**Dr. Kirk Stuart Simeon Barrow**

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Website: [www.kirkbarrow.com](http://www.kirkbarrow.com/)

**Citizenship:** United States of America

***Expertise:*** computational astrophysics, radiative transfer, orbital mechanics, optimization, mathematical and statistical modeling, instruction, atmospheric flight, unmanned aerial vehicle design

**Career Goal:** Professor, Research Scientist, Engineer

**CURRENT POSITIONS**

**NASA Hubble Postdoctoral Fellow 2021-present**

Harvard | Smithsonian Center for Astrophysics

Harvard University

**Adjunct Assistant Professor** **2021-2022**

Astronomy Department

University of Illinois at Urbana Champaign

**EDUCATION**

**Ph.D, Physics**,Astrophysics Specialization **2013-2018**

Georgia Institute of Technology

**M.S., Aerospace Engineering**,Orbital Mechanics Specialization **2014-2016**

Georgia Institute of Technology

**B.S., Aerospace Engineering**, Space Specialization **2004-2009**

Georgia Institute of Technology

**GRANTS, FELLOWSHIPS, AND AWARDS**

**2021 – 2024 NASA Hubble Fellowship at Center for Astrophysics | Harvard & Smithsonian**

**2021 University of Tokyo IPMU Visiting Research Fellowship**

**2019 – 2022 PI: XSEDE XRAC Research Allocation TG-AST190001 (Renewed 2020,2021)**

**2019 Co-Organizer: KIPAC Workshop-Hosting Grant**

**2018 – 2019 PI: XSEDE Computing Startup Allocation TG-AST180052**

**2018 – 2021 Stanford University Porat Postdoctoral Fellowship**

**2018 Lavender Diploma for Academics and Contributions to the LGBTQIA Community**

**2018 Georgia Tech School of Physics Amelio Award for Research Excellence**

**2017 NASA Jet Propulsion Laboratory Year-Round Graduate Internship**

**2016, 2017 School of Physics Conference Travel Grant**

**2014 XSEDE Conference Grant**

**2013 – 2016 Southern Regional Education Board 3-Year Doctoral Fellowship**

**Certifications Earned or in Progress**

* Stanford Postdoctoral Teaching Certificate (February 2021)
* Japanese Language Proficiency Test N2 (est. 2022)

**TEACHING EXPERIENCE**

**Lecturer,** University of Illinois at Urbana Champaign

**Fall Semester 2021**

* Seminar in Astronomy (ASTR 496 RI) – Undergraduate and graduate student introduction to research hosting a cross section of the faculty
* Gave a semi-interactive presentation of my research in an hybrid online and in person setting

**Guest Lecturer,** University of Tokyo

**Fall Semester 2021**

* Gradate Machine Learning and Astronomy – Original lectures, class activities, projects and homework assignments
* Prepared content for a hybrid online and in person class format suited to overcoming language barriers

**Lead Instructor,** Stanford University

**Summer Quarter 2020**

* The Origin and Development of the Cosmos (Physics 16) – Lead a course of 52 students, planned syllabus, created course content (lectures, activities, assignments, exams, projects), coordinated with a co-instructor and two teaching assistants
* Managed migration of the course to online teaching with a heavy emphasis on active learning

**Guest Lecturer,** Stanford University

**Winter Quarter 2020**

* Graduate Modern Astrophysics (Physics 360) – Original lectures and assignments on star cluster physics and HII regions

**Stanford Postdoctoral Teaching Certificate,** Stanford University

**May 2019 – February 2021**

* 70 hours of pedagogy/andragogy and curriculum design course work and journal clubs
* A minimum of 5 hours of in-class original course material taught with teacher assessments

**Physics Graduate Teaching Assistant,** Georgia Institute of Technology

**August 2013 – December 2014, May 2015 – August 2016**

* Electricity and Magnetism (Physics II) - Taught 3-5 lecture-style recitation sections per week per semester, proctored, and graded exams and assignments
* Mechanics (Physics I) – Created online homework assignments for a MOOC
* Fundamentals of Astrophysics (Physics 4347) - Held office hours, graded exams and assignments

**Professional Tutoring,** Tech Tutors, ClubZ! Atlanta Tutors, In-Home Tutors, Atlanta and privately

**November 2008 – September 2013, September 2016 – present**

* Worked for tutoring agencies focused on enhancing individual math and science skills at the grade school and college level
* Tutored over three hundred students for thousands of hours
* Developed an intuitive knowledge of multiple disciplines and sciences

**Education Research,** Kennesaw State University

**June 2009 – July 2009**

* Analyzed statistical performance data in conjunction with learning tests to determine correlations for use in executive MBA applications, documented methods and findings

