Yuan Wang

ORCiD: 0000-0002-0688-3276

I am passionate about the *quantum theory of light-matter interaction*, *parallel computing*, and *AI for science*.

Contact

- **Web**: *ywang.org* **GitHub**: *github.com/ywang-phy* **LinkedIn**: *linkedin.com/in/ywang-phy*
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Experience

- Sep 2023 - present: Visitor, University of Southampton, United Kingdom

Education

- Sep 2018 - Sep 2023: PhD in Physics, University of Southampton, United Kingdom
  Thesis entitled *"Tailored reservoir of exciton-polariton condensates"*
- Sep 2017 - Jul 2018: Master's Double Degree (M2 Nanoscience), University of Ferrara, Italy
- Sep 2016 - Jul 2017: Master's Double Degree (M1 General Physics), Paris-Saclay University, France
- Sep 2012 - Jul 2016: Bachelor's Degree in Physics, Anhui Normal University, China

Internship

- Feb 2018 - Jul 2018: Quantum Theory and Technology, University of Southampton, United Kingdom
  Topic: *Quantum theory of the intersubband polaritons*, mentored by Prof. Simone De Liberato
- Apr 2017 - Jul 2017: Quantum Optics, Sorbonne University - Pierre and Marie Curie Campus, France
  Topic: *Quantum squeezing variance in second-mode approximation*, mentored by Dr. Simon Pigeon

Activicities

- Poster at *NeurIPS 2023 AI for Science Workshop*
- Organizer of *QLM Summer School 2019*, guided by Prof. Hendrik Ulbricht

Languages

- Chinese (Native) & English (Fluent)

Skills

- **Programming**: C++, CUDA, MATLAB, Python **Machine learning**: PyTorch
- **Simulation**: COMSOL Multiphysics **Editing**: HTML, LaTex, Microsoft Office

Interests

- **Exciton-polariton condensate** The AlGaAs-like quantum wells within high-quality microcavities, can generate exciton-polaritons (polaritons) in the strong coupling regime. At cryogenic temperatures, the polariton condensates can be formed through optically excited high-energy excitons. I focus on the theoretical development of the methods for enhancing and focusing these condensates, utilizing localized nonresonant asymmetric-shaped excitation. A significant aspect of my work involves increasing spatial coherence and optimizing interaction strength between polaritons, paving the way for the realization of all-optical transistors and contributing to large-scale polariton condensates networks.
- **Parallel Computing** In the field of simulating polariton condensates, there's a strong emphasis on leveraging advanced numerical methods, underpinned by a specialized computational tool that utilizes the capabilities of graphics processing units (GPUs). The split-step Fourier method (SSFM) is one of the central technique used for these simulations, offering a streamlined approach to solving partial differential equations in parallel computing environments. This method is also notably efficient when integrated into machine learning frameworks, offering innovative solutions for complex equations. My focus lies in developing computational tools based on NVIDIA's CUDA architecture, using C++ and CUDA APIs. This expertise encompasses both CPU-based and GPU-based GPE solvers, with a particular emphasis on utilizing SSFM for efficient problem-solving in the realm of quantum fluid dynamics.
- **Machine Learning** Overcoming the challenges in simulating complex nonlinear systems for large-scale applications is a key focus in many fields. Innovatively, a machine-learning-based Fourier Neural Operator approach has been pioneered for application in these areas. This method, applied to solving the Gross-Pitaevskii equations coupled with exciton rate equations, can predict final-state solutions with high accuracy and is nearly 1000 times faster than traditional CUDA-based GPU solvers.

Publications

[6] Surya T. Sathujoda*, **Yuan Wang***, Kanishk Gandhi, *Exciton-Polariton Condensates: A Fourier Neural Operator Approach*, NeurIPS 2023 AI for Science Workshop (2023)

[5] K. Sawicki, D. Dovzhenko, **Y. Wang**, H. Sigurðsson and P. G. Lagoudakis, *Occupancy-driven Zeeman suppression and inversion in trapped polariton condensates*, arXiv:2308.05351 (2023)

[4] **Y. Wang**, *Tailored reservoir of exciton-polariton condensates*, University of Southampton (2023)

[3] **Y. Wang**, P. G. Lagoudakis, and H. Sigurdsson, *Enhanced coupling between ballistic exciton-polariton condensates through tailored pumping*, Physical Review B **106**, 245304 (2022)

[2] **Y. Wang**, H. Sigurdsson, J. D. Töpfer, and P. G. Lagoudakis, *Reservoir optics with exciton-polariton condensates*, Physical Review B **104**, 235306 (2021)

[1] **Y. Wang** and S. De Liberato, *Theoretical proposals to measure resonator-induced modifications of the electronic ground state in doped quantum wells*, Physical Review A **104**, 023109 (2021)