I. Preamble

The Chairman of the PAC for Nuclear Physics, M. Lewitowicz, welcomed the PAC members, the ex officio members from JINR and members of the JINR Directorate.

The Chairman presented an overview of the implementation of the recommendations taken at the previous meeting.

JINR Vice-Director M. Itkis informed the PAC about the Resolution of the 121st session of the Scientific Council (February 2017) and the decisions of the Committee of Plenipotentiaries (March 2017). 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 JINR Scientific Council and Directorate.

II. Status of the Factory of Superheavy Elements

The PAC heard reports on the status of the Factory of Superheavy Elements (SHE Factory) presented by I. Kalagin, S. Bogomolov, and A. Popeko. The PAC appreciates the high pace of the installation and commissioning work of their subsystems.

DC-280. The DC-280 cyclotron (Dubna Cyclotron, K-factor 280) is the central device of the new SHE Factory. The cyclotron and all its subsystems are in the installation phase.

The high-voltage platform on which the ion source will be located is being currently mounted. The mounting of the axial injection system is in progress. The main cyclotron magnet has been mounted and magnetic measurements will begin soon. The delay in starting magnetic measurements by about two months has been caused by a delay in obtaining permission to connect the magnet to the power supply from the Russian federal supervisory authorities. Completion of the installation work is planned for December 2017. The commissioning of the cyclotron is now planned from January to April 2018.

ECR sources. The new 14 GHz ECR-type ion source (DECRIS-PM) was constructed on permanent magnets. The first results obtained with the DECRIS-PM for Ar, Kr, Xe, Ca, Mg and Fe manifested the design intensities of the produced ions. In particular, the test with Ca ions confirmed that the design specifications of the source were reached in terms of the ion-beam intensity (210 eμA for $^{40}Ca^{9+}$) and of the low consumption of the calcium material. The source is ready for installation at the SHE Factory.

The superconducting ECR source for heavier ions to be installed in the future at the second HV platform is under design.

Target unit. Documentation for the new target unit designed for the new separator has been developed. The contract on the construction of the target unit will be signed in the coming few months and the system is expected to be operational for the first experiments in 2018.

Separator. The manufacturing of the new gas-filled separator (GFS-2) is ongoing and the initial testing of several components is being conducted. The separator should be delivered to Dubna and mounted on channel 3 in October 2017. The design of a pre-separator for studying the chemical properties of superheavy elements is in progress.

Detection unit. A detection system for recording rare events of formation of superheavy elements with a high position and energy resolution at GFS-2 is under development. First tests of the focal plane double-sided Si strip detector have demonstrated its excellent energy resolution. A combination of the existing digital and analog electronics is proposed to be used in the first experiments at the SHE Factory.

Recommendations. In order to meet the deadlines of the start-up and putting into operation of the SHE Factory, the PAC recommends that the JINR and FLNR Directorates ensure coordinated implementation of the schedule of civil construction, installation and commissioning work for the accelerator, separator, target and detector systems. The PAC also recommends a careful quality control to be ensured during the installation and commissioning of all mentioned SHE Factory components in order to guarantee the reliable operation of the facility at its optimal performance.

The PAC recommends that the FLNR Directorate focus on the preparation of day-one experiment. Special attention should be given to the timely provision of the SHE Factory complex with engineering and technical personnel.

III. New fragment-separator ACCULINNA-2 and its day-one experiments

The PAC heard a report on the progress in commissioning and preparing day-one experiments at the new fragment-separator ACCULINNA-2 presented by A. Fomichev. The start-up of this fragment-separator was carried out in March 2017. The design parameters of the set-up were experimentally confirmed. The measured intensities of the secondary beams exceeded the values obtained at the existing fragment-separator ACCULINNA-1 by a factor of 25. The collaboration proposed that the first experiments would investigate ^{7}H, ^{13}Li, ^{17}Ne and ^{26}S decaying via the 3n, 4n and 2p emission.

Recommendation. The PAC endorses the presented programme of the first experiments at the ACCULINNA-2 fragment-separator and looks forward to a report on their results at future meetings of the PAC.

IV. Project TANGRA

The PAC heard a proposal for the extension of the project “Design and development of the tagged neutron method for determination of the elemental structure of materials and nuclear reaction studies (project TANGRA)” presented by Yu. Kopatch. The project is aimed at developing the tagged neutron method and its application for basic nuclear physics research, as well as for applied studies. The PAC notes the successful realization of the first stage of the project during 2014–2016, the expansion of the list of its participants, as well as the balanced research programme for 2017–2019.

Recommendation. The PAC recommends extension of the TANGRA project until the end of 2019 with full allocation of the requested funding, according to the presented schedule of work.

V. Project E&T&RM

The PAC heard a report on the project “Study of deeply subcritical electronuclear systems and possibilities of their application for energy production, transmutation of radioactive waste and research in the field of radiation material science. Quasi infinite target (project E&T&RM)” presented by V. Wagner. The PAC notes the large amount of work carried out by the authors of the project to develop methods for studying the main nuclear physics parameters of the uranium assembly “Quinta” (the neutron field, the plutonium production time, the energy yield of the assembly, the transmutation rates of minor actinides). The results were included in the IAEA database on ADS-systems. A 660 MeV proton beam of the Phasotron at DLNP is used for experimental studies.

