Referee report

on the proposal of the JINR group participation in the COMET experiment

The search for "new physics" beyond the Standard Model is the main focus of particle physics experiments today. The COMET experiment aims at detecting lepton number violation (CLFV) processes in coherent neutrino-free muon-to-electron conversion μ-N→e-N in the nucleus field at the high-intensity proton accelerator J-PARC in Japan. The project will be carried out in two phases. The goal of the first phase is to achieve a sensitivity for the muon-electron conversion process in the aluminum nucleus field of 3.1×10-15, a 100- times improvement over the existing limit; in the second phase of the experiment this limit will be improved by another two orders of magnitude. The signal for the detection of the CLFV process is the registration of a monoenergetic electron with an energy of about 105 MeV with a minimal contribution of background events between the proton bunches.

The JINR DLNP staff has been successfully involved in the preparation of the experiment for a long time. At the first stage, the group's commitments included the fabrication and testing of over 2700 straw-tubes with a diameter of 9.8 mm and a length of 1.6 m for the straw-tracker. The JINR group is engaged in the development of the Electromagnetic Calorimeter (ECAL) and the Cosmic Ray Veto (CRV) system during the simulation and production phases of scientific and technical work, and staff members continue to be actively involved in the assembly and maintenance of these detectors. Notable contributions have been made to the analysis of test measurement data and preparation for the analysis of COMET experimental data.

The authors presented in their proposal the results of the research conducted and plans for further work. The characteristics of the main subsystems were studied by using the produced prototypes. It was shown that 5 mm straw-tubes in terms of efficiency and spatial resolution can be used in the COMET track system. At JINR DLNP, preparations are underway for the production of a complete set of strow-tubes for the second phase of the experiment, and a pilot version of the working module is being developed. A precision measuring stand was also created to study the characteristics of single-crystal scintillators used for the electromagnetic calorimeter. A large methodological work was carried out, which showed a rather good energy resolution (less than 5%) of the ECAL prototype. At the same time, it was shown that the crystals have a significant, up to 30%, variation in the value of light output. Therefore, it is planned to select modules with close characteristics. The question remains unclear - how much it will deteriorate the final energy resolution when the detector operates in a magnetic field? Small differences between the results of modeling and measurements presented in Fig. 61 are promising, but it would be good to repeat the modeling in conditions close to the test conditions for the completeness of the picture. It would also be necessary to clarify the question about the effect of "aging" of crystals?

The JINR group in the COMET project has assumed very significant and responsible obligations and has been successfully performing them for a period of several years. In particular, this concerns the preparation of Phase-α, planned for 2025, and ensuring the detector operation in the first phase of the experiment, as well as preparation of the second phase. The strength of the group's position in COMET is recognized and reflected in the management structure of the collaboration.

There is no reason to doubt the successful implementation of the group's plans for 2025-2029, including the most significant contribution - the establishment of a full-scale straw station at JINR for the production of new tubes (12 µm, 5 mm) and mass production of a complete set of straw tubes for Phase-2. The requested funding even without the details (presented, apparently, in a separate document) looks adequate to the plans.

In summary, the participation of the JINR group in the COMET project deserves high evaluation and extension of the work with the highest priority.



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