Know Thy Star,
Know That Planet 2
Conference

Chromospheric Activity, Lithium, and Rotational Velocities Among 1600 **K dwarfs** within 40 pc

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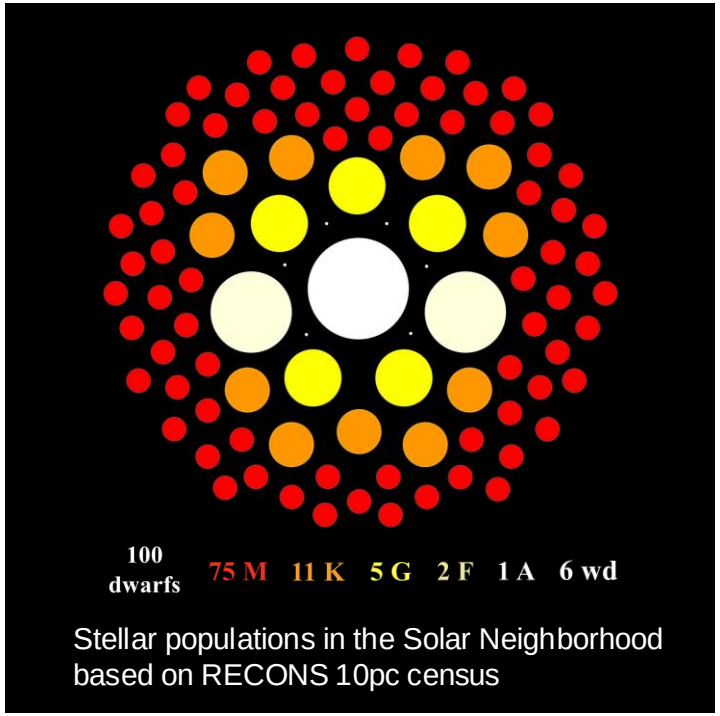
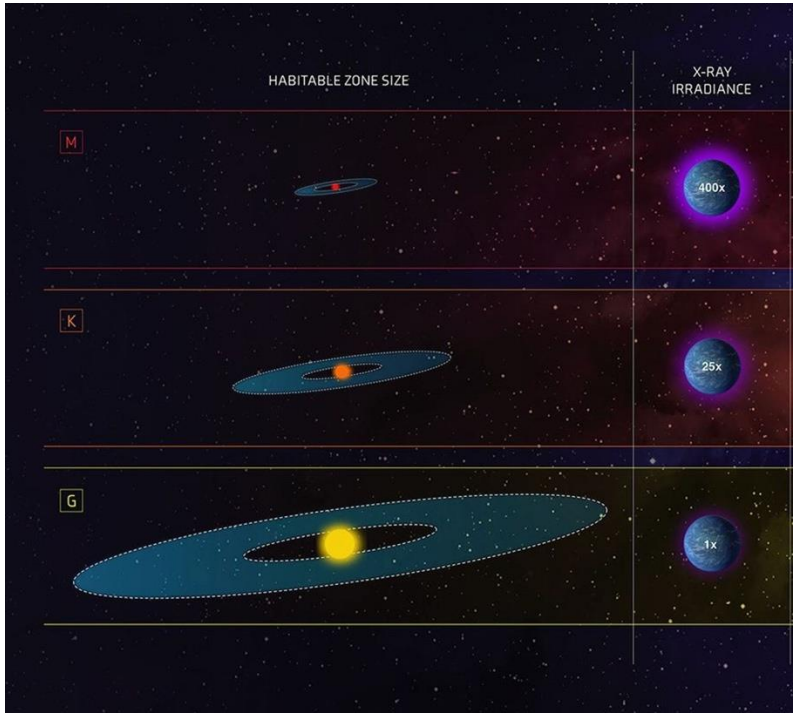
Why K dwarfs?

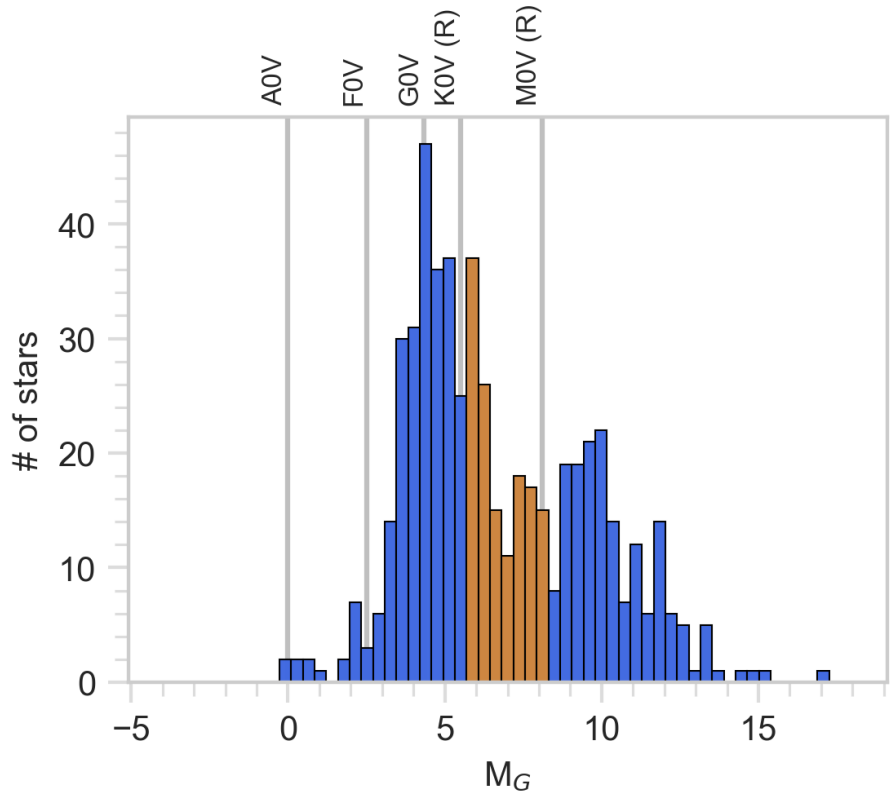


From: Henry & Jao (2024)



Adapted from: NASA, ESA, and Z. Levay (STScI)

Stars within 50 pc with confirmed exoplanets



Obtained from NASA Exoplanet Archive as of 01/25/2025

Science Questions and Motivations

- Number of Young, Mature, Chr. Active and Chr. Inactive K dwarfs
- Best Targets to Search for Companions and Exoplanets

Outline

RKSTAR Surveys

Observations & Methodology

Li I 6708 Å

Hα 6563 Å

Ca II 8542 Å

v sini

Conclusions

Results

RECONS' K and M Catalogs

RKSTAR

4471 primary

K dwarf stars

within 50 pc

RMSTAR

3321 primary

M dwarf stars

within 25 pc

*Go check their posters!

RECONS' K and M

RKSTAR

4471 primary
K dwarf stars
within 50 pc

Surveys

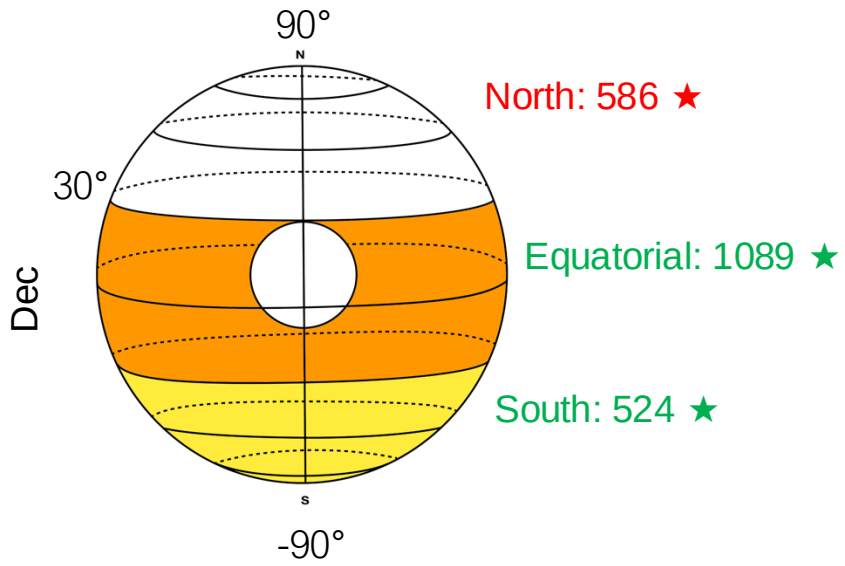
Radial Velocity
Speckle
Wide Companions
Characterization

RMSTAR

3321 primary
M dwarf stars
within 25 pc

RKSTAR Characterization Survey

- Surveying a Volume Limited sample within 40 pc



★ : K dwarfs primaries in the RKSTAR Catalog

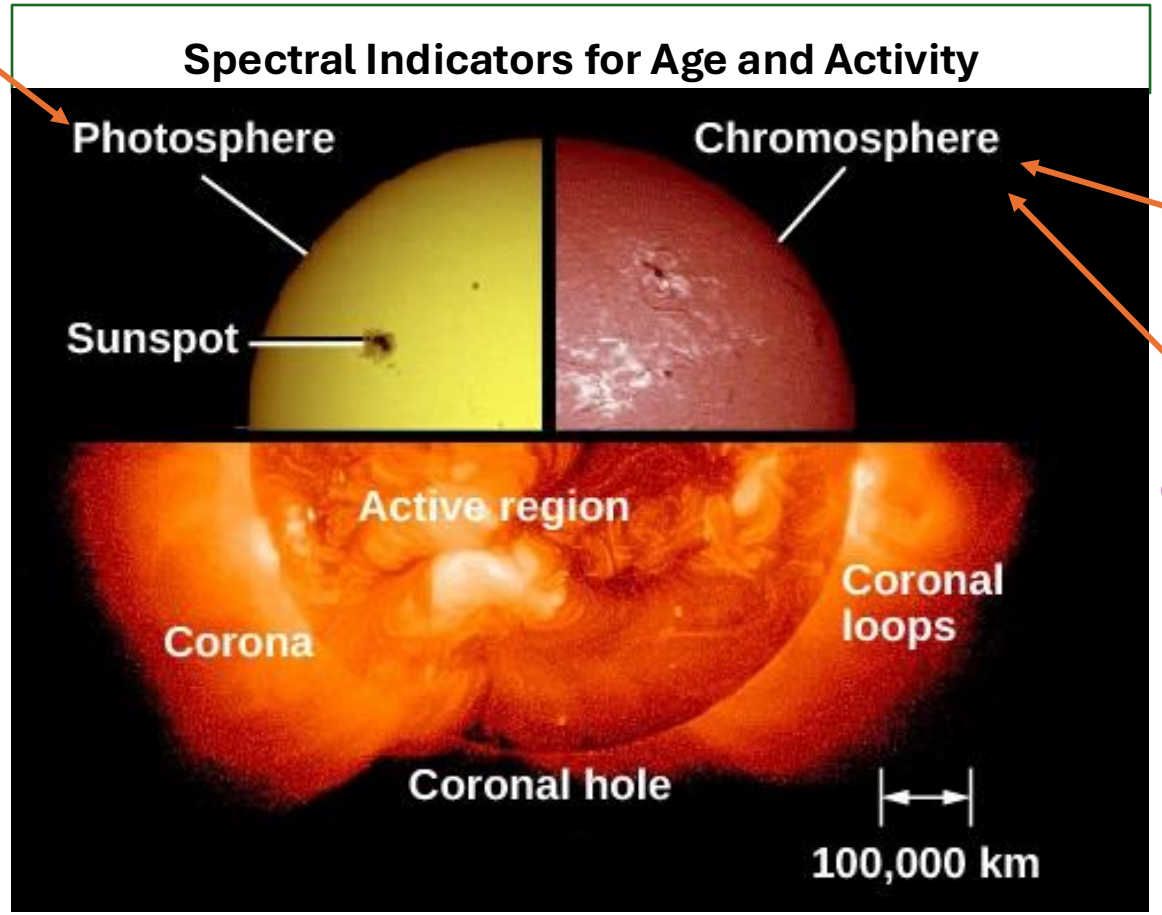
for:

Chromospheric Activity
Relative Ages
Rotational Vel.
Fundamental Properties
Rotation Periods
Space Kinematics

RKSTAR Characterization Survey

Chromospheric Activity
Relative Ages
Rotational Vel.

