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Research Experience

2016-Pres. 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   **E.M. Stoudenmire** and Steven R. White, "Sliced Basis Density Matrix Renormalization Group for Electronic Structure", arxiv:1702.03650

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

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.

Sep 2012	ITP Univ. of Cologne, *"New Tools for Simulating Realistic Systems with DMRG"*. Cologne, 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 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 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