

Due to the worldwide pandemic situation, the 53rd meeting of the Programme Advisory Committee for Particle Physics was held via videoconference with a reduced agenda.

I. Preamble

The Chair of the PAC for Particle Physics, I. Tserruya, presented an overview of the implementation of the recommendations taken at the previous meeting and highlighted the Resolution of the 127th session of the JINR Scientific Council (February 2020) relevant to the PAC for Particle Physics. The Scientific Council supported all the recommendations of the PAC on the evaluation of new projects and on the continuation of ongoing projects in particle physics within the suggested time scales, as outlined in the PAC's report. The PAC joins the Scientific Council in congratulating the leaders of the NICA project, I. Meshkov and V. Kekelidze, on their election as Full Member and Corresponding Member of the Russian Academy of Sciences respectively.

The PAC congratulates G. Trubnikov on his appointment as First Vice-Director of JINR and S. Dmitriev and B. Sharkov on their appointments as Vice-Directors of JINR and wishes them success in their new functions.

II. Reports on ongoing projects with emphasis on the impact of the pandemic situation

The PAC heard with interest the report on the progress towards realization of the Nuclotron-NICA project presented by A. Sidorin. Although the pandemic situation caused a two-month delay in vacuum testing of the beam pipe and construction of cryogenic equipment for the unique elements of the ring, the tests of the main Booster systems were completed. The PAC welcomes the active preparations for launching the Booster synchrotron with beam in August 2020. The PAC expresses its concern with the lack of manpower sufficient for the collider magnet construction and tests and urges the JINR management to take the necessary steps to address this issue that otherwise could seriously impact the overall schedule of the NICA project. The PAC requests the Nuclotron-NICA team to ensure that the Nuclotron maximum available energy of 4.5 GeV/n becomes available as soon as possible.

The PAC takes note of the progress report on the infrastructure developments at VBLHEP, including the Nuclotron facility, presented by N. Agapov. The Committee notes

with satisfaction that, despite the difficult pandemic situation, all areas of infrastructure development are advancing without downtime and, basically, at the necessary pace.

The PAC appreciates the progress towards realization of the BM@N project presented by M. Kapishin. The BM@N Collaboration is focused on upgrading the detector for the heavy-ion physics runs planned for 2021 and beyond and on the analysis of the data collected with carbon and argon beams on fixed targets. The PAC is pleased to note that the first results on short-range correlations of nucleon pairs in inverse kinematic reactions measured at the Nuclotron were presented by the BM@N team at a JINR colloquium. The PAC encourages the BM@N team to publish the results obtained with the C and Ar beams as soon as possible.

III. Reports on projects approved for completion in 2020 and proposed for continuation

The PAC takes note of the report on the progress towards realization of the MPD project presented by A. Kisiel. The Multi-Purpose Detector (MPD) is focused on studies of nuclear matter at the highest baryon density accessible at the NICA facility. The MPD physics programme is unique in many aspects including kinematic coverage, energy scan, and high luminosity for a wide range of beams from protons to gold ions. Excellent particle identification capabilities of the 4π detector are very well suited for studies of event-by-event fluctuations and correlations, collective flow, strangeness production, and femtoscopy. The detector also offers unique opportunities for the measurement of electron pairs and photons as well as for the search of the conjectured critical point in the QCD phase diagram.

Recommendation. The PAC welcomes the steady progress in the assembly and production of most of the MPD detector components foreseen in the first stage configuration as well as in the production of the Inner Tracking System which poses a special challenge due to its technical complexity. The PAC expresses its concern with the delay in the ECAL construction and the resulting impact on the physics programme, with only half of the coverage foreseen now at the first stage while the second half is expected at a later stage. The PAC appreciates the admission of new institutions to the MPD Collaboration and encourages the MPD management to increase its efforts in this direction. The PAC appreciates the ongoing Monte Carlo simulations of the detector and physics processes while preparing the first beams in MPD and welcomes the plans to intensify this effort. The PAC recommends extension of the project until the end of 2025 with first priority.

The PAC takes note of the report on the project “Studies of the nucleon and hadron structure at CERN — Project COMPASS-II” presented by A. Nagaytsev. The experiment will be focused on the study of semi-inclusive deep-inelastic scattering processes of polarized leptons on polarized nuclear targets. The goal is to extract the parton distribution functions which describe the nucleon structure in the leading twist approximation in QCD. The JINR group will provide technical support for maintenance and completion of the HCAL1 and ECAL0 calorimeters and the MW1 muon detector, and will develop online software for monitoring their operation. It will also participate in the analysis of experimental information.

