BRICS STI Framework Programme
3rd coordinated call for BRICS multilateral projects 2019

Call is open until 25th April 2019, 15:00 Moscow Time (UTC+3)

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I. General Description

I-1. Joint Funding of Multilateral Research Cooperation

The BRICS STI Framework Programme aims to support excellent research on priority areas which can best be addressed by a multinational approach. The initiative should facilitate cooperation among the researchers and institutions in the consortia which consist of partners from at least three of the BRICS countries.

As part of the initiative the following research funding organizations from the BRICS countries have agreed to jointly establish a new scheme for funding multilateral cooperative activities:

Brazil:

National Council for Scientific and Technological Development (CNPq)

Brazilian Innovation Agency (Finep)

Russia:

Foundation for Assistance to Small Innovative Enterprises (FASIE)

Ministry of Science and Higher Education (MSHE)

Russian Foundation for Basic Research (RFBR)

India:

Department of Science and Technology (DST)

China:

Ministry of Science and Technology (MOST)

National Natural Science Foundation of China (NSFC)

South Africa:

National Research Foundation (NRF)

I-2. Aim of the Joint Call and Thematic areas

Collaborative multilateral basic, applied and innovation research projects in the following thematic areas can be submitted in response to the call:

(a) Prevention and monitoring of natural disasters

Human factors such as globalization, population growth, poverty, urbanization and changes in land use are aggravating the adverse consequences of natural hazards. Earthquakes and more frequent and intense extreme weather and climate events are also increasing the risks faced by populations living in vulnerable areas. The losses are increasing in BRICS countries. Repeated exposure to disasters is hampering sustainable development in vulnerable localities. Although we are equipped with increased scientific knowledge and technology, we have not yet been successful in forecasting and effectively coping with unprecedented natural hazards. We need to identify potential risks, evaluate system vulnerabilities, take action from lessons learnt from past experiences and improve emergency preparedness and capacities to manage crises. The present status of international collaboration in disaster risk reduction and management needs to be improved.

To reconcile the relationships between development, environmental issues, and improved resilience to disasters, important global decisions were made and came to fruition in 2015, with the Sendai Framework for Disaster Risk Reduction (SFDRR) in March. To end poverty and hunger and make human settlement inclusive, safe, resilient and sustainable, it is essential to strengthen capacity for adaptation to climate change and holistic disaster risk management at all levels. It is first of all important to identify, visualize, and evaluate under-recognized disaster risks that hinder sustainable development by taking a holistic view of the changes in hazards, vulnerabilities and exposures arising from societal and environmental problems. Metrics and indicators should be developed for evaluating vulnerability and resilience. Then, effective measures should be taken to anticipate, prepare for, and reduce the consequent disaster risks. It is equally essential to be able to develop response and recovery countermeasures even in the face of disasters and to build capabilities to make proper decisions for action in a timely manner to protect lives, livelihoods, and communities in order to fully recover from the impact of a disaster. Thus, it is critical to construct societies resilient to disasters by improving understanding of natural and human-made hazards, by developing new technologies for disaster prevention, by constantly raising political and public awareness and by preparing for effective emergency response -

including mental and physical health management - and recovery under the concept of “Build Back Better.”

To build such resilient societies, scientists and engineers should develop and practice concrete steps to make full use of science and technology with the following two perspectives. The first perspective concerns the promotion of inter-disciplinary research between natural/applied sciences and humanities/social sciences, the former specializing in understanding disaster occurrence mechanisms and design/maintenance of infrastructure and its functions, and the latter in evaluating disaster impact on socio-economic activities and analyzing human perceptions from the viewpoint of behavioral science. The integration of these two domains should be proactively pursued to enhance the disaster reduction capabilities of humankind. The second perspective concerns the promotion of trans-disciplinary cooperation, which enables the social implementation of science and technology for disaster risk reduction, through effective collaboration with Future Earth, to secure sustainable development. Efforts should be made to develop and strengthen a national platform for disaster risk reduction where scientists and practitioners in each country can work closely together with all relevant stakeholders based on discussions on the actual situations faced by their respective countries in their mother tongues

The priority (thematic) areas addressed in this call for proposals in the BRICS is as follow:

1. Understanding Disaster Risk.

It is critically important to make unflinching efforts for understanding hazards expected to happen and for reducing vulnerability of our infrastructure and society. To make the efforts bear fruit, each country should be supported in

- Collecting and archiving hazard event records and characterizing them with relevant information on land use and socio-economic activities
- Producing wide-area hazards and its impact data and information with the utilization of satellite observation and numerical modeling
- Producing reliable disaster statistics will be conductive to allowing each country to make well-informed decision making for disaster risk reduction.
- Improving assessment of disaster risks, monitoring and prediction of changes in disaster risks levels,
- Conducting data integration, analysis and visualization supporting a holistic understanding of disaster processes and consequences.