Li I$_D$
(6707.8 Å)



H_α
(6562.8 Å)

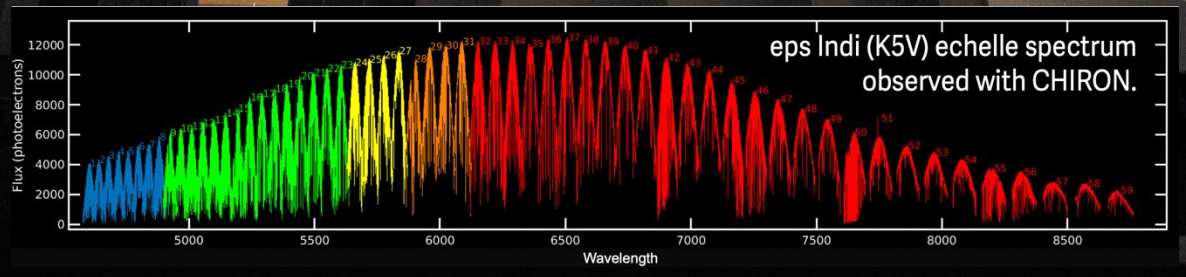
Ca II IRT$_{2nd\ line}$
(8542.1 Å)

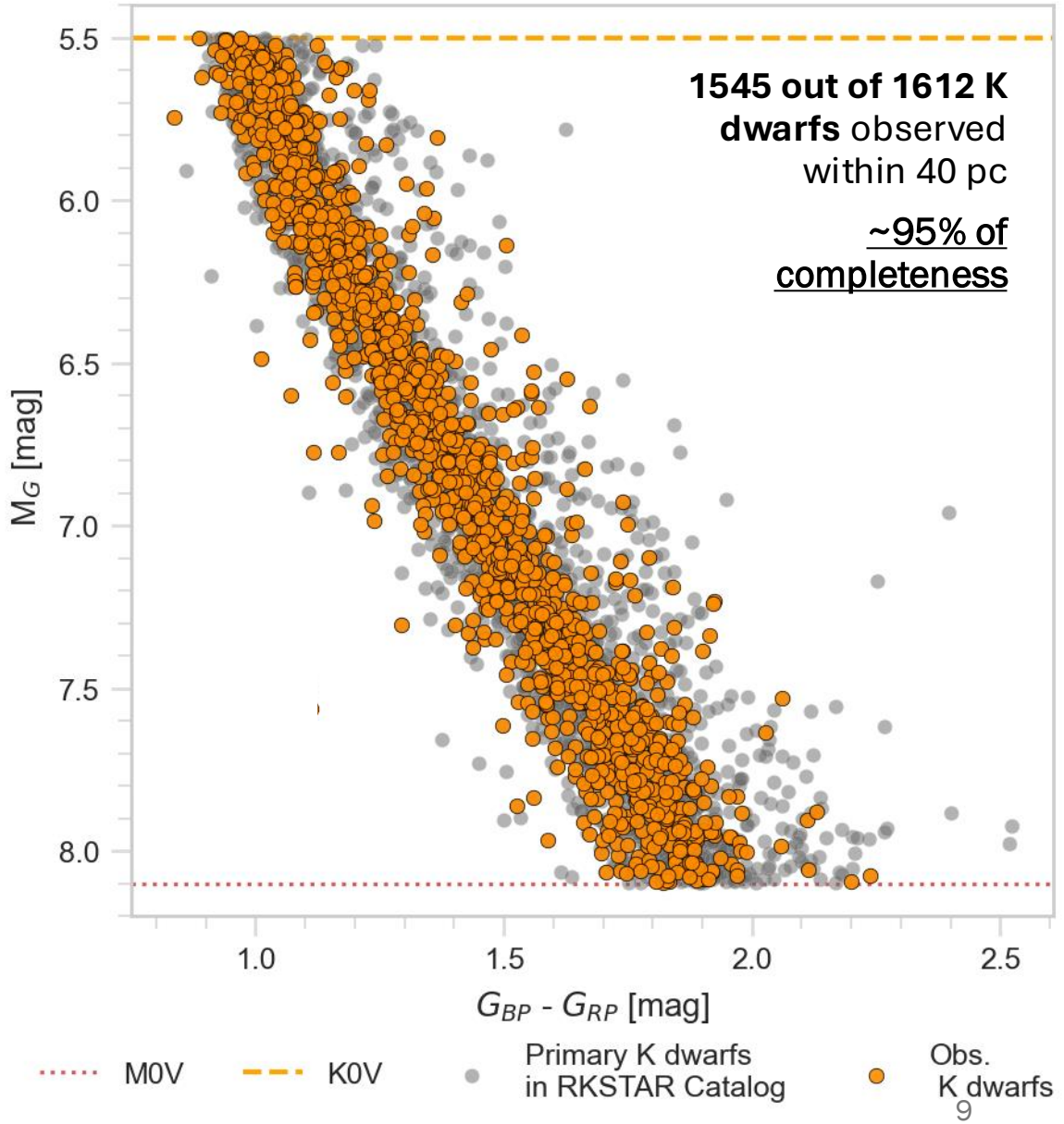
Obtained: UCF

Observations

CTIO/SMARTS 1.5m telescope with **CHIRON** spectrograph

R=80000 in slicer mode, range 4150-8800 Å



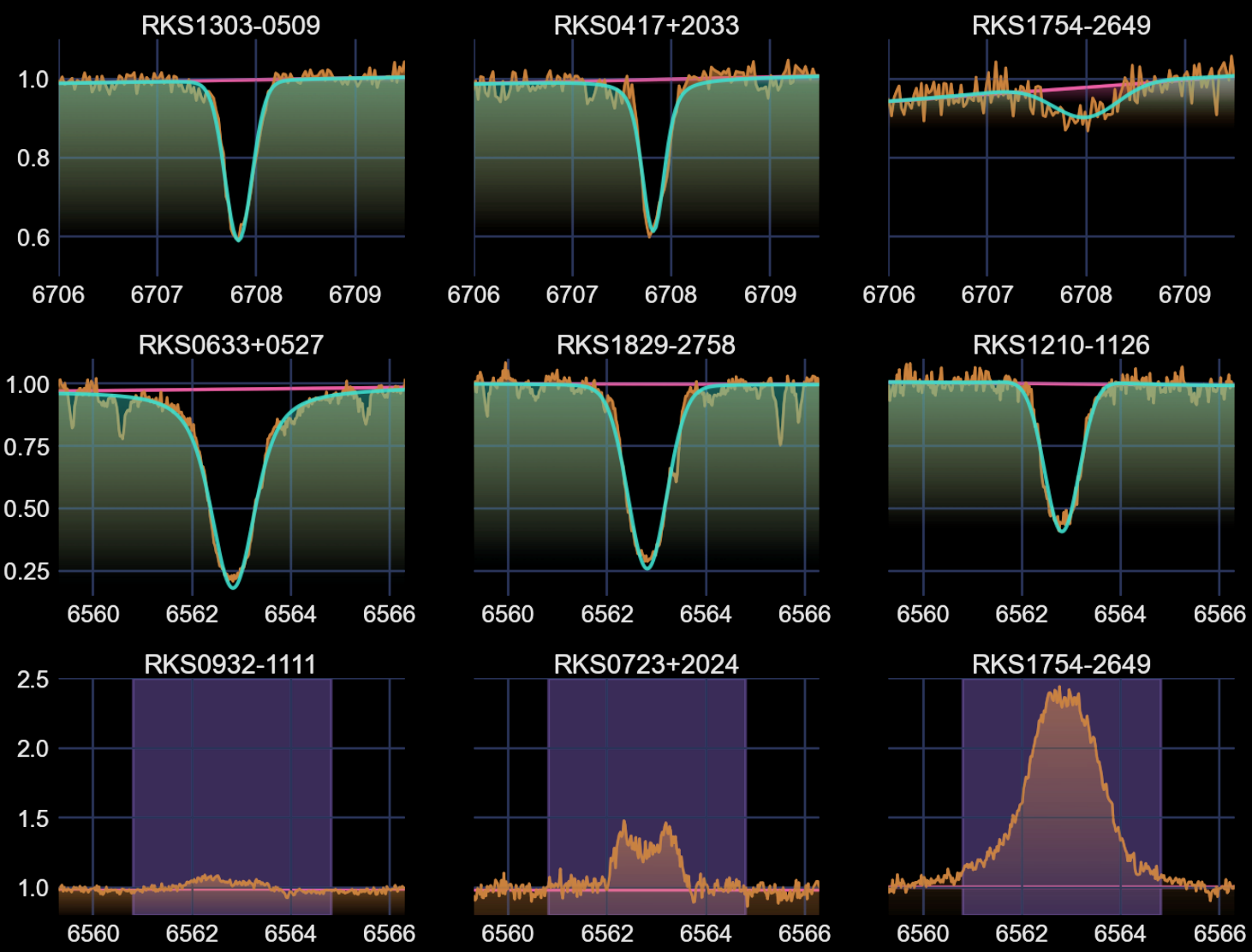


Methodology

- Measure of Equivalent widths (EW)
  - Voigt profile fitting
- Visual inspection
  - SNR
  - Continuum
  - SB2
  - Fast Rotators

