SPIN 2018

Report of Contributions

Contribution ID: **9** Type: **Parallel Sessions**

Searching for exotic spin-dependent interactions with single electron spin quantum sensors

Monday, 10 September 2018 15:10 (40 minutes)

Searching for new particles beyond the standard model is crucial for understanding several fundamental conundrums in physics and astrophysics. Several hypothetical particles can mediate exotic spin-dependent interactions between ordinary fermions, which enable laboratory searches via the detection of the interactions. We present a novel platform for investigating exotic spin-dependent interactions with micrometer scales. NV centers in diamond have been utilized to search for the exotic spin-dependent interactions. We first show an experiment to constrain the electron-nucleon coupling with the force range 0.1-23 micrometers(1). We also show that upper limits on the exotic dipole-dipole interactions between electrons can be established at force range from 10-900 micrometers by our method(2).

Reference

1. Xing Rong et al., Nature Communications, 9:739 (2018)
2. Xing Rong et al., arXiv:1804.07026 (2018)

Primary authors: Prof. DU, Jiangfeng (University of Science and Technology of China); Dr GENG, Jianpei (Hefei University of Technology); Ms MAN, Jiao (University of Science and Technology of China); Dr RONG, Xing (University of Science and Technology of China)

Presenter: Dr RONG, Xing (University of Science and Technology of China)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **10** Type: **Poster**

Constraints on a Spin-dependent Exotic Interaction between Electrons with Single Electron Spin Quantum Sensors

Recently, single NV center in diamond as a quantum sensor has been proposed and utilized to explore electron-nucleon monopole-dipole interaction, which sets a constraint for the electron–nucleon coupling, g_s^N g_p^e, with the force range 0.1–23 μm.(1) A new laboratory bound on the axial-vector mediated interaction between electron spins at micrometer scale is established with single nitrogen-vacancy centers in diamond. A single crystal of p-terphenyl doped pentancene-d14 under laser pumping provides the source of polarized electron spins. Based on the measurement of polarization signal via nitrogen-vacancy centers, we set a constraint for the exotic electron-electron coupling, g_A^e g_A^e, within the force range from 10 to 900 μm. The obtained upper bound of the coupling at 500 μm is|(g_A^e g_A^e)/4πℏc|≤ 5.7 × 10−19, which is one order of magnitude more stringent than previous experiment. Our result shows that the NV center can be a promising platform for searching for new particles predicted by theories beyond the standard model.

Reference:

(1). Xing Rong, Mengqi Wang, Jianpei Geng, Xi Qin, Maosen Guo, Man Jiao, Yijin Xie, Pengfei Wang, Pu Huang, Fazhan Shi, Yi-Fu Cai, Chongwen Zou and Jiangfeng Du, Nature communications, 2018, s41467-018-03152-9

(2). Xing Rong, Man Jiao, Jianpei Geng, Bo Zhang, Tianyu Xie, Fazhan Shi, Chang-Kui Duan, Yi-Fu Cai and Jiangfeng Du, arXiv, 2018,1804.07026

Primary authors: Prof. DU, Jiangfeng (University of Science and Technology of China); Prof. GENG, Jianpei (Hefei University of Technology); Ms JIAO, Man (University of Science and Technology of China); Prof. RONG, Xing (University of Science and Technology of China)

Presenter: Ms JIAO, Man (University of Science and Technology of China)

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **12** Type: **Parallel Sessions**

Electron - Ion Collider in China

Wednesday, 12 September 2018 15:30 (20 minutes)

In this talk, I will troduce the plan to construct a polarized electron-ion collider in China (EicC) based on the high intensity heavy ion facility (HIAF) which is under construction by the institute of modern physics (IMP). The EicC's accelerator design and main physics goals will be discussed.

Primary author: Prof. CHEN, Xurong (Institute of Modern Physics, CAS, China)

Presenter: Prof. CHEN, Xurong (Institute of Modern Physics, CAS, China)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **13** Type: **Parallel Sessions**

eRHIC - an electron-ion collider at BNL

Wednesday, 12 September 2018 14:50 (20 minutes)

The electron-ion collider eRHIC aims at a luminosity around 10^34 cm^-2 sec^-1. The design is based on the existing Relativistic Heavy Ion Collider (RHIC) facility, which has successfully accelerated, stored and collided polarized proton beams of up to 255 GeV as well as ions up t0 100 GeV/n beam energy. A 5-18 GeV electron storage ring will be added in the RHIC tunnel, thus providing electron-polarized proton or electron-ion collisions in up to two interaction regions. A spin-transparent rapid-cycling synchrotron (RCS) will serve as full energy polarized electron injector, thus enabling arbitrary spin patterns in the electron storage ring.

Primary author: Dr MONTAG, Christoph (Brookhaven National Laboratory)

Presenter: Dr MONTAG, Christoph (Brookhaven National Laboratory)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **14** Type: **Parallel Sessions**

H-JET POLARIMETER AT RHIC

Wednesday, 12 September 2018 14:30 (20 minutes)

The experience of the absolute H-jet polarimeter operation at RHIC in 2004-2018 Runs at RHIC will be reviewed. The H-jet polarimeter is a windowless internal polarized atomic hydrogen target inserted into the RHIC ring at the intersection point for measurement of the high-energy circulating proton beam polarization via p-p elastic scattering at low momentum transfer in the Coulomb-Nuclear Interference (CNI) region. The state-of-art designs of the dissociator, the vacuum system and the sextupole separating magnet produced the record atomic beam intensity and tight beam focussing. This resulted in achievement of the H-jet target thickness up to 1.2·1012 atoms/cm2. The precision tuning and continuous monitoring of the RF-transitions using the Breit-Rabi atomic beam polarimeter ensures transition efficiencies close to 100%. This provides the highest possible polarization defined only by the holding magnetic field value, which is 98% for the field of a 1.5kG. The polarization value is known with a good accuracy due to measured very small (less than 0.5%) molecular hydrogen contamination. The atomic hydrogen beam is crossing the RHIC vacuum chamber with minimal losses. The small diameter collimators were used due to tight beam focussing to minimize gas load to the RHIC vacuum system and to reduce background due to scattering on residual gas. The upgrade of the silicon detectors and DAQ for the Run-2015 reduced the statistical and systematic errors of the polarization measurements and produced precision measurements of the analyzing power for p-p scattering at 100 GeV and 255 GeV.

Primary author: Dr ZELENSKI, Anatoli (BNL)

Presenter: Dr ZELENSKI, Anatoli (BNL)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **15** Type: **Parallel Sessions**

OPTICALLY-PUMPED POLARIZED H- AND 3HE++ ION SOURCES DEVELOPMENT AT RHIC

Monday, 10 September 2018 15:50 (20 minutes)

The RHIC Optically-pumped Polarized H- Ion Source (OPPIS) upgrade with the atomic beam hydrogen injector and the He-ionizer cell was commissioned for operation in the Run-2013. The use of the high brightness primary proton source resulted in higher polarized beam intensity and polarization delivered for injection to Linac-Booster-AGS-RHIC accelerator complex in RHIC Runs 2013-2017. The proposed polarized 3He++ acceleration in RHIC and future electron- ion collider (eRHIC) will require about 2·1011 ions in the source pulse. A new polarization technique had been proposed for production of high intensity polarized 3He++ ion beam. It is based on ionization and accumulation of the 3He gas (polarized by optical-pumping and metastability-exchange technique in the high magnetic field of a 5.0 T) in the Electron Beam Ion Source (EBIS). We will present a status of the 3He++ ion source development.

Primary author: Dr ZELENSKI, Anatoli (BNL)

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Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **17** Type: **Parallel Sessions**

Status of RCS eRHIC Injector Design

Thursday, 13 September 2018 17:40 (20 minutes)

The proposed polarized injector for eRHIC, the rapid cycling synchrotron (RCS) is designed to preserve polarization over the accelerating energy range from 400 MeV to 18 GeV. We present progress on the existing design.

Primary author: Dr RANJBAR, Vahid (BNL)

Presenter: Dr RANJBAR, Vahid (BNL)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **18** Type: **Parallel Sessions**

Prospects for the spin structure study of hyperons using heavy quark decays at Belle II

Tuesday, 11 September 2018 15:30 (20 minutes)

The Belle II experiment is a substantial upgrade of the Belle detector and will operate at the SuperKEKB energy-asymmetric e^+e^- collider. The accelerator has already successfully completed the first phase of commissioning in 2016 and first electron positron collisions in Belle II were obtained on April 26, 2018. The design luminosity of SuperKEKB is 8×10^{35} $\mathrm{cm}^{-2}\mathrm{s}^{-1}$ and the Belle II experiment aims to record 50 ab^{-1} of data, a factor of 50 more than the Belle experiment. In this talk, we will explain the idea of a hyperon spin structure study using heavy quark decays: In weak decays of heavy quarks, the daughter quarks are highly polarized. On the other hand, one can naively expect that the fraction of the baryon spin carried by a quark is equal to the polarization transfer of the quark to the baryon. In this way, one can experimentally determine the spin structures of hyperons in decays of heavy quarks. Spin structures of ground state hyperons (i.e., Lambda and Sigma) are interesting in the context of the proton spin structure puzzle. In addition, excited states can be also studied to identify exotic hyperons. Especially in Lambda(1405), a two pole structure may be seen as a mass dependence of the polarization.

Primary authors: Prof. PERUZZI, Ida Marena (INFN Laboratori Nazionali di Frascati); Dr TANIDA, Kiyoshi (Japan Atomic Energy Agency)

Presenter: Dr TANIDA, Kiyoshi (Japan Atomic Energy Agency)

Session Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Track Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Contribution ID: **19** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Final Results from the Jefferson Lab Qweak Experiment and Constraints on Physics Beyond the Standard Model

Tuesday, 11 September 2018 11:30 (40 minutes)

The ep elastic scattering experiment used to extract a parity-violating asymmetry at Q2=0.0248 (GeV/c)2 will be described. The precision obtained on the final result is ±9.3 ppb- the most precise ep asymmetry ever measured. Some of the backgrounds and corrections applied in the experiment will be explained and quantified, and some of the experimental challenges will be described.

Several methods used to extract consistent values of the proton's weak charge Qw(p) from our asymmetry measurement will be outlined. From the proton's weak charge, a result for the fundamental standard model parameter sin^2 θw is obtained at the energy scale of our experiment. We compare that to the few other determinations of sin^2 θw available, as well as the predicted behaviour based on SM input.

We also show the multi-TeV mass reach for beyond-the-Standard-Model physics obtained from our determination of the proton's weak charge, and discuss our sensitivity to specifc examples of new particles like leptoquarks. We conclude by providing flavor-independent constraints on all new semi-leptonic parity-violating physics obtained from our result.

This work was supported by DOE Contract No. DEAC05-06OR23177, under which Jeerson Science Associates, LLC operates Thomas Jeerson National Accelerator Facility. Construction and operating funding for the experiment was provided through the U.S. Department of Energy (DOE), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the National Science Foundation (NSF).

Primary author: Dr SMITH, Greg (Jefferson Lab)

Co-author: QWEAK, Collaboration (Various affiliations)

Presenter: Dr SMITH, Greg (Jefferson Lab)

Session Classification: Plenary

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **20** Type: **Parallel Sessions**

Searches for dark matter and new particles with electric-dipole-moment and spin-precession measurements

Tuesday, 11 September 2018 16:40 (40 minutes)

Measurements of electric dipole moments (EDMs) in atoms, molecules and neutrons serve as sensitive probes of new physics. We give a brief overview of atomic EDM theory [1] and discuss several recent applications of EDM-based measurements to search for new particles.

New bosons can mediate anomalous forces between standard-model particles. Using data from existing atomic and molecular EDM measurements, we have placed limits on P,T-violating scalar-pseudoscalar interactions mediated by spinless bosons, improving on previous laboratory bounds from other experiments by many orders of magnitude for a broad range of boson masses [2,3].

Ultra-low-mass bosonic dark matter particles produced after the Big Bang may form an oscillating classical field. The interaction of this oscillating field with standard-model fermions and gluons can give rise to time-varying spin-dependent effects, including "axion wind"spin-precession effects and time-varying electric dipole moments, which can be sought for with atomic magnetometry, ultracold neutron and torsion pendulum experiments [4-6]. Recently, the nEDM collaboration performed the first experimental search for these effects, in the process improving on previous bounds by up to a factor of 1000 [7].

References

[1] J. S. M. Ginges, V. V. Flambaum, Phys. Rep. 397, 63 (2004).
[2] Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, Phys. Rev. Lett. 120, 013202 (2018).
[3] V. A. Dzuba, V. V. Flambaum, I. B. Samsonov, Y. V. Stadnik, arXiv:1805.01234.
[4] V. V. Flambaum, talk at 2013 Patras Workshop.
[5] Y. V. Stadnik, V. V. Flambaum, Phys. Rev. D 89, 043522 (2014).
[6] Y. V. Stadnik, Manifestations of Dark Matter and Variations of the Fundamental Constants of Nature in Atoms and Astrophysical Phenomena, (Springer, Cham, Switzerland, 2017).
[7] C. Abel et al., Phys. Rev. X 7, 041034 (2017).

Primary author: Dr STADNIK, Yevgeny (Johannes Gutenberg University of Mainz)

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Presenter: Dr STADNIK, Yevgeny (Johannes Gutenberg University of Mainz)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **21** Type: **Parallel Sessions**

Deeply Virtual Compton Scattering at 11GeV in Jefferson Lab Hall A

Tuesday, 11 September 2018 15:05 (35 minutes)

Introduced in the mid 90's, Generalized Parton Distributions (GPDs) are now a key element in the study of the nucleon internal structure. Indeed, GPDs encapsulate both spatial and momentum distributions of partons inside a nucleon. Through the Ji sum rule, they also allow to derive the total orbital angular momentum of quarks, which is a crucial point to unravel the nucleon spin structure.
GPDs are experimentally accessible through Deeply Virtual Compton Scattering (DVCS) and its interference with the Bethe-Heitler process at high momentum transfer Q^2. A worldwide experimental program was started in the early 2000's to extract these GPDs. The subject of this presentation, a DVCS $ep \to ep\gamma$ experiment performed at Jefferson Laboratory, Hall A (Virginia, USA) between 2014 and 2016, is encompassed in this program.
The aim of this experiment is to extract with high precision the DVCS helicity-dependent cross sections as a function of the momentum transfer Q^2, for fixed values of the Bjorken variable xB, on a proton target. The recent upgrade of the accelerator facility to 12 GeV allows to cover a larger Q^2 lever arm than for previous measurements and probe yet unexplored kinematic regions, while the polarized electron beam will allow the separation of the contributions from the real and imaginary parts of the DVCS amplitude to the total cross section.
This talk will present the preliminary results of this experiment.

Primary author: Mr GEORGES, Frederic (Institut de Physique Nucleaire d'Orsay)

Presenter: Mr GEORGES, Frederic (Institut de Physique Nucleaire d'Orsay)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **22** Type: **Parallel Sessions**

COMPASS polarized target in 2018 and 2021

Monday, 10 September 2018 14:50 (20 minutes)

The COMPASS collaboration performed a polarized Drell-Yan program to measure TMD (Transverse Momentum Dependent) and PDFs (Parton Distribution Functions) in 2015. To improve the statistics the program is continued for this year 2018. In the Drell-Yan program a negative pion beam of 190 GeV/c with an intensity of 108 /s is scattered on a transversely polarized proton target with a length of 110 cm.
We also plan to use a transversely polarized deuteron target for SIDIS (Semi-Inclusive-Deep-Inelastic-Scattering) program with muon beam in 2021 just after a long shut down of the CERN accelerators.
We are going to present the performance of the running COMPASS PT system and the future plan of the deuteron target in 2021.

Primary author: Dr REICHERZ, Gerhard (Ruhr University Bochum, Germany)

Presenter: Dr REICHERZ, Gerhard (Ruhr University Bochum, Germany)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **23** Type: **Parallel Sessions**

The Pomeron spin-flip and its measurements

Tuesday, 11 September 2018 17:05 (25 minutes)

We investigate the spin-flip component of the Pomeron using the single spin asymmetry, $A_N(t)$, arising from Coulomb-nuclear interference (CNI) in small-angle elastic scattering.
The study of elastic proton-nucleus scattering is important because it suppresses or excludes the contributions from iso-vector Reggeons which are predominantly spin-flip, and might have a significant impact on the results of fixed-target experiments at RHIC.

However, previous theoretical attempts fail to explain the recent data from the RHIC on polarized proton-gold scattering, exposing a nontrivial t-dependence of A_N, strongly contradicting theoretical predictions. We found that the absorptive corrections in the Coulomb amplitude of pA elastic scattering play a significant role. Namely, interference of ultra-peripheral and central collisions leads to a dramatic change in $A_N(t)$.
We also include less significant corrections from Gribov inelastic shadowing, NN correlations, and Odderon.

Finally, we present that the non-zero hadron spin-flip amplitude is required to describe the single spin asymmetry proton and nuclear data. This allows us to make conclusions about the spin-flip pomeron behavior and its impact.

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Co-author: Prof. KOPELIOVICH, Boris (UTFSM)

Presenter: KRELINA, Michal (Universidad Técnica Federico Santa María)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **24** Type: **Parallel Sessions**

JLEIC –Jefferson Lab Electron Ion Collider

Wednesday, 12 September 2018 15:10 (20 minutes)

The Jefferson Lab Electron Ion Collider (JLEIC) is designed to provide high luminosity and high polarization needed to reach new frontiers in the exploration of nuclear structure. The luminosity, exceeding 1033 cm-1s-1 in a broad range of the center-of-mass energy and maximum luminosity above 1034 cm-1s-1, is achieved by high-rate collisions of short small-emittance low-charge bunches made possible by high-energy electron cooling of the ion beam and synchrotron radiation damping of the electron beam. The design of the JLEIC interaction region aims for ~100% acceptance with the necessary resolution, based on a large 50mrad crossing angle and large apertures of final focusing quadrupoles and forward spectrometer dipoles. The unique figure-8 shape of collider rings easily preserves and manipulates the polarization of light ion species (p, d, 3He). A fully consistent set of parameters have been developed considering the balance of machine performance, required technical development and cost. This talk reports recent progress on the JLEIC accelerator design and R&D aspects including electron and ion complexes, integrated interaction region design, figure-8-ring-based electron and light polarization schemes, RF systems, crab crossing scheme, circulator-ring-based high-energy electron cooling and optimization of single particle non-linear dynamics.

Primary author: Dr LIN, Fanglei (Jefferson Lab)

Presenter: Dr LIN, Fanglei (Jefferson Lab)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **25** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Spin Physics with Photon Beams

Thursday, 13 September 2018 10:20 (40 minutes)

Pion photoproduction and Compton scattering are powerful tools to precisely determine the nucleon structure, thus providing very stringent tests for all non-perturbative QCD models.

The different observables accessible using polarized photon beams and/or polarized nucleon targets play an essential role in this experimental research due to their enhanced sensitivity both to the individual resonances and to the deformation of the nucleon ground state caused by an incoming photon.

Despite of this, data on polarized observables are scarce in many channels, especially in those involving a neutron target.

A systematic measurement of these observables is being carried out by the A2@MAMI collaboration at the tagged photon facility of the MAMI-Mainz accelerator and for energies ranging from the pion production threshold up to 1.6 GeV. The large acceptance Crystal Ball/TAPS detection set-up is used for this purpose.

The present talk will give an overview of the wide range of polarized observables measured so far on different reactions together with a perspective on future experiments.

Primary author: PEDRONI, Paolo (INFN-Pavia)

Presenter: PEDRONI, Paolo (INFN-Pavia)

Session Classification: Plenary

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **26** Type: **Parallel Sessions**

Spin Physics with a fixed-target experiment at the LHC

Thursday, 13 September 2018 16:40 (25 minutes)

A fixed-target experiment using the LHC beams with a polarized target would offer a unique opportunity to study the internal structure of the nucleon. Recent studies have shown that a number of spin and azimuthal asymmetries are large enough to be precisely measured, allowing to constrain several non-perturbative functions which encode the three-dimensional spin structure of the nucleon, as the quark and gluon Sivers functions.
In this talk I will review the ambitious spin physics program developed by the AFTER@LHC study group. I will confront the state-of-the-art theoretical predictions with the potential of a fixed-target experiment at the LHC to unravel the nucleon structure through different high-energy processes, using LHCb-like and ALICE-like detectors.

Primary author: Dr ECHEVARRIA, Miguel (INFN Pavia)

Presenter: Dr ECHEVARRIA, Miguel (INFN Pavia)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **27** Type: **Parallel Sessions**

Laser preparation of intense beams of vectorially polarized protons and tensorially polarized deuterons via molecular quantum beats.

Tuesday, 11 September 2018 15:50 (20 minutes)

Lasers can be used to polarize the valance electrons in an atomic or molecular system [1]. However, if this is done rapidly (< 1ns), it can establish a quantum beating mechanism which transfers polarization to the nuclear spin and ultimately provides the means to control nuclear spin with optical fields. The increasing capabilities (photon flux) of modern commercial lasers and the fact that laser excitation can take place in short timescales allow preparing high-density nuclear polarized samples, within few ns and using table-top set-ups. We have recently shown how lasers can be used to create polarized deuterium atoms in a molecular beam [2]. Here we present our recent results where we demonstrate the preparation of vectorially polarized hydrogen and deuterium samples at nearly atmospheric pressure (10^19 cm^-3). We also present results where laser excitation is used to control the tensor polarization in deuterium nuclei [3] and discuss the optimization of these methods. We discuss how these can be scaled to surpass the polarized beam intensities and/or polarized target densities offered by state-of-the-art methods. Finally, we examine how further scaling may allow applications to polarized fusion in ICF and MCF [2].

1 T. P. Rakitzis et al., Science 300 1936 (2003)

2 D. Sofikitis et al., Phys. Rev. Lett. 118 233401 (2017)

3 N. C-M Bartlett et al., Phys. Chem. Chem. Phys. 11 142 (2009)

Primary author: Dr SOFIKITIS, Dimitris (IESL-FORTH)

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Presenter: Dr SOFIKITIS, Dimitris (IESL-FORTH)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **28** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Overview and status of the muon g-2 experiment

Wednesday, 12 September 2018 10:20 (40 minutes)

Conventional wisdom suggests that new particles should exist as part of highly anticipated Standard Model extensions. Further, the discovery tool is expected to be an energy-frontier collider, where new particles are produced directly among the debris of the highest-energy pp collisions. The Higgs discovery affirmed this technique; although it has not signaled new physics (yet), it demonstrated the power of such experiments. Nonetheless, with significant data taking now completed at the LHC, the long-anticipated "TeV-scale"discoveries have not yet emerged. What else can one do? In this talk, I will describe the highly sensitive "low-energy"approach, as illustrated in particular by our measurement of the muon's anomalous magnetic moment, a_mu. Fermilab E989 recently completed its first data-taking campaign, acquiring a data set that exceeds that from the Brookhaven E821 experiment whose result, when compared to modern Standard Model theory, differs by more than 3 standard deviations. Is this a sign of new physics? Most importantly, we need to know if the deviation is real. Accordingly, we have designed and commissioned a new experiment whose goal is to improve by fourfold the precision on a_mu. I will present the status of the run and show blinded (sorry) plots that convey the excellent data quality already realized.

Primary author: Prof. HERTZOG, David (University of Washington)

Presenter: Prof. HERTZOG, David (University of Washington)

Session Classification: Plenary

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **29** Type: **Parallel Sessions**

Spin studies of the short-range correlations at Nuclotron

Monday, 10 September 2018 15:10 (20 minutes)

The results on the angular dependencies of the vector Ay and tensor Ayy and Axx analyzing powers in deuteron-proton elastic scattering at large scattering angles are presented. These data were obtained at internal target at JINR Nuclotron in the energy range 400-1800 MeV using polarized deuteron beam from new polarized ion source [1].
New data on the deuteron analyzing powers in in the wide energy range demonstrate the sensitivity to the short-range spin structure
of the isoscalar nucleon-nucleon correlations.
The perspectives of further studies of the short-range correlations
using polarized deuteron and proton beams are discussed.
[1] A.S.Belov et al., J.Phys.Conf.Ser. 938 (2017) 012017.

Primary author: Dr LADYGIN, Vladimir (VBLHEP JINR)

Presenter: Dr LADYGIN, Vladimir (VBLHEP JINR)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **30** Type: **Parallel Sessions**

Deuteron and proton beams polarimetry at internal target at JINR Nuclotron.

Thursday, 13 September 2018 14:50 (20 minutes)

The spin program at SPD NICA as well as the experiments at Nuclotron
require high intensity polarized proton and deuteron beams with high value of the polarization.
The upgraded deuteron beam polarimeter at internal target at Nuclotron [1] has been used to obtain the vector and tensor polarization for 6 different spin modes of new polarized source of ions [2]. The values of the beam polarization was about 65-75% from their ideal values. The longterm stability of the deuteron beam polarization was demonstrated.
The polarization of the firstly accelerated at Nuclotron proton beam has been measured at 500 MeV using quasi-elastic proton-proton scattering using internal target polarimeter [1]. The obtained value of the vertical polarization was about about 35%.
Further perspectives of the beam polarimetry development for NICA is discussed.

[1] P.K.Kurilkin et al., Nucl.Instr.Meth. in Phys.Res. A642 (2011) 45.

[2] A.S.Belov et al., J.Phys.Conf.Ser. 938 (2017) 012017.

Primary author: Dr LADYGIN, Vladimir (VBLHEP JINR)

Presenter: Dr LADYGIN, Vladimir (VBLHEP JINR)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **31** Type: **Parallel Sessions**

ELASTIC d ^{12}C SCATTERING WITHIN A THREE-BODY MODEL

Monday, 10 September 2018 17:40 (20 minutes)

Intrinsic electric dipole momenta (EDM) of particles and atoms if they do exist will indicate directly to time-reversal invariance violation (and CP violation under CPT symmetry) as well as P-parity violation. Knowledge of these signals is important to understand origin of matter-antimatter asymmetry of the Universe. An EDM of charged particles can be observed by measuring the rate of spin precession in an external electric field. Measurement of EDM of protons and deuterons is planned at COSY (Juelich) by JEDI Collaboration using the COSY storage ring [1]. This experiment suggests a measurement of deuteron - carbon scattering using high sensitivity in a carbon target polarimeter [2]. An important question is to choose an optimal energy of the deuteron beam which would provide a maximal figure of merit. Existing experimental data on polarized elastic scattering in region of ~100 -200MeV not enough complete. Therefore theoretical calculations are desirable as a guide for a choose of the beam energy.
In this work we apply spin-dependent Glauber theory [3] for calculation of differential cross section and vector analyzing power A_y of the d^{12}C elastic scattering. The formalism of the dp-scattering [3] is modified here properly to be applied to the d^{12}C scattering and Coulomb interaction is taken into account. As the first step the elementary N^{12}C elastic scattering amplitudes are taken from the optical model [4] which provide a fit to the absolute value of the unpolarized N^{12}C cross section but without fit to the vector analyzing power. Numerical results are obtained at the deuteron beam energy 270 MeV. We
find [5] the calculated differential cross section is in a good agreement with the data [6] in the forward hemisphere, whereas the calculated spin observables A_y and $A_z z$ are only in qualitative agreement with the data. The latter indicates an importance of further development of the model for the amplitudes of the N^{12}C elastic scattering.

[1] G. Guidoboni et al., Phys. Rev. Lett. 117, 054801 (2016).

[2] N.P.M.Brantjes et al., Nucl. Instr. Methods Phys. Rev. Sect. A 664, 49 (2012).

[3] M.N. Platonova, V.I. Kukulin, Phys. Rev. C81, 014004 (2010); Erratum Phys.Rev. C94, 069902 (2016).

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

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **32** Type: **Parallel Sessions**

Spin Physics at EIC

Wednesday, 12 September 2018 14:30 (20 minutes)

I will discuss the opportunities for spin physics to be studied at the future electron-ion collider in the US.

Primary author: YOSHIDA, Rik (Jefferson Lab)

Presenter: YOSHIDA, Rik (Jefferson Lab)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **33** Type: **Parallel Sessions**

The SPD project for spin physics studies at the NICA accelerator complex

Wednesday, 12 September 2018 17:00 (20 minutes)

We review the status of the Spin Physics Detector (SPD) project at the NICA accelerator complex now in construction at the JINR, Dubna. After a short introduction to the beams of polarized particles expected to be available at the NICA collider and their characteristics, we give some account on physics tasks that can be performed with colliding polarized protons and deuterons. Based on that, a concept for general purpose detector to study the interactions of these particles in collider mode is developed. Anticipated detector design and status of the Conceptual Design Report being prepared is given. A call for gathering of an international collaboration for construction of the SPD and performing experiments with it will be announced.

Primary author: Prof. TSENOV, Roumen (JINR)

Presenter: Prof. TSENOV, Roumen (JINR)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **34** Type: **Parallel Sessions**

Enhancements and suppressions of CP violating effect in the nucleons, nuclei, and atoms: role of the spin

Wednesday, 12 September 2018 16:40 (40 minutes)

The electric dipole moment (EDM) is a very sensitive probe of CP violation beyond the standard model, and it is measured in many systems such as atoms, neutrons, etc.
The EDM of composite systems may be sensitive to several CP violating processes at the elementary level, but the theoretical evaluations of the CP violation at different physical (atomic, nuclear, hadronic) hierarchies are required to unveil them.
In this context, we are particularly interested in which CP violating processes are enhanced in a given system, or vice versa.
In this talk, I will give an overview of the enhancement and suppressions of CP violation in processes contributing to the EDMs of composite systems.
It is inferred that the spin of the constituent is playing a crucial role in those mechanisms.

Primary author: Dr YAMANAKA, Nodoka (IPN Orsay)

Presenter: Dr YAMANAKA, Nodoka (IPN Orsay)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **35** Type: **Parallel Sessions**

Difficulties in the description of Drell–Yan processes at low invariant mass and high transverse momentum

Wednesday, 12 September 2018 16:40 (25 minutes)

In this talk, we discuss the transverse momentum distribution of Drell-Yan lepton pairs in fixed-target Drell-Yan experiments.
We show that fixed-order theory underestimates data at large qT, by an amount that cannot be explained by perturbative truncation errors nor PDF uncertainties. We consider a modification of the standard collinear formalism that includes the effect of intrinsic transverse momentum also at large qT. This is intended to parametrize possible higher-twist effects which are presently not under theoretical control.

