# Austin P. Spencer

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## Education

**University of Colorado Boulder** August 2009–August 2014
Ph.D. in Chemistry

- Courses: Advanced Topics in Physical Chemistry, Quantum Chemistry, Statistical Mechanics, Advanced Molecular Spectroscopy, Chemical Dynamics

**University of North Carolina at Chapel Hill** May 2009
B.S. Chemistry with Honors and Distinction
Minor in Computer Science

- Honors thesis: A study of the thermochemistry and dissociation dynamics of trichlorosilane derivatives using Threshold Photo-Electron Photo-Ion COincidence spectroscopy (TPEPICO)[17]

## Honors and Recognitions

**Cover & Feature article in *The Journal of Physical Chemistry C*[4]** November 2018
"Four-Dimensional Coherent Spectroscopy of Complex Molecular Systems in Solution"

**Featured in *Science*: 4D electronic–Raman spectroscopy[9]** June 2017
J. Goodknight, A. Aspuru-Guzik. Taking six-dimensional spectra in finite time.
*Science* **2017**, *356*, 1333–1333; DOI: 10.1126/science.aan2842

**Summer Undergraduate Research Fellowship** Summer 2008
University of North Carolina at Chapel Hill

## Research

**Postdoctoral Researcher** February 2018–present
Northwestern University, Department of Chemistry
Advisor: Lin X. Chen

- Investigated the role of nonadiabatic electronic–vibrational coupling for enhancing coherent dynamics in porphyrin dimers, polymers, and metal complexes.
- Studied coherent nuclear motion in bimetallic complexes using transient x-ray scattering and emission at the European X-ray Free Electron Laser (XFEL).

**Postdoctoral Researcher** August 2014–February 2018
Northwestern University, Department of Chemistry
Advisor: Elad Harel

- Developed a coherent 4D spectroscopy (GAMERS) for measuring 2D Raman–2D electronic spectra of complex chemical systems.[9, 20]
- Probed exciton–phonon coupling in CdSe quantum dots using GAMERS.[6]
- Demonstrated a compressive sensing detection scheme utilizing a digital micromirror array and a single-element detector as a sensitive alternative to 2D array detectors in multidimensional spectroscopy.[11, 21]
- Designed and built a single-shot 2DFT spectroscopy experiment, incorporating novel spatial-spectral interferometry detection for enhanced frequency resolution.[12, 21]

**Research Assistant** August 2009–August 2014
University of Colorado Boulder, Department of Chemistry and Biochemistry
Advisor: David M. Jonas

- Simulated 2DFT spectra of atomic Rb vapor with particular emphasis on modeling experimentally-observed propagation distortions at high optical densities.[13, 15]
- Studied carrier dynamics in colloidal InAs and PbS quantum dots using degenerate femtosecond pump–probe spectroscopy.[3, 22, 23]
- Conceived, designed, and built a beam scanning apparatus for reducing repetitive excitation in laser spectroscopy, and utilized the setup in pump–probe studies of solution-phase and thin film samples.[8]
- Applied Cold-Target Recoil-Ion-Momentum Spectroscopy (COLTRIMS) and a femtosecond X-ray laser source to study the excited state dynamics of ozone by imaging coincident photo-electrons and photo-ions.

**Undergraduate Researcher** Summer 2008
Eötvös Loránd University (Budapest, Hungary)
Advisor: Bálint Sztáray

- Inorganic synthesis of halo-silanes.
- Analyzed products using UV photoelectron spectroscopy.

