

James D. Gaynor

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EXPERIENCE

- June 2023- **Assistant Professor** | Chemistry Department, Northwestern University
- 2020-2023 **Arnold O. Beckman Postdoctoral Scholar** |
groups of Prof. Stephen R. Leone and Prof. Daniel M. Neumark, University of
California, Berkeley
- 2014-2019 **Doctoral Student** | group of Prof. Munira Khalil, University of Washington

EDUCATION

Ph.D. Chemistry, University of Washington, Seattle, WA., USA, 2019

Advisor: Professor Munira Khalil, Department of Chemistry

Dissertation Title: “Correlated Electronic and Vibrational Motion: A Direct Perspective
Through Multidimensional Electronic-Vibrational Spectroscopy”

Research Summary:

Developed two-dimensional electronic-vibrational (2D EV) spectroscopy using femtosecond broadband UV pump and mid-IR probe pulses; proved that 2D EV spectroscopy and two-dimensional vibrational-electronic (2D VE) spectroscopy directly measure molecular vibronic couplings using a vibronic Hamiltonian, nonlinear response theory, and simulations; discovered excited state intramolecular vibronic couplings and coherences which facilitate photo-excited energy transfer during intersystem crossing and nonadiabatic internal conversion in a solar cell photosensitizing dye molecule.

M.Sc. Chemistry, University of Washington, Seattle, WA., USA, 2016

B.Sc. Chemistry, University of Portland, Portland, OR., USA, 2014

Advisor: Professor Steven G. Mayer, Department of Chemistry

Graduated with Honors and High Distinction; Minors in Physics and Mathematics

HONORS AND AWARDS

- 2021 ACS Physical Chemistry Division Young Investigator Award
- 2020-2023 Arnold O. Beckman Postdoctoral Fellow
- 2020 Schmidt Science Fellowship Finalist (declined)
- 2020 Carl E. Anderson Division of Laser Science Dissertation Award, APS
- 2014-2019 National Science Foundation Graduate Research Fellow
- 2018 Emil Wolf Outstanding Paper, OSA Frontiers in Optics + Laser Science
- 2017 Time Resolved Vibrational Spectroscopy Meeting, PCCP Best Student Poster Prize
- 2017 Norman and Lillian Gregory Fellowship, University of Washington
- 2016 Siegmán International School on Lasers 2nd Place Research Presentation
- 2014-2016 Clean Energy Institute Fellow, University of Washington

2014–2015	Outstanding Teaching Assistant Award, University of Washington
2013	Barry M. Goldwater Scholar
2013–2015	Great Lakes Science, Technology, Engineering, and Mathematics Scholar
2012–2014	Environmental Protection Agency Greater Research Opportunity Fellow
2012–2014	University of Portland Academic Scholarship
2011	US Dept. of Energy SULI 2 nd Place Research Presentation

GRANTS

2020	Arnold O. Beckman Postdoctoral Fellowship
2019	Faraday Discussion Travel Grant, U.S. Dept. of Energy
2018	Clean Energy Institute Travel Grant, University of Washington
2017	University of Washington Graduate School Travel Grant
2016	Siegman International School on Lasers Grant, Optical Society of America

