# Christopher Cain

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**EMPLOYMENT**

**Beus Prize Postdoctoral Research Fellow**

- Arizona State University — Sep 2023-Present

**EDUCATION**

**University of California, Riverside**, Riverside, California, USA

- Ph.D. in Physics (Advisor: Dr. Anson D'Aloisio) — Jan 2020 – Jul 2023
- M.S. in Physics — Sep 2018 - Jan 2020

**Azusa Pacific University**, Azusa, California, USA

- B.S. in Physics, B.S. in Mathematics — Sep 2014 - Dec 2017
  - Graduated Summa Cum Laude

**PUBLICATIONS**

Total published papers: 22 (+5 submitted, +5 in prep., 32 tot.)
First-author papers: 10 (+3 submitted, +1 in prep., 14 tot.)
Student papers: 1 (+3 in prep., 4 tot.) Co-Author papers: 11 (+2 submitted, +1 in prep., 14 tot.)
Total (first-author) citations: 461 (156) h-index (first-author): 11 (6)
Source: NASA ADS

## First-Author

- Christopher Cain, Anson D'Aloisio, et. al., "Introducing *SAGUARO* - *S*imul*A*ting I*G*M Evol*U*tion and Environments *A*t High *R*es*O*lution: Simulation Setup and First Results", in prep.
- Christopher Cain, Alexander V. Engelen, et. al., "The CMB optical depth constrains the duration of reionization", accepted to ApJL.
- Christopher Cain, Matthew McQuinn, et. al., "Kiloparsec-scale turbulence driven by reionization may grow intergalactic magnetic fields", submitted to PRL, pending review.
- Christopher Cain, Anson D'Aloisio, et. al., "New constraints on the galactic ionizing efficiency and escape fraction at $2.5 < z < 6$ based on quasar absorption spectra", accepted to PASA
- Christopher Cain, "Towards an accurate treatment of the reduced speed of light approximation in parameterized radiative transfer simulations of reionization", *Journal of Cosmology and Astroparticle Physics*, vol. 2024, no. 12, Dec. 2024
- Christopher Cain, Garett Lopez, et. al., "Chasing the beginning of reionization in the JWST era", *The Astrophysical Journal*, vol. 980, no. 1, pp. 83, Feb 2025.
- Christopher Cain & Anson D'Aloisio, "FlexRT - A fast and flexible cosmological radiative transfer code for reionization studies I: Code validation", *Journal of Cosmology and Astroparticle Physics*, vol. 2024, no. 12, Dec. 2024
- Christopher Cain, Evan Scannapieco, et. al., "The hydrodynamic response of small-scale structure to reionization drives large IGM temperature fluctuations that persist to z = 4", *Monthly Notices of the Royal Astronomical Society Letters*, vol. 533, no. 1, pp. L100, Sept. 2024
- Christopher Cain, Anson D'Aloisio, et. al., "On the rise and fall of galactic ionizing output at the end of reionization", *Monthly Notices of the Royal Astronomical Society*, vol. 531, no. 1, pp. 1951, Jun 2024
- Christopher Cain, Anson D'Aloisio, et. al., "The Morphology of Reionization in a Dynamically Clumpy Universe", *Monthly Notices of the Royal Astronomical Society*, vol. 522, no. 2, pp. 2047, Jun 2023
- Christopher Cain, Anson D'Aloisio, et. al., "Small-scale clumping of dark matter and the mean free path of ionizing photons at $z = 6$", *Journal of Cosmology and Astroparticle Physics*, vol. 2023, no. 1, Jan. 2023

- Christopher Cain, Anson D'Aloisio, et. al., "A Short Mean Free Path at z = 6 Favors Late and Rapid Reionization by Faint Galaxies", *The Astrophysical Journal Letters*, vol. 917, no. 2, pp. 37, Aug 2021.
- Christopher Cain, Anson D'Aloisio, et. al., "A Model-Insensitive Baryon Acoustic Oscillation Feature in the 21 cm Signal from reionization", *The Astrophysical Journal*, vol. 898, no. 2, pp. 168, Aug 2020.
- * Christopher Cain, E. Baron, et al., "Investigating the Unusual Spectroscopic Time-Evolution in SN 2012fr," *The Astrophysical Journal*, vol. 869, no. 2, pp. 162, Dec 2018.

