

Programme Advisory Committee for Nuclear Physics

35th meeting, 26–27 January 2012

Recommendations

I. Preamble

The Chairperson of the PAC, W. Greiner, welcomed the PAC members, the ex-officio members from JINR, and reminded of the implementation of the recommendations taken at the previous meeting.

JINR Vice-Director M. Itkis informed the PAC about the Resolution of the 110th session of the Scientific Council (September 2011) and the decisions of the Committee of Plenipotentiaries (November 2011). The PAC is pleased to note that most of 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.

The PAC congratulates the staff of the Flerov Laboratory and their colleagues at the Livermore Laboratory (USA) for the recognition of their priority in the discovery of elements 114 and 116, and looks forward to the approval by IUPAC of the names proposed for these elements — “flerovium” and “livermorium”.

II. Theme “Non-Accelerator Neutrino Physics and Astrophysics”

The PAC heard with interest the report on the theme “Non-Accelerator Neutrino Physics and Astrophysics” (03-2-1100-2010/2012) presented by E. Yakushev. The theme is devoted to search for neutrinoless double-beta decay (NEMO-3, SuperNEMO and GERDA projects), experiments with the reactor antineutrino (GEMMA — search for the neutrino magnetic moment; reactor diagnostics and investigation of the neutrino properties with the DANSS detector), search for the Dark Matter (EDELWEISS project), deep-water investigations with the neutrino telescope at Lake Baikal (BAIKAL project).

In the NEMO experiment two-neutrino and neutrino-less double beta decay of isotope-enriched ^{48}Ca , ^{82}Se , ^{96}Zr , ^{130}Mo , ^{116}Cd , ^{128}Te and ^{150}Nd were investigated. Results of world-wide significance have been obtained. The measurement with the NEMO-3 spectrometer is now completed and the detector dismantled. The final analysis is still ongoing and will be achieved within one or two years. The investigation will be continued with 100 kg ^{82}Se in the new, next-generation experiment SuperNEMO (with a sensitivity for Majorana neutrino mass at the level of ~ 40 meV).

The first phase of the GERDA experiment measuring double-beta decay of ^{76}Ge with “naked” HPGe detectors in liquid argon has been taking data in the underground Gran Sasso laboratory since 2 December 2011.

Measurements of the ν -e scattering with the GEMMA detector provides the world-wide best upper limit for the neutrino magnetic moment (NMM): $\mu_\nu \leq 2.9 \cdot 10^{-11} \mu_B$. The measurement will be continued with the upgraded spectrometer GEMMA-2 at a shorter distance from the reactor core, which allows to expect the better NMM sensitivity ($\sim 1 \cdot 10^{-11} \mu_B$).

Recommendation. The PAC appreciates the high quality of investigations within the framework of the theme “Non-Accelerator Neutrino Physics and Astrophysics” and recommends their continuation with first priority in 2013-2015. This way the role of the JINR group in all these experiments is appreciated.

III. Continuation of the projects under the theme “Non-Accelerator Neutrino Physics and Astrophysics”

The PAC heard with interest the report of V Egorov on the reactor neutrino experiments performed by JINR physicists at the Kalinin Nuclear Power Plant — GEMMA and DANSS. Within the GEMMA project searching for the NMM, all the data obtained with GEMMA-1 spectrometer have been analyzed and a new NMM upper limit ($\mu_\nu \leq 2.9 \times 10^{-11} \mu_B$) appeared to be the world-wide best. The spectrometer is being upgraded to GEMMA-2 now: the detector mass increased by factor of 4, background and energy threshold are decreased, the neutrino flux is doubled. As a result, in 2-3 years of measurement it is expected to reach the NMM sensitivity at the level of $1 \times 10^{-11} \mu_B$. Construction of the neutrino detector DANSS is in progress. In addition to the previously announced reactor diagnostics (and the importance thereof), the detector will be used to search in fundamental studies for short-range neutrino oscillations of the sterile type.

The aim of the second project (DANSS) is to develop and create the antineutrino detector based on solid-state plastic scintillators. The detector could also be used for reactor monitoring. While the DANSS detector design was in progress, it was found that the detector (if made movable) would be best suited for the search of short-range neutrino oscillations. Taking into account the expected improvements, the DANSS team decided to equip the spectrometer with a special lifting gear.

Recommendations. The PAC recommends continuation of the investigations of the reactor antineutrino under the GEMMA project with first priority in 2013–2015.

The PAC recommends intensification of the activities under the DANSS project with first priority in 2013–2015, with special attention given to the neutrino oscillation aspects.

Investigation of the Dark Matter will be continued in the EDELWEISS experiment with improved cryogenic bolometers. The objective of this second phase is to reach a total active mass of 40 kg.

The PAC appreciates the new experimental results produced in the astroparticle projects EDELWEISS (search for Dark Matter) and BAIKAL (deep-water neutrino telescope at Lake Baikal), and notes the important contribution to the understanding of processes that accelerate cosmic rays to the highest energy and their point sources. The PAC appreciates the complementary role played by the project BAIKAL with respect to Ice Cube in studies of neutrino flux from all directions of the sky.

Recommendation. The PAC recommends continuation of the EDELWEISS and BAIKAL projects with first priority in 2013–2015.

The PAC appreciates the interesting results obtained in the GERDA project on the experimental search for neutrinoless double-beta decay, which was already considered at the previous PAC meeting.

Recommendation. The PAC recommends continuation of the GERDA experiment with first priority in 2013–2015.

