Joint Institute for Nuclear Research
International Intergovernmental Organization

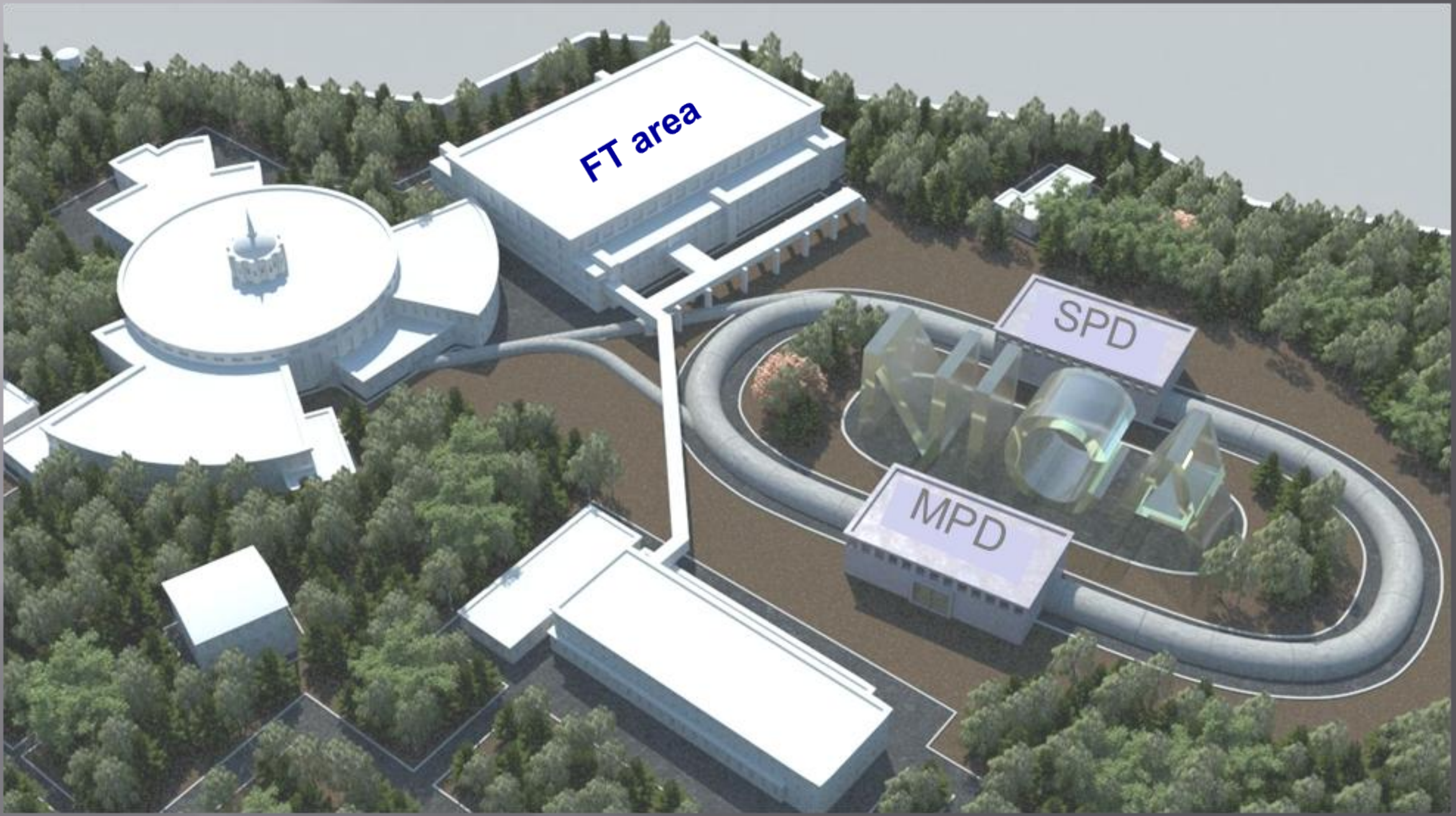
# Status of NICA/MPD at JINR

V. Kekelidze, A. Kovalenko, R. Lednicky, I. Meshkov, A. Sorin, G. Trubnikov
(for the NICA/MPD collaboration)

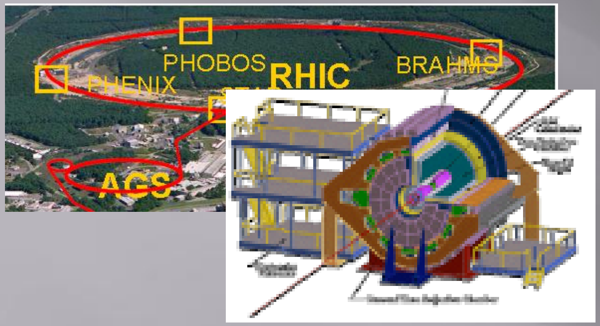
NICA

7th International Workshop on
Critical Point and Onset of Deconfinement
Wuhan, November 8, 2011

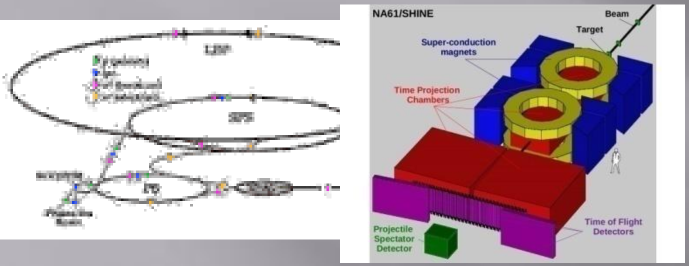
# Nuclotron-based Ion Collider fAcility (NICA)



# $2^{nd}$ generation HI experiments

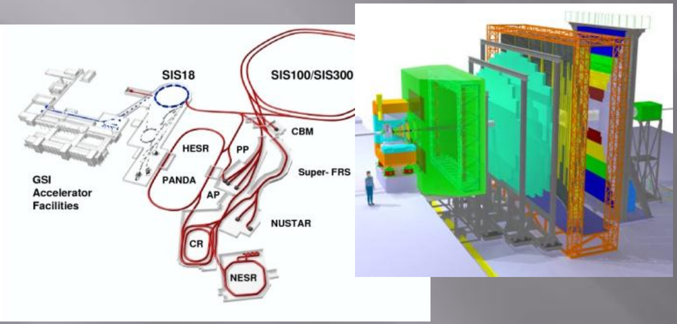



## BES STAR/PHENIX@BNL/RHIC



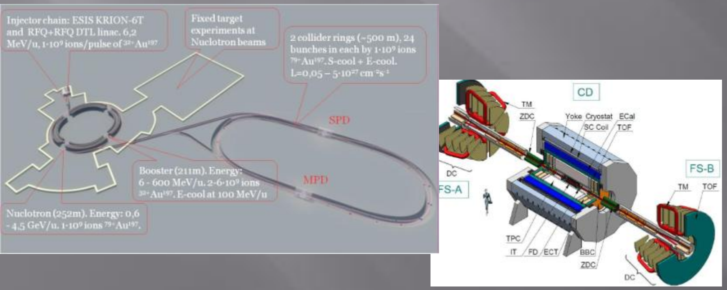

## NA61@CERN/SPS

# $3^{nd}$ generation HI experiments




## CBM@FAIR/SIS-100/300

**Fixed target, E/A=10-40 GeV, highest intensity**

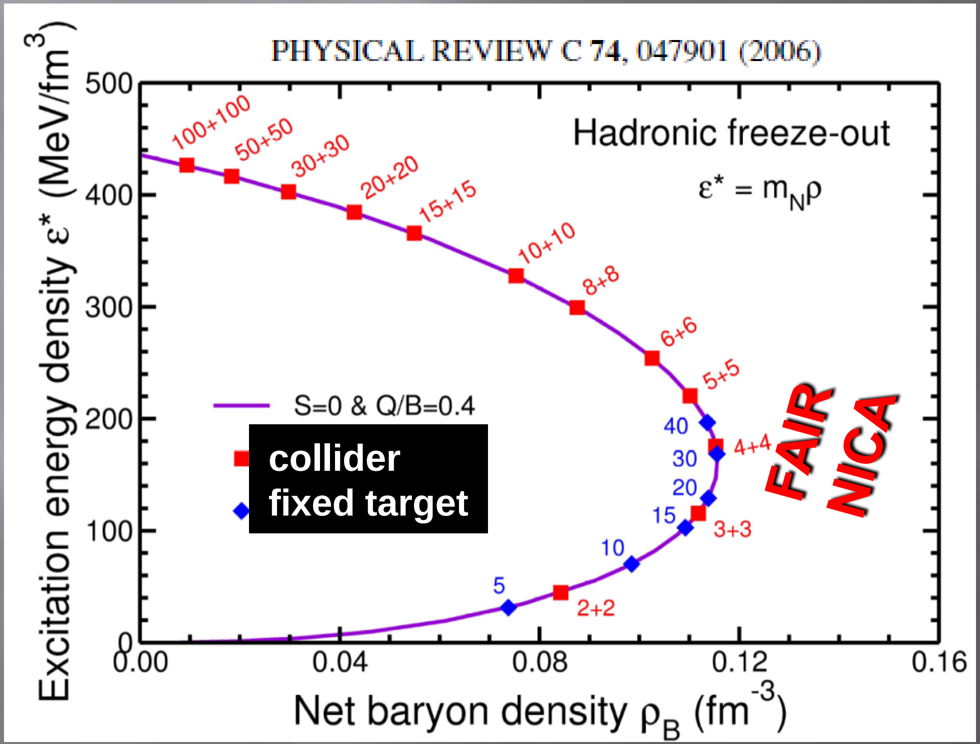



## MPD@JINR/NICA.

**Collider, $\sqrt{s_{NN}}$ = 4-11 GeV, L~$10^{27}$ $cm^{-2}s^{-1}$ for $Au^{79+}$**

# Highest baryon density at Lab

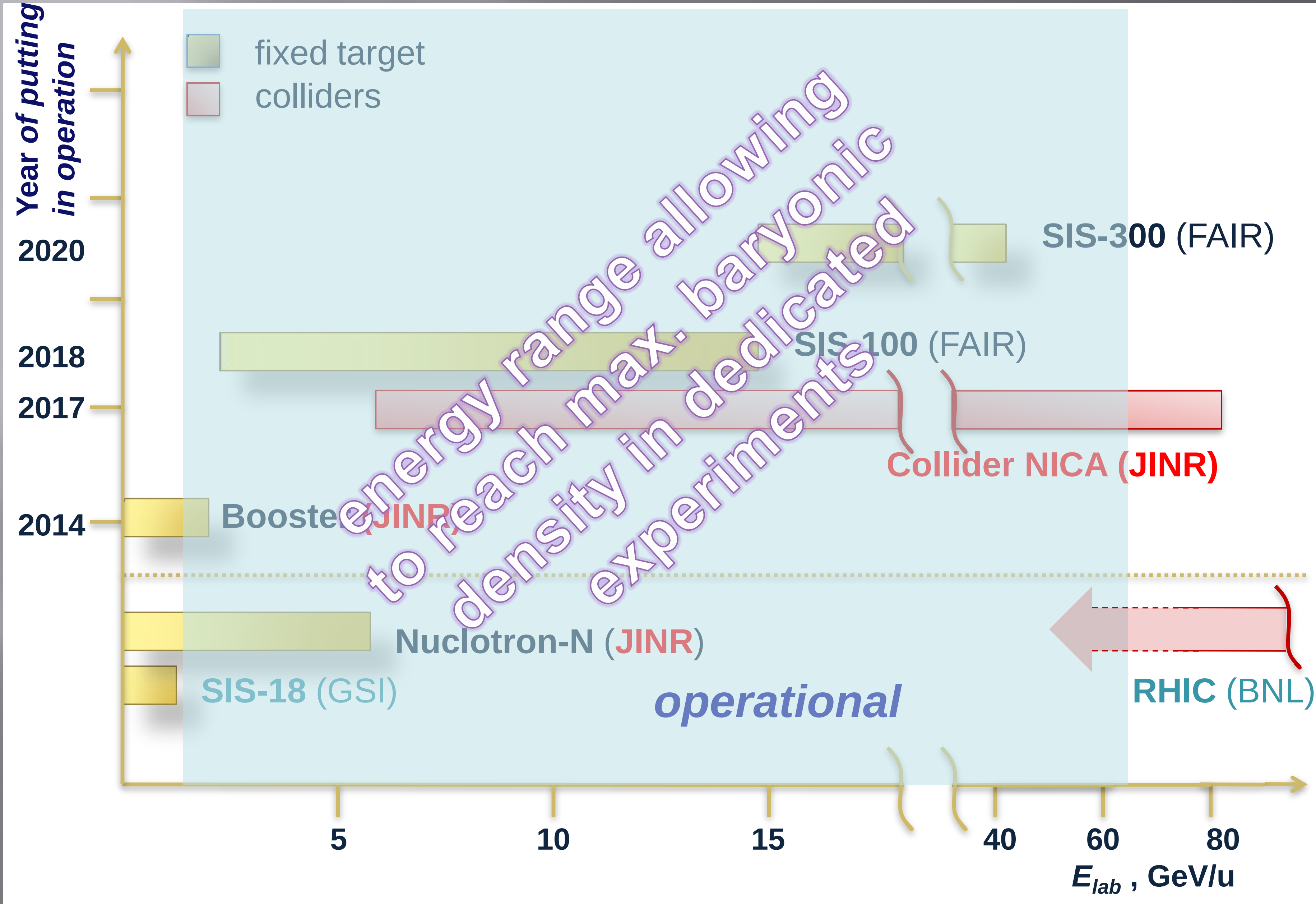
**System of maximal net baryon (freeze-out) density is created in A+A collisions at NICA energies → optimum for the compressed nuclear matter exploration**



