

## Education

- 2018– **Doctor of Philosophy**, *California Institute of Technology*, Pasadena, CA  
Astrophysics. Advisor: Andrew Howard  
Thesis: *From the Sun to the Stars: A Solar Calibrator for the Keck Planet Finder And New Frontiers in Exoplanet Obliquities*. Anticipated May 2024 defense.
- 2021 **Master of Science**, *California Institute of Technology*, Pasadena, CA  
Astrophysics
- 2014–2018 **Bachelor of Science**, *University of Rochester*, Rochester, NY  
Physics and Astronomy, *Magna cum laude* with highest distinction. Minor: Math.  
Senior thesis (Advisor: Segev BenZvi): *Identifying Type Ia Supernovae in Extragalactic Spectra*

## Academic Employment

- 2018– **Graduate Researcher**, *California Institute of Technology*, Astronomy Department  
Built an autonomous solar feed to measure Sun-as-a-star EPRV spectra, characterized exoplanet masses with radial velocities and obliquities using the classical and reloaded Rossiter-McLaughlin technique, and developed a hierarchical Bayesian probabilistic mass-radius relation for exoplanets  $< 8 R_{\oplus}$ .
- 2014–2018 **Undergraduate Researcher**, *University of Rochester*, Physics & Astronomy Department  
Simulated type-Ia supernova spectra and built a random forest classifier to estimate DESI yield, searched for and analyzed TeV phenomena with HAWC, including possible “Fermi Bubbles” in M31 and galactic TeV binaries, and simulated water-Cherenkov tanks for HAWC outtrigger expansion project.

## Awards and Honors

- 2023 **RODGER DOXSEY TRAVEL PRIZE**, American Astronomical Society
- 2018 **NSF GRADUATE RESEARCH FELLOWSHIP**, National Science Foundation
- 2018 **STODDARD PRIZE**, *best senior thesis in Physics & Astronomy*, U. of Rochester
- 2018 **JANET FOGG PRIZE**, *awarded to one senior for dedicated departmental service*, U. of Rochester
- 2018 **UNDERGRADUATE TEACHING AWARD**, U. of Rochester
- 2017 **BARRY M. GOLDWATER SCHOLARSHIP**, Goldwater Foundation
- 2017 **AWARD FOR EXCELLENCE IN PROGRAMMING**, for “*Earth Hour*”, U. of Rochester
- 2016, 2017 **CONTINUING STUDENT SCHOLARSHIP**, U. of Rochester
- 2014 **BAUSCH AND LOMB HONORARY SCIENCE AWARD & SCHOLARSHIP**, U. of Rochester

## Skills and Training

- Proficiency with advanced statistical techniques including Bayesian methods, WAIC/lppd, MCMC, Gaussian Processes, mixture models, neural networks, and random forests
- Familiarity with EPRV spectrographs, testing during commissioning, assessing detectors, drift, calibration sources, and wavelength solutions
- Experience in design, construction, alignment, and testing of opto-mechanical systems
- Observing on professional astronomical telescopes: 50 nights on Keck (48 HIRES, 2 KPF), 1 night on the Palomar 200” (WIRC+Pol/TripleSpec), 8 nights at C.E.K. Mees Observatory
- Managing big surveys: I scheduled  $\sim 10^4$  HIRES radial velocity observations for 104 stars in the TESS-Keck Survey across 298 Keck nights during 2019–2022
- Experience leading tours and stargazing events at observatories ( $\sim 40$  nights at C.E.K. Mees Observatory) and in the public (sidewalk astronomy, CaltechAstro outreach lecture series)

- Software: Python (proficient), Mathematica, SQL, Java, UNIX shell scripting (Bash), Docker, SLURM, SAOImage DS9, TheSky6, CCDSoft, CCDStack

