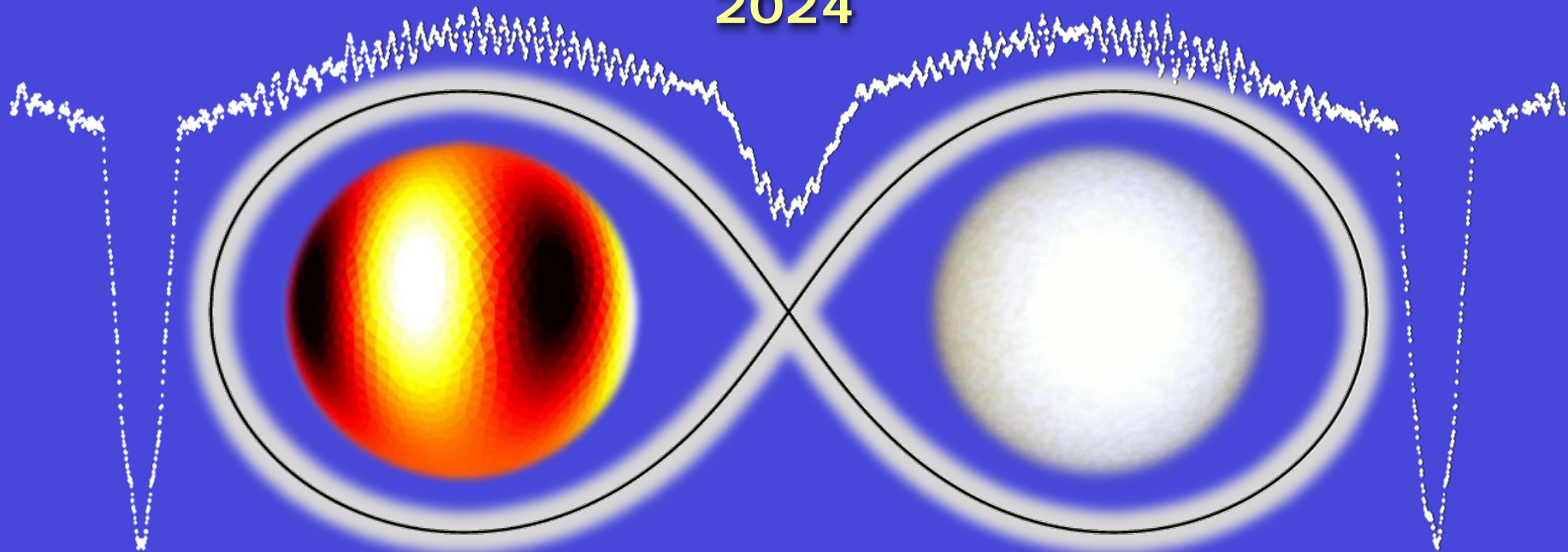


The catalogue of δ Sct pulsators in binary systems

2024



Alexios Liakos

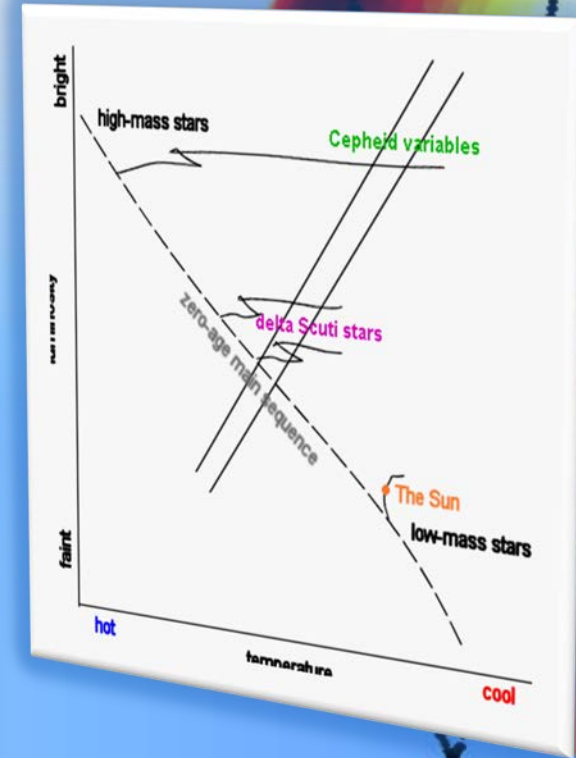
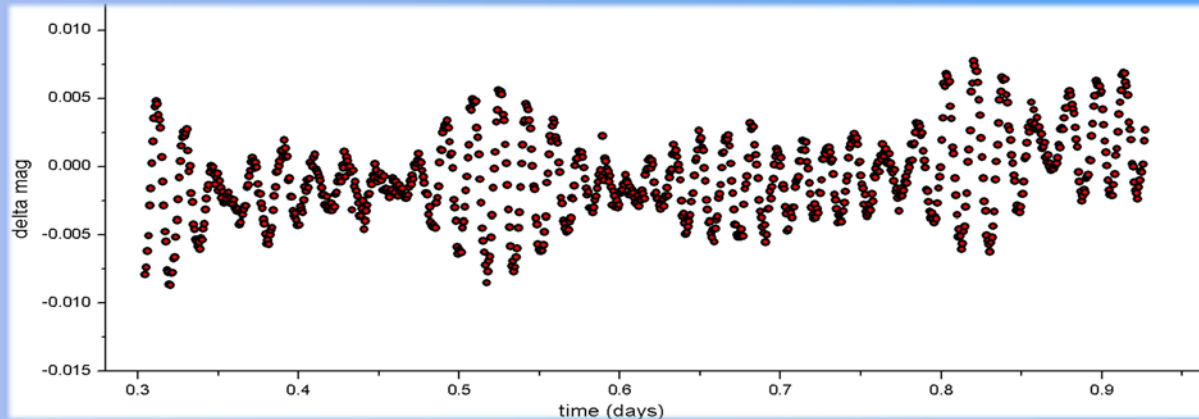
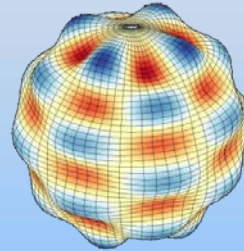
National Observatory of Athens

Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing

Binary and Multiple Stars in the Era of Big Sky Surveys, 9-13 Sep. 2024, Litomyšl, Czech Rep.

Characteristics of single δ Sct stars

- ❖ Spectral class: A - F
- ❖ Luminosity class: III - V
- ❖ Mass: $1.5 - 2.5 M_{\odot}$
- ❖ Pulsation period: 20 min – 8 hrs
- ❖ Radial & non-radial oscillations
- ❖ κ -mechanism (valve)
- ❖ Turbulent pressure within the hydrogen convective zone



Combination of two different topics



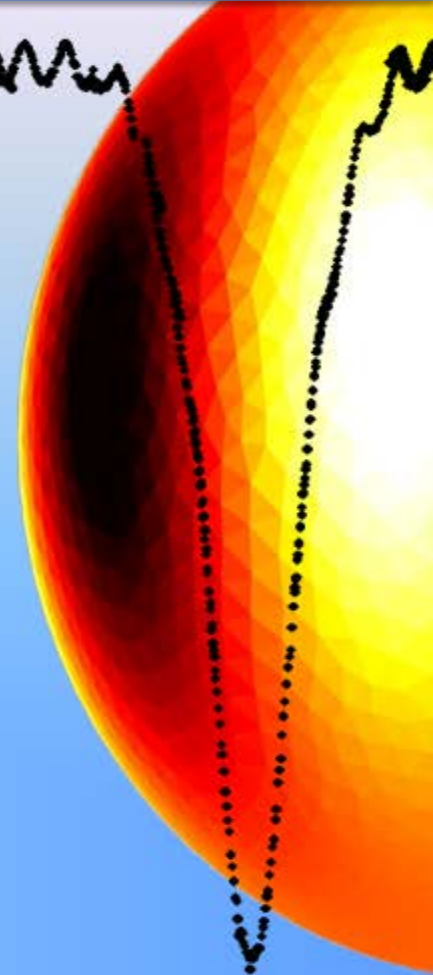
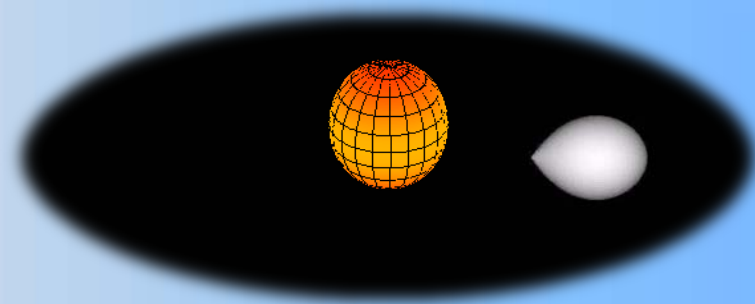
Pulsating stars → Asteroseismology – Physics of stellar oscillations

+

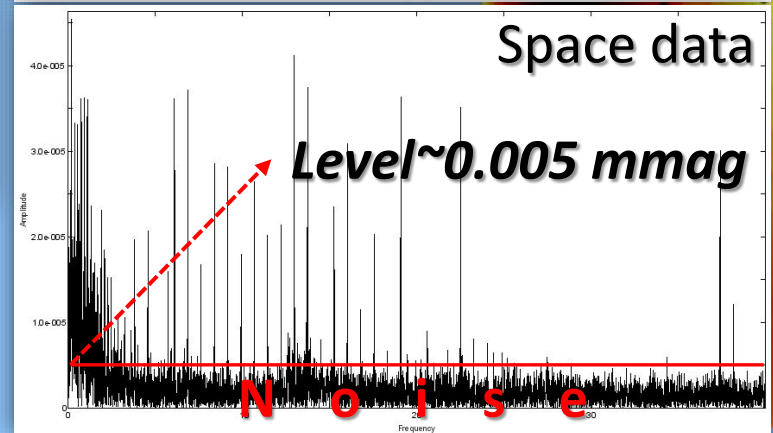
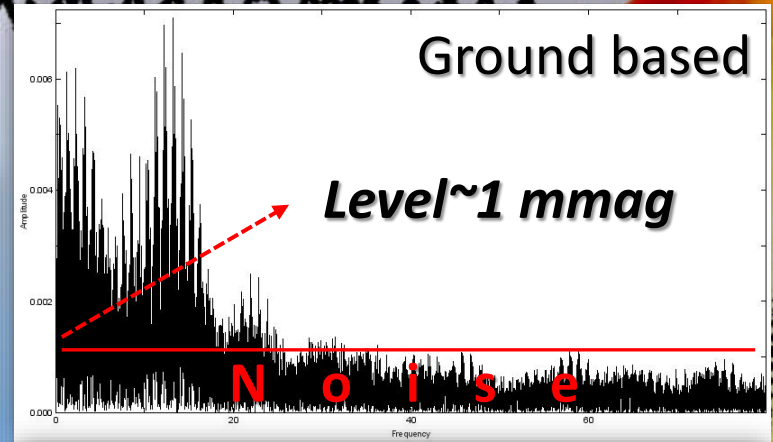
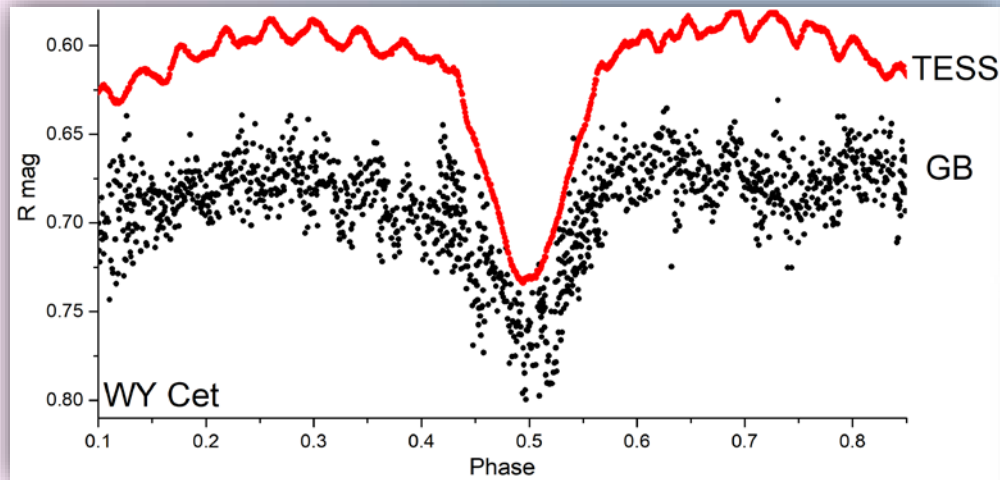
Binary systems → Physical parameters – evolutionary stages

