Due to significant air travel difficulties for PAC members, the 61st meeting of the Programme Advisory Committee for Particle Physics was held in a hybrid format via videoconference.

I. Preamble

The Chair of the PAC for Particle Physics, I. Tserruya, welcomed the new members of the PAC, Amaresh Jaiswal, Leandar Litov and Gobinda Majumder, and presented an overview of the implementation of the recommendations adopted at the previous meeting. JINR Vice-Director V. Kekelidze highlighted the resolution of the 136th session of the JINR Scientific Council (held in September 2024) relevant to particle physics and the decisions of the JINR Committee of Plenipotentiaries (held in November 2024). The Scientific Council supported all PAC recommendations on the evaluation of new projects and the extension of ongoing projects in particle physics within the suggested timescale and ranking, as outlined in the PAC's recommendations.

The PAC supports the decision of the CERN Council to benefit further from the participation of JINR in CERN's activities and welcomes the signing of a high-level agreement between JINR and the Ministry of Science and Technology of the People's Republic of China (MOST) on the beginning of the implementation of joint projects.

II. Reports on the Nuclotron-NICA projects

The PAC heard the progress report on the realization of the Nuclotron-NICA project presented by A. Sidorin. The Committee appreciates the significant progress achieved in preparation for the NICA collider commissioning, including the installation of the collider magnetic cryostat system, RF stations and final focusing lenses, the merging of the high-vacuum sections in the West and East arcs, the installation of cryogenic equipment and power supplies in the collider building, and the connection of power lines and energy evacuation systems. A detailed program for the physical launch of the complex has been developed. It includes tuning the complex elements while completing the collider and transport line assembly in parallel and forseees first collisions in the summer of this year. Several channels for applied research are ready for operation; 5 runs have already been

conducted at the SOCHI chip irradiation station. The PAC congratulates the accelerator team for all these achievements.

The PAC heard with interest the report presented by K. Mukhin on the readiness of the engineering infrastructure of Building 17 for the launch of the NICA collider and the MPD detector this year. The Committee notes that the license for the construction of a radiation source (the NICA collider) and permission from Rostekhnadzor to operate the main electrical substation of the LHEP were obtained in 2024. The PAC is pleased to note the readiness of the engineering equipment of the water cooling and power supply systems for the collider and the MPD detector for operation with colliding beams. A high degree of readiness of the cryogenic support system of the collider is noted: the launch of satellite refrigerators and a new cryogenic compressor station, as well as the installation and testing of liquid helium pipelines feeding the collider, were successfully carried out. The PAC congratulates the team on successfully achieving a significant milestone – cooling the MPD superconducting magnet to LHe temperatures. It also welcomes the work of automating the engineering systems.

The PAC appreciates the progress in the implementation of the BM@N project presented by M. Kapishin. A paper describing the complete configuration of the BM@N detectors in the first physics run of a Xe ion beam with a CsI target has been published in NIMA. The BM@N team focused on calibrating the time-of-flight system and developing centrality determination methods in Xe-CsI collisions at an energy of 3.8 A GeV. To implement improved reconstruction methods and new calibration data, the dataset was reprocessed on the MLIT and LHEP computers. The BM@N team presented preliminary results on neutron emission spectra at large angles and direct flow of protons in Xe+CsI interactions. A physics paper on the production of protons, deuterons, and tritons in argon-nucleus interactions at 3.2 A GeV is under discussion in the BM@N Collaboration. The next physics run of the BM@N experiment is planned with a Xe beam at an energy of 2–3 A GeV.

The PAC takes note of the report on the status of the SPD project presented by A. Guskov. Having finalized the Technical Design Report, the SPD team has started working on the first stage of the detector, which includes a superconducting solenoid magnet, a muon system, a straw tube-based main tracker, and a Micromegas-based central tracker. There will also be a pair of zero-degree calorimeters and beam-beam counters, as well as an electromagnetic calorimeter. Manufacturing of elements of the main detector systems has started. Progress has been achieved in establishing the computing infrastructure of the

project. The PAC encourages the SPD collaboration to continue working on the production of the first-stage setup.

The PAC takes note of the report on implementing the MPD project presented by V. Riabov. In 2020-24, the main elements of all detector subsystems of the Phase-I MPD were fabricated, which include the time-projection chamber (TPC), the time-of-flight system (TOF), the electromagnetic calorimeter (ECal), the forward fast detector (FFD) and the front hadronic calorimeter (FHCal). Their assembly, testing and calibration are currently underway. Extensive work has been done to assemble and commission the solenoid superconducting magnet. A test cooling of the magnet to liquid helium temperature was successfully performed at the end of 2024. A comprehensive program of detector performance and physics feasibility studies has been carried out, including measurements of light mesons, hyperons, resonances, light nuclei and (hyper)nuclei, direct photons and dileptons. Detailed studies of various options for the forward spectrometer geometry and possible detector technologies are being performed. The MPD upgrade program for Phase II will begin after the results of these studies are analyzed.

Recommendation. The MPD experimental facility is in the final stage of construction, with the detector commissioning expected in late 2025. The PAC notes a significant delay in the readiness of the MPD detector compared to the anticipated timeline of the NICA collider. The PAC urges the MPD Collaboration to check whether the construction and installation tasks could be sped up to match the collider schedule better. The PAC recommends extending the MPD project for 5 years with ranking A.

