Excited QCD 2020

Report of Contributions

https://indico.cern.ch/e/827578

Contribution ID: **1** Type: **not specified**

LHCb results on exotic spectroscopy

Monday 3 February 2020 11:00 (30 minutes)

The quark model, proposed in the 1960s, predicts exotic hadrons beyond the conventional quark-antiquark mesons and three quark baryons. However, it was less than 15 years ago that exotic candidates were observed. Since then a number of exotic states have been discovered. LHCb has reported on tetraquark candidates such as the X(3872) as well as the discovery of pentaquark resonances in 2015. Many theoretical approaches, including hadronic molecules and tightly bound tetra- and penta-quarks, aim to describe the nature and properties (mass/quantum numbers) of these states, also predicting that these exotic candidates may be part of a larger multiplet of exotic states. The discovery of further exotic hadrons and measurement of their properties will help to scrutinize these theoretical models and determine the internal structure of these states. LHCb is in a unique position to study a wide range of decay modes for multiple b-hadron species. The latest results of these studies from LHCb are presented along with prospects for the Run 3 data.

Primary author: KUCHARCZYK, Marcin (Polish Academy of Sciences (PL))

Presenter: KUCHARCZYK, Marcin (Polish Academy of Sciences (PL))

Contribution ID: **3** Type: **not specified**

Recent results of light hadron spectroscopy from BESIII

Tuesday 4 February 2020 09:00 (30 minutes)

With the world's largest sample of J/psi 1.3 billion events accumulated at the BESIII detector offers a unique opportunity to study light hadron spectroscopy and decays. In this presentation, recent results of the light hadron physics at BESIII will be highlighted. The BESIII experiment has made significant progresses on the light hadron spectroscopy in the J/psi decays, including the amplitude analyses of J/psi radiative and hadronic decays.

Primary authors: KUPSC, Andrzej; ZHANG, Jingzhi (IHEP); LIU, Zhiqing

Presenter: KUPSC, Andrzej

Contribution ID: **4** Type: **not specified**

XYZ at BESIII

Tuesday 4 February 2020 09:30 (30 minutes)

From 2011, BESIII has taken about 20 fbˆ-1 data samples at center of mass energies from 3.8 to 4.6 GeV, containing 21 energy points with luminosity larger than 400 pb-1. This makes the study of vector states Y, charged states Z, X states, as well as the connections between them through transition processes possible. Using these data samples, new information about X(3872) decays, Y states from open-charm final states, hidden-charm final states, and light hadron final states will be presented.

Primary authors: ZHANG, Jingzhi (IHEP); LIU, Zhiqing; KUPSC, Andrzej

Presenter: KUPSC, Andrzej

Contribution ID: **5** Type: **not specified**

Measurement of Diffraction and Underlying Event at ATLAS

Tuesday 4 February 2020 11:00 (30 minutes)

In this talk, we present two measurements sensitive to non-perturbative physics performed using data collected by the ATLAS experiment at the Large Hadron Collider. First, a measurement of charged-particle distributions sensitive to the properties of the underlying event is presented for an inclusive sample of events containing a Z-boson, decaying to a muon pair. Unfolded differential cross sections are presented for charged particle multiplicity and charged particle transverse momentum in regions of azimuth measured with respect to the Z-boson direction. In addition, a measurement of single diffractive dissociation (pp->pX) is presented. The intact proton is reconstructed and measured in the ALFA forward spectrometer, while charged particles from the dissociative system (X) are reconstructed and measured using the ATLAS inner tracking detector and calorimeters. Differential cross sections are presented as a function of the proton fractional momentum loss, the four-momentum transfer squared, and the size of a rapidity gap measured from the edge of the ATLAS calorimeters. The results are interpreted in the framework of Regge phenomenology.

Primary author: KENDRICK, James (University of Birmingham (GB))

Presenter: KENDRICK, James (University of Birmingham (GB))

Contribution ID: **6** Type: **not specified**

Measurements of jet fragmentation and jet substructures at ATLAS

In this talk, we present four measurements that probe the internal structure of jets using data collected by the ATLAS experiment. First, a measurement of the properties of jet fragmentation using charged particle tracks is presented, including charged particle multiplicity, jet charge, the summed fragmentation function, the momentum transverse to the jet axis, and the radial profile of the jet are measured. In addition, jet substructure observables are measured in ttbar and inclusive jet events. If available, the measurement of soft drop jet substructure observables in dijet events will be also presented. Finally, a measurement of the Lund Plane is also presented, using charged particles reconstructed inside jets in inclusive jet events. All measurements are performed using proton-proton collision data collected with the ATLAS detector at $\sqrt{s}$=13 TeV. The measurements are corrected for detector effects and are compared to the predictions of up-to-date Monte Carlo event generators and to the state-of-the-art calculations. New event generator configurations for the modelling of jet production, derived using ATLAS data will also be presented.

Primary author: ATLAS COLLABORATION

Presenter: ATLAS COLLABORATION

Contribution ID: **7** Type: **not specified**

Low-energy kaon-nucleon/nuclei studies at DAFNE: SIDDHARTA-2 and AMADEUS

Thursday 6 February 2020 11:00 (30 minutes)

The experimental low-energy kaon-nucleon/nuclei interaction studies are playing a key-role for the understanging of the low-energy QCD, impacting in particle and nuclear physics as well as in astrophysics.
The excellent quality of the kaon beam delivered by the DAFNE collider in Frascati (Italy), combined with a new dedicated technology of Silicon Drift Detectors as well as the high acceptance charged and neutral particles KLOE detector, allow to perform unprecedented measurements in the low-energy strangeness sector in the framework, respectively, of SIDDHARTA-2 and AMADEUS Collaborations.
The contribution will give an overview of the new SIDDHARTA-2 setup recently installed on DAFNE showing the preliminary results achieved up to now and future plans. Lastly, the main results of AMADEUS will be shown.

