



ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ УЧРЕЖДЕНИЕ

«*Российская Академия Наук*»

## РАСПОРЯЖЕНИЕ

19 января 2023 г.

№ 10007 – 46

Москва

On holding the World  
Congress "Systems Theory,  
Algebraic Biology, Artificial  
Intelligence: Mathematical  
Foundations and Applications"

1. In order to develop scientific research and implement a strategic breakthrough to a new quality of technological, scientific, economic and cultural development of Russia, hold the World Congress "Systems Theory, Algebraic Biology, Artificial Intelligence: Mathematical Foundations and Applications" on June 26-30, 2023 in Moscow (hereinafter - the Congress).

2. Attribute the holding of the Congress to the preparations for the celebration of the 300th anniversary of the Russian Academy of Sciences in accordance with paragraph 2.9. Plan of the main events for the preparation and holding of the celebration of the 300th anniversary of the Russian Academy of Sciences (dated November 11, 2020 No. 10514p-PV).

3. Approve:

3.1. the President of the Russian Academy of Sciences, Academician of the Russian Academy of Sciences Gennady Yakovlevich Krasnikov, as the Chairman of the Congress;

Vice-President of the Russian Academy of Sciences Vladislav Yakovlevich Panchenko as the co-chairman of the Congress;

3.2. the composition of the co-chairs of the Organizing Committee of the Congress (Appendix 1);

3.3. the composition of the co-chairs of the Executive Organizing Committee of the Congress (Appendix 2);

3.4. the composition of the Secretariat of the Congress (Appendix 3);

3.5. the open list of RAS subdivisions and organizations that agreed to participate in the organization, preparation and holding of the Congress (Appendix 4);

3.6. the composition of the Working Group for the preparation of the Congress (Appendix 5);

3.7. the main theme and organizational principles of the Congress (Appendix 6).

4. To the Co-Chairs of the Organizing Committee of the Congress: provide organization of work on the preparation of the Congress; submit in April 2023 its program of work for approval by the co-chair of the Congress.

5. The Administrative Department of the Russian Academy of Sciences to ensure the preparation of premises for the Congress events (June 26-30, 2023 - Presidential Hall Leninsky Prospekt 32 a), the technical conditions for the work of the Congress (audio and video communication, technical support for simultaneous translation, the formation of the Congress website, the publication of the program, theses, Proceedings of the Congress) and meals for the participants of the Congress.

6. The Department for International Cooperation of the Russian Academy of Sciences to ensure the fulfillment of regime requirements during the Congress.

7. I reserve control over the implementation of this order.

President of the Russian Academy  
of Sciences, academician  
of the Russian Academy  
of Sciences G.Ya. Krasnikov

Президент  
академик РАН Г.Я. Красников



The Composition  
of the Co-Chairs of the Organizing Committee  
of the World Congress "Systems Theory, Algebraic Biology,  
artificial intelligence: mathematical foundations and applications"

- |                   |   |  |
|-------------------|---|--|
| Ershov Yu.L.      | - | academician of the Russian Academy of Sciences |
| Kalyaev I.A.      | - | academician of the Russian Academy of Sciences |
| Kozlov V.V.       | - | academician of the Russian Academy of Sciences |
| Lachuga Yu.F.     | - | academician of the Russian Academy of Sciences |
| Lektorsky V.A.    | - | academician of the Russian Academy of Sciences |
| Lobachevsky Ya.P. | - | academician of the Russian Academy of Sciences |
| Ostrovsky M.A.    | - | academician of the Russian Academy of Sciences |
| Panchenko V.Ya.   | - | academician of the Russian Academy of Sciences |
| Tkachuk V.A.      | - | academician of the Russian Academy of Sciences |
| Khabrieva T.Ya.   | - | academician of the Russian Academy of Sciences |
| Chernoivanov V.I. | - | academician of the Russian Academy of Sciences |

The Composition  
of the co-chairs of the Executive Organizing Committee  
of the World Congress "Systems Theory, Algebraic Biology,  
artificial intelligence: mathematical foundations and applications"

