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Geodesic paths for quantum many-body systems[1] MICHAEL TOMKA, TIAGO SOUZA, STEVE ROSENBERG, MICHAEL KOLODRUBETZ, ANATOLI POLKOVNIKOV, Boston University — The quantum length is a distance between parameter-dependent eigenstates of an adiabatically driven quantum system. Its associated metric has many intriguing properties, for example it is related to the fidelity susceptibility, an important quantity in the study of quantum phase transitions. The metric also appears as the leading adiabatic correction of the energy fluctuations of a quantum system and gives rise to a time-energy uncertainty principle and a geometric interpretation of time. The adiabatic response of an open quantum system can as well be expressed through this metric. Further, the quantum length introduces the notion of Riemannian geometry to the manifold of eigenstates and hence allows one to define geodesics in parameter space. We study the geodesics in parameter space of certain quantum many-body systems, emerging from this quantum distance. These geodesic paths provide a well-defined optimal control protocol on how to drive the systems parameters in time, to get from one eigenstate to another. Generating optimal evolution plays a central role in quantum information technology, adiabatic quantum computing and quantum metrology.

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