11th Workshop on Non-Perturbative QCD
June 6-10, 2011

Abstracts

Ballon Bayona, Carlos Alfonso: "Electromagnetic Scattering of Vector Mesons in the Sakai-Sugimoto Model"

I discuss the description of electromagnetic scattering of hadrons in the holographic Sakai-Sugimoto model. I consider the calculation of elastic and non-elastic form factors and the structure functions of deep inelastic scattering.

Bartz, Sean: "Pions and Strange Mesons in a Soft-Wall Model of AdS/QCD"

The Anti-de Sitter Space/Conformal Field Theory (AdS/CFT) correspondence may offer new and useful insights into the non-perturbative regime of strongly coupled gauge theories such as Quantum Chromodynamics (QCD). Recently a soft-wall AdS/QCD model exhibiting linear confinement was modified to incorporate independent sources for explicit and spontaneous chiral symmetry breaking. This model contains a modified dilaton and higher-order interaction terms in the Lagrangian. Within this model we explore the pseudoscalar sector using two common representations of the pion field, which are shown to be equivalent. We find the pseudoscalar mass eigenvalues in good agreement with the experimental pion masses. The Gell-Mann--Oakes--Renner relation is also naturally obtained. Finally, the model is extended to include the a third quark flavor, and the equations of motion are derived.

Bender, Carl: "Latest Results on PT Quantum Theory"

PT quantum theory is described by a (non-Hermitian) Hamiltonian that commutes with PT, where P represents space reflection and T represents time reversal. Hermitian Hamiltonians are boring; the energies are always real. However, PT-symmetric Hamiltonians are interesting because they typically have a region of unbroken PT symmetry in which the eigenvalues are all real and a region of broken PT symmetry in which the some eigenvalues are complex. These regions are separated by a phase transition that can be observed experimentally. In the past year there have been many new theoretical and experimental results on PT quantum theory. This talk will summarize some of the latest developments

Bialas, Piotr: "Tree Graphs with Causal Structure"

There are two predominant approaches to random graphs (or networks): one which focuses on the time evolution (growth process) of the system, and another which considers an ensemble of graphs and uses the techniques from statistical physics. In the second approach the notion of time is absent. One can however introduce the time by using the labels assigned to nodes of the graph. The labels

specify the moment in which the vertex was introduced into the graph. The properties of trees with so introduced "causal" structure will be the subject of my talk.

Bogolubsky Igor: "On Localized Nonperturbative Solutions in 2D and 3D Gluodynamics"

We discuss the possibility of soliton existence in 2D and 3D pure gauge SU(2) theory. Hamiltonians for Yang-Mills field in terms of radial functions are presented. Search for localized in space YM field distributions is discussed. Such nontopological lumps if exist may be relevant to extended gluonic strings in mesons (2D) and

Branchina, Vincenzo: ``Fermion Masses from a Cross-Over Mechanism"

With the help of non-perturbative RG equations, a mechanism for the generation of fermion masses without fundamental scalars is discussed. In this framework, the critical exponents of four-fermion theories are computed, the results being in agreement with those obtained with the more conventional 1/N expansion. However, the RG equations allow to go beyond large N, thus opening the possibility of a non-perturbative study for generic (even small) N. The impact of higher power terms is also considered and it is shown that the relevance of the different operators depends on N.

Das, Sumit: ``Holographic Quantum Quench"

The study of non-equilibrium dynamics of a quantum field theory with a mass or coupling which depends on time is playing an increasingly important role in many-body physics. This is particularly interesting near quantum critical points where the dynamics carries several universal signatures. Recently, it has been realized that it is possible to study such a "quantum quench" in strongly coupled field theories using holographic techniques. This talk will describe several examples of holographic quantum quench and the resulting approach to thermalization, including those across quantum critical points.

de Forcrand, Philippe: "The Two-Body and the Many-Body Problem in QCD from the Lattice"

Numerical simulations of lattice QCD can now predict with good accuracy the properties of a single baryon. The same approach should also predict from first principles the residual interactions among baryons, that is, nuclear interactions, and the properties of nuclear matter. However, the "sign problem" makes such studies challenging. We show how and why this problem can be circumvented in the limit of infinitely large coupling. In this limit, we determine the QCD phase diagram, measure the nuclear interactions and explain their functional form, drawing attention to their entropic origin.

del Duca, Vittorio: "Wilson Loops and Amplitudes in N=4 SYM"

In the planar N=4 supersymmetric Yang-Mills theory, we discuss two-loop amplitudes and Wilson loops at weak coupling, and compare them to Wilson loops at strong coupling, which are available in the literature.

Di Giacomo, Adriano: "Confinement by Dual Superconductivity: an Update"

Recent progress on the Mechanism of Confinement by dual Superconductivity of QCD vacuum is reviewed. An improved order parameter for monopole condensation is constructed, with the infrared difficulties of the previous version understood and removed.

Djuric, Marko: "String-Gauge Dual Description of Deep Inelastic Scattering at Small x"

We examine the process of Deep Inelastic Scattering (DIS) in the small-*x* limit, where Pomeron exchange dominates. Using the AdS/CFT correspondence, we study Pomeron exchange in the dual string theory in AdS space, which allows us to study DIS at strong coupling. Two possibilities are examined, a purely conformal model, and a model with a hard-wall cutoff introduced to take into account effects of confinement. Comparing our calculations with HERA DIS data, we find a very good agreement not only at large Q^2 dominated by conformal symmetry, but due to our strong coupling approach which allows us to go beyond traditional pQCD methods, at small Q^2 as well, taking into account all available HERA small x data."