---

## Student Mentorship

- 2023 **Xuezheng Li**, Undergraduate, *Pasadena City College*  
As part of the [Caltech Connection program](#), Xuezheng researched the exoplanet measurement techniques, learned Python, and explored fitting real radial velocity and transit data to discover an exoplanet.
- 2021 **Jared Siegel**, Undergraduate, *University of Chicago*, (currently PhD student at Princeton)  
As a Caltech SURF student, Jared wrote a line-by-line radial velocity pipeline and derived a novel activity indicator based on the depth of individual spectral lines which outperformed traditional activity indicators in reducing the RMS of  $\alpha$ CenB HARPS RVs.
- 2020 **Aanica Gonzales-Rogers**, Undergraduate, *California Institute of Technology*  
As a Caltech SURF student, Aanica explored the detectability of exoplanets in wide orbits using *orbitize!* and simulated astrometric measurements anticipated in future Gaia data releases.

---

## TA Positions

[Astronomy Department, California Institute of Technology](#)

- 2020 Ay 124: Structure and Evolution of Galaxies, Ay 105: Optical Instrumentation Lab (remote)  
2019 Ay 122a: Optical/IR Measurements and Instrumentation

[Physics and Astronomy Department, University of Rochester](#)

- 2018 AST 142: Elementary Astrophysics (Honors)  
2017 AST 111: The Solar System & Its Origin, AST 142: Elementary Astrophysics  
2016 PHY 141 Lab: Mechanics (Honors), AST 102: Relativity, Black Holes, and the Big Bang  
2015 AST 106: Cosmic Origins of Life, AST 104: The Solar System

---

## Service

- 2021–2023 Organizer/facilitator, [Respect is a Part of Research](#), California Institute of Technology  
Presented material and facilitated group discussions for a peer-lead sexual harassment/sexual assault prevention workshop for incoming first year graduate students during orientation.
- 2021–2022 Teaching Assistant, [Code/Astro](#)  
Assisted students with writing their Python packages throughout the software development workshop.
- 2019–2021 Volunteer, [FUTURE](#), California Institute of Technology  
Co-ran a CV/SoP writing workshop for undergraduate women and nonbinary students
- 2019–2020 Teaching Assistant, [Intro2Astro](#)  
Presented lessons on Bayesian statistics, model fitting, and model comparison.
- 2018 [Peer Advisor](#), [College Center for Advising Services](#), University of Rochester  
Advised students with their majors, course selection, research opportunities, networking, independent study, study abroad, applying for grad school, and more.
- 2015–2018 Tour Guide, [C.E.K. Mees Observatory](#), University of Rochester  
Presented the history of the observatory, current research at UR, and operated the 24-inch telescope.

---

## Telescope Time

- 2023 Keck-I Telescope: KPF (5.75 nights, PI<sup>†</sup>, 2 nights co-I)  
<sup>†</sup>Functionally PI, but officially “PI: Howard” as Caltech grad students cannot PI Keck proposals

---

## Selected Presentations

- 2024 AAS 243, New Orleans, LA (dissertation talk)  
2023 Keck Science Meeting, Berkeley, CA (contributed talk)

- 2023 Exoplanets Seminar, Princeton University (invited talk)
- 2023 Dix Planetary Science Seminar, Caltech (talk)
- 2023 EPRV 5, Santa Barbara, CA (poster)
- 2023 Sun-as-a-star workshop, Flatiron Institute/CCA (invited talk)
- 2023 AAS 241, Seattle, WA (contributed talk #323.01)
- 2022 ERES VII, The Pennsylvania State University (contributed talk)
- 2020 AAS 235, Honolulu, HI (talk)
- 2019 Keck Science Meeting, UCLA (contributed talk)
- 2019 Extreme Solar Systems IV, Reykjavik, Iceland (poster #309.08)
- 2018 AAS 231, National Harbor, MD (poster #250.05)
- 2016, 2017 Rochester Symposium for Physics Students (talk)

## Press and Public Media

- 2023 “Is there life beyond Earth? The Keck Planet Finder could tell us.” Interviewed for article on KPF and the Solar Calibrator for Dell (**Rubenzahl**+23, PASP)
- 2021 “The Strange Case of the Misplaced Cotton Candy World” Interviewed for article on WASP-107 b for supercluster.com (**Rubenzahl**+21, AJ; Piaulet, Benneke, **Rubenzahl**+21, AJ)
- 2020 “Measuring the Speed of Stars” Presented a public talk for CaltechAstro outreach on YouTube

