

**I. Preamble**

The Programme Advisory Committee for Particle Physics takes note of the information presented by JINR Vice-Director R. Lednický on the Resolution of the 109th session of JINR Scientific Council (February 2011) and on the decisions of the JINR Committee of Plenipotentiaries (March 2011).

The PAC extends congratulations to Professor V. Matveev who was elected as Director of JINR for a term of 5 years, beginning 1 January 2012.

The PAC extends congratulations to Professors M. Itkis and Yu. Oganessian on the award of the 2010 State Prize of the Russian Federation in science and technology for the discovery of a new region of stability of superheavy elements.

**II. Recommendations on the Nuclotron-NICA project**

The PAC takes note of the report on the status of the Nuclotron-NICA project presented by G. Trubnikov. The PAC appreciates the active progress in designing and developing elements and prototypes of the NICA complex, in particular the successful construction and tests of the superconducting magnet prototypes, the progress in constructing the ion and polarized particle sources as well as in designing the collider lattice. It welcomes the productive cooperation with IHEP (Protvino) and the State Nuclear Centre (Sarov) on Heavy-Ion Linac, with the Budker INP (Novosibirsk) on RF, cooling and magnetic systems, with the All-Russian Electrotechnical Institute (Moscow) on high voltage technology and energetics, with the State Specialized Design Institute (Moscow) on the TDR, as well as with CERN, institutes in the USA (Fermilab, BNL) and Germany (GSI, IKP FZJ).

The PAC concurs with the recommendations of the NICA Machine Advisory Committee taken at its meeting on 7 June 2011 as reported by G. Trubnikov (Appendix).

The PAC repeats its former recommendation that the JINR Directorate should announce the availability and specifications of Nuclotron-M beams together with an international call for fixed target experiment proposals. This announcement should also be distributed to the funding agencies in the countries interested in this field. The submitted proposals shall be evaluated by the PAC. If needed, the PAC may seek help from additional experts to assist in the evaluation process.

### **III. Recommendations on the NICA White Paper**

The PAC takes note of the information, presented by A. Sorin, concerning the ongoing work to prepare the NICA White Paper dedicated to the research programme of the NICA project. The PAC appreciates the significant progress of this work. In particular, a new editorial section has been added which describes the main physical phenomena discussed for the project and the main parameters of the NICA facility including Nuclotron-NICA extracted beams. The PAC is pleased to note the broad international involvement in the preparation of this document, which points to the visibility of this activity in the world view. The PAC recommends continuation of this work including the traditional round-table discussions of the future research programmes at NICA/MPD and Nuclotron-NICA.

### **IV. Recommendations on the MPD project**

The PAC takes note of the report on the status of the MPD project presented by V. Kolesnikov. It appreciates the significant progress achieved in designing the MPD detector, in developing new technologies for its elements, and in simulation and feasibility studies. The beginning of prototyping of the MPD subsystems is also noted.

### **V. Recommendations on future scientific activities and proposal of experiments at the Nuclotron-NICA**

The PAC notes with interest the research programme to be performed by using the Nuclotron extracted beams, presented by V. Kekelidze. The PAC endorses this programme and considers its realization in the announced terms to be extremely important. Taking into account the intensive schedule for the commissioning of the experimental set-ups on the Nuclotron extracted beams, the PAC recommends that the project to study the hot dense baryonic matter be presented at the next PAC meeting.

### **VI. Recommendations for the new project**

The PAC takes note of the proposal, presented by G. Melkumov, concerning participation of the JINR groups in the NA61/NA49 project at CERN. The PAC appreciates the results obtained by this collaboration in the field of heavy-ion physics as well as for neutrino and cosmology interest. However, in view of the important results which are foreseen in the future, the PAC recommends the unification of the two JINR groups which should be reinforced by young scientists and PhD students. Therefore the

PAC looks forward to the implementation of this recommendation and to the presentation of this project at its next meeting before final approval.

## **VII. Recommendations on the projects previously approved for completion in 2011 and proposed for continuation**

The PAC takes note of the report on the D0 project presented by G. Alexeev. It appreciates the results obtained by this collaboration, notes the active participation of the JINR group in this project, and recommends its extension until the end of 2014, with first priority.

The PAC takes note of the report on the CDF project presented by V. Glagolev. It appreciates the results obtained by this collaboration, notes the active participation of the JINR group in this project, and recommends its extension until the end of 2014, with first priority.

