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REVIEW
"Investigation of neutrino properties with the low-background germanium spectrometer vGeN"
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This report is an evaluation of the proposal of the vGeN project and reflects conclusions of the meeting of Scientific-Technical Committee of DLNP (12. November 2020) as well as two reviews prepared by A.S. Barabash (NRC "Kurchatov institute" – ITEP) and A.I.Studenikin (Moscow State University). The proposal of vGeN project (leader A.V.Lubashevskiy, deputy leader E.A.Yakushev) provides full information about the present situation in the field of research, GEMMA experiment (first phase) and obtained results, planned activities in the period of 2022-2024, common research team and budget of the project vGeN.

The main task of the proposed project is the study of neutrino properties, neutrino magnetic moment and Coherent Elastic Neutrino-Nucleus Scattering (CEvNS, process predicted by the SM, but has not been observed yet for the reactor neutrinos). Project vGeN builds on the experiment GEMMA, which provided upper limit on the neutrino effective magnetic moment 2.9×10^{-11} Bohr magneton. The vGeN project is aimed at the further increase in sensitivity to the neutrino magnetic moment on the level of about $\sim (5-9) \times 10^{-12}$ Bohr magneton.

At present, the study of neutrino properties (mass, Majorana or Dirac particle, magnetic moment, cross sections of neutrino interaction with matter etc.) represents one of the most important problems of physics. Theoretical physicist Daniel Freedman presented the idea of neutrino coherent interaction with nucleus. The discovery of CEvNS was reported by the COHERENT collaboration in 2017 (using a 14.6 kg CsI(Na) detector for registration of neutrinos from the Spallation

Neutron Source at Oak Ridge Nat. Lab.). At present, the several different experimental approaches to detect CEνNS interactions using reactor neutrinos are being developed (TEXONO, CONNIE, CONUS, RED100, and MINER).

The project assumes cooperation of JINR and ITEP (Moscow). Experimental runs are planned at Kalinin Nuclear Power Plant. Team consist of 27 members (6.7 FTE in total) headed by experienced scientists A.V.Lubashevskiy and E.A.Yakushev. Comparing with GEMMA experiment, new phase has several improvements: i) neutrino flux at the detector is 2x higher (closer location of the detector to the reactor core), ii) higher mass of the HPGe detectors (3.7x more), iii) substantial decrease of the energy threshold of detector (from 2.8 keV to 200 eV) and iv) suppression of background measured by detectors (HPGe detector was tested in the LSM underground laboratory in a low-background passive shield. The achieved background level was about 1 cts/$(keV \cdot kg \cdot day)^{-1}$).

The budget of the project is reasonable (the total budget for period of 2022-2024, is 467 000 USD). The most of the budget (395 000 USD) is devoted to buy equipment (detectors, cryogenics, vacuum system), VME and NIM modules as well as additional materials. The rest, 72 000 USD, is planned for travel expenditures (60 000 USD), 6 000 USD for contracts and 6 000 USD for network.

The project is important. It is based on expertise of team in theory, simulations, data processing and in detection technique. The project team has direct access to nuclear reactor and to underground laboratory (testing of low background detectors). Due to the increasing competition in the world it would be necessary regularly publish the obtain results not only with physical results but also with R&D of detection apparatus.

As a result of this review, I suggest the PAC committee to approve the project **"Investigation of neutrino properties with the low-background germanium spectrometer νGeN"** and finance fully its realization within the planned period of 2022-2024 years.

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