Annex 3.

Form of opening (renewal) for Project / Sub-project of LRIP

APPROVED

JINR DIRECTOR

_____ /_____

"____" _____ 2025.

PROJECT PROPOSAL FORM

Opening/renewal of a research project/subproject of the large research infrastructure project within the Topical plan of JINR

1. General information about the project/subproject of a major infrastructure project (hereinafter referred to as LRIP)

1.1. Theme code / LRIP (for extended projects) – *08-2-1127-2016*

The theme code includes the opening date, the end date is not specified, since it is determined by the completion dates of the projects in the theme.

1.2. Project/subproject code LRIP *08-2-1127-1-2025/2027* (for extended projects and subprojects)

1.2. Laboratory

DLNP

1.3. Scientific direction *Accelerators, detectors, R&D, applied research*

1.4. Name of the project/subproject of the IPC

Creating test benches to check single systems of the MSC-230 cyclotron

1.5. Project/subproject manager(s) of the LRIP

Yakovenko Sergei Leonidovich

Karysheva Galina Anatolevna

1.6. Deputy(s) of the head of the project/subproject of the LRIP (scientific director of the project/subproject of the LRIP

2. Scientific case and project organization

2.1. Annotation

The project is aimed at creating the medical superconducting cyclotron MSC-230 and the infrastructure for radiobiological studies. The project implementation will allow continuing at a new level the research in proton-beam therapy, conducted with proton beams of the Phasotron at DLNP JINR over decades. The planned high intensity of the proton beam — with the maximum current of 1 μA in the continuous mode and of 10 μA in the pulsed mode — will allow to research the new FLASH therapy method.

It is necessary to simulate and test prototypes elements of the cyclotron, such as the superconducting coils, the proton source, and the deflector for successful commissioning of the MSC-230.

These tasks require:

- To complete the following test benches assembly:
  1. Proton source and deflector test bench;
  2. Cryogenic system test bench;
  3. The hall sensors calibration test bench;
  4. The MSC-230 cyclotron test bench.
  - To perform the tests of the single components of the cyclotron;
  - The MSC-230 assembling and commissioning on the cyclotron test bench;
  - The beam transport system design, manufacture and tune
  - To construct the treatment room with a control panel.

2.2. Scientific case (aim, relevance and scientific novelty, methods and approaches, techniques, expected results, risks)

- The development of MSC-230 superconducting proton cyclotron will create a source of intensive proton beam, opening up possibilities for modernization of equipment for precise control and high dose rate for Flash therapy method studies. The research in the field of proton radiation therapy, which was carried out for many years on proton beams of Phasotron at DLNP JINR will continue. Due to the planned high intensity of proton beam on the new accelerator it is possible to implement a transition to the so-called Flash therapy. Flash radiation is performed at a high dose rate (40 Gy/s) for a very short time (10-50 ms). This radiation method significantly reduces the damage to the healthy tissue surrounding the radiated tumor. There are no proton beam therapy centres in the world that can implement this radiation technique currently.
- The proton cyclotron MSC-230 will implement: the conduction of the broad-spectrum radiobiological studies; improvement of the efficiency of irradiation by protons using the heavy metal nanoparticles; practical challenges of space radiobiology; enhancing radiation protection systems of spacecraft for near-Earth pilot flights; development and calibration of new detectors for the space industry; study of effects of ionizing radiation on animal behavior (monkeys, rodents).
- The proton cyclotron MSC-230 will implement of the breakthrough R&D in the field of superconducting magnetic technologies for accelerators of the future, including technologies based on high-temperature superconductors (HTSC), ultracompact cryogenic supply systems, use artificial intelligence (AI) technologies in the modeling of cyclotrons for applied purposes, irradiation planning and radiobiology. To implement artificial intelligence (AI) technologies in the simulation of cyclotrons for applied purposes, irradiation planning and radiobiology.

Expected results:

2025: Installation of test stands for individual cyclotron elements, testing equipment on test stands, assembly of cyclotron MSC-230, design of a beam transport channel to the treatment room, design of the treatment room.

2026: Creation of the test benches for the single cyclotron elements test and the MSC-230 assembling, the beam transport channel and treatment room design.

2026: The MSC-230 commissioning. Manufacturing of the transport channel and treatment room with a control panel.

2027: Radiobiological studies, medical certification of the proton beam and dosimetry equipment.

