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THE MATHEMATICAL MODELLING OF GASDYNAMICS PROBLEMS

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The mathematical modeling of astrophysics processes are one of the most actual problem of modern applied mathematics.

To resolve a number of astrophysics problems one has to investigate the dynamics of the gas bodies that interact with a gravitating field. It is clear that the conceptions of astrophysics problems investigation can be based on the statement and solution of a number of gas motion dynamic problems. These problems are regarded as theoretic models that include important peculiarities of the motion and evolution of stars.

The methods, devices and considerations of modern theoretical gas dynamics and aerodynamics must be used for the construction and investigation of such models and the statement and solution of corresponding mechanic problems related to astrophysics ones.

This work proposes an asymptotic method of solution for a system of nonlinear nonhomogeneous equations of one class of initial-boundary problems with an unknown external boundary in the domain. The system of equations describes an adiabatic spherical and symmetrical motion of a gravitating gas, while a moving detonating wave (a spherical surface where the solution undergoes the first kind of discontinuity) is the external boundary of the domain.

As the first test problem in this work considered nonautomodel problem of a central explosion followed by a thermonuclear detonation of a nonhomogeneous bounded with vacuum, gas sphere that is balanced in its own gravitating field. The asymptotic method of a thin shock layer is used for the motion law and the thermodynamic characteristics of the medium are calculated. For the zero approximation of the detonating wave motion layer of Couch's problem in particular case are solved exactly and in general case – with numerical methods. Interpolation formulas and asymptotics are founded.

As the second test problem in this work considered nonautomodel problem of a central explosion followed by a thermonuclear detonation of a nonhomogeneous bounded with interstellar space (vacuum), gas sphere (nonhomogeneous star) that is balanced in its own gravitating field. The initial-boundary problem for a system of nonlinear nonhomogeneous equations are solved with asymptotic method of a thin shock layer. The first two approximations for the motion law and the thermodynamic characteristics of the medium are calculated. For the zero approximation of the detonating wave motion layer of Couch's problem are solved with numerical methods. Numerical results are founded.