

Implementation of the recommendations of the Scientific Council's 91st and 92nd sessions

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Contents

1	<i>Highlights of 2002</i>	2
1.1	Operation of the JINR Facilities.....	2
1.2	Scientific Results.....	3
1.2.1	Relativistic Nuclear Physics.....	3
	Nuclotron.....	3
1.2.2	Heavy-Ion Physics.....	3
	Element 118.....	3
	DRIBs.....	3
1.2.3	Condensed Matter Physics.....	3
	IBR-2.....	3
	Neutron Investigations at high pressure.....	3
1.2.4	Nuclear Physics with Neutrons.....	4
	IREN.....	4
	New demonstration of the universality of matter's quantum properties.....	4
1.2.5	Information technologies.....	4
1.2.6	Theoretical Physics.....	4
1.2.7	Elementary Particle Physics.....	4
	NA48.....	4
	ATLAS.....	5
	ALICE.....	5
1.2.8	Radiation and Radiobiological Research.....	5
1.2.9	Hadron Therapy at Phasotron.....	5
1.2.10	Educational Programme.....	5
1.3	Funding of research.....	6
2	<i>The JINR's Scientific Programme in 2003</i>	6
3	<i>Latest news in brief</i>	7
3.1	New Partnership Relations.....	7
3.1.1	Cooperation with China.....	7
3.1.2	Cooperation with India.....	7
3.1.3	Cooperation with Spain.....	7
3.2	Conferences, Meetings and Visits.....	8
3.2.1	Conferences.....	8
3.2.2	Exhibition in Romania.....	8
3.2.3	Visit of S.M. Mironov.....	8
3.2.4	Visit of Trubnikov.....	8
3.2.5	Conference: Intellectual Bridge "Russia – West: Problems and Perspectives".....	8

Dear Members of the Scientific Council,
 Honorary guests,
 Colleagues,
 Ladies and Gentlemen:

On behalf of the JINR Directorate, I inform you about implementation of the recommendations of the Scientific Council's 91st and 92nd sessions.

The plan of my report is the following (see CONTENTS).

You see the report includes three sections. First of all, I'll inform you about the scientific results of 2002 and briefly I shall speak about the finances and the financial news. Then I'll inform you on main parameters of the scientific programme of 2003. And, finally, in the conclusion I shall inform you on the latest news.

You have in your papers a preprint concerning scientific results of the previous year. In accordance with your recommendation that was made on the 91st session of the JINR Scientific Council, the preprint includes a brief review of the JINR scientific results that were published in the refereed journals or in the proceedings of the international conferences. The review is based on about 1000 articles by JINR scientists. These articles were published in journals and received by the JINR Scientific Library up to 16 December 2002 (about 75% of annual issues).

You have also the latest issue of "JINR News" journal where you can find information about current activities of the Joint Institute. I believe you will have time to read all these documents. So, you can find the main scientific results of the Institute in the papers. Due to the time limit, I will shortly inform you about the main results on implementation of the Scientific Council's recommendations.

1 Highlights of 2002

I would like to begin the report on implementation of the Scientific Council's recommendations with the information about the scientific highlights of 2002. Let me start with the information about the operation of the JINR facilities. As a rule, the JINR Chief Engineer presented information about the status and the nearest development plans for the JINR basic facilities. Professor I. Meshkov attended these duties during the last five years. His term is over. Dr. G.D. Shirkov will act as the JINR Chief Engineer during 2003 in accordance with the contract concluded.

The previous year was successful for Professor I.N. Meshkov.

Together with his colleagues from the Budker Institute of Nuclear Physics, Professor I. Meshkov was awarded with the State Prize of the Russian Federation. On 5 August 2000 President V. Putin signed the order for awarding. I have the pleasure of congratulating Professor I. Meshkov, Academician A. Skrynsky, who is a member of our Scientific Council, and their colleagues on the State Prize of the Russian Federation.

I would like also to thank Professor I. Meshkov for very active and efficient work in the rank of the Chief Engineer. He has brought large benefit for the Institute. He continues to work and can do scientific research more intensively acting as the adviser of Directorate in the field of accelerator physics and engineering, assisting the Directorate in this field.

Due to these circumstances on transferring the duties from I. Meshkov to G. Shirkov, I'll inform you shortly about the operation of the JINR facilities.

