

**XIXth Workshop on High
Energy Spin Physics dedicated
to 90th anniversary of A.V.
Efremov birth**

Report of Contributions

Contribution ID: 1

Type: **not specified**

Determination of location of the spin quantization axis of the vector meson-resonance V via the cross sections of the reactions

$$A + B \Longrightarrow V + X \Longrightarrow 1 + 2 + X$$
Tuesday, 5 September 2023 18:50 (20 minutes)

The general formula that represents location of the spin quantization axis of the meson-resonance V in the inclusive reaction $A + B \Longrightarrow V + X \Longrightarrow 1 + 2 + X$ is suggested. This formula determine the location of the spin quantization axis of the particles 1,2 and V via the cross sections of the subreactions $A + B \Longrightarrow V + X$ and $V \rightarrow 1 + 2$.

For this aim is used the relativistic field theoretical approach, where the amplitude of the reaction $A + B \Longrightarrow 1 + 2 + X$ is expressed as a product of the amplitudes of the subreactions $A + B \Longrightarrow V + X$ and $V \rightarrow 1 + 2$. It is shown that the special cases of the suggested formulation were used in the numerous high energy experiments in order to study of asymmetries and alignment of the particles 1 and 2 in reactions $A + B \Longrightarrow V + X \Longrightarrow 1 + 2 + X$.

Special attention is given to the partial wave decomposition of the relativistic amplitudes and cross section over the the orbital moments and spin of the intermediate V -meson and final particles 1 and 2. Equivalence of this partial wave decomposition and Jacob-Wick decomposition is considered.

Primary author: MACHAVARIANI, Alexander (LHEP JINR)

Presenter: MACHAVARIANI, Alexander (LHEP JINR)

Session Classification: Parallel B

Contribution ID: 4

Type: **not specified**

Phenomenology of Vector-Meson Electroproduction on Spinless Targets

Wednesday, 6 September 2023 13:00 (30 minutes)

The amplitude ratios of vector-meson production by heavy photons on spinless targets are shown to can be explicitly expressed in terms of the spin-density-matrix elements (SDMEs) only if the lepton beam is polarized. Making use of the amplitude ratios as free fit parameters instead of the SDMEs reduces the number of the real parameters in data description from 23 to 8. The exact formula for virtual-photon longitudinal-to-transverse cross-section ratio, R in terms of the SDMEs is obtained for spinless targets and the new approximate formula for R is proposed for nucleons.

Primary author: Dr MANAENKOV, Sergey (Petersburg Nuclear Physics Institute of National Research Centre "Kurchatov Institute")

Presenter: Dr MANAENKOV, Sergey (Petersburg Nuclear Physics Institute of National Research Centre "Kurchatov Institute")

Session Classification: Plenary

Contribution ID: 6

Type: **not specified**

Quantum electrodynamics with empty fermion vacuum without “sea” of states with negative energies and with opposite signs of mass summands in Dirac equations for particles and antiparticles. Possibilities of experimental verification.

Tuesday, 5 September 2023 12:10 (30 minutes)

We examined versions of quantum electrodynamics (QED) with opposite signs of particle and antiparticle masses in Dirac equations and with empty fermion vacuum without states with negative energies. Application of S-matrix elements of QED versions under consideration leads to complete coincidence of the computational results of physical processes with the appropriate results in the standard QED. In new versions of the theory, there are no virtual processes with creation and annihilation of particle-antiparticle pairs. The processes with vacuum creation of real pairs in intense electromagnetic fields are not available either. The new content of the fermion vacuum (without Dirac sea) in the considered QED versions lead to new physical consequences, a part of which can be experimentally verified in the future either at facilities with exawatt-power optical lasers or in the experiments in collision of heavy ions with the total $Z \geq 170 \div 175$ at the FAIR, HIAF, NICA acceleration centers under construction.

Primary author: NEZNAMOV, Vasiliy (Federal Nuclear Center-All-Russian Research Institute of Experimental Physics (FSUE "RFNC-VNIIEF"))

Presenter: NEZNAMOV, Vasiliy (Federal Nuclear Center-All-Russian Research Institute of Experimental Physics (FSUE "RFNC-VNIIEF"))

Session Classification: Plenary

Contribution ID: 7

Type: **not specified**

One-loop electroweak radiative corrections to polarized $e^+e^- \rightarrow ZZ$ process

Friday, 8 September 2023 15:35 (15 minutes)

Polarization effects of initial and final states for the process of Z-pair production at future Higgs-fabriques are investigated at one-loop EW level. Some advanced theoretical techniques to deal with massive particles are developed and applied.

Primary author: DYDYSHKA, Yahor (JINR)

Presenter: DYDYSHKA, Yahor (JINR)

Session Classification: Parallel A

Contribution ID: 8

Type: **not specified**

Electroweak radiative corrections to polarized top quark pair production

Friday, 8 September 2023 15:20 (15 minutes)

We investigate the effects of complete one-loop electroweak radiative corrections and higher-order radiative effects to the total cross section and analyze different types of asymmetries for polarized initial and final states for typical energies and degrees of polarization of the ILC and CLIC projects. Numerical results are obtained with the help of Monte Carlo tools: the ReneSANCe event generator and the MCSANC integrator.

Primary author: YERMOLCHYK, Vitaly (JINR; INP BSU)

Presenter: YERMOLCHYK, Vitaly (JINR; INP BSU)

Session Classification: Parallel A

Contribution ID: 9

Type: **not specified**

Simulation of the pp - scattering for the Beam-Beam Counter at SPD at NICA

Monday, 4 September 2023 15:30 (30 minutes)

The results of the pp-scattering simulation at the total energy up to 27 GeV for the TDR version of the Beam-Beam Counter at SPD are presented. The simulation has been performed using the FTF, Pythia8 and Pluto generators under SPDRoot framework. The results have been compared with the differential cross section of the existing experimental data. The first estimations of the inclusive charged particles production asymmetries with Beam-Beam Counter have been obtained.

Primary author: TEREKHIN, Arkadiy (JINR)

Co-authors: ABRAMOV, Victor (NRC «Kurchatov Institute» - IHEP); LADYGIN, Vladimir (VBL-HEP, JINR); KURMANALIYEV, Zhanibek (Joint Institute for Nuclear Reserch); ISUPOV, Alexander (JINR); VOLKOV, Ivan (LHEP-JINR, Dubna, Moscow region, Russia)

Presenter: TEREKHIN, Arkadiy (JINR)

Session Classification: Plenary

Contribution ID: 10

Type: **not specified**

Photon-photon collisions with arbitrary polarization in ReneSANCe Monte Carlo generator

Friday, 8 September 2023 15:00 (20 minutes)

We describe the implementation of processes of photon-photon collisions with arbitrary polarization in ReneSANCe Monte Carlo generator. Numerical results for a number of the Standard Model processes will be shown.

Primary authors: BONDARENKO, Serge (JINR); Dr KALINOVSKAYA, Lidia (JINR); Dr RUMYANTSEV, Leonid (JINR); SADYKOV, Renat (JINR); YERMOLCHYK, Vitaly (JINR; INP BSU)

Presenter: SADYKOV, Renat (JINR)

Session Classification: Parallel A

Contribution ID: 11

Type: **not specified**

Frustrated magnetism and quantum computing

Friday, 8 September 2023 13:00 (30 minutes)

Frustration is a universal concept which describes a situation where several competing interactions are present, which takes place not only in physics but also biology. The compromise of such interactions may result in a completely exotic ground state. In frustrated magnets such competition can yield a loss of long-range magnetic order due to strong quantum fluctuations - a so-called quantum spin liquid state. It is fascinating that frustration can come from both the structure of the lattice, such as the ones containing triangular motifs, as well as anisotropic interactions, e.g. Dzyaloshinskii-Moriya, Kitaev - both driven by spin-orbit coupling. The fractional excitations of spin liquids drew interest as a path towards topological quantum computation, which is stable towards small errors, plaguing standard quantum computing platforms. In this talk we review recent examples of spin liquid candidates and why they are hard to come by.

Primary author: MAKSIMOV, Pavel (Joint Institute for Nuclear Research)

Presenter: MAKSIMOV, Pavel (Joint Institute for Nuclear Research)

Session Classification: Parallel B

Contribution ID: 12

Type: **not specified**

Spin effects in the Sommerfeld-Gamow-Sakharov factor

Tuesday, 5 September 2023 17:20 (30 minutes)

A new resummation of the Sommerfeld-Gamow-Sakharov factor (S -factor) of a composite system of two relativistic spin-1/2 particles of arbitrary masses interacting via a Coulomb-like chromodynamical potential is presented. The analysis is performed in the framework of a relativistic quasipotential approach based on the Hamiltonian formulation of the covariant quantum field theory in the relativistic configuration representation suggested by A.A. Logunov, A.N. Tavkhelidze and V.G. Kadyshevsky. The pseudoscalar, vector, and pseudovector systems are considered and the behaviour of the S -factor near the threshold and in the relativistic limit is investigated in detail. The spin dependence of the S -factors is discussed as well. It is argued that at the threshold the contribution of spins significantly reduces the Sommerfeld effect, while at ultrarelativistic velocities their role diminishes and the S -factor becomes basically the same as for the spinless systems. Relations to previously obtained S -factors for scalar particles of arbitrary masses and for relativistic spinor particles of equal masses are established.

Primary authors: Dr CHERNICHENKO, Yurii (GSTU); Prof. KAPTARI, Leonid (JINR); Dr SOLOVTSOVA, Olga (JINR&GSTU)

Presenter: Dr SOLOVTSOVA, Olga (JINR&GSTU)

Session Classification: Parallel A

Contribution ID: 13

Type: **not specified**

Preservation of the proton polarization up to 13.5 GeV/c in the Nuclotron at JINR using partial snakes based on dynamic solenoids

Friday, 8 September 2023 11:50 (30 minutes)

The scheme of the proton polarization preservation throughout Nuclotron momentum range employing 20% partial snakes based on a dynamic solenoid with a field ramp rate of ~ 1 T/s is presented. Orbit and the beam optical parameters are not subjected to change over protons acceleration with dynamic solenoids. External targets experiments and injections of polarized protons into the NICA collider at any available energy, including those higher than the transition energy, will become feasible. It will open a possibility to inject protons in the NICA collider directly at energies corresponding to a spin transparency mode at integer spin resonances without employing of full solenoid snakes.

Primary authors: Dr FILATOV, Yury (MIPT); Mr KONDRATENKO, Mikhail (NTL Zaryad); KONDRATENKO, Anatoliy (NTL Zaryad); Dr VINOGRADOV, Stanislav (MIPT); Mr TSYPLAKOV, Evgeny (MIPT); BUTENKO, Andrey (JINR); KOSTROMIN, Sergei (JINR); LADYGIN, Vladimir (VBLHEP, JINR); SYRESIN, Evgeny (Joint Institute for Nuclear Researches)

Presenter: Dr FILATOV, Yury (MIPT)

Session Classification: Parallel A

Contribution ID: 14

Type: **not specified**

Polarization of hyperons produced by meson beams

Tuesday, 5 September 2023 18:20 (30 minutes)

In this work, we consider the transverse polarization (PN) of Λ -hyperons and the corresponding antihyperons, which are produced in meson-proton and meson-nuclear interactions in inclusive reactions. The currently available experimental data are compared with calculations based on the chromomagnetic polarization of quark (CPQ) model. Calculations based on the CPQ model have also been performed for yet unexplored kinematic regions and various targets and can be verified in the SPASCHARM experiment at the NRC Kurchatov Institute - IHEP.

