***Questionnaire***

*for the Joint session PAC for Nuclear Physics for the assessment of JINR projects*

Project **MONUMENT (Muon ordinary capture for the nuclear matrix**

**elements in ββ decays)**

***PART A: Achievements***

*1.   Contributions of the JINR group:*

*-List the contributions of the JINR group in hardware (including use of JINR computing resources for the project), software development and physics analyses*

Part of the hardware will be provided by JINR group (FADC VME modules Struck SIS3316), physics analyses mainly will be done by JINR group in Dubna.

*-List the responsibilities of JINR group members within the management structure of the collaboration, if any, giving the name of the JINR member, the managerial role and the appointment period.*

JINR group will play the main role in the experiment MONUMENT as the initiator of the project.

Leader of the project is Daniya Zinatulina, D. Zinatulina also is a spokesman of the OMC4DBD project (No. R-20-01.1) approved in PSI User Committee for three years (2021-2023 yy.).

*2.   Publications:*

*-List the papers published in the refereed literature (no conference proceedings) in which the JINR group had a major contribution (e.g. author of the analysis, promoter of the experiment, corresponding author, realization of a key equipment etc.). Give title of paper, reference and describe in 1-2 sentences the JINR contribution. Only papers published since the last approval of the project should be listed.*

Since the first measurement of the project was postponed from 2020 year to October 2021 due to the COVID-19 situation, there are no publications with new measurements.

The main publication with previous results of the investigations and method of the measurements was published in 2019 year in Phys.Rev.C 99 (2019) 2, 024327, title: “Ordinary muon capture studies for the matrix elements inββ decay”

The technical publication was published in 2020 inPhys.Part.Nucl.Lett. 17 (2020) 6, 848-855, PismaFiz.Elem.Chast.Atom.Yadra (2020), title: “Construction of the Gaseous and Solid-State Targets for the Muon Capture Measuring System in 130Xe, 82Kr, and 24Mg”

Our byproduct publication: “Electronic Catalogue of Mesoroentgen Spectra”, Published in: Phys.Atom.Nucl. 82 (2019) 3, 243-249, Phys.Atom.Nucl. 83 (2020) 5, 773 (erratum)

*3.   PhD theses:*

*-List the PhD theses completed within the last 3 years, or expected to be completed within 2021, by JINR students within the project, giving the student name, thesis title and graduation year.*

D. Zinatulina has been defended in 2019 with the following PhD thesis “Ordinary muon capture measurements in 48Ti, 76Se,82Kr, 106Cd and150Sm nuclei.”

*4.   Talks:*

*-List the invited plenary talks given by members of the JINR group at international conferences, workshops… since the last approval of the project: give name and date of the conference, title of talk and speaker name.*

“Neutrinos Electro-Weak interactions and Symmetries” (NEWS). Mini-workshop on neutrino nuclear responses for double beta decaysand astro neutrinos (Part II) (November 27 (Fri.), 2020). NEWS is a series of RCNP (Osaka University) science colloquiums, which emphasizes active discussions on current subjects on NEWS.

Invited talk. ZOOM video meeting.

Speakers:Zinatulina D. (JINR) "Muon capture reactions at PSI for DBD neutrino nuclear responses"

*-Give a similar list for parallel talks.*

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***PART B: Plans and requests***

*5.   Plans*

*-Describe the plans of the JINR group within the project, in physics analysis, data taking, software development. detector R&D, detector operation and maintenance, upgrade activities… for the period of time of the requested extension.*

The DLNP JINR group plans within the project: development and procuring of the targets, MC simulations, design of the target arrangement and its modernization, purchasing of the HPGe detectors, assembling and testing them at JINR, as well as logistics to TUM (Technical University of Munchen) – integration with DAQ and testing set-up at TUM, conducting an experiment (mounting, testing of equipment and electronics, beam tuning, running shifts, on-line/off-line data taking, calibration, maintenance), off-line analysis, preparation of publications on the Project.

*6.   Group size, composition and budget*

*-List the JINR personnel involved in the project, including name, status (e.g. PI, researcher, post-doc, student, engineer, technician…) and FTE. Mention the total number of people in the collaboration.*

Total number of people in the collaboration is 25.

