# Convective overshooting in hydrodynamic simulations of the F-type eclipsing binary BW Aquarii

#### Mary Geer Dethero

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Jane Pratt (GSU) I. Baraffe (Exeter, ENS Lyon) & the MUSIC developers team

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Global stellar simulation of BW Aqr

Convective overshooting measurements

## Realistic stellar simulations with MUSIC

- Fully compressible hydrodynamic convection with the MUlti-dimensional Stellar Implicit Code (MUSIC).
- Global simulations of stars 95% of the stellar radius.
- Structure, equation of state, and opacities produced using MESA (Modules for Experiments in Stellar Astrophysics) stellar structure and evolution code.

radial velocity from MUSIC simulation run on Blue Waters (University of Illinois at Urbana-Champaign and the NCSA)



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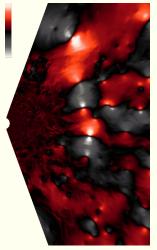
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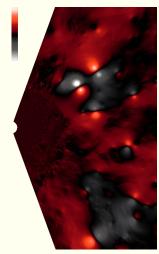
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### Size and structure of convective flows near boundary

A Star  $\begin{array}{c} M_A = 1.365 M_\odot \\ L_A = 9.836 L_\odot \end{array}$ 





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B Star  $\begin{array}{c} M_B = 1.483 M_{\odot} \\ L_B = 12.74 L_{\odot} \end{array}$ 

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Radial velocity (red outward, grey inward, black zero) overlayed with high vorticity magnitude (white).

#### **Conclusions and References**

- Preliminary results show that for the binary stars in BW Aquarii at the first dredge-up there is a difference in overshooting of 0.2H<sub>p</sub> (A star) vs 0.7H<sub>p</sub> (B star). This difference is slightly less than a factor of 4, which is the difference in overshooting programmed in the MESA model.
- In this work, BW Aquarii is modeled as two single stars. Next, we plan to include aspects of binary interactions in the multi-dimensional fluid simulations and see how the overshooting changes.

MUSIC webpage: http://www.astro.gsu.edu/~jpratt/ music\_webpage/music.html.

#### References:

Pratt, Baraffe, et al (2020). Comparison of 2D and 3D compressible convection in a pre-main sequence star. Astronomy Astrophysics, 638, A15. Baraffe, Pratt, et al (2017). Lithium depletion in solar-like stars: effect of overshooting based on realistic multi-dimensional simulations. ApJ Lett., 845(1), L6. Convective overshooting in hydrodynamic simulations of the F-type eclipsing binary BW Aquarii

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