## Publications

**Refereed** 3 first author, 2 second/third author, 32 nth author

**Non-Refereed** 1 first author, 1 second author, 2 nth author

### Selected peer-reviewed journal publications

- 2024 **R. A. Rubenzahl**, F. Dai, A. W. Howard, J. J. Lissauer, J. Van Zandt, C. Beard, S. Giacalone, J. M. Akana Murphy, A. Chontos, J. Lubin, et al., “The TESS-Keck Survey. XII. A Dense 1.8  $R_{\oplus}$  Ultra-Short-Period Planet Possibly Clinging to a High-Mean-Molecular-Weight Atmosphere After the First Gyr”, *accepted to The Astronomical Journal*
- 2023 **R. A. Rubenzahl**, S. Halverson, J. Walawender, G. M. Hill, A. W. Howard, M. Brown, E. Ida, J. Tehero, B. J. Fulton, S. R. Gibson, et al., “Staring at the Sun with the Keck Planet Finder: An Autonomous Solar Calibrator for High Signal-to-Noise Sun-as-a-Star Spectra”, *Publications of the Astronomical Society of the Pacific*, 135, 125002
- 2022 J. C. Siegel, **R. A. Rubenzahl**, S. Halverson, & A. W. Howard, “Into the Depths: A New Activity Metric for High-precision Radial Velocity Measurements Based on Line Depth Variations”, *The Astronomical Journal*, 163, 260
- 2022 A. Chontos, J. M. A. Murphy, M. G. MacDougall, T. Fetherolf, J. Van Zandt, **R. A. Rubenzahl**, C. Beard, D. Huber, N. M. Batalha, I. J. M. Crossfield, et al., “The TESS-Keck Survey: Science Goals and Target Selection”, *The Astronomical Journal*, 163, 297
- 2021 **R. A. Rubenzahl**, F. Dai, A. W. Howard, A. Chontos, S. Giacalone, J. Lubin, L. J. Rosenthal, H. Isaacson, N. M. Batalha, I. J. M. Crossfield, et al., “The TESS-Keck Survey. IV. A Retrograde, Polar Orbit for the Ultra-low-density, Hot Super-Neptune WASP-107b”, *The Astronomical Journal*, 161, 119
- 2021 C. Piaulet, B. Benneke, **R. A. Rubenzahl**, A. W. Howard, E. J. Lee, D. Thorngren, R. Angus, M. Peterson, J. E. Schlieder, M. Werner, et al., “WASP-107b’s Density Is Even Lower: A Case Study for the Physics of Planetary Gas Envelope Accretion and Orbital Migration”, *The Astronomical Journal*, 161, 70

- 2020 A. Albert, R. Alfaro, C. Alvarez, J. C. Arteaga-Velázquez, K. P. Arunbabu, D. Avila Rojas, H. A. Ayala Solares, E. Belmont-Moreno, S. Y. BenZvi, C. Brisbois, et al. (including **R. A. Rubenzahl**), “Constraints on the Emission of Gamma-Rays from M31 with HAWC”, *The Astrophysical Journal*, 893, 16

#### Selected conference proceedings/abstracts

- 2020 S. R. Gibson, A. W. Howard, K. Rider, A. Roy, J. Edelstein, M. Kassis, J. Grillo, S. Halverson, M. M. Sirk, C. Smith, et al. (including **R. Rubenzahl**), “Keck Planet Finder: design updates”, *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, 11447, 1144742
- 2019 **R. Rubenzahl**, A. Howard, & E. Sinukoff, “The Sub-Saturn Mass-Radius Relationship from K2 and a NASA-Keck Key Project”, *AAS/Division for Extreme Solar Systems Abstracts*, 51, 309.08
- 2017 C. D. Rho, **R. Rubenzahl**, S. BenZvi, & HAWC Collaboration, “Searching for TeV Gamma-ray Emission from Binary Systems with HAWC”, *35th International Cosmic Ray Conference (ICRC2017)*, 301, 742
- 2017 **R. Rubenzahl**, S. BenZvi, J. Wood, & HAWC Collaboration, “Limits on the Emission of Gamma Rays from M31 (The Andromeda Galaxy) with HAWC”, *35th International Cosmic Ray Conference (ICRC2017)*, 301, 594

