The XXIV International Scientific Conference of Young Scientists and Specialists (AYSS-2020)

Report of Contributions

https://indico.jinr.ru/e/AYSS-2020

Contribution ID: **707** Type: **Oral**

B_c^* radiative decay width

Tuesday 10 November 2020 14:00 (15 minutes)

Presenter: ISSADYKOV, Aidos (Jinr)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **716** Type: **Oral**

Study of the elemental composition of a fragment of the Chelyabinsk meteorite

Wednesday 11 November 2020 14:00 (15 minutes)

For analysis to the Laboratory of Neutron Physics named after I.M. Frank of the Joint Institute for Nuclear Research was provided with a fragment of the Chelyabinsk meteorite weighing 133.13 g. The fragment of the meteorite studied by us is a melted sample of an elongated-rounded shape and covered with a black melting crust (thermogenic border) with a thickness of 0.1 to 1 mm. For the first time in Russia, prompt gamma activation analysis (PGAA) was used to determine the elemental composition of a meteorite. PGAA is a unique, non-destructive nuclear analytical method with multi-element capabilities, offering analysis of the main components and some trace elements and the method is based on the registration of prompt (primary) gamma ray that are emitted as a result of radiative capture of thermal neutrons. Using PGAA and XRF methods, the mass fractions of 15 meteorite elements were determined, such as: Na, Mg, Al, Si, K, Ca, Ti, Mn, Fe, Cr, S, Sc, Co, Ni, Cl. The obtained data were compared with the previously obtained results of the study of the Chelyabinsk meteorite.The measurements were carried out on channel 11B of the IBR-2 pulsed reactor, equipped with a mirror curved neutron guide 15 m long.

Authors: Mr DMITRIEV, Andrew; Ms ZHOMARTOVA, Ayazhan; Dr BORZAKOV, Sergey

Presenter: Ms ZHOMARTOVA, Ayazhan

Session Classification: Applied research

Track Classification: Condensed Matter Physics

Contribution ID: **717** Type: **Oral**

Partial-wave analysis of $J/\psi \to K^+K^-\pi^0$

Monday 9 November 2020 16:45 (15 minutes)

A partial-wave analysis of the decay $J/\psi \to K^+K^-\pi^0$ made using $(223.7 \pm 1.4) \times 10^6$ J/ψ events collected with the BESIII detector in 2009 will be presented. We report the most precise measurements of $K^*(892)^\pm$ and $K_2^*(1430)^\pm$ mass and width. The analysis reveals contributions from $K_2^*(1980)^\pm$ and $K_4^*(2045)^\pm$ for the first time in J/ψ decays. Two resonance signals decaying to K^+K^- are also observed and their possible interpretations will be discussed. Results also include branching fractions for decays through intermediate states and a high precision measurement of $B(J/\psi \to K^+K^-\pi^0)$. The results of the partial-wave analysis differ significantly from those reported earlier by the BESII and BABAR Collaborations.

Author: DENISENKO, Igor

Presenter: DENISENKO, Igor

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **718** Type: **Oral**

Study of unstable states of the lightest nuclei in the dissociation of relativistic nuclei.

Friday 13 November 2020 14:00 (15 minutes)

The fragmentation of relativistic nuclei observed in its entirety only in nuclear emulsion (NTE) serves as a source of ensembles of the lightest nuclei of interest to cluster physics and astrophysics [1]. NTE allows one to study such ensembles in forward fragmentation cone with record spatial resolution and isotope identification of He and H fragments. Determination of the invariant mass of groups of relativistic fragments in the approximation of conservation of the velocity of the initial nucleus makes it possible to define the source of the formation of the fragments that can be decay of unstable nuclei. Recently, in the events of relativistic dissociation of ^{9}Be, ^{10}B, ^{10}C, ^{11}C nuclei were identified unstable ^{8}Be and ^{9}B nuclei by invariant mass approach [2]. The successful identification of ^{8}Be nuclei allowed us to cross to the problem of identifying triples of alpha particles in the Hoyle state (HS) in the dissociation of relativistic nuclei [3]. The identification of ^{8}Be, ^{9}B, and HS provide a unique opportunity to search for more complex long-lived states such as the Bose-Einstein condensate of α particles or nuclear molecules decaying through the HS and ^{8}Be, as well as ^{9}B.

References:

1. P.I.Zarubin // Lect. Notes in Physics, Clusters in Nuclei, **875**, 51 (2014); arXiv: 1309.4881.

2. D.A.Artemenkov, A.A.Zaitsev, P.I. Zarubin // Phys. Part. Nucl. **48**, 147 (2017); arXiv:1607.08020.

3.D.A. Artemenkov et al. // Recent Progress in Few-Body Physics. FB22 2018. Springer Proceedings in Physics, **238** (2018).

Author: ZAITSEV, Andrei (JINR, LHEP)

Presenter: ZAITSEV, Andrei (JINR, LHEP)

Session Classification: Nuclear Physics

Track Classification: Nuclear Physics

Contribution ID: **719** Type: **Oral**

WIGNER FUNCTION REPRESENTATION IN EIGENFUNCTION BASIS OF HARMONIC OSCILLATOR

Tuesday 10 November 2020 18:00 (15 minutes)

It was Wigner and Weyl who investigated quantum systems in phase space. The Wigner function determines the density of quasi-probabilities of the random radius vector and momentum. Weyl-Wigner-Moyal-Groenewold formalism is widely used. Also Wigner function has a representation as a trace of the product of the density matrix by the kernel operator.

This paper suggests new explicit expressions for the kernel operator in the harmonic oscillator basis. The polynomials obtained within the framework of this paper can be degenerated into Laguerre polynomials in a particular case. It was demonstrated that the diagonal elements of the kernel operator are the Wigner functions of harmonic and off-diagonal elements contain frequency oscillations which are responsible for dissipations in the quantum system. Also the Wigner distribution functions have been constructed in the phase space.

This work was supported by the RFBR No. 18-29-10014.

Authors: BURLAKOV, Evgeny; Dr PEREPELKIN, Evgeny; INOZEMTSEVA, N.G. (Dubna State University, Dubna,141980 Russia); SADOVNIKOV, Boris; SADOVNIKOVA, M.B. (Faculty of Physics, Lomonosov Moscow State University, Moscow, 119991 Russia)

Presenter: BURLAKOV, Evgeny

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **720** Type: **Oral**

Investigations of homochiral amino acids-based metal-organic frameworks in FLNP JINR

Friday 13 November 2020 14:15 (15 minutes)

Metal-organic frameworks (MOFs) are crystalline materials consisting of an infinite network of metal-ions, or metal-ion clusters, bridged by organic ligands through coordination bonds into porous two- or three- dimensional extended structures. MOFs are attracting increasing interest due to their unique properties such as magnetism, luminescence, high catalytic activity, gas storage and so on. An important area of use for MOFs is the adsorption of heavy metals. It is important for water purification from harmful ions (Pb2+, Cd2+, Hg2+) and for the extraction of valuable metal ions (Ru3+, Pd2+) from solutions. MOFs containing transition metals can be interesting because of the wide range of available metal oxidation states and coordination geometries. The use of chiral amino acids as building blocks for MOFs leads to chirality, biocompatibility and various modes of metal coordination. A new approach for the synthesis of homochiral porous coordination polymers was proposed [1]. A specific feature of this approach is the use in the synthesis of two simple ligands, namely, the chiral polyfunctional ligands forming chiral complexes with metal cations and the rigid bridging ligand that links these complexes to form a porous framework.
In the present work, we describe the synthesis and results of studying the structures and thermal stability of several metal-organic coordination polymers, with and without the rigid bridging ligand. In addition, these substances are interesting objects of Raman spectroscopy investigation. In particular, a new compound {[Ni(L-trp)(bpe)(H2O)]·H2O·NO3}n was synthesized (L-trp = L-tryptophan, bpe = 1,2-bis(4-pyridyl)ethylene). The dielectric, luminescence, and nonlinear-optic properties of such homochiral tryptophan-based MOF based on zinc were studied in [2]. These materials are stable in an aqueous medium. So, they can be interesting for the adsorption of heavy metals from aqueous solutions. In this work, special attention is paid to the hydrothermal synthesis of amino acids-based MOFs.

1. D.N. Dybtsev et al. Angew. Chem. Int. Ed., 2006, 45, № 6, 916-920.
2. Sh. Mendiratta et al. Cryst. Growth Des., 2014, 14, 1572–1579.

Authors: Dr IVANSHINA, Olga; Mr SUMNIKOV, Sergey; ZUBA, Iga (Institute of Nuclear Chemistry and Technology, Joint Institute for Nuclear Research); Prof. PAWLUKOJC, Andrzej (FLNP JINR)

Presenter: Dr IVANSHINA, Olga

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **721** Type: **Oral**

Higgs boson production in association with a single top quark at the LHC

Tuesday 10 November 2020 14:45 (15 minutes)

We analyze the possibility to discover the production of a Higgs boson in association with a single top quark at the LHC. The analysis considers single top quark production via t-channel using Higgs boson decays to a bottom quark-antiquark pair and semileptonic top quark decays. Such process is strongly suppressed in the Standard Model. An observation of this production mode would be an unambiguous indication of the New Physics providing an important insight on the nature of the Higgs mechanism. The production is sensitive to the relative sign of the coupling parameters describing its interaction with fermions and gauge bosons. We present a Monte-Carlo study of the pp⟶tHqb process and discuss the experimental signatures that can help to discover it at the LHC. Two scenarios have been considered, the Standard Model case and the Inverted Top Coupling scenario.

Author: KOVAL, Oksana

Co-authors: Dr BOYKO, Igor; HUSEYNOV, Nazim

Presenter: KOVAL, Oksana

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **722** Type: **Oral**

Applied research stations for microchips and radiobiology irradiation with low and high energy ion beams of NICA accelerator complex

Thursday 12 November 2020 14:30 (15 minutes)

Within the framework of NICA project an Innovation block based on three applied research stations is being constructed. The applied research station for microchips with package for radiation resistance testing (with the energy range of 150-350 MeV/n.); the applied research station for decapsulated microchips testing (with energy of ions up to 3.2 MeV/n.); the applied station for radiobiological research (with the energy range of 400-800 MeV/n.) with an absorbed dose of 3 Gy maximum are being constructed. The paper contains the design of applied stations, simulations, description of diagnostics and positioning systems, temperature setting system and etc. Diagnostics systems are designed to measure such beam parameters as: intensity, beam profile, fluence, ion flux density and absorbed dose for radiobiological station. The calculations for microchips irradiation with low and high energy ion beams are presented.

Author: SLIVIN, Alexey (JINR)

Co-authors: Mr FILATOV, Georgy; SYRESIN, Evgeny (Joint Institute for Nuclear Researches); Mr BUTENKO, Andrey; Mr TUZIKOV, Alexey

Presenter: SLIVIN, Alexey (JINR)

Session Classification: Particle accelerators and nuclear reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **723** Type: **Oral**

Online Logbook System for the NICA experiments

Tuesday 10 November 2020 17:15 (15 minutes)

The acquisition of experimental data is an integral part of all modern high-energy physics experiments. This task is of particular importance in the experiments of the NICA megaproject due to the high interaction rate of heavy ion collision events and the complexity of the detector systems. During experiments sessions, not only the collected data are important, but also parameters and conditions under which the experiments are conducted. To record and store all the information, the shift crew needs a structured and systematized electronic journal. The report presents a new implementation of the Online Logbook System designed to automate the latter process for the NICA experiments being constructed at the Joint Institute for Nuclear Research for investigation of properties of nuclear matter under extreme conditions. The Logbook System allows collaboration members during experiment runs to record information on current events, operating conditions of the detectors and their parameters, which are further used in the raw data processing, reconstruction and physics analysis of the particle collision events in the experiments. A new version of the Online Logbook has been implemented as a configurable platform to be used in different experiments, such as the NICA experiments: a fixed target BM@N (Baryonic Matter at Nuclotron) experiment, and collider MPD (MultiPurpose Detector) and SPD (Spin Physics Detector) experiments. In addition, the specialized API and Web-interface developed for viewing, changing and searching the required logbook data are considered.

Author: Mr CHEBOTOV, Alexander

Co-authors: Dr GERTSENBERGER, Konstantin; SLEPOV, Ivan (JINR); Mr MOSHKIN, Andrey

Presenter: Mr CHEBOTOV, Alexander

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **725** Type: **Oral**

FFD electronics testbench

Tuesday 10 November 2020 15:30 (15 minutes)

The Fast Forward Detector (FFD) is an important part of the Multi-Purpose Detector (MPD) facility for study of **Au + Au** collisions with beams at the NICA collider.
FFD consists of two modular arrays with 20 modules per sub-detector. Each module contains quartz radiators, an MCP-PMT, a high voltage divider and a front-end electronic board (FEE).
The FFD modules of each array are connected to the Arm Processor Unit (APU) electronics. Signal Processing Module (SPM) is a part of APU and it is used for FFD modules signal processing.
Each FFD modules must be tested before assembling the system and this procedure includes checking the channel gain, the pulse shape and width, the FEE working conditions e.t.c.
The test-bench includes a FEE test card and 2 types of pulse generator. The FEE testing card and one signal generator is used for checking the parameters of the front-end board. The second one is used for SPM testing with special software. The generator control is made with custom GUI on PC.

Author: EREMKINA, Irina

Co-authors: ROGOV, Victor (JINR); BOGOSLOVSKI, Dmitri (JINR)

Presenter: EREMKINA, Irina

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **726** Type: **Oral**

Nonleptonic weak decays of charmed baryons

Tuesday 10 November 2020 14:15 (15 minutes)

We have made a three-loop quark model calculation of the W-exchange contribution to the nonleptonic two-body decays of the doubly charmed baryons Ξ_cc and Ω_cc. The W-exchange contributions appear in addition to the factorizable tree graph contributions and are not suppressed in general. We make use of the covariant confined quark model previously developed by us to calculate the tree graph as well as the W-exchange contribution. We calculate helicity amplitudes and quantitatively compare the tree graph and W-exchange contributions. Finally, we compare the calculated decay widths with those from other theoretical approaches when they are available.

Authors: IVANOV, Mikhail (Joint Institute for Nuclear Research, Dubna, Russia); LYUBOVITSKY, Valery (Tuebingen University); GUTSCHE, Thomas (Tuebingen University); KÖRNER, Jürgen G.; TYULEMISSOV, Zhomart (Joint Institute for Nuclear Research, Dubna, Russia)

Presenter: TYULEMISSOV, Zhomart (Joint Institute for Nuclear Research, Dubna, Russia)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **727** Type: **Oral**

Lattice study of the confinement-deconfinement phase transition in SU(3) gluodynamics in rotating frames

Tuesday 10 November 2020 15:00 (15 minutes)

In ultrarelativistic heavy-ion collision (NICA, FAIR, etc.) the creation of quark-gluon plasma with a nonzero angular momentum is expected, especially in off-central collision. The rotation of QCD matter shoud leads to a number of nontrivial physical phenomena, and further study of rotation is of a great interest. In this work the influence of the rotation on the confinement/deconfinement phase transition in SU(3)-gluodynamics was investigated using the Monte-Carlo lattice simulations. The calculations have been performed in rotating reference frame, where the rotation is introduced using an external gravitational field. To study the confinement/deconfinement transition the Polyakov loop and its susceptibility have been computed for various values of the temperature and angular velocity. The obtained results show that the critical temperature of the confinement/deconfinement phase transition in SU(3)-gluodynamics increases with a growth in the angular velocity. It is shown that this effect does not depend on the lattice size and boundary conditions used.

Authors: BRAGUTA, Victor (JINR); KOTOV, Andrey (JINR); KUZNEDELEV, Denis (ITEP); ROENKO, Artem (JINR, BLTP)

Presenter: ROENKO, Artem (JINR, BLTP)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **728** Type: **Oral**

Automated book of abstract generation for JINR conferences organized with Indico

Wednesday 11 November 2020 14:00 (15 minutes)

Joint Institute for Nuclear Research hosts more than 40 international conferences every year. Organization means providing information about the event, registration page, abstract submission, timetable creation, and other important information. To do that, the Indico system is used heavily. Indico is open-source software for meetings organization developed and supported by CERN. One of the conference features is a book of abstracts. It is created before the beginning of a conference but after the abstract submission deadline. It consists of all titles, authors, affiliations, and emails given during the abstract submission process. The creation of such a book may be very tedious work. The book should be divided for sections, the order must be preserved withing sections, indices which represent authors' affiliation must be carefully set, etc. A good example of the usual problems are discrepancies in affiliation names.
Authors tend to name their institutes differently. For Joint Institute for Nuclear Research, more than 15 different variants exist. The system was developed to simplify and automatize the creation of a book of abstracts for conferences organized with Indico. An XML file with text information about all abstract exported from Indico and used to create DOCX file with the book of abstracts. Custom styles and special templates may be applied. The developed system: greatly speeds up the book of abstract creation, eliminates the possibility of typos in affiliation indices, brings attention to discrepancies like mixed language, too short/long abstract and others.

Author: ILINA, Anna (Joint Institute for Nuclear Research)

Co-author: Mr PELEVANYUK, Igor

Presenter: ILINA, Anna (Joint Institute for Nuclear Research)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **729** Type: **Oral**

SRC at BM@N: reconstruction of tracks upstream and downstream the target using the MWPC and Silicon detector systems

Wednesday 11 November 2020 14:00 (15 minutes)

The measurement of Short-Range Correlations (SRC) at Baryonic Matter at Nuclotron (BM@N) for the first time provides information on the nucleus properties after interaction. The coordinate and time detectors located upstream and downstream the analyzing magnet make it possible to determine the charge-to-mass ratio for each fragment.
The total charge in the event is measured by the scintillator counters. The number of tracks and possible combinations of fragments give an idea of the charge of each of them. The number of tracks is determined by the following detectors: GEM (Gas Electron Multiplier), DCH (Drift Chamber), MWPC (Multiwire Proportional Chamber) + Si (Silicon Detector). The charge-to-mass ratio of each fragment is determined using the turning angle in the analyzing magnet, which is measured by the detector systems: MWPC + Si (direct track upstream the magnet), DCH (straight track downstream the magnet).
In this contribution we discuss the track reconstruction algorithm in Si and MWPC detector systems.

