Megascience facilities in global research infrastructure

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Abstract. The term “unique scientific facility of the “Megascience” class” (USFMC) has come into widespread use in legal acts of a programmatic nature, which necessitates the study of the term in a legal context and determination of the relationship between this concept and the widely accepted term “global research infrastructure” (GRI). On the basis of the analysis of legal acts, policy documents and doctrinal sources, two key features of USFMC can be identified: 1) their large scale (physical, financial, technological), and 2) their particular relevance to science facilitating some breakthrough in a particular field of expertise. The study of the GRI essence makes it possible to propose the following definition: global research infrastructures are massive, valuable, unique due to their technical specifications complexes constructed and operated in the order of international cooperation (collaboration) between States, international organizations and other actors without international legal personality (State agencies, scientific institutions, funding institutions) and designed for long-term scientific research aimed at obtaining new breakthrough knowledge, substantially supplementing or modifying perceptions of reality. The domestic term “unique scientific facility of “Megascience” class” has the greatest overlap with such global research infrastructures as geographically localized (single-sited) large research infrastructures. The authors conclude that in order to align the domestic legal terminology in the field of “Megascience” with the terminology accepted world-wide, amendments should be made to the draft Federal Law “On Scientific, Scientific-Technical and Innovative Activities.”

1. Introduction
The Strategy for Scientific and Technological Development of the Russian Federation approved by the Decree of the President of the Russian Federation No. 642 of 1 December 2016, among the main directions and measures of implementation of the state policy in the field of scientific and technological development of the Russian Federation, provides support for the creation and development of unique scientific facilities of “Megascience” class, large research infrastructures on the territory of the Russian Federation (para. 32b).

Acceleration of scientific and technological development of the Russian Federation is one of the national goals proclaimed in the Decree of the President of the Russian Federation No. 204 of 07 May 2018 “On national goals and strategic objectives of the development of the Russian Federation for the period up to 2024” (para. 1e). Science has become one of the directions in compliance with which the Government of the Russian Federation is instructed to develop national projects (para. 2b). One of the key provisions of the Decree is that it is necessary to ensure the solution of the problem of creating an advanced research and development infrastructure and facilitating innovation activities, including
creation and development of a network of unique scientific facilities of the Megascience class, by the year 2024 (para. 10).

Under Decree No. 204 “On Main Directions of Activity of the Government of the Russian Federation” approved by the Government of the Russian Federation on 29 September 2018, it is expected that, in order to develop a contemporary research and development infrastructure and engineering activities, an international scientific research project will be launched on the premises of unique scientific facilities of the Megascience class at the International Center for Neutron Research based on high-flux research reactor PIK (ICNR PIK), the accelerator complex of Nuclotron-based Ion Collider Facility (NICA), the fourth-generation Specialized Synchrotron Radiation Source SSRS-4, the Siberian Circular Photon Source (SKIF) (para. 2.2.2).

At the end of 2018, these four mega-projects \(^1\) were included in the national project “Science” \(^2\). The total amount of project financing in 2019-2024 amounts to 635 959.9 million rubles, including 404 787.6 million rubles allocated from the federal budget \(^3\).

The Russian Federation in its capacity as the State and its scientific organizations take an active part in the implementation of Megascience projects abroad. Despite the fact that Russia is not a member of the European Centre for Nuclear Research (CERN), it has been actively involved in the construction of the Large Hadron Collider (LHC) and in experiments conducted at its four detectors on the basis of bilateral agreements with the international organization \(^4\). Russia is the second largest contributor (after Germany) to the two Megascience projects implemented in Germany, namely: the European X-ray Free Electron Laser (XFEL) \(^5\) and European Centre for Ion and Antiproton Research (FAIR) \(^6\). In 2014, Russia joined a megaproject on the territory of France—the European Synchrotron

