



KAZAN FEDERAL UNIVERSITY

BIOMEDICINE AND PHARMACEUTICS





Kazan University is one the oldest Russian universities that turns 210 years this year. Being always among the top higher educational institutions in Russia, in 2010 Kazan University was granted the status of federal university by the decision of the Government of Russian Federation. Implementation of the Development Program for 2010 - 2019 with the governmental support has resulted in establishment of some advanced research and educational units, including 370 well equipped laboratories, and overall teaching staff development and training. Such a dynamic breakthrough allowed our University - together with 14 other leaders of the Russian higher education - to get more support in "5 Top 100" Federal Project for improving its competitive position among world-class academic centers and universities.

Over the last years biomedicine field in Russia has made a significant progress both in research and practical health care process. Establishment of the Institute of Fundamental Medicine and Biology in our university in 2012 allows us to make a considerable input in these areas by developing great academic environment for cutting-edge research and teaching. The Institute prepares students for their future career in biology and medical disciplines with all necessary competences to be in demand both by knowledge-intensive industries and high-tech medical aid centers.

A preclinical innovation center of the Institute of Fundamental Medicine and Biology provides research in highly prioritized areas such as cell-tissue technologies, neurobiology, nuclear medicine and some others. The Institute gets success also in biomedical engineering technologies – an interdisciplinary sphere demanding integration of many KFU scientists with world-known research centers and specialists. Thanks to all these our university has become the 2nd in Life Sciences and Medicine and the 4th in Engineering Technologies and Biology among Russian universities.

To me and, I think, to many people involved in Kazan University life it is a great honor and opportunity to be here –studying, making research, developing careers and feeling the spirit of corporate consciousness and patriotism.

Professor Ilshat Gafurov
Rector



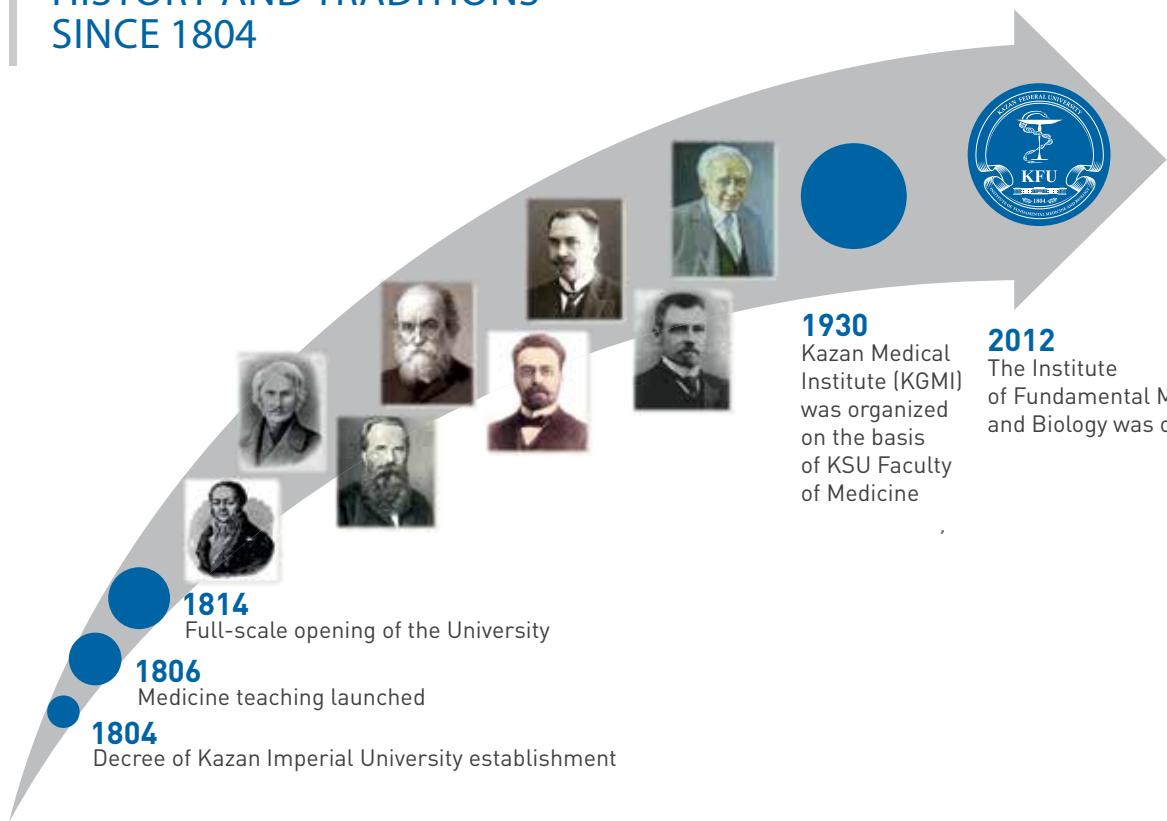
Our aim is high-quality education in the field of medicine and biology based on fundamental knowledge and research as well as on current International standards. The Institute of Fundamental Medicine and Biology possesses all necessary resources and facilities required to fulfill this task.