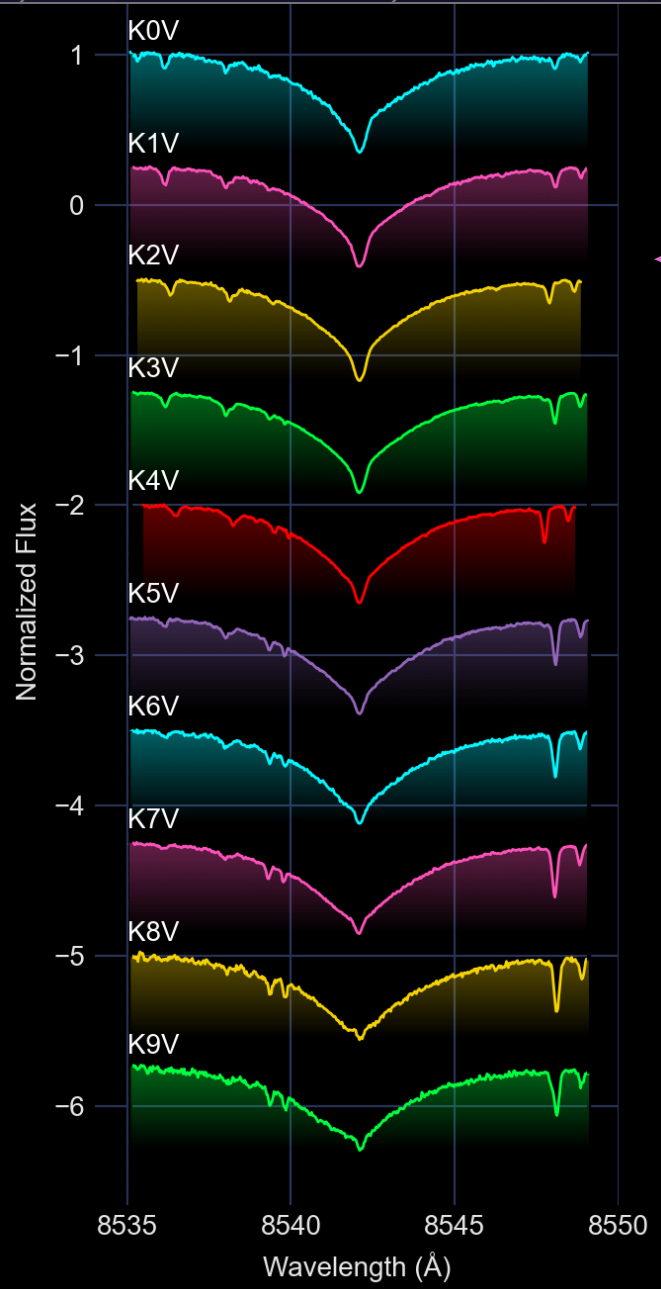
Li I $_D$ (6707.8 Å)

H_α (6562.8 Å)

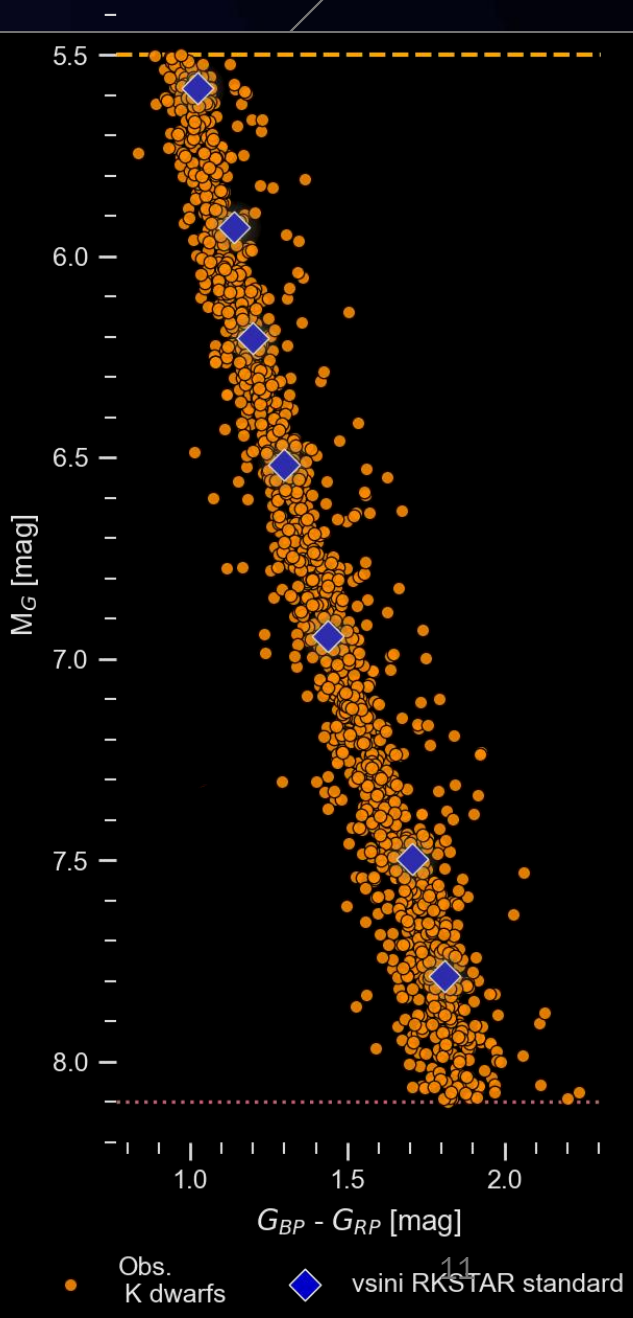


Methodology

- Ca II8542.1 Å excess
  - Measure residual EWs from empirical templates



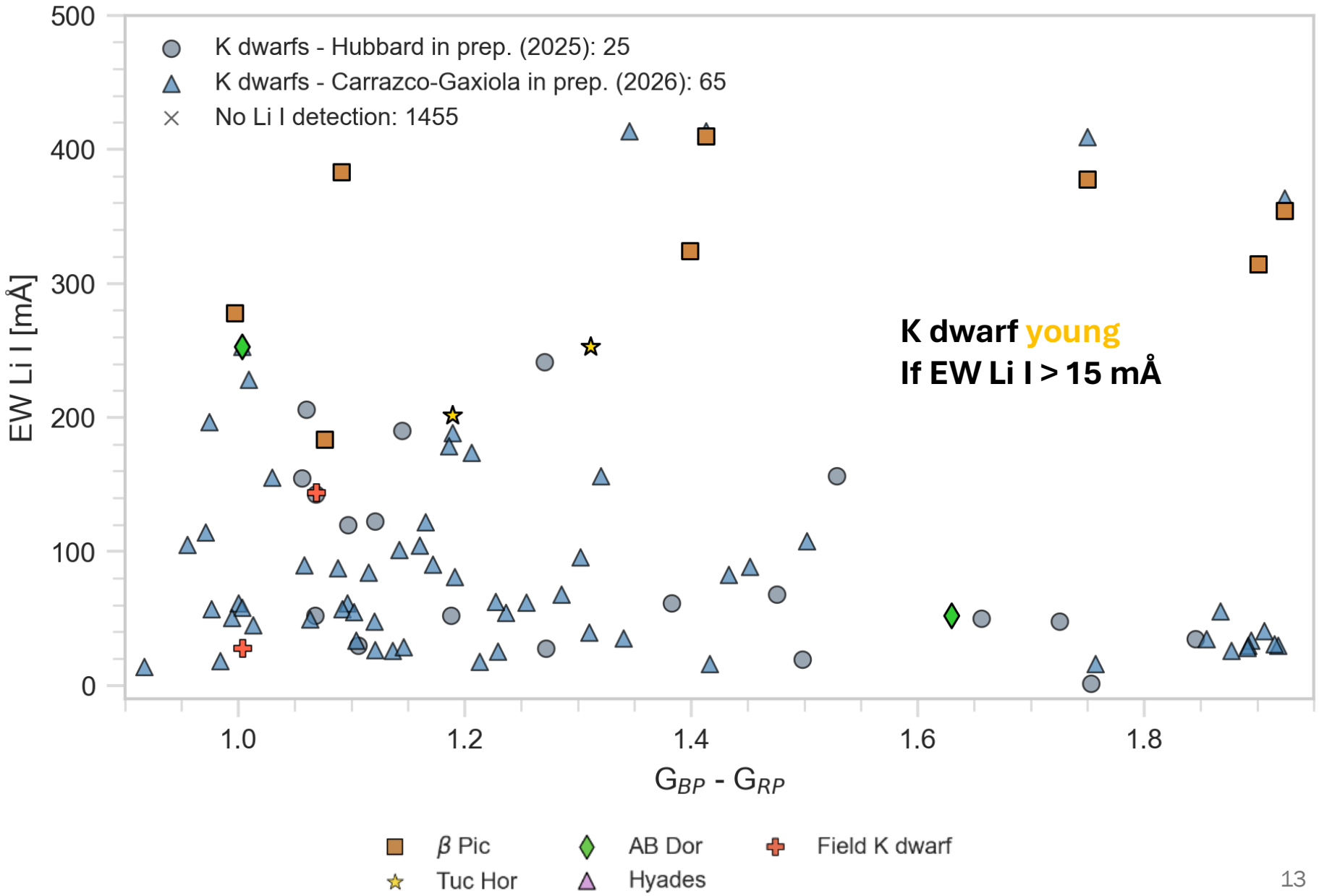
- Rotational Velocities
  - Empirical vsini (White et al. 2004, 2007)
  - vsini relative to standards with slow rot., inactive, with solar [Fe/H]



