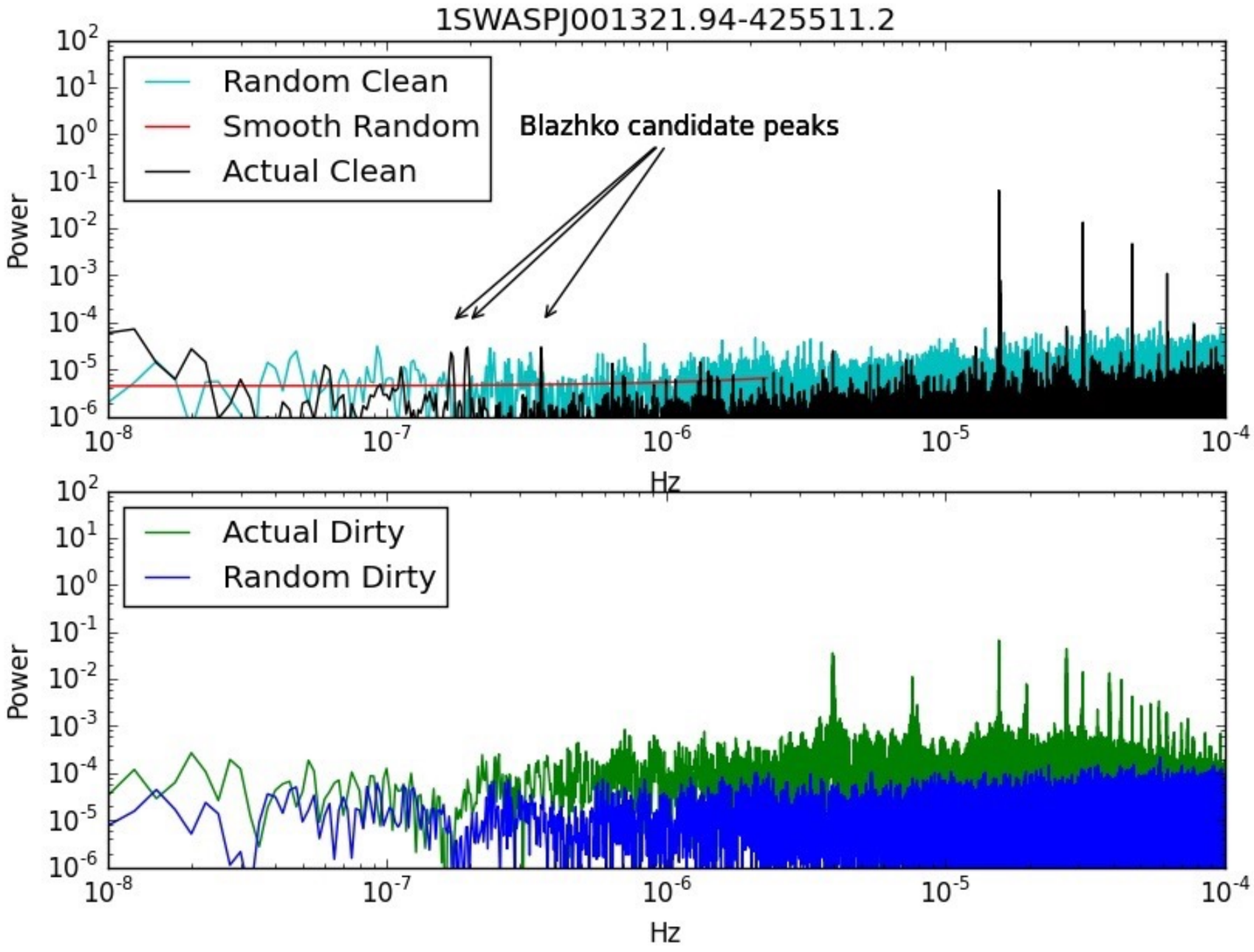




Low frequency Blazhko peaks in CLEAN spectra

- Flux was randomised and averaged to create a dirty and CLEAN residual noise level for each object.

- Peaks selected from 5 - 365 day range where SNR >= 3 above first order fit to residual noise.

