

Preface

The International Symposium on Exotic Nuclei "EXON 2012" took place on 1 - 6 October in Vladivostok (Russia). It was dedicated to one of the most important and rapidly developing areas of nuclear physics – the physics of exotic nuclear states. The symposium was jointly organized by five major research centers, where the discussed topics are of high priority – the Joint Institute for Nuclear Research (Dubna), the Large Heavy Ion National Accelerator GANIL (France), The Institute of Physical and Chemical Research RIKEN (Japan), The GSI Helmholtz Centre for Heavy Ion Research (Germany), and the National Superconducting Cyclotron Laboratory NSCL (Michigan, USA). This Symposium, having become a traditional one, was dedicated to the results of the recent experimental and theoretical studies on the synthesis and properties of nuclei far from the valley of stability - from the lightest to the super-heavy elements. In recent years, this area of research is rapidly developing, necessitating the regular organization of such scientific meetings. The previous Symposium "EXON-2009" was held in Sochi in 2009.

At present the most sophisticated physical experiments, that are carried out at large-scale accelerator facilities requiring enormous financial investments can be realized only through the combined efforts and cooperation of the leading scientific centers. As an example we can mention the creation of the Large Hadron Collider at CERN and of the heavy ion accelerators at the Joint Institute for Nuclear Research (Dubna) which has about 20 member-states. Thus the research is done in collaboration of the research centers of several countries. Each country makes its financial and intellectual contribution to the creation of the large-scale facilities, allowing to penetrate deeply into the mysteries of matter and to obtain new information not only for nuclear physics, but also for other scientific fields such, as astronomy, condensed matter physics and current technologies. The fundamental investigations and methods used in these centers are of great importance for the interdisciplinary fields of science and technology, such as nanotechnology, medicine and microelectronics.

Nuclei in exotic states are these, which have high angular momentum ("madly" rotating nuclei), high excitation energy ("hot" nuclei), large deformation (super- and hyper-deformation, nuclei with unusual shape), nuclei with abnormally large neutron or proton number (neutron- or proton-rich nuclei), and super-heavy nuclei with the atomic number $Z > 110$. The studies of the

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properties of nuclear matter in extreme states provide important information on the properties of the microcosm, and thus allow the modeling of the different processes in the Universe. The leading world centers studying the nuclei in exotic states are the Joint Institute for Nuclear Research (Dubna), the Large Heavy Ion National Accelerator GANIL (France), The Institute of Physical and Chemical Research RIKEN (Japan), The GSI Helmholtz Centre for Heavy Ion Research (Germany), and the National Superconducting Cyclotron Laboratory NSCL (Michigan, USA). The Leaders of these five centers were the co-chairmen of the Symposium organizing committee - Academician Yu.Oganesyan (JINR), Professor S.Gales (GANIL), Professor H.En'yo (RIKEN), Professor K.Stoecker (GSI) and Professor K.Gelbke (USA). This is the sixth Symposium on Exotic Nuclei taking place in Russia. The first one was held in 1991 in Foros (the Crimea), and then there was a symposium at the Baikal Lake, in Peterhof, in Khanty-Mansiysk and in Sochi. All these events aroused interest not only among the scientists of the institutes-organizers, but also of other research centers of the world. In addition to discussions of scientific issues and questions on cooperation, the participants have an opportunity to get acquainted with the most interesting places in Russia while the local authorities and universities receive the latest information about the scientific achievements of nuclear physics and about its possible application in the related fields of science and technology. About 130 scientists from 24 countries participated in the Symposium "EXON 2012". A lot of leading scientists of the institutions making research in the field of nuclear physics were among them. The most represented countries were Germany (10 delegates), France (12 delegates), Japan (10 delegates), USA (8 delegates). The scientific centers of Russia were represented by 28 participants. The scientific program included the invited papers on the most important areas in the physics of exotic nuclei and on the new projects of the largest accelerator facilities and experimental facilities. In addition the questions on fundamental physics and applied research were discussed at the Symposium. The representatives of the Far Eastern Federal University took an active part in the discussions. This relatively young University at the Far East of Russia has powerful scientific potential and good prospects for scientific research. There is also a plenty of institutions in the Far East that are members of the Far Eastern Branch of the Russian Academy of Sciences under the direction of V.I. Sergienko. This explains the choice of place for the symposium and the participation of local