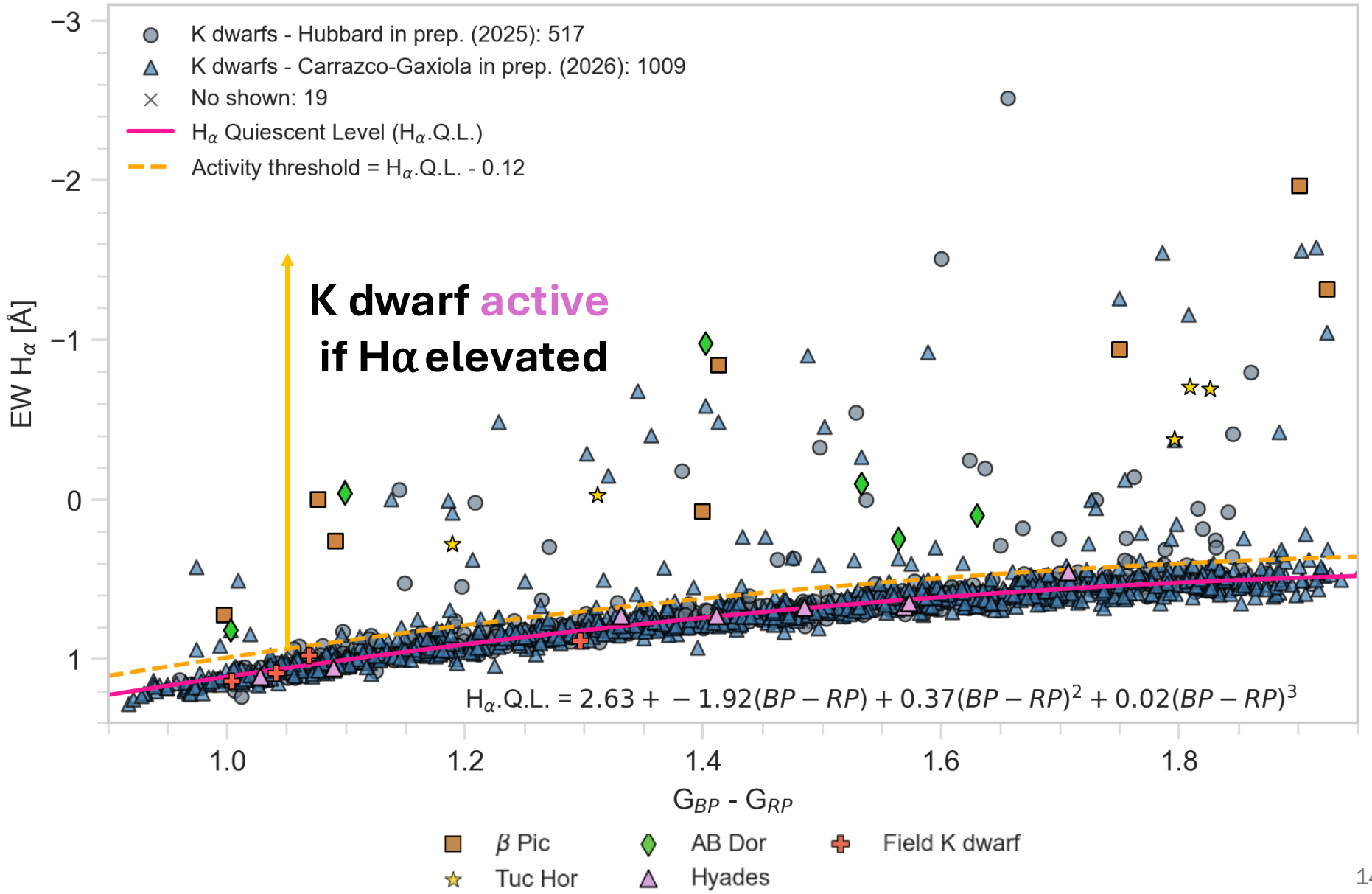
Results

NEXT:
Measurements in function of Gaia color

Li I

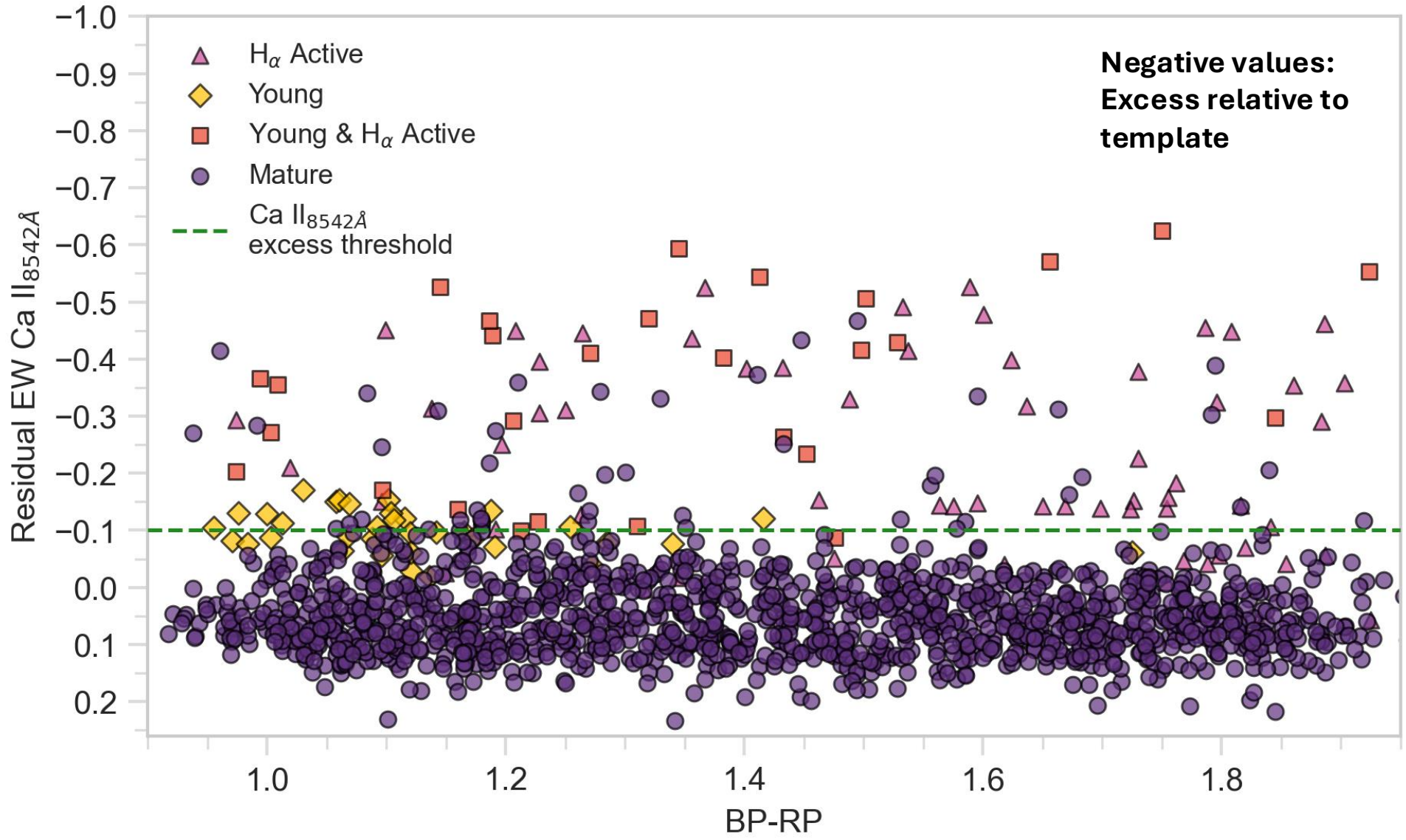

K dwarfs - Hubbard in prep. (2025): 25
K dwarfs - Carrazco-Gaxiola in prep. (2026): 65
No Li I detection: 1455
K dwarf young
If EW Li I > 15 mÅ
EW Li I [mÅ]
500
400
300
200
100
0
1.0
1.2
1.4
1.6
1.8
G_BP - G_RP
β Pic
AB Dor
Field K dwarf
Tuc Hor
Hyades

H_α


K dwarfs - Hubbard in prep. (2025): 517
K dwarfs - Carrazco-Gaxiola in prep. (2026): 1009
No shown: 19
Hα Quiescent Level (Hα.Q.L.)
Activity threshold = Hα.Q.L. - 0.12
K dwarf active if Hα elevated
EW Hα [Å]
−3
−2
−1
0
1
1.0
1.2
1.4
1.6
1.8
GBP - GRP
Hα.Q.L. = 2.63 + − 1.92(BP − RP) + 0.37(BP − RP)2 + 0.02(BP − RP)3
β Pic
AB Dor
Field K dwarf
Tuc Hor
Hyades

Ca II

8542.1 Å

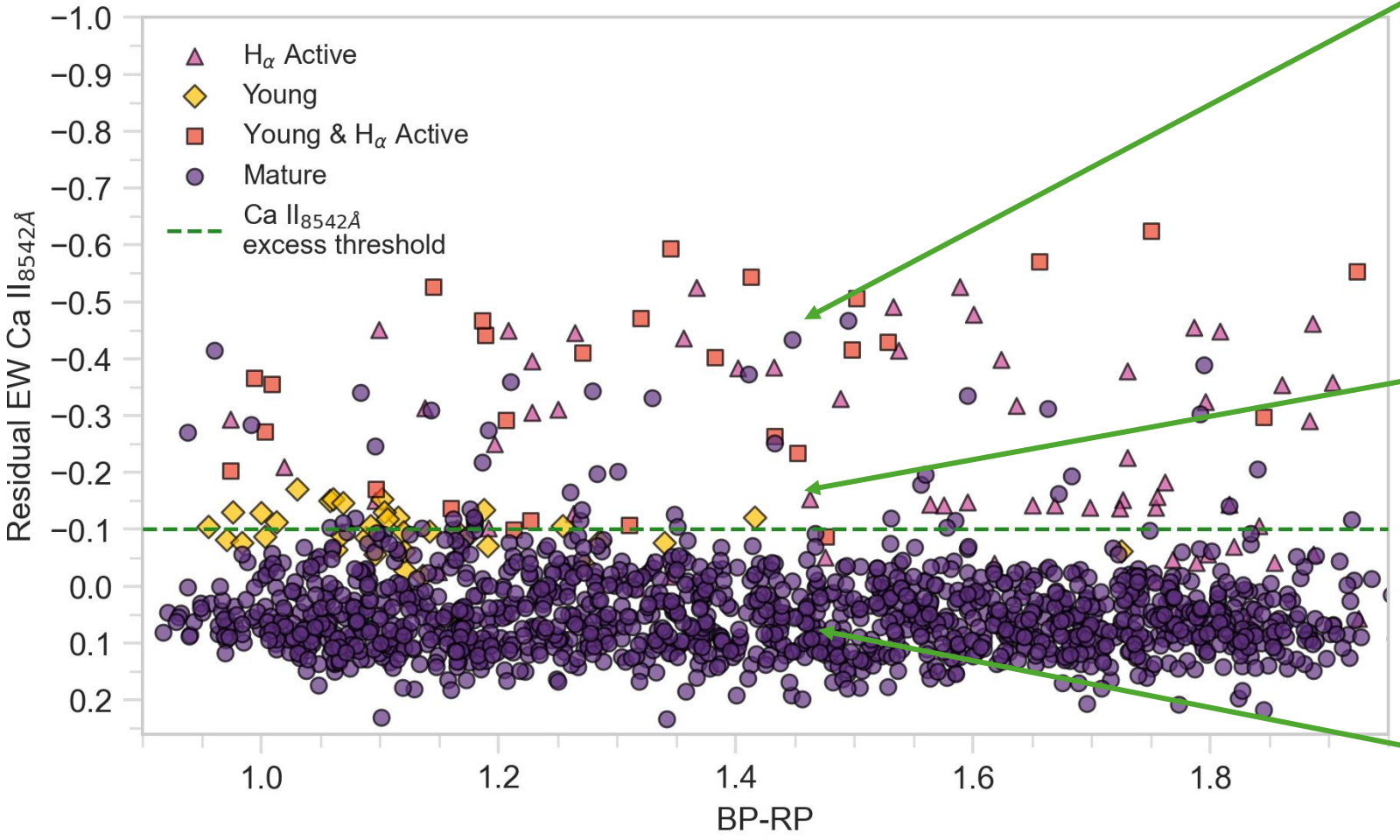


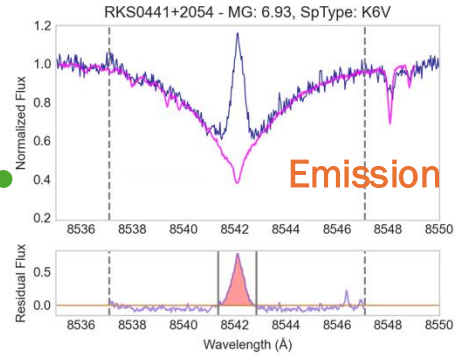
*Work in progress

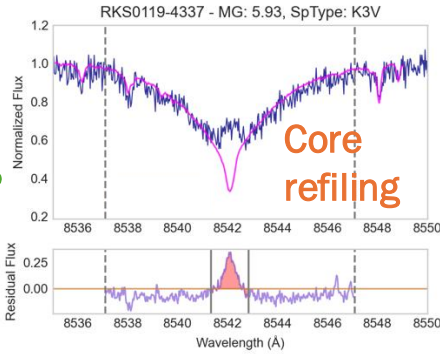
The residual excess tracks Activity better than Youth