Authors: LENIVENKO, Vasilisa (LHEP); PALICHIK, Vladimir (JINR Dubna); Mrs PATSYUK, Maria

Presenter: LENIVENKO, Vasilisa (LHEP)

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **730** Type: **Oral**

On the use of carbon nanotubes in prototyping the high energy density Li-ion batteries

Wednesday 11 November 2020 14:15 (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.
The main area of research aimed at improving the specific parameters of lithium-ion batteries is associated with the synthesis and study of new electrode materials and electrolytes providing higher specific lithium capacities and higher voltage. Moreover, 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.
The technological aspects of fabrication of high areal capacity LFP-based electrodes using the carbon nanotubes as conductive additives were considered. The influence of electrode slurry rheological properties and electrode composition on its areal (mAh cm-2), volumetric (mAh cm-3) and gravimetric (mAh g-1) capacity and C-rate performance has been studied.
The electrodes with 1% of the CNTs demonstrate a higher specific capacity compared with electrodes containing 5-15% of carbon black. However, increase in the CNT content up to 10% significantly lowers electrode volumetric capacity, which is even lower than for the electrodes with carbon black.
SANS measurements revealed that the CNT network embedded in the electrode layer provides its greater wettability by an electrolyte compared to carbon black used as conductive additive. This results in better electrode C-rate performance.
During fabrication of thick electrodes, it is necessary to take into account the rheological properties of the electrode slurry. Our results revealed that increase in the CNT mass content of more than 5% significantly complicates the process of their dispersion in a solvent and fabrication of thick homogeneous layers becomes problematic.
Electrode calendaring improves the electrode volumetric capacity. In our case, the optimal compression rate is of 10% at a roll temperature of 100℃.
It was demonstrated that using the CNTs as conductive additives opens prospect for fabrication of electrodes with areal capacity 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.
The results of electrochemical measurements showed that an increase in the CNT mass fraction in the electrode composition leads to an increase in its C-rate performance. However, for the formation of thick and dense electrodes with a high areal capacity, it is necessary to take into account the rheological properties of the electrode slurry as well as the fact that during drying the electrode coating undergoes shrinkage due to evaporation of a solvent. Thus, it is important to maintain a balance between the mass ratio of the electrode components and their total content in a unit of solvent.

Author: YERDAULETOV, Meir

Presenter: YERDAULETOV, Meir

Session Classification: Applied research

Track Classification: Applied Research

Contribution ID: **731** Type: **Oral**

Development of the Electron string ion sources thermometry systems

Thursday 12 November 2020 15:45 (15 minutes)

The Electron String Ion Source (ESIS) is a relatively novel type of ion source, which is under development since 1994, when the electron string phenomenon was first observed. ESIS is a sophisticated modification of Electron Beam Ion Source (EBIS) working in a reflex mode of operation under specific conditions, the operation is based on step-by-step ionization of the ions by hitting with electrons of an electron string

The ESIS KRION-6T is designed in order to produce the highly charged heavy ions for the NICA/MPD project at JINR. In the 55th Nuclotron (april 2018) run the C6+, Ar16+ and Kr26+ ion beams were produced and accelerated.

One of the most interesting parts of the KRION 6T slow control system is a thermometry system. The source temperature monitoring necessity is caused by the fact that one of the main elements is a superconducting solenoid 1.2 m long. A special measurement unit PKT-8 has been developed for these purposes. It includes functionality that has no analogues on the market: PoE standard supply, Modbus RTU interface, onboard precision current source and web-interface. The PKT-8 was used to monitor the cooling processes, maintain the superconductivity of the solenoid and its warming during the KRION 6T operation in the Nuclotron runs in 2014 and 2017, 2018.

Authors: Mr DONETS , Denis (LHEP JINR); Mr SMIRNOV, Alexander (LHEP JINR); Mr PONKIN, Dmitriy; BUTENKO, Elizaveta (JINR, LHEP, Dubna 141980); MALYSHEV, Nikolay (LHEP)

Presenter: Mr PONKIN, Dmitriy

Session Classification: Particle accelerators and nuclear reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **732** Type: **Oral**

Solitonic Vortex in 4d SQCD vs Critical Superstring

Tuesday 10 November 2020 15:45 (15 minutes)

In this talk we are going to discuss recent results on non-Abelian vortex strings in four-dimensional (4D) $\mathcal{N} = 2$ supersymmetric QCD with U($N = 2$) gauge group and $N_f = 4$ flavors of quark hypermultiplets.

It has been recently shown that these vortices behave as critical superstrings. The spectrum of closed string states in the associated string theory was found and interpreted as a spectrum of hadrons in 4D $\mathcal{N} = 2$ supersymmetric QCD. In particular, the lowest string state appears to be a massless BPS "baryon."

Here we show the occurrence of this stringy baryon using a purely field-theoretic method. To this end we study the conformal world-sheet theory on the non-Abelian string – the so called weighted $\mathcal{N} = (2, 2)$ supersymmetric $\mathbb{CP}$ model. Its target space is given by the six-dimensional non-compact Calabi-Yau space Y_6, the conifold. We use mirror description of the model to study the BPS kink spectrum and its transformations on curves (walls) of marginal stability. Then we use the 2D-4D correspondence to show that the deformation of the complex structure of the conifold is associated with the emergence of a non-perturbative Higgs branch in 4D theory which opens up at strong coupling. The modulus parameter on this Higgs branch is the vacuum expectation value of the massless BPS "baryon" previously found in string theory.

Authors: IEVLEV, Evgenii (Saint Petersburg State University & Petersburg Nuclear Physics Institute); Mr YUNG, Alexei (Petersburg Nuclear Physics Institute); Dr SHIFMAN, Mikhail (University of Minnesota, Minneapolis, MN 55455)

Presenter: IEVLEV, Evgenii (Saint Petersburg State University & Petersburg Nuclear Physics Institute)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **733** Type: **Oral**

System for checking of electrical parameters of superconducting magnets for NICA and FAIR projects

Thursday 12 November 2020 14:45 (15 minutes)

Serial production of superconducting (SC) magnets for the NICA and FAIR projects is currently underway at Joint Institute for Nuclear Research (JINR) in Dubna, Russia. SC-coil electrical parameters should be checked before each stage of assembling and cryogenic testing to avoid faults, such as inter-turn short circuit and insula-tion failure. A system for checking of SC-magnets electri-cal parameters is described in this paper. The results, obtained by this system, are presented and outlined.

Author: KONDRATIEV, Bohdan (-)

Co-authors: Mr ANTONOV, Andrey (JINR); BORISOV, Vladimir (JINR); DOLGIJ, Sergej (JINR); KHODZHIBAGIYAN, Hamlet (VBLHEP JINR); KOSTROMIN, Sergei (JINR)

Presenter: KONDRATIEV, Bohdan (-)

Session Classification: Particle accelerators and nuclear reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **734** Type: **Oral**

A STUDY OF RADIATION RESISTANCE FOR DISKS OF NEUTRON CHOPPERS IN ESS

Wednesday 11 November 2020 14:30 (15 minutes)

Key words: European Spallation Source –neutron choppers –radiation resistance –applied research –microstructural damages

Abstract

European Spallation Source (ESS) is designed as the world's most powerful neutron source, allowing to realize scientific breakthroughs in research concerning energy, materials, health and environment. Depending on the field of research, different neutron wavelengths from the full energy spectrum are required. The neutron chopper is a mechanical device that cuts out the required wavelength area from the entire neutron energy spectrum. One of the most important parts of the neutron chopper is the disc made of carbon fiber reinforced epoxy. During the operation of the chopper in the physical experiment, the disk will rotate at a high angular velocity in the conditions of high radiation fields. So, it follows that it is necessary to analyze the impact of radiation on the internal structure and mechanical properties of the chopper.

To investigate what kind of radiation damage occurs in different types of epoxies depending on the fluence, X-ray tomography together with the porosity analysis, three-point bending tests and the surface analysis have been carried out using scanning electron microscopy (SEM) for two different epoxies. Together, these studies provide the most complete picture of the resulting damages. Each type of epoxy has been irradiated with the following neutron fluences: 6,2·10^15 n/〖cm〗^2 ,8,9·10^15 n/〖cm〗^2 ,2,6·10^16 n/〖cm〗^2 which corresponds to the absorbed dose in water of 3 MGy, 10 MGy and 30 MGy.

X-ray tomography has been used to analyze microstructural damages after irradiation. It allowed to investigate the damages occurring not only on the surface of the sample, but also in its content. It has shown that the number of pores increases with the increasing dose. However, this effect was found only in one of the epoxies, which means that radiation damage is not universal for various types of epoxies.

Also, along with studies of mechanical properties using the three-point bending method, it was found that an increase in the number of medium-sized elliptical pores (40960 - 655360 μm3) enhances the maximum stress and Young's modulus of the material. Mechanism bringing together these two phenomena has not been established.

The next step in this project will be implementation of the neutron tomography and the subsequent data analysis. This will provide further information about the gas inside the pores, since X-rays and neutrons possess different cross sections.

A study of the orientation of pores on SEM will also be carried out. Are they directed along the fibers or perpendicular to them? Does their direction depend on the absorbed dose? Perhaps, the answers to these questions will help to understand the mechanisms of damage in the chopper material.

Author: Mrs BELOVA, Maria (JINR)

Co-authors: BULAVIN, Maksim (JINR); KULIKOV , Sergey (JINR); TSAPATSARIS, Nikolaos (ESS)

Presenter: Mrs BELOVA, Maria (JINR)

Session Classification: Applied research

Track Classification: Applied Research

Contribution ID: **735** Type: **Oral**

Pulse research reactor IBR-3 - optimization of parameters ”Method of reducing the level of power fluctuations in pulsed reactors”

Thursday 12 November 2020 14:00 (15 minutes)

Periodic Pulsed research reactors IBR-2 type in Dubna is the most effective source of slow neutrons extracted beams for studying various structures by diffraction, small-angle scattering, reflectometer, inelastic scattering and neutron diffraction, due to a short neutron pulse and a high average flux of up to 10 E +14 cm-2 s-1. At the same time, due to the specificity of the kinetics, fluctuations in the power energy of pulses in such a reactor are tens of times higher than in stationary reactors and create problems for the control of the apparatus. This paper proposes and substantiates a method for a significant reduction in the level of fluctuations in power pulses of such reactors using the example of the IBR-3 (NEPTUNE) pulsed reactor project with the threshold Np-237 isotope as a nuclear fuel.

Authors: Mr HASSAN, Ahmed (Joint Institute for Nuclear Research (JINR),Dubna, Moscow region, 141980 Russia.); Prof. SHABALIN , E. P. (Joint Institute for Nuclear Research (JINR),Dubna, Moscow region, 141980 Russia.); Dr KULIKOV, Sergey (Joint Institute for Nuclear Research (JINR),Dubna, Moscow region, 141980 Russia.); Dr RZYANIN, Michael (Joint Institute for Nuclear Research (JINR),Dubna, Moscow region, 141980 Russia.)

Presenter: Mr HASSAN, Ahmed (Joint Institute for Nuclear Research (JINR),Dubna, Moscow region, 141980 Russia.)

Session Classification: Particle accelerators and nuclear reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **737** Type: **Oral**

Production of metal ion beams from DECRIS-3 ion source

Thursday 12 November 2020 15:00 (15 minutes)

The article describes the experiments carried out up 2018 to 2019 at the accelerator complex DC-60 of Astana branch of the INP (Alma-Ata, Kazakhstan Republic), to develop methods for production of intense beams of metals with the use of volatile organometallic compounds (Metal Ions from Volatile Compounds) –MIVOC. As a result of performed work for the first time at DC-60 cyclotron a beams of nickel, silicium, cobalt, chrome, titanium, germanium and hafnium ions were produced.

Author: Mr BONDARCHENKO, Andrey (JINR)

Co-authors: BOGOMOLOV, Sergey (JINR); LOGINOV, Vladimir (Nikolaevich); LEBEDEV, Alexander (JINR FLNR); MIRONOV, Vladimir (JINR); PUGACHEV, Dmitry (JINR FLNR); Dr ZDOROVETS, Maxim (The Institute of Nuclear Physics); IVANOV, Igor (Institute of nuclear physics); SAMBAYEV, Yernaz (Institute of nuclear physics); KOLOBERDIN, Michael (The Institute of Nuclear Physics); KURAKHMEDOV, Alisher (Astana branch of the Institute of Nuclear Physics); MUSTAFIN, Daulet (Ayitmogambetovich); ABDIGALIYEV, Madi (Institute of nuclear physics)

Presenter: Mr BONDARCHENKO, Andrey (JINR)

Session Classification: Particle accelerators and nuclear reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **738** Type: **Oral**

Impedance model of the NICA collider for experiments at SPD

Thursday 12 November 2020 14:15 (15 minutes)

Effective studying of the nucleon spin structure in colliding polarized proton beams is possible with the pp collision luminosity L=1 10^32 cm^(-2) s^(-1) at the energy range of Ecm=27 GeV. Reaching of necessary level of the luminosity is connected with the accumulation of n=2 10^13 particles in each of the collider rings and solving the problems of stable beam dynamics. Building of an impedance model is necessary step for determining at an early stage of design possible limitations on the stored beam intensity, and reducing the influence of the impedance effect on the beam dynamics. In the report the physics of the beam motion in an accelerator chamber is considered, values of effective longitudinal and transverse impedances of the collider NICA are shown, the influence of effective transverse impedance on the betatron tune shift is described.

Authors: Mrs KOROBITSINA, Margarita; Prof. KOVALENKO, Alexander; Dr KOLOMIETS, Andrey

Presenter: Mrs KOROBITSINA, Margarita

Session Classification: Particle accelerators and nuclear reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **739** Type: **Oral**

Study of WH process using different event generators

Monday 9 November 2020 17:45 (15 minutes)

In this paper, we study the angular features of the signal and background processes of the associated production of the Higgs boson with W-boson. Signal and background processes are generated using the CompHEP, POWHEG and PYTHIA generators. Monte Carlo data is processed in ROOT software. We also compared the shape of the distribution of kinematic variables obtained from different generators. And it was found that the shape of these distributions is almost the same for different generators. The deviation of about 30% of POWHEG from other generators can be explained by the fact that it uses NLO correction when generating events

Authors: MANASHOVA, Munira (JINR, Veksler and Baldin Laboratory of High Energy Physics); Mr AHMADOV, Faig

Presenter: MANASHOVA, Munira (JINR, Veksler and Baldin Laboratory of High Energy Physics)

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **740** Type: **Oral**

Study of magnetic core-shell nanoparticles for drug delivery system in cancer treatment

Wednesday 11 November 2020 14:45 (15 minutes)

One of the promising areas of nanotechnology development is the medical field of application of nanostructures. Nanomedicine is a rapidly developing area in the last decade, including methods for the prevention, diagnosis and treatment of a wide range of diseases using various types of nanostructures. The control of the shape, size, and chemical composition of nanostructures allows to set their physical properties at the synthesis stage and opens up new possibilities for bioprocessing. A rather interesting possibility of using nanostructures is the targeted delivery of useful goods (drugs or proteins) using a magnetic field. In this method, a drug or protein is attached by functional groups to a magnetic nanostructure and introduced into the circulatory system, after which it is transported to a problem area through a magnetic field. One of the most promising materials for creating magnetic nanostructures is iron oxide or an alloy of iron with nickel due to its greater saturation magnetization compared to this value for pure ferromagnetic metals Co, Ni, and Fe.

The use of magnetic nanostructures in medicine can not only efficiently deliver biologically active molecules through various body barriers that they are not able to overcome on their own (skin, blood-brain), but also significantly change the nature of the drug. Nanostructures of magnetic metals (iron, cobalt and nickel) are rarely used in pure form for therapeutic purposes. Usually they are encapsulated or placed in bioinert matrices (various organic compounds or polymers, including those of natural origin) in order to reduce the possible toxic effects of the magnetic phase, increase its physico-chemical stability and create the possibility of immobilization of the surface of such capsules or matrices of drugs. Coating magnetic metals with a carbon shell or noble metals such as gold and silver increases their effectiveness in medical applications.

Authors: Mrs NAZAROVA, Assel; CHUDOBA, Dorota; Dr KOZLOVSKIY, Artem

Presenter: Mrs NAZAROVA, Assel

Session Classification: Applied research

Track Classification: Applied Research

Contribution ID: **741** Type: **Oral**

Probabilities of neutron transfer to free single-particle levels in the reaction ^{181}Ta(^{18}O,^{19}O) at near-barrier energies

Friday 13 November 2020 15:30 (15 minutes)

Numerical solution of the time-dependent Schrodinger equation (TDSE) 1 is used for studying neutron transfer processes at near-barrier energies. The evolution of the wave functions for outer neutron is determined for reactions ^{181}Ta(^{18}O,^{19}O). TDSE allows us to visualize the dynamics of taking place processes [1-3]. The probabilities are calculated for neutrons transfer from outer shells of the target ^{181}Ta. The results of calculations of transfer cross sections are in satisfactory agreement with experimental data [4] for reaction ^{181}Ta(^{18}O,^{19}O). High probability of neutron transfer from the ^{181}Ta nucleus to the $2s$ orbital of ^{18}O nucleus at near-barrier energies has been yielded (see Figure 1).

In our previous work [4], differential cross sections for the formation of oxygen isotopes in the reaction ^{18}O+^{181}Ta have been measured at projectile nucleus energy $10A$ MeV on the high-resolution magnetic spectrometer MAVR. Theoretical analysis has been performed in the DWBA formalism using the FRESCO code under the assumption of sequential neutron transfer mechanism.

Fihure 1. Evolution of probability density for for the outer neutrons of ^{181}Ta in collision with the projectile-nucleus ^{18}O at energy of $5A$ MeV.

1 A.K.Azhibekov, V.V.Samarin, K.A.Kuterbekov, Time-dependent calculations for neutron transfer and nuclear breakup processes in ^{11}Li+^{9}Be and ^{11}Li+^{12}C reactions at low energy, Chinese Journal of Physics 65 (2020) 292.

2 Yu.E. Penionzhkevich, Yu.G. Sobolev, V.V. Samarin et al., Energy dependence of the total cross section for the ^{11}Li+^{28}Si reaction, Phys. Rev. C 99 (2019) 014609.

3 Yu.E. Penionzhkevich, Yu.G. Sobolev, V.V. Samarin, M.A. Naumenko, Peculiarities in total cross sections of reactions with weakly bound nuclei ^{6}He, ^{9}Li // Physics of Atomic Nuclei 80 (2017) 928.

4 A.K. Azhibekov, V.A. Zernyshkin, V.A. Maslov, Yu.E. Penionzhkevich et al., Differential Production Cross Sections for Isotopes of Light Nuclei in the ^{18}O+^{181}Ta Reaction // Physics of Atomic Nuclei 83 (2020) 94.

Author: Mr AZHIBEKOV, Aidos

Presenter: Mr AZHIBEKOV, Aidos

Session Classification: Nuclear Physics

Track Classification: Nuclear Physics

Contribution ID: **742** Type: **Oral**

A Monte Carlo study of Lambda Hyperon Polarization at MPD

Wednesday 11 November 2020 14:15 (15 minutes)

The measurements of strange hyperons polarization in heavy ion collision allows to study important characteristics of QCD medium (vorticity, hydrodynamic helicity). One of the goals of BMN and MPD experiments at NICA is to research hyperons. In this analysis, we study Λ polarization produced with LAQGSM event generator and simulated via Monte Carlo. The simulation was performed for Au+Au collisions at 9 GeV.

Author: AKHAT, Raimbek (JINR)

Co-author: Dr ZINCHENKO, Alexander

Presenter: AKHAT, Raimbek (JINR)

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **743** Type: **Oral**

Spectator nucleons in most central Au—Au collisions at NICA

Wednesday 11 November 2020 15:30 (15 minutes)

Collisions of ^{197}Au nuclei with the center-of-mass energy $\sqrt{s_{NN}}$ from 4 to 11 GeV will be studied in the MPD (MultiPurpose Detector) experiment at NICA collider, which is presently under construction. In the BM@N experiment at the same facility nuclear beams interact with fixed targers. The NICA facility is designed for the investigations of baryon-rich strongly-interacting nuclear matter of high density and temperature. The formation of a new kind of matter known as the Quark-Gluon Plasma (QGP) is more likely in central collisions of heavy nuclei due to their compelete overlap.
The most central collisions are usually selected in experiments by the requirement of the highest muliplicity of produced secondary particles. In such collisions the number of participating nucleons in both of the colliding nuclei also reaches it maximum because of the largest overlap of these nuclei. In the case of central ^{197}Au—^{197}Au collisions one can naively expect zero number of non-participating (spectator) nucleons which otherwise continue to propagate strictly in the forward direction after the collision. However, several experiments at the CERN SPS, RHIC and LHC which employed
forward hadronic calorimeters to detect spectator nucleons clearly demonstrated their presense even in the most central collisions of equal nuclei, like ^{208}Pb or ^{197}Au.

