

Edwin Miles Stoudenmire

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Research Experience

- 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
- Scalable “sliced basis” DMRG approach to quantum chemistry.
 - Co-organized [Quantum Machine Learning](#) conference at the Perimeter Institute for Theoretical Physics.
- 2013-2016 Postdoctoral Researcher, Perimeter Institute for Theoretical Physics
- Proposed [machine learning framework](#) based on powerful tensor network methods developed in physics. [Link to video](#).
 - Performed highly cited [research on non-abelian topological order](#) in 2d lattice models and [universal entanglement properties](#) of critical systems
 - Significantly expanded user base of [ITensor software](#) and developed ambitious new version 2.0 design.
- 2010-2013 Postdoctoral Researcher, UC Irvine
Supervisors: Steven R. White and Kieron Burke
- Discovered a [method for parallelizing](#) the density matrix renormalization group (DMRG) algorithm in real space.
 - Extensively developed ITensor: an open-source C++ library for tensor network algorithms and DMRG. Website: <http://itensor.org/>
- 2005-2010 Graduate Research Assistant, UC Santa Barbara
Supervisor: Leon Balents
- Applied a variety of methods (bosonization, mean-field, spin wave high temperature series, Monte Carlo) to study frustrated magnets.
 - Collaborated with Steven R. White on a new method for simulating finite temperature quantum systems ([METTS](#) algorithm).

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

- 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”, arxiv:[1705.01608](#)
- 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 antiferromagnet 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

- Jul 2017 Kavli Inst. of Theor. Sci. (KITS), “*Machine Learning with Tensor Networks*”. Beijing, China.
- Apr 2017 Perimeter Institute, “*Applying DMRG to Continuous Systems in 1D and 3D*”. Waterloo, Canada.
- Mar 2017 RIKEN AICS, “*Machine Learning with Quantum-Inspired Tensor Networks*”. Kobe, Japan.
- Feb 2017 UCF, “*Machine Learning with Quantum-Inspired Tensor Networks*”. Orlando, FL.
- Feb 2017 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.
- Jan 2017 D-Wave Systems, “*Machine Learning with Quantum-Inspired Tensor Networks*”. Burnaby, 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.
- 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.

Invited Pedagogical Talks

- Jun 2017 & 2016 Simons Summer School on the Many-Electron Problem and Coding School, “*Design*”, “*Optimization*”, “*Intro to Julia*” and “*ITensor Hands-on*”. Stony Brook, New York.
- Jun 2016 & 2014 International School on Computational Methods for Quantum Materials, “*Hands-on with the ITensor Library*” (2 lectures and hands-on tutorials). Sherbrooke, Québec.
- 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

- 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