

# Jaren N. Ashcraft

PHD CANDIDATE · OPTICAL SCIENCES · NSTGRO FELLOW

✉ [jashcraft@arizona.edu](mailto:jashcraft@arizona.edu) | 🏠 [github.com/Jashcraf](https://github.com/Jashcraf)

## Appointments

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### University of California, Santa Barbara

NHFP SAGAN FELLOW

- Proposal Title: "Optimizing the Vector Field for Next-generation Astrophysics"
- Mentor: Dr. Maxwell Millar-Blanchaer

*Santa Barbara, CA*

*Sep 2024 - Present*

## Education

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### University of Arizona

PH.D (EXPECTED AUG 2024), M.S., OPTICAL SCIENCES

- Thesis Title: "Ray-based Physical Optics for the Design of Astronomical Observatories"
- Advisor: Dr. Ewan Douglas, Co-advisor: Dr. Daewook Kim

*Tucson AZ*

*Aug 2019 - Aug 2024*

### University of Rochester

B.S. OPTICAL ENGINEERING (HIGH HONORS) CERT. NANOSCIENCE AND NANOENGINEERING

- Advisor: Dr. Thomas Brown, Bryan McIntyre

*Rochester NY*

*Aug 2015 - May 2019*

## Graduate Research Experience

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### University of Arizona Research Assistant

ADVISOR: DR. EWAN DOUGLAS

- Assess influence of polarization aberrations on high-contrast imaging instruments
- Derivation of novel method for Gaussian Beamlet Decomposition optical propagation
- Design and assembly of a vacuum-compatible coronagraph testbed
- Modeling and performance predictions for freeform astronomical telescopes

*Tucson, AZ*

*Aug 2019 - Present*

### NASA Goddard Space Flight Center Visiting Technologist

ADVISORS: DR. BREANN SITARSKI

- Polarization aberration modeling of the LUVOIR-A ECLIPS Coronagraph
- Integration of polarization and exoplanet yield calculations to constrain HWO's baseline architecture

*Goddard, MD*

*Jan 2024 - Mar 2024*

### W.M Keck Observatory Visiting Scholar

ADVISORS: DR. PETER WIZINOWICH, DR. MAX MILLAR-BLANCHAER

- Polarimetric performance estimation of ORKID imaging path
- Phase retrieval algorithm development for daytime calibration

*Kamuela, HI*

*Jun 2023 - Sep 2023*

### NASA Jet Propulsion Laboratory Visiting Technologist

ADVISORS: DR. BRIAN MONACELLI, BRANDON DUBE

- Modeling polarization aberrations in an early-concept habitable worlds observatory
- Developing novel spatially-varying thin-film optimization method for minimizing polarization aberrations

*Pasadena, CA*

*Feb 2023 - May 2023*

### Subaru Telescope Visiting Technologist

ADVISOR: DR. OLIVIER GUYON

- Polarization aberration simulation of VAMPIRES imaging path
- Design of a pupil-imaging mode for VAMPIRES for polarized pupil measurements

*Hilo, HI*

*May 2022 - Aug 2023*

### NASA Jet Propulsion Laboratory Optical Design Intern

ADVISORS: DR. SONA HOSSEINI, DR. JUSTIN HAAG

- Design of an all-reflective spatial heterodyne spectrograph
- Develop tolerance procedure for interferometric spectrographs

*Pasadena, CA*

*Jun 2019 - Aug 2019*

## Awards, Fellowships, & Grants

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2024	<b>NASA Hubble Fellowship Program</b> , Prize Fellowship in Astronomy	\$ 314,000
2022	<b>Philip and Joan Slater Scholarship in Optical Sciences</b> , Departmental Award	\$ 2,000
2021	<b>Romeo and Erlinda Mercado Scholarship in Optical Sciences</b> , Departmental Award	\$ 5,000
2021	<b>NASA Space Technology Graduate Research Opportunity</b> , 3-year Graduate Fellowship	\$ 215,000
2020	<b>Philip and Joan Slater Scholarship in Optical Sciences</b> , Departmental Award	\$ 2,000
2019	<b>John Hayes and Jane Quale Endowed Scholarship in Optical Sciences</b> , First-year Graduate Fellowship	\$ 24,000
2017	<b>Fujimara Award</b> , Institute of Optics Departmental Award	
2015	<b>Whipple Science and Research Scholarship</b> , Undergraduate Merit Scholarship	