In this work we study the properties of spectator matter in most central (of 0-5% centrality) ^{197}Au —^{197}Au and ^{208}Pb—^{208}Pb collisions at NICA and the CERN SPS, respectively. We use a recently developed Abrasion-Ablation Monte Carlo Model for Colliders (AAMCC). AAMCC is based on the version 3.0 of the GlauberMC model, which estimates the volume of spectator matter from both colliding nuclei on the event-by-event basis. This matter is considered in the form of two excited prefragments with excitation energies depending on their sizes. Their exctations and decays are modeled on event-by-event basis by means of the evaporation, Fermi Break-up and SMM models from Geant4 library.

We demonstrate that the calulated numbers of spectator neutrons and protons in most central collisons of equal heavy nuclei are non-zero and they are sensitive to (1) the specific procedure used to calculate the excitation energy of prefragments; (2) the presence of neutron-skin in initial nuclei. We argue that the rates of events with unequal numbers of spectator neutrons and protons (e.g., a single proton and several neutrons and vice versa) in central collisions are especially sensitive to these effects.

This work has been carried out with financial support of RFBR within the project 18-02-40035-mega.

Authors: DMITRIEVA, Uliana (Institute for Nuclear Researchof the Russian Academy of Sciences); KOZYREV, Nikita (Institute for Nuclear Researchof the Russian Academy of Sciences); SVETLICHNYI, Aleksandr (MIPT, INR RAS); PSHENICHNOV, Igor (Institute for Nuclear Research, Russian Academy of Sciences)

Presenter: DMITRIEVA, Uliana (Institute for Nuclear Researchof the Russian Academy of Sciences)

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **744** Type: **Oral**

DsTau (NA65): Study of tau neutrino production at CERN-SPS

Monday 9 November 2020 17:00 (15 minutes)

DsTau (NA65) at the CERN-SPS is a recently approved experiment, which aims to study the tau neutrino production. The main source of tau neutrinos is the decay of Ds mesons, namely Ds $\rightarrow \tau\nu\tau$ and then $\tau \rightarrow \nu\tau X$. There is almost no data on the differential production cross section of Ds in proton-nucleus interactions, which leads to a large uncertainty of tau neutrino cross section measurements preventing a precise test of lepton universality in neutrino scattering.. DsTau addresses this issue and will provide essential inputs for future tau neutrino experiments. A large amount of charmed particles decay events (~ 10^5) is expected to be detected as well, providing a possibility for interesting by-product studies, in particular a search for intrinsic charm in a proton. The experimental method is based on a use of high resolution emulsion detectors for effective registration of events with short lived particle decays. Here I present the motivation of the study, details of the experimental technique, the first results of the analysis of the data collected during test runs and my personal contribution to the analysis

Author: Ms SITNIKOVA, Elizaveta (JINR)

Presenter: Ms SITNIKOVA, Elizaveta (JINR)

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **745** Type: **not specified**

Approbation of the three body model of light exotic nuclei in the direct nuclear reactions

Friday 13 November 2020 15:00 (15 minutes)

The properties and characteristics of light weakly bound atomic nuclei continue to attract interest against the background of the development of secondary beam accelerators. Many interesting features have been revealed in the He-6 and He-8 atomic nuclei such as halo, skin effects by I Tanihata. It is quite obvious, and very clear, that their participation in direct nuclear reactions also leaves its own inimitable traces.

In the work, the deuteron-induced reactions on a Be-9 target were studied at the collision energies 19.5 and 35 MeV. The developed theoretical model was applied successfully in describing the cross sections of elastic and inelastic scatterings, one-nucleon transfer and cluster-transfer reactions. The strong coupling effects were shown for the (d, p) and (d, t) one-nucleon transfer nuclear reactions. Furthermore, it was found that in the Be-9(d, α)Li-7 nuclear reaction the He-5 heavy cluster is transferred mainly simultaneously, and the contribution of its sequential transfer is an order of magnitude lower. The importance of taking into account the mechanism of sequential transfer of the n–p system was revealed. Based on these observations from studying the interaction of the deuteron with Be-9, it was concluded that the Be-9 nucleus has the α+α+n cluster structure.

It is interesting to apply the above highlighed theoretical approach to study the structure of the He-6 nucleus. The nucleus also attracts particular attention for its Borromian structure considered as the α + n + n three body system. The calculations are based on a three-body wave function of the ground state of He-6 with an attractive α-n potential, which excludes overlapping of forbidden s-states. The differential cross section of the elastic scattering of alpha particles with He-6 is calculated. It should be noted that the peculiarity of this reaction is the mixing of the elastic transfer of two neutrons.

Authors: URAZBEKOV, Bakytzhan (JINR); DENIKIN, Andrey (FLNR JINR); Prof. ITACO, Nunzio (INFN)

Presenter: URAZBEKOV, Bakytzhan (JINR)

Session Classification: Nuclear Physics

Track Classification: Nuclear Physics

Contribution ID: **746** Type: **Oral**

Ariadne: PyTorch Library for Particle Track Reconstruction Using Deep Learning

Wednesday 11 November 2020 14:30 (15 minutes)

Particle tracking is a fundamental part of the event analysis in high energy and nuclear physics (HENP). Events multiplicity increase each year along with the drastic growth of the experimental data which modern HEP detectors produce, so the classical tracking algorithms such as the well-known Kalman filter cannot satisfy speed and scaling requirements. At the same time, breakthroughs in the study of deep learning open an opportunity of application of high-performance deep neural networks for solving tracking problems in a dense environment of experiments with heavy ions. However, there are no well-documented software libraries for deep learning track reconstruction yet. We introduce Ariadne, the first open-source library for particle tracking based on the PyTorch deep learning framework. The goal of our library is to provide a simple interface that allows one to prepare train and test datasets and to train and evaluate one of the deep tracking models implemented in the library on the data from your specific experiment. The user experience is greatly facilitated because of the system of gin-configurations. The modular structure of the library and abstract classes let the user develop his data processing pipeline and deep tracking model easily. The proposed library is open-source to facilitate academic research in the field of particle tracking based on deep learning.

Authors: Mr GONCHAROV, Pavel; Mr SCHAVELEV, Egor (St. Petersburg State University); Ms NIKOLSKAYA, Anastasia (St. Petersburg State University); Prof. OSOSKOV, Gennady

Presenter: Mr GONCHAROV, Pavel

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **747** Type: **Oral**

Hamiltonian BFV-BRST quantization for the systems with unfree gauge symmetry

Tuesday 10 November 2020 15:30 (15 minutes)

We study Hamiltonian form of unfree gauge symmetry where the gauge parameters have to obey differential equations. The phenomenon of the unfree gauge symmetry is clarified from viewpoint of involution relations between Hamiltonian and constraints. Given the involution relations for the first-class constraints of all generations, we provide explicit formulas for unfree gauge transformations in the Hamiltonian form, including the differential equations constraining gauge parameters. We adjust the BFV-BRST Hamiltonian quantization method for the case of unfree gauge symmetry. The main distinction is in the content of the non-minimal sector and gauge fixing procedure. For the case when there are no higher-order ghost vertices, we deduce from the phase-space path integral the modified FP quantization rules such that account for the unfree gauge symmetry by imposing corresponding constraints on the ghosts. These ghost constraints mirror the equations imposed on gauge parameters in Hamiltonian formalism. The general formalism is exemplified by specific models, including linearized unimodular gravity.

Authors: Ms ABAKUMOVA, Victoria (Tomsk State University); Prof. LYAKHOVICH, Simon (Tomsk State University)

Presenter: Ms ABAKUMOVA, Victoria (Tomsk State University)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **748** Type: **not specified**

The LOOT Model for Primary Vertex Finding in the BES-III inner tracking detector

Thursday 12 November 2020 14:30 (15 minutes)

The track recognition process (tracking) plays a key role in the event reconstruction in high energy physics. Our study is devoted to tracking for the inner detector of the BES-III experiment, which has only three cylindrical GEM stations. This means, if a particle is registered only at two out of three stations, then its track in the magnetic field cannot be restored without additional information. Such information can be the coordinates of the primary event vertex, from which all tracks exit. Knowing the location of the primary vertex would also help to improve the precision in determining the particle momentum. Besides, it leads to the significant reduction of the algorithmic complexity during the track-candidate search –from O(n^2) to O(n), and can improve the overall track reconstruction efficiency. It should also be noted that tracking is especially complicated for strip GEM detectors due to their design specifics, which leads to the appearance of two orders of magnitude more fake hits in addition to useful ones. To solve the problem of vertex finding for the inner detector of the BES-III experiment, we chose a deep convolutional neural network model Look Once On Tracks (LOOT), which processes the whole event at once, as an image, and after proper training can predict the coordinates of the primary vertex location. In this work, the preliminary results of primary vertex prediction on the BES-III simulated data using the LOOT model are presented.

Authors: REZVAYA, Ekaterina; Mr GONCHAROV, Pavel; SCHAVELEV, Egor; DENISENKO, Igor; OSOSKOV, Gennady; ZHEMCHUGOV, Aleksey

Presenter: REZVAYA, Ekaterina

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Information Technology

Contribution ID: **749** Type: **Oral**

Deep Learning Methods for The Plant Disease Detection Platform

Wednesday 11 November 2020 14:15 (15 minutes)

We have introduced the Plant Disease Detection Platform (PDDP) which allows users to send photos of sick plant leaves or textual descriptions of theirappearance to obtain the information about an infection that hit the vegetation and treatment tips. The backend of the platform in terms of deep learning includes image classification model and text similarity model. The image classification model has two parts: feature extractor and classifier. The feature extractor is trained using the triplet loss along with transfer learning when the weights of the network are initialized from the MobileNetV2 pretrained on the ImageNet dataset. The classifier is a simple multilayer perceptron which test on 100 random plant images from the Internet shows 98% of the classification accuracy. We did the post-training static quantization in order to reduce the overall model size and increase inference performance. The final model has a size of 7 Mb and works 5 times faster than the initial model without significant loss of accuracy. The text similarity model is a BERT-based transformer for obtaining vector representation of input texts for further similarity calculation between user requests and disease descriptions on the PDDP.

Authors: Mr SMETANIN, Artem (ITMO University); Mr GONCHAROV, Pavel; UZHINSKIY, Alexander (JINR); OSOSKOV, Gennady; NECHAEVSKIY, Andrey (JINR)

Presenter: Mr SMETANIN, Artem (ITMO University)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **750** Type: **Oral**

A new method to reconstruct the Higgs boson mass at the CLIC collider.

Monday 9 November 2020 17:15 (15 minutes)

A variety of important studies is planned at the future CLIC e+e- collider with energy up to 3 TeV. One of the studies is the precision Higgs boson mass measurement planned at the first stage of the CLIC project. The traditional method of recoil mass reconstruction was shown to be ineffective for this type of studies in the CLIC experimental conditions. Instead the new method of the Higgs reconstruction using b-quarks jet directions, proposed before for the ILC, is expected to be especially effective at the CLIC. In this talk the studies on Monte-Carlo simulation of the Higgs mass reconstruction are presented. The goal of these studies is to evaluate the expected precision of the Higgs boson mass measurement at the CLIC using the new reconstruction method.

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Co-author: BOYKO, Igor (JINR)

Presenter: SHVYDKIN, Pavel (JINR)

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **751** Type: **Oral**

Cadmium content in soils and in Oriental tobacco leaves: a study in tobacco-growing regions of southeast Bulgaria

Thursday 12 November 2020 15:30 (15 minutes)

Over the last decades, concerted efforts to decrease tobacco consumption worldwide have been made. There is an extensive body of research on the content of harmful substances in tobacco raw materials and in cigarette smoke. Data on the statistical relationships between the heavy metal content in soils and in tobacco plants are of interest. For this study, 38 soil samples and 38 samples from mature Oriental tobacco leaves from the Eastern, Central, and parts of the Western Rhodope Mountains in Bulgaria were collected. Inductively coupled plasma atomic emission spectroscopy was used to measure the DTPA-extractable forms and total content of the element Cd in soil, as well as the concentration of Cd in tobacco leaves. The basic soil characteristics: pH, humus content, and texture were determined. The total content of Cd in the soils ranged from 0.15 mg/kg to 3.30 mg/kg; and the DTPA-extractable forms –from 0.02 mg/kg to 1.48 mg/kg. The Cd concentration determined in Oriental tobacco leaves varied between 0.05 mg/kg and 15.95 mg/kg. No visible symptoms of phytotoxicity were observed. Therefore, Oriental tobacco plants exhibited accumulating properties. The performed correlation/regression analyses revealed significant positive linear relationships between the total content and mobile forms of Cd in soils ($p<0.001$). The concentration of Cd in the tobacco leaves was linearly proportional to the Cd content in soils: both for the total content and the mobile forms ($p<0.001$). The power model adequately reflected the relationship between the mobile forms of Cd and the humus content. The same regression model described the relationship between the clay content and the Cd concentration in the tobacco leaves. The exponential model reflected the statistical relationships between the soil reaction (pH) and the content of Cd in the tobacco leaves; as well as the relationships between the DTPA-extractable forms of Cd with the clay (<0.002mm) and the silt + clay (<0.02mm) fractions of the soil.

Authors: HRISTOZOVA, Gergana; Mrs ZAPRJANOVA, Penka (Agricultural University); MARINOVA, Savka (, Plovdiv University Paisii Hilendarski)

Presenter: HRISTOZOVA, Gergana

Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **752** Type: **Oral**

Global strategy of tracking on the basis of Graph Neural Network for BES-III CGEM inner detector

Thursday 12 November 2020 14:00 (15 minutes)

Particle tracking in modern high-energy physics experiments is a challenging task. Well-proven algorithms are no longer capable of providing satisfactory results in terms of processing throughput due to an enormous amount of data being produced through the detector's environments. At the same time, Graph Neural Networks (GNN) have shown great potential, namely the GNN approach, which was introduced by the HEP.TrkX project at LHC. We have already applied such approach for the BM@N experiment of the NICA megaproject and, despite the fact that the straightforward adaptation of the original approach did not achieve significant results for the simulated data from the BM@N GEM detector, we proposed a novel Line Digraph approach with the usage of GNN model, which demonstrated a big potential in the BM@N GEM detector's fixed target environment. Because of such success, we decided to adapt our algorithm to experiments with the collider environment, such as BES-III experiment in China. The overall potential of Line Digraph approach generalization is demonstrated: we achieved encouraging results in terms of tracking efficiency and processing speed on Monte-Carlo simulated data.

Author: Mr SHCHAVELEV, Egor

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Presenter: Mr SHCHAVELEV, Egor

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Information Technology

Contribution ID: **753** Type: **Oral**

Local strategy of particle tracking with TrackNETv2 on the BES-III CGEM inner detector

Thursday 12 November 2020 14:15 (15 minutes)

The BESIII experiment is a multi-purpose detector operating at the beams of the electron-positron collider BEPCII in Beijing. Particle tracking is a fundamental part of data analysis for this experiment. The inner part of the BESIII tracker suffers from a strong beam-related background, which significantly reduces tracking efficiency for low-pT tracks and the physics performance of the experiment. The inner part of the tracker will be replaced with the CGEM detector, which is expected to have a better performance in the presence of a strong background. At the same time, it will produce a large number of fake hits. Traditional algorithmic solutions rely on hand-engineered features and metrics, do not parallelize easily, and scale poorly with detector occupancy. In this paper we present our solution for identification and reconstruction of tracks based on deep neural network called TrackNETv2. This model is lightweight, efficient and can be trained using Monte-Carlo simulation. TrackNETv2 was proposed for another experiment BM@N and proved its usefulness for task of particle tracking. Due to architectural restrictions we added some new blocks for this model developing it to TrackNetv2.1. In this paper we evaluated these ideas on simulated data and discussed its strengths and limitations for application in the BESIII tracking challenge.

Authors: Ms NIKOLSKAYA, Anastasia (St. Petersburg State University); SCHAVELEV, Egor; Mr GONCHAROV, Pavel; OSOSKOV, Gennady; Mr NEFEDOV, Yury; ZHEMCHUGOV, Alexey (JINR); DENISENKO, Igor

Presenter: Ms NIKOLSKAYA, Anastasia (St. Petersburg State University)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Information Technology

Contribution ID: **754** Type: **Oral**

The study of radiation defects in heterostructured semiconductors after irradiation at the irradiation facility of the IBR2 research reactor

Wednesday 11 November 2020 15:00 (15 minutes)

Heterostructures of high quality A3B5 arsenides with a quantum well based on In-Ga1-yAs exhibit high mobility of a two-dimensional electron gas and are actively used in microwave heterostructure electronics. In the heterostructures, the current-conducting layer is very thin —of the order of 10–20 nm, enclosed between wide-gap barriers; therefore, the radiation physics of such structures may differ from what was done in classical bulk semiconductors. A set of samples with heterostructures were irradiated in the irradiation unit of the IBR-2 research reactor. Preliminary results on x-ray diffraction and Raman spectroscopy are obtained.

Author: Mr YSKAKOV, Almas

Presenter: Mr YSKAKOV, Almas

Session Classification: Applied research

Track Classification: Applied Research

Contribution ID: **755** Type: **Oral**

Study of the scintillation properties of pure and yttrium-doped BaF2 crystals

Tuesday 10 November 2020 15:45 (15 minutes)

BaF2 scintillator crystals are considered as candidates for use in the electromagnetic calorimeter of the second phase of the Mu2e experiment. The key advantage of this scintillator is its high radiation stability and a fast emission component with a short decay time of 0.6-0.8 ns in the 190-250 nm range, which would significantly improve the speed and time resolution of the calorimeter. However, the high emission level of the slow component can significantly reduce the possibility of using BaF2 crystals at high beam intensities. Various methods are used to separate or suppress the slow component, including doping of BaF2 crystals with rare earth metals, such as Y, La, Ce. In this work we present study of scintillation properties of pure and yttrium-doped BaF2:Y crystals (1, 3, 5 at.% of Y) with dimensions of 10 × 10 × 10 mm. The scintillation properties of the samples before and after irradiation at the IBR-2 reactor are compared. Studies show the suppression of the slow emission component of yttrium-doped BaF2 crystals, as well as a change in the radiation hardness of yttrium-doped irradiated samples.

Author: VASILYEV, Ilya (JINR)

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Presenter: VASILYEV, Ilya (JINR)

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **756** Type: **Oral**

Study of low-lying resonance states in the break up of ^{11}Be

Tuesday 10 November 2020 17:30 (15 minutes)

We investigate the Coulomb breakup of the ^{11}Be halo nuclei on a heavy target at intermediate (70 MeV/nucleon) energies within non-perturbative time-dependent approach. The convergence of the computational scheme is demonstrated in all considered range of the energy including the low-lying resonances \textit{n}+^{10}Be in different partial and spin states of ^{11}Be. The obtained results are in good agreement with experimental data at 69 and 72 MeV/nucleon.