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1. For detailed information on the technical uniqueness and breakthrough nature of the expected results of scientific experiments, see: Portal “Scientific and technological infrastructure of the Russian Federation”/ Catalog of Megascience Facilities: URL: http://ckp-rf.ru/megauni/ (accessed: 27 April 2020).
2. Passport of the National Project “Science”, approved by the Presidium of the Council for Strategic Development and National Projects under the President of the Russian Federation on 24 December 2018. URL: http://government.ru/projects/selection/740/35565/ http://government.ru/projects/selection/740/35565/ (accessed: 27 April 2020).
3. The national project “Science” previously approved by the Government Commission on High Technologies and Innovations within the framework of the implementation of the Strategy for Scientific and Technological Development of 2016 does not include the following “Megascience” projects: Tokamak with a powerful magnetic field (Ignitor, Troitsk); Accelerator complex with colliding electron-positron beams (Super Charm-Tau factory, Novosibirsk); International Center for Research of Extreme Light Fields (C, Nizhny Novgorod Region). URL: http://www.sib-science.info/ru/grants/sbor-predlozheniy-po-sozdaniyu-proektov-29032018 http://www.sib-science.info/ru/grants/sbor-predlozheniy-po-sozdaniyu-proektov-29032018 (accessed: 27 April 2020). Nevertheless, these projects continue to be promising.
4. Agreement between the Government of the Russian Federation and the European Organization for Nuclear Research (CERN) on Further Developing Scientific and Technical Cooperation in High Energy Physics 1996, the Protocol on Participation in the Large Hadron Collider Project (LHC) to the Agreement between the Government of the Russian Federation and the European Organization for Nuclear Research (CERN) on Further Developing Scientific and Technical Cooperation in High Energy Physics of 30 October 1993. In 2019, a new agreement was signed between Russia and CERN that provides not only for participation of the Russian Federation in CERN experiments, but also participation of experts from CERN in Russian mega-projects under Order of the the Government of the Russian Federation No. 751-p of April 15, 2019, “On the Ratification of the Agreement between the Government of the Russian Federation and the European Organisation for Nuclear Research (CERN) on Research and Technical Cooperation in High Energy Physics and Other Fields of Mutual Interest and a Protocol to It”.
5. The 2009 Convention Concerning the Construction and Operation of a European X-ray Free-Electron Laser Facility 2009.
6. The Convention concerning the Construction and Operation of a Facility for Antiproton and Ion Research in Europe (FAIR) of 12 October 2010.
Radiation Centre (ESRF). Finally, Russia takes an active part in the construction of the International Thermonuclear Experimental Reactor (ITER).

Such mega-projects implementation is impossible without raising huge resources, and not only financial, but also—and primarily—intellectual ones, and without organization of research on an extended international front. “There is a need for pluralism of knowledge, opinions, technologies, mentalities, and only following this way you can get interesting, bright results,” said Vladimir Kekelidze, Vice-Director of the Joint Institute for Nuclear Research, Head of the NICA project. International cooperation is inherent to such mega-projects, which, in turn, requires normative and organizational consolidation.

In this regard, legal science faces the urgent task of researching the legal phenomenon of megascience and the global research infrastructure, the legal nature of international scientific collaborations, existing legal models of international scientific cooperation, identification of their advantages and disadvantages, elaboration of proposals for their development and improvement, evaluation of possibilities of application and adaptation to Megascience projects on the territory of Russia.

Within the framework of this article, an attempt is made to study the ways that are emerging in Russian legal doctrine and practice to understand what constitutes “a unique scientific megascience facility”, determine the relationship of this concept to the widely recognized term “a global research infrastructure”, analyze the legal nature of the global research infrastructure, its types and distinctions. On the basis of such analysis, authors suggest some recommendations concerning the draft Federal Law “On Scientific, Scientific-Technical and Innovative Activities”.

2. The Definition of a Unique Scientific Megascience Facility in Russian Doctrine and Jurisprudence

The current legislation of the Russian Federation does not give any legal definition of the concept of the unique research Megascience facility, although the term itself has already firmly entered into the legal instruments of programmatic nature, starting with the Strategy of Scientific and Technological Development of the Russian Federation for the period up to 2016. The definition of “a unique research facility” (hereinafter referred to as URF) given in the Federal Law No. 127-FZ of 23 August 1996 does not take into account the specificity added to the facility due to its Megascience characteristic. Moreover, the definition under consideration, from the point of view of logic, cannot serve as a generic concept as it limits the “uniqueness” of the facility because of lack of analogues within the Russian Federation.

