# ZACHARY STREETER

## PERSONAL INFORMATION


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|---|---|
| *email* | zacharylouis42@gmail.com |
| *LinkedIn* | https://www.linkedin.com/in/zachary-streeter-44a323102/ |
| *github* | https://github.com/zstreeter |


## BRIEF INTRODUCTION

My formal training is in computational physics and chemistry. These fields, in particular, have had limited success because of their massive combinatorial search spaces. This has lead to approximate techniques like density-functional theory (DFT) in quantum chemistry. However, these approximate techniques haven't yielded *ab-initio* understanding which, in some ways, has lead to stagnation. There are two novel solution paths for these statistically daunting areas of study, namely quantum computing and AI. With this in mind I have begun my career after my Ph.D., in AI. With this industry experience, I will create tools that leverage AI for teaching science with an initial objective of teaching physics. As these tools mature, I hope they will lead to *ab initio* understanding of emergent phenomena in physics and other fields like biology. This should keep me busy the rest of my life.

If you would like, please follow the red links above to email me, link up on LinkedIn, and/or check out my github page!

## TECHNICAL SKILLS

*Software*

Compiled · C(proficient), C++(proficient), Fortran(proficient), Cython(prior experience).

Parallel API · MPI(proficient), OpenMP(proficient), Cuda(prior experience), PETSc(proficient), SLEPc(proficient).

Scripting · Posix(prior experience), Bash(proficient), Python(proficient).

Build Process · CMake(proficient), Make(proficient).

Markup · LaTeX(expert), Markdown(proficient), ReStructuredText(proficient).

Debugger · gdb(proficient), lldb(proficient), TotalView(prior experience).

Profiler · Nsight/visual profiler(prior exexperience), VTune(prior experience).

Scheduler · SLURM(proficient).

*Workflow*

Editor · Vim/Neovim.

Multiplexer · Tmux.

Version-Control · Git.

## RESEARCH INTERESTS

*Computer Science* High Performance Computing · Deep Learning.

- Numerical algorithms/methods.
- Finite-Element Methods.
- Computational geometry.
- Computational physics/chemistry.
- Hybrid CPU/GPU Architectures.
- HPC and low level optimization.

*Theoretical* Physics and Chemistry

- Quantum Information and Computation.
- Deep Learning applied to quantum physics/chemistry.
- Quantum Computers applied to quantum physics/chemistry.
- Nonlinear chemical reaction kinetics.
- Scattering Theory.
- Symplectic Mechanics.
- Underlying Symmetries throughout Physics.

## JOBS

*September 2021 to present* Advanced Micro Devices

*AMD*

Part of the Deep Learning Frameworks team. Worked on improving novel AI models with end-to-end specifications for AMD hardware. Used profilers to pin-point bottlenecks and further optimized kernels. Directed projects that contributed to company's AI direction at large. Worked with several large clients in numerous asks. Furthered understanding of AI research directions and advised how AMD can leverage these novel neural-network architectures.
Manager: Peng Sun · Peng.Sun@amd.com

## INTERNSHIPS AND RESEARCH POSITIONS

*Summer 2016 to August 2021* Lawrence Berkeley National Laboratory

*LBNL*

Created fully dimensional potential energy surfaces for $H_2O^{++}$ using MOLPRO and Columbus Quantum Chemistry packages. These hypersurfaces were then used in a MPI parallelized classical trajectory simulation of $H_2O^{++}$ breakup following double ionization. This work was essential to deduce the body-frame of the water molecule at the momentum of photo-absorption and resulted in two immediate papers while also providing a benchmark for intense field experimentalist that will be in print shortly. Created a novel suite of high-performance codes that calculate double-ionization cross section for water and can be easily modified to other polyatomics. In general, honed programming skills in C, C++, Fortran, and Python, while becoming a learned software developer devoted to best practices, high performance, and good documentation. Used NERSC supercomputers EDISON and CORI, and also a cluster called Lawrencium, for running large parallel batch jobs (e.g. 40+ physical cores with 3000+ processors). Became proficient in parallel programing using PETSC, MPI, CUDA, and OpenMP.
Reference: Clyde W. McCurdy +1 (510) 486 4283 · cwmccurdy@lbl.gov

