

Matthew K. Sprague, Ph.D.

Associate Professor of Chemistry

St. Norbert College

(920)-403-3280 (work)

matthew.sprague@snc.edu

Professional Appointments

8/21 to present	Associate Professor of Chemistry (with tenure), St. Norbert College
8/15 to 7/21	Assistant Professor of Chemistry, St. Norbert College
5/13 to 5/15	Research Chemist, National Institute of Standards and Technology
8/12 to 4/13	Lecturer in Chemistry, California Institute of Technology

Education

Ph.D. 2012	Physical Chemistry – California Institute of Technology <ul style="list-style-type: none">• Thesis: Cavity ringdown spectroscopy, kinetics, and quantum chemistry of atmospherically relevant reactions• Advisors: Professor Mitchio Okumura, Dr. Stanley P. Sander (Jet Propulsion Lab)
B.S. 2005	Chemistry (with honors), Music (minor) – Ithaca College <ul style="list-style-type: none">• Thesis: Energetic and geometric insights of methoxide in methanol $\text{CH}_3\text{O}^-(\text{CH}_3\text{OH})_n$, for $n = 1-21$• Advisor: Professor Vincent F. DeTuri
B.A. 2005	Physics (with honors) – Ithaca College

Teaching Experience

8/15 to present	Assistant/Associate Professor of Chemistry (Asst. 2015–2021, Assoc. 2021–present) St. Norbert College, Division of Natural Sciences <ul style="list-style-type: none">• Instructor of record for the following courses<ul style="list-style-type: none">○ CHEM 105 – General Chemistry 1 + Lab (Fall semesters)○ CHEM 107 – General Chemistry 2 + Lab (Spring semesters)○ CHEM 330 – Physical Chemistry 1 + Lab (Fall semesters)○ CHEM 332 – Physical Chemistry 2 + Lab (Spring semesters)• Integrated computational chemistry exercises into the general chemistry and physical chemistry curricula• Academic advisor to 20 students per year
8/12 to 4/13	Course Coordinator for General Chemistry, Consultant for Physical Chemistry California Institute of Technology Department of Chemistry Professors: Nathan S. Lewis, Sarah E. Reisman, Geoffrey A. Blake, Mitchio Okumura <ul style="list-style-type: none">• Managed 18 teaching assistants, maintained course websites, developed problem sets, exams, and quizzes, held office hours, and performed course administrative duties for General Chemistry (Ch 1a and 1b, 260 students)• Developed and provided support for <i>Mathematica</i> computer code for students to visualize and perform complex mathematics for Quantum Chemistry (Ch 21a, 25 students)

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Teaching Experience (continued)

4/07 to 4/13

Physical Chemistry Tutor Self Employed

- Wrote review materials, practice examinations and providing homework assistance for one student enrolled in a year-long undergraduate physical chemistry course. Topics covered include quantum chemistry, spectroscopy, statistical mechanics, thermodynamics, and kinetics
- Tutored and mentored five students enrolled in graduate level physical chemistry: quantum mechanics, spectroscopy, thermodynamics, and research strategies

9/05 to 3/10

Graduate Teaching Assistant California Institute of Technology Department of Chemistry

Developed and graded problem sets and exams, held recitation sessions and office hours, and performed course administrative duties for:

- Ch 1a, 1b – General Chemistry – FA2005, WI2006
- Ch 21b – Spectroscopy and Computational Chemistry - WI 2010
- Ch 21c – Thermodynamics and Kinetics – SP2006, SP2007

8/02 to 5/05

Teaching Assistant Ithaca College Departments of Chemistry and Physics

Supervised lab sessions, graded problem sets and exams, and held review sessions for:

- CHEM 113 – General Chemistry Lab (non-majors) – FA2002
- CHEM 114 – Organic Chemistry Lab (non-majors) – SP2003
- CHEM 331 – Physical Chemistry 1 – FA2003, FA2004
- CHEM 332 – Physical Chemistry 2 – SP2004, SP2005
- PHYS 101 – General Physics 1 (non-majors) – FA2002
- PHYS 102 – General Physics 2 (non-majors) – SP2003
- PHYS 117 – Physics 1: Mechanics – FA2003, FA2004
- PHYS 118 – Physics 2: Electricity – SP2005
- PHYS 217 – Physics 3: Thermo and Waves – FA2003
- PHYS 218 – Physics 4: Modern – SP2004

9/00 to 6/01

Instructor (volunteer), Calculus Greece Arcadia High School Department of Mathematics

- Developed curriculum, delivered lectures, developed and graded homework assignments, and developed practice examinations for five students enrolled in Advanced Placement Calculus BC (Calculus II)

