

Earl Patrick Bellinger, Ph.D.

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Education

- 2015 – 2018 **Ph.D.** Computer Science / Astrophysics
• Max Planck Institute for Solar System Research, Germany
• Department of Astronomy, Yale University, USA
• Institute of Computer Science, University of Göttingen, Germany
- 2012 – 2014 **M.Sc.** Computer Science, minor: Bioinformatics
School of Informatics & Computing, Indiana University, USA
Graduate Fellow of the National Physical Science Consortium
- 2008 – 2012 **B.Sc.** Applied Mathematics, concentration: Scientific Computing
B.Sc. Computer Science, concentration: Artificial Intelligence
State University of New York at Oswego, USA
GPA: 3.81/4.0, summa cum laude
Rank #1 overall in Department of Computer Science

Research Positions

- 2021 – present *Postdoctoral Research Fellow*
Max Planck Institute for Astrophysics, Garching, Germany
- 2018 – 2021 *Postdoctoral Research Fellow*
Stellar Astrophysics Centre, Aarhus University, Denmark
- 2019 – 2020 *Visiting Fellow*
School of Physics, UNSW Sydney, Australia
- 2016 – 2017 *Visiting Assistant in Research*
Department of Astronomy, Yale University, USA
- 2015 – 2018 *Research Assistant / Doktorand*
Max Planck Institute for Solar System Research, Germany
- 2013 – 2015 *Research Assistant & Associate Instructor*
School of Informatics and Computing, Indiana University, USA
- 2013 – 2014 *Guest Researcher*
National Institute of Standards and Technology (NIST), USA
- 2013 *Research Student*
National Institute of Informatics, Tokyo, Japan
- 2012 *Research Fellow*
NASA Jet Propulsion Laboratory, USA

- 2011 *IRES/NSF Research Student*
Federal University of Alagoas, Brazil
- 2010 *IRES/NSF Research Student*
Federal University of Santa Catarina, Brazil

Teaching

Student supervision

- Doctoral students: 4 (3 co-supervised, 1 graduated, 3 ongoing)
- Master students: 4 (3 co-supervised, 3 graduated, 1 ongoing)
- Bachelor students: 10 (10 co-supervised, 7 graduated, 3 ongoing)
- High School students: 1 (1 graduated)

Courses

- 2018 – 2021 Assistant, Department of Physics and Astronomy, Aarhus University
E20 — *Advanced Stellar Structure and Evolution*
F19 — *Advanced Projects in Stellar Evolution*
- 2017 Assistant, Department of Astronomy, Yale University
ASTR 550 — *Stellar Astrophysics*
- 2016 Assistant, Institut für Astrophysik, Georg-August-Universität Göttingen
M.Phys.552 — *Numerical Experiments in Stellar Physics*
- 2012 Associate Instructor, School of Informatics and Computing, Indiana University
CSCI-C211/A591 — *Introduction to Computer Science*
- 2010 Seminar Leader, Honors Program, SUNY Oswego
HON 150 — *Introduction to Honors*

Other

- 2022 Lecturer, MESA Summer School, UC Santa Barbara
- 2022 Invited tutorial, MESA & GYRE, TASC6/KASC13
- 2022 Instructor, MESA@ESO

Presentations

Invited Talks

- 2022 TASC6/KASC13 – TESS/Kepler Asteroseismic Science Consortium
KU Leuven, Belgium
- 2019 TASC5/KASC12 – TESS/Kepler Asteroseismic Science Consortium
MIT, USA
- 2019 Dynamics of the Sun & Stars: Honoring the Life & Work of Michael Thompson
High Altitude Observatory, USA

Invited Seminars

- 2022 Czech Academy of Sciences, Prague, Czech Republic
- 2021 KU Leuven, Belgium
- 2021 University of Victoria, British Columbia, Canada
- 2020 Macquarie University, Sydney, Australia
- 2020 Monash University, Melbourne, Australia
- 2019 University of Sydney, Australia
- 2018 Stellar Astrophysics Centre, Aarhus University, Denmark
- 2017 University of Wisconsin–Madison, USA
- 2013 Kyoto University, Japan