"Terms and Definitions" section of the Passport of the national project “Science” explains: “Creation and development of the network of Megascience URFs means creation and development of the network of physical research facilities superior, according to their technical characteristics, parameters and achievable results, to the facilities now existing in the world. Their creation and exploitation can take place on the basis of international scientific and technical cooperation. A prerequisite for the project to be classified as ‘megascience project’ is the existence of a scientific program that allows the project to go beyond the current knowledge of the fundamental science and opens up opportunities for the development of technologies”.

The draft Federal Law “On Scientific, Scientific-Technical and Innovative Activity in the Russian Federation” developed by the Ministry of Education and Science of the Russian Federation in addition

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7 Protocol of Accession by the Government of the Russian Federation to the Convention of 16 December 1988 Concerning the Construction and Operation of a European Synchrotron Radiation Facility.
8 Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project.
9 At the NICA: Collider is under construction, elections of heads of collaborations MPD and BM @N have taken place. 01.11.2018 / Official video portal of the Joint Institute of Nuclear Research // URL: http://science-tv.jinr.ru/?p=4756 http://science-tv.jinr.ru/?p=4756 (accessed: 27 April 2020).
to defining “a unique research facility” gives the definition of “a unique research facility of worldclass (Megascience class)”\(^\text{10}\). In a later version of the draft law, the words “Megascience class” are excluded; however, the very definition remains\(^\text{11}\). Under the latest draft of the law—at the time of preparation of the article it has not yet been introduced to the State Duma—“a unique scientific world class facility” means a URF that has no analogues in the world and has been created to ensure the fulfilment of international obligations of the Russian Federation. As it can be seen, a world-class URF has two peculiarities: (1) the level of uniqueness has been raised from “uniqueness at the Russian level” to the “uniqueness at the international level”; (2) the international obligations of the Russian Federation serve as a connecting factor. On the one hand, the latter is an important clarification, since international scientific cooperation is a distinctive feature of Megascience projects. On the other hand, the wording does not look quite winning: first, scientific facilities appear to be created (and operated) for the purpose of obtaining new scientific knowledge, and international commitments are made to facilitate such activities rather than vice versa; second, international scientific cooperation, as an integral consequence of the necessity to establish a Megascience class facility, does not necessarily include interstate interaction, though usually it cannot be avoided.

In the Russian doctrine, the phenomenon of Megascience becomes an important object of research. What is more, it becomes an object of research in an interdisciplinary context. Economists, for example, view “Megascience centres or centres of Megascience”, as “a new organizational form of world economy transformation”. According to E. Inshakova and A. Voloshina, “they can be defined as a mega-economic form of the production of intellectual products of global importance, based on international or transnational capital according to the principle of international collaboration” [1].

O.V. Boltinova and L.L. Arzumanova [2] noted that “conducting studies encouraging new knowledge that can change the existing world order requires the construction of specific facilities providing a physical and digital scientific basis that does not have analogues in the world”.

E. N. Gorlova and R.V. Tkachenko [3] identify 5 characteristics of the Megascience class URF giving the following definition: a Megascience class URF means “a single systematic complex of scientific and research equipment that has no analogues, that is created with the help of international cooperation resources to achieve scientific results containing fundamental breakthrough knowledge, technologies or solutions of global importance, the achievement of which is impossible when using other equipment complexes”.

