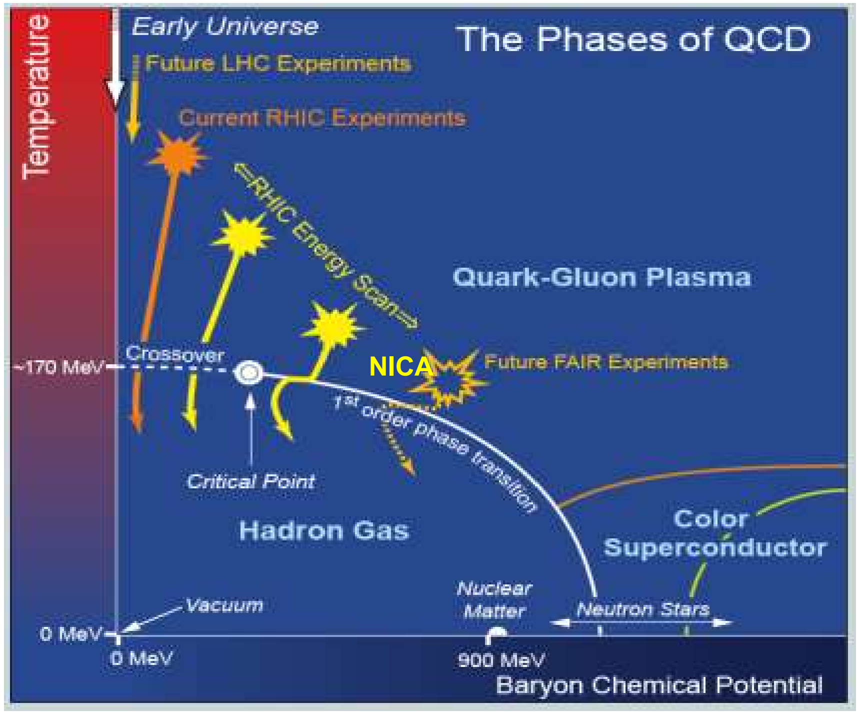
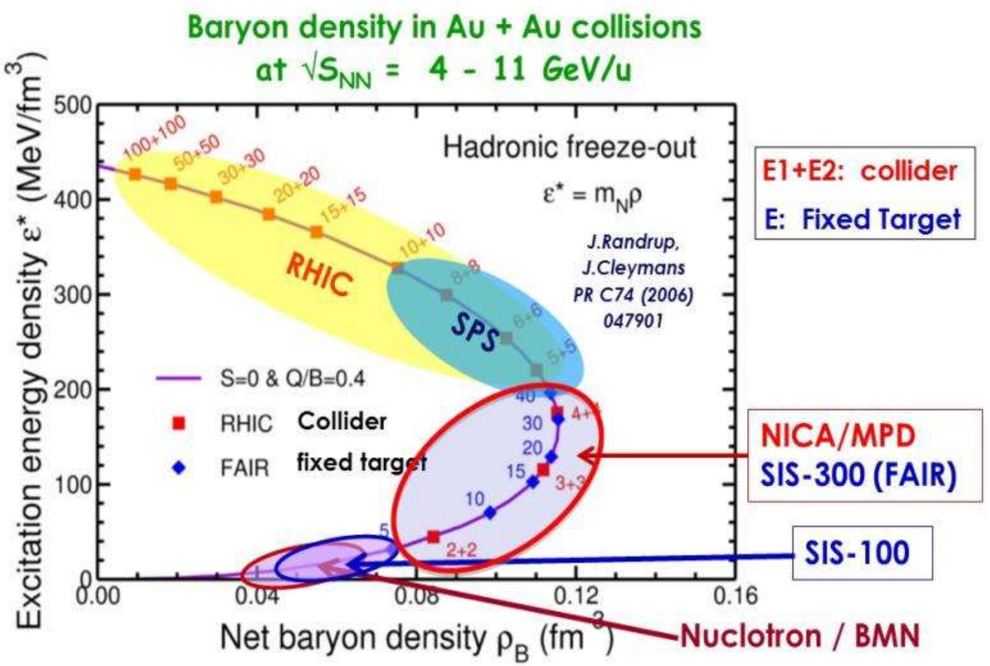
Status of the NICA project at JINR

G.V. Trubnikov
on behalf of team

RuPAC-2014
Obninsk, 07 October 2014





The First Proposals:

Towards Searching for A Mixed Phase of Strongly Interacting QCD Matter at the JINR Nuclotron

A.N. Sissakian, A.S. Sorin, M.K. Suleymanov, V.D. Toneev, G.M. Zinovjev

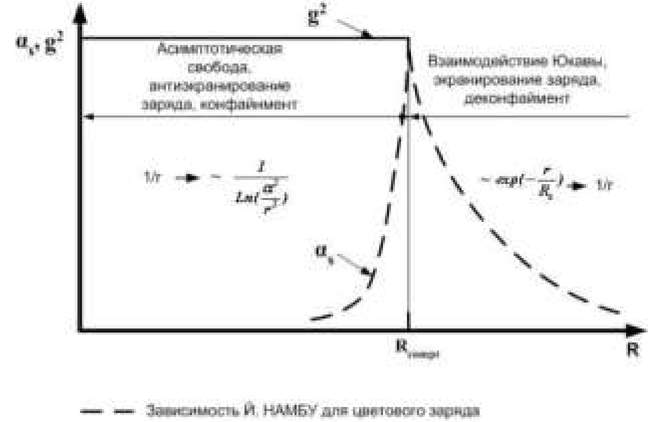
arXiv:nucl-ex/0601034 v1 24 Jan 2006 + ICHEP'06, nuclth/0608032

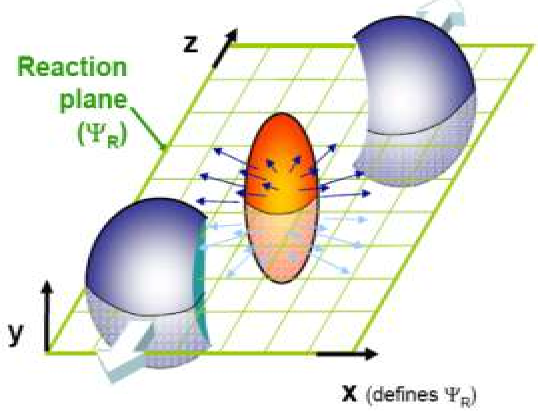
***An optimal way to reach the highest possible baryon density is* HI collision at $\sqrt{S_{NN}}$ = 4 - 11 GeV/u**

Main targets of "NICA Complex":

- ***study of hot and dense baryonic matter***
- *investigation of nucleon spin structure, polarization phenomena*
- *development of accelerator facility for HEP @ JINR providing intensive beams of relativistic ions from p to Au polarized protons and deutrons with max energy up to $\sqrt{S_{NN}}$= 11 GeV (Au^{79+}) and =26 GeV (p)*

Asymptotic freedom of quarks (*D.J.Gross, H.D.Politzer, F.Wilczek* *Nobel Prize in 2004): one can access the "asymptotically free" regime in hard processes, and in* **super-dense matter** *(inter-particle distances ~ 1/T).* **super-dense matter** *could be obtained in heavy ion collisions*

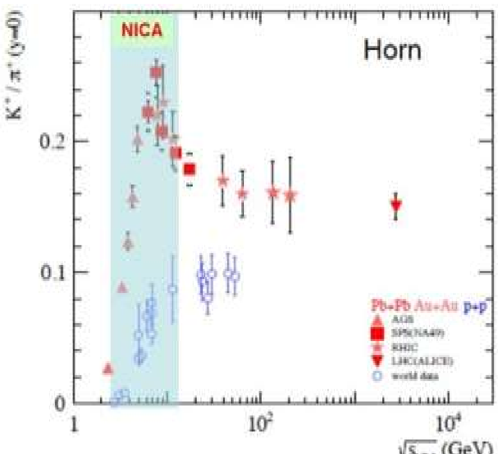


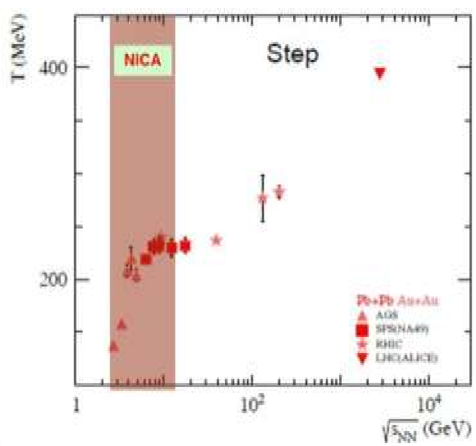


Estimate of ability to measure charge asymmetry w.r.t. reaction plane as a possible signature of ***strong P violation*** ***(***excess of positive charge***).*** Electric dipole moment of QCD matter!

Collective motion: Elliptic flow indicates to a strongly interacting matter at t ~ 0 (Anisotropy self-quenches, so v_2 is sensitive to early times)

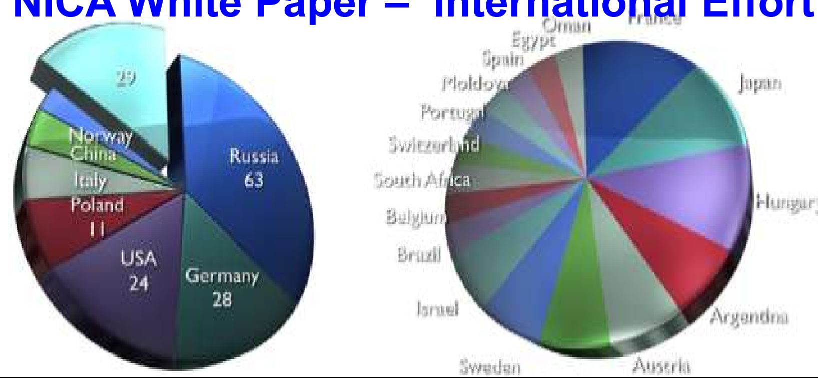
- Non-monotonic energy dependence of the K+/π+ ratio ("Horn") – onset of deconfinement?
- Plateau in the apparent temperature of the kaon spectra ("Step") – signal of the mixed phase?





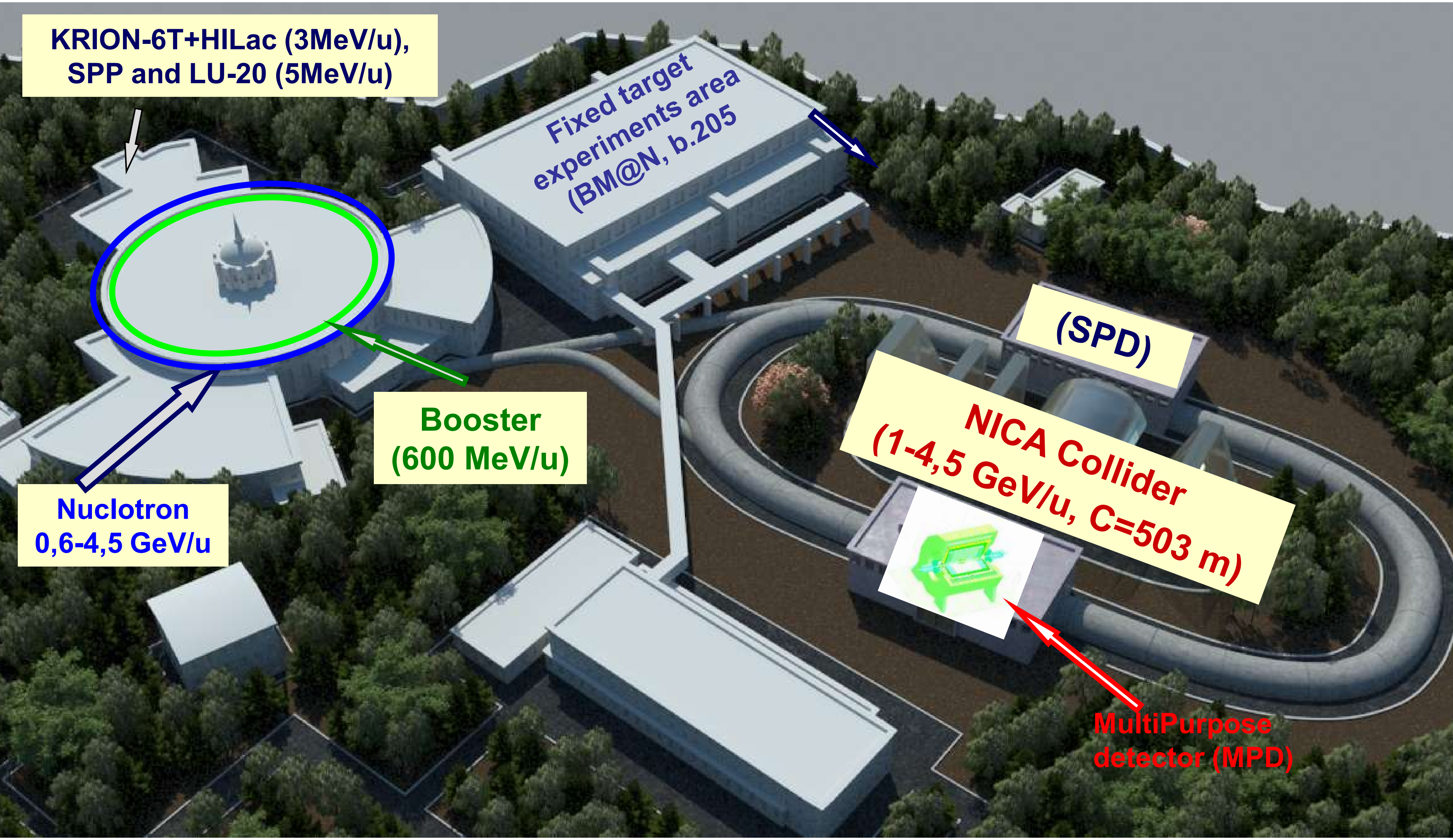
NA49 findings are confirmed by STAR and ALICE

NICA White Paper – International Effort



111 contributions:
188 authors from 70 centers in 24 countries

Superconducting accelerator complex NICA
(Nuclotron based Ion Collider fAcility)



NICA goals

1a) Heavy ion colliding beams 197Au79+ x 197Au79+ at

$\sqrt{s_{NN}}$ = 4 ÷ 11 GeV (1 ÷ 4.5 GeV/u ion kinetic energy)

at $L_{average}$= $1x10^{27}$ $cm^{-2} \cdot s^{-1}$ (at $\sqrt{s_{NN}}$ = 9 GeV)

1b) Light-Heavy ion colliding beams of the same energy range and L

2) Polarized beams of protons and deuterons in collider mode:

p↑p↑ $\sqrt{s_{pp}}$ = 12 ÷ 27 GeV (5 ÷ 12.6 GeV kinetic energy)

d↑d↑ $\sqrt{s_{NN}}$ = 4 ÷ 13.8 GeV (2 ÷ 5.9 GeV/u ion kinetic energy)

$L_{average} \geq$ $1x10^{31}$ $cm^{-2} \cdot s^{-1}$ (at $\sqrt{s_{pp}}$ = 27 GeV)

3) The beams of light ions and polarized protons and deuterons for fixed

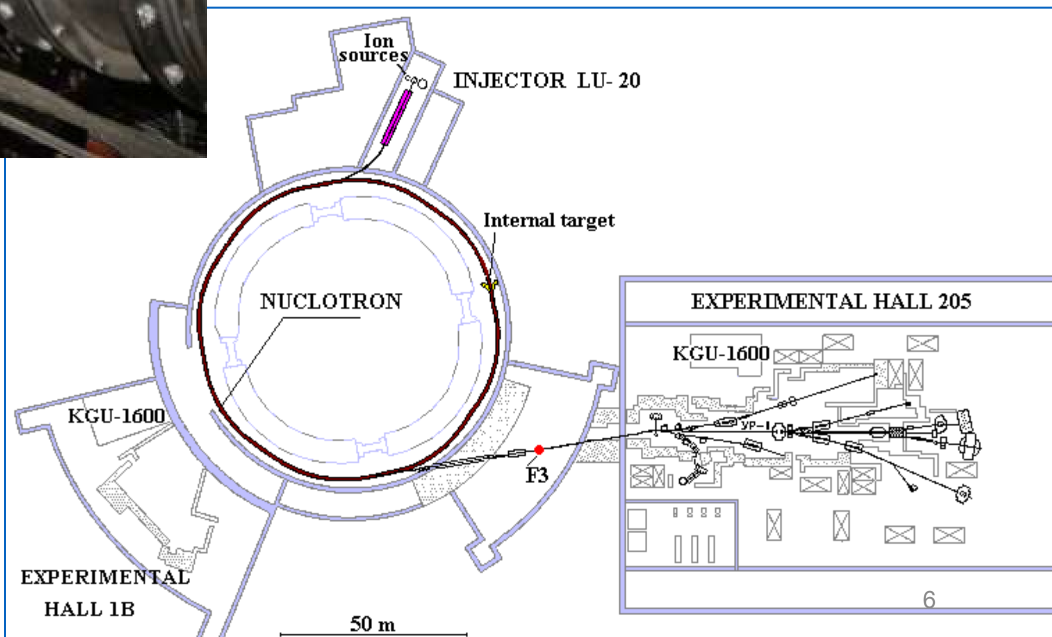
target experiments:

Li ÷ Au = 1 ÷ 4.5 GeV /u ion kinetic energy
p, p↑ = 5 ÷ 12.6 GeV kinetic energy
d, d↑ = 2 ÷ 5.9 GeV/u ion kinetic energy

4) Applied research on ion beams at kinetic energy

from 0.5 GeV/u up to 12.6 GeV (p) and 4.5 GeV /u (Au)

NICA: Nuclotron based Ion Collider fAcility



Routine
beam extraction at 5.2 GeV/u

Ions: from p to Xe

Acceleration up to 5.8 GeV/u (C6+)

Status of the Nuclotron

Perfect test-bench for NICA booster/collider modes

Energy:

5.8 GeV/u. @ B < 1.8 T – routine operation

Intensity:

Deuterons - 3e10 (maximum achieved 5e10)
Light ions – 5e9 ppp (new Laser Source for ions)
Heavy ions – 1e6, after the Booster commissioning – 1e9 (2016)
Polarized deuterons – 1e10 starting from 2015

Slow extraction:

K_dc = 0.8 – 0.9

Duty factor:

50% (the beam lines in bld. #205 have to be tested and recertified)

- Stochastic cooling of coasting and bunched carbon (C6+) beam
- **Beam acceleration up to maximum design field – 2 T**
- Coasting beam at two plateau
- Demonstration of slow extraction at spill duration of 20 s

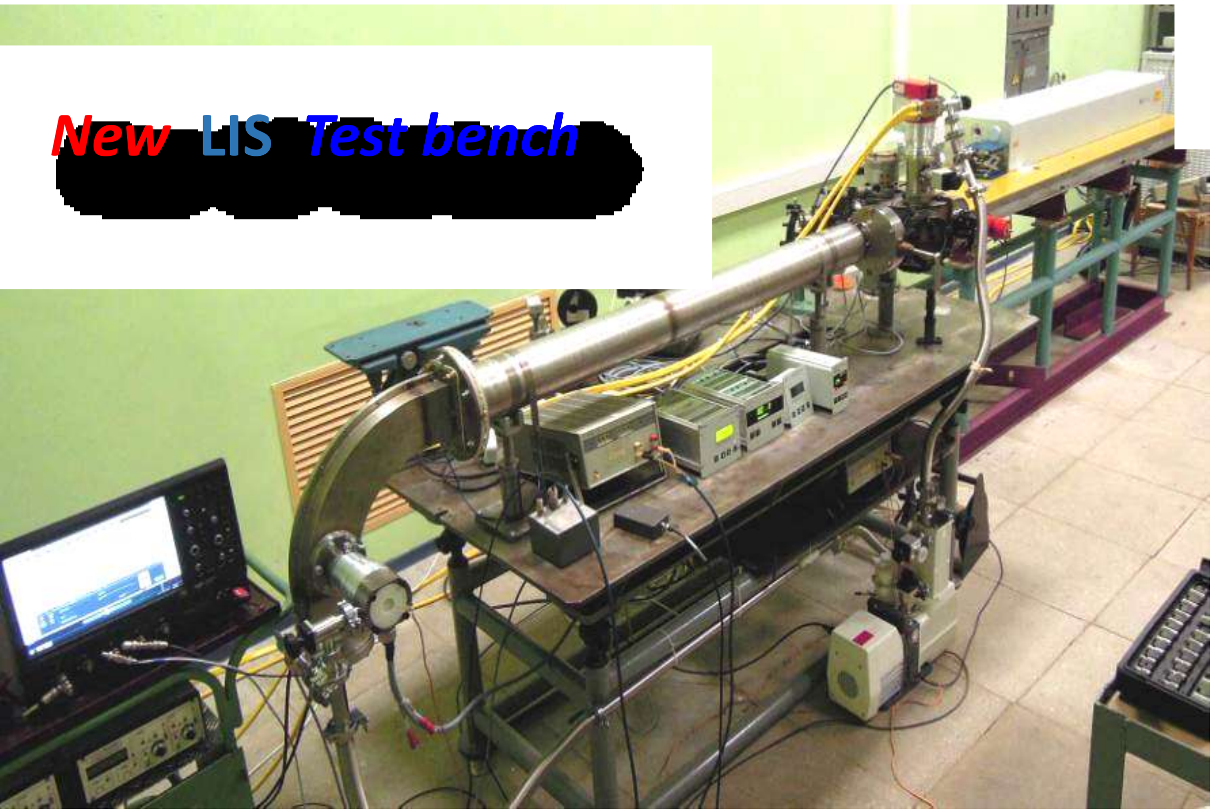
New laser ion source (LIS)

New Nd-YAG laser, instead of the old CO_2 laser

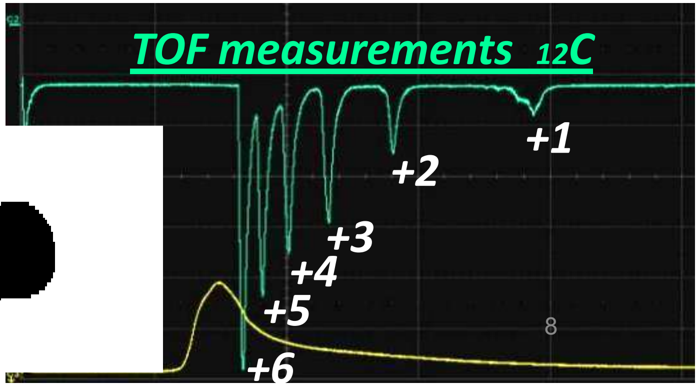
$E \geq 2$ J , $\tau \approx$ 7-8 ns, ~ $5 \cdot 10^{12}$ W/cm²

Acceleration of ${}_{12}C^{6+}$ without stripping after LU20

New LIS Test bench



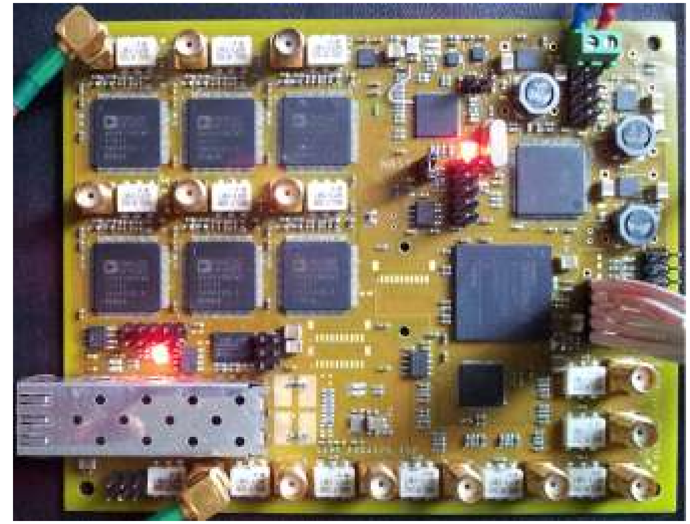
New LIS chamber under assembly



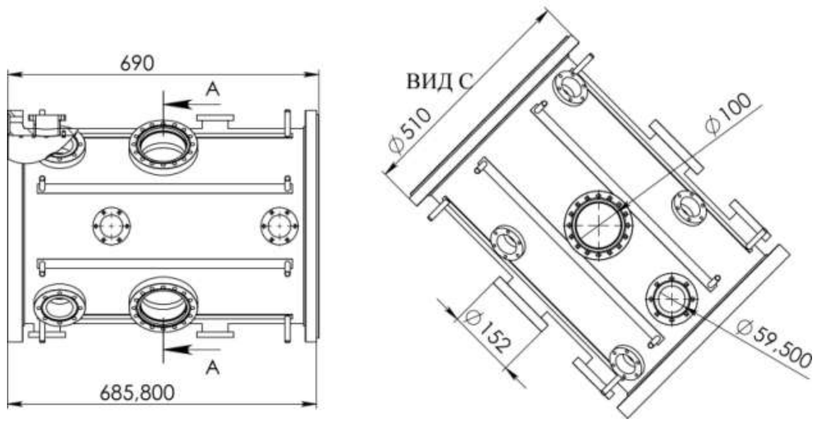
August 2013: ${}_{12}C^{+6}$ ions beam, 2us, ~30mA

RFQ design has been started in September 2011 (ITEP & MEPHI, Moscow)

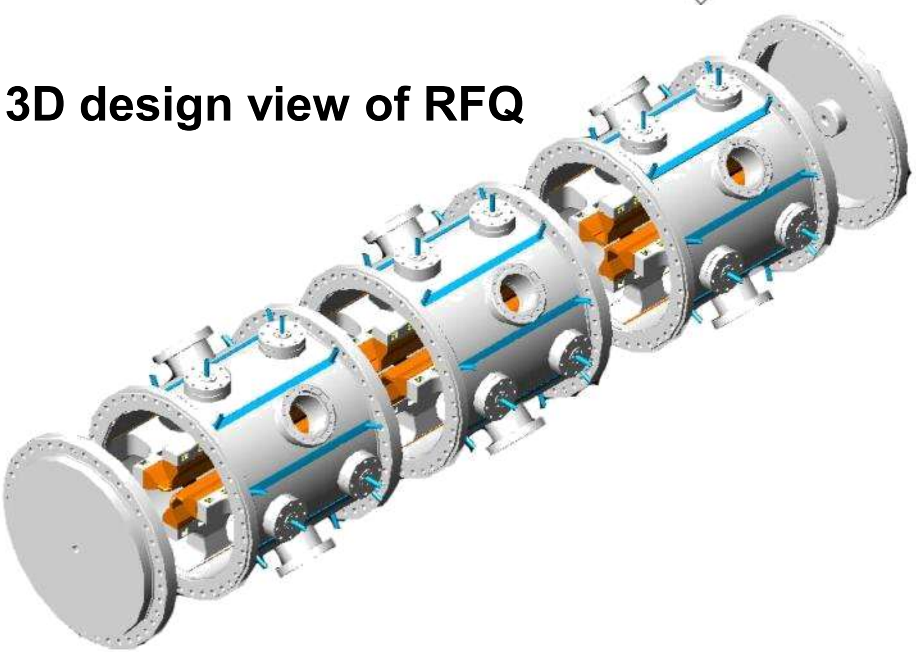
Single board refegence genegator



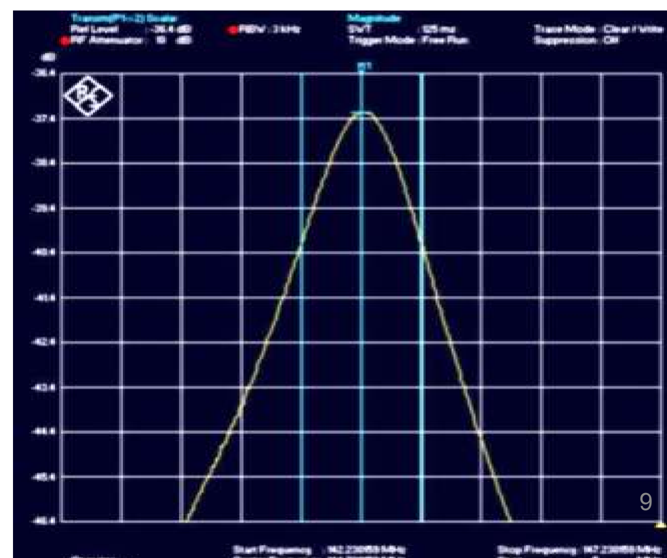
Production of the RFQ resonator started in August 2013 (contract with Snezhinsk)



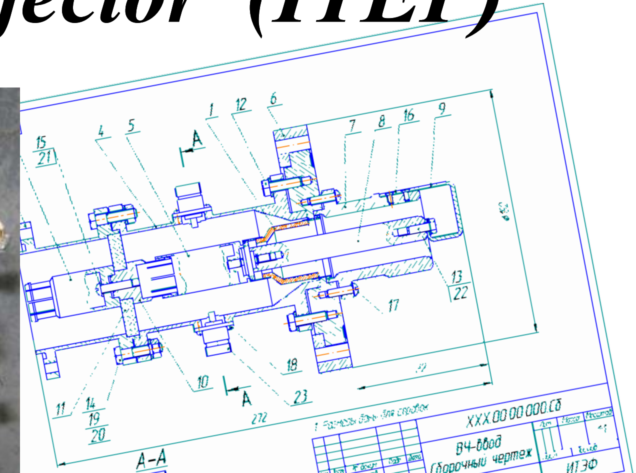
3D design view of RFQ

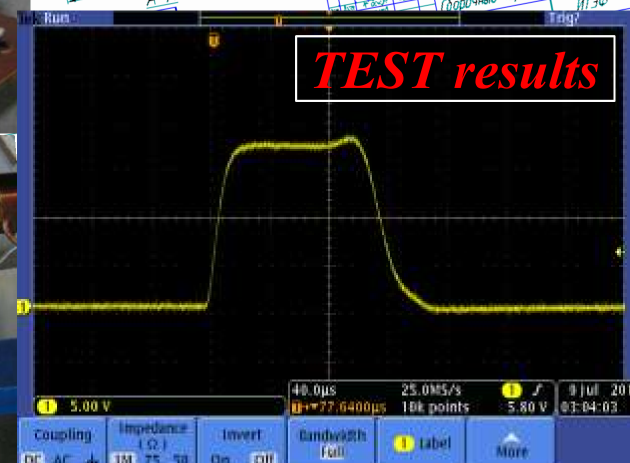


Freq. measurements in Snezhinsk



RF amplifier for the new foreinjector (ITEP)





LU-20 RFQ manufacturing & commissioning schedule

• End of 2011	– Contract with ITEP & MEPHI
• 2011- 2013	– RFQ Design stage
• End of November 2013	– RF amplifiers testing in ITEPH
• Aug 2013 Sept 2014	– Manufacturing (Snezhinsk)
• Okt 2014	– Copper plating
• End of June 2014	– RFQ ready for shipment.
• Okt – Dec 2014	– RFQ full RF tests in ITEPH
• Jan 2015	– Transport to JINR
• Feb - Sept 2015	– assembling and tests in JINR
• Okt - Dec 2015	– Commissioning

Progress in NICA injection complex (ion sources + HILac)

Source for polarized particles (SPP)

Source assembled in 2013 now is commissioned to achieve 10^{10} deutrons pp

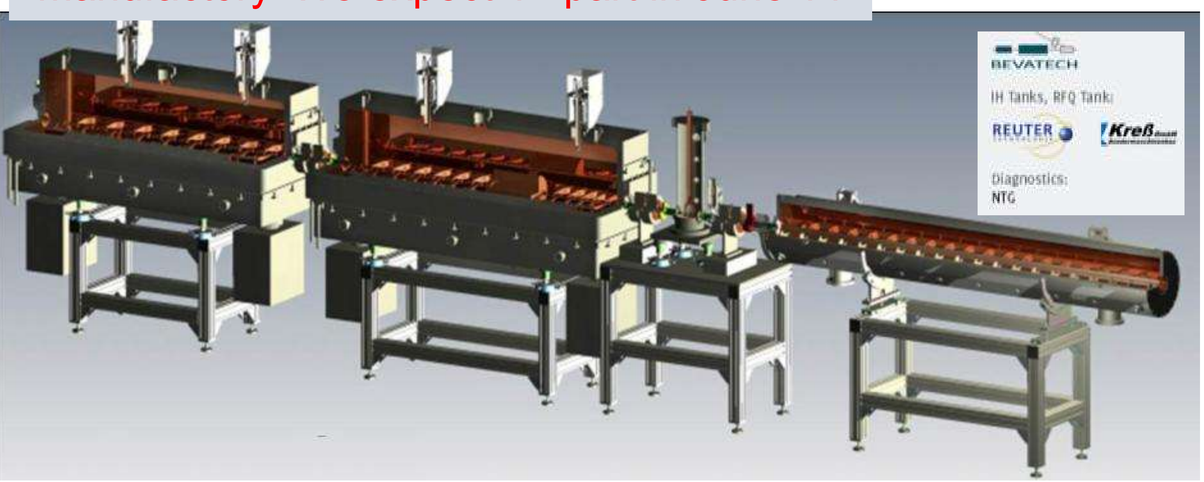
Heavy ion source: Krion-6T ESIS

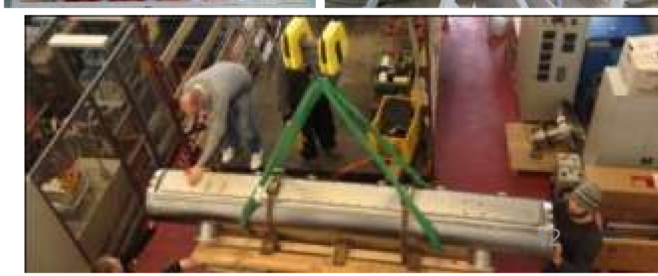
B= 5.4T magnetic field reached in a robust regime.

Test gold ion beams have been produced:

- $Au^{30+} \div Au32^{32+}$, 610^{8}, T_{ioniz}= 20 ms for
- Au^{32+} -> repetition rate 50 Hz.
- ion beams $Au^{51+} \div Au^{54+}$ are produced.

