

Alexander P. Ji

E-mail: alexji@uchicago.edu Twitter: @alexanderpji

Website: www.alexji.com Github: www.github.com/alexji

RESEARCH INTERESTS: NEAR-FIELD COSMOLOGY

The first stars and galaxies: metal-free stars, first galaxy relics, reionization
The origin of the elements, especially the rapid neutron-capture process
Milky Way halo substructure and the nature of dark matter

EDUCATION AND APPOINTMENTS

Assistant Professor , University of Chicago, Astronomy & Astrophysics	Jul 2021 – now
Senior Member , University of Chicago, Kavli Institute for Cosmological Physics	Jul 2021 – now
Carnegie Fellow , Observatories of the Carnegie Institution for Science	Aug 2020 – Jun 2021
Hubble Fellow , Observatories of the Carnegie Institution for Science	Aug 2017 – Jul 2020
Ph. D. Physics , Massachusetts Institute of Technology Advised by Anna Frebel, Astrophysics division	Jun 2017
M.S. Statistics , Stanford University Focus on Applied Statistics and Machine Learning	Jun 2012
B. S. Physics , Stanford University Minor in Computer Science	Jun 2011

HONORS, AWARDS, AND GRANTS

Carnegie Fellowship	2020-2021
Hubble Fellowship	2017-2020
Thacher Research Award in Astronomy	Jun 2020
Carnegie Institution P^2 Grant	Apr 2019
APS DAP Cecilia Payne-Gaposchkin Thesis Award Finalist	Apr 2019
Martin Deutsch Award for Excellence in Experimental Physics, MIT	Sep 2016
Young Scientist at 66th Lindau Nobel Laureate Meeting, Germany	Jun 2016
Best Poster Prize, Nuclei in the Cosmos XIV, Japan	Jun 2016
Henry Kendall Teaching Award, MIT	Sep 2014
Whiteman Fellow, MIT	Sep 2012 - Aug 2013
Outstanding Learning Assistant, American Association of Physics Teachers	Jun 2012
Stanford Alumni Award of Excellence	Jun 2011

INVITED TALKS

Review Talk Chemistry as Galactic Scissors, EAS Symposium	Jun 2021
Colloquium Carnegie Observatories	Jun 2021
Seminar Northwestern/CIERA	Apr 2021
Colloquium University of Indiana, Bloomington	Jan 2021
Seminar Minnesota Institute for Astrophysics Cosmology Seminar	Jan 2021
Seminar Near-Field Cosmology with UFD Galaxies, Rutgers	Dec 2020
Colloquium R-Process with Stellar Abundances and Astrophysical Transients, ANU	Sep 2020
Colloquium Near-field Cosmology with the Rapid Neutron-capture Process, MPIA	Aug 2020
Colloquium Near-field Cosmology with the Rapid Neutron-capture Process, UC Berkeley	Jun 2020

Talk First Star Signatures in First Galaxy Relics, First Stars VI, Concepcion, Chile	Mar 2020
Colloquium Near-field Cosmology with the Rapid Neutron-capture Process, UT Austin	Feb 2020
Colloquium Near-field Cosmology with the Rapid Neutron-capture Process, Stanford	Feb 2020
Colloquium Near-field Cosmology with the Rapid Neutron-capture Process, UChicago	Jan 2020
Talk Chemical Evolution of Galaxies: the Next 25 Years, Sesto, Italy	Jan 2020
Seminar The lanthanide fraction distribution in metal-poor stars JINA Online Seminars	Nov 2019
Colloquium Near-field Cosmology with the Rapid Neutron-capture Process, Caltech	Oct 2019
Talk Chemical evolution in ultra-faint dwarf galaxies, Hubble Symposium	Oct 2019
Talk Chemical evolution in ultra-faint dwarf galaxies, Dwarf Galaxy Cosmology, Durham	Jul 2019
Talk Signatures of the First Stars in Relics of the First Galaxies, APS Cecilia Payne-Gaposchkin Doctoral Dissertation Award in Astrophysics Finalist	Apr 2019
Talk Lanthanide fractions in metal-poor stars, Hubble Symposium	Mar 2019
Talk r-process nucleosynthesis in the first galaxies, Stellar Archaeology, Tokyo	Dec 2018
Talk Connecting dwarf galaxies to the stellar halo, Metal-Poor Galaxy, Ringberg	Jul 2018
Talk r-process nucleosynthesis in dwarf galaxies, AAS Denver	Jun 2018
Talk r-process nucleosynthesis in ultra-faint dwarf galaxies, Hubble Symposium	Mar 2018
Colloquium U. Virginia (Joint Physics/Astronomy)	Feb 2018
Seminar A rare and prolific r-process event in Reticulum II, CCAPP/OSU	Oct 2016
Highlight Talk Dwarf galaxy archaeology with Reticulum II, First Stars V, Heidelberg	Aug 2016
Talk A single prolific r-process event preserved in an ultra-faint dwarf galaxy, American Physical Society Hot Topics Session, April Meeting	Apr 2016
Colloquium “A rare and prolific r-process event in Reticulum II, University of Toledo	Jan 2016

