Review of the proposal on extension of the JINR project
"Search for new physics in experiments with the Fermilab high-intensity muon beams"
for the period of 2018-2020.

The Standard Model (SM) of elementary particles interactions, after the recent discovery of new boson, is widely acknowledged as a candidate to a fundamental theory (FT). Such theory should: (i) include the SM, tested in many experiments with high precisions, (2) account for a number of problems still not explained by SM and (3) stimulate further experimental searches for signals confirming the FT, i.e. signals of New physics (NP). Among problems, still not accounted by SM, there are those as the neutrino hierarchy, the absence of a mechanism leading to neutrino oscillation, the unknown origins of dark matter and of the cosmological constant.

Precision tests of some rules predicted by SM, like a rule of the charged lepton flavor conservation, or more precise measurements of some physics constants, like anomalous magnetic moment of a muon, are also ways to search for NP signals. The last two problems are the subjects of searches at the proposed experiments.

One of them is the experiment, referred to as Mu2e, on searches for the charged lepton flavor violation via the $\mu^- \to e^-$ conversion in the nuclear field, $\mu^- N \to e^- N$, strictly forbidden in SM but could occur in some of its extensions at the level of 10^{-15} - 10^{-16}. If not observed, these limits will be improved by four to five orders of magnitude.

The subject of the second experiment, referred to as Muon (g-2), within this proposal is an improvement of the measurements of the muon anomalous magnetic moment, a_μ = (g-2)/2. The most recent experiment at BNL has measured a_μ down to 0.54 ppm (part-per-million). The obtained value exhibits significant deviation of about 3.6 sigma when compared to the most updated SM predictions.The different classes of diagrams of new physics can contribute to anomalous magnetic moment. Obviously, further experimental clarification is required to conclude of the new physics impact on a_μ.

The Muon (g-2) experiments are based on the fact that for $a_\mu > 0$ the spin precesses faster than the momentum vector when a muon travels transversely to a magnetic field. The difference between the cyclotron frequency and the muon spin precession frequency is proportional to the anomaly, rather than to g. A precision measurement of a_μ requires the precision measurement of the muon spin precession frequency ω_a. With the "integrating" method developed in this proposal, a greater number of events are included in the analysis. With the improved experimental value of a_μ, to below 0.14 ppm, as it is suggested by this proposal, a new, and more stringent test of SM (> 5 sigma) will be performed.

For the past three years, JINR contributions to two experiments look as following. As a part of **contributions to the Muon g-2 experiment**, an online data quality monitoring (DQM) software for the calorimeter has been developed using the ROME (Root based Object oriented Midas Extension) framework and tested at SLAC in April 2016. A prototype of the straw tracker with 1 mm longitudinal space resolution was produced and tested. A number of items are in progress. Between them are: (i) development of an online event display program; (ii) development of the online data analysis and visualization software; (iii) development of the MIDAS online alarm system. **Contributions to the Mu2e experiment** are connected with an electro-magnetic calorimeter and a cosmic ray veto (CRV) sub-systems. The simulation of the calorimeter modules of the LYSO and CsI crystals and their tests were performed at electron beams of the Frascati accelerator. Good parameters obtained for the both. But, due to the unaffordable price for LYSO crystals, collaboration decided to go with CsI crystals only. JINR group performed several tests of the prototype CsI crystal matrix (3x3 crystals) at Yerevan electron accelerator (15-35 MeV), Frascati electron accelerator (70-105 MeV) and at the DLNP of JINR. The CsI showed suitable energy resolution characteristic (5-6 %) and a good timing resolution (about 200 psec). For the CRV system, simulations of scintillation counter characteristics of extra long CRV modules (6.6m) with one end read-out is performed. Basing on developed technology of the CRV 4-layers module, a pilot module is produced. The JINR group contributions are presented in 14 publications of NIM, JINST, IEEE TRANSACTIONS ON NUCLEAR SCIENCE and reported at different International conferences.

For the next 3 years (2018-2020) JINR group is planning to perform different quality assurance (QA) tests of JINR supplied portion of crystals (200 from 1400). These include QA tests with radioactive sources, optical tests and tests in the electron beams at Yerevan and Frascati. These will require resources to purchase crystals, the equipment in the DLNP lab and a travel expenses amounting in total of 143 k$ per year. As well, the group will develop a procedure of the calorimeter calibration with electrons using BaF2 crystals and solar blind photon detectors. The requested resources are 15 k$ per year. For QA tests of the CRV modules, a stand is to be designed and produced. Radiation hardness tests of the CRVscintillators will be performed at the JINR IBR-2 facility. The requested resources are 32 k$ per year. The JINR will further develop online event display program, alarm system and provide online data base support and interfacing for Muon g-2 experiment. The requested resources are 40 k$ per year. The JINR group will participate in the data analyses and presentations of the Muon g-2 and Mu2e experiments.

In conclusions, JINR contribution to the project looks well balanced, planned and justified. The requested funding of 230 k$ per year looks reasonable. I would recommend the extension of this project as the first priority one for the period 2018 - 2020 within a requested funding.

March 13, 2017 Prof. I.A. Savin