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Research Experience

8/15 to present

Assistant/Associate Professor of Chemistry
St. Norbert College, Division of Natural Sciences

- Computational thermochemistry studies on ozonolysis of unsaturated alcohols
- Constructed and maintained computers for the St. Norbert College computational chemistry laboratory (used for both research and teaching)
- Advisement of research students:
 - Thu Bui (Summer 2016, graduated May 2018)
 - Thomas Mellen (Summer 2017, graduated May 2020)

5/13 to 5/15

National Research Council Postdoctoral Research Associate
National Institute of Standards and Technology, Chemical Sciences Division

Advisor: Dr. Karl K. Irikura

- Studied computational thermochemistry, spectroscopy, and kinetics of atmospherically relevant reactions: HO₂ dimerization, ozonolysis of vinyl alcohol
- Showed that wavefunction diagnostics can be used to assign uncertainties in computed thermochemistry quantitatively
- Collaborated with experimentalists (Charles Clark and co-workers, Frank Lovas and co-workers) on assigning spectra of boron trifluoride and SO₂-CO complex
- Co-taught course in applications of quantum chemistry for three undergraduates and three high school students (with Karl Irikura)

3/06 to 8/12

Graduate Research Associate
California Institute of Technology, Department of Chemistry

Advisors: Prof. Mitchio Okumura, Dr. Stanley P. Sander (NASA Jet Propulsion Lab)

- Cavity ringdown spectroscopy and chemical kinetics of atmospherically relevant radical reactions: hydroperoxy radical with formaldehyde, alkoxy isomerization
- Predicted torsion-torsion coupling, vibrational spectra, and electronic spectra by quantum chemistry: peroxyacid and hydroxyalkylperoxy radicals
- Installed and repaired three lasers, non-linear optical systems, vacuum pumps, gas and vacuum lines, and over 20 computers
- Supervised and mentored one graduate and two undergraduate research students

8/04 to 5/05

Undergraduate Research Associate
Ithaca College, Department of Chemistry

Advisors: Prof. Vincent DeTuri, Prof. Anna Larsen

- Predicted energetics and cluster size of methoxide solvated by methanol by quantum chemistry calculations
- Created molecular orbital images and Flash animations for use in teaching LCAO / MO theory in general and inorganic chemistry, designed to be more accurate and more physically intuitive than existing textbook images

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Research Experience (continued)

5/02 to 8/04
(summers)

Student Intern

Sandia National Laboratories, Materials Chemistry Group

Advisors: Dr. Blake Simmons, Dr. LeRoy Whinnery

- Characterized novel cleavable and DNA-based surfactants by measuring micelle formation, micelle sizes, and cleavability of the surfactants (2004)
- Characterized cadmium sulfide nanoparticles synthesized in a mixed surfactant mesophase by measuring optical spectra and light scattering. Measured spatial distribution of nanoparticles on spin-coated silicon wafers (2003)
- Refined the formulation of a novel polyurethane foam by measuring physical properties and reaction characteristics (2002)
- Trained technical staff on newly purchased instruments: polyurethane foam qualification instrument, ellipsometer, dynamic light scattering apparatus.

Honors and Awards

- National Research Council Postdoctoral Research Associate (2013–2015)
- National Defense Science and Engineering Graduate Fellow (2006–2009)
- Caltech Chemistry Division Outstanding Graduate Teaching Assistant Award (2006)
- Ithaca College Dean's Award (Valedictorian) (2005)
- Honorable Mention – National Science Foundation Graduate Research Fellowship (2005)
- Ithaca College Russell A. Drago Chemistry Award (2004)
- Ithaca College Phi Kappa Phi Presidential Scholar Award (2003)
- Ithaca College Thomas Morrin Jones Memorial Scholarship (2003, 2004)
- Barry M. Goldwater Scholar (2003)
- Ithaca College Chemistry Book Award (2002)

Professional Society Memberships

- American Physical Society (2016)
- Sigma Xi (2005)
- American Chemical Society (2005)
- Sigma Pi Sigma (2004)
- Society of Physics Students (2004)
- Phi Kappa Phi (2003)
- Ithaca College Oracle Honor Society (2002)

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Committee Service at St. Norbert College

