Enhancing spin-spin correlations in mixed-field Ising model with stochastic resetting

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In several recent works, it was suggested that stochastic resetting in quantum systems may lead to emergence of non-trivial correlations and effective creation of open systems by external interventions [1, 2]. In classical systems, problems of stochastic resetting have been extensively studied, while in this context, much less is known for quantum systems and many open questions are yet to be answered. Here, we are interested in the mixed-field Ising (MFI) model in presence of resetting protocols that have been previously applied to systems with classical dynamics [3, 4, 5]. We analyze analytically the transverse correlations $\sigma_i^x\sigma_j^x(t)$ for a particular MFI without nearest neighbour interactions when being reset to the all-up state $|\uparrow\rangle$ and find nontrivial resetting induced correlations, similar to what was reported in [6] for the longitudinal correlations. For a specific magnitude of the transverse field, the $\sigma_i^x\sigma_j^x(t)$ correlations reach a maximum and increasing the field further only decorrelates the system. In order to obtain a deeper insight into the maximum of the correlations, we have analyzed their dependence on both, the resetting rate and the external fields. Furthermore, using numerical techniques we study analytically inaccessible realizations of MFI, like the chaotic regime, and explore the effects of resetting on the internal unitary dynamics. Our results suggest that the $\sigma_i^x\sigma_j^x$ spin-spin correlations can be fine tuned by the stochastic resetting and we concluded that some optimal range exists for the resetting rate parameter, which enhances those correlations. Further investigations are needed to confirm if the stochastic resetting is an efficient approach to enable modulation of the order parameter and even affect the phase transitions [7].

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