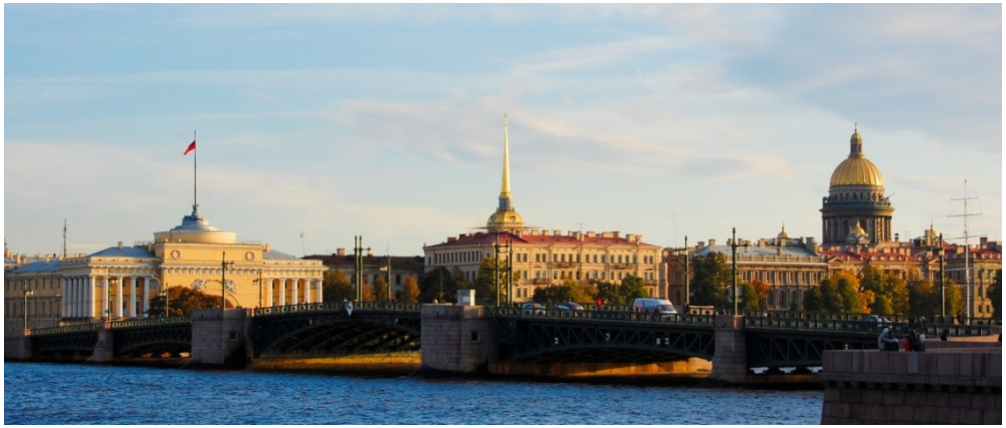


Spin Physics Detector at NICA

V.P. Ladygin on behalf of SPD collaboration

LXXV International Conference NUCLEUS2025

1-6 July, St.Petersburg, Russian Federation

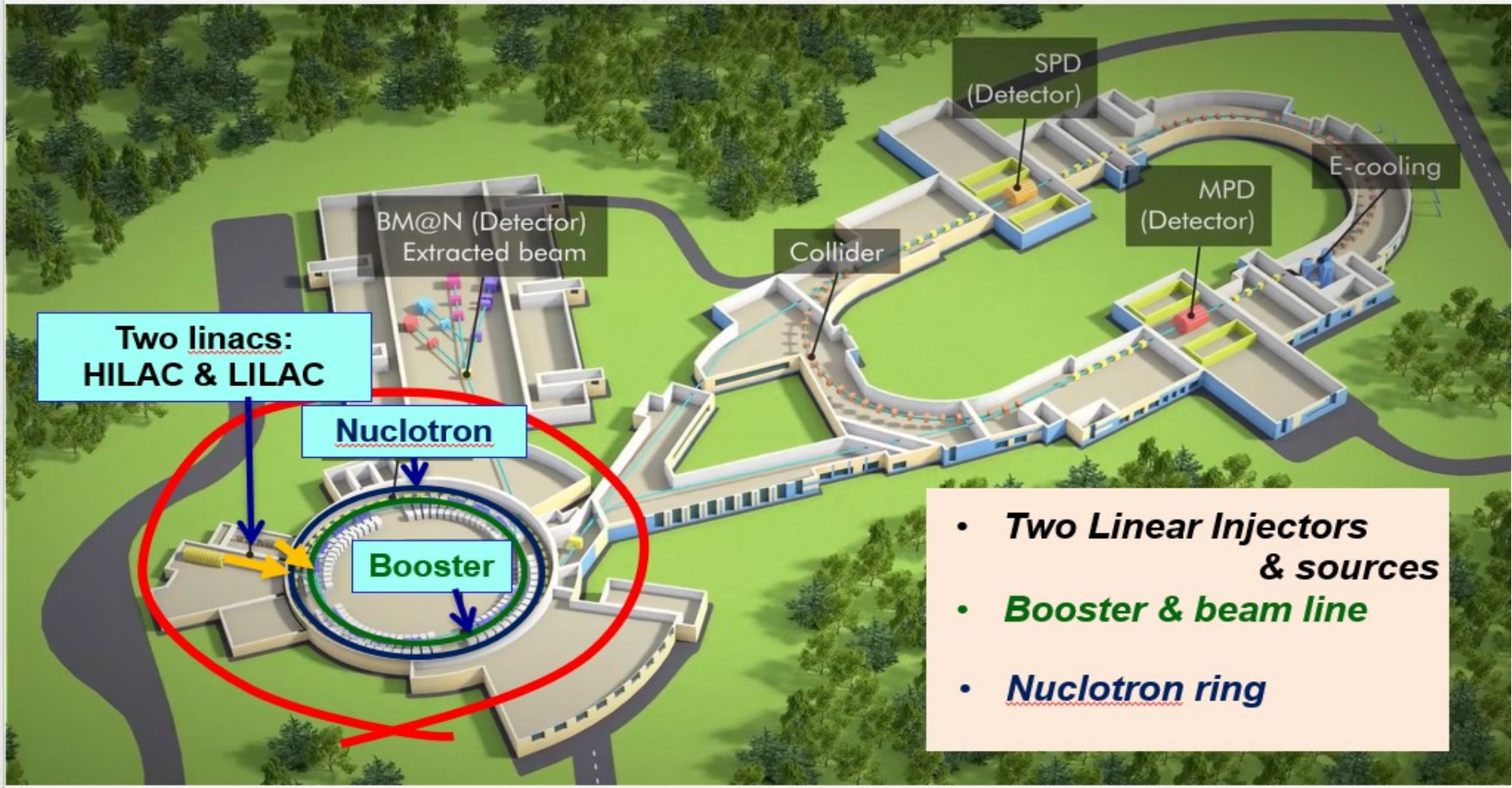
Outline

1. NICA status and requirements to polarized beams
2. Spin Physics Detector and its scientific mission
3. Progress in SPD: hardware and physics performance
4. Near future
5. Conclusions

NICA in 2024

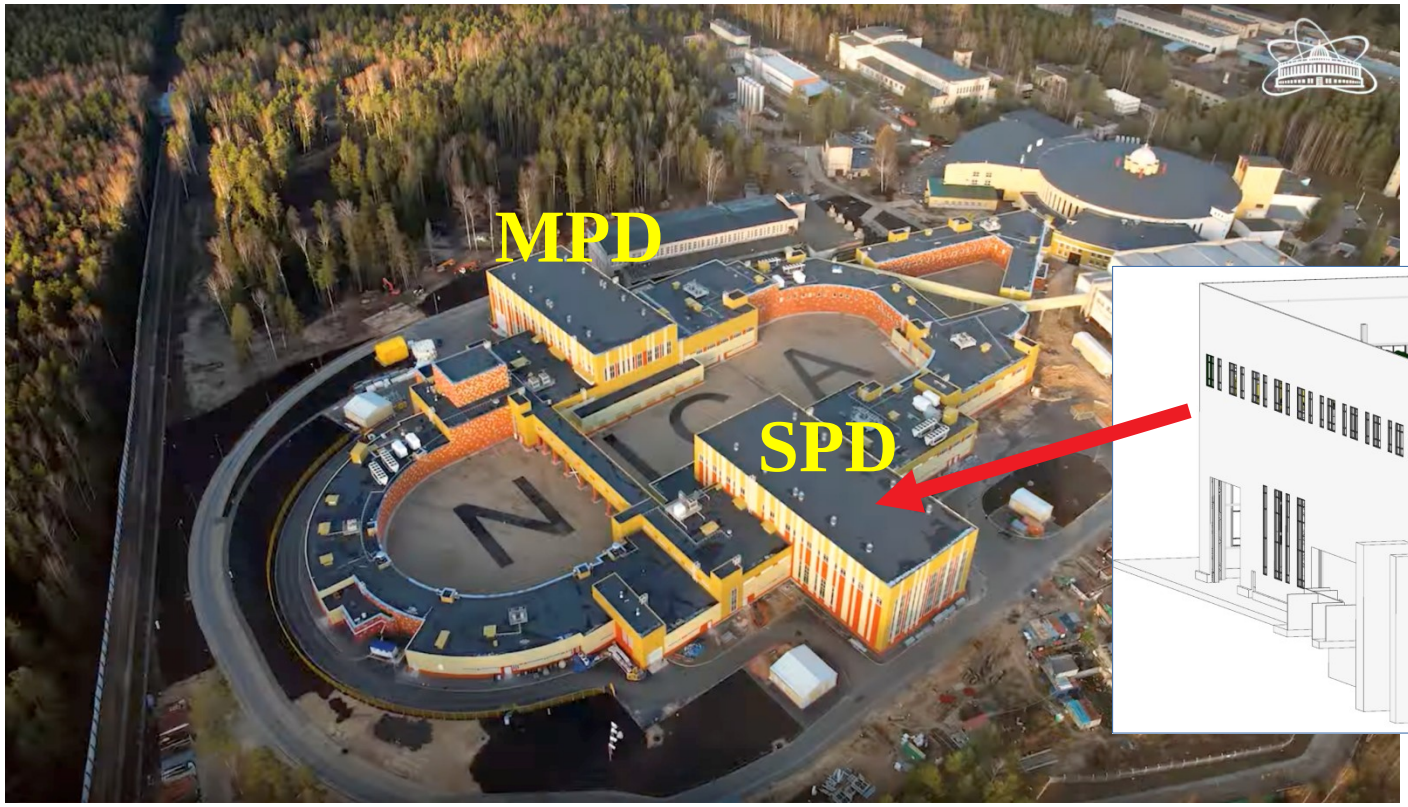
NICA technological launch – 13.06.2024
NICA beam circulation – 2025

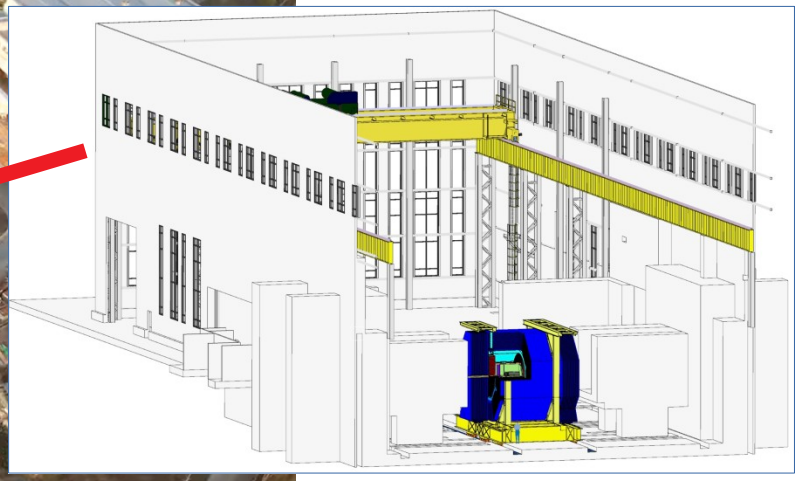
NICA in 2025



Injection complex is already in commissioning for few years (FT mode).
Run-2023 achievements: 5-8·10^{6} ^{124}Xe ions at 3.9 GeV/n.
Run-2025 started in February also with ^{124}Xe.
Injection to NICA is planned to the end of 2025.

SPD at NICA in 2025





SPD hall

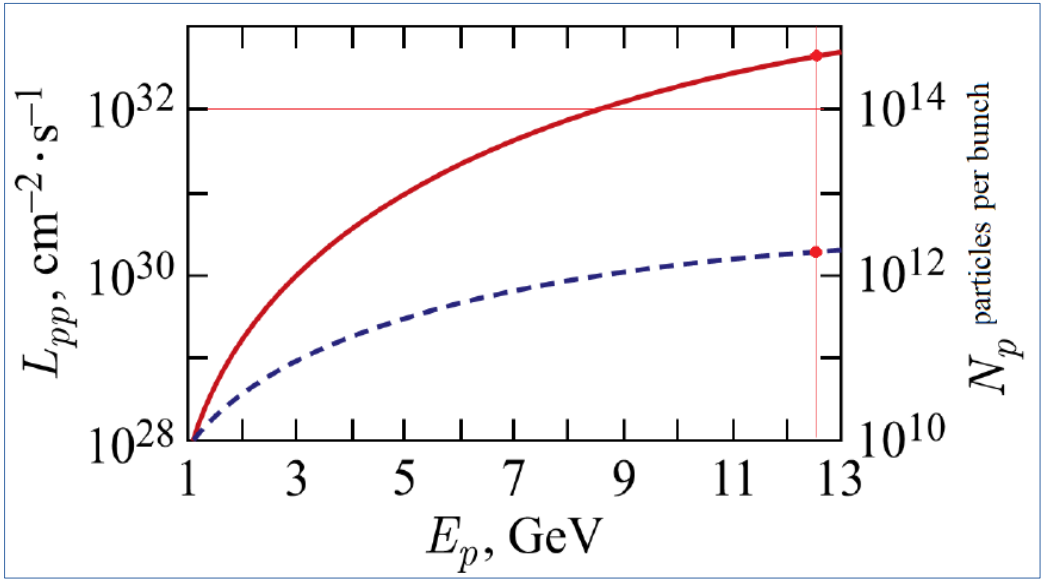
There are plans to study the detector prototypes at the SPD collision point in the fixed target mode (W-target) in current run.
These studies will be continued in the collider mode.

Requirements to polarized beam facility

- polarized and nonpolarized pp- , dd–collisions
- p↑p↑(p) at $\sqrt{s_{pp}} = 12 \div 27$ GeV (5 ÷ 12.6 GeV kinetic energy)
- d↑d↑(d) at $\sqrt{s_{NN}} = 4 \div 13$ GeV (2 ÷ 5.5 GeV/u kinetic energy)
- $L_{av} \approx 10^{+32}$ cm^{-2}s^{-1} (at $\sqrt{s_{pp}} \geq 27$ GeV)
- sufficient lifetime and polarization degree (few hours, ~70%)
- longitudinal and transverse polarization at the MPD and SPD IP
- pd- collision mode should be available

The facility operation in pp – mode at $\sqrt{s_{pp}} = 27$ GeV reaching average luminosity of 10^{+32} cm^{-2}·s^{-1} remains the first priority task for coming years.

NICA pp-collisions luminosity



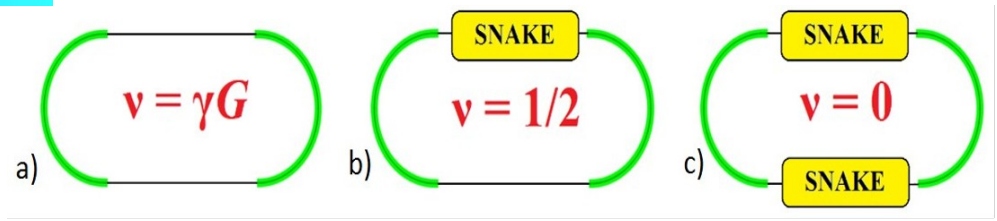
I.N.Meshkov,
Phys.Part.Nucl. 50 (2019) 663.

❑ IP parameters: **β** = 35 cm, bunch length **σ** = 60 cm
bunch number – 22, collider perimeter **C** = 503 m

Lpeak ≈ 1.8·10^{+32} cm^{-2}·s^{-1} → **Lav ≈ 10^{+32}cm^{-2}·s^{-1}**

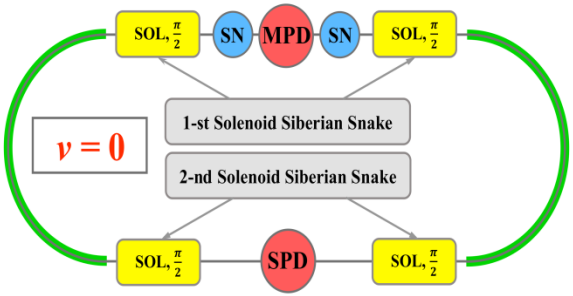
- Luminosities for polarized deuteron and proton beams are similar. Deuteron beam is preferable at the beginning of NICA operation in spin mode.
- The tests on the polarized p-beam injection, storage, electron cooling can be started at low energies (~2 GeV) from the beginning of NICA operation.
- New **LILAC** should be put into operation to achieve the full luminosity.

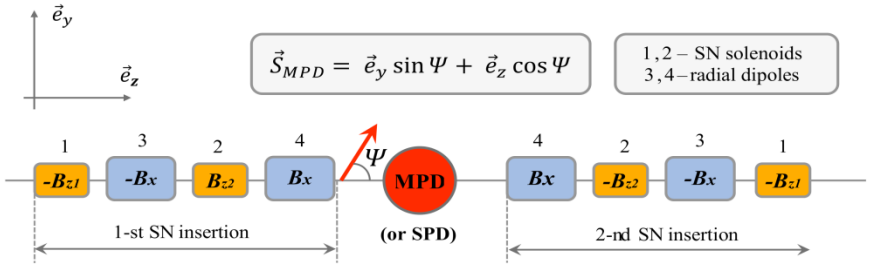
Proton spin manipulation at NICA



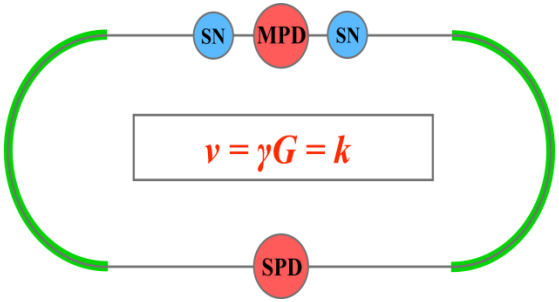
RHIC

LE-regime





HE-regime



Spin transparent (ST) mode with ν=0 is very well suited to the SPD physics tasks.

Realistic scenario.

LE-regime: ST up to $\sqrt{s_{pp}}$ = 6-7 GeV using ~12 T·m Siberian snakes in each ring.