Primary author: PIACENZA, Fulvio (PV)

Co-authors: BACCHETTA, Alessandro (PV); Dr BOZZI, Giuseppe (PV)

Presenter: PIACENZA, Fulvio (PV)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **36** Type: **Parallel Sessions**

Effect of flavor-dependent partonic transverse momentum on the determination of the W mass at hadron colliders

Monday, 10 September 2018 16:40 (25 minutes)

Within the framework of transverse-momentum-dependent factorization, we investigate for the first time the impact of a flavor-dependent intrinsic transverse momentum of quarks on the production of W bosons in hadronic collisions. We study the transverse-mass, lepton transverse momentum, and missing transverse momentum distributions of the W−decay products by means of a template-fit technique and we estimate the shift in the W boson mass induced by different choices of flavor-dependent parameters for the intrinsic quark transverse momentum. Our findings call for more detailed investigations of flavor-dependent non perturbative effects linked to the proton structure at hadron colliders.

Primary author: Dr BOZZI, Giuseppe (PV)

Co-authors: BACCHETTA, Alessandro (PV); Dr SIGNORI, Andrea (Jefferson Lab); Dr RADICI, Marco (PV)

Presenter: Dr BOZZI, Giuseppe (PV)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **37** Type: **Parallel Sessions**

Production and Storage of Polarized H2, D2, and HD Molecules

Monday, 10 September 2018 15:30 (20 minutes)

An atomic beam source (ABS) is producing a nuclear- and electron-polarized beam of hydrogen or deuterium atoms that can be used to feed a polarized storage-cell gas target. In a dedicated apparatus these atoms recombine on the surfaces inside the storage cells to molecules. Depending on the chosen surface material, the nuclear polarization of the atoms is at least partially preserved in the molecules. In recent experiments we ran our ABS with a mixture of hydrogen and deuterium and could polarize both isotopes independently. When those atoms recombine into molecules we produce H2, D2 and HD molecules as well. After ionization and acceleration of these molecules we could separate the different ions in a Wienfilter and measure the nuclear polarization of both nucleons with the Lamb-shift polarimeter. Depending on the hyperfine states that are determined by the ABS different spin-isomers of the HD are produced and used for further measurements. In a next step we will try to use a fully magnetized Nickel surface to investigate the influence of the electron polarization on the recombination rate and the nuclear polarization of the molecules. On a long term scale it is foreseen to freeze out the polarized molecules on a cold surface below 10 K to collect the D2 or HD gas as polarized ice.

Primary author: Dr ENGELS, Ralf (Institut für Kernphysik, Forschungszentrum Jülich)

Co-authors: Dr VASILYEV, Alexander (Laboratory of Cryogenic and Superconductive Technique, Petersburg Nuclear Physics Institute); Mr AWWAD, Hani (Institut für Laser- und Plasmaphysik, Heinrich-Heine Universität Düsseldorf); Prof. STROEHER, Hans (Forschungszentrum Juelich Germany); Dr GRIGORYEV, Kirill (Institut für Kernphysik, Forschungszentrum Jülich); Dr KOTCHENDA, Leonid (Laboratory of Cryogenic and Superconductive Technique, Petersburg Nuclear Physics Institute); Mr VZNUZDAEV, Marat (Laboratory of Cryogenic and Superconductive Technique, Petersburg Nuclear Physics Institute); Prof. BÜSCHER, Markus (Forschungszentrum Jülich / PGI-6); Dr KRAVTSOV, Peter (Laboratory of Cryogenic and Superconductive Technique, Petersburg Nuclear Physics Institute); Dr TROFIMOV, Victor (Laboratory of Cryogenic and Superconductive Technique, Petersburg Nuclear Physics Institute)

Presenter: Dr ENGELS, Ralf (Institut für Kernphysik, Forschungszentrum Jülich)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **38** Type: **Parallel Sessions**

Twist-2 transverse momentum distributions at NNLO in QCD

Wednesday, 12 September 2018 15:45 (25 minutes)

The factorization theorem for DY and semi-inclusive DIS holds for all leading twist transverse momentum distributions. However a QCD perturbative calculation shows several important characteristics of spin-dependent distributions. We consider all the different spin-dependent distributions which can be matched onto integrated twist-2 functions, focusing on the transversity and pretzelosity distributions. The pretzelosity case is specially relevant because, using a direct perturbative calculation at one loop, we obtain a null result which agrees with the experimental measurements. We show the complete set results of the matching at NLO and the results focusing on transversity and pretzelosity at NNLO.

Primary authors: Dr VLADIMIROV, Alexey (Regensburg University); Mr GUTIÉRREZ REYES, Daniel (Complutense University of Madrid); SCIMEMI, Ignazio (Universidad Complutense Madrid)

Presenter: Mr GUTIÉRREZ REYES, Daniel (Complutense University of Madrid)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **39** Type: **Parallel Sessions**

The Non-Existence of the Proton Spin Crisis

Wednesday, 12 September 2018 14:30 (20 minutes)

The paper on "A spin crisis in the parton model" first appeared 28 years ago. Since then numerous publications have attempted to clarify the issue, and to show that there is really no crisis, yet papers which talk about the "proton spin crisis" continue to appear at present.
We give a careful discussion of the subtleties involved and a precise statement of the proton spin sum rule, whereby it becomes clear that there is no crisis.

Primary author: Prof. LEADER, Elliot (Imperial College London)

Presenter: Prof. LEADER, Elliot (Imperial College London)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **40** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Hyperpolarizing 13C spins by dynamic nuclear polarization for MRI applications

Tuesday, 11 September 2018 12:10 (40 minutes)

Hyperpolarization by dynamic nuclear polarization (DNP) can increase magnetic resonance (MR) sensitivity by several orders of magnitude offering the opportunity to perform real-time in vivo MR imaging (MRI) experiments [1,2]. Numerous preclinical applications have demonstrated the enormous potential of hyperpolarized 13C MRI for in vivo metabolic imaging and several research hospitals are currently performing studies on patients [3,4].

Unpaired electron spins are used as polarizing agents to increase the nuclear spin polarization of 13C nuclei located on molecules that can be injected to follow metabolic processes. To take advantage of this technology, a DNP polarizer has to be placed in the vicinity of an MRI scanner and the hyperpolarized 13C-labeled metabolic substrates need to be produced a minute or less prior to the injection. This delay as well as the required synchronization between the production and the injection limits the type and number of in vivo metabolic imaging experiments that can be done.

In this lecture, I will present novel methods that open new opportunities to perform hyperpolarized 13C MRI through the circumvention of some of the limitations of the current hyperpolarization technology. In particular, I will show how DNP methods based on non-persistent photoinduced radicals can be designed to dramatically increase the lifetime of the hyperpolarized state by increasing the 13C longitudinal relaxation time of frozen 13C-molecules [5-7].

[1] J. H. Ardenkjaer-Larsen et al., Proc. Natl. Acad. Sci. USA (2003)
[2] A. Comment and M.E. Merritt, Biochem. (2014)
[3] S. J. Nelson et al., Sci. Transl. Med. (2013)
[4] V. Z. Miloushev et al., Cancer Res. (2018)
[5] T. R. Eichhorn et al., Proc. Natl. Acad. Sci. USA (2013)
[6] A. Capozzi et al., Nat. Commun. (2017)
[7] J. A. M. Bastiaansen et al., Magn. Reson. Med. (2018)

Primary author: Dr COMMENT, Arnaud (University of Cambridge)

Presenter: Dr COMMENT, Arnaud (University of Cambridge)

Session Classification: Plenary

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **41** Type: **Parallel Sessions**

Advantages of Nuclear Fusion with Polarized Fuel

Wednesday, 12 September 2018 14:30 (35 minutes)

Since more than 50 years it is known that different spin combinations of the fuel nucleons (t, d, or 3He) modify the differential and the total cross section of the d-t and the 3He-d fusion reactions. Therefore, polarized fuel can be used to increase the reaction rate in a fusion reactor or to focus the neutrons on special wall areas. Both options are useful to increase the energy output and to reduce the costs of future fusion reactors.

But before polarized fuel can be used for energy production, a number of problems must be solved. In this talk an overview on various activities in this field of research, e.g. of the PREFER collaboration, will be given:

• The spin-dependence of the d-d reactions is unknown.
The influence of the nuclear and, possibly, of the electron spin on the differential and the total cross section for the double-polarized d-d reaction is theoretically predicted but was never proved. In collaboration between the PNPI in Gatchina, Russia, the University of Ferrara, Italy, and the FZ Jülich, Germany, the spin- dependence of the d-d fusion reactions will be measured with a polarized deuteron beam at energies below 100 keV on a polarized deuterium jet target.
• Does the polarization survive in the different kinds of fusion plasmas?
Beside the magnetic confinement fusion even inertial fusion, e.g. induced with lasers, is tested at several institutes. For both concepts the important question is the lifetime of the polarization in the induced plasmas that must be long enough to support the fusion process.
• How to produce and handle polarized fuel?
When polarized fusion might be a reasonable option for energy production then the question of polarized fuel production will become important. This problem is solved for 3He and seems to be within reach for tritium. But for deuterium the situation is unclear. One option can be the production and storage of polarized D2 or DT molecules, but even new concepts for polarized ion sources will be discussed.

Primary author: Dr ENGELS, Ralf (Institut für Kernphysik, Forschungszentrum Jülich)

Presenter: Dr ENGELS, Ralf (Institut für Kernphysik, Forschungszentrum Jülich)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **42** Type: **Parallel Sessions**

Possible effect of mixed phase and deconfinement upon spin correlations in the $\Lambda\bar{\Lambda}$ pairs generated in relativistic heavy-ion collisions

Tuesday, 11 September 2018 17:30 (25 minutes)

Spin correlations for the $\Lambda\Lambda$ and $\Lambda\bar{\Lambda}$ pairs, generated in relativistic heavy-ion collisions, and related angular correlations at the joint registration of space-parity nonconserving hadronic decays of two hyperons are theoretically analyzed. These correlations give important information about the character and mechanism of multiple processes, and the advantage of the $\Lambda\Lambda$ and $\Lambda\bar{\Lambda}$ systems over other ones is due to the fact that the P-odd decays $\Lambda \to p + \pi^-$ and $\bar{\Lambda} \to \bar{p} + \pi^+$ serve as effective analyzers of spin state of the Λ and $\bar{\Lambda}$ particles – thus, the respective spin correlations can be rather easily distinguished and studied experimentally, which is especially meaningful for the investigations of multiple generation at modern and future ion colliders like RHIC, LHC and NICA . The correlation tensor components can be derived by the method of "moments" – as a result of averaging the combinations of trigonometric functions of proton (antiproton) flight angles over the double angular distribution of flight directions for products of two decays. The properties of the "trace" of the correlation tensor (a sum of three diagonal components), determining the angular correlations as well as the relative fractions of the triplet states and singlet state of respective pairs, are discussed.

In this talk, spin correlations for two identical particles ($\Lambda\Lambda$) and two non-identical particles ($\Lambda\bar{\Lambda}$) are generally considered from the viewpoint of the conventional model of one-particle sources, which implies that correlations vanish at enough large relative momenta. However, under these conditions (especially at ultrarelativistic energies), in the case of two non-identical particles ($\Lambda\bar{\Lambda}$) the two-particle annihilation sources – quark-antiquark and two-gluon ones – start playing a noticeable role and lead to the difference of the correlation tensor from zero. In particular, such a situation may arise, when the system passes through the "mixed phase" and – due to the multiple production of free quarks and gluons in the process of deconfinement of hadronic matter – the number of two-particle sources strongly increases.

Primary author: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

Co-author: Dr LYUBOSHITZ, Vladimir (JINR, Dubna)

Presenter: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **43** Type: **Parallel Sessions**

Experiments to measure the electric dipole moment of the neutron

Monday, 10 September 2018 16:40 (40 minutes)

Searches for finite permanent electric dipole moments (EDM) of fundamental systems with spin are among the most sensitive experimental tests of parity and time reversal symmetry. Invoking the CPT theorem, they also test the CP symmetry between matter and antimatter. Values of EDM from various fundamental particles and systems offer complementary information concerning the potential sources of CP violation. They are up to now all consistent with zero and provide stringent limits on physics beyond the standard model of particle physics. The neutron EDM plays a crucial role as the simplest hadronic system. Several efforts are under way aiming at much improved experimental sensitivities. An overview will be presented with a focus on the most sensitive search so far with data from 2015/16 taken by the international nEDM collaboration at PSI. As a first result from this data set, limits have been derived on oscillating EDM with implications for hypothetical ultralight axion dark matter [C. Abel et al., PRX7(2017)041034].

Primary author: Prof. KIRCH, Klaus (ETHZ & PSI)

Presenter: Prof. KIRCH, Klaus (ETHZ & PSI)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **44** Type: **Parallel Sessions**

On the spin correlations of muons and tau leptons produced in the high-energy annihilation processes $e^+e^- \to \mu^+\mu^-, \tau^+\tau^-$

Tuesday, 11 September 2018 17:55 (25 minutes)

The electromagnetic processes of annihilation of (e^+e^-) pairs –
which may be generated, in particular, in relativistic nucleus-nucleus and hadron-nucleus collisions – into heavy flavor lepton pairs are
theoretically studied in the one-photon approximation, using the
technique of helicity amplitudes . For the process $e^+e^- \to \mu^+\mu^-$, it is shown that – in the case of the unpolarized
electron and positron – the final muons are also unpolarized but their spins prove to be strongly correlated. For the final $(\mu^+\mu^-)$ system, the structure of triplet states is analyzed and explicit expressions for the components of the spin density
matrix and correlation tensor are derived; besides, the formula for
the angular correlation at the decays of the final μ^+ and μ^- is obtained .

It is demonstrated that the spin correlations of muons in the
process $e^+e^- \to \mu^+\mu^-$, have the purely quantum character, since one of the Bell-type incoherence inequalities for
the diagonal components of correlation tensor is always violated
(i.e., there is always one case when the modulus of sum of two
diagonal components exceeds unity) . In doing so, it is also established that, when involving the additional contribution of
the weak interaction of lepton neutral currents through the virtual Z^0 boson, the qualitative character of the muon spin correlations does not change.

Analogous consideration can be wholly applied as well to the annihilation process $e^+e^- \to \tau^+\tau^-$, which becomes possible at much higher energies.

Primary author: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

Co-author: Dr LYUBOSHITZ, Vladimir (JINR, Dubna)

Presenter: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **45** Type: **Parallel Sessions**

Design of a Polarized Gas Target (PGT) for the LHC

Monday, 10 September 2018 15:10 (20 minutes)

Since 2017, the LHCSpin study group (Ferara, Frascati, Jülich, Petersburg, Erlangen) is investigating the addition of a HERMES-type PGT in front of the LHCb detector in order to perform Fixed Target Single-Spin Azimuthal Asymmetry (SSAA) measurements. In cooperation with LHC experts, the conditions for applying a PGT are being studied. A cold openable storage cell is considered. A key role for avoiding instabilities of the 7 TeV proton beam is in the choice of coating and suppression of wake fields. A first warm test storage cell is planned for installation inside the VELO vessel in 2020, subject to final approval. It will help to improve the ongoing SMOG program on LHCb Fixed Target measurements. - The status of the discussion of critical machine issues and of the design of the target will be presented.

Primary author: STEFFENS, Erhard (Physics Dept., FAU Erlangen-Nürnberg)

Presenter: STEFFENS, Erhard (Physics Dept., FAU Erlangen-Nürnberg)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **46** Type: **Parallel Sessions**

Quark orbital angular momentum in the proton evaluated in Lattice QCD using a direct derivative method

Tuesday, 11 September 2018 15:45 (25 minutes)

Quark orbital angular momentum (OAM) in the proton can be calculated directly if a Wigner function encoding the simultaneous distribution of quark transverse positions and momenta is given. This distribution can be accessed via proton matrix elements of a quark bilocal operator (the separation in which is Fourier conjugate to the quark momentum) featuring a momentum transfer (which is Fourier conjugate to the quark position). Consequently, to generate the weighting by quark transverse position needed to calculate OAM, a derivative with respect to momentum transfer is required. A Lattice QCD calculation is presented in which this derivative is evaluated using a direct derivative method, i.e., a method in which the momentum derivative of a correlator is directly sampled in the lattice calculation, as opposed to extracting it a posteriori from the numerical correlator data. The method removes the bias stemming from estimating the derivative a posteriori that was seen to afflict a previous exploratory calculation. Data for Ji OAM generated on a clover ensemble at 317 MeV pion mass are seen to agree with the result obtained via the traditional Ji sum rule method. By varying the gauge connection in the quark bilocal operator, also Jaffe-Manohar OAM is extracted, and seen to be enhanced significantly compared to Ji OAM.

Primary author: ENGELHARDT, Michael (New Mexico State University)

Presenter: ENGELHARDT, Michael (New Mexico State University)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **47** Type: **Parallel Sessions**

Spin-density matrix elements in hard exclusive muoproduction of ω mesons at COMPASS

Tuesday, 11 September 2018 15:40 (30 minutes)

Spin density matrix elements (SDMEs) have been determined for exclusive ω meson production on unpolarized protons, in the COMPASS kinematic region of 1.0 (GeV/c^2) $< Q^2 <$ 10.0 (GeV/c^2), 5.0 GeV/c^2 $< W <$ 17.0 GeV/c^2 and 0.01 (GeV/c^2) $< p_T^2 <$ 0.5 (GeV/c^2) which corresponds to $\left\langle Q^2 \right\rangle = 2.1$~(GeV/$c^2$), $\langle W \rangle = 7.6$~GeV/c^2 and $\left\langle p_T^2 \right\rangle = 0.16$~(GeV/$c^2$) mean values. The analysis is based on data taken in 2012 with the 160 GeV muon beam and the liquid hydrogen target. Using extracted SDMEs the contribution of unnatural parity exchange amplitudes, the longitudinal-to-transverse cross section ratio, and the hypothesis of s-channel helicity conservation (SCHC) were studied. A sizable contribution of unnatural parity exchange amplitudes is found for the exclusive ω meson muoproduction, although there is a clear indication of its decrease with increasing W. Certain matrix elements e.g. r^5_{00} corresponding to transition $\gamma^*_T \rightarrow V_L$ indicate violation of SCHC in exclusive ω production.

Primary author: Dr MARIANSKI, Bohdan (National Centre for Nuclear Studies\ Warsaw, Poland\)

Presenter: Dr MARIANSKI, Bohdan (National Centre for Nuclear Studies\ Warsaw, Poland\)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **48** Type: **Poster**

Spin correlations of the final leptons in the high-energy two-photon processes $\gamma\gamma \to e^+e^-, \mu^+\mu^-, \tau^+\tau^-$

The theoretical study of spin structure for the processes
of lepton pair production by pairs of photons (which, in particular, may be emitted in relativistic heavy-ion and hadron-nucleus collisions) is performed. For the two-photon process $\gamma\gamma \to e^+e^-$, it is found that – in the case of unpolarized primary photons – the final electron and positron remain also unpolarized ,but their spins turn out to be strongly correlated. Explicit expressions for the components of the correlation tensor and for the relative fractions of singlet and triplet states of the final (e^+e^-) system are derived. It is established that in the process $\gamma\gamma \to e^+e^-$ one of the Bell-type incoherence inequalities for the correlation tensor components is always violated (i.e., there is always one case when the modulus of sum of two diagonal components exceeds unity), and, thus, spin correlations of the final electron and positron have the strongly pronounced quantum character.

Analogous consideration can be wholly applied also to the two-photon processes $\gamma\gamma \to \mu^+\mu^-$ and $\gamma\gamma \to \tau^+\tau^-$, which become possible at much higher energies.

Primary author: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

Co-author: Dr LYUBOSHITZ, Vladimir (JINR, Dubna)

Presenter: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **49** Type: **Poster**

Femtoscopic correlations of two identical particles with nonzero spin in the model of one-particle multipole sources

The process of emission of two identical particles with nonzero spin S and different helicities in relativistic heavy-ion collisions is theoretically investigated within the model of one-particle multipole sources. Taking into account the unitarity of the finite rotation matrix and the symmetry relations for d-functions, the general expression for the probability of emission of two identical particles by two multipole sources with angular momentum J, averaged over the angular momentum projections and over the space-time dimensions of the multiple particle generation region, has been obtained. For the case of unpolarized particles, the additional averaging over helicities is performed and the formula for two-particle correlation function at sufficiently large 4-momentum difference q is derived. For particles with nonzero mass, this formula is considerably simplified in the case when the angle β between the particle momenta equals zero, and also in the case when $J = S$.

In addition, the special cases of emission of two unpolarized photons by dipole and quadrupole sources, and emission of two "left" neutrinos ("right" antineutrinos) by sources with arbitrary J have also been considered, and the respective explicit expressions for the correlation function are obtained .

Primary author: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

Co-author: Dr LYUBOSHITZ, Vladimir (JINR, Dubna)

Presenter: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **50** Type: **Parallel Sessions**

POLARIZED ELECTRON GUN BEAM TESTS IN mA RANGE

Monday, 10 September 2018 17:40 (20 minutes)

The high intensity polarized electron gun at MIT-Bates was designed as an injector for the linac-ring version of ERHIC.. The design implements a separate preparation chamber, load lock, large area cathode, ring-shaped beam and active cathode cooling. Very good vacuum conditions have been achieved in both the gun chamber and the preparation chamber. Reliable cathode transfer between the load lock, the preparation chamber and the gun chamber has been demonstrated. Beam tests have been conducted with a current from 50 nA to 5 mA. The results of these tests are discussed.

Primary author: Dr TSENTALOVICH, Evgeni (MIT)

Presenter: Dr TSENTALOVICH, Evgeni (MIT)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **51** Type: **Parallel Sessions**

Spin dependent gluon distributions and their measurement in heavy quark production processes

Thursday, 13 September 2018 17:05 (25 minutes)

Gluon pdf's, GPD's and TMD's play a significant role in an array of scattering processes, including SIDIS, DVCS, exclusive meson electroproduction and p p scattering. Spin dependent gluon distributions can lead to distinctive features in the angular dependences and asymmetries of the scattering processes. Of particular interest are heavy quark production processes, wherein spin observables of the heavy quarks adumbrate the underlying gluon spin dependences. Top pair production at LHC is a prime example that proceeds primarily via gluon fusion. Decays of polarized top pairs through various channels produce a variety of correlations among the decay products - particles and jets. Combinations of the gluon distributions, either polarized or unpolarized, can be accessed experimentally through angular dependences of decay products, as will be shown, along with predictions from a "flexible"spectator model of gluon distributions.

Primary author: Prof. GOLDSTEIN, Gary (Tufts University)

Presenter: Prof. GOLDSTEIN, Gary (Tufts University)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **52** Type: **Parallel Sessions**

Projections for a future SIDIS measurement on transversely polarized deuterons by the COMPASS Collaboration.

Tuesday, 11 September 2018 14:55 (25 minutes)

Since 2005, measurements of Collins and Sivers asymmetries from the HERMES and COMPASS experiments have allowed to assess that the transversity and the Sivers PDF are different from zero and measurable in semi-inclusive DIS on transversely polarized targets. Most of the data were collected on proton targets, only few data were collected in the early phase of the COMPASS experiment on a deuteron (6LiD) target and more recently at JLab, on 3He, so that the d-quark and the sea-quarks PDFs are much more poorly known than the u-quark PDFs. This constitutes an important limitation to the knowledge of the transverse spin structure of the nucleon.
For this reason the COMPASS Collaboration has proposed to measure semi-inclusive DIS on transversely polarized deuterons with good accuracy, comparable with that of the existing transverse spin asymmetry data on protons. The proposal has been accepted by CERN and the experiment will run in 2021, as soon as the Long Shut-down 2 is over, providing measurements which will stay unique for many years to come.
Projections will be given for the extraction of the transversity PDFs, and for the evaluation of the vector tensor charge of the nucleon.

Primary author: Prof. BRADAMANTE, Franco (INFN, Trieste Section)

Presenter: Prof. BRADAMANTE, Franco (INFN, Trieste Section)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **53** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Internal gas target experiments at the LHC

Wednesday, 12 September 2018 09:40 (40 minutes)

New physics frontiers can be opened by using internal gas targets at the LHC. The various collision systems like pp, pA and PbA at energies varying from √s_NN=72 GeV to √s=115 GeV, and the implicit forward kinematic of the collisions, make accessible a broad programme of measurements, from the large-x frontier for particle and astroparticle physics to spin and heavy-ion physics. A first step into this new technology has been tested successfully at LHCb, specifically designed for Drell-Yan, quarkonia and heavy-flavour studies, with the SMOG system. An improved gas target, based on a storage cell (SMOG2), will be installed in the LHC Long Shutdown 2, subject to final approval. This will pave the way to quantitative searches in QCD through the study of the nucleon's internal dynamics in terms of both quarks and gluons degrees of freedom. Furthermore, in LHCb, final states with c- or b-quarks (e.g. inclusive quarkonia production) will be efficiently reconstructed, thus providing precious information on the so-far unknown gluon TMDs. In addition, SMOG2 will also act as R&D for the already proposed Polarised Gas Target (PGT). Here, with the use of the transversely polarized H and D targets, among several measurements, the quark TMDs in pp collisions, at unique kinematic conditions, can be determined. The status of the LHCb project and proposals related to the ALICE experiment will be presented.

Primary author: Dr DI NEZZA, Pasquale (LNF)

Presenter: Dr DI NEZZA, Pasquale (LNF)

Session Classification: Plenary

Track Classification: Future Facilities and Experiments

Contribution ID: **54** Type: **Parallel Sessions**

Higher-order QED corrections to polarized electron-proton scattering

Tuesday, 11 September 2018 14:30 (20 minutes)

The planned P2 experiment at MESA aims to measure the weak mixing angle with high precision at low momentum transfer from parity violating electron-proton scattering. In order to match this precision, higher order corrections to the asymmetry have to be taken into account. In this talk I will present the effects of 2nd order QED corrections to the asymmetry and the shift in Q2 due to these corrections.

Primary author: Mr BUCOVEANU, Razvan-Daniel (Johannes Gutenberg University)

Presenter: Mr BUCOVEANU, Razvan-Daniel (Johannes Gutenberg University)

Session Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Track Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Contribution ID: **55** Type: **Parallel Sessions**

Process dependence of the gluon Sivers function in inclusive pp collisions: theory

Tuesday, 11 September 2018 16:40 (25 minutes)

Within the color gauge invariant generalized parton model (CGI-GPM), that includes initial- and final-state interactions in a TMD formalism, we present the complete results, at leading-order, for transverse single-spin asymmetries in the inclusive hadroproduction of pions, direct photons, D mesons and quarkonia.

Primary author: PISANO, Cristian (CA)

Co-authors: FLORE, Carlo (CA); MURGIA, Francesco (CA); TAELS, Pieter Maria (P); D'ALESIO, Umberto (CA)

Presenter: PISANO, Cristian (CA)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **56** Type: **Parallel Sessions**

Commissioning of the Ultracold Neutron Facility at TRIUMF –a first step towards a neutron electric dipole moment search

Monday, 10 September 2018 18:00 (40 minutes)

A permanent electric dipole moment (EDM) of the neutron would violate parity and time reversal symmetry. Assuming CPT to be a good symmetry of nature, this implies a CP symmetry violation as well. Thus, observing or further limiting the existence of the neutron EDM beyond the current best measurement sensitivity of 3x10^-26 ecm would increase our understanding of the Baryon Asymmetry of the Universe.
The search for the neutron EDM makes use of the well understood coupling of its spin to the magnetic field by looking for a deviation in precession frequency when overlaying an electric field parallel or antiparallel to a magnetic one. Ultracold neutrons (UCN) are a particularly well suited tool for this technique due to their low kinetic energy and velocity. As a consequence they can be stored analogous to a gas and observation times of the order of 100-200s become possible.
This presentation shall show results from the commissioning of a prototype UCN source at TRIUMF in 2017, which comprises a major milestone towards the neutron EDM search. Furthermore, an outlook towards a high intensity new generation UCN source, as well as the ongoing design of a high precision neutron EDM spectrometer will be given.

Primary author: Dr FRANKE, Beatrice (TRIUMF)

Presenter: Dr FRANKE, Beatrice (TRIUMF)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **57** Type: **Parallel Sessions**

Process dependence of the gluon Sivers function in inclusive pp collisions: phenomenology

Tuesday, 11 September 2018 17:05 (25 minutes)

Within the so-called color gauge invariant generalized parton model (CGI-GPM), we will discuss how a phenomenological analysis of available SSA data for pion, D meson and J/psi production in pp collisions can be used to put the first constraints on the two universal types of gluon Sivers function. A comparison with the simpler generalized parton model, as well as predictions for SSAs in direct photon production, are also presented.

Primary author: D'ALESIO, Umberto (CA)

Co-authors: FLORE, Carlo (CA); PISANO, Cristian (CA); MURGIA, Francesco (CA); TAELS, Pieter Maria (P)

Presenter: D'ALESIO, Umberto (CA)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **58** Type: **Parallel Sessions**

Extracting the scalar dynamical polarizabilities from real Compton scattering data

Tuesday, 11 September 2018 17:20 (20 minutes)

In this presentation I will discuss the results of a recent
work on the extraction of the scalar dipole dynamic polarizabilities (DDPs) from proton Real Compton Scattering (RCS) data below pion production threshold.
The dynamical polarizabilities are energy dependent functions which parametrize the response of the internal degrees of freedom of the
proton to an external, real-photon field of arbitrary energy.

As such, they contain enriched information with
respect to the static polarizabilities defined in the limit of
zero-frequency photon field.

After the description of the
theoretical framework, which combines dispersion relations, the low-energy
expansion and a multipole decomposition of the scattering amplitude,
I will discuss the statistical analysis, based on the
parametric bootstrap technique, that has been used for this evaluation.

This statistical tool have been applied for the first time to analyze RCS
data, and has been crucial to overcome problems inherent to the analysis of the available data set.
I will present the main advantages of this fitting
method, including preliminary results about the statistical interpretation
of the chi-squared function when also systematical errors are taken into account.

Finally, I will show new results for the extraction of the static
polarizabilities alpha and beta, using subtracted dispersion
relations and the bootstrap technique.