institutions in it. During the symposium the results of the recent experiments on the synthesis and properties of the nuclei of new super-heavy elements were discussed, that indicates a high efficiency of international collaborations. Interesting results were obtained in the joint experiments of FLNR (JINR), GSI (Germany) and Paul Scherrer Institute (Switzerland). These experiments on the chemical identification of elements 112 and 114 were carried out in the beams of FLNR cyclotron U-400. A notable example of such cooperation is an experiment on the synthesis of element 117. It is done in collaboration with the scientists from the US Laboratories that provided the target material of ^{249}Bk . The ongoing experiment is carried out at JINR by a large group of physicists and chemists headed by Academician Yu. Oganessian. In October this year, right after the Symposium, the inauguration of two elements discovered in Dubna - 114 (Flerovium) and 116 (Livermorium) - took place in Moscow.

Many interesting results have recently been obtained in the studies of the interaction of weakly bound nuclei, such as ^6He , ^8He , ^6Li , ^{11}Li etc. The phenomenon of sub-barrier nuclear fusion was discovered and also the effect of strengthening of sections of exchange reactions in the subthreshold energy region was obtained. Interpretation of these results was presented in the theoretical presentations. The experimental results of search of resonance in the ^7H system were presented for the first time at the session. These experiments carried out at FLNR JINR give new interesting results indicating that the reactions with weakly bound nuclei look promising for the obtaining of information on the boundaries of nuclear drip line in the lightest elements. The experimental results of the search of the tetra-neutron (^4n), ^6H , ^7H and ^{10}He , obtained in different research centers, were presented at the Symposium. A large amount of new information on the properties of nuclei at the borders of nuclear drip line was presented by the physicists from GANIL, GSI, MSU and RIKEN. One day of the Symposium was entirely devoted to the present and future heavy-ion accelerator complexes and radioactive nuclei complexes at the leading research centers of the world. Five laboratories-organizers of the Symposium are now at the process of constructing a new generation of accelerators that will make significant progress in the direction of synthesis and study of new exotic nuclei properties. The projects SPIRAL, RIKEN, FAIR, DRIBs, NIKA and RIBF were presented by the project directors.

Since the realization of such large-scale projects is only possible through the joint efforts of the leading research centers of the world, it was an extremely

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important aspect of the symposium to discuss the possibilities of various collaborations in order to create the physical facilities and to develop the joint research programs. It was basically the main objective of the Symposium that explains the support of this event by the leading research centers of Europe. The organizational issues in this area were discussed and in particular the possibility of cooperation of JINR with the European physical communities. There were about 80 oral presentations and about 40 poster presentations at the Symposium. The extensive scientific program was combined with an equally rich cultural program. There were trips to Vladivostok and to the surrounding area, boat-trip to the numerous bays of the Pacific Ocean and also interesting folk concerts organized for the participants.

The next Symposium EXON-2015 is expected to be held in the West of Russia in Kaliningrad.



A handwritten signature in black ink, appearing to read 'Yuri Penionzhkevich'. The signature is written in a cursive style and is positioned to the right of the circular portrait.

Yuri Penionzhkevich

Chairman EXON-2012

WELCOME
**JINR: BRIEF INTRODUCTION INTO HISTORY, PRESENT
STATUS AND FUTURE DEVELOPMENT**

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Dear colleagues, friends,

First of all, I would like to express my sincere gratitude to the Organizing Committee of the International Conference EXON 2012 for the invitation to give an introductory talk at the opening ceremony of the Conference. I am going to make a brief introduction into the history, present status and perspectives of development of the Joint Institute for Nuclear Research in Dubna (JINR).

