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Autonomous Stabilization of Finite-energy Gottesman-Kitaev-Preskill States

Bosonic error-correction codes are emerging as an attractive and hardware-efficient alternative to qubit-based encodings. In particular, the Gottesman-Kitaev-Preskill (GKP) code has been shown in simulations to protect logical information better than other known bosonic codes against typical error channels. However, in their ideal form, GKP codewords contain an infinite amount of energy, making the stabilization of their realistic, finite-energy version challenging. More specifically, stabilization strategies for GKP states need to take into account the amount of energy injected at each error-correction step.

In this talk, we introduce an exact theory of finite-energy GKP states. Based on this new approach, we propose new stabilization protocols that allow the correction of errors in an autonomous fashion. We study these protocols numerically and show that they could potentially lead to an extension of the logical information lifetime by several orders of magnitude.