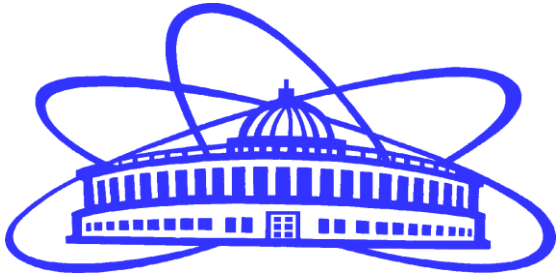

DESIGN AND DEVELOPMENT OF A TEST ZONE FOR METHODICAL STUDIES OF DETECTORS AT THE LINEAR ELECTRON ACCELERATOR IN DLNP

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Aim of the project :

New Linac-200 electron test beam facility at the Joint Institute for Nuclear Research is nearing completion.

Two test beam channels tested and will be ready for users in the nearest feature .

The test beam facility is open for scientific and methodological research in the field of accelerator physics and technology, elementary particles detectors research and development, as well as fundamental and applied research in the fields of materials science and radiobiology

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Overview about electron accelerator

Science Center	Year of construction of accelerator/beams	Particle type	Energy range [MeV]	dP/P [%]	The number of equipped lines
BTF (Frascati, Italy)	1997/2003	$e^{\pm}$	25-750	1	1
ELPH (Tohoku, Japan)	1997/2006	$e^{\pm}$	< 850	1	1
Bepc-II (IHEP, China, Beijing)	2008	e^{-} $e^{\pm}$ (secondary)	1100 - 1500 400 - 1200	1	3
FTBL (KEK, Japan)	1998/2007	e^{-}	500-3400	0,4	1
DESY-II (Germany)		e^{-}	1000-6000	1	3
CERN PS (Switzerland)	1960	e , hadrons, μ	$(1\text{-}15)*10^3$		4
CERN SPS (Switzerland)	1976	e , hadrons, μ	$(10\text{-}400)*10^3$		4
FTBF (FNAL, USA)	1999	e^{-} , π^{-} , μ	$(1\text{-}66)*10^3$		1
SLAC (USA)	1999	e^{-} e, hadrons, (secondary)	$13,6*10^3$ $(0,1\text{-}13,6)*10^3$	0,1-1,3	1
IHEP (Protvino, RF)	1967	e, hadrons, μ	$(1\text{-}45)*10^3$		4
BINP (Novosibirsk, RF)	1994/2012	e^{-}	100-3500	1,8-2	1
LPI (Troitsk, RF)	1974	e^{-}	300-1300		0
Yerevan Physics Institute (Armenia)	1967	e^{-}	75 6000		0
LINAC-200 (JINR)	*1975/2023*	*e^{-}*	*5 - 200*	*1*	*2*

LINAC-200

The linear accelerator Linac-200 at JINR is a new facility, constructed to provide electron test beams to carry out particle detectors R&D, to perform studies of advanced methods of electron beam diagnostics, and for applied research , also for Biological student training from JINR university.

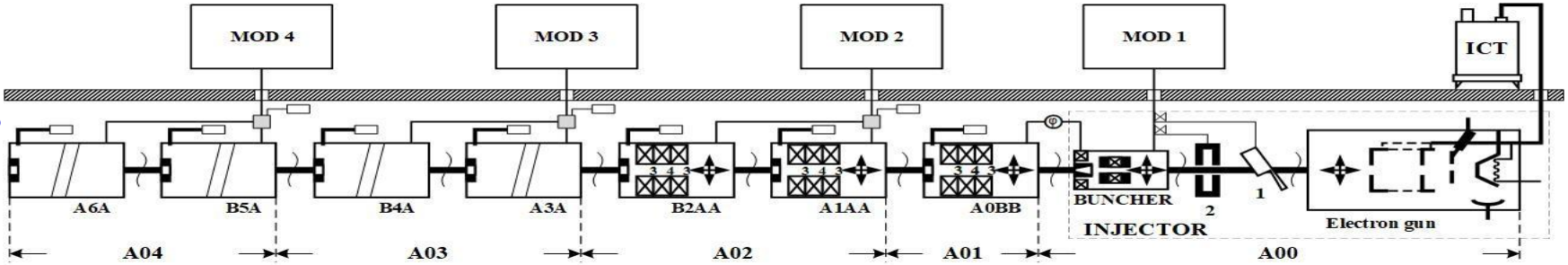
The accelerator subsystems including controls, vacuum, precise temperature regulation were completely redesigned or deeply modernized.

The pulse current varies smoothly from the maximum value down to almost zero (single electrons in a pulse).

