

# Dr Meridith P. Joyce

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## Research Interests

Theoretical and computational astrophysics: stellar structure and evolution, precision stellar modeling across the mass spectrum, asteroseismology, stellar interiors, convection and mixing, numerical methods, astronomy software development.  
Optical astronomy: variable and oscillating stars, low-metallicity stars, globular clusters.

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## Academic Work Experience

RSAA Postdoctoral Fellow — Australian National University, September 2018–present  
South African Astronomical Observatory — Postgraduate research assistant, June 2017–November 2017  
Massachusetts Institute of Technology — Research assistant, June–August 2015  
Dartmouth College — Research assistant, September 2013–July 2018

## Positions Held Concurrently

ARC Centre of Excellence ASTRO3D — Associate investigator, November 2019–present  
Modules for Experiments in Stellar Astrophysics (MESA) developer, September 2019–present  
Konkoly Observatory — Visiting resident astronomer, periodic from January 2018–present  
University of Cape Town — Visiting academic, periodic from June 2017–January 2019

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## Education

Ph.D. Physics and Astronomy — Dartmouth College, 2015–2018 — Prof. Brian Chaboyer, adviser  
*On the Scope and Fidelity of 1-D Stellar Evolution Models*  
M.S. Physics — Dartmouth College, 2013–2015 — Prof. Brian Chaboyer, adviser  
*Investigating the Consistency of Stellar Evolution Models with Globular Cluster Observations via the Red Giant Branch Bump*  
B.Sc. Mathematics, B.Sc. Physics — Bucknell University, 2009–2013

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## Publications: First authorships and co-leads

1. **Meridith Joyce**, Shing-Chi Leung, László Molnár, Michael J. Ireland, Chiaki Kobayashi, Ken'ichi Nomoto, *Standing on the shoulders of giants: New mass and distance estimates for Betelgeuse through combined evolutionary, asteroseismic, and hydrodynamical simulations with MESA*, ApJ, October 2020
  2. Simon J. Murphy, **Meridith Joyce**, Timothy R. Bedding, Timothy R. White, Mihkel Kama *A precise asteroseismic age and metallicity for HD 139614: a pre-MS  $\lambda$  Boo star with a protoplanetary disk in Upper-Centaurus Lupus (MNRAS; in revision)* (lead: modeling)
  3. **M. Joyce**, L. Lairmore, D. J. Price, S. Mohamed, T. Reichardt, *Density Conversion between 1-D and 3-D Stellar Models with <sup>1D</sup>MESA2HYDRO<sup>3D</sup>*, ApJ, September 2019
  4. **Meridith Joyce**, *Asteroseismic Binaries as non-Solar Mixing Length Calibrators*, Proceedings of the conference Stars and their Variability Observed from Space, Vienna, Austria, August 2019
  5. L. Molnár, **M. Joyce**, L. Kiss, *Stellar Evolution in Real Time: Models Consistent with Direct Observation of a Thermal Pulse in T Ursae Minoris*, ApJ, July 2019 (joint first and corresponding author)
  6. **M. Joyce** and B. Chaboyer, *Classically and Asteroseismically constrained 1D Stellar Evolution Models of  $\alpha$  Centauri A & B using Empirical Mixing Length Calibrations*, ApJ, September 2018
  7. **M. Joyce** and B. Chaboyer, *Not All Stars Are the Sun: Empirical Calibration of the Mixing Length for Metal-Poor Stars Using 1-D Stellar Evolution Models*, ApJ, March 2018
  8. **M. Joyce** and B. Chaboyer, *Investigating the Consistency of Stellar Evolution Models with Globular Cluster Observations via the Red Giant Branch Bump*, ApJ, December 2015
- + Seven poster contributions; see personal ADS library for more information

## Publications: Contributing

9. Amanda Karakas, Giulia Cinquegrana, **Meridith Joyce**. *The most metal-rich asymptotic giant branch Stars (in prep)*
10. Michael Hayden et al., including 30 co-authors (**Meridith Joyce** at position 24) *the GALAH Survey: Chemical Clocks (submitted to MNRAS)*
11. Margaret Streamer, Michael J. Ireland, **Meridith Joyce**, Simon J. Murphy, Maruša Žerjal. *RZ Mic: Identified modes in an Algol-type eclipsing binary with a  $\delta$  Sct component (submitted to MNRAS)*
12. Yixiao Zhou, Thomas Nordlander, Luca Casagrande, **Meridith Joyce**, Yaguang Li, Anish Amarsi, Martin Asplund, Henrique Reggiani *The relationship between photometric and spectroscopic oscillation amplitudes from 3D stellar atmosphere simulations (recommended for publication in MNRAS, in revision)*

