



NICA accelerator complex at JINR

Olha Kazinova
on behalf of the NICA team
Joint Institute for Nuclear Research



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Ghent, Belgium



NICA (Nuclotron based Ion Collider Facility)



Agreement between Government of the RF and JINR (April 2016)



ПРАВИТЕЛЬСТВО РОССИЙСКОЙ ФЕДЕРАЦИИ

РАСПОРЯЖЕНИЕ

от 27 апреля 2016 г. № 783-р

МОСКВА

О подписании Соглашения между Правительством Российской Федерации и международной межправительственной научно-исследовательской организацией Объединенным институтом ядерных исследований о создании и эксплуатации комплекса сверхпроводящих колец на встречных пучках тяжелых ионов NICA

1. В соответствии с пунктом 1 статьи 11 Федерального закона "О международных договорах Российской Федерации" одобрить представленный Минобрнауки России согласованный с МИДом России, Минфином России, Минэкономразвития России и международной межправительственной научно-исследовательской организацией Объединенным институтом ядерных исследований проект Соглашения между Правительством Российской Федерации и международной межправительственной научно-исследовательской организацией Объединенным институтом ядерных исследований о создании и эксплуатации комплекса сверхпроводящих колец на встречных пучках тяжелых ионов NICA (прилагается).

2. Поручить Минобрнауки России провести переговоры с международной межправительственной научно-исследовательской организацией Объединенным институтом ядерных исследований и по достижении договоренности подписать от имени Правительства Российской Федерации указанное в пункте 1 настоящего распоряжения Соглашение, разрешив вносить в прилагаемый проект изменения, не имеющие принципиального характера.

| | | | | |
|------------|----------------|------------|----------|------------|
| Armenia | China | Greece | Moldova | Serbia |
| Australia | Czech Republic | India | Mongolia | Slovakia |
| Azerbaijan | DPRK | Italy | Poland | Ukraine |
| Belarus | France | Japan | Romania | USA |
| Brazil | Georgia | Kazakhstan | RSA | Uzbekistan |
| Bulgaria | Germany | Mexico | Russia | Vietnam |

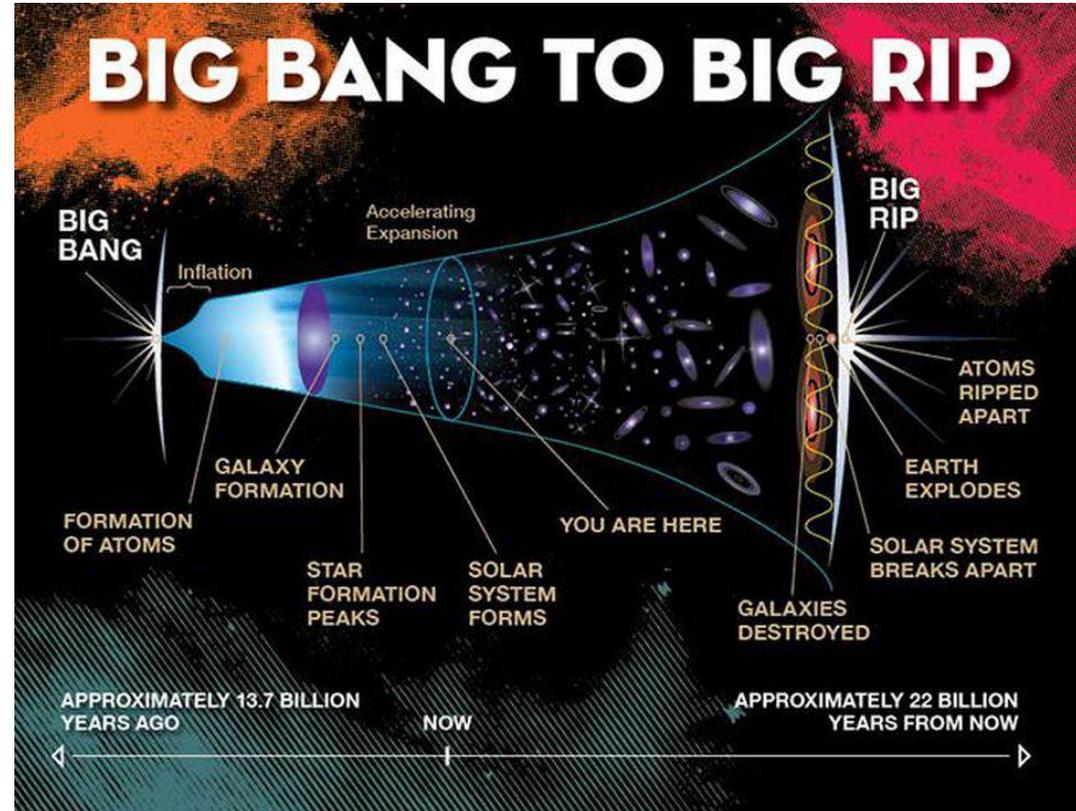
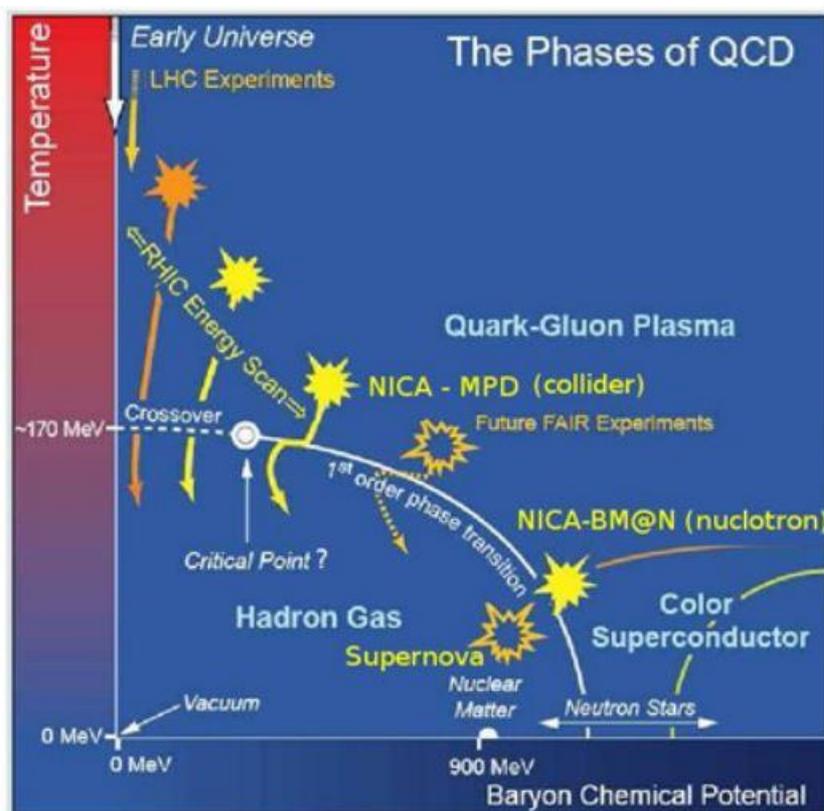
<http://nica.jinr.ru/>

