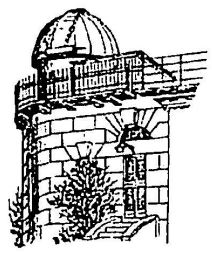

GAMOW MEMORIAL INTERNATIONAL CONFERENCE
DEDICATED TO 100-th ANNIVERSARY OF
GEORGE GAMOW

«ASTROPHYSICS AND COSMOLOGY AFTER GAMOW – THEORY AND OBSERVATIONS»

ABSTRACTS

Odessa, August 8-14, 2004

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Odessa
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This book of abstracts contains the summaries of plenary and sectional, oral and poster contributions submitted in time to the conference devoted to 100th anniversary of G. A. Gamow.
G.A. Gamow was born in Odessa (Ukraine) on March 4, 1904. Here he graduated high school and then entered the University. In Odessa he started his life of work as a calculator in Odessa Astronomical observatory. Some time after, Gamow graduated St.-Petersburg University and started to work in the Institute of applied physics of the Academy of Sciences. At that time he became a famous physicist theorist, then astrophysicist and finally cosmologist.
Abstracts within each Section are arranged in alphabetic order (upon the first author name). To find a requited abstract use the author index at the end of this issue.
The full texts of some contributions will be published as a separate proceedings book by the Cambridge Press publisher. Other will be appear in volume 17 of Odessa Astronomical Publications (2004).

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MEMORIAL SESSION AND PLENARY SESSION

"THE BIG BANG MAN"

A. D. Chernin

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George Gamow was a man with boundless interests and imagination that took him from relativity theory to quantum mechanics and nuclear physics, back to cosmology and then to genetics. He had made seminal contributions to these key areas of modern knowledge which ensured him an anduring place among the giants of science.

G. GAMOW AND THE GENETIC CODE

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Immediately after Watson and Crick proposed a model of DNA molecules Gamow started to think about the problem of information transfer in a living cell. At that time it was known that DNA contains the basic genetic information and information needed for all the complex chemical processes that go on inside a cell. It was not know however how the information encoded in the DNA is transformed and used to produce proteins - the main building blocks of a cell. Gamow invented a very original genetic code which could decode the information from DNA and a unique prescription on how to build different proteins. I will briefly discuss the genetic code proposed by Gamow.

REFLECTIONS ON GEORGE GAMOW'S UNIQUE SCIENTIFIC LEGACY AND PERSONALITY

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We discuss rich scientific legacy of George Gamow, an outstanding figure in XXth century physics and cosmology, whose talent has bridged the gap between East and West long before the decline of the totalitarian system. Our analysis is based partly on Gamow's original scientific and popular papers, partly on the reminiscences of his colleagues and contemporaries.

What we try to convey in our contribution is the idea that a creative and inquisitive mind of George Gamow has managed to escape from tantalising, brutal realities of his epoch into the realm of elementary particles and the childhood of our Universe. G.Gamow's creative style is unique in a sense, representing a peculiar amalgam in which artistic imagination, a sober rational approach of a scholar and psychoanalytic insight are all combined in one creative personality.

We discuss how these different facets of Gamow's rare talent are reflected in his transparent physical models, specifically that of a hot primordial Universe and confront some of his predictions with the realities of contemporary extragalactic research and observational cosmology.

GEORGE GAMOV AND NUCLEAR PHYSICS IN UKRAINE

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The article is devoted to the beginning of the nuclear physics in Ukraine and Gamow's role in the organization of the first nuclear experiments. On 16 May 1928 the Government of Ukraine accepted a decision concerning the formation of the Ukrainian Physics-Technological Institute (UPTI) and already in May of 1929 the new institute resonantly announced throughout the entire world the conduct of the first all union conference on theoretical physics in Kharkiv. Gamow's presentation at the conference was the only one that touched upon the issues of nuclear physics. He presented his already famous work about alpha particle disintegration, owing to which he received worldwide recognition. There should be no doubt that owing to Gamow's initiative and assertiveness is what led to the beginning of atomic nuclei fission research both in Cambridge and in Kharkiv. Joffe stated this just in time: "Gamow's theories opened the path to the penetration of the nucleus".

GEORGE GAMOW–AN APPRECIATION

Maurice M. Shapiro

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George Gamow's secure niche in the annals of science is engraved in the multi-faceted literature enriched by his genius and imagination. But his impact extended far beyond his own discoveries. To students and colleagues alike he imparted stimulus and inspiration for creative endeavor. Gamow's versatile range of interests was legendary. His seminal contributions to nuclear theory or to cosmology alone would have assured him an enduring place among the giants of 20th century science. However, his keen probing mind, roaming the expanse of nature, explored the field of biology as well. His early insights into the intriguing puzzle of the genetic code may well have paved the way to its elucidation.

SOURCES OF VERY HIGH ENERGY GAMMA RAYS

Felix Aharonian

Max-Planck-Institut für Kernphysik

I will highlight the recent discoveries of very high energy gamma-rays from a number of galactic and extragalactic sources and discuss astrophysical and cosmological implications of these results.

AXISYMMETRIC STATIONARY FLOWS IN ASTROPHYSICS

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My talk is devoted to the analytical results available for a large class of axisymmetric stationary flows in the vicinity of compact astrophysical objects. First, the most general case is formulated corresponding to the axisymmetric stationary MHD flow in the Kerr metric. Then, I discuss the hydrodynamical version of the Grad-Shafranov equation. Although not so well-known as the full MHD one, it allows us to clarify the nontrivial structure of the Grad-Shafranov approach as well as to discuss the simplest version of the 3 + 1-split language – the most convenient one for the description of ideal flows in the vicinity of rotating black holes. Finally, I consider several examples that demonstrate how this approach can be used to obtain the quantitative description of the real transonic flows in the vicinity of rotating and moving black holes.

Reference

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GAMMA RAY BURSTS: THEORY VERSUS OBSERVATIONS

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The present common view about gamma ray bursts (GRB) origin is related to cosmology. This conclusion is based on statistical analysis, and on measurements of the redshifts in the GRB optical afterglows of long GRB. No correlation is found between redshifts, GRB spectrum, and total GRB fluence. Comparison of KONUS and BATSE data about statistics and hard X-ray lines is done, and some differences are noted. Connection between GRB and supernova (SN) explosions was found due to comparison of optical spectra of GRB afterglows and SN. Review of different GRB models is done, and a model based on a collapse of massive star with a formation of black hole, surrounded by a massive accretion disk, looks out as the most attractive. Hard gamma-ray afterglows, prompt optical spectra, hard X-ray lines measurements could be important for farther insight into GRB origin. Possible possible connection of short GRB with soft gamma repeaters is discussed.

AGN "ZOO": RESEARCH METHODS, PROBLEMS, RESULTS – NOW AND IN THE FUTURE

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AGN is a wide class of extragalactic objects which, on the verge of the 20 and 21st centuries is one of the great challenges for and attracts attention of the biggest number of astronomers.

We shall have a brief excursion over the AGN "Zoo", the main types of observational manifestations and basic problems related to the research on AGN.

Several similarities of the physical process in AGN and X-ray binaries will be pointed to.

However we shall mostly concentrate on one methods of investigation of AGN: the so called reverberation mapping.

Only this method allows direct determination of the size of the compact emitting region, its structure and kinematics and the features evolution/variation over years/tens of years. The method is widely used for estimation of the central object (black hole) mass. A brief reconstruction of the history of the program, designing and development are given. The program is compared with others; the most important results are formulated; the main problems are considered and prospects of the method development and refinement. The possibilities opened by intensive X-ray observations are specially highlighted.

The possible natural sources of noise restricting resolution and application of reverberation mapping will be mentioned.

The importance of the methods will not decrease for another 20 years; X-ray monitoring will be reformed extensively.

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Bochkarev N.G.: 2004, *AGN Variability from X-ray to Radio Waves*, Crimea, June 14-17, 2004 /*Eds: Martin Gaskell at al.*, ASP Conference Series, under preparation.

SUPERCRITICAL MICROQUASAR SS 433: RESULTS OF INTEGRAL OBSERVATIONS AND COORDINATED CAMPAIGN

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Observations of SS 433, a microquasar in the supercritical accretion regime, aboard the orbiting X-Ray and gamma observatory INTEGRAL have shown that its spectrum in the 2-100 keV range corresponds to optically thin thermal plasma with the temperature 15-20 keV. The source has variability due to eclipses and precession with the amplitude reaching 80 per cent.

The analyses of X-Ray and optical eclipses together with the analysis of optical spectra obtained on the 6-meter telescope of RAS Special Astronomical Observatory allowed the parameters of this advanced massive X-Ray binary system to be constrained.

MECHANISM OF SUPERNOVA

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Visualization of hydrodynamic calculations is very important in present time. Calculations results on supercomputer lead to new problem which connected with view of these results. In our report we consider to physical tasks only. This report is the example of difficulties which increased in modern computered physics.

First result connected with problem of super novae explosion. Our idea connected with development of large-scale convection instability and high-energy neutrino interaction with envelope. During the collapse of the iron core, about 99% of the gravitational energy of the forming neutron star is carried away in the form of neutrinos. In order to eject the stellar envelope, some fraction of this energy must be transferred to the outer layers of the star by some efficient and rapid mechanism. Though convection both inside and outside the neutrino sphere can increase the transport of energy to the shock front, certain conditions are necessary for the convection to be realized. For example, the characteristic time for the development of convection should be less than the characteristic times for accretion and neutrino transport. In addition, convection requires constant feeding, similar to the case of entropy convection inside the protoneutron star.

At the next figures the results of large-scale instabolity development are presented. On fig 1 profile of entropy are shown for two moments. One can see the lifting of the matter along rotation axes.

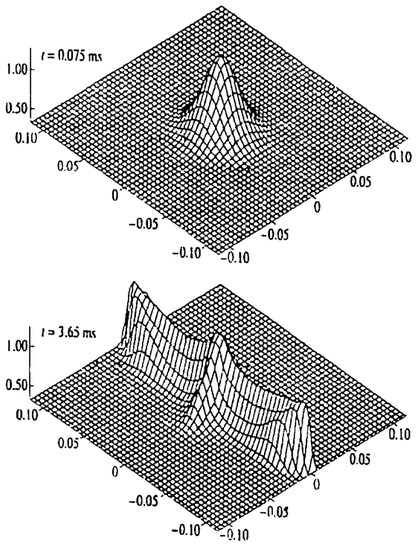

Fig. 1. Three-dimensional entropy profile for two characteristic times.

The processes of convection are shown in during time on fig 2. On last picture (t = 6.31 ms) you may see interaction beams with the envelope.

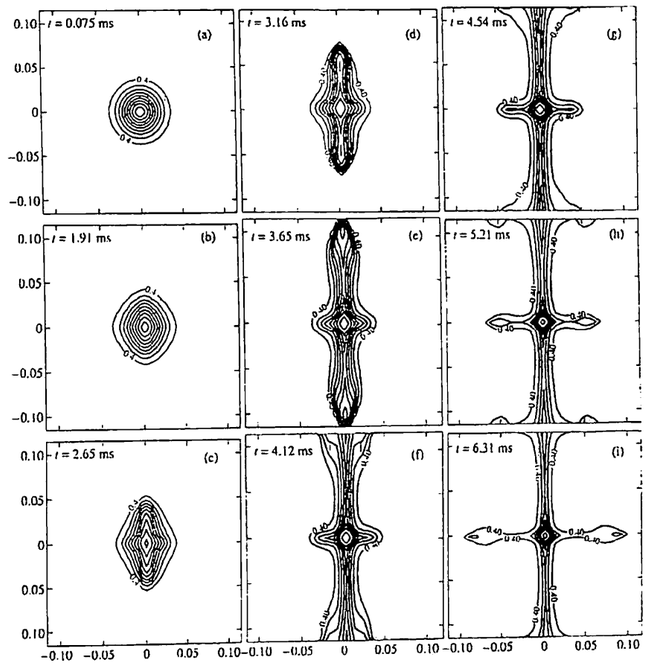

Fig. 3. Levels of constant entropy in the *Oxz* plane. Both axes have scales in fractions of the characteristic length; 0.1 corresponds to 20 km. The entropy is expressed in dimensionless units, normalized to the Boltzmann constant and the nucleon density. The initial background entropy is 1.6327 k_B/nucl (corresponding to the normalized value 0.37).

The structures of beams with velocity field are shown on fig 3.

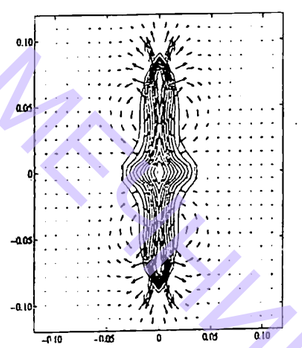

Fig. 4. Distributions of the entropy and velocity field in the O_{xz} plane during the formation and initial motion of a bubble toward the neutrosphere. The axis scales are the same as in Fig. 1.

LYMAN-α FOREST A NEW SOURCE OF COSMOLOGICAL INFORMATION

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Recent technological advances in observational astronomy made it possible to obtain high resolution spectra of very distant quasars. the observed absorption spectra of high redshift quasars contain very interesting cosmological information. We will briefly review the basic properties of the observed Lyman-α forest and present results of our recent analysis of all the available high resolution spectra of quasars at $z > 1.7$. To compare theoretical predictions with observational data we proposed a model of evolution of absorbers based on the Zeldovich theory of gravitational instability. We show first off all that this model describes quite well the observed properties of absorbers and later use this model to recover the primordial spectrum of density perturbations. We show that at small scale $\sim 10 - 300h^{-1}$kpc the observed spectrum is noticeably different form that predicted by the standard ΛCDM model what indicates a more complex inflation which generates more power at small scale.

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ON QUANTUM BIRTH of UNIVERSE and QUANTIZED SPACE-TIME

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The Friedmann-Hubble-Gamov classical relativistic cosmology leads to the question about the origin of hot expanding universe but cannot solve it because of the known difficulty with cosmological singularity. This problem is naturally solved by the quantum approach based on the unification of the principles of general relativity theory and quantum field theory (Fomin, 1975). General relativity theory leads to an important conclusion about the equality of the total energy of a closed universe to zero. Consequently, in frames of the quantum field theory, there arises a possibility of quantum creation of a closed universe from the vacuum without cost of energy. The subsequent growth of such an initially small universe can be provided, for example, by the inflationary mechanism (Linde, 1984).

The energetic preference of closed gravitating systems allows one also to conclude (Fomin, 1988; Fomin and Kuzmichev, 1994) about the instability of the gravitating vacuum fluctuations with respect to the process of gravitational self-closing of these fluctuations leading to spontaneous partition of the vacuum space into systems of connected massless closed microcells of Planckian size. The connection between these cells is taking place due to quadrupole forces of the Van der Waals type. In such a discrete ordered space, the continuous Poincare group is replaced by its discrete subgroup, and the spectrum of elementary excitations of the quantum fields acquires band structure. This opens up a possibility of relating the three generations of leptons and quarks with the existence of three energy bands. In this approach it can be solved the problem of zero, or almost zero, cosmological constant.

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Key words: Quantum cosmology, Birth of Universe, Quantized Space-time.

DARK ENERGY AND THE QUANTUM UNIVERSE

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There are two ways through which the quantum properties of dark energy can be considered.. On one hand, one can look at a primordial universe filled with dark energy and apply to it the conventional procedure of quantum cosmology, formulating from the Euclidean action the Hamiltonian constraint, and hence the corresponding Wheeler-DeWitt equation (González–Díaz, 2001). The choice of the final quantum state will then be conventionally made by applying suitable boundary conditions. Among these conditions we shall also consider those that correspond to the conception that the universe created itself. In such a case, the manifold cannot be foliated in a complete set of non-interacting hypersurfaces, due to the presence of closed timelike curves. Thus, a quantum state for the universe could not be obtained in such a case. Instead, we then use the method of generalized quantum theory developed by Hartle and others, which we apply to a higher-dimensional universe whose four-branes describe the quantum universe in an ekpyrotic representation (González–Díaz and Martín-Carrión, 2004). On the other hand, there exists a kind of dark energy which, even at the current universal scale must be regarded as a quantum system in the sense that its properties have no classical analog. We argue that this case corresponds to a dark-energy equation of state that violates the dominant energy condition, so allowing for the existence of natural wormholes and ringholes. The predictions for the future evolution of a universe filled with that type of dark energy are discussed, mainly in relation with the possibility of the occurrence of future singularity "sings", such as the "Big Rip", the "Big Trip" and other cosmic space-time weirdnesses (González–Díaz and Sigüenza, 2004). We also consider the thermodynamics of general dark energy, checking that the temperature of the dominant-energy-condition violating stuff is definite negative, so showing the essential quantum nature of it and making quite surprising the evolution of black holes that accrete this kind of energy. A brief discussion will also be included about the possibility that phantom fields can be responsible for the primordial inflation of the universe.

Acknowledgements. The author thanks C.L. Sigüenza and A. Jiménez-Madrid for valuable discussions. This work was supported by MCYT under Research Project No. BMF2002-03758.

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Key words: Dark energy, Quantum state, Phantom energy.

QUANTUM LOMG-RANGE CORRECTIONS IN GENERAL RELATIVITY

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We consider one-loop effects in general relativity that result in quantum long-range corrections to the Newton law, as well as to the gravitational spin-dependent and velocity-dependent interactions. Some contributions to these effects can be interpreted as quantum corrections to the Schwarzschild and Kerr metrics.

SIMULATIONS OF MAGNETOROTATIONAL SUPERNOVA EXPLOSION

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We present 2D results of simulations of the magnetorotational core collapsed supernova. For the first time we obtain strong explosion for the core collapsed supernova. In 2D approximation we show that amplification of the toroidal magnetic field due to the differential rotation leads to the formation of MHD shockwave, which produces supernova explosion. The amounts of the ejected mass and energy can explain the energy output for supernova type II or type Ib/c explosions. The shape of the explosion is qualitatively depends on the initial configuration of the magnetic field, and may form strong ejection neat the equatorial plane, or produce mildly collimated jets. We discuss the violation of the mirror symmetry of the supernova explosion in magnetorotational mechanism and possible explanation for the origin of the observed rapidly moving neutron stars.

Acknowledgements. The authors are thankful to partial support from grant RFBR 02-02-16900.

Key words: supernovae, magnetic field, stars, collpase.

GEORGE GAMOW AND DISCOVERY OF COSMIC MICROWAVE BACKGROUND RADIATION

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In this talk I review some of the scientific contributions to the field of cosmology and especially to the theory of the cosmic origin of the chemical elements and prediction of CMB of G. Gamow.

I also outline some aspects of the history of the discovery of CMB radiation.

Finally I describe the role of CMB as a very powerful tool of the modern cosmology and tell about the future PLANCK mission.

A CONFLUENCE OF THREE DISCIPLINES

Maurice M. Shapiro

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Our understanding of cosmic radiation evolved in the 20th century thanks to the symbiosis of three disciplines: nuclear physics, elementary-particle physics, and cosmic-ray astrophysics. The discovery opf cosmic rays by Hess and that of the atomic nucleus by Rutherford happened in the same year, 1912. The first discovery of an elemntary particle, i.e., the positron, in a cosmic-ray experiment by Anderson, took place 20 years later. And the identification of the main primary component–protons–waited for another nine years. After WWII, nature's accelerator yielded a bursdt of new elementary particles. Once the GeV accelerators were built, research in the cosmic-ray discipline turned to astrophysics.

THE IMPACT OF SUPER-STAR CLUSTERS ON THE ISM: WINDS, BUBBLES AND THE X-RAY EMISSION

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I discuss the mechanical feedback from the massive young stellar clusters (SSCs) on the surrounding interstellar medium. I focus my discussion on the internal structure of the gaseous outflows driven by SSCs and their appearance in the X-ray and visible line regimes.

I demonstrate that strong radiative cooling is a crucial ingredient which defines the physical properties of the star cluster winds and present a new radiative stationary wind solution. I show that cooling may drastically modify the distribution of temperature if the rate of injected energy approaches a critical value and prove that the stationary wind regime vanishes whenever the star

cluster mechanical energy input rate exceeds the critical value. This implies that stationary star cluster winds may evolve either in the quasi-adiabatic or in the strongly radiative regimes.

In the strong radiative regime cooling promotes the establishment of a compact ionized gaseous envelope which should be detected as a week and broad (~ 1000 km s^{-1}) emission line component at the base of a much narrower line caused by the central HII region. The X-ray emission from the shocked wind region should be separated from that radiated from the free wind region. The last one is harder and may dominate the total X-ray emission if the central star cluster is sufficiently young, massive and compact.

Finally I compare our results with observations from several well known super-star clusters.

BRANEWORLD COSMOLOGY

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Recent developments of the superstring theory have renewed an old braneworld idea. In particular, the fact that large extra dimensions are allowed in this scenario provides many important implications in cosmology. In this plenary talk, I would like to review the braneworld cosmology.

First of all, I will describe the idea of the braneworld in a semi-historical manner and classify the braneworld zoo. The possibility of large extra-dimensions and then the low scale quantum gravity is stressed. Some phenomenological and experimental constraints are commented.

Then, I move on to a specific 5-dimensional toy model to discuss the braneworld cosmology. After explaining the geometrical language, it is shown that the dynamics of the homogeneous background can be determined solely by the effective equations on the brane. The effect is dubbed "the dark radiation". Phenomenological aspects of this model and the difficulty in formulating the cosmological perturbation theory are briefly mentioned.

I will explain our formalism for the cosmological perturbation theory. I show that the nonlinear dynamics of inhomogeneous spacetime can be deduced without solving the equations of motion in the bulk in the low energy regime. Implication of our results on the CMB spectrum is also given.

Acknowledgements. The author is thankful to Sugumi Kanno for collaborations. This work was supported in part by Grant-in-Aid for Scientific Research Fund of the Ministry of Education, Science and Culture of Japan No.14540258 and also by a Grant-in-Aid for the 21st Century COE "Center for Diversity and Universality in Physics".

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Key words: braneworld, cosmology, low energy.

GAMOW LEGACY AND THE PRIMORDIAL ABUNDANCE OF LIGHT ELEMENTS

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The presently accepted "Theory of the Universe" was pioneered 60 years ago by Gamow, Alpher and Herman. As a consequence of the, later dubbed, Hot Big-Bang, matter was neutrons, and after some decay protons, and a history of successive captures built up the elements.

It wasn't until some 15 years later (with the discovery of the Cosmic Microwave Background radiation) that Gamow and colleagues theories were validated and present day Standard Big-bang Nucleosynthesis theory was developed.

I will discuss the importance of state of the art observations and modelling in the quest to determine precise values of the primordial abundance of D and ^{4}He, using observations of astrophysical objects and modern day atomic parameters. In particular, I will present the search for understanding and coping with systematic errors in such determinations.

NUCLEAR BURNING IN DENSE STELLAR MATTER

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We discuss nuclear reactions in very dense stellar matter, at densities up to 10^{13} g cm^{-3}. Nuclear burning in this matter can occur in several regimes (Salpeter and Van Horn 1969). We focus on the two regimes of (*i*) *thermonuclear* burning (in which reacting atomic nuclei mainly penetrate the Coulomb barrier if they have suprathermal energies near the Gamow peak energy) and (*ii*) *pycnonuclear* burning (in which Coulomb barrier is penetrated owing to zero-point vibrations of reacting nuclei even at zero temperature).

As an application, we analyze pycnonuclear burning of matter accreted on a neutron star in a binary system. The powerful pycnonuclear burning occurs (Haensel and Zdunik 1990, 2003) when accreted matter sinks into the stellar interior under the weight of a newly accreted material and becomes compressed to the densities from $\sim 10^{12}$ g cm^{-3} to $\sim 10^{13}$ g cm^{-3} in the inner stellar crust. For typical mass accretion rates $\dot{M} \sim 10^{-14} - 10^{-9}\ M_\odot$ yr^{-1} the nuclear energy release produces the deep crustal heating sufficient to warm the star. The surface thermal radiation of the star becomes dependent of the poorly known equation of state of supranuclear matter in the stellar core, which gives a method to explore this equation of state. We compare theoretical calculations of thermal states of transiently accreting neutron stars (Yakovlev et al. 2003) with observations of accreting neutron stars in soft X-ray transients. We summarize current constraints on the properties of superdense matter in neutron star cores, inferred from such a comparison.

Acknowledgments. This work was supported in part by the RBRF (grants 02-02-17668 and 03-07-90200), the RLSS (grant 1115.2003.2) and by the Russian Science Support Foundation.

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Key words: stars: neutron – dense matter.

PHENOMENOLOGY OF BRANE-WORLD COSMOLOGICAL MODELS

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The brane-world cosmological models, in which the space-time is described by a five (or more)-dimensional manifold with matter fields confined in a domain wall or three-brane, are reviewed. These models arise in the framework of M theory. Particular attention is paid to the generalized Randall-Sundrum models (covariant approach), the Cardassian scenario, the induced gravity models, the self-tuning models and the Ekpyrotic scenario. We discuss their basic properties and connection with the conventional cosmology.

Acknowledgements. The author is thankful to Uwe Günther for kind assistance with the literature.

Key words: Brane-world, M-theory, cosmology.

COSMOLOGY AND GRAVITATION

DISSOLUTION OF BLACK HOLES IN PHANTOM ENERGY

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The stationary spherical accretion of dark energy (including the case of super-negative equation of state) into the Schwarzschild black hole is described. The perfect fluid is taken as the model of dark energy with the arbitrary equation of state $p = p(\rho)$. The evolution of black hole mass due to the accretion of dark energy is calculated. The black hole mass changes at a rate (Babichev et. al.)

$$\dot{M} = 4\pi A M^2(\rho_\infty + p_\infty), \tag{1}$$

where ρ_∞ and p_∞ are the density and the pressure of dark energy at the infinity. From (1) it is easily seen that the accretion of phantom energy is accompanied with the gradual decrease of the black hole mass.

As a particular exactly solvable example the accretion of dark energy with the linear equation of state $p = \alpha(\rho - \rho_0)$, where α and ρ_0 are the arbitrary constants, is considered. For this case the constant A in (1) which fixes the flux of dark energy can be calculated analytically (Babichev et. al.):

$$A = \frac{(1+3\alpha)^{(1+3\alpha)/2\alpha}}{4\alpha^{3/2}}. \tag{2}$$

The interesting question arises about the fate of an universe coming to Big Rip. In this exotic scenario the cosmological phantom energy density and the scale-factor of the universe grow infinitely in finite time (Caldwell, 2002). We show that masses of all black holes tend to zero in the phantom energy universe approaching to the Big Rip. The evolution of black hole mass in the universe coming to Big Rip is described as follows (Babichev et. al.):

$$M = M_i \left(1 + \frac{M_i}{\dot{M}_0\,\tau}\,\frac{t}{\tau - t}\right)^{-1}, \tag{3}$$

where $\dot{M}_0 = (3/2)\,A^{-1}|1+\alpha|$ and M_i is the initial mass of the black hole.

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ON AN EXTENSION OF THE OPEN FRIEDMANN'S UNIVERSE

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The extension of the open Friedmann's model is considered. The conformal flat 4D-metric $ds^2 = exp(2\sigma(S))\delta_{\mu\nu}dx^\mu dx^\nu$, where $S^2 = \delta_{\mu\nu}x^\mu x^\nu = t^2 - r^2$; $\mu,\nu = 0,1,2,3$; $\delta_{\mu\nu} = diag(+1,-1,-1,-1)$ is taken. One equation from Einstein's system of equations with the energy-momentum tensor of perfect fluid can be rewritten as a equation of oscillator

$$y'' + B^2 \cdot y = 0,$$

where $'$ denotes d/dx, $x = 1/S$, $B = const$. The solution of this equation $y(x) = \sqrt{1 + A/B} \cdot cos(Bx + \alpha)$ is connected with metric as $y^4 = exp(2\sigma)$ and describes the open Universe with the matter and radiation (Baranov&Saveljev, 1984; 1994). If $B = 0$ (the radiation is neglected) we have the open Friedmann's Universe in Fok's form: $y(S) = 1 - A/S$.

New an extension of the open Friedmann's Universe is a solution of equation

$$y'' + (B^2 - 2a^2B^2 \cdot \sec^2(aBx)) \cdot y = 0,$$

where a is a parameter, $y(x) = \sqrt{1 + A/B} \cdot (cos(Bx + \alpha) + a \cdot tan(aBx) \cdot sin(Bx + \alpha))$. If we introduce a function of state as $p(x)/\varepsilon(x) = \beta(x)$,

$$\beta(x) = \frac{1}{3}\frac{(Bx)(1 - 2a^2/cos(aBx))^2)cot(Bx + \alpha)(h(x))^2}{f(x)(Bx \cdot tan(Bx + \alpha)f(x)) - h(x))}$$

where $f(x) = (-1 + a \cdot tan(Bx + \alpha)) \cdot tan(aBx) + a^2$, $h(x) = 1 + a \cdot tan(Bx + \alpha) \cdot tan(aBx))$, then a maximal value of $\beta(x) = 1/3$ (a radiation stage) and when $x = 0$ ($S = \infty$) we have $\beta = 0$ (Friedmann's stage).

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ON STRATIFORM STRUCTURE'S MODEL OF THE OPEN UNIVERSE

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The conformally flat 4D metric $ds^2 = exp(2\sigma(S)) \cdot \delta_{\mu\nu}dx^\mu dx^\nu$ (with $S^2 = t^2 - r^2$ (t, r are time and radial variables) and $\delta_{\mu\nu} = diag(1,-1,-1,-1)$) describes the open Universe model. The Einstein equations with the energy-momentum tensor of perfect fluid can be separated into two equations: $\sigma'/S + (\sigma')^2/2 = (1/6)æ \cdot \varepsilon \cdot exp(2\sigma)$ and $\sigma'' + 2\sigma'/S + (\sigma')^2/2 = -(1/2)æ \cdot p \cdot exp(2\sigma)$, where $\varepsilon(S)$ is an energy density, $p(S)$ is a pressure, $' = d/dS$.

We introduce a function of state $\beta(S)$ as $p(S)/\varepsilon(S) = \beta(S)$. If β is a constant, the solutions of the gravitational equations are harmonic functions and each of them describes the open Universe

model. So we have set models with various equations of state (see 1990). In general case the solution of the equations' system is

$$\sigma(S) = 2\int \frac{\frac{A}{S^2}\cdot exp(-3\int\frac{\beta(S)}{S}dS)}{1-\frac{A}{S}exp(-3\int\frac{\beta(S)}{S}dS)}dS.$$

Here we take the function of state $\beta(S)$ as a fuzzy step-function $\beta(S) = (a/S - sin(a/S))/b$, where a and b are constants connected with number of steps and value of β ($|\beta(S)| \leq 1$).

If we will take $\beta_1(\xi) = \xi/3 - (sin(6.5\cdot\xi))/19.5$, where $a/S = 6.5\cdot\xi$, $a = 10^{28}cm$ (a is an order of the Universe age which equals 15 billions years), $10^{-28}/6.5\ cm \leq S < \infty$, $0 < \xi \leq 1$, then $\beta_{1max} = 1/3$ (not far from Universe's origin we have the ultrarelativistic equation of state) and $\beta_{1min} = 0$ (Friedmann's stage of the open Universe).

