The effect of stellar activity on the stellar parameters of the young solar twin HIP 36515

Jhon Yana Galarza, Jorge Meléndez, Diego Lorenzo-Oliveira, Adriana Valio, Marília Carlos, Geisa Ponte, Raphaëlle Haywood et al.

Universidade de São Paulo
Departamento de Astronomia do IAG/USP

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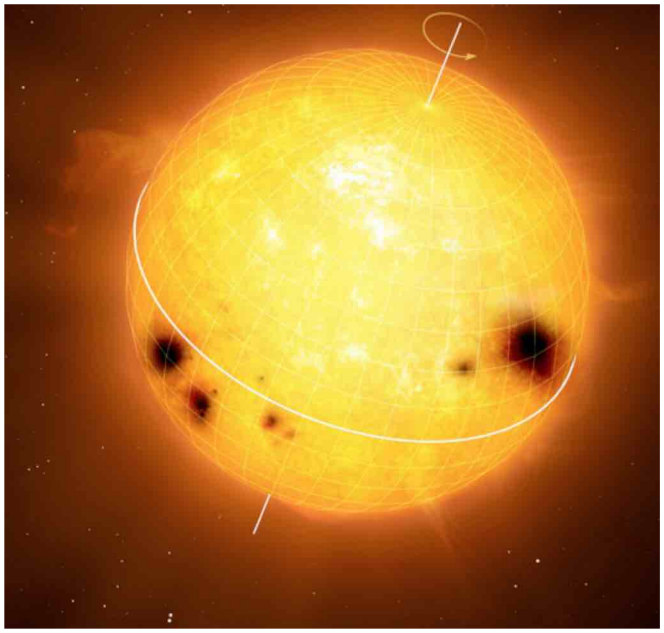
Mackenzie

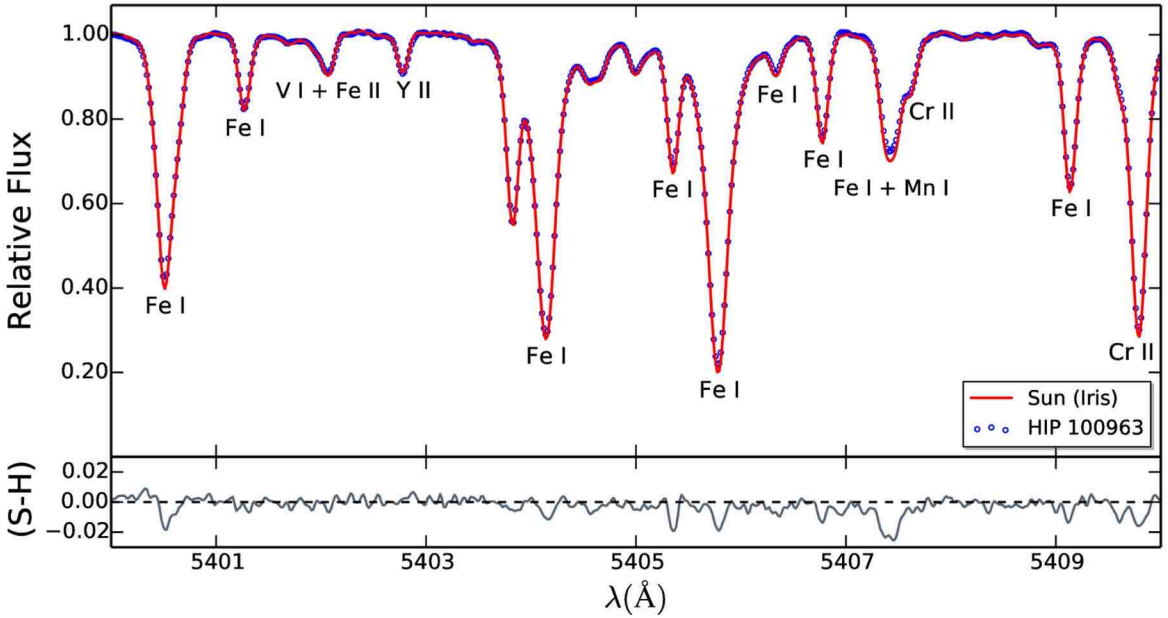
CNPq
Conselho Nacional de Desenvolvimento Científico e Tecnológico

SAMPA
Stellar Atmospheres, Planets and Abundances

Stellar Activity

Stellar activity





Indirect effects

↓

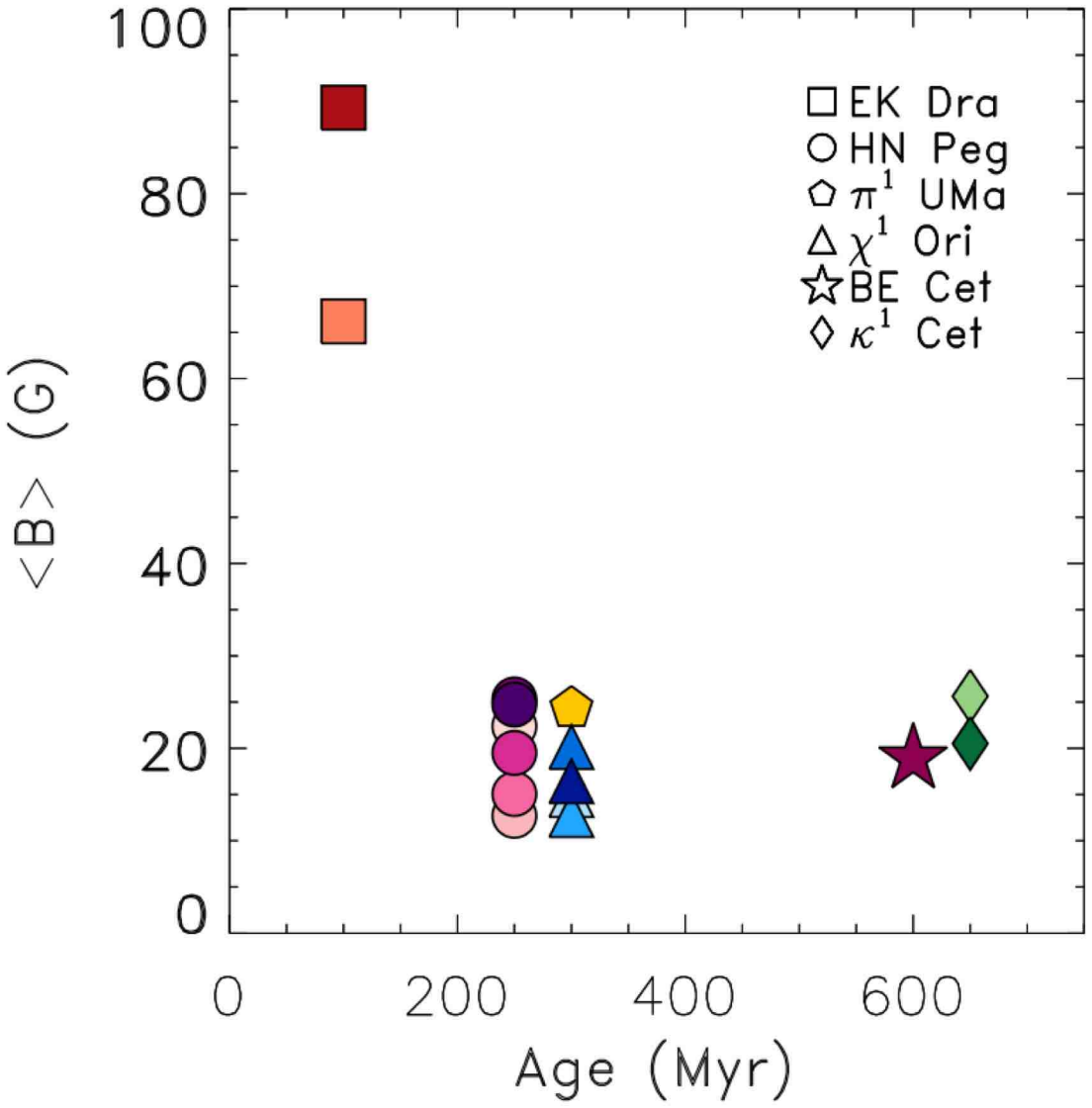
Forces on the stellar plasma

Direct effects

↓

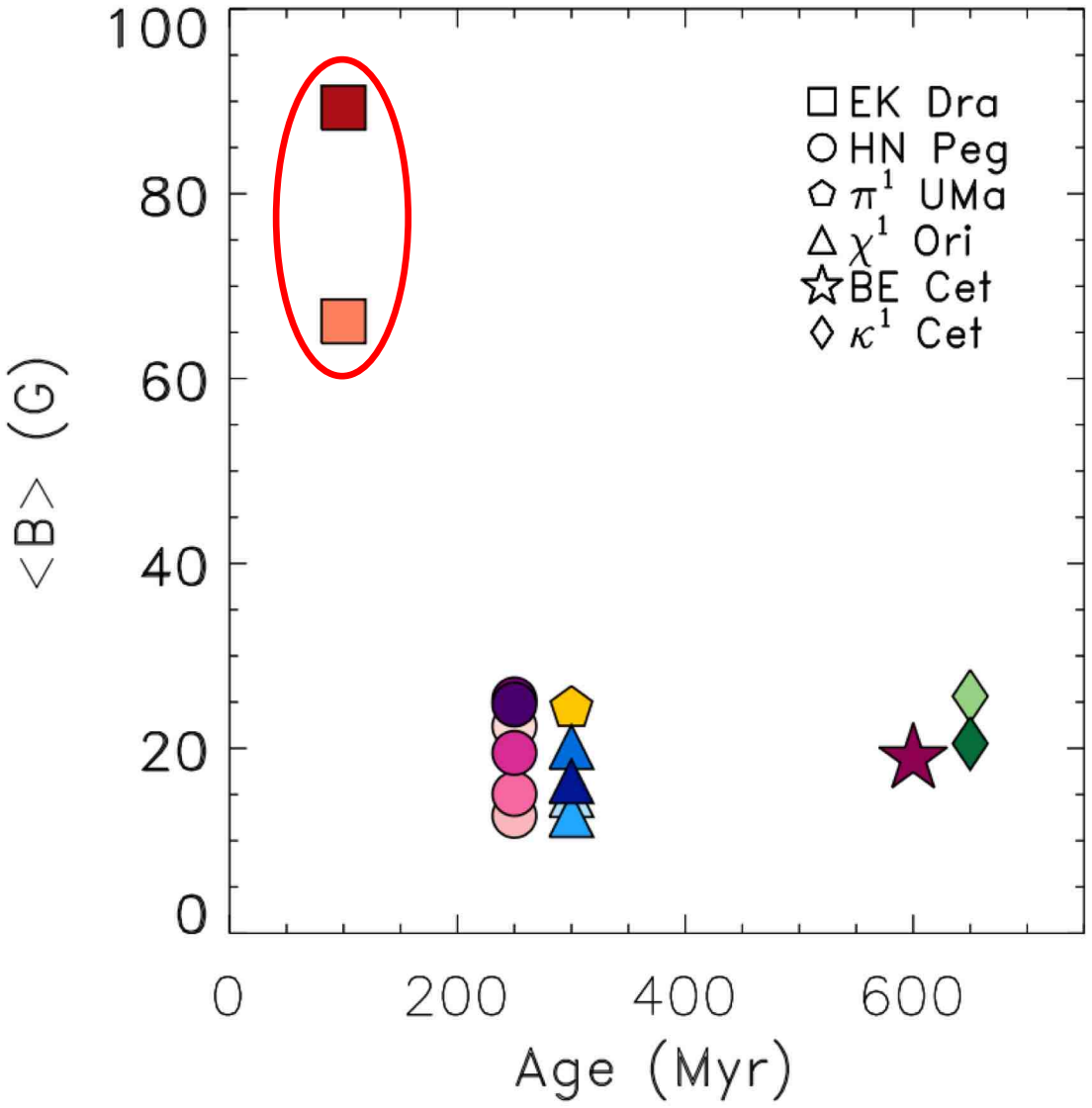
Magnetic broadening lines

Stellar activity



Rosén et al. (2016)

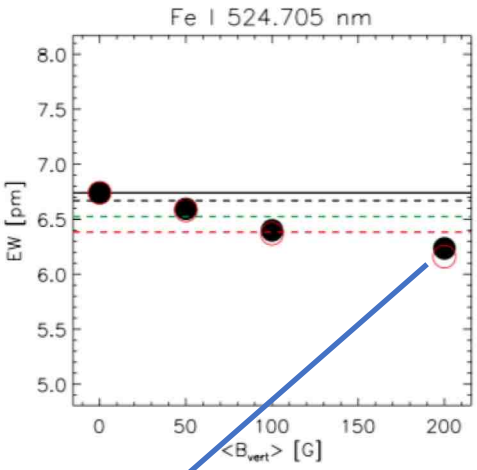
Stellar activity

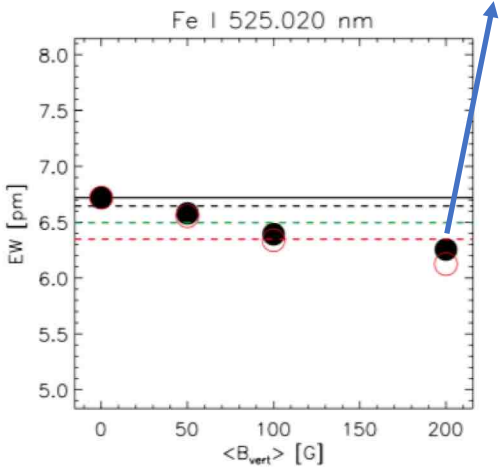


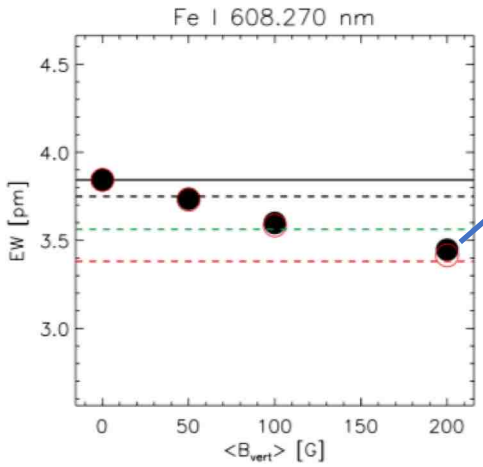
Rosén et al. (2016)

Stellar activity

Correction of 0.012 dex

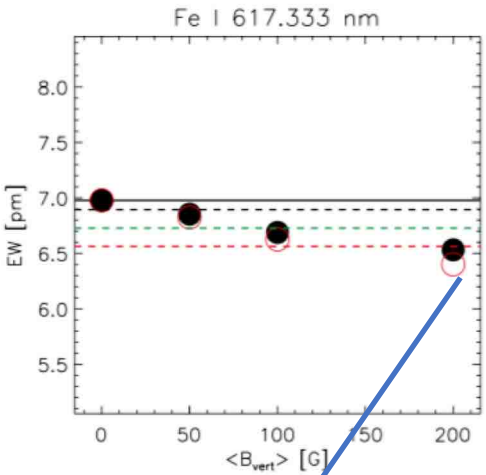


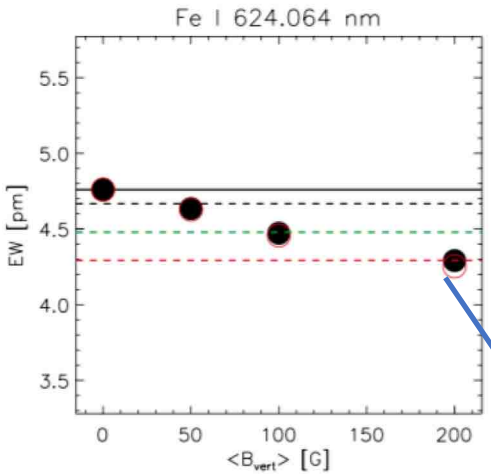




Correction of 0.08 dex

Correction of 0.014 dex





3D radiation-magnetohydrodynamics (MHD) simulations.

