

**I. Preamble**

1. The Programme Advisory Committee for Particle Physics takes note of the information presented by JINR Vice-Director R. Lednický on the Resolution of the 104th session of the JINR Scientific Council (September 2008), on the decisions of the JINR Committee of Plenipotentiaries (November 2008), and on the preparation of the Seven-Year Plan for the Development of JINR for 2010-2016.

The PAC notes with satisfaction the decision of the Committee of Plenipotentiaries to increase the JINR budget by 22.8% in 2009.

The PAC also notes that the Committee of Plenipotentiaries regards as important and timely the decision of the JINR Directorate to prepare a plan for the development of JINR for the years 2010–2016 in view of the completion, this year, of the current seven-year “Programme of the Scientific Research and Development of JINR”. The new seven-year plan should be based on the strategic provisions of the JINR road map, on the budget estimates for the future period, and especially on issues related to human resources and social reforms. The main scientific emphasis in the seven-year plan should be the future development of the in-house facility base for fundamental scientific research and effective exploitation of the science which is presently or about to be produced in external programmes in which JINR has made a major investment. It should also include such aspects as the realization of the educational and innovation programmes, and the development of the engineering infrastructure.

The PAC is pleased to note that the Committee of Plenipotentiaries reiterated its previous decision to address the governments of the Member States with a proposal to make provisions for an increase of the JINR budget in 2011–2015 (tentatively 2.5 times by the year 2015 relative to the level of the year 2010) with a view to creating an in-house facility base attractive to the Member States and the world scientific community. These facilities will include the Nuclotron-M and NICA/MPD, a third-generation DRIBs facility (DRIBs-III), and a complex of state-of-the-art neutron spectrometers for the modernized reactor IBR-2M.

The PAC notes the agreement of the Scientific Council with its conclusion that the success of the Nuclotron-M/NICA project will depend critically on the creation of a well-developed, detailed plan for realization, and notes that the Council looks forward to a report on progress in this direction from the Chairperson of the MAC for Nuclotron-M/NICA at a future session. The PAC recognizes and applauds the present effort to internationalize the construction and the scientific programme of Nuclotron-M/NICA and strongly encourages continued aggressive effort in this direction.

The PAC reiterates its previous conclusion that an essential step towards increasing international interest and visibility of the Nuclotron-M/NICA/MPD development will be a well-written white paper and conceptual design report which documents, with physics simulations, what compelling scientific questions will be answered by the proposed programme, and what machine parameters are critical to achieve scientific success.

The PAC notes the recommendation of the Scientific Council concerning the increase of the budget required to complete the creation of student laboratories in the JINR University Centre (UC), and to enlarge the number of PhD students. The lecture programmes for school teachers at JINR should also be funded. The possibility of accreditation of PhD status for students who participate in the Educational Programme should be explored, especially for the Member States.

2. The PAC notes with satisfaction the signing of the contract between JINR and the Russian State Enterprise "Space Communication" for creation of a high-speed communication channel Dubna–Moscow.

3. The PAC highly congratulates physicists from the Dzhelapov Laboratory of Nuclear Problems who, together with the American colleagues within the D0 project, collaborated on scientific analysis leading to the first observation of the  $\Omega_b$  baryon. This discovery has been ranked among the ten most significant achievements in physics in 2008 by the American Physical Society.

4. The PAC notes with interest the information, presented by V. Zhabitsky, about the ongoing work towards the start-up of the world's largest accelerator — the Large Hadron Collider (LHC) at CERN.

5. The PAC congratulates the Director of the JINR University Centre, D. Fursaev, on having been elected Rector of the International University "Dubna".

## **II. Recommendations on the long-term scientific programme**

In line with the recommendations of the Scientific Council, the JINR Directorate is preparing the first draft of the seven-year plan for JINR development for 2010–2016.

The PAC takes note of the information on the concept and the objectives of this programme, presented by JINR Vice-Director R. Lednický, and the proposals to this programme in the field of particle physics, presented by the directorates of the JINR laboratories.

The PAC endorses the main lines of the proposed long-term programme of particle physics research and looks forward to being presented the draft report documenting this programme well in advance of its next meeting in June 2009. This draft should take into account remarks and additions given at this PAC meeting and at the 105th session of the Scientific Council.

