

Curriculum Vitae

JEFFREY M. MCMAHON

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RESEARCH INTERESTS:

- Properties of dense hydrogen, in particular its equation of state and superconductivity
- Theoretical and computational electrodynamics, in particular nanophotonics and plasmonics

EDUCATION:

- **Ph.D.**, Northwestern University (2010)
Advisor: George C. Schatz
Dissertation Title: Topics in Theoretical and Computational Nanoscience: From Controlling Light at the Nanoscale to Calculating Quantum Effects with Classical Electrodynamics
- **B. S., Chemistry**, Western Washington University (2005)
Physics and Mathematics Minors

RESEARCH EXPERIENCE:

- **Postdoctoral Research Associate** (2010 – Present)
University of Illinois at Urbana–Champaign
Advisor: David M. Ceperley
Topic: Theory and modeling of dense hydrogen

- **Graduate Research Assistant** (2006 – 2010)
Northwestern University
Advisor: George C. Schatz
Topic: Theory and modeling of light interacting with metallic nanostructures
- **Graduate Research Assistant** (2006 – 2010)
Argonne National Laboratory
Advisor: Stephen K. Gray
Topic: Theory and modeling of light interacting with metallic nanostructures
- **Undergraduate Research Assistant** (2002 – 2005)
Western Washington University
Advisor: Steven R. Emory
Topic: Synthesis and characterization of metallic nanostructures

AWARDS AND HONORS:

- **MRSEC Fellowship**, Northwestern University (2009 – 2010)
- **ACS Graduate Student Award in Computational Chemistry** (2009)
- **Graduate Student Award to Attend the 59th Lindau Meeting of Nobel Laureates**, Lindau, Germany (2009)
- **MRSEC Fellowship**, Northwestern University (2008 – 2009)
- **Outstanding Presentation Award**, FACSS: The Federation of Analytical Chemistry and Spectroscopy Societies Meeting (2004)
- **Analytical Chemistry Student of the Year**, Western Washington University (2002 – 2003)
- **Honor Roll**, Western Washington University (2001 – 2003)

COURSES TAUGHT:

- **Accelerated General Chemistry Laboratory**, Northwestern University; (Chemistry 171 and 172) (2006)
- **Polymer Chemistry Laboratory**, Western Washington University; (Chemistry 308) (2005)

- **Organic Chemistry Laboratory**, Western Washington University; (Chemistry 354 and 355) (2003 – 2004)
- **General Chemistry Laboratory**, Western Washington University; (Chemistry 121, 122, and 123) (2002 – 2003)

COMMITTEES:

- **Student-Hosted Physical Chemistry Seminar Committee**, Northwestern University (2008)
- **Departmental Physical Chemistry Seminar Committee**, Northwestern University (2005 – 2006)
- **Vice President of the ACS Chemistry Club**, Western Washington University (2003 – 2004)

PROFESSIONAL AFFILIATIONS:

- American Physical Society
- American Chemical Society

SHORT COURSE:

- Accelerators for Science and Engineering Applications: GPUs and Multicores Summer School, National Center for Supercomputing Applications at the University of Illinois at Urbana–Champaign, Urbana–Champaign, IL, August 2008 (5 days)

SKILLS:

- C++ / C, Fortran 77 / 90 / 95, MPI, OpenMP, CUDA
- Mathematica, Maple, Mathcad
- Unix / Linux OS

MANUSCRIPTS SUBMITTED / IN PREPARATION:

5. L. K. Ausman, J. M. McMahon, S. Li, and G. C. Schatz, “Perspectives on the Fundamental Limitations to Electromagnetic Field Enhancements in Ag and Au Nanostructures,” In Preparation (2010).
4. J. M. McMahon, S. K. Gray, and G. C. Schatz, “Geometric Plasmonics and the Excitation of Curve Plasmon Polaritons,” In Preparation (2010).
3. J. M. McMahon and D. M. Ceperley, “Ground-State Structures of Atomic Metallic Hydrogen,” Submitted to *Physical Review Letters* (2010).
2. J. M. McMahon, S. K. Gray, and G. C. Schatz, “Fundamental Behavior of Electric Field Enhancements in the Gaps Between Closely Spaced Nanostructures,” Submitted to *Physical Review B* (2010).
1. N. Harris, L. K. Ausman, J. M. McMahon, D. J. Masiello, and G. C. Schatz, “Computational Electrodynamics Methods,” In: E. Bichoutskaia (ed), *Computational Nanoscience* (Royal Society of Chemistry: Cambridge, UK, Submitted 2010).

