Observing the brightest stars

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STELLAR ASTROPHYSICS CENTRE

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- Spectroscopy
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- Polarimetry

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A long history of observations.

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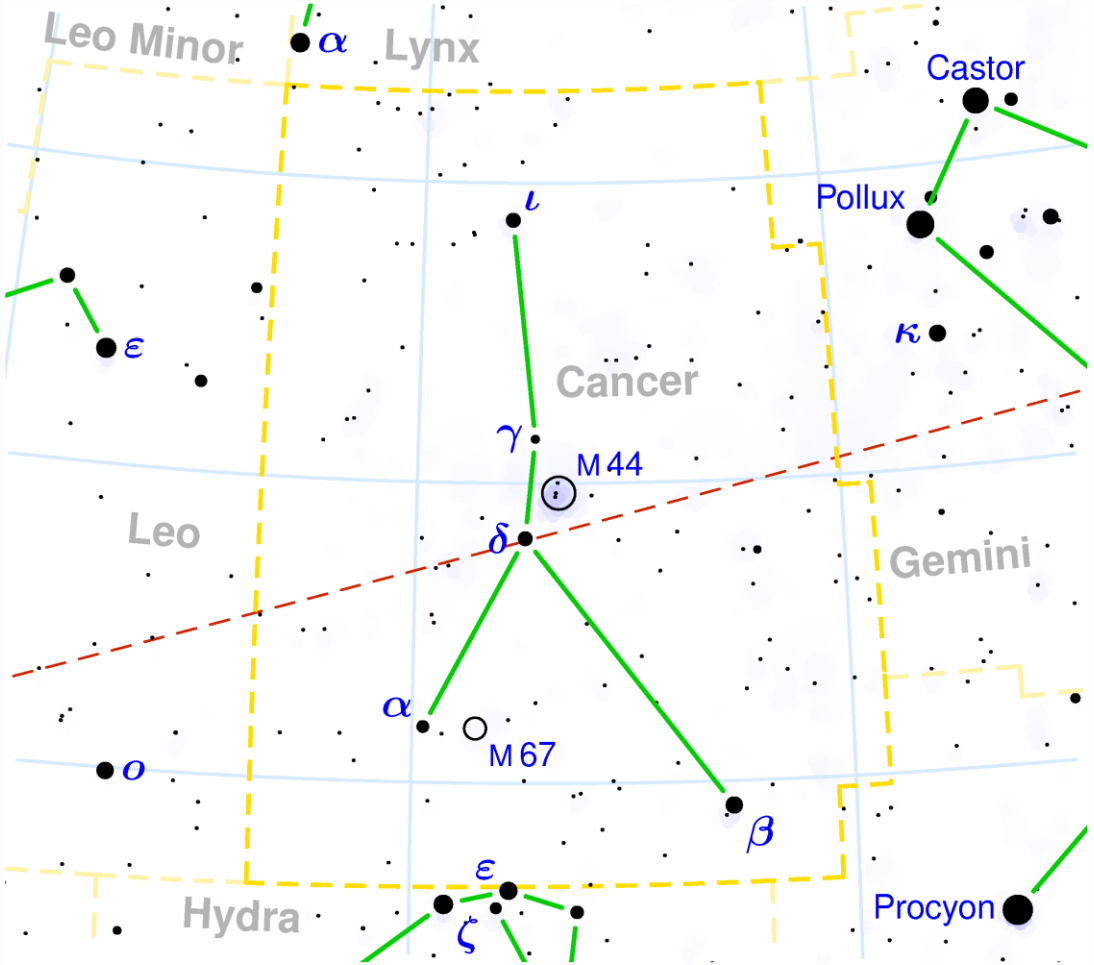

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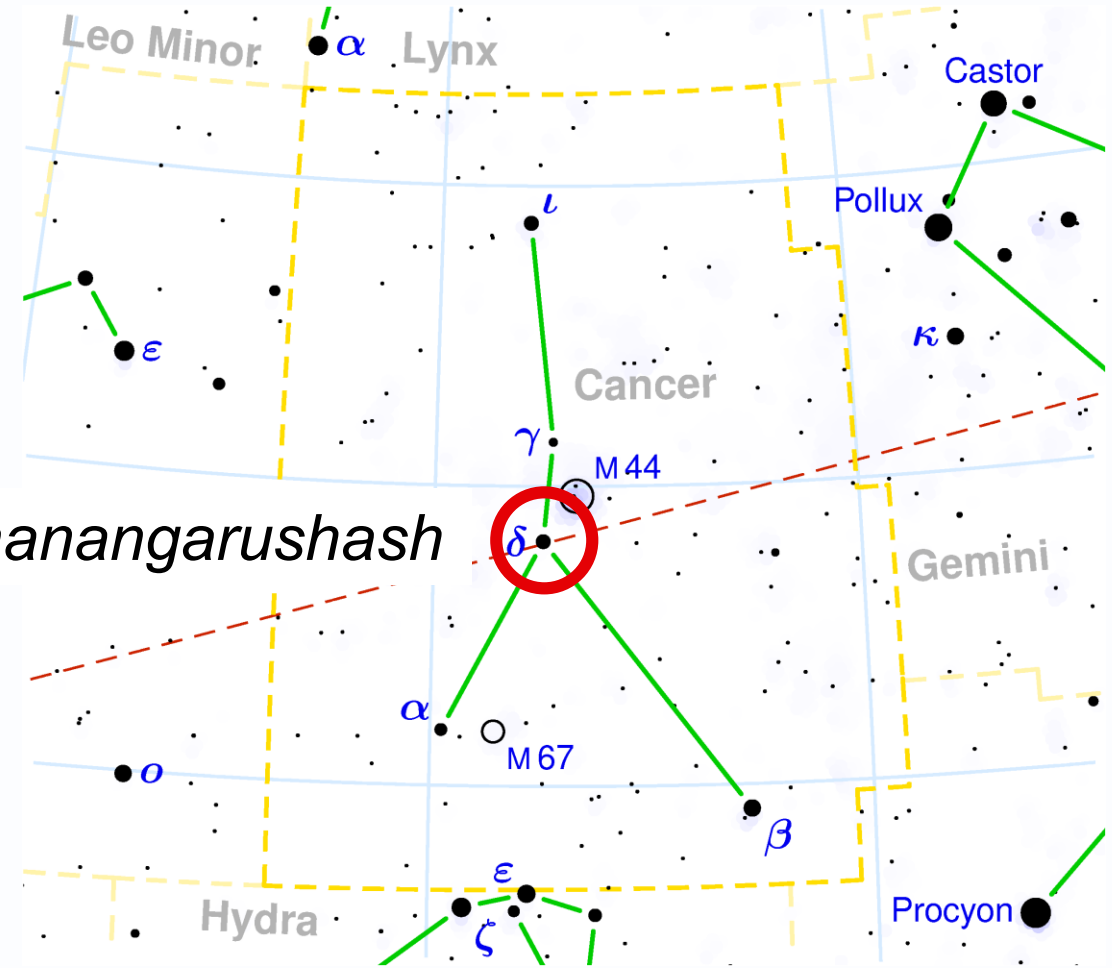

Arkūshanangarushash ūtu

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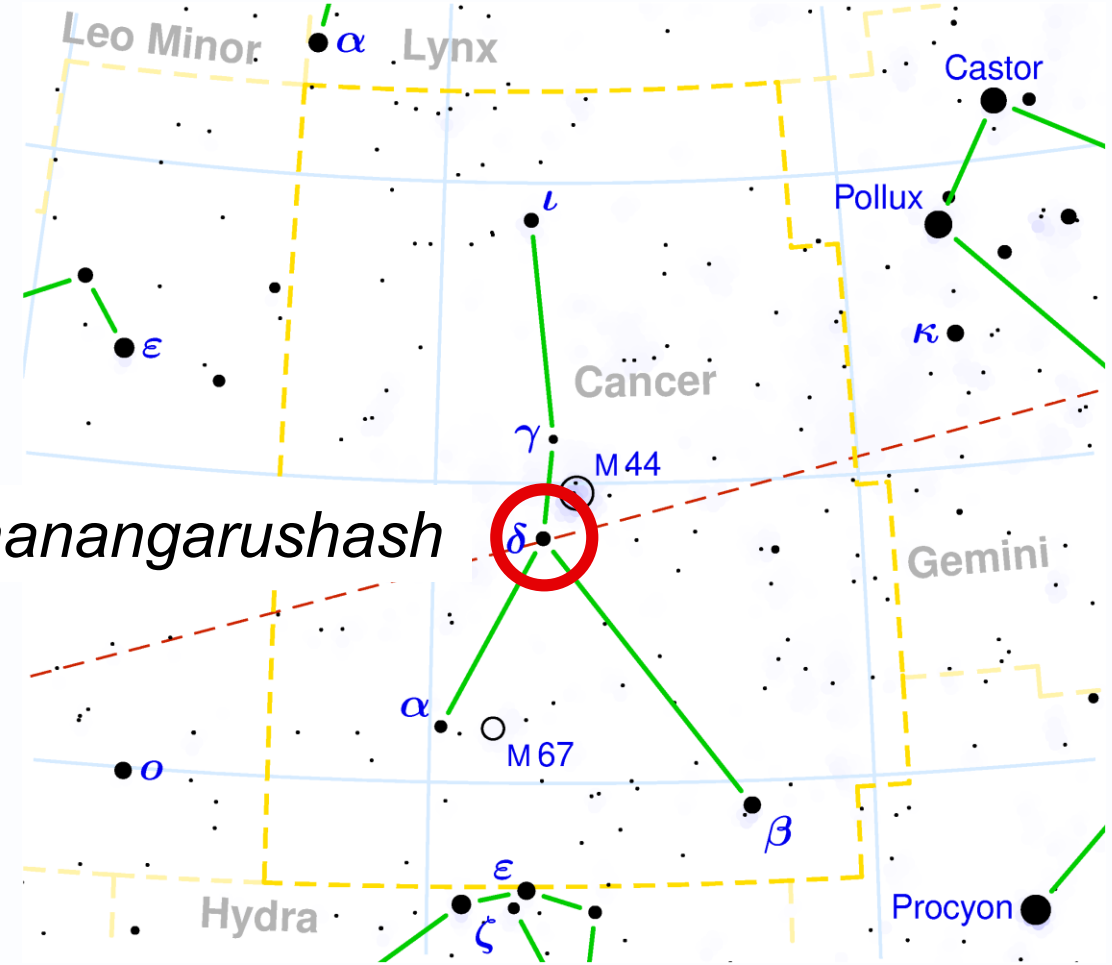
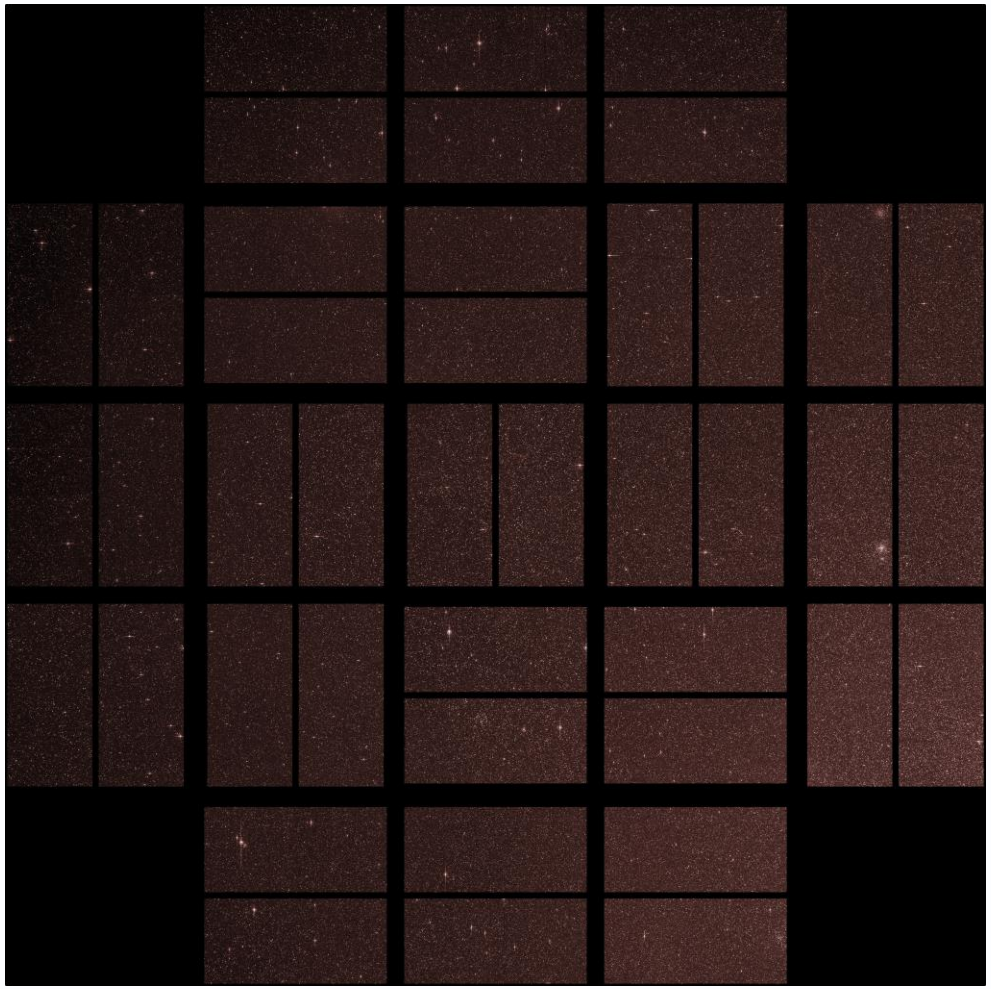
Often our instruments are built to observe many faint stars.

