EBRAHEEM KHALED FARAG

Yale University : Department of Astronomy (YCAA)
Arizona State University: School of Earth and Space Exploration (SESE)
Los Alamos National Laboratory: XTD Integrated Design & Assessment (XTD-IDA)
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RESEARCH INTERESTS

Evolution of massive stars: supernova progenitors and pair instability stars
Multi-messenger signals: stellar neutrinos and black hole initial mass functions
Impact of nuclear reaction uncertainties on nucleosynthesis and stellar evolution
Atomic opacities and stellar model micro-physics
Asteroseismology of white dwarfs and classical variable stars

POSITIONS

YCAA Prize Fellow *September 2024 - present*
Yale Center for Astronomy & Astrophysics Post-doctoral Research Fellowship Yale University

EDUCATION

Arizona State University *August 2019 - August, 2024 (PhD)*
PhD Astrophysics School of Earth and Space Exploration

The Ohio State University *2014 - 2019 (B.S.)*
Engineering Physics, Mechanical Specialization College of Engineering

SERVICE

Modules for Experiment in Stellar Astrophysics (MESA) Software Developer *2023 - present*
Astrophysical Journal Referee - Completed various referee reports for ApJ
SESE Graduate Council Recruitment Chair *2022-2023*
Member of Los Alamos National Laboratory Student Association *2015-2023*
Treasurer -The Society of Physics Students 2018-2019

TEACHING

TA: Modules for Experiment in Stellar Astrophysics (MESA) Summer School *2018-2025*
TA: AST 113 Introduction to Astronomy Laboratory *2020*

AWARDS

AAS 237 Chambliss Honorable Mention : 2021

Exploring the Black Hole Mass Gap Sensitivity to $^{12}C(\alpha,\gamma)^{16}O$.

PUBLICATIONS

Summary: 20 Total, 5 first Author, 3 second author:
381 citations, h-index: 9 (Google Scholar), 338 citations h-index: 8 (ADS)
Peer Reviewed Publications
First Author Publications:

5. "Self-Consistent Nonlinear Classical Cepheid Pulsations During Stellar Evolution with MESA" **(Accepted)**
   Farag, E., Bellinger, E. P., Mocz, P., Kalici, S., Smolec, R., Kanbur, S., Bettwy, K., & Lindsay, C. 2026, ApJ

4. "An Expanded Set of Los Alamos OPLIB Tables in MESA: Type-1 Rosseland-mean Opacities and Solar Models"
   Farag, E., Fontes, C. J., Timmes, F. X., Bellinger, E. P., Guzik, J. A., et al. 2024, ApJ, 968, 56

3. "Stellar Neutrino Emission Across The Mass-Metallicity Plane"
   Farag, E., Timmes, F. X., Chidester, M. T., Anandagoda, S., & Hartmann, D. H. 2024, ApJS, 270, 5

2. "Resolving the Peak of the Black Hole Mass Spectrum"
   Farag, E., Renzo, M., Farmer, R., Chidester, M. T., & Timmes, F. X. 2022, ApJ, 937, 112

1. "On Stellar Evolution in a Neutrino Hertzsprung-Russell Diagram"
   Farag, E., Timmes, F. X., Taylor, M., Patton, K. M., & Farmer, R. 2020, ApJ, 893, 133

Contributing Author Publications:

13. "Red-Giant Asteroseismology of Low-Mass Population III Stars" **(Accepted)**
    Ferreira, T., Bellinger, E. P., **Farag, E.**, & Lindsay, C. J. 2026, ApJ

12. "Evolution of Low-Mass Population III Stars: Convection, Mass Loss, Nucleosynthesis, and Neutrinos" **(Accepted)**
    Ferreira, T., Bellinger, E. P., **Farag, E.**, & Lindsay, C. J. 2026, ApJ

11. "Evolutionary Tracks and Spectral Properties of Quasi-stars and Their Correlation with Little Red Dots" **(Accepted)**
    Santarelli, A. D., **Farag, E.**, Bellinger, E. P., Natarajan, P., Naidu, R. P., Campbell, C. B., & Caplan, M. E. 2026, ApJL