=

Extraordinary knowledge for this specific evolutionary era

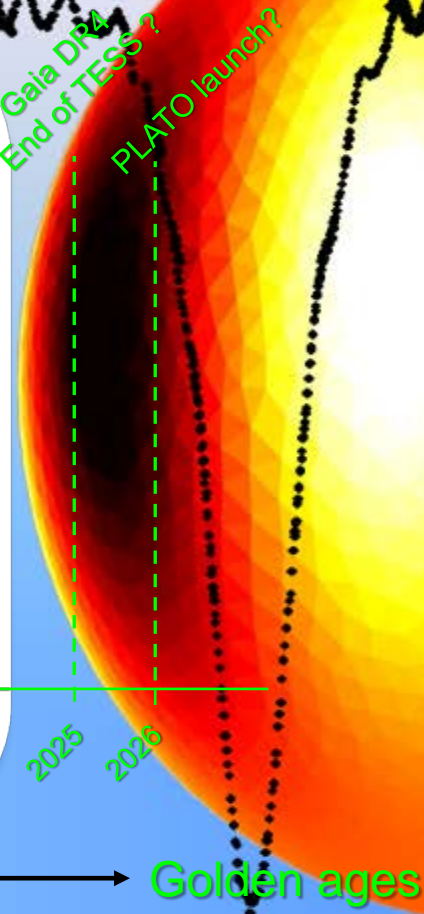
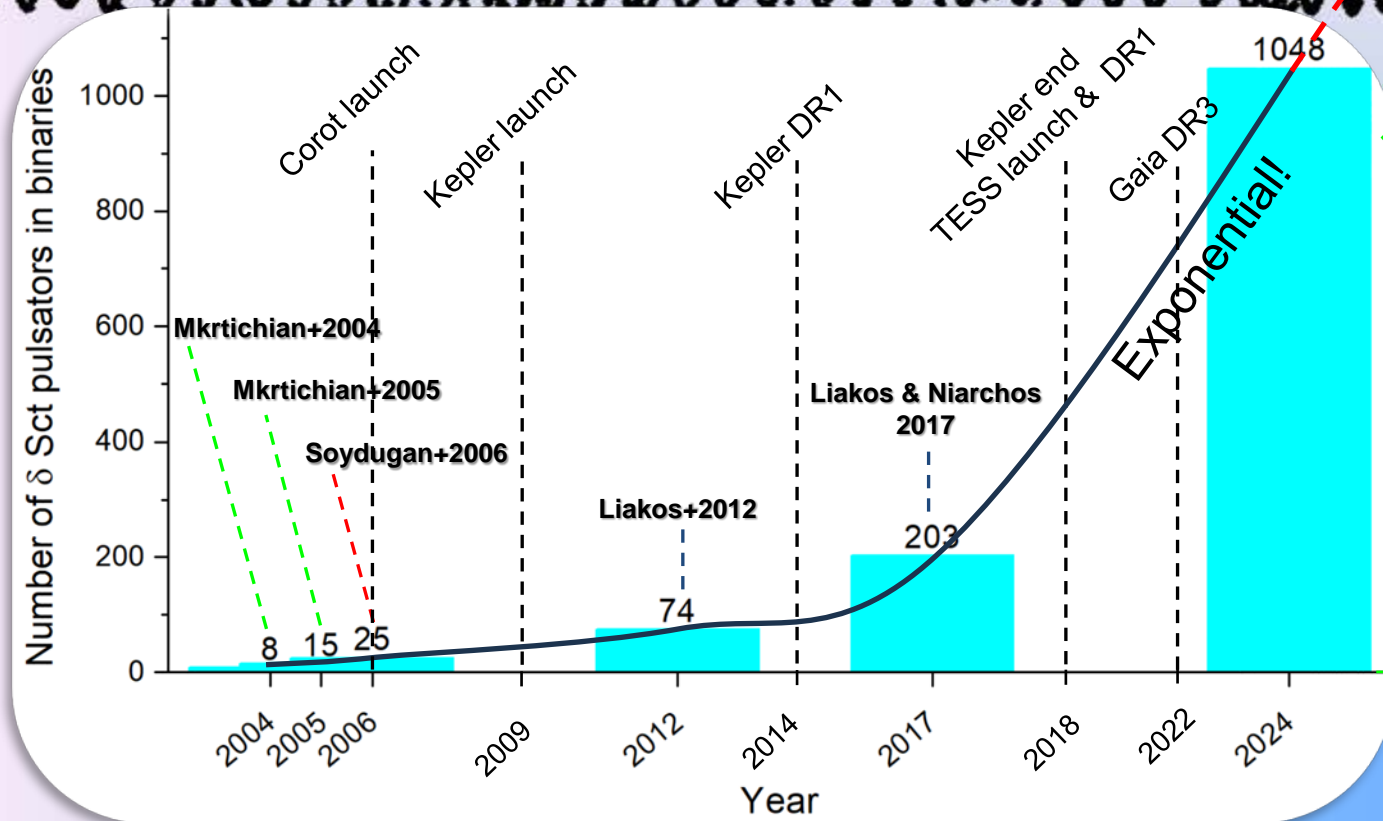


Space missions-Revolution for Asteroseismology



High detailed pulsations models!

Growing of the catalogue



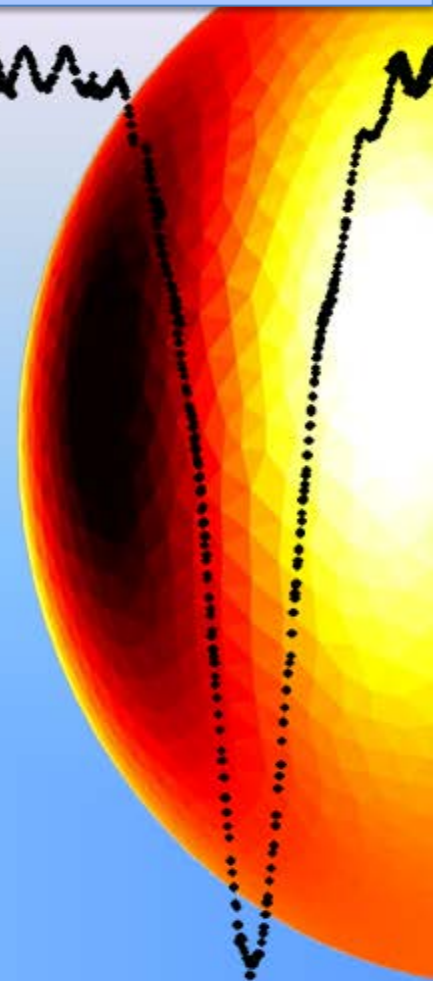
Dark ages

Renaissance

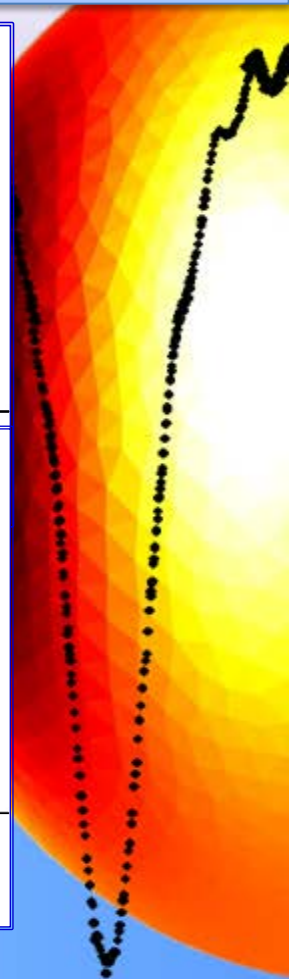
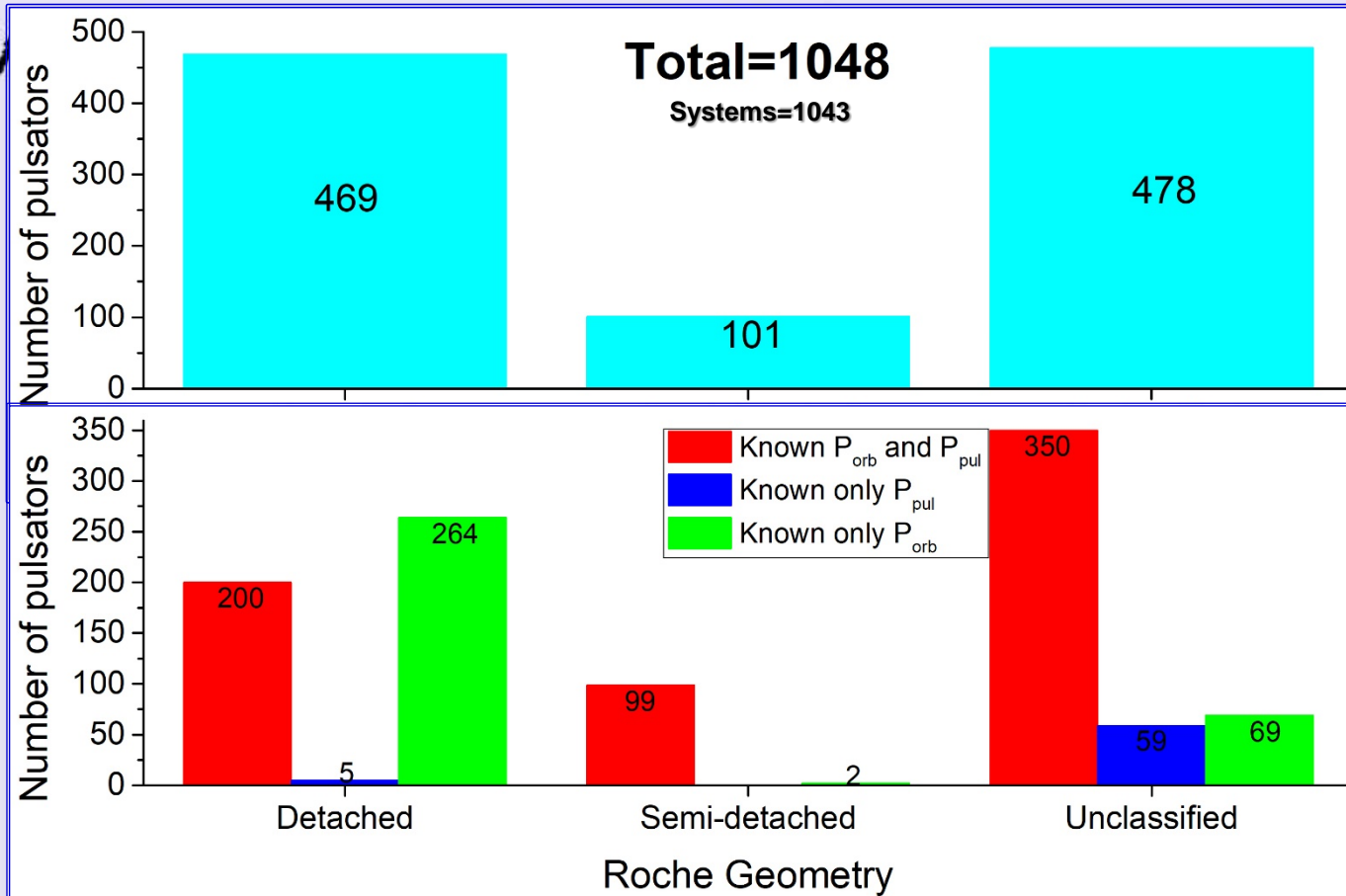
Golden ages

Sources

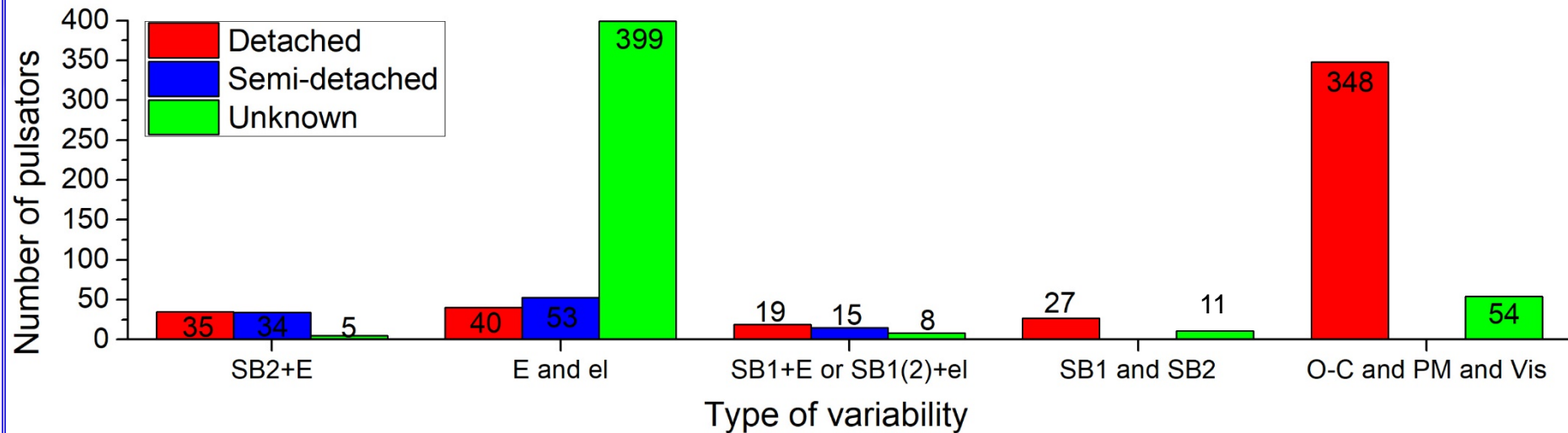
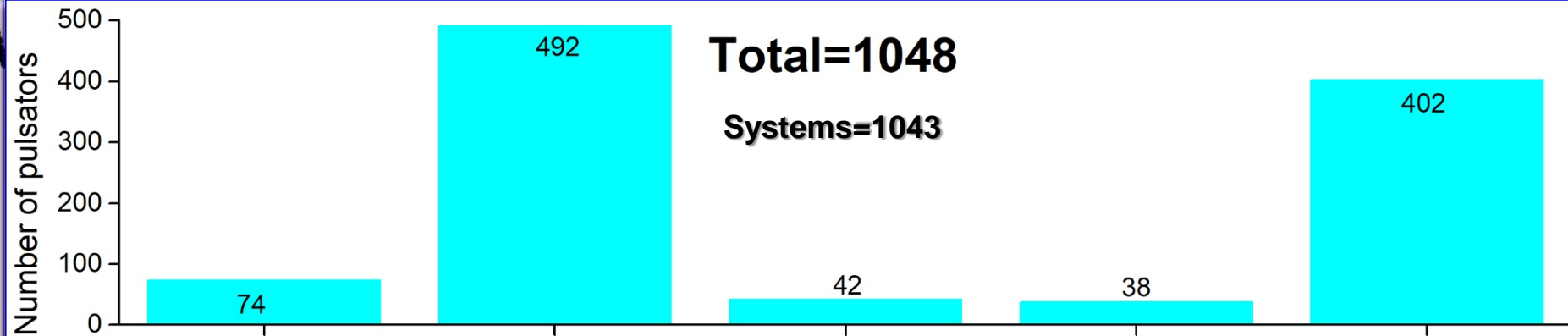
- *Previous catalogue of Liakos & Niarchos 2017*
- *Papers on satellite data mining and long lists of new cases (e.g. Murphy+2018, Gaulme & Guzik 2019, Soszynski+2021, Chen+2022, Kahraman-Alicavus+2022, 2023)*
- *Papers on individual cases*
- *Personal check on the old rejected and ambiguous cases using satellite short-cadence data and new observations*



