The Modern Physics of Compact Stars and Relativistic Gravity

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Book of Abstracts

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Influence of Phase-Transition-Scenarios on the Neutron Star Characteristics Abrupt Changes Triggered by the Formation of Quark Phase

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We present a study of abrupt changes of a compact star composition, structure and observable characteristics due to the quark deconfinement phase transition. First, we investigate the properties of the isospin-asymmetric nuclear matter in the improved relativistic mean-field theory, including a scalar-isovector δ-meson effective field. To describe the quark phase, we use the improved version of the MIT bag model, in which the interactions between u, d and s quarks inside the bag are taken into account in the one-gluon exchange approximation.
We analyze the catastrophic changes of the parameters of the near-critical configuration of the compact star and compute the amount of the energy released by the corequake for both cases of the deconfinement phase transition scenarios, corresponding to the ordinary first-order phase transition (Maxwell scenario), and the phase transition with formation of the mixed quark-hadron phase (Glendenning scenario). The results will give an opportunity to clarify the observational differences between the two scenarios of the quark-deconfinement phase transition and formulate a specific test for checking the phase transition scenario taking place in reality.

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Symmetry energy in the neutron star equation of state

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A systematic study of the role of the nuclear symmetry energy $E_s(n)$ for the description of neutron star (NS) matter is presented. In a first part, the behavior of $E_s(n)$ at subsaturation densities is discussed which is relevant for the location of the crust-core transition inside the star and thus for the crust thickness. We discuss how observations of glitches for the Vela pulsar constrain the fraction of the crustal moment of inertia and thus $E_s(n)$ at low densities. In a second part the conjecture of a {\it universal symmetry energy contribution} to the NS equation of state (EoS) at supersaturation densities is presented. Ths result is derived from the finding that for NS matter the asymmetry contribution to the energy per nucleon (in the parabolic approximation) has a maximum bound as a function of baryon density which corresponds to a proton fraction being almost constant and below the value for the threshold of the Direct Urca (DU) cooling mechanism, i.e., around $x_{\rm DU} \sim 1/8$. As we have safe knowledge that the DU process cannot be operative in a large class of NS, the EoS describing the matter their interior cannot allow proton fractions exceeding $x_{\rm DU}$. This implies the universal behaviour of the symmetry energy contribution which can be exploited for linking the EoS determination by NS observations with that by heavy-ion collision experiments.

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Coulomb crystals in neutron star crust

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It is well known that neutron star crust in a wide range of mass densities and temperatures is in a crystal state. At a given density, the crystal is made of fully ionized atomic nuclei of a single species immersed in a nearly incompressible (i.e., constant and uniform) charge compensating background of electrons. This model is known as the Coulomb crystal model. In this talk we analyze thermodynamic and elastic properties of the Coulomb crystals and discuss various deviations from the ideal model. In particular, we study the Coulomb crystal behavior in the presence of a strong magnetic field, consider the effect of the electron gas polarizability, outline the main properties of binary Coulomb crystals, and touch the subject of quasi-free neutrons permeating the Coulomb crystal of ions in deeper layers of neutron star crust.

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The influence of small scale magnetic field on the polar cap X-ray luminosity of old radio pulsars

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The influence of small-scale magnetic field on the polar cap heating by reverse positrons is considered. The reverse positron current is calculated in the framework of two models: rapid (J. Arons, E.T.Scharlemann (1979)) and gradually screening (A.K.Harding,A.G.Muslimov (2001), Yu.E.Lyubarskii (1992)). To calculate the electron-positron pairs production rate we take into account only the curvature radiation of primary electrons and its absorption in magnetic field. We use the polar cap model with steady space charge limited electron flow. It is shown that the rapid screening model is in the better agrement with observations of old (age > 10^6 years) radio pulsars. The second model usually leads to too strong heating and too large X-ray luminosities. The work has been supported by the RFBR (project 13-02-00112), by the State Program "Leading Scientific Schools of the Russian Federation" (grant NSh-4035.2012.2) and by the Ministry of Education and Science of Russian Federation (agreement No.8409).