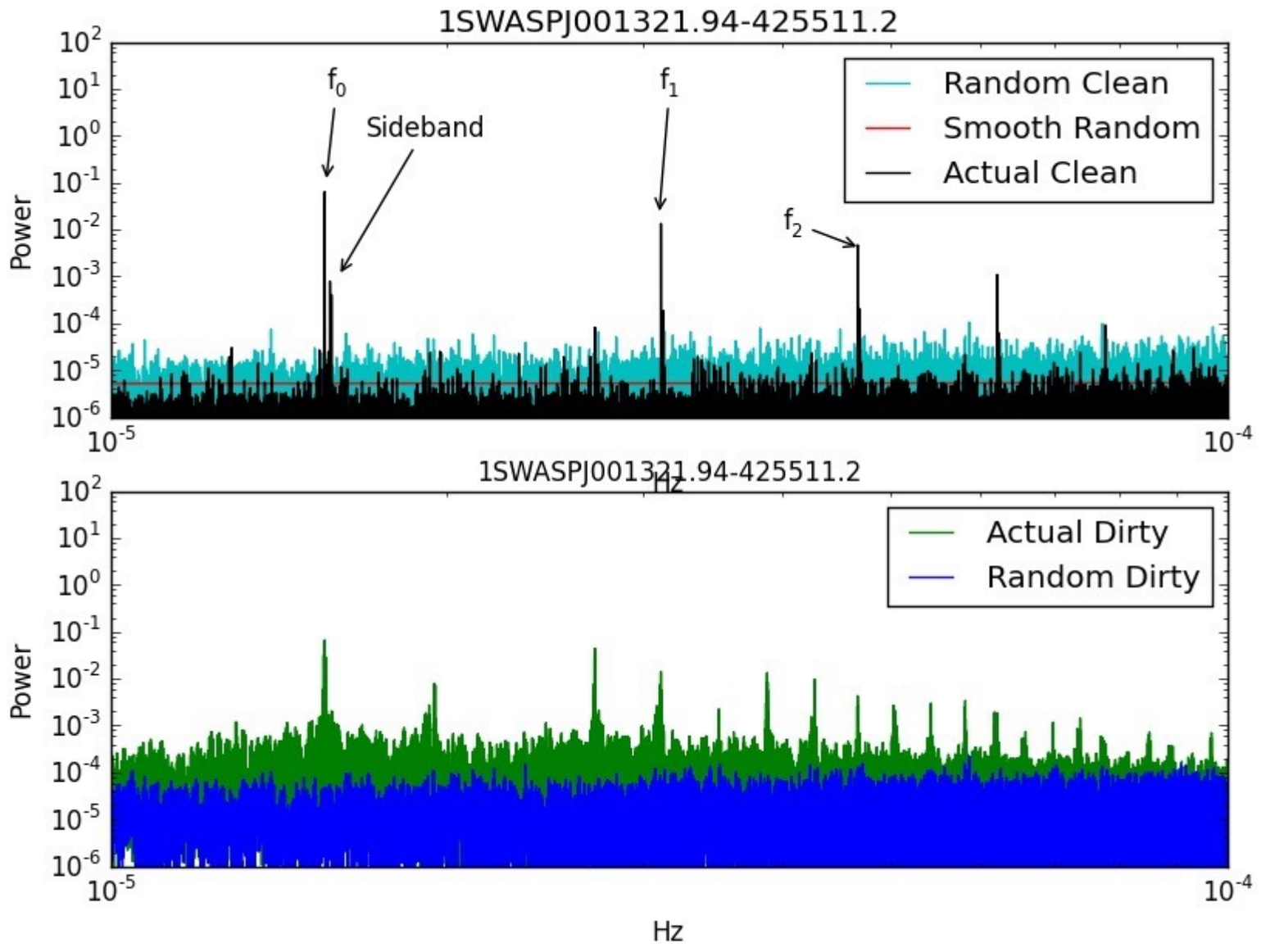


Blazhko effect sidebands in CLEAN spectra

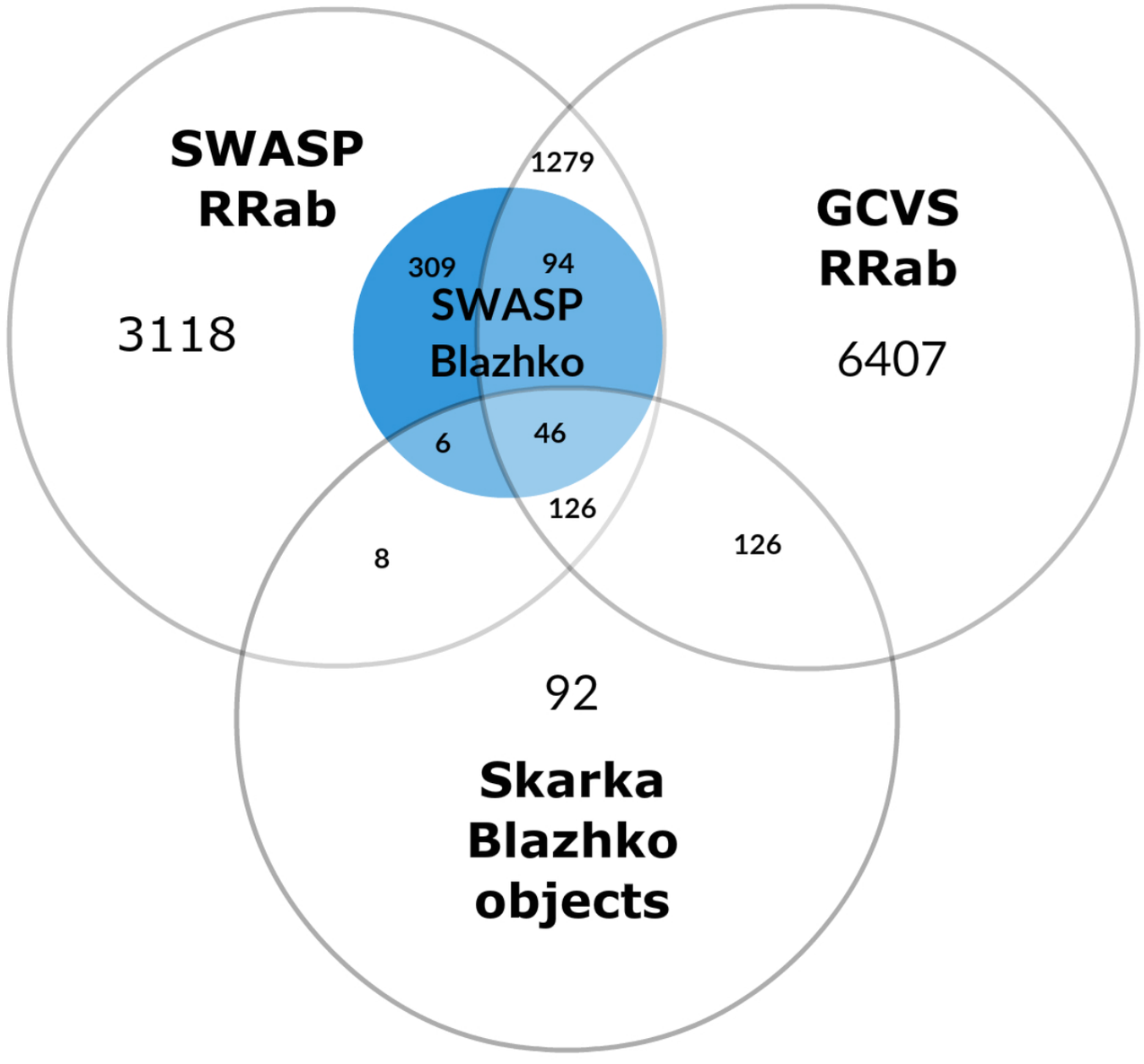
- Process repeated for sidebands in CLEAN spectra.

- Peaks selected from 5 - 365 days where SNR >= 10 above first order fit to residual noise.

- Power combined from fundamental and harmonics below 10^{-4} Hz to create pulse amplitude parameter.