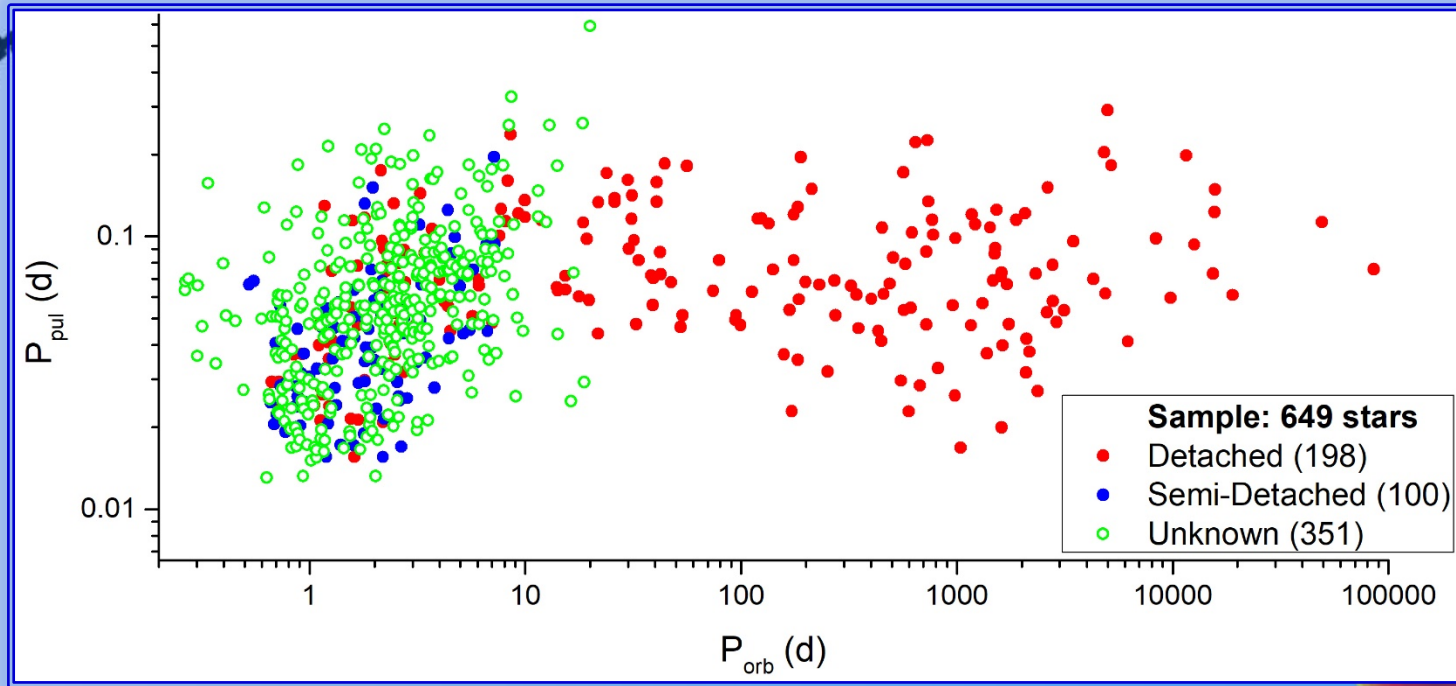
Demographics of binaries with δ Sct members



Demographics of binaries with δ Sct members



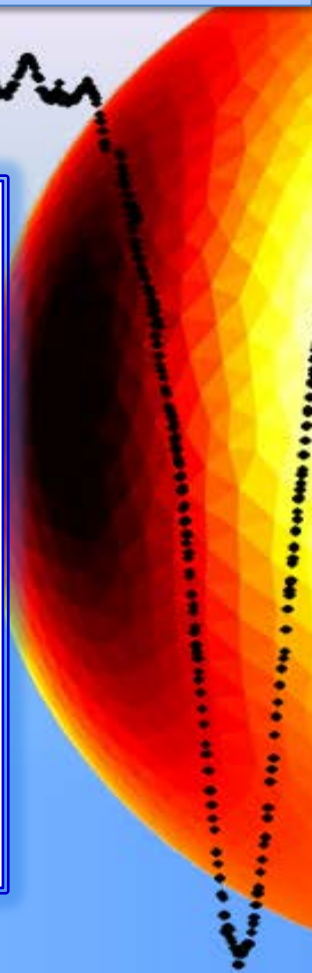
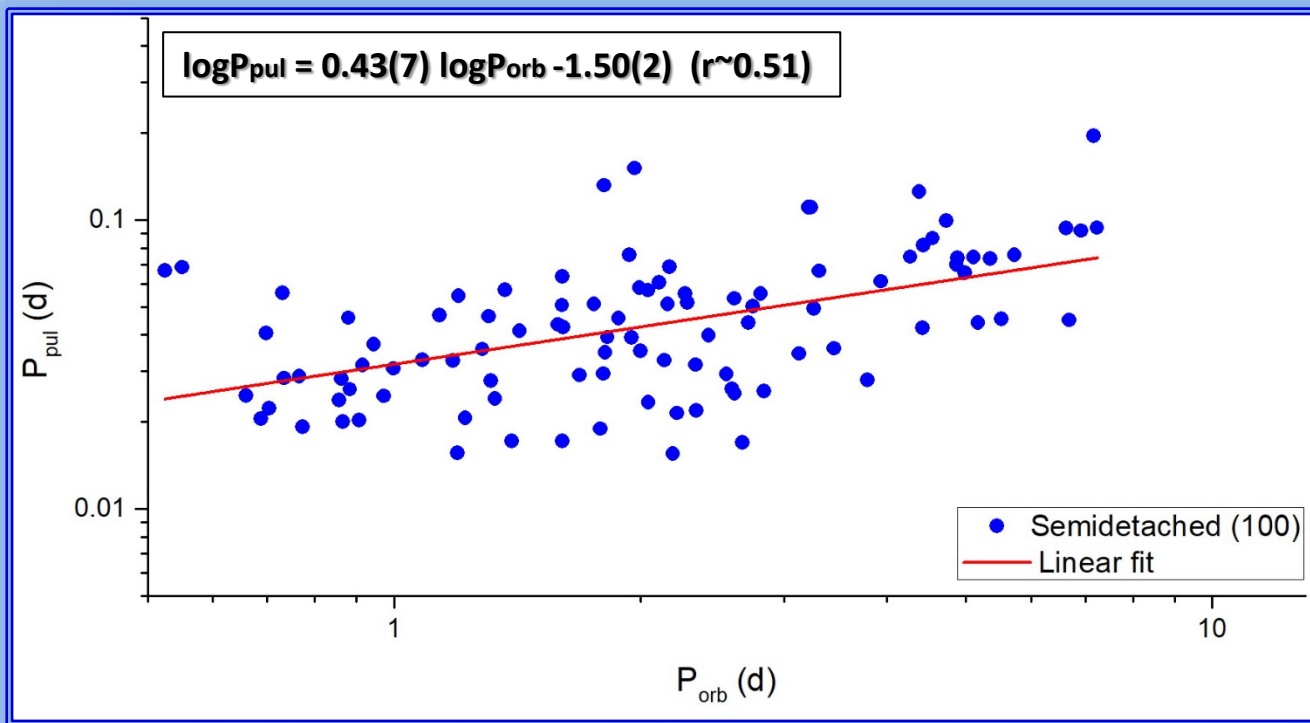
Correlation between P_{orb} - P_{pul}



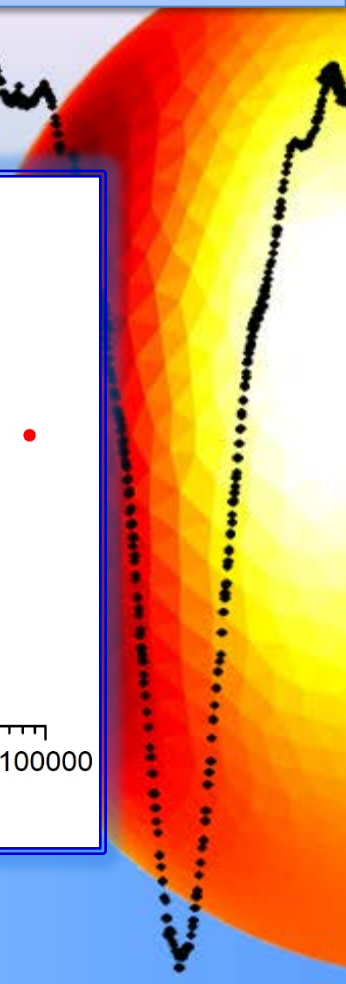
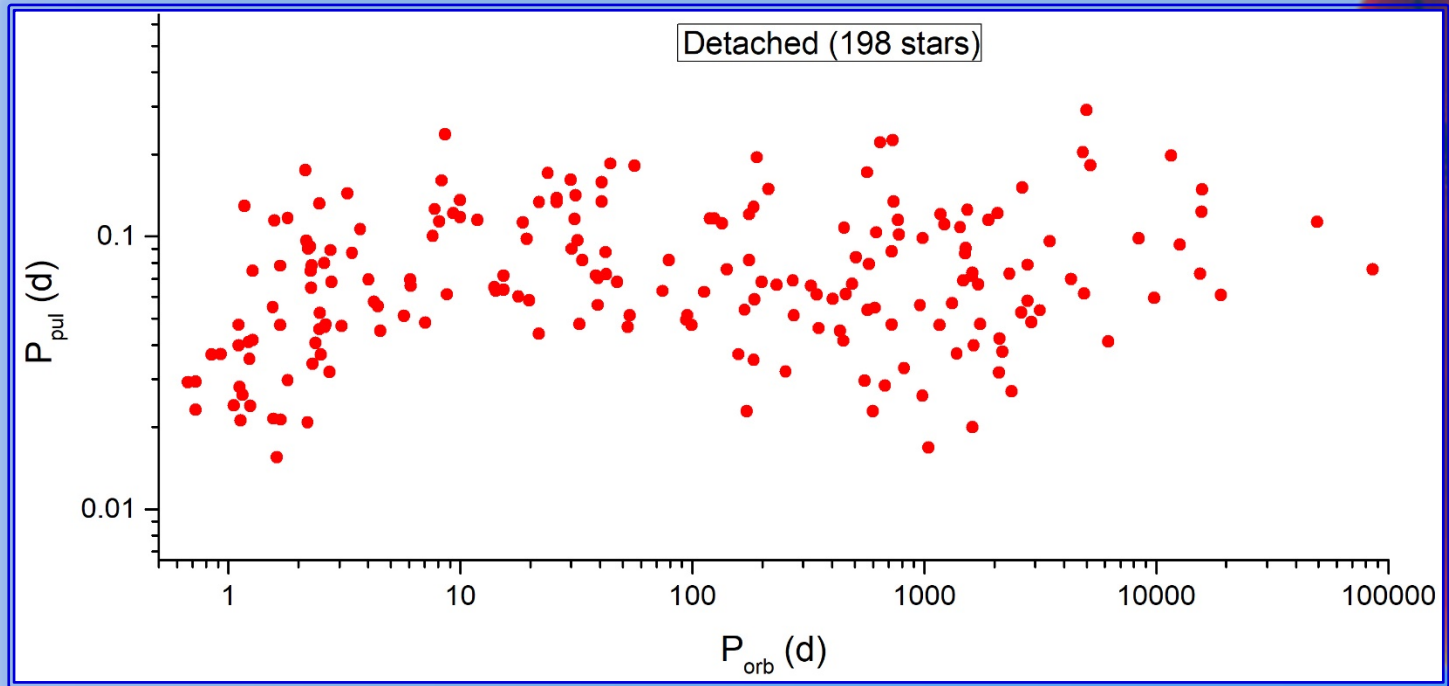
Assumptions for systems characterized as detached without model