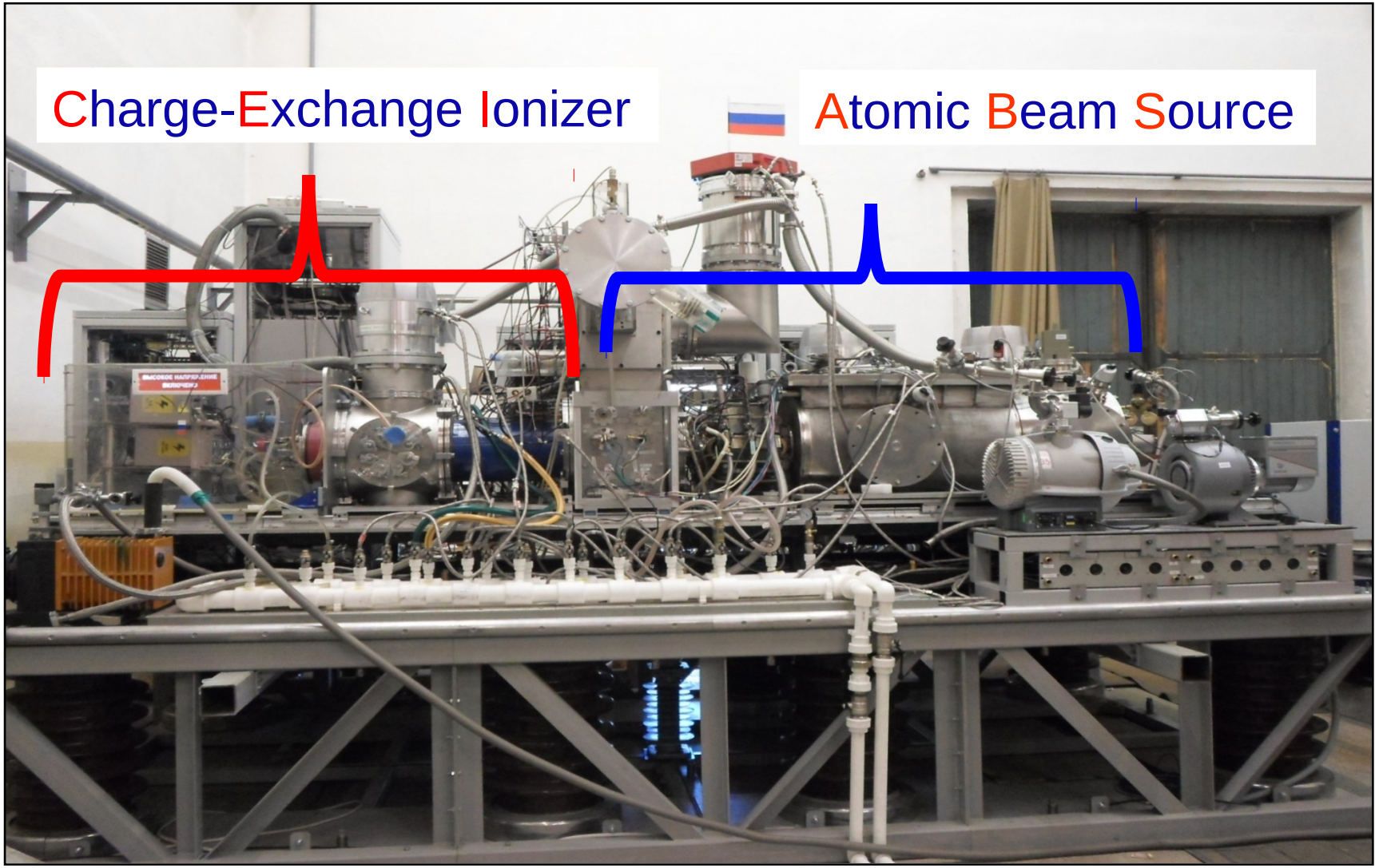
HE-regime: ST at the integer resonances k at $\sqrt{s_{pp}}$ > 6-7 GeV (E_p = 0.108+k·0.523 GeV).

Details:

Yu.N.Filatov,Phys.Part.Nucl.56 (2025) 363.

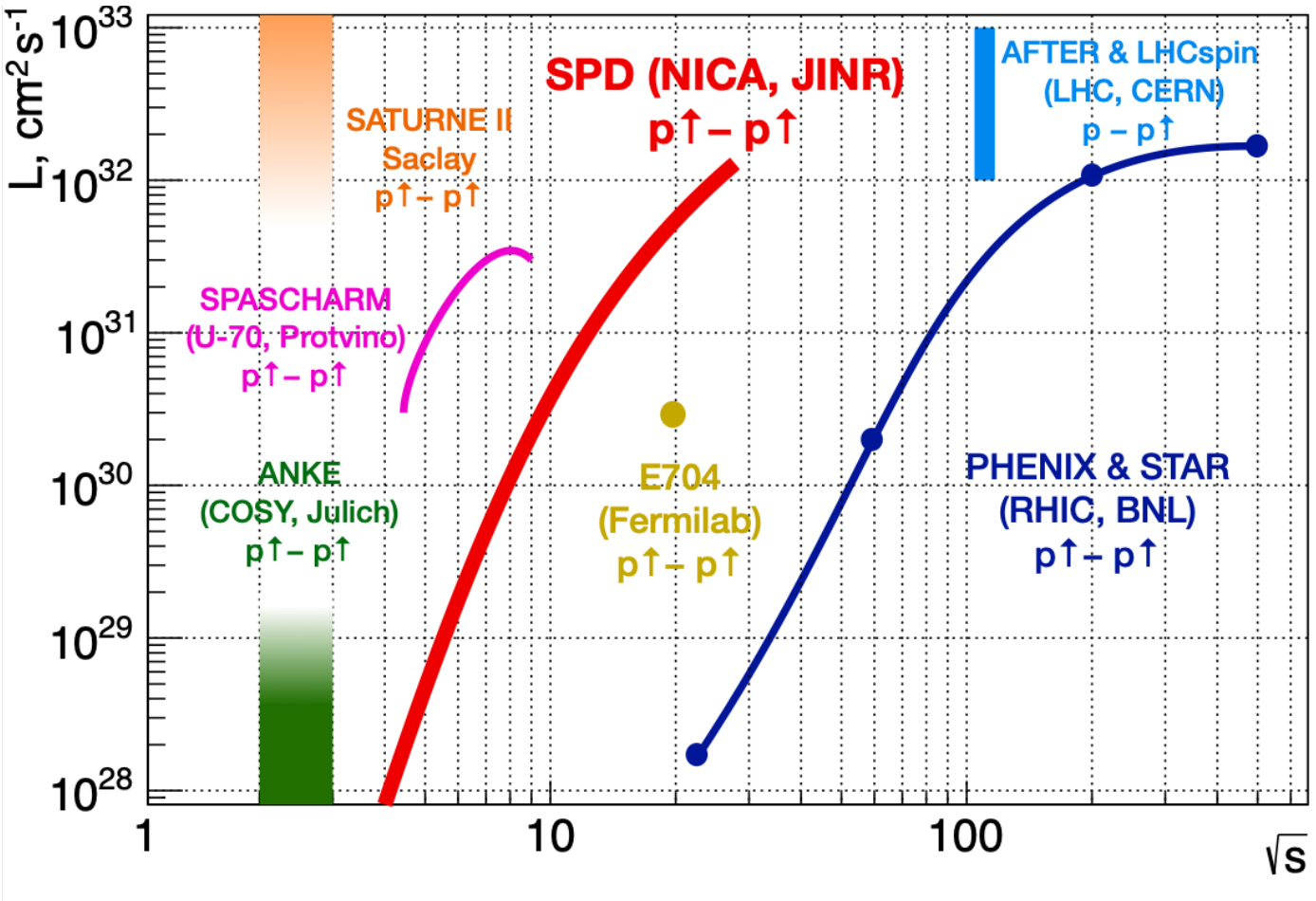
E.M.Syresin et al., Phys.Part.Nucl.52(2021) 997.

Source of Polarized Ions



SPI was put into operation in 2016-2017 with deuterons (tested with protons).
SPI current and polarization (for deuterons) are ~3 mA and 70-75%.

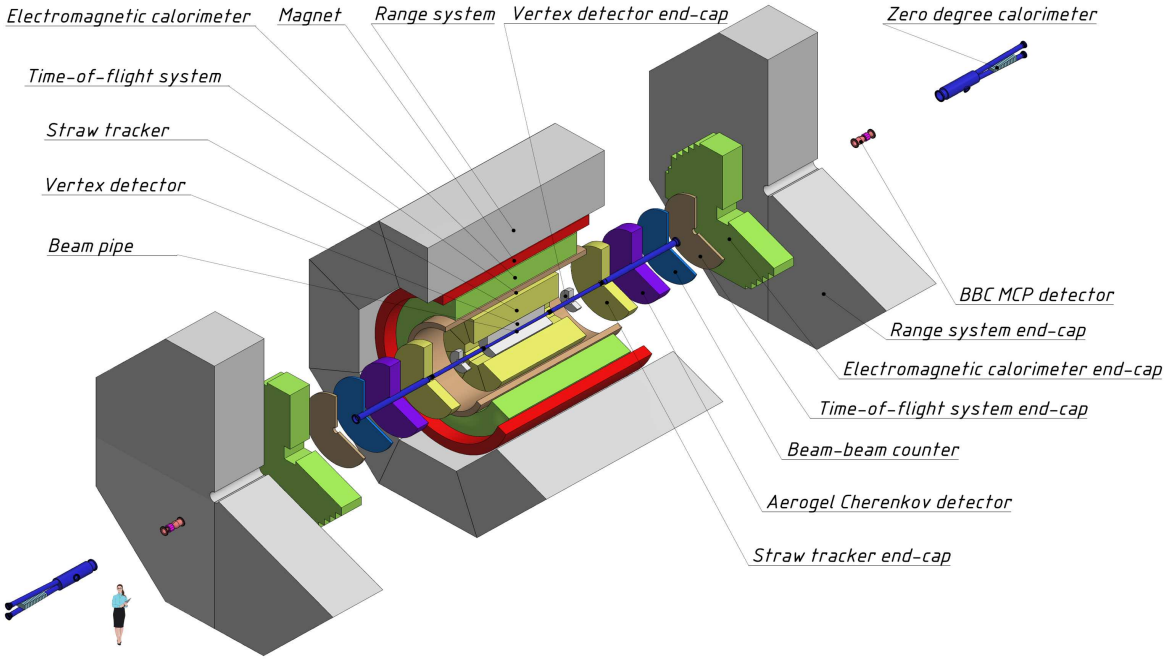
SPD and world polarized pp- facilities



Uniqueness: polarized dd-collisions are only at NICA!

At the 1-st phase polarized pd- collisions can be obtained from quasi-elastic dd- collisions.

Spin Physics Detector



SPD is a multipurpose 4π detector placed at the second interaction point of NICA and optimized to study spin effects and polarization phenomena at high energies using both hadronic and electro-magnetic probes.

SPD Techical Design Report:

V.Abazov et al.(SPD Collaboration), Natural Sci.Rev. 1 (2024) 1.

Spin Physics Detector Collaboration

35 institutes from 15 states, 300 members

~15 MoU are signed

Spin Physics Detector Collaboration

VIII SPD CM
November 2024
Dubna

IX SPD CM
May 2025
Erevan

70-80 talks

Scientific mission of SPD

-Contribute to the world effort in understanding the strong interaction using unpolarized and polarized *pp, pd* and *dd* collisions at up to $\sqrt{s}_{pp}$ =27 GeV.

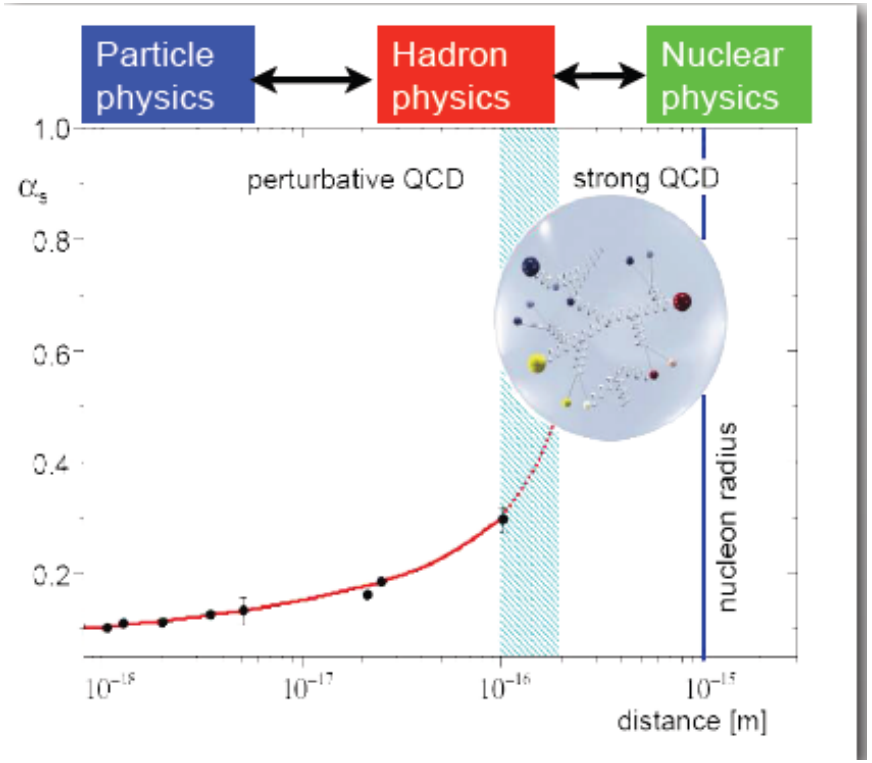
-Origin of the hadron mass: the Higgs mechanism accounts for some percent of the hadron mass: gluon dynamics

-Structure of the nucleon (charge, magnetic, spin distributions)

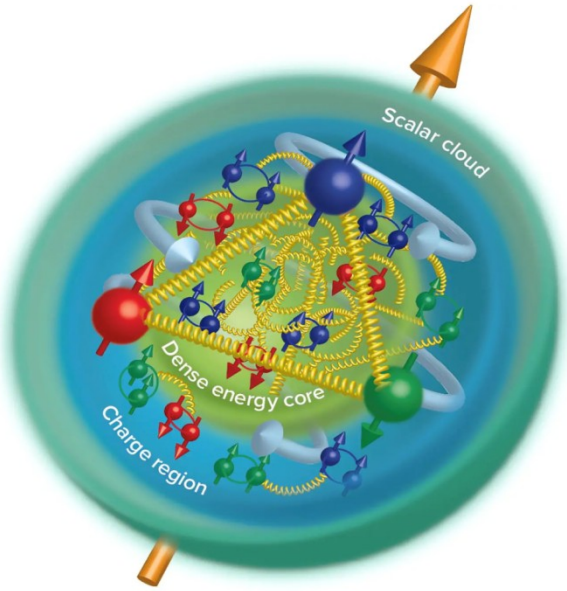
-Multiquark states

-Open questions in the light nuclei structure - spin observables

-Observables in ion-ion collisions (up to Ca-Ca system)



Gluon content at SPD



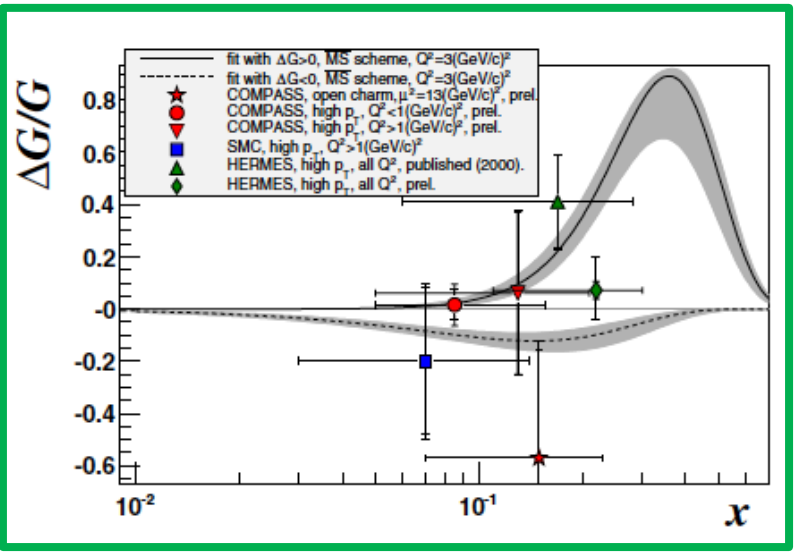
The ultimative goal of SPD is to measure observables sensitive to the gluon content of the proton and deuteron spin using colliding polarized beams at NICA

On the physics potential to study the gluon content of proton and deuteron at NICA SPD

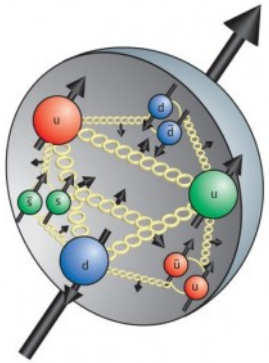
A. Arbuzov[a], A. Bacchetta[b,c], M. Butenschoen[d], F.G. Celiberto[b,c], U. D'Alesio[e,f], M. Deka[a], I. Denisenko[a], M. G. Echevarria[g], A. Efremov[a], N.Ya. Ivanov[a,h], A. Guskov[a,i], A. Karpishkov[j,a], Ya. Klopot[a,k], B. A. Kniehl[d], A. Kotzinian[h,m], S. Kumano[n], J.P. Lansberg[o], Keh-Fei Liu[p], F. Murgia[f], M. Nefedov[j], B. Parsamyan[a,l,m], C. Pisano[e,f], M. Radici[c], A. Rymbekova[a], V. Saleev[j,a], A. Shipilova[j,a], Qin-Tao Song[q], O. Teryaev[a]

Prog.Part.Nucl.Phys. 119 (2021) 103858

Nucleon spin at SPD



Gluon content of proton and deuteron: Transverse Momentum-Dependent PDFs



$S = 1/2$ **(measured: ~ 1/4)**

$\frac{1}{2}\Delta\Sigma$ + ΔG + L

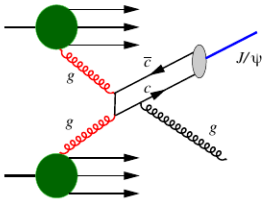
Quarks **Gluons** **orbital momentum**

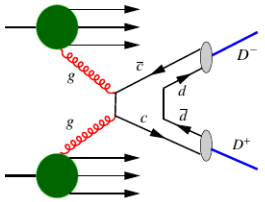
$\sigma(x_F, p_T)$ $A_{LL}(x_F, p_T)$ $A_{TT}(x_F, p_T)$ $A_N(x_F, p_T)$

