Effective counterdiabatic control



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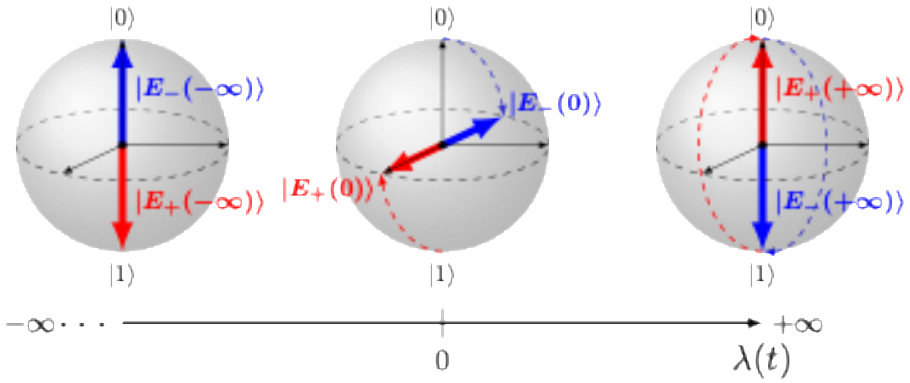
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We present a scheme for the systematic design of quantum control protocols based on shortcuts to adiabaticity. To fight decoherence, the adiabatic dynamics is accelerated by introducing high-frequency modulations in the control Hamiltonian, which mimic a time-dependent counterdiabatic correction. Our theory avoids the problem of nonlocal couplings in the Hamiltonian arising from the standard counterdiabatic terms. We present several applications for the high-fidelity realization of quantum state transfers and quantum gates based on *effective* counterdiabatic driving, in platforms ranging from superconducting circuits to Rydberg atoms [1]. We briefly sketch as well related ideas to control many-body interactions [2] and disordered or noisy quantum systems [3].

References

[1] F. Petiziol, F. Mintert, S. Wimberger, EPL 145, 15001 (2024)
[2] S. Dengis, S. Wimberger, P. Schlagheck, PRA 111, L031301 (2025)
[3] G. Theologou, M. F. Andersen, S. Wimberger, J. Phys. A **59**, 015303 (2026)

$$H(t) = \lambda(t)\hat{\sigma}_z + g\hat{\sigma}_x = \sum_{k=\pm} E_k(t)\,|E_k(t)\rangle\langle E_k(t)|$$



26 October 2026, Graduate School of Science, Department of Physics, Osaka University

2 p.m., Room H626 (Building H, 6th floor)