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Constraints on mass and effective temperature for pulsating white dwarfs from parallaxes

Agnès Kim, Ph.D.

White Dwarfs from Physics to Astrophysics
KITP, UC Santa Barbara, 14 November 2022

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Toward pipeline asteroseismic fitting of WD stars

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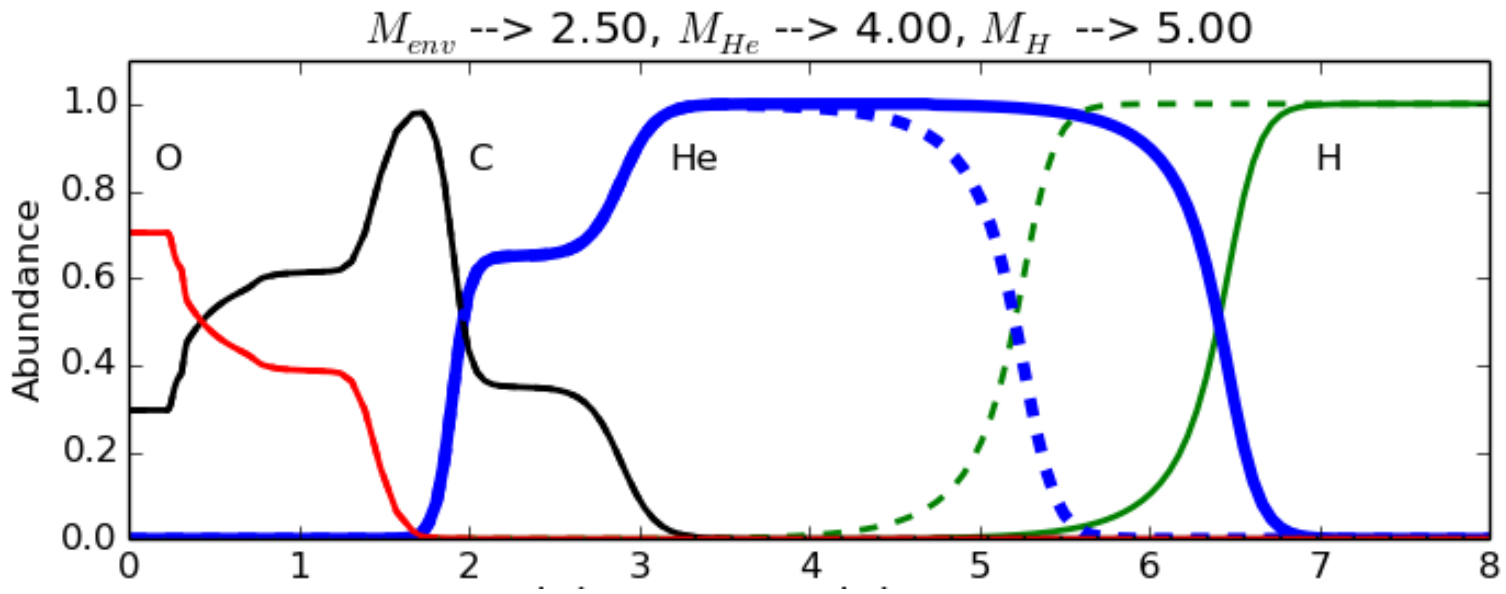
Introduction

- At last count, 50 known DBVs and 500 DAVs
- In WD asteroseismology, we still lack a pipeline
- Pioneering work: Castanheira & Kepler, 2009
- Problems:

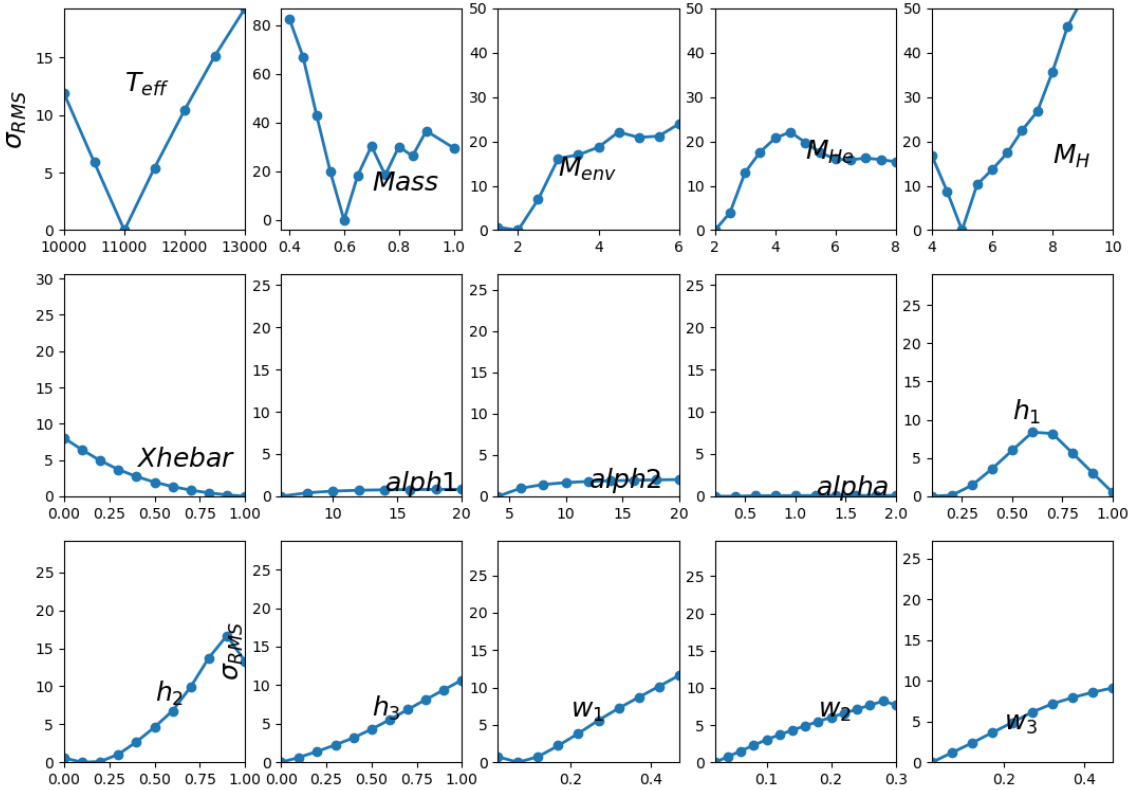
    - Parameterization that works for all
    - Mode identification (ell's and k's)
    - Uniqueness of solution

Parameterization

- Mass, effective temperature
- Envelope parameters
- Core parameters



Finding parameters that matter – Example R548



Results for 13 DAVs

			Envelope							Core					
	teff	mass	menv	mhe	mh	xhebar	alph1	alph2	alpha	h1	h2	h3	w1	w2	w3
BPM 30551	1	1	1	1	1	3	3	3	3	2	2	2	1	1	3
BPM 31594	1	1	1	1	1	3	3	3	3	3	2	2		3	3
EC 00497	1	1	1	1	1	3	3	3	3	3	3	1	1	3	3
EC 11266	1	1	3	1	1	3	3	3	3	3	1	3	3	3	3
EC 23487	1	1	2	1	1	3	3	3	3	1	1	2	1	1	2
HE 0532	1	1	1	2	2	2	3	3	3	3	1	3	2	1	2
HS 0507	1	1	2	2	2	3	3	3	3	2	2	2	2	3	3
HS 1013	1	1	1	1	1	3	3	3	3	3	1	2	3	3	2
J0925	1	1	1	1	1	3	3	3	3	2	3	3	2	2	3
L19-2	1	1	1	2	1	3	3	3	3	3	1	1	3	3	2
MCT 0145	1	1	1	1	1	3	3	3	3	3	2	2	1	1	1
R548	1	1	1	1	1	2	3	3	3	2	1	2	2	2	2
WD 0108	1	1	1	3	1	2	3	3	3	2	3	3	2	3	3

Takes too long to do it for each star!

- With this subset, explore if there is a correlation between the period spectrum and its sensitivity to a particular subset of parameters
- We expect that to be the case, though it's not simple (e.g. Bischoff-Kim A., 2017)
- If we can tell from the spectrum alone, which parameters matter the most, then that opens the way to improved pipeline fitting!