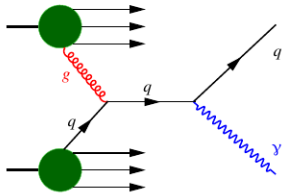
GLUONS	*unpolarized*	*circular*	*linear*
U	f_1^g		$h_1^{\perp g}$
L		g_{1L}^g	$h_{1L}^{\perp g}$
T	$f_{1T}^{\perp g}$	g_{1T}^g	h_{1T}^g $h_{1T}^{\perp g}$

in deuteron only

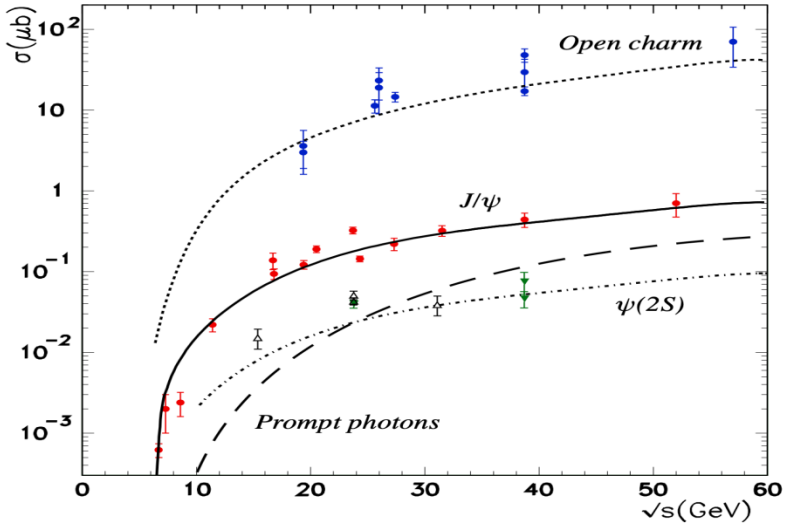
SPD kinematic range for gluons

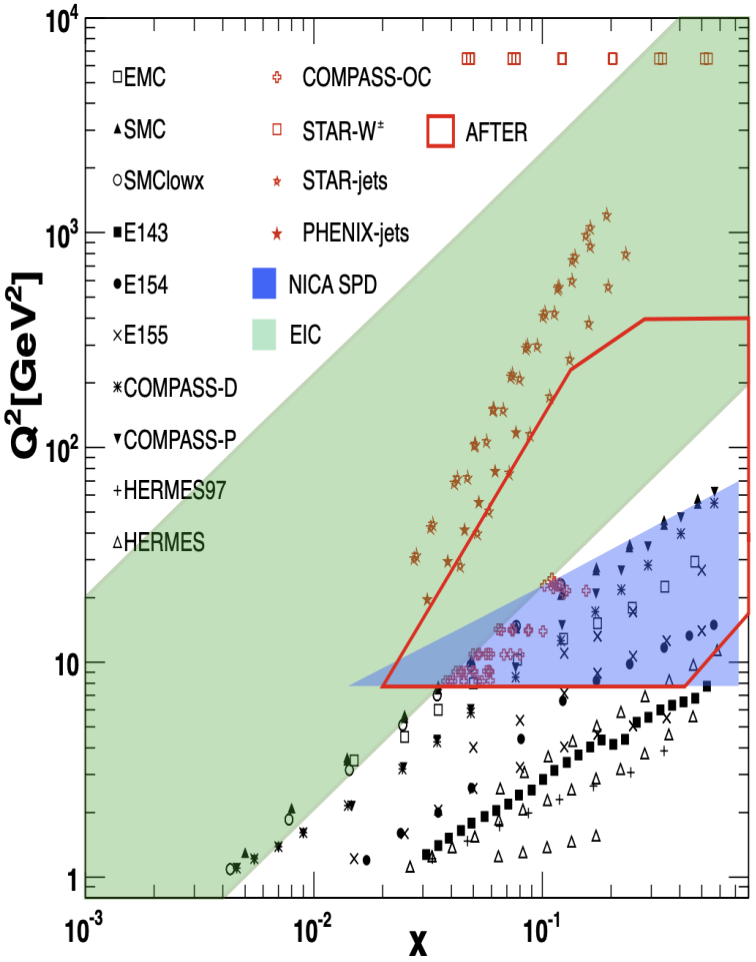






not only J/ψ! *Open charm* *Prompt γ*





Beam energies:

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

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

SPD phases

Creating of polarized infrastructure

Upgrade of polarized infrastructure

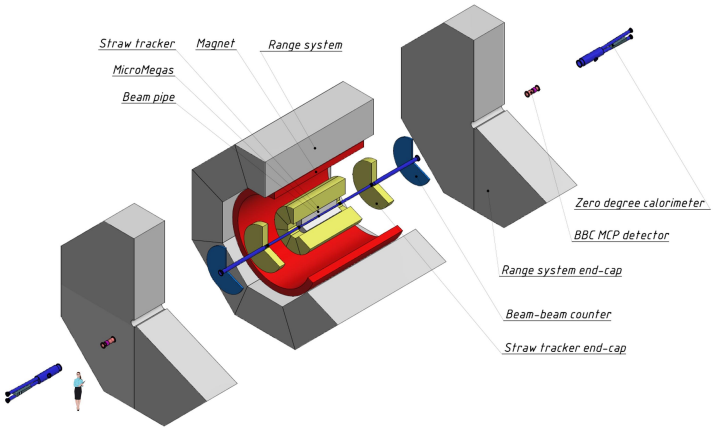
0 +2 +4 +6 +8 years

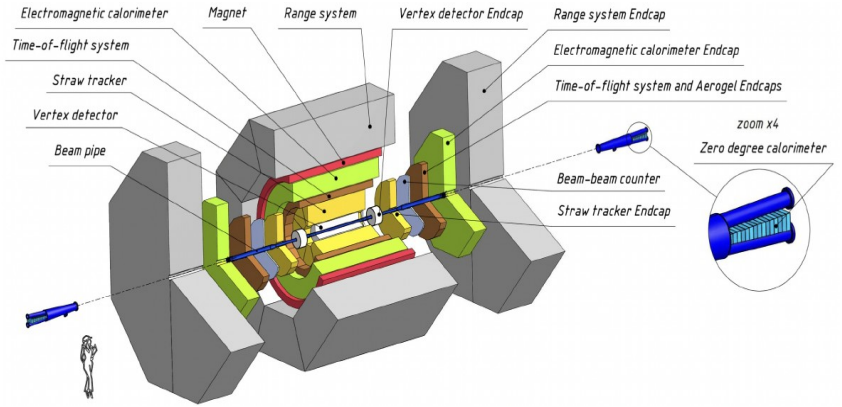
SPD construction

1st stage of operation

SPD construction

2nd stage of operation





The **first phase** of the SPD project (2025-2029) is included into JINR's 7 year topical plan (2024-2030)
It includes construction and commissioning of SPD, first data taking.

Spin Physics Detector: first phase

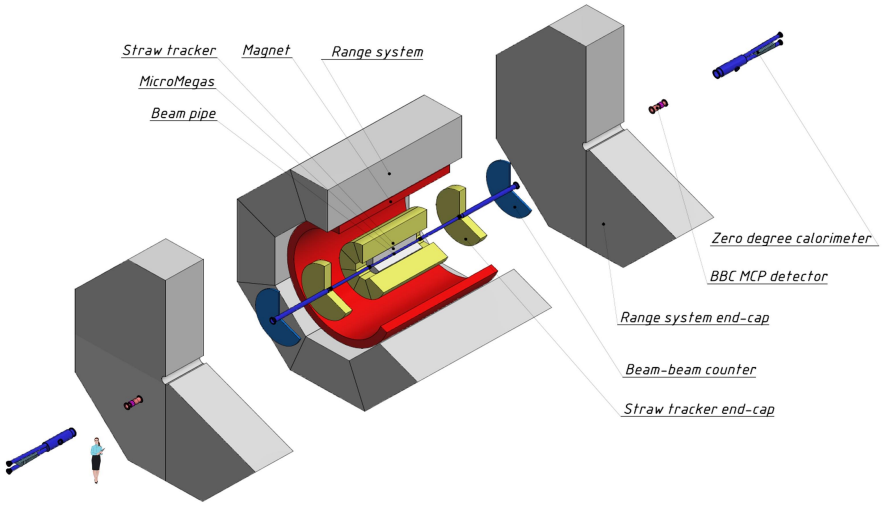
Studies with polarized and unpolarized beams at **low energies** (3.4 GeV < $\sqrt{s_{pp}}$ < 9.4 GeV) and **reduced luminosity**

p-p, d-d, and ion collisions (up to Ca)

Simplified detector set-up

Up to 2 years of data taking

Solenoidal SuperConducting Magnet
Magnetic field up to **1.2 T**



Range System
muon identification and coarse hadron calorimetry

BBC for local polarimetry and reaction plane
ZDC for online luminosity

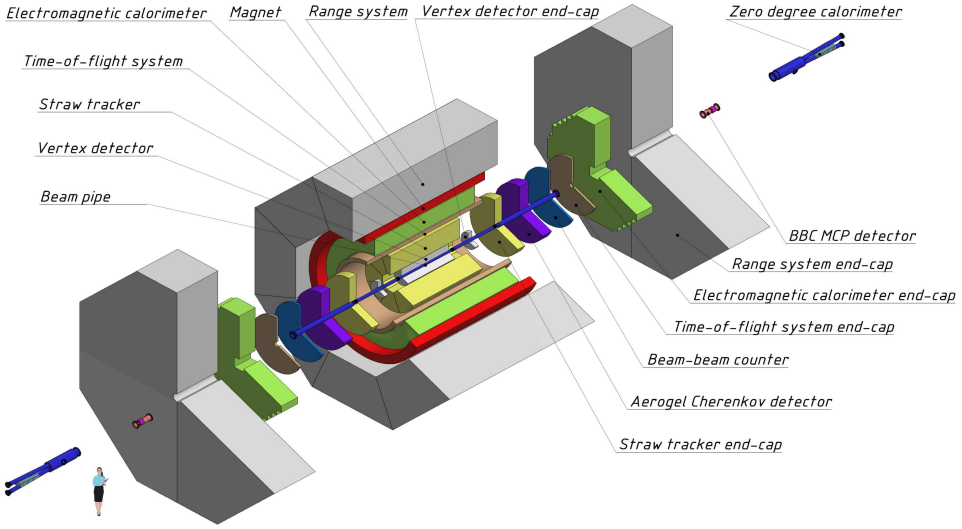
Straw tracker:
- **σ ~ 150 μm**
- **σ(dE/dx) = 8.5%**

Micromegas central tracker:
σ ~ 150 μm

SPD Techical Design Report:

V.Abazov et al.(SPD Collaboration), Natural Sci.Rev. 1 (2024) 1.

Spin Physics Detector: second phase



Electromagnetic calorimeter:
$\sigma E/E = 5\%/\sqrt{E} \oplus 1\%$

Time of flight system:
σ = 50 ps
3σ π/K separation for p < 1.5 GeV

Data AcQuisition system:
Free-streaming
Event rate up to **3 MHz**
Data flow up to **20 Gb/s**
Software online filter

FARICH in *endcaps* for pion/kaon separation for particle momentum up to **5.5 GeV**

Silicon vertex detector:
- MAPS (4 layers): **σ = 10 µm**
- DSSD (3 layers): **σ_φ = 27.4 µm, σ_z = 81.3 µm**

SPD Techical Design Report:

V.Abazov et al.(SPD Collaboration), Natural Sci.Rev. 1 (2024) 1.

SPD first phase physics

Part.Nucl.Phys. 52 (2021) 1044.

SPD inspired the review of the possible studies at SPD during the first phase. This physics program was preliminary, which relied on the detector and beam setups planned at that time, however, it is a good base to formulate Day-1 experimental program.

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Possible Studies at the First Stage of the NICA Collider Operation with Polarized and Unpolarized Proton and Deuteron Beams

V. V. Abramov[a], A. Aleshko[b], V. A. Baskov[c], E. Boos[b], V. Bunichev[b], O. D. Dalkarov[c], R. El-Kholy[d], A. Galoyan[e], A. V. Guskov[f], V. T. Kim[g, h], E. Kokoulina[e, i], I. A. Koop[k, l, m], B. F. Kostenko[m], A. D. Kovalenko[e, †], V. P. Ladygin[e], A. B. Larionov[o, n], A. I. L'vov[c], A. I. Milstein[j, k], V. A. Nikitin[e], N. N. Nikolaev[p, z], A. S. Popov[j], V. V. Polyanskiy[c], J.-M. Richard[q], S. G. Salnikov[j], A. A. Shavrin[r], P. Yu. Shatunov[j, k], Yu. M. Shatunov[j, k], O. V. Selyugin[n], M. Strikman[s], E. Tomasi-Gustafsson[t], V. V. Uzhinsky[m], Yu. N. Uzikov[f, u, v, *], Qian Wang[w], Qiang Zhao[x, y], and A. V. Zelenov[g]

SPD first phase physics

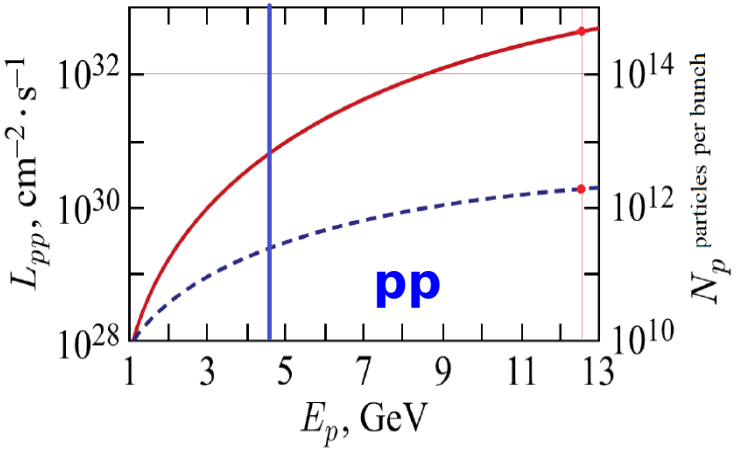
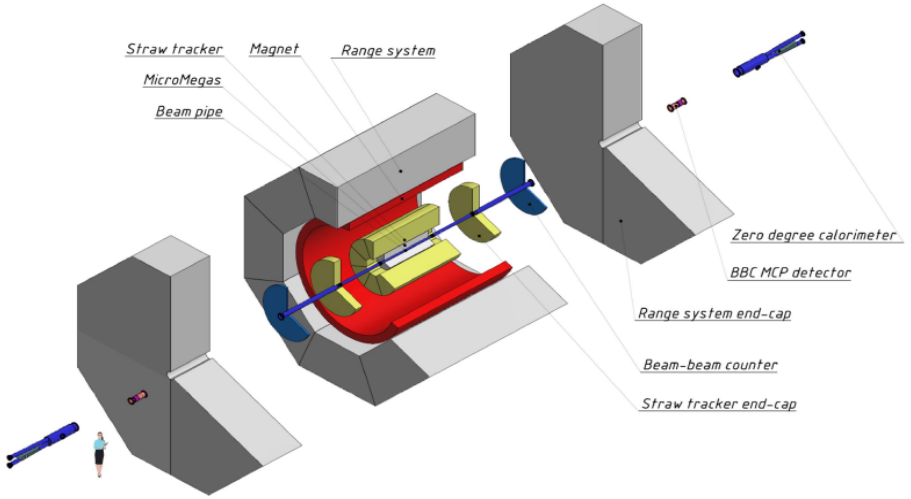
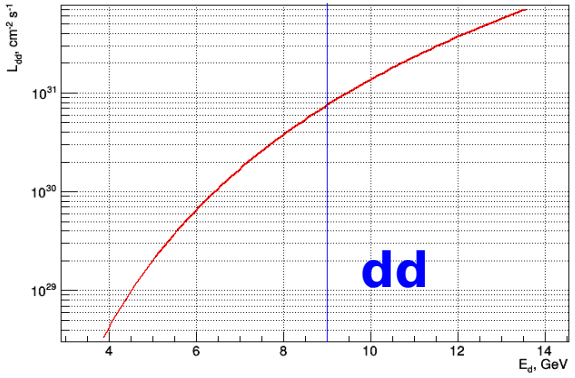


Figure 3.3: Normalized dependence of the luminosity L_{pp} (the red curve and the left scale) and the beam intensity N_p (the blue curve and the right scale) on the proton kinetic energy in the p-p collision [5]..





Lower colliding energies and luminosities for the pp- and dd-collisions

Restricted set of the detector systems:

-Solenoidal SM
-Micromegas Central Tracker
-Straw Tracker
-Range (muon) system
-Beam-Beam Counters
-Zero Degree Calorimeters

SPD first phase physics

Spin amplitudes of NN elastic scattering

High P_T-exotics

Λ-pairs and φ-pairs production

Vector meson production (strange, charmed)

Charmed baryons production

Color transparency

Deuteron short range spin structure

Scaling properties of spin observables

Dibaryons production

Fluctons

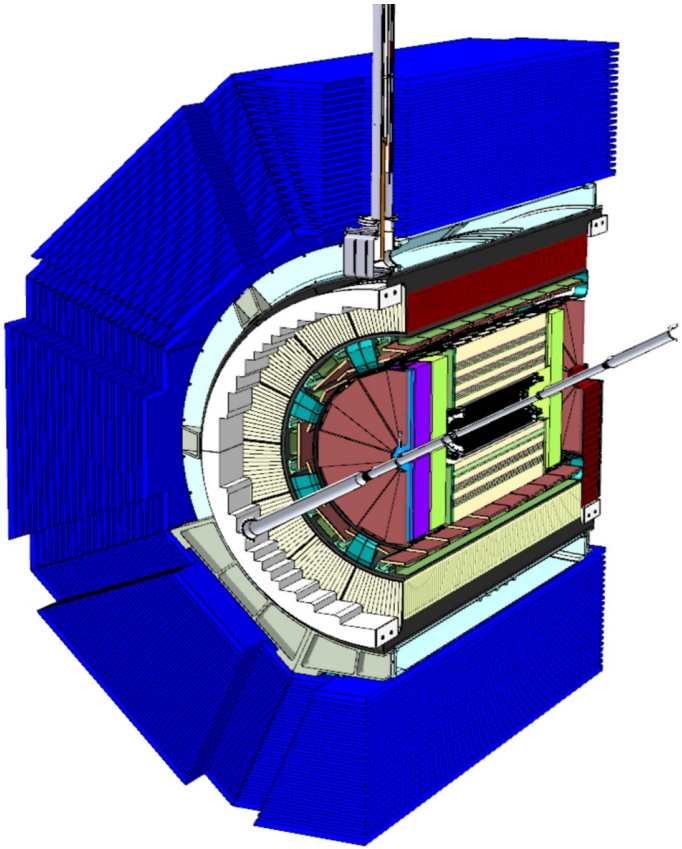
Observables in heavy ion collisions

…..

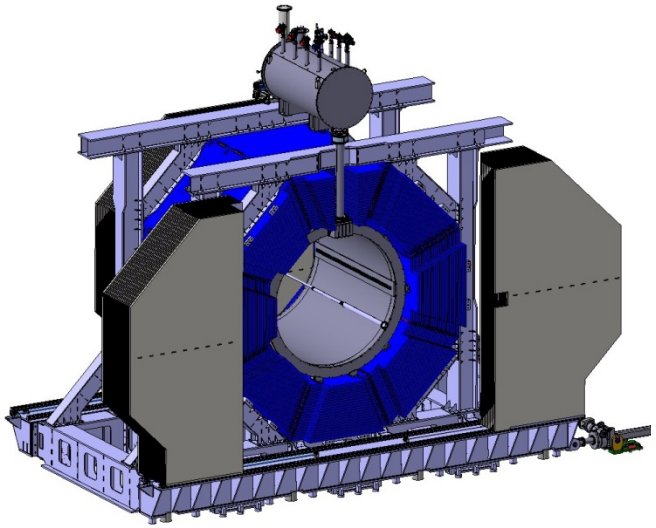
In total 14 proposals

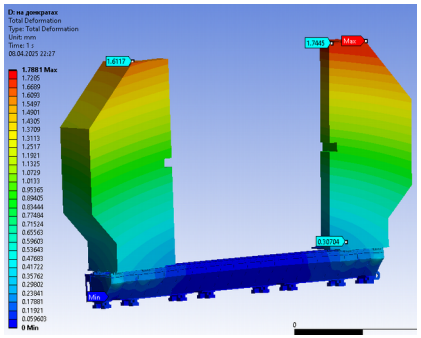
The call of additional proposals is still open!

