V RUSSIAN-IBERIAN CONGRESS: Particle, Nuclear, Astroparticle Physics and Cosmology

Report of Contributions

https://indico.fis.ucm.es/e/RIC19

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

Locality in the pseudo-Hermitian Quantum Field Theories

Tuesday, 8 October 2019 12:50 (35 minutes)

Many non-Hermitian but PT-symmetric Hamiltonians produce the quantum evolution that is unitary under the non-standard inner product. This allows us to interpret them in the pseudo-Hermitian way and relate to the well-behaved but very complicated quantum models through the non-unitary transformation. However for the generic PT-symmetric quantum field theory this transformation becomes non-local and causality issues arise. We explore possible ways to solve this problem.

Primary author: NOVIKOV, Oleg (Saint Petersburg State University)

Presenter: NOVIKOV, Oleg (Saint Petersburg State University)

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

Entanglement and thermal behaviour of pp collisions

Tuesday, 8 October 2019 09:40 (35 minutes)

The thermalization of particles produced in collisions of small systems can be achieved by quantum entanglement of the partons of the initial state. We study the transverse momentum distributions in pp and PbPb collisions at different energies and centralities, observing in all cases a relation between the effective thermal temperature of the low pt spectrum and the hard scale of the high pt spectrum. This relation is mainly due to the normalized fluctuations of the number of partons. We show a relation between these fluctuations and the temperature fluctuations by means of a Langevin equation for a white stochastic noise. We compute the entanglement entropy, Using that the multiplicity distribution associated to events with at least a hard collision is a gamma distribution. The leading contribution is the logarithm of the number of partons, meaning that these microstates are equally probable and the entropy is maximal

Primary author: PAJARES VALES, Carlos (Universidad Santiago de Compostela)

Presenter: PAJARES VALES, Carlos (Universidad Santiago de Compostela)

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

Exact solutions in modified gravity models with scalar fields

We consider the multifield models and modified gravity theories associated with them. Generalization of the superpotential method to multifield cosmological models is performed and the method of construction of exact solutions is developed. New classes of exact solutions in the two-component models connected with a f(R) gravity model with an additional scalar field have been constructed. and hyperbolic Hubble parameters.

Primary authors: Dr POZDEEVA, Ekaterina (Skobeltsyn Institute of Nuclear Physics of Moscow State University); VERNOV, Sergey (Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University)

Presenter: Dr POZDEEVA, Ekaterina (Skobeltsyn Institute of Nuclear Physics of Moscow State University)

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

Non-perturbative quantization of effective string

Thursday, 10 October 2019 16:50 (35 minutes)

I describe quantization of bosonic string about the mean-field ground state, which turns out to be stable in the target-space dimension 2 < d < 26 contrary to the usual classical ground state which is stable only for d<2, and discuss how this resolves some old problems with strings. I compute the string susceptibility index gamma_{str} in the mean-field approximation and demonstrate that it differs from the standard results by KPZ-DDK. Using Pauli-Villars regularization, I compute a correction to the Liouville action by going beyond the conformal anomaly and accounting for quadratic divergences and speculate on how the associated conformal field theory may look like.

Primary author: Prof. MAKEENKO, Yuri (ITEP, Moscow)

Presenter: Prof. MAKEENKO, Yuri (ITEP, Moscow)

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

Neutrino Masses from the Point of View of Economy and Simplicity

Thursday, 10 October 2019 11:30 (35 minutes)

In the framework of such basic principles as local gauge invariance, unification of the weak and electromagnetic interactions and spontaneous symmetry breaking in the Standard Model the most economical and simplest possibilities are realized. We discuss the problem of neutrino masses from the point of view of economy and simplicity. It is unlikely that neutrino masses are of the same SM origin as masses of leptons and quarks. The Weinberg effective Lagrangian is the simplest and the most economical, beyond the Standard Model mechanism of the generation of small Majorana neutrino masses. The resolution of the sterile neutrino anomaly and observation of the neutrinoless double β-decay would be crucial tests of this mechanism.

Primary authors: Prof. SAMOIL, Bilenky (JINR(Dubna)); SAMOIL BILENKY

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

Hyperasymptotic approximation to the OPE

Wednesday, 9 October 2019 09:00 (35 minutes)

We construct hyperasymptotic expansions for the static potential and the pole mass. We then compare the theoretical predictions with lattice data and the large β_0 approximation.