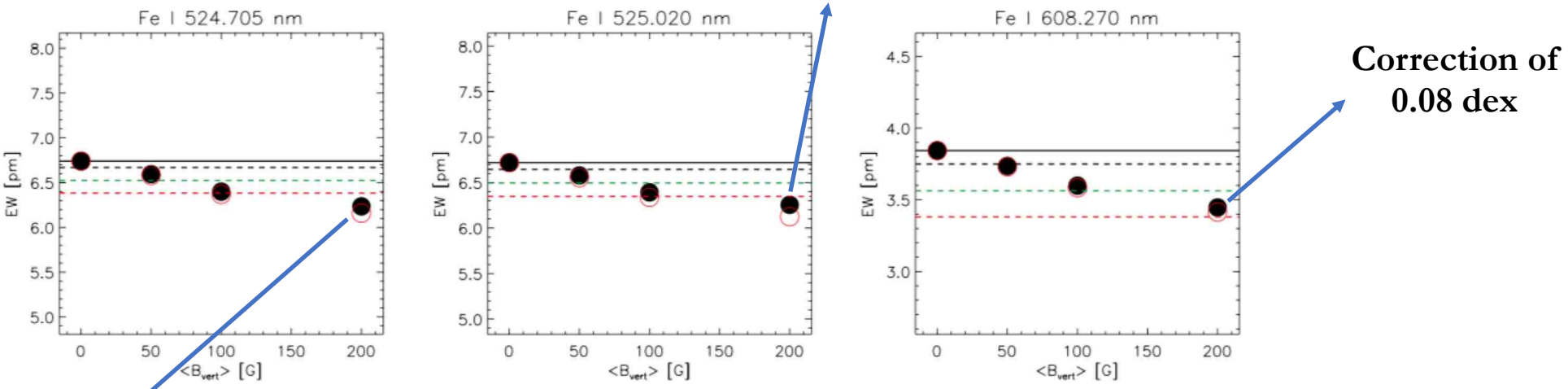
Fabbian et al. (2016)

Correction of 0.011 dex

Correction of 0.010 dex

Stellar activity

Correction of 0.012 dex



Correction of 0.08 dex

Correction of 0.014 dex

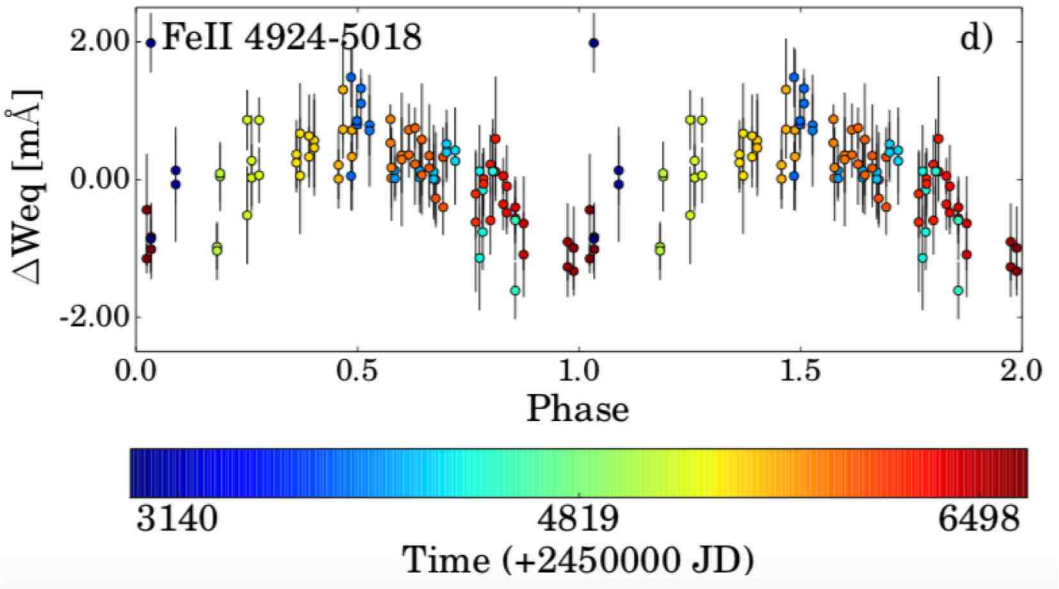
$$\sigma(T_{\rm eff}) = 5 \text{ K}$$

$$\sigma([\text{Fe/H}]) = 0.008 \text{ dex}$$

$$\sigma(logg) = 0.01 \text{ dex}$$

Stellar activity

Flores et al. (2016)



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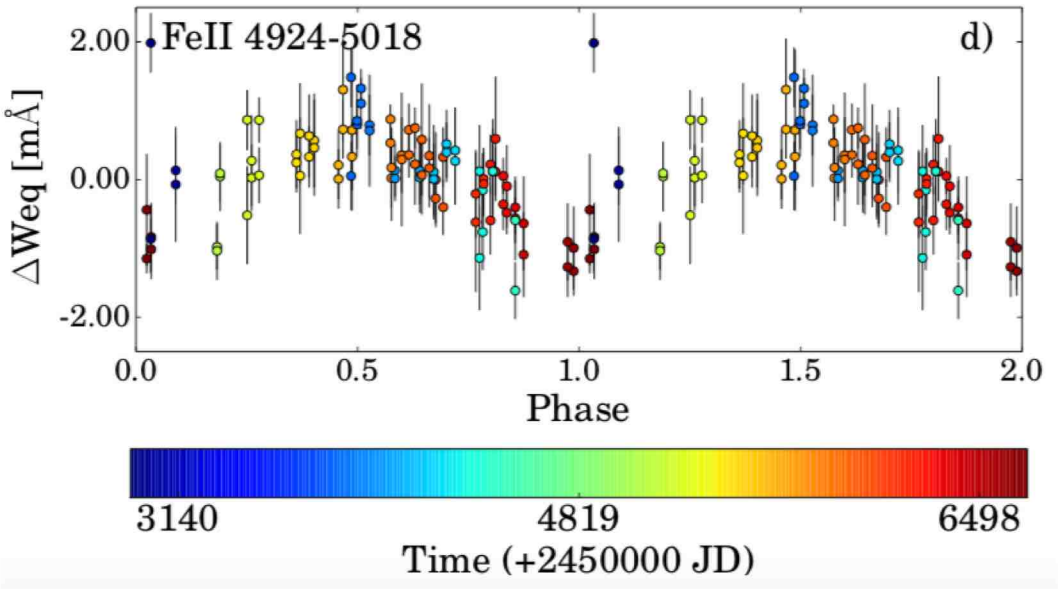
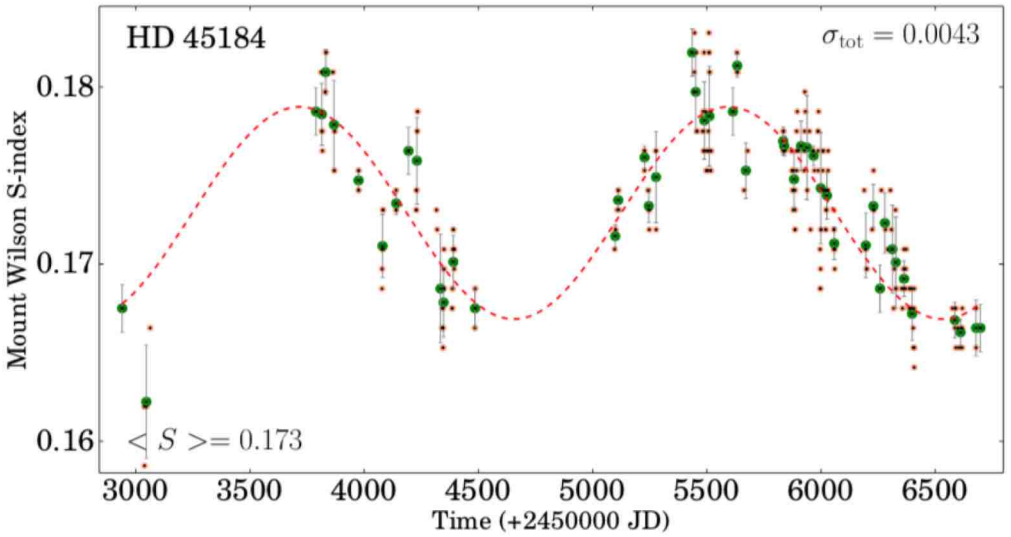
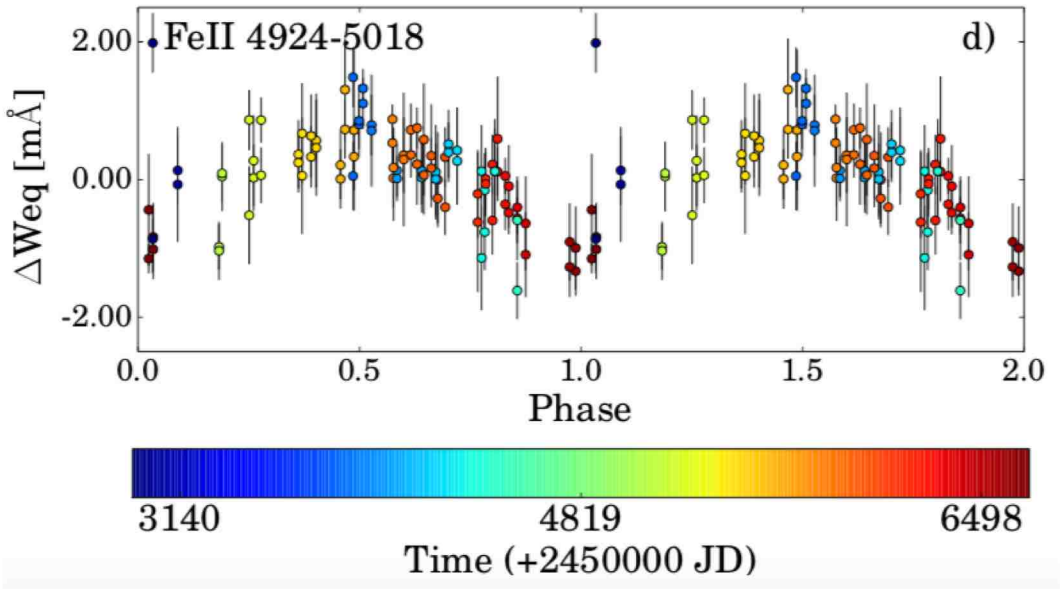
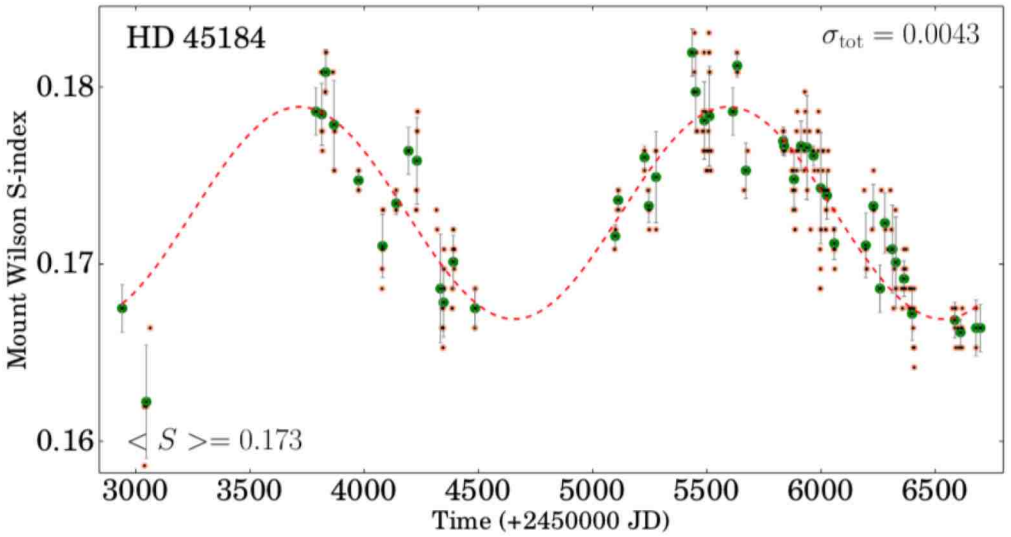




Stellar activity

Flores et al. (2016)





$$P = 1978 \pm 9 \text{ days}$$

$$< S >= 0.173$$

$$Age = 2.7 \pm 0.5 \text{ Gyr}$$

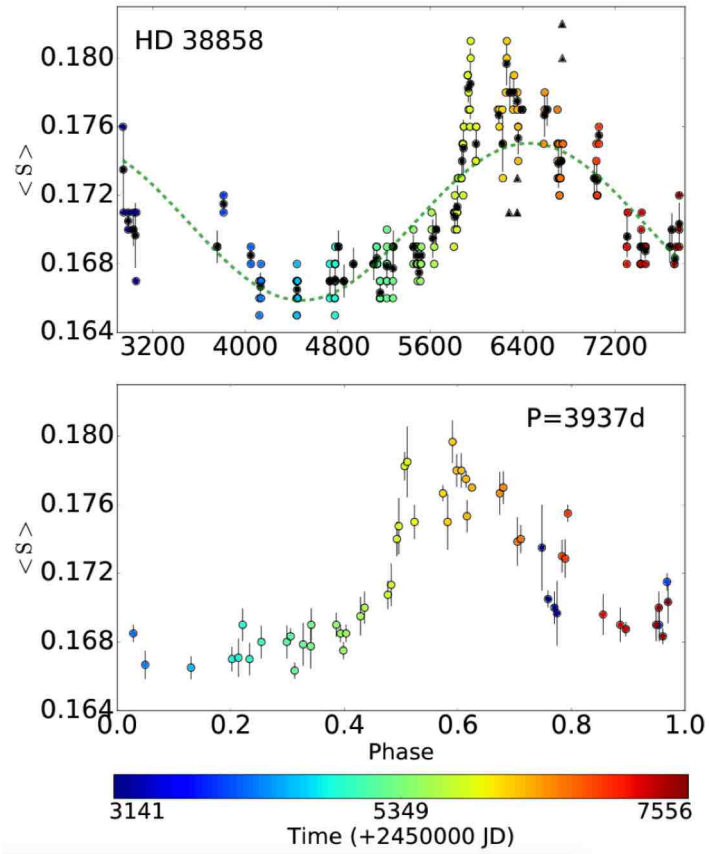
$$T_{eff} = 5871 \pm 6 \text{ K}$$

$$\log g = 4.445 \pm 0.012 \text{ dex}$$

$$[\text{Fe/H}] = 0.047 \pm 0.006 \text{ dex}$$

Stellar activity

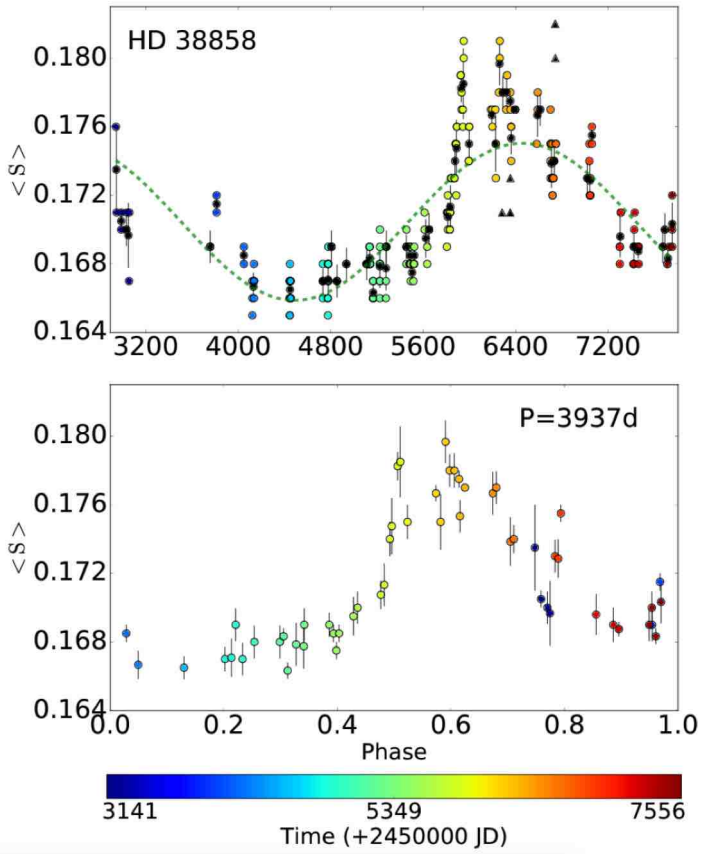
Flores et al. (2018)



$$\log R'_{\rm HK} = -4.94$$

Stellar activity

Flores et al. (2018)