Primary authors: PASQUINI, Barbara (PV); PEDRONI, Paolo (INFN-Pavia); SCONFIETTI, Stefano (P)

Presenter: PEDRONI, Paolo (INFN-Pavia)

Session Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Track Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Contribution ID: **59** Type: **Parallel Sessions**

On the extraction of the non-perturbative transverse momentum dependence of parton distribution and fragmentation functions from data

Monday, 10 September 2018 14:30 (25 minutes)

Transverse single spin asymmetries for hadron production in polarized semi-inclusive deeply inelastic scattering (SIDIS) are nowadays one of the main source of information on transversity, the quark Sivers distributions and the Collins fragmentation function, and on their transverse momentum dependence. However, in SIDIS the transverse momentum of the final hadron, that is the quantity actually measured, originates, in a strongly correlated way, from intrinsic transverse momentum dependences in both the distribution and the fragmentation sectors. As a consequence, a reliable separated extraction of the average transverse momentum for the two sectors is difficult.
In this contribution we analyze this problem in a simple kinematical Gaussian configuration and study its implications on predictions for the Sivers asymmetry in Drell-Yan processes and for the Collins asymmetry in e+e- annihilations.
We find that in some cases these effects can be relevant and must be carefully taken into account.

Primary author: MURGIA, Francesco (CA)

Co-authors: Dr PROKUDIN, Alexey (JLAb); BOGLIONE, Mariaelena (TO); ANSELMINO, Mauro (TO); D'ALESIO, Umberto (CA)

Presenter: MURGIA, Francesco (CA)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **60** Type: **Parallel Sessions**

Anomaly and Polarization in heavy-ion collsions

Tuesday, 11 September 2018 16:40 (25 minutes)

The relation of polarization in heavy-ion collisions to axial anomaly is systematically explored. The qualitative description of and quantitative
comparison with experimental data is discussed. The comparison to thermodynamocal approach to polarization is performed. The quark and hadronic degrees of freedom and duality between them are discussed. The role od mass effects, dissipation and instabilities is stressed.

Primary authors: Prof. SORIN, Alexander (JINR); Mr PROKHOROV, George (JINR); Prof. TERYAEV, Oleg (JINR); Prof. ZAKHAROV, Valentin (Max-Planck Institut fuer Physik, Foehringer Ring 6, 80805 Muenchen)

Presenters: Mr PROKHOROV, George (JINR); Prof. TERYAEV, Oleg (JINR)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **61** Type: **Parallel Sessions**

Pressure in generalized parton distribution and distribution amplitudes

Wednesday, 12 September 2018 14:30 (35 minutes)

The recently published description of pressure in proton is discussed in the context of crossing invariance between space-like and time-like hard processes. The relevant properties of the respective non-perturbative inputs are considered. The relations with the properties of space-like and time-like gravitational formfactors at very different scales are discussed.

Primary author: Prof. TERYAEV, Oleg (JINR)

Presenter: Prof. TERYAEV, Oleg (JINR)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **62** Type: **Parallel Sessions**

First extraction of transversity from data on lepton-hadron scattering and hadronic collisions

Tuesday, 11 September 2018 14:30 (25 minutes)

We present the first extraction of the transversity distribution based on the global analysis of pion-pair production in deep-inelastic scattering and in proton-proton collisions with one transversely polarized proton. The extraction relies on the knowledge of di-hadron fragmentation functions, which are taken from the analysis of electron-positron annihilation data. We compute the tensor charge and we compare with the results from other extractions and recent lattice calculations. We investigate the impact of additional theoretical constraints on the low-x behavior of transversity, and of more precise COMPASS pseudodata on deuteron target.

Primary author: Dr RADICI, Marco (PV)

Presenter: Dr RADICI, Marco (PV)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **64** Type: **Parallel Sessions**

The polarized deuteron source for the Van de Graaff accelerator

Tuesday, 11 September 2018 15:30 (20 minutes)

The first attempt is made to realize a polarized deuteron source suited for the Van de Graaff accelerator of Czech Technical University in Prague based on the idea of Kaminsky on channeling deuterons through a Nickel single crystal. The setup is described which contains permanent magnets with a transversal magnetic field (zero field transition) to increase the deuteron polarization up to 2/3 (in theory) using the Sona method. The preliminary results will be presented.
The final aim is to send the polarized deuterons to a tritium target for producing 14-MeV polarized neutrons which will be used
jointly with the frozen-spin polarized deuteron target for the measurement $\Delta\sigma_T$ and $\Delta\sigma_L$ in the nd transmission experiment.

Primary author: Dr PLIS, Yury (JINR, Dubna, Russia)

Co-authors: Prof. GUREVICH, Grygory (JINR, Dubna, INR, Moscow, Russia); Dr USOV, Yury (JINR, Dubna, Russia)

Presenter: Dr PLIS, Yury (JINR, Dubna, Russia)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **65** Type: **Parallel Sessions**

Beam Parameter Stabilization for P2 at MESA

Wednesday, 12 September 2018 18:00 (20 minutes)

The P2-experiment will measure the weak mixing angle with an all-time high precision via electron-proton scattering. The measured physics asymmetry and its uncertainty has to be corrected by the apparative
asymmetry, which is generated by helicity correlated fluctuations of the beam parameters position, angle, intensity and energy. In this talk will be described how the high precision of 0.1\,ppb of the parity violating asymmetry can be provided by the high precision measurements of the parameters position, angle, and intensity.

Primary author: Mrs KEMPF, Ruth (Johannes Gutenberg-Universität Mainz, Institut für Kernphysik)

Co-authors: Mr FICHTNER, Frank (Johannes Gutenberg-Universität Mainz, Institut für Kernphysik); Dr DIEFENBACH, Juergen (Johannes Gutenberg-Universität Mainz, Institut für Kernphysik)

Presenter: Mrs KEMPF, Ruth (Johannes Gutenberg-Universität Mainz, Institut für Kernphysik)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **66** Type: **Parallel Sessions**

Search for a permanent electric dipole moment of 129Xe

Tuesday, 11 September 2018 15:50 (20 minutes)

In this talk we report on the results of the experimental search for a permanent electric dipole moment of 129Xe (Xe-EDM) performed by the MIXed-collaboration. Our approach is to detect the free spin precession of hyperpolarized 129Xe nuclear spins and search for frequency changes correlated with the direction of an applied electric field. To eliminate frequency changes caused by magnetic field drifts we use co-magnetometry by adding hyperpolarized 3He to the measurement volume. We are able to measure frequency shifts with a statistical sensitivity of δω ~ 6x10^-10 rad/s within one day. To achieve this accuracy, numerous experimental challenges had to be mastered. For example, the development of a remarkably homogeneous magnetic field was an important step in order to obtain long spin coherence times of several hours and to achieve a high signal-to-noise ratio. The construction of the experimental setup and the optimization of the measurement procedures, along with systematic checks will be discussed in this presentation.
In a first proof of principle measurement we were already able to lower the present upper limit of the Xe-EDM by a factor of seven to |d(Xe)| < 1.0x10^-27 ecm (95% CL). The continuous development of the experimental conditions and the operating procedures will allow us to significantly improve our present sensitivity limits.

Primary author: Dr ZIMMER, Stefan (University of Heidelberg)

Co-authors: Prof. OFFENHÄUSSER, Andreas (Forschungszentrum Jülich); Dr NIEDERLÄNDER, Benjamin (Forschungszentrum Jülich); Dr ALLMENDINGER, Fabian (University of Heidelberg); Dr KRAUSE, Hans-Joachim (Forschungszentrum Jülich); Dr ENGIN, Ilhan (Forschungszentrum Jülich); Prof. JUNGMANN, Klaus (University of Groningen); Dr WILLMANN, Lorenz (University of Groningen); Dr REPETTO, Maricel (University of Mainz); Mr GRASDIJK, Olivier (University of Groningen); Dr KARPUK, Sergei (University of Mainz); Prof. SCHMIDT, Ulrich (University of Heidelberg); Prof. HEIL, Werner (University of Mainz)

Presenter: Dr ZIMMER, Stefan (University of Heidelberg)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **67** Type: **Parallel Sessions**

Longitudinal Double-Spin Asymmetries for Dijet Production at Intermediate Pseudorapidity in Polarized Proton+Proton Collisions at $\sqrt{s}$ = 200 GeV

Wednesday, 12 September 2018 17:40 (20 minutes)

One of the primary goals of the RHIC spin program is to determine the spin-dependent gluon distribution, Δg(x), of the proton. The measurements of the 2009 longitudinal double-helicity asymmetry, A_{LL}, for mid-rapidity inclusive jet and π^0 production in polarized proton+proton collisions at the center-of-mass energy √s = 200 GeV place strong constraints on Δg(x). They also for the first time find evidence for a non-zero gluon polarization value for partonic momentum fraction x greater than 0.05. In contrast to inclusive jets, dijet correlation measurements provide access to partonic kinematics at leading order, and thus give better constraints on the behavior of Δg(x) as a function of gluon momentum fraction. Furthermore, dijet measurements at higher rapidity probe the lower x values where ΔG is poorly constrained.

In this talk, we present the first measurement of A_{LL}, for dijets with at least one jet reconstructed within the pseudorapidity range 0.8 < η < 1.8 at STAR. The dijets were measured in polarized proton+proton collisions at √s = 200 GeV. Values of A_{LL} are determined for several distinct event topologies, defined by the jet pseudorapidities, and span a range of parton momentum fraction x down to x ~ 0.01. The measured asymmetries are found to be consistent with the predictions of global analyses that incorporate the results of previous RHIC measurements. They will provide new constraints on Δg(x) in this poorly constrained region when included in future global analyses.

Primary author: Dr LIN, Ting (Texas A&M University)

Presenter: Dr LIN, Ting (Texas A&M University)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **68** Type: **Parallel Sessions**

Status of polarized molecular source

Wednesday, 12 September 2018 15:30 (15 minutes)

An experimental setup to obtain polarized hydrogen and deuterium molecules is described. To separate the molecules with different magnetic moments superconducting sextupole magnets of a polarized atomic beam source with a magnetic pole-tip field of 34 kG and a field gradient of 32 kG/cm are used. Arguments explaining the choice of the location of the source elements are also given. To obtain an ultra-high vacuum in the molecular beam detection chamber cryogenic pumps are used. At a nozzle temperature of 7 K, the measured flux of polarized hydrogen molecules was found to be $3{\cdot}10^{12}$ mol/s. For deuterium, the measured flux is smaller by a factor of seven due to the smallness of the magnetic moments. The experimental results are compared with the Monte-Carlo simulation

Primary author: Prof. TOPORKOV, Dmitriy (Budker institute of nuclear physics, Novosibirsk State University)

Presenter: Prof. TOPORKOV, Dmitriy (Budker institute of nuclear physics, Novosibirsk State University)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **69** Type: **Parallel Sessions**

Symmetry tests and BSM searches using hyperpolarized gases

Tuesday, 11 September 2018 15:10 (40 minutes)

Precision measurement of the Zeeman splitting in a two-state system is important for magnetometry, as well as the search for physics beyond the Standard Model. The most precise tests of new physics are often realized
in differential experiments that compare the transition frequencies of two co-located clocks, typically radiating on their Zeeman or hyperfine transitions. The advantage of differential measurements is that they render the experiment insensitive to common systematic effects, such as uniform magnetic field fluctuations. Clock comparison experiments are used as ultra-sensitive probe
for non-magnetic spin interactions. Recent results are reported on searches for i) short-range P- and T violating interactions between nucleons and ii)
Lorentz violating signatures by monitoring the Larmor frequencies as the laboratory reference frame rotates with respect to distant stars (sidereal modulation). Finally, new experimental initiatives to search for an electric dipole moment of 129Xe (CP-violation) are discussed, which strongly benefit from the long spin-coherence times obtained, reaching T2,He> *100 h*
and T2,Xe > 8 h in case of 3He and 129Xe, respectively.

Primary author: Prof. HEIL, Werner (University Mainz)

Presenter: Prof. HEIL, Werner (University Mainz)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **70** Type: **Parallel Sessions**

Baryon Electromagnetic Form Factors at BESIII

Tuesday, 11 September 2018 17:00 (20 minutes)

Electromagnetic form factors are fundamental observables needed to parametrize the electric and magnetic structure of hadrons and used to probe the strong interaction.
In this contribution we report on the recent measurements of baryon electromagnetic form factors at the BESIII experiment in Beijing.
The BESIII spectrometer is located at the BEPCII collider, a symmetric e+e- collider running at the center-of-mass energies between 2.0 and 4.6 GeV.
This wide energy range allows direct measurement of electromagnetic form factors both from direct e+e- annihilation and from initial-state-radiation processes.
Based on the data collected by BESIII at 12 center-of-mass energies between 2.23 and 3.67 GeV, the e+e—>ppbar cross section and the time-like proton form factors are measured.
Preliminary results from the analysis on the initial-state-radiation radiation process e+e- —> ppbar gamma using a data set of about 7.4 fb^-1
collected at the center-of-mass energies between 3.773 and 4.6 GeV are also presented.
Besides nucleons, all hyperons in the SU(3) spin 1/2 octet and spin 3/2 decuplet are energetically accessible within the BEPCII energy range.
Furthermore, a world-leading data sample was collected in 2014-2015 for precision measurements of baryon form factors, which
allows the measurement of the relative phase between the electric and magnetic form factors for lambda and lambda_c hyperons with unprecedented accuracy.
The results from the e+e- —> lambda lambdabar and the e+e- —> lambda_c lambdabar_c channels are also discussed.

Primary author: GARZIA, Isabella (FE)

Presenter: GARZIA, Isabella (FE)

Session Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Track Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Contribution ID: **71** Type: **Parallel Sessions**

Design of a Prototype EDM Storage Ring

Wednesday, 12 September 2018 16:40 (20 minutes)

This contribution summarizes the efforts in the frame of the CPEDM consortium to design a prototype EDM (Electric Dipole Moment) storage ring, with predominantly electric bending.
Operated at proton beam energies between 30 and 50 MeV, the main purpose of this ring will be to carry out R&D work related to a final 233 MeV frozen-spin proton EDM ring. After demonstrating satisfactory beam lifetime and spin coherence time in the electrostatic ring, clockwise and counter-clockwise beam operation, beam spin control, beam-based element alignment, and methods for reducing systematic errors in EDM measurements will be investigated. At these reduced proton beam energies, the (weak) superimposed magnetic field required to freeze the proton spins can be provided by powering the iron-free (hysteresis-free) "cosine-theta" coils built into the ring design. This will allow the development of EDM measurement techniques and permit the first direct precision measurement of the proton EDM.

Primary author: Prof. LEHRACH, Andreas (FZ Jülich and RWTH Aachen)

Co-authors: Prof. TALMAN, Richard (Cornell University); Dr MARTIN, Siegfried (Forschungszentrum Juelich GmbH)

Presenter: Dr MARTIN, Siegfried (Forschungszentrum Juelich GmbH)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **72** Type: **Parallel Sessions**

Spin Physics with sPHENIX detector

Wednesday, 12 September 2018 18:00 (20 minutes)

sPHENIX is a major upgrade of the PHENIX experiment at Brookhaven National Laboratory's Relativistic Heavy Ion Collider (RHIC), designed for detailed studies of the Quark Gluon Plasma created in heavy ion collisions, with focus on jet, photon and heavy flavor measurement capabilities. With its excellent tracking and full calorimetry (hadronic and electromagnetic) in the central pseudo-rapidity region of |eta|<1.1, sPHENIX provides excellent opportunities for the studies of the polarized structure of the proton utilizing RHIC's polarized proton collisions. With enhanced RHIC luminosity anticipated in 2020+, and sPHENIX high rate capabilities, the expected precision will far exceed that achieved at RHIC by now, particularly for the measurements of gluon spin contribution to the spin of the proton, and quark transversity, related to the nucleon tensor charge, an important quantity to describe the nucleon spin structure. The proposed modest forward detector upgrade will open door to new exciting measurements in a new kinematic regime. Transverse Momentum Dependent (TMD) parton distributions measured in forward kinematics expand the parton imaging from one dimensional (longitudinal) to three dimensional momentum space, and along with the related Twist-3 parton correlation functions serve to study parton dynamics within the nucleon.
In this talk we will discuss these and other exciting opportunities for the measurements in polarized proton-proton and polarized proton-nucleus collisions with sPHENIX detector at RHIC. These high precision data along with future data from the anticipated Electron-Ion Collider will be vital to establish universality of parton distributions and their modification in nuclear environment.

Primary author: Dr BAZILEVSKY, Alexander (Brookhaven National Laboratory)

Presenter: Dr BAZILEVSKY, Alexander (Brookhaven National Laboratory)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **73** Type: **Parallel Sessions**

NMR Polarization Measurements for Jefferson Lab's Solid Polarized Targets

Monday, 10 September 2018 17:00 (20 minutes)

Solid polarized targets rely on Nuclear Magnetic Resonance techniques to provide measurements of the enhanced polarization provided under Dynamic Nuclear Polarization. Upcoming polarized target experiments in Jefferson Lab's Hall B present challenging conditions which would benefit from improvements to traditional NMR techniques. For decades, JLab has relied upon Liverpool QMeters for NMR measurements, but these are aging and no longer produced. The polarized target group at Bonn has successfully produced replacement QMeters with modern components, and we are following their example, exploring new designs for both an analog and a digital QMeter system. Unlike recent experiments in Halls A and C, the new Hall B target will require external NMR coils, resulting in a weaker signal. In addition, two separate target cells will be utilized, each held at different magnetic fields, allowing them to be polarized in opposing directions, but complicating the NMR measurement. We will discuss the challenges presented by the new Hall B target, lay out plans for improvements to our NMR system, and show results of initial tests of our designs.

Primary author: Dr MAXWELL, James (Dr.)

Presenter: Dr MAXWELL, James (Dr.)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **74** Type: **Parallel Sessions**

Jet Physics at an EIC

Thursday, 13 September 2018 15:30 (20 minutes)

Jets have been important observables in high-energy collider experiments for over four decades and have provided discoveries and insights in electron-positron, electron-hadron, hadron-hadron, and nucleus-nucleus collisions. With advances in experimental technique and theoretical understanding, jets have become precision tools in the exploration of QCD. As the primary purpose of the future electron-ion collider (EIC) is a detailed understanding of QCD, precision jet measurements will be an important component of both the electron-hadron and electron-nucleus EIC physics programs. This presentation will discuss experimental aspects of jet physics at an EIC, including kinematics, backgrounds, and detector effects. Several analysis examples will also be detailed, such as the use of dijets to constrain the partonic structure of the photon as well as the gluon contribution to the spin of the proton.

Primary author: PAGE, Brian (Brookhaven National Lab)

Presenter: PAGE, Brian (Brookhaven National Lab)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **75** Type: **Parallel Sessions**

Status of the Polarized Atomic Hydrogen Target at MAMI & MESA

Wednesday, 12 September 2018 17:40 (20 minutes)

One aim for the new electron accelerator MESA is to measure the weak mixing angle in electron proton scattering to a precision of 0.14\%. The beam polarization significantly contributes to this measurement. The Møller polarimeter proposed by V. Luppov and E. Chudakov opens the way to reach a sufficiently accurate determination of polarization. At the moment the polarized atomic hydrogen target is under construction. The current status and signifanct change in design is presented.

Primary author: Dr TYUKIN, Valery (Inst. of Nuclear Phys, University Mainz, Germany)

Presenter: Dr TYUKIN, Valery (Inst. of Nuclear Phys, University Mainz, Germany)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **76** Type: **Parallel Sessions**

Measurement of dC vector analyzing power and cross sections at COSY for EDM polarimetry

Wednesday, 12 September 2018 17:20 (20 minutes)

The JEDI (Jülich Electric Dipole moment Investigations) collaboration performs
a set of experiments at the COSY storage ring in Jülich, within the R&D phase to search for the Electric Dipole Moments (EDMs) of charged particles. A measurement of proton and deuteron EDMs is a sensitive probe of yet unknown CP violation. An EDM observation would also be an indication for physics beyond the Standard Model.

The method of charged particle EDM search will exploit stored polarized beams in order to observe a miniscule rotation of the polarization axis as a function of time due to the interaction of a finite EDM with large electric fields. Key challenge is the provision of a sensitive and efficient method to determine the tiny change of the beam polarization. Elastic scattering of the beam particles on carbon nuclei will provide the polarimetry reaction.

For this reason and as an input for future Monte-Carlo simulations, a good knowledge of the vector analyzing power and the unpolarized elastic cross section of deuterons scattered off a carbon target is very important to be able to determine the deuteron polarization. Over the course our experiment, the analyzing power and the differential cross section was measured using six different beam energies starting from 170 MeV up to 380 MeV deuterons.
In this talk an overview of the WASA detector setup installed at the COSY accelerator will be given and the results of the measured analyzing power and elastic cross section will be presented.

Primary author: Mr MÜLLER, Fabian (Forschungszentrum Jülich)

Co-authors: Dr STEPHENSON, Edward (Indiana University Center for Exploration of Energy and Matter); Ms ZUREK, Maria (FZ Juelich, University of Cologne)

Presenter: Mr MÜLLER, Fabian (Forschungszentrum Jülich)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **77** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Electric dipole moment searches using storage rings

Monday, 10 September 2018 12:10 (40 minutes)

The Standard Model (SM) of Particle Physics is not capable to account for the apparent matter-antimatter asymmetry of our Universe. Physics beyond the SM is required and is either probed by employing highest energies (e.g., at LHC), or by striving for ultimate precision and sensitivity (e.g., in the search for electric dipole moments). Permanent electric dipole moments (EDMs) of particles violate both time reversal (T) and parity (P) invariance, and are via the CPT-theorem also CP-violating. Finding an EDM would be a strong indication for physics beyond the SM, and pushing upper limits further provides crucial tests for any corresponding theo\-retical model, e.g., SUSY.

Up to now, EDM searches focused on neutral systems (neutrons, atoms, and molecules). Storage rings, however, offer the possibility to measure EDMs of charged particles by observing the influence of the EDM on the spin motion in the ring~\cite{Eversmann:2015jnk, PhysRevAccelBeams.20.072801, PhysRevAccelBeams.21.042002}. Direct searches of proton and deuteron EDMs bear the potential to reach sensitivities beyond
$SIe-29e.cm$. Since the Cooler Synchrotron COSY at the Forschungszentrum J\"ulich provides polarized protons and deuterons up to momenta of 3.7 GeV/c, it constitutes an ideal testing ground and starting point for such an experimental programme. The talk will present the JEDI plans for the measurement of charged hadron EDMs and discuss recent results.

Primary author: Dr RATHMANN, Frank (Forschungszentrum Jülich)

Presenter: Dr RATHMANN, Frank (Forschungszentrum Jülich)

Session Classification: Plenary

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **78** Type: **Parallel Sessions**

Nuclear Dependence of Transverse Single-Spin Asymmetries in Polarized p+A Collisions at RHIC

Monday, 10 September 2018 17:30 (25 minutes)

Large transverse single-spin asymmetries (TSSA) in hadron production at forward rapidity have been observed in polarized p+p interactions for many decades, over a large range of center-of-mass energies, and have led to the investigation of spin-momentum correlations such as the Sivers and Collins effects. In the last few years, it has been discovered at RHIC that these single-spin asymmetries may be enhanced or suppressed in p+A collisions, and the nuclear-size and centrality dependence have been studied. A variety of phenomena have been observed and likely they do not have all a single explanation; we see an apparent quenching of the TSSA in forward charged hadron production with increasing nuclear size, while we see an enhancement in the asymmetry in J/ψ production, and in very forward neutron production even a sign change in the asymmetry is seen. Other systems, such as π^0 production at central rapidity, do not display a nuclear-size dependence. These observations provide a bridge between the study of the initial state in heavy-ion collisions and that of the nucleon spin puzzle, and open up a new method for the investigation of cold nuclear matter.

Primary author: Dr PATE, Stephen (New Mexico State University)

Presenter: Dr PATE, Stephen (New Mexico State University)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **79** Type: **Parallel Sessions**

Measurement of analyzing powers for neutrons scattering on CH2, CH, C and Cu targets at the momenta from 3.0 to 4.2 GeV/c

Thursday, 13 September 2018 15:10 (20 minutes)

Analyzing powers for polarized neutrons have been measured only for thin hydrogen targets. Cross sections and analyzing powers for np, for both elastic scattering and charge exchange are known up to 29 GeV/c. No data exist for thick analyzers.

During two beam runs in the years 2016 and 2017, the analyzing powers for protons and neutrons scattering on CH2, CH, C and Cu targets were measured at the nucleon momentum from 3.0 to 4.2 GeV/c with the ALPOM2 setup at the Nuclotron accelerator. The data for polarized neutron beam are obtained for the first time, thanks to the unique polarized deuteron beam that is presently available up to 13 GeV/c.

The measurement of the angular dependence of Ay for the neutron is essential to the continuation of the neutron form factor measurements to the highest possible transferred momentum-Q2 at the Jefferson Laboratory. The reaction p+Cu(W), with the detection of a neutron in the forward direction by a hadron calorimeter, can be used for the measurement of the proton polarization at the future NICA collider.

Primary author: Dr PISKUNOV, Nikolay (JINR, Dubna)

Presenter: Dr PISKUNOV, Nikolay (JINR, Dubna)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **80** Type: **Parallel Sessions**

A Lambshift Polarimeter for Hydrogen Molecules

Monday, 10 September 2018 18:00 (20 minutes)

Usually, Lambshift polarimeters are used to measure the nuclear spin polarisation of hydrogen atomic beams or slow proton beams of about 1keV. As recent experiments aim to produce polarised hydrogen molecules (H2 HD, D2), either by recombining atoms (IKP @FZ-Jülich) or with a new molecular-beam-source (BINP), a nuclear spin polarimeter for molecules is needed. As it will be shown in this talk it is also possible to measure the nuclear spin polarisation of the hydrogen molecules with a Lambshift polarimeter.

Primary author: Mr HUXOLD, Lukas (HHU Duesseldorf)

Co-authors: Prof. TOPORKOV, Dmitriy (Budker institute of nuclear Physics, Novosibirsk State University); AWWAD, Hani (HHU Düsseldorf); Dr GRIGORYEV, Kirill (Institut für Kernphysik, Forschungszentrum Jülich); Prof. BÜSCHER, Markus (Forschungszentrum Jülich / PGI-6); Dr ENGELS, Ralf (Institut für Kernphysik, Forschungszentrum Jülich); SHESTAKOV, Yuri (Budker institute of nuclear Physics, Novosibirsk State University)

Presenter: Mr HUXOLD, Lukas (HHU Duesseldorf)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **81** Type: **Parallel Sessions**

Commissioning of the RF Wien filter for a first deuteron EDM measurement at COSY / Jülich

Tuesday, 11 September 2018 18:00 (20 minutes)

The JEDI Collaboration (Jülich Electric Dipole Investigations, http://collaborations.fz-juelich.de/ikp/jedi) aims for a measurement of the electric dipole moments (EDMs) of deuterons and protons at the COoler SYnchrotron (COSY). To make this possible, a novel high precision waveguide RF Wien filter was installed in COSY inside a so-called low-beta section, to modulate the spin of deuterons and protons. With this device the force of the radial electric field is canceled by the corresponding vertical magnetic force. So it is possible to directly manipulate the polarization vector of the particles without introducing any beam oscillations. The RF Wien filter has been designed to operate at harmonics of the spin precession frequency ranging from 0.6 to 1.7 MHz. For systematic investigations of sources of false EDM signals, the waveguide RF Wien filter can be rotated by more than 90 degree around the beam axis. The results of several weeks of commissioning experiments at COSY with the RF Wien filter, including Lorentz force measurements, driven oscillations and the resonant build-up of vertical polarization will be presented. A series of test measurements similar to the the upcoming first deuteron EDM measurement were performed as well. This work is supported by an ERC Advanced-Grant of the European Union (srEDM, No. 694340).

Primary author: Mr NASS, Alexander (Forschungszentrum Jülich)

Presenter: Dr RATHMANN, Frank (Forschungszentrum Jülich)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **82** Type: **Parallel Sessions**

Understanding SIDIS data from QCD

Wednesday, 12 September 2018 17:05 (25 minutes)

The most recent SIDIS measurements have challenged our understanding of factorization theorems in QCD. In order to perform reliable
extractions of transverse momentum dependent functions (TMDs) it is essential
to understand the extent to which the errors of factorization are under
control. In this talk I will discuss about the issues encountered when comparing theory and experiment. I will also argue that careful examination
of the features of the data is crucial for reliable TMD extraction. As an
example of this, I will present results from a recent analysis on Sivers
asymmetries by HERMES and COMPASS.

Primary author: GONZALEZ HERNANDEZ, Jose Osvaldo (TO)

Co-authors: FLORE, Carlo (CA); BOGLIONE, Mariaelena (TO); D'ALESIO, Umberto (CA)

Presenter: GONZALEZ HERNANDEZ, Jose Osvaldo (TO)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **83** Type: **Parallel Sessions**

97% Spin-Flip Efficiency at 255 GeV for Polarized Protons

Wednesday, 12 September 2018 14:50 (20 minutes)

In polarized proton collision experiments, spin flip is needed to reduce the systematic errors. At high energy colliders with Siberian snakes, a single magnet spin flipper does not work . A more sophisticated spin flipper, constructed of nine-dipole magnets, was used to flip the spin in the BNL Relativistic Heavy Ion Collider. A 97% spin-flip efficiency was measured at both 24 and 255 GeV. The spin flip experiment results are presented in this paper.

Primary author: Dr HUANG, Haixin (Brookhaven National Lab)

Presenter: Dr HUANG, Haixin (Brookhaven National Lab)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **84** Type: **Parallel Sessions**

THE STATUS OF THE DOUBLE POLARIZED DD-FUSION EXPERIMENT

Wednesday, 12 September 2018 15:05 (25 minutes)

A double-polarized dd-fusion experiment (PolFusion, PNPI, Gatchina) has been proposed to investigate the reactions d + d ⟶ 3He + n and d + d ⟶ t + p in the energy range of 10-100 keV. The possibility of using a vector and tensor polarized beam and target combination creates the opportunities to measure the asymmetry of the differential cross section and spin-correlation coefficients in the d + 3He and d + t reactions. Suggested measurements offer capabilities for determination of the quintet-state suppression factor for both reactions, one of the goals of PolFusion experiment program.

