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Mesoscopic fractional kinetic equations versus a riemann-liouville integral type

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Abstract

It is proved that kinetic equations containing noninteger integrals and derivatives are appeared in the result of reduction of a set of micromotions to some averaged collective motion in the mesoscale region. In other words, it means that after a proper statistical average the microscopic dynamics is converted into a collective complex dynamics in the mesoscopic regime. A fractal medium containing strongly correlated relaxation units has been considered. It is shown that in the most cases the original of the memory function recovers the Riemann-Liouville fractional integral. For a strongly correlated fractal medium a generalization of the Riemann-Liouville fractional integral is obtained. For the fractal-branched processes one can derive the stretched exponential law of relaxation that is widely used for description of relaxation phenomena in disordered media. It is shown that the generalized stretched-exponential function describes the averaged collective motion in the fractal-branched complex systems. The application of the fractional kinetic equations for description of the dielectric relaxation phenomena is also discussed. These kinetic equations containing non integer integral and derivatives with real and complex exponents and their possible generalizations can be applicable for description of different relaxation or diffusion processes in the intermediate (mesoscale) region. © 2007 Springer.

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Keywords

Generalized Riemann-Liouville fractional integral, universal decoupling procedure