The problem of variability of chemically peculiar Am stars

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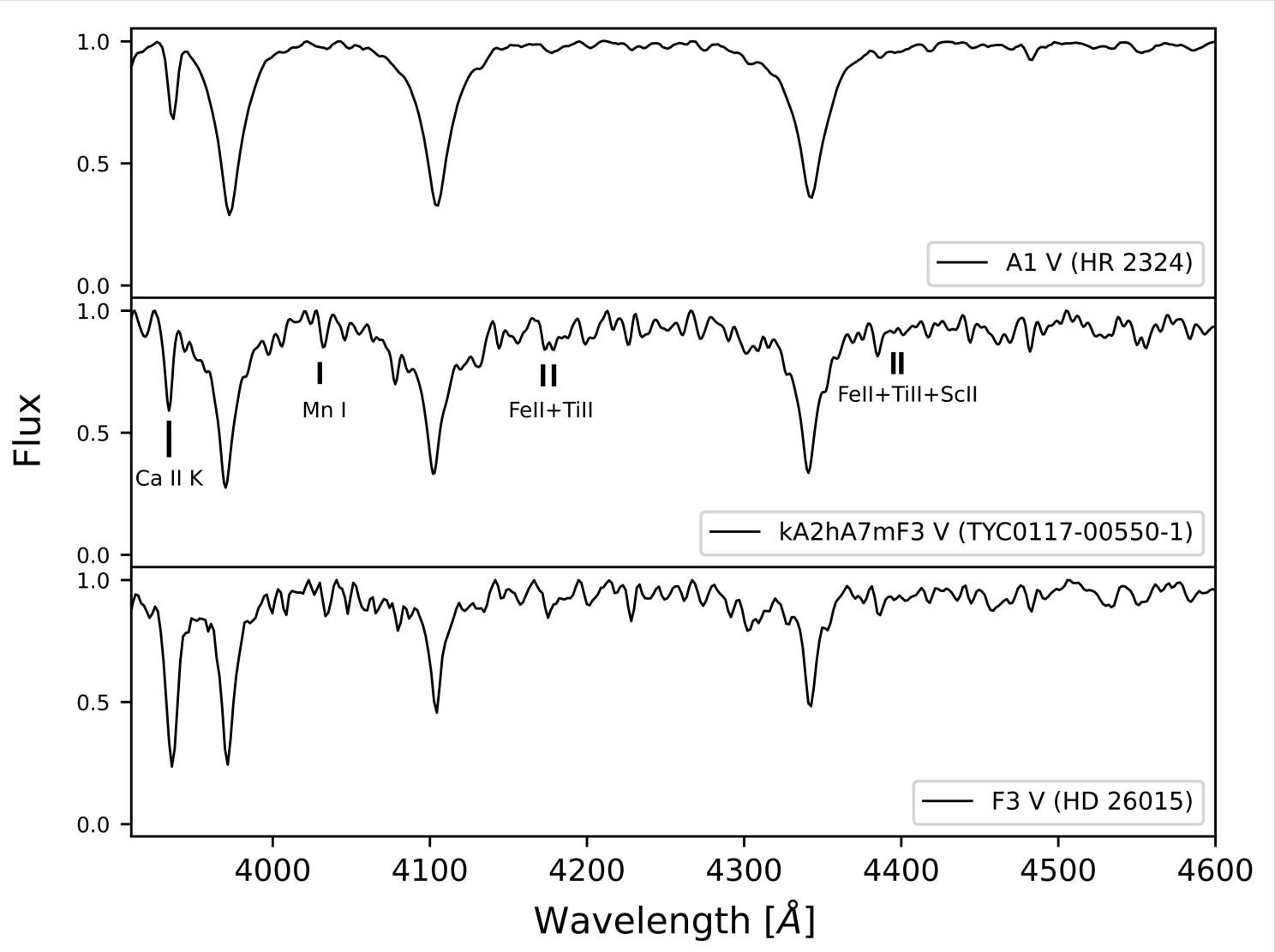
STELLAR VARIABILITY, STELLAR MULTIPLICITY: PERIODOCITY IN TIME & MOTION
MW-GAIA WG2 HYBRID WORKSHOP
SOFIA, 7.06.2023

