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 108th session of JINR Scientific Council (September 2010) and on the decisions of the JINR Committee of Plenipotentiaries (CP) (November 2010).

The PAC is pleased to note the recognition by the Scientific Council and by the CP of the significant accomplishments of JINR scientists in 2010 in the main fields of research, as well as in the areas of information technology, the education of young scientists, and innovative developments. In particular, the following achievements were mentioned concerning the particle physics programme and related issues:

– the impressive increase of new results from the LHC with visible contributions by JINR physicists (ALICE, ATLAS, and CMS experiments);

– new achievements in both accelerator-based neutrino physics (OPERA experiment) and non-accelerator neutrino physics and astrophysics;

– the high quality of theoretical studies related to the main directions of the JINR scientific programme;

– good performance of the internal computing infrastructure and Grid services;

– successes in the educational programme, now including schools for high-school teachers (together with CERN).

The PAC also notes that the Scientific Council:

– requested presentations at its next session of results of analyses of LHC data carried out by JINR physicists;

– invited the JINR Directorate to develop a road map for optimizing the external participation in the NICA project and the associated experiments MPD and SPD;

– also invited the Directorate to concretize in the near future the scope and areas of JINR's participation in the programme of upgrades of the LHC and its detectors;

– encouraged the holding of poster sessions with presentations by young scientists, and requested that the best be selected for presentation to the Scientific Council.

The PAC is pleased to note the decision of the Committee of Plenipotentiaries to increase the JINR budget by 21% in 2011 for implementation of the scientific programme in accordance with the Seven-Year Plan.

II. Recommendations on the Nuclotron-M/NICA projects

The PAC takes note of the report on the status of the Nuclotron-M/NICA projects presented by G. Trubnikov. The PAC congratulates the VBLHEP accelerator team for the significant progress in developing the accelerator complex and for the fulfillment of obligations for the Nuclotron-M project whose main goals have been achieved. Given the successful performances, the PAC reiterates the encouragement given at its previous meeting to publish an international call for experiments at the Nuclotron-M.

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 White Paper dedicated to the research programme of the NICA project. The PAC notes the progress reached in this direction and the emergence of new interesting proposals. It recommends a synthesis of this work to be done and a comprehensive research programme taking into account the competitiveness and complementarity with the research at CERN, RHIC, and FAIR.

Special efforts are needed to motivate JINR specialists to participate and to lead preparations for experiments at external beams of the Nuclotron-M. The PAC encourages the preparation of a physics programme for the fixed target experiments at this facility.

IV. Recommendations on the report from the Nuclotron-M/NICA MAC

The PAC takes note of the report by the Chairman of the Machine Advisory Committee (MAC) for the Nuclotron-M/NICA accelerator complex, presented by P. Zenkevich (ITEP). The PAC notes that the design of the NICA project is progressing well. Since the last MAC meeting significant modifications for the concept of the NICA collider have been adopted. There is considerable progress in developing a new lattice for the collider and the ring design. However, more aggressive work on the design is required in order to stay within proposed timeline for the project. The recommendations of the MAC taken at its meeting on 5 October 2010 are presented in Appendix 1.

The PAC suggests considering a possible extension to Electron Ion Collider option in the current design.

V. Recommendations for new projects

The PAC takes note of the new project Nuclotron-NICA for the next construction stage of the VBLHEP accelerator complex, presented by G. Trubnikov. The PAC endorses

the proposed programme, strategy and schedule, and recommends approval of this project with first priority for execution until the end of 2015.

The PAC requests the Nuclotron team to design the injector complex Linac-Booster to present-day particle intensities. There is, however, an urgent need for a state-of-the-art detector for fixed target experiments using the opportunity to study the 1–5 AGeV physics with high precision starting in 2012, going beyond the studies done at the AGS at BNL. In this respect the PAC encourages the JINR Directorate to pay special attention to a fair return of its LHC and RHIC investments, especially in the field of electronics and readout where JINR can profit most.

The PAC takes note of the report on the project COMPASS and the proposal of a new project COMPASS-II, presented by A. Nagaytsev. The PAC appreciates the results obtained by this collaboration with the participation of JINR physicists, considers the proposed research programme to be very important and recommends approval of JINR's participation in this project with first priority until the end of 2013.

VI. Recommendations on the JINR contributions to the LHC experiments

The PAC takes note of the reports on the participation of the JINR groups in the ATLAS, ALICE, and CMS experiments, presented by V. Lyubushkin, B. Batyunya, and A. Zarubin. 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 particularly appreciates the presentations given by the young physicists who are involved in the data analysis.