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Presenter: Mr VALIOLDA, Dinara

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **757** Type: **Oral**

special aspects of creating a synchronization system for injector of the NICA complex

Thursday 12 November 2020 15:30 (15 minutes)

In this paper, we will focus on the special aspects of the NICA injector sinchrinization system development.
The method of transmission of synchronization signals from the magnetic sycle system to the end-point devices will be shown. KRION-6T ion source synchronization issues will also be considered within the general synchronous timing system model.

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Presenter: SHIRIKOV, Ilya (JINR)

Session Classification: Particle accelerators and nuclear reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **758** Type: **Oral**

Non-destructive testing of materials at the TITAN neutron imaging facility of the WWR-K research reactor

Wednesday 11 November 2020 15:15 (15 minutes)

In 2019, a new experimental station TITAN (TITAN - "Transmission Imaging with ThermAl Neutrons") was put into operation at the research reactor WWR-K (Institute of Nuclear Physics, Ministry of Energy of the Republic of Kazakhstan, Almaty, Kazakhstan) to conduct research on non-destructive testing of materials using neutron radiography and tomography. The neutron radiography and tomography unit is located in the horizontal channel No. 1 of the WWR-K research reactor.

At this facility, a neutron beam with dimensions up to 200*200 mm is formed by a collimator system and an evacuated tube to reduce the intensity loss due to neutron scattering in air. The characteristic parameter L/D is determined by the ratio of the distance L between the entrance aperture of the collimator system and the sample position to the diameter of the entrance aperture of the collimator D. The corresponding values for the created setup are L=7 m, D=2 cm, which corresponds to the value of the parameter L/D=350. This value is at the level of similar installations in other world neutron centers. Additionally, a system for varying the diameter D of the entrance aperture of the collimator system from 5 mm to 90 mm was installed, which will allow operation in a wide range of the characteristic L/D parameter from 75 to 1400. A special detector based on a two-mirror optical scheme is used to obtain neutron radigraphic images. The neutron beam passing through the object under study is transformed into a light signal using a scintillation screen, which is focused by a variable focal length lens onto the CCD-matrix of a high-sensitivity video-camera.

This report will describe the current state of the TITAN facility and recent applications to materials science work.

Author: NAZAROV, Kuanysh (JINR)

Co-authors: MUHAMETULY, Bagdaulet (JINR); Dr KICHANOV, Sergey; ZHOLDYBAYEV, Timur (Institute of Nuclear physics, Almaty, Kazakhstan); SHAIMERDENOV, Asset (INP of the Ministry of Energy of the Republic of Kazakhstan); YERDAULETOV, Meir

Presenter: NAZAROV, Kuanysh (JINR)

Session Classification: Applied research

Track Classification: Applied Research

Contribution ID: **759** Type: **not specified**

Data Center Simulation for the BM@N experiment of the NICA project

Tuesday 10 November 2020 17:30 (15 minutes)

One of the uppermost tasks in creating a computing system of the NICA complex is predictive modeling centers of storing and processing data from experimental setups of the complex, in particular, the BM@N detectors, and simulated events of particles collision for comparison with the expected physical result and optimization of the facility detectors geometry.

A new approach was chosen to solve the problem. The approach is based on the representation of information processes as byte streams and use of probability distributions of significant data acquisition processes; in particular, the probabilities of losses of incoming information for different configurations of the data centers equipment must be defined.

The current status of the developed program and the first results of modeling centers of processing and storing data of the BM@N experiment of the NICA complex under different scenarios for executing tasks for the next run scheduled for 2021 are presented.

Author: PRIAKHINA, Daria (ЛИТ)

Co-authors: Mr TROFIMOV, Vladimir; Prof. OSOSKOV, Gennady; Dr GERTSENBERGER, Konstantin

Presenter: PRIAKHINA, Daria (ЛИТ)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **760** Type: **Oral**

Measurement of Ra and Th ion charges using a new gas-filled separator DGFRS-2

In 2019, test experiments on the production of Ra and Th isotopes in fusion reactions at the new gas-filled separator DGFRS-2 of the superheavy elements factory were conducted with varying target thicknesses. In this work, the mean charges of ions in a rarefied hydrogen are determined for the evaporation residues and the dispersion of dipole magnets of the separator is estimated. A comparison with the results of previous experiments at DGFRS-1 is given. The energy losses of the beam and evaporation products during their passage of certain separator layers are calculated.

Authors: Mr IBADULLAYEV, Dastan (FLNR, JINR); Mr UTYONKOV, Vladimir (FLNR, JINR)

Co-authors: POPEKO, Andrey (FLNR); Mr SAGAIDAK, Roman (FLNR, JINR)

Presenter: Mr IBADULLAYEV, Dastan (FLNR, JINR)

Session Classification: Nuclear Physics

Track Classification: Nuclear Physics

Contribution ID: **761** Type: **Oral**

High-performance analysis of the nucleus-nucleus elastic scattering data within the microscopic model of optical potential

Thursday 12 November 2020 15:15 (15 minutes)

The MPI/C++ /Fortran package of computer codes has been developed for high-performance numerical analysis of experimental data on elastic nucleus-nucleus scattering within a microscopic model of optical potential. In the package, a modified DWUCK4 Fortran-code for calculating the physical characteristics of elastic scattering based on a numerical solution of the corresponding Schrödinger equation has been incorporated into the C++ framework, which is responsible for the input-output procedure and a comparison of numerical results with experimental data. MPI-based parallelism allows efficient calculations of the observables depending on a wide range of parameters of real and imaginary parts of the microscopic OP. The package has been used to analyze experimental data on differential cross sections of nucleus-nucleus elastic scattering.

Author: Mr BASHASHIN, Maxim

Co-authors: Dr ZEMLYANAYA, Elena; KAKENOV, Meirzhan (Joint Institute for Nuclear Research (JINR)); Ms YERMEKOVA, Assel

Presenters: Mr BASHASHIN, Maxim; Ms YERMEKOVA, Assel

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **762** Type: **Oral**

ω-φ mixing and processes φ»3π, e+e-»φπ.

Tuesday 10 November 2020 14:45 (15 minutes)

The mixing angle of the vector ω and ϕ mesons is estimated in the framework of Nambu - Jona-Lasinio model. The decay $\phi \to \pi^0\gamma$ is considered as a basic process to determine this angle. The obtained value is compared with the results of the other authors. Besides, the width of the decay $\phi \to 3\pi$ and the cross-section of the process $e^+e^- \to \pi^0\phi$ are calculated by using this angle.

Authors: Prof. VOLKOV, Mikhail (JINR); NURLAN, Kanat (JINR); Mr PIVOVAROV, Aleksey (JINR)

Presenter: NURLAN, Kanat (JINR)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **763** Type: **Oral**

Anomaly sum rules for the case of a singlet current and their features

Tuesday 10 November 2020 16:30 (15 minutes)

We generalize the dispersive approach to axial anomaly by A.D. Dolgov and V.I. Zakharov to a non-Abelian case with arbitrary photon virtualites. We derive the anomaly sum rule for the singlet current and obtain the $\pi^0, \eta, \eta' \to \gamma\gamma^{(*)}$ transition form factors. Using them, we established the behavior of a non-perturbative gluon matrix element $\langle 0|G\tilde{G}|\gamma\gamma^{(*)}\rangle$ for the case of a real photons and for the case of a one virtual photon in both space-like and time-like regions. We found a significant contribution of the non-Abelian axial anomaly to the processes with one virtual photon, comparable to that of the electromagnetic anomaly. The duality between the axial and the vector channels was observed: the values of duality intervals and mixing parameters in the axial channel were related to vector resonances' masses and residues. The possibility of a light pseudoscalar glueball-like state is conjectured.

Authors: Mr OGANESIAN, Armen; TERYAEV, Oleg; Mr KHLEBTSOV, Sergei; KLOPOT, Yaroslav

Presenter: Mr KHLEBTSOV, Sergei

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **764** Type: **Oral**

Investigations on the radiation hardness of the flat tile scintillators for HGCAL CMS

Wednesday 11 November 2020 15:30 (15 minutes)

The results of irradiation of plastic scintillators with flat tile configuration are presented here. Radiation-resistant scintillators are required for the upgrade of the CMS Hadron Endcap Calorimeter for the work at the HL-LHC (Upgrade Phase-II). Given the scintillation part dimensions of the CMS detector, the results of this work are extremely relevant.
According to these conditions, the response of the scintillator samples (light yield) to the minimum ionizing particles before and after irradiation has been investigated. Irradiation has been performed in IBR-2 reactor in the last two years. Thus, the radiation hardness of BC-408 (Bicron, US) and EJ-260 (Eljen, US) scintillator samples based on polyvinyl toluene, and UPS-923A (Ukraine analogue BC-408), SCSN-81 (Kuraray, Japan), SC-301 and SC-307 (Protvino, Russia) scintillator samples based on polystyrene has been studied.
For this purpose a special test bench was developed. Scintillator tiles were read out on this bench by individual Hamamatsu silicon photomultipliers (SiPMs). It is possible to test several dozen samples at the same time. Before test each tile was wrapped in the reflecting foil, and the SiPM was coupled directly to the dimple side of the scintillator. The dimple is a lens for light collection on the sensitive area of SiPM. In addition, the research on the optimization of geometry of the scintillation SiPM-on-tile detector, which is increasingly popular in modern calorimetric devices, was carried out. Thus, there were studies on the dependence of the light output on the size of the light-gathering dimple and dependence of the light output on thickness of scintillator tile.
In addition, the new fast scintillation material (EJ-262), which seems very perspective for using in high-intense radiation fields, has been tested.

Author: USTINOV, Valentin (JINR)

Co-authors: SUKHOV, Evgenii (JINR); AFANASIEV, Sergei (JINR)

Presenter: USTINOV, Valentin (JINR)

Session Classification: Applied research

Track Classification: Applied Research

Contribution ID: **765** Type: **Oral**

Heavy neutrino signals in models with extended lepton sector

Tuesday 10 November 2020 16:45 (15 minutes)

Although the Standard Model (SM) has become the main theory that describes modern Particle Physics, it fails to answer a number of questions. The most famous of «problems beyond the SM» is the origin of neutrino mass, while SM considers only left massless neutrinos.
To explain «problems beyond the SM», it is necessary to introduce new particles and interactions, which haven't yet been detected, possibly because these particles have large mass or they interact weakly. Although the see-saw mechanism describes the scale of neutrino masses well, the masses of heavy neutral leptons (HNL) have a huge range and it's difficult to narrow the search interval. Detection methods may differ for masses of various orders of magnitude.
A relevant challenge for the planned experiments (e.g., SHiP at CERN) is to find the mass scale of HNL. Creating models using the LanHEP software package tools and testing them by means of CompHEP system will allow us not only to understand how well the obtained data coincide with experiments, but also to predict possible parameters to search for new particles on detectors. We can also study in CompHEP rare decays and production of HNL or other processes with them.
We consider several extensions of the SM lepton sector that take into account both Dirac and Majorana neutrinos. The model using only the Dirac mass type, as expected, differs from the experimental data. Two models were studied for Majorana neutrinos: a simplified model with one light and heavy neutrino, and a complete model with three generations.
The results for cross sections and exclusion contours in the model parameter space are presented for the process $e^+e^- \to \nu_e e^- u\bar{d}$ at complete tree-level set of diagrams. A comparison was made with the contours obtained in the L3 and DELPHI experiments in the simplified model.
For a model with three generations, contours were calculated for a specific case of parameterization of the Dirac mass matrix. The mixing structure is non-trivial, since the widths of all three HNL are considered. The exclusions for this model have taken into account cosmological observations.

Author: Mrs NIKOLAEVA, Tatiana (Lomonosov Moscow State University)

Presenter: Mrs NIKOLAEVA, Tatiana (Lomonosov Moscow State University)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **766** Type: **Oral**

Determination of the gamma-ray yields generated during the interaction of 14.1 MeV neutrons with Na, K and Cl nuclei by the tagged neutron method.

Friday 13 November 2020 15:15 (15 minutes)

In the frame of TANGRA-project at JINR-FLNP (Dubna) we measured the gamma-rays resulting from the inelastic scattering of 14.1 MeV neutrons on sodium (Na), potassium (K), and chlorine (Cl). As a source of 14.1-MeV "tagged"neutrons we used ING-27 portable neutron generator of VNIIA (Moscow) where the neutrons are produced in a d-t fusion nuclear reaction, ^{3}H(d,n)^{4}He. The alpha-particles were registered by a 64-pixel Si charge particle detector embedded in ING-27 vacuum chamber.
The aim of this work is to estimate the gamma yields and to determine the neutron induced reaction cross-section for Na, Cl and K nuclei. The experimental data obtained by means of a HPGe detector were processed and analysed with CERN-ROOT modular scientific software toolkit. In this work, we set and performed such tasks as: determining the detector efficiency using calibration gamma-ray sources (^{137}Cs, ^{152}Eu, ^{60}Co, ^{228}Th), using a coincidence window for the collected statistics, finding the full-energy absorption peaks, fitting a Gauss function to them, and determining the gamma-ray quantum outputs. The data obtained can be used for scientific, applied and methodological purposes.

Author: MARZHOKHOV, Ruslan

Co-authors: Mr ALIEV, Fuad; DABYLOVA, Saltanat (Laboratory of neutron physics); Mr DASHKOV, Ilya; Mr FEDOROV, Nikita; Mr GROZDANOV, Dimitar; GUNDORIN, Nikolay (Joint Institute for Nuclear Research, Dubna, Russia); Mr HRAMCO, Constantin; KOPATCH, Yuri (Joint Institute for Nuclear Research); RUSKOV, Ivan (INRNE); Dr SKOY, Vadim; Dr TRETYAKOVA, Tatiana

Presenter: MARZHOKHOV, Ruslan

Session Classification: Nuclear Physics

Track Classification: Nuclear Physics

Contribution ID: **767** Type: **Oral**

Development of a virtual research environment for modeling physical processes on the HybriLIT platform

Tuesday 10 November 2020 16:45 (15 minutes)

The report presents the status of work on the joint project of LIT and BLTP on the creation of a virtual research environment for studying Josephson junctions with magnetic systems. The virtual research environment (VRE) is designed to provide research groups with convenient tools for carrying out the entire research cycle: from building models, setting model parameters, both physical and numerical algorithm parameters, performing resource-intensive calculations on the HybriLIT platform to analyzing the results. The necessity of the VRE development is related, first of all, to the need to combine data storage resources, computing resources and tools for visualizing and analyzing data for various research groups into a unified digital space.

Author: MAROV, Dmitriy (Dubna State University)

Co-authors: BUTENKO, Yuri; NECHAEVSKIY, Andrey (JINR)

Presenter: MAROV, Dmitriy (Dubna State University)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **768** Type: **Oral**

Description of low-lying states of 96Zr based on the collective Bohr Hamiltonian including the triaxial degree of freedom

Tuesday 10 November 2020 17:00 (15 minutes)

Experimental data on ^{96}Zr indicate in this nucleus the coexistence of spherical and deformed structures with small mixing amplitudes. Several low-lying collective quadrupole states and the probabilities E2 and M1 of transitions between them are known in this nucleus. In our work, the observed properties of low-lying collective states of ^{96}Zr are investigated on the basis of a geometric collective model. The consideration is based on the collective Bohr quadrupole Hamiltonian, taking into account the triaxial degree of freedom, which provide the axial symmetry of the states localized in the deformed minimum. The shape of the potential near both minima was determined in such a way as to describe the observed properties of several low-lying collective quadrupole states of ^{96}Zr. Good agreement with experimental data on the reduced probabilities of E2 transitions was obtained in this work. It is shown that the low-energy structure of ^{96}Zr can be satisfactorily described in the framework of a geometrical collective model with a potential assuming the coexistence of spherical and deformed nuclei. However, the excitation energy of the 2_2^+ state can be reproduced only if the rotational inertia coefficient in the region of the deformed minimum is four times less than the vibrational one. It is also shown that shell effects are important for describing the probability of M1 transitions.

Authors: MARDYBAN, Evgenii; Dr KOLGANOVA, Elena; Dr SHNEIDMAN, Timur; Prof. JOLOS, Rostislav

Presenter: MARDYBAN, Evgenii

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **769** Type: **Oral**

Investigation of shape coexistence in 96Zr and 96Mo within the framework of one-dimensional geometric collective model

Tuesday 10 November 2020 17:15 (15 minutes)

The coexistence of forms is an interesting phenomenon that can occur in many nuclei. At the moment, there are experimental data that indicate the coexistence of spherical and deformed shapes in ^{96}Zr and ^{96}Mo. In this work, the observed properties of low-lying collective excitations ^{96}Zr and ^{96}Mo are investigated within the framework of the geometric collective nuclear model without taking into account the nonaxial degree of freedom with the Bohr Hamiltonian, the potential energy of which has two minima - spherical and deformed. The potential energy was selected in such a way as to describe the experimental data on the excitation energies 0_1^+, 0_2^+, 2_1^+, 2_2^+ and states and probabilities E2 of the transitions B(E2; $2_1^+ \to 0_1^+$), B(E2; $2_2^+ \to 0_2^+$) and B(E2; $2_2^+ \to 0_1^+$). A satisfactory description of the excitation energies and transition probabilities is obtained. It is shown that in the case of ^{96}Zr, both minima are rather deep, while in the case of ^{96}Mo, the deformed minimum is only outlined.

Authors: MARDYBAN, Mariia; Dr KOLGANOVA, Elena; JOLOS, Rostislav; Dr SHNEIDMAN, Timur; Mr SAZONOV, Dmitriy

Presenter: MARDYBAN, Mariia

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **770** Type: **Oral**

Calibration systems of the NICA-MPD electromagnetic calorimeter modules

Tuesday 10 November 2020 15:15 (15 minutes)

The multipurpose detector (MPD) has been designed at the JINR to study the properties of hot nuclear matter at the NICA collider. The electromagnetic calorimeter (ECal) is one of the subsystems responsible for the identification of γ-quanta and electron-positron pairs. In addition, it is responsible for their separation from hadrons (for example, π0-mesons) as well as for measuring their energy. The process of developing, tuning and validation of several monitoring systems for calibrating ECal modules is the focus of this paper.
One of these systems involves the use of highly efficient large-area scintillator detectors. The detectors have a fiber-optic light extraction that ensures the high uniformity of the output signals. The fibers are read out by silicon photomultipliers (SiPM). The calibration is carried out to the response of each cell of the calorimeter to the minimum ionizing particle that passes through it. Cosmic rays are used as the source of these particles.
Another method to calibrate ECal modules is the side-glow optical fiber (SOF-2) system. SOF-2 fiber emits light transversely along its entire length by means of special laser notches, and can be used to calibrate photosensors of the ECal modules. It is important that the fiber emits light isotropically along its entire length at a constant amplitude. The results of studying the properties of side-glow fibers on a specially developed test bench are presented in this research.