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Mass-radius constraints for compact stars and the QCD phase diagram

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We suggest a new Bayesian analysis using disjunct M-R constraints for extracting probability measures for cold, dense matter equations of state. One of the key issues of such an analysis is the question of a deconfinement transition in compact stars and whether it proceeds as a crossover or rather as a first order transition. The latter question is relevant for the possible existence of a critical endpoint in the QCD phase diagram under scrutiny in present and upcoming heavy-ion collision experiments.

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Equilibrium properties and oscillation frequencies of charged spheres in GR

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We derived an equation for the radial eigenmodes of charged spheres in GR. This equation is applied to stars with different equations of state. We construct stellar models of hadron stars and hybrid stars and calculate the frequencies of their lowest radial modes of vibration. For the hybrid stars a Gibbs construction is employed. It is found that the softening of the equation of state associated with the presence of deconfined quarks reduces the oscillation frequency, even though the average density increases. Chandrasekhar's equation for radial oscillations is generalized for stars with internal electric fields and some mistakes in earlier versions of that generalization are pointed out. We argue that the presence of slight charge inbalances can significantly affect the oscillation frequencies. The importance of non-linear effects for large perturbations or stars close to the maximum-mass configuration is emphasized.

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The influence of an interacting vacuum energy on the gravitational collapse of a star fluid

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To explain the accelerated expansion of the universe, models with interacting dark components (dark energy and dark matter) has been considered recently in the literature. Generally, the dark energy component is physically interpreted as the vacuum energy of the all fields that fill the universe. However, as the other side of the same coin, the influence of the vacuum energy in the gravitational collapse is a topic of scientific interest. Based in a simple assumption on the collapsed rate of the matter fluid density that is altered by the inclusion of a vacuum energy component that interacts with the matter fluid, we study the final fate of the collapse process and the related issue, the cosmic censorship conjecture. Besides, we briefly discuss the effective mass of the collapsed object.

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Role of hyperon–scalar-meson couplings on the EoS

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We study the equation of state and composition of hypernuclear matter within a relativistic density functional theory with density-dependent couplings. The parameter space of hyperon−scalar-meson couplings is explored by allowing for mixing and breaking of SU(6) symmetry, while keeping the nucleonic couplings constant fixed. The subset of equations of state, which corresponds to small values of hyperon−scalar-meson couplings allows for massive M < 2.25 M_solar compact stars; the radii of hypernuclear stars are within the range 12−14 km. We also study the equation of state of hot neutrino-rich and neutrinoless hypernuclear matter and confirm that neutrinos stiffen the equation of state and dramatically change the composition of matter by keeping the fractions of charged leptons nearly independent of the density prior to the onset of neutrino transparency. We provide piecewise polytropic fits to six representative equations of state of hypernuclear matter, which are suitable for applications in numerical astrophysics.

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Quark and Neutron stars

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We investigate the matter of Hybrid stars that we have three phases: quark, hadron-quark and hadron phase in which the hadron-quark phase transition in the interior of star. In quark phase, we calculated MIT bag model with constant and density dependent bag parameter, B(ρ). The other phase, the equation of state of hadronic matter part of star using two models[1]. The mass-radius relation and the maximum mass of various type of these compact objects are obtained. The maximum mass of star are highly dependent to choice of interaction. Finally we have compared our calculated results with observation data[3]. REFERENCES: [1] H R Moshfegh, M Ghazanfari Mojarrad. (2011) Thermal properties of baryonic matter. Journal of Physics G: Nuclear and Particle Physics 38:8, 085102. Online publication date: 1-Aug-2011. [2] H. R. Moshfegh, M. Darehmoradi, and M. Ghazanfari Mojarrad AIP Conf. Proc. 1377, pp. 405-407 http://dx.doi.org/10.1063/1.3628427 [3] J.M. Lattimer, M. Prakash, Astrophys. J 550, 426 (2001).