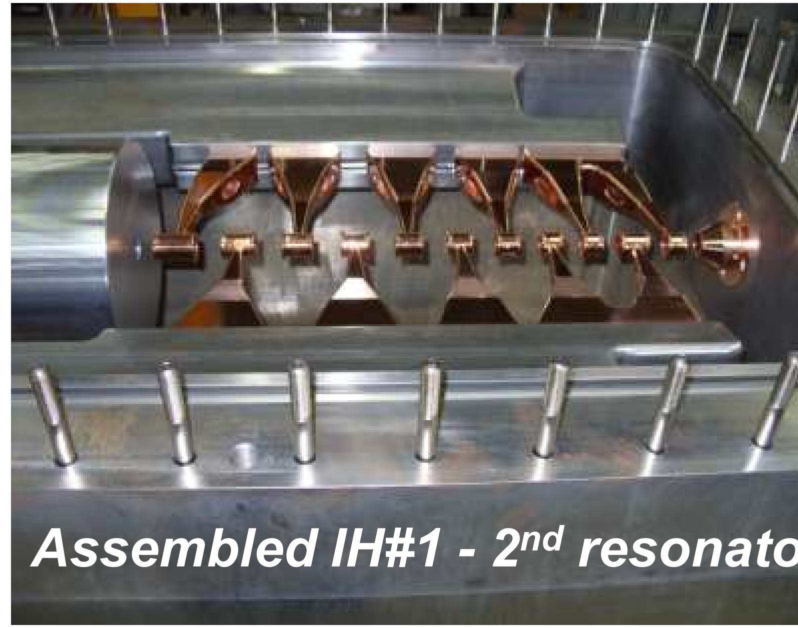
Heavy Ion Linac is under completion of manufactory. We expect 1st part in June'14



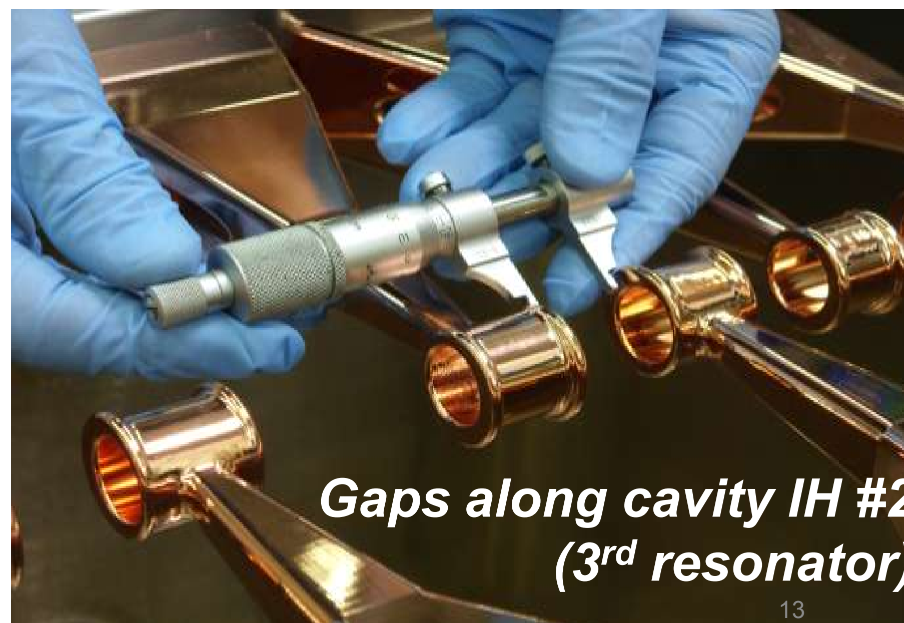


HILAc status

Resonator # 1 – RFQ section with electrodes inside

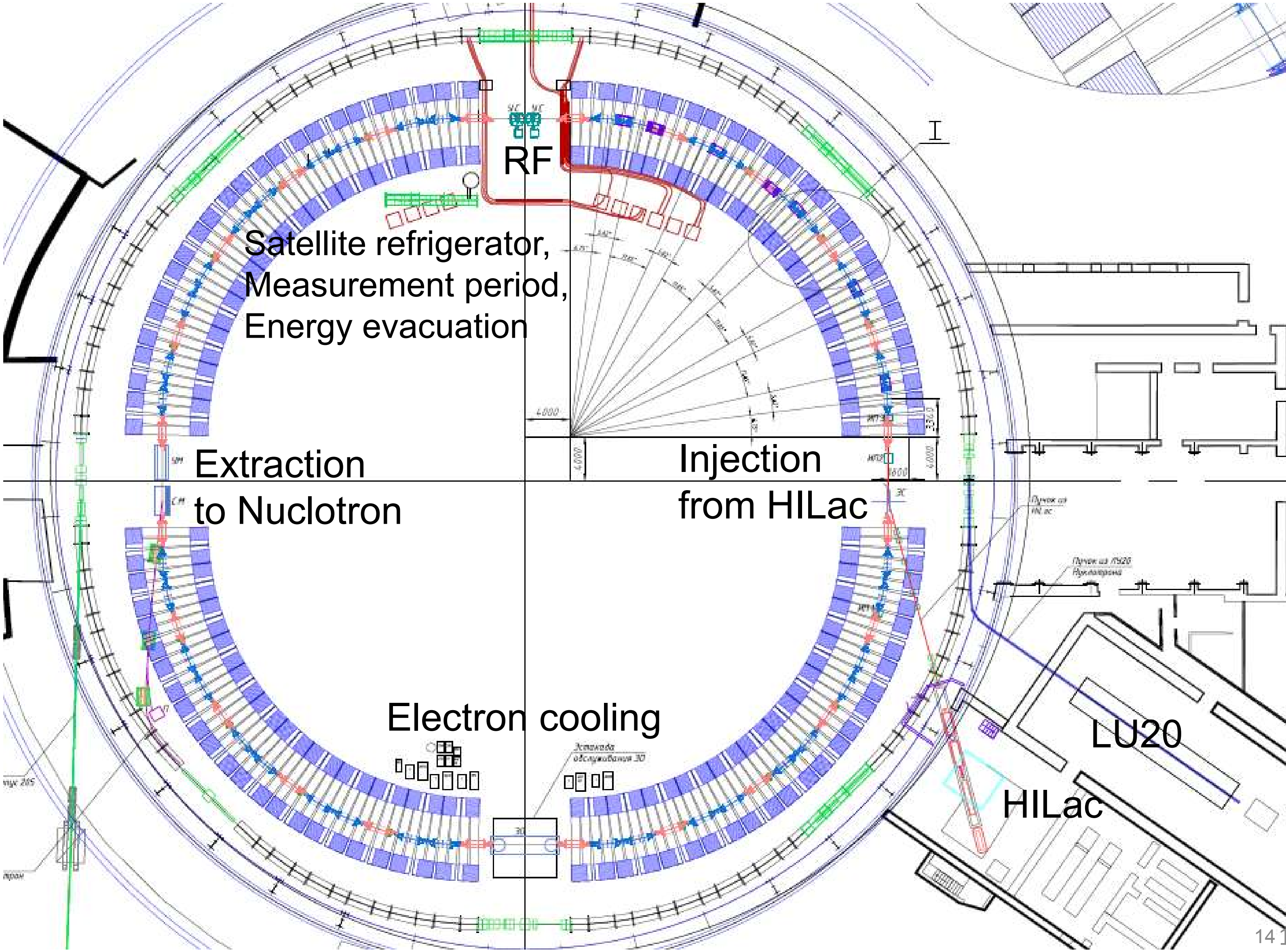


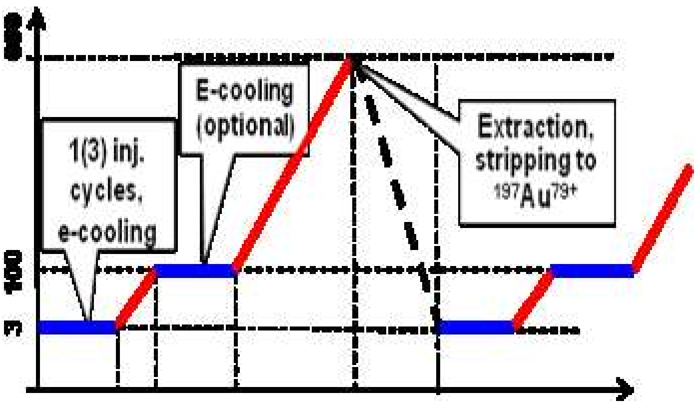
Assembled IH#1 - 2nd resonator



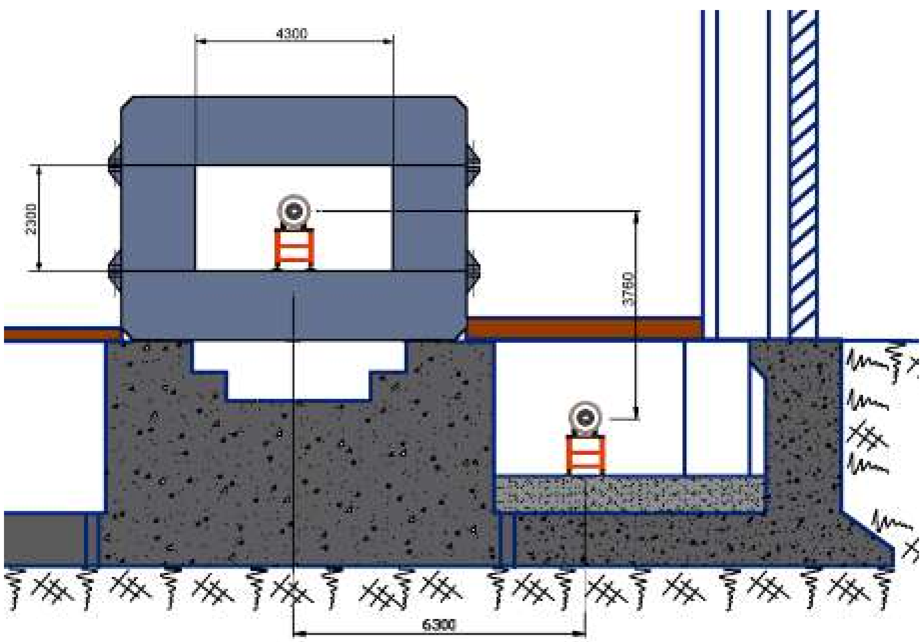
Gaps along cavity IH #2 (3rd resonator)

Progress in the Booster construction





Fold symmetry	4
Number of the FODO lattice cells per arc	6
Number of large straight sections	4
Length of large straight sections, m	2×4
Length of small straight sections, m	1.2/0.6
Betatron tunes	5.8/5.85
Amplitude of β-functions, m	14.3
Maximum dispersion function, m	2.9
Momentum compaction factor	0.039
Gamma-transition	5.064
Chromaticity	-6.5/-6.9
Horizontal acceptance, π·mm·mrad	138
Vertical acceptance, π·mm·mrad	40

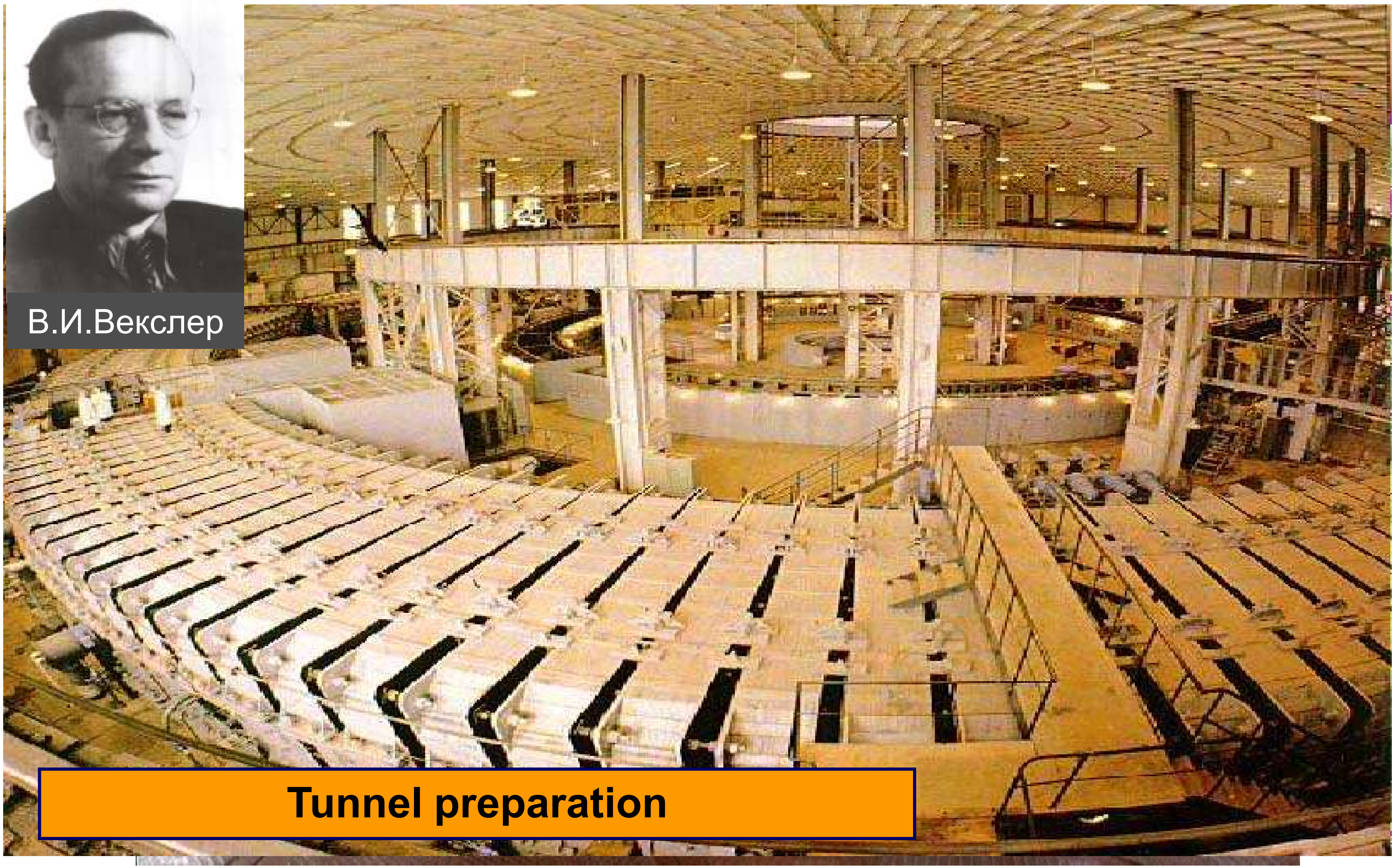


Sort of ions:	
before stripping station	Au^{31+}, Au^{52+}, Au^{65+}
after stripping station	Au^{79+}
Maximum energy of ions, MeV/u	685
Maximum magnetic rigidity of ions, T m:	
before stripping station	25
after stripping station	11
Ion number	$2 \cdot 10^9$

NICA Booster synchrotron

В.И.Векслер

NICA Booster synchrotron



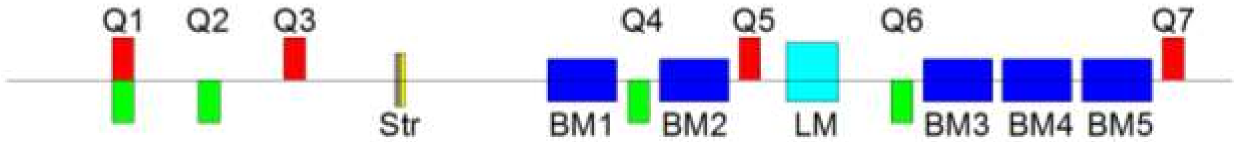
NICA Booster synchrotron

NICA Booster synchrotron

NICA Booster synchrotron

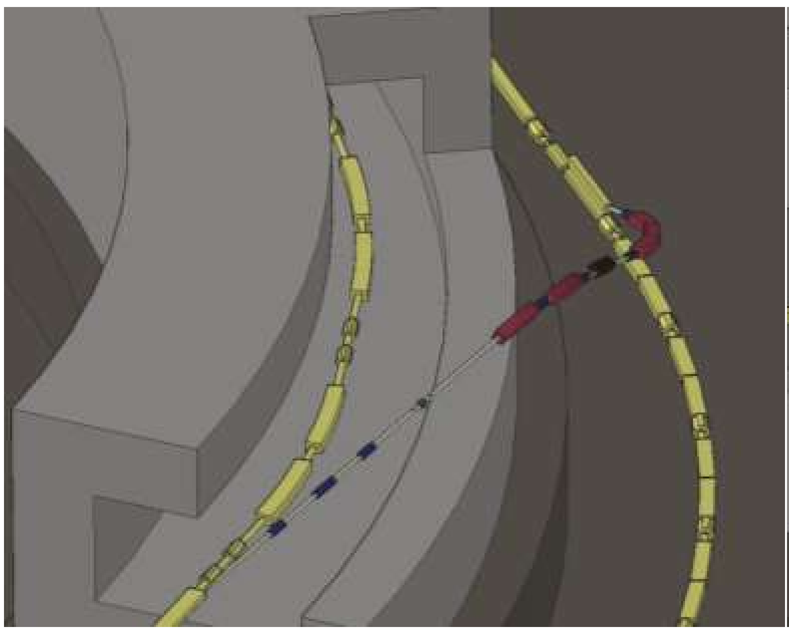
NICA Booster synchrotron

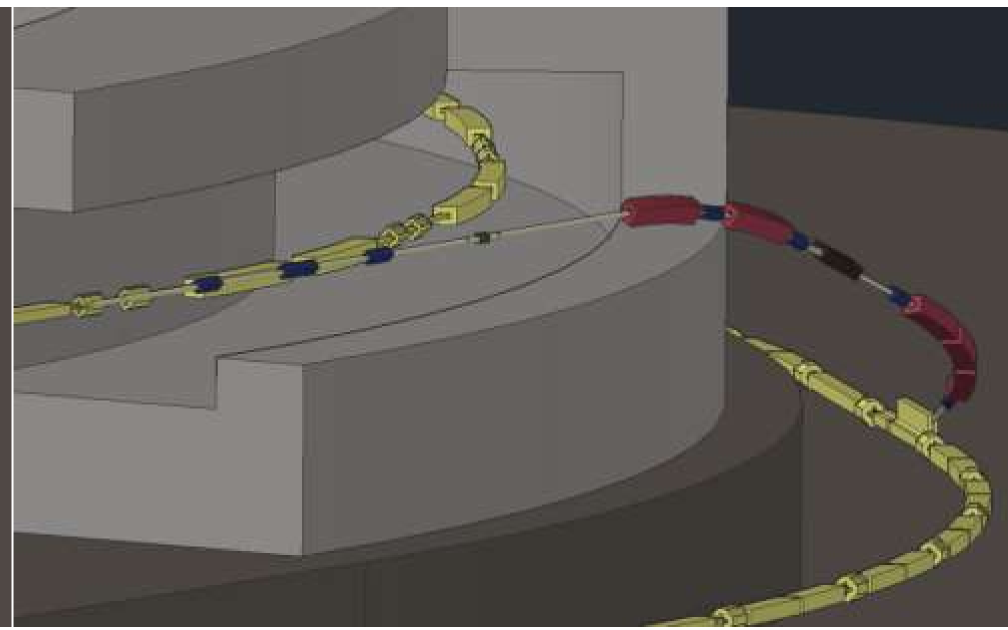
Booster – Nuclotron beam line



Parameters of magnetic elements

Magnetic element	Type	Effective length, m	Max. magnetic field (gradient), T (T/m)
BM1 – BM5	sector dipole	1,312	1,8
LM	Lambertson magnet	1	1,5
Q1, Q3	quadrupole	0,4	27
Q2	quadrupole	0,6	27
Q4 – Q7	quadrupole	0,4	12