2. Strengthening Disaster Risk Governance to Manage Disaster Risk.

in order to Strengthen Disaster Risk Governance, Initiatives should provide support in

- How society may curb the increase in disaster vulnerability arising from misguided development activities in land use, construction of infrastructure and housing.
- How individuals, communities and authorities may behave appropriately and be better informed before and during emergencies for protecting their lives, livelihoods and health.

Meanwhile, It is urgent to strengthen international cooperation in the development of monitoring, systems (in situ and from satellite technology),early warning networks and enhanced emergency cooperation during disasters, such as the International Disaster Charter by space agencies. BRICS should also

- Support initiating a forum to discuss practical solutions to reduce disaster risks in line with the Sendai Framework, with all types of stakeholders from all over the world.

(b) Water resources and pollution treatment

Water resources are necessary for sustaining human life and life of other living organisms, assuring manufacturing and agriculture. However, anthropogenic factors, natural geochemical and biological processes, climate change processes lead to disruptions of water ecosystems, worsening water quality and decreasing volumes of fresh water.

Access to fresh water is limited for certain categories of users, and, this represents one of the major global challenges due to increasing water consumption, low levels of water resources replenishment and the impact of external factors. High quality water reserves are shrinking, and this limits opportunities for preserving public health, biodiversity, nature's aesthetic and recreational potential. Water scarcity directly affects over 40% of the world population in water stressed regions of every continent. It also has severe repercussions for the neighboring countries and represent a growing global problem for humanity. The United Nations project that by 2050 one in four people or more will be affected by repeated water shortages. BRICS countries already face this problem either in a national or regional perspective.

Integrated (sustainable) water resources management and pollution treatment should be applied in order to address the global water challenges. This priority (thematic) area addresses research applications in two thematic fields: water resources management

and water pollution treatment. The topics of the call are based on the United Nations Sustainable Development Goals, specifically the targets of the Goal 6: Clean water and sanitation.

Integrated water resources management: sustainable water resources management and governance, including efficient water use, water conservation, transboundary water relations and water diplomacy; assuring access to clean water for all; assuring access to adequate and equitable sanitation and hygiene for all; evaporation control technologies; new approaches, methods and instruments for analysis of existing knowledge on temporary and spatial changes in flood patterns in various regions; monitoring and prevention of water- related disasters; sustainable management of water ecosystems; ICT and big data tools for water resource management and governance; testing and distribution of cheap water desalination technologies; promoting efficient food-water-energy nexus technologies; improving water and sanitation management at local level.

Water pollution treatment: comprehensive assessing negative impact on water quality in natural water bodies; industrial and agricultural wastewater pollution treatment, providing adequate water quality and quantity; innovative technologies of domestic (household) water and wastewater treatment, storm and urban runoff treatment; economically viable use of chlorine-free water treatment technologies and nanotechnology for pollution control and desalination; drinking water treatment for emerging pollutants; multi-purpose water reuse and recycle technologies; control of marine pollution including oil-spills, marine litter, ballast water treatment and seaport waste treatment systems.

(c) Geospatial technology and its applications

Globally, Geospatial Technology has made inroads into various sectors of development cutting across public, private and non-profit domains. In order to cater to the growing demand of Geospatial Information, Tools/ Technologies, and Skills in their respective economies, the BRICS Nations have been investing in developing reliable geospatial information infrastructures and putting in place appropriate policies.

In the above backdrop, the Call intends to promote Geospatial Research, Technology Development and Applications at national, regional and global levels for Good Governance and Decision-making. This is proposed to be achieved through joint

programmes and projects by harnessing the core competencies of the Academia; Research Institutions; Government Agencies and Industries of the BRICS Countries. In the long run, it is envisaged to establish a Joint BRICS Geospatial Research Centre that could harness the potential of Geospatial Technology in providing good governance Services and improved systems for decision-making.

The following priority areas have thus been identified through deliberations/ consultations amongst the Geospatial Technology representatives from the BRICS Countries.

• **Geosciences collaboration (Geodesy):** Research collaborations in the domains of Mathematical Geodesy and Physical Geodesy,The Global Space-ground Integrated Geodetic Reference Frame Construction,Satellite Gravity Data Processing and its Application, Development of Prospective Technologies in Geodesy, Applications of GNSS to Studies in Geodesy, Navigation, Earth Deformations; Modern techniques for Geodetic Network Analyses etc.

• **Remote Sensing data processing for People-centric Applications:** With the launching of indigenous remote sensing satellites and availability of various other earth observation tools/ technologies, BRICS Nations are now equipped to utilize the data generated by these satellites for various development oriented applications. This provides foundation to build a global radiation and geometric calibration and validation network for remote sensing data and geospatial products through making full use of the diversification in terrain surface, sun light, atmosphere and background climate conditions within BRICS. Proposals are invited in (though not restricted to) areas like Earth Observation Data and Geospatial Information Products Joint Calibration and Verification, Remote Sensing Data Processing and computing capacity including cyber GIS for typical features, geospatial applications, dynamic monitoring for applications in Agriculture, Ecology, Infrastructure Management, Land Use Land Cover study, Water Resources and Development of Smart Cities.

