

THE RUSSIAN ACADEMY OF SCIENCES  
Pavlov Institute of Physiology

TECHNOLOGIES OF THE 21<sup>st</sup> CENTURY:  
BIOLOGICAL, PHYSICAL, INFORMATIONAL  
AND SOCIAL ASPECTS

HUMBOLDT-KOLLEG CONFERENCE

St. Petersburg, Russia  
September 27–29, 2005

A B S T R A C T S

St. Petersburg  
2005

# CAVITATION MECHANISM OF FORMATION OF NANO- AND MICROSACLE MINERAL PARTICLES IN ORE DEPOSITS

V. V. Adushkin<sup>1</sup>, S. N. Andreev<sup>2</sup>, and S. I. Popel<sup>1</sup>

<sup>1</sup>*Institute for Dynamics of Geospheres, Russian Academy of Sciences*  
<sup>2</sup>*Prokhorov Institute of General Physics, Russian Academy of Sciences*  
*Moscow, Russia*

Cavitation is shown to be a rather common and important physical effect in the processes of formation of nano- and microscale particles of natural origin. We tested the so-called cavitation hypothesis of the formation of mineral microspherules 10–100  $\mu\text{m}$  in size on the basis of a cavitation model that takes into account the characteristic values of the radius of a cavitation bubble and its evolution and thermal interaction with a solid mineral particle placed inside the bubble [1, 2]. We demonstrate that the model explains the appearance of the microspherules in accordance with the data of observations. An analogous cavitation mechanism can lead to the formation of mineral nanospherules in hydrothermal fluids. Another mechanism that can result in the formation of mineral nanospherules is the ablation process. This process is realized as a release into the ambient fluid of a superheated layer taking the form of small nanosize drops of melted substance in the case when the temperature in the compressing cavitation bubble exceeds the boiling temperature of the substance of the drops, the boiling temperature corresponding to the external pressure in the hydrothermal fluid. The conditions of the formation of nano- and microscale particles depending on the depth of the rock are determined. We discuss the conditions of experiments on melting of refractory materials in the process of their interaction with cavitation bubbles; such experiments are important from the viewpoint of identification of mechanisms of formation of mineral nano- and microspherules in the Earth's crust. We discuss also a possibility of the use of the cavitation mechanism of formation of nano- and microscale particles for the beneficiation.

References:

- [1] Adushkin V. V., Andreev S. N., Popel S. I. *Doklady Earth Sciences*. 2004. 399: 1153–1155.
- [2] Adushkin V. V., Andreev S. N., Popel S. I. *Geology of Ore Deposits*. 2004. 46: 313–320.

*This work was carried out within the Program of Fundamental Investigations of the Division of Earth Sciences of the Russian Academy of Sciences «Nanoparticles in Nature: Conditions of Existence and Technological and Ecological Consequences».*

---

Prof. Sergey I. POPEL

Institute for Dynamics of Geospheres,  
Russian Academy of Sciences

38 Leninsky Ave., Building 1  
119334 Moscow, Russia  
Phone: +07 095 9397570  
Fax: +07 095 1376511  
E-mail: s\_i\_popel@mtu-net.ru

MODIFIED PYRIMIDINE NUCLEOSIDES  
AND 5'-O-PHOSPHONATES OF NUCLEOSIDES:  
SYNTHESIS AND ANTIVIRAL ACTIVITY

L. A. Alexandrova, E. V. Antonova, A. V. Ivanov, M. A. Ivanov,  
A. V. Maximov, L. K. Pigusova, M. K. Kukhanova

*Engelhardt Institute of Molecular Biology,  
Russian Academy of Sciences  
Moscow, Russia*

Nucleoside analogues play an important role as antiviral drugs in medicine. For example, 5-bromovinyl-2'-deoxyuridine inhibits the reproduction of herpes simplex virus type 1 (HSV-1), while 3'-azido-2',3'-dideoxythymidine is active against human immunodeficiency virus (HIV). We synthesized a set of novel modified cytidines, uridines and 2'-deoxyuridines.

5-Methylazole (I) and 5-oxyme (II) derivatives of 2'-deoxyuridine were synthesized from 5-bromomethyl-3',5'-O-diacetyl-2'-deoxyuridine (III). The azole derivatives (I) were obtained by the coupling of (III) with the corresponding azole. For the synthesis of oxyme-containing nucleoside analogues (II) the synthon (III) was converted into 5-hydroxymethyl derivative which was oxidized to give 5-formyl-3',5'-O-diacetyl-2'-deoxyuridine. The latter was coupled with appropriate O-alkylhydroxylamines to give (II).

Both series were tested in Vero cell culture infected with HSV-1 or viruses of the pox family. All the compounds showed no apparent toxicity. The azole-containing compounds (I) displayed moderate anti-HSV-1 activity, the imidazol derivative being the most potent. Both oxyme and azole nucleoside analogues were inactive in cell cultures infected with poxviruses.

Another series included N<sup>4</sup>- modified cytidines. They were obtained from 2',3',5'-O-triacetyluridine by reaction with phospho-*tris*-1,2,4-triazolide followed by the treatment with the corresponding amines or hydroxylamines. Among these compounds, the most promising antiviral agent was N<sup>4</sup>-hydroxycytidine, which effectively inhibited reproduction of measles and poxviruses. Therefore we synthesized its N<sup>4</sup>-O-pivaloyloxy and N<sup>4</sup>-O-benzoyloxy derivatives. Both compounds were found to be the same active but less toxic compared to the parent nucleoside analogue.

A set of bicyclic furanopyrimidines were synthesized by Pd(0)-catalysed coupling of 5-iodouridine with appropriate alkynes to afford the 5-alkynyl nucleosides which were subsequently cyclized in the presence of CuI. Antiviral properties of obtained compounds are under investigation.

One of the ways for the design of new antivirals is based on the synthesis of 5'-phosphonate derivatives of nucleoside analogues. Such approach has already resulted in a decrease of cytotoxicity of AZT – a well-known anti-HIV agent. We synthesized a series of 5'-phosphonate derivatives of N<sup>4</sup>-hydroxycytidine. In contrast to AZT, cytotoxicity of N<sup>4</sup>-hydroxycytidine phosphonate derivatives were higher than that of the parent nucleoside. Except for 5'-methylenephosphonate of N<sup>4</sup>-hydroxycytidine, the tested phosphonates exerted a low selective inhibitory effect on the reproduction of both vaccinia virus and bovine viral diarrhoea virus in cell cultures.

---

Ludmila A. ALEXANDROVA

Engelhardt Institute of Molecular Biology,  
Russian Academy of Sciences

32 Vavilov Str.  
117984 Moscow, Russia  
Phone: +07 095 1356065  
E-mail: ala2004@zmail.ru  
E-mail: va@landau.ac.ru

## InAs/InAsSbP PHOTODIODE STRUCTURES GROWN BY METALORGANIC VAPOR PHASE EPITAXY

I. A. Andreev, S. S. Kizhayevev, S. S. Molchanov,  
N. D. Stoyanov and Yu. P. Yakovlev

*Ioffe Physical Technical Institute, Russian Academy of Sciences  
St. Petersburg, Russia*

Indium arsenide and related compounds (InAsSb, InAsSbP) are of interest as a materials for mid-infrared optoelectronic devices. Recently InAsSb/InAsSbP light-emitting diodes [1] as well as InAs photodiode structures [2] obtained by epitaxy from metalorganic compounds were demonstrated. Now we present high-efficiency InAs/InAs<sub>0.27</sub>Sb<sub>0.23</sub>P<sub>0.50</sub> photodiodes grown by Metalorganic Vapor Phase Epitaxy.

Photodiodes operating at 3.6 mkm can be produced from InAs as a material for an active area in combination with multicomponent solid solution InAsSbP as a transparent window layer.

The substrates used were p-InAs (100), n-InAs (100), n-InAs (111). In the case of n-type substrates the grown structure included the undoped InAs active region with background electron concentration of  $2 \times 10^{16} \text{ cm}^{-3}$  and the InAs<sub>0.27</sub>Sb<sub>0.23</sub>P<sub>0.50</sub> wide-gap “window” Zn doped up to the level of  $2 \times 10^{18} \text{ cm}^{-3}$ . At the using the substrates with p-type conductivity the InAs<sub>0.27</sub>Sb<sub>0.23</sub>P<sub>0.50</sub> layer was undoped, and the active area of the structure was the same.

The InAs/InAsSbP photodiodes with 200, 300 and 500  $\mu\text{m}$  diameter active areas were fabricated by standard photolithography. The current-voltage, capacitance-voltage, and spectral characteristics of the photodiodes at  $T=77 \text{ K}$  and  $T=300 \text{ K}$  were investigated. The voltage depended on the capacitance according to the law  $1/C^2$ , that proved the sharpness of the heterojunction. The zero bias resistance of experimental diodes with 300 mkm active area was  $R_0=200\div 1000 \Omega$  at  $T=300 \text{ K}$ .

We obtained the photosensitivity  $S=1.6 \text{ A/W}$  at  $T=77 \text{ K}$  and  $S=1.42 \text{ A/W}$  at  $T=300 \text{ K}$ , respectively. The detectivity varied from  $D^*=1.2 \times 10^{11} \text{ cm}^2 \text{ Hz}^{1/2} \text{ W}^{-1}$  at  $T=77 \text{ K}$  down to  $D^*=10^9 \text{ cm}^2 \text{ Hz}^{1/2} \text{ W}^{-1}$  at  $T=300 \text{ K}$ . These data are comparable to standard commercial InAs photodiodes [3].

References:

[1] Kizhaev S. S. et al. *J. Cryst. Growth*. 1999. 248: 296–300.

- [2] Kizhaev S. S. et al. *Tech. Phys. Lett.* 1998, 24(4): 247–249.  
[3] Infrared Detectors, EG&G Optoelectronic JUDSON, 53, (1995).

---

Dr. Sergey S. KIZHAYEV  
Ioffe Physical Technical Institute,  
Russian Academy of Sciences

26 Politehnicheskaya Str.  
194021 St. Petersburg, Russia  
Phone: +07 812 2479929  
Fax: +07 812 2470006  
E-mail: serguie@mail.ru

## FRAGMENTATION PROCESS OF MOLECULES UNDER ELECTRON AND PROTON IMPACTS

E. A. Berezovskaya, A. Y. Timoshkin, A. V. Tulub

*St. Petersburg State University  
St. Petersburg, Russia*

The present work is devoted to experimental and theoretical study of donor-acceptor (DA) complexes, consisting of group 13 metal halides and bidentate N-containing organic ligands:  $(MX_3)_nL$  (where  $M=Al, Ga$ ;  $X=Cl, Br$ ;  $L=4,4'$ -bipyridyl, pyrazine;  $n=1,2$ ). These complexes are prospective precursors for obtaining binary heteronuclear semiconductor nitrides such as  $Al_xGa_{1-x}In_yN$ .

The homonuclear  $(MX_3)_nbipy$  and heteronuclear  $AlX_3 \cdot bipy \cdot GaX_3$  complexes have been synthesized for the first time, and their existence in the vapor phase have been proved by mass spectroscopy method. In addition to mass spectroscopy data, which provide information about fragmentation paths under the influence of electronic beams, data about fragmentation under the influence of proton beams have been obtained for some DA complexes  $MX_3$  with 4,4'-bipyridyl and  $C_nH_{2n+2}$  molecules of homologous series ( $n=1-4$ ). Both electronic and proton spectra have clear correlation of intensities of ion peaks with each other. Molecules of homologous series  $C_nH_{2n+2}$  have been chosen as model for studying of fragmentation pathways.

Structural, spectral and thermodynamic properties of new complexes

(MX<sub>3</sub>)<sub>n</sub>L, C<sub>n</sub>H<sub>2n+2</sub> molecules and its fragments in neutral and cationic forms have been calculated using the GAMESS 03 program package. In addition to thermodynamic properties the most advantageous fragmentation paths for (MX<sub>3</sub>)<sub>n</sub>L complexes and C<sub>n</sub>H<sub>2n+2</sub> molecules was suggested. These data about fragmentation process based on chemical bond breaking energy. Structures all molecules and ions were optimized using DFT/B3LYP methods.

It is very important that our calculated data in good agreement with experiment: there are correlation between theoretical predicted distribution of fragments and those in at electron or proton impact experiment.

---

Ekaterina A. BEREZOVSKAYA  
St. Petersburg State University

26 Universitetsky Ave., Old Peterhof  
198504 St. Petersburg, Russia  
Phone: +07 812 4284071  
Fax: +07 812 4286939  
E-mail: ekaterinaBer@yandex.ru

## STABILITY OF STATES – ENERGETICS OF TRANSITIONS

Iliya I. Blekhman

*Institute of Problems of Mechanical Engineering,  
Russian Academy of Sciences;  
«Mekhanobr-Tekhnika Corp»  
St. Petersburg, Russia*

The stable state of an object usually implies its ability to retain this state under external actions of a certain type. Between the stable states of objects of both the natural and spiritual world there are energetic and force barriers. It means that to make a transition from one stable state to another it is necessary to apply some or other force and spend some energy. The believer will say that God, when creating the World, took care of his creatures' being stable, i. e. being protected by the barriers. But the atheists will say that everything is understandable for him: in the progress of evolution only the

stable things have been preserved. It is of interest that Roger Penrose, the outstanding physicist and mathematician of our time considered people to be the most stable structures of the physical world. It is natural that there are different opinions on that point too. Without arguing about it, we will only say that the consumption of energy to realize the transition may often be irreversible and may exceed the advantage of the transition. In other words we have to pay a fine for breaking the state of stability, i.e. for the fight against Nature. This circumstance is of great applied interest since the transition of the system from one stable equilibrium state to another is the essence of many energy-intensive technical processes. Of particular importance are the energy-efficient methods of overcoming the barriers. There is no doubt that the solution of this problem will take a prominent place in the technology of XXIst century.

---

Prof. Iliya I. BLEKHMAN

Institute of Problem  
of Mechanical Engineering,  
Russian Academy of Sciences

61 Bolshoy Ave., V. O.  
199178 St. Petersburg, Russia  
Phone: +07 812 3310254  
Fax: +07 812 3277515  
E-mail: blekhman@vibro.ipme.ru

CONTRIBUTION OF GLUCOCORTICOID HORMONES  
IN THE MAINTENANCE OF GASTRIC MUCOSAL INTEGRITY  
IN RATS WITH DESENSITIZATION OF CAPSAICIN-  
SENSITIVE SENSORY NEURONS

P. Bobryshev, T. Bagaeva, T. Podvigina, L. Filaretova

*Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

*Background and Aim.* It is well known that prostaglandins (PGs) and capsaicin-sensitive sensory neurons play a pivotal role in gastroprotection. According to the results of our studies glucocorticoid hormones produced during activation of the hypothalamic-pituitary-adrenocortical axis in response

to various ulcerogenic stimuli also contribute to maintenance of the gastric mucosal integrity. We previously demonstrated that PG deficiency caused by indomethacin induces a compensatory enhancement in corticosterone production, which helps the gastric mucosa to resist a harmful action of the ulcerogenic agent. The gastric mucosa becomes more susceptible to injury during deficiency of both glucocorticoids and PGs. This study was designed to investigate the ability of glucocorticoids protect gastric mucosa in rats with concomitant PG deficiency induced by indomethacin and ablation of capsaicin-sensitive neurons.

*Methods.* Functional ablation of capsaicin-sensitive sensory neurons in male Sprague-Dawley rats was carried out by treating them with neurotoxic doses of capsaicin (20 + 30 + 50 mg/kg *sc* over 3 consecutive days) under ether anaesthesia. After one week of recovery, capsaicin-desensitized as well as control rats were adrenalectomized or sham-operated. Seven days later, indomethacin (35mg/kg *sc*) was given to sham-operated and adrenalectomized rats, with or without corticosterone replacement (corticosterone injection at the dose 4mg/kg *sc*, 15 min before indomethacin). Gastric lesions, plasma corticosterone and blood glucose levels were estimated 4 hours after indomethacin administration.

*Results.* Neither capsaicin desensitization nor adrenalectomy by itself provoked any damage in gastric mucosa even in fasted rats, however, their combination produced small gastric lesions in fasted animals without additional ulcerogenic stimuli. Indomethacin caused gastric erosions that were aggravated by adrenalectomy as well as desensitization of capsaicin-sensitive sensory neurons. Corticosterone replacement, which mimicked indomethacin-induced corticosterone rise, reversed the effect of adrenalectomy. Combination of adrenalectomy with the sensory desensitization profoundly potentiated the effect of sensory desensitization alone on indomethacin-induced gastric erosions: the mean gastric erosion area was increased approximately in 10 times. Corticosterone replacement prevented at all this profound effect of adrenalectomy too. It probably means that contribution of glucocorticoids to gastroprotection against indomethacin-induced injury was significantly increased during desensitization of capsaicin-sensitive neurons.

*Conclusions.* The results suggest a pivotal role of glucocorticoid hormones in the maintenance of gastric mucosal integrity in the case of impaired gastroprotective mechanisms provided by PGs and capsaicin-sensitive sensory neurons. One of the mechanisms responsible for the gastroprotective

action of glucocorticoids in these conditions may be provided due to a beneficial influence of these hormones on glucose homeostasis.

*The study was supported by grants from RFBR (04-04-48507), Sci. School (1163.2003.4), Fundamental Sciences – Medicine (2003).*

---

Peter BOBRY SHEV

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281301  
Fax: +07 812 3280501

PHOSPHONO ANALOGS  
OF  $\alpha$ -KETO- AND  $\alpha$ -AMINO ACIDS  
AS THE MECHANISM-BASED *IN VIVO* INHIBITORS  
OF THE KEY MITOCHONDRIAL DEHYDROGENASES

Victoria Bunik

*Bioinformatics and Bioengineering Department and Belozersky Institute  
of Physical-Chemical Biology, Lomonosov Moscow State University  
Moscow, Russia*

Diseases are often initiated and progressed through disfunction of a certain enzyme perturbing cellular metabolism and/or signaling. Hence, both the study of the disease mechanisms and evaluation of different therapeutic strategies require cellular models of the enzyme disfunction. Specific inactivation of an enzyme *in vivo* may be achieved, in particular, through the action of its mechanism-based inhibitors. Such compounds target certain enzymes because they mimic initial steps of catalysis, but are unable to complete the catalytic cycle. This class of compounds is also becoming increasingly useful in proteomic research to inhibit selective components in complex biological mixtures.

$\alpha$ -Ketoglutarate dehydrogenase complex (KGDHC), a control point of the tricarboxylic acid cycle, is partially inactivated in brain in many

neurodegenerative diseases. Potent and specific KGDHC inhibitors are needed to probe how the reduced KGDHC activity alters brain function. We showed that succinyl phosphonate (SP) effectively inhibits muscle and *Escherichia coli* KGDHC [1] by targeting its first and rate-limiting enzyme [2]. Phosphonates of the corresponding amino acid also inhibit metabolism through their *in vivo* conversion to the  $\alpha$ -keto acids [1, 3]. To identify the phosphonates with the highest affinity toward the brain KGDHC and with the greatest effect in living cells, we investigated the ability of SP and several of its ethyl esters to inhibit brain KGDHC, other  $\alpha$ -keto acid-dependent enzymes and KGDHC in cells [4]. Our study indicates that SP and monoethyl esters of its carboxyl or phosphono groups penetrate into cells, are minimally transformed by cellular enzymes and possess the high specificity in targeting KGDHC *in vivo*. They should thus be useful tools to study the effects of reduced KGDHC activity on neuronal and brain function.

References:

- [1] Biryukov A. I. et al. *FEBS Lett.* 1996. 382: 167–170.
- [2] Bunik V. I. et al. *FEBS Lett.* 1992. 303: 197–201.
- [3] Laber B., Amrhein N. *Biochem J.* 1987. 248: 351–358.
- [4] Bunik V. I. et al. *Biochemistry.* 2005. 44 (in press).

---

Dr. Victoria I. BUNIK, PhD, Dr.Sci.

Bioinformatics and Bioengineering Department  
and Belozersky Institute  
of Physical-Chemical Biology,  
Lomonosov Moscow State University

119992 Moscow , Russia  
Phone: +07 095 9394484  
Fax: +07 095 9393181  
E-mail: bunyk@online.ru

## COMPLETE EXPERIMENTS IN PHOTOIONIZATION OF ATOMS AND MOLECULES

Nikolai A. Cherepkov

*State University of Aerospace Instrumentation  
St. Petersburg, Russia*

Photoionization is the simplest process giving a detailed information on atomic and molecular structure. The explanation of atomic photoabsorption spectra played a key role in the foundation of quantum mechanics. Nevertheless, for a long time there was a great distance between a very detailed information with which theorists are dealing like matrix elements of the dipole operator and phase shifts of different partial waves of a photoelectron wave function, and a very general information like the total or partial photoionization cross sections for atoms and randomly oriented molecules which was usually measured by experimentalists. Only during the last two decades, owing to the application of synchrotron radiation sources in conjunction with photoelectron spectroscopy methods, it became possible to determine directly from experimental data the matrix elements and phase shifts calculated by theorists and in this way to establish a close connection between theory and experiment. An experiment (or usually a set of several experiments) from which one can extract all matrix elements and phase shift differences necessary for a theoretical description of the process, is called a complete (or perfect) experiment [1, 2].

The general discussion of different complete experiments in photoionization of atoms and molecules will be presented. In atoms the complete experiment must include measurements of the angular distribution and spin polarization of photoelectrons and the alignment or/and orientation of the residual ion. The complete experiments in photoionization of diatomic molecules are performed by measuring photoelectron angular distributions for fixed-in-space molecules with circularly or elliptically polarized light.

References:

- [1] Cherepkov N. A., Semenov S. K. *J. Phys. B.* 2004. 37: 1267.
- [2] Cherepkov N. A. et al. *J. Phys. B.* 2004. 37: 4803.

Prof. Nikolai A. CHEREPKOV  
State University of Aerospace  
Instrumentation

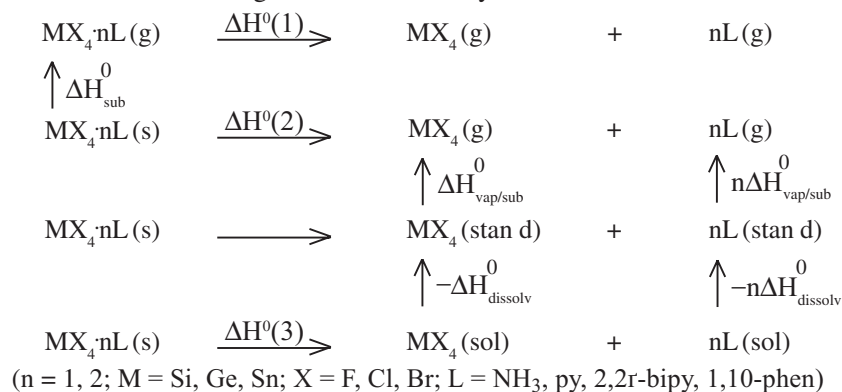
67 Bolshaya Morskaya Str.  
199000 St. Petersburg, Russia  
Phone: +07 812 3034439  
Fax: +07 812 3157778  
E-mail: nik\_cherepkov@yahoo.com

## EVALUATION OF SUBLIMATION ENTHALPY OF ADDUCTS 14<sup>th</sup> GROUP ELEMENT TETRAHALIDES

Elena I. Davydova, Tatiana N. Sevast'yanova, Anna S. Kosygina

*St. Petersburg State University  
St. Petersburg, Russia*

The reactions between group 14<sup>th</sup> halides and different nitrogen-containing ligands lead to the formation of stable donor-acceptor complexes (adducts). Such complexes are used in processes of extraction, rectification, catalysis, and are precursors of refractory nitrides and semiconductor materials. To choose the suitable compounds for technology the sublimation enthalpy ( $\Delta H_{\text{sub}}^0$ ) has to be known. However, for adducts of group 14<sup>th</sup> elements the determination of  $\Delta H_{\text{sub}}^0$  is complicated by dissociation or metal reduction processes [1]. Therefore in the present work the sublimation enthalpy was obtained from following thermochemical cycle:



$\Delta H^0(1)$  was calculated by quantum chemical method. All calculations have been carried out using the GAUSSIAN 98 program package. The geometries of all compounds were optimized by B3LYP/DZP methods with subsequent vibrational analysis.

$\Delta H^0(2)$  was obtained from  $\Delta H^0(3)$  that in one's turn had been experimentally determined through solution-reaction calorimetry.

In [2] has been shown that the sublimation enthalpy of adduct is equal to the enthalpy of sublimation or vaporization of ligand. However, the data obtained in present work showed that this approximation is not reasonable for adducts of 14<sup>th</sup> group element tetrahalides.

References:

[1] Sevast'yanova T. N., Misharev A. D., Anatsko O. E., Suvorov A. V. *Russ. J. Gen. Chem.* 2002. 72: 58.

[2] Chagas A. P., Airoidi C. *Polyhedron*. 1989. 8: 1093.

---

Dr. Elena I. DAVYDOVA  
Department of Inorganic Chemistry,  
Faculty of Chemistry,  
St. Petersburg State University

Universitetsky Ave. 26, Old Peterhof  
198504 St. Petersburg, Russia  
Phone: +07 812 4284071  
Fax: +07 812 4286939  
E-mail: elenadav@yandex.ru

## ANTIBODY ENGINEERING FOR CANCER DIAGNOSTICS AND THERAPY

Sergey M. Deyev

*Shemyakin & Ovchinnikov Institute of Bioorganic Chemistry,  
Russian Academy of Sciences, Moscow, Russia*

To obtain optimal tumor targeting antibody fragments of intermediate molecular weight can be designed to have the proper combinations of high tumor uptake and rapid clearance from normal tissues. We have prepared mono-, di-, and trimeric variants of scFv fragment with Mw 42, 80 and 130 kDa, respectively. Fusions were constructed using tumour-specific single-

chain antibodies (scFv) and the ribonuclease barnase as well as its inhibitor barstar. Anti HER-2/neu scFv and anti-ferritin scFv were used as a models. A peptide fragment for specific binding of technetium-99m radioactive complexes was attached to fusion proteins. An extremely tight barnase-barstar complex was used as general module to obtain multivalent targeting molecules.

The most important advantage of multivalent miniantibodies over monovalent ones is the enhancement of specific binding avidity towards antigens. We tested their binding properties using both ELISA and BIAcore experiments. ELISA analysis demonstrated specific binding, with the lowest apparent functional affinity for the monomers, intermediate affinity for dimeric complexes and highest functional affinity for the trimers. The functionality study using BIAcore was designed to evaluate differences in the off-rates of multivalent complexes, compared to monovalent construct. This analysis reveals a slower dissociation for the dimeric construct (96% of residual binding) and the trimeric construct (98%) compared with the monovalent construct (84%), indicating a significant contribution from multivalent binding. These data clearly reflected a gain in avidity for the designed multivalent scFv constructs, as anticipated.

To test whether the molecular design indeed leads to improved *in vivo* properties of the multivalent molecules, biodistribution studies in xenografted mice were carried out by *i.v.* injection of  $^{99m}\text{Tc}$ -labeled construct. All three constructs displayed bi-exponential time/activity curves with a fast equilibration rate and a subsequent elimination phase. The blood clearance profiles of the constructs resulted in half-lives of 1 min for the monomeric, 6 min for the dimeric and 49 min for the trimeric construct for the respective fast alpha phase.

The organ distribution was investigated in nu/nu mice xenografted with SK-OV-3 and SK-BR-3 cells highly expressing HER-2/neu antigen.

