

BY Draconis variable star catalogue & LAMOST Chromospheric activity indices

Deepak Chahal, supervised by Prof. Richard de Grijs & Dr. Devika Kamath

AIM: We aim to characterize the properties of BY Dra variables over wide range of masses, temperatures & rotation periods. We have derived Chromospheric activity indices to understand their relations with different physical parameters.

BY Draconis Catalogue

BY Draconis are FGKM-type main sequence stars, which exhibit light curve variability due to modulation of *starspots*.

Origin of Magnetic Activity (in BY Draconis)

Differential Rotation + Convection

Solar Dynamo (Regeneration of Magnetic fields)

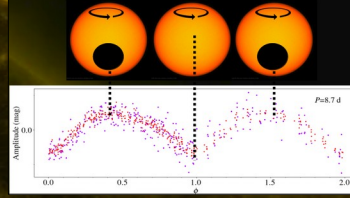
Starspots, flares, prominences (Heating of Chromosphere & Corona)

Key Questions:

- How does the **magnetic activity** vary with the **stellar rotation, masses & ages**?
- What are the **stellar parameters** that drive the regeneration of magnetic field?
- How do **Chromospheric activity** vary across the **period-colour** diagram, and what is the origin of **period-gap**?

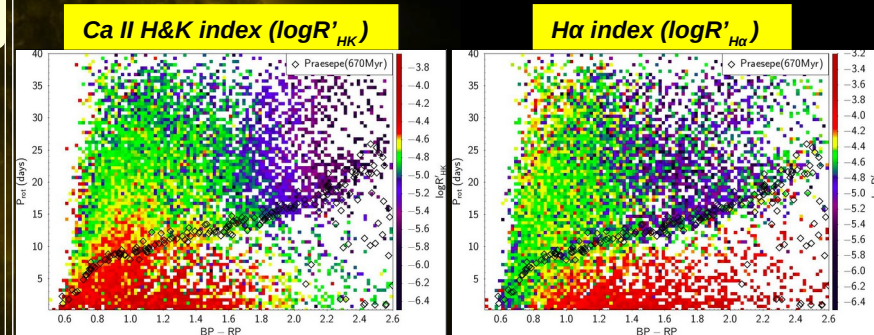
Physical properties: We have created a catalogue of 78,954 *BY Draconis* variables with photometry, stellar parameters and stellar activity. Most of our sources are *fast-rotating* compared to Kepler data.

Activity vs Stellar Parameters: We obtain *low correlation* between activity (photospheric activity index – S_{ph}) and stellar parameters because of complex inter-dependencies.



LAMOST Chromospheric activity indices

Data : Mcquilla 2014 (Kepler) + Reinhold 2020 (K2) + Chahal 2022 (ZTF)



- **Spindown Stallation** : Around the age of Praesepe cluster (670 Myr), we observe *decreased Chromospheric activity* especially for low-mass stars. This decrease in activity can be due to *spindown stallation* stage.
- We observe *larger decrease* in activity towards *K-M type* stars, which suggest that the *duration* of epoch of spindown stallation is *mass-dependent*.
- **Period-gap** : We have found that sources lying along the period-gap have *minimal activity*, suggesting that the period-gap arises due to *non-detection* of variability of sources due to minimum activity, which occur due to *spindown stallation*.

Conclusion

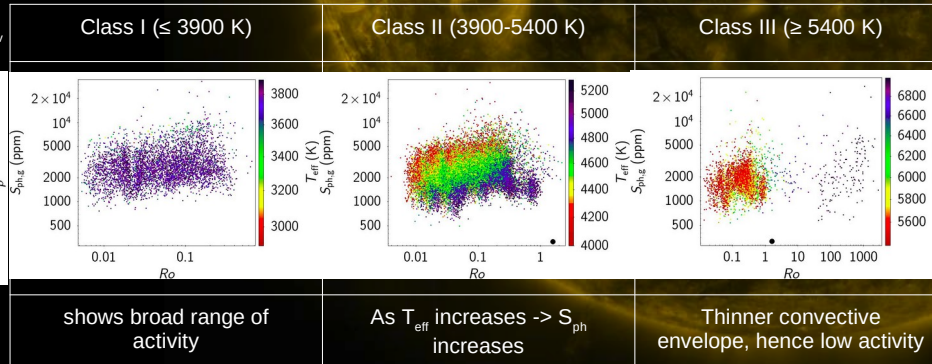
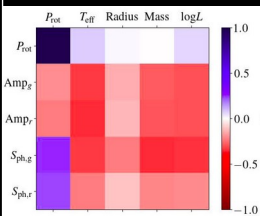
We have compiled a large catalogue of 78,954 *ZTF BY Draconis* variables with their *stellar parameter & stellar activity*. We have found *negative correlation* between stellar parameters (T_{eff} , Mass, Luminosity) with S_{ph} -index. We have also created a catalogue of *Chromospheric activity indices* (Ca II H&K and H α emission) using LAMOST DR7 data. We have found *evidences of spindown stallation* based on activity indices.

(Rossby no.) $Ro = P_{rot} / \tau_{conv}$

Class I (≤ 3900 K)

Class II (3900-5400 K)

Class III (≥ 5400 K)



Spearman correlation coefficient (ρ) matrix

shows broad range of activity

As T_{eff} increases $\rightarrow S_{ph}$ increases

Thinner convective envelope, hence low activity