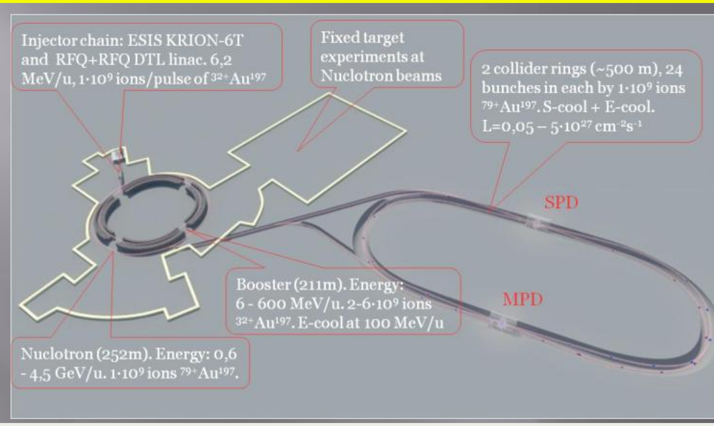

*J.Randrup, J.Cleymans, 2006*

## Energy region covered by the JINR and GSI facilities

*(in deutron energy, recalculated for $E_{lab}$ )*



# Nuclotron-based Ion Collider fAcility (NICA)




- **Exploration of the QCD phase diagram**

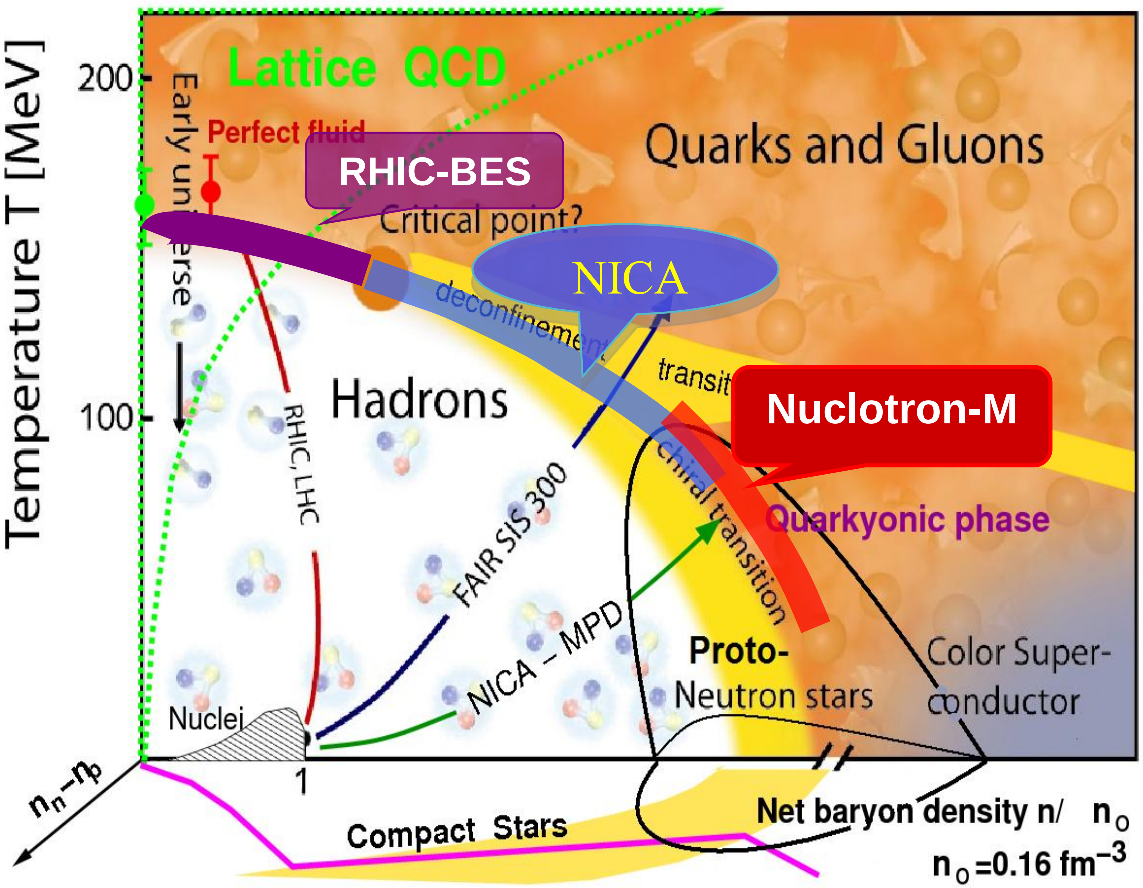
  ***- in-medium properties of hadrons & nuclear matter equation of state***
  ***- onset of deconfinement & chiral symmetry restoration***
  ***- phase transitions, mixed phase & critical phenomena***
  ***- local parity violation (P-odd effects)***

- **Spin physics**

  - ***to shed light on the origin of spin***
  - ***to define the nucleon spin structure***

**The planned data taking – 2017**

# QCD phase diagram: prospects for NICA




## Energy Range of NICA

**The most intriguing and unexplored region of the QCD phase diagram:**

- **Highest net baryon density**
- **Onset of deconfinement phase transition**
- **Discovery potential:**
  - **a) Critical End Point (CEP)**
  - **b) Chiral Symmetry Restoration**
  - **c) Hypothetic Quarkyonic phase**
- **Complementary to the RHIC/BES, NA61/CERN, CBM/FAIR and Nuclotron-M experimental programs**

**Comprehensive experimental program requires scan over the QCD phase diagram by varying collision parameters: system size, beam energy and collision centrality**

# NICA: Nuclotron-based Ion Collider fAcility

- Flagship project at JINR
- Based on the development of the Nuclotron facility
- Optimal usage of the existing infrastructure
- Modern machine which incorporates new technological concepts
- First colliding beams - 2017

## NICA advantages:

- Energy range $\sqrt{s_{NN}}$ = 4-11 GeV - highest baryon density
- Available ion species: from p to Au
- Highest luminosity: Au+Au up to $10^{27}$

# The NICA Project Goals

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

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

at $L_{average}$= 1E27 cm-2·s-1 (at $\sqrt{s_{NN}}$ = 9 GeV)

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 )

$L_{average} \geq$ 1E30 cm-2·s-1 (at $\sqrt{s_{pp}}$ = 27 GeV)

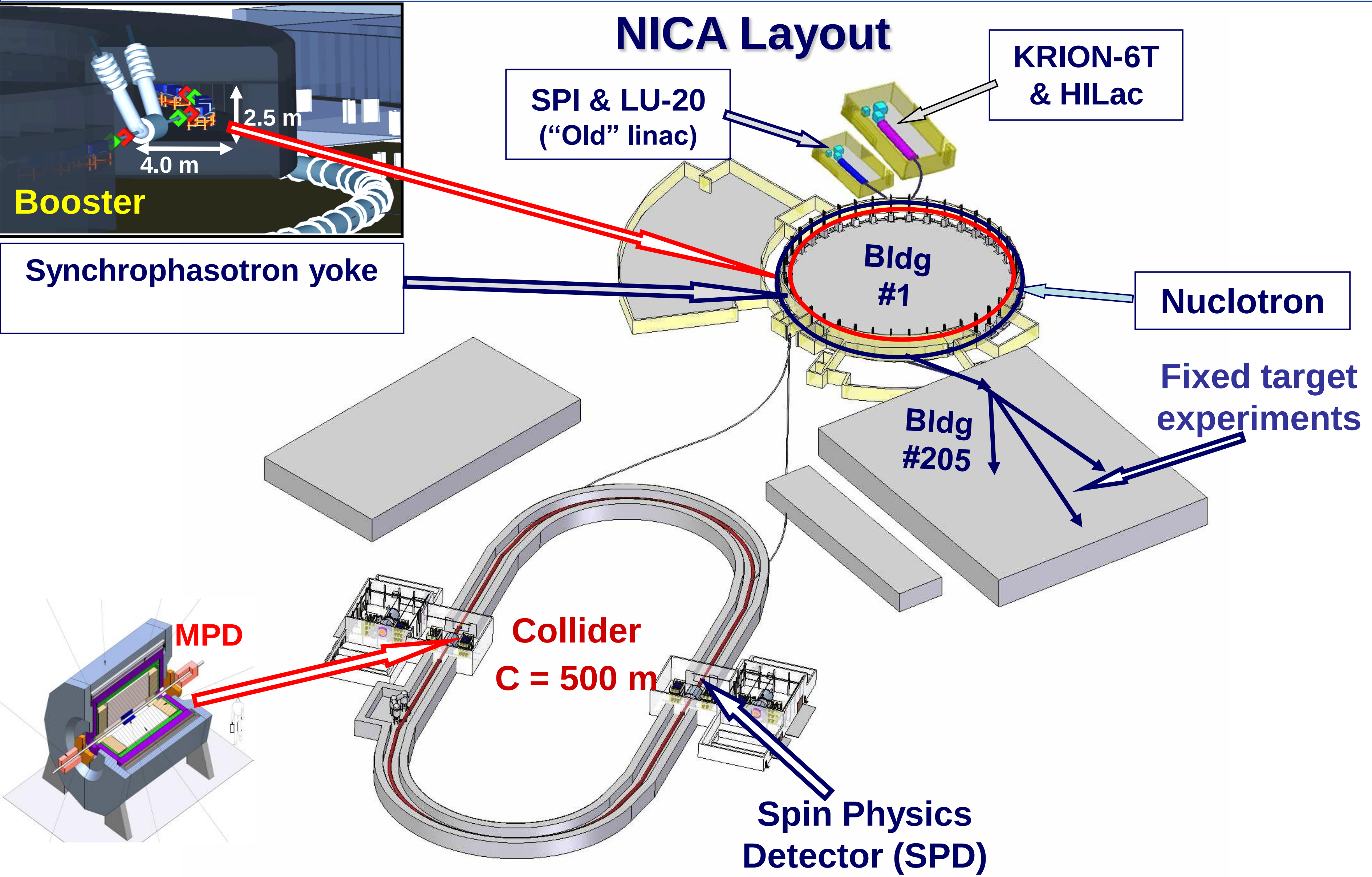
3) The beams of light ions and polarized protons and deuterons for fixed target experiments:

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)

# Facility Scheme and Operation Scenario

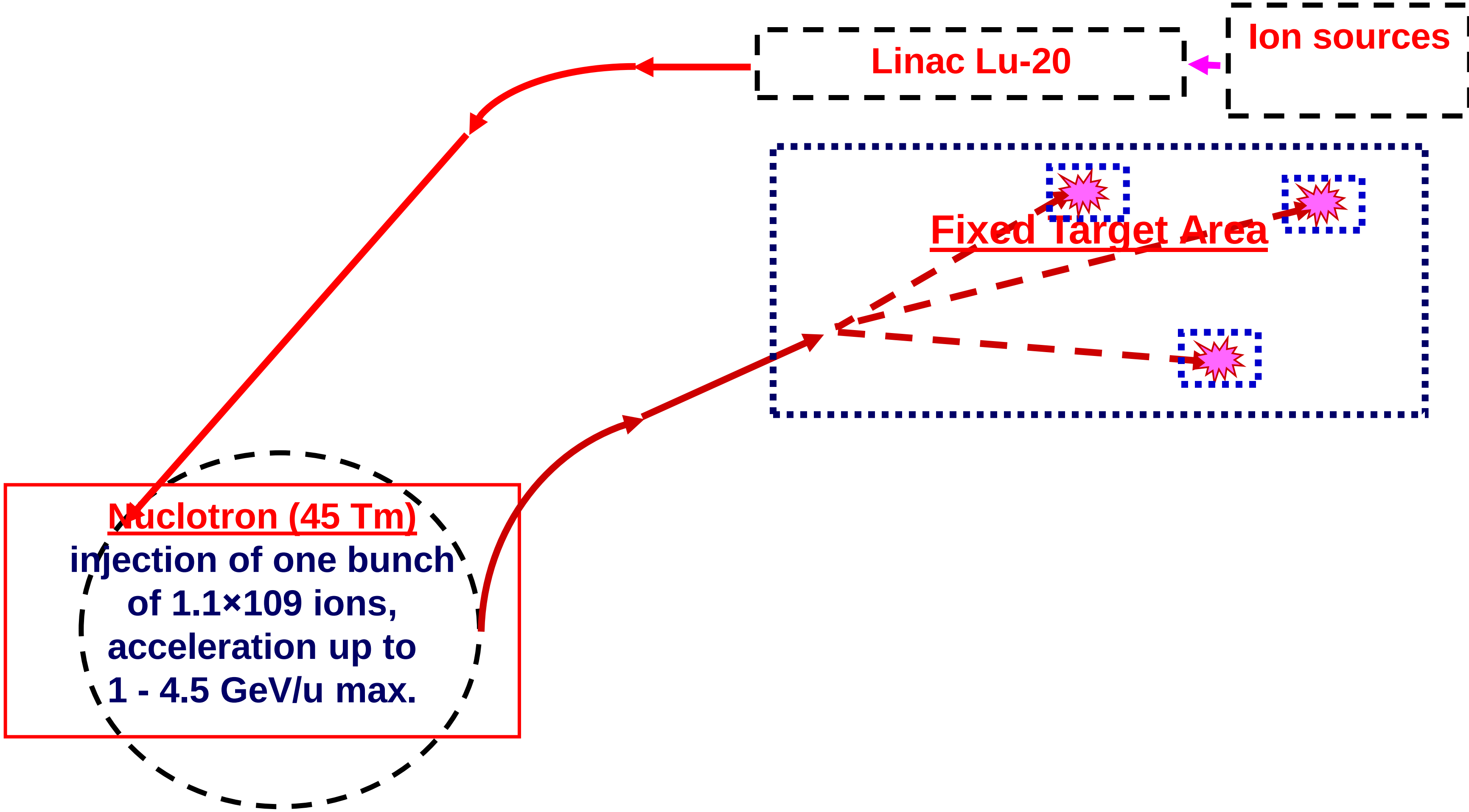


The Cosmonaut Yi So-Yeon (South Korea) flies inside the yoke of Synhrophasotron JINR