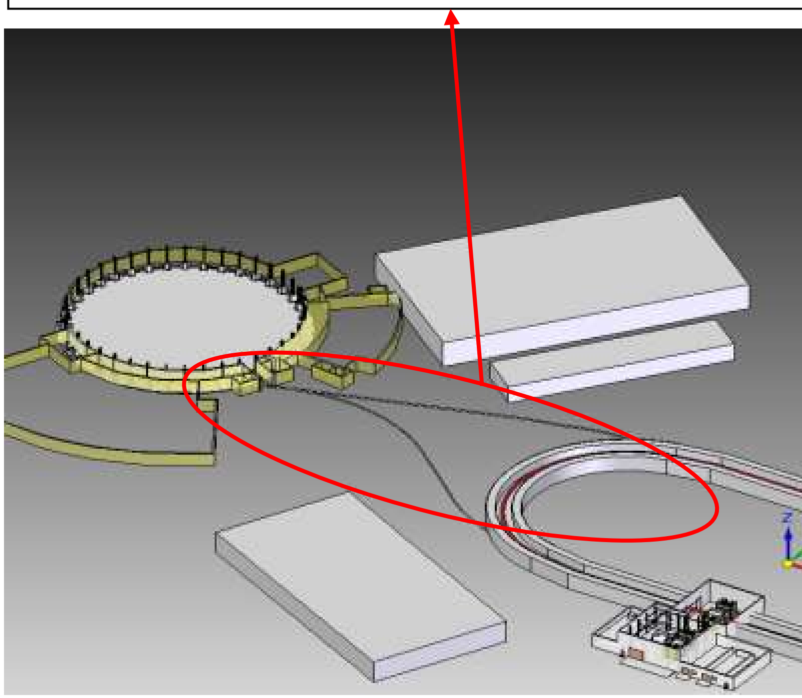


Nuclotron – Collider beam line

Goals of the beam line

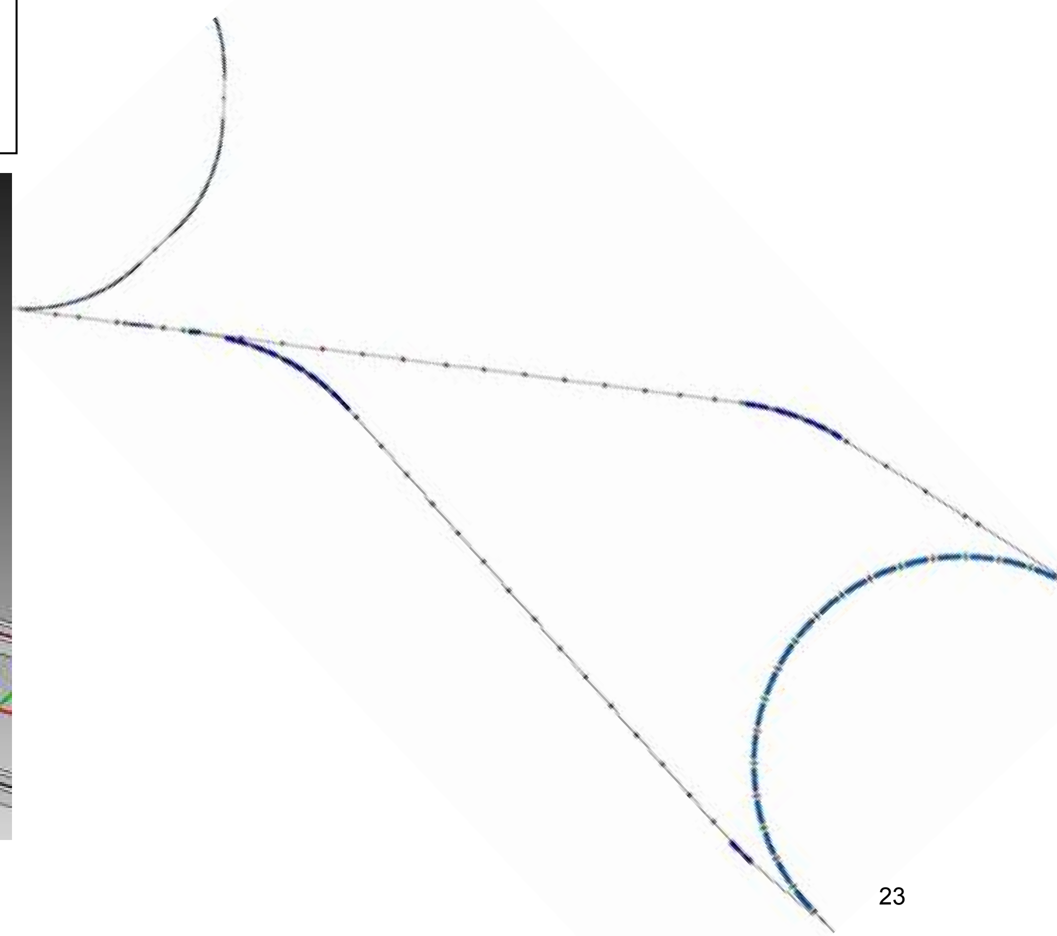
- The beam transport with minimal ion losses.
- The beam matching with lattice functions of Collider rings*.

* except vertical dispersion which suppression is required.



Beam Parameters

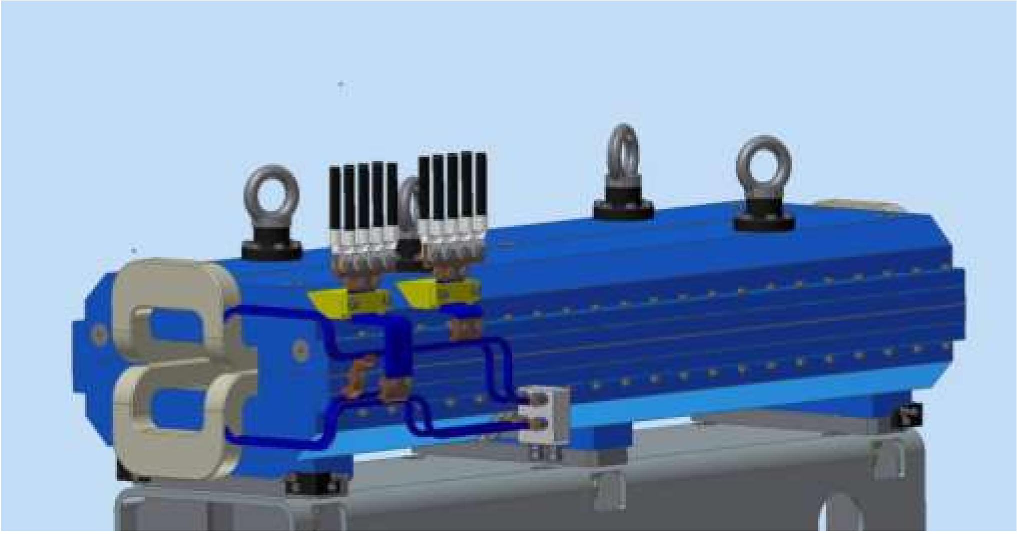
Sort of ions	Au^{79+}
Energy of ions, GeV/u	1 ÷ 4.5
Magnetic rigidity of ions, T m	14 ÷ 45
Ion number	$1 \cdot 10^9$

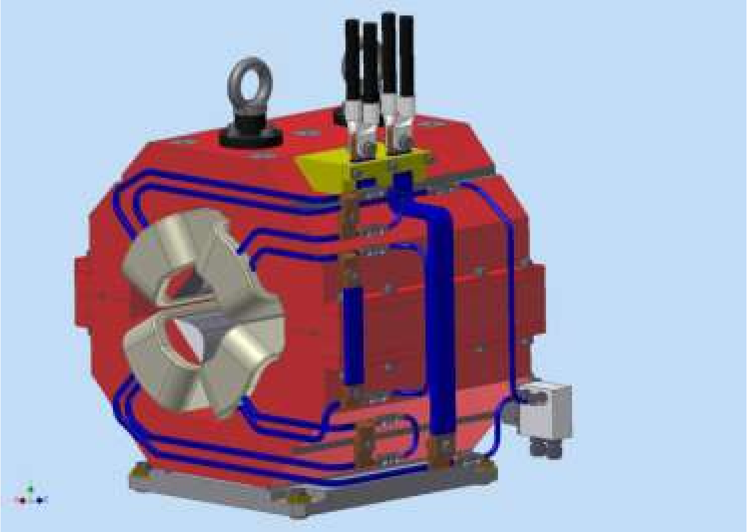


Nuclotron – Collider beam line

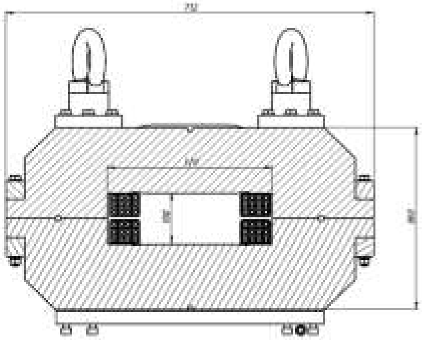
Parameters of magnetic elements

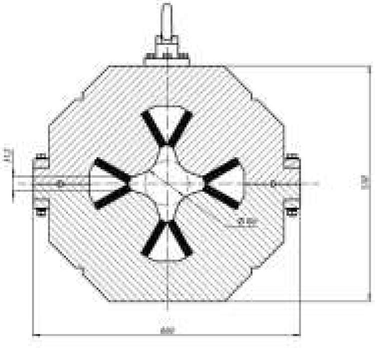
Magnetic element	Number	Effective length, m	Max. magnetic field (gradient), T (T/m)
Horizontal bending magnet	19	2	1.5
Vertical bending magnet	6	2	1.5
Switch bending magnet	1	2	1.5
Quadrupole	45 ÷ 50	0.5	20



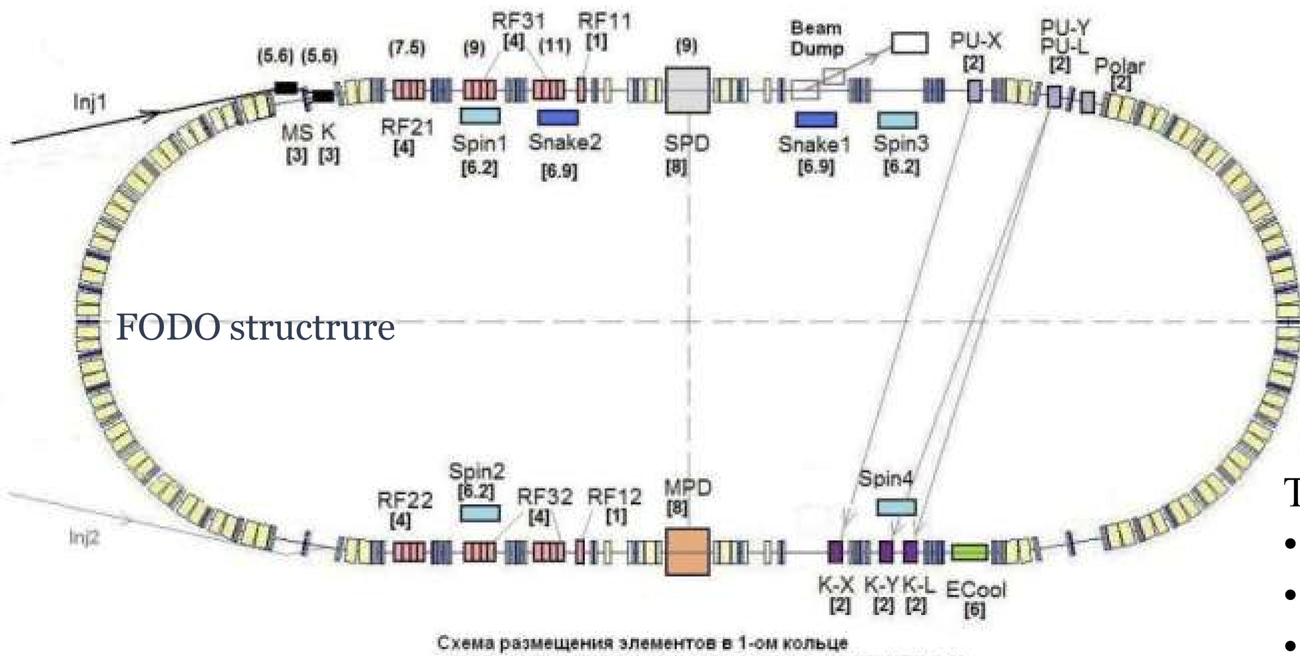


Designed by
BINP team





Unique low energy (1-4.5 GeV/u) collider with extremely high luminosity L=1e27
Scientific leader: Igor MESHKOV

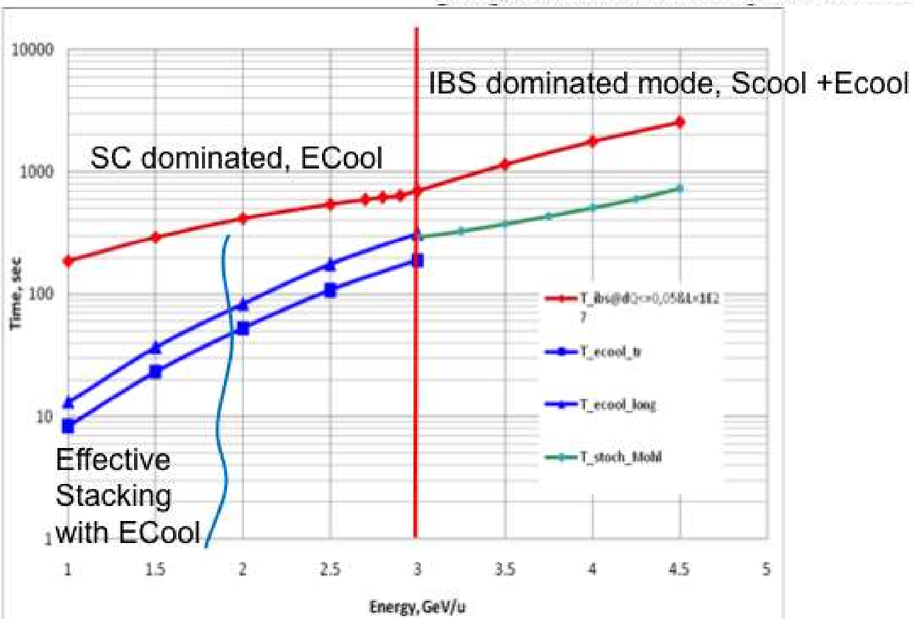


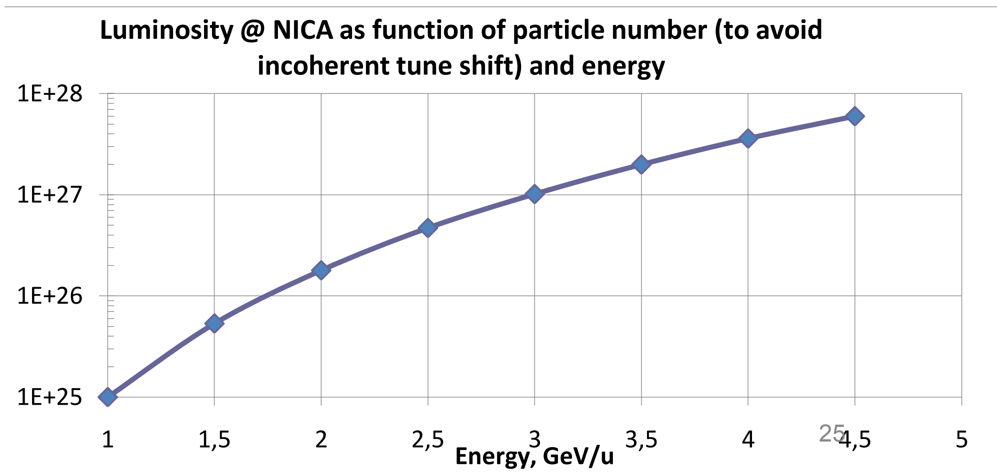
Fruitful collaboration between JINR and CERN, FNAL, BNL, GSI, FZJ, BINP, INR RAS:

- beam dynamics, tracking;
- electron clouds effect;
- beam stacking and cooling;
- lattice expertise;

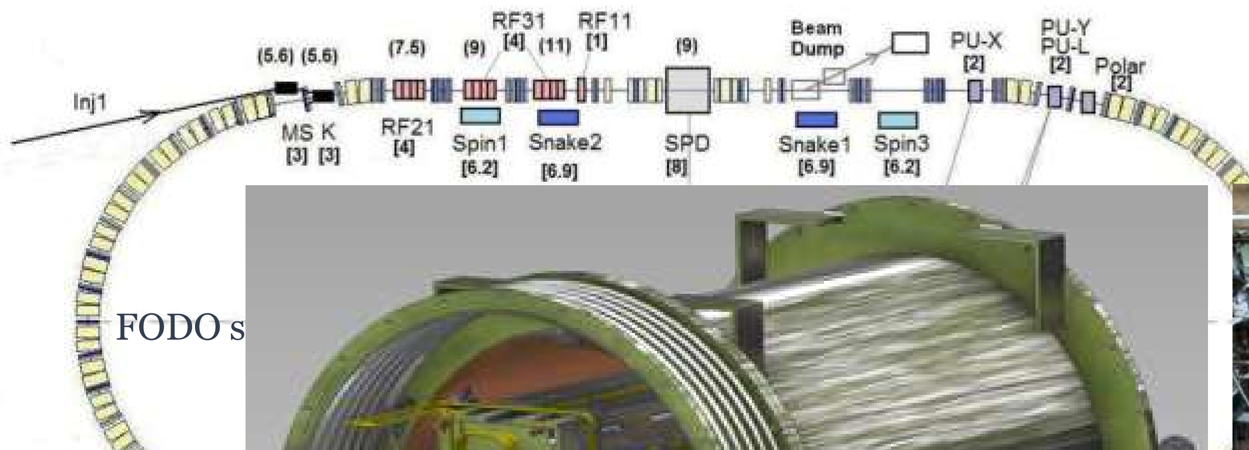
To reach maximum peak luminosity:

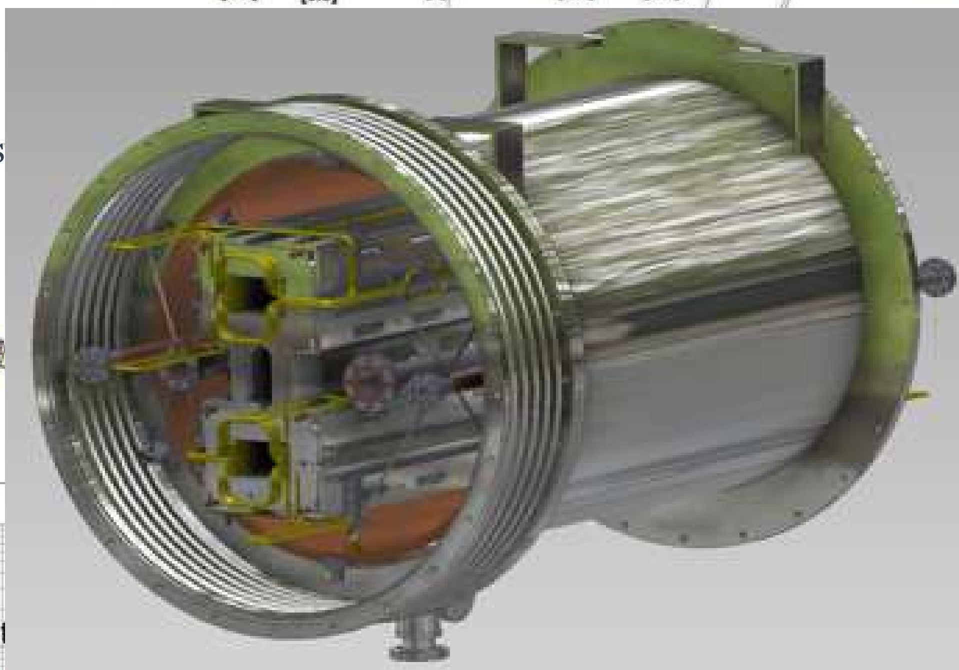
- minimum beta function in the IP;
- maximum bunch number;
- maximum bunch intensity;
- minimum beam emittance;
- minimum bunch length.





