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

Document information

Deliverable no.	D5.1
Deliverable title	Analysis report of the existing and potential user communities
Deliverable responsible	ESRF
Related Work-Package/Task	WP5/ Task 5.1
Type (e.g. Report; other)	Report
Author(s)	H. Reichert, ESRF
Dissemination level	Public
Submission date	31/08/2018
Download page	https://www.cremlin.eu/deliverables/

Project full title	Connecting Russian and European Measures for Large-scale Research Infrastructures
Project acronym	CREMLIN
Grant agreement no.	654166
Instrument	Coordination and Support Action (CSA)
Duration	01/09/2015 – 31/08/2018
Website	www.cremlin.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 654166.

Analysis report of the existing and potential Russian X-ray user communities and demands

CREMLIN Deliverable D5.1

CREMLIN WP5: "Science cooperation with the SSRS-4 synchrotron radiation source in the field of photon science"

Task 5.1 "Analysis of the existing and potential Russian X-ray user communities and demands"

Task Leader: ESRF

Author: Harald Reichert, ESRF

Introduction

Today, Russia operates two 2nd generation synchrotrons for X-ray science, one located in Moscow at the Kurchatov Institute, the other one located in Novosibirsk at the Budker Institute, which is mainly used for nuclear physics. The user base of these two machines is somewhat restricted due to their limited performance. In contrast to its European counterparts, Russia did not build a 3rd generation synchrotron radiation source but contemplates today the construction of a 4th generation storage-ring based radiation source as one the new 'megascience' facilities.

There is, however, a large, active community of X-ray users/scientists in Russia employing laboratory sources in universities and other research institutions. One of the goals of the CREMLIN WP5 was to assess the potential user community for a large 4th generation synchrotron radiation source to be built in Russia (SSRS-4). Another goal was to start growing a user community that would be able to fully exploit a 4th generation in Russia building on collaborations that have been established with some of the CREMLIN partners, in particular the ESRF, the European XFE and DESY, where Russian membership (ESRF, European XFEL) has been established in recent years.

Analysis report

In order to assess the potential Russian user community a special workshop was held at the 1st Russian Crystallography Congress 21-27 November 2016 (more than 1000 participants), where the participants were invited to express their needs in terms of high quality X-ray research infrastructures (see Figures 1 & 2).

The result of this inquiry was that the largest part of the synchrotron user community is located in the European part of the Russian Federation. Existing and potential users are mostly based at universities and academic institutions, but a rising interest was noted from industrial users (catalysts – chemical industry, composite materials, 3D printing – engineering materials research). The distribution of scientific areas shows a distinct pattern with a clear focus on solid state physics and materials science (Figure 1). This is reflected in the requested energy range for a new high performance facility with the usual focus on tender X-rays (4-20 keV), but a relatively large request for hard (20-60 keV) and extremely hard (>60 keV) X- rays (Figure 2). This suggests the need for a

high energy synchrotron radiation source, in particular for the study of engineering materials and palaeontological objects.

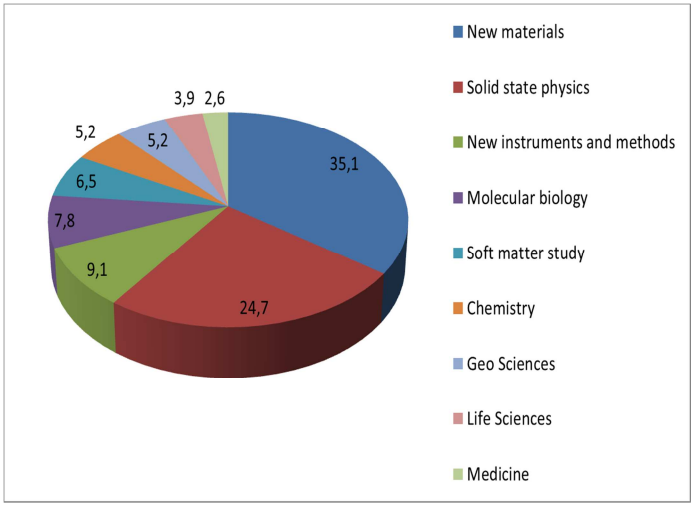

Figure 1: Scientific areas of potential users of SSRS-4.

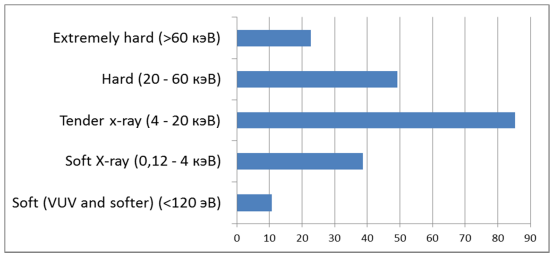

Figure 2: Requested energy range for SSRS-4.

Another channel is the monitoring of the use of the synchrotron at the Kurchatov Institute in Moscow.

Figure 3: Regional distribution of the users of the Kurchatov synchrotron in 2017. The radius of the circles is proportional to the number of users from the corresponding region. The chart is based on 254 accepted proposals from 53 institutions in 22 cities and encompasses about 120 user groups.