Primary authors: MILIUCCI, Marco (INFN - National Institute for Nuclear Physics); Dr CURCEANU, Catalina (LNF-INFN)

Presenter: MILIUCCI, Marco (INFN - National Institute for Nuclear Physics)

Contribution ID: **8** Type: **not specified**

High Sensitivity Quantum Mechanics tests in the Cosmic Silence

Thursday 6 February 2020 11:30 (30 minutes)

The VIP experiment aims to perform high sensitivity tests of the Pauli Exclusion Principle (PEP) for electrons, and look for a possible small violation.
In Local Quantum Field Theories approach any PEP violating transition is strongly constrained by the Messiah Greenberg Superselection (MGS) rule, which forbids superpositions of states with different symmetry. Such models can then be only tested with open systems. This condition is realised in VIP-2 by introducing "new"electrons in a pre-existing system of electrons, and then testing the resulting symmetry state. The data analyses results from the newest VIP-2 Open Systems data taking will be presented.
It was recently shown that a large class of Quantum Gravity models embeds the violation of PEP, violating the MSG rule, as a consequence of the space-time non-commutativity. High sensitivity tests of PEP violation in closed systems turn then to be the better candidates to put strong experimental limits on the energy scale of the non-commutativity emergence in Quantum Gravity. The results of exploratory studies based a High Purity Germanium (HPGe) Detecors and high radio-purity Roman Pb targets will be shown.

The extremely low background environment of LNGS is also suitable for investigating one of the main mysteries of Quantum Mechanics Foundations: the measurement problem. Collapse models propose phenomenological solutions to the measurement problem; by modifying the linear and unitary evolution of the Schroedinger equation adding a non-linear term and the interaction with a stochastic noise field. Collapse models account for the wave function collapse in space, which is characterised by an amplification mechanism, the biggest the mass the faster the reduction of the wave packet. The quantum to classical transition is then realised by ensuring that macroscopic objects always have well defined positions. On the other hand the interaction with the noise field is very small at the microscopic level, where the standard Schroedinger evolution dominates. The results of our analyses, setting the strongest constrains on collapse models, will be presented.

Primary author: Dr PISCICCHIA, Kristian (Centro Fermi, LNF (INFN))

Presenter: Dr PISCICCHIA, Kristian (Centro Fermi, LNF (INFN))

Contribution ID: **9** Type: **not specified**

Exotic hadrons from Dyson-Schwinger equations

Friday 7 February 2020 09:00 (30 minutes)

I review recent results on exotic hadrons such as glueballs, hybrids and tetraquarks obtained in the framework of functional Dyson-Schwinger and Bethe-Salpeter equations. First results for quenched glueballs in this framework have been published in 2012; I present an update of these results. For tetraquarks, based on our earlier results on the light scalar mesons we have generalized our approach to include heavy-light states with two charm and two light (anti-)quarks. I discuss results in several channels.

Primary author: Prof. FISCHER, Christian (JLU Gießen)

Presenter: Prof. FISCHER, Christian (JLU Gießen)

Contribution ID: **11** Type: **not specified**

Lattice QCD Three-Quark Potential Analysis using Hyperspherical Variables Redux: Sakumichi & Suganuma's Lattice Data and their Interpretation

Tuesday 4 February 2020 16:30 (30 minutes)

We analyze Sakumichi & Suganuma's, Phys.Rev.D92,034511(2015), lattice QCD results for the 3-quark potential, using hyper-spherical three-body coordinates. We show that their data supports neither the Delta, nor the Y-string interpretation, but something in-between. This lattice data is consistent with Koma & Koma's, Phys.Rev.D95, 094513 (2017) results, their different conclusions notwithstanding. We offer a new interpretion of their (joint) results in terms of a 3-string model.

Primary author: Prof. VELJKO, Dmitrasinovic (Intitute of Physics, University of Belgrade)

Presenter: Prof. VELJKO, Dmitrasinovic (Intitute of Physics, University of Belgrade)

Contribution ID: **12** Type: **not specified**

Dualities of the ($N_c = 2, 3, \infty$) QCD phase diagram: chiral imbalance, baryon density

Monday 3 February 2020 17:00 (30 minutes)

Part of the talk is
based on:
Phys.Rev. D95 (2017) no.10, 105010
Phys.Rev. D97 (2018) no.5, 054036
Phys.Rev. D98 (2018) no.5, 054030
Eur.Phys.J. C79 (2019) no.2, 151
JHEP 1906 (2019) 006
Phys. Rev. D 100, 034009 (2019)

Recently It has been shown that in the large-Nc limit (Nc is the number of colors of quarks) there exist duality correspondences
(symmetries) in the phase portrait, which are the symmetries of the thermodynamic potential and the phase structure
itself. The first one is a duality between the chiral symmetry breaking and the charged pion condensation
phenomena. And there are two other dualities that hold only for chiral symmetry breaking and charged pion condensation phenomena separately. For example, we have shown that charged pion condensation does not feel the difference between chiral and isospin imbalances of the medium. They were shown to exist in the matter with chiral imbalance that can be produced in compact stars or heavy
ion collisions. One of the key conclusions of these studies is the fact that chiral imbalance generates charged pion
condensation in dense baryonic/quark matter. It was shown that our results in particular cases are consistent with the simulation of lattice QCD, which is possible in these cases.
Duality was used to show that there takes place catalysis of chiral symmetry breaking by chiral imbalance.
It was also shown that chiral imbalance generates the phenomenon of charged pion condensation in dense baryonic/quark matter even in the case of charge neutral matter, which is interesting in the context of the astrophysics of neutron stars.
It is known that chiral imbalance can occur in high energy experiments of the collision of heavy ions, due to
temperature and sphaleron transitions. Our studies show that different types of chiral imbalance can occur in the cores of neutron stars or in heavy ion experiments, where large baryon densities can be reached, due to another phenomena - the so-called chiral separation and chiral vortical effects.
Duality was shown to exist even in case of inhomogeneous condensates. This example shows that the duality is not just entertaining mathematical property but an instrument with very high predictivity power.
The unified picture and full phase diagram of isospin imbalanced dense quark matter have been assembled. Acting on this diagram by a dual transformation, we obtained, in the framework of an approach with spatially inhomogeneous condensates and without any calculations, a full phase diagram of chirally asymmetric dense medium.

Continuing our studies of dualitiesl, we noted that there are dualities in 2-color QCD that are connected with adiitional symmetry of QCD with two colors namely Pauli-Gursey symmetry.
It has been also shown that found duality is a more fundamental and can be shown at the level of Lagrangian. It has been shown that duality is a property of real QCD. It is not bounded by large

Nc approximation and exists in the cases of 2 and 3 and infinite number of colours.

