Hao-Yang Yen

Interdisciplinary Program of Sciences
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Personal Statement

I am deeply committed to the study of theoretical physics, particularly within the domain of statistical mechanics. My focus is on the interdisciplinary junctions between statistical mechanics and quantum dynamics and the diverse applications of this study in plasma physics, biological physics, and nonlinear systems. My academic record and research also focus on these areas. My current research interest lies in the application of statistical mechanics to quantum dynamics, computer science, and biological evolution.

Education

BSc Interdisciplinary Program of Sciences *National Tsing Hua University* **Hsinchu, Taiwan** *2021-present*
This Tsing Hua's interdisciplinary program enables students to develop broad training across multiple science and related disciplines. My focus has been advanced mathematics and physics, where I have received top grades.
Relevant Courses: Quantum Physics I: A+ (highest), Statistical Mechanics I: A (highest), Statistical Mechanics II: A, Electrodynamics I: A, Electrodynamics II: A+ (highest), Nonlinear Dynamics and Chaos: A, Numerical Methods and Applications: A+ (highest), Scientific Computing: A (highest), Algebraic Topology: A+ (highest), Advanced Linear Algebra: A, Probability: A-, Statistics: A-, Statistical Learning: A-.
(Anticipated to complete Quantum Mechanics I and II during the senior year, fulfilling the credit requirements for obtaining physics postgraduate degrees at NTHU.) (Anticipated to complete Quantum Mechanics I and II during the senior year, fulfilling the credit requirements for obtaining physics postgraduate degrees at NTHU.)

Research Experiences

My main research experience lies in the interdisciplinary application of statistical mechanics, encompassing both analytic and numerical forms, in diverse theoretical physics research fields. Here are some research topics I have finisher before.

Department of Physics, NTHU
Undergraduate Student, PI: Prof. Yi-Ping Huang

- **Pattern Formation and Dynamics in Quantum System** *07/2023-present*

  I explore pattern formation in quantum systems by bridging quantum dynamics with non-linear phenomena. Using the quantum trajectories method and phase representation, I investigate pattern formation in various quantum systems. This study deepens our understanding of the interplay between non-linear dynamics, pattern formation, and statistical mechanics in quantum systems.More details

Institute of Physics, Academia Sinica
Summer Student, PI: Prof. Hong-Yan Shih

- **Tensor Network in Stochastic Dynamics** *07/2024-08/2024*

  Tensor networks represent a powerful theoretical framework for investigating quantum dynamical systems. Recently, there has been a growing focus on applying tensor networks to study stochastic dynamics. In our project, we utilize tensor networks to analyze the stochastic dynamics within biological systems. The use of tensor networks provides a robust method to explore and understand the complex behaviors of stochastic dynamics in complex systems. More details

Department of Physics, NTHU
Independent Researchs

- **SIR Model with Monte Carlo Method Simulation** *2023 spring*

  We model virus spread with basic differential equations with generalized SIR models. However, considering more variables makes the differential equations more complex. To avoid solving complex differential equations systems, our project employs the Monte Carlo method to simulate generalized SIR models.More details

- **Neural Network and the Renormalization Group** *2023 fall*

  In phase transition theory, phenomena arise when the correlation length diverges at critical points. This parallels occurrences in natural complex systems, where statistical models, like neural networks, categorize data akin to renormalization group theory, despite lacking a precise mathematical framework.More details

- **Numerical Simulation of Simplify Stellar Winds Model** *2024 spring*

  Plasma holds a pivotal position in the cosmology and astrophysics due to its prevalence. The sun, being a star, is predominantly composed of plasma, and this composition extends to many other celestial bodies, including most planets. As a result, plasma accounts for over 99.99% of the observable matter in the universe. In this paper, I will employ MHD equations to simulate a simplified model of stellar winds.More details

Work Experience

Assistant, *Center of General Education, NTHU* *02/2022 - 06/2022*
Assistant, *Executive Master of Business Administration, NTHU* *09/2023 - 01/2024*
Assistant, *MS in Regulatory Affairs for Drugs and Medical Devices, NTHU* *09/2023 - present*

Teaching Experience

Teaching Assistant *Statistical Mechanics (I) (offered in English), Department of Physics, NTHU* *02/2024 - 06/2024*

Teaching Assistant *Statistical Mechanics (II) (offered in English), Department of Physics, NTHU* *09/2024 - present*

Teaching Assistant *Electrodynamics (I) (offered in English), Department of Physics, NTHU* *09/2024 - present*
Teaching Assistant *Thermal and Statistical Physics (I), Department of Physics, NTHU* *09/2024 - present*

References

- **Asst Prof. Yi-Ping Huang:** NTHU, department of physics
  Email: yi-ping.huang@gapp.nthu.edu.tw

- **Asso Prof. Jen-Hao Chen:** NTHU, Institute of computational and modeling science
  Email: jh.chen@mx.nthu.edu.tw