



NATIONAL RESEARCH UNIVERSITY



Peter the Great St. Petersburg Polytechnic University: International scientific cooperation. Success stories.

V. A. Yerokhin

EU-Russia S&T Cooperation. St. Petersburg, 7-8 October 2016



General Information

Founded in **1899**

Nobel Prize Winners

Nicolay N. Semenov (Chemistry, 1956)

Pyotr L. Kapitsa (Physics, 1978)

Zhores I. Alferov (Physics, 2000)

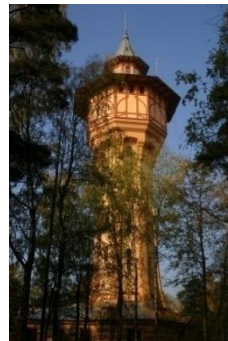


Students: 30 000 (among them, foreign:
3 000)

Education: 49 specialities

Staff: 8 500 (among them, teaching staff
3 200, > 500 Professors and Doctors of
science)

Buildings: 112





POLYTECH as a Research University

- Since 2010: status of “National Research University”.

29 Russian Universities.

- Strategic Development Program for 2010–2019

Main objective of the program is to update and develop SPbPU as a new type research university, which integrates multidisciplinary R&D activities and advanced technologies for rising up national economic competitiveness.

- Since 2011: participation in the “Mega grants” Federal program.

30M rub/year = 0.5M € /year per grant.

- Since 2013: participation in the “5-100 Russian academic excellence” program of Ministry of Education and Science of the Russian Federation.

The goal of Project 5-100 is to maximize the competitive position of a group of leading Russian universities in the global research and education market.

21 Russian Universities.

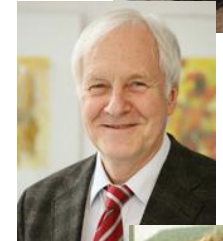




"Mega Grant" State Program

Since 2011: new research and innovation laboratories, directed by world's leading scientists:

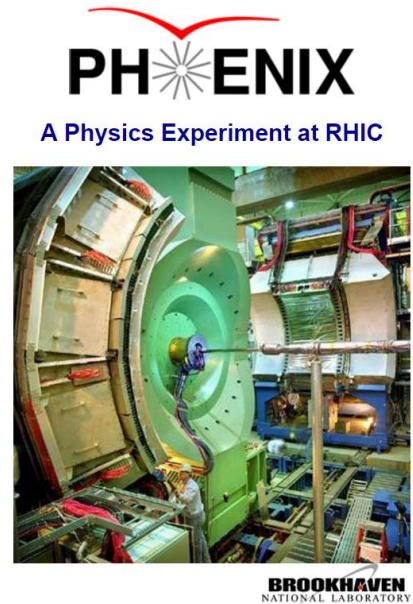
- **Interfaculty Laboratory "Astrophysics objects with extreme energy release"** (head – Prof. Georgy G. Pavlov, Pennsylvania State University, USA)
- **Interfaculty Research Laboratory of improved confinement tokamak plasmas** (head – Prof. Dr. Friedrich Wagner, Max Planck Institute for Plasma Physics, Germany)
- **Laboratory of neurodegeneration** (head – Prof. Ilya B. Besprozvanny, The University of Texas Southwestern Medical Center at Dallas, USA)
- **Laboratory of Molecular Microbiology** (head – Prof. Konstantin V. Severinov, The State University of New Jersey, Rutgers, USA)





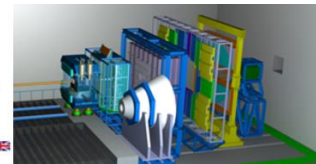
“Mega-Science” in particle physics

Participation of University researchers in Mega-Science nuclear physics projects:



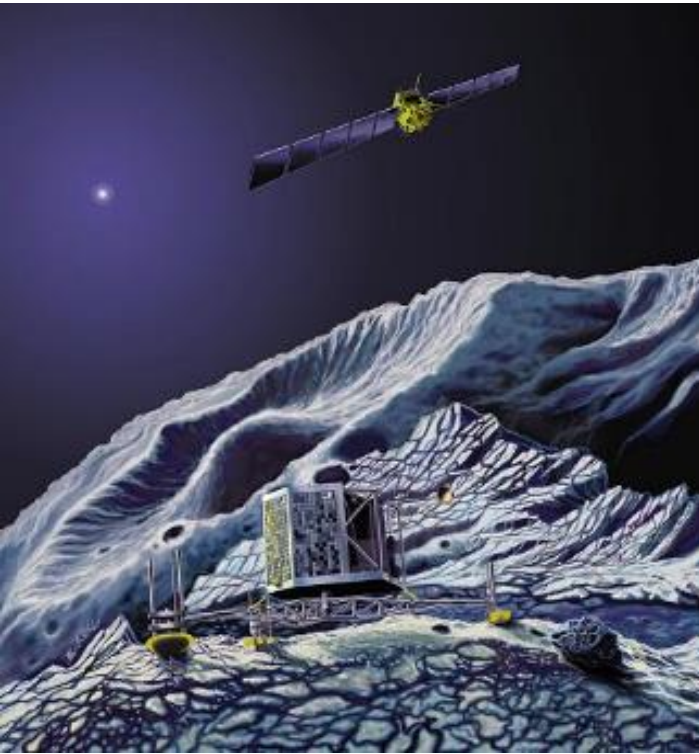
A Large Ion Collider Experiment

European Organisation for Nuclear Research





Physical gasdynamics of cometary atmospheres



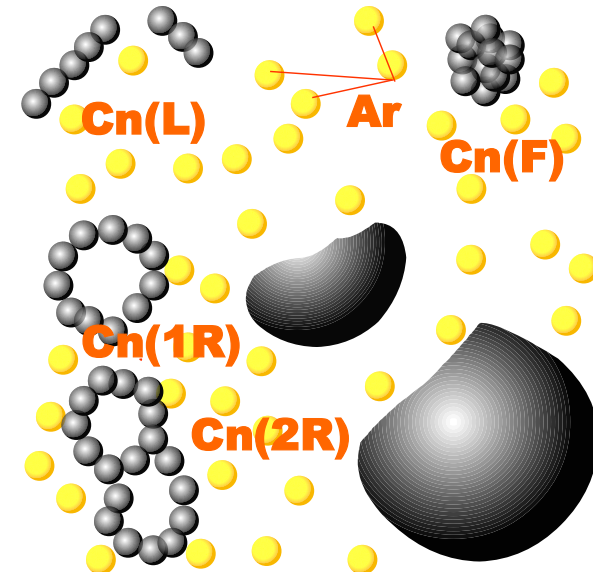
ROSETTA

A EUROPEAN SPACE AGENCY (ESA) CORNERSTONE MISSION
UNDERSTANDING COMET MYSTERIES

Research in the framework of the European Space Agency project “Rosetta” by the international team of scientists headed by Prof. J. F. Crifo (Service d’Aeronomie du CNRS, Paris, France) including Lab for Computational Physics of Complex Systems of Center for Advanced Studies.

Comet atmosphere modeling necessary for the flight control and landing of the explorer on the 67P/Churyumov–Gerasimenko comet.

12 November 2014



V.V. Zakharov, A.V. Rodionov, [G.A. Lukyanov](#), J.F. Crifo. Navier-Stokes and direct Monte Carlo simulations of the circumnuclear gas coma. III. Spherical, inhomogeneous source// Icarus.-194 (2008), p.327-346.

Dr. Nikolay Yu. Bykov

nbykov2006@yandex.ru



Computational Biology



FP7

SysPatho: New Algorithms for
Host Pathogen Systems Biology

Fit
for Health
.eu

"New Algorithms for Host Pathogen Systems Biology" SYSPATO (2010-2014)

Development of novel and generally applicable mathematical methods and algorithms for systems biology to study the complex interactions of hepatitis C virus (HCV), a human-pathogenic virus of high medical relevance, with its host at the systems level.

Collaboration with the group of Prof. John Reinitz (Stony Brook University; University of Chicago, USA), a mathematical model of the regulatory gene network for the segmentation gene family in *Drosophila*.



letters to nature

Dynamic control of positional information in the early *Drosophila* embryo

Johannes Jaeger¹, Svetlana Surkova², Maxim Blagov², Hilde Janssens¹, David Kosman³, Konstantin N. Kozlov², Manu¹, Ekaterina Myasnikova², Carlos E. Vanario-Alonso^{1,4}, Maria Samsonova², David H. Sharp⁵ & John Reinitz¹

¹Department of Applied Mathematics and Statistics, and Center for Developmental Genetics, Stony Brook University, Stony Brook, New York 11794-3600, USA

