FOREWORD

The present issue of the Scientific Report of the Laboratory of Information Technologies (LIT) contains the most important results obtained during the 2008-2009 years within the direction of research *Networking, Computing, Computational Physics.*

The main tasks of the Laboratory of Information Technologies consist in the provision with modern telecommunication, network, and information resources, as well as mathematical support of theoretical and experimental studies conducted by the JINR, Member State institutes at JINR, and other scientific centers.

The LIT activity is focused on two directions, namely Ïnformation, Computer, and Network Support of the JINR's Activity" (topic 05-6-1048-2003/2010, headed by V.V. Ivanov, V.V. Korenkov, and P.V. Zrelov) and "Mathematical Support of Experimental and Theoretical Studies Conducted by JINR" (topic 05-6-1060-2005/2010, headed by V.V. Ivanov, Gh. Adam, and P.V. Zrelov). The Laboratory staff involves high-skilled scientists and engineering personnel, including 26 doctors of science and 57 candidates of science.

Experiments at the JINR future basic facilities, JINR participation in the LHC experiments, and in other large-scale projects asked for a substantial increase of its networking and information resources, as well as the deployment of a large volume of work toward the development of the JINR Grid-segment and its integration in the Russian Grid-infrastructure RDIG (Russian Data Intensive Grid) and the world-wide grid-infrastructure (WLCG/EGEE projects).

In 2009, a new telecommunication link between Dubna and Moscow on the basis of the state-of-the-art technologies DWDM and 10 Gb Ethernet, was put in operation with a capacity of 20 Gbps (two channels of 10 Gbps). In perspective, the mentioned technologies allow the creation of up to 80 channels of 10 Gbps each, resulting in a total capacity of up to 800 Gbps.

During the 2008-2009 years the CICC hardware has been expanded up to 960 job slots of the total performance of 2400 KSI2K and the disk subsystem - 500 TB structured as dCache storage system. In October, 2009 the transition to Scientific Linux 5 has been accomplished at the computing farm. At present, JINR site is one of the 10 best sites of the worldwide Grid infrastructure for LHC.

Following the decision of the JINR Committee of the Plenipotentiary Representatives, adopted at its March 14-15 2008 meeting concerning the radical improvement of the computer telecommunication links with major partner organizations in the JINR Member States during the years 2010-2015, first steps have been undertaken towards the development of a unified Grid-environment of the JINR Member States. Such an infrastructure will allow all the participating sides to effectively join their forces for solving the foreseen fundamental and applied projects in elementary particle physics, nuclear physics, condensed matter physics, computational biophysics, nanotechnologies, etc., the successful realization of which would be impossible without using highly

efficient computations, new approaches to distributed and parallel computing, and large amounts of data storage.

There can be distinguished three main levels within the JINR Grid-environment: network, resource and applied ones. The network level deals with high-speed backbones and telecommunication links; the resource level consists of highly-efficient computing clusters, and data storage systems joined in a unified Grid-environment with the help of basic software and middleware. The applied level encompasses sets of research topics the solutions of which have been adapted to the Grid-environment in the frame of corresponding virtual organizations.

The significant consequence of this circumstance is the possibility to get efficient implementations at the Grid-applied level. The applied level encompasses sets of research topics the solutions of which have been adapted to the Grid-environment in the frame of corresponding virtual organizations (VOs). Instances of VOs working within the WLCG project are the VOs on the LHC experiments: ATLAS, CMS, ALICE, LHCb, the first three being carried out with the noticeable and direct participation of the JINR. Nowadays, as a Grid-segment of the EGEE/RDIG, the JINR CICC supports computations of the virtual organizations registered in the Russian Data Intensive Grid (RDIG). Alongside with the four VOs related to the LHC experiments, the main users of the JINR Grid-segment are currently the virtual organizations BioMed,PHOTON, eEarth, Fusion, HONE, Panda. Within existing VOs, noticeable specific mathematical and algorithmic support by LIT staff is done in frame of ATLAS, CMS, ALICE, HONE.

In the future, as the interest arises at a large-scale level, conditions are ripe for the VOs organization at JINR in the fields of nuclear physics and condensed matter physics and, most probably, in the new promising direction related to the research of the nanostructures. The creation of new VOs gets possible and necessary under maturation of the algorithmic approaches to the problem solution, the development of corresponding mathematical methods and tools. The organization of VOs covers adequately large and very large scale projects asking the solution of a great number of small or medium size problems. However, a significant fraction of the JINR projects asks for the solution of either single large size numerical problems, or particular separate problems arising from various projects under development at JINR.

The Laboratory staff participated in research work done within 21 topics of the Topical plan for JINR research and international cooperation.

The main results have been published in leading scientific journals, proceedings of scientific conferences, JINR preprints and JINR communications.

The JINR Member States show a high interest in the LIT activities. The LIT cooperation with Romanian institutes is successfully done within the Hulubei-Meshcheryakov programme. Protocols of cooperation have been conducted with INRNE (Bulgaria), ArmeSFo (Armenia), FZK Karlsruhe GmbH (Germany), IHEPI TSU (Georgia), NC PHEP BSU (Belarus), KFTI NASU (Ukraine), Tashkent (Uzbekistan), Wroclav(Poland), University of Bucharest, IFIN-HH (Romania), etc. In frames of our research we have

BMBF grant, CERN-JINR Cooperation Agreement on several topics, JINR-South Africa cooperation agreement.

Some work also was progressing within participation in common projects: NATO project EAP.NIG 982956 "DREAMS-ASIA" (Development of gRid EnAbling technology in Medicine&Science for Central ASIA), CERN-INTAS projects, Worldwide LHC Computing Grid (WLCG), and Enabling Grids for E-sciencE (EGEEIII) project co-funded by the European Commission (under contract number INFSO-RI-222667) through the Seventh Framework Programme. Seven grants were afforded by the Russian Foundation for Basic Research and two Contracts with the Russian Federal Agency of Science and Innovations (FASI).

The work under SKIF-GRID project - a programme of the Belarusian-Russian Union State was continued. The promotion of this direction is part of joint propositions of the National Academy of Science of Belarus and the Federal Agency of Science and Innovations of the Russian Federation "The development and use of hard- and software in grid-technologies and advanced supercomputer systems SKIF in 2007-2010 (SKIF-GRID)". LIT participates in the Grid National Nanotechnology Network (GridNNN) project performed under the federal target programme on the development of the infrastructure of nanoindustry in the Russian Federation in 2008-2010.

The work within the project on the Grid infrastructure development for WLCG financed by the Federal Agency of Science and Innovations of the Russian Federation was in progress, too.

LIT was the organizer of the XV International Conference "Mathematics. Computer. Education", January 28 - February 2, 2008, 12-th International Workshop on Computer Algebra, May 14 - 16, 2008, III International Conference "Distributed computing and Grid technologies in science and education" (GRID'2008), June 30 - July 4, 2008, "Digital libraries: advanced methods and technologies, digital collections" (RCDL'2008), October 7 - 11, 2008, International Conference "Mathematical Modeling and Computational Physics" (MMCP'2009), July 7 - 11, 2009, XXII International Symposium "Nuclear Electronics and Computing" (NEC'2009), Varna, Bulgaria, September 7 - 14, 2009.

It is our hope that the results of the research work collected in this report will be useful to the scientific community of JINR and JINR Member States to throw new bridges for joint scientific collaborations in the years to come.