Dr Meridith P. Joyce

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Research Interests

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.

Academic Work Experience

ARC Centre of Excellence ASTRO3D — Associate investigator, November 2019–present

Modules for Experiments in Stellar Astrophysics (`MESA`) developer, September 2019–present

RSAA Postdoctoral Fellow — Australian National University, September 2018–present

Konkoly Observatory — Visiting resident astronomer, periodic from January 2018–present

South African Astronomical Observatory — Postgraduate research assistant, September 2017–November 2017

University of Cape Town — Visiting academic, periodic from June 2017–January 2019

Massachusetts Institute of Technology — Research assistant, June–August 2015

Dartmouth College — Research assistant, September 2013–July 2018

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

Select Publications & Conference Contributions

* **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 *(recommended; in prep)*
* Simon J. Murphy, **Meridith Joyce**, Timothy R. Bedding, Mihkel Kama, Timothy R. White *A precise asteroseismic age and metallicity for HD 139614: a pre-MS λ Boo star with a protoplanetary disk in Upper-Centaurus Lupus (submitted to Nat. Astron.)*
* 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 (submitted to MNRAS)*
* Yixiao Zhou, Martin Asplund, Remo Collet, **Meridith Joyce**, *Convective excitation and damping of solar-like oscillations*, MNRAS, May 2020
* **M. Joyce**, L. Lairmore, D. J. Price, S. Mohamed, T. Reichardt, *Density Conversion between 1-D and 3-D Stellar Models with* ^{1D}*MESA2HYDRO*^{3D}, ApJ, September 2019
* **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
* 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)**
* **M. Joyce** and B. Chaboyer, *Classically and Asteroseismically constrained 1D Stellar Evolution Models of α Centauri A & B using Empirical Mixing Length Calibrations*, ApJ, September 2018
* **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
* 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
* **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

- **Meridith Joyce** and Brian Chaboyer, *Classically and asteroseismically constrained 1D stellar evolution models of α Cen A & B*
  Poster: Cool Stars 20, Boston University, Massachusetts, USA, July 2018
- **Meridith Joyce** and Brian Chaboyer, *Probing Convective Mixing in Stellar Interiors with α Cen A & B*
  Poster: The 339th IAU Symposium, Stellenbosch, South Africa, November 2017
- **Meridith Joyce** and Brian Chaboyer, *The RGBB: A Sensitive Probe of Mixing in Lower–Mass Stellar Models*
  Poster: The 19th Cambridge Workshop on Cool Stars, Uppsala, Sweden, June 2016
- **Meridith Joyce**, Brian C. Chaboyer, Gregory A. Feiden, Morgan Matthews, G. Fritz Benedict, Barbara McArthur, Thomas E. Harrison, Andrew McWilliam, Edmund P. Nelan, Richard J. Patterson, Ata Sarajedini, *Photometry on Metal-Poor Stars with HST Parallaxes*
  Poster: 224th American Astronomical Society meeting, June 2014

Select Talks

Upcoming:

Invited virtual seminar (host Chiaki Kobayashi), Univeristy of Hertfordshire, UK, November 2020

Invited virtual seminar (host Saida Caballero-Nieves), Florida Institute of Technology, November 2020

Invited virtual seminar (host Lars Bildsten), Kavli Institute for Theoretical Physics, UCSB, November 2020

Invited virtual seminar (host Josiah Schwab), University of California, Santa Cruz, November 2020

Invited virtual seminar (host Onno Pols), Radboud University, Netherlands, October 2020

Invited virtual seminar (host Richard Townsend), University of Wisconsin, Madison, October 2020

Invited virtual seminar (host Craig Wheeler), University of Texas, Austin, September 2020

Invited virtual seminar (host Selma de Mink), Stellar Research Group, Harvard University, September 2020

Past:

Invited virtual seminar (host Victor Silva Aguirre), TASOC and Aarhus University, August 2020
Seismic Stellar Evolution

Invited talk, Australian Institute for Theoretical Astrophysics Conference, UNSW Canberra, Australia, February 2020
3D Particle Maps from any MESA model in a few clicks

Invited seminar (host Ken'ichi Nomoto), Institute for the Physics and Mathematics of the Universe, University of Tokyo, Japan, January 2020
Better Stellar Modeling: Numerical Tools and Techniques for the Modern Observational Landscape

