# Courtney "CJ" Johnson

johnsonc5@janelia.hhmi.org

## Education

**Duke University,** Durham, NC — 2015-2022
Doctor of Philosophy, Chemistry
Cumulative GPA 3.8/4.0

**Texas Woman's University,** Denton, TX — 2010-2015
Bachelor of Science, *Summa Cum Laude,* Chemistry with ACS Certification
Cumulative GPA 4.0/4.0

**Chandler-Gilbert Community College,** Chandler, AZ — 2007-2010
Cumulative GPA 4.0/4.0

## Research Experience

**Howard Hughes Medical Institute Janelia Research Campus**, Ashburn VA
*Advisor: Hari Shroff, Ph.D.*

**Overview:**

- Developed microscopes from empty optical table
- Worked in collaboration with Misha Ahrens lab and Google on project 2.
- Worked in collaboration with theory fellow Magdalena Schneider on project 1 to implement deep neural network models.

**Project 1: Phase Diversity Wavefront Sensing for Adaptive Optics in Fluorescence Microscope**

**Aims:**

- Develop rapid, image-based adaptive optics technique which is broadly compatible across imaging modalities and facilitates high-resolution imaging at depth in living organisms.

**Results:**

- Built prototype widefield microscope and adapted algorithm developed in collaboration with Patrick La Riviere (U. Chicago) to test feasibility of phase diversity for fluorescence microscopy.
- Built asymmetric dual-view light-sheet microscope and extended method to measuring aberrations in 3D samples.
- Developed deep neural network model of deformable mirror behavior in collaboration with Magdalena Schneider, enabling acquisition of aberration-corrected images computationally, paving the way for hardware-free solutions for adaptive optics.

**Importance:**

- An easy, rapid method for estimating optical aberrations enables users to circumvent purchase and implementation of costly and difficult-to-use wavefront sensing devices.
- Broad compatibility across imaging methods enables broader accessibility of aberration-sensing and correction, enabling higher-quality imaging at depth.

**Project 2: Two-Photon Light Sheet for Brain-Body Zebrafish Imaging**

**Aims:**

- Develop whole-brain Zebrafish light sheet imaging system with two-photon excitation for improved image quality at depth and more biologically-relevant behavior results due to invisible NIR excitation.

**Results:**

- Designed and tested two-photon excitation modification to original Zebrascope design

- Built and tested scope for imaging performance, phototoxicity.
- Led team of graduate students and technicians on build

**Importance:**

- This imaging system will enable whole-brain Zebrafish experiments where the sample is not perturbed by visible-light stimulus, which corrupts behavioral data results. This result will enable us to tie functional Zebrafish behavior data to connectome.

**Duke University,** Durham, NC
*Advisor: Prof. Kevin D. Welsher, Ph.D.*

**Overview:**

- Developed microscopes from empty optical table
- Spearheaded development for automation of all acquisition, processing, and visualization.
- Mentored 2 undergraduate students.
- Led a 4-person team on the 3D-TrIm project consisting of myself, a postdoctoral scholar, junior graduate student, and undergraduate student.

**Project 1: 3D-FASTR – Rapid Point-Scan Volumetric Microscopy**

**Aims:**

- Develop new microscope capable of rapid volumetric Imaging a moving sample

**Results:**

- Conceived theory of volumetric point-scan using tessellating pattern
- Developed 3D-FASTR volumetric two-photon laser-scanning microscope
- Performs 3D point-scan imaging 4-8x faster vs. conventional z-stack

**Importance:**

- Generalizable theory for multi-dimensional scanning using tessellating pattern
- Ideal platform to integrate with active-feedback tracking systems

**Project 2: 3D-TrIm – Simultaneous Single-Virus Tracking and 3D Imaging**

**Aims:**

- Develop new microscope capable of single virus tracking with simultaneous 3D imaging of surrounding environment.

