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**THE JINR EDUCATIONAL PROGRAMME
IN 2004**

Report to the 97th Session
of the JINR Scientific Council
January 20–21, 2005

Dubna 2004

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Объединенный институт
ядерных исследований
БИБЛИОТЕКА

In 2004, the JINR University Centre (the UC) continued to work within the framework of the first-priority topic "Organization, Maintenance and Development of the University-Type Educational Process at JINR." The main aims of the topic were in 2004 the following:

- Support and development of the study process at the UC.
- Organization and conduction of international schools for students and postgraduates.
- Organization and conduction of specialized practice for students from higher education institutions of JINR Member States.
- Development of cooperation with international Funds (DAAD, EMSPS, etc.) for organizing student and postgraduate exchanges between the UC and research centres regulated by special agreements.
- Development of the specialized training of highly skilled specialists for JINR Member States. Organization of bilateral supervision of postgraduates by scientists of JINR and its Member States.
- Establishment of a modern PC-farm for studying Grid technologies.

JINR's educational activities are coordinated by the UC Scientific Council under the chairmanship of the JINR Vice-Director Prof. A.N. Sissakian.

The Programme of JINR's Educational Activity Development for 2003 – 2009, which was worked out in 2002, got further elaboration. It is based upon the concept of continuous education. The education system aimed at turning out highly skilled young specialists begins with attracting secondary school students to the studies on the basis of a special laboratory practicum.

Graduate students of Moscow Engineering Physics Institute (MEPI), Moscow Institute of Physics and Technology (MIPT), and a number of higher education institutions in Russia and JINR Member States attend at the UC full-time programmes during the

final two or three years of their studies. Their curricula are prepared jointly with their home departments and expanded to reflect the following fields of research carried out at JINR Laboratories: nuclear physics, elementary particle physics, condensed matter physics, theoretical physics, technical physics, and radiobiology.

Table 1 shows the distribution of the UC students over their home institutions as of 2004.

Table 1

Higher education institution	Number of its students at the UC in 2004
Moscow State University (MSU)	27
Moscow Engineering Physics Institute (MEPhI)	9
Moscow Institute of Physics and Technology (MIPT)	24
Institutions of other JINR Member States (Armenia, Belarus, Russia, Ukraine)	29
Total	89

Also on the basis of the UC, 155 students of Moscow Institute of Radiotechnology, Electronics, and Automation (MIREA) attend full-time programmes at the Department of the Electronics of Physics Installations and Department of Information Technologies for Computation Systems.

The courses offered at the UC include Elementary Particle Physics, Relativistic Nuclear Physics, Theory of Fundamental Interactions, Theory of Nuclear Reactions, Atomic Nucleus Structure, Introduction to the Theory of Accelerators, Experimental Nuclear Physics, Standard Model, Modern Methods of Detecting Nuclear Reactions and Nuclear Radiation, Programmable Logical Units, Fundamentals of Radio Engineering, Digital Units and Their Applications, Electronic Methods of Detecting Ionizing Radiation, Radiation Safety and Environment Protection, Mathematical Statistics, Object-Oriented Programming in C++, Computing in High Energy Physics, Internet Technologies, Database Management Systems, Telecommunication Systems and World

Information Resources, English for Students, and English for Postgraduates.

Within semesters, the UC offers short lecture courses on modern achievements in physics and related areas to its students and postgraduates. These courses form the lecture cycle "Modern Problems of Natural Sciences." In 2004, the following lectures were given within this cycle:

- F. Dydak (CERN), "Neutrino Oscillations: Status and Prospects";
- D. Blaschke (Rostock University and Bogoliubov Laboratory of Theoretical Physics, JINR), "Contemporary Problems in the Quantum Field Theory of Dense Nuclear/Quark Matter"

The list of the UC's publications for its students and postgraduates extended to include the following textbook:

- D.I. Kazakov (JINR), "Supersymmetric Generalization of the Standard Model of Fundamental Interactions", YHIJ-2004-23.

Noted should be the active participation of JINR's scientists in the educational process. In 2004, the UC's faculty numbered 21.

The JINR Educational Programme is realized and developed in close cooperation with Russia's leading higher education institutions. The UC has agreements on cooperation in education with a number of higher education institutions of Russia and JINR Member States, including MEPhI; MIPT; Moscow Power Engineering Institute; MIREA; A.D. Sakharov State Ecological University in Minsk (Belarus); Belgorod State University; Lipetsk State Technical University; Tula State University; P.O. Sukhoi State Technical University in Gomel (Belarus); Belarus State University; T.G. Shevchenko National University in Kiev (Ukraine); Yerevan State University (Armenia); Sofia University (Bulgaria); N. Rilsky State South-Western University (Blagoyevgrad, Bulgaria); International Postgraduate Studies at the Institute of Nuclear Physics (Krakow, Poland); and the Czech Technical University in Prague (the Czech Republic).

