**Dr. Kirk Stuart Simeon Barrow**

Email: [kssbarrow@stanford.edu](mailto:kssbarrow@gmail.com)

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

**Citizenship:** United States of America

Jamaica

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

**Career Goal:** Professor, Research Scientist

**CURRENT POSITION**

**Porat Postdoctoral Fellow 2018-present**

Kavli Institute for Particle Astrophysics and Cosmology,

Stanford University and SLAC National Accelerator Laboratory

**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**

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

**2019 – 2020 PI: XSEDE XRAC Research Allocation TG-AST190001**

**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**

**RESEARCH EXPERIENCE**

**Post-Graduate**

**Visiting Researcher –** Research in Cosmology and Machine Learning, University of Tokyo

**April 2020 – May 2020 (upcoming)**

* Month-long collaboration with faculty and students at Kavli IPMU at the University of Tokyo to use synthetic and real observations to discern galaxy formation histories

**Research Technician II –** Research in Computational Cosmology, Georgia Institute of Technology

**May 2018 – August 2018**

* Found physical observational characteristics for massive black hole formation in the early Universe
* Completed successful manuscript revisions for publication in Nature Astronomy

**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
* Found new feasible launch dates for trips from Earth to Mars

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

**August 2014 – 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

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

**August 2012 – August 2014**

**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

**Undergraduate**

**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

**MANUSCRIPTS IN REVIEW**

1. Aykutalp, A, **Barrow, K. S. S**, Wise, J. H., Johnson, J (2019) *Induced Metal-free Star Formation around a Massive Black Hole Seed*, The Astrophysical Journal Letters

**REFEREED JOURNAL PUBLICATIONS**

1. **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
2. **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
3. **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
4. **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
5. 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

**MENTORSHIP**

**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)
* Regular remote research meetings, joint grant application, in-person collaboration at Stanford

**Other Mentorship Activities**

* 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: NASA Astrophysics Theory Program grant review panelist
* 2019: SLAC Users Organization Congressional DC physics advocacy trip attendee, meetings with the office of 12 US Senators and Representatives
* 2019, 2020: Stanford physics undergraduate summer research program applicant reviewer
* 2019: Proposal reviewer for the NASA FINESST graduate student fellowship
* 2018-2019: Journal peer reviewer for the Monthly Notices of the Royal Astronomical Society
* 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

**INVITED TALKS**

**Recent and Upcoming**

1. Reed College, Portland, Oregon (4/3/2020): *Blue Galaxies: Modeling Nebular Emission Lines in the Time Domain* (**Seminar** )
2. Harvard-Smithsonian Center for Astronomy, Cambridge, Massachusetts (11/12/2019): *Emission Line Modeling in the High-Redshift Universe* (**30-minute Seminar**)

**Past**

1. University of California, Santa Cruz, Santa Cruz, California (12/14/2018): *Synthetic Observations of the High-Redshift Universe* (**1-Hour Seminar**)
2. University of California, Davis, Davis, California (11/1/2018) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**1-Hour Seminar**)
3. University of California, Berkeley, Berkeley, California (10/5/2019) *Synthetic Observables Using Monte Carlo Photon Simulations* (**Talk, Discussion Moderator**)
4. Stanford University, Stanford, California (10/9/2018) *Synthetic Observations of the High-Redshift Universe* (**Talk**)
5. Los Alamos National Laboratory, Los Alamos, New Mexico (12/14/2017) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**1-Hour Seminar**)
6. University of Arizona, Tucson, Arizona (11/6/2017) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**1-Hour Seminar**)
7. Flatiron Institute, New York, New York (10/13/2017) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**Talk**)
8. University of Maryland, College Park, Maryland (10/10/2017) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**1-Hour Seminar**)
9. Jet Propulsion Laboratory, NASA, Pasadena, California (7/26/2017) *Astrodynamics, Astronomy, and Astrophysics* (**1-Hour Seminar**)
10. Space Systems Design Laboratory*,* Georgia Institute of Technology (11/14/2016) *Multi-Objective Optimization of Mars-Earth-Venus Trajectories* (**Talk**)
11. Duke TIP Program, Georgia Institute of Technology (7/13/15) *Gravity* (**2-Hour Guest Lecture**)
12. Center for Relativistic Astrophysics, Georgia Institute of Technology (10/8/2014) *First Light: Exploring the Spectra of Galaxies in the Early Universe* (**Talk**)

**CONFERENCE PRESENTATIONS**

**Recent and Upcoming**

1. 235st American Astronomical Society Meeting, Honolulu, Hawaii (1/7/2020) *Blue Galaxies: Modeling Nebular Emission Lines in the Time Domain* (**Talk**)

**Past**

1. Frank Bash Symposium, UT Austin, Austin, Texas (10/23/2019): *Blue Galaxies: Exploring Nebular Emission in the Early Universe* (**45-minute Invited Review Talk**)
2. 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)**
3. 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)**
4. Extremely Big Eyes on the Early Universe, Los Angeles, California (1/28/2019) *Synthetic Observations of the High-Redshift Universe* (**Talk**)
5. Stellar Archaeology as a Time Machine to the First Stars, Kashiwa, Japan (12/4/2018) *Synthetic Observations of the High-Redshift Universe* (**Talk**)
6. 2018 National Society of Black Physicists Conference, Columbus, Ohio, (11/5/2018) *Synthetic Observations of the High-Redshift Universe* (**Invited Talk**)
7. 231st American Astronomical Society Meeting, Washington, DC (1/11/2018) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**Dissertation Talk**)
8. 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**)
9. 27th AAS/AIAA Space Flight Mechanics Meeting, San Antonio, Texas (2/5/2017) *Multi-Objective Optimization of Mars-Earth-Venus Trajectories* (**Talk, Conference Paper**)
10. Exploring the Universe with JWST II Conference, Montreal, Canada (10/27/2016) *First Light: Exploring the Spectra of Galaxies in the Early Universe* (**Talk**)
11. 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**)
12. 224th American Astronomical Society Meeting, Seattle, Washington (1/5/2015) *First Light: Exploring the Spectra of Galaxies in the Early Universe* (**Poster**)

**TEACHING EXPERIENCE**

**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 – August 2020 (est.)**

* 70 hours of pedagogy/andragogy 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 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

**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**

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

**CERTIFICATIONS IN PROGRESS**

* Stanford Postdoctoral Teaching Certificate (est. Spring 2020)
* Japanese Language Proficiency Test N3 (est. Summer 2020)