имени Векслера и Балдина
ЛАБОРАТОРИЯ ФИЗИКИ ВЫСОКИХ ЭНЕРГИЙ

131st session of the Scientific Council

Construction of ARIADNA applied stations based on the NICA accelerator complex

Presenter: Alexey Slivin on behalf of the team (JINR, Dubna, Moscow Region)
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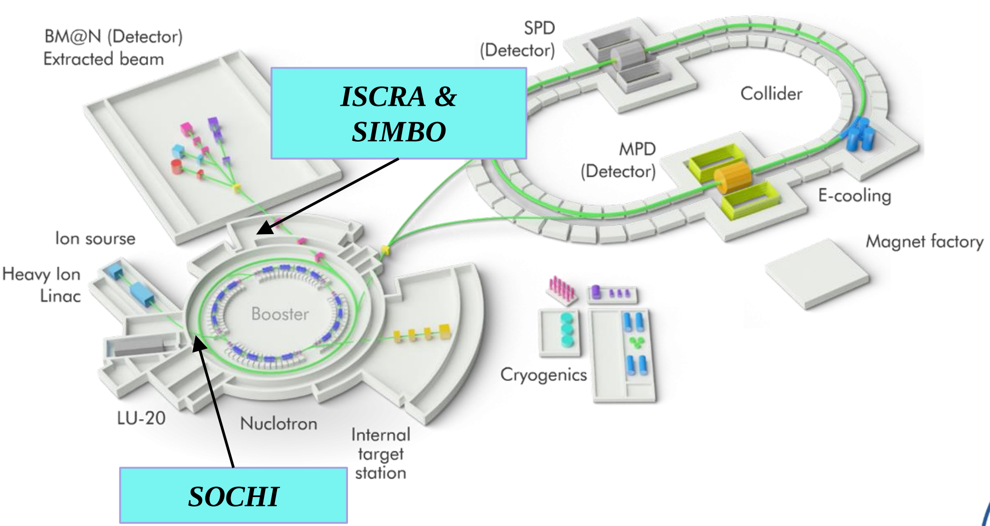
An applied research based on the NICA accelerator complex



Within the framework of the NICA project at JINR, the ARIADNA (**A**pplied **R**esearch **I**nfrastructure for **A**dvanced **D**evelopments at NI**C**A f**A**cility) applied stations are under construction: ***ISCRA*** – ***I**rradiation **S**etup for **C**omponents of **R**adioelectronic **A**pparature* for microchips with a package for Single Event Effects testing (energy range 150-500 MeV/n); ***SIMBO*** – ***S**etup for **I**nvestigation of **M**edical **B**iological **O**bjects* for space radiobiological research and modeling of influence of heavy charged particles on cognitive functions of the primates brain (energy range 500-1000 MeV/n). The mounting of the ***SOCHI*** (***S**tation **O**f **CH**ip* Irradiation) for decapsulated microchips for SEE testing with low-energy ion beams (3.2 MeV/n) has been completed.

- ***ISCRA*** — ***I**rradiation **S**etup for **C**omponents of **R**adioelectronic **A**pparature*. Heavy ions with the energy of 150..500 MeV/n
- ***SOCHI*** — ***S**tation of **CH**ip **I**rradiation*. Heavy ions with the energy of 3.2 MeV/n
- ***SIMBO*** — ***S**etup for **I**nvestigation of **M**edical **B**iological **O**bjects*. Heavy ions with the energy of 500..1000 MeV/n

Station of CHip Irradiation (SOCHI)

Technical requirements for the ion beams at the SOCHI station

Ion types	$^{12}C^{4+}$, $^{40}Ar^{8+}$, $^{131}Xe^{22+}$, $^{84}Kr^{14+}$, $^{169}Tm^{21+}$, $^{197}Au^{31+}$, $^{209}Bi^{34+}$
Ion energy at the exit from the HILac, MeV/n	3,2
Ion flux density, particles/(cm^2·s)	10^3..10^5
Maximum irradiation area, mm	Ø29
Uniformity in the beam center at the 20x20 mm area, %	10

a)The system for online diagnostics and control of peripheral ion flux density and fluence

