

AKSHAT SHARMA

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EDUCATION

Bachelor of Science in Physics

Expected Graduation Spring 2025

Minor in Mathematics and Computer Science

- College of Science and Engineering, University of Minnesota- Twin Cities Minneapolis, MN | Cumulative GPA: 3.823/4.0, Dean's Scholar, University Honors Programs
- Physics Coursework: Quantum Mechanics, Electromagnetism, Thermodynamics, Classical Mechanics, Experimental Physics
- Mathematics Coursework: Advanced Calculus, Partial and ordinary Differential equations, Fourier Analysis, Proofs in Mathematics
- Computer Science Coursework: Introduction to Programming (Python), Data Structures and Algorithms (java), Discrete Structures, Advanced Programming Principles (OCaml)

CS50: Introduction to Computer Science

Spring 2023

Harvard University (edX)

- Covered foundational programming concepts (C, Python), algorithms and data structures, web development (HTML, CSS, Javascript), databases (SQL), Flask, computer security, version control (Git), debugging, and problem-solving.

RESEARCH EXPERIENCE

Spectroscopy and Computational Modeling on Amorphous Hydrogenated Silicon-Germanium

September 2024 to Present

Prof. James Kakalios

- Conducting material characterization on amorphous hydrogenated silicon-germanium alloys ($a\text{-Si}_{1-x}\text{Ge}_x\text{:H}$) with different germanium to silicon ratios using SPM/AFM, Ellipsometer, FTIR, and Raman Vibrational Spectroscopy.
- Developing a computational model to explain high-temperature Berthelot-type charge transportation mechanisms in amorphous hydrogenated Germanium. (extension of my research done in February 2023)

Pattern Formation in Two Dimensional Nematics under Random Fields

January 2024 to Present

Prof. Jorge Viláls

- Developed and utilized Monte Carlo models to study the 2D XY model and Ising model, focusing on spin structures and topological defects, and their impact on long-range order and pattern formation.
- Investigated how defect dynamics and pattern formation are influenced by different strengths of random magnetic fields and examined the resulting changes in correlation functions.
- Currently extending the analysis to a nematic phase with random fields, investigating the effect of Historical Dependence in Nematic Liquid Crystals using annealed history and observing the changes in defect density.

Dispersive Bimolecular Recombination in Slow Relaxation of Amorphous Germanium

January 2024 to August 2024

Prof. James Kakalios

- Conducted an extensive literature review, analyzing previous studies and PhD theses to build a solid theoretical foundation on the electronic properties of amorphous materials, particularly hydrogenated amorphous germanium ($a\text{-Ge:H}$).
- Modeled the time-dependent conductivity of the films using the stretched exponential function to characterize relaxation behavior, identifying deviations from traditional models at specific temperature ranges.
- Investigated the anomalous conductivity behavior at around 405K, providing insights into potential new relaxation mechanisms and contributing to the understanding of the electronic transport properties in amorphous semiconductors.
- Studied dispersive bimolecular recombination model in hydrogenated amorphous germanium, analyzing recombination rates, relaxation time, and charge carrier mobility to demonstrate the impact of defect states on charge transport and recombination pathways.

Measuring Magnetic Susceptibility of Liquids Using the Moses Effect

January 2023 to April 2024

Asst. Prof. Theresa "Tracy" Chmiel

- Conducted as a class project to use a method for measuring magnetic susceptibility in liquids via the Moses effect, observing magnetic field-induced deformation on liquid surfaces.
- Conducted precise measurements using an optical lever technique, where laser reflections captured surface deformations in the liquid.
- Used magnetic field strength value and deformation data to calculate the maximum height caused by Moses effect and quantify magnetic susceptibility values for water and a 1 M Copper Sulfate solution

Cooling rate dependence of the conductivity of amorphous semiconductor thin films

February 2023 to August 2023

Prof. James Kakalios

- Conducted research on undoped amorphous hydrogenated germanium ($a\text{-Ge:H}$) and n-type hydrogenated amorphous silicon ($a\text{-Si:H}$) thin films to investigate conductivity behavior concerning temperature and cooling rate.
- Collected data using integrated software systems with electrometer and thermal compilers for conductivity, and temperature respectively.