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Nuclear Constraints on EoS and Supramassive Neutron Stars?

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Microscopic approach to string gas cosmology

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I will describe an approach to string gas cosmology based on a path integral where string worldsheets and uniform modes of the background cosmology (scale factors) appear as explicit dynamical variables.

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Giant Monopoles as a Dark Matter Candidate

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I will review recent challenges to WIMP dark matter models and describe how some of them are addressed by giant monopole models. Several consistency checks of such models will be described, including consistency with MACHO bounds, the bullet cluster and the CMB power spectrum. The main prediction of such models is that dwarf galaxies are embedded in halos which extend for tens of kpc, often beyond their tidal radius, which would be impossible for gravitationally bound particulate dark matter. This may explain the anomalously high abundance and relative velocities of dwarf galaxy pairs recently observed by Fattahi, Navarro, et al.

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On reduction of general three-body Newtonian problem and curved geometry

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The general three-body problem is a typical example of a dynamic system with non-trivial behavior and its study is topical up to now in the celestial mechanics and in other fields of physics and chemistry. After the foundation by Newton of classical mechanics, for the past several centuries a huge number of theoretical and numerical studies of this problem have been carried out. In particular, it has been proved theoretically that the general three-body problem is characterized by 12 integrals of motion, using which the initial 18-th order system is reduced to an autonomous 8-th order system. Moreover, till now, there is no strict proof that the general three-body problem can be reduced up to the autonomous 8-th order system, nor any proof that this problem cannot be reduced to 6-th order. In considering this problem, we put the question: can we by changing the geometry of the problem disclose any hidden additional symmetry in the problem? Obviously, this would allow to bypass the problem when there is no involution between certain integrals of motion and do a more complete reducing of the problem, that is reduce the dimensionality of the problem as much as is the number of integrals of motion.

In the present work the dimensionality reduction of the general three-body classical problem is considered in the framework of the ideas of separation of the internal and external motions of the body-system. We have proved that for a Hamiltonian system in the general case there exists equivalence between phase trajectories and geodesics ones on the Riemannian manifold M (the energy hypersurface of the three-body system). This allowed to formulate the classical three-body problem as a geodesic flow on the manifold M, in the framework of six ordinary differential equations (ODEs) of the second order. It is shown that when the total potential of a body-system depends on the relative distances between particles, the system of geodesic equations conditionally splits into two subgroups of symmetric equations to which only the total angular momentum of the system belongs. The latter is a result of introducing of curved geometry and, correspondingly, the local coordinate frame, and solves the problem of noninvolution of some integrals of motion. However, the main achievement of the approach is that it enables in the general case to solve exactly three nonlinear equations, describing rotational motion of a triangle formed by three bodies, from six ones. The remaining three nonlinear equations describe the internal motion of the three-body system and are easily transformed to a system of Riccati equations. Thus, it is proved that the general three-body classical problem can be reduced to a system of three nonlinear ODEs that in phase space is equivalent to autonomous system of the sixth-order. The developed approach forces to consider from another angle the problems of curved geometry in the theory of gravitation, and in physics in general.

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The spin evolution of the pulsars with non-rigid core

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We investigate the neutron star spin evolution (braking, inclination angle evolution and radiative precession), taking into account the non-rigidity of star core rotation. We consider a Newtonian star which core is described by linearised quasistationary hydrodynamical equations in the one-fluid and two-fluids (neutron superfluidity) approximations. Two limiting cases have been considered: 1) the case of strong coupling between crust and "charged" component (protons, electrons and normal neutrons) when the differential rotation only of the superfluid neutrons is taken into account, 2) and the case of weak coupling when the magnetic field does not penetrate the core and the crust-core interaction occurs through the viscosity. It is shown that the non-rigidity of core rotation accelerates the inclination angle evolution and makes all pulsars to evolve to the orthogonal state. The effect depends on the amount of the non-rigid rotating matter and the mechanism of its interaction with the rest of the star. Since rapid inclination angle evolution seems to contradict the observation data, the results probably may be used as an additional test for the neutron star core matter theories. This work was supported by the Russian Foundation for the Basic Research (project 13-02-00112), the Pro- gramme of the State Support for Leading Scientific Schools of the Russian Federation (grant NSh-4035.2012.2) and Ministry of Education and Science of Russian Federation (Agreement No. 8409).