Chemically peculiar Am star

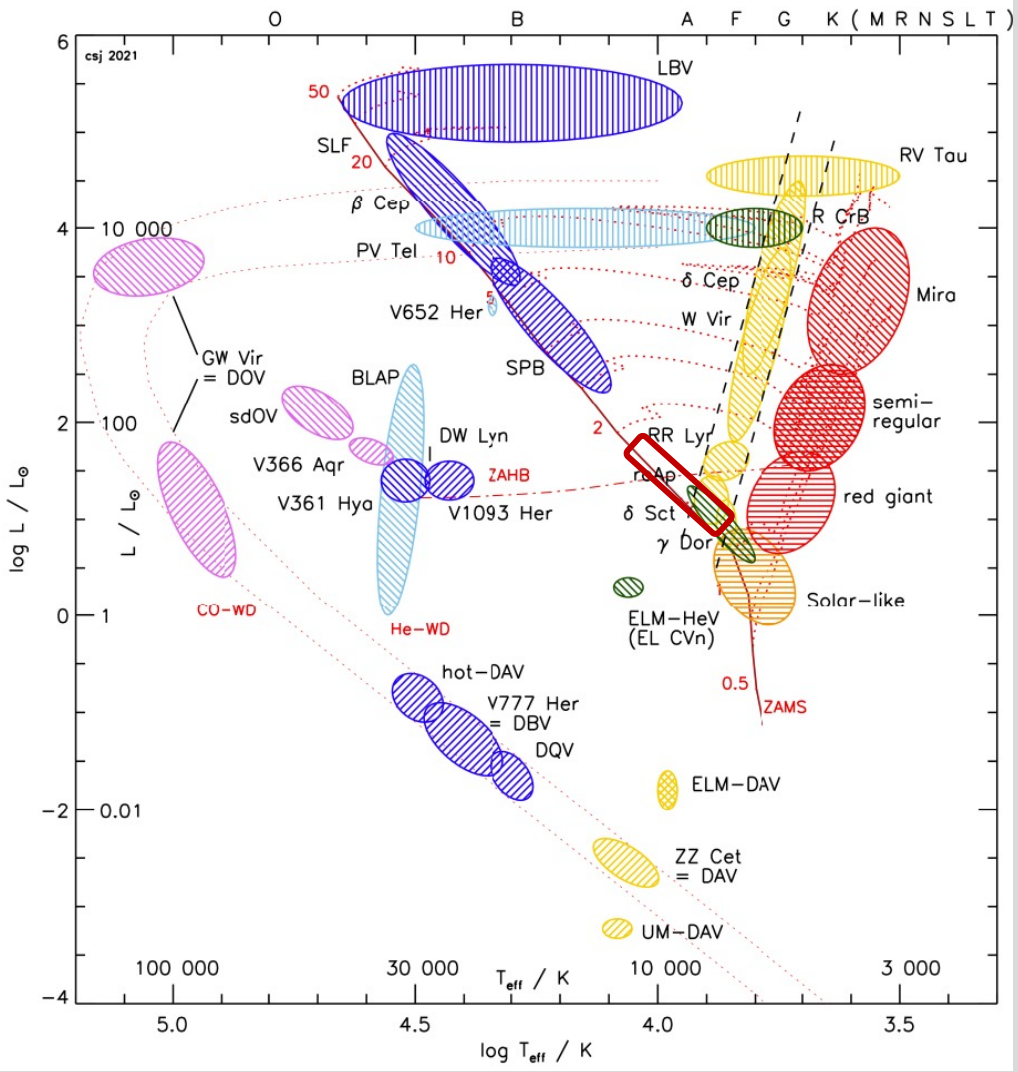


T_{eff} : 7000 – 10 000 (A0–F3)

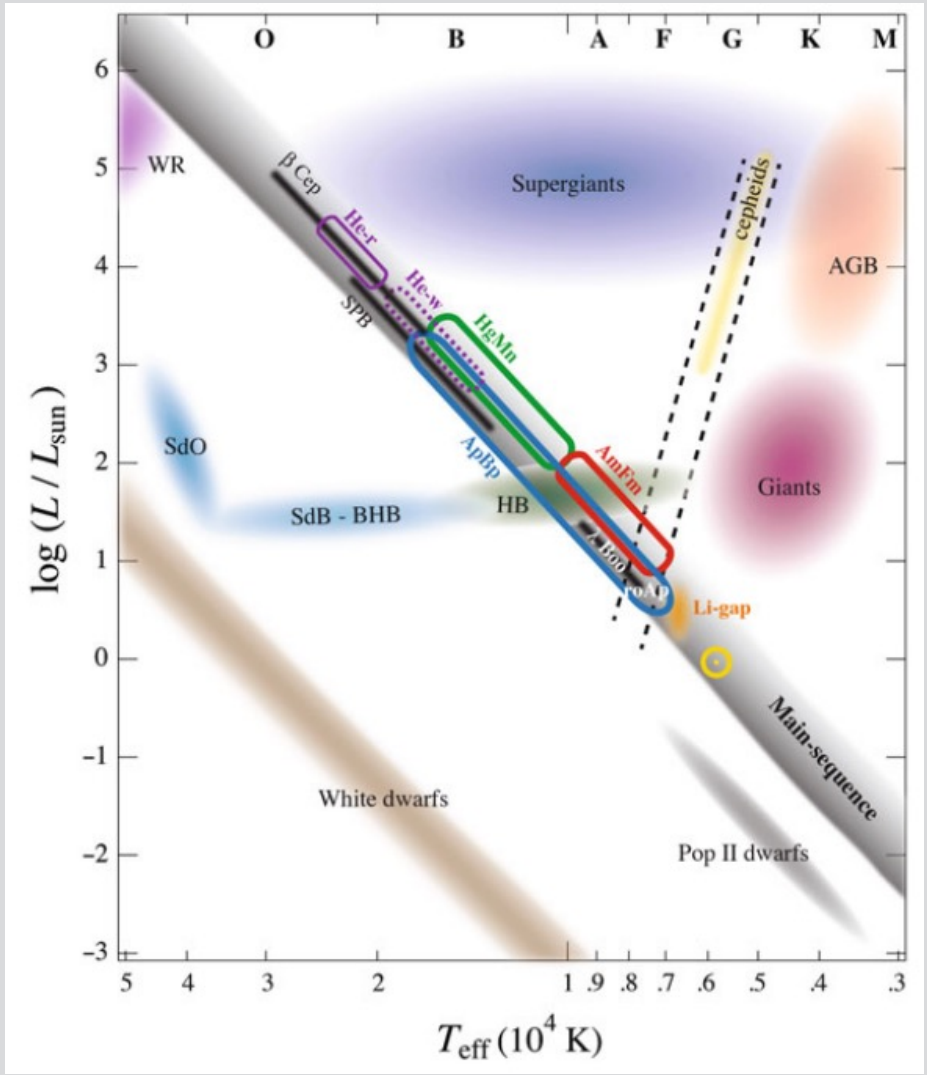
- weak lines Ca II, Sc II
- strong metallic lines