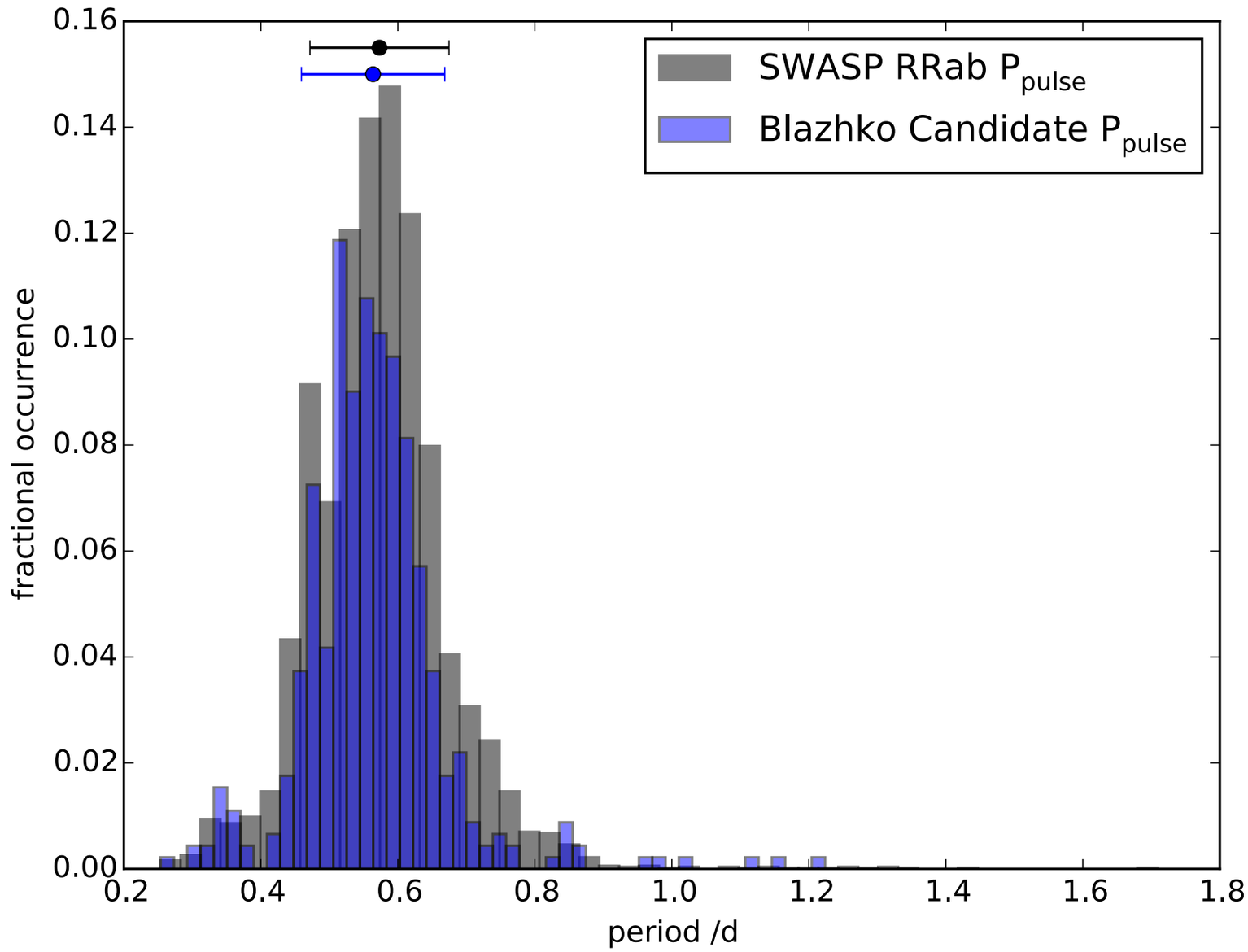


SWASP RRab within known RRab and Blazhko objects.



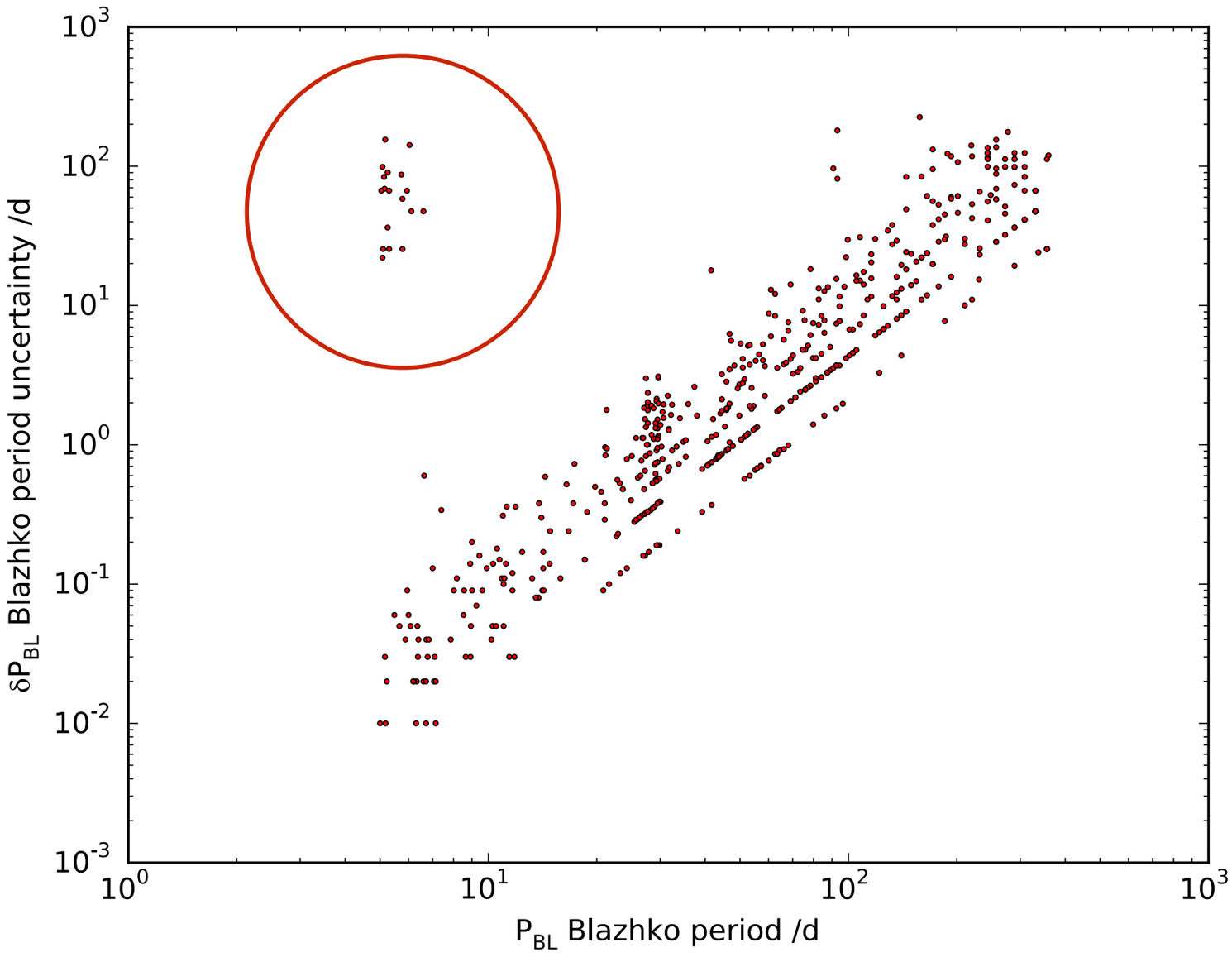
Pulsation periods of RRab and Blazhko populations

- **RRab**:
  - mean = 0.573 d, s.d. = 0.102 d.
- **Blazhko**:
  - mean = 0.564 d, s.d. = 0.104 d.