The Institute is carrying out cutting-edge research in molecular biomedicine, biomedical engineering, bio-nanotechnologies, space biology, biodiversity, bioinvasion and other advanced areas. Thanks to the recently created Center for Translational Medicine, modern biomedical research as well as diagnostic and rendering procedures may be incorporated into clinical practice extremely fast. Our alumni demonstrate skills in microscopy, gene diagnostics, nanotechnologies, NMR, EPR and other state-of-the-art approaches having reputation of high level experts.



Professor Andrey Kiyasov
Director of the Institute
of Fundamental Medicine and Biology

HISTORY AND TRADITIONS SINCE 1804



Both the University and the biomedical school came out simultaneously in Kazan with two departments set up by the Charter of Kazan Imperial University of November 05, 1804: the Department of Anatomy, Physiology and Forensic Medicine and the Department of Natural History and Botany. The history of Kazan University medical school is made up of such great biologists and medics as K. Fuks, E. Eversman, A. Kovalevsky, S. Zimnitsky, A. Samoylov, V. Gruzdev, P. Lesgaft, A. Vishnevsky and others.

The Institute of Fundamental Medicine and Biology is one of the most dynamic Institutes of Kazan University. There are over 60 units in the Institute (departments,

research laboratories, clinical units in the Republican Clinical Hospital, and etc.). The Institute has a Biomedical Center for Shared Facilities consisting of Genome Center, Proteome Center, Neurobiology Center, Biobank, Biomedical Microscopy Center, Vivarium, Clinical diagnostic laboratory, Research and training pharmaceutical center and other highly specialized laboratories, as well as the Center for Translational Medicine. There is a unique world-class Center of Simulation Medicine created in the Institute. It has a hospital model, Dental phantom classroom and the engineering Center for simulator designing.



Anatomy theatre of Kazan Emperor University.
Watercolour by an unknown artist, the 19th century

In 1804 Emperor Alexander I issued a decree establishing Kazan Imperial University. The Department of Anatomy, Physiology and Forensic Medicine and the Department of Natural History and Botany were founded among the first.

In 1806 Prof. of Medicine, anatomist I. Kamenskiy and Doctor K. Fuchs started teaching Medicine at the University. In 1807 I. Kamenskiy was superseded by Prof. I. Braun at the Department of Anatomy, who was elected the first Rector of Kazan Imperial University in 1814. Grand opening of Kazan Imperial University was held in 1814.

In 1930 the Medical Faculty was separated from Kazan University resulted in Kazan Medical Institute establishment. In 1933 the Faculty of Biology was opened at the University. In May, 2012 on the basis of the Faculty of Biology and Soils the Institute of Fundamental Medicine and

Biology was created in Kazan Federal University. Since 2013 there have been launched academic programs in medical majors.

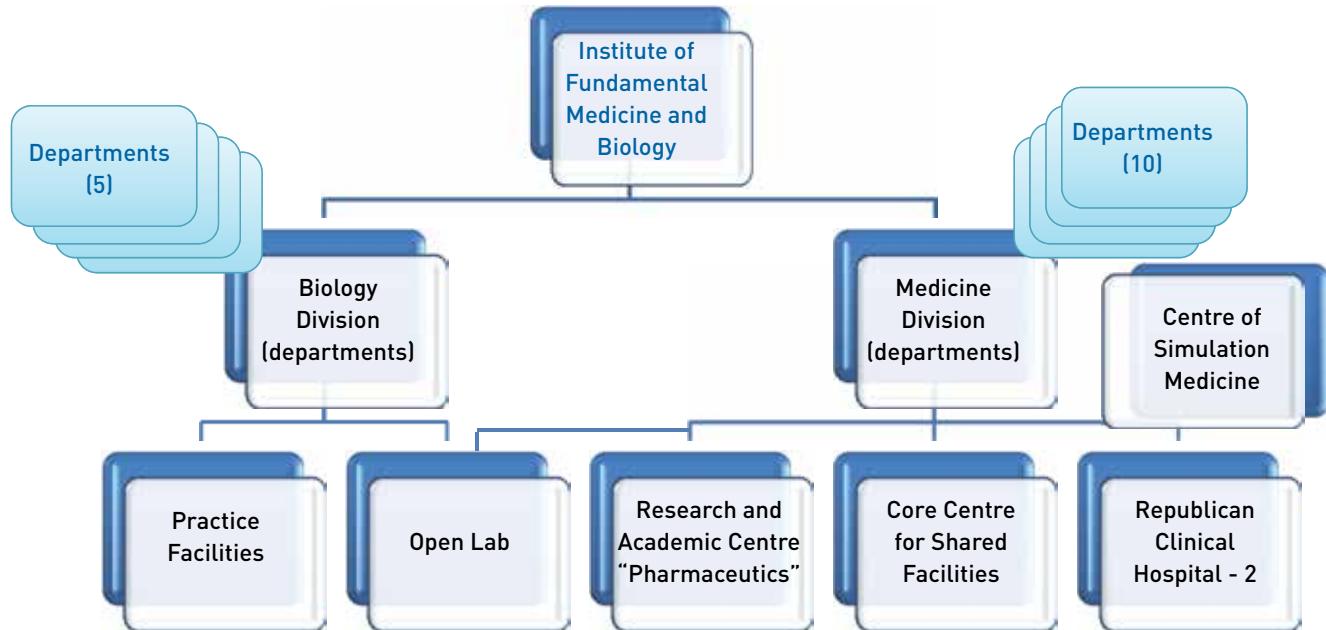
Highly qualified academic staff provides teaching and research in the Institute of Fundamental Medicine and Biology. There are 146 teaching members (including 2 RAS academicians, 1 academician of Tatarstan Academy of Sciences, 1 corresponding member of Tatarstan Academy of Sciences, 24 full professors, 76 associate professors, 12 lecturers, and 24 assistants) and 131 researchers working for the Institute.