A large-scale study of approaches, existing in foreign legal science and practice, to the concept of Megascience has been conducted by A.O. Chetterikov [4]. The scholar emphasizes that the term “Megascience” has become accepted to denote all projects designed for obtaining breakthrough knowledge, “more precisely, the underlying structures, instruments and equipment and other infrastructure”. The scholar also notes that “the most common legal category correlating Megascience in official documents is the expression ‘large research infrastructures’” [4]. To highlight the large/large-scale/very large/significant nature of Megascience facilities and to distinguish them from other research infrastructures (research facilities), the author writes: “I am referring primarily to the significant scale of such an object—not only based on their size (usually large and very large), but also in terms of the labour intensity necessary for their creation, their operation complexity, and, what is particularly important for the State, the amount of the required budgetary investment. Other criteria include: the innovative nature of Megascience objects, significant advances expected of them in scientific cognition, and their increased importance to the society as a whole” [4]. Thus, the scholar

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\(^{10}\) Draft Federal Law “On Scientific, Scientific-Technical and Innovative Activities in the Russian Federation”, Art. 57. Project ID 04/13/03-18/00079415. Draft of March 28, 2018. Federal portal of draft normative legal acts. URL: https://regulation.gov.ru/projects/List/AdvancedSearch#npa=69845 (accessed: 27 April 2020).

\(^{11}\) Draft Federal Law “On Scientific, Scientific-Technical and Innovative Activities in the Russian Federation”, Art. 57. Project ID 04/13/03-18/00079415. Draft of March 28, 2018 // Federal portal of draft normative legal acts URL: https://regulation.gov.ru/projects/List/AdvancedSearch#npa=69845 (accessed: 27 April 2020).
emphasizes two key features: large scale (physical, financial, technological) and special importance and significance for science.

3. Global Research Infrastructure

Foreign legal texts much more commonly use the term “research infrastructure” (with various epithets — large, large scale, significant, global, etc.), whereas “Megascience” is more commonly used in literature [5], and more often in non-legal literature. The most prominent international institutions established to study these issues and make recommendations include: the Global Science Forum of the Organisation for Economic Co-operation and Development (OECD) (OECD Global Science Forum) established by G8 in 2008, the Group of Senior Officials (GSO) on Global Research Infrastructures (GRIs) operating within the European Strategy Forum on Research Infrastructures (ESFRI). Even judging by their names we can conclude that they use the term “research infrastructure”.

How do the concepts of “Megascience” and “the large (global) research infrastructure” relate? In absolute terms, these concepts are closely interrelated, but they cannot be equated. Science is “the area of human activity the function of which is to develop and theoretically systematize objective knowledge of reality” [6]. Infrastructure [lat. infra — below, beneath + structure — a fitting together, adjustment; a building, mode of building] means components of the general structure of economic or political life of a subsidiary nature, but ensuring the normal functioning of the systems as a whole. Thus, science means an activity (area of activity), and infrastructure means the objects of the material world that provide this activity. The characteristics of science itself definitely determine the characteristics of its infrastructure.

A distinctive feature of Megascience (great science, from Greek. mega and Engl. science) is that its mission is to obtain completely new fundamental knowledge that substantially supplements or even changes our perceptions of the world around us, significantly, even in fits and starts, advancing humanity in its cognition of reality. The state of modern science is such that this cannot be achieved without international scientific cooperation and collaboration that ensures intellectual exchange both in terms of existing experience and the results achieved. The discovery in 2012 of the Higgs boson during the LHC experiments at CERN is an outstanding example of such knowledge. Thus, such a characteristic as a breakthrough nature of the achieved results correlates primarily to the concept of “Megascience” as an activity.

On the other hand, “mega-tasks” require a special “mega-infrastructure” for their solution. In turn, the hallmarks of such an infrastructure are scope of research, labour intensity, necessity to attract maximum possible resources, i.e. intellectual, material, and financial resources, for its creation and operation. On the other hand, as stated in the 2016 Australian National Research Infrastructure Roadmap [7], global research infrastructure is multinational, collaborative and of a scale where the cost of establishment is beyond the resources or expertise of a single nation.

Federal Law No. 127-FZ of 23 August 1996 “On Science and State Science and Technology Policy” does not contain the definition of the research infrastructure. It provides only the definition of “an innovative infrastructure”. The draft Federal Law “On Scientific, Scientific-Technical and Innovative Activities in the Russian Federation” defines the “infrastructure of scientific, technical and innovative activity” as a set of subjects and tools providing material, financial, organizational and methodical, information, advisory and other support for scientific, scientific-technical, innovative activities, and objects used therefor. (art. 2, para. 8).

