EDELWEISS/RICOCHET

Joint project for Direct Dark Matter search and precision study of CEvNS with new cryogenic detectors

The document contains answers to the Questionnaire for Joint session of the PAC for Particle Physics and the PAC for Nuclear Physics for the assessment of the JINR Neutrino Projects. The questions are marked yellow.

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

Dubna team participates and makes (will continue to make) commitments to the following parts of the EDELWEISS/Ricochet project:

- Development of new low threshold Ge detectors; Assembly and commissioning;
- New cryosystem for the Ricochet: development and running;
- Development of methods for low background measurements;
- Data taking (this includes daily routine procedures, as well as regular and special calibration runs);
- Low background study and development of methods of neutron and radon detection;
- Selection and production of less radioactive materials;
- Detector simulations and data analysis; Publication of results;
- Participation in development of the Ricochet veto system;
- Characterization of a NPP site for possible further phases of the Ricochet project.

Detailed description is provided in the project document from page 28 to page 32.

-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.

Evgeny Yakushev: member of the collaboration board. The EDELWEISS collaboration is too small to have dedicated complicated internal structure.

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.

- NA Mirzayev et al, Low radioactive NH_4Cl flux, Journal of Instrumentation 15 (05), T05004, 2020
  - Low radioactive flux developed and tested by JINR group for the experiment.
- Q Arnaud et al (EDELWEISS collaboration), First germanium-based constraints on sub-MeV Dark Matter with the EDELWEISS experiment, PRL 125, 141301 – Published 2 October 2020.
  - The result of dark matter search obtained by the collaboration in the LSM laboratory. Each member of the collaboration contributed to the result.
- DV Ponomarev et al, Measuring Low Neutron Fluxes at the Modane Underground Laboratory Using Iodine-Containing Scintillators, Instruments and Experimental Techniques 62 (3), 309-311, 2019
  - New method for low level neutron flux detection was developed by JINR group.
- E Armengaud, et al (EDELWEISS collaboration), Searching for low-mass dark matter particles with a massive Ge bolometer operated above ground, Physical Review D 99 (8), 082003, 2019
  - The result of dark matter search obtained by the collaboration in the sea level laboratory. Each member of the collaboration contributed to the result.
- PS Fedotov, NN Fedyunina, DV Filosofov, EA Yakushev, G Warot, A novel combined countercurrent chromatography–inductively coupled plasma mass spectrometry method for the determination of ultra trace uranium and thorium in Roman lead, Talanta 192, 395-399, 2019
  - Roman lead used as the internal part of the EDELWEISS shield was investigated by JINR group.
- E Armengaud, et al (EDELWEISS collaboration), Searches for electron interactions induced by new physics in the EDELWEISS-III germanium bolometers, Physical Review D 98 (8), 082004, 2018
  - The result of dark matter search obtained by the collaboration in the LSM laboratory. Each member of the collaboration contributed to the result.

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.

Dmitry Ponomarev, the PhD thesis dedicated to neutron measurements for LSM as well for experiments at KNPP is expected to be completed in 2021.

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.

– BLTP Workshop: Dark matter: theoretical proposals and experimental studies. October 22,2020, Detection of DM in underground experiments, E. Yakushev

– The 5th International Conference on Particle Physics and Astrophysics (ICPPA-2020), National Research Nuclear University “MEPhI”, Moscow, Russia, 5-9 October 2020, New mK-temperature Germanium detectors for Dark Matter direct search and for precision measurements of CEvNS, E. Yakushev

– Symposium on Nuclear Electronics and Computing - NEC'2019, 30/09 – 4/10/2019, Montenegro; Application of modern commercial digitizers for new approaches to neutron's detection. D. Ponomarev

– Nucleus 2019, Dubna 1-5 June 2019, Modern neutron detectors based on inorganic scintillators and their applicability for low neutron flux measurements". D. Ponomarev

– New Trends in High-Energy Physics, 24-30 September 2018, Montenegro, Direct low-mass WIMP searches with HPGe Semiconductor Bolometers. S. Rozov

– New Trends in High-Energy Physics, 24-30 September 2018, Montenegro, Modern approaches in ultra-low background experiments at the LSM underground laboratory, E. Yakushev

– VLVnT-2018, Dubna, 2-4 October 2018, Direct Dark Matter searches: overview. E. Yakushev

-Give a similar list for parallel talks.

