Report of the Physics Coordinator

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SPD Physics & MC meeting
25 January 2023

Subject **SPD Physics Seminar (01.02.2023)**

Dear colleagues,

I kindly invite you to our first SPD Physics Seminar scheduled for
01.02.2023 (Wednesday) at 11:00 MSK (GMT+3).

The seminar will be fully online via Zoom.

Speaker: Mikhail G. Ryskin (Petersburg Nuclear Physics Institute, NRC Kurchatov Institute, Gatchina)

Title: Non-perturbative polarization effects in inclusive processes

Abstract:

Simple model which enables to evaluate the polarization effects making use of the q_T dependence of the inclusive $Ed\sigma/d^3q$ cross section is considered. Three other non-perturbative models (Lund model, the model based on Thomas precession, and the instanton induced model) are mentioned.

Zoom connection details:
https://cern.zoom.us/j/4505922811?pwd=cFpxMGdOVkNVais2NFNlSnJtZjkzUT09
Meeting ID: 450 592 2811
Passcode: 279450

Kind regards,
  Igor

Thanks to Victor for help organizing it!

Ongoing activities and tasks: simulation (SpdRoot)

Detector: geometry, simulation, digis	
Silicon tracker	[I.Denisenko], TBA
MVD	D. Dedovich
MAPS	Optimization (geometry,...): TBA
Straw	Geometry: R. Akhunzyanov; digi: E. Kuzenstova (group) De/dx: R. Akunzynov (to reconstruction)
AEG	Geometry: A. Ivanov. Simulation/digis - TBA
TOF	Geometry and simplified performance: A. Ivanov
BBC (scintillator)	Geometry: Z. Kurmanaliev
Ecal	Geometry: A. Maltsev
RS	Geometry description and digis/hits: A. Verkheev
Simulation of ZDC	Analyzed in BMNRoot
MCP	TBA

* please remind me or let me know if I miss something

Ongoing activities tasks: reconstruction (SpdRoot)

Reconstruction	
Hits in silicons	TBA [I. Denisenko]
Hits in MVD	D. Dedovich
Hits in straw	Do we need? Track fit approaches? TBA
PID via dE/dx	R. Akhunzyanov
Pattern recognition (straw -> CT)	V. Andreev
Track fitting	V. Andreev, TBA
Primary and secondary vertex reconstruction	V. Andreev, TBA
Optimization of tracking	TBA
AEG	TBA
Tof T0	TBA
TOF PID	A. Ivanov
Clusters in ECal	Clustering, pi0/gamma separation - A. Maltsev
BBC performance	Z. Kurmanaliev
Muon/pion separation RS	I. Eleckih, I. Denisenko
Neutron/photon separation in ZDC	N. Zhigareva, P. Alekseev
Radiation doses	A. Gridin
Performance tests	I. Denisenko, A. Ivanov, R. Akhunzyanov, A Maltsev

* please remind me or let me know if I miss something

Physical processes	
1-stage physics	
elastic pp, dd	A. Gridin
small t elastic pp	A. Terkulov
J/psi and exclusive vector meson backward production cross-section	TBA
Squeezed states	A. Galoyan
pd -> ppn	pheasibility in dd? TBA
Scaling behavior of exclusive reactions with lightest nuclei and spin observables	TBA
Search for deconfinement in pp and dd central collisions	TBA
Multiquark correlations	A. Zelenov?
Search for light dibaryons	B. Kostenko, V. Kurbatov,
Soft photons	E. Kokoulina's group
Bose-Einstein Condensation and Correlations	E. Kokoulina's group (Kutov)
Lightest neutral hypernuclei	TBA
Single spin physics, Soft pp interactions	Inclusive pi0 production - R. Akhunzyanov Inclusive hadron production - E. Zemlyanichkina Iunclusive KS production - N. Rogacheva, two-particle Pt correlations, $\langle xF \rangle$ pT coorrelations - ?
Hadron production in heave ion collisions	TBA, some preliminary work done by R. Pandey
Antiproton production cross-section	TBA
2-stage physics	
Physics with charmonia (2-st stage)	V. Shalaev, I. Zhizhin, I. Denisenko
Physics with D-mesons	A. Datta
Phsyics with prompt photons	A. Datta
Physics with deutrons?	TBA
Cluster hadron production	Dmitriy

Ongoing activities tasks: polarimetry (SpdRoot)

Online polarimetry	
Polarimetry with pi0	K. Shtejer
Polarimetry with scintillator BBC	Z. Kurmanaliev
Polarimetry with MCP	TBA
Polarimaetry with neutrons	TBA

Ongoing activities tasks: theory and generators

Theoretical preidctions and inpact of SPD measurements	
cross-section, kinematic dependences, asymmetries,asociated production - V. Saleev's group	
D-mesons	predictions: done, impact?
charmonia production	predictions: done Impact of SPD measurements on gluon helicity function (A. Karpishkov)
prompt photons	predictions: done, impact: done

Also what pd collision physics can be studied in dd collisions?

