

# NATHAN R. SANDFORD

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## RESEARCH INTERESTS

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(Extra-)Galactic Archaeology, Galactic Chemical Evolution, Dwarf Galaxies;  
Resolved Stellar Spectroscopy, Stellar Chemical Abundances, Nucleosynthesis;  
Machine Learning, Neural Networks, Bayesian Inference

## EDUCATION

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Ph.D., Astrophysics, University of California, Berkeley Aug 2023  
Advisor: Dr. Dan Weisz  
Thesis: “Pushing Stellar Archaeology Farther & Fainter 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

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Postdoctoral Researcher & Arts and Science Fellow, University of Toronto 2023–present  
Graduate Research Assistant & NSF GRFP Fellow, UC Berkeley 2017–2023  
Summer Visiting Researcher, MPA, 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

## TEACHING & PEDAGOGY

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Institute for Scientist & Engineer Educators Professional Development Program 2024  
AstroTech Summer School Instructor Summer 2024  
**UC Berkeley**  
Certificate in Teaching and Learning in Higher Education 2023  
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, Fall 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

## MENTORSHIP

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Katie Sharpe (UC Berkeley Grad), *Co-supervised with Prof. Dan Weisz* 2023–present  
Julia Kim (UToronto Undergrad), *Summer Undergraduate Research Program* 2024–present  
Rosayla Coulthard (UToronto Undergrad), *Research Opportunity Program, Work Study* 2024–present  
Xuanqi Wei (UToronto Undergrad), *Research Opportunity Program* Summer 2024  
Colin McCurdy (UToronto Undergrad), *Astro 425 Research Project* 2023–2024  
Shuhan Zheng (UToronto Undergrad), *Astro 424 Research Project* 2023–2024

## SERVICE

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Summer Undergraduate Research Project Committee, UofT Astronomy Dept.	2024–present
Postdoc Representative, UofT Astronomy Dept. Faculty Committee	2024–present
Department Steward, CUPE 3902 Unit 5	2024–present
UCO Lick/APF Time Allocation Committee	2023–present
Journal Referee for ApJS	2024
LOC, DESI Milky Way Survey Workshop	2024
Department Organizer, UAW 2865/UAW-Student Researchers United	2020–2023
Grad. Student / Postdoc Seminar Coordinator, UCB Astronomy Dept.	2021–2022
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

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AstroTech Summer School	2024
UC Berkeley Compass Lecture	2023
UAW 2865, UAW 5810 & UAW-SRU Picket Line Astronomy Outreach, UC Berkeley	2022
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

## HONORS & AWARDS

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Arts & Science Postdoctoral Fellowship, University of Toronto	2024–present
NSF Graduate Research Fellow, National Science Foundation	2020–2023
Robert J. Trumpler Graduate Excellence Award, UC Berkeley	2022
Outstanding Graduate Student Instructor Award, UC Berkeley	2019
James A. Buchanan Scholarship, UC Berkeley	2017
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

## AWARDED GRANTS

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STScI Grant JWST-GO-04735 (\$238,335)	2024
Faculty of Arts & Science Postdoctoral Fellowship Award (2 years stipend & benefits)	2024
DESI Early Career Scientist Travel Grant (\$1000)	2024
ISEE PDP Travel Award & Fee Waiver (\$6000)	2024
NSF Graduate Research Fellowship (3 years stipend & tuition)	2020
Osterbrock Mini-grant (Co-PI, \$1500),	2017

*Reviving the Sierra Conference: A Collaborative Meeting For UC Astronomy Graduate Students*

