The XXVI International Scientific Conference of Young Scientists and Specialists (AYSS-2022)

Report of Contributions

https://indico.jinr.ru/e/AYSS2022

Contribution ID: **976** Type: **Oral**

Energy-dependent flavor ratios, cascade/track spectrum tension and high-energy neutrinos from magnetospheres of supermassive black holes

Wednesday, 26 October 2022 15:30 (15 minutes)

The IceCube neutrino observatory measures the diffuse flux of high-energy astrophysical neutrinos by means of various techniques, and there exists a mild tension between spectra obtained in different analyses. The spectrum derived from reconstruction of muon tracks is harder than that from cascades, dominated by electron and tau neutrinos. If confirmed, this tension may provide a clue to the origin of these neutrinos, which remains uncertain. Here we investigate the possibility that this tension may be caused by the change of the flavor content of astrophysical neutrinos with energy. We assume that at higher energies, the flux contains more muon neutrinos than expected in the usually assumed flavor equipartition. This may happen if the neutrinos are produced in regions of the magnetic field so strong that muons, born in pi-meson decays, cool by synchrotron radiation faster than decay. The magnetic field of ~10ˆ4G is required for this mechanism to be relevant for the IceCube results. We note that these field values are reachable in the immediate vicinity of supermassive black holes in active galactic nuclei and present a working toy model of the population of these potential neutrino sources. While this model predicts the required flavor ratios and describes the high-energy spectrum, it needs an additional component to explain the observed neutrino flux at lower energies.

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Presenter: RIABTSEV, Kirill (Moscow State University)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **977** Type: **Oral**

Skyrme-like Λ hyperonic interactions and neutron stars properties

Wednesday, 26 October 2022 15:45 (15 minutes)

Neutron stars are hydrostatically equilibrium stars, the matter of which consists mainly of neutrons and has a density of the order of the nuclear one, therefore, methods used in the particle and nuclear physics are applicable for their description. However, at high densities that are achieved in neutron stars, there may be additional sensitivity to certain properties of the baryonic interaction. Renewed interest in neutron stars physics has been inspired by first registration of gravitational signal from the merger of two neutron stars, which has provided a new measurable characteristic of a neutron star called tidal deformability.

In the present work, we consider neutron stars consisting of nucleons, leptons, and Λ-hyperons with Skyrme baryonic force. We calculate different characteristics of neutron stars such as mass, radius and tidal deformability and investigate their dependence on the properties of the interactions. In particular we consider two alternative ways to describe nonlinear effects in ΛN-interaction: dependence on nucleon density ($\sim \rho^{\alpha}$) and three-body ΛNN force, and investigate the difference between them in neutron stars.

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Presenter: Mr MIKHEEV, Semyon

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **978** Type: **Oral**

Annular-Radial Dose Distributions.

Monday, 24 October 2022 14:00 (15 minutes)

Annular dose, AD is a concept deduced from radial dose simulated codes that enables one to draw a map of dose distribution around the ion's path at the nanometer scale. The distribution of dose for different equal LET elements' groups of the same LET (in keV.µm-1) were studied using this concept.

- **Annular-dose (AD)** is a new conception introduced, based on the radial dose distribution, RDD, AD is the integrated dose for many shells around the ions and it is defined as the dose deposited in the shell volume perpendicular to the ion **path of width(r=0.1→R_min)**, length equal 2π and thickness equal unity (1nm). Thus, it integrates and maps the deposited dose due to ion in any medium at nanometer scale better than the ordinary radial dose. The annular dose, AD as a function of the shell width for the ions under investigation showed that dose distributions around the ions of same LET are not the same and a clear peak at certain shell width called the ion's maximum annular dose width.
- **rMADW** was determined for the first time. The rMADW is the position where the maximum reachable dose is delivered by secondary electrons around the ion. The ion's rMADW showed an increasing function with $Z^*\beta$ within the same LET group. Interestingly, it was found that rMADW behaves as an increasing monotonic function of the relative ion velocity, β.

The new concept of radial and annular dose distributions will be present for dose distribution around the latent track of an ion penetrating matter. These results were obtained from a large number of ion types which are summarized in groups of defined LET. Basing on two fundamental works by Katz (radial dose distribution)and Tabata (electron range), a simulation model was developed.

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Presenter: EL-SHEIKH, Ahmed (MSc Student)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **979** Type: **Oral**

Accounting system for the JINR Laboratories' experiments

Thursday, 27 October 2022 14:15 (15 minutes)

In 2021, accounting systems that make it possible to visually display various parameters of the functioning of computing clusters based on the JINR CMS Tier-1 and JINR WLCG Tier-2 Grid sites were put into operation at MLIT. The batch system, intended for performing calculations of the JINR Laboratories' experiments, operates on the Toque/Maui software, and the accounting system has not been implemented for it.

The paper presents the process of building this system and data loading to evaluate the efficiency for previous years, as well as conclusions about the growth rate of performance and efficiency of the computing center.

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Presenter: KASHUNIN, Ivan (JINR)

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **980** Type: **Oral**

Preliminary results of the Pilot Run in the NA65-DsTau experiment at CERN-SPS

Wednesday, 26 October 2022 14:00 (15 minutes)

For clarifying the validity of the Lepton Universality hypothesis, the interaction cross section for all three flavors of leptons have to be known with high precision. In neutrino sector, for electron and muon neutrinos, the interaction cross section is known fairly well, but for tau neutrino only poor estimations exist. In particular, the most direct measurement by the DONuT experiment was performed with rather poor accuracy due to low statistics and an uncertainty of the tau neutrino flux. The DsTau experiment proposes to study tau-neutrino production process and thus to improve significantly the accuracy of calculations of tau neutrino flux for neutrino accelerator experiments. To study reactions providing most of tau neutrinos, the experiment uses a setup based on high resolution nuclear emulsions, capable to register short lived particle decays created in proton-nucleus interactions. The present report shows the status of the experiment, including the estimations for the efficiency of detecting short lived particles and the beginning of the data analysis from the Pilot Run.

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **981** Type: **Oral**

The influence of proton irradiation on I-V characteristics of LPE graphene

Tuesday, 25 October 2022 15:15 (15 minutes)

Due to their outstanding physical properties, graphene and related materials have a huge potential for applications in electronic devices such as FETs with graphene channels and graphene-based sensors. So, one of the most important characteristics of graphene film is the I-V characteristics. In this research the authors discuss the I-V characteristics of few-layer graphene obtained by liquid phase exfoliation (LPE) method. The current- voltage characteristics of graphene deposited on sapphire substrate are measured and studied using data acquisition devices and LabVIEW programing. Firstly, they are affected by doping effect due to functionalization of graphene.
The synthesized graphene layers are deposited on sapphire substrate and irradiated with a beam of accelerated protons. Studies after irradiation show that LPE graphene layers are not only stable (do not disintegrate), but also have improved the I-V characteristics.

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Presenter: Ms GASPARYAN, Naira (A. Alikhanyan National Science Laboratory)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **982** Type: **Oral**

Preparation and study of Graphene/LN heterojunction for sensorial application

Tuesday, 25 October 2022 15:00 (15 minutes)

Due to their outstanding physical properties, graphene and related materials have a huge potential for applications in electronic and optical devices. In our research graphene layers are obtained by liquid phase exfoliation (LPE) method for the application in SAW sensors. On the other hand, stochiometric lithium niobate (LN) is the best material for such applications, because of its piezoelectric character and unique physical characteristics.
Synthesized in a colloidal solution, graphene layers are substituted to LN substrate and studied. As the fingerprint of graphene and other carbon nanomaterials, the spectrum of Raman scattering is measured and analyzed (Fig. 1).

`Fig. 1 Raman spectrum of thre layer graphene deposited on LN`

The current- voltage characteristics of graphene deposited on LN are measured and studied using data acquisition devices and LabVIEW programing. The studies revile the influence of screening effect on the electrical properties of graphene, because of high dielectric constant of LN crystal.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **983** Type: **Oral**

SU(3) Dual QCD Thermodynamics at Finite Temperature and Chemical Potential

Tuesday, 25 October 2022 14:15 (15 minutes)

Following the study for SU(2) case with zero bario -chemical potential, a dual QCD formulation for SU (3) color gauge has been proposed to be constructed in terms of dual gauge potentials which takes into account the local as well as the topological structure of the color gauge group into its dynamics. The dynamical configuration of the resulting dual QCD vacuum and its flux tube configuration have been proposed to be investigated for analyzing the non-perturbative features of QCD. The thermal behavior of the non-perturbative QCD vacuum has been proposed to be investigated for exploring the dynamics of quark-hadron phase transition at non-vanishing bario-chemical potential. Related thermodynamic quantities and Equation of State (EoS) to characterize quark matter have also been proposed to be discussed within the framework of dual QCD based hadronic bag which guarantees the critical parameters and the associated critical points for quark hadron phase transition. These thermodynamic quantities are expected to play important role in understanding the order of phase transition and are likely to predict the features of first order phase transition for non-vanishing bario-chemical potential. Furthermore, in addition to the variation of normalized pressure for hadron and QGP phases, the scaled pressure difference, quark number density and susceptibility have been proposed to be investigated, as they serves as useful tool to understand the nature of QCD phase transition and measures intrinsic statistical fluctuations close to thermal equilibrium. Moreover, we also propose to investigate the bulk properties of quark matter by constructing the free energy change and the associated surface tension for quark-hadron phase transition. For consistency and compatibility check, we will compared our results with state of the art three-loop Hard Thermal Loop perturbative results and available lattice QCD results.

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Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **985** Type: **Poster**

Theoretical study of dynamic viscosity of hydrocarbons

Friday, 28 October 2022 14:10 (5 minutes)

It is known that the determination of the dynamic viscosity of liquids is important for determining their various physical properties. Therefore, extensive research has been carried out in this direction in recent years. It has been established that many factors can influence the viscosity of liquids. When studying the dynamic viscosity of liquid metals, it was found that the dynamic viscosity of these materials varies depending on the temperature and ionic radius of the metal. In previous studies, various structural changes were observed in solids depending on the temperature of the ionic radius. Therefore, it is important to study the physical processes occurring in hydrocarbons as a result of these influences.

Although many of the chemical engineering problems with hydrocarbons have been studied, the physical processes are not well understood. It is very important to study in the laboratory many physical processes that occur during the transportation of hydrocarbons through pipes. In the course of previous studies, the dynamic viscosities of aromatic hydrocarbons have been widely studied and many physical processes occurring in them have been studied. In this study, the dynamic viscosity of hydrocarbons was studied. The study was carried out with phenomenological aspects. The objects of study were selected: cyclopentane, methylcyclopentane, ethylcyclopentane, propylcyclopentane, cyclohexane, methylcyclohexane and ethylcyclohexane. The studies were carried out in the temperature range T = 253-373 K. It has been established that with increasing temperature, the value of the dynamic viscosity of hydrocarbons decreases. In these materials, the mechanism of change in dynamic viscosity at high temperatures has been studied. Cyclopentane, methylcyclopentane, ethylcyclopentane, propylcyclopentane, cyclohexane, methylcyclohexane and ethylcyclohexane were taken in calculations. It was found that as the number of molecules in the composition increased, the viscosity value increased. At room temperature, the viscosity increased from C5H10 to C8H16 to $\Delta\eta$ = 446×106 kg/m•sec.

Primary author: MIRZAYEVA, Guney

Presenter: MIRZAYEVA, Guney

Session Classification: Online poster session

Track Classification: Condensed Matter Physics

Contribution ID: **988** Type: **Poster**

Effect of neutron beam on electrical properties of yttrium oxide nanoparticles

Friday, 28 October 2022 14:15 (5 minutes)

In the present work, the influence of a neutron beam on the electrical properties of yttrium oxide is studied. The experiments were carried out in the temperature range of 300-700 K and were irradiated with fast neutrons of different intensity (4.0×1012 n/cm², 1.3×1013 n/cm² and 4.0×1014 n/cm²). It has been established that the electrical properties of Y2O3 nanocrystals in a wide temperature range show an increase in the electrical conductivity according to a linear law after irradiation of various intensities. The increase in conductivity depending on the intensity of the radiation of fast neutrons is associated with the predominance of yttrium vacancies in the conductivity.
The electrical conductivity of unirradiated samples of Y2O3 nanocrystals varies linearly in the temperature range 290–340 K. However, an increase in the intensity of the fast neutron flux leads to an increase in the electrical conductivity in a given temperature range. To determine the mechanism of experimental experiments, the condition of repeated measurement of the electrical conductivity of unirradiated samples of Y2O3 nanocrystals was repeated. As is known, during repeated measurements, a decrease in the value of the electrical conductivity of the samples is observed and it becomes equal to the repeated values when moving to higher temperatures. Also, studies carried out by the method of "Differential Scanning Calorimetry" show that on the surface of samples of Y2O3 nanocrystals in the temperature range of 300-540 K, a complex process occurs, such as dehydration of weakly absorbed water molecules. The kinetics of the dehydration process as a mechanism makes it possible to reduce the numerical value of the electrical conductivity, establish regularities in a wide temperature range, and form an opinion on the general change in the electrical conductivity depending on the intensity of the fast reaction. neutron flux. Water molecules adsorbed on the active surface of nanostructured compounds form an ion-dipole interaction with bulk cations, and the overall result of this interaction leads to the formation of new hydroxyl functional groups. The mechanism of desorption of water molecules on the crystal surface has characteristic values of anions and cations Y and O in the electrical conductivity of the sample. As the intensity of the fast neutron flux increases, the observed changes in the electrical properties can be explained by the activation of vacancies, point defects, and excited states.

Primary author: RZAYEV, Ravil

Presenter: RZAYEV, Ravil

Session Classification: Online poster session

Track Classification: Condensed Matter Physics

Contribution ID: **990** Type: **Poster**

Analysis of possible functional conservation between genes Oxr1 and Ncoa7

Friday, 28 October 2022 14:30 (5 minutes)

Genomics is a rapidly developing research area that studies genome structure, mechanisms of its functioning and genome and genes evolution. One of the key mechanisms of novel gene emergence is gene duplication. These events lead to the emergence of a gene with identical functions that can be lost, can change, or novel functions may be acquired. An example of genes that have evolved following several duplication events are members of the TLDc family. In this work, I investigated the functional conservation of the two most closely related family members - Oxr1 and Ncoa7. These genes possess highly similar domain architecture and have been shown to share some functions and binding partners. Strikingly, Oxr1 knockout in mice leads to a severe phenotype of cerebellar degeneration, ataxia and early death, while Ncoa7 expression disruption is well tolerated and has only been shown to lead to increased urine pH. As Oxr1 and Ncoa7 genes share a high degree of similarity, it is possible that Oxr1 could compensate for the absence of Ncoa7 and protect animals from developing any abnormal phenotype - such a mechanism has previously been shown for other genes. Based on their promoter region sequences, we predict that Oxr1 and Ncoa7 are likely regulated by similar sets of transcription factors and are involved in multiple processes throughout the organism, such as central nervous system development, hematopoiesis and stem cell maintenance.
Keywords: gene duplication, transcriptional regulation

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Session Classification: Online poster session

Track Classification: Life Science

Contribution ID: **994** Type: **Oral**

Development of services for the condition database of the BM@N experiment at NICA

Thursday, 27 October 2022 14:45 (15 minutes)

The condition database of the BM@N experiment, the first experiment of the NICA megaproject, is used as a central location for storing vital experiment metadata, including session and run information, detector and subsystem parameters, and description of simulated event files. For an effective work with the database in the existing software environment, a set of various tools and services are required. In the report the implementation of two services for the information system is discussed, specifically a tool for transferring condition information from text, CSV, and XML formats to the condition database, and a REST API service to provide access to condition database records from other BM@N software systems. It will be shown how both tools improve overall degree of database integration and user experience.

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Presenter: ZELENYI, Mikhail (INR RAS, MIPT)

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **995** Type: **Oral**

Investigation of the radiation resistance and optical properties of new composite thermal barrier coatings.

Tuesday, 25 October 2022 14:45 (15 minutes)

Improved thermal barrier coatings (TBCs) will enable future gas turbines to operate at higher gas temperatures [1]. Considerable effort is being invested, in identifying new materials with even better performance than the current industry standard, yttrium stabilized zirconia (YSZ) [2]. Turbines should operate at as high temperature as possible to maximize their efficiency. Until about 15 years ago, relentless increases in operating temperatures were achieved through improved alloy design, the development of blades composed of textured microstructures and subsequently single crystals, and internal cooling by air flow through internal channels cast into the component. More recently increase in operating temperatures have been enabled by deposition of TBCs on high-temperature gas turbine components. Rare-earth silicates have been identified as a class of low-thermal conductivity ceramics for possible use in TBCs for gas-turbine engine applications. They are also supposed to be applied in spacecrafts as protective layer against heat. The operation of spacecrafts in cosmic conditions in turn suggests long-lasting irradiation with cosmic rays, particularly with MeV energy range protons, electrons and neutrons [3]. Therefore, it is very important to investigate the behavior of such barrier coatings under irradiation conditions. The aim of our work is to investigate the radiation resistance of TBCs based on silicate compounds obtained by a new method (hydrothermal microwave) by using high-energy electron, proton and neutron beam irradiation. For this purpose various silicates prepared by hydrothermal microwave method were irradiated with 20 MeV electrons, l8 MeV protons and neutron with doses 1013-1017 particle/cm2. The diffuse reflectance and absorption measurements of materials before and after irradiation indicated that the samples have a high radiation resistance. X-ray diffraction analysis (XRD) suggested that the samples after proton and neutron irradiation maintain the crystalline structure.

[1] V. Kumar and B. Kandasubramanian, "Processing and design methodologies for advanced and novel thermal barrier coatings for engineering applications," Particuology, vol. 27, pp. 1–28, 2016, doi: 10.1016/j.partic.2016.01.007.
[2] Z. Tian, L. Zheng, J. Wang, P. Wan, J. Li, and J. Wang, "Theoretical and experimental determination of the major thermo-mechanical properties of RE2SiO5 (RE=Tb, Dy, Ho, Er, Tm, Yb, Lu, and Y) for environmental and thermal barrier coating applications," J. Eur. Ceram. Soc., vol. 36, no. 1, pp. 189–202, 2016, doi: 10.1016/j.jeurceramsoc.2015.09.013.
[3] V.V. Baghramyan, A.A. Sargsyan, N.B. Knyzyan, V.V. Harutyunyan, A.H. Badalyan, N.E. Grigoryan A. Aprahamian, K.V. Manukyan (2020). Pure and cerium doped zinc orthosilicate as a pigment for thermoregulating coating, Ceramics International, Volume 46, Issue 4, 2020, pp. 4992-4997.

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Presenter: BADALYAN, Anush (Armenian)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **996** Type: **Poster**

Shift of the proton drip-line due to Λ-hyperons

Monday, 24 October 2022 18:00 (5 minutes)

Studies of nuclei with proton or neutron excess remain highly relevant in modern nuclear physics. New information about the nature of baryon-baryon interactions can be extracted from properties of hypernuclei near the stability limits. ΛN-interaction is attractive, therefore, addition of a Λ-hyperon to non-strange nuclei can lead to an increase in the binding energy and formation of a bound hypernucleus with an unbound nucleon core.

We consider light proton-rich hypernuclei. The position of the proton drip-line is determined by the sign of the separation energy of one or two protons. For light nucleus, these values are well known today. In particular, for isotopes with $5 \leq Z \leq 12$, the nuclei with the largest neutron deficiency are ^{8}B, ^{9}C, ^{12}N, ^{13}O, ^{17}F, ^{17}Ne, ^{20}Na and ^{20}Mg. Nuclei with an even Z: ^{12}O, ^{16}Ne, ^{19}Mg decay by emission of two protons. For nuclei with odd Z: ^{7}B, ^{11}N, ^{16}F, ^{19}Na the line of existence of nuclei is determined by the separation energy of one proton. ^{8}C is unstable with respect to the emission of four protons. Since the addition of a Λ-hyperon gives an extra binding, the goal was to answer the question: are hypernuclei ^{8}B, ^{9}C, ^{12}N, ^{13}O, ^{17}F, ^{17}Ne, ^{20}Na and ^{20}Mg stable with respect to protons emission?

To this aim, we employ the Skyrme-Hartree-Fock approach in order to describe the structure of the isotopes under consideration. The condition for the existence of bound isotopes is the positive value of the separation energy of one or two protons. Proton separation energy in hypernuclei depends on proton separation energy in nuclei S_p and Λ separation energies B:

S_p ($^{A+1}$Z) = S_p (^{A}Z) + B ($^{A+1}$Z) - B (^{A}(Z - 1)).

For two protons separation energy formula looks similar:

S_{2p} ($^{A+1}$Z) = S_{2p} (^{A}Z) + B ($^{A+1}$Z) - B ($^{A-1}$(Z -2)).

For estimates in the presence of experimental data, we use the values of the protons separation energies and Λ separation energies of hypernuclei from the experiment. The rest of the quantities we calculate in the Skyrme-Hartree-Fock approximation.

Calculations with various combinations of NN- and ΛN-interactions have shown that the addition of a Λ-hyperon to the nucleus ^{8}C leads to the formation of a bound hypernuclei ^{9}C. Based on the results obtained, it can be suggested that hypernuclei ^{17}F it is also bound, and the hypernuclei ^{8}B, ^{12}N, ^{13}O, ^{17}Ne and ^{20}Mg are not. The boundness of ^{20}Na remains questionable.

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Presenter: KORNILOVA, Anastasiia (Lomonosov Moscow State University)

Session Classification: In-person poster session & welcome drinks

Track Classification: Theoretical Physics

Contribution ID: **997** Type: **Oral**

Photoluminescence of swift heavy ion irradiated MgAl2O4 spinel single crystals

Tuesday, 25 October 2022 14:00 (15 minutes)

In the present work, swift heavy ion irradiation-induced defects in MgAl2O4 single crystals have been studied using photoluminescence (PL) spectroscopy technique. Samples were irradiated with high energy Ar (46 MeV), Kr (107 MeV), Xe (150 MeV) and Bi (710 MeV) ions in the fluence range of 10ˆ10-10ˆ14 cm-2 at IC-100 and U-400 cyclotrons in FLNR JINR (Dubna, Russia). The PL measurements were performed in two experimental geometries: standard (λexc. = 355 nm) using Shamrock SR303i spectrometer and confocal (λexc. = 355 nm, 445 nm, 473 nm and 532 nm) using confocal microscope at room temperature. It was found that the PL spectra from intact MgAl2O4 contain emission bands of Cr3+ (1.8 eV) and Mn2+ (2.4 and 1.6 eV) impurities. Irradiation of MgAl2O4 crystals by high-energy heavy ions causes the appearance an intense non-elementary bands around 1.55-3.1 eV under 355 nm, 445 nm, 473 nm and 532 nm excitation wavelengths. The analysis of the PL spectra obtained in standard geometry allowed us to assume that the radiation-induced defects created in the track region are surrounded predominantly by Mg and O ions. In confocal geometry, upon different energy of excitation, the PL spectra of samples have been demonstrated the similar spectral shapes, which have been tentatively ascribed to some of impurity centers in different charge states.

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Presenter: MAMATOVA, Meruyert (JINR)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **998** Type: **Oral**

Information Systems for the BM@N experiment and Common Deployment Service

Thursday, 27 October 2022 14:30 (15 minutes)

The efficient operation of large physics experiments is ensured by many factors, one of which is software used for both online and offline systems. A set of software systems is also being implemented for the first experiment of the NICA project, a fixed target BM@N setup, where they are used, among other things, for centralized storage, access and exchange of necessary information. The report briefly presents the status of the developed information systems for the BM@N experiment, such as online electronic logbook, configuration information system, condition database, geometry information system and event metadata system. It is obvious that the systems will be in demand in other experiments of the NICA project, therefore special attention is paid in the report to implementation of new common deployment services that provide convenient, configurable deployment of the presented information systems for other particle collision experiments, but primarily for experiments at NICA.

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Presenter: CHEBOTOV, Alexander

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **999** Type: **Poster**

Proton Beam Irradiation of CsPbBr3 Lead Halide Perovskites

Monday, 24 October 2022 18:05 (15 minutes)

During the last decade Lead Halide Perovskites (LHPs) have been widely researched in the photovoltaic and light emission fields due to their outstanding optoelectronic properties and exceptional performance. Owing to their low cost and easy fabrication, tremendous achievements were achieved in solar cell, photodetector, light-emitting diode and laser research fields.
On the other hand, space application of PSCs is also anticipated, driving much research attention on the stability of PSCs in the space environment, as lightweight, large-area, high-efficiency solar cells are in high demand in the space industry. Because spacecraft weight restrictions directly affect the progress of space development, reducing the weight of solar cells is of main importance. To be applied in space environment, radiation resistance of such materials is critical. Charged particles, such as protons and electrons can penetrate the materials, cause structural deformations thus limiting the operation lifetime of devices. In this sence radiation resistance of perovskites is an important issue to deal, prior to its application in space.
In this work lead halide perovskite thin films were subjected to proton-beam irradiation (energy 18MeV, dose 1014 – 1015p/cm2) in order to assess the durability and radiation tolerance of perovskite solar cells (PSCs) against space radiation. Proton-beam irradiation is chosen because proton beams significantly affect solar cell performance in the space environment. We evaluate the effects of proton beams by focusing on the absorption properties, crystal structure, and morphology by using optical spectroscopy, X-ray diffraction, and scanning electron microscopy. The results show that proton irradiation with energy 18 MeV and doses up to 1015p/cm2 does not significantly affect the absorption coefficient and crystal structure of the perovskite layer.

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Presenter: BADALYAN, Anush (Armenian)

Session Classification: In-person poster session & welcome drinks

Track Classification: Condensed Matter Physics

Contribution ID: **1000** Type: **Oral**

Flows of geometric parameters of Sasaki-Einstein manifolds Yp,q and Lp,q,r through isomonodromy

Wednesday, 26 October 2022 17:05 (15 minutes)

We investigate the equations of motion for a free point string on five-dimensional Sasaki-Einstein manifolds Yp,q/Lp,q,r. This results in Fuchsian equations with four singularities or a Heun equations. The asymptotic solutions of these equations are obtained through isomondromic deformation and are related to the sixth Painlevé equation. We derive the flows generated by the coalescence procedure for the hierarchy of Painlevé equations and the effect of these flows on the spectrum of energies. Through this procedure we search for dynamically occurring phase transitions in the spectra on the manifolds.

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Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1001** Type: **Oral**

Search for the evidence of 209Bi(γ,p5n)203Pb reaction in 60MeV and 80MeV photon beams

Thursday, 27 October 2022 14:00 (15 minutes)

The simplest photonuclear reaction (γ,n) usually takes place through the well-known mechanism of giant dipole resonance. For a large number of stable nuclei, the energy differential cross-section of this reaction has been successfully measured. The experimental evidence for the (γ,2n) reaction is much poorer, while for reactions where three or more neutrons are emitted (usually denoted by (γ,xn)), the values of the cross-sections can be obtained from theoretical calculations mostly. For reactions in which a charged particle, such as a proton, in the simplest case, is emitted (single or in addition to one or more neutrons) there is much poorer experimental evidence. The probability of emission of a charged particle in the interaction of nuclei with high-energy photons is significantly lower than the emission of neutrons due to the existence of the Coulomb barrier. It is a reason why experimental data concerning (γ,pxn) are insufficient in the literature.
In several recently published papers, photonuclear reactions with a target of natural bismuth (monoisotope 209Bi) were studied. Irradiation of some heavy elements by the photons having energies up to 80 MeV, will give several products of (γ,xn) reactions. The emission of protons or other charged particles is less probable due to the Coulomb barrier.
In this paper, an attempt was made to gain experimental evidence of Bi-209(γ,p5n)Pb-203 nuclear reaction by comparison of intensities of gamma lines following EC decay of Bi-203 and Pb-203. Pb-203 can be formed by (γ,p5n) nuclear reaction, but it is certainly created after the decay of Bi-203, obtained in Bi-209(γ,6n)Bi-203 reaction. After activation of the target from natural bismuth in photon beams of maximum energies of 60 MeV and 80 MeV, several gamma spectra were successively measured. Based on selected gamma lines from the measured spectra, the activities of Pb-203 and Bi-203 were monitored to assess the probability ratio for the occurrence of (γ,6n) and (γ,p5n) nuclear reactions. Furthermore, if some quantitative data concerning the probability of the mentioned reactions can be extracted, it can be a good way to compare the obtained result with theoretical predictions, which is done in this paper.

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Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1002** Type: **Oral**

Study of 104Rh using (nth,2γ) reaction

Thursday, 27 October 2022 15:45 (15 minutes)

104Rh nuclei was studied using the (nth,2γ) reaction. Measurements with two HPGe detectors for the 104Rh nuclei was conducted at the PGAA facility of the Centre for Energy Research (MTA EK), Budapest, Hungary. The obtained data is based on the analysis of the two-step gamma cascades in the mentioned compound nucleus to the final and some of the lower lying excited levels. The obtained primary and secondary gamma transitions, as well as intermediate cascade levels, were compared with the existing data in the ENSDF library. The comparison showed that a number of primary transitions, intermediate cascade levels, and secondary transitions can be considered as new data.

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Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1003** Type: **Poster**

Maxwell-Juttner distribution for ideal gas of spinning particles

Monday, 24 October 2022 18:20 (5 minutes)

We consider a statistical mechanics of a rotating gas of massive relativistic particles with nonzero spin. Applying the formalism of Gibbs ensembles, we derive a one-particle distribution function by positions, momenta, and directions of spin. For zero angular velocity, the distribution coincides with well-known Maxwell-Juttner distribution. For nonzero angular velocity, corrections caused by the presence of spin can be observed. The main attention is paid to the distribution function by directions of spin, and its dependence on angular velocity. It is shown that the rotation causes the polarization of the gas, with the majority of spins being directed along the angular velocity vector. This phenomenon is well known in non-relativistic systems, but the relativity increases the magnitude of the effect at high temperatures. We also observe a special kind spin-orbital interaction: the distribution function on-axis and off-axis affects in different ways. The phenomenon has no analogue in non-relativistic gas.

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Presenter: LEVIN, Nikita (National Research Tomsk State University)

Session Classification: In-person poster session & welcome drinks

Track Classification: Theoretical Physics

Contribution ID: **1005** Type: **Oral**

MeV energy electron and proton irradiation effects in semiconductor materials for space applications

Monday, 24 October 2022 15:15 (15 minutes)

Nowadays, space exploration is undergoing intensive investigation, and semiconductor electronic equipment in space operates in an environment irradiated by high-energy particles. MeV electrons and protons are present in the near-Earth space environment, where they are more intense, so the study was carried out in these simulated space conditions (energy, vacuum, temperature).
The effects of protons with an energy of 18 MeV and picosecond pulsed electrons with an energy of 3.5 MeV on the parameters (charge carriers' concentration and mobility, resistivity) of Si single crystals and n-GaP are investigated. On top of that, the introduction rate of radiation defects was studied depending on irradiation dose and it was demonstrated that the introduction rate of radiation defects at room temperatures could be expressed by the empiric exponential law of the form
\frac{\Delta N}{\Delta D}=\frac{n_{0}}{D_{0}}\text{exp}\left(- \frac{D}{D_{0}}\right),
which gives the best agreement with the experimental data, irrespective of the type of irradiation particle. Here N_{def} is the concentration of radiation defects and n_{0} is the initial concentration of charge carriers, D_{0} is the irradiation dose, at which the carrier concentration n\left(D \right) at a temperature T=300K decreases by a factor of e.

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Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1006** Type: **Oral**

Cost-effective automatization of experiment

Monday, 24 October 2022 14:00 (15 minutes)

Automation of a physical experiment is an important part of its preparation. Quite often, it is required to remotely control equipment that is in radiation hazardous conditions, control various parameters of the experimental setup, and monitor the temperature and humidity of the air in the experimental room.
To date, electronics has reached great heights. Microcontrollers costing less than 2 USD with built-in WI-FI have appeared, which makes it possible to create very cheap devices for remote control and monitoring. The high performance of these microcontrollers and a large amount of internal memory significantly reduce the requirements for the quality of the executable code, which, together with a large number of ready-made libraries for various peripheral devices, significantly speeds up the development of appliances.
To automate the experiments carried out within the framework of the TANGRA[1] project, a number of devices based on the ESP8266[2] microcontroller were created: a manipulator for moving various objects, a liquid nitrogen amount control system for the dewars of germanium detectors, and sensors for monitoring the parameters of the environment in the experimental room. The process of creating these devices, the features of their circuitry and the experience we gained when using these devices will be discussed in this report.