## Peer-Reviewed Publications

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1. **Ashcraft J.**, Douglas E., Kim D., Riggs A.J. et al. "A Generalized Expression for Accelerating Beamlet Decomposition Simulations". *Optica Optics Express In Review*
2. Anche R. A. **Ashcraft, J. N.**, et al 2023. "Simulation of high-contrast polarimetric observations of debris disks with the Roman Coronagraph Instrument". *Publications of the Astronomical Society of the Pacific. Accepted Nov 2023*
3. **Ashcraft J.**, Douglas E., Kim D., Riggs A.J., "Hybrid Propagation Physics for the Design and Modeling of Astronomical Observatories: A Coronagraphic Example", *SPIE Journal of Astronomical Telescopes, Instruments, and Systems Accepted Oct 2023 arXiv 2310.20026*
4. Anche R. A. **Ashcraft, J. N.**, Haffert S. Y., et al. 2023. Polarization aberrations in next generation ELTs I. Effect on the Coronagraphic Performance. *Astronomy & Astrophysics*, doi: 10.1051/0004-6361/202245651.
5. Douglas E., Debes J., Menneson B., Nemati B., **Ashcraft, J.**, et al. 2022. Sensitivity of the Roman Coronagraph Instrument to Exozodiacal Dust. *Publications of the Astronomical Society of the Pacific*, vol. 134, no. 1032, p. 024402, Feb. 2022, doi: 10.1088/1538-3873/ac3f7b.
6. Kim D., Choi H., **Ashcraft J.**, et al. 2021. *Advances in Optical Engineering for Future Telescopes, Opto-Electronic Advances Adv4*, 210040 (2021) . doi:10.29026/oea.2021.210040
7. **Ashcraft J.**, Dube B., Menneson B., Ziemer J., et al. "Analysis and mitigation strategies enabling  $10^{-10}$  contrast in coronagraphs behind large, off-axis segmented space telescopes". *SPIE Journal of Astronomical Telescopes, Instruments, and Systems in prep*
8. **Ashcraft, J. N.**, Anche R. A., Haffert S. Y., et al. "Polarization aberrations in next generation ELTs II. Influence of Segment-to-segment variations". *Astronomy & Astrophysics, in prep.*
9. **Ashcraft J.**, Douglas E., Dube B., Mulhal K. et al. "Poke: a Pythonic Interface for Raytracing and Physical Optics". *Journal of Open Source Software in prep*

## Presentations

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### INVITED TALKS

- Jan 2024. *Polarization Aberrations: High-Contrast Imaging Limits for Next-generation Observatories*. Invited talk: NASA Goddard Exoplanet Seminar, Goddard, MD.
- May 2023. *Polarization Aberrations: High-Contrast Imaging Limits for Next-generation Observatories*. Invited talk: UCSB Astronomy Seminar, Santa Barbara, CA.
- Oct 2022. *Open-source Beam Propagation Tools for Integrated Simulation of High-contrast Imaging Instruments*. Invited student talk: Optical Sciences Industrial Affiliates, Tucson, AZ.

## SELECTED CONFERENCE PRESENTATIONS

**Ashcraft, J.**, Douglase E., Kim D., Riggs A.J., et al. 2023. *Poke: An open-source ray-based physical optics platform*. SPIE Optics + Photonics, San Diego, CA.

**Ashcraft, J.**, Kim, D., Choi, H., Heap S., et al. 2021. *Cosmic Evolution through UV Surveys (CETUS): Optical Design and Modeling Efforts Supporting UV Observatories in Space*. SPIE Optics + PHotonics, San Diego, CA.