Primary authors: Dr ZHOKHOV, Roman (IHEP); Prof. KLIMENKO, Konstantin (IHEP); Dr KHUNJUA, Tamaz (University of Georgia)

Presenter: Dr ZHOKHOV, Roman (IHEP)

Contribution ID: **13** Type: **not specified**

Lattice QCD study of Zb tetraquark channel

Wednesday 5 February 2020 16:30 (30 minutes)

Belle experiment discovered two tetraquark candidates Z_b^+ with flavor structure $\bar{b}b\bar{d}u$ near $B\bar{B}^*$ threshold. Lattice QCD study of this system will be presented. Significant attraction is found between B-meson and $\bar{B}^*$-meson at small distances. This attraction leads to an exotic virtual bound state slightly below threshold and a narrow peak in the $B\bar{B}^*$ rate slightly above threshold. These features resemble Z_b^+ seen experiment. I'll also review further theoretical work that is needed to overcome certain simplifying approximations of this study.

Primary author: PRELOVSEK, Sasa

Co-author: BAHTIYAR, Huseyin (Istanbul Technical University (TR))

Presenter: PRELOVSEK, Sasa

Contribution ID: **14** Type: **not specified**

Quarkonium physics at Belle II

Tuesday 4 February 2020 10:00 (30 minutes)

An overview of quarkonium physics at Belle II is presented. It includes the prospects in conventional quarkonium, double charmonium production, charmoniumlike states observed in two-photon processes, ISR, and B decays, production of bottomoniumlike states in $\Upsilon(5S)$ decays, and other physics.

Primary authors: BELLE II COLLABORATION; CHILIKIN, Kirill (LPI RAS)

Presenter: CHILIKIN, Kirill (LPI RAS)

Contribution ID: **15** Type: **not specified**

Baryon fluctuations in extended linear sigma model.

Wednesday 5 February 2020 17:00 (30 minutes)

The existence and the location of the critical end point (CEP) between the crossover and the first order chiral phase transition in the phase diagram of the strongly interacting matter is a heavily studied area of recent particle physics. The baryon number fluctuations and related quantities such as kurtosis and other susceptibility ratios, that supposed be a good signature of CEP, has been calculated in an (axial)vector meson extended $(2+1)$ flavor Polyakov linear sigma model (ELσM) in zero and finite μ_B. It has been compared with the results of lattice calculations and effective models. Divergency of the kurtosis have been found at the critical end point, while unstable behaviour in $\mu_B > \mu_B^{crit}$. In the model next to the scalar and pseudoscalar we also plan to show vector and axialvector curvature masses.

Primary author: KOVÁCS, Győző (Wigner RCP)

Co-author: KOVACS, Peter (Wigner RCP)

Presenter: KOVÁCS, Győző (Wigner RCP)

Contribution ID: **16** Type: **not specified**

Surprises in Large Nc Thermodynamics

Thursday 6 February 2020 17:00 (30 minutes)

This talk takes a new look at the thermodynamics of QCD in the large Nc limit. In many contexts QCD in the large Nc limit gives a reasonable, if somewhat cartoonish, description of the theory at Nc=3. It is well-known, However, that the description of QCD near its cross-over from a hadronic regime to QGP is a place where the large Nc limit is quite different from Nc=3. Instead of having a cross-over as in Nc=3, it is generally believed that there is a first-order phase transition. A first order transition implies the possibility for the QGP phase to supercool and the hadronic phase to superheat. What is not generally appreciated is that at large Nc such a supercooled QGP phase has a remarkable property: it has negative absolute pressure; that is its pressure is lower than that of the true vacuum at T=0. The superheated hadronic phase at large Nc also reveals some interesting and surprising behavior. If the endpoint of the hadronic metastable phase as occurring at the Hagedorn temperature, then the analytic behavior of the entropy density as a function of the energy density is qualitatively quite different than one would have for a simple equation of state for a first order transition such as one would have in a van der Walls gas. The talk will conclude with an attempt to draw lessons for QCD Nc=3.

Primary author: Prof. COHEN, Thomas (University of Maryland)

Presenter: Prof. COHEN, Thomas (University of Maryland)

Contribution ID: **17** Type: **not specified**

O(6) harmonics in the three-heavy-quark problem

Wednesday 5 February 2020 18:00 (30 minutes)

We have constructed O(6) permutationally symmetric three-particle hyper-spherical harmonics. These hyper-spherical harmonics were applied to the non-relativistic three-quark problem, yielding eigen-energies corresponding to various confining potentials. We display these energy level splittings up to the K=5 shell as a function of confinement potential and briefly discuss the effects of relativity.

Primary author: Prof. SALOM, Igor (Intitute of Physics, University of Belgrade))

Presenter: Prof. SALOM, Igor (Intitute of Physics, University of Belgrade))

Contribution ID: **18** Type: **not specified**

Center regions as a solution to the Gribov problem of the center vortex model

Tuesday 4 February 2020 17:00 (30 minutes)

The center vortex model, capable of explaining confinement and chiral symmetry breaking, has been plagued by the lattice equivalent of Gribov copies: different maxima of the gauge functional lead to different predictions of the string tension. By using center regions, that is, arbitrary loops evaluating to a center element, as guide for the gauge fixing procedure, a solution to this problem is possible. The success of this approach was already shown, but the algorithms came with an arbitrary free parameter. In recent development this parameter has been fixed, even improving the results.

Primary author: GOLUBICH, Rudolf (Atominstitut, Techn. Univ. Wien)

Co-author: FABER, Manfried (Atominstitut, Techn. Univ. Wien)

Presenter: GOLUBICH, Rudolf (Atominstitut, Techn. Univ. Wien)

Contribution ID: **19** Type: **not specified**

The $K^+ \to \pi^+ \nu\bar{\nu}$ decay and New Physics searches at NA62

Wednesday 5 February 2020 11:30 (30 minutes)

The NA62 experiment at CERN was designed to measure the branching ratio of the ultra-rare decay $K^+ \to \pi^+ \nu\bar{\nu}$ with a decay-in-flight technique. The Standard Model prediction for this branching ratio is very precise and $K^+ \to \pi^+ \nu\bar{\nu}$ is an ideal candidate to search for indirect new physics at high-mass scales. NA62 took its first physics run in 2016, reaching the SM sensitivity for the branching ratio. In 2017 and 2018 the experiment collected, respectively, ˜10 and ˜20 times more data than in 2016. The results of the $K^+ \to \pi^+ \nu\bar{\nu}$ analysis with the 2016 and 2017 data sets are presented and future prospects are discussed. Moreover, the high-intensity setup, the flexibility of its trigger system and the hermetic coverage of the experiment make NA62 a useful tool for the direct search of very weakly coupled particles in the MeV-GeV range, such as heavy neutral leptons, dark photons and axion-like particles. The status of these searches will be reviewed, along with other BSM searches performed at NA62.