Unique low energy (1-4.5 GeV/u) collider with extremely high luminosity L=1e27
Scientific leader: Igor MESHKOV

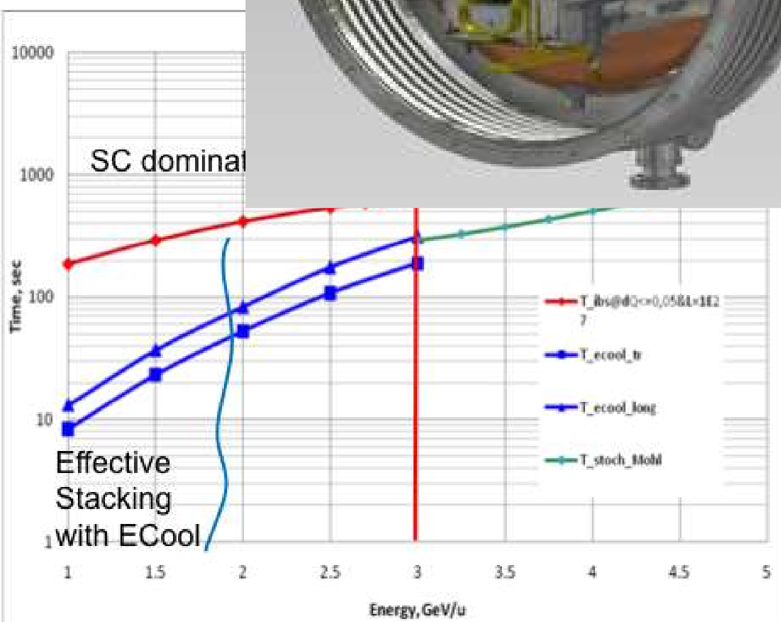


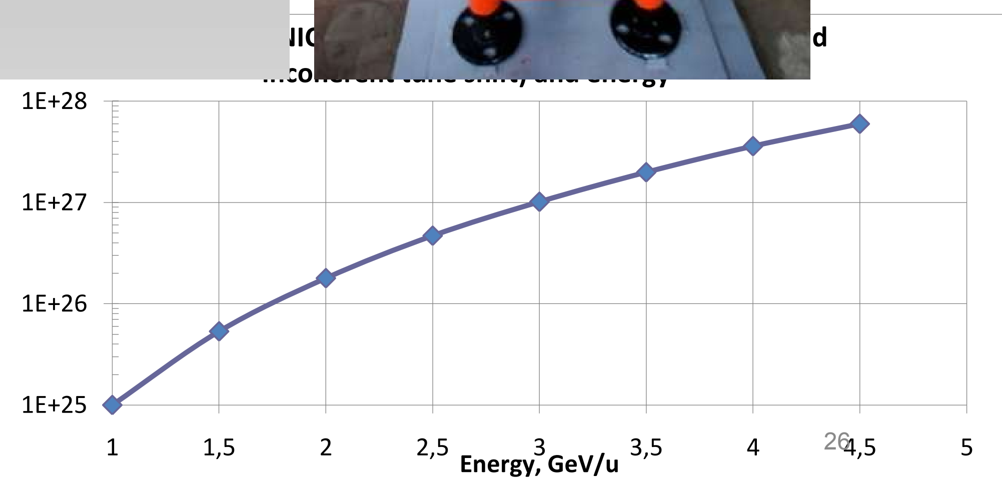


Fruitful collaboration between JINR and CERN, FNAL, BNL, GSI, FZJ, BINP, INR RAS:

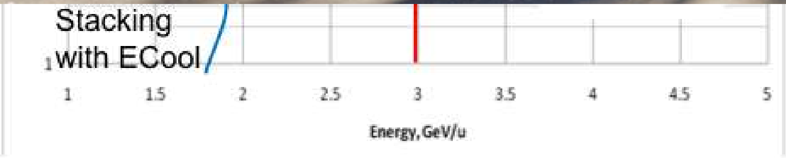
cking;
ct;
cooling;

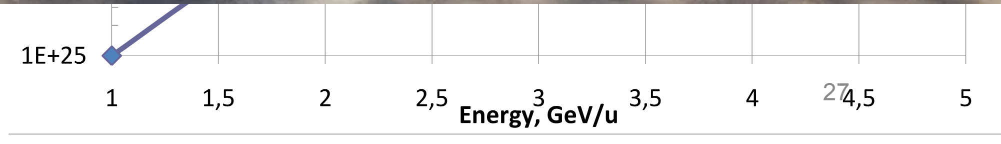
uminosity:
in the IP;
r;
y;
ce;





Unique low energy (1-4.5 GeV/u) collider with extremely high luminosity L=1e27
Scientific leader: Igor MESHKOV





Collider parameters

Parameter	Value
Circumference, m	503.04
Max. magnetic rigidity, T·m	45.0
Max. magnetic field, T	1.8
Acceptance, π·mm·mrad	40.0
Longitudinal acceptance ($\Delta p/p$)	± 0.01
Number of dipole magnets	80

Collider

FODO, 12 cells x 90° each arc,

γ_{tr} = 7.091 , β^* = 0.35 m (variable)

Collider parameters

Ring circumference, m	503,04		
Number of bunches	23		
Rms bunch length, m	0.6		
Beta-function in the IP, m	0.35		
Ring acceptance (FF lenses)	40 π mm mrad		
Long. acceptance, dp/p	±0.010		
Gamma-transition, γ_{tr}	7.091		
Ion energy, GeV/u	1.0	3.0	4.5
Ion number per bunch	$2.75\cdot10^{8}$	$2.4\cdot10^{9}$	$2.2\cdot10^{9}$
Rms momentum spread, 10^{-3}	0.62	1.25	1.65
Rms beam emittance, h/v, (unnormalized), π·mm·mrad	1.1/ 1.01	1.1/ 0.89	1.1/ 0.76
Luminosity, $cm^{-2}s^{-1}$	1.1e25	1e27	1e27
IBS growth time,sec	186	702	2540

Peak luminosity can be estimated as:

$$L = \frac{N_b^2}{4\pi\varepsilon\beta^*} F_{coll} f_{HG}\left(\frac{\sigma_s}{\beta^*}\right)$$

The collision repetition rate:

$$F_{coll} = \frac{\beta c}{l_{bb}}, \quad l_{bb} = \frac{C_{Ring}}{n_{bunch}}$$

Hour-glass effect ~ 1 (because in our case $\sigma s << \beta^*$):

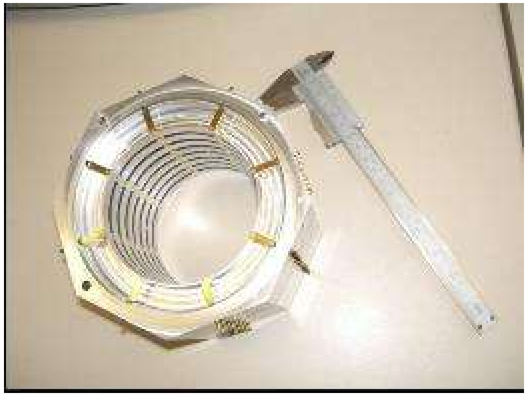
$$f_{HG}\left(\frac{\sigma_s}{\beta^*}\right) = \frac{1}{\sqrt{\pi}} \int_{-\infty}^{\infty} \frac{\exp(-u^2)du}{\left[1+\left(\frac{u\sigma_s}{\beta^*}\right)^2\right]}$$

Maximum luminosity is reached when the bunch phase volume corresponds to the ring acceptance

NICA

Stochastic Cooling System

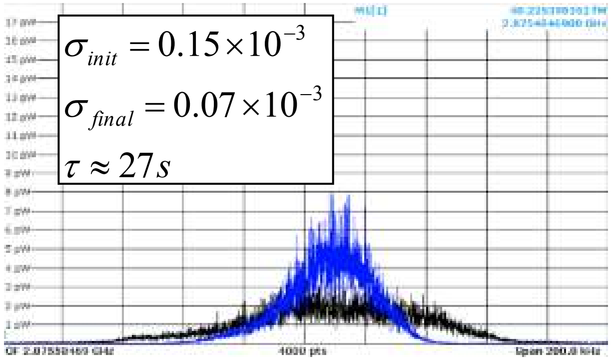
Stochastic Cooling System installed at Nuclotron - is a prototype for the NICA Collider:
W=2-4 HGz, P = up to 60 W
Collaboration: JINR-IKP FZJ-CERN



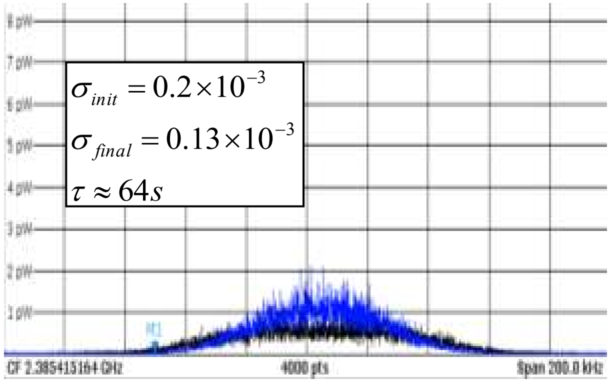
Ring slot-coupler RF structure (design FZJ)

Spectrum analyzer

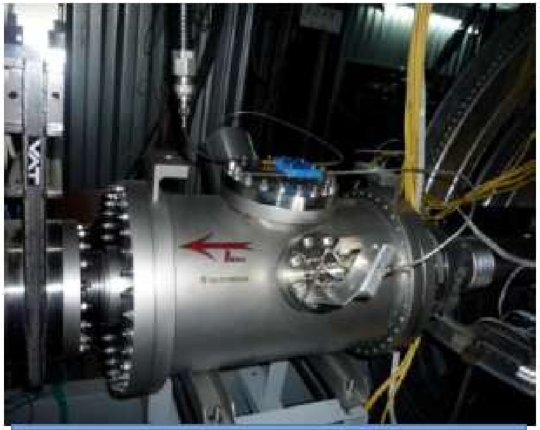
Coasting beam



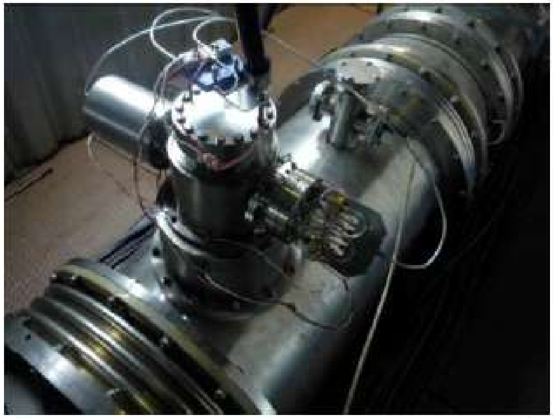
Bunched beam



Experimental results (2013): stochastic cooling of the carbon (C6+) beam, E = 2.5 GeV/u

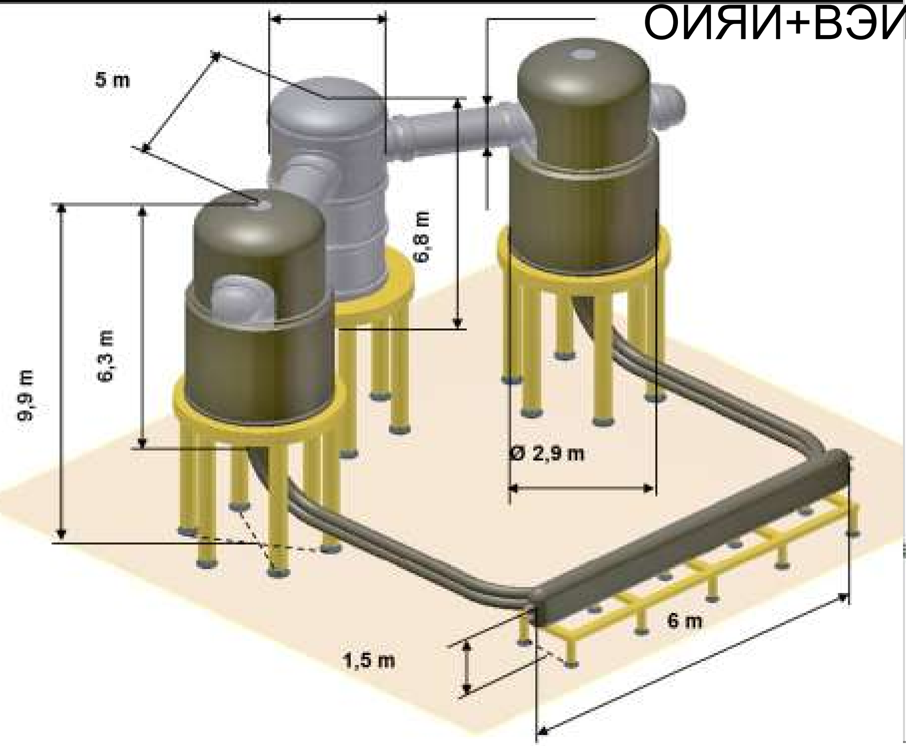


Kicker station



Pick-Up station

Collider Electron cooling



Maximum electron energy, MeV	2.5
Cooling section length, m	6.0
Electron beam current, A	0.5-1
Electron beam radius, cm	1
Magnetic field in cooling section, T	0.1-0.3

31

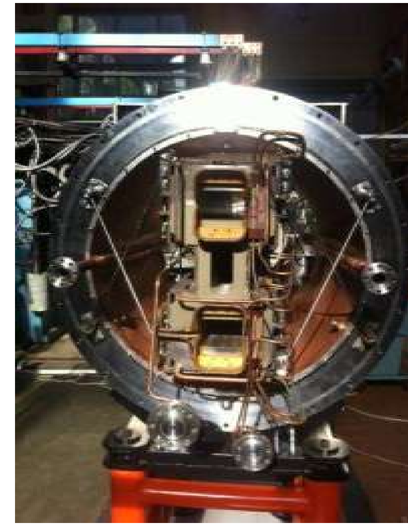
Full-scale Nuclotron–type superconducting prototypes of dipole and quadrupole magnets for the NICA booster and collider were manufactured at LHEP JINR, **have successfully passed the cryogenic test on the bench.** **Serial production of the magnets for the booster is scheduled for 2014.**

Booster dipole (up) and quadrupole lense and Q-doublet (down)

Booster UHV beam chamber (curved)

2-4 GHz RF structure for SCS

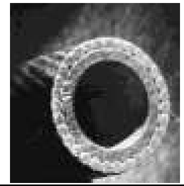
HTSC current leads 17 kA

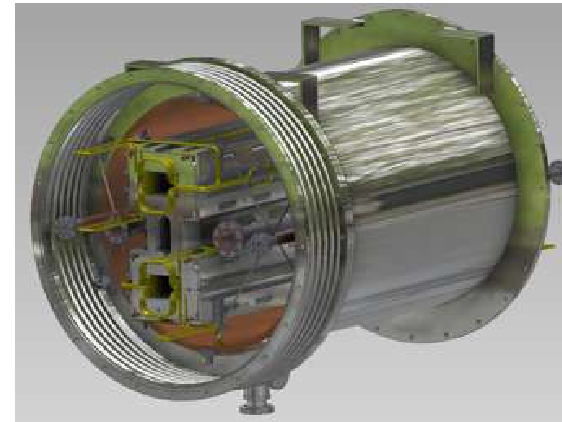


Collider dipole (up) and quadrupole lense (down)

Sextupole corrector prototype (up) for SIS100 and NICA booster) at assembly

Booster RF station (BINP, Novosibirsk)

