QIAN XU

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EDUCATION

Nanjing University *September 2015 - June 2019 (expected)*
Bachelor of Science in Physics (Elite Program) Overall GPA: 4.66/5.0; Ranking: 1/144
School of Physics

RESEARCH INTERESTS

Ultracold quantum matter, Quantum optics, Quantum information processing

RESEARCH EXPERIENCES

Department of Physics, University of Michigan October 2018 - January 2019
Research assistant — Nanophotonics and exciton-polariton condensate; Advisor: Prof. Hui Deng

- Project I: The ultrafast tuning of microcavities based on optical Kerr effect
  - Designed a microcavity with subwavelength grating (SWG) and distributed Bragg reflector (DRB) structure and numerically estimated the cavity shift resulting from the pump-induced optical Kerr effect.
  - Measured the time-dependent cavity shift using pump-probe techniques.
- Project II: The coupling between monolayer $MoSe_2$ exciton and tunable microcavities
  - Realized the strong coupling between monolayer $MoSe_2$ exciton and a mechanically tunable microcavity and observed large Rabi splitting (30 mev) of polariton mode in the frequency domain.
  - Built a pump-probe measurement setup gated by sum-frequency generation using BBO to measure the time-resolved photoluminescence of $MoSe_2$ exciton, which was expected to have radiative enhancement when weakly coupled to a cavity.
- Project III: Laser machining of concave mirrors
  - Built one setup with CO2 laser to machine concave mirrors on silica substrate, which can be used for confocal microcavities.
  - Characterized the radius of curvature (ROCs) of machined samples (in the level of 100 μm) by AFM measurement.

Department of Physics, Clarendon Laboratory, University of Oxford July 2018 - September 2018
Visiting student research assistant — Ultracold quantum matter; Advisor: Prof. Christopher Foot

- Project I: Optimization of two cold-atom sources
  - Optimized the fundamental experimental parameters of two cold-atom sources (one 2D+ Magneto-Optical-Trap (MOT) Strontium-88 source and one Pyramid MOT Rubidium-87 source) that produce highest-flux cold-atom beams based on numerical modeling.
  - Proposed two new approaches to further increase the output atomic flux of Pyramid MOT. One was elaborately tuning the angle of pyramid walls to form a 3D trapping geometry and another one was adding a pre-cooling region with Zeeman-slower-like magnetic field profile.

- Project II: Quantum non-demolition measurement of degenerate Rubidium gas in a magnetic trap with RF-dressed potential
  - Built electronics and optics to measure the birefringence of a off-resonant probe beam that probes spin dynamics of cold Rubidium gas in a magnetic trap with radio-frequency-dressed potential via dispersive interaction.
  - Obtained amplified AC readout signals and realized continuous imaging of Rubidium atoms.

School of Physics, Nanjing National Laboratory of Solid State Microstructures, Nanjing University March 2017 - July 2018

Research assistant — Quantum photonics; Advisor: Prof. Xiaosong Ma

- Project I: Experimental delayed-choice quantum wave-particle superposition
  - Set a time-tagging system to perform non-local coincident counts between four photons separated in two labs.
  - Characterized and optimized one two-photon quantum controlled-Hadamard gate based on quantum process tomography.
  - Ruled out one locality loophole in reported delayed-choice experiments and observed quantum wave-particle superposition of photons.
- Project II: Neural network state estimation for full quantum state tomography
  - Proposed a new state estimation algorithm, based on neural network and supervised learning, to accelerate the data processing of the full quantum state tomography (FQST).
  - Reduced the time complexity to d^3 (d is the dimension of the Hilbert space of a quantum system), which is much faster than the commonly-used maximum likelihood estimation (MLE) and more efficient than many recently-presented algorithms for full quantum state tomography.

School of Physics, Nanjing University June 2017 - October 2017

Undergraduate Research — Advisor: Prof. Sihui Wang

- Project I: Star-shaped oscillation of water drops under vertical excitation.
  - Proposed a parametrical resonance model to analytically solve the star-shaped oscillation of water drops under vertical excitation and explained the phenomenon of Leidenfrost star using our model.
- Project II: Nonlinear effect of forced harmonic oscillator subject to sliding friction and simulation by a simple nonlinear circuit.
  - Proposed a nonlinear RLC circuit damped by anti-parallel diodes to simulate the nonlinear behavior of the mechanical oscillators.

PUBLICATIONS AND WORKING PAPER

- **Qian Xu** and Shuqi Xu. Neural network state estimation for full quantum state tomography. *Physical Review A*, under revision. arXiv:1811.06654
- Kai Wang, **Qian Xu**, Shining Zhu and Xiaosong Ma. Quantum waveparticle superposition in a delayed-choice experiment. *Nature Photonics*, under review.
- **Qian Xu**, Wenkai Fan, Yao Luo, Sihui Wang and Hongjian Jiang. Nonlinear effect of forced harmonic oscillator subject to sliding friction and simulation by a simple nonlinear circuit. *Am. J. Phys.*, 87(2), 2019.
- Jiahao Dong, Yuping Liu, **Qian Xu**, Yinlong Wang and Sihui Wang. Complete modes of star-shaped oscillating drops. Submitted to *Physical Review E*.

- **Qian Xu**, Fanhao Meng, Zheng Xie and Huijun Zhou. Research on computer generated holograms. *Phys. Exp.*, 38(1):1-7, 2018. (In Chinese) Link.

CONFERENCE PRESENTATIONS

- **Qian Xu**. Star-shaped oscillation of water drops under vertical periodical excitation. Oral presentation at American Physics Society March meeting, Los Angeles, California, March 6, 2018. Link

PROFESSIONAL SKILLS

- **Computing skills:**

  Software & **language**: MATLAB, Mathematica, C++, Python, COMSOL, LabVIEW, Solidworks.

  Numerical methods: Machine learning, Rigorous coupled-wave analysis (RCWA).

- **Experimental skills:** Experiences in single-photon experiments (generation, manipulation and measurement of polarization-encoding photonic quantum states), nonlinear optics (SHG, SFG, SPDC, four-wave mixing), laser spectroscopy (Doppler-free saturated absorption spectroscopy, fluorescence spectroscopy, photoluminescence spectroscopy, pump-probe ultrafast spectroscopy), material characterization (AFM).

STANDARD TESTS

- TOEFL: 102 (Reading: 29; Listening: 27; Speaking: 22; Writing: 24)
- GRE: 322 (Verbal Reasoning 154, Quantitative Reasoning 168, Analytical Writing 3.0)
- GRE Physics: Scaled Score 990, Percentile 94

HONORS AND AWARDS

- Outstanding Winner (17/7,000+) and Ben Fusaro Award (1/7,000+) in 2017 Mathematical Contest In Modeling, organized by COMAP Inc. (2017)
- School Principal Scholarship (highest honor for undergraduate student in Nanjing University, 11/100+) (2017)
- National scholarship(4/200) (2017)
- First prize of the 7th China Undergraduate Physics Tournament (5/100+) (2016)