

# Dr. William Ratcliff II

NIST  
100 Bureau Drive  
Mailstop 6102, Bldg 235, Room E151  
Gaithersburg, MD 20899  
Phone: 301-975-4316  
Fax: 301-921-9847

## Education

**2003** Rutgers University, New Brunswick, Ph.D. Physics, Thesis Advisor: Professor Sang W. Cheong

**1997** University of Michigan, Ann Arbor, BSE in Engineering Physics

## Research Interests

The primary focus of my research has been multiferroic materials. Recently, I have explored geometric ferroelectricity in the LuFeO<sub>3</sub> series of compounds in both bulk and thin film samples (see 18,20, and 21) culminating in work with collaborators in the development of superlattices with near room temperature magneto-electric effects. Our neutron scattering work was key in understanding the intrinsic magnetic ordering of the LuFeO<sub>3</sub> geometric ferroelectric which templates LuFe<sub>2</sub>O<sub>4</sub> in the LuFeO<sub>3</sub>-LuFe<sub>2</sub>O<sub>4</sub> superlattice to dramatic effect. Currently, I am working on topological materials (see 2,3,4,5,16). Of particular interest is the interplay of magnetism with topological materials. For example in the MnBi<sub>2</sub>Te<sub>4</sub> system, our measurements of the magnetic structure under applied magnetic fields has direct implications for the band structure.

## Career/Experience

2019 - Present: Adjunct Associate Professor, Materials Science and Engineering, University of Maryland, College Park

2005-Present: Staff scientist at the NIST Center for Neutron Scattering

2003-2005: National Research Council Postdoc at the NIST Center for Neutron Research at NIST. Primary work concerned neutron scattering experiments on geometrically frustrated magnets and magnetoelectric systems. Also participated in x-ray experiments at Brookhaven and APS. Developed a GUI application for visualization of the resolution ellipsoid for inclusion in the DAVE project.

1997-2003: Worked with Sang W. Cheong in materials physics research including materials synthesis and characterization of novel magnetic systems.

## Workshops Organized

2018 ACNS Satellite School: 7th School on Representational Analysis and Magnetic Structure (RAMS), University of Maryland, College Park, Maryland

2018 Program Committee International Conference on Magnetism (ICM), San Francisco, CA

2017 Co-organizer of Fundamentals of Ferroelectrics Conference (FERRO), Williamsburg, WV

2015 5th School on Representational Analysis and Magnetic Structure (RAMS), University of Maryland, College Park, Maryland

2012 Workshop on Representational Analysis and Magnetic Structure Determination, BARC, Mumbai, India\*\*

2011 The NIST/Georgetown 2nd School on Representational Analysis and Magnetic Structures Aug1-5, Georgetown, Washington, D.C.

2010 Program Committee MMM Meeting, Atlanta, GA

2007 The NIST Workshop on Representational Analysis of Complex Magnetic Structures, Gaithersburg, MD

## Selected Honors and Memberships

Member of American Physical Society

Fellow of American Physical Society

Associate Editor of Science Advances (2019-present)

Vice Chair APS Topical Group on Data Science (March 2020 - present)

Member APS committee to select APS Congressional Fellow (2020)

Member of APS Committee on Informing the Public (2021-2023)

Steering Committee APS-IDEA Program (2020-present)

Member APS March Meeting Task Force (2020)

Member of Organizing committee APS Topical Group on Data Science (2018)  
Secretary APS Topical Group on Data Science (May 2019 - present)  
Mentor NSF Ideas Lab (2019)  
Reviewer: NSF, DOE, Swiss National Science Foundation (SNF), German Research Foundation (DFG), Cottrell Scholars, IUSSTF, Army Research Office  
Elected Representative to SNS-HIFR User Group Executive Committee (2019-present)  
Chapter Leader DataKind DC (2018-present)  
Elected Chair APS Committee on Minorities in Physics (2017-2018)  
Member APS Committee on Minorities in Physics (2016-2018)  
Elected ACA Neutron Scattering Special Interest Group Chair (2015-2016)  
Elected GMAG Member at Large (2013-2016)  
APS-IUSSTF U.S.-India Exchange Program (2012)  
NIST Bronze Medal (highest honorary recognition given by the institute) (2012)  
Minority in Research Science Trailblazer award (24th annual BEYA STEM) (2010)  
NRC Postdoctoral Fellowship (2003-2005)  
Member Sigma Xi  
Member Neutron Scattering Society of America

## Publications

### H-index

40 see <https://scholar.google.com/citations?user=Xly2-LYAAAAJ&hl=en>

### Citations

> 5000 see <https://scholar.google.com/citations?user=Xly2-LYAAAAJ&hl=en>

### Book Chapter

Multiferroics, William Ratcliff and Jeffrey W. Lynn, Chapter 5 in Neutron Scattering - Magnetic and Quantum Phenomena, Felix Fernandez-Alonso and David L. Price, editors (Academic Press, London, 2015).