²Department of Computational Biology, Center for Advanced Studies, St. Petersburg State Polytechnic University, St. Petersburg, 195251 Russia

³Department of Biology, University of California, San Diego, California 92093, USA

⁴Universidade Federal do Rio de Janeiro, Instituto de Biologia Carlos Chagas Filho, Rio de Janeiro 21949-900, Brazil

⁵Applied Physics Division, and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA

Morphogen gradients contribute to pattern formation by determining positional information in morphogenetic fields^{1,2}. Interpretation of positional information is thought to rely on direct, concentration-threshold-dependent mechanisms for establishing multiple differential domains of target gene expression^{1,3,4}. In *Drosophila*, maternal gradients establish the initial position of boundaries for zygotic gap gene expression, which in turn convey positional information to pair-rule and segment-polarity genes, the latter forming a segmental pre-pattern by the onset of gastrulation⁵⁻⁷. Here we report, on the basis of quantitative gene expression data, substantial anterior shifts in the position of gap domains after their initial establishment. Using a data-driven mathematical modelling approach⁸⁻¹¹, we show that these shifts are based on a regulatory mechanism that relies on asymmetric gap-gap cross-repression and does not require the diffusion of gap proteins. Our analysis implies that the threshold-dependent interpretation of maternal morphogen concentration is not sufficient to determine shifting gap domain boundary positions, and suggests that establishing and interpreting positional information are not independent processes in the *Drosophila* blastoderm.

Prof. Maria G. Samsonova

samsova@spbcas.ru

Prof. Ekaterina M. Myasnikova

ekmyasnikova@yandex.ru



Molecular Virology and Oncology

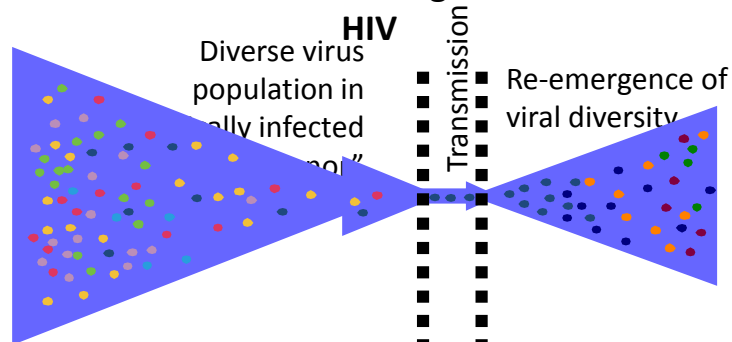
5100 Санкт-Петербургский
политехнический университет Петра Великого
ПРОГРАММА «5-100»

Under the “5-100” program grant support, a new Laboratory of Molecular Virology and Oncology is organized in 2014.

Main directions of the laboratory research:

- Study of molecular-genetic peculiarities of the HIV parenteral transmission. The main expected result is the estimation of the number of genomes transmitted parenterally;
- Investigation of HIV variants responsible for the parenteral transmission. By means of the deep sequencing several thousand of virus variants will be explored;
- Study of the bottle-neck effect at the HIV parenteral transmission.

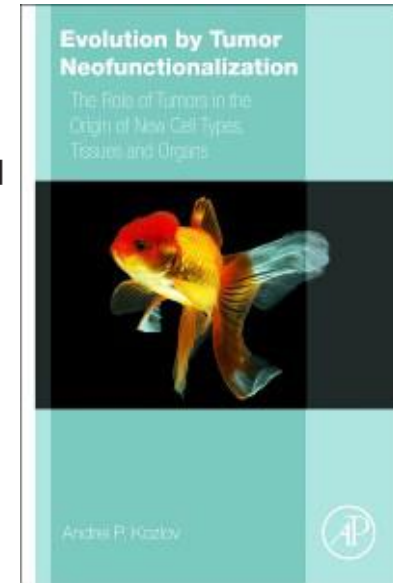
Genetic bottleneck during transmission of



NEWS SCIENCE VOL 329 9 JULY 2010

HIV/AIDS Investigators Few and Far Between

In the June 2010 *Journal of Virology*, Shaw's team reports that six of 10 IDUs had more than one variant at transmission; one man had 16. Yet the same month, the Biomedical Center team and Cohen published starkly contradictory findings in the *Journal of Infectious Disease*: In 13 IDUs, nine had a single variant at transmission—roughly the same as heterosexuals. Both studies involve



“A new book (2014) by Prof. A. Kozlov makes the eye-opening assertion that tumors play a positive role in evolution.”