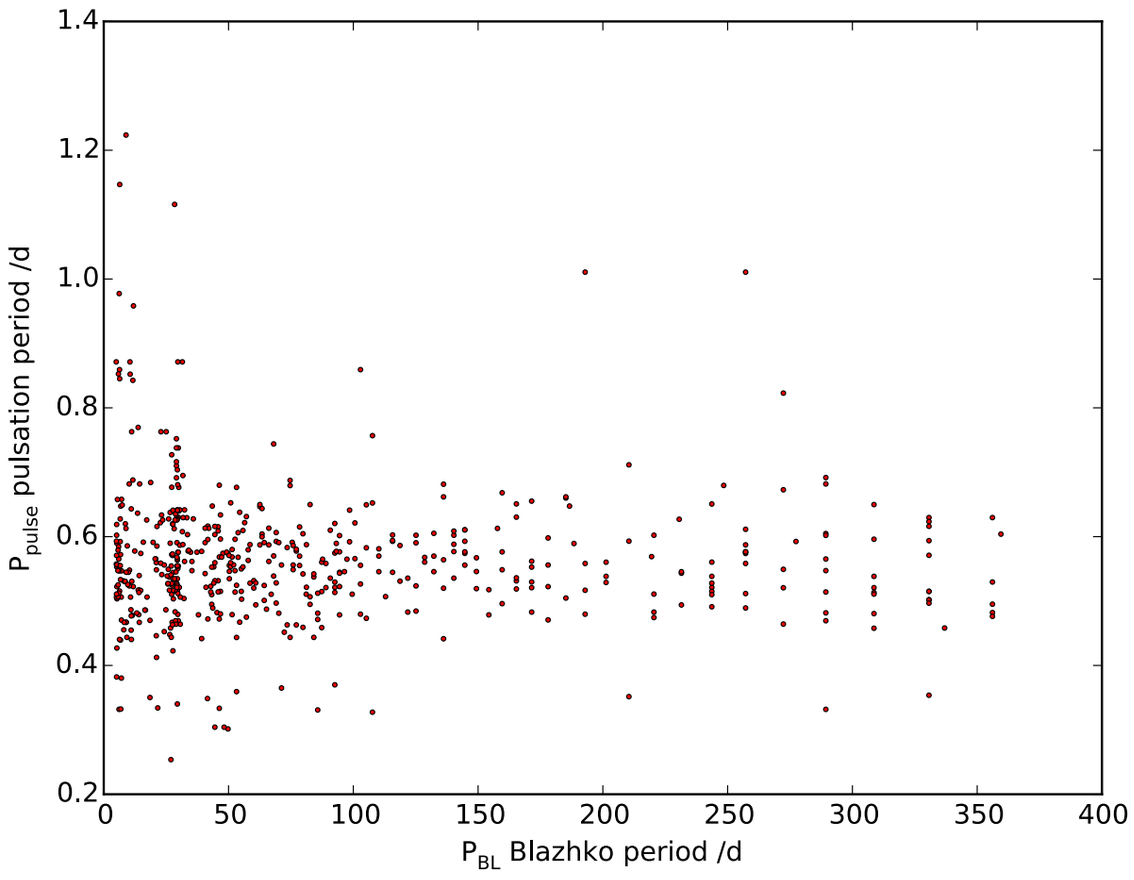
Blazhko periods and uncertainties

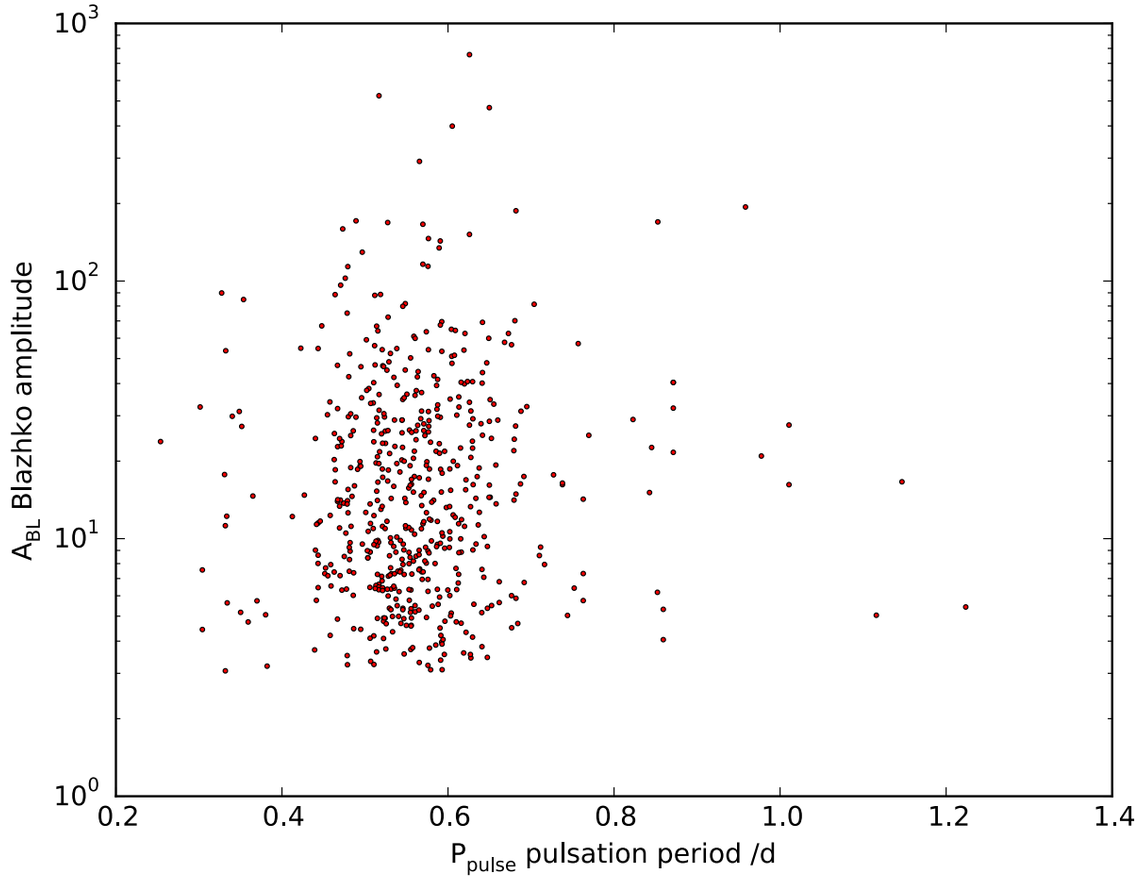
- Interesting cluster of Blazhko periods below 10 days with uncertainties approaching 100 days.



