

Jinjun Liu, Ph.D.

Associate Professor

Department of Chemistry, University of Louisville

2320 S. Brook St.
Louisville, KY 40292

Email: j.liu@louisville.edu

Web: <https://sites.google.com/site/uoflaserlabs/home>

Phone: (502) 852-1223

Fax: (502) 852-8149

Education and Training:

East China Normal University	Physics	B.S.	1999
The Ohio State University	Chemical Physics	Ph.D.	2007
Swiss Federal Institute of Technology (ETH) Zurich	Postdoctoral Researcher		2007-2010
The Ohio State University	Postdoctoral Researcher		2010-2011

Appointments:

Department of Chemistry, University of Louisville	Assistant Professor	2012-2017
Conn Center for Renewable Energy Research	Spectroscopy Theme Leader	2012-present
Department of Chemistry, University of Louisville	Associate Professor	2017-present
Department of Physics, University of Louisville	Adjunct Professor	2020-present

Research Interests:

- High-resolution laser spectroscopy of gas-phase reaction intermediates with significance in combustion, atmospheric chemistry, and astrochemistry.
- Spectroscopic and dynamic studies of vibronic interactions around conical intersections, especially in Jahn-Teller- and pseudo-Jahn-Teller-active free radicals.
- Precision spectroscopy of few-electron molecules and frequency metrology for fundamental physics.
- Energy and charge transfer processes in solar-cell materials studied by ultrafast laser spectroscopy techniques.

Selected Awards:

- Fundamental Physics Innovation Award, Gordon and Betty Moore Foundation and American Physical Society, 2018.
- Flygare Award, International Symposium on Molecular Spectroscopy, 2017.
- National Science Foundation CAREER Award, 2015.

Funding:

- "High-Resolution Laser Spectroscopy of Trace Gases in the Lower Atmosphere of Venus in Support of NASA's Exploration Missions", NASA-Kentucky, Research Initiation Award, RIA-20-049, \$57,680, 01/01/2021-12/31/2021, PI.
- "High-Resolution Molecular Spectroscopy on Multiple Potential Energy Surfaces using Cavity-Ring-Down-Based Two-Photon Techniques", NSF, CHE-1955310, \$524,041, 09/01/2020-08/31/2023, PI.
- "High-Precision Laser-Spectroscopy Investigation of Polyatomic Molecules as Candidates for Detection of Time-Reversal Symmetry Violation" Gordon and Betty Moore Foundation, Fundamental Physics Innovation Award, \$3,427, PI.
- "International Supplement: High Resolution Cavity Ring-down Spectroscopy of Jet-Cooled Hydroperoxyalkyl Radicals", NSF, CHE-641016, \$58,520, 08/01/2016-07/31/2020, PI.
- "Laser Spectroscopic Investigation of Vibronic Interactions in Free Radicals and Molecular Complexes", NSF - CAREER, CHE-1454825, \$435,542, 08/01/2015-07/31/2020, PI.
- "Looking for Molecular Funnels: Spectroscopy and Dynamics Beyond the Born-Oppenheimer Approximation", Kentucky Science and Engineering Foundation (KSEF) - The Research and Development Excellence Program (RDE), KSEF-3244-RDE-018, \$30,000, 07/01/2015-06/30/2016, PI.

- 7) "Spectroscopic Investigation of Vibronic Interactions in Molecules with Low Symmetry", American Chemical Society Petroleum Research Fund (ACS-PRF) - Doctoral New Investigator Program, 53476-DNI6, \$100,000, 09/01/2013-08/31/2015, PI.
- 8) "Nanoscale Materials and Architectures for Energy Conversion", DOE - EPSCoR, DE-FG02-07ER46375, \$1,350,000, 07/2011-06/2014, co-PI.
- 9) "Molecular Identification by High-Resolution Infrared Spectroscopy", Agilent Technologies Foundation - Applications and Core Technology University Research Grant (ACT-UR), \$50,000, 2011, co-PI.

