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Quantum Approaches to Biomedicine: Hybrid Algorithms and Rydberg-Atom Sensing

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Quantum technologies are rapidly emerging as powerful tools for addressing complex challenges in biology. In this talk, I will share a cross-section of Infleqtion's research at the intersection of both quantum computing and quantum sensing with applications in biomedicine. On the computing side, I will describe our ongoing work within the Wellcome Leap Q4Bio program, where we have developed a hybrid quantum-classical algorithm for biomarker discovery on high-dimensional, multimodal cancer datasets. By framing the problem as a higher-order combinatorial optimization task, we use a quantum processor to strategically constrain the search space before passing the reduced problem to a classical solver finish the problem. This approach enables us to identify small, clinically interpretable feature sets that enhance predictive accuracy on downstream tasks such as tumor classification and treatment response. On the sensing side, I will discuss our development of Rydberg-atom based electric field sensors for next-generation terahertz (THz) imaging. These sensors offer high sensitivity, broad tunability, and spectral selectivity, making them well-suited for biological applications where THz signals provide insights into water content, molecular structure, and tissue composition. Together, these projects demonstrate how quantum tools can unlock new biological insights and drive innovation in healthcare.

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