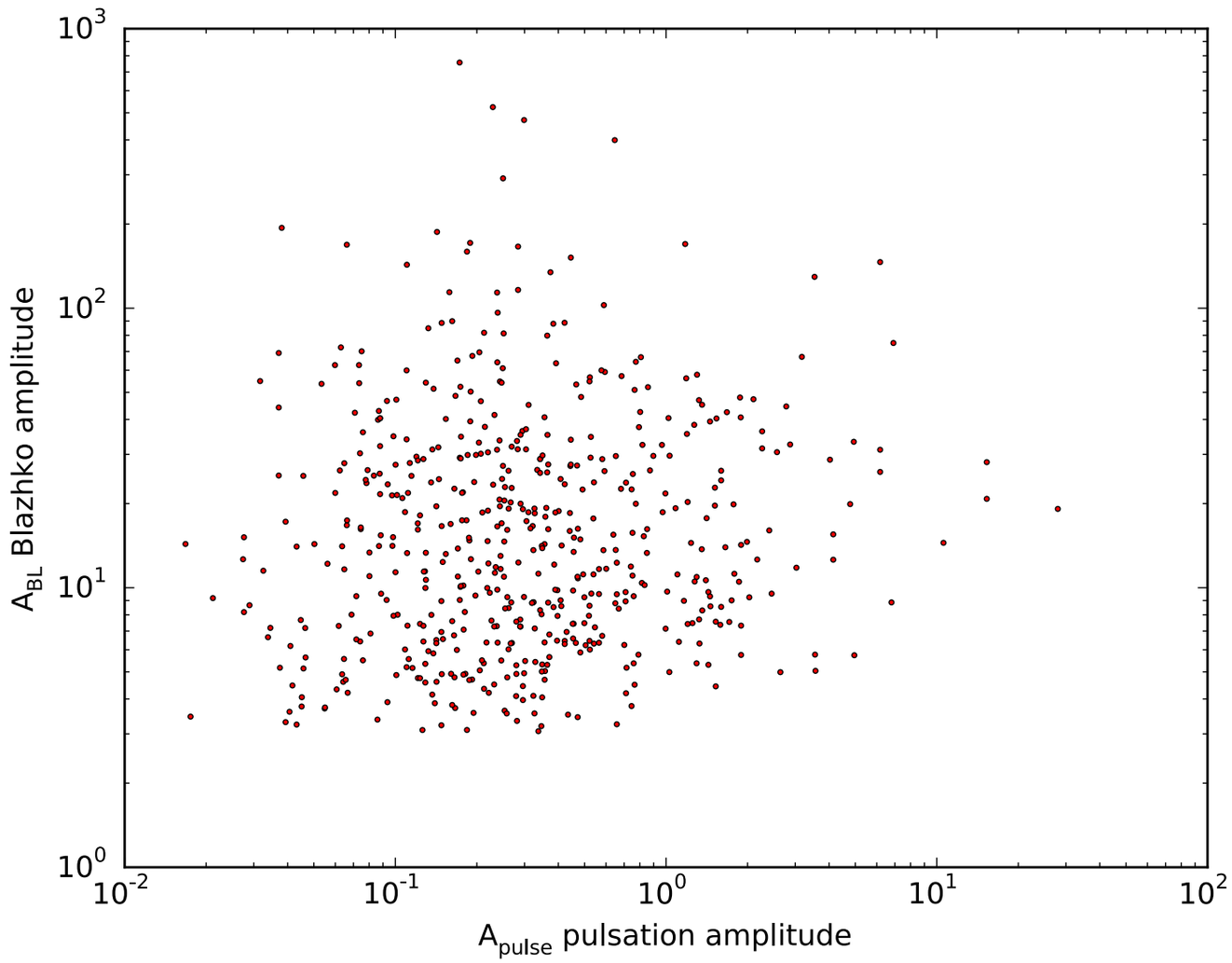
Pulsation period correlations

- Jurcsik et al (2005 a): for P_{pulse} > 0.6 d, P_{BL} > 20 d.
- Jurcsik et al (2005 b): P_{pulse} proportional to A_{BL}



