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**THE JINR EDUCATIONAL PROGRAMME
IN 2001**

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10 years ago, in January 1991, joint Order of the Ministries of Education and Atomic Energy No. 28/33 of January 16, 1991, was signed. It was titled "On Providing Staff for Research and Applied Work in Nuclear Physics, Elementary Particle Physics, Condensed Matter Physics, and High-Temperature Superconductivity." This Order initiated the specialized training on the basis of JINR of graduate students from Moscow State University (MSU), Moscow Engineering Physics Institute (MEPI), and, a little later, Moscow Institute of Physics and Technology (MIPT). On the grounds of this Order, the University Centre (UC) has been established, whose 10th anniversary was celebrated on March 21, 2001. The JINR Director Academician V.G. Kadyshevsky addressed the UC students, postgraduates, faculty, and founders with a congratulatory speech and wished them further achievements in their activities, which are ultimately aimed at maintaining and developing science. The ceremony was attended by representatives of MEPI, MIPT, and MSU.

By 1991, JINR already had a system of training young specialists. The system was founded upon the Dubna-based Departments of the Physics Faculty of MSU (the Dubna branch of MSU's Institute of Nuclear Physics was opened in 1961). However, JINR's demand for the scientific staff of different specialties was growing; so the establishment of the UC was a natural addition to, and extension of, JINR's unique scientific potentialities for training young specialists. Since 1995, postgraduate studies have been successfully proceeding at the UC, now comprising 10 specialties in physics and mathematics.

The development of JINR's educational activities required amendments to the Institute's official documents. Thus Paragraph 2 was included in Article 4 of the JINR Charter: "[JINR] ...develops

educational activities, including graduate and postgraduate programmes in the Institute's main fields of research, to provide highly skilled staff for the JINR Member States." The "Educational Activities" section has been included in the JINR Topical Plan for Research and International Cooperation.

In 2001, the UC continued its activities within the first-priority topic "Organization, Maintenance, and Development of the University-Type Educational Process at JINR."

Students of the fourth, fifth and sixth years traditionally complete their university education at the UC in the following areas: nuclear physics, elementary particle physics, condensed matter physics, theoretical physics, technical physics, and radiobiology.

In the academic year 2000 – 2001, there were 167 graduate students at the UC from higher education institutions of JINR Member States. The curricula have been worked out jointly with the institutions that have assigned their students to graduate at the UC. The table below shows the distribution of the UC students over higher education institutions.

Higher education institution	Academic year 2000 – 2001
Moscow State University	11
Moscow Engineering Physics Institute	10
Moscow Institute of Physics and Technology	30
Institutions of other JINR Member States (Armenia, Belarus, the Czech Republic, Georgia, Russia, Slovakia, and Ukraine)	37
Altogether	88

The UC total enrolment also includes 79 undergraduates of Moscow Institute of Radio Engineering, Electronics, and Automation, of whom 26 are first-year students.

The UC develops its own programmes for separate student groups.

Within the frames of training specialists for the Slovak Cyclotron Complex, which is being built with the help of JINR, Slovak students continued to attend full-time programmes at the UC. In January 2001, a second group of Bratislava Technical University (BTU) students successfully defended their theses. A third group, which is made up of students from BTU and the Komensky University (Bratislava), continued

to study at the UC the specialty "Accelerator Physics and Engineering." The specialized curriculum includes the following courses: Applied Mathematics, Charged Particle Beam Dynamics, Interaction of Radiation with Matter, Physics and Engineering of Heavy Ion Accelerators, Atomic and Plasma Physics, Heavy Ion Sources, and High-Frequency Systems of Accelerators. The lectures in these subjects are given by scientists of the Laboratory of Nuclear Reactions, Laboratory of Particle Physics, Department of Radiation and Radiobiological Research, and Laboratory of Nuclear Problems. The lectures have been preceded by an intensive course of Russian.

In 2001, the UC Physics Practicum was supplemented by a new exercise. From the next semester, within the laboratory exercise "Two-Dimensional X-Ray Detector for Medical and Biological Research," which has been prepared at the Laboratory of High Energies under the supervision of Yu.V.Zanevsky, students will be studying the fundamentals of multi-strip chamber operation and the specifics of their application in medical and biological research.