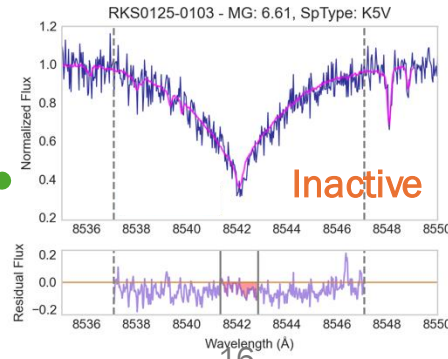
Ca II

8542.1 Å



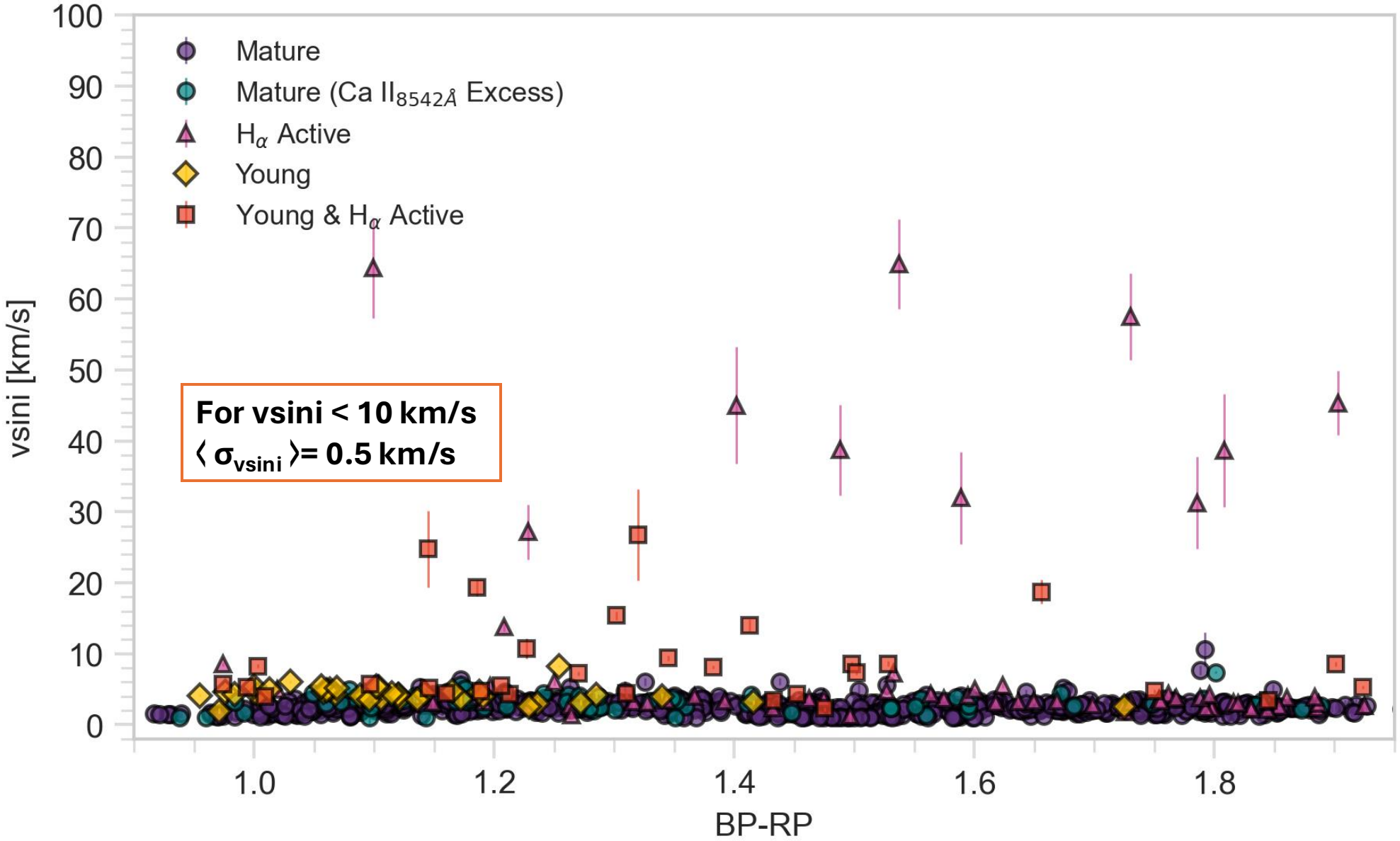






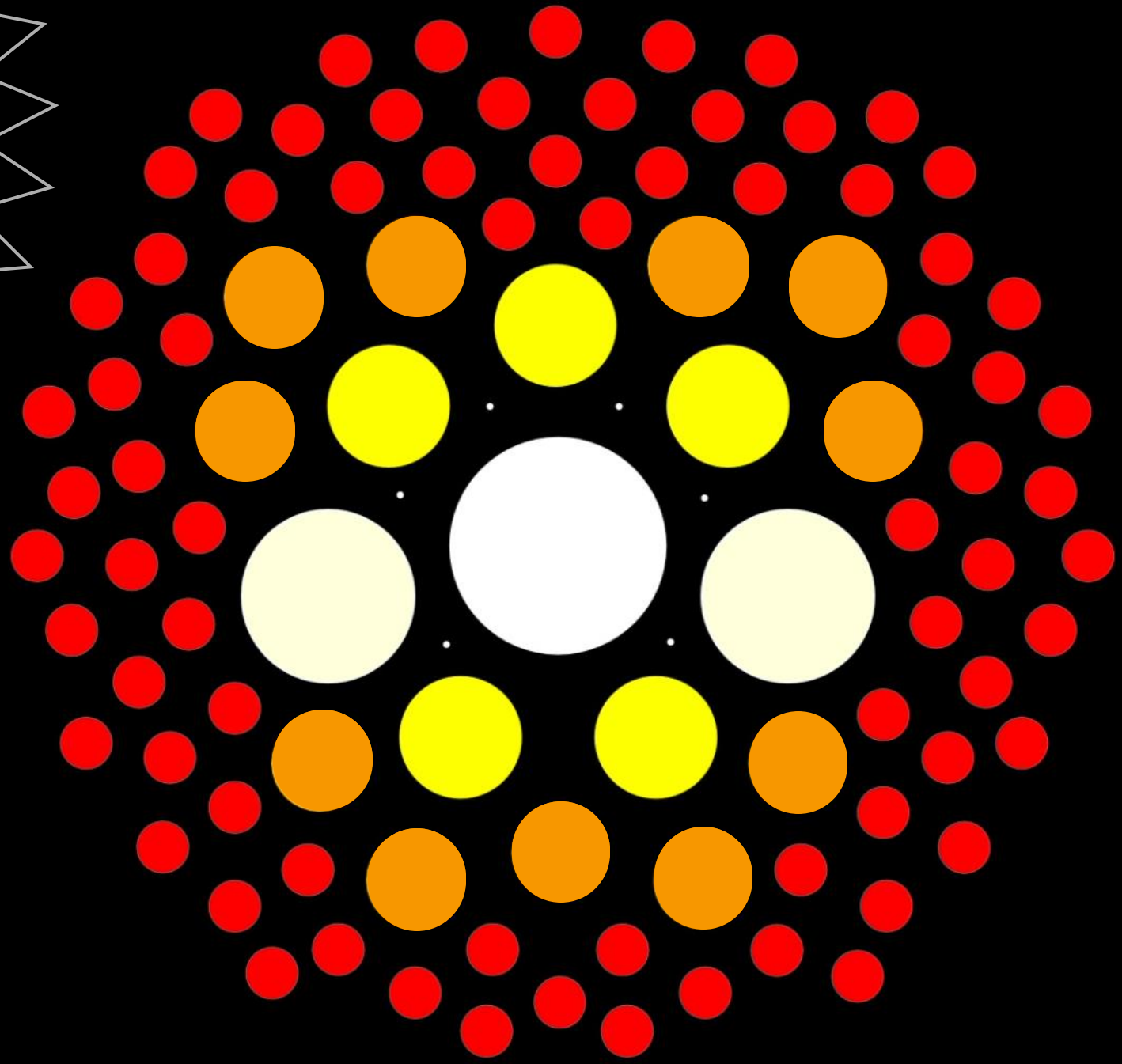
*Work in progress

vsin i



*Work in progress

Conclusions



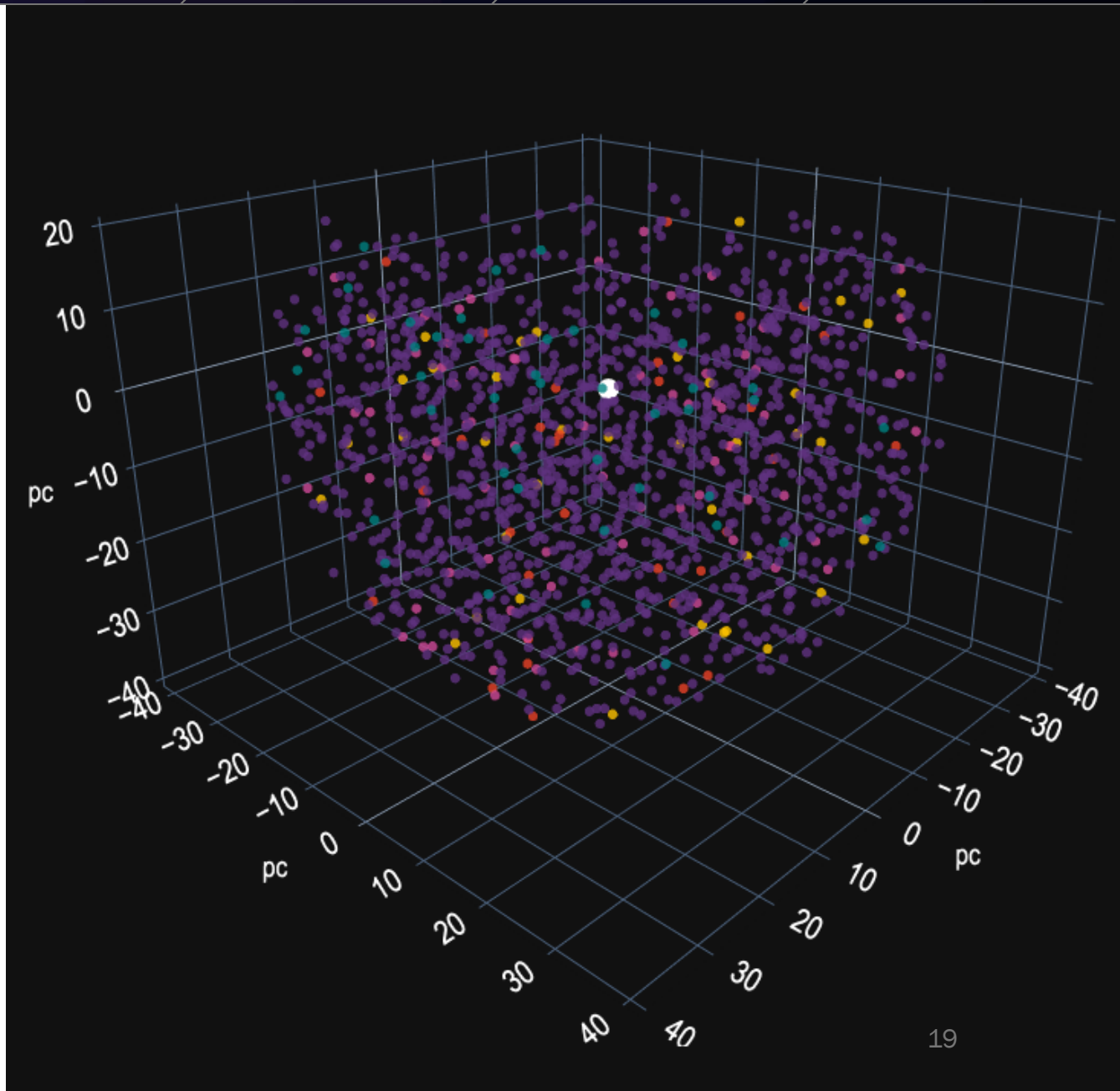
Young:
37 (2.5%)

Hα Active:
79 (5.2%)

Mature:
1360
(87.1%)

Young +
Hα Active:
34 (2.3%)