1. Fedorov N. A., Grozdanov D. N., Kopatch Yu. N. et al., EPJ A 57 (2021) 194.
2. https://www.espressif.com/sites/default/files/documentation/0a-esp8266ex_datasheet_en.pdf

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Presenter: FEDOROV, Nikita (JINR)

Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1007** Type: **Oral**

Evolution of the phenomenologically determined collective potential along the chain of Zr isotopes

Wednesday, 26 October 2022 14:00 (15 minutes)

The properties of the collective low-lying states of Zr isotopes indicate that some of these states are mainly spherical and the other are mainly deformed ones. In our previous works, it was shown that the structure of low-lying collective states of 96Zr can be satisfactorily described within the framework of a geometric collective model based on the Bohr Hamiltonian with a potential that supports the existence of various forms of the nucleus. Based on these results, the question arises about the possibility of investigating the properties of low-lying collective states of 92–102Zr on the basis of a five-dimensional geometric quadrupole collective model.

The quadrupole-collective Bohr Hamiltonian depending on both β and β shape variables with a potential having spherical and deformed minima, is applied. The relative depth of two minima, height and width of the barrier, rigidity of the potential near both minima are determined so as to achieve the best possible description of the observed properties of the low-lying collective quadrupole states of 92–102Zr.
Satisfactory agreement with the experimental data on the excitation energies and the E2 reduced transition probabilities is obtained. The evolution of the collective potential with increase of β is described and the distributions of the wave functions of the collective states in β–β plane are found.

It is shown that the low-energy structure of 92–102Zr can be described in a satisfactory way within the Geometrical Collective Model with the Bohr Hamiltonian. The β-dependence of the potential energy is fixed to describe the experimental data in a best possible way. The resulting potential evolves with β increase from having only one spherical minimum in 92Zr, through the potentials having both spherical and deformed minima, to the potential with one deformed minimum in 102Zr. A β-dependence of the wave functions is presented in a set of figures illustrating their distribution over β.

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Presenter: MARDYBAN, Evgenii (Vasilevich)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1008** Type: **Poster**

Quasiclassical trajectories of spinning electron in hydrogen atom

Monday, 24 October 2022 18:25 (5 minutes)

We consider the motion of a non-relativistic charged particle with an arbitrary spin in central potential Ze/r in terms of classical mechanics. We show that the spin-orbital interaction causes the precession of the plane of orbit around the vector of total angular momentum. The angular velocity of precession depends on the distance of the particle from the center. The effective potential for in-plane motion is central, with the corrections to Coulomb terms coming from spin-orbital interaction. The possible orbits of quantum particle are determined by Bohr-Sommerfeld quantization rule. We give the examples of orbits corresponding to small quantum numbers, which were obtained by numerical integration of equations of motion. The energies of stationary states are determined with account of spin-orbital interaction

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Session Classification: In-person poster session & welcome drinks

Track Classification: Theoretical Physics

Contribution ID: **1009** Type: **Oral**

On explicit cutoff regularization

Tuesday, 25 October 2022 15:00 (15 minutes)

The talk is devoted to an explicit cutoff regularization of the Green's function for a covariant Laplace operator. It is planned to give definitions, explain properties (spectral representation, homogenization, covariance), and formulate results for the case of the four-dimensional Yang-Mills theory.

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Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1010** Type: **Oral**

Resistive plate chamber with B-10 for registartion of thermal neutrons

Tuesday, 25 October 2022 14:30 (15 minutes)

Resistive plate chamber detector's type has wide application in high energy physics because their time resolution and the availability of materials for their producing. The electrical signal is induced on the reading cuprum strips. The spatial resolution of the detector can reach hundreds of micrometers. These reasons prompted us to create a new type of thermal and cold neutron detector – a single-band resistive plate chamber with a 10B converter. A conceptual design of detector and first results will be presented in the report.

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Presenter: Mrs PETROVA, Maria (JINR)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1011** Type: **Poster**

Long-term effects in immunocompetent organs during simulation of radiochemotherapy in mature rats

Monday, 24 October 2022 18:30 (5 minutes)

Standard radiotherapy for neoplasms is associated with a high risk of post-radiation damage. Due to this, the task of increasing the radiosensitivity of the tumor to radiation is relevant. One such promising medication is the synthetic nucleoside AraC (cytosine arabinoside). The aim of the work was to study the effect of the combined use of protons at a dose of 3 Gy and AraC on the physiological parameters of immunocompetent organs on the 90th day. The experiment was carried out on 22 mature male SD rats at the age of 8-10 weeks. Animals were randomized by weight into 4 groups: control, control+AraC, irradiation and irradiation+AraC. The animals were irradiated totally with protons in the cranio-caudal direction at a dose of 3 Gy with an energy of 170 MeV, the dose rate was 0.8 Gy/min. The medication was administered into the tail vein 1-1.5 hours before irradiation. body weight and immunocompetent organs were measured. White blood cell count (WBC) and leukogram was carried out by standard cytological methods. Statistical processing of the obtained results was carried out in the PAST and OriginPro 2018 programs. A comparative analysis of the number of leukocytes revealed a significant difference in the AraC group, however, the average values in all groups are included in the reference interval for rats of this line of this age, and a cytological examination of all blood smears did not reveal any abnormalities from the clinical norms, nor changes in the leukogram. A comparative analysis of the thymus mass showed a significant decrease in this indicator in the "Protons + AraC" group, which is the expected effect with total irradiation. The data obtained did not reveal functionally significant differences in the side effects of proton therapy when it was modified with cytosine arabinoside, since all significant changes correspond either to the physiological norm of rats or the expected effects of total irradiation. The results of the study on normal tissues indicate that the use of cytosine arabinoside in combination with proton irradiation does not lead to significant side effects in the long term, therefore, it can become a promising method of therapy. Further studies in tumor models are needed to determine efficacy and the presence of unrecognized side effects.

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Presenter: PRONSKIKH, Evgeniya (Vitalievna)

Session Classification: In-person poster session & welcome drinks

Track Classification: Life Science

Contribution ID: **1012** Type: **Oral**

Comprehensive Elemental Analysis of Nanodiamonds for Simulating the Properties of Cold and Very Cold Neutron Reflectors

Monday, 24 October 2022 17:05 (15 minutes)

Neutron reflectors are widely used to store, extract, focus and deliver neutrons to experimental facilities. For the last almost 20 years, Detonation NanoDiamond (DND) powders have been actively studied as a material for efficient diffuse reflectors of Very Cold Neutrons (VCN) with the velocities of 40-150 m/s. Moreover, the DND powder reflects cold neutrons (up to 1000 m/s) quasi-specularly at small grazing angles of incidence of the neutron beam. The use of such reflectors will make it possible to increase the neutron fluxes and expand the scope of VCN applications. But the experimental research of the properties of advanced nanodiamond reflectors is a highly challenging task. It is connected with problems of having a large amount of DND powders and developing a complex system of neutron detectors. Therefore, the simulation seems to be the easiest way to study the characteristics of neutron reflectors made of DND.

In earlier works [1–3], we proposed the model of neutron transport in DND powders based on the data of small angle neutron scattering on DND and its agglomerates. We used this model to analyse the structure of DND powders and to simulate the reflection of VCN from the raw, deagglomerated, and size separated DND. However, the impurity composition of DND powders has never been counted due to the emphasis on structural analysis in these studies. Nevertheless, the impurities also affect the properties of nanodiamond reflectors to no lesser extent. Neutrons are captured by the nuclei of the trace elements in the DND powders. As a result, the performance of the nanodiamond reflector is degraded.

To calculate the total neutron capture cross-section, it is necessary to provide the most complete quantitative elemental analysis. In this work, we used x-ray photoelectron spectroscopy (XPS), prompt gamma-ray neutron activation analysis (PGNAA), and neutron activation analysis (NAA). Methods are sensitive to certain elements. They complement each other to identify all possible nuclei of elements that are responsible for neutron capture in DND powders. XPS provides information about the fractions of such elements in DND powders as carbon (C), oxygen (O), nitrogen (N), and fluorine (F). PGNAA and NAA are neutron methods that measure the induced activities for impurities. And it is the most natural way to study the absorbing properties of neutron reflectors. PGNAA allows obtaining the concentration of C, N, hydrogen (H), boron (B), chrome (Cr), chlorine (Cl), and others whereas NAA measures the concentrations of elements activated in high neutron fields (basically metals). Considering the full composition of impurities in DND powders allows simulating the properties of nanodiamond reflectors for different applications in neutron physics.

The methods of comprehensive elemental analysis of different DND powders, as well as the effect of impurities on the neutron reflection, will be discussed. We will also present the simulation results of neutron reflection from flat DND layers and the VCN storage inside spherical traps with walls made of DND powders.

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References

1. Bosak A., Dideikin A., Dubois M., Ivankov O., Lychagin E., Muzychka A., Nekhaev G., Nesvizhevsky V., Nezvanov A., Schweins R., Strelkov A., Vul' A., Zhernenkov K. Fluorination of Diamond Nanoparticles in Slow Neutron Reflectors Does Not Destroy Their Crys-

talline Cores and Clustering While Decreasing Neutron Losses. Materials 13 (2020) 3337. DOI: 10.3390/ma13153337.

2. Aleksenskii A., Bleuel M., Bosak A., Chumakova A., Dideikin A., Dubois M., Korobkina E., Lychagin E., Muzychka A., Nekhaev G., Nesvizhevsky V., Nezvanov A., Schweins R., Shvidchenko A., Strelkov A., Turlybekuly K., Vul' A., Zhernenkov K. Clustering of Diamond Nanoparticles Fluorination and Efficiency of Slow Neutron Reflectors. Nanomaterials 11 (2021) 1945. DOI: 10.3390/nano11081945.
3. Aleksenskii A., Bleuel M., Bosak A., Chumakova A., Dideikin A., Dubois M., Korobkina E., Lychagin E., Muzychka A., Nekhaev G., Nesvizhevsky V., Nezvanov A., Schweins R., Shvidchenko A., Strelkov A., Turlybekuly K., Vul' A., Zhernenkov K. Effect of Particle Sizes on the Efficiency of Fluorinated Nanodiamond Neutron Reflectors. Nanomaterials 11 (2021) 3067. DOI: 10.3390/nano11113067.

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Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1013** Type: **Oral**

Effect of Geometrical and Physical Properties of Cantor Structure for Gas Sensing Applications

Tuesday, 25 October 2022 15:45 (15 minutes)

In this article, the effects of geometrical and Physical properties of gyroidal graphene and porous silicon of Cantor sequence terminated by gyroidal layer are studied for Gas sensing applications. The study is investigated in THz frequencies with transverse electric polarized light. Gyroidal graphene layers have good tunable optical properties and can excite Tamm resonance due to the metallic property of graphene in the THz range. The recorded spectral sensitivity of the proposed detector is 2431 THz/RIU when the analyte index of refraction is in the range from 1.000 to 1.002. Our research will be highly useful in the development of a high-sensitivity, multi-parameter Tamm resonance sensor.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1014** Type: **Poster**

The influence of total gamma radiation on behavior and brain changes of aged mice

Monday, 24 October 2022 18:40 (5 minutes)

The purpose of our experiment was to study physiological state of the body and morphofunctional changes in brain tissue of aged group of mice after 1 month of gamma irradiation. The experiment was conducted with 7 month old male mice, divided in 2 groups: control and irradiated one. One month after 2 Gy Gamma irritation we carried out behavioral test, blood analysis, and examined other biological material for histological analysis. The obtained results showed changes in behavioral state, according to data from Open Field test, as well as changes in physiological state and structural changes of brain cells in cortex and hippocampus.

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Presenter: Ms KOLESNIKOVA, Inna

Session Classification: In-person poster session & welcome drinks

Track Classification: Life Science

Contribution ID: **1015** Type: **Oral**

DEVELOPMENT OF INTELLIGENT CONTROL SYSTEMS WITH THE HUMAN FACTOR INCLUDED

Thursday, 27 October 2022 15:00 (15 minutes)

Modern information technologies make it possible to automate the control process and switch to unmanned (crewless) driving. For example, crewless ships are already being created in maritime transport which are capable of solving the problem of cooperative maneuvering without human help automatically1. In spite of the positive results, the automation of the process of managing moving objects has some disadvantages associated with the isolation of the vehicle operator from the control process. According to A. E. Sazonov, "The control system of a mobile object (ship, vessel, aircraft) is a man-machine and consists of a regulator, which includes both an operator (watchman, pilot), and a control object, which is a mobile object as engineering structure" 2.
If the human factor is not taken into account, this can adversely affect traffic safety and lead to emergency situations. For example, statistics show that the human factor is the main cause of accidents in maritime transport. According to the average statistics, it accounts for an average of 70–80% of all accidents 3. The inclusion of the operator in the chain of control of the motion process leads to the solution of the complex problem of simultaneously taking into account both the psychological characteristics of a person and the characteristics of the controllability of the control object. To solve the problem of the human factor, it is proposed to use an intelligent system for controlling the movement of moving objects in the study. Those system allows taking into account the influence of subjective characteristics of a person on the control process using the concept of *meaning*.
The purpose of the study is to develop a conceptual scheme for an intelligent control system for the movement of moving objects, taking into account the human factor. Research methods are based on the basic concepts of cybernetics, information theory, logic, probability theory and mathematical statistics. The theory of probabilistic evaluation of meanings was used while developing the concept of an intelligent control system for the movement of moving objects [4]. The main concept of this theory is the *concept of meaning*: "meaning is a statistical parameter that measures the average amount of entropy per one conclusion" [4, p. 86]. The concept of meaning allows one to characterize the effectiveness (degree of meaningfulness) of the decisions made by the operator and thereby take into account the human factor. From the point of view of the theory of probabilistic evaluation of meanings, the human factor is a statistical parameter of the Poisson distribution of a random variable that measures the average amount of entropy of the probabilistic state of the "operator-control object" system per one decision made by the operator.
Recently, artificial intelligence researchers have come to the conclusion that it is necessary to step over *the barrier of meaning* [5] firstly, in order to include an element of consciousness in the machine. Thus, scientists can come closer to creating an artificial intelligent system being capable of independently making reasonable management decisions and controlling various moving objects. The results of the study can be used for creating a new class of decision support systems like socio-cyber-physical and human-machine systems.

Bibliography

1. Smolentsev S. V., Smolentsev S. V., Sazonov A. E., Pelevin A. E. The meaning of context in the problem of cooperative maneuvering of unmanned ships. - 2020. - T. 12. - No. 2. - S. 221–229. DOI: 10.21821/2309-5180-2020-12-2-221-229.

2. Sazonov A. E. Human factor and safety of moving objects control / A. E. Sazonov // Sat. mater. XVI General Meeting of the Academy of Navigation and Traffic Control. - 2003. - S. 6–8.

3. Pazovsky V. M. Accident rate in the world fleet // Safety of navigation in the Far East basin: cb. report scientific-practical. conf. October 24-25, 2007 - Vladivostok: Mor. state un-t, 2007. — S.

108–113.
4. Fadyushin S. G. The Lost Estimation of Meanings. Logico-philosophical analysis of the problem of meaning in cybernetics: monograph. - Vladivostok: Dalnevost Publishing House. federal. un-ta, 2022. - 196 p. : ill. – (The best scientific publication of FEFU-2021). DOI https://doi.org/10.24866/7444-5223-0.
5. Mitchell M. Artificial Intelligence Hits the Barrier of Meaning. Information, 2019, no. 10(2), 51. doi:10.3390/info10020051.

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Presenter: KRIUCHKOV, Pavel

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1016** Type: **Poster**

Modeling of 14.1 MeV neutrons scattering on carbon

Monday, 24 October 2022 18:35 (5 minutes)

Reactions with 14.1 MeV neutrons are interest for fundamental research in nuclear physics. Due to the compactness and prevalence of modern neutron generators, reactions with neutrons of these energies have found wide application in applied work, for example, in elemental analysis. To perform such studies and plan new experiments, the complete and accurate databases of nuclear data are needed. On the other hand, on the basis of experimental data obtained in the study of neutron-nuclear reactions, the parameters of theoretical models can be refined, which can subsequently be used to calculate the properties of other processes. However, the use of available experimental data to optimize model parameters is hampered by the fact that they are in a format that is inconvenient for automation.

In the Frank Laboratory of Neutron Physics, the international project TANGRA is being implemented to study the scattering of tagged neutrons on atomic nuclei. For the purposes of the theoretical part of the project, the TALYS program is used. It has wide functionality, and also contains nuclear structure database and set of the nuclear reaction models parameters, based on the RIPL-3 library. The results of calculations usually have good agreement with experiment. To simplify access to the calculation results and the TALYS database, as well as ENDF and EXFOR databases, TalysLib is being developed.

TalysLib is a ROOT-based C++ object-oriented library. It can be used for:
1) Generating TALYS input files,
2) Reading data on the structure of the nucleus from the TALYS database,
3) Converting data to a form convenient for use in the program,
4) Launching TALYS with the given parameters,
5) Selection of model parameters using the MINUIT minimizer,
6) Visualization and saving data using the ROOT software environment.

At the moment, the library has been successfully used to select optical potentials on nuclei ^{12}C 1, ^{24}Mg, ^{28}Si, ^{56}Fe 2. Currently, we working on adding the ability to work with EXFOR and ENDF data focusing on ^{12}C optical parameters optimization. Information about the features of TalysLib, examples of applications and plans for future developments will be presented.

1. Dashkov I.D., Fedorov N.A., Grozdanov D.N et al., Bulletin of the Russian Academy of Sciences: Physics, 86 (2022) 893.
2. Fedorov N.A. PhD Thesisis. MSU, Moscow, 2021.

Primary author: PAMPUSHIK, Grigory

Co-authors: Mr FEDOROV, Nikita; Mr DASHKOV, Ilya (JINR); Mr MILOVANOV, Nikita (Lomonosov Moscow State University, faculty of physics); Dr KOPACH, Yuri; Dr TRETYAKOVA, Tatiana

Presenter: PAMPUSHIK, Grigory

Session Classification: In-person poster session & welcome drinks

Track Classification: Experimental Nuclear Physics

Contribution ID: **1017** Type: **Oral**

Deep learning applications for traffic sign detection and classification

Thursday, 27 October 2022 15:45 (15 minutes)

Advanced trends in computer vision and automotive engineering seek to control traffic conditions as much as possible to keep drivers safer, or to replace them at all. In addition to autopilot, traffic control is used in mapping, to monitor road infrastructure and its inventory, which allows controlling the functioning and maintaining the correct location of road elements. Such systems need maximum accuracy in recognizing objects of interest in real time, and this in turn imposes serious requirements on such algorithms. In this paper, an approach to road sign recognition based on the use of deep neural networks is considered. There are a large number of road elements, divided into groups, for each of which unique neural network methods and model architectures for their detection and classification are needed. This paper proposes a combination of a one shot learning YOLO neural detector pre-trained on the COCO dataset and a classification model pre-trained on ImageNet. Since there is no publicly available dataset with the large number of traffic sign classes needed to train a YOLO neural network detector, a custom labeled dataset was created. Transfer Learning was used, which reduced the time to train the models and achieved greater accuracy. The object tracking is performed by the DeepSort algorithm. The tracking mechanism allows to form a link between the frames by assigning a unique number to each detected object. The result of the pipeline can be used for further analysis. Preliminary results of the application of the proposed neural network model, trained on a dataset of real marked traffic signs are presented.

Primary authors: BORISOV, Maxim; Prof. OSOSKOV, Gennady (Joint Institute for Nuclear Research)

Presenter: BORISOV, Maxim

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1018** Type: **Oral**

Photons production in heavy ion collisions as a signal of deconfinement phase

Tuesday, 25 October 2022 14:00 (15 minutes)

The study of the hadron matter properties under extreme conditions of baryons high density, energy and strong electromagnetic fields in heavy ion collisions is one of the most important problems of modern high-energy physics. One of the possible ways to study the properties of quark-gluon plasma is the so-called electromagnetic probes - photons and leptons. Since these particles freely leave the plasma volume practically without interacting with hadron matter, they can carry direct information about the processes in the plasma.
The report is devoted to the mechanism of photon production during the conversion of gluons into photons $gg \longrightarrow \gamma$ in the framework of the mean-field approach to the QCD vacuum. According to the domain model of QCD vacuum, the confinement phase is dominated by Abelian (anti-)self-dual fields, while the deconfinement phase is characterized by a strong chromomagnetic field. In the confinement phase, the conversion probability of two gluons into a photon vanishes due to the random nature of the statistical ensemble of confining vacuum fields. In contrast, a strong magnetic field with preferred direction is generated by relativistic heavy ion collisions and plays the role of a catalyst for the deconfinement phase transition which is accompanied by the appearance of a chromomagnetic field with the same preferred direction as the magnetic field. As a consequence, the conditions of Furry's theorem are not satisfied, the conversion probability of two gluons into a photon is nonzero, and their distribution has a strong angular anisotropy. Thus, the photon distribution anisotropy can act as one of the important signals of the hadronic matter phase transition to the deconfinement phase.

• Sergei Nedelko, Aleksei Nikolskii, arXiv: 2208.00842 (2022).
• V.V. Goloviznin, A.V. Nikolskii, A.M. Snigirev and G.M. Zinovjev, Eur. Phys. J. A. 55, 142 (2019), arXiv: 1804.00559.
• S.N. Nedelko, V.E. Voronin, Eur. Phys. J. A. 51, 45 (2015), arXiv: 1403.0415.

Primary authors: NIKOLSKII, Aleksei (JINR); NEDELKO, Sergei (Bogoliubov Laboratory of Theoretical Physics, JINR)

Presenter: NIKOLSKII, Aleksei (JINR)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1019** Type: **Oral**

Timing resolution of fast gamma detectors

Thursday, 27 October 2022 14:15 (15 minutes)

 Positron Annihilation Lifetime Spectroscopy (PALS) technique enables atomic-scale investigation of a wide range of phenomena and material characteristics. It is based on measuring the time interval between positron production and annihilation and reflects the characteristics of the environment in which the annihilation takes place. The timing resolution of the PALS spectrometer is influenced mainly by the performance of its detectors. Barium fluoride (BaF₂) inorganic crystals assembled with fast photomultiplier tubes (PMTs) are often used in PALS measurements due to their high density, short radiation wavelength, and short decay time of 600 - 800 ps.

Experiments that are going to be performed at Extreme Light Infrastructure - Nuclear Physics will use a PALS system where slow positron beams will be guided by magnetic field. In this respect, this study presents the investigation of the timing resolution of BaF₂ detectors to determine their performance when subjected to magnetic fields. The results were compared with the timing resolution of the detectors that were not influenced by magnetic field.

The experimental equipment was a digital PALS system. It consisted of different combinations of two fast BaF₂ scintillation detectors in face-to-face geometry, the corresponding electronics, and a source of ⁶⁰Co. Five Hamamatsu H3378-50 PMTs with linear-focused dynodes were coupled to five polished BaF₂ crystals. Four of them had truncated pyramidal shapes (45 mm diameter x 27 mm height) and the fifth was cylindrical (50 mm diameter x 50 mm height). The spectrometer timing resolution function was well-represented by a Gaussian and as a quantitative estimation, the full width at half maximum (FWHM) was taken. FWHM represents the value of the spectrometer resulting from both detectors and the electronics. To obtain the timing resolution of the detectors, one should first determine that of the electronics. The timing resolution of the electronics was obtained through two methods. The first method used a single detector and a passive splitter that divided the anode signal of the PMT into two identical signals considered as start and stop and the second one used a wave generator that created two artificial and synchronized signals.

The results from this study showed that the timing resolution values of the electronics were quite similar for both methods. Within the first method, a value of 25 ps resulted and for the second one of 25.5 ps. For the experiments where the detectors were not subjected to magnetic fields, their timing resolution as a function of the voltage applied to PMTs, showed a linear improvement. The timing resolutions of the four detectors (BaF₂ truncated pyramidal shape) felt between 64 and 86 ps, indicating a good consistency among them. Instead, but the fifth detector (BaF₂ cylindrical shape) had a worse timing resolution corresponding to 96 - 107 ps. In addition, by performing a stability test (using ²²Na source) over longer periods of time (45h), the system proved to be extremely stable.

In order to mimic the magnetic field of the slow positron beam line around the detectors, coils were added to the experimental set-up configuration. Longitudinal magnetic field was created by a coil placed parallel to the axis of the detectors. Both timing resolution of the detectors and their energy spectrum were measured. The energy spectra were collected to determine how the magnetic field affects the strength of the detector signals. For the creation of transversal magnetic field, two Helmholtz coils were added one on top of each other and oriented perpendicularly to the detectors. Similarly, the timing resolution and energy spectra were evaluated. The results showed that the timing resolution values increased with the magnetic flux density and the longitudinal field has stronger effect.

Measurement was performed within transversal magnetic field. First, the energy spectra of the detectors were collected by individually rotating one of the detectors with an α angle along their

axis, i.e., one detector was fixed at 0^o angle, meanwhile the other was rotated with different angles (0^o, 45^o, 90^o, 180^o, 270^o, and 315^o). From this data, it was determined the best and worse axial detector orientation. The configuration at which the strongest and the weakest signals resulted from the energy spectra of both detectors correspond to different rotation angles, such as 180^o and 315^o for detector 1 and to 0^o and 90^o for detector 2. Then, to demonstrate the importance of the axial rotation orientation of the detectors, the spectrometer timing resolution was obtained for the best and worse orientations, showing a FWHM value of 293 ps and 384 ps correspondingly.

In conclusion, the similar timing resolution of the BaF₂ truncated pyramidal shape detectors indicated a good consistency among them. When the detectors were placed in longitudinal or transversal magnetic fields, their performance and, by default, their timing resolution values deteriorated due to the helical motion of the charged particles (the electrons between the dynodes of the PMT) within magnetic field. Moreover, the PMTs in transversal magnetic field need individual optimization of the axial angle to obtain their best performances.

Acknowledgment: This work was carried out through the Nucleu Program, developed with the support of MCI, project no. 10N/2019.

Primary author: Ms NEDELCU, Cosmina Viorela (ELI-NP, "Horia Hulubei" National Institute for Physics and Nuclear Engineering)

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Presenter: Ms NEDELCU, Cosmina Viorela (ELI-NP, "Horia Hulubei" National Institute for Physics and Nuclear Engineering)

Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1020** Type: **Oral**

RADIATION CORRECTIONS TO PROMPT PHOTON PRODUCTION IN COMPTON SCATTERING OF QUARK-GLUON $qg \longrightarrow q\gamma$ AND ANNIHILATION OF QUARK-ANTIQUARK PAIR $q\overline{q} \longrightarrow g\gamma$ PROCESSES

Tuesday, 25 October 2022 15:30 (15 minutes)

\documentclass{article}

\usepackage{amssymb}
\usepackage{amsmath}
\usepackage[dvips]{graphicx}

\begin{document}

\begin{center}
\textbf{RADIATION CORRECTIONS TO PROMPT PHOTON PRODUCTION IN COMPTON SCATTERING OF QUARK-GLUON }$qg \rightarrow q\gamma$ \textbf{AND ANNIHILATION OF QUARK-ANTIQUARK PAIR }$q\bar{q} \rightarrow g\gamma$\textbf{PROCESSES }

\textbf{}

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\textbf{}

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\end{center}

Radiation corrections to processes of Compton scattering of quark-gluon:
1. $q\gamma \rightarrow q\gamma$, 2. $q\gamma \rightarrow qg$, 3. $g\gamma \rightarrow q\bar{q}$,
4. $q\gamma \rightarrow qg\gamma$, 5. $qg \rightarrow g\gamma\gamma$, 6. $qg \rightarrow qg\gamma$ and
7. $g\gamma \rightarrow q\bar{q}\gamma$ and annihilation of quark-antquark pair:
1. $q\bar{q} \rightarrow \gamma\gamma$, 2. $q\bar{q} \rightarrow q\bar{q}\gamma$,
3. $q\bar{q} \rightarrow g\gamma\gamma$ and 4. $q\bar{q} \rightarrow gg\gamma$ without and
with taking into account of polarization of quark was considered.
Dependencies of differential cross section of subprocesses on energy
of colliding protons $\sqrt{s}$, transverse momentum p_T, cosine of
scattering angle \textit{cos(θ)} and \textit{y} of photons,
x_T were investigated.

Differential cross section of considered subprocesses decreases as the
transverse momentum increases. The following results were obtained:
$\frac{d\sigma_1}{dydp_T^2}$\textit{>}$\frac{d\sigma_2}{dydp_T^2}$\textit{>}\\ $\frac{d\sigma_3}{dydp_T^2}$ and
\textit{ }$\frac{d\sigma_4}{dydp_T^2}$\textit{>}$\frac{d\sigma_5}{dydp_T^2}$\textit{>}$\frac{d\sigma_6}{dydp_T^2}$\textit{>}
$\frac{d\sigma_7}{dydp_T^2}$\textit{ }for\textit{ }
Compton scattering process and $\frac{d\sigma_2}{dydp_T^2}$\textit{> }$\frac{d\sigma_3}{dydp_T^2}$\textit{>}$\frac{d\sigma_4}{dydp_T^2}$\textit{ }for\textit{ }annihilation of quark-antiquark pair process.
It was been determined that, contributions of corrections to differential cross
section of Compton scattering of quark-gluon process is significant than
contributions of corrections to differential cross section of annihilation
of quark-antquark pair process.

The doublespin asymmetry A_{LL} of subprocesses $q\bar{q} \to \gamma\gamma$,
$q\bar{q} \to g\gamma\gamma$ and $q\bar{q} \to gg\gamma$ of annihilation process
are independent of $\sqrt{s}$, p_T and \textit{cos(θ)}.
The doublespin asymmetry expression for these subprocesses is as follows
$A_{LL} = -\lambda_1\lambda_2$. Doublespin asymmetry A_{LL} of
subprocess $q\bar{q} \to q\bar{q}\gamma$ of annihilation process increases
(decreases) with increasing transverse momentum for \textit{$\lambda_1\lambda_2$ }<0 (\textit{$\lambda_1\lambda_2$}>0) and reach
plateu at certain p_T.
The value of this p_T increases with increasing of absolute value of
\textit{λ_1 λ_2}.

\end{document}

Primary author: ALIZADA, Mohsun (Baku State University)

Presenter: ALIZADA, Mohsun (Baku State University)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1021** Type: **Oral**

Parton distribution functions of positron in electron in QED

Tuesday, 25 October 2022 17:05 (15 minutes)

A method of solving of QED evolution equations for parton distibution functons
in the leading and next-to-leading orders is discussed. This method is a reduction
to QED of the method of iterative solution of DGLAP equations in QCD. Spacelike parton distribuuton
functions (PDFs) of positron in electron are calculated to the third order.
We consider process-independent PDFs $D_{e\bar{e}}$ which describe the probability
density of finding massless partons (positron) inside electron.
The results can be used to calculate cross-sections of high-energy
processes with electrons and positrons, such as electron-positron annihilation
and scattering. These results are important for precise calculation of radiative
corrections in QED and accurate predictions of high-energy processes on future colliders.

Primary authors: VOZNAYA, Uliana (LTP); ARBUZOV, Andrej (BLTP JINR)

Presenter: VOZNAYA, Uliana (LTP)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1023** Type: **Oral**

The Electron String Ion Sources (ESIS) cathode node electronics development

Tuesday, 25 October 2022 17:10 (15 minutes)

The electron beam produced by the cathode node in the Electron String Ion Sources (ESIS) is the basis of ionization process.

The new cathode node contains several interesting electronic modules which are designed by the JINR NICA accelerator division engineers.

The topic describes the Electron String Ion Sources (ESIS) cathode node electronics development, production and operation process.

Primary authors: PONKIN, Dmitriy (JINR); BUTENKO, Elizaveta (JINR, LHEP, Dubna 141980); MALYSHEV, Nikolay (LHEP); RASSADOV, Dmitry (JINR); DONETS, Marina

Presenter: PONKIN, Dmitriy (JINR)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1024** Type: **Oral**

Thermal-hydraulic analysis of our modified annular fuel-based reactor design

Tuesday, 25 October 2022 17:20 (15 minutes)

Abstract:
Our nuclear reactor design uses annular fuel which has a lot of good features and my work is to make
a detailed study of the thermal-hydraulic features of our 110MWe marine nuclear propulsion reactor
using COMSOL multi-physics.
As any other thermal hydraulic analysis this study, which is a part of a larger design of course, is meant to:
1. Determine the temperature distribution across the fuel.
2. Determine the coolant flow rate needed.
3. Determine the "Departure from Nucleate Boiling (DNBR)" and to ensure that the reactor is working within a certain limits.
4. Achieve high coolant temperature to improve the thermodynamic efficiency of the reactor
Due to limited computational power we chose to work on a rod-centred subchannel assuming that the
energy is generated within the fuel and any other energy generated within the coolant is to be neglected.
After setting our model and testing it using our three benchmarks (westinghouse typical PWR, VVER-1000 and Kazimi's annular fuel) we are abel to use it to avoid our thermal-hydraulic limitations which are:
1. To avoid bulk coolant coiling and to ensure the stability of the coolant.
2. To assure that the MDNBR > 1.3 (to have a sufficient margin away from film boiling)
3. The fuel temperature will not exceed the melting point at anypoint in the fuel.
As well as in achieving our certain, prescribed, goals!