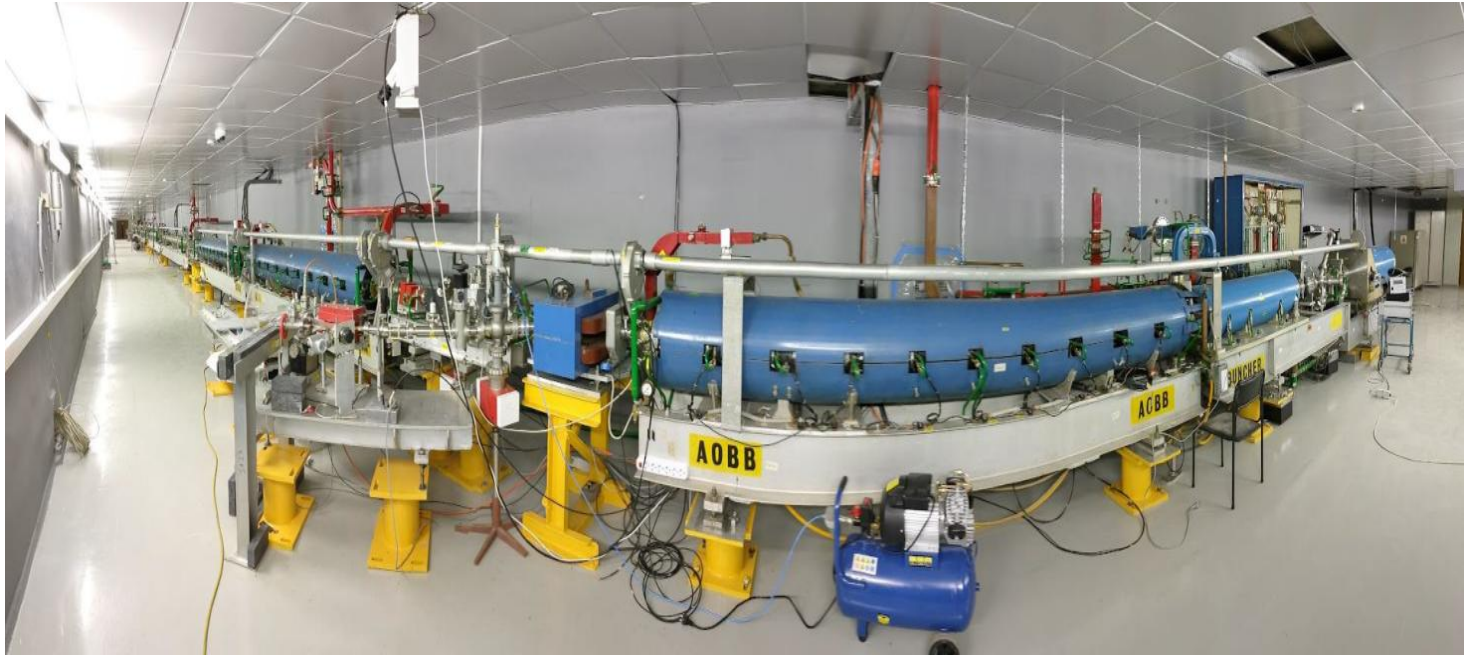
The electron beam is generated by the 400-kV DC triode-type electron gun with a thermionic cathode.

Main accelerator structure

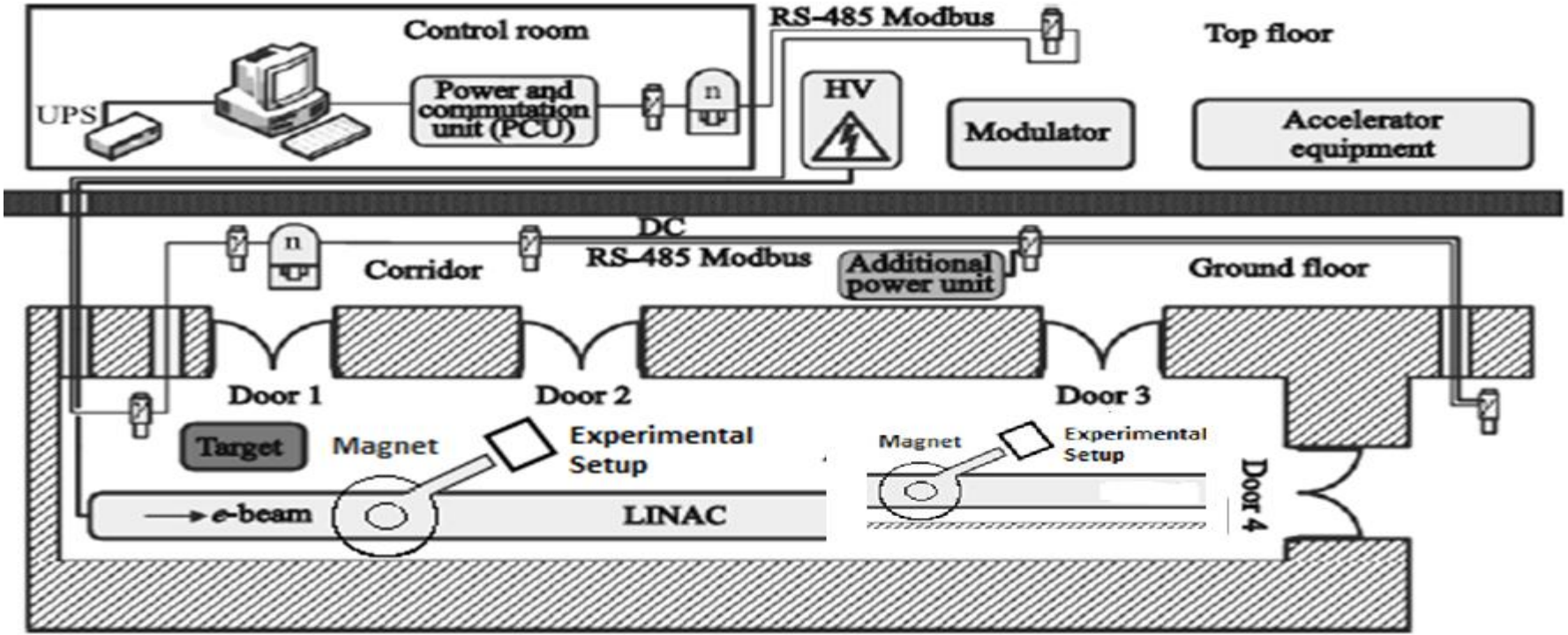
- The injector station A00 includes the electron gun, chopper, prebuncher and buncher.
- First accelerator station A01 includes one accelerating section and a klystron, which also feeds the RF equipment of the A00 station.
- All the rest stations include two accelerating sections and a klystron.
- Current setup consists of 5 stations, A00–A04, and allows generation of the 200