Primary author: PINEDA, Antonio

Presenter: PINEDA, Antonio

Contribution ID: **10** Type: **not specified**

Relativistic Quantum Meson Gas at Finite Temperature: Equilibrium, Nonequilibrium Initial States and Time Evolution and Dimensional Reduction (an Overview)

Monday, 7 October 2019 17:30 (35 minutes)

A quantum gas of interacting relativistic effective massive mesons at finite temperature (either at approximate thermal equilibrium or off-equilibrium), ressembling qualitatively those produced in a heavy-ion collision, is described by a scalar renormalizable relativistic quantum field theory (RRQFT) with quartic self-interaction, in (1+3)-dimensional Minkowski space.
A short discussion of the gas at equilibrium, in both imaginary and real time formalisms, is presented. Simplified descriptions of the equilibrium gas for high temperature and large spatial scales (equilibrium dimensional reduction or EDR) in both formalisms are summarized. In so doing, the well known (and certainly useful) EDR for the imaginary-time formalism is extended to the real-time one.
Most of the talk will be devoted to the off-equilibrium gas. A very short overview of existing approaches to the description of the time evolution of the off-equilibrium gas by other authors will be presented.
A general initial nonequilibrium state AT FINITE TIME in RRQFT gives rise to additional ultraviolet divergences, which pose known (and harder) conceptual difficulties. In spite of the above general difficulties, for gases and plasmas described by effective RRQFT, there do exist restricted (still physically meaningful) classes of initial nonequilibrium states for which the time evolutions do not meet those conceptual difficulties. Then, the time evolutions of the off-equilibrium gas can indeed be dealt with within the conceptual framework of perturbative renormalization, up to certain (non-trivial) modifications.
By assumption, the initial state AT FINITE TIME of the gas of effective mesons, not far from thermal equilibrium, belongs to the latter restricted class of initial nonequilibrium states and includes interactions and inhomogeneities. The gas at equilibrium in real-time formalism, outlined above, turns out to provide a source of hints for the off-equilibrium analysis. The time evolution of the off-equilibrium gas is described by means of nonequilibrium real-time generating functionals and correlators at non-zero temperature.
Main result.- For high temperature and large temporal and spatial scales, we justify that classical nonequilibrium statistical mechanics (including crucial renormalization effects, remnants of the underlying quentum theory) do describe
approximately the gas: nonequilibrium dimensional reduction (NEDR). In the NEDR regime, our arguments yield: 1) renormalized correlators do simplify, 2) the perturbative series for those simplified correlators can be resummed into a nonequilibrium generating functional, which is super-renormalizable and includes renormalization effects (large position-dependent thermal self-energies and effective couplings). The latter super-renormalizable nonequilibrium generating functional for the NEDR regime could enable to study nonperturbatively changes in the phase structures of the field, by proceeding from a general nonequilibrium quantum regime to the NEDR one.
References: R. F. Alvarez-Estrada: 1) “Initial States and Time Evolution in Nonequilibrium Quantum Field Theory”, Nucl. Phys. A, Vol. 785, 218c (2007); 2) Nonequilibrium Quantum Anharmonic Oscillator and Scalar Field: High Temperature Approximations, Ann. Phys. (Berlin), Vol. 18, 391 (2009); 3) Nonequilibrium Quantum Meson Gas: Dimensional Reduction, Eur. Phys. J. A, Vol. 41,

53 (2009).

Primary author: ALVAREZ-ESTRADA, Ramon F. (UCM)

Presenter: ALVAREZ-ESTRADA, Ramon F. (UCM)

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

GENUINE, MATTER-INDUCED AND INTERFERENCE COMPONENTS OF THE CP, T, CPT ASYMMETRIES IN NEUTRINO OSCILLATIONS

Thursday, 10 October 2019 10:20 (35 minutes)

These results represent the culmination of the solution for the historical problem of the contamination by matter effects in the discrete CP, T, CPT asymmetries for neutrino propagation. Using that vacuum is CPT-symmetric and matter is T-symmetric, the goal is accomplished in terms of a basis of three independent components: genuine CPT-even, matter-induced T-even, interference CP-even. Independent of the theoretical framework for the dynamics of the active neutrino flavors, we prove the Disentanglement Theorem
A(CP)=A(CP,T)+A(CP,CPT), A(T)=A(T,CP)+A(T,CPT), A(CPT)=A(CPT,CP)+A(CPT,T)
for the three independent experimental asymmetries (left-hand side) in terms of the three components (right-hand side). For even a T-symmetric matter, A(T) is -contrary to general belief- affected by matter due to quantum interference.

For the effective Hamiltonian written as the sum of free mass propagation plus the matter potential for electron-neutrinos, the three components have definite parities under the baseline L, the matter potential "a", the imaginary part sin(delta) of the PMNS mixing matrix and the hierarchy "h"=+-1 in the neutrino mass ordering: A(CP,T) is odd in L and sin(delta) plus even in a and h, A(CP,CPT) is even in L and sin(delta) plus odd in a and h, A(T,CPT) is odd in all L, sin(delta), a and h. The last interference component contains then
terms like a.sin(delta).

