Edwin Miles Stoudenmire

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Employment

2017-Pres.   Research Scientist, Flatiron Institute
Center for Computational Quantum Physics (CCQ)

2016-2017   Research Scientist, Univ. of California Irvine
Supported by the Simons Foundation, Many-Electron Collaboration

2013-2016   Postdoctoral Researcher, Perimeter Institute for Theoretical Physics

2010-2013   Postdoctoral Researcher, UC Irvine
Supervisors: Steven R. White and Kieron Burke

2005-2010   Graduate Research Assistant, UC Santa Barbara
Supervisor: Leon Balents

Education

2010   PhD in Physics, UC Santa Barbara. Advisor: Leon Balents
2005   BS in Physics, Georgia Institute of Technology, highest honors
2005   BS in Mathematics, Georgia Institute of Technology, highest honors

Publications

2022   Chunhan Feng, Alexander Wietek, **E.M. Stoudenmire**, Rajiv R. P. Singh, "Order, Disorder and Monopole Confinement in the Spin-1/2 XXZ Model on a Pyrochlore Tube", arxiv:2203.00032

2022   Y. Hur, J. G. Hoskins, M. Lindsey, **E.M. Stoudenmire**, Y. Khoo, "Generative modeling via tensor train sketching", arxiv:2202.11788

2021   Daniel Bauernfeind, Xiaodong Cao, **E.M. Stoudenmire**, Olivier Parcollet, "Minimally Entangled Typical Thermal States Algorithms for Finite Temperature Matsubara Green Functions", arxiv:2107.13941

2021   Alexander Wietek, Riccardo Rossi, Fedor Šimkovic IV, Marcel Klett, Philipp Hansmann, Michel Ferrero, **E.M. Stoudenmire**, Thomas Schäfer, Antoine Georges, "Mott Insulating States with Competing Orders in the Triangular Lattice Hubbard Model", *Phys. Rev. X* **11**, 041013

2021   Justin Reyes, **E.M. Stoudenmire**, "Multi-Scale Tensor Network Architecture for Machine Learning", *Mach. Learning: Sci. Tech.* **2**: 035036

2021   Alexander Wietek, Yuan-Yao He, Steven R. White, Antoine Georges, **E.M. Stoudenmire**, "Stripes,

Antiferromagnetism, and the Pseudogap in the Doped Hubbard Model at Finite Temperature", *Phys. Rev. X* **11**, 031007

2021   Peter Lunts, Antoine Georges, **E.M. Stoudenmire**, Matthew Fishman, "The Hubbard model on the Bethe lattice via variational uniform tree states: metal-insulator transition and a Fermi liquid", *Phys. Rev. Research* **3**, 023054

2020   Matthew Fishman, **E.M. Stoudenmire**, Steven R. White, "The ITensor Software Library for Tensor Network Calculations", arxiv:2007.14822

2020   Yiqing Zhou, **E.M. Stoudenmire**, Xavier Waintal, "What limits the simulation of quantum computers?", *Phys. Rev. X* **10**, 041038   [Associated Physics Viewpoint Article]

2020   Mario Motta, Claudio Genovese, Fengjie Ma, Zhi-Hao Cui, Randy Sawaya, Garnet Kin-Lic Chan, Natalia Chepiga, Phillip Helms, Carlos Jimenez-Hoyos, Andrew J. Millis, Ushnish Ray, Enrico Ronca, Hao Shi, Sandro Sorella, **Edwin M. Stoudenmire**, Steven R. White, Shiwei Zhang, "Ground-state properties of the hydrogen chain: insulator-to-metal transition, dimerization, and magnetic phases", *Phys. Rev. X* **11**, 031058

2020   Tai-Danae Bradley, **E.M. Stoudenmire**, John Terilla, "Modeling Sequences with Quantum States: A Look Under the Hood", *Mach. Learn.: Sci. Technol.* **1**, 035008

2019   Jing Chen, **E.M. Stoudenmire**, "Hybrid Purification and Sampling Approach for Thermal Quantum Systems", *Phys. Rev. B* **101**, 195119

2019   Katharine Hyatt, **E.M. Stoudenmire**, "DMRG Approach to Optimizing Two-Dimensional Tensor Networks", arxiv:1908.08833