**Ashcraft, J.**, Smith, G., Douglas, E., et al. 2021. *The Versatile CubeSat Telescope: Going to Large Apertures in Small Spacecraft*, SPIE Optics + Photonics, San Diego, CA.

**Ashcraft, J.** and Douglas E. *Poke: Augmenting Diffraction Models with Gaussian Beamlet Decomposition and Polarization Ray Tracing*. AAS 241 Chambliss Award Poster, Seattle, WA.

## Teaching Experience

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- Fall 2022 **Qualifying Examination Review Team**, Geometrical Optics Lead, University of Arizona
- Fall 2018 **Intro to Optics - OPT 101**, Teaching Assistant, University of Rochester
- Spring 2018 **MATLAB for Optics II - OPT 212**, Head Teaching Assistant, University of Rochester
- Fall 2017 **Intro to Optics - OPT 101**, Research Project Supervisor, University of Rochester
- Spring 2017 **Geometrical Optics - OPT 241**, Head Teaching Assistant, University of Rochester
- Spring 2017 **MATLAB for Optics I - OPT 211**, University Department
- Fall 2016 **Intro to Optics - OPT 101**, Teaching Assistant, University of Rochester

## Mentoring

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- 2022 **Guransh Mann**, *Full mueller polarimetry of high-contrast testbeds*, Electrical Engineering Undergraduate, University of Arizona
- 2020 **Bianca Payan**, *Updating optical propagation models of Roman-CGI*, Astronomy Undergraduate, University of Arizona
- 2018 **Rob Moore**, *Manufacturing single-mode Fiber lasers for injection-locked fiber lasers*, Optics Undergraduate, University of Rochester

## Professional Development

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### SERVICE

- 2023 **SPIE Optics + Photonics**, Astronomical Polarimetry Session Chair
- 2019-2023 **Akamai Workforce Initiative**, Alumni Panelist, Hana Hou Conference Organizing Committee

### DEVELOPMENT AND OUTREACH

**The Practical Optics Workshop (POW)**, Chair of a student-lead team of tutors that lead workshops on how to use optical modeling software. I was the primary tutor for the Introductory and Advanced CODE V and Zemax OpticStudio Workshops.

**The Practical Optical Design Seminar (PODS)**, Founder and chair of PODS. A student-lead optical design research team that aims to learn more about optical modeling by conducting a research project. Lead a design study of Cubesat objectives to maximize performance in a limited volume.

**The Student Optics Chapter (SOck)**, Vice president and treasurer. An Optica and SPIE affiliated pre-professional organization for professional development and outreach. Oversaw the development of remote outreach and social activities during the COVID-19 pandemic.

**Optics and Photonics Winter School Committee**, First student member. Contribute to planning and organization of College of Optical Science's winter school. Student poster session judge.

**OSA Student Chapter** President, Secretary, of the Optical Society (now Optica) student chapter at the University of Rochester. Responsible for the coordinate of professional development and outreach initiatives.

### OPEN-SOURCE SOFTWARE

**Poke**: A ray-based physical optics package that enables the direct integration of commercial ray tracers into open-source diffraction codes. Supports polarization ray tracing and gaussian beamlet decomposition. Creator and lead developer.

**prysm**: A physical optics and first-order modeling package developed in support of high-contrast imaging simulation. Contributing developer to the polarization and thinfilms submodules.

### PEER REVIEW

SPIE Journal of Astronomical Telescopes, Instruments & Systems

## Undergraduate Research Experience

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### University of Rochester Senior Design Lead

Rochester, NY

ADVISOR: DR. THOMAS BROWN

Aug 2018 - May 2019

- Design and lab validation of a polarimetric scatterometer for asthma trigger detection

### Akamai Optical Engineering Intern

Santa Cruz, CA

ADVISOR: DR. RENATE KUPKE, DARREN DILLON, NICHOLAS MACDONALD

Jun 2018 - Aug 2018

- Testbench assembly for analyzing the mode scrambling and focal ratio degradation for shaped-core optical fibers
- Fiber characterization for fiber-fed spectrographs on the Automated Planet Finder and Thirty Meter Telescope