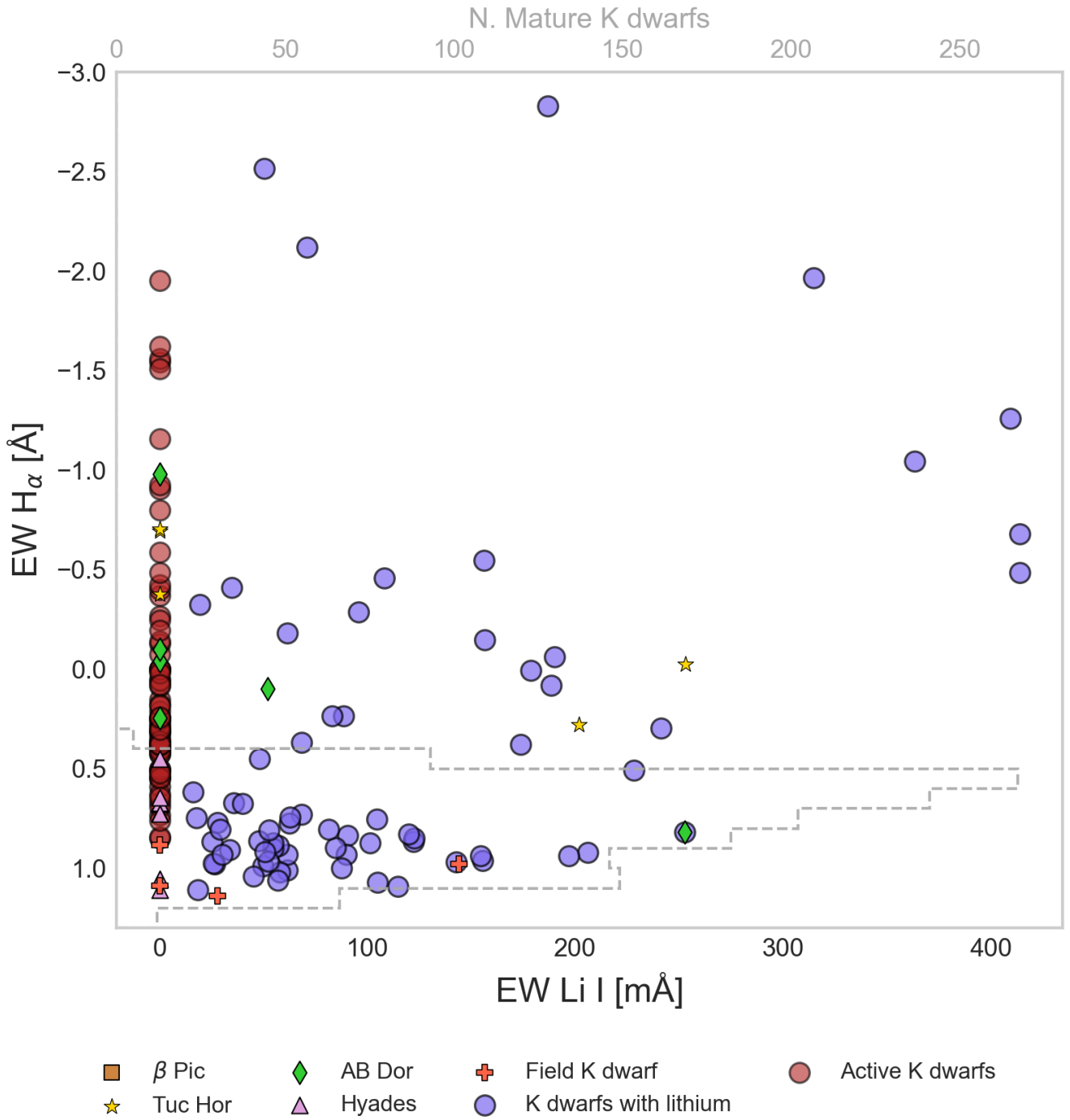
Mature +
Ca II excess:
45 (3.0%)



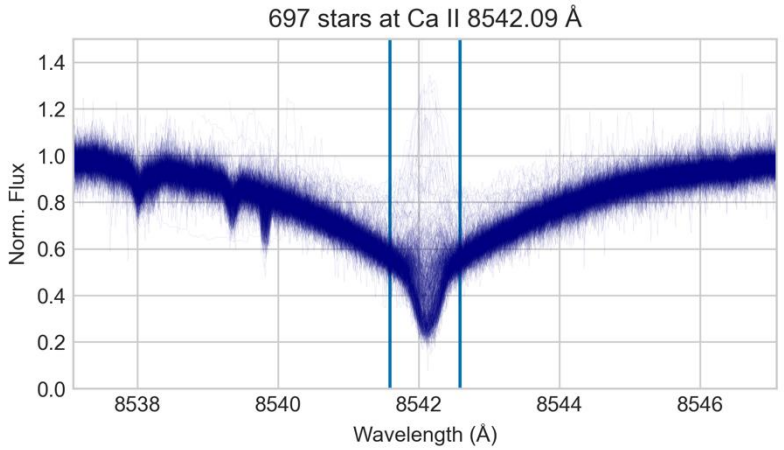
This effort has been supported by the NSF through grant AST-1910130, by NASA through grant 22-XRP22_2-0187, and via observations made possible by the SMARTS Consortium.