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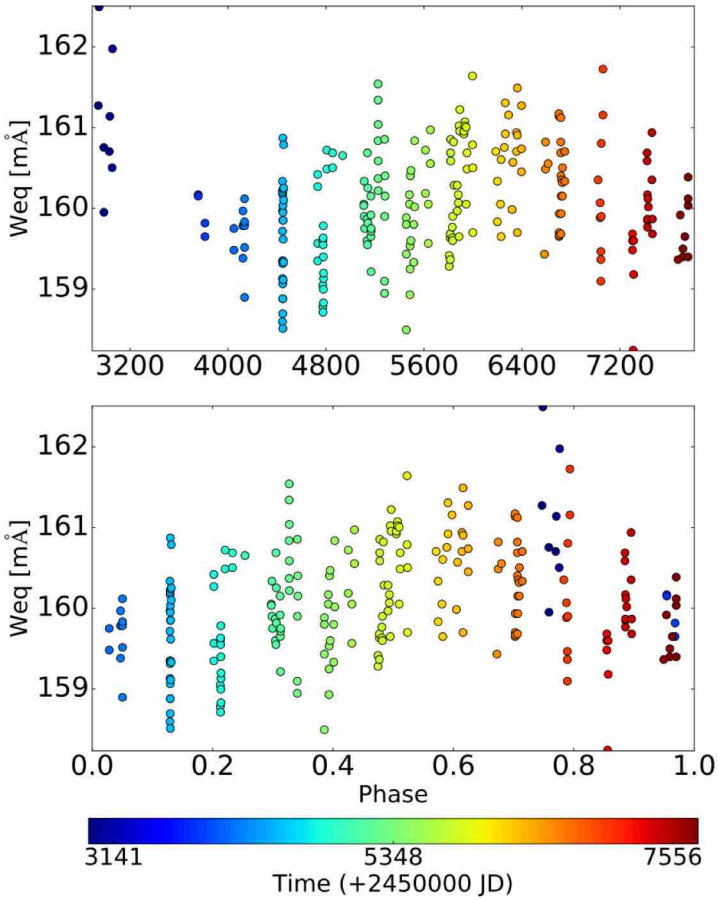
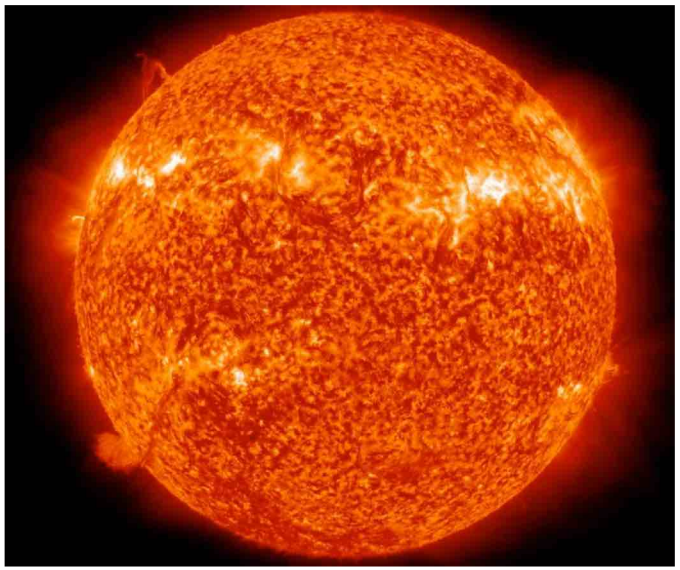


EW variation of the Fe II 501.8 nm line

Inconclusive studies!!

Stellar activity

HIP 36515



Stellar parameters very well defined!!!

$$T_{\rm eff} = 5855 \pm 12 \text{ K}$$

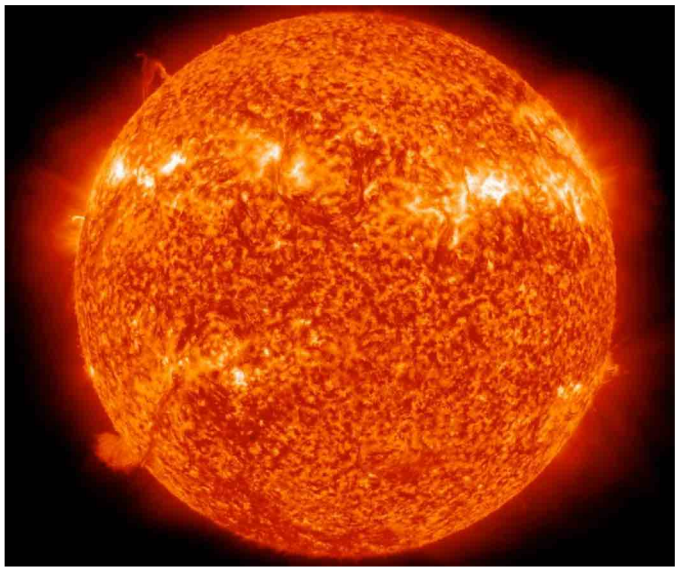
$$\log g = 4.555 \pm 0.023 \text{ dex}$$

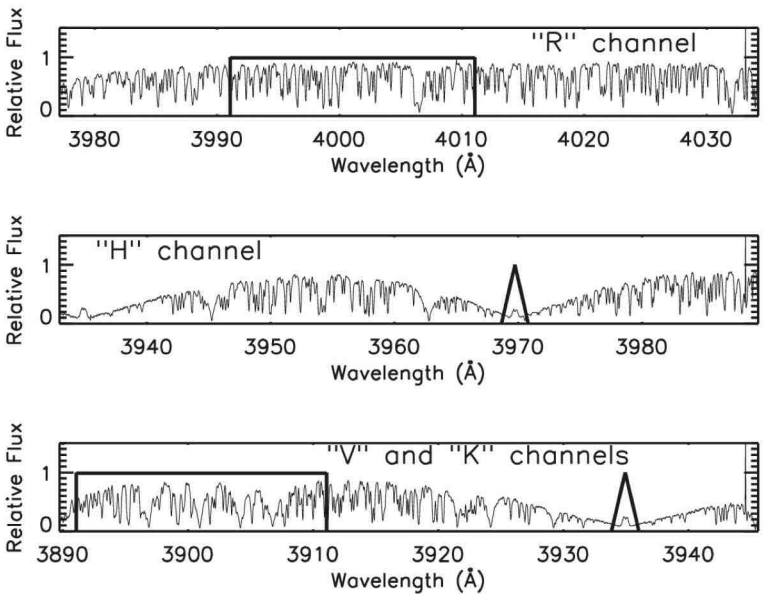
$$[\text{Fe/H}] = -0.029 \pm 0.009 \text{ dex}$$

$$\text{Age} = 0.5 \pm 0.3 \text{ Gyr}$$

Stellar activity

HIP 36515





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$${\rm Age} = 0.5 \pm 0.3 \ {\rm Gyr}$$

$$\langle S_{\rm HK} \rangle = 0.3270 \pm 0.0226$$

$$\log R'_{\rm HK}(T_{\rm eff}) = -4.420 \pm 0.031$$

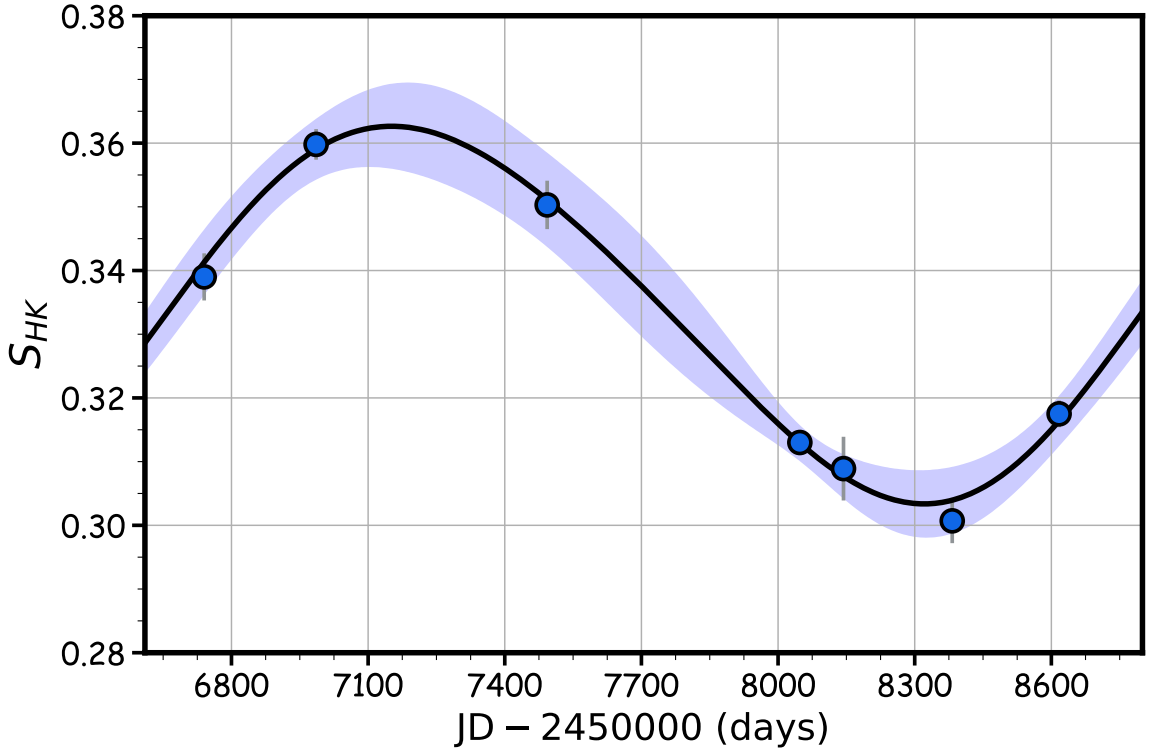
HIP 36515 is an active star

$$S_{{\rm MW}\odot} = 0.171$$

More details in
Lorenzo-Oliveira et al. (2018)

