GENERALIZED FOKKER-PLANCK EQUATION FOR ANALYSIS OF THE DYNAMICS OF THE NANOPARTICLE MAGNETIC MOMENT, IN THE CASE OF POISSON NOISE

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Nowadays it is very important to study the physical properties of nanoparticle materials, especially its magnetic properties. Comprehensive interest is based on the using of magnetic nanoparticles and their ensembles in many areas of engineering and medicine [1-3]. Investigation of magnetic properties of nanomaterials can significantly expand the scope of their application and make it possible to use them effectively in magnetic recording media, in sensors, based on the effect of giant magnetoresistance, in magnetic closures, magnetic refrigerators, ferro-fluids, electromagnetic screens and biotechnologies.

Due to continuous internal and external fluctuations, which are an integral part of real systems, the dynamics of the magnetic moment of nanoparticles is random. Landau-Lifshitz equation is used to describe the behavior of the magnetic moment, and in this case thermal fluctuations can be modeled as a noise with given statistical properties.

Today, there are a great amount of works devoted to studying the role of thermal fluctuations, which can be approximated by a Gaussian white noise. In this case, the dynamics of the nanoparticles magnetic moment is Markov, which means that the conditional density of approximation probability fully satisfies the Fokker-Planck equation in the angular variables [4]. However, the Gaussian white noise cannot display the complete picture of environmental influences on the dynamics of the nanoparticles magnetic moment. That is why it is very important to study the statistical properties of magnetic nano-sized particles in the case of non-Gaussian white noise. In spite of this, the mentioned problem was not considered earlier.

Nowadays, we can state that many stochastic differential systems can be analyzed using the Fokker-Planck equation. The

Fokker-Planck equation is a parabolic homogeneous linear differential equation of order two in partial differentiation for the transition probability density [5]. The Fokker-Planck operator is an adjoint operator. The Fokker-Planck equation is also known as the forward Kolmogorov equation in some modern literature. The forward Kolmogorov equation can be proved with the use of mild regularity conditions involving the notion of drift and diffusion coefficients [4]. The Fokker-Planck equation, integration by part formula, and definition of the conditional expectation make it possible to derive the evolution of the conditional moment. In the Risken's book [5], the stochastic differential equation involving the Langevin force was considered and then the Fokker-Planck equation was derived.

In this work we consider the derivation of the generalized Fokker-Planck equation for the analysis of the dynamics of the magnetic moment, which is affected by a two-component Poisson white noise.

We have introduced a toy model for studying the effects of Poisson white noise in the rotational dynamics of the nanoparticle magnetic moment and have shown that the dynamics is discontinuous and have developed an approach to account of the manifold rotations of the magnetic moment under pulses of the noise [6]. Finally, using this approach, we have derived the corresponding generalized Fokker-Planck equation.

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