

Kirk Stuart Simeon Barrow

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

Citizenship: United States of America

EDUCATION

Ph.D, Physics , Astrophysics Specialization Georgia Institute of Technology	2013-2018 May(est.)
M.S., Aerospace Engineering , Orbital Mechanics Specialization Georgia Institute of Technology	2014-2016
B.S., Aerospace Engineering , Space Specialization Georgia Institute of Technology	2004-2009

RESEARCH EXPERIENCE

Graduate

Astrophysics – Research in Computational Cosmology, Georgia Institute of Technology
August 2014 – Present

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

NASA Graduate Internship – Research in 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 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 an operating uninhabited aerial vehicle testing
- Tested the control program on flight hardware

GRANTS AND AWARDS

2017: NASA Jet Propulsion Laboratory Year-Round Graduate Internship

2016: School of Physics Travel Grant to the 32nd Annual Institut d'Astrophysique de Paris Conference

2014: XSEDE Conference Grant

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

JOURNAL PUBLICATIONS

- 1) **Barrow, K. S. S.**, Wise, J. H. (2018, in prep) *Capturing the Cosmic Background Using Diffuse Emission Modelling*, Monthly Notices of the Royal Astronomical Society
- 2) Aykutaalp, A, **Barrow, K. S. S.**, Wise, J. H. (2017, in prep) *X-ray induced Stellar Population in DCBH Host Galaxies*, The Astrophysical Journal Letters
- 3) **Barrow, K. S. S.**, Aykutaalp, A, Wise, J. H. (2017, submitted) *Photometry and Spectrometry of a Direct-Collapse Black Hole Scenario*, Nature Astronomy
- 4) **Barrow, K. S. S.**, Holzinger, M. J. (2017, in review) *Recursive Multi-Objective Optimization of Mars-Earth-Venus Trajectories*, Journal of Guidance, Control, and Dynamics
- 5) **Barrow, K. S. S.**, Wise, J. H., Aykutaalp, A., O'Shea, B. W., Norman, M. L., Xu, H. (2017) *First Light II: Emission Line Extinction, Population III Stars, and X-ray Binaries*, Monthly Notices of the Royal Astronomical Society, 10.1093/mnras/stx2973
- 6) **Barrow, K. S. S.**, Wise, J. H., Norman, M. L., O'Shea, B. W., Xu, H. (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.** (2009) *Learning Styles: Effective Tool for Deploying Finance Personnel in Changing Times*. Romanian Society for Quality Assurance, 10(104,2009),91-109

CONFERENCE PRESENTATIONS

- 1) 231st American Astronomical Society Meeting, Washington, DC (1/11/2018) *Caius: Synthetic Observables Using Monte Carlo Photon Simulations* (**Dissertation Talk**)
- 2) 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**)
- 3) 27th AAS/AIAA Space Flight Mechanics Meeting, San Antonio, Texas (2/5/2017) *Multi-Objective Optimization of Mars-Earth-Venus Trajectories* (**Talk, Conference Paper**)
- 4) Exploring the Universe with JWST II Conference, Montreal, Canada (10/27/2016) *First Light: Exploring the Spectra of Galaxies in the Early Universe* (**Talk**)
- 5) 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**)
- 6) 224th American Astronomical Society Meeting, Seattle, WA (1/5/2015) *First Light: Exploring the Spectra of Galaxies in the Early Universe* (**Poster**)

INVITED TALKS

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

TEACHING EXPERIENCE

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
- Mechanics (Physics I) - Prepared 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

- 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 in Education, 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

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

ENGAGEMENT, SERVICE, AND LEADERSHIP

- 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
- 2016-2017: Mentor and organizer for the Graduate Association of Physicists, Georgia Tech
- 2008-2017: Ongoing mentoring and tutoring of high school and undergraduate students
- 2015-2016: Led a startup competition group to build an automated solar energy pricing and permitting application
- 2007-2008: Primary and General Election Presidential Campaign Volunteer; organized a chapter within the Georgia Tech community. Created community outreach initiatives 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