It is an honor and great pleasure to me to speak to you – the participants of such a representative world-known Conference on fundamental issues of the modern nuclear physics.

I'd like to add that I am especially happy to participate in and speak at the Conference in Vladivostok where I grew up in my youth years, finished school and even started my higher education in the Far East University, before moving to the Leningrad State University to proceed studying theoretical physics at the V. Fock Chair. The Russian Island or Ruskii Ostrov where we are working now is dear to me as the birth place of my father – a son of a sailor from the Amur Fleet.

But let me go back to the topic of my presentation.

For those of you who have never been in Dubna I may start with a saying that Dubna is rather small, a town of about 70 thousand inhabitants on the banks of the Volga river and an artificial sea, about 120 km to the north of Moscow – a beautiful peaceful place of Russian Nature. Because of the presence of JINR, Dubna was given a special status of a Science Town and it is called in Russian “naukograd”. JINR has the status of the international

intergovernmental organization on the territory of the Russian Federation and its privileges as such are secured by the special Agreement between the RF Government and JINR, being ratified on 2 January 2000 as the Federal Law. If at the moment of JINR organization in 1956 – almost the same year as CERN- there were 12 member states, now, starting from the 1990s, JINR has 18 member states from Europe and Asia and 6 more (Germany, Italy, Hungary, Serbia, the Arab Republic of Egypt and the South African Republic) that participate in JINR activities on the basis of the bilateral intergovernmental agreements with JINR and are provisionally called associate members.

The supreme governing body of the Institute is the Committee of the Plenipotentiaries of the governments of the member states (CP) which elects the Directorate of JINR with maximal two re-elections for the 5-year terms and approves its program and corresponding funding on the recommendations of the Finance Committee (FC). CP also elects the international Scientific Council which has the right to formulate and supervise the scientific program of the Institute and by secret ballot elects the directors and their deputies of the seven major Laboratories of JINR. The JINR Scientific Council consisting of the outstanding physicists and leading specialists from all over the world also forms three Program Advisory Committees acting on the regular basis, according to the main scientific directions of research at JINR that include elementary particle and high energy physics, low and high energy heavy ions physics, nuclear physics, neutrino and astroparticle physics, condensed matter physics and radiobiology and extensive educational programs. And of course, not to forget, the traditionally very strong in Dubna theoretical physics.

It would be fair to say that JINR was established not on nothing, or as we say in Russian “not on an empty place”. Here in Dubna in the Laboratory established on I. Kurchatov’s initiative the proton Synchrocyclotron on the energy 680 MeV was completed and already started to work in 1949. And only a year after JINR was organized, in 1957 the Synchrophasotron with the world record energy of 10 GeV, constructed under the leadership of V. Veksler, gave the first proton beam. At present, JINR consists of 7 major Laboratories on the scale of big institutions, namely: the Bogoliubov Laboratory of Theoretical Physics, the Veksler-Baldin Laboratory of High Energy Physics, the Dzhelepov Laboratory of Nuclear Problems, the Flerov Laboratory of Nuclear Reactions, the Frank Laboratory of Neutron Physics, the Laboratory of Information Technologies, the Laboratory of Radiation Biology. JINR Staff consists of about

1200 physicists, one quarter of it from the member states outside Russia, and of highly qualified engineers, technicians, other specialists with the total number about 3200.

About four years ago the JINR Scientific Council and the Committee of Plenipotentiaries summarized the results and experience of the difficult years of what we in Russia call a survival and, relying on the opinion of scientific leaders of the Institute, took a very important and responsible decision. The JINR Road Map for the further development of the Institute was worked out and the corresponding Seven Year Plan for 2010-2016 was approved.

The main objectives of this Plan are modernization of the existing basic facilities of JINR and construction of the new one that will allow JINR to preserve or acquire the leading positions at those scientific directions where JINR has traditionally strong world-accepted status.