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The CasA a Hybrid-Neutron star?

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It is demonstrated that the highly accurate measured data for the temperature of the young neutron star in the supernova remnant Cassiopeia A over the past 10 years–as well as all other reliably known temperature data of neutron stars–could have their naturally explanation within the "nuclear medium cooling" scenario. The explanation is that the thermal conductivity, resulting from a suppression of both the electron and nucleon contributions to it by medium effects is substantially reduced. The successful description of the observed data is possible not only for the star models made of hadronic matter but also for the so called hybrid models, for which one assumes to have a deconfined state of quark matter in the core.

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Aspects of Trans-Planckian Scattering

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We study scattering processes at the center of mass energies much larger than the Planck scale, and at small impact parameters. Using the S-matrix formalism for gravity, we investigate the formation and evolution of black hole intermediate states. We assume that the gravitational S-matrix obeys the properties of unitarity, analyticity, crossing and causality.

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The Physics of Superdense Celestial Bodies and the Relativistic Theory of Gravitation in the Chair founded and headed by Prof. Sahakyan G.S.

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The report is dedicated to a survey of studies in the physics of superdense celestial bodies and the relativistic theory of gravitation carried out by associates of the Chair of Theoretical Physics of the Yerevan State University, that was founded and headed by Prof. Sahakyan G.S.
In the first part of report the studies in the theory of degenerate superdense stellar matter and the theory of equilibrium stellar configurations comprising such a plasma are reviewed. The next part of report is a review of studies of unique manifestations of neutron stars (the pulsars, bursters and so on). The concluding part (III) of report is devoted to a survey of works on two versions of scalar-tensor theory of gravitation developed by Prof. Sahakyan and his associates.

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Only the Science and Only "My Good Little Boy" - Reminiscences of Gurgen Serob Sahakyan

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The report is dedicated to 100 year Anniversary of outstanding Armenian physicist, - the founder and scientific leader of the Chair of Theoretical Physics (CTP) of YerSU for almost half the century, the Academician of NAS RA, Professor Sahakyan G.S. In what follows I shall try to non-formally recount:
1. The years of education (in the Vocational School, Yerevan State University, the Post-graduate studies in Moscow), the field duty during the World War II (1939 – 1945);
2. The foundation and direction of CTP, the collaboration with an Academician of the Academy of Sciences of the USSR, Victor Hambartsumyan, with associates of the Chair headed by him;
3. The students in the Chair of Theoretical Physics and the formation of theoretical physics in Armenia, the students of the Chair from Germany;
4. The prestige of Professor Sahakyan G.S.
This report is meant for a wide audience of those that take interest in peculiar persons in the Science.

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An Almost Einsteinian Theory of Gravitation

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A new version of relativistic theory of gravitation is proposed, in which the General Relativity is supplemented with two postulates. It is assumed in the first place that the part of metrical tensor describing the gravitational field is a covariant tensor and second that the gravitational field acts on the matter, on the non-gravitational field and on itself in a similar way (through the metric tensor). At last, in the theory proposed an allowance is made for the influence of Universe on the gravitating system under consideration.
The equations describing the gravitation field in the framework of proposed theory were derived and then the covariant (differential) conservation law, arising from an invariance of gravitational field action with respect to transformation of four-dimensional coordinates of space-time, has been obtained.
In its simplest version the proposed theory contains nine free parameters. At a particular choice of these parameters the theory is reduced to GR with a cosmological term. The differences of the proposed theory from other known versions of the relativistic theory of gravitation are discussed.