#### TESS-Keck Survey peer-reviewed publications

I contributed substantially to the TKS infrastructure by co-developing the sample construction algorithm (Chontos+22, AJ), constructing the nightly target lists (298 calendar nights), and co-leading the RV fitting of the HIRES/APF data for all TKS systems (Polanski+ in prep).

- 2023 J. M. Akana Murphy, N. M. Batalha, N. Scarsdale, et al., “The TESS-Keck Survey. XVI. Mass Measurements for 12 Planets in Eight Systems”, *The Astronomical Journal*, 166, 153
- 2023 M. G. MacDougall, E. A. Petigura, G. J. Gilbert, et al., “The TESS-Keck Survey. XV. Precise Properties of 108 TESS Planets and Their Host Stars”, *The Astronomical Journal*, 166, 33
- 2023 J. Van Zandt, E. A. Petigura, M. MacDougall, et al., “TESS-Keck Survey. XIV. Two Giant Exoplanets from the Distant Giants Survey”, *The Astronomical Journal*, 165, 60
- 2022 M. G. MacDougall, E. A. Petigura, T. Fetherolf, et al., “The TESS-Keck Survey. XIII. An Eccentric Hot Neptune with a Similar-mass Outer Companion around TOI-1272”, *The Astronomical Journal*, 164, 97
- 2022 E. V. Turtelboom, L. M. Weiss, C. D. Dressing, et al., “The TESS-Keck Survey. XI. Mass Measurements for Four Transiting Sub-Neptunes Orbiting K Dwarf TOI-1246”, *The Astronomical Journal*, 163, 293
- 2022 J. Lubin, J. Van Zandt, R. Holcomb, et al., “TESS-Keck Survey. IX. Masses of Three Sub-Neptunes Orbiting HD 191939 and the Discovery of a Warm Jovian plus a Distant Substellar Companion”, *The Astronomical Journal*, 163, 101
- 2022 P. A. Dalba, S. R. Kane, D. Dragomir, et al., “The TESS-Keck Survey. VIII. Confirmation of a Transiting Giant Planet on an Eccentric 261 Day Orbit with the Automated Planet Finder Telescope”, *The Astronomical Journal*, 163, 61
- 2021 M. G. MacDougall, E. A. Petigura, I. Angelo, et al., “The TESS-Keck Survey. VI. Two Eccentric Sub-Neptunes Orbiting HIP-97166”, *The Astronomical Journal*, 162, 265
- 2021 N. Scarsdale, J. M. A. Murphy, N. M. Batalha, et al., “TESS-Keck Survey. V. Twin Sub-Neptunes Transiting the Nearby G Star HD 63935”, *The Astronomical Journal*, 162, 215
- 2021 F. Dai, A. W. Howard, N. M. Batalha, et al., “TKS X: Confirmation of TOI-1444b and a Comparative Analysis of the Ultra-short-period Planets with Hot Neptunes”, *The Astronomical Journal*, 162, 62

