Denghui Pan 潘登辉 *April, 1995*

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Tsinghua University Master of Science in Engineering · Data Science and Information Technology
Hangzhou, Zhejiang Province, China Male

Research Interest

Ultrafast Laser Techniques, Ultrafast Laser-induced Chemical Reaction, Ultrafast Laser 3D Printing, Nonlinear Optics, Ultrafast Soliton Dynamics, and the Application of Artificial Intelligence in Ultrafast Optics.

Education

M.Sc, Tsinghua University Tsinghua-UC Berkeley Shenzhen Institute

Data Science and Information Technology (Cum. GPA: 3.67/4.0) *2020.9 – 2023.8*

Research Area: Ultrafast Fiber Laser, Laser Dynamics, Nonlinear Optics
Main Courses: Information Theory and Statistical Learning, Introduction of Photonics, Semiconductor Physics and Devices, Optical Fiber Communications, Nonlinear Optics, Femtosecond Laser Technology
Thesis: **Research on Transient Dynamics of Solitons in Passilvely Mode-locked Er-doped Fiber Laser**

B.Eng, Zhejiang University of Technology College of Chemical Engineering

Safety Engineering (Cum. GPA: 3.11/4.0) *2013.9 – 2017.6*

Main Courses: Principles of Chemical Engineering, Experimental Chemistry, Chemical Technology, Mechanical Engineering, Fluid Mechanics, Engineering Thermodynamics and Heat Transfer, Electrical and Electronic Technology

Award

Scholarships Tsinghua University

Tsinghua University Graduate 2nd Prize Scholarship *2021*

Scholarships Zhejiang University of Technology

Literary and Sports Scholarship *2016*

Academic Scholarship *2015*

Academic Competition Zhejiang University of Technology

First Prize in Zhejiang Province University Student Physics Theoretical Innovation Competition *2016*

Second Prize in National College Junior Mathematics Competition *2016*

Academic Conference Tsinghua University

Best Poster Award (Top Ranking) at the 21st Asia Communications and Photonics Conference (ACP2021)

Sports Events Tsinghua University

2023 National University Rowing Open Championship, Nanjing | Second Place in Men's Eight, 1000m

2023 Shenzhen X9 University Alliance Rowing League Spring Tournament | Champion in Men's Eight, 800m

Research Experience

1. Research on Linear Polarization-maintaining NPE Mode-locked Fiber Laser (Scientific Research)

Nano Device Lab (HYFUgroup), Center 2B, Tsinghua-UC Berkeley Shenzhen Institute

Project Introduction *2020.10– 2021.10*

I designed and constructed an innovative ultrafast fiber laser utilizing the principle of Nonlinear Polarization Evolution (NPE) for mode-locking in a Polarization-Maintaining (PM) erbium-doped fiber laser. The novelty of this work lies in the incorporation of a novel wavelength-division multiplexer (WDM) collimator integrated device, contributing to a more compact laser architecture. The resultant laser demonstrates stable output of ultrashort pulses at a repetition rate of 60.9 MHz.

Project Achievements

In this project, my primary contributions encompassed the establishment of the experimental optical setup, successful laser tuning and mode-locking, comprehensive laser performance assessment, experimental data processing, and the composition of a conference paper. This work led to an oral presentation at the 2021 Optoelectronics and Communications Conference (OECC). The outcomes of this project are encapsulated in a conference paper and two journal papers.

[1] **D. Pan**, X. Liu, H. Y. Fu, et al. Linear polarization-maintaining fiber laser mode-locked by nonlinear polarization evolution; proceedings of the *Optelectronics and Communications Conference*, F, 2021 [C]. Optica Publishing Group.

[2] X. Liu, Q. Li, **D. Pan**, et al. A robust and novel linear fiber laser mode-locked by nonlinear polarization evolution in all-polarization-maintaining fibers [J]. *Journal of Lightwave Technology*, 2021, 39(23): 7509-7516.

[3] X. Liu, R. Zhou, **D. Pan**, et al. 115-MHz linear NPE fiber laser using all polarization-maintaining fibers [J]. *IEEE Photonics Technology Letters*, 2021, 33(2): 81-84.

