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Quantum Control Operations in a Non-Hermitian Atomic System[1] CHENGXING HE, ROBERT JONES, University of Virginia — Driven dynamics within a two level system that is described by a non-Hermitian Hamiltonian can be surprisingly complex. In the presence of exponential loss and/or gain, they exhibit complex eigenenergy surfaces whose real and imaginary parts are chiral functions of coupling strength, γ, and the energy separation, δ between the bare states. There has been substantial interest in exploiting the chirality of these systems to induce robust quantum state control by transporting the system around closed loops in the γ-δ parameter space. Previous studies have stressed the importance of encircling an exceptional point (EP) of degeneracy in the real part of the energy surface as the critical transformation characteristic. However, in cases where the figure of merit is the relative amplitude or population in the two eigenstates, we find that the variation in the relative gain and decay rates of the two states also plays a significant role such that encircling the EP does not necessarily determine the result of the applied controls. We propose an equivalent three-level atomic system that could enable experimental verification of these previously unexplored effects.

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