Erika M. Holmbeck

PhD Physics · NHFP Hubble Fellow

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My research leverages high-resolution spectroscopy of metal-poor stars with nucleosynthesis simulations to investigate both the nuclear and astrophysical effects on heavy-element production by the rapid neutron-capture ("*r*") process

Appointments

2021 – **The Observatories of the Carnegie Institution for Science**
NASA Hubble Fellowship Program (NHFP) Hubble Fellow
Distilling Stellar Signatures to Characterize the Astrophysical Production Site of the Heavy Elements
Supervisor: Joshua Simon

2020 – 2021 **Rochester Institute of Technology**
Postdoctoral Researcher
Reconstructing Neutron Star Merger Properties from Metal-Poor Stars
Supervisor: Richard O'Shaughnessy

Education

Aug 2020 **University of Notre Dame**
Ph.D. Physics
"The Looking Glass and Beyond: Using Observations and Modeling of Stellar Actinide Abundances as a Window into r-Process Events"
Advisors: Profs. Rebecca Surman and Timothy C. Beers

Feb 2019 **University of Notre Dame**
M.S. Physics
"The Stellar Actinide Boost and its r-Process Implications"

Jun 2014 **University of California Los Angeles**
B.S. Astrophysics, *Cum laude*, Departmental Honors, Dean's Honors List
"New Members of Nearby Moving Groups"
Advisors: Profs. Benjamin Zuckerman and Smadar Naoz

Publication Summary

A full list of publications can be found on ADS.

Journal publications: 9 first-author (including 2 in press), 21 co-author

Other papers: 2 first-author conference proceedings, 2 co-author white papers

***h*-index:** 16

Total citations: 859

Teaching

2022 **Mentor,** Carnegie Observatories: Carnegie Astrophysics Summer Student Internship Program (CASSI)

2019 **Teaching Assistant and Lab Technician,** Holy Cross College and Westville Correctional Facility

Lecturer, JINA-CEE First Frontiers Summer School

2017 – 2019 **Private Tutor,** University of Notre Dame, Department of Physics

2015 – 2017 **Teaching Assistant and Lead Technician,** University of Notre Dame, Jordan Hall of Science Observatory

Honors, Grants & Fellowships

2022 **Dissertation Award in Nuclear Physics,** American Physics Society - Division of Nuclear Physics

2021 **NHFP Hubble Fellow,** Space Telescope Science Institute

2020 **Graduate Research and Dissertation Award,** Physics Department, University of Notre Dame

2019 **Grant Award: "Astronomy for Physicists and Physics for Astronomers Summer School,"** JINA-CEE

Award: Best Poster, Nuclear Physics in Astrophysics Conference IX

Grant Award: Graduate Student Union (GSU) Conference Presentation, University of Notre Dame

2018 **Grant Award: Zahm Research Travel,** University of Notre Dame

2017 – 2019 **Eartly-Lennox Graduate Student Fellow,** University of Notre Dame

2015 – 2020 **Arthur J. Schmitt Leadership Fellow,** University of Notre Dame

Awarded Proposals & Telescope Time

2022 **Magellan 6.5-m Clay** (PI) — 10 nights

Hubble Space Telescope Cycle 30 (Co-I) — 60 orbits

2021 **Facility for Rare Isotope Beams (No. 21080)** (Co-author) — 128 beam on target hours

2019 **Hubble Space Telescope Cycle 27** (Co-I) — 17 orbits

2018 **Hubble Space Telescope Cycle 26** (Co-I) — 47 orbits

2017 – 2022 ***Additional time awarded as Co-I***

- 45+ nights on the du Pont 100-in telescope, Las Campanas Observatory, Chile
- 70+ nights on the Harlan J. Smith 107-in telescope, McDonald Observatory, Texas, USA
- 25+ nights on the Magellan 6.5-m (Clay) telescope, Las Campanas Observatory, Chile

Student Supervision

2023 **Ian Johnson,** California Institute of Technology (Carnegie Astrophysics Summer Student Internship Intern and Summer Undergraduate Research Fellow)

Audrey Dunn, University of California Los Angeles (Research Course Credit)

2022 **Rafael Cottom,** Santa Barbara City College (Carnegie Astrophysics Summer Student Internship Intern)

2021 – **Audrey Lund,** University of Michigan (undergraduate research)

2018 **Phuong Hoang,** University of Hanoi (University of Notre Dame REU Student)

Tino Wells, University of Washington (University of Notre Dame REU Student)