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On the Radius of Hot Strange Stars

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The temperature dependence of the radius of strange stars is investigated. It is shown that the curves $M(\rho_c)$ (M-mass, and ρ_c - the central density of the strange star) for all temperatures are the same, and cooling of the strange star increases its radius. A physical explanation of these regularities is given.
Authors: G. S. Hajyan, A. G. Alaverdyan

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Observational constraints of the compactness of the isolated neutron stars

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We try to constrain the compactness of the isolated neutron stars by observations, i.e. via X-ray spin-phase resolved spectroscopy.
There are seven thermally emitting neutron stars known from X-ray and optical observations, which are young (up to few Myrs), nearby (hundreds of pc), and radio-quiet with blackbody-like X-ray spectra.
A model with a condensed iron surface and partially ionized hydrogen-thin atmosphere allows us to fit simultaneously the observed general spectral shape and the broad absorption feature (observed at 0.3 keV) in different spin phases. We constrain some physical properties of the X-ray emitting

areas, i.e. the temperatures, magnetic field strengths at the poles, and their distribution parameters. In addition, we are able to place some constraints on the geometry of the emerging X-ray emission and the gravitational redshift of the three isolated neutron stars.

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Comparison of accelerations of the model Universe in the "Einstein" and "proper" frames of the Jordan's theory of gravitation

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We consider de Sitter cosmological model with a self-consistent scalar field on the basis of Jordan's theory of gravity. Under the conformal transformation a variant of theory transforms to the Einstein theory with an independent scalar field as a source. De Sitter cosmological model for an independent scalar field in the presence of cosmological constant is investigated. Consequently it is of interest to compare the evolution of the Universe for this model, in particular, from the point of view of the accelerated expansion.
Authors: E.V. Chubaryan, R.M. Avagyan, G.H. Harutyunyan, A.V. Hovsepyan, A.S. Kotanjyan

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Sahakyan and the development of Quantum Mechanics in the Republic of Armenia

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The talk is devoted to the activity by academician G.S. Sahakyan in the development of quantum physics in the Republic of Armenia. We discuss applied problems of quantum mechanics, namely, quantum informatics, the appearance of which was anticipated by G. Sahakyan half a century ago. We briefly analyze the logical aspect of quantum processes of macro- and microworlds and the possibilities for their use in computer science, in simulation and for an exponential increase in the efficiency of calculations. We introduce the notion of physical logical structure and the physical calculation on its base as a new nonmathematical calculation method. Examples are presented for deterministic and indeterministic physical logical systems, the corresponding algebras, as well as physical calculations based on them. We discuss the classical principles of neuroinformatics for the creation of artificial intelligence and suggest a principle for the combination of informatics and neuroinformatics. A quantum neuron algorithm is constructed and the corresponding quantum scheme is discussed.

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Point massive particle in General Relativity

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It is well known that the Schwarzschild solution describes the gravitational field outside compact spherically symmetric mass distribution in General Relativity. In particular, it describes the gravitational field outside a point particle. Nevertheless, what is the exact solution of Einstein's equations with δ-type source corresponding to a point particle is not known. We prove that the Schwarzschild solution in isotropic coordinates is the asymptotically flat static spherically symmetric and geodesically complete solution of Einstein's equations with δ-type energy-momentum tensor corresponding to a point particle. Solution of Einstein's equations is understood in the generalized sense after integration with a test function. Metric components are locally summable functions for which nonlinear Einstein's equations are mathematically defined. The Schwarzschild solution in isotropic coordinates is locally isometric to the Schwarzschild solution in Schwarzschild coordinates but differs essentially globally. It is topologically trivial neglecting the world line of a point particle. Gravity attraction at large distances is replaced by repulsion at the particle neighbourhood.

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Kaluza-Klein theory revisited: projective structures and differential operators on algebra of densities.

