INTRODUCTION

In the year 2004, the activities of the Joint Institute for Nuclear Research were marked with most important scientific achievements in fundamental research, high technology instrumentation and organization of educational activities. The scientific 7-year programme of the Institute was successfully implemented. In accordance with the plans, experimental research was conducted at the JINR basic facilities, the installations were modernized and new experimental set-ups were developed.

Theoretical studies of urgent issues of modern mathematical physics, particle physics, nuclear physics, condensed matter physics, computer physics and mathematics were conducted in closer cooperation with experimental groups from JINR and centres which are its scientific partners. Among many interesting results I would like to mention hard electroproduction of exotic hybrid quark–gluon mesons. It was shown that in the case of their longitudinal polarization this process receives the contribution from the leading twist amplitude due to the gluons from the string produced by the nonlocal quark–anti-quark source. The corresponding cross section is only one order of magnitude smaller than the dominant cross section of p-meson production, opening a possibility of studying hybrids at COMPASS, HERMES and CLAS.

The production cross section for the heaviest nuclei $Z = 108-118$ in the ^{48}Ca-induced hot fusion-evaporation reactions was shown to depend on ratio of the neutron and proton numbers in the actinide target. It was demonstrated that the most neutron-rich targets available for the experiment lead to smaller cross sections. New optimal reactions for the synthesis of superheavy nuclei were suggested.

Seventeen isotopes of new chemical elements with atomic numbers from 112 to 118 were synthesized in the experiments on the synthesis of superheavy elements in the last five years. Due to considerable improvements in the accelerator equipment and experimental methods, dozens of events of new superheavy nuclei decay were observed. One of the important results of the past-year research into physical and chemical properties of superheavy elements and the identification of their atomic mass was the chemical identification of dubnium (Db) as the final product of the α-decay chain of element 115.

A record beam intensity was achieved in the first experiments on the radioactive ^{6}He beams obtained at the DRIBs accelerator complex in the framework of the realization of the first part of the project (light radioactive ion beams).

The experimental study of the μ-catalysis process in a deuterium/tritium mixture, initiated by the Dubna scientists, was conducted at the JINR Phasotron with a unique high-pressure tritium target developed in Sarov at the All-Russian Scientific Research Institute of Experimental Physics.

The first result of the measurement of the azimuthal asymmetry in processes of the deep-inelastic scattering of longitudinally polarized leptons on transversely polarized protons was obtained in the HERMES collaboration. The result is a direct indication of the existence of the orbital angular momentum of quarks.

The problem of the violation of the Cabibbo–Kobayashi–Maskawa unitarity matrix is concluded: the results presented by the NA48/2 collaboration (JINR–CERN) of the precision measurement of the relative probability of the $K^{\pm} \to \pi^{0}e^{\pm}\nu$ decay are in good agreement with the predictions of the Standard Model and the latest results of the E865 (BNL, the USA) experiment.

The year of 2004 was the start of a new experimental set-up — the low-energy positron storage facility LEPTA. Its development was successfully commissioned by the Institute specialists. The capture of the injected electron beam was implemented and its stable circulation in the storage ring was obtained.

The mounting of the third movable reflector was commissioned at the IBR-2 reactor. The start of the schedule work of the modernized IBR-2 reactor for physics experiments at a peak power of 1.5 MW was a most important and promising event for scientists who

conduct research in condensed matter physics and life sciences. Physicists from 25 countries perform about 140 experiments at the IBR-2 reactor annually.

A new internal target station was constructed and tested in 2004 at JINR with the active participation of specialists from the Prague vacuum plant and the Physics Institute of the Slovak Academy of Sciences (Bratislava). It was installed inside the vacuum chamber of the Nuclotron. The research for the project «Med-Nuclotron» successfully goes in progress due to the 500 $A \cdot$ MeV beam of multicharged carbon also obtained at the Nuclotron. It opens up new opportunities primarily in hadron therapy with this accelerator.