The independent measurement of the three asymmetries could only be made in neutrino factories and atmospheric neutrinos. For present terrestrial accelerator sources of muon-neutrinos and antineutrinos, the two components of the appearance CPV asymmetry A(CP) can be disentangled by either baseline dependence (HKK) or energy dependence (DUNE). At the DUNE baseline, the higher energy region above the first oscillation node provides a dominant matter-induced A(CP,CPT) component
and the sign of the experimental asymmetry A(CP) gives the hierarchy in the neutrino mass ordering. On the contrary, there is a "magic energy" E around the second oscillation maximum in which the fake A(CP,CPT) component has a first-rank zero whereas the genuine A(CP,T) component has a maximum (proportional to sin(delta)). With a modest energy resolution Delta E ~ 200 MeV an effective zero remains in the matter-induced A(CP, CPT).

Primary authors: BERNABEU, Jose; SEGARRA, Alejandro (IFIC and U. Valencia)

Presenter: BERNABEU, Jose

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

RG Equations and High Energy Behaviour in Non-Renormalizable Theories

Wednesday, 9 October 2019 10:50 (35 minutes)

We suggest a novel view on non-renormalizable interactions. It is based on the usual BPHZ R-operation which is equally applicable to any local QFT independently of whether it is renormalizable or not. As a playground we take the \phi^4_D theory in D dimensions for D=4,6,8,10 and consider the four-point scattering amplitude on shell. We derive the generalized RG equation and find the solution valid for any D that sums up the leading logarithms in all orders of PT in full analogy with the renormalizable case. It is found that the scattering amplitude in the \phi^4_D theory possesses the Landau pole at high energy for any D. We discuss the application of the proposed procedure to other non-renormalizable theories.

Primary author: Prof. KAZAKOV, Dmitry (JINR)

Presenter: Prof. KAZAKOV, Dmitry (JINR)

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

Long-range rapidity and angular azimuthal correlations in the model with a string fusion

Monday, 7 October 2019 16:50 (35 minutes)

In the framework of the model with quark-gluon strings considered as color flux tubes we study the correlations between various observables in two acceptance windows separated in rapidity and azimuth, used in the analysis of the multiparticle production in hadronic interactions at high energy. To take into account the string fusion effects leading to a formation of string clusters with new properties we introduce in the model the finite lattice (grid) in the transverse (impact parameter) plane.
In the framework of this approach, for a realistic case with an inhomogeneous distribution of strings in the transverse plane, we find explicit analytical formulas for the asymptotes of the coefficients of the long-range rapidity correlations between various quantities, including intense (the mean transverse momentum) at large string density.
We study also a strongly intense variable between the multiplicities of particles produced in two observation windows separated in rapidity and azimuth. We show that in the case of independent identical strings, this observable is indeed a strongly intense quantity. It depends only on the string characteristics and does not depend on the trivial, so-called "volume" fluctuations in the number of strings, arising, in particular, from inevitable impact parameter fluctuations. When taking into account the formation of string clusters with new properties, this variable becomes equal to the weighted average of its values for different clusters. The weights depend on the conditions of the collision, and the variable loses its strongly intensive property.
We analyze the properties of the obtained correlation coefficients and the strongly intensive variable under study, and also the possibilities of its experimental observation.
We also show that long-range azimuthal-rapidity correlations (the ridge) can arise from the superposition of many events with exchange of cluster of different number of strings and not from two-particle correlations in a single event. In this case it appears in the resulting two-particle correlation function due to the event-by-event fluctuation of the azimuthal distribution. The physical reason, which leads to the event anisotropy of the azimuthal distribution in this approach, is the final state interaction of produced particles with the fused string medium.
The presentation is based on the papers [1-5].

The research was supported by the Russian Foundation for Basic Research grant (No. 18-02-40075) and the St. Petersburg State University grant (Id: 43319394).

1. S.N. Belokurova, V.V. Vechernin, Strongly intensive variables and long-range correlations in the model with a lattice in the transverse plane, Theor. Math. Phys. 200 (2019) 1094–1109 [to be appear in the August issue]
2. E. Andronov, V. Vechernin, Strongly intensive observable between multiplicities in two acceptance windows in a string model, Eur. Phys. J. A 55 (2019) 14_1-12.
3. V. Vechernin, Short- and long-range rapidity correlations in the model with a lattice in transverse plane, EPJ Web Conf. 191 (2018) 04011_1-8.
4. M.A. Braun, C. Pajares and V.V. Vechernin, Ridge from strings, Eur. Phys. J. A 51 (2015) 44_1-11.
5. V.V. Vechernin, Forward-backward correlations between multiplicities in windows separated in azimuth and rapidity, Nucl. Phys. A 939 (2015) 21-45.

