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имени Векслера и Балдина
ЛАБОРАТОРИЯ ФИЗИКИ ВЫСОКИХ ЭНЕРГИЙ

56th meeting of the PAC for Particle Physics

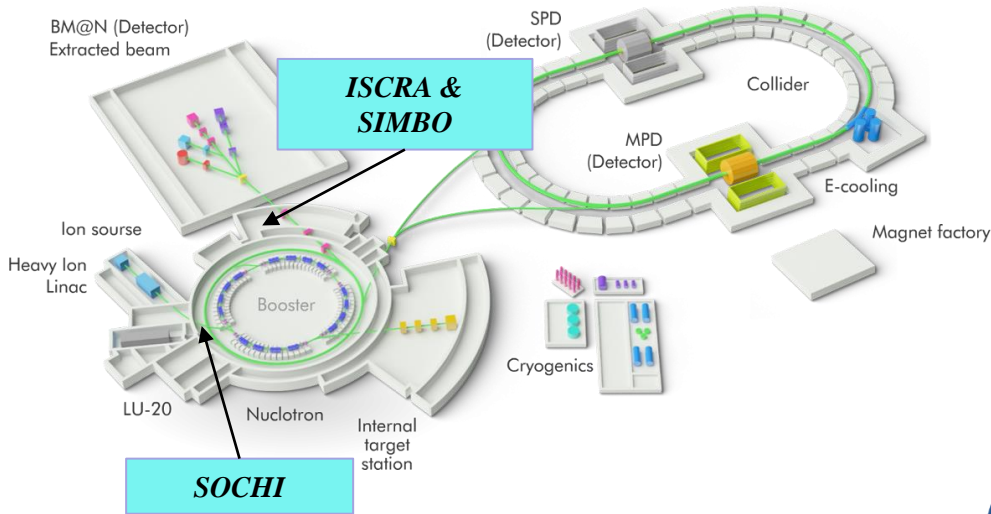
Construction of ARIADNA applied stations based on the NICA accelerator complex

*Presenter: Alexey Slivin on behalf of the team (JINR, Dubna, Moscow Region)
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Within the framework of the NICA project at JINR, the ARIADNA (Applied Research Infrastructure for Advanced Developments at NICA facility) applied stations are under construction: **ISCRA** – Irradiation Setup for Components of Radioelectronic Apparature for microchips with a package for Single Event Effects testing (energy range 150-500 MeV/n); **SIMBO** – Setup for Investigation of Medical Biological Objects 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** (Station Of CHip Irradiation) for decapsulated microchips for SEE testing with low-energy ion beams (3.2 MeV/n) has been completed.



- **ISCRA** — Irradiation Setup for Components of Radioelectronic Apparature. Heavy ions with the energy of 150..500 MeV/n
- **SOCHI** — Station of CHip Irradiation. Heavy ions with the energy of 3.2 MeV/n
- **SIMBO** — Setup for Investigation of Medical Biological Objects. Heavy ions with the energy of 500..1000 MeV/n

Technical requirements for the ion beams at the SOCHI station

Ion types	$^{12}\text{C}^{4+}$, $^{40}\text{Ar}^{8+}$, $^{131}\text{Xe}^{22+}$, $^{84}\text{Kr}^{14+}$, $^{169}\text{Tm}^{21+}$, $^{197}\text{Au}^{31+}$, $^{209}\text{Bi}^{34+}$
Ion energy at the exit from the HILac, MeV/n	3,2
Ion flux density, particles/($\text{cm}^2\cdot\text{s}$)	$10^3..10^5$
Maximum irradiation area, mm	$\varnothing 29$
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)

