

I. Preamble

1. The members of Programme Advisory Committee for Particle Physics honoured the memory of Professor Jan Nassalski who successfully worked in this PAC for a long period of time and who made outstanding contributions to the development of the scientific collaboration between JINR and Polish research centres.

2. The PAC takes note of the information presented by JINR Vice-Director R. Lednický on the Resolution of the 106th session of JINR Scientific Council (September 2009) and on the decisions of the JINR Committee of Plenipotentiaries (November 2009).

The PAC is pleased to note the decision of the Committee of Plenipotentiaries (CP) to increase the JINR budget by 20.7% in 2010. The CP also emphasized the importance of the annual increase of the budget in 2010–2016, planned according to the budget forecast approved by the CP, for achieving the milestones of the development strategy for the next seven-year period.

The PAC notes that the CP accepted the concept of the Seven-Year Plan for the Development of JINR 2010–2016, based on concentration of resources for updating the accelerator and reactor base of the Institute, and approved this plan taking into account the recommendations of the PACs and the Scientific Council. The CP also supported the efforts being taken towards integration of the JINR basic facilities into the common European research infrastructure.

The PAC notes that the Scientific Council highly appreciated the progress made in the effort to upgrade the Nuclotron to meet the performance required for the future NICA/MPD programme.

3. The PAC congratulates the directorates of JINR and DLNP and the entire staff of the Institute on the 60th anniversary of the commissioning of the JINR Synchrocyclotron — the first accelerator at Dubna. Many important scientific results, including 13 registered discoveries, have been produced at this accelerator.

II. General recommendations on the implementation of the “Programme of the Scientific Research and Development of JINR” in the field of particle physics (2003–2009) and on the JINR Programme of Particle Physics Research for 2010–2012

The PAC takes note of the reports presented by A. Sorin, Deputy Director of the Bogoliubov Laboratory of Theoretical Physics, V. Kekelidze, 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. The PAC endorses the main lines of the JINR Programme of Particle and Relativistic Nuclear Physics Research proposed for the period 2010–2012 in accordance with the new seven-year JINR development plan.

The PAC congratulates the Directorate and the international staff of JINR on the complete and successful realization of the previous seven-year scientific programme and highly appreciates the valuable contributions to the advancement of science and technology at the world level that have been achieved as part of this programme. The major milestones achieved in implementing this programme provide a solid basis for further scientific and technological development of JINR.

III. Recommendations on the progress towards realization of the Nuclotron-M project

The PAC takes note of the report on the status of the Nuclotron-M project, presented by JINR Deputy Chief Engineer G. Trubnikov, and appreciates the significant progress in upgrading the VBLHEP accelerator complex and the rigorous implementation of the work schedule. The PAC is pleased to note that during the autumn run the obligations concerning the research programme were fulfilled and stable operation of the accelerator complex at high intensity was demonstrated.

IV. Recommendations 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, and recognizes the significant progress in the realization of the Nuclotron-M project. The PAC expresses its gratitude to the MAC Chairman, members and experts for fulfilling an extremely important role in the project realization. The PAC especially notes that the expertise performed by the MAC has confirmed the feasibility of the NICA project. The PAC recommends preparing a project on realization of the next stage of the NICA complex construction and presenting it at a future PAC meeting.

The reviews on the progress in the realization of the Nuclotron-M project and on the progress in the development of the NICA/MPD projects, prepared by the Nuclotron-M/NICA Machine Advisory Committee at its meeting held in Dubna on 12–13 January 2010, are given in Appendices 1 and 2.

V. Recommendations on the progress towards the NICA Technical Design Report

The PAC takes note of the report on the preparation of the NICA Technical Design Report, presented by JINR Deputy Chief Engineer G. Trubnikov, and notes the substantial progress in this work.

VI. Recommendations on the progress towards the MPD Conceptual Design Report

The PAC takes note of the report on the preparation of the MPD Conceptual Design Report, presented by VBLHEP Director V. Kekelidze.

The PAC notes with interest the progress of work on the MPD conceptual design and supports the basic ideology of the construction of the detector which will be unique in acceptance and efficiency for the registration of charged hadrons in the energy field under study. The PAC supports the strategy of stage-by-stage construction of this detector and notes the substantial progress in scrutinizing all basic elements. The PAC recommends preparing a project of the first-stage realization of the multipurpose set-up MPD — the starting stage — and presenting at its next meeting. The PAC recommends coordinating the work on the machine, the detector, and the physics goals and consolidating the collaboration also through external experts and advice.