13. Lorenzo Spina, Yuan-Sen Ting, Gayandhi M. De Silva, Neige Frankel, Sanjib Sharma, Tristan Cantat-Gaudin, **Meridith Joyce** and 24 others from the GALAH collaboration *The GALAH survey: a comprehensive study of Open Clusters in the era of Gaia and large spectroscopic surveys (submitted to MNRAS)*
14. Yixiao Zhou, Martin Asplund, Remo Collet, **Meridith Joyce**, *Convective excitation and damping of solar-like oscillations*, MNRAS, May 2020
15. Daniel L. Holdsworth, H. Saio, D.M. Bowman, D.W. Kurtz, R. R. Sefako, **M. Joyce**, T. Lambert, B. Smalley, *Suppressed phase variations in a high amplitude rapidly oscillating Ap star pulsating in a distorted quadrupole mode*, MNRAS, January 2018

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## Select Talks

- Invited colloquium (host Chiaki Kobayashi), Univeristy of Hertfordshire, UK, November 2020
- Invited virtual seminar (host Saida Caballero-Nieves), Florida Institute of Technology, November 2020
- Invited group meeting presentation (host Lars Bildsten), Kavli Institute for Theoretical Physics, UCSB, November 2020
- Invited virtual seminar (host Sarbani Basu), Yale University, November 2020
- Invited virtual seminar (host Josiah Schwab), University of California, Santa Cruz, November 2020
- Invited virtual seminar, Space Telescope Science Institute, November 2020
- Invited virtual colloquium (hosts Onno Pols, Saskia Hekker), Radboud University, Netherlands & Heidelberg Institute for Theoretical Studies, Germany, October 2020
- Invited virtual colloquium (host Richard Townsend), University of Wisconsin, Madison, October 2020
- Invited virtual seminar (host Jan Eldridge), University of Auckland, New Zealand, October 2020
- Invited virtual seminar (host Craig Wheeler), University of Texas, Austin, September 2020
- Invited virtual seminar (host Charlie Conroy), CfA Seminar Series, Harvard University, September 2020
- Invited virtual seminar (host Selma de Mink), Stellar Research Group, Harvard University, September 2020
- Invited virtual seminar (host Victor Silva Aguirre), TASOC and Aarhus University, August 2020
- Invited talk, Australian Institute for Theoretical Astrophysics Conference, UNSW Canberra, Australia, February 2020
- Invited seminar (host Ken'ichi Nomoto), Institute for the Physics and Mathematics of the Universe, University of Tokyo, Japan, January 2020
- Invited speaker and **session chair**, Stars in Melbourne, Monash University, Melbourne, Australia, December 2019
- Astronomy on Tap** public lecture, Budapest, Hungary, September 2019  
*From Light to Insight: How computer modeling lets us watch stars die*
- Contributed talk, A Star Has Evolved, Smögen, Sweden, August 2019
- Contributed talk, Stars and their Variability, Universität Wien, August 2019
- Contributed talk, Stellar Archaeology as a Time Machine to the First Stars, Kavli IPMU, Japan, December 2018
- Contributed talk, Advances with SALT, Pretoria, South Africa, November 2018
- Invited seminar; SINS group meeting (host Amanda Karakas), Monash University, Melbourne, Australia, October 2018
- Invited seminar (host Mónica Jurkovic), Astronomical Observatory of Belgrade, Belgrade, Serbia, September 2018
- Public astronomy nights **outreach lecture series**, SAAO, Cape Town, South Africa, February 2018  
*Stellar Stories: Filling in the Observational Gaps with Computer Models of Stars*
- Invited Astronomy Seminar (host Conny Aerts), KU Leuven, Belgium, January 2018
- Invited Astronomy Colloquium (host Maria Lugaro), Konkoly Observatory, Hungary, January 2018
- Invited Astronomy Colloquium (host Paolo Ventura), Rome Observatory, Italy, January 2018
- New England Graduate Women in Science and Engineering (NE GWISE) Retreat, Boston University, August 2017  
*Supporting Women's Advancement in Science*; Dartmouth's representative speaker

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## Programming and Software Development

I am the most junior MESA developer and the second woman to join the team. I am the primary author and maintainer of the open-source Python package <sup>1D</sup>MESA2HYDRO<sup>3D</sup>. I have designed MESA-based exercises for undergraduate astronomy courses and written a range of publicly available visualization tools for stellar structure and evolution and asteroseismic data. My contributions can be explored at <https://github.com/mjoyceGR>

**Languages:** fluent in Python2, Python3, Bokeh, Jupyter, L<sup>A</sup>T<sub>E</sub>X, bash, command line tools; proficient in Fortran, Fortran 90, awk, Mathematica, MATLAB; some exposure to Perl, C, R, html, IRAF