## Publications

86. "Intermediate Sr<sub>2</sub>Co<sub>1.5</sub>Fe<sub>0.5</sub>O<sub>6</sub>-delta Tetragonal Structure between Perovskite and Brownmillerite as a Model Catalyst with Layered Oxygen Deficiency for Enhanced Electrochemical Water Oxidation" Sivasankara Rao Ede,Candyce Collins,Carlos Posada,Gibin George,Hui Wu,William D. Ratcliff, Yulin Lin,Jianguo Wen,Shubo Han, and Zhiping Luo ACS Catal. 2021 11, 4327 (<https://doi.org/10.1021/acscatal.1c00465>)
85. "Control of magnetoelectric coupling in the Co<sub>2</sub>Y-type hexaferrites" Chang Bae Park, Kwang Woo Shin, Sae Hwan Chun, Jun Han Lee, Yoon Seok Oh, Steven M. Disseler, Colin A. Heikes, William D. Ratcliff, Woo-Suk Noh, Jae-Hoon Park, & Kee Hoon Kim Phys. Rev. Materials 5, 034412 (2021)
84. "Kitaev interactions in Co honeycomb antiferromagnets Na<sub>3</sub>Co<sub>2</sub>SbO<sub>6</sub> and Na<sub>2</sub>Co<sub>2</sub>TeO<sub>6</sub>" M. Songvilay, J. Robert, J. A. Rodriguez-Rivera, W. D. Ratcliff, F. Damay, V. Baledent, M. Jimenez-Ruiz, P. Lejay, E. Pachoud, A. Hadj-Azzem, V. Simonet, and C. Stock Phys. Rev. B 102 224429 (2020)
83. "Evolution of the magnetic properties in simultaneously Cd and Ir-doped Ce<sub>2</sub>RhIn<sub>8</sub> antiferromagnet" D. S. Christovam, G. S. Freitas, M. M. Piva, J. C. Souza, M. O. Malcolms, J. Leao, W. Ratcliff, J. W. Lynn, C. Adriano, P. G. Pagliuso Phys. Rev. B 102, 195137 (2020)
82. "Large exchange splitting in monolayer graphene magnetized by an anti-ferromagnet" Yingying Wu, Gen Yin, Lei Pan, Alexander J. Grutter, Quanjun Pan, Albert Lee, Eun Sang Choi,Mingliang Tian, Peng Deng, Qiming Shao, Shin-Hung Tsai,Qinglin He, Dustin A. Gilbert, Julie A. Borchers, William Ratcliff II, Ang Li, Xiao-dong Han, and Kang L. Wang Nature Electronics, <https://doi.org/10.1038/s41928-020-0458-0> (2020)
81. "Magnetic phase transitions and spin density distribution in the molecular multiferroic GaV<sub>4</sub>S<sub>8</sub> system" Rebecca L. Dally, William D. Ratcliff II, Lunyong Zhang, Heung-Sik Kim, Markus Bleul, J.W. Kim, Kristjan Haule, David Vanderbilt, Sang-Wook CHeong, and Jeffrey W. Lynn Phys. Rev. B. 102, 014410 (2020)
80. "Termination switching of antiferromagnetic proximity effect in topological insulator" Chao-Yao Yang, Lei Pan, Alexander J. Grutter, Haiying Wang, Xiaoyu Che, Qing Lin, Yingying Wu, D. A. Gilbert, Padraic Shafer, Elke Arenholz, Hao Wu, Gen Yin, Peng Deng, J. A. Borchers, W. Ratcliff II, and Kang L. Wang Science Advances 6, eaaz8463, DOI: 10.1126/sciadv.aaz8463 (2020)
79. "Quantum oscillations from networked topological interfaces in a Weyl semimetal" I-Lin Liu, Colin Heikes, Taner Yildirim, Chris Eckberg, Tristin Metz, ShengRan, William Ratcliff II, Johnpierre Paglione, and Nicholas P. Butch Nature Quantum Materials, 5, Article number 62 (2020) <https://doi.org/10.1038/s41535-020-00264-8>
78. "Ferromagnetic van der Waals compound MnSb<sub>1.8</sub>Bi<sub>0.2</sub>Te<sub>4</sub>" Yangyang Chen,

Ya-Wen Chuang, Seng Huat Lee, Yanglin Zhu, Kevin Honz, Yingdong Guan, Yu Wang, Ke Wang, Zhiqiang Mao, Colin Heikes, P. Quarterman, Pawel Zajdel, Julie A. Borchers, William Ratcliff II, Jun Zhu Phys Rev. Matt. 4, 064411 (2020)

77. "Electronic and magnetic properties of stoichiometric CeAuBi<sub>2</sub>" D. S. Christovam, G. S. Freitas, M. M. Piva1, J. C. Souza, M. O.Malcolms, J. Leao, W. Ratcliff, J. W. Lynn, C. Adriano, P. G. Pagliuso M. M. Piva, R. Tartaglia, G. S. Freitas, J. C. Souza, D. S. Christovam, S. M. Thomas, J. Leao, W. Ratcliff, J. W. Lynn, C. Lane, J.-X. Zhu, J. D. Thompson, P. F. S. Rosa, C. Adriano, E. Granado, and P. G. Pagliuso Phys. Rev B 101, 214431 (2020)
76. "Ferromagnetic van der Waals compound MnSb<sub>1.8</sub>Bi<sub>0.2</sub>Te<sub>4</sub>" Yangyang Chen, Ya-Wen Chuang, Seng Huat Lee, Yanglin Zhu, Kevin Honz, Yingdong Guan, Yu Wang, Ke Wang, Zhiqiang Mao, Colin Heikes, P. Quarterman, Pawel Zajdel, Julie A. Borchers, William Ratcliff II, Jun Zhu arXiv:1910.13057
75. "Common acoustic phonon lifetimes in inorganic and hybrid lead halide perovskites" M Songvilay, N Giles-Donovan, M Bari, Z-G Ye, JL Minns, MA Green, Guangyong Xu, PM Gehring, K Schmalzl, WD Ratcliff, CM Brown, D Chernyshov, W van Beek, S Cochran, C Stock Physical Review Materials 3, 093602 (2019)
74. "Exchange Bias in Bulk alpha-Fe / gamma-Fe<sub>70</sub>Mn<sub>30</sub> Nanocomposites for Permanent Magnet Applications" Ian J McDonald, Michelle Jamer, Kathryn L Krycka, Elaf Anber, Daniel Foley, Andrew Charles Lang, William Ratcliff, Don Heiman, Mitra L Taheri, Julie A Borchers, Laura H Lewis ACS Appl. Nano Mater., 2, 1940 (2019) DOI: 10.1021/acsanm.8b02319
73. "Quantum oscillations from networked topological interfaces in a Weyl semimetal" I-Lin Liu, Colin Heikes, Taner Yildirim, Chris Eckberg, Tristin Metz, ShengRan, William Ratcliff II, Johnpierre Paglione, and Nicholas P. Butch arxiv.org/abs/1905.02277
72. "Large exchange splitting in monolayer graphene magnetized by an antiferromagnet" Yingying Wu, Gen Yin, Lei Pan, Alexander J. Grutter, Quanjun Pan, Albert Lee, Eun Sang Choi, Mingliang Tian, Peng Deng, Qiming Shao, Shin-Hung Tsai, Qinglin He, Dustin A. Gilbert, Julie A. Borchers, William Ratcliff II, Ang Li, Xiao-dong Han, and Kang L. Wang (submitted)
71. "Spin Scattering and Noncollinear Spin Structure-Induced Intrinsic Anomalous Hall effect in Antiferromagnetic Topological Insulator MnBi<sub>2</sub>Te<sub>4</sub>" Seng Huat Lee, Yanglin Zhu, Yu Wang, Leixin Miao, Hemian Yi, Timothy Pillsbury, Susan Kempinger, Jin Hu, Colin A. Heikes, Patrick A. Quarterman, William D. Ratcliff, Julie A. Borchers, H. Zhang, Xianglin Ke, David Graf, Nasim Alem, Cui-Zu Chang, Nitin Samarth, and Zhiqiang Mao Phys. Rev. Research 1, 012011(R) (2019)
70. "Probing Superexchange Interactions in Spin Ice Ho<sub>2</sub>Ti<sub>2</sub>O<sub>7</sub> Thin Films" Kevin Barry, Naveen Anand, Biwen Zhang, Yan Xin, Arturas Vailionis, Colin

