Room temperature Optical quantum computers for feature learning and classification

Background: We are constructing a room temperature, optical Quantum computer capable of solving feature learning and classification problems instantly, the technology is currently at TRL 5.0 at CQST, IIT Mandi. By transforming Qubits into a 3-D laser hologram with 20 faces, akin to an icosahedron, our computer harnesses 16 parallel channels, providing an equivalent of 16x320 Qubits. With a sophisticated user interface, Quantum simulator, and quantum processing capabilities in place, our computer operates as a graphics processor (GPU not CPU), seamlessly processing inputs such as videos or photographs. It extracts a model to explain inherent dynamics hidden in the input data and delivers output as Quantum live feed. Composing a Quantum algorithm is tedious, yet our computer mirrors an inquisitive mind of a scientist, swiftly suggesting an approximate theoretical model for unknown big data with an 86% accuracy, all without relying on algorithms.

Specific targets: We want to scale it up from 16 channel to 1024 channels, and while doing that we would make in India (1) Single photon source, (2) Phase sensitive Single photon avalanche diode, SPAD and (3) Multipurpose co-incidence counter, transform three products to TRL 9.0, commercialize by launching start-ups.

Operational Mechanism: Utilizing cutting-edge quantum computing principles, we have integrated Quantum Walk and Boson Sampling into a single Supramolecular hardware system. Quantum Walk, operating at room temperature amidst extreme noise, orchestrates precise protein-DNA binding at atomic scales, delivering universal quantum computing capabilities. Meanwhile, Boson Sampling, also functioning at room temperature, maps probabilistic contributions from distinct choices under random noise, effectively solving intractable computer science problems. Our system transforms input videos into a giant supermolecule from the atomic scale as DNA like helical nanowires assemble in solution constituting an on-demand Quantum circuit. Quantum circuits are read via photons, with queries facilitated through microwave antenna inputs. Autonomous updates and memory erasure occur through gel melting. Quantum Walk explores all possible dynamics from astronomical choices while Boson Sampling records decisions as deformations within the photon’s 3D geometric structure.

Technological novelty: 1. By introducing Gauge potential, we overcome the challenge of photon interaction in optical quantum computing, a crucial step in scaling up operations.

2. Leveraging light-matter interaction instead of solely relying on light-based computation enables advanced functionalities like memory storage and hierarchical information processing, akin to deep learning networks.

3. Implementing Quantum walk-based universal computing via dielectric resonator coupling with evanescent waves mirrors the atomically precise computation observed in proteins under room temperature and extreme noise conditions.

4. Autonomous reading of Quantum walk is achieved through Boson sampling, streamlining complex processes.

5. Adaptation of SPAD for phase quantization mapping lays the groundwork for universal quantum computing, crucial for operations like the C-NOT gate with a 180-degree phase gap.

6. Utilizing post-homodyne resolved signals in conjunction with coincidence counters facilitates the identification of variables and invariants essential for dynamic event modeling.

7. Organic gel serves as a long-term memory storage solution, lasting up to 18 to 20 years without the need for periodic flashing typical in silicon chips, one can melt and rebuild new Quantum circuits, no need to change hardware.

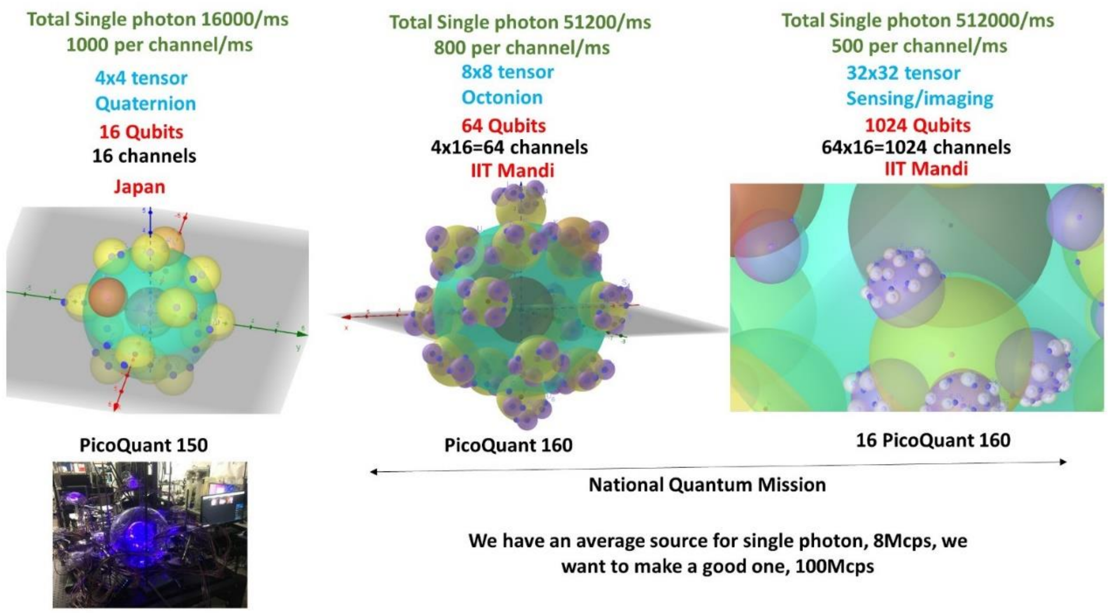

Figure 1. The prototype that we have built. The conceptual design, each module is shown with a sphere, each sphere contains beam splitters, spacers, phase modulators, function distinctly.

Empowering Indian Quantum technology outreach and AI industry entails two key thrusts:

(1) Enhancing feature learning and classification capabilities across diverse sectors such as genetics, astrophysics, finance, and weather forecasting. By extracting insights from vast unknown datasets, bolstering cybersecurity, and uncovering hidden patterns, our algorithm-free AI features promise targeted advancements. Integrating billions of computers, we aim to revolutionize data comprehension and predictive analytics, enabling impactful interventions in critical areas like financial security.

(2) Strategically selecting three immediate products – a single photon source, SPAD, and coincidence counter – we're poised to develop each component vital for building quantum computers. Through collaboration with startups and establishing a robust supply chain, we aim to commercialize these components locally, thus reducing import dependency and saving significant costs for the Indian government. This approach not only fosters indigenous innovation but also facilitates broader participation in the Quantum revolution.

Timelines of deliverables: We're embarking on the development of four products, starting at Technology Readiness Level (TRL) 5.0: a single photon source, SPAD, coincidence counter, and Quantum Neuromorphic Computer—a Quantum GPU equivalent. The first three products are poised for imminent commercialization, aligning with our strategy to leverage indigenous tools for scaling up our quantum computing capabilities. Alongside, we're unveiling a visual roadmap showcasing our current prototype and the envisioned scale-up process to achieve the ambitious 1000 Qubit target.