NICA: Recreating the first moments of the Universe in the Lab



NICA Physics

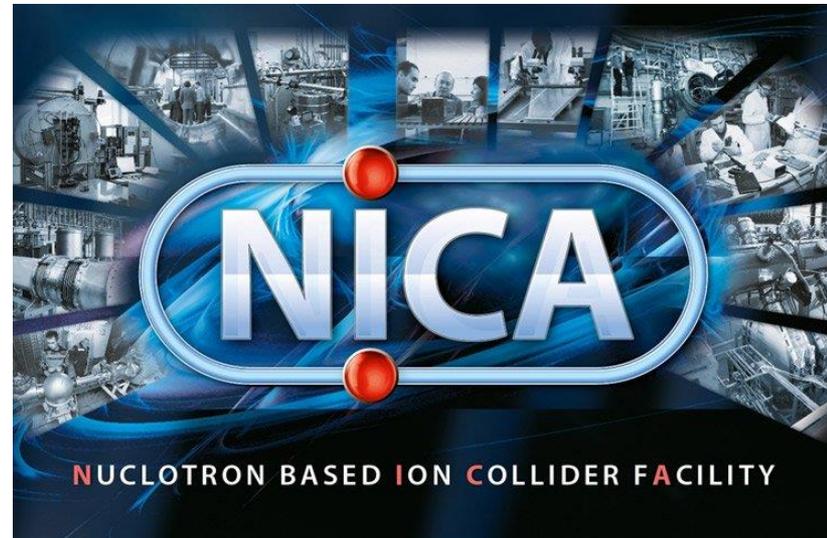
Nuclear matter in the region of the maximum baryonic density



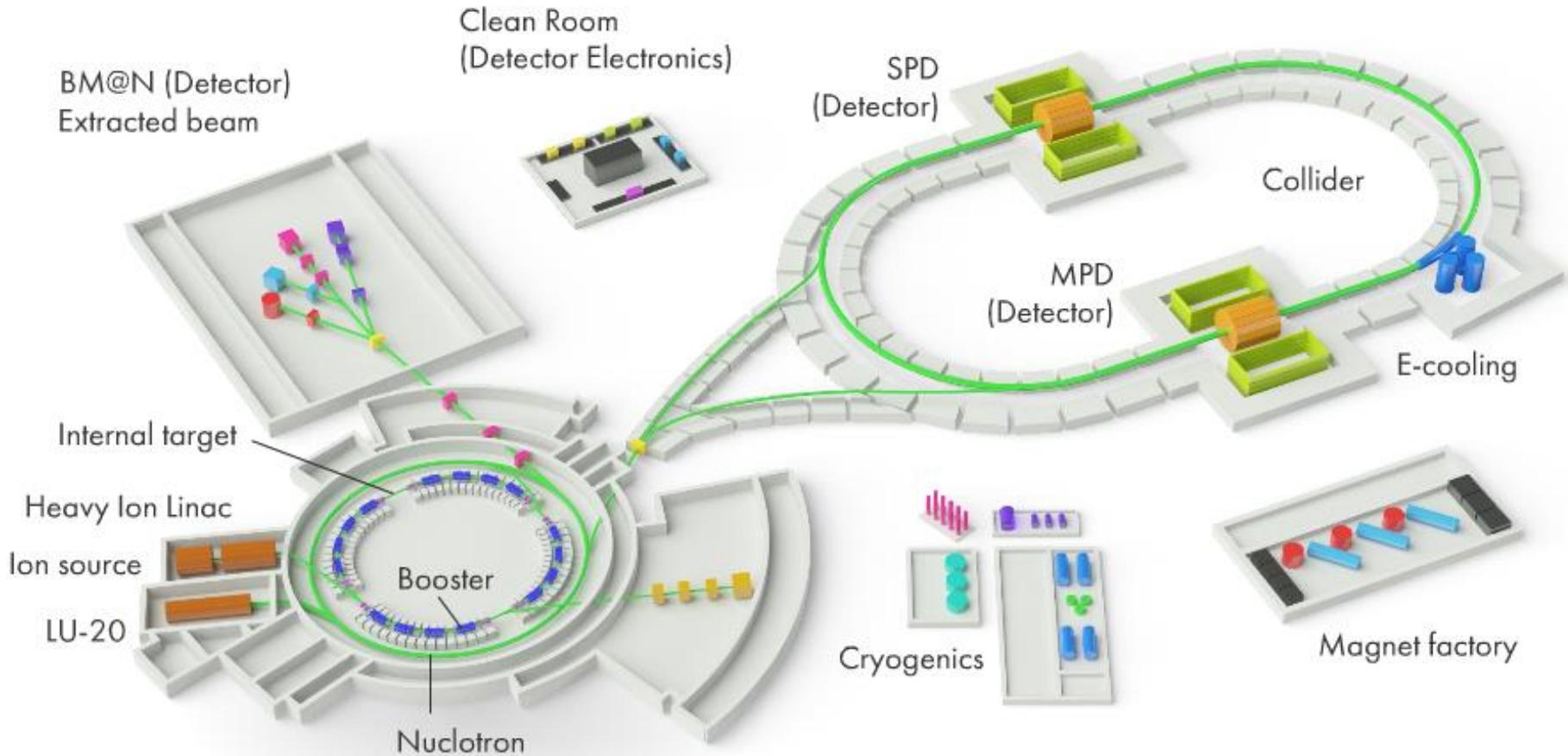
Main tasks of the NICA project

- *study of hot and dense baryonic matter*
- *investigation of nucleon spin structure, polarization phenomena*
- *modernization of existing accelerator facility*

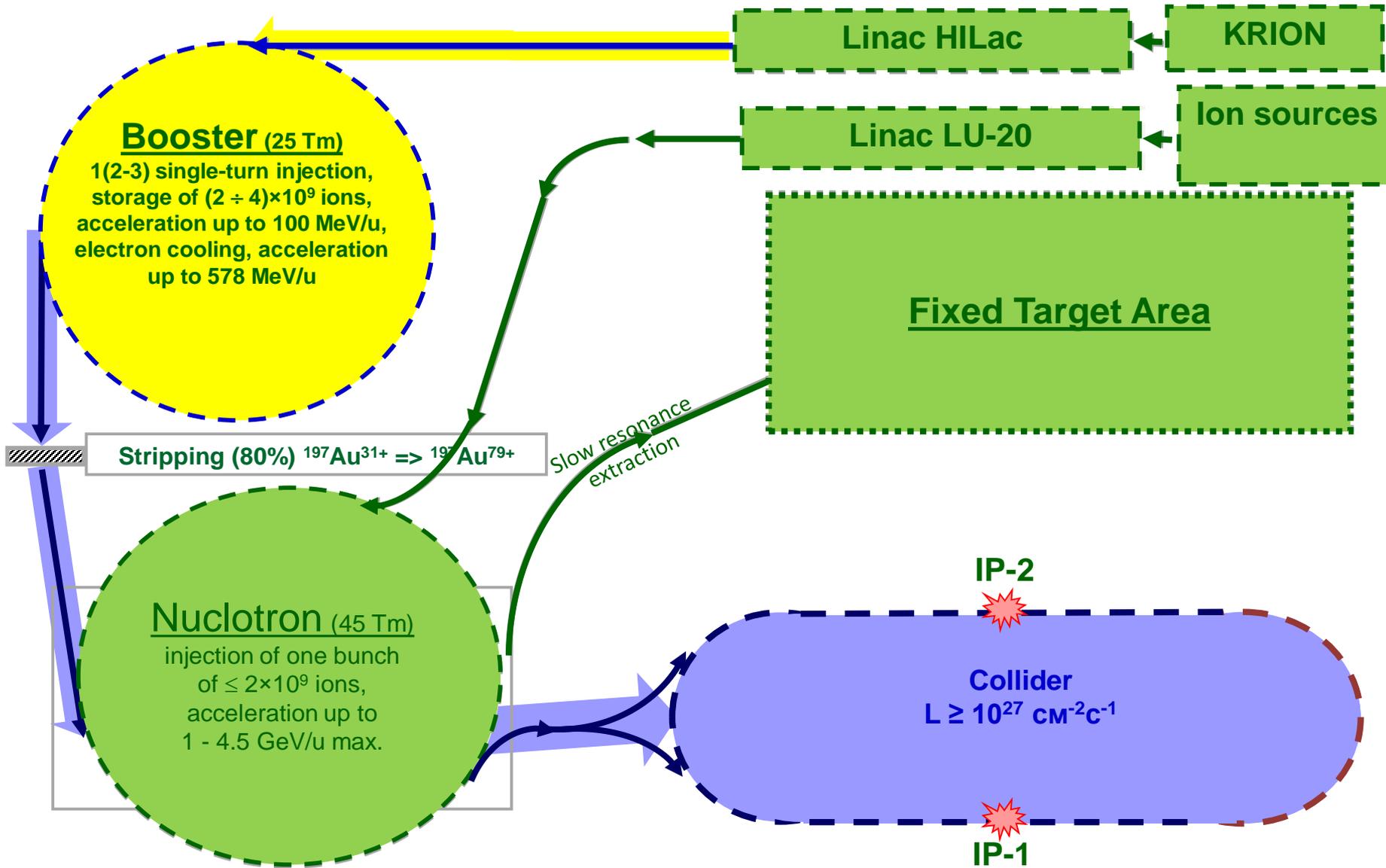
- relativistic ions from p to Au at energy range
 $\sqrt{s}_{NN} = 4 - 11 \text{ GeV}$
- polarized p and d at energy up to
 $\sqrt{s} = 27 \text{ GeV (p)}$