- Heikes, Haidong Zhou, Y. Qiu, William Ratcliff, Christianne Beekman Phys. Rev. Materials 3, 084412 (2019)
69. "Fe<sub>2</sub>MnGe: A Hexagonal Heusler Analogue" S. Keshavarz, N. Naghibolashra, M.E. Jamer, K. Vinson, D. Mazumdar, C.L. Dennis, W. Ratcliff II, J.A. Borchers, A. Gupta, P. LeClair Journal of Alloys and Compounds, 771, 793 (2019)
68. "Spin Rotation induced by applied pressure in Cd-doped Ce<sub>2</sub>RhIn<sub>8</sub> intermetallic compound" D. S. Christovam, C. Giles, L. Mendonca-Ferreira, J. Leao, W. Ratcliff, J. W. Lynn, S. Ramos, E. N. Hering, H. Hidaka, E. Baggio-Saitovich, Z. Fisk, P. G. Pagliuso1, C. Adriano Physical Review B 100, 165133 (2019)
67. "Mechanical control of crystal symmetry and superconductivity in Weyl semimetal MoTe<sub>2</sub>" Colin Heikes, I-Lin Liu, Tristin Metz, Chris Eckberg, Paul Neves, Yan Wu, Linda Hung, Phil Piccoli, Huibo Cao, Juscelino Leao, Johnpierre Paglione, Taner Yildirim, Nicholas P. Butch, 1, William Ratcliff II Phys. Rev. Materials 2, 074202 (2018)
66. "reductus: a stateless Python data-reduction service with a browser front-end" Brian Maranville, William Ratcliff II, Paul Kienzle Journal of Applied Crystallography 51, 1500 (2018)
65. "Ordered Magnetism in the Decorated 3D Ising jeff = 1/2 alpha-CoV<sub>3</sub>O<sub>8</sub>" P. M. Sarte, A. M. Arevalo-Lopez, M. Songvilay, D. Le, T. Guidi, V. Garcia-Sakai, S. Mukhopadhyay, S. C. Capelli, W. D. Ratcliff, K. H. Hong, G. M. McNally , E. Pachoud , J. P. Attfield, and C. Stock Phys. Rev. B. 98, 224410 (2018)
64. "Lifetime-shortened acoustic phonons and static order at the Brillouin zone boundary in the organic-inorganic perovskite CH<sub>3</sub>NH<sub>3</sub>PbCl<sub>3</sub>" M. Songvilay, C. Stock, Z.-G. Ye, Guangyong Xu, P. M. Gehring, W. D. Ratcliff, K. Schmalzl, F. Bourdarot, and B. Roessli Phys. Rev. Materials 2, 123601 (2018)
63. "A high-energy density antiferroelectric made by interfacial electrostatic engineering" Julia A Mundy, Colin A Heikes, Bastien F Gross, Dan Ferenc Segedin, Zhe Wang, Berit H Goodge, Quintin N Meier, Christopher T Nelson, Bhagwati Prasad, Lena F Kourkoutis, William D Ratcliff, Nicola A Spaldin, Ramamoorthy Ramesh, Darrell G Schlom arXiv:1812.09615
62. "Electric-field Induced Reversible Switching of the Magnetic Easy-axis in Co/BiFeO<sub>3</sub> on SrTiO<sub>3</sub>" Tieren Gao, Xiaohang Zhang, William Ratcliff, Shingo Maruyama, Makoto Murakami, Anbusathaiah Varatharajan, Zahra Yamani, Peijie Chen, Ke Wang, Huairuo Zhang, Robert D Shull, Leonid A Bendersky, John Unguris, Ramamoorthy Ramesh, Ichiro Takeuchi, Nano Letters 17, 2825 (2017). doi: 10.1021/acs.nanolett.6b05152
61. "Successive field-induced transitions in BiFeO<sub>3</sub> around room temperature" Shiro Kawachi, Atsushi Miyake, Toshimitsu Ito, Sachith E Dissanayake, Masaaki Matsuda, II Ratcliff, Zhijun Xu, Yang Zhao, Shin Miyahara, Nobuo Furukawa, Masashi Tokunaga Phys. Rev. Materials 1, 024408 (2017)