CONTRIBUTED TALKS AND POSTERS

Talk Kinematics of Antlia 2, Streams 21 Workshop, online	Feb 2021
Talk Chemical Abundances in UFD Galaxies, Local Group Symposium, StSci	Sep 2020
Session Lead Near/Far Age Workshop, Napa, CA	Dec 2019
Talk Chemical evolution in ultra-faint dwarf galaxies, GalFRESKA, UC Irvine	Aug 2019
Talk Lanthanide fractions in neutron star mergers, ASU <i>r</i> -process workshop	Mar 2019
Talk Dwarf galaxy archaeology with Reticulum II, UC Irvine	May 2018
Talk A full abundance pattern in Reticulum II, JINA Frontiers	May 2018
Talk Homogeneous Abundances in Ultra-faint Dwarf Galaxies, JINA Forging Connections	Jun 2017
Talk Dwarf galaxy archaeology with Reticulum II, The Galactic Renaissance	Feb 2017
Seminars Dwarf galaxy archaeology with Reticulum II, 7 talks At Caltech, CfA, UCSC, Yale, Carnegie, KIPAC, Tufts	Apr-Nov 2016
Poster Stellar Abundances in Ultra-faint Dwarf Galaxies, GMT Science Meeting	Sep 2017
Poster A rare and prolific r-process event in Reticulum II, Nuclei in the Cosmos XIV	Jun 2016
Poster Satellite Planes in Caterpillar, Local Group Astrostatistics Conf, U Michigan	Jun 2015
Poster Testing early star formation, Near-Field Far-Field Conf, UC Irvine	Feb 2014

TEACHING

Instructor ASTR 30100 Stars	Aut 2021
Professional Development Program* ISEE (as team leader, with A. Lanz, S. Uddin)	2019
Lecturer “Cosmology and First Stars”, JINA Frontiers Summer School, MSU	2019
Professional Development Program* ISEE (with R. McGurk, D. French)	2018

Workshop	Carnegie, Scientific Writing Workshop for Undergraduates (with J. Teske)	2017
Teaching Assistant	MIT, 8.282/8.284: Intro to Astronomy/Modern Astrophysics	2014/2016/2017
Head Teaching Assistant	Stanford, Physics 25/26: Modern Physics	2012
Teaching Assistant	Stanford, Physics 63: Electricity, Magnetism, and Waves	2012
Teaching Assistant*	Stanford, Physics 62: Classical Mechanics Laboratory	2010/2011
Instructor*	Stanford, Physics 91SI: Practical Computing for Scientists	2011
Teaching Assistant	Stanford, Physics 24: Electricity and Optics Laboratory	2011
Resident Tutor	Stanford CTL, Math, science, and engineering tutoring	2009 - 2010
Section Leader	Stanford, CS 106A/B: Programming Methods/Abstractions	2008 - 2009

