

**Referee's report on the Proposal of prolongation of the project**  
**“MEASUREMENT OF THE RARE DECAY  $K^+ \rightarrow \pi^+ \nu \nu$**   
**AT THE CERN SPS (NA62)”**

The probability of the super-rare decay  $K^+ \rightarrow \pi^+ \nu \nu$  (of the order of  $10^{-10}$ ) is directly connected to the CKM matrix parameters, related to CP-violation. Theoretically clean, it gives a chance to find a statistically significant deviation from Standard Model and to open experimentally the “new physics” domain.

To accomplish the NA62 experiment on the CERN SPS, aimed to measure the branching ratio of  $K^+ \rightarrow \pi^+ \nu \nu$  decay with a nearly 10% precision, the extraordinary experimental requirements are met. One of them is the need to measure the charged particle angles and momenta with a high precision in the conditions of minimum multiple Coulomb scattering. So the key element of NA62 detector is the Straw magnetic spectrometer that is produced of the very light drift tubes, containing a small amount of matter. JINR group together with the dedicated CERN team were responsible for this detector element design and production, as well as and for all the related R&D.

After the spectrometer installation in 2014 and extensive testing during the commissioning run in 2015, the physical data taking have been performed in 2016 - 2018. Now the experiment is entering the stage of the physical data analysis. And JINR group starts to take part in the extraction of the physical results from collected data, including the additional studies of the rare four-lepton decays of charged kaons.

During the period of 2016 - 2018 a series of works have been done by JINR group, and many important results have been achieved. On the basis of NA48/2 data, a new upper limit on the rate of the lepton number violating decay  $K \rightarrow \pi \mu \mu$  has been obtained. On the basis of NA62 data collected in 2007, a neutral pion electromagnetic transition form factor slope has been measured. New limits have been set on the squared matrix element  $|U_{\mu 4}|^2$  describing the mixing between the muon and hypothetical heavy neutrino states. These results were reported in details on the NA62 Collaboration meetings by JINR participants and have been presented at the international conferences.

Few special software tools for the NA62 spectrometer control and calibration have been developed. The results of the completed work on the spectrometer design and building have been published in a series of journal papers. A review of the kaon decay studies performed by NA48, NA48/1 and NA48/2 collaborations as well as a series of theoretical works has been prepared and published.

Accomplished work stages are adequate to the financial expenses that have been assigned for the project. In my opinion, the presented report related to the 2016 - 2018 should be approved.

The on-going and planned works are adequate to the financing to be allocated for the project in 2019 - 2021, and I am sure that a strong recommendation to prolong the NA62 project in JINR in 2019 - 2021 have to be done.

At the same time I recommend to authors to extend the participation in data analysis and obtaining results, by involving to these works and experienced and young physicists for whom it would become excellent school.

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