VII. Recommendations on the progress towards the NICA White Paper

The PAC takes note of the report by BLTP Deputy Director A. Sorin on the ongoing preparation of the white paper for the NICA programme on the mixed phase and spin physics. The PAC notes the progress achieved in this direction and recommends continuation of the work to elaborate a competitive research programme in view of its complementarity with studies planned at CERN, RHIC, and FAIR.

VIII. Recommendations for activities at JINR related to the ILC

The PAC takes note of the report by JINR Chief Engineer G. Shirkov on the progress for ongoing developments at JINR related to the ILC and recommends further participation in this work.

IX. Recommendations on the first experience of JINR physicists in data taking in the LHC experiments

The PAC takes note of the reports on the first experience of JINR physicists in data taking in the ALICE, ATLAS, and CMS experiments. The PAC congratulates these teams for having fulfilled their obligations in the construction of the detectors and the

commissioning phase. The PAC highly appreciates the presentation of the first physics results which witness the overall good operation of the detectors. The PAC recognizes the LIT important contribution to the first data analysis phase.

X. Recommendations for new projects

The PAC has considered the proposals of new projects presented at the session.

1. The PAC suggests supporting JINR's participation in the physics research programmes at the LHC on the basis of a five-year term. The PAC recommends approval of the projects "JINR's participation in the physics research at the LHC. ATLAS, ALICE, CMS" for execution until the end of 2014.

The PAC recommends that sufficient resources be allocated for the participation of JINR in the data taking and analysis, in order to match the strong commitment deployed during the construction phase with a corresponding effort during the physics and analysis phase. The PAC looks forward to receiving regular reports on these activities at its future meetings.

2. The PAC recommends approval of JINR's participation in the project "STAR at RHIC" until the end of 2012. The PAC supports the participation in the beam energy scan and in the polarized proton-proton data programme which will provide world-class results and represent an important training ground for the NICA collider project.

3. The PAC appreciates the ongoing activity at JINR and recommends approval of JINR's participation in the project "PANDA. Experiments at FAIR" until the end of 2014, considering the time scale of the project.

XI. Recommendations on the activities previously approved for completion in 2009 and proposed for continuation

1. The PAC takes note of the report on JINR's participation in the HADES project, highly appreciates the results obtained in this experiment and recommends continuation of this activity until the end of 2012.

2. The PAC takes note of the report on the theme "Development of high-precision straw detectors", regards this work as promising and in great demand, and recommends continuation of this activity until the end of 2012.

XII. Recommendations on the projects previously approved for completion in 2009

1. The PAC takes note of the report on the NA48 project and highly appreciates the obtained results. Due to the completion of this experiment, the PAC recommends that the

JINR Directorate close the participation in this project and supports the proposal to continue work on the NA48 data analysis under the theme “Study of Rare Charged Kaon Decays in Experiments at the CERN SPS (NA62 project)”.

2. The PAC takes note of the written report on the OKAPI project and highly appreciates the uniqueness of the obtained results. The PAC recommends that the JINR Directorate close the participation in this project and supports the proposal to continue the research work under the theme “Study of Rare Charged Kaon Decays in Experiments at the CERN SPS (NA62 project)”.

3. The PAC takes note of the written report on the NIS project and notes the high quality of the accomplished work. The PAC recommends that the JINR Directorate close this project and supports the proposal to continue the research work under the new project HyperNIS.

4. The PAC takes note of the written report on the ALPOM project. The PAC recommends that the JINR Directorate close this project and supports the proposal to continue the research work under the new project ALPOM-2.

5. The PAC takes note of the written report on the STRELA project. The PAC recommends that the JINR Directorate close this project.

6. The PAC takes note of the written report on the pHe3 project and notes the importance of the accomplished work. The PAC recommends that the JINR Directorate close this project and supports the proposal to continue the research work under the DSS project.

7. The PAC takes note of the written report on the LNS project and notes the importance of the accomplished work. The PAC recommends that the JINR Directorate close this project and supports the proposal to continue the research work under the DSS project.

8. The PAC takes note of the written report on the DELTA-SIGMA project. The PAC recommends that the JINR Directorate close this project and supports the proposal to complete the measurements on this programme after commissioning the polarized target and obtaining the Nuclotron beams of required parameters.

9. The PAC takes note of the written report on the DELTA-2 project. The PAC recommends that the JINR Directorate close this project.

10. The PAC takes note of the written report on the MARUSYA project. The PAC recommends that the JINR Directorate close this project.

11. The PAC takes note of the written report on the CLIC project. The PAC recommends that the JINR Directorate close the participation in this project.