Sometimes their names are hard to pronounce

Arkūshanangarushash ūtu



Overcoming saturation



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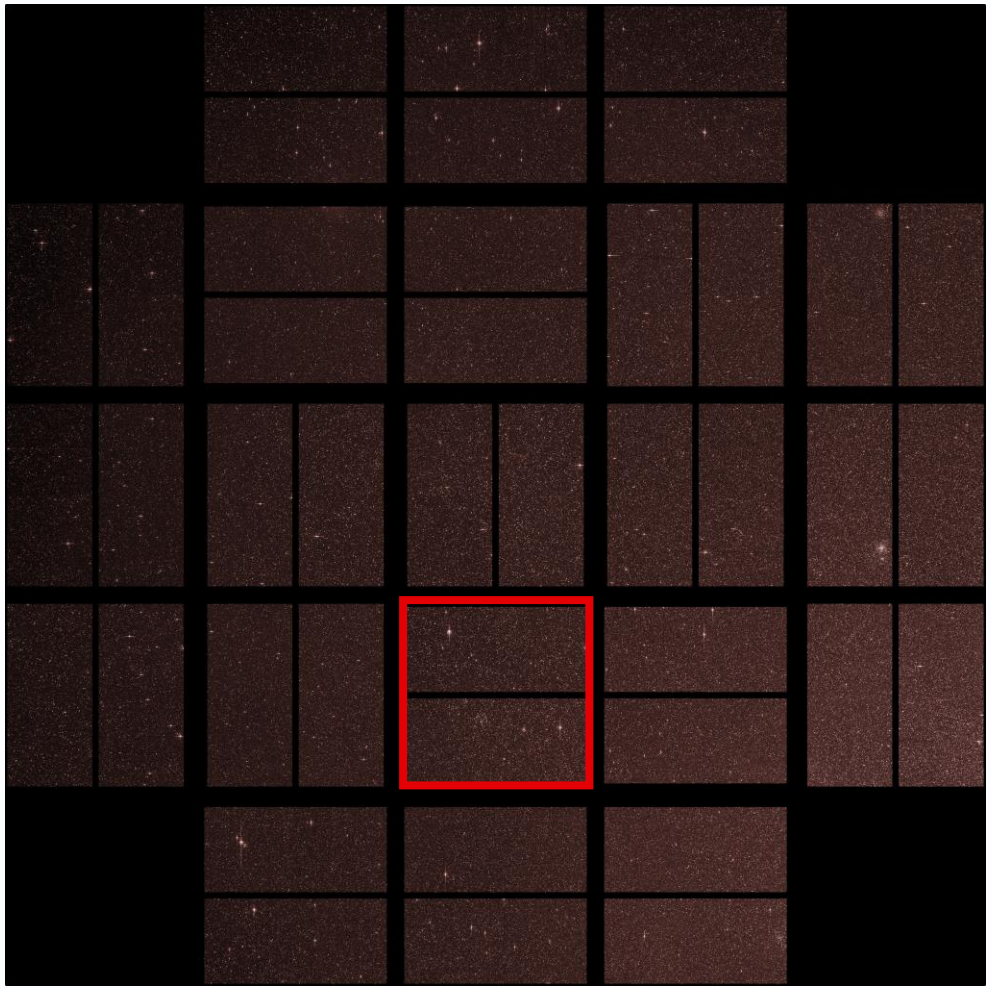

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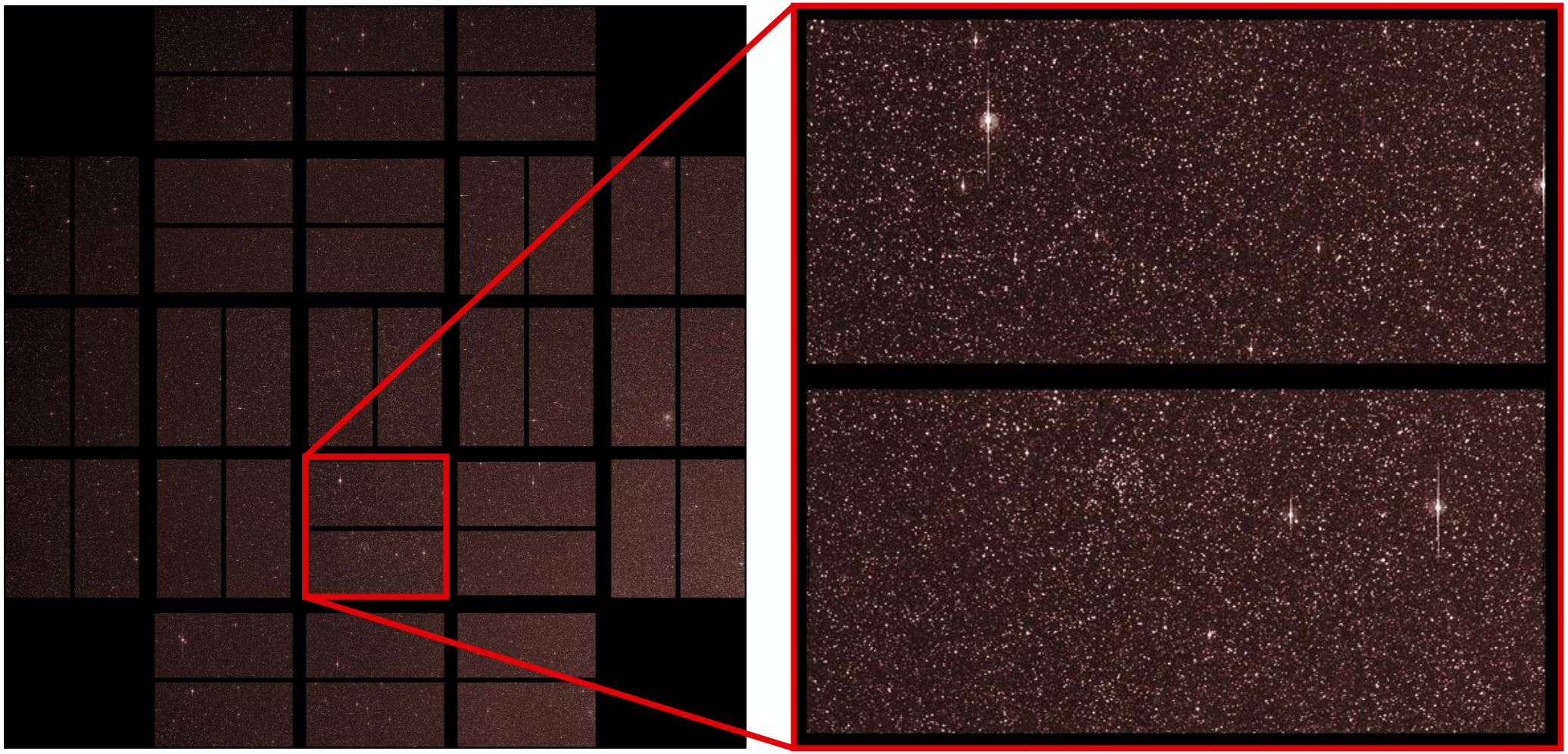

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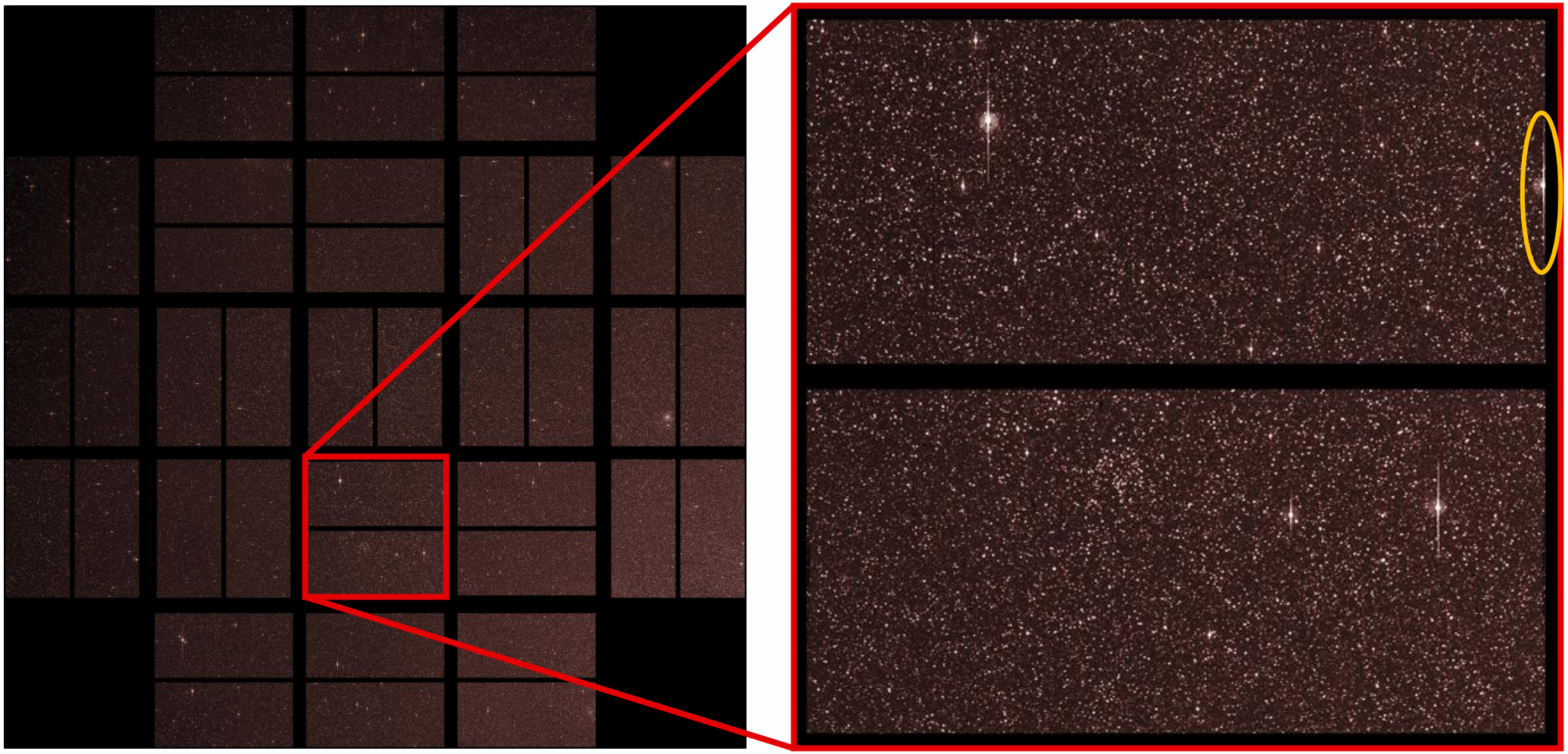

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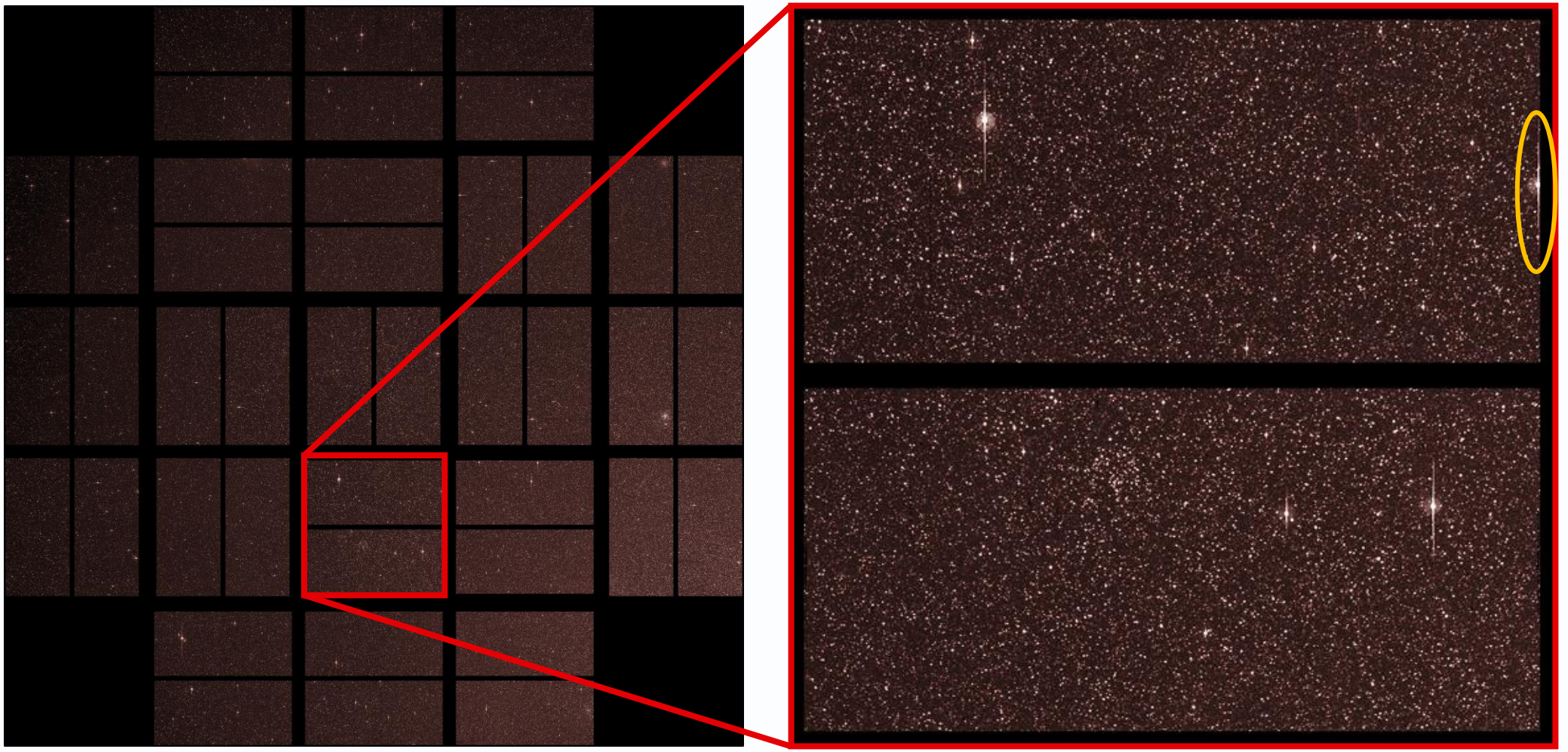

