Passport

4th generation Synchrotron Radiation Source

(«SSRS-4 project»)

Location: NRC "Kurchatov Institute"; Protvino in Moscow Region is considered

Initiating organization: NRC "Kurchatov Institute"

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Period of project implementation: 2017-2027

Costs of megascience project: ~ 1 billion euro

Brief description, main purpose of the construction.

Today Russian synchrotron users are conducting experiments at Kurchatov Synchrotron Radiation Source, European Synchrotron Radiation Facility (ESRF), PETRA-III, SPRing-8, ANKA and other leading facilities. Although the Kurchatov Synchrotron Radiation Source is a second plus generation facility, its characteristics and capabilities are insufficient to meet requirements of a growing users' community.

In Russian Federation there is need for high quality x-ray beam, which could be used for multi scale imaging, EXAFS and RFA with tens nanometers resolution and other «photon hungry» techniques. This need can be satisfied by creating the 4th generation light source.

The SSRS-4 project is designed to construct a brand new dedicated source of x-ray radiation – a source of synchrotron radiation of the 4th generation with three main characteristics: extremely high spatial coherence (corresponding to laser radiation), record brightness and temporal structure. It is expected that such facility will allow to carry out fundamental and applied research which may lead to breakthroughs in the field of condensed matter physics, nano- and biosystems, including hybrid systems, functional and biocompatible materials, medical diagnostic systems and targeted drug delivery and also to the innovation process in the field of superconductivity, magnetic systems, materials science, instrument engineering.

The SSRS-4 is intended to complement existing European sources and arouse interest of the European scientific community. It is planned that its research program will not be limited to only national scientific projects.

The SSRS-4 will become the basic facility of the Russian innovative nuclear-physical complex and will contribute to the formation of a new technological paradigm based on the convergence of science and technology in Russia.

Uniqueness (main advantages).

The machine should comply with all main demands of x-ray scientific community, so that its beamlines have to implement all main x-ray techniques in the area of x-ray diffraction, spectroscopy and imaging. As the machine will produce highly coherent beam, the most advanced beamlines will be dedicated to phase contrast imaging, photon correlation spectroscopy and nanofocused x-ray beams.

Scientific and practical importance.

The SSRS-4 facility should become an interdisciplinary shared use center of the world level. Main scientific fields to be addressed are following:

- investigation of the structure and dynamics of living and inanimate matter with atomic spatial and femtosecond time resolution;
- development of new technologies for synthesis and diagnostics of nanostructured and hybrid materials;
- studying the features of molecular biological and neurophysiological processes in living systems;
- new material search for ultrafast computers, including those basing of artificial intelligence, the development of new approaches to study brain functions and the genetic apparatus;
- creation of new drugs and methods for their targeted delivery, the development of x-ray medical nanodiagnostics and nanotherapy methods;
- studying the fine features of the structure of macromolecular crystals, biological cells and membranes, including their structural dynamics;
- synthesis of materials with new crystalline and magnetic properties;
- studying phase transitions under conditions close to the conditions on the center of the Earth and other planets;
- generation and analysis of plasma states and the stability of structural materials for the development of new types of thermonuclear facilities;

- increase by several orders of spatial and temporal resolution in the study of the structure of nanoobjects and nanomaterials up to single molecules.

Current state.

Currently the SSRS-4 project is at its initial stage of implementation. In 2015 the NRC “Kurchatov Institute” established a working group to develop conceptual solutions, including a series of research works to determine the configuration and key technical parameters of the installation.

At the moment NRC «Kurchatov Institute» together with ESRF and Budker Institute of Nuclear Physics are working together to prepare the preliminary design of the main machine scheme, diagnostics and control system, its RF system and insertion devices. In 2018 it is envisaged to start the project for development of injection complex based on linear accelerator.