Thus, for the fuzzy step-function β_1 the function $\sigma(\xi)$ can be written as the generalized solution of Friedman's open Universe

$$\sigma(\xi) = -2\int \frac{(A/a)\cdot exp(\Phi(\xi))}{1-(A/a)\cdot\xi\cdot exp(\Phi(\xi))}d\xi,$$

where $\Phi(\xi) = 3\int(\beta_1(\xi)/\xi)d\xi = \xi - Si(6.5\cdot\xi)/6.5$.

Finally, the conformal metric factor in case of fuzzy step-function with one step is

$$exp(2\sigma) =$$

$$\Big(1-(A/a)\xi exp(\Phi(\xi)\Big)^4 exp\Big(12(A/a)\int\beta_1(\xi)\cdot exp(\Phi(\xi)d\xi/(1-(A/a)\xi exp(\Phi(\xi)))\Big).$$

This expression is the generalized solution of Friedmann's open Universe and for $\beta_1 = 0$ we have Fok's form of the conformal metric factor.

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ACCELERATING COSMOLOGIES WITH SCALAR FIELDS

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Multidimensional cosmological model with a higher-dimensional product manifold $R\times M_0\times M_1$, where M_0 and M_1 are spherical and flat spaces correspondingly, in the presence of a scalar field is considered. The dimensions of spaces M_i $(i = 0, 1)$ are not fixed and the choice of an external (our) space in the product manifold is arbitrary. Dynamical behaviour of the model is analyzed both in Einstein and Brans-Dicke conformal frames. An accelerated expansion of the external space-time in this model is investigated.

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Key words: Accelerated cosmologies, Einstein frame, Brans-Dicke frame, scalar field.

SPHERICALLY SYMMETRIC, MINIMALLY COUPLED BRANE WORLDS

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In the RS2 brane world concept, we consider static, spherically symmetric configurations of a scalar field with an arbitrary potential $V(\phi)$. We use the 4D Einstein equations on the brane obtained by Shiromizu et al., containing the tensor E^ν_μ describing interaction with the bulk. In case $E^\nu_\mu = 0$ (the so-called minimally coupled brane world, MCBW) the 4D gravity is decoupled from the bulk geometry, and the 4D equations form a determined set.

Assuming $E^\nu_\mu = 0$, we extend to brane worlds some no-go theorems valid for scalar fields in general relativity (GR) (Bronnikov, 2001). It is shown (Bronnikov et al., 2003) that some objects, forbidden in GR (particlelike objects and black holes with $V(\phi) > 0$ as well as traversable wormholes) can appear in a brane world, but only at the expense of enormous matter densities in the strong field region (more than 10^{28} g cm^{-3}) due to the existing experimental restriction on the bulk length scale ($\ell < 1$ mm).

Trying to find a bulk metric corresponding to a MCBW, we consider the 5D equations $G_{AB} + \Lambda_5 g_{AB} = 0$ combined with the condition $E_{\mu\nu} = 0$. The metric dependence on the fifth coordinate is then found explicitly, but there appears an overdetermined set of equations for functions of the radial coordinate. Some special solutions have been found (Bronnikov et al., 2003), among which are the well-known "black string" solution with the Schwarzschild metric on the brane and its generalizations with a Schwarzschild–(A)dS metric on the brane. It is concluded that a MCBW should be embedded, in general, in a bulk where E^ν_μ is not identically zero but only vanishes on the brane.

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Key words: brane world, black holes.

A UNIQUENES THEOREM FOR THICK BRANE WORLDS

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A thick $\mathbb{Z}_2$-symmetric domain wall supported by a scalar field with an arbitrary potential $V(\phi)$ in 5D general relativity is considered as a candidate brane world. We show (Bronnikov&Meierovich, 2003) that, under the global regularity requirement, such a configuration (i) has always an AdS asymptotic far from the brane, (ii) is only possible if $V(\phi)$ has an alternating sign and (ii) $V(\phi)$ satisfies a certain fine-tuning type equality. The thin brane limit is well defined and conforms to the Randall-Sundrum (RS2) brane world model if the asymptotic value of $V(\phi)$ (related to Λ), the effective cosmological constant) is kept thickness-independent.

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Key words: brane worlds, topological defects.

QUASI-SPHERICAL GRAVITATIONAL COLLAPSE IN HIGHER DIMENSIONAL SZEKERES' SPACE-TIME

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We have obtained a class of interior solutions for non-spherical inhomogeneous perfect fluid distribution (with cosmological constant) in (n+2) dimensional Szekeres space-time. We study the occurrence and nature of naked singularities for a dust model with non-zero cosmological constant in (n+2) dimensional Szekeres space-time. The nature of the central shell focusing singularity so formed is analyzed by studying the radial null geodesic originated from it. We find that central shell-focusing singularities may be locally naked in higher dimensions but depend sensitively on the choice of initial data. In fact, the nature of the initial density determines the possibility of naked singularity in space-times with more than five dimensions.

DETECTION AND PROPERTIES OF A NEAR-EARTH FLUX OF DARK ELECTRIC MATTER OBJECTS (DAEMONS)

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If the dark mass of galaxies consists of elementary Planckian black holes (m $\sim 3 \cdot 10^{-5}$ *g*, $r_g \sim 2 \cdot 10^{-33}$ *cm*), their number should be fairly low, only one particle per $\sim 10^{18}$ protons, so that their flux should be small compared to that of hypothetical WIMPs, whose search is being presently actively pursued. If, however, the Planckian holes carry an electric charge corresponding to their mass (up to $Ze \sim 10e$), such DArk Electric Matter Objects, daemons, should interact strongly with matter. They should be slowed down to some extent when crossing celestial bodies, build up in them, and in multiple systems, in close lying orbits too (e.g., in Earth-crossing orbits). On the other hand, capture, say, of a Fe nucleus by a negative daemon would release more than 100 MeV of energy, i.e., give rise to ejection of ~10 nucleons from the nucleus. Besides, a daemon confined to a proton should conceivably catalyze rapid decay of the latter.

The scintillation detector consisting of two ZnS(Ag) screens stacked one upon the other (four modules 0.25 m^2 each) and developed by us in 2000 detects at a confidence level of >99% events with a time shift corresponding to velocities from ~30 down to ~5 *km/s* (in both down- and upward crossings). Such velocities correspond to objects trapped into helio- and geocentric orbits (with the latter crossing the surface of the Earth to become eventually confined to its interior). Of particular significance (more than 3 sigma) is a group with velocities of ~10-15 *km/s*, which are characteristic of bodies falling to the ground from near-Earth almost circular heliocentric orbits. Their flux is in excess of $\sim 10^{-9} cm^{-2} s^{-1}$. It varies with a period of 0.5 year, which may be assigned to the Earth's crossing the shadow and "antishadow" produced by the Sun as it moves relative to the daemon population of the Galactic disk.

The data obtained in our experiments estimate the time of the daemon-stimulated proton decay as $\sim 10^{-6}$ *sec*. Then many observations which have thus far remained imperfectly understood, e.g., the excess fluxes of heat (up to ~50%) and ^{3}He from the Earth's interior, emission of neutrinos of a non-electronic flavor from the Sun, discovery of an unexpectedly large abundance of positrons at Galactic center, etc., may find interpretation as due to daemons that concentrate there and catalyze the proton decay. (See *astro-ph*/0402367.)

Key words: Dark Matter; DM in the Solar System; DM objects' discovery; Planckian scales; proton decay.

TESTING THE LAMBDA-DOMINATED COSMOLOGICAL MODELS VIA THE SOLAR-SYSTEM EXPERIMENTS

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According to the recent cosmological models, the most part of the energy density in the Universe is in the "dark" form (such as the inflaton potential, polarization of vacuum, the so-called "quintessence", and so on), which is effectively described by Λ-term in Einstein equations. All arguments in favor of the dark energy were obtained so far from the observational data related to very large (intergalactic) scales. The aim of the present report is to show that Λ-dominated cosmology can be efficiently tested via the solar-system experiments, seeking for the local Hubble expansion.

It is commonly believed that in the "standard" cosmological models (whose dynamics is governed by ordinary matter) Hubble expansion manifests itself only from the sufficiently large distances ($5 \div 10$ Mpc) and is absent at all at smaller scales. Two basic arguments for such point of view are the so-called Einstein-Straus theorem (Einstein&Straus, 1945) and a quasi-Newtonian treatment of Hubble effect as tidal action of distant matter on the local masses (e.g. Domínguez&Gaite, 2001 and references therein). On the other hand, none of these arguments is applicable to the models governed by the dark energy, because of its perfectly-uniform spatial distribution. Moreover, the local Hubble expansion should evidently exist in the limiting case of purely de Sitter metric, completely determined by Λ-term.

The most straightforward way to reveal the local Hubble effect is to compare the rate of secular increase in the Earth–Moon distance measured by the lunar laser ranging (Dickey et al., 1994; Nordtvedt, 1999) (which is determined both by geophysical tides and the local cosmological expansion) with the same quantity derived indirectly from the intensity of tidal exchange of angular momentum between the Earth and Moon (Sidorenkov, 2002; Pertsev, 2000). As follows from the available data, a difference between the above-mentioned quantities is significantly nonzero and equals 1.3 cm/yr, resulting in the value of local Hubble constant about 30 (km/s)/Mpc, i.e. approximately two times less than at intergalactic scales (Dumin, 2003). Therefore, the Λ-dominated cosmological models, in general, cannot be excluded; but contribution of the dark energy seems to be somewhat less than the one commonly accepted (about 70%).

A promising way to improve the above result may be utilizing the data of martian microwave ranging, as well as laser ranging of artificial satellites (especially, the drag-free laser interferometers constructed for searching the gravitational waves).

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Key words: relativity, cosmological parameters, dark matter, celestial mechanics.

NONMINIMALLY COUPLED SCALAR FIELD IN EINSTEIN–CARTAN COSMOLOGY

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In the framework of the problem of existence of exact cosmological solutions in the Einstein – Cartan theory with scalar field (Jha et al., 1988; De Ritis, 1988; Galiakhmetov, 1993; Galiakhmetov, 1995; Krechet&Sadovnikov, 1997; Galiakhmetov, 2004), spatially flat homogeneous isotropic models with nonminimally coupled scalar field and ultrarelativistic gas are considered.

The interest to a nonminimally coupled scalar field in relativistic theories of gravity has been aroused by a number of circumstances: its role in the scalar-tensor theories; its presence in GUT models and Kaluza–Klein theories; in connection with the Higgs's mechanism and inflationary cosmology.

The account of the ultrarelativistic gas as an additional source of the gravitational field is caused by the fact that the Universe, generally speaking, is multicomponent system, and the earlier received results (see, e.g. (Zeldovich&Novikov, 1973; Zakharov, 1979) and references therein) obtained in the framework of General Relativity proved the importance of this component in the evolution of cosmological models.

Earlier in (Galiakhmetov, 1993; 1995) general exact cosmological solutions of the Einstein–Cartan equations for one and two–component models with the ultrarelativistic gas and the scalar field have been obtained at the fixed value of the coupling constant: $\xi = 1/6$. In this work general exact solutions are obtained (Galiakhmetov, 2003) for two–component models and those containing only a material scalar field ($\alpha_s = +1$) and a "gravitational" one ($\alpha_s = -1$) for an arbitrary coupling constant ξ. It is shown that both singular and countable number of nonsingular models is possible depending on the type of scalar field and the sign of ξ.

It is proved that, for $\alpha_s = +1$ and $\xi > 0$ three types of the cosmological models exist and for $\xi < 0$ there is one type. Whereas for $\alpha_s = -1$ and $\xi > 0$ only one type of the cosmological models exists and for $\xi < 0$ there are six types.

The special values of ξ and restrictions on ξ are found for the derived solutions. The role of ultrarelativistic gas in the evolution of models is revealed.

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Key words: Nonminimally coupled scalar field, ultrarelativistic gas, Einstein–Cartan cosmology, countable number of nonsingular models.

EXACTLY INTEGRABLE MODELS IN EINSTEIN – CARTAN COSMOLOGY

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In the recent paper (Galiakhmetov, 2003) cosmological models of flat space with a nonminimally coupled scalar field and ultrarelativistic gas have been studied within of the Einstein – Cartan theory. Exact general solutions have been derived for two–component models and those containing only a material scalar field ($\alpha_s = +1$) and a "gravitational" one ($\alpha_s = -1$) for an arbitrary coupling constant ξ. In particular, it has been shown that, for $\alpha_s = +1$, $\xi > 0$ and $\alpha_s = -1$, $\forall\xi$ the models are nonsingular, while for $\alpha_s = +1$, $\xi < 0$ the model is singular.

In this work, we consider multicomponent models which are filled with a nonminimally coupled scalar field, an ultrarelativistic gas and a stiff fluid (that is a perfect fluid with equation of state $P_{fl} = \varepsilon_{fl}$ where P_{fl} and ε_{fl} are, respectively, the pressure and energy density of the fluid).

The analysis of the exact solutions that have been obtained for an arbitrary coupling constant, shows that as compared with similar models in General Relativity the presence of a scalar–torsion field leads to:

- the slow–down of the late stages of the cosmological evolution for $\alpha_s = -1$, $\xi > 0$, $C_1 = 0$ ($C_2 = 1$).
- the creation of the effect similar to a curvature for $\alpha_s = -1$, $\xi > 0$, $C_1 = 0$ ($C_2 > 1$).
- the speeding–up of the late stages of the cosmological evolution for $\alpha_s = +1$, $\xi > 0$.
- the removal of the initial singularity for $\alpha_s = +1$, $\forall\xi$ and $\alpha_s = -1$, $\xi < 0$.

As distinct from the two–component cosmological models with ultrarelativistic gas and a nonminimally coupled scalar field [1], the account of the stiff fluid as an additional source of the gravitational field leads to :

- singular models for $\alpha_s = \pm 1$, $\xi > 0$.
- a nonsingular one for $\alpha_s = +1$, $\xi < 0$.
- the absence of the specific values of parameter ξ (for $\xi < 0$), i.e. those ones that, at a fixed sign of the parameter α_s, would qualitatively change the character of the evolution of cosmological models.

For the obtained solutions, restrictions on coupling constant are found.

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Key words: Einstein – Cartan theory, multicomponent cosmological models, scalar–torsion field with an arbitrary coupling constant.

CONFORMALLY FLAT FIVE-DIMENSIONAL COSMOLOGICAL MODEL AND CYLINDRICITY AND CLOSEDNESS CONDITIONS IN KALUZA KLEIN THEORY

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In five-dimensional gravity, we consider the cosmological model, which admit four-dimensional conformally flat space-time sections. We construct five-dimensional vacuum Einstein equations and find the additional Killing vector. We introduce also analogue of the five-dimensional mass function (charge function) for these spaces. The charge conservation law for this function results in the five-dimensional analogue of the Birkhoff theorem. Using this charge function we construct the solution of the five-dimensional Einstein equations.

$$ {}^{(5)}ds^2 = -\left(\frac{1+G/4u^2}{1-G/4u^2}\right)^2 dz^2 + \left(1-G/4u^2\right)^2 \eta_{\mu\nu}dx^\mu dx^\nu\,, \quad (u^2>0)\,. \tag{1} $$

$$ {}^{(5)}ds^2 = -\left(\frac{1-G/4v^2}{1+G/4v^2}\right)^2 dz^2 + \left(1+G/4v^2\right)^2 \eta_{\mu\nu}dx^\mu dx^\nu\,, \quad (v^2=-u^2>0)\,. \tag{2} $$

The solution describes an conformally invariant scalar field with a zero conformally invariant energy-momentum tensor on flat space-time background. For the obtained metrics, the regularity condition results in the closedness of the fifth coordinate. We can then relate the period of the fifth coordinate with the value of the conserved charge of scalar field. Thus, for considered five-dimensional cosmological model, the Kaluza cylindricity condition and compactness as well as the value of the period in the fifth coordinate are realized dynamically.

The Kaluza-Klein model can be considered as the lowest, most symmetric, nontrivial state of 5D-geometry. The obtained solution can treat the new type of Lorentz-invariant vacuum, not related with standard treatment of a cosmological term. The global structure and possible observable manifestations of the constructed model are considered.

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Key words: Birkhoff theorem, cylindricity condition, periodicity, mass function.

ADDITIONAL SYMMETRY OF A SPHERICALLY-SYMMETRIC CONFIGURATION IN A GENERAL RELATIVITY

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We consider the spherically symmetric space-time with the metric

$$^{(4)}ds^2 = g_{\mu\nu}dx^\mu dx^\nu = \gamma_{ab}dx^a dx^b - R^2 d\sigma^2\,, \tag{1}$$

where $d\sigma^2 = d\theta^2 + \sin^2\theta d\alpha^2$, $\gamma_{ab} = \gamma_{ab}(x^a)$ $R = R(x^a)$, $x^i : \{x^2 = \theta,\ x^3 = \alpha\}$ $(i,k = 2,3)$, x^a $(a,b = 0,1)$. In the book (Frolov&Novikov, 1998) the generalized Birkhoff's theorem is proved. Let T_{ab} are the components a stress-energy tensor $T_{\mu\nu}$ generating the spherically symmetric gravitational field. According to this theorem if T_{ab} obeys the condition

$$T_{ab} = \frac{1}{2}T^c_c\gamma_{ab}\,, \tag{2}$$

then the corresponding solution possesses an additional Killing vector field $\xi = e^{ab}R_{,b}\partial_a$. In this work for more general tensor T_{ab} we find the additional generalized symmetry (no isometry) and conservation laws, corresponding to it. There is the generalized Killing vector $\eta = e^{ab}R_{,b}\partial_a$, which satisfies to the generalized Killing equation

$$\eta_{a;b} + \eta_{b;a} + G_{tot}\,(n_a u_b + n_b u_a) = 0\,, \tag{3}$$

where u^a and n^A are eigenvectors of the tensor T_{ab}, and

$$G_{tot} = -\frac{4\kappa\pi}{c^4}\,(\varepsilon + p)R\,, \tag{4}$$

where ε and p are eigenvalues of the tensor T_{ab}. Further, we construct conservation laws: an integral of motion for the particle and mass function. With the help of these conservation laws we find exact solutions of the Einstein equations for some spherical configurations and, in particular, for configurations from a charged dust.

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Key words: Killing vector, generalized Birkhoff's theorem, generalized Killing equation, integral of motion, mass function.

INSTABILITY OF WORMHOLES WITH NON-MINIMALLY COUPLED SCALAR FIELD

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Static, spherically symmetric, traversable wormholes, induced by massless, non-minimally coupled scalar fields in general relativity, are shown to be unstable under spherically symmetric perturbations. We have found that the spectrum of perturbations is discrete and finite one. The gauge with identically zero perturbations of scalar field is used.

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Key words: worm holes, scalar field.

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE INTERACTION BETWEEN THE ELF EARTH ELECTROMAGNETIC FIELD AND THE GRAVITATIONAL FIELDS

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The theory of the non-minimal interaction of the gravitational waves with electrodynamic, kinetic and hydrodynamic systems was elaborated. The theoretical simulation of the electrical processes in the surface lower layer was done. The model of the moon and solar tide effects on the electrical field of the surface lower layer was elaborated and the theoretical estimation of the similar effects was got. A modified variant of the correlative quadrature detector was worked out including in its structure a low frequency filter which allowed to improve the reliability of the correlative spectral analysis results. During the field investigations in 2003, a digital recording system was introduced in a full volume in the multiplex receiving system for the first time in order to collect and to record the experimental data. The result of measurements were tied to the common timing system using the GPS global positioning satellite system. Continuous synchronous recording of the magnetic field (D components), temperature variations, atmospheric pressure, humidity, radiation background, wind speed was done with 14-channel receiving system on the experimental ground of the electromagnetic field in the surface lower layer. According to the synchronous monitoring results of the electrical, magnetic and gravitational fields in the lower layer in 2003 the experimental data of VSU, IZMIRAN, MGO SIC DMA, GAISH MSU) there were received vast cataloguist of the spectral and there were analyzed the main groups of the ELF signal sources: a daily Earth rotation and harmonics of that frequency (FAP 0.0001moon and solar tides (FAP 0.0001radiation of the double pulsars (FAP 0.6result of the investigations is an extract of the moon and solar tide effects of a high rate probability in the recording of the

electrical field of the surface lower layer which is an experimental corroboration of existence of the non-minimal interaction of the gravitational fields with the electromagnetic ones. The work is carried out with supporting of grants RFBR N 04-05-64895, N00-05-79028,N00-05-64652, N02-05-06255,N02-05-79011, N00-05-79020i, Program STP N 209.06.01.035.

THE ORGANIZATION AND CARRYING OUT OF THE FIELD INVESTIGATIONS ON THE TERRITORY OF THE EXPERIMENTAL PHYSICAL GROUND OF VLADIMIR STATE UNIVERSITY

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During the field investigations in 2003, a digital recording system was introduced in a full volume in the multiplex receiving system for the first time in order to collect and to record the experimental data. The distinctive features of the system are an analog-digital conversation of the signals spontaneously in the place of receiving them and using a hopeful electronic anticounter digital system for a connection of the base of the industrial interface RS-485. The result of measurements were tied to the common timing system using the GPS global positioning satellite system. The automatic gathering program was elaborated intended for receiving of the information from the specialized controller through the consequent port RS-232. Two fluxmeters with a pressurized electronic part were made, calibrated and included in the work of the experimental system. Continuous synchronous recording of the magnetic field (D components), temperature variations, atmospheric pressure, humidity, radiation background, wind speed was done with 14-channel receiving system on the experimental ground of the electromagnetic field in the surface lower layer. During the process of the recording, the receiving and recording equipment was calibrated and tested. The work is connected with the analysis of the experimental material having received on the scientific ground of Vladimir State University Physics Department, on the monitoring of the electrical and magnetic components of the electromagnetic Earth field in the surface low layer with the multiplex receiving system. There was raised a problem of extracting components during the experimental recording which were connected with the moon and solar tides, diurnal Earth and harmonics rotation of that frequency and the gravitational wave radiation of astrophysical objects of a double star-system type. There was worked out a modified variant of the correlative quadrature detector with a low frequency filter included into its structure which allowed to increase the reliability of the correlative spectral analysis results carried out according to the experimental recording of the surface low layer field in the problem of the extracting of the frequency components connected with the diurnal Earth rotation, the moon and solar tides and the gravitational wave radiation of the astrophysical sources. The result of the rolling up was fed to the input of the optimal quadrature receiver which is a device allowing to get an estimation of the input signal.

The work is carried out with supporting of grants RFBR N 04-05-64895, N00-05-79028, N00-05-64652, N02-05-06255,N02-05-79011, N00-05-79020i, Program STP N209.06.01.035.

MULTIDIMENSIONAL COSMOLOGICAL MODELS: STABILIZATION OF EXTRA DIMENSIONS IN THEORIES WITH NONLINEAR CURVATURE TERMS R^4, $1/R$

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Multidimensional gravitational models with nonlinear scalar curvature terms in the action functional are considered under spontaneous compactification of the higher dimensional spacetimes to warped product manifolds. Particular attention is paid to models with scalar curvature terms R^4 and $1/R$ and to the conditions which ensure a freezing stabilization of the compactification scales of the internal space components. Restrictions on the parameters of the nonlinear models are analyzed, and how they are connected with the $D-$dimensional and the four-dimensional fundamental mass scales. Furthermore, the stability sector of the volume moduli is compared to corresponding sectors of earlier considered models (Günther U., Moniz P., Zhuk A.: 2003) which contain R^2 nonlinearities and additional Freund-Rubin form fields (extra-dimensional magnetic flux fields). Finally, the relevance of the results with respect to late-time acceleration scenarios and recently considered SUGRA setups in $S-$brane cosmological models is discussed.

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Key words: Gravity in more than four dimensions, Kaluza-Klein theory, Compactification and four-dimensional models.

ON THE THICK HIGHER CO-DIMENSION BRANEWORLD

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The old idea that our universe may be a braneworld embedded in a higher dimensional space-time is renewed by the recent development in string theory which can be consistently formulated only in 10 dimensions. Instead of 10 dimensions, however, most studies of braneworld cosmology have been devoted to 5-dimensional models. Clearly, it is important to explore the possibility of the higher codimension braneworld.

In this contribution, we investigate a codimension 2 braneworld in the Einstein Gauss-Bonnet gravity taking into account the thickness. It is difficult to treat the finite thickness as it is. However, by examining the structure of the singularity in the equations of motion, we find a

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possibility to treat the thickness within the context of the distributional source. We name it a quasi-thick braneworld. This is the important point in our work which gives a framework to clarify various issues in the codimension 2 braneworld. In the case of the linearized gravity, we clarify the effect of the bulk on the brane by solving the whole set of equations of motion in the bulk with proper considerations of the boundary conditions. It turns out that the conventional Einstein gravity is recovered at the linear level. However, we also show some corrections due to the thickness can be expected at the second order level. The effect of the bulk geometry in the nonlinear regime is also discussed. We conclude that corrections to the conventional Einstein theory can be fully obtainable in the case of the quasi-thick braneworld. We also point out an interesting possibility that the thickness plays a role of the dark matter/energy in the universe.

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Key words: Braneworld, Co-dimension 2, Gauss-Bonnet, Quasi-Thick Brane.

THE EFFECTIVE FIXED POTENTIAL: FOOTPRINTS IN THE SOLAR SYSTEM

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It is considered the mechanism which produces the effective fixed potential. We arrive at the effective gravity which includes the Newtonian potential and the fixed potential

$$\Phi_{eff} = -\frac{Gm}{r} + \Psi.$$

Footprints of the effective fixed potential of the Sun are investigated. Footprints of the effective fixed potential of the Sun may be revealed as an anomalous shift of the perihelion of the Keplerian orbit of a planet or as an anomalous shift of the frequency of light or as a polarization of the planet's satellite orbit. The effective fixed potential of the Sun allows to explain 3 anomalous phenomena, the anomalous shift of the perihelion of Mercury, the anomalous acceleration acting on Pioneer 10, 11, the anomalous increase in the lunar semi-major axis.

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Key words: effective gravity – celestial mechanics, stellar dynamics.

THE HOMOGENEOUS COSMOLOGICAL MODEL WITH THE RADIATION AND THE COSMOLOGICAL CONSTANT

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The astronomical observations show that our Universe expends with acceleration, which can be explained by the presence of the nonzero cosmological constant. Therefore it is of interest to consider the models of the Universe with nonzero Λ.

In our work the exact solution for the Universe with the radiation and the cosmological constant, one for three types of the spatial curvature, is obtained.

The metric interval is taken in standard form:

$$ds^2 = dt^2 - a^2(t)(dR^2 + f^2(R)(d\theta^2 + \sin^2\theta d\varphi^2)), \tag{1}$$

here light velocity $c \equiv 1$, $a(t)$ is the scale factor, and $f(R) = \sin R, R, \sinh R$ for the three types of the spatial curvature $k = 1, 0, -1$, respectively. The obtained solution of the Friedmann equations for the Universe with the radiation and the cosmological constant has the form:

$$a^2(t) = a_{rad}a_\Lambda \sinh\frac{2t}{a_\Lambda} - \frac{ka_\Lambda^2}{2}(\cosh\frac{2t}{a_\Lambda} - 1), \tag{2}$$

where a_{rad} is the constant of integration and $a_\Lambda = \sqrt{3/\Lambda}$ In the solution (2) constants of integration are taken so that under $t = 0$ $a(t) = 0$. In the limit $t \to 0$ this solution goes into the known solution for the Universe filled with radiation only, general for all types of the spatial curvature:

$$a^2(t) = 2a_{rad}t - kt^2. \tag{3}$$

Under large times the solution (2) always turns to the de Sitter solution for the open model ($k = -1$), while for the closed model ($k = 1$) there is possibility to collapse, to turn to the de Sitter solution, or to turn to the static Einstein solution for which $a^2 = a_\Lambda^2/4$.

Key words: Universe, cosmological constant, radiation.

THE FISHER SCALAR FIELD WITH COSMOLOGICAL CONSTANT

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Recent observational data especially the data of Type Ia supernovae testify to the accelerating Universe. The acceleration may be explained by the presence of cosmological constant (Λ-term). From the physical point of view Λ-term is the energy density of vacuum which appears in gravitation as a real observable quantity. So we must take into account the Λ-term by the solving the Einstein equation in different physical situations.

Here we have considered the spherically symmetric static solution of the Einstein equation for the minimally coupled scalar field with Λ-term:

$$\begin{cases} R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R - g_{\mu\nu}\Lambda = 8\pi T_{\mu\nu} = 8\pi(\phi_{,\mu}\phi_{,\nu} - \frac{1}{2}g_{\mu\nu}\phi_{,\lambda}\phi^{,\lambda}); \\ \phi^{,\lambda}_{;\lambda} = 0; \end{cases} \quad (1)$$

with line element ($c = \gamma = 1$)

$$ds^2 = e^{\nu(r)}dt^2 - e^{\lambda(r)}dr^2 - r^2 d\sigma^2$$

(1) can be rewritten as

$$\begin{aligned} \frac{d(re^{-\lambda})}{dr} &= 1 - \frac{G^2}{r^2}e^{-\nu} - \Lambda r^2; \\ e^{-\lambda-\nu}\frac{d(re^{\nu})}{dr} &= 1 + \frac{G^2}{r^2}e^{-\nu} - \Lambda r^2; \\ \frac{d\phi}{dr} &= \frac{G}{\sqrt{4\pi}r^2}e^{\frac{\lambda-\nu}{2}}, \end{aligned} \quad (2)$$

where G is the constant of integration.

The functions e^{ν} and e^{λ} have the same behavior for all Λ at $r = 0$ that allows us to use appropriate boundary conditions from exact Fisher solution with $\Lambda = 0$. So the system (2) can be solved numerically.

We have found that the space-time has two essential singularities unlike the solutions of Schwarzschild and Reissner-Nordström where the presence of Λ-term lead to the additional cosmological horizon.

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Key words: Cosmology, cosmological constant, scalar field, static solutions.

A POSSIBLE QUANTUM CHARACTER OF THE DARK ENERGY

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Assuming the possibility of the physical vacuum quantization, the interpretation of the cosmological term energy has been made. Quantization parameters of the elementary "space-time" cell for the adopted $\lambda - term$ value on the basis of macroscopic and microscopic constants has been deduced. The introduction of the physical vacuum quantization will allow us to avoid the Universe singularity problem. Gravitational and electro dynamical parameters, that was became, may composite in the future the foundation for investigations dynamic, evolution of the Universe, particle interaction and electro dynamic process actions in that specific virtual quintessence.

Key words: Gravitation-physical vacuum-dark energy.