PEER-REVIEWED PUBLICATIONS

Journal Articles

29. **Gaynor, J.D.**; Fidler, A.P.; Kobayashi, Y.; Lin, Y.-C.; Keenan, C.L.; Neumark, D.M.; Leone, S.R.; “Non-resonant Coherent Amplitude Transfer in Attosecond Four-Wave Mixing Spectroscopy” *Physical Review A* (2023) (*accepted*).
28. Puskar, N.G.; Lin, Y.-C.; **Gaynor, J.D.**; Keenan, C.L.; Neumark, D.M.; Leone, S.R.; “Measuring Autoionization Decay Lifetimes of Optically Forbidden Inner Valence Excited States in Neon Atoms with Attosecond Noncollinear Four Wave Mixing Spectroscopy” *Physical Review A* (2023) (*in review*).
27. Fidler, A.P.; Lin, Y.-C.; **Gaynor, J.D.**; McCurdy, C.W.; Leone, S.R.; Lucchese, R.R.; Neumark, D.M.; “State-Selective Probing of CO₂ Autoionizing Inner Valence Rydberg States with Attosecond Extreme Ultraviolet Four-Wave Mixing Spectroscopy” *Physical Review A* (2022) 106, 063525. ([10.1103/PhysRevA.106.063525](https://doi.org/10.1103/PhysRevA.106.063525))
26. Liekhus-Schmaltz, C.; Fox, Z.W.; Andersen, A.; Kjaer, K.S.; Alonso-Mori, R.; Biasin, E.; Carlstad, J.; Chollet, M.; **Gaynor, J.D.**; Glowina, J.; Hong, K.; Kroll, T.; Lee, J.H.; Poulter, B.I.; Reinhard, M.; Sokaras, D.; Zhang, Y.; Doumy, G.; March, A.M.; Southworth, S.H.; Mukamel, S.; Cordones-Hahn, A.; Schoenlein, R.; Govind, N.; Khalil, M.; “Femtosecond X-ray Spectroscopy Directly Quantifies Transient Excited State Mixed Valency” *Journal of Physical Chemistry Letters* (2022) 13, 378–386 ([10.1021/acs.jpclett.1c03613](https://doi.org/10.1021/acs.jpclett.1c03613))
25. **Gaynor, J.D.**; Fidler, A.P.; Lin, Y.-C.; Chang, H.-T.; Zuerch, M.; Neumark, D.M.; Leone, S.R.; “Solid-State Core-Exciton Dynamics in NaCl Observed by Tabletop Attosecond Four-Wave Mixing” *Physical Review B* (2021) 103, 245140 ([PhysRevB.103.245140](https://doi.org/10.1103/PhysRevB.103.245140))
24. **Gaynor, J.D.**; Weakly, R.B.; Khalil, M.; “Multimode Two-Dimensional Vibronic Spectroscopy I: Orientational Response and Polarization Selectivity” *Journal of Chemical Physics* (2021) 154, 184201. ([10.1063/5.0047724](https://doi.org/10.1063/5.0047724))
23. Weakly, R.B.; **Gaynor, J.D.**; Khalil, M.; “Multimode Two-Dimensional Vibronic Spectroscopy II: Simulating and Extracting Vibronic Coupling Parameters from

Polarization-Selective Spectra" *Journal of Chemical Physics* (2021) 154, 184202.
([10.1063/5.0047727](https://doi.org/10.1063/5.0047727))