In addition to the standard set of courses, the UC offers optional lectures on the following subjects: Elementary Particle Physics, Relativistic Nuclear Physics, Theory of Fundamental Interactions, Quantum Chromodynamics, Theory of Nuclear Reactions, Atomic Nucleus Structure, Introduction to Accelerator Theory, Experimental Nuclear Physics, Modern Methods of Detecting Nuclear Reactions and Nuclear Radiation, Programmable Logical Units, Fundamentals of Radio Engineering, Digital Devices and Their Application, Electronic Methods of Detecting Ionizing Radiation, Radiation Safety and Environment Protection, Mathematical Statistics, Object-Oriented Programming in C++, Programming in UNIX, Computing in High Energy Physics, Internet Technologies, Computing in Nuclear Physics (seminars), Telecommunication Systems and World Information Resources, Visualization in Scientific Research, Operating the "Mathematica" System, English for Students, and English for Postgraduates.

In the spring semester of 2001, the following courses besides the regular lectures were given to the UC students and postgraduates, as well as to all those interested:

- N.B.Skachkov. *Computing in High Energy Physics*. The course provided the detailed study of modern software for processing large data arrays, in particular, the widespread

package ROOT, which was designed at CERN. The course included hands-on classes.

- D.Yu.Bardin. *Introduction to CalcPHEP (Calculus of Precision High Energy Physics)*. The lectures and seminars have been supplemented by demonstrating the capabilities of CalcPHEP at the Internet site <http://brg.jinr.ru>.
- M.V.Savina, S.V.Shmatov. *Computer-Modelled Study of Elementary Particle Interaction Using the Software Packages PYTHIA and JETSET*.
- A.A.Smolnikov. *Neutrino Physics and Non-Accelerator Experiments*. The course provided an overview of neutrino physics based on research in nuclear physics, elementary particle physics, astrophysics, and cosmology. Modern techniques of non-accelerator physics were considered using the examples of operating and planned underground, deep-sea, and under-the-ice experimental installations. The hands-on classes were held at the research departments of JINR's Laboratory of Nuclear Problems.

Within the lecture cycle "Modern Problems of Natural Sciences," the following courses were given in 2001:

- Yu.P.Pytyev (Moscow State University). *Lecture Cycle on Mathematical, Computer, and Information Technologies in Experimental Research*.
- R.Kragler (Fachhochschule Ravensburg – Weingarten/University of Applied Sciences, Germany). *Mathematica Tutorial Course, Part II*.

The list of textbooks published by the UC for its students and postgraduates has been supplemented with the following publications:

- V.V.Papoyan. *Lectures on Classical Mechanics*. YHIQ-2001-9.
- V.V.Papoyan. *Lectures on Vector and Tensor Analysis*. YHIQ-2001-10.
- N.V.Antonenko, S.P.Ivanova, O.V.Fotina. *Statistical Approach to the Analysis of Nuclear Reactions*. YHIQ-2001-11.

The JINR postgraduate programmes in 10 specialties in physics and mathematics have continued into 2001. In 2001, the UC had a total postgraduate enrolment of 68. The table below shows the distribution of

the UC postgraduates over the JINR Laboratories in the academic year 2000 – 2001.

Number of postgraduates in the academic year 2000 – 2001	
Laboratory of Theoretical Physics	14
Laboratory of Nuclear Problems	19
Laboratory of Nuclear Reactions	6
Laboratory of Neutron Physics	8
Laboratory of Particle Physics	7
Laboratory of Information Technologies	11
Department of Radiation and Radiobiological Research	1
University Centre	2
Altogether	68

The UC held its first postgraduate commencement in 1998. 10 of these alumni have already defended their Candidate's theses.

In 2001, the UC was actively developing its well-established ties with foreign institutions of higher education. Within the programme of the German Service of Academic Exchanges (DAAD) “Leonard Euler Scholarships,” a joint project of the UC and the Institute of Theoretical Physics of the University of Giessen (Germany) has been supported for the academic year 2000 – 2001. Thanks to this support, two UC postgraduates and one graduate student performing theoretical research in heavy ion physics are paid an additional scholarship during the academic year; they had a month's study in Giessen.