**Results:**

- Developed 3D-TrIm microscope which generates volume spaces with co-registered single particle trajectories and 3D cellular imaging

**Importance:**

- First Observation of virus “skimming” behavior
- Discovered distinct diffusional modes on actin-rich protrusions
- Extension of virus tracking to live tissue systems demonstrated using multi-layer epithelial cells.

**Texas Woman’s University,** Denton, TX
*Advisor: Prof. Richard D. Sheardy, Ph.D.*

Studied structure and physical properties of i-motif DNA conformation using spectroscopic (UV-Vis, and circular dichroism) and calorimetric (DSC, ITC) instrumental methods to evaluate sequence context of conformation physical and chemical properties.

# Publications

**DeepPD: Joint Phase and Object Estimation from Phase Diversity with Neural Calibration of a Deformable Mirror** 2025
Magdalena C. Schneider, Courtney Johnson, Cedric Allier, Larissa Heinrich, Diane Adjavon, Joren Husic, Patrick La Rivière, Stephan Saalfeld, Hari Shroff
*arXiv* **2025**
DOI: 10.48550/arXiv.2504.14157 (*preprint*)

**Phase diversity-based wavefront sensing for fluorescence microscopy** 2024
Courtney Johnson, Min Guo, Magdalena C. Schneider, Yijun Su, Satya Khuon, Nikolaj Reiser, Yicong Wu, Patrick La Riviere, and Hari Shroff
*Optica* **2024**
DOI: 10.1364/OPTICA.518559

**Capturing the start point of the virus-cell interaction with high-speed 3D single-virus tracking** 2022
Courtney Johnson, Jack Exell, Jonathan Aguilar, and Kevin Welsher
*Nature Methods* **2022**, 19, 1642–1652
DOI: 10.1038/s41592-022-01672-3

**Continuous Focal Translation Enhances Rate of Volumetric Imaging** 2019
Courtney Johnson, Jack Exell, Jonathon Kuo, and Kevin Welsher
*Opt. Express* **2019** 27, 36241-36258
DOI: 10.1364/OE.27.036241

**Real-Time 3D Single Particle Tracking: Towards Active Feedback Single Molecule Spectroscopy in Live Cells** 2019
Shangguo Hou, Courtney Johnson, and Kevin Welsher
*Molecules* **2019**, *24*(15), 2826
DOI: 10.3390/molecules24152826

**Point-Scan Volumetric Imaging Rate Increased by an Optimized Linear Sparse Sampling Pattern** 2019
Courtney Johnson and Kevin Welsher
*Frontiers in Optics + Laser Science APS/DLS* **2019** OSA Technical Digest (Optical Society of America), paper JTu4A.101.
DOI: 10.1364/FIO.2019.JTu4A.101

**Loop Sequence Context Influences the Formation and Stability of the i-Motif for DNA Oligomers of Sequence (CCCXXX)4, where X = A and/or T, under Slightly Acidic Conditions** 2016
Mikeal McKim, Alexander Buxton, Courtney Johnson, Amanda Metz, and Richard D. Sheardy
*The Journal of Physical Chemistry B* **2016** *120* (31), 7652-7661
DOI: 10.1021/acs.jpcb.6b04561