Primary author: LOLLINI, Riccardo (Universita e INFN, Perugia (IT))

Presenter: LOLLINI, Riccardo (Universita e INFN, Perugia (IT))

Contribution ID: **20** Type: **not specified**

$E(38)$ and $Z_0(57)$: possible surprises in the Standard Model

Friday 7 February 2020 09:30 (30 minutes)

With the reported observation of the Higgs boson at the LHC, the Standard Model of particle physics seems to be complete now as for its particle content. However, several experimental data at low and intermediate energies indicate that there may be two surprises.

The strongest evidence concerns $E(38)$, a very light spinless boson, probably a scalar, with a mass of 38 MeV and decaying into two photons. Theoretical arguments and experimental signals supporting its existence will be presented, including a very recent direct experimental confirmation at JINR in Dubna.

The other tentative new boson $Z_0(57)$, with a mass of about 57 GeV, we propose on the basis of small enhancements we observe in several experiments, using recent data obtained at the LHC as well as much older ones from LEP. We interpret this new particle as a pseudoscalar or scalar partner of a composite Z vector boson.

Primary authors: Dr RUPP, George (CeFEMA/IST, Lisbon); Prof. VAN BEVEREN, Eef (University of Coimbra, Physics Department)

Presenter: Dr RUPP, George (CeFEMA/IST, Lisbon)

Contribution ID: **21** Type: **not specified**

Hybrid star construction with the extended linear sigma model

Wednesday 5 February 2020 18:30 (30 minutes)

Inner structure of compact stars is a heavily studied field of research currently. The compact star is divided into two major parts, to the outer part called crust and the inner part called core. There are several possible scenarios of the composition of these parts. One possibility is the hybrid star, in which the crust is some nuclear matter, while the core part is quark matter. Since at large baryon densities basically one can only work with effective models, and usually nuclear matter and quark matter are described with different models some unification of these models are needed. In my talk I show recent development in hybrid star constructions using the extended linear sigma model for modeling the quark matter at the core.

Primary author: KOVACS, Peter (Wigner RCP)

Co-author: TAKÁTSY, János (Wigner RCP)

Presenter: KOVACS, Peter (Wigner RCP)

Contribution ID: **22** Type: **not specified**

Lattice study of the QCD phase diagram in (B, T, μ) space

Monday 3 February 2020 16:30 (30 minutes)

Using numerical simulations of lattice QCD with physical quark masses, we study the influence of magnetic-field background on chiral and deconfinement crossovers in finite-temperature QCD at low baryonic density. We show that the quadratic curvature of the chiral transition temperature in the temperature-chemical potential plane depends rather weakly on the strength of the background magnetic field. At weak magnetic fields, the thermal width of the chiral crossover gets narrower as the density of the baryon matter increases, possibly indicating a proximity to a real thermodynamic phase transition. Remarkably, the curvature of the chiral thermal width flips its sign at $eB_{\rm fl} \simeq 0.6\,{\rm GeV}^2$, so that above the flipping point $B > B_{\rm fl}$, the chiral width gets wider as the baryon density increases. Approximately at the same strength of magnetic field, the chiral and deconfining crossovers merge together at $T \approx 140\,{\rm MeV}$. The phase diagram in the parameter space temperature-chemical potential-magnetic field is outlined.

Primary authors: Dr NIKOLAEV, Aleksandr (Swansea University); MOLOCHKOV, Alexander (Far Eastern Federal University); KOTOV, Andrey; Dr CHERNODUB, Maxim (University of Tours, CNRS); Dr BRAGUTA, Victor (ITEP)

Presenter: KOTOV, Andrey

Contribution ID: **23** Type: **not specified**

Overview of Recent Results from the PHENIX Experiment at RHIC

Tuesday 4 February 2020 11:30 (30 minutes)

The PHENIX experiment at the Relativistic Heavy Ion Collider (RHIC) has established a comprehensive physics program to search for the quark–gluon plasma (QGP) and study its properties via rare penetrating probes. The PHENIX Collaboration has demonstrated that the QGP behaves as a nearly perfect fluid and that non-photonic electrons are substantially suppressed which has led to the use of heavy quarks as probes of the medium. Furthermore, RHIC experiments are investigating the phase diagram of QCD matter at different baryochemical potentialsand temperatures by varying the collision energy and system size.

This talk summarizes the latest PHENIX experiments' observations obtained from colliding small and large systems concerning collectivity, flow, hadronic production, and heavy quark measurements, and their interpretation with respect to the current theoretical understanding.

Primary author: NOUICER, Rachid (Rachid)

Presenter: NOUICER, Rachid (Rachid)

Contribution ID: **24** Type: **not specified**

Overview of heavy-flavour measurements in ALICE

Monday 3 February 2020 09:00 (30 minutes)

ALICE is devoted to the study of the properties of the Quark-Gluon Plasma (QGP). This new state of matter is created using ultra-relativistic heavy-ion collisions at the LHC. Heavy quarks are considered effective probes for the QGP since they, due to their large masses, are produced in hard scattering processes and experience the full evolution of the hot and dense medium while interacting with its constituents. The heavy-quark measurements provide insights on mechanisms like the in-medium energy loss and hadronization.

The ALICE detector uses its excellent particle identification and vertexing capabilities to reconstruct heavy-flavour hadrons and leptons coming from heavy-flavour hadron decays. Measurements in proton-proton collisions provide a baseline for interpreting heavy-ion collision results and constitutes an excellent test of pQCD calculations. In addition, proton-nucleus collisions allow separating cold nuclear matter effects from the effects of the deconfined strongly interacting matter created in heavy-ion collisions.

In this contribution, an overview of recent ALICE results for open heavy flavours, quarkonia, and heavy-flavour jets is presented.