Service & Outreach

2023 – **Mentorship Program Co-Lead,** NHFP Anti-Racism Initiative

2023 – **Referee,** Physical Review Journals

2023 **JWST Cycle 2 Panelist,** Stellar Populations 2

2022 – **Member,** NHFP Anti-Racism Initiative

Referee, The Astrophysical Journal

Referee, Monthly Notices of the Royal Astronomical Society

2022 **Committee Member,** Carnegie Fellowship Committee

Committee Member, NHFP Symposium Organizing Committee

Mentor, Carnegie Observatories: Carnegie Astrophysics Summer Student Internship Program (CASSI)

Volunteer/Exhibitor, STEM Savvy outreach event

2021 **Secretary,** *R*-Process Alliance

2019 **Cofounder and Organizer,** JINA-CEE First Frontiers Summer School

2018 – 2019 **Committee Member,** Graduate Qualification Exam Committee

2018 **Volunteer/Exhibitor,** Carnegie Observatories 16th Annual Open House

2017 – 2018 **Representative,** Graduate Student Union (GSU) for the Department of Physics

2016 **Teaching Assistant.** Sensing our World 2016: Mission to Mars

Volunteer/Exhibitor, Our Universe Revealed: Hands-On Physics and Astroblast!

Volunteer/Exhibitor, JINA-CEE Art 2 Science Camp

Invited Presentations (28)

2023 **Carnegie Observatories Colloquium**— *Pasadena, CA*
"Heavy-Element Nucleosynthesis in the Multi-Messenger Era"

CeNAM Frontiers in Nuclear Astrophysics 2023— *East Lansing, MI*
"Heavy-Element Nucleosynthesis in the Multi-Messenger Era"

UC Santa Cruz Astro Colloquium— *Santa Cruz, CA*
"Heavy-Element Nucleosynthesis in the Multi-Messenger Era"

Pasadena City College Carnegie Observatories Lecture Series— *Pasadena, CA*
"Astrophysical Alchemy: How the Universe makes the Heaviest Elements"

Santa Barbara City College Special Seminar— *Santa Barbara, CA*
"Astrophysical Alchemy: How the Universe makes the Heaviest Elements"

2022 **Texas A&M University Astronomy Seminar** — *College Station, TX*
"The Origin of the Elements: What We Can Learn from Metal-Poor Stars"

Michigan State University Astronomy Seminar — *East Lansing, MI*
"The Origin of the Elements: What We Can Learn from Metal-Poor Stars"

2022 JINA-CEE Frontiers in Nuclear Astrophysics — *South Bend, IN*
"Stellar Abundances"

Anton Pannekoek Institute for Astronomy Colloquium — *University of Amsterdam, Amsterdam*
"The Origin of the Heavy Elements: What We Can Learn from Metal-Poor Stars"

NDT-NPP Seminar — *Lawrence Livermore National Laboratory, CA*
"Stellar Actinides as Tracers of Heavy-element Nucleosynthesis"

2021 **APS Dissertation Award in Nuclear Physics Talk** — *Massachusetts Institute of Technology, MA*
"Constraining the *r*-process with Observation and Theory"

Institute for Nuclear and Particle Physics — *Ohio University, OH*
"Stellar Actinides as Tracers of Heavy-Element Nucleosynthesis"

Origins of the Isotopes Workshop — *IReNA Virtual Workshop*
"The Production of the Heaviest Elements through the Nuclear Lens"

Yale Astronomy Virtual Colloquium — *Yale University, CT*
"Heavy Element Nucleosynthesis in the Era of Multi-messenger Astronomy"

LANL Astrophysics Seminar — *Los Alamos National Lab, NM*
"Stellar Actinides as Tracers of Heavy-Element Nucleosynthesis"

TCAN Meeting 2021: BNS/BH-NS Merger Workshop — *Rochester Institute of Technology, NY*
"Observational Signatures of Heavy-Element Nucleosynthesis"

Star Talks Seminar Series — *University of Victoria, B.C., Canada*
"The Origin of the Heavy Elements: What We Can Learn from Metal-Poor Stars"

Virtual Joint Nuclear and Astrophysics Seminar — *Texas A&M University, TX*
"Heavy Element Nucleosynthesis in the Era of Multi-messenger Astronomy"

CCRG Lunch Talks — *Rochester Institute of Technology, NY*
"The Astrophysical Production of the Heaviest Elements"

FLASH Seminar — *University of California Santa Cruz, CA*
"The Astrophysical Production of the Heaviest Elements"