NICA Complex



Facility components: status

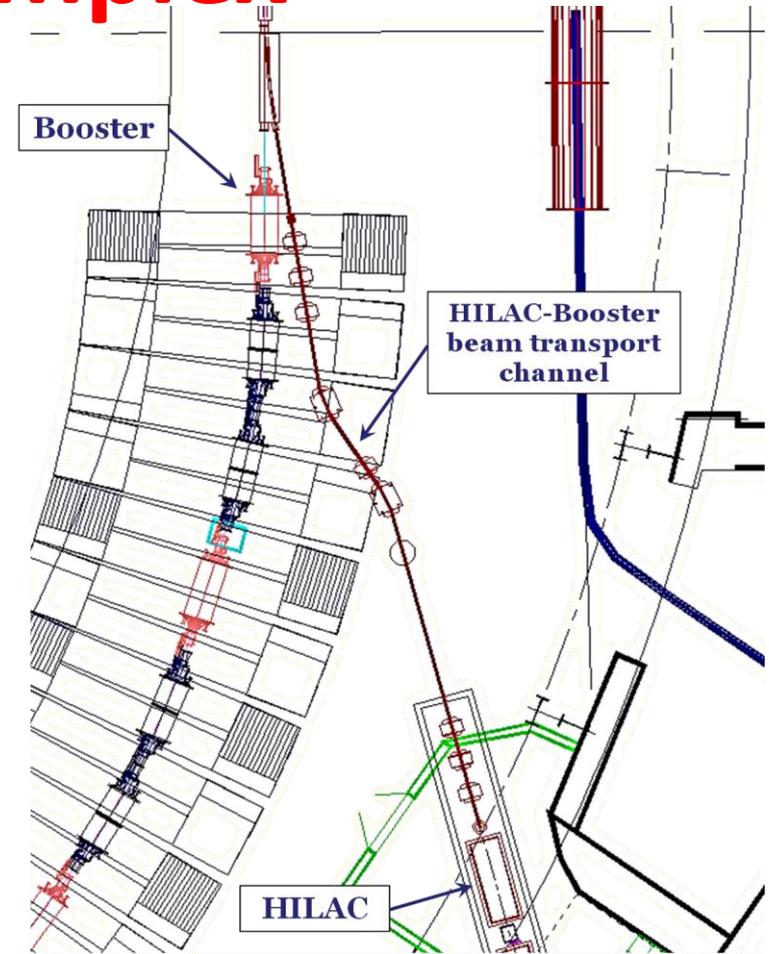


work in progress

assembly

commissioned / existing

Injection complex

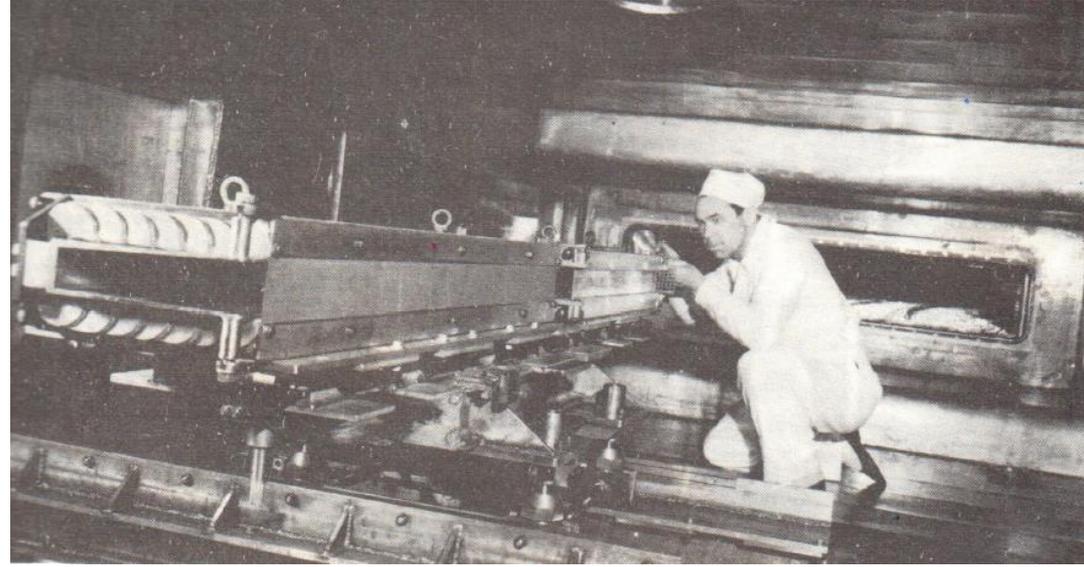


- cryogenic heavy ion source KRION of Electron String Ion Source (ESIS) type,
- laser source,
- source of polarized protons and deuterons,
- modernized linac LU-20 (existing),
- new heavy ion linear accelerator (HILAC),
- transfer channels.

JINR Synchrotron

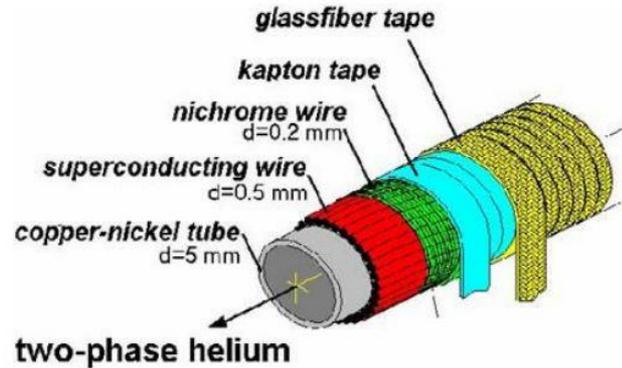
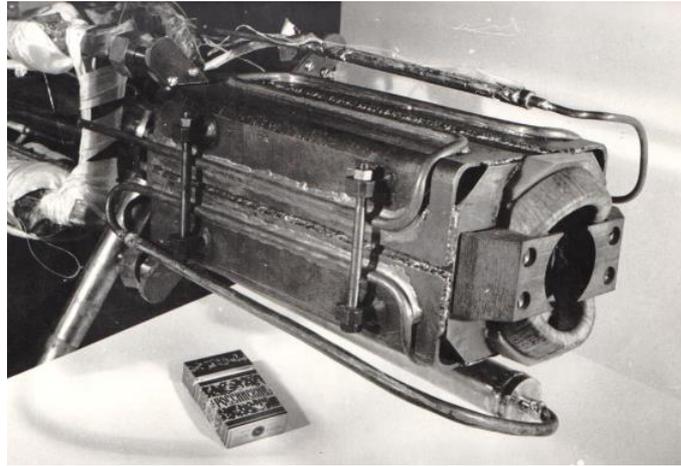
Magnetic system weight –
36 000 tons !!
most heaviest accelerator
people ever built

