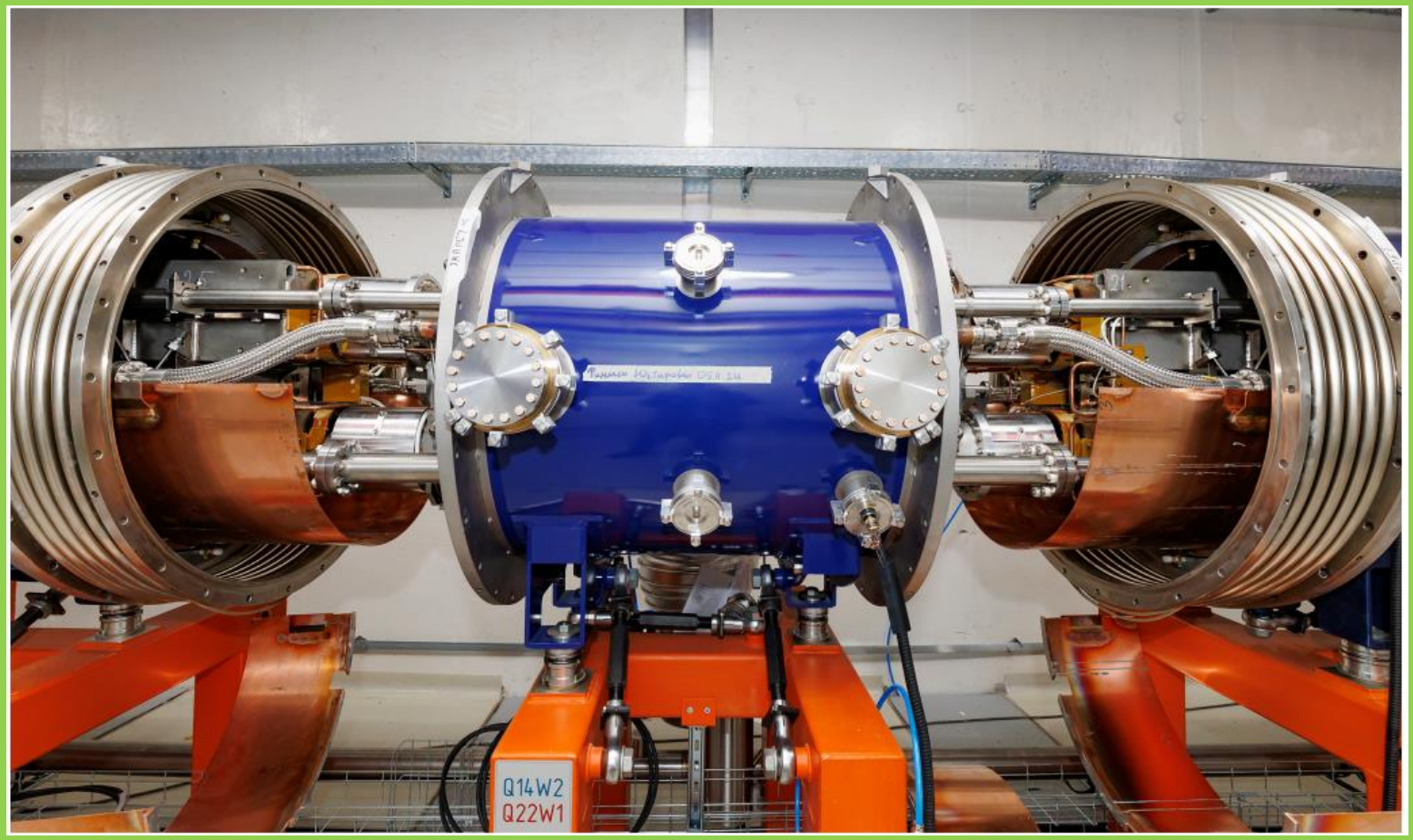
# Realization of the Nuclotron-NICA Project




A.Sidorin, on behalf of the NICA team

PP PAC, JINR, Dubna, 20 January 2025

# Contents

# Main results of 2024

June 2024 – start of the NICA technological run
(tests of Power supply, RF and other systems)