Detailed information of the JINR group human resources:

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Catego-ry | Responsibilities | Full Time Equivalent (FTE) |
| V.V. Belov | junior researcher | MC simulation, data analysis | 0.4 |
| V.B. Brudanin | Head of department | Administrative work, coordinator | 0.2 |
| К. N. Gusev | senior researcher | HPGe detector’s array coordinator, logistics, mounting, testing | 0.4 |
| I.V. Zhitnikov | junior researcher | Data analysis | 0.3 |
| D. R. Zinatulina | senior researcher | Management and participation in all works | 1.0 |
| S.V. Kazarcev | junior researcher | Muon trigger system, mounting, data taking | 0.6 |
| N.S. Rumyantseva | junior researcher | Data taking and data analysis | 0.6 |
| М. V. Fomina | junior researcher | Preparation, logistics, data analysis | 0.3 |
| M.V. Shirchenko | senior researcher | Deputy leader, data analysis coordinator | 1.0 |
| Yu.A. Shitov | Head of sector | Data taking and data analysis | 0.3 |
| Е.A. Shevchik | senior engineer | Detector array and holders design, muon trigger, beam profile control | 0.5 |
| Total FTE (engineers): 0.5, Total FTE (Scientific): 5.1, TOTAL FTE: 5.6 | | | |

*-Present the JINR group budget for the period of time of the requested extension, specifying the main budget items (equipment, computing, salaries, common funds, travel…)*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Expenditures, resources, financing sources | | | Costs (k$)  Resource  Require-ments | Proposals of the Labora-tory on the distribution  of finances and resources | | |
| 1styr | 2ndyr | 3rdyr |
| Expenditures | | Target materials (enriched stable isotopes, holders for the target, target itself) | 40 | 16 | 8 | 16 |
| Materialsforthemuon veto counters (scintillators, PMTs,WLSfibers, adapters, SiPMs, mechanics) | 18 | 15 | 3 | 0 |
| ComponentsandmaterialsforR&D (opticglue, cables, connectors, instruments, etc.) | 5 | 2 | 3 | 0 |
| HPGe detectors | 130 | 75 | 55 | 0 |
| Electronics for theDAQ (VME- andNIM-crates and devices, PC and additional hard disks for data) | 34 | 20 | 12 | 2 |
| **Total** | **227** | **128** | **81** | **18** |
| Required resources | Standard hour | Resources of  – Laboratory design bureau  – Laboratory experimental workshop | 300  600 | 100  200 | 100  200 | 100  200 |
| Financing sources | Budgetary  resources | Budget expenditures including foreign-currency resources. | **227** | **128** | **81** | **18** |
| External resources | *Contributions by collaborators.*  *Grants*  *(these funds are not currently guaranteed)* | *20*  *15* | *10*  *5* | *5*  *5* | *5*  *5* |

**Estimated expenditures for the Project**

**Muonordinarycaptureforthenuclearmatrixelements in ββ decays**

**MONUMENT**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NN | Expenditure items | Full cost | 1styr | 2ndyr | 3rdyr |
|  | Direct expenses for the Project |  |  |  |  |
| 1. | Computer connection | $ 6 k | 2 | 2 | 2 |
| 2. | Design bureau | 300 std hours | 100 | 100 | 100 |
| 3. | Experimental Workshop | 600 std hours | 200 | 200 | 200 |
| 4. | Materials | $ 63 k | 33 | 14 | 16 |
| 5. | Equipment | $ 164 k | 95 | 67 | 2 |
| 6. | Transportation of equipment | $ 30 k | 10 | 10 | 10 |
| 7. | Collaboration meetings and workshops | $ 15 k | 5 | 5 | 5 |
| 8. | Travel allowance, including:  a) non-rouble zone countries  b) rouble zone countries  c) protocol-based | $ 100 k  $ 100 k  -  - | 35  35  -  - | 35  35  -  -  - | 30  30  -  - |
|  | Total direct expenses: | $ 378k | 180 | 133 | 65 |

*-Indicate the use or needs of JINR computing resources for the group and for the project if any.*