



JINR has the unique Multifunctional Information and Computing Complex, being a key component of the JINR network and information-computing infrastructure and playing a defining role in scientific research, which entails modern computing power and storage systems. Another important activity is the provision of mathematical, algorithmic and software support for experimental and theoretical studies underway at JINR.

Mathematical Support of Studies Performed at JINR

The aim is to simulate physical processes, to create algorithms and software systems for processing and analyzing experimental data, to develop algorithms in the field of machine and deep learning, artificial intelligence and cognitive intelligent robotics, systems of quantum intelligent control, the development of methods of computer algebra and quantum computing, as well as Big Data analytics.

Expected results

1. Development of information and computing systems for data analysis and processing in the field of radiobiology.
2. Development of algorithms based on recurrent and convolutional neural networks for machine and deep learning, as well as Big Data analytics problems, created primarily to solve various tasks of particle physics experiments, including the NICA megaproject and neutrino experiments.
3. Creation of modern research tools for international collaborations (NICA, JINR neutrino programme, LHC experiments).
4. Development of new numerical and computing models, including quantum computing, for theoretical research at JINR.
5. Elaboration of algorithms for intelligent control of JINR experimental facilities based on the quantum approach.
6. Development of a system on the Big Data analytics platform for the analysis and protection of data of the JINR computer network in real time based on network traffic.
7. Development of machine learning and artificial intelligence algorithms to optimize the functioning and intelligent monitoring of distributed computing systems.
8. Creation of a new-generation analytical system based on effective methods and algorithms of formalization, knowledge extraction, and Big Data processing.
9. Development of intelligent information systems for research and applications.

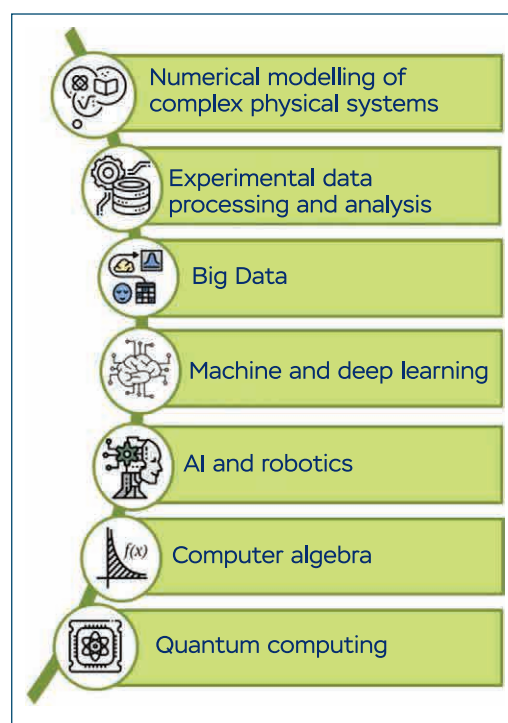


Fig. 33. Directions of development within the framework of mathematical support for research conducted at JINR

10. Development of quantum IT data processing technologies with access to NISQ (Noisy Intermediate-Scale Quantum) computers/quantum computers with reliable error protection.

11. Development of scalable algorithms and software for processing multiparameter, multidimensional, hierarchical datasets of exabyte volume.

JINR Digital Ecosystem

One of the uppermost tasks of the Seven-Year Plan is the creation of the JINR-wide digital platform “JINR Digital Ecosystem”. The main goal is the organization of a digital space with single access and data exchange between electronic systems, as well as the automation of actions that previously required a personal or written request. The platform should ensure the integration of existing and future services to support the Institute’s scientific, administrative and social activities, as well as the engineering and IT infrastructures.

The user will have the possibility of a single entry point for the JINR digital environment, through which access to a large-scale network of different services will be provided. The “Digital Ecosystem” interface will represent a “showcase” of digital services and resources with the ability to perform a certain set of actions (for example, account management) or switch to a fully functional version of the service. Examples of services are resources for users of basic facilities, library services, document servers, MICC computing resources, 1C administrative services (finance, personnel, electronic document management), etc.

Within the platform being created, registered users (with a JINR account, i.e., Single Sign-On, SSO) will be able to draw up and approve different documents in electronic form, to register and use scientific and administrative services without filling in paper forms and personally visiting the staff members responsible for them. A system of notifications from different services (for example, about documents that await signing) will be available in the personal account. The level of access to services will depend on the position of the staff member and his/her functional duties. A user-friendly interface allowing one to quickly update information will be organized for service administrators. Part of the resources will also be available to unregistered users: telephone directory, information on Dissertation Councils, scientific software, JINR map.

The JINR geoinformation system, including an interactive map, information on JINR buildings and other objects (plans of buildings, engineering and other networks, staff accommodation, ac-

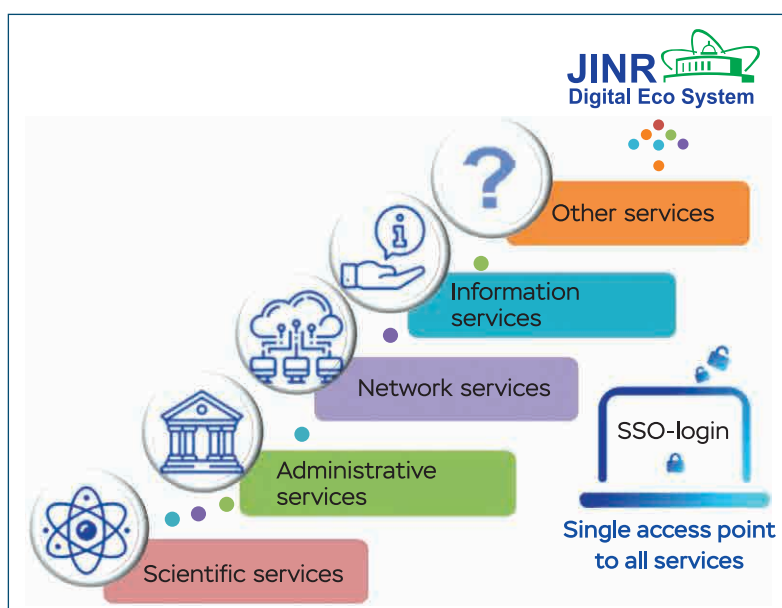


Fig. 34. JINR Digital Ecosystem

counting and analysis of the use of premises taking into account their class, type, and purpose), etc., will be developed within the digital platform. The geoinformation system will enable to perform a quick and convenient search for information on both JINR buildings and staff members. It is supposed to use the technology of mobile robots and quantum control elements to solve the tasks of premises' automatic explication (creating plans for buildings) and object localization on the map.

The platform should provide reliable and secure access to different types of data that arise in the course of the Institute's work, from open to confidential. A sample dataset from key services will be placed in storage for further joint analysis using Big Data and artificial intelligence technologies. The automated monitoring of performance indicators for both individual objects and the Institute as a whole will be possible on the basis of data such as information about staff members' publications, financial information, and the use of computing resources.

Expected results

Creation of the platform "JINR Digital Ecosystem".

Within the framework of the digitalization of JINR's administrative activities, the main task of the JINR specialized services is to create an Institute-wide information infrastructure for efficient operation of administrative and management processes. Information services aimed at the digital transformation of the Institute's administrative activities will be developed, and platforms will be created to unify digital services related to administrative processes. The key project in the medium term is the project on implementation of the integrated information system 1C:ERP. The created information infrastructure for administrative and management processes will be integrated into the digital platform "JINR Digital Ecosystem".