- |                |   |   |
|----------------|---|---|
| Goncharov S.S. | - | academician of the Russian Academy of Sciences          |
| Lachuga Yu.F.  | - | academician of the Russian Academy of Sciences          |
| Lektorsky V.A. | - | academician of the Russian Academy of Sciences          |
| Pertsov S.S.   | - | corresponding member of the Russian Academy of Sciences |
| Sudakov S.K.   | - | corresponding member of the Russian Academy of Sciences |

Members of the Secretariat  
of the World Congress "Systems Theory, Algebraic Biology, Artificial  
Intelligence: Mathematical Foundations and Applications"

- |                   |  |
|-------------------|--|
| Tolokonnikov G.K. | - Candidate of Physical and Mathematical Sciences, Scientific Council of the Russian Academy of Sciences on the Methodology of Artificial Intelligence and Cognitive Research, Head (by agreement)                                   |
| Alekshev A.Yu.    | - Doctor of Philosophy, Scientific Council of the Russian Academy of Sciences on the Methodology of Artificial Intelligence and Cognitive Research, Scientific Secretary (by agreement)  |
| Vityaev E.E.      | - Doctor of Physical and Mathematical Sciences, Federal State Budgetary Institution of Science Institute of Mathematics. S.L. Sobolev of the Siberian Branch of the Russian Academy of Sciences, Scientific Secretary (by agreement) |
| Markov V.V.       | - Doctor of Physical and Mathematical Sciences, Federal State Budgetary Institution of Science Mathematical Institute. V.A. Steklov of the Russian Academy of Sciences, Scientific Secretary (by agreement)                          |
| Telminov O.A.     | - Candidate of Technical Sciences, Scientific Council of the Russian Academy of Sciences "Quantum Technologies", Scientific Secretary (by agreement)   |

Appendix 4  
to the order of the Russian Academy of Sciences  
dated January 19, 2023 No. 10007-46

An open list  
of subdivisions of the Russian Academy of Sciences and organizations  
that have agreed to participate in the organization, preparation and holding  
of the World Congress "Systems Theory, Algebraic Biology, Artificial  
Intelligence: Mathematical Foundations and Applications"

Department of Mathematical Sciences of the Russian Academy of Sciences

Department of Nanotechnologies and Information Technologies of the Russian  
Academy of Sciences

Department of Social Sciences of the Russian Academy of Sciences

Department of Physiological Sciences of the Russian Academy of Sciences

Department of Agricultural Sciences of the Russian Academy of Sciences

Department of Medical Sciences of the Russian Academy of Sciences

Scientific Council of the Russian Academy of Sciences on the Methodology of  
Artificial Intelligence and Cognitive Research

Russian Physiological Society named after I.P. Pavlov

Composition of the Working Group  
for the preparation of the World Congress "Systems Theory, Algebraic Biology,  
Artificial Intelligence: Mathematical Foundations and Applications"

- |                  |   |
|------------------|---|
| Goncharov S.S.   | - academician of the Russian Academy of Sciences, Co-Chairman   |
| Lachuga Yu.F.    | - academician of the Russian Academy of Sciences, Co-Chairman   |
| Lektorsky V.A.   | - academician of the Russian Academy of Sciences, Co-Chairman   |
| Pertsov S.S.     | - Corresponding Member of the Russian Academy of Sciences, Co-Chairman  |
| Sudakov S.K.     | - Corresponding Member of the Russian Academy of Sciences, Co-Chairman  |
| Balonin N.A.     | - Doctor of Technical Sciences, Federal State Autonomous Educational Institution of Higher Education "St. Petersburg State University of Aerospace Instrumentation" (by agreement)                                    |
| Varfolomeev A.A. | - Candidate of Political Sciences, Department for International Cooperation of the Russian Academy of Sciences  |
| Vasilyuk N.A.    | - Federal State Autonomous Educational Institution of Higher Education First Moscow State Medical University. THEM. Sechenov of the Ministry of Health of the Russian Federation (Sechenov University) (by agreement) |
| Vinnik D.V.      | - Doctor of Philosophy, Federal State Educational Budgetary Institution of Higher Education Financial University under the Government of the Russian Federation (by agreement)  |
| Garbuk S.V.      | - Candidate of Technical Sciences, Technical Committee for Standardization TK164 "Artificial Intelligence" (by agreement)   |
| Godzhaev Z.A.    | - corresponding member of the Russian Academy of Sciences   |
| Zhdanov A.A.     | - Doctor of Physical and Mathematical Sciences, Joint Stock Company "Institute of Fine Mechanics and Computer Engineering named after S.A. Lebedev of the Russian Academy of Sciences" (by agreement)                 |