## Presentations

| | |
|---|---|
| ***Invited Speaker*** **– SPIE BIOS Adaptive Optics –** ***San Francisco, CA*** **(*forthcoming*)** | Jan. 2026 |
| ***Invited Speaker (International)*** **– Optica Imaging Congress, (Adaptive Optics: Methods, Analysis and Applications) –** ***Toulouse, France*** | Jul. 2024 |
| HHMI January 2024 Science Meeting (Poster) | Jan. 2024 |
| ***Invited Speaker/Panelist*** **– Mathworks Bio Roundtable Discussion** | Jan. 2024 |
| ***Invited Speaker*** **– SERMACS 2023 (Single-molecule Dynamics in Complex Chemical and Biological System Symposium) –** ***Durham, NC*** | Oct. 2023 |
| ***Selected Speaker*** **– Janelia Symposium 2023** | Jan. 2023 |
| Janelia/EMBL Optical Interest Group<br>*High-Speed 3D Tracking and Imaging Microscopy Captures Early Events of the Virus-Cell Interaction* | Jan. 2023 |
| ***Invited Speaker/Panelist*** **– TWU Celebration of Women in Science –** ***Denton, TX*** | Oct. 2022 |
| ***Invited Speaker*** **– TWU Jane Nelson Institute for Women's Leadership –** ***Denton, TX*** | May 2022 |
| ***Invited Speaker*** **– Southeast Biophysics Consortium Meeting –** ***Denton, TX*** | May 2022 |
| ***Selected Speaker*** **– Fitzpatrick Institute of Photonics Seminar Series** | Mar. 2022 |
| SPIE Photonics West (Poster) – *San Francisco, CA* | Jan. 2022 |
| Just Another (Chemistry) Webinar series (www.JAWSchem.com)<br>"Multi-Scale 3D Visualization of the Cellular Landscape through Single-Virus Tracking" | Nov. 2021 |
| Duke Chemistry Research Symposium (Talk) | Sep. 2021 |
| ***1st Prize Poster*** **– Fitzpatrick Institute of Photonics Annual Meeting**<br>*"Real-Time 3D Tracking and Imaging Microscopy"* | May 2021 |
| ***Invited Speaker*** **- 65th Annual Meeting of the Biophysical Society (Nanoscale Approaches to Biology Subgroup Symposium)**<br>*"Synchronous 3D Tracking and Imaging at Multiple Scales to Overcome Spatiotemporal Disparity"* | Feb. 2021 |
| 65th Annual Meeting of the Biophysical Society (Poster) | Feb. 2021 |
| Fitzpatrick Institute of Photonics Annual Meeting (Poster) | Mar. 2020 |
| ***Invited Speaker*** **– 259th ACS National Meeting (ACS Award for Encouraging Women into Careers in the Chemical Sciences: Symposium in honor of Katherine Franz)** | Mar. 2020 |
| Duke Chemistry Research Symposium (Poster) | Oct. 2019 |
| ALIS Kickoff and Southeast Ultrafast Laser Conference | Oct. 2019 |
| Frontiers in Optics + Laser Science (Lighting Talk + Poster) – *Washington, DC* | Sep. 2019 |
| Duke Chemistry Research Symposium (Talk) | Oct. 2018 |
| Fitzpatrick Institute of Photonics Annual Meeting (Poster) | Mar. 2018 |
| ***Invited Speaker*** **– STEM Education in Mississippi: Issues and Innovations –** ***Jackson, MS*** | Oct. 2017 |
| ***Invited Speaker/Panelist*** **– TWU Celebration of Women in Science –** ***Denton, TX*** | Oct. 2016 |
| Duke Chemistry Research Symposium (Poster) | Oct. 2016 |
| 247th American Chemical Society National Meeting (Poster) – *Dallas, TX* | Mar. 2014 |
| **Workshop Facilitator**<br>*Designing a SENCER Course (UT San Antonio)* **–** *San Antonio, TX* | Dec. 2014 |
| **Commendation of Excellence – National Society for Experiential Education 43rd Annual Conference (Poster) –** ***Baltimore, MD*** | Oct. 2014 |
| TWU Quality Enhancement Program Experiential Scholar Program (Talk) | Apt. 2014 |

## Grants and Scholarships

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|---|---|
| Joe Taylor Adams Fellowship (Duke Chemistry Department) | Fall 2021 |
| Marcus Hobbs Fellowship (Duke Chemistry Department) | Spring 2020 |
| TWU S-STEM QuaSARS Program - **Full Scholarship** (Tuition, Fees, Textbooks) | 2013-2015 |
| Robert A. Welch Foundation Grant for Undergraduate Research in Chemistry | SU 2013, 2014 |
| Helen Ludeman Scholarship (TWU Chemistry Department) | AY 2012, 2014 |
| TWU Quality Enhancement Plan Experiential Student Scholar Award to develop a laboratory exercise for a freshman chemistry course. | SU 2014 |
| TWU Undergraduate Research Microgrant Program Award | Spring 2015 |

