Nathan R. Sandford

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Research Interests

Resolved Stellar Spectroscopy, Stellar Chemical Abundances;
(Extra-)Galactic Archaeology, Galactic Chemical Evolution;
Neural Networks, Bayesian Inference

Education

Ph.D., Astrophysics, University of California, Berkeley — (expected) May 2023
Advisor: Dr. Dan Weisz
Thesis: "Pushing Stellar Archaeology Further & Farther with Low-Resolution Spectroscopy"

M.A., Astrophysics, University of California, Berkeley — Dec 2018

B.A., Physics, *magna cum laude*, Pomona College — May 2017
Academic Advisor: Dr. Philip Choi
Research Advisor: Dr. Yu Lu
Thesis: "Exploring Gas-Phase Metallicity Gradients in Disc Galaxies: A Semi-Analytic Approach"

Research Positions

Graduate Research Assistant & NSF GRFP Fellow, UC Berkeley	2017–present
Summer Visiting Researcher, MPIA, Heidelberg	2018, 2019
Science Undergraduate Laboratory Intern, KIPAC/SLAC—Fermi-LAT Collaboration	2017
Undergraduate Research Assistant, Pomona College—KBO and NEA Survey	2016–2017
Summer Undergraduate Intern, The Carnegie Observatories	2016

Honors & Awards

Trumpler Prize, UC Berkeley	2022
NSF Graduate Research Fellow, National Science Foundation	2020–2023
Outstanding Graduate Student Instructor Award, UC Berkeley (Astro C10)	2019
Magna Cum Laude, Pomona College	2017
The Frank Brackett, Jr., and Davida Brackett Prize, Pomona College 2017 Phi Beta Kappa, Pomona College	2016
Barry Goldwater Scholarship	2016
Tilestone Junior Physics Prize, Pomona College	2016
Tilestone Sophomore Physics Prize, Pomona College	2015
Moncrieff Astronomy Prize, Pomona College	2014
Pomona College Scholar	2013–2017

Teaching

UC Berkeley

Graduate Student Instructor, Astro 375, *Instruction Techniques in General Astronomy*	Fall 2020/Spring 2022
Head Graduate Student Instructor, Astro C10, *Introduction to General Astronomy*	Fall 2018
Graduate Student Instructor, Astro C12, *The Planets*	Spring 2018
Graduate Student Instructor, Astro C10, *Introduction to General Astronomy*	Fall 2017

Pomona College

Student Mentor, Phys 142, *Electricity & Magnetism*	Spring 2017
Student Mentor & Lab TA, Astro 101, *Techniques in Observational Astrophysics*	Fall 2015/2016
Student Mentor, Astro 002, *Introduction to Galaxies and Cosmology*	Spring 2016
Student Mentor, Phys 101, *Foundations of Modern Physics*	Fall 2015
Lab TA, Astro 051, *Advanced Introductory Astronomy*	Spring 2015

Service

Acting Astronomy Dept. Steward, Student Researchers United	2020–present
Grad. Student Representative, UCB Astronomy Dept. Faculty Search Committee	2022
Grad. Student Representative, UCB Astronomy Dept. Climate & DEI Committee	2020–2021
Grad. Student Representative, UCB Astronomy Dept. Small Council	2020–2021
Committee Member, UCB MPS Undergraduate DEI and Advancement Task Force	2019–2020
Committee Member, UCB Astronomy Dept. Prospective Grad. Student Visit Planning Committee	2017–2020
Co-PI, Conference Organizer & UC Berkeley Rep., Osterbrock Sierra Conference	2018
Physics Department Liaison, Pomona College	2014–2017
Mentor, Pomona College Physics Cohort Program	2016
Construction Coordinator, Sierra Service Project	2014–2016
Committee Member, Pomona College Academic Affairs Team	2015
Board Member, Sierra Service Project	2012