Generators	
Validation of generators (UrQMD, FTF, Pythia)	V. Uzhinsky, A. Galoyan
ULYSSES	A. Zelenov, V. Kim
Generators with polarized beams	SPHINX (V. Aleksahin)
Generators with kT factorization	Pegasus (+CASCADE?) - TBA

Ongoing activities tasks: Gaudi-based simulation framework

Gaudi framework	
Core framework	V. Onuchin
Geometry	A. Allakhverdieva
Geometry navigation for reconstruction	A. Allakhverdieva, A. Zhemchugov
Tracking (ACTS)	V. Lyubushkin
Alignment	TBA
TBA	S. Turchikhin

Docker container with Gaudi for tests to distributed by Alexey Zhemchugov soon.

SpdRoot update (4.1.5)

- The directory "macro/performance-tests" has been added. There are performance tests for track track fitting (ask me if you have questions, also please use them as an examples for default configurations for tracker) and ECal reconstruction (thanks to Andrey, see README for hists to check). Similar tests for track finding would be needed.

- ECal geometry update/fix (see the recent letter by Andrey).

- SpdPipe::SetPipeMaterial now works correctly (thanks to Artem). The default pipe material is aluminum, to change to beryllium do SetPipeMaterial("beryllium",0).

- Secondary vertex fitting code has been updated for SpdVertexFitPar. Now you can extract the decay and production vertex positions via SpdVertexFitPar2::GetDecayVertex() and SpdVertexFitPar2::GetProductionVertex() (thanks to Elena).

- Correct track PDG ID for K0 decays (thanks to Ruslan and Natalia).

