Cremlin Connecting Russian and European Measures for Large-scale Research Infrastructures

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First CREMLIN Recommendations for the European-Russian Megascience Collaboration

Stakeholders and scientists from five Russian megascience projects and their European partners have been collaborating and discussing in depth during three years of CREMLIN the opportunities and the proposed agendas for the forthcoming EU-Russian collaboration in the area of Research infrastructures (RI).

CREMLIN has been set up along the "*Report of the Expert Group on the Assessment of EU Cooperation with Six Russian Federation Megascience Projects*" (2013), as a project funded within the European Union´s Horizon 2020 research and innovation programme.

The consequently applied European-Russian balance has been a key factor for the success of the CREMLIN project. This balance has been followed at all levels, starting from the organization of particular workshops and events, to setting up the work package coordination and also the overall governance structure of the project.

As a result of the numerous European-Russian discussions, workshops, round tables, seminars, expert meetings and conferences, various Recommendations have been jointly worked out and agreed that can also be understood as a contribution to the European-Russian research policy dialogue, proposed to the EU-Russia Joint Science and Technology Cooperation Committee (JSTCC).

An external experts advisory board to CREMLIN has been set up: the Science Policy Advisory Board (SPAB), with five European and Russian independent senior experts[1]. In three dedicated SPAB meetings, as well as in numerous exchanges with the SPAB members, SPAB has been providing continuously specific recommendations to the CREMLIN Consortium Board (CB) with regard to the strategic orientation of the project implementation. The SPAB recommendations have been very valuable, important and helpful, and have also been taken up in the CREMLIN Recommendations.

The CREMLIN Recommendations can be briefly stated and summarized in two groups:

i. Specific Recommendations for the EU-Russian collaboration around all five megascience projects, or facilities
ii. General Recommendations for further actions concerning topics that are relevant for EU-Russian collaboration around a broader set of Russian RI

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1. Specific recommendations:

Recommendations for the collaboration around the Ion collider facility NICA
Intended period of project implementation: 2010-2023
CREMLIN Consortium: FAIR; JINR

GSI (Darmstadt) and JINR (Dubna) have a long-term successful cooperation in the field of synthesis of new elements, accelerator developments, as well as in in heavy-ion collision experiments. Starting from 2005, joint GSI-JINR collaboration on both FAIR and NICA projects is being performed: developments on superconducting accelerator magnets, detectors and software packages for simulations and data analysis for NICA and FAIR. NICA is considered as a "complementary facility" to the ESFRI Landmark FAIR since ESFRI Roadmap Update 2016 (ESFRI: European Strategy Forum on Research Infrastructures).

Within CREMLIN WP3, GSI/FAIR and JINR have been successfully performing joint R&D activities mainly on joint development of modern Silicon Tracking Systems for experiments at both accelerator facilities.

As to the collaborative consortium, it is recommended and planned to include various additional European FAIR-CBM collaborators from the Czech Republic, France, Germany, Hungary, Poland and Ukraine, as well as additional Russian collaborators.

GSI/FAIR and JINR recommend to expand their collaboration and to provide a substantial contribution to the instrumentation of NICA, focusing on activities such as the integration and installation of Silicon Trackers, the development and construction of components for NICA and CBM, but also on the development of common software packages and special data management technologies that will be used at NICA and FAIR.

Moreover, the collaborators recommend to prepare for joint development of future technologies for NICA and FAIR experiments, for instance the development of CMOS detector technologies for high-rate silicon trackers for NICA and FAIR experiments, or the development of new approaches for the integration of special sensors into ultralight structures of large-area cooling systems.