Chemically peculiar Am star

PULSATIONS



Kurtz, *Asteroseismology across the hertzsprung–russell diagram* (2022)



Michaud et al., *Atomic Diffusion in Stars* (2015)

Spectroscopic observations

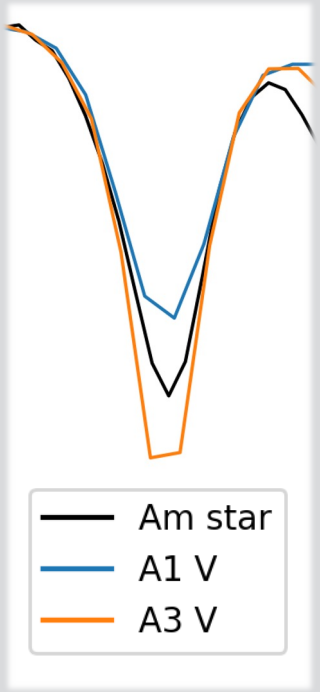
Spectrograph	Resolution	Wavelength range [Å]	Number of spectra	Number of objects
HRS (SALT)	66 700 (blue part), 73 700 (red part)	3700 - 8900	124	122
ESPRESSO	140 000	3800 - 7880	10	2
HARPS	115 000	3780 - 6910	233	88
FEROS	48 000	3500 - 9200	93	42
UVES	80 000 (blue part), 110 000 (red part)	3000 - 11000	242	85
ELODIE	42 000	3850 - 6800	168	81
SOPHIE	75 000	3872 - 6943	102	40
FIES	67 000	3700 - 8300	93	46

1065 414

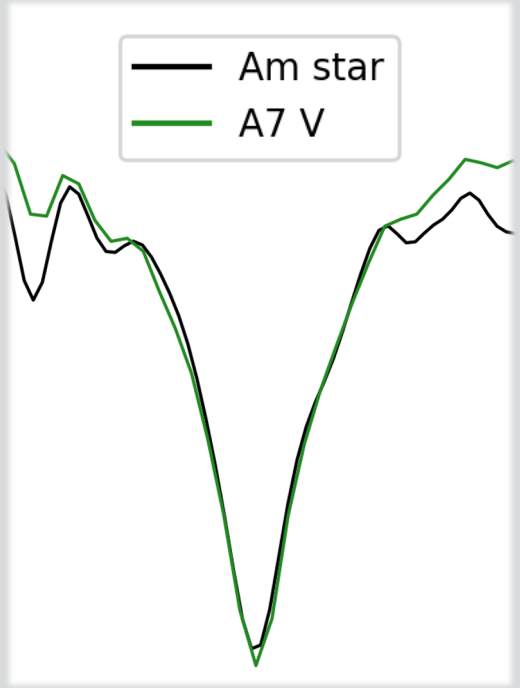
Normalization: *SUPPNet* https://rozanskit.com/suppnet/

Spectral classification

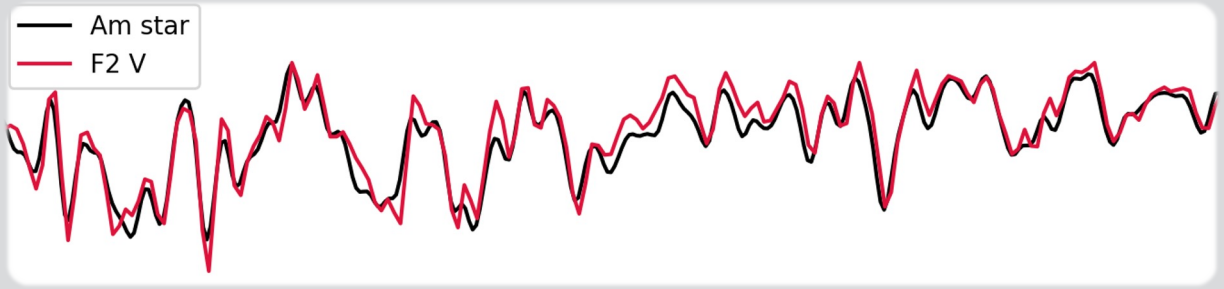
Ca II K



Balmer line (Hδ)



Metallic lines



MKCLASS (Richard O. Gray)

www.appstate.edu/~grayro/mkclass/

Results:

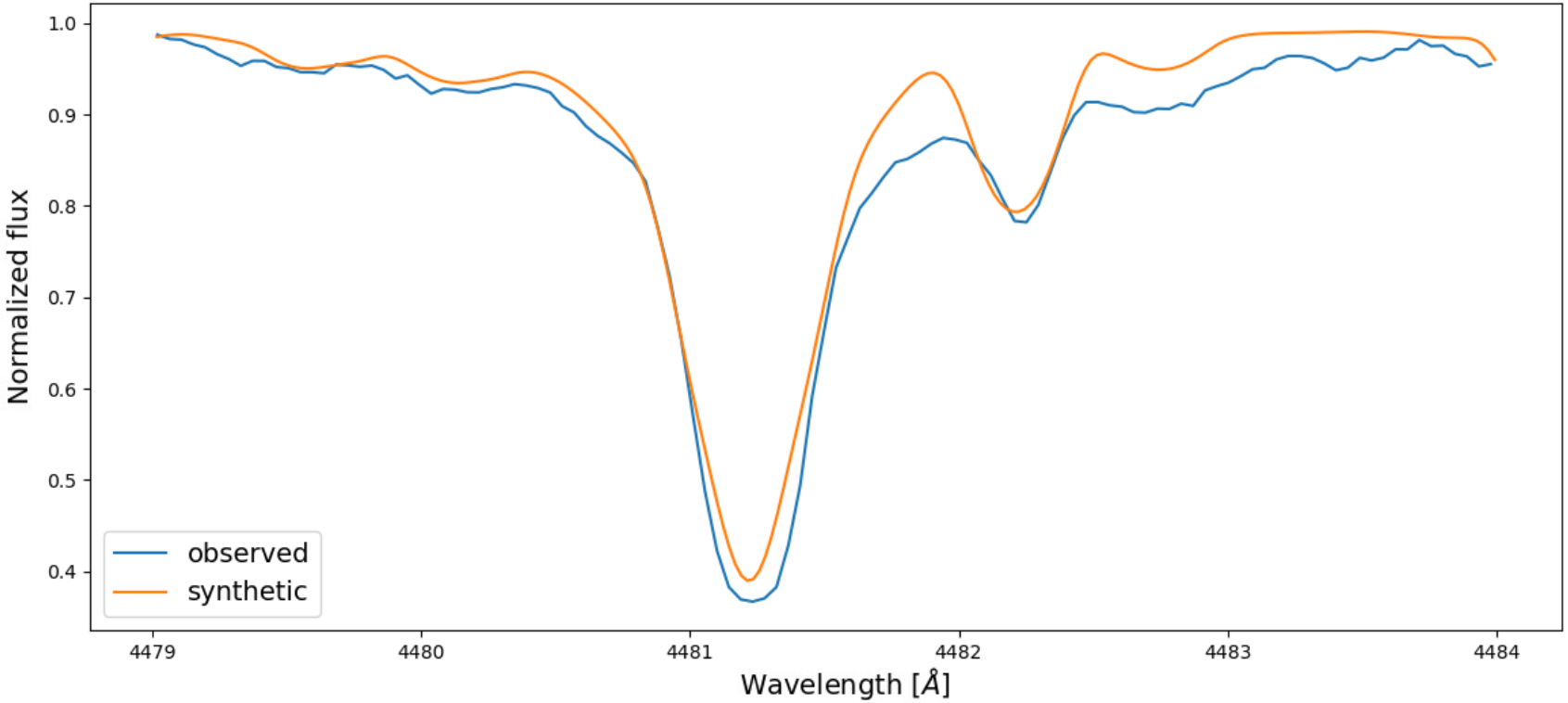
- 211 Am
- 56 Ap
- 9 HgMn
- 1 ρ Pup
- 1 Ae
- 134 chemically "normal" B, A, F stars

Spectral analysis

1. Atmospheric parameters:
   - effective temperature $T_{\rm eff}$
   - surface gravity log$g$
   - detailed chemical composition
   - microturbulence ξ
   - vsin$i$
2. Method and codes:
   Method: spectral synthesis
   Kurucz's codes: atmospheric models & spectra
   Fiorella Castelli: atomic data