• **Policy and Data Availability:** Policies, technologies and infrastructure on delivering data, information and knowledge are critical to informed decision making. Proposals are thus invited on The Establishment of Regional Remote Sensing Information Products Sharing Platform, The Development of the Regional Mechanism of Geospatial Information Resources Integration and The Global Standardization of Geospatial Products, Utilization of Open Geospatial Data amongst the BRICS Nations that may in the long run lead to the development of the BRICS Geospatial Data Portal

useful to the promotion of common global and domestic interests for people-centric development and the application of remote sensing information products within BRICS.

(d) New and renewable energy, and energy efficiency (including solid-state lightning)

Research institutions, enterprises, universities and other relevant entities from BRICS countries are encouraged to jointly develop collaboration in the areas of new and renewable energy, energy saving, energy efficiency and solid-state lighting (SSL). The priority topics for this 3rd BRICS call are:

1. Photovoltaic Power Generation and System Application Technology;

2. High Quality Biomass Energy Utilization Technology;

3. New Technology for Energy Storage.

4. Research on the key technologies of coal to clean gaseous fuel and its environmental protection to realize clean and efficient coal utilization.

5. Life Cycle Acceleration Testing Method and Reliability of LED Energy-saving Lighting Products.

6. High Quality Full-spectrum LED Lighting Materials, Devices and Lamps Manufacturing Technology.

7. Research, exchange and cooperation on developing standards.

(e) Astronomy

BRICS Astronomy shares many common research interests. These include observational, theoretical and computational studies: in cosmology, galaxy formation and evolution, stellar and compact object astrophysics, and big data Astronomy.

1. Cosmology

Cosmology - the study of our Universe - has made enormous strides over the past two decades, with two Nobel prizes being awarded in this period: for the discovery that the

Universe is expanding faster and faster, and for the high-precision measurement of the cosmic microwave background radiation (CMB), which is the after-glow of the Big Bang. We can summarise the key big questions where BRICS can make competitive contributions:

• *What was the primordial mechanism that generated the seeds for galaxy formation?*

• *What are the details of the Dark Ages, the Cosmic Dawn and the Epoch of Reionisation, which up to now have been inaccessible to observations?*

• *What is the mysterious dark energy that is accelerating our Universe today?*

• *Is it possible that there is no dark energy, but instead Einstein's theory breaks down on the largest scales?*

• *What is the nature of the dark matter that holds together cosmic structures?*

• *What are the properties of the elusive cosmic neutrinos that pervade the Universe?*

• *Is the Universe flat, isotropic and smooth on the largest scales?*

2. Galaxy formation and evolution

Tracing how galaxies evolve over the history of the Universe, from the Epoch of Reionisation (EoR) through to the assembly of the Hubble Sequence and the large clusters that we see in the Universe today is a key goal of modern Astronomy, because galaxies are central to all aspects of astrophysics and cosmology. Key questions in galaxy evolution that are the central focus of many current and upcoming forefront telescope facilities, and where BRICS can make significant contributions, include:

• *When did galaxies assemble most of their stars and where in the galaxy does this occur?*

• *What is responsible for the remarkable dichotomy in properties between 'blue' and 'red' galaxies?*

• *What were the objects responsible for reionizing the Universe, and how did reionization proceed?*

• *How do galaxies trace the underlying dark matter distribution, and what do galaxies tell us about the nature of dark matter?*

• *How do supermassive black holes form in the centres of galaxies, and what role does feedback from these black holes play in the evolution of galaxies?*

3. Stellar and compact object astrophysics

Stars are fundamental constituents of the Universe. All the chemical elements except hydrogen and helium have mainly been produced in the interiors of stars and sprayed all over the Universe through supernova explosions. The stars that populate many galaxies are almost as old as the Universe itself. Their impact on our understanding of the Universe has been profound. The key questions in stellar and compact object astrophysics, where BRICS can be competitive, include:

• What can stars in nearby galaxies tell us about the origin and evolution of galaxies?

• What are the final stages in the lives of Asymptotic Giant Branch stars, which recycle key chemical elements previously locked up in their interiors?

• Which stars harbour planets, especially Earth-sized planets with potentially habitable environments?

• What physical processes govern mass accretion onto compact objects?

• What is the nature of thermonuclear burning on the surfaces of compact objects?

• What are the parents of Type Ia supernovae, the objects which showed us the existence of dark energy?

• What is the origin and mode of acceleration of the highest-energy cosmic rays?

• What is the nature of space-time under the extreme conditions of black holes and neutron stars?

• Is there evidence for new physics beyond the Standard Model of particle physics, potentially found in such extreme environments?

• How are the relativistic jets from compact objects launched, accelerated, and collimated, in some cases over many thousands of light years?

• What is the nature of gravitational wave sources detected by ground-based facilities like LIGO and VIRGO?

4. Astronomy-related instrumentation, technology, and infrastructures

New technologies are driving new astronomical instruments around the world and at different wavelengths, including both large-scale telescope facilities (e.g. ISA, eELT, LSST, CTA, SKA, LOFAR etc.) and smaller-scale instrumentation for existing telescopes (e.g. high-contrast/high-resolution imagers, spectrographs, integral field units etc.), which provide astronomers with unique observational opportunities.

