

# John Franklin Crenshaw

Email: [jfc20@uw.edu](mailto:jfc20@uw.edu)  
 Web: <https://jfcrenshaw.github.io>  
 ORCID: [0000-0002-2495-3514](https://orcid.org/0000-0002-2495-3514)

Department of Physics  
 University of Washington, Seattle  
 Seattle, WA

<b>Education</b>	UNIVERSITY OF WASHINGTON, SEATTLE Ph.D. in Physics, expected June 2025 M.S. in Physics, December 2020 Advisor: Andrew Connolly	
	DUKE UNIVERSITY B.S. in Physics, May 2019 <i>summa cum laude</i> with highest distinction Advisor: Kate Scholberg	
<b>Research Experience</b>	LSST DARK ENERGY SCIENCE COLLABORATION (DESC) Leading the high-redshift cosmology analysis using Lyman-break Galaxies (LBGs), including measurements of the UV Luminosity Function, clustering, and cross-correlations with CMB lensing. Also developing the photometric redshift pipeline for DESC cosmology.	2019-present
	THE VERA C. RUBIN OBSERVATORY Developing and commissioning the active optics system, including leading development of wavefront estimation algorithms, using analytic, forward modeling, and deep learning methods. Member of the galaxy photometry and photometric redshift (photo-z) commissioning teams and the observing support team.	2021-present
	DUKE UNIVERSITY NEUTRINO AND COSMOLOGY GROUP Simulated core-collapse supernova neutrino bursts. Quantified sensitivity and developed Bayesian analysis methods for the Helium and Lead Observatory (HALO) neutrino detector.	2016-2019
	KARLSRUHE INSTITUTE OF TECHNOLOGY Studied muon content of cosmic rays detected with the IceTop Array and developed deep learning methods for data analysis (advised by Andreas Haungs).	2018
<b>First-Author Publications</b>	PROBABILISTIC FORWARD MODELING OF GALAXY CATALOGS WITH NORMALIZING FLOWS <b>Crenshaw, J.F.</b> , Kalmbach, J.B., Gagliano, A., Yan, Z., Connolly, A.J., Malz, A.I., Schmidt, S.J., LSST Dark Energy Science Collaboration (2024) <i>AJ</i> , 168 80. ( <a href="#">ADS</a> )	
	USING AI FOR WAVE-FRONT ESTIMATION WITH THE RUBIN OBSERVATORY ACTIVE OPTICS SYSTEM <b>Crenshaw, J.F.</b> , Connolly, A.J., Meyers, J.E., Kalmbach, J.B., Megias Homar, G., Ribeiro, T., Suberlak, K., Thomas, S., Tsai, T. (2024) <i>AJ</i> , 167, 86. ( <a href="#">ADS</a> )	
	LEARNING SPECTRAL TEMPLATES FOR PHOTOMETRIC REDSHIFT ESTIMATION FROM BROADBAND PHOTOMETRY <b>Crenshaw, J.F.</b> & Connolly, A.J. (2020) <i>AJ</i> , 160, 191. ( <a href="#">ADS</a> )	
<b>Fellowships Grants &amp; Awards</b>	DOE Cosmic Frontier Grant <i>contributor</i> (\$360,000)	2023
	DOE SCGSR Fellowship (\$10,400)	2023
	Rubin Observatory ISSC Ambassador (\$4,500)	2021-2022
	DOE Scholar (\$12,000)	2021
	Duke Faculty Scholar (\$10,000)	2018-2019
	Daphne Chang Memorial Award (\$1,000)	2019