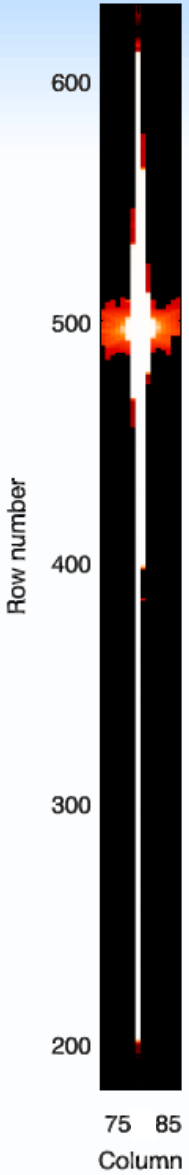

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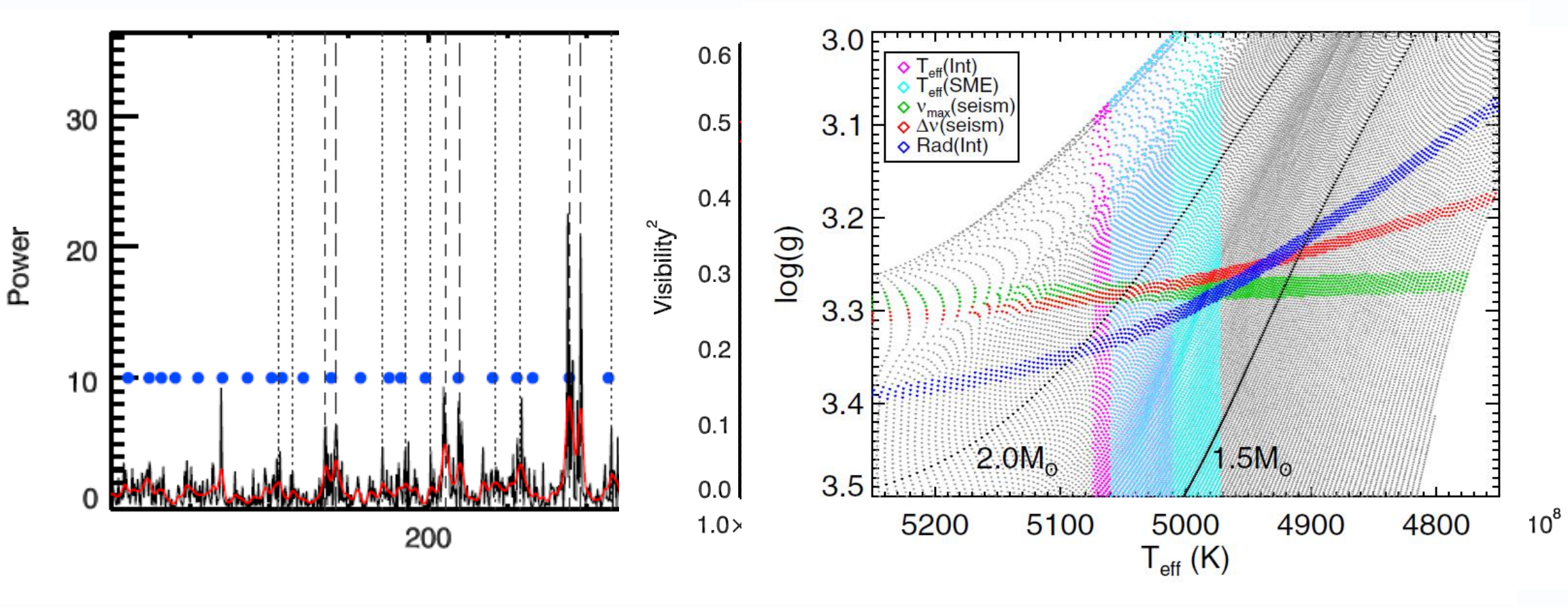
Solution: Wait until they evolve into cooler subgiants and giants.

Problem: How can you be sure these stars are evolved A stars?
Solution: Characterize them with asteroseismology and complementary techniques.

HD 185351 – a ‘retired’ A star?



Johnson et al. 2014, ApJ 794, 15

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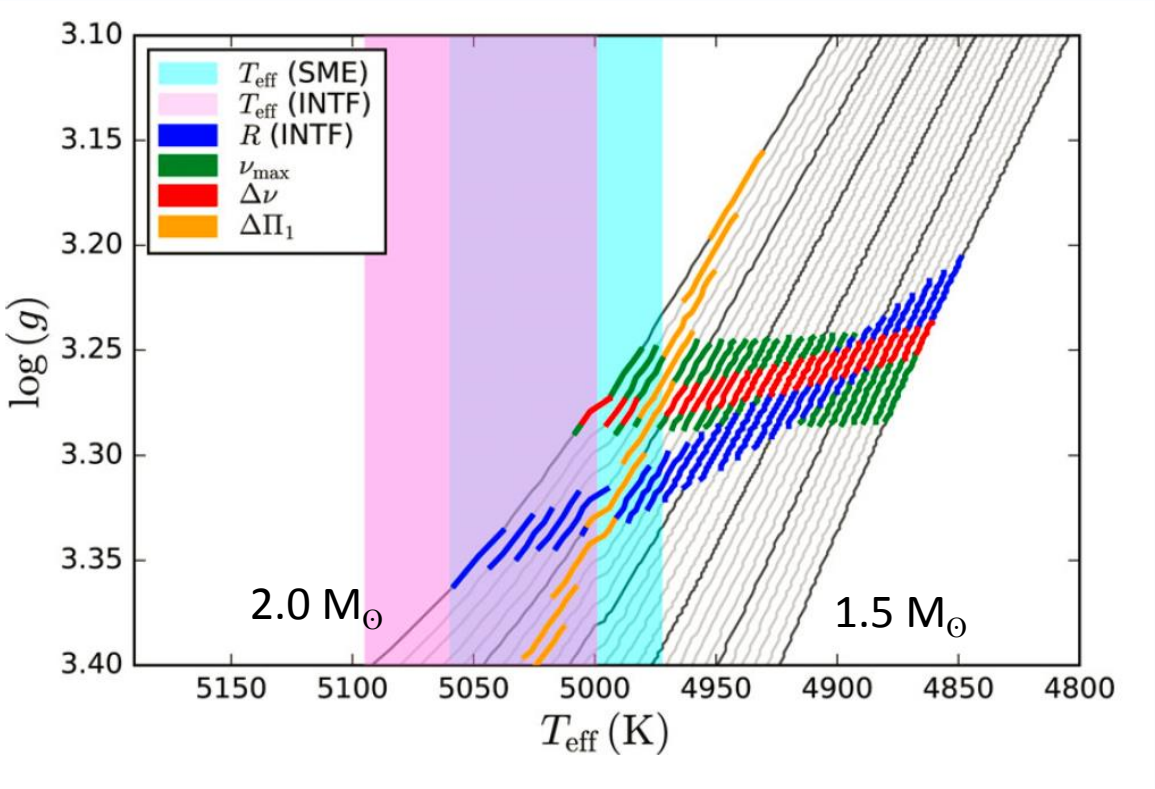
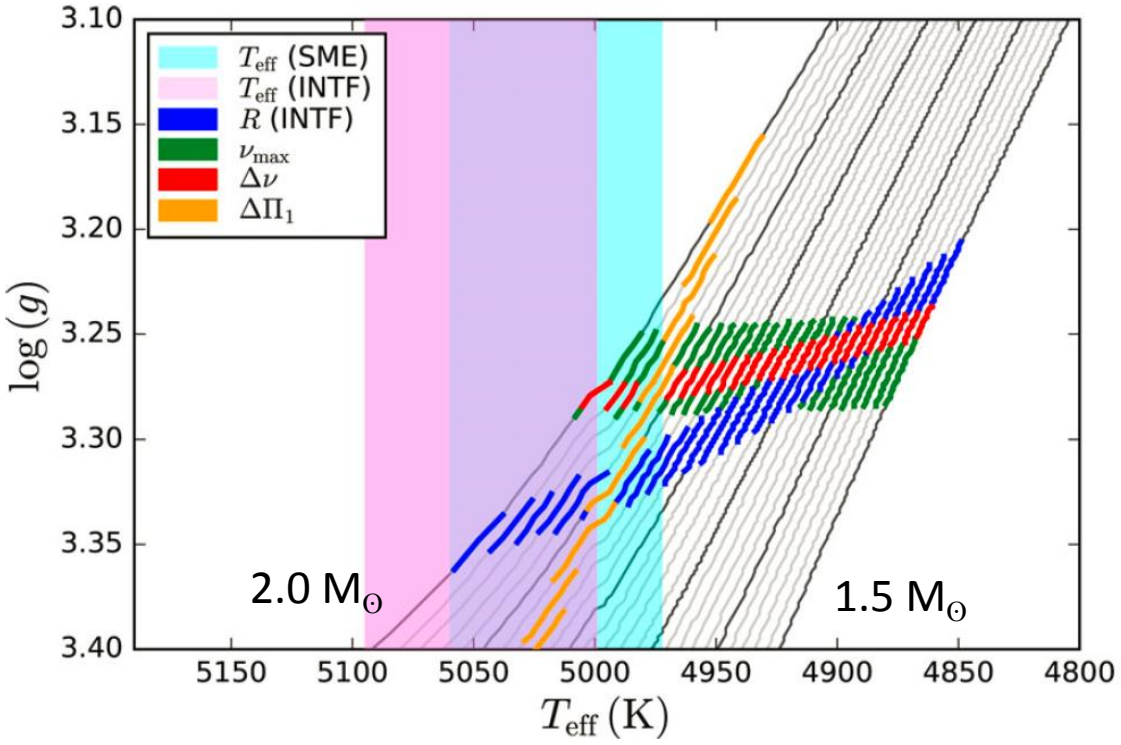


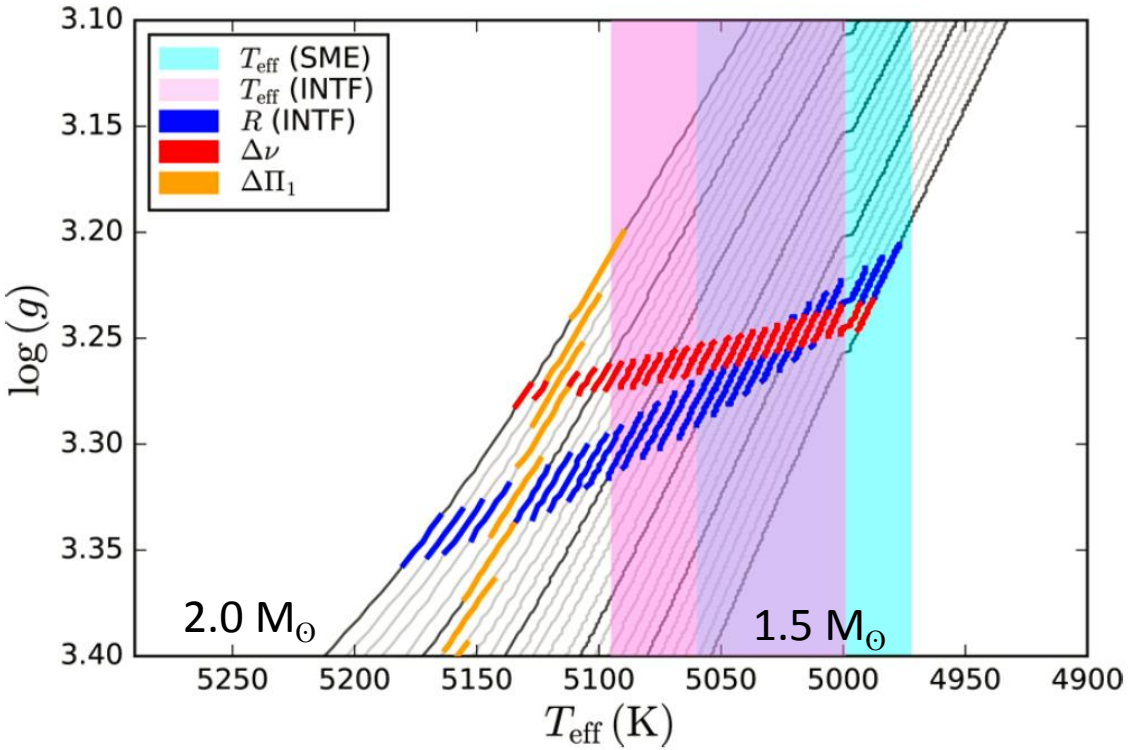
Hjørringgaard et al. 2017, MNRAS 464, 3713

