

# CURRICULUM VITAE

## PERSONAL INFORMATION:

Name: Xinhang Xu

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## EDUCATION:

### **Postdoc Researcher, University of California, Davis, California (03/2024 – present)**

I participated in NSTX-U spherical tokamak experimental proposals (e.g., investigating the role of electron-scale turbulence in driving electron thermal transport in the extended operational regime of NSTX-U, which offers unique advantages for such studies due to its low collisionality, high plasma beta). In addition, I collaborated with the team to develop and improve diagnostic systems (High-k Scattering Diagnostic and Far-Infrared Tangential Interferometer/Polarimeter, FIReTIP). I also developed a 1D FDTD simulation code to estimate the influence of the Cotton–Mouton effect on interferometer diagnostics and to evaluate polarization evolution during wave propagation in the NSTX-U system.

### **Ph.D. degree (2016 - 2023), University of Science and Technology of China, Hefei, China**

I have six years of experience on the EAST tokamak, participating in long-pulse/steady-state plasma experiments campaign and MHD instabilities campaigns. I am working in micro-tearing mode (MTM) project team as diagnostician, taking the responsibility to analysis experimental data by Backward Doppler Reflectometer, Electron Cyclotron Emission Imaging (ECEI), Langmuir probes.

This experimental campaign demonstrates that the electron temperature and radial electric field associated with micro tearing modes (MTMs) are consistent with the pressure balance equation. This result provides critical validation for theoretical and computational models, confirming that MTM-mediated transport is predominantly thermal, characterized by a large heat flux and a negligible particle flux.

Led the rapid, three-month design and installation of critical microwave diagnostic platforms (ECEI and MIR) for the EAST tokamak, demonstrating advanced project management and cross-functional team leadership under tight deadlines.

My Ph.D. also focused on computational plasma physics, developing novel numerical models to study electron-wave interactions. My research uncovered the essential role of angular momentum conservation in anomalous Doppler resonance, enhancing our fundamental understanding of non-thermal electron cyclotron emission.

**Bachelor's degree (2012 – 2016), Anhui University of Science and Technology (AUST), Huainan, China**

## **RESEARCH ACTIVITIES:**

### **Facilities**

I participated in experiments on NSTX-U, DIII-D, and EAST tokamaks. At NSTX-U, I was primarily responsible for the upgrade and optimization of the high-k scattering system and contributed to the preparation and review of five-year experimental proposals (e.g. **1. Understand the role of electron-scale turbulence in driving electron thermal transport in the extended regime of NSTX-U**, this objective aims to substantially advance our understanding of electron-scale turbulence and its relationship with electron thermal transport by utilizing a new high-k poloidal scattering system on NSTX-U coupled with extensive comparison between measurements and linear/nonlinear gyrokinetic simulations over a wide range of parameter regime provided by NSTX-U and **2. Achieve real-time density measurement for NSTX-U controllability improvement by the FIRETIP diagnostics system**, this real-time feedback control is crucial for supporting the advanced NSTX-U operational scenarios. Furthermore, the diagnostic system provides important constraints for EFIT equilibrium reconstructions, significantly improving the accuracy of plasma equilibrium modeling.). On DIII-D, I participated in analyzing diagnostic data and contributed to numerical model development.

### **Model development**

I developed a novel kinetic simulation program that synergistically combines the computational efficiency of the spectral method (from the CODE program) with the modular, object-oriented architecture of the NORSE program. This hybrid solver is designed to compute the full temporal evolution of the electron distribution function in 0D2P (zero spatial dimensions and two momentum dimensions) phase space under time-varying background parameters, such as plasma density and loop voltage. It self-consistently incorporates key physical processes—including electric field acceleration, test-particle collisions, synchrotron radiation damping, and the complete runaway electron avalanche source term—enabling the investigation of non-thermal electron dynamics in evolving discharge conditions. By moving beyond the limitations of previous steady-state solvers, this algorithm achieves significant gains in computational performance while maintaining high accuracy. The object-oriented framework ensures the code is both extensible and adaptable, facilitating the future integration of additional physics or its application to more complex scenarios.