- 1) Systems with $P_{orb} > 20$ d
- 2) Eccentric systems

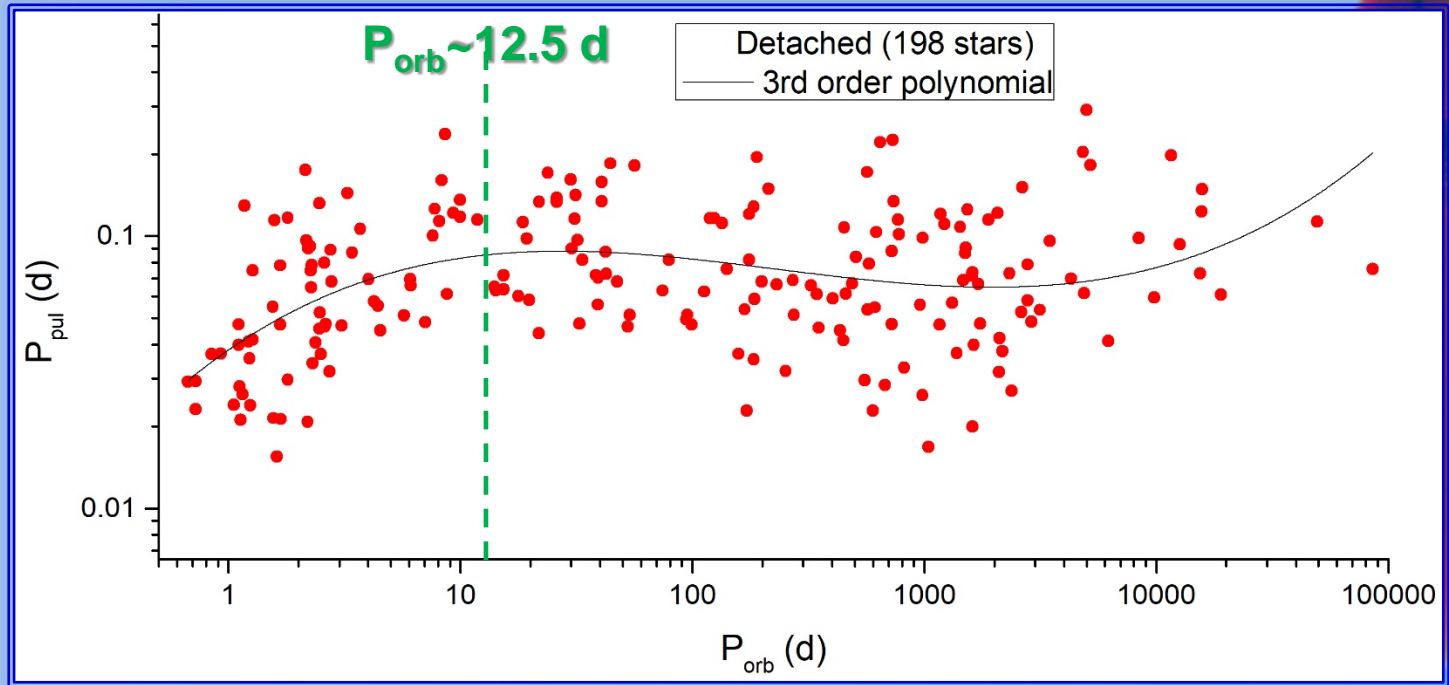
Correlation between P_{orb} - P_{pul}



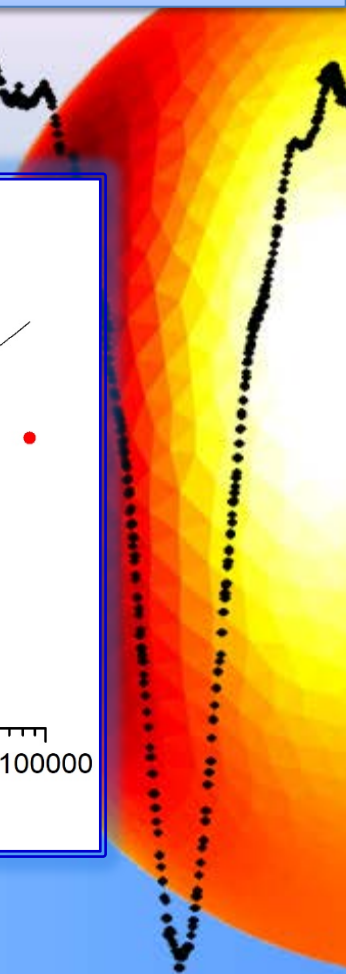
Correlation between P_{orb} - P_{pul}



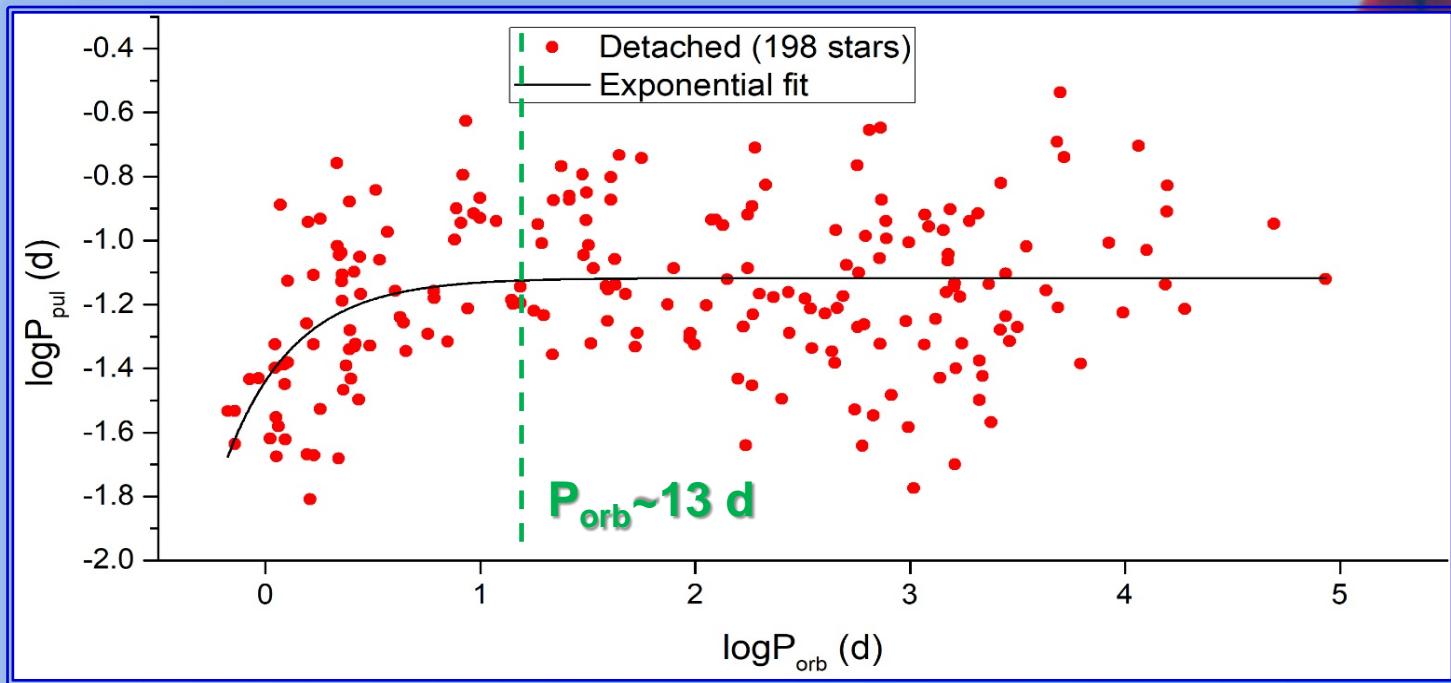
Correlation between P_{orb} - P_{pul}



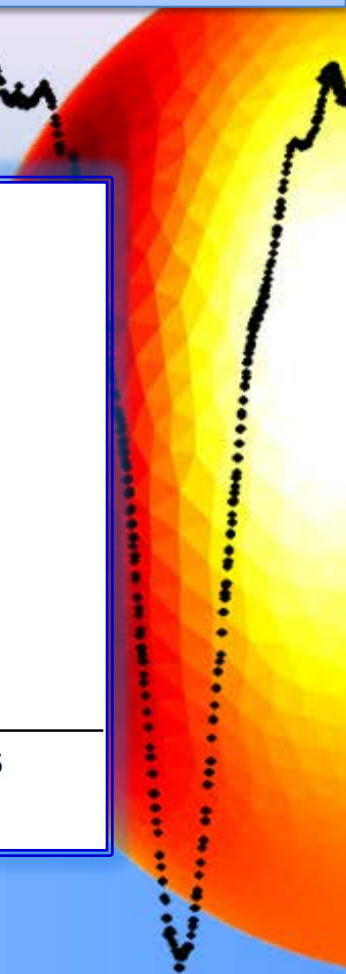
Third order polynomial fit + calculation of its local extrema



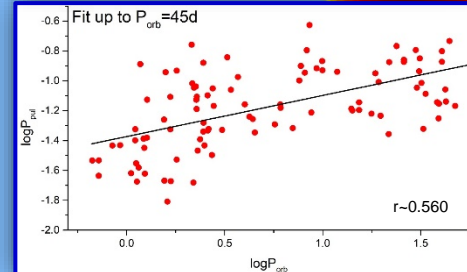
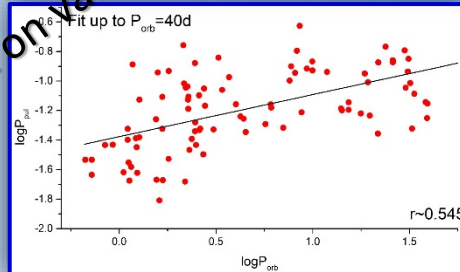
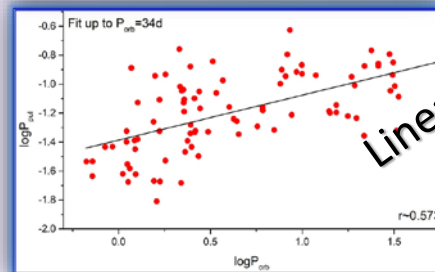
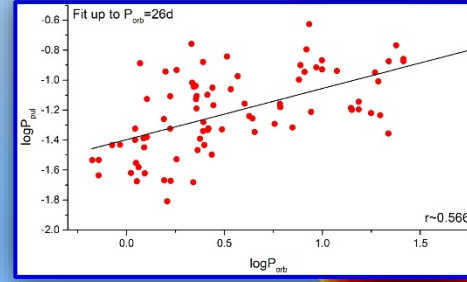
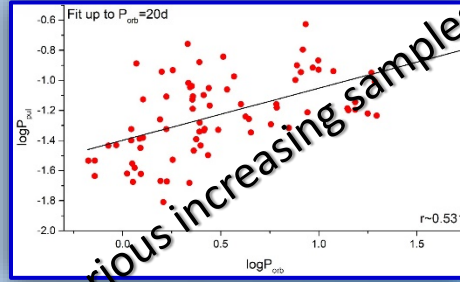
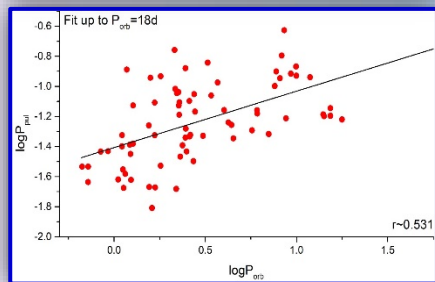
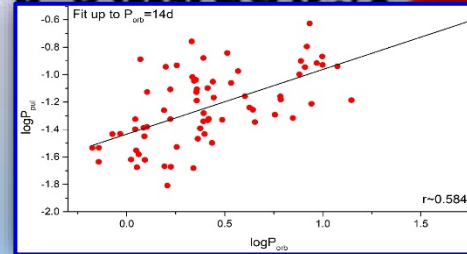
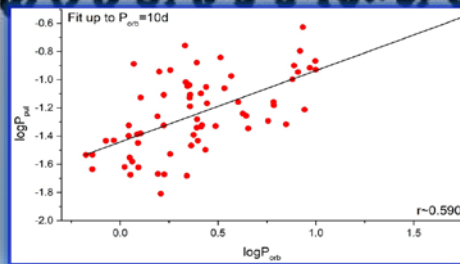
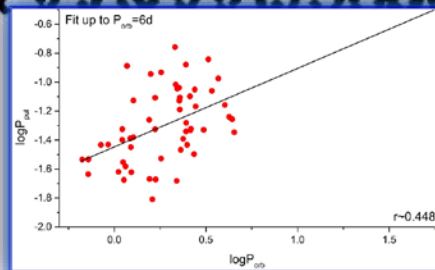
Correlation between P_{orb} - P_{pul}