Varying mixing length

α_{MLT}= 1.791



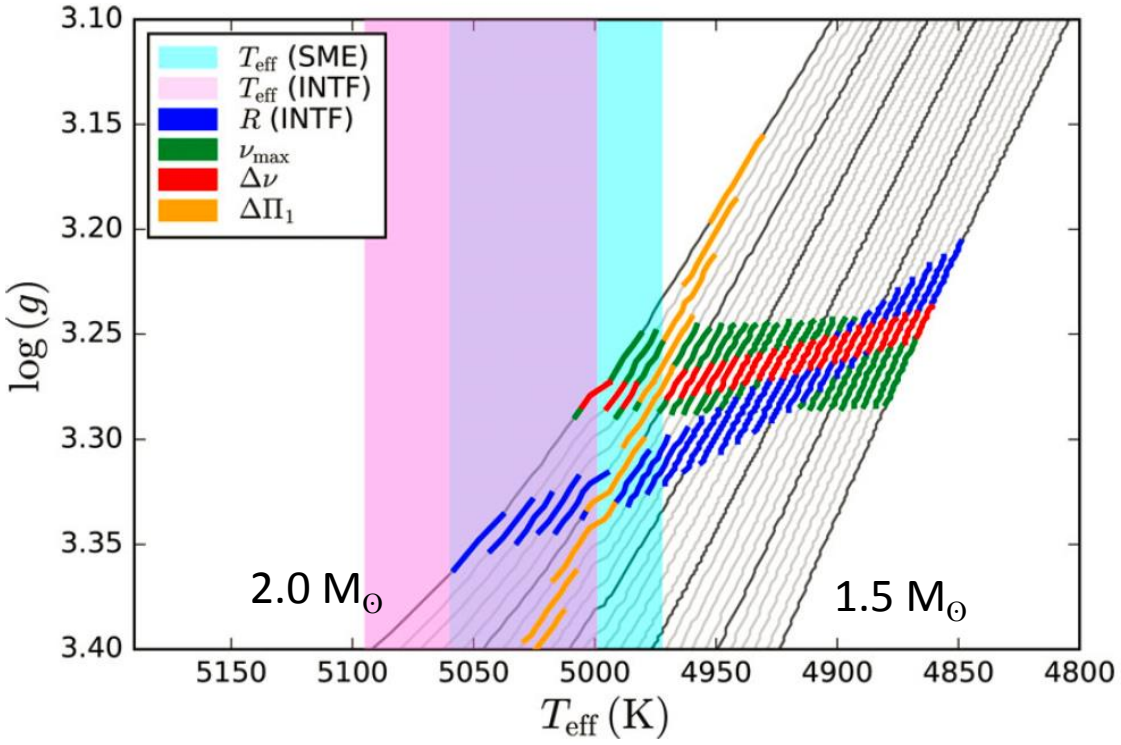
α_{MLT}= 2.00



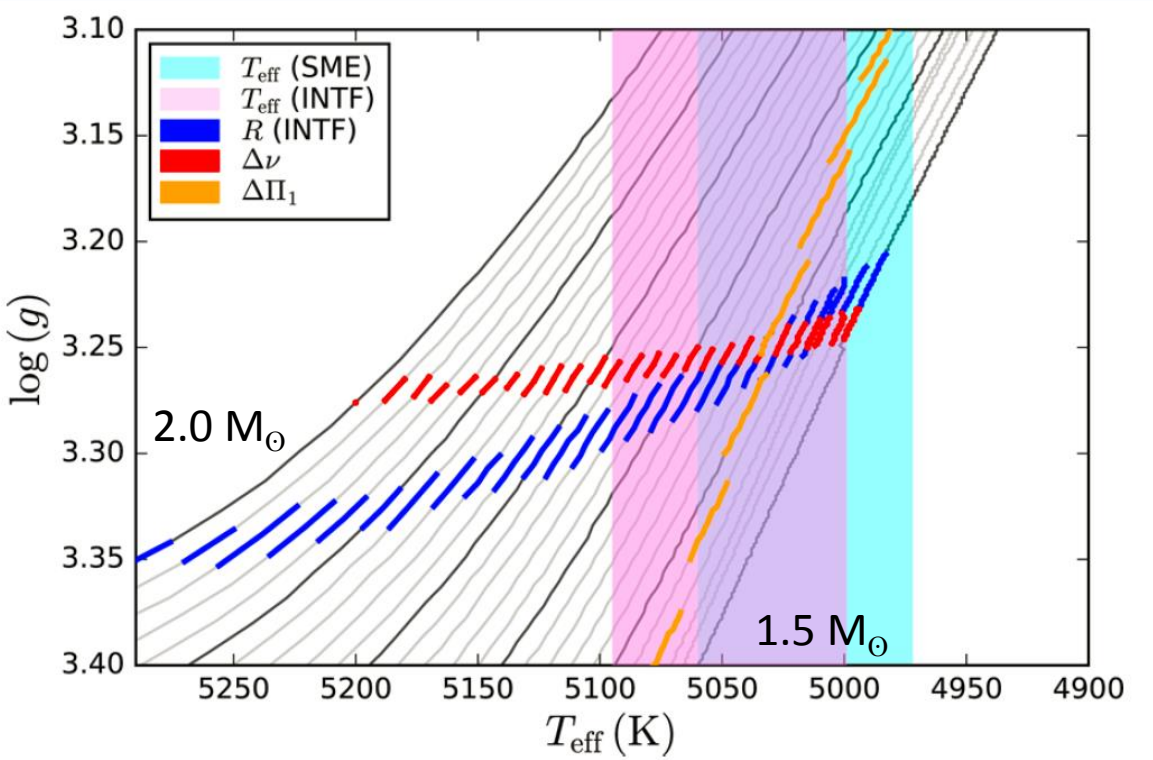
Hjørringgaard et al. 2017, MNRAS 464, 3713

