Report of the Physics Coordinator

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SPD Collaboration meeting 03.10.2022

Meetings:

- Physics & MC monthly, present results
- Physics (Bi-)Weekly once in two weeks, **communication**, presenting intermediate results or status, reporting problems, asking for help, ...

People involved:

- Many involved people (Physics & MC 30+, Physics Weekly 20-30)
- Smaller amount of actively contributing people
- A lot of **new groups show** interest for work in various fields (simulation, reconstruction, analysis, software development)

Communications

• email (SPD_MC mail list, private emails)



Theoretical predictions, precision of our measurements and their impact



Predictions & expected precision of our measurements

For our main probes of proton gluon structure we have

- predictions (thanks to the Samara group, prediction for A_N are shown)
- projected statistical uncertainties (in case of Dmesons we need an update)





Impact



The impact of our measurements

- is estimated for our prompt photon A_{LL} measurements
- can be expected soon for the J/ ψ $A_{_{L\!L}}$ measurements



• Impact on unpolarized gluon PDF

- Is it possible to estimate impact of out A_N measurements for extraction/constraining of the GSF?
- Can the following results be used for this purpose?



p_T-dependence for f-type Sivers TMD in the **spectator model**, Bacchetta, Celiberto, Radici, 2022

Courtesy: Sassot, Borsa, 2021, from A. Datta at NUCLEUS 2021

Simulation, reconstruction, and analysis



SpdRoot

Geometry

- All main detector subsystems are described (thanks Ivanov, Akunzyanov, Maltsev, Verkheev & Gridin for the update).
- Consistent with the TDR draft*.
- Update for silicon vertex detector is required.
- ZDC is included, but modeled separately.

Mostly "fast simulation" tool

- except ECal
- ongoing work by Gatchina group (E. Kuznetsova) towards realistic straw simulation (two talks at this CM)

Typical difficulties:

- difficult to install
- hard to start working with







Reconstruction task	Can be used for analysis?	Contact person	Note
Pattern recognition (MAPS+Straw)	±	V. Andreev*	slow, may not be applicable for Micromegas-based central tracker
Track fitting	+	V. Andreev*	requires optimization, issues for low- momentum tracks
Primary vertex finding & fit	+	V. Andreev*	validation scripts required
Secondary vertex fit	±	V. Andreev*	validation scripts required
dE/dx PID	+	R. Akhunzyanov	
TOF PID	+	A. Ivanov	simplified approach
Pattern recognition in ECal	+	A. Maltsev	barrel-endcap cluster matching?
Energy reconstruction in Ecal	+	A. Maltsev	
Track extrapolation in RS and muon PID	-+	I. Denisenko, G. Golovanov	slow, further work on muon PID is required

• Simulation of ZDC is developed separately, see talk on Thursday

Reconstruction in SpdRoot



- SpdRoot can be used to study most the most physics processes at SPD
- Many reconstruction algorithms in SpdRoot are MC-truth dependent

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Reconstruction in SpdRoot





dE/dx PID performance, R. Akhunzyanov, P&MC#16



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Modeling of physical processes

Process	Person	Note
Inclusive charmonia production	I. Denisenko	only muon ID updates since CDR
Open charm	A. Datta	ongoing update
Prompt photons	A. Guskov	no updates since CDR
Elastic pp and dd scattering	A. Gridin, A. Terkulov?	ongoing
Problems of soft pp interactions	R. Akhunzyanov,	ongoing work on study of inclusive cross-
Single spin physics	E. Zemlyanichkina,	Sections
Vector light and charm meson production		effect of absorber instead of ECal at 1-st stage
Exclusive reactions with lightest nuclei and spin observables		
Multiquark correlations and exotic hadron state production	A. Galoyan	
Exclusive hard processes with deuteron		
Search for deconfinement in pp and dd central collisions		
Search for dibaryons		
Search for lightest neutral hypernuclei with strangeness -1 and -2	M. Davydov	ongoing by START student
Measuring antiproton production cross-section for dark matter search		
Hadron formation effects in heavy ion collisions	R. Pandey	ongoing by START student
Polarization of hyperons		
Online polarimetry	K. Shtejer, Z. Kurmanaliev	note can be expected soon; ongoing work

