Research Plan

Over the course of this postdoctoral program spanning the next year, my focus will be on millimeter-wave/terahertz diagnostic development and applications at the National Spherical Torus Experiment Upgrade (NSTX-U) facility. My role encompasses diagnostic hardware development, laboratory instrument characterization and testing, synthetic diagnostic module development, and on-site installation at the Princeton Plasma Physics Laboratory. During the first three to six months of my on-boarding, I will be stationed at UC Davis to assemble, test, and calibrate the high-k scattering diagnostic. Additionally, I will contribute to the development and application of the synthetic scattering module during this period. For the remainder of my J1 visa period, I will install and operate the scattering diagnostic system on NSTX-Upgrade. Throughout this program, I aim to achieve three major objectives.

1. Cutting-edge Millimeter-wave Diagnostic Development

*During the initial phase, my primary focus will be on the development of diagnostic instruments. This includes comprehensive testing of the 693 GHz transmitter source, measurement of launching beams, optimization of transmitter/receiver optics, implementation of front-end receiver protection, and rigorous testing of back-end electronics. As a key member of the development team, I will also oversee on-site installation and validate operational configurations. The goal of this stage is to ensure that the diagnostic system is fully operational for the first day of plasma experiments on NSTX-U in 2025.*

2. Synthetic Module Development for Fusion Reactor Digital Twin

*In the subsequent stage, I will address the interpretation of experimental raw data by developing a sophisticated computing module. Considering the complexities of beam propagation paths and wave-particle interactions, the creation of a synthetic scattering module becomes imperative. Building upon existing beam propagation simulation modules, I will incorporate wave-particle interaction functions to enhance the accuracy of the scattering module. The output from the synthetic module will be instrumental in interpreting experimental data, validating transport theory, and contributing to neural network studies.*

3. Electron Temperature Gradient Instability and Transport Study

*This research delves into the intricate dynamics of electron temperature variations within a plasma, focusing on the exploration of electron temperature gradient instability and transport. The study seeks to unravel the underlying mechanisms of instability arising from electron temperature gradients and their subsequent impact on particle transport. By examining the complex interplay between these gradients and resulting instabilities, this research contributes significantly to our understanding of fundamental plasma phenomena. The insights gained are anticipated to advance both theoretical and experimental aspects, offering valuable contributions to the broader field of plasma physics and facilitating progress in controlled fusion and other plasma-based technologies.*