Excited QCD 2016

Report of Contributions

https://indico.cern.ch/e/453434

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

Medium modification of hadron masses and the thermodynamics of hadron resonance gas model

We study the effect of temperature (T) and baryon density (μ) dependent hadron masses on the thermodynamics of hadronic matter. We use linear scaling rule in terms of constituent quark masses
for all hadrons except for light mesons. T and μ dependent constituent quark masses and the light mesons masses are computed using 2+1 flavor Nambu-Jona-Lasinio (NJL) model. We compute the thermodynamical quantities of hadronic matter within excluded volume hadron resonance gas model
(EHRG) with these T and μ dependent hadron masses. We confront the thermodynamical quantities
with the lattice quantum chromodynamics (LQCD) at μ = 0 GeV. Further, we comment on the effect T and μ dependent hadron masses on the transport properties near transition temperature.

Author: Mr KADAM, Guruprasad (Physical Research Laboratory)

Co-author: MISHRA, Hiranmaya (Physical Research Laboratory)

Presenter: Mr KADAM, Guruprasad (Physical Research Laboratory)

Contribution ID: **50** Type: **not specified**

Thermalization and hydrodynamization in the color-flux-tube model

Monday 7 March 2016 11:35 (30 minutes)

Detailed study of thermalization of the momentum spectra of partons produced via decays of the color flux tubes due to the Schwinger tunneling mechanism is presented. The collisions between particles are included in the relaxation time approximation specified by different values of the shear viscosity to entropy density ratio. At first we show that, to a good approximation, the transverse-momentum spectra of the produced patrons are exponential, irrespectively from the assumed value of the viscosity of the system and the freeze-out time. This thermal-like behaviour may be attributed to specific properties of the Schwinger tunneling process. In the next step, in order to check the approach of the system towards genuine local equilibrium, we compare the local slope of the model transverse-momentum spectra with the local slope of the fully equilibrated reference spectra characterised by the effective temperature that reproduces the energy density of the system. We find that the viscosity corresponding to the AdS/CFT lower bound is necessary for thermalization of the system within about two fermis.

Literature:

1) R.Ryblewski, arXiv:1512.04117 [nucl-th]

2) R.Ryblewski, W.Florkowski, Phys.Rev. D88 (2013) 034028

Authors: Dr RYBLEWSKI, Radoslaw (Institute of Nuclear Physics PAN); FLORKOWSKI, Wojciech (Institute of nuclear Physics, Krakow)

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

Session Classification: Monday Morning

Contribution ID: **51** Type: **not specified**

Large-N pion scattering,finite-temperature efects and the relationship of the f0(500) with chiral symmetry restoration

Friday 11 March 2016 09:30 (30 minutes)

We study how the thermal properties of the f0(500) pole behave in a regime where temperature is below its critical chiral transition value. We attain this by considering an O(N +1)/O(N) invariant Non-Linear Sigma Model (NLSM) for a large number of N massless pions as an approach for the dynamics of Low Energy QCD, and after introducing a thermal bath via the imaginary time formalism. At T = 0, we fit the parameters of the NLSM such that we can describe both older and newer scattering data in the scalar channel and generate dynamically its associated resonance, thus obtaining a pole position that agrees with experimental determinations. Next, we calculate the pion scattering amplitude at finite T and check that exact thermal unitarity holds. Also, we show that one can define a proper renormalization scheme with T = 0 counterterms such that the renormalized T-dependent amplitude can be chosen to depend only on a few parameters. Next, we analyze the behaviour of the f0(500) pole at finite T, which is consistent with chiral symmetry restoration when the scalar susceptibility is saturated by the f0(500) state, in a second-order transition scenario and in accordance with lattice and theoretical analysis. Furthermore, we find its associated critical exponent and check that it lies within the range expected for a O(N) universality class.

Author: CORTES, Santiago (Universidad de los Andes)

Co-authors: Dr MORALES, John (Universidad Nacional de Colombia, sede Bogotá); Dr GÓMEZ-NICOLA, Ángel (Universidad Complutense de Madrid)

Presenter: CORTES, Santiago (Universidad de los Andes)

Session Classification: Friday Morning

Contribution ID: **52** Type: **not specified**

Soft Pomeron in Holographic QCD

Monday 7 March 2016 17:00 (30 minutes)

We study the graviton Regge trajectory in Holographic QCD as a model for high energy scattering processes dominated by soft pomeron exchange. This is done by considering spin J fields from the closed string sector that are dual to glueball states of even spin and parity. In particular, we construct a model that governs the analytic continuation of the spin J field equation to the region of real J < 2, which includes the scattering domain of negative Maldelstam variable t. The model leads to approximately linear Regge trajectories and is compatible with the measured values of 1.08 for the intercept and 0.25 GeV−2 for the slope of the soft pomeron. The intercept of the secondary pomeron trajectory is in the same region of the subleading trajectories, made of mesons, proposed by Donnachie and Landshoff, and should therefore be taken into account.

Author: COSTA, Miguel

Presenter: COSTA, Miguel

Session Classification: Monday Afternoon

Contribution ID: **54** Type: **not specified**

Chemical freeze-out in proton-proton and nucleus-nucleus collisions

Wednesday 9 March 2016 12:05 (30 minutes)

New results of the NA61/SHINE Collaboration at the CERN SPS on mean hadron multiplicities in proton-proton (p+p) interactions are analyzed within the transport models and the hadron resonance gas (HRG) statistical model. The chemical freeze-out parameters in p+p interactions and central Pb+Pb (or Au+Au) collisions are found and compared with each other in the range of the center of mass energy of the nucleon pair $\sqrt{s_{NN}}$=3.2–17.3 GeV. The canonical ensemble formulation of the HRG model is used to describe mean hadron multiplicities in p+p interactions and the grand canonical ensemble in central Pb+Pb and Au+Au collisions. The chemical freeze-out temperatures in p+p interactions are found to be larger than the corresponding temperatures in central nucleus-nucleus collisions.

Author: BEGUN, Viktor (UJK)

Presenter: BEGUN, Viktor (UJK)

Session Classification: Wednesday Morning

Contribution ID: **55** Type: **not specified**

Hadron Resonance Gas Model, Thermodynamics of QCD and Heavy Quark Physics

Monday 7 March 2016 17:30 (30 minutes)

We show how quark and glueball properties can be determined from the Hadron Resonance Gas model below the de-confinement phase transition [1,2,3,4]. This makes use of Quark-Hadron duality necessitating a tower of excited states and poses the interesting problem of identification of degrees of freedom at increasing temperatures [5]. In particular, we compute the equation of state of Gluodynamics and QCD, the Polyakov loop and the Heavy Quark Free Energy [6], and compare with existing lattice computations [7,8,9]. Finally we address on the Casimir scaling of the Polyakov loop at low temperatures, and test it with the most recent lattice results of [10].

References
[1] E. Megias, E. Ruiz Arriola and L.L. Salcedo, Phys. Rev. Lett. 109 (2012) 151601.
[2] E. Megias, E. Ruiz Arriola and L.L. Salcedo, AIP Conf. Proc. 1625 (2014) 73-79.
[3] E. Megias, E. Ruiz Arriola and L.L. Salcedo, Phys. Rev. D89 (2014) 076006.
[4] E. Megias, E. Ruiz Arriola and L.L. Salcedo, Nucl. Part. Phys. Proc. 258-259 (2015) 201-204.
[5] E. Ruiz Arriola, L.L. Salcedo and E. Megias, Acta Phys. Polon. B45 (2014) 2407-2453.
[6] E. Ruiz Arriola, L.L. Salcedo, E. Megias, Acta Phys. Polon. Supp. 8 (2015) 2, 439-444.
[7] O. Kaczmarek and F. Zantow, Phys. Rev. D71 (2005) 114510.
[8] S. Borsanyi, G. Endrodi, Z. Fodor, S. Katz, K. Szabo, JHEP 1207 (2012) 056
[9] S. Borsanyi et al. (Wuppertal-Budapest Collaboration), JHEP 1504 (2015) 138.
[10] P. Petreczky, H. -P. Schadler, Phys.Rev. D92 (2015) 9, 094517.