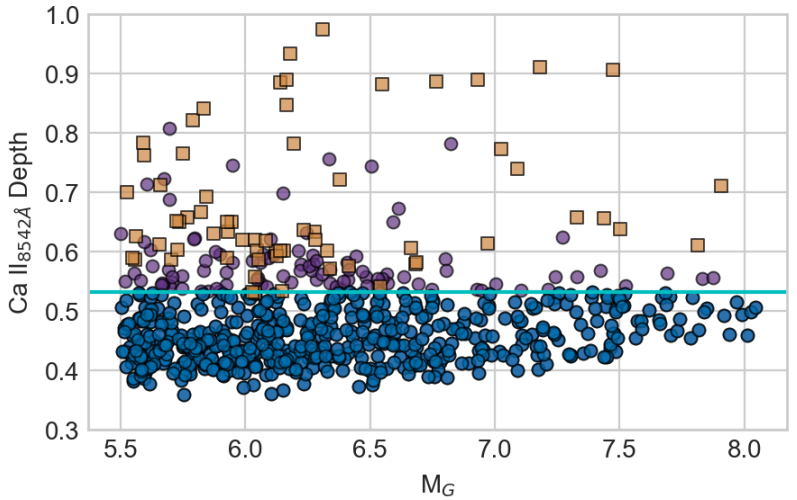
Back-up Slides

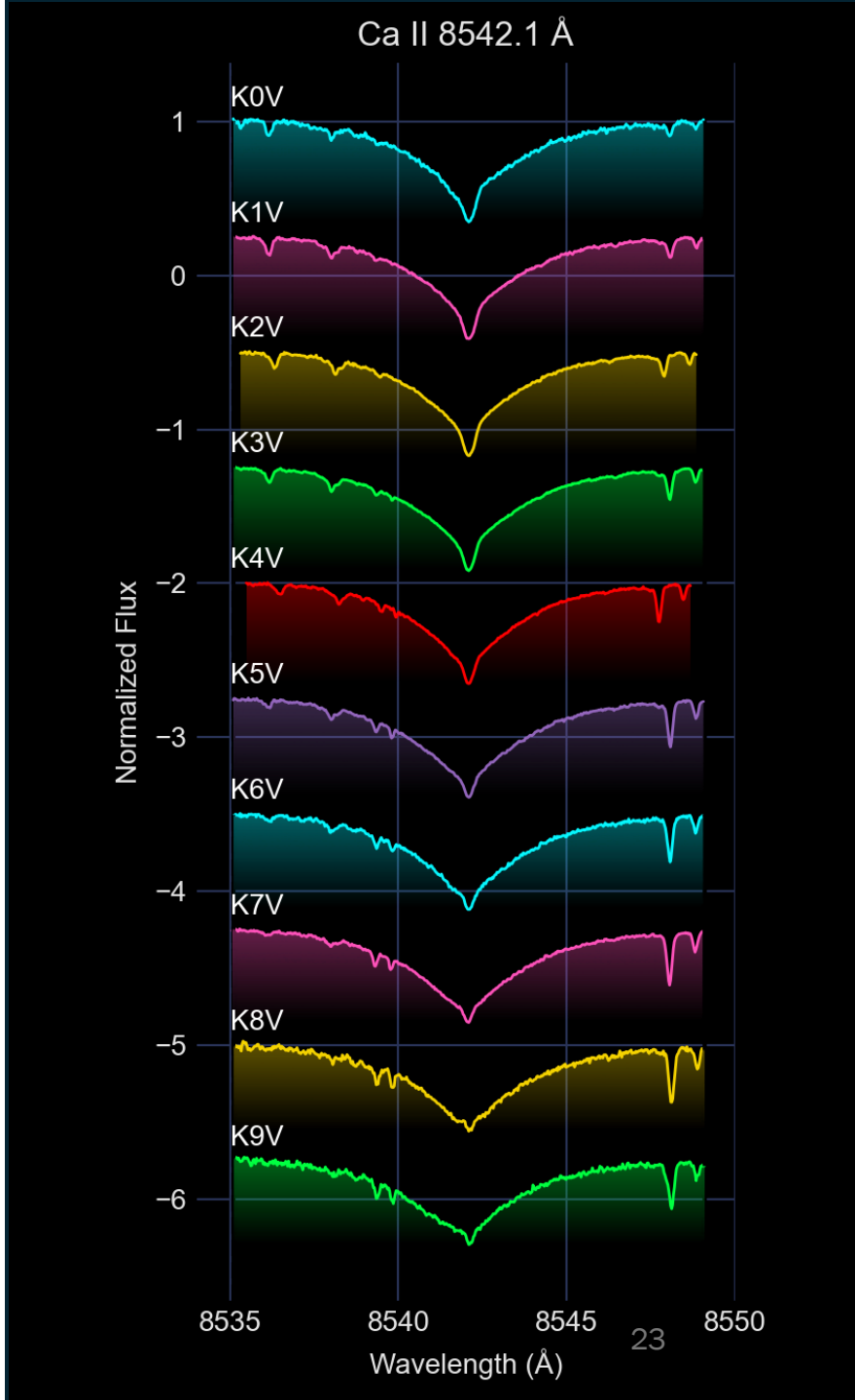
If needed

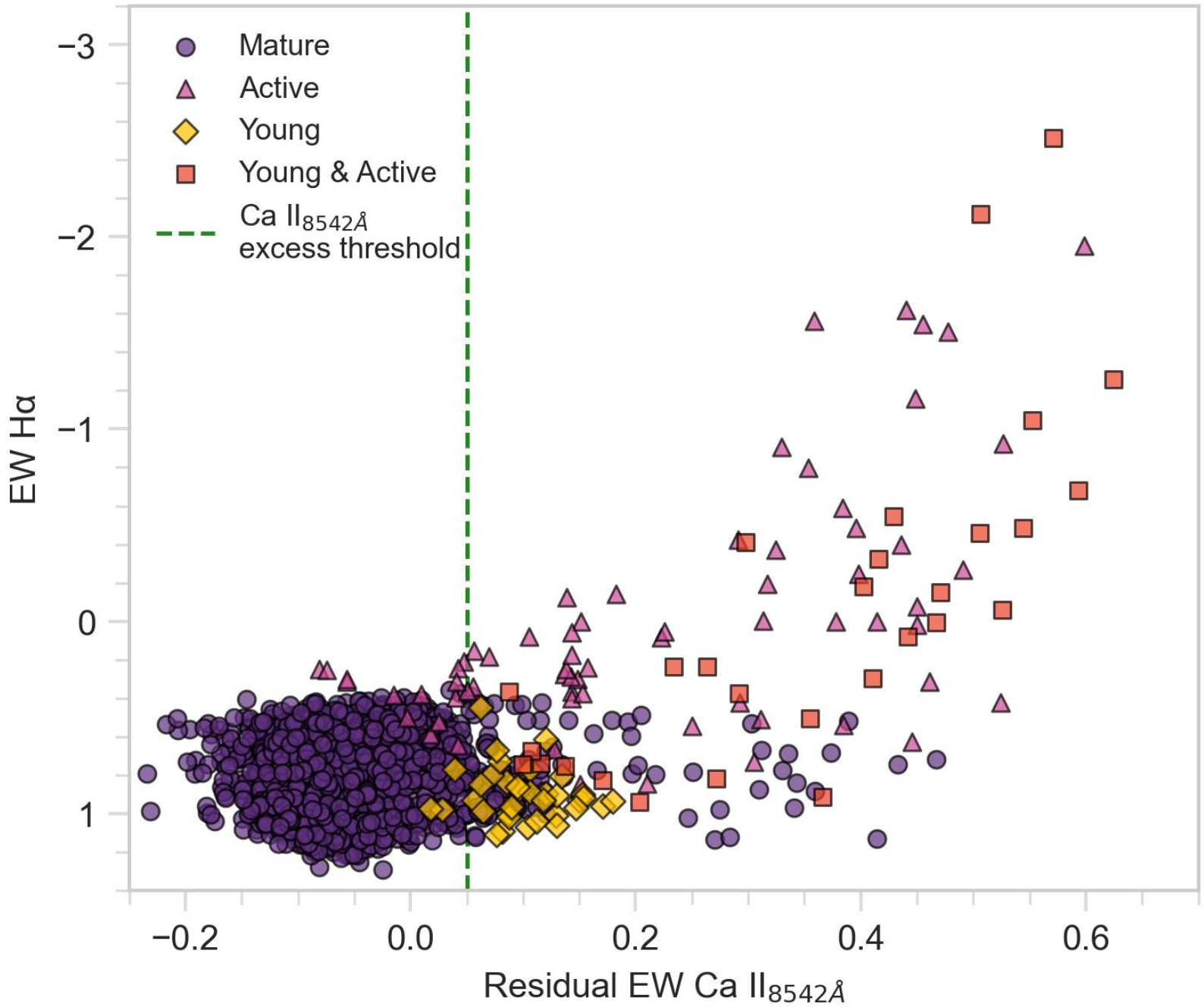

N. Mature K dwarfs
0
50
100
150
200
250
−3.0
−2.5
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
EW Hα [Å]
0
100
200
300
400
EW Li I [mÅ]
β Pic
Tuc Hor
AB Dor
Hyades
Field K dwarf
K dwarfs with lithium
Active K dwarfs

Ca II$_{8542.1\ Å}$

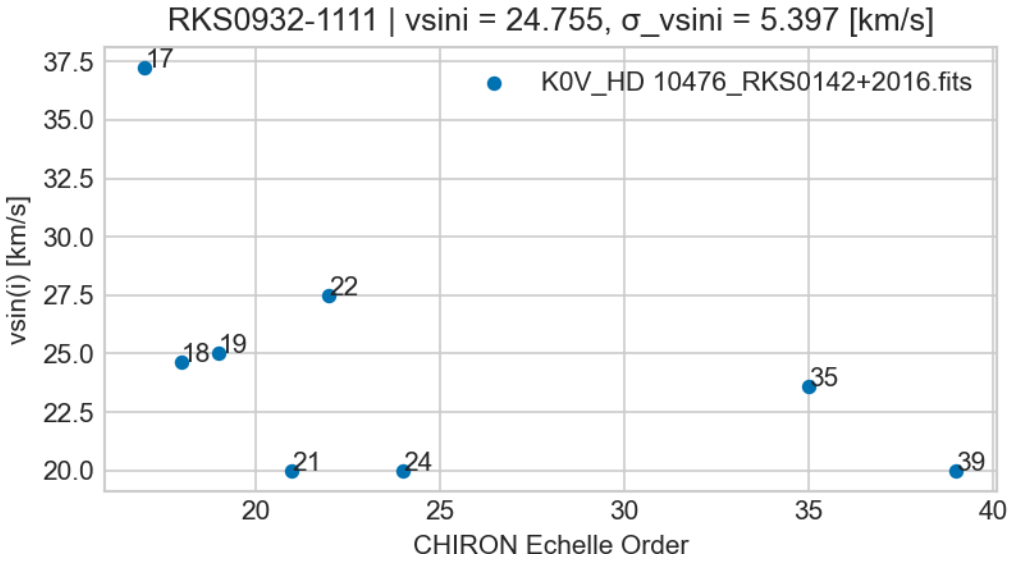

697 stars at Ca II 8542.09 Å
Norm. Flux
Wavelength (Å)

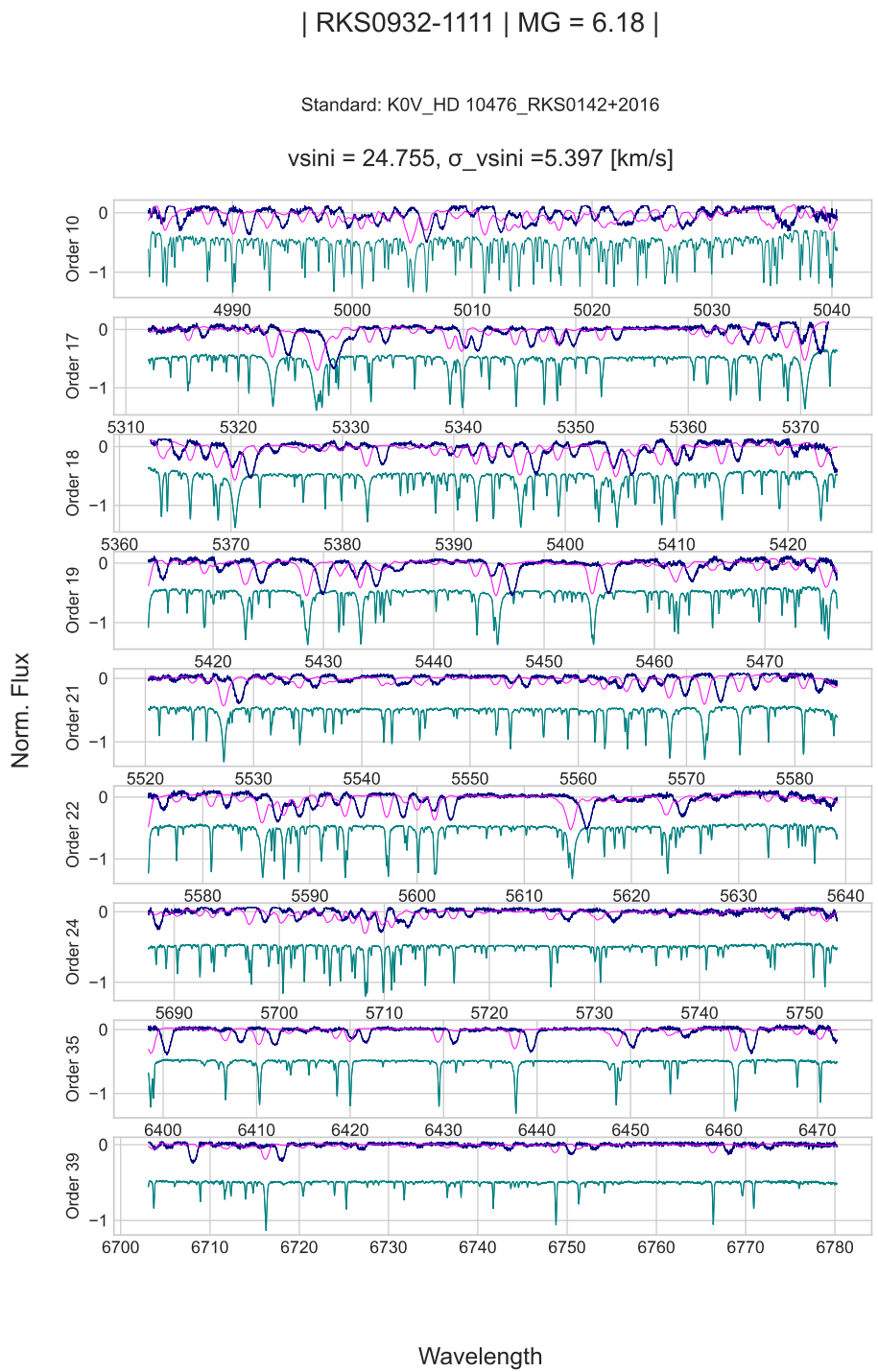

Ca II8542Å Depth
MG


Ca II 8542.1 Å
K0V
K1V
K2V
K3V
K4V
K5V
K6V
K7V
K8V
K9V
Normalized Flux
Wavelength (Å)


Mature
Active
Young
Young & Active
Ca II8542Å
excess threshold
EW Hα
−3
−2
−1
0
1
−0.2
0.0
0.2
0.4
0.6
Residual EW Ca II8542Å