1.1 Operation of the JINR Facilities

The operation of the JINR facilities in 2002

Facility	Data in hours	
	Plan for year	Actual for year
Basic facilities		
Nuclotron	2000	1850
IBR-2	2000	2113
U400	4500	4885
U400M	2100	2875
Users' request facilities		
Synchrophasotron	250	354
Phasotron	1500	1015

You see that in 2002 the actual data are higher than those planned for IBR-2, U400 and U400M.

1.2 Scientific Results

And now I switch to the presentation of the results obtained in 2002.

1.2.1 Relativistic Nuclear Physics

Nuclotron

Three runs at the Nuclotron of the Veksler-Baldin Laboratory of High Energies were carried out during 2002. The nuclotron operated 1850 hours totally.

In the March run the intensity of the external beam of magnesium ions was increased up to $\approx 10^8$.

In the summer run the ions of argon were accelerated for the first time with the intensity of $1.4 \cdot 10^6$ and $E_x \approx 1$ GeV/n. The duration of extracted beam was increased up to 1.9 s.

In December the polarized deuteron beam was accelerated and extracted from the Nuclotron with the energy of more than 2 GeV/n and beam intensity of $1.35 \cdot 10^8$ particles per cycle.

Obtaining of the polarized beam at the Nuclotron gives a new quality for this accelerator. This means also that the JINR research programme for the experiments on relativistic nuclear physics can be transferred from the Synchrotron to the Nuclotron. The termination of the Synchrotron exploitation is planned in 2003.

1.2.2 Heavy-Ion Physics

Element 118

Main attention in 2002 at the Flerov Laboratory of Nuclear Reactions was paid to the experiments aimed at the synthesis of element $Z=118$ in the reaction $^{249}\text{Cf} + ^{48}\text{Ca}$. In the course of the irradiation of a target with a ^{48}Ca ion beam dose of $2.6 \cdot 10^{19}$, the detector system of the Dubna gas-filled recoil separator registered two events indicating the formation and decay of the nucleus with $Z=118$. Both events correspond to the excitation energy $E_x = 30.0 \pm 2.5$ MeV of the compound nucleus $^{297}118$ with the cross section of about 0.5 pb. It has been established that the sequential α -transitions in the case of the first event correspond to the nuclear decays in the chain $^{294}118 \rightarrow ^{290}116 \rightarrow ^{286}114$.

DRIBs

Development of the accelerator technique at the Flerov Laboratory was focused on the realization of the project DRIBs (production of radioactive ion beams at Dubna cyclotrons). According to the schedule of stage I of the project, a complex for the generation, ionization and separation of ^6He and ^8He ions was constructed and tested at the ^7Li beam of the U400M cyclotron. A radioactive beam of ^6He was transported from the U400M cyclotron hall to a distance of 120 m and accelerated up to an energy of 15 MeV/A using the U400 cyclotron.

1.2.3 Condensed Matter Physics

IBR-2

One of the main tasks of the Frank Laboratory of Neutron Physics is the construction of the third movable reflector for the IBR-2 reactor.

The production and testing assembly of the protective block and some other subsystems for the movable reflector was completed at the JINR Central Workshop (you can see the protective block on the slide). Two systems of the movable reflector were manufactured in time at the N.A. Dollezhal Research and Development Institute of Power Engineering (Minatom, Russia), but the construction of one element is delayed. Hence, the stop of the IBR-2 reactor for reflector replacement is delayed, so that in 2003 two more reactor cycles are planned. Nevertheless, the planning foresees a restart of the reactor in January 2004.

I inform you also that the financial support of Minatom (13.5 million roubles) for the IBR-2 reactor modernization was contributed timely and in full volume.

Neutron Investigations at high pressure

The neutron spectrometer DN-12 for investigations of structure and dynamics of condensed matter under high pressure using a new type of high pressure cells with sapphire and tungsten carbide anvils has been essentially developed at IBR-2 high flux pulsed reactor in 2002. Now DN-12 is the only spectrometer all over the world which allows one to study crystal and magnetic structure of materials at high pressures up to 10 GPa in the temperature range 15 – 300 K and dynamics of materials (density of phonon states) in the pressure range up to 10 GPa. For comparison, in other neutron scattering centres in the world similar investigations of dynamics of materials can be performed in much narrower pressure range up to 1-2 GPa. During the last years, the DN-12 spectrometer has been successfully used for studies of different actual problems of the modern condensed matter physics: an effect of high pressure on the crystal structure of high- T_c superconductors, crystal structure and dynamics of ammonium halides, pressure-induced structural phase transitions, spin-reorientation magnetic phase transitions, etc.

