Khagendra Adhikari, PhD

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Professional Summary

- Self-motivated and highly independent researcher in computational condensed matter physics with 7+ years of experience in research resulting in a peer-reviewed scientific publication.
- Demonstrated lucid communication skills via teaching (science and mathematics to diverse groups of students for 10+ years) and 15+ conference presentations.

Education

2013 – 2020 **Ph.D. Physics, The University of Mississippi, Oxford, MS**
Dissertation title: *Numerical Studies of a Quantum Spin Chain With Three-body Interactions*
Advisor: Dr. Kevin Beach

2011 – 2013 **Physics MS, The University of Southern Mississippi, Hattiesburg, MS**
Project title: *Finding the Partial Wave Component of Tensor Interaction in Momentum Space*
Advisor: Dr. Khin Maung Maung

2005 – 2009 **M.Sc. Physics, Tribhuvan University,** Central Department of Physics, Kathmandu, Nepal

2004 – 2005 **B.Ed. Supervision and Administration, Tribhuvan University,** Prithivi Narayan Campus, Pokhara, Nepal

2001 – 2004 **B.Sc. Physics, Tribhuvan University,** Prithivi Narayan Campus, Pokhara, Nepal
Minors: *Mathematics and Statistics*

Experience

2020 – **Adjunct Instructor,** The University of Mississippi, Oxford, MS

2019 – 2020 **Research Assistant,** The University of Mississippi, Oxford, MS
Numerical characterization of the broader phase diagram that encompasses the Fredkin model and its so-called t-deformation.

2013 – 2019 **Teaching Assistant,** The University of Mississippi, Oxford, MS
Laboratory Instructor: *Phys221, Phys222*
Grader: *Phys211, Phys212, Phys213, Phys503* (Scientific Computing)

2011 – 2013 **Teaching Assistant,** The University of Southern Mississippi, Hattiesburg, MS
Laboratory Instructor: *Phy111L, Phy112L, Phy201L and Phy202L*

2009 – 2011 **Physics Lecturer,** Kathmandu Model Higher Secondary School, Kathmandu, Nepal

2004 – 2005 **Science and Mathematics Teacher,** Lok Deep Secondary Boarding School, Myagdi, Nepal

Research Publications

Published articles

1. **Adhikari, K.** & Beach, K. S. D. (2020b, November). Tunable quantum spin chain with three-body interactions. *Phys. Rev. B*, *102*, 184415. doi:10.1103/PhysRevB.102.184415
2. **Adhikar, K.** & Beach, K. S. D. (2019, February). Deforming the Fredkin spin chain away from its frustration-free point. *Phys. Rev. B*, *99*, 054436. doi:10.1103/PhysRevB.99.054436

Under review

1. **Adhikari, K.** & Beach, K. S. D. (2020a, November 13). *Slow dynamics of the Fredkin spin chain*. Version 1. arXiv: arXiv:2011.07110

Manuscripts in preparation

1. Do, H. T., **Adhikari, K.**, & Beach, K. S. D. (2019, May 21). *Effective interactions between local hopping modulations on the square lattice*. Version 2. arXiv: arXiv:1904.03220v2

Research Experiences

- Proposed various novel generalizations of the Fredkin Spin Chain model, a spin-half system with a specially tuned three-body interactions.
- Developed Exact Diagonalization, DMRG and Monte Carlo source code in C++.
- Solved for the classical version of the model using global optimization with Matlab.
- Implemented parallel codes using MPI.
- Deployed HPC resources at Mississippi Center for Supercomputing Research.
- Analyzed and visualized data using Python, R, Matlab, and Gnuplot.
- Prepared manuscripts using LaTeX.
- Used Bitbucket – web-based git version control repository – for source code and manuscripts.
- Presented research at annual American Physical Society March Meeting conferences.
- Designed and maintained a personal website using HTML and CSS.

Project 1: Deforming the Fredkin spin chain away from its frustration-free point

- Proposed a one-parameter family of models that interpolate between the conventional quantum Heisenberg spin chain (two-body interactions), in the limits of ferromagnetic and antiferromagnetic coupling, and the Fredkin spin chain (three-body).
- Solved for the low-energy properties of this model, numerically (using ED and DMRG) and semi-analytically using computational algebra techniques), in order to track the properties of the system as it is tuned between the two limits.
- Revealed the extreme brittleness of the Fredkin ground state to frustrating antiferromagnetic interactions.
- Discovered another special tuning point: Anti-Fredkin model.
- Published as a regular article in Physical Review B.

Project 2: Tunable quantum spin chain with three-body interactions

- Developed a representation of the Hilbert space using the language of matching and nested spin pairs.
- Discovered the number of defects as a quantum number of the Fredkin spin chain.

Research Experiences (continued)

- Devised a family of models that generalizes the original Fredkin spin chain in which the universe of Fredkin-like states lies on a unit circle in the phase diagram.
- Demarcated a unit circular boundary between regions that show ferromagnetic, antiferromagnetic, and dimerized behavior.
- Remarked on our discovery of a new phase in which the ground state is comprised of spin configurations with at least one spin mismatch defect.
- Published as a regular article in Physical Review B.

Project 3: Slow dynamics of Fredkin spin chain

- Formulated a projective Monte Carlo scheme for the Fredkin spin chain that is efficient and sign-problem free.
- Sampled the true quantum dynamics of excitation as a random walk executed in Monte Carlo time and made a quantitative measurement of the dynamical exponent.
- Provided an intuitive picture of the excited bond dynamics and also explained how it is related to the slow dynamics of the Fredkin spin chain.

