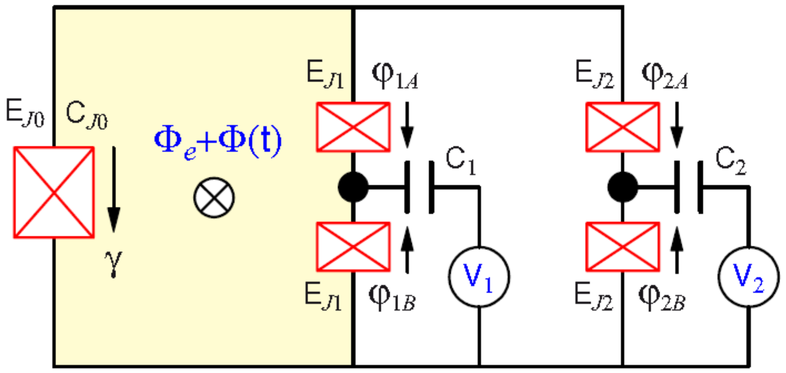
Influence of Kerr nonlinearity on the entanglement between two Josephson charge qubits

Bashkirov E.K.
Samara National Research University



X.-L. He at al. Phts. Rev. A 76, 022317 2007

Hamiltonian in the interaction picture

$$H = \hbar\gamma_{12}(a^{+}\sigma_1^{-}\sigma_2^{-} + \sigma_1^{+}\sigma_2^{+}a)$$

Initial qubits entangled state

$$|\Psi(0)\rangle_{Q_1\,Q_2} = \cos\theta|-,-\rangle + e^{i\phi}\sin\theta|+,+\rangle$$

Cavity field state

a) coherent

$$|\Psi(0)\rangle_F = \sum_{n=0}^{\infty} F_n|n\rangle$$

$$F_n = e^{-\bar{n}/2}\frac{\bar{n}^{n/2}}{\sqrt{n!}}$$

b) thermal

$$\rho_F(0) = \sum_n p_n |n\rangle\langle n|$$

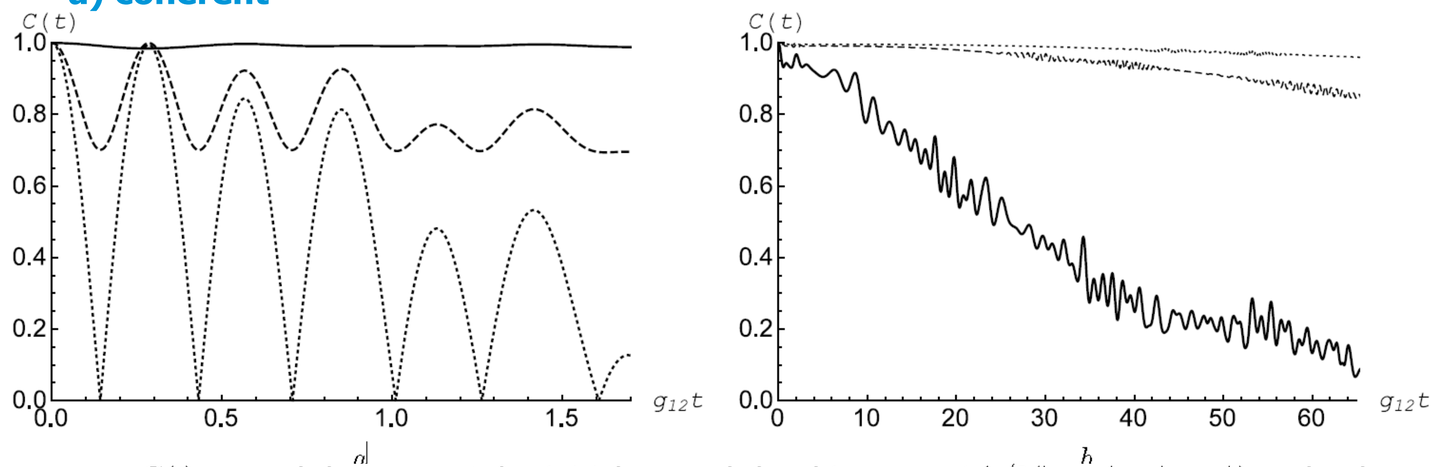
$$p_n = \frac{\bar{n}^n}{(1+\bar{n})^{n+1}}$$