12. The PAC takes note of the written report on the project “Development and introduction of compact electron and ion accelerators for applied purposes”. The PAC recommends that the JINR Directorate close this project.

13. The PAC recommends that the JINR Directorate close the participation in the E391a project.

XIII. Poster presentations by young scientists

The PAC appreciates the poster presentations by young scientists in the field of particle physics research and recommends that this form of presentations be included in the agenda of its future meetings.

XIV. Next meeting of the PAC

The next meeting of the PAC for Particle Physics will be held on 21–22 June 2010.

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 2010
- Status report on the Nuclotron-M/NICA and MPD projects
- Report on progress towards the NICA White Paper
- Report on progress for ongoing developments at JINR related to the ILC
- Reports by the JINR groups on the first scientific results in the LHC experiments.



E. Tomasi-Gustafsson
Chairperson of the PAC

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

The Nuclotron-M project is the first stage of the NICA/MPD 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. Very active work continued during the second half of 2009, and essential results were obtained in the realization of several dedicated subprojects.

The full-scale upgrade of the VBLHEP cryogenic complex which started in August 2008 was completed in June 2009. Substantial progress was achieved in the Nuclotron vacuum system upgrade (2nd stage) during the period July-November 2009. The completion of the full-scale modernization is planned to be in February 2010, and it is expected to get vacuum improvement up to the level better than 10^{-9} Torr.

The development of the high-intensity, high-charge state “Electron String Ion Source” (ESIS) is very well advanced. Highly charged Xe^{42+} have been produced for 780 ms of ionization time; a total pulse ion current is about 130 μA (about 3×10^7 Xe^{42+} extracted particles per pulse). Two runs (#39 and #40) were successfully performed at the Nuclotron in June and November-December 2009 correspondingly (about 1000 hours in total). Main results: commissioned several modern and complex systems for vacuum, guide field, RF, beam controls. All systems demonstrated stable and safe operation at 1.5 T; prototype of the new HV power supply for the electro-static septum deflector was constructed and tested at the voltage up to 220 kV; full-scale alignment of the accelerating-focusing system of the LU-20 linac was successfully performed: increase of the accelerated beam current at injector by a factor of 2 has been achieved.

Conclusion

1. The project Nuclotron-M is well planned and is in good progress — for some substages there is now phase of 70-80% completion. Key component is pushing the magnetic field up to 2 T. In previous years the machine operation was at the field level <1 T — due to problems with quench detection and energy evacuation systems. That problem is clearly identified and now the upgrade of new main power supply is on a good track. The power supply upgrade for electrostatic septum deflector for the slow extraction system has to be commissioned soon.

2. The MAC points out that the programme for accelerator physics (beam development) at modernized Nuclotron is not clearly formulated: it is necessary to define the programme for measurements to characterize the machine and beam parameters (beam orbit, acceptances, beam emittance, dependence $Q(dp/p)$, etc.), and especially to continue this development towards the NICA beam requirements.

3. To achieve substantial progress with beam parameters, the MAC recommends providing necessary dedicated operation hours for systematic machine development.

4. A proposal to install a prototype stochastic cooling system in the Nuclotron was presented. The committee finds the reasoning for this activity extremely compelling and recommends pushing it ahead. Perhaps, some staging is possible when one first installs a broad-band Schottky pickup followed by a study period and then by installation of a kicker. The goal should be a demonstration of cooling times of the order of several seconds. The MAC recommends a fast start of purchasing necessary equipment. Time schedule can be reduced significantly.

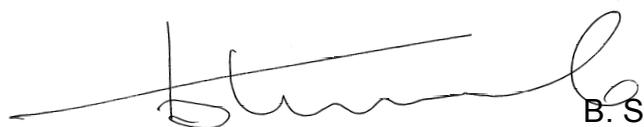
5. The nearest milestone of the Nuclotron-M project summarizing subprojects results has to be achieved in the spring run at the Nuclotron in 2010 with $^{144}\text{Xe}^{44(42)+}$ ions.

6. The MAC points out that the NICA team with physicists (from JINR, ITEP, IHEP, etc.) has to propose an adequate experimental physics programme using Nuclotron-M beams and beams from home basic facilities of different institutions for R&D on MPD elements.

7. The MAC recommends to pay more attention to the concept of the control system for NICA and to perform the upgrade of the Nuclotron-M control system in accordance with the accepted strategy for NICA.

The MAC recommends that the JINR Directorate continue funding the final stage of the Nuclotron modernization with highest priority and provide due attention to the creation of the required experimental test-benches and engineering infrastructure following the project plan and its schedule.