	DAAD RISE Research Exchange Fellowship (€5,000)	2018
<b>Invited Talks</b>	DES-DESC Special Session, AAS Winter 2025, National Harbor, MD	Jan 2025
	Plenary, Cosmopalooza 2023, online	Oct 2023
	Colloquium, University of Chile, Santiago, Chile	Mar 2023
	Plenary, AAS Astronomers Turned Data Scientists Meeting, online	Mar 2022
	Plenary, DESC Winter Meeting, online	Feb 2022
	Seminar, KIPAC, SLAC National Laboratory, online	Sep 2020
<b>Software</b>	PZFLOW: PROBABILISTIC MODELING OF TABULAR DATA WITH NORMALIZING FLOWS Creator and lead developer. Python package for efficient, high-dimensional joint density estimation and generative modeling of any tabular data. ( <a href="#">Github</a> ) ( <a href="#">PyPI</a> )	
	PHOTERR: PHOTOMETRIC ERROR MODEL FOR ASTRONOMICAL IMAGING SURVEYS Creator and lead developer. Python package for estimating photometric errors for point and extended sources observed in astronomical imaging surveys, including the Rubin, Euclid, and Roman observatories. ( <a href="#">Github</a> ) ( <a href="#">PyPI</a> )	
	TS-WEP: WAVE-FRONT ESTIMATION FOR RUBIN OBSERVATORY ACTIVE OPTICS Lead developer. Python package for performing wave-front inference on images from the Vera C. Rubin Observatory. I lead development of the wave-front estimation algorithms, including forward modeling and deep learning methodologies. ( <a href="#">Github</a> )	
	RAIL: REDSHIFT ASSESSMENT INFRASTRUCTURE LAYERS Contributing developer. Python package for photo-z estimation and evaluation on large scale data. I lead development of the galaxy catalog and systematic error forward modeling framework. ( <a href="#">Github</a> ) ( <a href="#">PyPI</a> )	
<b>Leadership &amp; Service</b>	DESC LYMAN-BREAK GALAXY TOPICAL TEAM LEADER Created and leading the Lyman-break Galaxy (LBG) topical team of the Dark Energy Science Collaboration (DESC), focusing on performing precision cosmology with high-redshift galaxies in the range $2 < z < 6$ .	2024-present
	CO-CHAIR OF THE DESC EQUITY, DIVERSITY, AND INCLUSION COMMITTEE Leading the Equity, Diversity, and Inclusion (EDI) committee of the Dark Energy Science Collaboration (DESC), including efforts to make DESC resources more accessible to new members, develop EDI guidelines for DESC meetings, and expand safety resources for meeting attendees covering issues such as racism, transphobia, homophobia, access to reproductive care, and mental health.	2023-present
	RUBIN OBSERVATORY SCIENCE COLLABORATIONS EDI COMMITTEE Serving as the Dark Energy Science Collaboration (DESC) representative on the Equity, Diversity, and Inclusion committee of the Vera C. Rubin Observatory's council of Science Collaborations.	2023-present
	DUSC COSMOLOGY AND ASTROPARTICLE GROUP LEADER Leading the cosmology and astroparticle group meetings of the Dark Universe Science Center (DUSC) at the University of Washington. Duties include setting the agenda, inviting speakers, and organizing events.	2022-present
	RUBIN COMMUNITY WORKSHOP SCIENCE ORGANIZING COMMITTEE Setting the science agenda and inviting speakers for the 2023 and 2024 Rubin Observatory Community Workshops.	2023-2024