A brief description of mathematical model, which allow to predict the observables, status of experimental data and first test measurements are given. Overview of the experimental setup, Monte Carlo simulation studies and details of future analysis are discussed.

Primary author: Dr KRAVCHENKO, Polina (PNPI NRC Kurchatov institute)

Presenter: Dr KRAVCHENKO, Polina (PNPI NRC Kurchatov institute)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **85** Type: **Parallel Sessions**

Longitudinal double-spin asymmetries in semi-inclusive deep-inelastic scattering of electrons and positrons by protons and deuterons

Thursday, 13 September 2018 14:30 (20 minutes)

A comprehensive collection of results on longitudinal double-spin asymmetries is presented for charged pions and kaons produced in semi-inclusive deep-inelastic scattering of electrons and positrons on the proton and deuteron, based on the full HERMES data set. The dependence of the asymmetries on hadron transverse momentum and azimuthal angle extends the sensitivity to the flavor structure of the nucleon beyond the distribution functions accessible in the collinear framework. No strong dependence on those variables is observed. In addition, the hadron charge-difference asymmetry is presented, which under certain model assumptions provides access to the helicity distributions of valence quarks.

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Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **86** Type: **Parallel Sessions**

Dynamic Nuclear Polarization for Neutron Macromolecular Crystallography

Monday, 10 September 2018 17:20 (20 minutes)

Neutron Macromolecular Crystallography is a powerful technique for the determination of the structure of proteins. The sensitivity of the neutron scattering cross section to the presence of hydrogen gives this technique a unique advantage compared to the more widely used X-ray crystallography. The problem with neutron crystallography is the low flux of even the most advanced neutron sources requires experimenters to use crystal samples orders of magnitude larger than those used at modern X-ray facilities. The requirement for large crystals greatly limits the proteins whose structures can be determined. Dynamic Nuclear Polarization (DNP) of the crystals allows provides a means to overcome the limitations imposed by low neutron flux by taking advantage of the strong spin dependence of the neutron-hydrogen scattering cross section to increase the coherent scattering from hydrogen by a factor of as much as twenty. As prototype test system has been built to measure neutron diffraction from DNP polarized protein crystals. The system has been successfully tested at the High Flux Isotope Reactor at Oak Ridge National Laboratory. Results of these measurements will be presented, as will plans for improvements to the system and potential applications of DNP to other neutron scattering techniques.

Primary author: PIERCE, Joshua (Oak Ridge National Laboratory)

Presenter: PIERCE, Joshua (Oak Ridge National Laboratory)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **87** Type: **Parallel Sessions**

Nuclear Polarization in Laser-induced Relativistic Plasmas

Wednesday, 12 September 2018 17:05 (25 minutes)

Laser-driven particle acceleration has undergone impressive progress in recent years. Nevertheless, one unexplored issue is how the particle spins are influenced by the huge magnetic fields inherently present in the plasmas. In the framework of the JuSPARC (Juelich Short-Pulse Particle and Radiation Center) facility and of the ATHENA consortium, the laser-driven generation of polarized proton and 3He-ion beams in combination with the development of advanced target technologies is being pursued. Another goal of these investigations is to experimentally demonstrate that the nuclear spin alignment in a fusion plasma survives for periods at least comparable to the energy confinement time.

In order to predict the degree of beam polarization from a laser-driven plasma accelerator, particle-in-cell simulations including spin effects have been carried out for the first time. For this purpose, the Thomas-BMT equation, describing the spin precession in electromagnetic fields, has been implemented into the VLPL (Virtual Laser Plasma Lab) code. A crucial result of our simulations is that a target containing pre-polarized hydrogen nuclei is needed for producing highly polarized relativistic proton beams.

For the experimental realization, a polarized HCl gas-jet target is under construction at the Forschungszentrum Juelich where the degree of hydrogen polarization is measured with a Lamb-shift polarimeter. The final experiments, aiming at the first observation of a polarized proton beam from laser-generated plasmas, will be carried out at the 10 PW laser system SULF at SIOM/Shanghai. In parallel we have built a hyper-polarized 3He gas–jet target for experiments at the PHELIX Petawatt Laser Facility, GSI Darmstadt, for measuring the spin-polarization degree of laser-accelerated 3He2+ ions.

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Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **88** Type: **Parallel Sessions**

Accessing the Gluon Sivers Function at a future Electron-Ion Collider

Thursday, 13 September 2018 15:10 (20 minutes)

In this work, we present a systematic study on the feasibility of probing the largely unexplored transverse momentum dependent gluon Sivers function (GSF) in open charm production, high p_T charged di-hadron and di-jet production at a future high energy, high luminosity Electron-Ion Collider (EIC). The Sivers function is a measure for the anisotropy of the parton distributions in momentum space inside a transversely polarized nucleon. It is proposed that it can be studied through single spin asymmetries in the photon-gluon fusion subprocess in electron proton collisions at the EIC. Using a well tuned Monte Carlo model for deep inelastic scattering, we estimate the possible constraints of the GSF from the future EIC data. A comparison of all the accessible measurements illustrates that the di-jet channel is the most promising way to constrain the magnitude of the GSF over a wide kinematic range.

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Presenter: Dr ZHENG, Liang (China University of Geosciences (Wuhan))

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **89** Type: **Parallel Sessions**

Quark-gluon correlations in the twist-3 TMD using light-front wave functions.

Thursday, 13 September 2018 14:55 (25 minutes)

Higher-twist transverse-momentum dependent parton distributions (TMDs) go beyond the parton model description of a proton as they describe correlations between quarks and gluons. Higher-twist TMDs, however, turn out to be very elusive objects, as they are difficult to extract from experimental data. Twist-3 distributions can be decomposed as a sum of different contributions. In general, these contributions are separated into two different types: lower-twist (i.e. twist-2) contributions and pure twist-3 contributions. Most of the phenomenological parameterizations and models rely on the so called Wandzura-Wilczeck (WW) approximation, that set to zero the pure twist-3 contributions.
The WW approximation, however, remove the richness of the twist-3 distributions. I will show how the quark-gluon correlations (pure twist-3 contributions) entering the T-even chiral-odd distribution e(x,k⊥) and in the T-even chiral-even distribution f⊥(x,k⊥) can be calculated by using the formalism of light-front wave functions (LFWFs). The LFWFs that are considered include the parton's orbital angular momentum dependence and an intrinsic, non-perturbative gluon contribution. These elements are fundamental in order to compute the pure twist-3 contributions.
The parametrization of the LFWFs is chosen by the comparison with the distribution amplitudes of the proton. The parameters of the LFWFs are fitted on the MMHT2014 parametrization for the valence-quark and gluon contributions to the unpolarized parton distribution f1(x). With these fit parameters, I will show predictions of the pure twist-3 contributions, and I will compare the results for e(x) to a recent extraction, obtained from the analysis of preliminary data of the beam asymmetry for di-hadron semi-inclusive deep inelastic scattering at CLAS 6 GeV.

Primary author: RODINI, Simone (PV & INFN)

Co-author: PASQUINI, Barbara (PV)

Presenter: RODINI, Simone (PV & INFN)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **90** Type: **Parallel Sessions**

TMD evolution as a double-scale evolution

Wednesday, 12 September 2018 15:20 (25 minutes)

Evolution of transverse momentum dependent distributions (TMD evolution) is an evolution with respect to two scales: the renormalization and rapidity scales. The double scale evolution grants a freedom in the definition of physical observables, which naively could lead to ambiguous results. We show that the double-evolution picture has a natural interpretation in terms of evolution potential, and allows the definition of universal (independent on evolution definition) TMD distribution. Altogether, we present a renewed version of the TMD evolution theory, that incorporates also the traditional approach. We also present recent results of phenomenological extraction of TMD evolution.

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Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **91** Type: **Parallel Sessions**

Tensor-polarized structure functions of spin-one deuteron

Thursday, 13 September 2018 17:40 (20 minutes)

There exist polarized structure functions b_{1-4} for the spin-one deuteron. These functions probe very different nature of hadron spin physics from the longitudinally-polarized distributions measured by g_1 for the nucleon. The twist-two structure functions b_1 and b_2 are expressed by tensor-polarized parton distribution functions (PDFs), which indicate unpolarized parton distributions in the tensor-polarized spin-one hadron [1].

First, we investigated the function b_1 in the standard convolution model for describing the deuteron [2]. Using a convolution integral for calculating nuclear structure functions, we obtain the structure function b_1 which is expressed by the lightcone momentum distribution for the nucleon in the deuteron and the unpolarized structure function F_1 for the nucleon. The lightcone momentum distribution is calculated by using a momentum-space wave function for the deuteron with D-state admixture. We found that the function b_1 calculated in this standard description is very different from HERMES b_1 measurements. It suggests that new hadron physics may be needed for explaining the HERMES data.

Second, we investigated the possibility of studying the tensor-polarized PDFs by the proton-deuteron Drell-Yan process in the Fermilab E1039 experiment with the fixed tensor-polarized deuteron target. For pursuing this experiment, it is crucial to estimate the magnitude of a possible tensor-polarization asymmetry theoretically. Using the optimum tensor-polarized PDFs obtained by analyzing the HERMES data, we calculated the tensor-polarization asymmetry by considering the Fermilab kinematics [3]. We found that the asymmetry A_Q is of the order of a few percent. It is a small quantity; however, we believe that it is worth for the measurement to find the physics mechanisms of tensor polarization in the parton level.

Since there is an approved experiment at JLab to measure b_1 and the polarized proton-deuteron Drell-Yan process could be studied at Fermilab, it is an interesting hadron-physics topic with the possibility of creating a new field in high-energy spin physics.

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[3] S. Kumano and Qin-Tao Song, Phys. Rev. D94 (2016) 054022.

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Presenter: Mr SONG, Qin-Tao (Sokendai/KEK)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **92** Type: **Parallel Sessions**

Recent results in the deuteron break-up with high momentum transfer at COSY

Monday, 10 September 2018 17:20 (20 minutes)

The hadron reactions with the production of a diproton final state, which is a proton pair $\{pp\}_s$ with small excitation energy, have been studied extensively at ANKE-COSY.
These included the break-up process $pd \to \{pp\}_s n$ at high and low momentum transfer, the $pN \to \{pp\}_s \pi$ one pion production, the $pp \to \{pp\}_s \gamma$ reaction and study of the ABC effect in the $pp \to \{pp\}_s \pi\pi$ reaction. The low excitation energy ensures the final pp-pair to be in the $^1S_0$ state, thus reducing the number of the partial waves accessible and simplifying the theoretical description of the process.

The hard break-up process $pd \to \{pp\}_s n$ in the colinear kinematics has been studied at ANKE in the energy range 0.5-2.0 GeV, where the main reaction mechanisms are the one nucleon exchange (ONE), Δ-excitation and the single scattering (SS). Selection of a diproton in the final state suppresses the Δ mechanism, allowing one to probe the deuteron structure at short distances. The obtained results, that included the differential cross-section and the vector analysing power, were compared to the model predictions produced with several modern NN-potentials.

Recently, this study was complemented by the data on the cross section and A_y at 353 MeV, where one expects the dominance of ONE mechanism, what provides an accurate test of the ONE+Δ+SS
model. These results, analysed together with the ANKE data on the $pn \to \{pp\}_s \pi^-$ and $pp \to \{pp\}_s \pi^0$ reactions, previously extracted at the same energy, may solve the existing ambiguity in the partial wave analysis of the pion production processes.

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Presenter: Dr DYMOV, Sergey (INFN)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **93** Type: **Parallel Sessions**

General relativity experiment with frozen spin rings

Wednesday, 12 September 2018 17:55 (25 minutes)

In a recent paper (https://doi.org/10.1088/1361-6382/aacfee), a general relativistic (GR) calculation was presented on the Earth's gravitational effect in a mixed magnetic-electric frozen spin storage ring on the spin transport. It was shown that GR causes a precession out of the orbital plane in a frozen spin ring, i.e. a slow vertical polarization buildup will be present, given that the initial beam polarization was longitudinal. The rate of the vertical polarization buildup is predicted to be -a*betagamma*g/c, where g is the gravitational acceleration on the surface of the Earth, c is speed of light, betagamma is the particle momentum over mass, and a is its magnetic moment anomaly. It is seen that the effect increases unboundedly with the Lorentz factor gamma. Moreover, is proportional to the magnetic moment anomaly a. The talk shall mainly address the experimental perspectives to detect this GR effect.

Primary author: LASZLO, Andras (Wigner Research Centre for Physics of the Hungarian Academy of Sciences)

Presenter: LASZLO, Andras (Wigner Research Centre for Physics of the Hungarian Academy of Sciences)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **94** Type: **Parallel Sessions**

Electromagnetic Dipole Moments of Heavy Baryons with Bent Crystals at the LHC

Wednesday, 12 September 2018 15:50 (20 minutes)

We propose a program of measurements of electric and magnetic dipole moments of charm, beauty and strange baryons at the LHC, based on the phenomenon of spin precession as induced by the intense electromagnetic field between atomic planes of bent crystals. Studies of crystal channeling and spin precession of positively- and negatively-charged particles are presented, along with the expected sensitivities using an optimized layout for the LHCb detector. The implications of such measurements are discussed emphasizing the potential of charm EDM physics to constrain speculative theories beyond the Standard Model.

Mostly based on Eur. Phys. J. C (2017) 77:828.

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Presenter: RUIZ VIDAL, Joan (IFIC-Valencia)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **95** Type: **Parallel Sessions**

Hadron tomography in meson-pair production and gravitational form factors

Tuesday, 11 September 2018 16:40 (35 minutes)

Generalized parton distributions (GPDs) are important 3D structure functions for hadrons, and they are used to solve the proton spin puzzle. The s-t crossed quantities of the GPDs are generalized distribution amplitudes (GDAs),and they can be studied in the two-photon process which is accessible at KEKB. The GDAs describe the amplitude from quark-antiquark to the hadron pair. In 2016, the Belle collaboration reported measurements for pion pair production in the electron-positron collision, and the pion GDAs can be obtained by analyzing the Belle data. In this talk, we explain the basic properties of the pion GDAs for explaining the cross section of the pion-pair production. In our analysis, the pion GDAs are expressed by a few parameters, which are determined by the fitting the Belle data. From the obtained GDAs, the form factors of energy-momentum tenor are calculated for pion in the timelike region. In order to study the gravitational radius for the pion, the form factors of energy-momentum tenor are obtained in the spacelike region by using the dispersion relation. Then, the mass radius is calculated as 0.56-0.69 fm for the pion by using the spacelike form factors. This is the first study on gravitational form factors and mass radius of hadrons from actual experimental measurements. In 2018, Belle II will begin to collect data with the higher luminosity Super KEKB, so that the GDAs of other hadrons should also be investigated in the near future. Our studies are valuable in understanding the 3D structure and gravitational properties of hadrons.

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Presenter: Mr SONG, Qin-Tao (Sokendai/KEK)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **96** Type: **Parallel Sessions**

Measurements of polarization transfer to a bound proton in light nuclei by quasi-elastic scattering at MAMI

Monday, 10 September 2018 16:40 (20 minutes)

I will report on recent polarization transfer experiments carried out at the Mainz Microtron (MAMI), via the quasi-elastic A(e ⃗,e^’ p ⃗) reaction, over a wide range of missing momentum and virtuality. We measured the ratio (Px/Pz)A of the transverse to longitudinal components of polarization transferred from an electron to a bound proton in 2H and 12C [1, 2] , and transverse (Px and Py) and longitudinal (Pz) components of the polarization transfer to a bound proton in 2H [3].
We observed consistent deviations from unity of the above ratio normalized to the free-proton ratio, (Px/Pz)A/(Px/Pz)1H, for both s-and p-shell knocked out protons, even though they are embedded in averaged local densities that differ by about a factor of two. The dependence of the double ratio on proton virtuality is similar to the one for knocked out protons from 2H and previous 4He data, suggesting a universal behavior, which seems to be independent of nuclear size, density and Q2.
A precise determination of the electron beam polarization, along with a novel analysis method [4], enabled a detailed comparison of the measured polarization transfer components to a bound proton in 2H to a state-of-the-art calculation, which uses free-proton electromagnetic form factors. We observe very good agreement between the measured and the calculated (Px/Pz)2H ratios, but deviations of the individual components. Our results cannot be explained by medium modified electromagnetic form factors (FFs), unless the GE/GM ratio is kept intact. Excluding FF modifications, these deviations point to an incomplete description of the nuclear reaction mechanism in the calculation.

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[4] D. Izraeli, I. Mardor, et al., arXiv:1803.06729 (2018)

Primary author: Prof. MARDOR, Israel (Tel Aviv University, Tel Aviv, Israel)

Presenter: Prof. MARDOR, Israel (Tel Aviv University, Tel Aviv, Israel)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **98** Type: **Parallel Sessions**

Weighted transverse spin asymmetries in 2015 COMPASS Drell–Yan data

Monday, 10 September 2018 15:20 (25 minutes)

In 2015 at the COMPASS experiment at CERN a pion beam with momentum of 190 GeV/c interacted with a transversely polarised NH_3 target. Muon pairs produced in the Drell–Yan process were detected. In addition to the extraction of the transverse spin asymmetries (TSAs) from this data, a complementary analysis of the TSAs weighted by powers of the dimuon momentum q_T has been done and will be presented in this talk. In the transverse momentum dependent parton distribution functions (TMD PDFs) formalism, the q_T-weighted TSAs can be interpreted in terms of products of the TMD PDFs of the beam pion and transversely polarised target proton, unlike the conventional TSAs, which are interpreted as their convolutions. This allowed us to make a straightforward comparison with the expectation based on the weighted Sivers asymmetry measured in the SIDIS process. Information on the Boer–Mulders function of the pion have also been obtained and will be presented.

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Presenter: MATOUSEK, Jan (University and INFN Trieste, Italy)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **99** Type: **Parallel Sessions**

Measurement of the J/psi photoproduction cross section close to threshold

Tuesday, 11 September 2018 15:50 (20 minutes)

We will present preliminary results for the J/psi close-to-threshold photoproduction obtained in the GlueX experiment at Jefferson Lab. Close-to-threshold photoproduction gamma+p−>J/psi+p probes small-size gluon configuration in the proton. This reaction may also contain a contribution from the s-channel production of the LHCb pentaquark P(4.4)−>J/psi+p at beam energies of about 10 GeV. Measuring the size of the contribution allows to evaluate, or put a limit on the branching ratio of the decay P−>J/psi+p.
The GlueX experiment is in the process of collecting data. The main research topic is the spectroscopy of light mesons produced by a linearly polarized photon beam with the end point of 12 GeV.

Primary author: CHUDAKOV, Eugene (Jefferson Lab)

Presenter: CHUDAKOV, Eugene (Jefferson Lab)

Session Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Track Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Contribution ID: **100** Type: **Parallel Sessions**

Measuring the free neutron lifetime with spin-polarized ultracold neutrons at TRIGA Mainz

Thursday, 13 September 2018 15:20 (25 minutes)

Ultracold Neutrons (UCN), neutrons with kinetic energies below 335 neV, provide a unique tool for fundamental neutron research with long observation times.
The τSPECT experiment, which is currently being commissioned at the pulsed UCN source of the TRIGA Mainz, aims to utilize this fact in order to precisely measure the free neutron lifetime.
In order to reduce systematic errors with respect to previous storage experiments using material bottles, τSPECT will implement 3D magnetic storage of spin polarized UCN and will be able to measure both the decaying and the surviving UCN.
An introduction to UCN and their properties will be given as well as a description of the τSPECT experiment and the planned neutron lifetime measurements at the TRIGA Mainz.

Primary author: Prof. RIES, Dieter (Institute of Nuclear Chemistry, Johannes Gutenberg University Mainz, Germany)

Presenter: Prof. RIES, Dieter (Institute of Nuclear Chemistry, Johannes Gutenberg University Mainz, Germany)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **101** Type: **Parallel Sessions**

K-/K+ multiplicity ratio in SIDIS from COMPASS

Thursday, 13 September 2018 14:50 (20 minutes)

For the first time, the K-/K+ multiplicity ratio was measured in deep-inelastic scattering for kaons carrying a large fraction z of the virtual-photon energy. The data were obtained using a 160 GeV muon beam and an isoscalar 6LiD target. They cover the range 0.01 < x < 0.4, z> 0.75, Q2 > 1 (GeV/c)2, and W > 5 GeV/c2. For values of z larger than 0.8, the results contradict expectations obtained using the formalism of (next-to-) leading order perturbative quantum chromodynamics. In particular, the K-/K+ data shows a strong dependence upon the missing mass Mx, not expected from the calculations. The results suggest that additional corrections to the formalism may be required to take into account the phase space available for hadronization.

Primary author: Dr KUNNE, fabienne (CEA saclay)

Presenter: Dr KUNNE, fabienne (CEA saclay)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **102** Type: **Parallel Sessions**

Measurement of Longitudinal Single-Spin Asymmetry for W Boson Production in Polarized Proton-Proton Collisions at STAR

Thursday, 13 September 2018 15:10 (20 minutes)

The contribution from the sea quark polarization to the nucleon spin is an important piece for complete understanding of the nucleon spin structure. The production of W bosons in longitudinally polarized p+p collisions at RHIC provides a unique probe to the sea quark polarization, through the parity-violating single-spin asymmetry, AL. At STAR, the W bosons through the W→eν channel at mid-rapidity (|η|<1.3) can be effectively determined with the Electromagnetic Calorimeters and Time Projection Chamber. The STAR measurements of AL for W boson from datasets taken in 2011 and 2012 at √s =510 GeV, have been included in the global analysis of polarized parton distribution functions, and provided significant constraints on the helicity distribution functions of u-bar and d-bar quarks. In 2013 the STAR experiment collected a much larger data sample, about three times larger than the total integrated luminosity of previous years. The AL results from 2013 STAR data sample will provide further constraints on the sea quark polarization in the nucleon.

Primary author: XU, Qinghua (Shandong University)

Presenter: XU, Qinghua (Shandong University)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **104** Type: **Parallel Sessions**

Multipurpose silicon detector for (polarized) internal target experiments at the COSY Storage Ring in Jülich.

Tuesday, 11 September 2018 18:20 (20 minutes)

The PAX Collaboration is being involved in experiments employing polarized internal targets. In this framework, the team is since years exploring techniques to produce a beam of polarized antiprotons by means of the spin-filtering technique.
Another physics objective of the collaboration, is a test of time reversal invariance by investigating the T-violating null observable Ay,xz that could be accessed by using a vector polarized proton beam and a tensor polarized deuteron target.
To support these investigations, the collaboration has developed and commissioned a multipurpose high-acceptance vertex detector. The detector of 4 silicon telescopes arranged in a diamond configuration around a storage cell. It has been designed to cope with proton (anti)proton and proton-deuteron reactions in the energy range between and 30 MeV and 200 MeV
In a commission run, the detector was installed in the "PAX"low ß section of the COSY storage and employed as a target polarimeter by making use of the analyzing power in p-d elastic scattering.
This paper is dedicated to technical part of different systems of the detector. The talk will address mechanical construction, arrangement of the silicon detectors and electronic readout together with additional supplementary devices such as Atomic Beam Source and Breit-Rabi polarimeter.

Primary author: Mr KONONOV, Anton (Ferrara University)

Presenter: Mr KONONOV, Anton (Ferrara University)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **105** Type: **Parallel Sessions**

Recent Transverse Spin Measurements in pp Collisions with STAR

Monday, 10 September 2018 15:45 (25 minutes)

The STAR Collaboration at RHIC is exploring the partonic origin of the proton spin with a broad range of measurements in polarized pp collisions. STAR measurements of the transverse single-spin asymmetry, A_N, for W boson production provide the first experimental investigation of the non-universality of the Sivers function. Precise follow-up measurements of A_N for direct photon production, Drell-Yan di-electron production, and W boson production are underway that will both provide a definitive test of the non-universality and constrain evolution of transverse-momentum-dependent distributions (TMDs) over a very wide Q^2 range. STAR has measured di-pion interference fragmentation functions and the transverse single-spin dependence of the azimuthal modulation of pions in jets in pp collisions at $\sqrt{s}$ = 200 and 500 GeV. The results provide the first observations of transversity in pp collisions, and enable tests of universality and factorization-breaking effects for TMDs in hadronic interactions. Additional transverse modulations provide limits on gluon linear polarization in polarized protons and the twist-3 analog of the gluon Sivers distribution. The current status of these analyses and the prospects to extend them in the near future will be discussed.

Primary author: Prof. GAGLIARDI, Carl (Texas A&M University)

Presenter: Prof. GAGLIARDI, Carl (Texas A&M University)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **106** Type: **Parallel Sessions**

Interpretation of the unpolarized azimuthal asymmetries in SIDIS

Wednesday, 12 September 2018 14:55 (25 minutes)

The measurement of azimuthal modulations in hadron leptoproduction on unpolarised nucleons allows to get information on the intrinsic transverse momentum of quarks in a nucleon through both the Cahn effect and the Boer-Mulders function. In particular the latter describes a possible correlation between the intrinsic transverse momentum and the transverse spin of the quarks of an unpolarized nucleon.
We have compared the azimuthal asymmetries in the cross section of 160 GeV/c muons scattered off an unpolarised deuteron target as measured by COMPASS with a Monte Carlo program, based on the 3P0 model, which accounts for both the Cahn and the Boer-Mulders effects. Possible other contributions are also investigated.

Primary author: KERBIZI, Albi (TS)

Presenter: KERBIZI, Albi (TS)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **107** Type: **Parallel Sessions**

Status of the experimental studies on DVMP and transversity GPDs

Tuesday, 11 September 2018 17:15 (35 minutes)

A longstanding goal in nuclear and particle physics has been to describe the three dimensional structure of the nucleon in terms of the quarks and gluon fields. In this regard, exclusive electron scattering experiments, in which all final state particles are measured, are important contributors. Examples are electron elastic scattering, deeply virtual Compton scattering (DVCS), and deeply virtual meson electroproduction (DVMP). The latter includes pseudoscalar mesons with intrinsic spin and parity JP=0-, such as π-, π0, π+ and η, and vector mesons, which have the same spin and parity as the photon, JP=1-, such as ρ-, ρ0, ρ+, ω and φ. Exclusive electron scattering reactions at high momentum transfers directly related to Generalized Parton Distributions (GPDs) of quarks and gluons. Most reactions studied, such as DVCS or vector meson electroproduction, are primarily sensitive to the chiral-even GPDs. Very little is known about the chiral-odd GPDs, except that HT becomes the transversity function h1 in the forward limit. The chiral-odd GPDs are difficult to access since hard subprocesses with the quark spin-flip are suppressed. It turns out that pseudoscalar meson electroproduction, and especially π0 and η production, were identified as especially sensitive to the parton helicity-flip subprocesses.
Dedicated experiments to study Deeply Virtual Meson Production have been carried out at Jefferson Lab. The cross sections and asymmetries of the exclusive pseudoscalar meson electroproduction processes in a very wide kinematic range of Q2, xB and t have been measured with CLAS. The comparison of these data with the theoretical models will be discussed in the report. The new CLAS12 experiments are a major component of the CLAS12 program to provide detailed tomographic images the quark and gluon distributions.

Primary author: Dr KUBAROVSKY, Valery (Jefferson Lab, USA)

Presenter: Dr KUBAROVSKY, Valery (Jefferson Lab, USA)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **108** Type: **Parallel Sessions**

Double helicity asymmetries for $\pi^{\pm}$ production in $p + p$ collisions at $\sqrt{s}$=510 GeV at PHENIX Mid-rapidity

Wednesday, 12 September 2018 17:00 (20 minutes)

One of the main goals of the RHIC spin program is the determination of the gluon helicity contribution to the proton spin. This can be accessed by measuring double helicity asymmetries (A_{LL}) of pion production at mid-rapidity in longitudinally polarized proton collisions. The ordering of the asymmetries with the charge of the final state pions can in addition directly infer the sign of the gluon spin contribution.

Charged pions are reconstructed in the central PHENIX tracking system. The asymmetries are evaluated between the collisions of bunches with the same and opposite helicity after correcting for differences in luminosity and for beam polarizations.

To extend our understanding of the gluon polarization to a lower gluon momentum fraction (x), high statistics data was collected at a higher $\sqrt{s}$=510 GeV in 2012-2013.

We present the physics motivation, the analysis procedure, current status of the $\pi^{\pm}$ A_{LL} measurements and comparisons to π^0 as well as $\pi^{\pm}$ at $\sqrt{s}$=200 GeV.

Primary author: Mr MOON, Taebong (Yonsei University/RIKEN)

Presenter: Mr MOON, Taebong (Yonsei University/RIKEN)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **109** Type: **Parallel Sessions**

COMPASS results on weighted Sivers asymmetry in SIDIS

Monday, 10 September 2018 14:55 (25 minutes)

The COMPASS Collaboration has recently measured the Sivers asymmetries weighted with the hadron transverse momentum, analyzing the high statistics data sample collected in 2010 to measure semi-inclusive deep inelastic scattering on a transversely polarised proton target.
These asymmetries provide direct information on the Sivers function, which is one of the most studied transverse momentum dependent distributions.
Their dependence on Bijorken x and z, the relative hadron energy, have been investigated and compared with the standard unweighted Sivers asymmetries and with the expectations in the present theoretical framework.
The results for the first transverse moments of the Sivers distributions for u and d quarks obtained in a model independent way from the weighted Sivers asymmetries will also be shown and compared with previous extractions.

