Convective overshoot below **red giant** envelopes changes the **mixed mode asteroseimology** of stellar models as they evolve through the **luminosity bump.**

Mixed Mode Asteroseismology of Red Giants Through the Luminosity Bump

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INTRODUCTION

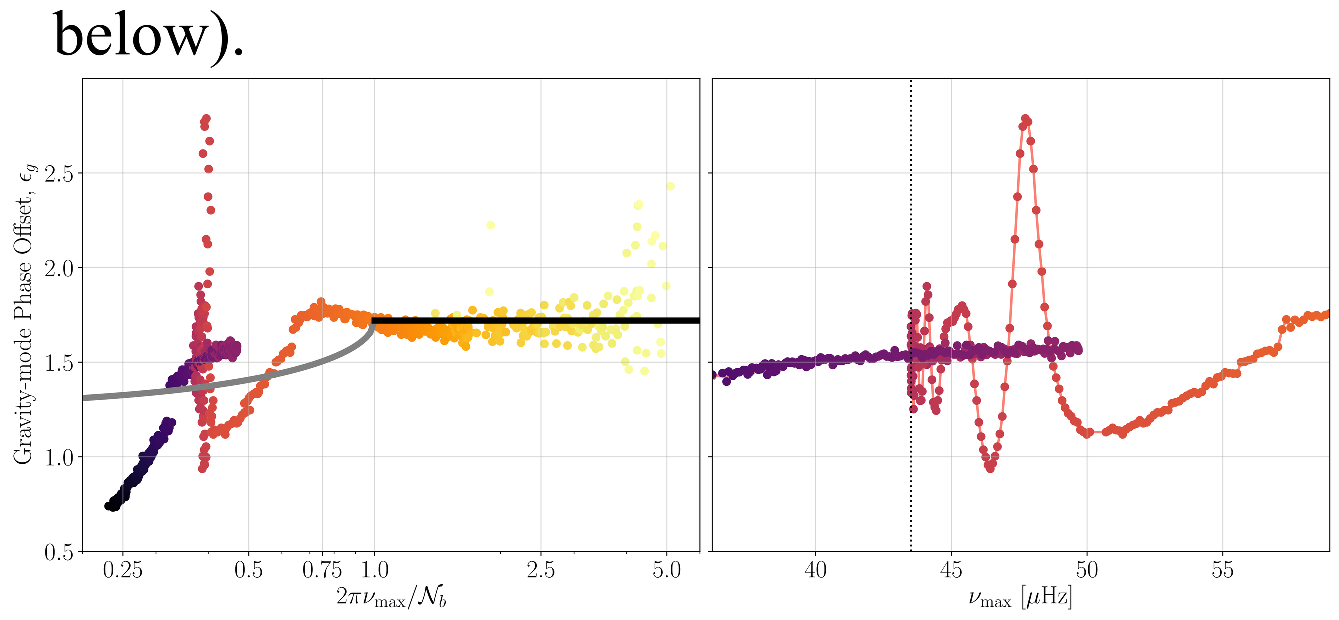
- Most models of **low mass red giants do not reproduce** the observed position of the red giant branch **luminosity bump**.
- **Convective overshoot** below the red giant convective envelope brings the modeled position of the luminosity bump to be **more in line with observations.**
- Red giant **mixed mode oscillations are dependent on the stellar structure** near the convective boundary.
- We performed a **modeling study** to investigate how **convective overshoot** changes the **asteroseismic** properties of red giants as they evolve up the red giant branch.

