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(I) Quantum Cryptography Beyond Qubits with Structured Photons

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Photons, the quanta of light, possess several different degrees of freedom, e.g., frequency, polarisation, spatial and temporal modes, which can be used as platforms for quantum information applications. Polarisation, corresponding to the vectorial nature of light, is bi-dimensional and can represent '0' and '1' in the digital world. Unlike, polarisation, transverse and temporal modes would provide an unbonded vector space and could be used to extend the alphabet beyond the '0' and '1's to any arbitrary integer numbers. Photons in superposition states of these different degrees of freedom are known as Structured Photons. In the classical regime, structured light has found tremendous applications, e.g., overcoming the diffraction limit (STED microscopy), for optical spanners, communication multiplexing, and generating non-trivial 3D topologies such as Möbius and Knots. In the quantum domain, structured photons may be used to realise higher-dimensional states, and thus are used for quantum communication, computation, and simulations. The recent progress, challenges, and applications of structured photons, beyond qubits, in quantum communication, will be the subject of my talk.

Author: Prof. KARIMI, Ebrahim (University of Ottawa)

Presenter: Prof. KARIMI, Ebrahim (University of Ottawa)

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