- Faculty Policy Committee (Fall 2022 – Spring 2025)
- Natural Sciences Strategic Plan Committee (Summer 2022 – Fall 2022)
- Natural Sciences Administrative Assistant Search Committee (Summer 2022)
- Discipline Coordinator, Chemistry (Fall 2021 – Spring 2023)
- HLC Reaccreditation Working Group (Fall 2020)
- Faculty Nominations and Elections Committee (Fall 2019 – Spring 2022, chair Fall 2020 – Spring 2022)
- Admissions Committee (Fall 2019 – Spring 2021)
- Physics Tenure-Track Search Committee (Fall 2017)
- Faculty Development Committee (Fall 2016 – Spring 2019)
 - Summer Grants Subcommittee (Spring 2017 – Spring 2018)
- Chemical Hygiene Officer Search Committee (Spring 2017)
- Academic Technology Advisory Group (Fall 2016 – Spring 2017)
- Physics Visiting Assistant Professor Search Committee, (Fall 2015 – Spring 2016)

Other Service

- New Faculty Mentor (Fall 2022 – present)
- Attended lunch with future NSF-STEM scholars and their parents (February 2020)
- AP Chemistry Reader (June 2019 – June 2020)
- Volunteered for SNC Dance Marathon's "Pie a Professor" (April 2019)
- Met with faculty candidates to represent the Faculty Development Committee (January 2019)
- Member, Tablets in Teaching User Group (September 2018 – May 2020)
- Summer advisement for twelve incoming students per year (June 2017 – June 2020)
- Poster judge at the Undergraduate Research Forum (April 2017)
- Lunches/Dinners with candidates for Math faculty searches (2016–2019)
- Met with students at the Multicultural Welcome Dinner (August 2016 – August 2019)
- Volunteered for Relay for Life's "Drench a Professor" (April 2016)
- Volunteer at SNC Day (2015, 2016)
- Spoke to Chemistry Club students about graduate school (October 2015)

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Publications (Peer Reviewed)

Published while at St. Norbert College (writing/revisions at SNC, research/writing at NIST)

9. F.J. Lovas and **M.K. Sprague**, "Microwave spectral study of SO₂-CO," *J. Mol. Spec.*, 2015, 316: 49–53, [doi:10.1016/j.jms.2015.07.005](https://doi.org/10.1016/j.jms.2015.07.005)
8. **M.K. Sprague** and K.K. Irikura, "Thermochemistry of HO₂+HO₂→H₂O₄: Does HO₂ dimerization affect laboratory studies?" *J. Phys. Chem. A*, 2015, 119 (27): 7052–7062, [doi:10.1021/acs.jpca.5b04265](https://doi.org/10.1021/acs.jpca.5b04265)

Published while at NIST

7. P.P. Hughes, A. Beasten, J.C. McComb, M.A. Coplan, M. al-Sheikhly, A.K. Thompson, R.E. Vest, **M.K. Sprague**, K.K. Irikura, and C.W. Clark, "High-resolution, vacuum-ultraviolet absorption spectrum of boron trifluoride," *J. Chem. Phys.*, 141, 194301 (2014), [doi:10.1063/1.4901324](https://doi.org/10.1063/1.4901324)
6. **M.K. Sprague** and K.K. Irikura, "Quantitative estimation of uncertainties from wavefunction diagnostics," *Theor. Chem. Acc.*, 2014, 133 (9): 1544, [doi:10.1007/s00214-014-1544-z](https://doi.org/10.1007/s00214-014-1544-z)

Published while at Caltech

5. **M.K. Sprague**, L.A. Mertens, H.N. Widgren, M. Okumura, S.P. Sander, and A.B. McCoy, "Cavity ringdown spectroscopy of the hydroxy-methyl-peroxy radical," *J. Phys. Chem. A*, 2013, 117 (39): 10006–10017, [doi:10.1021/jp400390y](https://doi.org/10.1021/jp400390y)
4. **M.K. Sprague**, E.R. Garland, A.K. Mollner, C. Bloss, B.D. Bean, M.L. Weichman, L.A. Mertens, M. Okumura, and S.P. Sander, "Kinetics of *n*-butoxy and 2-pentoxy isomerization and detection of primary products by infrared cavity ringdown spectroscopy," *J. Phys. Chem. A*, 2012, 116 (24): 6327–6340, [doi:10.1021/jp212136r](https://doi.org/10.1021/jp212136r)
3. A.K. Mollner, S. Valluvadasan, L. Feng, **M.K. Sprague**, M. Okumura, D.B. Milligan, W.J. Bloss, S.P. Sander, P.T. Martien, R.A. Harley, A.B. McCoy, and W.P.L. Carter, "Rate of gas phase association of hydroxyl radical and nitrogen dioxide," *Science* 330 (2010): 646–649, [doi:10.1126/science.1193030](https://doi.org/10.1126/science.1193030)
2. A.B. McCoy, **M.K. Sprague**, and M. Okumura, "The role of torsion/torsion coupling in the vibrational spectrum of cis-cis HOONO," *J. Phys. Chem. A*, 2010, 114 (3): 1324–1333, [doi:10.1021/jp905731h](https://doi.org/10.1021/jp905731h)