HOMOGENEOUS STATIC GRAVITATIONAL FIELD IN THE GENERAL RELATIVITY THEORY

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One of the basic heuristic principles used by A. Einstein when constructing general relativity theory (GRT) was the equivalence principle (EP). In its early formulations, EP stated equivalence of uniformly accelerated reference frame (UARF) and the reference frame with homogeneous static gravitational field in the sense of identically equal influence of inertia force field and homogeneous static gravitational field (HSGF) on all physical phenomena occurring there. It is of special interest to check whether EP in the above formulation holds true in GRT. Present paper is dedicated just to the clarification of this problem. The metrics of the reference frame with HSGF is derived by direct solution of Einstein equations. The symmetry of the above problem defines the structure of the metric tensor. Under the additional condition of the lack of tangential gravimagnetic forces in the domain free of matter, the space-time metrics indeed coincides with that in UARF. However, the field with such type of symmetry could not be in principle formed by the matter: Einstein equations lead to a zero energy density. Gravitational field formed by the real substance (e.g. by a massive plain-parallel plate) has another type of symmetry, resulting in the origin of tangential gravimagnetic forces. The metrics of the above field differs from that in UARF both in the domain occupied by the substance and in that free of substance.

Key words: equivalence principle, general theory of relativity, homogeneous gravitational field, static gravitational field, uniformly accelerated reference frame.

SCALAR-TENSOR THEORIES WITH SPECIAL SYMMERTIES

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In the paper we are considering Brans-Dicke scalar-tensor theory of gravity for spacies with special simmetry (Brans and Dicke, 1961; Weinberg, 1972). Similar theories are very important, in view of it's connection with string theory and M-theory.

The equation on the mertics and scalar fields has form:

$$\begin{cases} \Box\phi \equiv \phi^{\alpha}{}_{;\alpha} = 0 \\ R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R = \frac{\omega}{\phi^2}(\frac{1}{2}g_{\mu\nu}\phi^{\alpha}\phi_{\alpha} - \phi_{\mu}\phi_{\nu}) + \frac{1}{\phi}(g_{\mu\nu}\phi^{\alpha}{}_{;\alpha} - \phi_{\mu;\nu}) \end{cases} \quad (1)$$

Possible vastly simplify equation calling on conformal transformation with special choice of conformal factor:

$$\begin{cases} \Box\phi = 0 \\ R_{\mu\nu} = \alpha\phi_{\mu}\phi_{\nu} \end{cases} \quad (2)$$

Let's consider spaces possessing simmety of two types: spaces admitting separation of variables in the equation of movement in the form of Hamilton - Jakobi (so-called Stackel spaces), and also the homogeneous spaces admitting three-dimensional group of motion working it is transitive on spacelike orbits. These spaces are interesting from the point of view cosmology and have enough the simple appearance, allowing to receive exact solutions. The main aim of the work is classification of this space-times Killing vectors and tensors sets.

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GAMOV'S BIG BANG AND SCALAR FIELD BACKGROUND

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The Gamov Big Bang conception could be essentially modified by taking into account the universal scalar field background. Following to generalized Killing-type symmetries we get the special master-equation which brings us to universal method of *antiscalar* (that is similar to anti-de Sitter, with opposite sign of unremovable scalar field energy-momentum tensor) gravitation. Some preferences and features of antiscalar gravity are the following:

1. The cyclic-type scenario for 'eternal' living of our Universe is to be the best;
2. The *triple electro-weak (EW) bounce* (instead of a single planckian big bang) is manifested, thus only three big oscillations (three Pervushin's W,Z-factories (Pervushin, 2003) within the EW-threshold) historically have had place at the beginning of that evolution era;
3. This *triple bounce has produced just three generations* of leptons and constituents of baryons, each being in dynamical equilibrium with one of *three distinct energy levels of the background scalar condensate* (a density of the least energetic level dominates up to now);
4. Scalar background contains both laminar-type and vortex (pseudo-scalar) components;
5. As follows from dynamical equations the highly prevailing laminar component of scalar background can naturally be explained as the *direct neutral composition of electric fields* of both signs, and such universal basic field can be 'visible' only gravitationally;
6. The *background neutrino-antineutrino sea* is supposed to be responsible for the effective vortex component being also essential for the bound states of scalar background (Isaev, 2002);
7. It is proved: the *usual* (not the low-energy limit of superstring theories) basic gravitating scalar field is of *tachyonic* nature, as follows from stable appearance of imaginary masses of order $10^{-33}eV \approx 10^{-65}g$, belonging to highly penetrating effective scalar field carriers;
8. Its *sources (scalar charges)* prove to be the usual *masses*, so the gravity proper is always only a secondary effect with respect to ubiquitous basic scalar field, etc. If all so, then:

The last conclusion leads to a new comprehension of gravity as manifestation of well-defined gravitating scalar field, with *no energy-momentum pseudo-tensor problems*, etc. The various compact objects can exist, but *no* more *black-holes* solutions in such approach, *no* any *susy, monopoles* and other exotic matter behind and far behind the electro-weak limit, *no* chance to radiate *'gravitational waves'* propagating with speed of light, thus *no need to quantize* them. However, all the 'crucial effects' are to be confirmed and the usual quantum effects in strong (classical) fields remain to be meaningful. The well-defined scalar thermodynamics is built and carefully compared with black-hole thermodynamics showing the similar behavior of thermodynamical quantities when the appropriate equipotential surfaces replace the (unphysical) black-hole horizons. The Λ-vacuum and related problems are clarified due to strict distinction between the free and bound states of scalar background.

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Key words: Antiscalar gravity, Scalar thermodynamics, Vacuum, Cosmology.

INERTIA AND GRAVITATION BEFORE AND AFTER EINSTEIN

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The complete analytical analogy between Couloumb law and Newtonian law of world interaction endorses an idea of the closer parallels between electromagnetism and gravitation beyond statics as well. Among those who paid attention to this alternative way of constructing dynamic equations of gravity were Maxwell, Hertz, Heaviside, Poincare, Brillouin and others. The Maxwell-like equations of the gravity are derived as a possible version of the pre-general-relativistic field equations. The astrophysical consequences of the theory are discussed. The Einstein-Cartan theory (ECT) is considered as an example of the post-general-relativistic development of the gravitation theory. The number of cosmological consequences of ECT are derived and discussed as a solution for the number of problems of up-to-date cosmology.

HOMOGENEOUS STACKEL SPACETIMES

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This work is devoted to the problem of space-homogeneous cosmological model classification on the basis of a complete set of Killing Vectors (KV) and Killing Tensors, necessary for the integration of Hamilton-Jacobi equation

$$g^{ij} S_{,i} S_{,j} = m^2$$

by the method of Complete Separation of Variables (CSV).

Space-homogeneous models allow 3-parametrical transitive group of motions with the space-likes orbits. On the other hand, the Hamilton-Jacobi equation can be integrated by the CSV and allow first integrals, linear and quadratic by momenta

$$\underset{p}{Y} = \underset{p}{Y}{}^{i} p_i, \qquad \underset{\nu}{X} = \underset{\nu}{X}{}^{ij} p_i p_j.$$

if Y^i and X^{ij} are, respectively, KV and KT of the complete set. Space-times, which allow complete sets of integrals and motion and 3-parametrical transitive group of motions with the space-likes orbits simultaneously, are called Homogeneous Stackel Spaces (HSS).

This approach gives a possibility to solve some problems, which can not be solved by other methods (Bagrov et al., 1982). At first, this problem have been solved in (Obukhov, 2002) for Stackel spaces of type (3.1). Now, we present the solution for (3.1) and (2.1) types. 12 classes of HSS with complete sets of type (3.1) and 29 classes of HSS with complete sets of type (2.1) were found. The solutions were classificated according to Bianci, types I,III,V,VI,VII. According to the Petrov classification, all solutions are of the types III and N. Solutions of the type N have scalar curvature $R = 0$, solutions of the type III have $R = \text{const} < 0$.

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PARTICLE-LIKE SOLUTIONS OF THE EINSTEIN-DIRAC-MAXWELL-YANG-MILLS EQUATIONS: THE MODELS WITH STATIC SPHERICALLY SYMMETRIC GRAVITATIONAL FIELDS

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We study the conditions under which the system of Einstein-Dirac-Maxwell-Yang-Mills equations with $SU(2)$ gauge group may represent the particle-like models with electric charge and magnetic dipole moment, the own gravitational field of these models being spherically symmetric. In the models under investigation the fermion fields in its ground state serve as the sources for

electromagnetic field as well as for Yang-Mills fields with $SU(2)$ symmetry. The potentials for electric charge and for Yang-Mills charges are of quasi-Coulomb form. Properties of the constructed exact solutions are compared with the results obtained for more simple particle-like systems by numerical methods (see references).

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Key words: field theories; gravitational field.

COSMOLOGICAL MODEL WITH ROTATION

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We found the solution of Einstein equations for metric of Bianchi type IX, which has the following form

$$ds^2 = (dt + A\omega^1)^2 - (C\omega^1)^2 - C^2((\omega^2)^2 + (\omega^3)^2),$$

where $A = const, \omega^1, \omega^2, \omega^3$ are one-forms satisfying Bianchi type IX structure relations. Further, we use the metric in tetradic form. The sources of this model gravity field are Λ-term and a concomitance anisotropic liquid with tensor of energy-momentum in tetradic form, which is given by

$$T_{ab} = (\varepsilon + \pi) u_a u_b + (\sigma - \pi) \chi_a \chi_b - \pi \eta_{ab},$$

where $u_a u^a = 1$, $\chi_a \chi^a = -1$, $\chi^a u_a = 0$, $\sigma > \pi$. We suppose $u^a = \delta^a_0$, $\chi^a = \delta^a_1$.

We received the following results

$$C = \frac{1}{2H} \cosh Ht, \quad \Lambda = 3H^2, \ (H = const),$$

$$\varepsilon = \frac{-8A^2CC'' + 4A^2C'^2 + 3A^2}{4C^2},$$

$$\sigma = \frac{4A^2C'^2 - A^2}{4C^4}, \quad \pi = \frac{4A^2CC'' - 4A^2C'^2 + A^2}{4C^4}.$$

The cosmological model is considered for the time interval when $HC > 1$. For this metric the kinematic parameters of model, such as the expansion of model $\theta = \frac{3C'}{C}$, the rotation of model $\omega = \frac{A}{4C^2}$, the acceleration of model $a = 0$, shear of model $\sigma = 0$, were computed.

VACUUM POLARIZATION OF A QUANTIZED SCALAR FIELD IN ULTRASTATIC ASYMPTOTICALLY FLAT SPACETIMES

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The investigations of black hole evaporation and particle production by expanding universe have acted as a stimulus for a detailed and systematic investigation of the theory of quantum fields propagating in curved spacetimes. The main objects to calculate from quantum field theory in curved spacetime are the quantities $\langle\varphi^2\rangle$ and $\langle T_\nu^\mu\rangle$ where φ is the quantum field and T_ν^μ is the stress-energy tensor operator for φ. The renormalized stress-energy tensor $\langle T_\nu^\mu\rangle$ is an important quantity for the construction of a self-consistent model of an evaporating black hole, while the mean-square field $\langle\varphi^2\rangle$ plays a role in the study of theories with spontaneous symmetry breaking. The functional dependence $\langle T_\nu^\mu\rangle$ on metric $g_{\mu\nu}$ allows us to study the evolution of the background geometry driven by the quantum fluctuation of the matter fields propagating on it. This is the so-called backreaction, governed by the semiclassical Einstein equations $G_\nu^\mu = 8\pi\langle T_\nu^\mu\rangle$. However, the exact results for $\langle\varphi^2\rangle$ and $\langle T_\nu^\mu\rangle$ in four dimensions are not numerous. Numerical computations of these quantities are as a rule extremely intensive. One of the most widely used techniques to obtain information about these quantities is the DeWitt-Schwinger expansion. It may be used to give the expansions for $\langle\varphi^2\rangle$ and $\langle T_\nu^\mu\rangle$ in terms of powers of the small parameter $1/(mL) \ll 1$, where m is the mass of the quantized field and L is the characteristic scale of change of the background gravitational field. The analytical approximations to $\langle\varphi^2\rangle$ and $\langle T_\nu^\mu\rangle$ for the conformally coupled massless fields give good results (Page, 1982; Brown&Ottewill, 1985; Frolov&Zel'nikov, 1987). If the quantum field is massive but the mass of the field does not satisfy the condition $1/(mL) \ll 1$, the analytical approximations to $\langle\varphi^2\rangle$ and $\langle T_\nu^\mu\rangle$ are even less numerous (Anderson et al., 1995; Popov&Sushkov, 2001; Popov, 2001; Popov, 2003).

In this paper, approximate expressions for $\langle\varphi^2\rangle_{ren}$ of a quantized scalar field in ultrastatic asymptotically flat spacetimes are derived. The field is assumed to be both massless or massive with an arbitrary coupling ξ to the scalar curvature R, and in a zero or nonzero temperature vacuum state. The expression for $\langle\varphi^2\rangle_{ren}$ is divided into low- and high-frequency parts. The Bunch-Parker approach (Bunch&Parker, 1979) is used for derivation of high-frequency contributions to these quantities. As in the case of massless field the quantum state of the field with mass $m \ll 1/L$ is essentially determined by the topology of spacetime and the boundary conditions. In this paper such dependence is determined by the low-frequency contribution. As an example, this contribution is calculated on the background of the small perturbed flat spacetime in quantum state corresponding to the Minkowski vacuum at the asymptotic.

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INFLATION TEORIES AND PLANCK MASS PROBLEM

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Recently the problem of large value of Planck mass attracts special attention among researchers. Different models are being proposed in order to achieve effective value of Planck mass being equal to $M_{Pl} = 10^{19} GeV$ by means of special mechanisms, while real value of $M_{Pl}{}^*$ is considered rather small (e.g., in Randall-Sundrum model the problem is solved with aids of additional compact dimension). In the present investigation authors attempted to produce correct effective value of Plank mass from smaller $M_{Pl}{}^*$ by introducing scalar field φ into the action S. One cannot argue that inflation models with appropriate corrections to Einstein equations taken into account are to be thoroughly discussed in the case. Here we tested one simple inflation model with one real scalar field with inflation potential $V = \lambda(\varphi^2 - v^2)^2$.

Since equations of motion could not be solved analytically, special computer program was designed. An opportunity of real-time processing and data visualization was taken into advantage to perform primary analysis of evolutionary tracks without necessity to use side-built graphics packages. Differential equations' set is being solved by using Runge-Kutta IV-order algorithm with adaptive step-correction.

By means of numerical modelling we verified analytical approximations and give illustrative picture of evolution of fields and Hubble constant H for those periods of inflation, when it is not possible to perform analytical calculations.

In this research we picked up possible combinations of model parameters that ensure duration of inflation being greater than 60 e-foldings and estimated PCP spectrum indexes for those sets of model parameters.

As an outlook for further investigations we are to point out that it is planned to perform the study for the model of hybrid inflation, which includes two interacting scalar fields.

Key words: Cosmology, inflation.

MODEL OF OPTO-GRAVITATIONAL WAVE DETECTOR OGRAN

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The Gravitational Wave (GW) detection is fundamental problem of modern astrophysics. According to theoretical estimations, the sensitivity of GW detector should be of order $10^{-18} \div 10^{-21}$ of space strain amplitude for the frequencies of several kHz and bandwidth of several Hz for monitoring relativistic star events in the Galaxy and close region (≈ 100 Kps).

There are two main approaches to GW detection - massive bar-detectors (several tons) and Fabri-Perrot (FP) large-scale interferometers (several kilometers). GW bar-detectors should be cooled below liquid helium temperatures to decrease thermal noise influence. Long-term exploitation of such detectors is quite complicated engineering task.

This poster presents model of Opto-Gravitational Wave Detector - OGRAN which combines features of bar and FP-interferometer detectors. The OGRAN detector has sensitivity of the same order as cryogen GW bar-detectors, but operates at room temperature.

The ORGAN GW-detector consists of cylindrical aluminum bar with FP optical cavity along its central axis. The output signal consists of "acoustical" and "optical" parts. The acoustical part corresponds to the GW influence on the body of bar-detector and belongs to frequency range about one kHz. The optical part corresponds to the direct influence of GW on laser beam and theoretically can cover tenth kHz range.

The optical scheme realize the "optical standards comparator". The pump laser's frequency is stabilized by the FP cavity of the bar-detector and compared with the etalon FP interferometer (discriminator). Thus, it is possible to suppress frequency instability of laser beam which exceeds shot-noise level by several orders of magnitude. It is possible to enlarge the detection bandwidth and achieve cryogenic level of sensitivity at room temperature using optical sensor instead of mechanical transformer with capacity sensor.

The estimated sensitivity of OGRAN GW-detector of 3 ton weight is better then 10^{-18} of space strain amplitude. The model uses bar-detector of 50 kg weight and should archive sensitivity level of 10^{-17}.

The OGRAN GW-detector should be installed in the Baksan Neutrino Observatory in the mountain underground tunnel.

This project is developing in collaboration between Institute of Nuclear Research Rus.Ac., Institute of Laser Physics Rus.Ac.Novosibirsk and Sternberg Astronomical Institute, Moscow State University.

ON THE STRUCTURE OF FERMION CURRENTS IN THE PARTICLE-LIKE MODELS WITH ELECTRIC CHARGE AND MAGNETIC DIPOLE MOMENT

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The structure of fermion currents plays an important part in the particle-like models which nonspherical constituent fields form spherically symmetric gravitational field (Olyeynik, 2004). To select the appropriate fermion wave functions, we study the conditions for the separation of variables in the Dirac equation, when the potentials of electromagnetic field as well as the potentials of Yang-Mills field with SU(2) symmetry have the contributions of corresponding charges and of magnetic dipole moments. Next we compare the possible directions of Yang-Mills potentials in the space of SU(2) group with the directions of the fermion currents which are the sources of these Yang-Mills fields. Finally we investigate the properties of the particle-like model of the system of Einstein-Maxwell-Dirac-Yang-Mills fields with SU(2) symmetry when the massive fermion field is in its minimal energy state.

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Key words: field theories; gravitational field; elementary particles.

COSMOLOGICAL MODEL WITH EXPANSION AND ROTATION

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A cosmological model with expansion and rotation for Bianchi metric type IX was obtain,

$$ds^2 = (dt + A\omega^1)^2 - (B\omega^1)^2 - C^2((\omega^2)^2 + (\omega^3)^2),$$

where $A = A(t)$, $B = B(t)$, $C = C(t)$ and ω^1, ω^2, ω^3, are one-forms satisfying Bianchi type IX structure relations . A electro-magnetic field, field of radiation and ideal fluid are sources of gravitation field. We have considered the Maxwell equations. Components of electro-magnetic field are as follows

$$F_{01} = 1/(C \sin x)$$

or

$$F_{02} = 1/C.$$

Then we have solved the Einstein equations for case $A = 0$, $B = C$. We obtained components of radiation field, components of 4-velocity of fluid, pressure, density and kinematic characteristics: expansion, rotation and shift.

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THE UNIVERSE BEFORE THE FIRST BIG BANG

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Proceeding from the idea about existence of hidden physical substance called quintessence, the attempt to identify it with the bi-Hamiltonian dynamical system considered in (Sannikov-Proskuryakov, 2000). is made. We consider that before the First Big Bang (in zero cycle) our Universe had been in the form of ensemble of such systems (or quanta f). Its temperature $T_f \sim 1KeV$ and gravitational interaction determine size of the ensemble (radius of Universe) $R^{(0)}_{max} = 1/G^{1/2}T_f^2 \sim 10^{17}cm$, its mass $M^{(0)} = 1/G^{3/2}T_f^2 \sim 10^{45}g$ and number $N^{(0)} = 1/G^{1/2}T_f^3 \sim 10^{75}$ of quanta f in ensemble (in units $c = h = 1$; G is the Newtonian constant of gravitational interaction). The ensemble subjected further to the Friedman's compression (collaps) is contracted to the size $R^{(0)}_{min} = 1/G^{1/2}T_f|T_{\dot{f}}| \sim 10^5cm$ and maximal possible density $\rho_c = M^{(0)}/{R^{(0)}_{min}}^3 \sim 10^{30}g/cm^3$, where $T_{\dot{f}} \sim 10^6GeV$ is the temperature of the second component of the system. After this in the system the Big Bang (total irreversible quantum transition $f \to \dot{f}$) is accomplished. The energy $T_f - T_{\dot{f}} \sim |T_{\dot{f}}|$ released at this transition increases the mass of Universe from $M^{(0)}$ to the $M^{(1)} = \eta M^{(0)} \sim 10^{57}g$ ($\eta = |T_{\dot{f}}|/T_f \sim 10^{12}$) and leads to the creation of fundamental particles (Sannikov-Proskuryakov, 2001). In the beginning at maximal density

$\rho = \rho_c = const$ Universe is expanded to the size $R_s = \eta^{1/3} R_{min}^{(0)} \sim 10^9 cm$ according to the De-Sitter's law e^{Ht} ($H \sim \sqrt{G\rho_c}$). Hereby as it follows from the conservation law $\frac{d}{dR}(\rho R^3) = -3\rho R^2$ pressure is $p = -\rho_c$. After this, the Friedman's stage of extension is begun; it is characterized by integral $\rho R^3 = M^{(1)}$ and pressure $p = 0$. At disintegration regime of super dense state of Universe the 27 percentage of relic helium in Universe is calculated. In the framework of a new theory of elementary particles [2] the energy density of physical vacuum is obtained.

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Key words: Big Bang, de-Sitter's stage, Friedmann's collaps.

COSMOLOGY AND LIVING CELL

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In the cosmological model described in (Sannikov-Proskuryakov, 2004) after the De-Sitter's expansion, the Friedman's extension takes place. In the beginning of this stage ultra relativistic component of matter (relic radiation with density $\rho_\gamma \sim T^4$) predominates over the non-relativistic one (having density $\rho_m \sim T_f T^3$). At pressure $p = 0$ this leads to the temperature jump from T_f to $T_f/\eta^{1/4}$. With these pressure and temperature jumps unusual phase state of space is connected. It is called the H.Bohr's compactification of configuration space (Bohr, 1932). The space is as if in the condensed state characterized by the specific boundary conditions. At such conditions the process of forming of compound material structures is principally distinguished from the well known N.Bohr's structures (atoms and molecules). At the new conditions the integration operation is the H.Bohr's mean value therefore a new wave mechanics works here. It is connected with the so called almost periodical functions on the configuration space. This theory is well adopted to the description of structures characterized by the low symmetries and entropy. We call such structures biological ones (or almost periodical crystals). All they have membranes – special formations homeomorphic to the some Riemannian surfaces built over sphere (such membranes there are at living cells, nucleus of cells and so on). It is shown that at new boundary conditions usual potential interactions do not play any role. Therefore it is like free motion but characterized by solely quite not connected energy spectrum. General form of wave functions of biological structures is found.

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Key words: entropy, biological structures, membranas, Riemannian surfaces.

IS SU(3) YANG-MILLS FIELD A PROPER SOURCE OF GRAVITY?

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Einstein equations of General Relativity bind up curvature, which is determined by geometrical properties of a space-time, with energy-momentum tensor of a matter, rigidly restricting matter behaviour. In cited article, it was shown that nothing but Yang-Mills field with 3-parametric local symmetry group with or without sources is allowed to be a source of gravitational field in GR frame. Any other sets of fields must mimic such field to have the same energy-momentum tensor otherwise they will be prohibited.

In this work we study does SU(3) Yang-Mills field usually considered as a fundamental in hadron physics is a proper source of the gravitational field. Consequences for quark confinement are discussed.

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Key words: General Relativity, Yang-Mills fields, confinement.

THE EINSTEIN-ROSEN BRIDGES (WORMHOLES) AND THE FEATURES OF IT'S GRAVITY LENSING

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Bridges (wormholes) are possible objects in the world, which connects topologically with each other some parts of the Universe. It is shown that the bridges can be static solutions of the Einstein equations in general relativity. It is demonstrated that matter which generates bridges must have strong-anisotropic and hard-enough equation of state (phantom energy). The deflection of photons by gravitational field of such wormholes have been studied (gravity lensing).

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Key words: Bridge, wormhole, phantom energy, gravity lensing.

6D BRANE WITH GRAVITATIONAL TRAPPING POTENTIAL

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We present a new (1+3)-brane solution to Einstein equations in (1+5)-space. As distinct from previous models this solution is free of singularities in the full 6-dimensional space-time. The gravitational potential transverse to the brane is an increasing (but not exponentially) function and asymptotically approaches a finite value. The solution localizes the zero modes of all kinds of matter fields and Newtonian gravity on the brane. An essential feature of the model is that different kind of matter fields have different localization distances.

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Key words: brane models; matter field trapping.

COSMOLOGICAL EVOLUTION OF A GHOST SCALAR FIELD

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In this work we consider a scalar field ϕ with a negative kinetic term (a ghost scalar field) minimally coupled to general relativity. The action of the theory is

$$S = \int d^4x\sqrt{-g}\left[\frac{1}{8\pi G}R + (\nabla\phi)^2 - 2V(\phi)\right], \qquad (1)$$

where the potential $V(\phi)$ is taken in the exponential form:

$$V = V_0\exp(-k\phi). \qquad (2)$$

An exact non-static spherically symmetric solution, we have obtained in the theory (1), (2), has the following form:

$$ds^2 = -\exp(-2\alpha^2 aT + 2u)\,dT^2 + \exp(2aT - 2u)\left[dr^2 + (r^2 + r_0^2)d\Omega^2\right], \qquad (3)$$

$$\phi(T,r) = (4\pi G\alpha^2)^{-1/2}\left[u - \alpha^2 aT\right], \qquad (4)$$

with

$$u(r) = \frac{m}{r_0}\arctan\frac{r}{r_0}, \quad \alpha^2 = \frac{m^2}{m^2 + r_0^2},$$

where m, r_0 and a being three free parameters, and the parameters a and α are related to the parameters of the potential as follows:

$$k = 4\alpha(\pi G)^{1/2}, \quad V_0 = \frac{a^2(3+\alpha^2)}{8\pi G}.$$

The spacetime described by the metric (3) represents two asymptotically homogeneous spatially flat universes connected by a throat. In the other words, one may interpret such the spacetime as a wormhole in cosmological setting. It is important to notice that both the universes and the throat of the wormhole are simultaneously expanding with acceleration. The character of acceleration qualitatively depends on the wormhole's mass parameter m. In case $m = 0$ the acceleration is constant, so that the corresponding spacetime configuration represents two de Sitter universes joining by the throat. In case $m \neq 0$ the acceleration turns out to be infinitely growing, so that the metric (3) describes now the inflating wormhole connecting two homogeneous spatially flat universes expanding with infinitely growing acceleration into the final singularity.

NEUTRINO, BLACK HOLES AND BLACK MATTER

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The problem of Dark Matter and Black Holes as problem of the deficit of mass and energy in visible Universe may be resolved with the help of the traditional methods (Novikov&Frolov, 1986; Ruffini, 1982; Gondolo, 2004): the expansion of the experimental methods of modern astronomy and using the last results in physics of elementary particles.

Modern researches in this part of cosmology almost don't take care about the problem of relic objects. The synthesis of the Gamov's idea about the relic matter and deficit matter in Universe can be one of the possible ways of the resolution of the problem of Dark Matter and Energy.

In the beginning of Big Bang of planckeon, it might be various forms of relic matter and energy were rested. Among them are the light partners of Dark Matter: neutrino, neutralino, photons and photino. The Gamov relic irradiation is one type of this matter. The correlation between relic and habitual neutrinos is unknown precisely. For various scenarios of inflation (homogeneous or inhomogeneous) this number can be of order 1. Therefore, the deficit mass of visible Universe can be decreased from one to three masses of visible neutrino.

The another relic particles and irradiation may exist too for irregular inflation of planckeon. It may be relic quarks (1 on the 10^9 quarks of normal matter). But problem of registration of these particles is very difficult because we cannot observe the normal quarks in Universe.

For inhomogeneous inflation another relic particles can be still survive, e.g. Dirac monopoles, Higgs bosons, hyperons and other supermassive barions in our domain and corresponding antiparticles in another domains.

The problem of the interdomain interaction is not resolved too. The resolution of this problem can give new interesting results. Among them are existence, evolution and the interdomain

boundaries and the influence of these boundaries on the processes of the creation of matter and energy in the visible Universe.

The investigation of these problems in modern cosmology may reveals new forms of Black Holes and Dark Matter and possible ways of their evolution. Problem of the transition of condensed matter into irradiation and back and problem of formation of massive objects may give new results.

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ROLE OF BOUNDARY IN THERMODYNAMICS OF QUANTUM-CORRECTED BLACK HOLES

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A black hole, surrounded by a reflecting shell, acts as an effective starlike object with respect to the outer region that leads to vacuum polarization outside, where the quantum fields are in the Boulware state. We find the quantum correction to the Hawking temperature, taking into account this circumstance. It is proportional to the integral of the trace of the total quantum stress-energy tensor over the whole space from the horizon to infinity. For the shell, sufficiently close to the horizon, the leading term comes from the boundary contribution of the Boulware state. The similar effect is studied in 2D dilaton gravity. It is shown that account for the finiteness of the system plays a crucial role in some 2D theories (e.g., CGHS), where it enables to define the stable canonical ensemble, whereas consideration in an infinite space would predict instability.

Key words: Hawking temperature, Hartle-Hawking state, Boulware state, microcanonical ensemble.

LARGE-SCALE STRUCTURE OF THE UNIVERSE

CONSTRAINTS ON RELIC GRAVITATIONAL WAVES FROM CMB AND LSS OBSERVATIONS

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The existence of relic (primordial) gravitational waves is the most prominent prediction of inflationary models of large-scale structure (LSS) of the Universe formation. So that the detection of stochastic gravitational waves background would be the strongest evidence in support of inflational hypothesis. Direct detection of imprint of these gravitational waves on polarization pattern of cosmic microwave background (CMB) is planned for next generations experiments for CMB anisotropies explorations, e.g. Planck mission.

Here in this talk we present the results of search the constraints on the power spectrum of tensor mode of primordial perturbations (gravitational background) using the indirect methods. We have determined the constraints on amplitude and the slope of power spectrum of gravitational waves on the basis of set of observational data on:

- large-scale structure of Universe,
- anisotropies of cosmic microwave background (WMAP, Boomerang)
- measurements of global properties of Universe (Hubble constant measurements and cosmic acceleration measurements, Big Bang nucleosynthesis).

Using the statistic methods, we have investigated the most common inflationary model with 11 parameters, all of them evaluated simultaneously. Such approach gives the statistical upper limit on possible amplitude of relic gravitational waves and so on energy scale of inflation, building the criteria for selecting the most plausible amongst different models of inflation.

Key words: Large-scale structure of Universe, Cosmic Microwave background, inflationary model.

OBSERVATIONAL CONSTRAINTS FOR COSMOLOGICAL Λ MDM MODELS

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A reconstruction of cosmological parameters is a key problem of the modern cosmology. An analysis of cosmological models in spatially flat Friedmann Universe with cosmic gravitational wave background and nonzero Λ-term is presented. The normalization of the spectrum of density perturbations on galaxy cluster abundance (σ_8) has been used to calculate numerically the value of the large scale CMB anisotropy ($\ell \simeq 10$) and the relative contribution of cosmological gravitational waves T/S.