Today 1355 young people study in the Institute with 970 students specialized in biological science majors, and 241 - in biology teaching area.



STRUCTURE OF THE INSTITUTE OF FUNDAMENTAL MEDICINE AND BIOLOGY

ORGANIZATIONAL STRUCTURE



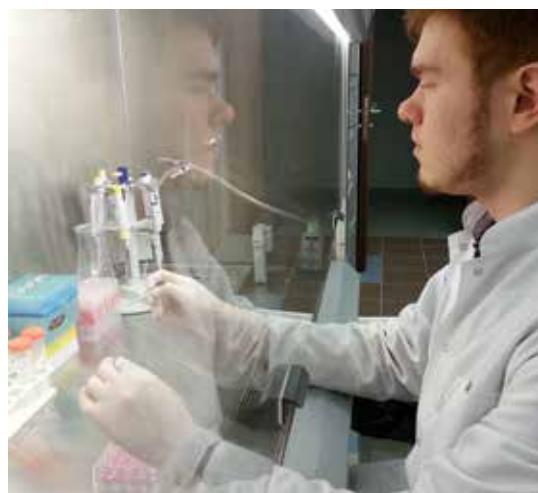
Development strategy for the priority area “Biomedicine and Pharmaceutics”:

- from separate breakthrough projects to the Centres of Excellence with interdisciplinary integration in natural sciences;
- implementing global initiatives in Neurosciences and Translational Medicine;
- engaging KFU’s humanities and social science institutes in these initiatives;
- establishing the University’s research and academic space for Life and Society Sciences or Socio-Humanitarian Biomedicine by 2020.

In 2013 – 2014, four Centres of Excellence were established as part of the Programme for Enhancing KFU’s Competitive Ranking (PECR), including:

- **“Neurobiology”**,
- **“Regenerative and Translational Medicine”**,
- **“Genomics, Proteomics and Biotechnology”**,
- **“Pharmaceutics”**.

These centres are comprised of 20 new laboratories organised under the OpenLab principle with a single Centre for Shared Facilities. Core Facilities include the Interdisciplinary Centre for Proteomic and Genomic Research, the International Centre for Magnetic Resonance, the Interdisciplinary Centre for Analytical Microscopy, “Biobank”, and the Research and Academic Centre for Pharmaceutics set up within Pharma 2020 programme. OpenLabs operate like science incubators with grant support for research projects, which are supervised by world-known scientists. In the Stage-I of the PECR, there were selected the projects for the OpenLabs’ introduction with the purpose of subsequent establishing the Centres of Excellence on the basis of several OpenLabs.

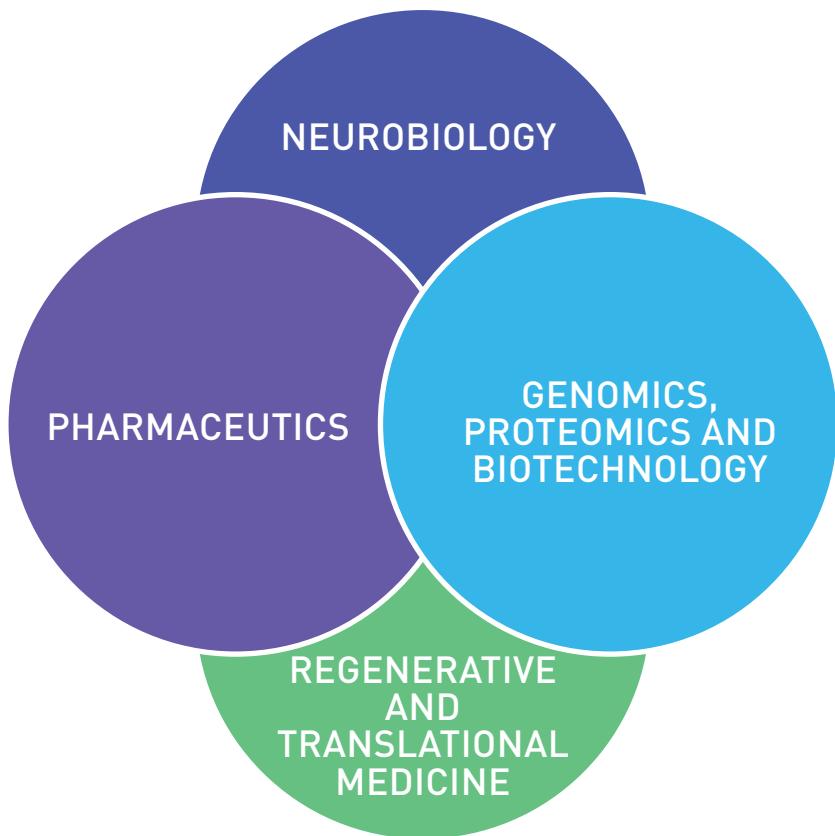


RESEARCH PRIORITIES

International research laboratories were established in the Institute of Fundamental Medicine and Biology in co-operation with several world leading scholars. Most of the laboratories were organized us OpenLab that reflects the new framework for conducting research.