4 runs of the KRION, 2 runs KRION+HILAC
(preparation for beam accumulation in the Booster,
SOCHI operation)

Development of magnet technology
(successful test of 1.8 T, 10 T/s dipole magnet,
construction of HTS cable machine, …)

November 2024 –
Applied research channels are ready for the beams

Progress in assembly of the collider cryo-magnetic system

# Schedule of the collider commissioning

**16 January – 31 March 2025**:
*Booster operation*
(tuning of cryogenics, Power supply units,
beam dynamics optimization, tuning of electron cooling,
beam accumulation at injection energy)

**April – May 2025:**
*Booster + Nuclotron operation*
(minimization of particle loss, tuning of the slow extraction,
BM@N + ARIADNA program,
test of fast extraction system)

**June - August 2025:**
*Collider operation*
(tuning of the Nuclotron – Collider beam line,
beam injection into Collider,
first collisions with internal target)

# Preparation of the KRION, HILAC, beam line and Booster for the beam accumulation

During 4 beam runs KRION, HILAC and transport line

were optimized for **Xe** beams generation

at repetition frequency of 10 Hz, pulse duration of 4 mcs,

the Booster RF is prepared for operation at first harmonics,

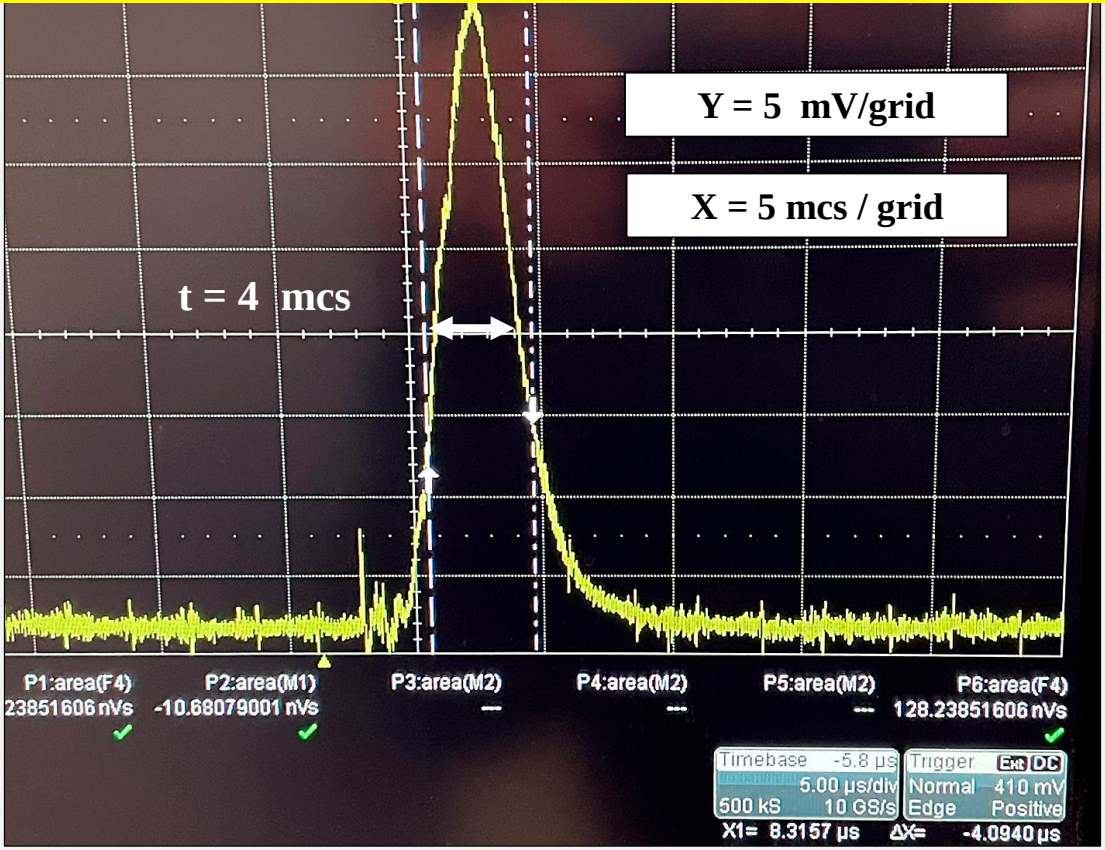
the Booster inflector plate source operated at test bench with short pulses,

the Booster electron cooling system is under preparation.