VII. Scientific reports

The PAC notes with interest the reports: "Is there any LSND anomaly?" presented by A. Bolshakova, "BOREXINO: current results and future" presented by O. Smirnov, and "Spin physics at NICA" presented by O. Teryaev, and thanks the speakers.

The PAC emphasizes the importance of JINR's ongoing and planned activities in neutrino physics and related subjects.

The PAC encourages the JINR Directorate to present a comprehensive programme on spin physics for the Nuclotron-M and NICA.

VIII. Poster presentations by young scientists

The PAC notes with interest the poster presentations in particle physics presented by young scientists from DLNP and BLTP, and selected the poster “Prospects of SUSY observation with the ATLAS detector” presented by E. Khramov to be reported at the Scientific Council session.

IX. List of first-priority activities

The list of themes and projects in the JINR programme on particle physics and relativistic nuclear physics having first priority in 2011 is presented in Appendix 2.

X. Next meeting of the PAC

The next meeting of the PAC for Particle Physics will be held on 21–22 June 2011.

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 2011
- Status report on the Nuclotron-NICA and MPD projects as well as SPD proposal
- Report on plans for future scientific activity and proposals of experiments at the Nuclotron-NICA complex
- 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

Appendix 1

Recommendations of the Machine Advisory Committee
for the Nuclotron-M/NICA Accelerator Complex

The design of the NICA project is progressing well. Since the last meeting significant modifications for the concept of the NICA collider have been adopted. There is considerable progress in developing a new lattice for the collider and the ring design. However, more aggressive work on the design is required in order to stay within proposed timeline for the project.

General recommendations

1. The design of the accelerator strongly depends on the physics goals. Experimentalists and machine designers have to agree upon a common set of parameters describing the physics goals and guiding the machine design. Thus, the project management needs to formulate clearly the priorities of the different programmes being considered (heavy ions and polarized protons) to understand what compromises in the accelerator design are acceptable. The project management should compile the baseline document (not more than 5 pages) with all major parameters and requirements for the accelerator and detectors. Creation of a dedicated web site with a formal list of common parameters is also desired.

2. Clear requirements on the allowed step in beam energy are needed, which influences the choice of the RF system for the collider. During the meeting it was discussed that a step in the range from 1 to 10% $\sqrt{S}$ could be satisfactory. This requirement should be clearly stated in the project management document. Discrete steps in energy may allow the operation of RF at fixed frequency by changing the harmonic number, e.g. as it is presently done for Low-Energy RHIC energy scan. This possibility should be studied in detail and presented to the MAC during the next meeting.

3. A close collaboration with RHIC physicists on the first results from the Low-Energy RHIC scan is desirable to optimize the NICA performance for energies of most interest for the future physics programme.

4. The lattice of the NICA collider and its configuration, including its circumference should be fixed well in advance before the anticipated start of the construction stage of the project.

5. In order to stay close to the presently proposed timeline of the project, the MAC recommends fixing the configuration of the collider and the choice of the ring lattice by the

middle of next year (next MAC meeting in June 2011, preliminary). During the period October 2010 – June 2011 it is recommended to evaluate different aspects and to propose a lattice which covers all necessary requirements. It is good to have upgrade potential and flexibility in the proposed structure. It is also necessary to define the optimal bunch length, taking into account the proposed length of the detector vertex.

6. Concerning the proposed electron cooling system for the collider, one should reserve the necessary space in the collider rings, but this system appears to be not a critical item for the present stage of the project (initial physics could be done without electron cooling). It is also too risky to connect the commissioning of the proposed state-of-the-art e-cooling system which requires a lot of R&D with the commissioning of the collider. The MAC recommends considering the proposed electron cooling system for an upgrade stage of the collider and continuing design work with lower priority.

7. The stochastic cooling system appears to be a crucial element for beam cooling in the NICA collider, and thus is a priority item. A special design will be needed consistent with all the requirements, including RF and lattice design. Sufficient space in the collider structure should be reserved for the maximal expected length of the stochastic cooling system. The Palmer method is considered the only way for realization of such a system at the NICA collider.

8. The lattice choice should be driven by the goal to maximize the luminosity and by the requirements from all subsystems of the collider. One should specify the number of required quadrupole families. One should evaluate and clearly describe the necessity of all the devices needed for the polarized programme. One should indicate requirements for the spin programme. One needs to foresee the flexibility for an upgrade and to respond to potential problems in the future with the lattice flexibility.

