Physics Coordinator's Report

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A Quick Recap

- Focus of the Physics Working Group :
  1. propose new measurements at the SPD
  2. study feasibility of proposed measurements and their impacts
  3. prepare and improve analysis tools for these studies i.e. MC software for event generation, detector description, reconstruction, MC data production
  4. organize seminars on special topics (suggestions are most welcome)
  5. supervise and coordinate conference talks
- Igor Denisenko and Evgeny Soldatov are Deputy Physics Coordinators
- With chronological importance of Stage-I in mind, dedicated effort to focus on the related physics program - separate sub-group convened by Evgeny Soldatov (next report)

Scope of Activities of the Physics Working Group

- Meeting to discuss physics analyses :
  1. First Stage Physics meetings : first Tuesday of each month, 15:00 MST) : convened by Evgeny Soldatov
  2. Physics Analysis meetings alternate Tuesdays, 15:00 MST : informal discussions of ongoing MC physics analysis and MC software development
  3. SPD Physics & MC meeting : Wednesday 11:00 MST : typically towards the end of the month : to present results of physics analysis and some software development (SpdRoot)
- Revisions of abstracts and slides for conference presentations
- Revisions of drafts intended for publications related to the SPD physics analysis

Activities Since the Last Collaboration Meeting ...

- Four Physics & MC meeting
- Three Physics Analysis meetings
- Three First Stage Physics meetings

Less than usual activities due to summer months (people are on vacations spread over the period)

Evgeny Soldatov will summarize report for First Stage Physics group activities next

Conference Participations

- Quarks-2026, May, 2026, Petrozavodsk
- Particle Physics at Intermediate and High Energies, June, 2026, Protvino
- ICHEP-2026, Aug, Brazil
- Nucleus-2026, Sep, Khabarovsk
- DSPIN-2026, Sep, 2026, JINR
- AYSS-2026, Oct, 2026, Uzbekistan
- PacificSPIN-2026, Oct, 2026, Taiwan
- ICPPA-2026, Oct, 2026, Moscow

Too many talks for individual mentions. In general, SPD overview plenary talks were presented by one or the other of our two co-spokespersons

Publications Since Last Collaboration Meeting ...

- 'Spin-spin correlations in $\Lambda\bar{\Lambda}$ pair production at the SPD experiment at NICA' : Eur. Phys. Journal C, A. Guskov et al. (submitted)
- 'Search for Dibaryon Resonances in the Reactions $dd \to dd\pi\pi$ and $pd \to pd\pi\pi$' : Phys. Part. Nucl., Y. Uzikov et al.
- 'Fresh Look at Polarized Deuterons at the Nuclotron/NICA, HIAF and Beyond' : Natural Sci. Rev., Y. Uzikov et al.
- 'A Monte Carlo Study to Improve Performance of the Electromagnetic Calorimeter at the SPD Experiment at NICA' : Physics of Atomic Nuclei, I. Zimin et al. (submitted)
- 'Classification of muon tracks from charmonium decays and pion tracks in the model of the SPD detector using neural networks' : Natural Sci. Rev., A. Didenko et al.

Many Conference Proceedings, plenary talks as well as individual reports on physics/software studies - not mentioned here individually

Notable Ongoing Works

- With a motivation to study polarization of vector mesons - study of measurements of angular coefficients of $J/psi \rightarrow \mu^+\mu^-$ using BDT and other ML techniques : Mikhail Bykovskij (talk on Nov. 19)
- New cross-section estimations for two-scale processes (i.e. $\gamma + jet/h$ production) from Siddesh Padwal et al. - more rigorous TMD factorization - working towards asymmetry estimations next
- Ongoing work towards online filter / fast reconstruction : both pattern recognition for fast tracking (Mihai Dima) and vertex reconstruction from track clusters in timeslices (Maria Dima) (Nov. 19)
- Photon resolution in ECal barrel : comparison of performances in SpdRoot and Sampo : A. Maltsev (Nov. 19)