Collaboration with:

- Munchen University, Germany
- University of North Carolina, USA

Prof. Andrei P. Kozlov,
contact@biomed.spb.ru



Precision Physics of Simple Atomic Systems



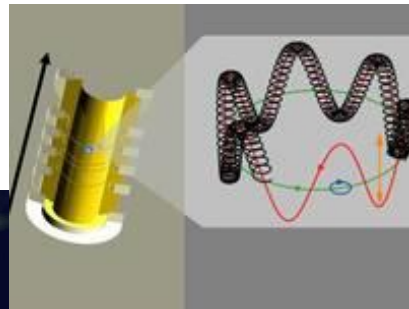
High-precision QED calculations of energy levels, Lamb shift, fine and hyperfine structure, isotope shifts of simple atoms. Determination of fundamental constants and low-energy tests of Standard Model.

Collaboration with:



- Warsaw University (group of Prof. K. Pachucki), Poland
NIST Precision Measurement Grant PMG 60NANB7D6153
- Max-Planck Institute Heidelberg, Germany.
Prof. C. Keitel, Prof. K. Blaum
ERC AdG 2011 MEFUCO
- Physikalisch-Technische Bundesanstalt (group of Prof. Surzhykov), Braunschweig, Germany

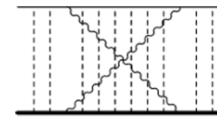
Dr. Vladimir A. Yerokhin
yerokhin@spbcas.ru



PHYSICAL REVIEW LETTERS

moving physics forward

Highlights Recent Accepted Collections Authors Referees Search About



EDITORS' SUGGESTION

Nuclear Recoil Effect in the Lamb Shift of Light Hydrogenlike Atoms

The nuclear recoil correction in hydrogen-like atoms has been calculated nonperturbatively in the nuclear binding strength, $Z\alpha$, improving the numerical accuracy by more than two orders of magnitude.

V. A. Yerokhin and V. M. Shabaev
Phys. Rev. Lett. **115**, 233002 (2015)

PRL 116, 100801 (2016)

PHYSICAL REVIEW LETTERS

week ending
11 MARCH 2016

g Factor of Light Ions for an Improved Determination of the Fine-Structure Constant

V. A. Yerokhin,^{1,2} E. Berseneva,^{1,3} Z. Harman,¹ I. I. Tupitsyn,³ and C. H. Keitel¹

¹Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, D 69117 Heidelberg, Germany

²Center for Advanced Studies, Peter the Great St. Petersburg Polytechnic University, 195251 St. Petersburg, Russia

³Department of Physics, St. Petersburg State University, 198504 St. Petersburg, Russia

(Received 24 September 2015; published 9 March 2016)

A weighted difference of the g factors of the H- and Li-like ions of the same element is theoretically studied and optimized in order to maximize the cancellation of nuclear effects between the two charge

PRL 107, 043004 (2011)

PHYSICAL REVIEW LETTERS

week ending
22 JULY 2011

QED Theory of the Nuclear Magnetic Shielding in Hydrogenlike Ions

V. A. Yerokhin,^{1,2} K. Pachucki,³ Z. Harman,^{1,4} and C. H. Keitel¹

¹Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, D 69117 Heidelberg, Germany

²St. Petersburg State Polytechnical University, Polytekhnicheskaya 29, St. Petersburg 195251, Russia

³Faculty of Physics, University of Warsaw, Hoza 69, 00-681 Warsaw, Poland

⁴ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung, D-64291 Darmstadt, Germany

(Received 4 May 2011; published 21 July 2011)



POLYTECH
Peter the Great
St. Petersburg Polytechnic
University

**Center
for Advanced Studies**



National Contact Point of European Research Council



National Contact Points (NCPs) are independent organizations of different nature (Ministries, Academies of Science, Research agencies, etc) that act as information providers to ERC applicants in their native language. They are based in all EU countries and Associated States, as well as in some non-European countries.

The mission of NCPs is to raise awareness, inform and advise on ERC funding opportunities at a national and local level.

ERC NCP Russia

Dr. Sergey V. KOZYREV
Dr. Vladimir A. Yerokhin
Dr. Mikhail V. Dubina
Svetlana V. Mamakina





*Thank you
for your attention*