## Student Papers

- Aloha Das, Christopher Cain, et. al., "Dynamics of the halo-opacity connection during reionization", in prep.
- Alexandra Nelander, Christopher Cain, et. al., "Can high-redshift AGN observed by JWST explain the EDGES absorption signal?", in prep.
- Joshua Cohon, Christopher Cain, et. al., "Ly$\alpha$ emission in JADES-GS-z13-1-LA at $z = 13$: a signpost of early reionization?", in prep.
- Joshua Roth, Anson D'Aloisio, Christopher Cain, et. al., "The effect of reionization on direct measurements of the mean free path", *Monthly Notices of the Royal Astronomical Society*, vol. 530, no. 4, pp. 5209, Jun 2024

## Co-Author

- Garett Lopez, ...,Christopher Cain, et. al., "Predicting the patchy kSZ signal in light of recent QSO absorption results", in prep.
- Yongda Zhu, ...,Christopher Cain, et. al., "Nuclear Winds Drive Large-Scale Cold Gas Outflows in Quasars during the Reionization Epoch", submitted to Nature Astronomy
- Darby Kramer, ...,Christopher Cain, et. al., "Cross-correlating the patchy screening and kinetic Sunyaev-Zel'dovich effects as a new probe of reionization", submitted to ApJ, in review
- Nakul Gangolli, ...,Christopher Cain, et. al., "The correlation between galaxy density and Ly$\alpha$ forest transmission in late reionization models ", *Journal of Cosmology and Astroparticle Physics*, vol. 2025, no. 3, pp. 69, Mar. 2025
- Bayu Wilson, ...,Christopher Cain, et. al., Imaging reionization's last phases with I-front Lyman-$\alpha$ emissions", *Journal of Cosmology and Astroparticle Physics*, vol. 2025, no. 1, pp. 66, Jan. 2025
- Yongda Zhu, ...,Christopher Cain, et. al., "Discovery of a Unique Close Quasar–DSFG Pair Linked by a [C II] Bridge at $z = 5.63$", *Research Notes of the American Astronomical Society*, vol. 8, no. 11, pp. 284, Nov. 2024
- Bayu Wilson, ...,Christopher Cain, et. al., "Quantifying Lyman-$\alpha$ emissions from reionization fronts", *Journal of Cosmology and Astroparticle Physics*, vol. 2025, no. 1, pp. 65, Jan. 2025
- Yongda Zhu, ...,Christopher Cain, et. al., "Damping Wing-Like Features in the Stacked Ly$\alpha$ Forest: Potential Neutral Hydrogen Islands at $z < 6$", *Monthly Notices of the Royal Astronomical Society Letters*, vol. 533, no. 1, pp. L49, Sept. 2024
- Geoff G. Murphy, ...,Christopher Cain, et. al., "Bayesian estimation of cross-coupling and reflection systematics in 21cm array visibility data", *Monthly Notices of the Royal Astronomical Society*, vol. 534, no. 3, pp. 2653, Nov. 2024
- Piyanat Kittiwisit, ...,Christopher Cain, et. al., "matvis: A matrix-based visibility simulator for fast forward modelling of many-element 21 cm arrays", *RAS Techniques and Instruments*, vol. 4, pp. rzaf001, Jan. 2025
- Yongda Zhu, ..., Christohper Cain, et. al., "Probing Ultra-late Reionization: Direct Measurements of the Mean Free Path over $5 < z < 6$", *The Astrophysical Journal*, vol. 955, no. 2, pp. 161, Aug 2023.

*Completed as an undergraduate.