During a month, four UC students attended courses of lectures on high energy physics at Pavia University (Italy). These studies were supported by a grant from the European Physical Society (EPS) that the UC received in 2000. For 2001, the EPS has allotted another grant to the UC, which will allow a UC postgraduate to study at one of the German universities during half a year. DAAD has prolonged its grant to the UC into 2001 – 2002.

The UC actively cooperates with Belarus. Among those completing their education at the UC, as well as among participants of student schools held in Dubna, regularly are students from Belarus State University (the city of Minsk).

In 2001, the UC continued to retrain technical staff members and raise their professional skills, as well as to organize and coordinate the training system on the basis of JINR's Laboratories and subdivisions.

The UC-based branch of the preparatory courses training entrants into Moscow Engineering Physics Institute (MEPI) continues to function. 15 Dubna's school students are attending these classes in the academic year 2001 – 2002. Two of those who completed the courses in the academic year 2000 – 2001 have entered MEPI within the system of special enrolment for training specialists for specific institutions.

A special laboratory is being created at the UC for the demonstration of secondary school experiments in physics. The laboratory is being completed with equipment and materials. The secondary school practicum in physics is to be broadened. It is also planned to arrange the demonstration of the laboratory exercises to Dubna's physics teachers.

The cycle of JINR's summer student schools was continued with the International Student School "Nuclear Physics Methods and Accelerators in Biology and Medicine," which was held on June 27 – July 11, 2001, on the basis of JINR's holiday home "Ratmino."

The purpose of the School was to acquaint students and postgraduates with latest achievements and current problems of applied medical physics. The wide application of ionizing and non-ionizing radiation, radionuclides, gamma therapy units, electron and proton accelerators, and computer tomographs in medicine has turned medical physics into the present and future of medicine. Modern applied medical physics is concerned with radiation therapy, nuclear medicine, radiation diagnostics, non-ionizing diagnostics and therapy, computer facilities and mathematical modelling in diagnostics and therapy, radiation safety, and radioecology.

The School was attended by students from Belarus, the Czech Republic, Ecuador, Macedonia, Poland, Romania, Russia, Senegal, and Slovakia. The working language of the School was English.

The lecturers of the School were 37 specialists of JINR, the Czech Republic, Germany, Poland, Russia, Switzerland, and the U.S.

The total number of the School students and lecturers was 127, of whom 80 were students. The audience also included 10 postgraduates of Moscow State University (MSU), the Oncology Centre (Moscow), Prague Technical University, Slovakia, and JINR.

The Organizing Committee included representatives of JINR Member States. Notably active were the Committee members of JINR, Moscow Engineering Physics Institute, the Czech Republic, and Poland. The Organizing Committee was headed by the Vice-Director of JINR Prof. A.N. Sissakian.

Among those invited to the official opening of the School were the Vice-Director of JINR Prof. Ts. Vylov, Director of the Dzhelepov Laboratory of Nuclear Problems Prof. N.A. Rusakovich, Head of a MEPI Department Prof. V.A. Klimanov, and Assoc. Prof. A.P. Chernyayev of MSU. The First Deputy Minister of Education of the Russian Federation Prof. V.M. Zhurakovsky sent a message of greetings to the School.

The School programme was diverse. The lecturers were very well prepared; most of them had computer-based presentations. They were all pleased to note the good technical and software support of the School, which provided excellent conditions for lecturing.

Separately mentioned should be the lectures by Prof. G.-J. Beyer (Switzerland), which got the audience's highest appraisal. Interesting results were presented by V.A. Klimanov (MEPI, Russia), G.I. Klenov (Moscow Institute of Radio Engineering), G.Yu. Gorlachyov (MEPI), P. Nizin and P. Heintz (the U.S.), I.A. Gulidov (Obninsk, Russia), and T. Beyer and G. Kuehnel (Germany). A scientific excursion to the Cardiology Centre (Moscow), which included a special lecture by Prof. Ye.L. Shcherbakova, was an excellent addition to the lectures given at the School.

Student sessions were an important feature of the School. At the end of the School, determined were three best student reports, and their authors were awarded prizes.

The students who actively participated in the School were given the School certificates. Attendance throughout the School was quite high – about 85%.

The location of the School in Ratmino made for close communication between the participants. Not only did the students attend the lectures and participate in the seminars, but they also enjoyed various sport and culture activities.