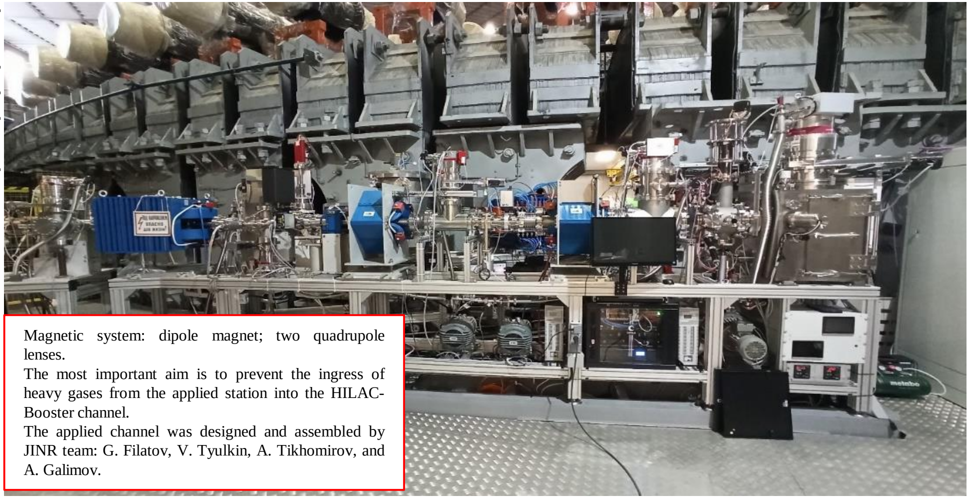
b) The ionization detector based on microchannel plates (MCP)

c) A Faraday cup

d) The fast total-absorption scintillation detector

e) The phosphor screen

SOCHI – an applied research station for decapsulated microchips for Single Event Effects (SEE) testing (ion energy up to 3,2 MeV/n)

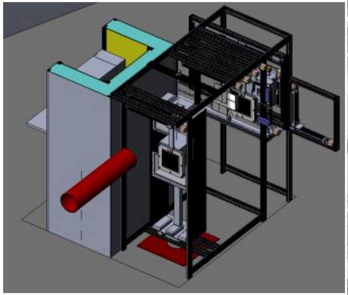


Magnetic system: dipole magnet; two quadrupole lenses.
The most important aim is to prevent the ingress of heavy gases from the applied station into the HILAC-Booster channel.
The applied channel was designed and assembled by JINR team: G. Filatov, V. Tyulkin, A. Tikhomirov, and A. Galimov.

The equipment for the SOCHI station is being developed as part of the ***JINR-NRC «Kurchatov institute»*** collaboration with ***SPELS/MEPhI-VST-GIRO-PROM*** participation

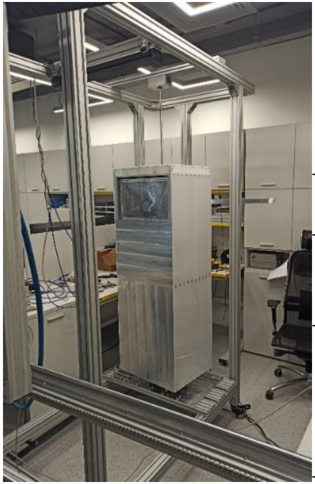
Irradiation Setup for Components of Radioelectronic Apparatus (ISCRA)

General 3D view of the ISCRA station



The system for positioning and movement of the test sample

Energy degrader



ISCRA — an applied research station for microchips with a package for Single Event Effects (SEE) testing (energy range of 150-500 MeV/n)