METHODS

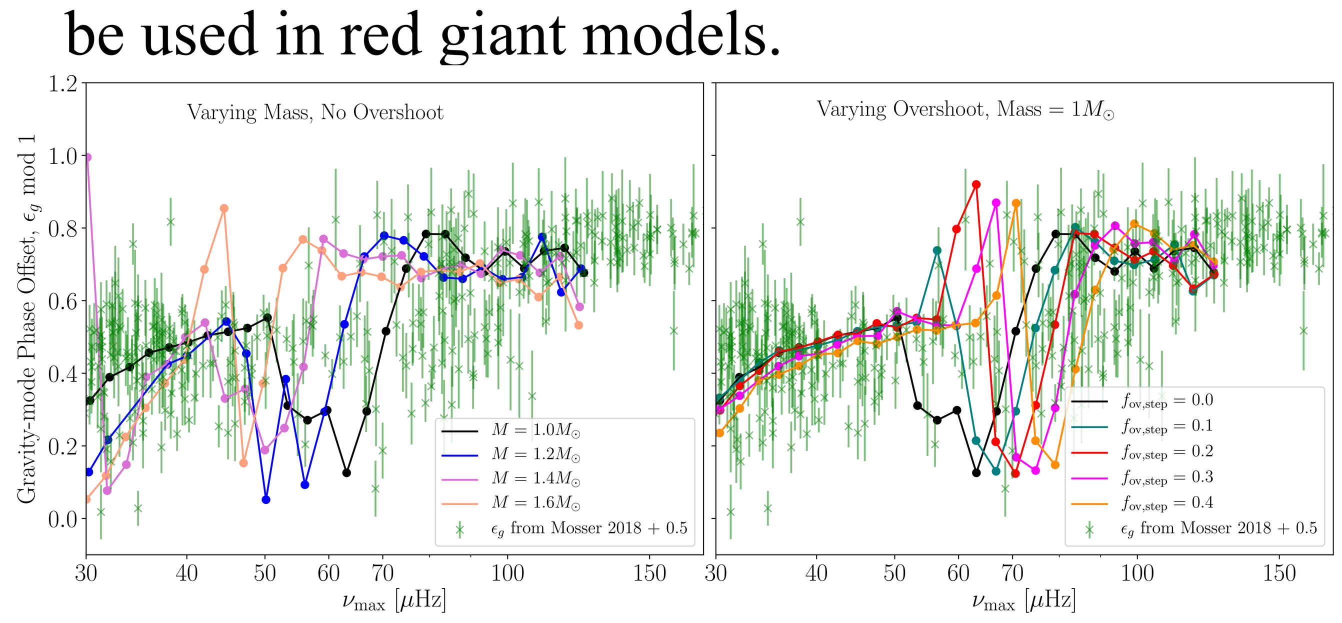
1. We produced a grid of red giant stellar models with **varying mass, metallicity, overshoot amplitude, overshoot profile shape,** and overshoot region **temperature gradient** using MESA. Varying the overshoot parameters **alters the structure** of the red giant just under the convective boundary.
2. Using GYRE, we calculated the **dipolar mixed mode oscillation frequencies** for each red giant model and compared the pairwise period spacings, period echelle diagrams, and gravity mode phase offset evolutions between tracks with **different overshoot prescriptions.**

RESULTS and DISCUSSION

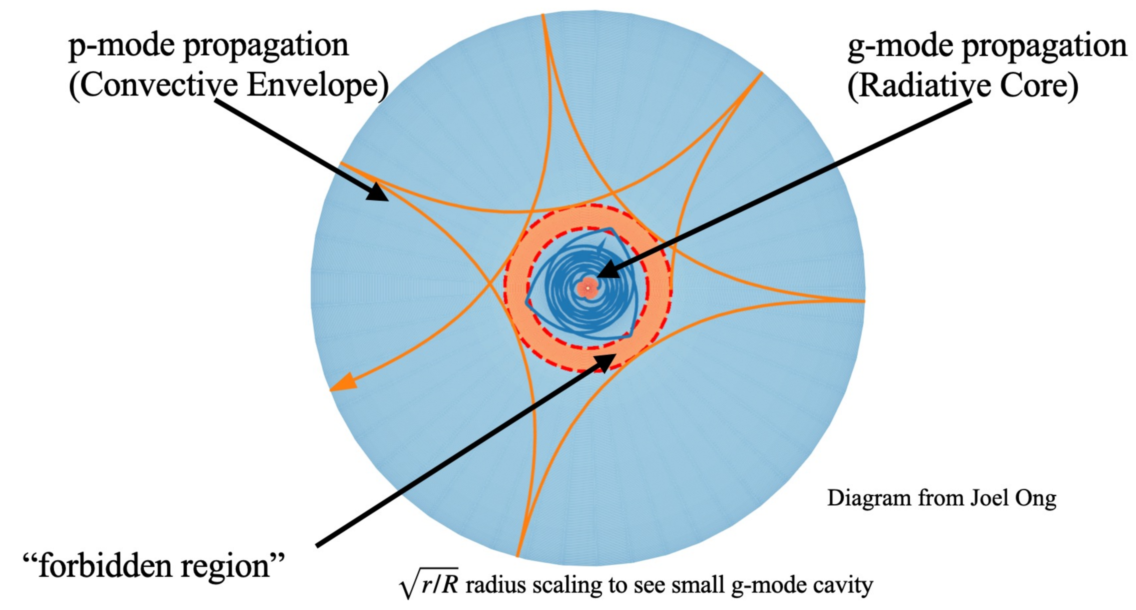
- The pattern of **period spacings** between adjacent mixed modes for red giant models at a given value of surface gravity is overshoot dependent.
- The **period échelle** diagrams showing mode frequency versus mode period modulo the calibrated period spacing evolves as the red giant model evolves but also depends on overshooting.
- Fitting the mode periods with; $\Pi(n_g, \ell) = \langle \Delta P \rangle (n_g + \epsilon_g)$ allows us to solve for the average **gravity mode phase offset term, ϵ_g**. The evolution of ϵ_g is complex though the reg giant branch bump (see below).