OpenLabs follow to the principle of business and science incubators. They are research laboratories equipped at the state-of-the-art level where world-class scholars can

pursue high level research with financial support from the Russian state subsidies. In the framework of the already established (as well as planned) OpenLabs, master's students, PhD students and young scholars can receive personal scholarships and grants (including salary, funding for chemicals reagents and consumables materials, expenses for internships and conference participation) in order to conduct research supervised by top-ranked international and Russian scholars.



NEUROBIOLOGY



Neurobiology



Combinatorial chemistry and neurobiology



Neuropharmacology



Electronic synapse



Rehabilitation in Movement Disorders

OpenLab "Neurobiology" (R. Khazipov, France, IH=37, R. Giniatullin, Finland, IH=25, A. Rozov, Germany, IH=25)

Study of the principles of the brain functions and development, studying pathophysiological mechanisms underlying the major diseases of the central nervous system (epilepsy, brain ischemia, trauma, pain) to ameliorate diagnostics and to find cure against these diseases. Research interests: Neuronal network mechanisms underlying generation of the early patterns of electrical activity in the developing brain and their role in the formation of synaptic circuits. Pathophysiology of Epilepsy, Brain ischemia, Trauma, Pain. Neurobiology Lab is a partner of the International Associated Laboratory between KFU and INSERM, France.

OpenLab "Neuropharmacology" (Patrick Masson, France, IH=33, Ye. Nikolskiy, IH=18) Research of molecular mechanisms of action of natural and synthetic compounds with neurotropic activity to investigate the development of effective medical tools for treatment of diseases of central and peripheral nervous systems (Alzheimer's disease, myasthenic syndromes etc.) as well as cardiovascular pathologies and diabetes.

OpenLab "Combinatorial chemistry and neurobiology" (A. Gabibov, IH=18) Application of combinatorial chemistry and biology for design of novel DNA-encoded scavengers for organophosphorus compounds capturing. Elaboration of "virtual maturation" of selected catalytic Ig repertoires with quantum mechanics/molecular mechanics (QM/MM) approach. Studying of molecular mechanisms of autoantigens' degradation and presentation in neurodegenerative diseases, particularly dealing

with ubiquitin-independent degradation of myelin basic protein by constitutive and immune 26S proteasomes.

OpenLab "Electronic Synapse" (V. Yerokhin, Italy, IH=21) The aim of the project is the organization of international laboratory together with Institute of Materials for Electronics and Magnetism. Areas of the scientific activities of the laboratory: development of electronic devices mimicking properties of nervous system elements; realization of neuromorphic networks, based on these elements; development of programming systems of biochemical computers with functional polymeric capsules; study of hybrid systems, including living organisms, for the applications in unconventional computers.

OpenLab "Rehabilitation in Movement Disorders" (Y. Gerasimenko, IH=20) Traumatic injuries of nervous system represent the leading cause of chronic impairment and mortality. Our research efforts are focused on investigation of traumatic spinal cord and brain injuries and on targeting the basic mechanisms of motor control. Ability to reactivate damaged components of neuronal networks requires multidisciplinary approaches and we focus on the most effective ways to activate spinal networks with electrical stimulation, pharmacology, and peripheral stimulation, to promote neuroplasticity and synaptic connectivity. Our methods combine animal experiments, clinical studies, engineering, biomechanics and biochemical techniques. Members of our team combine critical expertise in biological science, bioengineering, and medical research.



GENOMICS, PROTEOMICS AND BIOTECHNOLOGY



Omics technologies

Structural biology

Microbial biotechnologies

Protein-cell interrelation

Bionanotechnologs

OpenLab "Omics Technologies" (Corresponding member of the Russian Academy of Sciences V. Govorun, IH=15, V. Chernov, IH=6)

The Establishment of integrated informative and analytical platform to conduct biomedical research at KFU, search and validation new of biomarkers, study human pathogenesis at the molecular level. Training and education of specialists, who will be able to conduct research with omics technologies and successfully integrate data to achieve competitive advantages, create new academic programs in system biology and medicine.

OpenLab "Structural Biology" (M. Yusupov, France, IH=23)

Development of new approaches to molecular diagnostics and treatment of oncological diseases.