**Astronomy-specific:** MESA, GYRE, DSEP, Phantom, MIST; familiar with many stellar evolution programs and databases

**General tools:** Linux/Unix environment (Ubuntu, Red Hat, CentOS), bash, Overleaf, make, git, svn, Libre Office, Windows OS, Microsoft Office (Word, Excel, Powerpoint), Android, OpenMP, MPI, hdf5

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## Proposals, Grants, & Awards

- o ARDC Australian Data Partnerships ADP20E-757 *Building a National Data Asset with The Australian Astronomical Theory Hub* Simon O’Toole, Ashley J. Ruiter, **Meridith Joyce (Co-I)**, Amanda Karakas, Timothy R. Bedding
- o ADACS (Australian Data and Computing Services) Merit Allocation program, GPU optimization of MESA (Modules for Experiments in Stellar Astrophysics), **PI** (under consideration)
- o RSAA Distinguished Visitors Program, *Seismic Evolution of Variable Stars*, **Meridith Joyce** and László Molnár, March 2020
- o Observing proposal *Preliminary Low-Resolution Spectra of Metal-Poor Stars with HST Parallaxes*, 1.9m, SAAO, November 2017
- o Research Grant from the Neukom Institute for Computational Science, December 2017
- o Research proposal *On the origin of circumstellar CO shells surrounding thermally pulsating AGB stars*, SAAO, March 2017
- o Dartmouth Alumni Research Award, June 2017
- o American Astronomical Society’s Chambliss Graduate Student Poster Competition, Honorable Mention, 2016

Additionally, I was a co-investigator on three highly ranked but ultimately unfunded proposals for the 2019–2020 round:

*The Constellation network of networks*, AccelNet, National Science Foundation, PI Frank Timmes

*Asteroseismology and mapping with cosmic lighthouses*, European Research Council Starting Grant, PI László Molnár

*Pioneering stellar physics through asteroseismic laboratories*, Lendület scheme, Hungarian Academy of Sciences, PI László Molnár

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## Teaching Experience

Australian National University — **Lecturer**, Astronomy 3006: Stars, February–June 2020

University of Cape Town — Teaching assistant & contributing lecturer, computational astrophysics, February–April 2018

South African Astronomical Observatory — Guest Lecturer, NASSP Summer School, South Africa, January–February 2018

University of Cape Town via Dartmouth College — Teaching assistant, Dartmouth Foreign Studies Program, Cape Town, South Africa, January–March 2017

Dartmouth College — Teaching assistant, September 2013–July 2018

Dartmouth College Fitness and Recreation — dance instructor, April 2015–June 2017

## Higher Degree Research Supervision

- **Primary supervisor** of RSAA Ph.D. student Yixiao Zhou, March 2020–present
- **External co-supervisor** of Monash University Ph.D. student Giulia Cinquegrana, August 2020–present
- **Primary supervisor** of RSAA Ph.B. summer scholar program student Jianling Tang, November 2020–January 2021
- Currently involved in four student-led projects at the RSAA and one student-led project at the University of Sydney. Of these, one is led by a non-traditional, mature student who entered astronomy by way of hobby. Others are led by a set of racially and gender diverse junior scientists at various Ph.D. stages (from just starting to thesis in revision)

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## Organizations, Collaborations & Service

Current:

- o Recently active member of TESS Asteroseismic Science Operations Center (**TASOC**) Working Groups 2: *Oscillations in Solar-Type Stars*; pending member of WGs 3 and 7
- o Member of the GALactic Archaeology with HERMES (**GALAH**) collaboration; August 2020–present
- o **Founder and head** of the Australian node in the international MESA network: **AIMS** (Australians in MESA Science)
- o RSAA **computing time allocation committee**, June 2019–present
- o Representative for the RSAA to the all colleges of science (CoS) **Equity and Diversity Committee**
- o RSAA Inclusion, Diversity, Equity, and Access (IDEA) committee, November 2020–present
- o RSAA cultural reform initiative: **lead**, working group on mental health; member, working group on Code of Conduct
- o Astronomical Society of Australia (ASA), 2019–present
- o Australian National Institute for Theoretical Astrophysics (ANITA), 2019–present
- o Participant in weekly research group meetings led by Thomas Nordlander (ANU), Amanda Karakas (Monash University), and Tim Bedding (University of Sydney) and bi-weekly MESA developers meetings (virtual)

Notable past service roles:

- Two-time volunteer lecturer and organizer at the National Astrophysics and Space Science Program Summer School, SAAO & UCT, South Africa
- President of the Dartmouth chapter of the national organization Graduate Women in Science and Engineering (GWISE) and Dartmouth’s representative to the multi-collegiate New England GWISE consortium, 2016–2017