**REFEREED JOURNAL PUBLICATIONS**

1. **Barrow, K. S. S,** Robertson, B. E., Ellis, R. E., Nakajima, K. Saxena, A., Stark, D. P., Tang, M. (10/2020) *The Lyman Continuum Escape Survey: Connecting Time-Dependent [O III] and [O II] Line Emission with Lyman Continuum Escape Fraction in Simulations of Galaxy Formation,* The Astrophysical Journal Letters, 902 L39
2. Aykutalp, A, **Barrow, K. S. S.**, Wise, J. H., Johnson, J (7/2020) *Induced Metal-free Star Formation around a Massive Black Hole Seed*, The Astrophysical Journal Letters, 898 L53
3. **Barrow, K. S. S.** (11/2019) *Blue Galaxies: Modeling Nebular HeII Emission in High Redshift Galaxies,* Monthly Notices of the Royal Astronomical Society, 491 (3): 4509-4522
4. **Barrow, K. S. S.**, Aykutalp, A, Wise, J. H. (9/2018) *Observational signatures of massive black hole formation in the early universe,* Nature Astronomy, 10.1038/s41550-018-0569-y
5. **Barrow, K. S. S.**, Wise, J. H., Aykutalp, A., O’Shea, B. W., Norman, M. L., Xu, H. (2/2018) *First Light II: Emission Line Extinction, Population III Stars, and X-ray Binaries*, Monthly Notices of the Royal Astronomical Society, 474 (2): 2614-2634
6. **Barrow, K. S. S.**, Wise, J. H., Norman, M. L., O’Shea, B. W., Xu, H. (8/2017) *First Light: Exploring the Spectra of High-Redshift Galaxies in the Renaissance Simulations*, Monthly Notices of the Royal Astronomical Society, 469 (4): 4863-4878
7. Barrow, J., Smalt, S., Brock, S., **Barrow, K. S. S.** (1/2009) *Learning Styles: Effective Tool for Deploying Finance Personnel in Changing Times*. Romanian Society for Quality Assurance, 10(104,2009),91-109

**CONFERENCE PAPERS**

1. **Barrow, K. S. S.**, Holzinger, M. J. (2/2017) *Recursive Multi-Objective Optimization of Mars-Earth-Venus Trajectories,* AIAA/AAS, 27th AAS/AIAA Space Flight Mechanics Meeting

**RESEARCH EXPERIENCE**

**Post-Graduate**

**Visiting Researcher and Professor**

Kavli Institute for the Physics and Mathematics of the Universe

University of Tokyo

**Summer and Fall 2021**

* Investigated the time domain evolution of metallicity in merging galaxies
* Created observational calibration for detecting metallicity from cosmological simulations
* Developed JWST diagnostics for high redshift galaxies using machine learning

**Porat Postdoctoral Fellow**

Kavli Institute for Particle Astrophysics and Cosmology,

Stanford University and SLAC National Accelerator Laboratory

**Fall 2018 – Fall 2021**

* Developed advanced emission line radiative transfer and synthetic observation tools
* Studied high-cadence simulation outputs to determine the evolution of optical lines
* Reproduced observed relationships in observed galaxies with bespoke simulations

**Graduate**

**NASA Graduate Internship** – Research in Space Mission Design, Jet Propulsion Laboratory

**May 2017 – July 2017**

**Mentor: Nathan Strange**

* Developed trajectory tools for gravity assist leveraging
* Contributed code to an orbit optimizing software in development (Frost)
* Optimized a low-thrust tour from Titan to Enceladus (Malto)
* Found trajectories that reduced fuel cost by 80% to Enceladus compared to direct insertion

**Aerospace** **Engineering** – Research in Trajectory Optimization, Georgia Institute of Technology

**January 2016 – May 2017**

**Mentor: Marcus Holzinger**

* Developed a theoretical framework and algorithm to optimize Earth-Mars-Venus cycler trajectories on supercomputers
* Found new classes of trajectories that reduce round-trip times between Earth and Mars

**Astrophysics –** Research in Computational Cosmology, Georgia Institute of Technology

**August 2013 – May 2018**

**Mentor: John Wise**

* Developed a computational model to generate observables from simulated astrophysical data on the early Universe
* Found relationships between emission lines and bursts of star formation
* Found trends in the spectra and images of galaxies in the early universe
* Found identifying observational characteristics for the first generation of stars
* Found identifying observational characteristics for the formation of large black holes

**Undergraduate**

**Astrophysics –** Research in Computational Cosmology, Georgia Institute of Technology

**August 2012 – August 2013**

**Mentor: John Wise**

* Analyzed the rates of photo evaporation in cosmological simulations
* Developed a merger tree algorithm
* Found that large galaxies evacuate satellite halos and inhibit star formation