Atmospheric parameters

PROJECTED ROTATIONAL VELOCITY

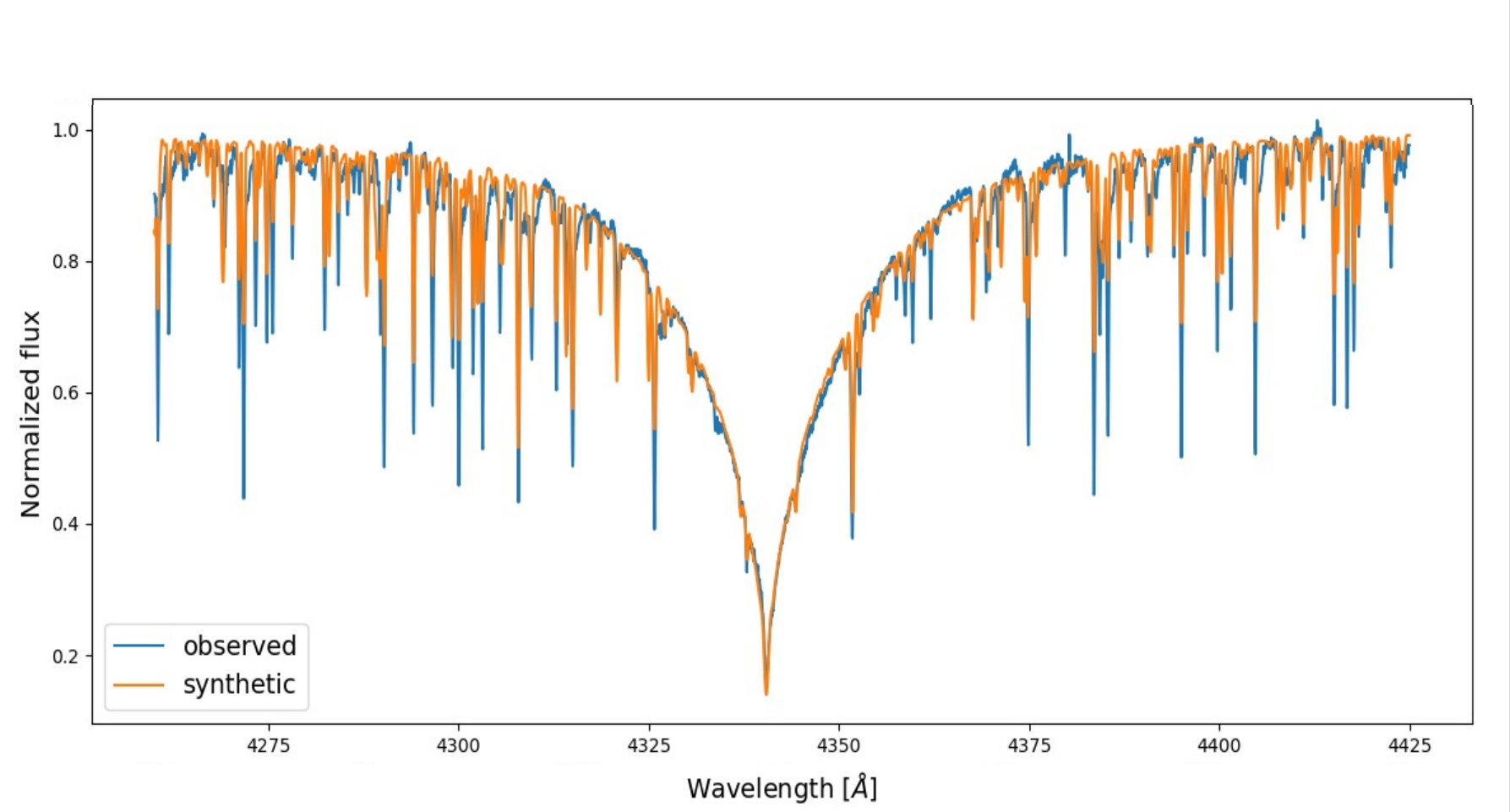


TYC 0103-01463-1

$v \sin i$ = 15 km/s

Atmospheric parameters

EFFECTIVE TEMPERATURE, SURFACE GRAVITY



TYC 0103-01463-1

T_{eff} = 8140 K

Log$g$ = 4.0

$v$sin$i$ = 15 km/s

Atmospheric parameters

