the perihelion of Mercury' orbit occurs [4]. This work explains an origin of Alfven' oscillating forces modifying forms of planetary orbits within the framework of the statistical theory of gravitating spheroidal bodies.

Keywords: gas-dust protoplanetary nebula, spheroidal bodies, gravitational condensation, Solar system, exoplanetary systems, Alfven' oscillating forces

References

1. Krot, A.M. A statistical approach to investigate the formation of the solar system. Chaos, Solitons and Fractals. 2009, Vol.41, No.3, pp. 1481-1500.

2. Krot, A.M. On the principal difficulties and ways to their solution in the theory of gravitational condensation of infinitely distributed dust substance. Proc. of the 2007 IAG General Assembly in the book "Observing our Changing Earth", Vol.133 (Ed. by M.G. Sideris). Berlin, Heidelberg: Springer, 2009, pp. 283-292.

3. Krot, A. M. A quantum mechanical approach to description of initial gravitational interactions based on the statistical theory of spheroidal bodies. Nonlinear Sci. Lett. A. 2010, Vol. 1, No.4, pp. 329-369.

4. Krot, A. M. A statistical theory of formation of gravitating cosmogonic bodies. Minsk: Bel. Navuka, 2012. – 448 p. – ISBN 978-985-08-1442-5 [in Russian].

Mathematical modeling of chaotic vibrations of strongly non-linear continuous structures

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We study the interaction of multi-layer packets consisting of beams, plates and shells, where there are gaps between the mentioned structural members. The proposed mathematical model takes into

account various types of non-linearity: (i) geometrical (in the Kármán form); (ii) physical (layer material properties depend on the space co-ordinates, deformation intensity and time); (iii) design (it either switches on or off a contact between layers). Physical properties of the material can be different. The governing partial differential equations, boundary and initial conditions are obtained using Hamilton's variation principle. The so far obtained boundary value problem is then reduced to the Cauchy problem by the following methods: FDM (Finite Difference Method) and the hybrid method matching FEM (Finite Element Method) and the Bubnov-Galerkin method with high order approximations. The obtained initial value problem is solved using the 4th, 6th and 8th Runge-Kutta techniques. It will be shown that those approaches are necessary to get the reliable results of our problem exhibiting strong non-linearity effects and chaotic vibrations. It should be emphasized that the obtained results are studied for all engineering required intervals of changes of the input load parameters, i.e. its amplitude and frequency (charts of vibration-type are constructed). Each output signal is analyzed via phase and modal portraits, Poincaré maps, auto-correlation functions, Fourier spectra as well as wavelets. In the latter case the efficiency of different wavelets is illustrated and discussed. Furthermore, we propose a novel approach to quantify regular and chaotic vibrations via signs estimation of the Lyapunov exponents. Different scenarios of transition from regular to chaotic dynamics exhibited by the studied objects for the mentioned types of non-linearity are illustrated and discussed. We show how the non-linearity type leads to a dramatic change of the transition from regular to chaotic vibrations. In addition, the influence on the non-linear vibrations of the studied multi-layer continuous systems of the non-linearity type, layer number, boundary conditions, layer thickness as well as magnitude of the gap between layers is investigated and reported.
Keywords: chaos, beam, plate, shell, Lyapunov exponents.

Cavitation by nonlinear interaction between inertial Alfvén waves and magnetosonic waves in low beta plasmas

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This paper presents the model equations governing the nonlinear interaction between dispersive Alfvén wave (DAW) and magnetosonic wave in the low- plasmas (; known as inertial Alfvén waves (IAWs); here is thermal to magnetic pressure, is unperturbed plasma number density, represents the plasma temperature, and is the mass of electron (ion)). This nonlinear dynamical system may be considered as the modified Zakharov system of equations (MZSE). These model equations are solved numerically by using pseudo-spectral method to study the nonlinear evolution of density cavities driven by IAW. We observed the