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Control of Extended Quantum Systems: the case of quantum optical solitons

Optical solitons are light pulses that propagate without distortion in a fiber. The origin of the propagation invariance is the interplay between material dispersion and nonlinearity. Classically, a soliton is invariant in shape upon evolution, and hence may be used to transmit information. In a second quantized theory, the properties of solitons radically change, a problem of specific relevance also for Bose-condensed gases. Here we review the theory of quantum solitons of the nonlinear Schroedinger equation. We show that quantum solitons “evaporate,” that is they decay emitting specific frequencies with a thermal like distribution, in analogy with Black Hole evaporation. We discuss the way such irreversible dynamics arise in a Hamiltonian system. We show that a quantum optical soliton is a paradigmatic example of “extended” quantum system with a many interesting directions in the field of coherent quantum control.

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