Primary author: VAN DOREMALEN (FOR THE ALICE COLLABORATION), Lennart (Utrecht University (NL))

Presenter: VAN DOREMALEN (FOR THE ALICE COLLABORATION), Lennart (Utrecht University (NL))

Contribution ID: **25** Type: **not specified**

Studying particle production in small systems through correlation measurements in ALICE

Monday 3 February 2020 09:30 (30 minutes)

One of the remaining puzzles in heavy-ion physics is that observables thought to be signatures of a Quark-Gluon Plasma - such as flow and strangeness enhancement - are not only observed in heavy-ion collisions, but also in high-multiplicity proton-proton and proton-nucleus collisions. Various phenomenological models are being developed to try to understand this. These include both extensions of QCD inspired models with new features, such as rope hadronisation in the Angantyr extension of PYTHIA, or adding new phases, such as in the core-corona model (i.e. a QGP core surrounded by a QCD like corona) used for example in EPOS. These models are fundamentally different from each other, and therefore more experimental input is crucial to be able to distinguish between them. One approach is to use angular correlations between different hadronic species, and in particular strange hadrons. In this presentation, various correlation measurements in pp collisions from ALICE will be presented, along with phenomenological predictions.

The observables presented here are $\Xi - \mathrm{K}$ and $\Xi - \pi$ correlations to probe strangeness production, $\pi - \pi$, $\mathrm{K} - \mathrm{K}$, $\mathrm{p} - \mathrm{p}$, $\mathrm{p} -$, and $\Lambda - \Lambda$ correlations to probe meson and baryon production, and π, K, and p balance functions - i.e. the difference between same-sign and opposite-sign correlations - to probe charge-dependent effects in particle production. These measurements are important to gain a better understanding of the hadron production mechanism in small systems.

Primary author: ADOLFSSON, Jonatan (Lund University (SE))

Presenter: ADOLFSSON, Jonatan (Lund University (SE))

Contribution ID: **26** Type: **not specified**

Heavy Flavour measurements in Pb–Pb collisions with the upgraded ALICE Inner Tracking System

Monday 3 February 2020 10:00 (30 minutes)

In future LHC runs the heavy flavour measurements in Pb–Pb collisions will enable precise studies of the Quark Gluon Plasma (QGP) transport properties. In the scope of this direction, after the major upgrade of the ALICE Inner Tracking System (ITS2) with seven layers of CMOS Monolithic Active Pixel Sensors (MAPS), a further upgrade, the ITS3, is planned for the third LHC Shutdown (LS3). Ongoing developments allow designing wafer scale silicon sensors which can be curved owing to the flexible nature of silicon when thinned below 40-50 μm. The three innermost layers of the ITS2 will be replaced by three cylindrical single chip ultra light silicon wafers which will surround the beam pipe. The inner radius and the thickness of the beam pipe will be reduced allowing the first detection layer to approach the collision point. The significant reduction of material budget, down to 0.05% X0 per layer, along with other design modifications will improve the detection capabilities and boost the ALICE physics program focusing on the measurements of low mass and low momentum particles. Monte Carlo simulations of a simplified ITS3 geometry within the ITS2 design indicate an improvement in the impact parameter resolution and the tracking efficiency. The measurements of charm and beauty which will benefit from these improvements will be the subject of this contribution. The significance of measuring the Λb particle, decaying to a Λc and a π, a decay channel with low branching ratio and large combinatorial background is one of the studies on heavy flavour particles which reflects the substantially improved performance of the next ALICE tracker.

Primary author: Mrs ANDREOU, Dimitra (CERN-Nikhef)

Presenter: Mrs ANDREOU, Dimitra (CERN-Nikhef)

Contribution ID: **27** Type: **not specified**

Renormalization group and and scattering-equivalent Hamiltonians on a coarse momentum grid

Wednesday 5 February 2020 09:00 (30 minutes)

We present a recent application of the Glazek-Wilson similarity renormalization group for Hamiltonians (SRG).
We consider the $\pi\pi$-scattering problem in the context of the Kadyshevsky equation, a 3D reduction of the Bethe-Salpeter equation that allows for a Hamiltonian formulation. In this scheme, we introduce a momentum grid and provide an isospectral definition of the phase-shift based on a spectral shift of a Chebyshev angle. We introduce a new method to integrate the SRG equations based on the Crank-Nicolson algorithm with a single step finite difference so that isospectrality is preserved at any step of the calculations. We discuss issues on the unnatural high momentum tails present in the fitted interactions and reaching far beyond the maximal CM energy of $\sqrt{s} = 1.4$ GeV and how these tails can be integrated out explicitly by using Block-Diagonal generators of the SRG.

Primary author: Dr GOMEZ ROCHA, Maria (University of Granada)

Co-author: Prof. RUIZ ARRIOLA, Enrique (University of Granada)

Presenter: Dr GOMEZ ROCHA, Maria (University of Granada)

Contribution ID: **28** Type: **not specified**

3-flavor extension of the excluded volume model for the hard-core repulsion

Monday 3 February 2020 18:00 (30 minutes)

There are many motivations to study the phase structure of quantum chromodynamics (QCD), related to investigations of relativistic heavy-ion collisions, early universe, and compact stars. Moreover, the QCD phase diagram remains poorly understood, despite all the efforts dedicated to its description over the years, due to the difficulty of first principle calculations and the lack of experimental observation in the region of intermediate and high baryon densities. On the other hand, recent observations of 2-solar mass neutron star and gravitational waves from neutron star inspiral have been providing important insights about the equation of state (EoS) of dense matter. To support such a massive state, and the radius inferred from the observed tidal deformability from the inspiral, sound velocity can be greater than its conformal value, $c_s^2 \leq 1/3$, for densities few times of the nuclear matter densities. One of the alternatives that can take into account this anticipation is the quarkyonic-like model, where the repulsive enough nuclear interaction makes the EoS stiff and the dynamically generated quark degrees of freedom make the stiffness moderate after the onset density. In this work, we suggest a model of hard core nucleon interactions in an excluded volume, particularly suitable for the description of the three flavor quarkyonic matter. In this model, the nucleonic shell has a density related to the size of the hard core and becomes thinner as the density increases, and eventually, the quark degrees of freedom dominates. We study how the strangeness affects the equation of state, the behavior of the sound velocity and verify if the results are in agreement with neutron stars observations.

