Quantum Physics

Global operations for protected quantum memories in atomic spin lattices

G.K. Brennen, K. Hammerer, L. Jiang, M. D. Lukin, P. Zoller

(Submitted on 25 Jan 2009)

Quantum information processed in strongly correlated states of matter can provide built in hardware protection against errors. We may encode information in highly non local degrees of freedom, such as using three dimensional spin lattices for subsystem codes or two dimensional spin lattices for topologically ordered surface codes and measurement based codes. Recently, in [L. Jiang et al., Nature Physics {\bf 4}, 482 (2008)] the authors showed how to manipulate these global degrees of freedom using optical lattices coupled to a bosonic degree of freedom via a cavity. We elaborate on these ideas and recapitulate two approaches to implement many body gates necessary for quantum information processing, both relying on controlled interactions of an ancillary cavity mode with the spin system and single ancilla particles. The main focus of the present paper is to analyze the effect of imperfections such a cavity decay and collective and individual spin decoherence. We present strategies to fight decoherence by monitoring cavity decay and show that high gate fidelities can be achieved in the strong coupling regime of cavity-QED with state of the art parameters.

Comments: 16 pages, 6 figures
Subjects: **Quantum Physics (quant-ph)**
Cite as: **arXiv:0901.3920v1 [quant-ph]**

Submission history

From: Gavin K. Brennen [view email]
[v1] Sun, 25 Jan 2009 20:48:35 GMT (1205kb,D)

Which authors of this paper are endorsers?