

# INTRODUCTION

The year 2009 at the Joint Institute for Nuclear Research has crowned the completion of the preceding seven-year scientific programme of the Institute development and the summation of its results. A new seven-year plan for the development of JINR for 2010–2016 was adopted the same year, at a regular session of the Committee of Plenipotentiaries of the Governments of the JINR Member States which, for the first time in the history of JINR, was held in one of the JINR Member States — in the capital of Kazakhstan Astana. Its basic concept involves concentration of resources for the upgrading of the JINR «home» fleet of accelerators and reactors that will provide the integration of the Institute basic facilities into the common system of the European scientific infrastructure. The triad science–innovation–education is the steadfast foundation of our scientific policy.

There will be no exaggeration to say that the results achieved by the Institute community in 2009 are impressive, even without making any allowance for the global financial crisis and its impacts. These are just a few examples to confirm it.

In January 2009, the physical start-up of the new JINR basic facility IREN-I (a source of resonance neutrons) was carried out. Due to the improvement of characteristics of some parts of the facility, considerable progress was achieved in its project parameters at the end of the year.

In collaboration with the Oak-Ridge National Laboratory (USA), JINR scientists launched a unique experiment on the synthesis and study of the properties of element 117 in the  $^{249}\text{Bk} + ^{48}\text{Ca}$  reaction. The experiment continued all the year through; the results were processed and prepared for the publication.

The cryogenics of the Nuclotron accelerator complex was considerably upgraded; today the working rate of the upgraded cryogenic module, that is in fact a modern helium production plant, is sufficient to provide the future NICA collider operation. Two scheduled runs of the Nuclotron were successfully conducted for physics

experiments and complex tests of a number of topmost systems, to operate the accelerator complex Nuclotron-M/NICA in the future. One of the main tasks of the second run was to test the re-installed equipment in different modes of the accelerator operation. Experiments on optimization of the particle dynamics in the accelerator were conducted; the digital system of the accelerating field frequency control was launched.

The NICA/MPD project has been substantially supported by international experts — the participants of the fourth round-table discussion on the NICA Physics Programme, the European Committee on Future Accelerators (R-ECFA), and the Committee on JINR–CERN Cooperation.

The development of a high-speed Dubna–Moscow communication channel is one of the most important results of the year in the development of the network and IT system of the Institute infrastructure. The advanced technology applied provides unlimited scalability of the established channel. The grid-infrastructure of JINR was considerably upgraded: a large number of new computational nodes and disk servers were purchased and launched into operation for the data storage. At present, the JINR grid-site is in the first top-ten list of the world grid-infrastructure.

The upgrading work of the neutron pulsed reactor IBR-2M was conducted according to the schedule. The working project of the moderators' complex was fully accomplished; the unique design of the moderators will allow a 25-fold increase in the cold neutrons flux; a track of cooling helium was constructed; a full-scale model of the track was developed for the delivery of the moderating material into the moderator chamber.

Theorists of the Institute have formulated the method of the analytical solution of the Baxter equation for the twist operators 2 and 3 in the planar  $N = 4$  Yang–Mills supersymmetry theory. The analytical solution obtained with this method proves the correctness of the formula postulated before for the three-loop anomalous dimension of the twist operators 2. In this case,

the transcendent part of the corresponding three-loop anomalous dimension in QCD was determined from the studies of the supersymmetric gauge theory in four dimensions exclusively on the basis of the theory integrability.

Significant results in high-energy physics were obtained in the experiments conducted in leading accelerator centres where JINR scientists were involved in the research. A series of the NA48, NA48/1 and NA48/2 high-precision experiments was completed at SPS (CERN) which studied kaon decays at the limit of the achievable intensity of events. The NA48 experiment was inside the top-five brightest experiments at CERN conducted during the period of more than five decades of the centre history. JINR staff members made a considerable contribution into this research at all stages, including the preparation of experiments, the experiments themselves, data analysis and processing of final results.

In November 2009, the launching of the LHC at CERN was started again. A considerable contribution to the repair of the damaged superconducting magnets of the LHC and improvement of the system of valves for the emergency evacuation of liquid helium in contingency was made by a team of high-skilled engineers and technicians from JINR. With the LHC launched, the main experimental facilities — ATLAS, CMS and ALICE, started to operate. JINR physicists took part in the data accumulation to check the operation of all systems of these most sophisticated machines.

Among the important achievements of 2009 in the frames of the CDF collaboration are the observation of the  $\Omega_b$  baryon and the first observation of electroweak production of a single top-quark.

The project carried out by JINR specialists in collaboration with their Macedonian colleagues to develop and compile a geochemical Atlas of an ecologically troubled region of Macedonia was awarded the State Prize of the Government of the Republic of Macedonia for 2009.

The research by JINR radiobiologists was internationally acknowledged. It concerned studies of mechanisms of the mutagenic process in microorganisms induced by radiation with various physical characteristics. On the basis of experimental results, for the first time a model was worked out that described in the terms of genetic networks the mutagenic process in bacteria at the action of the ultraviolet radiation. The results of the studies were published in the *Journal of Theoretical Biology*.