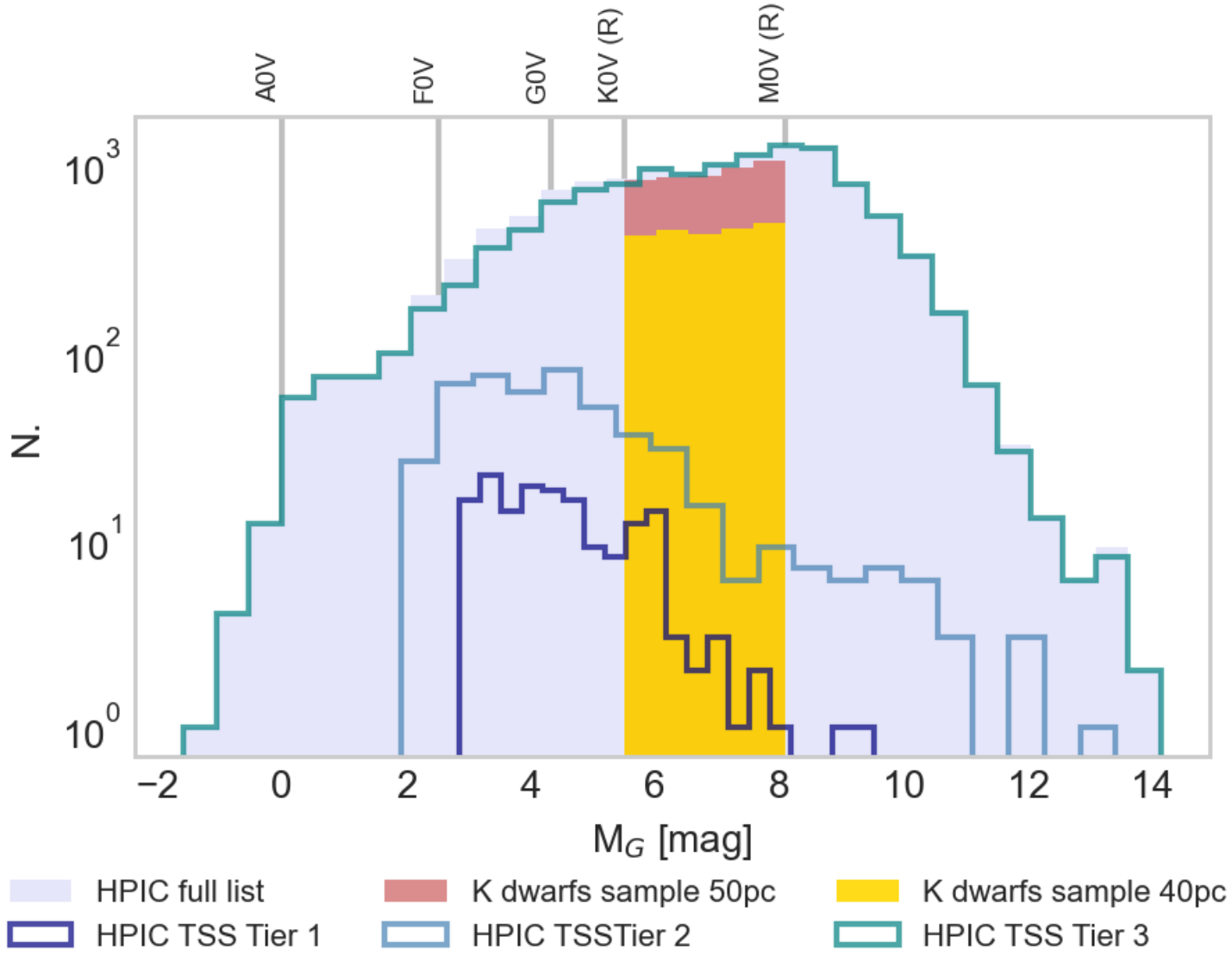
RKSTAR x vsini





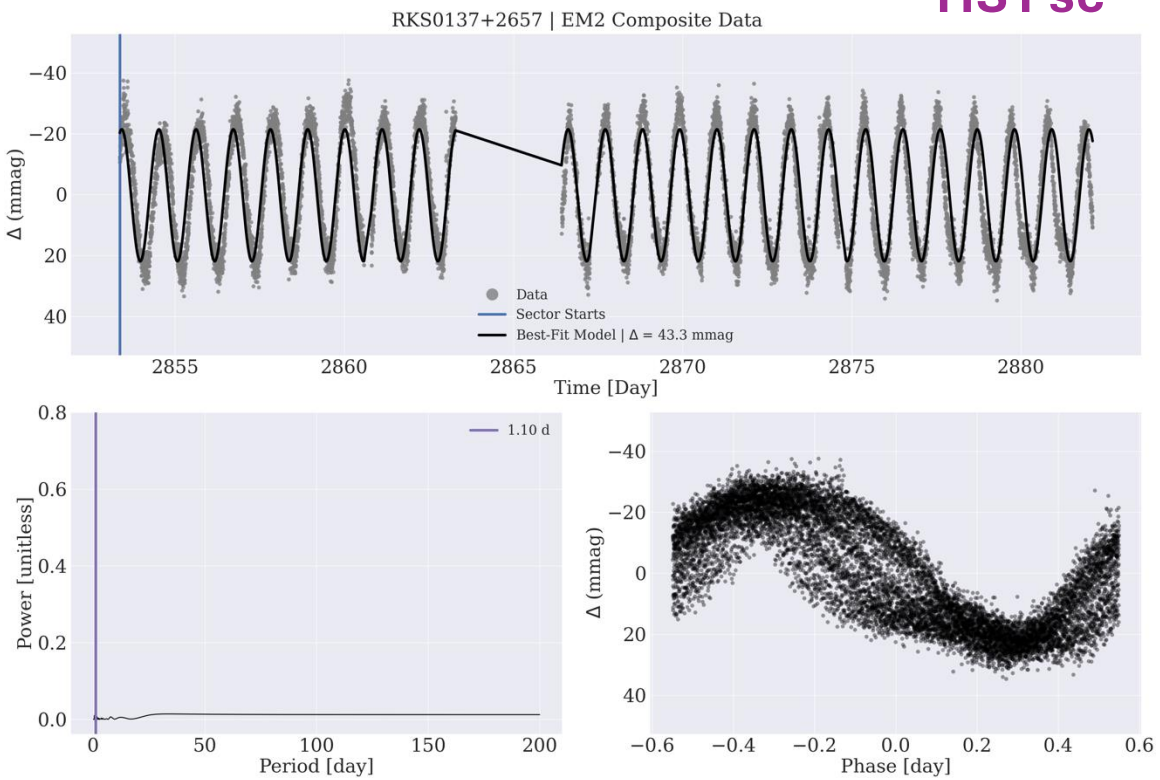
RKSTAR and HPIC

Habitable Worlds Observatory Preliminary Input Catalog (Tuchow et al. 2024)

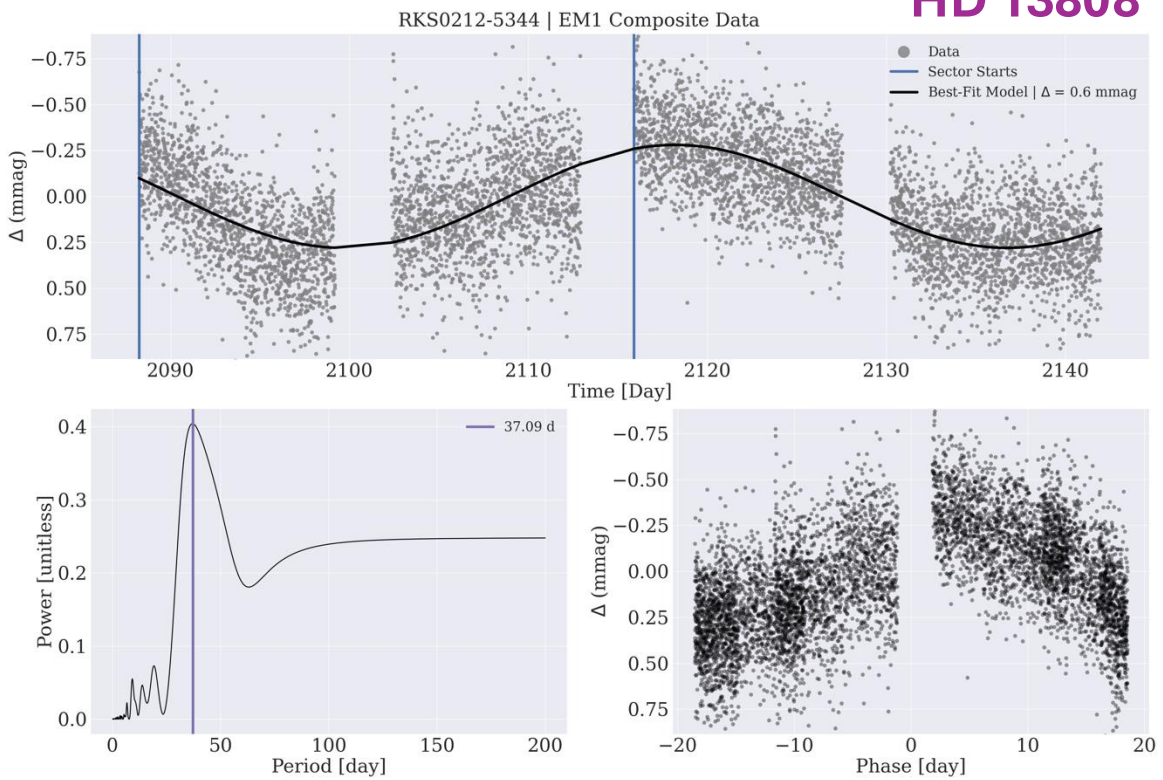


RKSTAR x TESS: Rotation Periods

HS Psc

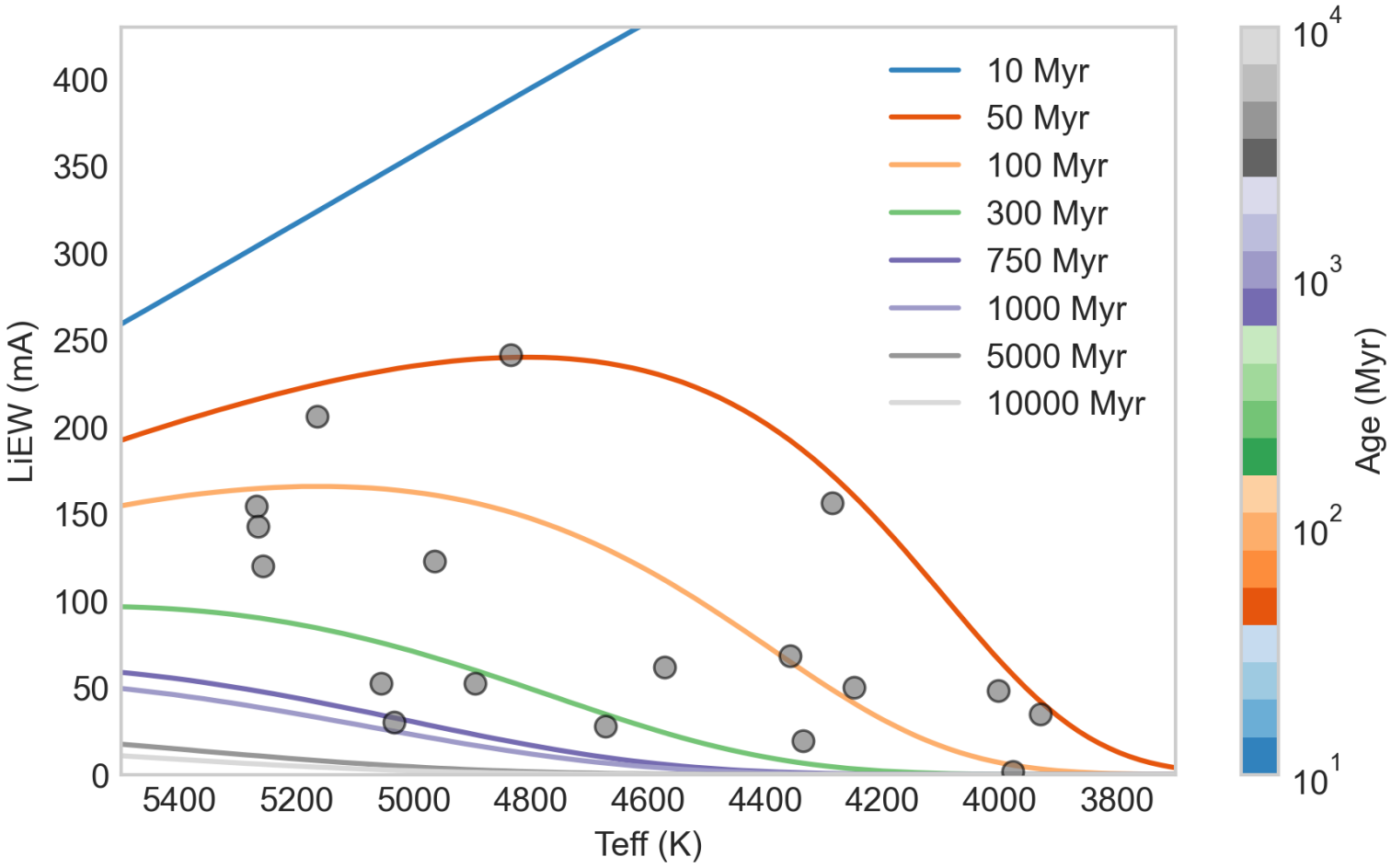


HD 13808



Methodology from: Kar et al. in prep

RKSTAR x EAGLES



Isochrones from Empirical AGes from Lithium Equivalent widthS (Jeffries et al. 2023)