



## CONCEPT NOTE

### 5<sup>th</sup> BRICS YOUNG SCIENTIST FORUM

*Theme: BRICS Partnership of Young Scientists and Innovators for Science Progress and Innovative growth*

**Venue: Zoom Conference**

**South Ural State University, Russia, September 2020**

## BACKGROUND

In accordance with paragraph 9 of the Brasília Declaration, adopted at the 2<sup>nd</sup> STI Ministerial Meeting (Brasília, March 2015), the proposal on the creation of the BRICS Young Scientist Forum (BRICS YSF) was adopted. The participants of the BRICS YSF should come from the scientific community and must be between 22 and 40 years of age.

Key goals of the BRICS YSF are the development of cooperation among the young scientists from the BRICS countries, initiating of new young scientific groups in the field of R&D, encouragement of mobility of scientists among BRICS countries and creation of BRICS cross-cultural talent pools for STI cooperation.

About 20 distinguished representatives of young scientific community are welcomed to participate from each BRICS country. The average number of participants is 100-130. The duration of the event is 5 days. The BRICS YSF participants are provided with local hospitalities, which include accommodation, transfers between airport, hotel and venue of the Forum and meals, as well as the participation in the welcome dinner. The costs of visas, medical insurance and air travel are borne by the BRICS participating countries.

The BRICS YSF Program, developed by the Chair country, includes plenary reports by the leading young scientists and reports on the most relevant and demanded STI areas. It should be noted that the Program of the Forum is being expanded every year by means of the implementation of new formats of interaction in the form of specialized seminars and prize-winning competitions. However, the implementation of the new participation formats within the Forum remains at the discretion of the organizers.

No formal declarations have been adopted at the BRICS YSFs, however, participants attempted to identify current positions of the young scientific community in the format of recommendations on how to address common problems intended for use by the leading scientists and the highest authorities of the BRICS members.

Support and involvement of young scientists in the BRICS STI initiatives is an integral part of the BRICS cooperation agenda. The BRICS YSF is one of the most effective

platforms for expanding the network of international contacts among young scientists and exchanging experience and best practices.

These activities ensure the sustainable development of the five-party cooperation, promote the development of the leadership position of the BRICS countries in the area of science, technology and innovation and are beneficial for the strengthening of the young talented population in BRICS countries.

## REFERENCE INFORMATION

The 1<sup>st</sup> BRICS YSF was held in Bangalore, India, on 26-30 September 2016. The thematic areas of the 1<sup>st</sup> Young Scientist Forum selected for debate were computational intelligence, affordable healthcare and energy solutions. Efforts undertaken by India in respect to organizing the first event were warmly welcomed by the BRICS STI Ministers at the 4<sup>th</sup> BRICS STI Ministerial Meeting in Jaipur, India in October 2016, the BRICS countries agreed to hold the BRICS YSF regularly in the country presiding in BRICS.

The 2<sup>nd</sup> BRICS YSF was held in Hangzhou, China, on 11-15 July 2017 under the theme «Building Young Scientists' Leadership in Science, Technology and Innovation». The Forum defined three subjects - energy, materials, biotechnology & biomedicine. There was also discussion on one cross-cutting field of science, technology and innovation policies, science communication and science popularization.

The 3<sup>rd</sup> BRICS YSF under the theme «Building BRICS Youth Leadership through Science, Technology and Innovation» was held in Durban, South Africa, on 25-29 June 2018. The 3<sup>rd</sup> BRICS YSF Program comprised parallel sessions on such thematic areas as energy, water sources, social science. Organizers of the event also held seminars addressing a wide variety of challenges, such as youth entrepreneurship, the role of women in science, the significance of science diplomacy. The 3<sup>rd</sup> BRICS YSF was the first time the BRICS Young Innovators Prize with the money prize in the framework of the BRICS Young Scientist was held. Two innovative projects aimed at providing solution of social and economic problems and improvement of life quality were expected from each BRICS country for participation. First three award-winning places were taken by the representatives of Brazil, South Africa and China.

The 4<sup>th</sup> BRICS YSF under the theme «Fostering Young Scientists and Innovators partnerships for a BRICS STI long-term cooperation» took place in Rio de Janeiro, Brazil, on 6-8 November 2019. It followed the 2<sup>nd</sup> BRICS Science Academies Meeting. The main thematic areas of the 4<sup>th</sup> BRICS YSF were cybersecurity, bioeconomics, young innovations and youth entrepreneurship. In the framework of the 4<sup>th</sup> BRICS YSF two plenary sessions on interdisciplinary thematic areas «Young women in science» and «Science diplomacy» were also held. BRICS Young Innovators Prize with the money prize was organized by the host country for the second time. First three award-winning places were taken by the representatives of India, Russia and Brazil.