Publications: (*corresponding author)

-- Peer-Reviewed Articles after Joining UofL Faculty --

- 1) "A computational and laser-spectroscopic investigation of lowest electronic states of the I_2^+ cation as a candidate for detecting the time variation of fundamental constants", *Phys. Rev. A*. Z. Wang, Q. Cui, X. He, D. Lu, X. Qiu, Q. He, Y. Lai, C. Li, * **J. Liu*** (under revision).
- 2) "Rotational and fine structure of open-shell molecules in nearly degenerate electronic states. II. Interpretation of experimentally determined interstate coupling parameters of alkoxy radicals", Y. Yan, K. Sharma, T. A. Miller, * **J. Liu**, * *J. Chem. Phys.* (accepted).
- 3) "Aligning an optical cavity: with reference to cavity ring-down spectroscopy", H. Telfah, A. C. Paul, **J. Liu**, * *Appl. Opt.* **59**, 9464-9468 (2020).
- 4) "An electro-active interface for enabling spectroelectrochemical investigations in evanescent-wave cavity-ring-down spectroscopy", S. A. Alnaanah, T. J. Roussel, J. H. Ghithan, A. Qatamin, M. A. Irziqat, H. Telfah, **J. Liu**, and S. B. Mendes, * *Anal. Chem.* **92**, 11288-11296 (2020).
- 5) "Revealing long-range substituent effects in the laser-induced fluorescence and dispersed fluorescence spectra of jet-cooled $CH_xF_{3-x}CH_2O$ ($x=1,2,3$) radicals", B. Koncz, G. Bázsó, Md A. Reza, H. Telfah, K. Hegedus, **J. Liu**, * G. Tarczay, * B. Koncz, G. Bázsó, Md A. Reza, H. Telfah, K. Hegedus, **J. Liu**, * G. Tarczay, * *J. Phys. Chem. A* **123**, 51, 10947-10960 (2019).
- 6) "Laser-induced fluorescence and dispersed fluorescence spectroscopy of jet-cooled isopentoxy radicals", Md. A. Reza, A. C. Paul, N. Reilly, and **J. Liu**, * *J. Phys. Chem. A* **123**, 8441-8447 (2019).
- 7) "Laser-induced fluorescence and dispersed-fluorescence spectroscopy of the $\tilde{A}^2E \leftarrow \tilde{X}^2A_1$ transition of jet-cooled calcium methoxide ($CaOCH_3$) radicals", A. C. Paul, K. Sharma, Md. A. Reza, H. Telfah, T. A. Miller, * and **J. Liu**, * *J. Chem. Phys.* **151**, 134303 (15 pages) (2019).
- 8) "Room-temperature cavity ring-down spectroscopy of methyl-allyl peroxy radicals", Md. A. Reza, H. Telfah, R. Xu, and **J. Liu**, * *J. Phys. Chem. A* **123**, 3510-3517 (2019).
- 9) "Organic polymer with dual chromophores and fast charge transfer properties for sustainable photocatalysis", J. D. Smith, A. M. Jamhawi, J. Jasinski, F. Gallou, **J. Liu**, and S. Handa, * *Nat. Commun.* **10**, 1837 (16 pages) (2019).
- 10) "Extensive high-resolution photoassociation spectra and perturbation analysis of $2(0^-)$ long-range state of ultracold RbCs molecules", D. Su, T. Gong, Z. Ji, Y. Yang, Y. Zhao, * L. Xiao, S. Jia, C. Li, * and **J. Liu**, * *Phys. Rev. A* **99**, 042513 (8 pages) (2019).
- 11) "Direct observation of tetrahydrofuran-yl and tetrahydropyran-yl peroxy radicals via cavity ring-down spectroscopy", H. Telfah, Md. A. Reza, J. Alam, and **J. Liu**, * *J. Phys. Chem. Lett.* **9**, 4475-4480 (2018).
- 12) "Candidates for direct laser cooling of diatomic molecules with the $^1\Sigma^+ \leftarrow ^1\Sigma^+$ electronic transition system", C. Li, * Y. Li, Z. Ji, X. Qiu, Y. Lai, J. Wei, Y. Zhao, * L. Deng, Y. Chen, and **J. Liu**, * *Phys. Rev. A* **97**, 062501 (9 pages) (2018).
- 13) "Rotational and fine structure of open-shell molecules in nearly degenerate electronic states", **J. Liu**, * *J. Chem. Phys.* **148**, 124112 (16 pages) (2018).
- 14) "Ultrafast exciton dynamics in shape-controlled methylammonium lead bromide Perovskite nanostructures: Effect of quantum confinement on charge carrier recombination", H. Telfah, A.