Primary author: MARTIN, Anna (TS)

Presenter: MARTIN, Anna (TS)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **110** Type: **Parallel Sessions**

Spin Transparency Mode in JLEIC

Thursday, 13 September 2018 16:40 (20 minutes)

An Electron-Ion Collider (EIC) is proposed as the first lepton-hadron collider in the world with both beams polarized. The nuclear physics program requires high polarizations, long polarization lifetimes, and unique capabilities of polarization control in both collider rings. The electron polarization must be longitudinal at the interaction points in the whole energy range of 3 to 10 GeV while the light ion polarization must be adjustable to transverse and longitudinal directions in the whole energy range of up to 100 GeV. The figure-8 configuration of the collider rings allows for control of the electron and ion polarizations in a spin transparency mode. In this mode, when a particle is moving along the closed orbit in an ideal collider lattice, any spin direction repeats every turn. The spin tune is energy independent and is equal to zero. To stabilize the beam polarization, it is sufficient to use weak solenoids with small field integrals. A universal scheme for control of the polarization using weak solenoids provides an elegant solution to the problem of ion acceleration completely eliminating resonant beam depolarization. It allows one to easily adjust the polarization of any ion species (including deuterons) in any direction at any orbital location, which becomes necessary when transferring the beam from one ring into another or when measuring the polarization by polarimeters. It also allows for an easy manipulation of the spin direction at an interaction point during an experiment. The latter feature allows one to set up a stable spin-flipping system with a spin reversal time of less than a second. This presentation discusses the option of increasing the maximum ion energy to 200 GeV in the existing collider lattice. In the original design, the electron ring is flat and the doglegs for stacking the electron and ion arcs are placed in the ion ring and occupy about 200 m of the experimental straights. Since the ion energy is an order of magnitude greater than the electron one, the doglegs in the ion ring require significantly higher field integrals and better element setup and alignment accuracy to maintain the beam collision mode. This talk also presents an optimized design of the electron spin rotator, which combines the functions of a dogleg and a universal spin rotator that allows one to save space both in the electron and ion collider rings.

Primary author: Dr LIN, Fanglei (Jefferson Lab)

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Presenter: Dr LIN, Fanglei (Jefferson Lab)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **111** Type: **Parallel Sessions**

Spin matching of interaction region with solenoidal spin rotators

Thursday, 13 September 2018 17:20 (20 minutes)

Longitudinal polarization of electron beam in the interaction point is an essential requirement for designs of electron-ion colliders developed in BNL and JLab. In electron energy range of these colliders the spin rotators on the basis of interleaved solenoidal and dipole magnets presents a most realistic design choice. But, the rotator insertions have to be spin-matched in order to minimize depolarization caused by stochastic effect of synchrotron radiation. The talk presents and discusses the optics conditions required for spin matching of solenoidal spin rotators, as well as possible realizations of these conditions in the interaction region lattice.

Primary author: Dr PTITSYN, Vadim (BNL)

Co-author: Dr TEPIKIAN, Steven (BNL)

Presenter: Dr PTITSYN, Vadim (BNL)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **112** Type: **Parallel Sessions**

Combined analysis of polarized and unpolarized PDFs and fragmentation functions

Wednesday, 12 September 2018 14:50 (20 minutes)

In this talk I will discuss the recent updates from the JAM collaboration to extract simultaneously polarized and unpolarized PDFs and fragmentation functions from the available global data.

Primary author: SATO, Nobuo (Jefferson Lab)

Presenter: SATO, Nobuo (Jefferson Lab)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **113** Type: **Parallel Sessions**

Understanding the Large qT spectrum in SIDIS and DY

Wednesday, 12 September 2018 17:30 (25 minutes)

In this talk I will discuss recent progress to understand the large qT spectrum in SIDIS and DY.

Primary author: SATO, Nobuo (Jefferson Lab)

Presenter: SATO, Nobuo (Jefferson Lab)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **114** Type: **Parallel Sessions**

Precision measurements using parity violation electron scattering

Monday, 10 September 2018 14:30 (40 minutes)

In the 40 years since the landmark E122 experiment, parity violating electron scattering (PVES) has proven to be a versatile and precise tool in both setting limits on beyond the standard model physics and in determining properties of nuclear matter. Its appeal stems from the use of the cleanly interpretable weak neutral current. Updated experimental techniques will allow a new generation of PVES experiments to better determine the weak charges of both the electron and proton, setting limits on possible new interactions not accounted by the standard model. Deep inelastic scattering off deuterium will provide new information on the nucleon partonic structure and test beyond the standard model physics processes to tens of TeV mass scale. In the immediate future this technique will be used to determine the neutron skin on heavy nuclei. This will constrain the nuclear equation of state in neutron rich media and provide a crucial comparison to recent results obtained from binary neutron star mergers. This talk will give an overview of recent PVES results and detail the future experiments listed above.

Primary author: GAL, Ciprian (University of Virginia)

Presenter: GAL, Ciprian (University of Virginia)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **115** Type: **Parallel Sessions**

Measurement of W single spin asymmetries at PHENIX

Thursday, 13 September 2018 15:30 (20 minutes)

The measurement of the single spin asymmetries of parity violating W boson production in longitudinally polarized proton collisions provides unique and clean access to the light sea quark helicity distributions. The W boson couples only to left-handed quarks and right-handed anti quarks, and hence one can directly relate the charge of the W with initial state quark flavors. The PHENIX experiment at RHIC has performed the single spin asymmetry measurements at √s =510 GeV in 2011-2013. W bosons are accessed through their lepton decays at PHENIX, electrons at mid-rapidity and muons at forward rapidity. In this talk, the recent results of the single spin asymmetries will be presented.

Primary author: Dr PARK, Sanghwa (Stony Brook University)

Presenter: Dr PARK, Sanghwa (Stony Brook University)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **116** Type: **Parallel Sessions**

Probing nucleon's spin structures with polarized Drell-Yan in the Fermilab E1039 experiment

Wednesday, 12 September 2018 17:20 (20 minutes)

Although the proton was discovered about 100 years ago, its spin structure still remains a mystery. Recent studies suggest that the orbital angular momentum of sea antiquarks could significantly contribute to the proton's spin. The SeaQuest experiment, which recently completed data collection, probed the unpolarized light sea antiquark distributions of the proton using the Drell-Yan process. Its successor, the Polarized SeaQuest experiment (E1039), will access the u_bar and d_bar Sivers functions using polarized NH3 and ND3 targets. A non-zero Sivers asymmetry will be a strong indication of non-zero orbital angular momentum. The experiment can also probe the sea quark's transversity distribution, which is relevant for the determination of proton's tensor charge. The current status and future plans of the experiment will be presented.

Primary author: Dr CHEN, Andrew (University of Illinois Urbana-Champaign)

Presenter: Dr CHEN, Andrew (University of Illinois Urbana-Champaign)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **117** Type: **Parallel Sessions**

Precise measurements of the single and double spin-flip asymmetries in CNI region in elastic proton-proton scattering at √s=13.7 GeV and √s=21.9 GeV at RHIC HJET polarimeter.

Wednesday, 12 September 2018 15:30 (20 minutes)

The Polarized Atomic Hydrogen Jet Target polarimeter (HJET) is employed by Relativistic Heavy Ion Collider (RHIC) to measure absolute polarization of the colliding proton beams. In RHIC Runs 2015 (E_beam=100 GeV) and 2017 (E_beam=255 GeV) we accumulated large statistics of about 10^9 events per beam per run for elastic polarized proton scattering on polarized target (HJET) protons for the momentum transfer range 0.0015<-t<0.018 GeV^2. Such statistics allowed us to measure single spin, A_N, and double spin, A_NN, analyzing powers with unprecedented statistical accuracy and very low systematic uncertainty (of order of statistical errors). For the first time hadronic single spin-flip r_5 and double spin-flip r_2 amplitudes were reliably isolated at these energies. The preliminary results (statistical errors only) are Rer_5=(-16.4±1.1)×10^(-3), Imr_5=(3.1±4.0)×10^(-3), Rer_2=(-3.58±0.28)×10^(-3), Imr_2=(-0.09±0.12)×10^(-3) for √s=13.7 GeV and Rer_5=(-6.7±0.5)×10^(-3), Imr_5=(19.2±2.4)×10^(-3), Rer_2=(-2.37±0.22)×10^(-3), Imr_2=(0.38±0.08)×10^(-3) for √s=21.9 GeV. Measurements at 2 beam energies allowed us to separate Pomeron and Regge-pole contributions to the hadronic single- and double- spin-flip amplitudes. No indication of Odderon contribution was found. Extrapolation of the measured A_N (t,s) to √s=200 GeV is in a good agreement with STAR measurements at this energy.

Primary author: Dr POBLAGUEV, Andrei (Brookhaven National Laboratory)

Presenter: Dr POBLAGUEV, Andrei (Brookhaven National Laboratory)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **118** Type: **Parallel Sessions**

Potential use of Solid Frozen-Spin HD Targets with Electron Beams

Tuesday, 11 September 2018 16:40 (20 minutes)

Solid frozen-spin hydrogen-deuteride targets, have been used successfully with polarized photon beams for nuclear physics measurements over the past decade, first at Brookhaven Lab, and recently at Jefferson Lab [1-4]. With the completion of the 12 GeV upgrade to the Jefferson Lab accelerator, the focus of polarized HD at JLab has shifted to experiments with electron beams. In particular, three experiments requiring transversely polarized HD (to study Transverse Momentum and Generalized Parton Distributions) have been approved by the JLab PAC for Hall-B with the highest scientific rating and designated "High Impact". Recognizing the need for development and testing of the HD target with charged particles, Jefferson Lab is developing a small 10 MeV accelerator that can serve as a test bed. While beam-energy loss in the target at 10 GeV is much larger, most of this is in the form of bremsstrahlung which leaves the HD unaffected. In fact, a 10 MeV beam from this Facility will deposit roughly the same energy in the target as GeV beams. However, these low energy beams are much less rigid and strongly focused by the magnetic fields within the target cryostat. Extensive transport simulations and target modifications have been carried out in designing a program of tests that are expected to be representative of full scale GeV experiments. While these initial tests will be run with a longitudinal holding field, development of a novel transverse magnet based on a bulk high-Tc superconductor is underway for the Hall-B experiments. This talk will summarize the factors affecting target polarization and the status of preparations and development for eHD experiments.

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Presenter: Dr SANDORFI, Andrew (Jefferson Lab)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **119** Type: **Parallel Sessions**

Optical excitation of molecules for Spin-Polarized Nuclear Fusion

Wednesday, 12 September 2018 16:40 (25 minutes)

It is known theoretically and from scattering experiments that nuclear spin polarization increases the cross sections of the D-T and D-3He reactions by 50%, while also spatially aligning the recoil directions of the reactions products, which can be used to improve the efficiency of reactors [1]. However, the lack of a sufficiently intense source of spin-polarized deuterium (SPD) has not yet allowed the observation of spin-polarized fusion in a plasma, which has left three important questions unanswered [1]:
(1) Does nuclear spin-polarization survive long enough in the plasma to benefit fusion?
(2) What is the effect of spin-polarization on the D-D reaction (which occurs as a side reaction in both D-T and D-3He), as numerous theoretical predictions range from prediction of enhancement to suppression?
(3) Can a source of SPD be found with a production rate of 10^22 SPD/s, necessary for a nuclear reactor, such as ITER (as traditional methods, e.g. Stern-Gerlach spin separation or spin-exchange optical pumping, have production rates about 4-5 orders lower)?
We describe two novel methods that we have developed, for the production of spin-polarized hydrogen isotopes through the UV and IR optical excitation of molecules [2-6]. We describe how the UV photodissociation method gives spin-polarized D nuclei at densities of at least 10^19 SPD/cm3, which is sufficient for the observation of inertial-confinement polarized fusion using kJ-MJ pulsed lasers [3]. In addition, we discuss some details of how the IR excitation method may be able to produce beams of 10^22 SPD/s, needed for polarized magnetic-confinement fusion, and, therefore, how the three fundamental questions of polarized fusion may be answered.

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Presenter: Prof. RAKITZIS, T. Peter (IESL-FORTH)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **121** Type: **Parallel Sessions**

Longitudinal and Transverse Spin Transfer to Lambda and anti-Lambda in Polarized p+p Collisions at 200 GeV at STAR

Thursday, 13 September 2018 17:55 (25 minutes)

The longitudinal or transverse spin transfer to Lambda and anti-Lambda hyperons in polarized proton-proton collisions is expected to be sensitive to the helicity or transversity distributions of strange and anti-strange quarks of the proton, and to the corresponding polarized fragmentation function. We report the first measurement of the transverse spin transfer to Lambda and anti-Lambda along the polarization direction of the fragmenting quark, D_TT, in transversely polarized proton-proton collisions at 200 GeV with the STAR detector at RHIC. The data correspond to an integrated luminosity of 18 pb^-1, and cover a kinematic range of |η|< 1.2 and transverse momentum pT up to 8 GeV/c. We also report an improved measurement of the longitudinal spin transfer D_LL to Lambda and anti-Lambda with pT up to 6 GeV/c, using data with about twelve times larger figure-of-merit than the previously published STAR results. The prospects of hyperon polarization measurements in the forward pseudo- rapidity region (η~3) in p+p collision in the year of 2021 and beyond will also be discussed, which is based on STAR forward detector upgrade plan including a forward tracking system and a forward calorimeter system.

Primary author: XU, Qinghua (Shandong University)

Presenter: XU, Qinghua (Shandong University)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **122** Type: **Parallel Sessions**

Overview of Gluon Helicity Measurements at STAR

Wednesday, 12 September 2018 17:20 (20 minutes)

The contribution to the spin of the proton from the gluon helicity is starting to come into focus: for
gluons carrying a large fraction x of the proton momentum, evidence of positive gluon polarization has
been observed, via measurements of the longitudinal double-spin asymmetry A_{LL} for inclusive jet and
dijet production. A_{LL} is sensitive to the polarized gluon distribution function, $\Delta g(x)$, and
while it is positive at high x, it is not well constrained for $x < 0.05$. Recent measurements at STAR of
observables originating dominantly from quark-gluon and gluon-gluon subprocesses aim to improve the
precision of $\Delta g(x)$ at high x, as well as for the first time provide insight into the low-x
contribution. A_{LL} measurements of inclusive jets and dijets at midrapidity ($|\eta| < 1$) and
intermediate rapidity ($0.8 < \eta < 2$) at STAR at $\sqrt{s} = 200$ and 510 GeV will be shown, along with
the statuses of ongoing analyses; these measurements will help improve the $\Delta g(x)$ precision for x
$gtrsim 0.01$. Recent π^0 A_{LL} measurements in the forward region ($2.65 < \eta < 3.9$) at
$\sqrt{s} = 510$ GeV will also be presented, which probe $\Delta g(x)$ down to $x \sim 10^{-3}$.
Comparisons of these results to recent global analyses and extrapolations will be discussed.

Primary author: DILKS, Christopher (Pennsylvania State University)

Presenter: DILKS, Christopher (Pennsylvania State University)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **124** Type: **Parallel Sessions**

Transverse Single-Spin Asymmetries of Midrapidity Eta Mesons at PHENIX

Tuesday, 11 September 2018 17:55 (25 minutes)

Transverse single-spin asymmetries (TSSAs) of proton-proton collisions have a long history of revealing the richness of QCD. They were originally measured in fixed target experiments and ignored for a couple decades because it was assumed that they came incalculable soft QCD interactions. But they have been found to persist in collisions up to \sqrt{s} = 510 GeV, well into the perturbative regime of QCD, and yet their origin remains poorly understood.
TSSA measurements have allowed for the development of both transverse momentum dependent and collinear twist-3 descriptions of nonperturbative spin-momentum correlations in the nucleons as well as in the process of hadronization. As hadrons, eta mesons are sensitive to both initial- and final-state nonperturbative effects for a mix of parton flavors. Their comparison to neutral pions may provide information on potential effects due to strangeness, isospin, or mass. The status of the TSSA of eta mesons at midrapidty for 200 GeV proton-proton collisions from the PHENIX 2015 data set will be shown.

Primary author: LEWIS, Nicole (PHENIX)

Presenter: LEWIS, Nicole (PHENIX)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **125** Type: **Parallel Sessions**

Neutron spin structure studies at EIC

Thursday, 13 September 2018 17:20 (20 minutes)

The study of the nucleon (spin) structure in terms of its basic degrees of freedom
is a central pillar of the EIC initiative; the availability of deuteron and 3He polarized beams will offer unprecedented opportunities to do measurements on the neutron comparable to those of the proton; the combination of these data will deepen our understanding of many aspects of the nucleon spin physics: from a more precise test of the Bjorken sum rule to a finer picture of flavor structure of the nucleon sea, as well as a precise determination of different spin and transverse momentum dependent distribution functions, at leading and higher twists. Moreover, the almost close kinematics, large acceptance detectors typical of a collider, will potentially offer new measurement perspectives beyond the asymmetries.

Primary authors: DEL DOTTO, Alessio (INFN); CISBANI, Evaristo (ROMA1)

Presenter: DEL DOTTO, Alessio (INFN)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **126** Type: **Parallel Sessions**

Development of LYSO detector modules for a charge-particle EDM polarimeter

Wednesday, 12 September 2018 17:00 (20 minutes)

The JEDI (Jülich Electric Dipole moment Investigations) collaboration carries out preparations, R&D and a first proof-of-principle measurement for the challenging project to measure permanent electric dipole moments of charged particles using a storage ring. In the long term, the experiments are targeted at the construction of a novel storage ring including a new polarimeter based on inorganic LYSO crystals and low voltage Silicon Photomultipliers (SiPMs). In order to find the best material and assembling configurations, more than 50 modules have been assembled in different set-ups so far. Modules have first been tested in the laboratory with internal and external radiation sources and subsequently, they have been examined under experimental conditions employing accelerator beams. We have performed five test beam times at several different beam energies using the new DAQ system, which was optimized for the new polarimeter. The results of these measurements and the accumulated experience of the module production will be presented.

Primary author: Mr SHERGELASHVILI, Dito (MA)

Presenter: Mr SHERGELASHVILI, Dito (MA)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **128** Type: **Parallel Sessions**

Simulation of Polarized Electron Interactions with Matter in the MeV Energy Range

Thursday, 13 September 2018 15:30 (20 minutes)

The effects of multiple interactions of electrons passing through matter cannot be calculated analytically, thus simulation tools have to be used to reliably model polarimetric measurements. A new method for simulation of polarized electron interactions, based on the commonly used Geant4 Monte Carlo package, will be presented.

In case of polarized electron beams in the MeV energy range, three main processes (listed in the order of importance) have to be considered: (i) Mott scattering (electron-nucleus), (ii) Møller scattering / ionization (electron scattering off atomic electrons) and (iii) bremsstrahlung emission. The Geant4 package includes models of Møller scattering and bremsstrahlung, that take into account electron polarization. However, polarization effects are not accounted for in the description of Mott scattering.

Therefore, a new model of Mott scattering for electrons, that can be used with Geant4 instead of the default description, has been created. The implementation uses scattering amplitudes from the ELSEPA package, which is a source of data for NIST reference database.

Reliability of the simulation has been proven by comparison with experimental data regarding the azimuthal asymmetry (effective Sherman function) in Mott scattering of polarized electron beams. Promising agreement with available data was found.

Presented results encourage the use of this code to obtain predictions for polarimetry in kinematical regions and conditions (energy, scattering angle, target material and thickness) where no measurements exist. Its usefulness is of particular value at the design stage of a polarimetric measurement. A comprehensive optimization of a measurement based on experimental studies would require collecting a large amount of data (e.g., the effective Sherman function has a complicated dependence on several parameters), which is no longer necessary provided a reliable simulation code.

Primary author: Mr DRAGOWSKI, Michal (University of Warsaw, Faculty of Physics)

Co-authors: Dr WEBER, Günter (Helmholtz Institut Jena); Prof. CIBOROWSKI, Jacek (University of Warsaw, Faculty of Physics); Dr ADAMUS, Marek (National Centre for Nuclear Research, Swierk); Dr WLODARCZYK, Marta (University of Warsaw, Faculty of Physics)

Presenter: Mr DRAGOWSKI, Michal (University of Warsaw, Faculty of Physics)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **129** Type: **Parallel Sessions**

First measurement of transverse single spin asymmetry for very forward pi0 production in polarized p+p collisions at sqrt{s} = 510 GeV

Monday, 10 September 2018 17:55 (25 minutes)

Non-zero transverse single spin asymmetry, AN, of forward pi0 production in the pseudo rapidity range of 3<eta<4 has been measured by various experiments so far and usually interpreted by hard process mechanism between polarized and unpolarized proton collisions. However, no clue can be found yet if there is a potential contribution from the soft process and recently larger AN was also observed when the pi0 was detected by more diffractive-like event at STAR experiment. The measurement of AN for very forward pi0 production in the range of 6<eta by RHICf experiment will provide a new insight on the origin of the non-zero AN, particularly from the view points of diffractive and non-diffractive interactions. To measure the very forward pi0 precisely, an electro-magnetic calorimeter was newly installed at STAR and data was taken in June, 2017. High position and energy resolution of the detector make the detailed AN study with wide kinematic range possible. In this presentation, we'll report our measurement of the very forward pi0 and its current analysis status on the AN depending on transverse momentum in different longitudinal momentum fraction ranges.

Primary author: Mr KIM, Minho (Korea University/ RIKEN)

Presenter: Mr KIM, Minho (Korea University/ RIKEN)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **130** Type: **Parallel Sessions**

COMPASS results on measurement of the spin-dependent structure function g_2 of the proton. (on behalf of the COMPASS Collaboration)

The spin-dependent structure function g_2 of the proton has been exacted by the COMPASS experiment (SPS, CERN) from DIS data collected in 2010 using 160 GeV/c muon beam and transversely polarized NH_3 target. Within the so-called Wandzura-Wilczek approximation, g2 can be related to the spin-dependent structure function g_1 while from the constraints imposed by Lorentz invariance relations, it is expected to be linked to the first k_T-moment of the g_{1T} TMD PDF.
The extraction of g_2 virtual photon-absorption asymmetry A_2 was based on the measurement of A_{T}^{cos(\phi_S)} asymmetry and on the available global fit results on g_1 and ratio of longitudinal and transverse photoabsorption cross sections R.
Compared to the previous measurements performed by SLAC and HERMES experiments, COMPASS covers larger kinematic range (0.003 < x < 0.9), providing access to the previously unexplored low-x domain.
In this talk COMPASS preliminary results on g_2 will be presented along with relevant details of the analysis and comparison with previous measurements.

Primary author: BRESSAN, Andrea (TS)

Presenter: BRESSAN, Andrea (TS)

Track Classification: Nucleon Helicity Structure

Contribution ID: **131** Type: **Parallel Sessions**

Twist-3 fragmentation contribution to single transverse-spin asymmetry in polarized hyperon production

We discuss the contribution of the twist-3 fragmentation function to the production of transversely polarized hyperons in unpolarized proton-proton collisions. In the framework of the collinear factorization, this contribution arise from the quark fragmentation correlators corresponding to the twist-3 quark fragmentation functions(FFs) and especially from the gluon fragmentation correlators corresponding to the twist-3 2-gluon and 3-gluon FFs. For the former contribution, we calculated the frame-independent cross-section by taking into account the constraint relations among twist-3 FFs which follow from the QCD equation-of-motion and the Lorentz invariance property of the nonlocal operators. In the same way, we derived the formalism for the later contribution by using collinear expansion and the equation-of-motion among twist-3 gluon FFs. In this talk, we first show the overview of the calculation of the twist-3 quark fragmentation contribution and then present our recent study for the twist-3 gluon fragmentation contribution.

Primary author: Mr YABE, Kenta (Niigata University)

Co-author: Prof. KOIKE, Yuji (Niigata University)

Presenter: Mr YABE, Kenta (Niigata University)

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **132** Type: **Parallel Sessions**

DIS on a polarized deuteron with spectator nucleon tagging

Thursday, 13 September 2018 17:00 (20 minutes)

Tagged DIS measurements on a polarized deuteron are possible at an electron-ion collider (EIC) with forward proton and neutron detectors. Using the pole extrapolation method, where one extrapolates to the on-shell pole of the struck nucleon, this would enable the extraction of high precision neutron (spin) structure functions in a wide range of x, Q^2. We outline the general form of the SIDIS cross section on a polarized spin 1 target, which has 41 structure functions. We show calculations in a factorized model using the NN light-front wave function for the deuteron for unpolarized and polarized observables, with focus on the extraction of g1 for the quasi-free neutron at an EIC. We discuss the influence of nuclear final-state interactions and shadowing effects on observables and comment on possible extensions such as medium modifications, exclusive channels and nuclei with A>2.

Primary author: COSYN, Wim (Ghent University)

Co-author: WEISS, Christian (Jefferson Lab)

Presenter: COSYN, Wim (Ghent University)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **133** Type: **Parallel Sessions**

Studying Neutral Current Elastic Scattering and the Strange Axial Form Factor in MicroBooNE

Tuesday, 11 September 2018 14:30 (35 minutes)

One of the least constrained contributions to the neutral current (NC) elastic neutrino-proton cross section is the strange axial form factor, which represents the strange quark spin contribution to the spin structure of the proton. This becomes the net strange spin contribution, Δs, in the limit when the negative four-momentum transfer squared (Q^2) is zero. The strange axial form factor can be determined by studying NC elastic scattering events in the MicroBooNE detector. MicroBooNE's unique ability to detect low-energy protons is expected to allow the reconstruction of these events with a Q^2 as low as 0.10 GeV^2 and to determine the strange axial form factor in a model-independent approach. We present a selection of neutral current elastic events in a subset of MicroBooNE neutrino data, as well as our plan to extract the strange part of the axial form factor and Δs from this selection in the full data set.

Primary author: WOODRUFF, Katherine (New Mexico State University)

Presenter: WOODRUFF, Katherine (New Mexico State University)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **134** Type: **Parallel Sessions**

Opportunities with light ions at the EIC

The Electron-Ion Collider (EIC) is intended to be the next-generation US facility for the study of the strong interaction. Its unique capability to accelerate beams of polarized protons and light nuclei, as well as unpolarized nuclei over the full mass range, will, for the first time, make it possible to directly probe the gluon fields that bind nuclei. Excellent near-beam detection of scattered ions and spectator particles will also provide particularly rich physics opportunities with light ions. These will not only include precise measurements of neutron structure through precise tagging of the proton spectator(s), but also coherent diffractive processes on light nuclei, where the intact nucleus can be detected directly, making the separation from incoherent backgrounds straightforward. Here it is of interest to note that light nuclei span a very wide range of density, with deuterium being the least dense nucleus and He-4 being comparable to the heaviest ones). But equally compelling is that He-3, and possibly deuterium, could also be polarized, making it possible to measure the 3D structure of nuclei (e.g., nuclear GPDs), in a way analogous to that of the proton. And while scatting on light nuclei does not provide as large a boost to gluon density ("oomph factor") as for heavy nuclei, the detailed understanding of the light nuclei allows for a more precise description of shadowing and the onset of gluon saturation. This talk will give an overview of the physics opportunities with light ions at an EIC and discuss the experimental requirements for the various processes.

Primary author: Dr NADEL-TURONSKI, Pawel (Jefferson Lab)

Presenter: Dr NADEL-TURONSKI, Pawel (Jefferson Lab)

Track Classification: Future Facilities and Experiments

Contribution ID: **135** Type: **Parallel Sessions**

The Polarized Target at the CBELSA/TAPS Experiment

Tuesday, 11 September 2018 15:10 (20 minutes)

In 2017, the polarized target system from Mainz/Dubna and Bonn were combined for data taking in Bonn. After testing the combined system, the experiment with the new polarized frozen-spin target and the upgraded Crystal Barrel detector started in winter 2017. First data with a transversal proton target were already taken.
In the meantime, the polarized target group at Bonn is building a continuous 4π polarized target. To get high target polarizations and long relaxation times, low temperatures are indispensable. This system will be able to reach temperatures below 30 mK and allows the use of an internal polarisation magnet. As an optimizing tool for the construction of dilution refrigerators and to gain detailed informations about the different incoming and outgoing fluid streams, several CFD-simulations were done. Thus, it was possible to calculate the performance of the precooling stages. First tests showed, that these simulations can be used to calculate the performance of the different heat exchangers. Nevertheless, some improvements of the model are ongoing.

Primary author: Dr RUNKEL, Stefan (polarized Target, University of Bonn)

Presenter: Dr RUNKEL, Stefan (polarized Target, University of Bonn)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **136** Type: **Parallel Sessions**

Measurements of azimuthal asymmetries on unpolarized protons

Wednesday, 12 September 2018 14:30 (25 minutes)

In 2016 and 2017 the COMPASS Collaboration has measured 160 GeV/c muon scattering on a 2.5 m long liquid Hydrogen target. The main goal of the measurement was to access GPDs via the deeply virtual Compton Scattering (DVCS) process, but in parallel SIDIS data were collected to investigate the azimuthal modulations of the hadron lepto-production cross-section. In this talk we present preliminary results from part of the 2016 data on the cos(phi) and cos(2phi) modulations, where the angle phi is the azimuthal angle of the hadron in a reference system with the z-axis along the virtual photon direction, the x-z plane is the lepton scattering plane and the positive x-direction along the lepton transverse momentum. The new preliminary results are compared with the existing published data.

Primary author: Mr MORETTI, Andrea (University of Trieste / INFN)

Presenter: Mr MORETTI, Andrea (University of Trieste / INFN)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **138** Type: **Parallel Sessions**

Transversity and Lambda polarization in polarized semi-inclusive DIS at COMPASS

Thursday, 13 September 2018 17:20 (20 minutes)

One among the several methods proposed to access the transversity function h_1^q(x) in semi-inclusive DIS is the measurement of Lambda hyperons polarization, which can be quantified by studying the angular distribution of the proton emitted in the self-analyzing Lambda -> p pi^- decay. The struck quark inherits the transverse polarization of the target with a proportionality factor given by the ratio of h_1^q(x) with the unpolarized parton distribution function f_1^q(x). The transverse polarization of the initial quark is transferred to the fragmenting final quark in lepton-quark hard scattering, thus the polarization of the Lambda, measured with respect to the final quark spin axis, can carry information on transversity. Nowadays transversity is already quite well known for u and d quarks as it has been extracted from Collins and dihadron asymmetries, so that a Lambda polarization different from zero can be used to infer a possible transversity distribution for the s quark h_1^s(x), as well as information on the chiral-odd fragmentation function H_1^{Lambda,q}.
The results obtained in COMPASS using data collected with a transversely polarized proton target will be shown in this talk, together with possible interpretations and with perspectives for the future COMPASS deuteron run to be held in 2021.

Primary author: MORETTI, Andrea (TS)

Presenter: MORETTI, Andrea (TS)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **140** Type: **Parallel Sessions**

Spin and kinematic correlations between partons inside the proton

Thursday, 13 September 2018 14:30 (25 minutes)

In processes where two quarks are extracted from the proton to enter two separate hard scatterings (double parton scattering), the interparton correlations can have an impact on the size of the cross section and significantly alter the distributions of particles in the final state.
In this work, we employ different models for the double parton distributions (DPDs) to study the quantum correlation between the spin of two quarks and the kinematic correlation between their longitudinal momentum fractions. We focus on the production of a pair of W bosons with the same electric charge and identify observables particularly promising for the experimental measurement of correlations at the LHC.

