Geophysical Research Abstracts,
Vol. 11, EGU2009-555, 2009
EGU General Assembly 2009

A protoplanetary system formation modeling into a dust-gas protoplanetary cloud

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This work investigates a protoplanetary system forming with usage of computational modeling based on modern program packages. Pictures of fields for pressure and velocity into a gravitating and rotating gas-dust cloud (around of a protostar) are obtained. The work shows that evolution of rotating gas-dust cloud forms planetary embryos in the centrally symmetric gravitational field.
This work also develops an analysis of hydrodynamic flows into a rotating protoplanetary cloud [1] with usage of nonlinear dynamics methods based on the matrix decomposition in the state-space [2] and the fractal-topological methods [3]. The computer simulation of hydrodynamic flows is carried out by means of program package STAR-CD [4].
The system of differential equations in partial derivatives containing the Navier-Stokes and continuity equations in cylindrical coordinates is investigated. Using a representation of velocity field as a sum of basic flow velocity (satisfying the Navier-Stokes equation) and disturbance of velocity the equation system relative to components of velocity disturbance is obtained.
The system of partial differential equations (modeling the hydrodynamic processes in the vortex flow) is reduced to the system of ordinary differential equations (describing an attractor) based on the Galerkin's method. Taking into account the continuity equation the form of components of velocity disturbance is chosen. This work shows the similar attractor of this system has been obtained in [5]. Then the fractal-topological characteristics of this attractor are investigated using matrix decomposition methods [2], [3]. The obtained results of analysis are in accord with the computational simulation.

References:
[1] Schlichting H. Grenzschicht-Theorie. Verlag G Braun, Karlsruhe, 1970.
[2] Krot A.M. Matrix decompositions of vector functions and shift operators on the trajectories of a nonlinear dynamical system. Nonlinear Phenomena in Complex Systems, vol. 4, no.2, pp. 106-115, 2001.
[3] Krot A.M. and Minervina H.B. Minimal attractor embedding estimation based on matrix decomposition for analysis of dynamical systems. Nonlinear Phenomena in Complex Systems, vol.5, no.2, pp.161-172, 2002.
[4] Methodology for STAR-CD: Version 3.24, Computational Dynamics Limited, 2004.
[5] Baldin V.A., Krot A.M. and Minervina H.B. The development of model for boundary layers past a concave wall with usage of nonlinear dynamics methods. Advances in Space Research, vol. 37, no. 3, pp. 501-506, 2006.