Primary author: Dr DUARTE, Dyana (Institute for Nuclear Theory)

Co-authors: Dr JEONG, Kie Sang (Institute for Nuclear Theory); Dr MCLERRAN, Larry (Institute for Nuclear Theory); Dr HERNANDEZ, Saul (Institute for Nuclear Theory)

Presenter: Dr DUARTE, Dyana (Institute for Nuclear Theory)

Contribution ID: **29** Type: **not specified**

Study of some (non-)conventional mesons in the framework of effective models.

Thursday 6 February 2020 16:30 (30 minutes)

The main aim of our study is to understand some conventional and non-conventional mesons by using an effective QFT models. Starting from a single $q\bar{q}$ seed state in the Lagrangian some states appear as a dynamically generated companion poles. We show that $K_0^*(700)$ is a companion pole of the heavier $K_0^*(1430)$ resonance, $X(3872)$ emerges as a virtual companion pole of $\chi_{c1}(2P)$, and the puzzling $Y(4008)$ is not a real state but an enhancement which appears when studying the state $\psi(4040)$.

Primary authors: PIOTROWSKA, Milena (Jan Kochanowski University); Prof. GIACOSA, Francesco (Kielce University)

Presenter: PIOTROWSKA, Milena (Jan Kochanowski University)

Contribution ID: **30** Type: **not specified**

Fluctuations of conserved quantities in heavy-ion collisions at high energies

Monday 3 February 2020 18:30 (30 minutes)

In this talk, several experimental observables used in heavy-ion collisions to probe the QCD phase diagram, such as net-baryon fluctuations and balance functions, will be reviewed, with emphasis on recent experimental results from ALICE and STAR. Important connections between the observables will be highlighted. Experimental challenges of their measurements will be discussed as well.

Primary author: ALTSYBEEV, Igor (St Petersburg State University (RU))

Presenter: ALTSYBEEV, Igor (St Petersburg State University (RU))

Contribution ID: **31** Type: **not specified**

Conformal anomaly and fluid dynamics

Thursday 6 February 2020 18:00 (30 minutes)

In this talk, we present theoretical findings on fluid dynamics with conformal symmetry broken. We discuss the physics of bulk viscosity and its limits. We focus on results concerning bulk relaxation time obtained from both a quantum-field-theoretical approach and kinetic theory.

Primary author: CZAJKA, Alina (National Centre for Nuclear Research)

Presenter: CZAJKA, Alina (National Centre for Nuclear Research)

Contribution ID: **32** Type: **not specified**

Space -matter. Unified theory

enter link description here

Here, in axioms of dynamic space-matter, the single theory of all math and physical theories is introduced, with a possibility of researches of energy levels of a singularity

Primary author: Mr PASTUSHENKO, Vladimir (http://pva1.mya5.ru/)

Presenter: Mr PASTUSHENKO, Vladimir (http://pva1.mya5.ru/)

Contribution ID: **33** Type: **not specified**

Hybrids in a chiral approach

Thursday 6 February 2020 12:00 (30 minutes)

We extend a chiral model of QCD, the so-called extended Linear Sigma Model (eLSM), in order to include ground-state hybrids (with exotic quantum numbers 1ˆ-+) and their axial-vector chiral partners. We then evaluate both masses and decays of these hybrid mesons into conventional quark-antiquark states, such as pseudoscalar and (pseudo)vector mesons. In particular, we also show that the decays of ground-state hybrids into eta-pion and etaprime-pion involve a term which follows from the chiral anomaly.

Primary author: GIACOSA, Francesco (Kielce University)

Presenter: GIACOSA, Francesco (Kielce University)

Contribution ID: **34** Type: **not specified**

The X(3872) as a mass distribution

Monday 3 February 2020 11:30 (30 minutes)

All existing experimental evidence of the bound state nature of the X(3872) relies on considering its decay products with a finite experimental spectral mass resolution which is typically $\Delta m \geq 2$MeV and much larger than its alleged binding energy, $B_X = 0.00(18)$MeV. On the other hand, there is a neat cancellation in the 1^{++} channel for the invariant $DD^{-}{}^{*}$ mass around the threshold between the continuum and bound state contribution. We discuss the impact of this effect for X(3872) at finite temperature, in prompt production in pp collisions data with a finite pT or the lineshapes of specific production experiments of exotic states involving triangle singularities

Primary authors: RUIZ ARRIOLA, Enrique (Universidad de Granada); Dr GARCIA ORTEGA, Pablo (University of Salamanca)

Presenter: RUIZ ARRIOLA, Enrique (Universidad de Granada)

Contribution ID: **35** Type: **not specified**

Double parton distributions of the pion

Thursday 6 February 2020 18:30 (30 minutes)

We present predictions for the double parton distribution of valence quarks in the pion in the framework of chiral quark models. The distribution has a very simple form with factorized transverse and longitudinal degrees of freedom. The dependence on the longitudinal momenta of the valence quarks is of the form $\delta(1-x_1-x_2)$, which complies to the formal requirements of the Gaunt-Stirling sum rules. The necessary dDGLAP evolution to higher momentum scales is performed via the Mellin moments. We explore its role on the correlation defined as the ratio of the double distribution to the product of single distributions. We notice that the ratios of the Mellin moments $< x_1^n x_2^m > / < x_1^n >< x_2^m >$ are scale invariant, providing suitable measures to be tested in future lattice simulations.

Primary authors: BRONIOWSKI, Wojciech (IFJ PAN); RUIZ ARRIOLA, Enrique (Universidad de Granada)

Presenter: BRONIOWSKI, Wojciech (IFJ PAN)

Contribution ID: **36** Type: **not specified**

A new evaluation of a_μ^{SM} to be deviated from the world averaged $a_\mu by 1.6\sigma$}is achieved by novel approach.

Thursday 6 February 2020 09:30 (30 minutes)

The elaborated Unitary and Analytic models of pseudoscalar meson nonet structure, and to some extent also of nucleons, give more precise theoretical prediction for the hadronic contribution $\Delta\alpha_h ad^{(5)}(t)$ to the running fine structure constant QED $\alpha(t)$ in space like region, which by the novel approach leads to the following complete SM muon anomalous magnetic moment value $a_\mu^{SM} = (11659196.35 \pm 481) \times 10^{-10}$. This result deviates from the world average experimental value $a_\mu^{exp} = (11659209 \pm 6) \times 10^{-10}$ by 12.65±7.69, i.e. 1.6σ.