Nuclotron-M/NICA Machine Advisory Committee:



B. Sharkov (ITEP) — Chairman



P. Belochitskii (CERN)



A. Fedotov (BNL)



S. Ivanov (IHEP)



M. Steck (GSI)



T. Katayama (ret. from Tokyo Univ.)

V. Lebedev (FNAL)



S. Nagaitsev (FNAL)



P. Zenkevich (ITEP)



A. Zlobin (FNAL)

Dubna, 13 January 2010

Review on the Progress in the Development of the NICA/MPD Project

The design of the NICA project is progressing well. Since the last meeting, two main modifications in the NICA collider concept have been done:

1. The longitudinal stacking scheme based on a barrier RF bucket technique and stochastic cooling application was chosen as a baseline for the collider injection.

2. The Nuclotron-type iron-dominated SC magnets with 2 T operation field were chosen for the collider, with the collider circumference increased to about 340 m.

Regarding these two modifications, the committee agrees that both proposals look feasible and adequate for the project goal. The committee recommends that serious attention should be paid to the injection kicker design, which is one of the key elements determining the stacking efficiency. The R&D activities on this subject should be initiated. For the longitudinal stochastic cooling system the Palmer method seems more attractive. One needs to reserve adequate space for the pick-ups and kickers. One needs to provide sufficient space for chromaticity correction optics. The final choice of the ring circumference can be made only after completion of the collider conceptual design and identification of all ring elements.

Regarding the collider magnetic system, the use of the iron-dominated magnets is a good solution to provide the required field parameters. Although at this stage the magnet aperture is not fixed yet, the magnet design is quite tolerant to aperture variation. Unlike the Nuclotron magnets, the collider magnets (double bore and curved) require special attention to the alignment and adjustment of the magnets without opening a cryostat. Proper attention has to be paid to the design of the final focus quadrupoles, which require large field gradient across large aperture.

At the present conceptual stage of the NICA project, the committee finds no show stoppers. The NICA project is quite complex and challenging but doable and realistic from the accelerator physics point of view. The project has the potential to exercise several accelerator technologies which are at the forefront of beam physics. It may be very attractive to accelerator experts and it could be a great catalyst for attracting world experts and facilitate local education of students in the field. The MAC strongly supports the JINR Directorate in the attempts for its realization.

Conclusion

1. The project assumes three types of experiments: ion-ion, ion-proton and light polarized ion collisions. To optimize the collider design for all these tasks appears quite complicated. The MAC recommends defining a strategy of staging the project. For example, it might be advantageous to realize the ion-ion collisions as the first stage. The second stage would require an upgrade of the final focus optics to realize the asymmetric ion-proton collisions. Finally, the polarization programme can be implemented at the third stage after the required upgrade of the collider. To this end, adequate free space along the orbit should be foreseen from the very beginning so as not to preclude these future machine upgrades.

2. For the ion-ion collisions the nearest goal is the completion of the collider conceptual design by the end of 2010. The MAC recommends developing the machine design considering three different ion energies (kinetic): 4.5, 3.5 and 1.5, GeV/u (in priority order) so as to have a realistic estimate of the luminosity dependence on energy. To determine the required circumference and the layout of the collider, one needs to prepare the machine model including the comprehensive list of the required technological equipment and reserve position to each element in the ring.

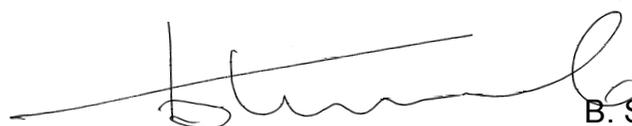
3. The development of the stochastic cooling system and the barrier bucket technique for the NICA project is important and should be performed in a close cooperation with FZJ, GSI, BNL, CERN, and FNAL.

4. Regarding the collider electron cooler design, the MAC recommends evaluating if electron cooling is required and providing an accurate comparison of two possibilities: magnetized and non-magnetized electron beam. This work can be done in cooperation with BINP, FZJ, BNL, and FNAL.

5. Serious attention has to be paid to the development of a project document management system (like EDMS). This work can be done in cooperation with CERN.

6. The MAC believes that the project will soon enter the stage where human resources may become critical for its success. For the next meeting the MAC requests to prepare a detailed plan of manpower required at all stages of the project, and to present detailed information about planned profile of the project funding.

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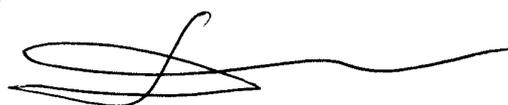
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