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Quantum optics and quantum information processing with solid state systems

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A single semiconductor quantum dot embedded in a monolithic microcavity with a large spontaneous emission enhancement (Purcell) factor is capable of producing identical single photons on demand. Those single photons realize a multi-particle interference effect as quantum mechanically indistinguishable particles. Various quantum phenomena, such as violation of Bell's inequality and quantum teleportation, can be demonstrated with only such single photons and linear optics. An important challenge for quantum information system applications is to replace a man-made quantum dot by a natural substitutional donor impurity with suppressed inhomogeneous linewidth and electron/nuclear spin capability. In this talk we will discuss the recent experimental progress on this new quantum dot system.