* Led or assisted in curriculum development

SELECTED OUTREACH AND SERVICE

Referee	for ApJ, ApJL, MNRAS, A&A	
Panelist/Reviewer	for NASA funding proposals	
Co-Chair	SDSS-V Milky Way Halo Working Group	2020-present
PhD Qualification Committee	Danielle de Brito Silva, UDP	Mar 2021
Public Talk	The Messy Milky Way, Carnegie Lunch with an Astronomer	Feb 2021
Admissions Committee	UChicago Astronomy & Astrophysics Graduate Program	2020-2021
Fellowship Committee	Brinson Prize Fellowship in Observational Astrophysics	2020-2021
Public Talk	“The First Stars”, San Diego Astronomy Association	Dec 2020
Working Group Co-Organizer	JINA Horizons, Explosive nucleosynthesis	Dec 2020
Public Talk	“The First Stars, Like, Ever”, Caltech Astronomy on Tap	Aug 2020
Co-Organizer	JINA-CEE Chemical Evolution Workshop	Mar 2020
Climate Survey Working Group	Carnegie Institution for Science	2019–2021
Public Talk	“Glimpses of the Cosmic Dawn”, Pasadena City College Lectures	Sep 2019
Program Committee	for JINA First Frontiers Summer School	May 2019
Public Talk	“Glimpses of the Cosmic Dawn”, Huntington Library Astronomy Lectures	Mar 2019
Public Talk	“Glimpses of the Cosmic Dawn”, Carnegie Lunch with an Astronomer	Nov 2017
Public Talk	“Searching for the First Stars”, Carnegie Open House	Oct 2017
Public Talk	“Glimpses of the Cosmic Dawn”, Whitin Observatory at Wellesley	Apr 2017
Public Talk	“The First Stars”, MIT IAP	Jan 2017
Einstein in the Classroom Instructor	Cambridge Science Festival	Apr 2015
Public Talks	“The Universe in a Box” and “The First Stars”, MIT IAP	2014/2015
Mentor	for two undergraduate students and one high school student at MIT	2013 - 2017

TELESCOPE AND COMPUTING ALLOCATIONS

As PI:

Magellan/MIKE High-resolution spectroscopy
Magellan/M2FS Multi-object spectroscopy
Magellan/IMACS Multi-object spectroscopy
Magellan/MegaCam Imaging
VLT/FLAMES Multi-object spectroscopy
Gemini/GRACES High-resolution spectroscopy
Du Pont/Echelle High-resolution spectroscopy

CTIO/DECam Wide-field imaging

As Co-I:

Keck/HIRES High-resolution spectroscopy

DCT/EXPRES High-resolution spectroscopy

Hubble/ACS Imaging

Hubble/COS UV spectroscopy

XSEDE/Stampede, Stampede2, Comet High Performance Computing

STUDENT COLLABORATORS

Graduate Students Kaley Brauer (MIT, 2017-present, r-process and stellar halo models),
Katy Rodriguez-Wimberly (UC Irvine, 2020-present, dwarf galaxy observations)

Undergraduate Students Allen Marquez (CSULA, 2019-2020, machine learning); Jandrie Rodriguez (ELAC, 2020-2021, stellar abundances); Mimi Truong (ELAC, 2020, stellar abundances); Fernando Barceló (Pomona, 2019, Pop III mass function); Jose Arizmendi (ELAC, 2019, stellar abundances); Sergio Escobar (Caltech, 2018, stellar halo kinematics); Maude Gull, Madelyn Cain (MIT, 2016-2018, r-process star abundances); Lizhou Sha (MIT, 2016-2017, dark matter simulations)

COLLABORATION MEMBERSHIP

The Southern Stellar Stream Spectroscopic Survey (S^5 , <https://s5collab.github.io/>, Project Builder)

SDSS-V, <https://www.sdss.org/future/>, Milky Way Halo Working Group co-chair

The *Caterpillar* Project (<https://www.caterpillarproject.org/>, Project Builder)

The R-Process Alliance (RPA)

The Magellanic Satellites Survey (MagLiteS)

DECam Local Volume Exploration Survey (DELVE, <https://delve-survey.github.io/>)

Joint Institute for Nuclear Astrophysics (JINA-CEE) and IReNA member

PUBLICATIONS

19 refereed or submitted first and second author papers, >600 total citations, h -index = 12.

47 refereed or submitted papers, >1600 total citations, h -index = 21.

As of Jun 2021 (via NASA ADS).