**Aerospace Engineering –** Research in Space Mission Design, Georgia Institute of Technology

**January 2009 – June 2009**

**Mentor: David Spencer**

* Developed an entry system for unmanned flight in Titan atmosphere
* Modeled and simulated entry, deployment, cruise, and landing for an extended multi-stage scientific study of Titan

**Aerospace Engineering –** Research in Uninhabited Aerial Vehicles, Georgia Institute of Technology

**May 2008 – January 2009**

**Mentor: Eric Johnson**

* Created a control program for use in testing of an uninhabited aerial vehicle
* Tested the control program on flight hardware

**INVITED TALKS**

1. Kavli IPMU/Univeristy of Tokyo (8/19/21) *High-Cadence Synthetic Observations and Neural Networks in the Era of JWST* (**Seminar**)
2. Princeton University (7/27/21) *High-Cadence Synthetic Observations and Neural Networks in the Era of JWST* (**Colloquium**)
3. NRAO/GBO/University of Virginia (4/15/21) *Using High-Cadence Synthetic Observations to Unlock a New Era in Astrophysics* (**Colloquium)**
4. University of Florida (3/25/21) *Using High-Cadence Synthetic Observations to Unlock a New Era in Astrophysics* (**Colloquium)**
5. Johns Hopkins University (3/1/21) *Using High-Cadence Synthetic Observations to Unlock a New Era in Astrophysics* (**Seminar)**
6. University of Texas at Austin (2/8/2021) *Using High-Cadence Synthetic Observations to Unlock a New Era in Astrophysics* **(Astronomy Colloquium)**
7. Massachusetts Institute of Technology (12/7/2020) *Using High-Cadence Synthetic Observations to Unlock a New Era in Astrophysics*
8. University of Illinois at Urbana-Champaign (12/4/2020) *Using High-Cadence Synthetic Observations to Unlock a New Era in Astrophysics* **(Astrophysics Colloquium)**
9. University of Arizona (11/19/2020) *Using High-Cadence Synthetic Observations to Unlock a New Era in Astrophysics* **(Steward Observatory/NOIRLab Colloquium)**
10. Stanford University (8/27/2020) *Time-Dependent Trends in Radiative Transfer and Nebular Emission Lines*  **(Astrophysics Colloquium)**
11. Harvard-Smithsonian Center for Astronomy (8/25/2020): *Time-Dependent Trends in Radiative Transfer and Nebular Emission Lines*
12. Harvard-Smithsonian Center for Astronomy, Cambridge, Massachusetts (11/12/2019): *Emission Line Modeling in the High-Redshift Universe* (**Seminar**)
13. University of California, Santa Cruz, Santa Cruz, California (12/14/2018): *Synthetic Observations of the High-Redshift Universe* (**Seminar**)
14. University of California, Davis, Davis, California (11/1/2018) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**Seminar**)
15. University of California, Berkeley, Berkeley, California (10/5/2018) *Synthetic Observables Using Monte Carlo Photon Simulations* (**Discussion Moderator**)
16. Stanford University, Stanford, California (10/9/2018) *Synthetic Observations of the High-Redshift Universe*
17. Los Alamos National Laboratory, Los Alamos, New Mexico (12/14/2017) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**Seminar**)
18. University of Arizona, Tucson, Arizona (11/6/2017) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**Seminar**)
19. Flatiron Institute, New York, New York (10/13/2017) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations*
20. University of Maryland, College Park, Maryland (10/10/2017) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**Seminar**)
21. Jet Propulsion Laboratory, NASA, Pasadena, California (7/26/2017) *Astrodynamics, Astronomy, and Astrophysics* (**Seminar**)
22. Space Systems Design Laboratory*,* Georgia Institute of Technology (11/14/2016) *Multi-Objective Optimization of Mars-Earth-Venus Trajectories*
23. Duke TIP Program, Georgia Institute of Technology (7/13/15) *Gravity* (**Guest Lecture**)
24. Center for Relativistic Astrophysics, Georgia Institute of Technology (10/8/2014) *First Light: Exploring the Spectra of Galaxies in the Early Universe*