### **III. General recommendations on the Programme of Particle Physics Research for 2009–2011**

The PAC takes note of the reports presented by A. Sorin, Deputy Director of the Bogoliubov Laboratory of Theoretical Physics, V. Kekelidze, Acting Director of the Veksler and Baldin Laboratory of High Energy Physics, A. Olshevskiy, Director of the Dzhelapov Laboratory of Nuclear Problems, and by V. Ivanov, Director of the Laboratory of Information Technologies, and the main lines of the JINR Programme of Particle and Relativistic Nuclear Physics Research proposed by them for the period 2009–2011 in accordance with the updated JINR road map.

The PAC notes that it will be presented by the VBLHEP Directorate with a proposal and supporting material for consideration at its next meeting concerning consolidation of the scientific programme of the laboratory.

### **IV. Recommendation on progress towards realization of the Nuclotron-M project**

The PAC takes note of the report on progress towards realization of the Nuclotron-M project, presented by JINR Deputy Chief Engineer G. Trubnikov, and appreciates the significant progress towards upgrading the Nuclotron-M machine.

The PAC is convinced that to attract international interest and investment it will be crucial for the Nuclotron-M advance to bring the performance of the accelerator as close as possible to the present state of the art in relation to comparable accelerator facilities at other international centers. It strongly encourages the Nuclotron-M development team to make a critical assessment of what performance and what resources would be required to achieve this goal. It looks forward to a report on this assessment at its next meeting.

### **V. Recommendation concerning the report from the Chairman of the Nuclotron-M/NICA Machine Advisory Committee**

The PAC takes note of the report by the Chairman of the Machine Advisory Committee (MAC) for the Nuclotron-M/NICA accelerator complex, Professor B. Sharkov (ITEP, Moscow); in particular of the written “Review on the Progress in the Realization of the Nuclotron-M Project” (Appendix 1). The PAC highly respects the pool of expertise constituted by the MAC and appreciates the work it is carrying out.

It notes, however, for this expertise to be most useful for the Nuclotron-M development, it is essential for the MAC to be aggressively involved in critically assessing the proposed design as soon as possible.

The PAC recommends a face-to-face review of the proposed plan and design for Nuclotron-M/NICA at the earliest appropriate time and looks forward to a report from the Chairperson of the MAC on the results of this review at its next meeting. The PAC notes

that a full review of the proposed design by the MAC is essential before publication of the NICA technical design report.

## **VI. Recommendation on progress towards a white paper on the mixed phase and potential future spin physics programs at NICA**

The PAC takes note of the information presented by BLTP Deputy Director A. Sorin on the ongoing preparation of a white paper on the mixed phase and potential future spin physics programmes at NICA.

The PAC looks forward to receiving, prior to its next meeting, the results of initial simulations toward a conceptual design report for MPD which documents, what compelling scientific questions will be answered by the proposed programme, and what machine parameters are critical to achieve scientific success.

The PAC notes the considerable progress reached in this direction.

## **VII. Recommendation for activities at JINR related to the ILC**

The PAC notes with interest the report presented by JINR Deputy Chief Engineer G. Trubnikov on the progress for ongoing developments at JINR related to the ILC.

The PAC feels strongly that in order for JINR to be competitive as a potential host laboratory for the ILC, a proactive team including scientists and engineers must work intensively to further document the viability and attractiveness of siting the ILC in the Moscow region with JINR as a host.

## **VIII. Recommendation on the status report on the CLIC project**

The PAC takes note of the status report on JINR's participation in the CLIC project and notes the importance of this activity for the future JINR projects in high-energy physics.

## **IX. Recommendations on the activities previously approved for completion in 2008 and proposed for continuation**

1. The PAC takes note of the report on the theme "Dubna International Advanced School of Theoretical Physics (DIAS-TH)". The PAC highly appreciates the work on the organization of schools, lectures and seminars for young scientists within this theme. The PAC notes with satisfaction the significant role of this theme in the development of the JINR research and education programme. The PAC recommends closing this theme and approval for opening a new theme "Research and education project "Dubna International Advanced School of Theoretical Physics (DIAS-TH)"" for execution until the end of 2013.

