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Optimal estimation of the parameters of a Bose-Einstein Condensate in an optical lattice

This presentation focuses on the application of optimal control techniques to maximize the Quantum Fisher Information (QFI), in order to estimate the value of a specific parameter of the model system. This study is a joint work with the experimental group of Pr. D. Guéry-Odelin in Toulouse University (France). The goal is to manipulate the motional states of an atomic Bose-Einstein condensate (BEC) in a one-dimensional optical lattice, allowing for a quantum sensing experiment. The control protocols operate on the momentum comb associated with the lattice through its amplitude and phase [1]. A precise and versatile control for a wide variety of targets has been demonstrated in [2]. However, a limitation of the experimental setup is the value of the Hamiltonian parameters such as the lattice depth or the quasi-momentum which are not perfectly known. We propose to use optimal control techniques to precisely estimate theses values. In the control problem, the quantity to maximize at a given time is the QFI which makes it possible to maximize the distance between two states associated with two different but close values of the parameters. We show that the QFI evolves respectively as t^2 and t^4 for the lattice depth and the quasi-momentum. We explain this difference from the properties of the operator corresponding to the parameter to estimate. We describe the different control mechanisms allowing to reach the maximum QFI in a given time. In addition of this result, other applications in quantum computing and in the design of robust pulses will be also briefly discussed [3].

[1] Dupont N., Chatelain G., Gabardos L., Arnal M., Billy J., Peaudecerf B., Sugny D. and Guéry-Odelin D. 2021 PRX Quantum 2, 040303
[2] Dupont N., Arrouas F., Gabardos L., Ombredane N., Billy J., Peaudecerf B., Sugny D. and Guéry-Odelin D 2023 New J. Phys. 25, 013012
[3] Dionis E. and Sugny D. 2022 J. Phys. B: At. Mol. Opt. Phys. 55, 184006

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