2018   Steven R. White, **E.M. Stoudenmire**, "Multisliced gausslet basis sets for electronic structure", *Phys. Rev. B* **99**, 081110(R)

2018   William Huggins, Piyush Patel, K. Birgitta Whaley, **E.M. Stoudenmire**, "Towards Quantum Machine Learning with Tensor Networks", *Quant. Sci. Tech.* **4**, 024001

2018   **E.M. Stoudenmire**, "Learning Relevant Features of Data with Multi-scale Tensor Networks", *Quant. Sci. Tech.* **3**, 034003

2017   William Huggins, C. Daniel Freeman, **E.M. Stoudenmire**, Norm M. Tubman, K. Birgitta Whaley, "Monte Carlo Tensor Network Renormalization", arxiv:1710.03757

2017   Benedikt Bruognolo, Zhenyue Zhu, Steven R. White, and **E.M. Stoudenmire**, "Matrix product state techniques for two-dimensional systems at finite temperature", arxiv:1705.05578

2017   Mario Motta, David M. Ceperley, **E.M. Stoudenmire**, et al., "Towards the solution of the many-electron problem in real materials: equation of state of the hydrogen chain with state-of-the-art many-body methods", *Phys. Rev. X* **7**, 031059

2017   **E.M. Stoudenmire** and Steven R. White, "Sliced Basis Density Matrix Renormalization Group for Electronic Structure", *Phys. Rev. Lett.* **119**: 046401

2016   **E.M. Stoudenmire** and D.J. Schwab, "Supervised Learning with Quantum-Inspired Tensor Networks", *Advances in Neural Information Processing Systems (NIPS)* **29**: 4799

2016   Sharmistha Sahoo, **E.M. Stoudenmire**, Jean-Marie Stéphan, Trithep Devakul, Rajiv R. P. Singh,

and Roger Melko, "Unusual Corrections to Scaling and Convergence of Universal Renyi Properties at Quantum Critical Points", *Phys. Rev. B* **93**: 085120

2015   Thomas E. Baker, **E.M. Stoudenmire**, Lucas O. Wagner, Kieron Burke, and Steven R. White, "One Dimensional Mimicking of Electronic Structure: The Case for Exponentials", *Phys. Rev. B* **91**: 235141

2015   **E.M. Stoudenmire**, David J. Clarke, Roger S. K. Mong, and Jason Alicea, "Assembling Fibonacci Anyons from a $\mathbb{Z}_3$ Parafermion Lattice Model", *Phys. Rev. B* **91**: 235112
 [**Editor's suggestion**]

2014   **E.M. Stoudenmire**, Peter Gustainis, Ravi Johal, Stefan Wessel, and Roger G. Melko, "Corner Contribution to the Entanglement Entropy of Strongly-Interacting O(2) Quantum Critical Systems in 2+1 Dimensions", *Phys. Rev. B* **90**: 235106

2014   Lucas O. Wagner, Thomas E. Baker, **E.M. Stoudenmire**, Kieron Burke, and Steven R. White , "Kohn-Sham Calculations with the Exact Functional", *Phys. Rev. B* **90**: 045109
 [**Editor's suggestion**]

2014   A.B. Kallin, **E.M. Stoudenmire**, P. Fendley, R.R.P. Singh and R.G. Melko , "Corner Contribution to the Entanglement Entropy of an O(3) Quantum Critical Point in 2+1 Dimensions", *J. Stat. Mech.* (2014) P06009

2013   Lucas O. Wagner, **E.M. Stoudenmire**, Kieron Burke, and Steven R. White , "Guaranteed Convergence of the Kohn-Sham Equations", *Phys. Rev. Lett.* **111**: 093003 [**Editor's suggestion**]

2013   **E.M. Stoudenmire** and Steven R. White, "Real-space parallel density matrix renormalization group", *Phys. Rev. B* **87**: 155137

2013   Salvatore R. Manmana, **E.M. Stoudenmire**, Kaden R.A. Hazzard, Ana Maria Rey and Alexey V. Gorshkov, "Topological phases in ultracold polar-molecule quantum magnets", *Phys. Rev. B* **87**: 081106(R)