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SMALL-SCALE CLUMPS IN THE GALACTIC HALO

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Production of small-scale DM clumps in halo of Galaxy is studied. We consider only the most conservative case of adiabatic fluctuations which enter the non-linear stage of evolution at the matter dominated epoch with the inflation-induced initial power-law power spectrum. A special attention is given to the following problems:

1. The mass spectrum of small-scale clumps with $M \leq 10^3 M_\odot$ is calculated with tidal destruction of the clumps taken into account within the hierarchical model of clump structure. The mass function
$$f(M)dM \simeq 0.01(n+3)\frac{dM}{M},$$
where n is the index of the perturbation spectrum. Only 0.1 - 0.5% of small clumps survive the stage of tidal destruction in each logarithmic mass interval $\Delta \ln M \sim 1$.

2. The mass distribution of clumps has a cutoff at $M_{\rm min}$ due to diffusion of DM particles out of a fluctuation and free streaming at later stage. $M_{\rm min}$ is a model dependent quantity. In the case the neutralino, considered as a pure bino, is a DM particle, $M_{\rm min} \sim 10^{-8} M_\odot$.

3. The evolution of density profile in a DM clump does not result in the singularity because of formation of the core under influence of tidal interaction. The radius of the core is $R_c \sim 0.1R$, where R is radius of the clump.

The applications for annihilation of DM particles in the Galactic halo are studied. The number density of clumps as a function of their mass, radius and distance to the Galactic center is presented. The enhancement of annihilation signal due to clumpiness, valid for arbitrary DM particles, is calculated. In spite of small survival probability, the annihilation signal in most cases is dominated by clumps.

Our approach is based on the hierarchical clustering model in which smaller mass objects are formed earlier than the larger ones. This condition is satisfied for objects with mass $M > M_{min} \simeq 2 \cdot 10^{-8} M_\odot$ only if the primordial power spectrum has the value of the power index $n_p > 0.84$, but the enhancement of the annihilation signal in fact is absent, $\eta \simeq 1$, for $n_p < 0.9$.

The clumps which give the dominant contribution to the annihilation signal have approximately the following properties: The mass $M \sim 10^{-8} M_\odot$, the radius $R \simeq 3.6 \cdot 10^{15}$ cm and the radius of the core $R_c \simeq 1.8 \cdot 10^{14}$ cm, the mean internal density of the clump $\bar{\rho}_{\rm int} \simeq 2.5 \cdot 10^{-22}$g cm^{-3}, the fraction of the halo mass in the form of these clumps ~ 0.002, and the mean number density of these clumps in the halo $n_{\rm cl} \sim 25$ pc^{-3}.

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DETECTION AND PROPERTIES OF A NEAR-EARTH FLUX OF DARK ELECTRIC MATTER OBJECTS (DAEMONS)

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If the dark matter of galaxies consists of elementary Planckian black holes (m $\sim 3 \cdot 10^{-5}$ *g*, $r_g \sim 2 \cdot 10^{-33}$ *cm*), their number should be fairly low, only one particle per $\sim 10^{18}$ protons, so that their flux should be small compared to that of hypothetical WIMPs, whose search is being presently actively pursued. If, however, the Planckian holes carry an electric charge corresponding to their mass (up to $Ze \sim 10e$), such DArk Electric Matter Objects, daemons, should interact strongly with matter. They should be slowed down to some extent when crossing celestial bodies, build up in them, and in multiple systems, in close lying orbits too (e.g., in Earth-crossing orbits). On the other hand, capture, say, of a Fe nucleus by a negative daemon would release more than 100 MeV of energy, i.e., give rise to ejection of ~10 nucleons from the nucleus. Besides, a daemon confined to a proton should conceivably catalyze rapid decay of the latter.

The scintillation detector consisting of two ZnS(Ag) screens stacked one upon the other (four modules 0.25 m^2 each) and developed by us in 2000 detects at a confidence level of >99% events with a time shift corresponding to velocities from ~30 down to ~5 *km/s* (in both down- and upward crossings). Such velocities correspond to objects trapped into helio- and geocentric orbits (with the latter crossing the surface of the Earth to become eventually confined to its interior). Of particular significance (more than 3 sigma) is a group with velocities of ~10-15 *km/s*, which are characteristic of bodies falling to the ground from near-Earth almost circular heliocentric orbits. Their flux is in excess of $\sim 10^{-9} cm^{-2} s^{-1}$. It varies with a period of 0.5 year, which may be assigned to the Earth's crossing the shadow and "antishadow" produced by the Sun as it moves relative to the daemon population of the Galactic disk.

The data obtained in our experiments estimate the time of the daemon-stimulated proton decay as $\sim 10^{-6}$ *sec*. Then many observations which have thus far remained imperfectly understood, e.g., the excess fluxes of heat (up to ~50%) and ^{3}He from the Earth's interior, emission of neutrinos of a non-electronic flavor from the Sun, discovery of an unexpectedly large abundance of positrons at Galactic center, etc., may find interpretation as due to daemons that concentrate there and catalyze the proton decay. (See *astro-ph*/0402367.)

Key words: Dark Matter; DM in the Solar System; DM objects' discovery; Planckian scales; proton decay.

ON THE EVOLUTION OF GALAXY CLUSTERS

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The dependence between ellipticities of galaxy clusters on redshifts, the subclustering in clusters as well as the orientation of nearby galaxy groups belonging to the Local Supercluster are discussed.

A NEW DYNAMICAL ESTIMATOR OF Ω_m

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We have recently introduced a new dynamical estimator of Ω_m – the mean mass density of the nonrelativistic (cold) component of the cosmic fluid, expressed in critical density units. Our technique, based on measurements of the mean relative peculiar velocity of pairs of galaxies, v_{12}, as a function of their separation, r, can be also used to estimate the amplitude normalization parameter for the density perturbations, σ_8. Unlike estimates from the cosmic microwave background (CMB) anisotropy power spectrum, these are free of parameter degeneracies and do not require prior assumptions about the value of the vacuum density parameter, Ω_Λ, ionization history, pure adiabaticity, initial power spectrum index or the tensor-to-scalar ratio. Therefore, our estimates, together with the CMB results can be used to measure Ω_Λ and provide a check on methods, based on the SN1a data. From four peculiar velocity surveys with a total of ~ 7000 D_n-σ and Tully-Fisher distances, we obtain $\Omega_m = 0.30^{+0.17}_{-0.07}$ and $\sigma_8 = 1.13^{+0.23}_{-0.22}$. In the near future we expect to improve the accuracy of our estimates dramatically by increasing the number of distance measurements by another order of magnitude, using 2dF and SDSS surveys as well as Sunyaev-Zeldovich measurements of cluster peculiar velocities.

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Key words: cosmological parameters, galaxies, cosmology.

MORPHOLOGY AND CONFIGURATIONS OF TRIPLE SYSTEMS OF GALAXIES IN THE LOCAL SUPERCLUSTER

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The morphological properties of triple systems in the Local Supercluster are considered. The sample contains of 156 triplets of galaxies ($V_{lg} < 3200\ km \cdot s^{-1}$) selected from the LEDA Data Base using the Karachentsev's criterion (1994). The median values of velocity dispersion, harmonic radius, virial mass and M/L relation of early types triplets (E-Sa) have been found to differ from respective values of late-type triplets (Sb-Irr): $S_v = 45km \cdot s^{-1}$, $R_h = 246kpc$, $M_{vir} = 10^{12} M_{sun}$, $M/L = 79 M_{sun}/L_{sun}$ for early-type triplets, and $S_v = 32km \cdot s^{-1}$, $R_h = 172kpc$, $M_{vir} = 4 \cdot 10^{11} M_{sun}$, $M/L = 28 M_{sun}/L_{sun}$ for late-type systems. The majority of triplet galaxy components are late morphological types. The following projected configurations of triplets were detached: 52 % of systems have hierarchical configurations, 37 % have triangle configurations and 11 % have linear configurations.

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Key words: groups of galaxies, morphology of galaxies, Local Supercluster.

NONLINEAR PERTURBATIONS IN UNIVERSE WITH DARK ENERGY

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The problem of two-component Universe consisting of dark energy and dark matter is discussed. The nonlinear growth is considered for spherically symmetrical perturbations. The dependence of critical amplitude δ_c for spherical perturbation on cosmological parameters is presented. Also the difference for this amplitude for Λ-constant and dark energy with $\omega^{(de)} \neq -1$ (at least for some part of Universe life) has been analyzed. The review of sources devoted to the nature of dark energy is also given in this report. The influence of dark energy model on large-scale structure of Universe formation is considered, including the linear stage of LSS formation and the stage of formation of gravitationally bound systems as well.

Key words: Large-scale structure of the Universe, dark energy, nonlinear perturbations.

DISCRETE SOURCES AS LARGE-SCALE STRUCTURE INDICATORS

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The joint analysis of the angular distribution of Zelenchuk survey sources has been carry out. The existence of the definite deviation scale in angle sources distribution through the celestial sphere from Poisson with a more high reliability was confirmed. It is show the availability a significant fraction of radio sources are associated with the supercluster-void network and composed of regular structures on scales about one degree. The scale coincidence of the angular distribution of sources and the first Doppler peak position of angular fluctuations for background radiation was considered in sense of the dust radiation existence from galaxies at redshift, connected with the epoch of a large scale structure formation ($z = 5 - 6$). The coincidence of angle scales of deviation from Poisson for discrete sources and the background radiation initiated the reconsideration for the connection of the protogalaxies radiation with the antenna temperature in the "MAP" experiment and other ones. It was examined what properties must had objects to correspond by observable background data.

Key words: Discrete sources-Large-scale structure-background radiation.

THE SPATIAL DENSITY OF QUASARS IN THE EXCURSION SET APROACH

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We present the method of calculation of the spatial density of quasars which is based on the excursion set model of hierarhical clustering. The calculations are held under the assumption that quasars are formed on the early stages of galaxy formation, and their lifetimes are negligible in comparison with the age of the Universe. In this case the collapse and formation of quasar corresponds to the moment when some local maximum of the Brownian random walk built in the framework of excursion set model hits the threshold level of the density fluctuation amplitude. We build the spatial density of quasars as function of redshift in the ΛCDM cosmological model and compare it with the observational data. The results are consistent with the observational data on the qualitative level and show the maximum of quasar's density at a certain redshift, which depends on the masses of host galaxies in which quasars are formed, and on the values of cosmological parameters. To obtain the position of maximum on $z \approx 2.2$ that is found from the observations, we should take the masses of host galaxies $\sim 10^{10} M_{\odot}$.

Key words: quasars: formation, redshift distribution.

FRACTAL MODEL OF THE UNIVERSE

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In the given paper it is presented for the first time the model of the Universe in which evolution occurs in a regular fractal way. Unlike chaotic script of the Universe inflation (see, for example, Linde, 1990), the proposed model is free of paradoxes (for example one of them: from the point of view of chaotic inflation $\sim 10^{87}$ of casually separated regions should simultaneously increase with the probability of $\sim \exp(-10^{90})$). It is shown that in the basis of a regular-reproduction vacuum there is a maximon with the mass $m_p = \sqrt{\hbar c/G} \approx 10^{-5} g$ and dimension of $l_p = \sqrt{G\hbar/c^3} \approx 10^{-33} cm$. From the point of view of the theory of knots the internal structure of such maximon may be topologically represented as a trefoil each leaf of which is a maximon itself, etc. (Markov, 1966; Monastyrsky, 1999).

Consequently at the beginning the Universe there was, for example, the right trefoil and then it starts to reproduce itself spontaneously. Each leaf of the trefoil transforms into three new right trefoils; their number equals nine. Then each of these nine trefoils again reproduces three new ones; their number 27. This amount of initial space quanta is packed into the initial cube of "black matter". Further the "black matter" crystal grows fractally since it is the most optimal way to a spherical form. The surface area (P surface) (see, for example, Turbin and Pratsevity, 1992) limits the final volume of the "black matter" at the each fractalization stage, approaching infinity. Inside this surface there are worlds with our crystal vacuum (it occurs a peculiar chain armoire of left and right trefoils). Further evolution of the Universe leads to the increase of our space volume at the expense of its escape from our matter at the velocity of the world. Imaginary speaking in the "black matter" like in a skeleton it occurs an everlasting plaiting of the space (the space is not blowing it is completing). Simultaneously from all sides it occurs an intervention in our space of isolated right trefoils-maximons, creating the effect of relic radiation (the oscillations of the surface layer of our space adjoined to the "black matter").

From the point of view of the channeling theory, as shown (Maksyuta, 2004), this is the radiation of channeling particles, moving towards us at zero velocity. By means of the equation $\partial^3 \vec{A}(\vec{r},t)/\partial t^3 - c^3 \mathrm{rot}\,\mathrm{rot}\,\mathrm{rot}\,\vec{A}(\vec{r},t) = 0$ got in the paper (trefoil equation) and its further modification (substitution of derivative exponent 3 by a fractal dimension Hausdorff–Besicovitch $\alpha = \ln 13/\ln 3 \approx 2.335$) is calculated a behavior of a scale factor coinciding with calculations got on the basis of general relativity (see Linde, 1990).

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Key words: fractal, trefoil, crystal.

LARGE SCALE STRUCTURE OF THE UNIVERSE: THEORY, OBSERVATIONS AND COSMOLOGICAL PARAMETERS

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We use the observational data on the large scale structure (LSS) of the Universe measured over a wide range of scales from sub-galaxy up to horizon ones for determination of cosmological parameters within the class of inflationary adiabatic models. We show that the best-fit model is Λ dominated (65% of total density) cold dark matter (30%) model with about 5% baryon content. The nowadays data which include the 1st year Wilkinson Microwave Anisotropy Probe (WMAP) observations, SDSS galaxy power spectrum and other ones do not need additional parameters like hot dark matter and tensor mode components for their explanation.

Key words: Large-scale structure of the Universe, cosmic microwave background, dark matter, dark energy, cosmological parameters.

DARK MATTER AND FORMATION OF STRUCTURE IN MULTI-COMPONENT UNIVERSE

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The gravitational instability is considered in the Newtonian approximation in the multi-component expanding medium in the classic universe. It is shown that dynamics of the small perturbations can be expressed as an analytic solution composed of G-functions of Meijer in the number of cosmologically consistent (realistic) situations. One of the components becomes the fastest growing one and others stay negligible. Luminous matter demonstrates falling into the clusters of the mean component. Besides common assumption about dark matter the hypothesis of the new type interactions is discussed such us gravi-magnetic interaction, gravi-inertion interaction dominating throughout the cosmological scales considered in the framework of some of the alternative theories. One of the alternative theories apply the very same approach which brought Maxwell from the Newton law to his equations and derives a system of gravitation and inertia equations from Newton formula of gravitation to dynamic theory of gravity and inertia.

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DUST HOLES IN AGNS

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At time of past Gamov Conference at (Oknyanskij, 1999) the Optical-to-Near-infrared variability time delays were known for a small number (~ 7) of AGNs and has been firmly established only for 5 of them (Oknyanskij, 1999). Now the time delays are found for tens of AGNs (Oknyanskij and Horne, 2000; Oknyanskij, 2001; Glass, 2004). The most naturally this time delays can be interpreted by the model where IR emission is attributed to circumnuclear dust heated by the nuclear radiation. In given model a suggestion on narrowness of the near-infrared (NIR) emission region is quite natural, as far as the dust can be not saved on distances from the nucleus closer then some critical value, on which it is reached the sublimation temperature for graphite particles. In paper 1 we assumed that the observed time delays allow us to derive a redshift independent luminosity distances to AGNs and estimate a Hubble constant. We are considering here this idea taking into account new observational data.

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Key words: AGNs, IR, time delays, cosmology.

THE ANALYSIS OF GALAXY DISTRIBUTION IN REGION OF ABELL CLUSTER 3846

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We assumed the Muenster Red Sky Survey as a basis for search of galaxy clusters in this work. Muenster Red Sky Survey (R. Ungruhe) is a large-sky galaxy catalogue covering an area of about 5000 square degrees on the southern hemisphere. It is complete till m 18.3. We decided to apply the Voronoi tessellation technique for cluster search. The fragment of field ESO/SERC 533 with Abell cluster 3846 was selected for analysis. The galaxy positions are input as the seeds for the 2D Voronoi tessellation, and the Voronoi cell around each galaxy is interpreted as the effective area that each galaxy occupies in projection plane.

NATURAL MODELING OF GALACTIC AND EXTRAGALACTIC STRUCTURES

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The experience of natural modeling ascends to the idealization of zodiacal belt by ecliptic (E), Milky Way – by Galactic plane (MW), the Gould Belt – by its mean line (GB), etc. The lines thicken to belts, the planes – to layers in the fractal approach.

The existence of similar structures is discovered in the Universe in different scales, as well as the brunching out the structures. The similarity is in the fact that the main elements of structures of different distances are projecting over the same belts of celestial sphere. The mentioned above E, MW, GB and the perpendicular to them Λ, Γ, $\perp$MW, $\perp$GB, etc are of small number of such belts. It is convenient to join them into triedr (E, Λ, Γ) and into the same ones, obtained by the turning it around the tops for $\pi/2$, $\pi/4$, $\pi/6$, that is brunching out. The regularity of triedr net or bunch of belts allows to give it and its elements the analytical notion.

The collection of model belts varies, beginning with the sole E, for different structures in the Galaxy or outside it. The narrow (dust ?) interlays, similar to the zone of avoidance in MW, are seen along the several structures, coinciding the model ones. The correlations between the observations and the model are not far from the regularity.

There are possible interpretations: the space anisotropy, the freak of light absorption, etc.

There are examples of modeling by the bunches of belts:

1. The system of globular clusters over Harris catalogue. There are several rather narrow layers, consisting of globular clusters, parallel to E and, not so clear, parallel to Γ, in the region of concentration to the Galactic centre. There are gaps between the layers.

2. The Local group of galaxies, over Vorontsov-Velyaminov. Two narrow layers at both sides parallel to E and two layers (Andromeda, et al) at both sides of Λ belt.

3. Supercluster of galaxies of Vacouleurs and counts of galaxies of Shapley and Ames. The main symmetry plane coincides Λ. There are the filaments of galaxies along E and $\perp$MW and other circles of our model.

4. The Peebles map for galaxies brighter 19^m. There are crossing in the centre the chains of filaments, corresponding to Λ and $\perp$MW, having the longitudes 7 - 187 and 97 - 277, accordingly. There are looking through the chains of filaments along E and parallel to them, and so on.

The merits of the offered modeling is the simple geometric and analytic forms, the universality of the model for all structures and its naturality in the astronomical sense – instead of the computer numerical simulations, different for every structure.

Key words: Galaxies Superclusters: structure.

THE FRIEDMANNIAN UNIVERSE MODELS IN THE LIGHT OF THE WILKINSON MICROWAVE ANISOTROPY PROBE (WMAP) OBSERVATIONS

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The mathematical-physical fundament of the present relativistic cosmology is represented by the *Friedmann equations* (Friedmann, 1922, 1924), which describe all theoretically possible models of homogeneous and isotropic relativistic universe in the first (linear) approximation.

In our observed *expansive homogeneous and isotropic relativistic Universe* in the linear approximation the Newtonian (classical-mechanical) relations are valid. Their validity is confirmed by the observations with an accuracy of 10^{-7}.

The Friedmann equations describe only one universe model in which the Newtonian relations are valid: the model of the *flat (expansive homogeneous and isotropic) relativistic universe (FRU)*, which is determined by the Friedmann equations with the curvature index $k = 0$, the cosmological constant $\Lambda = 0$, and the state equation $p = -\frac{1}{3}\,\varepsilon$ (Skalský, 1991, 1994).

From these facts it results unambiguously that FRU model describes our observed relativistic Universe in the linear approximation (See: Skalský, 2003).

This conclusion was confirmed by the *Wilkinson Microwave Anisotropy Probe (WMAP)* observations, too. Namely: The WMAP observations with large accuracy confirmed that our Universe is flat and they determined 31 basic and derived cosmological parameters (Bennett et al., 2003).

In the FRU model for the Hubble constant H and the cosmological time t is valid the relation (Skalský, 1991):

$$H = \frac{1}{t}\,. \qquad (1)$$

The average values of the present value of Hubble constant H_0, determined by the WMAP observations (Bennett et al., 2003), and the present value of Hubble constant H_0, determined by the relation (1) and the present age of the Universe t_0 (determined by the WMAP observations (Bennett et al., 2003)), differ only by $\pm 1.8 \times 10^{-3}$ (Skalský, 2003).

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Key words: observational cosmology, theoretical cosmology, mathematical and relativistic aspects of cosmology.

LOCAL SUPERCLUSTER OF GALAXIES IN 3D ATLAS. OVERVIEW OF THE LATEST 3D SURVEYS OF THE LOCAL UNIVERSE

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Modern astronomy science is seeking for the new problem solving techniques in understanding our Universe. We need to gather as much information as possible and then explain observational facts. Forever human being dreamt to look into the depth of space. Now not as whenever before we can realize our dreams. Using the latest technologies and the power of modern computers that let us visualize our observations we can build the Universe on the screen and watch it! We took this advantage and begun our project of constructing 3D Atlas of the LS. Last year we received the first picture of 3D distribution of galaxies in LS. This year we are in the process of building the complete interactive 3D Atlas of LS based on data taken from LEDA - the most up-to-date galaxy data repository. We have in possess more then 7000 galaxies with radial velocities less then 3000 km/sec. We use the fastest graphics library (OpenGL). The 3D Atlas will be a great help in study of LS, its members, structure and kinematics.

A SIMPLIFIED MODEL OF THE FORMATION OF STRUCTURES IN DARK MATTER

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We derive equations for a simple model of the dynamical behavior of a compressible rotating ellipsoid in which a motion along axes takes place in the gravitational field and under the action of the isotropic pressure. The gravitational potential is approximated by that of a uniform ellipsoid Jacobi. Development of gravitational instability and collapse in the dark matter do not lead to any shock formation or radiation, but are characterized by non-collisional relaxation ("violent relaxation", Lynden-Bell, 1967), which is accompanied by mass and angular momentum losses. This relaxation leads to a transformation of the kinetic energy of the ordered motion into the kinetic energy of the chaotic motion and a creation of effective pressure and thermal energy.

So the collapse of the rotating 3-axis ellipsoid is approximated by a system of ordinary differential equations, where the relaxation and losses of energy, mass and angular momentum are taken into account phenomenologically. The system are solved numerically for several parameters, characterizing the configuration.

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Key words: dark matter - large-scale structure of Universe.

PRIMORDIAL STAR FORMATION TRIGGERED BY UV PHOTONS FROM DECAYING PARTICLES

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The presence of decaying particles in the universe in the pre-ionization epoch enhances significantly H_2 kinetics in virialized halos. It results in more efficient radiative cooling and decreases the lower mass limit of the first star-forming systems. Consequently, the fraction of baryons contained in the first luminous objects and their contribution to the reionization of the universe can significantly increase in comparison with the standard scenario.

Key words: Cosmology: early universe, cosmology: miscellaneous, stars: formation.

SOME WAY OF STATISTIC MODELING OF GALAXY EVOLUTION

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Principal positions for algorithms of compiling of Galaxy statistic models are worked out. Idea of Galaxy evolution description by means of graphs, where probabilities of key events are located in graph knots, is a main one.

Mass functions, that are the initial conditions for any steps of Galaxy and its subsystems evolution, are assigned analytically. As a result, we receive percentages of main space formations and gas-dust component in Galaxy for investigated age of it.

A NEW TECHNIQUE OF GALAXIES CLASSIFICATION BY USING THEIR MORPHOLOGICAL STRUCTURE

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Using of coherent-optical image processor (COIP) for galaxies classification, based on determination of their space spectra parameters, is proposed. Power modern observation equipment enables to receive images with high spatial resolution. Computer processing of the images allows turn them as it need, reduce to the same scale and prepare the "working image" (WI). COIP allows to find two-dimension spatial spectra and autocorrelation function of such WI, which can be compared and be classified. The idea is approved in practice.

GRAVITATIONAL LENSES IN THE UNIVERSE

MONITORING OF THE QSO2237+0305 FROM MAIDANAK OBSERVATORY

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We report results of processing a data set of observations of the gravitational lens system Q2237+0305 obtained at 1.5-m telescope of the Maidanak Observatory over the period from August 2002 to November 2003. For the photometry treatment double-stage technique developed specifically for the purpose of gravitational lens image reconstruction was implemented. We apply the double-stage image reconstruction technique to derive 2002 - 2003 years light curves of four quasar components in the VRI spectral bands. Slow brightness variations over the observational period are found in all components. Images A, C, D have a tendency to decrease in brightness. Image B does not vary more than 0.05m. The observations did not reveal evidence for high variations in brightness of the components due to microlensing effects. To provide overall picture of monitoring of the QSO2237+0305 we summarize two years photometry results with the results of Kharkov group (Vakulik et al., 2003) from observations in 1995 - 2000 period.

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Key words: gravitational lensing – galaxies: quasars: individual: Q2237+0305 – techniques: image processing.

QUANTUM SCATTERING ON A COSMIC STRING

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Cosmic strings are topological defects which are formed as a result of phase transitions at the early stage of the evolution of the universe. We develop a quantum theory of scattering of a nonrelativistic test particle in the background of a string. S-matrix and scattering amplitude are found as functions of the flux and the linear mass density of the string and the spin of the test particle. We discuss some peculiarities of quasiclassical scattering which are due to the nonvanishing deficit angle.

INTERPRETING THE COLOR CHANGES OBSERVED IN GRAVITATIONALLY LENSED QUASAR Q2237+0305

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We present interpretation of color variations found from our VRI observations with the 1.5-m telescope of the Maidanak Observatory during 1995-2000 and reported in our recent publication (Vakulik et al., 2004). The observed variations of the $(V-I)$ colors of the Q2237+0305 components were shown to be statistically correlated with their magnitudes, in the sense that the components become bluer as their brightness increases. Our data confirmed predictions reported in (Jaroshinski et al., 1992) and arguing that variations of color are caused by microlensings of the source with the wavelength-dependent spatial structure.

To interpret the detected color variations and to explain the statistical dependencies obtained, computer simulation of microlensing events in Q2237+0305 was undertaken. To do this, we used a new empirical model of quasar spatial structure, (Elvis, 2000). According to this physical model, we considered a quasar photometric model consisting of a compact central source surrounded by some extended feature. In simulations we varied the size of the central source and the relative energy contributions of the central source and the extended feature in different spectral ranges to reach the best fit to the observed light curves and statistical dependence between the $(V-I)$ color indices and R magnitudes. The caustic pattern was created by the inverse ray tracing method for the randomly distributed microlenses.

The following source parameters provide the best fit to the well-sampled light curve presented in (Wozniak et al., 2000), and to statistical dependences reported in our recent work (Vakulik et al., 2004):
– the size of the central source should be chosen $r \approx 0.5 r_E$, where r_E is the Einstein radius of a microlens;
– energy contributions of the extended feature to the whole quasar luminosity in the V, R and I spectral band are 1.6, 3 and 3.7, respectively.

Assuming that the transverse velocity is 5000 km/s, we obtain the estimate for the size of the central source of the quasar $3 \cdot 10^{15}$cm.

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Key words: cosmology: gravitational lensing – galaxies: quasars: individual: QSO 2237+0305 – methods: observational – techniques: image processing.

QUASAR INTRINSIC BRIGHTNESS VARIATIONS IN THE EINSTEIN CROSS GRAVITATIONAL LENS SYSTEM

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We present new brightness monitoring observations of the quadruple gravitational lens Q2237+0 with the Maidanak 1.5-m telescope (Uzbekistan). The Einstein Cross is known to reveal high microlensing activity which prevents from direct determination of the time delays between the components. Essentially subdued microlensing activity at the monitoring time period allowed us to detect a $0.15^m \div 0.18^m$ synchronous brightening of the components during 40 days, that may be interpreted as the quasar intrinsic brightness change. Since the observed variations were rather slow, only preliminary estimates of the upper limit for the time delays were made, - about 3 days for the B, C and D components with respect to A. According to the macrolensing model by Schmidt et al. (1998, MNRAS, 295, 488), the time delays of 2 hours to one day are expected for the B, C and D components with respect to A. Observations from the Chandra X-ray Observatory (Dai X., et al. 2003, ApJ, 589, 100), gave 2.7 hours for the time delay between the A and B components, with image A leading. Therefore, the obtained constraint of the time delays can not be used to discriminate between competing macro-imaging models.

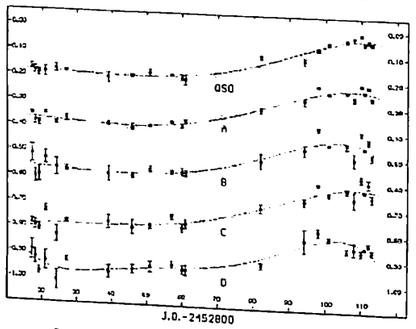

Figure 1: Synchronous variations of brightnesses of the A-D images in Q2237+0305, June 27 to October 2, 2003 (R magnitudes, shifted arbitrarily along the vertical axis are shown) The upper curve is a result of the aperture photometry of the whole object.

The importance of the reported results is in the fact that they provide the most convincing confirmation of gravitational-lensed nature of the Q2237+0305 system. And besides, they are the first direct measurements of the time delays made for this system from the ground-based observations in the visual wavelengths.

Key words: cosmology: gravitational lensing – galaxies: quasars: individual: QSO 2237+0305 – methods: observational – techniques: image processing.

NEUTRON STARS AND BLACK HOLES

BLACK HOLE PHYSICS IN A GENERAL SPACETIME OF GENERAL RELATIVITY

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The physical laws such as superradiance phenomenon, Hawking radiation, normal modes and many other results obtained in the context of black holes can also be obtained in the general spacetimes of general relativity which includes all the black hole solutions as well as the spacetimes which are not known as black holes. Even these physical laws can be obtained in the spacetimes endowed with NUT parameter, which has not any direct physical interpretation. Even further these physical laws can be obtained in the NUT spacetimes, which is considered as unphysical.

Furthermore our study of Hawking radiation in the Kasner type spacetime led to a result of particle creation in the contraction phase of the universe. This result goes beyond the idea that in the contraction phase it is necessary that particles should disappear. This interesting result shade doubts in the validity of Hawking radiation. However we have tried to save the idea of the celebrated Hawking radiation by putting forward an idea that particles do not disappear in the process of contraction but become immaterial. More interestingly we have suggested that "immaterial souls"of particles are creating during contraction. In the case of an oscillating universe, one may expect that particles will be created from these "immaterial souls".

Black hole idea created a lot of excitement in the Physical community in recent years, although there are some doubts behind its existence. We are in good company with the view that black hole does not exist in the universe, since that view was to greater or lesser extent, shared from the early days of gravitational collapsed objects by Einstein himself and others. If there does not exist any black hole, then all the beautiful physical results obtained in the context of black holes will be meaningless. But an outline of our works presented in this paper shows that the beautiful results obtained in the context of black holes will be not be meaningless even if there does not exist any black hole.

