Wendao Xu | PhD Candidate in Optics

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Professional Summary

Experienced PhD candidate in Optics with 6+ years of research experience in fiber-based and integrated photonic technologies. Specialized in designing and implementing high-performance photonic devices for advanced microwave photonic systems, with potential applications in telecommunications and signal processing solutions.

Technical Skills

Simulation Tools: Proficient in COMSOL, MATLAB, RSoft, and Zemax for the design, numerical simulation, and characterization of photonic systems. Experienced with Code V through advanced coursework, with additional skills in CAD softwares for designing 3D-printed components and creating technical illustrations.

Programming: Skilled in Python, LabVIEW, MATLAB, and C# for instrument control, automated measurements, data analysis, and numerical computations based on custom-developed theories.

Hands-on Experience: Designed and implemented complex heterodyne-detection-based Brillouin spectroscopy system and microwave photonic links. Conducted comprehensive free-space coupling and testing of multi-mode photonic waveguides. Performed automated data acquisition and analysis with customized graphical interfaces.

Instrumentation: Employed specialized instruments and components in comprehensive experimental setups, including:

- Optical: Tunable semiconductor laser, fiber amplifier, optical filter, lenses, mirrors, fiber array, optical microscope, optical spectrum analyzer.
- Optoelectronic: Intensity modulator, phase modulator, photodetector.
- Electrical: signal generator, function generator, oscilloscope, spectrum analyzer, lock-in amplifier.
- Others: Multi-axis or motorized translation stages, scanning electron microscope.

Education

University of Rochester — **Rochester, NY**
Ph.D. in Optics — *2019–Summer 2025*
- Topic: *Novel Ultranarrow-Linewidth Brillouin Scattering for High-Performance Microwave Photonic Filters.*
- Advisor: Prof. William Renninger

University of Rochester — **Rochester, NY**
M.S. in Electrical and Computer Engineering — *2017–2019*
- Thesis: *Forward Brillouin Scattering in Micro-Structured Hollow Core Fibers.*
- Advisor: Prof. William Renninger

Huazhong University of Science and Technology — **Wuhan, China**
B.Eng. in Optoelectronic Information Science and Technology — *2013–2017*
- Thesis: *Simultaneous Dual-parameter Fiber Sensing with Optical Thin Core Fibers.*
- Advisor: Prof. Ping Lu

Experience

University of Rochester — **Rochester, NY**
Graduate Researcher — *2019–Present*

- Designed and built a high signal-to-noise measurement setup based on four-wave mixing to characterize Brillouin spectral responses in multi-mode photonic devices, achieving Hz-level accuracy through the implementation of electrical frequency stabilization feedback loops.
- Designed, tested, and analyzed advanced photonic platforms, including optical fiber tapers, specialty fibers, and integrated photonic devices, achieving ultranarrow-linewidth forward inter-modal Brillouin scattering (**FIM-FAM**) with up to $>$ **100x** narrower linewidths and $>$ **10x** enhanced photon-phonon coupling efficiency compared to traditional devices.
- Collaborated with international and domestic researchers on the iterative design, fabrication, and packaging of Brillouin photonic devices, ensuring consistent performance improvements and manufacturability.
- Developed and validated new theoretical models for photon-phonon dynamics in ultranarrow-linewidth forward Brillouin scattering, with experimental confirmation of their accuracy and behavior.
- Developed and tested wideband, continuously tunable, reconfigurable Brillouin-based microwave photonic filters, achieving $>$ **10x** improvement in frequency resolution over conventional designs.
- Modeled and experimentally verified key microwave performance metrics for Brillouin-based microwave photonic filters, providing insights into performance limitations and guiding strategies for further optimization and system improvement.

University of Rochester **Rochester, NY**

Graduate Researcher *2017-2019*

- Developed LabVIEW programs to automate the acquisition of wavelength-dependent responses in photonic devices.
- Simulated and experimentally characterized Brillouin responses in specialty optical fibers, such as hollow-core fibers.

Selected Projects

FIM-FAM in Few-Mode Fiber Tapers: Demonstrated 100 kHz linewidth forward inter-modal Brillouin scattering in few-mode fiber tapers, with three iterations of design and fabrication completed and a fourth ongoing, focusing on reduced loss, extended waist regions, and excellent homogeneity. Adapted traditional Brillouin rate equations to match experimentally observed spectral behavior in the ultranarrow-linewidth regime.

FIM-FAM in Reduced-Cladding Two-Mode Fibers: Demonstrated 10 kHz linewidth forward inter-modal Brillouin scattering in reduced-cladding two-mode fibers with large cores designed to enhance Brillouin interaction strength. Additionally, developed in-house procedures for stripping, cleaving, and free-space mode coupling of these delicate fibers.

FIM-FAM-based Microwave Photonic Bandpass Filters: Demonstrated sub-MHz bandwidth Brillouin-based microwave photonic bandpass filter systems with near 100 kHz filter bandwidth, >20 GHz instantaneous bandwidth, continuous central frequency tunability, and reconfigurable passband. Developed theoretical models for the link gain, noise figure, and dynamic range, which agree well with experimental results.

Forward Brillouin Scattering in Integrated Photonic Devices: Demonstrated forward inter-modal and intra-modal Brillouin scattering in multi-core suspended silicon nitride waveguides, achieving sub-100 kHz linewidths and Brillouin interaction up to 40 times stronger than any current Brillouin devices. Currently in the fifth round of design, fabrication, testing, and novel physics analysis of these devices.

Publications

First author of 5+ peer-reviewed publications, including articles in Optica and APL Photonics, and conference proceedings, with additional co-author contributions in collaborative research, including but not limited to:

- W. Xu, et al., *Continuously tunable Brillouin-based Microwave Photonic Bandpass Filter with sub-MHz Bandwidth*, manuscript under preparation.
- W. Xu, et al., *Ultranarrow-linewidth stimulated Brillouin scattering with fundamental acoustic waves*, APL Photonics, 2025 [Editor's Pick].
- A. Iyer, Y. P. Kandel, W. Xu, et al., *Coherent optical coupling to surface acoustic wave devices*, Nature Communications, 2024.
- W. Xu, et al., *Tunable Brillouin-based Microwave Photonic Bandpass Filter with sub-MHz Bandwidth*, CLEO 2024
- W. Xu, et al., *Strong optomechanical interactions with long-lived fundamental acoustic waves*, Optica, 2023
- W. Xu, et al., *Ultranarrow-Linewidth Stimulated Intermodal Forward Brillouin Scattering*, CLEO, 2023

Full publication list available on Google Scholar.