Author: KUTINOVA, Olga (JINR)

Co-authors: USTINOV, Valentin (JINR); SUKHOV, Evgenii (JINR)

Presenter: KUTINOVA, Olga (JINR)

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **771** Type: **Oral**

START DETECTOR FOR TIME-RESOLVED HIGH ENERGY IONOLUMINESCENCE EXPERIMENTS

Friday 13 November 2020 14:30 (15 minutes)

Being a sensitive probe for structural imperfections, the ion beam induced luminescence is efficient tool for real-time characterization of irradiating materials. In particular, registration of the luminescence decay after single ion impact may provide very interesting information about dynamics of dense electronic excitations in vicinity of swift ion trajectory. Temporal resolution in such experiments is strongly dependent on parameters of start pulse of usually MCP based detector placed on some distance from studied specimen, which registers secondary electrons emitted from the thin metal foil by ion passage. To avoid any effects due to dispersion in the ion energy after passage of foil, we suggested using electron emission immediately from the target surface. The design of start pulse detector and first results of measurements of luminescence decay curves from 1.2 MeV/amu Xe ion irradiating aluminum oxide with 400 ps resolution are presented.

Author: ISSATOV, Askar (JINR)

Co-authors: SKURATOV, Vladimir; TETEREV, Yuri (JINR FLNR); MITROFANOV, Semen (FLNR); MORZABAEV, Aidar (L.N. GUMILYOV EURASIAN NATIONAL UNIVERSITY)

Presenter: ISSATOV, Askar (JINR)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **772** Type: **Oral**

Equation of State at Imaginary Chemical Potential and External Magnetic Field from Lattice QCD

Tuesday 10 November 2020 15:15 (15 minutes)

This report is devoted to lattice study of QCD equation of state (EoS) at finite baryon chemical potential and nonzero magnetic field. The simulations are performed with rooted dynamical staggered u, d, and s quarks at physical quark masses. In view of the sign problem, the study is carried out at imaginary chemical potential. The results are analytically continued to real chemical potential.

Our preliminary results for the pressure and energy density for various values of temperature, chemical potential and magnetic field are presented.

Authors: ASTRAKHANTSEV, Nikita (Universitat Zurich); BRAGUTA, Victor (JINR); KOLOMOYETS, Natalia (JINR); KOTOV, Andrey (JINR); NIKOLAEV, Aleksandr (Swansea University)

Presenter: KOLOMOYETS, Natalia (JINR)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **773** Type: **Oral**

Analysis of the rare $K^+ \to e^+ v^{+-}$ decay in the NA62.

Monday 9 November 2020 17:30 (15 minutes)

The main goal of the NA62 experiment at CERN is to measure the probability of the ultra-rare $K^+ \to {}^+vv$ decay. The collected statistics for 2016-2018 years allow us to analyze other rare decays, in particular, $K^+ \to e^+ v^{+-}$. Since the inner bremsstrahlung (IB) for $K^+ \to e^+ v^{+-}$ decay is suppressed (0.03%), this decay is well suited for measuring form factors (F_V, F_A, and R). The chiral perturbative theory (ChPT) prediction of the decay probability $K^+ \to e^+ v^{+-}$ with a value of $1.12 * 10^{-8}$ is known. The previous experimental result is $(1.7 \pm 0.5) * 10^{-8}$.
We present the research methodology, the first results of signal selection, and the study of the background sources for the decay.

Author: BAIGARASHEV, Dosbol (Maratuly)

Co-authors: Ms BAEVA, Aigul; KEREIBAY, Dias; SHKAROVSKIY, Sergey (JINR, Dubna); EMELYANOV, Dmitry (NA62)

Presenter: BAIGARASHEV, Dosbol (Maratuly)

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **774** Type: **Oral**

Ion beam irradiation of 12-tungstophosphoric acid – influence of energy of accelerated ions on structural and electrochemical properties

Friday 13 November 2020 14:45 (15 minutes)

Ion beam irradiation is a versatile tool for structural modification and engineering of new materials, where the energy of ions dictates the nature of interactions between accelerated ions and the target. In this study, 12-tungstophosphoric acid (WPA) films of different thickness were spin-coated on platinized silicon substrate and irradiated with: low energy light ions (H- and C+) with energies up to 20 keV and swift heavy ions (Bi, Xe and V) with energies up to 710 MeV. Raman spectroscopy was used as a main technique for investigation of structural properties of irradiated WPA. New wide vibrational bands in regions from 100 to 500 and 600 to 1000 cm-1 were observed in Raman spectra of all irradiated samples which are comparable to the ones recorded for WPA thermally treated at 600 ℃. Ratio of these bands compared to the bands of Keggin anion varied with the energy of ions and the sample thickness where swift heavy vanadium ions showed the most prominent change inducing significant modification of 20 μm films and partial modification of 120 nm films. In an attempt to correlate structural changes with electrochemical performance, samples irradiated with low energy light ions where characterized by cyclic voltammetry. 120 nm films irradiated with carbon ions showed increase in lithiation capacity and activity for HER with irradiation, while 20 μm-thick H¬- irradiated samples showed more uniform lithiation with cyclic voltammograms similar to those of phosphate tungsten bronzes.

Author: Mr MRAVIK, Željko

Co-authors: Dr BAJUK-BOGDANOVIĆ, Danica; Mr OLEJNICZAK, Andrzej (Nicolaus Copernicus University, Torun´, Poland Joint Institute for Nuclear Research, Dubna, Russia); Mr TRAJIĆ, Ivan; Mr VUKOSAVLJEVIĆ, Ljubiša; Dr GAVRILOV, Nemanja (bFaculty of Physical Chemistry, University of Belgrade, P.O. Box 47, 11158 Belgrade, Serbia); Dr JOVANOVIĆ, Zoran

Presenter: Mr MRAVIK, Željko

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **775** Type: **Oral**

SWIFT HEAVY ION IRRADIATION-INDUCED CHANGES IN MECHANICAL PROPERTIES OF Si3N4

Friday 13 November 2020 15:00 (15 minutes)

Silicon nitride is one of the perspective ceramics for inert matrix fuel hosts to be used for transmutation of minor actinides. Such materials should have structural stability and appropriate mechanical properties being irradiating with neutrons, α-particles and fission products.
In this work we report on mechanical properties of polycrystalline Si3N4 irradiated with swift heavy ions simulating fission fragment impact. The samples were bombarded with 167 MeV Xe, 220 MeV Xe, 46 MeV Ar, 107 MeV Kr and 710 MeV Bi to fluences ranged from 6×10^11 to 5×10^14 cm-2 and examined using nanoindentation technique. It has been found that radiation-induced changes in material hardness are strongly dependent on defect structure formed via relaxation of dense electronic excitation, i.e. accumulation and overlapping amorphous track regions.

Authors: Dr IBRAYEVA, Anel (JINR, Russia; Nur-Sultan Branch of Institute of Nuclear Physics, Kazakhstan); Dr KORNEEVA, Ekaterina (JINR, Russia); Dr JANSE VAN VUUREN, Arno (Centre for HRTEM, Nelson Mandela University, South Africa); Dr KURPASKA, Lukasz (National Center for Nuclear Research, Poland); Ms CLOZEL, Melanie (National Center for Nuclear Research, Poland); KIRILKIN, Nikita (FLNR); SKURATOV, Vladimir; Prof. NEETHLING, Jan (Centre for HRTEM, Nelson Mandela University, South Africa); Dr ZDOROVETS, Maxim (The Institute of Nuclear Physics)

Presenter: Dr IBRAYEVA, Anel (JINR, Russia; Nur-Sultan Branch of Institute of Nuclear Physics, Kazakhstan)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **776** Type: **Oral**

Development of detailed ROOT geometry for the inner tracker detectors in the BM@N experiment

Thursday 12 November 2020 15:00 (15 minutes)

The configuration of the basic detectors (Forward Si and GEM), included in the inner tracking system of the BM@N setup, has to be improved in order to be in compliance with requirements of the forthcoming experimental runs that will be held in 2021-2022. The preliminary estimation of geometric efficiency for the next configurations of tracking detectors is made with simulation procedure based on using ROOT geometry. Therefore, it is important to take into account not only sensitive planes but also passive elements such as frames, electronics, different material layers inside gas-filled chambers and others. In the report two versions of ROOT geometry for each detector configuration are presented. The first one is simplified geometry consisting of only sensitive planes and some basic frames. The second version is detailed, more realistic, geometry that comprises constructive elements (passive volumes of various materials). Also, comparison of these geometries in terms of material budget is given in the report.

Author: BARANOV, Dmitry (tuta)

Presenter: BARANOV, Dmitry (tuta)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **777** Type: **Oral**

A criterion for infinite positron feedback in the dynamics of runaway electron avalanches

Tuesday 10 November 2020 15:00 (15 minutes)

Terrestrial Gamma-ray Flashes (TGF) - short (~ 100 μs) and intense flashes of terrestrial gamma radiation, the source of which is thunderstorms. This remarkable natural phenomenon has been observed for over 20 years by satellites (for example, Fermi), as well as by ground-based observatories (for example, the Array telescope).
It is believed that the source of gamma radiation is avalanches of runaway electrons accelerated by thunderstorm electric fields.
Joseph Dwyer proposed a model of runaway avalanches - the Relativistic Feedback Discharge Model (RFDM). According to this model, there is a feedback mechanism in the dynamics of avalanches that leads to the reproduction of avalanches and, therefore, their endless existence within strong atmospheric electric fields. Such an amazing process is caused by the creation of positrons by the bremsstrahlung of electron avalanches.
In this work, an analytical study of RFDM is carried out. The spatial distributions of particles are obtained for all generations of self-replicating avalanches. A criterion for the existence of infinite positron feedback in thunderclouds is also derived. Simulations on Geant4 support the result.

Author: STADNICHUK, Egor (MIPT, INR RAS)

Presenter: STADNICHUK, Egor (MIPT, INR RAS)

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **778** Type: **Oral**

Computer simulation of radiation damage mechanisms in the structure of brain cells

Thursday 12 November 2020 15:15 (15 minutes)

Investigation of the effects of ionizing radiation on cells of the central nervous system is a challenging topic in modern radiation research, as well as treatment planning in radiation therapy and predicting the space radiation health risk for exploration cosmonauts. To contribute in understanding radiation damage mechanisms in complex morphology of brain cells, it is necessary to investigate the stochastic nature of particle tracks in critical structures of mature and immature neurons. In this work, we studied the processes of degradation of dendritic branches and spines, reduction in their number depending on the radiation dose of different particles using Monte Carlo simulations (Geant4). It is also estimated that energy and dose depositions, number of particle traversals, the neuronal cell hits and the formation of direct and indirect molecular damages as a function of LET, and dose-dependent survival of undifferentiated cells in the rat hippocampus following irradiation. Our simulation results for protons and heavy ions are consistent with the experimental results.

Author: MUNKHBAATAR, Batmunkh (LRB, JINR)

Co-authors: LKHAGVAA, Bayarchimeg (JINR); BUGAY, Aleksandr (Joint Institute for Nuclear Research); OIDOV, Lkhagva

Presenter: MUNKHBAATAR, Batmunkh (LRB, JINR)

Session Classification: Life Science

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **779** Type: **Oral**

Intermetallic Actinides Target Approach for Intensive Heavy Ion-Beam Irradiations

Friday 13 November 2020 14:30 (15 minutes)

Currently, the synthesis of new superheavy elements in nuclear fusion reactions requires long-term irradiations of actinide targets with high-intensity heavy ion-beams. For more intense ion beams construction of the Superheavy Element Factory (SHE Factory) of the Flerov Laboratory of Nuclear Reactions FLNR JINR, was recently completed and now it is fully operational. Whereas more intense ion beams were developed, the improvement of target technology is of current interest. Production of thin intermetallic actinide targets (Pu, Am, Cm, Bk, Cf) is a promising way for the preparation of high-power radioactive targets. We propose the approach to the preparation of intermetallic actinide compound targets based on a combination of physical vapor deposition and molecular electroplating, followed by coupled reduction. At the first step, our goal was to predict the behavior of americium with various metals under co-heating. We made a calculation of enthalpy solutions by using the Eichler-Miedema model. Based on the obtained results, the following combinations were selected: as a metal foil (backing material) - titanium; as a diffusion layer - palladium, platinum, iridium. The first targets were prepared by using an intermetallic target approach. The plan is to test targets under the conditions of actual irradiation. The targets are going to be examined analysis before and after the irradiation by AFM, SEM, EDX, XRF, XRD analyses.

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Presenter: Mrs MELNIK, Elizaveta (FLNR JINR)

Session Classification: Nuclear Physics

Track Classification: Nuclear Physics

Contribution ID: **780** Type: **Oral**

Study of the effect of anthropogenic load on the gene expression levels and elemental composition of endemic sponges of Lake Baikal

Thursday 12 November 2020 15:45 (15 minutes)

Sponges are one of the oldest multicellular animals that have survived almost unchanged to this day. The earliest finds of sponge remains date back 680 Ma. At the moment, the planet is inhabited by both marine and freshwater sponges. By the type of nutrition, all sponges are filter feeders, so they play an important role in aquatic ecosystems. At a certain moment events of mass diseases and mortality of sponges were noted in different aquatic ecosystems.

Lake Baikal is inhabited with 15 species of endemic sponges. Baikal sponges are not just one organism, but a whole community of sponge with symbionts - unicellular algae and bacteria. Due to the symbiosis, the sponges are green colored. In the last decade, events of mass diseases and mortality of sponges have been observed on Lake Baikal, which indicates negative changes in the ecosystem of the lake. Endemic sponges are an important object to study, since they make up a bulk of benthos biomass and play a key role in the ecosystem of Lake Baikal, which contains 20% of the world's fresh water and is a UNESCO World Heritage Site.

To reveal background of these events we perform analyses of elemental composition and gene expression of Baikal endemic sponge Lubomirskia baikalensis. Two sampling points were chosen by monitoring data, showed places with the highest and the lowest rates of sponge disease. It was Listvyanka bay, which is considered to be the most anthropogenic impacted point and Bolshie Koty bay, which looks like almost intact. Samples of L.baikalensis were collected by SCUBA diving at Listvyanka Bay, n=10, and Bolshie Koty Bay, n=10. Samples were collected at August 2020. Immediately after collection, the samples were frozen at -20℃ for Neutron Activation Analysis (NAA) and tissue parts were placed in IntactRNA solution for gene expression analyses.

Changing the level of gene expression is one of the main mechanisms of adaptation of a living organism to changes in the environment. Since the endemic Baikal sponges have lived in very stable conditions for the past several million years, even small changes in the environment should trigger a response at the level of gene expression. To study the mechanisms of sponge cells protection from the effects of heavy metals, an analysis of the gene expression, whose products are involved in the most important metabolic pathways of cell interaction with heavy metals, will be carried out.

To characterize expression patterns in L.baikalensis four candidate stress response genes were chosen for later qPCR analyses, based on previous assessments of upregulation in other aquatic invertebrate species [1,2] and studies of gene expression response to heavy metal exposure for different types of organisms. For glutathione-s-transferase mu class gene expression differences have been shown on Mollusca, collected in points with different anthropogenic load. Copper transporting ATPase 1 and copper chaperone for superoxidedismutase were also used in this study.2 MTF1 gene is shown to be transcriptional regulator involved in cellular adaptation to exposure to heavy metals 3

Specific primer pairs for these genes were selected based on previously published transcriptome data of L.baikalensis. [4] Primer design and further analyzes is carried out in Molecular Genetics Group DLNP, JINR.

As a result, a test system will be developed based on the expression levels of heavy metal defense genes to quickly assess the state of the ecosystem of Lake Baikal

Sample preparation for Neutron Activation Analysis was carried out in In the Sector of Neutron Activation Analysis and Applied Research, FLNP, JINR. Sponge samples were dried to dry weight and divided into 6 cm pieces. Each piece will be homogenized and analyzed separately. This approach will allow us to find out the dynamics of accumulation of heavy metals in sponges with age and differences in heavy metal concentrations at points with high and low percentage of diseased sponges. The elemental composition of the Baikal sponges was previously studied in the 1980s and 2000s [5,6]. The ability of sponges to accumulate copper and aluminum has been shown. Taking into account the dynamics of the development of the tourism industry on the shores of Lake Baikal and the annual increase in anthropogenic load, it is necessary to study how much the levels of accumulated heavy metals have changed in sponges during last 20 years.

All these data will help us assess the contribution of anthropogenic load to the development of the ecological crisis on Lake Baikal, which is currently being observed.

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Authors: YAKHNENKO, Alena (JINR, LIN SB RAS); YUSHIN, Nikita; NEBESNYKH, Ivan (LIN SB RAS); Dr ZINICOVSCAIA, Inga (Joint Institute for Nuclear Research); Dr KRAVCHENKO, Elena (JINR)

Presenter: YAKHNENKO, Alena (JINR, LIN SB RAS)

Session Classification: Life Science

Track Classification: Applied Research

Contribution ID: **781** Type: **Oral**

Problem-oriented interface for MICC

Tuesday 10 November 2020 15:30 (15 minutes)

The saas.jinr.ru service is an attempt to simplify the usage of the JINR Multifunctional Information and Computing Complex (MICC). The project mainly focuses on evaluating the potential of problem-oriented web-interfaces and ways to ease the access to all of the major computing facilities of the MICC. The talk will cover the project's current state, including the service architecture and capabilities, and further development plans.

Authors: BALASHOV, Nikita (JINR); KUTOVSKIY, Nikolay (JINR); SOKOLOV, Ivan (Alexandrovich)

Presenter: BALASHOV, Nikita (JINR)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **782** Type: **Oral**

Status of the GEM tracking system at the BM@N experiment

Tuesday 10 November 2020 16:30 (15 minutes)

Baryonic Matter at Nuclotron (BM@N) is a fixed target experiment at the NICA accelerator complex (JINR) aiming at studies of nuclear matter in relativistic heavy ion collisions. Detectors based on Gas Electron Multipliers (GEM) are used for the central tracking system, which is located inside the BM@N analyzing magnet. The current status of the GEM tracking system is presented.

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Presenter: Mr GALAVANOV, Andrei

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **783** Type: **Oral**

Detection of clustered DNA damage in mammalian neuronal cells induced by ionizing radiation with different physical characteristics

Thursday 12 November 2020 14:00 (15 minutes)

Ionizing radiation with different physical characteristics induces a wide spectrum of DNA damage. The structural DNA damage, such as single-strand breaks (SSB), double-strand breaks (DSB) and AP sites (abasic sites missing either a pyrimidine or purine nucleotide), as well as cluster damage, which are the set of all these damage, is the main factor which could lead to the formation of various mutations, chromosome aberrations, and further cell death. In this regard, research of DNA damage induction and repair under the action of ionizing radiation is the most important goal in radiation genetics, radiotherapy and space radiobiology.

It is commonly known that a substantial amount of enzymes implicated in the identification, localization and damage repair formed during the action of various physical, chemical or biological factors is involved in the repair process. The use of DNA repair enzymes involved in the base excision repair, such as DNA endonuclease III (Endo III) and formamidopyrimidine glycosylase (FPG) expanded the spectrum of experimentally-detectable clustered DNA damage.