2012   **E.M. Stoudenmire**, Lucas O. Wagner, Steven R. White and Kieron Burke, "One-dimensional continuum electronic structure with the density matrix renormalization group and its implications for density functional theory", *Phys. Rev. Lett.* **109**: 056402

2012   Lucas O. Wagner, **E.M. Stoudenmire**, Kieron Burke and Steven R. White, "Reference electronic structure calculations in one dimension", *Phys. Chem. Chem. Phys.* **14**: 8581

2012   **E.M. Stoudenmire** and Steven R. White, "Studying two dimensional systems with the density matrix renormalization group", *Annual Reviews of Condensed Matter Physics* **3**: 111

2011   **E.M. Stoudenmire,** Jason Alicea, Oleg A. Starykh and Matthew P.A. Fisher, "Interaction effects in topological superconducting wires supporting majorana fermions", *Phys. Rev. B* **84**: 014503 [**Editor's suggestion**, Synopsis Article]

2010   **E.M. Stoudenmire** and Steven R. White, "Minimally entangled typical thermal state algorithms" *New J. Phys.* **12**: 055026

2009   **E.M. Stoudenmire**, Simon Trebst and Leon Balents, "Quadrupolar correlations and spin freezing in S=1 triangular lattice antiferromagnets", *Phys. Rev. B* **79**: 214436

2008   **E.M. Stoudenmire** and Leon Balents, "Ordered phases of the anisotropic kagome lattice an-

tiferromagnet in a field", *Phys. Rev. B* **77**: 174414

2005   **E.M. Stoudenmire** and C.A.R. Sá de Melo, "Magnetoresistive effects in ferromagnet-superconductor multilayers", *J. Appl. Phys.* **97**: 10J108

Invited Research Talks

Oct 2021   Flatiron FWAM Math Conference, *"The Julia Programming Language"*.

Oct 2021   U. New Mexico, CQuiC, *"What Limits the Simulation of Quantum Computers?"*. (Given remotely.)

Aug 2021   Flatiron Seminar, *"Rivaling Near-Term Quantum Computers with Tensor Networks"*.

Jun 2021   Collège de France, *"Introduction and Perspective on Tensor Network Methods for Quantum Many-Body Physics"*. (Given remotely.)

May 2021   U. Washington, Workshop on Tensor Networks in Many Body and Quantum Field Theory, *"Automatic Fermion Signs for the ITensor Software"*. (Given remotely.)

Apr 2021   CUNY Symposium on Quantum non-unitary many-body dynamics, *"What Limits the Simulation of Quantum Computers?"*. (Given remotely.)

Mar 2021   IPAM Tensor Networks Workshop, *"Tensor Networks for Machine Learning and Applications"*. (Given remotely.)

Mar 2021   SIAM CSE Conference, Session on High-Performance Tensor Computations, *"Tensor Networks and the ITensor Software"*. (Given remotely.)

Feb 2021   European Tensor Network Seminar, *"What Limits the Simulation of Quantum Computers?"*. (Given remotely.)

Oct 2020   CUNY **Symposium** on Quantum-Inspired Machine Learning, *"Perspective on Machine Learning with Tensor Networks"*. New York, NY. (Given remotely.)

Apr 2020   Rice AMO Seminar, *"What Limits the Simulation of Quantum Computers?"*. Houston, Texas. (Given remotely.)

Apr 2020   MILA Seminar, *"A Theory of Generative Modeling Using Matrix Product State Tensor Networks"*. Montreal, Quebec. (Given remotely.)

Dec 2019   Weierstrass Institute, *"A Theory of Generative Modeling Using Matrix Product State Tensor Networks"*. Berlin, Germany.

Sep 2019   Asia Pacific Center for Theoretical Physics *"DMRG for 2D Systems and Advanced Topics"* and *"Tensor Networks for Machine Learning"*. Pohang, South Korea.

Sep 2019   DPG Fall Meeting, *"A Perspective on Quantum Machine Learning (Emphasizing Parameterized Circuits)"*. Freiburg, Germany.

May 2019   Google X Bootcamp Lecture, *"Matrix Product State Tensor Networks for Data"*. Mountain View, CA.