60. "Structural and Magnetic Phase Transitions in Chromium Nitride Thin Films Grown by RF Nitrogen Plasma Molecular Beam Epitaxy" Khan Alam, Steven M Disseler, William D Ratcliff, Julie A Borchers, Rodrigo Ponce-Perez, Gregorio H Coccoletzi, Noboru Takeuchi, Andrew Foley, Andrea Richard, David C Ingram, Arthur R Smith Phys. Rev. B 96, 104433 (2017)
59. "Pressure tuning of collapse of helimagnetic structure in Au<sub>2</sub>Mn" I-Lin Liu, Maria J. Pascale, Juscelino B. Leao, Craig M. Brown, William D. Ratcliff, Qingzhen Huang, and Nicholas P. Butch Phys. Rev. B 96, 184429 (2017)
58. "Tailoring Exchange Couplings in Magnetic Topological Insulator/Antiferromagnet Heterostructures" Qing Lin He, Xufeng Kou, Alexander J. Grutter, Gen Yin, Lei Pan, Xiaoyu Che, Yuxiang Liu, Tianxiao Nie, Bin Zhang, Steven M. Disseler, Brian J. Kirby, William Ratcliff II, Qiming Shao, Koichi Murata, Xiaodan Zhu, Guoqiang Yu, Yabin Fan, Mohammad Montazeri, Xiaodong Han, Julie A. Borchers & Kang L. Wang , Nature Materials 16, 94(2017). doi:10.1038/nmat4783
57. "Magnetic Structures and Dynamics of Multiferroic Systems Obtained with Neutron Scattering" W. D. Ratcliff, II, Jeffrey W. Lynn, Valery Kiryukhin, Prashant Jain, and Michael R. Fitzsimmons, Nature Partner Journals: Quantum Materials 1, 16003 (2016)
56. "Atomically engineered ferroic layers yield a room temperature magnetoelectric multiferroic" Julia A. Mundy, Charles M. Brooks, Megan E. Holtz, Jarrett A. Moyer, Hena Das, Alejandro F. Rbola, John T. Heron, James D. Clarkson, Steven M. Disseler, Zhiqi Liu, Alan Farhan, Rainer Held, Robert Hovden, Elliot Padgett, Qingyun Mao, Hanjong Paik, Rajiv Misra, Lena F. Kourkoutis, Elke Arenholz, Andreas Scholl, Julie A. Borchers, William D. Ratcliff, Ramamoorthy Ramesh, Craig J. Fennie, Peter Schiffer, David A. Muller, & Darrell G. Schlom , Nature 537, 523 (2016). doi: 10.1038/nature19343
55. "Bayesian method for the analysis of diffraction patterns using BLAND" JE Lesniewski, SM Disseler, DJ Quintana, PA Kienzle, WD Ratcliff, Journal of Applied Crystallography 49, 2201-2209 (2016)
54. "Magnetic Structure and Ordering of Multiferroic Hexagonal LuFeO<sub>3</sub>" Steven M Disseler, Julie A Borchers, Charles M Brooks, Julia A Mundy, Jarrett A Moyer, Daniel A Hillsberry, Eric L Thies, Dmitri A Tenne, John Heron, Megan E Holtz, James D Clarkson, Gregory M Stiehl, Peter Schiffer, David A Muller, Darrell G Schlom, William D Ratcliff Physical Review Letters, 114, 217602 (2015)
53. "Multiferroicity in doped hexagonal LuFeO<sub>3</sub>" Steven M. Disseler, Xuan Luo, Bin Gao, Yoon Seok Oh, Rongwei Hu, Yazhong Wang, Dylan Quintana, Alexander Zhang, Qingzhen Huang, June Lau, Rick Paul, Jeffrey W. Lynn, Sang-Wook Cheong, and William Ratcliff, II, Phys. Rev. B 92, 054435 (2015)
52. "One Dimensional(1D)-to-2D Crossover of Spin Correlations in the 3D Magnet ZnMn<sub>2</sub>O<sub>4</sub>" S. M. Disseler, Y. Chen, S. Yeo, G. Gasparovic, P. M. B.

- Piccoli, A. J. Schultz, Y. Qiu, Q. Huang, S-W. Cheong, and W. Ratcliff II, Scientific Reports, 5, 17771. <http://doi.org/10.1038/srep17771> (2015)
51. "Complex structures of different CaFe<sub>2</sub>As<sub>2</sub> samples" B Saparov, C Cantoni, MH Pan, TC Hogan, W. Ratcliff, SD Wilson, K Fritsch, BD Gaulin, AS Sefat, AS, Scientific Reports, 4120 (2014)
50. "Reflections on the magnetic pair distribution function" W. Ratcliff, Acta Crystallographica A 70, 1 (2014)
49. "Change in the magnetic structure of (Bi,Sm)FeO<sub>3</sub> thin films at the morphotropic phase boundary probed by neutron diffraction" Shingo Maruyama, Varatharajan Anbusathaiah, Amy Fennell, Mechthild Enderle, Ichiro Takeuchi, William D. Ratcliff, APL Materials, 2, doi10.1063/1.4901294 (2014)
48. "Electric-field-controlled antiferromagnetic domains in epitaxial BiFeO<sub>3</sub> thin films probed by neutron diffraction" W. Ratcliff II, Zahra Yamani, V. Anbusathaiah, T.R. Gao, P.A. Kienzle, H. Cao, I. Takeuchi, Phys. Rev. B. 87, 140405 (2013)
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46. "Local Weak ferromagnetism in single-crystalline ferroelectric BiFeO<sub>3</sub>", M. Ramazanoglu, M. Laver, W. Ratcliff II, S.M. Watson, W.C. Chen, A. Jackson, K. Kothapalli, Seongsu Lee, S.-W. Cheong, V. Kiryukhin Phys. Rev. Lett. 107, 207206 (2011)
45. "Antiferromagnetic order and superlattice structure in nonsuperconducting and superconducting Rb(y)Fe(1.6+x)Se<sub>2</sub> Phys. Rev. B 84, 094504 (2011)
44. "Giant Effect of Uniaxial Pressure on Magnetic Domain Populations in Multiferroic Bismuth Ferrite" M. Ramazanoglu, W. Ratcliff, H.T. Yi, A.A. Sirenko, SW Cheong, V. Kiryukhin, Phys. Rev. Lett. 107, 067203 (2011)
43. "Temperature-dependent properties of the magnetic order in single-crystal BiFeO<sub>3</sub>" M. Ramazanoglu, W. Ratcliff II, Y.J. Choi, Seongsu Lee, S-W. Cheong, V. Kiryukhin, Phys. Rev. B. 83, 174434 (2011)
42. "Giant Effect of Uniaxial Pressure on Magnetic Domain Populations in Multiferroic Bismuth Ferrite," Ramazanoglu, M., Ratcliff, II, W., Yi, H.T., Sirenko, A.A., Cheong, S.W., Kiryukhin, V., Physical Review Letters 107(6), 067203-1 (2011)
41. "Mechanism of exchange-striction of ferroelectricity in multiferroic orthorhombic HoMnO<sub>3</sub> single crystals" N. Lee, Y.J. Choi, M. Ramazanoglu, W. Ratcliff II, V. Kiryukhin, and S-W. Cheong, Phys. Rev. B 84, 020101 (2011)
40. "Neutron Diffraction Investigations of Magnetism in BiFeO<sub>3</sub> Epitaxial Films" William Ratcliff II, Daisuke Kan, Wangchun Chen, Shannon Watson, Songxue

Chi, Ross Erwin, Garry J. McIntyre, Sylvia C. Capelli, Ichiro Takeuchi, Advanced Functional Materials 21, 1567 (2011)