*Spring 2015* — Brookhaven National Laboratory, SULI internship

*BNL*

Performed experiments with soft X-rays utilizing the Linear Electron Accelerator Facility (LEAF) and the van de Graaff. Prepared samples in glove box and worked on purifying Xenon and CO. This work was essential in studying electron mobility through CO. Once this work was completed, we calculated the quasi-free electron energy resulting in a publication. Understanding the free-electron energy in various liquids is critical in order for those liquids to be used in scattering experiments.
Reference: Richard Holroyd +1 (631) 344 4329 · holroydr@optonline.net

*Summer 2014* — Center for Advanced Microstructures and Devices

*CAMD*

Became a user in order to continue research from SRC.
Reference: Cherice Evans +1 (718) 997 4216 · cherice.evans@qc.cuny.edu

*2012–2013* — Synchrotron Radiation Center

*SRC*

Built gas handling systems, ran leak checks for high vacuum line, wrote Igor Pro code for data analysis, and worked on calibrating the monochrometer. Also attended lectures in relativistic electrodynamics and worked on electrodynamic problem sets.
Reference: Gary Findley +1 (318) 342 1835 · findley@ulm.edu

## OPEN SOURCE PROJECTS

*Spring 2020* — quantumGrid

*Author and Maintainer*

quantumGrid is a python package for solving a 1-D Schrödinger equation for an arbitrary potential on any interval. The heart of this package is using a Finite Element Method with a Discrete Variable Representation (FEM-DVR) grid to solve the time-dependent or time-independent Schrödinger equation. This grid provides a compact supported foundation for numerically accurate integration and also allows for a natural application of outgoing scattering boundary conditions by adding a complex tail as the last finite element of the FEM-DVR grid, called exterior complex scaling (ECS). This project was created for a graduate course in time-dependent quantum mechanics at UC Davis.
Click on the read hyperlink to find out more!

## EDUCATION

*2015-August 2021* — The University of California, Davis

*Doctor of Philosophy*

GPA: 3.9 · School: Chemistry
Description: This degree is a PhD in Theoretical Chemical Physics.
Advisors: Prof. Clyde W. McCurdy, Prof. Robert. Lucchese (LBNL)

*Fall 2019* — The University of California, Berkeley

*Notable Course*

CS294 – 73 *Software Engineering for Scientific Computing*
School: Computer Science
Grade: A+
Description: This graduate course focused on the seven motifs in scientific computing: dense and sparse linear algebra, structured and unstructured grid methods, particle methods, fast Fourier transforms (FFT), and Monte Carlo.
Professor: Phillip Colella · colella@eecs.berkeley.edu

*Spring 2020* — The University of California, Berkeley

*Notable Course*

CS267 *Applications of Parallel Computers*
School: Computer Science
Grade: A+
Description: Graduate course focused on models for parallel programing. Overview of parallelism on scientific applications and study of parallel algorithms for linear algebra, particles, meshes, sorting, FFT, graphs, machine learning, etc. Survey of parallel machines and machine structures. Programming shared- and distributed-memory parallel computers, GPUs, and cloud platforms. Parallel programming languages, compilers, libraries and toolboxes. Data partitioning techniques. Techniques for synchronization and load balancing. Detailed study and algorithm/program development of medium sized applications.
Professor: Katherine A. Yelick · yelick@cs.berkeley.edu
Professor: James Demmel · demmel@cs.berkeley.edu
Professor: Aydin Buluç · aydin@eecs.berkeley.edu