Primary author: MEKAWY, Abdelrahman

Presenter: MEKAWY, Abdelrahman

Session Classification: Particle Accelerators and Nuclear Reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **1025** Type: **Oral**

Жидко-водородная мишень эксперимента ФОДС-2

Monday, 24 October 2022 16:50 (15 minutes)

Жидко-Водородные мишени являются неотъемлемой частью большинства экспериментов физики высоких энергий. Конструкции данных мишеней сочетают в себе массу уникальных технических решений в ответ на специфические требования, выдвигаемые условиями физических экспериментов и безопасностью работы с водородом. В статье изложен опыт создания первой жидко-водородной мишени с криорефрижераторным охлаждением, разработанной коллективом ЛФВЭ ОИЯИ для физического эксперимента ФОДС-2 ИФВЭ г.Протвино. Кроме того в материале представлены особенности конструкции, тестовые и экспериментальные данные работы мишени и приведена их оценка.

Primary authors: КЛИМАНСКИЙ, Дмитрий (НИКО, ЛФВЭ, ОИЯИ); Mr КОНСТАНТИНОВ, Антон (JINR); Dr АРХАРОВ, Иван (BMSTU); Mr РОМАНИШИН, Кирилл (IHEP); Mr ШИМАНСКИЙ, Степан (JINR)

Presenter: КЛИМАНСКИЙ, Дмитрий (НИКО, ЛФВЭ, ОИЯИ)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1026** Type: **Oral**

ESTIMATION OF THE FRACTAL DIMENSIONS OF CLOUDS

Monday, 24 October 2022 14:15 (15 minutes)

Abstract. Thesis concerns to a popular theme the fractal dimension of various objects and structural formations. The relevance of the theme is followed of the extensive literature in various fields of modern natural science on the use of fractals and the calculation of fractal dimensions of objects. The box-counting method, used in such distant fields as economics, medicine et cetera is applied to the study of the structure of cloud formations. The high importance of the topic predetermines a significant degree of its development. The complexity of the topic studied in the work is due to the differences of the calculation results depending on the location of the cells covering the object under study. The problems associated with such variability have not yet been resolved, which makes the result new. The article presents such examples found by the author, in which the results of calculations for the fractal dimensions of the same object really differ. There were also found examples of objects whose fractal dimensions turn out to be invariant with respect to the transformations mentioned in the article. An error estimate is given. These results are obtained in the work are new

Primary author: SHAPOSHNIKOV, Albert (TSU)

Presenter: SHAPOSHNIKOV, Albert (TSU)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1027** Type: **Poster**

Charge gap in SU(3) Yang-Mills with nonlinear spinor field

Friday, 28 October 2022 14:05 (5 minutes)

Particlelike solutions can be configurated in SU(3) Yang-Mills theory with color electric and magnetic fields created by a nonlinear spinor field. Then it can be shown that the electric field expresses the Coulomb asymptotic behavior, whereas one of color components of the magnetic field behaves asymptotically like the field of a magnetic dipole. Therefore the corresponding charge and magnetic moment can be determined. The profiles of the color charge and magnetic moment have global minimum, which may be called charge and magnetic moment gaps. The relationship between the total energy of the system and the color charge is provided. Discussion to find physical reason for the appearance of the mass, charge, and magnetic moment gaps is open.

Primary author: Mr BERKIMBAYEV, Daulet (Al-Farabi Kazakh National University)

Presenter: Mr BERKIMBAYEV, Daulet (Al-Farabi Kazakh National University)

Session Classification: Online poster session

Track Classification: Theoretical Physics

Contribution ID: **1028** Type: **Oral**

Design of the magnetic system for the MSC-230 isochronous cyclotron

Tuesday, 25 October 2022 16:20 (15 minutes)

The design of the magnet and the characteristics of the magnetic field will be discussed. A parametric 3D model was made for a fast sectors' shape adjustment to make the magnetic field isochronous.

Primary author: LYAPIN, Ivan (JINR)

Co-authors: MALININ, Vladimir (JINR); POPOV, Dmitry (JINR); KARAMYSHEV, Oleg (JINR); SHIRKOV, Stepan (Grigorievich)

Presenter: LYAPIN, Ivan (JINR)

Session Classification: Particle Accelerators and Nuclear Reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **1029** Type: **Oral**

Simulation results of BM@N computing infrastructure

Thursday, 27 October 2022 14:00 (15 minutes)

The main task in creating a computing infrastructure of any large experiment is predictive modelling of data storage and processing centres. A software complex is developed at the Meshcheryakov Laboratory of Information Technologies, which allows simulating processes of data handling to find out both how the data storage and processing infrastructure will work with the available computing power, and to estimate the load on computing farms and communication links with the specified parameters of data flows and tasks.

At present, the work on modelling the computer infrastructure for data processing of the BM@N experiment at NICA is in progress. The main goal is the assessment of the current and future resource requirements for the data storing and processing. The results of the modeling the distributed computing infrastructure for the BM@N experiment, according to the available allocated resources for the autumn Run in 2022, are presented. The prospects for the development of the software simulation complex are formulated. In addition, the future task of the simulation is obtaining predictive values for a number of necessary computing resources within the perspective of the development of the BM@N computing infrastructure for 2023-2030.

Primary author: PRIAKHINA, Daria (ЛИТ)

Co-authors: KORENKOV, Vladimir (JINR); TROFIMOV, Vladimir (JINR); Dr GERTSENBERGER, Konstantin

Presenter: PRIAKHINA, Daria (ЛИТ)

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1030** Type: **Oral**

R&D of tellurium-loaded liquid scintillator

Thursday, 27 October 2022 14:30 (15 minutes)

One of the methods for determining the nature of the neutrino mass is the search for neutrinoless double beta decay. Tellurium is one of the promising isotopes undergoing this decay and liquid scintillator detectors are among the most competitive instruments. Herein the results of the research and development of a new tellurium containing liquid scintillators (Te-LS) based on linear alkylbenzene. Two different approaches to loading of tellurium into a scintillation matrix are proposed and discussed in comparison. The dependence of the transparency and light yield as a function of tellurium concentration has been discussed, optimization of the scintillation composition has been done and the stability of properties of Te-LS has been determined.

Primary authors: SUSLOV, Ivan; NEMCHENOK, Igor (JINR); BYSTRYAKOV, Artem

Presenter: SUSLOV, Ivan

Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1031** Type: **Poster**

SIMULATIONS OF RADIOFREQUENCY ION FUNNEL OF CRYOGENIC GAS STOPPING CHAMBER OF MULTIPLE-REFLECTION TIME-OF-FLIGHT MASS SPECTROMETER

Friday, 28 October 2022 14:35 (5 minutes)

Multiple-reflection time-of-flight mass spectrometer (MR-TOF MS) is being built in Flerov Laboratory of Nuclear Reactions in Joint Institute of Nuclear Research in Dubna. MR-TOF MS will help to determine mass of superheavy elements produced there. To measure mass of produced superheavy nuclei, those nuclei have to be slowed down first. This is done using cryogenic gas stopping cell (CGSC). After stopping the ions are then guided from the CGSC to the MR-TOF MS using a radiofrequency (RF) funnel. RF funnel is an ion guide that consists of 76 individual ring electrodes with a decreasing inner diameter from 266 mm to 5 mm towards the extraction nozzle. Between neighboring electrodes, a 180° phase-shifted radio frequency is applied that creates a repulsive electric field force to prevent the ions from hitting the electrodes. where is located extraction radio-frequency quadrupole (RFQ). This paper deals with development of radiofrequency (RF) funnel. Optimal RF field in RF funnel was simulated using COMSOL Multiphysics and NI Multisim. Circuit layout was then designed and optimized using data from simulations.

Primary author: KOHOUT, Pavel (JINR)

Co-authors: OPICHAL, Antonin (Palacky University Olomouc); KOHOUTOVA, Alena; KRUPA, Lubos; Dr RODIN, Aleksander (FLNR JINR); CHERNYSHEVA, Elena (FLNR JINR); GULYAEV, Aleksander; Mrs GULYAEVA, Anya (FLNR JINR); KOMAROV, Aleksander (FLNE JINR); NOVOSELOV, Aleksey (FLNR JINR); Prof. PECHOUSEK, Jiri (Palacký University in Olomouc); SALAMATIN, Vladimir (FLNR JINR); STEPANTSOV, S.V. (FLNR JINR); PODSHIBYABKIN, Aleksander (FLNR JINR); VEDENEEV, Vyacheslav (Yurievich); YUKHIMCHUK, Sergei (FLNR JINR)

Presenter: KOHOUT, Pavel (JINR)

Session Classification: Online poster session

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **1032** Type: **Oral**

THE DEUTERON CHARGE RADIUS R_C IN THE FRAMEWORK OF THE HARD-WALL ADS/QCD MODEL

Wednesday, 26 October 2022 17:20 (15 minutes)

We study deuteron charge radius in the framework a hard-wall AdS/QCD model. We present basic elements of the hard-wall model, write metric for the AdS space. We introduce a vector field with twist $\tau = 6$ describing deuteron in the bulk of AdS space and other vector field to describe photon respectively, write an effective action for the bulk fields interactions, find a $G_1(Q^2)$, $G_2(Q^2)$ and $G_3(Q^2)$ form factors, then quadrupole $G_Q(Q^2)$ and charge $G_C(Q^2)$ form-factors of a deuteron. Thus, from the charge $G_C(Q^2)$ form-factor we find the deuteron charge radius R_C in the framework of a hard-wall AdS/QCD model. Then we compare our result with the results soft-wall model and experimental data.

Primary authors: Mrs ALLAHVERDIYEVA, Minaya (Institute of Physics of ANAS); Dr MAMEDOV, Shahin (Institute of Physics of ANAS); HUSEYNOVA, Narmin (Azerbaijani)

Presenter: HUSEYNOVA, Narmin (Azerbaijani)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1033** Type: **Oral**

STOPPING EFFICIENCY SIMULATION OF CRYOGENIC GAS STOPPING CELL

Thursday, 27 October 2022 15:30 (15 minutes)

The mass is a fundamental property of an atom comprising all information on its constituents and their interactions. Thus, it carries information on the internal structure of the nucleus, reveal the quantum mechanical shell structure within complex nuclei and determine the energy available for nuclear transformations in radioactive decay processes. Mass measurements allow us to benchmark nuclear models and thus contribute to investigations of the nature of the strong interaction itself. With the aim of high-precision mass measurement (HPMM) of heavy and super heavy elements, a new experimental setup is being built in FLNR, Dubna. The setup consists of the following parts: target unit; gas-filled separator of complete fusion reaction products; cryogenic gas stopping cell (CGSC); a radio-frequency system for transporting and cooling a low-energy beam; and a multi-reflection time of flight mass spectrometer (MR-TOF MS). CGSC is responsible for the final slowing down and thermalizing the energy-bunched fragments produced and selected in the Gas Filled Separator. The thermalization is achieved in a volume filled with ultra-pure helium gas at cryogenic temperatures. After the thermalization, the fragments are extracted and transported with a radio frequency quadrupole (RFQ) to the MR-TOF MS. The stopping and thermalization of the incoming fusion-evaporation residuals (EVRs) is a key step in HPMM of the heaviest elements. Due to the typically low incoming ion rates and low particle integrals CGSC has to be as efficient as possible. The HPMM requires at least a few ions for a measurement any loss should be avoided. The kinetic energy of the incident EVR, the entrance window foil type and thickness as well as the buffer-gas type and density of the CGSC condition the stopping efficiency. Only the ions that are stopped within the active gas volume of the CGSC can be extracted. The stopping efficiencies for EVRs cannot be tested on-line and one have to rely on simulations. To use the CGSC on ion beam the optimal entrance window foil thickness for every reaction is necessary evaluate. The Geant4 and SRIM software packages was used in these simulations with different entrance window materials and beam and target combinations.

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Presenter: KOHOUTOVA, Alena

Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1034** Type: **Oral**

CORE-OPTIMIZATION OF RITM-200 REACTOR FUEL CONSIDERING THORIUM FUEL CYCLE

Tuesday, 25 October 2022 17:05 (15 minutes)

For a variety of reasons, Russians begun the research and development of a range of small power reactors from the late 1950's. After about 30 years, the focus changed to the provision of electricity and district heating to remote and hard-to reach areas. The multipurpose and co-generational activities of these floating nuclear power plants (FNPP) have generated enormous attention. An essential parameter that justifies the interest in nuclear power reactors is the duration of the fuel campaign. Floating nuclear power plants (FNPP) have proven to be a solution to bridging the developmental gap between urban and remote areas in terms of providing electricity and district heating. This article seeks to investigate the core-optimization of the reactor RITM-200. Focus is placed on Th - U fuel cycle in all the calculations. The spectra of neutron flux density of the reactor RITM-200 were analyzed for (Th232 + U235)O2 and (Th232 + U233)O2 dispersed fuel. The fuel lifetime was then estimated with further studies of the dependency of fuel lifetime on the outer fuel element diameter of the two dispersed fuel compositions.

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Session Classification: Particle Accelerators and Nuclear Reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **1035** Type: **Oral**

Fast way to determine pp-collision time at the SPD experiment

Tuesday, 25 October 2022 16:20 (15 minutes)

The Spin Physics Detector, one of the two facilities of the future NICA collider at the Joint Institute for Nuclear Research, is for studying the nucleon spin structure and spin-related phenomena with polarized proton and deuteron beams. Understanding how dynamics of the quarks and gluons determine the structure and the fundamental properties of the nucleon is one of the interesting unsolved problems of QCD.
The main task of this work is to determine *pp*-collision time based on data from the Time-Of-Flight detector. Using the time when a particle intersects the detector and information about reconstructed tracks one can solve this problem. The *pp*-collision time allows to reconstruct particles' trajectories by the SPD tracker with high accuracy and to make particle identification.
Determination of the *pp*-collision time is an optimization problem. It can be solved by a brute-force algorithm, where all available variants of particles are checked. It is very slow method. Another approach is by a genetic algorithm, which works faster, for fewer number of steps. The idea of this project is to use fast simple methods to receive unbiased estimation of *pp*-collision time. We incorporate a priori knowledge about the process to accelerate solution of the problem even faster than the genetic algorithm.
For solving the problem the sliding window method was invented. The *pp*-collision time's estimation received by this method is unbiased and is expected to have a high resolution about 30 ps. The typical programme execution time is about 300 nanoseconds. It is 10^6 times faster than the brute-force algorithm and outruns the genetic one by a factor 10^3.

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Presenter: FILONCHIK, Polina (MIPT)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1036** Type: **Poster**

Charge fluctuations and superconductivity in strongly correlated electronic systems

Monday, 24 October 2022 19:05 (5 minutes)

We investigate electronic spectrum and superconductivity in the extended $t-J-V$ model where the intersite Coulomb repulsion and the electron-phonon interaction (EPI) are taken into account. The exact Dyson equation for the normal and anomalous (pair) Green functions (GFs) is derived for the projected Hubbard operator. The equation is found in the self-consistent Born approximation (SCBA) for the self-energy. We show that, the most important contribution comes from the kinematic interaction for HOs which results in a strong coupling of electrons with spin fluctuations (SFs) of the order of the hopping parameter $t(q)$ much larger than the exchange interaction $J(q)$.

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Session Classification: In-person poster session & welcome drinks

Track Classification: Theoretical Physics

Contribution ID: **1040** Type: **Poster**

Spin nature of the energy gap in superconductors of the second kind

Monday, 24 October 2022 19:55 (5 minutes)

This paper presents a model for determining the second critical field of superconductors, obtained on the basis of changes in the spin basis states of a system of two particles with spin 1/2 in a magnetic field. The obtained critical field estimate is consistent with experimental data for superconducting alloys, some metallic compounds, nitrides and Laves phases, fullerides and other superconducting compounds.

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Presenter: KRUGAN, George (MPEI)

Session Classification: In-person poster session & welcome drinks

Track Classification: Theoretical Physics

Contribution ID: **1041** Type: **Oral**

Food Recognition for Smart Restaurants and Self-service cafes

Thursday, 27 October 2022 15:30 (15 minutes)

In recent years, deep learning has been applied to different tasks in food recognition field. Number of interesting solutions have been proposed. Due to the complexity of background's food, the problem of pattern recognition on a limited data set is still a challenging problem. Experiments were conducted with a self-collected set of data on trays in the canteen, containing images of various dishes depending on the day of the week. The main objective of this work is to compare the effectiveness of modern object detection architectures, namely YOLO_v5, YOLO_v6, YOLO_v7 and YOLO_v5, with a custom classifier of the second stage in the conditions of the task. Experimental results show that the proposed architecture can effectively distinguish dishes with high performance.

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Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1042** Type: **Poster**

Qualitative analysis of KNN and PZT ceramics by Particle Induced X-Ray Emission and Rutherford Backscattering Spectrometry.

Friday, 28 October 2022 14:40 (5 minutes)

The first results of scientific cooperation between Cuban and the Joint Institute for Nuclear Research (JINR) of Russian Federation researchers in the application of ion beam analysis (IBA) methods are presented. PIXE and RBS measurements were carried out at the EG-5 accelerator facilities of the Frank Laboratory of Neutron Physics (FLNP)/JINR, contributing this way to the characterization of (K0.44Na0.52Li0.04)0.97La0.01Nb0.9Ta0.1O3 (KNN) and Pb(Zr0.53Ti0.47)O3:Gd (PZT:Gd) ceramic samples.

Samples were prepared at the Center of Nanoscience and Nanotechnology of the National Autonomous University of México (CNyN/UNAM) by researchers from the Faculty of Physics of Havana University, the Cuban Institute of Cybernetic, Mathematics and Physics (ICIMAF) and the CNyN/UNAM. Experimental data processing was achieved in parallel by researchers of the EG-5/FLNP/JINR and the Havana University (Institute of Materials Science and Technology - IMRE and Higher Institute of Technology and Applied Sciences - InSTEC).

As result of PIXE analysis, Na, Ta, Nb and K in one KNN ceramic sample; and Gd, Zr, Ti and Pb in the PZT:Gd ceramic were detected. On the other hand, the concentration profiles of Na, Ta, Nb, K and O in KNN samples, and of Gd, Zr, Ti and Pb in the PZT:Gd sample were obtained by RBS analysis, which was performed by applying the ion beam in two incident directions respect to the sample surface.

The present study is the first step to the further quantitative determination of elemental composition of these samples by IBA.

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Session Classification: Online poster session

Track Classification: Applied Research

Contribution ID: **1043** Type: **Oral**

Light-like path of anyon in magnetic field

Monday, 24 October 2022 15:30 (15 minutes)

We consider the light-like trajectories of a massive relativistic anyon travelling in a uniform stationary magnetic field. We show that the classical particle paths are helical lines with the light-like tangent vector. The configuration of magnetic field determines the equations of motion for the symmetry axis of helix, while the step of helix is determined by spin. The deviation of the particle path from smooth propagation is explained by zitterbewegung phenomenon. We explicitly find the cyclotron frequency, and it is shown to be spin-dependent, even though spin has no physical degrees of freedom in 3d space-time. Computer simulation is used for visualization of particular trajectories.

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Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1044** Type: **Poster**

The study of the collective formation of secondary particles by the Hurst method

Friday, 28 October 2022 14:45 (5 minutes)

According to the theoretical predictions, a mixed phase of the quark-gluon plasma (QGP), which includes both the free quarks and gluons, and the protons with neutrons, must be formed within the range of the energies of 4 to 11 GeV per nucleon. The study of multi-particle correlations and fluctuations in secondary particle distributions is often used to search for quark-gluon plasma, since the formation of secondary particles from a fireball of nuclear matter is of a collective nature. The difficulty in identifying the formation of quark-gluon plasma is mainly because QGP is formed against an extensive background due to the usual processes of strong interaction.
The initial state, about which there is usually very little direct experimental information, leads to significant fluctuations in the distribution of secondary particles and fragments. In a central collision, the maximum number of nucleons interacts. If the collision is peripheral, then the overlap of the nuclei is incomplete, and resulting fireball is taken to different directions asymmetrically. Thus, depending on the collision geometry, fluctuations of the average value of pseudo-rapidity distribution of secondary particles should be detected.
The event-by-event analysis of nuclear collisions at high energies is the most relevant for the search for dynamic fluctuations associated with the phase transition of nuclear matter to quark-gluon plasma. It is assumed that by analyzing in detail the characteristics of each individual event, it will be possible to directly observe the effects of a phase transition in those events in which the most favorable conditions for the formation of the quark-gluon plasma are created.
In this work, we carried out a joint study of multi-particle correlations and event-by-event pseudo-rapidity fluctuations to search for non-statistical clusters of secondary particles. For this purpose, we analyzed both secondary particles emitted from the interaction region and fragments of the projectile-nucleus and target-nucleus. To study correlations, we used the Hurst method. A detailed study of event-by-event pseudo-rapidity correlations in terms of the Hurst index, multiplicity of secondary particles and target dependence has been carried out for heavy (AgBr) and light (HCNO) targets present in the nuclear emulsion (Em,NIKFI BR-2) using Au-197 projectiles at 10.6 A GeV and Pb-208 projectiles at 158 A GeV.
According to the behavior of the Hurst curve, events were divided into two types: explosive and cascade-evaporative. Events of various types differ significantly in the fragmentation of the projectile-nucleus, multiplicity of secondary particles and pseudo-rapidity distribution. Also in explosive events, events were found in which secondary particles were emitted at high angles. When analyzing the fragmentation parameters of the Au + Em and Pb + Em interaction, the relative number of explosive events is almost the same. At that, the number of events with large values of the mean pseudo-rapidity distribution <η> differs by more than 4 times. In Au + Em interactions, 64.7% of explosive events are observed. Moreover, 8.1% of interactions are events of complete destruction, in which there are no fragments of the target nucleus. Pb + Em interactions account for 59.7% of explosive-type events and 8.9% of total destruction events. In Au + Em interactions, 35.6% of the events are explosive events with large <η> values. There are only 8.4% of such events in Pb + Em.
This research was funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant No. AP14869032)

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Presenter: FEDOSIMOVA, Anastasia

Session Classification: Online poster session

Track Classification: High Energy Physics

Contribution ID: **1045** Type: **Oral**

Promising cathode material for sodium-ion batteries: Prussian White modified with polyaniline

Tuesday, 25 October 2022 15:30 (15 minutes)

Developing efficient cathode materials is very important task for the wide distribution of the electrochemical devices, in particular sodium-ion batteries (SIB). One of the perspective cathode materials for SIB is an iron (III) hexacyanoferrate (II) (Prussian White, PW) currently being produced by Altris AB, Sweden 1. It is one of Prussian Blue Analogues AxM'[M(CN)6]1-y·zH2O (where A is an alkaline metal and M and M' are transition metal cations), the promising cathode materials for SIB due to their open framework structure and low-temperature synthesis. One of the main problems of PW-based cathodes in SIB is the degradation processes on the surface of the active material caused by humidity 2. There is a hypothesis that the organic coating on the active material would lead to an improving of the rate capability and capacity retention. Our aim was to evaluate the effect of polyaniline (PANI) coating on the electrochemical properties of PW. In the literature, there are controversial information about this kind of modification. For example, authors of 3 have demonstrated the positive effect of PANI on the characteristics of PBAs in processes of lithium storage and overall water splitting.
In our work, the commercial PW (Fennac) was coated with PANI via chemical oxidative polymerization according to the methodology from 3. It is important to note that the synthesis of polyaniline occurred in the presence of PW. Thus, the material was not a simple mixture of PW and PANI. Scanning electron microscopy showed that PANI was uniformly coated on the surface of PW nanocubes. Using thermogravimetric analysis and X-ray diffraction, it was revealed, that PANI promotes the formation of the cubic phase and shifts the temperature of transition from cubic to rhombohedral phase to higher temperature. The electrochemical cell assembled with PW@PANI as an active cathode material demonstrates the less capacity fall during long performance compared with the cell with the pure PW.

This work was supported the Russian Science Foundation, project No. 21-12-00261.

1 W. Brant et al. Method of producing a sodium iron(II)-hexacyanoferrate(II) material // United States Patent application publication. No: 2019/0270649 A1, Sep.5 2019.
2 D. O. Ojwang et al. Moisture-driven degradation pathways in prussian white cathode material for sodium-ion batteries // ACS Applied Materials & Interfaces (2021) V. 13, No: 8, PP. 10054–10063
3 L. Zhang et al. Multifunctional Prussian blue analogous@polyaniline core–shell nanocubes for lithium storage and overall water splitting // RSC Advances (2017) V. 7, PP. 50812–50821

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1046** Type: **Oral**

Approaches to the analysis of molecular dynamics trajectories

Monday, 24 October 2022 15:30 (15 minutes)

Molecular dynamics (MD) modeling is often becoming a key tool for studying biophysical systems due to increasing computational power and software availability. The MD method makes it possible to study in detail the mobility of molecules, both of their main chains and side chains. As a result of modeling, a large amount of data is generated. The stream of data generated when running an MD simulation even in microseconds is extremely difficult for human perception. Hence, there is a need to adapt already known methods or to come up with new tools for a better understanding of the simulation results. In this work, for these purposes, attempts were made to apply machine learning methods. The current challenge was to analyze in depth the large amount of data generated by the simulations to gain valuable insights and identify general trends.
Some cyclosporins, analogs of cyclosporin A, one of the family of cyclic peptides consisting of 11 amino acid residues, were used as objects. The most variable among them is the second residue.
In this work, high-resolution NMR spectra were preliminarily deciphered, and then MD modeling of various cyclosporine molecules was carried out. Trajectories obtained as a result of molecular dynamics were used for further analysis. Factor analysis was applied to reduce the dimension. Then 33 dihedral angles, which, as a result of factor analysis, became two features, were divided into clusters. The dihedral angles φ and ψ are one of the parameters describing the conformation of the molecule, so that the new division of new components into clusters also indicates that different conformers are present in the model. Python was chosen as the language for implementing the idea, in which we used the built-in method of the sklearn library - K-means.

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Presenter: KOBCHIKOVA, Polina

Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **1047** Type: **Oral**

Neutron Tomography in the Study of the Cultural Heritage of Antiquity and the Middle Ages

Tuesday, 25 October 2022 14:15 (15 minutes)

The study of cultural heritage by modern scientific methods is an important interdisciplinary field. Of particular interest are archaeological finds made of metal. They store valuable information about the technological, economic and social level of ancient states. Corrosion processes occurring in metals also require careful study. This allows the development of restoration and conservation methodologies. However, research methods traditional in archeology are often unacceptable or incorrect due to the destructive nature of the impact or low penetration depth. In such cases, neutron tomography can be used.

In this work, metal artifacts of various ancient states located on the territory of modern Russia were studied. Research experiments were carried out at the facilities of the IBR-2 high-flux pulsed reactor: neutron radiography and tomography (NRT) and a DN-12 diffractometer. Using neutron tomography, spatial variations in the phase composition were visualized, the degree of degradation and the spread of corrosion were determined, and the original appearance of some artifacts was reconstructed. The phase composition was measured by neutron diffraction and Raman spectroscopy. The data obtained made it possible to shed light on aspects of the craft, to identify archaeological objects.

Additionally, we faced a number of problems, the solution of which requires the use of new algorithms for tomographic reconstruction. This is an improvement in the quality of the resulting models, a decrease in the time spent on routine actions, a decrease in the time for the experiment. Therefore, modern approaches have been proposed and applied.

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Presenter: BAKIROV, Bulat (JINR FLNP)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1048** Type: **Oral**

The first results of PSD hadron calorimeter prototype response measurements at the mCBM

Thursday, 27 October 2022 14:45 (15 minutes)

The CBM experiment for the study of strongly interacting nuclear matter is currently under construction at the FAIR accelerator complex. As a demonstration experiment to check the performance of all detector systems of the CBM experiment, the mCBM experiment was launched within the framework of the FAIR Phase-0 program. One of the modules of the PSD hadron calorimeter (mPSD), equipped with the free-streaming readout electronics, was installed and studied at the mCBM in nuclear collisions at an interaction frequency of up to 5 MHz. This report mentions the primary experimental results of the mPSD response in O+Ni collisions at a kinetic energy of 2A GeV and their comparison with simulated data.

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Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1049** Type: **Oral**

Study of the crystalline and magnetic structure of half-Heusler compounds MnNi0.9M0.1Sb (M = Ti, V, Cr, Fe, Co, Zn) at high pressures and low temperatures

Wednesday, 26 October 2022 14:00 (15 minutes)

Half-Heisler magnetic intermetallic compounds of transition metals exhibit interesting physical properties such as magnetoresistance, ferromagnetic and antiferromagnetic magnetic states, and superconductivity. It is observed the shape memory effect and superelasticity with opportunity to control there phenomena by means magnetic field. It makes these compounds promising materials to apply for creation permanent magnets, elements of electronic devices and cooling technology.

In our work we present the results of investigation the crystal and magnetic structure of half-Heusler intemetallic compounds MnNiSb and MnNi0.9M0.1Sb (M = Ti, V, Cr, Fe, Co, Zn) by means of neutron diffraction in the temperature range 10–300 K and by X-ray diffraction in the pressure range 0–30 GPa at room temperature.

It has been found that the initial cubic structure F4¯3m and ferromagnetic phase remain in the investigated temperature range. New reflections correspond to the antiferromagnetic phase have not been found. Partial substitution of another transition element for nickel leads to a decrease in the magnetic moment of the Mn ions. Under high pressure, the cubic structure F4¯3m remains stable for all compounds under study.

This work have been supported by the Russian Foundation for Basic Research, project no. 20-52-04003 Bel_mol_a (Belarusian Foundation for Basic Research, project no. T21RM-029) and Grant Competition for JINR Young Scientists and Specialists 2022 № 22-402-07

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1050** Type: **Oral**

Neutron activation analysis for studies of elemental variability in the wild and farmed molluscs

Monday, 24 October 2022 14:00 (15 minutes)

The neutron activation analysis as a primary method for determination of mass fraction of high number of elements was applied for investigation of their temporal and spatial distribution among edible mussels and oysters. It allowed to find levels of the 29 macro and microelements in soft tissues and 24 in shells of such molluscs. To compare the samples of wild and farmed mussels were collected from the sites with different anthropogenic pressure in the coastal zones of South Africa, Namibia, Mozambique and Crimea. For determination of the long term physiological state, the length and wet weight of soft tissues were measured before analysis. Obtained data were used for calculation of the specific elemental ratios such as enrichment factors, soft tissue/shell ratios and condition factors.

In general, the mussels from harbor zones contained higher levels of such elements as Sc, V, Cr, Mn, Co, Ni, Sb, Cs, Th, U could be considered as terrigenous origin, while Co, Ni, Zn, As, Se, Br, I, Sb could have anthropogenic contribution to the soft tissue of organisms. The governmental organizations usually establish the maximum permissible levels for the most dangerous elements in edible food. Except well-known Cd, Hg and Pb, such trace elements as Cr, Ni, Zn, As, and Se could reach in mussels harmful levels. In addition, the effects of many others microelements to the human health were slight investigated. For human health such elements as Al, Cr, Co, Zn, As and I revealed high risks in consumption of mussels from the polluted marine water areas.

Another direction of biomonitoring studies is to define the levels in wild and farmed mussels from the natural and anthropogenic water areas (harbours). The non-destructive neutron activation analysis could be used for simple solving such task.

According to our studies, the main factors affect spatial variability of elements in the soft tissues and shells of mussels depend on the presence of resuspended bottom sediments, concentration and content of phytoplankton, lithogenic composition of the coastal rocks, freshening of coastal waters, storm activities and hydrological parameters of environment waters and anthropogenic influence (wastewater discharges, marine transport, and harbor loadings).

The obtained results were used for creation of database for future biomonitoring studies with attention to the redistribution of harmful trace elements and characterization of environmental parameters of a specific coastal zone.

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Presenter: NEKHOROSHKOV, Pavel (FLNP JINR)

Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **1051** Type: **Oral**

Investigations of characteristics of 2.45 GHz ECR ion source

Tuesday, 25 October 2022 16:35 (15 minutes)

A 2.45 GHz compact ECR ion source based on coaxial quarter wave resonator has been developed in JINR FLNR for production of singly charged ions and secondary radioactive ion beams. This paper describes the results of investigation of the source characteristics with different types of UHF couplers. In experiments extracted current was measured as a function of UHF power, frequency and gas flow. An optimal configuration of UHF coupler was determined.