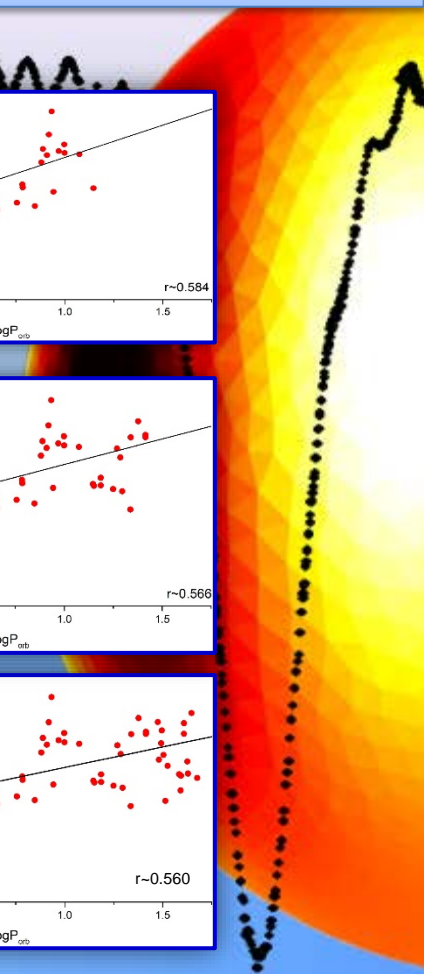
Exponential fit



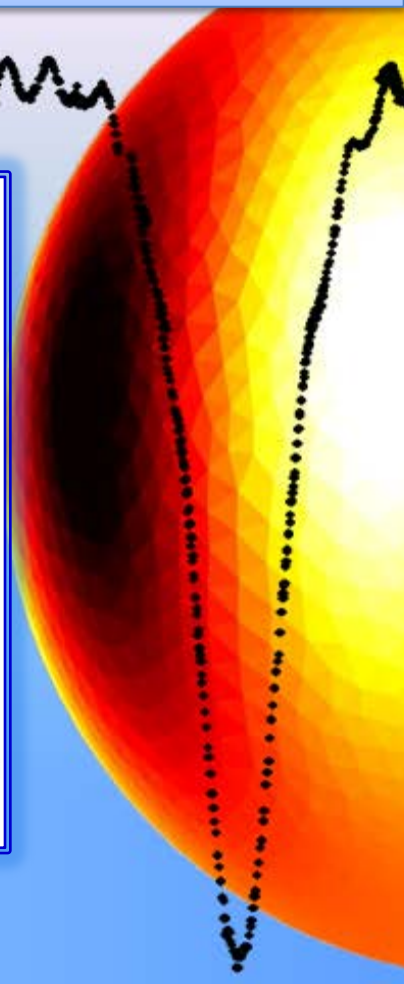
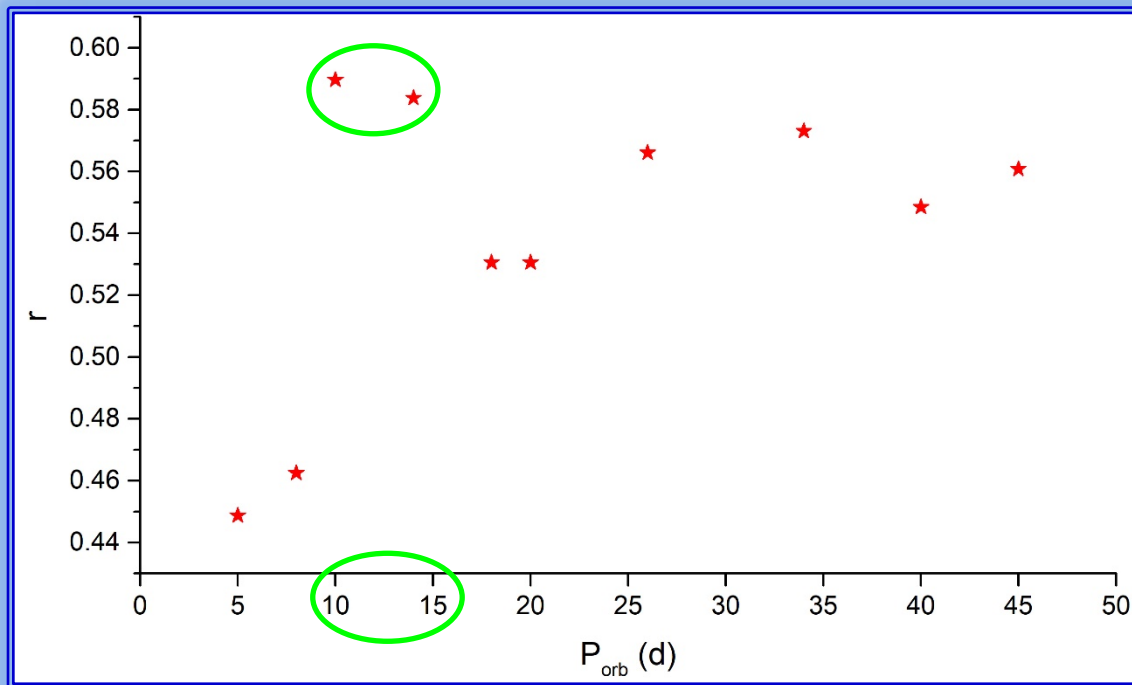
Correlation between P_{orb} - P_{pul}



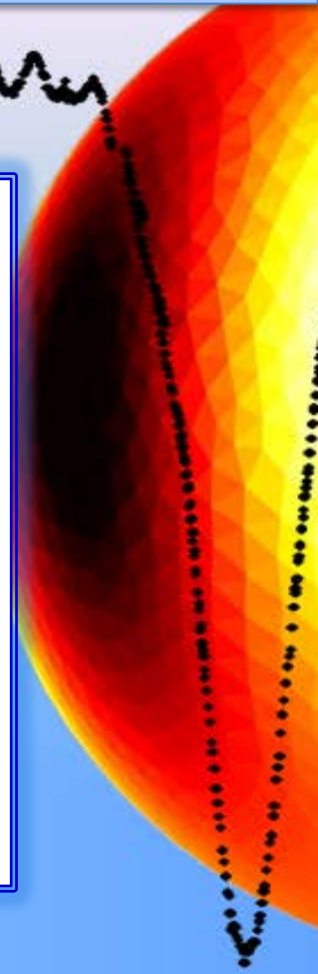
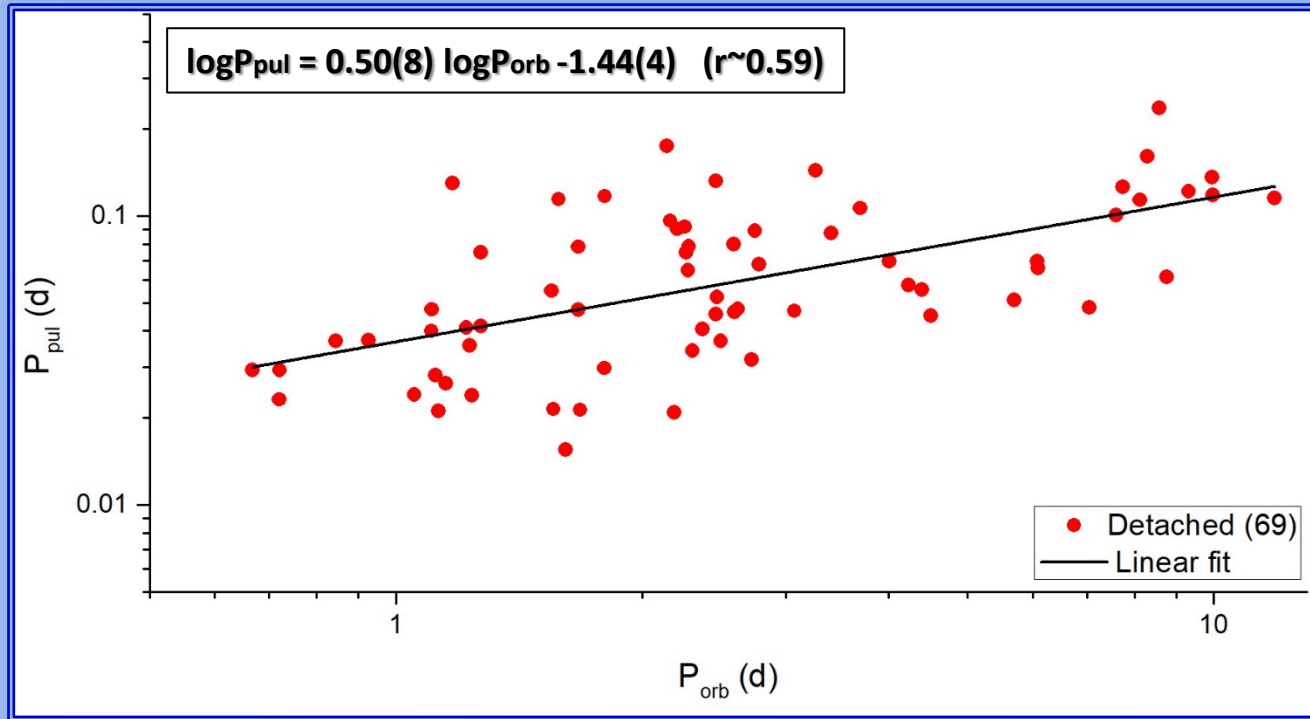
Linear fit on various increasing samples