*2007–2009, 2011–2015* The University of Louisiana, Monroe

*Bachelor of Science*

GPA: 3.46 · School: School of Sciences
Major (Concentration): Biology (Chemical Biology)
Personal Courses: Attended formal lectures in Statistical Mechanics, Quantum Mechanics, Electricity and Magnetism, and Relativistic Electrodynamics.
Advisor: Prof. Gary Findley & Prof. Ann Findley

## TEACHING

*Spring 2020* University of California, Davis

*Teaching Assistant*

Time-Dependent Quantum Mechanics: The first part of this graduate course covers the basic concepts and techniques for solving the time-dependent Schrödinger equation. The initial portion explores the concepts of quantum superpositions, Gaussian wave packets for free and interacting particles, time propagation, the Schrödinger, interaction and Heisenberg representations, time-dependent density matrices, the Wigner phase space distribution, Ehrenfest's theorem, the connection between quantum and classical mechanics in the context of molecular dynamics, the semiclassical wave packet approximation, and time-dependent perturbation theory. The second part of the course turned to applications. Those included absorption and emission of electromagnetic radiation, correlation functions and spectra, molecular dynamics, potential energy surfaces, conical intersections, nonadiabatic transitions and variational transition state theory.

*Winter 2020* University of California, Davis

*Teaching Assistant*

Quantum Chemistry: a graduate level discussion of the principles of quantum mechanics and its application to (primarily) stationary state problems in atoms and molecules, including Hartree-Fock calculations of their electronic structure. Using the Psi4 quantum chemistry codes and the Python programming language we performed calculations on small molecules using restricted Hartree-Fock, unrestricted Hartree-Fock, Møller-Plesset perturbation theory (MP2), and configuration interaction (CI) and coupled cluster (CCSD) methods..

*2015–2016* University of California, Davis

*Teaching Assistant*

Taught freshman chemistry for two quarters. My third quarter I taught quantum mechanics for physical chemistry students. This course laid the foundation for quantum mechanics needed later in spectroscopy courses.

*Spring 2015* Queens College

*Teaching Assistant* Taught second semester of freshman chemistry and the corresponding lab. Created lab and recitation quizzes and was the sole arbiter as to how the courses were conducted.
Assisted Professor: Prof. Cherice Evans

## TALKS AND POSTERS PRESENTED AT CONFRENCES

*2013 SRC Users Meeting* Zachary Streeter, Kamil Krynski, C. M. Evans, and G. L. Findley, "*Quasi-Free electron in near critical point hydrogen and deuterium,*" 2013 SRC Users Meeting, University of Wisconsin Synchrotron Radiation Center, Stoughton, WI, September 27 – 28, 2013.

*2013 SRC Users Meeting* Kamil Krynski, Zachary Streeter, C. M. Evans, and G. L. Findley, "*Field ionization and photoionization of $CH_3I$ perturbed by diatomic molecules: electron scattering in $H_2$, HD, $D_2$, $O_2$ and CO,*" 2013 SRC Users Meeting, University of Wisconsin Synchrotron Radiation Center, Stoughton, WI, September 27 – 28, 2013.

*2014 DAMOP* Cherice Evans, Kamil Krynski, Zachary Streeter, and G. L. Findley, "*Field Ionization and Photoionization of $CH_3I$ Perturbed by Diatomic Molecules: Electron Scattering in $H_2$, $D_2$, $O_2$, and CO,*" $45^{th}$ Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics, Madison, WI, June 2 – –6, 2014.

*2014 DAMOP* Zachary Streeter, Kamil Krynski, C. M. Evans, and G. L. Findley, "*The energy of the quasi-free electron in near critical point $H_2$, $D_2$, and $O_2$,*" $45^{th}$ Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics, Madison, WI, June 2 – –6, 2014.

*2016 APS* Kamil Krynski, Zachary Streeter, C. M. Evans, and G. L. Findley, "*Energy of the Quasi-Free Electron in $H_2$, $D_2$, and $O_2$: Probing Intermolecular Potentials within the Local Wigner-Seitz Model,*" American Physical Society March Meeting, Baltimore, MD, March 14 – 18, 2016.