2.3. Expected completion time

3 years (2025, 2026, 2027)

2.4. Participating JINR laboratories

BLTP, LIT, FLNP, VBLHE

2.4. 1. MICC resource requirements

Computing resources	Distribution by years				
	1st year	2nd year	3rd year	4th year	5th year
Data storage (TB) - EOS - Tapes					
Tier 1 (CPU core hours)					
Tier 2 (CPU core hours)					
SC Govorun (CPU core hours) - CPU - GPU					
Clouds (CPU cores)					

2.5 Participating countries, scientific and educational organizations

Organization	Country	City	Participants	Agreement type
NIEFA	**Russia**	**Saint Petersburg**	**Smirnov K.E.** **Osina Y.C.**	**Cooperation**
ASIPP	**China**	**Hefei**	**Yuntao Song** **Chen Gen**	**Cooperation**
Platov South-Russian State Polytechnic University (NPI)	**Russia**	**Novocherkassk**	**Lankin M.V.**	**Cooperation**
The A. I. Burnazyan Federal Medical Biophysical Center of the FMBA of Russia	**Russia**	**Moscow**	**Trubchekova E.I.** **Yashkina E.I.** **Ignatov M.A.** **Osipov A.A.** **Blohina T.M.**	**Cooperation**
Space Research Institute Russian Academy of sciences	**Russia**	**Moscow**	**Golovin D.V.** **Litvak M.L.**	**Cooperation**
Lomonosov Moscow State University	**Russia**	**Moscow**	**Latanov A.V.**	**Cooperation**

Institute of Medical and Biological problems Russian Academy of sciences	**Russia**	**Moscow**	**Belov O.V.**	**Cooperation**
Institute of Theoretical and Experimental Biophysics Russian Academy of Sciences	**Russia**	**Pushchino**	**Shemyakov A.E. Dukina A.R.**	**Cooperation**
The FSBI Federal Center of Brain Research and Neurotechnologies (FCBRN of FMBA of Russia)	**Russia**	**Moscow**	**Belousov V.V.**	**Cooperation**
Federal Scientific and Clinical Center for Medical Radiology and Oncology	**Russia**	**Dimitrovgrad**	**Udalov U.D.**	**Cooperation**
iThemba LABs	**Republic of South Africa**	**Somerset West**	**Vandevoorde Sh.**	**Cooperation**
National Center of Oncology	**Azerbaijan**	**Baku**	**Aliev D.**	**Cooperation**
Institute of Nuclear Physics of the Academy of Sciences of Uzbekistan	**Uzbekistan**	**Tashkent**	**Sodikov I.I.**	**Cooperation**
Egypt, Academy of Scientific Research and Technology (ASRT)	**Egypt**	**Cairo**	**al-Fiqi. J.**	**Cooperation**

2.6. Key partners *(those collaborators whose financial, infrastructural participation is substantial for the implementation of the research program. An example is JINR's participation in the LHC experiments at CERN).*

3. Personnel provision

3.1. Personnel requirements during the first year of implementation

№№ n/a	Category of personnel	JINR staff, amount of FTE	JINR Associated Personnel, amount of FTE
1.	research scientists	11	0
2.	engineers	17,8	
3.	specialists	6	
4.	office workers	-	
5.	technicians	3,6	
	Total :	**38,4**	**0**

3.2. Manpower

3.2.1. JINR staff

№№ п/п	Категория работников	ФИО	Подразделение	Должность	Сумма FTE
1.	research scien-tists	Karamyshev O.V.	DLNP SEDNA	Head of S.№1	1
		Kiyan I.N.	DLNP SEDNA	Head of S.№3	1
		Gursky S.V.	DLNP SEDNA	S.r.	1
		Dolya S.N.	DLNP SEDNA	S.s.r.	0.5
		Karamysheva T.V.	MLIT	S.s.r.	0.8
		Malinin V.A.	DLNP SEDNA	J.s.r.	1
		Lyapin I.D.	DLNP SEDNA	J.s.r.	1
		Popov D.V.	DLNP SEDNA	J.s.r.	1
		Skripka G.M.	DLNP SEDNA	S.r.	0.5
		Chesnov A.F.	DLNP SEDNA	S.s.r	0.2
		Agapov A.V.	DLNP SEDNA	S.s.r	1
		Shirkov S.G.	DLNP SEDNA	S.s.r	0.2
		Chernikov A.N.	FLNP	S.s.r.	0.3
		Novikov M.S.	VBLHEP	S.s.r.	0.2
		Khodzhibagiyan G.G.	VBLHEP	Dep.Dir.of Lab	0.2
		Borisov V.V.	VBLHEP SEDSMT	Head of S.№4	0.2
		Mitsyn G.V.	DLNP SEDNA	Head of S.№4	0.7
		Akishin P.G.	MLIT	Dep.Head of Dep..	0.2