Notable Ongoing Works

- Constant ongoing work on charged track reconstruction
  1. improvement of algorithm on current software (SpdRoot)
  2. transfering algorithm for new software (Gaudi based Sampo)
  3. adjusting to different stages of SPD : stage-I with Micromegas, stage-II with DSSD or MAPS
  4. barrel, end-cap, barrel + end-cap
  5. adapting to new tinkering of ST design (octagonal to hexagonal shape, new order of Z and U,V layers, new stereo angle)
  6. testing efficiency, momentum resolution in all these different scenarios
- Comprehensive overview talk from V. Andreev in after-lunch session today
- Ruslan Akhunzyanov also in the chain of these studies, especially providing new geometries available for use in the SpdRoot for further studies

Notable Ongoing Works

- FARICH both detector description and reconstruction software are updated and improved now : A. Ivanov (Nov. 19)
- A new interesting study in search of exotic state ($X(1835) \rightarrow p\bar{p}$) : D. Savrina - more in future
- $\Lambda\bar{\Lambda}$ study proposed by A. Guskov (simulation by D. Gubachev) in advanced stage and soon to be published (Nov. 19)
- New Λ measurement study by S. Bulanova (Nov. 19)
- Λ_c measurements using ML techniques : A. Smirnov (Nov. 19)
- ST performance study for different collision systems : A. Durov (Nov. 19)
- BBC usage as local polarimeter as well as a forward charged track detector in $d + d$ collisions studied by A. Terekhin (evening session today)

Looking Ahead for Publications

Envisioning advanced analyses to move towards publication in near future

- Polarimetry analysis using ECal by K. Shtejer working on manuscript
- Λ_c measurement study by A. Smirnov
- J/Ψ decay angular coefficient measurement study by M. Bykovskij
- FARICH performance study by A. Ivanov
- I need to repeat my D meson study with MUCH updated SpdRoot and publish

Sampo Progress

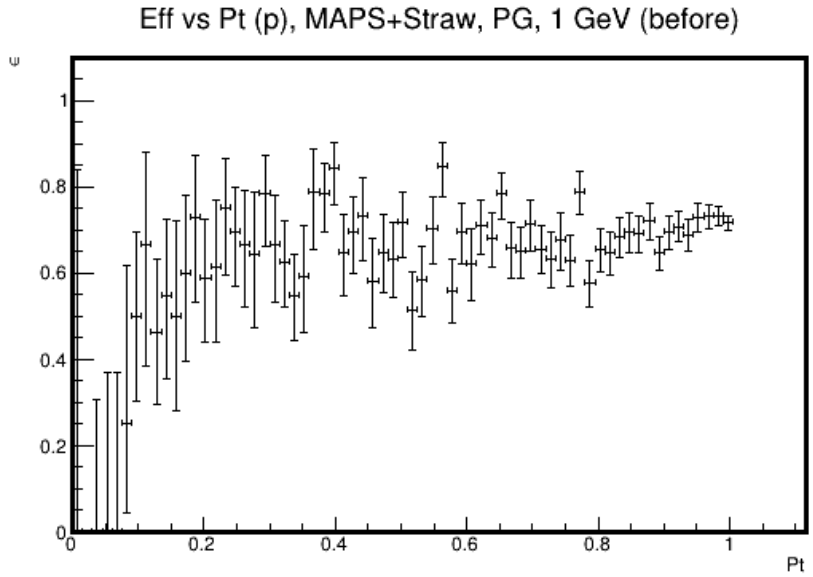
- Sampo development now almost completely decoupled from physics group - under Software group (Danila will give details soon)
- Lev Simbiriatin moved to greener pastures, Anna Kuzmenko picked up the responsibility
- Some works of common interest :
  1. V. Andreev on developing track reconstruction
  2. Hit clustering in the RS by A. Osetrov
  3. N. Chalyi implemented FTF and PPElastic event generators in SpdRoot and Sampo - very useful for many different studies, especially for Stage-I
  4. Validation for the newly included event gens still ongoing, there are some kinks that need to be smoothed out