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Presenter: BERESTOV, Kirill (JINR)

Session Classification: Particle Accelerators and Nuclear Reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **1052** Type: **Oral**

Monte Carlo Simulation of the Extraction System for Very Cold Neutrons Using a Nanodiamond Reflector

Monday, 24 October 2022 15:15 (15 minutes)

Intense fluxes of very cold neutrons (VCN) with the velocities between 20 and about 200 m/s are of great interest for a variety of applications both in fundamental research and neutron scattering. However, the absence of efficient VCN reflectors was one of the most significant problems for developing the intense VCN sources. The reflectors allow neutrons to be extracted from the source, focused and delivered to experimental facilities. The promising solution to the issue of VCN reflectors is Detonation Nanodiamonds (DND). In a series of works [1–4] it was experimentally shown that DND powders can be used as an effective diffuse reflector of VCN, providing even the possibility to store the VCN in a closed trap.

The latest experiment also demonstrates capability to extract and enhance a VCN flux using a DND reflector 5. The DND reflector has the shape of a thick-walled cylindrical tube closed at one end with a thick disk. The source is a VCN beam passing through a hole in the sidewall of the reflector and falling on its bottom. As a result of multiple reflections from the bottom and side walls of the cylindrical cavity formed by the reflector, VCN can escape through the open end of the cavity. Compared with a similar isotropic source without a DND reflector, the gain factor in the total VCN flux through the open end of the cavity is between ˜14 and ˜33 for neutrons with velocities of ˜92 and ˜45 m/s, respectively. The corresponding enhancement of a VCN flux extracted directionally using the DND reflector is about 10 times. It is itself a noticeable increase of the VCN flux delivered to experiments. Moreover, these results will make it possible to attract more attention to the development of the full-scale VCN sources and to expand the scope of VCN applications.

Nevertheless, the setup of the experiment discussed above does not allow us to obtain such basic characteristics of the DND reflector as the albedo (the diffuse reflection probability at all incidence angles of neutrons), losses of VCN, and others. It is only possible to calculate these characteristics via the full Monte Carlo simulation of the experiment. In this work, we present the results of the corresponding simulation. It includes the reproducing of the installation geometry, as well as the implementing the process of the VCN propagation inside a material of the DND reflector. Simultaneously, it is the first extensive test of the model of VCN interaction with DND powders for describing a complex experiment. The albedo, VCN extraction probability, and angular distribution of the extracted neutrons are the main simulation results obtained using Wolfram Mathematica. The application for Geant4 is being developed. Its features and first results compared to Mathematica will be discussed. The developed software and the model can be used for evaluating the performance and optimal parameters of the real sources and extraction systems of VCN. In turn, this will help to identify a list of scientific problems that could be solved using these VCN sources.

References

1. Nesvizhevsky V.V., Lychagin E.V., Muzychka A.Yu., Strelkov A.V., Pignol G., Protasov K.V., The reflection of very cold neutrons from diamond powder nanoparticles, Nucl. Instrum. Methods Phys. Res. A 595 (2008) 631–636. DOI: 10.1016/j.nima.2008.07.149.
2. Lychagin E.V., Muzychka A.Yu., Nekhaev G.V., Nesvizhevsky V.V., Pignol G., Protasov K.V., Strelkov A.V., Storage of very cold neutrons in a trap with nano-structured walls, Phys. Lett. BB 679 (2009) 186–190. DOI: 10.1016/j.physletb.2009.07.030.
3. Lychagin E.V., Muzychka A.Yu., Nesvizhevsky V.V., Nekhaev G.V., Pignol G., Protasov K.V., Strelkov A.V., Coherent scattering of slow neutrons at nanoparticles in particle physics experiments, Nucl. Instrum. Methods Phys. Res. A 611 (2009) 302–305. DOI: 10.1016/j.nima.2009.07.086.

4. Krylov A.R., Lychagin E.V., Muzychka A.Yu., Nesvizhevsky V.V., Nekhaev G.V., Strelkov A.V., Ivanov A.S., Study of Bound Hydrogen in Powders of Diamond Nanoparticles, Crystallogr. Rep. 56 (2011) 102–107. DOI: 10.1134/S1063774511070169.
5. Dubois M., Lychagin E.V., Muzychka A.Yu., Nezvanov A.Yu., Nesvizhevsky V.V., Nekhaev G.V., Strelkov A.V., Chernyavsky S.M., Enhanced Directional Extraction of Very Cold Neutrons Using a Diamond Nanoparticle Powder Reflector (preprint, 2022). DOI: 10.13140/RG.2.2.17165.61928.

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Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1053** Type: **Oral**

Joint fit of long-baseline accelerator neutrino experiments in GNA software.

Wednesday, 26 October 2022 14:15 (15 minutes)

Long-baseline accelerator neutrino experiments are researching a phenomenon of neutrino oscillations. They are studying unknown mixing parameters such as δ_{CP} (the charge-parity phase), Δm^2_{32} (the neutrino mass ordering) and the octant of mixing angle θ_{23} using samples of muon neutrino disappearance and electron neutrino appearance.

At the moment the sensitivities of each single existing experiment (NOvA, T2K) are not enough to determine mentioned above oscillation parameters with high significance. So the next generation accelerator neutrino experiment DUNE is under construction and has some advantages, i.e the longest baseline, a more intensive neutrino flux, a 40 kt FD fiducial mass and so on.

In order to estimate the sensitivities (single and joint) of NOvA, T2K, and DUNE, a universal shell is developed in GNA (Global Neutrino Analysis) software. It is able to check different oscillation statistical hypotheses and produce plots of sensitivities to oscillation parameters for an experiment of this type based on input files of fluxes, neutrino interaction cross sections and detector efficiencies. And a combination of experiment models is used to create a joint fit of these experiments.

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Presenter: STEPANOVA, Anna

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1054** Type: **Oral**

Directly computing reduced density matrices with influence functionals

Tuesday, 25 October 2022 17:20 (15 minutes)

The field theory of open quantum systems has ample applications in areas like particle or nuclear physics, cosmology and quantum gravity. Open quantum systems are commonly described by reduced density matrices, which are obtained by tracing out the environmental degrees of freedom, and whose evolution is given by quantum master equations. Solving such equations often poses an intricate or even analytically impossible task. As a way to circumvent such problems we will present a first principle-based and practicable formalism which allows for the direct computation of reduced density matrix elements without having to consider a master equation. It is based on techniques from non-equilibrium quantum field theory like thermo field dynamics, the Schwinger-Keldysh formalism and the Feynman-Vernon influence functional. As a simple example, we will discuss the open quantum dynamics of a real scalar field induced by an environment comprising another real scalar field.

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Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1055** Type: **Poster**

Investigation of atomic ordering processes in the bulk and surface layer of Fe-Ga alloys

Monday, 24 October 2022 19:25 (15 minutes)

Fe-Ga compounds show high magnetostriction values depending on Ga content and thermal treatment. The physical cause of the giant magnetostriction effect is still not clear despite more than 20 years of research. The alloys have a complex phase diagram, which continues to be investigated by various methods, including electron, neutron, X-ray and synchrotron radiation diffraction. In a number of papers [1, 2, 3] exotic crystalline phases with L60 and D022 structures were observed by the experimental techniques with a small penetration depth (X-ray and electron diffraction). These phases with tetragonal symmetry in principle may be responsible for the occurrence of the giant magnetostriction in the Fe-Ga alloys.
We carried out an extensive study of these alloys using all the previously listed methods and found that the phase composition of the surface and of the internal volume of the cast Fe-Ga alloy sample may differ, which directly affects the results of the phase analysis. When studying bulk samples by different methods minimizing the contribution from the material surface, no additional phases were observed. The defects in the ordering of atoms are present in the surface layer, which influence diffraction patterns and may be interpreted as new phases with L60 and D022 structures. Due to their small volume compared to the materials bulk, these phases do not affect the occurrence of magnetostriction.

1 A. G. Khachaturyan, D. Viehland, Structurally heterogeneous model of extrinsic magnetostriction for Fe-Ga and similar magnetic alloys: part I. decomposition and confined displacive transformation, Metall. Mater. Trans. A 38 (2007) 2308.
2 Y. He, X. Ke, C. Jiang, N. Miao, H. Wang, J.M.D. Coey, Y. Wang, H. Xu, Interaction of trace rare earth dopants and nanoheterogeneities induces giant magnetostriction in Fe-Ga alloys, Adv. Funct. Mater. 28 (2018) 1800858 (1-9).
3 Y. Han, H. Wang, T. Zhang, Y. He, C. Jiang, Exploring structural origin of the enhanced magnetostriction in Tb-doped Fe83Ga17 ribbons: Tuning Tb solubility, Scr. Mater. 150 (2018) 101–105.

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Presenter: Mr SUMNIKOV, Sergey

Session Classification: In-person poster session & welcome drinks

Track Classification: Condensed Matter Physics

Contribution ID: **1056** Type: **Oral**

Effect of irradiation and DNA synthesis and repair inhibitors treatment on DSBs formation and repair in normal and cancer cells

Monday, 24 October 2022 14:15 (15 minutes)

The immunocytochemical staining and fluorescence microscopy was used to investigate the effects of radiosensitization by the cytosine arabinoside AraC on the induction and repair of DNA double-strand breaks (DSBs) in normal human dermal fibroblasts and human glioblastoma U87. Cells were irradiated with 1.25 Gy of Bragg peak protons (LET = 2 − 25 keV/μm) and accelerated nitrogen ions with doses of 0.57 Gy (LET = 81 keV/μm) and 1.25 Gy (LET = 180 keV/μm). The most pronounced modifying effect of the AraC inhibitor on human fibroblast and glioblastoma cells was observed after proton irradiation. By contrast, the action of accelerated 15N ions with high LET value reduces the radiosensitizing effect of AraC in human fibroblast and glioblastoma cells. These results may reflect the changes in ratio of different types of induced DNA damage: direct and enzymatic double-strand breaks. Under the action of radiation with increasing LET values, the frequency of direct DNA DSBs formation increases and the yield of DNA single-strand breaks and modified bases decreases, which are the main substrates for the formation of enzymatic DNA DSBs under the influence of AraC.

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Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **1057** Type: **Oral**

Distribution of natural and anthropogenic radionuclides in soil samples in recreational zones of Moscow

Monday, 24 October 2022 14:30 (15 minutes)

Recreational zones play an important role in human life in urban environment. The activities of natural radionuclides and ^{137}Cs were determined by low background γ-ray spectrometry in soil samples collected at two depths (0–5 and 5–20 cm) in 15 recreational zones of Moscow. The average activity concentrations of analyzed radionuclides were 519, 35.1, 29, 1.9 and 8.0 Bq/kg for ^{40}K, ^{232}Th, ^{238}U, ^{235}U and ^{137}Cs, respectively. The distribution of natural radionuclides in soil profiles is almost uniform, while the distribution of ^{137}Cs decreases with depth. A number of radiological indices, namely radium equivalent activity, external and internal risk assessment, gamma-index, annual effective dose and excess lifetime cancer risk were calculated to assess the level of radiological hazard for population. The values of calculated parameters are within the recommended safety limits, showing that soil in studied recreational zones do not pose serious threat to human health.

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Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **1058** Type: **Poster**

Investigation of the conformational change dynamics of β-amyloid peptide by Raman spectroscopy

Monday, 24 October 2022 19:55 (5 minutes)

The aggregation of the β-amyloid peptide (Aβ) is known to contribute to the accumulation of amyloid plaques in brain, which leads to the formation of a variety of diseases such as Alzheimer's. This work focuses on the conformational changes of Aβ (1-42) in the lipid membrane. The study was carried out by Raman spectroscopy, which is non-invasive, fast and does not require any sophisticated preparation of the material under study. In this work, we present a comparative analysis of the Aβ (1-42) peptide conformational change dynamics over time, including in the phospholipid membrane system. The aim of our study was to elucidate the regularity of structural changes in the amide I region (1600-1700 cm^{-1}) in the spectra of peptides which contributes to the formation of amyloid plaques.

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Session Classification: In-person poster session & welcome drinks

Track Classification: Life Science

Contribution ID: **1059** Type: **Oral**

Likelihood based approach to the estimation of the background induced by the misidentification of a jet as a photon at pp collider experiment

Wednesday, 26 October 2022 17:50 (15 minutes)

The background induced by misidentification of a jet as a photon is usually estimated using two-dimensional sideband method (ABCD-method). This report is devoted to an alternative approach to the estimation based on maximum likelihood method which doesn't require the optimization of ABCD regions boundaries, which results in much faster estimation. This method has not been applied to the estimation of the background induced by misidentification of a jet as a photon before. One of the main advantages of the developed method is that it takes into account data, signal and all other backgrounds distributions, which allows better estimation accuracy. The estimates derived with the considered method based on several variables distributions were confirmed by standard ABCD-method.

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1060** Type: **Oral**

Phase transition of nanostructured zinc ferrite spinel at high pressure

Wednesday, 26 October 2022 14:45 (15 minutes)

The study of ferrites of spinel type is of great importance due to the wide variety of their structural and magnetic properties, which are of interest from the point of view of fundamental and applied research. In particular, canted states of an antiferromagnet, ferrimagnet, and spin glass can be realized in these compounds 1.
Significant saturation magnetization, relatively high electrical resistance, low electrical losses and good chemical stability make spinel-type ferrites are important for a wide range of technological applications as transformer cores, rod antennas, storage devices [2,3]. Moreover, such ferrites can be useful in biomedicine: as an effective heating agent for the treatment of cancer tissues through magnetic hyperthermia, as biomarkers for MRI diagnostics and magnetic drug delivery systems 3.
A wide range of magnetic properties of spinel ferrites is determined by the features of the distribution of iron ions between different crystallographic positions in crystal structures of the spinel type 2. One of the important parts of the prospective research of spinel-type ferrites is the synthesis of complex ferrites with a controlled redistribution of iron ions between positions A and B, leading to a change in the magnetic properties of ferrites 3. In addition, understanding of the relationship between the structural properties and the magnetic order of spinel ferrites can be given by high pressure exposure.
In the present work, ferrite with the spinel structure $Zn_{0.34}Fe_{2.53}O_4$ was chosen for X-ray and neutron diffraction studies at high pressure and in a wide temperature range. Experiments on neutron diffraction in a wide temperature range were carried out on a DN-12 diffractometer with a pulse high-flux reactor IBR-2 [FLNP, JINR]. X-ray diffraction data were obtained on a specialized Xeuss 3.0 diffractometer (Xenocs SAS, France) using a high-pressure cell with diamond anvils.

The distribution of magnetic moments of iron ions in the crystallographic positions A and B using temperature have been studied. Calculated lattice parameters, interatomic distances and angles, magnetic moments as functions of temperature and pressure were presented. The structural mechanisms of phase transition in ferrites with spinel structure are discussed.

This work was supported by RFBR grant no. 20-02-00550-a.

References

1. S.S. Ata-Allah, M. Yehia, Physica B. 404, 2382 (2009).
2. H. El. Moussaoui, et al., J. Supercond. Novel Magn. 25, 2473 (2012).
3. M. Veverka, Z. Jirák, O. Kaman, et al., Nanotechnology 22, 345701 (2011)

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Presenter: Ms BELOZEROVA, Nadezhda (FLNP)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1061** Type: **Poster**

Photoinduced neutrophil extracellular traps

Monday, 24 October 2022 19:55 (5 minutes)

NETosis is a programmed cell death which occurs in response to various types of stimuli. Nowadays, studies devoted to the investigation of photoinduced NETosis activated predominantly by ultraviolet (UV) radiation are becoming increasingly important. This work is devoted to the study of the activation of neutrophils at two wavelengths to cause photoinduced NETosis at three different doses of radiation (4, 16, 32 J/cm^2). Phorbol 12-myristate 13-acetate (PMA) used as a positive control for activation. We proposed that cytochromes are the prime photoacceptors of light sources. Cytochromes trigger the whole the descending chain, starting with the activation of ROS generation and ending with the released extracellular traps. Cytochromes are part of NADPH oxidase and granulocyte mitochondria. Application of selective inhibitors showed that under the influence of exposure of two wavelengths undergoes a mechanism of NETosis through two signaling pathways.

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Presenter: ZAKRYTNAYA, Darya

Session Classification: In-person poster session & welcome drinks

Track Classification: Life Science

Contribution ID: **1062** Type: **Oral**

A new type of ground-based simulator of inner radiation field of a spacecraft in deep space

Monday, 24 October 2022 16:20 (15 minutes)

The problem of full-scale ground-based modeling of cosmic radiation using heavy ion accelerators for space radiobiology is very relevant. A new type of cosmic radiation simulator based on a ^{56}Fe ion beam with an energy 1 GeV/n is proposed. The simulator uses rotating converters consisting of segmented targets of various thicknesses. This design ensures the uniformity of the fields of all secondary particles behind the targets using a flat uniform field of primary ^{56}Fe ions. The proposed setup with four replaceable converters makes it possible to simulate not only the distribution of linear energy transfers (LET) of cosmic radiation represented by the galactic cosmic rays (GCR) component, but also to reproduce continuous energy spectra of all charged fragments of a projectile ion from protons up to Co ions. The results of modeling the internal radiation field inside the habitable module of a spacecraft with a shell of 15 g/cm^2 Al, generated by particles of galactic cosmic rays during solar activity in the range from 0 to 190 Wolf numbers are presented.

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Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **1063** Type: **Oral**

THE PRESSURE EFFECT ON CRYSTAL AND MAGNETIC STRUCTURES OF VAN DER WAALS MATERIALS

Wednesday, 26 October 2022 14:15 (15 minutes)

The recent discovery of magnetic ordering in van der Waals (vdW) materials down to the monolayer limit has opened a new direction in the field of two-dimensional materials, allowing researchers to explore magnetism in lower dimensions in simple crystal systems. The advent of long-range 2D ferromagnetism brings about new transport phenomena in two dimensions, like tunneling magnetoresistance and electrical switching of magnetic states promoting 2D ferromagnets as versatile platforms for engineering new quantum states and device functionalities. CrBr3 and Fe3GeTe2 are also one of the brightest representatives of this class of materials, which also attract the attention of researchers because of the various observed physical phenomena. The knowledge of relationship between magnetic and crystal structure of such compounds, which can be obtained from high-pressure investigations, is very essential for understanding the nature and mechanism of physical phenomena observed in it.
The present work focuses on the investigations of crystal and magnetic structures of CrBr3 and Fe3GeTe2 in wide temperature and pressure ranges. Detailed studies of the crystal structure of the materials were carried out using neutron diffraction on a DN-6 diffractometer of a pulsed high-flux IBR-2 reactor (FLNP, JINR, Dubna, Russia) in temperature range of 6-300 K and at pressure up to 5 GPa. Neutron diffraction investigations of CrBr3 revealed to observe the formation of the long-range ferromagnetic order which leads to the negative thermal volume expansion and anomalous thermal variation of interatomic distances and angles, caused by the spin-lattice coupling. Related effects were found in vibrational spectra of this compound. Noticeable anomalies near the Curie point are observed on the temperature dependences of Raman peak frequencies as well as on their full-width at half-maximum which indicates the strong spin-phonon coupling in CrBr3. The high pressure effect made it possible to identify unusual changes in the diffraction spectra and changes of Raman modes, which may be associated with a phase transition in CrBr3. It was also obtained the evolution of the unit cell parameters, bond lengths under high pressure. The X-ray diffraction of Fe3GeTe2 at high pressure revealed anomalies on the baric behavior of structural parameters without clearable structural transition with changing the symmetry. The vanishing of the vibrational modes of Fe3GeTe2 at high pressures and low temperature can be caused by the suppression of the long-range magnetic order.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1064** Type: **Poster**

INVESTIGATION OF CRYSTAL AND MAGNETIC STRUCTURES OF MULTIFFERROIC MATERIALS

Monday, 24 October 2022 19:10 (15 minutes)

Lead iron tungsten oxide, Pb(Fe2/3W1/3)O3 (PFW), is one of the well-known magnetoelectric relaxors which may be considered as the prototype for fundamental understanding of the magnetoelectric interactions. It is a ferroelectric and antiferromagnetic perovskite, in which the cations (Fe3+ and W6+) are randomly distributed in the octahedral B-site positions. The ferroelectric Curie temperature TC for PFW has been indicated to occur between 170-190 K. In addition, PFW is an attractive material for some technical applications, e.g., thick film capacitors. The disordered magnetoelectric perovskite lead iron niobate, PbFe1/2Nb1/2O3 (PFN), is also well known as an intriguing candidate for manufacturing many electronic and electromechanical devices. PFN exhibits ferroelectric and antiferromagnetic properties with a Neel temperature in the range 143-170 K. However, the nature of the magnetic ordering in PFN remains poorly understood. Solid solutions in the PFW-PFN system have been studied as potential dielectric materials for multilayer capacitors. The low Curie temperature of PFW can easily be shifted upwards forming a solid solution with PFN. As a result, the multicomponent system may exhibit more attractive multifunctional properties near room temperature. Detailed experimental data on structural and magnetic properties of PFW-PFN solid solutions are currently unavailable. Further investigations of PFW-based solid solutions are relevant. We have chosen to study the compositions of (xPbFe2/3W1/3O3-(1-x)PbFe1/2Nb1/2O3) (x=1.0, 0.6, 0.1). The knowledge of relationship between magnetic and crystal structure of such compounds, which can be obtained from high-pressure and low temperature investigations, are very essential for understanding the nature and mechanism of physical phenomena observed in it. In addition, the detail studies of structural changes under extreme conditions were not carried out.

In present work were performed neutron diffraction studies of (xPbFe2/3W1/3O3-(1-x)PbFe1/2Nb1/2O3) (x=1.0, 0.6, 0.1) at high pressures and low temperatures. Neutron powder diffraction measurements at high pressures up to 7 GPa were performed with the DN-12 diffractometer at the IBR-2 high-flux pulsed reactor [FLNP, JINR, Dubna, Russia] using the sapphire anvil high-pressure cell. In order to improve the understanding of the lattice instabilities the Raman spectroscopy studies of the vibration spectra of the compound under pressure up to 30 GPa were performed. The crystal structures of these compounds also have been studied by X-ray diffraction at high pressures. Pressure and temperature dependences of the volume, unit cell parameters and of magnetic moments of antiferromagnetic (AFM) phase, Neel temperature were obtained for the compounds of solid system (xPbFe2/3W1/3O3-(1-x)PbFe1/2Nb1/2O3) (x=1.0, 0.6, 0.1). With increasing temperature and pressure, slight decreasing of the magnetic moments of iron ions in PFWO were observed, however, although the crystal structure remains stable up to high pressures with a space group Pm-3m. Some Raman modes have been found on the Raman spectra, which in such compounds are correlated with the existence of nanoregions, however, with increasing pressure, these modes noticeably widen and vanish.

The work was supported by the JINR Grant for young scientists 22-402-03.

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Presenter: LIS, Olga (JINR)

Session Classification: In-person poster session & welcome drinks

Track Classification: Condensed Matter Physics

Contribution ID: **1065** Type: **Oral**

Breeding of a drought-resistant rice variety as an application of mutagenesis induced by the neutron irradiation on the EG-5 installation in the FLNP, JINR

Monday, 24 October 2022 14:15 (15 minutes)

Rice (Oryza sativa L.) is the main food crop for half of the world's population, which could increase by another 3 billion in the next 30 years 1. Also, due to the relative simplicity of its genome 2, rice represents a key model for studying the genomics of agroecosystems. Thus, based on fundamental knowledge about the rice genome, it is possible to produce enough food in the future to satisfy the demands of the growing population of the planet.
It is important to consider the fact that just an increase in production is not enough, it is necessary to think about maintaining the current state of affairs in the growing influence of unfavorable conditions. Approximately 10 million hectares of agricultural land will be withdrawn from agricultural use each year due to salinization 3 associated with gradual sea level rise 4.
One strategy for the genetic improvement of rice is to use radiation-induced mutagenesis to find samples suitable for growing under unfavorable conditions such as drought and salinity 5.
At the same time, creating samples resistant to the abovementioned adverse factors leads to creation of gene combinations that increase the overall adaptability of the plant [6].
The mechanisms of neutron action on biological objects are poorly understood, but according to 2 they can be used to create new varieties, since in a number of studies the genes responsible for agronomically important traits have been changed.
The first stage of our study was to irradiate rice seeds of different varieties with neutrons with E=4.1 MeV to obtain a dose of 50 Gy. Irradiation was conducted at the electrostatic generator EG-5 in the FLNP, JINR. The place of research is the experimental site of LLP "Zhakhaev Kazakh Rice Research Institute" in the Republic of Kazakhstan located in Kyzylorda region. The climate of the Kyzylorda region is sharply continental, arid, with chloride-sulphate salinity [7]. Three rice varieties cultivated in this area (Syr-Syluy, Aikerim, Leader) were provided for irradiation. After irradiation, the seeds were germinated in a greenhouse, then planted in the fields, where they were subjected to additional treatment with salt and moisture-absorbing components.
It was found out that the reported dose of 50 Gy is sufficient to carry out mutagenesis in rice crops. The observed plants are weaker and dwarfish than the control plants. Also defects in the spike formation and the maturation of grain are observed. In the future, in this series of studies, it is additionally planned to implement the observation of the result of in vitro mutagenesis, which, according to study [8], reduces the number of chimeras and reduces the time for selecting the desired traits.

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1 R.A.Wing, M.D. Purugganan, Q. Zhang (2018). The rice genome revolution: from an ancient grain to Green Super Rice. Nat Rev Genet 19, 505–517.
2 V.E. Viana, C. Pegoraro, C. Busanello and A. Costa de Oliveira (2019). Mutagenesis in Rice: The Basis for Breeding a New Super Plant. Front. PlantSci. 10:1326. doi: 10.3389/fpls.2019.01326
3 S.R. Grattan, L. Zeng, M.C. Shannon, S.R. Roberts (2002). Rice is more sensitive to salinity than previously thought. Cal. Agric. V. 56: P. 189–195.
4 Z.H. Ren, J.P. Gao, L.G. Li et al. (2005). A rice quantitative trait locus for salt tolerance encodes a sodium transporter. Nature Genet. V. 37: P. 1141–1146.
5 A. Abdelnour-Esquivel, J. Perez, M. Rojas, W. Vargas, A. Gatica-Arias (2020).
Use of Gamma Radiation to Induce Mutations in Rice (Oryza sativa L.) and the selection of lines

with tolerance to salinity and drought. In Vitro Cell. Dev. Biol.—Plant, 56, 88-97.
[6] E. M. Kharitonov, Y. K. Goncharov, E. A. Maliuchenko. The genetics of the traits determining adaptability to abiotic stress in rice (Oryza sativa L.). Environmental genetics. vol. 13, no. 4, 2015, pp. 37-54.
[7] L. A. Tokhetova (2014). Promising samples of barley and oats for cultivation on saline soils of the Kyzylorda area. Molodoj uchenyj. № 1.2 (60.2). C. 31-34.
[8] A. J. Hernandez Soto Perez, R. Fait Zuniga, R. Rojas Vasquez et al. (2022). Temporary Immersion System Improves Regeneration of In Vitro Irradiated Recalcitrant Indica Rice (Oryza Sativa L.) Embryogenic Calli. Plants 11(3), 375.

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Presenter: KRUGLYAK, Anastasiya

Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1066** Type: **Oral**

Resonance phenomena in nanomagnet + Josephson junction system under external periodic drive

Wednesday, 26 October 2022 14:45 (15 minutes)

We demonstrated resonance effects in a system of nanomagnet coupled to the Josephson junction under the influence of external periodic drive. We show that the applied periodic drive brings to the appearance of additional resonance peaks, which positions determine by the driving frequency. The heights of the resonance peaks depend on the driving amplitude as a Bessel function. We develop a thorough analytical description that allows to classify all possible resonances arising in the system. The obtained result provide a method for controlling the resonance properties of the system. It has been demonstrated that by changing the amplitude of periodic drive it is possible to suppress the main ferromagnetic resonance and at the same time excite a new one with required aplitude and frequency. We consider that the obtained results open a wide field of research and applications related to the resonance properties of hybrid structures. Such a realization might play a crucial role in quantum information processing and spintronics.

Primary author: KULIKOV, Kirill (RF)

Presenter: KULIKOV, Kirill (RF)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1067** Type: **Oral**

Amyloid β-peptide: secondary structure analysis by Molecular Dynamics simulation

Monday, 24 October 2022 15:00 (15 minutes)

Alzheimer's disease (AD) is a neurodegenerative disorder that is the sixth leading cause of death and the most common cause of brain dementia worldwide. Over the last years, representative advancements have been made in our understanding of AD by studying the molecular mechanisms underlying amyloid-β(Aβ) and tau proteins pathology.
In general, AD is characterized by the deposition of β-sheet–rich, insoluble Aβ plaques. Here, we investigated Aβ peptide settled in lipid structure, to understand their interaction using Molecular Dynamics(MD) simulation. We hope that in future these investigations could provide an opportunity for translating our understanding of the pathogenesis and physiological mechanisms underlying disease and related disorders into new diagnostic approaches and disease-modifying therapies to prevent disease or restore brain function for symptomatic individuals.

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Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **1068** Type: **Oral**

Multiplicity distributions of prompt neutrons from spontaneous fission. Restoring techniques: advantages and limitations.

Thursday, 27 October 2022 15:00 (15 minutes)

The spontaneous fission is a complicated process that still could not be described by sufficiently reliable theory because of varying of possible final configurations of the system. There are a several theoretical models of the process (for example, semi-empirical 1 or fully-theoretical 2) but none of them can describe well all known nucleus that could decay by spontaneous fission. Therefore, experimental studies of such processes are high-interesting and important.

The experiments on study of the spontaneous fission properties of transfermium isotopes using the SHELS (Separator for Heavy Element Spectroscopy) 3 and the SFiNx (Spontaneous Fission, Neutrons and X-rays) detectors setup 4 that consists of more than 100 ^3He-filled counters were carried out at the Flerov Laboratory of Nuclear Reactions (JINR, Dubna, Russia). The main characteristic measured by setup is the multiplicity distribution of prompt neutrons. Since the registration efficiency of the SFiNx is far from 100% the measured distribution is heavily distorted in comparison with the original one. Many approaches could be used to restore the shape of original distribution. The most common one is to solving incorrect inverse problem by Tikhonov regularization technique 5. The method is simple and reliable but it is possible to get over smoothed solution and lost the information about exotic fission modes. The Bayesian approach [6] could be more powerful technique that the previous one. The Bayesian method requires the properly chosen prior information and could be much more calculation expensive in some implementations.

The techniques for multiplicity distribution of prompt neutrons restoring will be discussed in the report. Calculations with generated and experimental data will be compared with theoretical model predictions. Advantages and limitation of restoring methods will be discussed either.

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Presenter: MUKHIN, Roman

Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1069** Type: **Oral**

Manifestation of Devil's staircase and Negative Differential Resistance in the IV- Characteristics of φ0 Josephson Junction

Wednesday, 26 October 2022 15:00 (15 minutes)

The anomalous Josephson structures with coupled superconducting and magnetic characteristics allows the manipulation of magnetic properties by Josephson current 1. In junctions with a strong spin-orbit coupling (φ0 Josephson junction), we demonstrate an appearance of additional fractional subharmonic steps in the IV-characteristics under external electromagnetic radiation due to spin-orbit coupling. An origin of subharmonic steps is related to the locking of magnetic moment precession to the Josephson oscillations. We prove that the positions of those steps follow a continued fraction algorithm. In addition to this, we demonstrate the appearance of negative differential resistance on the IV-characteristic, resulting in an additional locking step of magnetic precession 2. We show that it is possible to control not only the frequency but also the amplitude of the magnetic precession in the locking region.

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Presenter: Dr NASHAAT, M. (BLTP)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1070** Type: **Oral**

Web interface and REST API for BM@N Event Metadata System

Thursday, 27 October 2022 15:15 (15 minutes)

The Event Metadata System (EMS) developed for BM@N, a fixed target experiment of the NICA (Nuclotron-based Ion Collider fAcility) project has been designed to store and index event records for particle collisions obtained at the BM@N facility. The system enables to quickly search for a required set of physics events based on various criteria for further physics analyses. The main interfaces to EMS include Web UI (user interface) and REST API (application programming interface), that are presented in the report in detail. Each interface has its own main use patterns, namely, Web UI is mostly used for browsing the event catalogue and checking its overall state, while REST API helps to integrate EMS with other software applications of the experiment, such as the main framework, BmnRoot. Both interfaces have been developed using Kotlin multiplatform technology, hence, both front-end and back-end components of the Web service are a part of the one project using the same language and a common codebase.