9. 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.

10. The execution strategy of the project should be considered as a very important issue. The MAC would like to see a detailed work planning of the execution strategy, including a work breakdown structure at the next meeting. 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.

Recommendations and requirements on the sub-systems of the facility

RF systems

An RF voltage amplitude of 300 kV is realistic (present 28 MHz, 150 kW RF systems at BNL operate at 250 kV per cavity) for RF below 50 MHz (for RF with higher frequency one can have higher voltage). A total (per turn) RF voltage amplitude of 1 MV should be achievable. The MAC would like to see the proposed choice of RF resonators for each frequency which is being considered, including needed power, tuning range and beam loading considerations.

At its next meeting MAC would like to see a report on the following subjects:

– the longitudinal dynamics in the collider from beginning to end:
– injection→RF1→RF2→RF3→collision;
– an instability review in all rings;
– the allowed maximal population in neighboring buckets;
– the use of harmonic number h=60 for RF3;
– estimates how to keep the luminosity with continuous injection.

BB (Barrier Bucket) system

The MAC does not see any obvious advantage for the proposed stacking system of BB compared to an RF system operating at the 1st harmonic (h=1), but it is necessary to confirm this by simulations made by NICA designers.

SC magnets

The MAC is impressed with the progress which has been achieved in a short period of time in an important direction: SC magnet design and construction of collider and booster dipole prototypes. The proposed scheme for alignment of the SC magnets inside cryostats looks reasonable. It is not a new approach in accelerator practice, but, due to its importance and complexity, the MAC suggests implementing and testing it as possible to gain useful experience with this important system.

The MAC asks for detailed information about magnets next to the IP (final focus quadrupoles). The R&D on these elements should also be started soon as the parameters are very challenging.

Other systems

The MAC recommends:

– considering kickers operated as transmission line;
– having more precise estimations of the beam life-time due to vacuum. One should estimate if a liner is necessary;

– paying attention to the simulations of the electron-cloud effect and defining whether it is necessary to coat the inner wall of the beam chamber;
– starting R&D on the feedback system for the collider.

Preliminary analyses of the spin dynamics should be done to specify the requirements and parameters of Siberian snakes and spin rotators. Also optimization of the location of those elements should be provided.

The MAC would like the following reports to be presented at its next meeting:
– a detailed concept of the stochastic cooling system for the collider;
– the concept of the vacuum system for NICA rings;
– the status of the injection chain(s);
– a detailed concept of the beam control and beam diagnostic systems for the NICA rings;
– a report on the beam scraping and beam collimation.

The MAC recommends that the project management set the highest priority to the following activities:
– upgrade of the Nuclotron. The Nuclotron — is a key element of the whole future facility;
– development of the stochastic cooling system;
– design and construction of the final focus quadrupole prototype;
– design and construction of collider and booster magnet prototypes;
– R&D on the RF cavities for the collider;
– development of the beam diagnostics;
– development of the Heavy Ion source;
– development of the Heavy Ion Linac.

The MAC recommends that the JINR Directorate provide all necessary resources for their realization.

/B. Sharkov (ITEP)/
Chairman of the MAC

Dubna, 5 October 2010

Appendix 2

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 2011:

- 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 $\sqrt{S_{NN}}$ = 11 GeV (project Nuclotron-NICA)
- MPD
- 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 DSS, ALPOM-2
- Study of the nucleon and baryon structure at CERN (COMPASS-II) and DES (HERMES, H1) (JINR’s participation)
- Projects CDF, D0 (JINR’s participation)
- Charmed and strange quarks in hadronic reactions (project NA62, CERN) (JINR’s participation)
- Study of neutrino oscillations and determination of oscillation parameters (projects OPERA, Daya Bay, BOREXINO) (JINR’s participation)
- Project HyperNIS
- DIRAC (JINR’s participation)
- ATLAS (JINR’s participation)
- CMS (JINR’s participation)
- ALICE (JINR’s participation)
- NN&GDH
- STAR (JINR’s participation)
- Investigation at the GSI accelerating complex (JINR’s participation)

- PANDA (JINR’s participation)
- CBM (JINR’s participation)
- Study of e^+e^- interactions, physics and detectors (projects SANC, BES-III (JINR’s participation))
- Development of prototype units for a Complex of Carbon Radiotherapy
- Project TUS (JINR’s participation)
- 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.