Continuous measurements for adaptive qubit thermometry

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Bayesian estimation was recently applied to quantum thermometry since it allows for better estimation accuracy when data is limited [1] and admits adaptive estimation schemes [2]. Here, we apply the Bayesian framework to the setting of continuous temperature measurement. We model a qubit probe, subject to continuous monitoring interacting with a bosonic bath of unknown temperature. The Kushner-Stratonovich equation from classical filtering theory is simulated to find the posterior distribution. Bayesian estimation is then used to infer the temperature from this probability distribution. This is compared to the discrete analogue, collisional thermometry [3]. An adaptive strategy for improved accuracy is described where Hamiltonian parameters of the qubit can be changed continuously by measurement feedback.

[1] J. Boeyens, S. Seah and S. Nimmrichter, Phys. Rev. A 104 (2021) 052214.

[2] Mohammad Mehboudi, Mathias R. Jørgensen, Stella Seah, Jonatan B. Brask, Jan Kołodyński and Martí Perarnau-Llobet, arXiv:2108.05932 (2021).

[3] Stella Seah, Stefan Nimmrichter, Daniel Grimmer, Jader P. Santos, Valerio Scarani, and Gabriel T. Landi Phys. Rev. Lett. 123 (2019) 180602.