39. "Antiferromagnetic Order and Superlattice Structure in Nonsuperconducting and Superconducting RbyFe1.6+xSe2" Wang, M., Wang, M., Li, G.N., Huang, Q., Li, C.H., Tan, G.T., Zhang, C.L., Cao, H., Tian, W., Zhao, Y., Chen, Y.C., Lu, X.Y., Sheng, B., Luo, H.Q., Li, S.L., Fang, M.H., Zarestky, J.L., Ratcliff, W.D., Lumsden, M.D., Lynn, J.W., Dai, P., Physical Review B 84, 094504-1 (2011)
38. "Nitrogen contamination in elastic neutron scattering" Songxue Chi, Jeffrey W. Lynn, Ying Chen, William Ratcliff II, Benjamin G. Ueland, Nicholas P. Butch, Shanta R. Saha, Kevin Kirshenbaum, Johnpierre Paglione, Measurement Science and Technology 22, 047001 (2011)
37. "Incommensurate Magnetism in FeAs Strips: Neutron Scattering from CaFe4As3" Yusuke Nambu, Liang L. hao, Emilia Morosan, Kyoo Kim, Gabriel Kotliar, Pawel Zajdel, Mark A. Green, William Ratcliff, Jose A. Rodriguez-Ruvera, Collin Broholm, Phys. Rev. Lett 106, 037201 (2011)
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35. "Cd Doping Effects in the heavy-fermion compounds Ce2Min8 (M=Rh and Ir)" C. Adriano, C. Giles, E.M. Bittar, L.N. Coelho, F. De Bergevin, C. Mazzoli, L. Paolasini, W. Ratcliff, R. Bindel, J.W. Lynn, Z. Fisk, P.G. Pagliuso, Phys. Rev. B 81, 245115 (2010)
34. "Magnetic from factor of SrFe2As2: Neutron diffraction measurements" W. Ratcliff II, P.A. Kienzle, Jeffrey W. Lynn, Shiliang Li, Pengcheng Dai, G.F. Chen, N.L. Wang, Phys. Rev B. 81, 140502 (2010)
33. "Evolution of the bulk properties, structure, magnetic order, and superconductivity with Ni doping in CaFe(2-x)NixAs2" N. Kumar, SX Chi, Y. Chen, KG Rana, AK Nigam, A. Thamizhavel, W. Ratcliff, SK Dar, JW Lynn Phys. Rev. B 80, 144524 (2009)
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26. "Low energy spin waves and magnetic interactions in SrFe<sub>2</sub>As<sub>2</sub>" Jun Zhao, Dao Xin Yao, Shiliang Li, Tao Hong, Y. Chen, S. Chang, W. Ratcliff I I, J. W. Lynn, H. A. Mook, G. F. Chen, J. L. Luo, N. L. Wang, E. W. Carlson, Jiangping Hu, and Pengcheng Dai Phys. Rev. Lett 101, 167203 (2008)
25. "Spin and Lattice Structure of Single Crystal SrFe<sub>2</sub>As<sub>2</sub>" Jun Zhao, W. Ratcliff II, J-W. Lynn, G.F. Chen, J.L. Luo, N.L. Wang, Jiangping Hu, Pengcheng Dai Phys. Rev. B 78, 140504 (2008)
24. "Magnetic order close to superconductivity in the iron-based layered LaO<sub>1-x</sub>F<sub>x</sub>FeAs systems" C. dela Cruz, Q. Huang, JW Lynn, JY Li, W. Ratcliff, JL Zaretsky, HA Mook, GF Chen, JL Luo, NL Wang, PC Dai Nature 453, 899 (2008)
23. "Neel to Spin-Glass-Like Transition Versus Dilution in Geometrically Frustrated ZnCr<sub>2</sub>-2xGa<sub>2</sub>xO<sub>4</sub>" S-H. Lee, W. Ratcliff, Q. Huang, T.H. Kim, S-W. Cheong PRB 77, 014405 (2008)
22. "Formation of pancakelike ising domains and giant magnetic coercivity in ferrimagnetic LuFe<sub>2</sub>O<sub>4</sub>" W. Wu, V. Kiryukhin, H.-J. Noh, K.-T. Ko, J.-H. Park, W. Ratcliff II, P. A. Sharma, N. Harrison, Y.J. Choi, Y. Horime, S. Lee, S. Park, H.T. Yi, C.L. Zhang, S-W. Cheong PRL 101, 137203 (2008)
21. "Electric field control of the magnetic state in BiFeO<sub>3</sub> single crystals" Seoungsu Lee, W. Ratcliff, SW Cheong, V. Kiryukhin APL 92, 192906 (2008)
20. "Single Ferroelectric and chiral magnetic domain of single-crystalline BiFeO<sub>3</sub> in an electric field" Seongsu Lee, Taekjib Choi, W. Ratcliff II, R. Erwin, S-W. Cheong, and V. Kiryukhin PRB RC 78, 100101 (2008)
19. "The pressure effect on the magnetic commensurability and ferroelectricity in multiferroic HoMn<sub>2</sub>O<sub>5</sub>" CR dela Cruz, B. Lorenz, W. Ratcliff, J. Lynn, MM Gospodinov, C.W. Chu Physica B 403, 1359 (2008)
18. "Observation of a continuous phase transition in a shape-memory alloy" J.C. Lahshley, S.M. Shapiro, B.L. Winn, C.P. Opeil, M.E. Manley, A. Alatas, W. Ratcliff, T. Park, R.A. Fisher, B. Mihaila, P. Riseborough, E. K. H. Salje, J.L. Smith Phys. Rev. Lett 101, 135703 (2008)
17. "Crystal distortions in geometrically frustrated ACr<sub>2</sub>O<sub>4</sub> (A=Zn,Cd)", S.-H. Lee, G. Gasparovic, C. Broholm, M. Matsuda, J-H Chung, YJ Kim, H. Ueda,

G. Xu, P Zschack, K. Kakurai, H. Takagi, W. Ratcliff, T-H. Kim, S-W Cheong  
Journal of Physics Condensed Matter 19, 145259 (2007)