Primary author: Dr ABRAMOV, Victor (NRC Kurchatov Institute - IHEP)

Presenter: Dr ABRAMOV, Victor (NRC Kurchatov Institute - IHEP)

Session Classification: Parallel A

Contribution ID: 15

Type: **not specified**

Vector Polarization of the Nuclotron Deuteron Beam at the Energies from 200 to 650 MeV/nucleon

Tuesday, 5 September 2023 15:00 (20 minutes)

The deuteron beam vector polarization was obtained at the Nuclotron Internal Target Station using the proton-proton quasielastic scattering on the polyethylene target at the beam energies of 200, 500, 550, and 650 MeV/nucleon. The selection of useful events was performed using the time and amplitude information from scintillation counters. The asymmetry on hydrogen was obtained by the subtraction of the carbon background. The obtained values are compared with the data obtained using the deuteron-proton elastic scattering at the beam energy of 135 MeV/nucleon.

Primary author: VOLKOV, Ivan (LHEP-JINR, Dubna, Moscow region, Russia)

Co-authors: ISUPOV, Alexander (JINR); LADYGIN, Vladimir (VBLHEP, JINR); TEREKHIN, Arkadiy (JINR); TISHEVSKY, Aleksey (JINR)

Presenter: VOLKOV, Ivan (LHEP-JINR, Dubna, Moscow region, Russia)

Session Classification: Parallel B

Contribution ID: 16

Type: **not specified**

Dual QCD thermodynamics at finite temperature and chemical potential

Tuesday, 5 September 2023 17:50 (20 minutes)

A Dual QCD formulation for SU(3) color gauge has been developed in terms of dual gauge potentials taking into account the local as well as topological structure of the color gauge group into its dynamics. For the purpose of examining the non-perturbative characteristics of QCD, the dynamical configuration of the resulting dual QCD vacuum and its flux tube configuration have been examined. The thermal behavior of the non-perturbative QCD vacuum has been investigated for exploring the dynamics of quark-hadron phase transition at finite chemical potential. Related thermodynamic quantities and equation of state (EoS) to characterize quark matter have also been discussed within the framework of dual QCD-based hadronic bag which guarantees the critical parameters and the associated critical points for quark-hadron phase transition. These thermodynamic quantities are expected to play important roles in understanding the order of quark-hadron phase transition and are likely to predict the features of a first-order quark-hadron phase transition for finite chemical potential. Moreover, we have investigated the bulk properties of quark matter by constructing the free energy change and the associated surface tension for quark-hadron phase transition. For consistency and compatibility check, we have also compared our results with state-of-the-art three-loop Hard Thermal Loop perturbative results and available lattice QCD results and in the process found reasonable agreements.

Primary author: Dr PUNETHA, Garima (LSM Campus, Soban Singh Jeena University Almora Uttarakhand, India)

Presenter: Dr PUNETHA, Garima (LSM Campus, Soban Singh Jeena University Almora Uttarakhand, India)

Session Classification: Parallel B

Contribution ID: 17

Type: **not specified**

How to access QED at a supercritical Coulomb field with heavy ions

Tuesday, 5 September 2023 12:40 (30 minutes)

It is known that in slow collisions of two bare nuclei with the total charge number larger than the critical value, $Z_1 + Z_2 > Z_c = 173$, the initially neutral vacuum can spontaneously decay into the charged vacuum and two positrons. Detection of the spontaneous emission of positrons would be the direct evidence of this fundamental phenomenon. However, the spontaneous positron emission is generally masked by the dynamical positron emission, which is induced by a rapidly changing electric field created by the colliding nuclei. For many years it was believed that the vacuum decay can be observed only in collisions with nuclear sticking, when the nuclei are bound for some period of time due to nuclear forces. But to date there is no evidence for the nuclear sticking in such heavy-ion collisions. In our recent papers [I.A. Maltsev et al., PRL, 2019; R.V. Popov et al., PRD, 2020; R.V. Popov et al., PRD, 2023], it was shown that the vacuum decay can be observed without any sticking of the nuclei. This can be done via measurements of the pair-production probabilities or the positron spectra for a given set of nuclear trajectories. The results of this study will be presented in the talk.

The author acknowledges the support by RSCF grant No. 22-62-00004.

Primary author: Prof. SHABAEV, Vladimir (St. Petersburg State University/ NRC “Kurchatov Institute” - PNPI)

Presenter: Prof. SHABAEV, Vladimir (St. Petersburg State University/ NRC “Kurchatov Institute” - PNPI)

Session Classification: Plenary

Contribution ID: 18

Type: **not specified**

Quantum model of spinning black holes. Quantum model of electron.

Monday, 4 September 2023 12:50 (40 minutes)

We propose the quantum model of spinning black holes with the integrable ring singularities. For the modified Kerr-Newman quantum metric, the complete regularization occurs at fixation of the maximal (cut-off) energy of gravitons $k_{UV}^{reg} = \hbar c / R_S^{reg}$.

The domains of existence of one, two and several events horizons r_q are presented depending on parameters of the Kerr and Kerr-Newman modified metrics.

We also propose the quantum model of extended electron with zero self-energy on the basis of the regular quantum Kerr-Newman metric.

Primary author: NEZNAMOV, Vasiliy (Federal Nuclear Center-All-Russian Research Institute of Experimental Physics (FSUE "RFNC-VNIIEF"))

Co-authors: Mr SEDOV, Sergey (Federal Nuclear Center-All-Russian Research Institute of Experimental Physics (FSUE "RFNC-VNIIEF")); Mr SHEMARULIN, Valery (Federal Nuclear Center-All-Russian Research Institute of Experimental Physics (FSUE "RFNC-VNIIEF"))

Presenter: NEZNAMOV, Vasiliy (Federal Nuclear Center-All-Russian Research Institute of Experimental Physics (FSUE "RFNC-VNIIEF"))

Session Classification: Plenary

Contribution ID: 19

Type: **not specified**

Spin effects in the neutrino gravitational scattering

Thursday, 7 September 2023 16:00 (30 minutes)

I study the neutrino scattering off a rotating black hole surrounded by a realistic magnetized accretion disk called a Polish doughnut. A neutrino is supposed to have a nonzero magnetic moment. I account for the contributions of the electroweak interaction of a neutrino with plasma of the disk and the interaction of the neutrino magnetic moment with magnetic fields in the disk on the neutrino spin precession. It leads to the conversion of active left neutrinos into sterile right particles. I study various configurations of magnetic fields in the disk. I discuss the idea of the neutrino tomography of magnetic field distributions in accretion disks near black holes.

References

M.Dvornikov, Neutrino spin oscillations in a magnetized Polish doughnut, arXiv:2307.10126

Primary author: DVORNIKOV, Maxim (IZMIRAN)

Presenter: DVORNIKOV, Maxim (IZMIRAN)

Session Classification: Plenary

Contribution ID: 20

Type: **not specified**

Search for new symmetries of hadron production in high energy collisions of protons and nuclei

Thursday, 7 September 2023 15:30 (30 minutes)

The status of z -scaling theory is reviewed. Basic physical principles such as self-similarity, locality, and fractality are discussed. The microscopic scenario of interactions of hadrons and nuclei at a constituent level in terms of dimensionless variables is studied.

The structure of the colliding objects and fragmentation process in final state is described by fractal dimensions δ_1, δ_2 and ϵ_a, ϵ_b , respectively. The fractal dimensions and the model parameter c interpreted as a specific heat of the produced medium are found from the scaling behavior of the dimensionless function $\psi(z)$, which depends on a self-similarity variable z . The scaling variable z is given in terms of the momentum fractions x_1, x_2, y_a , and y_b that define a selected constituent sub-processes. The principle of maximal entropy is used to determine the momentum fractions taking into account the momentum conservation for the selected binary interaction. Applicability of the z -scaling approach for the description of polarization processes is illustrated. The equivalence of the minimal resolution principle with respect to the constituent sub-processes and the maximal fractal entropy $S_{\delta, \epsilon}$ is shown. The principle of maximum entropy together with the assumption of the fractal self-similarity of hadron structure and fragmentation processes leads to the preservation of a scale-dependent quantity - fractal cumulativity, characterizing hadron interactions at a constituent level. The fractal cumulativity is a property of a fractal-like object (or fractal-like process) with fractal dimension D to form a "structural aggregate" with certain degree of local compactness which carries its momentum fraction ζ .

The conservation law for the fractal cumulativity is formulated.

The crossing symmetry for the part of the entropy $S_{\delta, \epsilon}$ dependent only on the fractal dimensions in high resolution limit is discussed.

Primary author: Prof. TOKAREV, Mikhail (Joint Institute for Nuclear Research)

Presenter: Prof. TOKAREV, Mikhail (Joint Institute for Nuclear Research)

Session Classification: Plenary

Contribution ID: 21

Type: **not specified**

Development of the SPD Beam-Beam Counter scintillation detector prototype with FERS 5200 front-end readout system.

Monday, 4 September 2023 16:40 (30 minutes)

Abstract.

The Spin Physics Detector is an experiment at NICA designed to study the spin structure of the proton and deuteron and the other spin-related phenomena using polarized beams. The collision energy is up to 27 GeV and the luminosity is up to $10^{32} \text{ cm}^{-2} \text{ s}^{-1}$ in pp mode.

Two scintillator-based detectors, Beam-Beam Counters (BBC), will be installed upstream and downstream the interaction point and will serve as a tool for beam diagnostics including local polarimetry.

In this talk, we present the design of the BBC prototype based on the tiles with green WLS and SensL SiPM readout. FERS-5200 is used as the front-end readout system. The amplitude and timing resolutions for different tiles using radioactive source and cosmic rays are obtained.

Primary author: TISHEVSKY, Aleksey (JINR)

Co-authors: DUBININ, Filipp (MEPhI); ISUPOV, Alexander Isupov (JINR); LADYGIN, Vladimir (JINR); NIGMATKULOV, Grigory (MEPhI); REZNIKOV, Sergey (JINR); TEREKHIN, Arkadiy (JINR); TETERIN, Peter (MEPhI); VOLKOV, Ivan (JINR); ZAKHAROV, Arseniy (MEPhI); ZHURKINA, Anastasia (MEPhI)

Presenter: TISHEVSKY, Aleksey (JINR)

Session Classification: Plenary

Contribution ID: 22

Type: **not specified**

Kinematical Vortical Effect and Gravitational chiral anomaly

Wednesday, 6 September 2023 16:10 (20 minutes)

Based on a general analysis of conservation laws, the duality between gravity and hydrodynamics of a relativistic quantum fluid in a flat space is shown. This duality is expressed in the equality between hydrodynamic transport coefficients and quantum corrections in curved space-time. It is shown that the gravitational chiral anomaly is dual to the axial current in the vortical and accelerated fluid, which arises in the third order of the gradient expansion. The corresponding current is a new anomalous transport phenomenon, which can be called the Kinematical Vortical Effect (KVE). The general analysis has been explicitly verified for fields with spins $1/2$ and $3/2$. In the case of spin $3/2$, an extended Rarita-Schwinger-Adler (RSA) field theory containing an additional field with spin $1/2$ is considered. Using the method of conformal three-point functions, we found the gravitational chiral anomaly in the RSA theory for the first time, and using the Zubarev density operator, we calculated the KVE transport coefficients. The results obtained confirm the duality and demonstrate the manifestation of the cubic spin dependence of the gravitational chiral anomaly, in hydrodynamics.

Primary author: PROKHOROV, George (Dubna, BLTP)

Co-authors: TERYAEV, Oleg (JINR); ZAKHAROV, Valentin

Presenter: PROKHOROV, George (Dubna, BLTP)

Session Classification: Plenary

Contribution ID: 23

Type: **not specified**

About toroidal leptons in space-time film theory

Thursday, 7 September 2023 12:50 (30 minutes)

Nonlinear field model of extremal space-time film is considered as unified field model [1-6]. Its space-localized solutions representing the elementary particles are investigated. In particular, we consider the field configuration having a form of the twisted lightlike soliton moving along the ring of the toroidal coordinate system. The exact solutions in the form of twisted light-like solitons moving in a straight line were found in [1]. As was shown in this work, the solitons of defined subclass of obtained solutions can be considered as photons. In the present work, we consider the approximate time-periodic solution in the quasi-cylindrical toroidal coordinate system with rotation. The inverse ring radius appears as a small parameter. We consider the exact solutions in the cylindrical coordinate system obtained in the work [1] as the initial approximation. We propose the initial approximation in the form of combination of the charged tubular shell and twisted lightlike soliton. Methods for determining the values of parameters of the initial approximation are considered. The correspondence of this class of solutions to real leptons is discussed.

