Stochastic resonance with unital quantum noise

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Mots-clés	Decoherence [4], Improvement by noise [5], Quantum estimation [6], Quantum noise [7], stochastic resonance [8]
Résumé en anglais	The fundamental quantum information processing task of estimating the phase of a qubit is considered. Following quantum measurement, the estimation efficiency is evaluated by the classical Fisher information which determines the best performance limiting any estimator and achievable by the maximum likelihood estimator. The estimation process is analyzed in the presence of decoherence represented by essential quantum noises that can affect the qubit and belonging to the broad class of unital quantum noises. Such a class especially contains the bit-flip, the phase-flip, the depolarizing noises, or the whole family of Pauli noises. As the level of noise is increased, we report the possibility of non-standard behaviors where the estimation efficiency does not necessarily deteriorate uniformly, but can experience non-monotonic variations. Regimes are found where higher noise levels prove more favorable to estimation. Such behaviors are related to stochastic resonance effects in signal estimation, shown here feasible for the first time with unital quantum noises. The results provide enhanced appreciation of quantum noise or decoherence, manifesting that it is not always detrimental for quantum information processing.
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