In the slide you can see new data for librational (L) and transverse optical (TO) modes frequencies in NH₄I (ammonium iodide) as functions of pressure that was obtained at DN-12.

1.2.4 Nuclear Physics with Neutrons

IREN

The significant progress in realization of the IREN project has been achieved.

The dismounting of the old linear electron accelerator LUE-40 is completed in 2002, and installation of a new linac is started. In the slide you can see an empty hall, where there was an old accelerator earlier, and the first supporting element for the linac section which is under installation.

New demonstration of the universality of matter's quantum properties

For the first time the quantum phenomenon – quantization of the neutron energy levels in potential field, formed with gravitational forces – was theoretically predicted in the Frank Laboratory of Neutron Physics (JINR) by Professor V.I. Luschikov and experimentally discovered at ILL (Grenoble, France). This experiment gave a demonstration of the universality of matter's quantum properties. For the first time the experiment on the level of 10^{-12} eV and unique investigations of ultracold neutron energy separation in a special dish-like trap were performed. Fermi potential, describing neutron reflection from the bottom of the trap, and the gravitational potential, connected with the Earth gravity, form a potential well with a set of quantum levels. The levels' quantization was discovered, which corresponds to the neutron lifting height of about 10 microns.

1.2.5 Information technologies

In 2002, work to create the JINR GRID segment and to incorporate it into the global GRID structure was actively held. The monitoring system operates in a test mode; its using for CMS, ALICE, ATLAS experiments is in progress.

The series of work to develop statistical and kinematics models of information traffic was performed. The models provide a basis for development of new effective tools of optimal traffic control in computer networks as well as suggest some new possibilities targeted to protect the computer networks from unauthorized intrusions.

1.2.6 Theoretical Physics

I continue with my presentation. Now, I'll tell you about three new results in theory.

It is shown that the excess of positrons in cosmic rays observed by the HEAT (High-Energy Antimatter Telescope) and AMS (α -Magnetic Spectrometer) collaborations can be explained by the annihilation of neutralinos from the Dark matter in galactic halo. The estimated neutralino mass ~ 100 GeV is compatible with the global fit to all low-energy data within the Minimal Supersymmetric Standard Model.

A finite rank separable approximation was extended to include the pairing correlations in nuclei. Properties of low-lying quadrupole and octupole vibrational states in nuclei away from stability were studied.

I informed you a year ago that a new S-matrix thermodynamical approach was suggested by the JINR theorists J. Manjavidze and A. Sissakian to describe extremely inelastic high-energy hadron interactions, when the multiplicities of the produced hadrons exceed considerably the corresponding mean multiplicity.

This approach interested many physicists. A. Sissakian reported the developed approach at the session of the Physics Department of the Russian Academy of Sciences, which was held on 27 November 2002 at the P.N. Lebedev Physics Institute in Moscow. Based on this approach, the phenomenon of thermalization of the finite state was predicted in the very high multiplicity region and later confirmed by the preliminary data obtained in STAR experiments (RHIC, BNL).

1.2.7 Elementary Particle Physics

NA48

Team of the LPP physicists headed by Prof. V.D. Kekelidze made a considerable contribution to the NA48 experiment (CERN) where the most precise result on the measurement of the direct CP-violation effect has been obtained from the analysis of data on the decays of neutral kaons into two pions:

$$\text{Re}(\epsilon'/\epsilon) = (14,7 \pm 2,2) \times 10^{-4}.$$

This result indicates that CP-violation effects are dominating in the $K_L^0 \rightarrow \pi^0 \gamma\gamma$ decay.

Let me emphasize that many physicists from JINR participate in the CERN programme, including the experiments at LHC, namely the ATLAS, CMS and ALICE experiments. The JINR physicists fulfil their tasks and obligations in due amount and time. I would like to illustrate my statement by two examples.

ATLAS

In 2002 the 65th module for the ATLAS detector was sent to CERN. JINR completed the production and assembly of the all modules for the Barrel part of the Tile Calorimeter. Let me remind you that the first module was shipped to CERN in August 1999.

ALICE

The iron yoke of the ALICE dipole magnet was manufactured at Savelovo machinery plant (near Dubna, Russia) as the joint JINR-CERN project. The dipole magnet is an essential part of the ALICE forward dimuon spectrometer. It is the largest dipole magnet ever built. The iron yoke consists of 28 modules. During spring 2003 the yoke will be transported to CERN.