[1] Chernitskii A.A. Lightlike shell solitons of extremal space-time film. J. Phys. Commun., 2018, vol. 2, 105013.

[2] Chernitskii A.A. About long-range interaction of spheroidal solitons in scalar field nonlinear model. J. Phys.: Conf. Ser., 2017, vol. 938, iss. 1, 012029.

[3] Chernitskii A.A. About toroidal soliton-particle of extremal space-time film. J. Phys.: Conf. Ser., 2020, vol. 1435, 012054.

[4] Chernitskii A.A. Gravitation in theory of space-time film and galactic soliton. J. Phys.: Conf. Ser., 2021, vol. 2081, 012016.

[5] Chernitskii A.A. About toroidal model of leptons in space-time film theory. JPS Conf. Proc., 2022, vol. 37, 020608.

[6] Chernitskii A.A. On leptons in the theory of space-time films. Phys. Part. Nucl., 2023, vol. 54, pp. 685-692.

Primary author: Dr CHERNITSKII, Alexander (St. Petersburg State Chemical and Pharmaceutical University)

Presenter: Dr CHERNITSKII, Alexander (St. Petersburg State Chemical and Pharmaceutical University)

Session Classification: Plenary

Contribution ID: 24

Type: **not specified**

Revisit the spin effects by thermal vorticity

Wednesday, 6 September 2023 15:00 (30 minutes)

We revisit the spin polarization effects induced by thermal vorticity by calculating them directly from the spin-dependent distribution functions. For the spin-1/2 particles, we find that the spin polarization from the acceleration relative to the vorticity is suppressed compared to the result derived from the mean spin polarization vector. For the spin-1 particles, we give the spin alignment in terms of acceleration and vorticity. Although the spin alignment receives only second-order contribution from acceleration or vorticity, we find that some non-diagonal elements in spin density matrix can receive first order contribution which can be detected in heavy-ion collisions.

Primary author: Prof. GAO, Jian-Hua (Shandong University, Weihai, China)

Presenter: Prof. GAO, Jian-Hua (Shandong University, Weihai, China)

Session Classification: Plenary

Contribution ID: 25

Type: **not specified**

Tunnel spin current in superferromagnets

Friday, 8 September 2023 15:00 (30 minutes)

Advances in micro- and nano-technologies have led to the widespread use of spintronic magnetoresistive (MR) sensors for both recording and non-recording applications. Such ultramodern magnetoresistive sensors have high sensitivity of the detected ultra-weak fields, which meet the requirements of intelligent sensor applications in the fields of the Internet, mobile devices, space technology, aeronautics, magnetic flux leakage, domotics, environment, healthcare and medicine. Moreover, their adaptability and miniaturization, simple integration and cost-effectiveness make these sensors uniquely competitive in terms of spread applications and production.

In this work, ensembles of superparamagnetic particles (SPM) imbedded in an insulator or semiconductor substrate are considered. At a sufficiently high concentration of SPMs these metamaterials show superferromagnetic properties and can be used as MR sensors [1]. We consider the electric current between the SPM particles and show that the resulting tunneling MR increases as the size of the SPM decreases.

1. 7. V. N. Kondratyev and V. A. Osipov Superferromagnetic sensors. // Nanomanufacturing 2023, V. 3, P. 263. <https://doi.org/10.3390/nanomanufacturing3030017>

Primary author: KONDRATYEV, Vladimir (BLTP JINR)

Co-author: Prof. OSIPOV, V.A. (JINR)

Presenter: KONDRATYEV, Vladimir (BLTP JINR)

Session Classification: Parallel B

Contribution ID: 26

Type: **not specified**

Double spin asymmetries in the elastic scattering of electrons on a polarized proton in the case of parallel spins.

Friday, 8 September 2023 16:30 (20 minutes)

We have proposed methods for measuring of the Sachs form factors ratio based on the polarization transfer from the initial proton to the final electron or proton in the elastic $e\vec{p} \rightarrow \vec{e}p$ or $e\vec{p} \rightarrow e\vec{p}$ processes in the case of parallel spins.

Primary author: Dr GALYNSKII, Mikhail (Joint Institute for Power and Nuclear Research – Sosny, National Academy of Sciences of Belarus, 220109 Minsk, Belarus)

Presenter: Dr GALYNSKII, Mikhail (Joint Institute for Power and Nuclear Research – Sosny, National Academy of Sciences of Belarus, 220109 Minsk, Belarus)

Session Classification: Parallel A

Contribution ID: 27

Type: **not specified**

Polarized Ion Sources for high-energy accelerators and colliders

Monday, 4 September 2023 10:50 (40 minutes)

New polarization techniques for the development of high-intensity polarized H- and $^3\text{He}^{++}$ ion sources will be reviewed.

Primary author: ZELENSKI, Anatoli (MIPT)

Presenter: ZELENSKI, Anatoli (MIPT)

Session Classification: Plenary

Contribution ID: 28

Type: **not specified**

Proton Polarimetry in energy range from keV to 255 GeV. 3He -absolute Polarimetry at 6 Mev

Friday, 8 September 2023 12:20 (30 minutes)

Proton polarimetry at RHIC in energy range from 1 keV to 255 GeV will be reviewed
Development of a new absolute polarimeter for 3He⁺⁺ ion beam will also be presented.

Primary author: ZELENSKI, Anatoli (MIPT)

Presenter: ZELENSKI, Anatoli (MIPT)

Session Classification: Parallel A

Contribution ID: 29

Type: **not specified**

Studies of the nucleons structure using the SIDIS azimuthal angle asymmetries calculated with modified double ratios of numbers of the hadrons

Monday, 4 September 2023 12:30 (20 minutes)

The COMPASS collaboration at CERN performs studies of the nucleons structure measuring the muon SIDIS cross sections differences (asymmetries) in numbers of the hadrons (h^+ and h^-) productions by muons from a target with two cells polarized oppositely to each other. These type of asymmetries, related to structure functions of the nucleons, is evaluated via the Double Ratios (DRs) of numbers of the hadrons in which the set-ups' luminosity and acceptance are cancelled. Modifications of the DRs (MDRs), suggested in this work, are aimed at minimization of possible false contributions to the muon SIDIS azimuthal asymmetries in hadron productions. The nucleons structure functions measured with the MDRs of numbers of the hadrons also commented on.

Primary author: O.KOUZNETSOV, JINR

Presenter: O.KOUZNETSOV, JINR

Session Classification: Plenary

Contribution ID: 30

Type: **not specified**

Extraction of information on transversity GPDs from π^0 and η production on EIC of China

Wednesday, 6 September 2023 12:00 (30 minutes)

The production of the π^0 and η mesons are studied adopting handbag approach with GPDs in electron-proton scattering in Electron-ions collider in China (EicC) energy ranges. GK model is used to study these reactions. The predictions indicate that transversity dominance $\sigma_T \gg \sigma_L$ observed at low energies is valid up to EicC energy range. The transversity GPDs can be extracted from the cross sections of π^0 and η process in electron-proton scattering.

Primary author: Dr XIE, Ya-Ping (Institute of Modern Physics of Chinese Academy of Sciences)

Co-authors: GOLOSKOKOV, Sergey (JINR); CHEN, Xurong (Institute of Modern Physics, Chinese Academy of Sciences)

Presenter: Dr XIE, Ya-Ping (Institute of Modern Physics of Chinese Academy of Sciences)

Session Classification: Plenary

Contribution ID: 31

Type: **not specified**

Bjorken sum rule with analytic coupling at low Q^2 values

Tuesday, 5 September 2023 15:00 (30 minutes)

The experimental data obtained for the polarized Bjorken sum rule for small values of Q^2 are approximated by the predictions obtained in the framework of analytic QCD up to the 5th order perturbation theory, whose coupling constant does not contain the Landau pole. We found an excellent agreement between the experimental data and the predictions of analytic QCD, as well as a strong difference between these data and the results obtained in the framework of standard QCD.

Primary author: KOTIKOV, Anatoly (JINR)

Co-authors: GABDRAKHMANOV,, I.R.; GRAMOTKOV,, N.A; VOLKOVA, D.A.; ZEMLYAKOV, I.A.

Presenter: KOTIKOV, Anatoly (JINR)

Session Classification: Parallel A

Contribution ID: 32

Type: **not specified**

Manifestation of dark matter axions in spin experiments

Tuesday, 5 September 2023 11:20 (30 minutes)

Manifestation of dark matter axions in spin experiments

A. J. Silenko

BLTP JINR, Dubna, Russia

The relativistic spin dynamics defined by the pseudoscalar field of dark matter axions is rigorously determined [1]. The relativistic Hamiltonian in the Foldy–Wouthuysen representation is derived. The biggest term describes the extraordinary (three orders of magnitude) enhancement of the axion wind effect in storage ring experiments as compared with experiments with immobile particles. This term defines the spin rotation about the longitudinal axis. The effects caused by the axion-induced oscillating EDM and the axion wind consist in the spin rotations about the different horizontal axes and phases of stimulating oscillations differ by $\pi/2$. The EDM effect for electrons is considered.

[1] A. J. Silenko, Relativistic spin dynamics conditioned by dark matter axions, Eur. Phys. J. C 82, 856 (2022).

Primary author: Prof. SILENKO, Alexander (Joint Institute for Nuclear Research)

Presenter: Prof. SILENKO, Alexander (Joint Institute for Nuclear Research)

Session Classification: Plenary

Contribution ID: 33

Type: **not specified**

The bare and gravitationally dressed electron based on the Kerr-Newman black hole solution

Thursday, 7 September 2023 12:20 (30 minutes)

The initiated by Carter (1969) electron model, based on the Kerr-Newman (KN) black hole solution, was recently modified to form a heavy electron model dressed by gravity. Similar to QED, gravitating electron can be considered as a bare or dressed model, where the bare electron represents a massless relativistic ring string creating wave function of quantum theory, while the dressed electron forms a heavy electron- positron vacuum core, dressed by two Wilson loops subjected to gravitational frame-dragging. We show that this modified gravitating electron model is not full indeed, since the exact KN solution is radiation free and excitations of the white (electron) sheet do not correlate with excitations of the black (positron) sheet. Based on our previous works (2002-2004), we obtain the corresponding radiative KN solutions, including the both chiral and anti-chiral excitations and find that these solutions acquires an additional axial stringy system containing both incoming and outgoing electromagnetic radiation. Surprisingly, the external manifestations of the radiative KN solution are similar to behavior of astrophysical systems known as Blasers.