Including convective core overshooting

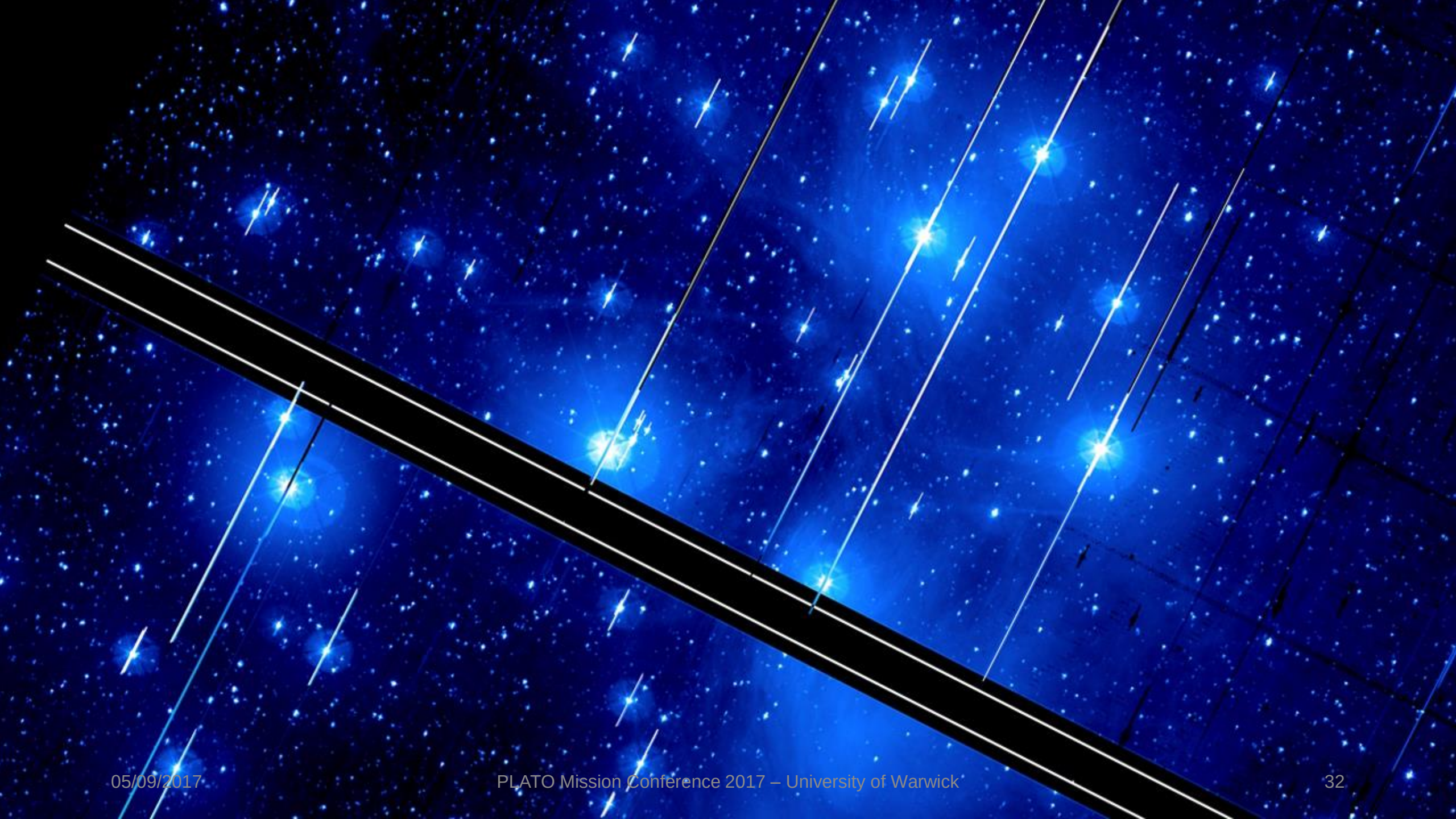
α_{MLT}= 1.791, f = 0



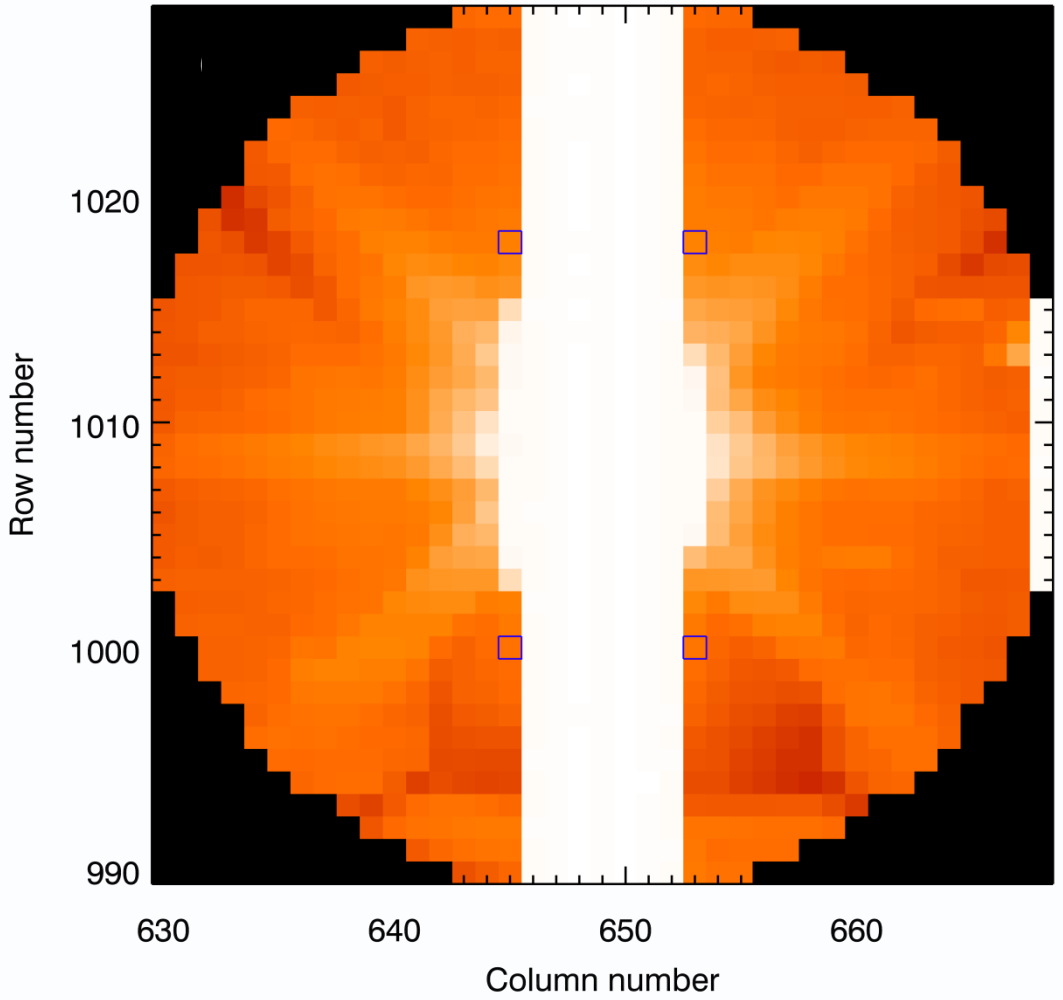
α_{MLT}= 2.00, f = 0.030

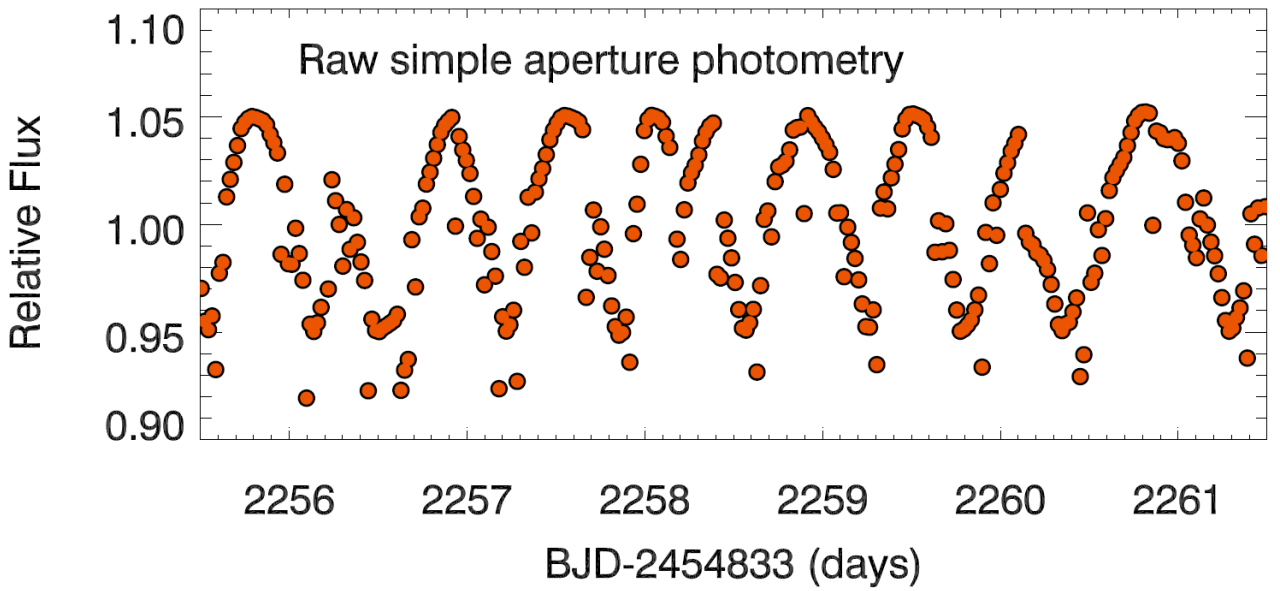


Hjørringgaard et al. 2017, MNRAS 464, 3713

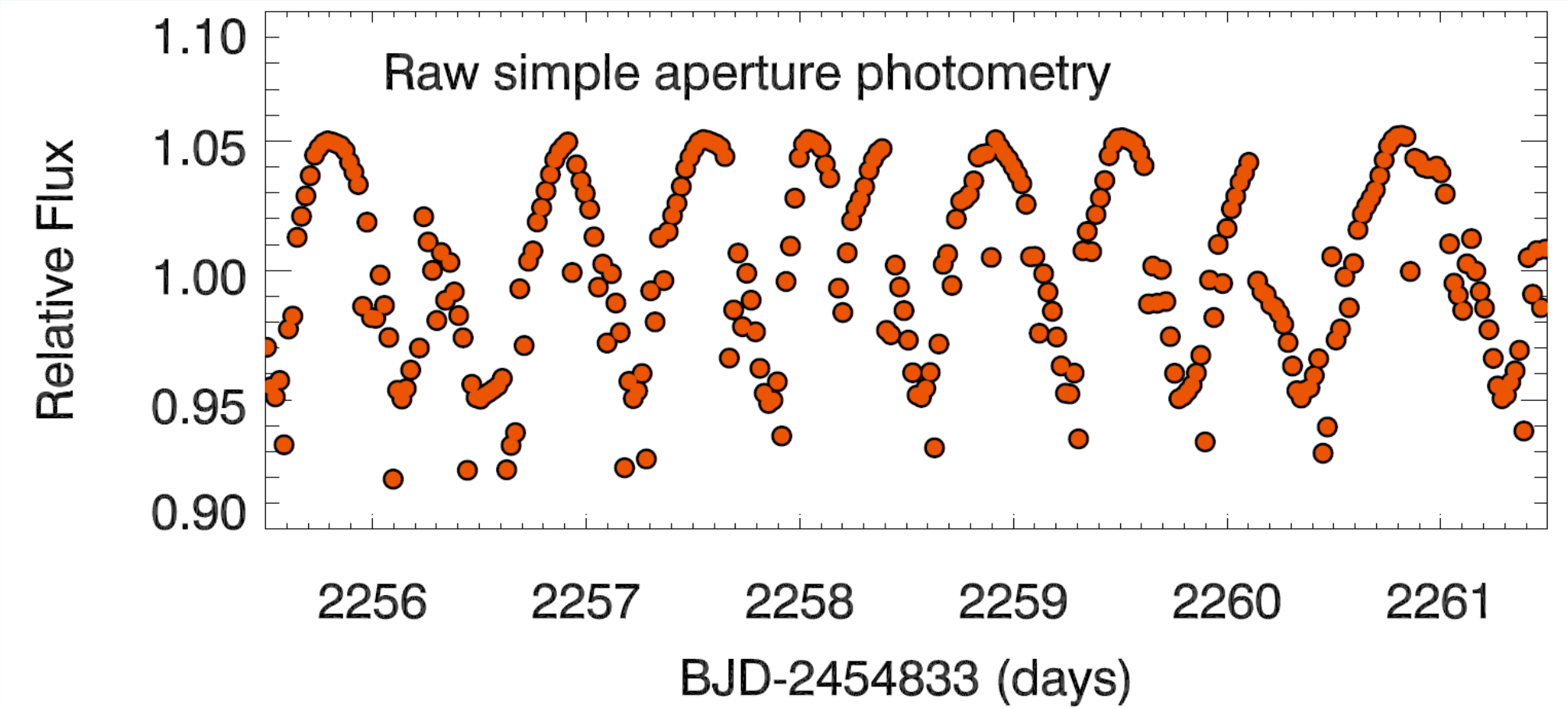


‘Halo’ photometry





White et al. 2017, MNRAS 471, 2882



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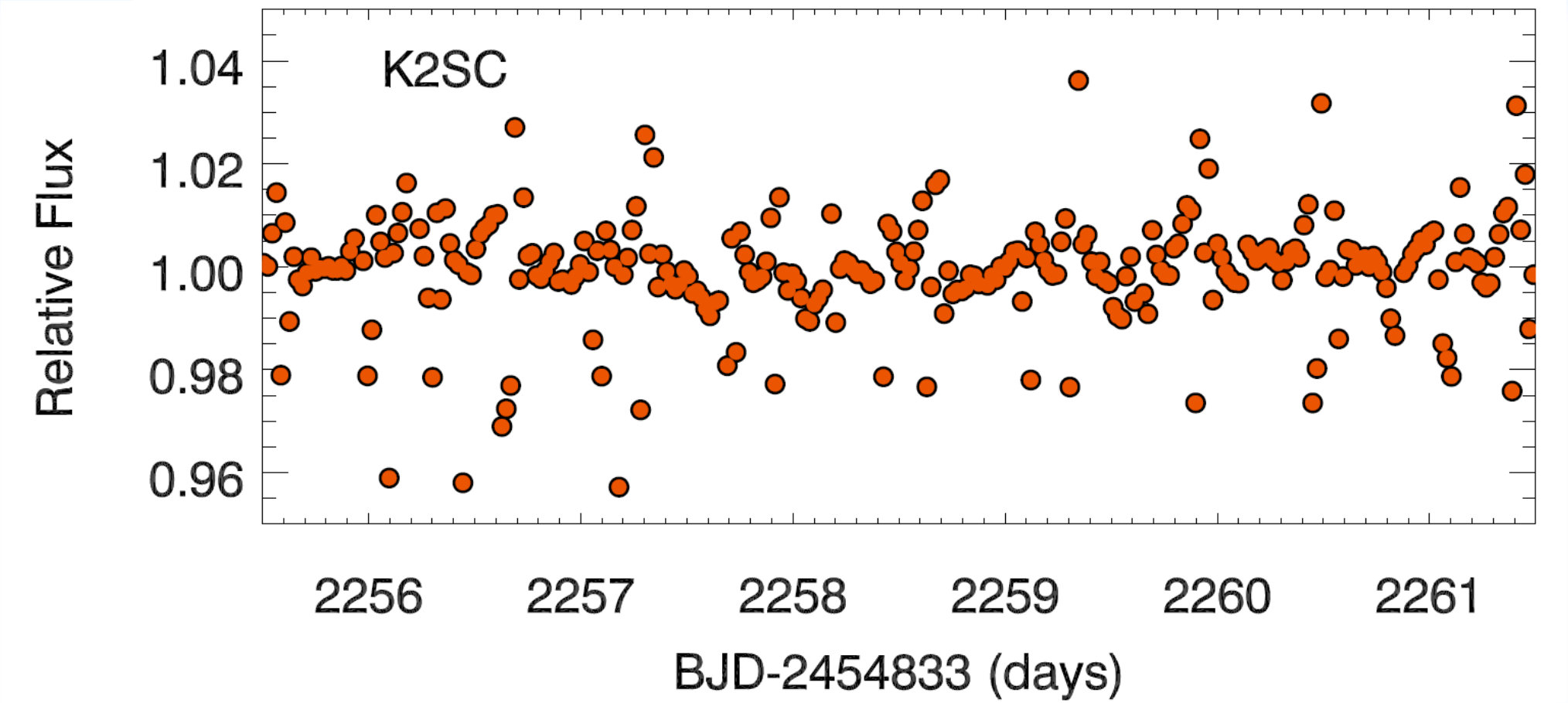
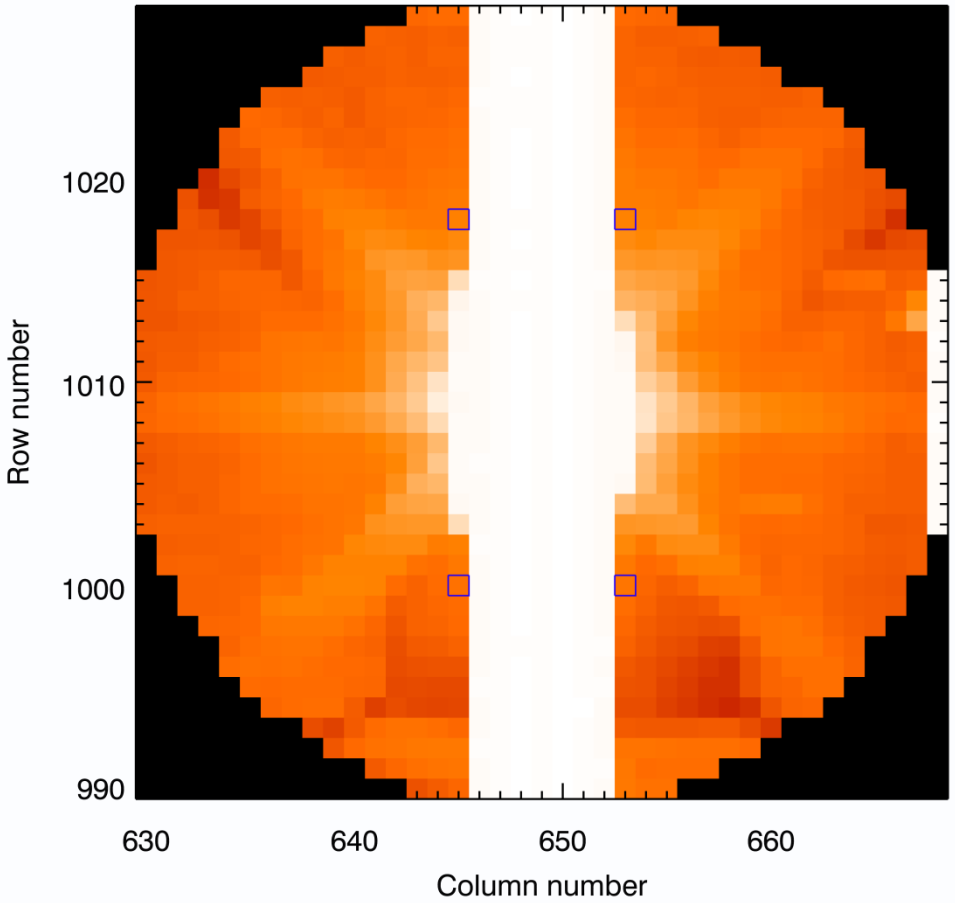