Author: Dr MEGIAS, Eugenio (Max Planck Institut fur Physik, Munich)

Co-authors: Prof. RUIZ ARRIOLA, Enrique (Universidad de Granada); Prof. SALCEDO, Lorenzo Luis (Universidad de Granada)

Presenter: Dr MEGIAS, Eugenio (Max Planck Institut fur Physik, Munich)

Session Classification: Monday Afternoon

Contribution ID: **56** Type: **not specified**

Existence of the critical endpoint in the vector meson extended linear sigma model

Thursday 10 March 2016 17:00 (30 minutes)

In the framework of an SU(3) (axial)vector meson extended linear sigma model with additional constituent quarks and Polyakov loops, we investigate the effects of (axial)vector mesons on the chiral phase transition. The parameters of the Lagrangian are set at zero temperature and we use a hybrid approach where in the effective potential the constituent quarks are treated at one-loop level and all the mesons at tree-level. We have four order parameters, two scalar condensates and two Polyakov loop variables and their temperature and baryochemical potential dependence are determined from the corresponding field equations. We investigate the thermodynamics of the system, and at zero temperature we compare our results with lattice calculations. We study, furthermore, the changes of the tree-level scalar meson masses in the hot and dense medium.

Author: SZÉP, Zsolt (MTA-ELTE Statistical and Biological Physics Research Group)

Co-authors: WOLF, Gyuri (KFKI RMKI); KOVACS, Peter (Wigner RCP)

Presenter: SZÉP, Zsolt (MTA-ELTE Statistical and Biological Physics Research Group)

Session Classification: Thursday Afternoon

Contribution ID: **57** Type: **not specified**

Latest Developments on Jet Quenching Phenomena

Wednesday 9 March 2016 11:35 (30 minutes)

In this talk, I will review the latest breakthroughs on the description of jet quenching phenomena, name given to the collection of modifications that a hard probe undergoes when travelling through a hot and dense medium, such as the quark-gluon plasma. Among the several probes, jets - collection of collimated particles - are one of the most promising tools. They provide us (i) with a unique tool to test the QCD theory against in-medium modifications of parton shower description - so far extremely successful in proton-proton (vacuum) collisions - (ii) an experimental observable to probe the hot and dense medium that is created in ultra-relativistic heavy-ion collisions. These goals are currently being pursued in both the LHC and RHIC. Nonetheless the success of this program depends crucially on the existence of (i) a full theoretical description of the dynamical effects of the medium on the jets that develop within it and (ii) application of such theory to create sensitive and experimentally robust phenomenological tools for QGP probing. I will address the latest developments that are being pursued in both forefronts.

Author: APOLINARIO, Liliana (Instituto Superior Tecnico (PT))

Presenter: APOLINARIO, Liliana (Instituto Superior Tecnico (PT))

Session Classification: Wednesday Morning

Contribution ID: **58** Type: **not specified**

QCD results in the forward region (LHCb)

Tuesday 8 March 2016 10:30 (30 minutes)

LHCb, while purpose built for b-physics, also functions as a general purpose forward detector, covering the pseudo-rapidity range 2.0 to 5.0.
A wide variety of forward QCD measurements have been performed, including jet production measurements, soft inclusive particle distributions and correlations, and central exclusive production. A selection of these results will be presented, highlighting the scope of the LHCb physics programme.

Author: CID VIDAL, Xabier (Universidade de Santiago de Compostela)

Presenter: CID VIDAL, Xabier (Universidade de Santiago de Compostela)

Session Classification: Tuesday Morning

Contribution ID: **59** Type: **not specified**

A study of the resonances k0*(800) and k0*(1430)

Tuesday 8 March 2016 17:30 (30 minutes)

We study the broad light scalar kaonic resonance k0*(800) as a dynamically generated state. Namely, we show that this resonance emerges when investigating the heavier quark-antiquark scalar state k0*(1430) dressed by quantum fluctuations with one kaon and one pion circulating in the loops. We analyse the spectral function in the whole kaonic sector up to 1.8 GeV and determine the position of the poles on the complex plane: k0*(1430) corresponds to a standard 'seed' state, while k0*(800) corresponds to a 'companion' additional pole.

Author: SOLTYSIAK, Milena (Jan Kochanowski University)

Co-authors: Prof. GIACOSA, Francesco (Kielce University); WOLKANOWSKI-GANS, Thomas (Goethe-Universität Frankfurt am Main)

Presenter: SOLTYSIAK, Milena (Jan Kochanowski University)

Session Classification: Tuesday Afternoon

Contribution ID: **61** Type: **not specified**

NICA Project at JINR'

Wednesday 9 March 2016 08:30 (30 minutes)

The Nuclotron-based Ion Collider fAcility (NICA) project is now under active realization at the Joint Institute for Nuclear Research (JINR, Dubna). The main goal of the project is an experimental study of hot and dense strongly interacting matter in heavy ion (up to Au) collisions at centre-of-mass energies up to 11 GeV per nucleon. Two modes of the operation are foreseen, collider mode and extracted beams, with the two detectors, MPD and BM@N. In the collider mode the average luminosity is 10E27 cm-2 s-1 for Au(79+). The fixed target experiment BM@N at the JINR superconducting synchrotron Nuclotron is in preparation stage. Extracted beams of various nuclei species with maximum momenta 13 GeV/c (for protons) will be available. The NICA project also foresees a study of spin physics with the detector SPD with extracted and colliding beams of polarized deuterons and protons at centre-of-mass energies up to 27 GeV (for protons). The proposed program allows to search for possible signs of the phase transitions and critical phenomena as well as to shed light on the problem of nucleon spin structure. General design, construction status and physics program of the NICA complex will be presented.

Authors: Prof. KOVALENKO, Alexander (Joint Institute for Nuclear Research, Dubna); Prof. SORIN, Alexander (Joint Institute for Nuclear Research, Dubna); Prof. TRUBNIKOV, Grigory (Joint Institute for Nuclear Research, Dubna); Prof. MESHKOV, Igor (Joint Institute for Nuclear Research, Dubna); Prof. LEDNICKY, Richard (Joint Institute for Nuclear Research, Dubna); Prof. MATVEEV, Viktor (Joint Institute for Nuclear Research, Dubna); Prof. KEKELIDZE, Vladimir (Joint Inst. for Nuclear Research, Dubna)

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

Session Classification: Wednesday Morning

Contribution ID: **62** Type: **not specified**

O(3) Model and Finite Density Physics

Tuesday 8 March 2016 11:00 (30 minutes)

I will discuss some lattice simulation of the O(3) non-linear sigma model model via dual-variables method. I will demonstrate that dual variables allow for a very physical Quantum Mechanical intepretation, and a very precise and reliable information about scattering data of the particle appearing in the infrared.

Authors: Prof. GATTRINGER, Christof (Graz U); Dr BRUCKMANN, Falk (University of Regensburg); KLOIBER, Thomas (Graz U); Dr SULEJMANPASIC, Tin (North Carolina State University)

Presenter: Dr SULEJMANPASIC, Tin (North Carolina State University)

Session Classification: Tuesday Morning

Contribution ID: **63** Type: **not specified**

Final combined deep inelastic scattering cross sections at HERA

Wednesday 9 March 2016 09:30 (30 minutes)

A combination is presented of all inclusive deep inelastic cross sections previously published by the H1 and ZEUS collaborations at HERA for neutral and charged current ep scattering for zero beam polarisation. The data were taken at proton beam energies of 920, 820, 575 and 460 GeV and an electron beam energy of 27.5 GeV. The data correspond to an integrated luminosity of about 1 fb^{-1} and span six orders of magnitude in negative four-momentum-transfer squared, Q^2, and Bjorken x. The correlations of the systematic uncertainties were evaluated and taken into account for the combination. The combined cross sections were input to QCD analyses at leading order, next-to-leading order and at next-to-next-to-leading order, providing a new set of parton distribution functions, called HERAPDF2.0. The analysis was extended by including HERA data on charm and jet production, resulting in the variant HERAPDF2.0Jets. The inclusion of jet-production cross sections made a simultaneous and precise determination of these parton distributions and the strong coupling constant possible.

Author: WING, Matthew (UCL)

Presenter: WING, Matthew (UCL)

Session Classification: Wednesday Morning

Contribution ID: **64** Type: **not specified**

Kinetic properties of the GribovZwanziger plasma

Wednesday 9 March 2016 11:05 (30 minutes)

We study kinetic properties of a plasma consisting of gluons whose infrared dynamics is improved by the Gribov-Zwanziger quantization. This approach includes essential features of color confinement which set the plasma apart from conventional quasiparticle systems in several aspects. Our study focusses on a boost-invariant expansion for in and out of equilibrium configurations, which at late times can be characterized by the sound velocity, cs, and the shear, eta, and bulk, zeta, viscosities. We obtain explicit expressions for the transport coefficients eta and zeta and check that they are consistent with the numerical solutions of the kinetic equation. At high temperature, we find a scaling zeta/eta ˜ 1/3 csˆ2 which manifests strong breaking of conformal symmetry in contrast to the case of weakly coupled plasmas.

based on the eprints: arXiv:1504.03176, arXiv:1509.01242

Author: FLORKOWSKI, Wojciech (Institute of nuclear Physics, Krakow)

Co-authors: TYWONIUK, Konrad (CERN); SU, Nan (Bielefeld University); Dr RYBLEWSKI, Radoslaw (Institute of Nuclear Physics PAN)

Presenter: FLORKOWSKI, Wojciech (Institute of nuclear Physics, Krakow)

Session Classification: Wednesday Morning

Contribution ID: **65** Type: **not specified**

The QCD sign problem: subtleties with the infinite volume limite

Monday 7 March 2016 08:30 (30 minutes)

The sign problem in QCD is important since it inhibits our ability to use numerical lattice gauge theory methods to describe many significant problems including QCD matter at nonzero baryon chemical potential. In this talk, the sign problem is explored for QCD with a theta term–a more straightforward problem than the case of the chemical potential. Various subtle effects arise in the infinite volume limit which at first brush seem highly counter intuitive. This talk will elucidate this effects.

