

**I. Preamble**

The Chairman of the PAC for Condensed Matter Physics, D. L. Nagy, welcomed the PAC members, the ex officio members from JINR, the invited experts A. Ioffe, J. Kulda, and M. Tashmetov, and members of the JINR Directorate, and presented an overview of the implementation of the recommendations concerning JINR research in the areas of condensed matter physics taken at the previous PAC meeting. The PAC is pleased to note that these recommendations have been accepted by the Scientific Council and the Directorate of JINR.

JINR Vice-Director B. Sharkov informed the PAC about the Resolution of the 125th session of the JINR Scientific Council (February 2019) and the decisions of the JINR Committee of Plenipotentiaries (March 2019).

**II. Reports and proposals on themes and projects**

The PAC heard a report on the concluding theme “Development of the IBR-2 Facility with a Complex of Cryogenic Neutron Moderators” and project “Construction of a complex of cryogenic moderators at the IBR-2 facility” being implemented within this theme and a proposal for their extension presented by A. Vinogradov.

Recommendation. The PAC recommends extension of this theme and project for 2020–2022.

The PAC heard a proposal for the opening of a new theme “Development of the Conceptual Design of a New Advanced Neutron Source at JINR” presented by V. Shvetsov. The PAC notes the significant progress achieved by the FLNP team in developing a technical justification for the concept of the new source. At the same time, it would like to draw the attention of the project leaders and FLNP Directorate to the necessity of developing a rationale for the scientific programme for the new source.

Recommendation. The PAC considers the human and material resources requested by the Laboratory to be adequate to the objectives identified and the results expected upon completion of the theme. The PAC supports this proposal and recommends the opening of a new theme “Development of the Conceptual Design of a New Advanced Neutron Source at JINR” for 2020–2022. The PAC requests the theme leaders to define a management structure, clear deliverables, milestones, and a time schedule for this theme. The PAC expects progress reports from the FLNP Directorate

and the Chairman of the Working Subgroup for Condensed Matter and Neutron Physics at each PAC meeting.

The PAC heard the status and recent developments of the JINR–SOLARIS collaboration to develop the joint facility for structural research using synchrotron X-rays and a proposal for opening a new theme “Development of the SOLCRYST Structural Research Laboratory at the SOLARIS National Synchrotron Radiation Centre” presented by N. Kučerka. The parameters of the existing facility and those for the new instruments proposed to be built allow one to estimate a potential for their future scientific use. An interest has been expressed by several organizations from JINR Member States.

Recommendation. The PAC recommends the opening of a new theme “Development of the SOLCRYST Structural Research Laboratory at the SOLARIS National Synchrotron Centre” for 2020–2022. The PAC expects the parameters of the three proposed stations and their connections with the scientific programme and the international synchrotron landscape to be reported at its next meeting.

The PAC heard a report on the concluding theme “Biomedical and Radiation-Genetic Studies Using Different Types of Ionizing Radiation” and project “Further development of methods, technologies, schedule modes and delivery of radiotherapy” and a proposal for their extension presented by G. Mitsyn. The PAC emphasizes the high importance of the results achieved both in the field of clinical research on proton radiotherapy applications for the treatment of different diseases and in the field of radiobiology. Particularly, it should be stressed that the clinical research has entered a new phase, in which the statistical analysis of the treatment results becomes possible and the effectiveness of the proton radiotherapy techniques realized at JINR is seen.

Recommendation. The PAC recommends extension of this theme and project for 2020–2022. The PAC recommends strengthening the research underway in this field at JINR. It also requests information on the fundamental research in the field and on how the research will be transferred to the medical treatment.

The PAC considered the report presented by K. Afanasyeva on the concluding project “RADIOGENE: Experimental justification of radiation genetic risk estimation according to the frequency of heritable DNA changes in human and animal structural genes” and a proposal for its extension with a new title “RADIOGENE: Molecular genetics

of radiation-induced changes at the gene, genome and transcriptome level in *Drosophila melanogaster*".

The PAC notes the challenge of the situation in research that, although there is a vast amount of evidence for radiation-induced mutations in diverse biological systems, there is no exact evidence for radiation-induced germ cell mutations that could cause genetic disease in human population. The PAC further notes that the concept of the project is based on results of hereditary diseases from mutations occurring in germ cells of *Drosophila*, and also on ionizing radiation capable of inducing similar changes in all experimental systems of the project. The PAC recognizes the significant progress in the development of this project and the new fundamental data in the nature of radiation genetics of living organisms and frequency of inherited changes in the DNA of gene mutations induced by  $\gamma$ -rays and fission neutrons in the *Drosophila* germ cells. The PAC especially notes the high scientific and methodological level of the research based on advanced DNA technologies.

Recommendation. The PAC recommends extension of this project with the new title "RADIOGENE: The molecular genetics of radiation-induced changes at the gene, genome and transcriptome level in *Drosophila melanogaster*" for its implementation within the theme "Biomedical and Radiation-Genetic Studies Using Different Types of Ionizing Radiation" for 2020–2022.

The PAC heard a report on the concluding theme and project "Research on Cosmic Matter on the Earth and in Space; Research on the Biological and Geochemical Specifics of the Early Earth", and a proposal of its extension presented by A. Rozanov.

The results achieved by the Astrobiology Sector of the Laboratory of Radiation Biology for the past three years indicate the high productivity of its research. The list of the publications has been expanded to include new papers in international journals of high impact factors. Thanks to the broad collaboration between JINR, the Russian Academy of Sciences, and a number of other institutions, the Astrobiology Sector has become one of the leading sectors of research in this field. The PAC does not doubt the high importance of the fundamental and applied problems being addressed by this Sector.