Feb 2019	SIAM CSE Conference, *"Classical and Quantum Machine Learning with Tensor Networks"*. Spokane, WA.
Jan 2019	MIT Workshop on Compiler Techniques for Sparse Tensor Algebra, *"Tensor Networks and the ITensor Library"*. Boston, MA.
Jan 2019	Zapata Quantum Computing, *"Introduction to Tensor Networks and Applications"*. Boston, MA.
Jan 2019	Aspen Workshop on Theoretical Physics for Machine Learning , *"Wavefunctions of Data: Classical and Quantum Machine Learning with Tensor Networks"*. Aspen, CO.
Nov 2018	QTML Conference, *"Classical and Quantum Machine Learning with Tensor Networks"*. Durban, South Africa.
Oct 2018	CIFAR Meeting on Quantum Information, *"Wavefunctions of Data: Classical and Quantum Machine Learning with Tensor Networks"*. Toronto, Canada.
Mar 2018	Laboratory for Physical Sciences, *"Wavefunctions of Data: Using Tensor Networks for Machine Learning"*. Gaithersburg, MD.
Feb 2018	UMD Workshop on Machine Learning Quantum Materials, *"Wavefunctions of Data: Using Tensor Networks for Machine Learning"*. Gaithersburg, MD.
Feb 2018	University of Amsterdam Seminar, *"Applications of Tensor Networks to Machine Learning"*. Amsterdam, Netherlands.
Jan 2018	Max Planck Workshop on Machine Learning for Quantum Many-Body, *"Applications of Tensor Networks to Machine Learning"*. Dresden, Germany.
Dec 2017	**Colloquium**, Max Planck Institute for Complex Systems, *"The inner life of the quantum wavefunction: tensor networks and their applications"*. Dresden, Germany.
Dec 2017	Vector Institute for Machine Learning, *"Classical and Quantum Machine Learning with Tensor Networks"*. Toronto, Canada.
Apr 2017	Perimeter Institute Condensed Matter Seminar, *"Classical and Quantum Machine Learning with Tensor Networks"*. Waterloo, Canada.
Mar 2017	INTRIQ Annual Meeting, *"Classical and Quantum Machine Learning with Tensor Networks"*. Bromont, Canada.
Feb 2017	Conference on Non-Thermal Quantum Systems, *"Matrix Product State Techniques for Studying Finite Temperature Systems"*. Boston, MA.
	Invited to APS March Meeting, *"Tensor Network Machine Learning Models"*. Los Angeles, CA.
	Workshop on Entanglement in Strongly Correlated Systems, *"Introduction to Machine Learning* and *"Learning Relevant Features of Data with Multiscale Tensor Networks"*. Benasque, Spain.
	CUNY, *"Learning Relevant Features of Data with Multiscale Tensor Networks"*. New York, NY.

Physics Informed Machine Learning, *"Learning Relevant Features of Data with Tensor Networks"*. Santa Fe, NM.

AI and Quantum Physics Workshop, *"Learning Relevant Features of Data with Tensor Networks"*. Nanjing, China.

Simons Center for Geometry and Physics, *"Learning Relevant Features of Data with Tensor Networks"*. Stony Brook, NY.

Perimeter Institute, *"Applying DMRG to Continuous Systems in 1D and 3D"*. Waterloo, Canada.

RIKEN AICS, *"Machine Learning with Quantum-Inspired Tensor Networks"*. Kobe, Japan.

UC Irvine AI/ML Seminar, *"Learning with Tensor Networks"*. Irvine, CA.

Jan 2017 UBC, *"Sliced Basis Set Approach to Quantum Chemistry with DMRG"*. Vancouver, BC.

Dec 2016 "Tensor Network States: Algorithms and Applications" Conference, *"Machine Learning with Quantum-Inspired Tensor Networks"*. Hsinchu, Taiwan.

Nov 2016 CUNY Graduate Center Symposium, *"Machine Learning with Quantum-Inspired Tensor Networks"*. New York, NY.

Oct 2016 Berkeley Chemistry Seminar, *"Quantum Chemistry by a Thousand Cuts"*. Berkeley, CA.

Apr 2015 MIT Condensed Matter Seminar, *"Uncovering the Fibonacci Phase in Z3 Parafermion Systems"*. Cambridge, Massachusetts.

