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Physica A 242 (1997) 509–521

PHYSICA A

Quasihydrodynamic approximation for memory functions in non-Markovian relaxation processes in condensed matter

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Received 16 December 1996

Abstract

A quasihydrodynamic approximation is introduced for senior memory functions in the chain of non-Markovian kinetic equations for time correlation functions in many-body systems. This approximation allows to describe complicated high-frequency and short wavelength spectra for a wide range of phenomena: from the molecular scattering and the scattering of slow neutrons in liquids to the description of the decay of magnetic induction signal in crystals.

1. Introduction

The existent conception of irreversible phenomena in condensed matter is based, in the main, on Markovian models for random statistical processes. The problem of a correct description of non-Markovity of kinetic processes in statistical physics arose at the beginning of the 60's when Zwanzig [1] and then Mori [2] obtained a non-Markovian kinetic equation for the time correlation functions (TCF) and for distribution functions. This problem contains two important points. First, it is related to the introduction and foundation of physical parameters for quantitative and qualitative descriptions of non-Markovian properties of statistical processes. The second peculiarity of non-Markovian conception is the result from foundation of the set of statistical memory functions of the collective variables of a system.

A series of assuring results were obtained by solving the first problem during the last 5–6 years in articles [3–10]. They are based on the use of non-Markovity parameter conception and its statistical spectrum. We think it discovers a new approach to theoretical and experimental investigation of non-Markovian physical processes. The second important task is the calculation of memory functions for molecular variables. The fact is, there is no correct method for statistic memory

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PII S0378-4371(97)00214-8