**Undergraduate Researcher** December 2007–May 2009
University of North Carolina at Chapel Hill
Advisor: Tomas Baer

- Investigated UV photodissociation and thermochemistry of halo-alkanes (1,2-dibromoethane, 1,2-dibromopropane, and 1,3-dibromopropane) and trichlorosilane derivatives ($SiCl_3R$ where R = Cl, H, $CH_3$, $C_2H_5$, $C_2H_3$, $CH_2Cl$, $SiCl_3$) using TPEPICO.[16, 17]

## Publications

1. M. S. Kirschner, Y. Jeong, A. P. Spencer, N. E. Watkins, X.-M. Lin, G. C. Schatz, L. X. Chen, R. D. Schaller. Phonon-induced plasmon-exciton coupling changes probed via oscillation-associated spectra. *Appl. Phys. Lett.* **2019**, *115*, 111903; DOI: 10.1063/1.5116836

2. P. E. Ohno, H. Chang, A. P. Spencer, Y. Liu, M. D. Boamah, H.-f. Wang, F. M. Geiger. Beyond the Gouy–Chapman Model with Heterodyne-Detected Second Harmonic Generation. *J. Phys. Chem. Lett.* **2019**, *10*, 2328–2334; DOI: 10.1021/acs.jpclett.9b00727

3. A. P. Spencer, W. K. Peters, N. R. Neale, D. M. Jonas. Carrier Dynamics and Interactions for Bulk-Like Photoexcitation of Colloidal Indium Arsenide Quantum Dots. *J. Phys. Chem. C* **2018**; DOI: 10.1021/acs.jpcc.8b09671

4. ¶A. P. Spencer, W. O. Hutson, E. Harel. Four-Dimensional Coherent Spectroscopy of Complex Molecular Systems in Solution. *J. Phys. Chem. C* **2018**; DOI: 10.1021/acs.jpcc.8b09184

5. S. Irgen-Gioro, A. P. Spencer, W. O. Hutson, E. Harel. Coherences of Bacteriochlorophyll a Uncovered Using 3D-Electronic Spectroscopy. *J. Phys. Chem. Lett.* **2018**, *9*, 6077–6081; DOI: 10.1021/acs.jpclett.8b02217

6. A. P. Spencer, W. O. Hutson, S. Irgen-Gioro, E. Harel. Exciton–Phonon Spectroscopy of Quantum Dots Below the Single-Particle Homogeneous Line Width. *J. Phys. Chem. Lett.* **2018**, 1503–1508; DOI: 10.1021/acs.jpclett.8b00065

7. W. O. Hutson, A. P. Spencer, E. Harel. Ultrafast Four-Dimensional Coherent Spectroscopy by Projection Reconstruction. *J. Phys. Chem. Lett.* **2018**, 1034–1040; DOI: 10.1021/acs.jpclett.8b00122

8. A. P. Spencer, R. J. Hill, W. K. Peters, D. Baranov, B. Cho, A. Huerta-Viga, A. R. Carollo, A. C. Curtis, D. M. Jonas. Sample exchange by beam scanning with applications to noncollinear pump–probe spectroscopy at kilohertz repetition rates. *Rev. Sci. Instrum.* **2017**, *88*, 064101; DOI: 10.1063/1.4986628

9. ‡A. P. Spencer, W. O. Hutson, E. Harel. Quantum coherence selective 2D Raman–2D electronic spectroscopy. *Nat. Commun.* **2017**, *8*, 14732; DOI: 10.1038/ncomms14732

10. W. O. Hutson, A. P. Spencer, E. Harel. Isolated Ground-State Vibrational Coherence Measured by Fifth-Order Single-Shot Two-Dimensional Electronic Spectroscopy. *J. Phys. Chem. Lett.* **2016**, 3636–3640; DOI: 10.1021/acs.jpclett.6b01733

11. A. P. Spencer, B. Spokoyny, S. Ray, F. Sarvari, E. Harel. Mapping multidimensional electronic structure and ultrafast dynamics with single-element detection and compressive sensing. *Nat. Commun.* **2016**, *7*, 10434; DOI: 10.1038/ncomms10434

12. A. P. Spencer, B. Spokoyny, E. Harel. Enhanced-Resolution Single-Shot 2DFT Spectroscopy by Spatial Spectral Interferometry. *J. Phys. Chem. Lett.* **2015**, 945–950; DOI: 10.1021/acs.jpclett.5b00273

¶Feature Article

‡Featured in *Science*: J. Goodknight, A. Aspuru-Guzik. Taking six-dimensional spectra in finite time. *Science* **2017**, *356*, 1333–1333; DOI: 10.1126/science.aan2842

