# Local polarimetry for SPD Beam-beam counter as T0

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SPD/NICA Collaboration

Status report 14 April 2019

# **Outlook**

- **1. Local polarimetry**
- 2. Beam-beam counter
- 3. Zero degree polarimeter
- 4. Endcap ECAL option
- 5. Conclusions

# **Major goals of local polarimetry**

**1.** Permanent monitoring of the beam polarization during data taking to reduce the systematic error coming from the beam polarization variation.

2. Independent from the major polarimeters (CNI and absolute) monitoring of the beam polarization and possible usage of this tool to tune the beam polarization axis.

Local polarimetry is just additional tools to the absolute **pp-** and **pC-** polarimeters in the collider!

# **Reactions for local polarimetry**

**1.** Asymmetry in inclusive production of charged particles in forward direction.

**2.** Single transverse spin asymmetry for very forward neutron production.

3. Inclusive pp  $\rightarrow \pi^{o}X$  reaction at large  $x_{F}$ 

# **Detectors for local polarimetry**



**BBC, ZDC, Endcap ECAL** 

# **BBC for local polarimetry**



 Inner zone – for luminosity estimation
Outer zone – for local polarimetry
Trigger and T0

#### **BBC: STAR experience**



#### Correlation between CNI polarimeter and STAR BBC asymmetries.

# **BBC: SPD energy range**



#### Data provided by A.Guskov

Most of charged particles in forward direction at SPD energies are protons and pions. We expect that the value of the effective analyzing power at SPD will be larger than at STAR energies.

# **Very forward neutron production**



B.Kopeliovich calculations are in good agreement with the PHENIX results. One can expect  $A_N \approx -0.02$  in very forward neutron production at SPD energies.

# **Forward neutrons: SPD energy range**



Data provided by A.Guskov

Quite large amount of neutrons in forward direction at large  $x_{r}$  at SPD energies.

However, seems, that due to quite small value of the effective analyzing power such method will work only at the enegries close to the maximal one at SPD.

# Inclusive pp $\rightarrow \pi^o X$ reaction



D.L.Adams et al., Phys.Lett.B 261, 201 (1991); Phys.Lett.B 264, 462 (1991). C.E.Allgower et al., Phys.Rev.D 65, 092008 (2002).

Method should work in the whole SPD energy range. However, analyzing power increases at high xF, therefore, measurements can be performed with the ECAL Endcaps only.

#### **Gammas at SPD energies**



Gammas at the energies up to 11-12 GeV for the reconstruction of the invariant mass of 2 of them.

# **BBC for L0-trigger and T0**



 Coincidence Left-Right corresponds to the beambeam interaction, while signals from the left or right correspond to the inteaction of the bem on the residual gas.
T0 signal.

#### **BBC for SPD**

- **1.** full BBC for the L0 trigger.
- 2. BBC inner part microchannel plate detectors with few ps time resolution for T0 purpose.
- **3.** BBC outer part scintillation counters with SiPM readout with 50-80 ps resolution for local polarimetry.

# **Inner part of BBC -MCP technology**



Nuclotron

# **Inner part of BBC**



**SPD BBC inner part** 

MCP signal for SPD prototype

G.Feofilov et al. - experience at ALICE (supported by RFBR)

**Contribution at the 15-th VCI-2019, Vienna.** 

## **Inner part of BBC**

A compact setup of two detectors with high timing capabilities based on the MCP applications - the Fast Beam-Beam Collision counters (FBBC) and the Beam Position Monitor (BPM), is proposed to meet the wide set of requirements of the future physics programme with the polarized beams in the SPD at NICA. The feasibility of the event-by-event monitoring of the beam-beam interactions at NICA is confirmed both by the previous developments of the UHF-UHV technology and by the beam tests at JINR and CERN of the prototype detectors and electronics, as well as by the in-lab tests of new 8µ-channels MCPs with the improved characteristics.

The new R&D efforts will be focused on the development and the in-beam tests of the next generation of compact fast MCP-based FBBC prototypes using the beam-test facility at JINR.

# **Outer part of BBC -SiPM technology**

Main option is the scintillation detectors with SiPM readout at several points to improve the time and space resolutions.



16 channels SiPM readout board has been developed and used for the tests.

# **Outer part of BBC: testbench**

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acquisition system was developed and used for the data taking from scintillation detectors.

#### **KETEK SiPM results with LED**



#### Hamamatsu SiPM results with LED



Talk of A.Tishevsky at AYSS-2019, 18 April, 2019

# **Nearest plans: outer part of BBC**

We are developping new preamplifier with the ToT function for Hamamatsu SiPM. (P.Polozov team from ITEP).

DAQ is ready.

We are going to get the data for 4 different of scintillation plates to make a preliminary design - middle of May.

#### **Status of the preamplifier with ToT**











Test of the prototypes of the BBC, including both inner and outer parts - 2020.





Вакуумная камера для дистанционного управляемых профилометров пучка и мишенной станции тестовой зоны SPD фокуса F4 выведенного пучка Нуклотрона ВП1 Договор о создании вакуумных камер и систем дистанционного управления мишеней и профилометров одобрен и принят к реализации в марте 2019 г. Исполнитель ООО «Вакуумные системы и технологии» руководитель д.ф.-м.н. А.С. Кубанкин





# **ZDC for forward neutrons polarimetry**



# Quartz fibers+ W -absorber

**No resources+problems with the space: postponed** But some R&D can be performed using 16-channel SiPM board

#### **Forward neutrons registration**



Option for<br/>spectatorneutron<br/>detectorperformancestudies

16-channel scintillation detector 2x2x2 cm<sup>3</sup> coupled with 16-channels Hamamatsu S12572-010P SiPM board.

# **ECAL Endcap for polarimetry**

No special detector is needed. ECAL endcap information will be used. The local polarimetry can be realized at the level of free-streaming DAQ via dedicated FPGA settings (A.Isupov, S.Reznikov). Fast selection algorithms should be developed.

# **1 GeV electrons "by quarters"**



- Y-scale 0-600 MeV
- Black numbers: loss in percents. Pass through, albedo, hadronics

Idea: O.Gavrichtchouk Simulation: V.Popov

# **1 GeV electrons, XY projection**



# **Nearest plans**

**1.** Tests of the prototypes in the laboratory- the necessary equipment was delivered.

2. Development of the detector model for the SPDRoot and simulation- urgent help is needed.

3. Development of the BBC system prototype for the SPD test zone at Nuclotron. Parts of outer BBC can be tested at internal target at Nuclotron.

4. Preparation of the neutron irradiation tests at LNP Accelerator (and INP, Rez ?)

**5.** Preparation of the contribution for CDR.

#### **Manpower request**

Missed: 0.5 FTE - designer 1.0 FTE = 2 Master students for SPDRoot 1.0 FTE = 2 Master students for detectors 0.5 FTE - 1 Master student of ECAL algorithm

## Conclusions

**1.** The BBC project is going quite smooth. Some delay with the ToT preamplifier development exists. Manpower, especially for the simulation is needed.

2. ZDC development is postponed. We need new collaborators to start this project. (Simulation, detector concept development etc.)

**3. ECAL can be used for the local polarimetry. Participation in the DAQ and ECAL teams.** 

4. We can help in the development of the neutron spectator detector.

**5.** Clean rooms are needed for the work with the detectors.

6. Support of our ITEP collaborators is needed (RFBR ?).

Thank you !