2. Research on Transient Dynamics of Dissipative Solitons in Mode-locked Fiber Lasers (Scientific Research) Nano Device Lab (HYFUgroup), Center 2B, Tsinghua-UC Berkeley Shenzhen Institute

Project Introduction *2021.1 – 2023.6*

By employing Time-Stretch Dispersion Fourier Transform (TS-DFT) technique, I investigated the dynamic process of dissipative soliton formation within an anomalous dispersion fiber laser. The construction of dissipative solitons revealed five distinct transient stages: relaxation oscillations, modulation instability, spectral broadening, soliton explosion, and stable mode-locking state. Notably, during the soliton explosion phase, the existence of dissipative rogue waves was discovered. This finding significantly contributes to comprehending the evolutionary dynamics of dissipative soliton formation within nonlinear dissipative systems.

Project Achievements

In this project, I played a pivotal role in independent design of the experimental laser, setting up the experimental optical path, conducting experiments, processing resulting data, and producing both conference and journal papers. The culmination of these efforts resulted in the publication of a conference paper and a journal paper. Notably, the conference paper was honored with the Best Paper Award at the 2021 Asia Communications and Photonics Conference (ACP), while the journal paper was designated as an Editor's Pick to highlight it with excellent scientific quality and are representative of the work taking place in a specific field.

[1] **D. Pan**, X. Liu, B. A. Malomed, et al. Build-up dynamics of dissipative solitons in a nonlinear polarization evolution mode-locked fiber laser; proceedings of the *Asia Communications and Photonics Conference*, F, 2021 [C]. Optical Society of America. **(Best Paper Award)**

[2] **D. Pan**, X. Liu, F. Ye, et al. Transient dynamics of dissipative solitons formation in a net-normal dispersion mode-locked fiber laser based on nonlinear polarization evolution [J]. *Applied Optics*, 2023, 62(22): 5946-5953. **(Editor's Pick)**

3. Research on Ultra-compact Femtosecond Fiber Laser Product (Engineering Research) Nano Device Lab (HYFUgroup), Center 2B, Tsinghua-UC Berkeley Shenzhen Institute

Project Introduction *2021.1–2023.1*

This project aims to transition the research-oriented, dispersion-managed, polarization-maintaining, erbium-doped femtosecond fiber laser (referred to as the fiber laser) developed within our laboratory into an industrialized product. The goal is to create a compact, portable, stable, and adaptable fiber laser product suitable for various complex engineering environments. The fiber laser employs full-polarization-maintaining fiber with erbium-doped gain medium and features a nine-mirror cavity structure. By adjusting the lengths of positively and negatively dispersive fibers, the net dispersion within the cavity can be controlled, yielding pulses with different characteristics. When approaching near-zero dispersion, the laser generates femtosecond pulses. In an industrial setting, the fiber laser is pumped by butterfly-packaged laser diodes for energy supply. Mode-locking is achieved by rotating an internal polarizing waveplate to ensure stable pulse output. During the product design phase, the precise components of the laser were modeled using Solidworks. These components were fabricated by a precision machinery factory, followed by assembly and performance testing of the laser to meet industrial-grade standards.

Project Achievements

I spearheaded this project as the sole responsible individual, focusing on designing the product framework based on the fiber laser architecture and constructing the laser model using Solidworks software. I collaborated with a precision machinery factory to coordinate the production of prototype components, sourced butterfly pumps and power drivers, and successfully assembled and tested the product

prototype. This prototype is capable of generating stable laser pulses at 97 MHz with an impressively narrow pulse width of only 293 femtoseconds. This product has been included in multiple research project and grant applications, including the **Tsinghua SIGS Concept Verification Project (Fiber Lasers for Biomedical Imaging)** and the **Overseas Research Cooperation Fund (Coexistence and Evolution of Bright and Dark Solitons in Mode-Locked Fiber Lasers)**.

4. Research on Hybrid Mode-locked Fiber Laser Based on Nonlinear Multimodal Interference (Scientific Research) Nano Device Lab (HYFUgroup), Center 2B, Tsinghua-UC Berkeley Shenzhen Institute

Project Introduction *2022.12 – 2023.6*

The project involved the design of a novel semi-polarization-maintaining erbium-doped fiber laser. A distinctive approach was employed, utilizing a reflective multi-mode interference saturable absorber (SA) for mode-locking. Within this specially designed SA, linearly polarized light was coupled into a 15 cm long gradient refractive index multi-mode fiber through polarization-maintaining fiber. The light was then reflected back into the polarization-maintaining structure via a mirror connected to a single-mode fiber. The measured modulation depth and saturation peak power were 1.5% and 0.6 watts, respectively. This laser generated mode-locked pulses of 409 femtoseconds at a repetition rate of 33.3 MHz. Compared to traditional nonlinear polarization evolution (NPE) mode-locking in non-polarization-maintaining fiber lasers, this laser exhibited superior optical performance metrics, including spectral bandwidth, pulse duration, and stability.