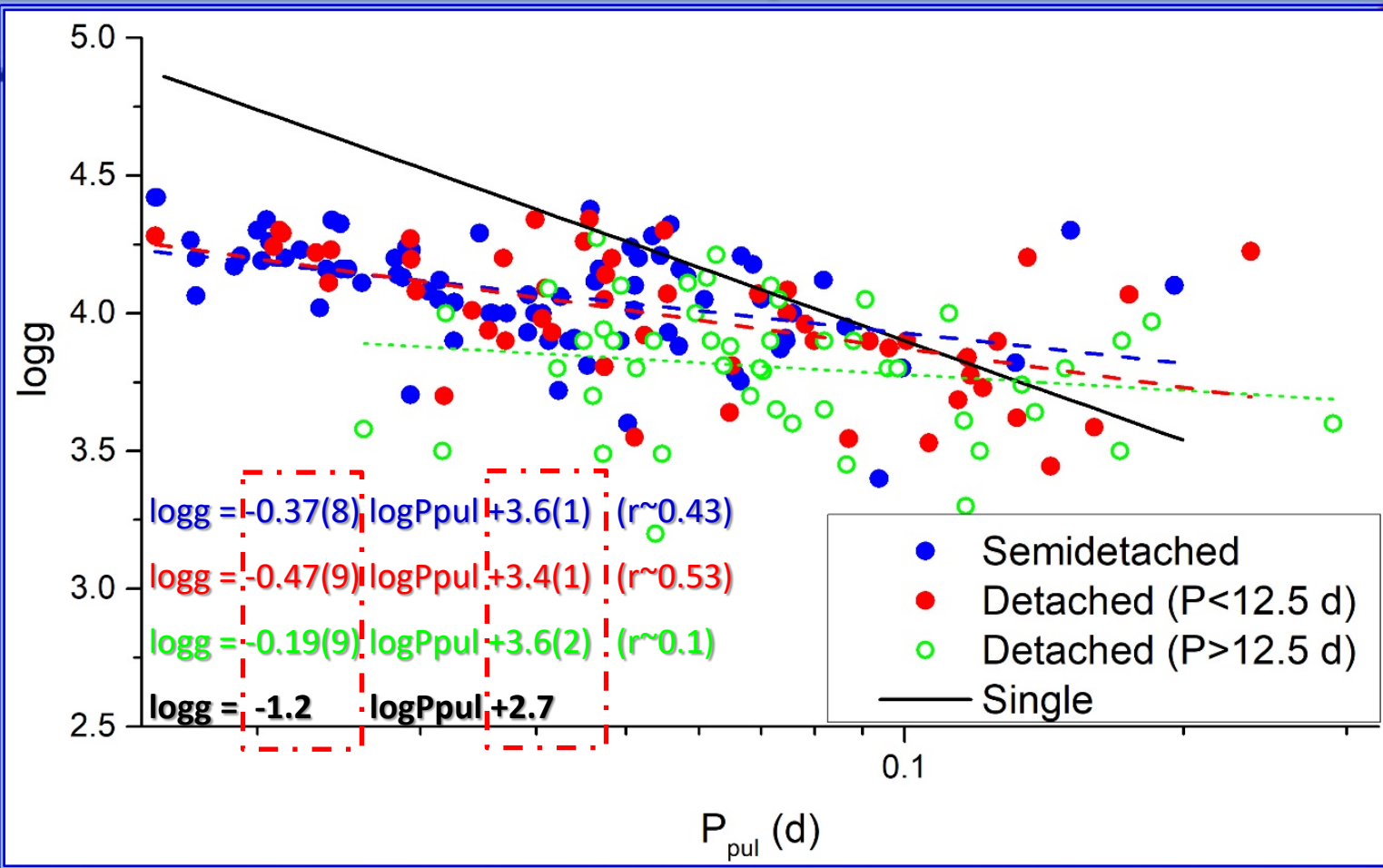
Correlation between P_{orb} - P_{pul}



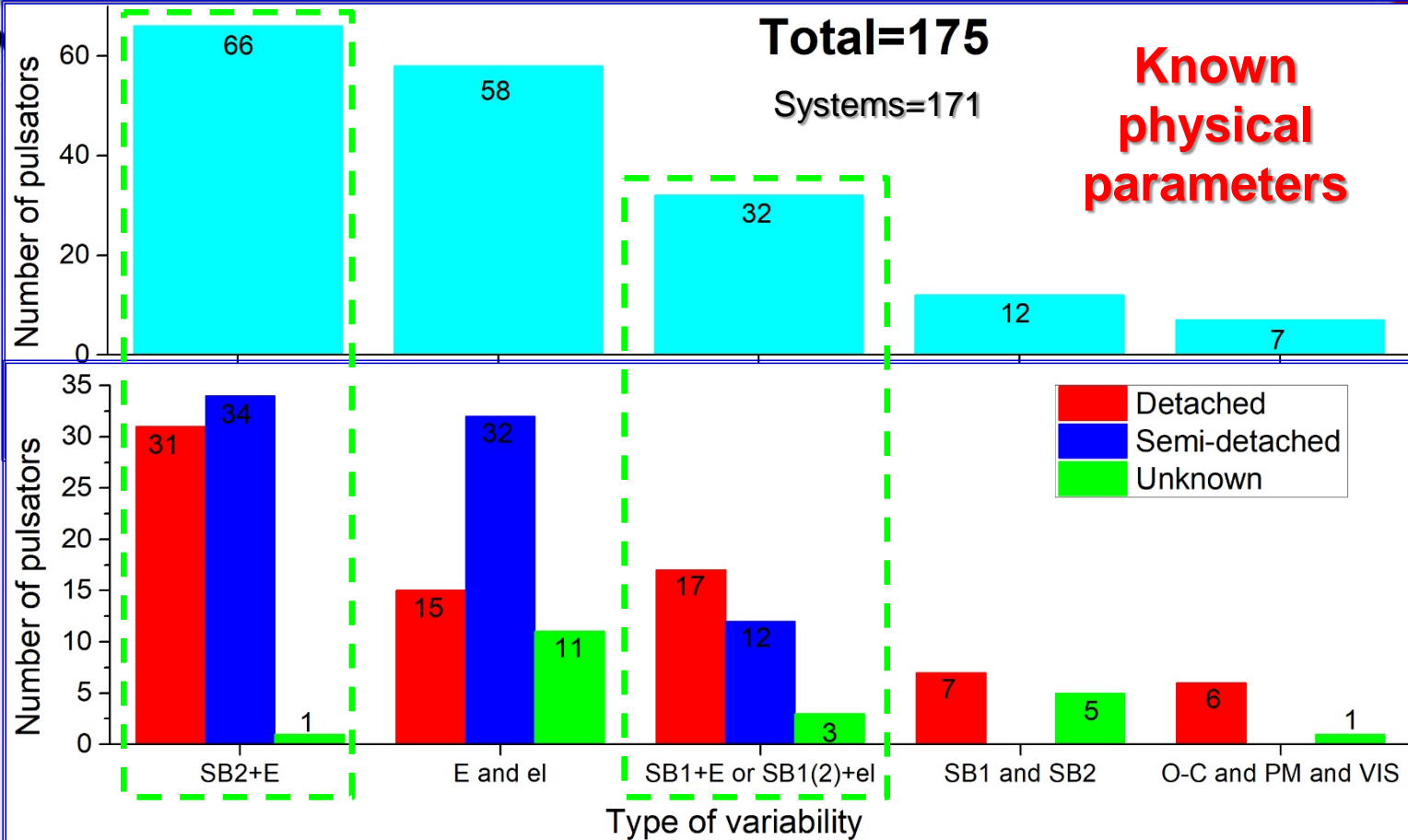
Correlation between P_{orb} - P_{pul}



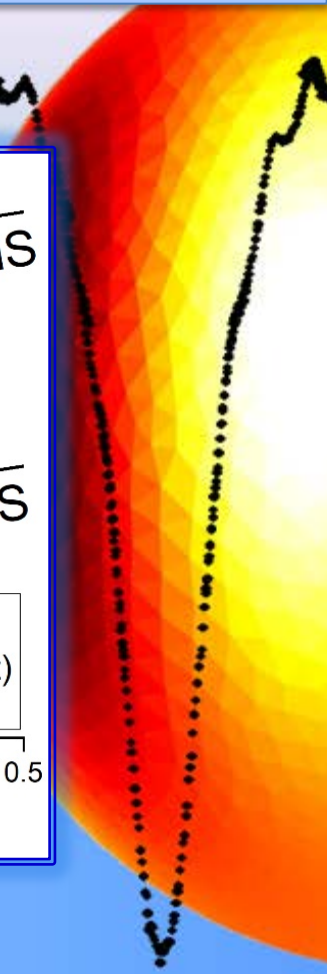
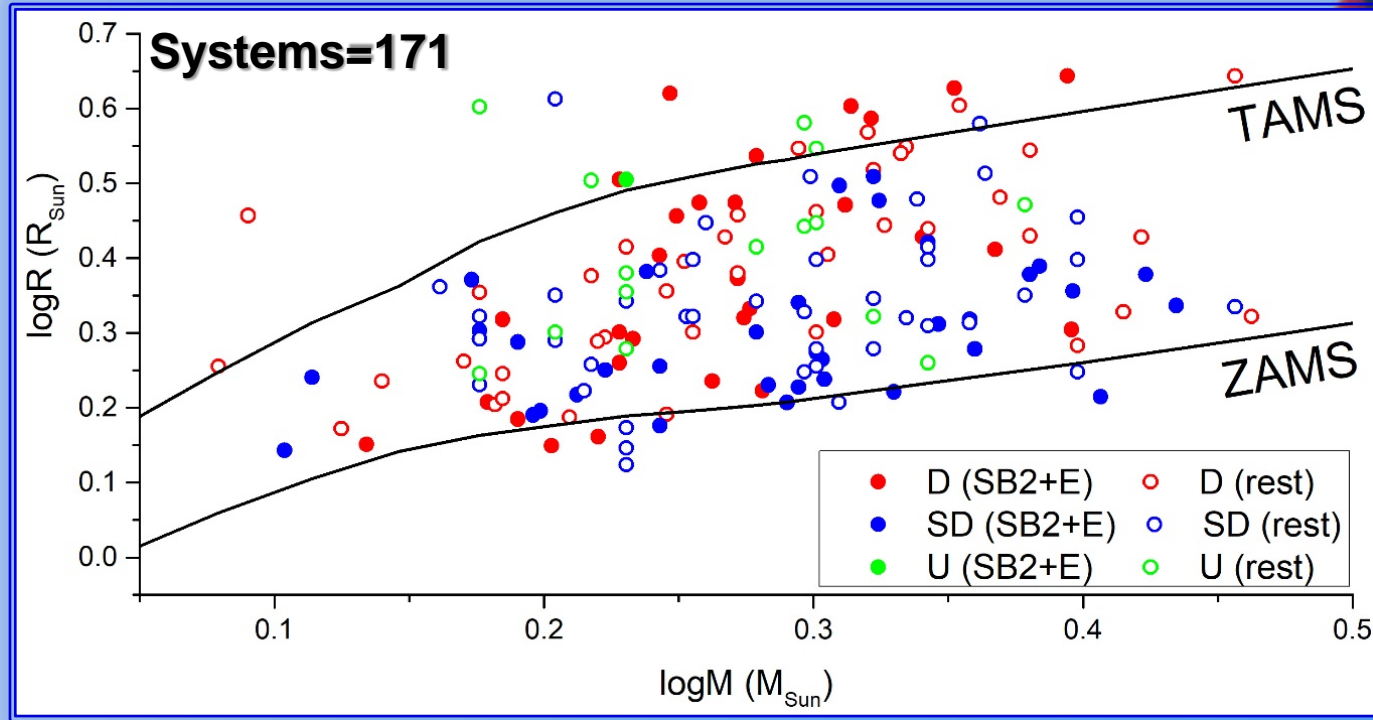
Correlation between $\log g$ - P_{pul}



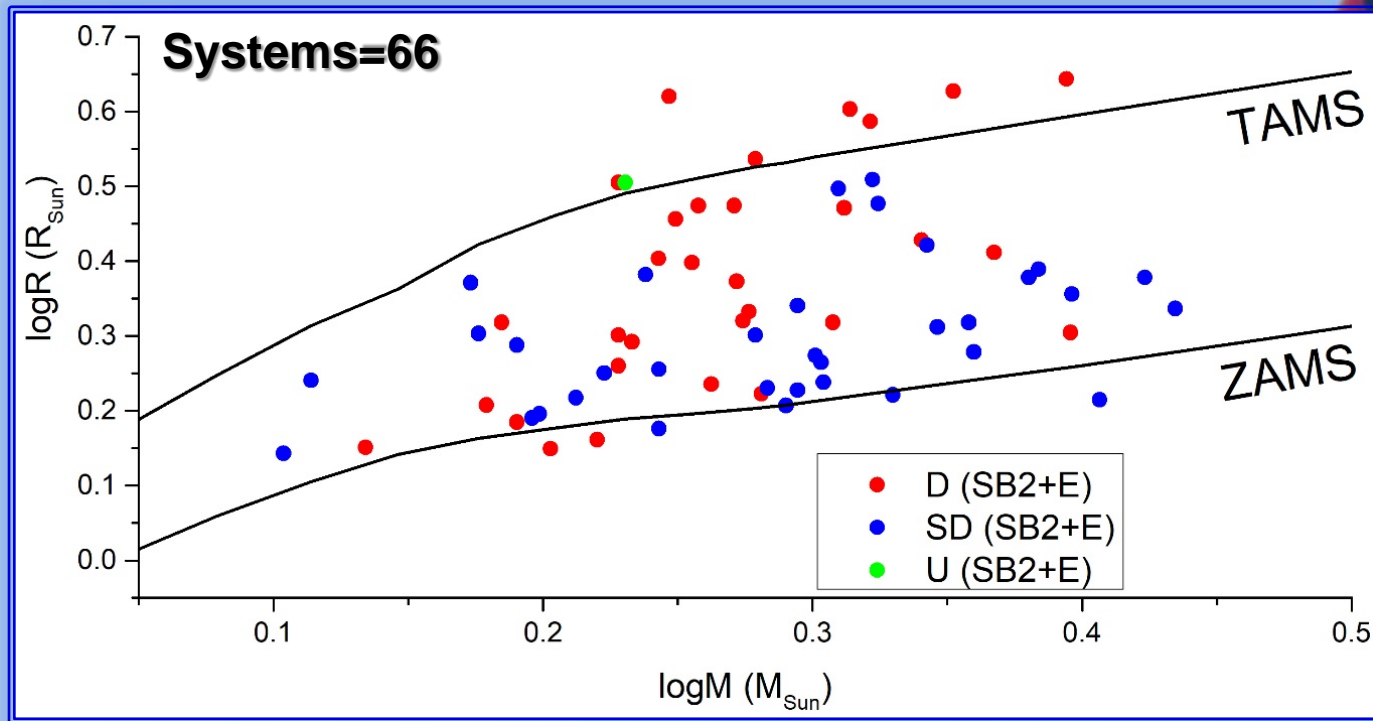
Demographics of binaries with δ Sct members



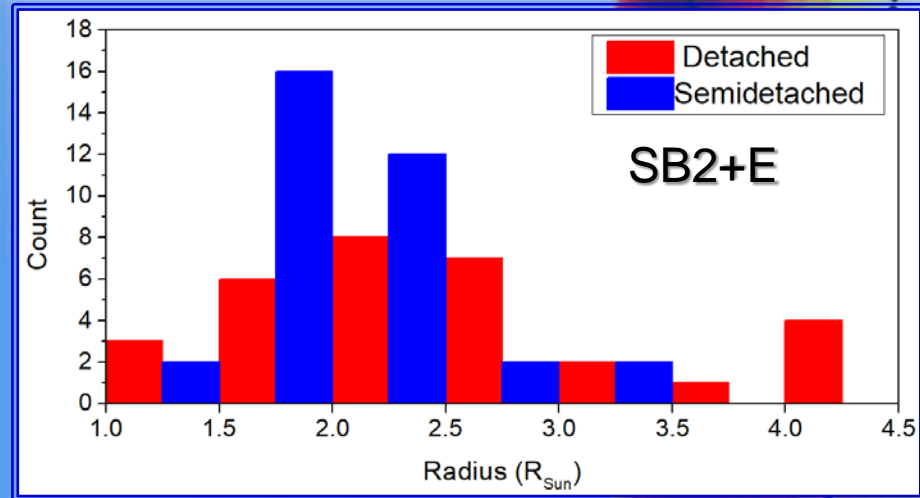
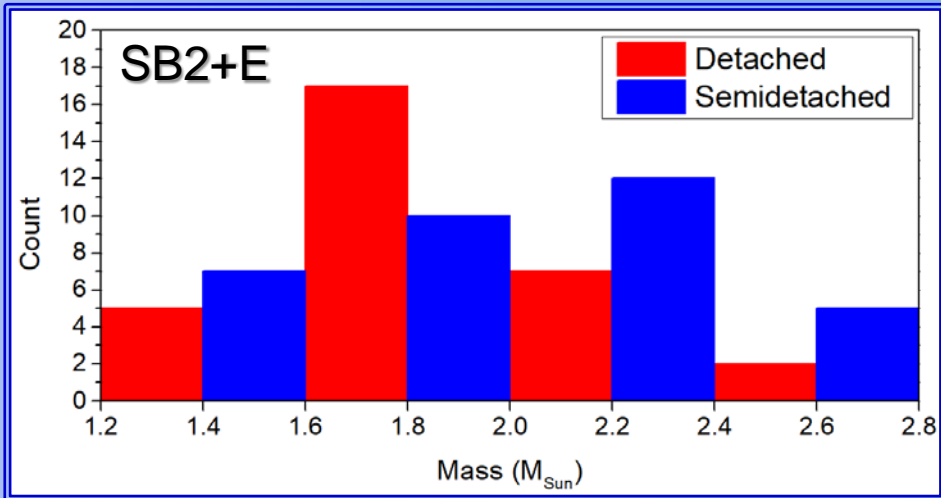
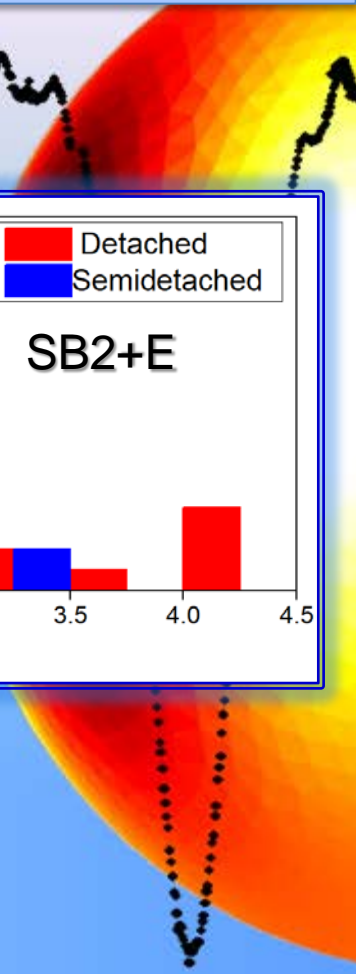
Evolutionary diagrams