White et al. 2017, MNRAS 471, 2882

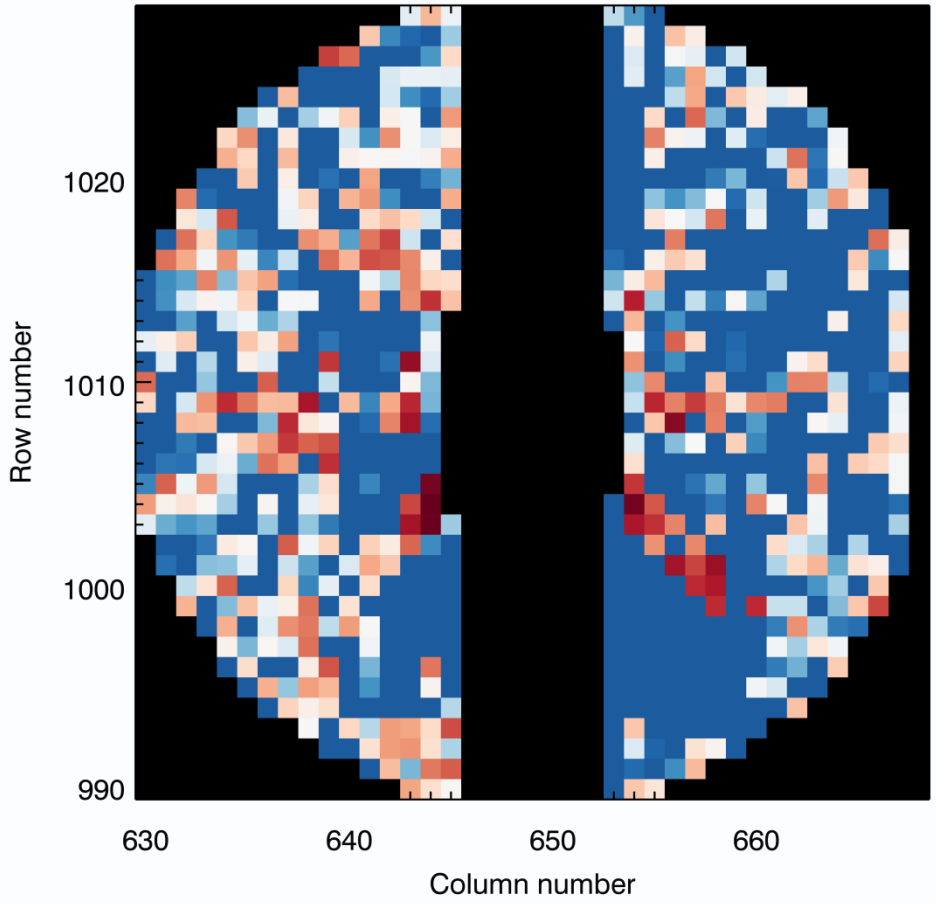
‘Halo’ photometry

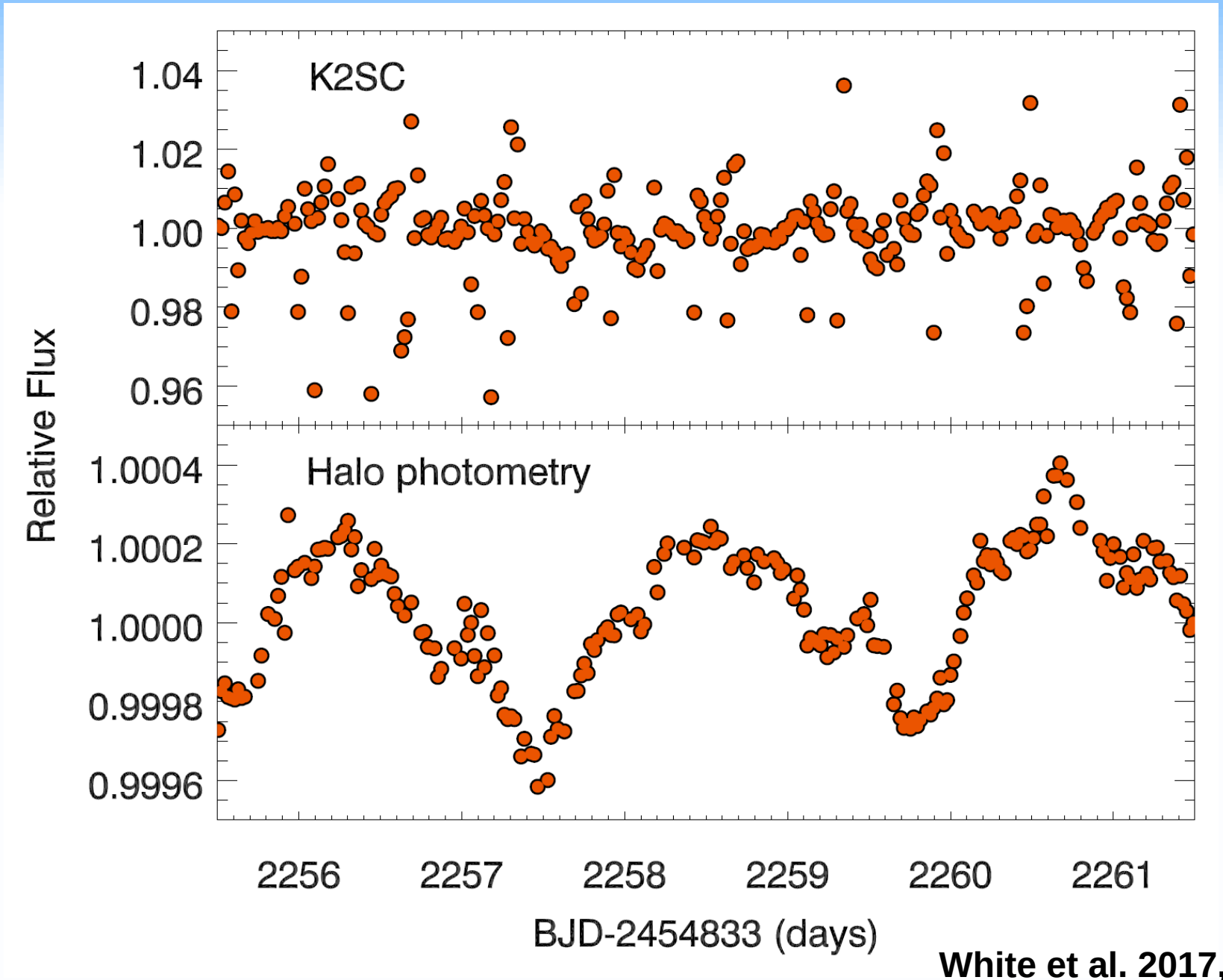
https://github.com/hvidy/halophot



$$f_i = \sum_{j=1}^{M} w_j p_{ij}$$

$$\mathrm{TV} = \frac{\sum_{i=1}^{N} |f_i - f_{i-1}|}{\sum_{i=1}^{N} f_i}$$





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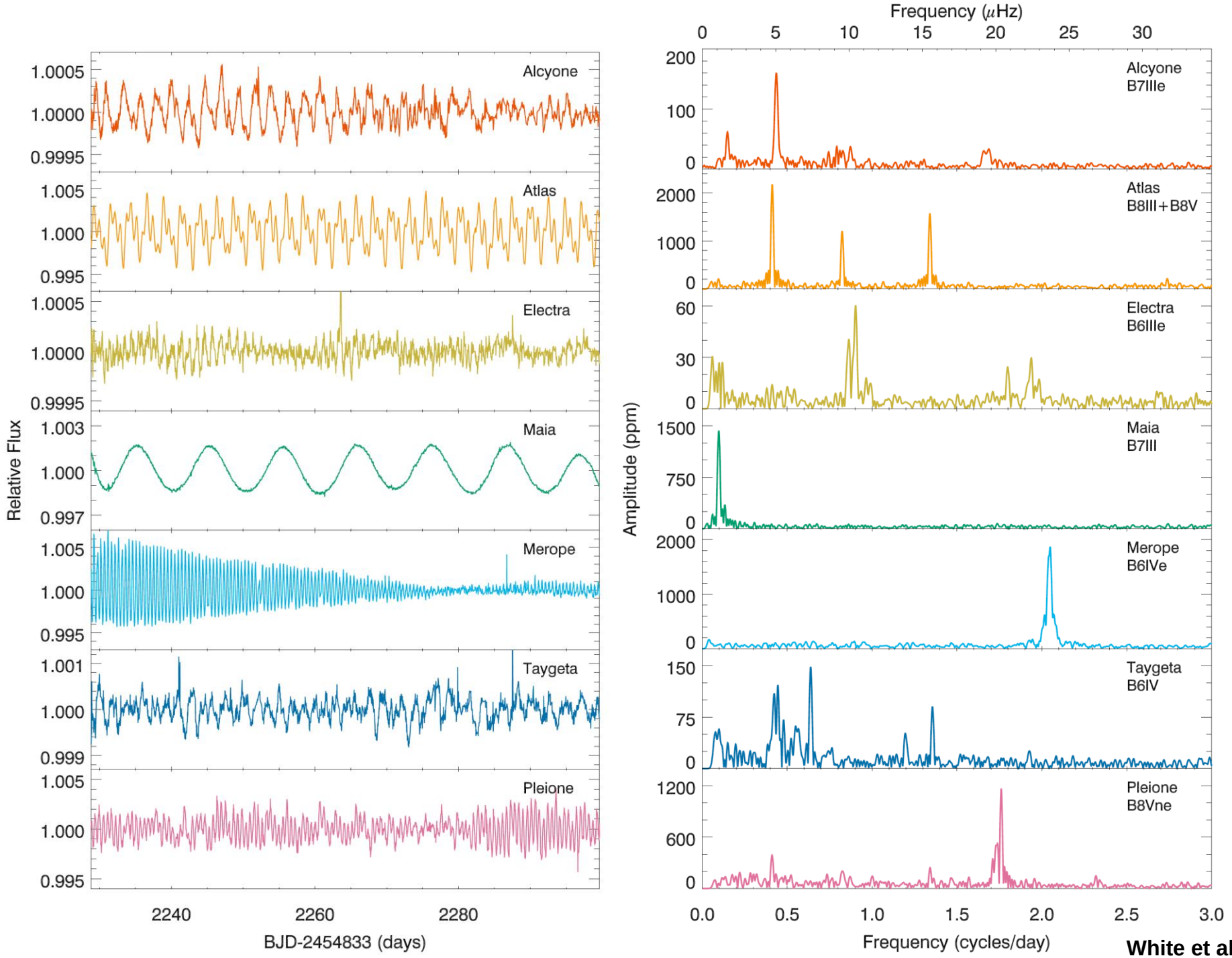

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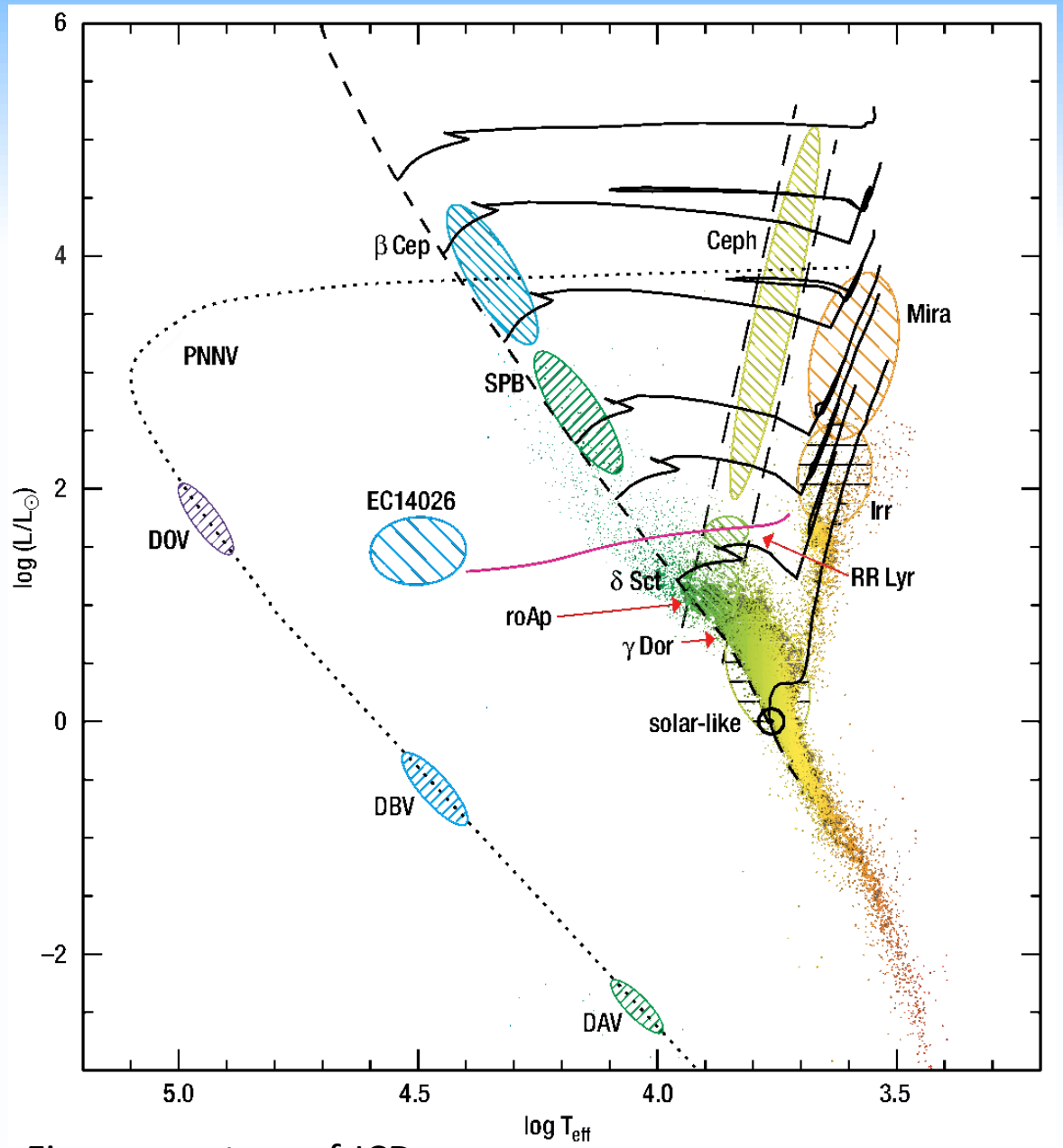