Primary authors: DEGTYAREV, Artyom (MIPT); KLIMAI, Peter (INR RAS); Dr GERTSENBERGER, Konstantin; Mr CHEBOTOV, Alexander

Presenter: DEGTYAREV, Artyom (MIPT)

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1071** Type: **Oral**

Individual dipole toroidal states in 58Ni

Wednesday, 26 October 2022 14:15 (15 minutes)

In early (e,e') experiments of TU-Darmstadt group, some dipole states at 8-11 MeV in 58Ni demonstrate enhanced transverse form factors. In this connection, we explored a possible toroidal nature of these states using the fully self-consistent Quasiparticle Random-Phase Approximation approach with Skyrme forces SVbas, SkM* and SLy6. The main attention was paid to well assigned 8.24 MeV 1- state. Various characteristics of the dipole states were analyzed. The calculations show that several 1- states at 8-11 MeV can indeed be toroidal. The available (e, e') data for 8.24-MeV 1- state are well described within the Plane Wave Born Approximation. A tentative prescription to distinguish toroidal states from irrotational ones is proposed. To our knowledge, 8.24-MeV 1- state in 58Ni is the first individual toroidal state proposed for spherical nuclei.

Primary author: VISHNEVSKIY, Petr

Presenter: VISHNEVSKIY, Petr

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1072** Type: **Oral**

Radiative Neutrino Mass with GeV Scale Majorana Dark Matter in Scotogenic Model

Wednesday, 26 October 2022 15:15 (15 minutes)

The experimental observations from the colliders established the standard model (SM), is the most successful phenomenological framework to explain the non-gravitational interactions of fundamental
particles at high energy. Non-zero neutrino mass and dark matter cast a shadow over its success. This necessitates the extension of the SM. The most straightforward and elegant extension of the SM
to explain these two phenomena is the Scotogenic model, where the SM particle spectrum extends with three isospin singlet right-handed neutrinos and one doublet scalar while all of these being odd under Z2 symmetry. In this work, we have considered the lightest right-handed neutrino as the
dark matter candidate and freeze-out mechanism for producing observed dark matter relic density. The charged lepton flavor violation decay processes constrain the upper side of Yukawa coupling while observed relic density limits the lower side. We have performed a unique parameterization to
attain the highest possible Yukawa coupling while satisfying LFV and DM constraints. The reduced number of free parameters and large Yukawa coupling make the model predictability at lepton colliders very high. Collider phenomenology for possible signatures performed at lepton colliders and the required luminosities estimated for detection.

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1073** Type: **Oral**

Worldsheet of a continuous helicity particle

Tuesday, 25 October 2022 15:45 (15 minutes)

We consider the class of spinning particle theories, whose quantization corresponds to the continuous helicity representation of the Poincare group. The classical trajectories of the particle are shown to lie on the parabolic cylinder with a lightlike axis irrespectively to any specifics of the model. The space-time position of the cylinder is determined by the values of momentum and total angular momentum. The value of helicity determines the focal distance of parabolic cylinder. Assuming that all the world lines lying on one and the same cylinder are connected by gauge transformations, we derive the geometrical equations of motion for the particle. The timelike world paths are shown to be solutions to a single relation involving the invariants of trajectory up to fourth order in derivatives. Geometrical equation of motion is non-Lagrangian, but it admits equivalent variational principle in the extended set of dynamical variables. The lightlike paths are also admissible on the cylinder, but they do not represent the classical trajectories of this spinning particle. The classical trajectories of massless particle (with zero helicity) are shown to lie on hyperplanes, whose space-time position depends on momentum and total angular momentum.

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Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1074** Type: **Oral**

Semi-rational optimization of VirChR1, a viral channelrhodopsin, via mutagenesis

Monday, 24 October 2022 14:45 (15 minutes)

The previously characterized viral channelrhodopsin VirChR1 shows the necessary characteristics of an optogenetic tool. It also shows a unique impermeability for Ca^{2+} ions, presumably helping avoid the impact of calcium influx, which is useful for the neuroscientific applications of optogenetics. VirChR1's ability to drive neural firing is compromised by the low ion conductance. To fix this, it is necessary to improve the protein's capacity to conduct photocurrents, while conserving its Ca^{2+} sensitivity. Here, an approach called semi-rational mutagenesis is used in order to alter the rhodopsin's characteristics in a desired fashion. Specifically, over 20 VirChR1's mutants were electrophysiologically characterized to find the effects of the particular mutations on the function of VirChR1 and enhance its features through mutation combinations.

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Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **1075** Type: **Oral**

Design and construction of a straw chamber telescope for muography of the steppe kurgans

Wednesday, 26 October 2022 14:30 (15 minutes)

High energy cosmic ray muons have highly penetration capability which allows them to cross kilometers of rocks. Due to the reasonable rate of cosmic muons at the Earth's surface and their high penetration capability they are of great use in fields beyond the particle physics, such as geology, archaeology, speleology and industrial construction.
The above mentioned features of cosmic muons have founded the development of such applied technique as muonography, which can be used for non-invasive inspection of large inaccessible volumes to determine their density distribution, as well as for reconstruction a three-dimensional image of the examined volume. The novel technique of muography has motivated to build a muon telescope based on straw drift tubes to monitor and explore steppe kurgans in Kazakhstan.

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Presenter: KAMBAR, Ysmaiyl (JINR)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1076** Type: **Oral**

SIMULATION PROTON DEPTH DOSE DISTRIBUTION FORMED USING PLEXIGLASS RANGE SHIFTER.

Monday, 24 October 2022 15:15 (15 minutes)

When treating cancer with proton beams, it is important to obtain flat dose plateau of the beam covering target volume where the tumor is located 1. In the dynamic irradiation method, the beam energy is changed using range-shifter to create the Spread-out Bragg peak (SOBP) at the required distance. In this work, the relationship between Plexiglas range-shifter and Bragg peak position was simulated using Fluka Monte Carlo code 2. A linear relationship was found between Plexiglass thickness and proton range in water phantom. To obtain a flat dose plateau at the depth 15cm with a width determined by a fraction 0.66 of the maximum depth consisting of 51 different energy intervals, the range of each contributing beam was determined by the Kleeman-Bragg rule 3. The distal Bragg peak had the highest weight and the proximal Bragg peak had the lowest weight. To find the optimal weighting of the irradiating time to obtain the desired SOBP, the p-value needed to be adjusted. The p-value can vary for different depths and energies. For the depth chosen for this simulation, the p-value 1.32 proved to be an adequate choice. The dose plateau is tilted in one direction or the other if a suitable p-value is not applied.

References:
1. Harald Paganetti. Proton Therapy Physics. CRC Press, Taylor and Francis Group, 2012.
2. A. Ferrari, P.R. Sala, A. Fasso, and J. Ranft, “FLUKA: a multi-particle transport code”, CERN-2005-10 (2005), INFN/TC 05/11, SLAC-R-773.
3. Weimin Chen David Jette. Creating a spread-out bragg peak in proton beams. Phys. Med. Bio., 2011

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Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **1077** Type: **Oral**

Centrality dependencies of charged pion production in 12C+12C collisions at 4.2 GeV/c per nucleon

Monday, 24 October 2022 15:00 (15 minutes)

The dependencies of the average kinematical characteristics of the negative and positive pions, produced in 12C+12C collisions at 4.2 A GeV/c, on the collision centrality have been investigated. The number of the produced negative pions per participant nucleon of a projectile 12C nucleus, the average inelasticity coefficients of π−mesons, and the shapes of their full and transverse momentum distributions do not depend on 12C+12C collision centrality. The number of the produced positive pions per participant nucleon of a projectile carbon-12 nucleus, the average values of the inelasticity coefficient, full, longitudinal and transverse momenta of π+ mesons have decreased with increasing the collision centrality. The observed dependencies of the characteristics of the π− and π+ mesons on the collision centrality have been interpreted as due to the used centrality selection criterion, based on the number of participant protons, and conservation of the baryon number and electrical charge in a collision event. The obtained results can be useful for analysis of the high energy heavy ion collisions in order to subtract the effects purely due to the collision centrality selection method, based on the number of participant protons, and conservation of the baryon number and electrical charge in a collision event.

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1078** Type: **Oral**

On 4 Dimensional Exceptional Drinfel'd Algebras

Wednesday, 26 October 2022 16:50 (15 minutes)

We review the mathematical foundations of Exceptional Drinfel'd Algebras. We present a brief account of Manin Triples which defines the algebra corresponding to T-duality and review the mathematical derivation of Exceptional Drinfel'd Algebras which constitute the algebra defining U-dualities. We present our results of classification of all 4+6 dimensional Exceptional Drinfel'd Algebras and use Killing Form to find U-dualities between these classified structures.

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Presenter: KUMAR, Sameer (Moscow Institute of Physics and Technology)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1079** Type: **Oral**

Deep tracking for the SPD experiment

Monday, 24 October 2022 15:45 (15 minutes)

The reconstruction of elementary particle trajectories (tracking) is an important part of event reconstruction in high-energy physics experiments. The recurrent neural network model TrackNETv3 was proposed as an analogue to classical tracking methods based on the Kalman filter, which allowed us to obtain high tracking efficiency values for the BM@N and BES-III experiments. Based on previous results with these experiments, the possibility of applying the TrackNETv3 model to the data from the SPD experiment is considered. In contrast to the BM@N experiment with a fixed target, SPD is a collider experiment, besides, it has a much larger number of tracking detector stations. The paper presents a way of adapting the original model to the data of the SPD experiment. Also, a study of the dependence of the performance quality of the tracking algorithm on the level of data contamination by false hits (fakes) appeared due to tracking detector specifics has been carried out. The results of calculations performed using the data of the preliminary Monte Carlo simulation of the SPD experiment are presented.

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Presenter: RUSOV, Daniil (Joint Institute for Nuclear Research)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Information Technology

Contribution ID: **1080** Type: **Oral**

pp scattering at the LHC with the lepton pair production and one proton tagging

Tuesday, 25 October 2022 15:15 (15 minutes)

In this work forward proton scattering in association with lepton pairs produced via the photon fusion mechanism process was studied. The ATLAS collaboration
has managed to measure the cross sections of the process above. Here analytical formulas for the corresponding cross-sections were derived. These formulas allow for simple numerical integration instead of the usual Monte Carlo approach and thus can provide intuitive insights into the process targeted by the experiment.The numerical results are in the ballpark of experimental data, while their substantional deviation would signal New Physics.

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Presenter: KARKARYAN, Evgeny (LPI RAS)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1082** Type: **Oral**

E-models of inflation towards describing formation of primordial black holes

Wednesday, 26 October 2022 16:35 (15 minutes)

We propose and study the new (generalized) E-type α-attractor models of inflation, in order to include formation of primordial black holes (PBHs). We numerically investigate the phases of inflation, derive the power spectrum of scalar perturbations, and calculate the PBHs masses. For the certain values of the parameters, the asteroid-size PBHs can be formed with the masses of $10^{17} \div 10^{19} g$, beyond the Hawking evaporation limit and in agreement with current CMB observations. Those PBHs are a candidate for (part of) dark matter in the present universe, while the gravitational waves induced by the PBHs formation may be detectable by the future space-based gravitational interferometers.

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Co-authors: KETOV, Sergei; SABUROV, Sultan

Presenter: FROLOVSKY, Daniel (Tomsk State University)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1083** Type: **Oral**

Development of the JINR CSA-1 charge-sensitive preamplifier and comparison with the CANBERRA model 2018EB preamplifier in terms of its main characteristics.

Monday, 24 October 2022 14:30 (15 minutes)

A JINR CSE-1 charge-sensitive preamplifier was developed at VBLHEP JINR to process signals from a semiconductor detector in the spectrometric pathway. The principle of the device calibration is described and the calibration data of the preamplifier in terms of charge sensitivity and noise are presented, a comparative analysis of the device with the charge-sensitive preamplifier CANBERRA Model 2018EB is performed.

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Presenter: PALNIKOV, Ilya

Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1084** Type: **Oral**

Production of various elements in ultraperipheral ^{208}Pb–^{208}Pb collisions at the LHC

Tuesday, 25 October 2022 15:45 (15 minutes)

As confirmed by theory and measurements, one, two or three neutrons are emitted frequently in ultraperipheral collisions (UPC) of heavy relativistic nuclei, in particular, ^{208}Pb. The exchange of soft equivalent Weizs\"{a}cker–Williams photons dominates in such interactions. This leads to the excitation and decay of Giant Dipole Resonances (GDR) in colliding nuclei typically below the proton emission threshold. Less is known about the electromagnetic dissociation of ^{208}Pb induced by more energetic photons leading to more violent fragmentation of ^{208}Pb. The UPC of lead nuclei at the LHC were simulated with Relativistic ELectromagnetic Dissociation (RELDIS) model to evaluate the contribution of photonuclear reactions in the domain of quasideuteron absorption and at higher photon energies. It was found that ^{208}Pb dissociates into a single nuclear residue and several protons and neutrons with a negligible contribution of photofission. The cross sections of production of Pb, Tl, Hg, Au, Pt, Ir, Os, Re, W, Ta and Hf were calculated along with the cross sections of emission of given numbers of protons. The contributions to these cross sections from the GDR excitations (7–40˜MeV), quasideuteron absorption (40–140˜MeV) and hadron photoproduction on intranuclear nucleons at higher photon energies were calculated. The cross sections of production of specific isotopes $^{197,198,\ldots 207}$Tl were also calculated, and the contribution of the quasideuteron absorption to the production of the heaviest thallium isotopes was shown. It was demonstrated that due to the presence of a single heavy residue in the final state mostly accompanied by protons and neutrons, the cross sections of the production of specific elements can be well approximated by the proton emission cross sections, which can be measured in the ALICE experiment at the LHC.

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1085** Type: **Oral**

Analysis of the counting rate of non-trigger signals at the Baikal-GVD neutrino telescope

Wednesday, 26 October 2022 14:45 (15 minutes)

The main goal of the Baikal-GVD project is to detect high-energy astrophysical neutrinos. In particular, the telescope's aim is to register the Cherenkov radiation emitted during the passage of secondary charged particles formed as a result of neutrino reactions with the environment through the deep waters of Lake Baikal. In addition to Cherenkov radiation, ambient background noise and non-trigger signals are also recorded. The procedure of the selectionof the astrophysical signal from a noise background is a non-trivial task, which includes a thorough study of the background itself. This work presents the results of the analysis of the counting rate of non-trigger and noise signals for the year 2021. Images of the optical activity level for 6 PMT of one telescope string were obtained, as well as the level of optical activity on all 36 PMT of one string for the year of the data set. Two optically inactive periods and one long period with high optical activity were identified. The resulting images were compared with data for 2020 published by V.A. Allakhverdyan et al. "The Baikal-GVD neutrino telescope as an instrument for studying Baikal water luminescence".

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1086** Type: **Oral**

Impact of non-universal Z' to the B-> Kvv decays

Tuesday, 25 October 2022 16:20 (15 minutes)

Semileptonic flavor changing neutral current transitions with a pair of neutrinos in the final state are very accurately determined in the standard model (SM) and thus provide an accurate and sensitive probe for physics beyond the SM. Until recently, the poor tagging efficiency for the $B \to K^{(*)}\nu\bar{\nu}$ modes made them less advantageous as a probe of new physics (NP) compared to the charged lepton counterparts. The most recent Belle II [Dattola:2021cmw] result on $B^+ \to K^+\nu\bar{\nu}$ indicates a possible enhancement in the branching fraction of $B^+ \to K^+\nu\bar{\nu}$. Therefore we have explored the possibilities of such an enhancement as a signal of NP within scenario described on [Bednyakov:2021fof] which can also explain some of the other tensions observed in neutral current B-decays. Also we explore sensitivity of these observables to new CP-violating NP contributions at present and planned future B-physics experiments. As such, these observables provide unique probes of CP violation in $b \to s\nu\bar{\nu}$ transitions.

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Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1087** Type: **Oral**

Particle identification in proton boron fusion reaction using Timepix3 detector

Monday, 24 October 2022 14:45 (15 minutes)

Proton-Boron Capture Therapy (PBCT) is a novel approach of radiation therapy aimed at enhancing proton biological effectiveness to cancer cell killing. PBCT uses a nuclear fusion reaction between low-energy protons and 11B atoms, which produces highly DNA-damaging α-particles. As a result of the interaction of low energy proton with 11B nucleus, three alpha particles are generated, which eventually stop inside the tumor and release all their energy in cancer cells:
p + 11B ⟶ 3 α + 8.68 MeV
Experimental measurements have been performed at the Nuclear Physics Institute of the CAS, CANAM laboratory in Řež using 3 MV Tandetron accelerator. Low energy proton beams (2.5, 1.5 and 1.25 MeV) were incident on 11B and natural boron isotope mixture targets. Generated particles were detected using pixel Timepix3 detector with 300 μm silicon layer. This device enregistered not only alpha particle emission from the nuclear reactions of protons with boron, but also backscattered protons. Python scripts and data processing engine (DPE engine) have been applied to analyze the obtained data. The proton incidence angle was 0^0 and the Si Timepix3 detector was placed at 170^0 laboratory angle. The applied experimental setup and obtained results will be described and discussed.

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Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1089** Type: **Oral**

Compton scattering of annihilation photons in entangled and decoherent polarization states.

Thursday, 27 October 2022 15:15 (15 minutes)

Our work concentrates on studying the Compton scattering kinematics of annihilation photons in different polarization states. Pairs of entangled annihilation photons with mutually orthogonal polarization are produced in positron-electron annihilation in a radioactive source. The Compton scattering of such photons is accurately theoretically and experimentally studied. In contrast, the polarization states of decoherent annihilation photon pairs were not measured. Such states are obtained in decohering process of photons interaction in surrounding matter. For example, during the Compton scattering of one of the photons, the entanglement of annihilation pair is lost and the photons become decoherent. For a long time, it was assumed that Compton scattering of decoherent pairs should be vastly different from that of entangled ones. Supposed difference in scattering kinematics of these two photon types is planned to use in future generation of Positron Emission Tomography. However, recent theoretical papers predict similar scattering cross-sections for decoherent and entangled photons. Our experiment confirms this statement. We present the results of measurements with the experimental setup composed of Compton polarimeters.

Primary author: STRIZHAK, Alexander (INR RAS)

Presenter: STRIZHAK, Alexander (INR RAS)

Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1090** Type: **Poster**

On thermodynamics of rigid rotors in the field of centrifugal forces

Friday, 28 October 2022 14:00 (5 minutes)

We consider thermodynamics of system of symmetric quantum rigid rotors that rotates with constant angular velocity. We show the free energy of the system is given by the sum of translational and rotational contributions. The rotational free energy is computed as the function of temperature and angular velocity. The angular velocity corrections to the thermodynamic potential are identified in the high-temperature limit. The main attention is paid to the rotational corrections to internal energy, entropy, and heat capacity.

Primary authors: IBRAGIMOV, Ravil (National Research Tomsk State University); Dr KAPARULIN, Dmitry (National Research Tomsk State University)

Presenter: IBRAGIMOV, Ravil (National Research Tomsk State University)

Session Classification: Online poster session

Track Classification: Theoretical Physics

Contribution ID: **1091** Type: **Poster**

The detecting device development for measuring the characteristics of high-energy charged particles beams

Monday, 24 October 2022 19:55 (5 minutes)

This study describes the detecting device development and approbation using for measurement of the flux density distribution in the transverse plane of the high-energy charged particle beams by the multi-angle scanning method. Currently, for the implementation of ion and proton radiotherapy procedures high-precision monitoring systems are needed to determine such characteristics of the beams as the intensity, position and spatial distribution of the beam in real time. Existing measuring systems do not meet all the necessary requirements, and therefore, the task of developing a detecting device for recording the spatial and energy characteristics of high-energy proton and ion beams becomes relevant.
This study presents the results of the detecting device development for measuring the characteristics of high-energy charged particles beams. It was based on the previously proposed concept 1 of the beam transverse intensity distribution determination with the help mathematical reconstruction of beam profiles obtained by multiple scanning at different angles with a fixed angular step. This approach will make it possible to determine the total density distribution of the beam in the transverse plane and to ensure continuous control of the high-energy charged particle beam parameters during hadron radiotherapy.

This work is supported by the Russian Science Foundation, project No. 21-79-00252.

References

1 Bulavskaya A.A., Cherepennikov Y.M., Grigorieva A.A., Miloichikova I.A., Stuchebrov S.G. Multiangle scanning for measuring radiation beam profiles with a typical size of 10 millimetres – Proof-of-principle experiments. Journal of Instrumentation, 2022, vol. 17, no. 07, pp. T07004.

Primary authors: Ms GRIGORIEVA, Anna (Tomsk Polytechnic University); Dr BULAVSKAYA, Angelina (Tomsk Polytechnic University); Ms BUSHMINA, Elizaveta (Tomsk Polytechnic University); Dr MILOICHIKOVA, Irina (Tomsk Polytechnic University, Cancer Research Institute of Tomsk National Research Medical Center of the Russian Academy of Sciences); Dr STUCHEBROV, Sergei (Tomsk Polytechnic University)

Presenter: Ms GRIGORIEVA, Anna (Tomsk Polytechnic University)

Session Classification: In-person poster session & welcome drinks

Track Classification: High Energy Physics

Contribution ID: **1092** Type: **Oral**

TOF700 to ZDC track matching on the Ar - data at the BM@N experiment

Monday, 24 October 2022 15:15 (15 minutes)

BM@N (Baryonic Matter at Nuclotron) is the first fixed target experiment at NICA Facility at JINR (Dubna, Russia). It is designed to study nuclear-nuclear collisions at high densities. The research program in Run-7 was devoted to studies of cross section of inelastic reactions Ar + A $\longrightarrow$ X with the beam kinetic energy from 2.3 to 3.5 GeV and different targets: C,Al,Cu,Pb,Sn.
The report presents a procedure for matching an extrapolated track from TOF700 (Time-of-Flight system) with its response in ZDC (Zero Degree Calorimeter) on experimental data (Run-7). This is an important step in evaluating the centrality of events.

Primary author: Ms ALISHINA, Ksenia (Russia)

Co-author: FOR THE BM@N COLLABORATION

Presenter: Ms ALISHINA, Ksenia (Russia)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1093** Type: **Poster**

Dualizations for the spin two fields

Monday, 24 October 2022 19:00 (5 minutes)

We propose higher-derivative dual representation for the massless spin two theory by the third-rank tensor with hook Young diagram. Using the general procedure for including Stueckelberg fields with reducible gauge symmetry, we demonstrate that we can switch between different dual formulations by the choice of gauge-fixing conditions in the Stueckelberg action. For the massless spin two field one of the gauges reproduced linearized Einstein gravity in terms of symmetric second-rank tensors, while another one leads to the third-order equations for hook-type symmetry tensor. We demonstrate that similar dual formulations exist for the fields of various spin, e.g for the massive spin two fields.

Primary authors: ABAKUMOVA, Victoria (Tomsk State University); Prof. LYAKHOVICH, Simon

Presenter: ABAKUMOVA, Victoria (Tomsk State University)

Session Classification: In-person poster session & welcome drinks

Track Classification: Theoretical Physics

Contribution ID: **1094** Type: **Oral**

Conductivity and electrochemical charge storage capacity of thermally treated and ion-beam irradiated graphene oxide/12-tungstophosphoric acid nanocomposites

Wednesday, 26 October 2022 15:00 (15 minutes)

Performance of carbon nanomaterials in electrochemical charge storage is highly dependent on the conductivity of the material, presence of pseudocapacitive functional groups, porosity and the structure. Graphene oxide (GO) is has interesting surface chemistry and structural properties that can be further modified in different ways. Additionally, 2D nature and different active sites make this material excellent for synthesis of nanocomposites with large variety of compounds. In this work composites of GO and 12-tungstophosphoric acid (WPA) with 6 and 13 wt.% of WPA were synthesized. The obtained material was modified with thermal treatment up to 400 ℃ in argon atmosphere and ion beam irradiation (low energy hydrogen and nitrogen ions 15-75 keV and swift heavy xenon ions 150 MeV). Resistivity of the pristine and modified samples was investigated with solid state electrochemical impedance spectroscopy while galvanostatic charge-discharge was used for assessment of charge storage properties. The results showed that the resistivity of the samples irradiated with hydrogen ions decreased up to fluence of $1\times10^{16}\ ions/cm^2$ after which the increasing structural damage caused the increase in resistivity. Capacitance of pristine and low energy irradiated samples was quite low which was connected to low conductivity of these samples and low penetration depth of the used ions. Thermally treated samples of GO exhibited substantially lower resistivity that was even lower in the case of composites which showed the beneficial influence of WPA on electric properties of GO. These samples also had increased charge storage capacity. Swift heavy ion irradiated samples showed charge storage capacitance comparable to the thermally treated samples whereas the composites showed improved capacity and cycling stability.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1095** Type: **Oral**

Sorption of Zirconium on Quartz

Monday, 24 October 2022 15:45 (15 minutes)

The issue of disposal of zirconium containing waste has not yet been resolved. The safety of storage facilities is defined by the migration ability of radionuclides; one of the main factors is sorption on minerals. This work is devoted to the study of the ability of zirconium to sorption on quartz. Sorption mechanisms and its quantitative characteristics have been investigated by experimental methods and calculations with DFT. Data on the sorption of zirconium on quartz have been obtained for the first time and can be used for further research.

Primary author: Ms KISELYOVA, Sofia

Co-author: Mr PETROV, Vladimir

Presenter: Ms KISELYOVA, Sofia

Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1096** Type: **Oral**

Laser resonance ionization spectroscopy on scandium: towards production of medical radioisotopes

Monday, 24 October 2022 15:45 (15 minutes)

The theranostics approach in nuclear medicine is based on the use of radiopharmaceuticals with similar chemical behavior, that enable both therapeutic and diagnostic applications with well managed kinetics and biodistribution in the body. As radionuclides are the active agents for such medicine, the most appropriate solution for the purpose is to use radioisotopes of the same chemical element, ensuring identical chemical properties.

Scandium isotopes are known candidates for theranostics approach: Sc-47 can be used for radionuclide treatment, while Sc-43 and Sc-44 are well suited for imaging procedures. On the other hand, the generation of scandium radioisotopes is often associated with isotopic cross-contaminations. This drawback can be overcome using the mass separation technique to extract desired radionuclides from an irradiated sample. The combination of an electromagnetic isotope separator with a resonant ionization laser ion source can provide an increased yield of extracted isotopes along with the highly improved elemental purity of the final product.

To develop a suitable ionization scheme, laser resonance ionization spectroscopy on scandium was accomplished. The work was focused on the characterization of a two-step ionization process, being considered as optimum in respect to efficiency, reliability and operation complexity. For this study, different first excitation steps in UV range were investigated, unfolding into broad spectra of auto-ionizing states. The spectroscopy results and further plans are going to be presented.

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Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **1097** Type: **Poster**

Structural modulations of CdS/graphene oxide with Gd2O3 for degradation of methylene blue

Friday, 28 October 2022 14:20 (5 minutes)

Efficient cleaning of contaminated water by photocatalysis has become an effective strategy in recent years due to its environmental and ecological designation. The cadmium sulfate (CdS) composition was modified with dopants including gadolinium oxide (Gd2O3) and combined with graphene oxide (GO) nanoparticles. The obtained powdered compositions are pristine Gd2O3, CdS/Gd2O3 and CdS/Gd2O3@GO. The crystallite size (Ds) of the Gd2O3, CdS/Gd2O3 and CdS/Gd2O3@GO was evaluated to be 29.62, 11.62 and 11.56 nm. The degradation of methylene blue (MB) reaches the highest values of 42.85%, 60.37% and 82.35% for pure Gd2O3, CdS/Gd2O3 and CdS/Gd2O3@GO after (60 min) under visible light irradiation with dye concentration of (0.25 ppm). However, the efficiency of MB removal reaches 65.23%, 77.93% and 91.07% for Gd2O3, CdS/Gd2O3 and CdS/Gd2O3@GO powdered compositions under UV irradiation with a dye concentration of (0.25 ppm). The degradation of methylene blue was enhanced denoting its potential employ in the applications of water treatment.

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Presenters: Ms ABDRABOU, Dalia (Misr University for Science and Technology); Prof. M EL-SHERBINI, Th (Cairo University)

Session Classification: Online poster session

Track Classification: Condensed Matter Physics

Contribution ID: **1098** Type: **Oral**

Monitoring of the uniformity of the distribution of the flux density of accelerated particles at the U-400 cyclotron by using an ionization multichannel monitor

Tuesday, 25 October 2022 16:50 (15 minutes)

The constant monitoring of the uniformity of the density distribution of the flux of the accelerated particles is required in various applied fields as such as the studies of biological objects and of radiation resistance of electronic devices. The ionization monitor has been developed at FLNR JINR in order to make the non-destructive detailed high precision measurement of the transverse profile of a wide beam of accelerated particles. The monitor design is aimed at measuring the concentration of residual gas ions arising along on the beam path. The distribution of the ions is proportional to the distribution of the particle flux density. The ions are extracted from the beam region by a constant electric field larger than 0.2 kV/cm and then are accelerated by a sawtooth voltage with a frequency of 2 Hz. During the extraction the ions get the kinetic energy proportional to the distance traveled in a constant field and to the value of the subsequent accelerating voltage. The extracted ions enter two consecutive electrostatic analyzers separated by a plate with 1 mm slit. Ions can enter the second analyzer through this slit only if they were created in a narrow beam region, which position depends on the value of the sawtooth voltage. The monitor sensitivity is increased by MCP (Micro channel plate) placed after the analyzers. The collector divided into 31 strips is located after the MCP. The current from the strips is digitized by several ADC (Analog to digital converter) channels. The first coordinate of the ion formation position is determined by the number of the collector strip. The second coordinated is extracted from the value of the sawtooth voltage measured by another ADC. The number of employed ADCs allows every second measurement of a detailed two-dimensional distribution with 31x31 points on a beam cross section up to 45 mm in diameter. Because the ions of the residual gas are collected from the beam path 90 mm long, the sensitivity of the monitor is almost two orders of magnitude higher than the existing analogs [1, 2]. The monitor can also be used to measure the profile of secondary beams. The method of non-destructive diagnostics based on the ionization of the residual gas was tested on accelerated beams of Ar, Kr and Xe of the U-400 cyclotron.

Primary authors: TIMOSHENKO, Konstantin (Dmitrievich); Mr TETEREV, Yuri (JINR); Mr KRYLOV, Alexey; Mr MITROFANOV, Semen (JINR); Mr ISSATOV, Askar

Presenter: TIMOSHENKO, Konstantin (Dmitrievich)

Session Classification: Particle Accelerators and Nuclear Reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **1099** Type: **Poster**

Determination of time and position of muon tracks with the help of light collecting system in liquid argon near detector of the DUNE experiment

Monday, 24 October 2022 19:55 (5 minutes)

Since the first detection of neutrino in 1956, scientists have discovered that there are three kinds (or flavors) of neutrino particles, that these particles have mass (in defiance of the Standard Model), and that they oscillate between the three types as they travel. Deep Underground Neutrino Experiment (DUNE) will be the world's most advanced and comprehensive experiment dedicated to understanding these particles. It includes two detection systems: near detector (ND) and far detector (FD). ND will be placed near the Long-Baseline Neutrino Facility (LBNF) and will allow scientists to examine the composition of the neutrino beam just after its creation. One of the main parts of ND are the liquid argon time-projection chambers (LArTPCs) combined with the light readout systems (LRS). The LRS provides fast timing information from the prompt scintillation light (at ~128 nm) emitted by charged particles traversing LAr. The optical detection of scintillation photons provides both an absolute reference (t0) and rejection of unassociated charge signals (pile-up) from the specific neutrino signals of interest. The LRS consists of two SiPM-based systems: the Light Collection Module (LCM) and the ArCLight module. The LCM light traps provide high collection efficiency and are to be used for accurate scintillation amplitude and energy reconstruction. The ArCLight light trap provides good position sensitivity and are used for accurate scintillation position reconstruction. Both the reconstructed energy and position will be useful for pile-up rejection. In my work, an overview of the DUNE experiment will be provided and an algorithm for processing data obtained by modeling the operation of LCM and ArCLight systems will be described.

