David P. Hoffman, PhD

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Summary

I'm a scientist and engineer with a proven track record of hardware and software development whose research has been featured on the cover of *Science* magazine. In graduate school at Berkeley I trained as a physical chemist and spectroscopist before diving into imaging and biology as a post-doc in Nobel Laureate Eric Betzig's group. While I enjoy digging into the nuts and bolts of instrumentation, theory and code, I always see my work in the context of the big picture and strive to do the most useful thing most efficiently. I'm goal focused, data driven and led by curiosity.

Expertise

Computational Tools and Software Python and its scientific data stack (NumPy, SciPy, Scikit-Learn, Pandas, Dask, Numba), AutoDesk Inventor, Git, LabVIEW, IGOR Pro, Adobe Suite, Microsoft Suite, Mathematica, MatLab, Amira

Experimental Methods Expertise in microscopy and optics, extensive experience with super-resolution (SIM, PALM) and single particle tracking (SPT) microscopy in both living and cryogenically frozen specimens, Correlative super-resolution light and electron microscopy (CLEM), experience with multiple spectroscopies (Raman, IR, UV-vis, single molecule, fluorescence) with particular expertise in ultrafast, time-resolved spectroscopy

Theoretical Methods Fourier analysis, Differential equations, Multivariate calculus, Linear algebra, Regression analysis, Optimization, Machine learning

Recent Experience

Engineer IV — Eikon Therapeutics, Inc.
October 2019–Present

- In charge of the development of the company's core technology platform, a high throughput single particle tracking microscope, with a focus on increasing throughput as efficiently as possible by engineering advanced illumination and analysis strategies.
- Designed and built a high powered, five color laser launch achieving the goal of simpler construction, alignment, and maintenance.
- Re-engineered a monolithic, fragile, and tightly coupled academic codebase into a modular, robust and loosely coupled Python package with composable functions for the analysis of single particle tracking data in pseudo-real time with multiple entry points for users of different programming experience with an emphasis on reproducibility and data provenance.
- Introduced the company to programming best practices and the use of GitHub for collaborative code development.
- Helped set up company operations such as IT (networking, email, onsite storage and compute), purchasing; and designed company logo.
- Built optics labs from the ground up; and provided electronics, plumbing, and pneumatic support for the automation and tissue culture lab buildouts.

Postdoctoral Researcher/Research Scientist — HHMI, Janelia Research Campus
Advisor: Dr. Eric Betzig — August 2014–September 2019

- Developed an advanced pipeline to correlate data taken from a cryogenic super resolution fluorescent microscope and a customized focused ion beam scanning electron microscope (FIB-SEM), to elucidate key questions in cell biology, research which was featured on the January 17th, 2020 cover of *Science* magazine.
- Organized collaborations with outside biologists and spear-headed experimental design, execution and analysis.

- Designed and built a cryogenic super-resolution volumetric fluorescence microscope
- Measured world's first SIM images under cryogenic conditions (~10 Kelvin)
- Adapted high pressure freezing and plunge freezing methods to be compatible with fluorescence microscopy under cryogenic conditions.
- Extensive experience with the instrumentation and algorithms of super-resolution fluorescence microscopy: structured illumination (SIM) and single molecule localization (SMLM) microscopy
- Modeled optical systems with Fourier optics and differential equations
- Developed a new method for sample positioning and created new algorithms for automatic optical alignment using computer vision
- Developed a flexible multicore and modular data analysis pipeline in Python

Graduate Student Researcher University of California, Berkeley
Advisor: Prof. Richard A. Mathies October 2008–May 2014

- Developed two-dimensional femtosecond stimulated Raman spectroscopy (2D-FSRS) offering an unprecedented view of chemical reaction dynamics.
- Led a diverse group of researchers to investigate interfacial charge transfer in dye-sensitized and polymeric solar cell materials, discovering that a common chemical motif (a carbon-carbon double bond) can be detrimental to light harvesting.
- Elucidated the ultrafast photoisomerization reaction coordinate in azobenzene.
- Extensive experience with ultrafast nonlinear optics, including the construction of a Ti:Sapphire femtosecond oscillator and a non-collinear optical parametric amplifier, from scratch
- Greatly improved data analysis workflow by automating many manual tasks and creating efficient GUI interfaces for those remaining
- Rewrote LabVIEW instrument control software that vastly increased maintainability and reliability; increased mean time to failure from ~2 hours to months