These advances allow astronomers to sample wide bands of data with very high time and/or frequency resolution. This results in much higher sensitivity, enabling the study of weaker and/or more distant objects (e.g. high-redshift supernovae, faint solar system objects, microlensing events), as well as to discover new classes of objects and events (e.g. fast radio bursts). It is in the direct interest of the BRICS countries to invest in these activities, to benefit both technologically and scientifically. New science challenges in the world require scientists and engineers in the BRICS countries to develop new technologies while designing new astronomical instruments.

5. Big data science

The digital revolution is sweeping across all aspects of human endeavour. Astronomy is not immune from this trend, and indeed is leading it in many aspects due to the massive data collection and analysis requirements of its new instruments (e.g.

MeerKAT, SKA, LSST). It is not sufficient to collect the data and then ship it elsewhere to researchers, who then perform the fundamental research (with associated skills development and economic spin-offs) and collect the Nobel prizes. To derive the wider benefits of involvement in such projects and facilities, BRICS needs to be globally competitive in Astronomy data processing, with the view to catalyse development of a knowledge economy, and act as a trigger for other knowledge-based cross-disciplinary activities. The big data challenge in this new era of Astronomy are four-fold:

- New approaches to data access and distribution. The exponential increase in rates and volumes of scientific data creates traditional challenges of scalability of storage, transfer and access. Delivery of the raw data itself to the end users is not practical;
- Development of next generation processing techniques. Converting the observations data into science quality data requires new approaches to data processing and high performance computing techniques. The big data sets are complex and often serve multiple commensal science goals;
- Testing big data simulations against theory. Not only big data sets from single facilities but also multi-wavelength data from multiple facilities (e.g. SKA and LSST) and big data from simulations will need to be jointly analysed to achieve scientific goals. This will require new algorithms and analytics techniques, visualization, data mining, machine learning, and cognitive systems to transform these big data into information;
- Development of e-science tools and web technologies for collaborative sharing and analysis. The execution of large projects executed by nationally or globally distributed teams collaborating around remote and distributed big data will require development of new analytical tools and technologies. This raises issues of access control, governance, provenance and policy around use of data in globally shared resources.

(f) Biotechnology and biomedicine including human health and neuroscience

Two areas have been identified for the initial phase of cooperation under the Biotechnology and Biomedicine including Human Health and Neuroscience thematic area: Antibiotic resistance and Cognitive disorders.

Antibiotic resistance

Antibiotic resistance is one of the greatest threats to our societies and health systems,

and the number of antibiotic-resistant bacteria is growing at a disquieting rate. The estimated number of people killed by antibiotic resistance each year worldwide is around 700,000, and it is believed it will reach 10 million by 2050. In February 2017 the World Health Organization (WHO) published a list of the most life-threatening multidrug-resistant bacteria to draw the attention to pathogens that are becoming a recurring deadly menace all over the world, and for which the developing of new antibiotics must be a paramount priority. The list is a guide for governments, which should "incentivize basic science and advanced R&D by both publicly funded agencies and the private sector investing in new antibiotic discovery."

Cognitive disorders

The development of novel diagnostic and person medicine tools and routines based on Biomedical Big Data is the fastest growing direction of clinical development for complex diseases, including common cognitive disorders. This growth is further linked to development of other Biomed directions, including precision medicine, telemedicine, drug development and testing automation, and so on. Proposed research priorities will be aimed at the development of new data science methods for analysis of neurobiology data with the primary focus on modern artificial intelligence methods. Types of data for analysis will cover multiple levels from omics data to neuroimaging data (including structural MRI, structural and functional connectomics) and phenotypical data.

Based on the above the applicants are invited to address the following topics:

- **Development of new tools based on Big Data analysis for patient stratification and optimized treatment selection in common cognitive and neurodegenerative disorders: schizophrenia, depression, bipolar disorder and autism**
- **Development of new tools based on Big Data analysis for patient stratification and optimized treatment selection in cancer, incl. liver cancer, lung cancer, gastroenteric cancer**
- **Development of new disease classifications for precision medicine based on combination of biological and clinical Big Data analysis**
- **Development of unified data storage and analysis resources for new diagnostic and treatment optimization algorithms, computational data formats and types**
- **Drug repurposing, and development of new drugs and vaccines to cure and prevent infectious diseases including AIDS, Viral Hepatitis, Tuberculosis and neglected diseases**
- **Antimicrobial resistance. Investigations of new aspects of drug resistance including antibiotics and anti-viral drugs. Computational drug design**

(g) Information technologies and high performance computing

Applicants are invited to submit proposals in the following areas:

1. **Advanced Precision Medicine and Public healthcare: Wearable Device technologies, Data analytics, Prediction of Health Anomalies, HPC Simulation and services.**
2. **Supercomputing Co-Design Technologies for Solving Grand Challenge Problems: Modeling, Algorithms, Architectures, Parallel Programming Technologies and Tools.**
3. **HPC and BigData for Sustainable Development: Solving Large Scale Ecological, Climate and Pollution Problems.**
4. **Research in Machine Learning, AI and Big Data Analytics: Development of efficient algorithms and tools.**
5. **HPC for Public Digital Security including, but not limited to: user and entity behavior analytics, cybercrime detection and investigation, Internet and social networks monitoring.**
6. **Development of the Integrated Knowledge Space for Digital Heritage based on OpenData environment.**
7. **Smart Cloud Manufacturing: General Purposed Robotic Operation System to Support Heterogeneous Swarm AI including but not limited to: Distributed Collaboration Architecture; Collective Perception; Collective Autonomic Collaboration; Collective Autonomic Learning.**
8. **Cloud based Visual Reality/Augmented Reality/Expanded Reality Platform and Its Industrial Applications.**
9. **Development of Integrated HPC Cloud Platform for BRICS Innovation and Collaboration**

(h) Ocean and polar science and technology

Considering that the five BRICS countries are washed by every ocean of the World and are strongly engaged in developing ocean and polar technology and science, this thematic area is of great importance. Nowadays, the ocean and polar systems are subject to climate change effects and increasing anthropogenic pressures. The latter

include not only emissions of greenhouse gases, but also pollution of different kinds. These stressors as mediated through complex ocean-atmosphere exchanges, sea-ice-air interactions, and land-sea interactions are particularly active in high-latitude regions and coastal areas worldwide. The predictability of the changes to come in the next decades depends strongly on availability and quality of observational data (including those collected from the abyssal depths) and capacities of prognostic numerical models to assimilate them.

Based on the abovementioned general considerations, the applicants are invited to address the following topics:

1. Anthropogenic pollution of oceans, seas, and coastal zones, including marine litter and plastic debris;

2. Land-ocean interactions and coastal processes, including dynamics of river plumes;

3. Climate variability and predictability;

4. Ice-air-sea exchanges in high latitude regions;

5. Deep sea research and technologies, including manned and remotely operated submersibles;

6. Data management and assimilation in models.

(i) Material science including nanotechnology

Development of the New Advanced Functional Materials, including magnetic materials, materials for power and the nanostructured materials is one of the most perspective directions of research and development in the world showing the largest growth of publications in the leading world editions, sufficient growth of number of patents and high level of business investments.

In the field of **Materials for Power engineering**, the following topics are proposed for the call: functional materials for more efficient accumulation and storage of electric energy; functional materials for alternative (hydrogen and solar) power and catalysts; functional materials for thermal, hydraulic and nuclear energy; new composition materials for power industry; materials for improving the reliability and effectiveness of power supply networks and systems.

In the field of **Nanostructured materials** the following topics are proposed for the call: functional materials with nanoscale dispersion; advanced nanostructured ferroelectric and related materials, ionic and mixed conductors and biomaterials; new nanostructured materials for sensors and transducers based on multicomponent

inorganic crystalline, composite and glassy materials; thin films and phase-change materials for data recording and storage; strongly-correlated and low-dimensional systems.

In the field of **Magnetic materials** the following topics are proposed for the call: nanostructured magnetically-ordered thin-films and bulk materials with new functional characteristics; new functional materials: multiferroics, helimagnets, magnetic fluids and gels, biocompatible magnetic materials; high-efficiency magnetosensitive medium for physical sensing applications; soft magnetic, hard magnetic, and magnetocaloric materials with complex magnetic structure; new effects in the dynamics of magnetic domain structure; composite magnetic materials with polymer matrix.

In the field of **Opto-electronic and semiconductors materials** the following topics are proposed for the call: methods of micro and nano-domain engineering for manufacturing nonlinear optical devices; materials for effective light converters, ionizing radiation detectors, luminophores and lasers; semiconductor heterostructures; domain structure in ferroelectrics; materials for memory devices.

In the field of **Materials in biology and medicine** the following topics are proposed for the call: bio-compatible materials and constructions; new biosensors for medical diagnostics; advanced materials for sensors and converters for biomedical purposes. Drugs; functional nanomaterials for biology and medicine. Perspective nano-size and supra-molecular agents of target delivery of biologically active substances, developing the methods of these substances synthesis and designing their transportation.

(j) Photonics

Light and light-based technologies form the foundation of life itself and enable the existence of human society on our planet. Over several decades photonics gradually intertwined into the fabric of our daily lives, revolutionizing the global information infrastructure, medical, financial, and economic systems. Light-based technology is rapidly changing industrial, cultural, economic, and political aspects of global society. Recognizing the importance of the science of light and its applications the United Nations proclaimed 2015 as the year of light and light-based technologies. A number of leading countries declared photonics programme development as their national priority.

Six major thematic fields in this area can be outlined:

- Integrated optics and radio frequency photonics;
- High speed data transmission and processing;
- Photonics in bio-medicine;

- Photonics for agriculture and food industry;
- Photonic quantum technologies;
- Photonic based sensor networks.