### **Diagnostics development**

Primarily involved in the development and operation of millimeter-wave diagnostics (ECEI and Microwave Imaging Reflectometry, MIR) and terahertz-wave diagnostics (High-k Scattering Diagnostic and Far-Infrared Tangential Interferometer/Polarimeter, FIReTIP). Responsible for system operation and maintenance, data acquisition, and data analysis.

## RESEARCH EXPERIENCE:

**Accumulated 7.5 years of hands-on experience** leading and supporting physics campaigns on major fusion facilities (6 years on EAST, 1.5 years on DIII-D).

**Architected a beam tracing simulation program** using a Finite Difference Time Domain (FDTD) method to model electromagnetic wave propagation and optimize diagnostic design (2023).

**Developed advanced kinetic models** to simulate and analyze runaway electron generation and emission phenomena in tokamak plasmas (2022).

**Investigated micro-tearing mode (MTM) instabilities**, studying their growth and dynamics to understand their role in plasma confinement and transport.

**Conducted research on non-thermal electron dynamics**, analyzing distribution functions and their impact on plasma stability using kinetic models.

## PUBLICATIONS:

1. Xu Xinhang, et al. "Improvement of transmittance using groove structured surface for microwave imaging diagnostics in tokamak plasmas." 2020 45th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz). IEEE, 2020.
2. Xu, Xinhang, et al. "Analysis of the Anomalous Doppler Effect from Quantum Theory to Classical Dynamics Simulations." Chinese Physics B (2025).
3. Zihan, L. I., et al. "A synthetic diagnostics platform for microwave imaging diagnostics in tokamaks." Plasma Science and Technology 26.3 (2024): 034006.

4. Liu, Xianzi, et al. "High-wavenumber Collective Scattering Diagnostic System for EAST and NSTX-U Tokamaks and Synthetic Diagnostic System Development." APS Division of Plasma Physics Meeting Abstracts. Vol. 2024. 2024
5. Gao, BingXi, et al. "Diagnostic capacity of electron cyclotron emission imaging system with continuous large observation area on EAST tokamak." Review of Scientific Instruments 89.9 (2018).
6. Han, Dongqi, et al. "In situ relative self-dependent calibration of electron cyclotron emission imaging via shape matching." Review of Scientific Instruments 89.10 (2018).
7. Fei-xue, G. A. O., et al. "Evaluation of optical performance of microwave reflection imaging system on EAST tokamak." Nuclear Fusion and Plasma Physics 42.2 (2022): 187.

## **Presentations:**

Poster: "Analysis of the Anomalous Doppler Effect from Quantum Theory to Classical Dynamics Simulations"; The 45th International Conference on Infrared, Millimeter, and Terahertz Waves

(Nov 2020)

Oral presentation: "Kinetic Simulation of Runaway Electrons"; 2023 Plasma Mixture Simulation Workshop, Hefei, China.

(Oct 2023)

Oral presentation: "Direct Simulation of the Anomalous Doppler Effect Using a Volume-Preserving Algorithm"; The 8th Graduate Academic Forum on Plasma Physics and Fusion Engineering, University of Science and Technology of China, China

(May 2023)

## **Collaborative Work**

- **Key Collaborator** on fusion diagnostics projects with a 24+ member team from General Atomics, Princeton Plasma Physics Lab (PPPL), and UC Davis, comprising senior

leadership (4 professors, 6 scientists) and technical staff (4 engineers, 10+ postdocs/graduate students).

- **Contributed to the full project lifecycle**, including experiment design & review, experimental campaign execution, data acquisition, simulation/data interpretation, and theory validation, leading to peer-reviewed publications and presentations.
- **Valued for exceptional interdisciplinary communication**, effectively mediating between scientific needs and engineering limitations to adapt designs, propose viable solutions, and define strategic optimization plans.