The study showed an increased accumulation at the tumor site with increasing degree of multimerization, ranging from 2% (monomer) to 6% (dimer) and 10% (trimer) injected dose per gram of tissue at 24 h, whereas kidney accumulation decreased from 140% (monomer) to 56% (dimer), or 21% (trimer), respectively. After 48 h no significant decrease of tumor accumulation for dimer and trimer was observed and tumor-to-blood ratios of 27 were reached. The strategy presented here is applicable to virtually any molecules that can be functionally attached to the barstar and barnase proteins. It seems particularly well suited to the production of heterooligomeric

constructs, because the extremely specific barnase:barstar interaction reliably eliminates mispairing problems. Many permutations of engineered multispecific fusion proteins become accessible with this technology of quasi-covalent heterodimers.

*The work was supported by the Russian Foundation for Basic Research № 04-04-49024.*

References:

[1] Deyev S. M., Waibel R., Lebedenko E. N., Schubiger A. P., Pluckthun A. *Nature Biotechnology*. 2003. 21: 1486–1492.

[2] Martsev S. P., Tsybovsky Y. I., Stremovsky O. A., Odintsov S. G., Balandin T. G., Arosio P., Kravchuk Z. I., Deyev S. M. *Protein Engineering, Design & Selection*. 2004. 17: 85–93.

---

Dr. Sergey M. DEYEV

Shemyakin & Ovchinnikov  
Institute of Bioorganic Chemistry,  
Russian Academy of Sciences

16/10 Miklukho-Maklay Str.  
117871 Moscow, Russia  
Phone: +07 095 4298810  
Fax: +07 095 3357103  
E-mail: deyev@ibch.ru

SOFTWARE DEVELOPMENT FOR GENOME ANALYSIS:  
KNOWLEDGE-BASED IMPROVEMENT  
OF THE AUTOMATICALLY GENERATED  
MULTIPLE SEQUENCE ALIGNMENTS

Dmitrij Degtjarev and Victoria Bunik

*Bioinformatics and Bioengineering Department and Belozersky Institute  
of Physical-Chemical Biology, Lomonosov Moscow State University  
Moscow, Russia*

High-throughput technologies made possible deciphering genomes from different species, resulting in enormous amount of sequence data that need to be effectively analysed. The goal of functional genomics is to determine the protein functions from their sequences. Automatic computational ap-

proaches developed to achieve this goal deal with the distribution of proteins between classes/families and/or identification of similarity to a known protein. Further detailed analysis of the structure-function relationship in order to find the exact function of a protein in a cell requires human intervention. However, tools to work with the automatically generated multiple sequence alignments and to change them in accord with the expert assessment are poorly developed. We faced this problem upon deciphering potential function of the two proteins present in genomes of higher organisms, which sequences show significant similarity to a key enzyme of the tricarboxylic acid cycle, the 2-oxoglutarate dehydrogenase. Are these homologues active enzymes and if so, are they the 2-oxoglutarate dehydrogenase isoforms (i. e. catalysing the same reaction with the same substrates) or the enzymes with distinct catalytic functions (e. g., acting upon different substrates)? To answer these questions, multiple approaches for the sequence comparison were employed and the software to merge the results of these applications developed. Our program allows a user the following options: 1. Sequence homology visualization; 2. Manual editing of the sequences of interest; 3. Improving the twilight-zone alignment by the CLUSTALW alignment of the sequences after the certain structurally conserved elements which are not revealed as such by the sequence alignment, have been fixed; 4. Superposition of the sequence alignment and secondary structure prediction; 5. Annotation of the sequence regions of interest. Using this software, an improved and annotated sequence alignment of the 2-oxoglutarate dehydrogenase and similar proteins was generated. The alignment reveals the conservation of overall structure and active site elements of the proteins, on one hand, and regions potentially responsible for their specific cellular functions, on the other hand.

---

Dr. Dmitrij DEGTJAREV

Bioinformatics and Bioengineering Department,  
Lomonosov Moscow State University

119992 Moscow , Russia

Phone: +07 095 9394484

Fax: +07 095 9393181

E-mail: ddegtyarev@itci.com

CALCULATIONS OF ELECTRON ANGULAR DISTRIBUTION  
IN RESONANT AUGER DECAY FOR ATOMS  
WITH OPEN SHELLS

A. Yu. Elizarov, I. I. Tupitsyn

*Ioffe Physical-Technical Institute, Russian Academy of Sciences  
St. Petersburg, Russia*

The study of angular distribution and polarization of Auger electrons can provide an important information on the Auger decay dynamics. Comprehensive theoretical studies were performed by N. M. Kabachnik et al., K. Blum et al., H. Acsele et al., and M. N. Chen by using the multichannel multiconfigurational Fock-Dirac method for closed shells in noble-gas atoms. The calculations for open-shell atoms were presented in fewer publications. By that reason, we calculated the angular anisotropy parameter of the Auger transitions KLL for atoms with open shells [1–3]. Multiconfigurational Fock-Dirac method was used in all calculations of the wave functions for single-hole initial and for double-hole final ionic states. The continuum orbitals were calculated by using full relativistic wave functions. The exchange interaction and orthogonalization of the atomic orbitals were included. In nonrelaxed approximation where bound orbitals are frozen during Auger transitions, the initial and final wave functions are calculated separately. As the result, these wave functions are not orthogonal. In the present work, angular distribution parameter was calculated for two cases. In the first case (the nonrelaxed approximation), wave functions for the final two-hole state were obtained from the construction of the initial one-hole state. In the second case, wave function for the final two-hole state was orthogonal to the wave function of the initial one-hole state. The orbital relaxation during Auger decay was taken into account.

Reference:

[1] Elizarov A. Yu., Tupitsyn I. I. Calculation of electron angular distribution in resonant Auger decay for Na, Ba, Hg and Kr. *Physica Scripta*. 2004. 70: 139–141.

---

Dr. Andrei Yu. ELIZAROV  
Ioffe Physical-Technical Institute,  
Russian Academy of Sciences

26 Politehnicheskaya Str.  
194021 St. Petersburg, Russia  
Phone: +07 812 2479178  
Fax: +07 812 2471090  
E-mail: a.elizarov@mail.ioffe.ru

## COMPARATIVE STUDY OF $\text{TiO}_2$ AND $\text{ZrO}_2$ CRYSTALS

Robert A. Evarestov, Andrej V. Bandura, Vitalij E. Alexandrov

*Chemistry Department, St. Petersburg State University  
St. Petersburg, Russia*

The electronic structure of different phases of  $\text{TiO}_2$  and  $\text{ZrO}_2$  crystals is studied using LCAO approximation and different Hamiltonians (Hartree-Fock, DFT PBE with GGA correction and hybrid B3LYP). The experimental data for the lattice constants and atomic positions were taken. In Tables 1 and 2 the comparison is made with the results of Plane Wave (PW) calculations of  $\text{TiO}_2$  [1, 2] and  $\text{ZrO}_2$  [3] and experimental data for the band gap and relative energies of different phases of both crystals. The experimental determinations of the stability of rutile and anatase have not conclusively resolved which phase is more stable [1], the experimental data and calculations for brookite are absent. The B3LYP results seem to be the mostly appropriate to the existing experimental data.

References:

- [1] Muscat J., Swamy V., N.M.Harrison N. M. *Phys. Rev. B.* 2002. 65: 224112.
- [2] Mikami M., Nakamura S., Kitao O., Gonze X. *Jpn J. Appl. Phys.* 2000. 39: L847.
- [3] Dash I. K., Vast N., Baranek P., Cheynet M. C., Reining L. *Phys. Rev. B.* 2004. 70: 245116.

Table 1

Band gap  $\Delta E$  (eV) at  $\Gamma$  point for different phases of  $\text{TiO}_2$  crystal (r-rutile  $P4_2/mnm$ , a-anatase  $I4_1/amd$ , b- brookite  $Pbca$ ) and their relative energies  $\Delta E_l$  (eV/ $\text{TiO}_2$ )

	HF	B3LYP	PBE	DFT-PW
$\Delta E_r(3.0)$	12.1	3.6	2.0	1.88[2]
$\Delta E_a(3.2)$	13.0	4.2	2.6	2.05[2]
$\Delta E_b$	12.4	3.8	2.2	–
$\Delta E_{Ia}$	-0.08	-0.08	-0.06	-0.10[1]
$\Delta E_{Ib}$	+0.02	-0.04	+0.04	–

In brackets there are given experimental data, zero value of  $\Delta E_l$  was taken for rutile phase.

Table 2

Band gap  $\Delta E$  (eV) at  $\Gamma$  point for different phases of  $\text{ZrO}_2$  crystal: cubic  $Fm3m$  (c), tetragonal  $P4_2/nmc$  (t) and monoclinic  $P12_1/c$  (m) and their relative energies  $\Delta E_l$  (eV/ $\text{ZrO}_2$ )

	HF	B3LYP	PBE	DFT-PW[3]
$\Delta E_c(4.5)$	14.0	5.5	3.7	3.9
$\Delta E_t(5.0)$	14.2	5.8	4.0	4.1
$\Delta E_m(5.3)$	13.8	5.7	3.9	4.0
$\Delta E_{Ic}(-0.06)$	+0.01	-0.04	-0.05	-0.05
$\Delta E_{Im}(-0.12)$	-0.04	-0.10	-0.09	-0.11

In brackets there are given experimental data, zero value of  $\Delta E_l$  was taken for cubic phase.

This work is supported by grant 05-03-32002-a of Russian Foundation of Basic Research.

Prof. Robert A. EVARESTOV  
Quantum Chemistry Department,  
St. Petersburg State University

26 Universitetskaya Ave., Old Peterhof  
198504 St. Petersburg, Russia  
Phone: +07 812 4286755  
Fax: +07 812 4286939  
E-mail: evarest@hm.csa.ru

## A NEW LOOK AT DECODING ALGEBRAIC CODES

Sergei Fedorenko

*St. Petersburg State Polytechnic University  
St. Petersburg, Russia*

In the recent article S. Gao [2] described a simple and natural algorithm for decoding algebraic codes in the class of algorithms decoding up to the designed error correcting capability. The asymptotic complexity of this algorithm coincides with the complexity of the best Reed-Solomon decoding algorithms, and the description is the simplest for known algorithms descriptions. In paper [1] the Gao algorithm's relation to the Welch-Berlekamp and Euclidean algorithms is given.

The Gao algorithm consists of the following steps:

1. Interpolation.
2. Partial greatest common divisor.
3. Division.

The first step of the Gao algorithm can be implemented by any fast algorithm for the discrete Fourier transform. One of the best implementations of the second step is the Moenck algorithm. Note that Moenck's implementation of the second step completely coincides with the algorithm of the key equation solving by Sugiyama *et al.* (Euclidean algorithm).

The demonstrative connection between known decoding algorithms has important methodological significance in the coding theory. We see that the Gao algorithm belongs to the class of the frequency domain algorithms with simple description. Thus the paper [1] demonstrates how carrying the algorithms from the time domain into the frequency domain results in simplification of their description. In author's opinion the Gao algorithm and its modifications are the simplest for codes with short lengths for any implementation.

References:

[1] Fedorenko S. A simple algorithm for decoding Reed-Solomon codes and its relation to the Welch-Berlekamp algorithm. *IEEE Transactions on Information Theory*. 2005. 51(3) [in press].

[2] Gao S. A new algorithm for decoding Reed-Solomon codes. In: *Comm-*

*nications, Information and Network Security* (V. Bhargava, H. V. Poor, V. Tarokh, and S. Yoon, Eds.), Kluwer Academic Publishers, Vol. 712, pp. 55–68, 2003.

---

Associate Professor,  
Dr. Sergei FEDORENKO

Department of Distributed  
Computing & Networking,  
St. Petersburg State  
Polytechnic University

21 Polytechnicheskaya Str., Room 9-104  
194021 St. Petersburg, Russia  
Phone: +07 812 2471639  
Fax: +07 812 2471639  
E-mail: [sfedorenko@at.ieee.dot.org](mailto:sfedorenko@at.ieee.dot.org)  
<http://www.svfedorenko.narod.ru>

## PHOTOACOUSTIC EFFECT AND RESIDUAL STRESSES

Alexei L. Glazov

*Ioffe Physical-Technical Institute Russian Academy of Sciences  
St. Petersburg, Russia*

Modern technologies from micro-electro-mechanical systems (MEMS) to spacecraft building come up against a problem of residual stress control at various stages of manufacturing and attendance. Materials used today are subjected to huge loading, so very small initial internal stress may result in disastrous consequences. Often residual stress influences on yield, quality and life expectance of the products. On the other hand, the problem of stress and residual stress influence on elastic and thermoelastic properties of solids is an important fundamental problem in modern mechanics. However, in spite of the problem topicality and long history, there is a lack of universal nondestructive methods of residual stress measurement with high spatial resolution.

During a development of nondestructive evaluation methods based on the photoacoustic effect it was found that the photoacoustic methods are very sensitive to the internal stresses. Under irradiation of an object by chopped laser beam thermoelastic waves are generated in the object's bulk and on the surface. It was shown that amplitude and phase of following acoustic waves may strongly depend on residual stress immediately near the

laser spot. Thus, one can obtain residual stress distribution with micron resolution using laser scan microscopy.

We performed experimental and theoretical study of photoacoustic effect in solids with residual stress [1–3]. Nonlinear model of thermoelastic photoacoustic effect in solids with residual stress was developed, because there is no residual stress influence on the photoacoustic signal in the frame of linear elastic theory. Using built photoacoustic microscope residual stress distributions was visualized in such materials as metals nanometals and composite ceramics. These experiments were used for an estimation of sensitivity of the photoacoustic method to mechanical stresses. It is also shown that these images can be used for extracting important relations between stress intensity factors of cracks characterizing external and residual stresses.

References:

- [1] Muratikov K. L. et al., *J. Appl. Phys.* 2000. 88: 2948–2955.
- [2] Muratikov K. L. et al. *High Temp.- High Press.* 2001. 33: 286–292.
- [3] Muratikov K. L., Glazov A. L. *Proc. SPIE.* 2003. 5066: 78–83.

---

PhD. Alexei L. GLAZOV  
A. F. Ioffe Physical-Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
Phone: +07 812 2479987  
Fax: +07 812 2471017  
E-mail: glazov.holo@mail.ioffe.ru

«VERY-MIXED» CLUSTERS OF SPECIFIED  
COMPOSITION. DIRECT INSERTION OF XIII GROUP  
METALS IN COORDINATION ENVIRONMENT  
OF TRANSITION METAL CARBONYL CLUSTERS

Elena V. Grachova

*St. Petersburg State University, Russia*

Compounds  $\mathbf{ECp}^*$  ( $\mathbf{E} = \text{Al, Ga, In}$ ;  $\mathbf{Cp}^* = \eta^5\text{-pentamethylcyclopentadienyl}$ ) can be used in organometallic chemistry of transition metals carbonyl

clusters as «building blocks» due to their capacity to substitute carbonyl ligands and to be coordinated directly with transition metal [1–2]. This fact opened up new possibilities to create small carbonyl clusters containing the bonds between transition and non-transition metals.

The reaction process between  $\text{ECp}^*$  and  $\text{M}_x(\text{CO})_y\text{L}_z$  ( $\text{M}$  is transition metal,  $\text{L}$  is heteroligand, for example phosphine) cluster complexes is controlled by very specific electronic and steric requirements for starting carbonyl clusters that gives hope to propose the product composition in advance [3–4].

Guided variation of the starting carbonyl cluster composition and geometry should permit to create the very special cluster objects with specified composition of transition and non-transition metals.

References:

- [1] Grachova E. V. Humboldt Introductory Meeting, Potsdam, Germany, November 21–23, 2002, Abstracts, p. 68.
- [2] Grachova E. V., Jutzi P., Neumann B., Schebaum L. O., Stammler H.-G., Tunik S. P. *Dalton Trans.* (2002) 302.
- [3] Grachova E. V., Jutzi P., Neumann B., Stammler H.-G. *IV Russian conference in the Cluster Chemistry: «Polynuclear systems and activation of small molecules»*, Ivanovo, Russia, August 25–29 2004, Book of Abstracts, p.96.
- [4] Grachova E. V., Jutzi P., Neumann B., Stammler H.-G. (Manuscript in preparation).

---

Dr. Elena V. GRACHOVA  
Department of Chemistry,  
St. Petersburg State University

26 Universitetskaya Ave., Old Peterhof  
198504 St. Petersburg, Russia  
Phone: +07 812 4284028  
Fax: +07 812 4286939  
E-mail: egrachova@hotmail.com  
E-mail: elena@EG5488.spb.edu

## DRINKING WATER CORRECTED TO THE COMPOSITION OF MINERAL ELEMENTS

Kristina A. Gusakova, Olga A. Pobilenskaya

*High School of Mechnikov's State Medical Academy,  
Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

The shortage of microelements (J and F) and macroelements (Ca and Mg) which provide drinking water with full value, causes locomotor, heart and thyroid gland diseases, and also lowering of mental faculties [1].

The aim of this work is the possibility of supplying people with drinking water of full value and increase of its consumer's quality.

While studying and analyzing literature and different methods of correcting the content of mineral elements in drinking water the most rational method of correcting the content of chemical elements was found. This method is the using of mineral addition «Severyanka» in drinking water. It was worked out by the scientists Pavlov's Institute of Physiology of the Russian Academy of Sciences under the guidance of Professor S. Churina [2].

The decision of the problem of the shortage of microelements (J and F) and macroelements (Ca and Mg) in drinking water in North-West of Russia with the help of mineral addition «Severyanka» is recommended by pediatricists of Saint-Petersburg, Institute of Nourishment, Institute of Cardiology of Russia.

### References:

[1] Voyner A. *Biological role of microelements in organisms of animals and people*. 2<sup>nd</sup> edition, M., High School, 1960, 277 p.

[2] Churina S., Makarov V., Semenov D. Artificial mineralized drinking water and elements for producing it. Patent RF № 2, 134 424. 1999.

---

Kristina A. GUSAKOVA

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281676  
Fax: +07 812 3280501  
E-mail: bvk@infran.ru

## NONLINEAR MAGNETO-OPTICAL SPECTROSCOPY OF THE SEMICONDUCTORS

A. M. Kalashnikova<sup>1</sup>, V. V. Pavlov<sup>1</sup>, R. V. Pisarev<sup>1</sup>, I. Sanger<sup>2</sup>,  
D. R. Yakovlev<sup>1,2</sup>, M. Bayer<sup>2</sup>

<sup>1</sup>*A.F. Ioffe Physical-Technical Institute, Russian Academy of Sciences,  
St. Petersburg, Russia*

<sup>2</sup>*Experimentelle Physik II, Universitat Dortmund, Germany*

The optical properties of semiconductors and semiconductor heterostructures are one of the most thriving fields of the solid state physics. However, *nonlinear* optics, and in particular second harmonic generation (SHG) being the simplest nonlinear process, is still far from the state of maturity that has been achieved in *linear* optics. At the same time the SHG can give an additional and completely new information about the electronic and spin structure of the semiconductors. Moreover applying the magnetic field gives rise to the new contributions to the SHG.

In the experiments the respective orientation of the sample, wave vector and polarization of the light were chosen so that the crystallographic contribution to the SHG vanishes.

In the diamagnetic GaAs the external magnetic field gives rise to a large number of narrow SHG lines in the vicinity of the fundamental band edge (Fig. 1) [1]. It is shown by means of studying the field dependencies of the signal that the magnetic-field-induced SHG lines can be assigned to the splitting of the valence and conductance bands by the Landau levels formation. The induced nonlinear polarization is the linear function of the field. The most surprising result is that the strongest SHG is observed in the polarization that is forbidden in the electric-dipole approximation. The phenomenological analysis of the angular dependencies of the signal shows that the nonlinear magneto-optical spatial-dispersion turns out to be of crucial importance for the observed field-induced SHG.

Another mechanism of the magnetic SHG is observed in the magnetic  $\text{Cd}_{0.76}\text{Mn}_{0.24}\text{Te}$  [2]. At temperature  $T < 35\text{K}$  in zero magnetic field the narrow band appears near the fundamental band edge (Fig. 2). The temperature dependence of the SHG intensity indicates that the signal is caused by the short-range spin ordering in the system of  $\text{Mn}^{2+}$  ions. The band in the SHG signal shifts to the lower energies when the external field is increased. This

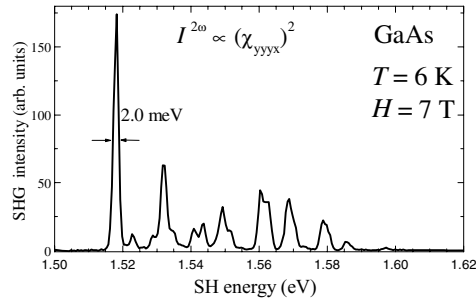


Fig. 1 Spectrum of the magnetic-field-induced the SHG in the GaAs.

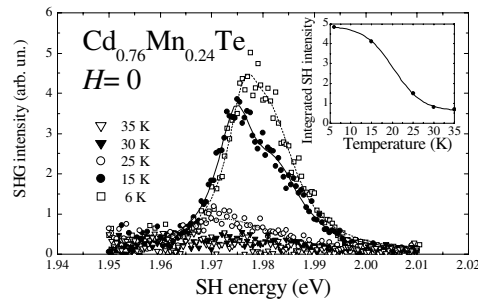


Fig. 2 Temperature dependence of magnetic SHG in (Cd,Mn)Te.

shift is related to the giant Zeeman splitting of the top of the valence band and the bottom of the conductance band. In conclusion, the different types of the magnetic SHG are observed and studied in the model semiconductors GaAs and (Cd,Mn)Te.

References:

- [1] Pavlov V. V. et al. *Phys. Rev. Lett.* (accepted).
- [2] Pavlov V. V. et al. *J. Opt. Soc. Amer. B.* 22, 168 (2005).

A.M. KALASHNIKOVA  
A. F. Ioffe Physical Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
Phone: +07 812 2479987  
E-mail: kalashnikova@mail.ioffe.ru

## HOW THE NEW TECHNOLOGIES CAN BE USED IN ORDER TO IMPROVE ACCESS TO LAW AND STATE ADMINISTRATION

Irina V. Kalinina

*LegalStudies.RU: Independent Legal Initiative NGO,  
Moscow, Russia*

Nowadays, we are facing the growing complexity of law and legal practice, on the one hand, and the worldwide tendency to make public administration more effective and transparent, on the other hand. Therefore there is a need for applying new technologies in order to improve access to law for its users, to create means for direct communications between state authorities with citizens, to design appropriate «whole of government approaches», to lessen compliance costs with due regard to the interests of all levels of government [1] etc.

For these purposes, the new technologies providing information and allowing direct communication, are developing both on the national and international level, in particular:

- accessible (via Internet) legal data bases focused on special topics, such as information, supporting small business (for example, the growing popularity of official web-sites/project supported for that purpose by Ministry of economic development of RF and, for example on the level of Moscow and its districts);
- introduction of electronic communication tools between citizens and public authority (for example, the introduction of facilities for electronic submission of tax returns, communication with local (district) authorities on the registration matters: German and Russian experience);
- developing of new systems of visualizing law (German and Russian experience) for its users.

New challenges of the developing information technologies: freedom of speech and encryption technologies to be used against public interests.

Reference:

[1] See, for example, OECD: *Principles of Good Tax Administration – Practice Note*. Prepared by the OECD Committee of Fiscal Affairs Forum on Strategic Management. GAP001, Issued: 25 June 1999, Amended: 2 May, 2001.

---

Irina KALININA, Ph.D in Law, LL.M.  
Director of Independent Legal Initiative  
«LegalStudies.RU», NGO

Moscow, Russia  
Phone: +07 095 7395141  
E-mail: info@legalstudies.ru  
<http://www.legalstudies.ru>

## LONG-WAVELENGTH QUANTUM WELL AND QUANTUM DOT LASER HETEROSTRUCTURES GROWN ON GaAs SUBSTRATES

Leonid Ya. Karachinsky

*A. F. Ioffe Physical-Technical Institute, Russian Academy of Sciences  
St. Petersburg, Russia*

Strong interest in long wavelength quantum dot (QD) lasers on GaAs substrates is motivated by the possibility to extend the advantages of the GaAs-AlAs material system to the mainstream datacom and telecom wavelengths. High-performance 1.3  $\mu\text{m}$  GaAs-based InAs QD lasers, including vertical cavity surface emitting lasers (VCSELs) have already been realized [1]. Two approaches are currently applied for 1.5  $\mu\text{m}$  GaAs-based lasers. In the frame of the first approach GaInAsN/GaAsN quantum wells [2] or GaInNAsSb/GaNAsSb quantum wells [3] are used as active region. The second approach is based on the concept of metamorphic growth [4]. Broad area lasers based on ten-fold stacked metamorphic InAs-InGaAs QDs grown using molecular beam epitaxy on GaAs substrates showed lasing in the range 1.48-1.52  $\mu\text{m}$ , threshold current density about 1-1.5  $\text{kAcm}^{-2}$  at 300K and external differential quantum efficiency up to 52 %. Output power exceeding 7 W was achieved under pulsed excitation [4]. Narrow ridge stripe lasers of the same type showed also high differential quantum efficiency of about 50%, single mode operation, and maximum cw power of 220 mW. Absence of beam filamentation was demonstrated up to the highest power levels studied. Obtained results clearly indicate that metamorphic InAs-InGaAs quantum dot lasers are promising candidates for high-performance 1.3  $\mu\text{m}$  – 1.5  $\mu\text{m}$  edge- and surface-emitting lasers on GaAs substrates.

References:

- [1] Bimberg D., Ledentsov N. N., Lott J. A. Quantum-Dot Vertical-Cavity Surface-Emitting Lasers. *MRS Bulletin*. 2002. 27: 531–538.
- [2] Gollub D., Moses S., Fischer M., Forchel A. 1.42  $\mu\text{m}$  continuous-wave operation of GaInNAs laser diodes. *Electron. Lett.* 2003. 39: 777–778.
- [3] Gollub D., Kamp M., Forchel A., Seufert J., Bank S. R., Wistey M. A., Yuen H. B., Goddard L. L., Harris J. D. Continuous-wave operation of GaInNAsSb distributed feedback lasers at 1.5  $\mu\text{m}$ . *Electron. Lett.* 2004. 40: 1487–1488.
- [4] Ledentsov N. N., Kovsh A. R., Shchukin V. A., Mikhlin S. S., Krestnikov I. L., Kozhukhov A. V., Karachinsky L. Ya., Maximov M. V., Novikov I. I., Shernyakov Yu. M., Soshnikov I. P., Zhukov A. E., Portnoi E. L., Ustinov V. M., Gerthsen D., Bhattacharya P., Zakharov N. F., Werner P., Hopfer F., Kuntz M., Bimberg D. *Quantum Dot Lasers: Physics and Applications*. SPIE Asia-Pacific Optical Communications APOC 04, November 1–11, 2004, Beijing, China, [5624–62].

---

Leonid Ya. KARACHINSKY

A. F. Ioffe Physical-Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
Phone: +07 812 2473620  
Fax: +07 812 2471017  
E-mail: karach@switch.ioffe.ru

$\alpha$ 3-IZOFORM OF  $\text{Na}^+$ - $\text{K}^+$ -ATPASE  
MODULATES PROCESS OF CELLS GROWTH  
IN THE CHICKEN RETINA

Andrey V. Karetsky, Ekaterina V. Lopatina\*, Valentina A. Pennyaynen\*\*

*St. Petersburg Research Institute of Phthisiopulmonology*

*\*Almazov Institute of Cardiology*

*\*\*I. P. Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

One of the tasks of the practical ophthalmology is the facilitation of the restoration processes of retina cells after surgery or therapeutic treatment.