- Koblyakov A.A. - federal state budgetary educational institution of higher education "Moscow State Conservatory named after P.I. Tchaikovsky" (by agreement)
- Labunets V.G. - Doctor of Technical Sciences, Federal State Educational Budgetary Institution of Higher Education "Ural State Economic University" (by agreement)
- Lyubimov A.P. - Doctor of Law, Deputy Chief Scientific Secretary of the Presidium of the Russian Academy of Sciences
- Mazurov M.E. - Doctor of Physical and Mathematical Sciences, Federal State Budgetary Educational Institution of Higher Education "Russian University of Economics named after G.V. Plekhanov" (by agreement)
- Molokanov S.V. - Deputy President of the Russian Academy of Sciences - Executive Director of the Russian Academy of Sciences
- Muzafarov V.M. - Candidate of Physical and Mathematical Sciences, Scientific Council of the Russian Academy of Sciences on the Methodology of Artificial Intelligence and Cognitive Research (by agreement)
- Petukhov S.V. - Doctor of Physical and Mathematical Sciences, Federal State Budgetary Institution of Science A.A. Blagonravov RAS (by agreement)
- Sviridenko D.I. - Doctor of Physical and Mathematical Sciences, Federal State Budgetary Institution of Science Institute of Mathematics. S.L. Sobolev Siberian Branch of the Russian Academy of Sciences (by agreement)
- Soloviev S.A. - academician of the Russian Academy of Sciences
- Umryukhin A.E. - Doctor of Medical Sciences, Federal State Autonomous Educational Institution of Higher Education First Moscow State Medical University named after I.M. Sechenov Ministry of Health of the Russian Federation (by agreement)

The main topics and organizational principles  
of the World Congress "Systems Theory, Algebraic Biology,  
artificial intelligence: mathematical foundations and applications"

1. The theme of the World Congress "Systems Theory, Algebraic Biology, Artificial Intelligence: Mathematical Foundations and Applications" is focused on the areas that correspond to its name .

2. The Congress is held at least once every two years.

3. Proceedings of the Congress are published under the auspices of the Presidium of the Russian Academy of Sciences (Scientific Council of the Russian Academy of Sciences on the methodology of artificial intelligence and cognitive research, etc.).

4. Between congresses, the topics are taught by the International Interdisciplinary Seminar "Algebraic Biology and Systems Theory" in parallel and / or in conjunction with the seminars of the Scientific Council of the Russian Academy of Sciences on the methodology of artificial intelligence and cognitive research of the Russian Academy of Sciences, with other seminars of the institutes of the Russian Academy of Sciences, domestic and foreign universities.

5. The “systems theory” in the name of the Congress refers to the science of sciences, as it is recognized for systems theory, while, first of all, it refers to systems theories based on the concept of a system-forming factor (as that force, according to P.K. Anokhin , which from a disparate form for a certain “goal, useful result”, etc. a system that achieves this “goal”): the theory of functional systems, biomachsystems, category theory of systems, as well as numerous varieties of mathematical theories of systems. The mathematical foundations of the listed systems theories (and other topics of the Congress) require the most fundamental and even undeveloped sections of mathematics, which are discussed below (paragraph 7 of this appendix). The scientific concept of a system, which can be formalized to varying degrees, originated with biologists and neurophysiologists, systems theory provides a bridge connecting neuro and biochemical research with the physiology of whole organisms, covers the deep issues of neurobiology and physiology presented at the Congress. Extensive section , presented at the Congress, interdisciplinary, based on strictly mathematical methods, generated by the problem approach of A.N. Kolmogorov and A.I. Maltsev to mathematics, developed by the school of Yu.L. Ershov and S.S. Goncharov and combined with the theory of functional systems , although related to systems theory, but covers virtually all topics of the Congress, including artificial intelligence. In addition to formalized systems theories, intuitive systems theories are presented at the Congress, in which attempts are made to at least partially formalize them. The listed systems theories are included in the topics of the Congress from the vast variety of systems and systems approaches.