Recommendations for the collaboration around the High-Flux Research Reactor PIK
Intended period of project implementation: 2011-2022
CREMLIN Consortium: Jülich; PNPI; ESS; ILL; HZG; TUM

Against the background of a shutdown of smaller national neutron sources in Europe during the coming years, and the operation of the ILL reactor until the 2030's, the Russian research reactor PIK may become an attractive facility for the European neutron research community. It is recommended to equip the PIK reactor with a second cold neutron source, a related beam extraction system and a suite of cold neutron instruments, all built on most modern neutron technologies. These activities will be a major strategic aim for the collaboration around PIK for the next years. Also, the complementarity of the future instrument suite at PIK with the instrumentation and research capabilities at the ESS and at ILL should be carefully taken into account in order to assure a preferably broad range of research opportunities for the European and Russian neutron research communities.

In addition to the equipment, it will be highly relevant to prepare an up to date access strategy in order to enable and facilitate an international utilization of PIK. The WP4 collaborators suggest that a

draft model for a platform should be worked out that could allow or facilitate the docking of European partners at the PIK facility.

Special emphasis should be put on training and development of the user base: The scientific neutron user communities in Russia and in Europe should both be prepared very well to utilise PIK´s instrument suite. This includes targeted training measures, such as dedicated neutron research schools introducing into the special research opportunities at the new instruments. Also, a special university master programme can be set up, in order to ensure well-structured and more in-depth training.

The WP4 CREMLIN collaborators strongly recommend continuing with the very successful and valuable work of the "EU-Russian Subcommittees for Instrumentation at PIK". These subcommittees, as a unique tool, have been constantly developing and providing specific recommendations for the PIK-instrumentation suite, and these recommendations will also be needed in the near future.

During the further collaboration, joint EU-Russian Research & Development efforts should be carried out, for instance the development of a modern neutron beam extraction system, joint development of neutron detector technologies, neutron choppers, joint moderator development, and other. A special focus should be the joint development of an instrument suite complementing the ESS instrument suite. Such R&D should lead to results that can be applied to not only PIK, but also to other neutron sources.

It is recommended to further extend the participation of the neutron collaboration and to better involve the neutron facilities of European relevance.

Recommendations for the collaboration around the Fourth Generation SR Source SSRS-4
Intended period of project implementation: 2018-2027
CREMLIN Consortium: ESRF; NRC KI; DESY; European XFEL; MAX IV; IC RAS

Russia plans to extend its research capabilities with synchrotron radiation. These plans include the creation of a specialised fourth-generation synchrotron radiation source in Protvino, Moscow Region, as well as a new synchrotron accelerator facility in Akademgorodok near Novosibirsk. The Protvino source SSRS-4 is suggested as a Russian national flagship project that will be open also for the international, especially European utilization. SSRS-4 will be based on a 1.3 km diffraction limited storage ring with an envisaged electron energy of 6 GeV.

It is generally recommended to establish ties – for instance an associated membership – between the Russian SSRS-4 project and the newly established European strategic LEAPS initiative ("League of European Accelerator-based Photon Sources").

The CREMLIN WP5 collaborators recommend to further elaborate the conceptual design as well as the technical design for the SSRS-4 project in a joint European-Russian collaborative effort. Also, the scientific case for the SSRS-4 facility shall be further elaborated, and the intended user community should be described more precisely.

It will be important to devise a well-structured and robust project management framework as well as an appropriate project governance for the conceptual and the technical design phases of SSRS-4, including mandates and allocation of tasks and responsibilities for the project and its management in the three areas of (i) experiments, (ii) accelerator, and (iii) infrastructure. This will include the setting

up of international committees, such as the Machine Advisory Committee (MAC) and the Scientific Advisory Committee (SAC) for SSRS-4.

Moreover, the collaborators recommend to jointly engage in the research and development of specific technologies which are essential for the construction and operation of diffraction limited light sources. Typical examples are the development of highly-specialised magnet structures, or the components and technologies for the electron injection linac, such as the construction of an electron booster cavity. Also, joint R&D work on special detector systems, as for instance photon counting pixel detectors is recommended by the collaborators.