Figure courtesy of JCD

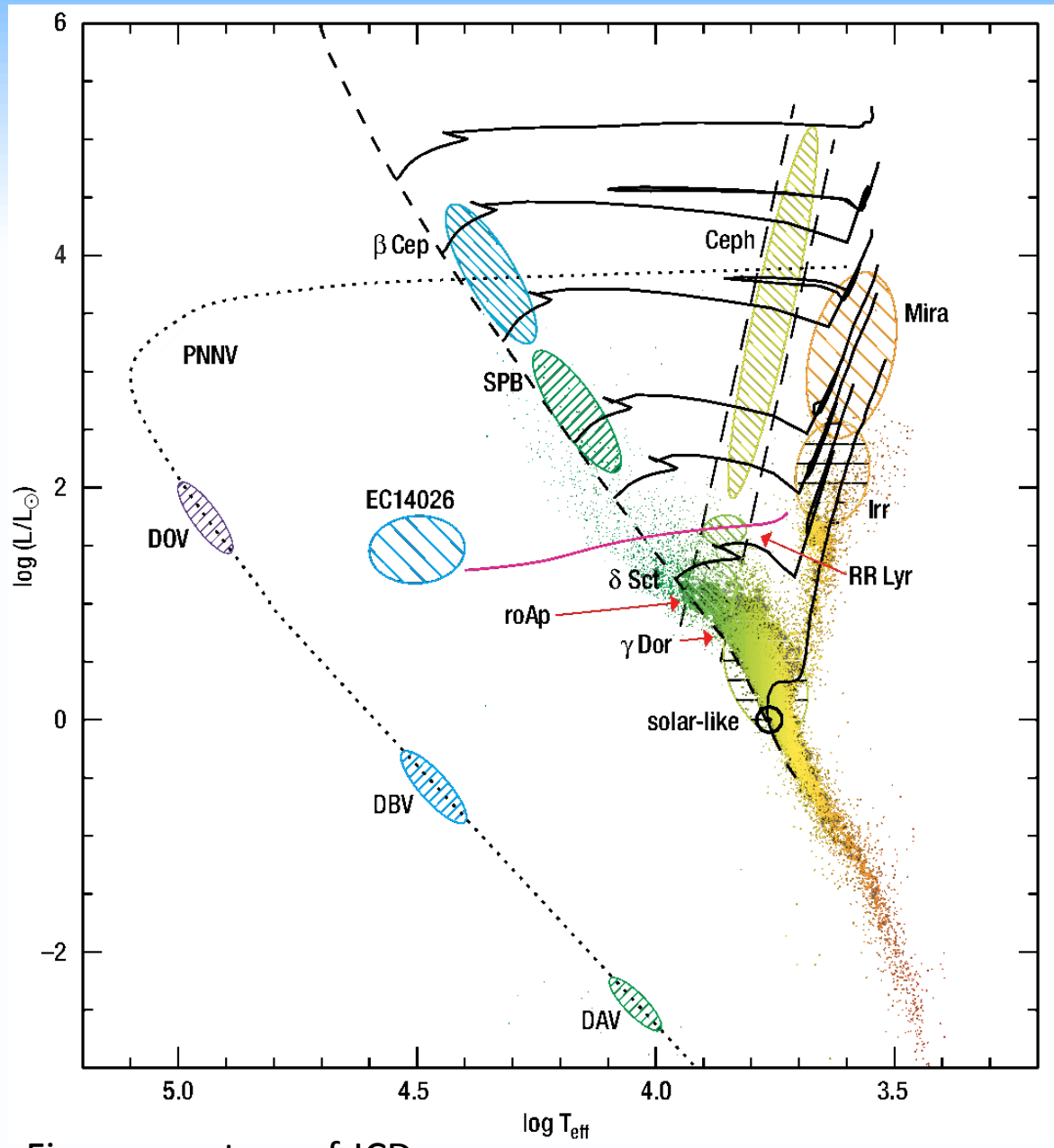
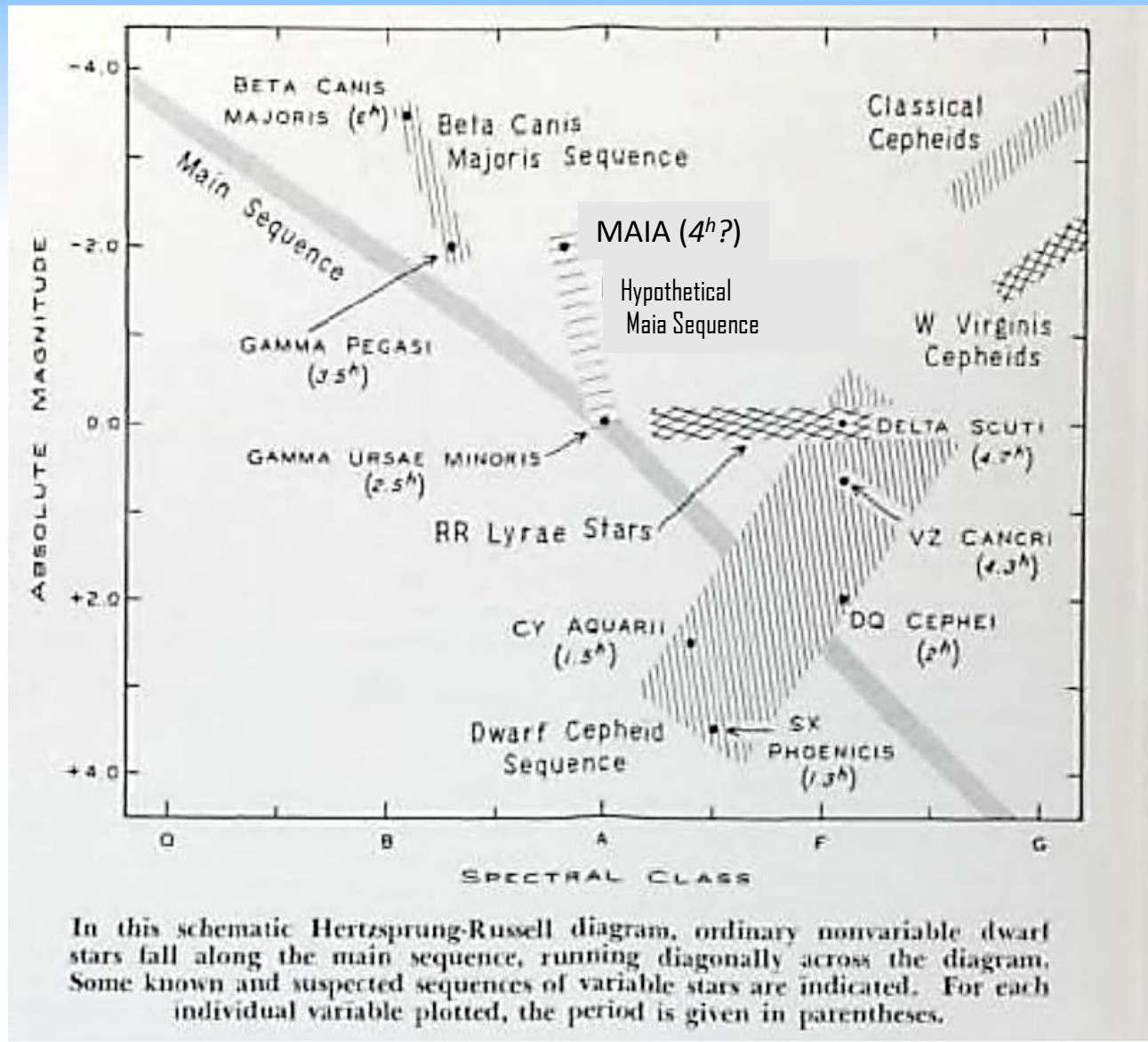
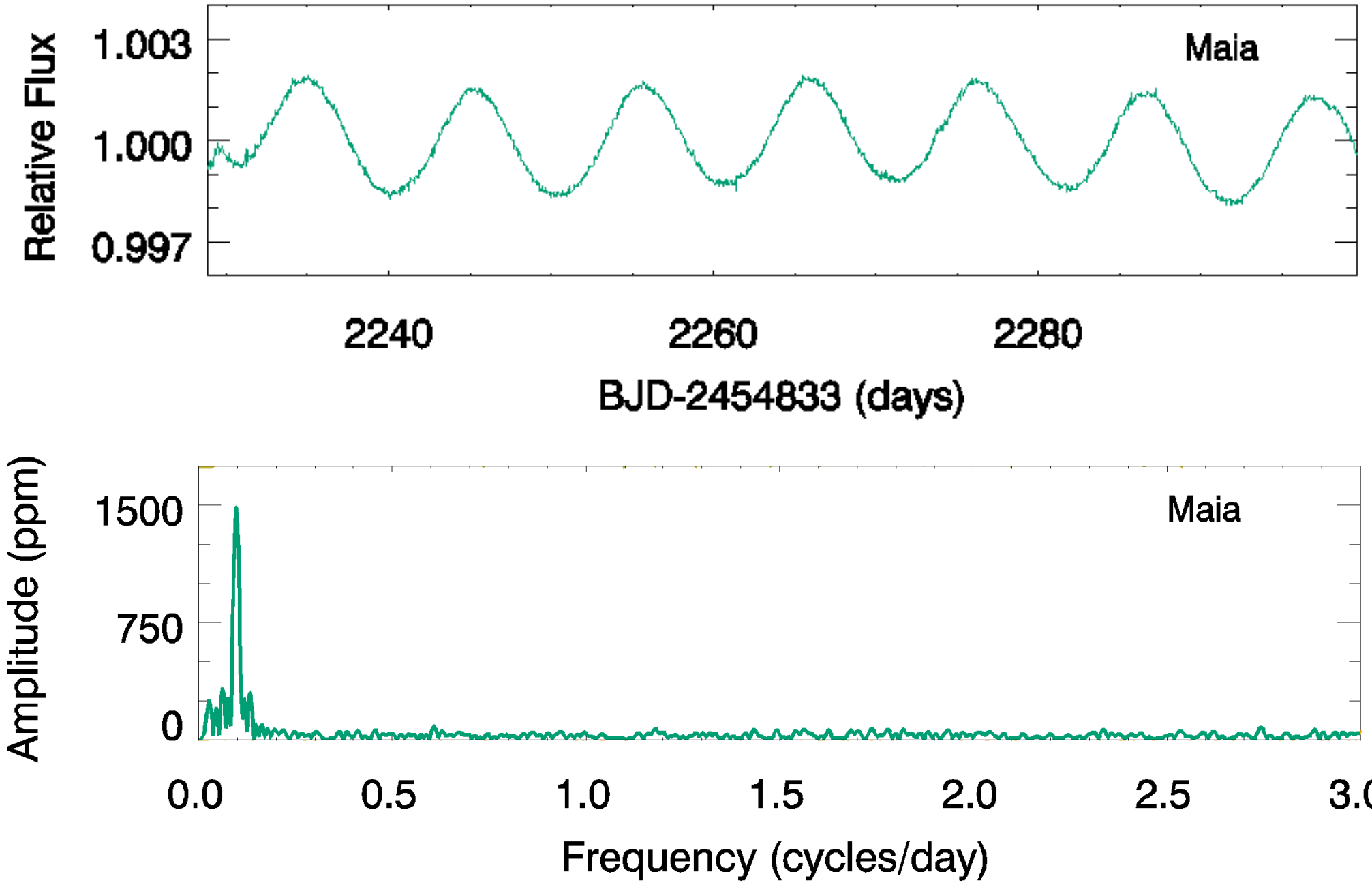


Figure courtesy of JCD



In this schematic Hertzsprung-Russell diagram, ordinary nonvariable dwarf stars fall along the main sequence, running diagonally across the diagram. Some known and suspected sequences of variable stars are indicated. For each individual variable plotted, the period is given in parentheses.

Struve 1955, Sky & Telescope 14, 461


Relative Flux
1.003
1.000
0.997
Maia
2240
2260
2280
BJD-2454833 (days)
Amplitude (ppm)
1500
750
0
Maia
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Frequency (cycles/day)