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

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

Session Classification: Monday Morning

Contribution ID: **66** Type: **not specified**

Searches for Supersymmetry and Exotic phenomena with the ATLAS Detector

Thursday 10 March 2016 10:30 (30 minutes)

Weak scale supersymmetry is one of the best motivated and studied extensions of the Standard Model and it is explored, together with other new physics scenarios, exploiting the recent increase in the center of mass energy of the proton-proton collisions at the Large Hadron Collider. This talk summarizes the searches performed with the ATLAS detector in the first run-2 data using 3.2 fbˆ(-1) at 13 TeV.

Author: BENEKOS, Nectarios (National Technical Univ. of Athens (GR))

Presenter: BENEKOS, Nectarios (National Technical Univ. of Athens (GR))

Session Classification: Thursday Morning

Contribution ID: **67** Type: **not specified**

QCD with chiral chemical potential: models vs. lattice

Wednesday 9 March 2016 17:30 (30 minutes)

QCD with chiral(axial) chemical potential will be reconstructed with the help of effective low energy Lagrangians and different models of NJL type. Their thermodynamic properties will be confronted to lattice predictions. Possible signatures of chiral imbalance will be guessed.

Author: ANDRIANOV, Alexander (Saint Petersburg State University)

Co-authors: ESPRIU CLIMENT, Domenec (University of Barcelona (ES)); Prof. ANDRIANOV, Vladimir (Saint-Petersburg State University)

Presenter: ANDRIANOV, Alexander (Saint Petersburg State University)

Session Classification: Wednesday Afternoon

Contribution ID: **68** Type: **not specified**

Soft-wall modelling of mesons

Thursday 10 March 2016 18:00 (30 minutes)

The holographic approach inspired by the gauge/gravity correspondence from string theory has been actively applied to the hadron spectroscopy in the last ten years.
One of directions in this field is to start from the real QCD and guess a tentative
dual higher dimensional weakly coupled field model following the principles of gauge/gravity correspondence - the so-called bottom-up approach. The Regge-like trajectories for light hadrons are reproduced within a special class of models referred to as "soft-wall holographic models". I will give a short review of the underlying ideas and technical aspects related to the meson spectroscopy.

Author: AFONIN, Sergey (Saint Petersburg State University)

Presenter: AFONIN, Sergey (Saint Petersburg State University)

Session Classification: Thursday Afternoon

Contribution ID: **69** Type: **not specified**

A non-perturbative study of the correlation functions of three-dimensional Yang-Mills theory

Monday 7 March 2016 12:05 (30 minutes)

Functional equations like the functional renormalization group, Dyson-Schwinger equations or n-PI methods are useful tools which provide insight into the non-perturbative regime of quantum field theories. The basic objects are Green functions which can be calculated non-perturbatively. However, while the underlying equations are exact, approximations have to be introduced for the actual calculations. I will discuss the effects of such approximations in the case of three-dimensional Yang-Mills theory using the 3PI effective action and Dyson-Schwinger equations. As a consequence of the UV finiteness of this theory, some technical ambiguities of the four-dimensional theory are absent and only pure truncation artifacts are observed.

Author: HUBER, Markus (University of Graz)

Presenter: HUBER, Markus (University of Graz)

Session Classification: Monday Morning

Contribution ID: **70** Type: **not specified**

Description of EM structure of nonet of pseudoscalar mesons by $Unitary\&Analytic$ model leads to more accurate muon g-2 anomaly and QED $\alpha(H_Z^2)$ evaluation

Monday 7 March 2016 18:30 (30 minutes)

It is demonstrated, if data on the EM form factors of the nonet of pseudoscalar mesons π^+, π^0, π^-, K^+, K^0, $\bar{K}^0$, K^-, η, η' are described by the $Unitary\&Analytic$ model, then with more precision the muon $g-2$ anomaly and QED running fine structure constant at the squared mass of the Z-boson $\alpha(M_Z^2)$ are evaluated The most important sources contributing to the error reduction of quantities under consideration are:
\begin{itemize}
\item The $Unitary\&Analytic$ model of the corresponding form factors provides a function behaving smoothly at small δt.
\item Also experimental data outside the integration region are exploited for determination of the errors of parameters of the model.
\item Theoretical knowledge of form factors, which by a construction respect their all known properties.
\end{itemize}

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

Co-authors: Dr LIPTAJ, Andrej (Inst.of Physics, SAS, Bratislava, Slovakia); Prof. DUBNICKA, Stanislav (Inst.of Physics, SAS, Bratislava, Slovakia)

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

Session Classification: Monday Afternoon

Contribution ID: **71** Type: **not specified**

Initial state correlations and the Ridge

Tuesday 8 March 2016 19:00 (30 minutes)

We point out that Bose enhancement in a hadronic wave function generically leads to correlations between produced particles. We show explicitly, by calculating the projectile density matrix in the Color Glass Condensate approach to high-energy hadronic collisions, that the Bose enhancement of gluons in the projectile leads to azimuthal collimation of long range rapidity correlations of the produced particles, the so-called ridge correlations.

Author: ALTINOLUK, Tolga

Presenter: ALTINOLUK, Tolga

Session Classification: Tuesday Afternoon

Contribution ID: **72** Type: **not specified**

Lattice QCD study of excited hadron resonances

Tuesday 8 March 2016 08:30 (30 minutes)

The spectrum of excited hadron resonances in QCD is studied using Monte Carlo path integration techniques formulated on a large $32^3 \times 256$ anisotropic space-time lattice. A large number of probe interpolating operators are used, and calculation of temporal correlations is accomplished using a stochastic method of treating the low-lying modes of quark propagation that exploits Laplacian Heaviside quark-field smearing. Progress in using an effective Hamiltonian to interpret the finite-volume energies and determine the masses and widths of the resonances is described.

Author: MORNINGSTAR, Colin (Carnegie Mellon University)

Presenter: MORNINGSTAR, Colin (Carnegie Mellon University)

Session Classification: Tuesday Morning

Contribution ID: **73** Type: **not specified**

Studies of the SM Higgs boson and searches for BSM Higgs bosons with the ATLAS Detector

Thursday 10 March 2016 11:00 (30 minutes)

The ATLAS collaboration has searched for the Standard Model Higgs Boson in the first run-2 data using 3.2 fbˆ(-1) at 13 TeV. Results are presented in terms of central value and limits on the fiducial and total cross-sections.
Several “Beyond Standard Model” theories predict the existence of additional heavy Higgs particles or di-Higgs resonances. Searches are conducted using the gamma-gamma, ZZ, WW and fermionic decay channels, and cover a large range of masses for the hypothetical resonances.

Author: LEIGHT, William Axel (Carleton University (CA))

Presenter: LEIGHT, William Axel (Carleton University (CA))

Session Classification: Thursday Morning

Contribution ID: **74** Type: **not specified**

Leading and sub-leading flows at the LHC from the CMS

Monday 7 March 2016 10:30 (30 minutes)

The initial state fluctuations of the colliding heavy ion nuclei play a major role in understanding the anisotropic flow of final state particles. Furthermore, an important signature of these fluctuations is the flow (event-plane) angle dependence from p_T that induces a measurable effect of factorization breaking in a pure relativistic hydrodynamic picture. The effect can be quantified by a Pearson like correlation coefficient, using the standard two-particle method, showing significant deviation below unity for very central collisions. Here, the effect of factorization breaking is described using a new method based on principal component analysis (PCA) and two-particle correlations. The method exposes leading and subleading mode, the leading corresponding to the standard elliptic and triangular flow and the subleading representing a new variable that is a direct response to initial state fluctuations. In this study, first measurements of the subflow are presented, as a function of transverse momentum in PbPb collisions at 2.76 TeV and high-multiplicity pPb collisions at 5.02 TeV with CMS data.

