Title: Certifiable Quantum Randomness for Enhanced Data Security and Encryption

Abstract:
The inherent unpredictability of quantum systems serves as a foundational resource for generating true randomness—an essential element in securing critical data. In this presentation, I will explore methods for generating **certifiable quantum random numbers** and demonstrate their pivotal role in strengthening encryption, secure communication, and cryptographic protocols.

I will specifically focus on small-scale quantum systems, using two- and four-qubit configurations, to illustrate how certifiable randomness can be extracted and applied to the generation of secure public and private cryptographic keys. A study involving a four-qubit photonic system prototype developed in our laboratory will be presented, showcasing experimental results that validate the generation of certifiable random numbers and their practical utility in quantum-secured encryption and decryption processes.