Due to the COVID-19 global pandemic and the related international travelling restrictions the 5<sup>th</sup> BRICS YSF under the theme «BRICS Partnership of Young Scientists and Innovators for Science Progress and Innovative growth» will take place in

videoconference mode in September 2020 under the Russian Presidency in BRICS in 2020. The main thematic areas of the 5<sup>th</sup> BRICS YSF will be ecology, materials science and artificial intelligence. The program will be expanded by Science Communication Program which implies engagement of youth in up-to-date science networking and activities. The host country will also organize the 3<sup>rd</sup> BRICS Young Innovators Prize with the money prize, focusing on 3 thematic areas - Ecology, Materials Science and application of Artificial Intelligence in the areas of Ecology and Materials science.

## **5<sup>th</sup> BRICS YSF Programme**

The 5<sup>th</sup> BRICS YSF programme will include the following activities:

- ❖ Three Parallel Sessions on the Thematic Areas: Ecology, Materials Science and Artificial intelligence (See Annex 1)
- ❖ BRICS Young Innovator Prize. Thematic Areas for projects are Ecology, Materials Science and application of Artificial Intelligence in the areas of Ecology and Materials Science
- ❖ Science Communication Program (youth science networking and activities)

## **PARTICIPANTS**

Per each BRICS country 21 participants are expected:

- 5 young scientists for thematic area «Ecology»;
- 5 young scientists for thematic area «Materials science»;
- 5 young scientists for thematic area «Artificial Intelligence»;
- 4 young innovators with projects for thematic areas «Ecology», «Materials Science» and «Artificial Intelligence applied in Ecology and Materials science areas»;
- 1 independent jury member for the Young Innovators Prize;
- 1 Head of Delegation (representative of the STI Ministry);

As previous editions, we consider young scientists as practicing researchers up to 40 years old who holds a PhD or Master's degree. Young innovators must be up to 30 years old. All participants will have an opportunity to attend the activities of Science Communication Program.

In accordance with established practice the BRICS YSF coordinators (Heads of Delegation) will have a joint meeting.

## I. ECOLOGY

Ecology – is a chemical and biological engineering science, that:

- studies the structure and functioning of systems of the supraorganism level (population, community, ecosystem) in time and space in human-modified conditions and in the natural environment;
- determines what impacts of anthropogenic and non-anthropogenic origin affect the environmental situation, including the spread of bacterial and viral diseases;
- develops engineering (including genetic engineering) methods for diminishing negative impact on the biosphere.

Modern environmental science is an interdisciplinary science that studies the problems of interaction between man and the biosphere, namely, the role of man in nature and changes in nature under the influence of anthropogenic factors. Regarding the world-wide growing industry, the negative impact on nature, the planet and mankind itself is constantly increasing. Industrial enterprises contribute heavily to air pollution that negatively affects respiratory systems of the human body, leading to a number of chronic and fatal diseases; the pollution is present on crops, it enters the soil, groundwater and the human body. Wastewater pollutes rivers and water bodies, making them unsuitable for organisms and thus disrupting the functioning of entire ecosystems. An important problem is the emission of greenhouse gases from cars when burning fuel. All of these are examples of the negative impact of anthropogenic activities. In addition, there are non-anthropogenic impacts, primarily associated with volcanic activity, earthquakes and solar activity. If the situation continues to develop in this direction, the humanity is under a threat of a global environmental disaster. In this regard, the issue of Green Industry, of reducing negative impact on nature, the planet and man is a matter of utmost urgency.

### Relevant topics

- 1) Clean air: condition monitoring, sensors, measurements of pollution in atmospheric air and emissions, modeling and predicting the state of atmospheric air using digital twins, air quality control;
- 2) Pure water: development of the best available water purification technologies, technological rehabilitation of water bodies, hybrid technologies for transferring industrial and agricultural enterprises to a closed water cycle;
- 3) An integrated solid waste management system: developing the best available technologies for processing solid industrial waste, designing finished products based on the life cycle, taking into account the subsequent collection and disposal, technology of biodegradable materials to reduce the overall load on the ecosystem;
- 4) Natural resources management, including the development of algorithms for the rational use of planetary resources, energy and resource-saving technologies, production and microchipping of organic products for use by a traceability system;

5) Bioecology: the study of the relationships of living organisms with their environment, study of the influence of certain groups of animals, insects, microorganisms on environmental changes, developing ways of reducing the risks of human intoxication with mycotoxins of plant materials; autecology: the study of the individual relationships of individual species of organisms on the environment; the study of biological methods of controlling plant pests (the study of the ecological mechanisms of the influence of the locust family on the fauna and environmental situation of the regions; the influence of the river beaver population on the change in the physical, geographical and environmental characteristics of their habitats, etc.);

6) Virus and pathogen ecology; the impact of viruses and bacteria on the planet, in particular, the impact of the COVID-19 pandemic on the environmental situation in the world; issues of the emergence, spread, and possible mechanisms for stopping disease outbreaks. Emergency preparedness and response;

7) Human ecology, including the development of technical and methodological systems for improving the physical and psychological state of a person in the short and long term, as well as the development of environmentally friendly materials and design solutions for creating environmentally friendly housing, including eco-settlements;

8) Environmental compliance: the ability of an organization, city, region to comply with environmental norms and rules, both external and internal, including assessment, management and control systems associated with the risks of non-compliance with regulatory documents, rules and standards of supervisory authorities, legislation requirements.