- Jamhawi, M. B. Teunis, R. Sardar, and **J. Liu**,* *J. Phys. Chem. C* **121**, 28556-28565 (2017).
- 15) “Dispersed-fluorescence spectroscopy of jet-cooled calcium ethoxide radical (CaOC_2H_5)”, A. C. Paul, Md. A. Reza, and **J. Liu**,* *J. Mol. Spectrosc.* **330**, 142-146 (2016).
 - 16) “Dispersed fluorescence spectroscopy of jet-cooled iso-butoxy and 2-methyl-1-butoxy radicals”, Md. A. Reza, J. Alam, N. J. Reilly, and **J. Liu**,* *J. Phys. Chem. A* **120**, 6761-6767 (2016).
 - 17) “Laser-induced fluorescence spectroscopy of jet-cooled t-butoxy”, **J. Liu**,* N. J. Reilly, A. Mason, and T. A. Miller, *J. Phys. Chem. A* **119**, 11804-11812 (2015).
 - 18) “Dispersed fluorescence spectroscopy of jet-cooled 2-, 3-, and 4-methylcyclohexoxy radicals”, J. Alam, Md. A. Reza, A. Mason, N. J. Reilly, and **J. Liu**,* *J. Phys. Chem. A* **119**, 6257-6268 (2015).
 - 19) “Ultrafast charge carrier relaxation and charge transfer processes in CdS/CdTe thin Films”, B. Pandit, R. Dharmadasa, I. M. Dharmadasa, T. Druffel, and **J. Liu**,* *Phys. Chem. Chem. Phys.* **17**, 16760-16766 (2015).
 - 20) “Molecule-like CdSe nanoclusters passivated with strongly interacting ligands: Energy level alignment and photoinduced ultrafast charge transfer processes”, Y. Xie, M. B. Teunis, B. Pandit, R. Sardar,* and **J. Liu**,* *J. Phys. Chem. C* **119**, 2813-2821 (2015).
 - 21) “A DGFETD port formulation for photoconductive antenna analysis”, J. C. Young,* D. Boyd, S. D. Gedney, T. Suzuki, and **J. Liu**, *IEEE Antenn. Wirl. Pr.* **14**, 386-389 (2015).
 - 22) “Jet-cooled laser-induced fluorescence spectroscopy of cyclohexoxy: Rotational and fine structure of molecules in nearly degenerate electronic states”, **J. Liu** and T. A. Miller,* *J. Phys. Chem. A* **118**, 11871-11890 (2014).
 - 23) “Jet-cooled laser-induced fluorescence spectroscopy of isopropoxy radical: Vibronic analysis of $\tilde{B} \leftarrow \tilde{X}$ and $\tilde{B} \leftarrow \tilde{A}$ band systems”, R. Chhantyal-Pun, M. Roudjane, D. Melnik, T. A. Miller,* and **J. Liu**, *J. Phys. Chem. A* **118**, 11852-11870 (2014).
 - 24) “High-resolution spectroscopy and quantum-defect model for the gerade triplet np and nf Rydberg states of He_2 ”, D. Sprecher, **J. Liu**, T. Krähenmann, M. Schäfer, and F. Merkt,* *J. Chem. Phys.* **140**, 064304 (16 pages) (2014).
 - 25) “Charge transfer in rare earth oxide hybrid solar cells”, K. Fernando, B. Pandit, **J. Liu**, and B. W. Alphenaar,* *Chem. Phys. Lett.* **592**, 155-159 (2014).
 - 26) “Spectroscopic investigation of photoinduced charge transfer processes in FTO/ TiO_2 /N719 photoanodes with and without covalent attachment through silane-based linkers”, B. Pandit, T. Luitel, D. Cummins, A. K. Thapa, T. Druffel, F. Zamborini, and **J. Liu**,* *J. Phys. Chem. A* **117**, 13513-13523 (2013).
 - 27) “Rotationally resolved $\tilde{B} \leftarrow \tilde{X}$ electronic spectra of the isopropoxy radical: A comparative study”, **J. Liu**,* D. Melnik, and T. A. Miller,* *J. Chem. Phys.* **139**, 094308 (27 pages) (2013).