The activities for mounting the new electron linear accelerator LAE-200 were continued in the IREN pavilion. Also, its first part was being assembled. The fuel for the multiplying IREN target was delivered to the special storage at JINR.

The long-standing and fruitful cooperation between JINR and CERN resulted in the successful implementation of the responsibilities taken by JINR to develop such detectors as ATLAS, CMS, ALICE and the participation of the Institute's specialists in physics programmes for LHC.

Discussing the involvement of the Dubna scientists in the LHC project, one should mention the considerable progress achieved in 2004. The big dipole magnet for the ALICE detector was tested successfully in October 2004. It was produced at the Savelovo machinery plant to an order from JINR. In December, the unique assembling of the hadron tile-calorimeter for ATLAS was completed in the LHC experimental hall, about 100 m underground.

Active work was conducted in developing the JINR GRID segment and incorporating it into the global GRID structure. In 2004, a one-mode optofiber cable was built in and the organizing of the JINR Gigabit Ethernet with 1 Gbit/s rate was completed.

Specialists of the Division of Radiation and Radiobiological Research worked out and successfully applied a new effective molecular dynamic method to analyze mutagenic processes in live cells. The genetic impact of radiation with different physical characteristics on human and mammalian cells was studied.

One of the aims of the JINR educational programme is training specialists from JINR Member States. For the first time an international practicum on physics for students and postgraduates was held at the University Centre of JINR in the summer of 2004. Its participants were 36 students from Poland, Russia, Slovak Republic, Czech Republic, Ukraine and Bulgaria. Students' summer practicum on JINR scientific trends will be held annually. The educational programme «Dubna International School in Modern Theoretical Physics», which started in 2003, was successfully implemented.

More than 50 conferences, seminars, schools and other meetings were organized by JINR and in collaboration with other research centres. They were held in Dubna, as well as in other cities of Russia, Armenia, Belarus, Czech Republic, Poland, Slovakia, Spain.

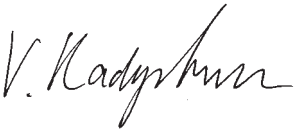
The International Symposium on Exotic Nuclei (EXON) can be rightly called a prestigious forum in the world scientific community. In the summer of 2004 it was held in Peterhof, a most beautiful place in Russia, and was dedicated to the production and study of the properties of nuclei far from the stability border. Besides JINR, its organizers were leading scientific centres such as RIKEN (Japan), GANIL (France) and GSI (Germany).

In September 2004 the international conference dedicated to the 95th anniversary of N. Bogoliubov was held at the Steklov Institute of Mathematics in Moscow and at JINR in Dubna. The conference was organized by JINR and the Russian Academy of Sciences under the support of RFBR and UNESCO (Regional Bureau of Science in Europe). Scientists from more than 20 countries took part in it.

In 2004 in Budapest a seminar was held which was devoted to the cooperation in the framework of the agreement between the Joint Institute for Nuclear Research and the Hungarian Academy of Sciences for 2001–2004. The representatives of the Hungarian Academy of Sciences valued highly the status of the joint projects implemented at JINR due to the bilateral agreement and expressed their support of widening further scientific contacts.

A remarkable event of the year 2004 was the meeting of outstanding scientists of France and JINR in Dubna. The official title of the event was the scientific seminar dedicated to 30 years of cooperation between the Joint Institute for Nuclear Research and the National Institute for Nuclear Physics and Particle Physics of France (IN2P3). The results of the joint work of scientists in collaborations were discussed and plans for the future were made. The JINR–IN2P3 cooperation plays an exceptionally important and positive part in modern particle physics and nuclear physics.

The Joint Institute will celebrate its 50th anniversary in 2006. JINR approaches its jubilee as a large scientific centre of world importance where first class research is conducted in urgent fields of modern physics. Applied research and science-intensive technology are also developing here, successfully establishing a high innovative potential of the Institute. To crown it all, JINR provides a high international level of education for young scientists in training programmes.



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