The total number of lesions in the DNA involving AP sites, DSBs and SSBs can be detected by using the enzymatic comet assay in neutral and alkaline conditions respectively. The induction and repair regularities of DNA damage (DSB, SSB, AP sites) in mammalian neuronal cells induced by ionizing radiation with different physical characteristics: 60Co γ-rays and accelerated 15N ions (LET = 85 keV/μm) were investigated. It was shown that the yield of DNA SSB and DSB increases in the presence of repair enzymes after exposure to both types of ionizing radiation. An amount increase of DNA DSB under the influence of EndoIII and FPG indicates the great contribution of modified bases to the cluster DNA damage formation. The quantity of modified purine bases (mPur, upon treatment with FPG) is slightly higher than the quantity of modified pyrimidine bases (mPyr, upon treatment with Endo III) in Sprague-Dawley rat hippocampal cells and in human U87 glioblastoma cells after exposure to accelerated 15N ions *in vitro.* These results can be explained by the fact that using of DNA repair enzymes (Endo III and FPG) which convert damaged bases and AP sites into DNA lesions allow us to identify that the number of arising DNA AP sites is large enough after exposure to different types of ionizing radiation.

The effect of DNA synthesis inhibitors – cytosine arabinoside (AraC) under the normal conditions and after repair enzymes treatment on the cluster DNA damage in rat hippocampal cells after exposure to 60Co γ-rays *in vivo* was studied. It has been shown that under normal conditions the number of DNA damage increases up until 4 h of and after that the processes of DNA damage repair were complete within 24 h of post-radiation incubation. In the presence of AraC an increase in the total amount of DNA damage is observed during the entire post-radiation incubation. In this case, the maximum yield of DNA SSB is shifted by 1 h of post-radiation incubation.

Author: Ms KOZHINA, Regina (LRB)

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Presenter: Ms KOZHINA, Regina (LRB)

Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **784** Type: **Oral**

Distributed information and computing infractructure of the JINR Member States organizations

Tuesday 10 November 2020 15:00 (15 minutes)

For a significant reduction of time spent on research to obtaining meaningful results in scientific domains, the computer resources of the Joint Institute for Nuclear Research (JINR) and some organizations of its Member States were integrated into a distributed information and computing environment (DICE). A technical possibility for running tasks in that environment was implemented for the BM@N, MPD and Baikal-GVD collaborations users. Resources that are not occupied by computational tasks within the main JINR scientific domains are used to conduct research on the SARS-CoV-2 virus that causes the COVID-19 disease. Besides, the paper provides a description of the technical implementation of the DICE, lists the participating organizations, provides statistics on the use of their resources.

Authors: MAKHALKIN, Alexandr (JINR); PELEVANYK, Igor (JINR); Mr BALASHOV, Nikita (JINR); KUTOVSKIY, Nikolay (JINR); SEMENOV, Roman (JINR); MAZHITOVA, Yelena (JINR)

Presenter: MAZHITOVA, Yelena (JINR)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **785** Type: **Oral**

Search for a high-mass DM mediator decaying to a dilepton final state.

Tuesday 10 November 2020 14:00 (15 minutes)

The presented search for new high-mass resonances decaying into lepton pair. The search uses pp collision data at a centre-of-mass energy of 13 TeV collected by the CMS experiment at the LHC in 2016, corresponding to an integrated luminosity of 36 fb-1. Upper limits on the product of a new resonances production cross section and branching fraction to dileptons are calculated in a model independent manner. Performed interpretation in a simplified model of dark matter production via a vector or axial vector mediator, limits at 95% confidence level are obtained on the masses of the dark matter particle and its mediator.

Author: ZHIZHIN, Ilia (JINR)

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Presenter: ZHIZHIN, Ilia (JINR)

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **786** Type: **Oral**

Comparison of methods for elliptic anisotropic flow measurements at NICA energies $\sqrt{s_{NN}}$=4-11 GeV

Wednesday 11 November 2020 15:00 (15 minutes)

The goal of the MPD experiment at NICA collider is to explore the QCD phase diagram of strongly interacting matter produced in nucleus-nucleus collisions at $\sqrt{s_{NN}}$=4-11 GeV in the region of high net baryon chemical potential and moderate temperatures. The anisotropic collective flow is one of the key observables sensitive both to the transport properties and equation of state of such matter. MPD performance for elliptic flow measurements is studied with Monte-Carlo simulations of Au+Au and Bi+Bi collisions using UrQMD and SMASH heavy-ion event generators. Different methods for flow measurements: event plane and Q-cumulants are applied for the investigation of the contribution of non-flow correlations and flow fluctuations.

Authors: Mr LUONG, Vinh (NRNU MEPhI); IDRISOV, Dim; Mr PARFENOV, Peter; Dr TARANENKO, Arkadiy; DEMANOV, Alexander; Mr TRUTTSE, Anton (NRNU MEPhI)

Presenter: Mr LUONG, Vinh (NRNU MEPhI)

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **787** Type: **Oral**

Reconstruction of energy and heavy ion collision point at FHCal (MPD)

Tuesday 10 November 2020 16:15 (15 minutes)

At present, in Dubna, Russia a new acceleration complex NICA is approaching final stages of its construction. At collider, there will we two major detectors, one of them, Multi-Purpose Detector (MPD), is going to be used for studying properties of dense baryonic matter. One of the most important parts of MPD is Forward Hadron Calorimeter (FHCal). FHCal will consist of two arms: left and right, which will be positioned symmetrically centre of MPD. Both arms have module structure and will consist of 44 modules each.
The main goal of FHCal is measurement of centrality and determination of reaction plane of collisions. Another important goal, which this work is dedicated to, is reconstruction of heavy ion collision point. To reconstruct energies inside FHCal a procedure of energy calibration needs to be carried out. This procedure is described in detail in my work. It was done on cosmic muons on a test stand of 3x3 modules. The resulting light yield is close enough in all sections in modules, which indicates good quality of produced modules. In order to estimate the expected accuracy of point collision measurement Monte-Carlo simulation was made and dependency of energy distribution in FHCal modules on coordinate of ion collision was studied. According to calculation estimated accuracy of collision point reconstruction was found to be 21 cm. Another method of ion collision point reconstruction that is based on measurement of difference of time when spectators reached FHCal arms was developed. The estimated accuracy of this method is better than 10 cm.

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Presenter: Mr STRIZHAK, Alexander (INR RAS)

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **788** Type: **Oral**

On One Implementation of the Numerov Method for the One-Dimensional Stationary Schrödinger equation

Thursday 12 November 2020 15:30 (15 minutes)

We present accurate numerical results for the one-dimensional stationary Schrödinger equation in the case of three quantum problems: quantum harmonic oscillator, radial Shrödinger equation for a Hydrogen atom, and a particle penetration through the potential barrier. All of them were solved by the Numerov method with high accuracy and we plot their wave functions using the results of the numerical calculations. Furthermore, we offer accurate numerical methods for solving boundary value problems, boundary condition problems, matrix elimination.

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Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **789** Type: **Oral**

Phenomenological methods for atomic nuclei masses evaluation in drip lines area

Friday 13 November 2020 14:45 (15 minutes)

In this work we obtain theoretical nuclear masses (or binding energy) and localize proton and neutron drip lines using method of local mass relations. This method demonstrates good applicability for atomic mass predictions [1, 2, 3]. For estimates we use an approximation of the formula that describes the residual *np*-interaction, the features of which were discussed in detail in the previous work [4].
In addition, we show results obtained by a completely different method –machine learning based on support vector regression. We predict the specific binding energies based on the specific binding energies of several neighboring nuclei and run several iterations of machine learning to reach an area far from the stability line.
Comparison with estimates of other works, which are based on other approaches, showed reliable accuracy of the results obtained.

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Presenter: VLADIMIROVA, Elena (Lomonosov Moscow State University, Faculty of Physics)

Session Classification: Nuclear Physics

Track Classification: Nuclear Physics

Contribution ID: **790** Type: **Oral**

Study of the 16-channel scintillation detector prototype with SiPM readout

Tuesday 10 November 2020 16:45 (15 minutes)

The paper presents measurements of the noise characteristic of SiPM in the temperature range from 27.7 ℃ to 39.1 ℃, as well as study of the response of the detector prototypes Ketek and Hamamatsu with SiPM readout to the LED at different voltages. The prototype with SiPM readout from Ketek was tested on the JINR Nuclotron deuteron beam at the energy of 4 GeV/nucleon. Time resolution and amplitude of the signal have been estimated.

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Presenter: TISHEVSKIY, Aleksey (JINR)

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **791** Type: **Oral**

Development and testing of multilayer neutron detectors

Tuesday 10 November 2020 17:00 (15 minutes)

One of the tasks of the precision hybrid magnetic spectrometer SCAN-3 at the Joint Institute for Nuclear Research (JINR) in Dubna is to register neutrons from the decay of the η-meson nucleus via the πn- and pn-channels. The only way to provide neutron spectrometry is to use the time-of-flight method. Taking into account the geometry of the SCAN-3, confines are imposed on the accuracy of measuring the time-of-flight for neutron δt=2.2 ns for the πn-channel and δt=0.4ns for the pn-channel in the region of the energy of neutrons from 100 to 300 MeV. The development, development and testing of such a neutron detector is not a trivial task for researchers. The most promising approach for this task is to create a multilayer hadron detector based on a plastic scintillator. The purpose is to achieve a time-of-flight resolution of better than 50 ps for each particle.
The main problem with the detection and spectrometry of high-energy deuterons at the NUCLOTRON accelerator at JINR is the lack of direct signals from the neutrons passing through the detector's material. Neutron registration is performed by the secondary product of neutron interaction with the material of detector. During elastic neutron scattering, rebound proton nuclei are registered, and in the case of detection by nuclear reactions, the resulting secondary particles, nuclear fragments, and γ-quanta are registered.
The point of neutron interaction in a material is a random value that depends on the interaction cross section of the neutron energy and the detector thickness. The method used for high-energy neutron time-of-flight spectrometry has a measurement error that depends on the thickness and time resolution of the detector.
To accurately determine the interaction point, a multi-layer neutron meter scheme was chosen, in which the interaction point is determined with the accuracy of the thickness of the plate used. The detector is based on 5 plastic scintillators with dimensions of 700 x 200 x 20 (mm)3. Light registration in the neutron detector is performed using the FEU-87 and FEU XP2041 with a time resolution not worse than 0.1 ns.

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Presenter: SUKHOV, Evgeni (LHE JINR)

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **792** Type: **Oral**

Ecosystem of information services for the BM@N experiment

Tuesday 10 November 2020 14:30 (15 minutes)

For effective work on constructing the BM@N experiment of the NICA project, it is necessary to use tools for centralized storing and exchanging of information, which should simplify the search for the required information, as well as ensure its relevance and consistency, especially when an international collaboration is being formed around the experiment. In the process of designing the experiment, various types of documentations are produced, experiment data are simulated, scientific articles are written, software systems are developed and other work is carried out with many sources of information, which must be systematized for convenient work. To operate with various types of information concerned with the BM@N experiment, specific information services were developed and integrated into one ecosystem. The report describes all the services that compose the ecosystem and details of their implementation. The following integrated services are presented, such as, a Single Authorization and Group Security Policy service, system for storing structured information of the experiment (BM@N Wiki), online Electronic Logbook system, collaboration forum, service for visualizing hardware parameters of the slow control system, user interface for offline database of the experiment and job definition service for distributed data processing. The main entry point for collaboration members is the official BM@N website, from which access to all the implemented information services is obtained.

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Presenter: SLEPOV, Ivan (JINR)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **793** Type: **Oral**

Polarized neutron reflectometry with secondary radiation registration

Friday 13 November 2020 15:15 (15 minutes)

One of the most actual problem at the physics of low-dimensional superconducting/ferromagnetic heterostructures is determination of the correlation between magnetic spatial profile and the spatial profiles of the elements at the interface between layers. Standard neutron reflectometry can't be used to measure neutron interaction with separate element, in particular, magnetic field induction. A new method allows one to determine the elemental and magnetic profiles. The reflected neutron beam and secondary radiation are simultaneously recorded in this method. Charged particles and gamma-quants can be secondary radiation because of neutron capture reaction. Also scattered neutrons and spin-flip neutrons can be secondary radiation.

At the REMUR reflectometer at the IBR-2 reactor, channels for secondary radiation registration were realized: spin flip neutrons, charged particles and gamma-quanta. Currently, a sufficiently large number of element isotopes are available for measurements. At measuring time $t = 1\,day$, resolution by the wave vector $\delta k/k = 0.1$, $\lambda = 1.5$, cross section of the beam at a sample of $0.1\,cm^2$, layer thickness 5 nm and neutron flux density at the sample of $2 \cdot 10^4\,cm^{-2}s^{-1}$ it's: a) for the charged particles registration channel, the minimum value of the cross section is $\sigma_{min} = 0.025\,barn$, the cross section $\sigma > \sigma_{min}$ has 22 isotopes; b) for the gamma-quanta registration channel, $\sigma_{min} = 0.3\,barn$, more than 100 isotopes have a cross section $\sigma > 0.3\,barn$; c) for the polarized neutrons registration channel, the minimum, perpendicular to the neutron polarization, component is 1 G.

Further progress is possible. The first is increasing of neutron intensity to 5–10 times. The second is the reduction of the fast neutrons and gamma-quanta background from the reactor core by 5-10 times. Third is increasing of the solid angle visible to gamma-ray detector by 4 times or increasing of the detectors number to 4. Realization of these improvements at the REMUR reflectometer make available cross section 1 mbarn for an absorbing layer 5 nm or cross section 50 mbarn for 1 Å layer. The spatial resolution can reach 1 Å by using super-mirror neutron reflector at the structure. In the case of studying periodic structures, high spatial resolution can be achieved by reducing the period of the structure. At nowadays technological level, structures with period 1 nm are available, which gives a value of 1-2 Å for resolution.

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Presenter: ZHAKETOV, V.D. (Joint Institute for Nuclear Research)

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **794** Type: **Oral**

Application of modern IT technologies for biological tasks

Tuesday 10 November 2020 16:15 (15 minutes)

This work is aimed at description of issues we face conducting radiobiology experiments at Laboratory of Radiobiology. Our investigations are based on organismic and cell levels. This work shows the opportunities to apply the modern IT technologies for storing the data (photo&video) of histological researches and after behavioral tests, optimization the work of the software, automatization of histological procedures by artificial neuronnetworks.

Authors: KOLESNIKOVA, Inna; Dr STRELTSOVA, Oksana

Presenter: KOLESNIKOVA, Inna

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **795** Type: **Oral**

Study of nucler halos and skin

Generally,in a nucleus, the number of protons and neutrons doesn't differ much. But recently, in some experiments where the no. of neutrons exceed the protons no. various new properties are discovered. When we see the nuclear landscape, particularly at neutron drip-line we see nuclear halos and skin. Like in case of 17-22**N** or in oxygen atom with excess neutrons. In my talk I want to elaborate "Neutron skin and signature of the N=14 shell gap found from measured proton radii of 17-22**N

Author: Mr CHAHAR, Vaibhav (M. S physics)

Presenter: Mr CHAHAR, Vaibhav (M. S physics)

Session Classification: Nuclear Physics

Track Classification: Nuclear Physics

Contribution ID: **796** Type: **Oral**

Geometry-dependent classicality of qutrits on low-dimensional orbits

Tuesday 10 November 2020 17:45 (15 minutes)

Unlike the standard statistical distribution, for some states the Wigner function takes negative values, and this property is generally considered to be an indicator of quantumness of a system. We analyze the global indicator of classicality for N-level quantum systems, which is based on the negative part of the Wigner function and defined on the orbit space of a quantum system endowed with a certain Riemannian metric. Meaning to find connections between the informational contents and geometrical characteristics of quantum states, we evaluate the global indicator of classicality of a qutrit for various metrics.

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Presenter: TOROSYAN, Astghik (LIT)

Session Classification: Theoretical Physics

Track Classification: Mathematical Modeling and Computational Physics

Contribution ID: **797** Type: **Oral**

Neutron diffraction studies of pressure induced phase transitions in Bi2WO6

Friday 13 November 2020 15:30 (15 minutes)

Bi2WO6 is the simplest member of the Aurivillius family, but it possesses many interesting physical properties such as ferroelectricity with large spontaneous polarization and high Curie temperature (Tc=960), piezoelectricity with a potential for high-frequency and high temperature applications, high ion conductivity and photocatalytic activity. But apart from potential application, bismuth layered compounds are attractive for great number of scientific research. However, pressure dependent studies of this family of compounds are scarce. It should note, the high pressure studies of the ferroelectric phase evolution, especially in the vicinity of para-ferroelectric phase transition are essential in order to reveal its formation mechanisms upon variation of interatomic distances. It present work the compound of Bi2WO6 was chosen at ambient condition, and performed neutron diffraction studies at high pressure. Neutron powder diffraction measurements at ambient and high pressures up to 7 GPa were performed at room temperatures 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 Bi2WO6 under pressure up to 30 GPa were performed.

The lattice compression of the unit cell is anisotropic with the most compressible of b parameter and weakly compressible a and c lattice parameters. At P≈3.5 GPa anomalies in pressure behavior of lattice parameters were observed, which are affected by the phase transition (from Pca21 to B2cb space group). There are also observed the clear changes of the vibrational modes of Bi2WO6 under compression. By increasing the pressure, wave numbers of the majority of modes increase, however, some modes exhibit negative pressure dependence. Changes in the slope of wave number vs pressure at 3.5 and 6 GPa are observed for a lot of modes, which indicates about a second order phase transitions associated with some subtle changes in the crystal structure. The first transition is most likely associated with the loss of the octahedral tilt mode around the pseudotetragonal axis and the phase symmetry changes from Pca21 to B2cb.The second transition is related to the disappearance of the soft mode. On the dependences of the vibrational modes from 6 to 30 GPa have revealed no anomalies.

The work was supported by the Russian Foundation for Basic Research, grant RFBR N19-52-45009 IND_a.

Authors: Ms LIS, Olga; Dr KICHANOV, Sergey; BELOZEROVA, Nadezhda (FLNP); Mr LUKIN, Evgeny; Dr SAVENKO, Boris; Prof. BALAKUMAR, S (National Centre for Nanoscience and Nanotechnology, University of Madras)

Presenter: Ms LIS, Olga

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **798** Type: **Oral**

USING SINGLE-CELLED EUCARYOTES AS A MODEL ORGANISM IN SPACE RADIATION BIOLOGY

Thursday 12 November 2020 14:15 (15 minutes)

An issue of crew members'health care is raised while planning long-term expeditionary space missions. It was determined that astronauts encounter an increased risk of developing bacterial infections, respiratory diseases, dermatoses and allergic reactions, gastrointestinal disorders, as well as reactivation of certain viruses during the flight to the ISS. This is in part the fact that the human microbiota changes by the influence of stress factors (microgravity, space radiation, hypodynamy, isolation and etc.), which, in turn, leads to a decrease in the reactivity of the immune system, changes in a brain and development of diseases. It is important to note that a source of infection most commonly is an astronaut himself, because his body contains a large number of microorganisms which can spread in the environment, get into the air, and deposit on a surface of a spacecraft. In addition, bacterial and yeast probiotics can be used to maintain a human microbiota. In that regard, there is a need to study the interaction of the ISS microbial community and its crew members in order to prevent biomedical and other complications during the flight, as well as to study the stability of probiotic properties in conditions of an altered microbiota.

The purpose of the study is to explore the influence of stressful conditions and the space ionizing radiation on the viability and evolution of microorganisms. In this work well-characterized yeasts of the genus Saccharomyces cerevisiae, which are part of the spacecraft microbiota, were used as a model organism. There are results of the analysis of the sensitivity of a laboratory yeast strain to the mutagenic action of nitrogen ions in this research. It is shown that accelerated nitrogen ions have a higher biological effect compared to rarely ionizing gamma rays. It concerns both lethal and mutagenic effects. A tester system that allows to cull mutations selectively of a frameshift effect was used to test mutations. A determining of the sequence of nucleotides showed that the mutations were mainly due to the loss of one nucleotide (75%). The remaining mutations were multiple. Next steps were to study the behavior of another strain of Saccharomyces boulardii, which has probiotic properties.