Apr 2015 Univ. of Illinois Condensed Matter Seminar, *"Uncovering the Fibonacci Phase in Z3 Parafermion Systems"*. Urbana-Champaign, Illinois.

Feb 2015 Conference on Advanced Numerical Algorithms for Strongly Correlated Quantum Systems, *"Uncovering the Fibonacci Phase in Z3 Parafermion Systems"*. Würzburg, Germany.

May 2014 UC Irvine, *"Numerical Evidence for Fibonacci Anyons in Lattice Models of Quantum Hall / Superconductor Heterostructures"*. Irvine, CA.

Sep 2012 LMU München, *"Parallelizing DMRG in Real Space"*. Munich, Germany.

Aug 2012 JILA and CU Dept. of Physics, *"Simulating Realistic Systems with DMRG"*. Boulder, CO.

May 2012 UC Merced Dept. of Chemistry, *"Exact Electronic Structure in 1d"*. Merced, CA.

Mar 2012 APS March Meeting, Symposium on DFT, *"Exact Density Functional Calculations with DMRG"*. Boston, MA.

Jun 2011 Microsoft Station Q Seminar, *"Interaction Effects in Topological Superconducting Wires"*. Santa Barbara, CA.

Oct 2010 L.A. Cond. Mat. Theory Meeting, *"DMRG Meets DFT"*. Pasadena, CA.

Invited Pedagogical Talks

Sep 2019   Autumn School on Correlated Electrons, Forschungzentrum Jülich, *"Tensor Networks for Ab Initio Quantum Systems"*. Jülich, Germany. Link to Book Chapter.

Apr 2018   One-week course on Tensor Networks, University of São Paulo, Brazil. Five lectures and four hands-on sessions. Poster link.

Jun 2017 &   Simons Summer School on the Many-Electron Problem and Coding School, *"Design"*, *"Optimization"*, *"Intro to Julia"* and *"ITensor Hands-on"*. Stony Brook, New York.
2016

Jun 2016 &   International School on Computational Methods for Quantum Materials, *"Hands-on with the ITensor Library"* (2 lectures and hands-on tutorials). Sherbrooke, Québec.
2014

Jun 2014   Simons Summer School on the Many-Electron Problem, *"Matrix Product States and DMRG"* and *"ITensor Hands-on"* (3 lectures and hands-on tutorials). Stony Brook, New York.

Dec 2012   National Taiwan University, Winter School: DMRG 101. *"Studying Density Functional Theory and One-Dimensional Electronic Structure with DMRG"*. Taipei, Taiwan. Video and Slides

Dec 2012   Northeastern University, *"Introduction to MPS with the ITensor Library"* (2 lectures and hands-on tutorials). Boston, MA.

Mar 2012   IMSC Chennai, K.S. Krishnan Meeting on Tensor Network States
"From DMRG to Tensor Network States" (2 Lectures, Delivered Online). Chennai, India.

Teaching Experience

Mar 2015   **Master's Course**, Perimeter Institute PSI Program: *"Condensed Matter Explorations"*
(14 lectures; I created and taught all the lectures)

2012-13   Guest Lecturer. UCI advanced undergraduate quantum mechanics and condensed matter physics (6 Lectures).

2008   Guest Lecturer. UCSB graduate condensed matter physics (4 Lectures).

Selected Activities and Contributed Talks

Jan-Mar   **Organizer**. KITP Program on *Machine Learning for Quantum Many-Body Physics*.
2019

Dec 2016   Neural Information Processing (NIPS) Conference, Barcelona. Poster: *"Learning with Quantum-Inspired Tensor Networks"*.

Aug 2016   **Organizer**. Quantum Machine Learning, Perimeter Institute.
Talk: *"Learning with Quantum-Inspired Tensor Networks"*. Talk video and slides.

Jan 2016   Physics Informed Machine Learning, Santa Fe. Poster: *"Supervised Learning with Quantum-Inspired Tensor Networks"*.

Aug 2014   Conference on Computational Physics, CCP2014, Boston University.
            Talk title: *"Corner Contributions to Entanglement Entropy in Critical Systems"*

References available upon request