2020 **Physics Colloquium** — *San Francisco State University, CA*
"The Astrophysical Production of the Heaviest Elements"

Physics Colloquium — *Gonzaga University, WA*
"The Astrophysical Production of the Heaviest Elements"

N3AS Seminar — *University of California Berkeley, CA*
"Properties of *r*-Process-Producing Neutron Star Mergers: What We Can Learn from Metal-Poor Stars"

Our Universe Revealed — *University of Notre Dame, IN*
"Cosmic Alchemy: How the Universe Made the Heaviest Elements"

Physics Colloquium — *Andrews University, MI*
"Through the Looking Glass: Understanding the *r*-Process with Stellar Actinide Signatures"

2019 **Nuclear Seminar** — *University of Notre Dame, IN*
"Constraining the *r*-Process with Actinide Production Studies"

Astrophysics Seminar — *University of Notre Dame, IN*
"The Stellar Actinide Boost and its *r*-Process Implications"

2018 **JINA-CEE Online Seminar** — *Michigan State University, MI*
"Actinide Production in Neutron Star Mergers: Observation and Theory"

First-author Publications

Refereed (9)

2023 **Superheavy Elements in Kilonovae, Holmbeck, E. M.**, Barnes, J., Lund, K. A., et al. 2023, arXiv:2304.02125 (ApJ, *in press*).

HD 222925: a New Opportunity to Explore the Astrophysical and Nuclear Conditions of *r*-process Sites, Holmbeck, E. M., Surman, R., Roederer, I. U., et al. 2023, arXiv:2210.10122 (ApJ, *in press*).

Nucleosynthesis and observation of the heaviest elements, Holmbeck, E. M., Sprouse, T. M., Mumpower, M. R., Eur. Phys. J. A. 59, 28 (2023).

2022 **A Nuclear Equation of State Inferred from Stellar *r*-process Abundances, Holmbeck, E. M.**, O'Shaughnessy, R., Delfavero, V., Belczynski, K. 2022, ApJ, 926, 196.

2021 **Reconstructing Masses of Merging Neutron Stars from Stellar *R*-Process Abundance Signatures, Holmbeck, E. M.**, Frebel, A., McLaughlin, G. C., et al. 2021, ApJ, 909, 21.

2020 **The *R*-Process Alliance: Fourth Data Release from the Search for *r*-Process-Enhanced Stars in the Galactic Halo, Holmbeck, E. M.**, Hansen, T. T., Beers, T. C., et al. 2020, ApJS, 249, 30.

2019 **Actinide-rich and Actinide-poor *r*-Process Enhanced Metal-Poor Stars do not Require Separate *r*-Process Progenitors, Holmbeck, E. M.**, Frebel, A., McLaughlin, G. C., et al. 2019, ApJ, 881, 5.

Actinide Production in the Neutron-Rich Ejecta of a Neutron Star Merger, Holmbeck, E. M., Sprouse, T. M., Mumpower, M. R., et al. 2019, ApJ, 870, 23.

2018 **The *R*-Process Alliance: 2MASS J09544277+5246414, the Most Actinide-Enhanced *R*-II Star Known, Holmbeck, E. M.**, Beers, T. C., Roederer, I. U., et al. 2018, ApJL, 859, L24.

Conference Proceedings (2)

2020 **Characterizing *r*-Process Sites through Actinide Production, Holmbeck, E. M.**, Surman, R., Frebel, A., et al. 2020, JPCS: Nuclear Physics in Astrophysics IX (NPA-IX), 1668, 15.

2017 **J2038−0023: The First Bright *R*-Process Enhanced Star Identified in the RAVE Survey,** 14th International Symposium on Nuclei in the Cosmos (NIC2016), 020612.

Co-authored Publications

Refereed (21)

2023 **Observational Signatures of Transuranic Fission Fragments in Stars,** Roederer, I. U., Vassh, N., **Holmbeck, E. M.**, et al. 2022 (Science, *under review*).

Uranium Abundances and Ages of r-process Enhanced Stars with Novel U II Lines , Shah, S. P., Ezzeddine, R., Ji, A. P., et al. 2023, arXiv:2301.11945 (ApJ, *under review*).

Constraining inputs to realistic kilonova simulations through comparison to observed *r*-process abundances, Ristic, M., **Holmbeck, E. M.**, Wollager, R., et al. 2022, arXiv:2206.02273 (Phys. Rev. D, *under review*).