Primary author: Prof. BURINSKII, Alexander (NSI, Russian Academy of Sciences)

Presenter: Prof. BURINSKII, Alexander (NSI, Russian Academy of Sciences)

Session Classification: Plenary

Contribution ID: 34

Type: **not specified**

Production of prompt polarized J/ψ in the NRQCD and Generalized Parton Model

Thursday, 7 September 2023 10:10 (20 minutes)

The heavy quarkonium spin-physics is an important task of high energy physics which we study using charmonium production within the Nonrelativistic Quantum Chromodynamics (NRQCD) approach and Generalized Parton Model (GPM). We extracted a set of the NRQCD and GPM parameters by fitting data of charmonium production in proton–proton collisions measured by the PHENIX and NA3 collaborations, both at small and large rapidities. This set includes the NRQCD octet nonperturbative matrix elements and values of averaged squared transverse momentum in Gaussian q_T -distributions for initial quarks and gluons. The data of NA3 collaboration ($\sqrt{s} = 19.4$ GeV) was used due to the energy closeness to the SPD NICA future experiment. Therefore, we could make predictions for unpolarised prompt J/ψ production for $\sqrt{s} = 27$ GeV. Also, we calculated polarization of the J/ψ as one of the angular coefficients λ in angular distribution of leptonic decay of J/ψ . Our results are compared with the PHENIX polarization data in a helicity frame. We found quite bad agreement for our polarization prediction unlike our prediction of unpolarized prompt J/ψ production. However, we provide calculations of the polarized prompt J/ψ for the SPD NICA experiment as well. Besides, we demonstrate validity of calculations in the GPM, as a version of Transverse-Momentum-Depended Parton Model, by comparison with the conventional Collinear Parton Model calculations.

Primary authors: KARPISHKOV, Anton (Samara National Research University, JINR); SALEEV, Vladimir (Samara National Research University, JINR); SHILYAEV, Kirill (Samara National Research University)

Presenter: SHILYAEV, Kirill (Samara National Research University)

Session Classification: Plenary

Contribution ID: 35

Type: **not specified**

Quasi-frozen spin concept at NICA for EDM search and its matrix analysis

Wednesday, 6 September 2023 10:20 (25 minutes)

The basic idea to search for the Electric Dipole Moment (EDM) of charged particles in a storage ring was first proposed by the BNL. It assumes observation of the vertical buildup of beam polarization caused by the EDM in a so-called Frozen Spin (FS) lattice. The latter is composed of electrostatic deflectors to keep the momentum of the beam aligned with the direction of a polarization vector. However, this concept can be realized only for particles with positive magnetic anomaly (G), e.g., protons, and requires a lattice to be designed specifically for this purpose.

To perform the EDM experiments with particles characterized with positive and negative G one can use Quasi-Frozen Spin (QFS) lattice. It can be realized on the basis of the existing synchrotron, e.g. NICA, with magnetic arcs and additional E+B elements at straight sections. So, that the net in-plane rotation of the spin-vector in the arcs is compensated in the E+B deflectors.

The main features of the QFS lattice were calculated in the spinor formalism, such as a spin-tune and a direction of the invariant spin axis. As the radial field perturbations play a crucial role in the EDM measurement procedure, the difference of FS and QFS lattices was investigated in this regard. The data for estimation of the QFS resonance strength are also presented.

Primary author: MELNIKOV, Aleksei (INR RAS)

Co-authors: AKSENTEV, Alexander (NRNU "MEPhI"); Mr KOLOKOLCHIKOV, Sergey (INR RAS); SENICHEV, Yury (The Institute for Nuclear Research of the Russian Academy of Sciences)

Presenter: MELNIKOV, Aleksei (INR RAS)

Session Classification: Plenary

Contribution ID: 36

Type: **not specified**

Global polarization of Ξ hyperons in Au+Au collisions in the STAR experiment

Wednesday, 6 September 2023 18:10 (20 minutes)

The study of global polarization in heavy-ion collisions has revealed the presence of a vortical fluid with significant angular momentum and vorticity. This phenomenon can be observed through weak decays of particles such as Λ hyperons. Experimental data of Λ global polarization from RHIC and LHC provided opportunity to get new insights into the collective behavior and hydrodynamic description of the system.

Global polarization of multistrange hyperons, such as Ξ , can provide new information for hydrodynamic description of the system and its vorticity structure. In this talk, we will report results of Ξ global polarization measurement for Au+Au collisions at $\sqrt{s_{NN}} = 19.6$ and 27 GeV.

Primary author: ALPATOV, Egor (NRNU MEPhI)

Presenter: ALPATOV, Egor (NRNU MEPhI)

Session Classification: Plenary

Contribution ID: 37

Type: **not specified**

Weyl group symmetry as an intrinsic color symmetry of QCD

Tuesday, 5 September 2023 17:50 (30 minutes)

We present the basic non-perturbative structure of the space of classical dynamical solutions and corresponding one particle quantum states in $SU(3)$ QCD. The Weyl group, as a non-trivial color subgroup of $SU(3)$, admits non-trivial singlet irreducible representations which lead to strict concepts of one particle quantum states for gluons and quarks. We show that a full space of dynamical gluon solutions is an infinite but countable space of solutions described by a finite set of integer numbers. It has been proved that the Weyl singlet structure of classical solutions provides the existence of a quantum stable non-degenerate vacuum which is known as a main precondition of the color confinement phenomenon. Some physical implications are considered.

Primary author: PAK, DMITRIY (Physical-Technical Institute, Tashkent, Uzbekistan (currently I am in BLTP JINR under contract, until Oct.15 2023))

Presenter: PAK, DMITRIY (Physical-Technical Institute, Tashkent, Uzbekistan (currently I am in BLTP JINR under contract, until Oct.15 2023))

Session Classification: Parallel A

Contribution ID: 38

Type: **not specified**

Prospects of Open-Charm Asymmetry Measurements at the SPD

Monday, 4 September 2023 15:00 (30 minutes)

The Spin Physics Detector (SPD) at the Nuclotron based Ion Collider Facility (NICA) is designed to study nucleon spin structure in the three dimensions. With capabilities to collide polarized protons (up to $\sqrt{s} = 27$ GeV) and deuterons (up to $\sqrt{s} = 13.5$ GeV) with peak design luminosity $10^{32} \text{cm}^{-2} \text{s}^{-1}$ for protons (an order of magnitude less for deuterons), the experiment will allow measurements of cross-sections and spin asymmetries sensitive to the unpolarized and various polarized (helicity, Sivers, Boer-Mulders) gluon distributions inside the nucleons. Studies of heavy flavor mesons probe gluon distributions directly. The leading mechanism of charm meson pair production in proton-proton collisions is the gluon fusion. In the perturbative QCD framework, the cross-sections of the open-charm pair production are directly proportional to the product of gluon densities in the two colliding protons and the asymmetries are proportional to the ratio of the polarized gluon distribution to that of the unpolarized one. At the SPD, charmed mesons can be detected via their hadronic decay channels. While these measurements are challenging due to orders of magnitude larger hadronic background from other hard processes, we demonstrate the capacity to obtain meaningful asymmetry measurements that can make an impact on the present understanding of gluon Transverse Momentum Dependent (TMD) distributions inside protons.

Primary author: DATTA, Amaresh (JINR)

Presenter: DATTA, Amaresh (JINR)

Session Classification: Plenary

Contribution ID: 39

Type: **not specified**

Spin-flipping within the Frequency Domain method of searching for particle electric dipole moment

Wednesday, 6 September 2023 09:30 (25 minutes)

The present work is part of a research devoted to the development of a method to search for particle EDMs in an existing storage ring. This method involves a flipping of the beam's polarization axis as part of its energy fitting sub-procedure (to realize the "Quasi-Frozen Spin" condition). Generally, the preservation of the polarization requires that spin-flipping be done adiabatically; but ours is not the case. In this investigation we get a sense and a measure of the methodologically-required rapidity of spin-flipping.

Primary author: AKSENTEV, Alexander (INR RAS)

Co-authors: Mr KOLOKOLCHIKOV, Sergey (INR RAS); MELNIKOV, Aleksei (INR RAS); SENICHEV, Yury (The Institute for Nuclear Research of the Russian Academy of Sciences)

Presenter: AKSENTEV, Alexander (INR RAS)

Session Classification: Plenary

Contribution ID: 40

Type: **not specified**

NICA facilities for the search for EDM light nuclei

Wednesday, 6 September 2023 09:55 (25 minutes)

One of the possible arguments in favor of violation of CP invariance is the existence of nonzero electric dipole moments (EDM) of elementary particles. The idea of searching for the electric dipole moment of the proton and deuteron using polarized beams in the storage ring was originally based on the “frozen spin” method in 3D space and the creation of conditions under which the contribution of the magnetic dipole moment to the change in the direction of the spin would be less than the contribution of the supposedly existing electric dipole moment. The rejection of 3D and the transition to the concept of a “quasi-frozen” spin in 2D space, when the study of the EDM is supposed to be carried out by the Frequency Domain method, made it possible to consider accelerators existing in the world suitable for search the EDM. The article considers a slight modernization of the magneto-optical structure of the NICA collider and the Nuclotron by introducing a bypass with Wien-filters, which will allow accumulating the EDM signal over times of the order of 1000 seconds to a value that can be measured using a polarimeter with a sensitivity of $10^{(-29)} \div 10^{(-30)} \text{ e}\cdot\text{cm}$. At the same time, modulating the spin precession with Wien filters will make NICA a broadband axion antenna. The new role of the bypass as an axion antenna, in addition to searching for the EDM of protons and deuterons, significantly increases the potential of the NICA complex as a unique platform for precision tests of fundamental symmetries in elementary particle physics.

Primary author: SENICHEV, Yury (The Institute for Nuclear Research of the Russian Academy of Sciences)

Co-authors: AKSENTEV, Alexander (NRNU “MEPhI”); Mr KOLOKOLCHIKOV, Sergey (INR RAS); LADYGIN, Vladimir (VBLHEP, JINR); MELNIKOV, Aleksei (INR RAS); NIKOLAEV, Nikolai (Landau Institute for Theoretical Physics); SYRESIN, Evgeny (Joint Institute for Nuclear Researches)

Presenter: SENICHEV, Yury (The Institute for Nuclear Research of the Russian Academy of Sciences)

Session Classification: Plenary

Contribution ID: 41

Type: **not specified**

Transition energy crossing of polarized proton beam at NICA

Monday, 4 September 2023 17:10 (30 minutes)

At an experiment on acceleration of a polarized proton beam up to an energy at 13 GeV, the possibility of crossing the transition energy at 5.7 GeV by a jump is considered. The scheme of crossing by a rapid change of transition energy, assumes the longitudinal movement of the beam near the zero value of the slip coefficient. The jump itself is carried out in the absence of an RF field. The paper presents the influence of the above features on the dynamics of a polarized beam.

Primary author: Mr KOLOKOLCHIKOV, Sergey (INR RAS)

Co-authors: AKSENTEV, Alexander (NRNU "MEPhI"); MELNIKOV, Aleksei (INR RAS); SENICHEV, Yury (The Institute for Nuclear Research of the Russian Academy of Sciences)

Presenter: Mr KOLOKOLCHIKOV, Sergey (INR RAS)

Session Classification: Plenary

Contribution ID: 42

Type: **not specified**

PROJECT ON RESEARCH OF NUCLEAR DD-SYNTHESIS WITH POLARISATION OF INITIAL PARTICLES AT LOW ENERGIES (POLFUSION)

Tuesday, 5 September 2023 15:20 (20 minutes)

The nuclear dd-fusion reaction can proceed by three possible channels: $3\text{H} + \text{p}$ ($\approx 50\%$); $3\text{He} + \text{n}$ ($\approx 50\%$); $4\text{He} + \gamma$ ($\approx 10\text{-}7\%$).

Interest in dd - fusion has been aroused by both fundamental research and astrophysics [1] and applied science, particularly in the field of fusion reactor development [2]. In 1967-1968 at the Kurchatov Institute, the idea of studying the nuclear dd - fusion reaction using polarised deuteron beams was proposed [3]. The development of this idea was continued in the PolFusion (Polarised Fusion) nuclear physics experiment.

The PolFusion nuclear physics experiment aims to study the reaction of nuclear dd-synthesis with polarized source particles in the low energy region. The experiment is planned to measure the scattering asymmetries of dd-synthesis reaction products in the final state at different mutual orientation of the spins of colliding deuterons in the energy range 10-100 keV.

The authors will present an overview of the status of the experiment.