Almost all the lecturers have left their lecture presentations with the School organizers. With the lecturers' permission, these materials have been put up at the Internet pages of the University Centre (<http://uc.jinr.ru/SummerSchool>).

It is planned to issue the proceedings of the School, which will include both lectures and students' reports.

The organizers of the School have received letters from many of its participants with high appraisals of the organization, conduction, and programme of the School and suggestions that more schools on these topics be arranged. Polish representatives proposed that the next school be held in Poznan in 2003; Czech representatives proposed that another school be held in Prague in 2005.

The School was conducted successfully thanks to the support from the JINR Directorate. The School was financed from Topic 10-0-1026-98/2003, "Organization, Maintenance, and Development of the University-Type Educational Process at JINR." The School was also supported by the Plenipotentiaries of the following JINR Member States: the Czech Republic, Poland (the Bogoliubov – Infeld Programme), Romania, and Slovakia. Other sources of support were the Czech Technical University, Centre of Applied Nuclear Physics of JINR's Flerov Laboratory of Nuclear Reactions, Russian Federal Programme "Integration," Soros Foundation, and companies Siemens Medical Solutions and HWM-Dresden GmbH.

Jointly with the regional public organization "Soros Professor Club," the UC participated in the organization and conduction of the conference "Education and Science in Russia," which took place in Dubna on September 22 – 23, 2001.

In 2001, reports on the fulfilment of the JINR Educational Programme, as well as on the preparation and results of the International Student School "Nuclear Physics Methods and Accelerators in Biology and Medicine" (June 27 – July 11, 2001, Dubna), were presented –

- in the electronic journal RUPHYS NEWS of the Joint Physical Society of the Russian Federation, No. IV, 2001 (a report on JINR's educational activities; <http://www.uniphys.ru/journal/N4-01/JINR/jinr.htm>);
- at the EUPEN jubilee conference in Cologne in September 2001 (a report on the cooperation between the UC and Bratislava Technical University, Slovakia);
- at the 14th session of the Programme Advisory Committee on Nuclear Physics, April 23 – 25, 2001;
- at the 14th session of the Programme Advisory Committee on Condensed Matter Physics, April 27 – 28, 2001;

- at the 15th session of the Programme Advisory Committee on Condensed Matter Physics, November 22 – 23, 2001;
- at the 15th session of the Programme Advisory Committee on Nuclear Physics, November 26 – 28, 2001.

Within the joint project of the UC and the Institute of Theoretical Physics of the University of Giessen (Germany), theoretical research in heavy ion physics has been conducted at the UC, which has resulted in the following publications:

- S.P.Ivanova *et al.*, *Statistical Approach to the Analysis of Nuclear Reactions*, JINR-01-11 (Dubna: JINR, 2001), 36 pp.;
- S.P.Ivanova *et al.*, "Fusion to Superheavy Nuclei and Quasifission," *Heavy Ion Physics* (14, 2001), 3-12;
- S.P.Ivanova, A.S.Zubov *et al.*, "Survival Probability of Superheavy Nuclei," *Phys. Rev. C* (in print);
- T.M.Shneidman *et al.*, "Cluster Interpretation of Parity Splitting in Alternating Parity Bands," in *Symposium on Nuclear Structure Physics*, ed. R.Casten, J.Jolie, U.Kneissl, and P.Lieb (Singapore: World Scientific, 2001), pp. 225-230;
- S.P.Ivanova and T.M.Shneidman, "Dinuclear System Model for Dynamics and Structure," in *Proc. Symposium on Exotic Nuclei, Baikal Lake (Russia), 2001* (in print).

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

UC's plans for 2002 include:

- Systematic publication of textbooks on the courses given at the UC. Publication of the lecture cycles given to the UC students and postgraduates.
- Development of the UC's Web server on the basis of modern information technology. Periodic update of the server contents reflecting the lectures given at the UC as well as schools and courses conducted on the basis of the UC.
- Development of the cooperation with international Funds (DAAD, EMSPS, and EuPEN) aimed at organizing student

and postgraduate exchanges between the UC and foreign research centres regulated by special agreements.

- Development of the system of the specialized training of highly skilled specialists for the JINR Member States.
- Establishment at the UC and development of specialized practicums for students and secondary-school students.

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