Primary author: VECHERNIN, Vladimir (St Petersburg State University (RU))

Presenter: VECHERNIN, Vladimir (St Petersburg State University (RU))

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

Neutrino oscillations in gravitational waves

Thursday, 10 October 2019 12:10 (35 minutes)

I study neutrino oscillations driven by a plane gravitational wave. First, I consider neutrino spin oscillations in this gravitational background. I derive the covariant equation for the neutrino spin evolution in a magnetic field and background matter in curved space-time. Then I discuss a particular situation when a neutrino interacts with matter, a transverse magnetic field and a gravitational wave. I demonstrate that a parametric resonance can appear in this system. Some astrophysical applications are discussed.
Then I turn to the consideration of neutrino flavor oscillations in a gravitational wave. I derive the effective Hamiltonian for neutrino oscillations. Then I study the situation when the stochastic gravitational waves background is present. The equation for the density matrix evolution is derived and solved both analytically (in the two flavors approximation) and numerically (for the general case of three neutrino flavors). I predict a specific flavor content of low energy neutrinos at a detector. Some applications for measurements of cosmic neutrinos are considered.
References
1. M. Dvornikov, Neutrino spin oscillations in external fields in curved spacetime, Phys. Rev. D 99, 116021 (2019), arXiv:1902.11285.
2. M. Dvornikov, Neutrino flavor oscillations in stochastic gravitational waves, arXiv:1906.06167.

Primary author: DVORNIKOV, Maxim (Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation)

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

Resumming the fermionic in-medium ladder diagrams to all orders

Friday, 11 October 2019 09:20 (35 minutes)

In the past I derived from QFT the generating functional of Green functions in a fermionic medium. Based on this many-body scheme I give an algebraic derivation from first principles of the purely diagrammatical method introduced by N. Kaiser [NPA860,411(2011)] to resum the ladder diagrams for the calculation of the energy per particle in a fermionic environment, including only a constant interacting term in the Hamiltonian. A generalization of this resummation for any given fermion-fermion scattering matrix in vacuum results from the new derivation provided. I also discuss other outcomes of this resummation.

Primary author: Prof. OLLER, José Antonio (Universidad de Murcia)

Presenter: Prof. OLLER, José Antonio (Universidad de Murcia)

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

Influence of the QCD critical point on the nucleon-nucleon potential and nuclear correlations

Tuesday, 8 October 2019 10:20 (35 minutes)

The scalar-isoscalar mode of QCD is expected to become very light close to the second-order chiral critical point. This mode is the main responsible for the attractive part of the nucleon-nucleon potential at distances of 1-2 fm. Therefore, a strong long-range attraction among nucleons is predicted to develop close to the QCD critical point. Using the Walecka-Serot model for the NN interaction we study the effects of the critical mode in a system of nucleons and mesons using a molecular dynamics code, complemented by a Langevin dynamics for the freeze-out conditions of heavy-ion collisions. Working beyond mean-field level, we observe strong nucleon correlations which might lead to baryon clustering. We propose that light-nuclei formation, together with an enhancement of the proton distribution cumulants can signal the presence of the QCD critical point.

Primary author: Dr TORRES-RINCON, Juan (Goethe University Frankfurt)

Co-author: Prof. SHURYAK, Edward

Presenter: Dr TORRES-RINCON, Juan (Goethe University Frankfurt)

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

Casimir effect, scattering processes and bound states in renormalizable models of interaction of QED fields with two-dimensional materials

Tuesday, 8 October 2019 16:05 (35 minutes)

The method proposed by K. Symanzik for constructing quantum field models in an inhomogeneous space-time is used to describe the interaction of the quantum electrodynamics (QED) fields with extended material objects. It is carried out within the framework of quantum field models in which the QED Lagrangian is modified according to the QED basic principles (locality, gauge invariance, renormalizability) and taking into account the properties of the material medium interacting with QED fields. Models with interactions of electromagnetic and Dirac fields with two-dimensional materials of flat, spherical and cylindrical shape are considered, and the specificity of their renormalization procedure is analyzed. The results obtained in such models for the Casimir effect, scattering processes and bound states are discussed.

Primary author: Prof. PISMAK, Yury (State University of Sankt Petersburg)

Presenter: Prof. PISMAK, Yury (State University of Sankt Petersburg)

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

X(3872) in relativistic heavy ion collisions

Monday, 7 October 2019 14:20 (35 minutes)

Right since its discovery in 2003 by the Belle collaboration, establishing the nature of the $X(3872)$ meson has been one of the main priorities in the field of quarkonium physics. Not qualifying as a conventional $c\bar{c}$ state, the multiquark structure of this exotic meson has received very different interpretations, ranging from a compact tetraquark configuration to an extended $D\bar{D}^*$ molecule.

In this work we explore the effect that a hot pion bath may have in the properties of the $X(3872)$, assuming this state to be a $D\bar{D}^*$ molecule. We derive the finite temperature effects on the $X(3872)$ from a coupled channels unitarized amplitude, obtained including the properties of the charmed mesons under such conditions.