The last weak focusing
machine for high energy
physics



Nuclotron cable technology

Developed at 1980th

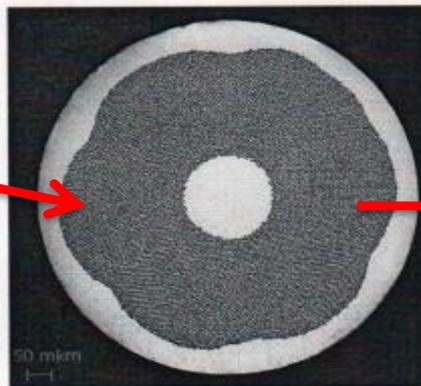


Diameter of NbTi filaments - 10 microns
Number of the filaments - 1045
Twist pitch of the filaments - 5 mm
Twist length of the wires - 47 mm
Number of the wires - 31
Nominal current - 6.0 kA

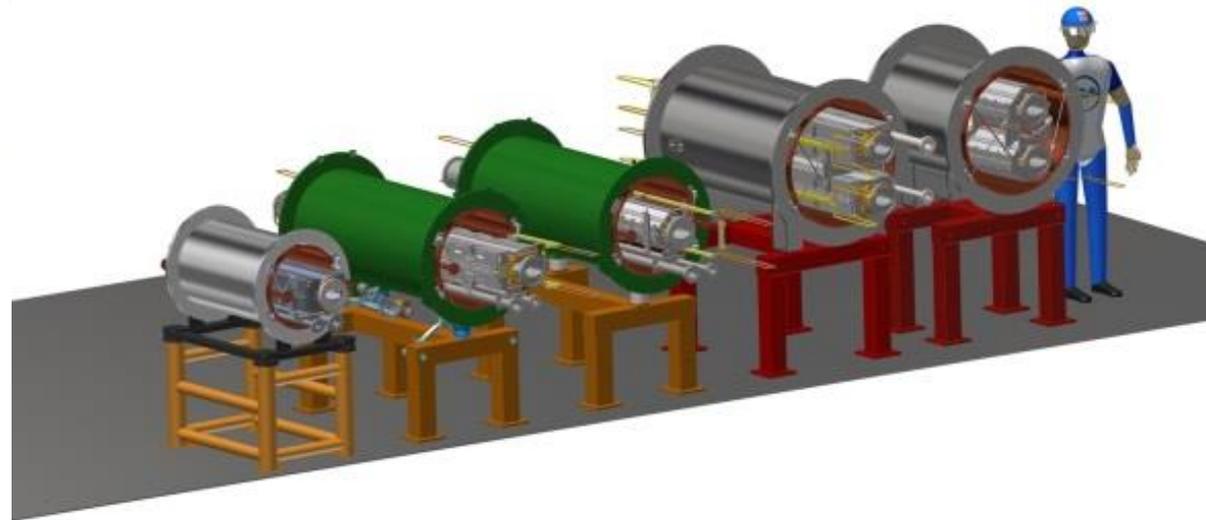
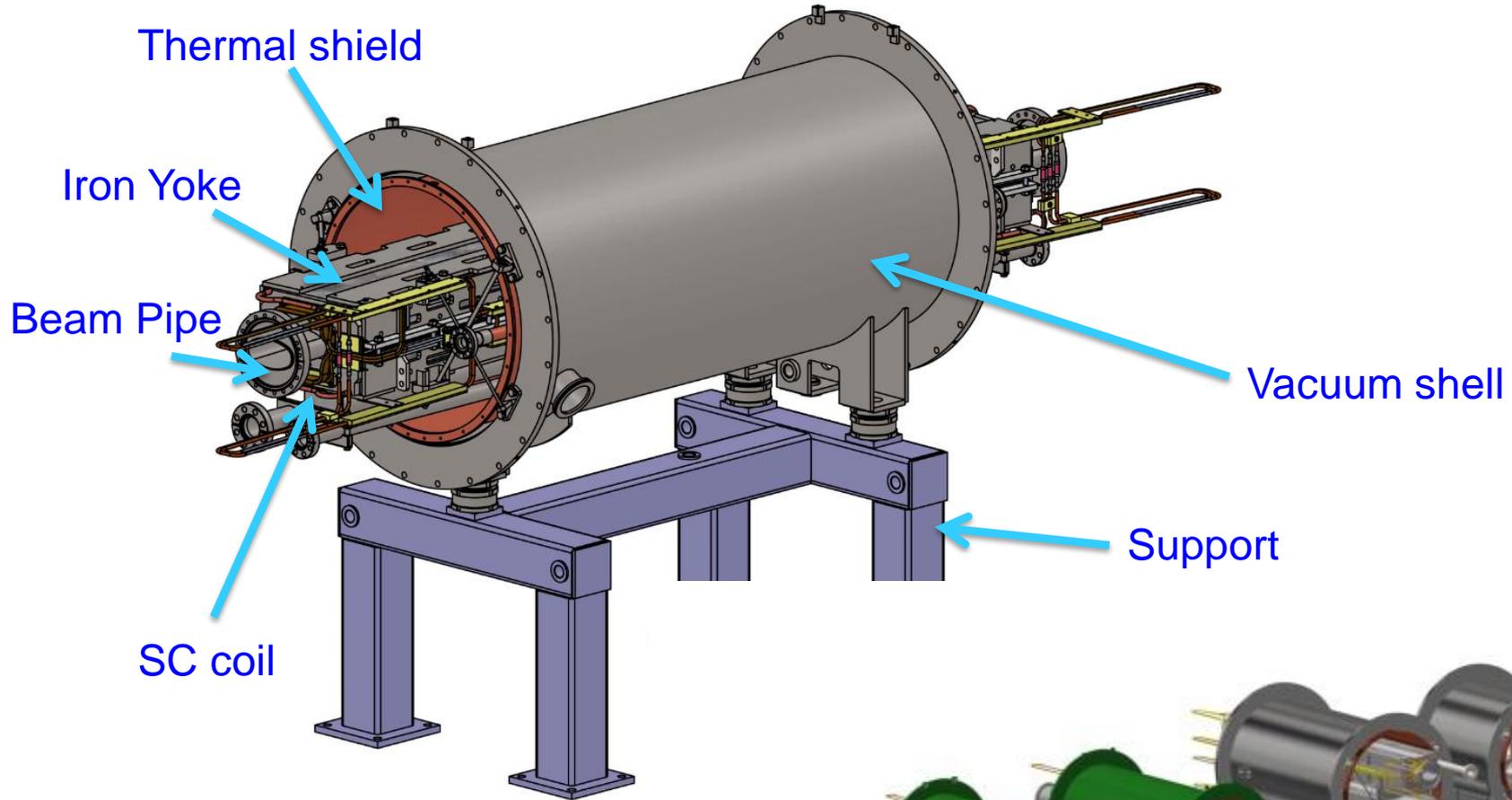
СЕРТИФИКАТ

Ниобий-титановый сверхпроводящий стренд усовершенствованной конструкции для модельного магнита Бустера ускорительного комплекса NICA