The PAC takes note of the report on the TUS project presented by L. Tkachev and recommends extension of JINR's participation in this project until the end of 2014, with first priority.

The PAC takes note of the report on the Daya Bay project presented by D. Naumov. It appreciates the results obtained by this collaboration, recognizes the importance of this activity, and recommends extension of JINR's participation in this project until the end of 2014, with first priority.

## **VIII. Recommendations on the JINR contributions to the LHC experiments**

The PAC takes note of the reports on the scientific results of the CMS, ATLAS, and ALICE experiments presented by S. Shmatov, A. Cheplakov, and M. Vala. It emphasizes the scientific significance of the results being obtained with the active participation of JINR physicists and encourages the groups to strengthen their efforts in the data analysis and in the presentation of the results at international conferences.

The PAC requests that future reports should focus on specific contributions and responsibilities of the JINR groups participating in these experiments and include in particular:

- a list of talks given at international conferences;
- a list of analysis notes submitted to the collaboration;
- a list of PhD students;

– a list of management duties and conveners of data calibration and analysis groups.

## **IX. Recommendations on activities previously approved for completion in 2011**

The PAC takes note of the written report on the THERMALIZATION project presented by E. Kokoulina. The PAC appreciates the physics results in studying the multiple particle production processes performed by the SVD-2 Collaboration in  $pp$  interactions with high multiplicity, and recommends continuation of this activity within the SVD-2 Collaboration under theme 02-1-1086.

The PAC takes note of the written report on the NA49 project presented by G. Melkumov. The PAC highly appreciates the important scientific results on hadron production obtained by the NA49 Collaboration and by the NA49 TOF-Dubna, in particular, and recommends the closure of this project.

The PAC takes note of the written report on the BECQUEREL project presented by P. Zarubin. A number of important results have been obtained in studying the peripheral fragmentation of light nuclei in nuclear emulsions. The PAC recommends continuation of this activity under theme 02-1-1087.

The PAC takes note of the written report on the theme “Physics and Engineering of Feedback Systems in Synchrotron” presented by V. Zhabitsky. Within the framework of this activity, all the systems for the LHC Damper were designed and constructed. The equipment developed jointly by CERN and JINR, built by JINR and by Russian Industry, worked as specified and has proved very reliable since its installation for the initial start-up of the LHC machine. The LHC Damper is used routinely during injection, ramp, and collisions preventing emittance blow-up. The PAC highly appreciates the results of this successful activity, which received the JINR First Prize in 2010, and recommends its closure due to the achievement of the goals of this project.

## **X. Scientific reports**

The PAC notes with interest the report “Muon  $g-2$ : current status” presented by A. Dorokhov and thanks the speaker.

The PAC notes the report “Experimental study of strange matter production in heavy-ion collisions at the Nuclotron” by V. Ladygin, and invites him to present a proposal at the next meeting.

## **XI. Poster presentations by young scientists**

The PAC notes with interest the poster presentations in particle physics presented by young scientists from VBLHEP and LIT. It selected the poster “Design of the Nuclotron booster in the NICA project” presented by A. Tuzikov (VBLHEP) to be reported at the Scientific Council session in September 2011.

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

The next meeting of the PAC for Particle Physics will be held on 23–24 January 2012.

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

- Consideration of new projects (including NA61/NA49) and themes
- Reports and recommendations on the projects to be completed in 2011
- Status report on the Nuclotron-NICA and MPD projects as well as an SPD proposal
- Report on progress towards the NICA White Paper
- Reports on the scientific results obtained by the JINR groups in the LHC experiments and plans for their future upgrades.



E. Tomasi-Gustafsson  
Chairperson of the PAC

## **Recommendations of the Machine Advisory Committee for the NICA Accelerator Complex**

The progress of the project is very clear. The Machine Advisory Committee (MAC) was impressed very much by the Nuclotron improvements. It is a demonstration that there are a very competent core group of accelerator physicists and engineers at JINR. The NICA Booster concept and parameters look well-developed, and they have been approved. The design of the NICA collider is progressing well. Construction and test of the prototypes of the Booster and Collider magnets are in the active phase. The results of cryogenic test of the Booster dipole magnet prototype have demonstrated that the main technical solutions of the magnet design are adequate to the goal.