10. "MESA-QUEST: Tracing the formation of direct collapse black hole seeds via quasi-stars" **(Accepted)**
    Santarelli, A. D., Campbell, C. B., **Farag, E.**, Bellinger, E. P., Natarajan, P., & Caplan, M. E. 2026, ApJ

9. "Solar-like Oscillations in Accreting Pre-main-sequence Stars: Insights and Prospects"
   Jorgensen, J., Zwintz, K., **Farag, E.**, Vorobyov, E. I., & Steindl, T. 2025, ApJ, 995, 223

8. "Nuclear Neural Networks: Emulating Late Burning Stages in Core-collapse Supernova Progenitors"
   Grichener, A., Renzo, M., Kerzendorf, W. E., Farmer, R., de Mink, S. E., Bellinger, E. P., Chan, C. K., Chen, N., **Farag, E.**, et al. 2025, ApJS, 279, 49

7. "Cosmic Massive Star Cannibals and Their Detectability with Gravitational Wave Observations"
   Arca Sedda, M., Scolnic, D., Bortolas, E., Goel, A., Gration, N., Sagar, R., **Farag, E.**, et al. 2025, arXiv:2502.07665

6. "Photons from neutrinos: The gamma ray echo of a supernova neutrino burst"
   Lunardini, C., Loeffler, J., Mukhopadhyay, M., **Farag, E.**, & Timmes, F. X. 2024, ApJ, 969, 149

5. "Seismic Signatures of the $^{12}C(\alpha, \gamma)^{16}O$ Reaction Rate in White Dwarf Models with Overshooting"
   Chidester, M. T., Timmes, F. X., & **Farag, E.** 2023, ApJ, 954, 51

4. "JWST Imaging of Earendel, the Extremely Magnified Star at Redshift z = 6.2"
   Welch, B., Coe, D., Zackrisson, E., de Mink, S. E., Ravindranath, S., Anderson, J., Brammer, G.,

Bradley, L., Yoon, J., Kelly, P., Diego, J. M., Windhorst, R., Zitrin, A., Dimauro, P., Jimenez-Teja, Y., Abdurro'uf, Nonino, M., Acebron, A., Andrade-Santos, F., Avila, R. J., Bayliss, M. B., Benitez, A., Broadhurst, T., Bhatawdekar, R., Bradac, M., Caminha, G. B., Chen, W., Eldridge, J., **Farag, E.**, Florian, M., Frye, B., et al. 2022, ApJL, 940, L1

3. "On Trapped Modes in Variable White Dwarfs as Probes of the $^{12}C(\alpha, \gamma)^{16}O$ Reaction Rate"
Chidester, M. T., **Farag, E.**, & Timmes, F. X. 2022, ApJ, 935, 21

2. "Observing Intermediate-mass Black Holes and the Upper Stellar-mass Gap with LIGO and Virgo"
Mehta, A. K., Buonanno, A., Gair, J., Miller, M. C., **Farag, E.**, deBoer, R. J., Wiescher, M., & Timmes, F. X. 2022, ApJ, 924, 39

1. "On the Impact of ^{22}Ne on the Pulsation Periods of Carbon-Oxygen White Dwarfs with Helium-dominated Atmospheres"
Chidester, M. T., Timmes, F. X., Schwab, J., Townsend, R. H. D., **Farag, E.**, Thoul, A., Fields, C. E., Bauer, E. B., & Montgomery, M. H. 2021, ApJ, 910, 24

Non-Peer reviewed Publications

2. "Investigating Opacity Modifications and Reaction Rate Uncertainties to Resolve the Cepheid Mass Discrepancy"
Guzik, J. A., **Farag, E.**, Ostrowski, J., et al. 2021, in Astronomical Society of the Pacific Conference Series, Vol. 529, RR Lyrae/Cepheid 2019: Frontiers of Classical Pulsators, ed. K. Kinemuchi, C. Lovekin, H. Neilson, & K. Vivas, 79

