

Hao-Yang Yen

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Personal Statement

I am passionately dedicated to the study of theoretical physics, with a particular emphasis on statistical mechanics. My research focuses on the interdisciplinary intersections between statistical mechanics and quantum dynamics, exploring the wide-ranging applications of this field across various research domains. My academic achievements and research endeavors reflect this commitment. Currently, my interests lie in applying statistical mechanics and quantum mechanics to computer science, quantum dynamics, and complex systems.

Education

BSc Interdisciplinary Program of Sciences [National Tsing Hua University](#) **Hsinchu, Taiwan** 2021-present
MSc Institute of Physics [National Tsing Hua University](#) **Hsinchu, Taiwan** 2025-

The interdisciplinary program at Tsing Hua University enables students to gain comprehensive training across multiple scientific and related disciplines. My focus has been on advanced mathematics and physics, where I have consistently achieved top grades.

Course	Grade	Course	Grade
Quantum Physics I	A (highest)	Numerical Methods and Applications	A+ (highest)
Statistical Mechanics I	A (highest)	Scientific Computing	A (highest)
Statistical Mechanics II	A	Algebraic Topology	A+ (highest)
Electrodynamics I	A	Advanced Linear Algebra	A
Electrodynamics II	A+ (highest)	Probability	A-
Nonlinear Dynamics and Chaos	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.)

Research Experience

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 finished 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

- Leveraging Variational Matrix Product States for Stochastic Dynamics** 07/2024-08/2024
The variational matrix product state (VMPS) is a powerful algorithm for investigating quantum many-body systems. Recently, there has been increasing interest in applying this approach to study stochastic dynamics. In our project, we employ the variational matrix product state to analyze the stochastic dynamics within the SIS model in epidemiology. We aim to compare the behaviors of the variational matrix product state in both quantum many-body systems and classical dynamical systems, highlighting the insights gained from each context.[More details](#)

- Tensor Networks in Stochastic Dynamics

08/2024-present

Tensor networks provide a robust theoretical framework for investigating quantum many-body systems. Recently, there has been a growing focus on applying tensor networks to study classical stochastic dynamics. However, the underlying physical principles of this application remain unclear and have primarily been explored in one-dimensional systems. Our objective is to elucidate the fundamental principles governing the use of tensor networks to analyze stochastic processes in classical dynamical systems. This research aims to shed light on the connections between quantum many-body systems and classical dynamical systems, offering insights into key concepts in equilibrium quantum statistical mechanics, such as topological order and symmetry breaking. Additionally, we seek to generalize the tensor network approach to encompass two-dimensional classical dynamical systems.[More details](#)

Department of Physics, NTHU
Independent Research

- 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

Honors

- Dean Feng-Chih Chang and Academician Shih-Lin Chang Memorial Scholarship [College of Sciences, NCTU](#)

2021
- Maxwell's Scholarship [Department of Physics, NTHU](#)

2024

Presentation

- Freshman Orientation Seminar, Experience Sharing [Interdisciplinary Program of Sciences, NTHU](#)

08/2024

Student Geometry Seminar, Geometry and Topology in Statistical Mechanics *Department of Mathematics, NTHU*
06/2024

Freshman Orientation Seminar, Experience Sharing *Interdisciplinary Program of Sciences, NTHU* 08/2023