Referee report

on proposal of JINR participation in the project

Search for new physics in the lepton sector

(Project leaders: V.V. Glagolev, Z. Tsamalaidze)

Discovery of neutrino oscillations shows that lepton flavor conservation is strongly violated in the neutrino sector. In the Standard Model (SM) this violation can be explained through the addition of nonzero neutrino masses, and thus SM must be extended. Nevertheless, up to date this is the only experimental fact. At the same time in some versions of extended SM it is natural to expect the charged-lepton flavor violation (CLFV). The found smallness of the neutrino squared mass difference strongly suppresses SM contributions to the CLFV processes, which is practically unreachable at experimental facilities. On the other hand, beyond SM the CLFV processes could occur with higher probability due to interactions at characteristic energy scale Λ. This carries the fundamental sense of experimental search for CLFV, where this search is the important low energy test of SM and the method to look for New Physics.

One of the most promising process is provided by experiments that utilize high intensity muon beams to search for CLFV in $\mu \rightarrow e$ transitions. Currently there are few competitive projects on measurement of ($\mu \rightarrow e$) conversion: MEG at PSI for the process $\mu^+ \rightarrow e^+\gamma$, Mu3e at PSI for the process $\mu^+ \rightarrow e^+e^-e^+$, Mu2e at Fermilab and COMET at J-PARC for coherent neutrino-less conversion of a muon to an electron in the field of a nucleus $\mu^- N \rightarrow e^-N$. All these projects have extremely high sensitivity of measurements and plan to improve the previous upper limits by three-four orders of magnitude, reaching at 90% C.L. limit up to order 10^{-17} on the conversion rate. These experiments will reach mass scales of nearly 10^4 TeV, far beyond the direct reach of colliders.

The purpose of the current project is participation of the JINR physicists in the Mu2e, COMET and MEG-II experiments. This group includes scientists from Russia and from the JINR member states as well. The main efforts of the JINR group will be participation in the further preparation, operation in the above mentioned experiments and also in the data storage, simulation and data analysis. More specific tasks are:

1. for Mu2e experiment to participate in production, tests, assembly and maintenance of the Cosmic Ray Veto modules; to perform RnD on production of the solar blind photodetectors for BaF_2 crystals for Mu2e-II.

2. for MEG-II experiment to develop Web based server and client application to visualize 3D interactive models of all sensors of MEGII detector connected to event data stream in online and offline modes for presentation and supervisory tasks without additional software on client side.

3. for COMET experiment to participate in the production of two main detector systems – the electromagnetic calorimeter and the straw tracker. The tracker is designed to provide the high precision momentum measurement that allows for the rejection of the decay-in-orbit background

events, while the calorimeter provides a separate energy and time measurement that provide particle identification and a seed for the reconstruction.

In the reported period (2018-2019) the group successfully fulfilled its obligations concerning construction of the detector.

Summarizing, and taking into account undoubtedly valuable expected scientific results, I recommend to extend the participation of the JINR team in the project "Search for new physics in the lepton sector" for the period of 2021-2023.

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