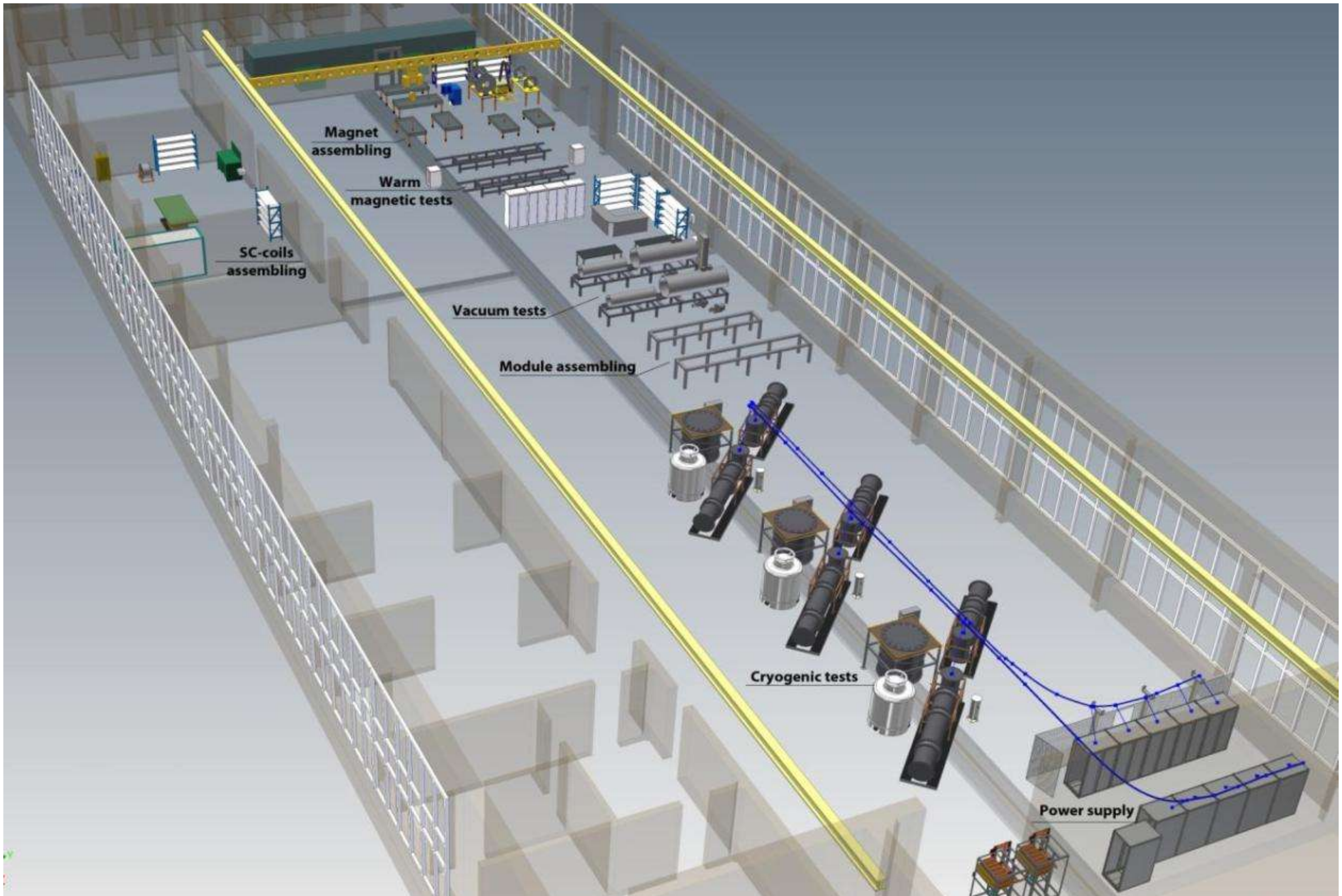




Unique Dubna technologies of fast-cycling superconducting magnets tested during several tens of Nuclotron runs and chosen as basic for accelerator complexes NICA and FAIR

Common European Research infrastructure for Heavy Ion High Energy Physics: NICA + FAIR

SC magnets assembly and test area (b.217): co-investments from JINR and BMBF (GSI, Germany)



SC magnets assembly and test area (b.217): co-investments from JINR and BMBF (GSI, Germany)

Workshops for SC coil production

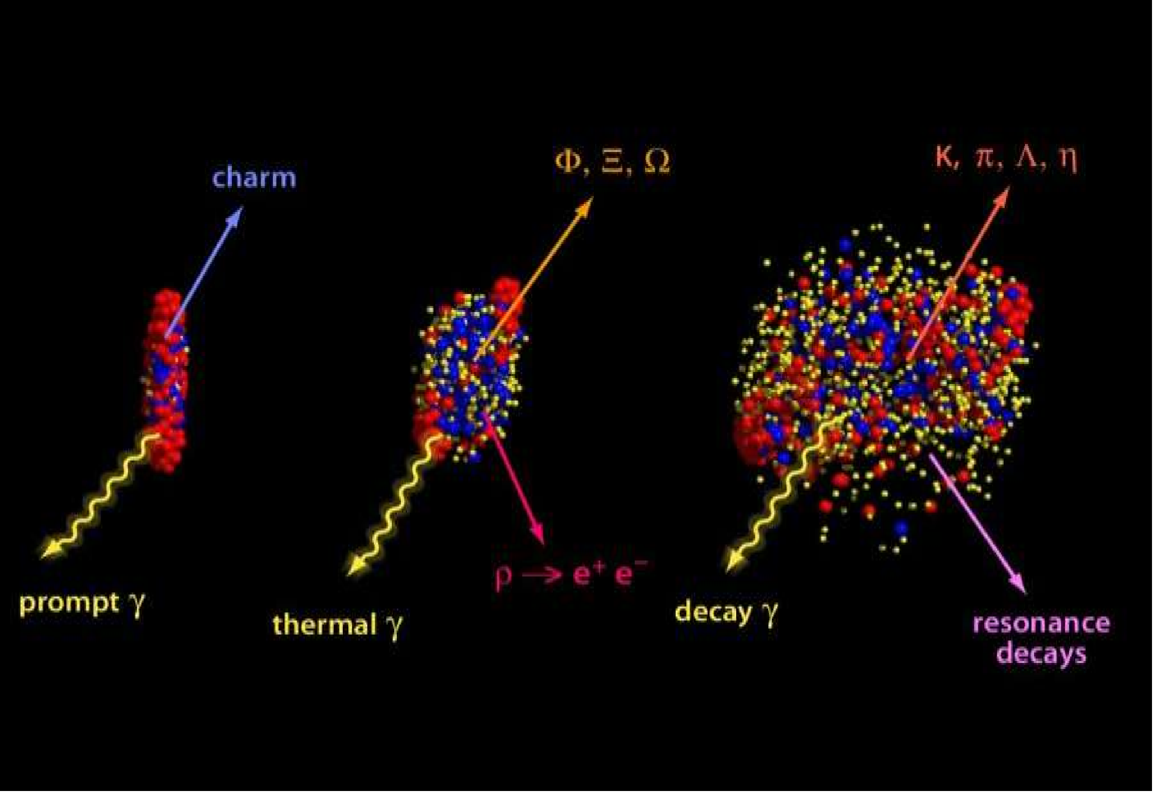
SC magnets assembly and test area (b.217): co-investments from JINR and BMBF (GSI, Germany)

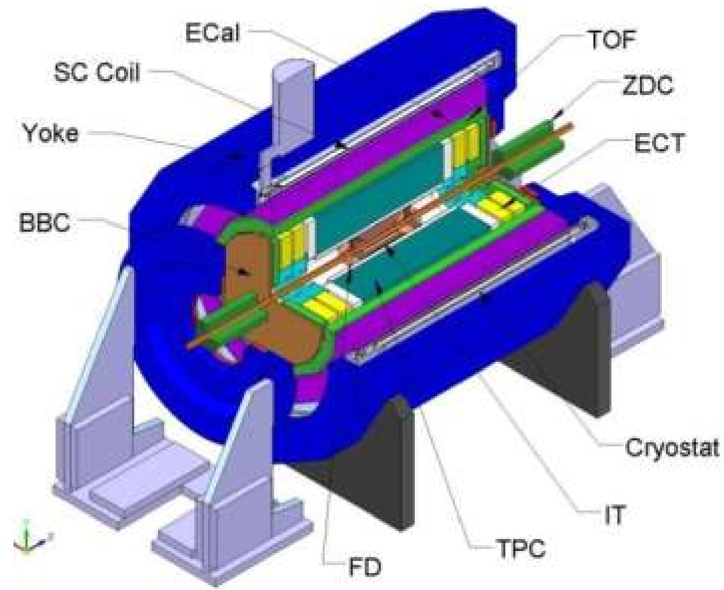
SC magnets assembly and test area (b.217): co-investments from JINR and BMBF (GSI, Germany)

SC magnets assembly and test area (b.217): co-investments from JINR and BMBF (GSI, Germany)

SC magnets assembly and test area (b.217): co-investments from JINR and BMBF (GSI, Germany)

The I-st arm has been put in operation in Aug'14

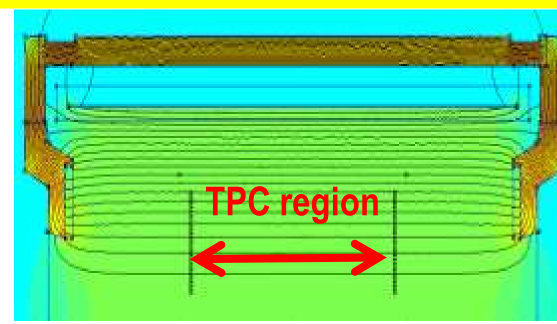




Magnet: *0.66T SC solenoid*
Tracking: *TPC, IT, ECT*
ParticleID: *TOF, ECAL, TPC*
T0, Triggering: *FFD*
Centrality, Event plane: ZDC

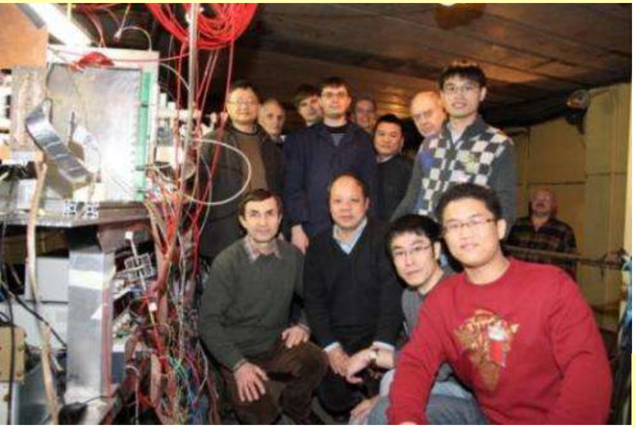
MPD observables:

- ✓ *Event-by-event fluctuations*
- ✓ *Femtoscopy involving π, K, p, Λ*
- ✓ *Hadron multiplicities (4-π particle yields : π, K, p, Λ, Ξ, Ω)*
- ✓ *Collective flow for identified hadron species and resonances*
- ✓ *Electromagnetic probes: e-, γ, vector meson decays*
- ✓ *Hyper Nuclei & other exotic*



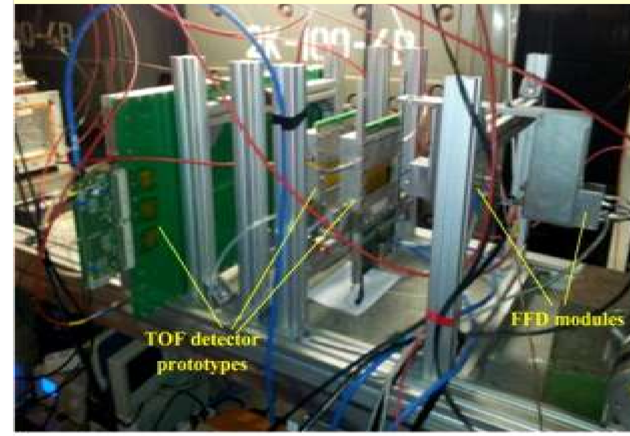
MPD Superconducting solenoid, B_0=0.66 T: **challenging project** - *to reach high level (~ 10^{-4}) of magnetic field homogeneity.* Technical *completed*; Survey for contractors: *the cold coil / cryostat; cryogenics.*

RPC deam test at NUCLOTRON: cooperation with SPb, China



Preproduction ECAL prototypes: co-operation with ISM *(Kharkiv, Ukraine)*

FFD tested with beam: achieved time resolution (38 ps) is better than required

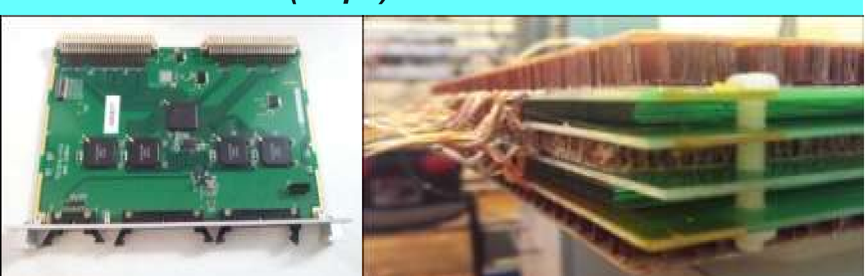


TPC: Cylinder C3 manufactured in Dec'13

ZDC coverage confirmed: 2.2<|η|< 4.8

Readout Electronics developed for *TPC, TOF, and ECAL* (*64 ch,13-bit,65 MSPS*)

RPC performance : ***required efficiency, rate capability & time resolution (63 ps) are reached***



The CBM - MPD consortium: *development & production of STS for **CBM** (FAIR), **MPD** & **BM@N***

mock-up carbon-fiber ladder (15 g / 1m)

SPD (Spin Physics Detector) at NICA

Collider provides both:
transversally & longitudinally
polarized ***p*** & ***d***
with energy up to $\sqrt{S}$ = ***27 GeV***

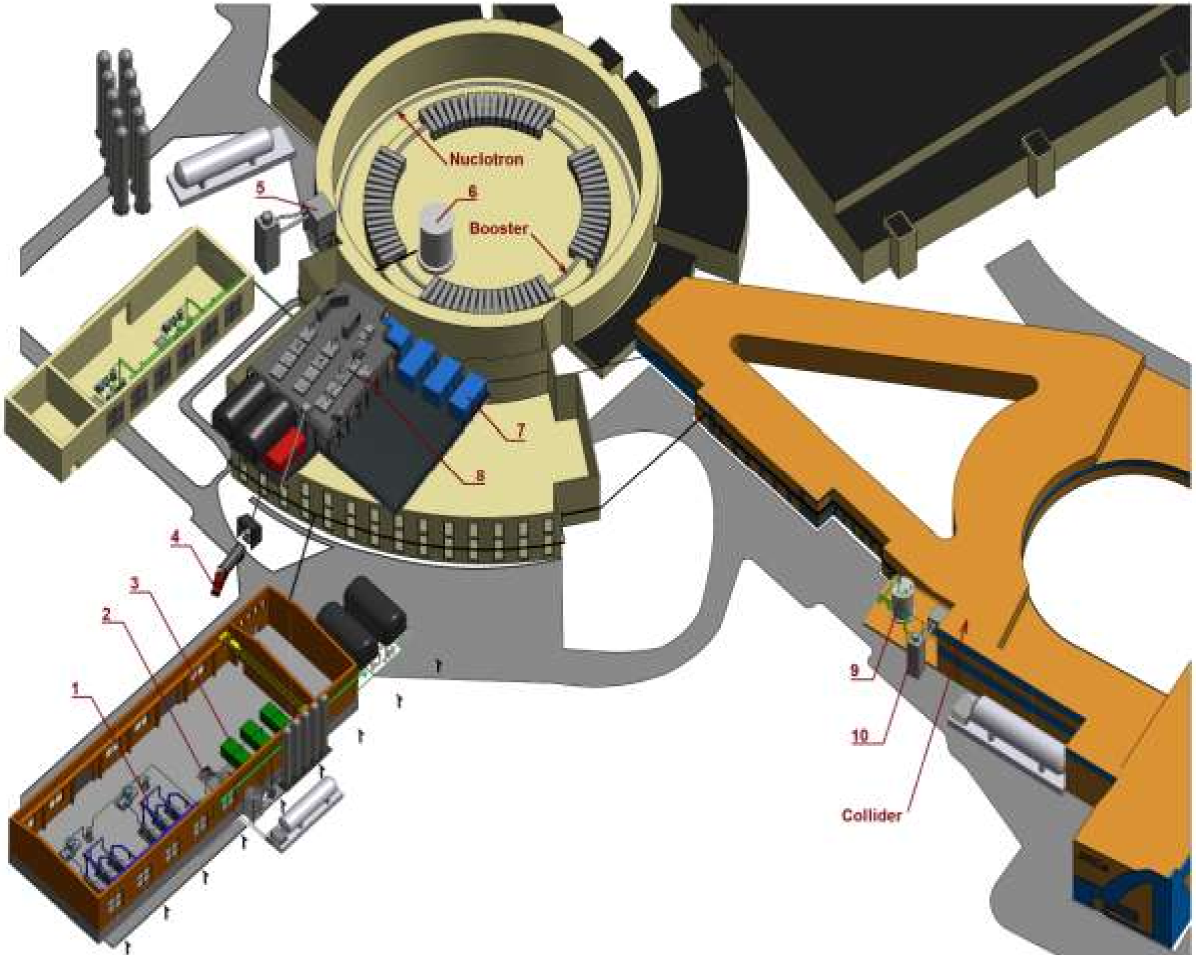
The issues to be studied:

- ► *MMT-DY processes*
- ► *J/Ψ production processes*
- ► *Spin effects in inclusive high-*p_T *reactions*
- ► *Spin effects in one and two hadron production processes*
- ► *Polarization effects in heavy ion collisions*

The Collaboration is forming

Project is under preparation

Cryogenic system for the NICA complex



New units for the NICA accelerators:

1 – 6600 Nm^3/h screw compressors Kaskad-110/30;
2 – 1300 kg/h nitrogen liquefier OA-1,3;
3 – nitrogen turbo compressors Samsung Techwin SM – 5000;
4 – liquid helium tank;
5 – 500 kg/h nitrogen re-condenser RA-0,5 of the booster;
6 – satellite refrigerator of the booster;
7 – draining and oil-purification units;
8 – 1000 l/h helium liquefier OG-1000;
9 – satellite refrigerator of the collider;
10 – 500 kg/h nitrogen re-condenser RA-0,5 of the collider.