ACCRETION DISKS AROUND BLACK HOLES WITH OPTICAL THIN-THICK TRANSITION AND ADVECTION.

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We consider the effects of advection and radial gradients of pressure and radial drift velocity on the structure of accretion disks around black holes.

Contrary to disk models neglecting advection, we find that continuous solutions extending from the outer disk regions to the inner edge exist for all accretion rates we have considered.

We show that the sonic point moves outward with increasing accretion rate, and that in the innermost disk region advection acts as a heating process that may even dominate over dissipative heating. Despite the importance of advection on it's structure, the disk remains geometrically thin.

Global solutions of advective accretion disks with optical depth transition are constructed and analyzed. For some values of parameters $\dot{m}$ and α the corresponding value of τ_0 is less or equal to unity which requires to include into system of equations the transition formulae for radiative pressure to discribe correctly the region of accretion disk between optically thick and optically thin zone.

The solutions are obtained by solving numerically a set of ordinary differential equations corresponding to a steady axisymmetric geometrically thin disk. We pay special attention to consistently satisfy the regularity conditions at singular points of the equations. For this reason we analytically expand a solution at the singular point, and use coefficients of the expansion in our iterative numerical procedure. We obtain consistent transonic solutions in a wide range of values of the viscosity parameter α and mass accretion rate.

We find that there are two singular points in solutions corresponding to the pressure-proportional shear stress. The inner singular point locates close to the last stable orbit around black hole. This point changes its type from a saddle to node depending on values of α and accretion rate. The outer singular point locates at larger radius and is always of a saddle-type. We argue that, contrary to the previous investigations, a nodal-type inner singular point does not introduce multiple solutions. Only one integral curve, which corresponds to the unique global solution, passes simultaneously the inner and outer singular points independently of the type of inner singular point. Solutions with the angular velocity gradient-dependent shear stress have one singular point which is always of a saddle-type and corresponds to the unique global solution.

PHASE-RESOLVED SPECTROSCOPY OF X-RAY BINARY SYSTEM 4U0115+63.

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We present results of the phase-resolved spectroscopy of the X-ray pulsar 4U0115+63 based upon Beppo-Sax satellite observations. Light curves on different energy ranges and spectra on various phase intervals have been obtained. It was shown that on the pulsar's surface there are most likely two active regions with different physical conditions instead of a one region with a complex emission diagram. Analysis of the obtaining data suggests that the magnetic field of the pulsar differs noticeably from the dipole one.

In accordance with previous observations a strong cyclotron feature in the spectrum has been observed. Second and third harmonics have been detected at all phases of the source; even a fourth harmonic was visible at some phases. An absorption model has been used to fit the peculiarity. The feature turned out to be strongly unequidistant and phase-dependent. Physical conditions under which this sort of cyclotron peculiarity could appear have been considered in close detail. Some difficulties emerging under an absorption interpretation have been discussed.

LOW ANGULAR MOMENTUM ACCRETION OF TURBULIZED GAS ONTO A BLACK HOLE

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Turbulence of accreting material in a quasi-spherical accretion, unlike in a disk-like geometry, counteracts accretion. We show that the modification of the classical Bondi solution for a spherical accretion may be dramatically improved by including the effects of turbulence. We use various second-order closure approximations computing double correlations for the turbulent equations. Unlike the CDAF models (Narayan et al. 2000) postulating dominance of convective transport, the foremost factor in our approach is the nonvanishing locally averaged centrifugal force that drives accreting matter outward. Formally for any branch of solution there is a turning point at which matter comes to a stop. Assuming the turning point be outside the gravitational radius we calculate the critical turbulence intensity for the given spectrum of turbulence.

Two-dimensional numerical simulations generally confirm our expectations for the deceleration of accreting turbulized flow. We observe either transition to the subsonic inflow or supersonic inflow with quasi-periodical formation of radially stretched dense structures and 'flickering' shocks around a black hole. We discuss possible observational manifestations of black holes with a quasi-sperical accretion.

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Key words: accretion - hydrodynamics - turbulence.

APPEARANCE OF SUBSONIC PROPELLERS IN A STRONG WIND

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The appearance of magnetized ($B \sim 3 \times 10^{12}$ G) neutron stars in the state of subsonic propeller, which are situated in a strong ($\dot{M}_c \sim 3 \times 10^{17}\,\mathrm{g\,s^{-1}}$) wind, is similar to that of AXPs in several important aspects. Namely, the rotational periods of these objects are limited to the range of 5–15 s, and the spin-down rates are about $7 \times 10^{-11}\,\mathrm{s\,s^{-1}}$. The emission of stars in this state is partly (5–10%) contributed to by the hot envelope surrounding its magnetosphere and mainly (90–95%) by the process of accretion of material onto the stellar surface. The efficiency of the accretion process, which is governed by the reconnection of the magnetic field lines at the magnetospheric boundary, is high enough for the luminosity of the considered objects to be of order a few $\times 10^{35}\,\mathrm{erg\,s^{-1}}$. Finally, the estimated ages of neutron stars under the conditions of interest are close to 10^5 yr.

SPECTRUM OF QUANTIZED BLACK HOLE, CORRESPONDENCE PRINCIPLE, AND HOLOGRAPHIC BOUND

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An equidistant spectrum of the horizon area of a quantized black hole does not follow from the correspondence principle or from general statistical arguments. On the other hand, such a spectrum obtained in loop quantum gravity (LQG) either does not comply with the holographic bound, or demands a special choice of the Barbero-Immirzi parameter for the horizon surface, distinct from its value for other quantized surfaces. The problem of distinguishability of edges in LQG is discussed, with the following conclusion. Only under the assumption of partial distinguishability of the edges, the microcanonical entropy of a black hole can be made both proportional to the horizon area and satisfying the holographic bound.

RELATIVISTIC MHD SIMULATIONS OF PULSAR WINDS AND INNER NEBULAE

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In this talk we present the results of recent relativistic MHD simulations of plerionic nebulae created by anisotropic pulsar winds. These simulations reveal complex dynamics of the post-shock flow, very different from the steady quasi-radial outflow assumed in earlier analytical models for plerions. The termination shock has the shape of a distorted torus and most of the downstream flow is initially confined to the equatorial plane. Provided the wind magnetization is higher than a certain value, the magnetic hoop stress stops the outflow in the surface layers of the equatorial disc and redirects it into magnetically confined polar jets. The outflow in the inner layers of the equatorial disc continues until it reaches the slowly expanding outer shell and then turns back and forms the vortex flow filling the nebular volume at intermediate latitudes. We simulated the synchrotron images of the nebula taking into account the relativistic beaming effect and the particle energy losses. These images are strikingly similar to the well-known images of the Crab and other pulsar wind nebulae obtained by Chandra and HST. They exhibit both a system of rings, which makes an impression of an equatorial disc-like or even a toroidal structure, and well collimated polar jets, which appear to originate from the pulsar. A number of fine details of the inner Crab nebula find natural explanation including the bright knot discovered by Hester et al.(1995) very close to the Crab pulsar.

Key words: pulsars: general – supernova remnants – ISM: individual: the Crab Nebula – ISM: jets and outflows – MHD – shock waves.

ON HYDRODYNAMIC SHEAR TURBULENCE IN SPECTRALLY STABLE KEPLERIAN DISKS

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We report on the hydrodynamic shear turbulence in non-magnetized Keplerian disks. Several papers have appeared recently on the subject, on possible linear instabilities which may be due to the presence of a stable stratification, or caused by deviations from cylindrical rotation. Here we wish to draw attention to another route to hydrodynamic turbulence, which seems to be little known by the astrophysical community, but which was worked out during the last decade by the hydrodynamic community for spectrally stable flows. In this so-called bypass concept for the onset of turbulence in shearing flows, vortical perturbations undergo transient growth by extracting energy from the shear (a linear process), thereby reaching an amplitude which is sufficient to allow for non-linear interactions which, by positive feedback, sustain turbulence. This transient growth (that is linear in nature) differs in principle from the well-known nonlinear instability. We describe the type of perturbations that according to this process are the most likely to lead to turbulence, namely non-axisymmetric vortex mode perturbations in the two dimensional limit. We show that the apparently inhibiting action of the Coriolis force on the dynamics of such vortical perturbations is substantially diminished due to the pressure perturbations, contrary to common opinion. We stress the similarity of the turbulent processes in Keplerian disks and in Cartesian flows and conclude that the prevalent skepticism of the astrophysical community about the occurrence of hydrodynamic shear turbulence in such disks is not founded. This report is based on papers: Chagelishvili et al. *A&A*, **402**, 401; Tevzadze et al. *A&A*, **407**, 779.

RADIO EMISSION OF ANOMALOUS X-RAY PULSARS

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The detection and the investigations of Anomalous X-ray Pulsar (AXP) 1E2259+586 and AXP candidate 1RXS J1308.6+212708 at the frequencies 111, 87, and 61 MHz are presented. The observations were carried out with two sensitive radiotelescopes of PRAO ASC FIAN (Russia). The main parameters are reported: the mean profiles, the flux densities, the estimations of the spectral index and the integral luminosity. In additional to the dispersion measure and the estimation of the distance to the both objects are presented. The comparison of our data with the X-ray data are carried out and the possible AXP models are discussed.

ON THE NATURE OF "MAGNETARS"

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The most popular model of Anomalous X-Ray Pulsars (AXPs) and Soft Gamma Repeaters (SGRs) is the magnetar one. It proposes the existence of very strong magnetic fields ($\sim 10^{14}$ – 10^{15} G) inside and at the surface of some neutron stars. Such fields give the necessary energy source to explain observable X-Ray luminosities and powers of gamma-ray bursts. However there are some difficulties of this model. Malov et al. (2003) put forward the new model of AXP and SGR on the base of the suggestion of usual magnetic fields ($\sim 10^{12}$ G) at the neutron star surface. If such a star have a short rotation period ($P \sim 0.1$sec) and small angle ($\beta \leq 10^0$) between rotation and magnetic axes then the drift waves in outer layers of its magnetosphere can explain observed pulse periods and their derivatives. Moreover in this model the losses of rotation energy $dE/dt \sim 10^{37}$ erg/sec provide the observed X-Ray luminosities and up to 10^4 gamma-ray bursts during 10^5 years.

Here some additional arguments for the new model are presented.

The modulation of observed emission with the rotation period ($P \sim 0.1$ sec) can be detected by future measurements. On the base of the new model the expected periods of such modulation are estimated for all known AXPs and SGRs. Some new correlations between parameters of these objects are predicted.

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Key words: neutron stars: pulsars: magnetars.

NEUTRINO EFFECTS IN A SUPERNOVA MANTLE WITH STRONG MAGNETIC FIELD

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The problem of a successful SN explosion with collapse of a central part is still far from its solution. It is obvious that such factors as a rotation of collapsar, an effect of strong magnetic fields and a heating of a stalled shock wave by neutrino flux should be taken into account. In particular, at present time the convectional and rotational magnetohydrodynamic instabilities in the SN mantle are the subjects of intensive investigations. Such instabilities could result in a generation of the strong small-scale magnetic fields in which novel processes become kinematically opened. In particular, such a process as $\nu_i \to \nu_i e^+ e^-$ $(i = e, \mu, \tau)$ can play an important role in a heating of the stalled shock wave in the framework of the neutrino-driven mechanism and be competitive with the direct URCA process when the field strength is $\sim 10^{15}$ G.

In the framework of the magnetorotational model of a SN explosion the effects of the parity violation in neutrino–nucleon processes are discussed. It is shown, that neutrinos transfer to medium a sufficiently large net momentum along the direction of the magnetic field. Thus, a part of the mantle with the strong toroidal magnetic field spins-up in one hemisphere and spins-down in the other one of the SN remnant. We discuss the connection of this phenomenon with the possibility of a one-side SN explosion and anomalously large kick velosities of the SN remnant.

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RADIO AND X-RAY EMISSION FROM AN ACCRETION DISK

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Radio and X-ray emission from compact sources with accretion disks (active galactic nuclei, pulsars and X-ray binaries) is considered. It is shown that both radio and X-ray emission from these sources can be interpreted as emission of a hot plasma in the inner part of an accretion disk or in the disk corona. Radio emission is produced by the maser amplification of thermal radio emission in a hot plasma and corresponds to the transitions between highly located energy levels (somewhat similarly to the recombination lines). The X-ray emission is either thermal radiation from dense filaments or is produced by the coherent inverse Compton scattering of radio photons in the same dense filaments. The same mechanism, which gives rise to the maser amplification at radio wavelengths, produces also laser amplification in optical in X-ray binaries.

In the unified model of compact radio sources, radio emission from active galactic nuclei and pulsars is treated as thermal radiation from an accretion disk amplified by a maser mechanism (Prigara 2003). A maser amplification of thermal radio emission in continuum produces the high brightness temperatures of compact radio sources and a rapid variability of total and polarized flux density, that is characteristic for non-saturated maser sources.

The unified model of compact sources can be extended to account for emission in other bands. X-ray binaries have roughly two-component X-ray spectra with a thermal blackbody component and a power law spectrum (see, e.g., Falcke, Koerding & Markoff 2003). The power law spectrum in the X-ray range has been also detected in some radio pulsars, X-ray pulsars and AGNs (Chakrabarty et al. 2001). The unified model predicts photon indices of the power law spectrum in the X-ray range which may be compared with the observed indices.

The inversion of the level population can produce also laser amplification in optical (e.g., the high variable shifts and intensities of the weak emission lines in Sco X-1 can be attributed to the weak laser sources) and X-ray bands. An on-off cycle in radio and X-ray pulsars may be explained by the periodic changes of the emitting gas temperature from higher to lower than the inversion temperature values.

The photon indices of the power law spectra in the X-ray range are obtained similar to the spectral indices of radio emission in the unified model of compact radio sources. The only difference is the higher density of an emitting gas. However, the detected correlation between radio and X-ray emission in X-ray sources suggests that another mechanism (the coherent inverse Compton scattering of radio photons) also contributes to the observed spectra.

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GENERATION OF GAMMA RAYS IN NEUTRON STARS

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We are presenting the mechanism of gamma ray generation induced by dibaryon decay in neutron star. Neutron stars exhibit conditions for generating sixquark states, dibaryons. In a neutron star dibaryons can be generated at three-nucleon interaction. Dibaryons can form dibaryon condensate because they are bosons. The dibaryon decay creates gamma rays of the energy about 70 MeV. Gamma rays can cause decay of the dibaryon condensate and generate gamma ray bursts. The possibility of the existence of gamma ray bursts caused by decaying of the dibaryons is indicated extragalactic gamma ray spectrum.

OSCILLATING NEUTRON STAR AS A PULSAR

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Pulsar "standard model" of a rotating magnetized conducting sphere surrounded by plasma is generalized in its essential parts for the case of oscillating star. Goldreich-Julian charge density, electromagnetic energy losses as well as polar cap scenario of particle accelerations are considered. Despite similarities, there are substantial differences between magnetospheres of rotating and oscillating stars. As an application influence of neutron star oscillations (excited by a strong glitch, for example) on pulsar emmision mechanism is discussed.

Key words: stars:neutron – stars:oscillations – pulsars:general.

SPHERICAL ACCRETION TO A MAGNETIZED STAR IN THE "PROPELLER" REGIME

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This work investigates spherical accretion to a rotating magnetized star in the "propeller" regime using axisymmetric resistive magnetohydrodynamic simulations. In this regime accreting matter tends to be expelled from the equatorial region of the magnetosphere where the centrifugal force on matter rotating with the star exceeds the gravitational force. The regime is predicted to occur if the magnetospheric radius is larger than the corotation radius and smaller than the light cylinder radius. The simulations show that accreting matter is expelled from the equatorial region of the magnetosphere and that it moves away from the star in a supersonic, disk-shaped outflow. At larger radial distances the outflow slows down and becomes subsonic. The equatorial matter outflow is initially driven by the centrifugal force, but at larger distances the pressure gradient force becomes significant. We find that the star is spun-down mainly by the magnetic torques at its surface with the rate of loss of angular momentum $\dot{L}$ proportional to $-\Omega_*^{1.3}\mu^{0.8}$, where Ω_* is the star's rotation rate and μ is its magnetic moment. The fraction of the Bondi accretion rate which accretes to the surface of the star is found to be $\propto \Omega_*^{-1.0}\mu^{-2.1}\eta_m^{0.7}$. Predictions of this work are important for the observability of isolated old neutron stars and for wind fed pulsars in X-ray binaries.

RADIO OBSERVATIONS OF THE X-RAY BINARIES

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We discussed the recent results of radio monitoring and mapping of microquasars – X-rays binaries with relativistic jets. The sample of the microquasars, defined amongst near 300 cataloged X-rays binaries in the Milky Way, consists of 15-20 radio emitted X-ray binaries, well-known, SS 433, GRS 1915+105, Cyg X-3, GRO 1655hB0, and new ones G339hBgmic.tex0, XTE 1118+480, XTE J1550hB64. The prominent radio emission from a star is a trace of the high brightness temperature or of large angular size of the region. The former case is from synchrotron mechanism of the emission and last case realized in the different kind shells around a star. The persistent (Cyg X-1) transient (GRO 1655hB0, XTEJ1819-254) and typically high-variable microquasars satisfy both the cases.

During last five years we carried out intense sets of monitoring of the radio variability of microquasars SS433, Cyg X-3, GRS 1915+105 with RATAN-600 radio telescope in 1-22 GHz range. The dozen powerful radio flares were detected from them. We discussed the spectral

and temporal properties of the variability and their relation with formation and evolution of the jets. We discussed the different variations of the finite segments models for description of the synchrotron radio emission of microquasars jets.

We present the recent VLBA data about SS433, Cyg X-3, GRS 1915+105 jets. The first periodically flaring source LSI+61°03 was monitoring during four orbital periods (26.5 d), and in first time we followed the radio activity at four frequencies 2, 4, 8 and 11 GHz.

In the first time we detected of 6-day modulation in quite radio emission of SS433, based on two $\sim$ 120 daily monitoring sets in 1997 and 1999) of the microquasar SS433. It shows variations with the period .05 $\pm$ 0.1 days at six frequencies from 1 to 22 GHz during quiet state of the radio emission. That 10–15%-modulation on the light curves differs significantly from well-known 6.28-day periodicity in spectral moving emissions and in photometric optical data, related with nodding motions of jets and changes in the accretion disk. Such modulation for SS433 can be caused by the boosting during the nodding and precessing motions of the jets because the effect is visible at all frequencies and the six-day harmonic has the same radio spectrum as the quiet radio flux of SS433: $\nu \sim \nu^{-0.6}$.

Generally the microquasars generate their radio-emitted electrons/positrons in jets during the processes in host binaries, where the rate and relations of accretion, internal size of accretion disk, density, magnetic fields can be dramatically changed in time. Probably the microquasars mimic the properties of the AGN and quasars, and possibly GRB.

The 'on-line' radio spectra of the SS433 are accessible on web-site: http://cats.sao.ru/cgi-bin/ss433-cgi. Many figures and animations of the microquasars radio studies with RATAN-600 could be found on site: http://cats.sao.ru/~/XB/.

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Key words: stars:individual:Cyg X-3, SS433, LSI+61°03, GRS1915+105, X-rays: binaries - radio continuum:microqasars, black holes.

RESULTS OF THE SEARCH OF NEW ACTIVE STARS IN THE GALAXY (IN X-RAY, RADIO & OPTICS)

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We report results of systematic search for new active stars in the Galaxy, particularly (and especially) microquasars. Due to this survey, a complete sample of bright ROSAT sources with hard XRB-like spectra in the wide belt of Galactic Plane ($|b| < 20^0$) has been tentatively identified with radio sources in the GB6/PMN/NVSS radio surveys, and subsequently observed with the Australia Telescope Compact Array and Very Large Array. Most of them are unresolved at the sub-arcsec scale and have flat or inverted spectra.
Precise radio coordinates have made unambiguous optical identifications possible, which, after the removal of galaxies, yielded a final list of 60 microquasar candidates. For 50 of them we got a moderate dispersion spectroscopy by the AAT (4-m), BTA (6-m) and VLT (8-m). Our main result is a list of 10 very active stars, possible microquasars.

One of them, MCQC J1628-41, is a prominent radio transient and a bright (R = 12.4) K5III object showing a strong and fast variable H-alpha emission and, also, periodic optical variability resembling a tidal like binary behaviour.
Our by-product is a sample of 26 featureless spectra objects, possible BL Lac type. Most intriquing, six of them have an evidence of significant proper motion, which, if confirmed, would manifest a discovery of a new type of peculiar galactic objects.
We also recorded 12 new Sy1/QSO/RG type objects in the Zone of Avoidance.
We encourage further detailed spectroscopic, photometric and VLBI observations of 10 microquasar candidates revealed in our survey.

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Key words: Active stars, X-ray Binaries, Microquasars.

PROJECT ASTRAL: ALL-SKY SPACE TELESCOPE TO RECORD AFTERGLOW LOCATIONS

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ASTRAL is a project incorporating wide-field optical telescopes on board a small satellite (FedSat or SMEX type) dedicated to the whole-sky detection of a variety of rapid astronomical phenomena, particularly optical flashes associated with gamma ray bursts (GRB). Those flashes only visible optically (so called *orphans*), as well as those which could precede associated GRBs, cannot be detected in the current triggering mode of the world wide GRB Coordinates Network (GCN). Hence ASTRAL would have a unique opportunity to trigger a follow-up multi-frequency study via GCN. ASTRAL consists of a set of 13 wide-field cameras, each with FOV = 70^o, equipped with 4096 × 4096 CCDs. The detection method is based on comparison of sky images with the reference image. Supernovae, novae and nova-like explosions, fast variable AGNs, flare stars, and even new comets would be promptly detected as well. See http://www.atnf.csiro.au/people/Gregory.Tsarevsky for details.

Acknowledgements. We are grateful to many colleagues for help, advice and encouragement, particularly to B. Paczynski, H. Pedersen and G. Popov

Key words: Gamma-Ray: Bursts. Space vehicles: instruments.

EVOLUTIONARY CONSTRAINTS ON THE MASSES OF THE COMPONENTS OF HDE 226868/CYG X-1 BINARY SYSTEM

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Calculations carried out to model the evolution of HDE 226868, under different assumptions about the stellar wind mass loss rate, provide robust limits on the present mass of the star. It has to be in the range 35 to 55 solar masses if the distance to the system is in the range 1.8 to 2.35 kpc. Including into the analysis observational properties such as the profiles of the emission lines, rotational broadening of the absorption lines and the ellipsoidal light variations, one can further narrow the range of the permitted masses to about 40 to 55 solar masses. The same analysis (using the evolutionary models and the observational properties listed above) limits the mass of the compact component to the range of about 16 to 32 solar masses and yields lower limit to the distance to the system of about 2.0 kpc. This limit to the distance does not depend on any photometric or astrometric considerations.

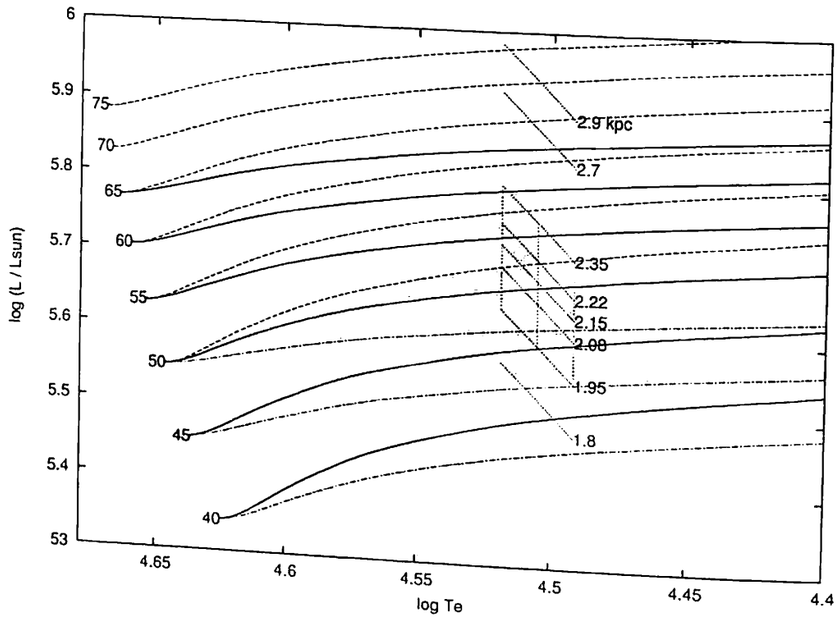

Figure 1: The evolutionary tracks in the H-R diagram. The tracks are labeled with the initial mass of the star (in solar units). The solid lines describe the tracks computed with the stellar wind mass loss rates according to HPT (Hurley et al., 2000) formula. The broken lines and the dash-dotted lines describe the tracks computed with the mass loss rates smaller by a factor of two and larger by a factor of two, respectively. The slanted dotted lines correspond to the position of HDE 226868 for different assumed values of its distance (the assumed value of the distance in kpc is given at the right end of each line). The vertical dotted lines correspond to the effective temperatures of HDE 226868 equal (from left to right) to 33, 32 and 31 $\times 10^3$K. The most likely position of HDE 226868 lies within the large parallelogram ($\pm 3\sigma$ error in distance).

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NUCLEOSYNTHESIS IN STARS, STARBURSTS AND INTERSTELLAR MEDIUM

ASTROPHYSICAL PHENOMENA IN LABORATORY, IMPLOSIVE NUCLEOSYNTHESIS IN COLLAPSING TARGETS

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The paper presents the results of the experiments on laboratory electron-nuclei collapse. The model of the artificially initiated collapse process is also proposed. Launching conditions for the collapse are ensured by stimulation of self-organizing processes in the substance at the level of dynamic effects in non-stationary degenerate states of the electron-nucleus system. Technological factors are crucial only at the controlled initial phase of the process stimulation. The subsequent target evolution towards the collapse and implosive nucleosynthesis is going on according to the natural automodel system laws.

Electrodynamics Laboratory Proton-21 was established in Ukraine in 1999 to realize the original idea of ignition the self-organizing collapse of electron-nucleus plasma starting from initial parameters of a solid body up to the state of relativistic degenerate gas when the Coulomb barrier becomes negligible and implosive isotope transmutation takes place. This process is somehow similar to the nuclear processes that occur in the gravitational collapse of stars. Launching conditions for the self-organizing collapse in the experimental setup are provided with the energy-concentrating set-up based on relativistic vacuum diode that creates a special coherent impact of the directed electron beam on a solid target. More than 6000 successful experiments on the ignited implosive nucleosynthesis were performed in the period of 1999–2004 using different targets made of light, medium, and heavy chemical elements.

Experimental results were analyzed using many independent methods (including about 10 types of mass-spectrometers, Rutherford backscattering, X-ray and Auger spectrometry, as well as fast microwave, optical, and X-ray measurements). Measurements were performed not only at Proton-21 but also at the institutes of National Academy of Sciences of Ukraine, Shevchenko Kiev National University, leading institutes of MinAtom of Russia, also at some specialized laboratories in the USA and Germany. The synthesis of almost all known isotopes in the range of $1 \le A \le 240$ was confirmed in all experiments (including those with monoelement targets e.g. made from chemically pure Al, Cu, Ti, Pb). Quantities of synthesized isotopes are many orders of magnitude higher than those of impurities in the initial target material. Distribution of the synthesized elements obtained in the process of the controlled collapse of a monoelement target varies greatly and at certain conditions is closed to the natural element distribution in space! Implosive nucleosynthesis duration in the collapsing system is less than 10 ns. One of the characteristic features of the synthesized isotopes is the almost complete absence of the radioactivity. Very large quantities (about $10^{10} \dots 10^{12}$ nuclei of each isotope) of stable superheavy isotopes with $250 \le A \le 1000$ are detected in the products of implosive nucleosynthesis. It has been shown by a theoretical analysis that at the last stage of the controlled collapse the density of degenerate electron gas $n_e > 10^{34} \dots 10^{36}$ cm^{-3} is reached. A state of the collapse at an intermediate stage corresponds to a white dwarf, and at the final stage – to a neutron star. This paper also describes the possible mechanism of the self-controlled collapse and prerequisites of implosive nucleosynthesis.

MECHANISM OF NUCLEOSYNTHESIS OF SUPERHEAVY AND BY-PASSED NUCLEI UPON THE SEQUENTIAL TANDEM OF GRAVITATIONAL AND COULOMB COLLAPSES OF MASSIVE STARS

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The paper considers the process of fast nucleosynthesis (including the process of creation of superheavy, transuranium and by-passed nuclei) in a volume of neutralized degenerate electron gas in shells of gravitating stars during the process of gravitational collapse and young neutron star formation. It was shown for the first time that for a neutral atom compressed by external forces, a threshold (crucial) electron density $n_{e(cr)} \approx 10^{36} Z^{-2}\,\mathrm{cm}^{-3}$ is shown to exist. At such density the attraction of electrons and nuclei exceeds the kinetic pressure of degenerate electron Fermi gas. The minimum of crucial density corresponds to the nuclei with maximal charge Z. This effect leads to the fall of electrons to the nucleus and Coulomb collapse of the electron-nucleus system with the release of large amount of binding energy.

Launching conditions of Coulomb collapse can be ensured in the process of electron gas and nuclei compression of a massive star shell during a synchronous gravitational collapse. The main mechanism and regularities of the sequential tandem of gravitational and Coulomb collapses of the degenerate electron-nucleus plasma are based on two independent but mutually consistent phenomena (two stages):

1 stage. The evolution of any star with $M > 1.45 M_\odot$ is terminated, as a rule, by the gravitational collapse of the central iron region of a star. During the collapse, the concentration of the degenerate relativistic electron gas in this plasma reaches a value (with respect for the process of neutronization) $n_{e(max)} \approx 10^{35} \dots 10^{36}$ cm^{-3}.

2 stage. Conditions for a Coulomb collapse of individual parts of the electron-nucleus plasma are satisfied on the final stage of a gravitational collapse.

The evolution of the electron-nucleus Coulomb collapse is distinguished by a sharp shift of the region of energy-gaining synthesis to heavy and superheavy nuclei which is accompanied by synthesis of light and by-passed nuclei. The synthesis of such nuclei may take place in massive stars during the formation of neutron stars and black holes and also, in a smaller scale, in less massive stars during the formation of white dwarfs. This effect leads to release of large amount of binding energy of electron-nuclear system (about $\Delta W_e \approx 100$ MeV/electron). It is well known that neither a shock wave nor the neutrino flux from the center of the gravitational collapse can ensure the transfer of such a great energy $E_s \approx 10^{51}$ from the central part of the gravitational collapse to the inner surface of the shell. But if we consider the possibility to realize the sequential tandem of gravitational and Coulomb collapses, the question about the source of this energy can be solved in a rather cardinal way: the energy E_s is not being transferred from the center of the gravitational collapse in various ways but is a result of numerous acts of the Coulomb collapse in the volume adjacent to the inner surface of the shell. For such aim only 1% of $M_\odot$ takes participation in the reactions of the Coulomb collapse in this aria.