On the basis of the UC, JINR offers postgraduate programmes in the following ten specialties in physics and mathematics:

- 01.04.16 – Nuclear and Elementary Particle Physics;
- 01.04.02 – Theoretical Physics;
- 01.01.20 – Charged Particle Beam Physics and Accelerator Techniques;
- 01.01.07 – Computational Mathematics;
- 01.04.07 – Solid State Physics;
- 01.04.01 – Physics Experiment Techniques, Instrument Physics, and Physics Research Automation;
- 05.13.11 – Mathematical Support of Computers, Computational Complexes, and Networks;
- 05.13.18 – Mathematical Modelling, Numerical Methods, and Software Complexes;
- 01.04.23 – High Energy Physics;
- 03.00.01 – Radiobiology.

In 2004, JINR total postgraduate enrolment was 69. Table 2 shows the distribution of the postgraduates over the JINR Laboratories.

Table 2

	Number of postgraduates, 2004
Bogoliubov Laboratory of Theoretical Physics	19
Dzhelepov Laboratory of Nuclear Problems	13
Flerov Laboratory of Nuclear Reactions	6
Veksler and Baldin Laboratory of High Energies	11
Frank Laboratory of Neutron Physics	6
Laboratory of Particle Physics	4
University Centre	2
Laboratory of Information Technologies	7
Department of Radiation and Radiobiological Research	1
Total	69

The distribution of the postgraduates over the specialties is shown in Table 3.

Table 3

Specialty	Number of postgraduates, 2004
Nuclear and Elementary Particle Physics	29
Theoretical Physics	10
Charged Particle Beam Physics and Accelerator Techniques	1
Solid State Physics	3
Physics Experiment Techniques, Instrument Physics, and Physics Research Automation	10
Mathematical Support of Computers, Computational Complexes, and Networks	2
Mathematical Modelling, Numerical Methods, and Software Complexes	5
High Energy Physics	1
Radiobiology	1

Up to now, 150 people have completed the JINR postgraduate programmes. The UC postgraduates are active in scientific research and report their work to seminars and conferences at JINR and other research institutes in Russia and JINR Member States. 20 of those who completed UC postgraduate programmes defended their Candidate's theses.

On 7 June, the UC hosted the seminar "Modern Physics Paradigm: Relation between Physics, Metaphysics, and Mathematics". It was held to continue and extend a course of philosophy given to the UC postgraduates, but attracted JINR's scientists. As lecturers, invited were Professors and Associate Professors of MSU; some of the postgraduates tried their skills presenting complementary reports. The seminar went off lively; all its participants actively discussed the presented reports and asked many questions. In the general discussion, the speakers were leading scientists of the Laboratory of Theoretical Physics and other Laboratories. Summing up the seminar, all the speakers,

especially those of MSU, stressed the importance and necessity of holding such seminars.

Keeping in line with JINR's international character, the UC actively develops its international cooperation. Especially busy are the UC's relations with universities of Belarus, Bulgaria, the Czech Republic, Poland, Romania, Russia, Slovakia, and Ukraine. On the basis of the UC, institutes and universities of JINR Member States unite their efforts in education activities. In 2004, JINR was visited by 72 students from Poland, 14 students from the Czech Republic, 9 secondary school students from Germany, 12 secondary school students from Poland, 5 students from Slovakia, 10 students from Romania, and 6 students from Bulgaria. Besides coming for acquaintance visits to the JINR Laboratories, the students attended the physics practicum and participated in research carried out at JINR.

One of the UC's missions is the organization and conduction of international scientific schools and training courses. For students and postgraduates from both the UC and JINR Member States, schools, which have now become regular, proved to be very useful. Those are the Schools in Memory of B. Pontecorvo and International Student School on Nuclear Physics Methods and Accelerators in Biology and Medicine.

In 2004, for the first time in its history, the UC hosted a Summer Student Practice in JINR Fields of Research, which was organized jointly with the Czech Technical University in Prague, Adam Mickiewicz University (Poznan, Poland), and MEPHI.

The Practice was attended by 36 students, who came from Bulgaria (4), Czech Republic (9), Poland (11), Romania (4), Russia (2), Slovakia (4), and Ukraine (2). They were selected on a competitive basis.