Primary author: Ms COTOGNO, Sabrina (Vrije Universiteit Amsterdam and Nikhef)

Presenter: Ms COTOGNO, Sabrina (Vrije Universiteit Amsterdam and Nikhef)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **141** Type: **Parallel Sessions**

The polarized injection system for MESA

Monday, 10 September 2018 14:30 (20 minutes)

Several extensions are being realized for the new MESA accelerator at Mainz university in comparison to the already existing injection system at MAMI. The new device is operating at 100keV beam energy and is called the Mesa Low-energy Beam Apparatus (MELBA). A new polarized source of the inverted type with increased extraction gradient has been build which is able to provide good beam quality at average currents of 1mA. MELBA also comprises a flexible spin rotation system and a double scattering Mott polarimeter. An overview of the different features is given and first results are discussed

Primary author: Dr AULENBACHER, Kurt (Institut für Kernphysik der Johannes Gutenberg-Universität Mainz)

Co-authors: Mr MATEJCEK, Christoph (Institut für Kernphysik der Johannes Gutenberg-Universität Mainz); Mr MOLITOR, Matthias (Institut für Kernphysik der Johannes Gutenberg-Universität Mainz); Mr HEIL, Philipp (Institut für Kernphysik der Johannes Gutenberg-Universität Mainz); Mr FRIEDERICH, Simon (Institut für Kernphysik der Johannes Gutenberg-Universiät Mainz); Dr TYUKIN, Valery (Inst. of Nuclear Phys, University Mainz, Germany)

Presenter: Dr AULENBACHER, Kurt (Institut für Kernphysik der Johannes Gutenberg-Universität Mainz)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **142** Type: **Parallel Sessions**

Neutron Electric Dipole Moment Searches

Wednesday, 12 September 2018 15:10 (40 minutes)

Since several decades people search for the electric dipole moment (EDM) of the neutron, an unambiguous manifestation of parity (P) and time reversal symmetry (T) violation. Assuming the conservation of CPT, T violation in a fundamental system also means CP violation. This has only been observed in very few systems in the Standard Model of particle physics (SM) as a tiny effect. However, it would be needed in much larger quantities to help explain the matter-antimatter asymmetry in the Universe. With a long history of innovation and persistence, the neutron EDM dn is now limited to below 3·10−26 e·cm, an extraordinarily small number, corresponding to an energy resolution of 10-22 eV. As a complementary system among a variety of possible options, it is still a very promising candidate due to its comparably simple composition, needed to understand the underlying fundamental physical processes. In this talk I will discuss experimental efforts and challenges to develop a next generation of neutron EDM searches, with one focus on magnetic fields and their implications for other precision experiments.

Primary author: Prof. FIERLINGER, Peter (TU München)

Presenter: Prof. FIERLINGER, Peter (TU München)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **143** Type: **Parallel Sessions**

Design and calculation of the 4Pi-Continuous-Mode-Target current leads

Tuesday, 11 September 2018 14:50 (20 minutes)

The new concept of the "4π-Continuous-Mode-Target" will allow for the first time the simultaneous usage of a large angular acceptance detector with a continuously polarised target. For polarising a target the process of Dynamic Nuclear Polarisation (DNP) is used which requires low temperatures and a high homogeneous magnetic field within the target volume. A thin, superconducting magnet as a part of the new horizontal cryostat creates a longitudinal magnetic field of \SI{2.5}{\tesla} with a field homogeneity of 10^{-4}. Since the internal superconducting magnet is operated with a high direct current there has to be two current leads for connecting the magnet terminals found in the low temperature region to the power supply located at room temperature. Due to \emph{Fourier's Law} and joule heating a current lead can be a large heat load on the magnet and the cryostat. As the magnet is operated near its critical parameters, it is important to reduce the heat flux to the superconducting wire to an absolute minimum. The geometry of the normal conducting part of these current leads has been adapted to the cryostat requirements and has been optimised to minimise the heat load. A FEM calculation has been additonally used to check the fulfillment of the requirements.

Primary author: Mr BORNSTEIN, Marcel (Physikalisches Institut Universität Bonn)

Presenter: Mr BORNSTEIN, Marcel (Physikalisches Institut Universität Bonn)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **144** Type: **Poster**

Neutron Spin Structure, Yang-Mills Theory, and the Mass Gap

An analysis of proton structure and spin based upon an electromagnetic model of geometric wavefunction interactions was presented to Spin 2016 [1]. A key point of that analysis was the supposition that only observed components of the eight-component Pauli wavefunction (electric charge, magnetic flux quantum, and magnetic moment) comprise the stable proton wavefunction. The dark components (magnetic charge, electric flux quantum, electric moment) cannot couple to the photon due to topological symmetry breaking of pseudoscalar magnetic charge[2]. Their impedance mismatch to the vacuum wavefunction and the resulting differential phase shift is the causal agent of decoherence, rendering wavefunctions containing dark components unstable[3, 4]. An unstable neutron wavefunction might then be extracted from the S-matrix by swapping one or more dark components for visible. Several possibilities exist. This Spin 2018 abstract submission[5] proposes to explore those possibilities, in hope of extending the Spin 2016 analysis to the neutron geometric wavefunction, thereby improving understanding of the anomalous moment[6] and illuminating the foundation of this Yang-Mills isospin pair[7].

[1] M. Suisse and P. Cameron, "Quantum Interpretation of the Proton Anomalous Magnetic Moment" in Proceedings of 22nd International Spin Symposium, Urbana-Champaign (2016). As of this writing the proceedings have not yet appeared.
The poster may be found here http://vixra.org/abs/1609.0422
and the companion video here https://www.youtube.com/watch?v=uyM4cZgSprI&t=19s
[2] E. Witten, "Duality, Spacetime, and Quantum Mechanics", Physics Today, p.28-33 (May 1997)
[3] P. Cameron, "Generalized Quantum Impedances: A Background Independent Model for the Unstable Particles" (2012)
http://arxiv.org/abs/1108.3603
[4] P. Cameron, "Impedance Representation of the S-matrix: Proton Structure and Spin from an Electron Model", accepted for presentation at 22nd International Spin Symposium, Urbana-Champaign (2016). http://vixra.org/abs/1605.0150
[5] http://spin2018.unife.it/
[6] M. Suisse and P. Cameron, "Quantum Interpretation of the Neutron Anomalous Magnetic Moment", submitted to Spin 2018.
[7] http://www.claymath.org/sites/default/files/yangmills.pdf

Primary author: CAMERON, peter (Independent Researcher)

Presenter: CAMERON, peter (Independent Researcher)

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **145** Type: **Parallel Sessions**

3D structure from JLab12 to EIC

Thursday, 13 September 2018 15:50 (20 minutes)

The study of the 3D nucleon structure by probing the transverse momentum dependent (TMD) distributions of partons in Semi-Inclusive DIS is widely accepted as one of the main goals of the future Electron Ion Collider (EIC).
Much wider kinematical coverage, and in particular higher PT and Q2, would allow validating and extending studies of evolution properties of TMDs planned at JLab12, and access the sea and gluon distributions. The EIC would allow much better separation of current fragmentation and target fragmentation regions than JLab12, and due to high polarization of electrons and protons is a natural choice for measurements of different spin dependent observables in a full range of accessible kinematics. EIC provides also a unique possibility for detection of hadrons produced in the target fragmentation region, providing a new avenue for studies of the non-perturbative structure of the nucleon in correlations of hadrons produced in DIS regime.

Primary author: Dr AVAGYAN, Harut (Jefferson Lab)

Presenter: Dr AVAGYAN, Harut (Jefferson Lab)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **146** Type: **Parallel Sessions**

Searches for Atomic Electric Dipole Moments

Tuesday, 11 September 2018 14:30 (40 minutes)

Based on fundamental symmetries, we would naively expect the permanent electric dipole moment (EDM) of atoms to be identically zero. This is because EDMs are symmetric under time reversal, while the spin of the atom is not, and so any particle having spin and an EDM correlated to that spin would violate time reversal symmetry, as well as parity. Due to the CPT theorem, EDMs also violate CP-symmetry, which is the combination of charge-conjugation and parity symmetries. However, the baryon asymmetry of the universe strongly suggests that there are yet undiscovered sources of CP-violation in nature. Thus, theories of physics beyond the Standard Model generically anticipate new sources of CP-violation to explain the existence of matter, and consequently also predict non-zero EDMs. Thus, searches for EDMs are sensitive tests of new physics models. As there are many possible ways to add CP-violation to the Standard Model, it is critical to have many parallel searches to properly constrain the phase space. Here, I will give an overview of some of those searches, their impact on searches for BSM physics, and discuss some future directions. My work is supported by the U.S. DOE, Office of Science, Office of Nuclear Physics, under contract DE-AC02-06CH11357.

Primary author: Dr DIETRICH, Matthew (Argonne National Laboratory)

Presenter: Dr DIETRICH, Matthew (Argonne National Laboratory)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **147** Type: **Parallel Sessions**

POLARIZATION STUDIES FOR THE eRHIC ELECTRON STORAGE RING

Thursday, 13 September 2018 17:00 (20 minutes)

A hadron/lepton collider with polarized beams has been under consideration by the scientific community since some years, in the U.S. and Europe. Among the various proposals, those by JLAB and BNL with polarized electron and proton beams are currently under closer study in the U.S. In the BNL Ring-Ring design electrons are stored at top energy in a ring to be accommodated in the existing RHIC tunnel. The transversely polarized electron beam is injected into the storage ring at variable energies, between 5 and 18 GeV. Polarization is brought into the longitudinal direction at the IP by a couple of spin rotators. In addition experimenters call for the simultaneous storage of electron bunches with both spin helicity. In this paper studies of the attainable beam polarization level and lifetime in the storage ring at 18 GeV are presented.

(*) This manuscript has been authored by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359
with the U.S. Department of Energy, Office of Science, Office of High Energy Physics.

Primary author: GIANFELICE-WENDT, Eliana (Fermilab)

Presenter: GIANFELICE-WENDT, Eliana (Fermilab)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **148** Type: **Parallel Sessions**

Spin dynamics in storage rings in application to searches for EDM

Tuesday, 11 September 2018 17:20 (40 minutes)

Understanding high precision spin dynamics in storage rings is one of major concerns for the JEDI collaboration's EDM experimentation at COSY. We report here recent results on the impact of synchrotron oscillations on spin rotations at large spin coherence time needed for enhancing feeble EDM signal. A particular emphasis will be on salient features of the Spin Echo phenomenon in storage rings . We also review briefly a recent activity in studies of the gravity induced background to the EDM signal in all-electric magic rings.

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

Co-authors: Dr SALEEV, Artem (IKP, Forschungszentrum Juelich); Prof. RATHMANN, Frank (IKP, Forschungszentrum Juelich)

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

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **149** Type: **Parallel Sessions**

Search for Exotic Gluonic States in the Nucleus via Polarized Deep Inelastic Scattering

Thursday, 13 September 2018 17:40 (20 minutes)

Although crucial to our understanding of nuclear structure, probes of gluonic components in the nucleus can be elusive, as gluons are accessed only indirectly in deep inelastic scattering. In 1989, Jaffe and Manohar identified a gluonic transversity structure function Delta(x,Q^2) which is sensitive to exotic gluonic states in the nucleus, and is accessible via an inclusive measurement on a transversely polarized nucleus of spin greater than or equal to 1. We are developing an experiment to utilize Jefferson Lab's 12 GeV electron beam with a transversely polarized 14N target to mount a first measurement of the Delta structure function. The Jefferson Lab experiment will probe Delta from from x of 0.3 to 0.05, but the vast kinematic reach of an electron-ion collider would allow a thorough probe of this quantity. We will discuss the impact of exciting new lattice QCD results on this quantity, our proposal to measure Delta(x,Q^2) at JLab, and what a measurement might look like at an EIC.

Primary author: Dr MAXWELL, James (Dr.)

Presenter: Dr MAXWELL, James (Dr.)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **150** Type: **Parallel Sessions**

Ratios of helicity amplitudes for exclusive rho0 electroproduction on transversely polarized protons

Tuesday, 11 September 2018 17:50 (35 minutes)

Results from the study of exclusive ρ0-meson electroproduction by the HERMES experiment, using the 27.6 GeV longitudinally polarized electron/positron beam of HERA and a transversely polarized hydrogen target, are presented. In analysis of the angular dependence of the distribution of the decay pions, 25 parameters are extracted, which determine the real and imaginary parts of the ratios of several helicity amplitudes describing ρ0-meson production by a virtual photon. The transverse target polarization allows for the first time the extraction of ratios of a number of nucleon-helicity-flip amplitudes. Results obtained in a handbag approach based on generalized parton distributions taking into account the contribution from pion exchange are found to be in good agreement with these ratios. Within the model, the data favor a positive sign for the $\pi-\rho$ transition form factor. By also exploiting the longitudinal beam polarization, a total of 71 ρ0 spin-density matrix elements is determined from the extracted 25 parameters, in contrast to only 53 elements as directly determined in earlier analyses.

Primary author: SCHNELL, Gunar (University of the Basque Country UPV/EHU)

Presenter: SCHNELL, Gunar (University of the Basque Country UPV/EHU)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **151** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Self-polarization in Storage Rings

Wednesday, 12 September 2018 11:30 (40 minutes)

The possibility of electrons becoming polarized in an uniform field was
predicted in the early 60s by Loskutov, Korovina, Sokolov and Ternov
(Sokolov-Ternov effect of radiative polarization).
The very first observation of beam self-polarization followed in 1968 at
ACO in Orsay and confirmed at Novosibirsk
VEPP-2 in 1970.
However in particular at high energy, e+− polarization is not really for free and in addition experiments
are mainly interested on longitudinal polarization. This is obtained through spin rotators
which may lead to depolarization.
The p/e+− high energy collider HERA in Hamburg was the first, and until now the only one, designed for delivering
longitudinal e+− polarization to the experiments.
In my talk I will give an overview of the theory behind radiative polarization in high energy storage rings
and I will describe the tools needed for fostering high polarization in practice.
Results from beam polarization observations, mainly at HERA, will be presented.

This manuscript has been authored by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359
with the U.S. Department of Energy, Office of Science, Office of High Energy Physics.

Primary author: GIANFELICE-WENDT, Eliana (Fermilab)

Presenter: GIANFELICE-WENDT, Eliana (Fermilab)

Session Classification: Plenary

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **152** Type: **Parallel Sessions**

Present and future prospects for lattice QCD calculations of matrix elements for nEDM

Wednesday, 12 September 2018 17:20 (40 minutes)

In this talk, I will review the opportunities for and challenges to calculating all CP violating operators up to dimension 6 that contribute to the neutron EDM. These include the Theta-term, quark EDM, quark chromo EDM, Weinberg and 4-quark operators. Major focus of the talk will be on evaluating the numerical signal and renormalization and mixing between operators. Results for the quark EDM operators and their phenomenological consequences will be presented.

Primary author: Dr GUPTA, Rajan (Los Alamos National Lab)

Presenter: Dr GUPTA, Rajan (Los Alamos National Lab)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **153** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Lattice QCD calculations of the quark and gluon contributions to the proton spin

Friday, 14 September 2018 11:30 (40 minutes)

The remarkable result, from the measurements of spin asymmetry in polarized deep inelastic scattering by the EMC collaboration, that the sum of the spins of the quarks contributes less than half of the total spin of the proton lay down the challenge to explain this "proton spin crisis"from QCD. I will show that calculations of the required matrix elements using Lattice QCD are now in a position to provide first principle results with all systematics under control and the steady reduction in the error budget. The most well determined of the contributions is of the quark's intrinsic spin. Existing lattice results will be reviewed and compared with current phenomenological/experimental estimates.

Primary author: Dr GUPTA, Rajan (Los Alamos National Lab)

Presenter: Dr GUPTA, Rajan (Los Alamos National Lab)

Session Classification: Plenary

Track Classification: Nucleon Helicity Structure

Contribution ID: **154** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Experimental overview of Transverse Momentum Distributions and Momentum Effects

Tuesday, 11 September 2018 09:40 (40 minutes)

In the last decade, new Transverse Momentum Dependent parton distributions and fragmentation functions have been introduced to account for the complexity of the hadron structure, taking into account the parton transverse degrees of freedom. In parallel, new channels of investigation have been developed such as, in DIS, the study of semi-inclusive deep-inelastic-scattering reactions, where hadrons from the struck quark are observed in conjunction with the scattered lepton, or, in polarized hadron interactions, the study of the lepton distributions from Drell-Yan reactions as well as vector bosons and jet productions. Such measurements have become possible by the parallel evolution of the experimental apparatuses. Studies of the parton distribution functions which encode transverse momentum information are currently driving the upgrades of several existing facilities (Jefferson Lab, COMPASS and RHIC), and having an important role in the design and construction of new facilities worldwide (EIC, FAIR, NICA and JPARC).
Here I will present a selection of the available observations obtained both with electromagnetic and hadronic probes and show perspective for the upcoming measurements at ongoing or planned experiments.

Primary author: BRESSAN, Andrea (TS)

Presenter: BRESSAN, Andrea (TS)

Session Classification: Plenary

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **155** Type: **Parallel Sessions**

Recent activities of the Bonn Polarized Target Group

Tuesday, 11 September 2018 14:30 (20 minutes)

In my talk, I will present the actual status of our projects with special focus on the first results of the dynamic polarizability of radiation-doped polypropylene in a dilution refrigerator under frozen spin conditions. Briefly, I will present new ideas and concepts for high field internal magnets for polarized target applications.

Primary author: Dr DUTZ, Hartmut (Universität Bonn)

Presenter: Dr DUTZ, Hartmut (Universität Bonn)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **156** Type: **Parallel Sessions**

Measurement of Vector and Tensor Asymmetries in Quasielastic Electron Scattering from Deuterium

Monday, 10 September 2018 17:00 (20 minutes)

The measurement of the beam-vector and tensor asymmetries in quasielastic electrodisintegration of the deuteron at the MIT-Bates Linear Accelerator Center up to missing momentum of 500 MeV/c. Data were collected simultaneously over a momentum transfer range 0.1 < Q2 < 0.5 (GeV/c)2 with the Bates Large Acceptance Spectrometer Toroid using an internal deuterium gas target, polarized sequentially in both vector and tensor states. The data are compared with calculations. The beam-vector asymmetry is found to be directly sensitive to the D-wave component of the deuteron and have a zero-crossing at a missing momentum of about 320 MeV/c, as predicted. The tensor asymmetry A at large missing momentum is found to be dominated by the influence of the tensor force in the neutron-proton final-state interaction. The new data provide a strong constraint on theoretical models.

Primary author: Prof. MILNER, Richard (MIT)

Presenter: Prof. MILNER, Richard (MIT)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **157** Type: **Parallel Sessions**

Forces inside hadrons: pressure, surface tension, mechanical radius, and all that

Monday, 10 September 2018 14:30 (35 minutes)

The physics related to the form factors of the energy momentum tensor spans a wide spectrum of problems, and includes gravitational physics, hard exclusive reactions, hadronic decays of heavy quarkonia, and the physics of exotic hadrons described as hadroquarkonia. It also provides access to the "last global unknown property:" the D-term. We review the physics associated with the form factors of the energy-momentum tensor and the D-term, their interpretations in terms of mechanical properties, their applications, and the current experimental status.

Primary author: Prof. POLYAKOV, Maxim (Ruhr-Universität Bochum)

Co-author: Prof. SCHWEITZER, Peter (University of Connecticut)

Presenter: Prof. POLYAKOV, Maxim (Ruhr-Universität Bochum)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **158** Type: **Parallel Sessions**

Storage of polarized ultracold neutrons

Thursday, 13 September 2018 15:45 (25 minutes)

Experiments searching for a permanent electric dipole moment of the neutron (nEDM) aim at discovering new sources of CP violation beyond the Standard Model of particle physics and understanding the origin of the matter-antimatter asymmetry of the Universe.
In recent experiments, polarized ultracold neutrons are stored in material bottles, subject to a strong electric field and a weak stable an uniform magnetic field.
The longer the storage time of the polarized neutrons, the better the sensitivity of the measurement.
In order to keep the final polarization as high as possible, all depolarization mechanisms must be understood and minimized.
In the experiment that was taking nEDM data in 2015-2016 at the Paul Scherrer Institute (PSI), a final polarization of 0.75 was obtained, after a storage time of 180~s.

We will review the main depolarization mechanisms of stored ultracold neutrons: the depolarization at wall collisions and the depolarization due to
residual magnetic field non-uniformity.
Dedicated measurements at PSI allowed to verify the theoretical predictions for the magnetic depolarization.
In particular we used a spin-echo technique that we invented to separate the different depolarization sources.

Primary author: Dr PIGNOL, Guillaume (Université Grenoble Alpes)

Presenter: Dr PIGNOL, Guillaume (Université Grenoble Alpes)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **159** Type: **Parallel Sessions**

Status of the P2 Experiment: A Measurement of the Weak Mixing Angle at Low Energy

Monday, 10 September 2018 15:50 (20 minutes)

The P2 collaboration prepares a precise determination of the weak mixing angle at low energy at the upcoming MESA accelerator in Mainz. The projected relativce accuracy is 0.15% which is comparable to the existing measurements at the Z-pole. This accuracy will allow for a test of the Standard Model up to a mass scale of 50 TeV.

The experimental method, the measurement of the parity violating asymmetry in the scattering of polarized electrons off unpolarized protons, will be discussed along with the challenging experimental techniques associated with such a precision goal. The status of the project will be reported.

Primary author: BAUNACK, Sebastian (JGU Mainz)

Presenter: BAUNACK, Sebastian (JGU Mainz)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **160** Type: **Parallel Sessions**

Transverse Single Spin Asymmetries in Electron Scattering on Hydrogen Targets

Tuesday, 11 September 2018 14:50 (20 minutes)

The asymmetry in the scattering of transversely polarized electrons off unpolarized protons or deuterons arises from the imaginary part of the two-photon exchange amplitude. The A4 collaboration at the MAMI accelerator has performed measurements at various beam energies between 300 MeV and 1.5 GeV both at forward and backward angles. We present an overview about published data and unpublished preliminary results in the elastic scattering and discuss future analyses for inelastic asymmetries in the resonance region.

Primary authors: Dr GOU, Boxing (Helmholtz-Institut Mainz); Dr BAUNACK, Sebastian (Institut für Kernphysik, Johannes Gutenberg-Universität Mainz)

Presenter: Dr GOU, Boxing (Helmholtz-Institut Mainz)

Session Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Track Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Contribution ID: **161** Type: **Parallel Sessions**

Studying nucleon structure via Double Deeply Virtual Compton Scattering (DDVCS)

Monday, 10 September 2018 15:40 (30 minutes)

Study of the structure and dynamics of the nucleon has been recently deeply renewed with the advent of an universal parameterization of the partonic structure of the nucleon in terms of the Generalized Parton Distributions (GPDs). Encoding the correlations between the elementary constituents of the nucleon, GPDs allows a 3-dimensional imaging of the nucleon from the dynamical link between the transverse position and the longitudinal momentum of partons.
Double Deeply Virtual Compton Scattering (DDVCS) corresponds to the scattering from the nucleon of a virtual photon that finally generates a lepton pair $ep \to ep\gamma^* \to epl^+l^-$ where the final leptons can be either an e^+e^- or a $\mu^+\mu^-$ pair. The virtuality of the final photon allows investigating in a decorrelated way the initial and transferred momentum dependences of the GPDs, as opposed to Deeply Virtual Compton scattering (DVCS) accessing unambiguously GPDs in a correlated way. This unique feature of DDVCS allows investigation of the transferred momentum dependence of GPDs which is of relevance, among others, for the determination of the transverse parton densities and the distribution of nuclear forces.
This presentation will discuss model-predicted DDVCS experimental observables at different kinematical regimes (JLab 12 GeV, EIC) and will address the impact of potential DDVCS experiments.

Primary author: Mr ZHAO, Shengying (Institut de Physique Nucléaire Orsay)

Presenter: Mr ZHAO, Shengying (Institut de Physique Nucléaire Orsay)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **162** Type: **Parallel Sessions**

The STAR Forward Rapidity Upgrade

Wednesday, 12 September 2018 17:40 (20 minutes)

The STAR experiment is planning to upgrade the forward rapidity region (2.5 < eta < 4.5) to enable novel measurements in pp, pA and AA collisions. The STAR forward upgrade is motivated by exploration of cold QCD physics in the very high and low regions of x. But it is specifically noted that the forward upgrade will also provide new detector capabilities at RHIC and STAR to explore the longitudinal structure of the initial state and the temperature dependent transport properties of matter in relativistic heavy ion collisions.
The current design of the forward upgrade consists of a Calorimeter System (FCS) integrating the refurbished PHENIX sampling electromagnetic Calorimeter and a hadronic calorimeter made of a sandwich iron scintillator plate sampling type. In addition to the FCS, a Forward Tracking System (FTS) is also proposed. The FTS must be capable of discriminating hadron charge sign in pp and pA collisions. In heavy ion collisions, it should be able to measure transverse momentum of charged particles in the range of 0.2<pT< 2 GeV/c with 20-30% momentum resolution. The FTS-system combines 3 Silicon mini-strip disks and 4 Small-Strip Thin Gap Chamber (sTGC) wheels ala ATLAS. The talk will highlight the physics opportunities enabled by these upgrades.

Primary authors: Dr ASCHENAUER, Elke-Caroline (BNL); Prof. BARISH, Kenneth (UC Riverside)

Presenter: Prof. BARISH, Kenneth (UC Riverside)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **163** Type: **Parallel Sessions**

Polarization measurements for hadron beams in colliders.

Wednesday, 12 September 2018 15:50 (20 minutes)

This talk will discuss the methods and challenges to make a high-precision measurement of hadron polarization in a high collision frequency and luminosity future electron ion colliders.

Primary author: Dr ASCHENAUER, Elke-Caroline (BNL)

Presenter: Dr HUANG, Haixin (Brookhaven National Lab)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **164** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Nuclear Spin Physics via Polarization Measurements

Tuesday, 11 September 2018 09:00 (40 minutes)

One of the primary goals of nuclear physics is to describe nuclei and their dynamics in terms of interactions between nuclear constituents.
In addition, high-precision experimental data and sophisticated theoretical calculations are very important for other research fields such astrophysics and neutrino physics.
In this talk, three topics will be discussed by comparing experimental data with recent sophisticated calculations; three-nucleon force (3NF) effects in few nucleon systems and
nuclear medium effects of nucleon-nucleon (NN) interactions, polarization phenomena and spin-isospin responses for the quest for a comprehensive description of nuclei, and applications of nuclear physics data and calculations for nuclear equation-of-state (EOS) and neutrino-less
double beta-decay nuclear matrix element (NME).

Primary author: Prof. WAKASA, Tomotsugu (Kyushu University)

Presenter: Prof. WAKASA, Tomotsugu (Kyushu University)

Session Classification: Plenary

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **165** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Nucleon Femtography from Exclusive Reactions

Wednesday, 12 September 2018 09:00 (40 minutes)

With the tantalizing search of the phase space available for supersymmetric particles turning out empty handed, we are on the verge of new profound paradigm changing discoveries where the strong interactions sector is once again taking on a leading role.
I will discuss deeply virtual exclusive processes as probes for the next frontier that will allow us to access dynamically correlated distributions in both momentum and coordinate space – the Wigner distributions – at the femtoscale. I will explain how a detailed phase space mapping of the quarks and gluons in both the nucleon and the atomic nucleus, besides providing for the first time images of quarks and gluons spatial distributions, is essential for understanding the so far elusive nucleon mass and spin decompositions in terms of its quark and gluon components.

Primary author: Dr LIUTI, simonetta (University of Virginia)

Presenter: Dr LIUTI, simonetta (University of Virginia)

Session Classification: Plenary

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **166** Type: **Parallel Sessions**

Progress toward spin-polarized fusion: Performance of laser-polarized He-3 during permeation into tokamak pellets

Wednesday, 12 September 2018 17:30 (25 minutes)

The possibility of spin-polarized fusion was introduced a few decades ago with the promise of a 50 % boost in the fusion cross section between Deuterium (D) and Tritium (T) in reaction D + T ⟶ He-5 ⟶ α + n. The same enhancement is expected in the isospin-mirrored fusion reaction, D + He-3 ⟶ Li-5 ⟶ α + p. This increase occurs if both nuclei fuse when their spins are parallel –i.e. fully polarized along the local magnetic field. However, to date, demonstration of spin polarized fusion in a tokamak reactor has not yet been carried out due to several logistical challenges. In particular, delivering polarized fuels to the plasma core has lacked a suitable method for encapsulating the fuel for tokamak injection. A multi-center collaboration, including Jefferson Lab, University of Virginia, and DIII-D/General Atomics, is planning the first direct test in the DIII-D tokamak in San Diego, using the mirror reaction D + He-3 ⟶ α + p. This proof-of-principle experiment would use inertial confinement fusion (ICF) pellets containing either polarized D (in the form of solid HD) or polarized He-3, which would be injected directly into the plasma core. The polymer shell ICF pellets can be filled by permeation at high temperatures and sealed by cooling. Deuterium can be permeated through the shell wall and then polarized using standard nuclear physics protocols; however, loading the pellet with polarized He-3 is more challenging, since He-3 must be polarized first (e.g. by spin-exchange optical pumping) and then permeated through the shell wall. Permeating He-3 is inherently prone to depolarization mechanisms such as collisions with the material of the pellet wall. Once permeated, it naturally decays to its thermal equilibrium polarization level with spin-relaxation time constant T1. He-3 must have sufficiently long T1 within the shell to allow for a practical injection sequence.