PEER-REVIEWED PUBLICATIONS:

17. J. M. McMahon, S. K. Gray, and G. C. Schatz, “Optical Properties of Nanowire Dimers with a Spatially Nonlocal Dielectric Function,” *Nano Letters* **10**, 3473 – 3481 (2010). DOI: 10.1021/nl101606j
16. H. Chen, J. M. McMahon, M. A. Ratner, and G. C. Schatz, “Classical Electrodynamics Coupled to Quantum Mechanics for Calculation of Molecular Optical Properties: A RT-TDDFT/FDTD Approach,” *Journal of Physical Chemistry C* **114**, 14384 – 14392 (2010).
15. S. Peng, J. M. McMahon, G. C. Schatz, S. K. Gray, and Y. Sun, “Reversing the size-dependence of surface plasmon resonances,” *Proceedings of the National Academy of Sciences of the United States of America* **107**, 14530 – 14534 (2010). DOI: 10.1073/pnas.1007524107
14. J. M. McMahon, S. K. Gray, and G. C. Schatz, “Calculating nonlocal optical properties of structures with arbitrary shape,” *Physical Review B* **82**, 035423 (2010). DOI: 10.1103/PhysRevB.82.035423
<http://arxiv.org/abs/0912.4746>
13. K. L. Wustholz, A.-I. Henry, J. M. McMahon, R. G. Freeman, N. Valley, M. E. Piotti, M. J. Natan, G. C. Schatz, and R. P. Van Duyne, “Structure–Activity Relationships in Gold Nanoparticle Dimers and Trimers for Surface-Enhanced Raman Spectroscopy,” *Journal of the American Chemical Society* **132**, 10903 – 10910 (2010). DOI: 10.1021/ja104174m

12. E. Ringe*, J. M. McMahon*, K. Sohn, C. Cobley, Y. Xia, J. Huang, G. C. Schatz, L. D. Marks, and R. P. Van Duyne, “Unraveling the Effects of Size, Composition, and Substrate on the Localized Surface Plasmon Resonance Frequencies of Gold and Silver Nanocubes: A Systematic Single-Particle Approach,” *Journal of Physical Chemistry C* **114**, 12511 – 12516 (2010).
DOI: 10.1021/jp104366r
11. J. M. McMahon, S. K. Gray, and G. C. Schatz, “Nonlocal Dielectric Effects in Core–Shell Nanowires,” *Journal of Physical Chemistry C*, part of the special issue “Protected Metallic Clusters, Quantum Wells and Metallic Nanocrystal Molecules,” Online (2010). DOI: 10.1021/jp910899b
10. T. W. Odom, H. Gao, J. M. McMahon, J. Henzie, and G. C. Schatz, “Plasmonic superlattices: Hierarchical subwavelength hole arrays,” *Chemical Physics Letters* **483**, 187 – 192 (2009). DOI: 10.1016/j.cplett.2009.10.084
9. J. M. McMahon, S. K. Gray, and G. C. Schatz, “Nonlocal optical response of metal nanostructures with arbitrary shape,” *Physical Review Letters* **103**, 097403 (2009). DOI: 10.1103/PhysRevLett.103.097403
Virtual Journal of Nanoscale Science & Technology **20**, 10 (2009).
8. J. M. McMahon, A.-I. Henry, K. L. Wustholz, M. J. Natan, R. G. Freeman, R. P. Van Duyne, and G. C. Schatz, “Gold nanoparticle dimer plasmonics: finite element method calculations of the electromagnetic enhancement to surface-enhanced Raman spectroscopy,” *Analytical and Bioanalytical Chemistry* **394**, 1819 – 1825 (2009). DOI: 10.1007/s00216-009-2738-4
7. H. Gao, J. M. McMahon, M. H. Lee, J. Henzie, S. K. Gray, G. C. Schatz, and T. W. Odom, “Rayleigh anomaly-surface plasmon polariton resonances in palladium and gold subwavelength hole arrays,” *Optics Express* **17**, 2334 – 2340 (2009). DOI: 10.1364/OE.17.002334
6. Y. Babayan, J. M. McMahon, S. Li, S. K. Gray, G. C. Schatz, and T. W. Odom, “Confining Standing Waves in Optical Corrals,” *ACS Nano* **3**, 615 – 620 (2009). DOI: 10.1021/nm8008596
5. J. M. McMahon, S. K. Gray, and G. C. Schatz, “A discrete action principle for electrodynamics and the construction of explicit symplectic integrators for linear, non-dispersive media,” *Journal of Computational Physics* **228**, 3421 – 3432 (2009). DOI: 10.1016/j.jcp.2009.01.019
4. J. M. McMahon, Y. Wang, L. J. Sherry, R. P. Van Duyne, L. D. Marks, S. K. Gray, and G. C. Schatz, “Correlating the Structure, Optical Spectra, and Electrodynamics of Single Silver Nanocubes,” *Journal of Physical Chemistry C* **113**, 2731 – 2735 (2009). DOI: 10.1021/jp8098736