We find that the $X(3872)$ develops a substantial width, of the order of a few tens of MeV, in hot pionic environments at temperatures 100-150 MeV, and its nominal mass moves above the DD^* threshold. The fact that the $X(3872)$ in a hot pion gas may no longer be a narrow resonance needs to be considered in the estimation of production yields in relativistic heavy ion collisions.

Primary authors: Prof. MAGAS, Volodymyr (Universidad de Barcelona, Spain); Dr CLEVEN, Martin (University of Barcelona, Spain); Prof. RAMOS, Angels (University of Barcelona, Spain)

Presenter: Prof. MAGAS, Volodymyr (Universidad de Barcelona, Spain)

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

Influence of resonance decays on forward-backward correlations

Monday, 7 October 2019 16:10 (35 minutes)

The study of forward-backward correlations between observables from separated rapidity intervals is considered as a sensitive tool for observing the collective phenomena in the ultrarelativistic collisions of hadrons and nuclei and for investigation of the initial stages of the hadronic interaction. The selection of a large gap between rapidity intervals facilitates the elimination of the short-range effects, such as jets, resonances decays, and correlated quark-antiquark pairs arizing during string decay.

In order to study the behavior of the forward-backward multiplicity and transverse momentum correlations, we calculated them in a Monte Carlo model with formation and fusion of quark-gluon strings, considering two options: with and without the resonance production and decay, provided that the mean multiplicity per rapidity stays the same. We show that the decay of the resonances causes the considerable modification of n-n and pt-pt correlations compared to the case of purely prompt particle production.

The decays have a small effect on the shape of the centrality dependence of the correlation coefficients in AA collisions but improve the agreement of string fusion model prediction with the experimental data.

The research was supported by the grant of the Russian Foundation for Basic Research (project 18-32-01055 mol_a).

Primary author: KOVALENKO, Vladimir (St Petersburg State University (RU))

Presenter: KOVALENKO, Vladimir (St Petersburg State University (RU))

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

Various definitions of heavy quarks masses in QCD and the structures of their perturbative relations through several resummations approaches

Wednesday, 9 October 2019 09:40 (35 minutes)

The asymptotic structure of the perturbative relation between $\bar{M}S$ and on-shell heavy quark masses is considered in QCD at the O(\alpha_s^6) level. The flavour-dependence of the considered PT corrections is analysed. In higher orders this dependence is estimated using three techniques, namely the effective charges motivated approach, the encoded in the asymptotic formula infrared renormalon method and the large-β0 approximation based on the explicit calculations of the leading in powers of the number nl of massless flavors terms. The following from the large-β0 analysis sign-alternating structure of the expanded in powers of nl estimated five- and six-loop corrections is studied in detail. It is demonstrated that application of the first and third techniques leads to the required sign-alternation, while the second method in used by us approximation respects it only after additional imposed requirements.

Primary authors: Dr KATAEV, Andrei (INR RAS); Mr MOLOKOEDOV, Viktor (Moscow Institute of Physics and Technology)

Presenter: Dr KATAEV, Andrei (INR RAS)

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

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

Tuesday, 8 October 2019 17:55 (35 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: Prof. VAN BEVEREN, Eef (Physics Department, University of Coimbra); Dr RUPP, George (CeFEMA, Instituto Superior Técnico, Lisbon)

Presenter: Dr RUPP, George (CeFEMA, Instituto Superior Técnico, Lisbon)

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

Gravitation wave driven CFS instability of neutron stars and current observational constraints

Friday, 11 October 2019 10:40 (15 minutes)

The Chandrasekhar-Friedman-Schutz (CFS) instability consist in enhancement of perturbations in a rotating star by emission of gravitational waves. In absence of dissipation, all rotating stars should be unstable and the emission of gravitational waves should spin down them rapidly. Observations of rapidly rotating neutron stars indicates that it is not a case and dissipative processes suppress the instability in these objects. It allows to constrain properties of dense matter by confronting observations and theoretical models of suppression of CFS instability.
In this talk, I describe the mechanism of the CFS instability, derive the evolution equation for CFS unstable neutron star and describe up-to date observational constraints on the instability windows – the region of temperature and spin frequencies there the instability can be unsuppressed without contradictions with observations. In particular, I discuss theoretically predicted class of neutron stars – HOt and Fast NonAccreting Rotators (HOFNARs) – which can emit persistent gravitational waves on cosmological timescale. Special attention is devoted to observations of PSR J0952-0607 – the second fastest known millisecond pulsar, which was recently detected in X-rays, providing strongest constraints to CFS instability in low temperature neutron stars.