It includes modernization of the first ever built in the world superconducting accelerator of heavy ions – the Nuclotron and its operation as the base for the construction of the new, unique in its parameters, superconducting collider of heavy ions up to gold. This project plays the role of the flagship project of JINR on its path to the leading positions in the world science. It has received the name the NICA/MPD Project. Its goals are search and study of the predicted by theorists critical phenomena in the superdense baryonic matter that can help us to understand the nature of the primordial quark-gluon phase of baryonic matter which existed in our Universe at the first moments after the so-called Big Bang.

The Plan includes the modernization of the complex of the existing cyclotrons of the Flerov Laboratory of Nuclear Reaction and construction of a more powerful new one to build the Factory of the Superheavy Elements (SHE) and complete the third phase of the Dubna Radioactive Ion Beams complex (DRIBS-III).

The task of modernization of the unique Dubna research Pulsed Neutron Reactor IBR-2M has already been achieved. After the modernization was completed at the end of 2011 the reactor achieved the average power 2 MWt and operates actively to implement the Users Program.

There are a number of very important tasks in the Seven Year Plan connected with the development of the research infrastructure, including education and innovations closely related to the research programs and corresponding social infrastructure.

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To secure the implementation of this ambitious program, the Committee of Plenipotentiaries accepted a very serious plan according to which the JINR member states should increase their contributions into the JINR budget annually in 2010-2016. And I am glad and proud to say that up to now these obligations have been fulfilled, in spite of all the economic problems in the modern world. If it works up to the end of the seven-year period 2010-2016, we are confident that all the goals of the Seven Year Plan will be achieved. Except for the NICA Project which requires for its completion a longer period, we are planning to complete the Booster and the Fixed Target Experimental Area and to start the corresponding experimental program on the basis of the joint JINR&GSI installation BM@N (that means studying the Baryonic Matter at the Nuclotron). To complete the whole NICA Complex with the superconducting rings of the heavy-ion collider and to start a corresponding research program we need two years more (2017-2018). To secure this more extended plan, we are looking for additional resources above the JINR budget. In that respect I may mention that the special Commission of the Russian Government on high technology and innovations headed by V.V. Putin visited Dubna and JINR in 2011, considering a possible implementation on the territory of RF of a number of Mega-Science projects, in addition to Russian participation in the international mega-science projects, such as EXFEL and FAIR in Germany and ITER in France. The NICA project was mentioned by this Commission among other six mega-science projects. At present, JINR specialists are actively working with the specialists of the Ministry of Education and Science of RF under preparation of negotiations with a number of other countries which have expressed their interest in joining this international enterprise called Mega Project NICA. If this decision is approved by a consortium of countries together with RF, JINR will get additional resources not only for completion of the NICA collider itself according to the schedule but for the development of a necessary infrastructure around it as well, taking advantage of the potential of the NICA complex to implement the modern educational and innovation initiatives.

The work on the construction of the NICA/MPD complex is now in a very active phase. In the final stage of preparation is the zone for assembling the superconducting magnets of a unique design made by JINR specialists for both NICA and FAIR projects (the so-called SIS-100 magnets). Intense work is going on design, beam-testing and production of the elements of the Multi-

Purpose Detector (MPD) for the NICA complex. In collaboration with GSI work is going on the preparation of the BM@N installation. I would like to stress the fact that physicists of JINR and GSI are working so closely together that it gives us the right to say that NICA and FAIR can be considered as an entity distributed between two sides of the joint project.

The work on construction of the DRIBS-III complex to substantially increase the research and discovery potential of the JINR research program on the search of the new superheavy atomic elements and study of the exotic and superheavy nuclei and their chemical properties is no less active. It is well known that the Flerov Laboratory of JINR is the world known leader in this area of the fundamental research. I am pleased to mention that in the coming October this year a remarkable event is planned to happen in Moscow– the International inauguration of the discovery of two new chemical elements of the Mendeleev Table – the Flerovium (114) and the Livermorium (116). I would use this as a chance to applaud to authors of this discovery and first of all, to Professor Yuri Oganessian among the participants in this room.