By “algebraic biology” in the title of the Congress, we mean a new strictly

mathematical science that analyzes the genome (and the properties of biomolecules, including on the basis of categorical systems theory) in order to predict (“calculate”) the properties of organisms developing from the genome. Algebraic biology is based on matrix genetics, discovered by Doctor of Physical and Mathematical Sciences S.V. Petukhov and developed by him and his colleagues. Undoubtedly, algebraic biology is one of the mathematicized branches of biology and neurobiology, it has practical outputs for modeling the intellectual properties of bioobjects, that is, outputs for artificial intelligence. Like algebraic geometry, algebraic biology is a well-defined science with its own subject and methods (algebras, monoidal categories, etc.), in contrast to the current concept of "mathematical biology", which is a rather eclectic set of mathematical techniques that turned out to be useful for certain issues in biology. Thus, the Congress serves to promote new promising areas, the formation of their conceptual apparatus and terminology, in particular, algebraic biology.

The term “artificial intelligence” (hereinafter referred to as AI) in the title of the Congress refers to the concept of a model of natural intelligence, as completing the following chain of a “smart machine”: a person (living being) and his intellectual properties - one or another mathematical model of a person (his individual subsystems and properties, including intellectual ones) - software (computer) implementation (with its limitations) of a mathematical model - electronic circuits of the program modules of the model - a robot (smart machine, etc.) or other actually functioning object with built-in indicated electronic circuits of models of intellectual properties. In other words, AI is considered as an image of a certain “morphism” from the totality of living organisms with intellectual properties into the totality of possible “smart machines” containing built-in and programmed models of the intellectual properties of living organisms. Of course, such an understanding of AI does not reflect all available approaches, but it provides the possibility of mathematical formulations and hopes for solving the emerging mathematical problems of AI. The field of AI is extremely wide, from the blind belief that intelligence is “itself born from big data” in deep learning artificial neural networks, to the skeptical and scientifically sound opinion that such AI is not yet a science.

The very extensive interdisciplinary material of the Congress is comprehended on a single platform of the philosophy of artificial intelligence, logic, Turing tests, etc. as relatively formalized parts of many philosophical approaches to intelligence, consciousness, and systems theory. The philosophical methodological platform of the Congress is provided by the outstanding scientists of the Scientific Council of the Russian Academy of Sciences on the methodology of artificial intelligence and cognitive research.

The term “applications” in the title of the Congress refers to the most diverse applications of systems theory, algebraic biology, artificial intelligence in practice, in mechanics, the theory of machines and mechanisms, but first of all, applications in the agro-industrial sector, the most extensive, including in the territorial sense, covering production relations and technologies, as well as rural society. The most important feature of the agricultural sector, which distinguishes it from other sectors in terms of the topics of the Congress, is that here, unlike, for example, mechanical engineering or the military-industrial complex, there are living objects as an integral

part of agricultural systems, and, in fact, are presented in an integrated among themselves all other economic and social branches (including mechanical engineering), which corresponds to the interdisciplinary nature of the Congress. It should be emphasized that the specified term “applications” is conditional in relation to the agro-industrial complex, in view of the sections of full-fledged agricultural science, including the theory of sectoral machines and mechanisms, not limited to the theory of machines and mechanisms in other industries, biology and physiology of higher plants, sections of social sciences that have the specifics of rural society .

6. Simultaneous translation of reports and speeches of the Congress into Russian, English and Chinese is carried out.

The Congress is supposed to be held within 5 days (the first Congress - from June 26 to June 30, 2023), if necessary, the online part can be extended to submit all reports and messages accepted at the Congress, take into account time shifts of different regions and other reasons.

Information support of the Congress is carried out by the following journals: Biosystems, Biomashsystems, Journal of Behavioral and Brain Science, Philosophy of Science and other journals.

#### 7. Brief list of topics of the Congress

The listed topics and areas of science bear the emphasis of interdisciplinary interaction within the chain: "fundamental mathematics - physiology, neurobiology - building models of living things, including modeling of intellectual properties - artificial intelligence - applications in the agro-industrial complex and other industries", implemented on the basis of a systematic approach and comprehended on the platform philosophy of artificial intelligence and others, allowing at least partial formalization of areas of philosophy.