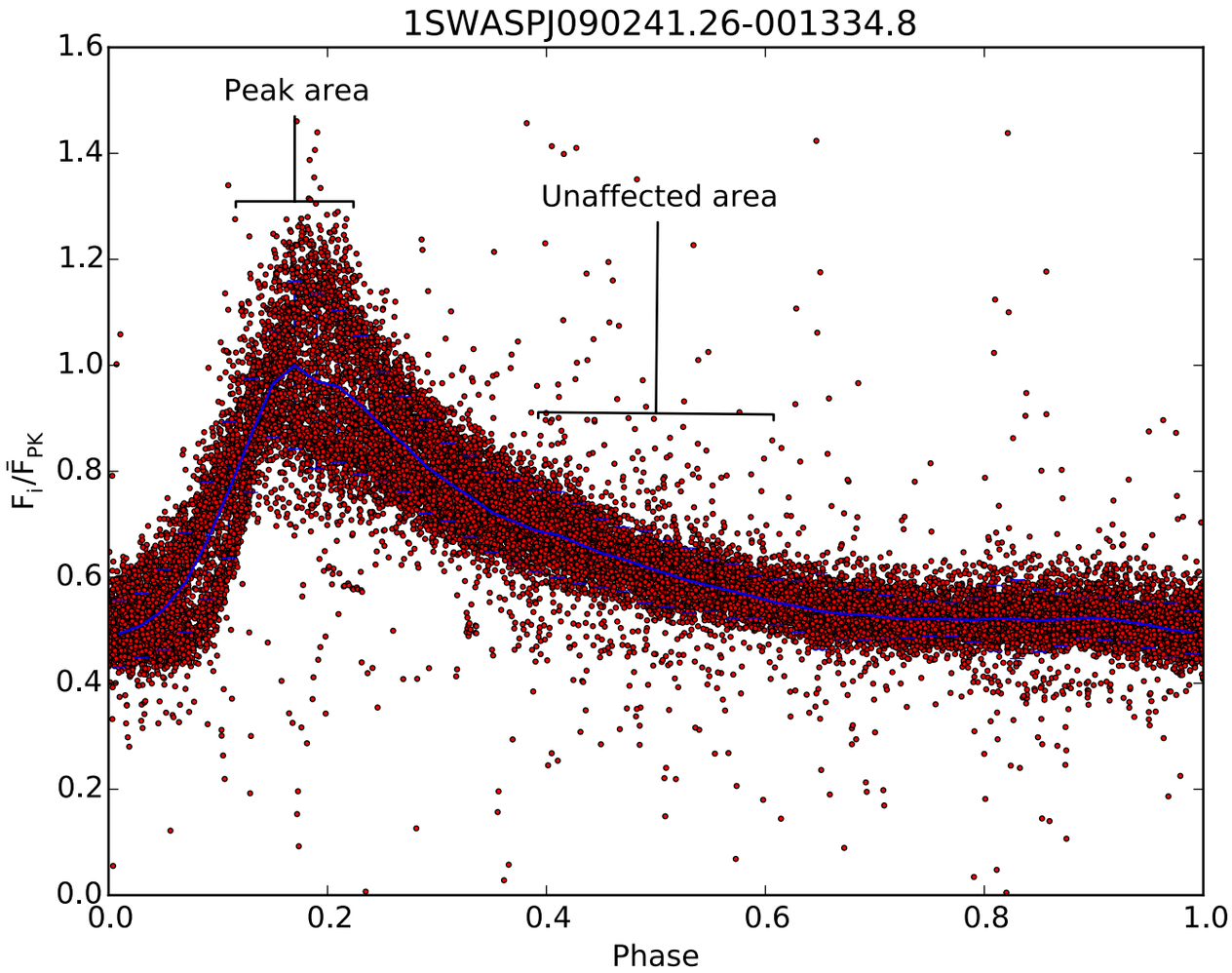


Blazhko amplitude vs Pulsation amplitude



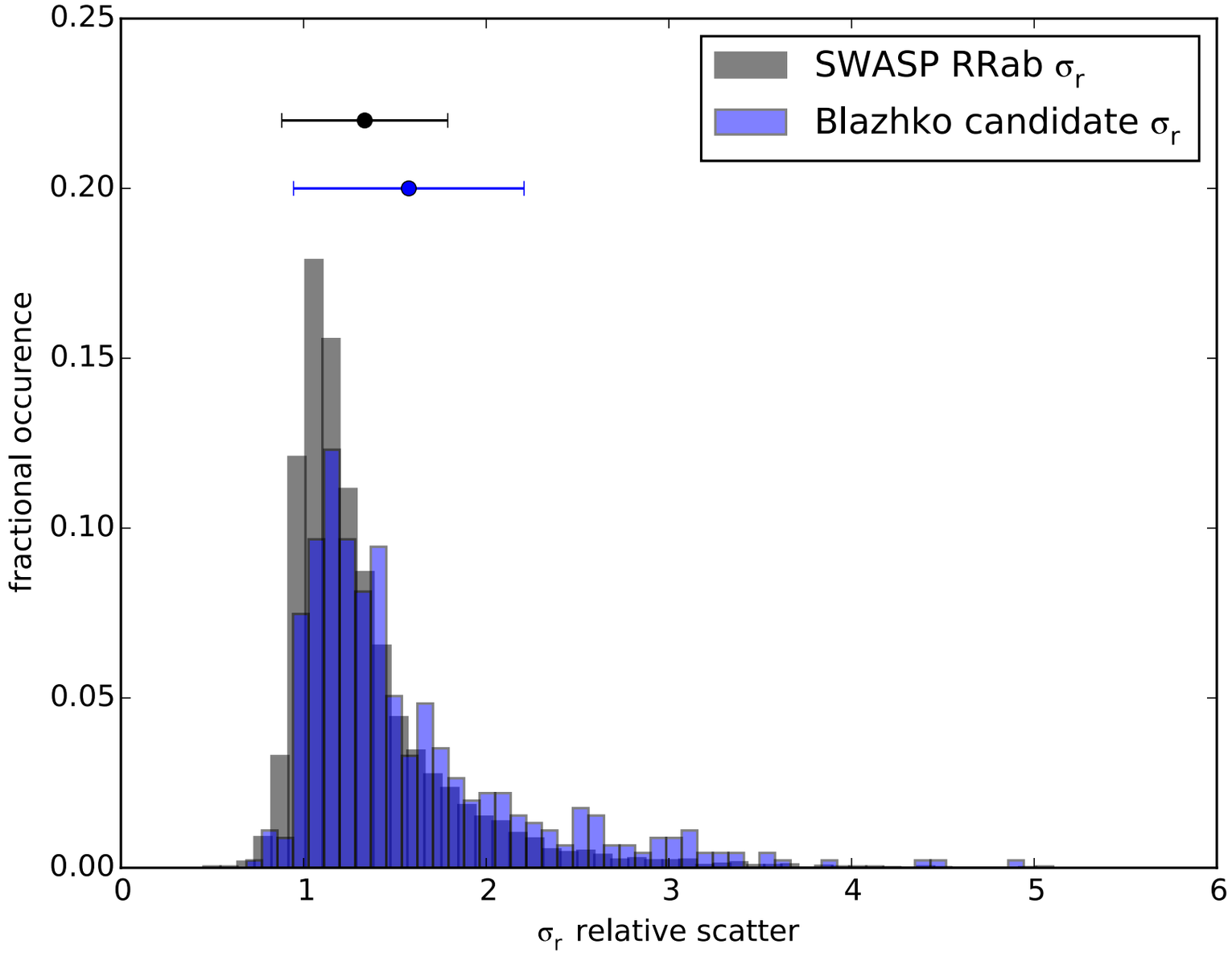
Blazhko effect in light curves

- Light curves normalised by the peak bin median flux.
- Standard deviation calculated for both peak and quiet areas.
- Peak area scatter divided by quiet area scatter to give relative scatter parameter as a measure of the envelope function.
- Light curve pulsation amplitude calculated as difference between peak and minimum bin medians.



