

Referee Report
on LRIP
2-2-1099-2010/2026 (Study of Neutrino Oscillations and Astrophysical
Research)

Subproject
Accelerator neutrinos
(Studying neutrino properties in accelerator experiments)

The neutrino oscillations are known to be one of the most interesting phenomena and powerful instruments of fundamental interactions investigations. They may be studied using various neutrino sources and detector techniques. Among them accelerator neutrino play the special role, as the neutrino source is under control and the classical scheme of particle physics experiment (from beam(s) via scattering to detection) originated by Rutherford is realized.

The main current accelerator experiments are NOvA and T2. Other ones are FASER and NA65 at LHC.

The studies of neutrino oscillations at JINR in the framework of the current LRIP is active and successful. It includes the participation in various experiments and strong theoretical support. The refereed Subproject, selecting accelerator experiments and addressing them is a coherent and well-balanced one.

The core of the project is a continuation of activity in the framework of NOvA experiment. ROC created in 2015, being the first non-american remote operations center, is indeed the “crown jewel” of the whole Subproject, and its operation will be continued. The possibility of real-time connection is of great importance for the physicists from JINR and Russian institutions, participating in the experiment (INR and LPI). The computer infrastructure developed in the framework of the experiment is quite impressive including 39 new servers, about 1000 CPU cores and 6 TB RAM. The active participation of JINR group in the physics analysis guarantees its continuation and development.

The activity in the framework of T2K experiment will explore the tendencies of already existing joint analysis of NOvA and T2K. The synergetic effect of this joint activity (which has a roots, in particular, in the joint analysis of ATLAS and CMS, resulting also in Higgs boson discovery) will be fully explored at JINR. The participation of JINR group in the searches for axions and axion-like particles is of special interest because of their fundamental importance and also because of the perspectives of the related experiments at SPD detector. The tests of the neutrino-nucleon interactions models are exploring the theoretical developments at BLTP and represent the effective collaboration between theory and experiment.

The FASER and NA65 experiments at CERN are seemingly quite different from NOvA and T2K, being of essentially smaller scale and using nuclear emulsion detectors. Nevertheless, after digitalization the synergy with the NOvA and T2K may be successfully explored. Like in the large scale experiments with the number of complementary tasks (mentioned axion searches, searches of slow monopoles, cosmic and atmospheric particles), the complementary probes of low transverse momentum hadrons produced in pp collisions at LHC are possible. I might add, that currently there is a direction of quark-gluon plasma studies, called “small systems” exploring the similarity between large multiplicity events in hadronic and heavy-ion collisions, and this can be also investigated by weak probes.

Generally, this Subproject is presenting a well balanced and carefully chosen collection of physical problems and experimental methods with the obvious synergy effect/. The team includes the experts in all the sides of experiment and computations, as well as theorists. The latter will support the implementation of the neutrino theory developing at BLTP. The Subproject leaders combine the expertise in physics and experimental techniques. They also manifest the great success of Dubna branch of Lomonosov University, being the deputy chief of the department and student, graduated only several years from now. The opportunities of and threats to the Subproject are thoroughly described,

I think that because of its synergy, well-defined choice of tasks and methods, strong team, international collaboration, the Subproject can strengthen the role of Dubna as an leading neutrino physics center. I strongly recommend its approval with a highest priority.

Oleg Teryaev (teryayev@jinr.ru)

15.11.2024