#### Branch of mathematics and mechanics

Mathematical logic, categorical and non-classical logics, category theory, univalent foundations of mathematics, Hamiltonian, dynamical systems, group methods of differential equations and orbit theory in representation theory, integrability and non-integrability of Hamiltonian systems, nonlinear differential equations with small parameters for modeling bioprocesses, other physical systems , based on the principle of stationary action (mathematical questions of mechanics, vakonomic mechanics, Shirokov-Nambu mechanics, quantum field theory, standard model, string theory) and other principles (nonholonomic mechanics, p-adic quantum and classical mechanics, categorical quantum mechanics), mechanics continuous medium, detonation waves, gas and liquid flows, mathematical questions of hemodynamics; the Yang-Baxter equation for the theory of knots and links, distributive laws in categories and in the method of the inverse scattering problem; mathematical system theory, probability theory, mathematical statistics, fuzzy logic and Zadeh sets, algebraic geometry and topology, computability theory, classical and quantum algorithms, homotopy and category models of neural networks, topoi and other non-set-theoretic universes for system modeling, categories , props,

polycategories and other categorical formations for modeling neurons and their connections in neuroscience and networks in other areas.

#### Branch of the mathematical theory of consciousness

This section also includes well-known informal approaches, in which the emphasis is on attempts to formalize theoretical concepts. The focus on the Congress of the topic of consciousness is formed by the theory of consciousness according to Tanoni and its generalization in the works of Yu.I. Manin, the approaches of K.V. Anokhin, E.E. Vityaev, M.E. Mazurov, V.G. which it is already possible to formalize or at least clearly formulate for mathematical understanding aspects of the phenomenon of consciousness, in particular, the problems of quantization of gravity, including in string theory and grand unification and R. Penrose's approach to the phenomenon of consciousness, other approaches to this phenomenon based on formalisms of mathematical physics (M.B.Mensky and others).

#### Branch of algebraic biology with genetic and biochemical bases

Genome, DNA, RNA, tensor-matrix modeling of molecular genetic systems and their emergent properties (matrix genetics), tensor products in systems of multidimensional configuration spaces of developing multi-parametric bodies, biological dualism "stochastics-determinism", universal rules of stochastic organization of DNA, gestalt biology, noise immunity and multichannel transmission of genetic information, methods of algebraic holography in the analysis of genetic and inherited physiological structures, bioresonances, modeling of resonant interactions in biology, search for resonant signal transmission in biology, electromagnetic resonances in biological macromolecules, quantum biology, formalisms of quantum mechanics and quantum informatics in modeling of genetic systems, atoms in molecules according to Bader, properties of biomolecules as biosystems; gene expression and phenotype; stem cells and disclosure of genetic information, bio-antenna lattices and energy-informational evolution, tensor unitary transformations, solitons in biology, algebraic models of morphogenesis and biorhythms, fractals, algebras of hypercomplex numbers and their extensions in models of physiological structures, hyperbolic geometry in models of physiological phenomena, the basic psychophysical law of Weber-Fechner, the analysis of genetic intelligence, the relationship of musical harmony in the molecular parameters of DNA, the inclusion of theoretical biology in the field of developed mathematical natural science.

#### Section of artificial intelligence

Expert systems, knowledge representation, artificial neural networks, machine learning, knowledge extraction from data, bigdata, knowledge engineering, Bayesian networks, solvers, Post calculus, Robinson's resolution method, S.Yu.Maslov's inverse method, S.N.Vasiliev's J-calculus, JSM-method of V.K. Finn, non-classical logics, methods of autonomous adaptive control, Clifford algebras and pattern

recognition, applications of the task approach in mathematics in artificial intelligence, semantic probabilistic inference, manipulators and methods of algebraic geometry in AI, quantum computing and quantum computers, cryptography, information security, quantum communication channels, multi-agent systems, artificial societies, artificial life, deserted industries, AI as a tool for solving human problems; AI in medicine and veterinary medicine; telecommunications, internet and AI; Turing tests; features of AI for the agro-industrial complex; the problem of trust in AI, legal and legal aspects of the development and implementation of AI in production and social practice; unmanned vehicles, intelligent prostheses and cyborgs and other types of AI technologies, protection of personal information in terms of legal assessment and legislation; empowering AI units with legal personality; digital transformation of complex-organized systems, about the intellectual twins of organizations; the use of mathematical statistics and other mathematical methods in matters of AI.