Recommendations for the collaboration around the High-power laser XCELS
Intended period of project implementation: 2012-2025
CREMLIN Consortium: CEA; IAP RAS; ELI

For the further elaboration of a technical design for the high-power laser project XCELS, it will be of special relevance to carry out joint EU-Russian research and development efforts in high-field physics. Especially the production of a 2-channel prototype for XCELS may be realized. This may include, among other, the development of relativistic plasma mirrors, or laser beam diagnostics.

It is furthermore recommended that the project will be stepwise introduced, approached, and perhaps integrated into existing European networks, like for instance the Laserlab Europe fabric, or the Extreme-Light Infrastructure (ELI).

A business plan for XCELS needs to be developed that will allow sustainable funding.

Recommendations for the collaboration around the collider facility SCT
Intended period of project implementation: 2017-2023
CREMLIN Consortium: CERN; BINP

The collaborative consortium around the Super Charm-tau project recommends to apply typical organizational models for international collaborative efforts for colliders in the field of Particle Physics for the extension of the current consortium and for the continuation of the study. This type of model will facilitate the recommended participation of further Russian and European or international groups and partners in the SCT project. Apart from technical participation, it will allow external partners to also participate in decision-making and coordination.

It is recommended to undertake joint efforts towards the technical design report (TDR) of the SCT within this broader consortium, and to study the key and critical issues of the SCT collider as well as detector and physics program. The main elements of SCT accelerator and collider shall be developed considering well-established technologies tested, for example, at the super B-factory SuperKEKB or technologies already thoroughly assessed for future state-of-the-art colliders. SCT detector technology options shall be assessed by the consortium, and selected according to their performance and robustness. In this context it is recommended to intensify activities on SCT detector simulation.

Moreover, the WP7 collaborators recommended to provide a broad advertising of the SCT facility by means of regular dedicated international workshops, conference talks and seminars in leading research centers and universities.

It will be important to establish a well-structured project management framework, comprising typical elements like dedicated technical working groups and overall coordination offices, but also an institute board to ensure the representation of all collaborating partners in strategic decision processes.

Regular meetings of the SCT International Advisory Committee (IAC) and the precise implementation of the IAC recommendations are crucial for the proper development of the SCT project.

The SCT experiment is in many aspects complementary to other international collider experiments like Belle II, BES III, LHCb and PANDA. The SCT physics program shall be permanently updated considering last results in experimental and theoretical particle physics in order to identify challenges and highlights of the future experiment.

The SCT facility should be positioned as a part of the European Strategy for Particle Physics (update of this Strategy is under preparation now).

2. General recommendations:

The project consortium has also carried out a sequence of open European-Russian thematic workshops, addressing urgent issues that are relevant for the European-Russian future collaboration in the area of RI in general and also beyond the five Russian megascience projects. These issues are, for instance, the complex preparation of European and international access to Russian facilities and the general process of internationalizing facilities, or the issue of big data management around large-scale facilities, the issue of innovation around mega-facilities, or the extremely important aspect of training of experts – not only scientific users of RI, but also RI managers, engineers.

Key recommendations found during these horizontal CREMLIN events are:

- Prepare a transnational access scheme to Russian facilities of European interest. A complex effort should be undertaken in order to facilitate the access of European and international scientists as users to Russian infrastructures and facilities. For this purpose, it is recommended to first identify a set of Russian facilities that are open for international utilization and intending to substantially increase their international clientele. A proposal for a Russian Charter of Access should be worked out.
- Set up a European-Russian staff exchange programme. The main focus of this recommendation will be on training – training of RI personnel, managers and engineers as well as scientific users. Such training should also include industrial and technological aspects of large-scale facilities, in order to support the utilization of the novel opportunities at these facilities. Training events can be for instance summer schools (like the successful RACIRI Summer Schools), staff exchange at all levels, exchange of best practice, thematic workshops and other.
- Continue addressing horizontal topics of interest: European-Russian workshops at senior expert and stakeholder level should be further organized, also in order to enable and ensure sustainability of the successful events during CREMLIN on topics like “Funding and Research programmes at the RI”, “Innovation”, “Big data management at RI”.