## Awards and Honors

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|---|---|
| **Leading Edge Fellow** | 2024 |
| 1st Prize Student Speaker for Fitzpatrick Institute of Photonics Seminar Series | 2022 |
| 1st Prize Poster at Fitzpatrick Institute of Photonics Annual Meeting 2021 | 2021 |
| TWU Chancellor's Student Research Scholar Award for outstanding achievement in research. | 2015 |
| Commendation of Excellence for poster presentation "Practice Makes ~~Perfect~~ Proficient: Reflections on the Impact of Experiential Learning" (from the National Society for Experiential Education) | 2014 |
| TWU Chancellor's List for achieving 4.0 GPA with full-time student status | 2010-2015 |
| Nominated to membership in the Honor Society of Phi Kappa Phi | 2014 |

## Professional Development Activities

**Duke Senior Leadership Insights Interviewer** — Oct. 2021

Selected by the assistant dean to interview a senior executive for a professional development seminar featured on the main Duke Youtube page.

**Nationally competitive University of Michigan NextProf Science Workshop** — May 2021

Workshop for promising future faculty candidates.

**Duke Preparing Future Faculty Program** — AY 2020

Prepared and delivered guest lecture for Analytical Chemistry at NCCU

**"Unity in Diversity – Leading Through a Crisis"** — August 2020

Published blog post, Duke Professional Development Blog

**Duke Emerging Leaders Institute Program** — Spring 2020

Competitive application process selects only 20 total postdocs and grad students campus-wide to study leadership, culminating in a team project.

**"Letting Go, and Other Lessons from the Mat"** — July 2019

Published blog post, Duke Professional Development Blog

## Teaching Experience

**Duke University** — 2015-2019

*Graduate Teaching Assistant*

CHEM 210 – Modern Applications of Chemistry Laboratory
CHEM 202 – Organic Chemistry II Laboratory
CHEM 110 – Core Concepts in Chemistry Discussion

*Grader* — 2015-2016

CHEM 201 – Organic Chemistry I Lecture

*Tutor* — 2016-2019

CHEM 101 – General Chemistry, Duke Athletics Tutor Program. Designed individualized program of instruction for 20+ student-athletes. Developed and taught 8-week summer preparation course for a small group of athletes taking CHEM101 in the fall.

**Texas Woman's University**
*Undergraduate Teaching Assistant* 2012- 2015
CHEM 1011 – Introduction to Chemistry Laboratory
CHEM 1111 – General Chemistry I Laboratory
CHEM 1121 – General Chemistry II Laboratory
*Grader* 2012, 2014
CHEM 1013 – Introduction to Chemistry Lecture

## Service and Outreach Activities

**Science Beyond the Bench** Spring 2023
Gave a talk at Science National Honor Society meeting at Broad Run High School
**Regeneron Science Talent Search** Spring 2023
Gave a talk to finalists of the Regeneron Science Talent Search during their tour of Janelia.
**Duke Women in Science and Engineering (WiSE)** Fall 2020
Invited to plan and organize women's self-defense programming
**Duke Brazilian Jiu-Jitsu Club** 2019-Present
Elected Safety Officer
Ensure safe behavior and assist with first aid for injuries of athletes
**Duke Graduate Chemistry Council** 2016-2018
Elected Media Coordinator
Promoted GCC activities and outreach events through social media and photographed events.
**Kappa Epsilon Mu "KEM Club"** 2014
Presented Chemistry Magic Shows at Events
Assisted in Preparation of Chemical Reagents for Magic Shows.

## Professional Certifications

**CompTIA A+ Certified IT Professional** 2006
Certified to build, troubleshoot and repair Windows-based PCs.
Certificate verification ID: N959CCKC6KQE5WRM

## Professional Society Memberships

**American Chemical Society**
**Optical Society of America**
**American Physical Society**
**Biophysical Society**
**SPIE**