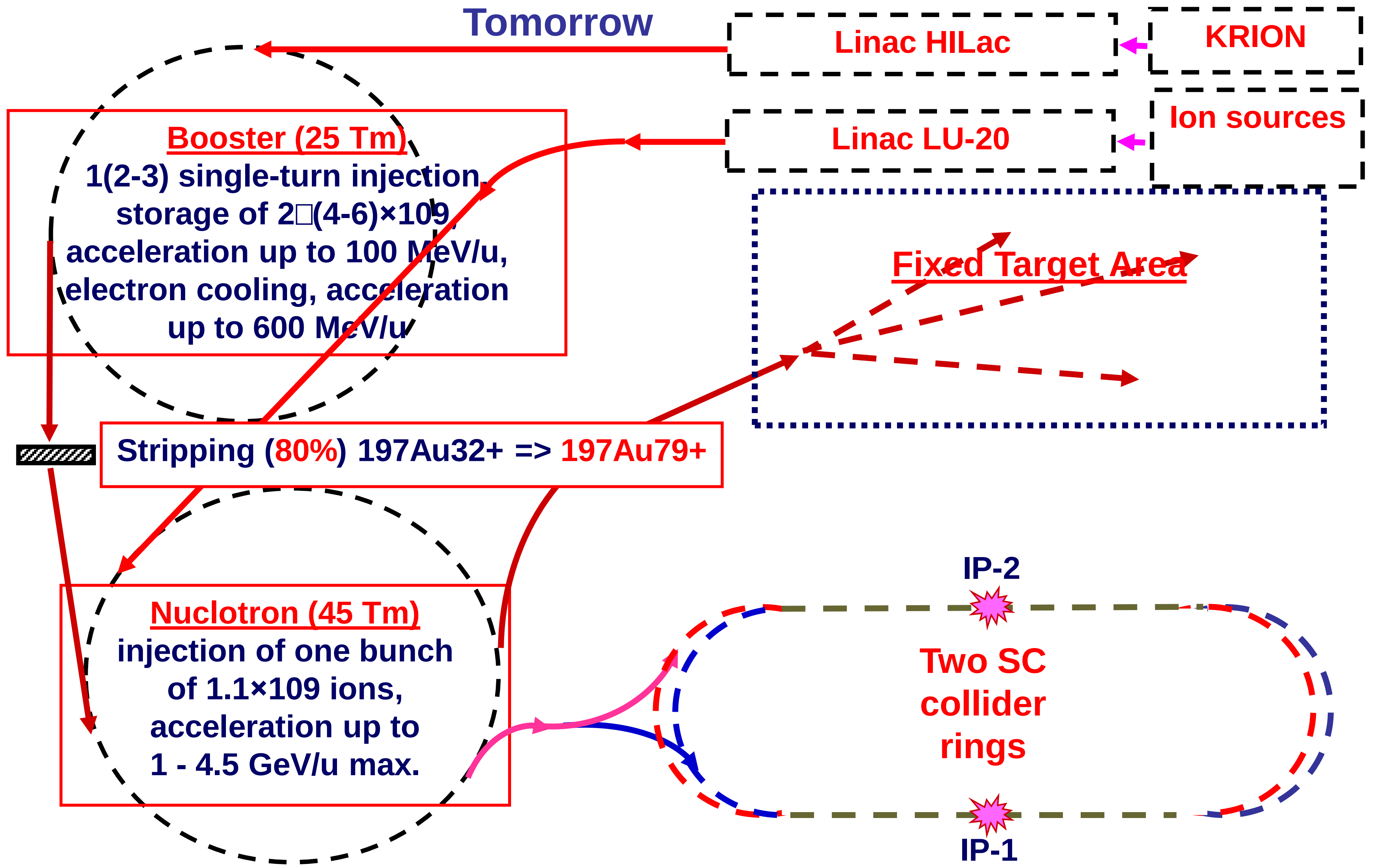
# Nuclotron-type SC magnets for Booster

# Facility Scheme and Operation Scenario

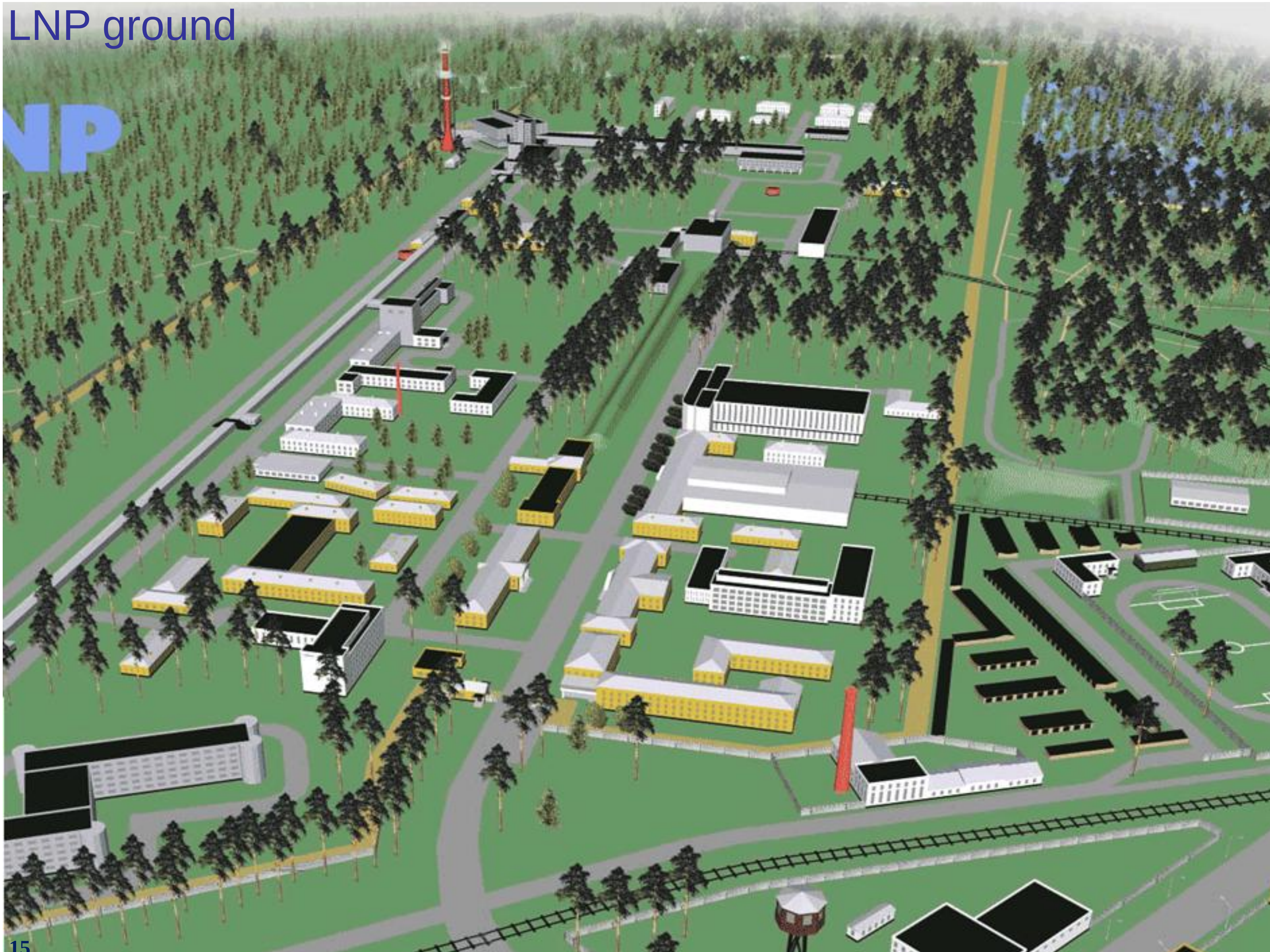
## Today



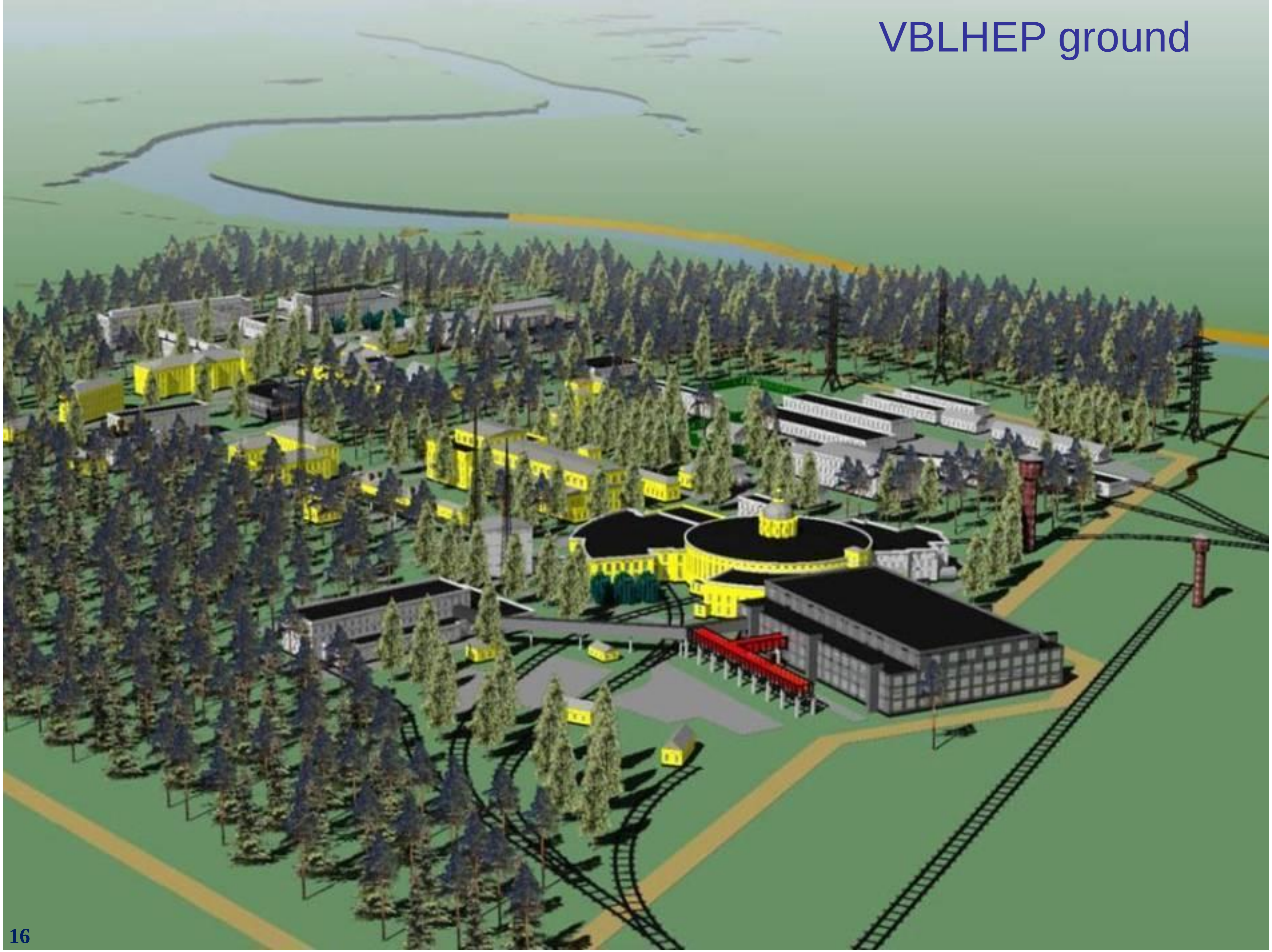
# Facility Scheme and Operation Scenario



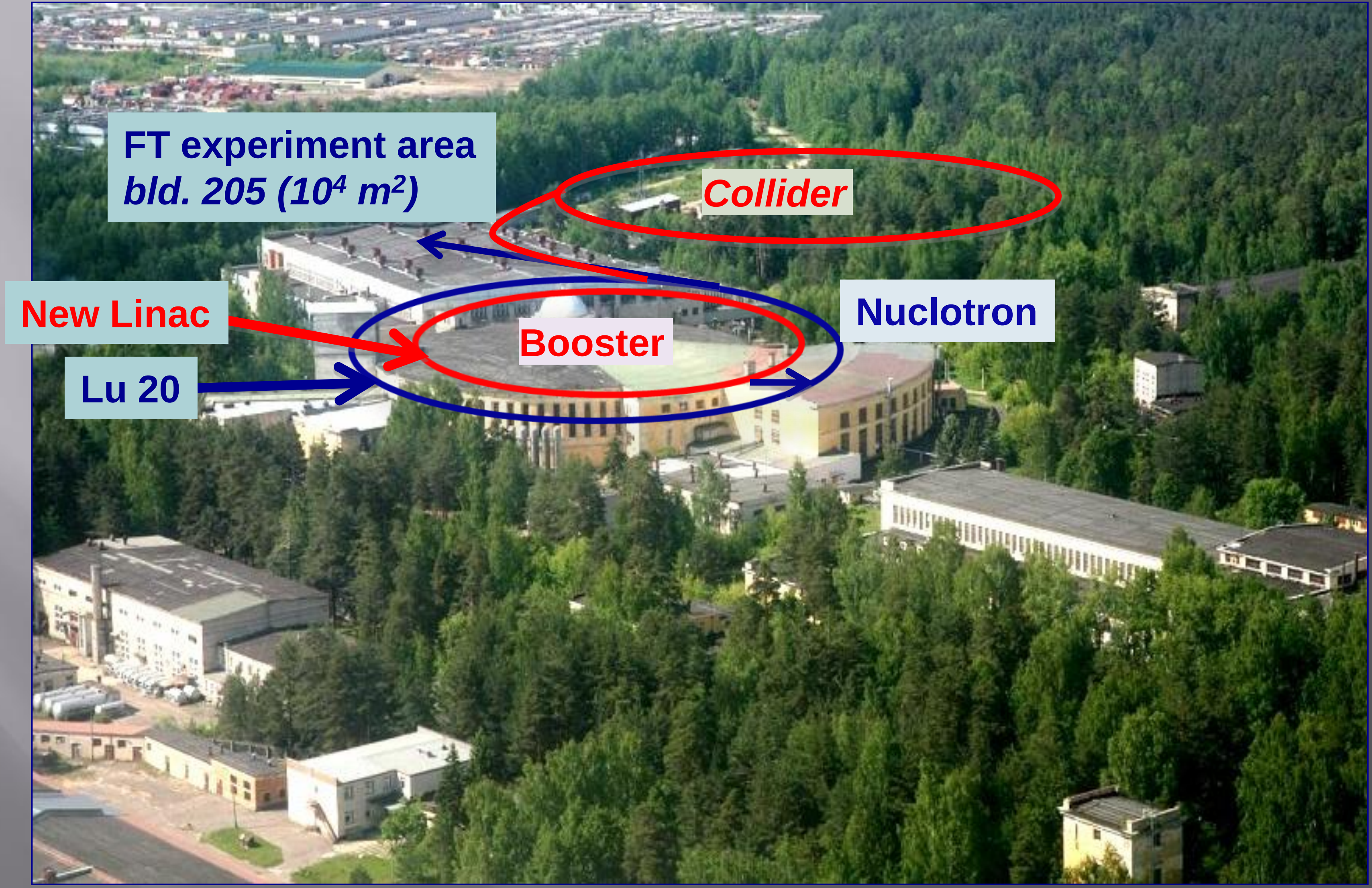
# LNP ground



# VBLHEP ground



# NICA



FT experiment area
bld. 205 (10⁴ m²)
Collider
New Linac
Booster
Nuclotron
Lu 20

| Beam | Nuclotron beam intensity (particle per cycle) | | |
|---|---|---|---|
| | Current | Ion source type | New ion source + booster |
| p | $3 \cdot 10^{10}$ | Duoplasmotron | $5 \cdot 10^{12}$ |
| d | $3 \cdot 10^{10}$ | --- ,, --- | $5 \cdot 10^{12}$ |
| $^{4}He$ | $8 \cdot 10^{8}$ | --- ,, --- | $1 \cdot 10^{12}$ |
| d↑ | $2 \cdot 10^{8}$ | SPI | $1 \cdot 10^{10}$ |
| $^{7}Li$ | $8 \cdot 10^{8}$ | Laser | $5 \cdot 10^{11}$ |
| $^{11,10}B$ | $1 \cdot 10^{9,8}$ | --- ,, --- | |
| $^{12}C$ | $1 \cdot 10^{9}$ | --- ,, --- | $2 \cdot 10^{11}$ |
| $^{24}Mg$ | $2 \cdot 10^{7}$ | --- ,, --- | |
| $^{14}N$ | $1 \cdot 10^{7}$ | ESIS ("Krion-6T") | $5 \cdot 10^{10}$ |
| $^{24}Ar$ | $1 \cdot 10^{9}$ | --- ,, --- | $2 \cdot 10^{11}$ |
| $^{56}Fe$ | $2 \cdot 10^{6}$ | --- ,, --- | $5 \cdot 10^{10}$ |
| $^{84}Kr$ | $1 \cdot 10^{4}$ | --- ,, --- | $1 \cdot 10^{9}$ |
| $^{124}Xe$ | $1 \cdot 10^{4}$ | --- ,, --- | $1 \cdot 10^{9}$ |
| $^{197}Au$ | - | --- ,, --- | $1 \cdot 10^{9}$ |