1. "Sound speed and oscillation frequencies for solar models evolved with Los Alamos ATOMIC opacities"
Guzik, J. A., Fontes, C. J., Walczak, P., et al. 2016, IAU Focus Meeting, 29B, 532

PRESENTATIONS & INVITED TALKS

13. From Stellar Evolution to Pulsation: Post-Main Sequence Massive Star Pulsations *Invited Seminar*
International Space Science Institute, Bern, Switzerland, 2026

12. Self-consistent Non-linear Radial Pulsations during Stellar Evolution *Invited Seminar*
Max Planck Institute for Astrophysics, 2025

11. Multi-Messenger Signals from Stellar Evolution *Invited Colloquium*
Yale Astronomy Colloquium, 2025

10. Neutrino Emission from Stars *Contributed Poster*
Farag, E., Chidester, M., & Timmes, F. 2023, in AAS/High Energy Astrophysics Division, Vol. 55, AAS/High Energy Astrophysics Division, 115.20

9. Resolving The Peak Of The Black Hole Mass Spectrum *Contributed Poster*
Farag, E., Renzo, M., Farmer, R., Chidester, M., & Timmes, F. 2023, in AAS/High Energy Astrophysics Division, Vol. 55, AAS/High Energy Astrophysics Division, 116.62

8. Resolving The Peak Of The Black Hole Mass Spectrum *Contributed Talk*
Farag, E., Renzo, M., Farmer, R., Chidester, M., & Timmes, F. 2023, in American Astronomical Society Meeting Abstracts, Vol. 55, American Astronomical Society Meeting Abstracts, 259.04

7. Recurrent Novae and Steady Burning *Invited Lecturer*
(MESA) Summer School, Santa Barbara, CA, 2022

6. Resolving The Peak of The Black Hole Mass Spectrum *Invited Seminar*
Farag, E. K., Renzo, M., Farmer, R., Chidester, M., & Timmes, F. 2022
Los Alamos Distinguished Seminar Series, Los Alamos, NM

5. Exploring The Black hole Mass Gap With Revised Nuclear Reaction Rates *Contributed Poster*
Farag, E., & Timmes, F. 2021, in American Astronomical Society Meeting Abstracts, Vol. 53, American Astronomical Society Meeting Abstracts, 524.03

4. Is There A Solar Model Solution to The Faint Young Sun Paradox? *Invited Seminar*
Farag, E. K. 2019
Los Alamos Distinguished Seminar Series, Los Alamos, NM

3. Modeling Cepheid Variable Stars Using the Open-Source MESA Code *Contributed Talk*
Guzik, J. A., **Farag, E.**, Ostrowski, J., et al. 2020, The Journal of the American Association of Variable Star Observers, vol. 48, no. 1, p. 102

2. Modeling Pulsations of Cepheid Variables using the Open-Source MESA Code *Contributed Talk*
Guzik, J. A., **Farag, E.**, Ostrowski, J., et al. 2020, in The 35th Annual New Mexico Symposium, ed. A. D. Kapinska, 5

1. A diffusive radiation hydrodynamics code, xRage, is implemented to compare radiation flow with experimental data from the Omega laser facility *Contributed Poster*
Vandervort, R., Elgin, L., **Farag, E.**, et al. 2015, in APS Meeting Abstracts, Vol. 2015, APS Division of Plasma Physics Meeting Abstracts, UP12.023

ACCEPTED PROPOSALS

1. A Strongly Magnified Individual Star and Parsec-Scale Clusters Observed in the First Billion Years at z = 6, JWST Proposal. Cycle 1, ID. #2282
Coe, D., Acebron, A., Avila, R., et al. 2021,

2. OzGrav: The Australian Research Council Centre of Excellence for Gravitational Wave Discovery
For the MESA Down Under Winter School, hosted by the University of Sydney, 2024