LABORATORY of INFORMATION TECHNOLOGIES

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Room 407

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Mathematical Modeling and Stability Analysis of Spherically Symmetric Gravitating Scalar Configurations

(Materials of Master's Thesis)

In this report we consider static black holes and particlelike configurations of minimally coupled gravitating nonlinear scalar fields within general relativity. An exact general solution of the inverse problem for spherically symmetric configurations in the form of integral formulas, whereby one can find spacetime metric and the associated selfinteracting potential for a given field function, is obtained.

The stability of a static scalar configuration to linear radial perturbations of the corresponding scalar field is studying. We consider the self-consistently posed problem in which the geometric background is not static and metric perturbations, induced by the scalar field fluctuations, are taken into account. The problem is reduced to a single wave equation and the associated Schrödinger equation for the quasinormal modes. We obtain a general form of the effective potential for an arbitrary selfinteracting scalar field potential and consider the stability of vacuum black holes for scalar field fluctuations.

A program package for numerical simulation of topological geons with phantom scalar field and specified potential is designed. A new mathematical model, based on a two-parameter family of exact asymptotically flat solutions to the Einstein-scalar field equations with the positive kinetic term and asymptotically positive selfinteracting potentials, is constructed.