IV. New projects

“Investigation of ^{82}Se double beta decay” (project SuperNEMO)

The PAC heard with great interest the report by O. Kochetov on experimental search for neutrinoless double beta decay with the NEMO-3 spectrometer and highly appreciates the results obtained. As a consequence, the PAC is confident that the construction of the SuperNEMO detector and its demonstrator will strongly benefit from the contribution of the Dubna collaboration.

Recommendation. Due to the successful completion of the NEMO-3 experiment, the PAC recommends approval of the new project SuperNEMO for implementation in 2013–2015, with first priority.

“Experimental study of the dynamics of thermal nuclear fragmentation” (project FASA-3)

The PAC appreciated the presentation of the FASA-3 project by V. Karnaukhov. The project is devoted to the study of very hot nuclei produced by the relativistic light ion projectiles of the Nuclotron. The central point of the programme is investigation of the thermal multifragmentation dynamics. The total time of the fragmentation process will have to be determined systematically by measuring relative velocity correlation functions for both the pairs of intermediate mass fragments and of heavier mass fragments.

Recommendation. The PAC supports the scientific programme of the FASA-3 project and recommends its continuation with first priority in 2013–2015.

V. Experiments with polarized targets

The PAC heard with interest the report “Experiments with polarized targets and beams with the MAMI C accelerator” presented by A. Thomas.

Recommendation. The PAC strongly recommends the support of the GDH&SPASCHARM project activity in 2013–2015.

VI. Status of the DRIBs-III complex

The PAC heard with great interest the report about the status of the DRIBs-III complex, presented by S. Dmitriev and G. Gulbekian. The PAC notes with satisfaction that the implementation of the DRIBs-III project proceeds according to the Seven-Year Plan for JINR Development and to the recommendations of the PAC and the JINR Scientific Council. The PAC notes that the first SHE-factory will be created on the basis of the new high current DC-280 cyclotron. This will allow JINR to keep its leading position in the field of synthesis and study of superheavy nuclei and elements.

The design of a new separator ACCULINNA-2 was started; the modernized VASSILISSA-GABRIELA set-up will be launched, and bench tests of the new superconducting ion source DECRIS-SC2 will also be accomplished in 2012.

The operating time of the accelerator complexes U400 and U400M was approximately 11500 hours, new results on the synthesis of element 115 in the reaction $^{243}\text{Am}+^{48}\text{Ca}$, essentially important for the recognition of the priority of the discovery of elements 113, 115, 117, were obtained. The PAC also notes with satisfaction that the realization of the new project is being carried out without stopping the ongoing FLNR scientific programme.

The PAC looks forward to further presentations of the status of the basic facilities being in operation and of new experimental physics facilities of FLNR at its future meetings.

Recommendations. The PAC was impressed by the status and the progress made in preparation of the DRIBs-III complex. The PAC recommends civil construction of the new experimental hall and fabrication of the new cyclotron as it was presented in the given overview. In addition, the PAC suggests starting already now the development of high current targets so that the experiments can make use of the high beam intensities in the future.

The PAC recommends inclusion of the project of reconstruction of the U400 accelerator and its experimental hall in the JINR Seven-Year Plan, thus allowing for a considerable expansion of research of nuclear reactions with stable and radioactive ions.

VII. New set-up of FLNR for on-line separation of reaction products by means of selective laser ionization

The PAC notes with great interest that the availability of such a facility extends the experimental possibilities of the laboratory in the field of low-energy heavy-ion physics, and, most importantly, in an unexplored region of the nuclear chart.

Recommendation. Taking into account the relevance of such studies and the international competition on similar approaches, the PAC strongly recommends the start of construction of such a facility in 2012.

VIII. Development of IREN

V. Shvetsov presented a report on the ongoing work for the development of the IREN facility. This concerns the effective introduction of the Toshiba klystron E3730A into the LUE-200 accelerator as a necessary step to increase neutron yield. The PAC also recognizes the need to upgrade the klystron modulator and encourages the IREN team to strengthen this process.

Recommendation. The PAC emphasizes the importance of the IREN facility and recommends continued efforts towards putting it into operation at designed parameters within shortest possible time. The results of this work should be presented at the next PAC meeting.

IX. Scientific reports

The PAC highly appreciated the report “Decay studies with the OTPC detector at the ACCULINNA separator” presented by Z. Janas. The properties of the OTPC detector make this device a unique tool for detection of exotic decay modes like the emission of several light particles or clusters.

Recommendation. The PAC suggests installation in 2012 of the OTPC detector at ACCULINA for studying the decay properties of light exotic nuclei.

The PAC heard with interest the report “New method for solution of coupled radial Schrödinger equations: applications to halo nuclei” presented by S. Ershov.

X. Poster session

The PAC was pleased with the presentations of new results and proposals by young scientists in the field of nuclear physics research. Two best posters have been selected: “Influence of proton shell closure on production of new superheavy nuclei” presented by A. Kuzmina and “Electronic atlas of muonic X rays” presented by D. Zinatulina. The PAC recommends them for presentation at the Scientific Council session in September 2012.

XI. Next meeting of the PAC

The next meeting of the PAC for Nuclear Physics will be held on 28–29 June 2012. Its tentative agenda will include:

- Reports and recommendations on themes and projects to be completed in 2012
- Consideration of new projects
- Poster presentations of new results and proposals by young scientists in the field of nuclear physics research
- Scientific reports.

Walter Greiner
Chairperson of the PAC