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A slow-flowing process of initial gravitational condensation of a protoplanetary cloud with the point of view of quantum mechanical interaction of particles

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Abstract

The gravitational condensation problem of an infinitely distributed substance (like a gas-dust protoplanetary cloud) is directly connected with the gravitational instability problem, see for example [1], [2]. The linearized theory of gravitational instability leads to the well-known Jeans' criterion [1]. However, the main difficulty of Jeans' theory is connected with a gravitational paradox: for an infinite homogeneous substance there exists no potential of gravitational field in accord with the Poisson equation [2]. This main problem of self-condensation of an infinitely distributed substance has been solved within framework of the proposed statistical theory of spheroidal bodies [3] – [7]. In particular, the works [6], [7] explains a self-condensation of an infinitely distributed substance through a slowly evolving process of gravitational condensation of a forming spheroidal body.

This work studies a quantum mechanical approach to description of slowly evolving process of gravitational condensation of a spheroidal body from an infinitely distributed gas-dust substance in space. The antidiffusion equation for an initial evolution of mass density function of a gas-dust cloud is considered here. This antidiffusion equation coincides completely with the analogous equation for a slowly gravitational compressible spheroidal body in the vicinity of instable mechanical equilibrium (initial and quasi-equilibrium) state [6], [7].

A quantum mechanical model for description of gravitating spheroidal body has been proposed in [8]. This work considers the slow-flowing process of initial gravitational condensation of a spheroidal body based on the proposed model of "vibrating strainer". The process of quasi-equilibrium gravitational compression of a spheroidal body in space within framework of the "vibrating strainer" model can be interpreted on the basis of Wiener process in a space-frequency domain.

Recently Nottale [9], [10] has developed a new model of the solar system structuring on the basis of the scale relativistic approach. In Nottale's approach, both direct and reverse Wiener processes are considered in parallel; that leads to the introduction of a twin Wiener (backward and forward) process as a single complex process [9]. For the first time backward and forward derivatives for the Wiener process were introduced in the work of Nelson [11]. The important point in Nelson's works is that a diffusion process can be described in terms of a Schrödinger-type equation, with help of the hypothesis that any particle in the empty space, under the influence of any interaction field, is also subject to a universal Brownian motion (i.e. from the mathematical view-point, a Markov–Wiener process) [10] based on the quantum nature of space-time in quantum gravity theories or on quantum fluctuations on cosmic scale [12], [13].

Independently in the reports [8], [14], the Wiener process in a space-frequency domain has been used as a basic model of quantum mechanical interaction of particles causing the slow-flowing process of initial gravitational condensation of a spheroidal body. This work shows that interactions of oscillating particles lead to resonance increase of parameter α of gravitational compression of spheroidal body under carrying out special quantum mechanical conditions.

According to the antidiffusion equation [5], [6], there exists a conductive antidiffusion flow in a slowly compressible gravitating spheroidal body. For the first time the conductive flow in dissipative systems was investigated by I. Prigogine in his works (see, for example, [15],

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[16]). However, if an intensity of conductive flow of mass density increases sharply then the linear antidiffusion equation becomes a nonlinear one. Using integral substitution, the nonlinear antidiffusion equation can be reduced to the linear antidiffusion equation relative to the function of an angular momentum density.

Thus, a nonlinear mass density flow induces a flow of angular momentum density because streamlines of conductive antidiffusion flow come close into a gravitating spheroidal body. Really, the streamline approach leads to more tight interactions of particles that implies a superposition of their specific angular momentums. This superposition forms an antidiffusion flow of angular momentum density into a gravitating spheroidal body that results in origin of a gravitational field (when the corresponding parameter of gravitational compression exceeds its threshold value α_g) [6], [7].

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