It should be noted that in early 2009 the JINR Laboratory of Radiation Biology was granted the status of an institution under the scientific and methodical guidance of the Russian Academy of Sciences. Since then the Department of Biological Sciences of RAS has been supervising biological studies at JINR.

Two milestones of the year were connected with the development of the educational programme of JINR

and had promising prospects. They were different in character, though both of them were held in November and not in Dubna but in other places. Firstly, it was the First All-Russian School for physics teachers at CERN organized by JINR. Those JINR staff members who take part in CERN projects gave lectures at the School, while the attendants of the event were physics teachers from different regions of Russia. Secondly, in the frames of a visiting session of the JINR Committee of Plenipotentiaries, a quadruple agreement was signed in Astana (Kazakhstan) on the joint training of Bachelors and Masters in nuclear physics between the Joint Institute for Nuclear Research and the Gumilev Eurasian National University.

In 2009, students from Poland, the Czech Republic, Romania, Serbia, the Republic of South Africa and, for the first time, from the Arab Republic of Egypt took part in the international student practice in JINR research trends. Unanimously, this practice course was considered successful and fruitful, as more and more JINR Member States become interested in it.

The year 2009 was marked by the centenary of the birth of Academician Nikolai Nikolaevich Bogoliubov — an outstanding scientist, mathematician, physicist, specialist in mechanics. The International Bogoliubov Conference «Problems of Theoretical and Mathematical Physics» held in Moscow and Dubna, and later in Kiev (Ukraine) was one of the central events of the jubilee year. In the year of the centenary of the birth of the outstanding scientist Metropolitan Juvenal of Krutitsy and Kolomna visited Dubna, to consecrate the church of Holy Mother Praise in Ratmino which was given back to Christians in the late 1980s due to the support and help rendered by N. N. Bogoliubov.

Centenary jubilees of the birth of the first JINR Vice-Directors Academicians Marian Danysz (Poland) and Václav Votruba (Czechoslovakia) were also celebrated in 2009. These scientists took an active part in the establishment of JINR as a large international scientific research centre.

The activities of the Institute in widening international cooperation were aimed at further development of partnership programmes with Member States and other countries. In 2009, these efforts brought convincing results: an Agreement was concluded on the governmental level on cooperation with the Arab Republic of Egypt; a Protocol was signed with the Republic of Hungary on the promotion of joint fundamental and applied research at JINR; a Protocol was signed on the promotion of joint activities in the frames of the Agreement on cooperation between the Republic of Serbia and JINR; the Agreement between JINR and the Federal Ministry of Education and Scientific Research of Germany was prolonged up to the end of 2011.

On the whole, it is possible to say that a new phase of JINR cooperation with scientific centres of its Member States started, where along with fundamental studies

and the educational programme innovation development plays a considerable role. The following events demonstrated a growing interest in this sphere: the Days of the Moldavian science held in May 2009 at JINR, the November meeting of the working group on the work-out of the project of the Inter-state target programme of innovative cooperation among CIS countries for the period up to 2020; the Italy–Russia round-table discussion «Efforts in Fundamental Research and Prospects for Scientific-Technological Applications and Development of Business» held in December 2009.

To achieve success in the innovation process in CIS countries it is necessary to develop large projects, like the one to establish an International Innovation Centre for Nanotechnology (IICNT) of CIS countries that is implemented by JINR jointly with the Russian Research Centre «Kurchatov Institute» and the International Association of Academies of Sciences (IAAS). The phase of the formal organization of IICNT was concluded in 2009: normative documents of the Centre were worked out, agreed upon and adopted. In March 2009, a ceremonial opening of the site of CJSC «NANO KASKAD» as the first element of IICNT in the right-bank part of the «Dubna» SEZ took place, during the visit of the General Director of the Russian Corporation of Nanotechnology «Rosnano» A.Chubais to Dubna. In July, Assistant to the RF President D.Pollyeva took part in the forum «Establishment of the International Innovation Centre for Nanotechnology (IICNT) of CIS Countries».



Another important event of 2009 concerns the development of the state programme «The Centre of Fundamental Research and Innovation Development on the Basis of the Accelerator Complex NICA of the Joint Institute for Nuclear Research». First Deputy Chairman of the RF Federation Council A.Torshin, who visited JINR in November, informed JINR authorities about the decision of the Parliamentary Assembly of the Union State Russia–Belarus to adopt the programme which is aimed at the large-scale involvement of Russian and Belorussian institutions for its efficient and speedy accomplishment. In early December 2009, RF Minister of Economic Development Eh.Nabiullina visited Dubna and expressed her support of the strategic programme of JINR development.

The 2009 year in review shows the role of JINR in the integration of science and education and the establishment of the common innovation space of its Member States. Serious efforts were taken in the development and upgrading of the Institute basic facilities, their introduction into the European scientific infrastructure, and in the elaboration of educational and innovation programmes. The concept of the strategic plan for the JINR development in the next seven-year period was adopted. It is aimed at the strengthening of the JINR position as one of the leading scientific research centres in the world and at the increasing of its attractiveness for the Member States and other partners. We are confident today that we will achieve success if, as a wise saying reads, we try not to catch up with others but get ahead of ourselves!

A. Sissakian  
Director  
Joint Institute for Nuclear Research