Primary author: LENSKY, Peter

Co-author: CHUKANOV, Artem (JINR)

Presenter: LENSKY, Peter

Session Classification: In-person poster session & welcome drinks

Track Classification: High Energy Physics

Contribution ID: **1100** Type: **Oral**

Ultracold rotating molecules inside the Rydberg atom

Wednesday, 26 October 2022 15:15 (15 minutes)

The goal of this project is to get the strong interaction of ultracold rotating dipole molecules. Initially, this interaction is weak at large distances. If the molecules are close enough to each other, chemical changes can occur. But we know that the Rydberg atom has a large dipole moment and a long lifetime. Therefore, we want to use it as a mediator of interaction between molecules.

We have constructed a theoretical model of the interaction of a dipole molecule with a Rydberg atom. The model was further generalized to an N-dipole system. We have studied the general properties of the interaction of dipole molecules through the Rydberg atom and considered some interesting special cases.

Primary author: ADAMYAN, Grigor (MIPT)

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Presenter: ADAMYAN, Grigor (MIPT)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1101** Type: **Oral**

Long and short-range interactions, phase transitions and crossovers of dipolar spin ice on Cairo lattice

Monday, 24 October 2022 14:30 (15 minutes)

We performed the Metropolis calculations of the thermodynamic properties of the system of dipoles on a 2D pentagonal Cairo lattice and revealed two explicit peaks in the temperature behavior of the heat capacity. This system is a sort of spin ice, which was experimentally studied in [Phys. Rev. Materials 3, 104402, 2019].
The low-temperature peak is due entirely to long-ranged dipole-dipole interactions between the vertically and horizontally directed spins, while all other, including nearest-neighbor dipole-dipole interactions are fully compensated (internal energy is 0).
We show the temperature behavior of the correlations between dipoles at different distances.
Models with a radius limited to the nearest neighbors lead to macroscopic degeneration of the ground state and the absence of a phase transition, since the configuration of the ground state phase is not defined.

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Presenter: SHEVCHENKO, Yuriy (Far Eastern Federal University)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1102** Type: **Oral**

Control problems for nonlinear models of heat and mass transfer

Monday, 24 October 2022 15:00 (15 minutes)

Control problems for nonlinear models of heat and mass transfer of a viscous and viscous conducting fluid are studied. It is assumed that the coefficients in equations and boundary conditions of the considered models depend non-linearly on the substance concentration and on the temperature, as well as on spatial variables. Thus, the heat and mass transfer models used in this work generalize the Boussinesq approximation. Note that the applications of these problems are not narrowed to the search of effective mechanisms for controlling physical fields. In the framework of the optimization approach inverse problems are reduced control problems, where the first ones consist of restoring unknown functions in the equations and boundary conditions of considered models with the help of the additional information about the solution of boundary value problems (see, for example, [1,2]). The physical field controlling mechanisms include the modeling of cooling systems for nuclear reactors, controlled thermonuclear fusion, the creation of new underwater engines and the development of MHD generators.

The study was supported by a grant from the Russian Science Foundation No. 22-21-00271)

References

1. Brizitskii R.V., Saritskaia Z.Y. Multiplicative control problems for nonlinear reaction-diffusion-convection model. J. Dynamical Control Syst. (2021); 27(2): 379-402.
2. Brizitskii R.V., Saritskaya Z.Y. Optimization analysis of the inverse coefficient problem for the nonlinear convection-diffusion-reaction equation. J. Inv. Ill-Posed Probl. (2018); 9:821-834.

Primary authors: SARITSKAIA, Zhanna; BRIZITSKII, Roman (Institute of Applied Mathematics FEB RAS)

Presenter: SARITSKAIA, Zhanna

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1103** Type: **Oral**

Methods for calculating integrals with a singularity of type 1/(x-c) as applied to the two-photon decay of a neutral pion at finite temperatures

Monday, 24 October 2022 14:45 (15 minutes)

Computation of the pi0gg decay width at high temperatures in the framework of the Nambu-Jona-Lasinio model requires the calculation of an integral with singularity 1/(x-c). To solve the problem, the most suitable method must be found that can effectively bypass the singularity and allow to obtain an answer with a minimal error and the high computation speed. In this work were considered non-adaptive and adaptive methods based on the Gauss-Kronrod quadrature formula and the Monte Carlo integration method. As a result, the temperature behavior of the two-photon pion decay width was obtained.

Primary authors: FRIESEN, Alexandra (Joint Institute for Nuclear Research); GODERIDZE, Daviti; KALINOVSKY, Yuri (Joint Institute for Nuclear Research)

Presenter: GODERIDZE, Daviti

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1104** Type: **Oral**

Application of machine learning for the analysis of Higgs boson production in association with single top-quark

Tuesday, 25 October 2022 15:15 (15 minutes)

This paper describes the implementation of a neural network for the problem of classifying the Higgs boson production signal in association with a single top quark (pp to Ht) and the main background processes (tt, ttH, ttW, ttZ). The tH channel is sensitive to the sign of the coupling, unlike ttH. Also, an accurate Higgs-top cross-section will allow setting the limits of the coupling constant within the SM and BSM.
The application of the obtained deep machine learning algorithm makes it possible to increase the significance of the signal by 1.6 times.

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Presenter: DIDENKO, Alice (JINR, Dubna)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1105** Type: **Poster**

Quantum interference effects on charge transport in molecular electronic junctions.

Monday, 24 October 2022 18:55 (5 minutes)

The technological application of nanoscale functional elements made of individual molecules is a promising approach towards the miniaturization of electronic devices. In particular, there is a potential for exploiting quantum interference effects in controlling the charge transport in these molecular-scale devices.
The electronic conduction *G=I/V* is determined by the electronic current *I* passing through a molecular junction from the left metallic lead to the right one and *V* is the voltage difference between the contacts. Current *I* is calculated based on the Landauer formula
I=(2e/h) ∫_(-∞)^∞ dE T(E) [f_left (E)-f_right (E)]
Here, *T(E)* is the transmission coefficient, *f* _left*(E)* (*f* _right*(E)*) is the Fermi distribution function of the left (right) metallic electrods.
Our work is aimed at developing a theoretical approach that explains the effects of the conformation and intrinsic chemical nature of a molecule, the features of its electronic structure, and the geometry of its connection with metal electrodes on the efficiency of electronic conduction along this molecular wire.

Primary author: SYURAKSHIN, Anton (Samara University)

Presenter: SYURAKSHIN, Anton (Samara University)

Session Classification: In-person poster session & welcome drinks

Track Classification: Theoretical Physics

Contribution ID: **1106** Type: **Oral**

Prospects of catalytically-induced decomposition of methane to produce core-shell structured contrast agent for medical imaging

Monday, 24 October 2022 15:30 (15 minutes)

Contrast agents (CA) are a well-established type of chemicals, used to enhance the contrast of tissues or vessels screened with non-invasive medical imaging modalities, such as computed tomography and magnetic resonance imaging, when introduced inside the body. Although many commercially available CAs are made of metal atom and chelate molecule, there is another promising composition of CAs, suggesting the use of metal nanoparticles incorporated in functionalized carbon or silica matrix, which enables targeted binding to given biomolecules, and consequently optimized biodistribution. However, nanoparticle-matrix CA composition does not provide as strong safety standards as atom-chelate composition, which diminishes toxic effects caused by a metal, in contrast to the first. Therefore, it is necessary for nanoparticle-matrix composition to additionally increase its metal safety and stability. One way to do it is to implement a core-shell approach, which consists in coating the metal nanoparticle with a uniform protective layer of chemically inert substance, thus protecting it from destructive bioprocesses. In this work, the synthesis of core-shell structured CA was attempted by means of catalytically-induced decomposition reaction of methane. The initial CA was prepared by ultrasonically-assisted impregnation of oxidized graphite nanoflakes in Lanthanum nitrate solution, followed by mild annealing the product in an inert atmosphere. The resulting composite was subsequently fluxed with methane to perform catalytic reaction of its decomposition into Hydrogen and elemental Carbon over Lanthanum nanoparticles, thus promoting deposition of carbon layers on their surface and forming core-shell structures. The properties of the composite before and after methane decomposition were probed and compared using various techniques, such as transmission electron microscopy, X-ray photoelectron spectroscopy, Raman spectroscopy. The core-shell CA, synthesized with described method, is expected to be investigated as a prototypical CA as part of pre-clinical research using computed tomography and phantoms.
This study was financially supported by the Russian Scientific Foundation (project no. 22-15-00072).

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Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1107** Type: **Oral**

Characteristics of the annihilation of positrons in nanosized metal coatings Zr/Nb after He+ ion irradiation

Monday, 24 October 2022 15:00 (15 minutes)

The samples were analyzed by means of annihilation line Doppler broadening (DB) spectrometry using variable positron energy at the Dzhelepov Laboratory of Nuclear Problems, JINR in Dubna, Russia. A monoenergetic positron beam 4 mm in diameter was used; the positron energy varied from 0.1 keV to 22 keV. Annihilation γ radiation was recorded by the HPGe detector model GEM25P4-70 (AMETEK ORTEC, Oak Ridge, TN, USA) with an energy resolution of 1.20 keV, interpolated for an energy of 511 keV. The obtained DB spectra were analyzed by estimating the parameters S and W of the annihilation line, as well as graphical representation of the R parameter as a function of S = f(W). The study of the radiation resistance of thin films was carried out by irradiation with helium ions in the low-energy channel of the DC-60 ion accelerator (channel of the electron-cyclotron resonance source) up to an ion fluence of 2·1017 ion/cm2. During irradiation, the temperature of the samples did not exceed 200 ℃. A layer-by-layer analysis of positron annihilation in Zr/Nb NMCs shows that irradiation by He+ ions with dose 2·1017 ion/cm2 leads to the formation of stable radiation defects. Once the energy reaches 20 keV, the probability of positron annihilation in the monocrystalline silicon substrate increases [1,2].

The research was supported by a grant from the Russian Science Foundation (project no. 20-79-10343).

1 Laptev, R., Stepanova, E., Pushilina, N., Svyatkin, L., Krotkevich, D., Lomygin, A., Ognev S., Seimek K., Doroshkevich A., Uglov, V. Distribution of Hydrogen and Defects in the Zr/Nb Nanoscale Multilayer Coatings after Proton Irradiation. Materials, 15(9), 3332 (2022).
2 Laptev, R., Lomygin, A., Krotkevich, D., Syrtanov, M., Kashkarov, E., Bordulev, Y., Seimek K., Kobets, A. Effect of Proton Irradiation on the Defect Evolution of Zr/Nb Nanoscale Multilayers. Metals, 10(4), 535, (2020).

Primary authors: LOMYGIN, Anton (National Research Tomsk Polytechnic University); Mr LAPTEV, Roman (National Research Tomsk Polytechnic University); Mr KROTKEVICH, Dmitriy (National Research Tomsk Polytechnic University); Mr UGLOV, Vladimir (Department of Solid State Physics, Belarus State University)

Presenter: LOMYGIN, Anton (National Research Tomsk Polytechnic University)

Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1108** Type: **Oral**

Feasibility study of K_s^0 in the BM@N experiment

Monday, 24 October 2022 14:00 (15 minutes)

The aim of the BM@N experiment is the study of collisions of elementary particles and ions with a fixed target at energies up to 4 GeV per nucleon. The experimental facility is one of the main elements of the first stage of the NICA collider development and will be used to study hot and dense matter in heavy ion collisions. It is well known that a transition from hadronic matter to Quark-Gluon Plasma (QGP) occurs during these collisions. This particular transition is accompanied by the formation of hyperons and strange particles. The focus of this study was the search for one of these strange particles, K_s^0 , in the experimental results.

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Presenter: BARAK, Ramin (NRNU MEPhI)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1109** Type: **Oral**

Simulation of the straw detector in the NA64 experiment for the muon run

Tuesday, 25 October 2022 14:15 (15 minutes)

The NA64 experiment is a fixed-target experiment at the CERN SPS combining the active beam dump and missing energy techniques to search for rare events. The experiment looks for new particles such as dark photons, axion-like particles, new light X or Z' bosons by colliding 100-150 GeV energy electron or muon beams onto an active target.
The report presents the muon part of the experiment. The simulation of the experimental setup, in particular the straw detector is given. The results of real data reconstruction are compared to simulated data.

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Co-author: NA64 COLLABORATION

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1110** Type: **Poster**

DEVELOPMENT OF A CRITERION FOR IDENTIFYING CONTRAST AGENTS BASED ON HIGH-Z ELEMENTS IN MULTI-ENERGY COMPUTED TOMOGRAPHY

Friday, 28 October 2022 14:50 (15 minutes)

The one of the main aim for new multi-energy X-ray tomograph development based on the Widepix detector is materials decomposition. The Widepix detector is one of the Medipix family pixelated semiconductor hybrid detectors developed in Medipix collaboration. This detector has a high intrinsic spatial resolution and detecting radiation capable for wide energy range. It make possible to use Medipix detector for multi-energy computed tomography. 1.
In this report presents the stage of development and applying the criterion results for identifying contrast agents in phantom containing probes with various concentrations of La, Nd, Gd and I. This criterion was tested on the energy information based presented in the form of a 2D image and a 3D reconstruction. The criterion is also capable of estimating the concentrations of contrast agents in samples.

1. R. Ballabriga. Asic developments for radiation imaging application: The medipix and timepix family / R. Ballabriga, M. Campbell, X. Llopart // Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment. – 2018. – T. 878. – p. 10-23.

Primary author: SOTENSKIY, Rostislav (НЭОВП ЛЯП)

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Presenter: SOTENSKIY, Rostislav (НЭОВП ЛЯП)

Session Classification: Online poster session

Track Classification: Applied Research

Contribution ID: **1113** Type: **Poster**

Applicability assessment of Fe3O4-SiO2-Au nanoparticles for the cancer radiotherapy

Friday, 28 October 2022 15:05 (15 minutes)

The object of our research is a Fe3O4-SiO2-Au nanoparticles. The electron microscopy study showed that the nanoparticles had a core-shell structure. The average size of the magnetite core was 227±7 nm, the thickness of the protective shell made of SiO2 was 2 nm, the average size of gold nanoparticles covering the core was 16±0.6 nm.
To estimate the output of secondary electromagnetic radiation during irradiation of the Fe3O4-SiO2-Au nanoparticles, an experimental unit was constructed.
A scintillation gamma-ray spectrometer based on a NaI(Tl) 78×78 crystal was used as a detector. The relative efficiency of registration at the 137Cs 662 keV line was 25%, and the resolution at the 137Cs 662 keV line was 9%. A collimated beam of gamma radiation from 137Cs was directed to the cuvette perpendicular to the axis of the spectrometer. The activity of the 137Cs radionuclide source was 99 MBq.
To take into account the background component of the obtained data, we measured the energy spectrum of the blank sample. A water sample was used as a blank. Measurements were carried out sequentially – replacing the test and blank samples. In the end of each measurement stage, the energy spectra of the standard gamma-ray sources (241 Am, 137 Cs) were measured.
To process the experimental data obtained, the measured energy spectra were conditionally divided into several ranges. The width of ranges was selected in accordance with the energy resolution of the spectrometer.
The intensity of the analytical signal of secondary radiation of the Fe3O4-SiO2-Au nanoparticles generated by gamma-ray of the 137Cs source was determined in accordance to the equation:

where: – the intensity of the analytical signal of secondary electromagnetic radiation; – the median value of the intensity of the analytical signal in the spectrum of the sample, – the median value of the intensity of the analytical signal in the spectrum of the blank sample, – the number of the energy range.
The absolute error of the data obtained was determined by the method of calculating the errors of indirect measurements according to the equation:

where: – the absolute error of determining the intensity of the analytical signal of secondary electromagnetic radiation; – the absolute error of determining the median value of the intensity of the analytical signal in the spectrum of the sample; – the absolute error of determining the median value of the intensity of the analytical signal in the spectrum of the blank sample.
As a result, the spectrum of secondary electromagnetic radiation generated by irradiation of Fe3O4-SiO2-Au nanoparticles was obtained. It was shown that the secondary radiation is caused by the photoelectric and the Compton effects.

We acknowledge the Russian Ministry of Science and Higher Education. Synthesis and structural studies of nanoparticles were carried out with financial support the Russian Ministry of Science and Higher Education, State Order No. 0657-2020-0013. Radiological studies were carried out with financial support of the Ministry of Russian Ministry of Science and Higher Education, State Order No. 0205-2021-0002

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Session Classification: Online poster session

Track Classification: Condensed Matter Physics

Contribution ID: **1114** Type: **Oral**

The possibility investigation of electron beam deep dose distribution formation by 3D-printed plastic bolus

Monday, 24 October 2022 16:20 (15 minutes)

Radiation therapy is an effective approach for cancer treatment. Electron beam therapy is prescribed for the superficial neoplasms irradiation 1. In radiation therapy, special devices called boluses are used to create a complex depth distribution of the absorbed dose. These devices, which follow the contours of the patient body, are located on the surface of the skin in the treatment field. Application of such devices allows reducing the dose value to healthy tissues located near the tumor 2.
In modern clinical practice the hydrogel and paraffin are widely used for boluses creation as standard approach. However, the first material is limited by the simplicity of the form, and the second is too brittle and fragile, and therefore its use is limited to several sessions of radiation therapy.
In this research, it is proposed to make a plastic bolus for electron beam deep dose distribution formation by 3D-printing methods. Today, 3D-printing techniques make it possible to create a product of the required shape with high accuracy and strength individually for each patient.
Experimental studies of the therapeutic electron beam deep dose distribution formation by hydrogel, paraffin and 3D-printed plastic bolus were carried out. It was been shown that a 3D-printed plastic bolus is as good as common devices in terms of its ability to shape the therapeutic field.
This work is supported by the Russian Science Foundation, project No. 19-79-10014-П.

References

1. Stuchebrov S. G. et al. Influence of 3D-printed collimator thickness on near-the-edge scattering of high-energy electrons //Journal of Instrumentation. – 2020. – V. 15. – №. 04. – P. C04023.
2. Vyas V. et al. On bolus for megavoltage photon and electron radiation therapy // Medical Dosimetry. – 2013. – V. 38. – №. 3. – p. 268-273.

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Presenter: BUSHMINA, Elizaveta

Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1115** Type: **Poster**

Investigation of the possibility of controlling the uranium concentration in natural and man-made raw materials of various compositions by INAA based on Cf-252 radionuclide neutron source

Friday, 28 October 2022 15:15 (15 minutes)

Determination of uranium by the INAA method was carried out with by a neutron activation unit. The unit was developed in the Institute of Chemistry of the Far Eastern Branch of the Russian Academy of Sciences, Vladivostok city. A 252Cf radioisotope source (type NK252M11) with a total neutron flux of 109 s-1 was used as a neutron source. Plexiglass was used as a moderator. It has been providing the maximum flux of thermal neutrons in the activation zone. To determine uranium by the INAA method, the capture reaction 238U + n ⟶ 239U + γ was used. The activation time of the samples varied from 30 to 90 minutes. The measurement time was 30 minutes. The quantitative determination of uranium was carried out using the photopic isotope 239U with an energy of 74.6 keV.

Calibration graphs of the dependence of the analytical signal intensity on the concentration of uranium concentration in the range from 15 to 300 ppm by the method of additives for samples of aluminosilicate sand were obtained. The maximum nonlinearity of the graphs does not exceed 6 and 5% for samples with a volume of 50 and 100 ml, respectively. It was established that the limit of detection and the limit of quantitative determination is 12.7±1. and 38.1±4.5 ppm for samples volume is 50 ml and 7.96±0.45 and 23.9±1.4 ppm for samples volume is 100 ml.

Similar measurements were carried out for samples of different mineral composition. A significant effect of the elemental macro composition of samples on the results of uranium determination was shown. It due to the absorption of thermal neutrons by the matrix components of samples during activation and the absorption of gamma ray of the 239U in the sample volume. The presence of trace elements with a high thermal neutron capture cross-section has been shown to have a significant effect on the results of neutron activation determination of uranium. When impurities (Y, Eu, B) introduced into samples – the analytical signal of 239U was decreased. The contribution of each of the factors for different samples types was calculated. Taking into account the macrocomposition of samples and the content of microimpurities that absorb neutrons allows to effective determination of uranium by the INAA method using a radionuclide neutron source based on Cf-252.

The work was carried out with financial support of the Ministry of Russian Ministry of Science and Higher Education, State Order No.0205-2022-0002.

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Session Classification: Online poster session

Track Classification: Experimental Nuclear Physics

Contribution ID: **1116** Type: **Oral**

THE CROSS-SECTION OF NUCLEAR-TUNGSTEN INTERACTIONS OBTAINED WITH MEASUREMENTS OF COSMIC RAYS BY PAMELA

Thursday, 27 October 2022 16:20 (15 minutes)

The aim of this work is to study the cross-section of the inelastic interactions of nuclei with tungsten based on the data of PAMELA space experiment 1. This instrument is a magnetic spectrometer designed to study fluxes of charged particles in cosmic rays, which was launched into the near-Earth orbit aboard the Resurs-DK1 satellite; data collection continued from 2006 to 2016. PAMELA includes a set of detectors which helps to identify the particles including their magnitude and sign of charge, rigidity, velocity, mass and energy.
So, we can select from the PAMELA data a necessary component of cosmic rays with known particles and their energy coming at a known angle. At the same time, another detector - a coordinate-sensitive calorimeter with a tungsten absorber plays a role of target for these particles. This looks like an experiment in particle physics on accelerators with formation of a beam of particles and observation of its interaction in target. Thus, it becomes possible to study the characteristics of nuclear-nuclear interactions with a large number of different nuclei in a beam according to chemical composition of cosmic rays in a wide energy range from hundreds of MeV to ˜TeV.
A similar method is used in ground-based observations of ultrahigh-energy cosmic rays; however, in this work, we use the previously proposed method relies on a much larger amount of information about cosmic ray particles due to the precision nature of the PAMELA measurements 2.
In the report, we present the experimental cross sections for the interaction of nuclei from protons to carbon with tungsten nuclei obtained by the described method. Obtained results compared with the cross-sections reconstructed from the simulation data coming from Geant4 software package 3, with measurements at accelerators and existing theoretical models.
Results can be used to improve our knowledges about nuclear forces and expand the standard Geant4 hadronic models and other numerical packages describing the interaction of particles with matter.

1. O. Adriani, G. Barbarino, G.A. Bazilevskaya et al, PAMELA - A Payload for Antimatter Matter Exploration and Light-nuclei Astrophysicsg, Astroparticle Physics, V.27, 2007.
2. О. Голуб, А. Майоров, Определение сечения неупругого взаимодействия протонов и ядер гелия с вольфрамом по данным космического эксперимента PAMELA, Учен. зап. физ. фак-та Моск. ун-та. 2019
3. S. Agostinelli et al., Geant4 - A Simulation Toolkit, Nucl. Instrum. Meth. A 506, 2003.

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Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1118** Type: **Oral**

Frobenius solution for non-polylogarithmic Feynman integrals and hypergeometry expansion

Tuesday, 25 October 2022 16:35 (15 minutes)

The analytical calculation of Feynman integrals is an important problem in modern quantum field theory. This task is important both for obtaining the most accurate predictions for observable quantities and for some areas of pure mathematics such as theory of periods in algebraic geometry. Nevertheless, it is not always possible to obtain analytical solutions for all Feynman integrals beyond one loop. All difficulties are usually associated with the appearance of elliptic or more complex geometric structures which inevitably arise when taking into account the masses of propagators.
In this work, we use an example of two loop elliptic master integrals arising from non-relativistic QCD as a laboratory to develop new methods for calculating non-polylogarithmic Feynman integrals. Specifically, the Frobenius method will be considered, which allows in this case to obtain exact solutions, in terms of the dimensional regularization parameter. In this case, the solutions will be expressed in terms of generalized hypergeometric series. In the second part of the report, we will focus on specific generalized hypergeometric functions present in the solution. Their expansion in terms of the dimensional regularization parameter will be considered. In this case, it is possible to obtain both integral representations and representations in the form of triangular sums.

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Presenter: BEZUGLOV, Maxim (JINR)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1119** Type: **Oral**

Theoretical analysis of rare decay $B^+ \to \pi^+\tau^+\tau^-$

Tuesday, 25 October 2022 16:50 (15 minutes)

The physics of bottom hadrons plays a fundamental role both in the precision tests of the Standard Model (SM) and in searches of possible New Physics (NP). Rare B-meson decays, which are induced by the Flavor-Changing Neutral Currents (FCNCs) $b \to s(d)$ transitions, provide a stringent test of the SM in flavor physics. Being loop-induced in the SM, these transitions are suppressed and NP effects can increase substantially their decay widths. In this talk we discuss the extremely rare decay $B^+ \to \pi^+\tau^+\tau^-$. We present its dilepton invariant-mass spectrum and decay rate calculated in the effective electroweak Hamiltonian approach for the $b \to d\ell^+\ell^-$ transitions in the SM, accounting long-distance contributions, for different types of the $B \to \pi$ formfactor parameterizations.
This research is supported by the RSF Grant № 22-22-00877, https://rcsf.ru/project/22-22-00877/.

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Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1120** Type: **Oral**

Thermal phase transition in rotating QCD with Nf = 2 clover-improved Wilson fermions

Tuesday, 25 October 2022 14:30 (15 minutes)

The relativistic rotation causes a change in QCD critical temperature. Various phenomenological and effective models predict a decrease in the critical temperature in rotating QCD. Nevertheless, it follows from lattice simulations that the critical temperature in gluodynamics increases due to rotation. But in QCD the rotation acts on both gluons and fermions, and combination of these effects may lead to unexpected results. In this report the first lattice results for a rotating QCD with dynamical Nf=2 clover-improved Wilson quarks will be presented. It is shown that the rotation of gluons and fermions has an opposite effect on the critical temperature. Dependence of the results on the pion mass is also discussed.

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Presenter: Dr ROENKO, Artem (JINR, BLTP)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1121** Type: **Oral**

The performance of a beam-beam monitoring detector (BeBe) for MPD-NICA

Monday, 24 October 2022 14:15 (15 minutes)

The QCD phase diagram was explored in certain regions of the parameter space by different experiments and a critical end point in this diagram is a theory-based prediction. In the Nuclotron-based Ion Collider fAcility (NICA) the Multipurpose Detector (MPD) is currently under construction intending to confirm this prediction. Motivated by the low trigger efficiency in low multiplicity p+p collision events given by the Fast Forward Detector (FFD) of MPD, a complementary detector is proposed (BeBe). BeBe is constituted of two hodoscopes (two plastic scintillator disks segmented in 80 cells) ±2m away from the interaction point of MPD. Based on Monte Carlo simulations, a discussion of the potential physics performance of the BeBe detector is given for triggering tasks and for the resolution in the determination of the event plane reaction and the centrality of the collisions at NICA. Also, laboratory measurements to estimate the time resolution of individual BeBe cell prototypes are presented. It is shown that the time resolution of an individual BeBe cell ranges from 0.47 and 1.39 ns depending on the number of photomultipliers attached to the cell. Our results suggest that the proposed BeBe detector can be used for beam monitoring in p+p and heavy-ion collisions at NICA energies with excellent trigger efficiencies for both systems [arxiv:2110.02506, already accepted for publication]. The experimental techniques and methods to determine the performance of BeBe will be described in this talk.

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1122** Type: **Oral**

Virtual Booster model

Tuesday, 25 October 2022 17:50 (15 minutes)

The virtual model of the accelerator is a computational-theoretical model supplemented with options for simulating beam diagnostics and accelerator control tools. At this stage of the NICA project implementation, the virtual Booster model allows, along with theoretical research in the field of beam dynamics, to work out various methods for tuning accelerator settings.

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Session Classification: Particle Accelerators and Nuclear Reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **1123** Type: **Oral**

ANALYSIS OF THE OPERABILITY OF THE VVER-1000 NUCLEAR REACTOR BASED ON A THORIUM-PLUTONIUM COMPOSITE

Tuesday, 25 October 2022 17:35 (15 minutes)

The results of the evaluation of the theoretical model of the VVER-1000 nuclear reactor using an alternative fuel composition consisting of a mixture of thorium and plutonium dioxide are presented in the work.Due to the limited nature of already known energy resources, a search is being made for new ones, including thorium-plutonium fuel. To analyze it's workability, computational studies of the neutron-physical and thermophysical parameters of the cell under consideration were carried out using the WIMS program code. This code is based on the application of the integral-differential Boltzmann equation.The calculation takes place in a group approximation and with given boundary conditions. The results show not only the workability of such fuel, but also it's efficiency. The amount of spent fuel will decrease, and more secondary fuel will be formed, which indicates a greater rationality of use. The thermophysical calculation showed that the maximum temperature in the fuel will be 400K less compared to uranium fuel, which will reduce the load on the reactor.

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Session Classification: Particle Accelerators and Nuclear Reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **1124** Type: **Oral**

Oxygen moieties on GO and GO/WPA nanocomposites after thermal treatment and chemical titrations

Wednesday, 26 October 2022 15:30 (15 minutes)

Nanocomposites have enriched modern material systems, contributed to sustainable progress in material science and engineering and improved quality of living. Among other aspects, the surface chemistry of nanomaterials is very important for preparation of nanocomposites. In this study we have analyzed the change in surface chemistry of graphene oxide (GO) and its nanocomposite with 12-tungstophosphoric acid (WPA, 5 to 50 wt.% of WPA, nominally). For modification of oxygen moieties, a chemical titration (NaOH, Na2CO3, NaHCO3) and thermal treatment (T=450 oC, in Ar) were selected. Fourier-transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), temperature programmed desorption (TPD), zeta-potential and adsorption of methylene-blue measurements were used for monitoring the changes of surface chemistry. The chemical titrations revealed that the presence of WPA affects the ability of surface oxygen groups to transfer protons, which is manifested by widening and merging of the peaks in the first derivative of titration curve. This behavior was observed in the case of composites with a higher WPA content (50 wt.%). Adsorption of methylene blue has shown that in the case of pure graphene oxide, oxygen groups have a positive effect. In the case of composites, the presence of WPA is advantageous because the adsorption capacity is improved compared to the initial GO. Also, it can be concluded that titration improves, while thermal treatment completely blocks the adsorption capacity of nanocomposite. These results improve the understanding of interaction between GO and WPA in suspensions, which is the initial step in the preparation of solid-state nanocomposites.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1125** Type: **Oral**

Physicochemical properties of hydrothermally synthesized nanocomposites of graphene-oxide and Zn/Ga-dopped cobalt ferrite

Wednesday, 26 October 2022 15:15 (15 minutes)

The formation of stable aqueous suspensions and the possibility of surface functionalization make graphene oxide (GO) a great material for composite materials. In this work, physicochemical properties of composites of GO and CoFe2O4 (CFO), including CFO doped with zinc (CFO_Zn) and gallium (CFO_Ga) were investigated. CFO, CFO_Zn, CFO_Ga nanoparticles were prepared by the solvothermal method with oleic acid as a surfactant. In order to obtain hydrophilic particles, ligand exchange with dihydrocaffeic acid (DHCA) was performed. Graphene-oxide was synthesized with modified Hummers' method. Nanocomposite has been obtained by adding CFO(_Zn/Ga) NPs to a GO suspension with nominal loading of 5 to 15 wt.%, followed by homogenization and hydrothermal treatment (T=120 ℃, t=3 h). Complete oxidation of graphene i.e. formation of GO was confirmed by X-ray diffraction and FTIR analysis. TEM and SEM images of nanocomposites show that the shape and size of CFO nanoparticles remain unchanged on GO layers. A difference between the distribution density between 5 and 15 wt.% is also observed. FTIR results have shown that a hydrogen bond between CFO nanoparticles and partially reduced GO was established. Electrochemical properties of composites were investigated by cyclic voltammetry and it was shown that all composites are stable at polarization rates of 5-400 mV s-1. Also, the specific capacities of all composites were calculated and the best electrochemical properties, in terms of the highest specific capacity, were shown by the composite with 15 wt.% CFO.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1126** Type: **Oral**

Amplitude analisys methods for the experimental studies of multiquark states

Wednesday, 26 October 2022 16:20 (15 minutes)

Nowadays one of the urgent tasks of high energy physics is search and study of multiquark XYZ states. Calculations obtained using Lattice QCD cannot fully describe spectrum of that states and predict parameters currently unopened states. Helicity amplutude formalism is one of the main instruments which are used in the process of amplitude analysis to measure the parameters of these states such as mass, width, spin, parity. In this report, the details of this formalism will be analyzed, as well as examples of its application in amplitude analyzes of B-hadron decays in problems of searching for and studying pentaquark and tetraquark states.

