Ziao WANG

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Last-year PhD candidate in free-space optical computing (ENS–PSL), building large-scale plug-and-play optical–ML systems, with a strong background in optics, deep learning, and statistical physics modelling. Excel at bridging theoretical insights with practical implementations, driving advancements on not only AI4Physics, also Physics4AI.

Research experience

Large Transformer Training with Optics surpassing GPU

Laboratoire Kastler Brossel, CNRS, Paris, France — Oct. 2023 – Present

- Built a hardware-in-the-loop pipeline that leverages an optical processor to train large Transformer families via unconventional training algorithm (ODFA); demonstrated across language, vision, and diffusion models.
- Experimentally investigated compute scaling laws and confirmed scale/energy/throughput optical merits; instrumented workflows in C++/Torch/DeepSpeed.
- Produced a first-author preprint under review of Nature (the main journal). Best Poster Award (only 1 seat) in MLP 2024.

Statistical-Physics Framework for Optical RBMs

Laboratoire de Physique de l'ENS, ENS, Paris, France — Apr. 2023 – Aug. 2023

- Developed a statistical-physics framework for analyzing Restricted Boltzmann Machines (RBMs) in optical setting, using energy-based modelling and the replica method, connecting to Ising models.
- Ran Monte-Carlo simulations for learning dynamics and phase behavior. Led to principles for later algorithm-hardware co-design.

Reconfigurable Optical Neural Nets at Scale

Laboratoire Kastler Brossel (with Cornell), Paris, France — Feb. 2022 – May. 2024

- Designed and implemented large-scale, reconfigurable Optical Neural Nets (ONN); conducted in-situ architecture search under optical constraints to approach digital baselines.
- Implemented Physics-Aware Training (PAT) with measured non-idealities, improving robustness for real-world use.
- Led to a co-first-author SPIE PW paper and presentations.

Bayesian Evaluation (BNN) for Physics-Based Data

Peking University, Beijing, China — Oct. 2018 – Aug. 2021

- Built Bayesian neural networks with uncertainty quantification to evaluate incomplete fission-product yields; Redesigned BNN multilayer architectures to avoid non-physical behaviour.
- Fused noisy/divergent datasets under physics-aware constraints for better evaluations.
- Produced multiple first-author publications (PRL/PRC)

Education

Laboratoire Kastler Brossel

2023 – Oct. 2026

- PhD Track (2nd Stage)
- Supervisor: Prof. Sylvain Gigan

L'École Normale Supérieure de Paris

2021 – 2023

- PhD Track (1st Stage, Top 2)
- International Center of Fundamental Physics (Quantum)

Peking University

2016 – 2021

- B.S., Physics
  Diploma of Weiming (Top 5)
- B.S., Economics

Skills

Machine Learning
Optical Engineering
Statistical Modelling
Algorithm Development
Data Analysis

Languages

English (Advanced)
Mandarin (Native)

Publications

Preprints / Under Review

- **Zi-Ao Wang**, Kilian Müller, …, Sylvain Gigan. *Streamlined optical training of large-scale modern deep learning architectures with direct feedback alignment*. arXiv preprint, under review at Nature, 2024.
- **Zi-Ao Wang**, Fei Xia, Logan Wright, …, Peter McMahon, Sylvain Gigan. *Architecture-Reconfigurable Deep Optical Random Neural Network*. Preprint under review, 2025.
- **Zi-Ao Wang**, Hao Wang, …, Sylvain Gigan, Qiang Liu. *Training deep physical neural networks with local physical information bottlenecks*. Preprint under review, 2025.
- Xue Dong, …, **Zi-Ao Wang**, Niao He, Sylvain Gigan. *Optical computing with spectrally multiplexed features in complex media*. Preprint under review, 2025

Journal Articles

- **Zi-Ao Wang**, Junchen Pei, Yongjing Chen, …. *Bayesian approach to heterogeneous data fusion of imperfect fission yields for augmented evaluations*. Physical Review C 106, L021304, 2022.
- **Zi-Ao Wang**, Junchen Pei. *Optimizing multilayer Bayesian neural networks for evaluation of fission yields. Physical Review C 104, 064608*, 2021.
- Chunyuan Qiao, Junchen Pei, **Zi-Ao Wang**, Yu Qiang. *Bayesian evaluation of charge yields of fission fragments of 239U*. Physical Review C 103, 034621, 2021.
- **Zi-Ao Wang**, Junchen Pei, Yue Liu, and Yu Qiang. *Bayesian evaluation of incomplete fission yields*. Physical Review Letters 123, 122501, 2019.

Conference Proceedings

- Xue Dong, Fei Xia, Yoonseok Baek, **Zi-Ao Wang**, Sylvain Gigan. *Optical additive kernel approximation using broadband scattering in complex media*. Proc. SPIE PC13375, PC133750K, 2025
- **Zi-Ao Wang**, Fei Xia, Logan Wright, …, Peter McMahon, Sylvain Gigan. *Hardware-efficient large-scale reconfigurable optical neural network (ONN) with backpropagation*. Proc. SPIE 12438, 124380Z, 2023.