Stellar activity

Activity cycle of HIP 36515



$$\langle S_{\rm HK} \rangle = 0.3270 \pm 0.0226$$

$$P_{\rm cycle} = 6.2 \pm 2.3 \text{ years}$$

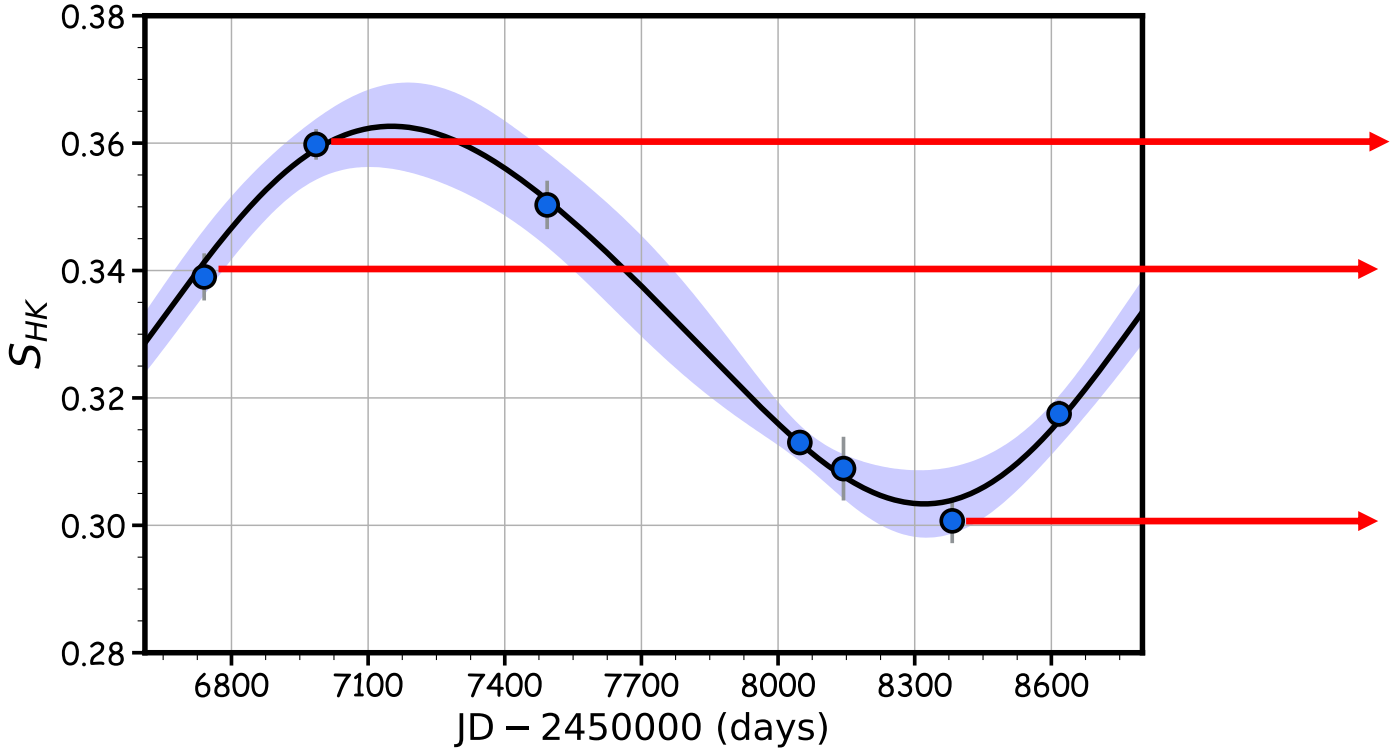
More information about the GP

Rasmussen & Williams 2006

Ambikasaran et al. 2015

Stellar activity

Activity cycle of HIP 36515



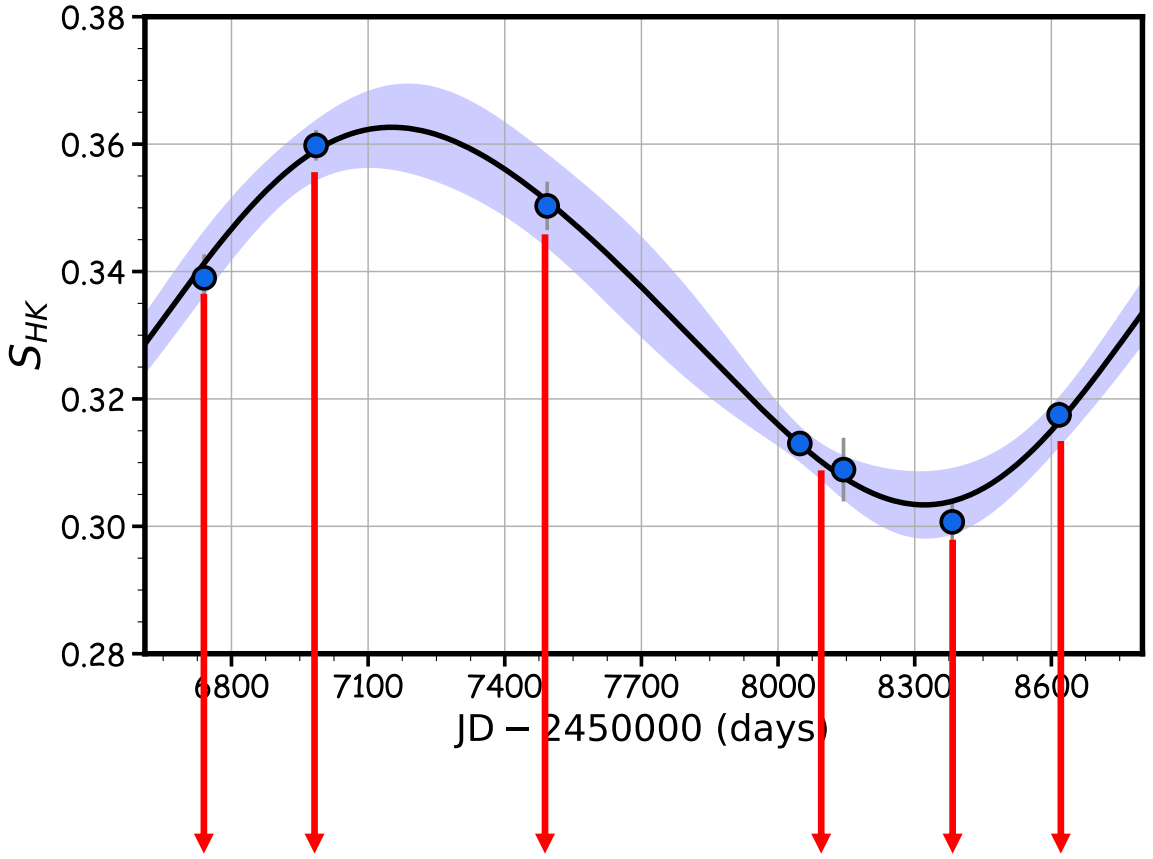
Maximum cycle

Intermedium cycle

Minimum cycle

Stellar activity

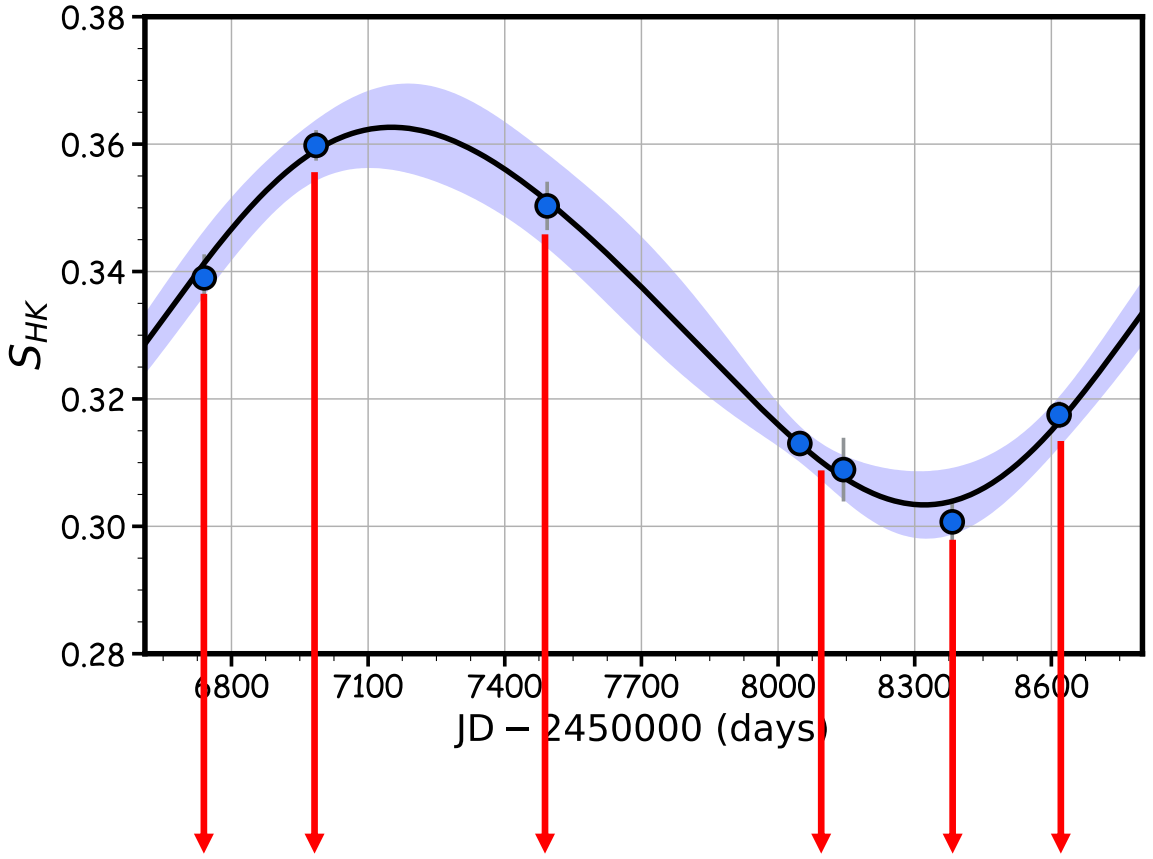
Activity cycle of HIP 36515

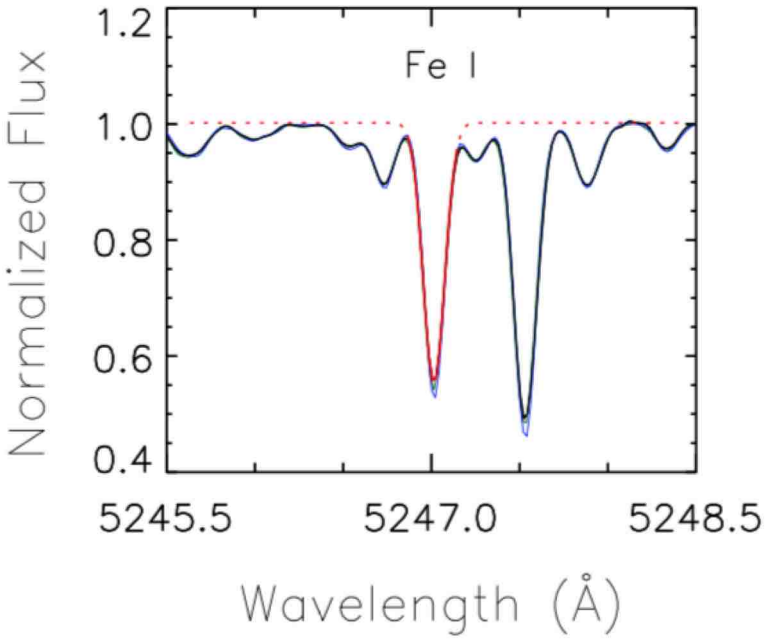


Equivalent widths (*EWs*) for different cycles

Stellar activity

Activity cycle of HIP 36515





Equivalent widths (*EWs*) for different cycles

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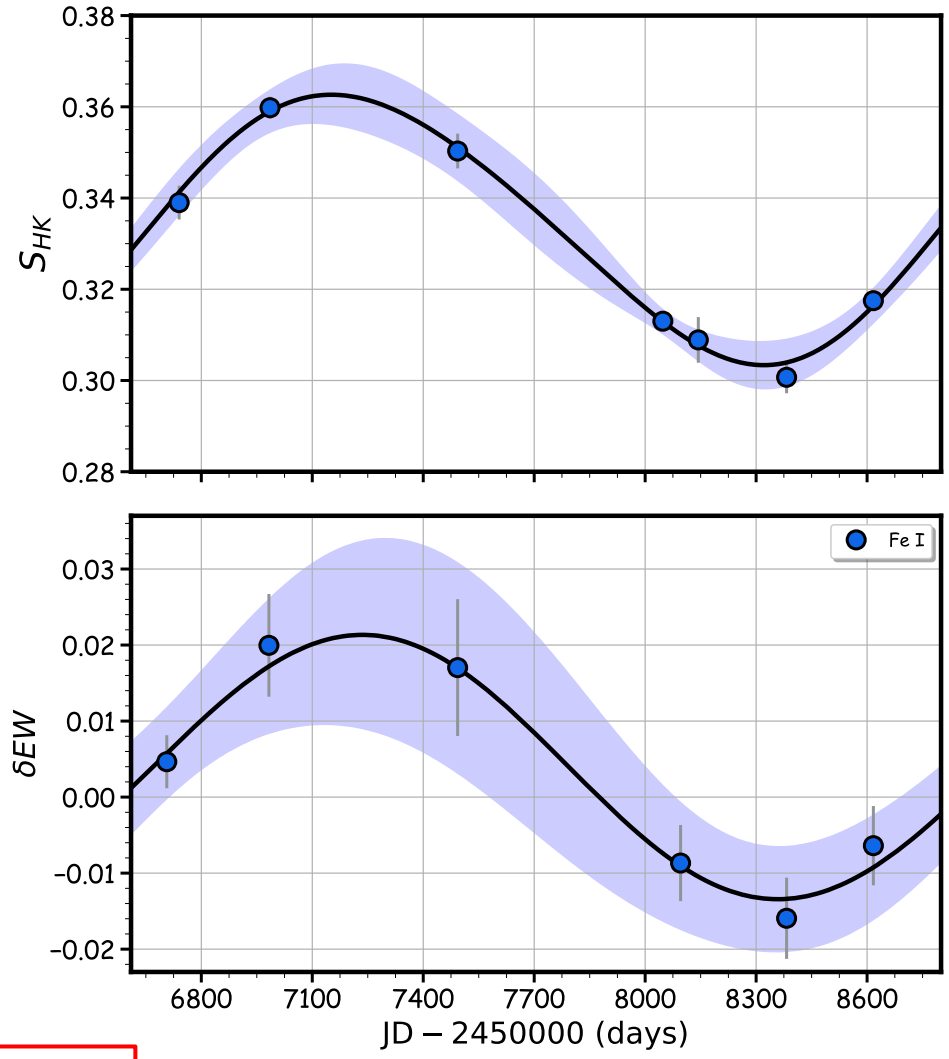
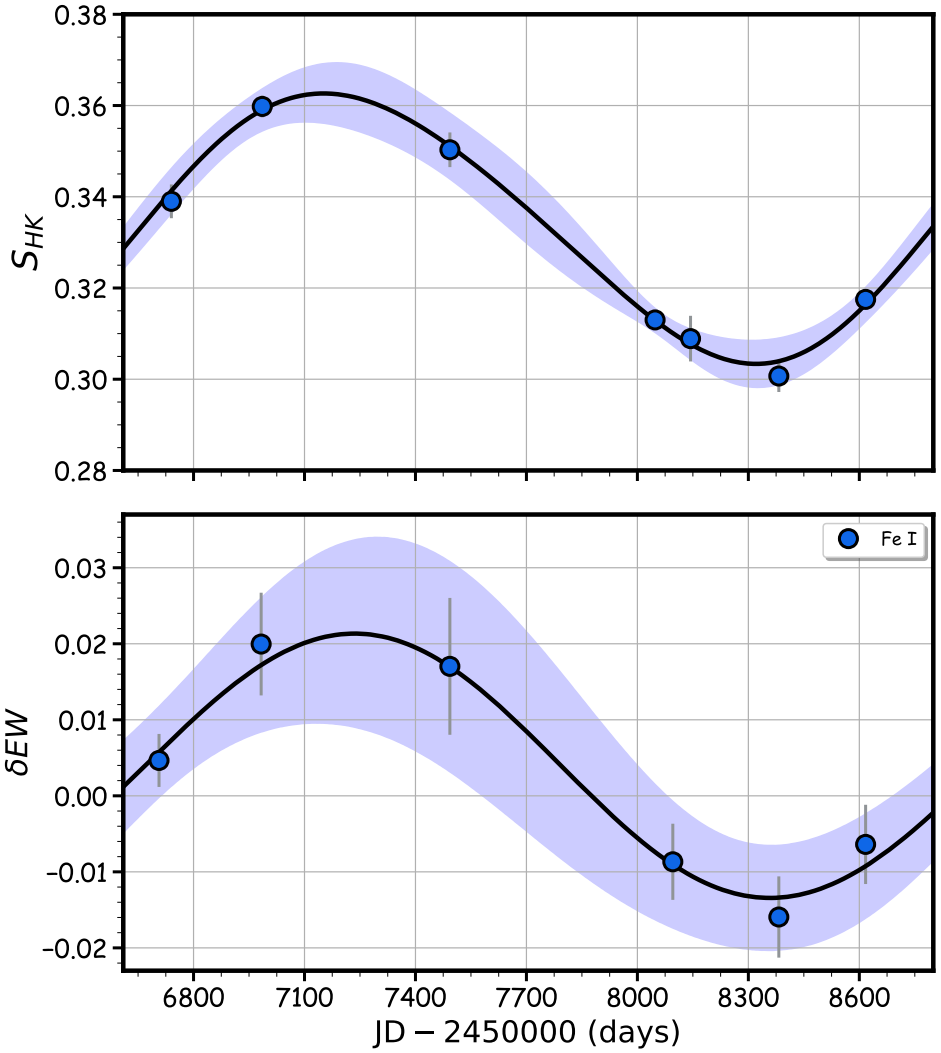
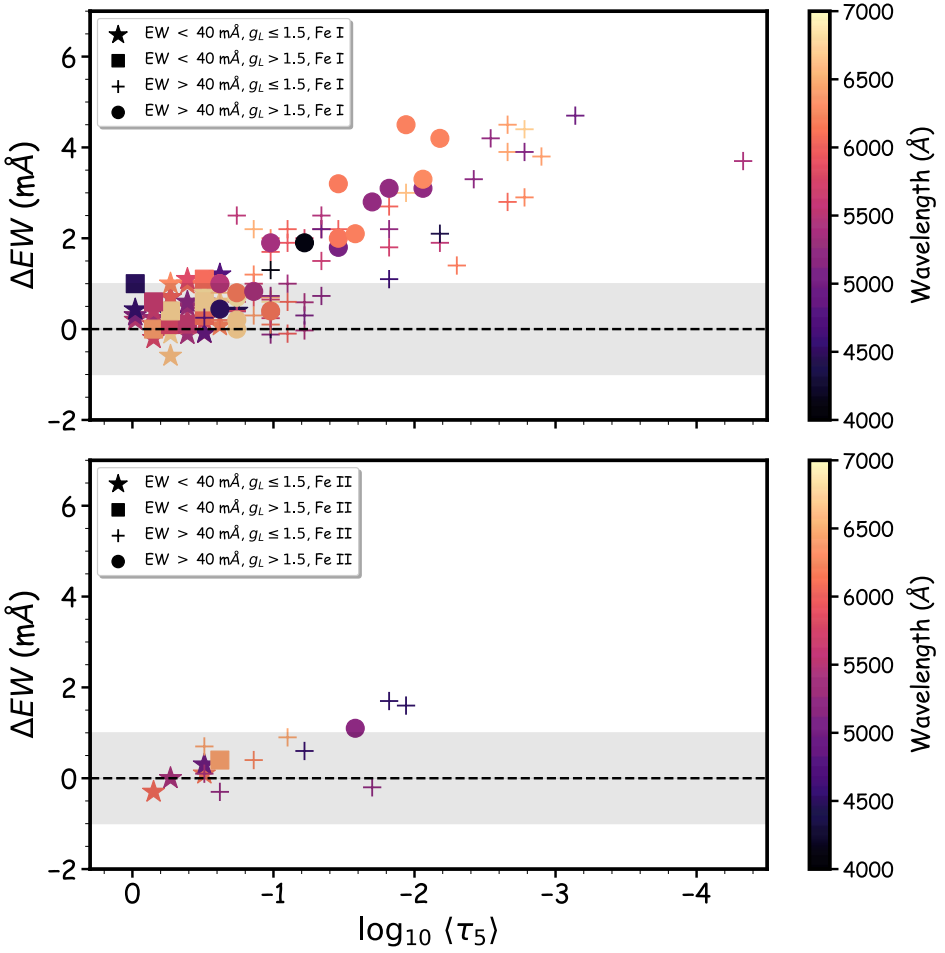