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In mathematical physics it is very useful to consider differential operators acting on densities of various weights on a manifold M. To study the geometry of such operators one can consider an operator pencil Δ_t where for an arbitrary real t an operator Δ_t acts on densities of weight t defined on a manifold M. Pencils of this kind can be interpreted as differential operators on a certain algebra of functions on extended manifold $\hat{M}$.
For second order operators the study of their geometry naturally fits into a Kaluza-Klein framework. For such an operator the related geometry is defined by principal symbol ("metric on M"), a connection on volume forms ("gauge field") and a function related with the scalar term ("Brans-Dicke scalar"). This becomes useful to study important and beautiful geometrical properties of second order differential operators.
The extended manifold $\hat{M}$ can be identified with Thomas bundle dating back in projective geometry to 1920. We see that study of the extended manifold $\hat{M}$ provides constructions on intersection of classical differential geometry and gravitational theory. Such investigations can be traced to H.Weil, Veblen, T.Y.Thomas, Pauli and Jordan.

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Kerr-like behavior of orbits around rotating Newtonian stars

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The innermost stable circular orbit and the splitting of epicyclic and orbital frequencies are among strong-field signatures of general relativity searched for in astronomical objects, particularly in the X-ray data accumulated in observations of neutron stars and black holes. It may come as a surprise

that these effects are present in the Newtonian physics of rapidly rotating gravitating bodies, such as the classic Maclaurin spheroids.

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Electromagnetic two-point functions and Casimir densities for a conducting plate in de Sitter spacetime

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Two-point functions for the electromagnetic field in background of (D + 1) dimensional de Sitter spacetime are evaluated assuming that the field is prepared in the Bunch-Davies vacuum state. By using these functions the vacuum expectation values (VEVs) of the field squared and the energy-momentum tensor are investigated in the geometry of a conducting plate. The VEVs are explicitly decomposed into the boundary-free and plate-induced parts. For points outside of the plate the renormalization is needed for the first parts only. Because of the maximal symmetry of the background spacetime and of the Bunch-Davies vacuum state the boundary-free parts do not depend on spacetime coordinates, whereas the plate-induced parts are functions of the proper distance of the observation point from the plate. The plate-induced part in the VEV of the energymomentum tensor vanishes for D = 3 which is a direct consequence of a conformal invariance of the electromagnetic field for this spatial dimension. For D > 3, in addition to the diagonal components, the vacuum energy-momentum tensor has a nonzero off-diagonal component which describes energy flux along the direction normal to the plate.

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Delayed pion spectroscopy of Λ hypernuclei

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Recently an experimental program of novel systematic studies of Λ-hypernuclei using pionic decay was established at JLab [1, 2] and at Mainz [3]. Meanwhile, a new ultra-precise RF timing technique was developed, which opens new possibilities for hypernuclear studies at modern electron and proton accelerators [4]. By using this timing technique, delayed pion ultra-precise spectroscopy of Λ hypernuclei can be realized at Jlab and Mainz, and binding energies of Λ-particles can be determined with precision better than 10 keV. This will be an essential step toward understanding of the strange sector baryon-baryon interactions. In addition, understanding of the unified baryon-baryon interactions is necessary to describe high density nuclear matter containing hyperons.

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Canonical Solutions of Variational Problems and Canonical Equations of Mechanics

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The canonical (non-parametric) solutions of the variational problems for integral functionals are considered and the canonical solutions of variational problems of mechanics in Minkowski spaces are derived. By combining the variational principles of least action, flow, and hyperflow canonically invariant equations for the energy–momentum variable are obtained. From these equations the equations for the action and wave functions as a general solution of the combined variational problems of mechanics are derived. These equations are applicable for describing different types of particles and interactions and are summarized within the approach of general relativity.

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Higher Derivative Theories of Gravity

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I will review recent progress in higher derivative theories, and present a procedure to obtain higher derivative theories starting from conventional ordinary-derivative formulation. We apply this procedure to derive generalization of New Massive Gravity and New Topologically Massive Gravity in any dimensions.