Author: Mr DEVETAK, Damir (CMS)

Presenter: Mr DEVETAK, Damir (CMS)

Session Classification: Monday Morning

Contribution ID: **75** Type: **not specified**

Light-by-light scattering in ultraperipheral heavy-ion collisions at the LHC

Thursday 10 March 2016 11:35 (30 minutes)

We calculate cross sections for diphoton production
in (semi)exclusive $PbPb$ collisions, relevant for the LHC.
The calculation is based on equivalent photon approximation in
the impact parameter space.
The cross sections for elementary $\gamma\gamma \to \gamma\gamma$
subprocess are calculated including two different mechanisms.
We take into account box diagrams
with leptons and quarks in the loops.
In addition, we consider a vector-meson dominance (VDM-Regge) contribution
with virtual intermediate hadronic (vector-like) excitations of the photons.
We get much higher cross sections in $PbPb$ collisions
than in earlier calculation from the literature.
This opens a possibility to study the $\gamma\gamma \to \gamma\gamma$
(quasi)elastic scattering at the LHC.
We present many interesting differential distributions which could
be measured by the ALICE, CMS or ATLAS Collaborations at the LHC.
We study whether a separation or identification of different components
(boxes, VDM-Regge) is possible. We find that the cross section for elastic
$\gamma\gamma$ scattering could be measured in the heavy-ion collisions
for subprocess energies smaller than $W_{\gamma\gamma} \approx 15 - 20$˜GeV.
My presentation will be based on [1].

[1] M. K{\l}usek-Gawenda, P. Lebiedowicz and A. Szczurek,
arXiv:1601.07001.

Author: SZCZUREK, Antoni (Institute of Nuclear Physics)

Presenter: SZCZUREK, Antoni (Institute of Nuclear Physics)

Session Classification: Thursday Morning

Contribution ID: **76** Type: **not specified**

Unitary multi-channel $\pi\pi$ scattering amplitudes of f_2 and ρ_3 mesons

Friday 11 March 2016 09:00 (30 minutes)

In a unitary multi-channel approach, precise determination of $\pi\pi$ scattering amplitudes for D and F waves has been presented. These scattering amplitudes are in the $I^GJ^{PC} = 0^+2^{++}$ sector on the processes of $\pi\pi \to \pi\pi$, 4π, $K\bar{K}$ and $\eta\eta$, likewise in the $I^GJ^{PC} = 1^+3^{--}$ sector on the processes of $\pi\pi \to \pi\pi$, 4π, $\omega\pi$ and $K\bar{K}$ for D and F waves respectively. The amplitudes were refined and re-fitted to the dispersion relations up to 1.1˜GeV, and to the experimental data in the effective two pion mass from the threshold to 2.7˜GeV and 1.9˜GeV for D and F waves, respectively. Old parameterizations did not satisfy the crossing symmetry condition and did not describe the $\pi\pi$ threshold region. Moreover, a satisfactory justification regarding the controversies in the states of f_2 and ρ_3 mesons about their masses and number of states that are taken into account has been discussed and finalized.

Author: NAZARI, Vahabeddin (Institute of Nuclear Physics, Polish Academy of Sciences)

Co-authors: ROBERT, Kaminski (Institute of Nuclear Physics PAN); BYDZOVSKY, Petr (Nuclear Physics Institute AS CR)

Presenter: NAZARI, Vahabeddin (Institute of Nuclear Physics, Polish Academy of Sciences)

Session Classification: Friday Morning

Contribution ID: **77** Type: **not specified**

Photoproduction of kaons

Thursday 10 March 2016 09:00 (30 minutes)

An isobar model for photoproduction of kaons on the proton was recently constructed [1] utilizing new experimental data from CLAS, LEPS and GRAAL collaborations. Higher-spin nucleon (3/2 and 5/2) and hyperon (3/2) resonances were included using the consistent formalism by Pascalutsa and found to play an important role in data description.

The set of chosen nucleon resonances agrees well with the set of the most probable contributing states determined in the Bayesian analysis with the Regge-plus-resonance model [2]. Particularly, we confirm that the missing resonances $P_{13}(1900)$ and $D_{13}(1875)$ do play important role in the description of data. However, the spin-1/2 state $P_{11}(1880)$ included in the Bayesian analysis was replaced in our analysis with the near-mass spin-5/2 state $N^*(1860)$, recently considered by the Particle Data Group.

In the analysis, a special attention was paid to the model predictions of the cross sections at small kaon angles that are important for accurate calculations of the hypernucleus-production cross sections. It was shown that the small-angle cross sections dominated by the background part of the amplitude get main contributions from the spin-1/2 and spin-3/2 hyperon exchanges in combination with the Born terms.

Results of two versions of the model will be compared in the third-resonance region with the experimental data and other models and discussed.

1. D. Skoupil and P. Bydzovsky: arXiv:1601.03840; accepted in Phys. Rev. C
2. L. De Cruz, T. Vrancx, P. Vancraeyveld, and J. Ryckebusch: Phys. Rev. Lett. 108, 182002 (2012); L. De Cruz, J. Ryckebusch, T. Vrancx, P. Vancraeyveld: Phys. Rev. C 86, 015212 (2012).

Author: BYDZOVSKY, Petr (Nuclear Physics Institute, Acad. Sci. of the Czech Republic, Rez)

Co-author: SKOUPIL, Dalibor (Nuclear Physics Institute, Acad. Sci. of the Czech Republic, Rez)

Presenter: BYDZOVSKY, Petr (Nuclear Physics Institute, Acad. Sci. of the Czech Republic, Rez)

Session Classification: Thursday Morning

Contribution ID: **78** Type: **not specified**

Magnetic properties in the inhomogeneous chiral phase

Wednesday 9 March 2016 18:30 (30 minutes)

We study the magnetic properties of the inhomogeneous chiral phase, considering the "dual chiral density wave (DCDW)", where both scalar and pseudoscalar condensates are spatially modulated. The response of quark matter to a tiny external magnetic field is investigated to show the spontaneous magnetization in the DCDW phase. In an external magnetic field, the energy spectrum of quarks becomes asymmetric about zero in the lowest Landau level, and it is clearly related to chiral anomaly.
We find that this spectral asymmetry also gives rise to the spontaneous magnetization, since a new term linearly proportional to the magnetic field is induced in the thermodynamic potential. Furthermore, this spontaneous magnetization includes not only the contribution of chiral anomaly but also one of valence quarks. Such spontaneous magnetization might be a candidate for the origin of the strong magnetic field in neutron stars.
We also show the peculiar behavior of magnetic susceptibility at the ferromagnetic transition point: it never diverges unlike the usual ferromagnetic transition, which suggests there is no spontaneous symmetry breaking as in the spin alignment.

Author: YOSHIIKE, Ryo (Kyoto university)

Co-authors: NISHIYAMA, Kazuya (Kyoto university); TATSUMI, Toshitaka (Kyoto U.)

Presenter: YOSHIIKE, Ryo (Kyoto university)

Session Classification: Wednesday Afternoon

Contribution ID: **79** Type: **not specified**

Complex Langevin in Lattice QCD: dynamic stabilisation and the phase diagram

Friday 11 March 2016 11:35 (30 minutes)

Complex Langevin simulations provide an alternative to sample path integrals with complex weights and therefore are suited to determine the phase diagram of QCD from first principles. We use our proposed method of Dynamic Stabilisation (DS) to ensure improved convergence to the right limit and present new systematic tests of this technique. We also show results on QCD in the limit of heavy quarks and preliminary results with fully dynamical staggered quarks.

Author: ATTANASIO, Felipe (Swansea University)

Co-authors: JÄGER, Benjamin (Swansea University); SEXTY, Denes (Uni Heidelberg); SEILER, Erhard (Max-Planck-Institüt für Physik); AARTS, Gert (Swansea University); STAMATESCU, Ion Olimpiu (Uni Heidelberg)

Presenter: ATTANASIO, Felipe (Swansea University)

Session Classification: Friday Morning

Contribution ID: **80** Type: **not specified**

Calculation of Regge trajectories of strange resonances and identification of the kappa(800) as a non-ordinary meson

Tuesday 8 March 2016 16:30 (30 minutes)

In ExcitedQCD2014, we presented a dispersive method to calculate Regge trajectories from their associated poles in elastic pion-pion scattering, which allowed to identify the rho(770) as an ordinary meson and the f0(500) as a non-ordinary one. Here we first present a dispersive treatment with more subtractions that confirms these results. In addition, extend this method to elastic or quasi-elastic resonances appearing in pion-pion, kaon-kaon, kaon-pion and K-*pion scattering. In this way the f2(1270), f2'(1525),* $K(892)$, K1(1410) and K0*(1430) resonances are identified as ordinary mesons.*
Finally, we identify the controversial kappa or K0(800) scalar resonance as a non-ordinary meson whose Regge trajectory is not linear and bears a striking similarity to that of the f0(500) and, at low energies, to a Regge trajectory of a Yukawa potential, whose parameters can be estimated.