Primary authors: Prof. DUBNICKOVA, Anna Zuzana (Comenius University); Prof. DUBNICKA, Stanislava (Inst.of Physics, SAS)

Presenter: Prof. DUBNICKOVA, Anna Zuzana (Comenius University)

Contribution ID: **37** Type: **not specified**

Prediction of coupling constant ratio values in the octet hyperon EM structure Unitary and Analytic models

Thursday 6 February 2020 10:00 (30 minutes)

Utilizing the SU(3) invariant vector-meson-baryon interaction Lagrangian, the knowledge of the invariant vector-meson coupling constants f_v and the numerical values of nucleon coupling constant ratios, specified in a comparison of the nucleon EM structure Unitary and Analytic model with all existing data on nucleon EM form factors, the coupling constant ratio values in all hyperon EM structure Unitary and Analytic models are evaluated numerically.

Primary author: Prof. DUBNICKA, Sanislav (Inst.of Physics, SAS)

Presenter: Prof. DUBNICKA, Sanislav (Inst.of Physics, SAS)

Contribution ID: **38** Type: **not specified**

The Physics Program of the PADME Experiment

Wednesday 5 February 2020 10:00 (30 minutes)

Massive photon-like particles are predicted in many extensions of the Standard Model as possible portals toward a hidden sector where Dark Matter is secluded 1. They are vector bosons mediating the interaction between ordinary and dark matter and can be produced in different processes through a dim mixing to the photon.
The PADME experiment searches for a signal of a Dark Photon A'in the e+e−⟶γA'reaction in a positron-on-target experiment. For this purpose, it is analyzed the missing mass spectrum of final states with a single photon, produced in the annihilation of the positron beam of the DAΦNE Beam-Test Facility, at Laboratori Nazionali di Frascati of INFN, on the electrons of a diamond target. In about one year of data taking, a sensitivity on the interaction strength (ε parameter) down to 0.001 is achievable in the mass region M(A') <23.7 MeV.
Actually, the PADME approach allows to look for any new particle produced in e+e− collisions through a virtual off-shell photon such as long lived Axion-Like-Particles (ALPs), proto-phobic X bosons, Dark Higgs ...
In the talk, the scientific program of the experiment, and its current status will be illustrated.

References

1 B. Holdom, Phys. Lett B 166, 196 (1986).

Primary author: GIANOTTI, Paola

Presenter: GIANOTTI, Paola

Contribution ID: **39** Type: **not specified**

Lightest strange resonance precision determination from a dispersive analysis of data

Thursday 6 February 2020 09:00 (30 minutes)

We present a precise and model-independent dispersive determination from data of the existence and parameters of the lightest strange resonance. We use both subtracted and unsubtracted partial-wave hyperbolic and fixed-t dispersion relations as constraints on combined piK and pipi to KKbar data. We then use the hyperbolic equations for the analytic continuation of the isospinI=1/2 scalar partial wave to the complex plane, in order to determine the pole parameters and residue of the kappa or K0*(700) resonance.

Primary authors: PELAEZ, Jose R. (Universidad Complutense de Madrid); Mr RODAS BILBAO, Arkaitz (William and Mary & Jefferson Lab); Dr RUIZ DE ELVIRA, Jacobo (ITP, University of Bern)

Presenter: PELAEZ, Jose R. (Universidad Complutense de Madrid)

Contribution ID: **40** Type: **not specified**

Holographic radial spectrum of mesons from higher dimensional QCD operators

Wednesday 5 February 2020 09:30 (30 minutes)

Within the framework of AdS/QCD models, the spectra of radially excited hadrons
are identified with towers of Kaluza-Klein (KK) states in a putative dual theory.
It is known, however, that the KK modes of dual theory must be qualitatively different
from the QCD excited states. We propose a possible solution for this discrepancy.
The idea is to describe excited hadrons as "would be" ground states in a particular dual model.
In our scheme, the higher radial excitations are interpolated by some higher dimensional QCD
operators. This dictates different 5D masses in a dual model. The excited hadrons are described
by zero KK mode of some five-dimensional fields while the higher KK modes
corresponding to the same 5D mass are interpreted as lying beyond the applicability of
holographic model under consideration. As a result the radial states with growing mass are enumerated
by growing dimension of interpolating QCD operators.
The idea is successfully tested in the Soft Wall and Hard
Wall holographic models in the sector of light mesons. The given approach in particular
leads to a much better phenomenological spectrum of vector radial excitations in
the Hard Wall model than the traditional KK description. Basing on a recent result by Fichet,
we also discuss a possible interpretation for quadratic dilaton background in the Soft Wall holographic
model: The introduction of this background may represent just a phenomenological way for taking
into account the one-loop interactions in the AdS bulk with gravitons and other fields.

Primary author: AFONIN, Sergey (Saint Petersburg State University)

Presenter: AFONIN, Sergey (Saint Petersburg State University)

Contribution ID: **41** Type: **not specified**

Gauge-covariant diagonalization of pion- a1 mixing and the resolution of a low energy theorem

Friday 7 February 2020 10:00 (30 minutes)

We show how to fulfill the low energy theorem of current algebra relating the form factors associated with the neutral pion decay in two photons and the anomalous virtual photon decay in three pions. This has been a long standing puzzle in a class of chiral models involving the mixing of pion and axial-vector mesons. The key to the solution is a gauge covariant formulation of the mixing and the identification of surface terms that are fixed according to the pertinent Ward identities. This work will soon appear in the net and is based on [1,2].

1 A.A. Osipov, B. Hiller, P.M. Zhang, Phys.Rev. D98 no.11, 113007 (2018) and Mod.Phys.Lett. A34 (2019) no.36, 1950301

[2] A.A. Osipov, M.M Khalifa, Phys. Rev. D98, 036023 (2018), A. A. Osipov, JETP Lett. 108, 161 (2018)

Primary authors: HILLER, Brigitte (University of Coimbra); OSIPOV, Alexander (JINR); KHALIFA, M.M.

Presenter: HILLER, Brigitte (University of Coimbra)

Contribution ID: **42** Type: **not specified**

Diphoton production in pp collision at NLO: Signal analysis

Friday 7 February 2020 11:00 (30 minutes)

The excess in the diphoton spectrum near the invariant mass Mγγ = 750 GeV at LHC late in 2016 generated considerable interest in the scientific community. One of the models that tried to explain this anomaly was a new scalar that can be produced at LHC via gluon fusion, and decays into two photons much like the Standard Model(SM) Higgs boson.
Hereby, my research work consisted of analyzing the Higgs boson production channel, gg → H, and its two photon decay channel, H → γγ, at tree level to obtain at the end the integrated differential cross section of gg → H → γγ. Subsequently, a complete next-to-leading order calculation for gg → H → γγ was presented in order to get precise theoretical predictions which match the accuracy of the experiments.