SPD design progress

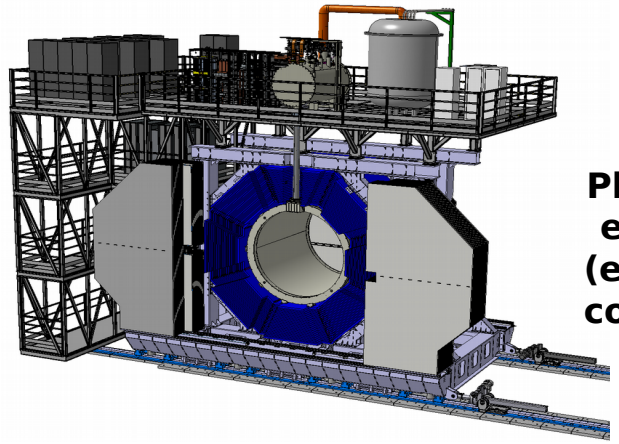


Power structure of “inner” detectors





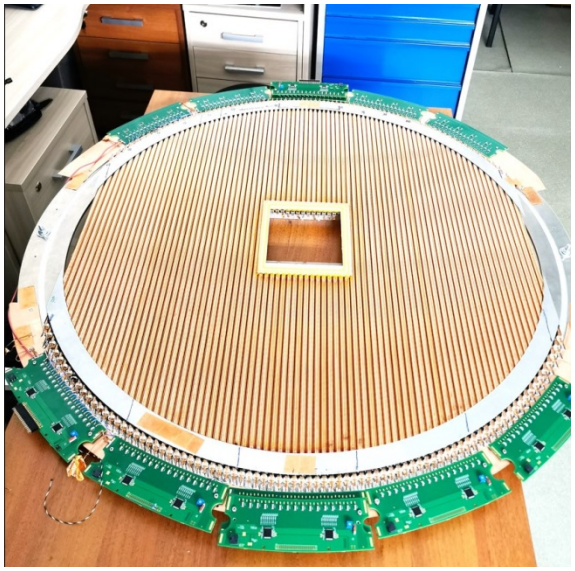
Power structure of the magnet yoke

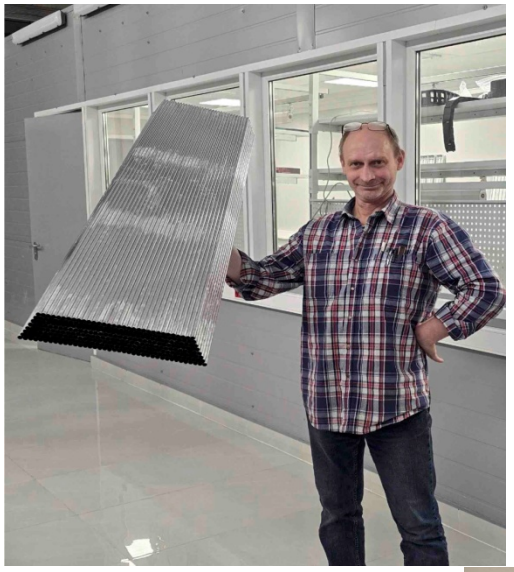


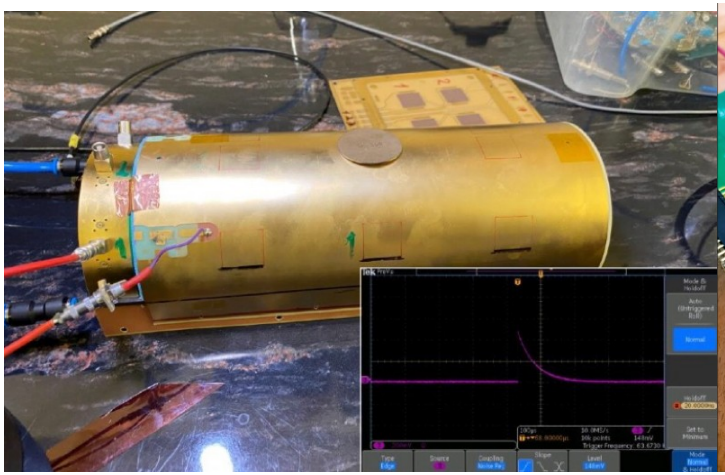
Platform for equipment (electronics, cooling etc.)

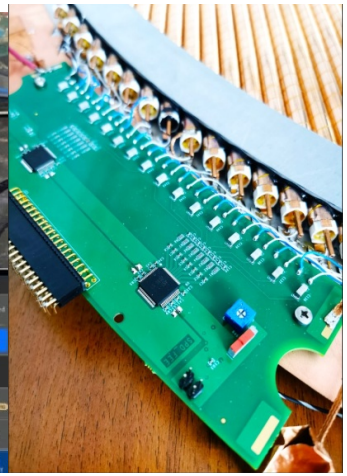
Significant progress in the design of detector power structure and infrastructure.

Hardware (phase 1) progress



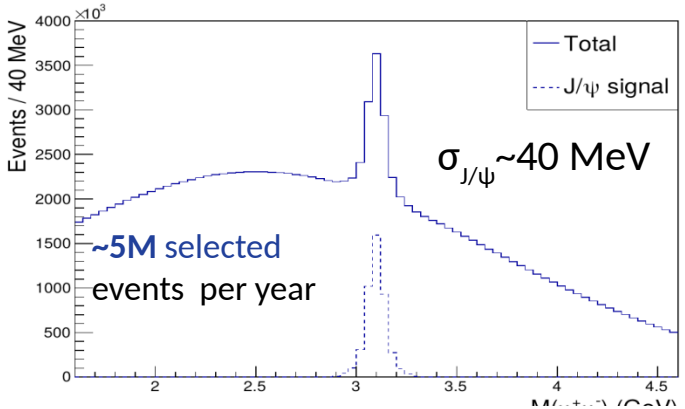


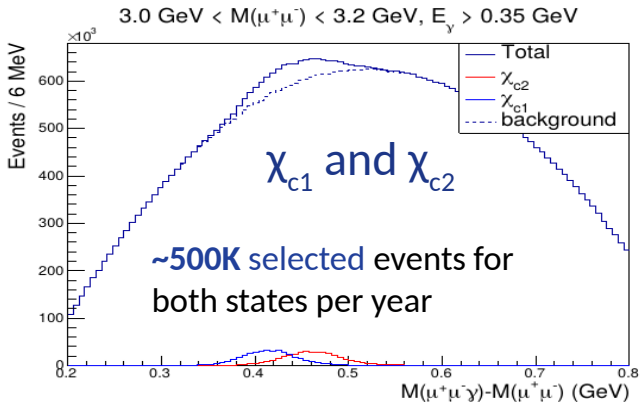




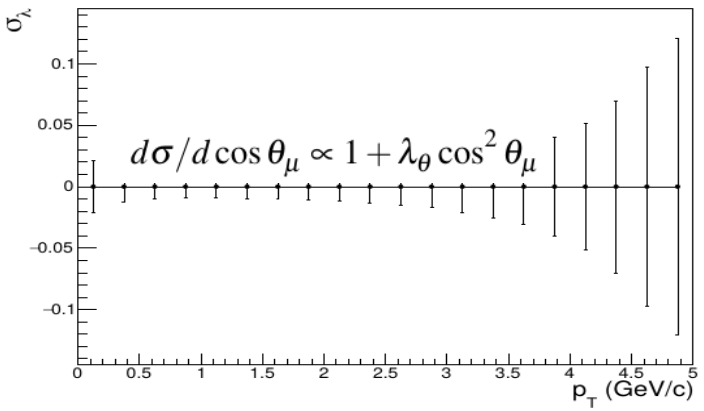
R&D for the 2-nd phase detectors is in progress

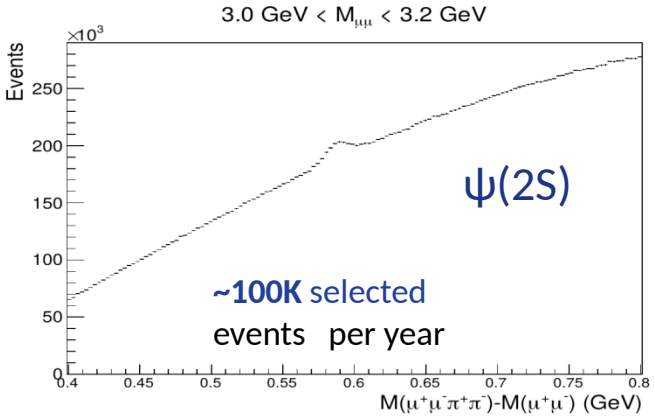
J/Ψ and charmonia as gluon probe





(1y=10^7s)

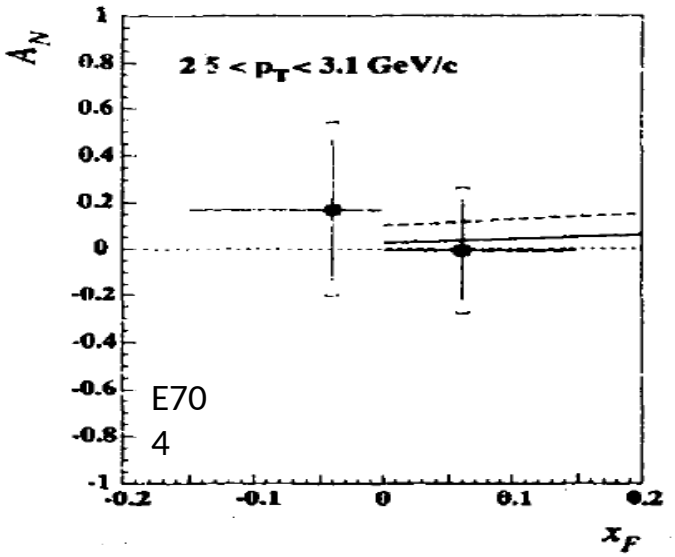


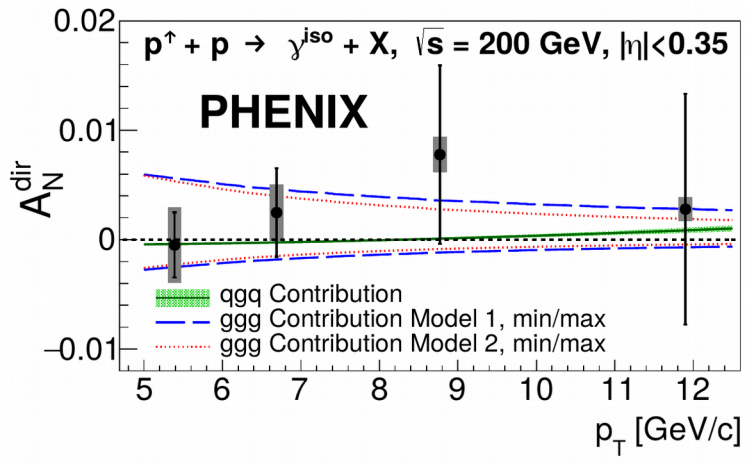


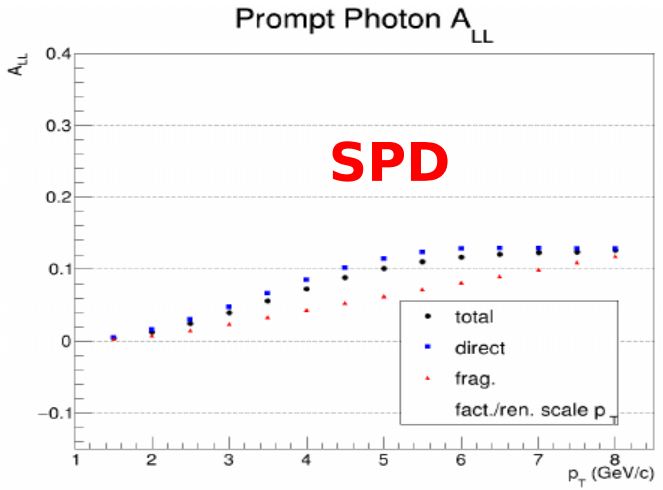
Reconstruction efficiency: ~40%
Large background due to pion decays and muon misidentification in RS

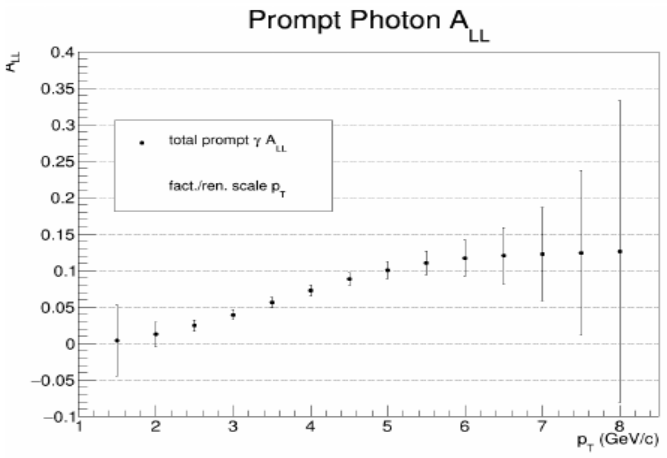
Observables:
cross-section, p_T-, x_F-dependencies, **polarization, A_N, A_{LL} asymmetries**

Prompt photons as gluon probe



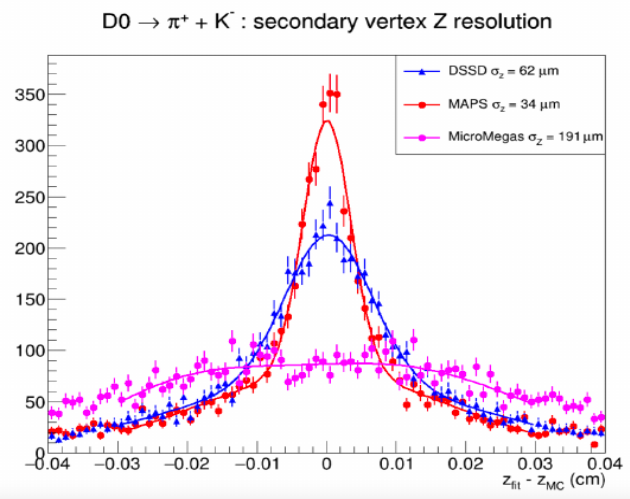


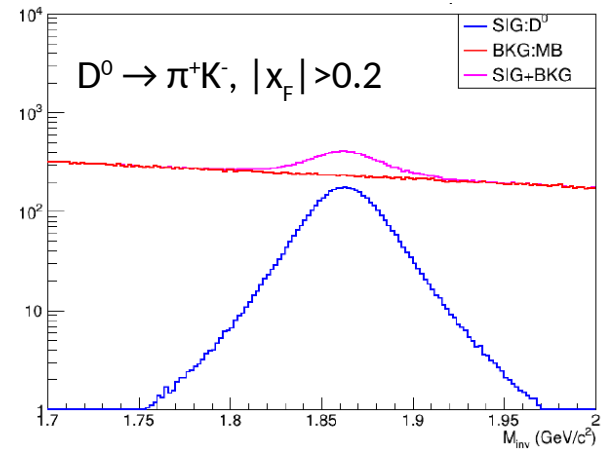


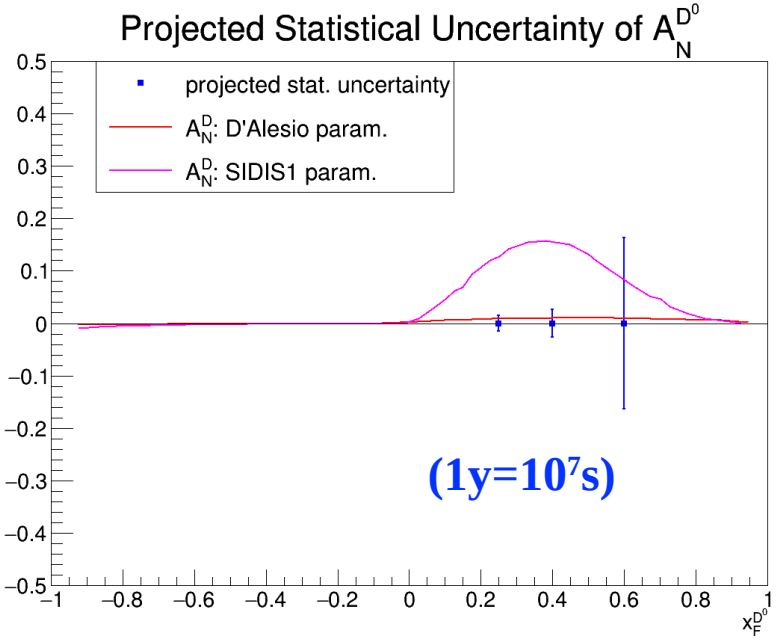


(1y=10^7s)

Open charm (D-mesons) as gluon probe



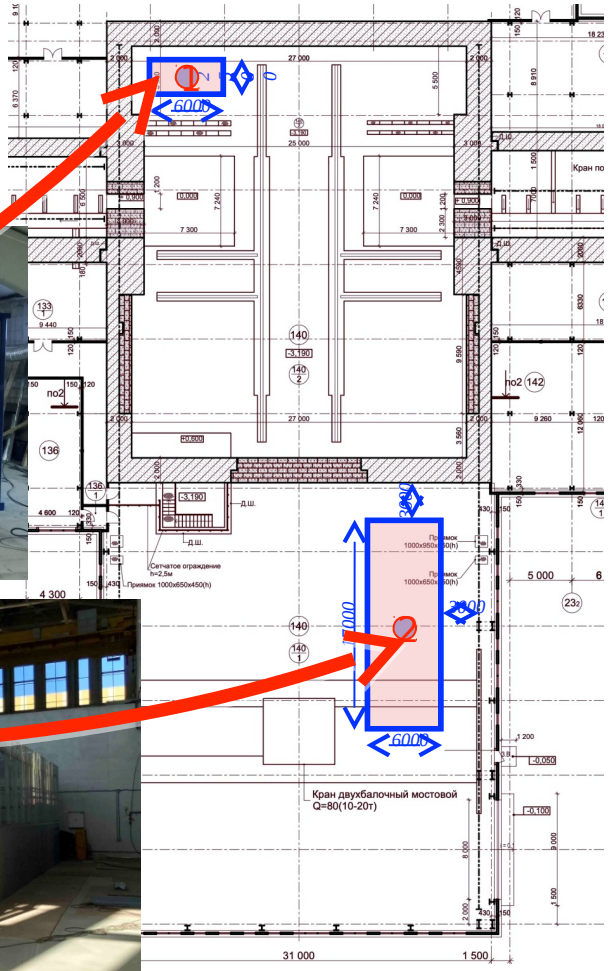




Project stat. uncert. for one year of data taking (*without FARICH PID*)