-- Peer-Reviewed Articles prior to UofL --

- 28) “The spectroscopic characterization of the methoxy radical. III. Rotationally resolved $\tilde{A}^2A_1 \leftarrow \tilde{X}^2E$ electronic and \tilde{X}^2E submillimeter wave spectra of partially deuterated CH_2DO and CHD_2O radical”, D. G. Melnik, **J. Liu**, M.-W. Chen, T. A. Miller,* and R. F. Curl, *J. Chem. Phys.* **135**, 094310 (2011).
- 29) “The ionization and dissociation energies of HD”, D. Sprecher, **J. Liu**, Ch. Jungen, W. Ubachs, and F. Merkt,* *J. Chem. Phys.* **133**, 111102 (2010). (“Editors’ Choice for 2010” by the Journal of Chemical Physics.)
- 30) “Vibrational spectra of chloroform, Freon-11 and selected isotopomers in the terahertz region”, Ch. Haase, **J. Liu**, and F. Merkt,* *J. Mol. Spectrosc.* **262**, 61 (2010).
- 31) “Determination of the ionization and dissociation energies of the deuterium molecule (D_2)”, **J. Liu**, D. Sprecher, Ch. Jungen, W. Ubachs, and F. Merkt,* *J. Chem. Phys.* **132**, 154301 (2010).
- 32) “Generation of widely tunable Fourier-transform-limited terahertz pulses using narrowband near-infrared laser radiation”, **J. Liu**, H. Schmutz, and F. Merkt,* *J. Mol. Spectrosc.* **256**, 111 (2009).

