INTRODUCTION

The year 2008 is a milestone in the implementation of the seven-year plan of 2003–2009. During these years the Institute changed the policy of surviving to the strategy of securing and development of its scientific priorities in present-day conditions. Fundamental science, educational activities and innovations are still the basis of the development. The key stress today is made on the upgrading of the existing facilities, the development of new basic installations at JINR, and on «home» experiments, planning at the same time the involvement in large international partnership programmes with CERN (Switzerland), GSI (Germany), FNAL and BNL (USA), and other scientific centres. The programmes where JINR specialists play remarkable role are also the issues of our support and attention.

2008 finished with launching of the first stage of the resonance neutron source — the IREN-I facility. Upgrading of the IBR-2 reactor follows the approved schedule. Experiments on the synthesis of element 117 of the Mendeleev periodic table are well under way. The Nuclotron-M is successfully upgraded; it is to become the basis for the superconducting collider NICA. The DRIBs-II complex for heavy ions is being established. The urgent task that faces the Institute community to increase the attractiveness of the research at home facilities for both the world scientific community and specialists from Member States, primarily for young scientists, is being settled.

The following interesting results of 2008 are worth mentioning:

• in the framework of the NA48/2 experiment (CERN–JINR, SPS), the $K_{3\pi}$ and Ke_4 decays were analyzed on the basis of the 2003–2004 data significantly contributed by the JINR staff members. Values a_0 and a_2 were extracted for the length of S-wave of $\pi\pi$ scattering with isotopic spin of 0 and 2 within the experimental error of several percent, which exceeds three times the results of the previous measurements and gives an opportunity to carry out a precision checking of the Chiral Perturbative Theory predictions. This result was considered at CERN as one of the most significant in 2008;

• JINR physicists, together with their American colleagues, performed in 2008 physics analysis of the D0 experiment at the Tevatron which led to the first observation of the Ω_b baryon. This discovery has been ranked among the ten most significant achievements in physics in 2008 by the American Physics Society;

• significant success was achieved in the experiments on the studies of chemical properties of the superheavy elements with $Z = 112$ and 114 conducted under the leadership of RAS Academician Yu. Oganessian and Professor S. Dmitriev. The obtained data show that element 112 is similar to its lighter analogue — mercury, while element 114 demonstrates deviation from the tendency of group IVa and forms with the gold surface a weak physical adsorption connection like heavy noble gases. This observation is the first indication of the influence of relativistic effects on the properties of the heaviest elements of the Mendeleev periodic table;

• a grid method was developed for the study of multichannel scattering of atoms in a waveguide with harmonic confinement. This method was employed to analyze the transverse excitations and deexcitations, as well as resonant scattering processes. Collisions of identical bosonic, fermionic and distinguishable atoms in harmonic traps with a single frequency allowing the centre-of-mass separation were explored. In the zero-energy limit and single mode regime, the known confinement-induced resonances for bosonic, fermionic and heteronuclear collisions were reproduced quite well. Furthermore, a series of Feshbach resonances was identified and analyzed. The dual confinement-induced resonances leading to a complete quantum suppression of atomic scattering were revealed in multichannel scattering processes. Possible applications include atom–atom collisions in atomic waveguides and electron-impurity scattering in quantum wires;

• the $\mathrm{O}(\alpha)$ and $\mathrm{O}(\alpha^3 \ln(\alpha))$ corrections to the total decay width of orthopositronium were obtained in a closed analytic form, in terms of basic transcendental numbers which can be evaluated numerically to arbitrary precision. The results reproduce the best numerical evaluations within their accuracy. Orthopositronium

is the system suitable for precision tests of the validity of electrodynamics; it plays an important role in atomic and particle physics. The results of this work are of fundamental importance;

• JINR specialists took an active part in the test launch of the LHC accelerator complex (CERN) and the facilities ATLAS, CMS and ALICE. In particular, the commissioning of the transverse oscillation damping system for the LHC was successfully performed. Despite the accident, the equipment assembled by JINR engineers and physicists not only successfully worked during a short beam run in the collider but also managed to register the few events that occurred in elementary particle interactions;

• measurements of the ultracold neutrons (UCN) «low heating» on the samples of copper, Teflon and diamond-like carbon were conducted on the neutron beam at the ILL reactor (France). Heated neutrons' spectra were measured at energies from UCN to the heating ones, as well as the time evolution of the UCN spectra in the trap. A method of «calibrated absorbers» was worked out to measure the neutron spectra. Monocrystal silicon plates and rhodium foils were used as absorbers. Neutron spectra were determined from the absorption curves in the monoenergy and more detailed approximations. It was discovered that different materials produce different spectra of heated neutrons and the heated neutrons' spectrum reaches the mkeV energy region;