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Electromagnetic two-point functions and densities for a conducting plate in de Sitter spacetime

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Two-point functions for the electromagnetic field in background of (D+1) dimensional de Sitter spacetime are evaluated assuming that the field is prepared in the Bunch-Davies vacuum state. By using these functions the vacuum expectation values (VEVs) of the field squared and the energy-momentum tenzor are investigated in the geometry of a conducting plate. The VEVs are explicitly decopmposed into the boundry-free and plate-induced parts. For points outside of the plate the renormalization is needed for only the first parts only. Because of the maximal symmetry of the background spacetime and of the Bunch-Davies vacuum state the boundary-free parts do not depend on spacetime coordinates, whereas the plate-induced parts are functions of the proper distance of the observation point from the plate. The plate-induced part in the VEV of the energymomentum tensor vanishes for D=3 which is a direct consequence of a conformal invariance of the erlectromagnetic field for this spatial dimension. For D>3, in addition to the diagonal components, the vacuum

energy-momentum tensor has a nonzero off-diagonal component which describes energy flux along the direction normal to the plate.

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Impact of the strangeness on the structure of a neutron star

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The analysis of theoretical models which describe the different stages of neutron star evolution, commences with the phase of a hot, contracting proto-neutron star through the subsequent phases, to the final state of a cold neutron star has been done. All calculations have been conducted by means of the equation of state (EoS) which changes gradually with the temperature and density. This is the EoS which determines the physical state and composition of matter at high densities. In this paper the analysis of neutron star models focuses on the appearance and evolution of the hyperon core throughout all the phases of a neutron star evolution. This requires taking into consideration the very inner region of a neutron star. In the performed calculations the EoS for the asymmetric neutron star matter with nonzero strangeness has been constructed. The considered model is characterized by the extended isovector sector and includes the nonlinear vector meson couplings which provides the additional possibility of modifying the high density components of the symmetry energy. Special efforts have been made to produce an optimal set of parameters for the strange sector of the model.

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Braneworld Black Holes Solutions: Quasar Luminosity Variation

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As far as there are many non-answered questions in fundamental physics, namely Astrophysics, a great variety of theories are viable and still acting as a candidates of a true theory. One of well defined and progressed class of this theories are extra-dimensional brane-world models. Besides they are answering many of fundamental problems, for instance hierarchy problem, they have predictions which can be a matter of test. In our work, we found and investigated brane-world induced horizon correction which have impact on the quasars luminosity, and therefore can be measured and detected.

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Primordial magnetism in CMB polarization

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A large scale B-mode signal in the CMB polarization would constitute a smoking gun of Inflation and is the main target of several ongoing and upcoming experiments. I will focus on distinguishing features of another potential source of primordial B-modes – magnetic fields. In particular, the Faraday Rotation of CMB polarization provides a distinctive signature of cosmic magnetic fields through the characteristic frequency dependence and the mode-coupling correlations of the CMB variables. I will discuss constraints on primordial magnetism that can be expected from future CMB experiments, taking into account the obstruction caused by the magnetic field of the Milky Way.

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Electromagnetic signatures from the dynamics of compact stars

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The merger of a binary system of compact objects (neutron stars or black holes) is expected to be a strong source of gravitational waves, but will also be accompanied by an intense electromagnetic signature. I will show how the dynamics of a binary of magnetized neutron stars leads to a rapidly-spinning black hole surrounded by a hot and highly-magnetized torus. The development of magnetohydrodynamical instabilities in the torus can amplify by several orders of magnitude the initially turbulent magnetic field, yielding an ordered poloidal field of ~ 10^(15) G along the black-hole spin-axis, within a half-opening angle of 30 deg, which may naturally launch a relativistic jet. I will also discuss the suggestion that the recently discovered fast radio bursts can be explained simply in terms of the collapse of a supramassive neutron star.

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Correlations in nuclear systems and the symmetry energy

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The account of correlations, in particular the formation of bound states at subsaturation densities, will modify the nuclear matter equation of state. Consequences for the composition and the symmetry energy are shown for parameter values (temperature, density, proton fraction) relevant for supernova explosions. The results of the quantum statistical approach are confronted with laboratory tests of the equation of state investigating heavy ion collisions.

