

Faster than Hermitian Quantum Mechanics

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Given initial and final quantum states $|I\rangle$ and $|F\rangle$, there exist Hamiltonians H under which $|I\rangle$ evolves into $|F\rangle$. The quantum brachistochrone problem is to find the Hamiltonian that achieves this transformation in the least time τ , subject to the constraint that the difference between the largest and smallest eigenvalues of H is held fixed. For Hermitian Hamiltonians τ has a nonzero lower bound. However, for non-Hermitian PT-symmetric Hamiltonians satisfying the same energy constraint, τ can be made arbitrarily small. This does not violate the time-energy uncertainty principle because for such Hamiltonians the path from $|I\rangle$ to $|F\rangle$ can be made short. The mechanism is similar to that in general relativity in which the distance between two space-time points can be made small if they are connected by a wormhole. This result may have applications in quantum computing.