## AWARDED TELESCOPE TIME

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PI: JWST <a href="#">GO-4735</a> - 25.5 hours	2024
<i>A Closer Look at the Formation and Evolution of M31's Inner Disk</i>	
co-I (PI Alessandro Savino): JWST <a href="#">GO-4783</a> - 24.40 hours	2024
<i>Anchoring the JWST Population II Distance Ladder to Gaia</i>	
co-I (PI Dan Weisz): JWST <a href="#">GO-3788</a> - 25.3 hours	2023
<i>Alpha Elements and the Baryon Cycle in Isolated Dwarf Galaxies</i>	
co-I (PI Dan Weisz): Keck/DEIMOS - 3 nights	2022B
<i>A Spectroscopic Investigation of Two Metal-rich Ultra-faint Galaxies around M31</i>	
co-I (PI Dan Weisz): Keck/ESI - 2 nights	2021B
<i>The Progenitors of Extremely Low-mass White Dwarfs</i>	
co-I (PI Dan Weisz): HST <a href="#">GO-16686</a> - 30 orbits	2021
<i>The Metallicity Distribution Functions of Faint M31 Satellites</i>	
co-I (PI Dan Weisz): Keck/LRIS, MOSFIRE - 2 nights	2020A
<i>Characterizing Extremely Metal-Poor Massive Stars in Leo A</i>	
co-I (PI Dan Weisz): HST <a href="#">GO-16226</a> - 23 orbits	2020
<i>The Metallicity Distribution Functions of Quenched Field Dwarf Galaxies</i>	
co-I (PI Dan Weisz): HST <a href="#">GO-15901</a> - 43 orbits	2019
<i>The Metallicity Distribution Functions of Ultra-Faint Dwarf Galaxies</i>	
*co-I (PI Dan Weisz): Keck/LRIS - 1 night	2019B
<i>Triangulum II: Globular Cluster or Dwarf Galaxy?</i>	
co-I (PI Dan Weisz): Keck/KCWI - 1 night	2019B
<i>Resolved Stellar Spectroscopy and Feedback from massive stars in M33: a KCWI view</i>	
*co-I (PI Dan Weisz): Keck/LRIS - 1 night	2019A
<i>The Chemical Enrichment of the Pre-Reionization Fossil Galaxy Sextans</i>	
( * Lead investigator; graduate students cannot PI UC Keck proposals)	

## OBSERVING EXPERIENCE

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Mayall/DESI (4 half-nights)	2024
Lick/KAST (2 nights)	2023
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

## COLLABORATIONS

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Dark Energy Spectroscopic Instrument (DESI)	2024–present
Sloan Digital Sky Survey-V (SDSS-V)	2023–present
Southern Stellar Stream Spectroscopic Survey (S <sup>5</sup> )	2023–present

**Publications:** ([ADS Bibliography](#))

- Gountanis, N., Weinberg, D., Beverage, A., **Sandford, N.**, et al., “Modeling the Ages and Chemical Abundances of Elliptical Galaxies,” Submitted to ApJ, [arXiv:2407.07971](#)
- Fu, S. et al. (including **Sandford, N.**), “Stellar Metallicities and Gradients in the Faint M31 Satellites Andromeda XVI and Andromeda XXVIII,” In press at ApJ, [arXiv:2407.04698](#)
- **Sandford, N.**, Weinberg, D., Weisz, D. & Fu, S., “Strong Outflows and Inefficient Star Formation in the Reionization-era Ultra-faint Dwarf Galaxy Eridanus II,” 2024, [MNRAS](#), **530**, 2315S
- Fu, S. et al. (including **Sandford, N.**), “Stellar Metallicities and Gradients in the Isolated, Quenched Low-Mass Galaxy Tucana,” 2024, [ApJ](#), **965**, 36F
- Magrini, L. et al. (including **Sandford, N.**), “HRMOS White Paper: Science Motivation,” 2023, [arXiv:2312.08270](#)
- Fu, S. et al. (including **Sandford, N.**), “Metallicity Distribution Function of 13 Ultra-Faint Dwarf Galaxy Candidates from Hubble Space Telescope Narrow-band Imaging,” 2023, [ApJ](#), **958**, 167.
- Jacobson-Galan, W. et al. (including **Sandford, N.**), “SN 2023ixf in Messier 101: Photo-ionization of Dense, Close-in Circumstellar Material in a Nearby Type II Supernova,” 2023, [ApJL](#), **954**, L42.
- **Sandford, N.**, Weisz, D. & Ting, Y.-S., “Validating Stellar Abundance Measurements from Multi-Resolution Spectroscopy,” 2023, [ApJS](#), **267**, 18S
- Beverage, A. et al. (including **Sandford, N.**), “From Carbon to Cobalt: Chemical compositions and ages of  $z \sim 0.7$  quiescent galaxies,” 2023, [ApJ](#), **948**, 140.
- Gull, M., Weisz, D., Senchyna, P., **Sandford, N.**, et al., “A Panchromatic Study of Massive Stars in the Extremely Metal-Poor Local Group Dwarf Galaxy Leo A,” 2022, [ApJ](#), **941**, 206.
- Fu, S. et al. (including **Sandford, N.**), “Metallicity Distribution Function of the Eridanus II Ultra-Faint Dwarf Galaxy from Hubble Space Telescope Narrow-band Imaging,” 2022, [ApJ](#), **925**, 6.
- Bundy, K. et al. (including **Sandford, N.**), “Keck Science in the FOBOS Era,” 2021, Keck Strategic Planning White Paper.
- Bundy, K. et al. (including **Sandford, N.**), “The Keck-FOBOS spectroscopic facility: conceptual design,” 2020, [SPIE](#), 11447.
- **Sandford, N.**, Weisz, D. & Ting, Y.-S., “Forecasting Chemical Abundance Precision for Extragalactic Stellar Archaeology,” 2020, [ApJS](#), **249**, 24.
- Xiang, M., Ting, Y.-S., Rix, H.W., **Sandford, N.**, et al., “Abundance Estimates for 16 Elements in 6 Million Stars from LAMOST DR5 Low-Resolution Spectra,” 2019, [ApJS](#), **245**, 34.