European Union legal instruments contain several definitions of the research infrastructure. For example, this term is defined as “facilities, resources and related services that are used by the scientific community to conduct research in their respective fields and covers scientific equipment or sets of instruments, knowledge-based resources […] or any other entity of a unique nature essential to conduct research”[12].

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[12] Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty, para 91. OJ L 187, 26.6.2014, Pp.
However, this is, so to say, a “conventional” research infrastructure. What we are interested in is the one that is able to provide the solution of the problems that Megascience faces. For example, the definition given in the EU Regulation establishing the EU Research and Innovation Programme Horizon-2020 contains a significant addition: “any other infrastructure of a unique nature essential to achieving excellence in research and innovation”\(^{13}\). Finally, the Council Regulation establishing the specific Community legal framework for a European Research Infrastructure Consortium (ERIC) specifically designed for the implementation of integrated scientific and infrastructure projects—the European Research Infrastructure Consortium (ERIC)\(^{14}\)—supplements the definition with the wording that such infrastructures are "used […] to conduct top-level research … and cover major scientific equipment or sets of instruments."\(^{15}\) This definition is interesting because it is given in the legal instrument that was passed due to the fact that research infrastructures “are becoming increasingly complex and expensive, often placing them beyond the reach of a single Member State or even continent” (Preamble, Para. 5).

In 2010, the Group of Experts from the OECD Global Science Forum prepared the Report on the development of large international research infrastructures. Explaining the principles of their study, the experts highlighted that it concerns only infrastructures that are “truly international”, i.e. infrastructures that “are based on formal agreements between governments, agencies, or research institutions from more than one global region”\(^{16}\).

The 2014 Framework Document drafted by Senior Officials on Global Research Infrastructures identifies 14 criteria for classifying an infrastructure as global. The 1st criterion states that “[g]lobal Research Infrastructures should address the most pressing global research challenges, i.e. those frontiers of knowledge where a global-critical-mass effort to achieve progress”\(^{17}\), while referring infrastructures whose governance is “fundamentally international in character”\(^{18}\) to the global research infrastructures.

Concluding the review of approaches to the definition of the global research infrastructure, it should be noted that two types of research infrastructures, including global, are distinguished: (1) located in one place, geographically localized infrastructures (facilities) - single-sited research infrastructures (facilities); and (2) international distributed research infrastructures consisting of facilities and other equipment and instruments located in different countries integrated into one network to implement specific scientific projects.

1–78. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0651&from=EN (accessed: 27 April 2020).

13 Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020), art. 2 (6) // Official Journal of the European Union. 2013. L 347. Pp. 104-117. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1291&from=EN (accessed: 27 April 2020)

14 See more about this unique organizational and legal form: Chetverikov A 2019 European Research Infrastructure Consortia: International Organization under European Law or Legal Entities Sui Generis? Lex Russica 7 141-150. https://doi.org/10.17803/1729-5920.2019.152.7.141-150. (accessed: 9 September 2020).

15 Council Regulation (EC) No 723/2009 of 25 June 2009 on the Community legal framework for a European Research Infrastructure Consortium (ERIC), art. 2(a). Official Journal of the European Union. 2009. L 206. Pp. 1-8. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0651&from=EN (accessed: 27 April 2020).

16 Organisation for Economic Co-operation and Development (OECD). Global Science Forum. Establishing Large International Research Infrastructures: Issues and Options. December, 2010. P. 3 URL: http://www.oecd.org/sti/mono/47057832.pdf (accessed: 27.04.2020).

17 Group of Senior Officials (GSO) on global Research Infrastructures. Framework Criteria. 2014 URL: https://ec.europa.eu/info/sites/info/files/research_and_innovation/framework_criteria.pdf (accessed: 27 April 2020).

