Darien J. Morrow

Scientific Software Developer at Emerald Cloud Lab
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I build computationally reproducible acquisition, analysis, simulation, and representation pipelines.
I am interested in spectroscopy, nonlinear optics, lasers, magnetic resonance, and algorithm development.

EDUCATION

University of Wisconsin–Madison 2015 - 2020
PhD: Physical Chemistry. GPA: 4.0/4.0 Madison, WI

- Dissertation title: Development of multidimensional spectroscopies to investigate transition metal dichalcogenide and lead halide perovskite semiconductors
- Adviser: John C. Wright.

Missouri Western State University 2011-2015
BS (Honors): Chemistry; Minors: Mathematics & Physics. GPA: 4.0/4.0 Saint Joseph, MO

RESEARCH & WORK EXPERIENCE

Emerald Cloud Lab 2023 - Present
Scientific Software Developer

- Empowering end-to-end remote life-science research

Center for Nanoscale Materials at Argonne National Laboratory 2020 - 2022
Postdoctoral Appointee supervised by Xuedan Ma Lemont, IL

- Researching doped low-dimensional materials as RF to NIR transducers for Quantum Information Science.
- Building a cryogenic, paramagnetic spin resonance microscope.
- Modeling nanolasers, noise sources & transients in single-photon detectors, exciton trapping, and RF antennas

John C. Wright Research Group 2015 - 2020
Graduate Assistant Madison, WI

- Pioneered spectrally resolved harmonic generation as a probe of semiconductor excited state dynamics
- Developed a suite of ultrafast techniques to explore excited state dynamics of thin film semiconductors relevant to photovoltaics (lead halide perovskites and transition metal dichalcogenides)
- Developed open-source software packages for the collection, processing, and modeling of multidimensional spectra (see `github.com/wright-group`)
- Responsible for maintenance and furtherance of custom ultrafast laser systems including construction of new optomechanical & electronic hardware, training new users, and troubleshooting hardware & software

Christopher G. Elles Research Group 2014
REU Fellow Lawrence, KS

- Investigated the excited state dynamics of substituted thiophene photo-rearrangement reactions
- Developed and implemented reaction quantum yield measurement technique
- Used ultrafast transient absorption spectroscopy to probe singlet and triplet excited state manifolds

Michael W. Ducey Research Group 2011 - 2012
Undergraduate Assistant Saint Joseph, MO

- Investigated the solvatochromism of room temperature ionic liquids (RTILs) in common solvents

· Demonstrated that solvents can induce order in the alkyl side chains of methylimidazolium RTILs

Morrow Contracting and Construction LLC 2011 - 2015
Skilled Laborer Saint Joseph, MO

PUBLICATIONS

· *In preparation:* **Morrow, D. J.**; Room temperature paramagnetic spins in carbon nanotubes with sp^3 defects.

· *In preparation:* **Morrow, D. J.**; Coherent modulation of broadband optical harmonic generation in graphene.

· *In preparation:* **Morrow, D. J.**; Ferrimagnetic states with tunable, chiral emission in layered $BaFMn_{0.5}Te$.

· *In preparation:* **Morrow, D. J.**; Modulation of carbon nanotube emission with GHz split ring resonators.

· *In preparation:* **Morrow, D. J.**; Ultrafast dynamics of WS_2-MoS_2 Lateral Heterojunctions.

· *Submitted:* Kohler, D. D.; **Morrow, D. J.**; Zhao, Y.; Scheeler, J. M.; Jin, S.; Wright, J. C. Spatially Resolved Spectroscopy Reveals the Disorder of WS_2-MoS_2 Lateral Heterojunctions.

· *Submitted:* **Morrow, D. J.**; Ma, X. Noisy detectors with unmatched detection efficiency thwart identification of single photon emitters via photon coincidence correlation.
· Preprint: `arXiv:2204.07654`.

· *Submitted:* **Morrow, D. J.**; Ma, X. Facile reconstruction of time-resolved fluorescence data with exponentially modified Gaussians.
· Preprint: `arXiv:2201.03561`.