**CONFERENCE PRESENTATIONS**

1. SAZERAC-sip: First Stars, (10/23/2020) *Unraveling Time-Dependent Trends in Star Formation Using Cosmological Simulations* (**Talk**)
2. 235st American Astronomical Society Meeting, Honolulu, Hawaii (1/7/2020) *Blue Galaxies: Modeling Nebular Emission Lines in the Time Domain* (**Talk**)
3. Frank Bash Symposium, UT Austin, Austin, Texas (10/23/2019): *Blue Galaxies: Exploring Nebular Emission in the Early Universe* (**Invited Review Talk**)
4. Enzo Workshop, SLAC Linear Accelerator Center, Menlo Park, California, (6/11/2019) *Photometry and emission line modeling of high-redshift stellar clusters and H II regions* **(Talk)**
5. Formation of Stars and Massive clusters in Dwarf Galaxies over Cosmic Time, Leiden, Netherlands (2/22/2019) *Photometry and emission line modeling of high-redshift stellar clusters and H II regions***(Invited Talk)**
6. Extremely Big Eyes on the Early Universe, Los Angeles, California (1/28/2019) *Synthetic Observations of the High-Redshift Universe* (**Talk**)
7. Stellar Archaeology as a Time Machine to the First Stars, Kashiwa, Japan (12/4/2018) *Synthetic Observations of the High-Redshift Universe* (**Talk**)
8. 2018 National Society of Black Physicists Conference, Columbus, Ohio, (11/5/2018) *Synthetic Observations of the High-Redshift Universe* (**Invited Talk**)
9. 231st American Astronomical Society Meeting, Washington, DC (1/11/2018) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**Dissertation Talk**)
10. Spectral Diagnostics to Explore the Cosmic Dawn with JWST, STScI, Baltimore, Maryland (8/1/2017*) First Light: Exploring the Spectra of Galaxies in the Early Universe* (**Talk**)
11. 27th AAS/AIAA Space Flight Mechanics Meeting, San Antonio, Texas (2/5/2017) *Multi-Objective Optimization of Mars-Earth-Venus Trajectories* (**Talk, Conference Paper**)
12. Exploring the Universe with JWST II Conference, Montreal, Canada (10/27/2016) *First Light: Exploring the Spectra of Galaxies in the Early Universe* (**Talk**)
13. 32nd Annual Institut d'Astrophysique de Paris Conference, Paris, France (6/19/2016) *First Light: Exploring the Spectra of Galaxies in the Early Universe* (**Poster, Poster Talk**)
14. 224th American Astronomical Society Meeting, Seattle, Washington (1/5/2015) *First Light: Exploring the Spectra of Galaxies in the Early Universe* (**Poster**)

**MENTORSHIP**

**Bryen Irving,** Graduate Student, Stanford University

**Spring 2020 – present**

* Secondary mentor along with Tom Abel and Roger Blandford. Developing models for massive black hole formation and evolution.

**Lillian Santos-Olmsted,** Undergraduate, University of California, Santa Cruz

**Spring 2020 – present**

* Primary mentor. Student selected from a competitive, funded quarter-long Cal-Bridge Summer Research Program (CAMPARE). Developing diagnostic tools for observers from simulation synthetic observations.

**Luz Ángela García Peñaloza,** Postdoctoral Scholar, Universidad ECCI, Columbia

**Winter 2020 – Summer 2020**

* Host and research mentor for Luz Ángela García Peñaloza as part of the KIPAC Program for Astrophysics Visitor Exchange at Stanford (PAVES)

**Other Mentorship Activities**

* 2020-2021: Lead and organized weekly research group meetings with mentees
* 2018: American Physics Society Bridge Program and National Mentoring Community Conference panelist
* 2016-2017: Mentor and organizer for the Graduate Association of Physicists, Georgia Tech
* 2008-2018: Mentoring and tutoring of high school and undergraduate students

**ENGAGEMENT, SERVICE, AND LEADERSHIP**

* 2019-2020: Stanford KIPAC Cosmology Seminar committee member and speaker host
* 2019: SLAC Users Organization Congressional DC physics advocacy trip attendee, meetings with the office of 12 US Senators and Representatives
* 2018-2019: Co-organized the first interdisciplinary Space Sciences at Stanford conference
* 2018: Represented Stanford University at the National Society of Black Physicists Conference
* 2017-2018: Nominated to College of Sciences Graduate Student Diversity Council, Georgia Tech
* 2017: Represented Georgia Tech at the National Society of Black Physicists Conference
* 2015-2016: Led a startup competition group to build an automated solar energy pricing and permitting computer application
* 2007-2008: Primary and General Election Presidential Campaign Volunteer; organized a chapter within the Georgia Tech community. Created community outreach initiates at community centers, churches, and with local businesses.
* 2006-2008: President, Georgia Tech Airsoft Club; built and organized membership from inactivity to an intercollegiate competitive level

**Application, Proposal, and Journal Reviews**

* NASA Astrophysics Theory Program
* NASA FINESST Graduate Student Fellowship
* National Science Foundation Theory Grant Program
* Monthly Notices of the Royal Astronomical Society
* Stanford physics undergraduate summer research program

**SKILLS**

**Creator**

* CAIUS Radiative Transfer Pipeline

**Highly Proficient**

* Applied mathematical modeling of dynamic physical systems
* Enzo, yt, Hyperion, Cloudy, Malto
* Python, Linux, Mathematica, MATLAB, Cluster Computing
* Microsoft Office, LateX

**Experienced**

* Neural Networks
* Statistical modeling
* CAD, Solid Edge
* C++, FORTRAN, Julia
* Orbit optimization tool development