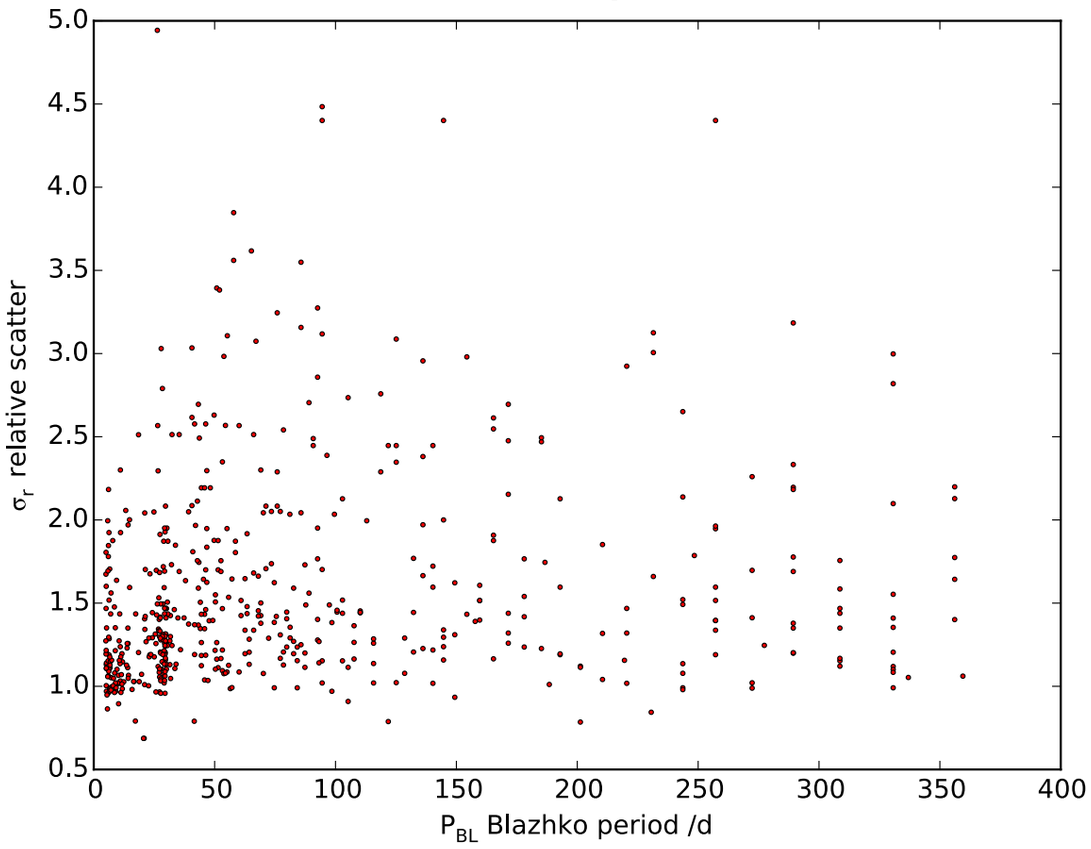
Relative scatter of RRab and Blazhko populations

- **RRab**:
  - mean = 1.33 d, s.d. = 0.45 d.
- **Blazhko**:
  - mean 1.58 d, s.d. = 0.63 d.