OpenLab "Microbial Biotechnologies" (Dr.E.V. Shakirov, USA, IH=10, L. Bogomolnaya, USA, IH=9, M. Sharipova, IH=7)

Development of new approaches to understand the molecular mechanisms and genetic factors responsible for antibiotic resistance in bacteria, in particular, the contribution of efflux systems. Understanding molecular mechanisms responsible for in-

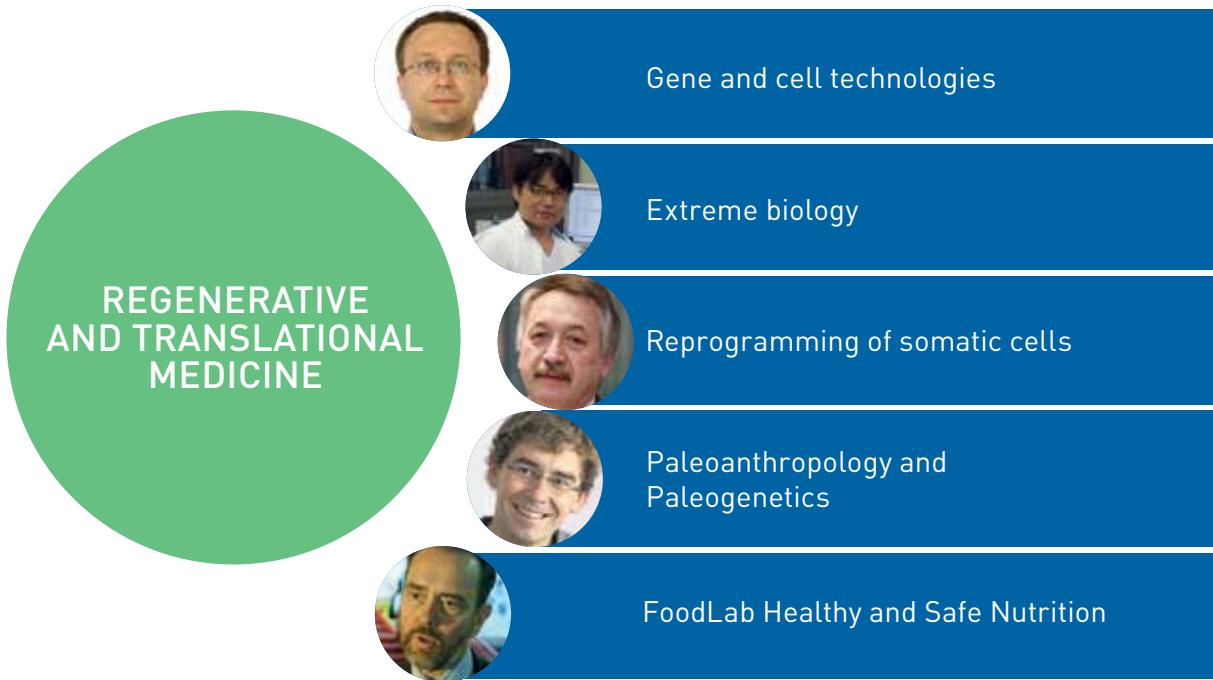
traspecific variation in telomere length, development of efficient technologies for their creation of transgenic plants to improve growth and cropping capacity, investigation of plant metabolism.

"Protein and Cell Interrelations" OpenLab (R. Litvinov, USA, IH=18)

Apoptosis and autophagy of blood cells in autoimmune diseases; interaction of antinuclear antibodies with nuclear proteins and DNA at molecular level; structural foundations of biologically active peptides and low molecular weight proteins; molecular and cell mechanisms of blood clot retraction in norm and in pathology.

"Bionanotechnolog" OpenLab (Yury Lvov, USA, IH=60, R. Fakhrullin, IH=15)

Development of new approaches to research of nanomaterials toxicity; fabrication of functional nanocontainers based on halloysite nanotubes for targeted delivery of biologically active compounds into cells; development of composite biopolymer matrices modified by halloysite nanotubes for tissue engineering; cell surface engineering, fabrication of magnetic-modified carriers.



“Gene and cell technologies” OpenLab (Saverio Belucci, Germany, IH=37, Andras Palatas, Hungary, IH=18, Vincent Clifford Lombardi, USA, IH=17, A. Rizvanov, IH=15)

Development of new approaches in gene and cell therapy of humans and animals; research of biomarkers of infectious and autoimmune diseases; development of gene and cell technologies for stimulation of liver regeneration.

“Extreme Biology” OpenLab (Takahiro Kikawada, Japan, IH=16)

Development of new approaches to improve the stress-resistance in living cells, research of the unique symbiotic interactions of extreme organisms, research of molecular bases of animal hypometabolism. Biology, -omics and biomedicine of hypometabolic and metabolic states. Adaptation of diverse organisms to extreme environments.

“Paleoanthropology and Paleogenetics” OpenLab (Prof. Dr. Johannes Krause, Germany, IH=28)

The main research highlight is the reconstruction of ancient populations mode of life such as paleo diet, migration and domestication processes, interaction with microbial and viral

communities (pathogen and aboriginal microbiota) in vector of changing climate conditions, based on complex of archaeological and molecular biological methods, such as isotope analysis, radiocarbon dating, phenotypic profiling, protein fingerprinting, genome-wide studies and whole genome sequencing.

