

I. Preamble

The Chair of the PAC for Nuclear Physics, M. Lewitowicz, presented an overview of the implementation of the recommendations taken at the previous meeting.

JINR Vice-Director S. Dmitriev informed the PAC about the Resolution of the 127th session of the JINR Scientific Council (February 2020) and the decisions of the JINR Committee of Plenipotentiaries (June 2020).

The PAC is pleased to note that the recommendations of the previous PAC meeting concerning JINR research in the areas of nuclear physics have been accepted by the Scientific Council and the Directorate.

The PAC was informed about the appointments of G. Trubnikov as First Vice-Director of JINR, S. Dmitriev as Vice-Director of JINR, B. Sharkov as Vice-Director of JINR, and S. Sidorchuk as Director of the Flerov Laboratory of Nuclear Reactions (FLNR). The PAC wishes them a fruitful and bright future in these new positions. The Committee would like to acknowledge the excellent and enthusiastic work accomplished by the former FLNR Director S. Dmitriev and the former JINR Vice-Director M. Itkis. Their actions and contributions to the progress of FLNR and JINR have been invaluable.

The PAC was informed about the status of the Factory of Superheavy Elements (SHE Factory) at FLNR. At present, installation of the “flat-top” system has been completed at the DC-280 cyclotron and is being tested, which will further increase the efficiency of production of heavy-ion beams. A differential pumping system is constructed at the GFS-2 gas-filled separator to accept the highest possible ion current produced by DC-280. All previously scheduled test experiments have been completed. The first experiment to produce moscovium isotopes in the $^{48}\text{Ca}+^{243}\text{Am}$ reaction at the SHE Factory has been prepared. The americium target has been installed and tested. The beginning of the experiment is planned for the autumn of this year.

II. Report on the theme “Improvement of the JINR Phasotron and Design of Cyclotrons for Fundamental and Applied Research”

The PAC heard the report on the results of work under the theme “Improvement of the JINR Phasotron and Design of Cyclotrons for Fundamental and Applied Research”, presented by G. Karamysheva. Due to the upgrade of the Phasotron and its beam lines carried out between 2016 and 2020, a stable operation of the accelerator was ensured for an average of 1000 hours per year; of these, about 80% was used for medical research.

Research under the theme focused mostly on developing and improving cyclotrons used in hadron therapy.

The most important activities were carried out in collaboration with the Institute of Nuclear Physics, Polish Academy of Sciences (Kraków, Poland) on the modernization of the conventional IAC-144 cyclotron in Kraków and with the Institute of Plasma Physics of the Chinese Academy of Sciences (Hefei, PRC) on the design and manufacture of the superconducting isochronous SC200 cyclotron for proton therapy. The construction of the SC200 cyclotron has faced a number of engineering challenges, which mainly arise due to the high magnetic field of the accelerator. Subsequently, a design of the SC230 compact superconducting cyclotron with smaller dimensions and a required magnetic field level was developed. An accelerator with such parameters can become potentially the cheapest and most energy-efficient accelerator for proton therapy due to low-energy consumption of the accelerating system. The SC230 accelerator has become a candidate for further realization of the biomedical research programme at JINR. A concept document of a carbon-ion accelerator for cancer therapy was indicated. The report presented by the authors was of high technical standard and clearly showcases the depth of JINR's expertise.

However, it is unclear which direction JINR will choose towards the realization of a modern proton therapy facility. Clear criteria need to be formulated according to which the choice of the dedicated medical accelerator can be made. In particular, it would be commendable if more details are presented, for example, on how many patients and fractions for proton therapy are planned.

Recommendation. The PAC took note of the report on the concluding theme "Improvement of the JINR Phasotron and Design of Cyclotrons for Fundamental and Applied Research". The PAC recommends continuing the studies planned by the team in the field of development, construction and upgrade of cyclotrons, continuing cooperation in the field of medical cyclotrons within the framework of one of the themes of the Dzheleпов Laboratory of Nuclear Problems. The PAC recommends that the JINR Directorate make soon a decision on this direction and support the realization of an optimized facility for proton therapy with high priority.

III. Modernization of the EG-5 accelerator and development of its experimental infrastructure

The PAC heard the well prepared and documented report on the plans for the development of the EG-5 accelerator and its experimental infrastructure at FLNP, presented by A. Doroshkevich. The PAC notes the utmost importance of EG-5 for JINR

and its Member States. The authors compare in detail two technical solutions: a modernization of the existing EG-5 accelerator and a purchase of a new accelerator with similar design parameters. The choice of the most cost-effective solution, namely the modernization of the EG-5 accelerator, was proposed.

Recommendation. The PAC recommends the realization of modernization of the EG-5 accelerator with first priority. The PAC recommends preparing and opening a project to modernize the existing accelerator and associated experimental infrastructure activities under the theme “Investigations of Neutron Nuclear Interactions and Properties of the Neutron” with financing from the budget of the current Seven-Year Plan for the Development of JINR, starting in 2021.

IV. New project MONUMENT

The PAC heard the proposal to open a new project “Measurement of ordinary muon capture for testing nuclear matrix elements of 2β -decays (project MONUMENT)” presented by D. Zinatulina.

This project is aimed at carrying out experimental measurements of muon capture at several daughter candidates on 2β -decay nuclei. Obtained results would have high importance for checking the accuracy of theoretical calculations of nuclear matrix elements. The measurements of muon capture will be carried out at the meson factory of the Paul Scherrer Institute (PSI) in Switzerland. This application was reviewed and approved by the PSI User committee; the beam time was officially granted in 2020 for a preliminary study of ^{136}Ba with a further experimental programme for at least three years. This project continues and extends the previous ordinary muon decay programme proposed and implemented under the guidance of JINR researchers from 1998 to 2006. The participants of the MONUMENT project have required expertise and experience in the field of high-precision nuclear spectroscopy and its implementation for studying not only rare processes but also muon capture.

Recommendation. The PAC recommends opening the project MONUMENT for 2021–2023 with first priority and providing the project with full requested funding.

V. Next meeting of the PAC

The next meeting of the PAC for Nuclear Physics will be held on 21–22 January 2021.

Its tentative agenda will include:

- reports and recommendations on themes and projects to be completed in 2021;
- first experiments at the SHE Factory and its scientific programme;

- results of the experiments at ACCULINNA-2;
- consideration of new projects;
- scientific reports;
- poster presentations of new results and proposals by young scientists in the field of nuclear physics research.



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