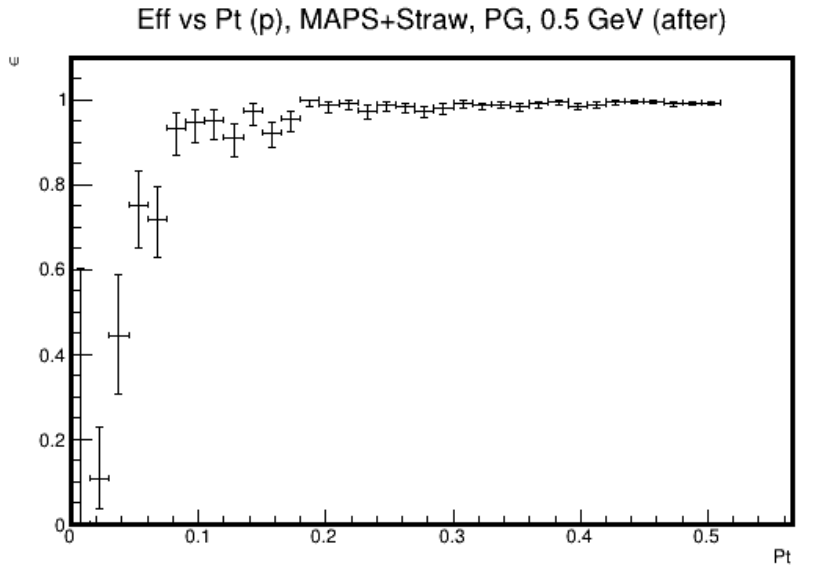
SpdRoot Still Up and Running

- Used on regular basis for physics studies
- Bug fixes, improvements and updates at regular intervals
- Latest version : 4.3.3 : https://git.jinr.ru/spd/spd-sw/spdroot/-/tree/4.3.3?ref_type=tags
  1. FARICH simplified PID (A. Ivanov)
  2. UrQMD event generator implemented (A. Durov)
  3. RS clustering (A. Osetrov)
  4. ZDC update (A. Gaute)
  5. Bug fixes in SpdMCEventMaker (A. Lazarev, I. Denisenko, R. Akhunzyanov)

SpdRoot Bug

- ST group at PNPI reported unexpectedly low tracking efficiency for protons when testing ST barrel performance in MC
- I. Denisenko traced bug to SpdMCEventMaker (set track count to 0 unless it found secondary tracks)
- Problem was specific to single p tracks (particle gun) and single detector (small material budget) - much less prominent effect for lighter single particles
- Fixed now and tested by V. Andreev (plots $\longrightarrow$)





Challenges Ahead

- Detailed design shows significant material for ST barrel cover
- Almost 67 kg mass for tracks to pass through before end-cap
- Corresponds to $\sim 12.4\%\ X_0$, severely under-represented in SpdRoot now
- Need to study impact on track reconstruction, matching tracklets from barrel to end-cap, momentum res. of tracks, performance of ECal in end-cap etc.