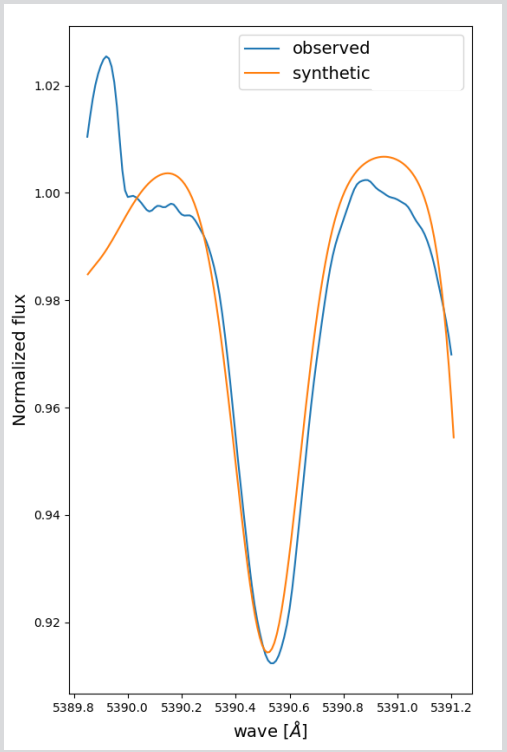
SURFACE GRAVITY

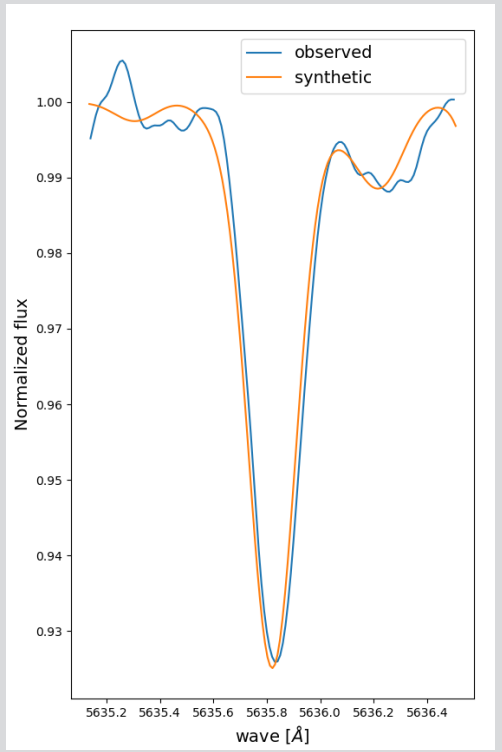
MICROTURBULENCE

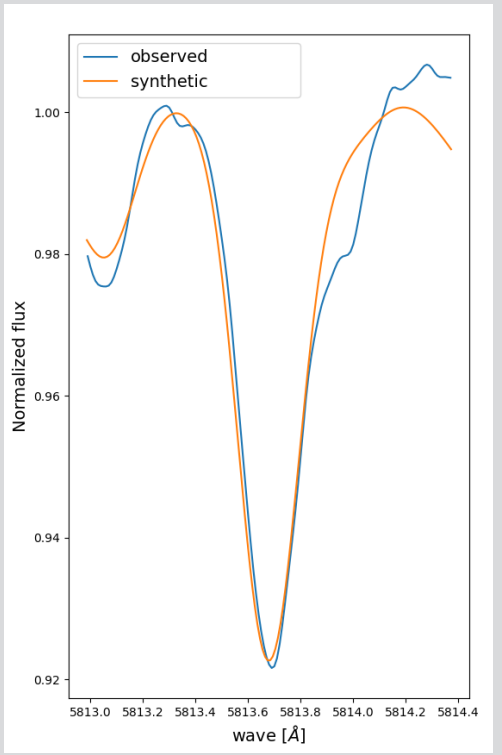
PROJECTED ROTATIONAL VELOCITY

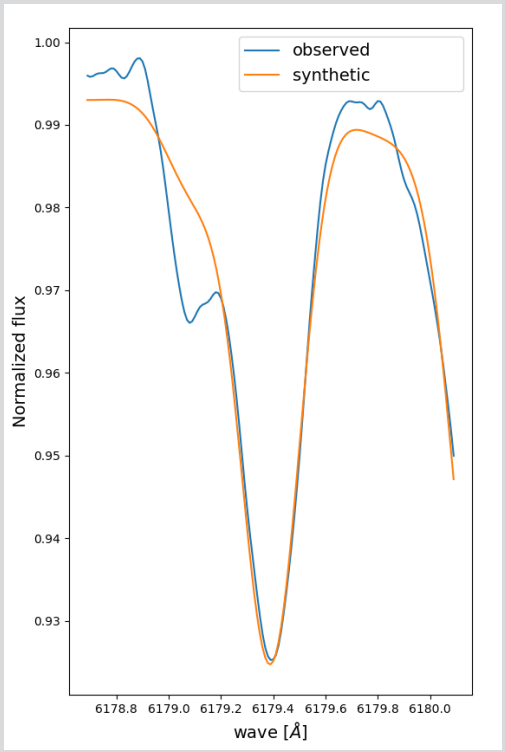
Mg

Fe I, Fe II

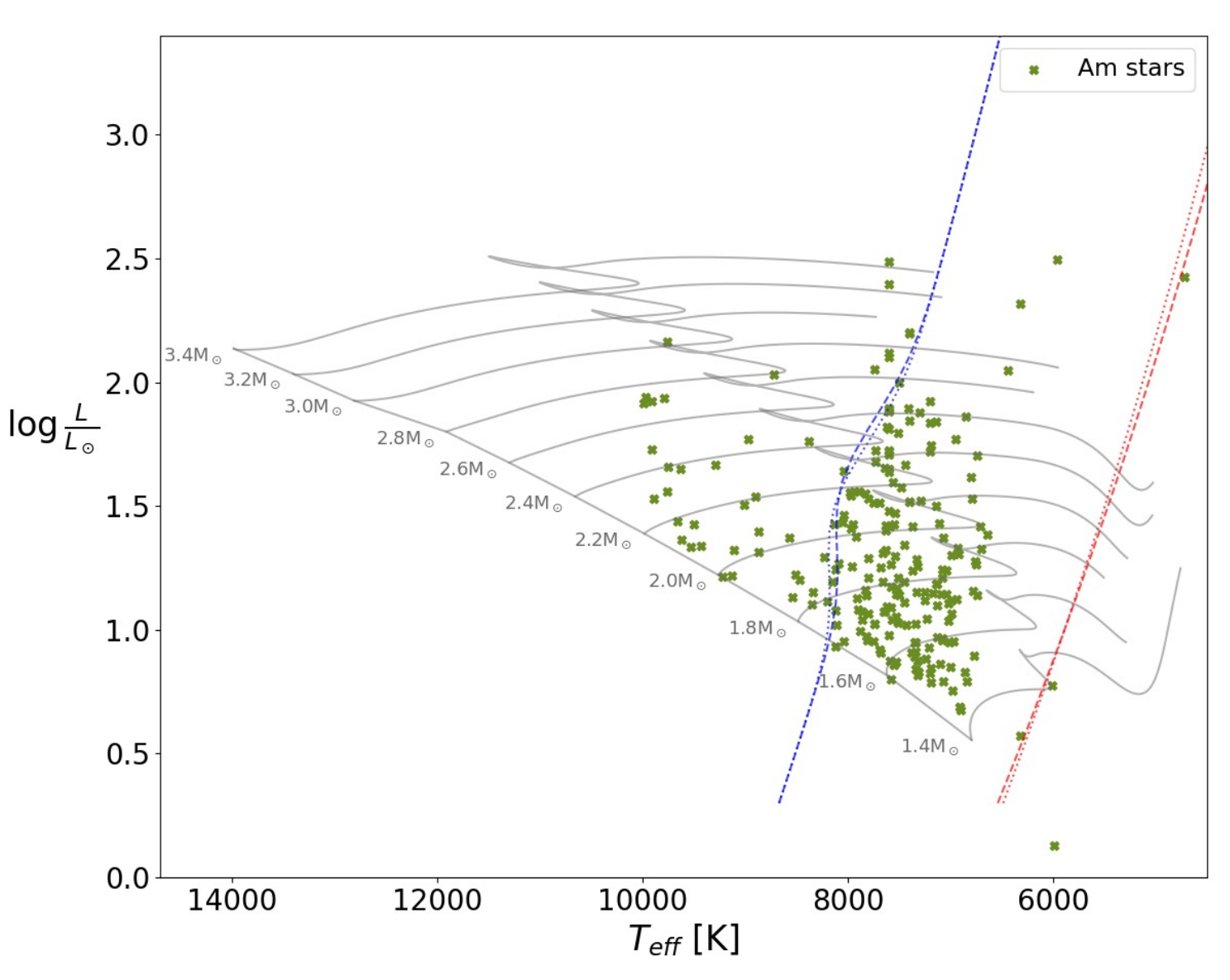