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Presenter: VASYUKOV, Artem (JINR)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1127** Type: **Oral**

Use case application of SU2 software package

Monday, 24 October 2022 16:20 (15 minutes)

We present a use case of our SU2 software package of SU(2) scalars. The package offers seamless F77-style coding in C++ for the user, but comes with move-semantix and polymorphic implementations of sub-scalars: arithmetic_scalar and cpx<same>, which is essential for a scientific library (such as our NXV4 library). The use case we present if of a driven damped harmonic oscillator, known to require 2 integrals, of which one constitutes the Green function for the problem. However, with SU(2) scalars the differential equation is 1D, is integrated trivially and the Green function is a matrix element of the propagator - as we show. Perhaps this mathematical flare is dismissible as equivalent to other known methods, however from the computational point of view it makes all the difference in the world, both in simplicity of design and especially in numerical precision, as only one integral is needed.

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Co-author: Mr DIMA, Mihai Tiberiu

Presenter: DIMA, Maria (JINR - MLIT)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1128** Type: **Poster**

Simulation of helicity based background reduction at NA-62

Monday, 24 October 2022 19:55 (5 minutes)

The NA-62 is a CERN fixed-target experiment upgraded from the NA-48 detector at the Super Proton Synchroton. The main scope of NA-62 is the study of the ultra-rare kaon decays in a higher luminosity context than the E-949 experiment of the C4 beamline (LESB III) at the AGS-Synchrotron (Brookhaven National Laboratory). Since in the Standard Model the branching ratios are almost completely suppressed, it is logical that any New Physics (NP) would show much stronger in this system. In this respect K+ -> pi+ nu, nu_bar is a very interesting candidate given its few-percent branching ratio theoretical uncertainty. From experimental perspective 2nu mass cuts and particle-ID show promise for clean signal selection, however as an orthogonal selection criterion, helicity distribution offers an additional advantage, that we have investigated and report here.

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Presenter: DIMA, Mihai-Tiberiu (JINR - MLIT)

Session Classification: In-person poster session & welcome drinks

Track Classification: High Energy Physics

Contribution ID: **1129** Type: **Oral**

Numerical simulation of the behavior of particles in hot and dense nuclear matter

Monday, 24 October 2022 16:50 (15 minutes)

In this paper we study the properties of particles in hot and dense nuclear matter within the framework of the SU(3) Nambu - Jona - Lasinio model. To calculate the mass and width of diquars (scalar, pseudo scalar, vector, axial vector) as functions of temperature, the Bethe-Salpeter equation is presented as a system of two equations. To solve a self-consistent system of the nonlinear integral equations, a FORTRAN code is written. The behavior of the diquark mass at finite temperature was investigated. The obtained results are used to describe baryons as quark-diquark pairs.

Primary author: PAPOYAN, Georgiy

Presenter: PAPOYAN, Georgiy

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1130** Type: **Oral**

Monte Carlo models validation for the FHCal calorimeter response simulation in the MPD NICA experiment.

Monday, 24 October 2022 14:30 (15 minutes)

To simulate the forward hadron calorimeter (FHCal) response, in the future MPD/NICA experiment two Monte Carlo generators DCM-SMM and PHQMD with two variants of cluster detection (MST and SACA) for the last one are used. Monte Carlo simulations are crucial in developing methods for centrality and orientation of the reaction plane determination with FHCal. We present an experimental verification for a beam momentum of 30A GeV/c, comparing models and experimental Pb-Pb data obtained on the Projectile Spectators Detector (PSD) of the NA61 CERN experiment. PSD is similar to FHCal and has a similar configuration, excluding the hole in the centre. Two comparisons of experimental and Monte Carlo data are presented, in the first case the data are compared in a complete calorimeter configuration, in the second case an artificial hole in the centre of the calorimeter is made to approximate the data to the FHCal configuration. A good agreement of the DCM-SMM model with the experimental data is shown. For a configuration with an artificial hole modification of the PSD calorimeter DCM-SMM shows dramatically better performance.

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Presenter: VOLKOV, Vadim (INR RAS)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1131** Type: **Oral**

ADVANTAGES AND DISADVANTAGES OF TIMEPIX DETECTOR FOR SPECT/CT

Thursday, 27 October 2022 16:35 (15 minutes)

The report presents the advantages and disadvantages of using the Timepix family detectors as a registration system for SPECT and CT scanners. The possibilities of using pixel detectors for creating multimodal SPECT/CT systems are demonstrated. The possibilities of using pixel detectors for creating multimodal SPECT/CT systems are demonstrated. Much attention is paid to microtomography systems. The perpectives for using CdTe as a sensor are considered.

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Presenter: ROZHKOV, Vladislav

Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1132** Type: **Oral**

The effect of Cu doping on physicochemical properties of bismuth vanadate

Wednesday, 26 October 2022 15:45 (15 minutes)

Bismuth vanadate (BiVO4) has attracted a lot of attention as a promising photoanode for use in the photoelectrochemical (PEC) water splitting. It posseses numerous advantageous features such as great visible light harvesting properties, band edge positions and low-cost synthesis method. The major drawback of BiVO4 is poor charge transfer properties due to the high rate of electron-hole recombination. One of the promising strategies for improving this is metal doping which efficiently boosts charge separation and increases PEC water splitting activity. Herein, we report physicochemical properties of pristine and 1%-, 2.5%- and 5%- Cu-doped BiVO4 powders, after 20h synthesis time. X-ray diffraction (XRD) study indicates that, depending on the doping level, the material exists in monoclinic or tetragonal scheelite phase, but mixed phase composition was also possible. Pure monoclinic and tetragonal phase was formed in a case of pristine and 1% doped sample. Samples doped with 2.5% and 5% of copper showed mixed phase composition. Scanning electron microscopy (SEM) reveals that sample with monoclinic phase consists of worm-like morphology, while morphology of tetragonal samples was mostly spherical.In case of samples with mixed phase a combination of prismatic and spherical shape morphology was observed. The structure was examined with Raman and Fourier Transformed Infrared (FTIR) spectroscopy. The results were in accordance with XRD study where band positions well matched the phase composition. Optical properties were characterized with UV-Vis Diffuse Reflectance Spectroscopy (DRS) and Photoluminescence (PL) spectroscopy. The band gap of pristine sample was ˜2.4 eV, while band gap of sample with tetragonal phase has band gap was ˜ 2.9 eV. Dual phase samples had two different band gaps that could originate from presence of both phases. From the PL spectroscopy, it can be concluded that monoclinic samples possess better recombination features than tetragonal ones. Photoelectrochemical measurements of BiVO4 samples imply that material is light sensitive and, after doping, improved performance towards oxygen evolution reaction was obtained.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1133** Type: **Oral**

Comparison of Geant4 simulation data with hadron shower data in the PAMELA experiment

Thursday, 27 October 2022 16:50 (15 minutes)

The PAMELA electromagnetic calorimeter consists of 44 single-sided silicon sensor planes interleaved with 22 plates of tungsten absorber. It provides a comprehensive information about spatial development of hadronic showers, and about deposited energy amount.

In this work, Monte Carlo simulations (based on Geant4) performed using different available models, including Fritiof (FTF) and Quark Gluon String (QGS) models of high energy hadron–nucleus interactions with Li\˜ege (INCL) and Bertini (BERT) intranuclear cascade models. We compared various hadronic shower parameters of simulated data with the data obtained during PAMELA experiment. These parameters describe energy release in the calorimeter, longitudal profile, position of the shower maximum etc. As a representative parameter, we use correlation curves, or size-rate curves, which are describing a dependence of the cascade size on the rate of development of the cascade process.

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Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1134** Type: **Oral**

Investigation of superconducting-ferromagnetic heterostructures by polarized neutron reflectometry with secondary radiation registration

Wednesday, 26 October 2022 14:30 (15 minutes)

Nowadays studying of proximity effects at the interface between two media are in focus of view [1-5]. In particular it relates to the interface between superconductor and ferromagnet. The work 3 can be can demonstrate as representative experiment, where diamagnetism of the [Nb(25nm)/Gd(d_f)]$_{12}$ periodic heterostructure was observed. The magnetic field was displaced from the volume of a superconducting-ferromagnetic structure, and the superconducting layers were paired through the ferromagnetic layers. The prospects of using rare earth metals and, in particular, gadolinium, in such structures were demonstrated. Current work is dedicated to investigation of electromagnetic proximity effect [6] at the structures Nb(100nm)/Gd(d_f)/V(70nm). A new experimental approach is used.

Due to the mutual influence of ferromagnetism and superconductivity, because of the finite values of the coherence lengths, a significant modification of the magnetic and superconducting properties occurs. It appears, in particular, as changing of magnetization's spatial distribution. It is important to establish the correspondence of the magnetic spatial profile (spatial dependence of magnetization) to the nuclear spatial profiles of the elements of the contacting media. To determine the spatial magnetic profile, the standard method of reflectometry of polarized neutrons is used, which makes it possible to determine the energy of the potential interaction of a neutron with a medium. At the interface between two media, the interaction potential is the sum of the interaction potentials of elements penetrating each other. Standard neutron reflectometry does not make it possible to establish which elements are associated with changes in the interaction potential and, in particular, in the magnetic profile. To determine the profile of the interaction potential of a neutron with individual elements, it is necessary to register the secondary radiation of the elements. At the moment, channels for recording charged particles [7], gamma quanta and spin-flip neutrons [8] have been implemented at the REMUR spectrometer of the IBR-2 reactor in Dubna. Several tens of isotopes and magnetic elements are available for measurements.

REFERENCES
1 V.D. Zhaketov et al. // JETP, Vol. 156, № 2, pp. 310 (2019)
2 V.D. Zhaketov et al. // JETP, Vol. 152, № 3, pp. 565 (2017)
3 Yu.N. Khaydukov et al. // Phys. Rev. B, 99(14), 140503 (2019)
4 Yu.N. Khaydukov et al. // Phys. Rev. B, 97(14), 144511 (2018)
5 D.I. Devyaterikov et al. // PMM, Vol. 122, № 5, pp. 465-471 (2021)
[6] S. Mironov et al. // Applied Physics Letters 113, 022601 (2018).
[7] V.D. Zhaketov et al. // Journal of Surface Investigation, Vol. 6, pp. 20–30 (2019)
[8] V.D. Zhaketov et al. // Journal of Surface Investigation, Vol. 6, pp. 1-15 (2021)

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1135** Type: **Oral**

Dilution cryostats as a part of Atomic Hydrogen Targets for electron beam polarimetry

Monday, 24 October 2022 16:35 (15 minutes)

A dilution cryostat and a hydrogen gas cell for a novel method of precision measurement of the polarization of a high-power electron beam with almost 100% polarization are discussed. An ultra-cold magnetic trap for polarized atomic hydrogen gas in a strong magnetic field is used as a target for electron beam polarimetry based on Møller scattering. JINR is performs calculations, design work and manufacturing of units of a new polarimeter for MESA accelerator in Mainz, Germany.

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Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1136** Type: **Oral**

Estimations of GASSOL capabilities in investigations of multinucleon transfer reactions

Thursday, 27 October 2022 17:05 (15 minutes)

Multinucleon transfer (MNT) reactions are known as possible access to neutron-rich isotopes of heavy and superheavy nuclei, but their application in experiments is complicated by a broad angular distribution of emitted products. A new superconducting solenoid GASSOL is being designed in FLNR JINR, the main purpose of which is an investigation of the chemical properties of superheavy elements. Large angular acceptance of the GASSOL gives reason to believe that it is suitable for the kinematics of MNT reactions. In this report, a theoretical estimation of GASSOL capabilities for 238U + 238U reaction is presented.

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Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1137** Type: **Oral**

The perturbation series solution of the time dependent radiative transfer equation

Wednesday, 26 October 2022 16:35 (15 minutes)

Studies of light propagation in random media are of great importance in many areas of physics, such as, for example, astrophysics, biophotonics, particle physics, applied researches. Understanding and optimization of particles detector's response usually requires extensive simulations of photons transportation, often performed with Monte-Carlo techniques. Powerful Monte-Carlo methods, efficient for detectors with nearly 4π coverage of the light source, drastically loose their efficiency for detectors sparsely distributed in media, such as Neutrino Telescopes. The need of CPU resources, required to achieve accurate results with a Monte-Carlo method in these cases, becomes very demanding. So we try to find an exact solution of transport equation. Existing solutions have big problems with calculations at high anisotropy parameters. The solution proposed in our work successfully copes with this problem and is an analytical-numerical scheme for calculating the light flux

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Presenter: ALLAKHVERDIAN, Vladimir (Russian Federation)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1139** Type: **Oral**

Second order viscous hydrodynamics within an effective kinetic theory and thermal particles from QGP

Wednesday, 26 October 2022 16:50 (15 minutes)

We investigate the thermal dilepton and photon production yields from relativistic heavy ion collisions in presence of both shear and bulk viscosities by employing the recently developed second order viscous hydrodynamic framework within a quasiparticle description of hot QCD medium. The sensitivity of shear and bulk viscous pressures to the temperature dependence of relaxation time is studied under one dimensional boost invariant expansion of quark gluon plasma. The viscous corrections to the non-equilibrium distribution functions are obtained from the Chapman-Enskog like iterative solution of effective Boltzmann equation in the relaxation time approximation. Thermal dilepton and photon production rates for QGP are determined by employing this viscous modified distribution function. Thermal particle yields are calculated for the one dimensional expansion of QGP with different temperature dependent relaxation times. Our analysis indicate that the particle spectra gets enhanced by both bulk and shear viscosities and is well behaved. Also, the particle yields are found to be sensitive to relaxation time.

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1140** Type: **Oral**

Pressure effected phase transition of perovskite like La2Ti2O7

Wednesday, 26 October 2022 16:20 (15 minutes)

The crystal structure of lanthanum titanate La2Ti2O7 was investigated by X-ray diffraction and Raman spectroscopy at high pressures up to 32 GPa and for structural determination neutron diffraction done at ambient condition. The La2Ti2O7 structure is monoclinic with the space group P21 at ambient condition. We observed a structural phase transition into the orthorhombic phase with a space group Pna21 at P=17.3 GPa. It was found that the phase transition highly depend on titanium oxide source. Dependences of parameters and volume of the unit cell on the pressure was found, and the bulk modulus has been calculated.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1141** Type: **Oral**

Synthesis, Thermogravimetric, Dielectric, Electrical, and Mössbauer Studies of the CuCrO2 Phase with the Delafossite Structure

Wednesday, 26 October 2022 16:50 (15 minutes)

Thermogravimetric, X-ray diffraction, Mössbauer, dielectric, and electrical studies were performed on ceramic samples of the CuCrO2 phase with the delafossite structure synthesized by the method of solid-phase reactions. The effect of electric-field threshold switching of the studied samples from a high-resistance to a low-resistance state, which occurs in the temperature range of 170–200 K when a biasing electric field with a strength of >1 kV/cm is applied to the samples.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1142** Type: **Oral**

Scaling properties of anisotropic flow at Nuclotron-NICA energy range

Monday, 24 October 2022 15:30 (15 minutes)

A central goal of current relativistic heavy-ion experiments is to study the properties of the hot and dense QCD matter. Such studies provide better insight in the QCD phase diagram, as well as the transport coefficients of the strongly-coupled Quark Gluon Plasma (sQGP). Anisotropic flow measurements of identified particles play an essential role in such studies.
We report on the results of the recent measurements of anisotropic flow using state-of-the-art models, provide detailed comparison with existing experimental data and discuss them using different scaling relations for azimuthal anisotropy.

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Presenter: PARFENOV, Peter (MEPhI, Moscow)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1143** Type: **Oral**

Control and monitoring system for the SRC experiment at BM@N

Thursday, 27 October 2022 16:50 (15 minutes)

The SRC experiment searches for short-period two-nucleon correlations using the detector subsystems of the BM@N facility. Successful experiments of this kind require an easy-to-operate, reliable system for controlling and monitoring the slowly changing parameters of the experimental hardware. Slowly changing parameters of experimental hardware that require constant monitoring are high and low supply voltages, environmental parameters, data from gas subsystems, etc., often from a large number of hardware manufacturers.

Slow control system provides solution of the following tasks: control and monitoring of control parameters of detectors and other subsystems in the process of operation and setup of experimental facility, timely detection of failures in facility operation and alarming of emergency situations, monitoring of environmental parameters, archiving of facility parameters in database for further use in analysis of experimental data for the purpose of their correction.

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Presenter: Mr SMOLYANIN, Timofey (JINR (Dubna), INP (Almaty))

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1144** Type: **Oral**

BIOHLIT for automation of biological research at JINR

Thursday, 27 October 2022 16:35 (15 minutes)

The BIOHLIT information system (IS) for analyzing behavioral and pathomorphological changes in the central nervous system when studying the effect of ionizing radiation on laboratory animals. Information system is being jointly developed by specialists from MLIT and LRB JINR.
The information system provides interfaces for: storing experimental data in a single information space (for behavioral tests and pathomorphological changes in the central nervous system), processing video files of behavioral tests (open field, T-maze, etc.). To solve this problem it was necessary to design and develop several subgroups of modules: data storage, algorithmic block, API-server, web-client. Together, these modules reduce time costs and minimize the human factor in dealing with histological slides. This will allow processing experimental data in no time and defining qualitative and quantitative changes in the central nervous system after exposing to ionizing radiation. For these purposes, on the basis of modern technologies of computer vision and machine learning, an algorithms was developed; it enables to automate the analysis of the behavioral reactions of laboratory animals through video files. For automate the processing of pathomorphological changes, active work is underway to develop a neural network approach for slides segmentation.

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Presenter: BUTENKO, Yuri (JINR)

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1145** Type: **Oral**

EFFECT OF CARBON ADDITIVES ON THE STRUCTURE OF ELECTRODES FOR HIGH ENERGY DENSITY Li-ION BATTERIES

Monday, 24 October 2022 16:50 (15 minutes)

Energy storage technology based on lithium-ion electrochemical systems makes it possible to manufacture batteries with high specific energy and power densities. Over the past decades, such batteries have been the most widely used ones in applications related to electric vehicles, portable electronics, and robotics. Lithium-ion battery specific parameters can be significantly improved by reducing the mass contribution of inactive components, as well as by controlling the microstructure of the electrode layers. Using small-angle neutron scattering (SANS), the effect of conducting carbon additives (carbon black, graphene, and carbon nanotubes (CNTs)) on the porous structure of positive electrodes based on lithium iron phosphate (LiFePO4, or LFP) was studied. To separate scattering by closed pores from scattering by open pores, the electrodes were wetted with a deuterated electrolyte, which made it possible to match the scattering from open pores. The used additives were found to change the electrode porosity to different extents and affect the wettability of the material both through a different efficiency of the incorporation of the initial material into pores and due to a change in the LFP-matrix. Thus, CNT network embedded in the electrode layer provides its greater wettability by an electrolyte compared to widely used carbon black. This results in better electrode C-rate performance. The structure analysis allowed us to improve and optimize the technology of the fabrication of high areal capacity LFP-based electrodes. It was demonstrated that the use of CNTs as conductive additives opens prospects for producing electrodes with areal capacity of more than 5 mAh•cm−2 . The practical applicability of the considered electrode technology was approved on the pouch cell prototype with specific energy density of 150 Wh•kg−1 /295 Wh•l −1 .

1. M. V. Avdeev, M. S. Yerdauletov, O. I. Ivankov, et al., J. Surf. Investigation 13(4), 614 (2019). 2. F. Napolskiy, M. Avdeev, M. Yerdauletov, et al., Energy Technology 8, 2000146 (2020).

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Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1146** Type: **Poster**

Analysis of composite operators of the dynamic model A

Monday, 24 October 2022 18:50 (5 minutes)

There is a model that includes viscosity at the lambda point in the transition to the superfluid state. This viscosity is expressed in terms of composite operators of dimension 8, but composite operators of dimension 6 are mixed with them. In dynamics, composite operators were almost not considered, but dynamic operators of dimension 6 can be investigated without additional calculations.

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Session Classification: In-person poster session & welcome drinks

Track Classification: Theoretical Physics

Contribution ID: **1147** Type: **Oral**

String fusion mechanism and studies of correlations.

Wednesday, 26 October 2022 17:05 (15 minutes)

As quantum chromodynamics (QCD) does not work in non-perturbative regime that dominates in hadron collisions, one could use the approach of quark–gluon (color) string model to quantitatively describe soft processes of multi-particle production. For instance, study the mechanism of string fragmentation and particles sources interaction by looking at different correlations between produced particles is a promising way to reveal intriguing features of the initial stages of hadron collisions. For example, in the study of forward–backward correlations (FBCs) one can distinguish two regimes of short- and long-range correlations that have different nature. In this work, we continue to develop Monte-Carlo model of interacting quark-gluon strings of finite length in rapidity space 1. It takes into account, event-by-event, the string fusion phenomenon caused by string overlap in the transverse plane. It is this process of fusion that modifies string fragmentation characteristics and changes the mean values of multiplicities and transverse momenta of produced particles. Moreover, model predictions are not invariant under translations in rapidity. It is due to the fact that strings ends positions are found from PDFs for valence and sea quarks pulling string in opposite directions and, therefore, fluctuate significantly. In this approach, it is interesting to estimate effects of string fusion at different rapidities, thus we calculated correlation coefficients $b_{corr}[N_F, N_B]$ and $b_{corr}[N_F, PT_B]$ 2 for multiplicities and mean transverse momenta defined for particles found in regions separated in rapidity. We compare results with Monte-Carlo event generators and with ALICE data 3 on p+p collisions at $\sqrt{s_{NN}}$ = 0.9, 2.76 and 7 TeV. Results are discussed.

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Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1148** Type: **Oral**

PHOTOPROTON REACTIONS ON NATURAL MIXTURE OF STRONTIUM

Thursday, 27 October 2022 17:20 (15 minutes)

The method of induced activity was used to study photonuclear reactions on a natural mixture of strontium isotopes. The experiment was performed on a bremsstrahlung of the RM-55 electron accelerator at an electron energy of 55 MeV. A brake target made of tungsten was used. Between the brake target with strontium target was placed copper monitor. During irradiation the electron current of the accelerator was measured using a Faraday cup located behind the target assembly. The absolute value of the current was calculated by comparing the experimentally measured and theoretical values of the outputs on the monitor. Experimental data on the cross-sections of photoproton reactions on Sr isotopes are not available in the literature. In this work were given the values of the cross sections of photonuclear reactions per equivalent quantum. The experimentally obtained yields and the values of the cross sections per equivalent quantum are compared with the yields calculated using theoretical cross-sections of photonuclear reactions from CMPR.

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Session Classification: Experimental Nuclear Physics

Track Classification: Experimental Nuclear Physics

Contribution ID: **1149** Type: **Oral**

Molecular orientation by two-color laser fields

Wednesday, 26 October 2022 16:20 (15 minutes)

We have theoretically investigated the molecular orientation by a asymmetric potential created by the superposition of two-color laser fields. The time-dependent Schrodinger equation is solved numerically for different field parameters. We have compared the quantum dynamics with the solution of the classical equations and have described the conditions, where the classical physics description is valid. We have shown how enhancement or suppression of the molecular orientation can be manipulated by the laser field parameters, such as time between laser pulses, the different intensity of the pulses, etc. These results are important to the operations on a quantum cubit, based on the polar molecules in the optical lattices.

Primary author: Dr KOVAL, Eugene (BLTP, JINR)

Presenter: Dr KOVAL, Eugene (BLTP, JINR)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1150** Type: **Oral**

Behavior of moment of inertia in highly deformed 24Mg and 20Ne

Wednesday, 26 October 2022 14:30 (15 minutes)

V. O. Nesterenko[1,2], M.A. Mardyban[1,2], P.-G. Reinhard[3], A. Repko[4].

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We suggest the self-consistent description of the ground-state moment of inertia (MI) in highly prolate light nuclei ^{24}Mg and ^{20}Ne (with experimental equilibrium axial quadrupole deformations β_2=0.605 and 0.72, respectively 1). These nuclei provide an interesting opportunity to explore dependence of MI on the pairing, ground-state correlations and nuclear shape at extreme deformations. The calculations are performed with Skyrme forces SVbas, SkM*, and Sly6 for deformation range $0.1 < \beta_2 < 1.6$. Three approaches are applied 2: Inglis-Belyaev (within Hartree-Fock-Bogoliubov method), QRPA Thouless-Valatin (within Quasiparticle Random-Phase Approximation method 3) and ATDHF (Adiabatic Time-Dependent Hartree Fock method). For Inglis-Belyaev and ATDHF calculations, the code SKYAX 4 was used. All three approaches show that, near the equilibrium deformation, the pairing in ^{24}Mg and ^{20}Ne vanishes and we get the maximum of MI. With further grow of the deformation above the equilibrium values, we see decrease of MI. Such behavior of MI is explained by rearrangement of single-particle levels with deformation. The analysis reveals main two-quasiparticle contributions responsible for the behavior of MI in different regimes.

1. Database http://www.nndc.bl.gov
2. P.Ring and P.Schuck, TheNuclearMany-BodyProblem (Springer-Verlag,Berlin,1980)
3. A. Repko, J. Kvasil and V.O. Nesterenko, Phys. Rev. C 99, 044307 (2019).
4. P.-G. Reinhard, B. Schuetrumpf, and J. A. Maruhn, Comput. Phys. Commun. 258, 107603 (2021).

Primary authors: MARDYBAN, Mariia; NESTERENKO, Valentin (BLTP, Joint Institute for Nuclear Research)

Presenter: MARDYBAN, Mariia

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1151** Type: **Oral**

Data Acquisition System of the NA64 Experiment

Wednesday, 26 October 2022 15:45 (15 minutes)

NA64 is a fixed-target experiment located at the H4 beam line of the Super Proton Synchrotron (SPS) at CERN. It is dedicated for searches for dark matter production in both visible and invisible decays of sub-GeV vector mediators.

The experiment facility includes different types of detectors: Calorimeters, Straws drift tubes, Gas Electron Multipliers (GEM), Micromegas, Beam Momentum Stations (BMS), and scintillator-based hodoscopes. The Data Acquisition System (DAQ) is responsible for collecting the event data, for forming and propagating the trigger decision, and for time synchronization across different subsystems.

The DAQ hardware architecture is based on custom front-end electronics, data concentrator, buffering readout cards, server PCs and network equipment. All DAQ equipment is configured, managed and monitored by the RCCARS software package, which is also responsible for reading the experimental data and writing them to a data storage.

Primary author: SALAMATIN, Kirill

Presenter: SALAMATIN, Kirill

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1152** Type: **Poster**

New features of the Rutherford Backscattering Spectroscopy in powder nanotechnologies

Monday, 24 October 2022 19:55 (5 minutes)

Rutherford Backscattering Spectrometry (RBS) is an ion scattering technique used for compositional thin film that are less than 1μm thick analysis. During an RBS analysis, high-energy He2+ ions with energies in the region from several hundred kiloelectron-volts to 2 - 3 MeV are directed onto the sample and the energy distribution and yield of the backscattered He2+ ions at a given angle is measured. Since the backscattering cross-section for each element is known it is possible to obtain a quantitative compositional depth profile from the RBS spectrum obtained.
The capabilities of this method can be significantly expanded. In particular, the method can be used in powder nanotechnology to study elemental composition in microscopically small objects. The application of methods based on Rutherford Backscattering Spectrometry is extremely interesting for adsorption energy devices, in particular, these methods can be used with maximum efficiency for various chemoelectronic converters.
A unique opportunity is to study the elemental surface of adsorbates on the surface phase separation in functional nanostructured layers.
For this reason, the preparation of planar-distributed chemoelectronic converters and the study of the elemental composition of adsorbates using the Rutherford Backscattering Spectrometry technique was the purpose for the investigation.
The tasks of this study included: development and optimization of the technology for producing planar chemoelectronic converters a functional layer in the form of rounded drops containing monodisperse nanosized (7.5 μm) particles of a solid solution of the ZrO2 system - 3 mol% Y2O3 (YSZ) in the PVA polymer matrix, study of the theoretical characteristics of the obtained chemoelectronic converters 1, study of the elemental composition of the obtained chemoelectronic converters using Rutherford Backscattering Spectrometry.
The atomic and chemical composition of these layers has been studied using nuclear and atomic methods.
The thickness of the oxide layers was found to be approximately the same for all implanted samples. These values were determined on the basis of Rutherford Backscattering Spectrometry and nuclear reactions (RBS/NR).

The study was performed in the scope of the H2020/MSCA/RISE/SSHARE number 871284 project, RO-JINR project No. 366 / 2021 item 82-83, RO-JINR grant No. 367 / 2021 item 27, and Poland-JINR Projects No. 168 / 2021 item 26.

1 L. Chemical-Electric Energy Conversion Effect in Zirconia Nanopowder Systems A. S. Doroshkevich, A. I. Lyubchyk, A. V. Shilo, T. Yu. Zelenyak, V. A. Glazunovae, V. V. Burhovetskiy, A. V. Saprykina, Kh. T. Holmurodov, I. K. Nosolev, V. S. Doroshkevich, G. K. Volkova, T. E. Konstantinova, V. I. Bodnarchuk, P. P. Gladyshev, V. A. Turchenko, S. A. Sinyakina. (2017). Journal of Surface Investigation: X-ray, Synchrotron and Neutron Techniques Vol. 11, No. 3. - Pp. 523–529. DOI: 10.1134/S1027451017030053.

Primary authors: TATARINOVA, Alisa (JINR); DOROSHKEVICH, Aleksandr (JINR); Prof. KULIK, Miroslav (Institute of Physics, Maria Curie-Skłodowska University, Lublin, Poland)

Presenter: TATARINOVA, Alisa (JINR)

Session Classification: In-person poster session & welcome drinks

Track Classification: Applied Research

Contribution ID: **1153** Type: **Oral**

Online Gas Gain Monitoring System

Monday, 24 October 2022 17:05 (15 minutes)

Different kinds of gaseous detectors are widely used in present and future experiments. Straw Tube Trackers (STT) and Micro-Pattern Gaseous Detectors (MPGD) are capable for both precise hit charge and coordinate measurements. Flexibility of their operation makes them to be an attractive solution for detector instrumentation in future High Energy and Neutrino Physics experiments.
High quality of gas mixture is necessary for achieving the best detection performance. To monitor the gas mixture quality during gaseous detector operation a Gas Gain Monitor System (GGMS), was developed. The GGMS consists of reference straw tubes with the diameter of 10 mm, readout electronics and a 55Fe radioactive source. The signal charge produced by 55Fe X-rays in the reference straws is measured, and changes in the obtained charge distribution correspond to changes in the gas gain. Corrected for dependence on the atmospheric pressure and temperature, the gas gain should remain constant if the working gas mixture quality is stable.
We present first results on the performance of the developed GGMS. A dedicated measurement setup developed at JINR allows to study the STT and MPGD performance with generator test pulses, cosmic ray muons and radioactive sources while monitoring the gas mixture quality.
We present also examples of Garfield simulation of a straw tube response interfaced to the LTSpice electronics simulation package. This approach allows efficient optimization of the signal circuit path and its operation mode, and supports performance studies for GGMS operated with different high voltages and with different gas mixtures.
Future potential applications of GGMS include the Straw Tube Trackers for the Near Detector complex of the DUNE experiment and the central tracker of the SPD experiment at NICA.

Primary author: BAUTIN, Vitaly (JINR)

Co-authors: ENIK, Temur (Jinr); KUZNETSOVA , Ekaterina (NRC «Kurchatov Institute» - PNPI); SALAMATIN, Kirill; SOSNOV, Dmitry (NRC «Kurchatov Institute» - PNPI); ZELENOV, Andrei (NRC «Kurchatov Institute» - PNPI); NASYBULIN, Sergey (NRC «Kurchatov Institute» - PNPI)

Presenter: BAUTIN, Vitaly (JINR)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1154** Type: **Poster**

Study of Di-hadron correlations of heavy ion collisions at NICA energies using maximum transverse momentum method

Monday, 24 October 2022 19:55 (5 minutes)

Di-hadron angular correlations are a useful tool to study the mechanisms of particle production by observing the angular separation ($\Delta\eta$, $\Delta\varphi$) between pairs of particles in an event. Different structures in the $\Delta\eta - \Delta\varphi$ space are caused by various modes of particle production and interactions between particles shortly after production. Examining these structures can give us insight into the nature of these interactions. One of these structures is called "the Ridge"

The Ridge-effect phenomenon was first reported in the STAR collaboration at RHIC as decomposition of the distribution of interacting particles into jet and flow components.
The ridge effect can be characterized by the values of azimuthal and pseudorapidity differences $\Delta\eta x\Delta\varphi$ for fitted transverse impulse intervals for both trigger and associated particles. The study of the ridge effect with method of maximum transverse momentum, which is a global characteristic of the entire event, makes it possible to more clearly describe the jet and stream components on the distribution map.