Outreach

Astronomy Department Exposition at Cal Day, UC Berkeley	2017–2019
15th Annual Open House, The Carnegie Observatories	2016
Astronomy Department Founder's Day Exposition, Pomona College	2015
Science Night, Stork Elementary School	2014

Awarded Grants

Co-PI, Reviving the Sierra Conference: 2017
A Collaborative Meeting For UC Astronomy Graduate Students (Co-PI: Felipe Ardila, $1500)

Awarded Telescope Time

co-I (PI Dan Weisz): Keck/DEIMOS - 3 nights 2022B
A spectroscopic investigation of two metal-rich ultra-faint galaxies around M31
co-I (PI Dan Weisz): Keck/ESI - 2 nights 2021B
The progenitors of extremely low-mass white dwarfs
co-I (PI Dan Weisz): HST GO (Cycle 29) - 30 orbits 2021
The Metallicity Distribution Functions of Faint M31 Satellites
co-I (PI Dan Weisz): Keck/LRIS, MOSFIRE - 2 nights 2020A
Characterizing Extremely Metal-Poor Massive Stars in Leo A
co-I (PI Dan Weisz): HST GO (Cycle 28) - 23 orbits 2020
The Metallicity Distribution Functions of Quenched Field Dwarf Galaxies
co-I (PI Dan Weisz): HST GO (Cycle 27) - 43 orbits 2019
The Metallicity Distribution Functions of Ultra-Faint Dwarf Galaxies
co-I (PI Dan Weisz): Keck/LRIS - 1 night 2019B
Triangulum II: Globular Cluster or Dwarf Galaxy?
co-I (PI Dan Weisz): Keck/KCWI - 1 night 2019B
Resolved Stellar Spectroscopy and Feedback from massive stars in M33: a KCWI view
co-I (PI Dan Weisz): Keck/LRIS - 1 night 2019A
The Chemical Enrichment of the Pre-Reionization Fossil Galaxy Sextans

Observing Experience

Keck/LRIS (3.5 nights)	2018–2021
Keck/DEIMOS (2.75 nights)	2020
Keck/NIRES (0.5 nights)	2018
Keck/MOSFIRE (0.5 nights)	2018
Craft Observational Astronomy Workshop, Lick Observatory	2017
Pomona College Table Mountain Observatory (∼30 nights)	2015–2017

Publications, Talks & Posters

Publications:

- **Sandford, N.**, Weinberg, D., Weisz, D. & Fu, S. In Prep.
  "The Chemical Evolution of Ultra Faint Dwarf Galaxy Eridanus II"
- **Sandford, N.**, Weisz, D. & Ting, Y.-S. In Prep.
  "Validating Stellar Abundance Measurements from Multi-Resolution Spectroscopy"
- Gull, M., Weisz, D., Senchyna, P., **Sandford, N.**, et al. Submitted to ApJS.
  "A Panchromatic Study of Massive Stars in the Extremely Metal-Poor Local Group Dwarf Galaxy Leo A"
- Fu, S. et al. (including **Sandford, N.**). 2022, ApJ, 925, 6.
  "Metallicity Distribution Function of the Eridanus II Ultra-Faint Dwarf Galaxy from Hubble Space Telescope Narrow-band Imaging"
- Bundy, K. et al. (including **Sandford, N.**). 2020, SPIE, 11447.
  "The Keck-FOBOS spectroscopic facility: conceptual design"
- **Sandford, N.**, Weisz, D. & Ting, Y.-S. 2020, ApJS, 249, 24.
  "Forecasting Chemical Abundance Precision for Extragalactic Stellar Archaeology"
- Xiang, M., Ting, Y.-S., Rix, H.W., **Sandford, N.**, et al. 2019, ApJS, 245, 34.
  "Abundance Estimates for 16 Elements in 6 Million Stars from LAMOST DR5 Low-Resolution Spectra"

Talks:

- "TBD."
  University of Chicago KICP Seminar, Chicago, IL, Oct 2022.
- "TBD."
  Yale Astronomy Galaxy Lunch Talk, New Haven, CT, Sept 2022.
- "Self-Consistent Stellar Chemical Abundance Measurements: From Near to Far, High to Low (Resolution)."
  IAUGA 2022 Focus Meeting: Stellar Synthetic Spectra to Study Stellar Populations in the Gaia Era, Busan, Republic of Korea, August 2022.
- "Stellar Chemistry Beyond 1 Mpc with Next Generation Low-Res Spectrographs: Forecasts and Validation."
  A Comprehensive View of Galaxy Evolution from the Milky Way to I Zwicky 18, Sexten, Italy, July 2022.
- "Following Up Faint Substructures Beyond 1 Mpc with Next Generation Spectrographs."
  EAS 2022 Symposium: Satellite Galaxies and Tidal Streams in the Framework of Cosmological Models, Valencia, Spain, June 2022.
- "Stellar Chemistry Beyond 1 Mpc with ELTs."
  Spatially Resolved Spectroscopy with ELTs, Online Workshop, September 2021.
- "Stellar Chemistry Beyond 1 Mpc with Space-Based MOS."
  Massively Parallel Large Area Spectroscopy from Space, Online Workshop, June 2021.
- "Forecasting Chemical Abundance Precision for Extragalactic Archaeology."
  Science Talk, Waimea, HI, October 2019.
- "Forecasting the Chemical Information Content of Stellar Spectra."
  Small Galaxies, Cosmic Questions, Durham, UK, July 2019.

Posters:

- Sandford, N. "Stellar Chemistry in M31 and Beyond with Next Generation Low-Resolution Spectrographs: Forecasts and Validation." Linking the Galactic and Extragalactic, Wollongong, NSW, Australia, Nov 2022.
- Sandford, N. & Weisz, D. "Stellar Chemical Abundance Measurements: From Near to Far, High to Low." 2021 Keck Science Meeting, San Diego, CA, Sept 2021.
- Sandford, N., Weisz, D. & Ting, Y.-S. "Precision Extragalactic Stellar Chemcial Abundances with Next Generation Multi-Object Spectrographs" STScI MOS Workshop, May 2021.
- Sandford, N., Weisz, D. & Ting, Y.-S. "Forecasting Stellar Chemical Abundance Precision for WMKO Spectrographs" 2020 Keck Science Meeting, San Diego, CA, Sept 2020.
- Sandford, N., Charles, E. & Di Mauro, M. "A Blind Search Pipeline for Dark Satellites of the Milky Way in Gamma Rays." 229th AAS Meeting, Grapevine, Tx, Jan 2017.
- Sandford, N. & Lu, Y. "A Semi-Analytic Study of Feedback Processes and Metallicity Profiles in Disc Galaxies." 227th AAS Meeting, Kissimmee, Fl, Jan 2016.

Undergraduate Thesis:

- "Exploring Gas-Phase Metallicity Gradients in Disc Galaxies: A Semi-Analytic Approach." Thesis with distinction, Pomona College, May 2017.

Code Contributions

- **Sandford, N.** 2020, Zenodo:3924672
  "Chem-I-Calc: The Chemical Information Calculator"
- Prochaska, J. X. et al. (including **Sandford, N.**). 2020, Zenodo:3743493
  "PypeIt: Release 1.0.0"
- Rybizki, J. et al. (including **Sandford, N.**). 2019, ASCL:1909.006
  "ChempyMulti: Multi-star Bayesian inference with Chempy"

Skills

Computer Languages	Python, SQL/ADQL, LaTeX, bash, git
Parallel Computing	Python multiprocessing, MPI, SLURM
Machine Learning	PyTorch, Theano/Aesara
Reduction Pipelines	PypeIt
Stellar Codes	ATLAS12, SYNTHE
Chem Ev Codes	Chempy
Other Software	emcee, PyMC3
Language	German (basic)