For references see G. Roepke et al., arXiv:1305.3942 (to be published in PRC).

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Quantum effects from boundaries in de Sitter and anti-de Sitter spacetimes

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Vacuum expectation values of the field squared and the energy-momentum tensor for scalar and fermionic field are investigated in de Sitter and anti-de Sitter spacetimes in the presence of flat and spherical boundaries. The dependence of the Casimir forces on the bulk and boundary geometries is discussed. It is shown that the curvature of the background spacetime decisively influences the behavior of these forces at separations larger than the curvature scale of the bulk. Applications to the problems of the radion stabilization and the cosmological constant generation are given in Randall-Sundrum-type braneworld scenarios.

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Protons in High Density Neutron Matter

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Based on the recent observation of the strong dominance of proton-neutron short range correlations (SRCs) as compared to proton-proton and neutron-neutron SRCs the new properties are predicted for the beyond Fermi-shell momentum distribution of nucleons in asymmetric nuclei. The first property is that there is a approximate scaling relation between high momentum distributions of proton and neutron weighted by their relative fractions and the second property is that the high momentum distributions are inverse proportional to their relative fractions. We then discuss the implication of these new properties in high density asymmetric matter and demonstrate that it explains the several recent experimental anomalies observed for neutron rich heavy nuclei. We further discuss the possible implications for neutron stars, one of them being the strong modification of the protons in the core of a neutron star.

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Magnetosonic waves in the crust of a neutron star

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Based on the MHD equations, it is shown that the energy release on the inner surface of the neutron star's crust leads to the generation of magnetosonic wave beams that propagate to the surface of the star. It is shown that for frequencies 10^7 Hz≤omega≤10^11 Hz and for the conditions of matter in the crust of a neutron star, these equations are linearized, and solutions are found. In the crust standing wave beam with a constant radius is formed, the outer base of which, situated on the surface of the star, becomes a source of radio waves. In this source electric currents are induced and the source becomes an antenna that emits radio waves in the circumstellar space. It is shown that with increasing frequency the radio emission intensity decreases, and therefore the spectrum of the pulsars is limited (omega≤10^11 Hz).

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Time-dependent Ginzburg-Landau Equations for Rotating Two-flavor Color Superconductors

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We discuss a time-dependent generalization of the stationary theory for the two-flavor color superconducting quark matter and its modification in the presence of rotation. General expressions are obtained for the relaxation time-scales of the order parameter and color-magnetic fields and for dissipative function, which obtains contribution from the relaxation of the order parameter and Ohmic dissipation. We also obtain a stationary equation that governs the penetration of the color-electric field in the color superconductor.

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Dense matter equation of state in strong magnetic field

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Coupled post-glitch response of the crust and interior of neutron stars

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The spin-up of magnetized plasma and its role in the post-glitch response of neutron stars was first studied over thirty years ago, where it was demonstrated that co-rotation between crust and plasma is established rapidly (within a few seconds) by a process analogous to Ekman pumping in a viscous fluid. However, if the magnetized plasma is considered to be ideal, conservation of energy implies that the final state cannot be co-rotation. Using an exact analytical solution for the coupled motion of the crust and plasma, we demonstrate that the system oscillates persistently and explore the consequences for neutron star observations.

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Stability of strange dwarfs. Their possible observational date

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It is studied the stability of strange dwarfs - superdense stars, which have a small self-retaining core $M_{core} < 0.02M_{\odot}$ containing strange quark matter and extensive crust consisting of atomic nuclei and degenerate electron gas. The mass and radius of such stars are of the same order as for usual

white dwarfs. A comparison of the mass and radius of theoretical models of strange dwarfs with observational data obtained by the program HIPPARCOS is made, the most probable candidate for strange dwarfs is determined.
Authors: Yu.L.Vartanyan, G.S.Hajyan, A.K.Grigoryan, T.R.Sarkisyan