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 — in progress
Advisor: Dr. Dan Weisz

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-
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
Undergraduate Research Assistant, Pomona College—Bose-Einstein Condensate Lab — 2014

Honors & Awards

NSF Graduate Research Fellow, National Science Foundation — 2020-2023
Trumpler Prize, UC Berkeley — 2022
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
Pomona College Senior Astronomy Award
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
Comcast Leaders and Achievers Scholarship — 2013

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

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

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

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

Grants

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

Publications, Talks & Posters

Publications:

- **Sandford, N.**, Weisz, D. & Ting, Y.-S. In Prep.
  "Validating Stellar Abundance Measurements from Multi-Resolution Spectroscopy"
- 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:

- Sandford, N. "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.
- Sandford, N. "Stellar Chemistry Beyond 1 Mpc with Next Generation Low-Resolution Spectrographs: Forecasts and Validation."
  A Comprehensive View of Galaxy Evolution from the Milky Way to I Zwicky 18, Sexten, Italy, July 2022.
- Sandford, N. "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.
- Sandford, N. "Stellar Chemistry Beyond 1 Mpc with ELTs."
  Spatially Resolved Spectroscopy with ELTs, Online Workshop, September 2021.
- Sandford, N. "Stellar Chemistry Beyond 1 Mpc with Space-Based MOS."
  Massively Parallel Large Area Spectroscopy from Space, Online Workshop, June 2021.
- Sandford, N. "Forecasting Chemical Abundance Precision for Extragalactic Archaeology."
  Science Talk, Waimea, HI, October 2019.
- Sandford, N. "Forecasting the Chemical Information Content of Stellar Spectra."
  Small Galaxies, Cosmic Questions, Durham, UK, July 2019.

Posters:

- Sandford, N. & Weisz, D. "Stellar Chemical Abundance Measurements: From Near to Far, High to Low." 2021 Keck Science Meeting, San Diego, Ca, September 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, September 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, January 2017.
- Sandford, N. & Lu, Y. "A Semi-Analytic Study of Feedback Processes and Metallicity Profiles in Disc Galaxies." 227th AAS Meeting, Kissimmee, Fl, January 2016.

Undergraduate Thesis:

- Sandford, N. "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
Stellar Codes	ATLAS12, SYNTHE
Chem Ev Codes	Chempy
Other Software	emcee, PyMC3
Language	German (beginner)