Due to significant air travel difficulties for PAC members, the 62nd meeting of the Programme Advisory Committee for Particle Physics was held in a hybrid format.

### I. Preamble

The Chair of the PAC for Particle Physics, I. Tserruya, opened the meeting with one minute of silence honoring the memory of Hans Gutbrod, long-time member of the PAC for Particle Physics and strong supporter of JINR and the NICA project, who passed away recently.

I. Tserruya then presented an overview of the implementation of the recommendations adopted at the previous meeting. JINR Vice-Director V. Kekelidze highlighted the resolution of the 137th session of the JINR Scientific Council (held in February 2025) relevant to particle physics and the decisions of the JINR Committee of Plenipotentiaries (held in March 2025). 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.

### II. Reports on the NICA projects

The PAC takes note of the report on the realization of the Nuclotron-NICA project presented by A. Sidorin. The Committee appreciates the progress in optimization of the particle dynamics in the Booster, which made it possible to implement the beam storage with electron cooling for accumulating $7 \cdot 10^7$ Xe ions from 5 pulses with a pulse intensity of $2 \cdot 10^7$ ions each. Assembly of the fast extraction system elements from the Nuclotron was completed, and the Nuclotron cryomagnetic system was prepared for operation. Construction work on installing the Nuclotron-Collider beamline was completed in Building 1. The Collider beamline assembly is progressing well. Vacuum tests of the Collider's West arc and its cryomagnetic system assembly are in the final stage. The NICA beam commissioning is still foreseen before the end of the year.

The PAC appreciates the progress in the implementation of the BM@N project presented by M. Kapishin. 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 AGeV. The data were reprocessed on the MLIT and VBLHEP computers to implement improved reconstruction methods and new calibration constants.

The BM@N team presented a preliminary result on the direct flow of deuterons in Xe+CsI interactions. A study is ongoing on the production of Λ-hyperons, $K^0$- and φ-mesons, and light hyper-nuclei in Xe+CsI interactions. A paper with physics results on the production of protons, deuterons, and tritons in argon-nucleus interactions at 3.2 AGeV has been accepted for publication in JHEP. The next physics run of the BM@N experiment is planned with a beam of Xe ions at an energy of 2–3 AGeV.

The PAC takes note of the report on the implementation of the MPD project presented by V. Riabov. The MPD experimental facility is at the final stage of construction; the detector commissioning is planned to start at the end of 2025 with all detector subsystems of the first phase of MPD. Extensive work is ongoing on the commissioning of the solenoidal superconducting magnet. Magnetic field measurements will begin in the summer and will take several months for different field configurations, using the mapper manufactured by Budker INP. A comprehensive programme of physics feasibility studies of the MPD facility has been carried out, and the detector performance for the measurement of various observables for collider and fixed-target modes of operation has been studied. It has now been published in two collaboration papers. Detailed simulation and technical design development for the forward spectrometers using realistic event generators and track reconstruction using the ACTS code continues. The MPD upgrade programme for Phase-II will start once the results of these studies are available.

The PAC takes note of the report on the status of the SPD project presented by A. Guskov. Work is underway to optimize the supporting structure of the detector and the external platform for placing the equipment, as well as the design of communication lines. Documentation for the construction of a superconducting solenoid is being prepared. Thermal analysis of the detector components is being carried out. Production sites for the gas detectors for the tracking and muon identification systems are being deployed. A prototype of the zero-degree calorimeter has already been installed in the collider ring near the SPD interaction point; a second prototype is expected to be installed soon. A dedicated data storage with a capacity of 7.2 PB for SPD has been deployed at MLIT. Work continues to update the physics programme for the first phase of the experiment. The PAC welcomes the success of the SPD collaboration and supports its efforts to prepare the initial phase of the experimental facility.

**III. Reports on the projects terminating in 2025 and proposals for their extension**

The PAC heard the report on the preparation of the project “Development of a physics program and detectors for experiments at CEPC” (former name “Development of a particle registration technique in future experiments with the participation of JINR”) presented by Yu. Davydov. The decision to start construction of the Circular Electron-Positron Collider (CEPC) in China is expected in 2026. However, work on preparing the research programme and developing technical design has been underway since 2012, after the discovery of the Higgs boson by the ATLAS and CMS collaborations. The main goals of CEPC will be precision studies of the physics of the Higgs boson, Z boson, top quark physics and the search for new physical phenomena beyond the Standard Model. The goal of this project is to prepare proposals for the physics research programme, participate in software development and theoretical calculations, and conduct a series of R&D studies of detectors for experiments at CEPC. The JINR group is well balanced to solve all the tasks set in the project. Over the next two years, conditions will be laid for JINR’s future long-term participation in experiments at CEPC, subject to approval of the construction of this accelerator by the Chinese government.

Recommendation. Considering the importance of preparing for full-fledged participation of JINR in experiments at the planned circular electron-positron collider CEPC, the PAC recommends extending the project “Development of a physics program and detectors for experiments at CEPC” for the period 2026–2027 with ranking A.