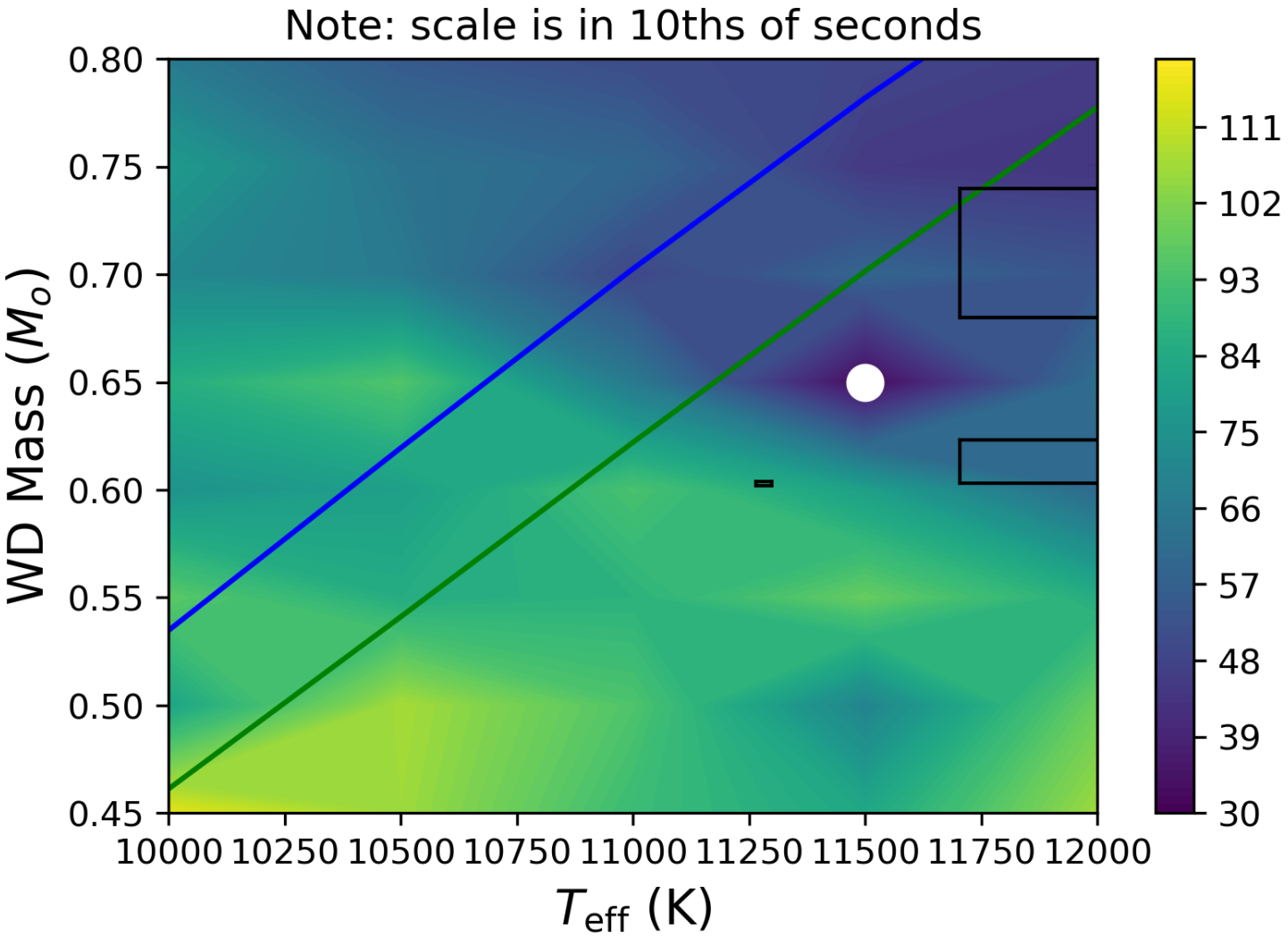
Choice of best fit models/ell identification

- Often, we get families of solutions
- We can narrow that down in the mass-effective temperature plane
- We've been using spectroscopy but that has its challenges
- We can improve on the constraints by folding in distances

The “Gaia lines”

- Use Gaia parallaxes, logg, and a mass-radius relationship. Advantage: we don’t need the effective temperature
- Carry the error bars in parallaxes and logg
- Use WDEC to determine mass-radius relationship. The mass-radius relationship is temperature dependent, but for the rest, we use a fiducial model

Example - EC23487



Conclusions

- I presented a path to improve pipeline fitting of WD period spectra
- Gaia parallaxes are a key part of the process
- One missing link is a systematic mapping between what parameters matter most and the types of period spectra

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