We hypothesize that the  $\alpha 3$ -isoform of  $\text{Na}^+/\text{K}^+$ -ATPase is involved in the control of retina cell metabolism and its growth.

The experiments were performed in 10–12 day old chicken embryos. 800 explantats of retina tissue was investigating.

The culture media contained Eagle's Basal Medium with Earle's salt (BME) supplemented with 2 mg/ml D-glucose, 10 ng/ml insulin, 2 mm glutamine, 75 IU penicillin and 10% bovine fetal serum. The explants were grown on collagen at 36.5 °C with  $\text{CO}_2$ -incubation. Growth of the retina tissue was meargereated using a phase-contrast microscope. Morphology of retina tissue explantats was studied after staining with hematoxylin-eosin and metylene blue. In the growth zone pigment retina cells, ganglion cells and two types of photoreceptors cells were described.

The square index (SI) was calculated as the ratio of the whole explantat square area (peripheral growth zone included) to the central zone square area. The Student's criteria were used for statistical analysis. Data are expressed as means and SE. Differences were considered significant when  $p < 0.05$ . SI was expressed as a percentage; the SI of control explants was set as 100%. The control explants were grown in the nutrition medium without additives. The effects of noradrenalin and ouabain on the growth of explantat retina tissue were measured quantitatively.

Noradrenalin was investigated in a wide range of concentrations ( $10^{-9}$ – $10^{-12}$  M). In the concentration equal to  $10^{-12}$  M noradrenalin decreased SI in average to 40% in comparison with the control value ( $p < 0.05$ ). At the concentrations of  $10^{-8}$  M both noradrenalin and ouabain totally inhibited the growth of retina cells. Ouabain was investigated in the range of concentrations from  $10^{-13}$  M to  $10^{-8}$  M. It was found that ouabain in concentration of  $10^{-13}$  M stimulates the growth of retina cells on 34% in comparison with the control value ( $p < 0.05$ ).

It is known that  $\alpha 3$ -izoform and beta2-isoform of  $\text{Na}^+/\text{K}^+$ -ATPase are the dominant isoforms that are expressed in photoreceptors and retina [1]. It is  $\alpha 3$ -izoform of  $\text{Na}^+/\text{K}^+$ -ATPase that has so high affinity to ouabain. Our results show that simultaneous application of noradrenalin ( $10^{-12}$  M) and ouabain ( $10^{-8}$  M) leads to statistically reliable block of inhibiting ouabain effect. As a result of these agents simultaneous action was increase in the value of retina cell growth. The data obtained show that the agents that modulates  $\alpha 3$ -izoform of  $\text{Na}^+/\text{K}^+$ -ATPase could control retina cell growth.

Reference:

[1] Mey J., Tanos S. *Brain Research Revs.* 2000. 32: 343–379.

*The work was supported by the grant of Russian Basic Research Foundation № 04-04-49859.*

---

Andrey V. KARETSKY

St. Petersburg Research Institute  
of Phthisiopulmonology

2–4 Ligovsky Ave.  
St. Petersburg, Russia  
Phone: +07 812 2478528  
Fax: +07 812 2478528  
E-mail: ev11112@infran.ru

THE PROPRIETY LAW  
IN THE ANGLO-NORMAN ENGLAND.  
ABOUT BEGINNINGS OF MODERN EUROPEAN  
PROPRIETY LAW, A METHODOLOGICAL ASPECT

Andrey A. Kasatov

*Institute of History, Russian Academy of Sciences  
St. Petersburg, Russia*

One of the peculiar institutions of the English proprietary law was the seisin usually described by the verbal forms such as «sacire» (appeared about 700 in Gallia) or roman forms «saisire», «saisiare» etc. transferred in England after the Conquest. Our concern is not only to reconstruct the origins of the seisin as it given in continental sources of the 8–10 cc. but also to demonstrate the relations between the seisin and different forms of conveyance.

The institution «seisin» originated in German law and initially was the extrajudicial procedure of sharing and legitimating the acquisitions at meetings of Frankish warriors. Later act «sacire» became an official and public procedure used to obtain the property in the court.

In the Anglo-Norman kingdom contrary to the continental practice where the powerful person effected «seisin» it was now a king acting mostly through his representatives who did so. The act seisin guaranteed a protection of new owner's proprietary rights. The protection of the king made a new owner free of any dependence on whomever as to the disposing the property granted.

According to tradition different symbols were used for transferring the proprietary rights. The most popular were knives (*cultellus*). The Norman conquerors on their part must have borrowed the usage of the knife as a symbol from the Franks. There could be stable mental association in Anglo-Norman England between the knife and the sword symbolizing the rights of the high-ranking owners. There was a practice to break the knives that served for irrevocability of grant and firmer printing in memory the transfer.

Together with the symbol «*cultellus*» there existed not less popular symbol 'baculus'. It's worthy pointing out that it was the baculus that associated with verb «saisire». The symbol 'baculus' served in early time as substitute for the spear. It was spear that appeared at the ceremony of transferring property or authority by hereditary rights in German law. In general the symbolical acts with *baculus* served to exclude any claims and guaranteed the rights comparable with alodial ones. Its social area was much larger than this where the knife as a symbol had been applied.

Glanville (12 c.) and Bracton (13 c.) emphasized in their treatises the idea that it was seisin not the homage that served to transfer the property rights. The personal relations characteristic of feudal society weaken and give the way to proprietary ones.

My work is hardly to have been effected without the kind assistance of the colleagues from England and Germany. As a result of the correspondence per Internet the invitation to make a report in Max Planck Institute for European History of Law was received. Now the presentation in Power Point is in progress.

---

Dr. Andrey A. KASATOV  
Institute of History,  
Russian Academy of Sciences

7 Petrozavodskaja Str.  
197110 St. Petersburg, Russia  
Fax: +07 812 2356485  
E-mail: akasatov@mail.ru

## ENDOGENOUS ANTIBIOTICS CONTROL GATING MECHANISM OF TTX-RESISTANT SODIUM CHANNELS (Na<sub>v</sub>1.8)

I. E. Katina, E. A. Karymova, V. N. Kokryakov

*St. Petersburg State University  
Pavlov Institute of Physiology, Russian Academy of Sciences  
Science Research Institute of Experimental Medicine  
St. Petersburg, Russia*

Unmyelinated C-fibers originate from small primary sensory neurons and transmit nociceptive information into the CNS. Nociceptive neurons are unusual in expressing voltage-gated sodium channels resistant to tetrodotoxin (TTX-R, Na<sub>v</sub>1.8). The results of many studies suggest, that Na<sub>v</sub>1.8 may play an important role in the generation of spontaneous activity after axonal injury and therefore contribute to neuropathic pain. A selective action on pain might be expected from a drug that selectively targets this type of Na<sub>v</sub>1.8-channels in sensory afferents (exhibiting negligible actions on cardiac TTX-R Na<sub>v</sub>1.8-currents). Although no drug at present exhibits such selectivity, the development of selective blockers or modulators of neuronal Na<sub>v</sub>1.8 channels remains an attractive goal.

Ionic currents in short-term culturing DRG cells were investigated with whole-cell patch-clamp method. In previous papers we have shown that opioid analgesics decreased effective charge transfer in the activation gating system of Na<sub>v</sub>1.8-channels (Zeff) in a dose-dependent manner from 6–6.5 to 3.8–4.2 e<sup>-</sup>. In present study the same effect was obtained after extracellular application of endogenous antibiotic-peptides – defensins NP-1 and NP-4 in nanomolar range of concentration. To investigate the possible contribution of Na<sub>v</sub>1.8 gating properties to neuron excitability we carried out computer simulation using modified Hodgkin-Huxley model. Numerical simulation have shown that decreasing of Zeff from 6 to 4 is sufficient for pronounced positive shift of threshold and frequency-amplitude relationship. These data suggest that defensins may possess the analgesic action and show the direction of investigation of new class of drugs.

---

E. A. KARYMOVA

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281676 (add. 103)  
Fax: +07 812 3280501  
E-mail: okeann@bk.ru

## NEW RESULTS IN LASER SPECTROSCOPIC STUDIES OF ORGANOMETALLIC SANDWICH MOLECULES

Sergey Yu. Ketkov<sup>1</sup>, Heinrich L. Selzle<sup>2</sup> and Edward W. Schlag<sup>2</sup>

<sup>1</sup>*Razuvaev Institute of Organometallic Chemistry,  
Russian Academy of Sciences  
Nizhny Novgorod, Russia*

<sup>2</sup>*Institut für Physikalische und Theoretische Chemie  
der Technischen Universität München  
Garching, Germany*

The methods of nanosecond resonance-enhanced multiphoton ionization (REMPI) and mass-analyzed threshold ionization (MATI) have been employed to study the electronic structures of chromium 18 electron sandwich compounds  $(C_6H_6)_2Cr$  (**I**),  $(C_6D_6)_2Cr$  (**II**) and  $(C_6D_6)(C_6D_5H)Cr$  (**III**) cooled in a supersonic jet. The sandwich molecules were excited via the lowest Rydberg p state in a two-color experiment. The REMPI spectra show a rich vibronic structure of the Rydberg transition. Frequencies of over 10 normal vibrations in free sandwich molecules have been determined. The REMPI spectra demonstrate an extremely high sensitivity to the sandwich structure. When replacing only one deuterium atom in **II** with hydrogen, the peaks corresponding to the CH vibrations shift to higher frequencies and new features appear in the spectrum as a result of the symmetry reduction.

The MATI spectra appear to provide a very high accuracy (0.0002 eV) in determination of the first ionization potentials of bisbenzene complexes. The ionization energies of **I–III** are 5.4661, 5.4557 and 5.4561 eV, respectively. A 4 cm<sup>-1</sup> difference between the MATI peaks of **II** and **III** is clearly seen in the spectra. The MATI spectroscopy gives also vibrational frequencies of the gas-phase cations. The ground-state cation vibrational frequencies of the  $\nu_{21}$  (the metal-ligand symmetric stretch) and  $\nu_{11as}$  (the CH umbrella vibration) modes determined from the MATI spectra are, respectively, 262 and 788 cm<sup>-1</sup> for **I**<sup>+</sup>, 249 and 594 cm<sup>-1</sup> for **II**<sup>+</sup>, 251 and 595 cm<sup>-1</sup> for **III**<sup>+</sup>.

The  $R4p_{x,y}$  Rydberg term value determined from the MATI and REMPI experiments changes on going from **I** to **II**. This is assigned to the Jahn-Teller instability of the Rydberg state. The presence Jahn-Teller coupling is confirmed by appearance of the vibronic components corresponding to the  $e_{2g}$  modes in the REMPI spectra. Information obtained from the REMPI and

MATI spectra of **I** – **III** form a basis for further studies of the electronic structures and excited-state dynamics of sandwich molecules.

---

Prof. Sergey Yu. KETKOV

G. A. Razuvaev Institute  
of Organometallic Chemistry,  
Russian Academy of Sciences

49 Tropinin St.  
603950 Nizhny Novgorod, Russia  
Phone: +07 831 2127370  
Fax: +07 831 2127497  
E-mail: sketkov@iomc.ras.ru

## THE SUBJECT OF ECONOMICS debating with Lionel Robbins

Michael V. Khotyakov

*Economic Faculty, St. Petersburg State University  
St. Petersburg, Russia*

Since long time economics is no more trying to define itself. Quite a full stop in this question was put by Mr. Lionel Robbins in 1935 when his essay was first published. There he gave his now well known definition: «Economics is the science which studies human behavior as a relationship between ends and scarce means that have alternative uses». It covered all the fields economics at that time concerned and, everybody should admit, it now does. Nevertheless, this definition is not suitable, as it covers much more than it should.

A statement that a serious science can not develop without strong definition is wrong. Extension of knowledge opens frontiers for its further extension, and there is no finish. It is very important especially now, in the 21<sup>st</sup> century when these frontiers are so vague that they let sciences unite and knowledge – flow from one to another. But if we make an attempt to give a strong definition we should try not only to include in it everything we need, but also exclude what we don't.

Concept of the price seems to be fitting best to our needs. The price is considered as the result of interaction between supply and demand (which is not to be understood directly to include non-market economies). Each economical phenomenon deals with price, so the latter forms a part of the definition of economics, cutting off only spheres of human life that have a lot to do with ends and means, but nothing – with economics as everybody understands it.

---

Michael V. KHOTYAKOV  
Economic Faculty,  
St. Petersburg State University

9 Nastavnikov Ave., № 219  
195298 St. Petersburg, Russia  
Phone: +07 812 5247403  
E-mail: khmike@bk.ru

## MALDIVEAN REEFS: RECOVERY AFTER 1998 MASS BLEACHING EVENT

R. Kikinger<sup>1</sup>, A. Ostrovsky<sup>2</sup>

<sup>1</sup>*Biological Station Kuramathi, Maldives*

<sup>2</sup>*St. Petersburg State University, Russia*

In 1998 coral reefs were affected in a global scale by high seawater temperatures. During April and May 1998 the elevated seawater temperatures of up to 32 °C were recorded in the Maldives. As reaction to this temperature-stress many coral polyps expelled their single-celled symbiotic algae *Zooxanthellae*. The resulting loss of colour is known as coral bleaching. If no reinfection with *Zooxanthellae* occurs, the corals eventually die. In general, the high water temperatures are blamed for the global coral bleaching. However, other reasons are also discussed, for example increasing UV-radiation due to the decreasing atmospheric ozone shield. In any case, stressed reefs are especially vulnerable to infections with viruses and bacteria, to pollution, eutrophication and sedimentation.

The extent of damage of the Maldivian reefs was depth-related, species-dependant, and locally different. Corals in greater depths were less affected than shallow reefs. Branching species like staghorn and table corals (mainly of the genus *Acropora*) have been more affected than massive shaped corals (e.g. *Porites* sp., *Platygyra* sp., *Favia* sp., *Favites* sp.). In some reefs, erosive processes in a form of both, bioerosion and physical erosion are still dominating. Many branching corals are already eroded and form large areas of coral rubble.

The amount of regeneration and recolonization in the damaged reef is locally very different. The recolonization is mainly due to planktonic larvae and therefore depends on the local hydrographic conditions. Some damaged reef parts are colonized now by fast growing opportunistic species like sponges, soft corals, and ascidians. Within the reef-building hard corals some less sensitive species (for instance, *Porites* cf. *rus*) dominate the recolonization until now. In some sites *Acropora* colonies reached almost a meter in length during few years. However, the percentage of living-coral-cover is increasing only slowly, and it is unknown how much time the complete regeneration of the reef will need.

The fish population is still impressive, both in numbers and species diversity. No quantitative data are available, but a shift of species composition is supposed. Numbers of coral-polyp feeding specialists are low (some Butterfly fishes, File fishes), while herbivore fish (Parrot fishes, Surgeon fishes) and planktivore fishes (Fusiliers, red tooth Trigger fish) are abundant. Also, the number of large reef fish (groupers, snappers, barrakudas, sharks) seems to decline.

---

A. OSTROVSKY  
St. Petersburg State University

St. Petersburg, Russia  
E-mail: oan\_univer@yahoo.com

## EFFECT OF ETHANOL ON SENSORY NEURON NEURITE GROWTH IN ORGANOTYPIC CULTURE

A. V. Kipenko, V. A. Penniyaynen<sup>1</sup>, G. I. Lobov

*Mechnikov State Medical Academy*

*<sup>1</sup>Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

Effects of ethanol were investigated in organotypic tissue culture of sensory neurons of chicken embryos. The experiments were performed in 10–12 day old chicken embryos dorsal root ganglion [1]). The culture media contained Eagle's Basal Medium with Earle's salt (BME) supplemented with 2 mg/ml D-glucose, 10 ng/ml insulin, 2 mM glutamine, 75 IU penicillin and 10% bovine fetal serum. The explants were grown on collagen at 36.5 °C. Growth of the neurites was investigated using a phase-contrast microscope. Neurites morphology was studied after staining with hematoxylin-eosin and methylene blue. The square index (SI) was calculated as the ratio of the whole explant square area (peripheral growth zone included) to the central zone square area. The Student's criteria were used for statistical analysis. Data are expressed as means and SE. Differences were considered significant when  $p < 0.05$ . SI was expressed as a percentage; the SI of control explants was set as 100%. The control explants were grown in the nutrition medium without additives.

Ethanol was investigated in a wide range of concentrations (4–500  $\mu\text{M}$ ). Ethanol in concentrations of 100 and 40  $\mu\text{M}$  decreased SI on average on 30% in comparison with the control value ( $n=22$  and  $n=23$ , respectively;  $p < 0.05$ ). At concentration of ethanol exceeding 200  $\mu\text{M}$  the growth of neurites was totally inhibited.

It was shown, that application of 0,4  $\mu\text{M}$  ethanol to the culture medium leads to the increase of SI on 19+5% compared to the control. The neurite-stimulating effect was obtained when ethanol concentration was equal to 4  $\mu\text{M}$ . In this case the SI of the experimental explants increased on 58% compared to the SI of control explants. The data obtained show that application of small ethanol concentrations lead to neurite-stimulating effect.

Reference:

[1] Penniyaynen V. A. et al. *Tsitologiya*. 2003. 45(4): 377–379; 29: 445–448.

---

A. V. KIPENKO

I. I. Mechnikov State  
Medical Academy

47 Piskarevskij Ave.  
195067 St. Petersburg, Russia  
Phone: +07 812 5431409  
E-mail: kipenko@yandex.ru

MODULATORY EFFECT OF AMINOACIDS  
ON BRAIN CORTEX TISSUE CULTURE OF RATS

A. V. Komashnya, N. I. Chalisova, A. N. Zakutskii

*Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

Repair processes in tissues are known to be regulated by cytokines in opposite directions: cell proliferation can both be stimulated and be inhibited via apoptosis. However, it can be assumed that the aminoacids contained in cytokines as structural elements may exhibit certain regulatory properties with respect to target tissues *per se*. This aspect of the aminoacid effect is poorly understood thus far [1, 2]. The experiments were performed by method of organotypic culture [3–5] with 500 explants of the brain cortex of 1-day-old Wistar rats and 450 explants of the brain cortex of 21-day-old Wistar rats. All 20 essential and non essential aminoacids were added to the culture medium. Mainly low-hydrophobic aminoacids in the brain cortex culture of 1-day-old rats had the inhibitory effect on the development of immature brain cortex. So, lysine decreased area index by 25+3% compared to the control (n=24 and 21, respectively;  $p<0.05$ ). Asparagine, arginine, glutamine acid decreased area index by 40–45% compared to the control. Another picture was observed in the explants of 21-day-old rats. After the addition of lysine, arginine, asparagine and glutamine acid to the culture medium there was no decrease of growth area of explants (as in 1-day-old explants) and the means

of AI were at the level of means in control explants. It is observed the expressive stimulating effect of another group of high-hydrophobic aminoacids – of asparagine acid, tyrosine, valine, methionin. It is necessary to note, that the inhibitory effect in brain tissue culture was due to apoptosis development. Thus, we found differences in the responses of brain cortex explants to the aminoacids in newborn (1-day-old) and mature (21-day-old) rats. This effect of aminoacids can be used in clinic for treatment of neurological diseases.

References:

- [1] Fu Y. M., Yu Z. X., Li Y. Q. et al. *Nutr. Cancer*. 2003. 45: 60–73.
- [2] Oehler R., Roth E. *Cur. Opin Clin Nutr. Metab. Care*. 2003. 6: 277–282.
- [3] Chalisova N. I., Akoev G. N., Penniainen V. A. *Neurosci. & Behav. Physiol.* 1999. 29: 445–448.
- [4] Goncharova V. P., Chalisova N. I., Romanjuk A. V. et al. *Neurosci Lett.* 1987. 82: 1–5.
- [5] Levi-Montalchini R., Angeletty P. *Ann. Rev. Physiol.* 1982. 48: 534–569.

---

Dr. Natalia I. CHALISOVA

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.

199034 St. Petersburg, Russia

Phone: +07 812 3280701

Fax: +07 812 3280501

E-mail: nata@infran.ru

## SIMULATION AND MEASUREMENT OF FLOW PHENOMENA IN A COAXIAL JET MIXER

N. Kornev

*Institute of Technical Thermodynamics, University of Rostock  
Rostock, Germany*

The jet mixers are used in chemical engineering for homogenization of streams of different fluids or as chemical reactors to control chemical reactions. Despite of the geometric simplicity the flow in jet mixers is rather complicated. It takes two forms depending on the the ratio of the co-flow rate to the injected

one from the nozzle  $\dot{V}_D/\dot{V}_d$ . If the quantity  $(1+\dot{V}_D/\dot{V}_d)$  is larger than the diameter ratio  $D/d$ , then the flow pattern in the pipe is a similar to that of the free jet. When  $1+\dot{V}_D/\dot{V}_d < D/d$ , a co-flow separates near the pipe walls behind the nozzle and the recirculation area is generated. Both regimes were investigated using modern laser diagnostics technique and numerical simulations. The measurements [1] of the concentration of the injected liquid have been done using the laser induced fluorescence technique (LIF) with a high spatial resolution. The velocity field was obtained from LDV measurements. The theoretical part of the paper is based on the Large Eddy Simulation used to solve the filtered continuity and Navier–Stokes equations as well as the transport equations for the mixture fraction and the temperature [2, 3]. We proposed a new technique for generation of inflow conditions and clipping procedures for SGS models.

The recirculation area is a real challenge for mathematical modelling and measurement technique. It has been shown, that it is highly unsteady and contains concentrated coherent structures, whereas in previous knowledges the recirculation zone was considered as a steady symmetric vortex pair. We showed that the models of micromixing based on the beta-pdf distributions and classical RANS approaches (k- $\epsilon$ , k- $\omega$ , SST, RSM) failed in this area. Among SGS models of the LES only the dynamic mixed model seems to be able to describe the separated flow and turbulent mixing properly.

Using theoretical methods, two methods of the mixing control were proposed. It was shown that the flow rate oscillations can reduce the mixing length by 25% under certain conditions. If the excitation frequency is close to the eigenfrequencies of the vortices generated between the jet and the coflow we have an effect similar to resonance that is in this case for Strouhal numbers between 0.2 and 0.4. Enhancement of the overall mixing by a swirling jet is another possibility of mixing control. The larger is the non-dimensional angular velocity the shorter is the mixing length.

#### References:

- [1] Zhdanov V. L., Kornev N. V., Hassel E. Lasermethoden in der Strömungsmesstechnik. 12 Fachtagung. 7–9 September, 2004. Universität Karlsruhe. Karlsruhe, 2004. P. 16-1–16-8.
- [2] Jahnke S, Kornev N, Tkatchenko I., Hassel E., Leder A. (2004) Numerical study of influence of different parameters on mixing in a coaxial jet mixer using LES, Heat and Mass Transfer.

[3] Jahnke S., Kornev N., Hassel E., Leder A. LES simulation of jet mixing processes with heat transfer in turbulent pipe flow. *J. Chemical Engineering and Technology*. 2004. 27(3): 243–248.

---

N. KORNEV

Institute of Technical Thermodynamics,  
University of Rostock

2 A. Einstein Str.  
18059 Rostock, Germany

A NOVEL LIGHT SOURCE  
BY MEANS OF RELATIVISTIC PARTICLES  
PROPAGATION THROUGH A CRYSTAL

Andrei V. Korol

*St. Petersburg State Maritime Technical University  
St. Petersburg, Russia*

A novel mechanism of formation of intensive electromagnetic radiation of continuous spectrum is discussed from theoretical viewpoint and estimates of the feasibility of its experimental study is carried out.

The phenomenon to be discussed is the radiation from ultrarelativistic positively charged particles (positrons, protons, heavy ions) which experience strongly correlated collisions with atoms in the crystal whose crystallographic planes are periodically bent. This effect was very recently predicted theoretically [1] and gave rise to the research activity in the field which is called “radiation from a crystalline undulator”. Original ideas for constructing such an undulator are presented, the feasibility of a crystalline undulator is discussed, and the unique properties and characteristics of the spontaneous radiation formed in this device are analyzed. It is shown that this scheme allows to generate the intensive photon flux of the energy from tens keV up to several MeV. Also, we demonstrate the possibility to use a crystalline undulator for obtaining the laser-type emission within the photon

energy range far beyond those which could be achieved in conventional free-electron lasers.

Possible applications of the novel light source in technology, medicine, nano-science, nuclear waste diffusion are discussed.

References:

[1] Korol A. V., Solov'yov A. V., Greiner W. J. Phys. G: Nucl. Part. Phys. 24, L45–53 (1997), *ibid.* 27 95–125 (2001); Int. J. Mod. Phys. E 8, 49–100 (1999); *ibid.* 9, 77–105 (2000); *ibid.* 13, 867–916 (2004).

---

Dr. Andrei V. KOROL  
Department of Physics,  
St. Petersburg State Maritime  
Technical University

101 Leninsky Ave.  
198262 St. Petersburg, Russia  
Phone: +07 812 7571055  
Fax: +07 812 2479191  
E-mail: korol@pro.ioffe.rssi.ru

## FORECASTING OF THE ECOSYSTEM DISTRIBUTION IN A MOUNTAIN REGION (BY THE EXAMPLE OF THE CAUCASUS HIGH MOUNTAINS)

Konstantin O. Korotkov

*Severtsov Institute of Ecology and Evolution,  
Russian Academy of Sciences  
Moscow, Russia*

Long term study of plant communities in the Caucasus alpine belt reveals general trends in their regional distribution and local patterns as well. Relief forms (roughly divided into two categories – positive and negative, or convex and concave) satisfactorily explain basic variation in local vegetation pattern (at least for closed types – alpine meadows and alpine carpets). Climatic factors and primarily continentality are most likely to be responsible for regional distribution of vegetation types along the Great Caucasus Range.

A traditional approach in ecology seeks for ecosystem processes and patterns dependencies on environmental factors. The pointed out above results allow to state a reciprocal aim – to forecast vegetation pattern on the basis

of known geomorphology. This idea is being tested in high mountains of Caucasus – the region with well explored relief and phytosociology but many gaps in vegetation cover estimates primarily in hardly accessible or remote parts of this mountain system. Three keystone sites in the Western, central and Eastern Caucasus were elected for this study. Unfortunately it appears that the problem cannot be solved directly as it was stated above. Contour dimensions of local phytosociological unites can differ so great that do not allow there simultaneous representation on a map of single scale. Some necessary for this study fine relief contours are omitted on geomorphological maps of available scales in our country. The mapping of fine relief and vegetative units is not yet possible due to the lack of equipment for highly precise positioning. One way out is to switch from mapping of individual vegetation unites to mapping of their complexes.

---

Dr. Konstantin O. KOROTKOV

A. N. Severtsov Institute  
of Ecology and Evolution,  
Russian Academy of Sciences

33 Leninsky Ave.  
119071 Moscow, Russia  
Phone: +07 095 1312127  
E-mail: korotkov@polisma.ru

THE REUNITED ARCHIV OF OSIP MANDELSTAM  
AND A SMALL XML-BASED TOOLKIT  
FOR MANUSCRIPTS PUBLISHING IN THE INTERNET

Artem Kozmin, Pavel Nerler

*Mandelstam Society*  
*Moscow, Russia*

*The Main Project.* Mandelstam's poems, as well as the remainders of his family archive, were saved by his wife, Nadezhda Mandelstam: his brilliant poetry has found its readers through samizdat (unofficial typewritten publications), while the laboratory of the poet's creativity, and the heritage of his archive will find their readers through the internet, where the materials of

family archive (currently kept in Princeton University) will be reunited with dozens of other collections scattered throughout the globe. The project, titled «Reunited Digital Archive of Osip Mandelstam», is under construction and planned to be prepared together with Prof. Jennifer Baines (Oxford University) and Vladimir Litvinov (Mandelstam Society, Moscow).