	DESC COLLABORATION MEETING SCIENCE ORGANIZING COMMITTEE Planned the Winter 2023 meeting of the Dark Energy Science Collaboration (DESC), with a focus on the poster session, events for early career researchers, and the DESC spokesperson election.	2022-2023
	AAS SOFTWARE CARPENTRY WORKSHOP VOLUNTEER Assisted instruction in command line and Python programming in the Software Carpentry Workshop at the 241st meeting of the American Astronomical Society, in Seattle, WA.	Jan 2023
	PHYSICS UNDERGRADUATE READING COURSE LEADERSHIP COMMITTEE Organized reading course for undergraduates, including reviewing student applications, verifying progress during the term, and hosting final presentations.	2022
	PHYSICISTS FOR INCLUSION AND EQUITY OFFICER Lead group in the University of Washington Physics Department, with a focus on providing community and programming for underrepresented groups in physics.	2020-2021
<b>Mentored Students</b>	DOMINIK RIEMANN Developing deep learning methods for the active optics system of the Vera C. Rubin Observatory's Auxiliary Telescope (AuxTel).	2022-2024
<b>Teaching Experience</b>	READING COURSE INSTRUCTOR, UNIVERSITY OF WASHINGTON Independently designed syllabi and taught advanced reading courses to undergraduates. Courses included <i>Tensions in <math>\Lambda</math>CDM Cosmology</i> and <i>Gravitational Lensing: From Exoplanets to Large Scale Structure</i> .	2020-2022
	TEACHING ASSISTANT, DUKE UNIVERSITY Led lab and discussion sections. Lectured on introductory mechanics, fluid dynamics, electromagnetism, and optics.	2016-2019
	UNDERGRADUATE TUTOR, DUKE UNIVERSITY Tutored undergraduate students in introductory physics, modern physics, calculus I-II, and linear algebra.	2016-2019
<b>Outreach</b>	ASTRONOMY ON TAP: DARK ENERGY IN THE ERA OF DESI Public talk at a Seattle brewery on Baryon Acoustic Oscillations, the Dark Energy Spectroscopic Instrument (DESI), and theories of Dark Energy.	May 2024
	ASTRONOMY ON TAP: BEFORE THE BIG BANG Public talk at a Seattle brewery on the CMB, inflation, primordial perturbations, and the potential for an inflationary multiverse.	Apr 2023
	OUTREACH AT SCIOŠKOLA PRAHA 11 Taught a class of Czech middle school students about Earth's magnetic field, the solar wind, and how the environment of Mars was impacted by the loss of its magnetic field.	May 2022
	GRADUATE STUDENT Q&A PANEL, UC BERKELEY Spoke on panel serving undergraduate students. Discussed aspects of graduate student life and research, with an emphasis on work-life balance, and navigating academic spaces as a queer person.	Jul 2021
	STEM PALS ORGANIZER & PEDAGOGICAL SIMULATION LEAD Helped launch a STEM outreach program at the University of Washington. Designed interactive simulations to teach high school students how simulations allow researchers to study complex systems.	2021

	DUKE UNIVERSITY TEACHING OBSERVATORY Held star parties for members of the public, using telescopes to observe nebulae, star clusters, and planets.	2018-2019
	QUEER IN RESEARCH DISCUSSION PANEL Spoke on panel discussing experiences as a queer person in STEM. Gave advice on how to find queer-friendly research groups and how to build queer support systems in a professional context.	Oct 2018
	PUBLIC LECTURE: WHERE DID WE COME FROM AND ARE WE ALONE – COSMIC ORIGINS AND THE SEARCH FOR LIFE Public lecture for undergraduates at Duke University explaining the standard model of cosmology, the search for life in the solar system and on exoplanets.	Jan 2018
<b>Contributed Talks</b>	DESC Summer Meeting, Chicago, IL	Aug 2022
	DESC Winter Meeting, online	Feb 2022
	Rubin Observatory Project & Community Workshop, online	Aug 2020
	DESC Winter Meeting, Tucson, AZ	Jan 2020
<b>Posters</b>	Rubin Observatory Community Workshop, Palo Alto, CA	Jul 2024
	American Astronomical Society 241st Meeting, Seattle, WA	Jan 2023
	American Astronomical Society 238th Meeting, online	Jun 2021
	Statistical Challenges in Modern Astronomy VII, online	Jun 2021
	Duke Physics Research Symposium, Durham, NC	Apr 2019
	5th Joint Meeting of the American Physical Society and the Physical Society of Japan, Waikoloa, HI	Oct 2018
	28th International Conference on Neutrino Physics and Astrophysics, Heidelberg, Germany	Jun 2018