Author: Ms ELIZAROVA, Veronika (Northern State Medical University)

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Presenter: Ms ELIZAROVA, Veronika (Northern State Medical University)

Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **799** Type: **Oral**

Weak rare decays for $B \to \omega$ transitions within covariant confined quark model framework

Tuesday 10 November 2020 14:30 (15 minutes)

We present the branching fractions for the rare semileptonic decay $B \to \omega \ell^+ \ell^-$ for $\ell = e, \mu, \tau$. The necessary transition form factors are computed in the entire range of momentum transfer within the Standard Model framework of Covariant Confined Quark Model with built-in infrared confinement. We further compute different physical observables such as forward backward asymmetry, longitudinal and transverse polarization and different other angular observables. We compare our findings with other theoretical models and available experimental data.

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Presenter: Dr SONI, Nakul (The Maharaja Sayajirao University of Baroda, Vadodara)

Session Classification: Theoretical Physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **801** Type: **Oral**

Effect of stroke on telomere length in the cells of the subventricular zone of lateral ventricles in mice

Thursday 12 November 2020 14:30 (15 minutes)

It was shown ischemic cerebral stroke stimulates neurogenesis in the subrentricular zone of the lateral ventricles and the subgranular zone of the dentate gyrus of the hippocampus. In the MCAO model of ischemic stroke, these processes have been well studied, but changes in the genetic apparatus of the cells of the neurogenic niche have not been studied. We conducted a study of telomere length in cells of the subventricular zone using the FISH method, because this indicator is considered an important marker of youth and the ability of stem cells to divide. Since the activity of stem cell division increases after MCAO, we assume that telomere length also changes. But the nature of this change is not obvious: one can expect both the forced shortening of telomeres as a result of the increased frequency of cell divisions and their compensatory lengthening.

Authors: SHADRINA, Maria; Mr NEMIROVICH-DANCHENKO, Nikolai

Presenter: SHADRINA, Maria

Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **802** Type: **Oral**

Analyzing power in quasi-elastic proton-proton scattering at 500 and 650 MeV/nucleon

Tuesday 10 November 2020 14:30 (15 minutes)

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

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

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **803** Type: **Oral**

Möbius function in modeling the fractal properties of colloidal structures

Friday 13 November 2020 16:00 (15 minutes)

The study of the structural properties of non-compact colloidal associates, as well as linear and branched polymers, is an important task of modern physical chemistry, since the structure at the nanoscale determines a number of important macroscopic features. Such systems often have fractal properties, that is, they exhibit scale invariance in a number of characteristics.
The development of the physics of fractal nanosystems determines an active interest in methods that make it possible to operate reliably at a level of (1-1000) nm. One of them is the small-angle scattering method, which analyzes the scattering of thermal neutrons or X-rays by material inhomogeneities, the size of which significantly exceeds the radiation wavelength 1.
The so-called phase problem somewhat limits the capabilities of scattering methods when solving the inverse problem on reconstructing the scatterer structure; therefore, complementary approaches, including direct modeling, are increasingly used in practice. Regarding fractals, a lot of algorithms for constructing deterministic 2 and stochastic 3 fractal objects have been proposed recently. The former are based on an exact repetition of the shape at different scales, while when using the latter, the scaling ratios are observed only "on average".
In this paper, we propose a new algorithm for constructing a fractal object, called the Möbius fractal, which is essentially on the verge between deterministic and stochastic fractals. The model is based on the Möbius function [4], which is defined for all natural numbers N and takes values -1; 0; 1, depending on the nature of the decomposition of the number N into prime factors. Within the framework of the developed algorithm, the values of the function -1; 0; 1 correspond to the directions left/straight/right in a plane. Thus, we get not a random walk, but, in a sense, a deterministic walk. On the other hand, the values of the Möbius function alternate randomly, thus ensuring the stochasticity of the procedure. The result of the construction is a rather complicated curve on the plane. It has self-intersections (thus, up to half of all the vertices of the figure are excluded). According to the correlation analysis, the fractal dimension of such a system is close to 1.8. The fractal dimension does not depend on the size of the system and does not depend on the range of natural numbers used in modeling, but is a global characteristic of this system.
In the given paper, a detailed analysis of the correlation functions of Möbius fractals in both real and reciprocal space is carried out, and prospects for the further use of these objects in describing the results of experimental methods of structural diagnostics of nanomaterials, including small-angle scattering, are outlined.

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[4] Möbius A.F. // Journal für die reine und angewandte Mathematik 9 (1832) 105.

Authors: Mr TOMCHUK, Oleksandr; Dr AVDEEV, Mikhail

Presenter: Mr TOMCHUK, Oleksandr

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **804** Type: **Oral**

Drell-Yan angular coefficients measurements with the CMS experiment at the LHC

Tuesday 10 November 2020 14:15 (15 minutes)

The results of measurements of angular coefficients for Z bosons produced in pp collisions and decaying to mu+mu- are presented. The data collected by the CMS detector during the LHC Run-I and Run-II was used.

Author: SHALAEV, Vladislav

Presenter: SHALAEV, Vladislav

Session Classification: High energy physics

Track Classification: HEP I - physics on accelerators

Contribution ID: **805** Type: **Oral**

Hyperconverged multi-layered system of processing and storing data from super-hot to super-cold on the "Govorun" supercomputer

Tuesday 10 November 2020 14:15 (15 minutes)

At present, the "Govorun" supercomputer is used to solve different tasks facing JINR. One of the main tasks is modeling of physical events for the NICA megaproject. A peculiarity of such tasks is to work with large amounts of simulated data, amounting to hundreds of terabytes. To speed up the processing of big arrays of data, a hierarchical hyperconverged system of data processing and storage with a software-defined architecture was implemented on the "Govorun" supercomputer. According to the speed of accessing data, the system is divided into levels that are available for the user's choice, namely, a super-hot layer implemented on the basis of Intel Optane, a hot layer based on Intel SSD NVMe under the management of the Lustre file system, a warm layer implemented as "an on-demand storage system", which can be managed by different file systems defined by the user, a cold layer implemented on HDD of sufficient volume, which ensures data storage, but does not meet the peak requirements of a computational task. Each layer of the developed data storage system can be used both independently and as part of data processing workflows. It is noteworthy that a part of the cold storage is managed by the geographically distributed EOS file system, which allows one to connect the data processing and storage system implemented on the "Govorun" supercomputer to geographically distributed storages, the so-called DataLakes. A super-cold layer is a tape storage. The implemented hierarchical data processing and storage system provides the low time of data access and a data read/write speed of 300 Gb/s. The DIRAC software is currently used to manage jobs and the process of reading/writing/processing data from different types of storages and different types of file systems. Due to the high performance of the system described, over 140 million events, modeling the collision of heavy ions of different energies for the MPD experiment, were generated and reconstructed for the NICA megaproject over the past year.
The studies in this direction were supported by the RFBR special grant ("Megascience –NICA"), №18-02-40101.

Authors: BELYAKOV, Dmitry; Mr MOSHKIN, Andrey; Mr PELEVANYUK, Igor; Dr PODGAINY, Dmitry; Dr ROGACHEVSKY, Oleg; Dr STRELTSOVA, Oksana; Mr ZUEV, Maxim

Presenter: Mr ZUEV, Maxim

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **806** Type: **Oral**

Charged particle identification by the Time–of–Flight method in the BM@N experimen

Wednesday 11 November 2020 14:30 (15 minutes)

BM@N (Baryonic Matter at Nuclotron) is a fixed target experiment at the NICA - Nuclotron accelerator complex (JINR). It is aimed at studies of nuclear –nuclear (up to gold-gold) collisions at high densities. The Nuclotron provides heavy ion beams with energies from 2.3 to 3.5 GeV, which is suitable for studies of strange mesons and multi–strange hyperons produced in nucleus-nucleus collisions close to the kinematic threshold. At these energies, nucleon densities in a collision zone exceed the saturation density by the factor of 3-4, can be useful for studying the equation of state (EOS) of dense nuclear matter.
The contribution is devoted to the identification of light particles (pi, K, p) and fragments (He3, d/He4, t) in the BM@N experiment using the Time–of–Fight method. Three detector subsystems are involved: it is a central tracker (inside the analyzing magnet), Cathode Strip Chamber (CSC) and Time–of–Flight detector (TOF). The main purpose of the central tracker is to reconstruct the charged particles tracks and momenta. We use CSC to filter out the bad tracks. And we obtain the time information from the TOF. For now, the method allows us to separate the light particles up to 2 GeV/c and the light fragments up to 4 GeV/c by the full momentum.

This work is supported by the RFBR grant No 18–02–4003

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Presenter: Ms ALISHINA, Ksenia (VBLHEP JINR)

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **807** Type: **Oral**

Evolution of anisotropic flow of produced particles from Au+Au collisions at $\sqrt{s_{NN}}$=4.5 - 200 GeV in a hybrid models

Wednesday 11 November 2020 14:45 (15 minutes)

The beam energy scan program has been carried out by STAR experiment at the
Relativistic Heavy Ion Collider to search for the onset of deconfinement and a possible critical point where the transition from a Quark Gluon Plasma to a hadronic phase changes from a rapid cross over to a first-order phase transition. Azimuthal anisotropy of produced particles is one of the important observables sensitive to the transport properties of the strongly interacting matter: the equation of state, the speed of sound, and the value of specific shear viscosity. In this work, we report on the calculations of azimuthal anisotropy of inclusive and identified charged hadrons produced in Au+Au collisions at $\sqrt{s_{NN}}$ = 4.5 - 200 GeV from two hybrid models: AMPT and viscous hydro+hadronic cascade vHLLE+UrQMD and direct comparison with published results from STAR experiment.
The results would be useful as predictions for the upcoming beam energy scan experiments at Nuclotron-based Ion Collider fAcility (NICA).

Authors: Dr TARANENKO, Arkadiy; DEMANOV, Alexander; POVAROV, Alexey (NRNU MEPhI); Mr PARFENOV, Peter; NIGMATKULOV, Grigory (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute))

Presenter: DEMANOV, Alexander

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **808** Type: **Oral**

Designing an agent information-analytical system in the thematic area "Cloud Computing"

Tuesday 10 November 2020 15:15 (15 minutes)

Currently, there is a significant increase in the number of sources of scientific and technical information on the Internet, which complicates its high-quality processing by scientists. At the same time, the use of cloud computing environments is gaining popularity in organizations.
The Joint Institute for Nuclear Research (JINR) has its own cloud computing environment developed by the Laboratory of Information Technologies (LIT). At the moment, LIT JINR is actively working on the study of cloud computing environments capabilities, developing methods for using cloud technologies to solve various classes of problems.
Thus, there is a need to use agent technologies to extract news information in the subject area under study and reduce the time it takes for people to search for it.
The development and operation of a specialized agent information-analytical system in the direction of "Cloud Technologies"are considered in this paper. The data are extracted from more than 100 sources of authoritative publications in fields of cloud computing. Aggregation of the material is done in a centralized database and then is uploaded to files of various formats to study for users and migrate new publications to the web portal.
As a result of the work, an analysis of existing information sources on the subject area "Cloud Technologies"was carried out and their selection by a group of specialists, the algorithm for automated data collection and a data storage and management system was developed, search agents were set up, a system work schedule was implemented, and information of interest was downloaded to files of various formats and to the web portal in the form of an RSS-feed. It is concluded that the use of agent technologies for collection and processing of materials in this field significantly accelerates the analysis of scientific and technical publications in comparison with manual mode, since the developed agent system allows us to conduct information retrieval work on the Internet automatically, without human intervention.

Author: KOSHLAN, Diana (JINR, LIT)

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Presenter: KOSHLAN, Diana (JINR, LIT)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **809** Type: **Oral**

The software development for data processing from the heavy ion beam loss diagnostics system for the DC-280 accelerator

Thursday 12 November 2020 15:15 (15 minutes)

Abstract

The subject/topic.
The article describes in detail the key parameters and the principle of the heavy ion beam loss diagnostic system operation. The article also provides a detailed description of the software required for collecting, storing and online visualization of data from this system.
Goals/Objectives.
The aim of the work is the development of the software for collecting, storing and online visualization of data for a non-destructive method for diagnosing the loss of a heavy ion beam, based on the registration of neutrons formed as a result of the interaction of an accelerated heavy ion beam with structural materials of the ion duct.
The Results.
The NI LabView development environment was chosen to organize the development of software for the heavy ion beam loss diagnostics system (BLDS) for the base unit of the superheavy elements factory - DC-280. The National Instruments products were used for the implementation of the SDPP software.
Conclusions / Relevance.
Beam diagnostics is one of the most actively developing disciplines at the crossroads of various fields: accelerators, physics, electronics, and programming. Usually the basic instruments are sufficient for the routine operation of the accelerator, but new instruments and methods are needed due to constantly arising problems.
Application.
The software considered in the article can be used in the field of diagnostics of high-intensity beams and the nuclear radiation detectors.

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Presenter: Mr TIMOSHENKO, Konstantin

Session Classification: Particle accelerators and nuclear reactors

Track Classification: Particle Accelerators and Nuclear Reactors

Contribution ID: **810** Type: **Oral**

Dp breakup reaction investigation at intermediate energies at Nuclotron

Friday 13 November 2020 14:15 (15 minutes)

The aim of the deuteron spin structure (DSS) experiment is to obtain polarization observables in dp elastic scattering at large CMS angles (> 60°) and in dp breakup.

The dp breakup reaction has been investigated by the scintillation detectors placed at the vicinity of Internal Target Station (ITS) of Nuclotron. Data have been obtained at the angles of 19° - 54° in the laboratory frame at the deuteron energy of 300 - 500 MeV.

The main goal of this report is to present a calibration procedure of Δ-E -E detectors. Calibration coefficients are used to recover deposited particle energy.

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Presenter: MEZHENSKA, Olena (P. J. Šafárik University in Kosice)

Session Classification: Nuclear Physics

Track Classification: Nuclear Physics

Contribution ID: **811** Type: **Oral**

Spectroscopic analysis of P2O5–ZnO–Na2O doped glasses

Friday 13 November 2020 15:45 (15 minutes)

The wide range of technological applications of phosphate glasses enable them to occupy high rank in the science of glass. This is due to, the ease of network modification of the phosphate glasses via additive other modifiers character, low glass transition temperature, high thermal expansion coefficient, high electrical conductivity and very high transmission in the ultraviolet region. These characteristics open the way to make them one of the most commonly utilized glasses in many applications. They are used for instance, in optoelectronic devices, laser host materials and solid electrolytes in solid state ionic devices. Also, it is found that phosphate glasses become electronic conductors or semiconductors, depending on the relative ratio of the added transition metal oxides that represent a transition from an isolated modifier to link through non-bridging oxygen. Oxide glasses containing transition metal oxides (TMO) are of continuing interest, because of their applicability in memory switching, electrical threshold, and optical switching devices, etc. The structural and electronic properties of these glasses as well as their optical, magnetic, and mechanical properties depend on the relative proportions of the different valence states of the TM ions present.
This paper includes the investigation of P2O5–ZnO–Na2O glasses doped with various concentrations of NiO in the range from 1 to 6 mol %. The prepared samples were subjected to different tests such as X-ray diffraction, UV-VIS spectrophotometer, Fourier transform infrared spectroscopy (FTIR) and ac conductivity. From these measurements found that all composites have optical filter behavior in the VIS and IR regions, also they show grate dielectric properties which make it can be used in wide industry applications. All data were analyzed in terms of current theories.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **812** Type: **Oral**

Statistical Physics of Associative Memory on Small World Networks

Wednesday 11 November 2020 15:00 (15 minutes)

The ability to store and recall information based on associations between objects is considered a characteristic trait of intelligent systems. In biological neural networks, learning is believed to take place at a synaptic level by modification of synaptic connections. In this project, we study the statistical physics of memory and learning through the Hopfield Model of Associative Memory. We computationally simulate the model in Python and devise an algorithm to find the critical memory capacity of a Hopfield Network.

However, unlike magnetic systems, the structure of wiring in the brain is far from homogeneous. The synaptic wiring in the brain is far from random like that in spin glasses or regular like that in an Ising lattice and instead follows evolutionary favorable organizing principles. To study how the collective function of the brain and neural systems depends on the structure, we use tools from graph theory and generative network models to simulate the Hopfield Model on a Watts-Strogatz (WS) small-world network which interpolates between regular and random network structures.

We devise a set of open-source Python codes that simulate the Hopfield Network on any given network structure and numerically estimates the memory capacity as a function of various parameters. Finally, we understand how changes in the network structure affect the function by varying the rewiring probability of a WS network and study the overlap with the desired state using an algorithm of ensemble averaging over multiple initial states with random and sequential noise to characterize the recall quality of the network.

We find the small world networks achieve performance as good as a random network but for a fraction of total wiring length, and are thus favorable. Our findings support the experimental evidence for the existence of small-world characteristics in biological networks in literature.

Author: Mr GURBANI, Yash (Shiv Nadar University)

Co-authors: Dr KAMIL, Syed Mohammad (Assistant Professor, Shiv Nadar University); Dr KUMAR, Santosh (Associate Professor, Shiv Nadar University)

Presenter: Mr GURBANI, Yash (Shiv Nadar University)

Session Classification: Information Technologies

Track Classification: Applied Research

Contribution ID: **813** Type: **not specified**

Multilevel tree-based lookup table for acceleration of numerical calculations

Wednesday 11 November 2020 14:45 (15 minutes)

In the proces of numerical calculations, one often encounters situation, when some computationally expensive function is called multiple times for the same set of input parameters. Proper caching of alreasy obtained values can speed-up the calculations. In my work I concentrate on case, when function of multiple parameters needs to be cached. In order to be able to find requested values quickly, special multi-level tree structure was proposed and implemented. Further speed-up was obtained by allowing the use of OpenMP parallelization method which required revision of search and write algorithm in order to allow multiple tasks working simultaneously on the same tree-based caching structure.

Author: Mr KOSHEEV, Gleb (Olegovich)

Co-author: BUSA, Jan (LIT JINR)

Presenter: Mr KOSHEEV, Gleb (Olegovich)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **814** Type: **not specified**

HybriLIT platform insights

With the increase of users of the HybriLIT heterogeneous platform, the development of new services for users remains the key task.
Today we have an environment of information services for users of the platform which help organize work in the system in a more efficient way.
This report presents a new developed and implemented service for the users of the HybriLIT platform.

Author: Ms TOROSYAN, Shushanik

Presenter: Ms TOROSYAN, Shushanik

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **815** Type: **Oral**

New proton polarimeter at the Nuclotron

Wednesday 11 November 2020 15:15 (15 minutes)

The program of the polarimeter upgrade at Internal target station at the Nuclotron are presented. The simulation of the pd-elastic and pp-elastic scattering for 500 - 1000 MeV proton energy is performed. First results of the proton polarization measurements are presented.

Author: TEREKHIN, A.A.

Presenter: TEREKHIN, A.A.