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2. Casey D. T. et al. Thermonuclear reactions probed at stellar-core conditions with laser-based inertial-confinement fusion, Nature Phys., 2017, Vol. 13. Issue 12, P. 1227-1231.
3. Adjasevich B., Antonenko V. Measurements of the polarization correlation coefficients in reactions $d(d, p)t$ and $d(d, n)^3\text{He}$, Preprint IEA-2704, Moscow, 1976.

Primary authors: ROZHDESTVENSKIY, Anton; Mr ANDREYANOV, Alexey; Mr VASILYEV, Alexander; Mr VZNUZDAEV, Marat; Mr IVSHIN, Kuzma; Mr KOCHENDA, Leonid; Mr KRAVTSOV, Peter; Mrs KRAVCHENKO, Polina; Mr LARIONOV, Vladislav; Mr SOLOVYEV, Alexander; Mr TROFI-MOV, Victor; Mr FOTYEV, Vasiliy

Presenter: ROZHDESTVENSKIY, Anton

Session Classification: Parallel B

Contribution ID: 43

Type: **not specified**

Z-boson pT-spectrum and lepton angular coefficients in the LO high-energy factorization with the real NLO corrections

Thursday, 7 September 2023 09:30 (40 minutes)

We study Z-boson production at the LHC energies within framework of the parton Reggeization approach of high-energy QCD [1,2]. Oppositely the previous calculation [3], based on LO approximation with the partonic process $Q + \bar{Q} \rightarrow Z$, we take into account NLO contribution from the partonic process $Q + R \rightarrow q + Z$, where R is the Reggeized gluon and Q is the Reggeized quark. The good agreement with experimental data as for Z-boson pT-spectra as for total cross section was found. The lepton angular coefficients in Z-boson events are studied by the same way, in the LO and in the NLO of the Parton Reggeization approach. The last one is performed in the high-energy factorization in the first time.

[1] M. Nefedov and V. Saleev, Off-shell initial state effects, gauge invariance and angular distributions in the Drell-Yan process, *Phys. Lett.* B790 (2019), 551-556

[2] M.A. Nefedov, V.A. Saleev and A.V. Shipilova, Dijet azimuthal decorrelations at the LHC in the parton Reggeization approach, *Phys. Rev.* D87 (2013) no.9, 094030

[3] M.A. Nefedov and V.A. Saleev. High-Energy Factorization for Drell-Yan process in pp and $p\bar{p}$ collisions with new Unintegrated PDFs, *Phys. Rev.* D102 (2020), 114018

Primary author: Prof. SALEEV, Vladimir (Samara National Research University)

Co-authors: Mr OMELYANCHUK, Saveliy (Samara National Research University); SHIPILOVA, Aleksandra (Samara University)

Presenter: Prof. SALEEV, Vladimir (Samara National Research University)

Session Classification: Plenary

Contribution ID: 44

Type: **not specified**

Test of T-invariance in Double Polarized Scattering of ^3He Nuclei on Deuterons

Thursday, 7 September 2023 15:00 (30 minutes)

The total cross section of scattering of vector polarized protons on tensor polarized deuterons provides a null-test signal of violation of invariance with respect to time reversal (T) while conserving spatial (P) parity [1]. Very similar is the double polarized ^3He -d scattering considered here. The null-test signal cannot be simulated by the interaction in the initial and final states. We have calculated this observable for the ^3He -d scattering process up to an unknown constant of the T-odd P-even NN interaction at the energies of the ^3He nuclear beam in the range of 100-1000 MeV/nucleon based on the Glauber theory. The necessary spin amplitudes of $p^3\text{He}$ and $n^3\text{He}$ elastic scattering are calculated in the S-wave approximation for the wave function of the ^3He nucleus taking into account the spin dependence of the pN elastic scattering amplitudes [2] with the contribution of T-invariance violating, but P-parity conserving interactions between nucleons. All types of mechanisms –single, double and triple scatterings, are included for both T-even and T-odd amplitudes. When calculating the amplitude of elastic ^3He -d scattering, the previously developed formalism for elastic pd scattering [1,2] is used, taking into account the S and D waves of the deuteron wave function, while the spin-dependent pN scattering amplitudes are replaced by the corresponding spin-dependent amplitudes of the ^3He -N scattering. The results of the calculation of the differential cross section, vector analyzing power A_y and spin correlations of the ^3He scattering process are in good agreement with the available experimental data [3,4] in the forward hemisphere at energies of 150-1000 MeV. The dependence of the null-test signal on the ^3He -d collision energy for different types of T-odd P-even NN interaction [5] is presented.

The research was carried out at the expense of the grant of the Russian Science Foundation No. 23-22-00123, <https://rscf.ru/project/23-22-00123/>.

List of references

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4. E.J. Brash et al., Phys. Rev. C 52, 807 (1995).
5. M. Simonius, Phys. Rev. Lett. 78, 4161 (1997).

Primary authors: PLATONOVA, Maria (Lomonosov Moscow State University, Skobeltsyn Institute of Nuclear Physics); TURSUNBAYEV, Nurbek (JINR, DLNP); UZIKOV, Yury (Joint Institute for Nuclear Researches)

Presenter: UZIKOV, Yury (Joint Institute for Nuclear Researches)

Session Classification: Plenary

Contribution ID: 45

Type: **not specified**

Composite effective field theory signal in case of searching for neutral triple gauge couplings with $ZZ \rightarrow \ell^+ \ell^- \nu \bar{\nu}$ production

Thursday, 7 September 2023 17:30 (30 minutes)

The Standard Model (SM) is a theory of elementary particles and their interactions that has a good agreement with experimental high-energy-physics data. However, this model should be extended to a more general theory due to the some theoretical problems of the SM and experimental facts beyond the SM. Effective field theory (EFT) is a way that allows one to search for any deviations from the SM by studying of anomalous couplings. It is based on the parameterization of the Lagrangian with the operators of higher dimensions accompanying by the Wilson coefficients. These operators represent contributions from physics of currently inaccessible energies and were constructed from the SM fields so that the gauge invariance is respected.

In order to set more stringent limits on Wilson coefficients one should use methods of sensitivity increasing in addition to the luminosity growth. In this work the method of composite anomalous signal is studied. It is based on accounting for background processes anomalous contributions in addition to the signal process one. This technique is considered for $ZZ \rightarrow \nu \bar{\nu} \ell^+ \ell^-$ production at the LHC. This process is sensitive to the neutral triple gauge couplings (nTGCs), that are described by six dimension-eight operators. Anomalous contribution from the main background, WZ production, is significant for some operators. This contribution was accounted in the limit-setting procedure in addition to the contribution from the signal process, and the derived limits on the Wilson coefficients are more stringent.

Primary author: SEMUSHIN, Artur (National Research Nuclear University MEPhI and A. Alikhanyan National Science Laboratory)

Co-author: Mr SOLDATOV, Evgeny (National Research Nuclear University MEPhI)

Presenter: SEMUSHIN, Artur (National Research Nuclear University MEPhI and A. Alikhanyan National Science Laboratory)

Session Classification: Plenary

Contribution ID: 46

Type: **not specified**

Negative moment of inertia and rotational instability of gluon plasma

Using first-principle numerical simulations of the lattice SU(3) gauge theory, we calculate the isothermal moment of inertia of the rigidly rotating gluon plasma. We find that the moment of inertia unexpectedly takes a negative value below the “supervortical temperature” $T_s = 1.50(10)T_c$, vanishes at $T = T_s$, and becomes a positive quantity at higher temperatures. The negative moment of inertia indicates a thermodynamic instability of rigid rotation. We derive the condition of thermodynamic stability of the vortical plasma and show how it relates to the scale anomaly and the magnetic gluon condensate.

Primary authors: BRAGUTA, Victor (JINR); Dr CHERNODUB, Maxim (Institut Denis Poisson, University of Tours, France); Dr ROENKO, Artem (JINR, BLTP); SYCHEV, Dmitrii (BLTP JINR, MIPT); KUDROV, Ilya (IHEP)

Presenter: SYCHEV, Dmitrii (BLTP JINR, MIPT)

Contribution ID: 47

Type: **not specified**

Correlations of kinematic quantities for pions and nucleons in PHSD model

Wednesday, 6 September 2023 17:50 (20 minutes)

Time dependencies of the correlations between the velocities of pions and nucleons, as well as between their vorticities are obtained in frames of PHSD model for Au+Au collision at $\sqrt{s_{NN}} = 7.8$ GeV and fixed impact parameter 7.5 fm. The difference in results for these two correlations is explained. It is shown, that the Hubble-like expansion of the fireball gives a significant contribution to the difference of the results. However, for the times around the overlap of the colliding nuclei, the rotation of the surfaces $v_z = 0$ for the considered types of particles is important too.

Primary authors: Dr KOLOMEITSEV, Evgeni (BLTP, JINR, Dubna and Matej Bel University, Slovakia); KOLOMOYETS, Natalia (JINR); TERYAEV, Oleg (JINR); TSEGELNIK, Nikita (JINR); VORONYUK, Vadym (JINR, LHEP)

Presenter: KOLOMOYETS, Natalia (JINR)

Session Classification: Plenary

Contribution ID: 48

Type: **not specified**

Inhomogeneous phases in rotating gluon plasma

Wednesday, 6 September 2023 17:30 (20 minutes)

Using first-principle numerical lattice simulations of rotating quenched QCD, we demonstrate that the hot gluon plasma develops strong inhomogeneity with angular rotation. In certain conditions the existence of mixed confinement-deconfinement phase, when the periphery and central regions of rotating system are in the different phases, becomes possible. We study the spatial distribution of the Polyakov loop in the plane orthogonal to the rotational axis and find the conditions when the co-existing of two phases may be possible. We also will present preliminary results for the local critical temperature of rotating gluon plasma and its dependence on the angular velocity and radius of the system.

Primary author: Dr ROENKO, Artem (JINR, BLTP)

Co-authors: BRAGUTA, Victor (JINR); Dr CHERNODUB, Maxim (Institut Denis Poisson, University of Tours, France)

Presenter: Dr ROENKO, Artem (JINR, BLTP)

Session Classification: Plenary

Contribution ID: 49

Type: **not specified**

GPDs and gravitational form factors of nucleons (quark and gluon contributions)

Wednesday, 6 September 2023 12:30 (30 minutes)

Taking into account the recent parton distribution functions (PDFs), obtained in the recent time, the momentum transfer dependence of generalized parton distributions (GPDs), of nucleons is obtained in the limit $\xi \rightarrow 0$. The gravitational quark and gluon form factors of nucleons are calculated. The power dependence of the form factors is investigated.

Primary author: SELYUGIN, Oleg (JINR)

Co-author: Dr TERYAEV, Oleg (BLTPb, JINR)

Presenter: SELYUGIN, Oleg (JINR)

Session Classification: Plenary

Contribution ID: 50

Type: **not specified**

Brief history of effective time-reversal in QCD

Monday, 4 September 2023 11:50 (40 minutes)

The different QCD mechanisms of single spin asymmetries related to “naive” T-violation are discussed, with the special emphasis to contributions of Anatoli Vasil’evich Efremov. The relevant imaginary phases may correspond to hard (perturbative loops) and soft (T-odd fragmentation and fracture functions) regimes and their overlap (twist 3, effective T-odd distribution functions). The comparison with the polarization in heavy-ion collisions, where dissipation plays the prominent role, is discussed.

Primary author: TERYAEV, Oleg (JINR)

Presenter: TERYAEV, Oleg (JINR)

Session Classification: Plenary

Contribution ID: 51

Type: **not specified**

Proposal for realizing Majorana fermions in strongly correlated nanowires

Friday, 8 September 2023 11:50 (40 minutes)

We show that the $1\bar{D}$ topological superconductivity can be placed in the context of phenomena associated with strongly correlated electron systems. Here we propose a system consisting of a one-dimensional chain of strongly correlated fermions placed on a superconducting (SC) substrate that exhibits a spin-singlet extended \bar{D} -wave pairing. Strong electron correlation is shown to transform an extended \bar{D} -wave SC into a topological SC that can host Majorana fermions. Neither a Rashba spin-orbit coupling nor an external magnetic field are required to produce such an effect.