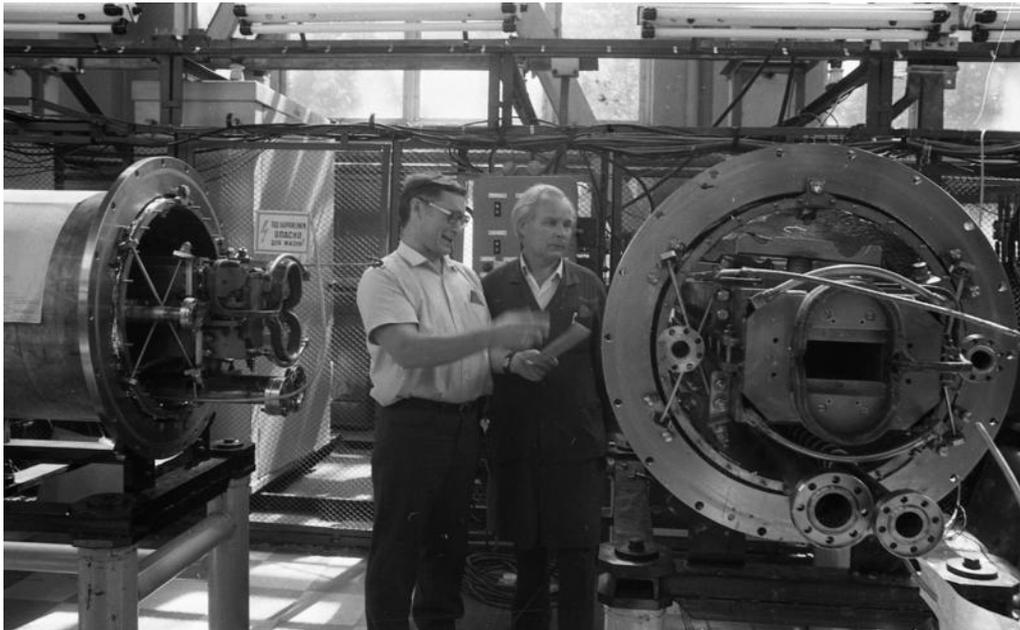
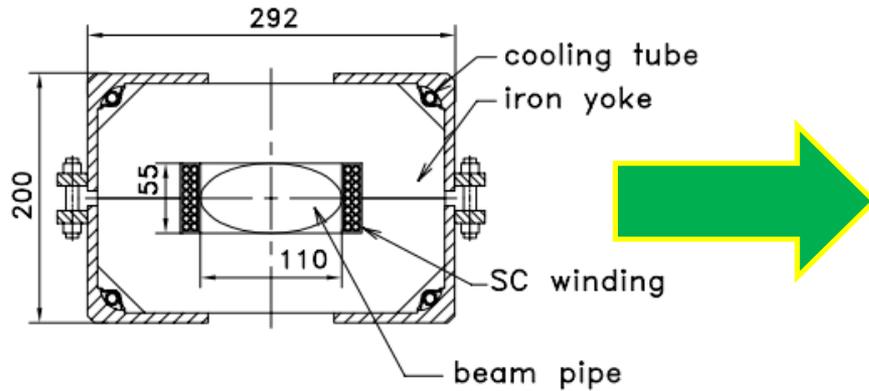
СКНТ 0,78-8214-1,38
Партия 1-C2-18-1-12/2-1-2