### Lasers and Photonic Systems group Research Assistant

Rochester, NY

ADVISOR: DR. JOHN MARCIANTE

Aug 2017 - May 2018

- Development of a method for rapid assembly of single-mode fiber lasers

### UR Integrated Nanosystems Laboratory

Rochester, NY

ADVISOR: DR. BRIAN MCINTYRE

Aug 2017 - May 2018

- Development of a method to generate optical stack interference filters with physical vapor deposition

### University of Hawaii Institute for Astronomy REU

Hilo, HI

ADVISOR: DR. CHRISTOPH BARANEC

May 2017 - Aug 2017

- Design of a telescope simulator for calibration of the Robo-AO 2.0 instrument on the UH 88"

### Akamai Optical Engineering Intern

Pukalani, HI

ADVISOR: DR. JEFF KUHN, DR. ANDRE FEHLMAN

Jun 2016 - Aug 2016

- Calibration and testing of a HgCdTe photodetector in a cryogenic environment

## First-Author Conference Proceedings

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1. **Jaren N. Ashcraft**, Ewan S. Douglas, Daewook Kim, A. J. E. Riggs, Ramya Anche, Trent Brendel, Kevin Derby, Brandon D. Dube, Quinn Jarecki, Emory Jenkins, Kian S. Milani, "Poke: an open-source, ray-based physical optics platform," Proc. SPIE 12664, Optical Modeling and Performance Predictions XIII, 1266404 (28 September 2023); <https://doi.org/10.1117/12.2678001>
2. **Jaren N. Ashcraft**, Trenton Brendel, Simran Agarwal, Joel Berkson, Alexander D. Hedglen, Hyukmo Kang, Yanqi Zhang, Heejoo Choi, Daewook Kim, "The practical optics workshop: educating the optical engineers of tomorrow," Proc. SPIE 12213, *Optics Education and Outreach VII*, 122130H (3 October 2022); <https://doi.org/10.1117/12.2632801>
3. **Jaren N. Ashcraft**, Heejoo Choi, Ewan S. Douglas, Kevin Derby, Kyle Van Gorkom, Daewook Kim, Ramya Anche, Alex Carter, Olivier Durney, Sebastiaan Haffert, Lori Harrison, Maggie Kautz, Jennifer Lumbres, Jared R. Males, Kian Milani, Oscar M. Montoya, George A. Smith, "The space coronagraph optical bench (SCoOB): 1. Design and assembly of a vacuum-compatible coronagraph testbed for spaceborne high-contrast imaging technology," Proc. SPIE 12180, *Space Telescopes and Instrumentation 2022: Optical, Infrared, and Millimeter Wave*, 121805L (27 August 2022); <https://doi.org/10.1117/12.2628855>
4. **Jaren N. Ashcraft**, Heejoo Choi, Sara R. Heap, Robert A. Woodruff, Dae Wook Kim, "Cosmic evolution through UV surveys (CETUS): point spread function analysis of three mirror anastigmat telescope," Proc. SPIE 11820, *Astronomical Optics: Design, Manufacture, and Test of Space and Ground Systems III*, 118200H (24 August 2021); <https://doi.org/10.1117/12.2598879>
5. **Jaren N. Ashcraft**, Ewan S. Douglas, Daewook Kim, George A. Smith, Kerri Cahoy, Tom Connors, Kevin Z. Derby, Victor Gasho, Kerry Gonzales, Charlotte E. Guthery, Geon Hee Kim, Corwynn Sauve, Paul Serra, "The versatile CubeSat Telescope: going to large apertures in small spacecraft," Proc. SPIE 11819, *UV/Optical/IR Space Telescopes and Instruments: Innovative Technologies and Concepts X*, 1181904 (20 August 2021); <https://doi.org/10.1117/12.2594884>

6. **Jaren N. Ashcraft**, Ewan S. Douglas, "An open-source Gaussian beamlet decomposition tool for modeling astronomical telescopes," Proc. SPIE 11450, *Modeling, Systems Engineering, and Project Management for Astronomy IX*, 114501D (13 December 2020); <https://doi.org/10.1117/12.2561921>