• in the framework of the JINR–GSI (Germany) cooperation, the first full-scale dipole and quadrupole magnets of the nuclotron type were constructed for the fast cycling superconducting synchrotron of the FAIR accelerator complex. This task was accomplished as part of the FP6 programme with the financial support of the European Union;

• within the framework of the Helmholtz Association (Germany)–RFBR cooperation, experiments were continued to study lower concentrated magnetic fluids stabilized with saturated carboxyl acids of different length, including lemon acid, oleic acid, myristic and lauric acids. The structure analysis that included magnetization studies, experiments on transmission electron microscopy and small-angle neutron scattering showed that part of magnetite nanoparticles in the studied systems forms stable aggregates with the mean dimensions up to 40 nm. It is shown that the preferable source of magnetic nanoparticles is the magnetic fluid stabilized with lauric acid. Among its structure peculiarities is the lowest aggregation that is responsible for better penetration of magnetic nanoparticles into cells and might be the reason for the lowest toxicity for cells;

• issues of computer biosensor nanotechnology related to the biosensor construction were studied. The electrostatic properties of quite a few enzymes and nucleic acids were calculated. The obtained results reveal a number of patterns in interaction of enzymes with charged nanostructure and can be directly applied in the process of biosensor design provided that software for data systematization and processing is developed on immobilized proteins in the form of the corresponding database and an expert system. The worked-out software can be the first step on the way towards implementing computer nanotechnology for designing biosensor with predetermined properties;

• modifying effect was studied on the induction and repair of DNA double-strand breaks in human lymphocytes under the action of gamma quanta of DNA repair inhibitors — cytosine arabinoside and hydroxyurea. It was found that under the influence of the inhibitors the number of DNA double-strand breaks increases;

• the amount of the JINR CICC contribution to the solution of tasks within the Russian grid for high-rate operations with data was 40% in 2008 (the Russian grid overlaps JINR grid-segment and 15 resource centres in Russian institutes). Regretfully, the Dubna–Moscow information channel capacity was not increased to 20 Gbit, and this work was shifted to the start of 2009.

There were several achievements in the educational activities of JINR: the UC physics training course was delivered «ready-to-operate»; a partner programme with CERN was started to improve qualifications of physics school teachers in Europe — Russian school teachers also take part in this programme.

On the whole, the most urgent task today is active participation of the Institute in European scientific programmes. Dubna should become an integral part of the EU infrastructure and plans for scientific research. Russia and other JINR Member States hold this opinion. Meetings and forums held in 2008 (one of the latest examples is the organization of JINR Days in Hungary) proved once again this steady tendency.

The Directorate of the Institute closely worked in innovation activities with the RosSEZ administration, the Dubna SEZ technical-innovation management, the city and the region governing bodies. Definite results were achieved in the development of the right-bank part of the city one of whose central segments will be a multi-access centre of nanotechnologies. This example of the direct application of scientific and technical elaborations of JINR in the market economy was appraised at the summit of the leaders of scientific agencies in Bishkek (Kirghizia), at the International Association of CIS Academies of Sciences in Kiev (Ukraine).

Among the significant events of 2008 is the visit of RF President D. Medvedev to JINR, when he clearly stated the significance of fundamental science as the basis of the innovative economy; the necessity to support the «sowing phase» of elaborations (from a scientific idea to the product) on the level of development institutions (SEZ, venture funds, state corporations, etc.); fundamental urgency to attract youth to science and adjustment of education to the innovation system. Another remarkable event of 2008 – the early 2009 was the signing of several partnership Agreements: with the

Government of Moscow Region, Rosatom corporation, RRC «Kurchatov Institute», and others.

In 2008 JINR celebrated a whole package of centenary anniversaries of the birth of the Institute founders: D. Blokhintsev (Russia), Ş. Ţiţeica (Romania), E. Djakov (Bulgaria), M. Markov, and I. Frank (Russia). The year 2009 will mark in Dubna the centenary jubilee of the most outstanding scientist, mathematician, specialist in mechanics and physicist Academician N. Bogoliubov. In December 2008 the Decrees were issued by Russian and Ukrainian Presidents on the celebration of this remarkable event.

The year 2009 is the last year of the current seven-year programme. The elaboration of a new seven-year programme has already been started. Fundamental science, as before, will be the major component of the science–innovation–education cluster. It is no doubt that the development of fundamental trends of research will be accompanied by the progress in theoretical disciplines, computer and network research, development of new methods for designing equipment and staff training.

Today Dubna is the initiator of the development of new large-scale multifaceted projects. Despite the world financial crisis, it will allow us to be at the forefront of the world science because, as our outstanding contemporary Academician B. Paton said, «Science will overcome everything, and the financial crisis as well».

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