- 33) “Determination of the ionization and dissociation energies of the hydrogen molecule”, **J. Liu**, E. J. Salumbides, U. Hollenstein, J. C. J. Koelemeij, K. S. E. Eikema, W. Ubachs, and F. Merkt,* *J. Chem. Phys.* **130**, 174306 (2009).
- 34) “The spectroscopic characterization of the methoxy radical. II. Rotationally resolved $\tilde{A}^2A_1 \leftarrow \tilde{X}^2E$ electronic and \tilde{X}^2E microwave spectra of the perdeuteromethoxy radical CD_3O ”, **J. Liu**, M.-W. Chen, D. Melnik, T. A. Miller,* Y. Endo, and E. Hirota, *J. Chem. Phys.* **130**, 074303 (2009).
- 35) “The spectroscopic characterization of the methoxy radical. I. Rotationally resolved $\tilde{A}^2A_1 \leftarrow \tilde{X}^2E$ electronic spectra of CH_3O ”, **J. Liu**, M.-W. Chen, D. Melnik, J. T. Yi, and T. A. Miller,* *J. Chem. Phys.* **130**, 074302 (2009).
- 36) “Nuclear-spin effects in the photoionization of krypton”, Th. A. Paul, **J. Liu**, and F. Merkt,* *Phys. Rev. A* **79**, 022505 (2009).
- 37) “Generation of tunable Fourier-transform-limited terahertz pulses in 4-*N,N*-dimethylamino-4'-*N*-methyl stilbazolium tosylate crystals”, **J. Liu** and F. Merkt,* *Appl. Phys. Lett.* **93**, 131105 (2008).
- 38) “Development of the Hamiltonian and matrix elements for partially deuterated methoxy radical”, D. Melnik, **J. Liu**, R. F. Curl, and T. A. Miller,* *Mol. Phys.* **105**, 529 (2007).
- 39) “High-resolution spectra and conformational analysis of 2-butoxy radical”, V. L. Stakhursky, L. Zu, **J. Liu**, and T. A. Miller,* *J. Chem. Phys.* **125**, 094316 (2006).
- 40) “Jet-cooled laser spectroscopy of the cyclohexoxy radical”, L. Zu, **J. Liu**, G. Tarczay, P. Dupré, and T. A. Miller,* *J. Chem. Phys.* **120**, 10579 (2004).
- 41) “The rotationally resolved electronic spectra of several conformers of 1-Hexoxy and 1-Heptoxy”, L. Zu, **J. Liu**, S. Gopalakrishnan, and T. A. Miller,* *Can. J. Chem.* **82**, 854 (2004).
- 42) “Band (5, 0) in the red system $\tilde{A}^2\Pi_i \leftarrow \tilde{X}^2\Sigma^+$ of CN studied by optical heterodyne magnetic rotation enhanced concentration modulation spectroscopy”, C. Xu, L. Wu, **J. Liu**, S. Wu, C. Duan, Y. Chen, and Y. Liu,* *Chinese. Phys. Lett.* **19**, 1277 (2002).
- 43) “Velocity modulation laser absorption spectroscopy of the $\tilde{A}^2\Pi_i \leftarrow \tilde{X}^2\Sigma^+$ transition of the CS^+ cation”, Y. Liu,* C. Duan, **J. Liu**, L. Wu, C. Xu, Y. Chen, P. A. Hamilton, and P. B. Davies, *J. Chem. Phys.* **116**, 9768 (2002).

-- Conference Proceeding --

- 1) “Determination of the ionization and dissociation energies of H_2 and He_2 ”, **J. Liu**,* D. Sprecher, F. Merkt, E. J. Salumbides, and W. Ubachs, *AIP Conf. Proc.* **1504**, 495 (2012).

Presentations:

-- Invited Conference Talks/Public Lectures --

- 1) 25th International Symposium on the Jahn-Teller Effect (2020 – postponed).
- 2) Telluride Science Research Workshop on “Spectroscopy and Dynamics on Multiple Potential Energy Surfaces” (2020 – postponed).
- 3) “Cavity ring-down spectroscopy of free radicals”, in the 70th Southeastern Regional Meeting of the American Chemical Society (2018).
- 4) “High-resolution laser spectroscopy of free radicals in nearly degenerated states”, in the 72nd International Symposium on Molecular Spectroscopy (2017).
- 5) “Laser spectroscopy: A powerful tool for energy research”, in Telluride Science Research Workshop on “Spectroscopy and Dynamics on Multiple Potential Energy Surfaces” (2016).
- 6) “Precision determination of the ionization and dissociation energies of H_2 , HD, and D_2 ”, in Symposium on Precision Measurement Physics with Atoms and Molecules, by the Chinese Academy of Sciences (CAS, 2015).
- 7) “Rotational and fine structure of molecules in nearly degenerate electronic states”, in Telluride Science Research Workshop on “Spectroscopy and Dynamics on Multiple Potential Energy Surfaces” (2014).

- 8) “The methoxy radical - or what in the world are molecular spectroscopists doing in the lab, on the scratch paper, and in front of their computers?”, in *Engineering Platforms for Exploring Cellular and Molecular Processes* at the University of Louisville (2012).
- 9) “Determination of the ionization and dissociation energies of H₂ and He₂”, in the 7th *International Conference of Computational Methods in Sciences and Engineering* (ICCMSE 2009).