Primary authors: MYKTYBEKOV, Demezhan (Joint Institute for Nuclear Research (JINR)); Dr ROGACHEVSKY, Oleg (Joint Institute For Nuclear Research)

Presenter: MYKTYBEKOV, Demezhan (Joint Institute for Nuclear Research (JINR))

Session Classification: In-person poster session & welcome drinks

Track Classification: High Energy Physics

Contribution ID: **1155** Type: **Oral**

Memory Effect in Porous Polyethylene Films Preliminarily Deformed in the Medium of Supercritical CO2

Monday, 24 October 2022 17:20 (15 minutes)

The dynamics of recovery of the open porous structure in HDPE films, which are preliminarily uniaxially deformed in the medium of supercritical CO2 followed by shrinkage in the longitudinal direction, upon their repeated stretching in air is studied by structural mechanical methods. The process of shrinkage is accompanied by the approach of lamellas and the disappearance of the oriented fibrillar structure. The value of relative shrinkage may be as high as 70–80%. According to atomic force microscopy and small-angle X-ray scattering, these polymer films "remember" their previous strain in CO2 and in their repeated stretching in air, which is not a physically active medium, and restore the fibrillar porous structure of crazes with similar parameters. The phenomenon of such a memory makes it possible to use PE films preliminarily formed by the mechanism of intercrystallite crazing followed by their subsequent relaxation in the freestanding state as "precursors" for producing mesoporous materials with the pore volume on the order of 30 vol % for application in various fields, in particular, as vapor permeable membranes.

Primary authors: Mrs ROENKO, Anna (Dubna State University); Dr TROFIMCHUK, Elena (Moscow State University); Dr EFIMOV, Alexander (Moscow State University); NIKONOROVA, Nina (Moscow State University)

Presenter: Mrs ROENKO, Anna (Dubna State University)

Session Classification: Applied Research

Track Classification: Applied Research

Contribution ID: **1156** Type: **Oral**

Simulation of the setup for studying the kinematics of Compton scattering of annihilation photons in entangled and decoherent states

Tuesday, 25 October 2022 16:35 (5 minutes)

Currently, positron emission tomography (PET) is one of the most effective tools for medical diagnostics. The basic principle of PET is the detection of gamma pairs with an energy of 511 keV generated by the annihilation of a positron with an electron in organic tissue. According to the theory, annihilation photons have mutually perpendicular linear polarizations, and their quantum states are entangled. This feature is proposed to be used in the future generation of PET tomographs, in which different angular correlations of scattered annihilation photons in entangled and decoherent states can be applied to suppress the background and improve image quality. However, these differences have not been confirmed experimentally.
We have constructed a setup to identify the quantum state and observe the angular correlations of scattered annihilation photons. The results of Monte Carlo simulation of the setup in Geant4 toolkit are presented in the comparison with experimental data. Detailed study of systematic errors is shown.

Primary author: MUSIN, Sultan (MIPT)

Presenter: MUSIN, Sultan (MIPT)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1157** Type: **Oral**

PMT optical model

Wednesday, 26 October 2022 15:30 (15 minutes)

PMTs are widely used in different areas of physics, especially in neutrino experiments that use great amount of PMTs, both large and small, in order to determine the neutrino hierarchy and oscillation parameters through achieving excellent energy resolution. PMTs do collect the photo-signal from the detector and convert it into the electric signal. The quality of such convertation depends on so-called PDE (photo-detection efficiency) that is connected with quantum efficiency (the property of the photocathode layer inside each PMT). The main goal of this report is to describe optical processes (principally light absorption) inside the photocathode theoretically but not only by fitting experimental results as was done before. Also the research how the light absorption works and how the electromagnetic field changes along the photocathode layer width was done.

Primary authors: ANTOSHKINA, Tatiana (JINR); NAUMOV, Dmitry (JINR)

Presenter: ANTOSHKINA, Tatiana (JINR)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1158** Type: **Oral**

The ML/DL/HPC Ecosystem of the HybriLIT Heterogeneous Platform (MLIT JINR) for Applied Research

Thursday, 27 October 2022 16:20 (15 minutes)

The ML/DL/HPC ecosystem deployed on the HybriLIT Heterogeneous Computing Platform (Meshcheryakov Laboratory of Information Technologies JINR) on top of JupyterHub, allows you to conduct research not only in the field of machine learning and deep learning, but also allows you to develop and implement program modules in Python, as well as to carry out methodical computations. Using the example of solving a problem to study the processes occurring in Josephson junctions, a methodology for developing software modules is presented; it enables not only to carry out calculations, but also to visualize the results of the study and accompany them with the necessary formulas and explanations. In addition, the possibility of parallel implementation of the algorithms for performing computations for various values of parameters of the model based on the Python libraries are shown, and the results of computational experiments demonstrating the efficiency of parallel data processing are presented.
This work was supported by Russian Science Foundation grant No 22-71-10022.

Primary authors: ZUEV, Maxim (JINR); BUTENKO, Yuri (JINR); NECHAEVSKIY, Andrey (JINR); PODGAINY, Dmitry (JINR); STRELTSOVA, Oksana (JINR); RAHMONOV, Ilhom (BLTP, Joint Institute for Nuclear Research)

Presenter: ZUEV, Maxim (JINR)

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1159** Type: **Oral**

Analyzing Power of Quasi-Elastic Proton-Proton Scattering at the Energies from 200 to 650 MeV/nucleon

Tuesday, 25 October 2022 16:40 (15 minutes)

Vector analyzing power in quasielastic proton-proton scattering was obtained at the Nuclotron Internal Target Station using a polarized deuteron beam and a polyethylene target. The selection of useful events was performed using the time and amplitude information from scintillation counters. The asymmetry on hydrogen was obtained by the subtraction of the carbon background. The values of analyzing power were obtained at the beam energies of 200, 500, 550, and 650 MeV/nucleon. The obtained values are compared with the predictions of the partial-wave analysis SAID.

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

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

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1160** Type: **Poster**

Upgrade of SCAN-3 spectrometer at Nuclotron

Friday, 28 October 2022 15:15 (15 minutes)

The SCAN-3 spectrometer has been upgraded to three-arm configuration. New arm added to spectrometer in 2022. Arm are presented setup of six multilayer neutron detectors orientated under 90 degree to another arms. The main aim of additional arm is determination of background components of the studied processes with the registration of correlated pairs by TOF method. The status of readiness to autumn run at NICA complex are presented here.

Primary authors: USTINOV, Valentin (JINR VBLHEP); AFANASIEV, Sergei (JINR); SUKHOV, Evgeni (JINR); KUTINOVA, Olga (JINR)

Presenter: USTINOV, Valentin (JINR VBLHEP)

Session Classification: Online poster session

Track Classification: High Energy Physics

Contribution ID: **1161** Type: **Oral**

The central tracking system of the BM@N experiment based on GEM detectors

Monday, 24 October 2022 14:45 (15 minutes)

Baryonic Matter at Nuclotron (BM@N) is the first experiment at the NICA accelerator complex. The aim of the BM@N experiment is to study interactions of relativistic heavy ion beams with fixed targets. Detectors based on Gas Electron Multipliers (GEM) are used of the central tracking system, which is located inside the BM@N analyzing magnet. The next BM@N physics run is planned at the end of 2022. The current installation and commissioning status of the GEM tracking system is presented.

Primary author: GALAVANOV, Andrei (JINR, MEPhI)

Presenter: GALAVANOV, Andrei (JINR, MEPhI)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1162** Type: **Oral**

Power supply unit for SiPMs

Tuesday, 25 October 2022 16:55 (15 minutes)

The barrel detector (BD) is used for selection of AA-collisions on centrality. For this purpose, a threshold on a number of fired channels of both detectors is set in the fast interaction trigger in the T0U module.The scintillation light produced by charged particles is detected on a single end of a strip by SiPM Micro FC-60035-SMT from Sensl which is directly connected with the strips.
The 16-channel power supply (PS) unit for SiPMs have been designed. Each channel of SiPM PS unit has parameters as follow: the output voltage range is 0 – 30.2 V with step of dV = 7.4 mV; reading back of the actual channel voltage value with accuracy of dV = 7.4 mV; max output current is 50 mA.
A special control software has been developed for this units. This software has following features: setting of the voltage values in channels, read-out of the actual value of channel voltages and settings reading back. The control software also allows to create configuration files of voltage settings for different run conditions, to save them and to upload these settings back to the power supply unit.

Primary author: EREMKINA, Irina

Co-authors: YUREVICH, Vladimir (JINR); SERGEEV, Sergey (JINR); ROGOV, Victor (JINR)

Presenter: EREMKINA, Irina

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1163** Type: **Oral**

Influence of relativistic rotation on the equation of state of gluodynamics

Tuesday, 25 October 2022 14:45 (15 minutes)

Relativistic rotation may have some impact on various properties of quark-gluon plasma. For example, lattice simulations show an increase in critical temperature of both QCD and gluodynamics due to rotation. In this report the first lattice study of an effect of rotation on gluodynamics' equation of state will be presented. In particular, it will be shown that in deconfinement phase rotation's impact on free energy density changes sign with temperature increase.

Primary authors: BRAGUTA, Victor (JINR); KOTOV, Andrey (JINR); ROENKO, Artem (JINR, BLTP); SYCHEV, Dmitrii (BLTP JINR, MIPT)

Presenter: SYCHEV, Dmitrii (BLTP JINR, MIPT)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **1164** Type: **Oral**

Study of the scintillation detector prototype for the upgraded polarimeter at the Internal Target Station at the Nuclotron

Monday, 24 October 2022 16:20 (15 minutes)

The paper presents the performance studies of the scintillation detector prototype with SiPM readout using different types of the front-end electronics (FEE).
The timing and amplitude resolutions with LED have been obtained. These results can be applied for the proton and deuteron beams polarimetry at the Internal Target Station at Nuclotron.

Primary author: TISHEVSKY, Aleksey (JINR)

Presenter: TISHEVSKY, Aleksey (JINR)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1167** Type: **Oral**

NEUTRON ABSORPTION AND SCATTERING OF BY SUB-BARRIER REFLECTION

Wednesday, 26 October 2022 16:35 (15 minutes)

A cold neutron storage project is being considered for the projected NEPTUNE reactor. The neutron density in the storage is determined by the absorption and scattering (leakage) of neutrons on the walls of the storage. To determine the probability of neutron leakage, it is proposed to use a neutron wave resonator in which the probabilities of the studied processes are increased. The resonator is made in the form of a three-layer Cu/Al/Cu structure. Experimental studies were carried out for two structures manufactured in NRC "Kurchatov Institute" - PNPI (Gatchina) and IMP UB RAS (Ekaterinburg). It is shown that the contribution to neutron leakage is associated with scattering on roughness, non-flatness of the interface and resonant neutron absorption.

Primary author: KOLUPAEV, Evgenii (MSU, JINR)

Co-authors: ZHAKETOV, Vladimir (JINR); NIKITENKO, Yuri (Joint Institute for Nuclear Research)

Presenter: KOLUPAEV, Evgenii (MSU, JINR)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1168** Type: **Oral**

Study of the Higgs boson production with a single top quark in ATLAS experiment

Tuesday, 25 October 2022 14:30 (15 minutes)

Взаимодействие бозона Хиггса с топ-кварком, как наиболее тяжелых частиц стандартной модели, представляет интерес с точки зрения поиска новой физики за рамками стандартной модели. Это взаимодействие определяется постоянной взаимодействия Юкавы. Ее комплексная фаза до сих пор остается неизвестной, но может быть определена при исследовании канала рождения бозона Хиггса совместно с одиночным топ-кварком. Этот канал пока не наблюдался. В данной работе рассматривается возможность увеличения значимости сигнала канала рождения бозона Хиггса совместно с одиночным топ-кварком посредством добавления новых комплексных переменных и применения машинного обучения (нейронной сети).

Primary author: TROPINA, Anastasia (JINR)

Co-authors: HUSEYNOV, Nazim (JINR); BOYKO, Igor (JINR); YELETSKIKH, Ivan (JINR)

Presenter: TROPINA, Anastasia (JINR)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1169** Type: **Oral**

Performance for spectator symmetry plane estimation with the BM@N experiment

Monday, 24 October 2022 17:20 (15 minutes)

The Baryonic Matter at Nuclotron experiment (BM@N) aims to study the area of QCD phase diagram at high net baryon densities and moderate temperatures with collisions of heavy ions at $\sqrt{s_{NN}}$ = 2.3–3.5 GeV. Anisotropic transverse flow is one of the most important observable phenomena in a study of the properties of matter created in such collisions. Flow measurements require the knowledge of collision symmetry plane, which can be determined from deflection of collision spectators in the plane transverse to the direction of the moving ions.
BM@N performance for projectile spectator symmetry plane estimation is studied with Monte Carlo simulations using Xe+Cs collisions with beam energies of 4A GeV generated with the DCM-QGSM-SMM model. Investigated different data-driven methods to extract correction factor in flow analysis for the resolution of spectator symmetry plane estimated with the BM@N Forward Hadron Calorimeter.

Primary authors: MAMAEV, Mikhail (NRNU MEPhI); FOR THE BM@N COLLABORATION

Presenter: MAMAEV, Mikhail (NRNU MEPhI)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1170** Type: **Oral**

Linear and non-linear methods applied to fitting non-isothermal kinetic curves of dehydration of PAAG hydrogel swollen to equilibrium and non-equilibrium state

Wednesday, 26 October 2022 17:05 (15 minutes)

Hydrogels are three-dimensional cross-linked structures capable of absorbing significant amounts of water, water solutions, and biological liquids without dissolving or losing their structural integrity. The main goal of this work was to describe the kinetics of non-isothermal dehydration of poly(acrylic acid)-g-gelatin (PAAG) hydrogel, swollen in distilled water to different swelling degrees, by using the Weibull distribution function of reaction times. The comparative analyses of linear and non-linear methods of fitting non-isothermal kinetic curves of dehydration of PAAG hydrogel were performed and the influence of linear and non-linear fitting methods on the value of the parameters determined by the Weibull distribution of reaction times and the quality of fitting was investigated. The non-isothermal thermogravimetric curves were recorded at different heating rates (5 K min-1 to 20 K min-1) from 290 K to 460 K at the same conditions. The quality of the fit in the case of the linear regression method was evaluated using error functions (the coefficient of determination, ☒(R☒ˆ2) and chi-square test (χˆ2)), while the quality of the fit using non-linear regression method was evaluated using five different error functions (the sum square of errors (ERRSQ), the hybrid fractional error function (HYBRID), the average relative error (ARE), the Marquardt's percent standard deviation (MPSD) and the sum of absolute errors (EABS)). For all the examined swelling degrees and heating rates, the quality of non-linear fitting was higher than that of the linear method fitting. The lower quality of fitting in the case of applying the linear regression method is a consequence of the double logarithm applied in this method, which results in an unrealistic increase in the value of the Weibull function parameters. Changes in the values of the Weibull parameters with the degree of swelling of the hydrogel and the rate of heating during dehydration indicate a change in the state of absorbed water when the degree of swelling changes. Based on the obtained results, we have shown that both examined ways of fitting non-isothermal conversion curves allow the fitting of experimental conversion curves of dehydration of PAAG hydrogel.

Primary author: Mr PETKOVIĆ , Darija (Trainee researcher)

Co-authors: Prof. ADNAĐEVIĆ, Borivoje (retired professor); Dr JOVANOVIĆ , Jelena (Scientific advisor)

Presenter: Mr PETKOVIĆ , Darija (Trainee researcher)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **1171** Type: **Oral**

Parallel Simulation of the Magnetic Moment Reversal within the Josephson Junction Spintronic Model using MPI and OpenMP implementations

Monday, 24 October 2022 16:35 (15 minutes)

A Josephson junction spintronic model is investigated by means of the two-stage Gauss–Legendre algorithm for numerical solution of the respective system of nonlinear differential equations in a wide range of physical parameters. Parallel implementation is based on the MPI and OpenMP techniques. The simulations have been carried out at the Heterogeneous Platform "HybriLIT" and on the supercomputer "Govorun" of the Multifunctional Information and Computing Complex of the Meshcheryakov Laboratory of Information Technologies, JINR (Dubna). Results of numerical study of the magnetization effect depending on physical parameters, as well as results of comparative analysis of the efficiency of MPI- and OpenMP-based parallel implementations, are presented.

Primary author: BASHASHIN, Maxim (JINR)

Presenter: BASHASHIN, Maxim (JINR)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1172** Type: **Oral**

Tests parameters of pade of TPS of MPD

Monday, 24 October 2022 15:45 (15 minutes)

The accelerator complex NICA is builting at JINR (Dubna).
Two interaction points are foreseen at NICA for two detectors which will operate simultaneously. One of these detectors, the Multi-Purpose Detector (MPD), is optimized for investigations of heavy-ion collisions. The Time-Projection Chamber (TPC) is the main tracking detector of the MPD central barrel. It is a well-known detector for 3-dimensional tracking and particle identification for high multiplicity events. The conceptual layout of MPD and detailed description of the readout system based on MWPC (Multi-Wire Proportional Chambers) with cathode pad readout (ROC) will be presented. The pads which has a rectangular shape,
and the total number is 95232 are testing. Main measured parameters of pads are presented.

Primary author: LAZAROV, David

Co-authors: PUKHAEVA, Nellie; MOVCHAN, Sergey (JINR)

Presenter: LAZAROV, David

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1173** Type: **Oral**

Simulaltion of magnetization reversal in Phi-0 junction by the pulse of magnetic field

Monday, 24 October 2022 17:05 (15 minutes)

In Superconductor-Ferromagnet-Supperconductor structure with noncentrosymmetric ferromagnetic interlayer is observed anomalouse Josephson effect. In this structure current-pahse relation demonstrates phase shift Phi-0, which is proportional to the magnetisation of ferromagnetic layer and such junction are colled Phi-0 junction.

In this work we simulate dynamics of single junction SQUID (superconducting quantum interference device) with the Phi-0 junction. We demonstrate that under the pulse of external magnetic field can be realised magnetization reversal in the ferromagnetic layer. The influence of the model parameters of the systems on magnetization reversal is investigated in detail. We expect that, the observed features might find applications in different fields of superconducting spintronics.

Primary author: Mrs RAHMONOVA, Adiba (Joint Institute for Nuclear Research)

Presenter: Mrs RAHMONOVA, Adiba (Joint Institute for Nuclear Research)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **1175** Type: **Oral**

Simulation of job execution in distributed heterogeneous computing infrastructures

Thursday, 27 October 2022 17:05 (15 minutes)

Execution of one computing job demonstrates that software is correctly working. But, when the same job has to be executed thousands of times, it may cause different issues. Nowadays special distributed heterogeneous computing infrastructures are widely used for this type or workload. Main issue when running big workloads on them is network limits. These limits may be imposed in different levels: server, cluster, and storage level. With limited network there is a threshold after which incrementing of cpu resources does not speed up jobs execution rate. The purpose of this work is creation of a software platform for simulation of job execution in distributed computing infrastructures which can predict job execution rate in real infrastructure and show efficient job distribution among computing clusters. Limiting factors are CPUs amount and performance, network speed, RAM size, and disk size. The software platform was developed and tested. Python programming language was used for development. InfluxDB is used for results storage and visualization.

Primary author: PELEVANYUK, Igor (Joint Institute for Nuclear Research, Plekhanov Russian University of Economics)

Presenter: PELEVANYUK, Igor (Joint Institute for Nuclear Research, Plekhanov Russian University of Economics)

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1176** Type: **Oral**

Search for dark matter produced in association with a leptonically decaying Z boson with the CMS Experriment at the LHC

Tuesday, 25 October 2022 14:45 (15 minutes)

A search for dark matter particles is performed using events with a Z boson candidate and large missing transverse momentum. The analysis is based on proton-proton collision data at a center-of-mass energy of 13 TeV, collected by the CMS experiment at the LHC in 2016-2018, corresponding to an integrated luminosity of 137 fb^{-1}. The search uses the decay channels Z→ee and Z→μμ. No significant excess of events is observed over the background expected from the standard model. Limits are set on dark matter particle production in the context of simplified models with vector, axial-vector, scalar, and pseudoscalar mediators, as well as on a two-Higgs-doublet model with an additional pseudoscalar mediator. The results of preparation for RUN3 analysis are also discussed.

Primary author: SLIZHEVSKIY, Kirill (JINR)

Co-author: Dr SHMATOV, Sergei (JINR)

Presenter: SLIZHEVSKIY, Kirill (JINR)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1177** Type: **Oral**

Measurement of gluon jet fraction in the inclusive jets channel

Tuesday, 25 October 2022 15:00 (15 minutes)

A method for measuring the gluon fraction in a jet sample based on a quark-gluon likelihood discriminator was proposed in report. Measuring the gluon fraction opens the way to measuring the characteristics of quark and gluon jets. The report presents the results of measurements of gluon fraction in channel of inclusive jets selected by the CMS detector in 2016 at energy of 13 TeV with an integral luminosity of 36.3 fbˆ(-1).The problems that have arisen on the way to the implementation of the measurement plan, methods of their solution, preliminary results and short-term plans are described.

Primary authors: BUDKOUSKI, Dzmitry; Dr SHULHA, Siarhei (JINR)

Presenter: BUDKOUSKI, Dzmitry

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1178** Type: **Oral**

System for planning and logging excursions at JINR

Thursday, 27 October 2022 17:20 (15 minutes)

One of the tasks of the JINR organizational activity is to conduct excursions in the Institute's laboratories for different types of target audience and age groups. The organization of each excursion goes through a number of steps related to negotiation of excursion time, availabiolity of the facility and the guide. All negotiation were carried out through telephone and email conversations between excursion organizer and responsible persons from laboratories. As a result, by the end of the year, it was not a trivial task to calculate the number of excursions conducted, as well as to prepare statistics related to the excursion activity of laboratories. The purpose of this work is to automate the processes of data collection during organization of excursions in JINR laboratories. This can be achieved through the design and implementation of an information system. It was decided that the system should be organized as a web application. It was developed and deployed in February 2022. Right now it is used by University Center of JINR and some guides from laboratories.

Primary authors: ILINA, Anna (Joint Institute for Nuclear Research); PELEVANYUK, Igor (Joint Institute for Nuclear Research, Plekhanov Russian University of Economics)

Presenter: ILINA, Anna (Joint Institute for Nuclear Research)

Session Classification: Information Technology

Track Classification: Information Technology

Contribution ID: **1179** Type: **Poster**

CHARGED PARTICLE AND HEAVY ION BEAM MONITORING SYSTEM FOR THE LOW AND MIDDLE ENERGY ACCELERATORS

Monday, 24 October 2022 18:45 (5 minutes)

Today, low and middle energy accelerators (linac, cyclotron) play an important role for the study of the nuclei structure, for the radiation material science, for the production of radionuclides used in medical technologies and for the cancer treatment. One of the main goals for these accelerators operation is to improve the quality of the extracted beams. Therefore, one can develop the system for the charged particle beams diagnostic, which make it possible to obtain information about the main parameters of the beam: beam profile, beam current, beam emittance. To monitor the charged particle and heavy ion beams and increase their intensity on the targets the different types of the sensors are used. The sensors operated on secondary electron emission effects are widely used for such purposes. In this work, the monitoring system for charged particle and heavy ion beams (consists of a scanning gold-plated tungsten wires grid) is discussed. The beam particles interact with the wires and knock out secondary electrons. As a result, each wire becomes a current generator. By measuring the current from each wire, one can reconstruct the beam profile and investigate the secondary electron emission processes.
In present work the charged distributions of secondary electrons formed during interaction of heavy ion (40Ar), alpha-particles and proton beams (cyclotron of the A.F.Ioffe Institute, Russian Academy of Science) with a grid of thin scanning wires were obtained. Also a model for the visualization of the beam profile was developed. Finally, the currents of secondary emitted electrons for different beam intensity were precisely measured and analyzed. This provides us important information about parameters of secondary electron emission processes.

Primary author: ZEMLIN, Egor (”Saint-Petersburg State University”, Department of Nuclear Physics Research Methods)

Co-authors: KUDOIAROV, Mikhail (Head of the Unique Scientific Installation of the Ioffe Physical-Technical Institute); ZHEREBCHEVSKY, Vladimir (Saint-Petersburg State University); MALTSEV, Nikolay (Saint-Petersburg State University)

Presenter: ZEMLIN, Egor (”Saint-Petersburg State University”, Department of Nuclear Physics Research Methods)

Session Classification: In-person poster session & welcome drinks

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **1181** Type: **Oral**

Evaluation of the sensitivity of DarkSide-50 experiment to double K-capture on Ar-36.

Wednesday, 26 October 2022 15:00 (15 minutes)

The search for neutrinoless double β-decay, in particular double K-capture, is of great importance. Confirmation of its existence would mean that the neutrino is Majorana particle. The investigation of this process provides one of the best opportunities to study physics beyond the Standard Model. The double electron capture process 2EC2ν was experimentally discovered only once in the XENON1T experiment, and the search for 2EC0ν has so far been unsuccessful. These processes are very difficult to register. There are 34 candidate isotopes in which the 2EC2ν process is possible; 12 nuclei can experience only two-neutrino 2e-capture. Previously, the search for these processes was carried out on ^{78}Kr and ^{124}Xe, since the lower theoretical predictions of their half-lives lie in the experimentally achievable region is $\sim 10^{22}$ years, and they are relatively accessible isotopes of inert gases. The purpose of this work is to evaluate the sensitivity of the DarkSide-50 experiment to two-neutrino double electron capture on the ^{36}Ar isotope. To achieve the goal of the study, the following tasks were performed:
– development of a software module for constructing the energy spectrum of double electron capture (2EC2ν) on ^{36}Ar;
– application of the detector response function due to this effect for the DarkSide-50 detector;
– statistical analysis of data using a model spectrum;
– obtaining a lower limit for the half-life of ^{36}Ar.
The novelty of this work is in the fact that such processes have not previously been studied on the argon isotope ^{36}Ar. The analysis performed in this work will remain relevant in the future.

Primary author: Ms LYCHAGINA, Olga (JINR, MSU)

Presenter: Ms LYCHAGINA, Olga (JINR, MSU)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1182** Type: **Oral**

PID in the NICA experiment using machine learning techniques

Tuesday, 25 October 2022 17:25 (15 minutes)

Particle Identification (PID) analysis for the Multi-Purpose Detector (MPD) with TPC signals. Data is generated by implementing the MPDROOT software of the NICA experiment. Transporting and track reconstruction for Bi-Bi collisions at center-of-mass energy of 11 GeV is simulated. The PID is computed using a statistical technique (Bayesian Method) for Bethe-Block signal and machine learning techniques (Multi-Layer Perceptron, Decision Tree, Support Vector Machine). All methods have been compared with confusion matrix analysis and ROC-AUC computation. Results display good performance for machine learning techniques at high-momentum (1.8 MeV $\leq P <$ 2.4 MeV) with more than 80% for True Positive (TP) and True Negative (TP) of the classifier prediction, and ROC-AUC $>$ 0.95. It is demonstrated that the Bayesian Method is inadequate for those ranges of total momentum.

Primary author: MALDONADO GONZALEZ, JULIO CESAR (UNIVERSIDAD AUTONOMA DE SINALOA)

Presenter: MALDONADO GONZALEZ, JULIO CESAR (UNIVERSIDAD AUTONOMA DE SINALOA)

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1183** Type: **Oral**

Design and thermal test of the stave cooling plate

Tuesday, 25 October 2022 14:00 (15 minutes)

The staves of the MPD-ITS detector will be composed by large arrays of Monolithic Active Pixel Sensors (MAPS) forming the cylindrical layers of the Inner Tracking System of the MPD experiment at NICA. These MAPS will be attached to a cooling plate for the power dissipation. Ultra-lightweight cooling concepts were put forward as a technical solution offering a good compromise among all constraints. The idea consists in embedding a lightweight cooling channel in a lightweight stave structure that provides mechanical and cooling capabilities at the same time. The materials delivering the best balance between material budget, thermal conductivity and stiffness are CFRPs. In this work it is presented the result of the comparison between the CERN-produced cooling plate and those developed on our lab.

Primary author: LIGDENOVA, Tuyana

Co-authors: VORONIN, Alexei; IGOLKIN, Sergey; MURIN, Yuri

Presenter: LIGDENOVA, Tuyana

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1184** Type: **Oral**

CONSTRUCTION MANAGEMENT INFORMATION SYSTEM AT JINR

Wednesday, 26 October 2022 17:35 (15 minutes)

The commissioning of an all-around Construction Management information System (CMIS) was recently completed as a joint effort of two JINR Laboratories (LHEP and LIT). The system is particularly useful for the fine-grained control and continuous feedback of the production of complex multipart objects like the detectors subsys- tems composing the MPD and BM@N experiments of the NICA facility at LHEP. Currently, the CMIS is meant to be used to follow the production of silicon tracker detectors at the STS department of the LHEP at JINR, although it would as well be used by any other hardware production projects related to JINR whose complexity would make it very hard to fulfilling its quality and timing requirements otherwise. In this seminar the current implementation on this system of the projects for the construction of the silicon trackers for the MPD and BM@N experiments, respectively will be presented.

Primary authors: Dr CEBALLOS SANCHEZ, Cesar (JINR); KOLOZHVARI, Anatoly (JINR); DOLBILOV, Andrey (JINR); SEMENOV, Roman (JINR); TSAPULINA, Ekaterina; RODRIGUEZ ALVAREZ, Alejandro; SHEREMETEV, Aleksie (Joint Institute for Nuclear Research); MURIN, Yuri

Presenter: RODRIGUEZ ALVAREZ, Alejandro

Session Classification: High Energy Physics

Track Classification: High Energy Physics

Contribution ID: **1186** Type: **Plenary**

Biological effects of radiation exposure on the body, biomedical and pharmaceutical applications

Monday, 24 October 2022 11:30 (1 hour)

Presenter: LALKOVICOVA, Maria

Session Classification: Plenary session

Contribution ID: **1187** Type: **Plenary**

Opening a new chapter in neutrino astronomy with Baikal-GVD

Monday, 24 October 2022 10:10 (1 hour)

Presenter: ZABOROV, Dmitry

Session Classification: Plenary session

Contribution ID: **1188** Type: **Plenary**

Current status of particle physics experiments

Thursday, 27 October 2022 11:30 (1 hour)

Presenter: BOYKO, Igor (JINR)

Session Classification: Plenary session

Contribution ID: **1189** Type: **Plenary**

Ginzburg's list of unsolved problems

Friday, 28 October 2022 10:00 (1 hour)

Presenter: MELEZHIK, Vladimir (BLTP JINR Dubna)

Session Classification: Plenary session

Contribution ID: **1190** Type: **Plenary**

Deep neural networks and their application at JINR

Wednesday, 26 October 2022 10:00 (1 hour)

Presenter: OSOSKOV, Gennady (Joint Institute for Nuclear Research)

Session Classification: Plenary session

Contribution ID: **1191** Type: **Plenary**

Raman spectroscopy in life science

Tuesday, 25 October 2022 11:30 (1 hour)

Presenter: ARZUMANYAN, Grigory (JINR)

Session Classification: Plenary session

Contribution ID: **1192** Type: **Plenary**

Heavy-Ion Collisions at Nuclotron-NICA Energies

Tuesday, 25 October 2022 10:00 (1 hour)

Presenter: TARANENKO, Arkadiy (NRNU MEPhI)

Session Classification: Plenary session

Contribution ID: **1193** Type: **Plenary**

NICA and its Accelerator Technologies

Friday, 28 October 2022 11:20 (1 hour)

Presenter: LEBEDEV, Valery

Session Classification: Plenary session

Contribution ID: **1194** Type: **Plenary**

Radiation material science at accelerator facilities of FLNR JINR

Thursday, 27 October 2022 10:00 (1 hour)

Presenter: RYMZHANOV, Ruslan (Joint Institute For Nuclear Research)

Session Classification: Plenary session

Contribution ID: **1195** Type: **Plenary**

Welcome remarks

Monday, 24 October 2022 10:00 (10 minutes)

Presenters: Ms SEITOVA, Diana; KOLUPAEVA, Liudmila (JINR)

Session Classification: Plenary session

Contribution ID: **1196** Type: **Plenary**

Closing remarks

Friday, 28 October 2022 12:20 (10 minutes)

Presenters: SEITOVA, Diana; KOLUPAEVA, Liudmila (JINR)

Session Classification: Plenary session

Contribution ID: **1198** Type: **not specified**

Registration

Monday, 24 October 2022 09:00 (1 hour)

Contribution ID: **1201** Type: **Plenary**

TBD

Wednesday, 26 October 2022 11:30 (1 hour)

Presenter: ACADEMICIAN OF RAS GRIGORY V. TRUBNIKOV

Session Classification: Plenary session