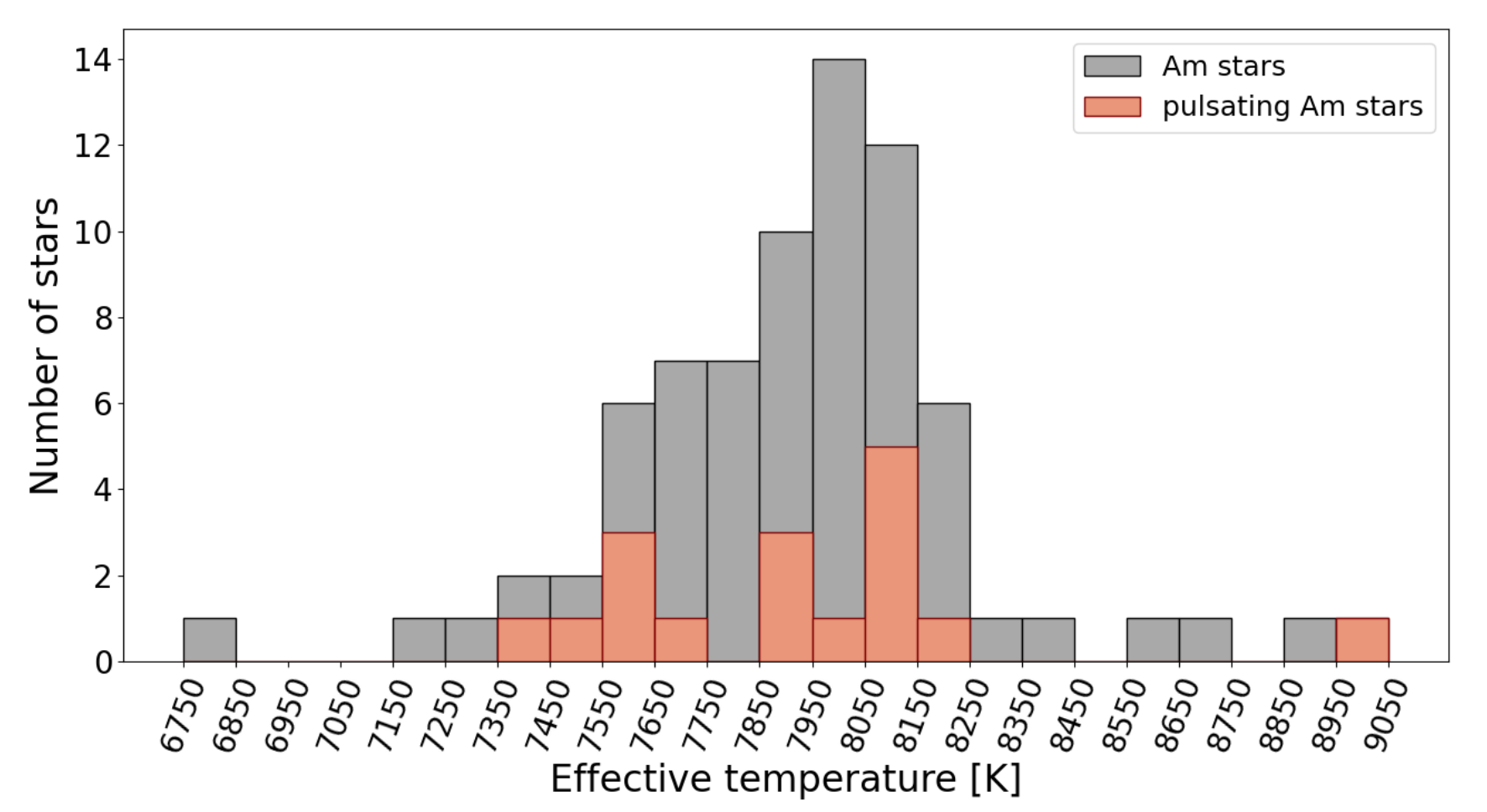
Preliminary results



Evolutionary tracks
Grigahcène et al. (2005)

δSct instability strip
Xiong et al. (2016)
--- radial
··· non-radial

Preliminary results

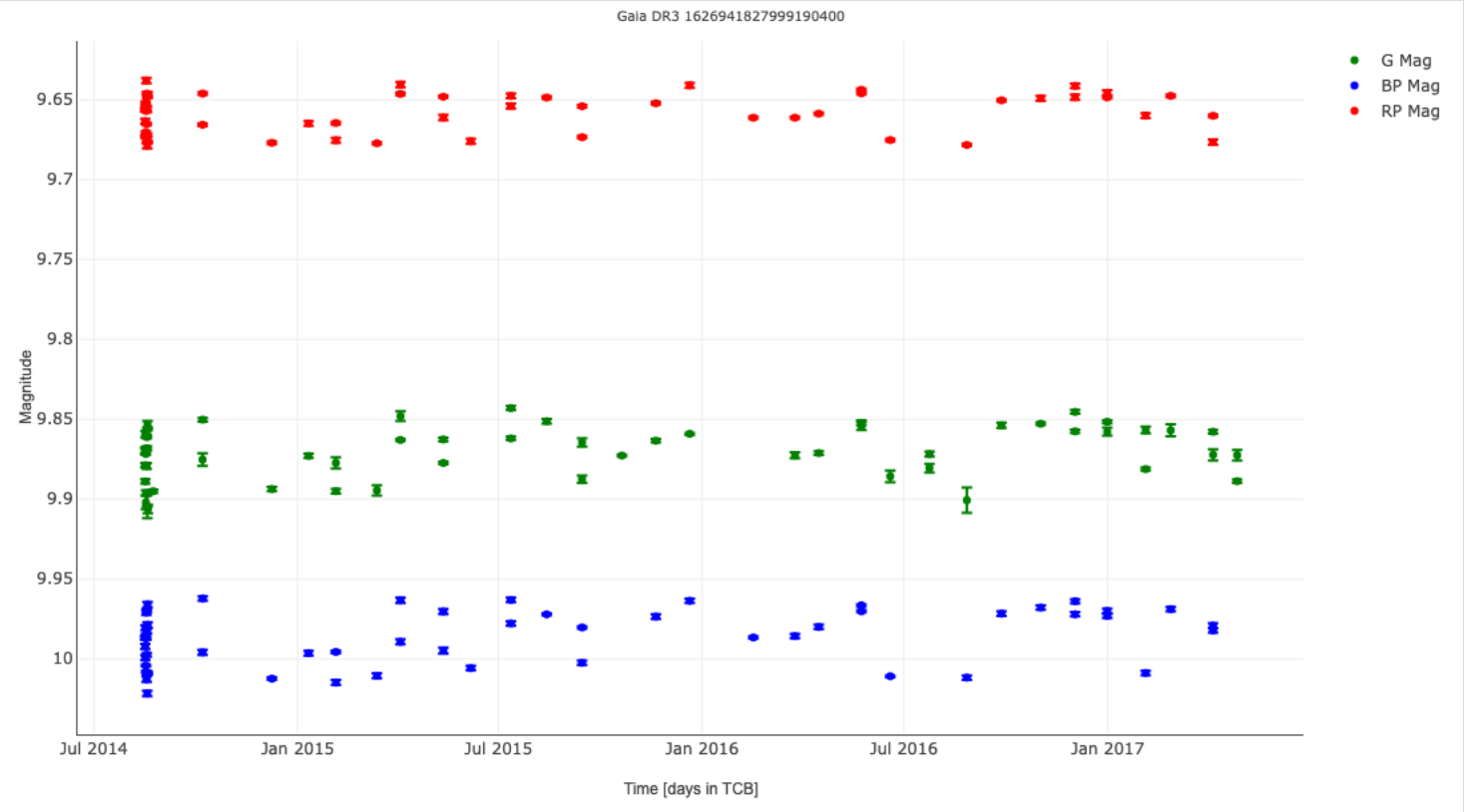


Smalley et al. (2017)
6900 – 7600 K

High-resolution spectroscopy: atmospheric parameters and chemical abundances

Pulsation analysis: photometric data – GAIA, TESS, Kepler

(collaboration with Victoria Antoci, Barry Smalley, Simon J. Murphy)



Why Am stars pulsate?

- Atmospheric parameters
- Chemical abundances
- Rotational velocity
- Binarity

Thank you for your attention