SC dipole for the NICA Booster



First superconducting heavy ion accelerator

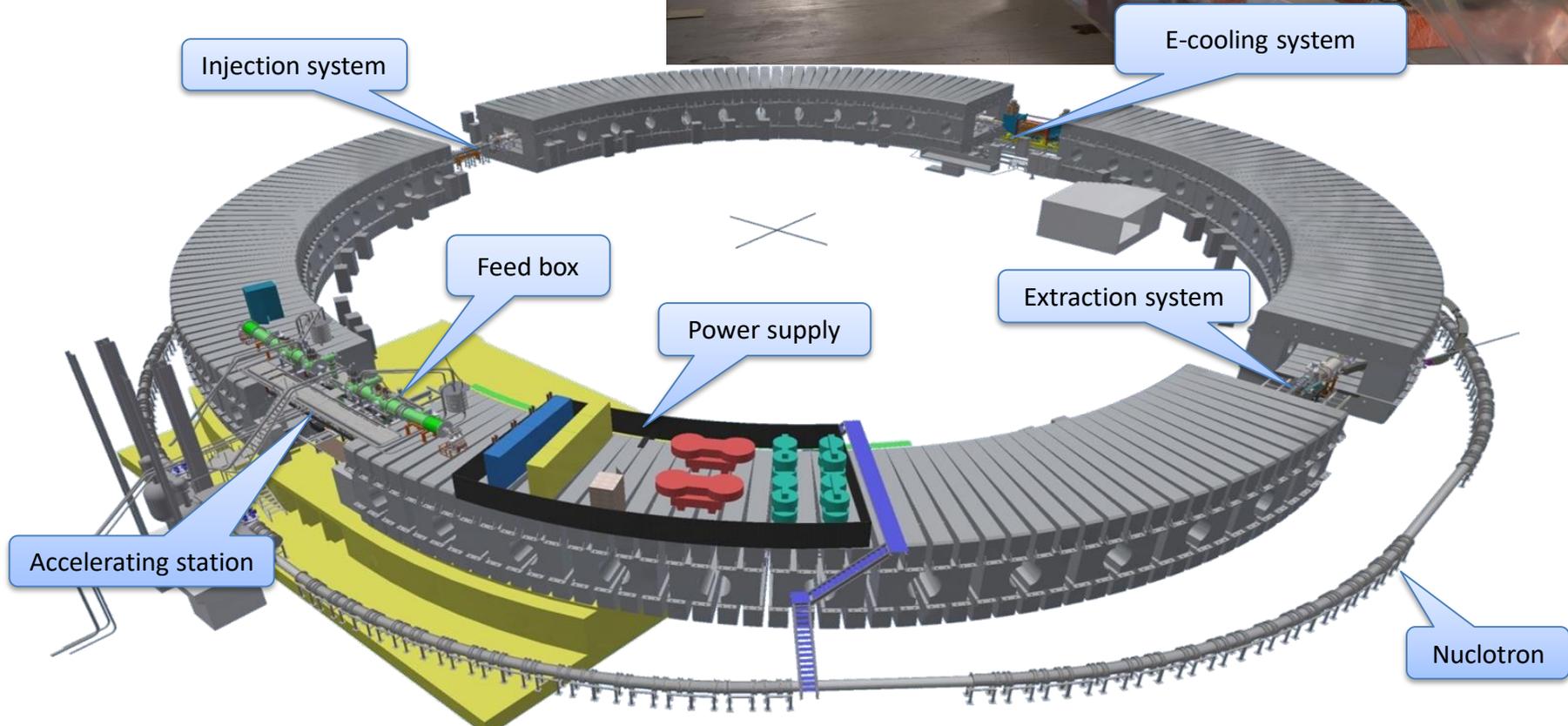


Nuclotron –
Superconducting
Synchrotron
operation since 1993

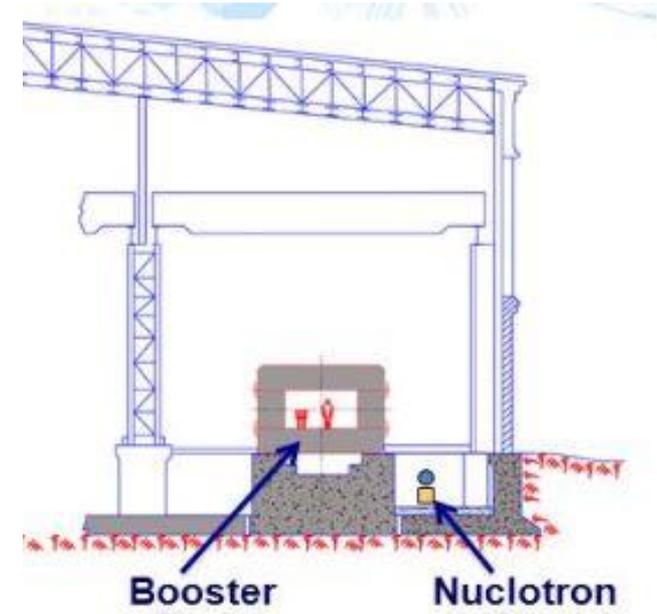
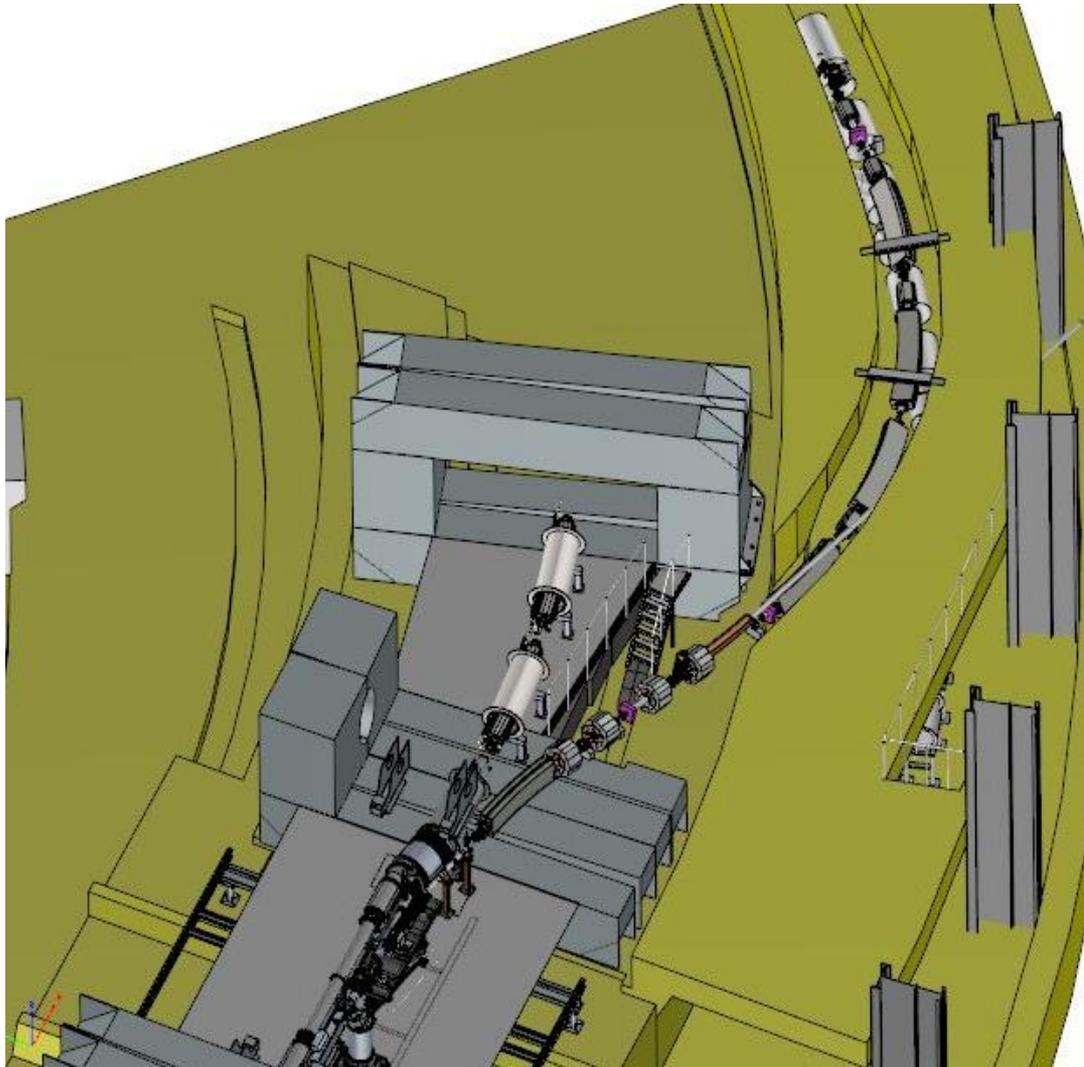


NICA Booster

| | |
|----------------------------|---------------------|
| Ions | Au ³¹⁺ |
| Circumference, m | 211 |
| Fold symmetry | 4 |
| Max energy, MeV | 578 |
| Max magnetic rigidity, T·m | 25 |
| Dipole field, T | 1.8 |
| Vacuum, Torr | 10 ⁻¹¹ |
| Beam intensity, ions/pulse | 1.5·10 ⁹ |



Booster-Nuclotron transport channel



- under contract with BINP
- Channel delivery March 2020
- ...April 2020 start mounting

Nuclotron



- Acceleration of **heavy ions** for storage in the collider

0.6 ÷ 4.5 GeV/u

1 ÷ 1.5 · 10⁹ ions

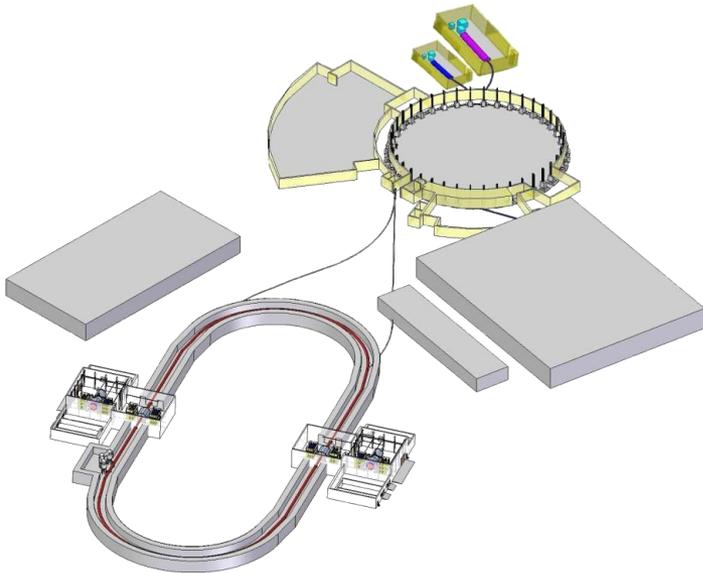
- Acceleration of **polarized protons and deuterons** for feeding the collider

p 20 MeV ÷ 12 GeV

d 5 MeV/u ÷ 5.6 GeV/u

10¹⁰ particles

- Acceleration of **both polarized and unpolarized protons and deuterons and heavy ions** for internal target experiments or slow extraction to fixed target experiments



