Project Summary

Overview

This proposal is in response to the **Beginnings track**. The power of quantum computers can be utilized to speed up the computation from drug design to machine learning, cybersecurity, and outer space. However, the same power can also be used by malicious actors to break modern cryptography and steal encrypted data. In May 2022, the National Security Memo (NSM-10) was signed and released to call for efforts to mitigate the risks of **quantum attacks**. We must take immediate action to migrate from asymmetric encryption to **post-quantum cryptography (PQC)** to bring a quantum-safe future to our data and software systems. This migration is massive due to the complexity and scale of the software systems in modern society. To prepare for the migration, we need a trained workforce versed in **PQC, an emerging technology at the intersection of cybersecurity and quantum computing**, a specific field in Quantum Information Science and Technology (QIST). According to the QIST Workforce Development National Strategic Plan, there is an urgent need to diversify the workforce and "make careers in QIST and related fields more accessible and equitable."

We propose an **A**ctive and **IM**mersive learning program for **P**ost-**Q**uantum **C**ryptography (**AIM-PQC**) using active and experiential learning approaches to provide training in essential knowledge and skills in cybersecurity and quantum cryptography for diverse beginning students in science, technology, engineering, and mathematics (STEM). The program is comprised of 6-week on-ramp workshops followed by 8-week internships with **four companies active in cybersecurity (i.e., Northrop Grumman, TCecure, CyDeploy, and Technuf) and a university-based applied research lab**. A total of **48 participants** will be recruited from the **University of Maryland, Baltimore County**, a **Minority-Serving Institution**, and **Montgomery College**, a community college with a **Hispanic Serving Institution** designation. The research team has expertise in **applied PQC, quantum software engineering, data science, and STEM education**, supported by a solid partnership with industry, government agencies (i.e., **NIST**), and existing initiatives in Broadening Participation in Computing, i.e., **UMBC Center for Women in Technology (CWIT)**.

Intellectual Merit

The intellectual merit of this project is the design and development of the AIM-PQC program to provide underrepresented groups in STEM access to career-oriented training in emerging technologies in PQC and transferable problem-solving skills in QIST careers. The AIM-PQC program advances knowledge in experiential learning approaches in QIST to support beginning STEM students with diverse backgrounds and generate knowledge in research and practice communities in Discipline-based Education Research in QIST, Experiential Learning, and Broaden Participation in Computing.

Broader Impacts

The AIM-PQC program is a timely response to the urgent need for a diverse cybersecurity and quantum cryptography workforce to develop quantum-safe solutions and ensure the **leadership of the USA in the quantum race**. Through the **academic-government-industry partnership**, we will train **beginning STEM students** who are competent with PQC-related skills and ready to contribute to significant efforts to ensure quantum-safe software systems. This project will serve as a foundation for large-scale education and workforce development towards a vision of a **"Capital of Quantum"** in the DMV area and beyond. Moreover, this program will provide a model and curriculum for education and workforce development in PQC that can be adopted and adapted by other institutions or organizations. The knowledge generated may also inform the training of diverse beginning STEM students for other emerging technologies.