gravitation [4] in four and five dimensions. We also discuss possible non-Abelian generalization of classical 4-dimensional Fokker's action in the N-point interaction scheme taking into account Vladimirov—Turygin perturbative scheme for Einstein's gravity [5] and the Kaluza—Klein approach.

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Geodesics in the Hartle-Thorne spacetime

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The influence of both rotation and quadrupole moment of a central body on the motion of a test particle is investigated in the Hartle-Thorne spacetime [1]. The Hartle-Thorne metric is given with accuracy up to the second-order terms in the body's angular velocity. We give, with the same accuracy [2], analytic equations for geodesics at arbitrary plane different from equatorial one and integrate them numerically.

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Regular solutions in GR with two scalar fields

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Regular solutions for two scalar fields in general relativity are considered. The potential for scalar fields is similar to Mexican hat but has ϕ^6 and ϕ^8 terms. The next cases are considered:

(a) domain wall, (b) boson stars, (c) cosmic strings, (d) thick branes, (e) wormholes. The higher order terms in the potential change the asymptotical behavior of the solutions in comparing with previously found solutions with potential having ϕ^4 terms [1]. The physical characteristics of such objects are discussed.

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Entropy principle for charged self-gravitating fluid in static spacetimes

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We show that for any perfect fluid in a static spacetime, if the Einstein constraint equation is satisfied and the temperature of the fluid obeys the Tolman law, then the other components of Einstein's equation are implied by the assumption that the total entropy of the fluid achieves an extremum for fixed total particle number and for all variations of metric with certain boundary conditions. Conversely, one can show that the extrema of the total entropy of the fluid are implied by Einstein's equation. The above results can be extended to uniformly charged perfect fluid. Compared to previous works on this issue, we do not require spherical symmetry for the spacetime. Our results suggest a general connection between thermodynamics and general relativity.

Electrodynamics of oriented point as a consequence of the real relativity principle

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In [1], the author put forward *the principle of real relativity*, with its first part stating the equivalency of real reference frames for the description of physical events (such as registering the flashes of light from a distant source):

All the real reference frames are equal to each other as a means of describing events.

The second part of the principle sets the requirement for the basic equations describing the laws of nature:

It is required of the equation expressing locally the law of nature to be invariant under transformations of coordinates of events between the real reference frames (L-covariance).

Section 1 — Classical Gravity. GR Extensions

Approximate perfect-fluid solutions with quadrupole moment

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We investigate approximate interior solutions of Einstein's equations in the case of static and axially symmetric perfect-fluid spacetimes which can be matched smoothly with an exterior spacetime, characterized by an arbitrary mass and a small quadrupole moment. We find several solutions which satisfy the matching conditions, but do not satisfy the energy conditions, in particular, because the pressure diverges at the origin.

Restricted three body problem in GR mechanics

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In the work we consider the periodic solutions of the planar circular restricted three-body problem in the mechanics of GR. We consider the dependence of the solutions on the mass parameter, and analyze the influence of the orbital moments of massive bodies on the motion of a test body.

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Rotational motion of a test body in the field of mass with inner motion and structure

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We investigate the influence of a mass distribution and internal motion on a test body's proper rotational motion in this work. The equations of motion of the test body, obtained by the second Fock method, have been integrated numerically for the models of real bodies. All necessary conditions for solving an inverse problem have been analyzed.

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Extended axion dynamo-optics: Anomalous response of a magnetized medium induced by a pp-wave gravitational field

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A self-consistent Einstein-Maxwell-axion model is formulated for the case when the motion of the medium is characterized by non-vanishing expansion, acceleration, shear and vorticity (in [1] we considered the same model without axion field). The model is based on the decomposition of the Lagrangian with respect to the irreducible set of invariants, quadratic in the Maxwell tensor, linear in pseudo-scalar of axion field (following [2] and [3]), and also linear in the covariant derivative of the velocity four-vector of the medium as whole.

The modified evolutionary equations are obtained, which describe the influence of irregularity of the medium motion on the electromagnetic and axion fields. Master equations of the extended axion electrodynamics are used for the description of the response of an axionically active electrodynamic system, induced by a pp-wave gravitational background. We show that this response has a critical character, i.e., the electric and magnetic fields, dynamo-optically coupled to the axions, grow anomalously under the influence of the external pp-wave gravitational field.

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Exact analytical solution for strong shock propagation in the expanding Friedmann universe

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Exact analytic solution of self-similar equations is obtained for propagation of a strong shock in the flat expanding Friedman universe. Dependence of the radius and velocity of the matter behind the shock wave on time and radius are obtained [1]. The velocity of the shock in the expanding medium decreases as $\sim t^{-1/5}$, slower than the shock velocity in the static uniform medium $\sim t^{-3/5}$, and its radius increases $\sim t^{4/5}$, more rapidly than in the uniform non-gravitating medium $\sim t^{2/5}$ [2]. So, the shock propagates in the direction of decreasing density with larger speed, than in the static medium, due to accelerating action of the decreasing density, even in presence of a self-gravitation.

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Rotating hot white dwarfs

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According to the latest observational data, at present time there are about 9316 registered white dwarfs (WDs), which, are divided into groups and subgroups depending on their mass, temperature, chemical composition, age, magnetic field and other physical characteristics [1,2]. Physical properties of WDs, taking into account temperature and rotation are investigated in this work. The hydrodynamic equilibrium configurations of static and rotating WDs including thermal effects are considered in classical physics. Theoretical results are compared with the observational data in order to explain the physical properties of WDs [3].

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Electromagnetic waves propagation near rotating gravitating astrophysical object with atmosphere

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Increasing accuracy of astrophysical observations and experimental data leads to necessity to improve habitual models for process describing when electromagnetic radiation interacts with remote astrophysical objects. First of all its concern new generations of experiments for testing General Relativity, gravitational lensing, anisotropy of relict electromagnetic radiation and other experiments, where besides graviting mass influence we need take into account that the result of measuring depends on motion of medium where electromagnetic radiation propagates. Even the medium has low density and speed of motion, effects of light dragging can became outstanding for long distances, i.e. long interaction between light and a moving medium. Partially the conditions are implemented in atmospheres of stellar and planets that is of interest and opens up new possibilities for testing Relativity Theory and Electrodynamics. Rotation of a massive object brings to changes of space-time geometry in its vicinity which is defined with Kerr metric in the case and, consequently, to additional deflection of light beams past near a stellar object. The analogical influence on electromagnetic radiation occurs from a rotating stellar atmosphere. The deflection of light beams is made up of relativistic gravitational deflection and non-relativistic deflection of the trajectory due to inhomogeneity of the medium. These effects give contributions of opposite signs. Thus, we consider the effects of gravitational lensing for rotating massive objects taking into account the movement of the atmosphere. As a result of numerical calculations are obtained depending on the angle of deflection of the beam on the speed of rotation of the spherical massive body at the equator, the delay time in the Schwarzschild metric (Shapiro effect), as well as the deviation of the light beam in a rotating stellar atmosphere. It is shown that under certain conditions the gravitational and electrodynamic deflection order of magnitude have similar values.