18 https://ec.europa.eu/info/research-and-innovation/strategy/european-research-infrastructures/group-senior-officials-gso/gso-toolkit_en (accessed: 27 April 2020).
According to the definition given by the experts at the OECD Global Science Forum, the International Distributed Research Infrastructure (IDRIS) is a “a multi-national association of geographically-separated distinct entities that jointly perform, facilitate or sponsor basic or applied scientific research”\(^\text{19}\).

According to the definition made by the European Strategic Forum on Research Infrastructure (ESFRI), the research infrastructures are central facilities geographically localised in a single site or in a few dedicated complementary sites designed for user access, whose governance is European or international. And a distributed research infrastructure “consists of a Central Hub and interlinked National Nodes.” The distributed RI should, \textit{inter alia}, have: a unique specific name, legal status and governance structure with clear responsibilities and reporting lines, including international supervisory and relevant external advisory bodies; the Central Hub should have legally binding coordination competencies and resources\(^\text{20}\).

According to OECD experts, an IDRIS \textit{should} have the following: 1) an identity and a name; 2) a set of international partners who are, typically, funding agencies, research institutes, academic institutions, foundations, or other research-oriented organisations from the public or private sectors; 3) a formal agreement by the partners to contribute resources, expertise, equipment, services or personnel towards achieving a common scientific purpose; the agreement does not necessarily need to define a new legal entity, or be legally binding; 4) a strategic plan, or work programme, that conveys the rationale for establishing the IDRIS and its added value over-and-above separate activities of the partners; 5) a governance scheme (for decision-making, at a minimum) and a set of officers (not necessarily salaried staff) with well-defined responsibilities; 6) a focus on the provision of services to its members and users\(^\text{21}\). As an example we can name the European very Large Baseline Interferometry Network (VLBI)\(^\text{22}\). It appears that the Siberian Circular Photon Source (SKIF) will be organized following a similar pattern as a network infrastructure with the pilot machine in Novosibirsk, the head machine in the Moscow region, and the source of synchrotron radiation in Vladivostok.

These peculiarities indicate the difference between distributed research infrastructures and a research coordinated network (international collaborations of independent research organizations).

Summing up the above regarding the global research infrastructure, the following distinctive features can be named:

- Physically large size (this feature is an important one inherent to the majority of facilities, especially geographically localized facilities; however, exceptions are also possible). For example, the diameter of the Large Hadron Collider (LHC) tunnel is 27 km; it runs underground in the territory of two countries; only one of its detectors (CMS) weighs 12,500 tons\(^\text{23}\).

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\(^\text{19}\) Organisation for Economic Co-operation and Development (OECD). Global Science Forum. International Distributed Research Infrastructures: Issues and Options. 2014. P. 7 // URL: http://www.oecd.org/sti/innovation/international-distributed-research-infrastructures.pdf (accessed: 27 April 2020).

\(^\text{20}\) ESFRI. Strategy Report on Research Infrastructures and Roadmap 2018. P. 12. URL: http://roadmap2018.esfri.eu/media/1048/mr2018-part1-20.pdf (accessed: 27 April 2020).

\(^\text{21}\) Organisation for Economic Co-operation and Development (OECD). Global Science Forum. International Distributed Research Infrastructures: Issues and Options. 2014. P. 7-8. URL: http://www.oecd.org/sti/innovation/international-distributed-research-infrastructures.pdf (accessed: 27 April 2020).

IDRIS \textit{may} have: (1) an independent legal status (or an equivalent legal identity under the terms of an existing intergovernmental agreement); (2) a common fund and rules for acquisition/spending of funds; (3) a secretariat; (4) a host institution.

\(^\text{22}\) The European very Large Baseline Interferometry Network (VLBI). URL: https://www.evlbi.org/ (accessed: 27 April 2020).

\(^\text{23}\) LHC the guide. CERN-brochure. 2017. Pp. 18, 40. URL: https://home.cern/sites/home.web.cern.ch/files/2018-07/CERN-Brochure-2017-002-Eng.pdf (accessed: 27 April 2020).
• High cost. For example, the LHC and its detectors cost of construction alone amounted to CHF 4,332mln\(^{24}\). The cost of the International Thermonuclear Experimental Reactor (ITER) construction initially was estimated at €6 billion. It is currently estimated at €17 billion\(^{25}\), and this estimate is not final. Construction costs for the European Synchrotron Radiation Centre (ESRF) amounted to more than €3.5 billion\(^{26}\). The expected construction costs of the European X-ray Free Electron Laser (XFEL) amount to more than €1 billion\(^{27}\).