$$\delta EW = EW_{\lambda_{i,j}} / \langle EW \rangle_{\lambda_i} - 1$$

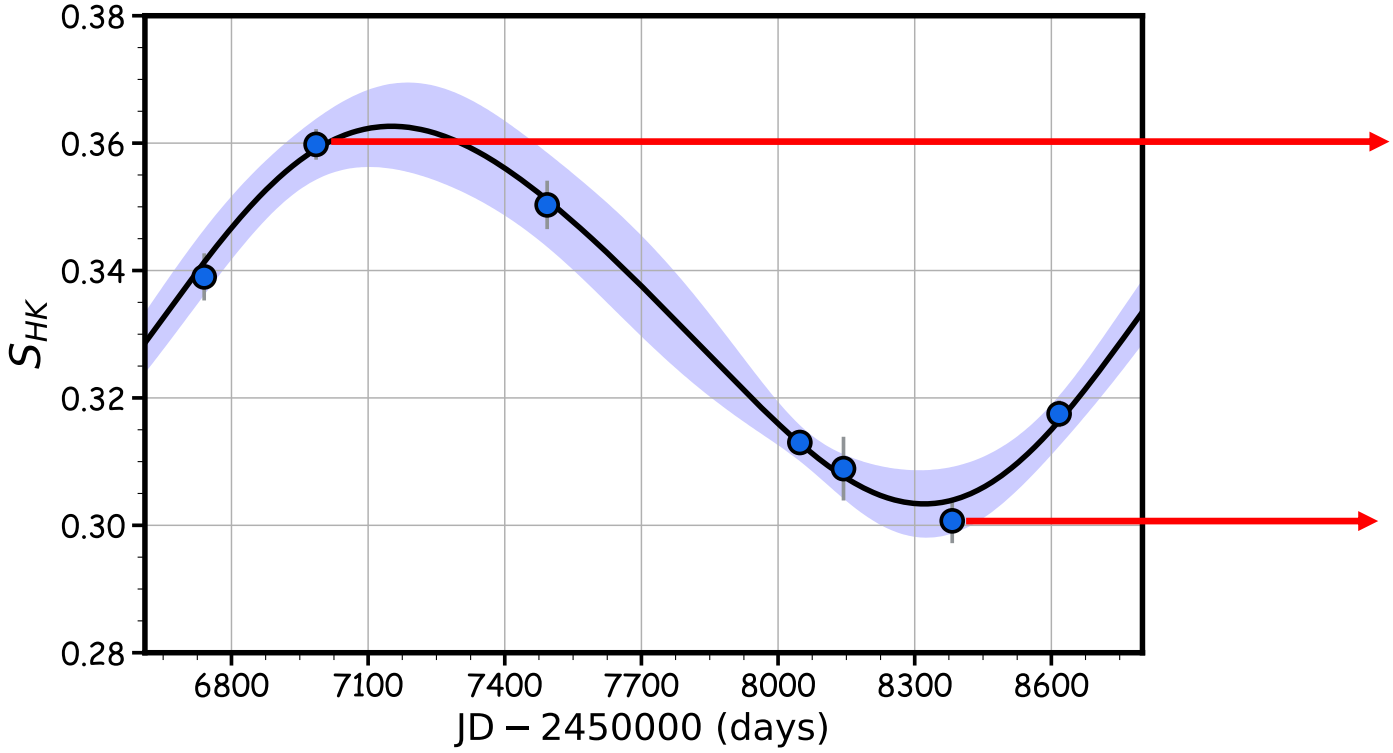
Equivalent widths (*EWs*) for different cycles