*2017 DAMOP* Zachary Streeter, Frank Yip, Dylan P. Reedy, Allen Landers, C. William McCurdy, "*Classical trajectory studies on the dynamics of one-photon double photionization of $H_2O$,*" $48^{th}$ Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics , Sacramento, CA, June 5 – –9, 2017.

*2018 ACS* Cherice M. Evans, Jennifer Hare, Baxter Flor, Kamil Krynski, Zachary Streeter, and G. L. Findley, "*Energy of the Quasi-Free Electron in CO and HD: Extension of the Local Wigner-Seitz Model to Polar Fluids,*" $225^{th}$ ACS National Meeting and Exposition, New Orleans, LA, March 18 – –22, 2018.

*2019 DAMOP* Z. L. Streeter, and C. W. McCurdy, "*Sequential dissociation of $H_2O^{++}$ following double photoionization*" $50^{th}$ Annual Meeting of the APS Division of Atomic, Molecular, and Optical Physics, Milwaukee, WI, May 27 – –31, 2019.

## PUBLICATIONS

*Published* C. M. Evans, Kamil Krynski, Zachary Streeter, and G. L. Findley, "*Energy of the Quasi-free Electron in $H_2$, $D_2$ and $O_2$: Probing Intermolecular Potentials within the Local Wigner-Seitz Model,*" J. Chem. Phys. **143**, 224303 (2015)"

*Published* C. M. Evans, Baxter Flor, Kamil Krynski, Zachary Streeter, and G. L. Findley,"*Energy of the Quasi-Free Electron in CO and HD: Probing Intermolecular Potentials within the Local Wigner-Seitz model,*" J. Chem. Phys. **149**, 064307 (2018).

*Published* Zachary L. Streeter, Frank L. Yip, Robert R. Lucchese, Benoit Gervais, and C. William McCurdy,"*Dissociation dynamics of the water dication following one-photon double ionization I: Theory,*" Phys. Rev. A, **98**, 053429 (2018).

*Published* D. Reedy, J. B. Williams, B. Gaire, A. Gatton, M. Weller, A. Menssen, T. Bauer, K. Henrichs, Ph. Burzynski, B. Berry, Z. L. Streeter, J. Sartor, I. Ben-Itzhak, T. Jahnke, R.

Dörner, Th. Weber, and A. L. Landers,"*Dissociation dynamics of the water dication following one-photon double ionization I: Experiment*," Phys. Rev. A, **98**, 053430 (2018).

*Published* Kirk A. Larsen, Thomas N. Rescigno, Travis Severt, Zachary L. Streeter, Wael Iskandar, Saijoscha Heck, Averell Gatton, Elio G. Champenois, Richard Strom, Bethany Jochim, Dylan Reedy, Demitri Call, Robert Moshammer, Reinhard Dörner, Allen L. Landers, Joshua B. Williams, C. William McCurdy, Robert R. Lucchese, Itzik Ben-Itzhak, Daniel S. Slaughter, Thorsten Weber,"*Photoelectron and fragmentation dynamics of the $H^+ + H^+$ dissociative channel in $NH_3$ following direct single-photon double ionization*,'Phys. Rev. Res., **2**, 043056 (2020).

*Published* Kirk A. Larsen, Thomas N. Rescigno, Zachary L. Streeter, Wael Iskandar, Saijoscha Heck, Averell Gatton, Elio G. Champenois, Travis Severt, Richard Strom, Bethany Jochim, Dylan Reedy, Demitri Call, Robert Moshammer, Reinhard Dörner, Allen L. Landers, Joshua B. Williams, C. William McCurdy, Robert R. Lucchese, Itzik Ben-Itzhak, Daniel S. Slaughter, Thorsten Weber,"*Photoionization and dissociation dynamics of the NH+2 + H+ and NH+ + H+ + H fragmentation channels upon single-photon double ionization of NH3 at 61.5eV*"Journal of Physics B., **53**, 24 (2020).

August 7, 2022