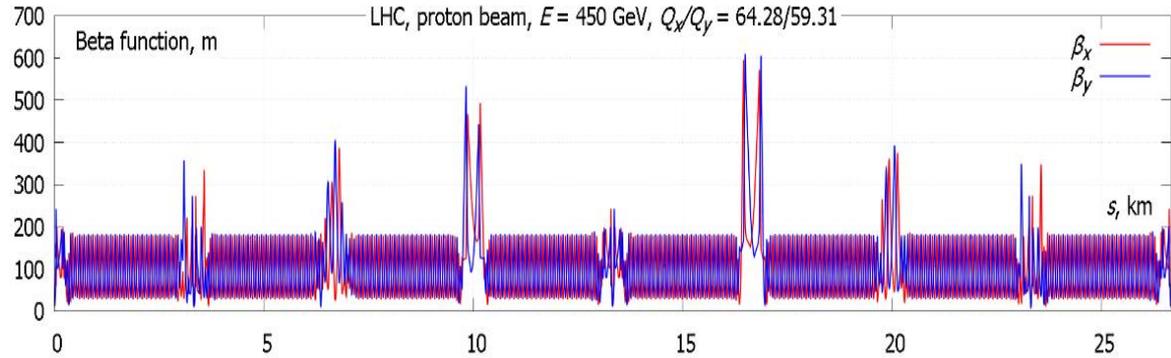
NICA Collider



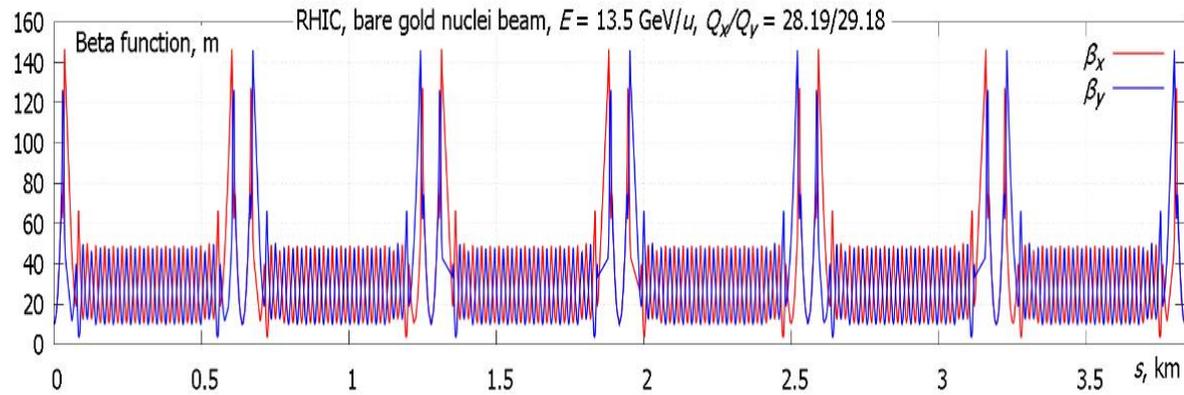
How does NICA collider look like?