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **816** Type: **Oral**

Evaluation of JINR computing resources performance with DIRAC

Tuesday 10 November 2020 14:45 (15 minutes)

The evaluation of the performance of computing resources is important for workload distribution and workload planning. It is usually done with standard benchmark tools. The most well-known benchmark in grid infrastructures in High Energy Physic is HEP-SPEC06. This benchmark is based on industrial benchmark SPEC06. Running of HEP-SPEC06 takes a substantial amount of time but gives a precise estimation of the computing performance of one worknode. DIRAC interware uses the DB12 benchmark for performance estimation. It takes less than a minute to run and gives estimations very close to HEP-SPEC06. When a job is executed on a resource by DIRAC DB12 benchmark test is performed and results are saved in the database. That means that there is no need to stop operations on computing resources to estimate full performance. It just requires to aggregate information about all individual DB12 results. Aggregation of benchmark results was done in JINR on all big computing components: Tier1, Tier2, Govorun supercomputer, Cloud, and NICA cluster. It did not require to send dedicated jobs since DIRAC was actively used for Monte-Carlo generation by MPD experiment. Tier1 results show good correspondence between HEP-SPEC06 and DB12.
The studies in this direction were supported by the RFBR special grant (“Megascience –NICA”), №18-02-40101.

Author: PELEVANYUK, Igor (Joint Institute for Nuclear Research)

Presenter: PELEVANYUK, Igor (Joint Institute for Nuclear Research)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **817** Type: **Oral**

Raman spectroscopy study of damages induced in polycrystalline Si3N4 by swift heavy ion irradiation

In this work the Raman spectroscopy method was used to study the radiation damage and associated internal mechanical stresses in polycrystalline silicon nitride (Si_3N_4). Si_3N_4 samples have been irradiated with swift heavy Xe and Bi ions with energies of 167 and 710 MeV, respectively, in the range of fluences from 1E11 to 4.87E13 $ions/cm^2$. The spectra of the cross-section of the irradiated region and the near-surface layer of the samples were registered at room temperature. The parameters of the FWHM - 205 cm^{-1} and peak position - 862 cm^{-1} were used to characterize the amorphization and mechanical stress level.

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Presenter: MUTALI, Alisher (L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazakhstan; FLNR JINR, Russia)

Session Classification: Applied research

Track Classification: Applied Research

Contribution ID: **818** Type: **Oral**

On recent results in Feynman integrals calculation and related topics

Tuesday 10 November 2020 16:15 (15 minutes)

In my talk, I'll briefly describe recent results in the field of calculation of multi-loop and phase-space integrals arising in many QFT problems. Included problems with various masses and scales in different space-time dimensions. We give a review of modern methods and calculation setups needed for performing such complicated problems with available computer resources.

Author: Dr PIKELNER, Andrey (BLTP JINR)

Presenter: Dr PIKELNER, Andrey (BLTP JINR)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics

Contribution ID: **819** Type: **Oral**

Simulation of the Drift Chambers in BM@N experiment

Thursday 12 November 2020 14:45 (15 minutes)

An overview of the tuned simulation of the drift chambers in the BM@N experiment is given. The comparison with experimental data is also presented.

Authors: VOYTISHIN, Nikolay (JINR); PALICHIK, Vladimir (JINR Dubna)

Presenter: VOYTISHIN, Nikolay (JINR)

Session Classification: Mathematical Modeling and Computational Physics

Track Classification: Information Technology

Contribution ID: **820** Type: **Oral**

Investigation of the beam energy dependence of particle production in gold collisions at MPD energy region.

Tuesday 10 November 2020 17:30 (15 minutes)

We present the analysis of the identified charged particles (π±, K±, p, p-bar) formation at mid-rapidity (|η|< 0.5) in collisions of Au-Au ions with energies √SNN = 4, 7, 9, 11 GeV. Particle momentum spectra for charged hadrons (kaons, pions, protons) are measured using data from statistical Monte-Carlo generator of Ultrarelativistic Quantum Molecular Dynamics (UrQMD) for a Multi-Purpose Detector (MPD) made with the Geant 3 model. Particle identification efficiency and various track level cuts for lowering uncertainties are discussed. We analyze particle multiplicity dependence on the collision energy. Centrality dependence of the spectra was calculated for all particle species. In the end, we analyze the particle ratios dependence on the collision energy. Our goal is to study possible signatures of the phase transition between the hadron state of matter and the quark-gluon plasma (QGP) state.

Authors: PERVYSHINA, Elena (JINR); Dr APARIN, Alexey (Joint Institute for Nuclear Research)

Presenter: PERVYSHINA, Elena (JINR)

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **822** Type: **Oral**

Project, development and testing of the Gas System of the MPD/Time-of-Flight detector

Tuesday 10 November 2020 17:15 (15 minutes)

The Multi-Purpose Detector (MPD) being currently developed in the High Energy Physics Laboratory, will allow observations of particles created in heavy ion collisions. One of the most important systems of the MPD which is going to be used in identification of these particles is gaseous Time-of-Flight detector, based on the mRPC (Multi Resistive Plate Chambers) technology. To the formation of final electrical signals lead complex physical processes and the parameters of the gas environment have a major influence on its registration possibilities. Gas System ensuring right and stable working environment, crucial for proper functioning of the detector, will be discussed in the details.

Author: DĄBROWSKI, Daniel (Warsaw University of Technology)

Presenter: DĄBROWSKI, Daniel (Warsaw University of Technology)

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **823** Type: **Oral**

Extended static model of user requests processing for a heterogeneous data aggregation platform with S storages

Tuesday 10 November 2020 15:45 (15 minutes)

Inter-disciplinary research and open data access are big trends in modern science. Globalization facilitates the exchange of experiences and ideas between different domains of knowledge, and allows us to expand the horizons of our understanding of the processes taking place in nature and society. To make this happen, aggregated data access systems are being established to link together storages of heterogeneous data. Throughtput optimization for these systems leads to NP-hard problems, involving a wide space search with a vast number of variables.

In this talk we present a mathematical model of a data aggregation system with S heterogeneous storages, and set up an optimization problem of users requests processing in the form of a general job shop problem with precedence constraints. The results of numerical modeling employing CSP heuristics are going to be discussed.

Author: TOKAREVA, Victoria (Karlsruhe Institute of Technology (KIT))

Presenter: TOKAREVA, Victoria (Karlsruhe Institute of Technology (KIT))

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **824** Type: **Oral**

GEANT4 modeling of the mini-SPD test stand

Wednesday 11 November 2020 15:45 (15 minutes)

Geant4 toolkit is a common instrument for the simulation of the experiments in high-energy physics. This work discusses the stand MiniSPD, its main goals and objectives. The model of the stand implemented using the Geant4 package is presented. The results of the run a simulation of cosmic ray particle beam depending on the selected parameters are discussed and analyzed.

Author: KASYANOVA, Elina (JINR)

Presenter: KASYANOVA, Elina (JINR)

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **825** Type: **Oral**

Mini-SPD test stand at JINR

Tuesday 10 November 2020 17:45 (15 minutes)

MiniSPD is an installation for cosmic muon tests of all types of the detectors that to be used in the SPD setup. The detectors and readout electronics for the NA64 experiment also will be tested. It includes the scintillator-based trigger system, straw, silicon and GEM trackers, modules of the electromagnetic calorimeter, and the lead filter to remove the soft component of cosmic rays. It will serve for the measurement of such significant parameters as spatial and time resolution, efficiency, drift characteristics, amplification, etc. Data acquisition, slow control, and online monitoring systems also could be examined there

Author: BURTSEV, Vitalii (JINR)

Presenter: BURTSEV, Vitalii (JINR)

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **826** Type: **Oral**

The system for parameters of working gas monitoring at MiniSPD stand

Tuesday 10 November 2020 18:00 (15 minutes)

The paper presents a method and means for automated monitoring of the stability of the gas gain coefficient in the registration system based on gas-discharge proportional counters.
Experiments using straw-detectors require constant monitoring of the gas gain, which depends on a complex of variables. However, it is not always possible to control each parameter, hence the need to track the complex influence of all factors.
To solve this problem, a system was built that digitizes the complex influence of all factors and is designed to diagnose and debug the detector, as well as prevent distortion of experimental data.
The work of system is based on tracking the peak position from a calibrated source (Fe55) on the ADC spectrum obtained from the data acquisition system.
The position of this peak in the specified range of values is the main indicator of the correct operation of the system.
Using this system, useful information was obtained about the undesirable influence of some of external factors and complex troubleshooting were detected on the experimental stand.

Author: SALAMATIN, Kiril (JINR)

Presenter: SALAMATIN, Kiril (JINR)

Session Classification: High energy physics

Track Classification: HEP II - detectors/electronics

Contribution ID: **827** Type: **Oral**

Implementation CGIS in LIT

Wednesday 11 November 2020 15:15 (15 minutes)

In this study, LIT JINR is considered as an object of implementation of corporate GIS.
This information system is designed to optimize management decisions on the operation of the LIT building based on the creation and maintenance of an up-to-date database on all aspects of the functioning of the building infrastructure. The main goal of the introduction of CGIS in LIT is the competent operation of the building, its technical communications, monitoring of engineering networks, the systematic storage of archival documentation. The aim of this work is to develop guidelines for the implementation of corporate GIS to ensure proper management of the LIT building, monitoring all existing and planned engineering systems throughout the entire life cycle of the enterprise. To achieve the goal in the course of work, the following tasks must be solved:
 To study aspects of the creation and implementation of information systems designed to solve the managerial problems facing engineering services that ensure the operation of buildings;
 Analyze the requirements for corporate geographic information systems designed to ensure the efficient operation of the engineering services of LIT JINR;
 Justify the choice of the implemented CGIS on the basis of software and technological support of the company LLC “ERMA SOFT”;
 Review the technological tools for the implementation of CGIS at the enterprise;
 Highlight the main stages of the development and implementation of CGIS;
 Describe user scenarios for the implementation of the CGIS;
 Propose further expansion of the capacities of the CGIS.

Author: KUZNETSOVA, Ekaterina (Engineer)

Presenter: KUZNETSOVA, Ekaterina (Engineer)

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **828** Type: **Oral**

DNA double-strand breaks comlexity in human fibroblasts under the action of low and high-LET radiation

Thursday 12 November 2020 14:45 (15 minutes)

High-order clustered DNA lesions is the hallmark of the action of dense-ionizing radiation. It is defined as a combination of two or more individual lesions (single-strand and double-strand breaks (DSB), base damage, etc.) located within 1-2 DNA helical turns. Clustered DNA DSBs, which contains DSB and other DNA lesions, represent specific interest for investigation.
For investigation of induction and repair clustered DNA DSBs, human fibroblasts were irradiated with 60Co ⊠-rays (LET ≈ 0.3 keV/μm), 15N ions (LET = 181.4 keV/μm, E = 13 MeV/n) and protons in the expanded Bragg peak (LET = 2 –100 keV/μm, E = 0.01 –44 MeV/n). The dose for all types of radiation was 1.25 Gy. Key proteins that involved in the repair of base damage (OGG1) and DSB DNA (53BP1) were visualized by immunocytochemical staining and fluorescence microscopy. The quantitative analysis of 53BP1 and OGG1 foci that characterize the structure of clustered DNA lesions, were completed. The obtained results showed the high complexity of the structure of clustered DNA DSBs under the action of protons and 15N ions. The increase in the number of individual damage of different types in the cluster and the preservation of cluster's complex structure up to 24 hours under the action of charge particles were shown. The achieved results indicate that it is difficult to repair all types of damage included in the cluster compared to individual DNA lesions.

Author: SHAMINA, Daria (Dmitrievna)

Presenter: SHAMINA, Daria (Dmitrievna)

Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **829** Type: **Oral**

DNA DSBs repair kinetics in neurons and astrocytes of primary hippocampal cell culture after irradiation with Co60 g-rays and proton

Thursday 12 November 2020 15:00 (15 minutes)

DNA DSBs repair kinetics in neurons and astrocytes of primary hippocampal cell culture after irradiation with Co60 g-rays and proton
Abstract
The induction and repair of DNA double-strand breaks (DNA DSB) were analyzed in primary hippocampal cell culture under the action of Co60 g-rays or protons at 3 Gy dose. For investigation of DNA DSBs formation, we established two cell cultures: neuronal cell culture, created with using of antimitotic agent 1-β-D-arabinofuranosil cytosine (AraC), and primary hippocampal cell culture without influence of Ara-C includes both neuronal and glial elements. The study of DNA DSB formation and repair in neuron and primary cell culture was conducted using DNA repair protein markers –γH2AX and 53BP1.
It was established that the gH2AX/53BP1 foci quantity reached the maximum 1h after both types of radiation and decrease in 24 h post- irradiation. However, 24h post-irradiation the radiation-induced foci (RIF) level remained significantly different to non-irradiated samples. In case of proton irradiation, a higher number of RIF was observed 24 h after exposure compare to γ-irradiation.
The study of the formation and elimination kinetics of γH2AX foci in primary hippocampal cell culture showed the maximum of foci number 1 h after exposure to γ-rays. There was a delay in foci elimination, followed by an increase in the number of RIF 4 h after proton irradiation. The structure of RIF clusters in astrocytes becomes more complex in comparison with neuronal cells after exposure to both types of irradiation throughout the entire post-radiation period.

Author: FILATOVA, Anfisa (Dubna University)

Presenter: FILATOVA, Anfisa (Dubna University)

Session Classification: Life Science

Track Classification: Life Science

Contribution ID: **830** Type: **Oral**

Comparison of software products for virtualization of desktops on the basis of the HybriLIT platform.

Tuesday 10 November 2020 17:00 (15 minutes)

With increasing performance of the heterogeneous HybriLIT platform and the release of new components, users have more modes to work with its resources. One of the key modes is the presence of a virtualized environment and interactive access to applied software.
Access to applied software can be organized using free software products, but in this case, the efficiency of resource use is limited. To overcome these limitations, competing solutions from two companies, Citrix and VMware, have been deployed on the basis of the HybriLIT platform. The paper presents the results of these solutions'comparison according to the main criteria based on the most important issues from the point of view of a user of the heterogeneous platform.

Author: MATVEYEV, Mikhail

Presenter: MATVEYEV, Mikhail

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **831** Type: **Oral**

The influence of external radiation on the Josephson junction + nanomagnet system

Friday 13 November 2020 14:00 (15 minutes)

We investigate the dynamics of a system of nanomagnet coupled to the Josephson junction. The manifestation of the Kapitsa pendulum features in such a system is studied. The role of quasiparticle current on the change of frequency dependence in the Kapitsa-like pendulum features is revealed. We also investigate the effect of external radiation on the properties of the Kapitsa pendulum features. It is shown that voltage value of a complete reorientation of magnetic moment of the nanomagnet depends on amplitude of external radiation applied to the junction.
Acknowledgments
This work is supported by RFBR grant № 20-37-70056.

Authors: Mr KULIKOV, Kirill; Mr NASHAAT, Majed; ANGHEL, Dragos-Victor (IFIN-HH); Dr SHUKRINOV, Yuri

Presenter: Mr KULIKOV, Kirill

Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics

Contribution ID: **832** Type: **Oral**

Centrality and spectators properties measurements with hadron calorimeter in MPD/NICA experiment

Wednesday 11 November 2020 16:00 (15 minutes)

At present, the heavy-ion accelerator complex NICA is being built at JINR (Dubna). One of the experimental facilities, MPD at NICA was designed to investigate the properties of the strongly interacting matter. The centrality of the ion collisions is the most significant parameter for the global event characterization. In general, a few methods can be used for centrality determination. The first one is the fit of produced particles multiplicity distributions based on the Glauber model. This approach allows estimation of participant nucleons number in the ion collision. The second option considers the energy depositions in the forward calorimeters to measure the number of spectators, i.e. number of non-interacting nucleons.
In this work, we will discuss the second approach, namely, the measurements of spectator's energy in Forward Hadron Calorimeter (FHCal) at MPD. Unfortunately, due to the beam hole in the centre of FHCAL, the heavy non-interacting fragments fly in this hole. Therefore, the energy depositions in FHCal for central and peripheral events are similar. To resolve this ambiguity, a few physical observables were constructed and are used for centrality determination. The calculations of the transverse and longitudinal components of the energy, as well as subtraction of the pion contamination in the FHCal energy, allow identification the central and peripheral events and, hence, to measure their centrality. Based on the obtained observables, one can determine some properties of the spectators such as transverse momentum.

Author: VOLKOV, Vadim (INR RAS)

Presenter: VOLKOV, Vadim (INR RAS)

Session Classification: High energy physics

Track Classification: HEP III - NICA physics/modeling

Contribution ID: **834** Type: **Oral**

Development of information system for radiobiological reserch on the HybriLIT platform

Tuesday 10 November 2020 16:30 (15 minutes)

The report presents the status of work on the joint project of LIT and LRB on the creation of a service for
studying behavioral and pathomorphological changes in the central nervous system of biological objects.
To conduct modern scientific research in the field of radiobiology, it is usually necessary to use many
different modern approaches to data analysis, image and video processing such as Computer Vision,
Machine Learning \ Deep Learning, and information technology (IT) methods for data analisys.
The developed service provides an environment for the development and implementation of ML\DL algorithms, debugging of relevant software and tools for visualizing the results of experimental data
analysis. Service provide access to the computing resources of the HybriLIT platform and «Govorun»
supercomputer for massive-parallel computations.

Authors: BUTENKO, Yuri; KOLESNIKOVA, Inna; NECHAEVSKIY, Andrey (JINR); Dr PODGAINY, Dmitry; Mr STADNIK, Alexey (LIT, JINR); Dr STRELTSOVA, Oksana

Presenter: BUTENKO, Yuri

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **835** Type: **Oral**

A new service implemented on the HybriLIT platform

Tuesday 10 November 2020 14:00 (15 minutes)

With the increase of users of the HybriLIT heterogeneous platform, the development of new services for users remains the key task.
Today we have an environment of information services for users of the platform which help organize work in the system in a more efficient way.
This report presents a new developed and implemented service for the users of the HybriLIT platform.

Author: Ms TOROSYAN, Shushanik

Presenter: Ms TOROSYAN, Shushanik

Session Classification: Information Technologies

Track Classification: Information Technology

Contribution ID: **836** Type: **not specified**

JINR's strategic plan for long-term development

Monday 9 November 2020 15:00 (1h 15m)

Presenter: ACADEMICIAN OF RAS GRIGORY V. TRUBNIKOV

Session Classification: Plenary session

Contribution ID: **837** Type: **not specified**

Life of neutron stars with evolving magnetic field

Tuesday 10 November 2020 11:00 (1h 30m)

Presenter: DR. SERGEI B. POPOV

Session Classification: Plenary session

Contribution ID: **838** Type: **not specified**

Higgs boson discovery and other selected results from LHC

Wednesday 11 November 2020 11:00 (1h 30m)

Presenter: DR. RUSTEM K. OSPANOV

Session Classification: Plenary session

Contribution ID: **839** Type: **not specified**

Omic technologies in radiation biology

Thursday 12 November 2020 11:00 (1h 30m)

Presenter: DR. POLINA YU. VOLKOVA

Session Classification: Plenary session

Contribution ID: **840** Type: **not specified**

Neutron physics at JINR

Friday 13 November 2020 11:00 (1h 30m)

Presenter: DR. VALERY N. SHVETSOV

Session Classification: Plenary session