Nicholas J. Mayhall

Contact Information

Department of Chemistry (0212)
480 Davidson Hall
Virginia Tech
900 W. Campus Drive
Blacksburg, VA 24061

Voice: (540) 231-3298
E-mail: nmayhall@vt.edu

Education

Ph.D.	Indiana University, Bloomington, IN	Computational Chemistry	2011
B.S.	University of Southern Indiana, Evansville, IN	Chemistry	2006

Experience

Assistant Professor — 2015 - Present
Virginia Tech

Post-Doctoral Associate — 2011 - 2015
University of CA – Berkeley
Research group of Prof. Martin Head-Gordon

Graduate Research Assistant — 2007 - 2011
Indiana University
Research group of Prof. Krishnan Raghavachari

Graduate Student Instructor — 2006 - 2007
Indiana University
General Chemistry I Lab with Prof. Todd Stone
General Chemistry II with Prof. Srinivasan Iyengar

Undergraduate Teaching Assistant — 2005 - 2006
University of Southern Indiana
Physical Chemistry I and II with Prof. Evan Millam

REU Undergraduate Researcher — 2005 - 2005
University of Memphis
Research group of Prof. Ted Burkey

Awards

NSF Career Award	VT	2018
ACS PHYS Division Postdoctoral Research Awards	UC Berkeley	2014
Richard Slagle Fellowship	Indiana University	2010
E.M. Kratz Fellowship	Indiana University	2009
Felix Haurowitz Award	Indiana University	2009
E. Campaigne C500 Award	Indiana University	2008
Academic Achievement Award for Chemistry	USI	2006
Outstanding Achievement Award in Physical Chemistry	USI	2005
Integra Bank Distinguished Professor Scholar	USI	2005
O. John Logsdon Chemistry Scholarship	USI	2005
CRC Freshman Chemistry Achievement Award	USI	2003

Publications

27 **A Simple Rule to Predict Boundedness of Multi-Exciton States in Covalently-Linked Singlet Fission Dimers**
V. Abraham and N. J. Mayhall
Journal of Physical Chemistry Letters, 8, 5472-5478, (2017)

26 **Using Higher-Order Singular Value Decomposition To Define Weakly Coupled and Strongly Correlated Clusters: The n-Body Tucker Approximation**
N. J. Mayhall
Journal of Chemical Theory and Computation, 13, 4818-4828, (2017)

25 **From model Hamiltonians to ab initio Hamiltonians and back again: Using single excitation quantum chemistry methods to find multiexciton states in singlet fission materials**
N. J. Mayhall
Journal of Chemical Theory and Computation, 12, 4263-4273, (2016)

24 **Computational Quantum Chemistry For Multiple Site Heisenberg Spin Couplings Made Simple: Still Only One Spin Flip Required**
N. J. Mayhall and M. Head-Gordon
Journal of Physical Chemistry Letters, 6, 1982-1988, (2015)

23 **Advances in molecular quantum chemistry contained in the Q-Chem 4 program package**
Y. Shao, et al.
Molecular Physics, 113, 184-215, (2014)

22 **Computational quantum chemistry for single Heisenberg spin couplings made simple: Just one spin flip required**
N. J. Mayhall and M. Head-Gordon
Journal of Chemical Physics, 141, 134111, (2014)

21 **Spin-Flip Non-Orthogonal Configuration Interaction: A variational and almost black-box method for describing strong correlation**
N. J. Mayhall, P. Horn, E. J. Sundstrom, and M. Head-Gordon
Physical Chemistry Chemical Physics, 16, 22694-22705, (2014)

20 **Increasing spin-flips and decreasing cost: Perturbative corrections for external singles to the complete active space spin flip model for low-lying excited states and strong correlation**
N. J. Mayhall and M. Head-Gordon
The Journal of Chemical Physics, 141, 044112, (2014)

19 **A Quasidegenerate Second-Order Perturbation Theory Approximation to RAS-*n*SF for Excited States and Strong Correlations**
N. J. Mayhall, M. Goldey, and M. Head-Gordon
Journal of Chemical Theory and Computation, 10, 589-599, (2014)

18 **On the Formation of Silacyclopropenylidene (c-SiC_2H_2) and its Role in the Organosilicon Chemistry in the Interstellar Medium**
D. S. N. Parker, A. V. Wilson, R. I. Kaiser, N. J. Mayhall, M. Head-Gordon, and A. G. G. M. Tielens
The Astrophysical Journal, 770, 33, (2013)