In addition to using JINR's facilities, in particular the Phasotron and the IBR-2 reactor, the Sector has acquired its own equipment. In 2017, a modern Tescan Vega 3 scanning electron microscope was put into operation, by which fossilized microorganisms in meteorites are searched for and studied. Eukaryotic microorganisms have been found in the Orgueil meteorite; the results of this research have been published in the Paleontological Journal of the Russian Academy of Sciences.

The PAC finds the funding requested for the fulfillment of the project and the programme of the project's realization to match its tasks.

Recommendation. The PAC believes that research in the fields specified by the proposal would make a remarkable contribution to the advancement of the interdisciplinary science of astrobiology and recommends extension of this theme and project for 2020–2022.

The PAC heard a report on the concluding theme “Methods, Algorithms and Software for Modeling Physical Systems, Mathematical Processing and Analysis of Experimental Data” and a proposal for its extension presented by Gh. Adam.

The PAC highly appreciates the results obtained in the development of new mathematical methods, algorithms, and software packages intended to address topics of the utmost importance for the experimental and theoretical research conducted at JINR. Issues of condensed matter physics address within the present theme are represented, on the one hand, through high-class computer support of the data acquisition and processing at IBR-2 spectrometers and, on the other hand, through important computer developments for the numerical solution of theoretical models describing either dynamic phenomena or structural properties of complex materials of interest in JINR laboratories.

The basis for future developments within this theme will be the maximum realization, for the benefit of the whole JINR scientific community, of the unique opportunities offered by the heterogeneous computing platform HybriLIT through its Govorun supercomputer and its education and testing site. The PAC endorses the efforts aimed at the in-house development and implementation of specialized packages of parallel programs, tools based on machine learning and Big Data analytics, and on quantum computing. The PAC recognizes the availability of adequate expertise of the basic staff working within this theme and supports further efforts towards enhancing the role of LIT as attractor of young talents in computer sciences. The requested financial resources fully comply with the objectives of the theme.

Recommendation. The PAC considers the proposal to be well formulated and recommends extension of the theme for 2020–2023.

The PAC heard a status report by M. Avdeev on the project “A system for neutron operando monitoring and diagnostics of materials and interfaces for electrochemical energy storage devices at the IBR-2 reactor” (ELCHEM-NS) within the theme “Investigations of Condensed Matter by Modern Neutron Scattering Methods”.

Recommendation. The PAC is satisfied with the progress of the ELCHEM-NS project and recommends its continuation.

General recommendation. The PAC recommends that speakers presenting reports on themes and projects change the manner of delivering information. The presentation must clearly indicate the science and/or technology value of theme or project, the current stage of its implementation in connection with the whole timeline of suggested activities, the year-by-year plan of its implementation, the steps already completed and those to be completed, as well as relation of reported activities to the corresponding part of the Seven-Year Plan for the Development of JINR. The results obtained within the theme or project should be summarized briefly and reported in a concise manner. For new proposals the expected results should be identified in the presentation.

### **III. Reports on inelastic neutron scattering at IBR-2**

The PAC heard with interest an overview of the current trends in neutron spectroscopy worldwide presented by J. Kulda.

The PAC took note of the presentation by D. Chudoba on the current state of inelastic neutron scattering instruments operating at IBR-2. The PAC notes that the two spectrometers mentioned in the report are the only inelastic neutron scattering instruments available at JINR. The PAC was informed about FLNP plans to open a new project to further develop these spectrometers under the theme “Condensed Matter Research Using Modern Neutron Scattering Methods” for 2021–2023.

Recommendation. The PAC supports the development of new inelastic neutron scattering instruments and the preparation of a proposal for a new project for 2021–2023. The PAC expects a full-length proposal for this new project to be presented at its next meeting.

### **IV. Preparation of JINR’s strategic long-range plan**

The PAC took note of the information on the current activities of the Working Subgroup for Radiobiology and Astrobiology for the preparation of JINR’s strategic long-range plan presented by B. Sharkov and E. Krasavin.

Recommendation. The PAC endorses the efforts of the Working Subgroup for Radiation Biology and Astrobiology and of LRB towards finalizing the document on strategic development of radiation biology at JINR.

### **V. Scientific report**

The PAC heard with interest the scientific report “Emergence of life in formamide-based origin scenario” and thanks the speaker R. Saladino.

## VI. Poster presentations

The PAC reviewed poster presentations by young scientists in the fields of information technology and condensed matter physics. The poster “Investigations of polystyrene-fullerene nanocomposite thin films by neutron and X-ray reflectometry” by M. Karpets was selected as the best poster at the session. The author of this poster will receive diploma at the next meeting.

Recommendation. The PAC recommends this poster to be reported at the session of the Scientific Council in September 2019. The PAC, however, is concerned about the low number of posters presented this time and recommends that the directorates of the Laboratories involved, on the one hand, encourage young scientists to participate more actively in poster sessions and, on the other hand, use poster sessions for presenting broader information on themes and projects reported at PAC meetings.

## VII. Next meeting of the PAC

The next meeting of the PAC for Condensed Matter Physics will be held on 20–21 January 2020.

Its tentative agenda will include:

- information by the PAC Chairman on the implementation of the recommendations of the current PAC meeting;
- information by the JINR Directorate on the sessions of the Scientific Council (September 2019) and of the Committee of Plenipotentiaries (November 2019);
- reports and recommendations on themes and projects to be completed in 2020;
- progress of the development of a concept for JINR’s new neutron source;
- status reports on upgrades of FLNP instruments;
- discussion of a general scheme of evaluating themes and projects by the PAC;
- information about scientific meetings;
- scientific reports;
- poster session.



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Chairman of the PAC  
for Condensed Matter Physics



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