Recommendation. The PAC recommends extending the work on this project until the end of 2019. More detailed recommendations on this topic will be formulated at the next PAC meeting.

VI. Scientific results obtained in the projects of the theme “Physics of Light Mesons”

The PAC heard reports on the results obtained in the PEN-MEG, TRITON, and PAINUC experiments within the theme “Physics of Light Mesons”.

The PAC heard a report on the results obtained in the PEN-MEG experiment presented by N. Chomutov. The PAC recognizes the world-class results produced in implementing this project. The PEN experiment accumulated some $2.3 \cdot 10^7$ $\pi^+ \to e^+ \nu$ and more than $1.5 \cdot 10^8$ $\pi \to \mu \to e$ decays as well as significant numbers of pion and muon radiative decays. A comprehensive blinded maximum likelihood analysis is underway to extract a new experimental value of the ratio $R^{\pi}_{e/\mu}$. The PEN goal is $\Delta R/R \approx 5 \cdot 10^{-4}$. The PAC recommends continuation of the processing of the data analysis in the PEN experiment on the radiative decay of a pion that will allow improvement of the previous results. Within the MEG experiment, a new upper limit on the branching ratio of this decay of B $(\mu^+ \to e^+ \gamma) < 4.2 \cdot 10^{-13}$ (90% CL) was established, which represents the most stringent limit on the existence of this decay to date. The PAC supports participation in the MEG-II project.

The PAC heard a report on the results obtained in the TRITON experiment presented by D. Demin. The PAC notes that the measured rates of the nuclear reaction p + t in the channels with the output of gamma quantum and muon conversion confirm the results of the only PSI experiment (1993) and are in substantial contradiction with the modern theory. Taking into account the new data on previously not observed pt-fusion channels with the emission of an electron-positron pair and gamma-quantum pair, as well as the complexity of the method of investigation, the PAC recommends continuation of the activity in the TRITON experiment in order to carry out in particular:

– modeling of kinetics of mesoatomic and mesomolecular processes in the target;

– calibration of detectors on an electron beam with an energy up to 20 MeV;

– development of a technique for modeling the channel registration process with the emission of two gamma quanta from the pt-fusion reaction in the TRITON installation;

– in-depth analysis of the experimental data obtained, as well as the decommissioning of the TRITON installation from operation by 2020.

The PAC heard a report presented by G. Pontecorvo on the results obtained in the study of □‡ ^{4}He-interactions at beam energy lower than the Delta resonance in the PAINUC project. The research was conducted using DLNP's self-shunted streamer chamber placed in a magnetic field. During the past three years the collaboration has concentrated on reliable identification of the strongly ionizing charged secondaries, making use of information on their ionizing power as well as kinematics, and on enhancing the intensity of the pion beam extracted from the DLNP Phasotron. About 20% of the available raw data has been analysed. A significant part of the events of

negative pion interaction with helium are shown to involve two deuterons in the final state. The mass of the neutral component of the Delta resonance has been estimated to be in agreement with the negative Delta mass previously determined by PAINUC. The PAC hopes that the PAINUC collaboration will successfully complete the analysis of all the existing data as well as extraction of pion beams and launch a new project as soon as possible. The PAC encourages the PAINUC collaboration to have a more aggressive strategy for publication.

General recommendation. The PAC endorses the final reports on the results obtained in the MEG-PEN, TRITON, and PAINUC experiments. The participation in the upgraded MEG-II frontier experiment in the search for lepton flavour violation should be continued.

VII. Scientific reports

The PAC heard with interest the report “Dipole toroidal resonance: vortical properties, anomalous deformation splitting, relation to pygmy mode” presented by V. Nesterenko. Theoretical models which describe well and give a deep interpretation of the experimental results were widely discussed. The models are also able to predict new results on the ^{24}Mg nucleus. The results are very interesting and should be published very soon.

The PAC heard with interest the report “Search for spatial parity violation effects in reactions of cold polarized neutrons with lightest nuclei” presented by P. Sedyshev. The scientific goal of the experiment $^{10}B(n,\alpha)^{7}Li$ is to determine the value of the weak π-meson-nucleon exchange constant f_π and report $f_\pi \leq 0.6 \cdot 10^{-7}$.

VIII. Poster session

The PAC appreciated the high quality of presentations of new results and proposals by young scientists in the field of nuclear physics research. The best posters selected are: “Investigation of exotic states in light nuclei” presented by D. Janseitov and “Impact of tensor interaction on β-delayed neutron emission in neutron-rich Ni isotopes” presented by E. Sushenok.

The PAC recommends the poster “Investigation of exotic states in light nuclei” for presentation at the session of the Scientific Council in September 2017.

IX. Visit to FLNR

The members of the PAC thank the Directorate of the Flerov Laboratory of Nuclear Reactions for the organization of the visit to this laboratory to get acquainted with the progress of construction of the Factory of Superheavy Elements.

X. Next meeting of the PAC

The next meeting of the PAC for Nuclear Physics will be held on 17–18 January 2018.

Its tentative agenda will include:

– reports and recommendations on themes and projects to be completed in 2018;
– consideration of new projects;
– poster presentations of new results and proposals by young scientists in the field of nuclear physics research;
– scientific reports;
– visit to the Dzhelepov Laboratory of Nuclear Problems.

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Chairman of the PAC
for Nuclear Physics

N. Skobelev
Scientific Secretary of the PAC
for Nuclear Physics