16. "Evidence for strong spin-lattice coupling in multiferroic RMn<sub>2</sub>O<sub>5</sub> (R=Tb, Dy, Ho) via thermal expansion anomalies", CR dela Cruz, F. Yen, B. Lorenz, S. Park, SW Cheong, MM Gospodinov, W. Ratcliff, JW Lynn, CW Chu Journal of Applied Physics 99 08R2103 (2006)
15. "Structural Anomalies at the magnetic and ferroelectric transitions in RMn<sub>2</sub>O<sub>5</sub> (R=Tb, Dy, Ho)", CR dela Cruz, F. Yen, B. Lorenz, MM Gospodinov, CW Chu, W. Ratcliff, JUW Lynn, S. Park, S-W Cheong Phys. Rev. B 73, 100406 (2006)
14. "Conformation of the HIV-1 Gag protein in solution", SAK Datta, JE Curtis, W.Ratcliff, PK Clark, RM Crist, J Lebowitz, S. Krueger, A. Rein Journal of Molecular Biology 365, 812 (2007)
13. "Structural anomalies at the magnetic and ferroelastic transitions in RMn<sub>2</sub>O<sub>5</sub> (R=Tb, Dy, Ho)" C.R. dela Cruz, F. Yen, B. Lorenz, M.M. Gospodinov, C.W. Chu, W. Ratcliff, J.W. Lynn, S. Park, and S-W.Cheong. Phys. Rev. B 73, 100406 (2006)
12. "Pressure-dependent magnetic properties of geometrically frustrated ZnCr<sub>2</sub>O<sub>4</sub>" Y. Jo, JG Park, HC Kim, W. Ratcliff, S-W. Cheong, Phys. Rev. B. 72, 184421 (2005)
11. "Magnetic Phase Diagram of the Colossal Magneoelectric, DyMn<sub>2</sub>O<sub>5</sub>" W. Ratcliff II, V. Kiryukhin, M.A. Kenzelmann, S-H. Lee, J. Schefer, R. Erwin, N. Hur, S. Park, and S-W. Cheong. Phys Rev. B. (R) 72, 060407 (2005)
10. "Effects of spin-phonon coupling in the magnetic transition in strongly frustrated ZnCr<sub>2</sub>O<sub>4</sub>" A. B. Sushkov, H. D. Drew, O. Tchernyshyov, W. Ratcliff, S.W. Cheong, Phys. Rev. Lett. 94, 137202 (2005)
9. "Spin Singlet formation in MgTi<sub>2</sub>O<sub>4</sub>: evidence of a chiral dimerization pattern" M. Schmidt, W. Ratcliff II, P.G. Radaelli, K. Refson, N.M. Harrison, S.W. Cheong, Phys. Rev. Lett. 92, 056402 (2004)
8. "First-Order nature of the ferromagnetic phase transition in (La-Ca)MnO<sub>3</sub> near optimal doping." C.P. Adams, J.W. Lynn, V.N. Smolyaninova, A. Biswas, R.L. Green, W. Ratcliff II, S.-W. Cheong, Y.M. Mukovskii, D.A. Shulyatev, Phys. Rev. B. 70, 134414 (2004)
7. "Emergent excitations in a geometrically frustrated magnet" S.-H. Lee, C. Broholm, W. Ratcliff, G. Gasparovic, Q. Huang, T.H. Kim and S-W. Cheong. Nature 418, 856-858 (2002)
6. "Fluctuations and Freezing of Spin-Correlated Nanoclusters in a Geometrically Frustrated Magnet" W. Ratcliff II, S.-H. Lee, C. Broholm, S-W. Cheong, Q. Huang Physical Review B: Rapid Communications 65, 220406/1-220406/4 (2002)

5. "Magnetic properties of the frustrated antiferromagnetic spinel ZnCr<sub>2</sub>O<sub>4</sub> and the spin glass Zn<sub>1-x</sub>CdxCr<sub>2</sub>O<sub>4</sub> (x=0.05,0.10)" H Martinho, NO Moreno, JA Sanjurjo, C Rettori, AJ Garcia-Adeva, DL Huber, SB Oseroff, W Ratcliff, SW Cheong, PG Pagliuso, JL Sarrao, GB Martins Phys. Rev. B. 64, 024408/1-024408/6 (2001).
4. "Studies of the three-dimensional frustrated antiferromagnetic ZnCr<sub>2</sub>O<sub>4</sub>" H Martinho, NO Moreno, JA Sanjurjo, C Rettori, AJ Garcia-Adeva, DL Huber, SB Oseroff, W Ratcliff, SW Cheong, PG Pagliuso, JL Sarrao, GB Martins Journal of Applied Physics 89, 7050-7052 (2001)
3. "Muon spin relaxation study of La<sub>1-x</sub>CaxMnO<sub>3</sub>" RH Heffner, JE Sonier, DE MacLaughlin, GJ Nieuwenhuys, GM Luke, YJ Uemura, W Ratcliff, SW Cheong, G Balakrishnan Phys. Rev. B. 63, 094408/1-094408/14 (2001)
2. "Local spin resonance and spin-Peierls-like phase transition in a geometrically frustrated antiferromagnet" SH Lee, C Broholm, TH Kim, W Ratcliff, SW Cheong Phys. Rev. Lett. 84, 3718-3721 (2000)
1. "Intergrain magnetoresistance via second-order tunneling in perovskite manganites" S Lee, HY Hwang, BI Shraiman, WD Ratcliff, SW Cheong Phys. Rev. Lett. 82, 4508-4511 (1999)

## Selected Conference Talks/Posters

"Investigations of the first intrinsic topological insulator: MnBi<sub>2</sub>Te<sub>4</sub>", Invited, University of Maryland, College Park (virtual) 2021 "Investigations of the first intrinsic topological insulator: MnBi<sub>2</sub>Te<sub>4</sub>", Invited, UC Santa Cruz (virtual) (2021) "Reinforcement Learning to optimize crystal structure determination" March Meeting of the American Physical Society, Nashville , TN (virtual) (2021)

"Investigations of the first intrinsic topological insulator: MnBi<sub>2</sub>Te<sub>4</sub>", Invited, Fayetteville State University (virtual) (2020) "DPOLY Short course Machine Learning for Polymer Physicists: Neural Networks" March Meeting of the American Physical Society, Denver, CO (2020) "Red Cross Fire Risk" JSM 2020 Virtual Conference (2020) "Exerimental Considerations for Magnetic Neutron Scattering", Virtual Workshop on Magnetic Structures, Oakridge National Laboratory (virtual) (2020)

"Neutron Investigations of the Multiferroic Skyrmion GaV<sub>4</sub>S<sub>8</sub>" March Meeting of the American Physical Society, Boston, MA (2019)

"Neutron Investigations of the Multiferroic Skyrmion GaV<sub>4</sub>S<sub>8</sub>" Strongly Correlated Electronic Systems Conference, Okayama, Japan (2019)

"Neutron Investigations of Thin Film Ho<sub>2</sub>Ti<sub>2</sub>O<sub>7</sub>" March Meeting of the American Physical Society, Los Angeles, CA (2018)