Invited speaker and session chair, Stars in Melbourne, Monash University, Melbourne, Australia, December 2019
New Tricks with Old Dogs: Advances in Precision Stellar Modeling of Low-mass Stars in 1D

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
Stellar Evolution in Real Time: Models consistent with direct observation of a thermal pulse in T Ursae Minoris

Contributed talk, Stars and their Variability, Universität Wien, August 2019
Asteroseismic Binaries as non-Solar Mixing Length Calibrators

Contributed talk, Stellar Archaeology as a Time Machine to the First Stars, Kavli IPMU, Japan, December 2018
The impact of metal depletion on convective mixing prescriptions in 1D stellar evolution models

Contributed talk, Advances with SALT, Pretoria, South Africa, November 2018
The power of HRS for mixing length calibrations in theoretical stellar evolution models

Invited seminar and SINS group meeting, Monash University, Melbourne, Australia, October 2018
Empirically constraining the Mixing Length Theory: Calibrations of α_{MLT} in non-solar stars

Invited seminar (host Mónika Jurkovic), Astronomical Observatory of Belgrade, Belgrade, Serbia, September 2018
On the Scope and Fidelity of 1D Stellar Evolution Models

Public Outreach Lecture, 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
Stellar Modeling in the Observational Era

Invited Astronomy Colloquium (host Maria Lugaro), Konkoly Observatory, Hungary, January 2018
Stellar Modeling in the Observational Era

Invited Astronomy Colloquium (host Paolo Ventura), Rome Observatory, Italy, January 2018
Not All Stars are the Sun: Rethinking the Mixing Length

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

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 (remote), October 2020 *(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

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 ^{1D}MESA2HYDRO^{3D}. 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, LaTeX, 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

Proposals, Grants, & Awards

- ARDC Australian Data Partnerships ADP20E-757 *Exploiting astronomical models with the Australian Astronomical Theory Hub* Simon O'Toole, Ashley J. Ruiter, **Meridith Joyce**, Amanda Karakas, Timothy R. Bedding
- RSAA Distinguished Visitors Program, *Seismic Evolution of Variable Stars*, **Meridith Joyce** and László Molnár, March 2020
- Observing proposal *Preliminary Low-Resolution Spectra of Metal-Poor Stars with HST Parallaxes*, 1.9m, SAAO, November 2017
- Research Grant from the Neukom Institute for Computational Science, December 2017
- Research proposal *On the origin of circumstellar CO shells surrounding thermally pulsating AGB stars*, SAAO, March 2017
- Dartmouth Alumni Research Award, June 2017
- 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

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

Supervision, Organizations, & Service

- 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)
- 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
- 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)
- Representative for the RSAA to the all-science faculty Equity and Diversity Committee

- Founder and head of the Australian node in the international MESA network: AIMS (Australians in MESA Science)
- Astronomical Society of Australia (ASA) and Australian National Institute for Theoretical Astrophysics (ANITA), 2019–present
- RSAA computing committee, June 2019–present
- Two-time volunteer lecturer and organizer at the National Astrophysics and Space Science Program Summer School, SAAO & UCT, South Africa

Observing Experience

- SAAO-Sutherland 1.9m, 7 nights, **Principal Investigator**, November 2017
- SAAO-Sutherland 1.9m, 4 nights, September 2017
- SAAO-Sutherland 1m, 7 nights, July 2017
- MDM 1.3m, remote, 1 night, May 2017

Professional 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

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 and an international profile; work and life experience on five continents
- Outstanding written and verbal communication skills, evidenced by, e.g., 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 (e.g. Hungarian, Afrikaans, Japanese)
- Demonstrated commitment to diversity and equity initiatives and outspoken advocate for the advancement of underrepresented groups in astronomy. Leader of cultural reform initiatives at the RSAA
- Certified mental health first aid provider

Referees

(1) Prof. Brian Chaboyer (PhD adviser)
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Dartmouth College
Hanover, NH 03755, USA
brian.c.chaboyer@dartmouth.edu

(2) Dr. László Molnár
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Budapest, Hungary, 1121
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(3) A/Prof. Michael J. Ireland
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(4) Prof. Timothy R. Bedding
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