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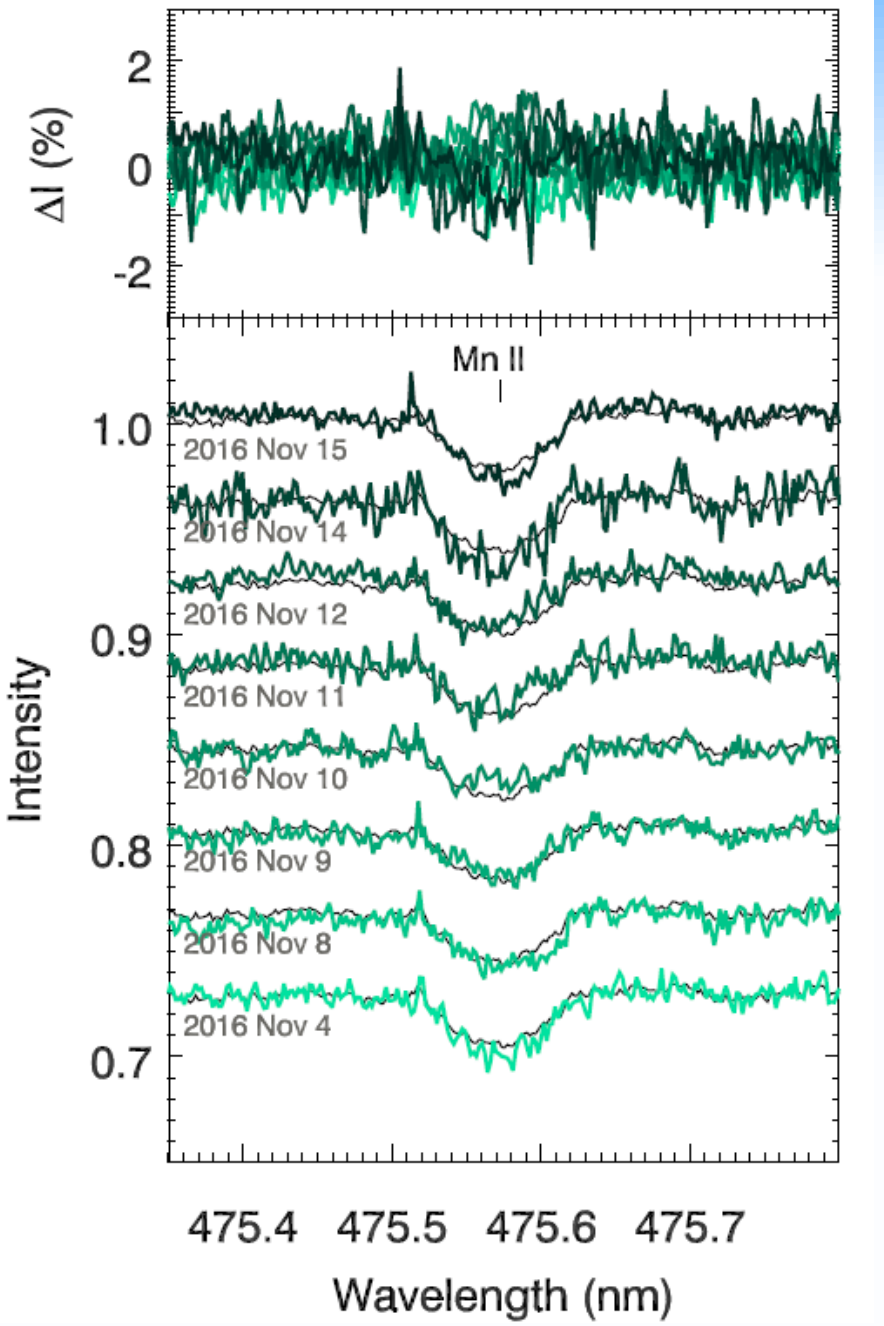
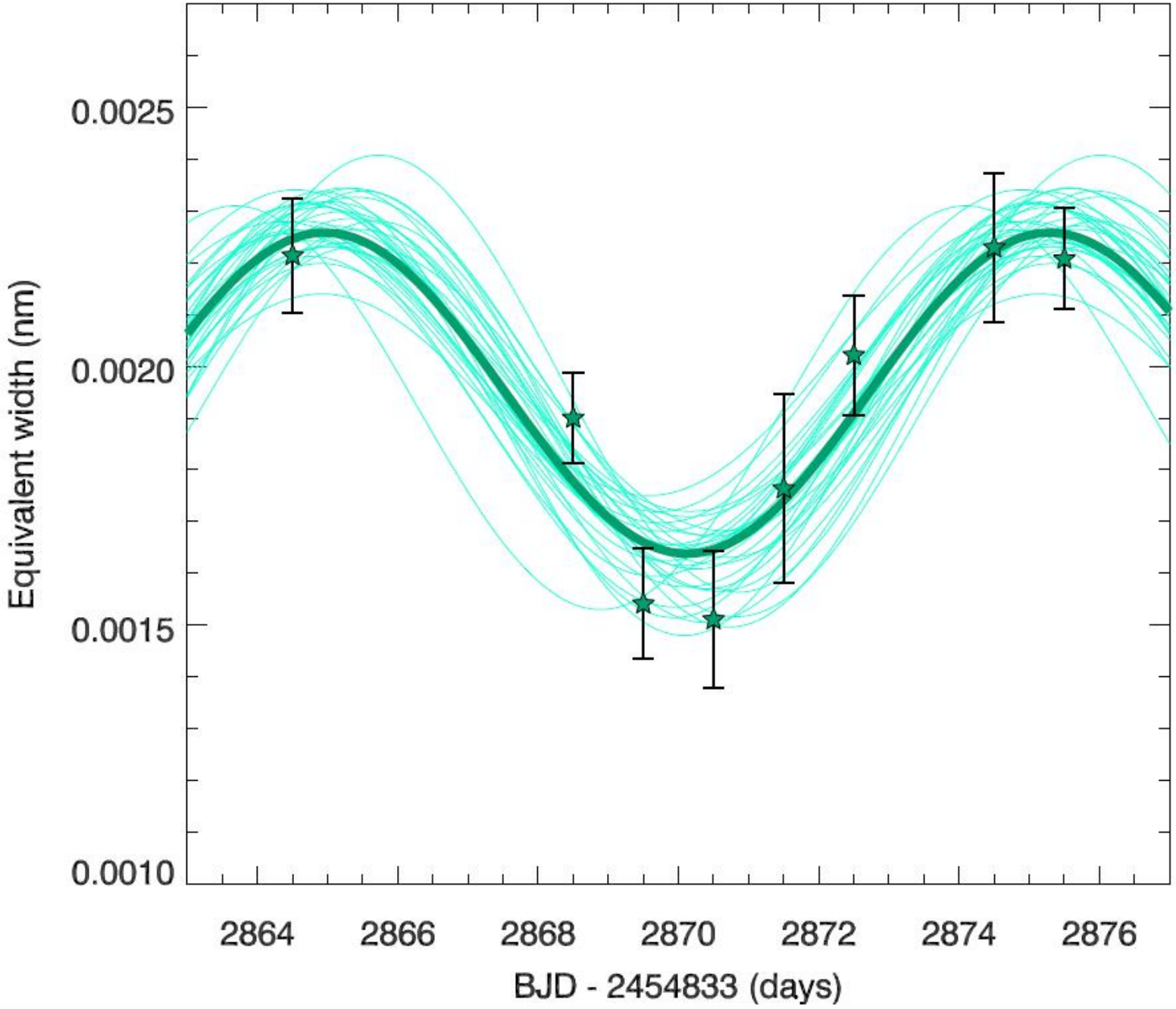
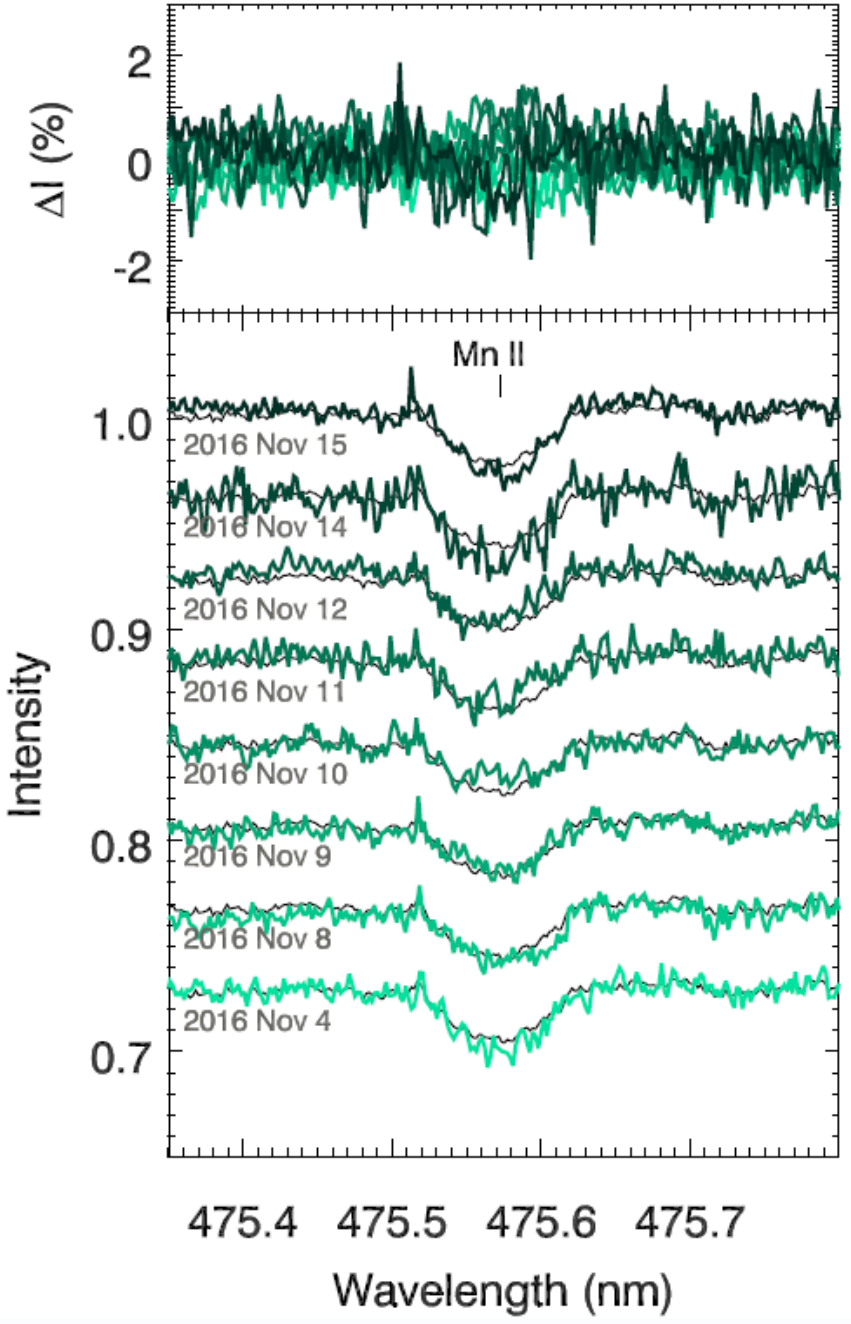
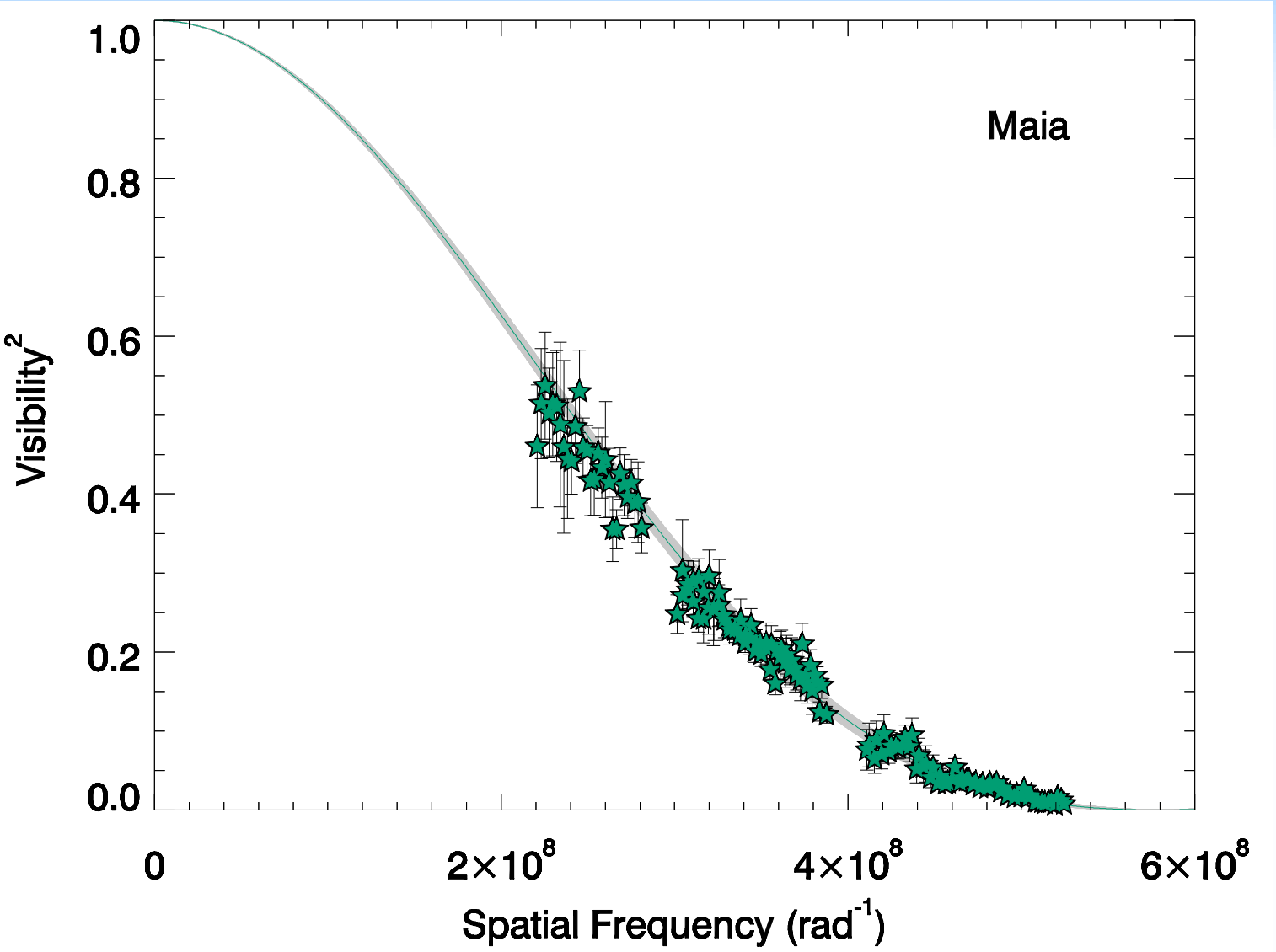



0.0025
0.0020
0.0015
0.0010
Equivalent width (nm)
2864
2866
2868
2870
2872
2874
2876
BJD - 2454833 (days)


2
0
-2
ΔI (%)
Mn II
1.0
0.9
0.8
0.7
Intensity
2016 Nov 15
2016 Nov 14
2016 Nov 12
2016 Nov 11
2016 Nov 10
2016 Nov 9
2016 Nov 8
2016 Nov 4
475.4
475.5
475.6
475.7
Wavelength (nm)



$$R = 6.61 \pm 0.11\ R_\odot$$

$$v \sin i = 33 \pm 5\ \mathrm{km\ s^{-1}}$$

$$T = 10.34 \pm 0.09\ \mathrm{d}$$

$$i = 90\ ^{+0}_{-30}\ ^\circ$$

Summary

The brightest stars provide the best opportunities to characterize stars and test stellar models.

We have learnt from previous missions how to overcome the problems caused by saturation to achieve high precision photometry. We will apply these lessons to observe the brightest stars with PLATO.