# Energy of beams extracted from Nuclotron

covers the gap between SIS-18 and AGS *(with some overlaps)*

| | *Z/A* | ***max*** $\sqrt{s_{NN}}$ *(GeV/n)* | ***max.*** $T_{kin}$ *(GeV/n)* |
|---|---|---|---|
| ***p*** | ***1*** | ***≈ 5.2*** | ***≈ 12*** |
| ***d*** | ***1/2*** | ***≈ 3.8*** | ***≈ 5.7*** *(including polarized deuterons)* |
| ***Au*** | ***0.4*** | ***≈ 3.5*** | ***≈ 4.5*** *(at **2T** in dipoles)* |

**It allows:**

- *study of dense baryonic matter at temperatures up to **100** MeV,*
- *(multi)strangeness (open & hidden) production in dense baryonic matter,*
- *modification of particle properties in dense nuclear matter*

The corresponding multi-purpose setup

***Baryonic Matter at Nuclotron (BM@N)***

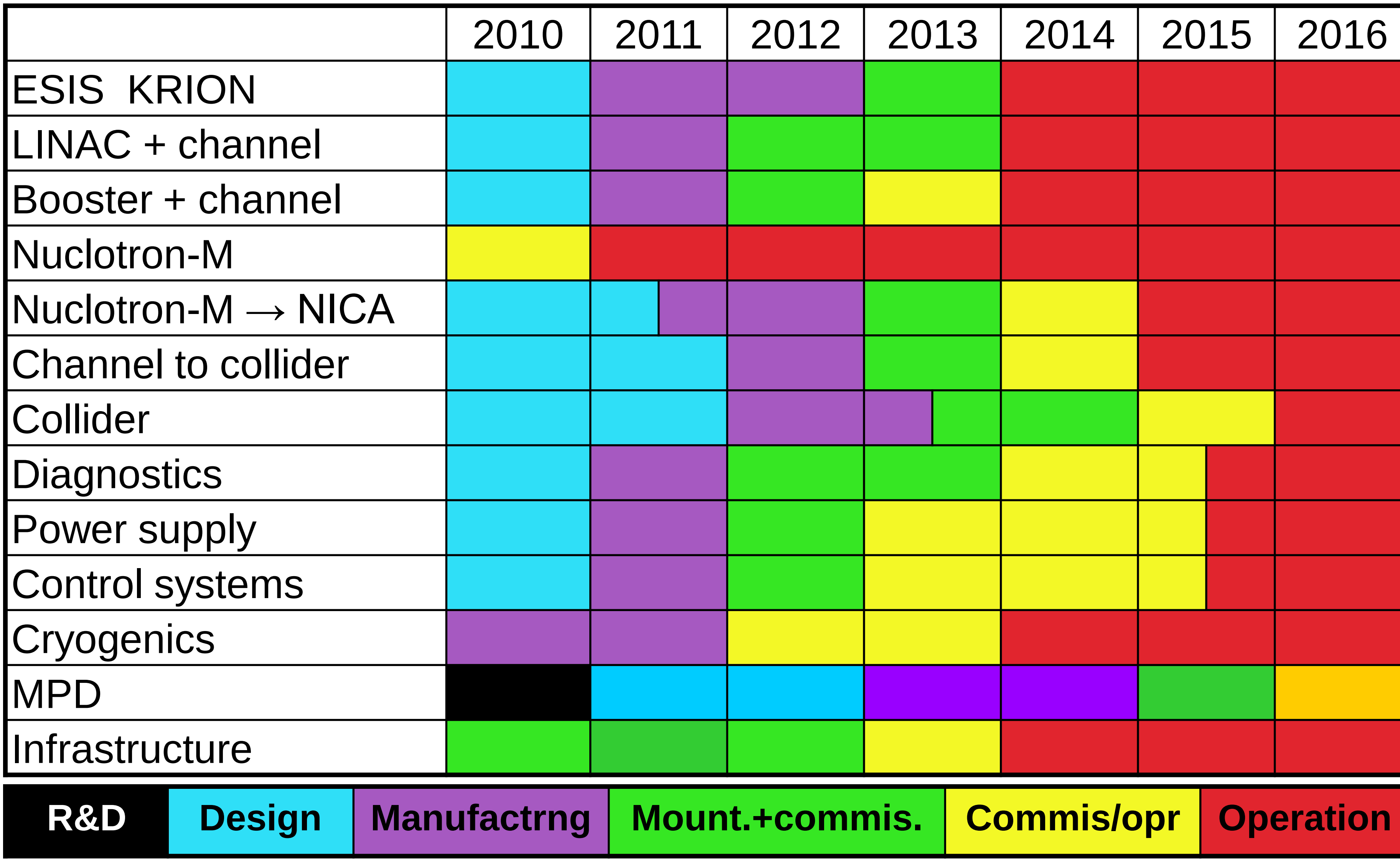
The NICA design passed the stage of concept formulation and is presently under

- ✓ detailed simulation of accelerator parameters,
- ✓ development of working project,
- ✓ manufacturing and construction of prototypes,
- ✓ preparation of the project for state expertise

in accordance with regulations of Russian Federation.

The project realization plan foresees a staged construction and commissioning of accelerators forming the facility. The main goal is the facility commissioning in 2016.

# NICA construction schedule



# *MPD: tasks and challenges*

- ***bulk observables (hadrons): 4p particle yields (OD, EOS)***
- ***event-by-event fluctuation in hadron productions (CEP)***
- ***femtoscopic correlations involving π, K, p, Λ (OD)***
- ***flows (directed, elliptic,…) for identified hadron species (EOS,OD)***
- ***multistrange hyperon production: yields & spectra (OD, EOS)***
- ***electromagnetic probes (CSR, OD)***
- ***hypernuclei (DM)***
- ***local parity violation (P-odd effects)***

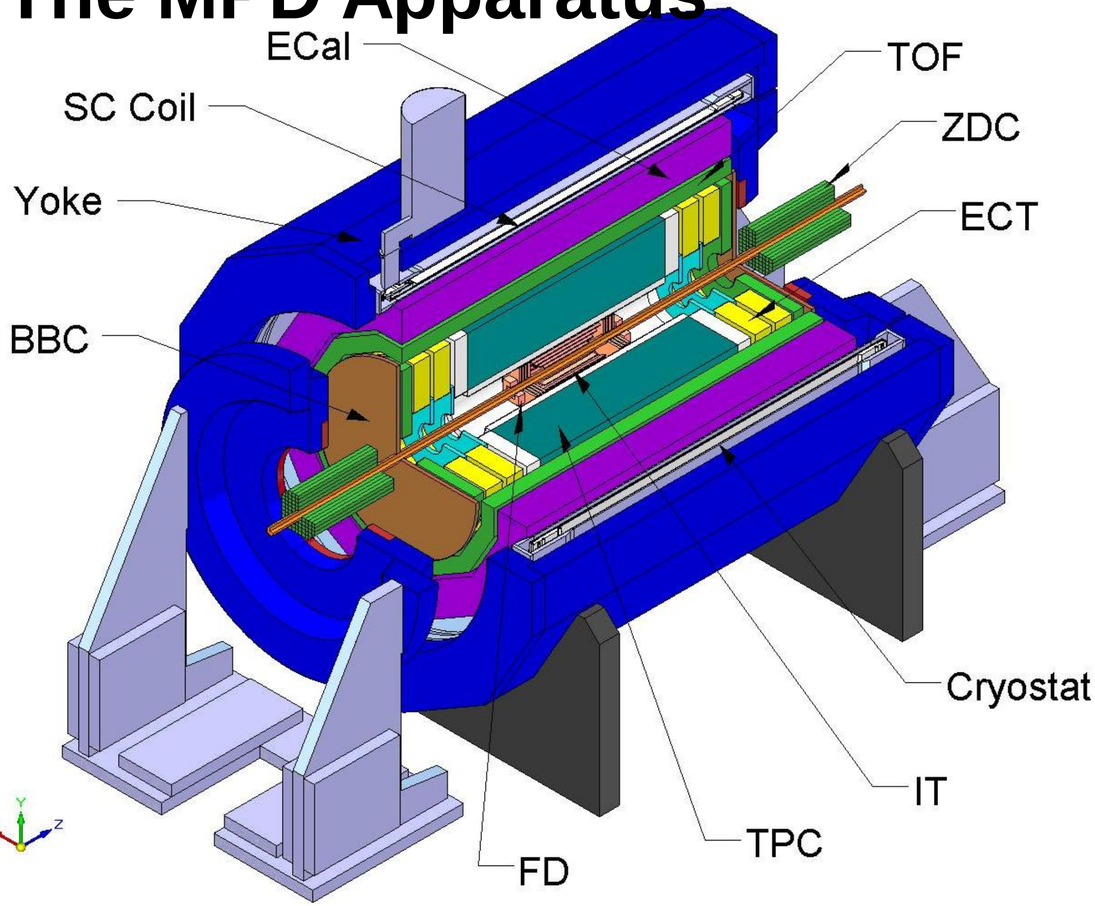
**OD** – Onset of Deconfinement
**CEP** – Critical End Point
**DM** – Dense Matter

**CSR** – Chiral Symmetry Restoration
**EOS** – Equation Of State

**Challenges:**

- **Vast nomenclature of colliding systems – from p+p to Au+Au**
- **simultaneous observation of a variety of phenomena**
- **Small effects over large kinematical range, sensitivity to acceptance constrains (‘correlations & fluctuations’ studies)**
- **Pattern recognition in high track multiplicity environment**

# The MPD Apparatus



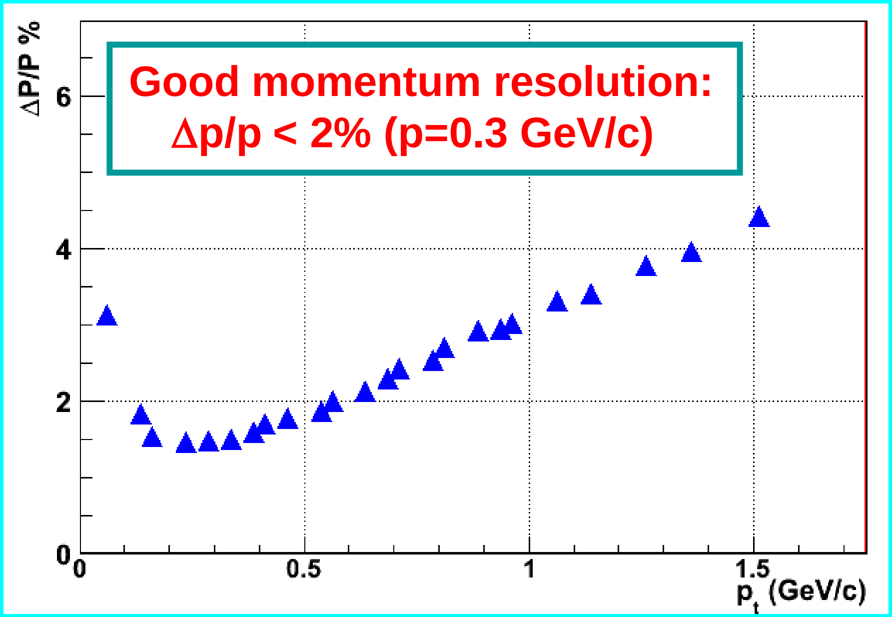

- **Active volume**
  **5 m (length) x 4 m (diameter)**
- **Magnet**
  **0.5 T superconductor**
- **Tracking**
  **TPC & straw EndCapTracker & silicon pixels (IT) for vertexing**
- **ParticleID**
  **hadrons(TPC+TOF), $\pi^0$,$\gamma$ (ECAL), $e^+e^-$(TPC+TOF+ECAL)**
- **Centrality & T0 timing**
  **ZDC FD**

