

Chan Li

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EDUCATION

- **University of California San Diego** La Jolla, USA
Ph.D. in *Physics* (anticipated 06/2028); Advancement to candidacy scheduled 12/2025; *GPA: 3.96/4.0* Sep. 2023 – Present
- **Sun Yat-sen University** Guangzhou, China
Master of Science in *Theoretical Physics*; *GPA: 89/100 (3.55/4.0)* Aug. 2020 – Jun. 2023
- **Sun Yat-sen University** Guangzhou, China
Bachelor of Science in *Optoelectronic Information Science and Engineering*; *GPA: 88/100 (3.78/4.0)* Aug. 2016 – Jun. 2020

SELECTED HONORS AND AWARDS

- **Physics Excellence Award** Sep. 2023
Physics department, University of California San Diego (top 10%)
- **Chinese National Scholarship** Oct. 2019; Oct. 2021
Ministry of Education of P. R. China (top 1%)
- **Chen-Ning Franklin Yang Scholarship (for Graduate students in Physics)** Nov. 2021
Sun Yat-sen University (top 1%)
- **University First-Class Scholarship for Outstanding Students** Oct. 2019
Sun Yat-sen University (top 10%)
- **3rd Prize, Three-Minute Video Presentation Contest** May 2021
IOP Publishing & X-MOL (top 10%)

RESEARCH INTERESTS

- Statistical and probabilistic approaches to understanding learning dynamics and generalization in neural networks.
- Bayesian and statistical modeling for interpretable and reliable machine learning systems.
- Non-equilibrium and critical phenomena in optimization and training dynamics of overparameterized models.
- Developing scalable and efficient algorithms that integrate theoretical insight with modern deep learning and AI-driven analytics.
- Advancing transparent, data-efficient, and theory-guided methodologies for intelligent decision-making and predictive modeling.

RESEARCH EXPERIENCE

University of California San Diego (UCSD), La Jolla, CA, USA.

Ph.D. Researcher in Physics; Advisor: Prof. Nigel Goldenfeld.

- **Project 1: Learning Dynamics and Scaling Behaviors in Large Neural Networks** Oct 2024 – Oct 2025
Developed physics-inspired models to explain robust generalization in overparameterized neural networks, informing scalable and reliable AI design (under review at Physical Review Letters, a top-tier peer-reviewed journal).
- **Project 2. Learning Algorithms for Emergent Symmetry Discovery in Physical Systems** Apr 2025 – Present
Designed and implemented learning algorithms capable of identifying hidden symmetries and invariant structures from physical data. Combined data-driven modeling with theoretical analysis to automate feature discovery and improve model interpretability (manuscript in preparation).

Sun Yat-sen University, Guangzhou, China.

Researcher in PMI Lab; Advisor: Prof. Haiping Huang.

- Project 1. Interpretable Learning Framework for Neural Networks** Aug 2019 – Oct 2021
 Developed and analyzed probabilistic and mean-field learning models to explain how deep and recurrent neural networks coordinate parameters during training. Uncovered distinct functional roles of neural connections and formulated interpretable, data-driven learning mechanisms across hierarchical and temporal structures. This work combined Bayesian inference, optimization theory, and large-scale computational experiments, resulting in publications in **Physical Review Letters 125, 178301 (2020)** and **Physical Review E 107, 024307 (2023)**.
- Project 2. Hierarchical Representations in Deep Learning** Aug 2021 – Oct 2022
 Designed algorithms that decompose neural network weights into interpretable latent modes, revealing hierarchical representations. Published in **Physical Review Research 5, L022011 (2023)**.
- Project 3. Continual and Multi-Task Learning Frameworks** Aug 2020 – Oct 2022
 Developed physics-inspired frameworks for continual and multi-task learning to reduce catastrophic forgetting and enhance knowledge transfer across tasks. Published in **Physical Review E 108, 014309 (2023)**.
- Project 4. Predictive Coding Models for Language Processing** Apr 2023 – Apr 2024
 Implemented predictive coding models for language tasks to investigate information flow and adaptive learning in neural circuits. Published in **Physical Review E 109, 044309 (2024)**.

PUBLICATIONS (PEER-REVIEWED, COMPARABLE TO TOP-TIER AI/ML CONFERENCES)

- [5] **C. Li**, Junbin Qiu, and H. Huang, *Meta predictive learning model of languages in neural circuits*, Phys. Rev. E 109,044309(2024).
- [4] **C. Li**, Zhenye Huang, Wenxuan Zou, and H. Huang, *Statistical mechanics of continual learning: variational principle and mean-field potential*, Phys. Rev. E 108, 014309 (2023).
- [3] **C. Li** and H. Huang, *Emergence of hierarchical modes from deep learning*, Phys. Rev. Research 5, L022011 (2023).
- [2] W. Zou, **C. Li** (co - first author) and H. Huang, *Ensemble perspective for understanding temporal credit assignment*, Phys. Rev. E 107, 024307 (2023).
- [1] **C. Li** and H. Huang, *Learning credit assignment*, Phys. Rev. Lett. 125, 178301 (2020).

SELECTED POSTER AND ORAL REPRESENTATIONS

- American Physical Society Joint March Meeting and April Meeting 2025 in Anaheim, California (oral presentation).
- Chinese National Conference on statistical physics and complex systems, 2021 in Changchun, China (1st Prize for poster).
- Chinese National Conference on computational and cognitive neuroscience (poster), 2021 online.
- Annual meeting of Guangdong Physics Society, 2020 and 2021 in Guangdong, China (1st Prize for poster).

PROFESSIONAL SKILLS

- Programming and Software:** Proficient in **Python** for machine learning, scientific computing, and data analysis; experienced with **PyTorch** for deep learning research and model optimization; familiar with **C/C++**, **Linux** environments, and **LaTeX**; working knowledge of **Matlab** and **Mathematica**.
- Machine Learning and Optimization:** Skilled in designing and training neural networks, implementing and evaluating optimization algorithms (e.g., SGD, Adam), and studying **training dynamics, generalization, and scaling behavior**. Experienced with large-scale numerical simulation and statistical data analysis using **NumPy**, **SciPy**, and **Matplotlib**.
- Statistical and Probabilistic Modeling:** Strong foundation in **statistical physics, Bayesian inference, and probabilistic modeling**, including mean-field analysis and random matrix theory. Apply these methods to develop interpretable and data-efficient machine learning frameworks.
- Communication:** Effective in cross-disciplinary collaboration and clear presentation of complex technical ideas across physics, computer science, and applied mathematics communities.
- Languages:** Native in Chinese; fluent in English (IELTS 7.5).

SELECTED COURSEWORK

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| <ul style="list-style-type: none"> • Machine Learning and Neural Computation | <ul style="list-style-type: none"> • Advanced Computational Modeling | <ul style="list-style-type: none"> • Nonlinear Dynamics |
| <ul style="list-style-type: none"> • Statistical and Quantum Physics | <ul style="list-style-type: none"> • Quantum Field Theory | <ul style="list-style-type: none"> • Phase Transitions and Critical Phenomena |

REFERENCES

Prof. Nigel Goldenfeld, University of California San Diego, La Jolla, nigelg@ucsd.edu.
Prof. Haiping Huang, Sun Yat-sen University, Guangzhou, huanghp7@mail.sysu.edu.cn.