## Contributed Conference Proceedings

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1. Ramya M. Anche, Sebastiaan Y. Haffert, **Jaren N. Ashcraft**, Kian Milani, Kyle Van Gorkom, Kevin Derby, Ewan S. Douglas, Maxwell A. Millar-Blanchaer, "Estimation of polarization aberrations and their effect on the coronagraphic performance for future space telescopes," Proc. SPIE 12680, *Techniques and Instrumentation for Detection of Exoplanets XI*, 126800R (5 October 2023); <https://doi.org/10.1117/12.2677486>
2. Ramya M. Anche, Grant Williams, Hill Tailor, Chris Packham, Daewook Kim, **Jaren N. Ashcraft**, Ewan S. Douglas, "Polarimetric modeling and assessment of science cases for Giant Magellan Telescope-Polarimeter (GMT-Pol)," Proc. SPIE 12690, *Polarization Science and Remote Sensing XI*, 126900F (3 October 2023); <https://doi.org/10.1117/12.2676777>
3. Manxuan Zhang, Maxwell Millar-Blanchaer, Boris Safonov, Miles Lucas, Lucinda Lilley, **Jaren Ashcraft**, Barnaby Norris, Julien Lozi, Olivier Guyon, Michael Bottom, "Characterizing the instrumental polarization of SCEAO VAMPIRES," Proc. SPIE 12680, *Techniques and Instrumentation for Detection of Exoplanets XI*, 126800S (5 October 2023); <https://doi.org/10.1117/12.2677599>
4. Christopher B. Mendillo, **Jaren N. Ashcraft**, Kevin Zhang Derby, Ewan S. Douglas, Daewook Kim, Jared Males, "Reflective lyot stop low-order wavefront control for future large space telescope coronagraphs," Proc. SPIE 12680, *Techniques and Instrumentation for Detection of Exoplanets XI*, 126802E (5 October 2023); <https://doi.org/10.1117/12.2677654>
5. Kevin Z. Derby, Sebastiaan Haffert, **Jaren Ashcraft**, Kian Milani, Heejoo Choi, Young-Sik Kim, Laird Close, Christopher Mendillo, Supriya Chakrabarti, Gregory Allan, Leonid Pogorelyuk, Kerri Cahoy, Mamadou N'Diaye, Daewook Kim, Jared Males, Ewan Douglas, "Tolerance analysis of a self-coherent camera for wavefront sensing and dark hole maintenance," Proc. SPIE 12180, *Space Telescopes and Instrumentation 2022: Optical, Infrared, and Millimeter Wave*, 1218069 (27 August 2022); <https://doi.org/10.1117/12.2629578>
6. Kyle Van Gorkom, Ewan S. Douglas, **Jaren N. Ashcraft**, Sebastiaan Haffert, Daewook Kim, Heejoo Choi, Ramya M Anche, Jared R. Males, Kian Milani, Kevin Derby, Lori Harrison, Olivier Durney, "The space coronagraph optical bench (SCoOB): 2. Wavefront sensing and control in a vacuum-compatible coronagraph testbed for spaceborne high-contrast imaging technology," Proc. SPIE 12180, *Space Telescopes and Instrumentation 2022: Optical, Infrared, and Millimeter Wave*, 121805M (27 August 2022); <https://doi.org/10.1117/12.2630704>
7. Kevin Z. Derby, James B. Breckinridge, James E. Harvey, Tony Hull, Charles F. Lillie, **Jaren N. Ashcraft**, Heejoo Choi, Ewan S. Douglas, Daewook Kim, "Curved primary aperture segmentation enabling a robust quasi-Airy pattern point spread function," Proc. SPIE 12188, *Advances in Optical and Mechanical Technologies for Telescopes and Instrumentation V*, 121880N (29 August 2022); <https://doi.org/10.1117/12.2628819>
8. Ramya M. Anche, Ewan S. Douglas, Kian Milani, **Jaren Ashcraft**, John Debes, "Simulations of polarimetric observations of debris disks through the Roman Coronagraph Instrument," Proc. SPIE 12180, *Space Telescopes and Instrumentation 2022: Optical, Infrared, and Millimeter Wave*, 1218056 (27 August 2022); <https://doi.org/10.1117/12.2629497>
9. Kian Milani, Ewan S. Douglas, **Jaren Ashcraft**, "Updated simulation tools for Roman coronagraph PSFs," Proc. SPIE 11819, *UV/Optical/IR Space Telescopes and Instruments: Innovative Technologies and Concepts X*, 118190E (20 August 2021); <https://doi.org/10.1117/12.2594807>
10. Paul Serra, Ondrej Čierny, William Kammerer, Ewan S. Douglas, Dae Wook Kim, **Jaren N. Ashcraft**, George Smith, Charlotte Guthery, Tom Vergoossen, Alexander Lohrmann, Robert Bedington, Chithrabhanu Peru-