Integrated optics and radio frequency photonics: on-chip waveguides and interconnects (including microresonators and plasmonic based components); microwave opto-electronic on-chip components, coherent on-chip light sources; high-bandwidth on-chip detectors; packaging of active and passive photonic devices; numerical tools for design of new photonic materials and integrated and radio frequency photonic components.

High speed data transmission and processing: high speed optical fiber and free space (including satellite) communications; quantum and classical photonic technologies for information security; optoelectronic components and devices for information networks; novel photonics materials; high performance optical data storage and processing; digital signal processing algorithm and hardware; numerical tool for design of high performance information systems.

Photonics in bio-medicine: optical bioimaging methods; lasers in modern clinical practice; opto-acoustics methods for theranostics; passive and active micro/nanostructures for diagnostics and targeted drug delivery; body parameters real time monitoring; biosensors; regulations for joint (within BRICS countries) clinical testing and certification of the new medical equipment and methods.

Photonics for agriculture and food industry: photonics applications for remote sensing (spectroscopy); photonics in precision farming, food control and processing; big data and machine learning algorithms for photonic data analysis – for early detection of plant diseases,
prediction and increase of land productivity, decrease of usage of fertilizers, control of food processing and storage.

Photonic quantum technologies: quantum key distribution techniques for security communication; combination of complimentary quantum and classical security methods on physical level; photonic quantum simulators; quantum photonic sensors; on-chip signal photon detectors; optical quantum computing.

Photonic based sensor networks: structural health monitoring (SHM) for aviation, ship, and construction industries; detectors for extremely low level of contamination values; perimeter control systems for oil and gas pipelines.

(k) Aeronautics

Applicants are invited to submit proposals in the following areas:

1. **Flight safety.**
2. **Aeroacoustics and environment friendliness.**
3. **Perspective aircraft aerodynamics and structures.**

(l) Research infrastructures, including mega-science projects

The corner stone of BRICS strategy in building the global research infrastructure network (GRAIN) will be based on supporting BRICS collaborative projects on joint using the existing RI and designing and prototyping around building and/or upgrading RI. It will be desirable to encourage these collaborative projects in areas of astronomy, physics, materials science and nanotechnology (both biological and non-biological materials), life sciences, big data, oceans, earth sciences and natural disaster resilience, but not limited to these.

The projects will include both the very complex and expensive unique RI such as particle and ion accelerators, elementary particle detectors, telescopes, oceanographic ships, synchrotron light sources, neutron sources, etc., and creation of special open for collective use facilities (collective infrastructure centers) equipped with the advanced “medium-sized equipment” such as high resolution scanning and transmission electron microscopes, Cryo-electron microscopes, Analytical electron microscopes, Mass spectrometers for proteins analysis, 800-1000 MHz Nuclear Magnetic Resonance for analysis of protein structures, etc.

It is very important to stimulate the BRICS cooperation based on both the unique big RI and collective medium size infrastructure centers. Such cooperation may involve the interchange of leading scientists and specialists, students and technicians working in the following types of projects:

a) development of new or upgrading existing megascience and unique facilities including large scale network infrastructures;

b) technological improvement in the medium-sized equipment in projects of scientific instrumentation;

c) methodological improvements in the use of research infrastructures of all types, including methods of data taking and processing, development of new sample preparations to be analyzed, optimization of the operation of the network infrastructures.

The projects consortia applying under current thematic area, as exception, are allowed to consist of only two partners that request funding from the respecting participating national funding agencies, however with a clear indication of a third partner from BRICS country willing to participate in the project implementation on own costs. A clear statement on participation in a project implementation on own costs of a partner from a third BRICS country must be attached with online application with indicating the statement Signatory as third PI in the project (see below "Application" section).

(m) Science, Technology, Innovation and Entrepreneurship Partnership (STIEP)

The goal of this thematic area is to create innovation and entrepreneurship partnerships between BRICS countries aimed on innovation R&D projects. Within this call area a collaborative innovation projects may be supported in 12 thematic priority areas mentioned above (a-l) and are expected to lead to innovative products, services or processes of significant economic and/or societal value.

Based on existing experience of building international market oriented innovation collaborations, as exception, the projects consortia applying under current STIEP thematic area are allowed to consist of only two partners that request funding from the respecting participating national funding agencies, however with a clear indication of a third partner from BRICS country willing to participate in the project implementation or project results dissemination activities on own costs. A clear statement on participation in a project implementation on own costs or interest in the project outcomes utilization or market introduction of a partner from a third BRICS country must be attached with online application with indicating the statement Signatory as third PI in the project (see below "Application" section).