Commissioning 2014: started in June

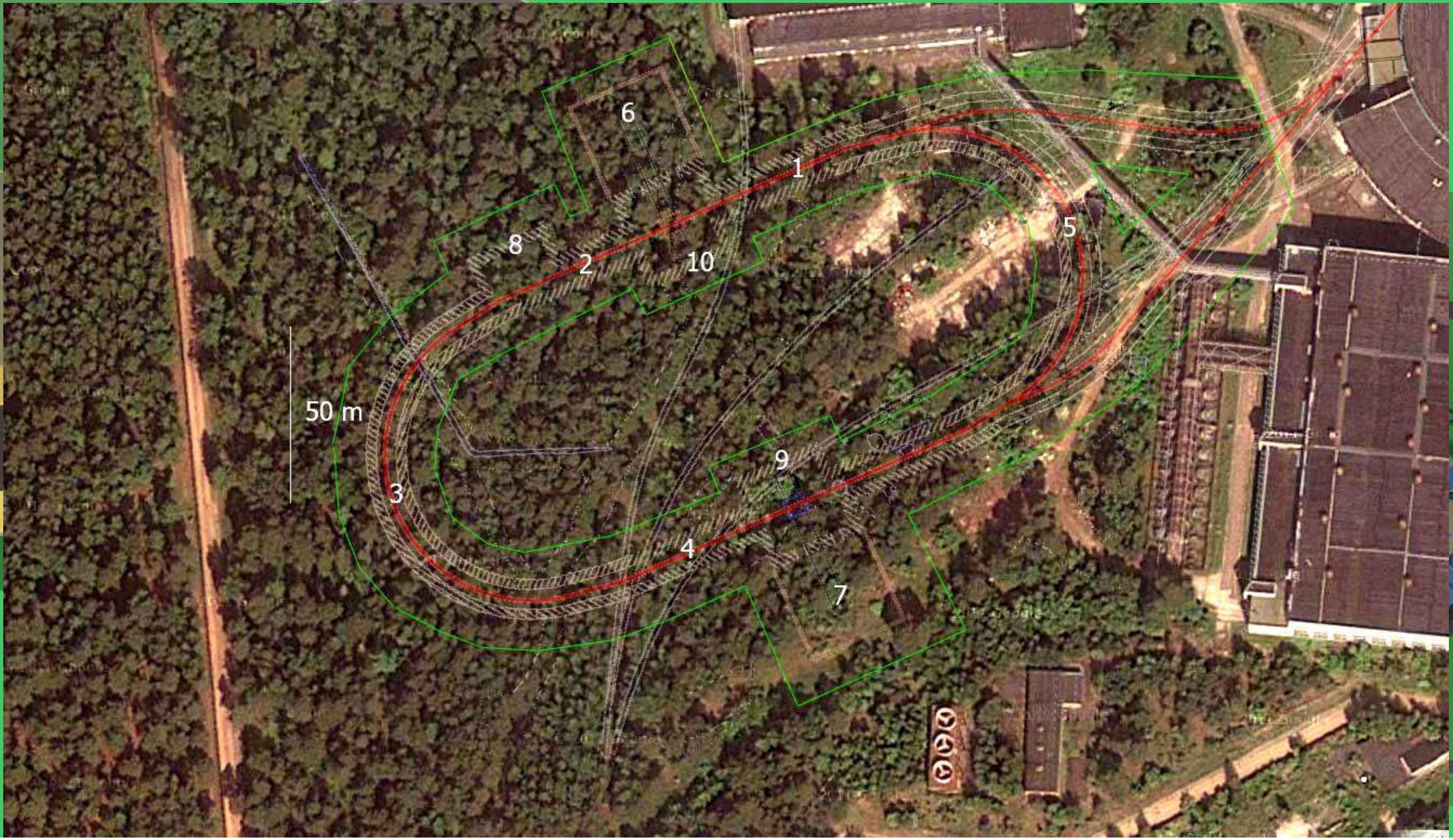
Screw compressors – delivered to Dubna

He liquifier (OG-1000) for full-scale NICA complex – delivered to Dubna, mounting started

Nitrogen recondensator (HELIIMASH) – design completed in mid 2014. November 2014 – start of production (2 years).

Helium satellite refrigerator for Booster – contracted.

 45


6
1
8
2
10
5
50 m
9
3
4
7


30 Dec 2013

Reguar workshops (weekly) with Strabag and KOMETA in Moscow

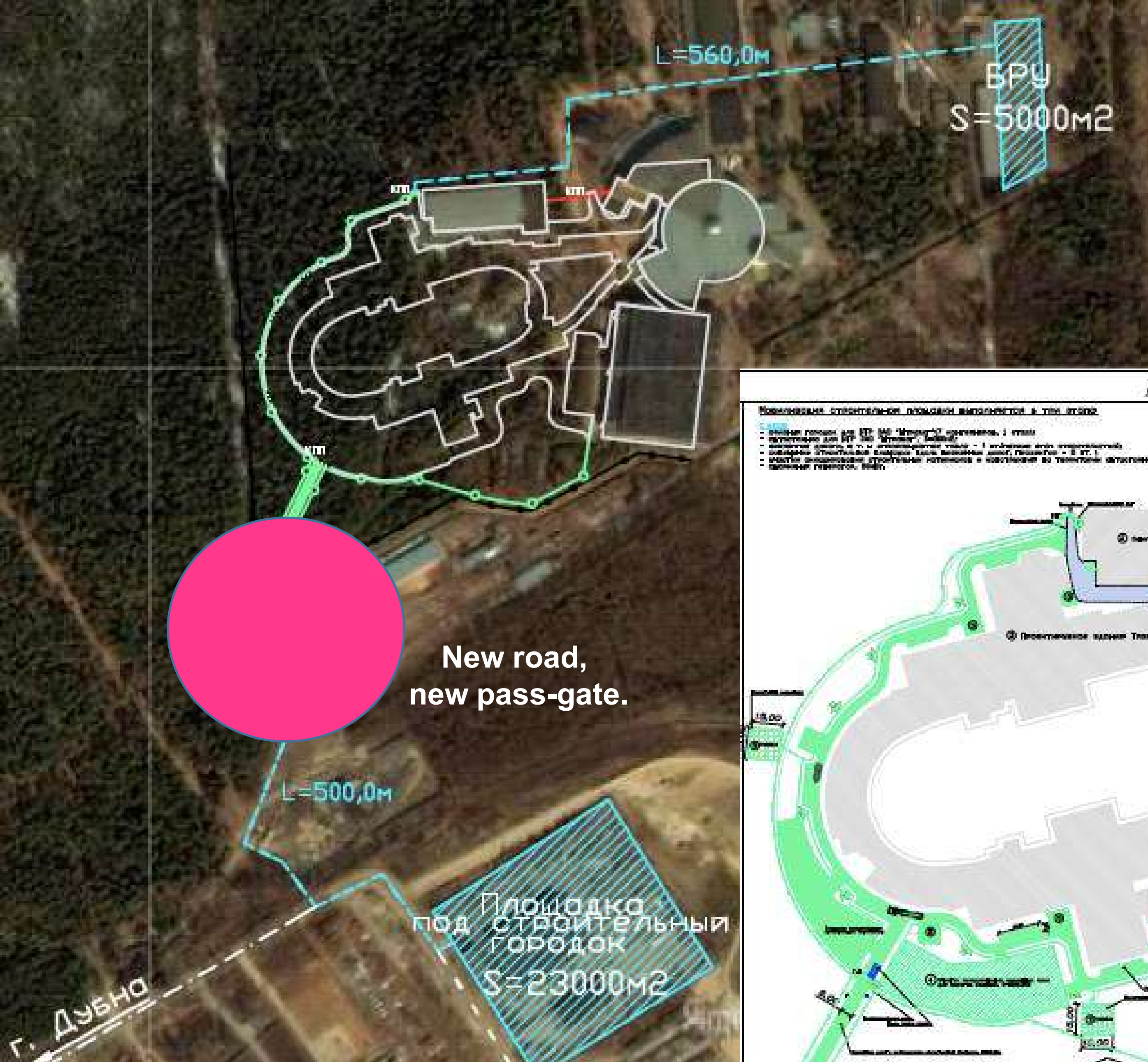
Contract for Working Documentation signed in August. Ready WDR – mid 2015

JINR and Strabag representatives on the future construction area

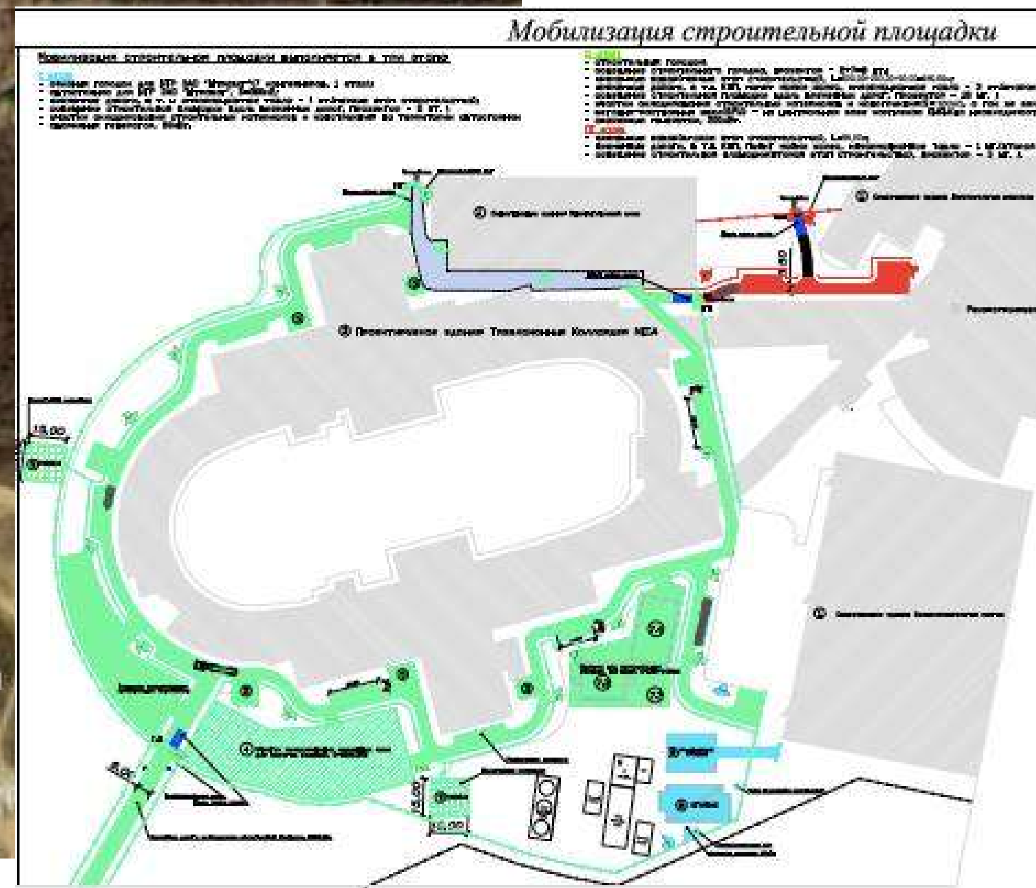
Contract for Construction area mobilization (construction site, temporary building new pass-gate, 250 test piles) – final discussion. Start – October 2014, ~ 3 months.

Contract for Civil Construction – goal to sign in Jan 2015. Spring 2015 – basic ground works.

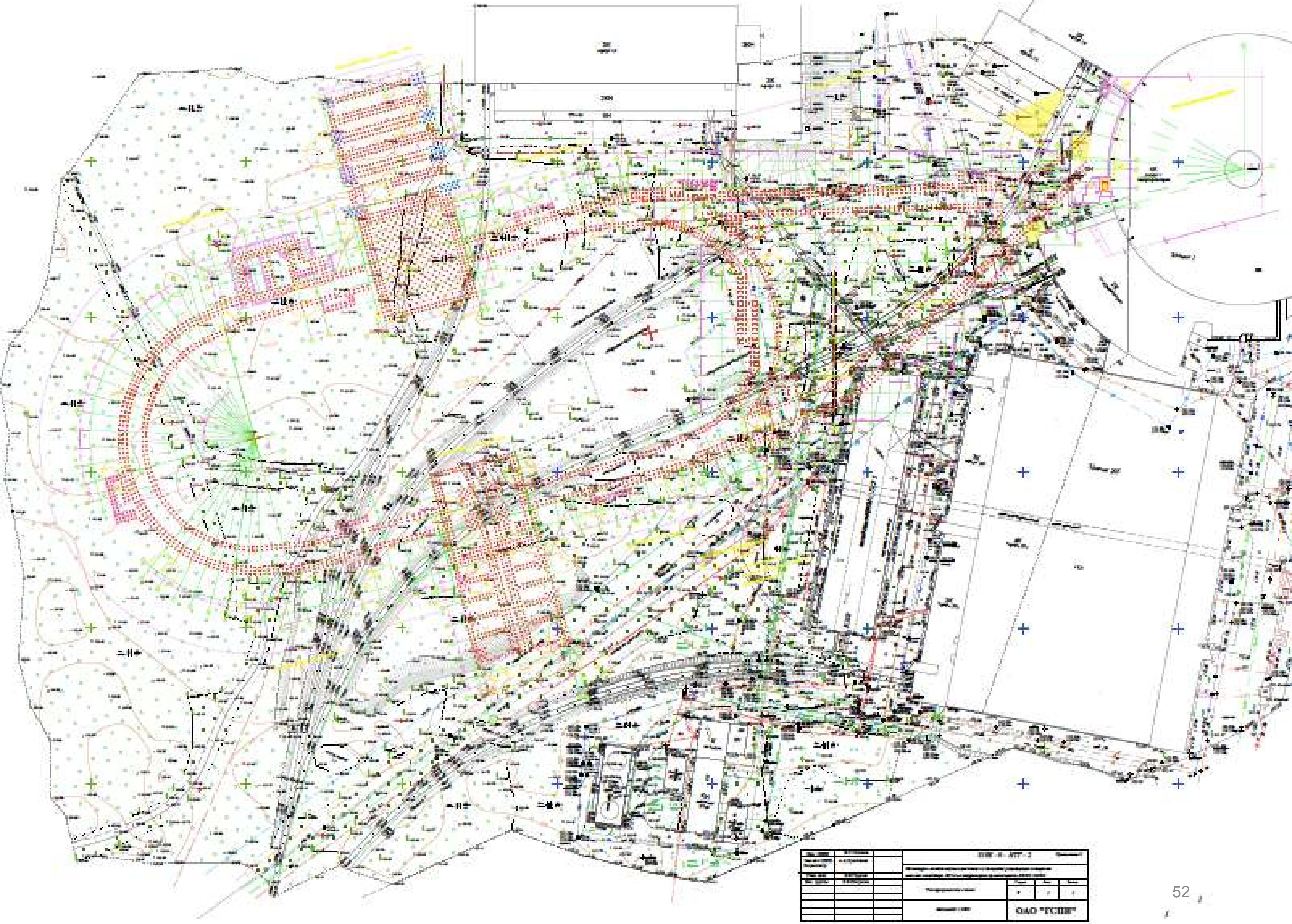

L=560,0м
БРУ
S=5000м2
New road,
new pass-gate.
L=500,0м
Площадка
под строительный
городок
S=23000м2
г. Дубна



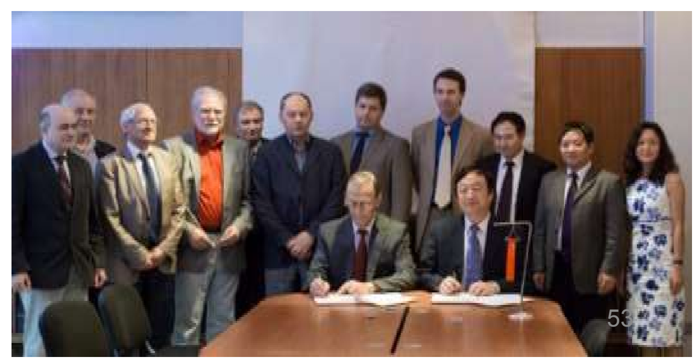
L=560,0м
БРУ
S=5000м2
L=500,0м
Площадка под строительный городок
S=23000м2
г. Дубна
New road,
new pass-gate.



Мобилизация строительной площадки


ОАО "ГСПИ"

Scientific cooperation @ NICA projects



European commission on Russian mega-science projects (May-Dec 2013)

The fact that NICA/JINR are part of the EU research infrastructures landscape has already been recognized by ESFRI. The Expert Group (EG) recommends that the NICA project be fully taken into account in the forthcoming discussions on the next update of the ESFRI Roadmap.
The EG encourages JINR to continue actively develop new and extended cooperation with potential European partner institutions. The exceptional opportunities available in Dubna to young scientists and engineers should be more widely promoted.

→ **HORIZON - 2020**

08 Aug'13: Representatives of 13 countries, 6

08 Aug'13: Representatives of 13 countries, 6 signed (**Belarus, Bulgaria, Germany, Kazakhstan, RF, Ukraine**). China and South Africa – are ready to join.
The Parties have agreed to inform their Governments about the Meeting on Prospects for Collaboration in the Mega-Science Project "NICA Complex" and to express their interest in preparing corresponding multilateral Agreement and in taking steps for approval by their countries

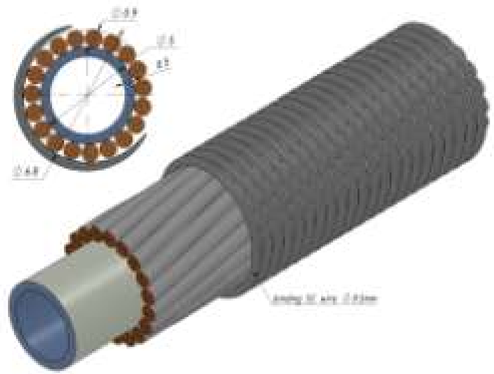
Germany (BMBF, GSI) – to the Test Facility for SC magnets and Si tracker Lab; **MoU**
China (ASIPP) – to the HTSC current leads, SC magnets, vacuum systems; **MoU**
USA (FNAL) – to the NICA collider stochastic and electron cooling systems; **MoU**
CERN – to the BM@N and MPD elements (drift chambers, MM systems…); **MoU**
Rep. of South Africa – cryostats, diagnostics for SC ion source, cryogenics. **MoU**

Cooperation in NICA mega-projects

High temperature superconducting current leads obtained for the NICA project from China ASIPP.