2022 **Discovery of an Ultra Lithium-rich Metal-Poor Red Giant star,** Kowkabany, J., Ezzeddine, R., Charbonnel, C., et al. 2022, arXiv:2209.02184 (ApJ, *under review*).

The *R*-Process Alliance: Chemo-Dynamically Tagged Groups II. An Extended Sample of Halo *r*-Process-Enhanced Stars, Shank, D., Beers, T. C., Placco, V. M., et al. 2022, arXiv:2208.09712 (ApJ, *in press*).

The R-Process Alliance: Abundance Universality among Some Elements at and between the First and Second R-Process Peaks, Roederer, I. U., Cowan, J. J., Pignatari, M., et al. 2022, ApJ, 936, 84.

The *R*-process Alliance: A Nearly Complete *R*-process Abundance Template Derived from Ultraviolet Spectroscopy of the *R*-process-enhanced Metal-poor Star HD 222925, Roederer, I. U., Lawler, J. E., Den Hartog, E. A., et al. 2022, ApJS, 260, 27.

Investigation of the ^{10}B(*p*, α)^{7}Be reaction from 0.8 to 2.0 MeV, Kolk, B. V., Macon, K. T., deBoer, R. J., et al. 2022, Phys. Rev. C., 105, 055802.

2021 **The *R*-Process Alliance: Chemodynamically Tagged Groups of Halo *r*-process-enhanced Stars Reveal a Shared Chemical-evolution History,** Gudin, D., Shank, D., Beers, T. C., et al. 2021, ApJ, 908, 79.

2020 **Detection of Pb II in the Ultraviolet Spectra of Three Metal-Poor Stars,** Roederer, I. U., Lawler, J. E., **Holmbeck, E. M.**, et al. 2020, ApJL, 902, L24.

The *R*-Process Alliance: The Peculiar Chemical Abundance Pattern of RAVE J183013.5−455510, Placco, V. M., Santucci, R. M., Yuan, Z., et al. 2020, ApJ, 897, 78.

2019 **Using excitation-energy dependent fission yields to identify key fissioning nuclei in *r*-process nucleosynthesis,** Vassh, N., Vogt, R., Surman, R., et al. 2019, Journal of Physics G Nuclear Physics, 46, 065202.

The R-Process Alliance: Spectroscopic Follow-up of Low-metallicity Star Candidates from the Best & Brightest Survey, Placco, V. M., Santucci, R. M., Beers, T. C., et al. 2019, ApJ, 870, 122.

2018 **The *R*-Process Alliance: First Release from the Southern Search for *r*-Process Enhanced Stars in the Galactic Halo,** Hansen, T. T., **Holmbeck, E. M.**, Beers, T. C., et al. 2018, ApJ, 858, 92.

β-Delayed Fission in *R*-Process Nucleosynthesis, Mumpower M. R., Kawano T., Sprouse T. M., et al., 2018, ApJ, 869, 14.

Californium-254 and Kilonova Light Curves, Zhu, Y., Wollaeger, R. T., Vassh, N., Sprouse, T. M., et al. 2018, ApJL, 863, L23.

The *R*-Process Alliance: Discovery of the First Metal-poor Star with a Combined *r*- and *s*-process Element Signature, Gull, M., Frebel, A., Cain, M. G., et al. 2018, ApJ, 862, 174.

The *R*-Process Alliance: First Release from the Northern Search for *r*-process-enhanced Metal-poor Stars in the Galactic Halo, Sakari, C. M., Placco, V. M., Farrell, E. M., et al. 2018, ApJ, 868, 110.

The *R*-Process Pattern of a Bright, Highly *r*-Process-Enhanced, Metal-Poor Halo Star at [Fe/H] ~ -2, Sakari, C. M., Placco, V. M., Hansen, T., et al. 2018, ApJL, 854, L20.

Spectroscopic Validation of Low-metallicity Stars from RAVE, Placco, V. M., Beers, T. C., Santucci, R. M., et al. 2018, AJ, 155, 256.

2017 **RAVE J203843.2−002333: The First Highly *r*-Process-Enhanced Star Identified in the RAVE Survey,** Placco, V. M., **Holmbeck, E. M.**, Frebel, A., et al. 2017, ApJ, 844, 18.

White Papers (2)

2022 **Horizons: Nuclear Astrophysics in the 2020s and Beyond,** Schatz, H., Becerril Reyes, A. D., Best, A., et al. 2022, arXiv:2205.07996.

2018 **FRIB and the GW170817 Kilonova,** Aprahamian, A., Surman, R., Frebel, A., et al. 2018, arXiv:1809.00703.