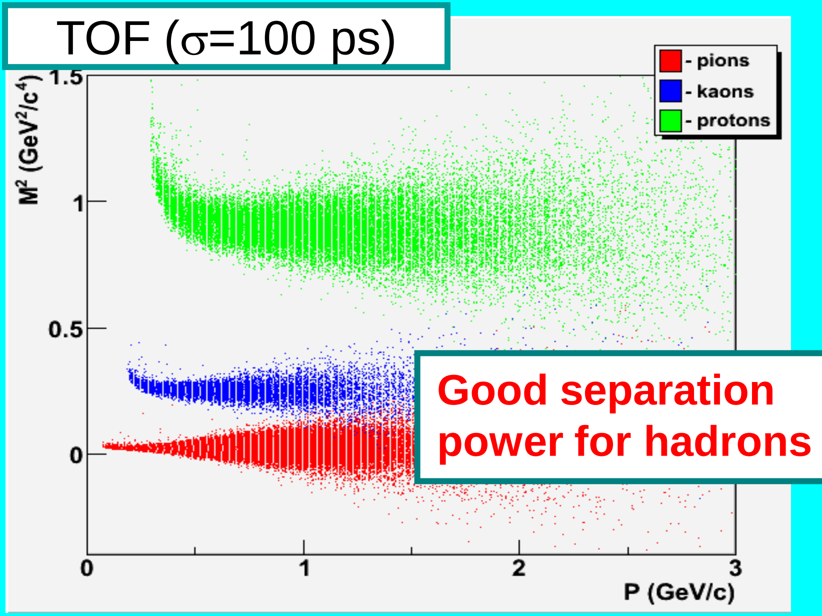
**MPD Advantages:**

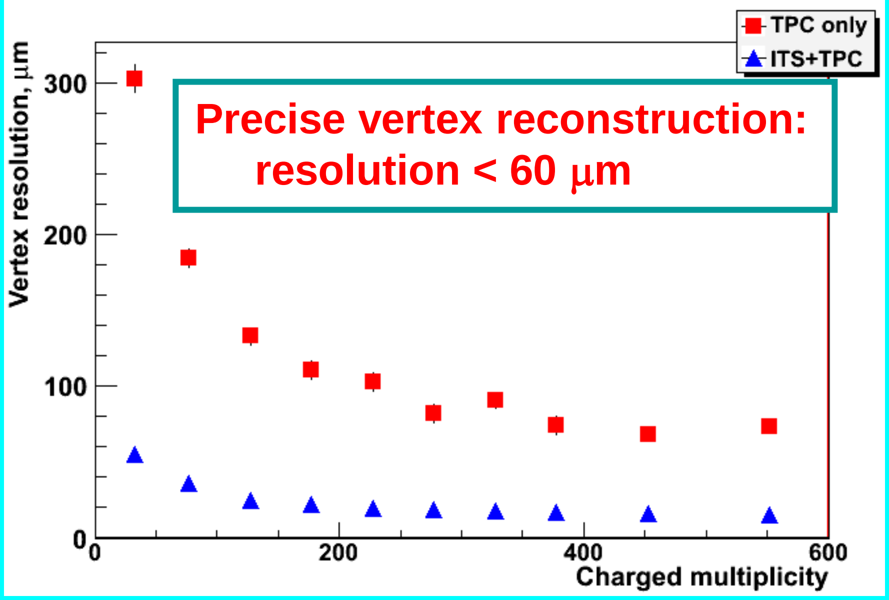
- **Hermeticity, homogenous acceptance (2$\pi$ in azimuth), low material budget**
- **Excellent tracking performance and powerful PID**
- **High event rate capability and careful event characterization**

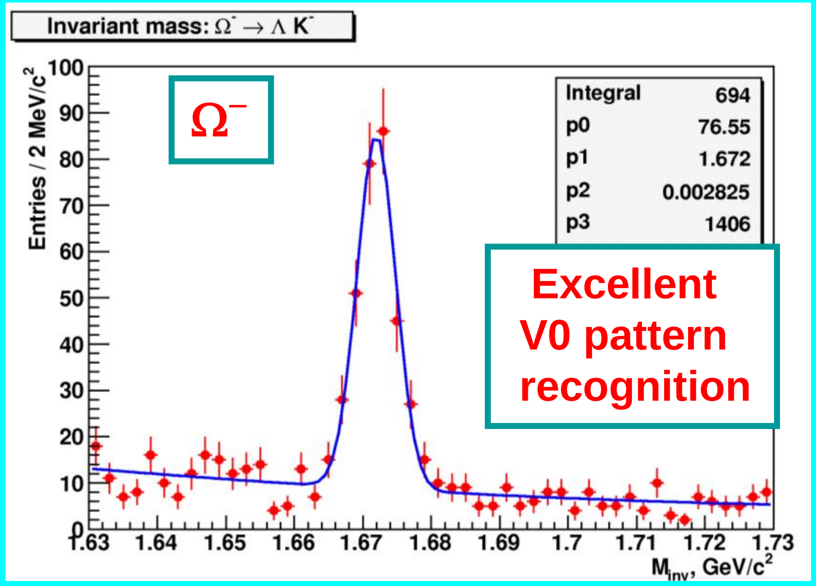
# MPD tracking and PID performance

(realistic detector simulation)

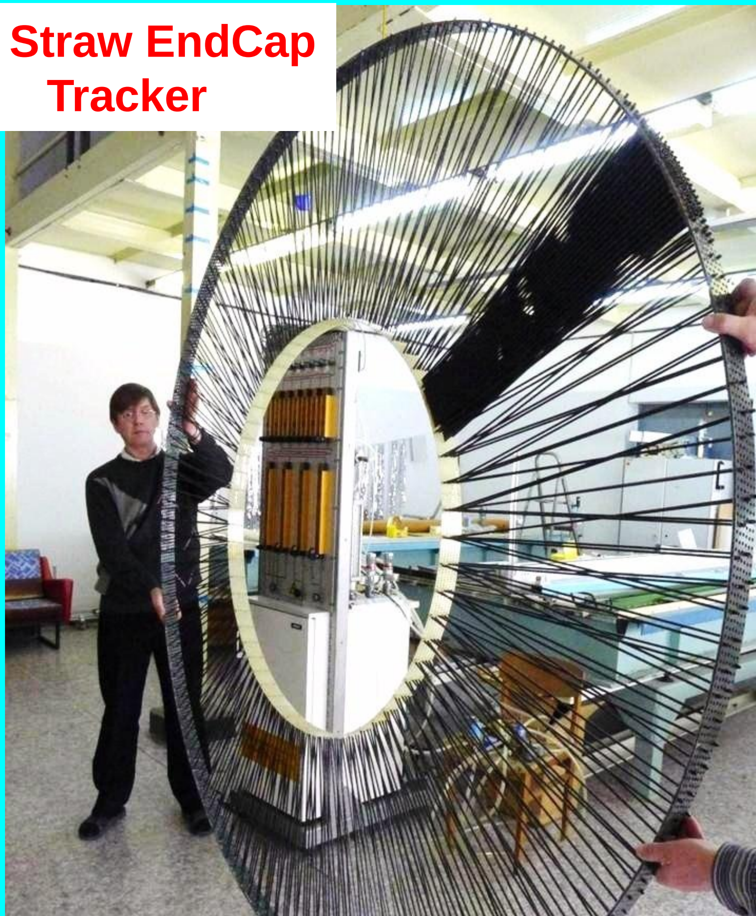


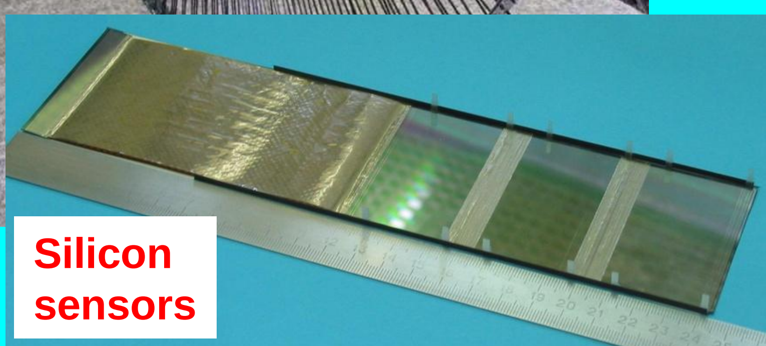



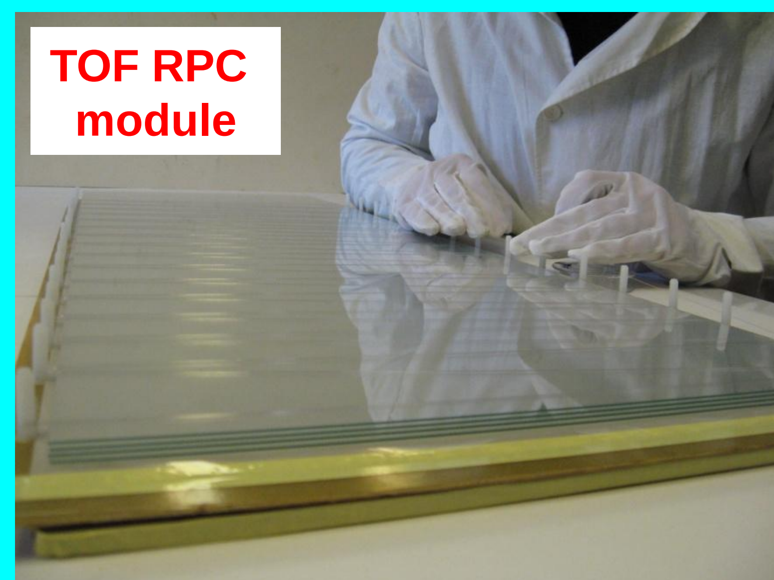



# Progress in R&D and prototyping for MPD

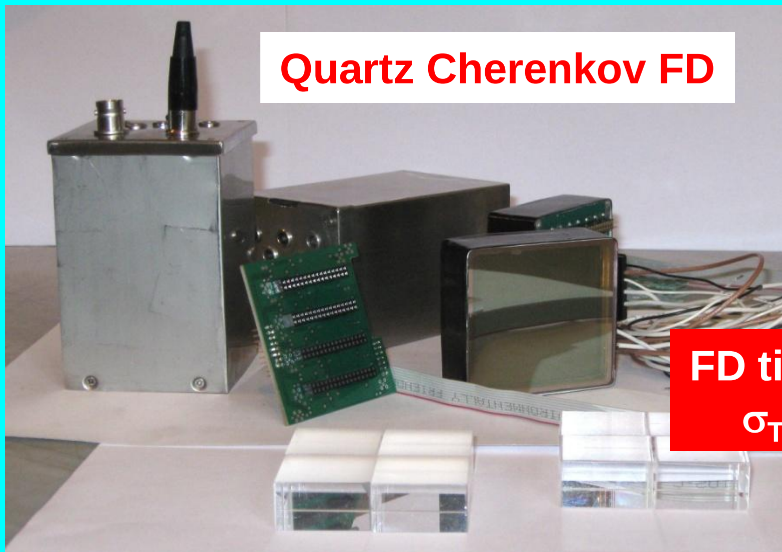

Straw EndCap Tracker

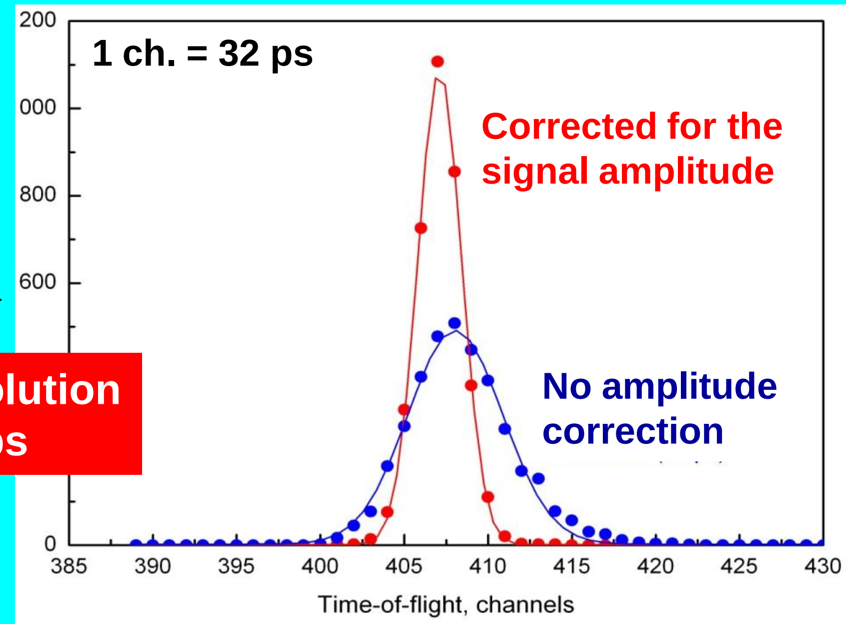

TPC prototype


Silicon sensors

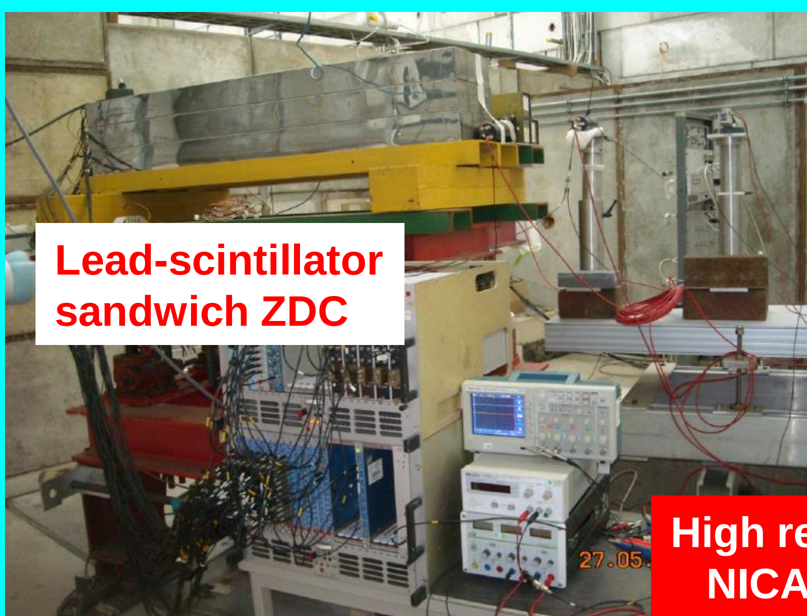

TOF RPC module

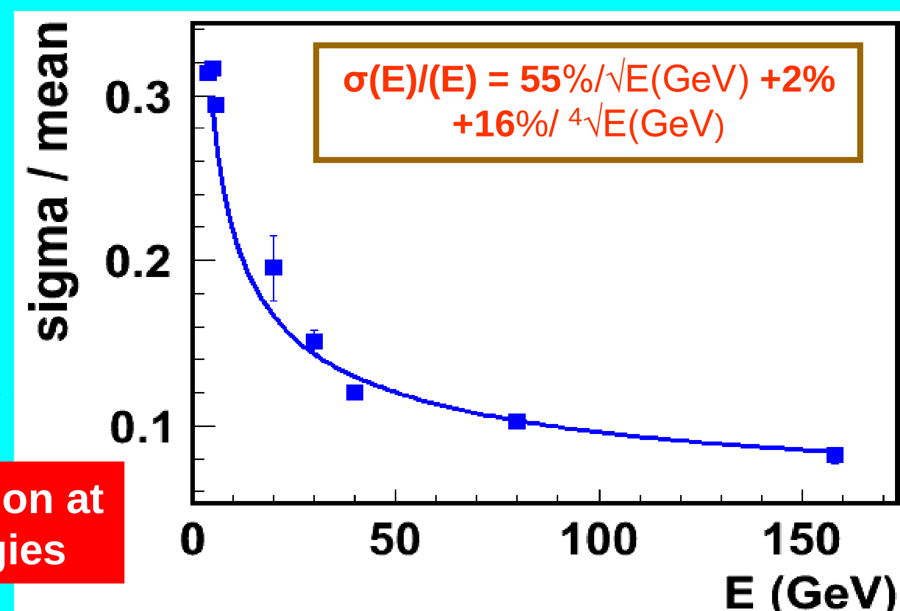
# Successful beam tests of the FD and ZDC prototypes at Nuclotron and SPS