The main aim that the International Practice organizers set before themselves was active involvement of students in the work of experimental and theoretical research teams at JINR's facilities. Therefore, the Practice was arranged in such a way that in the morning they attended lectures, and in the afternoon they worked with research teams at JINR's Laboratories.

On the day of the Practice opening, the students got acquainted with their supervisors; then began their daily work at the Laboratories, where they were to be absorbed in real research – that is, to immediately participate in the fulfilment of specific scientific tasks under the supervision by JINR's leading specialists.

Thus, at the Laboratory of Neutron Physics students were broken up in twos and threes and were assigned to the following fields: the study of n-e interaction, methodology of correlation gamma-spectroscopy, study of moderated neutrons, fission physics in the experiments at the IBR-2 reactor, study of ultra-cold neutrons, and neutron activation analysis at IBR-2.

At the Laboratory of Nuclear Problems, students worked with a group concerned with thermal multifragmentation at the 4 π -facility FAZA placed at a nuclotron beam, and studied scintillation spectrometry of different kinds of nuclear radiation.

At the Laboratory of Nuclear Reactions, the Practice participants worked with groups performing laser spectroscopy research, studying nuclear reaction mechanism, and carrying out experiments to study exotic nuclei at the AKULINA high-resolution channel and heavy element properties at the VASILISA separator.

The lecture programme of this year's Practice matched the mentioned range of the laboratory fields. To lecture, invited were leading specialists of JINR and its Member States. The lectures were mainly concerned with the physics of low and intermediate energies. Two lectures focused on modern information technologies. The students learned about the Grid technologies and their use in various areas of knowledge – in particular, considered was the establishment of the Grid-infrastructure at JINR and its Member States for processing results of experiments performed at the LHC. The leading scientists were responsible for providing the Practice at the JINR Laboratories and selecting the immediate supervisors of the students.

During the last ten days of the Practice, its participants, as envisaged by the Practice programme, attended the International Student School on Selected Issues of Theoretical Nuclear Physics,

which was held on July 20 – 29 at the Laboratory of Theoretical Physics and dealt with the results of the latest research into nuclear structure and nuclear reactions, theoretical methods, and their use in astrophysics and mesoscopic systems. As lecturers, besides the JINR's leading specialists, invited were prominent scientists of the Czech Republic, Germany, Russia, and Ukraine. The School programme included the following topics: nuclear excitations at different energies, nuclear structure and nuclear reactions at the stability border, astrophysical aspects of nuclear structure, double beta-decay and the neutrino mass problem, and hypernuclei. Much attention was also paid to the study of the properties of radioactive nuclei and the reaction mechanisms through which they are produced, including the fusion reactions leading to the formation of massive nuclear systems. On July 20 – the day of the School opening – Acad. Yu.Ts. Oganessian gave a lecture on superheavy elements.

All the Practice participants submitted written reports on their work under supervisors at the Laboratories and received certificates from the Organizing Committee.

During their stay in Dubna, all the students were acquainted with JINR's Laboratories: they saw the Central Computational Complex at the Laboratory of Information Technologies, medical beams at the Laboratory of Nuclear Problems, and experimental facilities at the Laboratory of Neutron Physics and Laboratory of Nuclear Problems. They also visited MEPHI, where they were shown the NEVOD facility. As regards the culture programme, the students had an excursion to Sergiyev Posad, a get-together party with the participants of the student practice in medical physics at the Dubna Branch of the MSU Institute of Nuclear Physics, and a picnic on the bank of the Dubna River.

One would be right to say that the Summer Student Practice in JINR Fields of Research has become another step towards the development of the system of student schools and conferences and offered its participants a unique opportunity not only to attend a lecture course but also to be immediately involved in actual research performed at JINR's Laboratories.

Noted must the concluding speech by Tomasz Cybulski (Poland) at the closing session of the summer Practice:

"I have an honour to inform you about an idea that has risen in our minds during our wonderful stay at the Summer Student Practice in JINR Fields of Research and International Student School on Nuclear Theory. We would like to create an organization of friends of JINR and Dubna. We would like to unite all those of us who have already been here and those who are yet going to come to JINR – who have devoted a part of their life to Dubna. Our purpose will be to cooperate with students of our universities and give them the best information about projects in Dubna, about possibilities of doing here their own research, and to tell them about their opportunities to come here for practice, schools, and conferences. We would like to organize meetings for them presenting JINR's latest research and news, but our main purpose will be to help them to come to Dubna and make great contribution to JINR becoming a great place for young people to do their scientific career and a place where all their expectations will be met."