Thus, the mechanism involving the sequential tandem of gravitational and Coulomb collapses of a part of the shell of a massive star allows one to answer many unsolved problems of astrophysics and nucleosynthesis.

THE GALACTIC ABUNDANCE GRADIENT FROM CEPHEIDS

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This paper reports on radial metallicity distribution in the disk of our Galaxy. We show that this distribution experiences an obvious spatial change. In particular, the wriggle in the iron abundance distribution is found to fall at approximately galactocentric distances 10-11 kpc (assuming galactocentric distance of the Sun RG = 7.9 kpc). Within the transition zone from 10 to 11 kpc the relative-to-solar iron abundance decreases approximately to -0.2 dex.

Using a quite simple consideration of galactic chemical evolution we show that the observed distribution can be explained in the framework of a model which includes the spiral arms. In particular, the wriggle feature associated with RG 11 kpc can be interpreted as a change of metallicity level in the vicinity of the galactic corotation resonance.

THREE DIMENSION SPECTROSCOPY OF A STARBURST REGION IN THE SPIRAL GALAXY NGC6946

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3D spectroscopy of the "Hodge Object", a massive and ongoing star formation region in the starburst galaxy NGC6946, has been performed. The data were taken at "Roque de los Muchachos" observatory with INTEGRAL IFU + WYFFOS spectrograph attached to the 4.2 m telescope. Three different fields, 30 arsecond of diameter, were observed. This region is dominated by a massive and young star cluster (10^6 solar masses younger than 10 My) surrounded by half an arc of young MS stars (around 4 My old) and with a crown of Halpha emission forming an outer ring. At least, seven other young clusters have been detected in a radius of around 300 pc centered in the massive cluster, being their ages of a few tens My. The star formation history of this object has been previously studied, but the spatial distribution of the actual star formation rate shows a complicated pattern difficult to match with a simple scenario for its generation. The large number of massive and young clusters present in this region makes of this complex a natural lab for the study of the physical conditions driving two different modes of star formation: isolated stars or clusters. In this contribution we analyze the 2D velocity field and the diagnostic diagrams of the ionized gas in order to go inside the physical state of the gas. Finally, we discuss the results in terms of its possible origin.

GAMMA-RAY BURST INTERACTION WITH DENSE INTERSTELLAR MEDIUM

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Interaction of cosmological gamma ray burst radiation with the dense interstellar medium of host galaxy is researched. Gas dynamical motion of interstellar medium driven by gamma ray burst is investigated in 2D approximation for different initial density distributions of host galaxy matter and different total energy of gamma ray burst. The maximum velocity of motion of interstellar medium is $1.8 \cdot 10^4$ km/s. Light curves of gamma ray burst afterglow are calculated for set of non homogeneous density, gamma ray burst total energy, and different viewing angles. Spectra of gamma ray burst afterglow are modeled taking into account conversion of hard photons (soft X-ray, hard UV) to soft UV and optics photons.

CHEMICAL AND DYNAMICAL EVOLUTION IN THE SOLAR NEIGHBOURHOOD

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Nearly 700 Tycho-2 stars have been observed in the solar neighbourhood at distances smaller than 100 pc or in a 720 square degree field in the direction of the North Galactic Pole with the high resolution echelle spectrograph ELODIE. Absolute magnitudes, effective temperatures, gravities and metallicities have been estimated, as well as distances and 3D velocities.

Abundances of Fe, Si and Ni have been determined from equivalent widths under LTE approximation, whereas abundances of Mg have been determined under NLTE approximation using equivalent widths of 4 lines and profiles of 5 lines. Most of these stars are clump giants and span typical distances from 0 pc to 800 pc to the galactic mid-plane. This new sample, free of any kinematical and metallicity bias, is used to investigate the vertical distribution of disk stars.

The old thin disk and thick disk populations are deconvolved from the velocity-metallicity distribution of the sample and their parameters are determined. The thick disk is found to have a moderate rotational lag with respect to the Sun with a mean metallicity of $[Fe/H] = -0.48 \pm 0.05$ and a high local normalization of $15 \pm 7\%$.

We also determine both the gravitational force law perpendicular to the Galactic plane and the total surface mass density and thickness of the Galactic disk. The surface mass density of the Galactic disk within 800 pc derived from this analysis is Sigma ($|z|$ <800 pc) = 76 Msun pc^{-2}.

The thickness of the total disk mass distribution is dynamically measured for the first time and is found to be 390 pc in relative agreement with the old stellar disk scaleheight. All the dynamical evidences concerning the structure of the disk (its local volume density – i.e. the Oort limit-, its surface density and its thickness) are compatible with our current knowledge of the corresponding stellar disk properties. This result implies that the dark matter component of our Galaxy cannot be distributed in a flat or disk-like component but must be distributed in a round halo.

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Key words: stars: kinematics, abundances, Galaxy: kinematics and dynamics, Galaxy: solar neighbourhood.

A SIMPLE SCENARIO OF AGN EVOLUTION

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We propose a simple scenario of AGN evolution, which includes 4 stages.

The standard model of AGN central engine assumes there is in its center a super massive BH surrounded by an accretion disk. The disk, in its turn, is wrapped in an inhomogeneous atmosphere and surrounded by could gas-dust torus. Jets following the orientation of the axis of rotation may form.

However, the matter does not initially exist in the form of super-massive black holes. Also the problem of the first generation of objects in the Universe is not still solved, at least in the nearest AGN, for instance, in M87, and, probably, many others, a compact stellar core does exist.

So the first stage of AGN evolution most probably is a process of transformation of the stellar core into a super-massive BH. It must have been going differently in different objects, depending of the mass, rotation, angular momentum, etc. of the central core. Dokuchaev (2002) has shown that dense massive cores go over several millions of years through the stage of accumulation of a large number of stellar-mass black holes, encircled by a common envelope. Inside the envelope stellar mass BH are merging. This object may emit high energy (up to 1022 eV) cosmic rays. Several such sources located inside 100 Mpc may be responsible for the most energetic cosmic rays.

Naturally, once the first stage is over, and the envelope disappears we must be left with super massive black holes of moderate (104-107 M sun) mass. The upper parts of the stellar core, however, must remain and produce a strong enough accretion flow. As BH mass is comparatively low, the value of the accretion rate must be found somewhere near the Eddington limit. This 2nd stage probably corresponds to the so-called NLS1 (improper, but widely used abbreviation for Narrow Line Seyfert 1 galaxies). This stage is probably best described by Vilkoviskij & Czerny (2002).

Once the BH mass reaches the value of 107 - 108 Msun 3rd (main) stage is incoming. To the stage the stellar core becomes considerably attenuated, the number of stars getting too close to the BH considerably decreases and the accretion rate becomes unsteady. Sometimes, when the accretion decreases too much, the system goes through its periods of deep minimum (months, years, tens of years or more). If the minimum period is of one or several years new shares of gas may form a new disk with an orientation and physical parameters differing from those of the former disk (Lyuty et al, 2001). We then say we observe the transition $Sy1 > Sy2 > Sy1$.

When the BH mass reaches and then exceeds several billion M sun the 4th (final) stage begins. At this stage the gravitational radius is so enlarged that the stars penetrate into the BH without disruption. There is no disk therefore, nor any visible evidence of activity except during galactic

merger that might return AGN at the 2nd and 3rd stage. In this case binary super-massive BH may be formed inside AGN.

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CYG X-1 (V1357 CYG) AND ITS INTERSTELLAR ENVIROMENT

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The first candidate to black hole Cyg X-1 locates in the sky area with the very complicated structure of interstellar matter (ISM) and has significant interstellar absorption. We re-analyze available data on ISM absorption localization toward this object. As a result we renew the Cyg X-1 distance limits. 3D velocity vector and ISM space distribution reconstruction permit us to limit black hole age and birth place of this binary system.

LINE-DRIVEN WINDS NEAR BLACK HOLES

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A general physical mechanism of the formation of line-driven winds at the vicinity of strong gravitational field sources is proposed and investigated. We argue that gravitational redshifting should be taken into account to model such outflows. The radiation force that is due to absorption of the radiation flux in lines is derived. We derive the generalization of the Sobolev approximation in the frame of General Relativity and in a flat space-time of the newtonian gravity. In the latter case the radiation force becomes a function of the local velocity gradient (as in the standard line-driven wind theory) and the gradient of the gravitational potential. A solution of the equation of motion is obtained and confronted with that obtained from the Castor, Abbott & Klein (CAK) theory. Possible applications to AGN, X-ray binaries and "microquasars are discussed. It is shown that the proposed mechanism may have an important contribution to the formation of such outflows.

BLUE STRAGGLERS AS A MERGING PRODUCT OF THE LOW MASSIVE MAIN-SEQUENCE DETACHED BINARIES

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The search problem of the evolutionary relationship between the different classes of close binaries is reckoned one of the actual subjects of the population synthesis theory. The global objective of this theory is to estimate and clarify the current and changing in time mutual correlations of the numbers of the objects having different evolutionary status in order to ascertain their unique nature.

So the study of the merging process in low massive detached main-sequence (*DMS*) close binariess in the timescale of the orbital angular momentum loss due to magnetic stellar wind allows to reconstruct the following evolutionary chain: *DMS*→*short-periodic RS CVn* → *W UMa*→*BS*.

Here the single objects known as *"Blue Stragglers"* (*BS*) appear in the role of final product the formation stages of short- periodic *RS CVn*-type yet detached systems with $P \leq 1.^d2$ and *W UMa*- type contact binaries with $P \leq 0.^d5$ and Sp_1 later than F0 precede which.

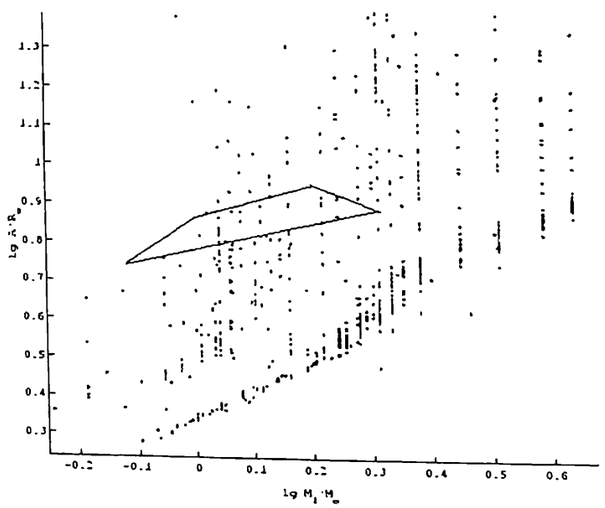

Figure 1: Distribution of close binaries from catalogue (Svechnikov&Kuznetsova, 1990) in the *"primary mass - major semi-axes"* diagram.

One way of population synthesis theory is the restore on the basis of observation data the so-called *"true"* (i.e. revised for effects of observation selection) modern and primordial distributions of close binary systems in their physical parameters. This question was solved with the use of extensive observation material (Svechnikov&Kuznetsova, 1990). In the framework of magnetic breaking formalism (Iben&Tutukov, 1984) the trapezium-like domain (Fig.1) in the *"primary mass - major semi-axes"* diagram populated with young detached binaries with $A \leq 10R_\odot$ and $M_1 \leq 1.5 - 2M_\odot$ and $M_2 \leq 1.5M_\odot$ was found as a habitat of the potential *"parents"* of *BS*.

The relations of statistics and lifetimes obtained for systems participating in evolutionary chain serve as an evidence for genetic relationship of given objects.

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Key words: close binary systems, blue stragglers, magnetic braking.

FLUX DENSITY ABSOLUTE MEASUREMENTS OF SUPER NOVAE REMNANTS USING TWO-TEMPERATURE BLACKBODY CALIBRATION STANDARD

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Radio emission flux density absolute measurements of cosmic sources are of principle importance since they permit to measure energetic and associated parameters of astronomical objects. The method of "blackbody" disks has been designed and thoroughly developed at the Nizhny Novgorod (Gorky) Radiophysical Research Institute to carry out flux density absolute measurements of cosmic radio sources. The substance of the method is in radio telescope calibration by noise radio emission of an artificial radiation standard which is a metallic disk covered by a radio-absorbing material; the standard has the radio emission brightness temperature equal to that of the environment.

One of the ways to develop the antenna calibration method of "blackbody" disks is the application of two identical standards with different temperatures. The increase of accuracy is achieved due to the elimination of calculations of the atmosphere temperature behind the disk and diffraction effects that permits to widen the application range of the method.

The calibration of radio sources by the "blackbody" disk method had been carried out at NIRFI since 1960-s and were cut off in the end of 1980-s. In 2002–2003 the facility to carry out flux density absolute measurements of cosmic sources in the frequency bands of 3 and 10 GHz (in which the first measurements of Cassiopeia A, Taurus A and Cygnus A radio emission flux densities were made in autumn 1952 (Plechkov and Razin, 1956)) was reconstructed and upgraded at the Radioastronomical Observatory "Staraya Pustyn'" (120 km from Nizhny Novgorod). The facility consists of a 7-m fully-steerable parabolic antenna and a two-temperature calibration standard mounted on a 25-m tower 100 m apart from the radio telescope. The maximum heating temperature of one of the disks is about 55° C. Receivers at 2829 MHz (wavelength 10.6 cm) and 8834 MHz (wavelength 3.4 cm) have the sensitivity threshold 0.1 K at the time constant 1 s. The data processing is made by PC Omnibook XE3100.

The first series of observations were made in summer and autumn 2003.

The following values of SNR radio emission flux densities were obtained at $\lambda = 10.6$ cm: Cassiopeia A – 1059.0 ± 9.3 Jy, Taurus A – 698.1 ± 17.2 Jy. The flux density of the stable source Cygnus A was 666.6±12.5 Jy. Flux density ratios of Cassiopeia A / Cygnus A and Taurus A / Cygnus A are equal, respectively, to 1.59 and 1.047 with errors 2.1% and 3.1%.

Measurements at the wavelength 3.4 cm gave the following values of SNR radio emission flux densities: Cassiopeia A – 416.4 ± 8.6 Jy, Taurus A – 471.2 ± 8.4 Jy. The flux density of the stable source Cygnus A was 163.0 ± 5.1 Jy. Flux density ratios of Cassiopeia A / Cygnus A and Taurus A / Cygnus A are equal, respectively, to 2.55 and 2.89 with errors of about 3%.

According to our observations the spectral indices of three sources in frequency range (3-10) GHz ($S_\nu \sim \nu^{-\alpha}$) are: $\alpha_{\mathrm{Cyg\,A}} = 1.24 \pm 0.03$, $\alpha_{\mathrm{Cas\,A}} = 0.82 \pm 0.02$ and $\alpha_{\mathrm{Tau\,A}} = 0.34 \pm 0.01$.

The work has been done under financial support of grant of the Leading Science School No. NSh-1483.2003.2.

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STELLAR COMPLEXES AND STARBURST CLUMPS

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Complexes of stars and clusters with size up to 1 kpc are the key entities for studies of the large scale star formation. They include most of OB-associations and star clusters younger than 100-200 Myr. The complexes within the irregular galaxies may represent just the largest and oldest regions of the star formation in the hierarchy of star groupings determined by the fractal properties of the parent turbulent gaseous network.These complexes and embedded groupings have to obey the size-age relation: the smaller and younger groupings arise within the larger and older one. The reality of this relation is still the controversial issue, however.

Stellar complexes within the spiral galaxies mostly located along the spiral arms and often (but not always) are at the starting points of the arm spurs. The chains of complexes delineate the long symmetric arms in the grand design spirals. These arms being the spiral density waves, the complexes are considered to be the results of evolution of the gas superclouds formed due to gravitational or gravo-magnetic instability along the arm. We note that the regular spacing of complexes along the arms is observed in two galaxies with the regular magnetic field along the arms: Milky Way and the Andromeda galaxy. In most galaxies only quasi-regular or, more often, random spacing of complexes along the arms is observed. In NGC 6946 where the magnetic arms are outside the optical ones, the divison of the latters into complexes is about impossible. This may point to the Parker instability as the primary mechanism for formation of complexes in the grand design arms in the galaxies with the low rate of star formation.

Sometimes very bright and large blue complexes are observed in the arms. Many of them were noted earlier as the superassociations, or starburst clumps, the best local example being OB78 in M31. They are seemingly not just extreme cases of the general distrubution of the stellar complexes because the age spread in the superassociations is very small. The starburst clumps are common in the interacting galaxies. They often (but not always) include the massive compact young clusters, having to evolve into classical globular clusters. In this relations such starburst clumps are similar to the blue compact dwarf galaxies, the best example being the peculiar complex in NGC 6946. Sometimes complexes of clusters outside the arms have the perfect arc- like shape (in the LMC4 region of the LMC, in M83, NGC 300..), which is expected to be the result of the star formation in the expanding gas shell. However, no sources of the central pressure are visible.

Key words: stellar complexes, starbursts, spiral arms.

CHEMICAL COMPOSITION OF GALACTICAL PLANETARY NEBULAE WITH TAKING INTO ACCOUNT THE INHOMOGENETIES OF GAS DENSITY IN ITS ENVELOPES

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The results of chemical composition investigation in galactical planetary nebulae (PNs) [1] with taking into account versatile inhomogeneties of nebular gas density in PNs envelopes are presented. The new analytical expressions for ICFs are obtained and used for chemical composition determination of nebular gas. The abundances of He, N, O, Ne, S and Ar for 193 objects are determined. The results are located at [2, 3]. The $Y - Z$ diagrams for different He abundances singly for the type II PNs as well as in conjuction with the HII regions in blue compact dwarf galaxies are analyzed. The primordial helium abundances Y_p and the enrichment ratios dY/dZ are derived. We obtained that our more accurate values are $Y_p(I) = 0.245 \pm 0.003$ and $dY/dZ(I) = 3.77 \pm 0.63$, $Y_p(II) = 0.247 \pm 0.004$ and $dY/dZ(II) = 4.09 \pm 0.93$ for two sets (I, II) of new expressions for ICFs. The obtained values of Y_p and dY/dZ are compared with corresponding data of other authors. The radial abundance gradients in the galactic disk are investigated using the type II PNs. The optimization photoionization models of some galactical PNs are calculated using the Cloudy94 Ferland's code [4]. The obtained chemical abundances are compared with corresponding data from [2, 3].

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Key words: planetary nebulae, chemical composition, abundance gradients.

THE FIRST RESULTS OF HIGH-RESOLUTION SPECTROSCOPY OF X-RAY BINARY CYG X-1 FULFILLED ON PEAK TERSKOL OBSERVATORY

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The first row of high-precision spectral observations of Cyg X-1 was carried out with echelle spectrometer of the 2-m telescope of Peak Terskol Observatory (3100 m). This spectra cover the whole or the main part of optical spectral range at the same time. The 14 spectra have spectral resolution of 45000 (August and November 2002, November 2003) and 13000 (June 2003). The 12 spectra were obtained during the "soft" state of Cyg X-1 and only 2 (November 2002 and November 2004) - during its "hard" state. The different types of profile dependencies for some spectral lines from X-ray 2-12 keV flux value were researched by comparing this spectral material with X-ray RXTE/ASM data. This behavior we connect with variations of ionization structure of matter in the system Cyg X-1. The sequence of line profile variation with the orbital phases is clearly observed. The preliminary results are discussed.

INFLUENCE OF DUST ON CHEMICAL PATTERN OF SPIRAL GALAXIES

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In frames of chemical evolution scenario of spiral galaxies it is numerically investigated what consequences may follow from the self-consistent inclusion of dust evolution. Gas in a model galaxy is considered as two-phase system and the gas fraction of a refractive element depends on the processes of dust evolution (dust condensation in stellar ejecta, dust destruction, dust grain growth by accretion onto preexisting grains etc.) Here we present results of our selective dust evolution model which reproduce well the dust depletion pattern of ISM in our Galaxy and can explain the chemical evolution of damped Ly-alpha systems.

SIMULATION OF SUPERNOVA REMNANTS IN A MULTIPHASE INTERSTELLAR MEDIUM

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We present the results of 2D numerical simulation of supernova remnant dynamics in a cloudy interstellar medium. We consider a series of models in which an unperturbed ISM consists of warm intercloud gas ($T \sim 10^4$ K, $n \sim 0.1$ cm^{-3}) and cool dense clouds of HI gas ($T \sim 10^2$ K, $n \sim 10$ cm^{-3}, $R \sim 1 \div 10$ pc) over a wide range of volume filling factors for the dense component ($f \sim 0.02 \div 0.25$).

In numerical simulation of a multiphase ISM we base upon the single-fluid approximation and employ the TVD-hydrocode with a fine resolution computational mesh (2000×1000 or 4000×2000).

The primary shock interacting with clouds produces a great many of secondary shocks that turbulize gas inside the remnant. The increase of suitably defined energetic turbulent α-parameter amounts up to $\sim 7 \div 11$. An effective turbulent dissipation and cooling on dense clouds significantly reduce the radiative cooling time. As a consequence of this the ballistic ("Oort") stage becomes dominating $2 \div 3$ times earlier in a cloudy medium compared to expansion in a uniform medium with the same mean density. The dynamics at this stage does not display similarity as is predicted by the analytical models (McKee & Ostriker, 1977; Cowie et al., 1981; White & Long, 1991). We also observe the effect of "bullets" – high-speed clouds accelerated by the shock at the early stage of SNR expansion which break through the shell and force their way into the ambient medium at the ballistic stage.

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Key words: supernovae; shocks; clouds; gasdynamics; simulations.

OPTIMIZATION PHOTOIONIZATION MODELING WITH GRAIN PRESENCE OF HII REGIONS IN BLUE COMPACT DWARF GALAXIES

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A new determination method of the physical characteristics and chemical composition of HII regions and of the ionizing L_c spectrum of HII regions nucleous are proposed. This method is based on the coupled iteration calculation of the L_c spectrum and optimization photoionization models (OPhM). The L_c spectrum is calculated by independent on Initial Mass Function method. In OPhM 12 free parameters, 22 observed relative line intensities and luminosity in H_β line

are adopted for calculation and minimization of χ^2 function. Also, in optimization modeling is included our procedure for underlying stellar absorbtion correction. The free parameters were initialized by corresponding optimal values previously obtained without grain presence. Taking into account the grain presence, we used this method for the determination of L_c spectrum, physical characteristics and the chemical composition of HII region in blue compact dwarf galaxy with low metallicity SBS 0940+544. Such OPhMs were calculated for ISM grain abundance with different scale factors. The influence of grain presence on OPhM calculation for the case of the low metallicities HII regions in blue compact dwarf galaxies are analyzed on the base of obtained results.

Acknowledgements. We are thankful to Yu.I. Izotov (MAO, Ukraine) for the discussion on results of this work.

Key words: photoionization modeling, grain, optimization method, L_c spectrum, chemical composition, HII regions, blue compact dwarf galaxies.

DUST AND YOUNG OBJECTS IN GLOBULAR CLUSTERS? WHY NOT!

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Some modern observational data inform us about a number of inexplicable phenomena in globular clusters. In that clusters there exist at least: - blue stragglers which appear as more young and more massive stars in contrast with stars near main sequence turn off point; - a number of long period pulsars which appear as young objects too.

In 1997 Rubenstein and Bailyn (ApJ 474, 701) showed that colour-magnitude diagrams in the most central part of the core of NGC 6752 (within 0.25 pc) and around the area (between 0.25 and 0.62 pc) are greatly different. To explain the result we suppose a hypothesis that a dense and compact gas and dust cloud can exist in the most central part of the cluster core. This unexpected supposition can provide an explanation for most if not all of incomprehensible globular cluster phenomena. It is not inconceivable that star formation continue in modern epoch at the centers of any globular lusters.

THE BEHAVIOUR OF α- ELEMENT ABUNDANCES IN THE THIN AND THICK DISKS OF THE GALAXY

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We have carried out the detailed analysis of 350 high-resolution spectra of FGK dwarfs and giants obtained with the ELODIE echelle spectrograph at the Observatoire de Haute-Provence. Abundances of Fe, Si, Ca and Ni have been determined under LTE approximation, whereas abundances of Mg have been determined under NLTE approximation. Spatial velocities with an accuracy better than 1 kms, as well as orbits, have been computed for dwarfs (or all) stars. They have been used to define 2 subsamples kinematically representative of the thin disk and the thick disk in order to highlight their respective properties. A transition occurs at $[Fe/H] = -0.3$. Stars more metal-rich than this value have a flat distribution with Zmax< 1 kpc and $\sigma_W < 20$ kms, and a narrow distribution of α. There exist stars in this metallicity regime which cannot belong to the thin disk because of their excentric orbits, neither to the thick disk because of their low scale height. Several thin disk stars are identified down to $[Fe/H] = -0.80$. Their Mg enrichment is lower than thick disk stars with the same metallicity. Both the dwarfs and the giants show a decrease of [α/Fe] with FeH in the thick disk. That may be interpreted as the signature of the SNIa which have progressively enriched the ISM with iron. However our data suggest that the star formation in the thick disk stopped when the enrichment was $[Fe/H] = -0.30$, $[Mg/Fe] = +0.20$, $[Si/Fe] = +0.17$. A vertical gradient in [α/Fe] may exist in the thick disk but should be confirmed with a larger sample. *Acknowledgements.* Based on observations taken at the Observatoire de Haute Provence (OHP) (France), operated by the French CNRS.

Key words: Stars: fundamental parameters – Stars: abundances – Stars: kinematics – Stars: atmospheres – Galaxy: stellar content.

INTERSTELLAR MATTER AND STARFORMATION (TO THE 110 YEARS OF ACADEMICIAN GRIGORY ABRAMOVICH SHAIN)

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Paper is related to the 110 years of the first director of Crimean Astrophysical Observatory academician Gregory Abramovich Shain. Observational data in favor of genetic connection of young stars, diffuse and dust nebulae were expanded using data of the papers, fulfilled in the framework of Galaxy structure Shain Plan. All results obtained by Shain and under his leadership have left behind for more than 10 years the jump in the understanding of the observational evidences of starformation from interstellar medium which has taken place in the 1970th and was caused by discovering of massive cold molecular clouds.

Key words: interstellar matter, starformation, structure of Galaxy.

INVESTIGATION OF LOCAL GALACTIC MAGNETIC FIELD BY MULTIWAVE POLARIMETRY OF INTERSTELLAR MEDIUM SYNCHROTRON RADIO EMISSION

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Long-term polarimetric studies of Galactic synchrotron emission carried out at the NIRFI have shown a possibility to sound the interstellar medium along the line of sight using the multiwave measurements of polarization parameters in decimetre and metre wavebands. A particularly promising is to get information on the Galactic local magnetic field which is still badly in need so far.

The report discusses the polarimetric data on the synchrotron radio emission of the local interstellar medium along the ridge of the North Polar Spur, the bright part of the Loop III and the North Celestial Pole in the waveband from 50 cm to 2 m. A map of the Faraday rotation measure in the local interstellar medium has been presented which allows to determine a loop structure of the Galactic local magnetic field. Rotation measures were determined with taking into account of the ionosphere Faraday rotation.

The work has been done under the financial support of the RFFI (Project No 03-02-16685) and the Grant of the leading scientific school (No NSh-1483.2003.2).

r-PROCESS OF THE HEAVY NUCLEI CREATION IN THE NEUTRON FLOW FORMED VIA SLOW WAVE OF THE NUCLEAR BURNING AT THE BOUNDARY BETWEEN LIQUID AND SOLID PHASES OF THE PLANETARY CORE

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The only existing at present astrophysical mechanism of creation of the elements heavier than iron is that based on the consequent free neutron capture by the seed nuclei during the Super Novae explosions (Burbidge et al., 1957; Fowler, 1985). According to (Fowler, 1985), the works that were carried out by G.A. Gamow and his collaborators Alpher and German (Alpher & Herman) and devoted to the study of neutron capture and β-decay processes during the Big Bang appeared to be the basis for the subsequent works of the group headed by Fowler. Depending upon specific astrophysical conditions, and first of all the concentration of free neutrons n_n and temperature $T_9 = T/10^9$ K, the neutron capture is realized in two ways (Burbidge et al., 1957; Fowler, 1985): as a rapid capture, or so-called r-process, which takes place when $n_n \sim 10^{20} \div 10^{30}$ cm^{-3} and $T_9 \sim 0,5 \div 5$, and as a slow capture, or s- process, that requires $n_n \sim 10^{14} \div 10^{16}$ cm^{-3} and $T_9 << 1$. Numerical model of these processes has been elaborated (Ljutostansky et al., 1985). In connection with the results of the recent experiments on neutrino oscillations, the problem of geo-antineutrino deficiency has been formulated (Rusov et al., hep-ph/0312296). The actuality of this problem solution is explained by a necessity and importance for the modern neutrino physics to correctly interpret those recent results (Eguchi et al., 2003). As it was shown (Rusov et al., hep-ph/0402039), the hypothesis about an existence of the slow wave of nuclear burning at the boundary between the liquid and solid phases of the Earth's core can eliminate the problem, and

therefore solve the problem concerning the real spectrum of the geo-antineutrino. There exist some additional geophysical phenomena (e.g. the Morgan plumes, geomagnetic field inversions, ^{3}He/^{4}He ratio in the mantle) that can get their explanation within the discussed hypothesis about the slow wave of the nuclear burning (Rusov et al., hep-ph/0402039). Nevertheless, according to (Rusov et al., hep-ph/0402039) the crucial evidence about an existence of the slow wave of nuclear burning is connected with experiment devoted to the measurement of the energy spectrum of geo-antineutrino with the help of the multi-detector scheme (similar to that presented in (Tarasov and Shaaban, 2002)) allowing one to register the geo-antineutrino at the large scale. Our study of the kinetics of uranium- plutonium reactor of L.F.Feoktistov and slow wave of the nuclear burning at the boundary between the liquid and solid phase the of the Earth's core, that are partially presented in (Rusov et al., hep-ph/0402039), as well as simple temperature estimates, show that within zone of the nuclear burning the neutron concentration of about $n_n \sim 10^{13} \div 10^{23}$ cm^{-3} and temperature $T_9 \sim 1$ can take place. Therefore one can suppose that within discussed zone the process of the heavy elements production similar to r- and s-processes can really proceed. Such a process could be considered as a secondary astrophysical process. In contrast to the primary ones (r- and s-processes) that should operate in the Super Novae explosions, the process proposed by us should operate in the planetary cores. At present we are working on the numerical consideration of the kinetics of this process.

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LITHIUM IN THE ATMOSPHERES OF SOME SLOWLY ROTATING ROAP STARS

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Lithium lines 6708 and 6103 were analyzed in the spectra of some sharp-lined and slowly rotating roAp stars of high resolution with two spectral synthesis codes – STARSP, SYNTHM. New REE lines from DREAM database and lines calculated on the basis of NIST energy levels are used for lithium blends synthetic profiles modelling. Magnetic splitting of Li and REE lines are taking into account for calculations. Various causes of line broadening are considered. Enhanced Lithium abundance is proved by modelling of both lithium line profiles.