1. One of the main goals of the meeting was to endorse the choice of the collider lattice. Selection of a lattice is essential in order to move forward with detailed design of the ring. Overall, very good progress is seen. However in many aspects technical parameters are only starting to emerge. The project team presented two versions of the collider lattice having comparable parameters, and proposed to consider the lattice based on FODO elementary cell as the base and the structure based on Triplet elementary cell as a reserved one. It was clearly demonstrated that the both lattices can provide required luminosity at maximum beam energy. The FODO structure have been selected as preferable due to less circumference and sufficiently simpler injection. One should explore and show which lattice is more flexible for the full energy range of interest. One should start doing realistic tracking simulations with magnetic field errors, impedances (to be yet defined after all ring elements are finalized), etc.

Details of acceptance in final focus magnets; injection and abort kickers, etc. have to be fully developed and presented at the next MAC meeting. It would be useful to have presentation on collider ring systems, including apertures, collimators, injection and abort kickers, all diagnostics and their location within the ring. Careful study and technical design of RF systems has to be developed and presented.

2. The key problem for the NICA collider is beam cooling, both electron and stochastic. If it is possible to use only one type of cooling, that would be preferable. Nothing was shown which would suggest the need of electron cooling instead of stochastic cooling at low energies. If electron cooling should stay in the project a credible scenario of machine operation with electron cooling has to be presented at the

next MAC meeting. More details are also required on the scenario with the stochastic cooling only. At maximum designed energy the estimates were presented for the system having bandwidth from 3 to 6 GHz. 8 GHz system will damp the beam faster and should be considered as well. This frequency range is well developed at Fermilab and does not have significant technical risks.

Probably the NICA management should organize a special workshop of reasonable duration with invitations to the experts from many laboratories of the world to clarify the role and select the design of the cooling systems.

3. The design of the NICA control system has been started. For the moment there is good progress, but no technical details yet. The Nuclotron control system is based mainly on MS Windows and uses UNIX (LINUX) only occasionally. The world expertise showed that UNIX (LINUX) based system is strongly preferred for large accelerator complex. Before final choice of the platform for NICA control system MAC recommends performing specification of all required functions of the control system. One also needs to look into long run cost implications and scalability of the system. Underestimation of possible control system problems can cost both significant time and money to fix them in the future.

4. The MAC recommends that the JINR Directorate actively search and involve young scientists (including students) in the project and provide all possible conditions for that. Probably it would be good to organize (to allocate) a dedicated budget for such a purpose. The execution strategy of the project should be considered as a very important issue. The MAC recommends that the JINR Directorate provide the required finance profile and manpower for the project realization in accordance with the schedule of construction and commissioning.

The MAC would like the following reports to be presented on the next meeting:

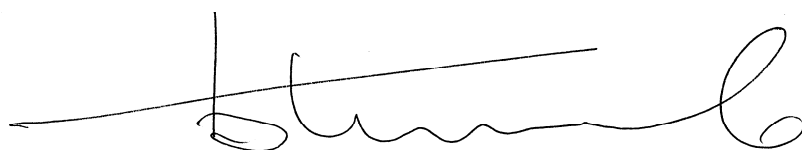
- the detailed concept of the cooling strategy for the collider in the full energy range of interest;
- the detailed NICA ring composition;
- the detailed concept of the beam diagnostic systems for the NICA rings.

In accordance with the presented parameters the Passport of the NICA project was compiled and presented to the MAC. The project timelines should be corrected to address the present stage of the project.

The MAC recommends that the project management set the highest priority to the following activities:

- development of the Nuclotron towards NICA (injection and extraction systems);
- development of required engineering infrastructure for NICA booster a.s.a.p.;
- test of the stochastic cooling system at the Nuclotron;
- design and construction of the final focus quadrupole prototype;
- pre-serial construction and tests of the collider and booster magnet;
- development of the cryogenic magnet test facility for NICA;
- test of the heavy ion source;
- design and construction of the Heavy Ion Linac.

The meeting was well prepared and managed. The presentations were prepared at good level; the project team provided clear answers for main part of questions during discussion.

A handwritten signature in black ink, consisting of a long horizontal line that curves upwards at the end, followed by a series of loops and a final flourish.

B. Sharkov (ITEP)  
Chairman of the MAC

Dubna, 7 June 2011