Author: PELAEZ, Jose R.

Co-author: RODAS BILBAO, Arkaitz (Universidad Complutense de Madrid)

Presenter: PELAEZ, Jose R.

Session Classification: Tuesday Afternoon

Contribution ID: **81** Type: **not specified**

Finite-T Lattice QCD - Baryons in the Quark Gluon Plasma

Tuesday 8 March 2016 11:35 (30 minutes)

Studying baryons across the deconfinement transition allows us to test symmetries in the hadronic and the deconfined phase. Looking at baryonic correlation functions and their spectral decompositions, we find evidence that parity and chiral symmetry are restored in the Quark Gluon Plasma. We present a systematic study of the nucleon and the delta resonance, and elaborate on the lattice techniques used in this study.

Author: JÄGER, Benjamin (Swansea University)

Presenter: JÄGER, Benjamin (Swansea University)

Session Classification: Tuesday Morning

Contribution ID: **82** Type: **not specified**

Forward Dispersion Relations for pion-kaon scattering

Tuesday 8 March 2016 17:00 (30 minutes)

A precise determination of pion-kaon scattering amplitudes is very relevant for our understanding of both light meson physics as well
as input for analysis of other hadronic decays. In this talk we first present our analysis of the fulfillment of Forward Dispersion Relations by the existing data up to 1.7 GeV ., which is not very satisfactoy, particularly at high energies. Second by using these relations as constraints on the fits, we provide a set of simple data parameterizations that satisfy Forward Dispersion Relations while simultaneously describing the data up to 1.6 GeV
Finally, we present preliminary results on the controversial kappa or K0*(800) resonance as well as on scattering lengths and several combinations of threshold parameters.

Author: RODAS BILBAO, Arkaitz (Universidad Complutense de Madrid)

Co-author: PELAEZ, Jose R.

Presenter: RODAS BILBAO, Arkaitz (Universidad Complutense de Madrid)

Session Classification: Tuesday Afternoon

Contribution ID: **83** Type: **not specified**

Chiral-symmetry breaking and pion structure in the Covariant Spectator Theory

Friday 11 March 2016 18:30 (30 minutes)

We introduce a covariant approach in Minkowski space for the description of quarks and mesons that exhibits both chiral-symmetry breaking and confinement. Our interaction kernel in momentum
space is the sum of a δ-function potential and a covariant generalization of
the linear confining interaction. We assume a Lorentz vector structure for the δ-function and a mixed equally-weighted scalar-pseudoscalar structure for the confining part. With this Lorentz structure, the kernel preserves the axial-vector Ward-Takahashi identity and our model complies with the Adler zero constraint for π-π-scattering imposed by chiral symmetry.

Within this model, we have calculated the dressed quark mass function in Minkowski space. In order to compare our mass function with Euclidean approaches, our result is analytically continued to the region of negative four-momenta squared, where it is fitted to the existing lattice QCD data.

As a first application the mass function is used, together with a dressed off-shell
quark current that satisfies the vector Ward-Takahashi identity, in the calculation of the pion electromagnetic form factor. Our result for the form factor depends on the pion mass m_π, in particular, at small Q^2. The value $m_\pi = 0.42$ GeV gives the best fit to the experimental data. At large Q^2, our pion form factor exhibits the typical monopole behavior and we find an interesting scaling behavior between the form factors calculated with different pion masses.

Author: Dr BIERNAT, Elmar P. (Centro de Física Teórica de Partículas (CFTP), Instituto Superior Técnico (IST), Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal)

Co-authors: Prof. STADLER, Alfred (Departamento de Física, Universidade de Évora, 7000-671 Évora, Portugal); Prof. RIBEIRO, Emílio (CeFEMA, Instituto Superior Técnico (IST), Universidade de Lisboa, 1049-001 Lisboa, Portugal); Prof. GROSS, Franz (Thomas Jefferson National Accelerator Facility (JLab), Newport News, Virginia 23606, USA and College of William and Mary, Williamsburg, Virginia 23188, USA); Prof. PEÑA, M.T. (Centro de Física Teórica de Partículas (CFTP), Instituto Superior Técnico (IST), Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal)

Presenter: Dr BIERNAT, Elmar P. (Centro de Física Teórica de Partículas (CFTP), Instituto Superior Técnico (IST), Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal)

Session Classification: Friday Afternoon

Contribution ID: **84** Type: **not specified**

Numerical study of the baryon spectrum and chiral symmetry restoration

Thursday 10 March 2016 09:30 (30 minutes)

We study light baryons using a simple relativistic but non covariant Coulomb Gauge QCD inspired model. A variational basis is employed to compute the energies and wavefunctions of the baryon states, for different values of angular momentum and parity. Results are obtained for both the Nucleon and the Delta sectors. A special look is given to the high angular momentum states going up to J = 13/2. In this limit, we test the effect of chiral symmetry restoration on the baryonic spectrum.

Author: CARDOSO, Marco (Instituto Superior Técnico)

Co-authors: LLANES-ESTRADA, Felipe J. (Universidad Complutense de Madrid); BICUDO, Pedro (IST Lisboa)

Presenter: CARDOSO, Marco (Instituto Superior Técnico)

Session Classification: Thursday Morning

Contribution ID: **85** Type: **not specified**

Recent Progress in the Understanding of the Baryon Spectrum

Tuesday 8 March 2016 09:30 (30 minutes)

One of the primary approaches for understanding quark-gluon structure in baryons is to interpret the baryon spectrum in terms of the effective degrees of freedom. A significant amount of information about the light baryon spectrum comes from photoproduction experiments. Of particular interest are recent results on the photoproduction of vector mesons (ω, ρ and ϕ) and two-pion final states. It is anticipated that the resonances above 1.7 GeV c.m. energies, which have been predicted by the constituent quark model as well as Lattice QCD calculations but not yet confirmed experimentally, may predominantly couple to these final states. Therefore, it is essential to study these decay modes of excited baryons for discovering new resonances and understanding many known resonances that have been seen only in a few other decay modes. Recently published results on ω photoproduction off a proton from various collaborations and their interpretation will be presented. In addition, preliminary results on polarization observables for the same reaction using a transversely-polarized FROzen Spin butanol Target (FROST) at CLAS will be reported. The high-quality results are expected to provide further constraints to identify the N^* resonances that decay to $p\omega$ with minimal ambiguities. Furthermore, published results on $\pi^0\pi^0$ photoproduction from CBELSA/TAPS and preliminary results from the complimentary $\pi^+\pi^-$ photoproduction from the FROST experiment using a transversely-polarized target will be discussed. These results will give important information on the intermediate resonances that are involved in sequential decays to multipion-final states as well as on the decay modes of the resonances to ρ vector mesons. Many observables presented here are first-time measurements and will significantly augment the world database in these final states.

Author: ROY, Priyashree (on behalf of the CLAS collaboration)

Presenter: ROY, Priyashree (on behalf of the CLAS collaboration)

Session Classification: Tuesday Morning

Contribution ID: **86** Type: **not specified**

A density-of-states approach to numerical computations in Lattice Gauge Theories

Wednesday 9 March 2016 16:30 (30 minutes)

In Lattice Gauge Theories, Monte Carlo calculations often rely on the concept of importance sampling, whereby configurations are generated according to their Boltzmann probability distribution. While this approach is very efficient at computing vacuum expectation values of observables and quantities that can be derived from the latter (e.g. masses of particles), it leads to spectacular failures in situations in which certain rare configurations play a non-secondary role. This happens for instance in the determination of the free energy (whose fluctuations are exponential in the volume) and near first order phase transition points, where tunnelings between the two phases require the formation of interfaces, a process that arises with a probability that is exponentially suppressed with the size of the system. In this talk, we review the advantages of an approach based on the density of states and describe a recently introduced algorithm (the LLR method [1,2]) for computing the density of states in gauge theories. A remarkable feature of the method is exponential error suppression, which allows us to determine the density of states over several orders of magnitude with the same relative accuracy. As an application, we discuss Compact U(1) Lattice Gauge Theory, for which using the LLR algorithm highly accurate results are obtained in the pseudo-critical region on lattice sizes that are out of reach with importance sampling techniques. The scaling of the autocorrelation time with the volume V is also investigated and found to be polynomial in V and compatible with a V^2 asymptotic behaviour. This contrasts with the exponential behaviour observed for importance sampling methods.