Peer-Reviewed Publications

- **Hoffman, D. P.;** Shtengel, G.; Xu, C. S.; Campbell, K. R.; Freeman, M.; Wang, L.; Milkie, D. E.; Pasolli, H. A.; Iyer, N.; Bogovic, J. A.; et al. Correlative Three-Dimensional Super-Resolution and Block-Face Electron Microscopy of Whole Vitreously Frozen Cells. *Science* **2020,** *367* (6475) **Featured on the cover.**
- Ellis, S. R.; **Hoffman, D. P.**; Park, M.; Mathies, R. A. Difference Bands in Time-Resolved Femtosecond Stimulated Raman Spectra of Photoexcited Intermolecular Electron Transfer from Chloronaphthalene to Tetracyanoethylene. *J. Phys. Chem. A* **2018**, *122* (14), 3594–3605.
- **Hoffman, D. P.**; Mathies, R. A. Femtosecond Stimulated Raman Exposes the Role of Vibrational Coherence in Condensed-Phase Photoreactivity. *Acc. Chem. Res.* **2016,** *49* (4), 616–625.
- Valley, D. T.; **Hoffman, D. P.**; Mathies, R. A. Reactive and Unreactive Pathways in a Photochemical Ring Opening Reaction from 2D Femtosecond Stimulated Raman. *Physical Chemistry Chemical Physics* **2015**, *17* (14), 9231–9240.
- **Hoffman, D. P.;** Leblebici, S. Y.; Schwartzberg, A. M.; Mathies, R. A. Exciton Mobility in Organic Photovoltaic Heterojunctions from Femtosecond Stimulated Raman. *J. Phys. Chem. Lett.* **2015**, *6* (15), 2919–2923.
- **Hoffman, D. P.**; Ellis, S. R.; Mathies, R. A. Characterization of a Conical Intersection in a Charge-Transfer Dimer with Two-Dimensional Time-Resolved Stimulated Raman Spectroscopy. *J. Phys. Chem. A* **2014**, *118* (27), 4955–4965.
- **Hoffman, D. P.**; Valley, D.; Ellis, S. R.; Creelman, M.; Mathies, R. A. Optimally Shaped Narrowband Picosecond Pulses for Femtosecond Stimulated Raman Spectroscopy. *Opt. Express* **2013**, *21* (18), 21685–21692.

- **Hoffman, D. P.**; Lee, O. P.; Millstone, J. E.; Chen, M. S.; Su, T. A.; Creelman, M.; Fréchet, J. M. J.; Mathies, R. A. Electron Transfer Dynamics of Triphenylamine Dyes Bound to TiO_2 Nanoparticles from Femtosecond Stimulated Raman Spectroscopy. *J. Phys. Chem. C* **2013**, *117* (14), 6990–6997.
- **Hoffman, D. P.**; Ellis, S. R.; Mathies, R. A. Low Frequency Resonant Impulsive Raman Modes Reveal Inversion Mechanism for Azobenzene. *J. Phys. Chem. A* **2013**, *117* (45), 11472–11478.
- **Hoffman, D. P.**; Mathies, R. A. Photoexcited Structural Dynamics of an Azobenzene Analog 4-Nitro-4'-Dimethylamino-Azobenzene from Femtosecond Stimulated Raman. *Phys. Chem. Chem. Phys.* **2012**, *14* (18), 6298–6306.