14. Lu, S.†; **Morrow, D. J.**†;Li, Z.; Yu, X.; Wang, H.; Schultz, J. D.; O'Connor, J. P.; Jin, N.; Fang, F.; Wang, W.; Cui, R.; Chen, O.; Su, S.; Wasielewski, M. R.; Ma, X.; Li, X. Encapsulating Semiconductor Quantum Dots in Supramolecular Cages Enables Ultrafast Guest–Host Electron and Vibrational Energy Transfer *Journal of the American Chemical Society*. `DOI: 10.1021/jacs.2c119816`. **2017**.
†: equal author contribution

13. Chen, J-S.; Dasgupta, A.; **Morrow, D. J.**; Emmanuele, R.; Marks, T. J.; Hersam, M. C.; Ma, X. Room Temperature Lasing from Semiconducting Single-Walled Carbon Nanotubes. *ACS Nano*. `DOI: 10.1021/acsnano.2c06419`. **2022**.

12. **Morrow, D. J.**; Ma, X. Trapping Interlayer Excitons in van der Waals Heterostructures by Potential Arrays. *Physical Review B*. `DOI: 10.1103/PhysRevB.104.195302`. **2021**.
· Preprint: `arXiv:2107.13096`.

11. Lohmann, S.; Cai, T.; **Morrow, D. J.**; Chen, O.; Ma, X. Brightening of Dark States in $CsPbBr_3$ Quantum Dots Caused by Light-Induced Magnetism. *Small*. `DOI: 10.1002/smll.202101527`. **2021**

10. Pan, D.; Fu, Y.; Spitha, N.; Zhao, Y.; Roy, C.; **Morrow, D. J.**; Kohler, D. D.; Wright, J. C.; Jin, S. Deterministic fabrication of arbitrary vertical heterostructures of 2D Ruddlesden-Popper halide perovskites. *Nature Nanotechnology*. `DOI:10.1038/s41565-020-00802-2`. **2020**

9. **Morrow, D. J.**; Kohler, D. D.; Zhao, Y.; Scheeler, J. M.; Jin, S.; Wright, J. C. Quantum interference between the optical Stark effect and resonant harmonic generation in WS_2. *Physical Review B*. `DOI: 10.1103/PhysRevB.102.161401`. **2020**.
· Preprint: `arXiv:2006.01183`.
· Data and code repository: `DOI 10.17605/OSF.IO/sntpc`.

8. **Morrow, D. J.**; Hautzinger, M. P.; Lafayette, D. P.; Scheeler, J. M.; Dang, L.; Leng, M.; Kohler, D. D.; Wheaton, A. M.; Fu, Y.; Guzei, I. A.; Tang, J.; Jin, S.; Wright, J. C. Disentangling Second Harmonic Generation from Multiphoton Photoluminescence in Halide Perovskites using Multidimensional Harmonic

Generation. *Journal of Physical Chemistry Letters*. DOI:10.1021/acs.jpclett.0c01720. **2020**
· Preprint: DOI: 10.26434/ChemRxiv.12055440.
· Data and code repository: DOI 10.17605/OSF.IO/jn24u.

7. Hautzinger, M. P.; Pan, D.; Piggs, A. K.; Fu, Y.; **Morrow, D. J.**; Leng, M.; Kuo, M.; Spitha, N., Lafayette, D. P.; Kohler, D. D.; Wright, J. C.; Jin, S. Band Edge Tuning of 2D Ruddlesden-Popper Perovskites by A Cation Size Revealed through Nanoplates. *ACS Energy Letters*. DOI:10.1021/acsenergylett.0c00450. **2020**
· Code repository: DOI 10.17605/OSF.IO/m9dnw.

6. **Morrow, D. J.**; Kohler, D. D.; Zhao, Y.; Jin, S.; Wright, J. C. Triple sum frequency pump-probe spectroscopy of transition metal dichalcogenides. *Physical Review B*. DOI: 10.1103/PhysRevB.100.235303. **2019**.
· Preprint: arXiv:1909.06445.
· Data and code repository: DOI 10.17605/OSF.IO/UMSXC.

5. Thompson, B. J.; Sunden, K. F.; **Morrow, D. J.**; Kohler, D. D.; Wright, J.C. WrightTools: a Python package for multidimensional spectroscopy *The Journal of Open Source Software*. DOI: 10.21105/joss.01141. **2019**.

4. **Morrow, D. J.**; Kohler, D. D.; Czech, K. J.; Wright, J. C. Communication: Multidimensional Triple Sum-Frequency Spectroscopy of MoS_2 and Comparisons with Absorption and Second Harmonic Generation Spectroscopies. *Journal of Chemical Physics*. DOI: 10.1063/1.5047802. **2018**.
· Preprint: arXiv:1805.06985.
· Data and code repository: DOI 10.17605/OSF.IO/2WF6G.