International Scientific and Technical Conference 2019: "55 Years of Safe Operation of NPPs with VVER in Russia and Abroad", September 2019, Novovoronezh, REACTOR NEUTRINOS FOR APPLIED PROBLEMS AND FUNDAMENTAL PHYSICS; E. Yakushev

Nucleus 2018, Voronezh, 1-7 June 2018, "Low neutron flux measurements in underground laboratory in Modane using iodine-containing scintillators". D. Ponomarev.

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.

Dubna team participates and makes (will continue to make) commitments to the following parts of the EDELWEISS/Ricochet project:

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Detailed description is provided in the project document from page 28 to page 32.

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.

JINR group human resources are:

Name	Category	Responsibilities	Time that each participant will give to the work under the Project in relation to its Full Time Equivalent(FTE)
V. Belov	Physicist	NVNPP site measurements, new detectors, commissioning and running.	0.1
V. Brudanin	Physicist	Administrative work	0.1
Yu. Gurov	Physicist	Detectors' development and production	0.2
A. Inoyatov	Physicist	Spectrometry, calibrations	0.2
B. Kalinova	Engineer	Project support, low background technique	0.1
D. Karaivanov	Physicist	Low background technique	0.2
Z. Kazarcev	Physicist	NVNPP site measurements, new detectors, commissioning and running.	0.1
J. Khushvaktov	Physicist	MC, data analysis	0.3
A. Lubashevskiy	Physicist	MC, data analysis, cryosystem.	0.2
S. Evseev	Engineer	Detector building, testing, calibration, running, cryosystem.	0.5
V. Evsenkin	Engineer	Test of supplementary detectors, MC, calibration	0.5
D. Filosofov	Radiochemist	Radiochemistry, low background technique	0.3
N. Mirzaev	Radiochemist	Radiochemistry, low background technique	0.3
L. Perevoshikov	Physicist	Computer and calculation support, MC, data analysis, spectrometry	0.2
D. Ponomarev	Engineer	Neutron background measurements, detectors building, testing. Experiment running. Cryosystem.	0.3
A. Rakhimov	Radiochemist	Radiochemistry, neutron activation analysis, nuclear spectrometry	0.2
I. Rozova	Engineer	Data analysis	0.1
S. Rozov	Physicist	Background study and improvement, detector building, testing, calibration, running, cryosystem.	0.5
A. Salamatin	Physicist	Acquisition system	0.1
K. Shakhov	Engineer	Radon gas, radon emanation detection / development and measurements	0.9

N. Temerbulatova	Radiochemist	Radiochemistry, low background technique	0.2
V. Trofimov	Physicist	Cryosystems	0.3
Yu. Vaganov	Physicist	Calibration sources, spectrometry	0.2
V. Volnykh	Engineer	Computer support	0.1
E. Yakushev	Physicist	Administrative work, radon and neutron measurements, detectors building, commissioning, running, cryosystem.	0.7
Total FTE (Engineers): 2.5, Total FTE (Scientific staff): 4.2, Total FTE: 6.7			

-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…)

#	Designation for outlays	Total cost	1 year	2 year	3 year
	Direct expenses for the project				
1.	Networking	6.0K US$	2.0	2.0	2.0
2.	DLNP workshop	1500 norm-hours	500	500	500
3.	JINR workshop	3300 norm-hours.	1100	1100	1100
4.	Materials	75.0K US$	25.0	25.0	25.0
5.	Equipment	195.0K US$	90.0	50.0	55.0
6.	Collaboration fee	60.0K US$	20.0	20.0	20.0
7.	Travel expenses	75.0K US$	25.0	25.0	25.0
	Total	**411.0K US$**	**162.0K US$**	**122.0K US$**	**127.0K US$**

Expected salary is 114 kUS$ per year. Estimation based on 2020 data and includes spending on technical personnel not listed in the project. 1US$ = 64RUB assumed in the estimation.

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

Local computing resources available at DLNP are sufficient for the project.