- "Mechanical control of the band structure of MoTe<sub>2</sub>" Telluride , Telluride, Colorado (2018)
- "Using neutron scattering to understand solid state materials" Corning Research, Sunnyvale, CA (2018) (invited)
- "Neutron Investigations of the Multiferroic Skyrmion GaV<sub>4</sub>S<sub>8</sub>" International Conference on Magnetism, San Francisco, CA (2018)
- "Multiferroic LuFeO<sub>3</sub>: Adventures in Neutron Scattering" Howard University, Department of Chemistry (2018) (invited)
- "Effects of Electric Field on the magnetic structure of multiferroic (Sm,Bi)FeO<sub>3</sub> films" March Meeting of the American Physical Society, New Orleans, LA (2017)
- "Magnetic structures and dynamics of multiferroic systems obtained with neutron scattering", Mid-Atlantic Sectional Meeeting, Newark, NJ (2017) (invited)
- "Multiferroic h-LuFeO<sub>3</sub>--adventures in Neutron Scattering", Pittsburgh Diffraction Society, Indiana, PA (2017), (invited)
- "Neutron Investigations of thin film Ho<sub>2</sub>Ti<sub>2</sub>O<sub>7</sub>", Quantum Materials Symposium 2017, Berlin, Germany (2017)
- "Bayesian Library for the Analysis of Neutron Diffraction Data" March Meeting of the American Physical Society, Baltimore, MD (2016)
- "Bayesian Library for the Analysis of Neutron Diffraction Data(BLAND)" American Conference on Neutron Scattering (2016)
- "Bayesian Library for the Analysis of Neutron Diffraction Data" American Crystallography Association, Denver (2016)
- "Atomically engineered ferroic layers yield a room temperature magnetoelectric multiferroic" Gordon Conference on Multiferroics, Lewiston, Maine (2016)
- "Atomically engineered ferroic layers yield a roomtemperature magnetoelectric multiferroic" Quantum Materials Synthesis Conference, New York Academies of Science, New York, New York (2016)
- Invited Lecturer Magnetic Structure Determination from Neutron Data, Florida State University, Tallahassee, FL(2016)
- "Neutron scattering investigations of bulk and thin film multiferroic LuFeO<sub>3</sub>" International Conference on Magnetism, Barcelona, Spain (2015)
- "Neutron investigations of multiferroic LuFeO<sub>3</sub>" American Crystallography Association, Philadelphia (2015)
- "The intrinsic magnetic structure and ordering of multiferroic h-LuFeO<sub>3</sub> Films" March Meeting of the American Physical Society, San Antonio, TX (2015)
- "Neutron Investigations of Multiferroic LuFeO<sub>3</sub>" Gordon Research Conference, Biddeford, ME (2014)

- "Neutron diffraction investigations of BiFeO<sub>3</sub>" Polarized Neutrons for Condensed Matter Investigations, U. Sydney, Sydney, Australia (2014) (invited)
- Invited Lecturer Magnetic Structure Determination from Neutron Data Oak Ridge National Lab, Knoxville, TN (2014)
- "Neutron Investigations of Multiferroic LuFeO<sub>3</sub> Thin Films" American Conference on Neutron Scattering, Knoxville, TN (2014)
- "Neutron Investigations of Multiferroic LuFe<sub>1-x</sub>Mn<sub>x</sub>O<sub>3</sub>" March Meeting of the American Physical Society 2014 (Denver)
- "Neutron Investigations of Multiferroic LuFe<sub>1-x</sub>Mn<sub>x</sub>O<sub>3</sub>" Magnetic North IV, Victoria, British Columbia, Canada (2014)
- "Evolution of the magnetic structure in (Sm,Bi)FeO<sub>3</sub> Thin Films" March Meeting of the American Physical Society 2013 (Baltimore)
- "Neutron Investigations of Multiferroic LuFeO<sub>3</sub>" Magnetism and Magnetic Materials, Denver, Co (2013)
- "Neutron Diffraction Investigations of Electric-Field Control of Antiferromagnetic Domains in Epitaxial BiFeO<sub>3</sub> Thin Films" Fundamental Physics of Ferroelectrics and Related Materials, Ames, IA (2013)
- Invited Lecturer Magnetic Structure Determination from Neutron Data Oak Ridge National Lab, Oakridge, TN (2012)
- "Neutron Diffraction Investigations of Magnetism in BiFeO<sub>3</sub> Epitaxial Films" American Conference on Neutron Scattering 2012 (invited)
- "Investigation of Electric Field Control Antiferromagnetic Domains in Epitaxial BiFeO<sub>3</sub> Thin Films Using Neutron Diffraction" March Meeting of the American Physical Society 2012
- "Neutron Diffraction Investigations of Magnetism in BiFeO<sub>3</sub> Epitaxial Films" DAE Solid State Physics Symposium (2012) (invited), IIT Bombay
- "Neutron Diffraction Investigations of Magnetism in BiFeO<sub>3</sub> Epitaxial Films" MMM 2011, Desert Ridge, Arizona (invited)
- "Neutron diffraction investigations of the BiFeO<sub>3</sub> thin films" European Spallation Source, Lundt, Sweden 2011 (invited)
- "The Renaissance of Multiferroics" Missouri University Science Technology, Sep. 2011 (invited).
- "The Renaissance of Multiferroics" Howard University, April 2011 (invited).
- "The Magnetic Form factor of SrFe<sub>2</sub>As<sub>2</sub>" March Meeting of the American Physical Society 2011 (Dallas, Texas) (talk was presented by Pengcheng Dai due to budgetary constraints)
- "The Magnetic Form Factor in SrFe<sub>2</sub>As<sub>2</sub>" MMM 2010 (Atlanta, Georgia)

"Neutron investigations of BiFeO<sub>3</sub> Films" March Meeting of the American Physical Society 2010 (Portland, Oregon)

"Introduction to SPINAL (Spinwave Analyzer), A program for Calculating and Analyzing Spinwaves" American Conference on Neutron Scattering 2010 (Ottawa, Canada)

"BiFeO<sub>3</sub>" Flipper, International Workshop on Single Crystal Diffraction with Polarized Neutrons, 2010 (Grenoble, France)

"BiFeO<sub>3</sub>" Aspen Winter Conference on Fundamental Physics of Ferroelectrics, 2010 (Aspen, Colorado)

"Neutron Scattering Studies of the Fe-Based Superconductors" National Conference of Black Physicists, 2009 (Nahville) W. Ratcliff II, Jun Zhao, J.W. Lynn, G.F. Chen, J.L. Luo, N.L. Wang, Jiangping Hu, Pengcheng Dai (Invited Talk)

"Dimensional Crossover in ZnMn<sub>2</sub>O<sub>4</sub>" William Ratcliff , Ying Chen , Goran Gasparovic , Yiming Qiu , Qing Huang , Jeffrey Lynn , Sunmog Yeo , Sang Cheong , Paula Piccoli , Arthur Schultz. March Meeting of the American Physical Society 2008 (New Orleans, Louisiana).