The PAC takes note of the progress report of the JINR group participating in the ALICE experiment presented by B. Batyunya. New results were obtained in the study of femtoscopic correlations of kaon pairs in p-p, p-Pb, Pb-Pb interactions, vector meson production in coherent photoproduction processes in ultraperipheral Pb-Pb collisions (UPC), Σ-hyperon production in p-p interactions, and the description of hadron production in the framework of a three-component thermal model. The results of these analyses were presented at various conferences and published. The PAC also notes the plans to continue the studies of the femtoscopic kaon pair correlations at the highest LHC energies, the gluon shadowing effect in Pb-Pb UPC, diffraction formation of resonances in p-p collisions, the search for a new hypernucleus ($\Sigma^0$-hypertriton), the development of the thermal model to describe new hadronic states and the parameters $v_3$ and $v_4$ of the azimuthal asymmetry. The JINR group will participate in the maintenance and development of the new fast interaction trigger, in carrying out all necessary maintenance work on this system and maintaining the operation of the GRID-ALICE system at JINR.

Recommendation. The PAC supports these plans and recommends extending JINR's participation in the ALICE experiment for the period 2026–2030 with ranking A.

The PAC takes note of the report on the results obtained by the JINR group participating in the ATLAS experiment at the LHC, presented by I. Yeletskikh. The Committee notes the significant contribution of the JINR physicists to various physics analyses, software development and detector upgrades. In particular, the JINR group participated in the measurement of the Higgs boson production cross section in gluon-gluon and vector boson fusion processes, and the measurement of heavy quark Yukawa couplings with the Higgs boson produced in association with gauge bosons. Significant results were obtained in the analysis of the resonance production of J/ψ-J/ψ and J/ψ-ψ(2S) near thresholds, the search for the Higgs boson produced in association with a single top quark, the measurement of the CP-violating phase in B-meson decays, and the measurement of the reconstruction efficiency of electrons and gamma quanta in ATLAS. The JINR team is actively involved in the development and support of the ATLAS software: a lot of work has been done on the development and support of the database, calorimeter simulation and reconstruction of objects. A significant contribution has been made to the upgrade of various detector subsystems, which will be continued during Phase-II of the ATLAS detector upgrade, including participation in the development and construction of the High-Granularity Timing Detector (HGTD).

Recommendation. The PAC recommends extending JINR's participation in the ATLAS experiment within the framework of the single project "ATLAS. Detector upgrade and physics at the LHC" for the period 2026–2030 with ranking A.

The PAC heard the report on the results of the JINR group participating in the CMS experiment within the framework of two projects, "CMS" and "Upgrade of the CMS detector", presented by V. Karzhavin. The PAC acknowledges the significant contribution of the JINR group to the maintenance and operation of the hadron calorimeter and the CMS endcap muon system during the RUN3 data taking period to ensure their reliable operation. The JINR Tier-1 and Tier-2 grid centres were actively and continuously used for processing and storing experimental data from the CMS detector. As part of the CMS upgrade for operation at high-luminosity conditions of the HL–LHC, the JINR group is actively involved in developing the high-granularity calorimeter HGCAL and upgrading the endcap muon system. The PAC notes with satisfaction the large number of publications with key contributions from JINR physicists. A significant number of conference reports were presented by young scientists. The main objectives of the joint project are to develop and implement a JINR physics research programme on precision testing of the Standard

Model (SM) and the search for new physics beyond the SM, as well as to participate in the Phase-II upgrade of the CMS detector to ensure its efficient operation in the HL–LHC era.

Recommendation. The PAC supports the merging of the two above-mentioned projects into a single project, “Physics studies at the CMS experiment and the second phase of the upgrade of the facility for operation under high-luminosity conditions,” and recommends extending JINR’s participation in the CMS experiment for the period 2026–2030 with ranking A.

**IV. Scientific report**

The PAC heard the scientific report “Theoretical calculations for future electron-positron colliders: status and prospects” presented by A. Arbuzov and thanks the speaker for the interesting presentation.

**V. Presentations by young scientists**

The PAC considered with interest 22 reports by young scientists from DLNP, MLIT, and VBLHEP at the poster session. The Committee selected the report “Dilepton measurements in the MPD experiment at NICA” made by Sudhir Pandurang Rode to be presented at the next session of the Scientific Council in September 2025.

**VI. Next meeting of the PAC**

The next meeting of the PAC for Particle Physics is scheduled for 26–27 January 2026.

The preliminary agenda for the next meeting includes:

– status report on the Nuclotron-NICA project;
– report from the coordinator of the experimental programme 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;
– review of the JINR neutrino programme;
– final reports and recommendations for the projects to be completed in 2026;

– posters from young physicists.

I. Tserruya

Chair of the PAC
for Particle Physics

A. Cheplakov

Scientific Secretary of the PAC
for Particle Physics