**FD time resolution $\sigma_{TOF} < 30$ ps**



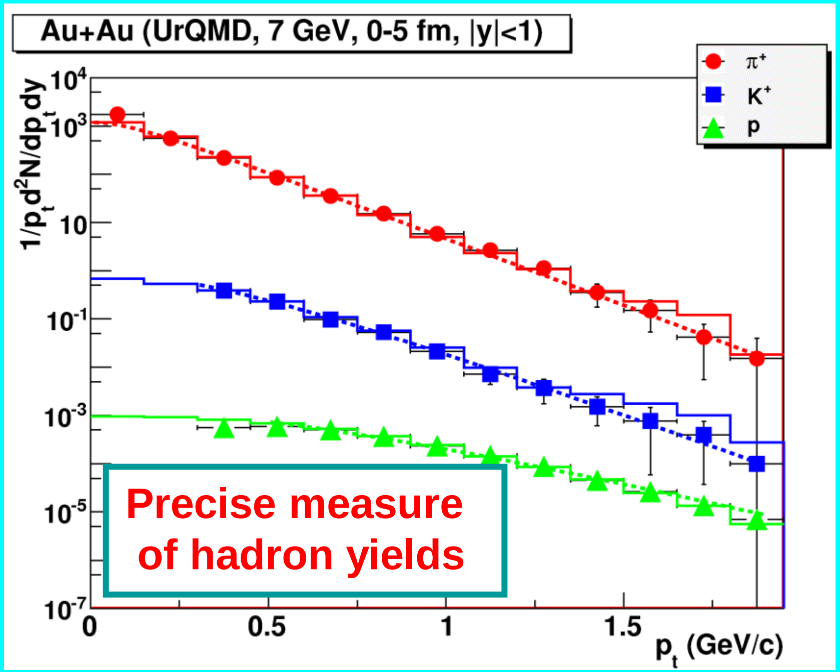



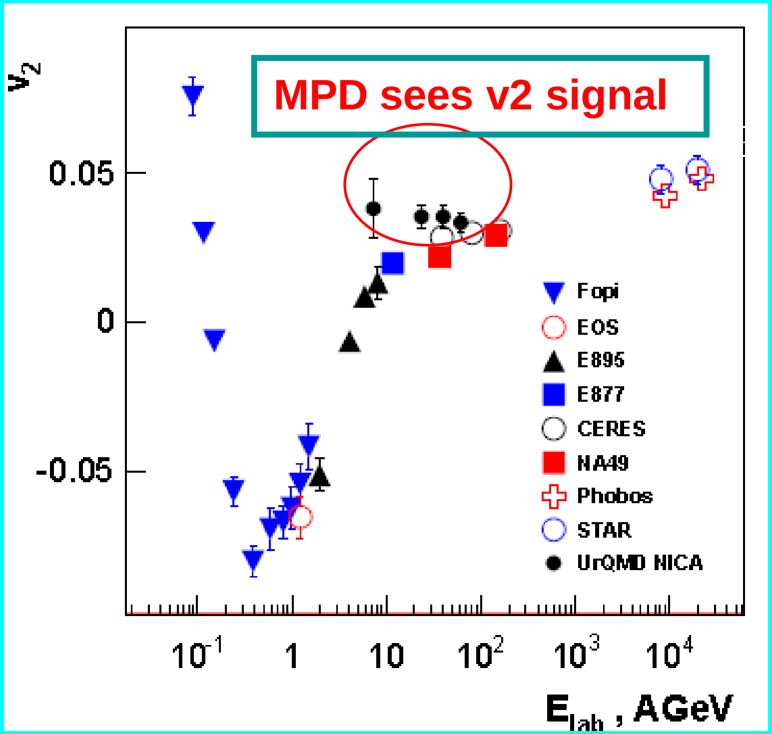

**High resolution at NICA energies**

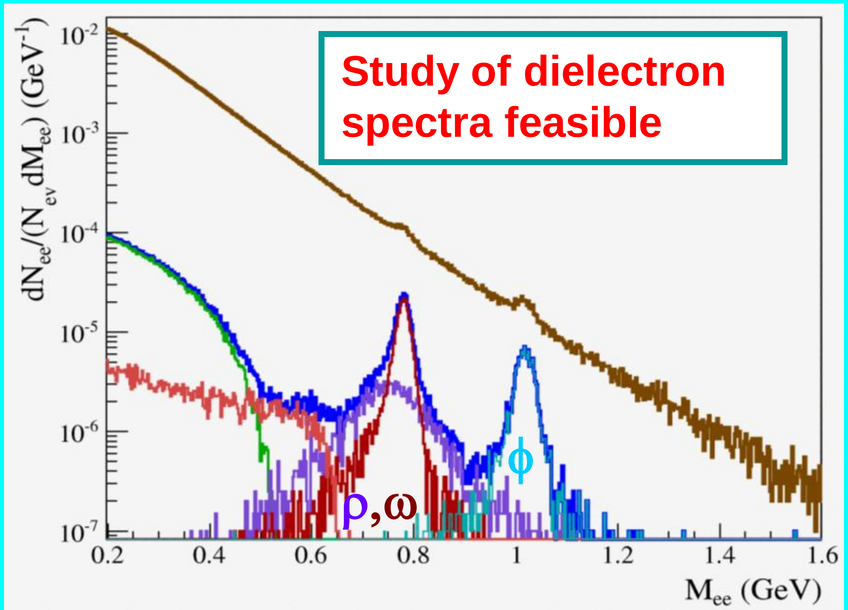
# MPD feasibility studies

**Real MPD simulation and reconstruction algorithms:**

- pT-spectra of hadrons
- Invariant mass of dielectrons
- Event plane and flow



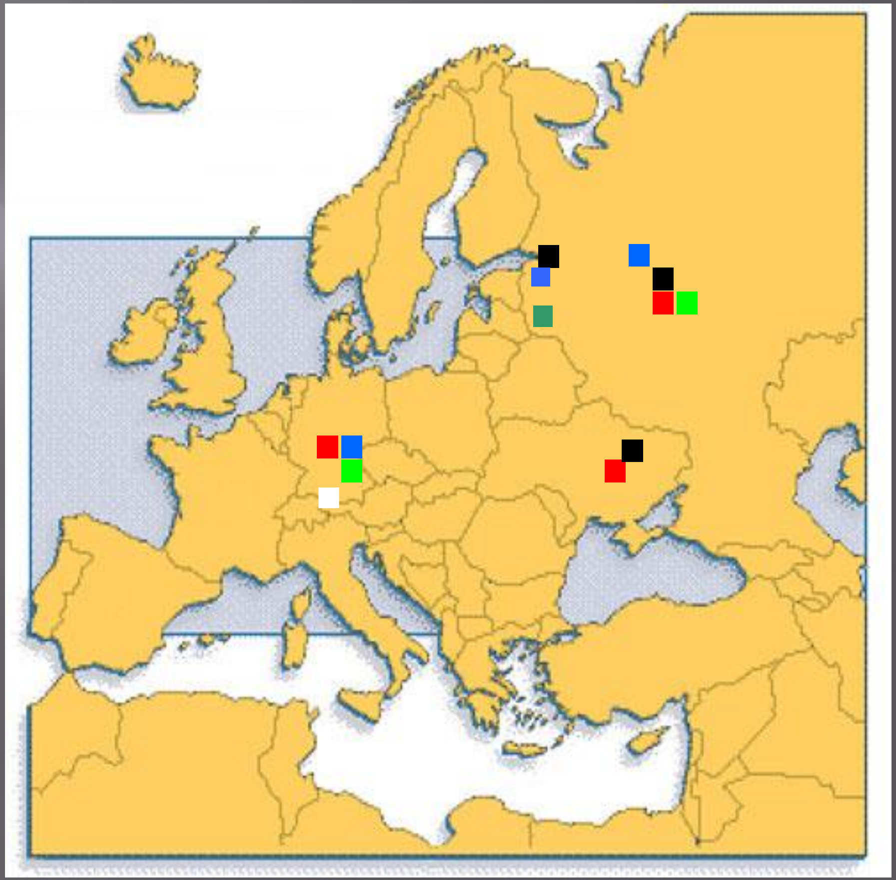
# The CBM/FAIR-MPD/NICA Consortium

- **7 institutes**
- **3 countries**

**CBM @ FAIR (Darmstadt)**

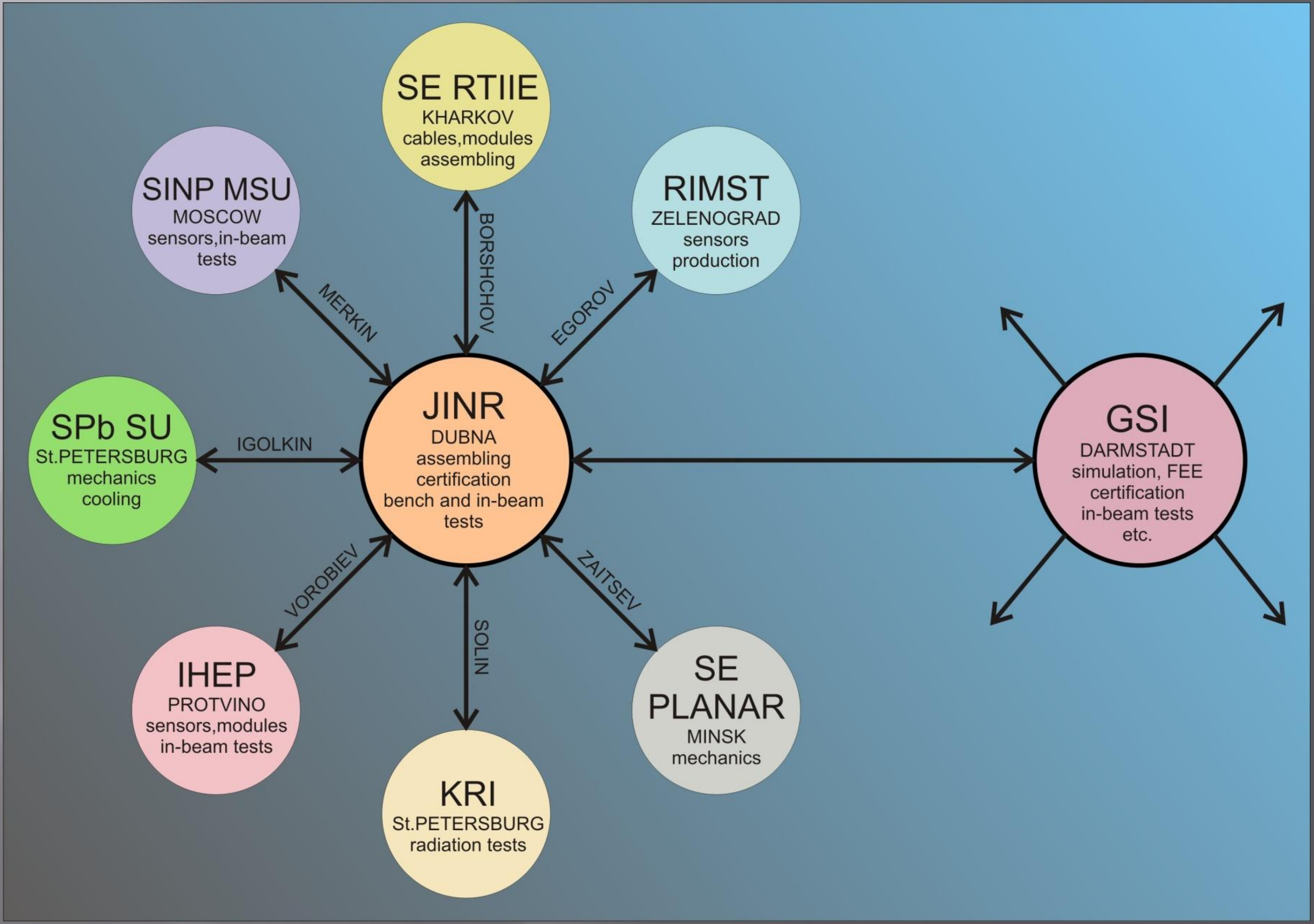
**MPD @ NICA (Dubna)**

- **GSI**, Darmstadt, Germany
- **JINR**, Dubna, Russia
- IHEP, Protvino, Russia
- MSU, Moscow, Russia
- KRI, St.Petersburg, Russia
- University, St.Petersburg
- SE SRTIIE, Kharkov, Ukraine



- Modules assembly
- Components
- Ladder assembly
- Radiation tests
- In-beam tests

# The CBM-MPD Consortium Structure



# Timetable of MPD construction and commissioning

| | Stage/Year | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|---|
| | **Budget profile for MPD ----→** | 1080 | 12500 | 15500 | 9300 | 2560 | **40940** |
| **1** | **Experimental Hall** | | | | | | |
| | NICA Hall Construction | | | | | | |
| | Electricity,water & infrastructure | | | | | | |
| | Crane(construction & certification) | | | | | | |
| **2** | **Superconducting Magnet** | | | | | | |
| | Magnet TDR and Tender | | | | | | |
| | Call for Tender-Yoke,SC,trim coils | | | | | | |
| | Contracts signing | | | | | | |
| | Construction of Iron York & SC | | | | | | |
| | Transportation | | | | | | |
| | Cryogenics for Solenoid | | | | | | |
| | Assembling & Commiss. of Solenoid | | | | | | |
| | Field measurements | | | | | | |
| **3** | **TPC** | | | | | | |
| | TPC Assembling workshop | | | | | | |
| | TPC Construction | | | | | | |
| | TPC tests | | | | | | |
| | TPC installation and Commissioning | | | | | | |
| **4** | **TOF** | | | | | | |
| | TOF Assembling area | | | | | | |
| | Test area of TOF mRPC | | | | | | |
| | TOF Mass Production and test | | | | | | |
| | TOF installation & Commissioning | | | | | | |
| **5** | **ECal modules production** | | | | | | |
| | ECal Assembling in sectors | | | | | | |
| | ECal installation & Commissioning | | | | | | |
| **6** | **ZDC construction and installation** | | | | | | |
| **7** | **Electronics, Network and** | | | | | | |
| | DAQ production &implementation | | | | | | |
| | Control Room construction | | | | | | |
| | Slow Control system implementation | | | | | | |
| | Computing for Data taking & network | | | | | | |
| **8** | **Detector Assembling** | | | | | | |
| **9** | **Commissioning and Cosmic Tests** | | | | | | |