All the systems are prepared for the beam storage at injection energy,

we expect improvement of the beam intensity by a few times

# Preparation of the KRION, HILAC, beam line and Booster for the beam accumulation



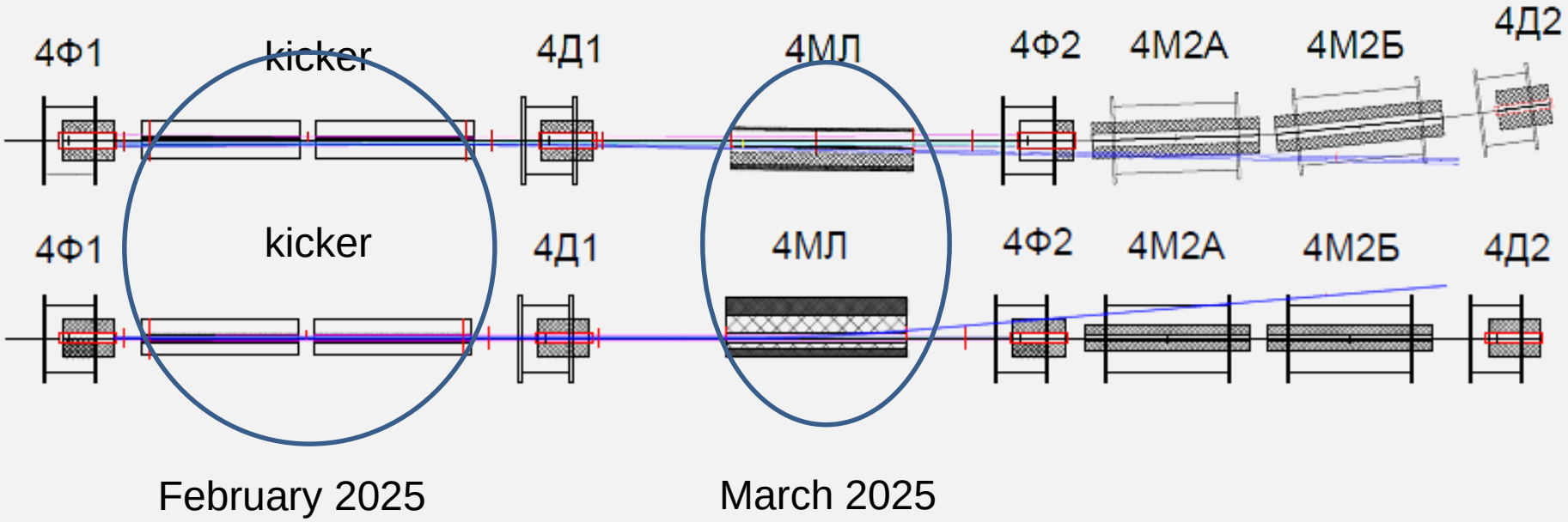

E.Donets

Pulse of the $^{124}Xe^{28+}$ (Z/A=1/4.4) ions at Faraday cap at the exit of KRION-6T;
Pulse duration ~ 4 mcs (HWHM); total charge ~ 3 nQ.