Primary author: Dr CHUGUNOV, Andrey (Ioffe Institute)

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

Chiral perturbation theory vs. Linear σ model in a chiral imbalance medium

Tuesday, 8 October 2019 11:30 (35 minutes)

We compare Chiral Perturbation Theory (ChPT) and the Linear Sigma Model (LSM) as realizations of low energy QCD for light mesons in a chirally imbalanced medium. The relations between the phenomenological low-energy constants of the Chiral Lagrangian and the corresponding constants of the Linear Sigma Model are established as well as the expressions for the decay constant of the pi-meson in the medium and the mass of the a_0 -meson. In the large Nc count taken from QCD the correspondence of ChPT and LSM is remarkably good and give a solid ground for search of chiral imbalance manifestation in pion physics. A possible experimental detection of chiral imbalance tracks (and therefore a phase with local parity breaking) in the charged pion decays inside the fireball is outlined

Primary authors: Prof. ANDRIANOV, Vladimir (Saint Petersburg State University); Prof. ANDRIANOV , Alexandr (Saint Petersburg State University); Prof. ESPRIU, Domenec (University of Barcelona)

Presenter: Prof. ANDRIANOV, Vladimir (Saint Petersburg State University)

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

Cosmic analogy in the search for new physics in pp collisions at the LHC

Thursday, 10 October 2019 09:00 (35 minutes)

We present an analogy between multiparticle production in proton-proton collisions at the LHC and the time evolution of the early universe. In particular we focus on long-range angular correlations of the CMB on the one hand, and particle emission in pp interactions on the other hand, pointing out suggestive connections between both physical cases. Moreover, we show how the analysis of angular correlations under the applications of strict selection cuts events could uncover the presence of New Physics (hidden/dark sectors) in hadronic collisions, while providing a new insight into the cosmological evolution of the universe.

Primary authors: Prof. SANCHIS-LOZANO, Miguel-Angel (IFIC-University of Valencia); Prof. SARKISYAN-GRINBAUM, Edward (CERN); Dr DOMENECH-GARRET, Juan Luis (Universidad Politénica de Madrid)

Presenter: Prof. SANCHIS-LOZANO, Miguel-Angel (IFIC-University of Valencia)

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

Unitarity problems in higher derivative field theories and Quantum Gravity

Wednesday, 9 October 2019 11:30 (35 minutes)

We analyze the unitarity properties of higher derivative quantum field theories which are free of ghosts and ultraviolet singularities. We point out that in spite of the absence of ghosts most of these theories are not unitary. This result confirms the difficulties of finding a consistent quantum field theory of quantum gravity.

Primary author: Prof. ASOREY, Manuel

Presenter: Prof. ASOREY, Manuel

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

Cylindrically symmetric 2+1-dimensional gravity: quantization in terms of global phase space variables.

Thursday, 10 October 2019 15:00 (35 minutes)

We perform canonical analysis of a model in which gravity is coupled to a circular dust shell in 2+1 spacetime dimensions.
The result is a reduced action depending on a finite number of degrees of freedom.
The emphasis is made on finding canonical variables providing the global chart for the entire phase space of the model.
It turns out that all the distinct pieces of momentum space could be assembled into a single manifold which has ADS^2-geometry, and the global chart for it is provided by the Euler angles.
In quantum kinematics, this results in non-commutativity in coordinate space and discreteness of the shell radius in timelike region, which includes the collapse point.
At the level of quantum dynamics, we find transition amplitudes between zero and non-zero eigenvalues of the shell radius, which describe the rate of gravitational collapse (bounce). Their values are everywhere finite, which could be interpreted as resolution of the central singularity. We also find the map between ADS^2 momentum space obtained here and momentum space in Kuchar variables, which could be helpful in extending the present results to 3+1 dimensions.

Primary author: Prof. ANDRIANOV, Alexander (SPbSU)

Co-authors: Dr STARODUBTSEV, Artem (SPbSU); Mr ELMAHALAWY, Yasser (SPbSU)

Presenter: Prof. ANDRIANOV, Alexander (SPbSU)

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

Hadronization in Terms of First-Order Phase Transition

Tuesday, 8 October 2019 09:00 (35 minutes)

The hadronization of the deconfined matter arising in high-energy particle collisions is considered in terms of the first-order phase transition in the multiple flux tube approach. Based on the compactification of the standard (3+1) chromodynamics into $QCD_{xy}+QCD_{zt}$, the rate of hadron production in particle collisions with respect to both the rapidity and p_T distributions is derived in the flux tube approach. The obtained rate strongly depends on the energy of the colliding particles, number of tubes, hadron mass as well as on the temperature of the confinement-deconfinement phase transition. Under the concept of the longitudinal dominance and the transverse confinement in a flux tube, and provided that the hadronization process is governed by the phase transition of the first kind, the hadron rate is obtained in the explicit form in the multiple tube approach. In the case of the pion production in pp collisions we obtain a good agreement to the experimental results on the pion yield with respect to both the rapidity and p_T distributions.