Primary author: KOCHETOV, Evgenii (JINR)

Presenter: KOCHETOV, Evgenii (JINR)

Session Classification: Parallel B

Contribution ID: 52

Type: **not specified**

Effective Potential and Conformal Symmetry in ϕ^4

Thursday, 7 September 2023 11:50 (30 minutes)

We present the study of the multi-loop effective potential evolution in ϕ^4 -theory using the conformal symmetry. We demonstrate that the conformal symmetry can still be useful for the effective potential approach even at the presence of the mass parameter. To this goal, it is necessary to introduce the special treatment of the mass terms as sorts of interaction in an asymptotical expansion of the generating functional. The new-introduced vacuum $V_{z,x}$ -operation is the main tool to the algebraic scheme of anomalous dimension calculations. It is shown that the vacuum $V_{z,x}$ -operation transforms the given Green functions to the corresponding vacuum integrations which generate the effective potential.

Primary author: ANIKIN, Igor V. (Bogoliubov Lab of Theor Phys JINR)

Presenter: ANIKIN, Igor V. (Bogoliubov Lab of Theor Phys JINR)

Session Classification: Plenary

Contribution ID: 53

Type: **not specified**

Probing axion physics with spin

Tuesday, 5 September 2023 10:50 (30 minutes)

The dynamics of spin in external electromagnetic, gravitational, and axion fields is analysed in the framework of the gravitoelectromagnetism approach in Einstein's general relativity theory. We consistently extend the recent studies from the flat Minkowski geometry to the curved spacetime manifolds, contributing to the discussion of the possible new role of a precessing spin as an "axion antenna" that can be used to detect the hypothetical axion-like dark matter. The formalism developed helps to clarify the subtle influence of the gravitational/inertial and axion fields in the ultra-sensitive high-energy spin experiments with charged particles and neutrons at accelerators and storage rings devoted to testing fundamental physical symmetries, including attempts to establish the nature of dark matter in the Universe.

Primary author: OBUKHOV, Yuri (Nuclear Safety Institute (IBRAE), Russian Academy of Sciences)

Presenter: OBUKHOV, Yuri (Nuclear Safety Institute (IBRAE), Russian Academy of Sciences)

Session Classification: Plenary

Contribution ID: 56

Type: **not specified**

The study of the nonleptonic decay $\Xi_c^0 \rightarrow \Lambda_c^+ \pi^-$ in the covariant confined quark model

Thursday, 7 September 2023 11:00 (30 minutes)

The nonleptonic decay $\Xi_c^0 \rightarrow \Lambda_c^+ \pi^-$ with $\Delta C = 0$ is systematically studied in the framework of the covariant confined quark model (CCQM) with account for both short and long distance effects. The short distance effects are induced by four topologies of external and internal weak W^\pm exchange, while long distance effects are saturated by an inclusion of the so-called pole diagrams with an intermediate $\frac{1}{2}^+$ and $\frac{1}{2}^-$ baryon resonances. The contributions from $\frac{1}{2}^+$ -resonances are calculated straightforwardly by account for single charmed Σ_c^0 and $\Xi_c'^+$ -baryons whereas the contributions from $\frac{1}{2}^-$ -resonances are calculated by using the well-known soft-pion theorem in the current-algebra approach. It allows to express the parity-violating S-wave amplitude in terms of parity-conserving matrix elements. It is found that the contribution of external and internal W -exchange diagrams is significantly suppressed by more than one order of magnitude in comparison with data. The pole diagrams play the major role to get consistency with experiment.

Primary author: IVANOV, Mikhail (Joint Institute for Nuclear Research, Dubna, Russia)

Presenter: IVANOV, Mikhail (Joint Institute for Nuclear Research, Dubna, Russia)

Session Classification: Plenary

Contribution ID: 57

Type: **not specified**

Manifestation of the electric dipole moment in the decays of τ leptons produced in e^+e^- annihilation

Wednesday, 6 September 2023 10:45 (25 minutes)

CP-odd asymmetries in the processes $e^+e^- \rightarrow \tau^+\pi^-\nu_\tau$, $e^+e^- \rightarrow \pi^+\tau^-\bar{\nu}_\tau$, $e^+e^- \rightarrow \tau^+\rho^-\nu_\tau$, $e^+e^- \rightarrow \rho^+\tau^-\bar{\nu}_\tau$, $e^+e^- \rightarrow \tau^+e^-\nu_\tau\bar{\nu}_e$, and $e^+e^- \rightarrow \tau^-e^+\nu_e\bar{\nu}_\tau$ are investigated with account for longitudinal polarization of electron (or positron) beam. These asymmetries are a manifestation of electric dipole form factor $F_3^\tau \equiv b$ in the $\gamma\tau^+\tau^-$ vertex. It is shown that to measure $\text{Im } b$ in the specified processes, polarization is not needed, while to measure $\text{Re } b$ it is required. The processes $e^+e^- \rightarrow \pi^+\pi^-\nu_\tau\bar{\nu}_\tau$, $e^+e^- \rightarrow e^+e^-\nu_\tau\bar{\nu}_\tau\nu_e\bar{\nu}_e$, $e^+e^- \rightarrow \mu^+\mu^-\nu_\tau\bar{\nu}_\tau\nu_\mu\bar{\nu}_\mu$, $e^+e^- \rightarrow \mu^+e^-\nu_\tau\bar{\nu}_\tau\nu_\mu\bar{\nu}_e$, and $e^+e^- \rightarrow \mu^-e^+\nu_\tau\bar{\nu}_\tau\nu_e\bar{\nu}_\mu$ are also discussed for the case of unpolarized electron and positron beams. In the latter cases it is possible to measure $\text{Re } b$ using the differential cross section over momenta of both registered particles.

Primary authors: Prof. MILSTEIN, Alexander (Budker Institute of Nuclear Physics, 630090 Novosibirsk, Russia and Novosibirsk State University, 630090, Novosibirsk, Russia); OBRAZTSOV, Ivan (Budker Institute of Nuclear Physics, 630090 Novosibirsk, Russia and Novosibirsk State University, 630090, Novosibirsk, Russia)

Presenter: OBRAZTSOV, Ivan (Budker Institute of Nuclear Physics, 630090 Novosibirsk, Russia and Novosibirsk State University, 630090, Novosibirsk, Russia)

Session Classification: Plenary

Contribution ID: 58

Type: **not specified**

General Covariant Dirac Equation

Tuesday, 5 September 2023 17:10 (20 minutes)

All attempts to include the original Dirac equation into the frameworks of the Principle of General Covariance and to obtain observable results have failed. It was shown that the Dirac field does not interact with the gravitational field (see for example: {S. Weinberg,} *Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity*, Wiley, New York, 1972. 685 p.; {Kenji Hayashi and Takeshi Shirafuji,} // { *Phys.Rev.*, {\bf D19}(1979),3524-3623.} But this is in conflict with experiment ({F.C. Witterborn and W.M. Fairbank,} // { *Phys.Rev.Lett.*, {\bf 19}(1967),1049-1052.})

Hence, it is very important to bring the concept of Spin into correspondence with the Principle of General Covariance. This problem has solution in a form of General Covariant Dirac equation. Particles that correspond to different states of a general covariant Dirac field can be called inelectrons.

It is demonstrated that these particles are characterized by the Spin and the electrical charge in one case and the Spin and two charges (electrical and dual) in another case. An operator of the electric charge anticommutes with an operator of dual charge. This provides existence of four internal states of the general covariant Dirac field. The transitions between these internal states are in current physics considered as electroweak interactions. We can conclude that to discover new physics it is enough to put all invented by the observers notions into correspondence with the Principle of General Covariance.

Primary author: PESTOV, Ivanhoe (Bogoliubov Laboratory of Theoretical Physics, JINR)

Presenter: PESTOV, Ivanhoe (Bogoliubov Laboratory of Theoretical Physics, JINR)

Session Classification: Parallel B

Contribution ID: 59

Type: **not specified**

Influence of relativistic rotation on QCD properties

Wednesday, 6 September 2023 16:50 (40 minutes)

In this report the influence of relativistic rotation on QCD properties will be considered. This study is carried out within lattice simulation of QCD which is performed in the reference frame which rotates with the system under investigation. In this case rotation is reduced to external gravitational field. Within the report I am going to discuss the following topics: the moment of inertia and inhomogeneous phase transitions in quark-gluon plasma.

Primary author: BRAGUTA, Victor (JINR)

Co-authors: Dr CHERNODUB, Maxim (Institut Denis Poisson, University of Tours, France); Dr ROENKO, Artem (JINR, BLTP); SYCHEV, Dmitrii (BLTP JINR, MIPT)

Presenter: BRAGUTA, Victor (JINR)

Session Classification: Plenary

Contribution ID: 60

Type: **not specified**

Performance of hyperon global polarization measurements with NICA/MPD

Thursday, 7 September 2023 18:30 (20 minutes)

The investigation of vortical structure of matter in heavy-ion collisions at the energies of a few GeV per nucleon is one of the goals of future MPD experiment at NICA. Within this work it is done by studying global polarization of Λ hyperons within the framework of the MPD, in order to assess the performance of the detector with respect to these observables. The study is performed via Monte Carlo simulation of Bi+Bi collisions at $\sqrt{s_{NN}} = 9.02$ GeV using PHSD model.

Primary author: NAZAROVA, Elizaveta (LHEP, JINR)

Co-authors: KOLESNIKOV, Vadim (VBLHEP, JINR); PARFENOV, Peter (MEPhI, Moscow); TARANENKO, Arkadiy (VBLHEP JINR); TERYAEV, Oleg (JINR); VORONYUK, Vadym (JINR, LHEP); ZINCHENKO, Alexander (Joint Institute for Nuclear Research)

Presenter: NAZAROVA, Elizaveta (LHEP, JINR)

Session Classification: Plenary

Contribution ID: 61

Type: **not specified**

Search for axions at NICA

Tuesday, 5 September 2023 10:10 (40 minutes)

Besides offering a solution to the strong CP problem in QCD, axions are one of the prime candidates for dark matter. One of manifestation of the galactic axion halo of light “invisible” axions is generation of the oscillating electric dipole moment of nucleons and light nuclei, and the NMR like rotation of spins in the axion induced pseudomagnetic field. For spins in storage rings the pseudomagnetic field is 3 orders in magnitude stronger than that acting on spins at rest in terrestrial laboratories.

The prospects for spins as resonant axion antennas at the NICA facility will be discussed. The sensitivity to axions can be strongly enhanced complementing NICA rings with bypasses, which can also make possible a search for the deuteron electric dipole moment.

Primary author: Mr NIKOLAEV, Nikolai (Landau Institute for Theoretical Physics)

Presenter: Mr NIKOLAEV, Nikolai (Landau Institute for Theoretical Physics)

Session Classification: Plenary

Contribution ID: 62

Type: **not specified**

Measurement of quark and gluon jet fractions: methodology and preliminary results for the CMS

Friday, 8 September 2023 10:40 (20 minutes)

The generator describes all the microparameters and macroparameters of quark(q) and gluon(g) jets - objects that we recognize in the data. The experimenter is provided with information that allows to determine “jet-by-jet” whether the jet has quark or gluon flavour with a given probability. In 2018, we were the first to notice that instead of flavour recognizing “jet-by-jet”, we can measure q/g-jet fractions in jet sample. The q/g-jet fractions contains important physical information about hard parton process and the process of hadronization. The report is devoted to the method of measuring the q/g-jet fractions at the hadron collider. The technique is illustrated by preliminary measurement results on CMS data.

