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When Will Betelgeuse Explode? Numerical and Computational Approaches to Problems in Stellar Astrophysics



Alpha Orionis, popularly known as Betelgeuse, is a nearby red supergiant star visible to the naked eye. Oral records of Betelgeuse and similar bright, evolved stars span tens of thousands of years, and recorded observations can span centuries. When observational data have been collected over long enough periods of time, we can combine these rich archives with modern numerical and computational techniques to make predictions for the star's eventual fate.

The current controversy surrounding Betelgeuse concerns whether it will explode as a supernova within the next few years, centuries, or millennia. Using one-dimensional stellar evolution models, hydrodynamic simulations, linear oscillation calculations, Fourier analysis, and the techniques of a sub-field of stellar astrophysics known as asteroseismology, my collaborators and I have constrained the timeline for Betelgeuse's demise and revised many of the best estimates for its fundamental properties along the way. In this seminar, I will use the mystery of Betelgeuse's "Great Dimming" -- a sudden, extreme drop in the star's brightness that occurred in early 2020 -- to highlight the computational and numerical techniques employed in modern stellar astrophysics.

Short Bio

Dr Meredith Joyce began a professorship at the University of Wyoming (USA) in August of this year. She works on 1D stellar modeling, primarily with the MESA stellar structure and evolution code. Dr Joyce has been a member of the [MESA software developers team](#) since 2019 and plays a leading role in the annual MESA Summer School Programs, including serving as the program director for last year's workshop in Budapest. Dr Joyce's current research interests include the study of evolved, variable stars and reconstructing the evolutionary history of the Milky Way through age--metallicity relations in the Galactic Bulge. Dr Joyce is a world expert in 1D stellar modeling and uncertainty analysis and has recently authored an invited review on convection in

1D stellar models. She also consults on a diverse array of projects related to stellar physics, working closely with asteroseismologists, nuclear astrophysicists, and spectroscopists.

Dr Joyce completed her PhD at Dartmouth College in 2018 and has since held research positions and residences on five continents. She did a pre-doctoral research project at the University of Cape Town and the South African Astronomical Observatory; completed a postdoc at Australian National University; held a visiting residence at the Institute for the Physics and Mathematics of the Universe at the University of Tokyo, Japan; won the Lasker Data Science Prize Fellowship at NASA's Space Telescope Science Institute; held a visiting residence at the Kavli Institute for Theoretical Physics in Santa Barbara, California; and held one of Europe's most prestigious fellowships, the Marie Curie Fellowship (Widening designation), which she took to Konkoly Observatory In Budapest, Hungary. She enjoys a large, international network of collaborators who work in many different sub-disciplines.