Figure 3 shows the regional distribution of Russian users of the Kurchatov synchrotron. The chart clearly shows that there is a very strong concentration of users in the Moscow region. Most of the users are located in the European part of the Russian Federation. This suggests that a potential 4th generation source would most likely draw a large part of its users from this this area.

The scientific areas represented by these users are shown in Figure 4. This is generally consistent with the results depicted in Figure 1 although there are some marked differences compared to the results from the questionnaire at the 1st Russian Crystallography Congress. This could indicate that

the composition of today's user community is determined mostly by the offer of available techniques and instruments. The true potential of the Russian user community would therefore unfold only when there is a broader offer of available techniques and instruments with high performance.

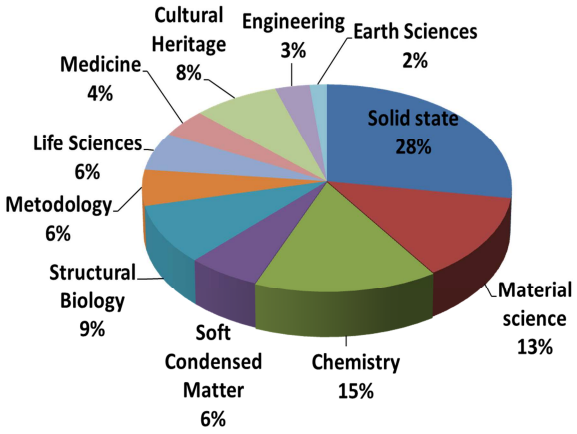

Figure 4: Areas of research at the Kurchatov synchrotron in 2017.

This assumption can be tested by analyzing the use of the ESRF by Russian users. Russia became a member state of the ESRF in 2014 at the level of 6% of its total use. Efforts have been undertaken in the last few years to raise the number and level of Russian users at this highly performing 3rd generation synchrotron radiation source. This is reflected in a rapid increase in the number of Russian users at the ESRF (Figure 5), quickly reaching its target value around 6% (Figure 6).

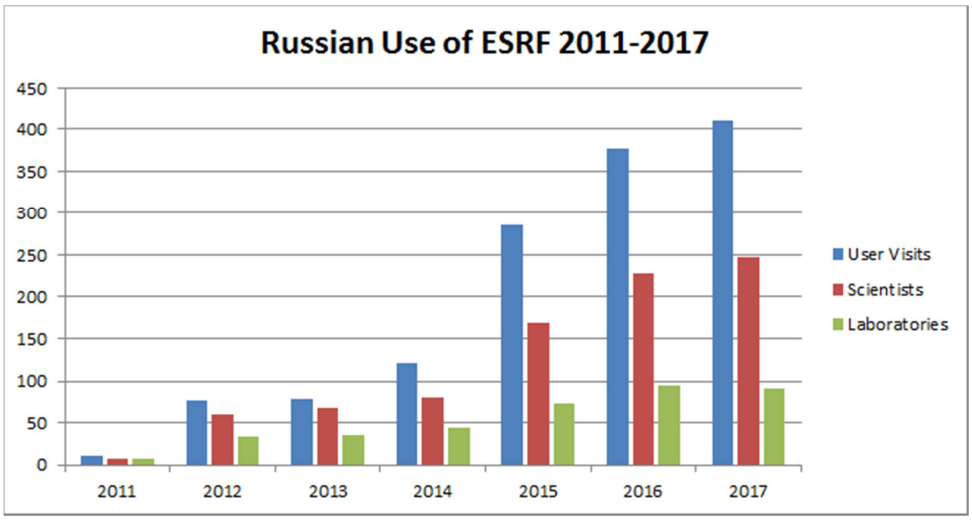

Figure 5: Number of Russian users at the ESRF. The chart also shows the increase in the number of laboratories using the ESRF.

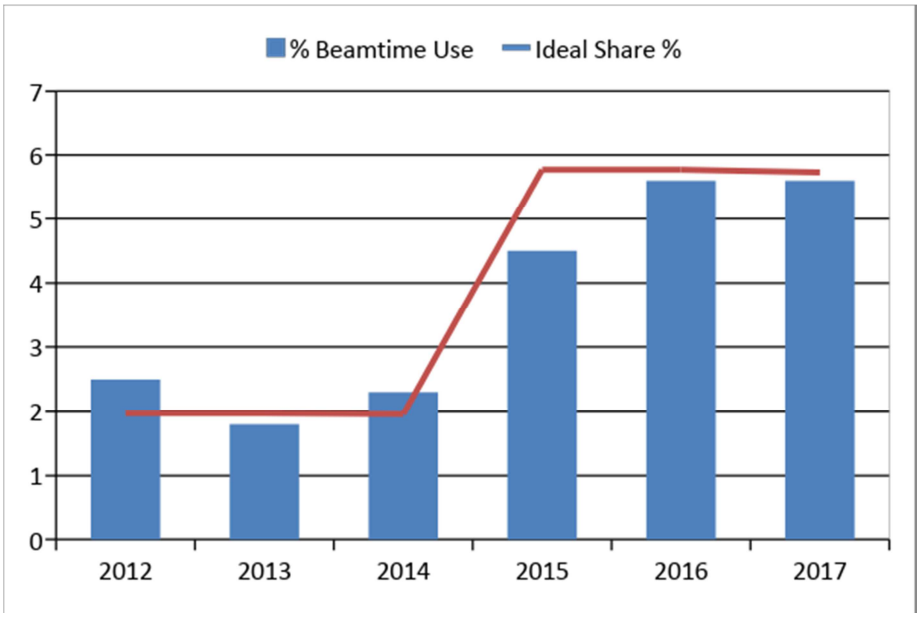

Figure 6: Development of the Russian utilization of the ESRF over the past few years.

