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Lecture I: From qubit to qudit with hybrid OAM-polarization quantum state.

In quantum information processing based on optical techniques, single photons offers a variety of degrees of freedom in which information can be encoded. By exploiting these resources, it is possible to implement high-dimensional quantum states, or qudits, which enable higher security in quantum cryptographic protocols, as well as implications in fundamental quantum mechanics theory. In this framework, the orbital angular momentum of photons, being defined in an infinitely dimensional Hilbert space, offers a promising resource for high-dimensional optical quantum information protocols. Finally, we will discuss how the q-plate device can be adotped to manipulate OAM qubit and qudit states.

Lecture II: Photonic optimal quantum cloning.

Optimal quantum cloning is the process of making one or more copies of an arbitrary unknown input quantum state with the highest possible fidelity. We will first review the demonstration of quantum cloning limited to copying two-dimensional quantum states, or qubits. Hence we will we report the experimental realization of the optimal quantum cloning of four-dimensional quantum states, or ququarts, encoded in the polarization and orbital angular momentum degrees of freedom of photons.