FIRST AND SECOND AUTHOR PUBLICATIONS

19. **Ji, A. P.**, Koposov, S. E., Li, T. S., Erkal, D., Pace, A. B., ..., *Kinematics of Antlia 2 and Crater 2 from The Southern Stellar Stream Spectroscopic Survey*, submitted to ApJ
18. Casey, A. R., **Ji, A. P.**, Hansen, T. T., Li, T. S., ..., *Signature of a massive rotating metal-poor star imprinted in the Phoenix stellar stream*, submitted to ApJ
17. Hansen, T. T., **Ji, A. P.**, Da Costa, G. S., Li, T. S., et al., *S⁵: The destruction of a bright dwarf galaxy as revealed by the chemistry of the Indus stellar stream*, accepted to ApJ
16. Brauer, K., **Ji, A. P.**, Drout, M. R., Frebel, A., *Collapsar R-Process Yields Can Reproduce [Eu/Fe] Abundance Scatter in Metal-Poor Stars*, submitted to ApJ, arXiv:2010.15837
15. **Ji, A. P.**, Li, T. S., Hansen, T. T., Casey, A. R., et al., *The Southern Stellar Stream Spectroscopic Survey (S⁵): Chemical Abundances of Seven Stellar Streams*, 2020, AJ, 160, 181
14. **Ji, A. P.**, Li, T. S., Simon, J. D., et al., *Detailed Abundances in the Ultra-Faint Magellanic Satellites Carina II and III*, 2020, ApJ, 889, 27
13. **Ji, A. P.**, Drout, M. R., & Hansen, T. T., *The Lanthanide Fraction Distribution in Metal-poor Stars: a Test of Neutron Star Mergers as the Dominant r-process Site*, 2019, ApJ, 882, 1
12. Frebel, A., **Ji, A. P.**, Ezzeddine, R., Hansen, T. T., Chiti, A., Thompson, I. B., Merle, T. *Chemical abundance Signature of J0023+0307 – A Second-Generation Main-Sequence Star with [Fe/H] < -6*, 2019, ApJ, 871, 146
11. Brauer, K., **Ji, A. P.**, Frebel, A., Dooley, G. A., Gomez, F. A., O’Shea, B. W. *The Origin of r-process Enhanced Metal-Poor Halo Stars In Now-Destroyed Ultra-Faint Dwarf Galaxies*, 2019, ApJ, 871, 2
10. **Ji, A. P.**, Simon, J. D., Frebel, A., Venn, K. A., Hansen, T. T. *Chemical Abundances in the Ultra-Faint Dwarf Galaxies Grus I and Triangulum II: Neutron-Capture Elements as a Defining Feature of the Faintest Dwarfs*, 2019, ApJ, 870, 83
9. **Ji, A. P.** & Frebel, A. *From Actinides to Zinc: Using the full abundance pattern of the brightest star in Reticulum II to distinguish between different r-process sites*, 2018, ApJ, 856, 138
8. Safarzadeh, M., **Ji, A. P.**, Dooley, G., Frebel, A., Scannapieco, E., Gomez, F., O’Shea, B. W. *Selecting ultra-faint dwarf candidate progenitors in cosmological N-body simulations at high redshifts*, 2018, MNRAS, 476, 5006
7. **Ji, A. P.**, Frebel, A., Ezzeddine, R., Casey, A. R. *Chemical Diversity in the Ultra-faint Dwarf Galaxy Tucana II*, 2016, ApJL, 832, 1
6. **Ji, A. P.**, Frebel, A., Simon, J. D., Chiti, A. *Complete element abundances of nine stars in the r-process galaxy Reticulum II*, 2016, ApJ, 830, 93
5. **Ji, A. P.**, Frebel, A., Chiti, A., Simon, J. D. *R-process enrichment from a single event in an ancient dwarf galaxy*, 2016, Nature, 531, 610