1.2.8 Radiation and Radiobiological Research

The new investigations, named “Biophysics of photo-biological processes”, have been started in the Department of Radiation and Radiobiological Research. The important problems of photo-biology will be studied using the JINR basic facilities. Tomorrow Acad. M.A. Ostrovsky, who is the leader of these investigations, will make the detailed report on the biophysics of photo-biological processes.

1.2.9 Hadron Therapy at Phasotron

A medical complex for hadron therapy of oncological diseases is operating successfully at the JINR phasotron. In 2002, 43 patients underwent 1057 proton treatment procedures. Gamma ray therapy (2840 ray procedures) was applied to 69 patients.

Tomorrow Dr. G.V. Mitsin will make the detailed report on the hadron therapy complex at phasotron.

I am sure you know that Professor V.P. Dzhelepov was a founder of hadron therapy at JINR. In recognition of his contribution to the JINR development and in connection with his 90th anniversary, the Dzhelepov Laboratory of Nuclear Problems is organizing the Memorial Conference which will be held in Dubna on 11 April 2003.

I inform you also that the other Memorial Conferences will be organised by JINR during this year dedicated to Professors D.I. Blokhintsev, B.M. Pontekorvo and G.N. Flerov.

I am inviting you to these conferences.

I would like to inform you also that the JINR activities on the hadron therapy were supported from the “Science City Dubna” programme with 3 million roubles.

A project on design and construction of the Tomograph with a weak magnetic field was also included in this programme.

On 14 January a meeting of the Council on Science and High Technology chaired by the Russian President V.V. Putin was held. The situation in Russian science-cities and problems of financing of academic and applied science research were the topics of the discussion at the meeting. The Council meeting continued for more than two hours. Speaking about science-cities, President V. Putin marked the unique scientific, technical and personnel potential accumulated at these centres. That is why our main task is “to keep it and use it properly under new circumstances.” Closing the meeting he said, “Our main goal is to help the government to find ways to create more effective conditions for the development in science and in innovation sphere, to establish new economy in the country.” I think that the participants of this meeting - the Scientific Secretary of the Council, a member of the JINR Scientific Council Professor M. Kovalchuk and the Mayor of Dubna V. Prokh - can give you a more detailed information about the discussions in the Kremlin.

1.2.10 Educational Programme

215 students from higher education institutions of JINR Member States attended studies at the JINR University Centre in 2002. I emphasize that 99 students of the Dubna Branch of the Moscow Institute of Radio Engineering, Electronics, and Automatics have special studies on the new educational programme for engineers in framework of activity for renewing of engineers’ personnel, for example at IBR-2.

JINR continued its postgraduate programmes in 10 specialities of physics and mathematics. The UC's total number of PhD students was 62 in 2002. By now, 11 former UC postgraduates have defended their Candidate's theses.

In October, 2002, a delegation from the JINR University Centre, jointly with students and postgraduates of the Adam Mickiewicz University (Poznan, Poland) and Prague Technical University, visited a number of research centres and universities of Poland and the Czech Republic. On the initiative of the Polish Professors W. Nawrocik and A. Dobek, who is the Dean of the Faculty of Physics at the Adam Mickiewicz University, a meeting and photo exhibition “JINR Today and Tomorrow” were organized.

I emphasize that together with famous scientists, young scientists and students from the Czech Republic, Poland and JINR presented their reports. All of them had education and practice courses in Dubna.

It is planned to organize new meetings in order to inform the JINR Member States about our educational programme and for presentation of the best students' reports.

Now I inform you briefly about current financial situation at JINR.

1.3 Funding of research

Data on incomes and expenditures during three last years you can see in the next slide.

Let me underline that the highest level of income was achieved in 2002 (about 76.7 % of the budget planned).

Let's hope, that this tendency will proceed in 2003. I can confirm my optimism by some examples.

The JINR delegation headed by me visited Moldova in September 2002. The important meetings organized by Academician V. Moskalenko, the Moldavian Plenipotentiary, were held with V. Iovv (Deputy Prime Minister), A.M. Andries (President of the Academy of Sciences) and A. Rotaru (President of the Supreme Council for Science and Technological Development). Taking into account the heavy economic situation in this republic, we agreed upon re-structuring the debt and regular payments.

The important agreements were achieved in negotiation with the Polish delegation headed by Academician A. Hrynkiewicz, the Polish Plenipotentiary, concerning the strategy of the fees' forming.

The results of these activities in the financial area were accepted by the Working Group of the Committee of Plenipotentiaries which was held on 27 November 2002 in Dubna.