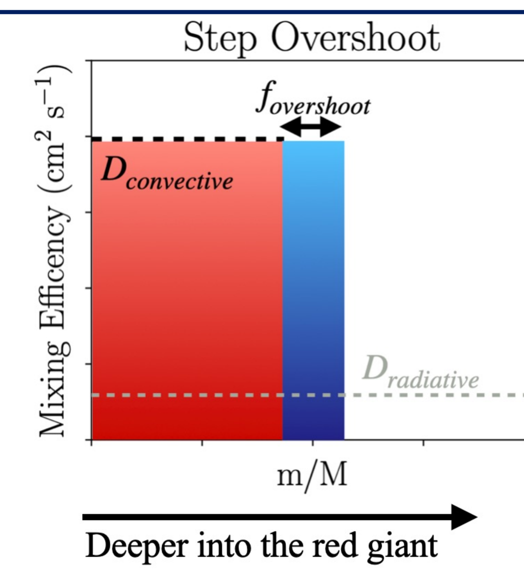
- The evolution of **ϵ_g is also dependent on the amount of convective overshoot** and, in conjunction with ϵ_g measurements from *Kepler* or *TESS* red giants, ϵ_g could be used to determine the **amount of envelope overshoot** which should be used in red giant models.



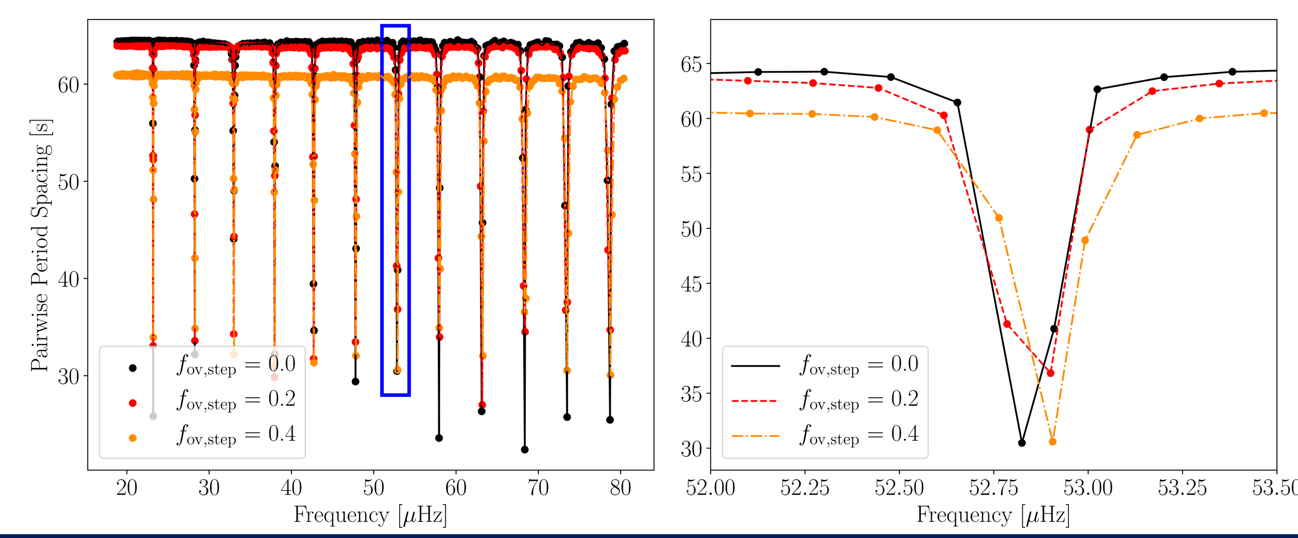
Red Giant Propagation Regions: Mixed modes sample the core/envelope boundary region.