The major objective of the project is the reunification and presentation of the archive of Osip Mandelstam (the great Russian poet perished in Stalin's Gulag in 1938) on the Internet. The images of archive documents will be displayed together with the poet's works in new scholarly editions, specially reworked as part of the project, and commentary.

At the same time, an important goal will be met: collections of archival documents pertinent to the life and work of Osip Mandelstam will be safeguarded by digitization.

Main goal of the toolkit is fast publishing of scanned literary manuscripts in the Internet.

*Technological Overview.* The toolkit is designed for Internet archive of Osip Mandelstam. As a rule, number of manuscripts of a poet or a prose writer is not large, so it is unreasonable to use «big» publishing systems. On the other hand, it is important that design of manuscripts representation would be customizable.

The best solution may be using of XML/XSLT/JavaScript. Now the toolkit includes: (1) a set of XML files; (2) a set of XSLT style files; (3) a set of JavaScript scripts for Windows OS. Each of XML files represents one manuscript. XML file contains path to image file of manuscript and archive information (source, code, etc.). JavaScript scripts transform XML files into Web pages (HTML files) using XSLT style files. The transformation is not dynamic, it creates static web pages, so they can be placed into all web servers. Customization of design is simple changing of XSLT files.

*Manuscript representing.* An XML file for single manuscript representation includes: (1) references to image files (high-, middle-, low-resolution); (2) text of the manuscript. All text pieces are encoded in TEI (TEI means Text Encoding Initiative). This makes files compatible with currently used mechanisms of text data handling. (3) reference to a commentary file. Commentary files are XML-based too.

*Styling files.* Style (XSLT format) files convert XML files into HTML files, i.e. they create a full web-site of digital manuscript archive. A style file includes: (1) site navigation elements (menus, headers, etc.); (2) style elements for text representing (paragraphs, corrections, etc.).

*Generating.* There is a single scripting file (JScript programming language) that generates HTML files for uploading on the web server. It runs under Windows. The main steps of work are: (1) getting a list of preferences for generation (path to style file, paths to image directories etc.); (2) getting of list of XML files (=manuscripts); (2) transformation of each XML files into HTML files using style file.

---

Dr. Artem KOZMIN  
Prof. Dr. Pavel NERLER (Polian)

akozm@mail.ru  
polian@aha.ru

INDUCTION OF AUTOIMMUNE ANTIBODIES  
TO THE NUCLEOLAR PROTEIN FIBRILLARIN  
BY LONG-TERM INJECTIONS OF SJL MICE  
WITH SUBTOXIC DOZES OF HgCl<sub>2</sub>

Marina S. Krasilshchikova, Elmira R. Kunafina,  
Anatoly I. Speransky\*, Olga V. Zatsepina

*Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry,  
Russian Academy of Sciences*

*\*Institute of Rheumatology, Russian Academy of Medical Sciences  
Moscow, Russia*

Autoantibodies against fibrillar, a 34-kD nucleolar protein associated with U3-snRNP, are present in blood of patients with systemic sclerosis, mixed connective tissue diseases, CREST syndrome and other autoimmune diseases (Kasturi K. et al., 1995). Anti-fibrillar autoantibodies can also be developed in mice of susceptible strains after administration of mercuric chloride (Takeuchi K., 1995; Monestier M., 1994). Similar to autoimmune diseases in humans, an experimentally induced autoimmune process is accompanied by formation of renal IgG deposits (Abedi-Valugerdi M. et al., 2000) and activation of B-lymphocytes (Abedi-Valugerdi M. et al., 2000).

Based on this data, it is tempting to suggest that experimental models of induction of anti-fibrillar antibodies can be used for testing of potent autoimmunity drugs. The main objective of this work was to study the dynamics of anti-fibrillar autoimmune response in SJL mice following long-time administrations of  $\text{HgCl}_2$ , and also when the administrations were ceased. Two months-old SJL and BALB/c females and males were injected *sc* twice a week with 40  $\mu\text{g}$   $\text{HgCl}_2$  during 20 weeks. Control animals (SJL and BALB/c mice) were injected with 0.9% sterile NaCl. Blood was taken weekly by retroorbital puncture under light ether anesthesia during the entire injection period and also within 19 weeks after its cessation. Anti-fibrillar autoantibodies were detected by indirect immunofluorescence (IIF) and electrophoretic mobility of the protein. We have shown that in blood of female and male SJL mice autoantibodies against fibrillar appear after 3 weeks of  $\text{HgCl}_2$  injections, and no essential differences in autoimmune response between the females and males were noticed. The maximum titer of anti-fibrillar antibodies (1:40000) was observed within 4–10 week  $\text{HgCl}_2$  of administration. Then, the autoantibody titer was declined by several magnitudes (1:5000), but the autoantibodies remained present at the detectable levels even when the injections of  $\text{HgCl}_2$  were ceased. The control mice did not develop anti-fibrillar autoantibodies at any time-point examined. Based on the dynamics of autoimmune response observed in the  $\text{HgCl}_2$ -injected SJL mice, we conclude that the animals are able to develop anti-fibrillar autoantibodies for a long period of time (not less than for 39 weeks), and thus represent an appropriate experimental model for testing of potent autoimmunity drugs.

---

Marina S. KRASILSHCHIKOVA  
Shemyakin & Ovchinnikov  
Institute of Bioorganic Chemistry,  
Russian Academy of Sciences

16/10 Miklukho-Maklay Str.  
117997 GSP Moscow, Russia  
Phone: +07 095 7273861  
Phone: +07 095 7531978  
E-mail: msk@ibch.ru

A DOUBLE-BLIND, PLACEBO CONTROLLED TRIAL  
OF NALTREXONE AND FLUOXETINE FOR HEROIN  
ADDICTION TREATMENT IN RUSSIA

E. Krupitsky, E. Zvartau, D. Masalov, M. Tsoi, V. Egorova,  
A. Burakov, T. Didenko, T. Romanova, A. Beshpalov, E. Verbitskaya,  
N. Neznanov, A. Grinenko, G. Woody

*St. Petersburg Scientific-Research Center of Addictions  
and Psychopharmacology affiliated with St. Petersburg State  
Pavlov Medical University  
St. Petersburg, Russia*

*University of Pennsylvania, Department of Psychiatry  
and Veterans Affairs Medical Center  
Philadelphia, PA, USA*

*Background:* Our previous double blind pilot study has demonstrated that naltrexone is more effective than placebo for relapse prevention in heroin addicts in Russia. However, that study provided no data to indicate that naltrexone itself reduced the depression, anxiety and anhedonia that are typically associated with heroin dependence and withdrawal following detoxification. It is possible that psychiatric symptoms might increase the risk for dropout and relapse, and therefore antidepressants might alleviate these symptoms and thus improve results of naltrexone medication. This study is aimed to test this hypothesis using fluoxetine with and without naltrexone.

*Methods:* 280 heroin addicts who completed detoxification at addiction treatment units in St. Petersburg and who provided informed consent were included into 6 month course of biweekly drug counseling and randomly assigned to one of four medication groups of 70 subjects each: Naltrexone (N) (50 mg daily) + Fluoxetine (F) (20 mg daily), Naltrexone + Fluoxetine placebo (P), Naltrexone placebo + Fluoxetine, and Naltrexone placebo + Fluoxetine placebo. The study design was four cell double-dummy and double-blind. Urine drug testing and brief psychiatric evaluations were done at each biweekly visit. Medication compliance was evaluated using a riboflavin marker; more extensive psychiatric evaluations were done at 3 and 6 months.

*Results:* 414 patients were asked if they would be interested, 343 gave informed consent and 280 met study entrance criteria and were randomized. At the end of six months, 43% of subjects in the N+F group remained in the

study and had not relapsed as compared to 36% in the N+P group, 21% in the F+P group, and 10% in the P+P group. Based on the retention rate in 6 months, N+F was more effective than P+P ( $p<0.001$ ), N+P was more effective than P+P ( $p<0.001$ ), F+P was also more effective than P+P ( $p<0.05$ ), N+F was more effective than F+P ( $p<0.01$ ), and N+P was more effective than F+P ( $p<0.05$ ); N+F did not differ significantly from N+P ( $p=0.2$ ). However, in women N+F was more effective than N+P probably due to a higher level of depression, anxiety, and anhedonia in women at the intake.

*Conclusions:* Both Naltrexone and Fluoxetine are more effective than placebo for relapse prevention in heroin addicts. Also, the combination of N+F and Naltrexone alone are more effective than Fluoxetine. The combination of N+F is more effective than Naltrexone alone only in women.

---

Dr. E. KRUPITSKY

St. Petersburg State  
Pavlov Medical University

6/8 Lev Tolstoy Str.  
197089 St. Petersburg, Russia  
Phone: +07 812 5327397  
E-mail: kru@ek3506.spb.eu

## NEW PHYSIOLOGICAL MECHANISMS FOR PAIN RELIEF

Boris V. Krylov

*Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

Nociceptive responses of sensory neuron cell membrane were investigated after application of comenic acid and infrared light low-power irradiation (IR) using whole-cell patch-clamp method. As a function of comenic acid dose, the effective charge transfer is found to be decreased in the activation gating system of the tetrodotoxin-resistant (TTXr) sodium channels which are responsible for peripheral pain sensation. Using the Hill equation, the value of the dissociation constant and the Hill coefficient is shown to be equal to  $K_d=100$  nM and  $n=0.5$ . The nonspecific antagonist of opioid receptor naltrexone is found to block comenic acid effects.

The low-power IR irradiation leads to diminishing of the effective charge transfer in the activation gating system of TTXr channels; this effect depends on the wave length. Maximal response is found for the  $\lambda=10.6 \mu\text{m}$ , which was generated by CO<sub>2</sub> laser. The effect was blocked by ouabain, the specific blocker of sodium pump. The data presented confirm the prediction that in the membrane of sensory neuron exists the signaling pathway that involves opioid receptor, sodium pump as a signal transducer and TTXr channel [1–2]. This mechanism is strongly involved in the process of nociceptive signal coding. The data obtained have implications in the fields of chronic pain relief and drug abuse treatment which are of the great importance for practical medicine [3].

References:

- [1] Krylov B. V. et al. *Rossiiskii Fiziologicheskii Zhurnal imeni I.M.Sechenova*. 1999. 85: 225–236.
- [2] Plakhova V. B. et al. *SPIE*. 2000. 4348: 143–145.
- [3] Krylov B. V., Shchegolev B. F. Substance with sedative effect. Pavlov Institute of Physiology RAS. United States Patent and Trademark Office. N 10/389.538. Filing date 03/14/2003.

---

Dr. Boris V. KRYLOV

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281301  
Fax: +07 812 3280501  
E-mail: krylov@infran.ru

## SELF-ASSEMBLED QUANTUM DOTS: GROWTH AND PROPERTIES

Natalia V. Kryzhanovskaya

*Ioffe Physical Technical Institute, Russian Academy of Sciences  
St. Petersburg, Russia*

In the present work self-ordered quantum dots for optoelectronic devices on the basis of semiconductors are discussed. Nanostructures are widely

explored for the use in the field of optoelectronics due to the promise of superior characteristics of devices, e. g. lasers. Currently diode lasers are widely used as cheap and compact sources of coherent light in many applications including data transfer, optical storage, diode pumping, laser printing, etc. Among existing variety of nanostructures the most exciting are quantum dots. Quantum dots (QDs), coherent inclusions in a semiconductor matrix, present the properties resemble those of atoms and rendering possible fascinating novel devices, in particular laser diodes. Discrete energy spectrum of QDs leads to higher temperature stability of devices, higher defect tolerance, potential for large output powers with stable emission wavelength, potential for extremely high speed operation, etc. In the beginning of the 1990s a modified Stransky-Krastanov growth mechanism driven by self-organization phenomena at the surface of strongly strained heterostructure was realized for the fabrication of the QDs [1]. Since then self-ordering phenomena on crystal surfaces has become a subject of intense experimental and theoretical studies. This method allows fabricating arrays of coherent QDs ordered in size and shape with high area density and high optical efficiency. Properties of QDs are highly dependent on the growth regimes and parameters and thus can be controlled. Influence of the growth parameters on the QDs optical and structural properties are discussed in this work for a widespread system InAs/GaAs as an example. Understanding of self-organization phenomena and optimizing of the growth conditions has resulted in quantum dots devices demonstrating advanced properties for different applications [2].

References:

- [1] Arakawa Y., Sakaki H. Multidimensional quantum well laser and temperature dependence of its threshold current. *Appl. Phys. Lett.* 1982. 40: 939–941.
- [2] Ledentsov N. N., Zhukov A. E., Ustinov V. M., Maximov M. V., Shernyakov Yu. M., Kryzhanovskaya N. V., Kaiander I. N., Ouyang D., Sellin R., Zakharov N. D., Werner P., Shchukin V. A., Kovsh A. R., Bimberg D. Near-ideal InAs Qds on GaAs substrates for 1.3–1.55  $\mu\text{m}$  laser applications. *Physica Scripta*. 2004. 114: 37–40.

---

Natalia V. KRYZHANOVSKAYA

A. F. Ioffe Physical-Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
Phone: +07 812 2473182  
Fax: +07 812 2473178  
E-mail: kryj@mail.ioffe.ru

## AMELIORATION OF ISCHEMIC BRAIN DAMAGE BY CREATINE SUPPLEMENTATION

M. V. Lensman, S. A. Polenov, V. A. Otellin\*, M. Balestrino♦,  
S. V. Burov\*, D. E. Korzevsky\*, V. B. Kostkin\*, A. I. Artemieva

*Pavlov Institute of Physiology, Russian Academy of Sciences*

*\*Institute of Experimental Medicine, Russian Academy of Medical Sciences*

*\*Institute of Macromolecular Compounds, Russian Academy of Sciences  
St. Petersburg, Russia*

*♦University of Genova  
Genova, Italy*

*Background:* One of the most important determinants of irreversible brain ischemic damage is critical decrease of ATP level. It has been repeatedly demonstrated in *in vitro* studies that administration of creatine (Cr) increases the neural content of phosphocreatine, delays ATP depletion and protects against harmful effects of anoxia. Although the data from *in vitro* models have been repeatedly confirmed, neuroprotection by creatine in *in vivo* models of ischemia has not so far been demonstrated.

*Aim and Methods:* At the present study we investigated whether or not intracerebroventricular (i.c.v.) Cr affords protection against brain ischemic damage *in vivo*. A cannula was inserted into the lateral cerebral ventricle of male Sprague-Dawley rats and connected to an Alzet osmotic mini-pump (pumping rate 0.25 µl/h). The latter was filled with either 50 mM Cr or saline and lodged subcutaneously between the shoulder blades. The solutions were continuously infused i.c.v. in two paradigms: (a) starting 5 days before the ischemia and continued for 7 days after the ischemia («prophylactic» paradigm) and (b) starting 30 min after the ischemia induction and continued for 7 days («treatment» paradigm).

Global cerebral ischemia (GCI) was induced in anaesthetised rats by clamping both common carotid arteries for 12 min with simultaneous controlled hypotension (45 mm Hg). On day 7 after ischemia rats were sacrificed, and removed brains subjected to the morphological analysis.

*Results:* Creatine i.c.v. administration in both «prophylactic» and «treatment» paradigms highly significantly (up to 12 times) reduced the percentage of shrunken neurons in various brain regions of ischemic rats as compared to control animals (ischemia with saline infusion).

*Conclusions:*

1. Exogenous Cr produced a remarkable neuroprotective effect against brain ischemic damage being administered i.c.v. both before and after induction of ischemia in rats. This is a first *in vivo* evidence of the beneficial role of exogenous Cr in the animal models of brain ischemia.

2. Thus, Cr can be an effective neuroprotective compound in brain ischemia. However, as Cr penetrate blood-brain barrier very poorly, and since i.c.v. administration is not practical in humans, development of novel analogs of Cr with better blood-brain barrier permeability together with high affinity to phosphokinase is needed, which may allow its use as a novel therapeutic remedy in brain ischemia and stroke.

*Supported by INTAS-grant 2000-0441 and RFBR-grant 05-04-08072 .*

---

Dr. Michael V. LENSMAN

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.

199034 St. Petersburg, Russia  
Phone: +07 812 3281301  
Fax: +07 812 3280501  
E-mail: lensman@kolt.infran.ru

THE INFLUENCE OF CARDIAC GLYCOSIDE  
ON THE GROWTH OF EXPLANTAT  
OF CARDIAC TISSUE

Ekaterina V. Lopatina, Vitaly A. Tsyrlin

*Almazov Institute of Cardiology  
St. Petersburg, Russia*

The hypothesis that the  $\text{Na}^+, \text{K}^+$ -ATPase is a signal transducer was investigated on cardiac tissue [1, 2]. The experiments were performed in 10–12 day old chicken embryos [2]. The culture media contained Eagle's Basal Medium with Earle's salt (BME) supplemented with 2 mg/ml D-glucose, 10 ng/ml insulin, 2 mm glutamine, 75 IU penicillin and 10% bovine fetal serum. The explants were grown on collagen at 36.5 °C with

CO<sub>2</sub>-incubation. Growth of the explant of embryonic cardiac tissue was investigated using a phase-contrast microscope. Morphology of cardiac tissue was studied after staining with hematoxylin-eosin and methylene blue. The square index (SI) was calculated as the ratio of the whole explant square area (peripheral growth zone included) to the central zone square area. The Student's criteria were used for statistical analysis. Data are expressed as means and SE. Differences were considered significant when  $p < 0.05$ . SI was expressed as a percentage; the SI of control explants was set as 100%. The control explants were grown in the nutrition medium without additives. The effects of ouabain, strophantin K and digoxin on the growth of explant cardiac tissue were measured quantitatively. We have found the value of the concentration of ouabain which stimulates the activity of Na<sup>+</sup>,K<sup>+</sup>-ATPase, as the signal transducer. It was equal to 10<sup>-10</sup> M. The growth zone included 97% cardiomyocyte and 3% fibroblasts.

Strophantin K and digoxin stimulate growth of cardiac tissue in concentration equal to 10<sup>-16</sup> M and 10<sup>-18</sup> M respectively. In the last case, the value of the growth zone of 90% of fibroblasts was described. The data obtained show that the application of glycosides led to control of cardiac tissue growth in the dose-dependent manner. We hypothesize that  $\alpha 3$ -isoform of Na<sup>+</sup>,K<sup>+</sup>-ATPase controls as a signal transducer the process of regulation of cardiac cell metabolism and their growth.

References:

- [1] Z. Xie, A. Askari. *Eur. J. Biochem.* 2002. 269(10): 2434–2439.
- [2] E.Lopatina, V. Pennijainen. *Byull. Exper. Biol. i Med.* 2005. 8.

*The work was supported by the grant of Russian Basic Research Foundation № 04-04-49859.*

---

Dr. Ekaterina V. LOPATINA  
Almazov Institute of Cardiology

15 Parkhomenko Str.  
194156 St. Petersburg, Russia  
Phone: +07 812 5500700  
Fax: +07 812 3280501  
E-mail: ev11112@infran.ru

A NEW PHYSIOLOGICAL MECHANISM  
OF THERMOREGULATION OF HOMOIOOTHERMAL  
ORGANISMS IN THE THERMONEUTRAL ZONE

Yuri I. Luchakov

*Pavlov Institute of Physiology, Russian Academy of Sciences,  
St. Petersburg, Russia*

A new mechanism of thermoregulation in the thermoneutral zone (TNZ) area has been elicited in homoiothermal animals. Physiology of thermoregulation of homoiothermal organisms distinguishes the core (internal area of the organism providing constant temperature) and tissues of the membrane (peripheral areas of the organism changing the temperature in a few degrees) [1]. Our investigations have indicated that the heat transmission in tissues of the organism core occurs in a convectional way due to the blood flow in the vascular bed, whereas the heat transmission in tissues of the membrane occurs in a conductional way due to the temperature gradient. Experimental and theoretical studies have shown that the sizes of the core area and membrane change when the ambient temperature is not stable. When rising the ambient temperature within the TNZ, the core area in the organism is extended, whereas the membrane area is reduced. Due to this phenomenon, the temperature of core tissues remains invariable.

Thus, changing the ambient temperature, the temperature of core tissues remains constant without changes in heat production and heat loss processes due to the mechanisms of change in the core size and membrane.

Reference:

[1] Ivanov K. P. *The principles of energetics in organism: Theoretical and practical aspects*. Vol. The general energetics, heatexchange thermoregulation. (1990).

---

Dr. Yuri I. LUCHAKOV

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281301  
Fax: +07 812 3280501  
E-mail: luch@infran.ru

BIOTECHNOLOGY FOR THE IMPROVEMENT  
OF INDICA RICE – APPLICATION OF MOLECULAR  
GENETIC TRANSFORMATION METHODS  
FOR THE GENERATION OF TRANSGENIC RICE

Lutful Hassan

*Bangladesh Agricultural University  
Mymensingh-2202, Bangladesh*

We develop a protocol for the efficient DNA transformation in indica rice (*Oryza sativa* L.) using *Agrobacterium tumefaciens* strains. Although there are problems relating to regeneration and transformation but overall the indica rice transformation system was based upon the development of a tissue culture protocol of multiple shooting inductions, shoot elongation and rooting. Therefore, much effort is still necessary before a reliable protocol is developed for the transformation and regeneration to obtain transgenic indica rice. We used *Agrobacterium tumefaciens* strains I) the strain GV3101 with the vir plasmid pMP90 II) the strain C58C1 ATHV with the vir-plasmid pTiBo542, a strain similar to EHA101 which has been shown to be highly virulent for many of the important crops. As selectable marker genes the *nptII* gene (*neomycin phosphotransferase*) was used. As reporter gene the  $\beta$ -*Glucuronidase*-gene (GUS-Gene: Jefferson *et al.* 1987) under the control of the Ubi and the 35S-Promotor and with an Intron (Vancanneyt *et al.* 1990) were used. MS media supplemented with 5.0 mg/l of TDZ, 0.5 mg/l GA<sub>3</sub> and 2.0 mg/l of Kinetin proved to be the best combination for the shoot regeneration. The above findings together with modifications of the protocol was followed to achieve a high rate of transformation and regeneration in indica rice. The putative transformants were transferred to the hardening chamber after rooting. In order to identify & characterize the transgenic plants the plantlets will be tested by performing polymerase chain reaction (PCR) and southern blot analysis to determine the integration and copy number of the transgenes.

---

Professor Dr. LUTFUL HASSAN  
Department of Genetics & Plant Breeding,  
Bangladesh Agricultural University

Mymensingh-2202, Bangladesh  
Phone: +880 91 54968  
Fax: +880 91 55810  
E-mail: LH@royalten.net

## THE HYGIENE OF LOCOMOTOR APPARATUS OF PUPILS

Zhanna S. Matveeva, Olga A. Pobilenskaya

*High School of Mechnikov's State Medical Academy  
Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

Such diseases of locomotor apparatus of pupils as flat-footedness and breach of attitude are widely spread nowadays. At the same time observing certain hygienic habits can prevent the illnesses.

The aim of this work is to name the rules of forming right attitude and prophylaxis of flat-footedness (using the results of checking up a group of pupils at the age of 7–18 with diseases of locomotor apparatus) [1].

For having the right attitude pupils must sit well at the desk. Classrooms for pupils at the age of 12–14 (who have great difference in height) should be well-appointed with desks of three or four types in measuring. Massage and a complex of special gymnastic exercises are of great importance in the development of locomotor apparatus.

For forming a good skeleton pupils must get health food and balanced amount of mineral matters (Ca, Mg and F are obligatory).

To prevent flat-footedness, children's shoes must be tight-fitting (but shouldn't be too tight), must have hard back, elastic sole and a heel no more than 8 mm (due to hygienic demands).

Regular special gymnastic exercises (done during the school hours), massage and cool bath strengthen copula and muscle of feet.

At the beginning of flat-footedness it is obligatory for pupils to use inner soles – arch supports in the shoes; they correct the form of feet.

Reference:

[1] Smetancin A. *Health without medicine: biological adverse effect*. St. Petersburg: «Bioeffect» Publishing House, 2001, 68 p.

---

Zhanna S. MATVEEVA

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281676  
Fax: +07 812 3280501  
E-mail: bvk@infran.ru

SEMICONDUCTOR LASERS  
BASED ON SELF-ORGANIZED QUANTUM DOTS:  
FROM INVENTION TO COMMERCIALIZATION

M. V. Maximov<sup>1</sup>, N. N. Ledentsov<sup>1,2</sup>

<sup>1</sup>*Ioffe Physical Technical Institute, Russian Academy of Sciences,  
St. Petersburg, Russia*

<sup>2</sup>*Institut für Festkörperphysik, Technische Universität Berlin,  
Berlin, Germany*

Quantum Dot (QD) lasers emerged about decade ago and now they are one of the most rapidly developing and exciting area in the field of semiconductor optoelectronics. A QD is a coherent inclusion of a narrow gap material in a wide gap matrix in which electrons are quantized in all three spatial directions. Thus, a single semiconductor QD exhibits a discrete  $\delta$ -function-like energy spectrum similar to that in a real atom keeping the advantage of direct current injection, impossible in other types of lasers based on atomic transitions. The physical advantages of QD lasers resulting from  $\delta$ -function-like density of states are: low threshold current, high material gain, high temperature stability of the threshold current (characterized by characteristic temperature  $T_0$ ), high differential efficiency, high differential gain, small  $\alpha$ -factor and correspondingly reduced filamentation and chirp (shift of the lasing wavelength with current).

In addition, QD medium has some advantages, which are not directly related to size quantization effects such as the possibility to reach emission wavelengths that are larger than those obtainable with quantum wells of the same material system. For instance, lasing at wavelengths up to 1.32  $\mu\text{m}$  is demonstrated for InAs QDs on GaAs substrate, in contrast to quantum wells devices, in which lasing is limited to approximately 1.15  $\mu\text{m}$ .

At present all the advantages of QD laser are basically experimentally proved. At the same time we believe that still there is room for improvement in characteristics of QD lasers. Experimental and theoretical studies of QD lasers are exploding scientific areas and further progress in the field of QD lasers can be foreseen. Recently the first commercial QD lasers have been announced.

Reference:

[1] Bimberg D., Grundmann M., Ledentsov N. N. *Quantum dot Heterostructures*. John Wiley & Sons, Chichester, 1999.

---

M. V. MAXIMOV

A. F. Ioffe Physical Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
E-mail: maximov@beam.ioffe.ru

## ANCIENT GRAMMAR AND ITS POSTERIOR TRADITION IN THE MODERN SCIENCE

Vladimir I. Mazhuga

*St. Petersburg Institute of History, Russian Academy of Sciences  
St. Petersburg, Russia*

The modern grammatical terminology, the most of grammatical paradigms have been created in the Classical Antiquity. The terms had however their particular history, which is investigated in a very modest measure. There were many disputes about the questions of language between the ancient grammarians and philosophers, which remain very interesting for the modern linguists. One needs meantime the detailed studies for better understanding of old theoretical disputes, known only in the fragmentary form

The German Philologists of the 19<sup>th</sup> and of the beginning of the 20<sup>th</sup> century have published the main bulk of the Greek, Roman and Byzantine grammatical texts. These critical editions build up to now the solid ground of all researches in the field of the history of linguistics. Since about the 1830s until 1914 the commentaries on these texts were published regularly in Germany, a considerable number of which appeared as theses issued from the university seminars of Königsberg, Leipzig, Halle, Bonn, Jena, Greifswald, Kiel and somewhere else. H. Steinthal, L. Jeep and somewhat later Karl Barwick have presented great essays on the general development of gram-

matical thought of Antiquity. Prof. W. Ax and many other scholars continue this scientific tradition in Germany.