# Nuclotron Fast Extraction System

A.Tuzikov

**Start configuration (magnetic rigidity up to 29 T·m)**

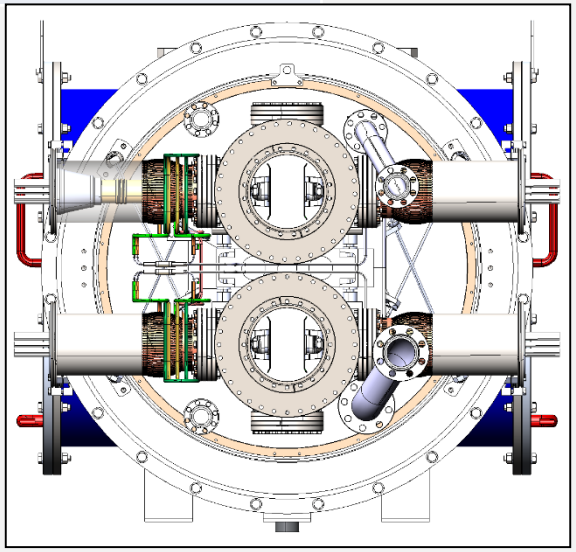



**Application of one extraction Lambertson magnet permits to reach the maximal kinetic ion energy 2.5 GeV/n in first Collider beam runs**

# Kickers for Nuclotron and Collider

| | Extraction from Nuclotron | Injection into Collider |
|---|---|---|
| **Effective length, m** | 2×1.3 | 3×1.3 |
| **Max. field, T** | 0.13 | 0.055 |
| **Bending angle, mrad** | 8.4 | 5 |
| **Pulse duration, ns:**<br>**rise**<br>**plateau**<br>**fall** | <br>550<br>200<br>600 | <br>200<br>200<br>200 |
| **Current amplitude, kA** | 27 | 11 |

A.Tuzikov,
A.Fateev,
A.Sidorov



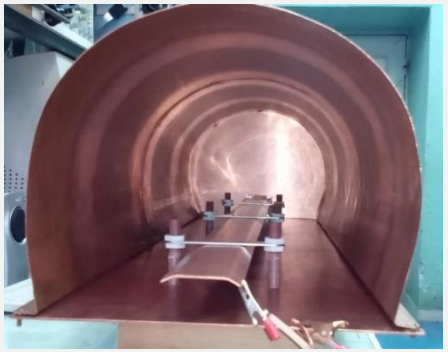
**Extraction kicker – in assembly at Nuclotron**

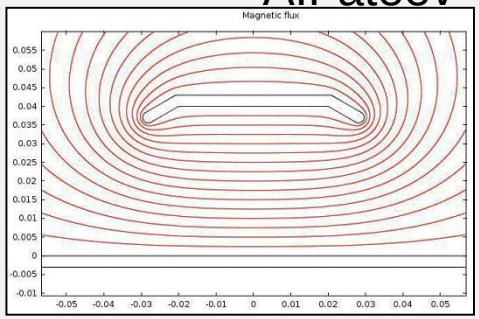
***Max. ion energy, 2.5 Gev/u***

# Collider Beam Injection

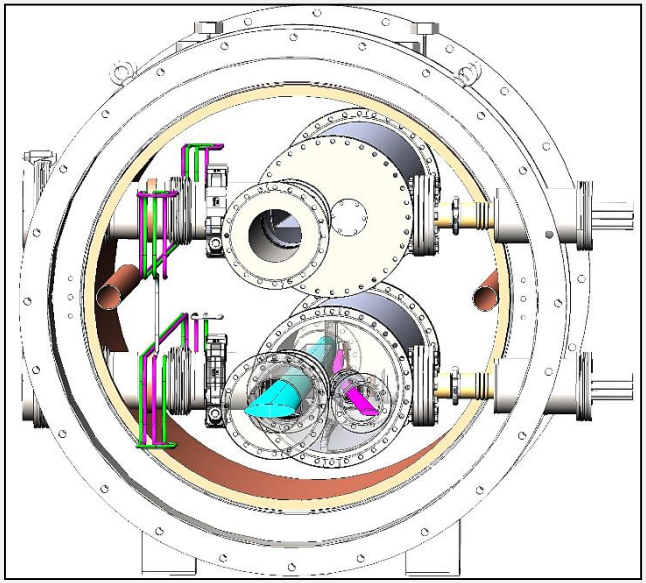
A.Tuzikov,
A.Fateev

| | |
|---|---|
| Effective length, m | 2.5 |
| Max. magnetic field, T | 0.42 |
| Bending angle, mrad | 24 |
| Gap, mm | 30 |
| Septum thickness, mm | 3 |
| Current, кА | 50 |
| Pulse duration, μs | 10 |