Technical requirements for the ion beams at the ISCRA station

Type of ions, energy MeV/n	$^{197}Au^{79}$	150-350
	$^{131}Xe^{54+}$	150-367
	$^{12}C^{6+}$	150-392
	$^{40}Ar^{18+}$	150-449
	$^{56}Fe^{26+}$	150-426
	$^{84}Kr^{36+}$	150-507
Ion flux density, particles/(cm^2·s)	$10^2..3\cdot10^5$	
Maximum irradiation area in the scanning mode/ nonscanning mode, mm	200x200/Ø29	
Flux uniformity for the maximum irradiation area in the scanning mode/nonscanning mode, %	15/10	
Irradiation time per run, min	30-40	

a) A 80×80 mm scintillation-fiber detector is used ***to measure the ion flux density, beam profile*** before the experiment during beam adjustment

b) Ionization chamber № 1 (128×128 mm) is used ***to control primary beam parameters in front of the degrader*** before the experiment during beam adjustment

c) Ionization chamber № 2 (256×256 mm) is used ***to measure the ion flux density of the secondary beam in the target area*** before the experiment during beam adjustment

d) Miniature gas-filled ionization chamber 3 is used to measure the LET in the target area before experiment.

e) A silicon detector (the set of 6 Si-planes) — a duplicate detector ***to control and measure the LET of ions in the target area*** before experiment.

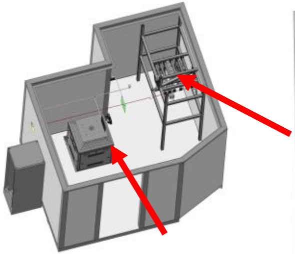
f) A particle flux density meter based on four scintillators (or four silicon detectors) is ***used to control the ion flux density in the peripheral area of the ion beam in real-time.***

The equipment for the ISCRA station is being developed as part of the ***JINR-NRC «Kurchatov institute*** collaboration with ***SPELS/MEPhI-GIRO-PROM*** participation

Setup for Investigation of Medical Biological Objects (SIMBO)

SIMBO – an applied research station for space radiobiological research and modelling of influence of heavy charged particles on cognitive functions of the brain of small laboratory animals and primates (energy range 500-1000 MeV/n).

*General 3D view of the **SIMBO** station*



Positioning element for laboratory animals

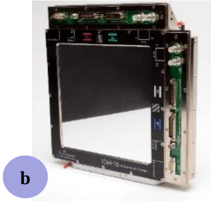
The beam diagnostics system for the SIMBO station

a. *Ionization chamber № 1 based on scintillation-fiber detectors (is used to measure **ion flux density, beam profiles in nonscanning mode before the experiment during beam adjustment**).*
b. *Ionization chamber № 2 based on the IC64-16 (Pyramid Technical Consultants, Inc)strip ionization chamber is a duplicating chamber for ionization chamber 1 and **solves similar problems***
c. *Ionization chamber № 3 ionization chamber is used to determine **the absorbed dose**.*
d. *The system for online diagnostics and control of the peripheral ion flux density based on four scintillation detectors.*

Technical requirements for the ion beams at the SIMBO station

Ion types	$^{12}C^{6+}$, $^{40}Ar^{18+}$, $^{56}Fe^{26+}$, $^{84}Kr^{36+}$
Ion energy at the exit from the Nuclotron, MeV/n	500-1000
Ion flux density, particles/(cm^2·s)	10^3..10^6
Irradiation time per run, min	1-5
Radiation dose, Gy	1-3
Maximum irradiation area in the scanning mode/nonscanning mode, mm	100x100/Ø10
Flux uniformity for the maximum irradiation area in the scanning mode/nonscanning mode, %	5/10

e. *Ionization chamber № 4 based on a model QIC-2S (Pyramid Technical Consultants, Inc) four-channel ionization chamber is used as a local dose detector*
f. *A diamond semiconductor detector (detector of the local dose and average ion energy) installed on the positioning system*
g. *Thin scintillation counter is used for the measurement of impurities in a beam of non-target ions*



The equipment for the SIMBO station is being developed as part of the ***JINR-VST*** collaboration. The equipment for Positioning device is being developed as part of the ***JINR-OSTEC GROUP*** collaboration

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