Primary author: Dr KOSHELKIN, Andrew

Presenter: Dr KOSHELKIN, Andrew

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

Large N limits and the golden ratio

Tuesday, 8 October 2019 12:10 (35 minutes)

We analyze the low lying spectrum of SU(N) gauge theories on a 2-dimensional spatial torus in a singular large N limit obtained by sending the rank of the group to infinity while shrinking the size of the torus to zero. The absence of tachyonic instabilities along the process leads to constraints on the possible values of N and the magnetic flux on the torus, singling out a limiting sequence constructed out of Fibonacci numbers. We will discuss the implications of this observation for non-commutative gauge theory and volume reduction.

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Presenter: GARCIA PEREZ, Margarita (Instituto de Fisica Teorica)

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

STUDY OF THEE CORE-CRUST TRANSITION IN NEUTRON STARS WITH FINITE-RANGE INTERACTIONS: THE DYNAMICAL METHOD

Friday, 11 October 2019 10:00 (35 minutes)

The properties of the core-crust transition in neutron stars are investigated
using effective nuclear forces of finite-range. Special attention is paid to the
so-called dynamical method for locating the transition point, which, apart from the stability of the uniform nuclear matter against clusterization, also considers contributions due to finite-size effects.In particular, contributions to the transition density and pressure from the direct and exchange energies are carefully analyzed. To this end, finite-range forces of Gogny, Momentum-Dependent
Interaction (MDI) and Simple Effective Interaction (SEI) types are used in the numerical applications. The results from the dynamical approach are compared with those from the popular thermodynamical method that neglects the surface and Coulomb effects in the stability condition.In the particular case of the D1M and D1M* Gogny forces, the core-crust transition density and pressure are also compared with the estimate obtained from the crust side making use of a recently calculation of the Equation of State in the inner crust performed with these Gogny interactions.The dependence of the core-crust transition on the stiffness of the symmetry energy of the finite-range models i also addressed. Finally, we analyze the impact of the transition point on the mass, thickness and fraction of the moment of inertia of the neutron star. Prominent differences in these crustal properties of the star are found between using the transition point obtained with the dynamical method or the thermodynamical method. It is concluded that the core-crust transition needs to be ascertained as precisely as possible in order to have realistic estimates of the observed phenomena where the crust plays a significant role.

Primary author: VIÑAS GAUSÍ, Xavier (Universitat de Barcelona)

Presenter: VIÑAS GAUSÍ, Xavier (Universitat de Barcelona)

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

To Positivity and Beyond, where Higgs-Dilaton Inflation has never gone before

Thursday, 10 October 2019 09:40 (35 minutes)

We study the consequences of (beyond) positivity of scattering amplitudes in the effective field theory description of the Higgs-Dilaton inflationary model. By requiring the EFT to be compatible with a unitary, causal, local and Lorentz invariant UV completion, we derive constraints on the Wilson coefficients of the first higher order derivative operators. We show that the values allowed by the constraints are consistent with the phenomenological applications of the Higgs-Dilaton model.

Primary author: Dr TOKAREVA, Anna (Institute for Nuclear Research)

Co-authors: Dr TIMIRYASOV, Inar (EPFL); Dr HERRERO-VALEA, Mario (SISSA)

Presenter: Dr TOKAREVA, Anna (Institute for Nuclear Research)

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

Quantum Cosmology without wave function in conformal time

Tuesday, 8 October 2019 15:25 (35 minutes)

Primary authors: YUROV , A. V.; YUROV, V.A.

Presenter: YUROV , A. V.

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

Registration

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

Morgane Fortin: Constraints on neutron star properties (From N*-Theory workshop)

Friday, 11 October 2019 11:30 (35 minutes)

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

Daniela Doneva: Neutron stars in modified theories of gravity - models, astrophysical implications and gravitational wave emission (From N*-Theory workshop)

Friday, 11 October 2019 12:10 (35 minutes)

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

Analytic Infinite Derivative (AID) gravity

Thursday, 10 October 2019 15:40 (35 minutes)

I will explain how theories with analytic functions of derivatives are connected to strings and in particular arise in string field theory (SFT) and will spent the most part of my talk on the good and unrevealed properties of analytic infinite derivative (AID) gravity. In particular, I will discuss questions of avoiding singularities as well as possible observational evidences for such a non-local modification of Einstein's theory. Namely, imprints in inflationary spectra including non-gaussianities. On top of this I will raise several purely mathematical questions which need to be solved in order to push the physics developments further.

Primary author: KOSHELEV, Alexey (Univ. of Beira Interior)

Presenter: KOSHELEV, Alexey (Univ. of Beira Interior)

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

Holographic description of heavy ions collisions

Monday, 7 October 2019 15:00 (35 minutes)

We consider holographic description of heavy ions collisions. The dependence of total multiplicity on the energy forcing us to deal with anisotropic holographic models. We derive the holographic renorm group flow (HRGF) equations in the presentce of anisotropy and a non-zero chemical potential. We show that in particular cases HRGFs reproduce the QCD RGFs. We consider the behaviour of the Wilson loops in the constructed backgrounds and find the form of the anisotropic QCD phase diagrams.