I draw your attention also to the fact that repayment of debts of the last years was started in 2002. The debts have arisen due to the payments failure for the electric power, gas and some taxes.

In the slide, which demonstrates the structure of expenditures at JINR in 2002, you can see that JINR gave about 5 % of its incomes for repayment of the debt.

Funding of the priority activities was planned in the sum about 4 million US\$. The expenditures for these projects have been already made in ~2.6 million US\$. Contracts on the sum about 300 thousand US\$ have been paid and are in stage of shipping. These figures correspond to the level of incomes in 2002.

2 The JINR's Scientific Programme in 2003

Documents concerning scientific programme are presented in "Topical plan for JINR research" (Russian and English versions).

You can see the data on the research topics in the table in the next slide.

Table: Data on the research topics

Field of activity	Number of research topics
Theoretical physics	4
Elementary particle physics	20
Relativistic nuclear physics	11
Heavy-ion physics	3
Low- and intermediate-energy physics	3
Nuclear physics with neutrons	2
Condensed matter physics	5
Radiation and radiobiological research	2
Networking, computing, computational physics	3
Educational programme	1
Total:	54

In 2003 the scientific programme includes 54 research topics. In accordance with the PACs recommendations, the JINR Directorate opens 5 new topics. You can find the detailed information about all research topics in the documents mentioned above.

The JINR Directorate together with leaders of Laboratories and Research projects and in accordance with the PACs recommendations prepared the list of priority activities in 2003. I suppose the PACs Chairpersons will inform

you about their recommendations on research priorities. The list of priority activities as a part of the Scientific Council's recommendations will be discussed at this meeting.

Concluding this section, let me attract your attention to the fact that 2003 is the first year of the 7-years' period connected with the Long-Range Programme of JINR's Scientific Research and Development.

I would like to say some words in connection with the 7-years' Programme.

A week ago Albrecht Wagner from DESY, who is a member of the JINR Scientific Council, informed me that he should miss the present Council's meeting. He apologises and writes the following: "I was informed by our ministry that we have to provide them by the end of the next week, 17 January 2003, with the detailed planning and budget for the coming 10 years." So, working at JINR on the long-range plan we are not alone in the Universe.

Active discussions took place on the preparation of the seven-year plan. Some of the E-mail messages were sent to my address. So, Tim Hallman in his message to the members of the PAC for Particle Physics marked that the main science problems to be tackled in Particle Physics are the origin of mass; nature of spin; fundamental symmetries, and so on.

In this connection I recall how many years ago I spoke to James Bjorken, shortly BJ, about the problems of particle physics of the day. He told me the following: "I cannot find an experimenter who would agree to verify symmetry with respect to the Poincaré group".

As it is known, the 10-parametric Poincaré group together with reflections describes the full symmetry of the Minkowski space-time. Mass and spin are the invariants of this group. According to Tim, the nature of mass and spin should be in focus of our 7-year Programme and modern experiments. So, BJ can be happy.

This afternoon Professor A.N. Sissakian will present a report dedicated to 7-year Programme.

Then Professor P. Spillantini will inform us about the summary of the Scientific Council's Committee for the Preparation of Recommendations Concerning the draft 7-year Programme which was held yesterday.

3 Latest news in brief

3.1 New Partnership Relations

I start my presentation about the news that happened after the summer session of the JINR Scientific Council, with information that State Secretary of BMBF (Germany) signed on 18 December 2002 the renewed Agreement between BMBF and JINR for the next 3 years.

Let me inform you that representatives of the German Embassy in Moscow will visit Dubna on 22 January 2003.

3.1.1 Cooperation with China

Very important news concerns JINR relations with China.

A delegation of prominent Chinese scientists, which was headed by Academician Zhou Guanzhao, President of China Association for Science and Technology (CAST), visited JINR on 27 June 2002.

On invitation of Zhou Guanzhao, Professor A.V. Belushkin, Director of FLNP, Professor S.N. Dmitriev, Deputy Director of FLNR, and myself visited China in September.

I had an opportunity to present the report "JINR is Open for Cooperation" to the numerous audiences at the CAST Annual Meeting. After the Conference a meeting with Xu Guanhua, the Chinese Minister of science and technology, was held in Beijing on 9 September 2002. It was agreed that the future participation of China at JINR will be discussed during the visit of the Chinese authorities to Dubna on February 2003.

Hence, the process of China's return to JINR has started.