I am also glad to add that this year we have received the confirmation of the existence of the element 117 previously observed in Dubna.

Returning to elementary particle physics, I must say that physicists of JINR actively participate in major international world projects in this area. First of all, I can mention the visible contribution to the discovery of the Higgs-like boson in the ATLAS and CMS experiments at the LHC in CERN and not less valuable measurement of the neutrino oscillation angle Teta-13 in the experiments at Daya Bay in China and at T2K in Japan. The valuable results were received in the neutrino physics studies and the double beta decay search. Next year we will celebrate the centenary jubilee since the birthday of Academician Bruno Pontecorvo – one of those great physicists who stood at the beginning of JINR in Dubna. His pioneer works and ideas, his genius of a physicist changed the landscape of the modern fundamental science. The notion of the neutrino oscillations is a key to understanding physics beyond the Standard Model and to possible solutions of the most difficult puzzles in modern physics – the Baryonic Asymmetry of Universe. His scientific school is still one of the moving forces of the Laboratory of Nuclear Problems of JINR, with an extensive involvement into a number of the key neutrino experiments: the high energy neutrino study at the Baikal deep underwater telescope, search

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for the double-beta decay and dark matter, monitoring neutrino fluxes at the Kalinin Atomic Station in Russia and others.

JINR has the Laboratory of information technologies with the well-developed GRID complex which is extensively used by JINR as well Russian institutions in the experimental studies at the LHC at CERN. At present, JINR in collaboration with the National Research Centre “Kurchatov Institute” and in accordance with the Agreement between Russia and CERN participates in the construction of the Tier-1 Centre in Russia. At the end of the last year the prototype of this Centre was successfully tested.

One of the last Laboratories established in JINR is the Laboratory of Radiobiology which performs an extensive program of research on the genetic phenomena under the irradiation of cells by neutrons and heavy ions. One of the problems being studied at this Laboratory is connected with the medical problems of long space flights, let us say, to Mars. Just recently a new very exciting theme has been approved by the Program Advisory Committee to be studied at this Laboratory – Astrobiology or to be more concrete the problem of the origin of life on the Earth. Using the physics methods in this Laboratory the traces of the primitive organisms on the cuts of meteorites and accessible space dust are looked for. These studies are going in the close collaboration with the Biology Division of the Russian Academy of Sciences and under their scientific guidance.

One of the major pillars of the scientific program of JINR is the extensive educational program and innovation activities. JINR has its own Education-Scientific Centre and also the basic Chairs of a number of the Leading Russian Universities: Moscow State University, the Moscow Physical Technical University, the Moscow Engineering Physical Institute or the Nuclear University as it is called now. And Dubna has its own local University “Dubna” which plays nowadays a very important role in the JINR educational program.

Speaking about innovations, I can mention the special advantage we have in Dubna as here the Special Economic Zone is established by the Russian Government decision. It helps in implementation of the innovative technologies developed in the JINR Laboratories. One of the examples: the Flerov Laboratory of Nuclear Reactions has assembled for one of the Projects called “BETA” the special cyclotron DS-110 for production of the track membranes to be used in the medical instrumentation for the plasmapheresis of blood. Another example is the production of the detectors for the identification of the

narcotic and explosive materials by using the method of the marked neutrons. There are many others.

To conclude I may say that JINR is in a stage of very active development having great perspectives. The international ties of JINR are expanding. And we are very interested in developing the collaboration with the Russian Institutions and Universities.

Being now in the Ruskii Ostrov at Vladivostok at this great campus of the Far East Federal University I would like to express especially our intention to establish active scientific ties with this University and the institutions of the Far East Division of the Russian Academy of Sciences.

We are especially interested in attracting young talented people for participation in implementation of the new projects of the mega-science scale at JINR in Dubna.

Let me once more thank our hosts in Vladivostok and the Far East Federal University for their help in organization of our International Conference EXON'2012 and wish all the participants fruitful work and rich impressions from that unique place.

Thank you for your attention!



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