Primary author: SHULGA, Sergey (JINR)

Presenter: SHULGA, Sergey (JINR)

Session Classification: Plenary

Contribution ID: 63

Type: **not specified**

Statistical potentials, AdS/CFT correspondence and (higher-)spin effects in heavy ion collisions

Tuesday, 5 September 2023 18:30 (20 minutes)

Higher spin dynamics and multiparticle production in heavy ion collision process, AdS/CFT correspondence, quarkonium potentials including finite temperature, finite density and entropic corrections considered.

Primary author: Dr MAKHALDIANI, Nugzar (JINR)

Presenter: Dr MAKHALDIANI, Nugzar (JINR)

Session Classification: Parallel B

Contribution ID: 64

Type: **not specified**

Axial current and hydro-gravity duality

Wednesday, 6 September 2023 15:30 (40 minutes)

We recall the notion of duality between theory of equilibrium of media and gravity, in the version introduced at JINR. As an application a dissipation-free axial current is evaluated.

Primary author: ZAKHAROV, Valentin

Presenter: ZAKHAROV, Valentin

Session Classification: Plenary

Contribution ID: 65

Type: **not specified**

Relative contributions of cross-even and cross-odd parts to the spin dependent elastic hadron scattering amplitudes at high energies

Tuesday, 5 September 2023 15:40 (30 minutes)

The form and energy dependence of the Odderon contribution to the hadron scattering amplitude is determined in the framework of the High Energy Generalize Structure (HEGS) model. Its contribution to the spin-flip scattering amplitude is analysed. The impact of different assumptions on the extraction of the parameters of the elastic scattering amplitude, especially on the size of the $\rho(t = 0)$ and spin-correlation parameters, is examined.

Primary author: SELYUGIN, Oleg (JINR)

Presenter: SELYUGIN, Oleg (JINR)

Session Classification: Parallel B

Contribution ID: 68

Type: **not specified**

Simulation of spin effects with ultracold gases in optical traps

Friday, 8 September 2023 15:30 (30 minutes)

Development of physics of ultracold atoms has opened unique possibility for realisation of R. Feynman's idea: to use simple quantum systems with desired properties (amenable quantitative description and modeling) to describe more complex systems and phenomena. Particularly, in solid state physics one can mention the modeling of matter phase-transition with the ultracold atom simulator (realization of the Bose-Hubbard model). Another intriguing perspective in this direction is a possibility to control of dipolar many-body phase. As an example, we discuss the use of dipolar confinement-induced resonances of ultracold gases in waveguides for modeling tunable magnetic moment (or dipole-dipole) interactions.

Primary author: MELEZHIK, Vladimir (BLTP JINR Dubna)

Presenter: MELEZHIK, Vladimir (BLTP JINR Dubna)

Session Classification: Parallel B

Contribution ID: 69

Type: **not specified**

Feasibility of model-independent reconstruction of the amplitudes of the pp elastic scattering matrix at the SPASCHARM facility at U70

Friday, 8 September 2023 10:10 (30 minutes)

Abstract. The concept design of the SPASCHARM experiment setup allows us to measure non-vanishing observables for direct reconstruction of the pp elastic scattering amplitudes at the energy of 16 GeV. We discuss experimental measurements required to extract all amplitudes for two types of polarized target and polarized proton beam.

Realistic simulation was carried out to estimate accuracy and required time to measure analyzing power of the pp-scattering at the SPASCHARM experiment.

Primary author: MARINA, Nurusheva (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute))

Co-authors: A.A. BOGDANOV (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, 115409, Russia); P.A. SEMENOV (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, 115409, Russia NRC «Kurchatov Institute» - IHEP, Protvino, Moscow region, 142281, Russia); V.L.RYKOV (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, 115409, Russia); V.P. LADYGIN (Joint Institute for Nuclear Research, Dubna, Moscow region, 141980, Russia); V.V. MOCHALOV (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, 115409, Russia NRC «Kurchatov Institute» - IHEP, Protvino, Moscow region, 142281, Russia); V.V. MOISEEV (NRC «Kurchatov Institute» - IHEP, Protvino, Moscow region, 142281, Russia)

Presenter: MARINA, Nurusheva (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute))

Session Classification: Plenary

Contribution ID: 70

Type: **not specified**

Hyperon polarization in HICs and in hadronic reactions

Thursday, 7 September 2023 18:00 (30 minutes)

Heavy-ion collisions at center-of-mass nucleon collision energies 2.3–11.5 GeV are analyzed within the parton-hadron-string dynamics (PHSD) transport model. After the separation of spectator nucleons, the momentum distributions of particles constituting a fireball are fluidized and the energy and baryon number densities, temperature, and velocity fields are obtained in the Landau frame. It is shown that the velocity field has dominantly Hubble-like transversal and longitudinal expansion and a small vortical component on top of it. The vorticity is concentrated in the form of two oppositely rotating vortex rings moving in opposite directions along the nuclear collision axis. Global polarization of various hyperons species induced by the local vorticity of the medium is calculated. The polarization of all anti-hyperon species is found to be significantly larger than that of hyperons. The observable global polarization of Lambda hyperons is strongly influenced by the feed-down from weak and electromagnetic decays of heavier hyperons. Strong suppression is found to be due to electromagnetic decays of Sigma0 hyperons, which multiplicities obtained in the transport are poorly constrained both from the microscopic input of the Sigma0 production reactions and from the experimental data. The results of the calculation are compared with the available measurements of hyperon polarization.

Primary authors: Dr KOLOMEITSEV, Evgeni (BLTP, JINR, Dubna and Matej Bel University, Slovakia); TSEGELNIK, Nikita (BLTP, JINR); VORONYUK, Vadym (JINR, LHEP)

Presenter: Dr KOLOMEITSEV, Evgeni (BLTP, JINR, Dubna and Matej Bel University, Slovakia)

Session Classification: Plenary

Contribution ID: 71

Type: **not specified**

Resolution of SPD Detector in the Search of Dibarions with small energy excitations

Monday, 4 September 2023 16:10 (30 minutes)

There are some indications on the existence of two barion states, that are systems with barion number 2(dibarion) and excitation energy lower than π^0 mass. Such state according to barion number conservation after its production decays into proton and neutron and has a mass $M_X = M_d + E_{exc}$, where M_d and E_{exc} are deuteron mass and excitation energy.

The simulations of dd collisions is performed in assumption that in final state we have deuteron and dibarion with mass M_X . E_{exc} is taken here as a fraction $1/4, 1/2, 3/4$ of π^0 mass equal to 0.135 GeV, what corresponds to M_X equal to 1.90935, 1.9431, 1.97685 in GeV respectively.

Momenta of colliding deuterons were taken equal to 2.6 GeV/c what corresponds to the conditions of Baldin et al. experiment (Baldin A.M. et al., Communication of the JINR, Dubna 1979, 1-12397). This study is performed under the conditions that the collider momentum is fixed at the 2.6 GeV/c; the transferred momentum of unbroken deuteron $t = -0.5$ (GeV/c)², all the collisions take place at the center of the detector, and the dibarion has zero decay width.

The analysis shows that the resolution of dibarion mass under these conditions is $\approx 2 - 3$ MeV and opening the way to propose the study of this process at the commissioning stage of SPD detector.

Primary author: KURBATOV, Vladimir (JINR)

Presenter: KURBATOV, Vladimir (JINR)

Session Classification: Plenary

Contribution ID: 72

Type: **not specified**

On the possibility of observing weakly excited 6-quark states in $d-d \rightarrow 6q+d$ scattering processes at the NICA SPD

There are theoretical indications that phase transitions can occur in highly compressed nuclear matter at moderate temperatures. Conventional nuclear physics as well as astrophysical constraints has not yet provided direct evidence for their existence. It is expected that future experiments at the NICA MPD facility will be able to at least partially solve this problem. However, due to the large theoretical uncertainty in the description of multinucleon systems, the interpretation of such experimental data can be very ambiguous. Therefore, the experimental detection of possible transformations in small-nucleon systems is of special importance. In case of their existence, information on the properties of these systems will have scientific value comparable to knowledge of ionization characteristics of atoms for building a microscopic theory of ordinary plasma.

In this paper we discuss the possibility of detecting weakly excited (below the pion birth threshold) deuteron states in $d-d \rightarrow d+d$ reactions at the colliding beams of the NICA SPD facility at JINR. Since the identification of these processes by the change in momentum or scattering angle of the deuteron is not feasible against the background of the associated elastic scattering processes, the following workaround is discussed. We propose to register protons generated from the decay of $6q$ states in the kinematic region "almost" forbidden for $d-d \rightarrow p+n+d$ direct proton knockout processes. Calculations of the contribution to the observed events of very rare deuteron scattering processes on high momentum protons in another colliding deuteron are currently underway. In particular, the problem of fast simulation of the momentum distribution of deuteron nucleons in the whole range of variation of its wave function has already been solved.

A scheme of the dibaryon detection experiment is also proposed, which exploits the effect of flipping the spin of the polarized deuteron in $d\uparrow+d \rightarrow d\downarrow+d$ processes.

Primary author: KOSTENKO, Boris (JINR)

Presenter: KOSTENKO, Boris (JINR)

Session Classification: Plenary

Contribution ID: 73

Type: **not specified**

Study of Spin Effects in SPASCHARM Experiment at U-70 facility

Friday, 8 September 2023 09:30 (40 minutes)

SPASCHARM experiment started to study spin effects in hadron production. Data taking runs were carried out with polarized and nuclei targets. Current status of the experiment is presented.

Primary author: MOCHALOV, Vasilii (NRC "Kurchatov Institute" - IHEP)

Presenter: MOCHALOV, Vasilii (NRC "Kurchatov Institute" - IHEP)

Session Classification: Plenary

Contribution ID: 74

Type: **not specified**

Study of charmonia production in e^+e^- annihilation at center-of-mass energies above 3.81 GeV

Tuesday, 5 September 2023 18:50 (20 minutes)

We present measurements of charmonia production cross sections in e^+e^- annihilation at center-of-mass energies from 3.81 GeV to 4.95 GeV at BESIII. The number of observed vector states in this energy region exceeds that of the predicted vector charmonium states. These features suggest that some of these supernumerary vector states are candidates of an exotic nature. To clarify the nature of these states and to distinguish between the different theoretical models, precise measurements of the production cross section and of the resonance parameters are essential.

Primary author: BAKINA, Olga (Joint Institute for Nuclear Research)

Presenter: BAKINA, Olga (Joint Institute for Nuclear Research)

Session Classification: Parallel A

Contribution ID: 75

Type: **not specified**

Flipping chiral edge states through nuclear spin S and spin modulating vector in topological insulators

Friday, 8 September 2023 12:30 (30 minutes)

Non chiral spin texture gives rise to the topological Hall effects (THE). We analyze the topological property of one such spin texture, which was recently observed in van der Waals (vdW) magnet Fe_3GeTe_2 . In this spin texture both the azimuthal and polar angle of the spin depend on the spatial coordinates. The Hamiltonian in strongly correlated regime with this spin texture for arbitrary large nuclear spin S is found. The large spin- S treatment is necessary as magnetic atoms of the vdW magnets can have spin $S > 1/2$. It was found that on a honeycomb lattice for two band material the first Chern number depends on the spin S and azimuthal angle. For a fixed S as the spin modulating vector – related to the azimuthal angle – changes from 0 to π the sign of the Chern number changes multiple times. Physically, as the Chern number is related to the Hall conductivity, and the chiral edge states, sign change of Chern number will result in flipping of the former. We also argue that no matter how complex is the spin texture, the topological properties depends only on a single factor: the change in azimuthal angle between neighboring spins. It confers with the recent view that topological properties can occur with zero scalar spin chirality. We also discuss possible experimental ways to observe this effect.