[1] Langfeld, Lucini and Rago, PRL 109 (2012) 111601, arXiv:1204.3243

[2] Langfeld, Lucini, Pellegrini and Rago, arXiv:1509.08391

Author: LUCINI, Biagio (Swansea University)

Co-authors: RAGO, Antonio (University of Plymouth (GB)); LANGFELD, Kurt (Plymouth University); Dr PELLEGRINI, Roberto (Edinburgh University)

Presenter: LUCINI, Biagio (Swansea University)

Session Classification: Wednesday Afternoon

Contribution ID: **87** Type: **not specified**

Lattice Landau Gauge Quark Propagator and Quark-Gluon Vertex

Monday 7 March 2016 09:00 (30 minutes)

We report an ongoing lattice calculation of the Landau gauge quark propagator and quark-gluon vertex form factors using two flavours of dynamical O(a) improved Wilson fermions.

Author: Dr OLIVEIRA, Orlando

Presenter: Dr OLIVEIRA, Orlando

Session Classification: Monday Morning

Contribution ID: **88** Type: **not specified**

Hidden charm pentaquark states studied with different reactions

Thursday 10 March 2016 08:30 (30 minutes)

I shall report on different reactions where hidden charm states, of molecular type or other, can be seen. In particular I will describe theoretically the $\Lambda_b \to J/\psi K^- p$ and $\Lambda_b \to J/\psi \pi^- p$ reactions, where experimentally some peaks have been observed and associated to two pentaquark states by the LHCb collaboration. Then I will present studies of related reactions where some predicted states of hidden charm with strangeness could be observed.

Author: Prof. OSET, Eulogio (University of Valencia)

Presenter: Prof. OSET, Eulogio (University of Valencia)

Session Classification: Thursday Morning

Contribution ID: **89** Type: **not specified**

Twisted Mass Wilson ch-PT vs lattice data: a case study

Tuesday 8 March 2016 09:00 (30 minutes)

We compare lattice data obtained from a dynamical simulation with Twisted Mass fermions to the analytical predictions of Twisted Mass Wilson ch-PT and extract an estimate for the chiral condensate and the LEC W_8.

Author: Dr ZAFEIROPOULOS, Savvas (Goethe University Frankfurt)

Co-authors: Prof. SPLITTORFF, K. (Niels Bohr Institute); Dr CICHY, Krzysztof (Goethe University Frankfurt)

Presenter: Dr ZAFEIROPOULOS, Savvas (Goethe University Frankfurt)

Session Classification: Tuesday Morning

Contribution ID: **90** Type: **not specified**

Description of hadronic effects in weak decays of beauty mesons using covariant quark model

Thursday 10 March 2016 12:05 (30 minutes)

Rare weak decays of heavy mesons, nowadays experimentally measured, allow for sensitive testing of the validity of the Standard Model. To achieve a reliable theoretical predictions, one needs, besides an appropriate description of the weak transition, to properly describe the hadronic effects. The covariant quark model with infrared confinement represents a suitable framework for such purpose. With hadronic effects taken into account using this model, I will present predictions for several observables for chosen B meson decays.

Authors: LIPTAJ, Andrej (Slovak Academy of Sciences (SK)); IVANOV, Mikhail

Co-authors: DUBNICKOVA, Adubni (Comenius University (SK)); DUBNICKA, Dubnicka (Slovak Academy of Sciences (SK))

Presenter: LIPTAJ, Andrej (Slovak Academy of Sciences (SK))

Session Classification: Thursday Morning

Contribution ID: **91** Type: **not specified**

Finite density QFT from a density-of-states perspective

Wednesday 9 March 2016 17:00 (30 minutes)

For more than three decades, finite density quantum field theories have evaded first principle Monte-Carlo simulations due to the notorious sign-problem. The recent years have seen some remarkable progress towards the understanding of cold and dense quantum matter. The density-of-states approach aims to calculate the probability distribution of the imaginary part of the action. The partition function then appears as a Fourier integral of this density, which is carried out (semi-)analytically. The LLR method [1] is a Wang-Landau type of approach. We established that it features an exponential error suppression [2], which allows us to reliably estimate the density-of-states over hundreds of orders of magnitude. I review the results for a Z3 spin theory at finite densities [3], which serves as proof that the LLR method amasses enough precision to solve a strong sign problem. I will also address new results for QCD at finite densities of heavy quarks.

[1] Langfeld, Lucini and Rago, PRL 109 (2012) 111601, arXiv:1204.3243

[2] Langfeld, Lucini, Pellegrini and Rago, arXiv:1509.08391

[3] Langfeld, Lucini, PRD D90 (2014) 9, 094502, arXiv:1404.7187.

Author: LANGFELD, Kurt (Plymouth University)

Co-authors: RAGO, Antonio (University of Plymouth (GB)); LUCINI, Biagio (Swansea University); GARRON, Nicolas (Plymouth University); PELLEGRINI, Roberto (University of Edinburgh)

Presenter: LANGFELD, Kurt (Plymouth University)

Session Classification: Wednesday Afternoon

Contribution ID: **92** Type: **not specified**

Pion form factor in DSBSEs formalism

Monday 7 March 2016 19:30 (30 minutes)

New methods for solution of inhomogeneous as well as homogeneous Bethe-Salpeter equation for mesons will be discussed. Within covariant formalism of Dyson-Schwinger and Bethe-Salpeter equations, the calculation of production pion form factor will be presented and compared with recent BABAR experiment.

Author: SAULI, Vladimir (Nuclear Institute Rez near Prague)

Presenter: SAULI, Vladimir (Nuclear Institute Rez near Prague)

Session Classification: Monday Afternoon

Contribution ID: **93** Type: **not specified**

Saturation and geometrical scaling in large and small systems

Monday 7 March 2016 16:30 (30 minutes)

I this talk we shall discuss different pieces of experimental evidence of geometrical scaling in hadronic collisions. We shall also speculate on possible fluctuations of the saturation scale and their impact on rapidity spectra.

Author: PRASZALOWICZ, Michal (Jagiellonian University)

Presenter: PRASZALOWICZ, Michal (Jagiellonian University)

Session Classification: Monday Afternoon

Contribution ID: **94** Type: **not specified**

Flux tubes at finite temperature

Tuesday 8 March 2016 12:05 (30 minutes)

In this work, we show the flux tubes of the quark-antiquark and quark-quark at finite temperature. The chromomagnetic and chromoelectric fields are calculated above and below the phase transition.

Author: CARDOSO, Nuno (IST)

Co-authors: CARDOSO, Marco (Instituto Superior Técnico); BICUDO, Pedro (IST Lisboa)

Presenter: CARDOSO, Nuno (IST)

Session Classification: Tuesday Morning

Contribution ID: **95** Type: **not specified**

A real time lattice simulation of the thermalization of QGP: first results

Thursday 10 March 2016 18:30 (30 minutes)

An ab initio understanding of the thermalization of QGP is a formidable task that one would like to comprehend starting from QCD without model assumptions. We study the early stage dynamics of a relativistic heavy ion collision in the framework of real time classical simulations of QCD with the Color Glass Condensate as initial conditions. Our study aims to generalize a previous one by Fukushima and Gelis from SU(2) to SU(3). We focus on the chromo-electric and chromo-magnetic energy densities as well as the ratio of the longitudinal to the transverse pressure which provide evidence of the thermalization. We show preliminary results on coarse lattices, indicating the occurrence of Weibel instabilities before thermalization.

Authors: WAGENBACH, Björn (Goethe-Universität Frankfurt am Main); SCHÄFER, Christian (Goethe-Universität Frankfurt am Main); PHILIPSEN, Owe (Goethe-University Frankfurt); ZAFEIROPOULOS, Savvas; ATTEMS, maximilian (University of Barcelona)

Presenter: WAGENBACH, Björn (Goethe-Universität Frankfurt am Main)

Session Classification: Thursday Afternoon

Contribution ID: **96** Type: **not specified**

In-medium decay width of $\eta \to 3\pi$ process as a possible probe for chiral restoration

Monday 7 March 2016 09:30 (30 minutes)

In this talk, we present the result of our investigation of the $\eta \to 3\pi$ ($\pi^+\pi^-\pi^0$ and $3\pi^0$) decay width in the nuclear medium and the possible relevance of the chiral restoration using linear sigma model.
In the decay process of the η meson into three pions, the S-wave interaction of the pions which is called sigma mode gives a significant contribution.
The sigma mode is expected to be softened in the nuclear medium along with the chiral restoration and the softening would affect the decay width in the nuclear medium through the modification of the final-state interaction.
We study the decay process in the nuclear medium utilizing the linear sigma model which enables us to investigate the effect of the softening of the sigma mode in association with the chiral restoration on the decay process.
The decay width in the nuclear medium is enhanced at most about four to ten times larger than that in the free space though the enhancement has a relatively large dependence on the mass of the sigma meson in the free space which is an input parameter in this study.
The enhancement is significant even in the small density;
the decay width becomes several times larger than that in the free space at a half of the normal nuclear density and the dependence on the sigma mass is small.
This enhancement of the decay width in the nuclear medium is caused by the softening of the sigma meson through the chiral restoration.
We expect that the enhancement of the decay width in the nuclear medium can be a new possible probe for the chiral restoration.