mangatt, Alexander Ling, Kerri Cahoy, "Optical front-end for a quantum key distribution cubesat," Proc. SPIE 11852, *International Conference on Space Optics – ICSO 2020*, 118523C (11 June 2021); <https://doi.org/10.1117/12.2599542>

11. Ewan S. Douglas, **Jaren N. Ashcraft**, Ruslan Belikov, John Debes, Jeremy Kasdin, John Krist, Brianna I. Lacy, Bijan Nemati, Kian Milani, Leonid Pogorelyuk, A.J. Eldorado Riggs, Dmitry Savransky, Dan Sirbu, "A review of simulation and performance modeling tools for the Roman coronagraph instrument," Proc. SPIE 11443, *Space Telescopes and Instrumentation 2020: Optical, Infrared, and Millimeter Wave*, 1144338 (16 December 2020); <https://doi.org/10.1117/12.2561960>
12. Erin R. Maier, Ewan S. Douglas, Dae Wook Kim, Kate Su, **Jaren N. Ashcraft**, James B. Breckinridge, Heejoo Choi, Elodie Choquet, Thomas E. Connors, Olivier Durney, Kerry L. Gonzales, Charlotte E. Guthery, Christian A. Haughwout, James C. Heath, Justin Hyatt, Jennifer Lumbres, Jared R. Males, Elisabeth C. Matthews, Kian Milani, Oscar M. Montoya, Mamadou N'Diaye, Jamison Noenickx, Leonid Pogorelyuk, Garreth Ruane, Glenn Schneider, George A. Smith, Christopher C. Stark, "Design of the vacuum high contrast imaging testbed for CDEEP, the Coronagraphic Debris and Exoplanet Exploring Pioneer," Proc. SPIE 11443, *Space Telescopes and Instrumentation 2020: Optical, Infrared, and Millimeter Wave*, 114431Y (13 December 2020); <https://doi.org/10.1117/12.2560878>
13. Yi-Ting Feng, **Jaren N. Ashcraft**, James B. Breckinridge, James E. Harvey, Ewan S. Douglas, Heejoo Choi, Charles Lillie, Tony Hull, Dae Wook Kim, "Topological pupil segmentation and point spread function analysis for large aperture imaging systems," Proc. SPIE 11568, *AOPC 2020: Optics Ultra Precision Manufacturing and Testing*, 115680I (5 November 2020); <https://doi.org/10.1117/12.2575809>
14. Jake R. Rosvold, Luis Alemán Castañeda, **Jaren N. Ashcraft**, Dylan Beckman, Maximillian C. Bruggeman, Pellegrino Conte, Shenghan Gao, Qi Jin, Nicholas Kochan, Zilong Li, Yuxuan Liu, Matthew Page, John Piotrowski, Jordan Rabinowitz, Colleen Stone, Julie L. Bentley, "Comparing optical design complexity of high zoom ratio lenses within the VIS, SWIR, and LWIR," Proc. SPIE 11106, *Zoom Lenses VI*, 111060B (9 September 2019); <https://doi.org/10.1117/12.2528875>