It is especially in two last decades that the studies on the history of linguistics became a matter of international concern. Some important learned Societies were built, such as Henry Sweet Society, Societe d'Histoire et d'Epistemologie des Sciences du Langage (France), Studienkreis 'Geschichte der Sprachwissenschaft (Germany) and the Seminarium Historiographiae Linguisticae (Belgium). All these societies pay much attention to the origins of the linguistics in the Antiquity. Their activities are being deployed essentially in organizing international colloquia and in publishing the papers presented.

The legacy of the eminent German Philologists together, as well as studies of their pupils, is being anew studied and evaluated. Yet some other national traditions flow together with the great German tradition. Since about the 1950s the Italian scholars represent a particular stream in the historiography of linguistics. Their studies are distinguished by the special interest in researching the manuscripts. The late English scholar Vivian Law and French scholars Louis Holtz and Colettes Jeudy joined the Italian colleagues. Thanks chiefly to the activities of Jean Collart and Pierre Flobert a new flourishing school arose in France in the second half of the 20<sup>th</sup> century. One must mention else the new researches in the Low Country and now in Finland and Greece.

In the former Soviet Union, the ancient grammar was studied mainly in the University of Lvov (L'viv, Lemberg) in the footsteps of some brilliant Polish scholars. Now, as the Russia is becoming more and more an open country and recovers its former European connections, Saint-Petersburg is growing up to the center where many European scholars meet.

On April 20–23, 2005, the Institute of Linguistic Studies of the Russian Academy of Sciences and F.W.O Scientific Network "History and Historiography of Western Linguistics" had organized an international scientific colloquium "Ancient Grammar and its posterior tradition". The most of the participants come from France, Italy, Belgium, Switzerland, Germany and Cyprus. Nine Russian colleagues have contributed to composing a coherent and interesting program.

The reporters treated the history of classical Greek and Roman grammatical doctrines, as well as the early philosophical language theories. Special sessions were devoted to the later manuscript tradition of classical grammatical theory and to the persistence of the classical paradigms in grammar

teaching until the Modern times. The colloquium languages were French, English, German and Italian. The Russian was reserved for discussions.

---

Dr. Vladimir I. MAZHUGA

St. Petersburg Institute of History,  
Russian Academy of Sciences

7 Petrozavodskaya Str.  
197110 St. Petersburg, Russia  
Phone: +07 812 5114768  
Fax: +07 812 2354198; 2356485  
E-mail: VMazhuga@mail.ru  
E-mail: VMazhuga@nevalink.ru

BUILDING OF EFFICACIOUS  $\alpha$ -CONOTOXIN BINDING  
MODEL TO NICOTINIC ACETYLCHOLINERECEPTORS  
AND ACETYLCHOLINE BINDING PROTEINS

D. Yu. Mordvintsev, I. E. Kasheverov, M. N. Zhmak, V. I. Ilin,  
Yu. N. Utkin, V. I. Tsetlin

*Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry,  
Russian Academy of Sciences  
Moscow, Russia*

The modeling of interactions dynamics and final conformational states of the complexes of  $\alpha$ -conotoxins (small neurotoxic peptides isolated from venomous mollusca *Conus*) with extracellular domains of nicotinic acetylcholine receptors (nAChR) was performed, also as design of artificial conotoxins with elevated affinity and selectivity. The action of natural  $\alpha$ -conotoxins on different nAChR subtypes and water-soluble acetylcholine binding proteins of *Lymnea stagnalis* and *Aplysia californica* (AChBP, exhibit the fold and functional characteristics of extracellular domains of nAChRs) was investigated. Models of extracellular domains of nAChRs were built using comparative modeling techniques on basis of known X-ray structures of AChBPs and their complexes with low-weight agonists. Molecular dynamics procedures were carried out to check the mobility of subdomains. Natural conotoxins were docked to structures obtained and

maps made according both literature and docking data. Affinity and selectivity influencing substitutions in conotoxin sequences were predicted, 3D structures of such “mutants” created, analysed and docked again. Best solutions were selected and conotoxins with these substitutions synthesized, e.g. PnIA[A10L,D14K] (PnIA conotoxin with Ala10 and Asp14 changed to Leu and Lys, respectively). Their activity was measured on both the AChBPs and natural nAChRs. Predicted characteristics correlated sufficiently to experimental data. Thus PnIA[A10L,D14K] Kd to *Aplysia* AchBP consisted 27,5±23,6 nM and 31±9 nM, by isothermic calorimetry and binding free energy calculation, respectively. Hence the model constructed is satisfactorily to be used for rational virtual design of  $\alpha$ -conotoxins with wishful affinity and selectivity to different pharmacological subtypes of nAChRs.

---

D. Yu. MORDVINTSEV

Shemyakin & Ovchinnikov  
Institute of Bioorganic Chemistry,  
Russian Academy of Sciences

16/10 Miklukho-Maklay Str.  
117997 GSP Moscow, Russia  
Phone: +07 095 1619494  
E-mail: chlorine@yandex.ru

#### EFFECT OF CREATINE TREATMENT ON BEHAVIORAL CONSEQUENCES OF GLOBAL CEREBRAL ISCHEMIA IN RATS

V. O. Mourovets, M. V. Lensman, A. I. Artemieva,  
V. A. Zolotarev, S. A. Polenov

*Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

Compensation or expansion of brain reserves of macroergic compounds seems to be very perspective method of ischemic brain damage prophylaxis and treatment. The purpose of the present study was to evaluate the protective and therapeutic efficiency of creatine (Cr) on neurological and cognitive consequences of global (GCI) ischemia in rats.

*Methods:* GCI was induced in nembutal-anesthetized male Sprague-Dawley rats by transient (12 min) occlusion of both carotid arteries and simultaneous arterial hypotension to 45 mm HG (2 VO + Hypo model). For neurological examination test battery combined from tests of the muscular strength and sensomotory coordination was used. Cognitive impairments were assessed in spatial version of Morris water maze. Water maze learning (4 trials with 30 sec intertrial interval daily, five consecutive test days, constant location of hidden platform, search time was limited to 120 sec, four diametric starting points varying between trials) started two days after induction of GCI. Osmotic minipumps (Alzet-pump filled with 50 mM or 100 mM Cr saline or physiological saline or glycerol solution) were used for continuous (2.5  $\mu$ l/h) infusions through i.c.v. cannulae. Glycerol was used to assess the osmolarity effect *per se* as compared to the similar concentration of Cr.

*Results:* The i.c.v. infusion of Cr or saline *per se* did not impair cognitive abilities and neurological state of rats. Cr significantly reduced GCI-induced neurological impairments when administered five days before GCI (prophylactic paradigm), however, it had tendency to retard water maze acquisition in doze-dependent manner (100 mM more then 50 mM). I.c.v. glycerol infusion completely blocked water maze acquisition after GCI: glycerol-treated rats did not demonstrate any task acquisition during first 5 days of learning and significantly differed from both Cr and saline-treated rats. Cr i.c.v. infusion, started immediately after GCI (treatment paradigm) did not reduce neurological impairments and retarded water maze acquisition. Hence, one may conclude that not Cr *per se* but i.c.v. infusion after GCI is responsible for cognitive impairments. Moreover, additional control experiments with i.c.v. glycerol suggest that the absence of beneficial effects of Cr i.c.v. infusion on cognitive abilities of rats after GCI may be explained also by osmotic effects of Cr solution on the brain tissue. In conclusion the i.c.v. Cr pretreatment is capable of reducing neurological impairments, but the i.c.v. route of infusion and osmolarity of Cr solution may mask possible beneficial effect of Cr on cognitive abilities when it is administered after GCI.

*Supported by INTAS-grant 2000-0441 and RFBR-grant 05-04-08072 .*

---

Dr. Vladimir O. MOUROVETS

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 583607  
Fax: +07 812 3280501  
E-mail: murovetss@yahoo.com

## NATURAL NUCLEAR REACTOR OKLO AND VARIATION OF FUNDAMENTAL CONSTANTS

A. Nazarov

*Petersburg Nuclear Physics Institute, Russian Academy of Sciences  
St. Petersburg, Russia*

Number of prominent scientists of the last century (E. Miln, G. Gamov, P. Dirac and F. Dyson) suggested the variation of fundamental physics constants in time. In 1976–1977 Prof. Yu. Petrov and his PhD-student A. Shlyakhter understood, that natural nuclear reactor Oklo, which run in Gabon  $1,8 \cdot 10^9$  years ago, is a best experimental device for measuring the temporal changes of the cross sections of strong absorbers [1]. The resonance shift  $DE_r \sim G_g/2 \gg 0.05eV$  ( $G_g$  is width of absorption resonance), changes of the absorption cross section is strongly. In report [2] for the first time we are compute the reactor neutron spectrum for the fresh core of reactor Oklo, using full-scale computer model and modern Monte-Carlo methods. After averaging the  $\gamma$ -capture cross-sections of  $^{149}_{60}Sm$  over the reactor neutron spectrum and comparing it with data, were obtained the most accurate limit on a rate of changing of the electromagnetic constant  $\alpha$ :

$-4\text{q}0^{-17} \text{ year}^{-1} < \frac{d\alpha}{\alpha} < 3\text{q}0^{-17} \text{ year}^{-1}$ . The influence of the fuel burn-up will be taken into account in the next two years. The fuel burn-up can show the negative shift of fundamental constants.

References:

[1] a) Shlyakhter A. Nature, 264 (1976) 340; б) Petrov Y., UPS, 123 (1977) 477–486.

[2] Petrov Yu. V., Nazarov A. I., Onegin M. S., Petrov V. Yu., Sakhnovsky E. G. Natural Reactor Oklo and Variation of Fundamental Constants Part 1: Computation of Neutronic of Fresh Core. Preprint PNPI-2581(2004) 58 p.

---

Dr. A. NAZAROV

E-mail: alnazar@thd.pnpi.spb.ru

Petersburg Nuclear Physics Institute,  
Russian Academy of Sciences

## FEATURES OF INNOVATIONS IN FINANCIAL SPHERE

Tatjana V. Nikitina

*State University of Economic and Finance  
St. Petersburg, Russia*

Now international financial system in the increasing degree becomes a global information-financial complex. In this connection, it is necessary to search the answer to a question, why so conservative financial institutions, such as the banks inclined to traditional ways of organisation of management, now actively have engaged innovations probably, in features of development of modern world (global) economy, in epoch globalisation, information technologies, which make a nucleus innovative of changes. The functioning of banks for today as never in many respects depends on changes occurring in external environment.

These changes occur at several levels: global, regional, national.

It is possible to unit major factors determining directions of transformation in banks, in the following groups:

1. Globalisation of the financial markets, predetermined transition to more homogeneous market of financial services.
2. Liberalisation and deregulation of the national financial markets promoting occurrence of the new competitors, not being banks (suppliers of new bank technologies, telecommunication firms; supermarkets etc.).
3. Transition to the world (global) integrated technological systems (Internet) giving an opportunity to generate a uniform global network.
4. Demographic factors, in particular ageing of the population, which define(determine) potential demand for services of banks.
5. Factors connected to legislative restriction of certain kinds of operations.

References:

- [1] <http://www.investor100.ru/articles/novye-bankovskie-produkty.htm>, 14.02.2005.
- [2] Gotovtshchikov A. Ways of introduction of new bank technologies. *Bank technologies*. 2004. 9: 38–40; 2005. 1. - With. 26.
- [3] Sacharov J. Innovationsmanagement by process in bank. *The Bulletin of the financial information*. 2000. 6: 61.

---

Tatjana V. NIKITINA  
State University  
of Economic and Finance

St. Petersburg, Russia  
Phone: +07 812 3194942  
E-mail: nikitina@finec.ru

## NARROW VERTICAL BEAM DIVERGENCE LASER DIODES BASED ON LONGITUDINAL PHOTONIC BAND CRYSTAL WAVEGUIDE

Innokenty I. Novikov

*Ioffe Physical Technical Institute, Russian Academy of Sciences  
St. Petersburg, Russia*

The efficient coupling of radiation from a semiconductor laser diode to single-mode or multimode fiber is critical in the performance/cost ratio in applications from pump laser diodes for optical amplifiers to industrial and medical optical power delivery systems. High divergence of emitted beam makes coupling between the laser and optical fiber difficult and requires the use of sophisticated optical elements to correct the beam shape. Recently, an idea of using an a longitudinal photonic band crystal (PBC) structure has been proposed to realize stable single-mode lasing with an arbitrary narrow modal spot size [1]. A longitudinal PBC with an irregularity (an optical defect) can be designed in such a way that only one optical mode, e. g. the fundamental one, is localized at the defect and decays away from it, whereas all other (high-order) optical modes are extended over the entire photonic band gap crystal due to the effective “resonant tunnelling effect” and show order (orders) of magnitude higher leakage losses. In a similar manner in our waveguide only one (the fundamental) mode is localised at the PBC waveguide region having a maximum intensity in the gain region (multiple quantum wells (QWs)) while all extended high-order modes are leaky and penetrate into the substrate or the contact layers.

Our results on 980 nm PBC lasers with ultrabroad ( $>10\ \mu\text{m}$ ) waveguide were described in [2, 3]. Small vertical divergence less than  $10^\circ$ , high differ-

ential efficiency of 85% and CW output power of 1.8 W (10.6 W pulsed) have been obtained. For lasers with increased modal spot size very small vertical divergence emitting angle of 4.8° has been realized [2, 3].

In this work we study the properties of a red PBC GaInP-AlGaInP semiconductor laser and compare its performance with that for conventional red DVD lasers currently used for commercial applications. Very small vertical divergence of 8° (full width at half maximum), high differential efficiency up to 85% and pulsed output power of 20 W are obtained. This value is 2.5 higher with respect to the number obtained for the lasers fabricated from the state-of-the-art epiwafers for commercial 650 nm DVD lasers.

References:

- [1] Ledentsov N. N., Shchukin V. A. *SPIE Optical Engineering*. 2002: 41: 3193.
- [2] Maximov M. V., Shernyakov Yu. M., Novikov I. I., Shchukin V. A., Shamid I., Ledentsov N. N. *Electronics Letters*. 2003. 39: 1729.
- [3] Maximov M. V., Shernyakov Yu. M., Novikov I. I., Karachinsky L. Ya., Gordeev N. Yu., Shchukin V. A., Samid I., Ledentsov N. N. *Physica status solidi (c)*. 2005. 2(2): 919.

---

Innokenty I. NOVIKOV

A. F. Ioffe Physical-Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
Phone: +07 812 2473620  
Fax: +07 812 2471017  
E-mail: Novikov@switch.ioffe.ru

## THE ROLE OF COMMUNICATION IN THEORETICAL KNOWLEDGE

Dmitri Panchenko

*St Petersburg State University, Smolny College of Liberal Arts and Sciences  
St. Petersburg, Russia*

Theory is an arguable statement, and an arguable statement comes to anticipate questions, such as why one should believe in what is asserted.

Consequently, a particular form of human interaction is impressed into the very logic of theoretical knowledge.

Historically, theoretical knowledge emerged in the Greek world within small groups formed by free and relatively equal individuals. Their communication was oral. The use of written media has not essentially affected that kind of interaction which is responsible for maintenance of theoretical knowledge, and it is not likely that any communicative means will essentially change it. However, one's both fear of criticism and hope for recognition are sensible to particular ways of communication within scientific or scholarly community.

---

Dmitri PANCHENKO

St. Petersburg State University,  
Smolny College  
of Liberal Arts and Sciences

St. Petersburg, Russia  
E-mail: dmpanchenko@yahoo.com

## RESEARCH OF A ROLE OF $\text{Na}^+, \text{K}^+$ -ATPASE IN REGULATION OF GROWTH NEURITES OF SENSORY NEURONS

V. A. Penniyaynen

*Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

$\text{Na}^+, \text{K}^+$ -ATPase hydrolyzes ATP to maintain the transmembrane gradients of  $\text{Na}^+$  and  $\text{K}^+$  found in most mammalian cells and is inhibited specifically by cardiac glycosides such as ouabain [1, 3]. Recently, it was shown that  $\text{Na}^+, \text{K}^+$ -ATPase also carries out a role as a signal transducer [2, 5]. We investigated influence ouabain on growth neurites of sensory neurons of chicken embryos. The experiments were performed in the organotypic culture of a 10–12 day old chicken embryos dorsal root ganglion [4].

Specific inhibitor of Na<sup>+</sup>,K<sup>+</sup>-ATPase ouabain was investigated in a wide range of concentrations (10<sup>-12</sup> – 10<sup>-4</sup> M). It was found, that ouabain inhibited growth neurites of sensory neurones in a dose-dependent manner. At addition of inhibitor in concentration 10<sup>-12</sup> M to the culture medium the influences on growth neuritis of sensory neurones did not observe. The Hill coefficient was defined as 1, and the K<sub>D</sub> was estimated as 1\*10<sup>-10</sup> M. It was shown, that at concentration of inhibitor exceeding 1\*10<sup>-9</sup> M the growth of neurites was totally inhibited. Thus received results suggest that Na<sup>+</sup>,K<sup>+</sup>-ATPase plays important role in regulation of process of growth neurites and in normal development of sensory neurons and that Na<sup>+</sup>,K<sup>+</sup>-ATPase participate in intracellular signaling as a signal transducer.

References:

- [1] Blanco G., Mercer R. W. *Am. J. Physiol.* 1998. 275: 633–655.
- [2] Krylov B. V. et al. *Rossiiskii Fiziologicheskii Zhurnal imeni I. M. Sechenova.* 1999. 85: 225–236.
- [3] Mobasheri A. et al. *Biosci. Reports.* 2000. 20: 51–90.
- [4] Penniyaynen V. A. et al. *Tsitologiya.* 2003. 45(4): 377–379; 29: 445–448.
- [5] Xie Z., Askari A. *Eur. J. Biochem.* 2002. 269(10): 2434–2439.

---

Valentina A. PENNIYAYNEN

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3280701  
Fax: +07 812 3280501  
E-mail: pvalentina2@yandex.ru

## LINEAR AND NONLINEAR OPTICAL SPECTROSCOPY OF MULTIFERROIC MATERIALS

R. V. Pisarev

*Ioffe Physical Technical Institute, Russian Academy of Sciences  
St. Petersburg, Russia*

Multiferroic materials were discovered in the 1960s and created a lot of excitement because the crosslink between magnetic, electric, ferroelectric,

and elastic properties. However, original efforts to develop new devices failed due to the smallness of the relevant susceptibilities and effects. At present, a startling revival of interest in multiferroic materials is observed because new materials and heterostructures have been discovered and developed.

In this talk we report on the study of electronic and magnetic structures in several groups of 3d transition-metal multiferroic materials using linear and nonlinear optical spectroscopy [1]. The main experimental methods used are polarized optical absorption, variable angle spectroscopic ellipsometry, and second harmonic generation (SHG). Experiments were done in a wide spectral range from 0.5 to 5.4 eV, at temperatures from 2 to 300 K, and in magnetic fields up to 7 T.

The following materials and topics are discussed in the paper:

1. Ferroelectric antiferromagnetic hexagonal manganites  $\text{RMnO}_3$  (R=Sc, Y, In, Ho- Lu), where a new type of SHG susceptibility was discovered and allowed us to study magnetic structures and phase diagrams of these materials that were a controversial issue for several decades [2].

2. Noncentrosymmetric copper borate  $\text{CuB}_2\text{O}_4$  where three types of magnetic-field-induced second harmonic (MFISH) generation are observed and provide selective access to nonequivalent copper sublattices [3].

3. Noncentrosymmetric gadolinium-iron borate  $\text{GdFe}_3(\text{BO}_3)_4$  where we prove for the first time possibility of phase matching for SHG in magnetic materials [4].

4. A new type of magnetoelectric coupling was observed in  $\text{YMnO}_3$  [5]. We explain this phenomenon by piezomagnetic interaction of ferroelectric and antiferromagnetic order parameters within domain walls [6].

5. Piezoelectric ferrimagnet  $\text{GaFeO}_3$ , where we studied electronic structure, Faraday rotation, and second harmonic generation [7].

References:

- [1] Fiebig M., Pavlov V. V., Pisarev R. V. *J. Opt. Soc. Amer. B*. 2005. 22: 96.
- [2] Frohlich D., Kohn K., Leute St., Lottermoser Th., Pavlov V. V., Pisarev R. V. *Phys. Rev. Lett.* 2000. 84: 5620.
- [3] Pisarev R. V., Sanger I., Petrakovskii G. A., Fiebig M. *Phys. Rev. Lett.* 2004. 93: 037204.
- [4] Kalashnikova A. M., Pavlov V. V., Pisarev R. V., Bezmaternyukh L. N., Rasing Th. *JETP Lett.* 2004. 80: 293.
- [5] Fiebig M., Lottermoser Th., Frohlich D., Goltsev A. V., Pisarev R. V. *Nature* (London). 2002. 419: 818.
- [6] Goltsev A. V., Pisarev R. V., Lottermoser Th., Fiebig V. *Phys. Rev. Lett.* 2003. 90: 177204.

[7] Kalashnikova A. M., Pisarev R. V., Bezmaternyukh L. N. *et al.* (submitted).

---

R. V. PISAREV

A. F. Ioffe Physical-Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
E-mail: pisarev@mail.ioffe.ru

### DEVELOPMENT OF NOVEL APPROACH FOR PROPHYLAXIS AND TREATMENT OF BRAIN ISCHEMIA AND STROKE

S. A. Polenov, M. V. Lensman, M. Balestrino♦, S. V. Burov\*,  
V. A. Otellin\*, P. P. Yakutseni\*, A. I. Artemieva,  
V. O. Mourovets, N. L. Izvarina

*Pavlov Institute of Physiology, Russian Academy of Sciences*

*\*Institute of Experimental Medicine, Russian Academy of Medical Sciences*

*\*Institute of Macromolecular Compounds, Russian Academy of Sciences*

*♦Polytechnic University  
St. Petersburg, Russia*

*♦University of Genova  
Genova, Italy*

Hypoxic brain damage is a widespread pathology among elderly people and stroke is still a major crippling disease being the third cause of death in major industrialized countries. Despite some recent progress in the treatment, at the present time there are no clinically effective neuroprotective agents available. Based on some evidence of critical reduction of ATP level in ischemic tissue and beneficial effect of ATP supplementation, a hypothesis was put forward that creatine (Cr) supplementation is capable of increasing brain phosphocreatine (PCr) that can phosphorylate ADP to ATP, thus replenishing the high-energy stores even in the absence of oxygen and glucose. Indeed, in a number of previous *in vitro* studies on brain slices Cr pre-treatment was shown to increase PCr and ATP levels and to protect neurons

against anoxic damage.

In our recent studies, the effect of i.c.v. Cr supplementation was tested in *in vivo* model of global cerebral ischemia (GCI) in rats. Cr was continuously infused at a dose of 50 mM into the lateral cerebral ventricle via cannula, connected to Alzet osmotic mini-pump (pumping rate 0.25  $\mu$ l/h). The remarkable neuroprotective effect of Cr supplementation was seen (by post-mortem morphological assessment of brain damages) in both «prophylactic» paradigm (Cr was administered for 5 days before GCI) and «treatment» paradigm (Cr administration starts soon after induction of GCI and continued for 7 days). Very highly significant reduction in the percentage of shrunken neurons in various brain regions was determined.

This was the first *in vivo* evidence for beneficial neuroprotective role of exogenous Cr in the rat model of GCI. However, Cr is a very polar molecule and poorly penetrates BBB. Hence, in the next step of our work, analysis of chemical databases, computer modelling and simulation were performed that permitted to predict a number of perspective Cr derivatives with better blood-brain barrier permeability together with high affinity to phosphokinase, which were further synthesized and tested.

One of them (designated CrXY) proved to be rather stable in blood serum and was shown to increase brain content of PCr and ATP after intraperitoneal (i.p.) administration in rats. In the rat models of GCI and focal cerebral ischemia, i.p. administration of CrXY produced a potent amelioration of brain damage in both prophylactic and treatment paradigms. Also, behavioural and toxicological testing revealed no unfavourable effects of i.p. CrXY injections.

On the whole, these studies provide promising evidence for the use of Cr and particularly its modified analogues by showing their potent neuroprotective properties in the rat, thus opening a new route for clinical investigation in humans.

As a necessary next step, further efforts should be directed to the development of new drugs effective at oral application.

*Supported by INTAS grant 2000-04410441 and RFBR grant No 05-04-08072.*

---

Sergey A. POLENOV

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281301  
Fax: +07 812 3280501  
E-mail: polenov@kolt.infran.ru

## NONLINEAR WAVES IN COMPLEX (DUSTY) PLASMAS

S. I. Popel<sup>1</sup>, G. E. Morfill<sup>2</sup>

<sup>1</sup>*Institute for Dynamics of Geospheres, Russian Academy of Sciences  
Moscow, Russia*

<sup>2</sup>*Centre for Interdisciplinary Plasma Science,  
Max-Planck-Institut für Extraterrestrische Physik  
Garching, Germany*

A review on nonlinear waves in complex (dusty) plasmas is presented. The basic experiments on nonlinear wave structures in complex plasmas are described and the corresponding theoretical descriptions are given. For the description of formation and evolution of nonstationary dust ion acoustic shocks the so-called ionization source model is forwarded. This model allows us to describe all the features of the laboratory experiments on dust ion acoustic shocks performed at the Institute of Space and Astronautical Science (Japan) and at the University of Iowa (USA): the suppression by dust of charge separation in the front of shock; the width of the shock front; the dependence of the shock speed on dust density; the fact that shocks are excited for rather large dust densities. The most important dissipative processes, which are responsible for the generation of dust ion acoustic shocks, are investigated. Among them are the anomalous dissipation due to dust charging process; absorption and scattering of ions by dust grains; as well as the kinetic (including Landau) damping. The possibility of observation of shocks related to the dust charging process in active rocket experiments, which involve the release of some gaseous substance in near-Earth space, is shown. As an example of dust ion acoustic shocks in nature, we consider the bow shock formed in the interaction of the solar wind with cometary dusty coma. We investigate the possibility of experimental observation of the dust ion-acoustic solitons. We show that in complex plasmas important role in the formation of the compressive solitons belongs to the so-called “adiabatically trapped” electrons. We discuss the possibility of formation of the shock wave-like structures during the soliton evolution. The nonlinear dust acoustic waves are discussed from the viewpoint of the experiments fulfilled in dc glow discharge plasma and rf discharge plasma under both usual laboratory and microgravity conditions. In particular, we discuss the experiments in rf plasma

discharge where phase transition (melting of plasma crystal) was occurred during dust acoustic shock propagation. Furthermore, we study the possibility of the observation of the dust acoustic solitons in Earth's dusty mesosphere which can be helpful from the viewpoint of the determination of the sign of dust grain charges and the material of the contaminated dust grains, as well as can serve as a diagnostic means of the phenomena related to noctilucent clouds and Polar Mesosphere Summer Echoes.