13. A. P. Spencer, H. Li, S. T. Cundiff, D. M. Jonas. Pulse Propagation Effects in Optical 2D Fourier-Transform Spectroscopy: Theory. *J. Phys. Chem. A* **2015**, *119*, 3936–3960; DOI: 10.1021/acs.jpca.5b00001

14. B. Cho, V. Tiwari, R. J. Hill, W. K. Peters, T. L. Courtney, A. P. Spencer, D. M. Jonas. Absolute Measurement of Femtosecond Pump–Probe Signal Strength. *J. Phys. Chem. A* **2013**, *117*, 6332–6345; DOI: 10.1021/jp4019662

15. H. Li, A. P. Spencer, A. Kortyna, G. Moody, D. M. Jonas, S. T. Cundiff. Pulse Propagation Effects in Optical 2D Fourier-Transform Spectroscopy: Experiment. *J. Phys. Chem. A* **2013**, *117*, 6279–6287; DOI: 10.1021/jp4007872

16. N. S. Shuman, A. P. Spencer, T. Baer. Experimental Thermochemistry of SiCl3R (R = Cl, H, CH3, C2H5, C2H3, CH2Cl, SiCl3), SiCl3+, and SiCl3•. *J. Phys. Chem. A* **2009**, *113*, 9458–9466; DOI: 10.1021/jp9054186

17. A. P. Spencer, *TPEPICO Spectroscopy of SiCl4, SiCl3CH3, SiCl3CH2Cl, SiCl3C2H3, and SiCl3C2H5: Thermochemistry of Trichlorosilane Derivatives*, Honors Thesis, University of North Carolina at Chapel Hill, Chapel Hill, NC, **2009**. URL

## Presentations

18. A. P. Spencer, W. Helweh, D. Edwards, G. E. Bullard, M. J. Therien, L. X. Chen, *Dissecting quantum coherence in photosynthesis: lessons from porphyrin dimers*, Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics; Milwaukee, WI, **2019**[*]

19. A. P. Spencer, P. Kim, W. Helweh, L. X. Chen, *Coherent dynamics in porphyrin dimers*, Gordon Research Conference on Electron Donor–Acceptor Interactions; Newport, RI, **2018**[†]

20. A. P. Spencer, H. W. O., E. Harel, *Electronic–vibrational coupling probed by 4D Raman–electronic spectroscopy*, Gordon Research Conference on Photochemistry; Lewiston, ME, **2017**[†]

21. A. P. Spencer, B. Spokoyny, E. Harel, *Spatial Spectral Interferometry and Compressed Sensing Detection in Single-Shot 2DFT Spectroscopy*, Time-Resolved Vibrational Spectroscopy; Madison, WI, **2015**[†]

22. A. P. Spencer, W. K. Peters, V. Tiwari, B. Cho, N. R. Neale, D. M. Jonas, *Carrier dynamics in colloidal indium arsenide quantum dots in the weak excitation limit*, March Meeting of the American Physical Society; Denver, CO, **2014**[*]

23. D. M. Buckley, A. P. Spencer, D. Baranov, T. L. Courtney, D. M. Jonas, *Degenerate Femtosecond Pump Probe Studies of Lead Sulfide Nanocrystal Colloidal Solutions and Arrays at the Band Gap*, Meeting of the Center for Advanced Solar Photophysics, an Energy Frontiers Research Center; Golden, CO, **2012**[†]

24. A. P. Spencer, *The thermochemistry and dissociation dynamics of 1,2-dibromoethane, 1,2 dibromopropane, and 1,3-dibromopropane*, Gordon Research Conference on Gaseous Ions; Galveston, TX, **2009**[†]

[*]Oral presentation
[†]Poster presentation

## Teaching and Mentoring

**Teaching Assistant, General Chemistry II** Spring 2013
University of Colorado Boulder

**Teaching Assistant, General Chemistry II** Summer 2012
University of Colorado Boulder

**Teaching Assistant, General Chemistry II** Spring 2010
University of Colorado Boulder

**Teaching Assistant, General Chemistry for Engineers** Fall 2009
University of Colorado Boulder