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Quantum-AI Biophotonic Diagnostics for Point-of-Care Brain Tumor Screening

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This talk introduces *Quantum-AI Biophotonic Diagnostics for Point-of-Care Brain Tumor Screening*, a next-generation framework that unites quantum computing, artificial intelligence, and nanoscale biophotonics to transform biomedical diagnostics. We present an integrated approach for early cancer detection that combines plasmonic biophotonic sensors with a quantum machine learning (QML) pipeline, designed for high-sensitivity, non-invasive detection and classification of brain tumors in a compact point-of-care device.

Our system harnesses spectral data from nanoscale plasmonic biosensors, encoding these features via quantum-enhanced methods into a quantum kernel-based learning model. This platform uses quantum-driven feature encoding to process both spectral and imaging signals, enhancing diagnostic accuracy while reducing computational overhead. The framework's architecture emphasizes efficiency and portability, enabling real-time analysis suitable for clinical and bedside applications.

We further detail the system's architecture, simulation fidelity, and early experimental results, which demonstrate promising performance in distinguishing tumor signatures. The multidisciplinary innovation—situating light-matter interactions at the nanoscale in concert with quantum intelligence—opens new opportunities for intelligent diagnostic devices capable of immediate cancer screening. Importantly, the implementation highlights pathways for clinical translation, including integration with existing healthcare workflows, regulatory considerations, and validation methodologies.

By leveraging the synergy of quantum technology, artificial intelligence, and biophotonics, this approach has the potential to reshape the landscape of precision oncology and personalized healthcare. Attendees will gain insights into how quantum-biophotonics convergence can revolutionize diagnostic capabilities, enabling earlier and more reliable detection of brain tumors.

Author: Dr KHAN, Mansoor Ali (Department of Electrical and Computer Engineering, National University of Singapore, 117575, Singapore)

Co-authors: Prof. SIKDAR, Biplab (Department of Electrical and Computer Engineering, National University of Singapore, 117575, Singapore); Prof. AMAN, Muhammad Naveed (School of Computing College of Engineering University of Nebraska, Lincoln, NE 68588, United States)

Presenter: Dr KHAN, Mansoor Ali (Department of Electrical and Computer Engineering, National University of Singapore, 117575, Singapore)

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