Author: SAKAI, Shuntaro (Kyoto University)

Co-author: KUNIHIRO, Teiji (Kyoto University)

Presenter: SAKAI, Shuntaro (Kyoto University)

Session Classification: Monday Morning

Contribution ID: **97** Type: **not specified**

Status and perspectives with exotic states at LHCb

Tuesday 8 March 2016 18:30 (30 minutes)

The analysis of the full LHC Run I data set of proton-proton collision events collected with the LHCb detector, corresponding to an integrated luminosity of 3.0 fb-1, is yielding several improved results on exotic hadron candidates, such as $X(3872)$ and $Z(4430)^+$, as well as the first observation of two new states compatible with the pentaquark hypothesis. Run II data allow LHCb to further sharpen the experimental picture, opening up the possibility to observe new states. The measurements of the properties of these exotic states and the Run II prospects will be presented, including the determination of their quantum numbers, with model dependent and independent methods.

Author: MELNYCHUK, Dmytro (National Centre for Nuclear Research (PL))

Presenter: MELNYCHUK, Dmytro (National Centre for Nuclear Research (PL))

Session Classification: Tuesday Afternoon

Contribution ID: **98** Type: **not specified**

Unquenching the meson spectrum: a model study of excited rho resonances

Friday 11 March 2016 19:00 (30 minutes)

Recent lattice results indicate that including meson-meson interpolating fields in unquenched calculations of the light-meson spectrum may give rise to huge relative mass shifts as compared to similar computations with only quark-antiquark degrees of freedom. I this talk I shall focus on the rho meson and its radial excitations, in the context of a unitarised quark model with all experimentally relevant meson-meson decay channels up to 2.0 GeV included. Note that such a system of highly excited mesonic resonances is still way beyond the capacities of the most advanced lattice approaches.
The employed formalism is the Resonance-Spectrum Expansion, which allows to solve the multi-channel
S-matrix in closed form. The few model parameters are adjusted to the P-wave pion-pion phase shifts measured several decades ago.
This work is in progress.

Author: Dr RUPP, George (CeFEMA/IST, Univ. of Lisbon)

Co-authors: Prof. VAN BEVEREN, Eef (Physics Department, Univ. of Coimbra); Dr COITO, Susana (IMP/CAS, Lanzhou, China)

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

Session Classification: Friday Afternoon

Contribution ID: **99** Type: **not specified**

Flavoured aspects of the QCD thermodynamics

Friday 11 March 2016 10:30 (30 minutes)

We discuss recent progress in lattice QCD studies on various aspects involving strange and heavy quarks. Appropriate combinations of conserved net strange and net charm fluctuations and their correlations with other conserved charges provide evidence that in the hadronic phase so far unobserved hadrons contribute to the thermodynamics and need to be included in hadron resonance gas models.
In the strange sector this leads to significant reductions of the chemical freeze-out temperature of strange hadrons.
We have found that a description of the thermodynamics of open strange and open charm degrees of freedom in terms of an uncorrelated hadron gas is valid only up to temperatures close to the chiral crossover temperature. This suggests that in addition to light and strange hadrons also open charm hadrons start to dissolve already close to the chiral crossover.
Further indications that open charm mesons start to melt in the vicinity of Tc is obtained from an analysis of screening masses, while in the charmonium sector these screening masses show a behavior compatible with a sequential melting pattern.

Author: KACZMAREK, Olaf (University of Bielefeld)

Presenter: KACZMAREK, Olaf (University of Bielefeld)

Session Classification: Friday Morning

Contribution ID: **100** Type: **not specified**

Computing the topological susceptibility from fixed topology QCD simulations

Friday 11 March 2016 17:00 (30 minutes)

The topological susceptibility is a very important quantity in QCD, which can be computed using lattice methods. However, at fine lattice spacing, or when using high quality chirally symmetric quarks, typical simulation algorithms tend to become stuck in a single topological sector. In such cases the computation of the topological susceptibility is not anymore straightforward. Here we present two methods to extract the topological susceptibilty from lattice QCD simulations restricted to a single topological sector. The first method is based on the correlation function of the topological charge density, while the second method is based on measuring the topological charge within spacetime subvolumes. Numerical results for QCD obtained by using both methods are presented.

Author: DROMARD, Arthur (Goethe University)

Co-authors: Dr CICHY, Krzysztof (Goethe-Universität Frankfurt am Main); WAGNER, Marc (Goethe University Frankfurt); Prof. BIETENHOLZ, Wolfgang (Universidad Nacional Autónoma de México)

Presenter: DROMARD, Arthur (Goethe University)

Session Classification: Friday Afternoon

Contribution ID: **101** Type: **not specified**

Modeling two-boson mass distributions, E(38 MeV) and Z(57.5 GeV)

Thursday 10 March 2016 16:30 (30 minutes)

Besides general features of two-boson mass distributions, experimental results are are discussed. Furthermore, E(38 MeV) and Z(57.5 GeV) are highlighted.

Author: Prof. VAN BEVEREN, Eef (Dept. Fisica, Univ. Coimbra)

Presenter: Prof. VAN BEVEREN, Eef (Dept. Fisica, Univ. Coimbra)

Session Classification: Thursday Afternoon

Contribution ID: **102** Type: **not specified**

Ultra-intense lasers, plasmas and PIC - overview, developments and a look into the future

Tuesday 8 March 2016 19:30 (30 minutes)

We have witnessed fundamental breakthroughs in many areas of science due to fast development of laser technology. One such breakthrough was introducing advanced accelerator concepts: taking advantage of very high acceleration gradients (~ TeV / m) that can be created in laser-plasma interactions and using them to accelerate particles over very short distances compared to conventional accelerators. Another important aspect of having access to extreme laser intensities is bringing astrophysics to the laboratory. We are now able to study the collective effects of electron-positron plasmas in the presence of intense fields approaching the order of the Schwinger limit, and recreate conditions found in astrophysical shocks, pulsars, jets, neutron stars and gamma-ray bursts. The most ambitious projects for near-future experiments aim at studying QED cascades and even quark-gluon plasmas with lasers.

The ability to perform large-scale reliable computer simulations has played a vital role for the successful developments in studies of laser-matter interaction. Particle-in-cell (PIC) codes can account for the self-consistent evolution of plasma and electromagnetic fields in a fully kinetic description. They are based on discretised Maxwell's equations and can be used to simulate systems that consists of millions of particles. Newest code developments combine Monte-Carlo (MC) with PIC algorithms, using MC to account for quantum processes such as ionisation or electron-positron pair creation, while following the classical dynamics of the system with PIC. We will discuss the methods and developments in theory and simulations necessary to give support to the new generation laser facilities, and reflect on the exciting areas of physics where this work can bring new insights.

Author: Dr VRANIC, Marija (GoLP / IPFN, Instituto Superior Tecnico)

Presenter: Dr VRANIC, Marija (GoLP / IPFN, Instituto Superior Tecnico)

Session Classification: Tuesday Afternoon

Contribution ID: **103** Type: **not specified**

Pion-pion scattering and the timelike pion form factor from Lattice QCD

Wednesday 9 March 2016 19:00 (30 minutes)

The calculation of infinite-volume hadron-hadron scattering amplitudes from Lattice QCD simulations requires precisely determined finite-volume energy spectra. This required level of precision is achieved using an efficient algorithm to treat the physically important low-lying modes of quark propagation. We show results for elastic pion-pion scattering amplitudes from simulations with heavier-than-physical pion masses $m_\pi = 240$ and $280\,\mathrm{MeV}$ in the total isospin $I = 1$ and $I = 2$ channels. We additionally determine a simple resonance photoproduction amplitude, the isovector timelike pion form factor, which is an important low-energy contribution to the hadronic vacuum polarization.