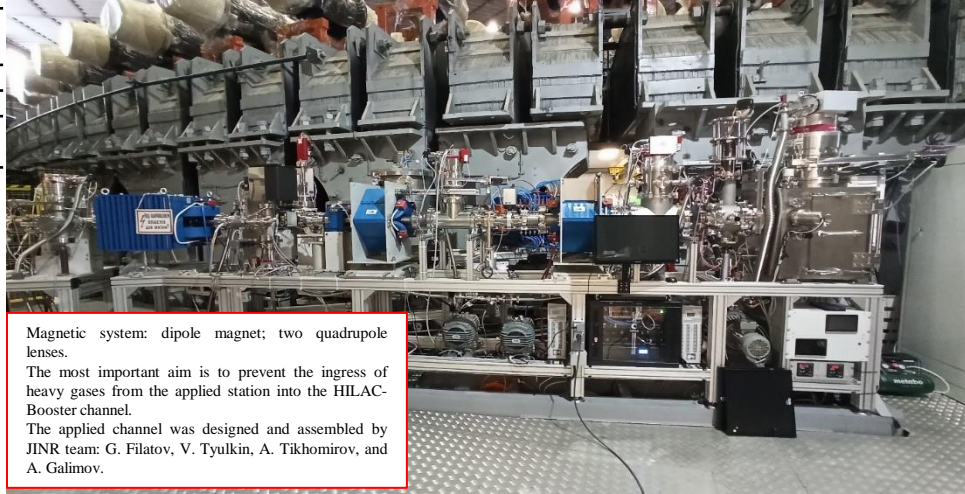
c) A Faraday cup

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)

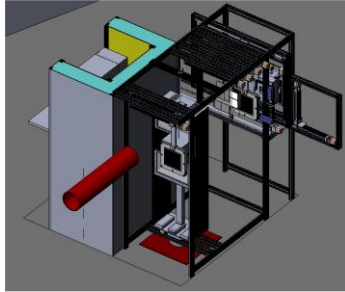


Magnetic system: dipole magnet; two quadrupole lenses.

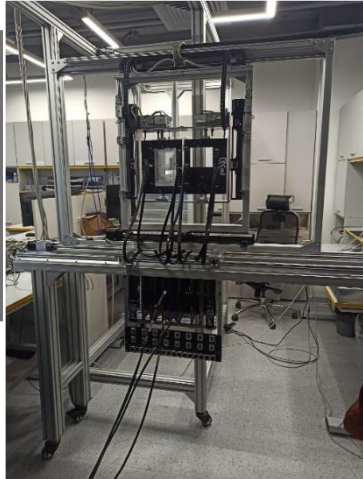
The most important aim is to prevent the ingress of heavy gases from the applied station into the HILAC-Booster channel.

The applied channel was designed and assembled by JINR team: G. Filatov, V. Tyulkin, A. Tikhomirov, and A. Galimov.

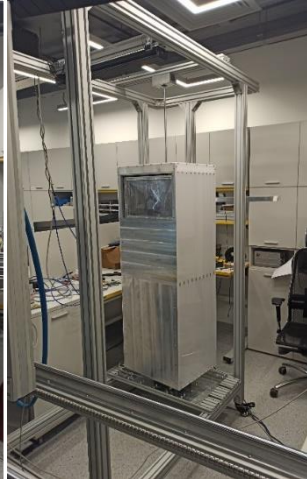
General 3D view of the
ISCRA station



The system for positioning and movement
of the test sample



Energy degrader



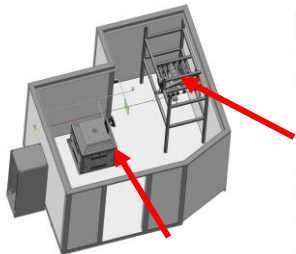
Technical requirements for the ion beams at the ISCRA station

Type of ions, energy MeV/n	$^{197}\text{Au}^{79}$	150-350
	$^{131}\text{Xe}^{54+}$	150-367
	$^{12}\text{C}^{6+}$	150-392
	$^{40}\text{Ar}^{18+}$	150-449
	$^{56}\text{Fe}^{26+}$	150-426
	$^{84}\text{Kr}^{36+}$	150-507
Ion flux density, particles/($\text{cm}^2 \cdot \text{s}$)	$10^2 \dots 3 \cdot 10^5$	
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	

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

- 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.

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



Positioning element for laboratory animals



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).

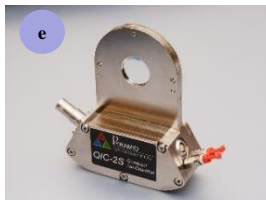
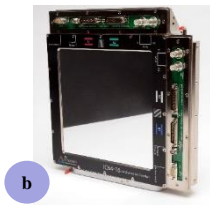
The beam diagnostics system for the SIMBO station

- 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**).
- 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**
- Ionization chamber № 3 ionization chamber is used to determine **the absorbed dose**.
- 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	$^{12}\text{C}^{6+}$, $^{40}\text{Ar}^{18+}$, $^{56}\text{Fe}^{26+}$, $^{84}\text{Kr}^{36+}$
Ion energy at the exit from the Nuclotron, MeV/n	500-1000
Ion flux density, particles/($\text{cm}^2\cdot\text{s}$)	$10^3..10^6$
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

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





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