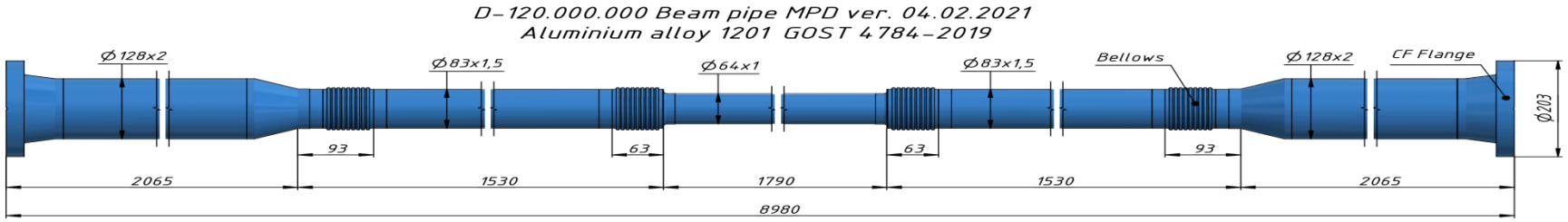
Phase0: SPD hall

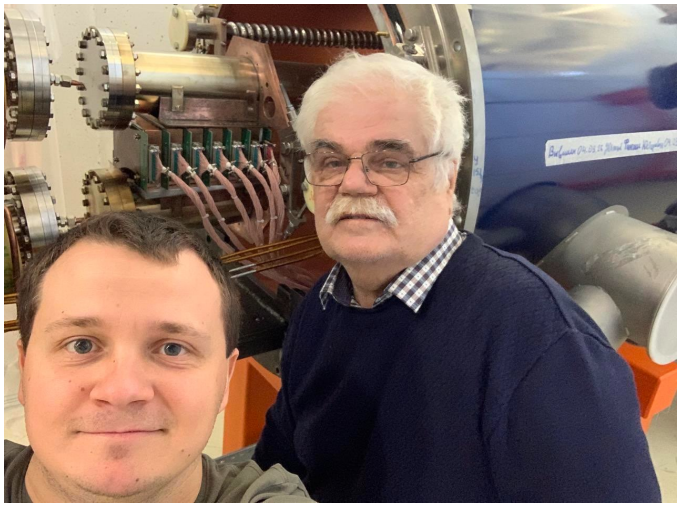
2 places can be used already for detectors and electronics

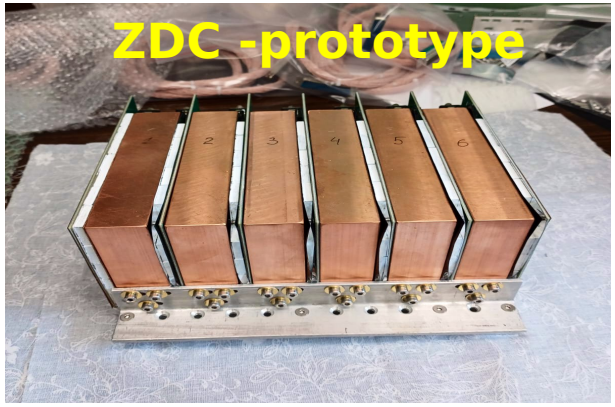


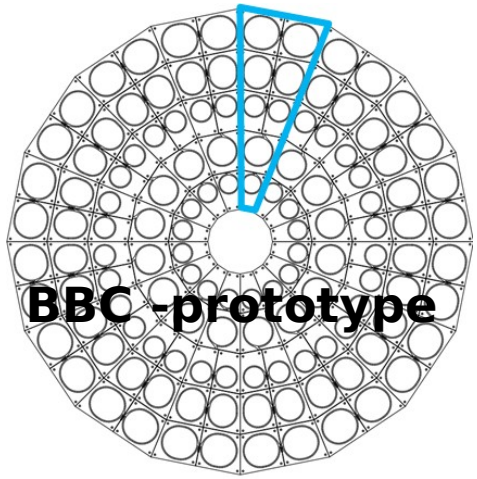
Beampipe with 2 W- wires, electric power, network, gas mixture need to be provided.

Phase0: ion beams at NICA









^{124}Xe + W collisions (FT mode)

^{124}Xe+^{124}Xe collisions

First runs: 2 prototypes of BBC and ZDC
Prototypes of ST, Micromegas, ECAL etc. will come later

Conclusions

Spin Physics Detector at the NICA (JINR) is a multipurpose 4π detector for QCD studies with polarized proton and deuteron beams at $\sqrt{s}$ up to 27 GeV

SPD is a facility for comprehensive study of gluon content in proton and deuteron at large x and moderate Q^2

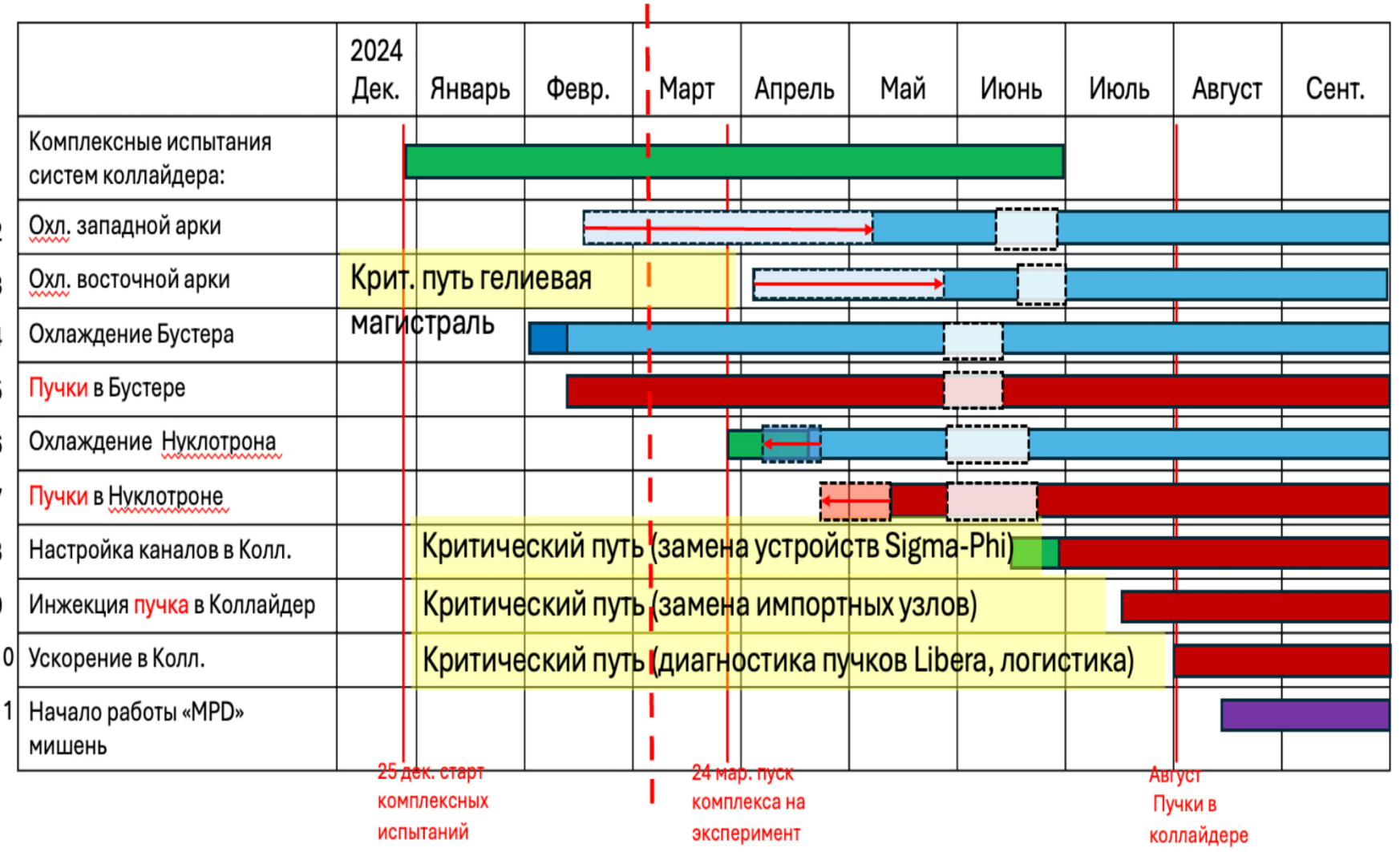
SPD is a unique facility for polarized deuteron collisions

SPD first phase physics program is under discussion
New ideas are welcome.

Thank you for the attention!

Backup

NICA LAUNCH PLANS



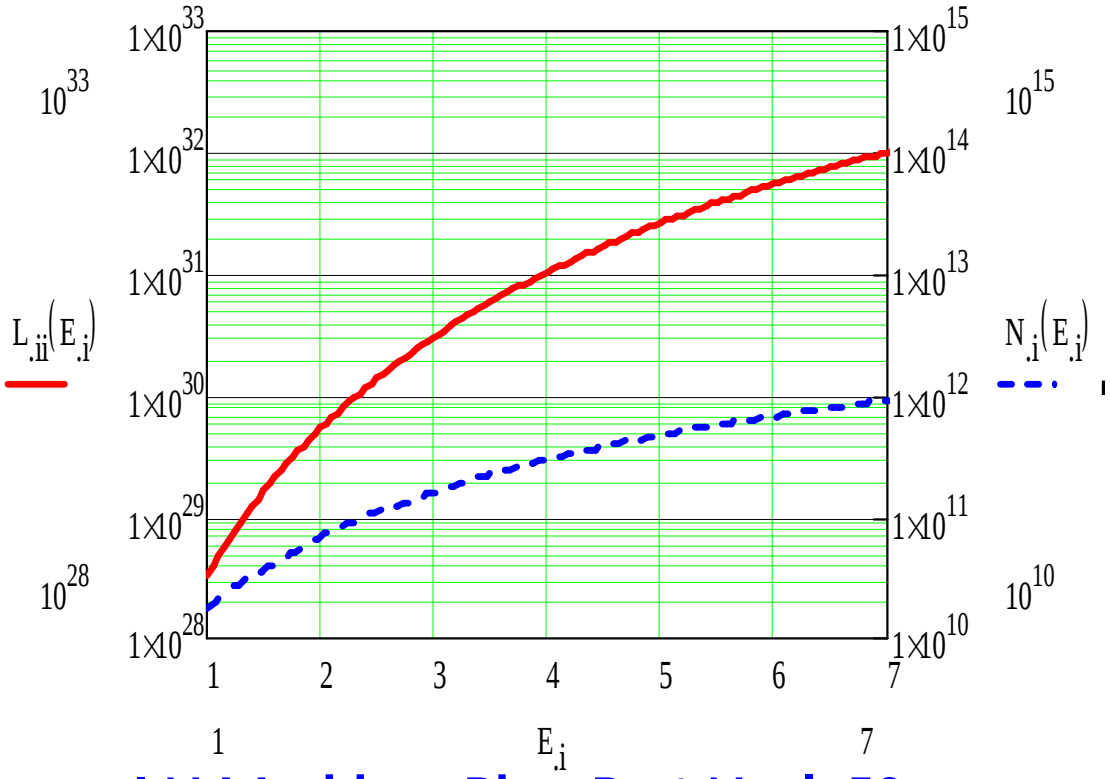
NICA CC 4.3.25

NICA dd-collisions luminosity

Collider parameters

Parameter	Value
β^* , m	0.6
σ_s , m	0.6
$\varepsilon_{x,y}$, $\pi \cdot$ mm $\cdot$ mrad	1.1
N_{IP}	2
E_i , GeV/u	1.0 – 6.5
$\sqrt{s}$, GeV/u	3.86 – 14.86

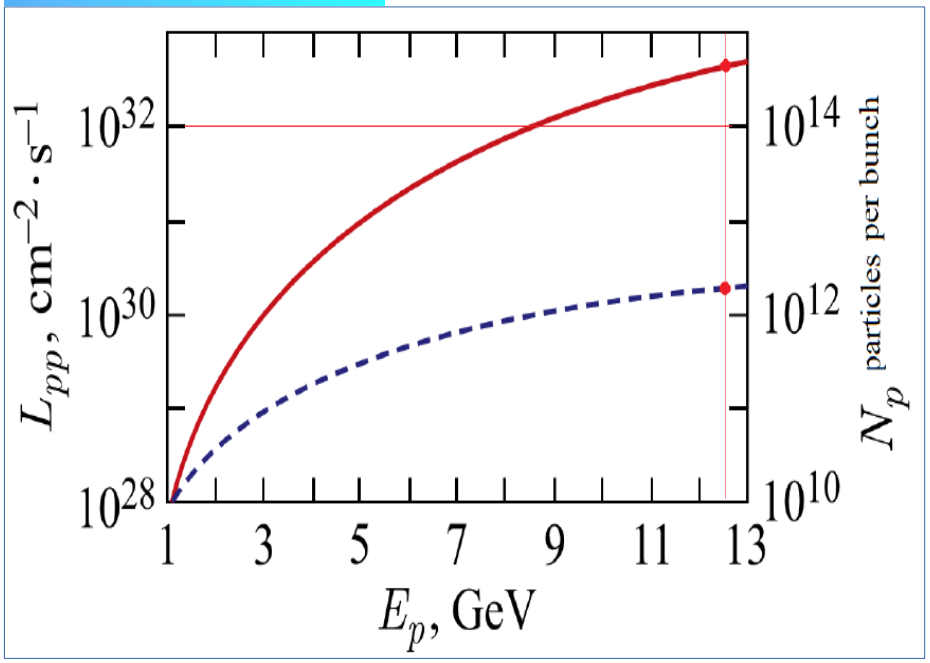
Collider Luminosity vs deuteron kinetic energy (GeV/u) at one IP



I.N.Meshkov, Phys.Part.Nucl. 50 (2019) 663-682.

Polarized dd-collisions are unique → new physics!

NICA pp-collisions luminosity



Parameter	beam energy	
	2.0 GeV	7.2 Gev
Nuclotron Dipole Field Ramp up, T/s	0.6	0.6
Nuclotron Dipole Field Ramp down, T/s	1.0	1.0
Magnet field flat top duration, s	0.5	0.5
Total useful cycle duration, s	1.62	4.02
Dipole Magnetic Field	0.42	1.22
Acceleration time, s	1.67	1.67
Number of accelerated protons per pulse	$7\cdot10^{10}$	$7\cdot10^{10}$
Number of cycles to store $2\cdot10^{13}$ particles	2x285	2x285
Collider filling time at cycle duration, s	923.4	2291
Preparation of the beam in the collider (cooling, bunching emittance formation), s	100	100
Magnetic field ramp in the collider, T/s	0.06	0.06
Acceleration time from E_i to 12.6 GeV	~ 27	~ 13
Luminosity life time (30% polarization degradation due to spin resonances), s	5400	5400
Beam deceleration up to the new injection	~ 1.7	~ 0.8
Total cycle duration, s	6450	7803
Working part, %	~ 83	~ 70

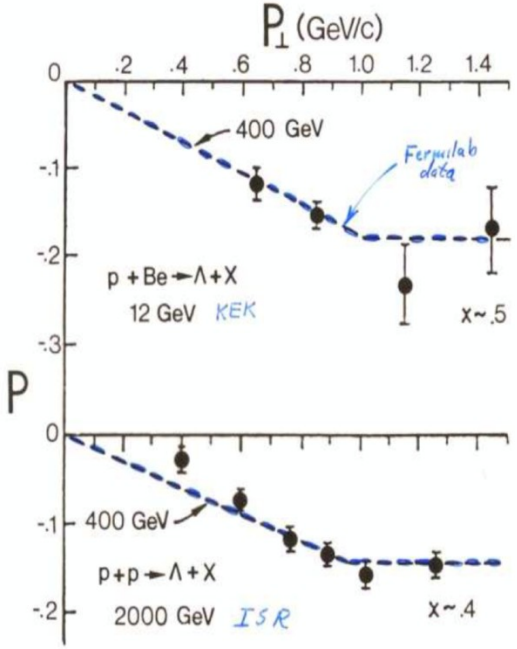
- IP parameters: **β** = 35 cm, bunch length **σ** = 60 cm
bunch number – 22, collider perimeter **C** = 503 m

Lpeak ≈ $1.8\cdot10^{+32}$ cm$^{-2}\cdot$s^{-1} → **Lav ≈ (10^{+32}cm$^{-2}\cdot$s^{-1})**

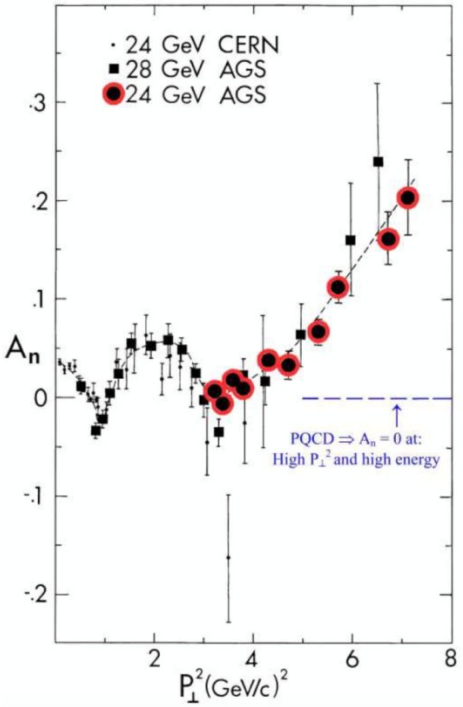
- **The tests on polarized p-beam injection, storage, electron cooling can be started at ~2 GeV energy level from the beginning of the collider operation. The intensity of $5\cdot10^{+8}$ ppp can be provided.**
- **New LILAC should be put into operation to achieve the full luminosity.**

Spin effects at large transfer momenta

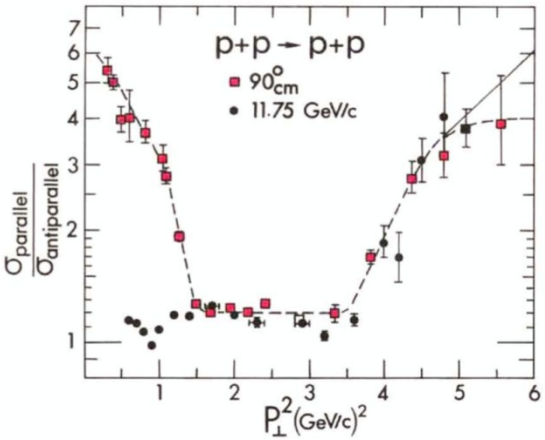
Hyperon polarization



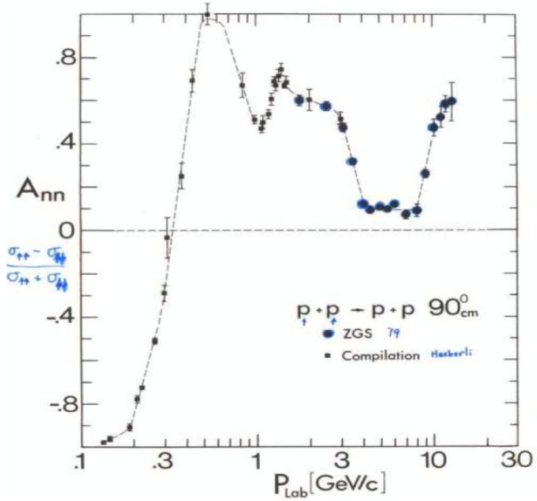
PRL 51 (1983) 2025



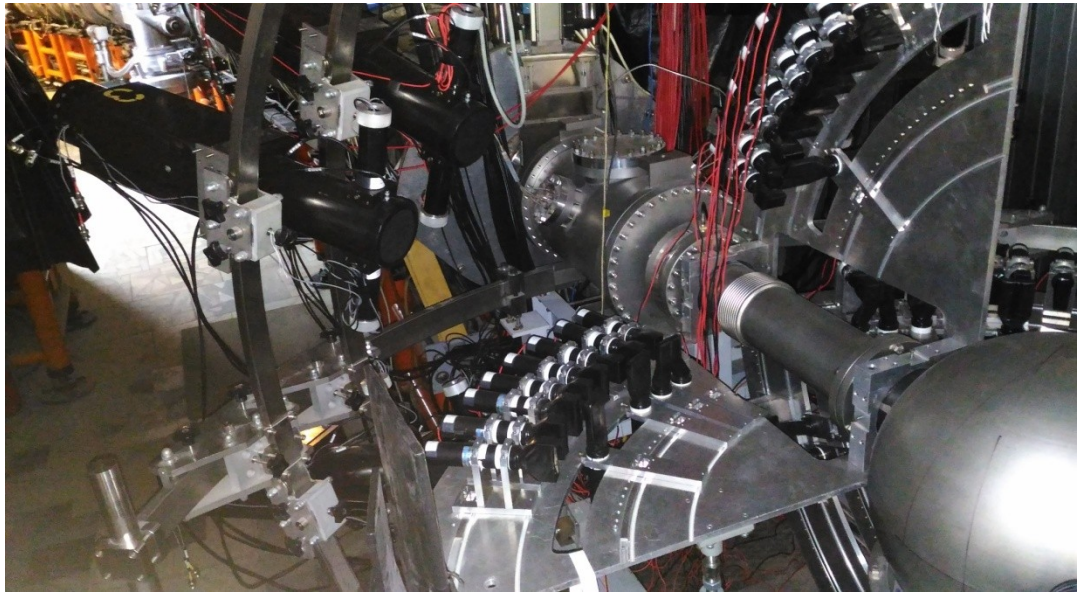
Large angle *pp* scattering



PRD 23 (1981) 600



Setup to study dp- elastic scattering at ITS at Nuclotron



- Deuterons and protons in coincidences using scintillation counters
- Internal beam and thin CH_2 target (C for background estimation)
- Permanent polarization measurement at 270 MeV (between each energy).
- Analyzing powers measurement at 400-1800 MeV
- The data were taken for three spin modes of SPI: unpolarized, “2-6” and “3-5” $(p_z,p_{zz}) = (0,0)$, (1/3,1) and (1/3,-1).
- Typical values of the polarization was 70-75% from the ideal values.