17 **A Composite Energy Treatment for Sterically Hindered Cluster Models for the Si(100) Surface**
B. C. Gamoke, N. J. Mayhall, and K. Raghavachari
Journal of Chemical Theory and Computation, 8, 5132-5136, (2012)

16 **Many-Overlapping-Body (MOB) Expansion: A Generalized Many Body Expansion for Nondisjoint Monomers in Molecular Fragmentation Calculations of Covalent Molecules**
N. J. Mayhall and K. Raghavachari
Journal of Chemical Theory and Computation, 8, 2669-2675, (2012)

15 **Modeling Nonperiodic Adsorption on Periodic Surfaces: A Composite Energy Approach for Low-Coverage Limits**
B. C. Gamoke, N. J. Mayhall, and K. Raghavachari
Journal of Physical Chemistry C, 116, 12048-12054, (2012)

14 **Properties of metal oxide clusters in non-traditional oxidation states**
J. E. Mann, N. J. Mayhall, and C. C. Jarrold
Chemical Physics Letters, 525-526, 1-12, (2012)

13 **Molecules-in-Molecules: A Hybrid-Energy Fragmentation Approach for Accurate Calculations on Large Molecules and Materials**
N. J. Mayhall and K. Raghavachari
Journal of Chemical Theory and Computation, 7, 1336-1343, (2011)

12 **Molybdenum Oxides vs. Molybdenum Sulfides: Geometric and Electronic Structures of Mo_3X_y (X=O, S and y=6, 9) Clusters**
N. J. Mayhall, E. L. Becher, A. Chowdhury, K. Raghavachari
Journal of Physical Chemistry A, 115, 2291-2296, (2011)

11 **Charge transfer across ONIOM QM:QM boundaries: The impact of model system preparation**
N. J. Mayhall and K. Raghavachari
Journal of Chemical Theory and Computation, 6, 3131-3136 (2010)

10 **A Proton Hop Paves the Way for Hydroxyl Migration: Theoretical Elucidation of Fluxionality in Transition Metal Oxide Clusters**
R. Ramabhadran, N. J. Mayhall, K. Raghavachari
Journal of Physical Chemistry Letters, 1, 3066-3071 (2010)

9 **Multiple solutions to the single-reference CCSD equations for NiH**
N. J. Mayhall, K. Raghavachari
Journal of Chemical Theory and Computation, 6, 2714 (2010)

8 **ONIOM-based QM:QM electronic embedding method using Löwdin atomic charges: Energies and analytic gradients**
N. J. Mayhall, K. Raghavachari, H. P. Hratchian
Journal of Chemical Physics, 132, 114107 (2010)

7 **Termination of the $W_2O_y^-$ + H_2O/D_2O $\rightarrow W_2O_{y+1}^-$+H_2/D_2 sequential oxidation reaction: An exploration of kinetic versus thermodynamic effects**
D. W. Rothgeb, E. Hossain, N. J. Mayhall, K. Raghavachari, C. C. Jarrold
Journal of Chemical Physics, 131, 144306 (2009)

6 **Water Reactivity with Tungsten Oxides: H_2 Production and Kinetic Traps**
N. J. Mayhall, D. W. Rothgeb, E. Hossain, C. C. Jarrold, K. Raghavachari
Journal of Chemical Physics, 131, 144302 (2009)

5 **Electronic structures of $MoWO_y^-$ and $MoWO_y$ determined by anion photoelectron spectroscopy and DFT calculations**
N. J. Mayhall, D. W. Rothgeb, E. Hossain, K. Raghavachari, C. C. Jarrold
Journal of Chemical Physics, 130, 124313 (2009)

4 **Investigation of G4 Theory for Transition Metal Thermochemistry**
N. J. Mayhall, K. Raghavachari, P. C. Redfern, L. A. Curtiss
Journal of Physical Chemistry A, 113 5170-5175 (2009)

3 **Unusual products observed in gas-phase $W_xO_y^-$ + H_2O and D_2O reactions**
D. W. Rothgeb, E. Hossain, A. T. Kuo, J. L. Troyer, C. C. Jarrold, N. J. Mayhall, K. Raghavachari
Journal of Chemical Physics, 130, 124314 (2009)

2 **Toward accurate thermochemical models for transition metals: G3Large basis sets for atoms Sc-Zn**
N. J. Mayhall, K. Raghavachari, P. C. Redfern, L. A. Curtiss, V. Rassolov
Journal of Chemical Physics, 128, 144122 (2008)

1 **Two Methanes are Better than One: A Density Functional Theory Study of the Reactions of $Mo_2O_y^-$ (y = 2-5) with Methane**
N. J. Mayhall, K. Raghavachari
Journal of Physical Chemistry A, 111, 8211-8217 (2007)