## II. MATERIALS SCIENCE

Materials science is an interdisciplinary branch of science that studies the methods of production, structure and properties of materials, the relationship between their composition, structure and properties (mechanical, thermal, chemical, electro-physical, magnetic, optical) and the behavior of materials depending on various factors.

In the modern world, materials science is one of the most promising areas of natural science and a locomotive of technological progress. Advances in space exploration, new means of communication, computers, smartphones, artificial implants (in medicine) and the widespread use of laser technology - these and other achievements would not have been possible without previous achievements in materials science. Knowledge of the structure and properties of materials allows you to create fundamentally new products, as well as new industries. At the same time, the knowledge gained by scientists in the field of materials science is in demand by traditional industries and is widely used to improve safety and economic efficiency of production, expand the product range, develop technological innovations and solve existing production problems. Without new research in the field of materials science, further development of electronics, metallurgy, mechanical engineering, aircraft manufacturing, building materials industry, chemical and textile industries, the industry of new carbon and polymer structural and composite/nano materials, as well as of other industries is impossible.

### **Relevant topics**

1) New metallic materials, as well as the new generation metal-matrix composite materials (both construction and functional); the development of methods for designing automotive, aerospace, and construction products using aforementioned materials;

2) Materials for additive manufacturing, including gas-dynamic spraying and laser surfacing; nano and microadditives in alloys, prediction of the properties of metals and alloys with additives, technology for the production of innovative steels and products from them;

3) New functional materials, including nanomaterials, whose operational characteristics (magnetic, electrophysical and optical properties, catalytic activity) can be changed using quantitative control;

4) Materials resistant to extreme conditions, including new polymers and nanomaterials, for energy sector (including nuclear energy, as well as actively developing sectors of alternative energy) and for space sector;

5) Nature-like medical materials (including hybrid and nanostructured), in particular, innovative polymers and the creation of artificial organs based on them;

6) New composite materials resistant to extreme conditions (including Arctic conditions), for use in the construction industry;

7) New functional and construction materials, including nanomaterials containing carbon, namely: fullerenes, carbon nanotubes, graphene, glassy carbon, etc.;

8) Nature-like materials for use in modern electro-chemical energy sector: magnetic, ferroelectric, luminescent and ion-conducting mineral-like functional materials, including new mineral-like piezoelectric and optical materials;

9) Minerals and mineral-like compounds as components of heat-resistant ceramics and matrix-immobilizers of toxic and radioactive elements.

### **III. ARTIFICIAL INTELLIGENCE**

Artificial Intelligence (AI) is one of the current breakthrough scientific directions. The AI research is conducted in all developed countries of the world. The AI can be described as a set of solutions that allows to simulate the human mental functions (including learning and self-training, as well as finding a solution without a given algorithm) and based on this to obtain results comparable to the results of human intellectual activity. The AI research results are actively implemented into all spheres of life. In medicine, systems are developed and implemented for automatic processing of test results, diagnostic data and monitoring of treatment methods. In industry, it is now possible to track equipment wear, fulfillment of production plans and other activities that are usually done manually. In agriculture, the use of artificial intelligence allows for proper control over the condition of plants, the level of moisture, the availability of nutrients in the soil and for well-timed care of plantings that are automatically weeded, watered and harvested. The AI can be used in road traffic management for analyzing data from traffic lights and collecting information on traffic congestion, unforeseen accidents, negative weather conditions and other factors

affecting traffic. By analyzing the data, AI can adjust the operation of the road system. In everyday life, AI is best represented in the form of the Smart Home system, which optimizes energy consumption, level of heating and ventilation, and control over the operation of household appliances.

### **Relevant topics**

1) Development and application of artificial intelligence methods for solving the digital industry challenges (sensorics of industrial facilities, creation of digital twins, energy saving, information security of industrial facilities);

2) Creation of a multibiometric information system using artificial intelligence methods, surpassing in its capabilities all known biometric systems in the world;

3) The use of artificial intelligence to solve the environmental problems of large industrial agglomerations;

4) Creation of advanced computer vision systems for solving a wide range of tasks (control of production processes, medical diagnostics, adaptive traffic control, safety and counter-terrorism, production of autonomous robotic devices);

5) Development of methodology and algorithms for the classification and formation of forecasts based on the analysis of Big Data;

6) Machine learning methods for solving combinatorial optimization challenges (application of combinatorial optimization: to develop the optimal air traffic network; to develop the best way to deliver goods; in applied sociology; in business research – to predict the behavior and preferences of consumers, competitors and markets, etc.);

7) Development of algorithms for creating synthetic images based on the architecture of generative-competitive neural networks (creation of technology for improving Deep HD images based on generative-competitive neural networks);

8) Development of a unified payment system based on cryptocurrency; improvement of national payment systems and their continuous implementation as an element of economic cooperation between the BRICS countries in the face of growing market risks of the global payment infrastructure.