Figures 5 & 6 clearly demonstrate that the offer of high quality synchrotron radiation immediately drives the demand from users. Interestingly, about 2/3 of the user groups at the Kurchatov synchrotron are also users at the ESRF. Similar conclusions can be drawn from the user statistics of the Russian-German Beamline at BESSY-II at the HZB in Berlin.

Figures 7 & 8 show the evolution of the Russian scientific use of the ESRF by scientific areas. It is apparent that areas where the ESRF offers far superior instruments in terms of performance show a very strong increase in the number of users, e.g. in molecular biology and chemistry & medicine.

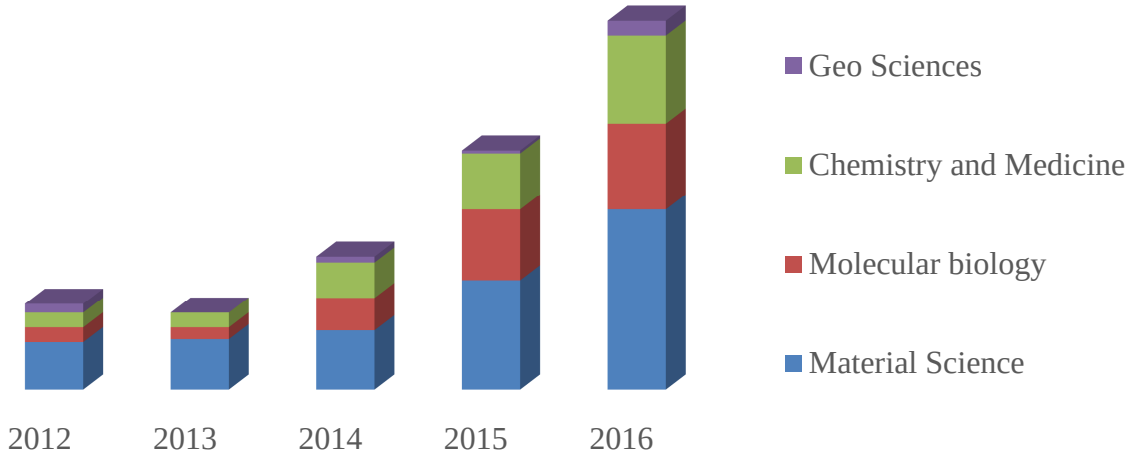

Figure 7: Increase in the number of Russian researchers in different scientific areas at the ESRF

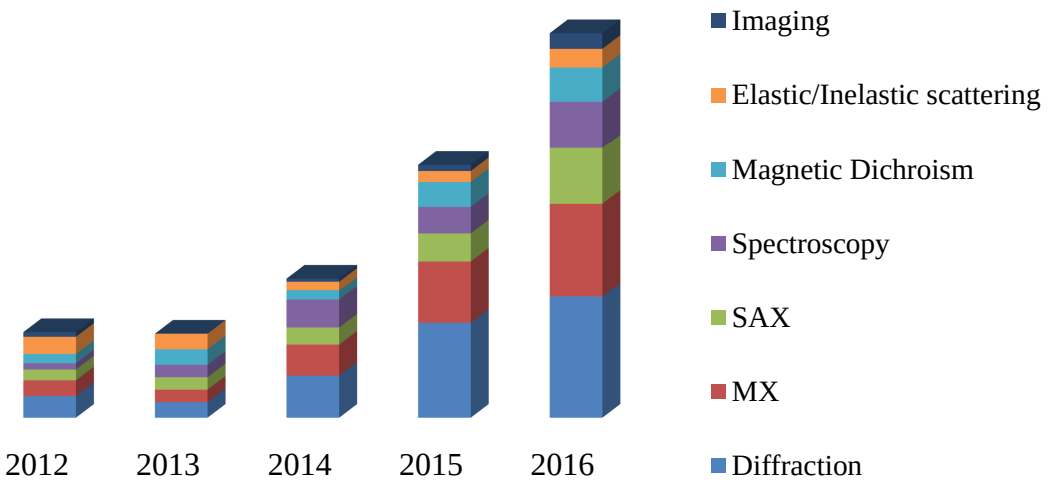

Figure 8: X-ray techniques used by Russian research groups at ESRF.

Combining the input from all available sources, we conclude therefore that there is a potentially very large user base in the Russian Federation for a 4th generation high performance synchrotron radiation source that will grow rapidly once the SSRS-4 will be realised.