Primary author: Ms HAMMOUD, Nadine (Instituteof Nuclear Physics, PAS)

Presenter: Ms HAMMOUD, Nadine (Instituteof Nuclear Physics, PAS)

Contribution ID: **43** Type: **not specified**

Gauge-covariant diagonalization of pion- a1 mixing and the resolution of a low energy theorem

We show how to fulfill the low energy theorem of current algebra relating the form factors associated with the neutral pion decay in two photons and the anomalous virtual photon decay in three pions. This has been a long standing puzzle in a class of chiral models involving the mixing of pion and axial-vector mesons. The key to the solution is a gauge covariant formulation of the mixing and the identification of surface terms that are fixed according to the pertinent Ward identities. This work will soon appear in the net and is based on [1,2].

1 A.A. Osipov, B. Hiller, P.M. Zhang, Phys.Rev. D98 no.11, 113007 (2018) and Mod.Phys.Lett. A34 (2019) no.36, 1950301

[2] A.A. Osipov, M.M Khalifa, Phys. Rev. D98, 036023 (2018), A. A. Osipov, JETP Lett. 108, 161 (2018)

Primary author: HILLER, Brigitte (University of Coimbra)

Co-authors: OSIPOV, Alexander (JINR); KHALIFA, M.M.

Presenters: HILLER, Brigitte (University of Coimbra); OSIPOV, Alexander (JINR); KHALIFA, M.M.

Contribution ID: **44** Type: **not specified**

Polarization-vorticity coupling within the fluid dynamics with spin

Friday 7 February 2020 11:30 (30 minutes)

We compare thermodynamic and kinetic approaches, that have been recently used to study relations between the spin polarization and fluid vorticity in systems consisting of spin-one-half particles. The thermodynamic approach refers to general properties of global thermal equilibrium with a rigid-like rotation and demonstrates that the spin-polarization and thermal-vorticity tensors are equal. On the other hand, the kinetic approach uses the concept of the Wigner function and its semiclassical expansion. In most of the works done so far, the Wigner functions satisfy kinetic equations with a vanishing collision term. We show that this assumption restricts significantly applicability of such frameworks and, in contrast to many claims found in the literature, does not allow for drawing any conclusions regarding the relation between the thermal-vorticity and spin-polarization tensors, except for the fact that the two should be constant in global equilibrium. We further show how the kinetic-theory equations including spin degrees of freedom can be used to formulate a hydrodynamic framework for particles with spin.

Primary author: Dr RYBLEWSKI, Radoslaw (Institute of Nuclear Physics PAN)

Presenter: Dr RYBLEWSKI, Radoslaw (Institute of Nuclear Physics PAN)

Contribution ID: **45** Type: **not specified**

From string breaking to quarkonium spectrum

Tuesday 4 February 2020 18:00 (30 minutes)

QCD string breaking results in two flavour QCD by Bali et al. 2005 combined with the Born-Oppenheimer expansion have recently been used to gain insight into I=0 quarkonium resonances (Bicudo et. al, 2019). The aim of this work is to give a more precise input of relevant lattice QCD static potentials for the aforementioned quarkonium spectrum studies and at the same time get a better understanding of string breaking in two flavour QCD with improved Wilson fermions. Here, we show preliminary static potential data, which is a first ingredient towards getting the string breaking distance.

Presenter: Dr CATILLO, Marco (LMU Munich)

Contribution ID: **46** Type: **not specified**

Charmonium Spectrum from Nf=3+1 Lattice QCD

Tuesday 4 February 2020 18:30 (30 minutes)

We produced a set of gauge configurations generated with a new $N_f = 3+1$ massive renormalization scheme for three degenerate light quarks with a mass that equals the average light quark mass in nature and a physical charm quark mass, and a non-perturbatively determined clover coefficient for dynamical Wilson quarks on the lattice. We present the details of the algorithmic setup and tuning procedure of ensembles with three different volumes. We discuss finite volume effects and lattice artifacts and present physical results for charmonium spectra and dimensionless quantities in a first continuum limit study.

Primary author: HÖLLWIESER, Roman (University of Wuppertal)

Co-authors: KNECHTLI, Francesco Giacomo; KORZEC, Tomasz (University of Wuppertal)

Presenter: HÖLLWIESER, Roman (University of Wuppertal)

Contribution ID: **47** Type: **not specified**

News from NA61/SHINE – small and large systems

Wednesday 5 February 2020 11:00 (30 minutes)

NA61/SHINE is a fixed target experiment at the CERN Super Proton Synchrotron. The main goals of the experiment are to discover the critical point of strongly interacting matter and to study the properties of the onset of deconfinement. In order to reach these goals, a study of hadron production properties is performed in nucleus-nucleus, proton-proton and proton-nucleus interactions as a function of collision energy and size of the colliding nuclei. The experiment has recently completed data acquisition for its original programme on strong interactions. The Collaboration has gathered rich data on collisions of ions in a two-dimensional scan:varying the beam energy and the sizes of colliding nuclei. The most recent analysis of hadron production in ˆ40Ar+ˆ45Sc and ˆ7Be+ˆ9Be interactions deliver some puzzling results which none of the theoretical models can reproduce.

In this talk, the newest preliminary results on identified hadron spectra produced in Ar+Sc and Be+Be collisions at five beam momenta (19A, 30A, 40A, 75A and 150A GeV/c) will be shown. The kinematic distributions and measured multiplicities of identified hadrons will be compared with NA61/SHINE and NA49 p+p and Pb+Pb results, as well as with available world data.

Primary author: Mr LEWICKI, Maciej Piotr (University of Wroclaw (PL))

Presenter: Mr LEWICKI, Maciej Piotr (University of Wroclaw (PL))

Contribution ID: **48** Type: **not specified**

A fresh look at the excited baryon spectrum: What have we learned?

Tuesday 4 February 2020 12:00 (30 minutes)

Presenter: CREDE, Volker (Florida State University)