• Continuity (longer duration). For the ITER, the project development began in the 1980s and the Convention on its construction was signed in 2006. The construction began in 2010. The earliest technically achievable First Plasma date is currently estimated to be in 2025\(^{28}\).

• Scientific, technical, engineering uniqueness. Each of these objects is unique. They embody the most advanced scientific achievements and developments. The expected scientific results cannot be obtained otherwise.

• The focus on innovative breakthrough knowledge that substantially supplements or changes perceptions of reality, extending the frontiers of the human mind in its aspiration to cognize the world around, anticipation of serious, sometimes galloping advancement in scientific cognition.

Finally, the most important feature predetermined by the said above is **international scientific cooperation and international governance of the creation and operation of the global research infrastructure**, which, by virtue of its characteristics, requires integration of intellectual, substantive, financial and other efforts of various States, agencies, scientific and funding organizations. Such cooperation involves actors of international law—States and international intergovernmental organizations, as well as other actors not possessing legal personality under international law—first of all, scientific institutions, government agencies, funding organizations, as well as legal entities established on the basis of intergovernmental agreements made under domestic or European law. Legal models of organization of such scientific cooperation are diverse and complicated. They are complex in nature and combine regulation under national and international laws, as well as self-regulation within the framework of international scientific collaborations (memorandums of understanding), legally binding rules and rules of soft law.

4. Conclusion
The study of the essence of global research infrastructures makes it possible to propose the following definition of the global research infrastructure. A global research infrastructure means a massive, valuable, unique due to its technical specifications complex constructed and operated in the order of international cooperation between States, international organizations and other actors without international legal personality (State agencies, scientific institutions, funding institutions) designed for long-term scientific research aimed at obtaining new breakthrough knowledge, substantially supplementing or modifying perceptions of reality. Such an infrastructure can be geographically localized in one location as a large plant, or be distributed (as a network of interconnected facilities within the implementation of one scientific project under central governance).

\(^{24}\) LHC the guide. P. 17

\(^{25}\) URL: http://www.iter.org/faq#Do_we_really_know_how_much_ITER_will_cost (accessed: 27 April 2020).

\(^{26}\) Annex 3 to the Convention of 16 December 1988 concerning the construction and operation of a European Synchrotron Radiation Facility. URL: http://www.esrf.eu/files/live/sites/www/files/about/organisation/ESRF-convention-annex3.pdf http://www.esrf.eu/files/live/sites/www/files/about/organisation/ESRF-convention-annex3.pdf (accessed: 27 April 2020).

\(^{27}\) Technical document No. 2. Annex 3 to the 2009 Convention on the Construction and Operation of the European X-ray Free Electron Laser Installation. URL: https://www.xfel.eu/organization/company/index_eng.html (accessed: 27 April 2020).

\(^{28}\) URL: https://www.iter.org/construction/construction (accessed: 27 April 2020).
The term “a unique research facility of Megascience class (world-class)” used in Russian doctrine and practice has the greatest overlap with such a category of the global research infrastructure as “a geographically localized (single-sited) large research infrastructure”. In order to bring the legal terminology accepted in the Megascience field in line with the terminology accepted internationally, we should consider the possibility of incorporating into the draft Federal Law "On the Scientific, Scientific-Technical and Innovative Activities,” along with the definition of “infrastructure of scientific, scientific-technical and innovative activities” (art. 2), the definition of “a global research infrastructure” (“global infrastructure of scientific, technological and innovative activities”); and Chapter 8 of the Federal Law (Scientific and Technological Equipment, Collective Equipment) should incorporate provisions devoted to the two types of the global research infrastructure, namely: geographically localized and distributed research infrastructures.

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