Kamal Sharma

PhD Student
Theoretical Condensed Matter Physics
Georgia Institute of Technology

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EDUCATION

Aug 2012 – present
PhD Candidate in
Condensed Matter **Physics**
Georgia Institute of Technology, Atlanta, GA
Minor: **Computational Physics**
GPA: 3.43

Physics GRE: 980/990 (94%)
GRE :

Aug 2005 – July 2009
Bachelor of Technology in
Civil Engineering
Indian Institute of Technology (IIT), Roorkee

RESEARCH INTERESTS

Solid State Physics, Electronic Structure, **Mesoscopic Transport**, **Machine Learning**

KEY SKILLS

Simulations, Theoretical Physics, **MATLAB**, **WEKA**, **Mathematica, C.**

RELEVANT COURSES

Machine Learning, Non-equilibrium Statistical Physics, Non-Linear Dynamics (Chaos)**,** Quantum Mechanics (I &II), Electromagnetism (I & II), **Fluid Mechanics,** Mathematical Methods (I & II)

RECENT WORK SUMMARY

(details on page 2)

GEORGIA TECH, ATLANTA

May 2014 – present
Transport in low dimensional interacting systems
Studying correction to conductance in quantum nano-wires due to electron-electron interactions within a wire and between two wires.

April 2014 – April 2015
Control of Calcium-ion induced electrical alternans in cardiac cells
Simulation and control of cardiac arrhythmia on a cardiac tissue model using C programming language.

Summer 2017
Analyzing Gravitational Waveforms and handwriting recognition using Machine Learning
Classification of black-hole mergers using signal processing and machine learning. **WEKA, MATLAB**

RAMAN RESEARCH INSTITUTE, BANGALORE

January 2011-May 2012
Monte Carlo simulations to study liquid crystals
Simulated Annealing methods to study phase transitions in liquid crystals using C, **MATLAB**, theory of Phase Transitions.

January 2011-May 2012
First Passage Time for a random walker on a Lattice vs Continuum

POSTERS

Gravitational Wave Analysis using Machine Learning
Sharma, K., Bolla R., and Khamesra B., Georgia Regional Astronomy Meet, 2017.

PUBLICATIONS

[1] FIRST-PASSAGE TIME: LATTICE VERSUS CONTINUUM
Sharma, Kamal, and N. Kumar, *Physical Review E* 86.3 (2012): 032104.
[2] GETTING ACQUAINTED WITH GEARS AND WHEELS – QUANTUM MECHANICALLY
Sharma, Kamal, and N. Kumar, *Resonance* 18.1 (2013): 67-77.

TEACHING EXPERIENCE

Graduate Teaching Assistant (GTA), Georgia Tech School of Physics

August 2012 – Present

- Taught recitations an labs in class of ~75 engineering students for introductory Electromagnetism and Mechanics courses.
- Graded assignments and exams for graduate level Quantum Mechanics and Electromagnetism courses.
- Served as judge at 13th Annual Undergraduate Research Spring Symposium

DETAILS OF PROJECTS

Transport in low dimensional interacting systems

PhD candidate (Adviser: Prof. Michael Pustilnik) at Georgia Institute of Technology, Atlanta

April 2015 – Present

We study the effects of interaction among electrons on the thermal and electrical properties of one-dimensional systems. These effects are becoming more dominant as the world is moving towards smaller electrical components that are very closely packed. We use Quantum mechanics (Luttinger liquid theory) along with semi-classical tools like Boltzmann kinetic theory to calculate corrections to transport properties of such physical systems. The research is important both from an applied as well as a fundamental physical perspective.

- Used: Many-body Quantum Physics, Boltzmann Equation, continuum mechanics.
- Research Tags: Wigner crystals, Luttinger liquid, **Phonon Scattering**, **Thermalization**, Coulomb Drag.

Control of Calcium ions induced electrical alternans in cardiac cells

April 2014 – April 2015

Worked on developing control methods for electrical alternans on cardiac tissue which are considered a pretext to cardiac complications like arrhythmia. These alternans are induced by calcium release inside the cardiac cells. We used computer simulations of modified Hodgkin Huxley models of cardiac tissue to achieve control of the dynamics to eliminate these alternans on the tissue scale.

- Used: C programming language, **MATLAB**

Analyzing Gravitational Waveforms and Handwriting Recognition using Machine Learning

Course Project @ Georgia Tech, Summer Semester 2017

Accelerating massive astronomical objects emit gravitational waves that can be detected on Earth. We classified such waveforms obtained from simulations of black-hole mergers using a combination of signal processing techniques, pre-processing of data, data transformation and machine learning algorithms. We compared a number of methods and successfully classified the waveforms with a classification error of only 6%. Also, worked on **handwriting recognition** for an assignment in the same course.

- Used: **WEKA**
- Techniques & Algorithms: **PCA, Discrete Fourier Transforms,kNN, Power Spectral Density, Neural Networks.**

First-passage time in one dimensional lattice versus continuum [1]

Visiting Student @ Raman Research Institute, Adviser: Prof. Narendra Kumar

Worked on the First-passage time (FPT) probability problem for hopping on a discrete lattice and determined a modification to the traditional boundary conditions needed to solve the corresponding integral equations. FPT is the probability that a random/stochastic walker will cross a given barrier for the first time. Applications include systems that break down once an adverse state is reached, e.g., *gambler's ruin, a machine's or hospital patient's lifespan, alpha decay in atoms, etc*. Also studied a toy-problem for a **quantum mechanical gear-wheel system [2]**.

Electric Field induced phase transitions in transversely polarized liquid crystals using Monte Carlo

Used Simulated Annealing algorithm (Monte Carlo) on Axial Next Nearest Neighbor model of Smectic-A liquid crystal to study the variation of polarization and the details of **phase transitions** that occur as the field is gradually increased.

- Used: **Simulated Annealing** using **Metropolis-Hastings algorithm**
- Used: C programming language

CIVIL ENGINEERING EXPERIENCE

Tata Consulting Engineers Limited, Mumbai, India

April 2010-January 2011

Worked as a Structural Engineer. My work involved load analysis and design of Reinforced Concrete and Steel structures.

EXTRA CURRICULUR

Vocalist in college music group, guitar, Additional Secretary of Cultural Council, IIT Roorkee (2008), Coordinator of the Civil Engineering Consortium (2007).