## Publication List

---

### First-Author Publications

4. QUANTIFYING THE IMPACT OF LSST *u*-BAND SURVEY STRATEGY ON PHOTOMETRIC REDSHIFT ESTIMATION AND THE DETECTION OF LYMAN-BREAK GALAXIES  
**Crenshaw J. F.**, Leistedt B., Graham M. L., Payerne C., Connolly A. J., Gawiser E., Karim T., Malz A. I., Newman J. A., Ricci M., LSST Dark Energy Science Collaboration (*in collaboration review*)
3. PROBABILISTIC FORWARD MODELING OF GALAXY CATALOGS WITH NORMALIZING FLOWS  
**Crenshaw J. F.**, Kalmbach J. B., Gagliano A., Yan Z., Connolly A. J., Malz A. I., Schmidt S. J., LSST Dark Energy Science Collaboration (2024) *AJ*, 168 80. ([ADS](#))
2. USING AI FOR WAVE-FRONT ESTIMATION WITH THE RUBIN OBSERVATORY ACTIVE OPTICS SYSTEM  
**Crenshaw, J. F.**, Connolly A. J., Meyers J. E., Kalmbach J. B., Megias Homar G., Ribeiro T., Suberlak K., Thomas S., Tsai T. (2024) *AJ*, 167, 86. ([ADS](#))
1. LEARNING SPECTRAL TEMPLATES FOR PHOTOMETRIC REDSHIFT ESTIMATION FROM BROADBAND PHOTOMETRY  
**Crenshaw J.F.** & Connolly A.J. (2020) *AJ*, 160, 191. ([ADS](#))

### Co-Author Publications

7. IMPACT OF SURVEY SPATIAL VARIABILITY ON GALAXY REDSHIFT DISTRIBUTIONS AND THE COSMOLOGICAL  $3\times 2$ -POINT STATISTICS FOR THE RUBIN LEGACY SURVEY OF SPACE AND TIME (LSST)  
Hang Q., Joachimi B., Charles E., **Crenshaw J. F.**, Larsen P., Malz A. I., Schmidt S., Yan Z., Zhang T. (2024) *MNRAS*, 535, 4. ([ADS](#))
6. THE ACTIVE OPTICS SYSTEM ON THE VERA C. RUBIN OBSERVATORY: OPTIMAL CONTROL OF DEGENERACY AMONG THE LARGE NUMBER OF DEGREES OF FREEDOM  
Megias Homar G., Kahn S. M., Meyers J. M., **Crenshaw J. F.**, Thomas S. J. (2024) *ApJ*, 74, 108. ([ADS](#))
5. IMPROVING PHOTOMETRIC REDSHIFT ESTIMATES WITH TRAINING SAMPLE AUGMENTATION  
Moskowitz I., Gawiser E., **Crenshaw J. F.**, Andrews B. H., Malz A. I., Schmidt S., LSST Dark Energy Science Collaboration (2024) *ApJL*, 967. ([ADS](#))
4. RUBIN OBSERVATORY SIMONYI SURVEY TELESCOPE ACTIVE OPTICS  
Thomas S., Connolly A. J., **Crenshaw J. F.**, Kalmbach J. B., Megias Homar G., Meyers J. E., Ribeiro T., Tsai T., Claver C., Neill D., Braga V. F., Fiorentino G., Savarese S., Schipani P., Schreiber L., Di Criscienzo M. (2023) *AO4ELT*, 7, 67. ([ADS](#))
3. THE SIMULATED CATALOGUE OF OPTICAL TRANSIENTS AND CORRELATED HOSTS (SCOTCH)  
Lokken M., Gagliano A., Narayan G., Hložek R., Kessler R., **Crenshaw J. F.**, Salo L., Alves C. S., Chatterjee D., Vincenzi M., Malz A. (2023) *MNRAS*, 520, 2. ([ADS](#))
2. THE SENSITIVITY OF GPZ ESTIMATES OF PHOTO-Z POSTERIOR PDFs TO REALISTICALLY COMPLEX TRAINING SET IMPERFECTIONS  
Stylianou N., Malz A., Hatfield P., **Crenshaw J. F.**, Gschwend J. (2022) *PASP*, 134, 1034. ([ADS](#))

1. AN INFORMATION-BASED METRIC FOR OBSERVING STRATEGY OPTIMIZATION,  
DEMONSTRATED IN THE CONTEXT OF PHOTOMETRIC REDSHIFTS WITH APPLICATIONS  
TO COSMOLOGY  
Malz A. I., Lanusse F., **Crenshaw J. F.**, Graham M. L. (2021) *arXiv*. ([ADS](#))