Specially noted should be the development of the UC's contacts with Polish universities. The Bogoliubov – Infeld Programme was established to support Polish universities' and JINR's initiatives in working out and realizing educational projects. The UC's and Polish students and postgraduates exchange visits and participate in schools and conferences held both in Dubna and Poland. The results of these activities were evaluated at a seminar in Poznan on October 23, 2004. Polish students who attended the UC-based Summer Student Practice in JINR Fields of Research reported their research work to the seminar and expressed their opinion of the Practice. They also appraised another practice of 2004 – the one that was hosted by the Frank Laboratory of Neutron Physics and received organizational support from the UC. It was attended by students of the Adam Mickiewicz University (Poznan, Poland), Ural Polytechnic Institute (Yekaterinburg, Russia), and Bucharest University (Romania).

In September 2004, a three-week practice was organized for Romanian students and a week's practice for Czech students, which went off very successfully.

Prof. Dr. Anisoara Constantinescu (Romania) gave the following appraisal of the practice: "During the weeks of the practice, the students visited all the JINR Laboratories. Each student had an opportunity to discuss in detail with at least one scientist of JINR the problems in which the student is interested. We are convinced that the present visit to JINR was very conducive to the prospect of students becoming scientists and enhanced their knowledge of physics."

On the whole, the summer student practice was mutually useful – both to students, who acquired new experience, and to staff members of the Laboratories as regards the development of contacts with JINR Member States and attracting young scientists to the Laboratories.

This activity of the UC was supported by the Autumn Sessions of the JINR Programme Advisory Committee (PAC). Marked was the great success of these courses organized on the UC's initiative in cooperation with JINR Laboratories. The efforts by the laboratory staff who contributed to the education and training were much appreciated. PAC recommends continuation of these courses and considers this activity to be important for promoting contacts with Member States and for attracting young people to JINR.

It should be noted that these activities were supported by the plenipotentiaries of the concerned JINR Member States.

On 23 November, a meeting took place at the UC between the authorities of the Bogoliubov – Infeld Programme and members of JINR's Polish staff. Opinions were exchanged on expanding the UC's collaboration with higher education institutions of Poland and other JINR Member States and broadening their involvement in JINR's educational and research activities.

In 2004, efforts were continued to involve postgraduates and students in the UC's international scientific and educational projects. The UC, together with Lund University (Sweden),

St. Petersburg University, National Institute of Chemical Physics and Biophysics (Estonia) and Tartu University (Estonia), got a grant from the joint Visby Research Programme "Collaboration in Internet-Based Technologies for Education and Science between Estonian, Russian and Swedish Institutions" (Swedish Institute, contract No. 01657/2004). Within the framework of this grant, a UC postgraduate worked for two months at Lund University and studied there Grid technologies. This experience will allow him to begin preparing a practical course for the UC students and postgraduates, which will be based on the UC's special PC-farm intended for training specialists in Grid technologies.

In 2004, prolonged was a joint project by the UC and the Institute of Theoretical Physics of Giessen University (Germany), which is supported within the Leonard Euler Scholarship Programme of the German Academic Exchange Service (DAAD). Three students of the UC specializing in theoretical heavy ion physics had additional scholarship during an academic year.

Two students of the UC-based Department of High Energy Particle Interaction, MIPT, attended the CERN Summer School, which was held on 1 July – 1 September.

A student of University of Applied Sciences in Ravensburg – Weingarten, Germany, had a practice at the Laboratory of Nuclear Reactions from 15 March to 31 August, 2004.

In 2004, the UC continued the training, retraining, and improvement of the qualifications of working staff and specialists.

JINR's four new staff were trained in allied professions; 23 JINR's staff were trained in a second profession. At the JINR courses training personnel for facilities that are within the jurisdiction of the Federal Technical Inspection, 116 JINR's staff and 26 staff of Dubna's organizations were trained and certified.

In 2004, 22 JINR's senior officials and specialists were trained and certified as members of the JINR Central Certification Commission, certification commissions of the Laboratories, and certification commissions of the subdivisions responsible for industrial accident prevention.

133 JINR's staff were trained and certified as those responsible for operating and maintaining machines, mechanisms, and pressurized vessels.

Five JINR's staff improved their qualifications at special seminars organized by education institutions in Moscow and Ivanovo.

In 2004, 53 students of State Professional Lyceums No. 67 and 95 had practice in their specialties at JINR.