Book Chapters

- *Energy Transfer in Metal Organic Frameworks*
J. Zhu, S. Shaikh, N. J. Mayhall, & A. Morris
in *Elaboration and Applications of Metal-Organic Frameworks*
Editor: S. Ma
World Scientific Publishers/Imperial College Press (2017)

Journals Refereed

Journal of Chemical Physics

Journal of Chemical Theory and Computation

Journal of Physical Chemistry

Physical Chemistry Chemical Physics

Journal of Physical Chemistry Letters

Molecular Physics

Chemical Physics Letters

Oral Presentations

- *Using higher-order singular value decomposition to define weakly coupled and strongly correlated clusters: the n-body Tucker approximation*
255th ACS National Meeting, March 21 (2018)
- *A generalized Ovchinnikov's rule can predict the biexciton boundedness in covalently linked singlet fission chromophores*
255th ACS National Meeting, March 19 (2018)
- *Multiexcitons and strong correlation via single-excitation wavefunctions: applications and future directions*
2017 WATOC, Munich, Germany, August 31 (2017)
- **Invited Talk:** *Spin flip methods for Spin Hamiltonians*
New Frontiers in Electron Correlation, Telluride TSRC, CO, June 23 (2017)
- *Using single-excitation wavefunctions to compute exciton-binding energies in singlet fission materials*
253rd ACS National Meeting, San Francisco, CA, April 4 (2017)
- **Invited Talk:** *Using simple ab initio methods to construct even simpler Hamiltonians: applying spin-flip methods for strong correlation and excited states*
Joint Condensed Matter and Center for Soft Matter and Biological Physics Seminar, Virginia Tech, Nov. 14 (2016)
- **Invited Talk:** *Using single-excitation wavefunctions to compute exciton-binding energies in singlet fission materials*
Department Seminar, James Madison University, Nov. 11 (2016)

- **Invited Talk:** *Using simple ab initio methods to construct even simpler Hamiltonians: spin-flip methods for strong correlation and excited states*
  SETCA, Tallahassee, FL (2016)
- **Invited Talk:** *Ab initio Quantum Chemistry for multiradical molecules: A spin-flip approach*
  251st ACS National Meeting, San Diego, CA (2016)
- **Invited Talk:** *Heisenberg spin couplings are difficult but not impossible: Ab initio Quantum Chemistry for multiradical molecule*
  UC Merced, Merced, CA (2015)
- **Invited Talk:** *Toward accurate single-reference descriptions of strongly correlated systems: Spin-flip methods for several coupled electrons*
  248st ACS National Meeting, San Francisco, CA (2014)
- *Cost effective modeling of spin-coupled molecules: A 2nd order perturbative treatment of orbital relaxation in complete active space spin-flip CI*
  246st ACS National Meeting, Indianapolis, IN (2013)
- *Improving hybrid energy schemes for large molecules: Inclusion of charge-redistribution across regional boundaries*
  241st ACS National Meeting, Anaheim, CA (2011)
- **Invited Talk:** *Composite Energy Models in Quantum Chemistry*
  UC Berkeley, CA (2011)
- *H_2 Production and Kinetic Traps: Water Reactivity with Tungsten Oxides*
  65th International Symposium on Molecular Spectroscopy, The Ohio State University, Columbus, OH (2010)
- *First Principles Determination of the Acetyl Anion Photoelectron Spectrum*
  Undergraduate Research Conference, Butler University, Indianapolis, IN (2006)

Poster Presentations

- *Active space-based spin-flip methods for strongly correlated systems: Method development and phenomenological extensions*
  SciDAC-3 PI Meeting, Washington DC (2014)
- *A perturbative approximation to RAS-nSF for excited states and strong correlations*
  SciDAC-3 PI Meeting, Rockville, MD (2013)
- *Is Coupled Cluster a Black Box?*
  42st Midwest Theoretical Chemistry Conference, Purdue University, West Lafayette, IN (2010)
- *H_2 Production and Kinetic Traps: Water Reactivity with Tungsten Oxides*
  41st Midwest Theoretical Chemistry Conference, University of Southern Illinois, Carbondale, Ill (2009)
- *Transition Metal Thermochemistry with Composite Methods: Application and Assessment of Current Methods*
  40th Midwest Theoretical Chemistry Conference, University of Michigan, Ann Arbor, MI (2008)
- *Two Methanes are Better than One: A Density Functional Theory Study of the Reactions of $Mo_2O_y^-$ (y = 2-5) with Methane*
  39th Midwest Theoretical Chemistry Conference, Indiana University, Bloomington, IN (2007)