Previously, we presented preliminary results on performance of spin-polarized He-3 permeation through the ICF pellets as well as survival rate of the polarization inside the pellet. In this talk, we present recent advancements in optimizing permeation and polarization survival rate, using magnetic resonance imaging in a clinical 1.5T scanner. A 0.5-mm spatial resolution, which is sufficient for resolving the 2-mm diameter pellets used in this study, was achieved by using specially designed RF coils and chemical shift imaging (CSI) MRI pulse sequences. CSI is ideal for separately measuring signals generated by He-3 inside and outside the pellet. The presence of the pellet creates magnetic susceptibility-induced off-resonance effects such that gas inside the pellet has a slightly different precession frequency as compared to the gas outside, which enables us to track their relative concentrations over time independently. This allows us to extract two critical parameters: polarization loss during permeation and lifetime (T1) of polarized He-3 inside the pellet. We have found that the polarization loss during permeation depends on pellet wall thickness; the thinner the pellet wall, the higher polarization transfer success rate, as polarized He-3 nuclei face fewer depolarizing influences within the pellet material while permeating. For pellets with wall thickness of 15 μm, we are able to retain 91 +/- 10% of the polarization during the permeation process, and T1 = 35 +/- 7 minutes inside the pellet at room temperature. The polarization survival drops to ~ 65% in pellets with 26 μm wall thickness.

- Work supported by UVa's College of Arts and Sciences faculty research initiative seed fund, and U.S. Department of Energy contract DE-AC05-060R23177 under which Jefferson Science Associates, LLC, operates Jefferson Lab.

Primary author: Mr TAFTI, Sina (University of Virginia)

Co-authors: Dr DEUR, Alexandre (Jefferson Lab); Dr SANDORFI, Andrew M. (Jefferson Lab); Dr MILLER, G. Wilson (University of Virginia); Dr LIU, Jie (University of Virginia); Mr WEI, Kevin (University of Connecticut); LOWRY, Michael (Jefferson Lab); Dr WEI, Xiangdong (Jefferson Lab); Dr ZHENG, Xiaochao (University of Virginia)

Presenter: Mr TAFTI, Sina (University of Virginia)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **167** Type: **Parallel Sessions**

Medical application of spin-polarized noble gases: Emphysema index based on polarized He-3 and Xe-129 diffusion in the lung

Thursday, 13 September 2018 14:55 (25 minutes)

Over the past few decades, spin-polarized noble gases He-3 and Xe-129 have been used extensively as imaging media for magnetic resonance imaging (MRI) in medical research to characterize abnormalities in the lungs such as chronic obstructive pulmonary disease (COPD), which is the 4th leading cause of death worldwide. In particular, diffusion-weighted magnetic resonance imaging (DW-MRI) of spin-polarized Xe-129 has shown potential to serve as a clinical diagnostic tool for such diseases. DW-MRI of inhaled polarized He-3 and Xe-129 generates maps of apparent diffusion coefficient (ADC) throughout the lung; these maps represent mean squared displacement of individual gas molecules diffusing within the alveolar microstructure. Since displacement of the polarized gas inside the lungs is severely limited by the alveolar walls and microstructure of the lung tissue, elevated ADC indicates enlargement of alveolar volumes. ADC maps provide sensitivity to a finer length scale than computed tomography (CT) and 1H (conventional) MRI and can be used to study emphysema, which is a disease that causes destruction of alveolar walls leaving enlarged airspaces and effectively compromising microstructure of the lungs. CT provides a direct measure of lung tissue density and is considered the gold standard for image-based characterization of emphysema, despite its ionizing radiation exposure to the patient. In particular, emphysema index (EI) using CT, defined by the fraction of image pixels with attenuation coefficient less than an established threshold corresponding to no discernible tissue density, provides a quantitative measure of emphysema burden over the whole lung.

Inspired by EI based on CT, here we propose EI based on polarized He-3 and Xe-129 ADC values and compare its performance with CT-based EI. Healthy volunteers as well COPD patients (with varying stages of COPD determined by pulmonary function tests) were given CT along with He-3 and Xe-129 DW-MRI scans. We define EI based on polarized He-3 and Xe-129 ADC values: fraction of the volume elements (voxels) with ADC values greater than a threshold we determined based on 95th percentile of the distribution for all the voxels in our healthy volunteers. While low CT values correspond to low tissue density, elevated ADC values correspond to enlarged airspaces where the gas can more freely diffuse. The threshold based on healthy voxels'ADC values essentially separates out emphysematous regions that have higher ADC values than 95% of ADC values corresponding to voxels in healthy volunteers. Comparison of EI based on polarized He-3 and Xe-129 ADC and EI based on CT reveals that in our subjects, ADC-based emphysema index is significantly more sensitive to emphysema detection (particularly separating healthy from early stages of emphysema) than CT-based EI. We found significantly more elevated ADC values in COPD subjects, corresponding to emphysema, than depressed CT values associated with emphysematous regions. Another key finding of this study is that both He-3 and Xe-129 are found to be equally more sensitive to emphysema than CT. Similarity in performance of He-3 and Xe-129 is critical because going forward, in clinical applications of spin-polarized gas as a diagnostic tool, Xe-129 is the only viable option because it is a naturally abundant noble gas.

- Work supported by NIH grant R01 HL 105566

Primary author: Mr TAFTI, Sina (University of Virginia)

Co-authors: Dr DE LANGE, Eduard E. (University of Virginia); Dr MILLER, G. Wilson (University of Virginia); Dr CATES, Gordon D. (University of Virginia); Dr MATA, Jaime F. (University of Virginia); Dr

MUGLER, John P. (University of Virginia); Dr QING, Kun (University of Virginia); Dr TUSTISON, Nicholas (University of Virginia); Dr ALTES, Talissa (University of Missouri); Mr GARRISON, William J. (University of Virginia); Dr SHIM, Y. Michael (University of Virginia)

Presenter: Mr TAFTI, Sina (University of Virginia)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **168** Type: **Parallel Sessions**

Nucleon 3D imaging program with SoLID at Jefferson Lab

Thursday, 13 September 2018 18:00 (20 minutes)

The 3D imaging of nucleon is at the frontier of understanding visible Universe and QCD. There are many efforts to access the nucleon's 3D partonic structure both in the transverse coordinate space (Generalized Parton Distributions) and in the transverse momentum space (Transverse Momentum Dependent distributions). The proposed Solenoidal Large Intensity Device (SoLID) in Hall A at Jefferson Lab, will fully utilize the great physics potential of the 12-GeV energy upgrade by combining high luminosities and large acceptance to allow high-precision measurements of the observables of interest in a wide kinematical region. In this talk, we will give an overview of the experiment plan and highlight some of the expected physics results. This work is supported in part by U.S. Department of Energy under contract number DE-FG02-03ER41231.

Primary author: ZHAO, Zhiwen (Duke University)

Presenter: ZHAO, Zhiwen (Duke University)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **169** Type: **Parallel Sessions**

Fermilab Polarized Target Drell-Yan Experiment

Tuesday, 11 September 2018 17:20 (20 minutes)

The combination of high luminosity and large kinematic coverage makes SeaQuest at Fermilab an optimal facility to measure single spin asymmetries, with high precision, in polarized Drell-Yan scattering. Scattering the unpolarized beam at Fermilab from the UVA/LANL polarized target will allow isolation of the dynamics of sea quarks in the polarized nucleon. This will allow for the first time a measurement of the sign, magnitude, and shape of the Sivers function with sufficient precision to verify fundamental prediction of QCD. An overview of the SeaQuest setup for this experiment (E1039) with a focus on the polarized target system used in dynamic nuclear polarization is given.

Primary author: KELLER, dustin (uva)

Presenter: KELLER, dustin (uva)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **170** Type: **Parallel Sessions**

Designs and construction techniques for the CLAS12 Dynamically Polarized Target

Monday, 10 September 2018 16:40 (20 minutes)

Construction of a new, dynamically polarized target for the recently commissioned CLAS12 detector package at Jefferson Lab presents new challenges. The target, currently under construction by a collaboration comprised of Christopher Newport University, Old Dominion University, the University of Virginia, and the Jefferson Lab Target Group, will feature samples of solid, irradiated ammonia longitudinally polarized at 1K and 5T for experiments examining the spin structure of the nucleon. A description of the target and its design philosophy will highlight lessons gathered from previous systems and the flexibility to accommodate a variety of target configurations for future experiments.

Primary author: Mr BROCK, James (Jefferson Lab)

Presenter: Mr BROCK, James (Jefferson Lab)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **171** Type: **Parallel Sessions**

J/Psi Transverse Single Spin Asymmetries (TSSA) and Spin Alignment to Decay Leptons in p+p Collisions at RHIC

Tuesday, 11 September 2018 17:30 (25 minutes)

The J/Psi, a bound state of charm and anti-charm quark with spin 1, decays into lepton pairs with a large branching ratios. Its production in polarized and unpolarized p+p collisions sheds light on different aspects of QCD. At RHIC energies, charmonium production in p+p collisions is dominated by gluon-gluon interaction. As a result, measurements of the TSSA in polarized p+p collisions are sensitive to initial state spin-momentum correlation effects such as gluon Qui-Sterman or tri-gluon correlation in collinear factorization and gluon Sivers effects in the transverse momentum dependent (TMD) formalism. Hadronization of charmonium in unpolarized p+p collisions, is also accessible in more robust nonrelativistic QCD formalism due to the relatively large quark mass relative to the hadronization scale. Measuring how the spin of a decay lepton aligns with the spin of J/Psis can test and map out various production mechanisms. Recent results of forward and backward TSSA measurements for p+p,p+Al and p+Au collisions from PHENIX data taken at$\sqrt{s}$ =200 GeV in 2015 and the status of mid-rapidity and forward-rapidity measurements of the J/ψ polarization for p+p collisions from data taken at$\sqrt{s}$ =510 GeV in 2013 will be presented.

Primary author: Dr LEE, Sook Hyun (Iowa State University)

Presenter: Dr LEE, Sook Hyun (Iowa State University)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **172** Type: **Parallel Sessions**

Spin, Isospin and the short range nucleon –nucleon interaction

Monday, 10 September 2018 14:30 (20 minutes)

The nuclear force that binds nucleons together is predominantly scalar, i.e., spin and isospin independent. This force includes tensor, spin-isospin and other components, but these parts are much weaker than the main scalar part. Since the scalar force is attractive at typical distances between nucleons in nuclei and becomes repulsive at shorter distances, it must vanish in between, and there the tensor force become important. The tensor force prefer the spins of the nucleons to be aligned (deuteron like configurations). Study of Short Range Correlation (SRC) nucleon pairs is a powerful way to investigate the short range tensor force and the illusive repulsive nucleon-nucleon core. Recent exclusive studies of SRC demonstrated that the nucleon-nucleon interaction in short distances is not sensitive to nuclear structure and exhibits a universal scaling. The fact that the nucleon-nucleon interaction is insensitive to the nuclear size enables usage of light nuclei for which experimental results can be compared to theoretical predictions. Data from a recent exclusive measurement on 4He and from the data mining project, performed in Hall A and Hall B (CLAS), respectively, both in Jefferson Laboratory, VA, USA.

Primary author: Dr KOROVER, Igor (NRCN)

Presenter: Dr KOROVER, Igor (NRCN)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **173** Type: **Parallel Sessions**

Short-Range correlations studies using the nuclear contact formalism

Monday, 10 September 2018 14:50 (20 minutes)

Due to their complexity, atomic nuclei are traditionaly studied using effective theories. While these tend to describe the low-momentum part of the nucleon momentum distribution well, they fail to describe two-nucleon short-range correlations (SRC). The latter account for approximately 20% of nucleons in the nucleus and dominate the many-body wave function at short distances. The Contact formalism is an effective theory developed for the study of the high-momentum behavior of dilute ultra-cold two-component atomic gases. Even though nuclei don't fully satisfy the conditions of this theory, there is experimental evidence that shows it can be applied to nuclear systems. Here, we preset a generalization of the contact formalism to nuclear systems and extract spin and isospin dependent nuclear contact coefficients from ab-initio 2-body momentum distributions. We compare the contact-derived distributions to 1-body momentum distributions in the region sensitive to SRC, and to experimental data. We then discuss applications of this formalism to the extraction of nuclear correlation functions by combining the short and long distance nucleon behaviors using a blending function. We argue that this model can be used to calculate neutrinoless double beta decay matrix elements for nuclei lacking ab initio calculations.

Primary authors: Prof. MILLER, Gerald (Washington); Prof. HEN, Or (MIT); Mr CRUZ TORRES, Reynier (MIT)

Presenter: Mr CRUZ TORRES, Reynier (MIT)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **174** Type: **Parallel Sessions**

The D-term form factor from dispersion relations in deeply virtual Compton scattering

Tuesday, 11 September 2018 14:30 (35 minutes)

We review the dispersion analysis of deeply virtual Compton scattering and present a dispersive representation of the D-term form factor for hard exclusive reactions. We use unsubtracted t-channel dispersion relations, where the t-channel unitarity relation is saturated with the contribution of two-pion intermediate states, using the two-pion distributions amplitude for the $\gamma^*\gamma \to \pi\pi$ subprocess and reconstructing the $\pi\pi \to N\bar{N}$ subprocess from available information on pion-nucleon partial-wave helicity amplitudes.
Results for the D-term form factor as function of t as well as at $t = 0$ are discussed in comparison with available model predictions and phenomenological extractions.

Primary author: PASQUINI, Barbara (PV)

Co-authors: Prof. VANDERHAEGHEN, Marc (University Mainz); Prof. POLYAKOV, Maxim (Ruhr-University Bochum)

Presenter: PASQUINI, Barbara (PV)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **175** Type: **Parallel Sessions**

Longitudinal spin structure of the nucleon at COMPASS

Thursday, 13 September 2018 16:40 (20 minutes)

The study of the longitudinal spin structure is one of the main objectives of the COMPASS experiment at CERN. It achieves this objective via spin-dependent measurements, both inclusive and semi-inclusive. In this talk, I will first present the final results obtained by inclusive measurements, including the spin dependent structure function g1 and derivatives obtained from it. Secondly, I will give a summary of our Semi-Inclusive DIS measurements, and on the improved the flavour-by-flavour knowledge of the spin structure these allow. Last, I will report on our latest results concerning the gluon polarisation, obtained via high-pT hadron production in the DIS and photoproduction regimes.

Primary author: Dr BEDFER, Yann (CEA Saclay)

Presenter: Dr BEDFER, Yann (CEA Saclay)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **176** Type: **Parallel Sessions**

Proton and 3He polarimetry with new forward pp helicity flip amplitudes

Wednesday, 12 September 2018 15:10 (20 minutes)

Seeking the level of polarization of spin-polarized hadrons that have been accelerated to high energies is a continuing challenge. A theoretical study of electromagnetic hadronic interference indicates that scattering of polarized protons and polarized helium-3 ions at small angles on a suitable target can provide an effective polarimeter. A more complete understanding of the asymmetry of the collisions requires one to assess the hadronic spin dependent amplitudes. Recent proton forward scattering data taken at two distinct energies using a polarized hydrogen jet as target have revealed that single and double helicity flip hadronic amplitudes, while small, are clearly non-zero. An analysis of the spin dependent amplitudes at the two incident energies in terms of exchanges with different spin, charge conjugation and parity properties enables an interpolation of the analyzing powers over a range of energies with implications for polarimetry.

Primary author: Dr BUTTIMORE, Nigel (Trinity College Dublin)

Presenter: Dr BUTTIMORE, Nigel (Trinity College Dublin)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **177** Type: **Parallel Sessions**

Direct photon cross section and double helicity asymmetry at mid-rapidity in $\vec{p}$+$\vec{p}$ collisions at $\sqrt{s}$ = 510 GeV

Wednesday, 12 September 2018 16:40 (20 minutes)

Double helicity asymmetries A_{LL} in hadron, jet and direct photon production in $\vec{p}$+$\vec{p}$ collisions at the Relativistic Heavy Ion Collider (RHIC) are sensitive to the gluon helicity contribution to the proton's spin. Unlike hadrons and jet, direct photon production provides clean access to the polarized gluon distribution since there is no hadronization. However, the small direct photon production cross section compared to that of π^0 and jet production has so far limited its utility in extracting the polarized gluon distribution. With recent increases in RHIC luminosity, we expect this limitation to be partially overcome and try to revisit this "golden" measurement of polarized gluons based on RHIC data from 2013. This analysis measures the direct photon cross section and A_{LL} from the data collected employing the PHENIX detector at mid-rapidity ($|\eta| < 0.35$). This will be the first direct photon cross section and A_{LL} measurement in $\vec{p}$+$\vec{p}$ at $\sqrt{s}$ = 510 GeV with this detector. In this talk I will present the status of direct photon cross section and A_{LL} analysis.

Primary authors: Prof. DESHPANDE, Abhay (Stony Brook University); Dr FEEGE, Nils (Stony Brook University); Dr PARK, Sanghwa (PHENIX Collaboration and Stony Brook University); Mr JI, Zhongling (PHENIX Collaboration and Stony Brook University)

Presenter: Prof. BARISH, Kenneth (UC Riverside)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **178** Type: **Parallel Sessions**

On the interrelationship among leptonic g−2, EDMs and lepton flavor violation

We summarize the status of charged lepton flavor violation (cLFV) in models beyond the SM. The interrelationship among leptonic g-2, EDMs
and cLFV will be emphasized as a tool to disentangle among different
NP scenarios.

Primary author: PARADISI, Paride (Univesity of Padova and INFN)

Presenter: PARADISI, Paride (Univesity of Padova and INFN)

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **179** Type: **Parallel Sessions**

DVCS off the Neutron with Spectator Proton Tagging in Hall A at Jefferson Laboratory

Wednesday, 12 September 2018 15:40 (30 minutes)

Generalized Parton Distributions (GPDs) provide a three-dimensional parametrization of the quarks and gluons inside the nucleon, and give a particularly valuable insight on the nucleon spin content and on the orbital angular momentum of quarks and gluons in particular. Knowledge on GPDs may be acquired performing measurements on exclusive electroproduction channels off the nucleon in the deep inelastic regime such as Deeply Virtual Compton Scattering (DVCS) eN -> eN\gamma.

Of these, neutron DVCS measurements are of particular importance, since combined with results from proton DVCS measurements, they provide a very important combination of GPDs observables which gives a strong constraint on quark angular momentum.
We propose to measure the Deeply Virtual Compton Scattering (DVCS) on the neutron, using a deuterium target, and with spectator proton tagging. The identification and measurement of the spectator proton not only allows to unambiguously identify the neutron-DVCS events from proton and coherent deuterium DVCS events, but also to apply corrections to the nuclear effect of the neutron in the deuteron. This setup would use the Super BigBite Spectrometer (SBS) in Hall A at Jefferson Laboratory to measure the scattered electron, combined with a high resolution electromagnetic calorimeter to detect the outgoing real photon, and with the multiple Time Projection Chamber (mTPC) developed for the Tagged Deep Inelastic Scattering experiment in Hall A (with which this experiment would run), for the identification and measurement of the spectator proton.
This time projection chamber will be able to
operate at fairly high luminosity, which will allow us to obtain significant statistics in a relatively short amount of time.
In this talk, an overview of the experimental setup will be provided, along with its main assets to perform this specific measurement. The expected results from this measurement will be presented, and will be put in context with other similar measurements.

Primary author: Dr FUCHEY, Eric (University of Connecticut)

Presenter: Dr FUCHEY, Eric (University of Connecticut)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **180** Type: **Parallel Sessions**

Spin Probes of Physics Beyond the Standard Model

Monday, 10 September 2018 17:20 (40 minutes)

The ability to manipulate or measure a particle's spin played a key role in the rise of the Standard Model (SM), and it continues to be crucial to the elucidation of physics that the SM cannot explain. Hints, e.g., to the origin of dark matter, of the cosmic surfeit of baryons, or of the weak scale could conceivably come from experiments that exploit spin degrees of freedom. I will offer a perspective of the discovery opportunities, drawing examples from a broad range of experiments at the precision frontier.

Primary author: Prof. GARDNER, Susan (University of Kentucky)

Presenter: Prof. GARDNER, Susan (University of Kentucky)

Session Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **181** Type: **Parallel Sessions**

Multidimensional imaging of the partonic structure of hadrons with an Electron-Ion Collider

Thursday, 13 September 2018 14:50 (20 minutes)

The American 2015 nuclear physics long-range plan endorsed the realization of an electron-ion collider (EIC) as top priority for a next large construction project in the United States.
With the design of an EIC, advancements in theory and further development of phenomenological tools, we are now preparing for the next step in subnuclear tomographic imaging. The collider's large range of center-of-mass energies in combination with very high luminosity and polarization of both the lepton and the hadron beams, will open a unique opportunity for very high precision measurements of both cross sections and spin-asymmetries. This will allow us for a detailed investigation of the partonic substructure of hadrons in multi-dimensions, as well as addressing the role of orbital angular momentum with respect to the nucleon spin.
Generalized parton distributions (GPDs) and transverse momentum dependent (TMDs) describe the multi-dimensional partonic structure of a nucleon in coordinate and momentum space respectively, providing new information about the internal dynamics of quarks and gluons. Measurements of GPDs with hard exclusive processes and TMDs in semi-inclusive deep inelastic scattering, with all related probes, are an essential element of the EIC science program. This talk will highlight key measurements, experimental challenges, and nally discuss the EIC's expected impact over the current knowledge of the partonic 3D-structure of hadrons.

Primary author: Dr FAZIO, Salvatore (Brookhaven National Laboratory)

Presenter: Dr FAZIO, Salvatore (Brookhaven National Laboratory)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **182** Type: **Poster**

Towards Nuclear Spin Polarization of Deuterium - Tritium

The parallel polarization of D and T nuclei should increase the reactivity of the fuel used, both in Magnetic Confinement Fusion (MCF) and Inertial Confinement Fusion (ICF). One has to make sure however, i) that the polarization will survive at high temperature in the MCF and ICF very different plasma conditions, ii) that high polarization rate for useable quantities of material can be reached before injection in the fusion reactors.
In this contribution, we shall briefly review the recent projects [1] aiming at the experimental demonstration of the long enough polarization survival in fusion processes as predicted in early papers [2, 3] and some progresses in producing and storing polarized fuel.
For the specific case of ICF, gains predicted by realistic calculations and resulting from 100% polarized fuel are significant [4] and will be advocated. Finally, we shall discuss the possibilities to produce suitable polarizations. In the case of ICF, long polarization relaxation times are not needed which may leave a way for the Dynamic Nuclear Polarization (DNP) of the "ortho"configurations of T2 and D2 short time before implosion, another possible path could be the DT hetero-molecule polarization, by revisiting the early investigated DNP techniques for HD [5] and applying them to the DT case, which is certainly not easy but would provide much longer relaxation times [6]. Recently, the production of hyperpolarized H2 molecules from polarized H atoms in gas-storage cells has been demonstrated [7]. This opens a new path to produce a mixture of polarized D2, DT and T2 fuel suitable for both ICF and MCF.

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[7] R. Engels et al., Phys. Rev. Lett. 115, 113007 (2015)

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Presenter: Dr DIDELEZ, Jean-Pierre (IPN CNRS/IN2P3 & Université Paris-Sud (UMR-CNRS 8608), 91406 ORSAY, France)

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **183** Type: **Parallel Sessions**

Source of polarized ions and polarized beams at the NUCLOTRON

Tuesday, 11 September 2018 17:40 (20 minutes)

The high intensity pulsed source of polarized ions (SPI) has been developed at JINR in collaboration with INR RAS for injection of polarized deuterons and protons into the Nuclotron and future collider of heavy and light ions NICA. The SPI is an atomic beam-type polarized ion source with a charge-exchange plasma ionizer and a storage cell in the ionization region. The source was commissioned and used in the NUCLOTRON runs in 2016 and February –March 2017. Polarized and unpolarized deuteron beams as well as polarized proton beam were produced to accelerate in the NUCLOTRON.
Deuteron beam polarization of 0.6-0.9 of theoretical values for different modes of high frequency transition units has been measured with the NUCLOTRON ring internal polarimeter for the accelerated deuteron and proton beams.

Primary author: Dr FIMUSHKIN, Victor (Joint Institute for Nuclear Research)

Presenter: Dr FIMUSHKIN, Victor (Joint Institute for Nuclear Research)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **184** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Status and Perspectives of the NICA Project

Tuesday, 11 September 2018 10:20 (40 minutes)

The NICA (Nuclotron-based Ion Collider fAcility) is the new international research facility under the constructing at the Joint Institute for Nuclear Research (JINR, Dubna). The main targets of the facility are: study of hot and dense baryonic matter over the energy range of the maximum baryonic density; investigation of nucleon spin structure and polarization phenomena; and the development of the main JINR facility as well based on the new collider of relativistic ions from protons to gold and polarized protons and deuterons at the maximum collision energy of sqrt(sNN) =11GeV (Au79+) and 27 GeV (p). Two collider detector setups MPD and SPD are under construction and design respectively. The setup BM@N (Baryonic Matter at Nuclotron) had started data taken at the new fixed target area of the Nuclotron. An average luminosity of the collider is expected at the level of 1·10e27 cm-2 s-1 for Au (79+) and 1·10e32 cm-2 s-1 for polarized protons (at the maximum energy). The status of NICA design and construction is presented some details of the SPD design and polarization research program is discussed.

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

Co-authors: Prof. SORIN, Alexander (JINR); Prof. TRUBNIKOV, Grigory (JINR); Prof. MESHKOV, Igor (JINR); Prof. LEDNICKI, Richard (JINR); Prof. TSENOV, Rumen (JINR); Prof. MATVEEV, Victor (JINR); Prof. KEKELIDZE, Vladimir (JINR)

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

Session Classification: Plenary

Track Classification: Future Facilities and Experiments

Contribution ID: **185** Type: **Parallel Sessions**

XVII INTERNATIONAL WORKSHOP ON HIGH ENERGY SPIN PHYSICS (DSPIN-17)

Wednesday, 12 September 2018 16:40 (20 minutes)

Main results of DSPIN-17 Workshop are presented.

Primary author: Prof. EFREMOV, Anatolii (JINR, Dubna)

Presenter: Prof. EFREMOV, Anatolii (JINR, Dubna)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **186** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Spin Phenomena in Jets

Thursday, 13 September 2018 09:40 (40 minutes)

For decades, jets have served as the tool of choice at colliders around the world. They have been used to search for new particles and to probe the inner workings of Quantum Chromodynamics. The jet community continues to innovate and thrive, responding to the experimental and theoretical challenges posed by the TeV scale beam energies at the Large Hadron Collider and the extreme backgrounds produced in the quark gluon plasma. Similarly, the advent of polarized proton beams at the Relativistic Heavy Ion Collider (RHIC) at the turn of the century motivated the adaptation of jet reconstruction techniques for spin dependent measurements. Close collaboration between theory and experiment has produced a wealth of new data on spin topics ranging from the gluon helicity distribution to novel new probes of transverse momentum distributions. An overview of recent RHIC jet results, as well as new techniques developed for spin measurements will be presented. The implications for further measurements at RHIC and at a future Electron-Ion-Collider will be discussed.

Primary author: FATEMI, Renee (University of Kentucky)

Presenter: FATEMI, Renee (University of Kentucky)

Session Classification: Plenary

Track Classification: Nucleon Helicity Structure

Contribution ID: **188** Type: **Parallel Sessions**

Measurements of the transverse magnetization of a bulk MgB2 cylinder

Tuesday, 11 September 2018 17:00 (20 minutes)

An innovative magnetic solution is being pursued for inserting a transversely polarized target inside the central solenoid of the CLAS12 detector at Jefferson Lab, in order to measure transverse spin effect in SIDIS with the 11 GeV upgrade of CEBAF. A feasibility study of a bulk superconducting magnetic system is underway, to provide a transverse holding field for the target while compensating for the spectrometer field within the target volume and meeting the stringent requirements of geometry, compactness and material budget imposed by the high-energy measurements. We review a bench test in which a cylinder of MgB2 is conductively cooled by a cold head, temperature controlled by a heater and magnetized by external resistive coils. The transverse magnetization of a bulk MgB2 cylinder has been studied, along with its magnetic shielding efficiency. Updated results will be reported, along with the corresponding long-term stability performance.

Primary author: STATERA, Marco (MI)

Co-authors: Dr SANDORFI, Andrew (Jefferson Lab); CIULLO, Giuseppe (FE); TAGLIENTE, Giuseppe (BA); BALOSSINO, Ilaria (FE); Dr BARION, Luca (FE); CONTALBRIGO, Marco (FE); Dr LOWRY, Michael (Jefferson Lab); LENISA, Paolo (FE)

Presenter: STATERA, Marco (MI)

Session Classification: Polarized Ion and Lepton Sources and Targets

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **189** Type: **Poster**

Quantum Interpretation of the Nucleon Anomalous Magnetic Moment

A century's proliferation of Quantum Interpretations[1] has been driven by an incomplete understanding of the measurement problem[2], by an incomplete understanding of the unobservable wavefunction and its unobservable interactions. Yet it remains that the observer effect - observing a phenomenon necessarily changes that phenomenon - is at the historical foundation of quantum mechanics. The semantic confusion, that wavefunction interactions are unobservable yet the observer effect is irrefutable, can be resolved by considering the difference between simple passive measurement and active transfer function measurement. In the first, one registers whatever lump of energy lands upon a sensor, and there is no observer effect. In the second, one excites the system of interest and measures the response, and there is an observer effect[3]. Magnetic moment measurements are transfer function measurements. To measure an amplitude one must align the spin, applying a magnetic field to separate the energy eigenstates, and excite the system to measure their difference. A paper presented to Spin 2016 [4] suggests that the measured anomaly is not an intrinsic property of the fermionic proton, but rather an observer effect. In our presentation to Spin 2018 [5] we propose to extend the Spin 2016 interpretation to the neutron anomalous moment[6].

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[3]see also the statements of Heisenberg, Bell, and Feynman in the references of https://en.wikipedia.org/wiki/Observer_effe
[4]M. Suisse and P. Cameron, "Quantum Interpretation of the Proton Anomalous Magnetic Moment"in Proceedings of 22nd International Spin Symposium, Urbana Champaign (2016). As of this writing the proceedings have not yet appeared. The poster may be found here http://vixra.org/abs/1609.0422 and the companion video here https://www.youtube.com/watch?v=uyM4cZgSprI&t=19s
[5]http://spin2018.unife.it/
[6]P. Cameron, "Neutron Spin Structure, Yang-Mills Theory, and the Mass Gap", abstract submitted to Spin 2018.