Contributed Talks

- 2022 European Astronomical Society, Valencia, Spain
- 2022 Fundamental stellar parameters from asteroseismology, Aarhus, Denmark
- 2019 Stars in Melbourne, Monash University, Melbourne, Australia
- 2019 Annual Danish Astronomy Meeting (ADAM) 2019, Nyborg, Denmark
- 2018 TESS Asteroseismic Science Consortium 4, Aarhus University, Denmark
- 2017 ERES-III: Emerging Researchers in Exoplanet Science, Yale University, USA
- 2015 RR Lyrae 2015, Visegrád, Hungary
- 2015 American Astronomical Society, Washington, USA

Workshops (*Invited talk)

- 2021 *PLATO WP122 Liege Workshop #4
- 2021 *MPA–Potsdam Workshop on Hot Subdwarfs, Garching, Germany
- 2020 TESS Ninja 3, University of Sydney, Australia
- 2019 8th Aarhus Red Giants Workshop, Astronomical Observatory of Catania, Italy
- 2017 7th Aarhus Red Giants Workshop, Max Planck Institute for Astrophysics
- 2016 *6th Aarhus Red Giants Workshop, Max Planck Institute for Solar System Research
- 2015 *Indo-US Science Workshop on Variable Stars, Delhi University, Delhi, India
- 2014 *Indo-US Science Workshop on Variable Stars, St. Thomas College, Kerala, India

Awards & Funding

- 2023 Flanders Research Foundation Postdoctoral Fellowship (KU Leuven, deferred)
- 2021 Max Planck Institute for Astrophysics Postdoctoral Fellowship
- 2018 NVIDIA GPU Grant
- 2018 Stellar Astrophysics Centre Postdoctoral Fellowship
- 2012 National Physical Science Consortium Graduate Fellowship
- 2012 SUNY Chancellor's Award for Student Excellence
- 2012 Oebele Van Dyk Outstanding Computer Science Senior Award
- 2008 SUNY Oswego Presidential Scholarship

Professional Activities

Associations

- 2020 – Developer, MESA Stellar Evolution Code
- 2019 – Junior Member, International Astronomical Union

Observing Time

- 2018 δ Eridani – the first SONG-TESS simultaneous target (P.I.)
Instrument: **SONG telescope** (50 nights)
- 2018 Simultaneous observations of oscillations in Procyon with SONG and TESS (co-P.I.)
Instrument: **SONG telescope** (30 nights)

Refereeing

The Astrophysical Journal Letters
The Astronomical Journal
Astronomy & Astrophysics
Monthly Notices of the Royal Astronomical Society
Frontiers in Astronomy and Space Sciences

Scientific Organizing

- 2022 Organizer, MESA Summer School 2022, UC Santa Barbara
- 2022 Scientific Organizer, European Astronomical Society 2022 Special Session
"Stellar characterization, large data sets, and Machine Learning"
- 2022 – Organizer, Seminar on Stellar Astrophysics (SESTAS), MPI for Astrophysics
- 2019 – 2021 Organizer, Stellar Astrophysics Centre Seminar, Aarhus University
- 2015 – 2018 Organizer, SAGE Seminar Series, Max Planck Institute for Solar System Research

Publications – Earl Patrick Bellinger

Number of publications = 48 || first author = 19 || citations = 535 || h-index = 15

Google scholar profile: https://scholar.google.com/citations?user=Woj_Tu4AAAAAJ

Publications in peer-reviewed scientific journals

(total = 30, first author = 10, single author = 2, student-led = 5)