β -functions

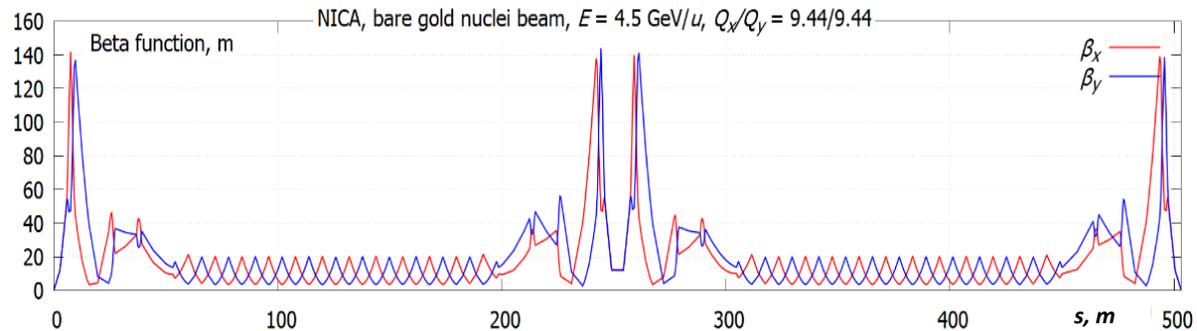
LHC



RHIC

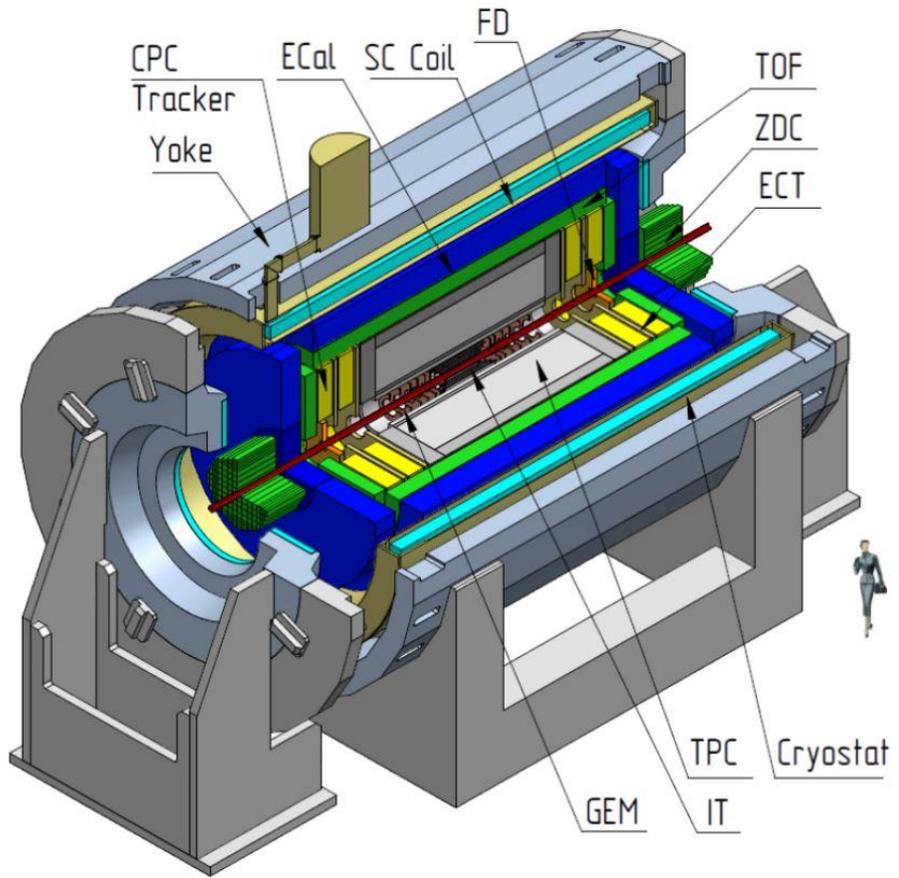


NICA



...like others

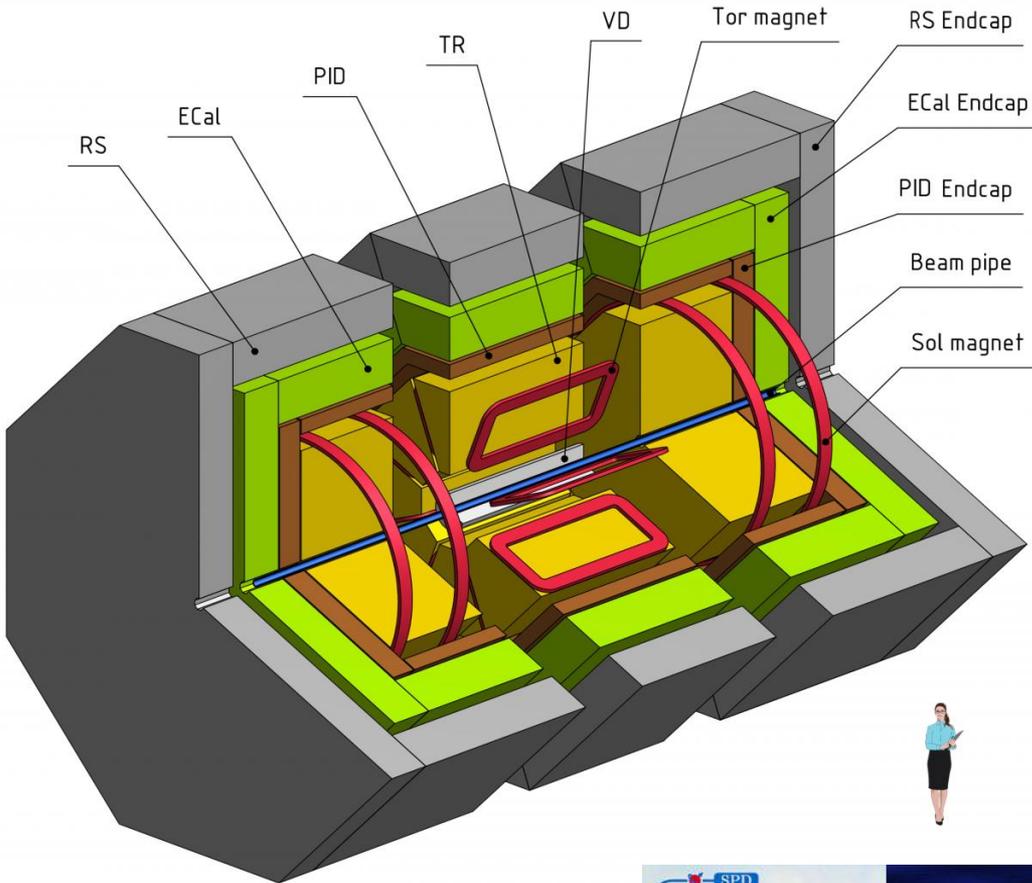
NICA **M**ulti **P**urpose **D**etector



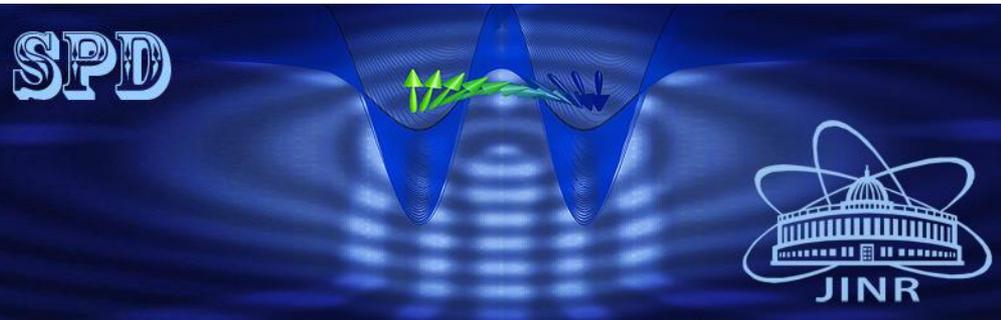
- SC Coil – superconducting solenoid
- IT – inner detector
- ECT – straw-tube tracker
- TPC – time-projection chamber
- TOF – time-of-flight stop counters
- FD – fast forward detectors
- ZDC – zero degree calorimeter
- BBC – beam-beam counter



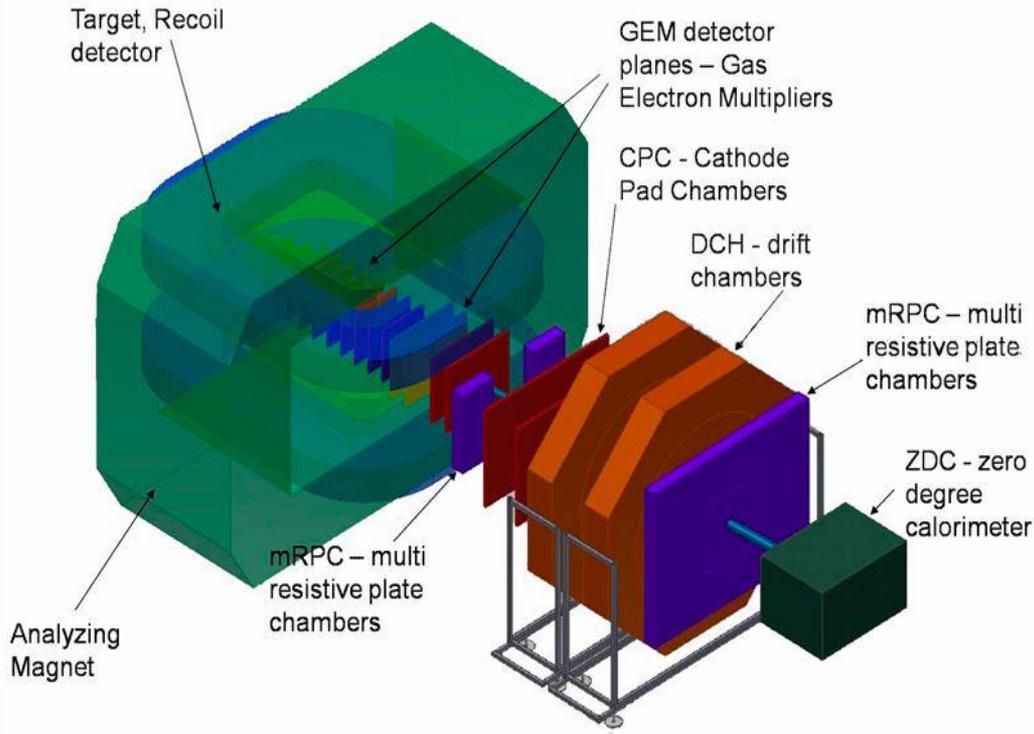
Spin Physics Detector



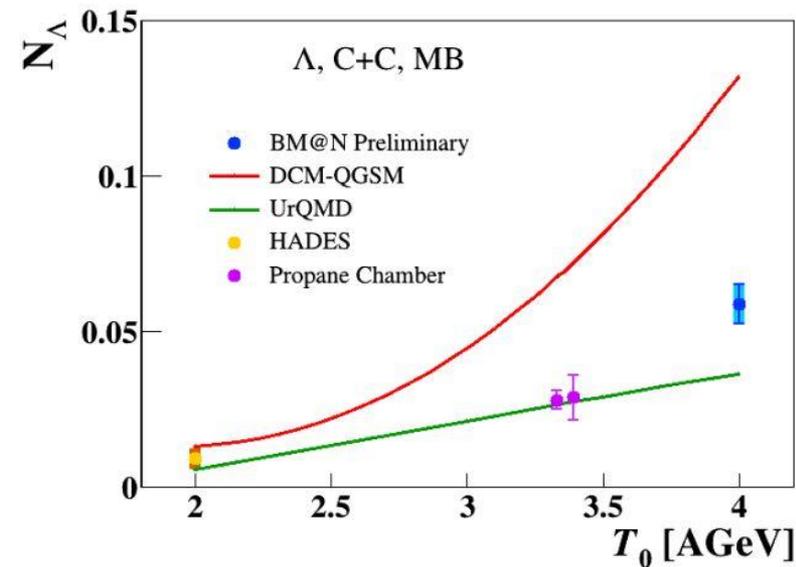
- Drell-Yan pair, J/ψ and prompt-photon production with longitudinally and transversely polarized p and d beams aiming at extraction of unknown (poorly known) parton distribution functions;
- spin effects in baryon, meson and photon production in various exclusive reactions;
- diffractive processes;
- multiquark states and correlations;
- studies of cross sections, spin asymmetries (Krisch effect) and spin-dependent amplitudes in elastic scattering.



Baryonic Matter at Nuclotron (BM@N)



- study of elementary reactions and “cold” nuclear matter
- study of the properties of dense nuclear matter with strangeness
- hypermatter production
- hadron femtoscopy



Thank you for your attention!