Published while at Caltech (research at Sandia National Labs)

1. P.M. Dentinger, B.A. Simmons, E. Cruz, and **M. Sprague** "DNA-mediated delivery of lipophilic molecules via hybridization to DNA-based vesicular aggregates," *Langmuir*, 2006, 22 (7), 2935–2937, [doi:10.1021/la053005o](https://doi.org/10.1021/la053005o)

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Selected Seminars and Presentations

- M.K. Sprague, K.K. Irikura, T.H. Bui, T.M. Mellen, "Effect of Internal Hydrogen Bond Formation on the Thermochemistry of Hydroxylated Criegee Intermediates," Gordon Research Conference: Atmospheric Chemistry – Poster Presentation, 28 Jul 2019
- M.K. Sprague, K.K. Irikura, T.H. Bui, T.M. Mellen, "Effect of Internal Hydrogen Bond Formation on the Predicted Thermochemistry of Hydroxylated Criegee Intermediates," American Chemical Society National Meeting – Poster Presentation, 23 Aug 2017
- M.K. Sprague, "Quantum chemistry and thermochemistry of atmospherically important reactions," Ithaca College Physics Colloquium – Invited Talk, 26 March 2014
- M.K. Sprague, K.K. Irikura, "Effect of internal hydrogen bond formation on the predicted thermochemistry and vibrational spectroscopy of hydroxylated Criegee intermediates," 61st Pacific Conference on Spectroscopy and Dynamics, 1 February 2014
- M.K. Sprague, "Introduction to computational chemistry," NIST Postdoctoral Association Tool Talk, 17 September 2013
- M.K. Sprague, K.K. Irikura, "Does HO₂ self-combination affect laboratory studies? – Thermochemistry of HO₂ dimerization," Gordon Research Conference: Atmospheric Chemistry, 31 July 2013
- M.K. Sprague, "Cavity ringdown spectroscopy, kinetics, and quantum chemistry of atmospherically relevant reactions," California Institute of Technology Ph.D. Thesis and Seminar, 18 May 2012
- M.K. Sprague, "The ν_1 and A-X cavity ringdown spectra, and relative kinetics of alkoxy isomerization," Jet Propulsion Laboratory Chemical Kinetics Group – Invited Talk, 14 November 2011
- M.K. Sprague, M. Okumura, S.P. Sander, "Cavity ringdown spectroscopy and kinetics of HO₂ + formaldehyde: Detection of ν_1 and A-X of HOCH₂OO," 31st International Symposium on Free Radicals, 27 July 2011
- M.K. Sprague, M. Okumura, S.P. Sander, "Cavity ringdown spectroscopy and kinetics of butoxy isomerization: Detection of the A-X Band of HOC₄H₈OO," 66th International Symposium on Molecular Spectroscopy, 21 June 2011
- M.K. Sprague, M. Okumura, S.P. Sander, Cavity ringdown spectroscopy and kinetics of HO₂ + formaldehyde: Detection of ν_1 and A-X of HOCH₂OO," 66th International Symposium on Molecular Spectroscopy, 21 June 2011
- M.K. Sprague, "Cavity ringdown spectroscopy and chemical kinetics of HO₂ + HCHO," Jet Propulsion Laboratory Chemical Kinetics Group – Invited Talk, 20 July 2009
- M.K. Sprague, A.B. McCoy, A.K. Mollner, M. Okumura, "Modeling the torsion-stretch coupling in the OH Spectrum of cis-cis HOONO using a three dimensional potential surface," American Chemical Society National Meeting – Poster Presentation, 9 April 2008
- M.K. Sprague, A.S. Larsen, "Unified molecular orbital images for the chemistry classroom," American Chemical Society National Meeting – Poster Presentation, 8 April 2008
- M.K. Sprague, "Measuring kinetics of atmospherically relevant reactions using cavity ringdown spectroscopy," Ithaca College Chemistry Seminar Series – Invited Talk, 26 February 2008
- M.K. Sprague, A.B. McCoy, A.K. Mollner, M. Okumura, "Modeling the torsion-stretch coupling in the OH Spectrum of cis-cis HOONO using a three dimensional potential surface," 62nd International Symposium on Molecular Spectroscopy, 18 June 2007
- V.F. DeTuri, M.K. Sprague, "Energetic and geometric insights of methoxide in methanol CH₃O⁻(CH₃OH)_n, for n = 1–20," American Chemical Society National Meeting – Poster Presentation, 16 March 2005
- M.K. Sprague, A.S. Larsen, "Unified molecular orbital images for the chemistry classroom," American Chemical Society National Meeting – Poster Presentation, 14 March 2005