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CALDEIRA-LEGGET MODEL FOR PARTICLE-BATH SYSTEMS IN THE PRESENCE OF A MAGNETIC FIELD

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The Brownian motion of a particle immersed in a bath of charged particles is considered when the system is placed in a magnetic field. The widely accepted Caldeira-Legget particle-bath model is modified so that not only the charged Brownian particle (BP) but also the bath particles respond to the external field. For stationary systems, two equations for the BP motion across the field are derived. They are of the type of generalized Langevin equations with two memory functions. The time correlation function of the thermal force is connected with one of these functions through the fluctuation-dissipation theorem but, unlike all previous theories, it is found to depend on the external field. In the absence of the magnetic force, the other memory function disappears. Analytical expressions are obtained for the velocity correlation functions and other relevant quantities such as the mean square displacement and the diffusion coefficient of the BP for different distributions of the eigenfrequencies of the bath oscillators. Assuming the Drude distribution of the frequencies, it is found that at long times the motion of the particle is sub-diffusive, with the exponent 1/2. The case of the fractional thermal noise is also analyzed.

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