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Dynamically assisted tunneling in the impulse regime

We investigate how tunneling through a potential barrier, V(x), can be intensified by time-varying electrical fields, whether they take a pulse-shaped form or adhere to harmonic oscillations. To facilitate numerical computations significantly, we employ the Kramers-Henneberger frame. In the context of a periodically driven system, we aim to identify clear resonance signatures when the incident energy E matches the driving frequency, ω=E, revealing the breakdown of the time-averaged potential approximation. Regarding the dependence on a pulse-shaped electrical field, we discover that, in addition to the known effects of pre-acceleration and potential deformation present in the adiabatic regime, there is also energy mixing, reminiscent of the Franz-Keldysh effect in the nonadiabatic (impulse) regime. Specifically, the pulse Ax(t) can enhance tunneling by effectively propelling a portion of the wave function beyond the rear end of the barrier.

For practical experimental applications, especially in solid-state physics, we examine a simplified model utilizing a rectangular potential. This model can also be validated by comparing it with analytical results. Additionally, we explore the truncated Coulomb potential, which holds relevance in the context of nuclear fusion.

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