1. **Bellinger, E. P.** & Christensen-Dalsgaard, J. (2022). Towards solar measurements of nuclear reaction rates. *Monthly Notices of the Royal Astronomical Society*, accepted.
2. **Bellinger, E. P.**, Basu, S., Hekker, S., Christensen-Dalsgaard, J., Ball, W. (2021). Asteroseismic Inference of the Central Structure in a Subgiant Star. *The Astrophysical Journal*, 915 (2).
3. **Bellinger, E. P.** (2020). A seismic scaling relation for stellar age II. The red giant branch. *MNRAS Letters*, 492 (1).
4. **Bellinger, E. P.**, Kanbur, S. M., Bhardwaj, A., Marconi, M. (2020). When a Period Is Not a Full Stop: Light Curve Structure Reveals Fundamental Parameters of Cepheid and RR Lyrae Stars. *Monthly Notices of the Royal Astronomical Society*, 491 (4).
5. **Bellinger, E. P.** & Christensen-Dalsgaard, J. (2019). Asteroseismic constraints on the cosmic-time variation of the gravitational constant from an ancient main-sequence star. *The Astrophysical Journal Letters*, 887 (1).
6. **Bellinger, E. P.**, Basu, S., Hekker, S., Christensen-Dalsgaard, J. (2019). Testing stellar evolution with asteroseismic inversions of a main sequence star harboring a small convective core. *The Astrophysical Journal*, 885 (2), 143.
7. **Bellinger, E. P.** (2019). A seismic scaling relation for stellar age. *Monthly Notices of the Royal Astronomical Society*, 486 (4).
8. **Bellinger, E. P.**, Hekker, S., Angelou, G. C., Stokholm, A., Basu, S. (2019). Stellar ages, masses and radii from asteroseismic modeling are robust to systematic errors in spectroscopy. *Astronomy & Astrophysics*, 622, A130.
9. **Bellinger, E. P.**, Basu, S., Hekker, S., Ball, W. (2017). Model-independent Measurement of Internal Stellar Structure in 16 Cygni A and B. *The Astrophysical Journal*, 851 (2), 80.
10. **Bellinger, E. P.**, Angelou, G. C., Hekker, S., Basu, S., Ball, W., Guggenberger, E. (2016). Fundamental Parameters of Main-Sequence Stars in an Instant with Machine Learning. *The Astrophysical Journal*, 830 (1), 20.

* denotes the paper was led by a student

11. *Deka, Kanbur, Deb, Das, Kurba, **Bellinger**, Bhardwaj (2022). Period-Colour and Amplitude-Colour relations for OGLE δ Scuti stars in the Galactic Bulge and LMC. *Monthly Notices of the Royal Astronomical Society*, accepted.
12. *Vynatheya, P., Hamers, A. S., Mardling, R. A., **Bellinger, E. P.** (2022). Algebraic and machine learning approach to hierarchical triple-star stability. *Monthly Notices of the Royal Astronomical Society*, accepted with minor revisions.
13. Jermyn, Bauer, Schwab, Farmer, Ball, **Bellinger**, et al. (2022). Modules for Experiments in Stellar Astrophysics (MESA): Time-Dependent Convection, Energy Conservation, Automatic Differentiation, and Infrastructure. *The Astrophysical Journal Supplement Series*, submitted.
14. Caplan, M. E., Freeman, I. F., Horowitz, C. J., Cumming, A., **Bellinger, E. P.** (2021). Cooling Delays from Iron Sedimentation and Iron Inner Cores in White Dwarfs. *The Astrophysical Journal Letters*, 919 (1).
15. Grunblatt, S. et al. including **Bellinger, E. P.** (2021). Age-Dating Red Giant Stars Associated with Galactic Disk and Halo Substructures. *The Astrophysical Journal*, 916 (2).
16. Plachy, E. et al. including **Bellinger, E. P.** (2021). TESS observations of Cepheid stars: first light results. *The Astrophysical Journal Supplement Series*, 253 (1).
17. *Hon, M., **Bellinger, E. P.**, Hekker, S., Stello, D., Kuszlewicz, J. S. (2020). Asteroseismic Ages of Subgiant Stars with Deep Learning, *Monthly Notices of the Royal Astronomical Society*, 499 (2).
18. *Ahlborn, F., **Bellinger, E. P.**, Hekker, S., Basu, S., Angelou, G. C. (2020). On the asteroseismic sensitivity to internal rotation along the red-giant branch. *Astronomy & Astrophysics*, 639, A98.
19. Angelou, G. C., **Bellinger, E. P.**, Hekker, S., Mints, A., Elsworth, Y., Basu, S., Weiss, A. (2020). Convective boundary mixing in low- and intermediate-mass stars I. Core properties from pressure-mode asteroseismology. *Monthly Notices of the Royal Astronomical Society*, 493 (4).
20. Angelou, G. C., **Bellinger, E. P.**, Hekker, S., Basu, S. (2017). On the Statistical Properties of the Lower Main Sequence. *The Astrophysical Journal*, 839 (2), 116.
21. Glover, M., **Bellinger, E. P.**, Radivojac, P., Clemmer, D. (2015). Penultimate Proline in Neuropeptides. *Analytical Chemistry*, 87 (16), 8466–8472.
22. *Das, S., Kanbur, S. M., **Bellinger, E. P.**, Bhardwaj, A., Singh, H. P., Meerdink, B., Proietti, N., Chalmers, A., Jordan, R. (2020). The stellar photosphere-hydrogen ionization front interaction in Classical Pulsators: a theoretical explanation for

