QUANTUM LOCALIZATION AND EXCITATION DYNAMICS FOR A SYSTEM OF COUPLED STATES IN THE PRESENCE OF A PERIODIC LASER FIELD

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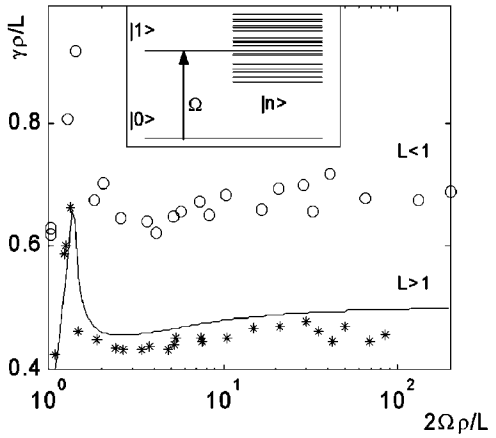
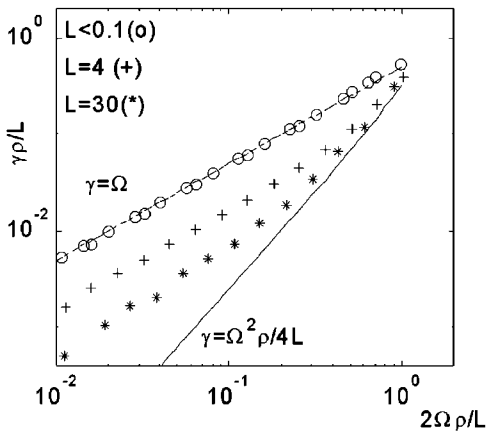
In the work we study the excitation dynamics for a two-level system (the upper state |1> is coupled with a band of states {|n>}), excited resonantly by an external quasimonochromatic field (see the insert in Fig. 1) and a linkage between the coherence evolution and the quantum localization effect. The zero-order energy for the band levels and the state coupling strength are considered to be random numbers. We apply a Random Matrix Theory approach and find the Fourier transform C_ω for the correlation C_t (C_t=Re{<φ(t)|0>}) averaged over random samplings specifying the band {|n>}. The lower state |0> is an initial state. The halfwidth γ for the C_ω contour is associated with the coherence decay rate

Similar to the two-level system with irreversible losses (TLIL) the correlation C_t exhibits an aperiodic or oscillating temporal behavior depending on the ratio between Rabi frequency Ω and the local density halfwidth L/ρ (L is a localization length, ρ is a zero-order state density). The C_ω shape is well approximated by the contour curve given by the TLIL model. The shape halfwidth γ is shown in Figs.1-2 as a function of Ω. In the figures the solid line represents the halfwidths for the TLIL model. At a strong field (Ω>L/ρ) the γ values lie in the range from L/2ρ (dynamical localization at L>1) to $L/2^{1/2}$ρ (perturbative localization, L<1). In a weak



F i g. 1. Oscillations: Ω>L/2ρ



F i g. 2. Aperiod ic: Ω<L/2ρ

field ($2\Omega < L/\rho$) the rate γ exhibits a linear (at $\Omega<1/\rho$) or quadratic (if $1/\rho<\Omega<L/\rho$) dependence on Ω. With increasing the parameter L the Ω-dependence for γ approaches asymptotically to the curve given by the TLIL model. The quadratic Ω-dependence of the coherence decay rate (at $\Omega>1/\rho$ and $L>1$) is explained as a manifestation of the 'classical'-like behavior for the mesoscopic system. The linear dependence of the rate γ on Ω (when $\Omega<1/\rho$ or $L<1$) can be associated with the quantum nature of the considered levels+field system.

QUANTUM LOCALIZATION AND COHERENCE DECAY FOR A CONSERVATIVE SYSTEM OF COUPLED STATES

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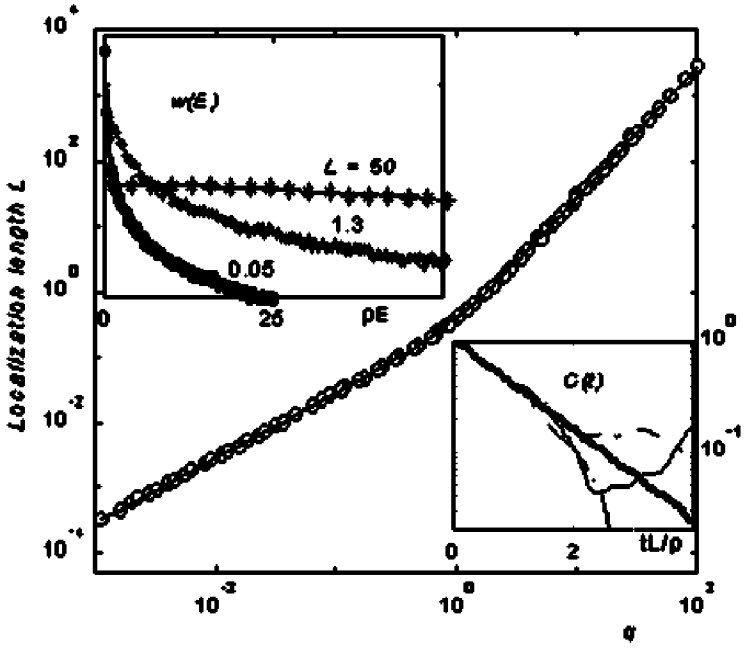
The linkage between the distribution of close-spaced interacting zero-order states over molecular eigenstates, the quantum localization effect and the time-evolution of an initially excited state is of a special interest for laser control of molecular dynamics. In the work we study this linkage for a conservative quantum system, which zero-order levels are randomly spread in the wide energy range and the strength of the state-state coupling is a random number. The system can be considered as a simple model of the polyatomic molecule quasicontinuum.



We apply a Random Matrix Theory approach for a band of N coupled states specified by the mean density of zero-order states ρ, the mean squared energy of the state interaction v and the number of links coupling one level with others δ ($\delta < N/2$). We determine