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Please note that the thematic areas and type of supported research vary depending on particular participating funding organization. More details can be found in respecting National Annex document (available on http://brics-sti.org/index.php?p=new/22) or from national contact points. However, the general information on thematic areas supported by each of the participating funding organization is presented below:

		Brazil		Russia			India	China		South Africa
	Thematic areas	CNPq	Finep	FASIE	MSHE *	RFBR	DST	MOST	NSFC	NRF
a	Prevention and monitoring of natural disasters	V				V	V		V	V
b	Water resources and pollution treatment	V				V	V		V	V
c	Geospatial technology and its applications	V				V	V	V		V
d	New and renewable energy, and energy efficiency, including SSL	V				V	V	V		V
e	Astronomy	V				V	V		V	V
f	Biotechnology and biomedicine including human health and neuroscience	V	V			V	V	V		V
g	Information technologies and high performance computing	V				V	V	V		V
h	Ocean and polar science and technology	V				V	V	V		V
i	Material science including nanotechnology	V	V			V	V		V	V
j	Photonics	V				V	V		V	V
k	Aeronautics	V	V			V	V	V		V
l	Research infrastructures, including mega-science projects		V							
m	STIEP		V	V				V		

** - Information on list of supported thematic areas by respecting funder will be updated later.*

I-3. Invitation of Proposals and Prospective Applicants

The BRICS STI FP participating funding organizations shall invite researchers from their countries to identify potential partners in at least two other BRICS countries and to jointly prepare proposals for cooperative research projects in the thematic areas of the call.

All applicants must fulfil their respective national eligibility rules for research grant applications (please refer to the National Annex document and consult with national research funding organization participating in the call).

I-4. Financial Support

The participating funding organizations plan to support cooperative activities including exchange of researchers within the participating counterpart countries. Conditions of support will vary by country and respecting national funding organizations' approaches, with a common rule that each participating funding organization funds its national researchers or institutions.

The duration of a cooperative research project will be up to three years with start of projects in 1st quarter 2020.

II. Application

A joint project will comprise of at least one Principal Investigator (PI) from each of the participating countries (please also refer to national annexes for additional requirements), with one of the project participants also acting as a Project Coordinator (or leading PI). Project consortia should consist of partners from at least three of the BRICS countries participating in a specific thematic area of the call.

A **Joint Application Form (JAF)** (link for download: http://brics-sti.org/files/JAF_BRICS_3rd_Call_2019.docx) shall first be submitted by the Project Coordinator to the Call Secretariat through the online **BRICS STI Framework Programme Application Management System (BRICS AMS)** at http://ams.rfbr.ru/BRICS. JAF shall be written in English.

In addition to the JAF, each national team of a project **shall submit an additional national component** (i.e. proposal) to the relevant national participating funding

organization following all required procedures of each particular organization.

The Joint Application Form includes information on:

1) Thematic area;
2) Title and acronym of cooperative research project;
3) Abstract;
4) Proposed period of cooperative research project;
5) Research team;
6) Budget requested.

The national component to be submitted shall vary in form, terms and information provided depending on the particular participating funding organization. More details can be found in the National Annex document (can be downloaded from http://brics-sti.org/index.php?p=new/22 page) and on the websites of participating funding organizations.

The project which does not submit in due date a fully completed Joint Application Form to the Call Secretariat through Application Management System (ams.rfbr.ru) or a national components to all respecting national funding organizations will automatically be considered as non-eligible.

II-2. Preparation of Application Forms

Applicants should agree on aims, strategy of research and management, and the title of the project, and agree on the project coordinator. Based on those agreements the applicants should complete the Joint Application Form (JAF) and national component.

II-3. Submission of Application Forms by Applicants

Applicants should submit the Joint Application Form (JAF) to the Call Secretariat via online application submission tool until **15:00 (Moscow Time, UTC+3) on 25th April 2019**.

To submit the JAF an online-submission form should be completed via the BRICS STI Framework Programme Application Management System (BRICS AMS) at http://ams.rfbr.ru/BRICS. The project coordinator should register in BRICS AMS, log in and create a proposal for the BRICS STI FP Call 2018. Project coordinator must fill in all the required fields and submit an application. The online submission form fields are

identical to the information provided in JAF, however the completed JAF as file attachment to the online form is encouraged to be uploaded in the “upload file” section of online submission form.
For Thematic areas “l” and “k” in case one of the project partners participates on own costs a clear statement on participation in a project implementation on own costs must be attached.
All fields for partners participating on own costs must be completed with “0” stated for requested funding.

Applications submitted to the Call Secretariat by any method other than through online submission form at http://ams.rfbr.ru/BRICS, such as post or e-mail, will be rejected.

An additional national component should be submitted to the respective national funding organization according to its own rules and procedures. Please note that submission deadline for national component may vary from the deadline for JAF submission to the Call Secretariat.

II-4. Receipt of Application Forms by Call Secretariat

Following the online submission of an application, the respecting confirmation message with proposal registration number will be shown in confirmation message. On “my projects” page in BRICS AMS the project thereafter will be shown with assigned registration number and status “Registered”.

II-5. Retraction of submitted application

At any time after online submission of an application an applicant can retract for modification submitted application on “my projects” page in BRICS AMS. After retraction action an application is considered as “not submitted”. Re-submission of application is only possible until the call deadline (15:00 (Moscow Time, UTC+3) on 25th April 2019).