It is shown that the shock waves in complex (dusty) plasmas may find significant technological applications in, e. g., the so-called hypersonic aerodynamics.

*This work was supported in part by the Russian Foundation for Basic Research (project no. 03-02-16664-a).*

---

Prof. Sergey I. POPEL

Institute for Dynamics of Geospheres,  
Russian Academy of Sciences

38 Leninsky Ave., Building 1  
119334 Moscow, Russia  
Phone: +07 095 9397570  
Fax: +07 095 1376511  
E-mail: s\_i\_popel@mtu-net.ru

## MICROFLUIDICS IN VIEW OF POLYMER COMPOSITE APPROACHES

Aleksei O. Pozdnyakov

*Institute of Problems of Mechanical Engineering,  
Russian Academy of Sciences  
St. Petersburg, Russia*

Thermal properties of polymer-fullerene composites are shown to be altered compared to neat polymer ([1–3] and Refs. therein). Some of these composite systems are shown to change its response to IR laser ablation (LA) compared to neat polymer. The details of these effects in view of their use for LA fabrication technologies of thin channels in polymer microfluidic chips is discussed.

References:

[1]. Pozdnyakov A. O. et. al. Fullerene C<sub>60</sub> Diffusion in Thin Layers of Amorphous Polymers: Polystyrene and Poly(6-methylstyrene). *Tech. Phys. Lett.* 2004. 30(10): 839–842.

[2]. Pozdnyakov A. O. et. al. Thermally stimulated desorption of C<sub>60</sub> and C<sub>70</sub> fullerenes from rigid-chain polyimide films. *Phys. of the Sol. State.* 2004. 46(7): 1371–1375.

---

Dr. Aleksei O. POZDNYAKOV

Institute of Problems  
of Mechanical Engineering,  
Russian Academy of Sciences

61 Bolshoy Ave., V. O.  
199178 St. Petersburg, Russia  
Phone: +07 812 2479323  
Fax: +07 812 2478924  
E-mail: ao.pozd@mail.ioffe.ru

DETERMINATION  
OF THERMODYNAMICAL CHARACTERISTICS OF PbV<sub>2</sub>O<sub>6</sub>  
BY HIGH-TEMPERATURAL MASS-SPECTROMETRY

Ivan A. Rodionov

*St. Petersburg State University  
St. Petersburg, Russia*

Many salts may be considered to be compounds of two oxides: a basical and an acidal. There are typical acidal oxides, such as N<sub>2</sub>O<sub>5</sub>, Mn<sub>2</sub>O<sub>7</sub>, Cl<sub>2</sub>O<sub>7</sub>, SO<sub>3</sub> and there are typical basical ones, such as Na<sub>2</sub>O, CaO, Rb<sub>2</sub>O. To determine the character of the oxide one can use its average orbital electronegativity  $\chi$ . The less is the difference between  $\chi$  of oxides forming the salt, the less thermal stable is it. Therefore we can expect PbO ( $\chi=5,88$ ) and V<sub>4</sub>O<sub>10</sub> ( $\chi=6,44$ ) being gases to react under high temperature forming PbV<sub>2</sub>O<sub>6</sub>. The occurrence of this reaction may be proved by the method of high-temperatural mass-spectrometry. This method is used in the project to determine the main thermodynamical characteristics of PbV<sub>2</sub>O<sub>6</sub>. In previous projects they were already determined, but the results are not reliable because of some assumptions made against the structure of the salt.

---

Ivan A. RODIONOV, 1<sup>st</sup> year student  
Chemical Faculty,  
St. Petersburg State University

26 Universitetsky Ave., Old Peterhof  
198504 St. Petersburg, Russia  
Phone: +7 921 3289429  
E-mail: chimikus@yandex.ru

## METAL-BOUND FORMS OF 4H-PYRAN-4-ONE DERIVATIVES MODULATE NOCICEPTIVE RESPONSES OF SENSORY NEURONS

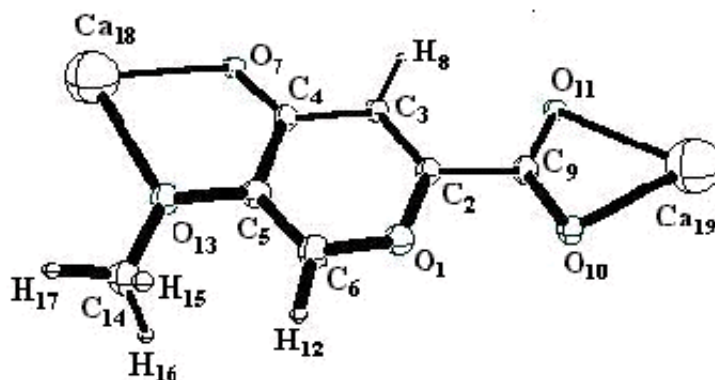
V. Rogachevsky, V. B. Plakhova, S. A. Podzorova

*Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

Effects of the series of 4H-pyran-4-one derivatives on sensory neuron cell membrane were investigated by the whole-cell patch-clamp technique. Five molecules were chosen for the study: comenic acid (2-carboxy-5-hydroxy-4H-pyran-4-one, **I**), meconic acid (2,6-dicarboxy-3-hydroxy-4H-pyran-4-one, **II**), chelidonic acid (2,6-dicarboxy-4H-pyran-4-one, **III**), kojic acid (2-hydroxymethyl-5-hydroxy-4H-pyran-4-one, **IV**) and 2-carboxy-5-methoxy-4H-pyran-4-one (**V**). Extracellular application of **I**, **II** and **V** resulted in the decrease of the effective charge transfer in the activation gating system of tetrodotoxin-resistant (TTXr) sodium channels which are responsible for peripheral nociceptive signal coding. For **I** and **II**, the decrease is found to be dependent on the dose of the agent applied. Using the Hill equation, the values of the dissociation constants and the Hill coefficients were shown to be  $K_d=100$  nM,  $n=0.5$  (**I**);  $K_d=10$  nM,  $n=0.5$  (**II**). For **V**, the dose dependency was not investigated. **V** was found to be active at 100 nM. **III** and **IV** did not exhibit any channel-modulating activity at concentrations from 200 nM to 200  $\mu$ M. The non-specific opioid receptor antagonist naltrexone and the specific blocker of sodium pump ouabain totally blocked the effects of **I**, **II** and **V**. The data obtained are in agreement with the prediction that in the sensory neuron membrane exists the signaling pathway which involves opioid receptor, sodium pump as a signal transducer and TTXr channel [1–2].

Ligands of opioid receptors normally have at least one positively charged moiety which is generally thought to bind to an acidic residue of the receptor [3]. Two aspartate residues, absolutely conserved in opioid receptors, are shown to be involved in ligand binding [4]. None of the molecules studied here possess positively charged groups which could interact with the aspartates. Hence, it is suggested that the metal-bound forms of 4H-pyran-4-one derivatives bind to opioid receptor. The carboxy groups in alpha-positions to the pyranone ring oxygen can form salts with inorganic cations, whereas the hydroxy and the carbonyl groups in adjacent positions of the pyranone ring are known to chelate divalent cations in aqueous solutions [5].

In the patch-clamp experiments all agents were added to the extracellular solution containing  $\text{Na}^+$ ,  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  at 65, 2 and 2mM correspondingly. Various divalent cations  $\text{M}^{2+}$  ( $\text{M} = \text{Ca}, \text{Cd}, \text{Co}, \text{Ni}, \text{Zn}, \text{Cu}$ ) were shown to form chelates with **I** and **IV** [5, 6]. In these experiments [6], the ligand and  $\text{M}^{2+}$  concentrations were 100  $\mu\text{M}$  and 1–2 mM correspondingly. Since such chelates were stable at ionic strengths from 0 to 1.5, and the ionic strength was altered by addition of  $\text{NaClO}_4$  or  $\text{KCl}$ ,  $\text{Na}^+$  and  $\text{K}^+$  at high concentrations do not affect the stability of  $\text{M}^{2+}$  chelates. The electron-accepting ability of  $\text{Ca}^{2+}$  is higher than that of  $\text{Mg}^{2+}$ , and both cations are present in the extracellular solution at equal concentrations. This leads to the assumption that  $\text{Ca}^{2+}$  is the cation which forms the complex with the chelating moiety of the ligands under consideration. Since the concentration of  $\text{Ca}^{2+}$  is much higher than those of the agents, the chelate stoichiometry is suggested to be 1:1.



Both polar moieties of the molecules in question seem to be involved in binding to the receptor, since **III** which lacks the chelating moiety and **IV** which does not have the carboxy groups were shown to be fully inactive at concentrations up to 200  $\mu\text{M}$ . Thus, it is proposed that the agents studied bind to the receptor with the involvement of two inorganic cations: one of those is chelated and the other one is the counterion for the carboxy group.

The full 6-31G\*/RHF geometry optimization of **V** in the forms of free acid, anion,  $\text{Ca}^{2+}$  chelate,  $\text{Ca}^{2+}$  and  $\text{Na}^+$  salts, and  $\text{Ca}^{2+}$  and  $\text{Na}^+$  salts with  $\text{Ca}^{2+}$  chelate was performed. The spatial structure of **V** with two Ca-ions bound is presented on the picture. It was of importance to determine whether the substitution of the hydroxyl to the methoxy group in the chelating moiety of 4H-pyran-4-ones would energetically or sterically disfavor the  $\text{Ca}^{2+}$  chelation. The enthalpic effect of the  $\text{Ca}^{2+}$  chelation in the gas phase was calculated to be  $-110 \text{ kcal}\cdot\text{mol}^{-1}$ . The dihedral angle  $\tau(\text{C}_4\text{C}_5\text{O}_{13}\text{C}_{14})$  defining the orientation of the  $\text{CH}_3$ -group in relation to the pyranone ring was equal to  $-66.3^\circ$  in the free acid, whereas the methoxy group, the carbonyl group and  $\text{Ca}^{2+}$  in the  $\text{Ca}^{2+}$  chelate structure were located in the pyranone ring plane. These results show that hydroxy to methoxy substitution does not hinder the  $\text{Ca}^{2+}$  chelate formation. The distance between two bound cations was not significantly dependent on the origin of the cation which served as a counterion ( $d(\text{Ca}^{2+}\text{-Ca}^{2+}) = 9.5 \text{ \AA}$ ,  $d(\text{Ca}^{2+}\text{-Na}^+) = 9.4 \text{ \AA}$ ). This distance must be in match with the distance between the conserved aspartates in opioid receptor to provide the complementarity of the ligand and the receptor binding pocket.

The model accounting for the metal ions involvement in the binding of ligands and receptor activation as well as for many other experimental data was elaborated [7]. According to this model, the distance between two aspartates falls in the range of 9–11  $\text{\AA}$ . The distance between the cations in the complex of naloxone, the non-specific opioid receptors antagonist, with two  $\text{Na}^+$  is equal to 8.4  $\text{\AA}$ , the  $\text{Na}^+\text{-Na}^+$  distance in the metal-bound agonist bremazocine is shown to be 8.9  $\text{\AA}$ . The distances between cations in our calculations are of similar range.

Since the molecules studied modulate the nociceptive response of sensory neurons, they may be applied in practical medicine as a novel class of analgetics. The clearer understanding of their ligand-receptor binding mechanism could lead to the molecular design of more potent agents of this structural class.

References:

- [1] Krylov B. V. et al. *Rossiiskii Fiziologicheskii Zhurnal imeni I. M. Sechenova*. 1999, 85: 225–236.
- [2] Plakhova V. B. et al. *SPIE*. 2000. 4348: 143–145.
- [3] Strader C. D. et al. *Annu. Rev. Biochem.* 1994. 63: 101–132.
- [4] Baldwin J. M. *Curr. Opin. Cell Biol.* 1994. 6: 180–190.
- [5] Bryant B. E., Fernelius W. C. *J. Am. Chem. Soc.* 1954. 76: 5351–5352.
- [6] Petrola R. *Finn. Chem. Lett.* 1985. 12: 219–224.
- [7] Zhorov B. S., Ananthanarayanan V. S. *Arch. Biochem. Biophys.* 2000. 375: 31–49.

*V.B.P. is supported by personal grant from the Government of Saint-Petersburg for young Ph.D. scientists (2005).*

---

Ilya V. ROGACHEVSKY, Ph. D.

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.

199034 St. Petersburg, Russia  
Phone: +07 812 3281676 ext. 203  
Fax: +07 812 3280501  
E-mail: roggie@mail.ru

## COLOR DISTINCTION OF TELEVISION PICTURE DETAILS

Vladimir I. Salin

*Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

In ITV the color distinction of the television picture details is the main task unlike broadcasting television systems.

In colorimetry, the color distinction (color contrast) is evaluated by the number of “color thresholds”.

When observing a television picture, a viewer sees no way to compare immediately color of a picture with color of a standard. In this case “color memory” of a viewer plays a large role in evaluating color contrast. Worsening of observation conditions causes the number of “color thresholds” sensed

from the television picture to decrease by an order of magnitude.

Observation of the details of the television picture is made on a general (color) background. Adaptation of visual organs for this background leads to distortions in color sensing of the picture details as compared with colorimetric color values. The color of details is shifted to complementary colors, which causes color depth to decrease and color contrast of the details about picture background to lower.

---

Vladimir I. SALIN

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281301  
Fax: +07 812 3280501  
E-mail: krylov@infran.ru

## ATOMIC-SCALE MONTE CARLO SIMULATION: A USEFUL TOOL OF MODERN NANOTECHNOLOGY

A. A. Schmidt

*St. Petersburg State Polytechnical University  
St. Petersburg, Russia*

Nowadays semiconductor industry continues its exponential growth, which was predicted by Gordon Moore back in mid 60s [1]. He predicted that the maximum number of transistors integrated in one circuit would double every other year, thus exponentially increasing the computational power of computers. Such integration growth also led to the decrease of the transistor size from several microns to a hundred of nanometers and even less [2]. At the same time methods of the nano-size fabrication found further application in novel technology branches such as micro- and nanoelectromechanical systems construction, molecular biology and so forth. Wide usage of “man-made” materials [3], molecules [4] and atom-by-atom assembly are the distinguishing features of modern nanotechnology. It is obvious that such a fine technology demands manipulation and “tuning” of a vast amount of the processing

parameters, which makes implementation of solely experimental methods for the determination of the optimal production conditions inefficient. An alternative way is to use computer simulation that is less expensive and time-consuming. At present four major methods are used for the nanotechnology simulation: *ab initio* density functional theory, molecular dynamics, statistical methods based on Monte Carlo algorithms and continuum mechanics [5]. We will focus on the Monte Carlo which is named by John von Neumann [6] because it is based on the random numbers sampling and reminds of the city renowned for its casinos. Monte Carlo has a great advantage, comparative to other methods, because it is capable to provide atomic-scale precision data on the nano-objects evolution at appropriately long time-scale that is in a range of real process time. In the present work Monte Carlo method was used to study the growth of silicon carbide on the silicon substrate in vacuum [7]. Although SiC on Si hetero-system allows many applications for high-frequency and high-power electronics production, its utilization in semiconductor technology is hampered, because of the certain complexity of the physical processes that take place during the growth process and so make the production of the device with desired properties virtually impossible. Computer simulations allowed us to get an insight to the growth process and to investigate the spontaneous self-ordering of SiC clusters on the surface features (as steps of defects) [8].

References:

- [1] <http://www.intel.com>
- [2] <http://public.itrs.net>
- [3] Alferov Z. I. *Rev. Mod. Phys.* 2001. 73: 767.
- [4] Iijima S. *Nature*. 1991. 354: 56.
- [5] Vvedensky D. D. *J. Phys.: Condens. Matter*. 2004. 16: R1537.
- [6] McCracken D. D. *Sci. Am.*, 192 (1955) 90.
- [7] Schmidt A. A., Safonov K. L., Trushin Yu. V., Cimalla V., Ambacher O., and Pezoldt J. *Phys. Stat. Sol. A*. 2004. 201: 333.
- [8] Cimalla V., Schmidt A. A., Foerster Ch., Zekentes K., Ambacher O., Pezoldt J. *Superlattices and Microstructures*. 2004. 36: 345.

---

A. A. SCHMIDT  
St. Petersburg State  
Polytechnical University

St. Petersburg, Russia  
Phone: +07 812 5565140  
E-mail: [schmidt@theory.ioffe.ru](mailto:schmidt@theory.ioffe.ru)

## PHYSIOLOGY OF SUBTHRESHOLD CURRENTS

Jurgen R. Schwarz

*Institute of Applied Physiology, University of Hamburg  
Hamburg, Germany*

Information processing within the brain involves the generation of action potentials which are responsible for fast communication between nerve cells. Action potentials have a short duration and are generated by a transient influx of  $\text{Na}^+$  and a delayed outflow of  $\text{K}^+$  through voltage-gated ion channels. In addition to these canonical ion channels, nerve cells are equipped with a large number of voltage-gated and  $\text{Ca}^{2+}$ -gated ion channels which are able to modulate their excitability. These ion channels are activated within the subthreshold potential range. This property enables them not only to influence the threshold potential, they also change the action potential duration, induce various forms of afterhyperpolarizations and set the interspike interval. By modulating the shape of action potentials and spiking patterns they are able to change information processing in neurons, thus contributing to neuronal plasticity. The  $I_h$  and the M-current belong to the most important threshold currents.  $I_h$  is a pacemaker current, mediated by hyperpolarization-activated cyclic-nucleotide-gated cation channels (HCN). The M-current is mediated by members of the family of voltage-gated KCNQ channels. One important function of M-currents is the induction of frequency adaptation. The current mediated by ether-a-go-go-related gene  $\text{K}^+$  channels (*erg*) is predominantly known as a cardiac current which takes part in repolarizing the heart action potential. However, *erg* channels have recently been shown to also modulate neuronal electrical activity. Further members of subthreshold currents are the A-type current mediated by voltage-gated  $\text{K}^+$  channels of the  $\text{Kv4}$  family and  $\text{Ca}^{2+}$ -gated SK channels. Both types of current are involved in the modulation of the frequency of action potential firing, i.e. the precise timing of the interspike interval. In addition to the usage of slices for patch-clamping or of heterologous expression systems an overview of transgenic animal models used to study the properties of e.g. KCNQ and HCN channels will be given. Thereafter the molecular properties and physiology of the ion channels mediating the different types of subthreshold currents will be presented as well as an insight into their complex subunit composition. Special emphasis will be laid upon the description of a M-like

current in the rat node of Ranvier as well as on the presentation of the physiology of erg K channels in various types of neurons and neuroendocrine cells.

---

Prof. Dr. Jurgen R. SCHWARZ, M.D.

Institut für Angewandte Physiologie  
Zentrum für experimentelle Medizin  
Universitätsklinikum Eppendorf

52 Martinistrasse

D-20246 Hamburg, Germany

Phone: 040-42803-2190

Fax: 040-42803-9127

E-mail: schwarz@uke.uni-hamburg.de

## FORMATION AND ACTIVITY OF RADICAL CURRENTS IN RUSSIAN ORTHODOX CHURCH IN XX CENTURY

Mikhail Shkarovskij

*St. Petersburg State Archive*

*St. Petersburg, Russia*

The creation of radical currents in Russian Orthodox was connected to occurrence as a result of the antireligious actions (shares) of the Soviet state so-called Katakomb church. The first secret orthodox communities have appeared in the Soviet republic in 1918, after an output (exit) of the appeal of the patriarch Tihon, about anafeme The persecutors of church. Brightly shown itself within civil war country Revol has arisen in many respects on religious ground. In Central Chernozemie of Russia the secret communities have appeared during revolts 1918–1922. However till 1927 katacomb of communities was immeasurably less legally working arrivals. Before this time of attempt to subordinate church came to an end by failure. By a boundary in this plan was the legalization of a Synod at Mitropolit Sergij (Stragorodskij), required significant concessions. «The Declaration of 1927» about loyalty of church of the Soviet authority, moving episkop on political motives etc. Created new conditions of mutual relation of church with the state. Such compromises were negatively perceived (negatively recognized) by many believers. Soon after publication of «Declaration» the transition to

an illegal rule (situation) of hundreds arrivals was developed (unwrapped). A major role in creation Katakomb church has played arhiepiskop Andrey (Uhtomskij). He is the author of the term true – orthodox the christians (IPCH), originally designating left in underground still in 1922–1928. In 1930–1939 – the time of the strongest persecutions has taken place sharp growth of number katacombers. The Soviet authorities during war 1941–1945. Alongside with improvement of the attitude (relation) to the Moscow patriarchy have tried to make rout in «katakomb», that it was possible much to them in. The new activization of activity katacombers began from 1954–1957. From camps have appeared hundreds of priests and The preachers believers are issued. Thus the part IPCH has risen on a way of a deepening of alienation from «world», denying of all Soviet laws, sermon asketism, down to the requirement without a marriage. To revival of activity IPCH of authority have reacted by new persecutions in 1958–1964. As a result of reprisals the movement IPCH has incurred (carried) the large losses, however Katakomb the church as a whole at this time repeatedly has grown. When because of persecutions about 4000 priests of a patriarchy remained without places and registration, the majority of them has continued to serve spiritual needs of the believers secretly. In result in Katakomb church in 1960–1979. There were qualitative changes. Inside it there were 8 new basic groupings, the share traditional IPCH was constantly reduced. An aggregate number katacombers to the beginning 1990-er. Made by different ratings 100–500 thousand the man. Now on the data katacombers their number makes about 900 thousand, and the quantity (amount) of groups and has grown up to 16 with approximately 70 arhierejami. It is possible to tell, that katacomb the church was the most complete, consecutive form of mass resistance to the Soviet authority. The phenomenon orthodox «katakomb» (religious nonconformists) has shown the not only extreme stability in various conditions, but also presence of the tendency to self-reproduction and increase at the expense of inverted. This phenomenon experienced the different periods, including essential decline. In due course appreciable there was a tendency of degeneration of a part katacombers in a sect, but as a whole, to the moment of fall of the Soviet authority the «secret» church was on rise. Its history in Russia is far from end. The present authorities cause trust not in all katacombers, and church underground in the country is kept.

## RESISTIVE TRANSITIONS BROADENING IN SUPERCONDUCTING MgB<sub>2</sub>

Anatoli S. Sidorenko

*Institute of Applied Physics, Academy of Sciences of Moldova  
Kishinev, Moldova*

Discovery of superconductivity in MgB<sub>2</sub>, the material with hexagonal layered crystal structure and the highest for a simple intermetallic compound critical temperature [1], raised questions about its transport properties. The crystal structure of MgB<sub>2</sub> and the band structure calculations suggest that the quasi-two-dimensional boron planes are mainly responsible for the charge transport. Therefore the superconducting properties of MgB<sub>2</sub> are expected to reflect this 2D character. On the other hand, the layered structure should also influence the magnetic flux penetration and flux motion in the presence of an external magnetic field. In particular, thermally activated vortex creep processes (TAFF) should play a crucial role in the resistive transitions broadening for MgB<sub>2</sub>.

In the present work the results of the experimental studies of the resistive transitions broadening for MgB<sub>2</sub> thin films are reported. Two-dimensional fluctuations of the order parameter in the weak fluctuation region above T<sub>c</sub> are responsible for the broadening of the upper part (R>0.9R<sub>N</sub>) of the resistive transitions. Thermally activated flux-flow is the reason of the lower parts (R<0.1R<sub>N</sub>) of the resistive transitions broadening. The unusual flux creep behavior of magnesium diboride needs further investigation, especially in view of future technical applications for superconducting wires and cables with high current density.

### References:

- [1] Namagatsu J., Nagakawa N., Muranaka N., Zenitani Y., Akimitsu J. *Nature*. 2001. 410: 63.
- [2] Fogel N. J., Cherkasova V. G., Koretzkaya O. A., Sidorenko A. S. *Phys. Rev. B*. 1997. 55: 85.

---

Prof. Dr. Anatoli SIDORENKO  
Head of Laboratory  
of Superconductivity  
Institute of Applied Physics,  
Academy of Sciences of Moldova

5 Academiei  
MD2028 Kishinev, Moldova  
Phone: +37322-737072  
Fax: +37322-738149  
E-mail: anatoli.sidorenko@int.fzk.de  
E-mail: sidorenko@lises.asm.md  
<http://lises.asm.md/superlab>

CHANGES OF THE NEUROPHYSIOLOGICAL INDICES  
IN CONDITIONS OF PERIPHERAL NERVES IMPAIRMENT  
AND THEIR CORRECTION BY STIMULATION  
OF THE SOMATO-VEGETATIVE PHYSIOLOGICALLY  
ACTIVE ZONES

Irina N. Sidorenko

*Institute of Physiology and Sanocreatology,  
Academy of Sciences of Moldova  
Kishinev, Moldova*

Electrophysiological patterns of myelinopathies and axonopathies were revealed by means of electromyographical examinations. Velocity diminishing in the motor and sensory fibers of the peripheral nerves, affection of both proximal and distal segments of the peripheral nerves, terminal latency and F-wave latency increasing, conduction block and temporal dispersion are characteristic for myelinopathies. Decreasing of the motor and sensory potential amplitude on background of normal conduction velocities is specific for axonopathies. The investigation revealed that in both forms of polineuropathies the conduction in the fibers of the pyramidal pathway is decreased. For axonopathies increasing of the central motor conduction time is associated with diminishing of the amplitude of the potential, recorded after transcranial magnetic stimulation, but in the case of myelinopathies motor evoked potentials are not affected regarding the amplitude and form criteria.

---

Dr. Irina SIDORENKO  
Institute of Physiology  
and Sanocreatology,  
Academy of Sciences of Moldova

1 Academiei  
MD2028 Kishinev, Moldova  
Phone: +37322-222901  
Fax: +37322-738149  
E-mail: sidorenko@lises.asm.md  
<http://lises.asm.md/superlab>

## MUSEUMS AND NATIONAL IDENTITY IN THE PROCESS OF GLOBALIZATION

Elena S. Soboleva

*Peter the Great Museum of Anthropology and Ethnography  
(Kunstkamera), Russian Academy of Sciences,  
St. Petersburg, Russia*

Since 1950es international economic ties developed faster rates, than national economies grew. Challenges of Global economic system drew to reorganization of relationship between the state, museums and communities. These changes have touched problems of national identity, democratic values, evaluation of political history, cooperation with the world of business, etc.

Large scale migrations and deleting of borders in Europe strengthen the task to develop models of behavior in multicultural milieu. Contemporary Europeans turn from the national state consciousness towards multicultural reality.

Museums actively respond to modification of public life. Conceptual transformation is marked at a symbolic level and in everyday practice. Many Ethnografic Museums changed their names for Museum of Cultures, started to act according to requirements of target segments. Academic expositions reflected evolution of national cultures, but marketing technologies help to promote new ideas. Museums organize various workshops, create Internet sites, forward intercultural events, etc., trying to stimulate interaction and to involve visitors into space of exposition culture. Globalization forces long-

term cooperation (INTERREG program in EU) between museums, and the largest ones work together like transnational companies.

Two tendencies – convergence and divergence – predominate in modern communities. The service to maintain cultural diversity is not less important than to construct a uniform cultural space. Many small museums are being created with the aim to underline the significance of local achievements in the global culture. Attempts are entered to revive and to preserve minor ethnic groups, to unite diasporas.

When the place of Russia in the world historical process got changed and the frontiers were opened, the theme of technological and cultural development of mankind became most important. Museums in the USSR had to propagandize the Soviet way of life, but now the accent has moved to reconstruction of ethnic history of the peoples of the Russia. The process of revealing the valid historical experience, national and democratic traditions, real historical experiences is accompanied by the oblivion of undesirable cultural influences, by the attempts to satisfy some national and political momentary interests.