Dimensional Crossover in ZnMn<sub>2</sub>O<sub>4</sub> William Davis Ratcliff, Ying Chen, Yiming Qiu, S. Yeo, G. Gasparovic, Q. Huang, J. Lynn, Sang Cheong, Paula Piccoli, and Arthur Schultz ACNS 2008 (Santa Fe, New Mexico)

"BiFeO<sub>3</sub>" PNCMI, 2008 (Mito, Japan). W. Ratcliff, Y.Chen, S. Yeo, G. Gasparovic, A. Schultz, P. Piccoli, Q. Huang, Y. Qiu, S-W. Cheong (Invited Talk)

"Elucidation on the effects of hydrostatic pressure on multiferroic, HoMn<sub>2</sub>O<sub>5</sub>", William Ratcliff, C.R. dela Cruz, B. Lorenz, Q. Huang, S. Park, S-W. Cheong. March Meeting of the American Physical Society 2007 (Denver).

"A New Magnet, ZnMn<sub>2</sub>O<sub>4</sub>" National Conference of Black Physicists, 2007 (Boston). (Invited Talk)

"The low dimensional magnet, ZnMn<sub>2</sub>O<sub>4</sub>" Contributed talk, March Meeting 2006 of the American Physical Society (APS), Baltimore, Maryland

"The Giant Magnetoelectric, DyMn<sub>2</sub>O<sub>5</sub>" Contributed talk, March Meeting 2005 of the American Physical Society (APS), Los Angeles, California

"The Giant Magnetoelectric, DyMn<sub>2</sub>O<sub>5</sub>" Contributed talk, American Conference on Neutron Scattering (ACNS), June 2004 College Park, Maryland

"The Magnetic Structure of ZnCr<sub>2</sub>O<sub>4</sub>" Contributed talk, March Meeting 2004 of the American Physical Society (APS), Montreal, Canada

"Frustration in Flatland Revisited" Poster, Boulder Summer School for Condensed Matter Physics, July 2003, Boulder Colorado

"Magnetism of Sr(Ti,Co)O<sub>3</sub>" Poster, Gordon Research Conference on Strongly Correlated Electrons, June 2002, Maine.

"Magnetism of Sr(Ti,Co)O<sub>3</sub>" Contributed talk, March Meeting 2002 of the American Physical Society (APS), Indianapolis, Indiana

"Site-vs-Bond disorder in the geometrically frustrated magnet, ZnCr<sub>2</sub>O<sub>4</sub>" Poster, SCES2001, August 2001, University of Michigan, Ann Arbor

"Site-vs-Bond disorder in the geometrically frustrated magnet, ZnCr<sub>2</sub>O<sub>4</sub>" Contributed talk, March Meeting 2001 of the APS, March 12-16, Seattle, Washington

"The geometrically frustrated magnet, ZnCr<sub>2</sub>O<sub>4</sub>" Poster, Gordon Research Conference Strongly Correlated Electrons, June 2000. New Hampshire.

## Instruction Experience

- Conducted numerous summer schools at the NCNR
- Summer High School Intern Program (SHIP) mentor for high school students
- Summer Undergraduate Research Fellowship (SURF) mentor for undergraduate students
- Outreach through Adventures in Science
- Part time lecturer Physics 205 Employer Rutgers Inclusive Dates 6/1/2003-7/1/2003
- Curriculum development and teaching of 6th and 9th graders in 6th grade math and earth science at South Brunswick Upper Elementary School and 9th grade physical science at East Brunswick Churchill Middle School through the NSF GK-12 fellowship Inclusive dates 8/99-6/01
- Part time lecturer Physics 203 Employer Rutgers Inclusive Dates 6/1/99 - 7/1/99
- Part time lecturer Physics of Sound Employer Rutgers Inclusive Dates 1/1/99 - 6/1/99
- Part time lecturer, Physics 204 Employer Rutgers Inclusive Dates 1/1/99 - 6/1/99
- Part time lecturer Honors Modern Physics Employer Rutgers Inclusive Dates 9/1/98 - 1/1/99
- Part time lecturer Physics 204 Employer Rutgers Inclusive Dates 6/1/98-7/1/98
- Part time lecturer Physics 203 Employer Rutgers Inclusive Dates 7/1/98-8/1/98

## Students and Postdocs

- Colin Heikes (now UMD)
- Kate Meuse (Cornell) 2021
- Jessica Opsahl-Ong (Rice University) 2021
- Joseph Rath 2019
- Abigail Wilson 2018

- Rohit Mandavia 2017
- Nathan Super 2016
- Joseph Lesniewski (graduate school Georgetown) 2014,2015
- Alex Yee 2013
- Dylan Quintana 2012
- Andrew Tracer 2011
- Joseph Redmon (now graduate school in CS at U. Washington) 2010
- Thomas Sarvey (now graduate school at Georgia Tech)
- William Flynn (now graduate school in Physics at Rutgers)
- Ed Schwartz (now staff at Carnegie Mellon)
- Man Kit Patrick Lee (intern from U. Maryland)
- Kate Meuse(Montgomery Blair High School) 2019, 2020
- Jessica Opsahl-Ong () 2019,2020
- Ryan Cho (Montgomery Blair High School) 2018
- Telon Yan (Montgomery Blair High School) 2018
- Michael Yang (Thomas Jefferson High School) 2017
- Nayman Leung 2016
- Cynthia Liu (Montgomery Blair High School) 2015, 2016
- Alexander Zhang (Montgomery Blair) 2013, 2014
- Erica Peng (Thomas Wootton High School) 2013
- Esther Wang (Thomas Jefferson High School) 2012
- Priyanka Patel (Poolesville High School) 2012
- Elakian Kanakaraj (Northwest High School) 2011
- Ophir Lifshitz (Walter Johnson High School) 2010, 2011
- Alex Yee (Poolesville High School) 2010,2011
- George Curtis (high school intern)