Stellar activity

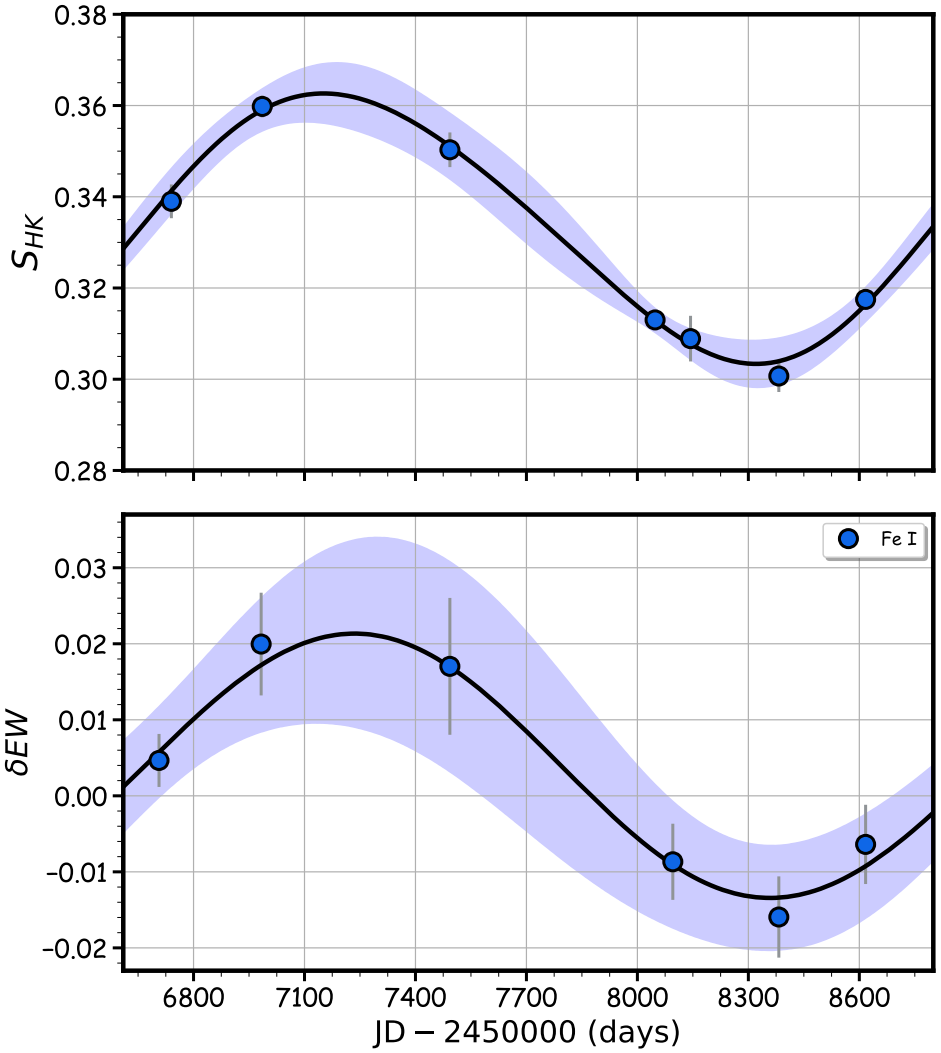
Activity cycle of HIP 36515

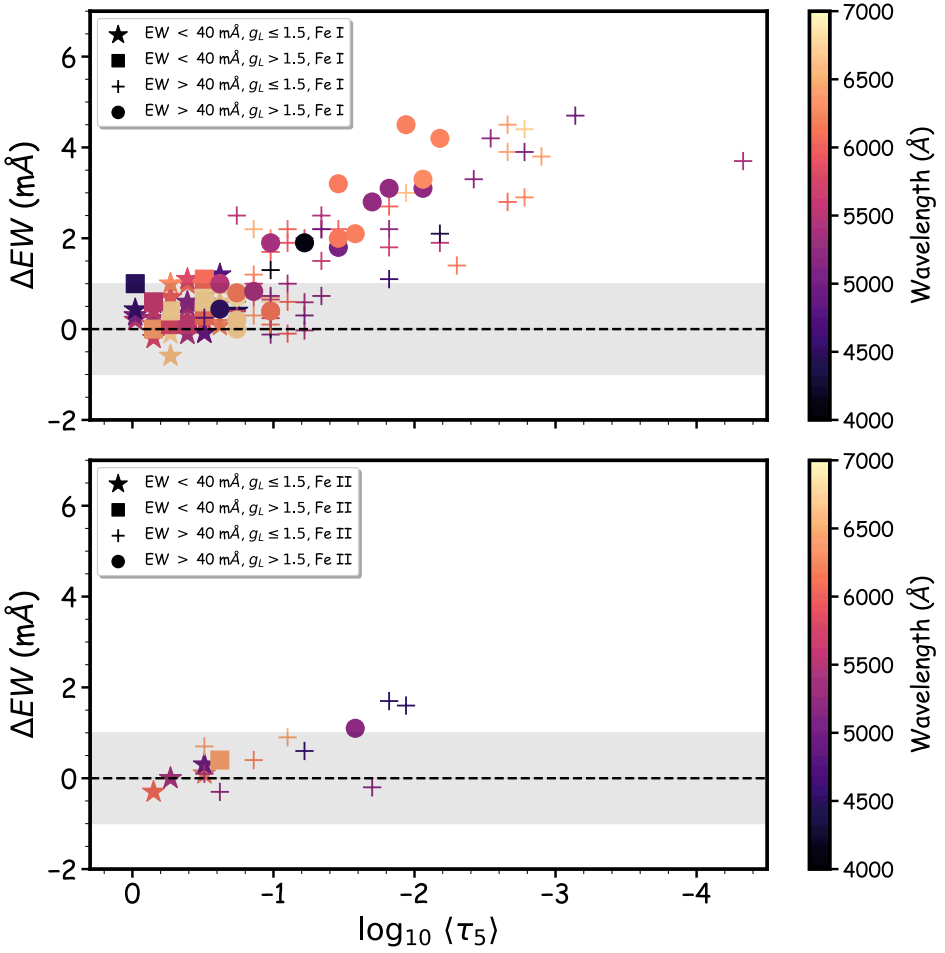


Maximum cycle

Minimum cycle

Equivalent widths (*EWs*) for different cycles





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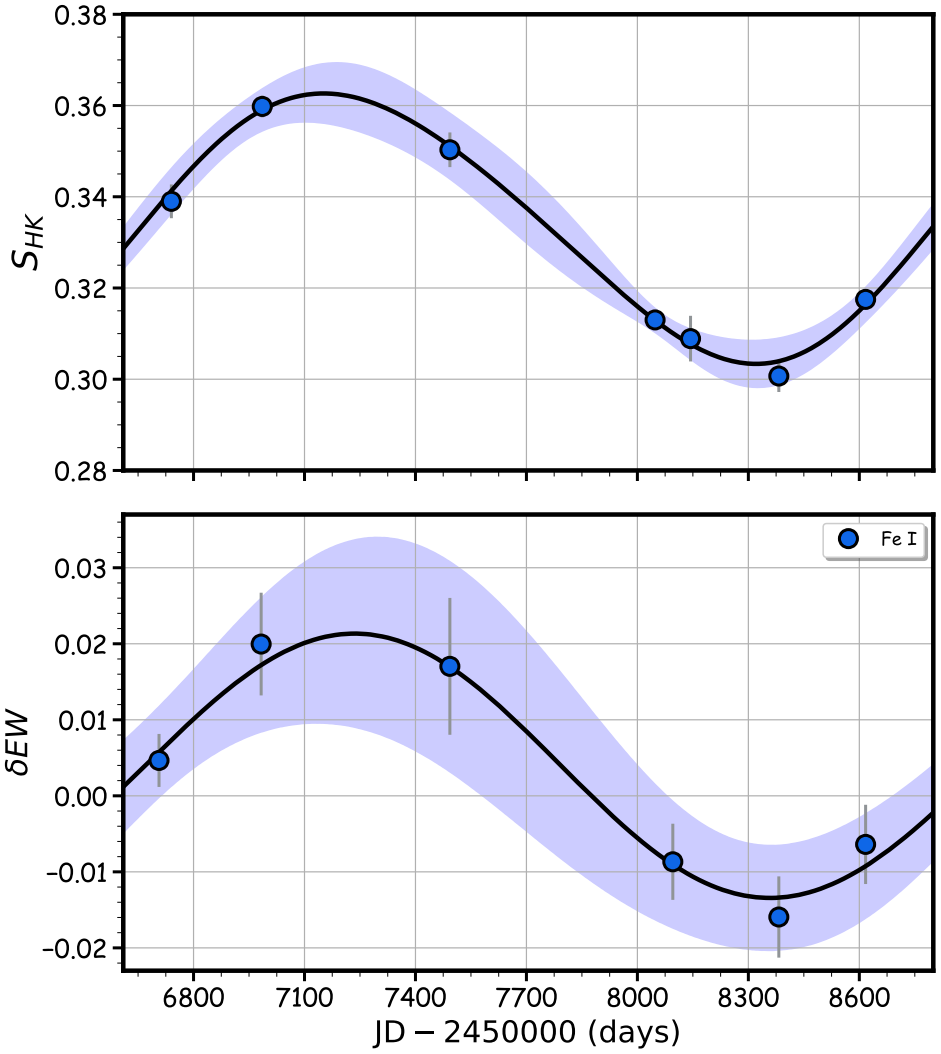
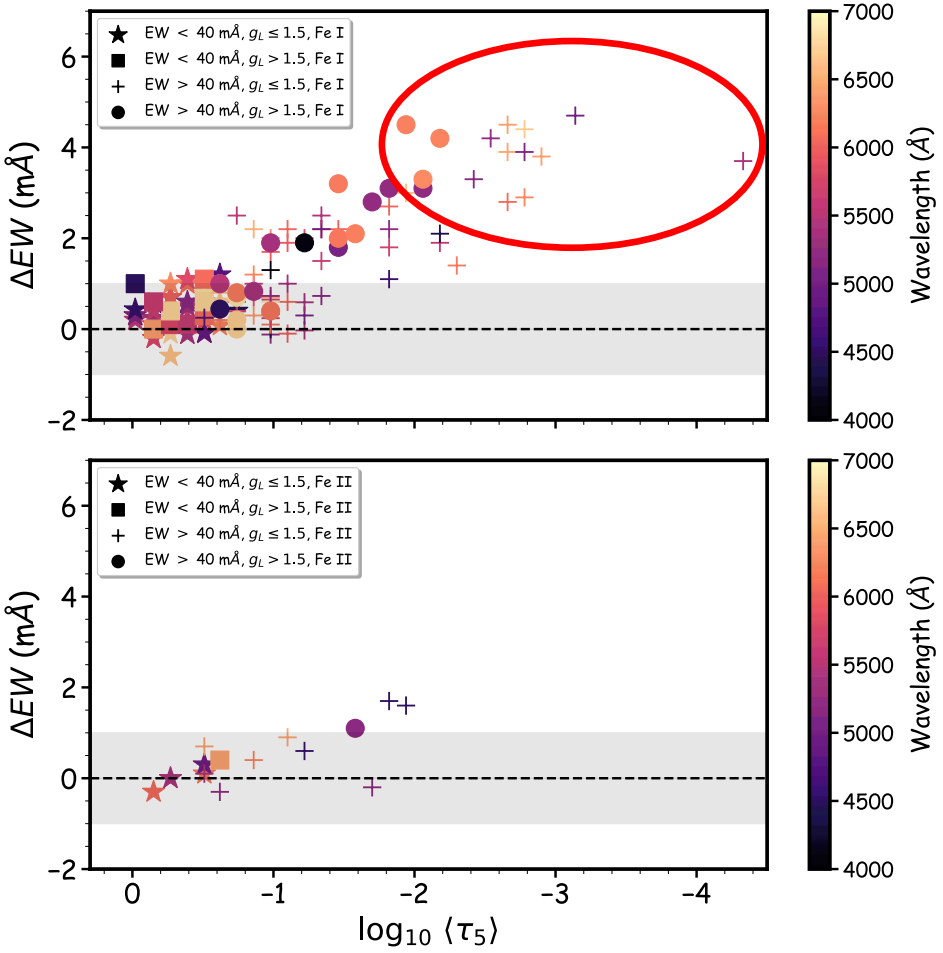
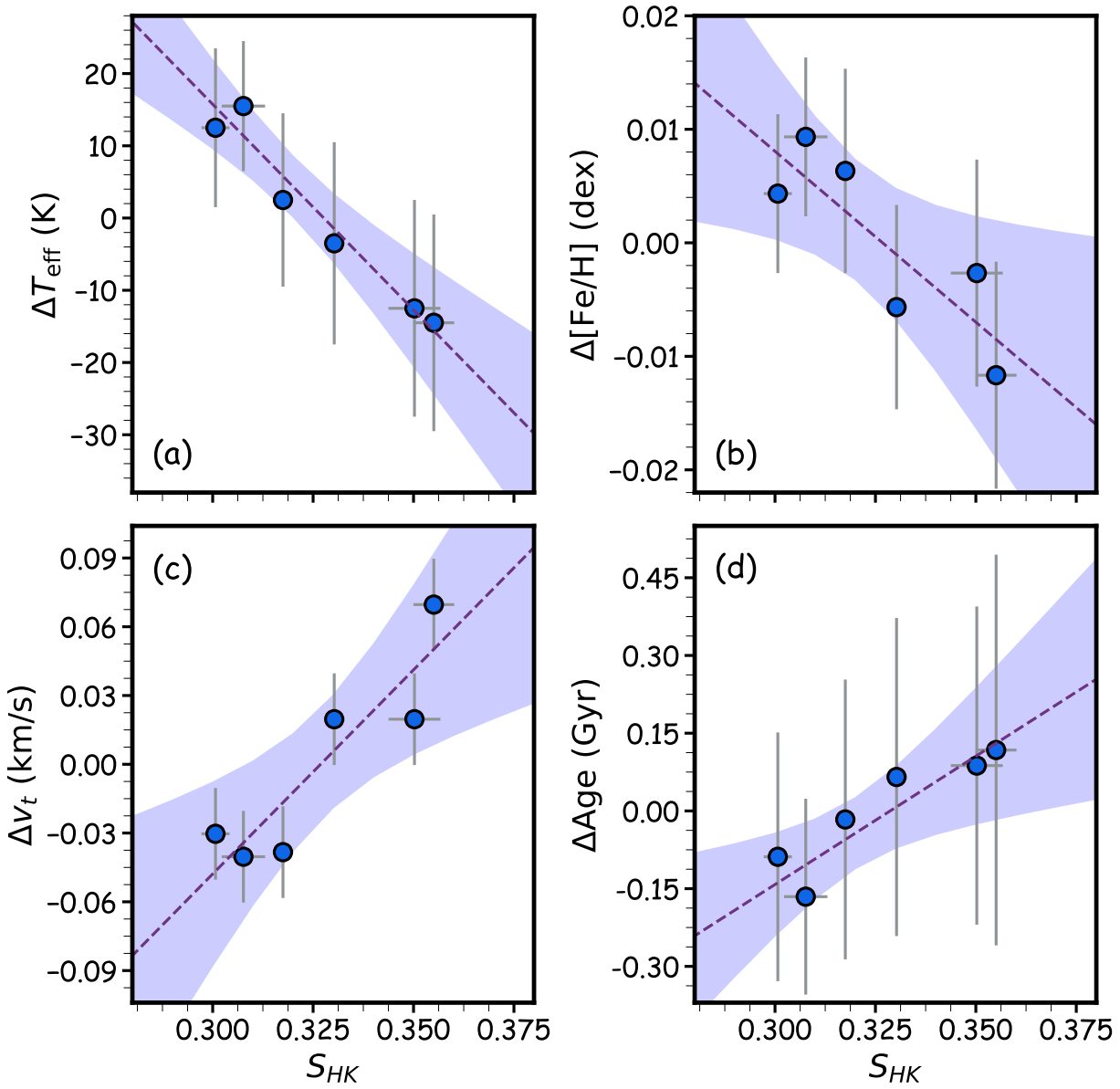
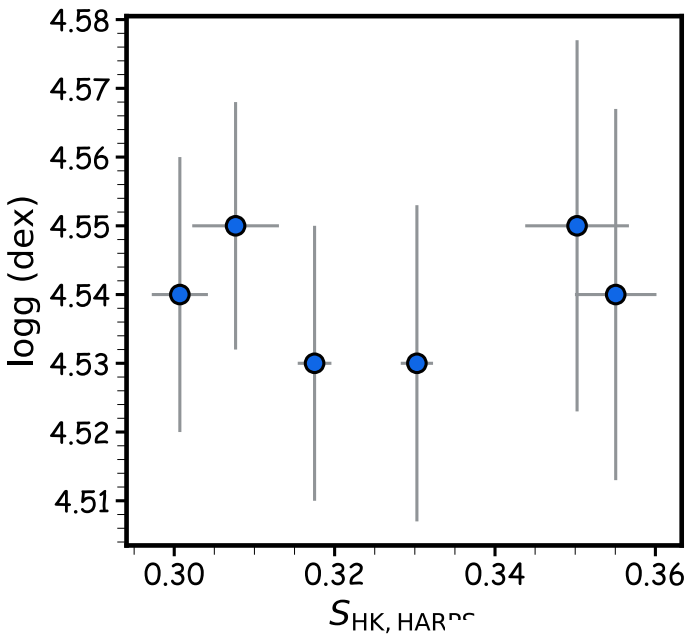


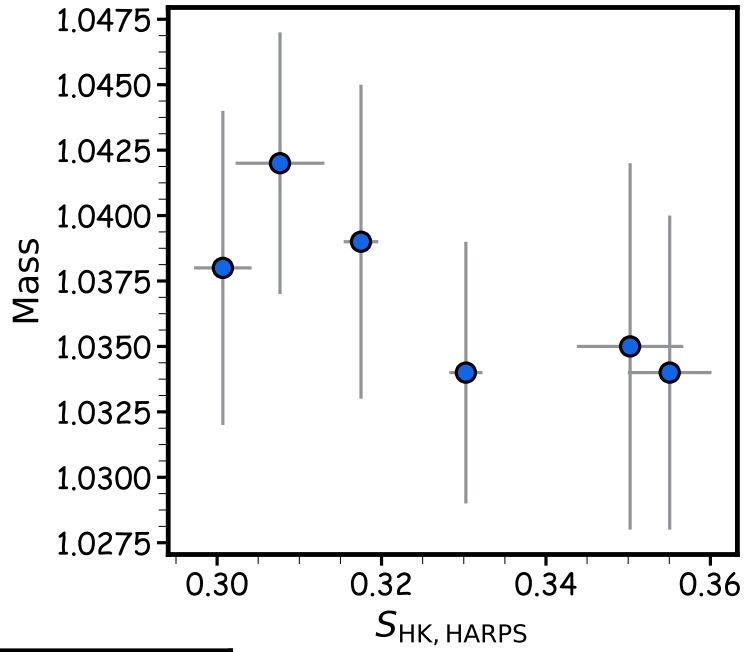


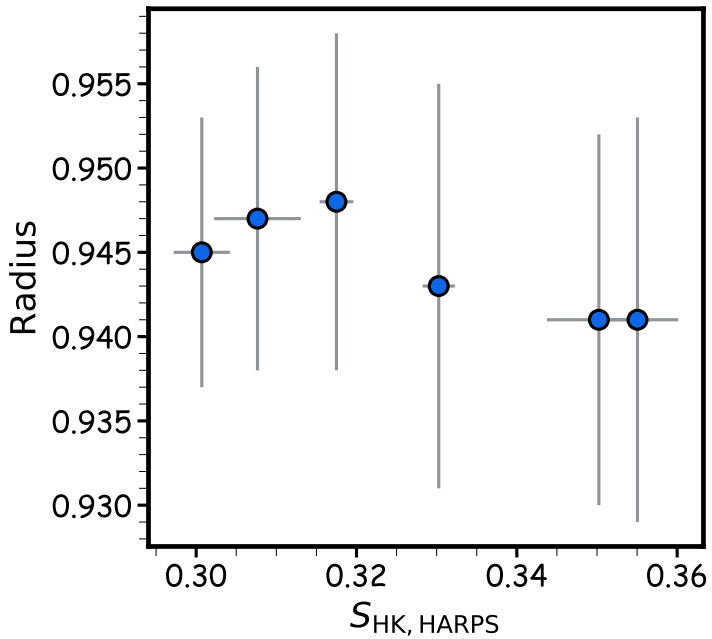
Stellar parameters



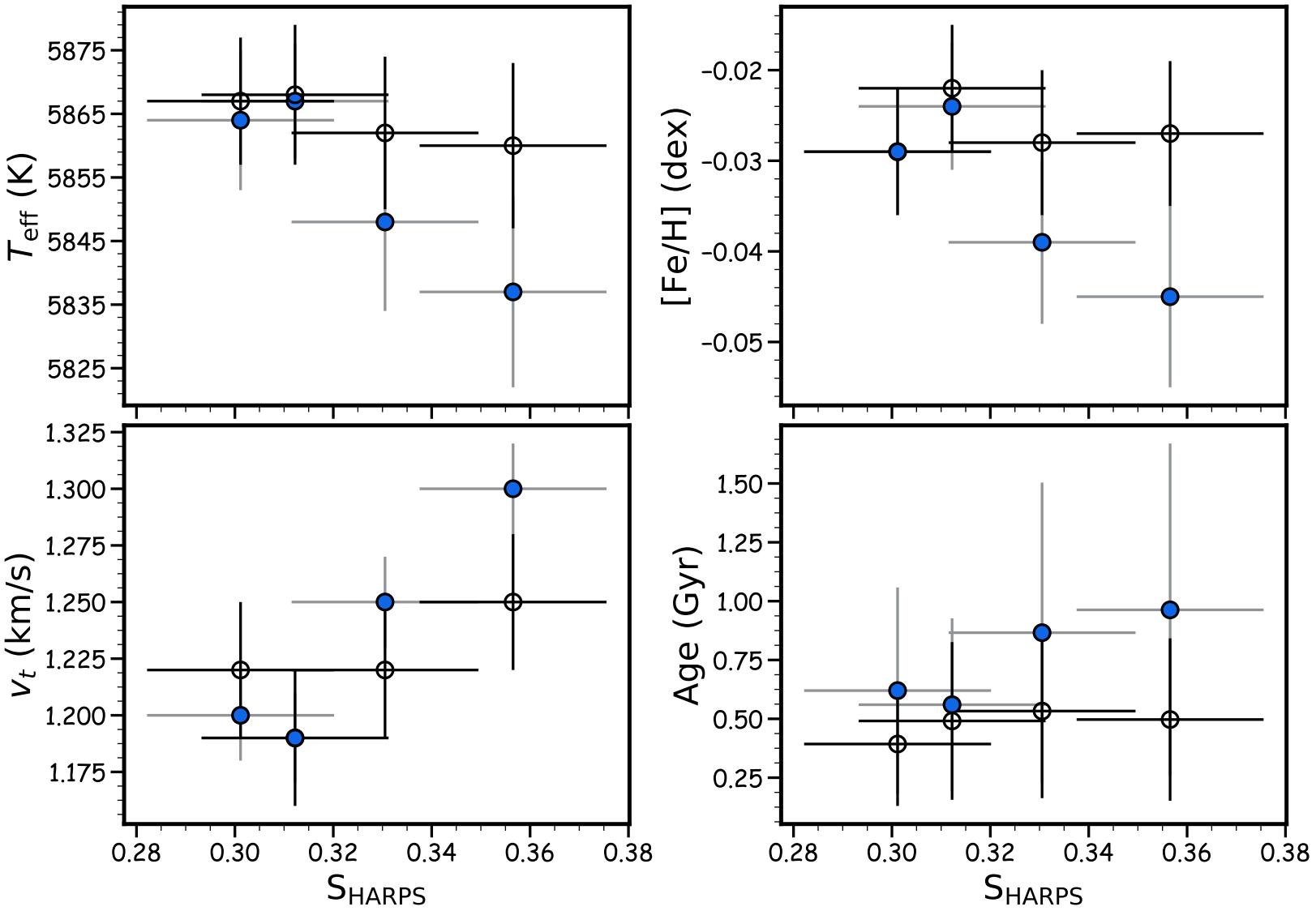
Stellar parameters







New line list

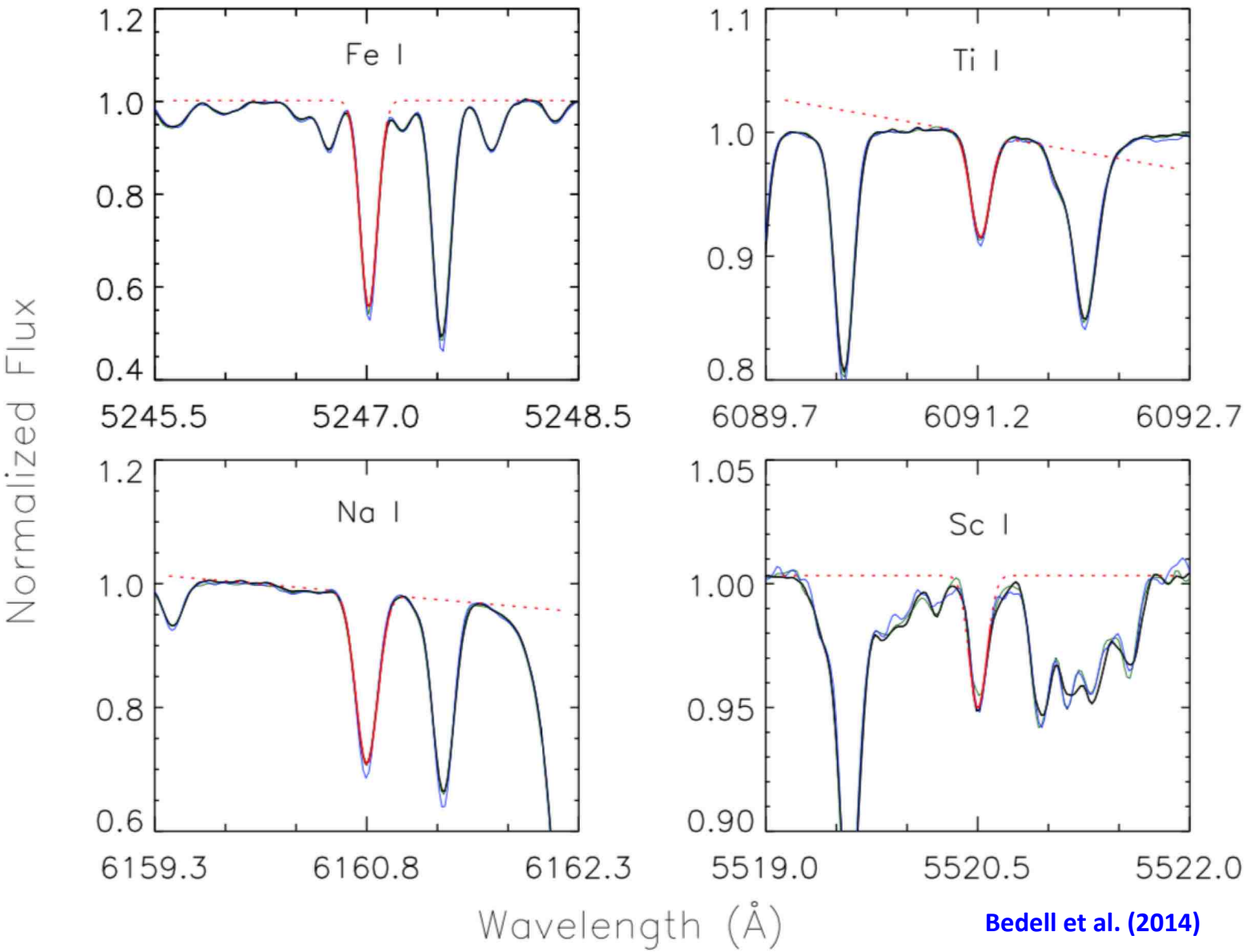


Thanks so much for your attention!!

