Spontaneous breaking of time-reversal symmetry in open quantum systems

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We consider classes of open quantum systems modeled by a tight-binding Hamiltonian as well as by the Friedrichs model. We start with a time-reversal symmetric expansion of unity involving discrete eigenstates of the Hamiltonian. This expansion includes complex-conjugate pairs of resonant and anti-resonant states. We show how time-reversal symmetry is spontaneously broken as an initially time-reversal invariant state evolves in time. We show that there is a time-scale for the breaking of time-reversal symmetry, which we associate with the Zeno time. We also compare the time symmetric expansion with a time-asymmetric expansion used previously by several researchers including the first author. We show how the present time-symmetric expansion bypasses the non-Hilbert nature of the resonant and anti-resonant states, which previously introduced divergences into the time-asymmetric expansion.

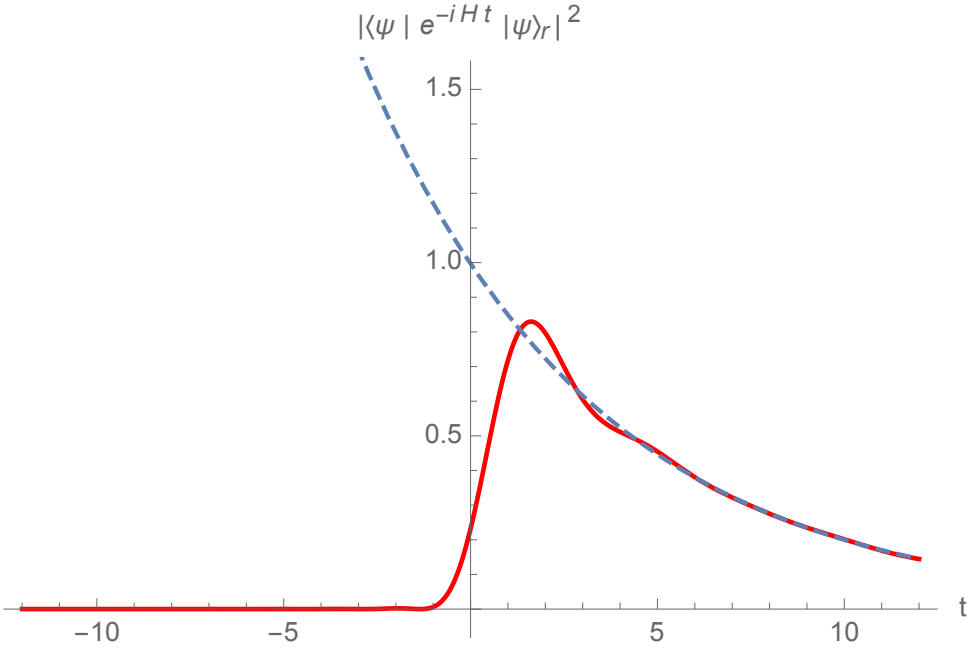

Figure 1: The resonant component of the survival probability in a tight-binding model (solid line) compared to the non-Hilbert state component (dashed line). The resonant component is spontaneously suppressed for $t < 0$ while the non-Hilbert state component diverges exponentially.