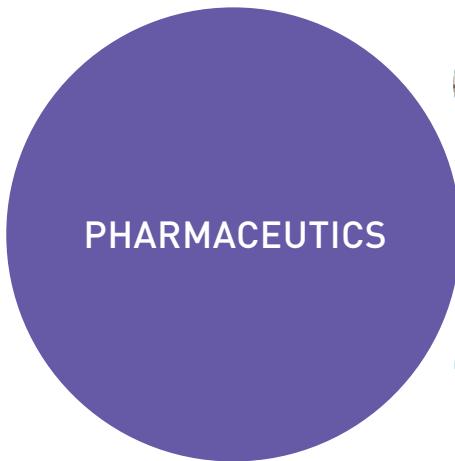
“Reprogramming of Somatic Cells” OpenLab (S. Kiselyov, IH=17)

Development of reprogramming technologies for grown-up organisms in order to establish model systems of socially important diseases, conduct research of their molecular mechanisms, retrieve drugs, develop new therapeutic methods and research fundamental mechanisms of cell specialization.

“FoodLab Healthy and Safe Nutrition” OpenLab (Professor Jussi Kauhanen, Finland, IH=40).

The core project mission is to study differences between local agricultural products and those imported from abroad by content of vitamins, macro- and microelements, and toxic components (heavy metals, nitrates, pesticides and others) controlled according to international and national standards.

RESEARCH PRIORITIES



Pathogenesis Markers



Molecular and biochemical bases of pathogenesis and therapy of tumor diseases



Technologies of the Drug Delivery

OpenLab “Pathogenesis Markers” (Klauss Preissner, Germany, IH=46, O. Ilyinskaya, IH=15)

Development of new approaches for therapy of human cancer and vascular diseases; investigation of molecular and cell targets that facilitated the derected action of new therapeutic agents; development of biotechnologies for getting microbial enzymes as potential antitumor and antivirus means.

“Molecular and Biochemical Bases of Pathogenesis and Therapy of Tumor Diseases” OpenLab

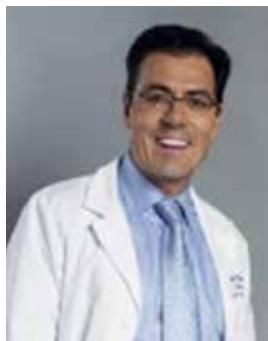
(I. Serebriyskiy, USA, IH=20, I. Astsaturov, USA, IH=16)

Research of molecular bases of pathogenesis and therapy of cancer, in particular, to determine the biomarkers, study mechanisms and develop therapy of cancer. Development of technologies for inhibition of tumor multiple drug resistance, transdermal delivery of bioactive substances, therapy of wounds and burns.

Adaptation of diverse bionts to extreme environments.

“Technologies of the Drug Delivery” OpenLab

The research of our group is focused on the development and study of novel polymer-based (bio-)materials, which can be applied for drug delivery and tissue engineering. Based on our research we proposed the new class of amphiphilic polymers, which improve intracellular trafficking of anti-cancer drugs and plasmid DNA. Studies on the preparation and investigation of composite hydrogels for the controlled drug release, nerve regeneration and wound defects are carried out recently. Research project is conducted with support of 7 Framework program (EN-SOR FP7-PEOPLE-2010-IRSES-269267) in collaboration with international partners: Brighton University, Brighton, UK and Budapest University of Technology and Economics, Budapest, Hungary.



PHARMACEUTICS

Richard Pestell, professor,
Thomas Jefferson University,
USA (HI-90)



Rustem Khazipov, professor,
University of the Mediterranean Aix-
Marseille II (HI-35)

GENOMICS, PROTEOMICS AND BIOTECHNOLOGY

Marat Yusupov, professor,
University of Strasbourg (HI-21)



REGENERATIVE AND TRANSLATIONAL MEDICINE

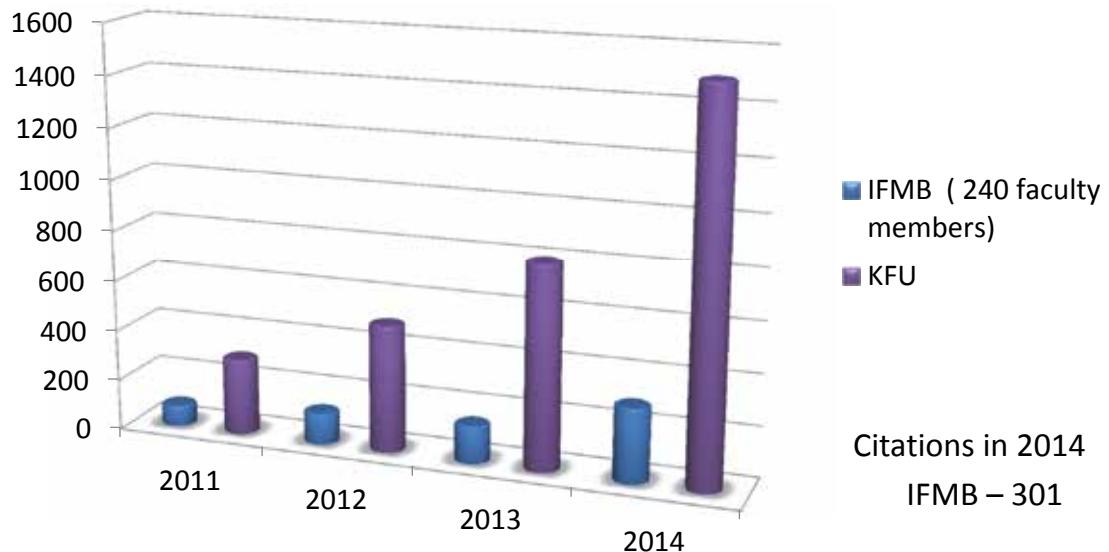
Yoshikhide Hayashizaki,
professor, RIKEN (HI-71)