Recommendation. The PAC encourages the JINR team to enhance its participation in the data analysis and develop collaborative work for the physics exploitation of the data in order to secure scientific recognition of the group’s two-decade-long work in COMPASS. By the project completion in 2022, the group should explore new opportunities like e.g., MPD and SPD where its expertise is certainly very much needed. Meanwhile, young scientists should be given an opportunity to work on data analysis and they should be encouraged to give talks at international conferences. The PAC recommends extension of the COMPASS-II project until the end of 2022 with first priority.

The PAC takes note of the report on the project “Astrophysical studies in the TAIGA experiment” presented by L. Tkatchev. The TAIGA project is designed to cover a large area of approximately 10 km² and reach the sensitivity for the local source of photon fluxes at the level of 10⁻¹³ erg cm⁻² s⁻¹ in the energy range of 30-200 TeV. It can shed light on the origin of galactic cosmic rays (CR) in the region of the “knee” energy ~1000 TeV up to extragalactic CR at 1000 PeV. During 2019–2020 the complex of telescopes successfully passed important quality checks of the hardware and data processing algorithms — gamma quanta from the Crab nebula were measured at a significance level of more than 6 sigma. The main responsibility of the JINR group is the design of Imaging Atmospheric Cherenkov Telescope (IACT), mechanics manufacturing and tests. The third telescope was sent to Siberia in April 2020, the fourth IACT will be built during 2021–2023. The group also participates in Monte Carlo simulation and data analysis.

Recommendation. The PAC notes that the TAIGA project has a solid in-house component with significant international participation. The JINR group is playing an important role in the TAIGA collaboration for the design and production of the IACTs. The PAC encourages the team, in particular its young researchers, to strengthen their participation in the data analysis. Publication of the methodological results obtained by the

group should be carried out more actively. The PAC recommends extension of the TAIGA project until the end of 2023 with first priority.

The PAC appreciates the report presented by D. Naumov on the status of JINR's participation in the Daya Bay and JUNO experiments. The latter is aimed primarily at determining the hierarchy of neutrino masses with high sensitivity and at measuring lepton mixing parameters with sub-percent precision level. The contributions of the JINR group to both experiments made in many important systems of the detectors are acknowledged and imprinted in the structure of the collaboration management. The JINR team will continue the oscillation analysis and searches for sterile neutrinos in the Daya Bay experiment and will contribute to the development, construction and commissioning of various parts of the JUNO project: high-voltage units, Top Tracker detector, new test station for the large detector PMTs, TAO near detector, software packages for data processing and Global Neutrino Analysis. The JINR data centre is expected to be one of the three European centres managing JUNO data.

Recommendation. The PAC notes the high quality of the work performed by the JINR group and recommends continuation of the JUNO project with first priority until the end of 2023. The PAC encourages the group to ensure that the present personnel overlap with the DUNE project will not lead to future potential conflicts between the two international collaborations.

The PAC heard with interest the report on JINR's participation in the NOvA experiment and on the new results in the study of neutrino oscillations, presented by A. Olshevskiy. Since 2014 the JINR group has made significant contributions to the experiment, including the construction of the detector, the development of electronics and scintillator test benches, the development of computer infrastructure at JINR based on GRID and cloud technologies, the setting up of a Remote Operation Centre (ROC-Dubna) for participation in data taking and quality monitoring. The team members are well involved in the ongoing neutrino oscillation analyses and in the studies of supernova and atmospheric neutrinos, as well as in monopole searches. JINR employees also act in various leading roles, such as Detector Simulation Convener, offline and DAQ software release managers, DAQ, DDT and ROC experts.

The JINR group also presented its plans for the future LBNF/DUNE neutrino project at Fermilab/SURF, with a gradual increase of their participation in this large-scale international experiment, expected to start after completion of NOvA. Their first

commitments concern the light collection system in the liquid argon TPC for the Near Detector, the preparation of computer resources at JINR, and the development of data analysis tools.

Recommendation. Taking into account the visible role of the JINR group in the NOvA experiment and its solid plans for further advances in forefront neutrino physics research with the DUNE experiment, the PAC recommends continuation of NOvA and approval of the group's participation in DUNE, both until 2023 with first priority. The PAC encourages the JINR Directorate to provide the necessary resources to the DUNE project in order to guarantee visible participation of the group. One could envision JINR's possible contribution to the LBNF facility, similar to what is done by other major international laboratories. In this framework, the JINR group should play the role of bridgehead for the future joining of more groups associated with JINR.

IV. Next meeting of the PAC

The next meeting of the PAC for Particle Physics will be held on 18–19 January 2021.

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

- follow-up on the to-do-list from this PAC meeting;
- status report on the Nuclotron-NICA project;
- status report on infrastructure issues including Nuclotron;
- status report on the MPD project including simulation results;
- report on the BM@N project including simulation and physics results;
- Conceptual Design Report of the SPD experiment;
- progress reports on the JINR participation in the LHC experiments;
- consideration of new projects;
- reports and recommendations on the projects to be completed in 2021;
- posters from young physicists.



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for Particle Physics



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