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Multimode quantum optics for hybrid quantum information processing

Abstract: Optical quantum information processing can be classified mainly into two approaches depending on the encoding of quantum information: One is based on discrete photon numbers (thus referred to as discrete-variable quantum information), and the other is continuous electric-field quadratures (continuous-variable quantum information). Each of the approaches has its own advantages compared with the other. For example, in the continuous-variable approach, highly multimode entangled states can be deterministically generated, and in the discrete-variable approach, quantum processes that cannot be classically simulated can be implemented. A new approach, called hybrid quantum information processing, is to combine the two approaches to take both advantages. In this seminar, I will present development of a multimode quantum optical system for hybrid quantum information processing. We employ the intrinsic multimode structure of an ultrafast frequency comb to construct the multimode squeezed vacua, and apply a coherent single-photon subtraction to the multimode resource. I will further discuss about our recent experimental progress on the implementation.