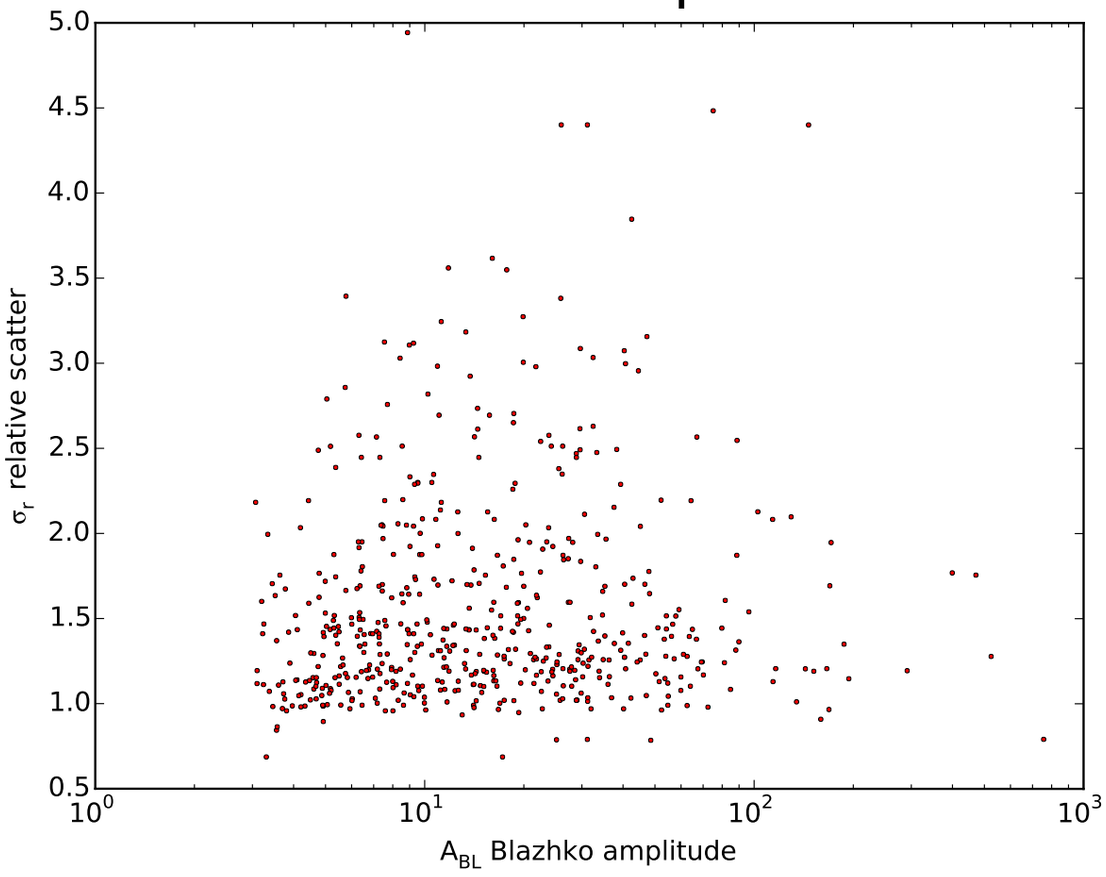


Relative scatter and Blazhko parameters

Blazhko period

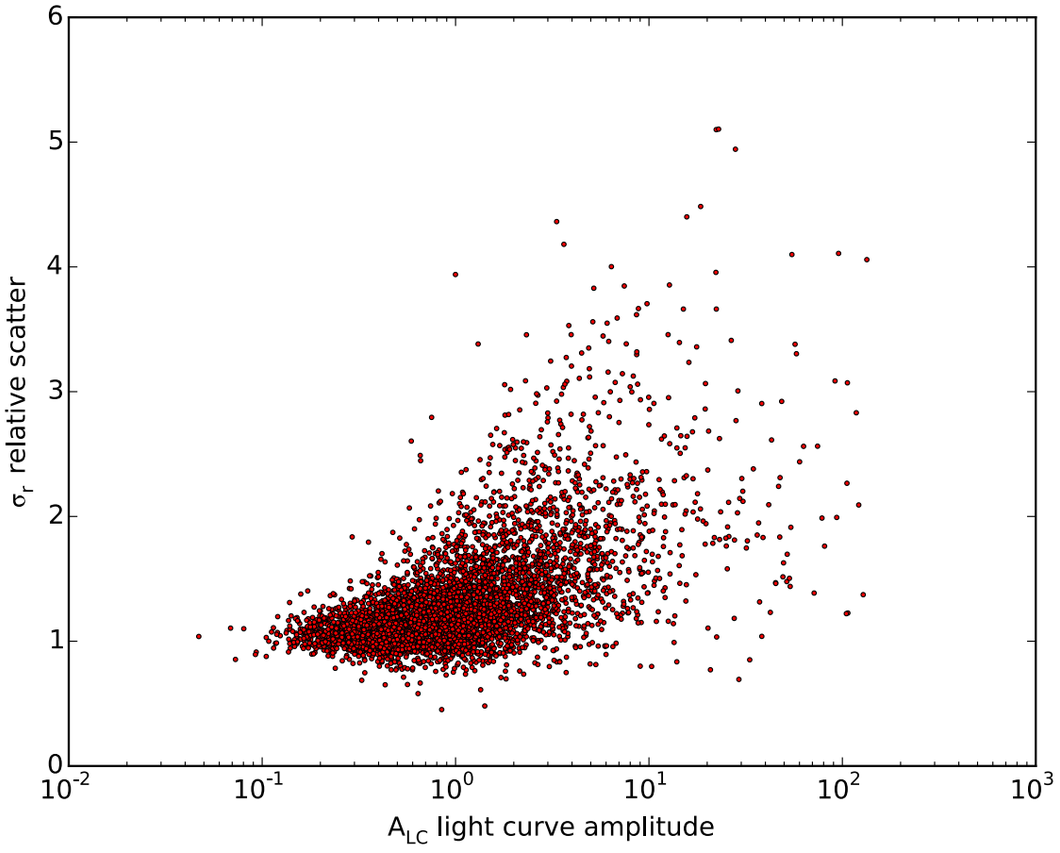


Blazhko amplitude

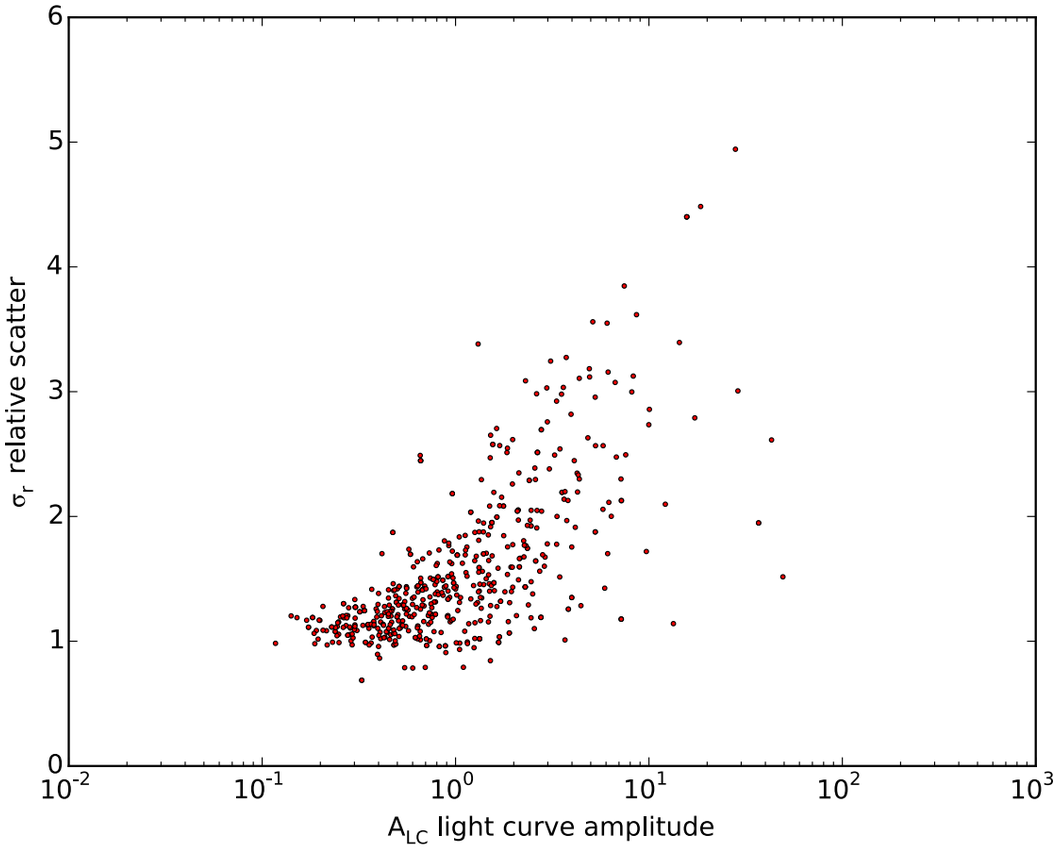


Relative scatter and light curve amplitude.

SWASP RRab



Blazhko Candidates



Summary

- SWASP RRab population of 4986 objects.
- 455 Blazhko candidates, with 522 potential Blazhko periods.
- 403 previously unknown candidate Blazhko objects.
- No bimodality in relative scatter between RRab and Blazhko populations using light curve analysis.
- Few correlations between Blazhko characteristic parameters.

Future work

- Investigate the large-uncertainty, short-Blazhko periods for signs of a variable Blazhko effect in SWASP RRab.

- Use O-C techniques to measure any variability in the Blazhko effect.

- Look for binarity in non-Blazhko effect stars.