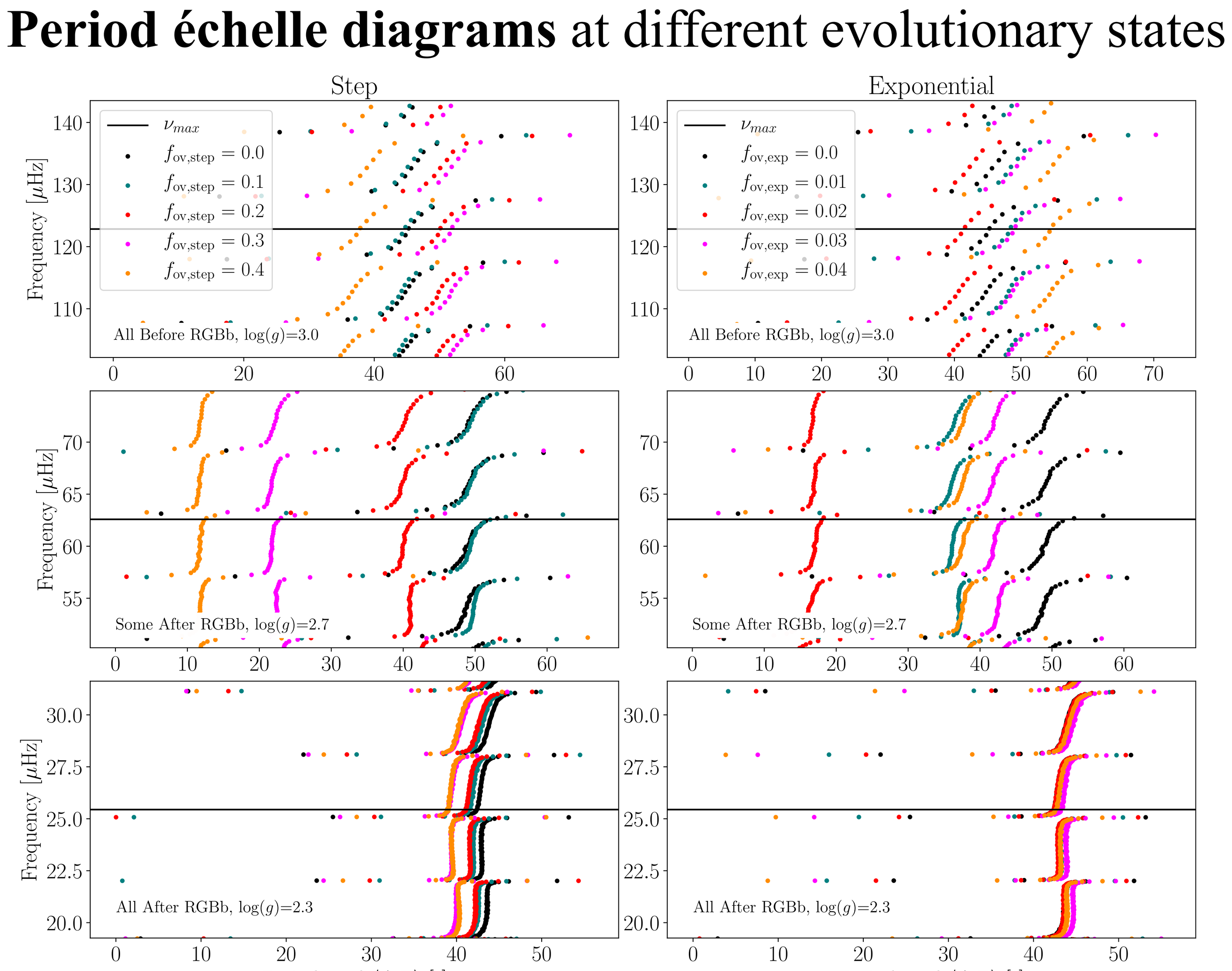
Right: Schematic showing step overshoot extending the well-mixed convective envelope.



Below: Pairwise period spacing versus mode frequency with zoom-in plot.



Period échelle diagrams at different evolutionary states



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Take a picture to download the full paper (Lindsay, Ong, and Basu 2022, ApJ) or email christopher.lindsay@yale.edu