- Performed Zabrodskii analysis on conductivity to compare results with established models (e.g., Mott or Efros-Shklovskii variable-range hopping) to understand the charge transport mechanism of the sample at different annealing rates.
- Identified Berthelot-like charge transportation mechanism in (a-Ge:H) sample at specifically high temperatures $T > 440\text{K}$. Explored theories related to amorphous materials and the mechanisms governing conductivity, contributing to better data interpretation and comprehension.

Graphene Super-conductor Exfoliation and Spectroscopy

September 2021 to April 2022

Asst. Prof. Ke Wang

- Exfoliating Graphene into quasi-2D nanostructures to explore its super-conductor potential.
- Conducted spectroscopic analysis with an optical microscope to distinguish mono-layer, bi-layer, and tri-layer graphene, identifying high-quality graphene locations on the silicon disk.
- Gained hands-on experience in handling delicate materials and instruments, ensuring the integrity of the experimental setup and measurements.

TEACHING EXPERIENCE

Peer Tutor Mentor

January 2022 to Present

TASC: Tutoring and Academic Success Center at the University of Minnesota

- Provided academic mentorship to over 400 students in mathematics and physics, offering expert guidance and support to help them develop effective study skills and improve their academic performance.
- Proactively supported struggling students by reaching out to them, coordinating suitable tutoring options and schedules, and fostering an environment of continuous academic progress and success.
- Assumed the role of mentor for new tutors, offering regular check-ins, support, and conducting staff meetings to address tutoring-related topics, contributing to the professional development of the tutoring team.

Outreach Assistant

June 2022 to August 2022

Department of Diversity, Equity and Inclusivity, UMN

- Adapted college-level mathematical concepts into engaging presentations for middle school students, inspiring hundreds of under-represented and under-served students to pursue careers in STEM fields.
- Demonstrated strong leadership and problem-solving skills by managing unprecedented situations, including conflicts among students and emergency evacuations, while prioritizing the group's health and safety by following established policies and procedures.
- Developed essential interpersonal and communication skills, including team building, clear communication, and active listening, through comprehensive training and real-world experiences while engaging with the students.

COMPUTATIONAL PROJECTS

Project: WeChat- Chat-based Web App

September 2023

- Created a chat-based web application using HTML, CSS, JavaScript, Flask, SQL and JSON, allowing users to communicate with each other in real-time.
- Incorporated user account management features, enabling users to create accounts, log in securely, provide users with meaningful error messages and reset passwords when necessary.
- Ensured data privacy and security by implementing appropriate encryption measures like password hashing and followed best practices for handling user information.

Project: Real-Time Stock Price Web App with Virtual Trading

May 2023

- developed a dynamic web application using HTML, CSS, JavaScript, Flask and Jinja to provide real-time stock prices for any company stock.
- Enabled users to access real-time stock prices for any company and practice buying and selling stocks with virtual currency.
- Applied responsive design principles to create a mobile-friendly user interface, catering to users on various devices and screen sizes.

Project: Player vs. Player Chess Game

March 2023

- Designed and developed a fully functional chess game in Java, allowing players to engage in matches against each other on the terminal.
- Implemented object-oriented programming principles by creating classes in Java to represent the chess pieces, board, and game logic.
- Utilized data structures and algorithms to handle move validation, piece movements, and check/checkmate conditions, ensuring accurate and fair gameplay.

HONORS, AWARDS AND GRANTS

- Harry and Viola St. Cyr Scholarship in Physics (Award, May 2024)
- Undergraduate Research Opportunity Program (Grant, January 2024)
- University Honors Program (Honor, May 2023)

- The Undergraduate Research Scholarship (Grant, February 2023)
- Dean's List (Honor, since January 2023)
- The Global Excellence Scholarship (Award, September 2022)

CONFERENCE PRESENTATIONS

- Summer Undergraduate Research Expo (SURE) - August 2024
- Spring Undergraduate Research Symposium - April 2024
- Summer Undergraduate Research Expo (SURE) - August 2023

PROFESSIONAL AFFILIATIONS

- Member, American Physical Society (APS), since 2023
- Member, Society of Physics Student, since 2022

SKILLS

Industrial	Advanced physics and mathematics, Python, SQL, C, Java, Flask, Jinja, front-end web development
Professional	Fluent in English and Hindi, MATLAB, LATEX, Google and Microsoft apps
Laboratory	Optical microscopy, Ellipsometry, Graphene exfoliation, error measurement/correction, Labview, computational modeling (Monte Carlo simulations, charge transport mechanisms), material handling