Primary author: Ms SUISSE, Michaele (Independent Researcher)

Co-author: CAMERON, peter (Independent Researcher)

Presenter: Ms SUISSE, Michaele (Independent Researcher)

Track Classification: Fundamental Symmetries and Spin Physics Beyond the Standard Model

Contribution ID: **191** Type: **Parallel Sessions**

Deeply Virtual Compton Scattering off the Neutron in Jlab Hall A (6 GeV experiements)

Monday, 10 September 2018 16:40 (35 minutes)

Generalized Parton Distribution (GPDs) are considered as a suitable tools to study the structure of the hadron in term of quarks and gluons. Deeply virtual Compton Scattering (DVCS) is the simplest process that can be described in term of GPDs by measuring its cross section. DVCS on the neutron (nDVCS) is sensitive to the GPD "E", the least constrained GPD, which allows access to the quark angular momentum via Ji's sum rule.
Our experiment was performed in the Hall A of Jefferson Lab to measure the unpolarized cross section off the neutron in the valence region (xB=0.36) at Q^2=1.75 GeV^2 for two beam energies. The unpolarized cross section off quasi-free neutrons and coherent deuteron will be presented here. By combining proton and neutron data measurement, we will show an estimated flavor decomposition of the u and d quarks contributions to the photon electroproduction cross sections.

Primary author: Ms BENALI, meriem (LPC Caen)

Presenter: Ms BENALI, meriem (LPC Caen)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **192** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

More than 50 years of Polarized Targets - A Personal Memoir

Monday, 10 September 2018 11:30 (40 minutes)

I will discuss the role of polarized solid targets in particle physics from their inception in 1962 to the present day. I will present the developments, such as cryogenic improvements and better materials, that have contributed to our better understanding of the physical processes involved in particle scattering. Examples of current efforts will be given.

Primary author: Prof. CRABB, Donald G. (University of Virginia)

Presenter: Prof. CRABB, Donald G. (University of Virginia)

Session Classification: Plenary

Track Classification: Polarized Ion and Lepton Sources and Targets

Contribution ID: **193** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Quantum technologies: manipulating individual spins

Friday, 14 September 2018 12:10 (40 minutes)

The coherent manipulation of individual quantum degrees of freedom, such as single spins, was long considered to be possible only in thought experiments. At the end of last century this became routine in labs around the world, opening up new possibilities for technological applications. Pseudospins associated to electronic states in single trapped atoms or to quantum electronic circuits can be used as quantum bits to build quantum computers; coupled spins in controlled arrays can be employed as quantum simulators; individual electron spins in solid state (for instance defect centers in diamond) can be applied to sensing tiniest external fields; single photons' angular momenta can be exchanged between distant locations to establish secure communication channels. In this talk I will present an overview of such emerging quantum technologies and of the worldwide efforts to bring them to wider fruition.

Primary author: Prof. CALARCO, Tommaso (University of Cologne and Jülich Research Centre)

Presenter: Prof. CALARCO, Tommaso (University of Cologne and Jülich Research Centre)

Session Classification: Plenary

Track Classification: Future Facilities and Experiments

Contribution ID: **194** Type: **Parallel Sessions**

Reduced hadronic uncertainty in the determination of V_{ud}

Tuesday, 11 September 2018 16:40 (20 minutes)

We propose a novel dispersion relations-based evaluation of the γW-box correction to the universal radiative correction Δ_R^V to the neutron and nuclear β decay. This correction is the main source of the theoretical uncertainty in extracting the value of V_{ud} from those decay processes. We relate the needed input into the dispersion integral to the data on neutrino and antineutrino scattering. This leads to a significant shift in the central value accompanied by a reduction of the uncertainty due to hadronic structure. Applied to the superallowed nuclear β decays, these two effect create a tension in the first row CKM unitarity if assuming all other ingredients remain unchanged, $|V_{ud}|^2 + |V_{us}|^2 + |V_{ub}|^2 = 0.9983(4)$. We discuss further ways to improve the precision of the calculation of the γW-box, and point out that dispersion relations provide a unified formalism for hadronic and nuclear corrections to nuclear beta decay.

Primary author: Dr GORSHTEYN, Mikhail (Mainz University)

Presenter: Dr GORSHTEYN, Mikhail (Mainz University)

Session Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Track Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Contribution ID: **196** Type: **Parallel Sessions**

Overview of Spin Physics at EIC

Thursday, 13 September 2018 14:30 (20 minutes)

This talk will review from a theoretical point of view possibilities to measure spin effects at a high-energy Electron-Ion Collider (EIC). Various types of spin distributions will be reviewed and promising observables will be discussed.

Primary author: BOER, Daniel (University of Groningen)

Presenter: BOER, Daniel (University of Groningen)

Session Classification: Future Facilities and Experiments

Track Classification: Future Facilities and Experiments

Contribution ID: **197** Type: **Parallel Sessions**

The neutron structure function F_2 at high-x with BONuS at CLAS

Tuesday, 11 September 2018 15:05 (35 minutes)

The Barely Off-Shell Nucleon Structure (BONuS) experiment at CLAS will measure the neutron structure function F_2 for $0.1 < x < 0.8$ over a broad Q^2 range, from 1 to 14 GeV$^2/c$, using electron scattering from deuterium with spectator-proton tagging. By selecting the low-momentum recoil protons at large backward angles, final-state interactions as the deuteron breaks up can be minimized, and the deep-inelastic kinematics for the neutron can be determined. This technique, which has been used successfully at CLAS at 6 GeV, will be extended to 11 GeV beam energy with significantly increased luminosity. Details of the BONuS third generation Radial Time Projection Chamber and expected high-x F_2^n results will be presented.

Primary author: Dr AYERBE GAYOSO, Carlos (The College of William and Mary)

Presenter: Dr AYERBE GAYOSO, Carlos (The College of William and Mary)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **198** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

30 years of HERMES - how self-polarization in storage rings was exploited at HERA

Wednesday, 12 September 2018 12:10 (40 minutes)

Three decades ago it became that the simple quark model approach for the proton failed in describing the spin structure —the spin contribution from quarks, as measured by the European Muon Collaboration (EMC), came out small, by far insufficient to explain the proton spin of 1/2. The experiment utilized the polarized muon beam from CERN's SPS, which is naturally polarized originating from the weak decay of mainly pions. The EMC results triggered a wealth of activity trying to explain the "spin puzzle", but also to confirm (or falsify) those findings.

Already some twenty years early, it had been demonstrated that electrons in a storage ring will also be polarized —under certain conditions and in particular if waiting sufficiently long enough. The verification of this Sokolov-Ternov effect will be celebrated today in a different talk from this one. However, this talk will concentrate on how the Sokolov-Ternov effect got exploited in the East Hall of the HERA storage rings at DESY to study the spin structure of the proton. It took five hard years to convince DESY to host a spin experiment and in particular that it was feasible to achieve sizable polarization of the 27.6 GeV electrons/positrons of HERA. Part of this effort also included convincing people to install a gas storage cell internal to the HERA lepton ring as part of a polarized gas target system.

When this experiment, HERMES, finally turned on in 1995, it marked the beginning of an extremely successful physics program that ran until 2007, the shutdown of the HERA facility. During those years, HERMES took a wealth of data with longitudinally polarized H, D, and 3He targets, with transversely polarized H, as well as a wide range of unpolarized nuclei. In fact, analysis and publication of these data are still ongoing, as for the other HERA experiments.

This talk will focus on some of the highlights of the HERMES program, with emphasis of exploiting the polarized beam, but also remembering some of the pioneering measurements, e.g., the first observation of the Sivers and Collins effects in semi-inclusive deep-inelastic scattering. Besides the discussion of the physics results, the talk will also reflect on the early years, e.g., on how the experiment and the collaboration was formed, to celebrate this milestone in nucleon-spin physics.

Primary author: SCHNELL, Gunar (University of the Basque Country UPV/EHU)

Presenter: SCHNELL, Gunar (University of the Basque Country UPV/EHU)

Session Classification: Plenary

Track Classification: Nucleon Helicity Structure

Contribution ID: **200** Type: **Parallel Sessions**

Absolute polarimeter APol for NICA collider project.

Thursday, 13 September 2018 14:30 (20 minutes)

Conceptual design of the absolute polarimeter APol with an internal polarized atomic hydrogen/deuterium jet target for NICA collider is presented. It is proposed to install the polarimeter into the “warm”gap of the collider ring arc. The polarized jet will cross both accelerated beams. The jet target is based on the classical atomic beam source principle. Expected target thickness of the jet in the interaction regions is 10^12 atom/cm^2. Polarization of the atomic hydrogen/deuterium jet will be measured by Breit-Rabi polarimeter placed under collider ring into a jet catcher volume. APol will utilize a reaction of elastic scattering of identical nuclei (protons or deuterons).

Primary author: Mr KULIKOV, Mikhail (JINR)

Co-authors: Mr SHUMKOV, Alexey (JINR); Dr KUZYAKIN, Roman (JINR); Dr FIMUSHKIN, Victor (Joint Institute for Nuclear Researsh); Mr PROKOFICHEV, Yuri (JiNR)

Presenter: Mr KULIKOV, Mikhail (JINR)

Session Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Track Classification: Acceleration, Storage and Polarimetry of Polarized Beams

Contribution ID: **201** Type: **Parallel Sessions**

Iso-vector transversity quark distributions from lattice QCD

Tuesday, 11 September 2018 15:20 (25 minutes)

Using the quark quasi-distribution approach, we present the first direct calculation of the transversity parton distribution function within the nucleon from lattice QCD. The calculation is performed using simulations with the light quark mass fixed to its physical. We employ non-perturbative renormalization to subtract the linear and log divergences present in the bare matrix elements, and a
matching formula to extract the light-cone PDFs from the quasi PDFs. Final results are presented in the MS scheme at a scale of $\sqrt{2}$ GeV.

Primary author: Dr STEFFENS, Fernanda (DESY - Zeuthen)

Presenter: Dr STEFFENS, Fernanda (DESY - Zeuthen)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **202** Type: **Parallel Sessions**

First CLAS12 results in SIDIS measurements

Monday, 10 September 2018 17:05 (25 minutes)

In January 2018, the CLAS12 spectrometer has started taking data using the 10.6 GeV, higly polarized, electron beam on a liquid hydrogen unpolarized target, at a luminosity as high as 10^35 cm^-2 s^-1, about one order of magnitude higher than during the 6 GeV era with the CLAS spectrometer.

The high beam quality combined with the large acceptance of CLAS12 will allow for the first time to look at the 3-dimensional structure of the nucleon in a large kinematical domain with an unprecedented statistical precision.

A large part of the CLAS12 experimental program is devoted to the study of the transverse momentum dependent partonic distribution and fragmentation functions through experiments of Semi-Inclusive Deep Inelastic Scattering
electroproduction of mesons (pions and kaons).
The main observables in these measurements are the Single Spin Asymmetries and the hadron multiplicities.

In this talk, the performances of the CLAS12 spectrometer in SIDIS measurements will be shown and the first preliminary results will be presented.

Primary author: MIRAZITA, Marco (LNF)

Presenter: MIRAZITA, Marco (LNF)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **203** Type: **Parallel Sessions**

Medical Imaging of Hyperpolarized Noble Gases: Perspectives and prospects at the quarter- century mark

Thursday, 13 September 2018 14:30 (25 minutes)

The first biological magnetic resonance images of laser-polarized xenon-129 were published in 1994, in a seminal paper in Nature. In addition to the first proof-of-concept images in a mouse lung, this paper presented a variety of advanced human imaging possibilities ranging from simple ventilation imaging in the lung to dissolved-phase imaging of xenon-129 in the brain. Almost 25 years later, nearly all the originally predicted capabilities of xenon-129 and helium-3 MRI have been fully realized, at least on the technical side. However, adoption of these techniques by medical practitioners has been painfully slow. Hyperpolarized-gas MRI is still not FDA-approved in the United States, not due to any deficiency in the quality of the obtainable information but rather in its usefulness for informing decisions about medical care. This talk will discuss the past history and future prospects for medical imaging of inhaled hyperpolarized gases, from the perspective of a trained nuclear physicist now working in medicine.

Primary author: Prof. MILLER, Wilson (University of Virginia)

Presenter: Prof. MILLER, Wilson (University of Virginia)

Session Classification: Application of Nuclear Polarization Techniques to Other Fields

Track Classification: Application of Nuclear Polarization Techniques to Other Fields

Contribution ID: **204** Type: **Parallel Sessions**

Measurement of the analyzing powers in pd elastic and pn quasi-elastic scattering at small angles

Tuesday, 11 September 2018 15:10 (20 minutes)

The analyzing powers in proton-deuteron elastic and proton-neutron quasi-elastic scattering were measured at small angles using a polarized proton beam at the COSY storage ring incident on an unpolarized deuterium target. Data were taken at 796 MeV and five energies from 1600 MeV to 2400 MeV. The analyzing power in pd elastic scattering was studied by detecting the low energy recoil deuteron in telescopes placed symmetrically in the COSY plane to the left and right of the beam whereas for pn quasi-elastic scattering a low energy proton was registered in one of the telescopes in coincidence with a fast scattered proton measured in the ANKE magnetic spectrometer. Though the experiment explores new domains, the results are consistent with the limited published information. The ratio of the deuteron to proton analyzing power in pd elastic scattering is broadly consistent with the predictions of an extended Glauber model.

Primary author: Dr DYMOV, Sergey (INFN)

Presenter: Dr DYMOV, Sergey (INFN)

Session Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Track Classification: Low Energy Spin Physics with Lepton, Photon and Hadron Probes

Contribution ID: **205** Type: **Parallel Sessions**

Probing the Spin Structure of the Nucleon: Recent Results and Upcoming Measurements of SSF and their moments at JLab

Wednesday, 12 September 2018 15:30 (20 minutes)

The last several years of Jefferson Lab's 6~GeV physics program saw a wealth of nucleon spin structure measurements run across several Halls. In particular, E06-014 (d_2^n") in Hall A (polarized neutron), and E07-003 (SANE") in Hall C (polarized proton) took advantage of significant advances in target design and new/upgraded large solid angle detector packages to run precision measurements of neutron and proton spin structure functions (SSFs) over a broad range in x and Q^2 during the 6 GeV era. These measurements of g_1, g_2, spin asymmetries A_1 A_2 and the associated higher twist reduced matrix element d_2 are fundamentally coupled to quark-gluon interactions and transverse momentum of the quarks in the nucleon, and are among the cleanest higher twist observables we can access. Those now-final data on the neutron and proton will be revisited, and upcoming measurements that exploit JLab's 12~GeV upgrade will be presented.

Primary author: Dr SAWATZKY, Brad (Jefferson Lab)

Presenter: Dr SAWATZKY, Brad (Jefferson Lab)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **206** Type: **Parallel Sessions**

Spin Structure at Low Q2, with Applications to Hyperfine Splitting

Wednesday, 12 September 2018 15:50 (20 minutes)

Moments of spin structure functions at low Q2 provide a benchmark test of chiral dynamics, and are necessary input for calculations of atomic energy levels. We will present the results from the Jefferson Lab Hall A and C spin structure experiments at low Q2 ("g2p" and "SAGDH").

Primary author: Prof. SLIFER, Karl (UNH)

Presenter: Prof. SLIFER, Karl (UNH)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **207** Type: **Parallel Sessions**

Experimental studies of GPDs at COMPASS

Monday, 10 September 2018 15:05 (35 minutes)

Together, GPDs and TMDs provide the most complete description of the partonic structure of the nucleon, and their study represents the major goal of the COMPASS-II program.

GPDs are experimentally accessible via lepton-induced exclusive reactions, in particular DVCS and DVMP. At COMPASS, these processes are investigated using a 160 GeV high intensity muon beam impinging on a 2.5~m long liquid hydrogen target. In order to optimize the selection of exclusive reactions at these energies, the target is surrounded by a new barrel-shaped time-of-flight system to detect the recoiling particles.

The pure DVCS cross-section and its $|t|$-dependence are extracted from the sum of cross-sections measured with opposite beam charges and polarizations.
From this measurement, the first estimate of the transverse size of the nucleon in the uncharted x_{Bj} domain from 0.02 to 0.20 will be given.

COMPASS is also capable of accessing several DVMP channels, from which different combinations of quark and gluon GPDs can be extracted. In this talk we will report on the first measurement of the exclusive π^0 cross section and its $|t|$-dependence in the same x_{Bj} domain from 0.02 to 0.20.

Primary author: Mr FERRERO, Andrea (CEA-Saclay/IRFU/DPhN)

Presenter: Mr FERRERO, Andrea (CEA-Saclay/IRFU/DPhN)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **208** Type: **Parallel Sessions**

The Generalized Polarizabilities of the proton

Monday, 10 September 2018 17:15 (35 minutes)

The Generalized Polarizabilities (GPs) are fundamental quantities of the nucleon and as such they are extremely valuable for a complete understanding of the nucleon structure. The GPs can be accessed experimentally through measurements of the Virtual Compton Scattering reaction. They can be seen as Fourier transforms of local polarization densities (electric, magnetic, and spin) and are a probe of the nucleon dynamics, allowing us to study the role of the pion cloud and of the quark core contributions at various length scales. In this talk recent results from MAMI will be presented and future experimental prospects at JLab will be discussed.

Primary author: Prof. SPARVERIS, Nikos (Temple University)

Presenter: Prof. SPARVERIS, Nikos (Temple University)

Session Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Track Classification: 3D Structure of the Nucleon: GPDs and Form Factors

Contribution ID: **209** Type: **Parallel Sessions**

Spin-dependent PDFs from lattice QCD

Wednesday, 12 September 2018 15:10 (20 minutes)

We present spin-dependent parton distribution functions calculated within lattice QCD simulations using physical values of the light quark mass. Non-perturbative renormalization is employed, and the lattice data are converted to the MS-scheme at a scale of 2 GeV. We then reconstruct the light-cone parton distribution functions using a matching procedure. We obtain a nice overlap for a range of Bjorken-x values between our results and phenomenological parameterizations of the polarized distributions. This presents a major success for the emerging field of direct calculations of quark distributions using lattice QCD.

Primary author: Dr STEFFENS, Fernanda (DESY - Zeuthen)

Presenter: Dr STEFFENS, Fernanda (DESY - Zeuthen)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **210** Type: **Parallel Sessions**

A New Window into Nuclear Structure

Monday, 10 September 2018 15:30 (20 minutes)

Whenever technological advancements provide access to a new degree of freedom, previously inaccessible quantities can be measured. Currently, we are seeing the beginning of a renaissance of experiments utilizing a tensor polarized target to probe the structure of the deuteron. This is due to two recent developments: the JLab 12 GeV upgrade, and a high-luminosity, high-tensor-polarized target. Experiments utilizing these new capabilities can explore aspects of the nature of matter that have so far proven elusive, some for decades: from 6-quark hidden-color effects in the DIS region to the short-range and high-momentum components of the deuteron wavefunction in the x>1 SRC region, and beyond. This presentation will discuss the first two experiments already approved to measure the tensor b1 and Azz observables, recent advances in tensor target development, and future opportunities to better understand nuclear and nucleon structures that are only accessible through experiments utilizing tensor polarized targets.

Primary author: Prof. LONG, Elena (University of New Hampshire)

Presenter: Prof. LONG, Elena (University of New Hampshire)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **211** Type: **Parallel Sessions**

New results on spin structure functions at very low momentum transfers from the EG4 experiment at Jefferson Lab

Tuesday, 11 September 2018 15:40 (30 minutes)

Several experiments at Jefferson Lab have collected a large amount of data on the spin structure of nucleons using a polarized electron beam directed onto various polarized targets (NH3, ND3, and 3He). In these double polarization experiments, either the double spin asymmetries A|| and A⊥ or the polarized cross section differences Δσ|| and Δσ⊥ are measured with unprecedented precision and over a wide kinematic range, with 0.01 GeV2 < Q2 < 5.0 GeV2 and 1.08 GeV < W < 3.0 GeV. From these measurements, the spin structure functions and their moments are extracted. These data help us shed more light on the nucleon spin structure in the region of quark-confinement as well in the transition region between hadronic and partonic degrees of freedom. At sufficiently low momentum transfer, it is possible to test various predictions for moments of structure functions from sum rules and QCD-based effective theories such as Chiral Perturbation Theory (cPT) as well as from phenomenological models. In particular at very low momentum transfers (Q2⟶0), the first moment (G1) of the structure function g1 is constrained by the GDH sum rule and its extensions based on cPT, which makes measurements of g1 in this region uniquely interesting. In this talk, I will present new results from the EG4 experiment with CLAS, which measured the double polarized cross section difference on NH3 and ND3 (with both electron beam and targets longitudinally polarized), down to Q2 = 0.02 GeV2. The results of a parallel analysis of double polarization observables in exclusive pion electroproduction in the same kinematic region will also be shown.

Primary author: RIPANI, Marco (GE)

Presenter: RIPANI, Marco (GE)

Session Classification: Spin physics in Nuclear Reactions and Nuclei

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **212** Type: **Parallel Sessions**

Collinear and TMD parton densities from fits to precision DIS measurements in the parton branching method

Wednesday, 12 September 2018 17:55 (25 minutes)

Collinear and transverse momentum dependent (TMD) parton densities are obtained from fits to precision measurements of deep inelastic scattering (DIS) cross sections at HERA. The parton densities are evolved
by DGLAP evolution with next-to-leading-order (NLO) splitting functions using the parton branching method, allowing one to determine simultaneously collinear and TMD densities for all flavors over a wide range in
x, μ2 and kt, relevant for predictions at the LHC. The DIS cross section is computed from the parton densities using perturbative NLO coefficient functions. Parton densities satisfying angular ordering
conditions are presented. Two sets of parton densities are obtained, differing in the renormalization
scale choice for the argument in the strong coupling αs. This is taken to be either the evolution scale μ or the transverse momentum qt. While both choices yield similarly good χ2 values for the fit to
DIS measurements, especially the gluon density turns out to differ between the two sets. The TMD densities
are used to predict the transverse momentum spectrum of Z–bosons at the LHC.

Primary author: HAUTMANN, Francesco (University of Oxford)

Presenter: HAUTMANN, Francesco (University of Oxford)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **213** Type: **Parallel Sessions**

Fragmentation of hadrons and photons inside jets

Wednesday, 12 September 2018 18:00 (20 minutes)

We discuss the processes pp –> (jet h) X and pp –> (\gamma h) X, for which a specific hadron or photon is observed inside a fully reconstructed jet. We present NLO results for the corresponding cross sections and show that the results can be cast into simple and systematic forms based on suitable universal jet functions. We present phenomenological results for experiments at the LHC and at RHIC which suggest that the processes should enable sensitive probes of fragmentation functions, especially of the so far little known fragmentation functions for photons. We also touch on QCD threshold resummation calculations for the cross sections.

Primary author: VOGELSANG, Werner (Univ. Tuebingen)

Presenter: VOGELSANG, Werner (Univ. Tuebingen)

Session Classification: Nucleon helicity structure

Track Classification: Nucleon Helicity Structure

Contribution ID: **215** Type: **not specified**

DVCS on 4He with CLAS (TBC)

Contribution ID: **217** Type: **Parallel Sessions**

Pion-induced Drell-Yan scattering at COMPASS

Thursday, 13 September 2018 15:20 (25 minutes)

An overview of pion-induced Drell-Yan (DY) scattering at COMPASS is given. In 2015, COMPASS was scattering a 190 GeV pion beam off a transversely polarized proton target and unpolarized nuclear targets. The Sivers asymmetry, and other spin-dependent azimuthal asymmetry amplitudes, were extracted from these data. The Sivers asymmetry is of particular interest since it is expected to change sign between DY and semi-inclusive deep-inelastic (SIDIS) scattering. By averaging the target spins, COMPASS has also access to the spin-independent azimuthal modulation arising from the Boer-Mulders TMD, which allows to study the violation of the so-called Lam-Tun relation. The comparison of cross sections off different nuclear targets provides the pathway to investigating a flavor-dependent EMC effect. A second data set of spin-dependent Drell-Yan data is being taken in the 2018 run and is expected to supersede the precision of the 2015 data by at least 50%. For this DY analysis, COMPASS currently uses the supercomputer Blue Waters (BW) for production of both experimental data (tracking) and simulated Monte Carlo (MC) data. Due to the massive parallel computing resources of BW, experimental data can be processed significantly faster than at CERN, detector efficiency maps can be produced in much greater detail, and MC data can be generated at larger amount, including CPU-intensive tasks such as pile-up.

Primary author: RIEDL, Caroline (University of Illinois at Urbana-Champaign)

Presenter: RIEDL, Caroline (University of Illinois at Urbana-Champaign)

Session Classification: 3D Structure of the Nucleon: TMDs

Track Classification: 3D Structure of the Nucleon: TMDs

Contribution ID: **218** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

Status and Perspectives of a US-based Electron-Ion Collider (EIC)

Thursday, 13 September 2018 09:00 (40 minutes)

Understanding the properties of nuclear matter and its emergence through the underlying partonic structure and dynamics of quarks and gluons requires a new experimental facility in hadronic physics known as the Electron-Ion Collider (EIC). A US-based facility capable of colliding high-energy polarized electron and ion beams at high luminosity has been envisaged for a long time and articulated as the highest priority for new construction following the completion of the Facility for Rare Isotope Beams (FRIB) at Michigan State University, most recently in the last 2015 long-range plan by the US nuclear science community.
The EIC will address some of the most profound questions concerning the emergence of nuclear properties by precisely imaging gluons and quarks inside protons and nuclei such as the distribution of gluons and quarks in space and momentum, their role in building the nucleon spin and the properties of gluons in nuclei at high energies. Two facility concepts have been presented to address these conditions, at Brookhaven National Laboratory and at Jefferson Laboratory taking advantage of existing accelerator infrastructure and accelerator expertise. In addition, detector concepts have been presented to provide the necessary experimental tools. The realization of the full EIC physics program requires in addition a theory program to predict and interpret future experimental results at an EIC facility.
The US Department of Energy requested following the release of the last long-range plan in 2015 the review of the science case of a future EIC program by the US National Academy of Sciences (NAS). This review process started in January 2017 and concluded with the release of a report which was publicly presented on July 24, 2018 stating that 'the committee unanimously finds that the science that can be addressed by an EIC is compelling, fundamental and timely'.
The status and perspectives of a US-based ElC facility will be presented in this plenary presentation including highlights of the planned physics program, requirements, an overview of the EIC users group, a summary of the recent NAS review report and anticipated next steps.

Primary author: Prof. SURROW, Bernd (Temple University)

Presenter: Prof. SURROW, Bernd (Temple University)

Session Classification: Plenary

Track Classification: Future Facilities and Experiments

Contribution ID: **219** Type: **Plenary Sessions (for INVITED PLENARY TALKS only!)**

The Wonder of Spin Dynamics in QCD

Monday, 10 September 2018 10:20 (40 minutes)

Spin is an intrinsic and quantum property of all particles that we know of, including the elementary particles of the standard model, as well as composite particles, such as nucleons and nuclei that make up essentially all the visible matter in the universe. Without the spin, our world would not be the same as what we have seen and lived in. In this talk, I will briefly review the spin phenomena in strong interactions and the wonder of spin dynamics in QCD that has caught us off guard in a number of occasions, and has kept us going to explore and search for the ultimate solution and understanding of the spin of hadrons - emerged as strongly interacting, relativistic bound states of quarks and gluons in QCD.

Primary author: Prof. QIU, Jianwei (Jefferson Lab)

Presenter: Prof. QIU, Jianwei (Jefferson Lab)

Session Classification: Plenary

Track Classification: Spin Physics in Nuclear Reactions and Nuclei

Contribution ID: **220** Type: **not specified**

Gravitational waves, spin and polarization

Monday, 10 September 2018 09:40 (40 minutes)

Presenter: Prof. VAN DEN BRAND, Jo (Nikhef)

Session Classification: Plenary

Contribution ID: **221** Type: **not specified**

HL - Low Energy Spin Physics

Thursday, 13 September 2018 11:50 (20 minutes)

Presenter: Prof. MAAS, Frank (Helmholtz-Institut Mainz)

Session Classification: Plenary

Contribution ID: **222** Type: **not specified**

HL - Fundamental Symmetries and Spin Physics BSM

Thursday, 13 September 2018 12:10 (20 minutes)

Presenter: Dr WIRZBA, Andreas (Forschungszentrum Juelich)

Session Classification: Plenary

Contribution ID: **223** Type: **not specified**

HL - Acceleration, Storage and Polarimetry

Friday, 14 September 2018 10:00 (20 minutes)

Presenter: Dr PTITSYN, Vadim (BNL)

Session Classification: Plenary

Contribution ID: **224** Type: **not specified**

HL - Future Facilities and Experiments

Friday, 14 September 2018 10:40 (20 minutes)

Presenter: Dr ILIEVA, Yordanka (University of South Carolina)

Session Classification: Plenary

Contribution ID: **225** Type: **not specified**

HL - 3D Structure of the Nucleon: TMDs

Friday, 14 September 2018 09:20 (20 minutes)

Presenter: Dr DRACHENBERG, James (Abilene Christian University)

Session Classification: Plenary

Contribution ID: **226** Type: **not specified**

HL - Nucleon Helicity Structure

Friday, 14 September 2018 09:00 (20 minutes)

Presenter: PAGE, Brian (Brookhaven National Lab)

Session Classification: Plenary

Contribution ID: **227** Type: **not specified**

HL - 3D Structure of the Nucleon: GPDs

Friday, 14 September 2018 09:40 (20 minutes)

Presenter: Dr LORCE, Cedric (Ecole polytechnique, Paris-Saclay U.)

Session Classification: Plenary

Contribution ID: **228** Type: **not specified**

HL - Applications to Other Fields

Friday, 14 September 2018 10:20 (20 minutes)

Presenter: Dr SANDORFI, Andrew (Jefferson Lab)

Session Classification: Plenary

Contribution ID: **229** Type: **not specified**

HL - Polarized Ion and Lepton Sources and Targets

Thursday, 13 September 2018 12:30 (20 minutes)

Presenter: Dr KEITH, Christopher (Jefferson Lab)

Session Classification: Plenary

Contribution ID: **230** Type: **not specified**

HL - Spin Physics in Nuclear Reactions and Nuclei

Thursday, 13 September 2018 11:30 (20 minutes)

Presenter: Prof. MILNER, Richard (MIT)

Session Classification: Plenary

Contribution ID: **231** Type: **not specified**

Conclusions

Friday, 14 September 2018 12:50 (20 minutes)

Presenter: Prof. GAO, Haiyan (Duke University)

Session Classification: Plenary