Project Achievements

In this project, I made significant contributions by assisting in experimental tasks, collecting experimental data, and contributing to the revision and refinement of the manuscript. As a result of these efforts, a journal paper was published, showcasing the collaborative work done within the project.

[1] X. Liu, M. Dai, **D. Pan**, et al. Robust mode-locking in a hybrid ultrafast laser based on nonlinear multimodal interference [J]. *Optics & Laser Technology*, 2023, 159: 108941.

Publication

2020.8 – 2023.8

[1] **D. Pan**, X. Liu, H. Y. Fu, et al. Linear polarization-maintaining fiber laser mode-locked by nonlinear polarization evolution; proceedings of the *Optelectronics and Communications Conference*, F, 2021 [C]. Optica Publishing Group.

[2] X. Liu, Q. Li, **D. Pan**, et al. A robust and novel linear fiber laser mode-locked by nonlinear polarization evolution in all-polarization-maintaining fibers [J]. *Journal of Lightwave Technology*, 2021, 39(23): 7509-7516.

[3] X. Liu, R. Zhou, **D. Pan**, et al. 115-MHz linear NPE fiber laser using all polarization-maintaining fibers [J]. *IEEE Photonics Technology Letters*, 2021, 33(2): 81-84.

[4] **D. Pan**, X. Liu, B. A. Malomed, et al. Build-up dynamics of dissipative solitons in a nonlinear polarization evolution mode-locked fiber laser; proceedings of the *Asia Communications and Photonics Conference*, F, 2021 [C]. Optical Society of America. **(Best Paper Award)**

[5] **D. Pan**, X. Liu, F. Ye, et al. Transient dynamics of dissipative solitons formation in a net-normal dispersion mode-locked fiber laser based on nonlinear polarization evolution [J]. *Applied Optics*, 2023, 62(22): 5946-5953. **(Editor's Pick)**

[6] X. Liu, M. Dai, **D. Pan**, et al. Robust mode-locking in a hybrid ultrafast laser based on nonlinear multimodal interference [J]. *Optics & Laser Technology*, 2023, 159: 108941.

[7] X. Liu, Z. Li, **D. Pan**, Q. Li, and H. Y. Fu, "All-polarization-maintaining Bidirectional Dual-comb Fiber Laser by Nonlinear Polarization Evolution," in 26th Optoelectronics and Communications Conference, P. Alexander Wai, H. Tam, and C. Yu, eds., OSA Technical Digest (Optica Publishing Group, 2021), paper T3C.5.

[8] F. Ye, X. Liu, **D. Pan**, H. Y. Fu, and Q. Li, "Two pulsed regions in a L-band dissipative-soliton fiber laser controlled by two pump injections," in CLEO 2023, Technical Digest Series (Optica Publishing Group, 2023), paper JTu2A.112.

Please refer to my Researchgate profile for the complete list of research publications.

Skills

Research Skills

1. Designing, modeling, assembling, and testing fiber laser systems.
2. Conducting real-time measurements of ultrafast laser transient dynamics.
3. Performing simulations using MATLAB.
4. Creating and editing scientific visualizations.
5. Typesetting documents in LaTeX.

6. Proficient in artificial intelligence techniques, including TensorFlow and PyTorch, for executing tasks related to computer vision, neural networks, and machine learning.

Language

Chinese (Native), English (Fluent (CET-6: 479, TOFEL: 85))

Tools

TensorFlow, PyTorch, SOLIDWORKS, AutoCAD, Matlab, Python, MySQL, C++, Zemax, Arduino, LaTeX.

Extracurricular Activities

Tsinghua University SIGS Swimming Association — Tsinghua University
President/Club Manager — *2020.9–2021.9*

Tsinghua University Rowing Team — Tsinghua University
Captain — *2022.6–2023.6*

Hobbies

Rowing, Swimming, Dragon Boat, Basketball, Surfing, Music, Traveling, Photography.