2. The PAC takes note of the report on the theme "Organization, maintenance and development of the university-type educational process at JINR". The PAC appreciates the

impressive progress of the JINR Educational Programme, pursued by the University Centre during the last 10 years, in particular the increased number of students and JINR-based university departments, the successful organization of the international practice for students of JINR Member States, and the creation of educational infrastructure. The PAC recommends closing this theme and approval for opening a new theme “Organization, support and development of the education process at JINR” for execution until the end of 2013.

3. The PAC reiterates, in the strongest terms, that now is the time for JINR scientists participating on ALICE, ATLAS and CMS to position themselves, through detailed preparation for analysis of data, to play a leading role in the production of new science from these experiments in which JINR, Russia and the other Member States have invested heavily and successfully made major contributions. The PAC looks forward to a report at its next meeting on the work by the JINR ALICE, ATLAS and CMS groups toward the start of data taking and processing, on the physics research programmes to be carried out by the JINR teams, and on future plans for upgrades of the LHC detectors.

3.1. The PAC takes note of the report on JINR’s participation in the ALICE project, highly appreciates this important activity, and recommends its continuation until the end of 2009.

3.2. The PAC takes note of the report on JINR’s participation in the ATLAS project, highly appreciates this important activity, and recommends its continuation until the end of 2009. The PAC regards as especially important the creation at DLNP of the remote monitoring centre for the ATLAS detector.

3.3. The PAC takes note of the report on JINR’s participation in the CMS project, highly appreciates this important activity, and recommends its continuation until the end of 2009.

4. The PAC takes note of the report on JINR’s participation in the DIRAC project. The PAC appreciates the important results obtained in this experiment, and recommends continuation of this activity until the end of 2011.

5. The PAC takes note of the report on the pHe3 project and recommends its continuation until the end of 2009. The PAC notes the importance of the research programme of this project, and looks forward to a proposal at the next meeting for the future continuation of this activity.

6. The PAC takes note of the report on the ALPOM project and recommends its continuation with second priority until the end of 2009. The PAC notes the scientific importance of this project and the results already obtained, and looks forward to a proposal at its next meeting for the future continuation of this activity.

7. The PAC takes note of the written report on the theme “Study of  $e^+e^-$  interactions, linear collider physics and detector”, and notes the high quality of the accomplished work. The PAC recommends closing this theme and approval for opening a new theme “Study of  $e^+e^-$  interactions, physics and detectors” for execution until the end of 2011.

8. The PAC takes note of the written report on the OKAPI project and recommends its continuation until the end of 2009. The PAC notes the scientific importance of this project, and looks forward to a proposal at its next meeting for the future continuation of this activity.

9. The PAC takes note of the written report on the HADES project and recommends its continuation until the end of 2009. The PAC notes the importance of this research for the preparation of the NICA/MPD scientific programme, and looks forward to a proposal at its next meeting for the future continuation of this activity.

10. The PAC takes note of the written report on the NIS project, and recommends its continuation until the end of 2009. The PAC expects with interest to hear the first results of the experiment, and looks forward to a proposal at its next meeting for the future continuation of this activity.

11. The PAC takes note of the written report on the Med-Nuclotron project and recommends its continuation until the end of 2009. The PAC looks forward to a proposal at the next meeting for the planned research in the future, including a substantiation of its competitiveness.

12. The PAC takes note of the written report on the theme “Development of particle detection methods based on thin-wall drift tubes for precision coordinate measurements at high luminosity” and recommends continuation of this work until the end of 2009. The PAC invites the authors to present a proposal for a project on this topic.

13. The PAC takes note of the written report on JINR’s participation in the TUS project, notes the achieved progress in this activity, and recommends its continuation until the end of 2011.

14. The PAC takes note of the written report on the project “Development of accelerators for radiation technologies”. The PAC recommends continuation of the sub-project “electron accelerator” with second priority until the end of 2009.

15. The PAC takes note of the written report on the project “Modernization of the polarized proton target” and recommends to close this project and continue this activity within the framework of the theme “Search for non-nucleon degrees of freedom and spin effects in few-nucleon systems”.

## **X. Recommendation on the project previously approved for completion in 2008**

The PAC takes note of the written report on JINR's participation in the PHENIX project and recommends that the JINR Directorate close this work. The PAC recognizes the contribution of the JINR group to this experiment.