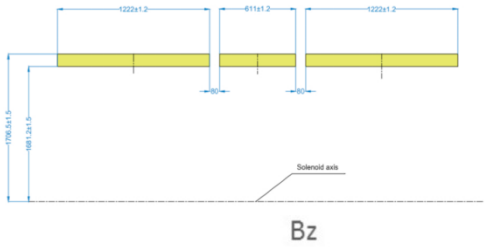
World facilities for gluonic structure

Experimental facility	SPD @NICA	RHIC	EIC	AFTER @LHC	LHCspin
Scientific center	JINR	BNL	BNL	CERN	CERN
Operation mode	collider	collider	collider	fixed target	fixed target
Colliding particles & polarization	$p^{\uparrow}$-$p^{\uparrow}$ $d^{\uparrow}$-$d^{\uparrow}$ $p^{\uparrow}$-d, p-$d^{\uparrow}$	$p^{\uparrow}$-$p^{\uparrow}$	$e^{\uparrow}$-$p^{\uparrow}$, $d^{\uparrow}$, ^{3}He$^{\uparrow}$	p-$p^{\uparrow}$, $d^{\uparrow}$	p-$p^{\uparrow}$
Center-of-mass energy $\sqrt{s_{NN}}$, GeV	≤27 (p-p) ≤13.5 (d-d) ≤19 (p-d)	63, 200, 500	20-140 (ep)	115	115
Max. luminosity, 10^{32} cm^{-2} s^{-1}	~1 (p-p) ~0.1 (d-d)	2	1000	up to ~10 (p-p)	4.7
Physics run	>2025	running	>2030	>2025	>2025

Rates for the main SPD probes

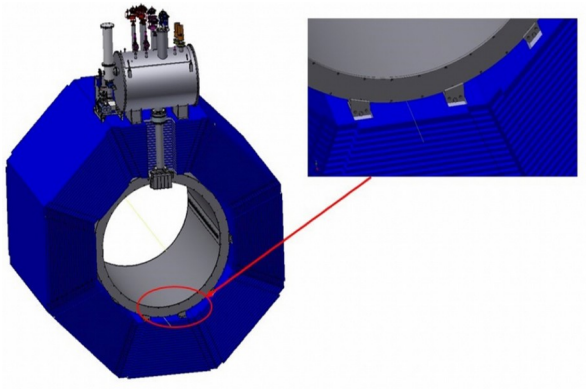
Probe	$\sigma_{27\,\mathrm{GeV}}$, nb (×BF)	$\sigma_{13.5\,\mathrm{GeV}}$, nb (×BF)	$N_{27\,\mathrm{GeV}}$, 10^6	$N_{13.5\,\mathrm{GeV}}$ 10^6
Prompt-γ ($p_T > 3$ GeV/c)	35	2	35	0.2
J/ψ	200	60		
$\to \mu^+\mu^-$	12	3.6	12	0.36
$\psi(2S)$	25	5		
$\to J/\psi\pi^+\pi^- \to \mu^+\mu^-\pi^+\pi^-$	0.5	0.1	0.5	0.01
$\to \mu^+\mu^-$	0.2	0.04	0.2	0.004
$\chi_{c1} + \chi_{c2}$	200			
$\to \gamma J/\psi \to \gamma\mu^+\mu^-$	2.4		2.4	
η_c	400			
$\to p\bar{p}$	0.6		0.6	
Open charm: $D\overline{D}$ pairs	14000	1300		
Single D-mesons				
$D^+ \to K^-2\pi^+$ ($D^- \to K^+2\pi^-$)	520	48	520	4.8
$D^0 \to K^-\pi^+$ ($\overline{D}^0 \to K^+\pi^-$)	360	33	360	3.3

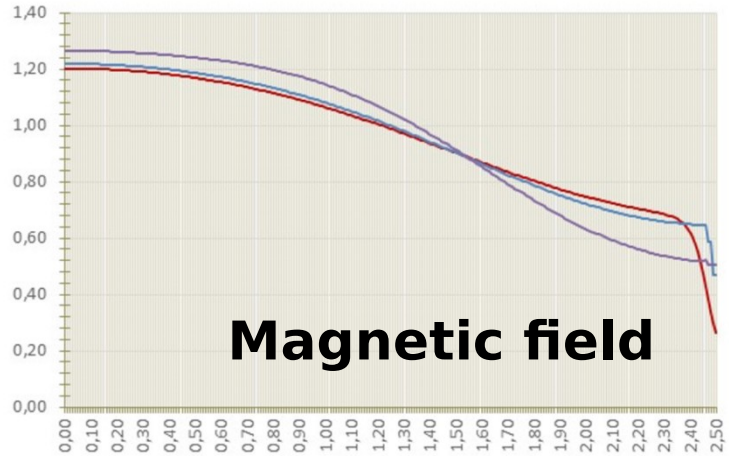
Superconducting magnet



Bz

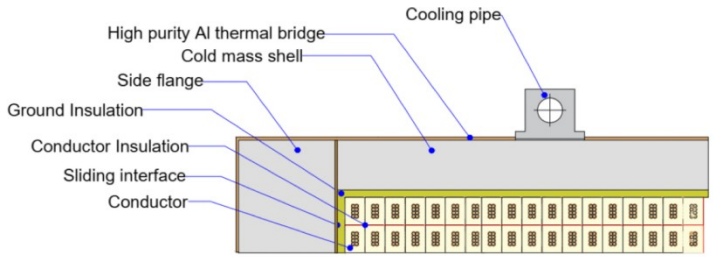
- *PANDA technology*
- *Field at axis: 1.0 T*
- *Operating current: 4.4 kA*
- *Total stored energy: 19.3 MJ*

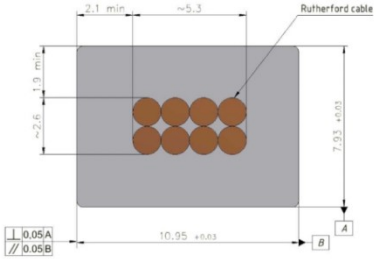




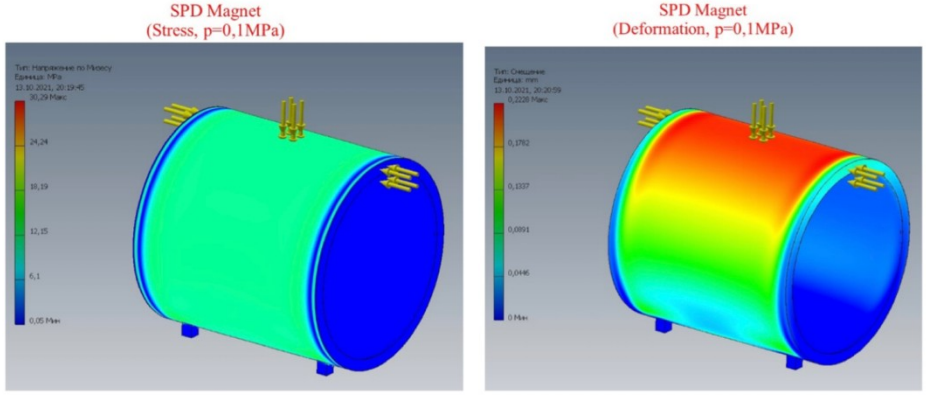
Magnetic field

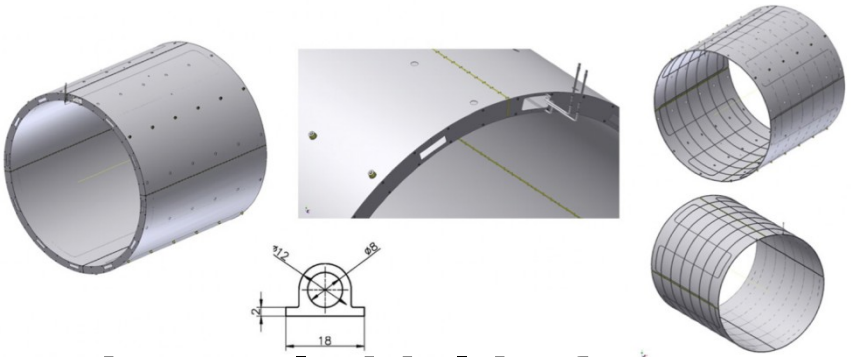
Cross section of the cold mass and cable





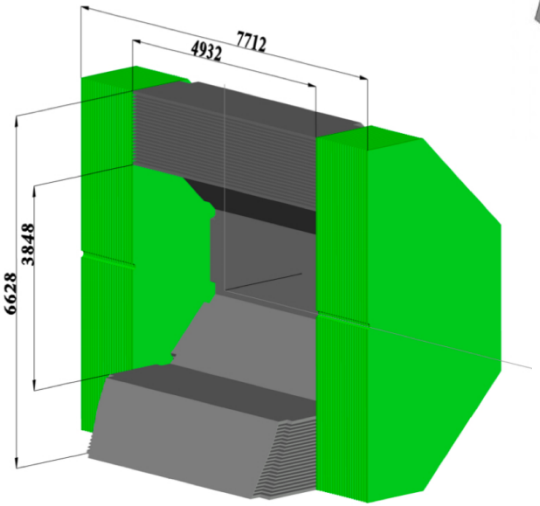
Mechanical properties

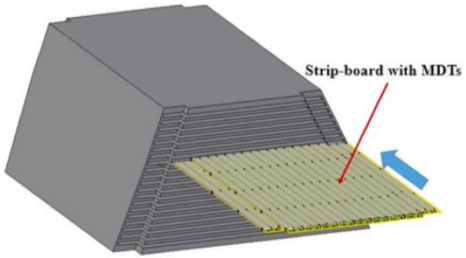


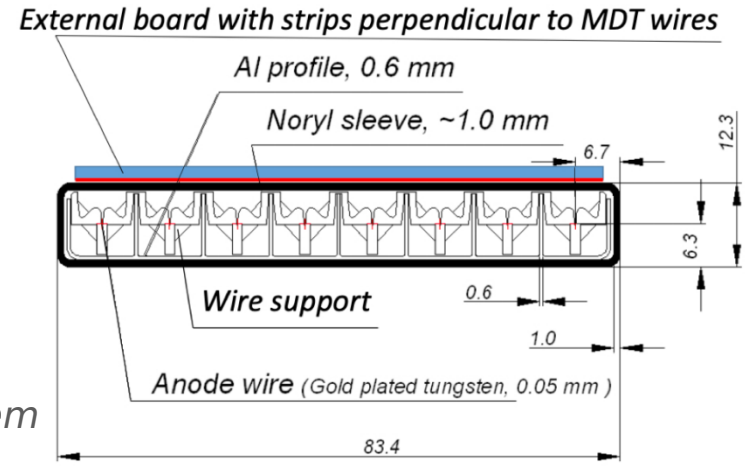


Thermal shield of cryostat

Range system





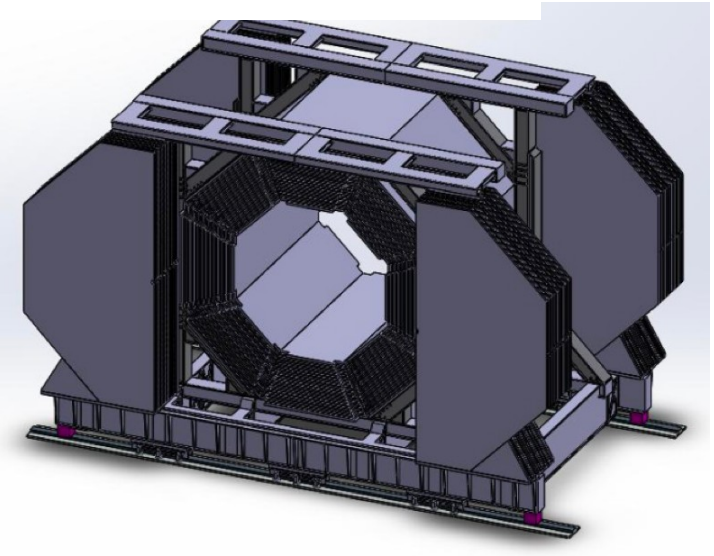


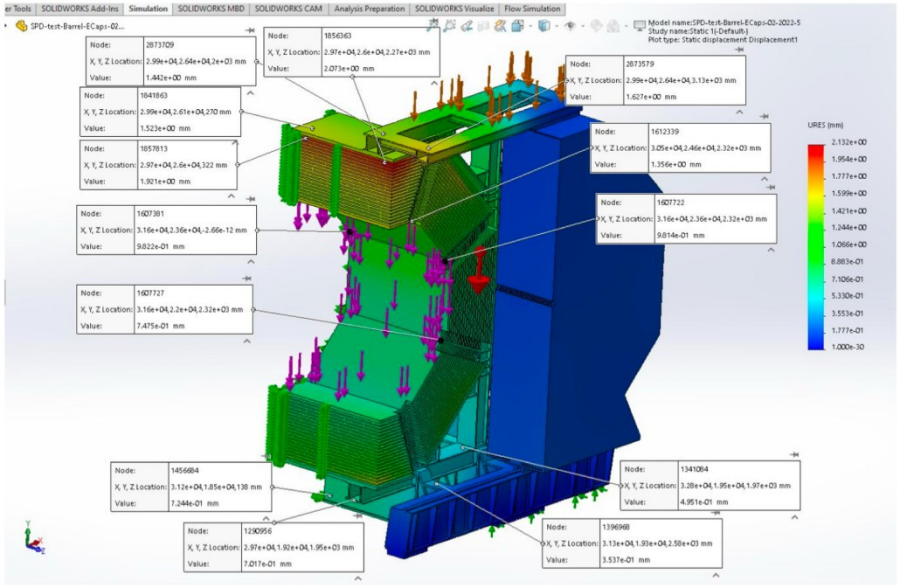
Goals:

- *Muon identification*
- *Rough hadron calorimetry*
- *Yoke of the magnetic system*

Requirements:

- *should have at least $4\lambda_I$*





Straw Tracker

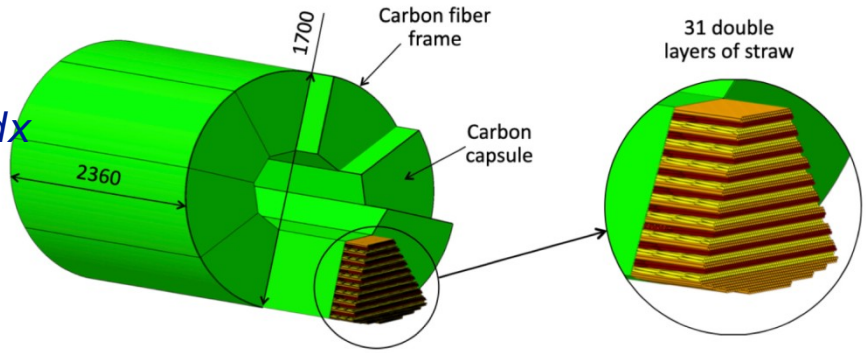
Barrel

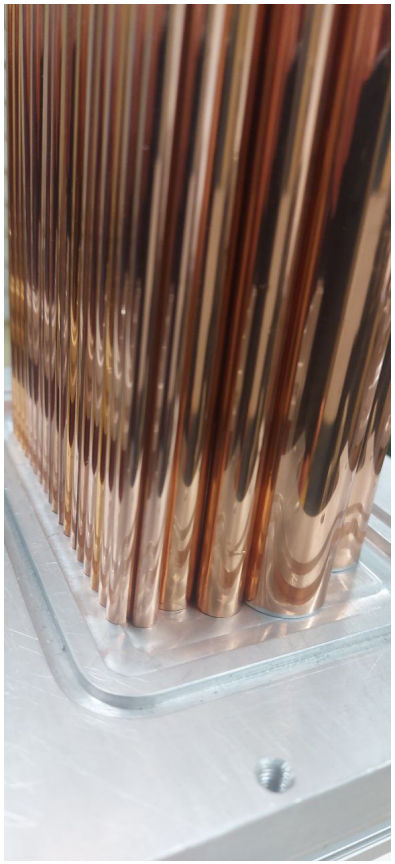
Goals:

- *Track reconstruction and momentum measurement*
- *Participation in PID via dE/dx measurement*

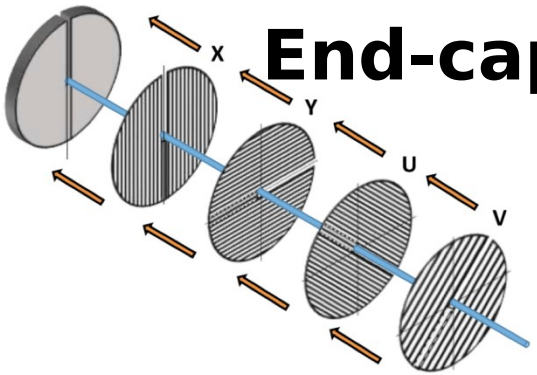
Requirements:

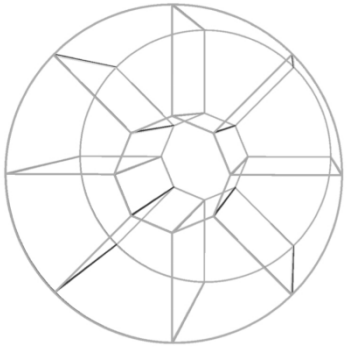
- *Spatial resolution ~150 μm*
- *Low material budget*
- *Operation in magnetic field of about 1 T*

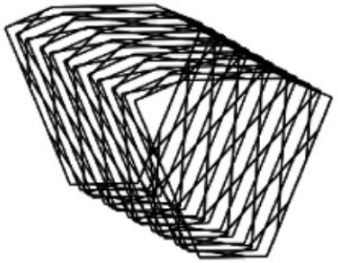


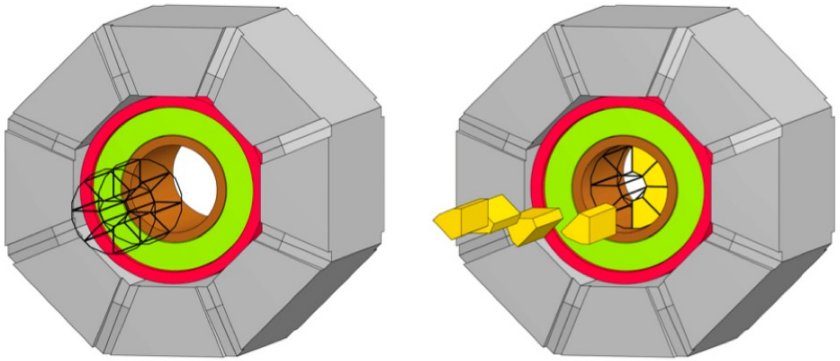


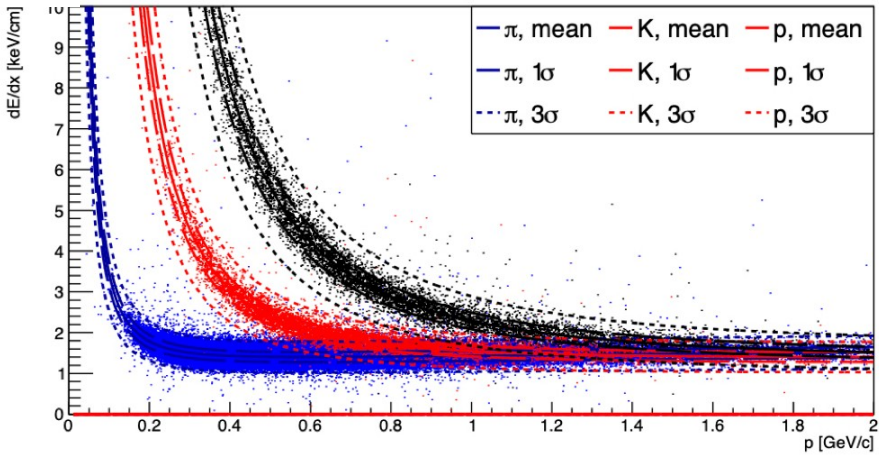
End-caps











Silicon Vertex Detector

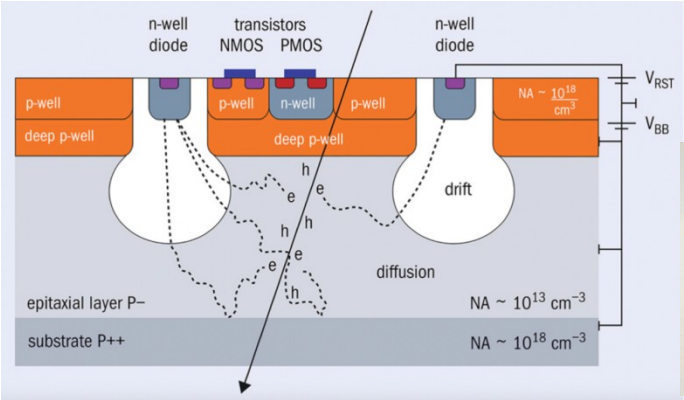
Goals:

- *Reconstruction of secondary vertices for D-mesons decay*
- *Participation in track reconstruction and momentum measurement*

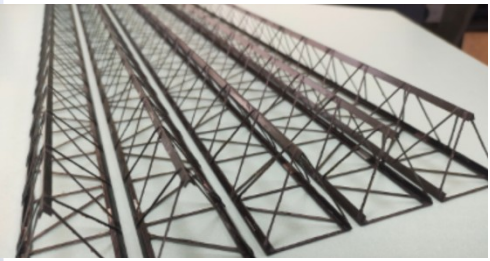
Requirements:

- *Spatial resolution <100 μm*
- *Low material budget*
- *Has to be installed as close as possible to the IP*

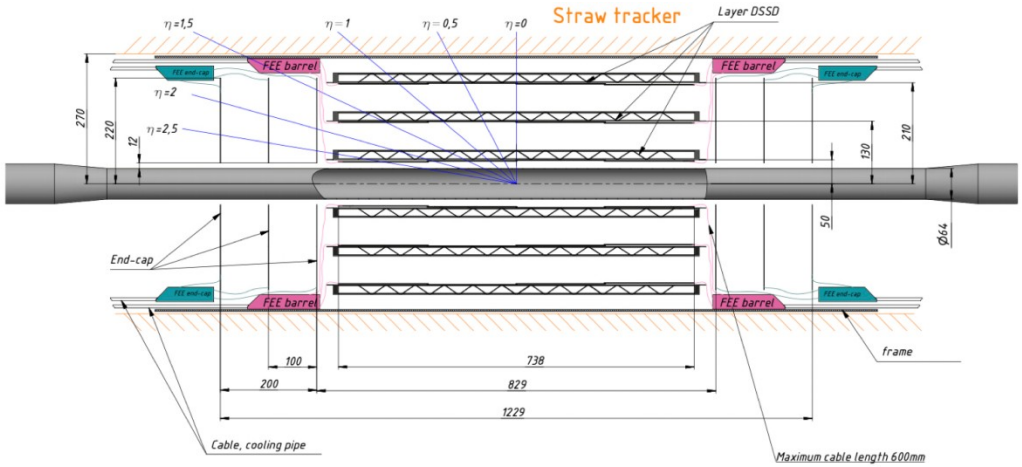
MAPS option: 4 layers

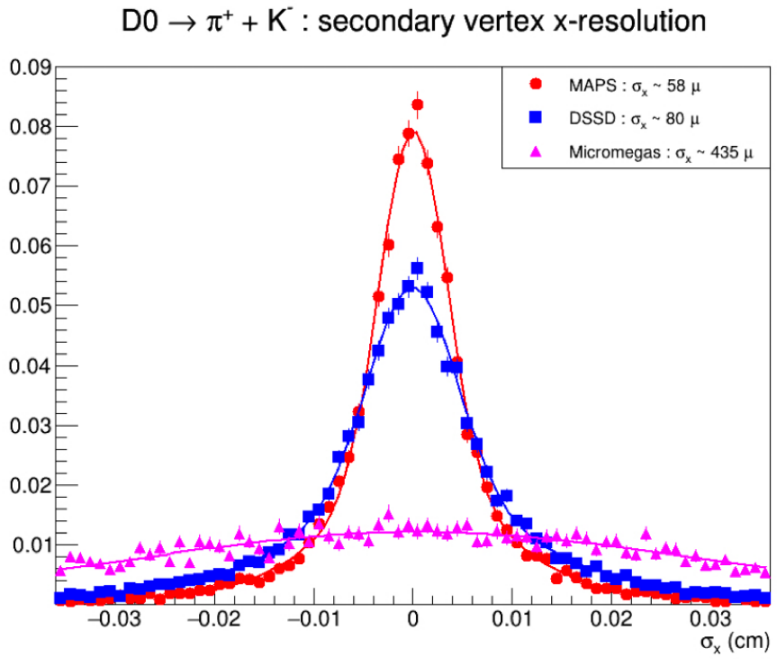


Carbon supports



DSSD option: 3 layers





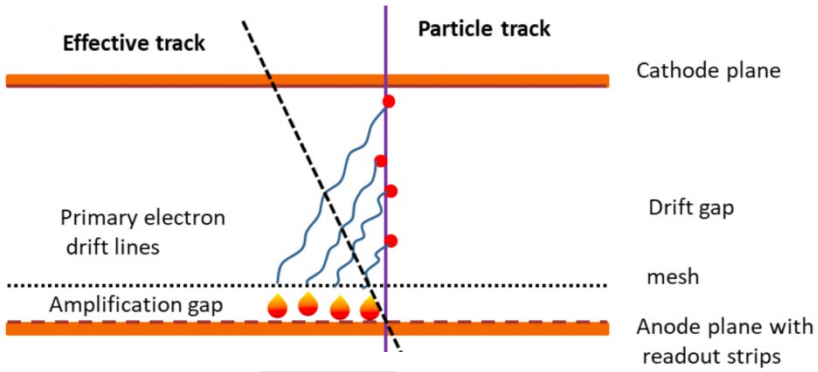
Micromegas-based Central Tracker

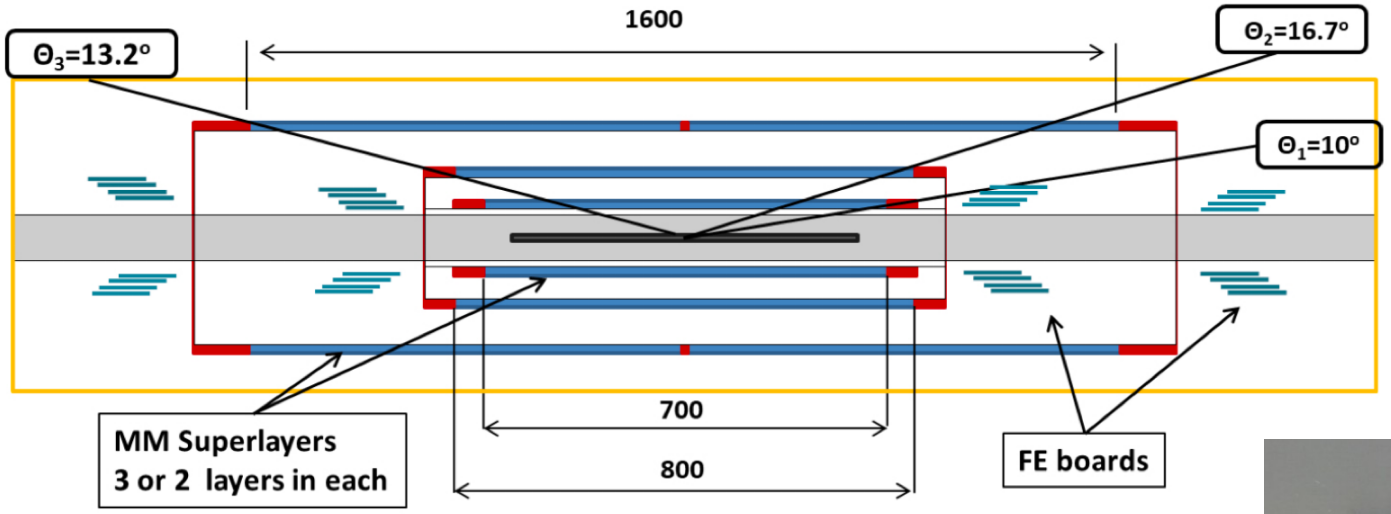
Goals:

- *Improvement of the momentum resolution*

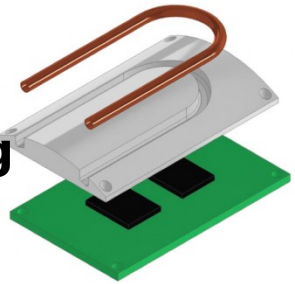
Requirements:

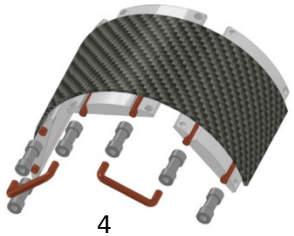
- *should operate in 1 T magnetic field*

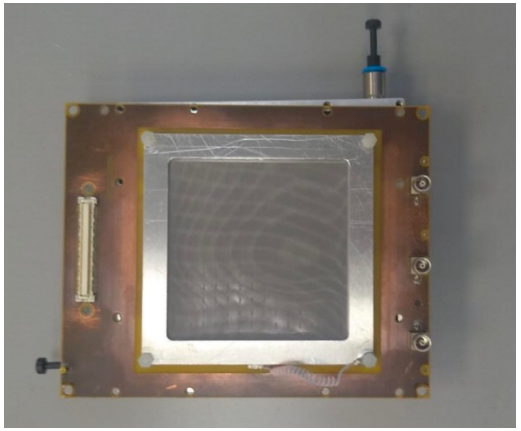




Water cooling

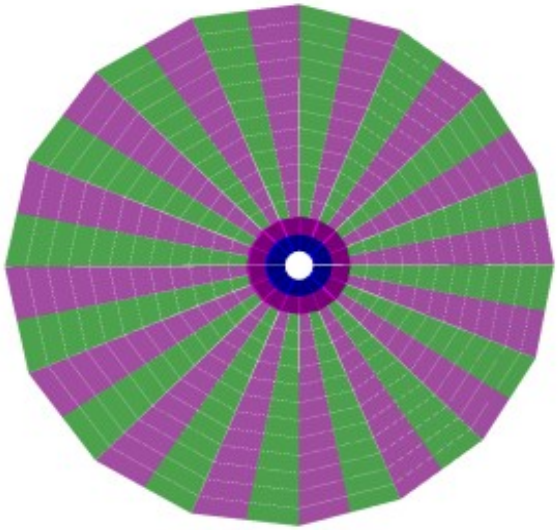


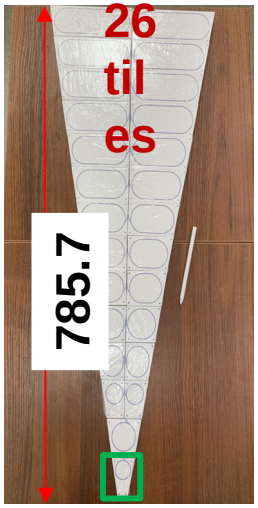




Beam-Beam Counters

Plastic scintillator-based outer part



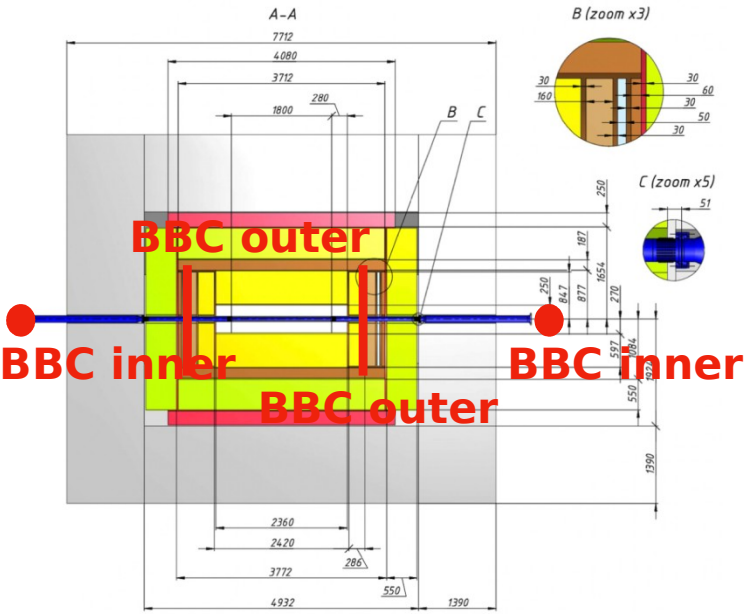


Goals:

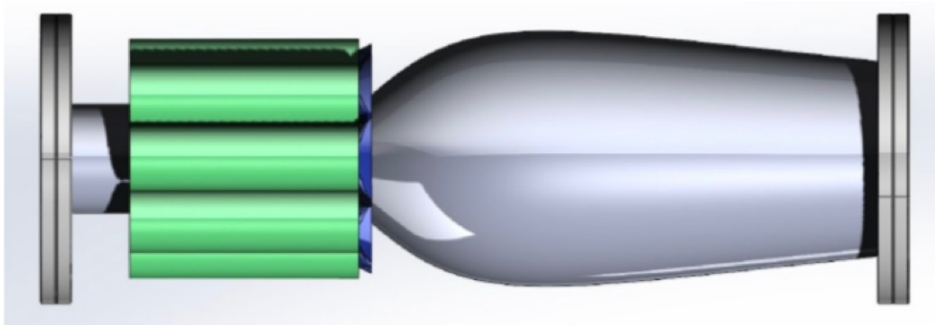
- *Local polarimetry*
- *Luminosity control*
- *Timing*

Requirements:

- *Operation close to the beam pipe (inner part)*
- *Time resolution ~1 ns (inner) and ~400 ps (outer part)*

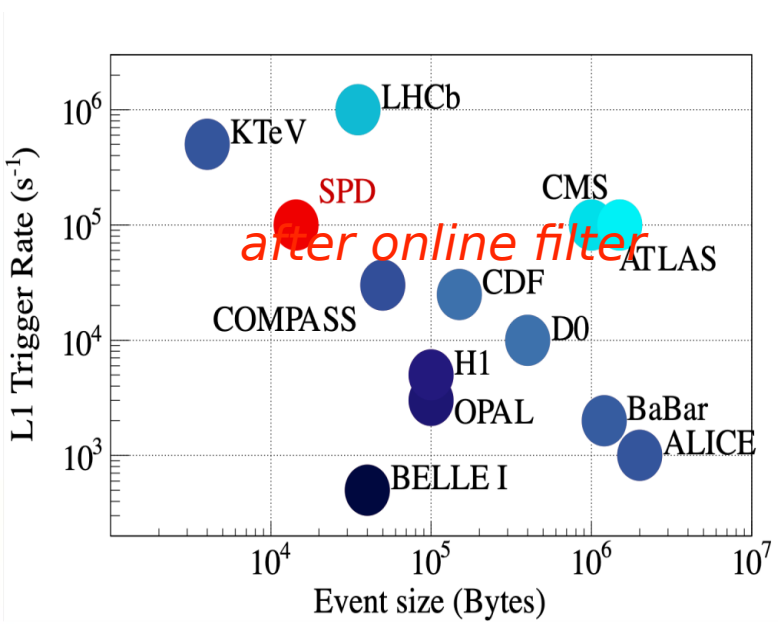


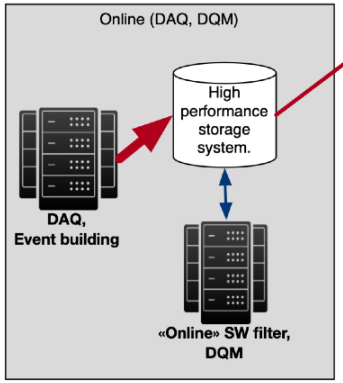
MCP-based inner part

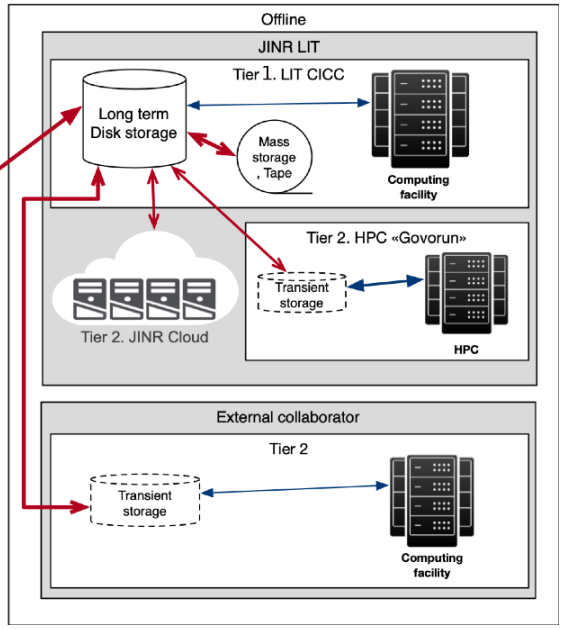


SPD DAQ

Free running (triggerless) mode !