3. **Morrow, D. J.**; Kohler, D. D.; Wright, J. C. Group and phase velocity mismatch fringes in triple sum-frequency spectroscopy. *Physical Review A*. DOI: 10.1103/PhysRevA.96.063835. **2017**.
· Preprint: arXiv:1709.10476.
· Data and code repository: DOI 10.17605/OSF.IO/EMGTA.

2. Fu, Y.; Rea, M. T.; Chen, J.; **Morrow, D. J.**; Hautzinger, M. P.; Zhao, Y.; Manger, L. H.; Wright, J. C.; Goldsmith, R. H.; Jin, S. Selective Stabilization and Photophysical Properties of Metastable Perovskite Polymorphs of $CsPbI_3$ in Thin Films. *Chemistry of Materials*. DOI: 10.1021/acs.chemmater.7b02948. **2017**.

1. Chen, J.; **Morrow, D. J.**; Fu, Y.; Zheng, W.; Zhao, Y.; Dang, L.; Stolt, M. J.; Kohler, D. D.; Wang, X.; Czech, K. J.; Hautzinger, M. P.; Shen, S.; Guo, L.; Pan, A.; Wright, J. C.; Jin, S. Single-Crystal Thin Films of Cesium Lead Bromide Perovskite Epitaxially Grown on Metal Oxide Perovskite ($SrTiO_3$). *Journal of the American Chemical Society*. DOI: 10.1021/jacs.7b07506. **2017**.
· Data and code repository: DOI 10.17605/OSF.IO/V5KZN.

PATENTS

1. *US Patent 10,823,664* **Morrow, D. J.**; Kohler, D. D.; Wright, J. C. Ultrafast, multiphoton-pump, multiphoton-probe spectroscopy.

POSTERS & PRESENTATIONS

8. Presentation. **Darien J. Morrow**, Zhengjie Huang, Jia-Shiang Chen, Xuedan Ma. Spin triplets in carbon nanotubes with sp^3 defects. 8^{th} Workshop on Nanotube Optics and Nanospectroscopy (WONTON). 2022.

7. Invited Presentation. **Darien J. Morrow**. Developing new, multidimensional pump-probe spectroscopies for investigating semiconductors. APS March Meeting. 2021.

6. Presentation. **Darien J. Morrow**, Xuedan Ma. Modeling Interlayer Exciton Trapping in Two-dimensional Heterostructures with Discrete, Random-walks. APS March Meeting. 2021.

5. Poster. **Darien J. Morrow**, Daniel D. Kohler, John C. Wright. Development of sum-frequency and transient sum-frequency spectroscopies to study transition metal dichalcogenide nanostructures. ACS National Meeting, Philadelphia, PA, March 2020. (meeting was canceled due to COVID-19)

4. Poster. **Darien J. Morrow**, Daniel D. Kohler, John C. Wright. Multi-photon pump, multi-photon probe spectroscopies and their application to MX_2 nanostructures. CMDS 2018, Seoul, South Korea. June 2018.

3. Poster. **Darien J. Morrow**, Jenna M. Wasylenko, Christopher G. Elles. Kinetics and Dynamics of the Photorearrangement Reactions of Aryl-Substituted Thiophenes. ACS National Meeting, Denver, CO. March 2015.

2. Poster. Michael W. Ducey, **Darien J. Morrow**, Bethany Thornton, Varun Lahoti. Conformational behavior and applications of mixed room temperature ionic liquid solvent systems examined with a panel of solvatochromic probes. ACS Midwest Regional Meeting, Columbia, MO. November 2014.

1. Poster. **Darien J. Morrow**, Jenna M. Wasylenko, Christopher G. Elles. Kinetics and Dynamics of the Photorearrangements of Conjugated Thiophenes. Council on Undergraduate Research, Research Experiences for Undergraduates Symposium, Arlington, VA. October 2014.