## **XI. Recommendations on first-priority activities**

The list of the themes and projects having first priority in 2009 is presented in Appendix 2.

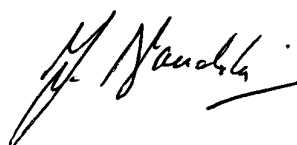
The PAC notes that as part of the ongoing effort to streamline the JINR particle physics programme, the priority and funding of all projects, including those with first priority, may be reviewed as appropriate, even if they have been previously approved for a three-year period.

## **XII. Next meeting of the PAC**

The next meeting of the PAC for Particle Physics will be held on 10–11 June 2009.

The following items are proposed to be included in the agenda:

- Consideration of new projects and themes
- Reports and recommendations on the projects to be completed in 2009
- Preliminary results of the implementation of the current “Programme of the Scientific Research and Development of JINR” and preparation of the new seven-year plan for 2010–2016
- Report on progress for ongoing developments at JINR related to the ILC
- Report on progress towards realization of the Nuclotron-M/NICA projects
- Report from the Nuclotron-M/NICA Machine Advisory Committee
- Progress towards first data taking and analysis from the LHC experiments
- Proposal to begin consolidation of the VBLHEP physics programme
- First draft of the Conceptual Design Report for the MPD detector
- Progress towards a white paper for the NICA/MPD programme.



J. Nassalski  
Chairperson of the PAC

### **Review on the Progress in the Realization of the Nuclotron-M Project**

The Nuclotron-M project is the initial phase of a general project aimed at developing the JINR experimental base for production of intense beams of heavy ions and polarized nuclei with the ultimate goal of studying the problem of phase transitions in strongly interacting nuclear matter. During 2008, essential results were obtained in the realization of a few subprojects.

A large amount of expensive and time consuming work has been done on the VBLHEP cryogenic complex. The full-scale upgrade, started in June 2008 after run 38, is in the final stage now. During July-November, the total modernization of the oil-cleaner unit for liquid helium at KGU-1600 plant was successfully completed. The main part of the KGU-1600 equipment was renewed. Such reconstruction procedures of the KGU-1600 will allow the accelerator complex of VBLHEP to be safe and stable operational for extended runs and will decrease liquid He and liquid nitrogen consumption substantially.

Essential progress was achieved in the modernization of the magnetic system power supply. Main Nuclotron power supplies (19 TV and 20 TV) were totally reconstructed, re-mounted and prepared for the machine operation at 1.5 T (experimentally tested at equivalent current 4500 A). A special prototype of the energy evacuation system (modernized existing electronic scheme with new thyristors) was successfully constructed and installed in the ring tunnel. It will allow safely to operate with the Nuclotron magnetic system at magnetic fields up to 1.5 T. Activities Work on the old power lines dismantling and routing of the new power supply cable lines (several kilometers of cables) in total was started in October 2008 and is in active phase now. All this activity is performed in the frame of total modernization of the power system of the accelerator complex.

Substantial progress was achieved in the Nuclotron vacuum system upgrade. The improvement of the vacuum was confirmed with circulating deuteron beam by using newly installed instrumentation in accordance with PAC recommendations. The vacuum conditions in the Nuclotron beam pipe are estimated to be improved by about two orders of magnitude. The realization of the 2nd stage has been started now with emphasis on the development of automatic control system for the Nuclotron vacuum equipment.

The development of the high-intensity, high-charge state "Electron String Ion Source" (ESIS) is well advanced. Four runs (one month each) on the existing ion source KRION-2 (solenoid field 3T) are performed with  $\text{Xe}^{36+}$  in order to prepare the source for operation in the Nuclotron run (autumn 2009) with  $\text{Xe}^{44+}$  ions ( $A=129$ ,  $Z/A=0,341$ ). Within the framework of the development of the new ion source KRION-6T in 2008, the technical design was



completed and manufacturing of the source elements was started. All elements of the vacuum vessel for the KRION-6T source are designed, manufactured and tested. All necessary elements of the oil-free vacuum pumping system are purchased or manufactured. The vacuum system of the source is assembled and ready for the vacuum tests. The BNL EBIS design presents a possible fall-back option for the NICA project.

The upgrade of the automation and diagnostic systems, RF system and extraction of the accelerated beam are in very active phase.