Evolutionary diagrams

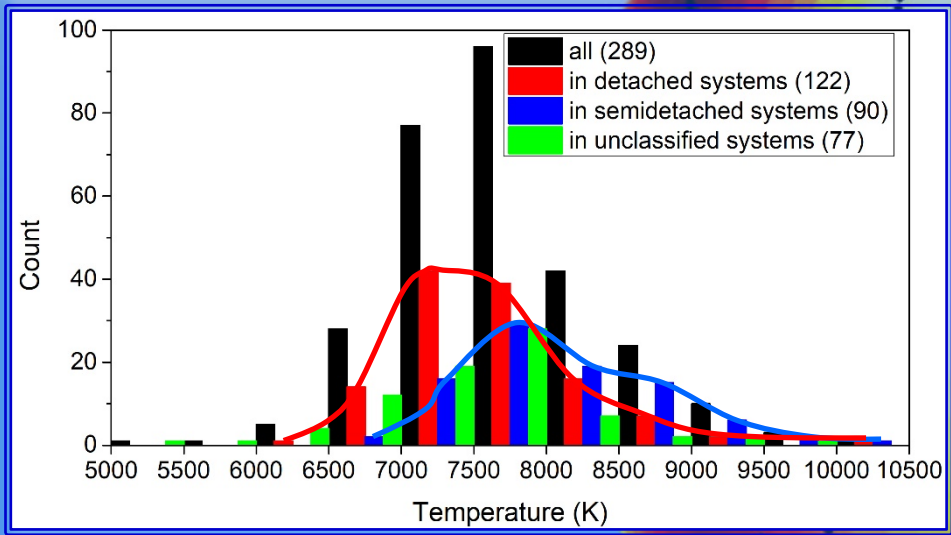
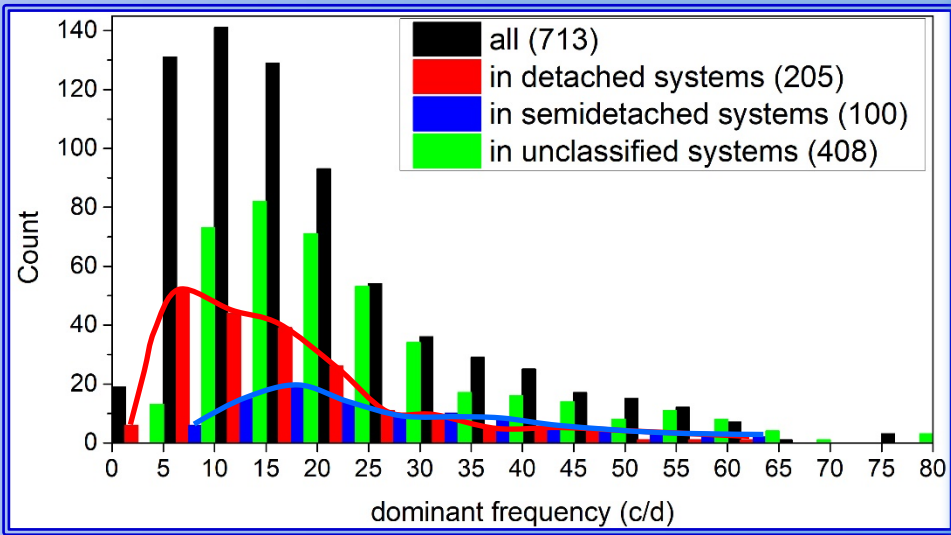


Mass and radius distributions



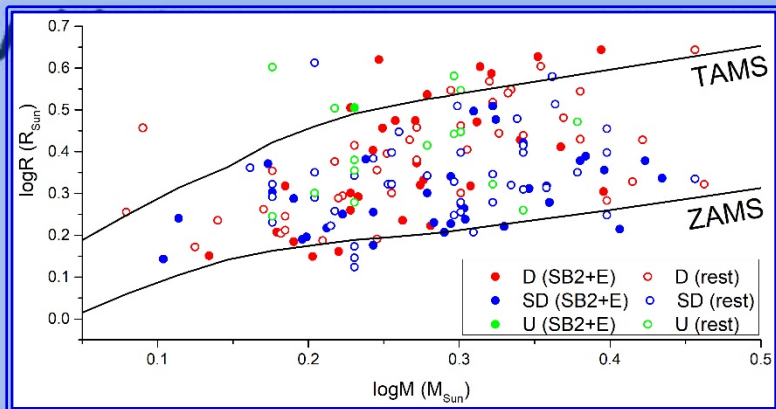
δ Sct stars in semidetached systems appear more compact

Temperature and frequency distributions

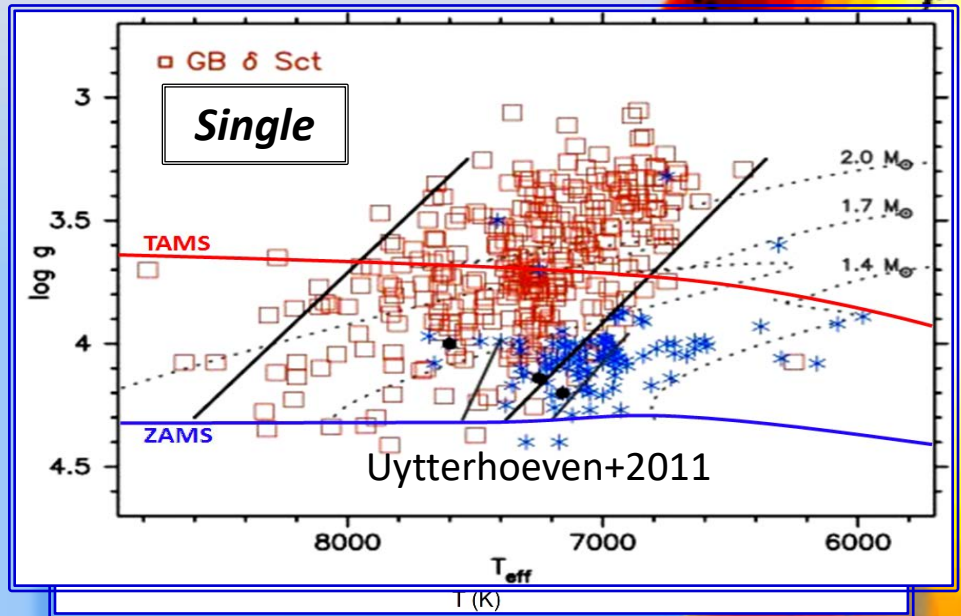
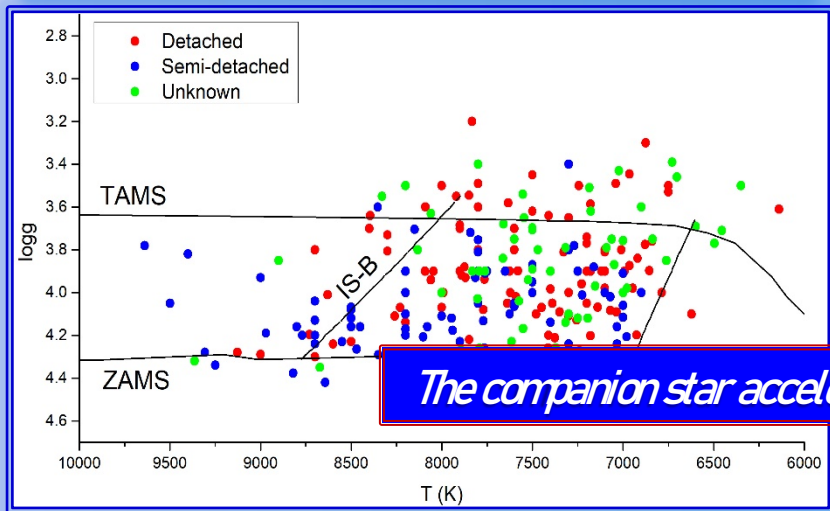


*δ Sct stars in detached systems exhibit slower pulsations and are slightly cooler
in comparison with those in semidetached systems*

Evolutionary diagrams



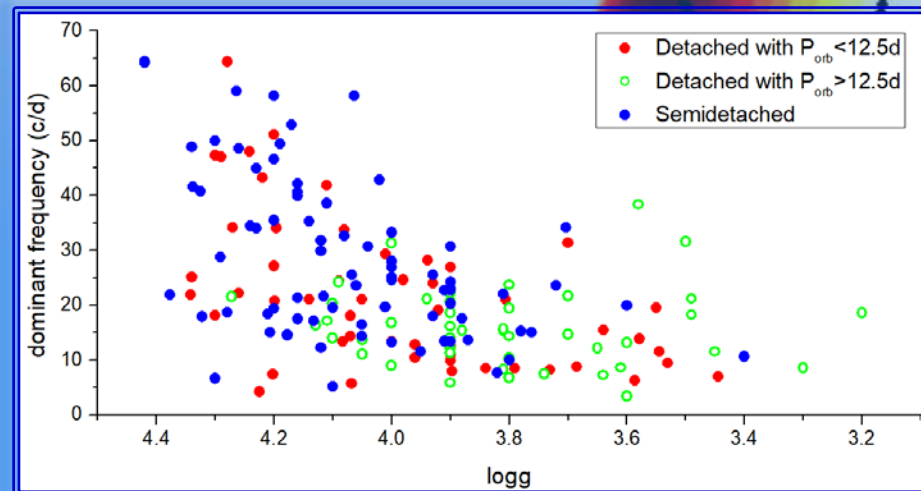
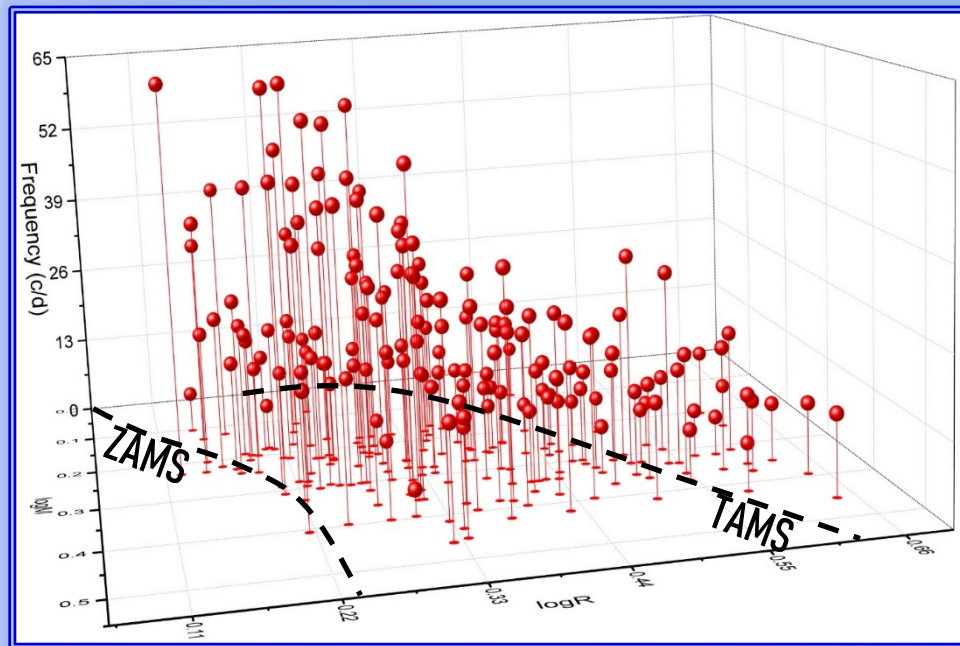
δ Sct stars-members of binaries are mostly MS stars