General photo for LINAC -200



User facilities



5-25 MeV

40-200MeV

Parameter	Beam extraction point № 1 (EP1)	Beam extraction point № 2 (EP2)
Electron energy, MeV	5–25	40–200
Pulse duration, μs	0.2–3.5	
Max. pulse current, mA	60	40
Pulse repetition rate, Hz	1–50	1–25

Test zone requirements Characteristics of test beams

5-25 MeV

• Energy Determined by the current in the bending magnets.
• Measurement of photon energy using total absorption calorimeters based on scintillation detectors.
• Intensity Measured using Faraday cups.
•Low energy and dose For biologists from some Gy .
•Dose measurements up to some MGy for materials irradiation
•Beam control using radiochromic film.

40-200MeV

•Determined by the current in the bending magnets. Measurement of photon energy using total absorption calorimeters based on scintillation detectors.

•Intensity Measured using the Rogowski belt.

•Beam coordinates and direction from MWPC by MicroMegas, Multiwire gas chambers .

•measurement accuracy of the order of 100 μm .

Existing equipment

The following tools are used for diagnostics:

- **Compton radiation monitors to detect major beam trajectory errors.**
- **Current transformers for current measurement in the operation mode.**
- **Traveling wave monitors allow to define both beam current and position.**
- **Beam viewers with scintillator screens and video cameras**
- **Electronic devices and software for control dose and beam stability**
- **Target control online horizontal and vertical**

Required equipment

- beam monitor and tracker (based on multi-wire gas chambers)
- gamma profile measurement (Ionizations chamber)
- Electronics for dose measurement from some Gy up to MGy
- Scintillator detector for energy measurement
- Shielding materials
- Radiochromic film for dose control and beam profile

Available research program at the Linac-200 in the nearest future

- Testzone for particle detectors R&D.
- Terahertz radiation source and beam diagnostics R&D.
- Material irradiation.
- Radiobiological studies.
- Education and training

▪study the characteristics and calibration of elementary particle detectors.

▪applied research (radiation materials science, radiation genetics).

- Investigation of the characteristics of detectors for the straw tracker of the SPD facility.
- Study of the characteristics (efficiency, spatial resolution, maximum load) of gas detectors of the bulk Micromegas type for the SPD and AMBER experiments.
- Calibration of detectors for the COMET experiment on low-intensity electron beams with energies up to 100 MeV.
- Calibration of dosimetric instruments .
- Study of silicon pixel detectors for the vertex tracker of the MPD and SPD experiments.
- Calibration of electromagnetic calorimeter modules for the SPD experiment.
- study of photonuclear reactions.

Future prospect

- We have 2 test zone with different electron energy with some equipments and hope to have another equipments for information about beam energy, dose , beam profile, and provide all information about beam and software for users .
- Design website for test zone in our lab for users included requirements parameter for irradiation:

1- Data and time for irradiation
2- energy
3- dose
4- equipments

Manpower

Manpower needs in the first year of implementation

N	Category of personnel	JINR staff, amount of FTE
1.	research scientists	4.9
2.	engineers	2.2
3.	specialists	
4.	office workers	
5.	technicians	
	Total:	7.1

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				
				1st year	2nd year	3rd year	4th year	5th year
		International cooperation		15	15	15	15	15
		Materials		70	70	70	70	70
		Equipment, Third-party company services		130	130	130	130	130
		Commissioning						
		R&D contracts with other research organizations						
		Software purchasing						
		Design/construction						
		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)*	1075	215	215	215	215	215
	Extra fudning (supplementary estimates)	Contributions by partners Funds under contracts with customers Other sources of funding						