

FOREWORD

The present Scientific Report of the Laboratory of Information Technologies (LIT) covers the most important results obtained during the 2010–2011 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 high-performance 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 and with the creation and implementation of a unified Grid-environment of the JINR Member States.

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.

Experiments at the JINR basic facilities, JINR participation in the LHC experiments and in other large-scale projects asked for a substantial increase of the networking and information resources together with 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 in the world-wide grid-infrastructure.

The fulfillment of these tasks needed:

- development of telecommunication channels of JINR with the JINR Member States on the basis of national and regional telecommunication networks;
- fault-tolerant operation and further development of the high-speed and protected local area network of JINR;

- development and maintenance of the distributed high-performance computing infrastructure and mass storage resources;
- information, algorithmic and software support of the research-and-production activity of JINR;
- development and reliable operation of the JINR grid-segment as a component of the global grid-infrastructure;
- new mathematical methods and tools for modeling physical processes and experimental data analysis;
- methods and numerical algorithms for modeling magnetic systems;
- software and computer complexes for experimental data processing;
- mathematical modeling, numerical algorithms and software for the simulation of complex physical systems;
- new methods, algorithms and software of computer algebra;
- new generation computing tools;
- development of applications covering topics in other branches of the science and technology (nanotechnology, biology, medicine, economy, industry, etc.).

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 24 topics of the JINR Topical Plan.

During 2010-2011, the CICC hardware has been expanded to 2064 job slots securing a total performance which exceeded 5000 KSI2K, while the disk subsystem reached about 1500 TB.

A huge work was done at JINR on data handling and processing for the experiments ALICE, ATLAS and CMS. The CPU time monitoring during 2010-2011 ranked the JINR grid-site on an excellent 10-11-th place among more than 160 Tier2 sites worldwide. Within the RDIG consortium, which comprises, besides the CICC JINR, fourteen Russian, two Ukrainian, and one Belorussian site, our cluster covered more than 40% of the

RDIG share. LIT successfully participated in two large-scale global grid-projects: “Worldwide LHC Computing Grid” (WLCG), “Enabling Grids for E-science” (EGEE) and its continuation - “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 development of the infrastructure of the nanoindustry in the Russian Federation in 2008-2010 and 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 process of cooperation on the development of grid-segments of the JINR Member States was continued. In addition to three Grid sites located at JINR and the grid-sites in the Institute of High Energy Physics (Protvino), the Institute of Mathematics and Information Technologies AS of Republic of Uzbekistan (Tashkent, Uzbekistan), the Sofia University “St. Kliment Ohridski” (Sofia, Bulgaria), the Bogolyubov Institute for Theoretical Physics (Kiev, Ukraine), the National Technical University of Ukraine “Kyiv Polytechnic Institute” (Kiev, Ukraine), the new grid site of L.N. Gumilyov Eurasian National University (Astana, Republic of Kazakhstan) was set up and integrated into the grid infrastructure in August 2011. The development of the Mongolian Grid-segment was discussed at the Nuclear Energy Agency of Mongolia, the Institute of Computer Science MAS, the National University of Mongolia and the Mongolian University of Science and Technology in September 2011. The first successful steps in this area were undertaken at the Institute of Computer Science MAS with active LIT support. An educational Grid-site was developed

as part of the educational-scientific infrastructure of the JINR Member States.

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, the JINR-South Africa cooperation agreement.

LIT was an organizer, alone or in cooperation, of six international conferences: the XVII International Conference “Mathematics. Computer. Education”, January 25-30, 2010, the 13-th International Workshop on Computer Algebra, May 24 – 25, 2010, the IV International Conference “Distributed computing and Grid technologies in science and education” (GRID’2010), 28 June - 3 July, 2010, the 14-th Workshop on Computer Algebra, June 2 – 3, 2011, the International Conference “Mathematical Modeling and Computational Physics” (MMCP’2011), July 4 – 8, 2011, Stará Lesná, Slovakia, the XXIII International Symposium “Nuclear Electronics and Computing” (NEC’2011), Varna, Bulgaria, September 12 – 19, 2011.

A scientific and historical memorial seminar dedicated to the 100th anniversary of the outstanding scientist, the founder of the Dubna synchrocyclotron, the organizer and the first director of the JINR Laboratory of Computing Techniques and Automation, the Prof. M.G. Meshcheryakov, was held on September 17, 2010. A second edition of the book about M.G. Meshcheryakov was published.

The Laboratory staff involves high-skilled scientists and engineering personnel, including 29 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.

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