-- Invited Seminars at Peer Institutes --

- | | |
|---|---|
| 1) Case Western Reserve University (2020) | 10) University of Missouri (2017) |
| 2) Missouri University of Science and Technology (2019) | 11) Eastern Kentucky University (2016) |
| 3) Murray State University (2019) | 12) Syracuse University (2016) |
| 4) Argonne National Laboratory (2019) | 13) Oak Ridge National Laboratory (2016) |
| 5) University of California Santa Barbara (2019) | 14) University of New Brunswick (2015) |
| 6) Southern Illinois University (2019) | 15) Western Kentucky University (2015) |
| 7) California Institute of Technology (2018) | 16) Southern Methodist University (2015) |
| 8) University of Cincinnati (2018) | 17) University of Kentucky (2012) |
| 9) Johns Hopkins University (2018) | 18) University of Connecticut, <i>Atomic, Molecular, and Optical Physics Seminar</i> (2011) |

-- Other Conference Talks/Presentations --

Over 100 conference talks and posters. List available upon request.

Educational Activities:

i. Teaching:

(All course materials available on group webpage.)

Chem 465: “Physical Chemistry I” (Fall, 2019-2020).

Chem 470: “Physical Chemistry Laboratories” (Spring, 2012-2019).

Chem 661: “Thermodynamics, Statistical Thermodynamics, and Kinetics” (Fall, 2013, 2015, 2017).

Chem 665: “Special Topics in Physical Chemistry: Molecular Spectroscopy” (Spring, 2015).

Chem 672: “Quantum Chemistry” (Fall, 2014, 2016).

Chem 698: Student Seminars (Spring, 2016).

Advanced Molecular Spectroscopy, at the University of Science and Technology of China (Summer, 2017).

ii. Mentoring:

(a) Three (3) postdoctoral researchers:

Bill Pandit (08/2012-04/2014, now at Ultrafast Systems)

Neil Reilly (11/2012-06/2014, now Assistant Professor at U. Mass. Boston)

Hamzeh Telfah (01/2020-present)

(b) Seven (7) Ph.D. students. One (1) M.S. student.

(c) Fourteen (14) undergraduate research students and one (1) Research Experiences for Undergraduates (REU) student.

(d) One (1) high-school student for the Louisville Regional Science Fair.

Synergistic Activities:

i. Member of the Editorial Board: *J. Mol. Spectrosc.*

ii. Co-Chair: *International Free Radical Symposium* (2023).

iii. Mini-symposium organizer for *International Symposium on Molecular Spectroscopy* (2017).

iv. Session Chair: *International Symposium on Molecular Spectroscopy* (2007, 2009, 2012, 2017, 2019).

v. Proposal reviews: ACS Petroleum Research Fund, Department of Energy, National Science Foundation, Polish National Science Foundation, Swiss National Science Foundation.

- vi. Journal reviews: *Appl. Spectrosc.*, *Chem. Phys.*, *Chem. Phys. Lett.*, *Chem. Sci.*, *J. Am. Chem. Soc.*, *J. Chem. Phys.*, *J. Lumin.*, *J. Mol. Spectrosc.*, *J. Phys. Chem.*, *Mol. Phys.*, *Methods Appl. Fluoresc.*, *Nanoscale*, *Mol. Phys.*, *Phys. Chem. Chem. Phys.*, *Spectrochim. Acta A*, *Spectrosc. Lett.*
- vii. Book reviews: *Cambridge University Press*.
- viii. Judge: Miller Prize, *International Symposium on Molecular Spectroscopy* (2014, 2015, 2016 (as Chair), 2017, 2018).
- ix. Judge: *Louisville Regional Science Fair* (2018).
- x. Industrial partnership: Agilent Technologies, Toptica Photonics.
- xi. Memberships: American Chemical Society, American Physical Society.