Jhon Yana Galarza
ramstojh@usp.br

Diferencial abundances

Be carefull with the local pseudo-continuum



Bedell et al. (2014)

Age and mass

$$p \propto \exp[-(T_{eff} - T)^2/2\sigma(T_{eff})^2]$$
$$\times \exp[-(\log g - \log G)^2/2\sigma(\log g)^2]$$
$$\times \exp[-([\mathrm{Fe/H}] - [\mathrm{M/H}])^2/2\sigma([\mathrm{Fe/H}])^2]$$

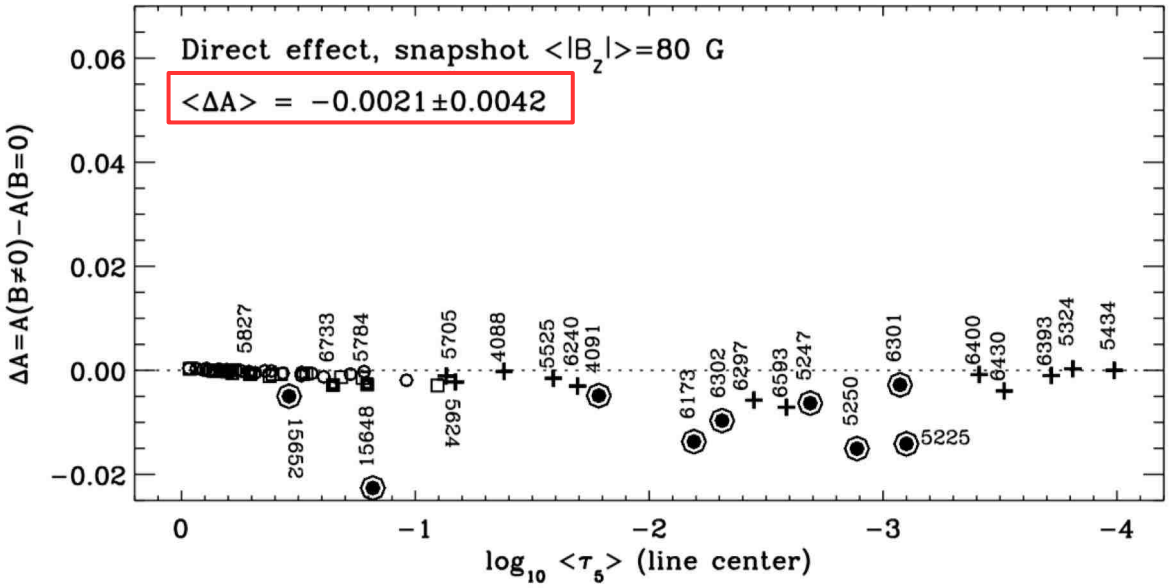
$$p[\log g\ \Lambda\ M_V] \propto \exp[-(T_{eff} - T)^2/2\sigma(T_{eff})^2]$$
$$\times \exp[-(\log g - \log G)^2/2\sigma(\log g)^2]$$
$$\times \exp[-([\mathrm{Fe/H}] - [\mathrm{M/H}])^2/2\sigma([\mathrm{Fe/H}])^2]$$
$$\times \exp[-(M_V - V)^2/2\sigma(M_V)^2]$$

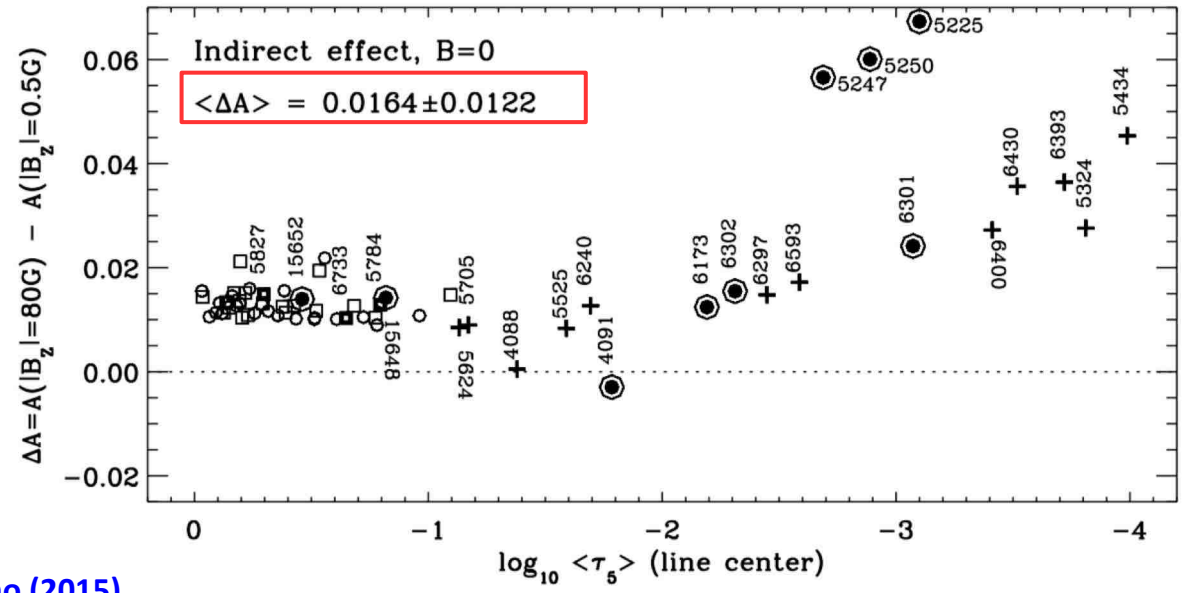
New probability distribution!!

Spina et al. (2018)

Stellar activity

Magneto-convection simulations with small-scale dynamo action (Rempel 2014)





Shchukina and Trujillo Bueno (2015)

Stellar activity

Atividade cromosférica

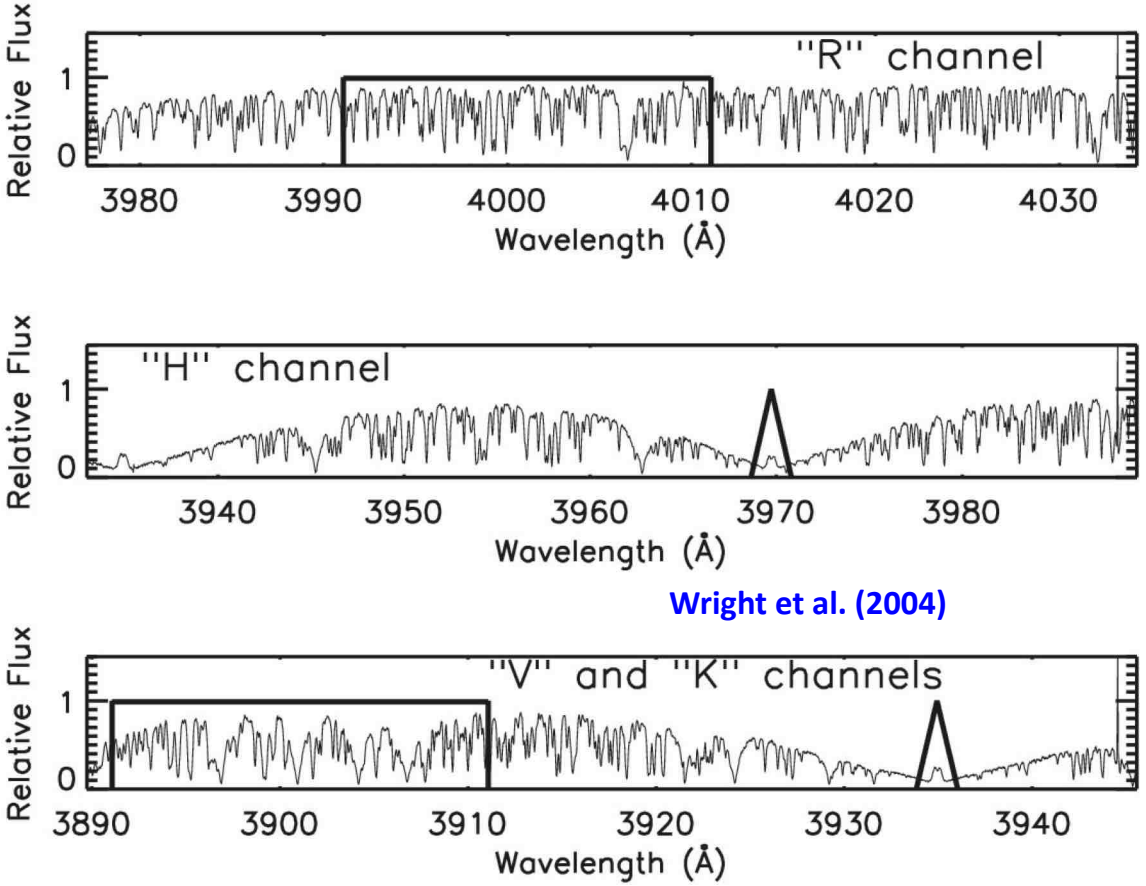
$$S = \alpha \left(\frac{H+K}{R+V} \right)$$

Wilson (1978)

Transformar o índice *S* em fluxo usando calibrações (B-V)

$$0.44 < B - V < 0.90$$

$$R_{HK} = 1.340 \times 10^{-4} C_{cf} S$$



Wright et al. (2004)

$$C_{cf} = 1.13(B-V)^3 - 3.91(B-V)^2 + 2.84(B-V) - 0.47$$

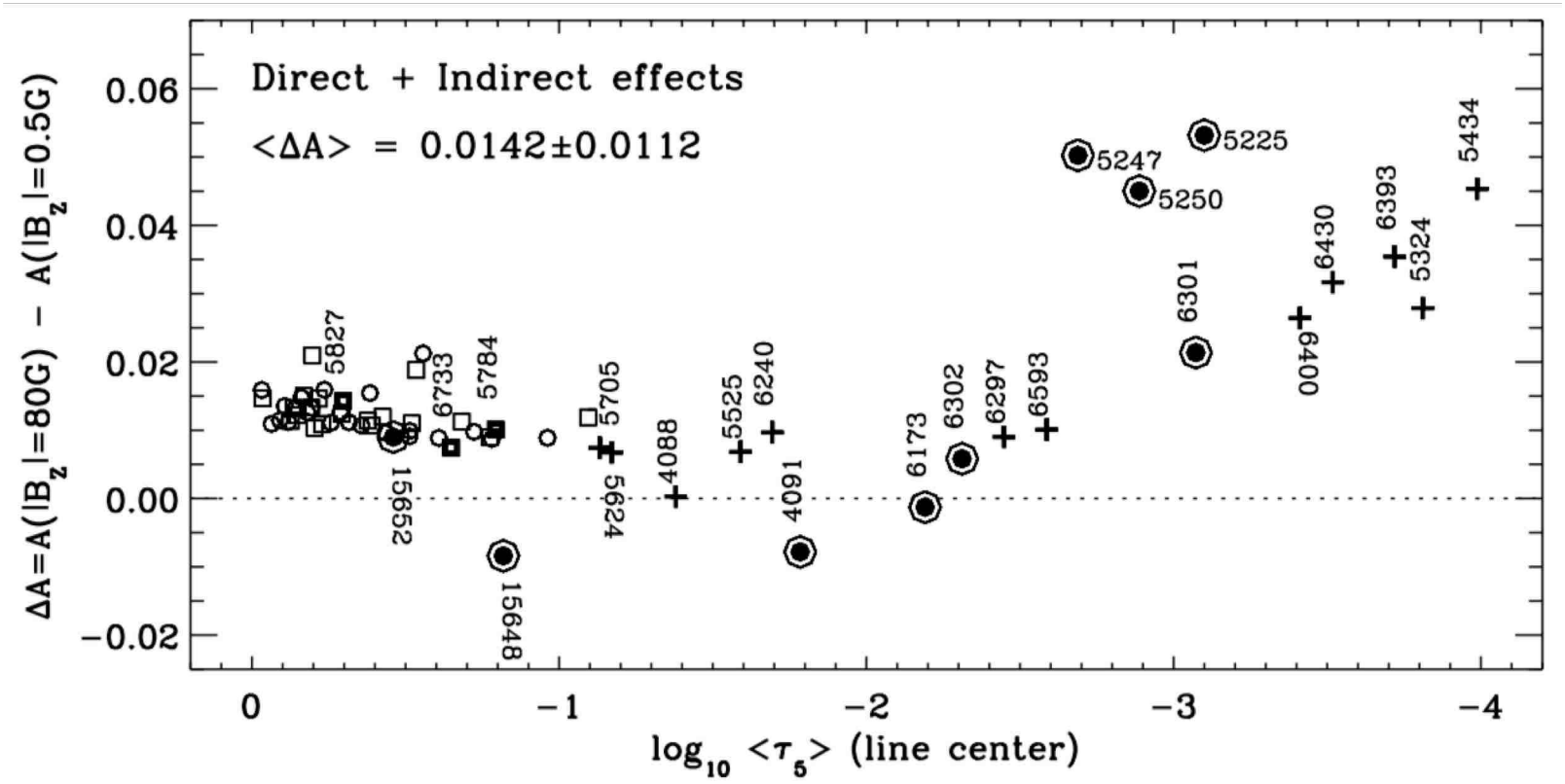
Correção a contribuição do fluxo fotosférico

$$\log R_{fot} = -4.898 + 1.918(B-V)^2 - 2.893(B-V)^3$$

Noyes et al. (1984)