OPEN LAB SUPERVISORS



DYNAMICS OF PUBLICATION ACTIVITY (SCOPUS)



WORLD-CLASS LABORATORIES

The Institute of Fundamental Medicine and Biology is carrying out research in up-to-date areas including Fundamental Medicine (Molecular Medicine, Biomedical Engineering), Bionanotechnologies, Space Biology, Biodiversity and Bioinvasion. The Institute alumni demonstrate skills in microscopy, gene diagnostics, nanotechnologies, NMR, EPR and other state-of-the-art approaches having reputation of high level experts.

CENTER FOR SHARED FACILITIES





BIOMEDICAL MICROSCOPY CENTER

Biomedical Microscopy Center is fitted with state-of-the-art multifunctional equipment and designed for research of microscopic objects and student instruction. The Laboratory is equipped with an atomic-force microscope Bruker Fast Scan, a scanning electron microscope Carl Zeiss Merlin, a laser confocal microscope Carl Zeiss LSM 780, a system of hyper-spectral microscopy CytoViva, fluorescent microscopes Carl Zeiss, and equipment required for preparing samples. The laboratory equipment is designed for capturing high quality images, carrying out chemical microanalysis of living and dead cells, samples of tissues and organs and making research of biomaterials. Both undergraduate and PhD students of KFU Institute of Fundamental Medicine and Biology pursue their research under the supervision of the Institute academic staff.

INTERDISCIPLINARY CENTER FOR PROTEOMIC AND GENOMIC STUDIES

The interdisciplinary Center for proteomic and genomic studies allows to conduct full proteomic analysis of biological samples, decipher genomes of microorganisms, humans and animals. The center is fitted with cutting edge equipment to conduct biomedical research and studies: mass-spectrometers of super high resolution (Bruker MALDI-TOF-TOF Ultraflex, Q-TOF Maxis Impact), system for express identification of microorganisms Bruker MALDI BioTyper, next generation sequenators (high efficiency genomic sequenator Solid 5500 Wildfire, compact desk genomic sequenator GS Junior, personal genomic sequenator PGM Ion Torrent) and auxiliary equipment. Equipment of the Center for Shared Facilities allows KFU teaching and research laboratories to conduct high-tech research work in KFU without engagement of outside organizations.



PHARMACEUTICS

The Research and Training Centre of Pharmaceutics and pilot factory for innovation drug and substance development and production organising were established in the framework of the Federal Target Programme "Pharmaceutical and medical industry development in the Russian Federation till 2020 and thereafter":

- the RTC of Pharmaceutics includes science-oriented laboratories, training facilities, clean premises for temporary keeping of small laboratory animals, with the cleanliness grades K and D according to GMP standards; microbiological laboratory with the cleanliness grades C and D; over 150 equipment item names destined for full cycle of innovation drug and substance development;
- Pilot factory includes clean premises with the cleanliness grades K, D and C for developing finished drug (FD) technology, manufacturing pilot batches of import-substituting drugs and pilot batches of innovation drugs. The entire infrastructure for development and pilot production of innovation medical products has been created according to international GMP standards.

In 2014 we launched works on pre-clinical study of innovation drugs:

1. The State contract for research and experimental designing works "Pre-clinical study of antitumour drug – a composition of doxorubicin and oligopolyester inhibitor of reverse cell carriers with multiple drug resistance" in the framework of the Federal Target Programme "Pharmaceutical and medical industry development in the Russian Federation till 2020 and thereafter".
2. An agreement on the topic: "Development of innovation antimicrobials for curing intra- and extra-hospital infections provoked by multi-resistant strains of Gram-positive bacteria" in the framework of the Federal Target Programme "Research and development in priority areas of Russian science and technology sector development in 2014-2020".
3. Two state assignments in scientific activities sphere.



4. The plan for 2015 is to launch two more projects for pre-clinical study of innovation medical (anti-inflammatory and antimicrobial) products in the framework of the Federal Target Programme "Pharmaceutical and medical industry development in the Russian Federation till 2020 and thereafter".