Unique hollow superconducting cable (Nuclotron type: JINR know-how) technology is implemented now for Chineese megaproject EAST and ASIPP contribution to ITER.

6 kA HTSC (77K) current leads for accelerator Nuclotron



Nuclotron-type SC cable
(jointly patented with Germany)

New generation of HTSC ceramics, assembly technologies, devices

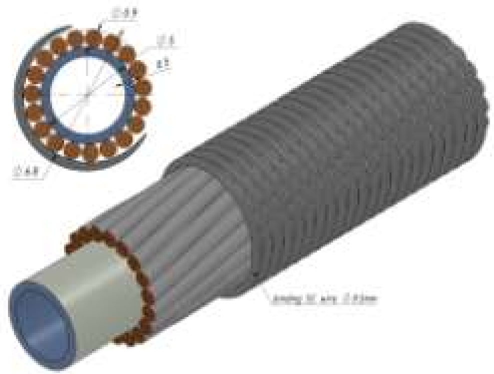
12 kA HTS current leads at mounting on JINR's test facility

Cooperation in NICA mega-projects

High temperature superconducting current leads obtained for the NICA project from China ASIPP.

Unique hollow superconducting cable (Nuclotron type: JINR know-how) technology is implemented now for Chineese megaproject EAST and ASIPP contribution to ITER.

6 kA HTSC (77K) current leads for accelerator Nuclotron



Nuclotron-type SC cable
(jointly patented with Germany)

New generation of HTSC ceramics, assembly technologies, devices

17 kA HTS current leads made by NRC KI

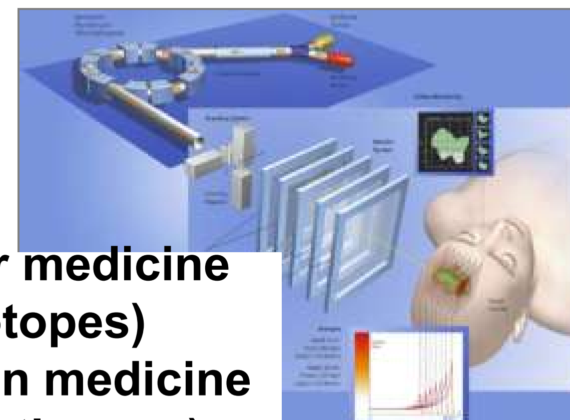
MEGAPROJECT NICA

Innovative Perspectives

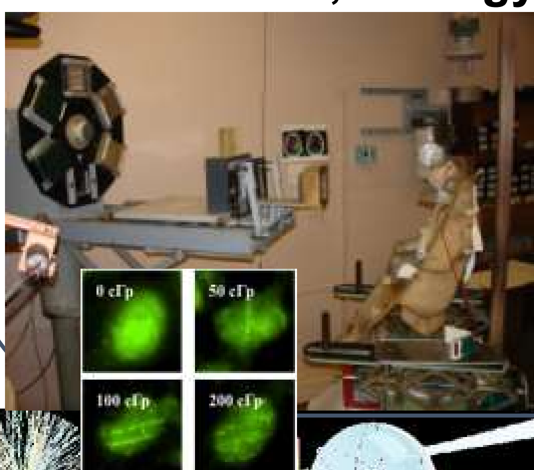
Power saving, nuclear energetics, industrial accelerators, ecology

Security

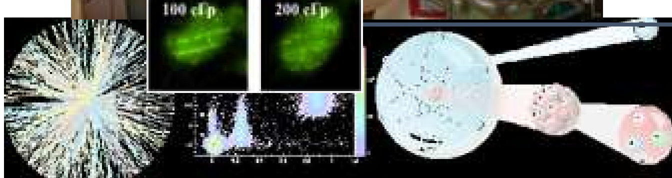
Space Technologies

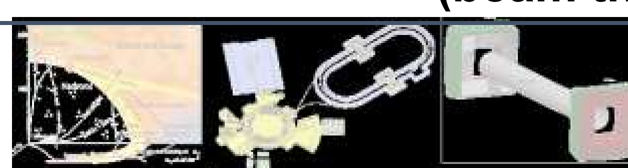


Nuclear medicine (isotopes)
Radiation medicine (beam therapy)

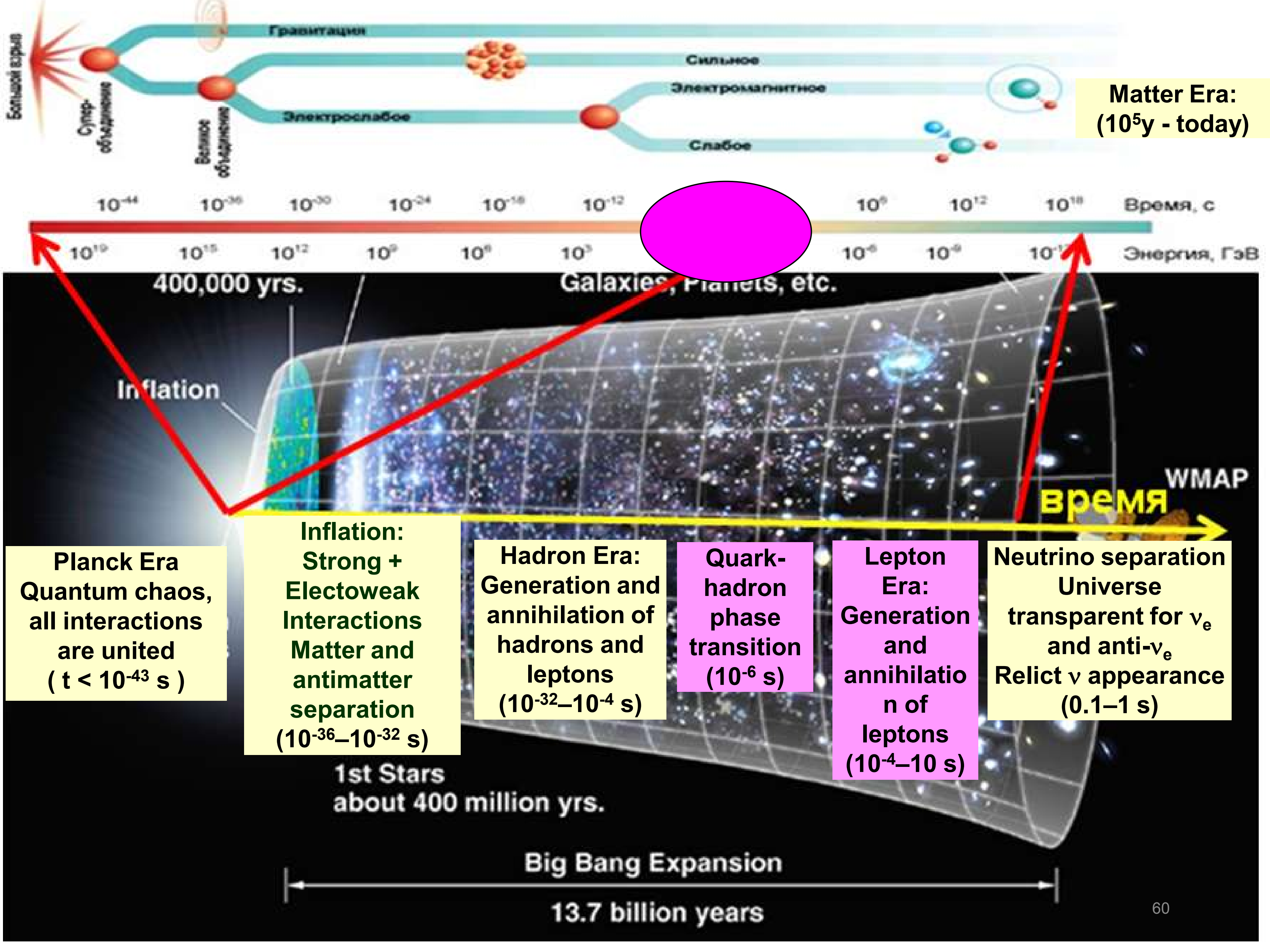


Radiobiology





Thank you for your attention!



Большой взрыв
Супер-объединение
Великое объединение
Гравитация
Сильное
Электрослабое
Электромагнитное
Слабое
Matter Era:
(10⁵y - today)
10⁻⁴⁴ 10⁻³⁶ 10⁻³⁰ 10⁻²⁴ 10⁻¹⁸ 10⁻¹² 10⁶ 10¹² 10¹⁸ Время, с
10¹⁹ 10¹⁵ 10¹² 10⁹ 10⁶ 10³ 10⁻⁶ 10⁻⁹ Энергия, ГэВ
400,000 yrs.
Galaxies, Planets, etc.
Inflation
время
WMAP
Planck Era
Quantum chaos, all interactions are united
(t < 10⁻⁴³ s)
Inflation: Strong + Electoweak Interactions
Matter and antimatter separation
(10⁻³⁶–10⁻³² s)
Hadron Era: Generation and annihilation of hadrons and leptons
(10⁻³²–10⁻⁴ s)
Quark-hadron phase transition
(10⁻⁶ s)
Lepton Era: Generation and annihilation of leptons
(10⁻⁴–10 s)
Neutrino separation
Universe transparent for νe and anti-νe
Relict ν appearance
(0.1–1 s)
1st Stars
about 400 million yrs.
Big Bang Expansion
13.7 billion years

Startup version of the collider

Energy range from 3 to 4.5 GeV/u (optimum ~ 3.5 GeV/u)

Operation scenario:

- Stacking with BB + Stoch. longitudinal cooling
- Bunching at h = 22 and Stoch. longitudinal cooling

Parameters

Bunch length is about 1.2 m (instead of 0.6 m)

Momentum spread of $4.2 \cdot 10^{-4}$ (instead of $1 \cdot 10^{-3}$)

Bunch intensity $5 \cdot 10^{8}$ (instead of $2 \cdot 10^{9}$)

Luminosity $(1 \div 7) \cdot 10^{25}$ cm^{-2}s^{-1}

Startup version of the collider: goals

-Test of the beam stacking procedure:

stacking efficiency, evolution of transverse emittance

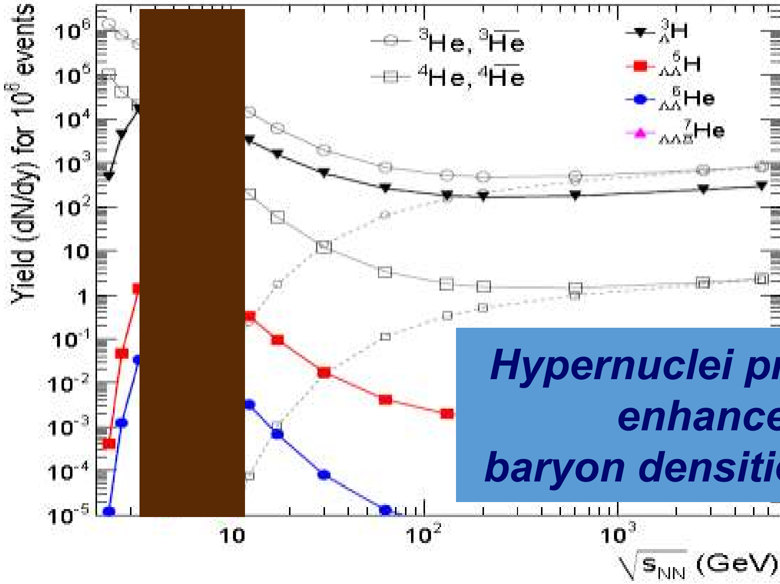
- Test and optimization of Stoch. cooling system

-Test of the beam bunching with cooling

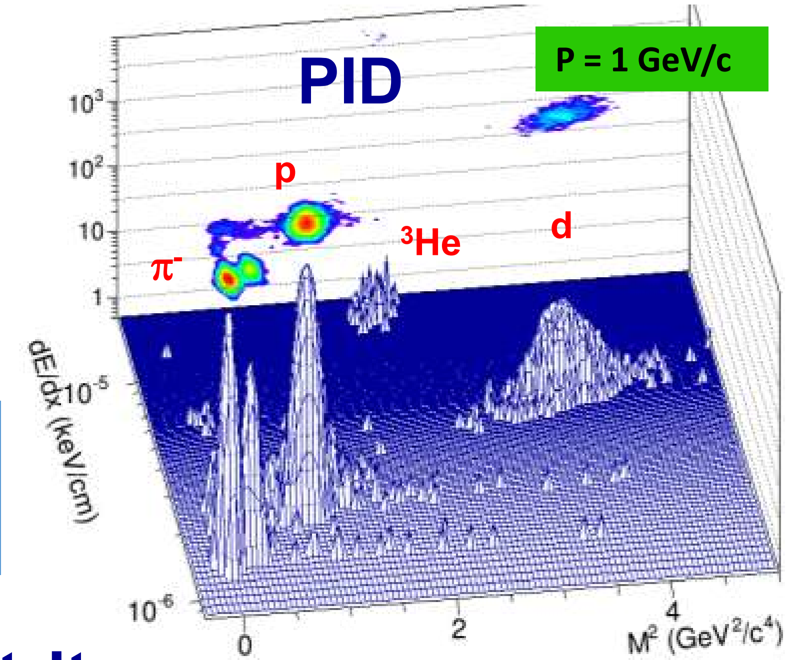
-Investigation of IBS, ring tune ability, beam life-time…

-Test of MPD systems at L ~ 1-5 $\cdot 10^{25}$ $cm^{-2}s^{-1}$

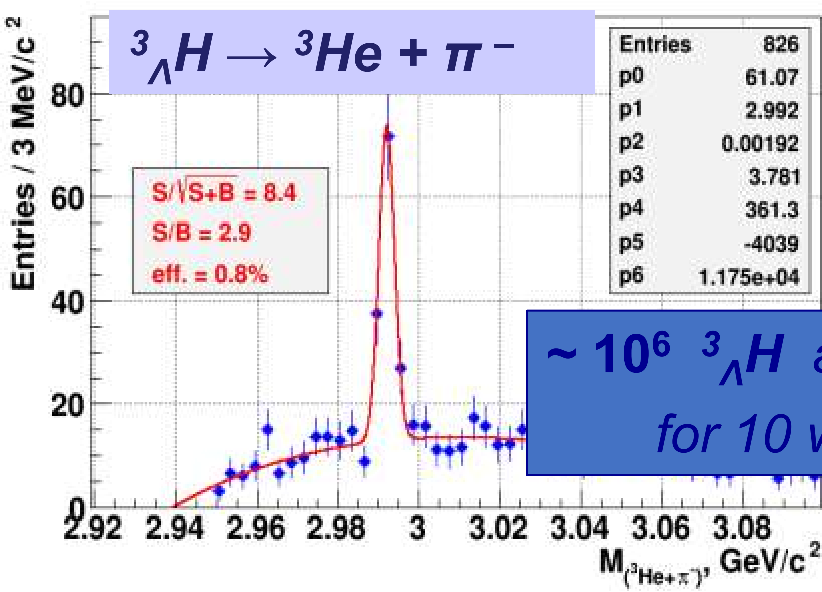
Hypernuclei @ MPD

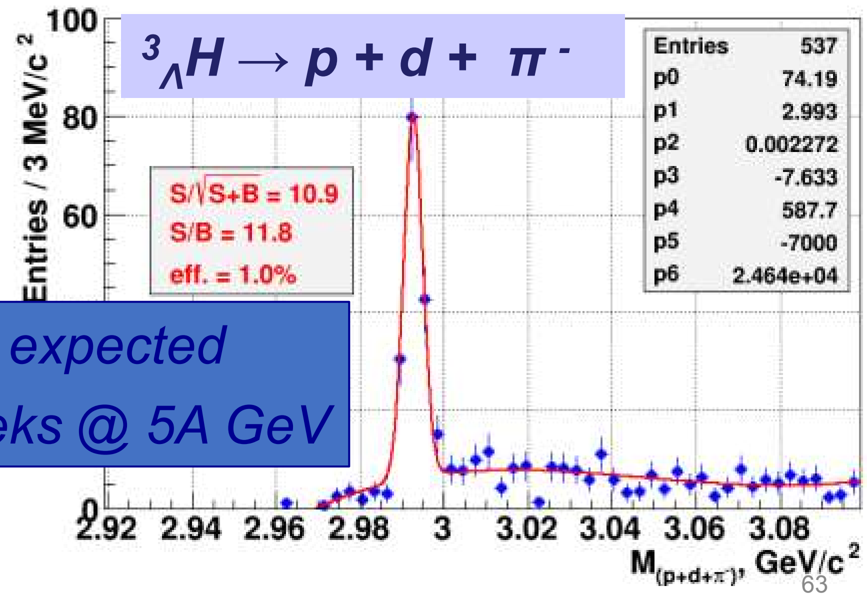


Hypernuclei production enhanced at high baryon densities (NICA)



Hypertritons





~ 10^6 $^3_\Lambda H$ are expected for 10 weeks @ 5A GeV

MEGAPROJECT NICA

Participation of Russia and International Cooperation

Armenia	
Australia	*Italy*
Azerbaijan	*Japan*
Belarus	*Kazakhstan*
Bulgaria	*Moldova*
Brazil	*Mongolia*
CERN	*Poland*
China	*Romania*
Cuba	*RSA*
Czech Rep.	*Russia*
DPRK	*Serbia*
France	*Slovakia*
Georgia	*Ukraine*
Germany	*USA*
Greece	*Uzbekistan*
India	*Vietnam*