3. J. Zhao, A. O. Pinchuk, J. M. McMahon, S. Li, L. K. Ausman, A. L. Atkinson, and G. C. Schatz, "Methods for Describing the Electromagnetic Properties of Silver and Gold Nanoparticles," *Accounts of Chemical Research* **41**, 1710 – 1720 (2008). DOI: 10.1021/ar800028j
2. J. M. McMahon, J. Henzie, T. W. Odom, G. C. Schatz, and S. K. Gray, "Tailoring the sensing capabilities of nanohole arrays in gold films with Rayleigh anomaly-surface plasmon polaritons," *Optics Express* **15**, 18119 – 18129 (2007). DOI: 10.1364/OE.15.018119
Virtual Journal of Nanoscale Science & Technology **17**, 10 (2008).
1. J. M. McMahon and S. R. Emory, "Phase Transfer of Large Gold Nanoparticles to Organic Solvents with Increased Stability," *Langmuir* **23**, 1414 – 1418 (2007). DOI: 10.1021/la0617560

BOOK CHAPTERS:

2. J. M. McMahon, S. K. Gray, and G. C. Schatz, "Surface Nanophotonics Theory" and Cover Image, In: G. Wiederrecht (ed), *Handbook of Nanoscale Optics and Electronics* (Elsevier: Amsterdam, 2010). ISBN: 978-0-12-375178-2
1. A. L. Atkinson, J. M. McMahon, and G. C. Schatz, "FDTD Studies of Metallic Nanoparticle Systems," In: *Self Organization of Molecular Systems, From Molecules and Clusters to Nanotubes and Proteins, NATO Science for Peace and Security Series A: Chemistry and Biology* (Springer: Netherlands, 2009). DOI: 10.1007/978-90-481-2590-6

CONFERENCE PROCEEDINGS:

2. J. M. McMahon, S. K. Gray, and G. C. Schatz, "Dephasing of Electromagnetic Fields in Scattering from an Isolated Slit in a Gold Film," *Proceedings of SPIE* **7033**, 703311/1 – 6 (2008). DOI: 10.1117/12.790647
1. G. C. Schatz, J. M. McMahon, and S. K. Gray, "Tailoring the parameters of nanohole arrays in gold films for sensing applications," *Proceedings of SPIE* **6641**, 664103/1 – 8 (2007). DOI: 10.1117/12.731368

ORAL PRESENTATIONS:

4. J. M. McMahon and G. C. Schatz, "Determining the Nonlocal Optical Properties of Metallic Nanostructures via High-Performance Computing," invited talk at HPCNano09 at SC09, Portland, OR, November 2009.

3. J. M. McMahon and G. C. Schatz, "Computational Nanophotonics: Applications of Classical Electrodynamics to Nanoscience," The Elsevier Seminar, invited talk at The Ohio State University, Department of Chemistry, Columbus, OH, May 2009.
2. J. M. McMahon and S. R. Emory, "Preparation of Gold Organosols for Applications in Surface-Enhanced Optical Spectroscopies," presented at Pittcon: The Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Chicago, IL, March 2004.
1. J. M. McMahon and S. R. Emory, "Preparation of Gold Organosols for Applications in Surface-Enhanced Optical Spectroscopies," presented at Pacific Lutheran University, Department of Chemistry, Tacoma, WA, March 2003.

POSTER PRESENTATIONS:

6. J. M. McMahon and G. C. Schatz, "Computational Electrodynamics Studies of SERS Antennas," presented at the 41st Midwest Theoretical Chemistry Conference (MWTCC), Carbondale, IL, May 2009.
5. J. M. McMahon and G. C. Schatz, "Computational Electrodynamics Studies of SERS Antennas," presented at the SERS S&T Fundamentals Review, the Hilton Minneapolis, Minneapolis, MN, January 2009.
4. J. M. McMahon, S. K. Gray, and G. C. Schatz, "Confinement and Dephasing of Electromagnetic Fields in Scattering from Optical Corrals," presented at the Optical Metamaterials Workshop, The Aspen Lodge, Estes Park, CO, September 2008.
3. J. M. McMahon, S. K. Gray, and G. C. Schatz, "Confinement and Dephasing of Electromagnetic Fields in Scattering from Optical Corrals," presented at ACTC: The American Conference on Theoretical Chemistry, Northwestern University, Evanston, IL, July 2008.
2. J. M. McMahon, S. K. Gray, and G. C. Schatz, "Transmission of Light through Infinite Arrays of Holes in Thin Gold Films on Dielectric Materials," presented at the Center for Nanoscale Materials Users Week, Argonne National Laboratory, Argonne, IL, May 2007.
1. J. M. McMahon and S. R. Emory, "Preparation of Gold Organosols for Applications in Surface-Enhanced Optical Spectroscopies," presented at FACSS: The Federation of Analytical Chemistry and Spectroscopy Societies Meeting, Portland, OR, October 2004.

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