TEACHING EXPERIENCE

Physical Chemistry: Thermodynamics — Fall 2016
Teaching Assistant for Prof. Gilbert M. Nathanson — Madison, WI

General Chemistry — Fall 2015 - spring 2016
Teaching Assistant for Prof. Ive Hermans and Dr. Paul Hooker — Madison, WI

Organic Chemistry II — Fall 2013
Teaching Assistant for Prof. Steven P. Lorimor — Saint Joseph, MO

FELLOWSHIPS & SCHOLARSHIPS

- Link Foundation Energy Fellowship. July 2018 - June 2020.
  Two year full stipend for *Investigation of Coherent Charge Transfer in Transition Metal Dichalcogenide Heterostructures with Multiresonant Coherent Multidimensional Spectroscopy*.
- Pei Wang Fellowship. Fall 2015 - spring 2016.
- Golden Griffon Honors scholarship. Fall 2011 - spring 2015.
- NSF funded Midwest Apex Project scholarship. Fall 2011 - spring 2015.
- Missouri Bright Flight scholarship. Fall 2011 - spring 2015.

AWARDS & HONORS

- (One of three finalists) American Physical Society Justin Jankunas Doctoral Dissertation Award in Chemical Physics. 2021.
- UW–Madison Department of Chemistry, Richard and Joan Hartl Award for Research Excellence in Physical Chemistry. 2020.
- UW–Madison Department of Chemistry, Roger Carlson Memorial Award for Excellence in Analytical Chemistry. 2018.
- (Honorable mention) NSF Graduate Research Fellowship Program. 2017.
- MWSU Department of Chemistry, Edgar C. Little Outstanding Student Award. 2015.
- ACS Division of Analytical Chemistry, Undergraduate Award in Analytical Chemistry. 2015.
- ACS Division of Inorganic Chemistry, Undergraduate Award in Inorganic Chemistry. 2013.
- MWSU President's Honor's List. Fall 2011 - spring 2015.

SERVICE ACTIVITIES & COMMUNITY INVOLVEMENT

- Member of Argonne's Nanoscience and Technology Diversity, Equity, and Inclusion (DEI) Working Group. 2021-present
- Volunteered weekly with the Palos Restoration Project and the Forest Preserves of Cook County. 2021-present.
- Journal Reviewer: *Journal of Chemical Physics*, *Physical Review Letters*, *Physical Review B*
- Served on panel to talk to KU REU students about navigating career options outside of the academy. Summer 2022.
- Hosted "Detector Building" competition at the Science Olympiad Regional Tournament. Madison, Wisconsin. Winter 2020
- Organized weekly seminar for physical chemistry graduate students to present their research to fellow graduate students. 2018-2019
- Served as a moderator for the annual Wisconsin Middle School Science Bowl (sponsored by the DOE). 2017-2020.
- Wisconsin Institute for Discovery volunteer. 2017-2020.
- Taught/supervised electronics for a week to high schoolers in the PEOPLE program. Summer 2017.
- Served on panel to talk to UW REU students about experiences applying to and surviving graduate school. Summer 2017.
- Talked and demonstrated to Institute of Chemical Education summer camp attendees about my research, renewable energy, and how solar cells work. Summer 2017.
- Served as vice-president (2014-2015) and member of Missouri Western State University's ACS affiliated Chemistry club. 2011-2015.
- Aided in the organization and implementation of Super Science Saturday and Chemathon at Missouri Western State University. 2011-2015.

SOFTWARE SKILLS

- Wolfram Mathematica
- Python and the scientific Python software stack (numpy, matplotlib, scipy, h5py)
- Working knowledge: Arduino, Git, Latex, Autodesk Inventor, Ansys HFSS
- Active contributor/maintainer of open source projects:
  - `yaq` (project): a modular and extensible instrument control framework
  - `WrightTools` (library): loading, processing, and plotting of multidimensional spectroscopy data
  - `PyCMDS` (application): orchestrating many hardware into multidimensional spectrometers
  - `attune` (library): tuning/calibrating multidimensional spectrometers

REFERENCES

- Prof. John C. Wright (Doctoral advisor) | `wright@chem.wisc.edu` | 608-262-0351
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  University of Wisconsin–Madison
  1101 University Ave Rm 3209
  Madison, WI 53706
- Dr. Xuedan Ma (Postdoctoral advisor) | `xuedan.ma@anl.gov` | 630-252-3716
  Center for Nanoscale Materials
  Argonne National Laboratory
  9700 S. Cass Avenue. Building 440 Rm A242
  Lemont, IL 60439
- Prof. Martin T. Zanni (Member of dissertation committee)| `zanni@chem.wisc.edu` | 608-262-4783
  Department of Chemistry
  University of Wisconsin–Madison
  1101 University Ave Rm 8305L
  Madison, WI 53706

· Prof. Gilbert M. Nathanson (Teaching reference) | nathanson@chem.wisc.edu | 608-262-8098
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