**Talks:** (*\*invited*)

Small Galaxies, Cosmic Questions II	July 2024
CASCA 2024	June 2024
AAS 241st Contributed Dissertation Talk	Jan 2023
*KICP Seminar, University of Chicago	Oct 2022
OSU Astronomy Galaxy Hour	Oct 2022
Yale Astronomy Galaxy Lunch Seminar	Sept 2022
Harvard ITC Luncheon	Sept 2022
IAUGA 2022 FM 9: Stellar Synthetic Spectra to Study Stellar Populations in the Gaia Era, Busan, KR	Aug 2022
A Comprehensive View of Galaxy Evolution from the Milky Way to I Zwicky 18, Sesto, IT	July 2022
EAS 2022 S4a: Satellite Galaxies and Tidal Streams in the Framework of Cosmological Models, Valencia, ES	June 2022
Spatially Resolved Spectroscopy with ELTs, Online	Sept 2021
Massively Parallel Large Area Spectroscopy from Space, Online	June 2021
*WMKO Science Talk	Oct 2019
UC Berkeley Astronomy Lunch Talk	Oct 2019
Small Galaxies, Cosmic Questions, Durham, UK	July 2019
Pomona College Thesis Presentation	May 2017
Stanford SULI Research Symposium	Aug 2016

## Posters:

55th Annual DDA Meeting, Toronto, ON, Canada	May 2024
241st AAS Meeting, Seattle, WA	Jan 2023
Linking the Galactic and Extragalactic, Wollongong, NSW, Australia	Nov 2022
2021 Keck Science Meeting, San Diego, CA	Sept 2021
STScI Multi-Object Spectroscopy Workshop	May 2021
2020 Keck Science Meeting, San Diego, CA	Sept 2020
229th AAS Meeting, Grapevine, TX	Jan 2017
227th AAS Meeting, Kissimmee, FL	Jan 2016
Pomona College Summer Research Symposium	Sept 2015

## Graduate Thesis:

“Pushing Stellar Archaeology Farther & Fainter with Low-Resolution Spectroscopy” Ph.D. Dissertation, UC Berkeley	August 2023
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## Undergraduate Thesis:

“Exploring Gas-Phase Metallicity Gradients in Disc Galaxies: A Semi-Analytic Approach” Thesis with distinction, Pomona College	May 2017
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## CODE CONTRIBUTIONS

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- Gountanis, N., **Sandford, N.**, et al. 2024, [In Prep.](#)  
“Flexible ANalytic Chemical Evolution”
- **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

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Computer Languages	Python, SQL/ADQL, L <sup>A</sup> T <sub>E</sub> X, bash, git
Parallel Computing	Python multiprocessing, MPI, SLURM
Machine Learning	PyTorch, Theano/Aesara
Statistics Packages	emcee, PyMC, pocomc
Reduction Pipelines	JWST, PypeIt
Stellar Codes	ATLAS12, SYNTHE

## REFERENCES

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### Prof. Daniel Weisz

Associate Professor of Astronomy  
University of California, Berkeley  
[dan.weisz@berkeley.edu](mailto:dan.weisz@berkeley.edu)

### Prof. Ting Li

Assistant Professor of Astronomy  
University of Toronto  
[ting.li@astro.utoronto.ca](mailto:ting.li@astro.utoronto.ca)

### Prof. Philip Choi

Associate Professor of Physics and Astronomy  
Pomona College  
[philip.choi@pomona.edu](mailto:philip.choi@pomona.edu)

### Prof. David Weinberg

Distinguished University Professor  
The Ohio State University  
[dhw@astronomy.ohio-state.edu](mailto:dhw@astronomy.ohio-state.edu)

### Candice Brown Pacheco

Assistant Director  
Institute for Scientist and Engineer Educators  
[candiceb@ucsc.edu](mailto:candiceb@ucsc.edu)