QUANTUM COHERENCE AND QUANTUM CORRELATION OF TWO QUBITS MEDIATED BY A ONE-DIMENSIONAL PLASMONIC WAVEGUIDE

Zheng-Da Hu, Xiuye Liang, Jicheng Wang, and Yixin Zhang

School of Science, Jiangsu Provincial Research Center of Light Industrial Optoelectronic Engineering and Technology, Jiangnan University, Wuxi 214122, China

Abstract. We investigate the dynamics of quantum coherence and quantum correlation of two qubits mediated by a one-dimensional plasmonic waveguide. The analytical expression of the dissipative dynamics of the two qubits is obtained for the initial *X* state. The dynamical behaviors of the quantum coherence and quantum correlation are shown to be largely dependent on the parameters of the initial state. Starting from a product state, quantum coherence and quantum correlation can be induced by the plasmonic waveguide. Under continuous drivings, steady quantum correlation can be obtained at specific distance larger than the operating wavelength and large values of steady quantum coherence are attainable at arbitrary distance. The detuning effect on the dissipation-driven generation of steady quantum coherence and quantum correlation is also explored.

Introduction. Decoherence is usually unavoidable due to the fact that any realistic quantum system is disturbed by its surrounding which may lead to loss of quantum coherence [1]. The presence of decoherence causes obstacles for precisely carrying out quantum tasks because quantum states (to be distributed) and nonclassical correlations (used as resources) are easily destroyed. In this sense, the mediations of nonclassical correlations (between two nodes of a quantum network) in dissipative environments are crucial in quantum information science [2]. It has been reported that photons can be used as a medium to mediate the entanglement between two nodes [3,4]. Recently, some proposals for long-distance entanglement of two nodes by using plasmons instead of photons have attracted considerable interest [5–9]. Plasmons traveling along an interface are known as surface plasmon polaritons [10, 11] and display strong local surface effect, which is effective for breaking the classical diffraction limit and manipulating light in the nanoscale domain.With the development of nanotechnologies, strong and efficient coupling in plasmonic quantum electrodynamics is attainable and much work has been devoted to exploring potential applications of plasmonic nanostructures to quantum information science [12,13]. In this theses, we report the dynamics of quantum coherence and quantum correlation between two separated qubits which are modulated by a one-dimensional (1D) plasmonic waveguide (PW) via quantum coherence and quantum correlation, respectively. The analytical solution for the dynamics of the two-qubit system is obtained for initial X states. By considering a concrete class of X states, i.e., the extended Werner-like states, the dynamical behaviors of the quantum coherence and quantum correlation is shown to be largely dependent on the parameters of the initial state. The phenomena of sudden change or double sudden changes occur in the dynamics of quantum correlation. Besides, the incoherent coupling parameter is more crucial in the creation of quantum coherence and quantum correlation from the initial product state of the two qubits, although they decay to zero asymptotically due to the individual spontaneous emission. To obtain steady quantum coherence and quantum correlation, classical fields for driving can be locally applied to the qubits. Under the continuous drivings, the second sudden change point is removed and steady quantum correlation can be obtained at specific distance larger than the operating wavelength. By contrast, large values for steady quantum coherence are attainable at arbitrary distance. Finally, we explore the detuning effect on the dissipation-driven generation of steady quantum coherence and quantum correlation.

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