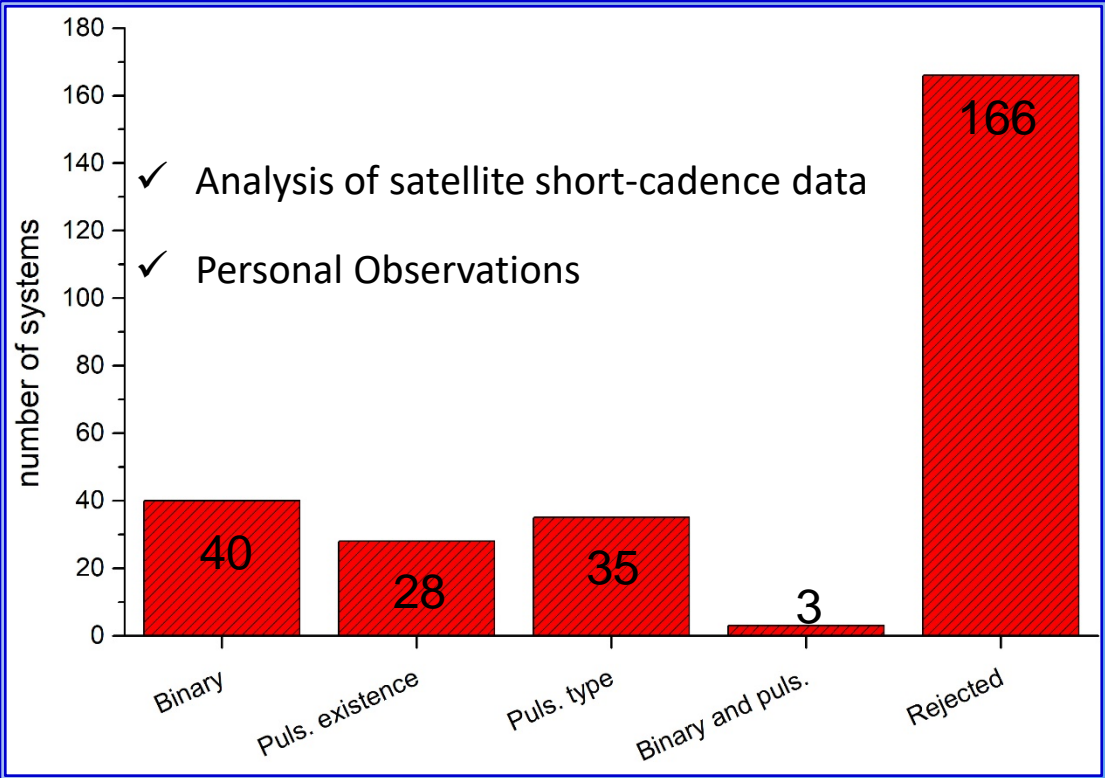
The companion star accelerates the initiation of the pulsations

$M-R-P_{pul}$ 3D diagram & $\log - f$ correlation

The younger the star the faster the pulsations!



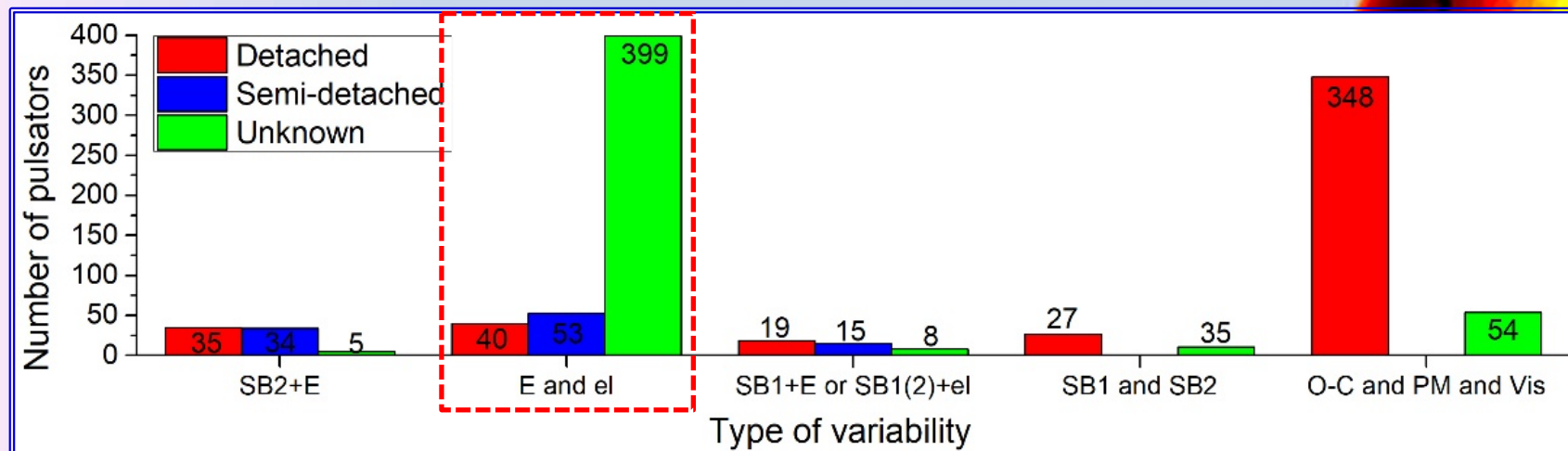
Ambiguous and rejected cases



1.2 m Kryoneri telescope (f2.8)
+
CCD
+
B or V filter



Target tank



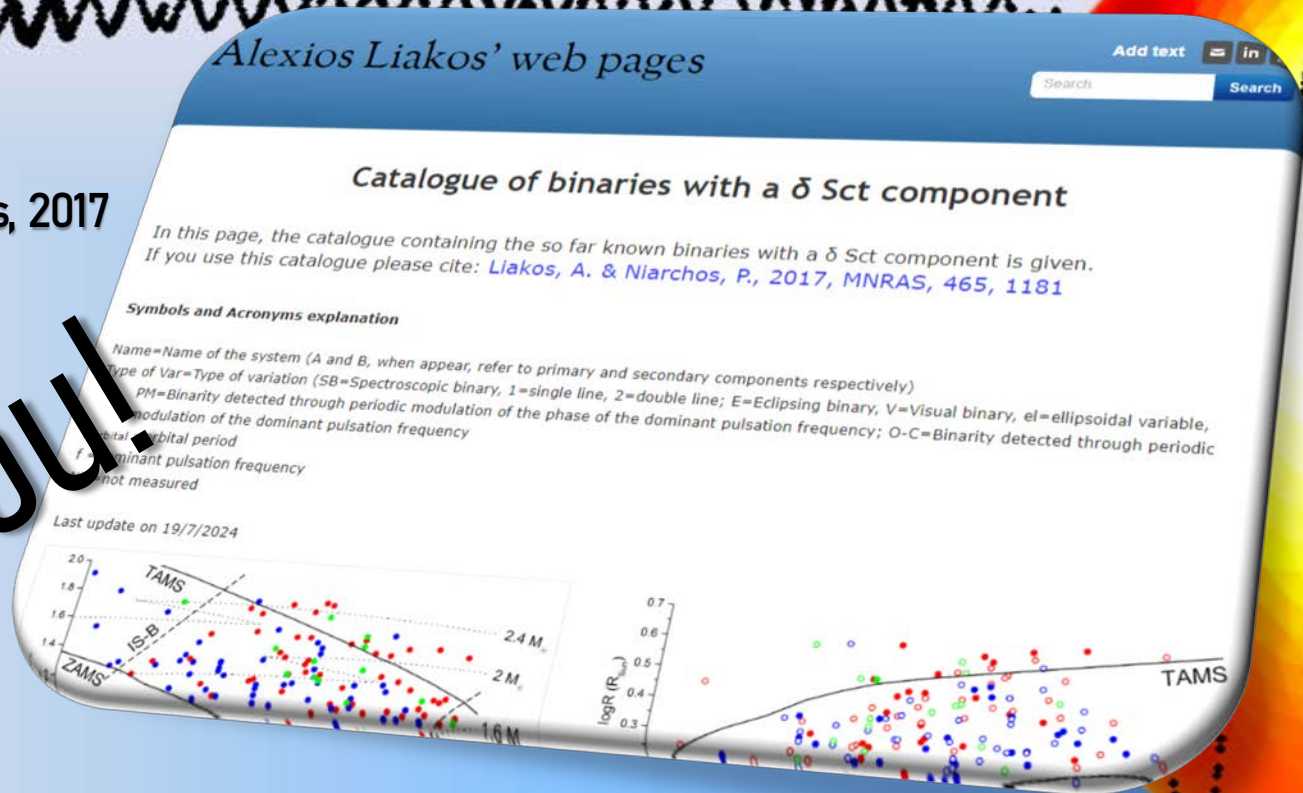
Online Catalogue

1st version-Liakos+2012

2nd version-Liakos & Niarchos, 2017

3rd version-Liakos, in prep.

Thank you!



<http://alexiosliakos.weebly.com/catalogue.html>

Small picture → Analyses on individual cases

TARGETS

DATA

Photometric

Spectroscopic

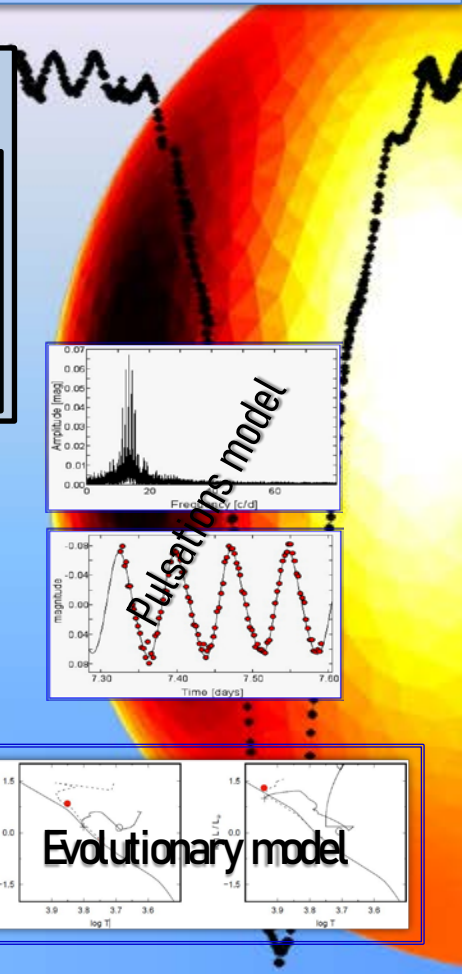
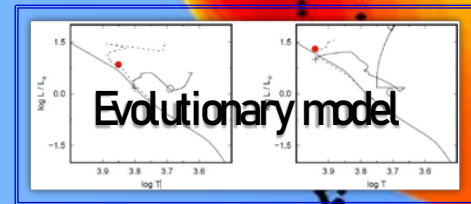
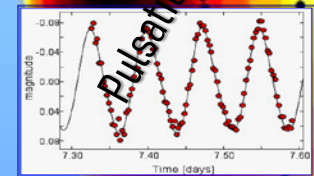
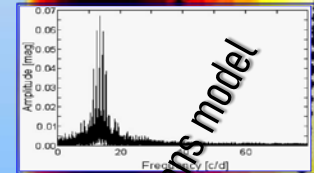
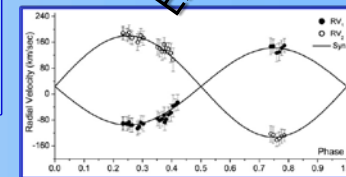
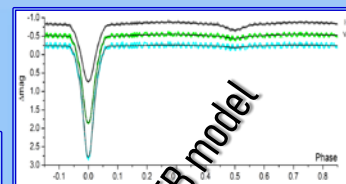
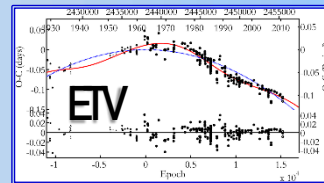
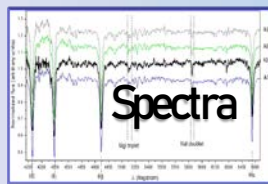
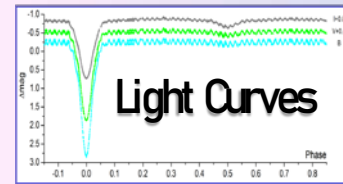
ANALYSES

EIV

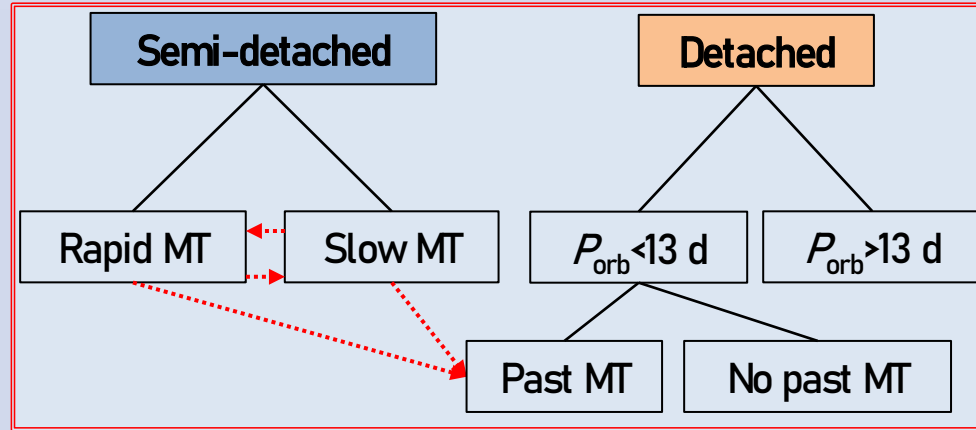
EB model

Pulsations model

Evolutionary model



Big picture & open questions



- ❖ Differences between single and binary-members δ Scuti stars
- ❖ Pulsations history in terms of tidal interaction and mass transfer
- ❖ Which A-F stars become pulsators?