$$R'_{HK} = R_{HK} - R_{fot}$$

Stellar activity

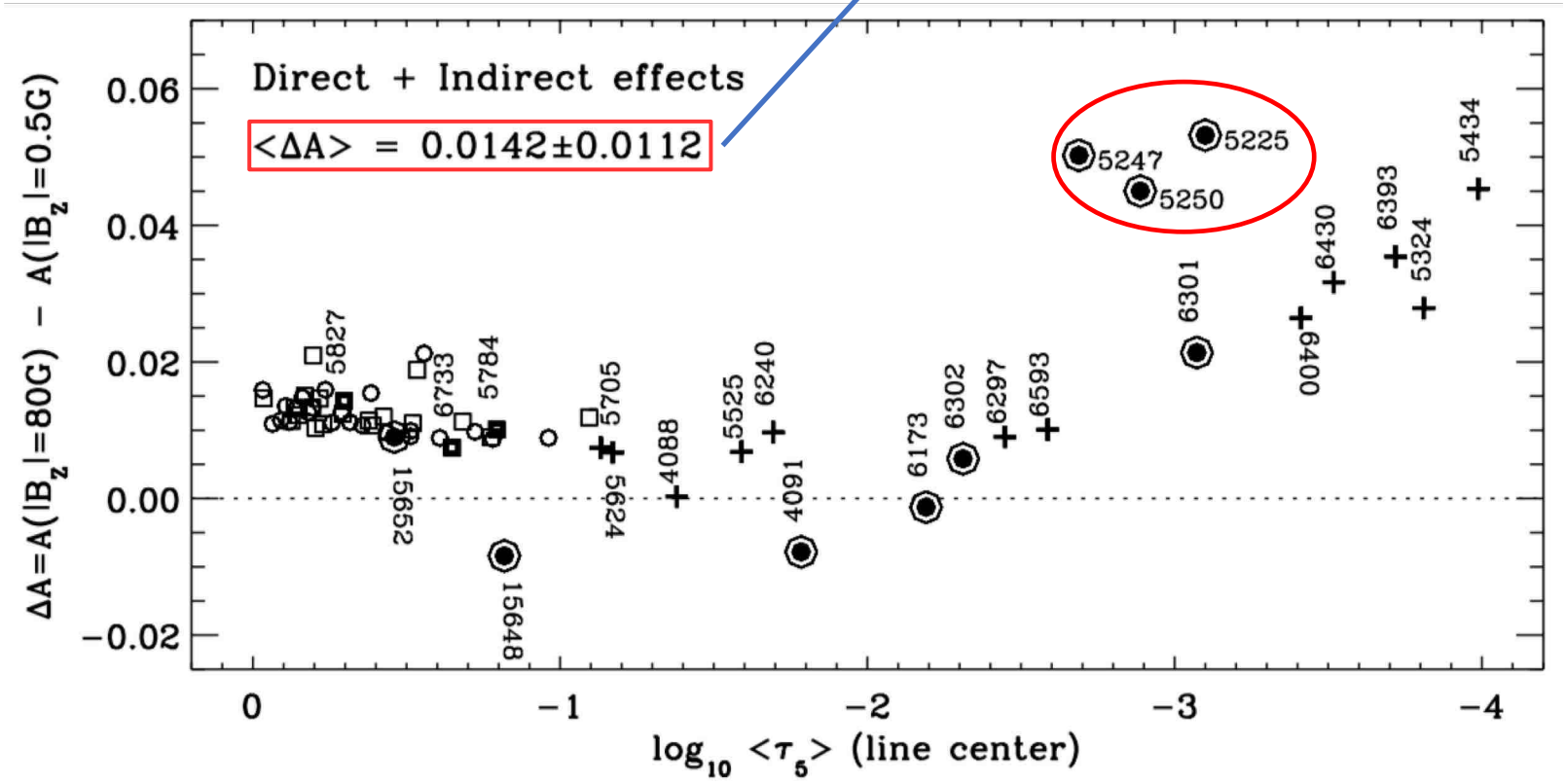


Shchukina and Trujillo Bueno (2015)

Magneto-convection simulations with small-scale dynamo action (Rempel 2014)

Stellar activity

Important impact in determination of stellar parameter!!



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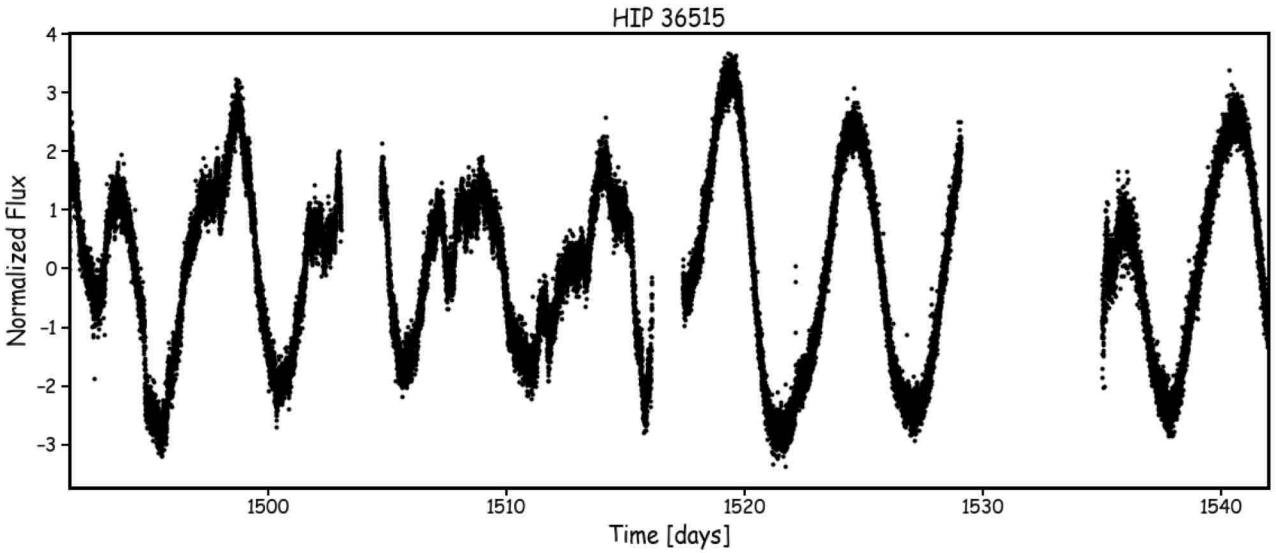
Stellar activity

Activity cycle of HIP 36515



$$\langle S_{\rm HK} \rangle = 0.3270 \pm 0.0226$$

$$P_{\rm rot} = 4.6 \pm 1.2 \text{ days}$$

$$P_{\rm rot} = 4.2 \pm 1.1 \text{ days}$$

Stellar activity

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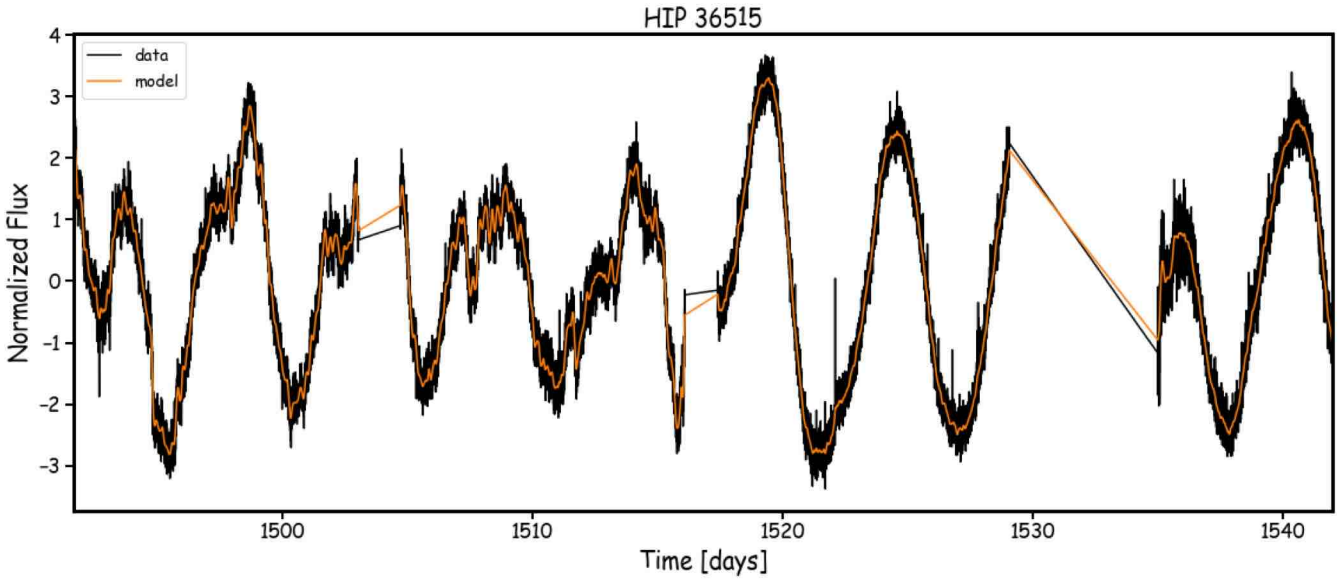

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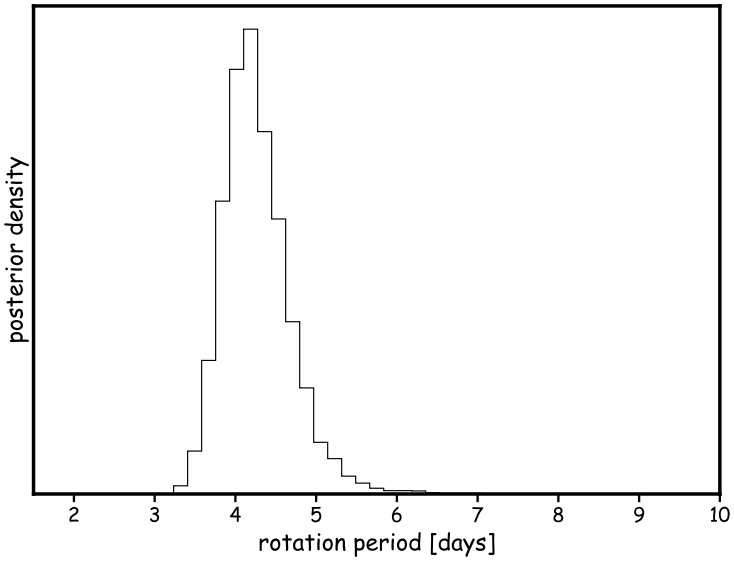
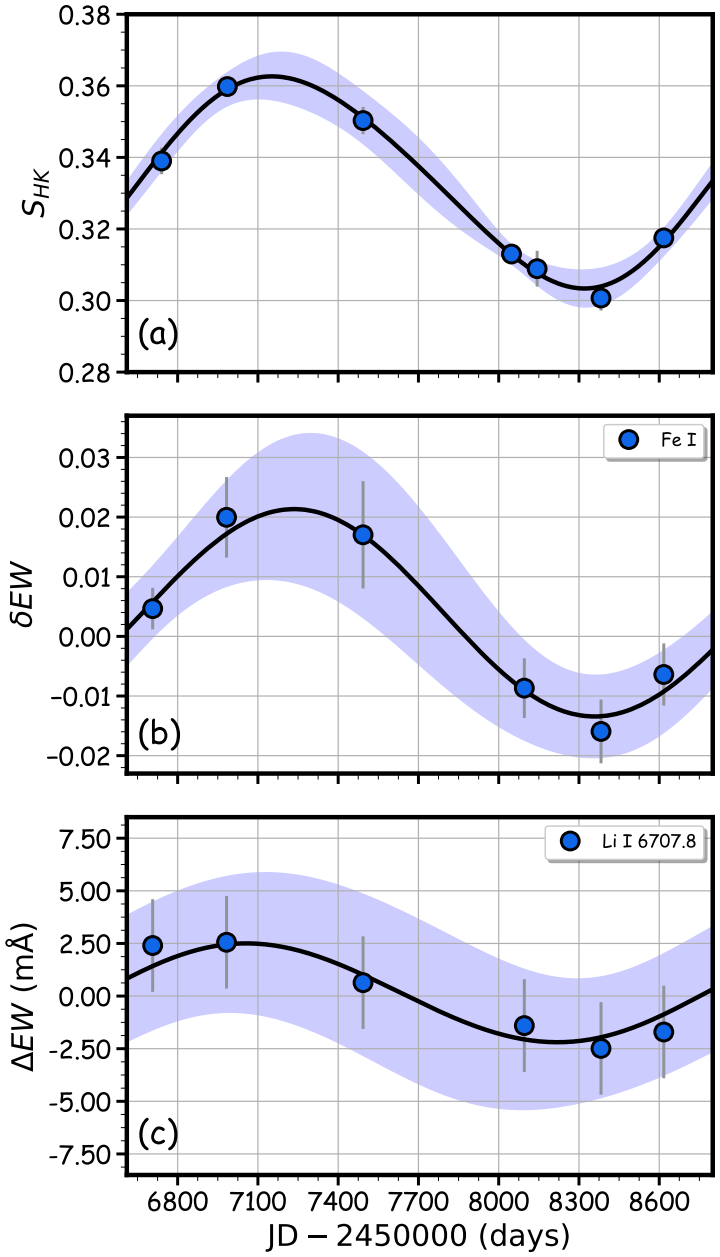
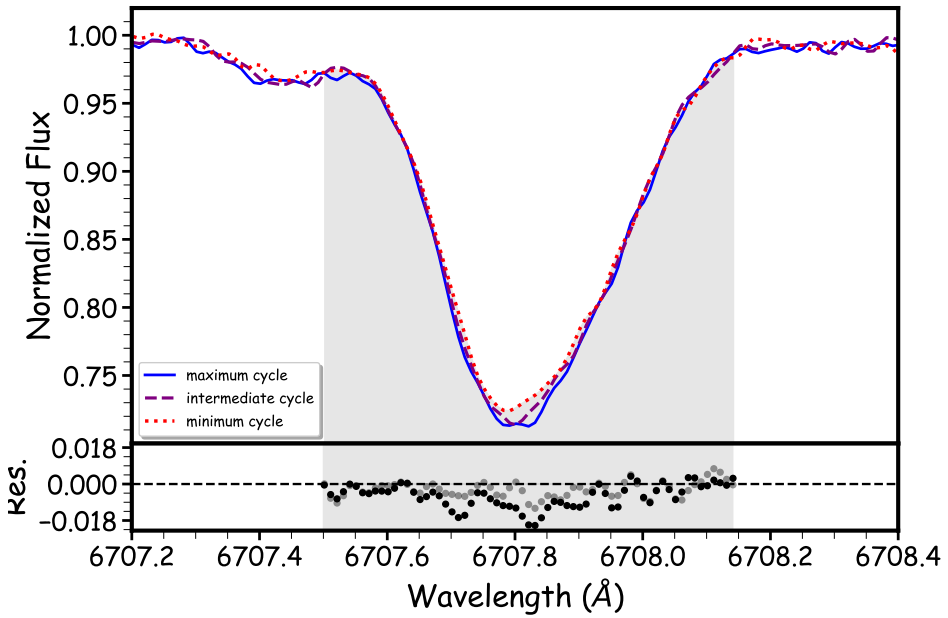
$$P_{\rm rot} = 4.6 \pm 1.2 \text{ days}$$

$$P_{\rm rot} = 4.2 \pm 1.1 \text{ days}$$



Lithium abundances





Conclusions

- There is no significant variations of FeI and FeII lines.
- We conclude that stellar activity does not affect the espectroscopic equilibrium in Sun-Like stars, at least for ages older than 0.5 Gyr.