OXYGEN ABUNDANCE DISTRIBUTION IN THE DISKS OF EIGHTH SPIRALS

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The study of radial distribution of the oxygen abundance in the disks of spirals has shown that the real O/H distribution can be well represented by the single exponential function. As usual, the oxygen abundance is given in logarithmic scale. Therefore the oxygen distribution in the spiral galaxies can be represented by the following equation:

$$12 + lg(O/H) = a + b \times r, \quad (1)$$

where (O/H) is a ratio between the number of oxygen and hydrogen atoms at the galactocentric distance r; a and b – coefficients of the linear relation.

The numerous studies of the oxygen distribution in the disks of spirals show that there is a remarkable scatter in the oxygen abundance as derived from the spectra of HII regions situated at the close galactocentric distances. There is no doubt that partially (if not entirely) such a scatter is due to the methodical errors of the oxygen abundance determination. For oxygen abundance determination it is implicitly supposed that there exist an azimuthal symmetry in the O/H distribution, i.e. it is being usually supposed that HII regions with close galactocentric distances should have similar heavy metal content. In the reality, two HII regions, say having the galactocentric distance of about 10 kpc could be, in principal, spatially separated by as large distance as 20 kpc. Of course, such regions will evolve independently of each other, and quite likely they will have different chemical composition. If azimuthal asymmetry do exist, this should contribute in observed scatter of the oxygen abundances from HII regions even with close galactocentric distances.

We have determined oxygen abundance using p-method for the 8 spirals. The parameters of the radial spatial distributions of oxygen abundance for each considered galaxy. Obtained results show that the oxygen abundance distributions in each case possess an azimuthal symmetry, at least in the first approximation. The compact group of the HII regions was discovered in the NGC 2903 galaxy. Those regions have oxygen abundance 0.3 - 0.4 dex lower than average for their galactocentric distance. Within the NGC 5457 galaxy the HII regions with the increased oxygen abundance are concentrated within the sector with an angle raster of about 130 degrees. This could possibly indicate about deviation in the oxygen abundance distribution from azimuthal symmetry. Nevertheless, a reliable conclusion about the azimuthal asymmetry in a certain galaxy can be made only on the base of very accurate observational data.

MOLECULAR TRACERS OF EJECTIONS AND OUTFLOWS IN MASSIVE STAR FORMING REGIONS

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Results of observations, interpretation and theoretical modelling of molecular radioemission arising in the regions of interaction between ejections and outflows from the massive young stellar objects with surrounding diffuse medium will be considered. These regions are revealed by emission in the lines of molecules experiencing considerable increase of abundance in the regions affected by the shocks arising in the young stars and initiating the formation of new stars.

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Key words: star formation: molecules, ejections, outflows.

PRIMORDIAL HELIUM ABUNDANCE BY RRL: NEW RESULT

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The new result of the Primordial Helium abundance (Y_p) measurement by radio recombination lines (RRL) observations from galactic HII regions is presented. The RRL observations were carried out with two Parabolas: RT32(λ =13.5 mm and 3.5 cm, Medicina, Italy) and RT22 (λ = 8 and 13.5 mm, Pushchino, Russia). The current value was obtained on the base of five source observations with the accurate correction for the ionization structure, dust influence and more. At present, the obtained Y_p = 25.74($\pm$1.0)% value seems to be higher than that suggested by the optical data and allows the presence of unknown light particles. On the other side, it's in agreement with the conclusion of measuring of background radiation angular asymmetry.

Key words: Cosmology: observations HII regions - ISM: recombination radio lines - helium abundances.

A MODEL OF NONTHERMAL RADIATION OF A SHELL-TYPE SUPERNOVA REMNANTS

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It is discussed recently that a high energy nonthermal radiation detected from some SNRs could be a direct evidence of an effective acceleration of protons and nuclei up to an energies $\sim$ 10 TeV in these remnants. Modeling of this nonthermal radiation is very important because it could give a valuable information about SNR and surrounding interstellar medium.

Based on our kinetic model of an electron acceleration by collisionless shock waves (Bykov and Uvarov, 1999) we studied the generation of an electron distribution function in the vicinity of a shell-type SNR and applied our results to IC 443. We calculated the radiation spectrum of this remnant in radio, X-ray and gamma energy ranges taking into account bremsstrahlung, synchrotron and inverse Compton radiation processes. We showed that the nonthermal radiation spectrum of IC 443 can be described as a pure electron emission in all energy range.

We studied possible consequences of the second order Fermi acceleration of electrons on magneto-hydrodynamic (MHD) fluctuations in the shell. This acceleration leads to generation of a spatially nonhomogeneous electron distribution function that differs from a pure power law distribution. In emission of IC 443 this difference could result in a special spectral feature in the energy band $\sim 10-100$ MeV that can be detected by upcoming γ-ray telescopes. Future observations in this energy range could provide an opportunity to study strength and spatial distribution of the MHD fluctuations in SNR IC443.

Acknowledgments. Our work was supported by RFBR grants 03-02-17433 and 03-07-90200, president of the Russian Federation grant for young candidates of sciences 2642.2004.02, Russian science school grant 1115.2003.2.

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Key words: particle acceleration, nonthermal radiation, supernova remnants, IC443, Cosmic Rays.

PHYSICS OF STARS AND GALAXIES – WITHOUT PROTON TO PROTON FUSION AND WITHOUT DARK MATTER AND BLACK HOLES

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Recent observations indicate the abundant presence of neutron stars near the galactic centers; also a possible decay of super-heavy nuclei into the elements of periodic table (Proton 21 experiments). The theoretical evaluation of ancient atoms' collision systems results in an understanding of these new observations, and a coherent representation of physical reality. The galactic centers are systems of neutron stars and the General Relativity predicted gravitational effect makes the hypothetical black holes and dark matter unnecessary.

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Key words: Neutron Stars.

HIGH ENERGY ASTROPHYSICS

DISCOVERY OF HARD X-RAY SUBSTRUCTURES IN HOTSPOTS OF CYGNUS A

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We present results of a new analysis of the *Chandra* observations of Cygnus A in 2000, in which the X-ray hotspots at the ends of the jets are mapped in detail. Hardness maps obtained by dividing images in two energy bands reveal not previously known structures in the form of arcs and spots, in which the hardness is significantly enhanced compared with central regions inside the hotspots. The discovered hard arcs coincide with expected hotspot bow shocks and weaker hard spots with the sites where jets may hit the hotspot structures. We demonstrate that these features cannot result from electrons radiating by the synchrotron self-Compton process. Instead we consider two possible sources of the hard emission: thermal radiation of hot intracluster gas compressed at the bow shock and/or non-thermal synchrotron radiation of electrons accelerated in turbulent regions highly perturbed by shocks and shear flows. We favour the non-thermal explanation, but the present data are insufficient to perform solid spectral analysis of the emission. The observed hard spots facing the central source possibly indicate a not finished jet activity still powering the *secondary* Cyg A hotspots.

Acknowledgements. This work made use of the *Chandra* data archive; it was supported in part by the Polish Committee for Scientific Research by grant PBZ-KBN-054/P03/2001.

Key words: galaxies: active–galaxies: individual (Cygnus A)–X-rays: individual (Cygnus A).

HIGH-ENERGY NEUTRINOS FROM FROM COLLAPSING SUPERMASSIVE STAR

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We describe the scenario of massive black hole (MBH) formation inside a supermassive star (SMS) in the galactic nucleus. Dynamical evolution of dense central stellar clusters in the galactic nuclei is accompanied by the growth of the velocity dispersion of constituent stars v or, equivalently, by the growth of the central gravitational potential $\phi \sim v^2$. A SMS is naturally formed in the dynamically evolving galactic nucleus after collisional destruction of normal stars. This destruction takes place when virial velocity of constituent stars in the evolving cluster become high enough, namely $v \geq v_{\rm esc} = (2Gm_*/r_*)^{1/2}$, where $v_{\rm esc}$ is the escape velocity from the surface of star with mass m_* and radius r_*. For a solar type star the escape velocity is $v_{\rm esc} \simeq 620$ km s^{-1}. In the cluster with $v > v_{\rm esc}$ the normal stars are eventually disrupted in mutual collisions or in collisions with the extremely compact stellar remnants: neutron stars (NSs) or stellar mass black holes (BHs). Only these compact stellar remnants survive the stellar-destruction stage of evolution ($v \simeq v_{\rm esc}$) and may form the self-gravitating core. The survived neutron stars (NSs)

and stellar mass black holes form a compact self-gravitating subsystem deep inside the SMS. This subsystem is short-lived in comparison with the host SMS and collapses finally into the MBH.

Frequent NS collisions in this nearly collapsing subsystem are accompanied by the generation of multiple ultra-relativistic fireballs. Ram pressure of multiple shocks produced by these fireballs supports a quasi-stationary rarefied cavity inside the SMS, which is a suitable place for particle acceleration. Only the secondary high-energy neutrinos escape from the SMS interior. The accompanying gamma-radiation is fully absorbed in the case of thick enough envelope. The formed hidden HE neutrino source is short-lived and very powerful: neutrino luminosity may exceed the Eddington limit for the electromagnetic radiation. The resulting high-energy neutrino signal can be detected by underground neutrino telescope with an effective area $S \sim 1$ km^2 and can give the evidence for MBH formation in the distant galactic nucleus. The duration of maximal activity of the described high-energy hidden neutrino source is $\sim 0.1 - 1$ yr. in the galactic nucleus.

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Key words: black holes, neutrino, cosmic rays.

EXTRAGALACTIC UHE PROTON SPECTRUM AND PREDICTION FOR IRON-NUCLEI FLUX AT $10^8 - 10^9$ GeV

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We investigate the problem of transition from galactic cosmic rays to extragalactic ultra high energy cosmic rays. Using the model for extragalactic ultra high energy cosmic rays and observed all-particle cosmic ray spectrum, we calculate the galactic spectrum of iron nuclei in the energy range $10^8 - 10^9$ GeV (Berezinsky et al., 2004). The flux and spectrum predicted at lower energies agree well with the KASCADE data. The transition from galactic to extragalactic cosmic rays is distinctly seen in spectra of protons and iron nuclei, when they are measured separately. The shape of the predicted iron spectrum agrees with the Hall diffusion.

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Key words: cosmic rays: ultra high energy, cosmic rays: knee.

SPECTRA OF UHECRS FROM ASTROPHYSICAL SOURCES: OVERDENSITY IN DISTRIBUTION OF LUMINOUS MATTER AND EXTRAGALACTIC MAGNETIC FIELDS

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The influence of the extragalactic magnetic field connected with Local Supercluster of galaxies and overdensity in distribution of luminous matter in the local Universe on the energy spectra of ultra-high energy cosmic rays (UHECRs) is considered. The Updated Zwicky Catalogue is proceeded to obtain distribution of galaxies applicable to restoring the distribution of UHECR sources, and compared to data of other catalogues. Analysis of different z-surveys of galaxies (CfA2, PSCz, UZC and recent data of B.Tully) show that we may expect the local (within 40 Mpc) overdensity in UHECR source distribution only of order of 1-5. Such values are not able to solve the problem of disagreement of AGASA data with modeled UHECR spectra from astrophysical sources neither without magnetic field nor in its presence.

Key words: cosmic rays – galaxies: clusters: general – magnetic fields.

THE PROPAGATION OF ULTRA HIGH ENERGY COSMIC RAYS IN THE GALACTIC MAGNETIC FIELDS

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We investigate the propagation of Ultra High Energy Cosmic Rays (UHECRs) in the magnetic field of Galaxy. Two models of galactic magnetic field - paired and unpaired have been considered (Tinyakov, Tkachev, 2002). The maps of angular dependence of deviation of UHECR arrival directions for both models of magnetic field have been constructed. Correction of observable UHECR arrival direction was made with taking into account magnetic field of Galaxy. In case of unpaired magnetic field model a near-equatorial zone of avoidance of cosmic rays is revealed. We investigate also the possibility of magnetic lensing of UHECR stream by magnetic fields of galaxies.

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Key words: Cosmic rays, Galactic magnetic field, magnetic lensing.

TeV/keV CORRELATED ACTIVITY FROM THE GALAXY Mrk 501 IN 2002

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BL Lac object Mrk 501 is a point source of TeV gamma-rays and it is associated with the elliptical galaxy at redshift 0.033. Its characteristic feature is correlated variability in the keV and TeV energy bands on various time scales (Aharonian et al., 1999). Mrk 501 was observed with the aid of atmospheric Cerenkov detector GT-48 between April and July 2002. After cleaning of observing data on weather conditions a total of 11 hr and 40 m of source exposition were taken for selection of Cerenkov's flashes initiated by very-high energy (> 1 TeV) gamma-quanta from cosmic rays ones.

During observing period the source showed the relatively low mean flux on the level of approximately 46% of the steady flux in this energy band from Crab Nebula (Crab) with statistical significance 4.73 σ. However, the source exhibited two flaring states. In the first flare, occurred May 16 (MJD52411), the flux rose up to $\approx$1.6 Crab at statistical level 2.33 σ and in the second one, occurred July 8 (MJD52464), up to $\approx$1.8 Crab (2.83 σ). Distribution of TeV emission from object in May and July, the periods with most observed statistics, was different. In May 13-17 the intensity feature including flare was also seen in light curve in 2 -10 keV energy band (Figure 1).

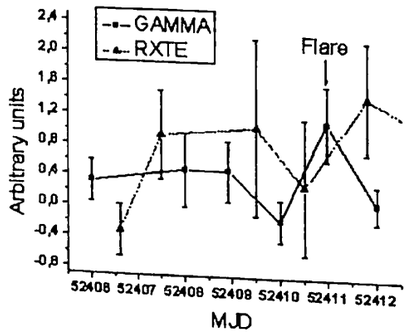

Figure 1: Figure 1. Comparison between the light curves of BL Lac in 2-10 keV energy band (quick-look results provided by ASM/RXTE team) and at E > 1TeV.

In July 2-17 the source underwent slow transition from relatively high state to low one in both keV and TeV energy bands.

These results may shed light on the physics of variability in BL Lacertaes and gain our insight in the structure of their black holes environment which believed to power the radiation processes.

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Key words: BL Lacertae objects: individual (Mrk 501) – gamma-rays: observations.

X-RAY/GAMMA-RAY OBSERVATIONS OF BL LAC OBJECT IN HIGH STATE IN 2000

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BL Lacertae, the sample of galaxies with active variable nuclei, is the source of synchrotron and Inverse Compton emission. To investigate the possible behavior of both types of emission BL Lac is generally observed in active states by means of space and ground-based detectors (Ravasio et al., 2002).

Our retrospective analysis of Cerenkov data, obtained in 2000 with the aid of GT-48 telescope, with a total of 22 hr and 10 m of BL Lacertae expositions splitted between July through November epochs reveals the mean flux at E > 1 TeV on the level of $\approx$0.5 of the steady gamma-ray flux from Crab Nebula with statistical significance 4.65 standard deviations. In the observing period the source exhibited a regular trend in increasing intensity from low state priory September (MJD51753 -51782) to high luminosity state at E > 1 TeV in October-November (MJD51820 -51868) (Figure 1a). During this period a flux enhancement come approximately to fourfold increasing of intensity.

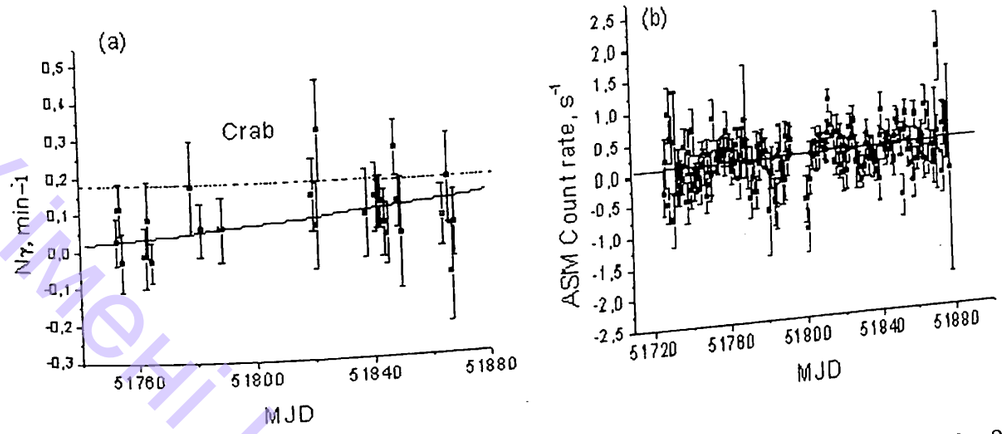

Figure 2: Figure 1. Time history of BL Lac emission (a) at E>1 TeV and (b) in the 2-10 keV energy band. Dashed line on the left plot corresponds to count rate of Very High Energy gamma-quanta from Crab Nebula observed in the same season.

This increasing tendency is also distinctly seen in light curve extracted from quasi-simultaneous observations in 2 -10 keV energy band (quick-look results provided by the ASM/RXTE team)(Figure 1b). Our estimations one more confirm the results of extensive multi-wavelength campaign of BL Lac monitoring in the second half of 2000 during which the object underwent the major transition from a rather quiescent state priory to September, to a flaring state for the rest of the year (Böttcher et al., 2003).

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Key words: BL Lacertae objects: individual (Bl Lac) - gamma-rays: observations.

RELATIVISTIC JETS IN AGN AS LEARNED FROM RATAN-600 OBSERVATIONS

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Main results of broad band instantaneous 1–22 GHz spectra measurements for 2000 AGN and relativistic jet model interpretation for them are reported. All objects are selected from VLBI catalogs and have correlated flux density more than 100 mJy at wave length 13 cm or less. The hypothesis of the two-component structure of spectra proposed by us earlier and verified for a significantly smaller sample (Kovalev & Kovalev, 1996) is confirmed. As a rule, observed instantaneous 1–22 GHz spectra of the studied objects consist of two components: high frequency (HF) and low frequency (LF). Sometimes one of these components can be absent. HF-component has a maximum at centimeter or millimeter wave lengths. Spectrum of LF-component is decreasing with frequency. Using a relativistic jet model of AGN we explain the HF component by a spectrum of synchrotron emission from a continuous relativistic jet at milliarcsecond scales ejected from an active core of an AGN along the strong magnetic field. The LF component is explained by a synchrotron spectrum of an optically thin extended magnetized envelope. Both regions are connected to the core by common magnetic field. The jet pumps particles from the core to the envelope along the magnetic field. As a result, a contribution of the emission from the envelope (LF component) relative to the relativistic jet emission (HF component) may increase with aging of an AGN, and the total spectrum should evolve from the HF component dominated (junior AGN) to LF component dominated (old AGN) stage. If such hypothesis of two component AGN is true then the HF component is the correlated flux density spectrum of an AGN jet, which could be measured by a single-dish antenna as an alternative to the VLBI method.

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Key words: galaxies: active – galaxies: compact – BL Lacertae objects: general – quasars: general – radio continuum: galaxies – radio continuum: general.

COLLAPSING STARS: FROM A THEORY TO THE OBSERVATION

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The test for search of collapsing stars using the non-thermal emission of the particles in the magnetospheres of collapsing stars is proposed. This emission is generated when the star magnetosphere compresses during collapse and its magnetic field increases considerably. The electric field thus produced involves acceleration of charged particles, which generate radiation moving in the magnetic field. The particle dynamics and their non-thermal emission in the magnetospheres of collapsing stars with initial dipole magnetic fields and a certain initial energy distribution of charged particles in a magnetosphere (power law, relativistic Maxwell, and Boltzmann distributions) are considered. The radiation flux depends on the distance to the star, its magnetic field, and the particle spectrum in the magnetosphere. The effect can be observed by means of modern instruments (radio, X- and gamma- telescopes). The radiation flux grows with decreasing stellar radius and frequency and can be observed in the form of radiation pulse with duration equal to the stellar collapse time.

Key words: collapsing stars-particle acceleration-nonthermal emission.

WEAK MAGNETISM EFFECTS IN THE DIRECT URCA PROCESSES IN COOLING NEUTRON STARS

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We study the effects of weak magnetism and pseudoscalar interaction in the neutrino energy losses caused by the direct Urca processes on relativistic nucleons in the degenerate baryon matter. Our formula for the neutrino energy losses incorporates the effects of nucleon recoil, parity violation, weak magnetism, and pseudoscalar interaction. For numerical testing of our formula, we use a self-consistent relativistic model of the multicomponent baryon matter. In the mean field approximation, we found that, due to weak magnetism effects, relativistic emissivities increase by approximately 40-50 percents, while the pseudoscalar interaction only slightly suppresses the energy losses, approximately by 5 percents.

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Key words: Neutron star, Neutrino radiation.

REVIEW OF UK DARK MATTER SEARCH AT BOULBY MINE UNDERGROUND FACILITY

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UK Dark Matter Collaboration (UKDMC) has been conducting Direct Search for Galactic Dark Matter at the Boulby underground facility in the North of England. The main component of Dark Matter is believed to be a WIMP, most likely a neutralino predicted by SUSY models. The main thrust of the collaboration has been the use of Xe targets both liquid and gaseous. This talk will give a review of the techniques used by UKDMC and latest limits from single phase liquid Xe detector. Also future plans for dual phase Xe detectors and Xe TPC detectors will be discussed.

GAMMA-RAY FLASH FROM RELATIVISTIC SHOCK BREAK OUT AT THE SURFACE OF HYPERNOVA STAR

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The hydrodynamics and observational signatures of relativistic shock break-out at the surface of Hypernova star (Woosley et al., 1999; Tan et al., 2001) are investigated. The characteristics of hydrodynamically accelerated external layers of star (energy spectrum of accelerated particles etc.) are estimated and an interaction of accelerated particles with the circumstellar medium is considered. Particularly we analyse a gamma-ray flash as a result of inelastic proton-proton collisions (Berezinsky et al., 1996). The parameters of the flash are calculated and a possibility of detection of such flash by current and future space missions is estimated.

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Key words: stars: Hypernovae – relativistic shock wave – gamma rays.

EVOLUTION EFFECTS FOR QUASARS AND GALAXIES WITH JET STRUCTURE

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We determine the key physical characteristics of quasars and galaxies with jet structure from the observed data. The analysis of relationship of radio and optical luminosities upon redshift is carried out for these objects. We estimate the lifetime of jet sources by different methods. Also we study the relation of spectral indices of objects with cosmological epoch.

COSMIC RAYS, STRUCTURE AND PHYSICS OF THE HELIOSPHERE

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In this review much of the current knowledge about the physics of Cosmic Rays (Galactic Cosmic Rays, Solar Cosmic Rays, and Anomalous Cosmic Rays) is briefly surveyed. Especially addressed are the local interstellar spectrum of Galactic Cosmic Rays (GCR), the termination shock and the outer boundary of the modulation volume, the structure of the heliospheric magnetic field and its implication for particle propagation within the heliosphere, the variation of the propagation parameters and dynamics of heliospneric boundary over the solar cycle (Heber, 2001). In this context, the Anomalous Cosmic Rays (ACR) are of special interest (Fichtner, 2001). These energetic particles are, most probably, accelerated at the so-called heliospheric shock, which terminates the supersonic solar wind expansion.

After a presentation of the general scenario embracing a description of the heliosphere, the basic paradigm explaining the existence of anomalous cosmic rays and the relevant observations, the main problems connected to the physics of this particular cosmic-ray component are identified and discussed in detail. To this end, the characteristics of the progenitor as well as descendant particle populations, i.e. interstellar neutral atoms, pick-up ions, and energetic neutral atoms, and those of GCR are described from an observational as well as a theoretical perspective, as far as they are related to heliospheric research.

Extrapolating the gradients observed during the 1980s inside 49 AU outward to the shock source led to a best fit shock location of 84±5 AU (Stone and Cummings, 1999). The Voyager 1 trajectory suggests the possibility of one or more encounters with the termination shock by 2005. The relevance of heliospheric physics is pointed out as a vital link between basic (plasma) physics and (extra-heliospheric) astrophysics as well as a "test bed" for some astrophysical concepts.

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Key words: Cosmic rays, heliosphere, termination shock, anomalous component.

EVALUATION OF THE DISK PRESENCE IN AGNs

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Analysis of the UV and optic spectra of the active galaxies 3C 390.3 and NGC 5548 shows that the observed line ratios for the broad components of lines CIV/Lα and Lα/Hβ can be accounted for by two system of clouds. One corresponds to the high ionization line zone with an electron density $10^8 - 10^{10} cm^{-3}$, located above an accretion disk. The other system corresponds to the low ionization line zone which is probably part of the accretion disk and which has a higher electron density $10^{12} - 10^{13} cm^{-3}$. Thus, profiles of Balmer line Hβ represented by tree components: -central narrow component emission from NLR; -broad component emission of low density gas, located above disk or in a conical gas steam and -broad component emission from the disk at a larger radius and with the density, $N_e = 10^{12} - 10^{13} cm^{-3}$.

The contribution from an accretion disk is less than 40% for in 3C 390.3 and is about 80-90% in NGC5548. The shape of line profiles in both galaxies is discussed.

ELECTRON INJECTION AND ACCELERATION ON THE SHOCKS OF SUPERNOVA REMNANTS

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In order to correctly interpret the observed emission from supernova remnants, one must find out how is the electron distribution partitioned into thermal and nonthermal component. Although the overall picture of the acceleration is generally accepted, the question "how does an electron start to accelerate" remains open and is the subject of ongoing discussions. This is the "injection problem", i.e determination of the distribution of particles which are able to be involved into the acceleration process. The extension of the individual particle approach of Bell (1978) to the problem of injection is proposed. The basic idea is the direct relation between the injection and thermalisation of particles on the shocks. Once particles which are capable to be accelerated are defined (as a solution of injection problem), we may follow their distribution during acceleration cycles to obtain the final distribution. Such an approach allows us to separate the thermal and nonthermal components of cosmic rays, depending on the properties of the shock.

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Bell: 1978, *MNRAS*, **182**, 147.

Key words: ISM: supernova remnants – acceleration of particles.

RESULTS OF FLUX DENSITY MONITORING OBSERVATIONS OF EXTRAGALACTIC RADIO SOURCES AT 22, 37 GHZ ON RT-22 CRAO AND 102 MHZ RESEARCH PROGRAMS OF ODESSA OBSERVATORY "URAN-4" RI NASU

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The observations of millimeter wave emission variability of extragalactic radio sources may give important information about active processes in their inner parts. Millimeter wave observations of extragalactic radio sources were started at the 22-m Crimean Astrophysical Observatory radio telescope in 1973. Since 1973 over 10000 observations of some 140 sources have been obtained. The data are between 1990 and 1996, and combined with our earlier published data they form a 23 year database. As extended monitoring programs have demonstrated, there are unpredictable outburst, quiescent periods, minimum flux levels and secular trends. It follows from analysis that the flare evolution can be divided on 3 phases: rapid flux increase; plateau when the flux relatively constant; slow intensity decrease. It is not found significant differences in the flare evolution in various optical classes of radio sources. The Odessa observatory of Institute of Radio Astronomy NAS Ukraine long-term flux monitoring of extragalactic radio sources have been made at the DKR-1000 radio telescope of Pushchino Radio Astronomy Observatory of Astro -Space Center of Lebedev Physical Institute at 102 MHz. About 20 sessions of the observations of over 80 compact and extended radio sources have been obtained in 1984 -1985, 1988 - 1992 and 1996 - 1998. In this paper we present the comparison of the data of two independent observations programs. Own activity of radio sources has been take into account and the flux variability with the delay time at millimeter and meter wavelengths has been considered. It was possible as the result of more duration of RT-22 observations. 3C 111, 3C 216, 3C 273, 3C 279, 3C 380 and 3C 454.3 radio sources were most extensively observed at high and low frequencies. They were in a various stage of activity. The data of monitoring was the best at high frequency. We have calculated the relative units of the flux density for comparison of observations of sources at RT-22 and DKR-1000.

Using monitoring of sources at high and low frequencies, the preliminary analysis of the variations in radio intensity shows differently changes. Probably for each source depending on its structure and the activity, there is "script" of development of bursts from high to low frequencies.

There can be various displays of the variations in radio intensity at low and high frequencies: 1) the 2 year delay in the variations of flux density from high frequencies to low (source 3C279); 2) the quasi-synchronous variations of flux density, when the bursts are observed at high and low frequencies (source 3C454.3); 3) the independent displays of the variations of flux density at low and high frequencies, when the variability of radio sources at low frequency is caused "scintillations" of the flux density of the inhomogeneous of the local interstellar medium. A further joint program of the observations at meter, decimeter, centimeter and millimeter for detailed study of the variations of flux density of AGN is planned.

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Key words: radiogalaxy, quasars, variable of radio sources.

MOTION OF THE RELATIVISTIC PARTICLE WITH POSITION-DEPENDENT MASS AND DEFORMED HEISENBERG ALGEBRA

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The motion of Dirac particle in Cuolomb potential with position dependent mass $m(1+a/r)$ is ivestigated. Here r is radial variable, a is unit of length, $a \leq Ee^2/m^2c^4$, E is energy of the particle. The exact energy spectrum reads:

$$E = \frac{mc^2}{1+(\alpha/n^*)^2}\left\{\frac{ma}{\hbar^2 n^{*2}}e^2 + \sqrt{1+\left(\frac{\alpha}{n^*}\right)^2 - \left(\frac{mca}{\hbar n^*}\right)^2}\right\},$$

$$\alpha = e^2/\hbar c, \qquad n^* = n_r + l^* + 1, \qquad n_r = 0,1,2,\ldots,$$

$$l^* = \sqrt{(j+1/2)^2 + \left(\frac{mca}{\hbar}\right)^2 - \alpha^2} - \frac{1}{2} \pm \frac{1}{2}, \qquad j = l + 1/2, \qquad l = 0,1,2,\ldots.$$

At $a \to 0$ this result is transformed into the well known one.

The motion of the particle in the field $U = U(r)$ in a space with coordinate-deformed Heisenberg algebra when the function of deformation $f = f(r)$ satisfies the condition $r^2U'/f = \text{const}$ is also studied. The prblem is reduced to the radial equation of the nonrelativistic problem with effective potential energy:

$$\left\{-\frac{\hbar^2}{2m}\left(f\frac{d}{dr}\right)^2 + \frac{\hbar^2 f^2}{2mq^2}\left[\left(j+\frac{1}{2}\right)^2 \mp \sqrt{\left(j+\frac{1}{2}\right)^2 - (q^2U'/f\hbar c)^2}\right] + \frac{\hbar^2}{2m}\frac{f}{q}f' + U\frac{E}{mc^2} - \frac{U^2}{2mc^2}\right\}\chi(r) = \frac{E^2 - m^2c^4}{2mc^2}\chi(r).$$

In particular an interesting case appears for the deformation function $f = 1+\nu r^2$ (ν is constant) when $U = \text{const}(-1/r + \nu r)$:

$$\left\{-\frac{\hbar^2}{2m}\frac{d^2}{dx^2} + \left[\frac{A}{\frac{1}{\sqrt{\nu}}\tan(x\sqrt{\nu})} + \frac{B}{\sqrt{\nu}}\tan(x\sqrt{\nu}) + C\right]^2\right\}\chi = E\chi,$$

$$x = \frac{1}{\sqrt{\nu}}\arctan(r\sqrt{\nu}), \qquad 0 \leq x\sqrt{\nu} \leq \frac{\pi}{2},$$

A, B, C depend on the parameters of the initial problem and the quantum number j.