- Bug fixes for BBC and ZDC (thanks to Artem).
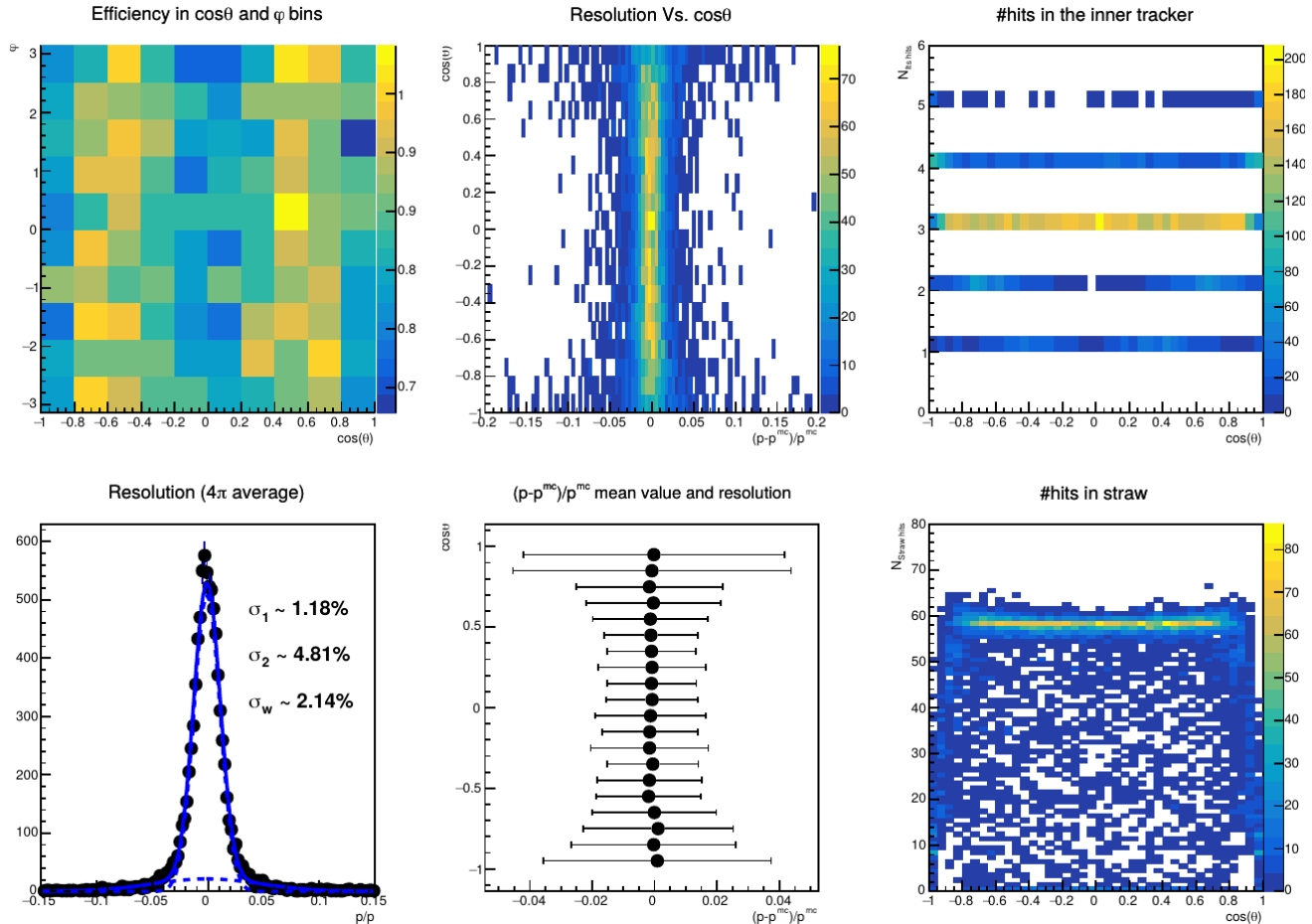
What is missing
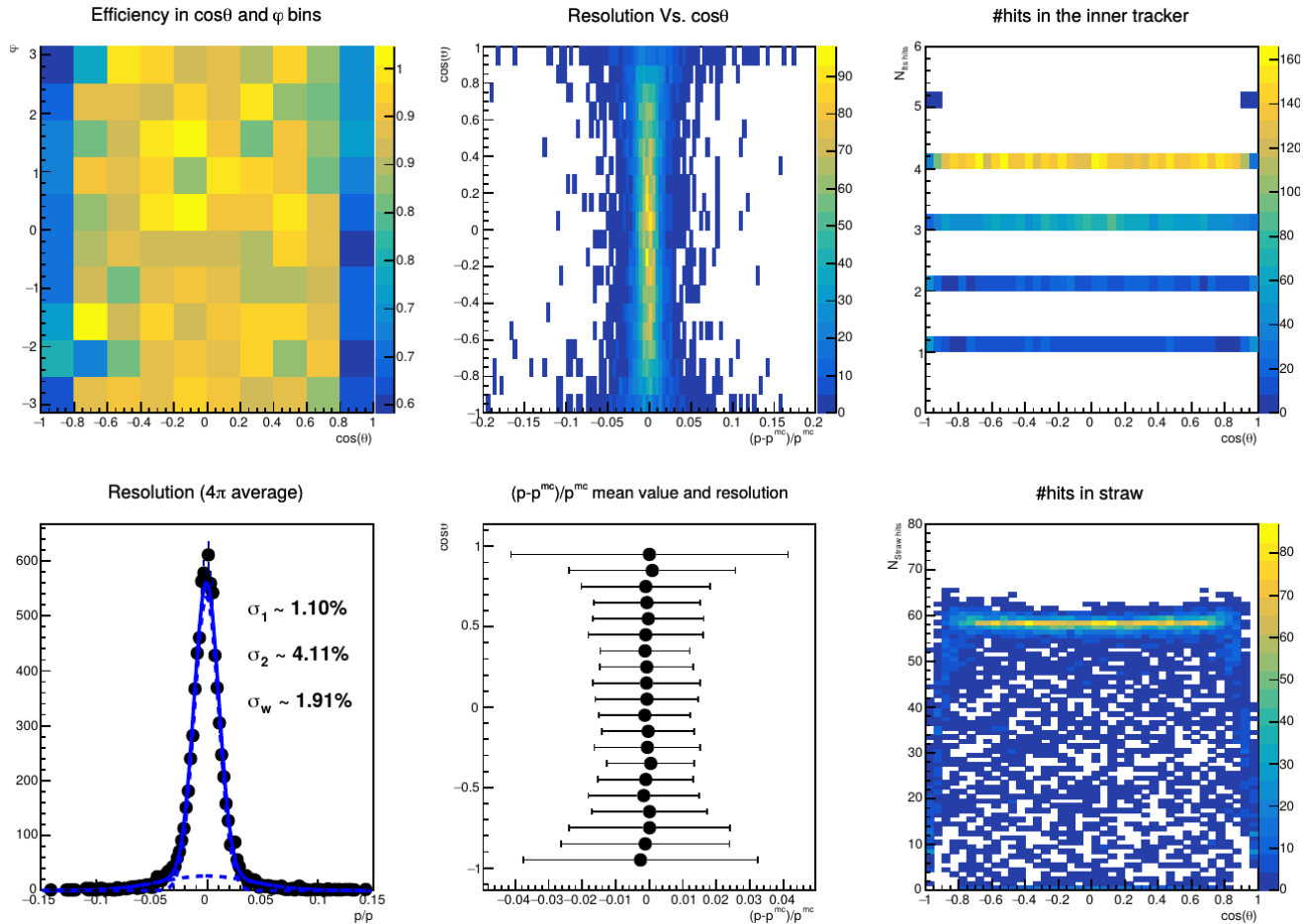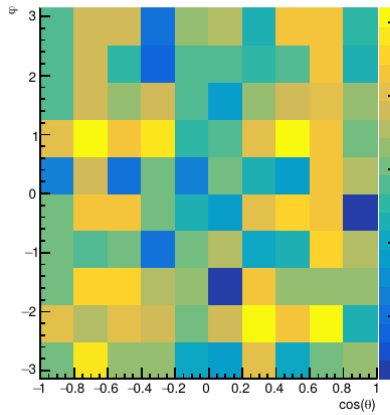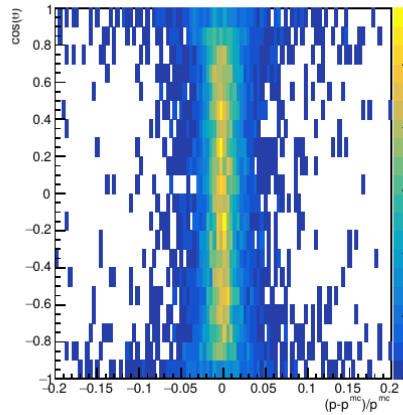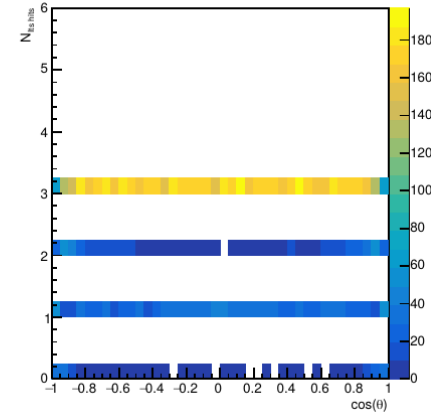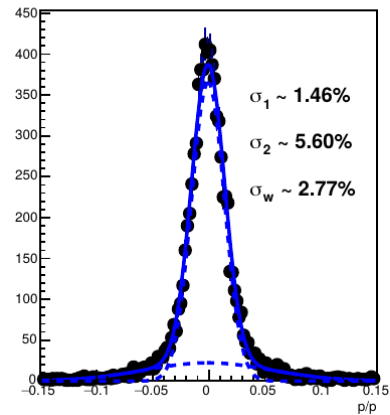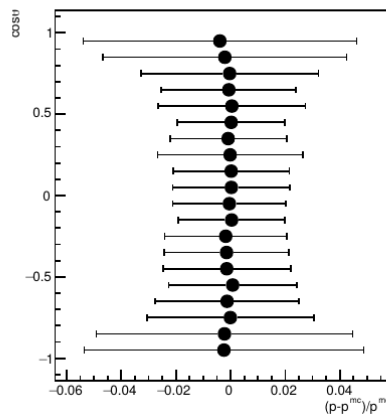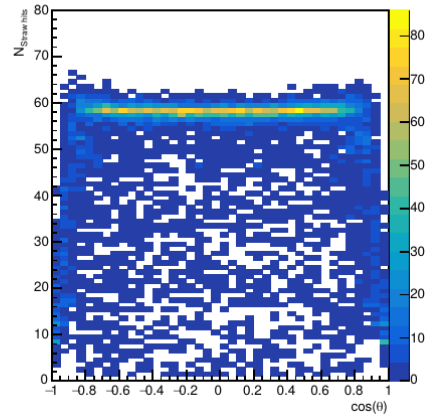
Things that can be quickly added:

- plots from physical examples (integrate them, code update is required)
- dE/dx and TOF
- pattern recognition in tracker
- Significant work needed
  - D-meson, K_s
  - General performance (time per event, etc.)
- Many other things…

How it should be integrated to SpdRoot software development infrastructure?

- Update plots for each release or major code changes?
- Where to store plots and how to compare?
- Batch production may be needed for some cases…

Summary

- Our simulation framework SpdRoot is capable of (simplified) modeling of the most of the suggested processes. Some parts are still missing.

- We miss many performance tests which may be used as starting points for analysis or references of correct usage of information from subsystems.

- The ongoing activities cover part of the suggest physics. More contributors are much welcome! Our capabilities of measurements with deuteron beams require additional attention.

- Mostly, we have necessary predictions from theory. We miss impact studies for our measurements in case of charmonia (ongoing work) and open charm production.

- The Gaudi-based is being developed, much software work will be required.