4. Griffen, B. F., **Ji, A. P.**, Dooley, G. A., Gomez, F. A., Vogelsberger, M., O'Shea, B. W., Frebel, A., *The Caterpillar Project: A Large Suite of Milky Way Sized Halos*, 2016, ApJ, 818, 10
3. **Ji, A. P.**, Frebel, A., Simon, J. D., Geha, M., *High-resolution spectroscopy of extremely metal-poor stars in the least evolved galaxies: Bootes II*, 2016, ApJ, 817, 41
2. **Ji, A. P.**, Frebel, A., Bromm, V., *Preserving chemical signatures of primordial star formation in the first low-mass stars*, 2015, MNRAS, 454, 659
1. **Ji, A. P.**, Frebel, A., Bromm, V., *The chemical imprint of silicate dust on the most metal-poor stars*, 2014, ApJ, 782, 95

N-TH AUTHOR PUBLICATIONS

28. Nelson, T., Ting, Y.-S., Hawkins, K., **Ji, A. P.**, Kamdar, H., El-Badry, K., *Distant Relatives: The Chemical Homogeneity of Comoving Pairs Identified in Gaia*, submitted, arXiv:2104.12883
27. Gull, M., Frebel, A., ..., **Ji, A. P.**, Brauer, K., *R-process-rich stellar streams in the Milky Way*, accepted to ApJ
26. Jenkins, S., Li, T. S., Pace, A. B., **Ji, A. P.**, Koposov, S. E., Mutlu-Pakdil, B., *VLT Spectroscopy of Ultra-Faint Dwarf Galaxies. 1: Bootes I, Leo IV, Leo V*, submitted to AAS, arXiv:2101.00013
25. Chiti, A., Frebel, A., Simon, J. D., ..., **Ji, A. P.**, ..., *An extended halo around an ancient dwarf galaxy*, 2021, Nat Astron., 5, 392
24. Li, T. S., Koposov, S. E., Erkal, D., **Ji, A. P.**, ..., *Broken into Pieces: ATLAS and Aliqa Uma as One Single Stream*, 2021, ApJ, 911, 149
23. Wan, Z., Lewis, G. F., Li, T. S., ... **Ji, A. P.**, ..., *The tidal remnant of an unusually metal-poor globular cluster*, 2020, Nature, 583, 768
22. Reggiani, H., Schlaufman, K. C., Casey, A. R., **Ji, A. P.**, *The Most Metal-poor Stars in the Inner Bulge*, 2020, ApJ, 160, 173
21. Cain, M., Frebel, A., **Ji, A. P.**, Placco, V. M., ..., *The R-Process Alliance: J1521-3538, a very metal-poor, extremely r-process-enhanced star with $[Eu/Fe]=+2.2$, and the class of r-III stars*, 2020, ApJ, 898, 1
20. Ezzeddine, R., Rasmussen, K., Frebel, A., ... **Ji, A. P.**, ..., *The R-process Alliance : First Magellan/MIKE Release from the Southern Search for R-Process-enhanced Stars*, 2020, ApJ, 898, 150
19. Placco, V. M., Santucci, R. M., ... **Ji, A. P.**, ..., *The R-Process Alliance: The Peculiar Chemical Abundance Pattern of RAVE J183013.5–455510*, 2020, ApJ, 897, 78
18. Hawkins, K., Lucey, M., Ting, Y.-S., **Ji, A. P.**, ..., *Identical or fraternal twins? The chemical homogeneity of wide binaries from Gaia DR2*, 2020, MNRAS, 492, 1164
17. Norfolk, B. J., Casey, A., ..., **Ji, A. P.**, *Discovery of s-process enhanced stars in the LAMOST survey*, 2019, MNRAS, 490, 2219
16. Koposov, S. E., Boubert, D., Li, T. S., ..., **Ji, A. P.** (7th/20), ..., *Discovery of a nearby 1700 km/s star ejected from the Milky Way by Sgr A**, 2020, MNRAS, 491, 2645,
15. Li, T. S., Koposov, S. E., Zucker, D. B., ..., **Ji, A. P.** (7th/32), ..., *The Southern Stellar Stream Spectroscopic Survey (S^5): Overview, Target Selection, Data Reduction, Validation, and Early Science*, 2019, MNRAS, 490, 3508