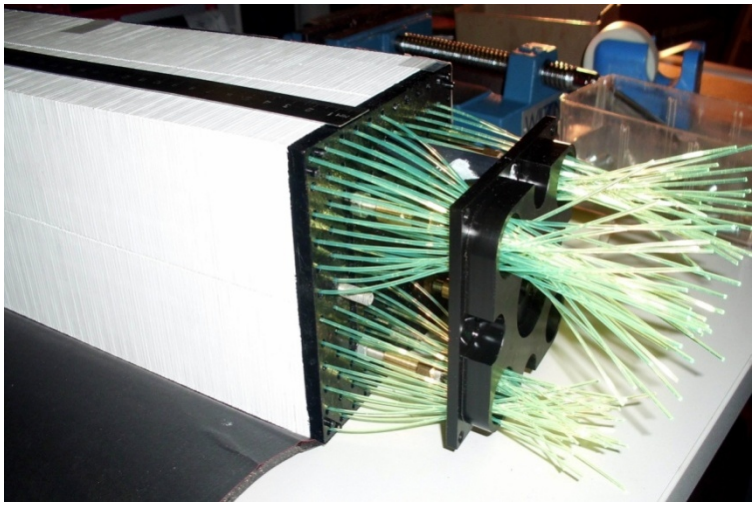






	CPU [cores]	Disk [PB]	Tape [PB]
Online filter	6000	2	none
Offline computing	30000	5	9 per year

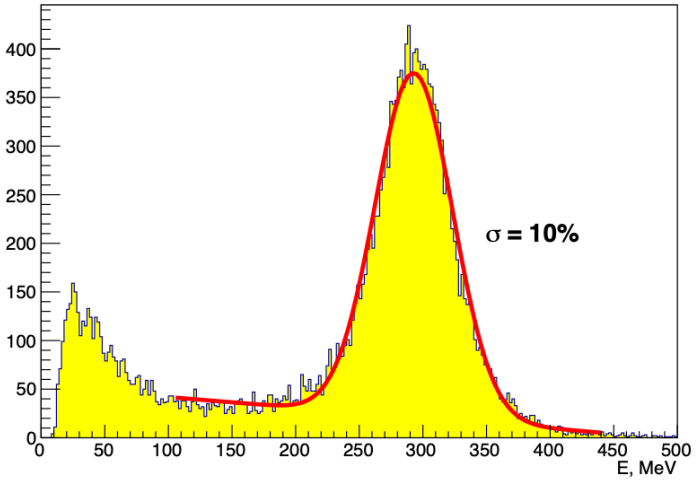
Electromagnetic Calorimeter (ECal)



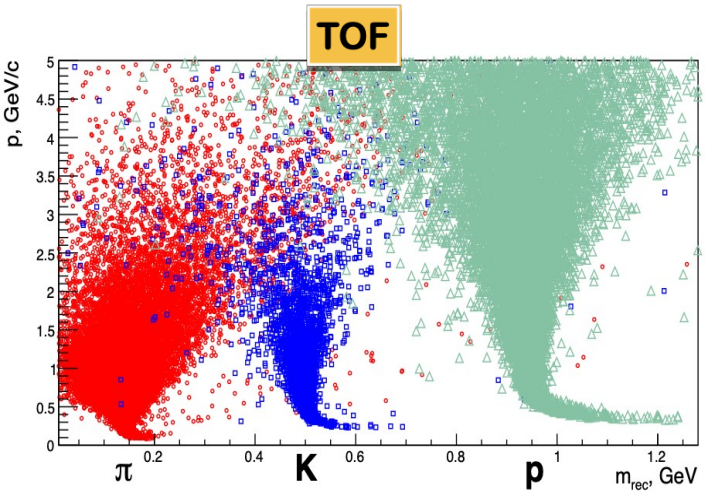
- Purpose: detection of prompt photons and photons from π^0, η and χ_c decays
- Identification of electrons and positrons
- Number of radiation lengths $18.6X_0$
- Total weight is 40t (barrel)+2×14t (endcap) = 68t
- Support structure will be made of carbon composite materials
- Total number of channels is ~30k

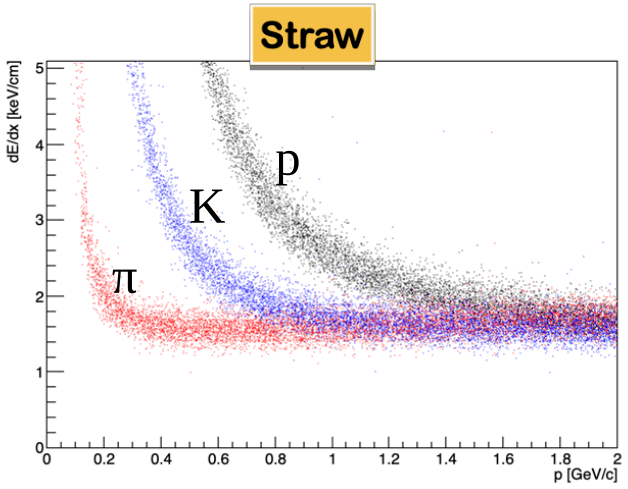
- 200 layers of lead (0.5 mm) and scintillator (1.5mm)
- Size of one sandwich: $4 \times 4 \times 40$ cm^3
- Moliere radius is ~2.4 cm
- 36 fibers of one cell transmit light to 6×6 mm^2 SiPM
- Energy resolution is ~5% / √E
- Low energy threshold is ~50 MeV
- Time resolution is ~0.5 ns

Energy deposition of one cell for MIP

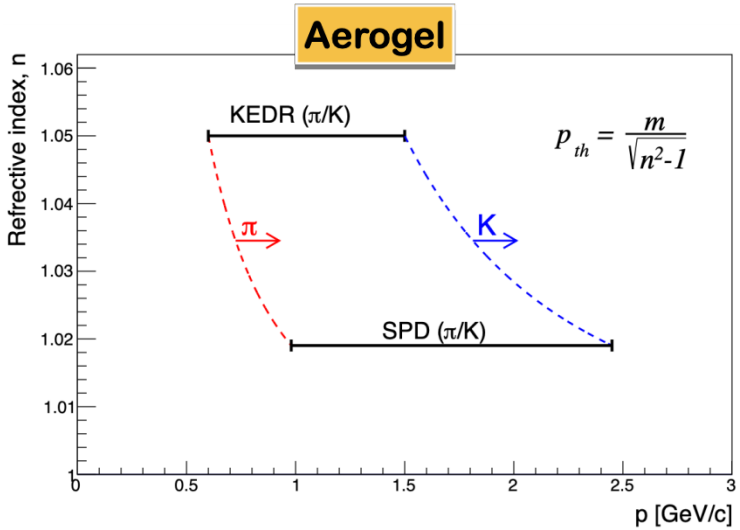


PID analysis in SPD (π, K, p)





π/K separation

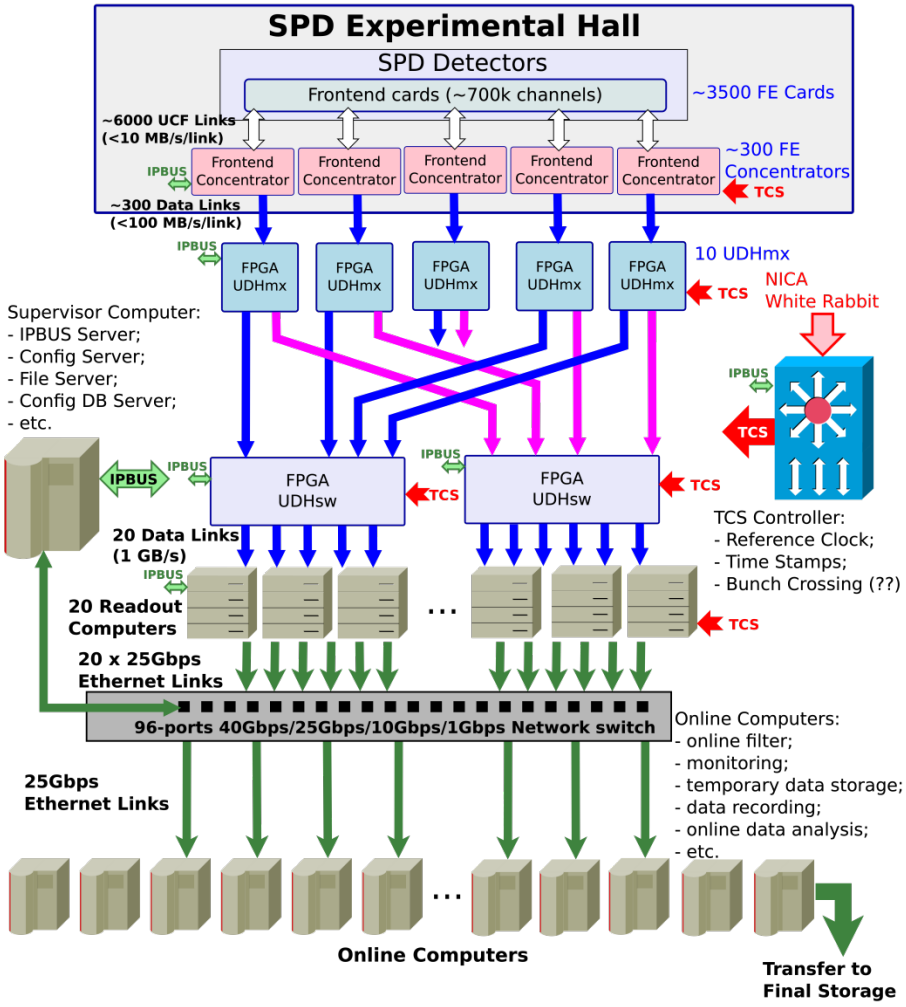


-Short tracks (R<1m) to be identified by straw up to 0.7 GeV/c

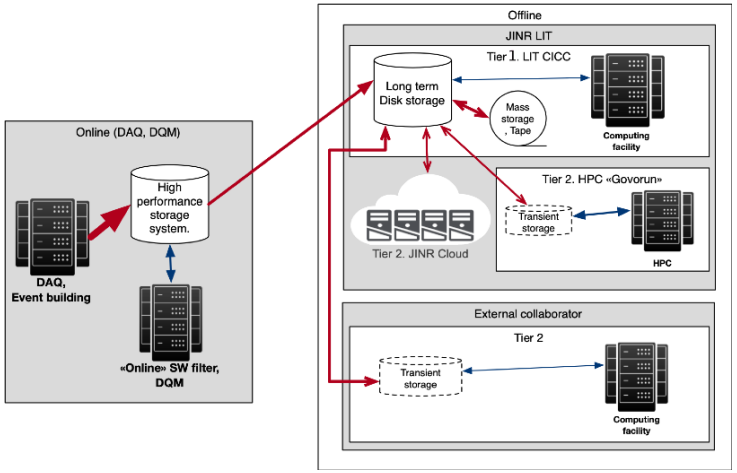
-Long tracks (R>1m) to be identified by straw+TOF up to 1.5 GeV/c

-tracks with p>1.5 GeV/c to be identified by aerogel

Data Acquisition System (DAQ)

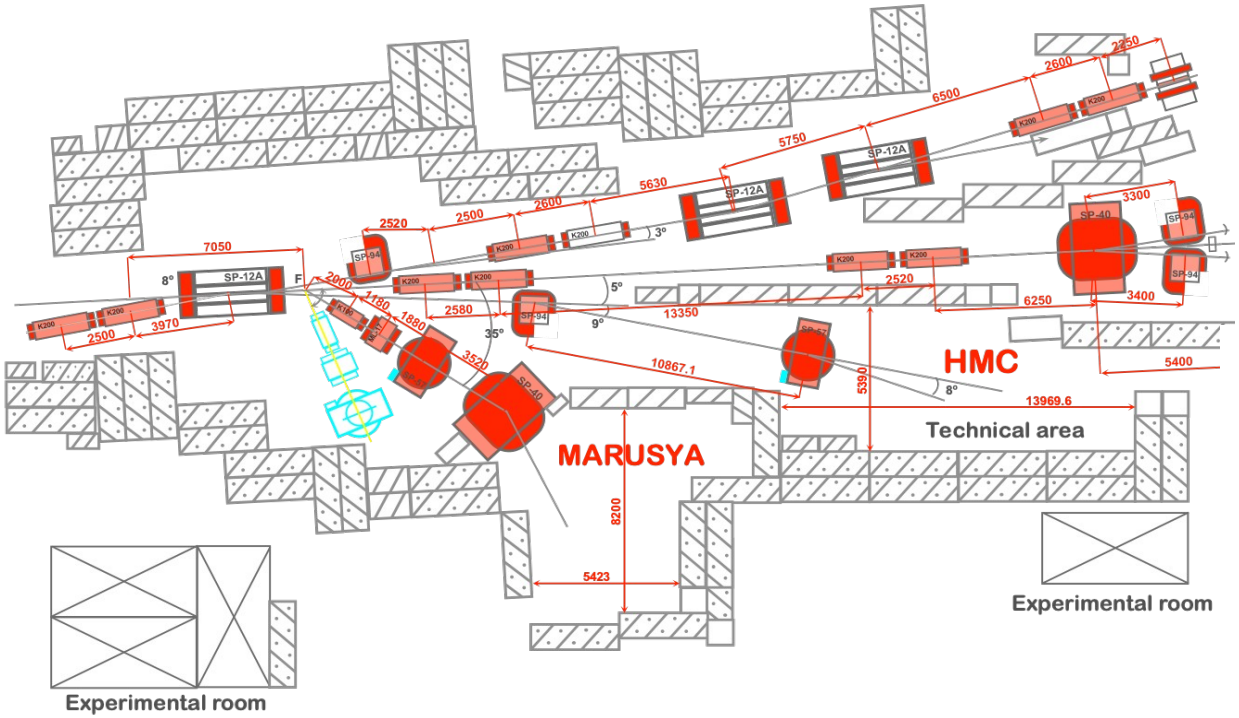


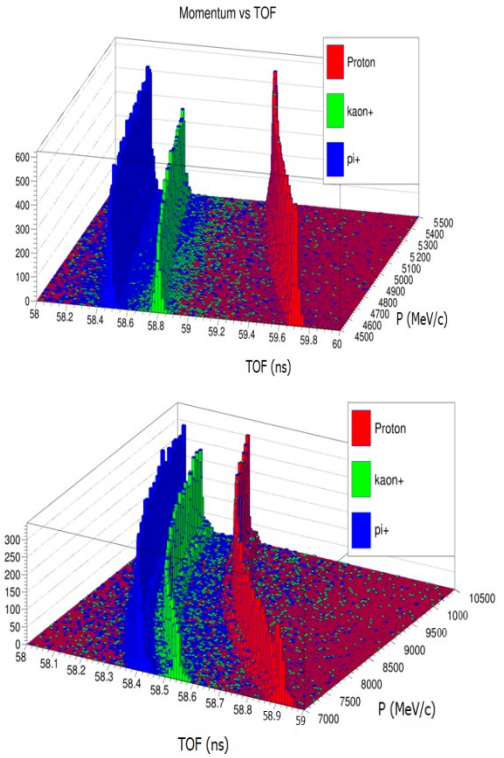
- **Bunch crossing every 76 ns → crossing rate 12.5 MHz**
- **At maximum luminosity of 10^{32} $cm^{-2}s^{-1}$ the interaction rate is 4 MHz**
- **No hardware trigger to avoid possible biases**
- **Raw data stream 20 GB/s or 200 PB/year**
- **Online filter to reduce data by oder of magnitude ~10 PB/year**



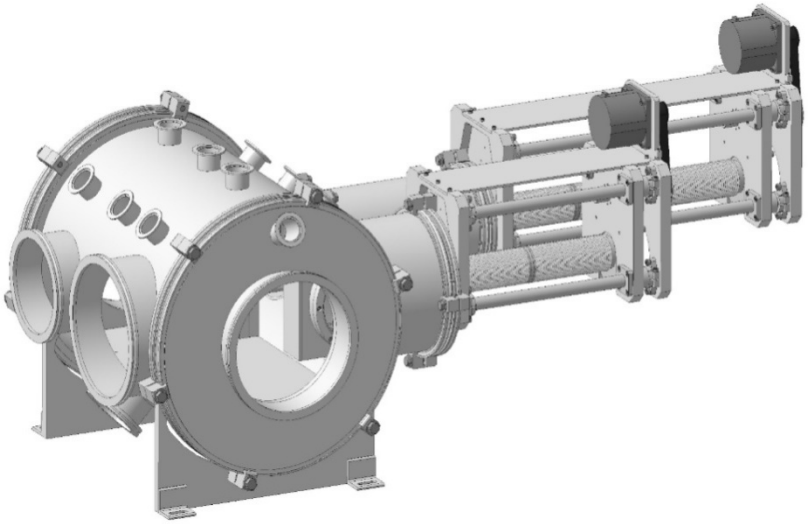
	CPU [cores]	Disk [PB]	Tape [PB]
Online filter	6000	2	none
Offline computing	30000	5	9 per year

Beam test area of SPD at Nuclotron





Beam test area of SPD at Nuclotron



2 target stations,
2 spectrometers with PID
gas, DAQ, DCS (TANGO)

P, MeV/c	d	p,n	$\pi^{\pm}$	K^{+}	K^{-}	$\mu^{\pm}$	$e^{\pm}$
400	10^3	10^5	10^5	10^3	10^2	10^3	10^3
800	10^3	10^4	10^4	10^3	10^2	10^3	10^3
1500	10^2	10^4	10^4	10^3	10^2	10^2	10^2
2000	10^4	10^5	10^4	10^3	10^2	10^2	10^2
7000	10^4	10^6	10^3	10^3	10^2	10^2	10^2