### Section of Physiology and Neurobiology

The body as an ensemble of interacting functional systems, system quanta, subsystems of hemostasis, maintenance of optimal pressure, blood pH, etc., neurotransmitters, advanced reinforcement, action result acceptor and elements of consciousness, intercellular communication, spike and non-spike activity of neurons, neurochemical organization and molecular mechanisms of specific activity of the brain and individual nerve cells; molecular, cellular and systemic neurobiology of memory, theory of memory and its biological foundations, visualization of functional systems in the brain; physiology of addictions, endogenous opioid system, reinforcement in learning, objectification of the human condition using reinforcing stimuli; interaction in the central and peripheral parts of neurochemical systems separated by the blood-brain barrier; central and peripheral mechanisms of individual-typological features of decision-making in the process of active choice by the subject of conditions and ways to achieve a useful result; neurophysiological processes of choice and decision-making in the joint activity of people, neurophysiological mechanisms of purposeful behavior of animals, interpretation of electroencephalograms of cortical and subcortical structures of the brain; activity of individual neurons, neurophysiological, neurochemical and molecular mechanisms of dominant motivation as a system-organizing component of goal-directed behavior; direct and remote electrical and chemical stimulation of subcortical structures of the brain; directed influence on behavior by immunization of animals with "chimeric" peptides; systemic mechanisms of formation of emotional stress, individual resistance of the organism to the development of negative consequences of exposure to extreme factors; endogenous biologically active substances, immunomodulators, peptide compounds and neurohormones; non-drug rehabilitation of the functional state of athletes, sports physiology; thalamus as a switch of signals in the brain, information processing in the retina, absorption of photons and entangled quantum states; pathological systems according to G.N. Kryzhanovsky; a systematic approach to locomotion according to N.A. Bernstein; neurobiology of plants, intellectual properties of living things (animals, plants, bacteria).

## Section of element base and electronics

Quantum solid state physics, Fermi surfaces, p-n junctions, transistors, CMOS technologies, neuromorphic computers, neuron spike model; computational architectures, von Neumann and neural network approaches, architectures on memristor devices, ecosystems and development environments for neural networks (frameworks, compilers, translators, converters, libraries), energy-efficient high-speed memory, processors for neural network computing, neural networks based on a neuron spike model, analog computers with synapse imitation on memristive elements, implementation of calculations in memory, micro- and nanochips, human-computer interface, cyborgs.

## Section of machines and mechanisms, applications in the agro-industrial complex and other industries

Body mechanics, strength of materials, machines and mechanisms, robots and manipulators, their AI equipment; features of agricultural machines interacting with a productive living, the chain "genome - biomachsystems theory, solvers, AI - selection - design of agricultural machines" as the basis for a modern understanding of the agricultural machine and its purpose, unmanned vehicles in the agro-industrial complex, the use of artificial neural networks of deep learning and methods of autonomous adaptive management, digitalization of agricultural production; features of agricultural systems, including those including rural society, higher plants as the basis of agricultural production, plant neurobiology, action potentials and neurotransmitters in plants, plant intelligence and its use in production, individual approach to productive animals and plants using AI and strong AI ; electromagnetic impact on animals and plants in the process of agricultural production, agro-cyborgs in the implementation of biomachsystems, a system-forming factor for agrosystems, a systematic approach in the agro-industrial complex based on the theory of biomachine systems.

## AI Methodology and Philosophy Section

Philosophy of artificial intelligence, Korsakov machines, Babbage, generalized Turing tests, ideological and methodological functions of philosophical studies of artificial intelligence, varieties of artificial intelligence, weak, strong, hybrid, global, general AI, modern AI projects as a realization of a universal spectrum of cognitive phenomena of the vital, mental, personal and social content in computer systems of avatars, robots, cyborgs; classical approaches to the development of AI: logical, algebraic, semiotic, neural networks, strategies for the development of AI (conceptual, hermeneutical, phenomenological, complexity approaches), general philosophical questions of the possibility and obstacles to the mathematical modeling of mental processes, solving the difficult problem of consciousness, opportunities and obstacles to the formalization of the phenomenon the consciousness of living

organisms, necessary for the implementation of the bionic approach to AI in its varieties of strong or general AI; high humanitarian technologies and metauniverses.