Primary author: Prof. AREF'EVA, Irina (Steklov Mathematical Institute)

Presenter: Prof. AREF'EVA, Irina (Steklov Mathematical Institute)

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

Sterile neutrino dark matter

Thursday, 10 October 2019 12:50 (35 minutes)

Sterile neutrino is one of the well motivated candidate to form the Dark Matter component in the Universe. We discuss standard mechanisms of dark matter production in the early Universe and its modifications in the presence of cosmic scalar field.

Primary author: GORBUNOV, Dmitry (INR RAS)

Presenter: GORBUNOV, Dmitry (INR RAS)

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

One-loop quantum-gravitational corrections to the R+R^2 inflationary model

Tuesday, 8 October 2019 14:45 (35 minutes)

Quantum field theory in curved space-time and quantum gravity predict one-loop quantum corrections to the R+R^2 (Starobinsky) inflationary model. Observational consequences of a number of such corrections are considered. One of them – the form of the Fourier power spectrum of primordial scalar (matter density) perturbations – has been actually measured and has appeared to be in the excellent agreement with the theoretical prediction. The model also makes the definite prediction for the tensor-to-scalar ratio r=3(1-n_s)^2=0.004 which serves as a target for future observational search. The action of these corrections after inflation provides the decay of the effective scalar particle in this model (dubbed scalaron) into pairs of particles and anti-particles of known quantum fields (but not into pairs of gravitons), that is necessary for internal consistency of the model. Finally, effect of these corrections on the background dynamics during inflation can be calculated and compared with data. In this case no noticeable effect is found, and only upper bounds on quantum corrections are obtained. This has been expected since the relative smallness of these corrections is caused by the appearance of new hierarchy - the anomalously large value of the dimensionless coefficient in front of the R^2 term that finally follows from the actual amount of present large-scale inhomogeneity of the Universe. The large value of the effective R^2 term compared to the Weyl squared one also makes possible to consider the model non-perturbatively in the scalar sector (where it is renormalizable) for curvatures much less than the Planck one, while corrections in the tensor sector are still small.

Primary author: Prof. STAROBINSKY, Alexey (Landau Institute for Theoretical Physics RAS)

Presenter: Prof. STAROBINSKY, Alexey (Landau Institute for Theoretical Physics RAS)

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

Measuring H_0 in PTA with gravitational waves

Friday, 11 October 2019 12:50 (35 minutes)

Pulsar Timing Arrays have yet to find convincing evidence of gravitational waves. Some time ago it was pointed out by one of the authors that a dramatic enhancement of the signal would take place for particular values of the angle subtended by the source and the observed pulsar. This enhancement is due to the fact that waves propagate in a Friedmann-Lemaitre-Robertson-Walker metric where, contrary to some wide-spread belief, a simple harmonic function with a red-shifted frequency is not a solution of the equation of motion. At the first non-trivial order, proper solutions have an effective wave number that differs from the frequency. This leads to some interesting effects in Pulsar Timing Arrays whose most visible manifestation is the enhancement of the signal that, all other parameters kept fixed, is related in a simple manner to the value of H_0.

Primary authors: ESPRIU, Domènec (University of Barcelona); GABBANELLI, Luciano (University of Barcelona); RODOREDA, Marc (University of Barcelona)

Presenter: ESPRIU, Domènec (University of Barcelona)

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

The light meson spectrum from QCD sum rules for linear radial trajectories

Monday, 7 October 2019 13:40 (35 minutes)

A scheme of calculation of large-Nc masses of light mesons from
the planar QCD sum rules is discussed. We will present two methods based on the use of linear radial Regge trajectories with a special emphasis on the scalar sector.

Primary author: AFONIN, Sergei

Presenter: AFONIN, Sergei

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

BFKL as QCD asymptotics at high energies

Tuesday, 8 October 2019 17:15 (35 minutes)

Recent BFKL evolution developments are briefly reviewed. BFKL evolution manifestations at high energies are discussed.

Primary author: Prof. KIM, Victor (NRC KI - PNPI, Gatchina & SPbPU, St. Petersburg)

Presenter: Prof. KIM, Victor (NRC KI - PNPI, Gatchina & SPbPU, St. Petersburg)

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

TOURISM: TOLEDO

-Return from Toledo: 19:00
-Arrival at Moncloa: 20:00
(near L6 Moncloa subway station)

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

TOURISM: TOLEDO - VISIT

-Lunch: 13:30 (Restaurant Venta de Aires)

-Guided visit: 14:30 (old city, Cathedral and Santo Tomé church)

-Departure from Toledo: 19:00

-Arrival at Mocnloa: 20:00 (near L6 Moncloa subway station)

Session Classification: TOURISM: TOLEDO - VISIT