**Start up minimum**

**http://nica.jinr.ru**

Version 1.4

# The MultiPurpose Detector – MPD

*to study Heavy Ion Collisions at NICA*
*(Conceptual Design Report)*

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Skobeltsyn Institute of Nuclear Physics Moscow State University

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Institute of Applied Physics, AS, Moldova

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& Technology Research Institute for Apparatus
raine

Particle Physics Center of Belarusian State University

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Physics Institute Az.AS, Azerbaidjan

T.K.Koshurnikov
"Neva-Magnet" S&E, ltd, St-Petersburg, Russia


**The MPD Collaboration consists of about 180 scientists from:**

- JINR ~ 100
- Other Institutions 80

**Participating Institutions:**

- JINR
- 15 Institutes from 8 countries

**The size of the Collaboration is growing continuously and new members are welcome!**

## Strange matter production in heavy ion collisions at the Nuclotron extracted beam:
## Baryonic Matter at Nuclotron (BM@N)

- Collaboration **GSI-JINR** (preparation of the joint experiment has started)
- The goal of the experiment is the systematic measurements of the observables for multistrange objects ($\Xi^-$, $\Omega^-$, exotics) in Au-Au collisions in the energy domain of the Nuclotron extracted beam (up to 5 A GeV)

NICA

Workshop

**Fixed Target@Nuclotron-N and SIS100@FAIR**

**Detector R&D, Synergies and Physics Opportunities**

GSI Helmholtz Centre, 2010 November 3rd

**Wednesday, November 3rd**

**GSI WD-Zimmer**

| | | |
|---|---|---|
| 09:30 – 09:45 | **Welcome and Goals of the Meeting** | H. Stöcker |

Chair: A. Sorin

| | | |
|---|---|---|
| 09:45 – 11:00 | **Technical Status of the Facilities** | |
| Nuclotron-M: Status of the Facility and the New Fixed Target Program | | V. Kekelidze |
| Towards Nuclotron-N@JINR & SIS100@FAIR Physics Program | | H. Stöcker /A. Sorin |
| *Coffee Break* | | |

Chair: G.Trubnikov

| | | |
|---|---|---|
| 11:15 – 12:15 | **Nuclear Structure Physics** | |
| Nuclear Structure and Nuclear Astrophysics opportunities with RIBs | | G. Martinez-Pinedo |
| Status of R3B | | T. Aumann / H.Simon |
| *Lunch Break (small Lunch incl. coffee / WD-Zimmer)* | | |

Chair: V. Kekelidze

| | | |
|---|---|---|
| 13:00 – 15:00 | **Nuclear Matter Physics** | |
| Status of the HADES Upgrade, recent results | | R. Holzmann / J. Pietraszko |
| Status of FOPI, recent results | | N. Herrmann |
| Nuclear Matter Physics at Nuclotron and SIS100 energies | | P. Senger |
| Status of R&D CBM | | W. Müller |
| The STS Consortium | | J. Heuser |
| *Coffee Break* | | |

| | | |
|---|---|---|
| 15:15 – 17:00 | **Final Panel Discussion:** | |
| **Synergies and Joint R&D Projects** | | Chair: H. Stöcker |
| 17:30 *Dinner at the GSI Guesthouse* | | |

# *Study of dense baryonic matter at < 6 GeV/n*

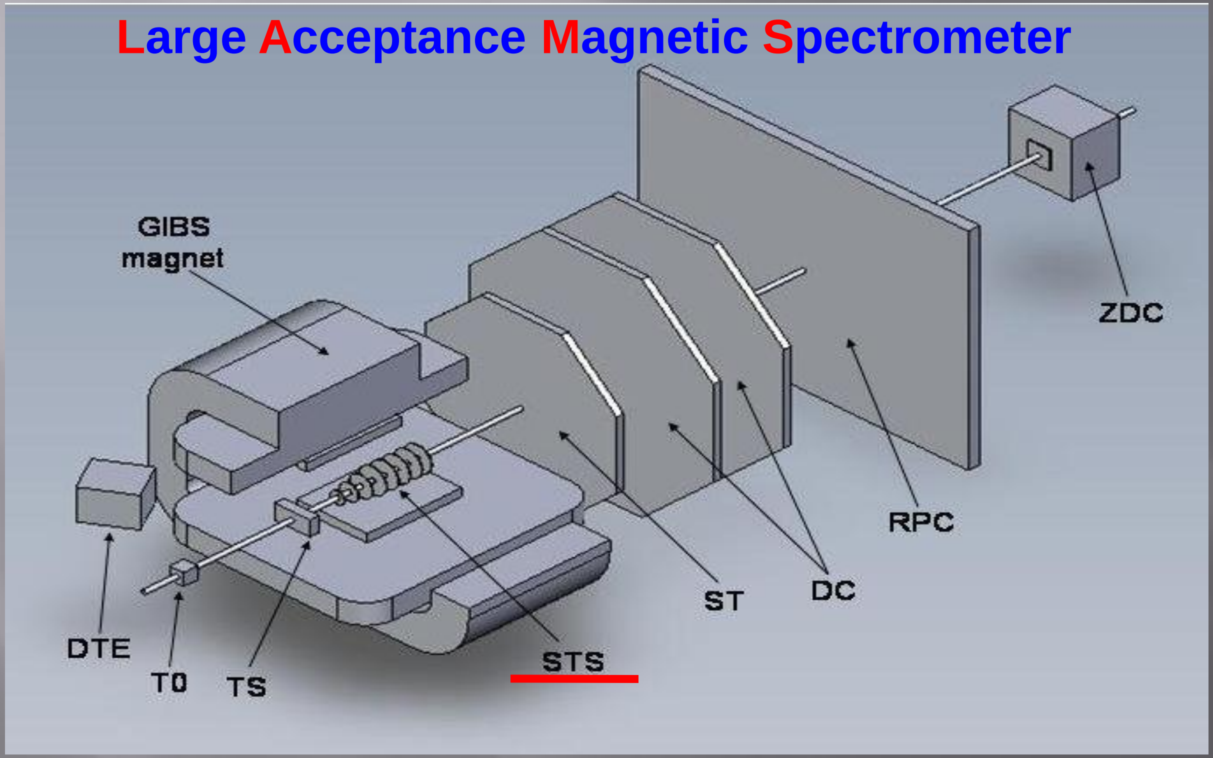
***Physics is complementary to the MPD program***
***& will be actual even after start of the MPD runs:***

- **AA interactions:**
  - particle production, incl. subthreshold one;
  - particle(collective) flows, event-by-event fluctuations, correlations;
  - multiplicities, phase space distributions of p, n, π, K, hyperons,
    light nuclear fragments, vector mesons, hadronic resonances,
    direct light hypernuclei production in central AA collisions,
  - ratios of yields (π/K etc) in different kinematical regions.

- **pA, nA, dA interactions in direct & inverse** (Ap, Ad) **kinematics:**
  - to get a "reference" data set for comparison with AA interactions,
  - to investigate particle modifications in hadronic matter
    advantages of the inverse kinematics (Ap, Ad collisions)
    may play significant role
  - to look for polarization effects in particle production
    off nuclear targets by polarized d, p, n.

# Baryonic Matter at Nuclotron (BM@N)

- **measurements of the multi-strange (Ξ, Ω, exotics) & hypernuclei in HI collisions**
- **close to the threshold production in the region of high sensitivity to the models prediction**



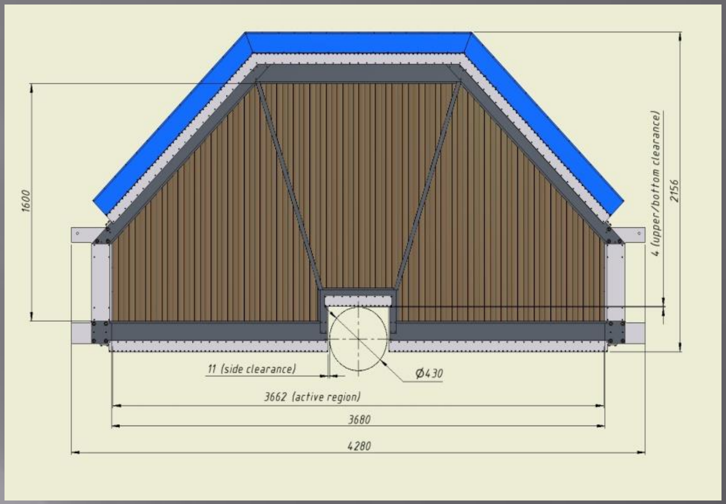

***GIBS magnet (SP-41)***

***TS-target station,***
***T0- start diamond detector,***
***STS - silicon tracker,***
***ST- straw tracker,***
***DC- drift chambers,***
***RPC- resistive plate chambers,***
***ZDC- zero degree calorimeter,***
***DTE – detector of tr. energy.***

- the detector based on the sub-detectors developed for CBM, MPD & SPD

Preparation of the joint GSI - JINR experiment Baryonic Matter at Nuclotron (**BM@N**) has started. **The planned data taking - 2015**

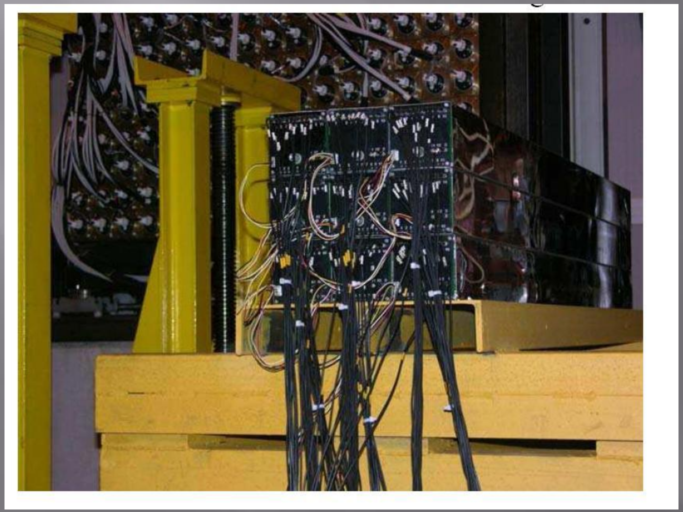
# Main subdetectors (tracking, particle ID & centrality measurements)

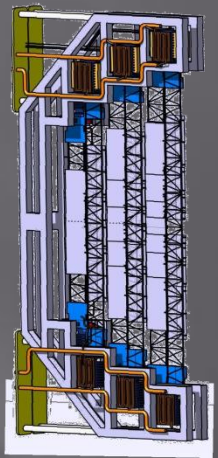



**Straw tracker (CBM/MPD)**

**Outer Tracker: NA48 drift chambers**

**RPC TOF**





**Silicon Tracker System (CBM-GSI)**

**ZDC (CBM/MPD -INR, JINR)**

# Time table of the experiment

| Working package | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| Simulations | | | | | | |
| Preparation of experimental site | | | | | | |
| Installation beam line, | | | | | | |
| Installation GIBS magnet | | | | | | |
| Installation beam tube, beam monitors | | | | | | |
| Construction prototype STS | | | | | | |
| Construction SC magnet | | | | | | |
| Construction straw tube tracker | | | | | | |
| Construction TOF-RPC, T0 | | | | | | |
| Construction DAQ, slow-control | | | | | | |
| Installation drift chambers | | | | | | |
| Installation detectors, commissioning | | | | | | |

- **Phase 0 (2011) – The site preparation and simulation**
- **Phase 1 (2012-2014) – The detector construction**
- **Phase 2 (2015-.....) - The data taking**



NICA

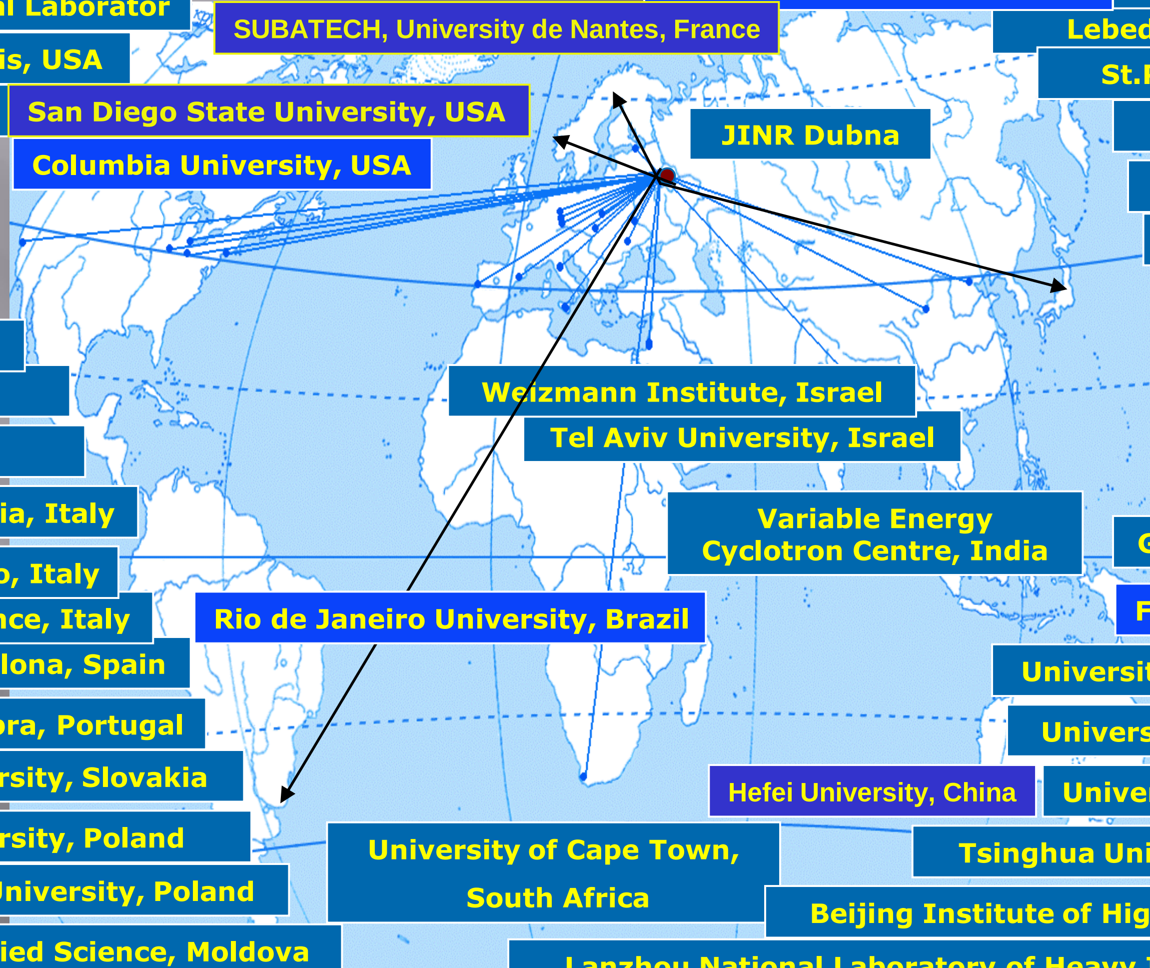
Draft v 5.01
June 20, 2011

SEARCHING for a QCD MIXED PHASE at the NUCLOTRON-BASED ION COLLIDER FACILITY
(NICA White Paper)