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## Workshops & Special Training

KITP Program *Probes of Transport in Stars*, by invitation, October–December 2021 (*upcoming*)

MESA Summer School, teaching assistant by invitation, August 2021 (*upcoming*)

Aarhus Red Giants Challenge modeling workshop, participation by invitation, date TBD (*upcoming*)

MESA developers virtual science meeting, June 2019

TESS*ninja* 3 data sprint, University of Sydney, Sydney, Australia, February 2020

Astrophysics of LIGO/Virgo sources in O3 era, participation by invitation, University of Tokyo IPMU, January 2020

MESA developers retreat, Santa Barbara, CA, USA, October 2019

Center for Scientific Computing Summer School, Espoo, Finland, Summer 2016

MESA Summer School, student, August 2015

## Observing Experience

- . November 2017, SAAO-Sutherland 1.9m, SpUpNIC grating spectrograph, 7 nights, **Principal Investigator**, Preliminary Spectra of Metal-Poor Stars with HST Parallaxes
- . September 2017, SAAO-Sutherland 1.9m, SpUpNIC grating spectrograph, 4 nights
- . July 2017, SAAO-Sutherland 1m, SHOC SAAO CCD, 7 nights
- . May 2017, MDM 1.3m, remote, 1 night

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## Non-academic Work Experience

Mathematical Science Publishers — Independent Contractor, Software Development, November–December 2016  
Hillary for America — Campaign Ground Organizer, New Hampshire Democratic Party, July–November 2016  
MIT Lincoln Laboratory — Graduate Intern, Tactical Defense Systems Group, June–August 2015  
Dance instructor and choreographer, Dartmouth Fitness and Recreation Department, 2015–2017

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## Notable Skills

- + Strong foundations and formal training in mathematics and computer science
- + Demonstrated track record of successful collaborations with multi-national astronomers and industry software engineers
- + Fluent in statistical analysis, programming, and numerical methods
- + Experience developing software independently and in group development environments
- + Experience with computing clusters, high performance computing, parallelization, grid optimization
- + Experience with algorithm design, pipeline construction, workflow automation, numerical techniques, and large data processing

### Non-technical Strengths

- Maintainer of large, multi-national network of collaborators; international profile; work and life experience on **five continents**
- **Outstanding written and verbal communication skills**, evidenced by appearances on TV and radio, features in popular science magazines, research highlights, international speaking invitations, well-attended outreach events; see personal website
- Speaker of native English and conversational German; **comfortable working in non-English-dominant cultures** and learning basic phrases (past examples: Hungarian, Afrikaans, Japanese)
- **Demonstrated commitment to diversity and equity initiatives** and outspoken advocate for the advancement of under-represented groups in astronomy. Leader of cultural reform initiatives at the RSAA
- Certified mental health first aid provider

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## List of Referees

### (1) Prof. Brian Chaboyer (PhD adviser)

249 Wilder Laboratory  
Dartmouth College  
Hanover, NH 03755, USA  
brian.c.chaboyer@dartmouth.edu

### (3) Prof. Richard H D Townsend

Head, Department of Astronomy  
University of Wisconsin-Madison  
475 N Charter St, Madison, WI 53706, United States  
townsend@astro.wisc.edu

### (2) Dr László Molnár

Konkoly Observatory  
Konkoly-Thege Miklós út 15-17  
Budapest, Hungary, 1121  
molnar.laszlo@csfk.mta.hu

### (4) Prof. Matthew Colless

Director, Research School of Astronomy and Astrophysics  
Mount Stromlo Observatory  
Cotter Road, Weston Creek, ACT, Australia  
matthew.colless@anu.edu.au

## Department Testimonials

A/Prof. Michael J. Ireland  
Research School of Astronomy and Astrophysics  
Mount Stromlo Observatory  
Cotter Road, Weston Creek, ACT, Australia  
michael.ireland@anu.edu.au

Prof. Mark Krumholz  
Research School of Astronomy and Astrophysics  
W29 Mount Stromlo Observatory  
Cotter Road, Weston Creek, ACT, Australia  
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## External Scientific Endorsements

Prof. Timothy R. Bedding  
Department of Physics and Astronomy  
University of Sydney  
Sydney, Australia  
tim.bedding@sydney.edu.au

A/Prof. Amanda Karakas  
School of Physics and Astronomy  
Monash University  
Clayton, VIC 3168, Australia  
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Prof. Thomas Jarrett  
University of Cape Town  
Rondebosch 7701  
Cape Town, South Africa  
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Prof. J. Craig Wheeler  
Department of Astronomy, RLM 5.208  
University of Texas at Austin  
Austin, TX, United States  
wheel@astro.as.utexas.edu