22. Biasin, E.; Fox, Z.W.; Andersen, A.; Ledbetter, K.; Kjaer, K.S.; Alonso-Mori, R.; Carlstad, J.; Chollet, M.; **Gaynor, J.D.**; Glowina, J.; Hong, K.; Kroll, T.; Lee, J.H.; Liekhus-Schmaltz, C.; Rienhard, M.; Sokaras, D.; Zhang, Y.; Doumy, G.; March, A.M.; Southworth, S.H.; Mukamel, S.; Gaffney, K.; Schoenlein, R.; Govind, N.; Cordones-Hahn, A.; Khalil, M.; "Direct Observation of Coherent Femtosecond Solvent Reorganization Coupled to Intramolecular Electron Transfer" *Nature Chemistry*, (2021), 13, 343-349. ([10.1038/s41557-020-00629-3](https://doi.org/10.1038/s41557-020-00629-3))
21. **Gaynor, J.D.**; Sandwisch, J.; Khalil, M.; "Vibronic Coherence Evolution in Multidimensional Ultrafast Photochemical Processes" *Nature Communications*, (2019) 10, 1, 5621. ([10.1038/s41467-019-13503-9](https://doi.org/10.1038/s41467-019-13503-9))
20. Leger, J.D.; Friedfeld, M.; Beck, R.; **Gaynor, J.D.**; Petrone, A.; Li, X.; Cossairt, B.; Khalil, M. "Carboxylate Anchors Act as Exciton Reporters in 1.3 nm Indium Phosphide Nanoclusters" *Journal of Physical Chemistry Letters*, (2019) 10, 8, 1833-1839. ([10.1021/acs.jpcllett.9b00602](https://doi.org/10.1021/acs.jpcllett.9b00602))
19. **Gaynor, J.D.**; Petrone, A.; Li, X.; Khalil, M.; "Mapping Vibronic Couplings in a Solar Cell Dye with Polarization-Selective Two-Dimensional Electronic-Vibrational Spectroscopy" *Journal of Physical Chemistry Letters*, (2018) 9, 21, 6289-6295. ([10.1021/acs.jpcllett.8b02752](https://doi.org/10.1021/acs.jpcllett.8b02752))
18. **Gaynor, J.D.**; Khalil, M.; "Signatures of Vibronic Coupling in Two-Dimensional Electronic-Vibrational and Vibrational-Electronic Spectroscopies" *Journal of Chemical Physics*, (2017) 147, 9, 094202. ([10.1063/1.4991745](https://doi.org/10.1063/1.4991745))
**Journal of Chemical Physics* Editor's Choice 2017
17. **Gaynor, J.D.**; Weichman, M.L.; "Viewpoints on the 2017 Pacific Conference on Spectroscopy and Dynamics" *Journal of Physical Chemistry A*, (2017) 121, 2863-2867. ([10.1021/acs.jpca.7b02628](https://doi.org/10.1021/acs.jpca.7b02628))
16. **Gaynor, J.D.**; Courtney, T.L.; Balasubramanian, M.; Khalil, M. "Fourier Transform Two-Dimensional Electronic-Vibrational Spectroscopy using an Octave-Spanning Mid-IR Probe." *Optics Letters*, (2016) 41, 2895-2898. ([10.1364/OL.41.002895](https://doi.org/10.1364/OL.41.002895))
*Featured in OSA Spotlight.
15. Balasubramanian, M.; Courtney, T.L.; **Gaynor, J.D.**; Khalil, M. "Compression of Tunable Broadband Mid-IR Pulses with a Deformable Mirror Pulse Shaper." *The Journal of the Optical Society of America B*, (2016) 33, 2033-2037. ([10.1364/JOSAB.33.002033](https://doi.org/10.1364/JOSAB.33.002033))
14. **Gaynor, J.D.**; Wetterer, A.M.; Valente, E.J.; Mayer, S.G. "The ν_3 - ν_4 Difference Band Contribution to the CCl_4 Symmetric Stretch Mode." *Journal of Raman Spectroscopy*, (2015) 46, 189-193. ([10.1002/jrs.4625](https://doi.org/10.1002/jrs.4625))
13. **Gaynor, J.D.**; Wetterer, A.M.; Cochran, R.M.; Valente, E.J.; Mayer, S.G. "Vibrational Spectroscopy of the CCl_4 ν_1 Mode: Theoretical Prediction of Isotopic Effects." *Journal of Chemical Education*, (2015) 92, 1081-1085. ([10.1021/ed5004965](https://doi.org/10.1021/ed5004965))

12. **Gaynor, J.D.**; Wetterer, A.M.; Cochran, R.M.; Valente, E.J.; Mayer, S.G. "Vibrational Spectroscopy of the CCl₄ ν_1 Mode: Effect of Thermally Populated Vibrational States." *Journal of Chemical Education*, (2015) 92, 1949-1952. ([10.1021/acs.jchemed.5b00339](https://doi.org/10.1021/acs.jchemed.5b00339))
11. **Gaynor, J.D.**; Karakoti, A.S.; Inerbaev, T.; Sanghavi, S.; Nachimuthu, P.; Shutthanandan, V.; Seal, S.; and Thevuthasan, S. "Enzyme-free Detection of Hydrogen Peroxide using Cerium Oxide Nanoparticles." *Journal of Materials Chemistry B*, (2013) 1, 3443-3450. ([10.1039/C3TB20204F](https://doi.org/10.1039/C3TB20204F)) *featured cover image

Books and Book Chapters:

10. **Gaynor, J.D.** "Correlated Electronic and Vibrational Motion: A Direct Perspective Through Multidimensional Electronic-Vibrational Spectroscopy," University of Washington, Ph.D. Dissertation; 2019. ([PDF](#))

Conference Proceedings:

9. **Gaynor, J.D.**; Fidler, A. P.; Lin, Y.-C.; Puskar, N. G.; Neumark, D. M.; Leone, S. R.; "Dynamics via Attosecond Four-Wave Mixing" *International Conference on Attosecond Science and Technology* (2022).
8. **Gaynor, J.D.**; Sandwisch, J.W.; Khalil, M.; "Vibronic Coherence Evolution in Ultrafast Charge Transfer" *International Conference on Ultrafast Phenomena 2020, OSA Technical Digest (Optical Society of America)*. ([10.1364/UP.2020.Tu2A.3](https://doi.org/10.1364/UP.2020.Tu2A.3))
7. Sandwisch, J.W.; **Gaynor, J.D.**; Khalil, M.; "Implementation of Broadband near-UV Pump Pulses for Ultrafast 2D Electronic-Vibrational Spectroscopy" *International Conference on Ultrafast Phenomena 2020, OSA Technical Digest (Optical Society of America)*. ([10.1364/UP.2020.Tu2A.2](https://doi.org/10.1364/UP.2020.Tu2A.2))
6. Weakly, R.B.; **Gaynor, J.D.**; Khalil, M.; "A Theoretical Study of Polarization Selective Two-Dimensional Vibronic Spectroscopies of Multimode Systems" *International Conference on Ultrafast Phenomena 2020, OSA Technical Digest (Optical Society of America)*. ([10.1364/UP.2020.MB4.20](https://doi.org/10.1364/UP.2020.MB4.20))
5. **Gaynor, J.D.**; Khalil, M.; "Ultrafast Vibronic Phenomena Directly Revealed by Multidimensional Electronic-Vibrational Spectroscopy" *Frontiers in Optics + Laser Science 2020, OSA Technical Digest (Optical Society of America)*. ([10.1364/LS.2020.LM2F.2](https://doi.org/10.1364/LS.2020.LM2F.2))
4. **Gaynor, J.D.**; Leger, J.; Khalil, M.; "Generating Broadened UV Pulses for Ultrafast Nonlinear Experiments" *Frontiers in Optics + Laser Science 2018, OSA Technical Digest (Optical Society of America)*. ([10.1364/FIO.2018.JTu2A.8](https://doi.org/10.1364/FIO.2018.JTu2A.8))
3. **Gaynor, J.D.**; Courtney, T.L.; Balasubramanian, M.; Khalil, M. "Coherent Fourier Transform Two-Dimensional Electronic-Vibrational Spectroscopy using an Octave-Spanning Mid-IR Probe." *International Conference on Ultrafast Phenomena 2016, OSA Technical Digest (Optical Society of America)*. ([10.1364/UP.2016.UTu4A.7](https://doi.org/10.1364/UP.2016.UTu4A.7))

2. Fox, Z.W.; Cordones-Hahn, A.; Kjaer, K.S.; **Gaynor, J.D.**; Hong, K.; Lee, J.H.; Carlstad, J.; Reinhard, M.; Lee, S.; Alonso-Mori, R.; Chollet, M.; Kroll, T.; Glowina, J. M.; Kim, T.K.; Andersen, A.; Zhang, Y.; Mukamel, S.; Govind, N.; Schoenlein, R.W.; Khalil, M. "Monitoring Charge Transfer Excited States of Transition Metal Mixed Valence complexes with Femtosecond X-ray Absorption and Emission Spectroscopies" *International Conference on Ultrafast Phenomena 2016, OSA Technical Digest (Optical Society of America)*. ([10.1364/UP.2016.UTh4A.2](https://doi.org/10.1364/UP.2016.UTh4A.2))
1. Balasubramanian, M.; Courtney, T.L.; **Gaynor, J.D.**; Khalil, M. "Generation and Compression of Tunable Broadband Femtosecond Mid-IR Pulses for Nonlinear Spectroscopy" *International Conference on Ultrafast Phenomena 2016, OSA Technical Digest (Optical Society of America)*. ([10.1364/UP.2016.UW4A.37](https://doi.org/10.1364/UP.2016.UW4A.37))

PRESENTATIONS (* = invited)