- observed period-colour relations. *Monthly Notices of the Royal Astronomical Society*, 493 (1).
23. Bo Nielsen, M. et al. including **Bellinger, E. P.** (2020). TESS asteroseismology of the known planet host star λ^2 Fornacis, *Astronomy & Astrophysics*, 641, A25.
 24. Christensen-Dalsgaard, J. et al. including **Bellinger, E. P.** (2020). The Aarhus Red Giants Challenge II: Stellar oscillations in the red giant branch phase. *Astronomy & Astrophysics*, 635, A165.
 25. Silva Aguirre, V. et al. including **Bellinger, E. P.** (2020). The Aarhus Red Giants Challenge I: Stellar structures in the red giant branch phase. *Astronomy & Astrophysics*, 635, A164.
 26. Tang, Y., Basu, S., Davies, G. R., **Bellinger, E. P.**, Gai, Ning (2018). Asteroseismology of KIC 8263801: Is it a member of NGC 6866 and a red clump star? *The Astrophysical Journal*, 866 (1), 59.
 27. Guggenberger, E., Hekker, S., Basu, S., Angelou, G. C., **Bellinger, E. P.** (2017). Mitigating the mass dependence in the $\Delta\nu$ scaling relation of red-giant stars. *Monthly Notices of the Royal Astronomical Society*, 470 (2).
 28. Guggenberger, E., Hekker, S., Basu, S., **Bellinger, E. P.** (2016). Significantly improving stellar mass and radius estimates: A new reference function for the $\Delta\nu$ scaling relation. *Monthly Notices of the Royal Astronomical Society*, 461 (2).
 29. Ji, C., Li, Y. F., **Bellinger, E. P.**, Li, S., Arnold, R. J., Radivojac, P., Tang, H. (2015). A maximum-likelihood approach to absolute protein quantification in mass spectrometry. In refereed proceedings of the *6th ACM Conference on Bioinformatics, Computational Biology and Health Informatics* (pp. 296-305).
 30. Ngeow, C. C., Kanbur, S. M., **Bellinger, E. P.**, Marconi, M., Musella, I., Cignoni, M., & Lin, Y. H. (2012). Period-luminosity relations for Cepheid variables: from mid-infrared to multi-phase. *Astrophysics & Space Science*, 341(1), 105-113.

Publications in conference proceedings

(total = 14, first author = 6)

31. **Bellinger, E. P.**, Basu, S., Hekker, S. (2020). Inverse analysis of asteroseismic data: a review. *Dynamics of the Sun & Stars*.
32. **Bellinger, E. P.**, Angelou, G. C., Hekker, S., Basu, S., Ball, W., Guggenberger, E. (2017). Fundamental Parameters in an Instant with Machine Learning: Application to Kepler LEGACY Targets. *Seismology of the Sun and Distant Stars*, EPJ Web of Conferences, Volume 160, id.05003.