3.1.2 Cooperation with India

Let me remind you that members of the JINR Directorate and scientific leaders of the Joint Institute had many contacts with the authorities of India and research centres of this country during the last two years.

Prof. Bhawalkar during his visit to Dubna on 27 September 2002 informed the JINR Directorate that Department of Atomic Energy and Department of Science and Technology have agreed in principle for India becoming an Associate Member of JINR, like Germany, for example.

3.1.3 Cooperation with Spain

At the invitation of the Supreme Council on Scientific Research of Spain, the JINR delegation visited two scientific centres located in Madrid, namely the Institute of Matter Structure and the Institute of Mathematics and Fundamental Physics. Prof. P.N. Bogoliubov and I were received by President of the Supreme Council on Scientific Research of Spain Professor R. Tarrach. During very fruitful talks an agreement was reached to broad scientific

cooperation between Spanish scientific centres and JINR. Preparation of protocols on cooperation with the Institute of Matter Structure and the Institute of Mathematics and Fundamental Physics has become one of the results of the visit to Madrid. In future we plan to sign an agreement with the Royal Scientific Society of Spain.

3.2 Conferences, Meetings and Visits

3.2.1 Conferences

47 conferences, workshops, schools and other meetings were organised by JINR in 2002. I underline the fact that these conferences took place in Dubna and in Belarus, the Czech Republic, Greece, Mongolia, Romania, the Slovak Republic, and Ukraine. On the slide you can see a list of some conferences.

More than 4800 scientists were the participants of these conferences, including 276 physicists from the JINR Member States (without Russia) and 275 scientists from the other countries.

3.2.2 Exhibition in Romania

Another important event that I would like to mention is the traditional JINR-CERN poster exhibition “Science Bringing Nations Together” recently organized in Romania.

Since 1997, when the first joint exhibition of this series was held at the University of Oslo (Norway), CERN and JINR organize these exhibitions every year. It was shown also at UNESCO in 1998, at the UN Office in Geneva in 1999, in the European Parliament in Brussels in 2000, and in the Russian State Duma in Moscow in 2001.

The recent joint exhibition was held in Romania.

The Directorates of JINR and CERN believe that the organization of these exhibitions contribute to the popularization of the scientific achievements of the two international centres and hope to continue this joint effort in the future.

Next exhibition will be held in Yerevan (Armenia) during CERN-JINR School on High Energy Physics (on August 2003).

3.2.3 Visit of S.M. Mironov

On 29 November 2002 the Speaker of the Federation Council of the Federal Assembly of the Russian Federation S. Mironov visited Dubna and JINR. The purpose of his visit was to see the accumulated experience in Dubna in the development of innovation economy, science and education.

In particular, in connection with the idea to hold a summit of Commonwealth of the Independent States (CIS) on the Dubna and JINR basis S. Mironov said, "It is an absolutely right idea and I, in my turn, will also address the President V. Putin with a request to support it."

3.2.4 Visit of Trubnikov

Very significant meeting was held on 23 December 2002. V. Trubnikov, First Deputy Minister of Foreign Affairs of Russia and the Federal Minister on the CIS Affairs, visited JINR together with Yu. Baturin, the Russian astronaut and the former chairman of the Defence Council of Russia.

3.2.5 Conference: Intellectual Bridge “Russia – West: Problems and Perspectives”

Intellectual Bridge “Russia – West: Problems and Perspectives” was held in Dubna on 24 December, where Russian scientists who work abroad, representatives of Russian science cities, scientific centres of the Moscow region took part. The initiative to organize the forum belongs to the Moscow Region’s Governor B. Gromov.

At the opening ceremony of the conference spoke the Governor B. Gromov, Mayor of Dubna V. Prokh, rector of the Dubna University Prof. O. Kuznetsov, former Russian Minister of Science B. Saltykov, and others. B. Gromov pointed out: “At the very first meeting with President V. Putin I will discuss with him the question of establishment of free economic zones on the basis of science cities”.

Concluding, let me remind you that all of you as members of the JINR Scientific Council effectively worked during 5 years or 10 years. Some members confirmed their participation in the Council for the next 5 years. The JINR Directorate welcomes your desire and plans to prolong the participation in the Council.

We are very grateful to all Members of the Scientific Council. We regard the Scientific Council as a really working body who helps to accept strategically important plans and to solve arising problems.

So much for the information about the implementation of the recommendations of the Scientific Council’s 91st and 92nd session and the latest news.

Thank you for attention.