- Fahad Nasir, Christopher Cain, et. al., "Hydrodynamic Response of the Intergalactic Medium to Reionization II: Physical Characteristics and Dynamics of Ionizing Photon Sinks", *The Astrophysical Journal*, vol. 923, no. 2, pp. 161, Dec 2021.
- Anson D'Aloisio, ..., Christopher Cain, et. al., "Hydrodynamic Response of the Intergalactic Medium to Reionization", *The Astrophysical Journal*, vol. 898, no. 2, pp. 149, Aug 2020.
- * Carlos Contreras, ..., Christopher Cain et. al., "SN 2012fr: Ultraviolet, Optical, and Near-Infrared Light Curves of a Type Ia Supernova Observed Within a Day of Explosion," *The Astrophysical Journal*, vol. 859, no. 1, pp. 1–24, May 2018.

**PROPOSALS & ALLOCATIONS**

- NSF ACCESS Accelerate Compute Allocation (PHY240332, PI)
  *An accurate parameter study of reionization to constrain the ionizing properties of the first galaxies*
  - ≈ 2.5 million CPU hours + 450 TB storage — Jan 2025-Present
- NSF ACCESS Accelerate Compute Allocation (PHY230158, PI)
  *A comprehensive treatment of the intergalactic ionizing opacity for studies of reionization*
  - ≈ 3 million CPU hours + 400 TB storage, est. value $92,720 — Oct 2023-Dec 2024
- NSF ACCESS Explore Compute Allocation (PHY230063, PI)
  *Accurate simulations of reionization for studies of the Lyman alpha forest and other high-redshift observables*
  - ≈ 400K CPU hours — May 2023-May 2024
- George Becker, ...Christopher Cain, et. al., "The Mean Free Path at z = 5.6: Insights into How Reionization Ends", ESI proposal 2024A U281 — Sep 2023
- Yongda Zhu, ...Christopher Cain, et. al., "The Mean Free Path of Ionizing Photons at z = 5.6: A Robust Constraint on Reionization", ALMA proposal 2022.1.00662.S — Apr 2022
- George Becker, ...Christopher Cain, et. al., "The Mean Free Path at z = 5.6: Insights into Ultra-Late Reionization", Keck proposal 2021A_U039 — Mar 2020

**SELECTED AWARDS, SCHOLARSHIPS & FELLOWSHIPS**

- Beus Prize Postdoctoral Fellowship
  Beus Center for Cosmic Foundations
  School of Earth & Space Exploration, Arizona State University — Jun 2023
- Robert T. Poe Memorial Scholarship for Outstanding PhD Graduate
  Dept. of Physics and Astronomy, University of California Riverside — Jun 2023
- Beus Prize Postdoctoral Fellowship,
  School of Earth & Space Exploration, Arizona State University — Feb 2023
- Senior Graduate Student of the Year Award,
  Dept. of Physics and Astronomy, University of California Riverside — Jun 2022
- Junior Graduate Student of the Year Award,
  Dept. of Physics and Astronomy, University of California Riverside — Jun 2020
- 1st Year Graduate Student of the Year Award,
  Dept. of Physics and Astronomy, University of California Riverside — Jun 2019
- Provost Research Fellowship, University of California Riverside — Apr 2018

**COMMUNITY & PROFESSIONAL SERVICE**

**Academic Journals**

- Referee for *The Astrophysical Journal*, *Monthly Notices of the Royal Astronomical Society*, *Journal of Astropartical Physics & Cosmology*
  - Papers refereed: 12

**Computational Resources**

- Reviewer for computer time proposals for the DiRAC Resource Allocation Committee.

**SKILLS**

C/C++, Fortran, Python, Bash Script, MATLAB, Mathematica, R, Java, LaTeX, Microsoft Office, LibreOffice, Linux, Windows

**ORIGINAL SOFTWARE**

3D Cosmological Radiative Transfer Code (C++)
1D Radiative Transfer & Hydrodynamics Code (C++)