Author: HÖRZ, Ben

Presenter: HÖRZ, Ben

Session Classification: Wednesday Afternoon

Contribution ID: **104** Type: **not specified**

Coherent gluon radiation in proton-nucleus collisions

Monday 7 March 2016 11:00 (30 minutes)

I will review the main features of medium-induced coherent gluon radiation associated with the hard forward scattering of a parton crossing a nuclear medium, as well as its effects on hadron production in proton-nucleus collisions

Author: Dr PEIGNE, Stephane (CNRS)

Presenter: Dr PEIGNE, Stephane (CNRS)

Session Classification: Monday Morning

Contribution ID: **105** Type: **not specified**

News from FAIR

Wednesday 9 March 2016 09:00 (30 minutes)

The new international accelerator facility FAIR under construction in Darmstadt aims at studying matter at atomic, nuclear, and hadronic levels. I will discuss recent developments and several aspects of the current status of the Facility for Antiproton and Ion Research. I will present the focus of the experimental programmes - hadron physics, nuclear structure and compressed nuclear matter physics, plasma and atomic physics, as well as related applications.

Author: NICMORUS, Diana (Facility for Antiproton and Ion Research)

Presenter: NICMORUS, Diana (Facility for Antiproton and Ion Research)

Session Classification: Wednesday Morning

Contribution ID: **106** Type: **not specified**

Light quark mass differences in the pion eta and eta' system

Monday 7 March 2016 19:00 (30 minutes)

Isospin breaking effects in the low lying spin 0 meson sector are studied within a chiral three flavor multiquark Lagrangian with explicit symmetry breaking interactions taken to NLO in the large Nc counting.

Author: HILLER, Brigitte (Coimbra U.)

Co-authors: OSIPOV, A. A. (Coimbra U.); BLIN, A. H. (Coimbra U.); MOREIRA, J. (Coimbra U.)

Presenter: HILLER, Brigitte (Coimbra U.)

Session Classification: Monday Afternoon

Contribution ID: **108** Type: **not specified**

Monte Carlo calculations on Lefschetz thimbles and beyond

Friday 11 March 2016 11:00 (30 minutes)

A possible solution of the notorious sign problem for systems with non-zero chemical potential is to deform the integration region in the complex plane to a Lefschetz thimble. We introduce an easy to implement Monte Carlo algorithm to sample the dominant thimble, based on a contraction map on a thimble. We point out that manifolds other than Lefschetz thimble could be useful for numerical simulations. We describe a family of such manifolds, using the contraction map, that interpolate between the tangent space at one critical point (where the sign problem could be severe) and the union of relevant thimbles (where the sign problem is mild but a multimodal distribution function complicates the Monte Carlo sampling). We show how this works using a simple fermion model.

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Session Classification: Friday Morning

Contribution ID: **109** Type: **not specified**

Heavy-light mesons in Minkowski space

Friday 11 March 2016 17:30 (30 minutes)

We present a study of the heavy-light pseudoscalar and vector meson masses, using a covariant formalism based on the Covariant Spectator Theory (CST). Derived directly in Minkowski space, our approach approximates the Bethe-Salpeter equation, effectively taking into account the contributions of both ladder and crossed ladder diagrams in the kernel.

Our goal was to provide—without already performing a comprehensive fit—an initial test whether our approach was able to describe the experimental data in a reasonable fashion. Our results show that such a description is indeed possible. Not only do we obtain a surprisingly good match in the heavy sector of the spectrum, but also the masses of mesons containing light and strange (anti-) quarks are very well described.

This is an encouraging first step towards a comprehensive study of mesons in this approach. Further steps will involve a fit of our model parameters to a wider range of data, but will also have to include a more general—and more complicated—version of our bound-state equation. That equation is more appropriate for the description of mesons consisting of light quarks, and we expect that its solutions will be closer to the experimental masses than the ones calculated with the approximation used in this work. This is of particular importance for a good description of the pion, which has already been studied successfully within CST, however only with a simpler phenomenological kernel.

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Session Classification: Friday Afternoon

Contribution ID: **110** Type: **not specified**

Towards a precise and accurate non-perturbative determination of the strong coupling constant at the electroweak scale.

Friday 11 March 2016 12:05 (30 minutes)

Relating the value of the strong coupling at the electroweak scale with the experimental value of hadronic quantities is a theoretical challenge that requires a non-perturbative formulation of the strong interactions. Lattice QCD provides an adequate theoretical framework to attack this problem. Our collaboration has developed a systematic strategy to connect non-perturbatively the low energy region of QCD with its high energy perturbative domain. After many years of applications to the pure gauge theory and two-flavour theory, we have applied this strategy to the three flavour theory. This study allow us to determine $\alpha_s(M_Z)$ in a controlled and precise fashion.

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Session Classification: Friday Morning

Contribution ID: **111** Type: **not specified**

Status and perspectives of the search for eta-mesic nuclei

Friday 11 March 2016 08:30 (30 minutes)

The negatively charged pions and kaons can be trapped in the Coulomb potential of atomic nucleus forming so called mesonic atoms. Observations of such atoms allows for studies of strong interaction of pions and kaons with atomic nuclei on the basis of shifts and widths of the energy levels. It is also conceivable that a neutral meson could be bound to a nucleus. In this case the binding is exclusively due to the strong interaction and hence such object can be referred to as a mesic nucleus. Here the most promising candidate is the η-mesic nucleus since the η-N interaction is strongly attractive.

The η-mesic nucleus was predicted about 30 years ago. Many promising indications of the existence of such an object were reported, but so far none was independently confirmed. Initially the η-mesic nuclei were considered to exists for A ≥ 12 only due to the relatively small value of the η N scattering length estimated in eighties. A decade later, large values of the η-nucleon scattering length (up to 1 fm) were extracted in some analyses. Such large value does not exclude the formation of bound η-nucleus states for such light nuclei as helium or even for deuteron. However so far there is no direct experimental confirmation of its existence. The search of the η-mesic nucleus was conducted in many inclusive experiments via reactions induced by pions, protons, deuterons and photons. In the case of the eta-mesic helium the determined upper limits are close to the newly predicted values of total cross sections.

The status and perspectives of the search for the eta-mesic nuclei will be reviewed emphasizing the high statistics and exclusive measurements conducted with the WASA detector at COSY.
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Session Classification: Friday Morning

Contribution ID: **112** Type: **not specified**

Recent heavy ion results from the LHC and future perspectives

Wednesday 9 March 2016 10:30 (30 minutes)

Strongly interacting matter at high densities and temperatures can be created in high-energy collisions of heavy atomic nuclei. Heavy quarks (charm and beauty) provide particular good probes to study this so-called Quark-Gluon Plasma state and its evolution since they are predominately produced in initial hard partonic scattering processes in the early stages of the collision and thus Since 2010 the Large Hadron Collider at CERN deliver proton-proton, proton-lead and lead-lead collision at an unprecedented energy. Especially, the measurement of heavy-flavour production in heavy-ion collisions allow studying the dynamical properties of the plasma phase, whereas measurements in proton-lead collisions provide access to cold nuclear matter effects in the initial state, and the particle yields in proton-proton serve as a baseline and provide crucial tests of perturbative QCD calculations.
The foreseen increase of the interaction rate for LHC run-3 after the second long shutdown in 2019/20 will require a significant upgrade of the experiments that will allow a substantial improvement of the current performances for the heavy flavour reconstruction capabilities.
In this contribution I will give an overview of recent results and the interpretation of the data.

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Session Classification: Wednesday Morning

Contribution ID: **113** Type: **not specified**

An attempt of a determination of mass-differences $m_{K_L} - m_{K_S}$ and $m_{K_2} - m_{K_1}$ from CPLEAR data on semileptonic decay of K^0 and $\bar{K}^0$

Friday 11 March 2016 16:30 (30 minutes)

In an investigation of the decays and oscillations of neutral K-mesons two types of neutral particles have been introduced. The K_1^0, K_2^0 with well defined CP-parity and K_S^0, K_L^0 respecting the experimental fact of CP violation in weak decays of neutral K -mesons, whereby only particles K_S^0, K_L^0 are explicitly presented in Rev.Part.Physics. Despite of this fact one can in principle determine the mass-differences of both types of particles, $m_{K_L} - m_{K_S}$ and $m_{K_2} - m_{K_1}$, from CPLEAR data on ASYMMETRY to be immune against CP transformations as it is obtained by semi-leptonic decays of neutral K -mesons, and applying for their description either theoretical formula for ASYMMETRY neutral K-meson oscillations trough K_S^0 and K_L^0, or theoretical for ASYMMETRY neutral K -meson oscillations trough K_1^0 and K_2^0.

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Session Classification: Friday Afternoon