III. Proposal of new project

The PAC heard the report “Study of neutrino properties in accelerator experiments” on JINR’s participation in the ongoing accelerator neutrino experiments NOvA, T2K, FASER and DsTau, presented by L. Kolupaeva. All these experiments aim to study the fundamental properties of neutrinos at accelerators with well-controlled particle sources. During several years, JINR teams have made significant and diverse contributions to the development of these experiments and data analyses, and group members have taken coordinator positions in the collaborations. The presented project combines the participation of JINR in experiments with neutrinos from accelerators into one project, which will make it possible to use the complementary experience of the participating groups. The main objectives of the

project are measurements of the neutrino masses ordering and lepton CP violation, searches for neutrinos from supernovae and exotic signals, as well as measurement of cross-sections and development of neutrino interactions models.

Recommendation. Taking into account the significant role of the JINR group in the NOvA experiment, and prospects for its scientific contribution to the T2K, FASER and DsTau experiments, the PAC recommends opening the project “Study of neutrino properties in accelerator experiments” from 2026 for three years with ranking A.

IV. Reports on research results obtained by JINR groups in the LHC experiments

The PAC takes note of the report on new results obtained by the JINR group in the ALICE collaboration presented by E. Rogochaya. The study of ultra-peripheral Pb-Pb collisions (UPC) at 5.36 TeV and the development of the Three-Component Thermal Model of particle production in Pb-Pb interactions were the focus of the group’s activity. In the analysis performed for the UPC, it was shown that dimuon continuum production is in good agreement with the model predictions by taking into account the flux of photons at impact parameters smaller than the nuclear radius. Also, new results for the coherent photoproduction of charmonium J/ψ, ψ(2S) have been obtained, and the comparison with the impulse approximation description showed clear evidence of strong nuclear shadowing of gluon density. The updated version of the Thermal Model, including the strange particle and resonance productions, describes different characteristics well, such as the ratio of particle yields depending on the charged particle density. The results were reported at various forums, and some are being prepared for publication. In addition, the group continues to participate in the maintenance of the GRID-ALICE system at JINR.

The PAC takes note of the report on physics results obtained by the JINR team in the ATLAS experiment presented by I. Yeletskikh. The Committee notes progress in various physics analyses and recognizes their scientific significance and visibility. Since the previous PAC session, the JINR team has significantly contributed to the published results on the measurement of the differential cross-sections of the Higgs boson production in association with Z- and W-bosons and the cross-section measurements of top-antitop pairs produced in association with W-bosons. The JINR team also made advances in the analysis of J/ψ-J/ψ and J/ψ-ψ(2S) resonant production near thresholds, searches for the Higgs boson produced in association with a single top quark, measurement of the CP-violating phase in B-meson

decays, and measurement of the electron and gamma reconstruction efficiencies in the ATLAS detector. The team members made significant contributions to the publication of 4 papers of the ATLAS Collaboration. The JINR team actively participates in the ATLAS software development and its support. In particular, extensive work has been done on the trigger development for B-physics and the development of the calorimeter software. The team has completely fulfilled its obligations in the production of RPC panels and continues to participate in the development and production of the High Granularity Timing Detector and LAr calorimeters.

The PAC takes note of the report on JINR's participation in the CMS experiment presented by V. Karjavine. The Committee noted the significant contribution made by the JINR group in physics analyses. A search is continued for dark matter particle candidates. New upper limits on the cross-section of DM-nucleon interactions were established. A novel method for calculating the model uncertainty for measuring the fractions of quark and gluon jets was developed. Work on studying the polarization properties of the Z boson was continued. The angular polarization coefficients in the Drell-Yan process were measured at an energy of 13.6 TeV. The influence of radiative contributions to the forward-backward asymmetry was analyzed in a wide kinematic region, including the period of the high-luminosity LHC operation. The JINR’s Tier-1 and Tier−2 centers were actively used in 2024 for modeling, processing and storing CMS experiment data. The PAC acknowledges the important participation of the JINR group in ensuring reliable operation of the CMS muon endcap and the hadron calorimeter during the RUN3 period of the data taking. In the framework of the CMS detector upgrade, the JINR group is actively involved in the construction of the high granularity calorimeter (HGCAL) and the upgrade of the muon endcap system. The PAC is pleased to note the significant contribution of young scientists from the JINR-CMS group to the preparation of a large number of scientific publications and presentations at international conferences, workshops and seminars.

V. Scientific reports

The PAC heard two scientific reports: “Status of the SRC program of the HyperNIS+SRC project” presented by M. Patsyuk, and “Study of dark matter physics using fixed target experiments” presented by A. Zhevlakov. The PAC thanks the speakers for the very interesting presentations.

VI. Presentations by young scientists

The PAC considered with interest 17 reports by young scientists from DLNP and VBLHEP at the poster session. The Committee selected the report “Construction of the ISCRA and SIMBO stations for applied research on high-energy ion beams. Radiation hardness testing of microchips by low energy pulsed ion beams at the SOCHI station” made by A. Slivin to be presented at the next session of the Scientific Council in February 2025.

VII. Next meeting of the PAC

The next meeting of the PAC for Particle Physics is scheduled for 23–24 June 2025.

The preliminary agenda for the next meeting includes:

- status report on the Nuclotron-NICA project,
- report from the coordinator of the experimental program with the Nuclotron beams,
- status report on the MPD project, including simulation results,
- report on the BM@N project, including physics results for the Xe run,
- progress report from the SPD project,
- progress reports on JINR’s participation in the LHC experiments,
- consideration of new projects,
- final reports and recommendations for the projects to be completed in 2025,
- posters from young physicists.

I. Tserruya

Chair of the PAC
for Particle Physics

A. Cheplakov

Scientific Secretary of the PAC
for Particle Physics