New Insights on Pulsating White Dwarfs from 3D Radiation-Hydrodynamical Simulations

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Golden Age for Asteroseismology and Galactic Archeology

K2 (-2016), Gaia (-2020), Hubble (-2020+), JWST (2018-2028), Euclid (2020-2026), TESS (2017-2019), Plato (2024-2030), LSST (2022-) ...

Is convection an hurdle in deriving precise individual stellar parameters?

Towards precise asteroseismology with white dwarfs
  -> unique constraints on the interior composition of cooling ages
Cooling pure-hydrogen (DA) atmospheres

ZZ Ceti instability strip
CO\textsuperscript{5}BOLD 3D simulations (Freytag et al. 2012)
Observed ZZ Ceti Instability Strip

Predicted ZZ Ceti Instability Strip (log $g = 8$)  

- 3D Seismic models ($\alpha = 0.4$)  
- 3D Seismic models ($\alpha = 2.0$)  

3 dex uncertainty in 1D
3D Simulations of Magnetic White Dwarfs

opacity profile (6500 K, log g = 8.0)

- convective driving unlikely
- $\kappa$-like mechanism possible but critically depends on the strength and geometry of the magnetic field
- magnetic white dwarfs can pulsate!
Conclusions

Improved 3D atmospheres for white dwarfs
• 3D radiation-hydrodynamics can be precise at the 1% level

Asteroseismology
• 3D spectroscopic parameters of pulsating ZZ Cetis different by up to 20%
• Position of the ZZ Ceti instability strip is similar to 1D
• 3D models confirm the accuracy of the seismic results close to the blue edge