Modeling of physical processes

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Problems of soft pp interactions		R. Akhunzyanov,	ongoing work on s	study of inclusive cross-
Single spin physics				
Vector light and charm meson production	A lot of opportunities	to contribute:		nstead of ECal at 1-st stage
Exclusive reactions with lightest nuclei and sp	 physics with main probes of gluon structure, 			
Multiquark correlations and exotic hadron sta	exclusive processes	,		
Exclusive hard processes with deuteron	multiquark correlat	ions,		
Search for deconfinement in pp and dd centr	•			
Search for dibaryons	Fax dataila ana			
Search for lightest neutral hypernuclei with s	• Progress in Particle	and Nuclear Dhysics 110 1	103858 (2021)	tudent
Measuring antiproton production cross-secti	 Progress in Particle and Nuclear Physics 119, 103858 (2021) Physics of Particles and Nuclei 52, 1044 (2021) 			
Hadron formation effects in heavy ion collisio	,		-,	student
Polarization of hyperons				
Online polarimetry		K. Shtejer, Z. Kurmanaliev	note can be expec	cted soon; ongoing work

Agenda of Physics & MC day at CM

10:00	Spin dependent measurements at COMPASS: recent results and highlights	Dr Bakur Parsamyan	
	Conference Hall, Building 215, VBLHEP, JINR, Dubna	10:00 - 10:30	
	Will NICA be able to test the various parametrizations of Fragmentation Functions?	Dorota Kotlorz	
	Conference Hall, Building 215, VBLHEP, JINR, Dubna	10:30 - 11:00	15:00
11:00	Color coherence effects at SPD-NICA	Dr Alexey Larionov	
	Conference Hall, Building 215, VBLHEP, JINR, Dubna	11:00 - 11:20	
	Coffee break		
	Building 215, VBLHEP, JINR, Dubna	11:20 - 11:50	16 [.] 00
	Challenges and problems in charmonium production at the SPD NICA	Prof. Vladimir Saleev	10.00
12:00	Conference Hall, Building 215, VBLHEP, JINR, Dubna	11:50 - 12:20	
	Large-pT hadron correlations in pp-collisions at NICA energies	Andrei Zelenov	
	Conference Hall, Building 215, VBLHEP, JINR, Dubna	12:20 - 12:40	
	Straw simulation and beam tests	Dmitriy Sosnov	17:00
	Conference Hall, Building 215, VBLHEP, JINR, Dubna	12:40 - 13:00	

Status of track reconstruction for SPD experiment	Vladimir Andreev
Conference Hall, Building 215, VBLHEP, JINR, Dubna	14:10 - 14:30
dE/dx and TOF performance at SPD	Artem Ivanov
Conference Hall, Building 215, VBLHEP, JINR, Dubna	14:30 - 14:50
Status of reconstuction in ECal	Andrei Maltsev
Conference Hall, Building 215, VBLHEP, JINR, Dubna	14:50 - 15:10
Measurements of D mesons at SPD	Amaresh Datta
Conference Hall, Building 215, VBLHEP, JINR, Dubna	15:10 - 15:30
Elastic pp scattering at SPD	Andrei Gridin
Conference Hall, Building 215, VBLHEP, JINR, Dubna	15:30 - 15:50
Coffee break	
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- We have an increased interest of people to participate in SPD project, including physics and MC simulations. I tried to make an outline of the current situation and suggested tasks.
- Four START students have come to work for SPD-related tasks.
- Despite some complications, it has been a number of improvements in SpdRoot.
- Our simulation software is capable of simulating most of the suggested physical processes. Many processes, especially from the suggested for the first stage has not been investigated yet.
- Work on improving simulation, reconstruction, their validation, maintaining geometry and analysis tools in SpdRoot is also extremely important.

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- Except for A_{μ} the impact of future SPD measurements on our understanding of polarized and unpolarized proton and deuteron gluon structure has not been estimated yet.
- Software work for developing a new software prototype will be needed.