- 2021 L. M. Weiss, F. Dai, D. Huber, et al., “The TESS-Keck Survey. II. An Ultra-short-period Rocky Planet and Its Siblings Transiting the Galactic Thick-disk Star TOI-561”, *The Astronomical Journal*, 161, 56
- 2020 F. Dai, A. Roy, B. Fulton, et al., “The TESS-Keck Survey. III. A Stellar Obliquity Measurement of TOI-1726 c”, *The Astronomical Journal*, 160, 193
- 2020 P. A. Dalba, A. F. Gupta, J. E. Rodriguez, et al., “The TESS-Keck Survey. I. A Warm Sub-Saturn-mass Planet and a Caution about Stray Light in TESS Cameras”, *The Astronomical Journal*, 159, 241
- Peer-reviewed publications contributed to as observer
- 2023 A. Householder, L. M. Weiss, J. E. Owen, et al., “Investigating the Atmospheric Mass Loss of the Kepler-105 Planets Straddling the Radius Gap”, *arXiv e-prints*, arXiv:2309.11494
- 2023 F. Dai, K. C. Schlaufman, H. Reggiani, et al., “A Mini-Neptune Orbiting the Metal-poor K Dwarf BD+29 2654”, *The Astronomical Journal*, 166, 49
- 2023 E. Knudstrup, D. Gandolfi, G. Nowak, et al., “Radial velocity confirmation of a hot super-Neptune discovered by TESS with a warm Saturn-mass companion”, *Monthly Notices of the Royal Astronomical Society*, 519, 5637
- 2023 F. Dai, K. Masuda, C. Beard, et al., “TOI-1136 is a Young, Coplanar, Aligned Planetary System in a Pristine Resonant Chain”, *The Astronomical Journal*, 165, 33
- 2023 M. El Mufti, P. P. Plavchan, H. Isaacson, et al., “TOI 560: Two Transiting Planets Orbiting a K Dwarf Validated with iSHELL, PFS, and HIRES RVs”, *The Astronomical Journal*, 165, 10
- 2022 O. Barragán, D. J. Armstrong, D. Gandolfi, et al., “The young HD 73583 (TOI-560) planetary system: two 10- $M_{\oplus}$  mini-Neptunes transiting a 500-Myr-old, bright, and active K dwarf”, *Monthly Notices of the Royal Astronomical Society*, 514, 1606
- 2022 M. C. Johnson, T. J. David, E. A. Petigura, et al., “An Aligned Orbit for the Young Planet V1298 Tau b”, *The Astronomical Journal*, 163, 247
- 2022 J. G. Winters, R. Cloutier, A. A. Medina, et al., “A Second Planet Transiting LTT 1445A and a Determination of the Masses of Both Worlds”, *The Astronomical Journal*, 163, 168
- 2022 N. Heidari, I. Boisse, J. Orell-Miquel, et al., “HD 207897 b: A dense sub-Neptune transiting a nearby and bright K-type star”, *Astronomy and Astrophysics*, 658, A176
- 2021 M. El Mufti, P. P. Plavchan, H. Isaacson, et al., “TOI 560 : Two Transiting Planets Orbiting a K Dwarf Validated with iSHELL, PFS and HIRES RVs”, *arXiv e-prints*, arXiv:2112.13448
- 2021 M. Rice, S. Wang, A. W. Howard, et al., “SOLES I: The Spin-Orbit Alignment of K2-140 b”, *The Astronomical Journal*, 162, 182
- 2021 J. Llop-Sayson, J. J. Wang, J.-B. Ruffio, et al., “Constraining the Orbit and Mass of epsilon Eridani b with Radial Velocities, Hipparcos IAD-Gaia DR2 Astrometry, and Multiepoch Vortex Coronagraphy Upper Limits”, *The Astronomical Journal*, 162, 181
- 2021 J. Zhang, L. M. Weiss, D. Huber, et al., “Long-period Jovian Tilts the Orbits of Two sub-Neptunes Relative to Stellar Spin Axis in Kepler-129”, *The Astronomical Journal*, 162, 89
- 2021 L. J. Rosenthal, B. J. Fulton, L. A. Hirsch, et al., “The California Legacy Survey. I. A Catalog of 178 Planets from Precision Radial Velocity Monitoring of 719 Nearby Stars over Three Decades”, *The Astrophysical Journal Supplement Series*, 255, 8
- 2021 B. J. Fulton, L. J. Rosenthal, L. A. Hirsch, et al., “California Legacy Survey. II. Occurrence of Giant Planets beyond the Ice Line”, *The Astrophysical Journal Supplement Series*, 255, 14
- 2021 M. R. Kosiarek, D. A. Berardo, I. J. M. Crossfield, et al., “Physical Parameters of the Multiplanet Systems HD 106315 and GJ 9827”, *The Astronomical Journal*, 161, 47