2.	Engineers	Vlasov A.I.	DLNP SEDNA	Engineer	1
		Galkin R.V.	DLNP SEDNA	Eng.const.	1
		Gerasimov V.A.	DLNP SEDNA	Engineer	1
		Gonshior A.L.	DLNP SEDNA	Engineer	1
		Lepkina O.E.	DLNP SEDNA	Engineer	1
		Lomakina O.V.	DLNP SEDNA	Engineer	1
		Malysh D.A.	DLNP SEDNA	Engineer	1
		Petrov D.S.	DLNP SEDNA	Engineer	1
		Palnikov I.M.	DLNP DESIGN DEP	Engineer	1
		Romanov V.M.	DLNP SEDNA	Adviser	0.5
		Sinitsa A.A.	DLNP SEDNA	Eng.const.	1
		Fedorenko S.B.	DLNP SEDNA	Engineer	1
		Kudrinsky M.R.	DLNP	Engineer	0,5
		Pavlova A.A.	DLNP DESIGN DEP	Eng.const	0.8
		Vesenkov V.A.	DLNP DESIGN DEP	Eng.const	0.8
		Slesarenko N.V.	DLNP DESIGN DEP	Engineer	0.8
		Potapova N.S.	DLNP DESIGN DEP	Engineer	0.8
		Rumyantsev M.A.	DLNP DESIGN DEP	Eng.const	0.8
		Yakovenko S.L.	DLNP	Sen. engineer	0.5
		Stankus A.S.	DLNP	Dep. Sen.eng.	0.5
		Ponomarev A.A.	VBLHEP	Engineer	0.2
		Fedorov A.N.	DLNP DRI	Engineer	0.3
		Belov N.D.	DLNP DRI	Eng.const.	0.3
3.	specialists	Kirichkov N.V.	DLNP DESIGN DEP	Head of Dep.	0.8
		Rybakov N.A.	DLNP DESIGN DEP	Head of group	0.8
		Sedov L.D.	DLNP SEDNA	laboratory ass.	0.5
		Evseeva I.V.	DLNP SEDNA	Technician	1
		Musina Y.B.	DLNP DESIGN DEP	H. of archive	0.5
		Maslennikov A.B..	DLNP	Head of group	0,5
		Chernetskaya I.V.	DLNP	Ass.sen.eng.	0,9
		Petrov M.V.	VBLHEP	Head of group	0.2
		Nikiforov D.N.	VBLHEP	Head of Dep.	0.2
		Talyzin R.V.	VBLHEP SEDSMT	Head of group	0.2

		Merkuryev A.V.	VBLHEP	Sen. technician	0.2
		Pivin R.V.	VBLHEP	Head of group	0.2
4.	workers	Rogozin D.V.	DLNP SEDNA	Mechanic	1
		Fedorov D.A.	DLNP	Locksmith	0.8
		Akatov V.A.	DLNP	Locksmith	0.5
		Timofey V.P.	DLNP	Electrician	0.8
		Shustrov S.V.	DLNP	Locksmith	0.5
	Total :				**38,4**

3.2.2. JINR associated personnel

№№ n/a	**Category of personnel**	**Partner organization**	**Amount of FTE**
1.	research scientists		
2.	engineers		
3.	specialists		
4.	technicians		
	Total :		

4. Financing

4.1 Total estimated cost of the project/LRIP subproject

The total cost estimate of the project (for the whole period, excluding salary).
The details are given in a separate table below.

9 355 000 $

4.2 Extra funding sources

Expected funding from partners/customers – a total estimate.

Project (LRIP subproject) Leader _____/Kakovenko S.L./
_____/_____/

Date of submission of the project (LRIP subproject) to the Chief Scientific Secretary: _____
Date of decision of the laboratory's STC:_____, document number:_____

Year of the project (LRIP subproject) start:_____

(for extended projects) – Project start year:_____

Proposed schedule and resource request for the Project / LRIP subproject

Expenditures, resources, funding sources			Cost (thousands of US dollars)/ Resource requirements	Cost/Resources, distribution by years				
				2025 год	2026 год	2027 год		
		International cooperation	144	40	52	52		
		Materials	-	-	-	-		
		Equipment, Third-party company services	8270	6319	1383	568		
		Commissioning	570	-	570	-		
		R&D contracts with other research organizations	-	-	-	-		
		Software purchasing	10	-	5	5		
		Design/construction	361	206	155	-		
		Service costs (*planned in case of direct project affiliation)*				-		
Resources required	**Standard hours**	Resources				-		
		– the amount of FTE,						
		– accelerator/installation,						
		– reactor,…						
Sources of funding	**JINR Budget**	JINR budget *(budget items)*	9355	6565	2165	625		
	Extra fudning (supplementar	Contributions by partners Funds under contracts with customers Other sources of funding						

Project manager(s) _____ / Yakovenko S.L.

_____ / Kazanovskaya

Laboratory Economist _____ / Usova /

APPROVAL SHEET FOR PROJECT

NAME OF THE PROJECT: CREATION OF TEST BENCHES FOR TESTING INDIVIDUAL SYSTEMS OF THE MSC-230 CYCLOTRON

SHORT NAME OF THE PROJECT MSC-230

PROJECT CODE: 08-2-1127-1-2025/2026

THEME CODE: 08-2-1127-2016

PROJECT LEADER (s) KARAMYSHEVA G.A., YAKOVENKO S.L.

AGREED

	SIGNATURE	NAME	DATE
JINR VICE-DIRECTOR			
CHIEF SCIENTIFIC SECRETARY			
CHIEF ENGINEER			
LABORATORY DIRECTOR		Yakushev	
CHIEF LABORATORY ENGINEER			
LABORATORY SCIENTIFIC SECRETARY		Simonenko I.	
THEME LEADER			
PROJECT LEADER		Yakovenko S.L.	
PROJECT LEADER		Karamysheva	

	SIGNATURE	NAME	DATE
APPROVED BY THE PAC			