Primary author: Dr KESHARPU, Kaushal Kumar (BLTP, JINR)

Presenter: Dr KESHARPU, Kaushal Kumar (BLTP, JINR)

Session Classification: Parallel B

Contribution ID: 76

Type: **not specified**

Transverse momentum distributions of hadrons in the Tsallis-3 statistics

Tuesday, 5 September 2023 17:30 (20 minutes)

We have derived the exact and approximate hadron transverse momentum distributions for the Fermi-Dirac, Bose-Einstein and Maxwell-Boltzmann statistics of particles in the framework of the Tsallis statistics with escort probabilities (the Tsallis-3 statistics). We have revealed that the classical approximate phenomenological Tsallis distribution in the framework of the Tsallis-3 statistics corresponds to the zeroth term approximation and to the unphysical condition of zero entropy of the system in the whole range of state variables. The quantum approximate phenomenological Tsallis distribution does not correspond to the quantum transverse momentum distribution obtained in the Tsallis-3 statistics. We have revealed that the transverse momentum distributions in the zeroth term approximation and in the factorization approximation of the zeroth term approximation are the same in the Tsallis-3, Tsallis-2 and q -dual statistics. The exact Tsallis-3 classical distribution and the classical approximate phenomenological Tsallis distribution have been applied to describe the experimental spectra of the charged pions produced in the proton-proton collisions at high energies. We have found that the classical approximate phenomenological Tsallis distribution approximates the exact Tsallis-3 classical distribution unsatisfactory in the whole energy range.

Primary author: PARVAN, Alexandru (JINR and IFIN-HH)

Presenter: PARVAN, Alexandru (JINR and IFIN-HH)

Session Classification: Parallel B

Contribution ID: 77

Type: **not specified**

Scattering of unstable particles

Wednesday, 6 September 2023 11:10 (30 minutes)

The scattering $R + T \rightarrow A + X$, where A and X are known sets of particles, is discussed. With known momenta of all participants, process is described by the scattering amplitude and cross section.

Real colliding particles exist in the form of wave packets – superpositions of monochromatic states with some spread Δp . In many cases, the amplitude change in the Δp interval is negligible and the mentioned quantities describe the observed phenomena (the monochromatic plane wave approximation – MPWA).

If the particle R is unstable, then there are points in the space of final states where our process can be represented as a cascade two-stage process $(R \rightarrow A + B) \oplus (B + T \rightarrow X)$ with real intermediate particle B . At these points, the amplitude diverges (the t -channel singularity) and the cross section does not exist – MPWA is not applicable. For physical scattering, these divergences are smoothed out by the non-monochromaticity of the initial wave packet. It gives a finite probability of the process. The result depends not only on the average values of the momenta, but also on the properties of wave packet determined by the mechanism of its preparation.

Similar phenomenon for s -channel is well known. For the scattering of slow neutrons on Uranium, cross section at $p \rightarrow 0$ diverges while probability of process is finite (the s -channel singularity).

Primary author: GINZBURG, Ilya (Sobolev Inst. of Mathematics SB RAS)

Co-author: KISELEV, A.V. (SIM and NSU)

Presenter: GINZBURG, Ilya (Sobolev Inst. of Mathematics SB RAS)

Session Classification: Plenary

Contribution ID: 78

Type: **not specified**

Decay Of High-Spin Isomers Into Odd-Odd Holmium Nuclei With $A= 160,158,156$.

Friday, 8 September 2023 11:00 (30 minutes)

The report discusses experimental and theoretical problems of describing high-spin isomers in the beta decay of nuclei. The experiments were carried out within the framework of the Energy-Transmutation program at JINR accelerators and at the YASNAPP experimental complex, created on the basis of the JINR nuclear power Plant phasotron, in “on-line” and “off-line” modes.

The experiments used large-volume HPGe detectors (efficiency 20% - 70%) and planar HPGe detectors (O30mm x 3mm).

In the nuclei of 156,158,160, the lifetimes of 5 levels and half-lives of high-spin isomers were measured. :

$T_{1/2}^{9+} 160m2Ho = 3.2 \pm 0.2s$, $T_{1/2}^{29+} 158m2Ho = 21min$, $T_{1/2}^{29+} 156m2Ho = 7.25 \pm 0.35min$.

The figure shows a fragment of the decay of a high-spin isomer in the $156No$ nucleus.

Primary author: YUDIN I.P

Co-authors: STEGAILOV V.I; TYUTYUNNIKOV S.I.

Presenter: YUDIN I.P

Session Classification: Plenary

Contribution ID: **81**

Type: **not specified**

SANC: process gamma + gamma \rightarrow Z + H at one-loop level including polarization effects

Friday, 8 September 2023 15:50 (20 minutes)

The process gamma + gamma \rightarrow Z + H is described within the SANC system at the one-loop accuracy level. The corresponding covariant and helicity amplitudes are presented.

Primary authors: BONDARENKO, Serge (JINR); KALINOVSKAYA, Lidia (JINR); RUMYANTSEV, Leonid (DLNP JINR); SADYKOV, Renat (JINR); YERMOLCHYK, Vitaly (JINR; INP BSU)

Presenter: RUMYANTSEV, Leonid (DLNP JINR)

Session Classification: Parallel A

Contribution ID: 83

Type: **not specified**

Analog of Weyl meson as analog of the dark photon

Tuesday, 5 September 2023 13:10 (20 minutes)

The relationship between the Weyl-gauge vector and the electromagnetic potential vector is considered.

Primary author: Mr SEDOV, Sergey (Sarov State Physics Technical Institute, National Research Nuclear University MEPhI, Sarov Branch (SarPhTI), Sarov, Russia)

Presenter: Mr SEDOV, Sergey (Sarov State Physics Technical Institute, National Research Nuclear University MEPhI, Sarov Branch (SarPhTI), Sarov, Russia)

Session Classification: Plenary

Contribution ID: **84**

Type: **not specified**

OPENING

Monday, 4 September 2023 10:00 (10 minutes)

Session Classification: Plenary

Contribution ID: 85

Type: **not specified**

Physics with SPD experiment at NICA

Monday, 4 September 2023 10:10 (40 minutes)

Presenter: KIM, Victor (PNPI NRC KI, Gatchina & SPbPU, St. Petersburg)

Session Classification: Plenary

Contribution ID: **91**

Type: **not specified**

Fast simulation of nucleon momenta in deuteron for experiments at NICA SPD

Monday, 4 September 2023 17:40 (30 minutes)

Presenter: KOSTENKO, Boris (JINR)

Session Classification: Plenary

Contribution ID: 92

Type: **not specified**

Active role of gluons in multiparticle production

Monday, 4 September 2023 18:10 (30 minutes)

Presenter: Prof. KOKOULINA, Elena (JINR)

Session Classification: Plenary

Contribution ID: 93

Type: **not specified**

Status and physics reach of the proton EDM experiment

Tuesday, 5 September 2023 09:30 (40 minutes)

Presenter: SEMERTZIDIS, Y.

Session Classification: Plenary

Contribution ID: 95

Type: **not specified**

The CBK-relation and the β -expanded representations for the Bjorken polarized sum rule

Tuesday, 5 September 2023 15:30 (30 minutes)

Presenter: KATAEV, Andrei (Institute for Nuclear Research of RAS)

Session Classification: Parallel A

Contribution ID: 96

Type: **not specified**

On the recent polemics on Structure Function g_1 at small x

Tuesday, 5 September 2023 16:00 (30 minutes)

Presenter: ERMOLAEV, Boris (Ioffe Institute)

Session Classification: Parallel A

Contribution ID: 97

Type: **not specified**

T-odd angular coefficients for Drell-Yan process with Z neutral boson

Tuesday, 5 September 2023 16:50 (30 minutes)

Presenter: ZHEVLAKOV, Alexey (TSU)

Session Classification: Parallel A

Contribution ID: 99

Type: **not specified**

Investigation of the decay of the high-spin isomer 9+ of the odd-odd nucleus ^{156}No at ^{156}Dy levels

Presenter: STEGAILOV, Vladimir (Jinr)

Session Classification: Parallel B

Contribution ID: **100**

Type: **not specified**

Bessel functions to fermion quantization

Tuesday, 5 September 2023 16:50 (20 minutes)

Presenter: SHINDIN, Roman (JINR)

Session Classification: Parallel B

Contribution ID: 101

Type: **not specified**

Spin Radiative Corrections to the Radiation Probability and Power in Classical and Quantum Electrodynamics

Tuesday, 5 September 2023 18:10 (20 minutes)

Presenter: LEBEDEV, S.L.

Session Classification: Parallel B

Contribution ID: **102**

Type: **not specified**

Exclusive reactions and Spin problems at SPD

Thursday, 7 September 2023 10:30 (30 minutes)

Presenter: SHIMANSKIY, Stepan (JINR)

Session Classification: Plenary

Contribution ID: **104**

Type: **not specified**

Modified Spinning Black Hole as a Nonperturbative Electron Model

Presenter: BURINSKII, Alexander (NSI, Russian Academy of Sciences)

Session Classification: Plenary

Contribution ID: **105**

Type: **not specified**

Evolution of Helicity Property of Relic Neutrinos

Thursday, 7 September 2023 16:50 (40 minutes)

Presenter: PENG, J.-C.

Session Classification: Plenary

Contribution ID: **107**

Type: **not specified**

Electroweak corrections to dilepton production at LHC: the Drell-Yan, the photon fusion, and the inverse photon emission

Friday, 8 September 2023 16:10 (20 minutes)

Presenter: ZYKUNOV, Vladimir (JINR)

Session Classification: Parallel A

Contribution ID: 111

Type: **not specified**

Beam polarimetry in the NICA collider using a proton cluster target.

Friday, 8 September 2023 12:50 (40 minutes)

Presenter: PISKUNOV, Nikolay (JINR, Dubna)

Session Classification: Parallel A

Contribution ID: 112

Type: **not specified**

Lattice models of quantum magnetism with strong spin-orbit interaction: ab initio cluster calculations

Friday, 8 September 2023 16:00 (30 minutes)

Presenter: YUSHANKHAI, Viktor (JINR, BLTP)

Session Classification: Parallel B

Contribution ID: 114

Type: **not specified**

Effect of neutron irradiation on the optical and electrical properties of the doped AlGaAs/GaAs quantum wells

Friday, 8 September 2023 17:00 (15 minutes)

Presenter: KLOCHKOV, Alexey

Session Classification: Parallel C

Contribution ID: 115

Type: **not specified**

The electronic and optical properties of AA and AB diamanes, deposited on metal and dielectric substrates

Friday, 8 September 2023 17:15 (10 minutes)

Presenter: GREKOVA, Anastasiya

Session Classification: Parallel C

Contribution ID: 116

Type: **not specified**

Investigation of the influence of mechanical deformations on the dielectric band gap and optical characteristics of graphene on a molybdenum ditelluride substrate

Friday, 8 September 2023 17:25 (10 minutes)

Presenter: KULIAMIN, Pavel

Session Classification: Parallel C

Contribution ID: 117

Type: **not specified**

All-nitrogen High Energy Density Materials and their electronic and energy characteristics

Friday, 8 September 2023 17:35 (10 minutes)

Presenter: MERINOV, Valeriy

Session Classification: Parallel C

Contribution ID: **118**

Type: **not specified**

Thermal stability of novel carbon material, hexatetracarbon

Friday, 8 September 2023 17:45 (10 minutes)

Presenter: BAUETDINOV, Yusupbek

Session Classification: Parallel C

Contribution ID: 119

Type: **not specified**

Dependence of the critical current of HTS tapes in different magnetic field orientations

Friday, 8 September 2023 17:55 (10 minutes)

Poster

Presenter: VESELOVA, Svetlana

Session Classification: Parallel C