FOREWORD

The present Scientific Report of the Laboratory of Information Technologies (LIT) covers the most important results obtained during the 2012–2013 years within the JINR direction of research Networking, Computing, Computational Physics.

The LIT provides the Joint Institute for Nuclear Research (JINR) and the JINR Member States with modern telecommunication, network, informational and computing resources asked by the conducted theoretical and experimental research. The main efforts of the Laboratory are aimed at developing the information and computing infrastructure as a basic facility of JINR, serving all the Institute staff needs in the above mentioned activities. The Scientific Report is focused on three main directions.

The first one covers the current status of the JINR telecommunication channels, the high-speed local area network, the distributed computing infrastructure and mass storage resources, the information, algorithmic and software support of the research-and-production activity of JINR.

The second one deals with the grid-environment at JINR as well as its development during the last two years in connection with the JINR participation at LHC and other large scale projects.

Third, the most important results of LIT in the field of computational physics, such as new mathematical methods and tools for modeling processes in physics and for experimental data processing are presented.

The great diversity of the research problems in the JINR Laboratories and Institutes in the JINR Member States asking for LIT support entails the interdisciplinary character of the LIT activity.

Within the Topical Plan for JINR research and international cooperation, the LIT effort was done along two ways. First, there were two distinct LIT topics, namely "Information, Computer, and Network Support of the JINR's Activity" (topic 05-6-1048-2003/2013, headed by V.V. Ivanov, V.V. Korenkov, and P.V. Zrelov) and "Mathematical Support of Experimental and Theoretical Studies Conducted by JINR" (topic 05-6-1060-2005/2013, headed by V.V. Ivanov, Gh. Adam, and P.V. Zrelov). Second, the Laboratory staff brought specific contributions within other 25 topics of the JINR Topical Plan.

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 world-wide grid-infrastructure (WLCG/EGEE/EGI projects).

Of great importance for the development of both the JINR informational-computational infrastructure as a whole and its grid-segment is the collaboration with the NRC Kurchatov Institute on the design, in 2011-2013, of an automated system for the LHC data processing at the Tier1 level and provision of the grid-services for distributed data analysis. The work is carried out within the federal program Research and development on the priority directions of the development of the scientific - technological complex in Russia for 2007-2013. The general plan of this project comprises three basic stages for 2012-2014. A first stage foresees creation of a prototype at the foreseen level of 10% of the scheduled total capacity of the Tier1 center. To this aim, modules consisting of 1200 64-bit processors, 660 TB disk memory, and a 72 TB tape system have been purchased and installed.

During the 2012-2013 years the CICC hardware has been expanded to 2560 64-bit processors and a data storage system of 1800 TB total capacity (1104 processors and the disk subsystem of 1068 TB in 2010). The primary CICC network router is connected to the main JINR network router at a rate of 10 GB Ethernet.

A huge work was done at JINR on data handling and processing for the experiments ALICE, ATLAS and CMS. The CICC share within the Russian Data Intensive Grid (RDIG) consortium comprising besides JINR other 16 resource centers in institutes from Russia and JINR Member States is a lasting 33%. More than 11 million jobs were executed at JINR CICC during the years 2012-2013 for the LHC experiments. LIT successfully participated in two large-scale global grid-projects: "Worldwide LHC Computing Grid" (WLCG) and - "Integrated Sustainable Pan-European Infrastructure for Researchers in Europe" (EGI-InSPIRE) co-funded by the European Commission through the Seventh Framework Programme.

Grants were afforded by the Russian Foundation for Basic Research and contracts were concluded with the Ministry of education and science of the Russian Federation under the Federal Target Programmes (FTP) of Research and development in priority areas of scientific-technological complex of Russia for 2007 - 2013 years. In frames of FTP, LIT participates, in cooperation with SINP MSU, RSC "Kurchatov Institute" and PNPI, in the

Grid National Nanotechnology Network (GridNNN) project; in cooperation with RSC "Kurchatov Institute", in the project "Creation of the automated system of data processing for experiments at the Large Hadron Collider (LHC) of Tier1 level and maintenance of Grid-services for a distributed analysis of these data", and it was the main executor of the project "Model of a shared distributed system for acquisition, transfer and processing of very large-scale data volumes, based on Grid technologies, for the NICA accelerator complex".

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 FZK Karlsruhe GmbH (Germany), INRNE (Bulgaria), ArmeSFo (Armenia), IHEPI TSU (Georgia), NC PHEP BSU (Belarus), KFTI NASU (Ukraine), Tashkent (Uzbekistan), University of Bucharest, IFIN-HH (Romania), etc. This research was founded by BMBF grants, within the CERN-JINR Cooperation Agreement on several topics.

LIT was an organizer, alone or in cooperation, of nine international conferences: the XIX International Conference "Mathematics. Computer. Education", January 30 – February 4, 2012, the 3-rd JINR/CERN School of Information Technology GRID and Advanced Information Systems, May 14 – 18, 2012, the 15-th Workshop on Computer Algebra, June 2 – 3, 2012, the V International Conference "Distributed computing and Grid technologies in science and education" (GRID'2012), July 16 – 21, 2012, the International Conference-School for Young Researchers Modern Problems of Applied Mathematics & Computer Sciences, August 22 – 27, 2012, the 16-th Workshop on Computer Algebra, May 21 – 22, 2013, the 4th JINR/CERN School of Information Technology GRID and Advanced Information Systems, April 22 – 26, 2013, the International Conference "Mathematical Modeling and Computational Physics" (MMCP'2013),

July 8 – 12, 2013, the XXIV International Symposium "Nuclear Electronics and Computing" (NEC'2013), Varna, Bulgaria, September 9 – 16, 2013.

The Laboratory staff involves high-skilled scientists and engineering personnel, including 30 doctors of science and 59 candidates of science. The main results have been published in leading scientific journals, proceedings of scientific conferences, JINR preprints and JINR communications.

In 2013 JINR Prizes, awarded annually for the best scientific, technical, methodical, and applied research studies were sended to the following LIT employees:

- First Prize (Physics Instruments and Methods): JINR Grid Infrastructure as a Component f Russian and World-Wide Grid. Authors: N. Astakhov, S. Belov, A. Dolbilov, N. Gromova, V. Korenkov, N. Kutovskiy, V. Mitsyn, T. Strizh, E. Tikhonenko, V. Trofimov.

- First Prize (Theoretical Physics Research): Theory of Spin Fluctuations and High-Temperature Superconductivity in Cuprates. Authors: N. Plakida, S. Adam (LIT), Gh. Adam(LIT), A. Vladimirov, D. Ihle, V. Oudovenko.

- Second Prize (Applied Physics Research): Implementation of the Operation Mode of the AIC-144 Cyclotron (Poland) for the Proton Therapy of Eye Melanoma. Authors: K. Daniel, K. Gugula, J. Sulikowski, I. Amirhanov(LIT), G. Karamysheva, I. Kiyan, N. Morozov, E. Samsonov.

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.

The editors