Heralded Single-Photon Qubits from Photonic Molecules

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Developing integrated sources of single-photon and entangled two-photon states of light is an important problem of quantum optics and optical quantum technologies. In particular, preparing single-photon states via nonlinear optical effects in microring resonators is a forward-looking approach to develop compact and effective on-chip devices that is compatible with existing CMOS technology. In doing so, a system of coupled microring resonators which is often referred to as a photonic molecule, has proved to be a promising structure for creating effective quantum light sources and controlling basic properties of the generated quantum states.

In this talk, we present promising schemes for heralded generation of frequency-bin photonic qubits in a photonic molecule which allow one to control the qubit state by the frequency amplitude of the pump field and thereby provide the highest possible heralding efficiency. It is shown that coupling parameters of the photonic molecule can be optimized to provide the generation of nearly pure heralded photons. Generalization of the proposed approach for more complicated photonic molecules, allowing the generation of high-dimensional photonic states, is discussed.