The UC-based courses training entrants to MEPHI continued to function in 2004. In Academic Year 2004–2005, their enrolment was 12 students of the city's secondary schools. 11 of those who completed the courses held throughout Academic Year 2003–2004, entered MSU, MEPHI, Moscow Aviation Institute, and Dubna University.

The UC has a special laboratory for demonstrating experiments in physics to secondary school students. Three groups of the 10th and 11th-year students of Dubna's secondary schools, 34 people altogether, attend classes at the UC – once a week each. They perform exercises of the laboratory practicum "Experimental Methods in a School Course of Physics."

On 18 – 30 January, 2004, 12 Polish graduation-class students of secondary schools and their teachers were on a visit to the UC. They came from the cities of Leszno, Lublin, Poznan, and Swinoujscie. The visit was organized within the Bogoliubov – Infeld programme for winners and prizemen of different school contests in physics. A special educational programme had been prepared for them, which included both lectures on physics and performance of laboratory exercises of the UC's specialized physics practicum for secondary school students under the supervision by a UC's lecturer I.A. Lomachenkov. In their free time, the school students had an opportunity to work at the UC's computer classrooms.

At the same time, the UC hosted a special seminar attended by school teachers of physics of Poland and Dubna, and the UC representatives. An interesting and mutually useful opinion exchange took place between the teachers. To maintain and

develop Polish and Dubna school students' interest in physics and to favour their contacts, it was decided to create a joint practicum in physics by two teams.

From January 2005 on, a new exercise of the physics practicum will be offered, "Correlation Gamma-Spectroscopy in Nuclear Physics Research Using Scintillation Detectors Based on NaI(Tl) Crystals."

On 30 June – 11 July, 2005, the Third International Student School on Nuclear Methods and Accelerators in Biology and Medicine will be held in Dubna. It is planned as another school within the cycle of the UC-based summer student schools. By an already formed tradition, it will be attended by students and postgraduates of Belarus, Bulgaria, the Czech Republic, Germany, Poland, Romania, Russia, Slovakia, and Ukraine.

The participants will be selected on the basis of the reports on their research work, which will be presented at special student sessions.

As lecturers, invited are specialists in applied medical physics of Russia, Poland, the Czech Republic, Slovakia, and Switzerland.

Information on the previous International Student Schools on Nuclear Methods and Accelerators in Biology and Medicine is available at the UC's Internet site, <http://uc.jinr.ru/SummerSchool/>, and <http://uc.jinr.ru/2SummerSchool/>. In 2004, the Proceedings of the Second International Student School "Nuclear Physics Methods and accelerators in Biology and Medicine" (Poznan, Poland, 19-30 July, 2003) – JINR, E18-2004-63, was published.

On 12 July – 4 August, 2005, according to the Topical Plan for JINR Research and International Cooperation, the UC, Adam Mickiewicz University (Poznan, Poland), Czech Technical University in Prague, Bratislava Technical University, MEPHI, MIPT, and MSU will jointly hold in Dubna a Summer Student Practice in JINR Fields of Research.

Scientists and postgraduates of the UC, jointly with scientists of the Bogoliubov Laboratory of Theoretical Physics (a Sector headed by R.V. Jolos) and Giessen University, Germany,

have been studying for many years the interactions between heavy ions and nuclei. In 2004, within the statistical model and using recent theoretical predictions of nuclear properties [2], survival probabilities of superheavy nuclei were calculated [1]. Level densities of the Fermi-gas model and of a model with collective enhancement are used. The evaporation residue cross-sections of superheavy nuclei in cold and hot fusion reactions were calculated. The cross-sections $\sigma_{(2-3)n}$ for the nuclei with $Z = 103, 107-109$ were predicted. The results obtained with the collective enhancement model are more sensitive to even-odd effects than those obtained with the Fermi-gas model.

A possibility of producing new isotopes of the superheavy nuclei with $Z = 101-108$ in incomplete fusion reactions was studied for the first time [2]. The predicted cross-sections are above the present experimental limit.

The results of [1,2] were reported to the International Conference NUCLEUS-2004.

In 2004, reports on the JINR Educational Programme were presented at the –

- international conference EXON-2004, Peterhof (Russia), 5–12 July, 2004;
- workshops at Krakow, Opole, and Kielce (Poland); October, 2004.

The UC's Internet site (<http://uc.jinr.ru>) has been regularly updated.

1. *A.S. Zubov et al.* // *Eur. Phys. J. A.*, 23, 2005.
2. *G.G. Adamian et al.* // submitted to *Phys. Rev. C*.