14. Kozłowski, S., Bañados, E., . . . , **Ji, A. P.**, . . . , *Discovery of two quasars at $z = 5$ from the OGLE survey*, 2019, ApJ, 878, 115
13. Placco, V., Santucci, R. M., . . . , **Ji, A. P.**, . . . , *The R-Process Alliance: Spectroscopic Follow-up of Low-metallicity Star Candidates from the Best & Brightest Survey*, 2019, ApJ, 870, 122
12. Kemp, A., Casey, A., . . . , **Ji, A. P.**, . . . , *On the discovery of K-enhanced and possibly Mg-depleted stars throughout the Milky Way*, 2018, MNRAS, 480, 1384
11. Cain, M. G., Frebel, A., Gull, M., **Ji, A. P.**, . . . , *The R-Process Alliance: Chemical Abundances for a Trio of R-Process-Enhanced Stars*, 2018, ApJ, 864, 43
10. Gull, M., Frebel, A., Cain, M. G., Placco, V., **Ji, A. P.**, . . . , *The R-Process Alliance: discovery of the first metal-poor star with a combined r- and s-process element signature*, 2018, ApJ, 862, 174
9. Chiti, A., Frebel, A., **Ji, A. P.**, Jerjen, H., Kim, D., Norris, J. E., *Chemical Abundances of New Member Stars in the Tucana II Dwarf Galaxy*, 2018, ApJ, 857, 74
8. Li, T. S., Simon, J. D., . . . , **Ji, A. P.**, . . . , *Ships Passing in the Night: Spectroscopic Analysis of Two Ultra-Faint Satellites in the Constellation Carina*, 2018, ApJ, 851, 145
7. Hartwig, T., Yoshida, N., . . . , **Ji, A. P.**, . . . , *Descendants of the first stars: the distinct chemical signature of second generation stars*, 2018, MNRAS 478, 1795
6. Griffen, B. F., Dooley, G., **Ji, A. P.**, O’Shea, B. W., Gomez, F., Frebel, A., *Tracing the origin of the first stars and galaxies within the hierarchical assembly history of the Milky Way*, 2018, MNRAS, 474, 443
5. Drout, M. R., Piro, A. L., . . . , **Ji, A. P.**, . . . , *Light Curves of the Neutron Star Merger GW170817/SSS17a: Implications for R-Process Nucleosynthesis*, 2017, Science, 358, 1570
4. Shappee, B. J., Simon, J. D., . . . , **Ji, A. P.**, . . . , *Early Spectra of the Gravitational Wave Source GW170817: Evolution of a Neutron Star Merger*, 2017, Science, 358, 1574
3. Placco, V. M., Holmbeck, E. M., . . . , **Ji, A. P.**, . . . , *RAVE J203843.2–002333: The first highly r-process enhanced star identified in the RAVE survey*, 2017, ApJ, 844, 18
2. Frebel, A., Chiti, A., **Ji, A. P.**, Jacobson, H. R., Placco, V. M., *SD 1313–0019 — another second generation star with $[Fe/H] = -5.0$, observed with the Magellan telescope*, 2015, ApJL, 810, 27
1. Dooley, G., Griffen, B. F., Zuck, P., **Ji, A. P.**, Vogelsberger, M., Hernquist, L., Frebel, A., *The effects of varying cosmological parameters on halo substructure*, 2014, ApJ, 786, 50

UNREFEREED MANUSCRIPTS

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5. **Ji, A. P.** et al., *Local Dwarf Galaxy Archaeology*, White Paper submitted to the Astro 2020 Decadal Survey
 4. Simon, J. D. et al. including **Ji, A. P.**, *Dynamical Masses for a Complete Census of Local Dwarf Galaxies*, White Paper submitted to the Astro 2020 Decadal Survey
 3. Roederer, I. U. et al. including **Ji, A. P.**, *The First Stars and the Origin of the Elements*, White Paper submitted to the Astro 2020 Decadal Survey
 2. Roederer, I. U. et al. including **Ji, A. P.**, *The astrophysical r-process and the origin of the heaviest elements*, White Paper submitted to the Astro 2020 Decadal Survey
 1. The MSE Science Team including **Ji, A. P.**, *The Detailed Science Case for the Maunakea Spectroscopic Explorer, 2019 edition* (contributed to Chapter 4), arXiv:1904.04907