The MAC recommends paying more attention to the work related to the upgrade of the existing linac LU-20, which is planned to be used in the proton and light polarized ion injection chain.

The design of the NICA project is well in progress. The NICA conceptual design report presents tables of consistent parameters for heavy-ion injection chain, which can be a base for a technical design of the new injector linac and booster. The booster is based on the Nuclotron type magnets; therefore a long R&D stage is not necessary. Thus, serious attention should be paid to modernization and development of the existing VBLHEP experimental set-up for cryomagnetic tests. It is important both for the Booster magnet commissioning and for R&D of the collider magnets. Accelerator physics studies and simulations should be completed for the collider rings in order to provide required luminosity in polarized beam collisions as well as proton-ion collisions.

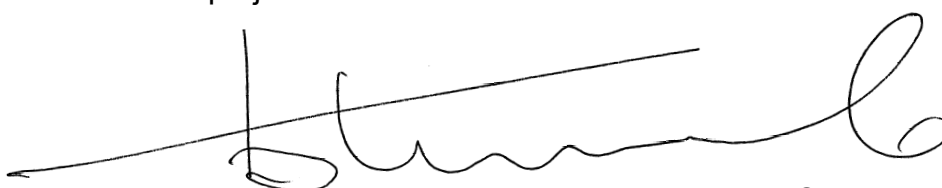
### **Conclusion**

1. The project Nuclotron-M is on the whole aimed at solving the key technological problems that restrict the operating parameters of the Nuclotron accelerator essential both for the NICA project and for the efficiency of the physics experiments currently being conducted and planned at the accelerator.

2. To the moment, essential results have been obtained in the realization of the main part of subprojects.

3. The nearest milestone of the Nuclotron-M project summarizing subprojects results has to be passed in the fall of 2009 during the Nuclotron run with  $\text{Xe}^{44+}$  ions ( $A=129$ ,  $Z/A=0,341$ ).

The MAC recommends that the JINR Directorate provide regularly the required funding of the activities in accordance with the time schedule for successful completion of the Nuclotron-M project.



Professor B. Sharkov  
Chairman of the

Nuclotron-M/NICA Machine Advisory Committee

### **List of First–Priority Activities**

The following activities are noted to have first priority in the JINR Programme of Particle Physics and Relativistic Nuclear Physics for the year 2009:

- Theory of elementary particles
- Modern mathematical physics: gravitation, supersymmetry, integrability
- Research and education project “Dubna International Advanced School of Theoretical Physics”
- International Linear Collider: accelerator physics and engineering
- Development of the JINR basic facility for generation of intense heavy-ion and polarized nuclear beams aimed at searching for the mixed phase of nuclear matter and investigation of polarization phenomena at the collision energies up to  $\sqrt{s_{NN}} = 9$  GeV
- Projects HADES (JINR’s participation), NA49/61 (JINR’s participation), BECQUEREL
- Search for non-nucleon degrees of freedom and spin effects in few-nucleon systems. Projects pHe3, ALPOM
- Projects COMPASS (NA58, CERN), HERMES and H1 (DESY) (JINR’s participation)
- Projects CDF, D0
- Charmed and strange quarks in hadronic reactions (projects NA48 CERN and OKAPI/NA62–CERN SPS (JINR’s participation))
- Study of neutrino oscillations and determination of oscillation parameters (projects OPERA (JINR’s participation), Daya Bay (JINR’s participation))
- Project NIS
- DIRAC (JINR’s participation)
- ATLAS (JINR’s participation)
- CMS (JINR’s participation)
- ALICE (JINR’s participation)
- Study of rare processes (projects E391a (JINR’s participation), KLOD, NN&GDH)
- STAR (JINR’s participation)
- Investigation at the GSI accelerating complex (JINR’s participation)
- Study of  $e^+e^-$  interactions, physics and detectors (projects SANC, BES-III (JINR’s participation))
- Development and creation of a prototype complex for radiotherapy with heavy-ion beams of the Nuclotron-M

- Project TUS
- Physics and engineering of feedback systems in synchrotrons
- Mathematical support of experimental and theoretical studies conducted by JINR
- Information, computer and network support of JINR's activity
- Organization, support and development of the education process at JINR.