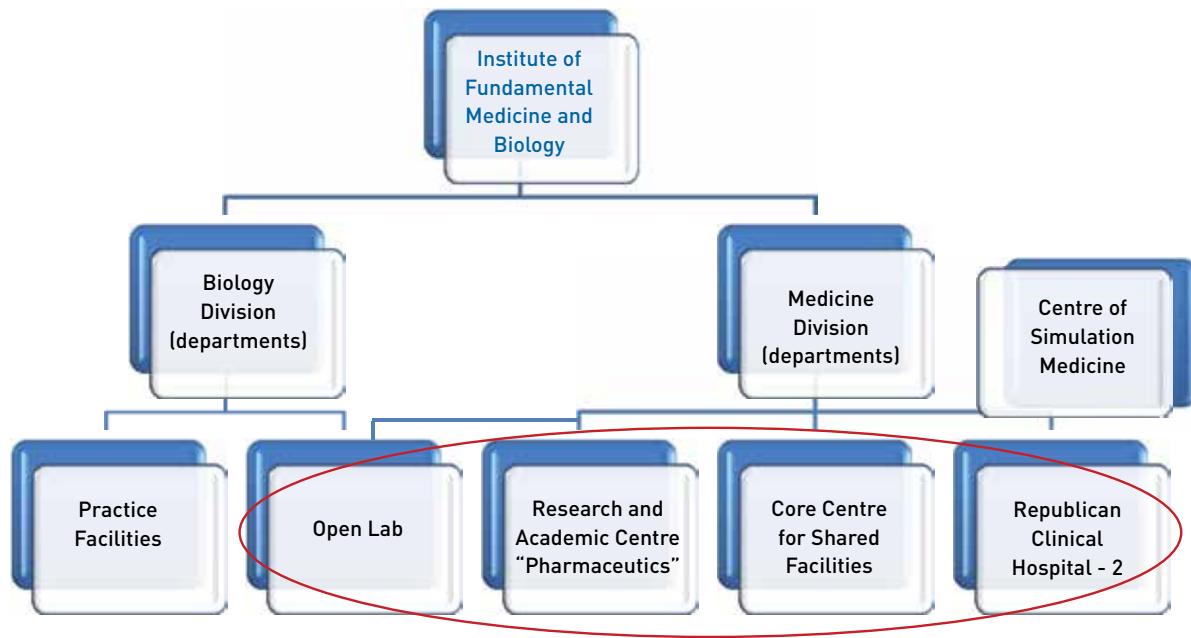
5. Anti-inflammatory external-application gels "Ketoprofen-gel" and "Diclofenac-gel" developed in collaboration with KFU are planned for manufacturing at Tatchimpharmpreparaty, OJSC at the end of 2015.

Tatchimpharmpreparaty, OJSC is KFU strategic partner in drug development sphere. It is assigned an exclusive license for intellectual property asset. The Federal state budgetary institution "Federal Centre for Toxicological, Radiological and Biological Safety", the Volga-region branch of the Federal State Budgetary Research Institution "N. N. Blokhin Russian Cancer Research Centre" and the State Autonomous Health Care Institution "Republican Centre for AIDS and Infectious Disease Prophylaxis and Fighting under the Ministry of Health Care of the Republic of Tatarstan" are other partners of KFU RTC of Pharmaceutics.

Other co-contractors for state contracts of KFU RTC of Pharmaceutics outside the territory of Tatarstan are "Chemical Diversity Research Institute "High-Tech Center "Chemrar", CJSC ("CDRI", CJSC, Moscow) and Gause Institute of New Antibiotics, Russian Academy of Science (Moscow).

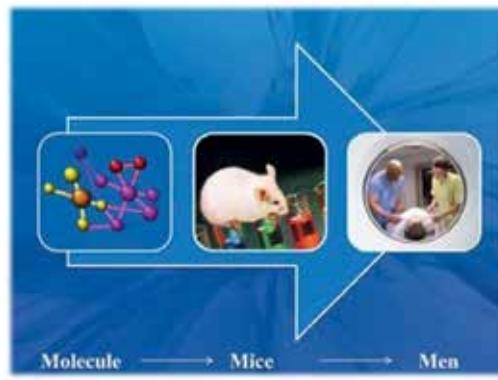


DEVELOPMENT OF THE CENTRE FOR TRANSLATIONAL MEDICINE



A very important step, which will permit us to reach a high level of Biomedicine and Pharmaceutics development, is the Republican Clinical Hospital No. 2 merger with KFU. After this merger the research marketing strategy will be focused on implementation of two global initiatives – “Translational Medicine” and “Brain”.

Completion of the “Human Genome” project has launched a new “postgenomic” (or “functional”) era of Biomedicine development. The core mission of the “Translational medicine” initiative is introduction of high biomedical diagnostic and treatment technologies into practical health care system and educational process, while the final goal is to create a world-class clinic. The key international partners for this initiative implementation are RIKEN and Junten-do University in Japan, and Jefferson University and Fox Chase Cancer Centre – in USA.



Path from discovery to practice is getting extremely short, thus, providing a ground for a new field of Medicine – **Translational Medicine**.

INTERDISCIPLINARY RESEARCH CENTRE OF BIOMEDICINE AND PHARMACEUTICS

CENTRE FOR SHARED FACILITIES, RESEARCH AND ACADEMIC CENTRE “PHARMACEUTICS”

- Genome Centre
- Proteomic Centre
- Laboratory of Neurobiology
- Centre of Microscopy
- Vivarium
- Clinical and Diagnostic Laboratory
- Research and Academic Centre “Pharmaceutics”



PARTNERS



University of Brighton



EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN



Juntendo University
順天堂大学



WHITTEMORE PETERSON
INSTITUTE FOR NEURO-IMMUNE DISEASE



JUSTUS-LIEBIG-
UNIVERSITÄT
GIESSEN



• U C •

UNIVERSIDADE DE COIMBRA

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