COMPETITIVENESS OF AN ADSORBING-STATE QUANTUM SYSTEM COUPLED WEAKLY TO THE ENVIRONMENT

Oleksiy L. Kapitanchuk, Victor I. Teslenko

Bogolyubov Institute for Theoretical Physics, National Academy of Sciences of Ukraine, 14b, Metrolohichna Str., Kyiv 03680, Ukraine.
(email: *alkapt@bitp.kiev.ua*)

Competitivity is applicable for many realizations of transition processes in the natural, life, economic and information chains. The finite state supply chain lies at the heart of interpreting a time evolution of many kinetic processes. For instance, a Markov chain is widely used for modeling the multistage dynamics of multidimensional states in physics, chemistry and biology. Competitiveness of a particular system depends on the number of its characteristics, which as a rule are interrelated and can not be considered in isolation. Main factors include: the initial conditions for population of input states, the time evolution of population of functionally significant intermediate and output states, and the kinetic coefficients providing a growth of population with the probabilities to transit some states of interest toward others due to their weak competitive coupling with the environment. We report on the microscopic description of the nonequilibrium quantum system with fluctuating energy levels weakly coupled to the equilibrium environment. The corresponding kinetic equation for diagonal elements of the density matrix of the nonequilibrium system and the master equation for population of the different modules of a system's states are derived analytically [1]. Rate constants of transitions between the modules corresponding to the aggregated transition probabilities in an absorbing state system are computed. The proposed master equation formalism is used to describe the possibility for peak population amplitudes of two nonstationary states in a 3-stage linear kinetic system to be endowed with an untraditional physical quantity - competitiveness, established in regard to the differences for the degree of the peak responses to a change in the input rate constants. Calculated coefficients of competitiveness are found to agree with observations of performance for the three optical materials with respect to their reliability in different operating windows. It is concluded that, for nonequilibrium linear kinetic system, the competitiveness constitutes a common dynamic property of its nonstationary states and, in the case of their directed irreversible evolution, comprises the property of system's anti-cooperativity.

[1] O.L. Kapitanchuk et al, Chem. Phys. **472**, 249 (2016).