**http://theor.jinr.ru/twiki-cgi/view/NICA/WebHome**

# The NICA White Paper

**140 authors** *from* **56 scientific centers** *in* **21 Countries (8 JINR members)**



- Arizona State University, USA
- University of Oslo, Norway
- Lulea Technical University, Sweden
- Kurchatov Institute, Russia
- Los Alamos National Laborator
- SUBATECH, University de Nantes, France
- Lebedev Institute, Russia
- University of Illinois, USA
- St.Petersburg SU, Russia
- Wayne SU, USA
- San Diego State University, USA
- JINR Dubna
- IHEP, Russia
- LBNL, USA
- Columbia University, USA
- ITEP, Russia
- BNL, USA
- INP MSU, Russia
- Ohio SU, USA
- MEPhI, Russia
- BITP, Ukraine
- INR, Russia
- INFN, Italy
- Weizmann Institute, Israel
- Osaka University, Japan
- Tel Aviv University, Israel
- SISSA, Italy
- YITP Kyoto, Japan
- University of Catania, Italy
- Variable Energy Cyclotron Centre, India
- GSI Darmstadt, Germany
- University of Trento, Italy
- FIAS Frankfurt, Germany
- University of Florence, Italy
- Rio de Janeiro University, Brazil
- University of Barselona, Spain
- University of Frankfurt, Germany
- University of Coimbra, Portugal
- University of Giessen, Germany
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- Hefei University, China
- University of Bielefeld, Germany
- Wroclaw University, Poland
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- Tsinghua University, Beijing, China
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- Beijing Institute of High Energy Physics, China
- Institute of Applied Science, Moldova
- Lanzhou National Laboratory of Heavy Ion Accelerator, China

http://theor.jinr.ru/twiki-cgi/view/NICA/WebHome

# NICA White Paper - Contents

(68 contributions)

1  Editorial (2)

2  General aspects (6)

3  Phases of QCD matter at high baryon density (11)

4 Hydrodynamics and hadronic observables (12)

5  Femtoscopy, correlations and fluctuations (9)

6  Mechanisms of multi-particle production (6)

7  Electromagnetic probes and chiral symmetry in dense QCD matter (7)

8  Local P and CP violation in hot QCD matter (6)

8  Cumulative processes (2)

10  Polarization effects and spin physics (4)

11  Related topics (3)

12 Fixed Target Experiments (4)

# Chiral Vortaic Effect and Neutron Asymmetries at NICA

O. Rogachevsky, A. Sorin, O. Teryaev

*Phys. Rev. C82 054910, 2010*

Both, chiral magnetic effect (CME) and chiral vortaic effect (CVE) belong to the class of effects based on the triangle anomaly in QFT. CVE is generalized to the conserved charges other than the electric one. In case of baryon charge and chemical potential, it should manifest itself by neutron asymmetries, which can be explored at NICA/MPD.

**The crucial difference of CVE with respect to CME is due to a very small number of produced antibaryons, in particular, antineutrons. Therefore, no sign change for correlators is expected!**

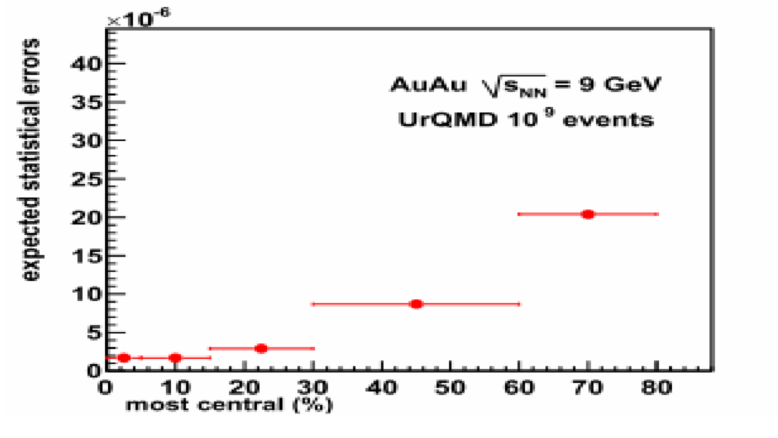
$$e_j A_\alpha J^\alpha \Rightarrow \mu_j V_\alpha J^\alpha$$

$$e_j \vec{H} \rightarrow \mu_j \vec{\nabla} \times \vec{V}$$

$$J_e^\gamma = \frac{N_c}{4\pi^2 N_f} \varepsilon^{\gamma\beta\alpha\rho} \partial_\alpha V_\rho \partial_\beta (\theta \sum_j e_j \mu_j)$$

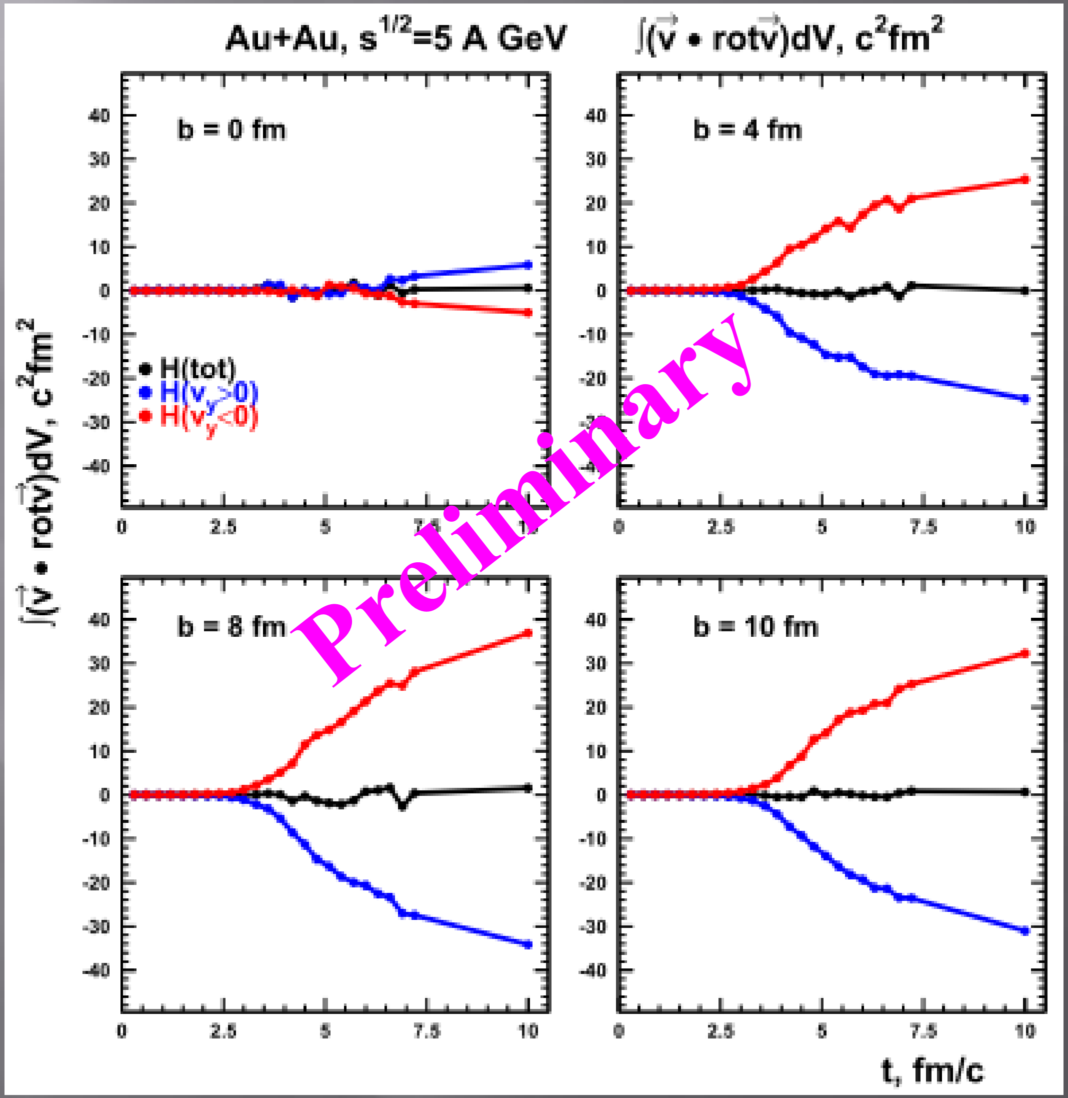
Observable: three-particle correlator: $\langle cos(\phi_\alpha + \phi_\beta - 2\phi_c) \rangle$

**In CME case at RHIC: 15 M events were sufficient to establish the effect.**
**For demonstrating the CVE, we need 1000 M events, which can be collected at NICA/MPD within a few months of running time!**



# Vorticity in DCM (QGSM)

M. Baznat, K. Gudima, A. Sorin, O. Teryaev (in progress)



# The prospects for experimental study of directed, elliptic, and triangular flows in asymmetric heavy ion collisions at NICA energies

M. Bleicher (1,3), K. Bugaev (2), Ph. Rau (1,3),
A. Sorin (4), J. Steinheimer (1,3), H. Stoecker (1,5)
(1) Frankfurt Institute for Advanced Studies, Frankfurt, Germany
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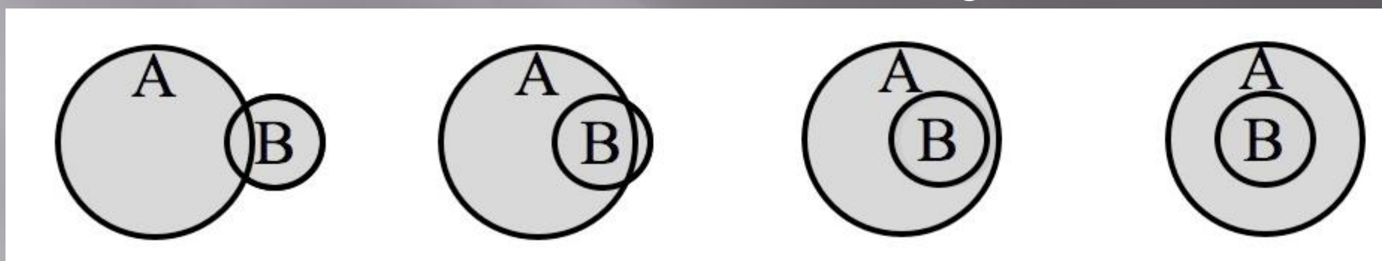


**Proposal:** arXiv:1106.3647

$$\frac{dN}{dy p_T dp_T d\varphi} = \frac{dN}{dy p_T dp_T} \frac{1}{2\pi} \left(1 + 2v_1 \cos(\varphi) + 2v_2 \cos(2\varphi) + v_3 \dots\right)$$

**To explore asymmetric nuclear collisions (ANS) both with extracted Nuclotron beams up to 5 AGeV and with a center of mass energy up to 11 AGeV in the NIICA collider mode. In framework of UrQMD transport model, ANS directed, elliptic, and triangular flows have a very rich and complicated structure of energy and centrality dependencies compared to the flows in symmetric nuclear collisions worth to be investigated experimentally. In addition, ANS directed, elliptic, and triangular flow coefficients for collisions with existing density fluctuations in the target nucleus crucially differ from those obtained in absence of such fluctuations. Such ANS may allow one to reach highest baryonic charge densities and, perhaps, to study a mixed quark-hadron phase even at the Nuclotron energy range. ANS flow patterns are very sensitive to the details of the employed interaction which can be used both for tuning of the transport codes and for elucidation of essential features of hadron interactions in the medium.**

# Round Table Discussions on NICA/MPD@JINR

**Round Table Discussion I: Searching for the mixed phase of strongly interacting matter at the JINR Nuclotron, *July 7 - 9, 2005***
**http://theor.jinr.ru/meetings/2005/roundtable/**

**Round Table Discussion II: Searching for the mixed phase of strongly interacting matter at the JINR Nuclotron: Nuclotron facility development JINR, Dubna, October 6 - 7, 2006**
**http://theor.jinr.ru/meetings/2006/roundtable/**

**Round Table Discussion III: *Searching for the mixed phase of strongly interacting QCD matter at the NICA: Physics at NICA* JINR (Dubna), November 5 - 6, 2008,**
**http://theor.jinr.ru/meetings/2008/roundtable/**

**Round Table Discussion IV: *Searching for the mixed phase of strongly interacting QCD matter at the NICA: Physics at NICA (White Paper)* JINR (Dubna), September 9 - 12, 2009**
**http://theor.jinr.ru/meetings/2009/roundtable/**

**Round Table Discussion V: *Searching for the mixed phase of strongly interacting QCD matter at the NICA: Physics at NICA (White Paper)* JINR (Dubna), August 28, 2010**
**http://theor.jinr.ru/~cpod/Dubna_2010_program2.htm**

*RF Prime Minister V.V. Putin at NICA, 5 July 2011*

# Welcome to the collaboration!

JOINT INSTITUTE FOR NUCLEAR RESEARCH

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NICA

# Thank you for attention!