33. **Bellinger, E. P.**, Wysocki, D., Kanbur, S. M. (2015). Measuring amplitudes of harmonics and combination frequencies in variable stars. *Communications from the Konkoly Observatory of the Hungarian Academy of Sciences*, 105.
34. **Bellinger, E. P.**, Kanbur, S. M., & Ngeow, C.-C. (2012). New insights into the Cepheid PL Relation through the use of multiphase relations. *Proceedings of the 20th Stellar Pulsations Conference*.
35. **Bellinger, E. P.** (2012). Multiphase Relations of Magellanic Cloud Cepheids. *Proceedings of the 2012 National Conference on Undergraduate Research*.
36. **Bellinger, E. P.**, Kanbur, S. M., & Ngeow, C.-C. (2011). Multiphase Comparison of Period-Luminosity Relations for Magellanic Cloud Cepheids. *Proceedings of the 9th Pacific Rim Conference on Stellar Astrophysics*, 451, 311.
37. Kanbur, S. M., **Bellinger, E. P.**, Bhardwaj, A., Marconi, M. (2020). Light Curve Structure Reveals Fundamental Parameters of Cepheid and RR Lyrae Stars. *Proceedings of RR Lyrae 2019*.
38. *Das, S., Kanbur, S. M., **Bellinger, E. P.**, Bhardwaj, A., Singh, H. P. (2020). A study of the stellar photosphere-hydrogen ionisation front interaction in pulsating variables using period-color relations. *ASP Conference Series*, 529.
39. *Ahlborn, F., **Bellinger, E. P.**, Hekker, S., Basu, S., Angelou, G. C. (2020). Rotational inversions along the lower part of the red-giant branch. *Stars and their Variability Observed from Space*.
40. Kanbur, S. M., **Bellinger, E. P.**, Bhardwaj, A., Marconi, M. (2020). Light Curve Structure Reveals Fundamental Parameters of Cepheid and RR Lyrae Stars. *RR Lyrae 2019*.
41. Reyner, S., **Bellinger, E. P.**, & Kanbur, S. M. (2012). The approximation of RR Lyrae and eclipsing binary light curves using cubic polynomials. *Proceedings of the 20th Stellar Pulsations Conference*.
42. Das, S., Kanbur, S. M., **Bellinger, E. P.**, Bhardwaj, A., Singh, H. P. (2020). A study of the stellar photosphere-hydrogen ionisation front interaction in pulsating variables using period-color relations. *RR Lyrae 2019*.
43. Bhardwaj, A., Kanbur, S. M., Marconi, M., Das, S., **Bellinger, E. P.**, Singh, H. P., Rejkuba, M., Ngeow, C.-C. (2018). Time-series analyses of Cepheid and RR Lyrae variables in the wide-field variability surveys. *IAUS347: Early Science with ELTs*.
44. Hekker, S., Elsworth, Y., Basu, S., **Bellinger, E. P.** (2017). Evolutionary states of red-giant stars from grid-based modelling. *Seismology of the Sun and Distant Stars*, EPJ Web of Conferences, Volume 160, id.04006.

Additional publications

(total = 4, first author = 3)

45. **Bellinger, E. P.** (2019). An idea to an image: the prediction and confirmation of black holes. Invited book review, *Metascience*, 29 (1), Cambridge: Harvard University Press.
46. **Bellinger, E. P.** (2018). Inverse Problems in Asteroseismology. Doctoral thesis, *International Max Planck Research School*.
47. **Bellinger, E. P.**, Conner, D., Mittman, D., Magee, K., & Heventhal, B. (2012). CASSIUS: the Cassini Uplink Scheduler. *Jet Propulsion Laboratory: National Aeronautics and Space Administration*, hdl:2014/43122.
48. The MSE Science Team et al. including **Bellinger, E. P.** (2019). The Detailed Science Case for the Maunakea Spectroscopic Explorer.