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Entanglement generation in the collective atomic recoil laser

We focus on exploiting the instability of the light-matter interaction of CARL in the good cavity regime to parametrically amplify atomic and optical waves as well as to generate entanglement between atomic and optical fields. We show that, in the linear model, the evolved state is a fully inseparable three mode Gaussian state that, for different regimes, may reduce to a thermal atom-atom or atom-photon entangled state. Indeed we illustrate a scheme to realize the interspecies teleportation of the quantum state of a single mode radiation field onto the collective state of atoms with a given momentum out of a BEC. Finally the results obtained are extended to include the effects due to atomic decoherence and cavity losses.



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