PRESENTATIONS

1. "Correlative three-dimensional super-resolution and block face electron microscopy of whole vitreously frozen cells", ASCB|EMBO National Meeting, December 7th, 2019 (**invited talk**)
2. "Correlative three-dimensional super-resolution and block face electron microscopy of whole vitreously frozen cells", John Lawrence Seminar Series, LBNL, October 15th, 2019 (**invited talk**)
3. "Seeing the forest and the trees: cryogenic correlative super-resolution microscopy", Rutherford Appleton Laboratory, March 15th, 2019 (**invited talk**).
4. "Seeing the forest and the trees—Cryogenic correlative super- resolution microscopy", *Single Biomolecules*, Cold Spring Harbor Laboratory, August 29th, 2018 (**contributed talk**).
5. "Seeing the forest and the trees: Cryogenic single molecule microscopy and spectroscopy enables new approaches to cellular imaging", *Single Molecule Approaches to Biology Gordon Research Conference*, West Dover, VT, July 16th, 2018 (**poster presentation, GRC poster award**).
6. "Cryo-Correlative Light and Electron Microscopy at High Resolution of Large Volumes", *Frontiers in Microscopy Technologies*, Janelia Research Campus, Ashburn, VA, February 26th, 2018 (**invited talk**).
7. "Cryo-Correlative Light and Electron Microscopy at High Resolution of Large Volumes", *Seeing is Believing–Imaging the Processes of Life*, European Molecular Biology Laboratory, Heidelberg, Germany, October 6th, 2017 (**contributed talk**)
8. "Volumetric Correlative Super Resolution Cryo-Fluorescence and Electron Microscopy." National Institute of Standards and Technology, Gaithersburg, MD, June 16th, 2017 (**invited talk**)
9. "Volumetric Correlative Super Resolution Cryo-Fluorescence and Electron Microscopy." *Frontiers in Imaging Science*, Janelia Research Campus, Ashburn, VA, April 3rd, 2017 (**invited talk**).
10. "Electron Transfer Dynamics of Triphenylamine Dyes Bound to TiO_2 Nanoparticles from Femtosecond Stimulated Raman Spectroscopy." *245th ACS National Meeting & Exposition*, New Orleans, LA, April 10th, 2013 (**poster presentation, ACS Poster Award**).
11. "Electron Transfer Dynamics of Triphenylamine Dyes Bound to TiO_2 Nanoparticles from Femtosecond Stimulated Raman Spectroscopy." *60th Annual Western Spectroscopy Conference*, Pacific Grove, CA, January 31st, 2013 (**contributed talk**).
12. "Photoexcited Structural Dynamics of an Azobenzene Analog 4-Nitro-4'-Dimethylamino-Azobenzene from Femtosecond Stimulated Raman." *Vibrational Spectroscopy Gordon Research Conference*, Biddeford, ME, August 7th, 2013 (**poster presentation**).
13. "Excited State Intramolecular Proton Transfer." *Undergraduate Research Symposium in Chemistry*, McGill University, May 3rd, 2008 (**poster presentation**).

14. "Controlled Deposition of DNA Nanostructures." *CPIMA SURE Forum and Poster Session*, IBM Almaden Research Center, August 9th, 2007 (**poster presentation**).

EDUCATION

University of California, *Berkeley, CA* — September 2008–May 2014
Ph.D., Physical Chemistry — *GPA 3.987*

McGill University, *Montréal, QC, Canada* — September 2004–May 2008
B.Sc., First Class Honours in Chemistry, Minor in Physics — *GPA 3.87*

HONORS AND AWARDS

GRC Poster Award (Single Molecule Approaches to Biology)	2018
ACS PHYS Division Outstanding Student Poster Award	2013
Berkeley Conference Travel Grant	2013
Vibrational GRC Registration Award	2012
Berkeley Fellowship for Graduate Study	2008–2010
NSF Graduate Research Program Honorable Mention	2008, 2009
Clifford B. Purves Prize in Chemistry	2008
Fredric J. LeMaistre Award	2007
Principal's Student-Athlete Academic Honour Roll	2006
Dean's Honour List	2005, 2007

TEACHING EXPERIENCE

CHEM 223A: Chemical Kinetics — University of California, Berkeley
Prof. K. Birgitta Whaley — Spring 2014

CHEM 120B: Statistical Mechanics — University of California, Berkeley
Prof. Naomi Ginsberg — Fall 2010

CHEM 120A: Quantum Mechanics — University of California, Berkeley
Prof. David Chandler — Spring 2010

CHEM 1A: General Chemistry — University of California, Berkeley
Dr. Michelle Douskey — Fall 2008

McGill Tutorial Service — McGill University
Fall 2005–Winter 2008
General Chemistry, Organic Chemistry, Thermodynamics, Quantum Mechanics, Linear Algebra, Calculus of Single and Multiple Variables, Ordinary Differential Equations.

PEER REVIEWER

The Journal of Physical Chemistry C	2013–Present
Proceedings of the National Academy of Sciences	2017–Present
Accounts of Chemical Research	2017–Present
Biomedical Optics Express	2017–Present
ACS Nano	2018–Present