Key words: deformed algebras, position-dependent mass, Dirac equation, Coulomb problem.

SMALL BODIES IN SOLAR SYSTEM. ASTRONOMY IN ODESSA

FROM ASTEROIDS TO KUIPER BELT OBJECTS: AN OVERVIEW OF PHYSICAL PROPERTIES

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The recent discovery of trans-Neptunian objects (Jewitt and Luu 1993), called also Kuiper belt objects, has opened new frontiers in the Solar system study. These objects are believed to be the most pristine bodies from the formation of our Solar system. Their study has rapidly evolved in the past few years, which let us to overview their physical properties and compare to well-studied asteroid belt. At present more than 940 objects beyond the orbit of Neptune have been discovered and some information about their physical properties are available for about 100 objects, mostly broadband colors. Diversities and similarities in physical properties of minor bodies orbiting at different distances from the Sun will be discussed. The most intriguing property is the large diversity of surface colors and spectral characteristics of trans-Neptunian objects and Centaurs. They present the widest color range among Solar system objects. In the diagram of the broadband B-V and V-R colors trans-Neptunian objects are spread-out while asteroids and cometary nuclei are clustered. The attemps of first taxonomy of trans-Neptunian objects and Centaurs have been made using the same methods as for asteroid taxonomy (Barucci et al. 2001). Information on the surface structure of trans-Neptunian objects and Centaurs can be obtained from studies of their brightness and polarization phase dependences. First measurements of magnitude-phase dependences of these objects have shown the largest phase slope ever observed for other Solar system bodies. It may indicate a high porosity of the regoliths of trans-Neptunian objects (Belskaya et al. 2003). Available data on physical properties of Kuiper belt objects are still very limited but they have given the first evidence that their composition structure is far more complicated that originally suspected.

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Key words: trans-Neptunian objects, Kuiper belt objects, asteroids, physical properties.

THE NEGATIVE POLARIZATION OF LIGHT SCATTERING BY COSMIC DUST AT SMALL PHASE ANGLE

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The linear polarization of light scattered by dust cometary atmospheres and planetary surfaces (regoliths) gives similar phase dependences, negative polarization branches. It allows us to assume that the linear polarization is formed by a common physical mechanism. Results of our laboratory polarimetric measurements of structural analogs of the planetary regoliths show that the mechanism could be single-particle light scattering by particles of irregular shape. The measurements carried out by laboratory photopolarimeters in the range of phase angles from 0.2° up to 60°. We studied the powdery samples. These samples were earlier used for the measurements of scattering matrix of single particles by an instrument located in the University of Amsterdam. The polarimetric phase dependences of single particles and particulate surfaces consisting of the particles are qualitatively similar to each others.

COMPARISON OF SPECTRA OF COMETS C/1999 S4 (LINEAR) AND C/2002 C1 (IKEYA-ZHANG)

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Some results of comparison of spectra of the two C/1999 S4 (Linear) and C/2002 C1 (Ikeya-Zhang) are presented. The spectra of comet C/1999 S4 (LINEAR) were obtained with the eshelle-spectrograph (and CCD) installed on the 2-m Zeiss reflector of the Shamakhy Astronomical Observatory of the Azerbajan Academy of Sciences (Mount Pirkuli) on July 21 and 23, 2000. Detailed identification of emission lines in the spectra of comet C/1999 S4 (LINEAR) was made. Changes in the lists of the identified spectral emission lines on July 21 and 23, 2000 during splitting of the cometary icy nucleus are discussed. The spectra of comet C/1999 S4 (LINEAR) were also obtained with the UAGS spectrograph (long slit and CCD) installed on the 1-m Zeiss reflector of the SAO of the RAS (Northern Caucasus, Nizhny Arkhyz) on July 23/24, 26/27 and 27/28, 2000. Detailed identification of emission lines in the spectra of comet C/1999 S4 (LINEAR) was made. Changes in the spectra on July 23/24, 26/27 and 27/28, 2000 are analyzed. The peculiarities of cometary luminescent continuum in the specta of cometC/1999 S4 (LINEAR) are discussed. The results of study of middle-resolution optical spectra of comet C/2002 C1 (Ikeya-Zhang) obtained on May 5, 2002 with the help of the 2.12 - m reflector of the Guillermo Haro Astrophysical Observatory are discussed. Emission lines of the molecules C2, C3, CN, NH2, CO (Asundi and triplet bands), and H2O+ were identified in these spectra. On the basis of the intensity distribution along the slit of the spectrograph in C2, C3, CN emission lines the velocities expansion and life times of these molecules were determined. Comparison of spectra of two comets is discussed.

Key words: comet, spectra, emission line, velocity of expansion, life time.

SCALE-SIMILARITY STRUCTURES ON THE ACTIVE SUN

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Entropy, information, fractals, and fractal dimensions today these notions are used in all natural science, economics, medical and other, and in the same time they have some magic tinge and cosmic beauty. Owing to their universality and outstanding effectiveness for study complicated systems and processes of various natures, these notions and the corresponding methods gain big popularity in the last decades. Hundreds of special papers devoted to fractal time series analyses only are issued every year. The entropy-fractal parameterization in complexity systems identification is the other important field for application of these methods. Stochastic self-similarity in solar activity phenomena is discussed in this report. The next results are shown and discussed:

1. It is shown, that the fractal dimension extracted from correlation between magnetic flux and its cross section (by photosphere) area is time invariant for a solar active region (AR) as a rule. But fluxes in polarities in the same AR can have various values. So the fractal dimensions in polarities, obtained in such a way, one can use as the good parameters for ARs quantitative classification.

2. Solar spots umbra fractal dimension is obtained with 'area-perimeter' method. Possible physical mechanisms of solar local power magnetic fields generation, which able to realize such value dimensions, are discussed.

3. Multi-fractal nature of ARs magnetic fields was conformed with study of their Reni entropy scaling properties: it is shown, that the Hausdorf dimension is near to the cover dimensions, information and correlation dimensions shows different values on the different scales. Some consequences of these results are discussed.

4. The R/S analysis was used for Wolf series with the purpose to get the estimation of long time 'memory' structure of this series. It was found time periods with different persistence and non persistence scales. These results can be of interest for everybody who deals with retrospective analyses and Wolf series forecasting.

5. Higuchi method was used for study of Solar X-ray flux variations (by GOES data). It is shown, that the fractal dimensions obtained with this algorithm, can be used as a good X-ray index, which takes into account not only integral level of the flux, but also its time structure. The main aim of the report is to show fractal analyses methods possibilities in field of investigation of solar active processes.

SPACE MISSION ROSETTA TO THE NUCLEUS OF COMET 67P/CHURYUMOV-GERASIMENKO: GOALS, SUCCESSFUL START AND FIRST OBSERVATIONS

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On March 2, 2004 Rosetta space mission successfully started from the Kourou cosmodrom to comet 67P/Churyumov-Gerasimenko. Upon entering orbit around the nucleus observations will be made as the comet becomes more active as it journeys towards the Sun. A lander, named Philae, will be deployed and attempt to make the first ever controlled landing on a comet. On its 10 year journey Rosetta will fly-by two asteroids – 2867 Steins in Sept. 2008 and 21 Lutethia in July 2010. Rosetta will be the first spacecraft to orbit a comet's nucleus. It will be the first spacecraft to fly alongside a comet as it heads towards the inner Solar System. Rosetta will be the first spacecraft to examine from close proximity how a frozen comet is transformed by the warmth of the Sun. Shortly after its arrival at Comet 67P/Churyumov-Gerasimenko, the Rosetta orbiter will despatch a robotic lander for the first controlled touchdown on a comet nucleus. The Rosetta lander's instruments will obtain the first images from a comet's surface and make the first in situ analysis of the relict matter of the Solar system. The main goals of Rosetta are: 1. Global characterisation of the nucleus, determination of dynamic properties, surface morphology and composition; 2. Determination of the chemical, mineralogical and isotopic compositions of volatiles and refractories in a cometary nucleus; 3. Determination of the physical properties and interrelation of volatiles and refractories in a cometary nucleus; 4. Study of the development of cometary activity and the processes in the surface layer of the nucleus and the inner coma (dust/gas interaction); 5. Global characterisation of asteroids, including determination of dynamic properties, surface morphology and composition.stages of implementation. Some of them are carrying out while others are being planned. The mission falls into several distinct phases: Launch – March 2, 2004. First Earth gravity assist – March 2005. Mars gravity assist – March 2007. Second Earth gravity assist - November 2007. Third Earth gravity assist – November 2009. Enter hibernation – July 2011. Exit hibernation – January 2014. Rendezvous manoeuvre – May 2014. Global Mapping – August 2014. Lander Delivery – November 2014. Perihelion Passage – August 2015. End of Mission – December 2015. On 30 April 004, the OSIRIS camera system, which was scheduled for commissioning on that date, took images of comet C/2002 T7 (LINEAR). Later that day, three more instruments on board Rosetta (ALICE, MIRO and VIRTIS) were activated in parallel to take measurements of the comet. The four instruments took images and spectra of Comet C/2002 T7 (LINEAR) to study its coma and tail in different wavelengths, from ultraviolet to microwave. Rosetta successfully measured the presence of water molecules in the tenuous atmosphere around the comet. The image showing a pronounced nucleus and a section of the tenuous tail extending over about 2 million kilometres was obtained by OSIRIS in blue light. This first check-out worked flawlessly and showed that the spacecraft and all instruments are functioning well and in excellent shape.

Key words: Rosetta, comet 67P/Churyumov-Gerasimenko, relict matter.

NEWS FROM MT. DUSHAK-EREKDAG OBSERVATORY. II

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We continue the series of reports about the working progress at the Mt. Dushak-Erekdag Observatory (Central Asia, Turkmenistan, longitude 58 D E, latitude +38 D, the altitude above 2000 m). We give the new meteorological data as assemblage of the site sky seeing researchers. The 0.8 m telescope of Astronomical Observatory, Odessa National University is installed at the site. During 2001-2003 the telescope with the two-star PMT photometer participated in 5 asteroseismological campaigns and 2 cooperative programmes.

The experience of the latter ten years has shown, that the observations obtained at the Mt. Dushak-Erekdag Observatory the can fill breaks in the data of existing networks. The traditional directions of researches of low amplitudes pulsating and binary stars and investigations of Solar system by means of photometric observations are continued.

The Observatory was initially projected and built as a large-scale site for astronomical observations and we propose to involve it to the total globe network of the middle telescopes equipping by the modern CCD detectors.

Key words: Observatories, instrumentation.

TIME-RESOLVING MONITORING OF V603Aql

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The test photometry of cataclysmic variable V603 Aql(Nova Aquilae 1918, V=11.64, Be/sd) with a time resolution from 0.2 sec. to 1 sec of is presented. The observations in Johnson's filter B during 5 nights of June-July 2003 (about 4 hours per night) were obtained at the Mt.Dushak-Erekdag (Central Asia) with the two- star high speed photometer attached to 0.8 m telescope of Odessa Astronomical Observatory. Rapid flickering and oscillations were detected on the time scale from some seconds to some minutes. The preliminary statistical treatment has been done.

Key words: stars: individual: V603 Aql, stars: novae, cataclysmic variables.

THE CONNECTIONS OF BINARY MAIN BELT'S ASTEROIDS WITH RESONANCES

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It's known, that about 1% of all Main Belt's asteroids are binary. Practically all of them are members of asteroid dynamic families. It was considered the connection between mean motions of known binary asteroids and resonances produced by large planets of Solar System. It was shown that the most part of binaries is disposed near resonances of different orders.

MODELING OF COMETS 95P/CHIRON'S AND 29P/SCHWASSMANN-WACHMANN'S LIGHT CURVES

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Photometric data from ICQ were used to build light curves of distant periodic comets 95P/Chiron (Centaurs object 2060) and 29P/Schwassmann-Wachmann 1. Revision and correction of their photometric parameters are made. The connection of the brightness outburst activity of these objects with the solar activity is discussed. Published data about size and mass of 95P/Chiron, its dust coma, spectral features, and light curve allow us to model the integral brightness profiles and to compare them with observational one. Among model parameters are size distribution of coma particles, chemical composition, geocentric and heliocentric distances of Chiron. Comparative analysis of physical characteristics of distant comets 95P/Chiron (Centaurs 2060) and 29P/Schwassmann-Wachmann 1 is carried out.

Key words: comet, light curve, photometric parameters, solar activity.

DESINTEGRATION OF SMALL BODIES IN THE SOLAR SYSTEM AND METEOROID COMPLEXIS EVOLUTION

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In addition to great amounts of technogenic debris stipulating danger near the Earth, there is a great many of various natural fragments in he Solar System. One of their components is the result of comeraty nuclei and large asteroid breakdown in their disintegration or encounter with each other and it can be specified as space debris of natural origin. A deterministic forecast model

of this component presumes the construction of a large number of cross-sections for the meteoroid formation formed in the parent-body disintegration. This model allows one to assess a degree of expected danger qualitatively and to a certain extent qualitatively in the Earth or artificial body passage through a given space area or an expected catastrophic situation in the Earth's biosphere. This paper presents the analyzed results of formation and evolutionary development of meteoroid complexes of some comets for the whole period of their life cycle know at present. The principal method to achieve this goal is simulation based on a universal computer model of meteoroid complex formation and evolution and analysis of simulation results and their comparison with available catalogs of observational data on specific objects. This allows one to conclude on the orbit form and the nature of a meteoroid stream accompaning the comet when it moves around the Sun. Different criteria accepted by scientists as a measure of orbit generality of two celestial bodies are used to analyze these complexes. Presented are also the D_{SH}, D_D and D_J criteria dependencies for different velocities of matter ejection at the points of true anomalies within $0 - 360°$. The upper and the lower limits of these criteria for the studied meteoroid complexes appearing at a given time moment are assessed for the Halley, Tempel-Tuttle, Giacobini-Zinner and Pons- Brooks comets. The work is supported by the regional RFFI-grant N 05-02-97244 and the "Astronomy" grant.

METEOROID COMPLEX EVOLUTION OF THE TEMPLE-TUTTLE COMET FROM COMPUTER SIMULATION RESULTS

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Computer simulation has been performed of a computer of meteoroid bodies formed in disintegration of the Temple-Tuttle II comet during all most known its appearances. Simulation was realized by prababilistic methods at any point of the cometary orbit. The results obtained allow to isolate main tendencies in the variations of the orbital elements of ejected fragments and to construct a general pattern of filling a given space area with disintegration products of this comet within the calculated time interval. The established fine structure of a formed meteoroid complex is one of the safety save vehicle flights during their long missions. The work is supported by the regional RFFI-grant N 05-02-97244 and the "Astronomy" grant.

IDENTIFICATION OF EMISSION LINES IN THE SPECTRUM OF COMET C/2002 V1(NEAT)

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The result of identification of emission lines in the spectrum of C/2002 V1 (NEAT) are presented. Two middle-resolution spectra of comet C/2002 V1 (NEAT) were obtained with the (and CCD) installed on the 2.12-m reflector of the Guillermo Haro Astrophysical Observatory in Cananea (Mexica) on Jan. 27, 2003 (at 2^h6^m and 2^h37^m UT). Comet was at r=0.78 A.E. and Δ = 0.924 A.E. Total visual magnitude of comet was 5.5^m. Detailed identification of emission lines in the spectra of comet C/2002 V1 (NEAT) was made. Emission lines of the molecules C2, C3, CN, NH2, H2O+ and others were detected in these spectra. On the basis of the intensity distribution along the slit of the spectrograph in C2, C3, CN emission lines we also determined the velocities expansion and life times of these molecules.

Key words: comet, spectra, emission line, velocity of expansion, life time.

STATISTICAL CHARACTERISTICS OF THE HYPERBOLIC METEORS ORBITS

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The orbital elements and parameters of the interstellar motion of hyperbolic meteors selected from the DMS (Dutch Meteor Society) Photographic- and Video- Database during the period from 1982 to 1999 (Photographic) and from 1991 to 2000 (Video) with the aim to detect some peculiarities which are typical for interstellar meteors were investigated. The conditions of an approach of their orbits with the Earth were defined.

DETERMINATION OF PLANETOCENTRIC COORDINATES OF ALBEDO DETAILS ON SURFACE OF THE SPHERICAL PLANET AND SOME POINTS OF THE ILLUMINATED PART OF PLANET'S VISIBLE DISK UNDER VARIOUS PHASE ANGLES FROM GROUND TELESCOPIC OBSERVATIONS

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The method of processing of the images of planets is based on use of auxiliary coordinate system connected with equator of intensity, is applied for determination of planetocentric coordinates of albedo details on the visible disk of a spherical planet under various conditions of its illumination.

The position of a detail on the planet image is determined not relative to the center of the planet geometric disk, but relative to the center of an illuminated part of its visible disk, which permits the planetary phase influence to be excluded. With the help of the given method the planetocentric coordinates of albedo details on the images of a Mercury and Mars derived from ground telescopic observations were determined.

The formulas for determination of planetocentric coordinates of some basic points of the illuminated part of the visible disk of a spherical planet, in a projection to a picture plane, are derived. The formulas do not require attraction of auxiliary coordinate system, in spite of the fact that they are deduced from general expressions using this coordinate system.

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PHYSICAL MODEL OF THE ORBITAL MOVEMENT OF THE JUPITER SATELLITE SINOPE

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The physical models of orbital movement of heavenly body have limited application. On the one hand, it is very difficult to take into account all effects of gravitational interaction in complex systems. Therefore the physical models cannot compete on accuracy of calculation of ephemeris with statistical models. On the other hand, the known equation of world gravitation of Newton strictly corresponds only to gravitational interaction of two bodies. With its use it is impossible, for example, to explain a movement of the Moon around the Earth, as the Moon is in sphere of Sun gravitation. The similar situation exists and in case of the external satellites of Jupiter: Pasiphe and Sinope. In the given work is used the original equation for the description of gravitational interaction in system of many bodies (for system of two bodies it is converted in the Newton equation) (Ostrovski, 2003):

$$\vec{F_{12}} = G \times m_1/r_{12} \times \sum m_i/\vec{r_{1i}^3},$$

This equation eliminates the known contradiction. For construction of adequate physical model are needed the dynamic characteristics of nodes line and apses line of Sinope orbit, that are unknown. Therefore the given model cannot have a strict conformity with an ephemeris, but allows to analyse influence of the various factors on a movement of a body. First of all, in work is shown, that an Sinope orbit, described in known parameters ($T = 758$ days, $R_{Mid} = 2,37 \cdot 10^{10}$, $x = 0,28$) for isolated system Jupiter-Sinope cannot exist. The influence of the Sun, as well as in case of the Moon, results to osculating of an orbit, as its parameters in each moment of time depend on a corner between radius-vectors of the Jupiter and Sinope. If we "start" a body on a

flat circular orbit with radius, equal to average radius of Sinope orbit, for one revolution its orbit gets eccentricity from 0,05, if the body was in "full moon", up to 0,08 for an initial longitude 90 degrees. The influence of orbit plane inclination to the ecliptics plane is various for a various situation of an nodes line. So, if an initial longitude of descending node concerning a radius-vector of the Jupiter the wound to zero, eccentricity for one revolution varies in a range from 0,051 up to 0,066. If the initial longitude of descending node equal 90 degrees, the range of change eccentricity is increased up to 0,019-0,078. The minimum corresponds to a corner of an inclination 90 degrees, and maximum – 180 degrees. Accounts have shown, that to an orbit with average orbital period (for 100 terrestrial years), equal 758 days and inclination equal 150 degrees, corresponds average radius $2,52 \cdot 10^{10}$ m. Herewith average value of eccentricity of an orbit will be 0,29 (maximum 0,40), and the line of units makes a complete revolution for 29000 terrestrial days. What it was possible to calculate ephemeris of Sinope it is necessary to know rather precisely in a determined moment of time its linear and radial speeds, length of a radius – vector and situation in space.

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THE COMPLEX OF METHODS AND ALGORITHMS FOR THE PHOTOMETRIC AND COORDINATE CONTROL OF SPACE

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The paper is devoted to an elaboration of the new optimized methods, algorithms and programs for the solution of problems of the remote control of outer space, which are related to an investigation of space objects based on the photometric and coordinate data. It is shown, that for satellite control a period of CO rotation around center of mass, the orientation of CO rotation axis, and also CO color, polarization and spectral characteristics can be used. The main principles of a system of the CO identification based on their light curves are elaborated. A new algorithm of EAS orbit determination using the network station data is created. Its accuracy is 3-4 magnitudes higher than that of algorithms based on the well-known methods of celestial mechanics. This was confirmed on practice many times.

TAMPORAL VARIATIONS OF IONOSPHERIC SCINTILLATION PARAMETERS OBTAINED FROM OBSERVATIONS SIGNALS OF DESCRET COSMIC SOURCES AT DECAMETRIC RADIOWAVES

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As show measurements cosmic radio sources have scintillations on ionospheric irregularities at decametric waves. Analysis of temporal variations scintillation periods and indexes was carried out on the base of observation data obtained on RT URAN-4 during 1988-1989.

TO THE QUESTION OF THE PRINCIPLE OF EQUIVALENCE IN THE EINSTEIN'S GTR

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Two classes of the frame of reference--dynamical and kinematical ones are considered. If the considered system of material particles is moving together with the frame of reference Σ, which in turn is moving relative to the absolute (in Newtons sense) frame of reference Σ^0, then Σ is called the dynamical frame of reference for the given process. If the considered system of material particles does not participate in transport motion together with the frame of reference Σ', the last is called kinematical for the given process. It is shown that well-known proof of the general equation of the relative motion of the particle in the accelerated frames of reference is true only in the kinematical frame of reference. It is given the proof of this equation also in the dynamical accelerated frames of reference. It has been found that the transport and Coriolis forces of inertia is fictive (kinematic) in the first case and real (dynamic) in the second case. In this, the Einsteins principle of equivalence of the gravitational field and the field of forces of inertia is true only in the dynamical accelerated frames of reference.

"OBSERVATIONS IN THE PAST" OF MINOR PLANETS IN MAO NAS OF UKRAINE PLATE ARCHIVE

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The Plate Archive of the Main Astronomical Observatory (MAO) of the National Academy of Science of Ukraine includes about 85 thousands plates which have been taken for various astronomical projects for period more then 50 years. Among them there are 20 thousands of direct sky area plates which will be useful for search and rediscovery of asteroids, comets and other solar system bodies, optical sources in direction of gamma-bursts and other interesting objects. For 122 of our archive photographic plates we pick out 876 main-belt asteroids with magnitude up to 16m.7. Among them we have found 63 asteroids which were firstly discovered after time of observation, when our plates have been taken.So we can rediscovery them by so called observation in the past and obtain its coordinates on the moment before time of its discovery. On our estimation the plates of our achive contain more then hundred thousand images of minor planets. The objects choose criteria, methods of it search, identification and determination of position are discussed. First results of potentially hazardous asteroids search in MAO plate archive are presented.

RADIATION OF SPECTRA OF METEORS

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The interpretation of radiation of spectra of meteors is done. The character of a radiating spectrum depends first of all on a speed of a meteor, and also on a chemical and mechanical structure of meteoroid's; the spectrum of a meteor changes along the path of a meteor in an atmosphere according to the law of Wien; for the fast meteors the final flares are inherent which are formed due to the particular conditions of power interaction of meteoric plasma with the particles in atmosphere. Such features confirm an opportunity for the meteor plasma to radiate at the speed more than 60 km/s in flares by the mechanism of cascade radiation similar to the radiation of the gas-dynamic lasers.

THE WAVE PRINCIPLE OF THE DISTRIBUTION OF SUBSTANCE IN SOLAR SYSTEM

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The wave principle of planet system formation and systems of satellites of Jupiter, Saturn and Uranus in Solar system is considered. Similarly in experiments of Chladni, during the formation of standing wave on the planes of fluctuating plate scattered along its particles are collecting together, getting from points which fluctuate with maximal amplitude, to the points, the amplitude of fluctuations of which is equal to zero, filling in the main lines. (On space this will be the "main surfaces"). The planet' orbits of Solar system the same located in main lines and points, being away from numerals which are multiple $\lambda/2$, where $\lambda = 0,52$ AU. The distribution of large semi-major axes of hundred fifty thousand radiometeor orbits also shows wave structure with length of a wave $\lambda = 0,52$ AU. Presuming the length of standing wave equal $\lambda = 240 \cdot 10^3$ km for the system of satellites of Jupiter we can receive the same result. If we will admit as the "common measure" the length of characteristic standing wave for Saturn $\lambda = 27 \cdot 10^3$ km, then the distances of the Saturn' system of satellites display the same wave regularity. If we will admit the effective length of wave for the system of Uranus' satellites equal to $\lambda = 62 \cdot 10^3$ km then we can receive the picture of the nodes of standing wave, in which these satellites were formed. The same concept of the wave nature of material distribution in the Solar System comes from a fundamental book "Welt Harmonic" by J.Kepler.

Key words: Welt Harmonic, standing wave.

OPTICAL OBSERVATION OF SPACE DEBRIS IN GEO IN ODESSA ASTRONOMICAL OBSERVATORY

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Odessa Astronomical Observatory took place in International Experimental Optical-Radar Observations of space debris (SD) in the geostationary orbit from 2003 to 2004. The observation of space debris in optical wave are carried out at Observatory Station in Mayaki. For the debris observation we used 30-sm telescope Richey-Cretien. The field of view is about 0.5 degrees, the illumination powder is 1:8. As detector system we used the television handset superizocon. This allows detection of 15 magnitude objects with time of accumulation 0.04 sec and 15.7 magnitude object with time of accumulation 0.16 sec. For two years we obtained more than 1 500 measurements of 20 space debris objects.

PECULIARITIES OF THE INFORMATION VISUALIZATION TECHNOLOGY OF DYNAMIC EVOLUTION OF METEOROID COMPLEXES

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Probability models of the Solar system small body disintegration are used to study the dynamic evolution of meteoroid complexes. Stochastic methods of simulating such problems generate enormous data files difficult to be analyzed without extra transformations. One of the ways to solve this problem is visual representation of simulation results in a three-dimensional space. The paper presents a computer technology of calculations based on the probability-stochastic model of fragment orbits in parent-body disintegration and the developed space model of a meteoroid complex formed by disintegration fragment orbits at different ejection rates within a given range of true anomaly variations. To visualize the object orbits the control window-oriented interface of representation elements is used. Within this technology it is possible to analyze the dynamic evolution of several objects in one figure. The obtained space three- dimensional representation allows the expected population structure in a region under investigation to be detected. Input data for a visualization technology are prescribed by the Keplerian orbital parameters of a studied object, the expected range of of substance ejection rates, the orbital ejection point specified by the angle of true anomaly and the colour parameter to represent a set of orbits at a given ejection point. When illustrating the technology performance the information is used on objects observed during long periods. A computer simulation of disintegration for all known comet appearances has been performed to study the possible formation of meteoroid complexes, their subsequent evolution as well as to determine a region of expected encounter with their disintegration fragments during long-term space flights.

PHOTOMETRIC INVESTIGATION OF XX CYG

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The photometric observations of SX Phe type star XX Cyg (V=12^m, A5) were made in seven nights using 48 cm reflector at the Astronomical Observatory of Odessa National University. The CCD photometer and the V filter of the UBV system was used. The variable and comparison stars monitored in the frame simultaneously. Light curves indicates a total light range 0.8 mag. A frequency analyses allow to find only one frequence of pulsating and it cause to consider this star as unique among this type. The light variation of XX Cyg can be well fitted with a single pulsation frequency during 60 years. This pulsating is very stable, but, possibly, the light curves show, besides the primary maximum, a small bump of an amplitude of approximately 0.1 mag.

Key words: SX Phe – stars: individual (XX Cyg).

ABUNDANCES OF HEAVY ELEMENTS IN THE ATMOSPHERES OF K SUPERGIANTS IN THE SMALL MAGELLANIC CLOUD

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Abundances of chemical elements of the r,s-process in the atmospheres of the K-supergiants in the SMC, where special attention was devoting to more heavy elements, was researching very detailed. The spectrums of the nine choosen K - supergiants, which we have received in European South observatory (Chile) with resolution $\lambda/\delta\lambda = 30000$ and on 3,6m -telescope with the CASPEC spectrograph (resolution 20000), were using. Diapasons of the wavelengthes are $\lambda\ \lambda$ = 500-630 and 580-700 nm. Identifycation of the lines was realizing on the grounds spectrums and synthetic spectrums accordingly for nine stars SMC. Abundances of chemical elements were defenitioning towards Sun abundance by the method of model atmospheres. Unlike light elements and elements of the "iron*s peak" (in star SMC, which we was abundancing), which evidence the deficit of the abundance in that boundary La[0.48-1.18], Pr[0.06-0.84], Nd[0.44-1.00], Eu[0.93-1.27], Gd≈0.82.

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INTERSTELLAR ABSORPTION IN SOME DIRECTIONS

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Interstellar absorption has been researched towards of Kaptein areas KA-64, KA-65, KA-86, KA-87, KA-88, KA-98 by the method of a colour excess. The star magnitudes V and indexes of colour (B-V) of stars were received by the employees of Odessa Astronomical Observatory (Yasinskaya et al., 2000). The stars of all spectral classes were used for definition of quantity of interstellar absorption. The received curves of absorption have allowed to estimate density of an absorption substance in explored directions. The results are presented in a graphical view. The calculations have shown, that the effect of selection is absent for all Kaptein areas, and the random error of definition of complete visual absorption for KA-64, KA-86, KA-88 makes $\pm\ 0^m.10$, for KA-65 is equal to $\pm\ 0^m.09$, for KA-87, KA-98 - $\pm\ 0^m.11$. The random error of definition of distance for all areas makes 110 pc on the first kiloparsec. At the distance of 2 kpc the random error increases up to 220 pc.

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Gamow Memorial International Conference dedicated to 100-th anniversary of George
G 16 Gamow «Astrophysics and Cosmology after Gamow – theory and observations». Міжнародна меморіальна наукова конференція, присвячена 100-річчю з дня народження Г. А. Гамова «Астрофізика і космологія після Гамова – теорія і спостереження». Одеса, 8-14 серпня 2004 р.: Тези. – Одеса: Астропринт, 2004. – 140 с.

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Збірка містить тези пленарних та секційних, усних та постерних наукових доповідей, що надіслані на меморіальну наукову конференцію «Астрофізика і космологія після Гамова – теорія і спостереження», присвячену 100-річчю з дня народження Г. А. Гамова.

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