In 1990–2000es there was a reassessment of values and stereotypes, change of concepts aside deideologization of several trends and amplification of democratic values. Characteristic feature of a modern museums' policy is strengthening of a practical trends in their activities: introduction of technologies and subjects – elements of other cultures – into everyday use; reproduction of elements of old culture for creation of national identity; adaptation to the multicultural environment; formation of skills (by transfer of technologies); socialization of personality. Participation in international programs also promotes overcoming of the crisis phenomena.

---

Dr. Elena S. SOBOLEVA  
Peter the Great Museum  
of Anthropology and Ethnography  
(Kunstkamera),  
Russian Academy of Sciences

3 Universitetskaya Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3284122  
Fax: +07 812 3280811  
E-mail: soboleva@kunstkamera.ru

## OPTICALLY INDUCED SPACE-CHARGE AND CONDUCTIVITY GRATINGS IN WIDE-GAP SEMICONDUCTORS

Igor A. Sokolov, Vladimir V. Kulikov, Mikhail A. Bryushinin

*Ioffe Physical Technical Institute, Russian Academy of Sciences  
St. Petersburg, Russia*

The process of light interaction with condensed matter is an important problem of the modern solid state physics and quantum electronics. Holographic recording in wide-gap photorefractive materials is of particular interest from the scientific and practical point of view [1]. Such a recording includes the stage of space charge formation, which is associated with the spatial redistribution of photoinduced carriers. A number of new methods studying the dynamics of space charge and photoconductivity in wide-gap semiconductors were proposed during recent years.

The approach based on non-steady-state photocurrent investigation is considered to be very attractive and powerful technique for characterization of wide-gap semiconductors, molecular crystals, amorphous materials, photorefractive polymers [2]. The development of the new experimental and theoretical approaches for investigation of the non-steady-state photo-emf using dynamic holographic gratings was the main goal of this work.

Experimental investigation adaptive photodetector based on the effect of the non-steady-state photoelectromotive force [3] showed the possibility of application of such kind of devices for the vibration monitoring with high resolution. Adaptive photodetectors using photorefractive crystals and the effect of the photo-emf are promising for utilization in systems for nondestructive testing of critical infrastructure elements.

### References:

[1] Stepanov S. I. Applications of photorefractive crystals. *Reports on Progress in Physics*. 1994. 57: 39–116.

[2] Bryushinin M. A., Dubrovsky G. B., Sokolov I. A. Non-steady-state photocurrents in  $\text{SnS}_2$  crystals/ *Appl. Phys. B*. 1999. 68(5): 871–875. Bryushinin M., Kulikov V., Sokolov I. Giant resonant enhancement of the nonstationary holographic currents in an alternating electric field. *Phys. Rev. B*. 2003. 67(7): 075202.

[3] Sokolov I. A. Adaptive photodetectors: novel approach for vibration measurements. *Measurement*. 2000. 27: 13–19.

---

Dr. Igor A. SOKOLOV

A. F. Ioffe Physical-Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
Phone: +07 812 5159195  
Fax: +07 812 5156747  
E-mail: i.a.sokolov@mail.ioffe.ru

THEORETICAL PHYSICS  
OF COMPLEX MESOSCOPIC AND NANO SYSTEMS:  
CURRENT STATUS AND NEW PERSPECTIVES

Andrey V. Solov'yov

*Frankfurt Institute for Advanced Studies, Johann Wolfgang Goethe University  
Frankfurt am Main, Germany  
Ioffe Physical-Technical Institute, Russian Academy of Sciences  
St. Petersburg, Russia*

Atoms and their aggregations into molecules, clusters, and solids determine numerous properties of the world we inhabit. There are many examples of complex mesoscopic and nano- systems, such as atomic clusters (tiny pieces of matter consisting of a few tens (hundreds or thousands) of atoms), fullerenes, carbon nanotubes, endohedral atoms and fullerenes, biomolecules (amino-acids, polypeptides, proteins, DNA, RNA etc); nanostructures or nanosystems (nano-fractals, nano-particles, quantum dots, quantum wires) formed on a surface; atomic clusters, nanoparticles embedded into thin films or attached to biomolecules. Most of these mesoscopic and nano-systems possess unique properties and provide challenging theoretical tasks.

There is a number of common open fundamental problems that can be addressed to the most of the mentioned systems in spite of differences in their nature and origin: (i) what are the principles of matter self-organization, self-assembling and functioning at nano-scale and in mesoscopic systems,

(ii) are these principles classical or quantum (iii) what are the criteria for the stability of complex mesoscopic and nano-systems, (iv) what are their characteristic conformations and dynamic properties, (v) how the properties (electric, magnetic, optical, transport, thermodynamic, quantum etc) of mesoscopic and nano-systems intrude and change with the variation of the system size, (vi) how the properties of mesoscopic and nano-systems change by the presence of environment such as liquid medium, solid substrate, endohedral cage or thin film, (vii) how some specific features of complex mesoscopic and nano-systems manifest themselves in physical, chemical and biological processes with their involvement.

The understanding of structure and dynamics of mesoscopic and nano-systems lies at the heart of a large variety of interdisciplinary problems at the forefront of physics, chemistry and biology [1,2]. A detail theoretical description and complete understanding of these systems and new phenomena with their involvement can only be achieved by utilizing a wide range of traditional approaches and methods known from theoretical physics and chemistry combined with the advanced computational techniques and methods and with the use of the powerful computers.

References:

[1] Connerade J.-P., Solov'yov A. V. (eds). *Latest Advances in Atomic Clusters Collision: Fission, Fusion, Electron, Ion and Photon Impact*, Imperial College Press, World Scientific, London (2004), P. 1–396.

[2] Connerade J. P., Greiner W., Solov'yov A. V. The science of clusters: an emerging field. *Europhysicsnews*. 2002. 33(6): 200–202.

---

Andrey V. SOLOV'YOV

Frankfurt Institute for Advanced Studies,  
Johann Wolfgang Goethe University

A. F. Ioffe Physical -Technical Institute,  
Russian Academy of Sciences

1 Max-von-Laue-Str.  
60438 Frankfurt am Main, Germany  
Phone: +49-69-798 47507  
Fax: +49-69-798 47611  
E-mail: solovyov@fias.uni-frankfurt.de  
26 Polytekhnicheskaya  
194021 St. Petersburg, Russia  
Phone: +07 812 2479191  
Fax: +07 812 2471017  
E-mail: solovyov@rpro.ioffe.rssi.ru

## REPRESENTATION OF SOUND SOURCE MOTION PERCEPTION IN THE HUMAN EVENT-RELATED POTENTIALS

Lidia V. Starostina, Anton L. Varfolomeev

*Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

Electrical sound evoked brain responses were investigated using moving audio objects. Intentionally synthesized broad band noises were used as stimuli. The introduction of interaural time difference (ITD) provided certain location of virtual sound source and the linearly increasing of ITD provided feeling of movement with several velocities (120°/s, 180°/s, 360°/s, 540°/s, 720°/s and instant displacement), stimuli were produced to subject through earphones.

Each stimulus evoked two types of responses, first to the onset of sound and second to the start of sound moving. Comparison of these responses showed that Event-Related Potentials (ERPs) recorded to the start of auditory image movement is found to be larger in latencies and smaller in amplitude compared with ones to beginning of sound, furthermore EP to movement were remarkable for asymmetry. The analysis of velocity and direction interaction revealed that the amplitudes of N1 component were greater at sites contralateral to the moving direction, but only for 540°/s and 720°/s. The slowdown of ITD change leads to ERPs with increased latencies and decreased amplitudes of N1 and P2 components.

---

Lidia V. STAROSTINA

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3280779 ext. 156  
Fax: +07 812 3280501  
E-mail: starli@peet.spb.ru

## BENEFITS AND HAZARD OF RADON

Nadezhda V. Stepanova, Olga V. Chudovskaya

*High School of Mechnikov's State Medical Academy  
Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

Gaseous radon is one of the most dangerous radioactive poisons. Its contribution in natural background radiation is about 80%. Radon is water-soluble, and water is the main carrier of this radioactive element. One of radon-bearing regions of the world is situated in the area of Ladoga-Baltic Terrace, where concentration of radon in Gdov water-plane reaches 100 to 200 Bq/l [1]. High levels of radiation induce risk of cancer, genetic disease, and radiation sickness.

High concentration of radon in natural water sources can be hazardous, first, due to drinking of water containing high concentration of radon and its decay products, and second, due to radon transfer from water into air. Water can be decontaminated in this case by boiling, aeration or filtration with carbon filters [2].

However, low concentration of radon in water (<100 Bq/l) may be useful. From of old radon baths are widely used in balneology and physiotherapy. Radonotherapy is used for treatment of nervous system, cardiovascular system, musculoskeletal system, metabolic disease. IT is, however, necessary to take into account the fact that radon released during such treatment can be harmful for medical personnel being subjected to long-term influence of low concentrations of gaseous radon.

### References:

[1] *Red Book of Nature, Leningrad Region*, Vol. 1. *Nature Reserves Under Special Care*. Nauka: SPb., 1999, 149 p.

[2] Voronov A. *Radon in Water – Environmental Risk*. Znanie: SPb., 1999, 30 p.

---

Nadezhda V. STEPANOVA

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281676  
Fax: +07 812 3280501  
E-mail: bvk@infran.ru

## RUSSIA'S ACCESSION TO THE WORLD TRADE ORGANIZATION: SOCIAL CONSEQUENCES

Svyatoslav R. Tarasenko

*St. Petersburg State University, St. Petersburg, Russia*

Russia's accession to the WTO matters. It has great significance for the organization itself, it's crucial for the European Union, but most of all it matters to Russia. The vigorous efforts to find a certain alternative to this membership, taken by the scholars, both in Russia and abroad, have been unsuccessful, inasmuch as the projects available (Single Economic Space between Russian Federation, Belorussia, Ukraine and Kazakhstan or Single European Economic Space with the EU) should not be considered as the real alternatives, more likely as parallel processes. Hence the question "Does Russia need to join the WTO?" should be replaced by another one – "When does Russia need to become a member of the WTO?". The accession, scheduled by the government of the Russian Federation for the year 2007, can be characterized as untimely and thoughtless step. It fits well with the course of the neo-liberal reforms, initiated by German Gref, Minister for Economic Development, but the improvement of people's life is at stake.

The membership of Russia in the WTO is in favor of transnational corporations, but it will affect badly some sectors of the domestic industry for sure. First of all, national motor-car industry, protected by the tariffs now, that is 5 million employed workers. The main criteria here and within the manufacturing industry overall is noncompetitiveness of country's factories and the absence of the efficient industrial policy in Russia, which could prevent negative consequences. We don't need to predict a social crisis, however, but the collected data gives us a possibility to define some real effects, which the Russia's accession to the WTO can entail. Besides the above-mentioned factors we anticipate that the gap in the disparity of outcomes between the regional centers and provinces will increase and drastic changes will happen within the regional labour-market. The further studies in this area are needed to present a more detailed picture.

---

Svyatoslav R. TARASENKO

E-mail: [mindflyer@yandex.ru](mailto:mindflyer@yandex.ru)

Faculty of International Relations,  
St. Petersburg State University

## REMOTE SENSING OF ATMOSPHERE FROM SPACE

Yuriy M. Timofeyev

*Research Institute of Physics, St. Petersburg State University  
St. Petersburg, Russia*

Satellite methods for measuring the environmental parameters are widely used in different Earth sciences – meteorology, climatology, oceanology, etc. At present a considerable body of information on the atmosphere is obtained by satellite remote methods. Global data on temperature, humidity, wind field are widely used in the weather analysis and forecasting. Data on the ozonosphere condition are very important for monitoring the UV irradiance of the Earth surface. The adoption of Kyoto protocol made actual permanent satellite measurements of greenhouse gases in the atmosphere.

In Remote Sensing Laboratory (RSL) (Research Institute of Physics, SPbSU), different remote methods for measuring the atmospheric parameters have been developed for a long time. Many investigations in this field are carried out in close cooperation with German scientists.

In the paper, results of retrieving the vertical profiles of temperature, total vapor, ozone and a number of greenhouse gases from ground-based measurements of downward thermal radiation performed in Max-Planck Meteorology Institute (Hamburg, PI – Prof. H. Grassl) and Potsdam Meteorology Observatory (Potsdam, PI – Prof. D. Spaenkuch) by the unique Fourier spectrometers are given. These results were obtained and analyzed by Ya.A. Virolainen and A.V. Polyakov, scientists of RSL team. The joint studies showed the great potential of ground-based systems for measuring the downward thermal radiation with high spectral resolution for the analysis of diurnal variations of different atmospheric parameters and the validation of satellite measurements.

Great attention has been paid to the interpretation of the unique satellite measurements by German apparatus CRISTA-1 and -2 (Wuppertal, PI – Prof. K. Grossmann, the interpreter – V.S. Kostsov). Examples of retrievals of vertical profiles of temperature at 50–120 km, ozone and CO<sub>2</sub> at 50–90 km in global scale are given. It has been shown that recent models for CO<sub>2</sub> in mesosphere and estimates of radiation regime of this atmospheric region are needed in revision. Analysis of CRISTA-1 and -2 data has shown numerous

temperature inversions in mesosphere, which are in good agreement with results of the numerical 3-D modeling (Max-Planck Meteorology Institute, the model Hamonia, PI – Prof. J. Brassier). This proves the high quality of modeling the temperature regime of mesosphere.

The numerical error analysis for retrieving the different atmospheric parameters by Furrrier spectrometer MIPAS (onboard the satellite ENVISAT) with high spectral resolution (Karlsruhe Institute of Meteorology and Climatology, PI – Prof. H. Fischer, the interpreter – V.S. Kostsov) is given. It has been shown that MIPAS satellite measurements will make it possible to obtain a new valuable information on the ozonosphere.

---

Prof. Dr. Yuriy M. TIMOFEYEV    1 Ulyanovskaya Str.  
198504 St. Petersburg, Russia  
Research Institute of Physics,    Phone: +07 812 4284486  
St. Petersburg State University    Fax: +07 812 4284486  
E-mail: Yuriy.Timofeev@pobox.spbu.ru

## THEORETICAL SEARCH FOR SINGLE-SOURCE PRECURSORS FOR NANOELECTRONIC MATERIALS

Alexey Y. Timoshkin

*St. Petersburg State University  
St. Petersburg, Russia*

Gallium arsenide, gallium nitride and other 13–15 binary materials and their composites play important role in modern microelectronics and are promising materials for the future technologies. One of the methods of their production is chemical vapor deposition (CVD). Usually CVD is performed under conditions in which deposition is controlled by the surface reactions between the radicals. It is widely believed that gas phase association reactions are “parasitic” processes for CVD and therefore they should be avoided. However, results of the extensive quantum chemical modeling of group 13–15 CVD [1–4] show high thermodynamic favorability of association

reactions at high temperatures. These association reactions lead to formation of ring and cage compounds in the gas phase. It is expected, that these species will be an excellent “natural” single-source precursors for controlled synthesis of 13–15 composites.

Formation of a variety of cluster species is thermodynamically favorable in vapors [2], but needle-shaped oligomers and polymers are predicted to have an exceptional stability in broad temperature range (298–1000 K) [1, 4]. Thus, gas phase generation of 13–15 nanowires and nanoparticles via association route emerges as a viable alternative to the traditional CVD techniques.

References:

- [1] Timoshkin A. Y., Schaefer H. F. *J. Am. Chem. Soc.* 2004. 126: 12141–12154.
- [2] Timoshkin A.Y., *Inorg. Chem. Commun.* 2003. 6: 274–277.
- [3] Timoshkin A.Y., Schaefer H.F. *The Chemical Record.* 2002. 2: 319–338.
- [4] Timoshkin A.Y., Schaefer H.F. *Inorg. Chem.* 2005. 44: 843–845.

---

Dr. Alexey Y. TIMOSHKIN  
Inorganic Chemistry Group,  
Department of Chemistry,  
St. Petersburg State University

Universitetsky av. 26, Old Peterhof  
198504 St. Petersburg, Russia  
Phone: +07 812 4284071  
Fax: +07 812 4286939  
E-mail: alextim@AT11692.spb.edu

## BIOCATALYSIS FOR SYNTHESIS OF CHIRAL DRUGS

Vladimir I. Tishkov

*Lomonosov Moscow State University  
Moscow, Russia*

Stereoisomers of organic compounds can provide different therapeutic effect. That is why compounds used as synthons in pharmaceutical industry have to have 100% enantiomeric purity. NAD(P)<sup>+</sup>-dependent dehydrogenases can be used for synthesis of chiral compounds due to absolute stereospeci-

ficity of hydrid-ion transfer in enzyme active site from reduced coenzyme to organic substrate. For example, alcohol dehydrogenase from baker's yeast catalyses reaction of acetaldehyde reduction by transfer of hydrid-ion from 4-*Re* position of NADH. The enzyme makes one stereochemical "mistake" (transfer of 4-*Si* hydrogen of NADH) every 7,000,000,000 turnovers (!!!) (Weinhold et al., PNAS 1991). Due to high cost of NADH and especially NADPH, main reaction has to be coupled with the second one for *in situ* coenzyme regeneration. For preparative applications, three components have to be combined: an appropriate enzyme, an efficient coenzyme-regenerating step and a suitable reaction-engineering technique. In present work recent achievements in coenzyme regeneration and practical application of dehydrogenases for synthesis of chiral compounds have been reviewed. Different approaches used in practice have been analyzed and compared.

---

Prof. Dr. Vladimir I. TISHKOV

Department of Chemical Enzymology,  
Chemistry Faculty,  
M.V. Lomonosov Moscow  
State University

Leninskie Gory  
119992 Moscow, Russia  
Phone: +07 095 9393208  
Fax: +07 095 9392742  
E-mail: vit@enz.chem.msu.ru  
E-mail: tishkov@pochta.ru

THE ENVIRONMENT-FRIENDLY  
MANAGEMENT OF SOILS AND ORGANIC WASTE:  
LOW INPUT, SLOW PROGRESS

Alexei V. Tiunov

*Severtsov Institute of Ecology and Evolution,  
Russian Academy of Sciences  
Moscow, Russia*

Agricultural exploitation leads to ever-increasing degradation and loss of fertile soil layer. This problem is severe in industrial Europe, but often reaches a catastrophic scale in developing countries. On the other hand, enormous

quantities of organic waste are being produced, and the ability to manage wasted organic matter is indispensable for sustainable development. A large proportion of municipal and agricultural organic wastes is treated biologically to reduce mass and to gain a recycled product coherent with legislation. In principle, the re-application of the recycled organic matter to arable soils might mitigate soil degradation. Since the second half of 19 century, a number of «natural» technologies of organic waste recycling have been proposed, including controlled inoculation with particular microbial strains, treatment with earthworms or other soil animals, phytoremediation etc. The rationale is to imitate processes that are responsible for the decomposition of dead organic matter in natural ecosystems. The main products of the natural process are (i) chemically simple nutrients, that can be easily assimilated by plants, and (ii) complex and stable organic compounds that eventually join soil humus pool and ensure long-term fertility and other essential properties of soil.

One of the postulated advantages of such techniques inevitably was the low cost. Indeed, various methods of the «natural» composting of organic wastes (especially of the «rural» origin, like animal manure, straw or sawdust) do not need large monetary or energy investment. Unfortunately, the natural processes operate at relatively slow rate. This is especially true for the formation of soil humus. Moreover, the stabilization of the humified organic matter is virtually impossible without mineral soil fraction, which is usually absent in composts. As a result, the organic composts often contain a relatively large amounts of easily available plant nutrients, thus promote immediate increase in plant productivity. But they are usually poor in stable humus-like compounds, and can hardly contribute to the long-term remediation of degraded soils. The solution lays in the creation of modern technology (not necessarily cheap) of the wasted organic matter management, which would adequately simulate but also accelerate natural processes of the humus formation.

---

Dr. A.V. TIUNOV

Laboratory of Soil Zoology,  
A. N. Severtsov Institute  
of Ecology and Evolution,  
Russian Academy of Sciences

33 Leninsky Ave.  
119071 Moscow, Russia  
Phone: +07 095 9581449  
E-mail: tiunov@sevin.ru

## USE OF COMPUTER TECHNOLOGIES IN CORRECTION EYESIGHT AT SCHOOLCHILDREN

Alexandra S. Tomilova, Albina A. Kisileva

*Gymnasia attached to St. Petersburg I. I. Mechnikov Medicine Academy  
Pavlov Institute of Physiology, Russian Academy of Sciences  
St. Petersburg, Russia*

It has been shown in literature [1], that the children from 40 to 60% have visual impairment at present time. Correction the visual function at children with myopia or amblyopia can be accomplish with special visual exercises and using computer technologies [2]. In this work was estimated the effectiveness of this technology visual function at 15 children from 11 to 12 ages old.

It was presented [picture] one of three computer programs for patients during 15–20 minutes:

- the interactive training program for cure of amblyopia and myopia;
- the program stimulating neuron n different level of visual analyzer;
- the program for estimate condition binocular stereovision and treatment of binocular disorder.

The one course of treatment consists of 20–25 seances. The 5 of 12 patients had improvement visual functions with myopia after two courses of treatment. Two patients with amblyopia were recovered. The patient with pseudomyopia had improvement in his condition.

The treatment was conducted like a game, there fore it was interesting for them and it was reduced dead line of treatment. This method is painless and interesting for children in contrast to invasive methods.

References:

[1] Terehova U. S. *Correction Eyesight at Children*. Rostov onDon, 2000, 318 p.

[2] Yrmakov V. P. *Professional Orientation of Pupils With a Visual Impair*. Moscow: Medicine, psychology, pedagogy, 2000, 298 p.

---

Alexandra S. TOMILOVA

Pavlov Institute of Physiology,  
Russian Academy of Sciences

6 Makarova Nab.  
199034 St. Petersburg, Russia  
Phone: +07 812 3281676  
Fax: +07 812 3280501  
E-mail: bvk@infran.ru

## DIVIDE-AND-CONQUERE APPROACH IN LIST DECODING OF REED-SOLOMON CODES

Peter Trifonov

*St. Petersburg State Polytechnic University  
St. Petersburg, Russia*

One of the most important results obtained in coding theory within last ten years is polynomial time algorithm for list decoding of Reed-Solomon codes [1]. This method was shown to provide considerable performance gain compared to traditional decoding algorithms. The most complex stage of the algorithm consists in finding a bivariate polynomial of minimum weighted degree having a number of roots of a given multiplicity. Nielsen's iterative interpolation algorithm [2] can be used to solve this problem. However, its complexity appears to be quite high.

In [3] it was shown that the interpolation problem can be reduced to a number of smaller ones, which can be solved independently and their solutions combined to form the solution of the original problem. Combining the solutions of two interpolation problems consists in finding a product of two polynomial ideals. The standard method for computing the product of two ideals [4] requires computing all pairwise products of the basis polynomials of the ideals being multiplied. It appears that the ideal basis constructed in this way is highly redundant.

In this report we show that multiplication of two ideals under certain conditions can be performed by means of well-known fast polynomial multiplication algorithms [5]. This reduces the complexity of ideal multiplication from  $O(\rho^2)$  to  $O(\rho \log \rho)$ , where  $\rho$  is the basis size of the ideals being multiplied.

However, solution of the decoding problem still requires finding Groebner basis of the product of two ideals. This can be done by Buchberger algorithm [4]. However, it appears to have quite high complexity. An open research problem is therefore how to avoid Groebner basis computation in list decoding of Reed-Solomon codes.

References:

[1] Guruswami V., Sudan M. Improved decoding of Reed-Solomon and algebraic-geometric codes. *IEEE Transactions on Information Theory*. 1999. 45(6): 1757–1767.

[2] Refslund Nielsen R., Hoholdt T. Decoding Reed-Solomon codes beyond half the minimum distance. In: *Proceedings of the International Conference on Coding Theory and Cryptography*, Mexico 1998. Springer-Verlag, 1998.

[3] Ma J., Trifonov P., Vardy A. Divide-and-Conquer Interpolation for List Decoding of Reed-Solomon Codes. In: *Proceedings of IEEE International Symposium on Information Theory*, June 2004, P. 386.

[4] Cox D., Little G., O'Shea D. *Ideals, varieties and algorithms*. Springer-Verlag, 1992.

[5] Knuth D. E. *The art of computer programming*, Vol. 2. Addison-Wesley, 1998.

---

Research Assistant  
Peter V. TRIFONOV

Department of Distributed  
Computing & Networking,  
St. Petersburg State  
Polytechnic University

21 Polytechnicheskaya Str., Room 9-104  
194021 St. Petersburg, Russia  
Phone: +07 812 2471639  
Fax: +07 812 2471639  
E-mail: ptrifonov@ieee.org  
<http://den.infos.ru/~petert>

## PROTEINS AND PEPTIDES FROM SNAKE AND SNAIL VENOMS: STRUCTURAL AND PHARMACOLOGICAL IMPLICATIONS

V. Tsetlin

*Shemyakin & Ovchinnikov Institute of Bioorganic Chemistry,  
Russian Academy of Sciences, Moscow, Russia*

A number of toxins and other proteins have been isolated in preparative amounts from different snake venoms. Among them are not only the well-known components ( $\alpha$ -neurotoxins, cytotoxins, nerve growth factors, phospholipases, and others), but also many new proteins, including those present in minor amounts (for example, muscarinic toxins and weak neurotoxins). Data in literature show that diverse snake venom proteins, either as such or in modified form, have a plethora of pharmacologically useful activities (antimicrobial, anticancer, etc). In particular, we have recently demonstrated

antiproliferative activity for a “weak toxin” which is practically devoid of toxicity.

Another line of research concerns neurotoxic peptides from the poisonous marine snails of *Conus* genera. The preparative schemes of their solid-phase peptide synthesis have been developed in our laboratory, which gave large amounts both of naturally occurring peptides and their analogs. Among the latter we have some which exceed the native compounds in potency and selectivity. The literature has already demonstrated the use of some conotoxins as potential pain killers and antiepileptic means.

The available series of  $\alpha$ -neurotoxins and  $\alpha$ -conotoxins (prepared also in appropriately labeled forms) is used for distinction of diverse types and subtypes of nicotinic acetylcholine receptors whose malfunctioning is associated with different muscle and neuronal degenerations and psychiatric diseases [1].

References:

[1] Tsetlin V. I., Hucho F. Snake and snail toxins acting on nicotinic acetylcholine receptors: fundamental aspects and medical applications. *FEBS Lett.* 2004. 557: 9–13.

---

Prof. V. TSETLIN

Shemyakin & Ovchinnikov  
Institute of Bioorganic Chemistry,  
Russian Academy of Sciences

16/10 Miklukho-Maklay Str.  
177997 Moscow, Russia  
Phone: +07 095 3355733  
E-mail: vits@ibch.ru

## IMPRECISE PROBABILITIES AS A UNIFIED FRAMEWORK FOR RISK ANALYSIS

Lev V. Utkin

*St. Petersburg State Forest Technical Academy  
St. Petersburg, Russia*

Modern economics and societies depend on responsible and reliable processing of knowledge and information. Therefore, most realistic risk

analysis problems meet with a lack of detailed knowledge or experience, missing data, incomplete information about unwanted events and their consequences. When the events occur frequently, it is relatively simple to calculate the risk and to make an optimal decision by means of commonly used methods based on variations of the principle of maximizing the expected utility. When, on the other hand, the frequency of damages is low and the quality of the estimates is poor, the situation is considerably more difficult, in particular, if catastrophic events can occur. One of the promising frameworks for dealing with uncertainty and for credible decision making in this case is the theory of imprecise probabilities independently founded by Kuznetsov [1], Walley [2] and Weichselberger [3]. Since the imprecise probabilities cover all mathematical models, which measure chances or uncertainty without sharp numerical probabilities, then new unified methods for solving risk-related decision problems under more general and realistic assumptions are developed. In order to take into account heterogeneity of available imprecise information (statistical data, expert judgments, measurements), it is also proposed to use the so-called imprecise Dirichlet model [1, 4]. It turns out that some combination of this model and the imprecise probabilities leads to a very powerful framework for risk analysis allowing us to solve rather difficult and realistic decision problems. Moreover, this framework provides us with the possibility to consider «cautious» risk models.

