Static error compensation for multi-level interacting quantum systems

Michele Delvecchio[1,2], Francesco Petiziol[3], Ennio Arimondo[4,5], Sandro Wimberger[1,2]

[1]Department of Mathematical, Physical and Computer Sciences, University of Parma, Parco Area delle Scienze 7/A, 43124, Parma, Italy
[2]National Institute for Nuclear Physics (INFN), Milano Bicocca Section, Parma Group, Parco Area delle Scienze 7/A, 43124, Parma, Italy
[3]Institut für Theoretische Physik, Fakultatät II Mathematik und Naturwissenschaften, Technische Universität Berlin, Eugene-P.-Wigner-Gebäude, Hardenbergstr. 36, 10623 Berlin-Charlottenburg, Germany
[4]Dipartimento di Fisica E.Fermi, Università di Pisa - Largo B. Pontecorvo 3, 56127 Pisa, Italy
[5]INO-CNR, via G.Moruzzi 1, 56124 Pisa, Italy

Controlling experimental quantum systems is one of the challenges in the last years, both from a fundamental and practical perspective. One of the most significant application is the control of interacting systems, for instance, qubits in a quantum computer. In the latter case, in particular, one wants to perform quantum operations without errors, namely with high fidelity. However, imperfections in the control parameters, imposed by the technological limits, can generate errors during a quantum operation, degrading the performance of the system. In this contribution, I am going to show that it is possible to properly tune the interaction between the qubits to mitigate static errors generated by, for instance, control parameter imperfections. In particular, due to the difficulty in analyzing a large number of qubits, we reduced our problem to two qubits, deriving then an analytical optimal condition for their interaction strength.

[1] M. Delvecchio, F. Petiziol, E. Arimondo and S. Wimberger, *Atomic interactions for qubit-error compensations*, arXiv:2104.10928 (2021)