Concurrence

$$C(t) = \max[0,\ \lambda_1 - \lambda_2 - \lambda_3 - \lambda_4]$$

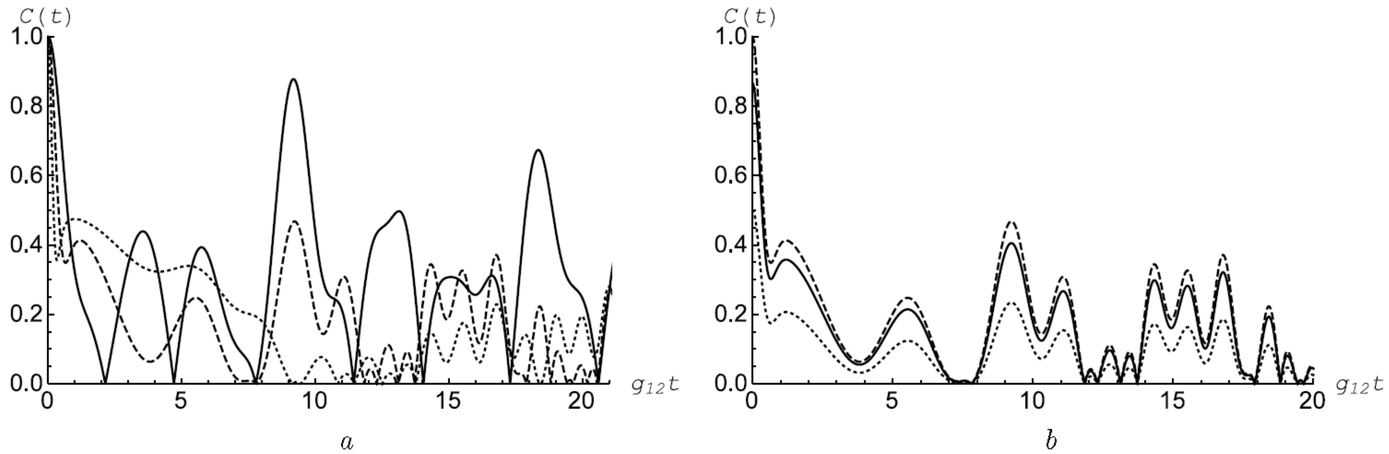
Simulations

a) coherent



Concurrence $C(t)$ vs scaled time $g_{12}t$ for initial entangled qubits state $1/\sqrt{2}(|+,+\rangle + |-,-\rangle)$ and coherent microwave field. Case (a) corresponds to short scaled times. Mean photon number $\bar{n} = 30$ Parameter $\phi = 0$ (solid), $\phi = \pi/4$ (dashed) and $\phi = \pi/2$ (dotted). Case (b) corresponds to long scaled times. Mean thermal photon number $\bar{n} = 10$ (solid), $\bar{n} = 30$ (dashed) and $\bar{n} = 60$ (dotted)

b) thermal



Concurrence $C(t)$ vs scaled time $g_{12}t$ for initial entangled qubits state $1/\sqrt{2}(|+,+\rangle + |-,-\rangle)$ and thermal microwave field. For case (a) the mean thermal photon number $\bar{n} = 1$ (solid), $\bar{n} = 5$ (dashed) and $\bar{n} = 20$ (dotted). Case (b) the mean thermal photon number $\bar{n}$=5. Parameter $\theta = \pi/6$ (solid), $\theta = \pi/4$ (dashed) and $\theta = 5/12\pi$ (dotted)

САМАРСКИЙ УНИВЕРСИТЕТ
SAMARA NATIONAL RESEARCH UNIVERSITY
34, Moskovskoye shosse, Samara, 443086, Russia