III. Evaluation of Project Proposals

III-1. Evaluation Procedure

Each participating funding organization evaluates all proposals where researchers from its own country request funding from their respective funding organization. Based on

the results of the evaluation, a joint decision by the participating funding organizations will be made regarding the selected proposals to be co-funded.

III-2. Evaluation Criteria

The following general evaluation criteria will be considered (please also refer to national call announcements information on national component):

- Scientific quality and innovation of the joint research plan
- Sound project management, methodological approach, feasibility and appropriateness of the joint research plan
- Added value to be expected from the research collaboration
- Balanced cooperation
- Competence and expertise of teams and complementarities of consortium (interdisciplinary / all necessary expertise)
- Appropriateness of resources and funding requested
- Expected impacts: e.g. scientific, technological, economic, societal
- Opportunities for early career researchers
- To encourage the participation and joint research by the business sector.

III-3. Announcement of Decision

Applicants will be notified of the final decision in fourth quarter 2019 regarding the approved joint projects for funding.

IV. Responsibilities of the PI following Approval of Projects

After the proposals have been approved, the PI and his/her own affiliated institution will observe the following when carrying out the cooperative research and utilising funding:

IV-1. Progress Report

IV-1.1 Progress Report to the BRICS STI Funding Working Group

Halfway through the research period (i.e. after one and a half years), the leading PI shall promptly develop and submit an integrated progress report to the Call Secretariat on the status of the joint research. The report will be reviewed by the BRICS STI Funding Working Group.

IV-1.2 Progress Report to each participating funding organization

All researchers must follow their own funding organizations' rules and procedures.

IV-2. Final Report

IV-2.1 Final Report to the BRICS STI Funding Working Group

After completion of the period of joint research, the project coordinator shall develop and submit within one month an integrated final report to the Call Secretariat on the results of the joint research. The report will be reviewed by the BRICS STI Funding Working Group.

IV-2.2 Final Report to each participating funding organization

All researchers must follow their own funding organizations' rules and procedures.

BRICS STI Framework Programme – Joint Call Secretariat

http://brics-sti.org/

Contact person:
Mr. Yaroslav Sorokotyaga
Russian Foundation for Basic Research
E-mail: brics@rfbr.ru
tel: +7 499 941 0196

V. National Contact Points

Applicants should contact the following national contact points for information on each Party's national eligibility rules or support conditions:

Brazil:

National Council for Scientific and Technological Development (CNPq)

Lelio Fellows Filho
General Coordinator of Intenational Cooperation
National Council for Scientific and Technological Development - CNPq
Tel: +55-61-3211-9247
E-mail: leliof@cnpq.br

Brazilian Innovation Agency (Finep)

to be updated

Russia:

Foundation for Assistance to Small Innovative Enterprises (FASIE)

Mrs. Olga Levchenko
Foundation for Assistance to Small Innovative Enterprises
Phone: +7 495 231 38 51
Email: levchenko@fasie.ru

Ministry of Science and Higher Education (MSHE)

Ms. Albina Kutuzova
Phone: +7 495 629 73 32
Email: kutuzovaaa@minobrnauki.gov.ru

Ms. Anastasia Zadorina (ICISTE)
Phone: +7 495 660 34 29
Email: zadorina@mniop.ru

Russian Foundation for Basic Research (RFBR)

Mr. Yaroslav Sorokotyaga
Division Director
International Relations Department
Russian Foundation for Basic Research
Tel: +7 499 941 0196
E-mail: ysorokot@rfbr.ru

Mr. Denis Rudik
Senior Expert
International Relations Department
Russian Foundation for Basic Research
Tel: +7 499 941 0196
E-mail: rudik@rfbr.ru

India:

Department of Science and Technology (DST)

Dr. Arvind Kumar
Scientist E
International Multilateral and Regional Cooperation Division
Department of Science and Technology
Tel: +91-11-26602213
email: arvind.kumar71@nic.in

Sadhana Relia,
Scientist G & Head
International Multilateral and Regional Cooperation Division IMRCD ,
Department of Science and Technology
Government of India.
Telefax: +91-11- 26602216
email:srelia@nic.in

China:

Ministry of Science and Technology (MOST)

中华人民共和国科学技术部
Ministry of Science and Technology of the People´s Republic of China

LI Wenjing (Ms.)
Programme Officer
Department of International Cooperation
Ministry of Science and Technology (MOST), China
Tel: +86-10-58881321
E-mail: liwj@most.cn

National Natural Science Foundation of China (NSFC)

NSFC

Rong Nianhe (Mr.)
Programme Officer
Bureau of International Cooperation
National Natural Science Foundation of China
Tel: +86-10-62326998
Fax: +86-10-62327004
E-mail: rongnh@nsfc.gov.cn

South Africa:

National Research Foundation (NRF)

NRF National Research Foundation

Ms. Nombuso Madonda
Professional Officer
Knowledge Advancement and Support
National Research Foundation
Tel: +27 (0) 12 481 4285
Email: nombuso.madonda@nrf.ac.za