# The measurement of Drell-Yan processes with SPD detector at NICA. Background studies.

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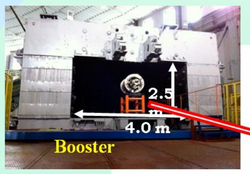
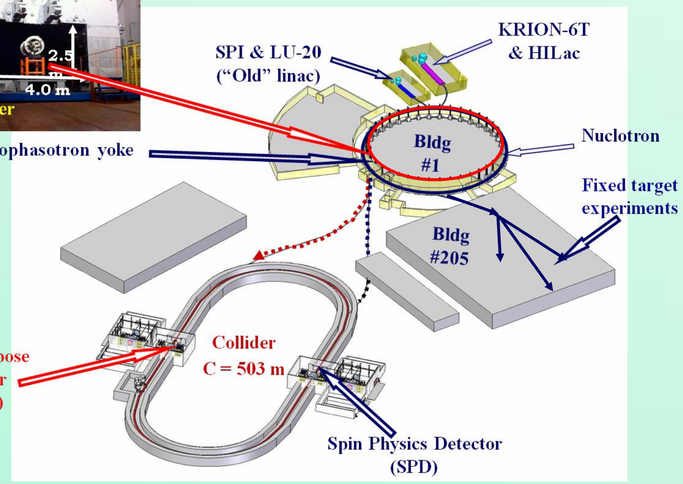
**SPD-NICA project is under preparation at second interaction point of the NICA collider. The purpose of this experiment is the study of the nucleon spin structure with high intensity polarized light nuclear beams. It is argued that the design of the collider can allow us to reach with proton beams a very high collision energy up to $\sqrt{s}$ ~ 26 GeV with average luminosity up to $10^{30}$-$10^{31}$ cm$^2$/s. At the same time, the respective number for deuteron collisions is also quite considerable: at a collision energy per nucleon up to $\sqrt{s}$ ~ 12 GeV, the average luminosity reaches up to $10^{29}$ - $10^{30}$ cm$^2$/s. It is of great importance that both proton and deuteron beams can be effectively polarized. The preliminary design of the SPD detector for spin physics studies is based on the requirements imposed by the Matveev-Muradyan-Tavkhelidze-Drell-Yan and productions studies. The some sources of background to the Drell-Yan process are the combinatorial background from decays ($\pi^0$, η) and gamma contribution and the decays of charmed-mesons, which are studied now.**

## Nuclotron-based Ion Collider fAcility (NICA)




## Schematic construction of NICA

## The NICA Project Goals

**The facility will have to provide:**

**1a) Heavy ion colliding beams $^{197}Au^{79+}$ x $^{197}Au^{79+}$ 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)**

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

**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)**

**$L_{average}$ ≥ 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**

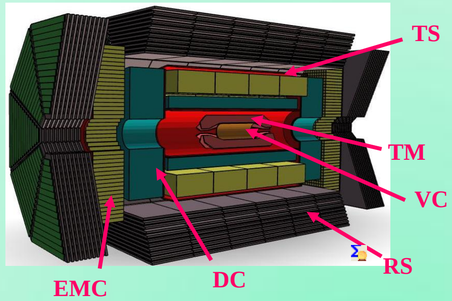
**d, d↑ = 2 ÷ 5.9 GeV/u ion kinetic energy**

**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)**

## Proposed measurements

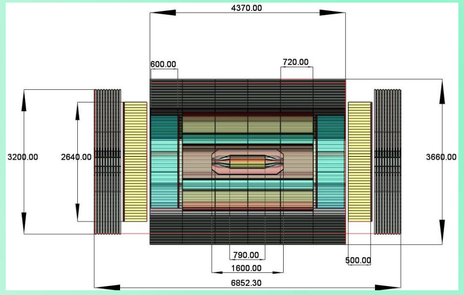
- **studies of DY processes with longitudinaly and transversely polarized *p* and *D* beams. Extraction of unknown parton distribution functions (PDFs)**
- **studies of J/ψ production processes and PDFs**
- **studies of elastic reactions**
- **spin effects in one and two hadron production processes**
- **spin effects in inclusive high-pT reactions**
- **polarization effects in heavy ion collisions**
- **spectroscopy of quarkonia with any available decay modes**

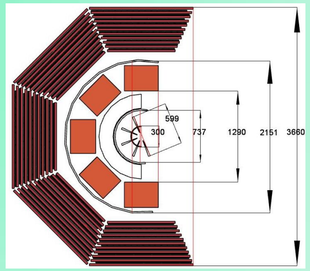
## Proposal on Spin Physics Detector (SPD)



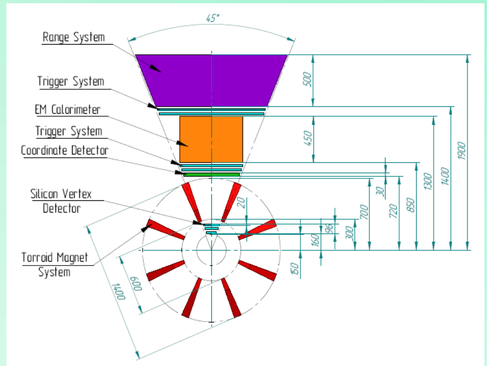

**Proposed scheme of the SPD:**
**Torroid magnet system (TM)**
**Silicon detectors (VC)**
**Drift chambers (DC)**
**EM Calorimeter (EMC)**
**Range System (RS)**
**Trigger System (TS)**
**EndCap detectors with RS, tracking system and EMC**

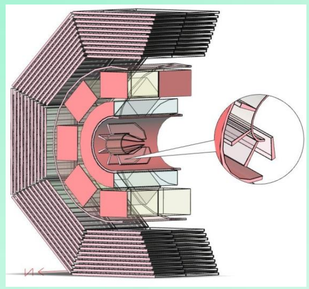
**SPD sizes: ~ 6.8 m along beams**
**~ 3.7 m in diameter**




## Barrel Sector



## Simulation of DY processes

- **for pp beams with E = 12.6 GeV**
- **pure MMT-DY events**
- **PYTHIA generator was used**
- **VC, DC, EMC,RS have to be fired**