Oral Presentations

14. *Frontiers in Optics + Laser Science 2022, Rochester, NY, October 2022
13. Gordon Research Conference – Multiphoton Processes, June 2022
12. *ACS Fall Meeting 2021, PHYS Young Investigator Award Talk
11. APS Division of Atomic, Molecular, and Optical Physics 2021 (virtual)
10. International Conference on Ultrafast Phenomena 2020, virtual symposium
9. *Frontiers in Optics + Laser Science 2020, virtual symposium
8. Frontiers in Optics + Laser Science 2018 (*rapid fire talk*), Washington, D.C., Sept. 2018
7. *Chemistry Dept. Seminar, University of Portland, Portland, OR, Sept. 2017
6. Pacific Conference on Spectroscopy and Dynamics, Asilomar, CA, January 2017
5. Murdock College Science Research Conference, Walla-Walla, WA, October 2012
4. *Physics Dept. Seminar Series, University of Portland, Portland, OR, October 2012
3. *User Executive Committee Meeting for the Environmental Molecular Sciences Laboratory, PNNL, Richland, WA, August 2012
2. Oregon Academy of Sciences, Beaverton, OR, February 2012
1. *EMSL Director's "Featured Undergraduate" Presentation, PNNL, July 2011

Posters

15. International Conference on Attosecond Science and Technology, July 2022
14. Gordon Research Seminar – Multiphoton Processes, June 2022
13. Arnold and Mabel Beckman Symposium, August 2021
12. Faraday Discussion: Ultrafast Photoinduced Energy and Charge Transfer, April 2019
11. Frontiers in Optics + Laser Science 2018, Washington, D.C., September 2018
10. Gordon Research Conference – Vibrational Spectroscopy, Biddeford, ME, July 2018
9. Gordon Research Seminar – Vibrational Spectroscopy, Biddeford, ME, July 2018
8. 9th Coherent Multidimensional Spectroscopy Meeting, Seoul, South Korea, June 2018
7. Time Resolved Vibrational Spectroscopy Meeting, Cambridge, England, July 2017
6. Siegman International School on Lasers (2nd place), Barcelona, Spain, July 2016
5. 20th International Conference on Ultrafast Phenomena, Santa Fe, NM, July 2016

4. 247th ACS National Meeting, Dallas, TX, March 2014
3. *ACS Linus Pauling Award Symposium, Portland, OR, October 2013
2. Council on Undergraduate Research "Posters on the Hill" Washington D.C., April 2012
1. Dept. of Energy SULI Conference (2nd place), PNNL, Richland, WA, July 2011

PROFESSIONAL SERVICE / LEADERSHIP

2021-2023	Member, Diversity, Equity & Inclusion Committee, Chemical Sciences Division at Lawrence Berkeley National Laboratory
2017-2018	Co-Chair, 2018 Gordon Research Seminar on Vibrational Spectroscopy
2016-2019	Co-Chair, Chemistry Colloquium Committee, University of Washington
2016-2019	Vice-President, Optical Society of America Chapter, University of Washington

PROFESSIONAL MEMBERSHIPS

2016-Present	Optical Society of America (Member)
2011-Present	American Chemical Society (Member)
2019-Present	Royal Society of Chemistry (Member)
2020-Present	American Physical Society (Member)

TEACHING EXPERIENCE / COURSES TAUGHT

2014-2015	<i>Teaching Assistant, University of Washington</i>
Courses:	General Chemistry I / II, Principles of Chemistry (non-majors).
2012-2014	<i>Teaching Assistant, University of Portland</i>
Courses:	Physical Chemistry Lab I / II, General Chemistry I / II

MENTORSHIP

Students to whom I have provided academic mentorship during the years indicated:

Graduate Students

2023-	Gerrit Christenson, Chemistry Dept. Northwestern University
2020-2023	Yen-Cheng Lin, Chemistry Dept., University of California, Berkeley
2020-2023	Nicolette Puskar, Chemistry Dept., University of California, Berkeley
2018-2019	Jason W. Sandwisch, Chemistry Dept., University of Washington
2018-2019	Dr. Robert B. Weakly, Chemistry Dept., University of Washington

Undergraduate Research Students

2020-2022	Ruoyi Yin, Physics Major, University of California, Berkeley
2016-2017	Cindy Tseng, Biochemistry Major, University of Washington
2016-2017	Puja Das, Chemistry Major, University of Washington