Technical Skills

Operating systems	Windows, Linux, Mac OS X
Coding	C++, Python, R, FORTRAN, MATLAB
Databases	PostgreSQL
Graphical Software	Gnuplot, ggplot2, Matplotlib, Inkscape
Web Dev	HTML, CSS
Misc.	Parallel Computing (MPI) and job management on clusters (PBS scripting), Object-oriented Programming, Bash scripting, SSH, version control (git), Academic research, teaching, LaTeX typesetting and publishing

Certification

July 15, 2017 — **Machine Learning**, online non-credit course authorized by Stanford University and offered through Coursera. https://www.coursera.org/account/accomplishments/certificate/Z3C6M99M6BBJ

Awards and Achievements

Summer 2019 — **Summer Graduate Research Assistantship**, University of Mississippi, USA

Fall 2018 — **Dissertation Fellowship**, University of Mississippi, USA

Summer 2018 — **Summer Graduate Research Assistantship**, University of Mississippi, USA

Professional Memberships

- Golden Key International Honor Society
- Student Member of American Physical Society (APS)
- Lifetime Member of Nepal Physical Society (NPS)
- Association of Nepali physicists in America (ANPA)

Professional Service

- **Undergraduate Research Conference** *by University of Southern Mississippi.* April 20, 2013. **Moderator:** Panels **XIX** (The Chemical World, Macro and Micro) and **XXVI** (Pushing Theoretical Boundaries)

Oral Presentations

Conferences

- **APS March Meeting 2019** *by American Physical Society.* March 4-8, 2019, Boston, MA, USA. Title: SLOW DYNAMICS OF FREDKIN SPIN CHAIN. http://meetings.aps.org/Meeting/MAR19/Session/E07.14
- **SESAPS 2018** *by American Physical Society Southeastern Section.* November 8-10, 2018, Knoxville, TN, USA. Title: SLOW DYNAMICS OF THE FREDKIN SPIN CHAIN. http://meetings.aps.org/Meeting/SES18/Session/F01.2
- **APS March Meeting 2018** *by American Physical Society.* March 5-9, 2018, Los Angeles, CA, USA. Title: A TUNABLE QUANTUM SPIN CHAIN WITH THREE-BODY INTERACTION. http://meetings.aps.org/Meeting/MAR18/Session/H19.11
- **APS March Meeting 2017** *by American Physical Society.* March 13-17, 2017 New Orleans, LA, USA. Title: DEFORMING THE FREDKIN SPIN CHAIN AWAY FROM ITS FRUSTRATION-FREE POINT. https://meetings.aps.org/Meeting/MAR17/Session/X20.10
- **81 Annual Meeting** *by Mississippi Academy of Sciences.* February 23-24, 2017, University of Southern Miss, MS, USA. Title: DEFORMING THE FREDKIN SPIN CHAIN AWAY FROM ITS FRUSTRATION-FREE POINT
- **79 Annual Meeting** *by Mississippi Academy of Sciences.* February 26-27, 2015, University of Southern Miss, MS, USA. Title: EXACT DIAGONALIZATION OF FRUSTRATED QUANTUM SPIN CHAINS. (oral and poster presentation)
- **77 Annual Meeting** *by Mississippi Academy of Sciences.* February 21-22, 2013, University of Southern Miss, MS, USA. Title: FINDING THE PARTIAL WAVE COMPONENTS OF TENSOR INTERACTION IN MOMENTUM SPACE

Symposiums and Seminars

- **3MT** *by Graduate school, The University of Mississippi.* October 22, 2019. Title: COMPUTER SIMULATION OF QUANTUM MANY-BODY SYSTEMS
- **3MT** *by Graduate school, The University of Mississippi.* October 23, 2018. Title: QUANTUM STATES OF MATTER
- **Seminars/Colloquia, Spring 2018** *by Department of Physics and Astronomy.* April 17, 2018, The University of Mississippi, MS, USA. Title : DEFORMING THE FREDKIN SPIN CHAIN AWAY FROM ITS FRUSTRATION FREE POINT. http://www.phy.olemiss.edu/Colloquia/1718spring.html
- **3nd Annual UM-MSU Physics Research Symposium** *by UM Physics Graduate Student Association.* April 8, 2018. Title : A TUNABLE QUANTUM SPIN CHAIN WITH THREE-BODY INTERACTION
- **2nd Annual UM-MSU Physics Research Symposium** *by MSU Physics Graduate Student Association.* March 4, 2017, Starkville, MS, USA. Title : DEFORMING THE FREDKIN SPIN CHAIN AWAY FROM ITS FRUSTRATION FREE POINT
- **PGSA Research Symposium Fall 2016** *by UM Physics Graduate Student Association.* September 23, 2016. Title: FREDKIN SPIN CHAIN
- **1st Annual UM-MSU Physics Research Symposium** *by UM Physics Graduate Student Association.* February 27, 2016, Oxford MS, USA. Title: SOLUTION OF FRUSTRATED QUANTUM SPIN CHAIN USING LANCZOS METHOD

Oral Presentations (continued)

- **PGSA Research Symposium Fall 2015** *by UM Physics Graduate Student Association.* September 4, 2015. Title: NUMERICAL SOLUTION OF FRUSTRATED QUANTUM SPIN CHAINS

Participation

- **Theory Winter School** *by National Hight Magnetic Field Laboratory.* January 8-12, 2018, Tallahassee, Florida, USA. Focus: QUANTUM INFORMATION THEORY AND MANY-BODY PHYSICS. https://nationalmaglab.org/news-events/events/2018-theory-winter-school
- **76 Annual Meeting** *by Mississippi Academy of Sciences.* February 23-24, 2012, Hattiesburg, MS, USA
- **5th National Conference on Science and Technology** *by Nepal Academy of Science and Technology.* November 10-12, 2008, Kathmandu, Nepal

References

Available on Request