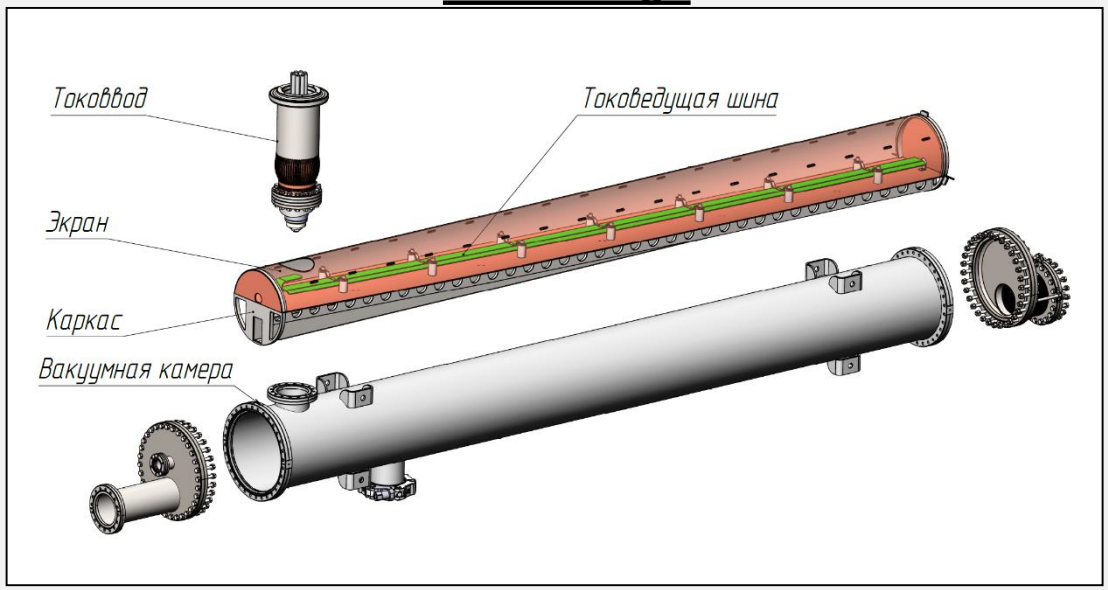





## Septum cryostat module



## Septum's internal chamber with feedthrough




**injection kickers & septa - assembly June 2025**

# Nuclotron-Collider beam transport line

A.Tuzikov

Quadrupoles installed and adjusted at beam line

## Parameters of pulsed magnet elements

| Magnetic element | Number | Effective length, m | Max. magnetic field (gradient), T (T/m) |
|---|---|---|---|
| Long dipole | 21 | 2 | 1.5 |
| Short dipole | 6 | 1.2 | 1.5 |
| Quadrupole Q10 | 22 | 0.353 | 31 |
| Quadrupole Q15 | 6 | 0.519 | 31 |
| Steerer | 33 | 0.466 | 0.114 |

**Nuclotron-Collider transfer line was contracted by France company Sigma Phi**

**JINR could not obtain part of already built equipment: power supplies, beam diagnostics, vacuum chambers and support stands. JINR has been rebuilding this equipment since Summer 2023.**

**Assembly of the transport lines is in progress; expected date of completion – May 2025**

# Progress in assembly of the Collider cryo-magnetic system

A.Galimov,
O.Brovko,
V.Karpinsky,
E.Gorbachev,
A.Konstantinov,
E.Ivanov

The following main elements are installed:

- the Collider magnetic cryostat system,
- RF stations and final focusing lenses,
- the merging of the high-vacuum volume sections in the West arc,
- cryogenic equipment and power supplies in the Collider building,
- connection of power lines and energy evacuation systems

The Collider Rings have been prepared for vacuum and cryogenic tests

**Collider is expected to be ready for beam tests in June 2025**

# Thank you for attention