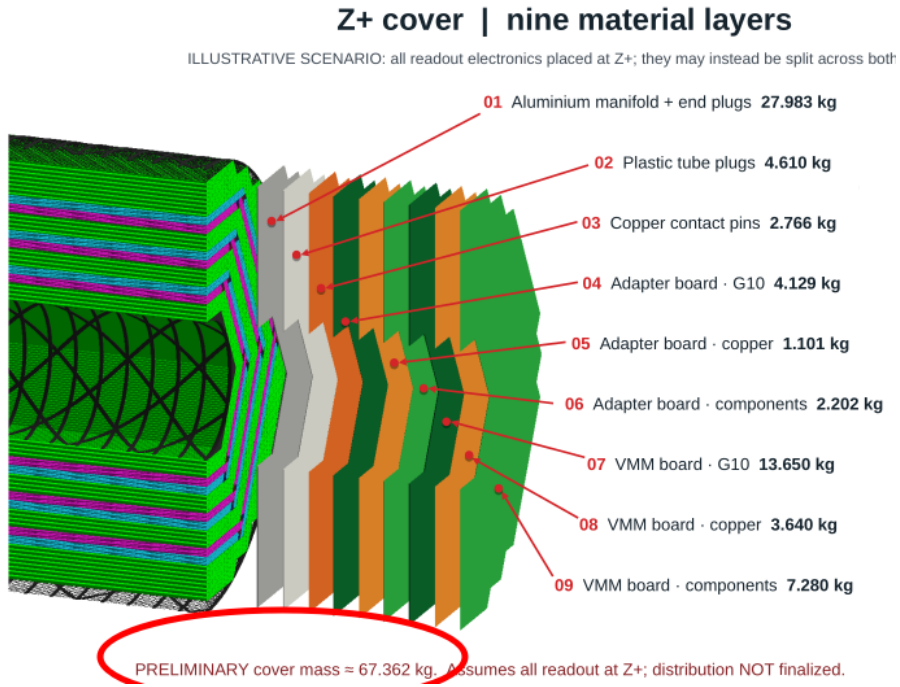


Figure from Sergey Romakhov in Hardware Meeting on Nov 5

Simulation Software : Looking Ahead

- SpdRoot still going strong
- Report bugs if your notice
- Will continue to get update i.e. FARICH updated PID
- Sampo made huge progress recently, event generators, a few subsystems are ready
- ST realistic description, hit definition, tracking needs work
- Hopefully in usable form for physics analyses in foreseeable future
- More than 500 Million $\sqrt{s} = 27$ GeV $p + p$ MB events produced with SpdRoot 4.2 (DSSD MVD, includes FARICH PID) - on track towards 1 Billion events - a considerable amount for background studies for different analyses (big thank you to A. Petrosian and E. Zemlyanichkina) - more on productions from Danila Olyenik later

Regular Reminders

- Topic-specific (hardware, software or physics) talks to conferences and publications need to be approved by the corresponding coordinators
- Please send abstracts to be approved ($\sim$ a week) BEFORE submitting
- Presentation slides (preferably two weeks, at least one) BEFORE conference
- Please send proceedings to be published well BEFORE deadline
- For theoretical talks and publications (not requiring simulation, software or data from SPD), please **notify** the PubCom
- You **need to** present work at one of the regular meetings to quality presentation at the Collaboration Meetings - and I STRONGLY suggest not to wait for the last meeting before the Collaboration Meeting next time
- PLEASE subscribe to SPD_MC mailing list (send your email to iden@jinr.ru or amaresh@jinr.ru with the request)

Schedule of Physics Talks on Thursday, Nov 19, 2026

10:00	**Evaluation of Factorization Frameworks in Photon Pair Pr...** *Prof. Vladimir Saleev*
	Spin-spin correlations in Lambda Lambda-bar pairs prod... *Alexey Guskov*
	Spin Observables of the dd→n+p+d and pd→pd Processes *Yury Uzikov*
11:00	**Quark-counting rules for inclusive processes in the high-t...** *Vladimir Vechernin*
	Coffee break
12:00	**DLSA in light and heavy meson production at NICA** *Dr Anton Karpishkov*
	Optimization of Hadron Production Simulation at the SPD *Roman Shorkin*
	Constraining Intrinsic-Charm Proton Content with the SPD *Leonid Gladilin*
14:00	**Pattern recognition for online tracking - SEG splicing** *Mihai-Octavian Dima*
	FARICH Reconstruction *Artem Ivanov*
	Study of Lambda_c+ Measurements with the SPD Stage II... *Артём Смирнов*
15:00	**Straw Tracker Performance for ion-ion Collisions at the SPD** *Andrei Durov*
	Coffee break
16:00	**Monte Carlo simulations of light nucleus-nucleus elastic i...** *Аида Галоян*
	Dependence of the Angular Coefficients of J/ψ Meson on ... *Mikhail Bykovskij*
	ECAL resolution studies: Sampo vs SPDROOT *Andrei Maltsev*
17:00	**Lambda0 -> p+pi- in Proton-Proton Collisions at the SPD** *Sofia Bulanova*
	Multiple IP clustering for SPD timeslices *Maria Dima*

Thank You