References:

- [1] Kuznetsov V. P. *Interval Statistical Models*. Moscow: Radio and Communication. 1991.
- [2] Walley P. *Statistical Reasoning with Imprecise Probabilities*. Chapman and Hall (1991).
- [3] Weichselberger K. *Elementare Grundbegriffe einer allgemeineren Wahrscheinlichkeitsrechnung*. Vol. 1. Intervallwahrscheinlichkeit als umfassendes Konzept. Heidelberg: Physika. 2001.
- [4] Utkin L. V. Probabilities of judgments provided by unknown experts by using the imprecise Dirichlet model. *Risk, Decision and Policy*. 2004. 9(4): 391–400.

---

Dr. Lev V. UTKIN  
St. Petersburg State  
Forest Technical Academy

5 Institutsky Per.  
194021 St. Petersburg, Russia  
Phone: +07 812 2476937  
Fax: +07 812 5500815  
E-mail: lvu@utkin.usr.etu.spb.ru

## HIERARCHY OF SCALES IN MAGNETIC NANOSTRUCTURES

Valery M. Uzdin

*St. Petersburg State University  
St. Petersburg, Russia*

Processes and structures in physics of low-dimensional magnetism (LDM) might easily involve variables that span ten or more orders of magnitude in time and space. Phenomena observed at such various scales are governed by different laws and need elaborated and expansive tools for their experimental and theoretical study. Although the expression «magnetic nanostructures» presupposes a well-defined length scales, we can, however, speak about a hierarchy of length-scales for these systems. Several examples attractive both for fundamental science and for applications are presented.

Possibility to build artificial structures (quantum corrals), using tip of scanning tunneling microscope with unique accuracy and observation of Kondo resonance on single atom caused considerable attention on the magnetism in few-atom-size artificial structures. Adequate theoretical explanation of phenomena in such systems has to include strong electronic correlations, possibility of non-collinear magnetic ordering in small clusters, interaction of adsorbed magnetic atoms with surface and bulk states of substrate [1].

Investigation of low-dimensional magnetism in multilayer structures where loading of the hydrogen allows to change continuously the interlayer exchange interaction made it possible to realize experimentally transitions from quasi-2D to 3D magnetism [2]. Thus in contrast to the previous development of the science when theoretical models were suggested to describe some features of real systems, now it is possible to grow the artificial magnetic structures which able very exact reproduce behaviour of the theoretical models and even to realize the transition between different theoretical models.

Large progress was achieved in the understanding of atomic scale interface structure and its influence on the magnetic properties [3]. Using of complementary experimental methods together with modelling of epitaxial growth and subsequent self-consistent calculations of magnetic structure lead to the revision of traditional view on the LDM.

References:

[1] Kudasov Y. B., Uzdin V. M. Kondo state for a compact Cr trimer on a metallic surface. *Phys. Rev. Lett.* 2002. 89: 276802.

[2] Uzdin V., Westerholt K., Zabel H., Hjorvarsson B. Interface alloying and tunability of magnetic structure with hydrogen in Fe/V multilayers and. *Phys. Rev. B.* 2003. 68: 214407.

[3] Uzdin V. M., Keune W., Schror H., Walterfang M. Fe/Cr interface magnetism: Correlation between hyperfine fields and magnetic moments. 2001. *Phys. Rev. B.* 63: 104407.

*This work is supported by INTAS-NETWORK project 03-51-4778.*

---

Dr. Valery M. UZDIN  
St. Petersburg State University,  
ICAPE

29, 14th Linia, V. O.  
199178 St. Petersburg, Russia  
Phone: +07 812 3733692  
Fax: +07 812 3237175  
E-mail: v\_uzdin@mail.ru

## ION IMAGING OF CHEMICAL REACTIONS

Oleg S. Vasyutinskii

*Ioffe Physical Technical Institute Russian Academy of Sciences  
St. Petersburg, Russia*

Ion imaging of the products of chemical reactions is a novel tool for investigation of the elementary chemical and photochemical reactions in the atmosphere of Earth and planets as well as in industrial and scientific devices. It combines lasers, supersonic molecular beams, and mass spectrometers and makes possible the visualization of chemical reactions. These studies have already resulted in observation of a series of new remarkable phenomena some of which are still far from being understood.

These are: discovering of a new (coherent) mechanism of chemical reactions [1], determination of the phase of the reaction product matter waves and producing highly spin-polarized hydrogen atoms [2], and observation

and analysis of the velocity-dependent quantum yield in photolysis of polyatomic molecules [3]. These results are important for atmospheric chemistry and ecology, and for developing the methods of control on chemical reactions.

References:

- [1] Bracker A. S., Wouters E. R., Suits A. G., Lee Y. T., Vasyutinskii O. S. *Phys. Rev. Lett.* 1998. 80(8): 1626.
- [2] Rakitzis T. P., Samartzis P. C., Toomes R. L., Kitsopoulos T. N., Brown A., Balint-Kurti G. G., Vasyutinskii O. S., Beswick J. A. *Science*. 2003. 300: 1936.
- [3] Schoefer L., Goedecke N., Ott O., Maul C., Gericke K.-H., Shternin P. S., Orlenko E. V., Vasyutinskii O. S. *Chem. Phys.* 2004. 301: 213.

---

Prof. O.S. VASYUTINSKII

A. F. Ioffe Physical Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
Phone: +07 812 2472064  
Fax: +07 812 2471017  
E-mail: osv@pms.ioffe.rssi.ru

## ELECTRICAL AND OPTICAL PROPERTIES OF SILICON MOS TUNNEL STRUCTURES

M. I. Vexler

*Ioffe Physical Technical Institute Russian Academy of Sciences  
St. Petersburg, Russia*

A MOS tunnel structure is the metal – silicon dioxide (SiO<sub>2</sub>) – silicon (Si) structure, where the electrons and holes may be transported through the oxide by means of a direct quantum-mechanical tunneling. This transport mechanism provides measurable current if the SiO<sub>2</sub> layer is thinner than 3-4 nm. Since the applicability of sub-3 nm oxide as gate dielectric in field-effect transistors (MOSFETs) is shown [1], MOS tunnel structure became one of key objects of technical semiconductor physics.

Considering the MOS structure as a gate MOSFET section, tunnel leakage should be treated as a parasitic effect. However, the same MOSFET can also be used as a bipolar device, if the metal is taken as emitter, source and drain together as base contact and Si bulk as collector. So, the study of tunneling and of related electrical and optical phenomena in MOS structures is important from several points of view.

The most interesting electrical properties of MOS tunnel structures arise from the interplay between the electron and hole current components. These features are reflected by the small-signal current gain in bipolar mode, which is non-monotonous as a function of base bias. Furthermore, the impact ionization of Si by injected hot carriers introduces the positive current feedback leading to the bi- or multi-stability of a reverse-biased MOS structure on an n-Si wafer [2], except for high doping  $N_d$ . For  $N_d \sim 10^{18}$ – $10^{19}$  cm<sup>-3</sup>, additional band-to-band tunneling within semiconductor comes into effect, supporting the inversion and causing some resonant features. The achieved standards of simulation technique (essential parameters:  $m_{e,ox} = 0.42m_0$ ,  $m_{h,ox} = 0.34m_0$  [carrier effective masses in SiO<sub>2</sub>],  $\chi_e = 3.15$ eV [Si/SiO<sub>2</sub> c-band discontinuity],  $E_{g,ox} = 8.9$ eV [SiO<sub>2</sub> bandgap]) allow for satisfactorily reproducing of electrical characteristics of MOS tunneling devices, in particular of all the above-mentioned features [3].

Light-emitting properties of MOS tunnel structures can be revealed by positive substrate bias and are due to the hot-electron induced radiative transitions within Si. The recording and study of luminescence spectra offer deeper understanding of the physics of hot carriers in the industrially significant device. Moreover, the optical characteristics are sensitive to the oxide damage and can be used for its monitoring. The spectra of MOS structures [4] present a convolution of hot-injection near-surface luminescence and relatively less interesting bulk radiation. The form of a spectrum and the position of its blue border depend primarily on the energy of injected electrons; in the p-Si diodes, this energy may be easily changed through changing the terminal bias. Oxide damage causes the shift of blue border toward lower  $\hbar\omega$ . Some refined details of the spectra are related to the Si band structure; if the electron energy is high enough, the direct recombination ( $\hbar\omega \sim 3.4$ eV) optical transition is observed.

References:

- [1] Momose H. S. et al. *IEEE Trans. Electron Dev.* 1996. ED-43: 1233.
- [2] Grekhov I. V. et al. *Solid-State Electron.* 1995. 38: 1533.

[3] Vexler M. I. et al. *Microel. Eng.* 2001. 59: 161; *Microel. Eng.* 2004. 72: 180.

[4] Asli N. et al. *Semicond. Sci. Technol.* 2003. 18: 147.

---

M. I. VEXLER

A. F. Ioffe Physical Technical Institute,  
Russian Academy of Sciences

26 Polytekhnicheskaya Str.  
194021 St. Petersburg, Russia  
E-mail: shulekin@pop.ioffe.rssi.ru

## A TOY MODEL OF GENE EXPRESSION REGULATORY NETWORK

Dmitri Volchenkov

*Research Institute of Physics, St. Petersburg State University*  
*St. Petersburg, Russia*  
*Centre de Physique Theorique (C. N. R. S.)*  
*Luminy, Marseille, France*

The process of gene expression controlled by the promoters of other genes expressed at the same time by the external signals is called the gene regulation [1]. Gene transcription begins downstream from the promoter at a particular sequence of DNA that is recognized by the polymerase as the start site of transcription. A central goal of postgenomic biology is the elucidation of the regulatory relationships among all constituents that together comprise the “genetic network” of a cell. The cooperative interactions between genes can be visualized through a graph  $\Gamma$  where nodes denote genes and links do activating or repressing effects on transcription. We study a toy discrete time deterministic model of a large regulatory network comprising of dynamically coupled synchronously updated units defined on both the homogeneous and scalable initial graphs.

Being interested in the highly reproducible dynamical patterns of regulatory processes in the toy model, we consider a statistical ensemble of such networks in which any layout of switching parameters featuring step-

like interactions between the network units can be possible with some probability. It helps to study the robust dynamical patterns of regulatory processes in a lack of empirical data concerning genetic switches. The multistationarity and multiperiodicity of oscillations exhibited by the system rely upon the feedback circuits. Statistics of their appearance depends upon the relative number of negative regulations between the genes of network, the number of cycles in the maximal graph, and their lengths.

The model defined on the scalable graphs demonstrates the high persistence in oscillations and the high error tolerance.

References:

- [1] Ptashne M., Gann A. (2002): *Genes and Signals* (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY).
- [2] Volchenkov D., Lima R. *Stochastic and Dynamics*. 2005. 5(1): 001–021.

---

Dr. Dmitri VOLCHENKOV  
Research Institute of Physics,  
St. Petersburg State University

Po. Bo. #234  
195279 St. Petersburg, Russia  
Phone: +07 812 4275128  
Fax: +07 812 4284449  
E-mail: dima427@yahoo.com  
E-mail: volchen@cpt.univ-mrs.fr

## ON THE APPROXIMATION OF THE SAMPLE BY A POISSON POINT PROCESS

Andrei Yu. Zaitsev

*St. Petersburg Department of Steklov Mathematical Institute,  
Russian Academy of Sciences  
St. Petersburg, Russia*

It is shown [1] that the results obtained earlier on the approximation of distributions of sums of independent summands by accompanying infinitely divisible laws may be interpreted as substantial quantitative estimates for the closeness of a sample containing independent observations and a Pois-

son point process, obtained after a Poissonization of the initial sample. The most interesting results are obtained for a scheme of rare events.

Let  $X_i, i=1, \dots, n$ , be independent random elements of a measurable space  $\Omega$ . We consider the problem of approximating the sample  $(X_1, \dots, X_n)$ , by a Poisson point

process  $(Y_1, \dots, Y_n)$  with intensity measure which is the sum of distributions of  $X_i$ .

Let  $\mathbf{f} : \Omega \rightarrow \mathbf{R}^d$ , be a measurable mapping. We shall approximate the probabilities of events of the form  $\{\sum_i \mathbf{f}(X_i) < \mathbf{x}\}$  which may be treated as the probabilities of that the cumulative influences of the risk factors  $f_j$  do not exceed fixed critical values  $x_j$ . We show that, for arbitrary  $\mathbf{f}$ , the probabilities of these events may be well approximated by the probabilities of events  $\{\sum_i (\mathbf{f}(Y_i) - \mathbf{a}_{ni}) < \mathbf{x} - \sum_i \mathbf{a}_{ni}\}$ , where  $\mathbf{a}_{ni}$  are non-random vectors, which depend on the distributions of  $X_i$ .

In conclusion, we shall consider a scheme of independent non-identically distributed rare events, which, being actually a particular case of the situation considered above, admits substantial estimates without additional centering for actually arbitrary mappings  $\mathbf{f}$ . The rare events are similar to extreme incidents, each of them is unique and has his own individual distribution. Thus, the results may be useful, for example,

in the insurance theory to estimate the probabilities that the cumulative influence of the risk factors  $f_j$  do not exceed fixed critical values  $x_j$  (see, for example, [2]).

References:

[1] Zaitsev A. Yu. On the approximation of the sample by a Poisson point process. *Zap. Nauchn. Semin. POMI*. 2003. 298: 111–125.

[2] Gerber H. U. *An Introduction to Mathematical Risk Theory*. Huebner Foundation Monograph. 1981.

---

Dr. Andrei Yu. ZAITSEV  
St. Petersburg Department  
of Steklov Mathematical Institute,  
Russian Academy of Sciences

27 Fontanka  
191023 St. Petersburg, Russia  
Phone: +07 812 3124058  
Fax: +07 812 3105377  
E-mail: zaitsev@pdmi.ras.ru

## BIOPOLYMER NANOSTRUCTURES BASED ON TWO POLYELECTROLYTES AND ENZYME

Sergei Yu. Zaitsev<sup>1</sup>, Reinhard Miller<sup>2</sup>

<sup>1</sup>*Moscow State Academy of Veterinary Medicine and Biotechnology, Acad*

<sup>2</sup>*Max-Planck-Institut für Kolloid- und Grenzflächenforschung*

The design of supramolecular nanostructures based on enzyme dispersions is one of the most promising fields of modern colloid and biological chemistry. While a lot of publications concern complex formation between two oppositely charged polyelectrolytes; polyelectrolyte and surfactant; polyelectrolyte and protein, very little is known about the immobilization of enzymes in the complex of two oppositely charged polyelectrolytes (PEC) as three-component system. A study of the optimal conditions of the immobilization of various enzymes in polycation-polyanion complexes (PEC) and the influence of different properties of such complexes is the main goal of this work.

The basic idea consists in the fact that enzyme can be integrated into an excess of a polycation-polyanion complex and the interaction between protein and two polyelectrolytes can be changed by variation of the pH-value, restoring the enzyme activity. Thus, in our experiments the excess polymer was slowly added to the mixture of trypsin and the polyelectrolyte of the same kind of charge as trypsin at the chosen pH. Na-poly(styrene sulfonate) [PSS] was chosen as polyanion and poly(diallyldimethylammonium chloride) [PDADMAC] – as polycation. The trypsin activity measurements in the complex dispersions were performed spectrophotometrically at 255 nm with substrate (1 mM BAEE in 50 mM Tris-HCl at pH 7.5). The centrifugation of the obtained complexes and activity of supernatants measurements reflected mainly the portion of the of free enzyme in the complex dispersion. So, the difference of these activities (effective activity) is a real measure for the activity of the bound enzyme. The complex prepared at pH 11.0 showed a drastic decrease in the effective trypsin activity (only 5%). At pH 7.5 the net charge of trypsin is significantly reduced and a high portion remains as free molecules in solution, excluding such conditions for immobilization of the enzyme. The highest effective activities were obtained at pH 3.0 (from 52 till 82%) by enhancing the polyelectrolyte concentrations in relation to the concentration of trypsin (ratio from 5:1 till 20:1), whereas the enzyme activity in the supernatant changes slightly. Thus, the optimal conditions for the

trypsin immobilization can be as following: PSS(M=10<sup>6</sup> g/mol)/PDADMAC/trypsin, pH 3.0, mass ration PDADMAC/trypsin = 10:1.

The relative activity of the immobilized lipases in PSS and PDADMAC strongly depended on the pH value during complex formation, the relative concentrations of the polyelectrolytes to lipase, the use of particular salts for the enzyme and/or polyelectrolyte preparations. Introduction of salts (NaCl, KH<sub>2</sub>PO<sub>4</sub>, NaH<sub>2</sub>PO<sub>4</sub>) in the lipase-polymer or pure lipase dispersions strongly influenced on the rate of triacylglycerol hydrolysis by lipase. An increase of the lipase activities was found in all studied salt solutions as compared to those in distilled water (100% control). Moreover, both types of lipases had higher activity in solutions of KH<sub>2</sub>PO<sub>4</sub> (122% for lipase from *Pseudomonas fluorescens*, 129% for lipase from *Hog Pancreas*) than in NaCl (about 100% for both lipases). However, by increasing the salt concentration up to 0.05 M solutions of KH<sub>2</sub>PO<sub>4</sub>, the activity of lipase from *Hog Pancreas* was decreasing to 114% in comparison with a 0.01M solution (129%). The enzyme activity of studied lipase had a maximum in pH-optimum intervals and decreased at low and high pH values. The obtained temperature dependence gave evidence of the relatively high thermostability of the lipase from *Pseudomonas fluorescens* (at 60 °C the activity is 111%) and low thermostability of the *Hog Pancreas* lipase (at 50 °C the activity is 68%). The use of a phosphate buffer as solvent for lipase and the polyelectrolytes resulted in activities much higher than those obtained for the free lipases. Most likely, these effects are due to both, hydrophobic and electrostatic interactions between the lipases and the polyelectrolytes. The highest effective lipase activity of about 62-68% in PEC (as difference between activity in PEC solution and in the supernatant) was found at pH 9.0 and a high excess (100 fold) of the polyelectrolyte to lipase during complex formation. Thus, the following optimal conditions for preparations of such three-component complexes can be recommended: ratio polymer to lipase of 100 : 1 in phosphate buffer at pH 9.0.

*This work was supported by parts from the Alexander von Humboldt-Stiftung, Deutsche Forschungsgemeinschaft and Russian Foundation for Basic Research..*

---

Sergei Yu. ZAITSEV  
Moscow State Academy  
of Veterinary Medicine  
and Biotechnology

23 Skryabina Str.  
109472 Moscow, Russia  
Phone: +07 812 4275128  
E-mail: szaitsev@mail.ru

## THE NUCLEOLUS AS A TARGET FOR INDUCTION OF APOPTOSIS IN MAMMALIAN CELLS

Olga V. Zatsepina

*Shemyakin & Ovchinnikov Institute of Bioorganic Chemistry,  
Russian Academy of Sciences  
Moscow, Russia*

The nucleolus is the major nuclear structural domain, which main function is the assembly of ribosomes. However, numerous recently obtained data show that the nucleolus also participates in regulation of other key cellular processes, including apoptosis [1]. It has been shown that specific manifestation of the nucleolar structure or/and function results in apoptotic cell death [2].

The major aim of our work is to study the nucleolus reaction on inhibition of translation or action of subtoxic doses of heavy metals, which are known to provoke an autoimmune response to self-nucleolar antigens in humans and laboratory animals.

Our data show that partial or complete inhibition of protein synthesis by different antibiotics, such as anisomycin, cycloheximide or puromycin, as well as by an alkaloid emetine, cause a massive apoptotic death in human cervical carcinoma cells HeLa. Early stages of apoptosis, when nuclei still remain morphologically intact, are accompanied by migration of the specific nucleolar proteins involved in rDNA transcription, from the nucleolus to the nucleoplasm. These observations indicate that "the nucleolar reaction" can be used as a sensitive indicator for biological activity of old and novel translation inhibitors at the cellular level. Heavy metals, such as  $\text{Hg}^{2+}$ ,  $\text{Cd}^{2+}$  and  $\text{Zn}^{2+}$ , are toxic for mouse cells both *in vivo* and *in vitro*. The most toxic effects were investigated upon cell incubation with  $\text{Cd}^{2+}$ , which also causes intense skin manifestations following injections to laboratory mice. The metal cytotoxic effects were preceded by structural and functional alterations of the nucleolus.

References:

[1] Olson M.O. Sensing cellular stress: another new function for the nucleolus? *Sci. STKE*. 2004. 224: 1–3.

[2] Rubbi C.P., Milner J. Disruption of the nucleolus mediates stabilization of p53 in response to DNA damage and other stresses. *EMBO J.* 2003. 22: 6068–6077.

---

Dr. Olga V. ZATSEPINA

Shemyakin & Ovchinnikov  
Institute of Bioorganic Chemistry,  
Russian Academy of Sciences

16/10 Miklukho-Maklay Str.  
117997 Moscow, Russia  
Phone: +07 095 7792366  
Fax: +07 095 3357103  
E-mail: [zatsepin@ibch.ru](mailto:zatsepin@ibch.ru)

## Author Index

### A

Adushkin V. V. – 2  
Alexandrov V. E. – 19  
Alexandrova L. A. – 3  
Andreev I. A. – 5  
Andreev S. N. – 2  
Antonova E. V. – 3  
Artemieva A. V. – 53, 63, 72

### B

Bagaeva T. – 8  
Balestrino M. – 53, 72  
Bandura A. V. – 19  
Bayer M. – 26  
Berezovskaya E. A. – 6  
Bespalov A. – 49  
Blekhman I. I. – 7  
Bobryshev P. – 8  
Bryushinin M. A. – 90  
Bunik V. – 10, 16  
Burakov A. – 49  
Burov S. V. – 53, 72

### C

Chalisova N. I. – 40  
Cherepkov N. A. – 12  
Chudovskaya O. V. – 94

### D

Davydova E. I. – 13  
Degtjarev D. – 16  
Deyev S. M. – 14  
Didenko T. – 49

### E

Egorova V. – 49  
Elizarov A. Yu. – 18  
Evarestov R. A. – 19

### F

Fedorenko S. – 21  
Filaretova L. – 8

### G

Glazov A. L. – 22  
Grachova E. V. – 23  
Grinenko A. – 49  
Gusakova K. A. – 25

### I

Ilin V. I. – 62  
Ivanov A. V. – 3  
Ivanov M. A. – 3  
Izvarina N. L. – 72

### K

Kalashnikova A. M. – 26  
Kalinina I. V. – 28  
Karachinsky L. Ya. – 29  
Karetsky A. V. – 30  
Karymova E. A. – 34  
Kasatov A. A. – 32  
Kasheverov I. E. – 62  
Katina I. E. – 34  
Ketkov S. Yu. – 35  
Khotyakov M. V. – 36  
Kikinger R. – 37  
Kipenko A. V. – 39  
Kisileva A. A. – 101  
Kizhayev S. S. – 5  
Kokryakov V. N. – 34  
Komashnya A. V. – 40  
Kornev N. – 41  
Korol A. V. – 43  
Korotkov K. O. – 44  
Korzevsky D. E. – 53  
Kostkin V. B. – 53

- Kosygina A. S. – 13  
 Kozmin A. – 45  
 Krasilshchikova M. S. – 47  
 Krupitsky E. – 49  
 Krylov B. V. – 50  
 Kryzhanovskaya N. V. – 51  
 Kukhanova M. K. – 3  
 Kulikov V. V. – 90  
 Kunafina E. R. – 47
- L
- Ledentsov N. N. – 59  
 Lensman M. V. – 53, 63, 72  
 Lobov G. I. – 39  
 Lopatina E. V. – 30, 54  
 Luchakov Yu. I. – 56  
 Lutful H. – 57
- M
- Masalov D. – 49  
 Matveeva Zh. S. – 58  
 Maximov A. V. – 3  
 Maximov M. V. – 59  
 Mazhuga V. I. – 60  
 Miller R. – 113  
 Molchanov S. S. – 5  
 Mordvintsev D. Yu. – 62  
 Morfill G. E. – 74  
 Mourovets V. O. – 63, 72
- N
- Nazarov A. – 65  
 Nerler P. – 45  
 Neznanov N. – 49  
 Nikitina T. V. – 66  
 Novikov I. I. – 67
- O
- Ostrovsky A. – 37  
 Otellin V. A. – 53, 72
- P
- Panchenko D. – 68  
 Pavlov V. V. – 26  
 Pennyaynen V. A. – 30, 39, 69  
 Pigusova L. K. – 3  
 Pisarev R. V. – 26, 70  
 Plakhova V. B. – 77  
 Pobilenskaya O. A. – 25, 58  
 Podvigina T. – 8  
 Podzorova S. A. – 77  
 Polenov S. A. – 53, 63, 72  
 Popel S. I. – 2, 74  
 Pozdnyakov A. O. – 75
- R
- Rodionov I. A. – 76  
 Rogachevsky V. – 77  
 Romanova T. – 49
- S
- Salin V. I. – 80  
 Sanger I. – 26  
 Schlag E. W. – 35  
 Schmidt A. A. – 81  
 Schwarz J. R. – 83  
 Selzle H. L. – 35  
 Sevast'yanova T. N. – 13  
 Shkarovskij M. – 84  
 Sidorenko A. S. – 86  
 Sidorenko I. N. – 87  
 Soboleva E. S. – 88  
 Sokolov I. A. – 90  
 Solov'yov A. V. – 91  
 Speransky A. I. – 47  
 Starostina L. V. – 93  
 Stepanova N. V. – 94  
 Stoyanov N. D. – 5
- T
- Tarasenko S. R. – 95  
 Timofeyev Yu. M. – 96  
 Timoshkin A. Y. – 6, 97  
 Tishkov V. I. – 98  
 Tiunov A. V. – 99  
 Tomilova S. A. – 101  
 Trifonov P. – 102

Tsetlin V. I. – 62, 103  
Tsoi M. – 49  
Tsyrlin V. A. – 54  
Tulub A. V. – 6  
Tupitsyn I. I. – 18

#### U

Utkin L. V. – 104  
Utkin Yu. N. – 62  
Uzdin V. M. – 106

#### V

Varfolomeev A. L. – 93  
Vasyutinskii O. S. – 107  
Verbitskaya E. – 49  
Vexler M. I. – 108  
Volchenkov D. – 110

#### W

Woody G. – 49

#### Y

Yakovlev D. R. – 26  
Yakovlev Yu. P. – 5  
Yakutseni P. P. – 72

#### Z

Zaitsev A. Yu. – 111  
Zaitsev S. Yu. – 113  
Zakutskii A. N. – 40  
Zatsepina O. V. – 47, 115  
Zhmak M. N. – 62  
Zolotarev V. A. – 63  
Zvartau E. – 49

