The zero-point field and emergence of entanglement

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The linearity of the Schrödinger equation allows for the superposition of state vectors and the creation of entangled states in a composite system. The origin of such entanglement —or rather of the associated quantum correlations— seems clear when the subsystems interact directly. However, for identical non-interacting particles, the quantum formalism postulates the (anti)symmetrization rule, leaving aside the physical gears responsible for the ensuing of correlations. Here we throw light on both the physical agent and the mechanism behind the entanglement of two non-interacting particles, by allowing a pair of (otherwise classical) identical particles to interact with the common random zero-point radiation field. The analysis is made in the context of Linear Stochastic Electrodynamics, and constitutes an extension of the theory developed for the single-particle case [1, 2]. The dynamical variables of the particles are shown to become correlated whenever the particles resonate to a common frequency of the background field. In terms of state vectors in the appropriate Hilbert space, the entangled states emerge naturally as the only ones that can reproduce such correlations. Further, some properties of invariance of the system imply that entanglement is maximal and must be described by totally (anti)symmetric states [1, 3, 4].

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