Duhr, Claude: "Two-loop Remainder Functions in N = 4 Super Yang-Mills"

MHV amplitudes in N=4 Super Yang-Mills (SYM) are believed to be dual to polygonal Wilson loops, whose functional form in turn is constrained by a certain conformal symmetry. I will discuss techniques for the computation of two-loop Wilson loops in N=4 SYM, with a special focus on two-loop remainder functions, and I will review the recent progress made in this field.

Eden, Burkhard: "From Correlators to Wilson Loops and Super-Amplitudes"

We consider higher point functions of the stress tensor multiplet of N=4 SYM theory in four dimensions in a limit in which the operators are put onto the vertices of a polygon with light-like edges. Depending on which regularisation procedure is employed we find that they reduce to either Wilson loops with light-like edges or to scattering amplitudes in the same model. If the loop corrections to the correlator are calculated by Lagrangian insertions, the correspondence to amplitudes holds on the level of the integrand. In a number of examples we find exact agreement with a recent conjecture for the all-loops integrand of scattering amplitudes. This duality extends to non-MHV amplitudes.

Eggert, Karten: "Status of the TOTEM Experiment and Latest Results"

The TOTEM experiment at the LHC, placed symmetrically with respect to the CMS Interaction Point IP5, is optimized to measure in dedicated special-optics runs, luminosity independently, the total pp cross-section and to study elastic pp scattering over a wide range in momentum transfer from $-t \sim 10^{-3}$ to 10 GeV^2. Furthermore, diffractive dissociation, including single, double and central diffractive topologies will be studied using the forward detectors in combination with Roman pot detectors close to the beams. Very forward event topologies and particle multiplicities are also studied in view of interpretations for Cosmic Rays.

Two tracking telescopes T1 and T2, at distances between 7.5 and 14m to the IP, will measure charged particles in the forward region covering an adequate acceptance over a rapidity interval of $3.1 < h < 6.5$. Leading protons, scattered elastically or quasi -elastically, will be detected by silicon detectors placed in Roman Pot stations at distances of 147 and 220 m from IP5. During 2010, TOTEM commissioned the RP detectors at 220 m and the T2 telescopes and was able to take data at sqrt(s) = 7 TeV. For the first time after the ISR measurements, the t-distribution ($-t > 0.4$ GeV2) of elastic pp scattering (at ~ 100 times larger energy than at the ISR)

is presented, exhibiting the diffractive minimum and a similar slope at large t-values as at the ISR. Also the analysis of charged particle distributions in the very forward regions is in progress.

During the LHC technical stop of 2010/11, the T1 telescopes and the Roman Pot detectors at 147 m were installed and commissioned, completing the TOTEM apparatus. With the successful preparation of the $b^* = 90$ m optics,TOTEM will now be able to carry out a major part of its physics program during 2011

Enberg, Rikard: "Astrophysical Neutrinos from Charm Production: QCD Issues"

High energy cosmic rays that hit Earth, and astrophysical sources where protons are shock-accelerated to high energies are both examples of cosmic beam dump experiments where high energy protons produce neutrinos. Neutrinos are produced in these high-energy collisions through semileptonic decays of produced mesons and baryons. At very high energies, neutrinos from charm are expected to dominate, but so far the IceCube experiment has not seen any evidence of this "prompt" contribution. Charm production occurs at very high energy, corresponding to very small x, and I will discuss some of the QCD issues involved.

Fleming, George: " Non-Perturbative Evidence for Technicolor"

The phenomenological viability of technicolor theories has been questioned on the basis of flavor-changing neutral currents and the precision electroweak S parameter. Walking, or nearly conformal, gauge dynamics has been proposed as a solution but the existence of walking gauge theories has not yet been established. The Lattice Strong Dynamics (LSD) collaboration has recently completed a study of the flavor dependence of SU(3) Yang-Mills. In two recent letters, they have shown

non-perturbative evidence that the phenomenological viability of technicolor improves as the number of flavors increases towards the conjectured walking regime.

***Frasca, Marco**: "Low-Energy Limit of QCD at Finite Temperature"*

We show that a Nambu-Jona-Lasinio model is the proper low-energy limit for quantum chromodynamics. We derive explicitly the bosonized action and the spectrum of the theory. Then, we extend the model to finite temperature and derive the gap equation. An analysis of the behavior in temperature of the equation is done and some observables are obtained.

Fried, Herb: "A New, Analytic, Non-Perturbative, Gauge-Invariant Formulation of `Realistic' QCD"

A simple and previously overlooked choice of one parameter allows the Schwinger/Symanzik Generating Functional of QCD to be re-written in a manifestly gauge-invariant fashion, without the need of Fadeev-Popov insertions. When combined with Fradkin functional representations for the Green's function, G[A], of a quark in an effective color potential A, and the vacuum loop functional L[A], all QCD correlation functions can be represented as Gaussian, functional-linkage operations connecting relevant combinations of G[A] and L[A]. And because the Fradkin representations for those functionals are Gaussian in their dependence on A, the functional-linkage operation can be done exactly, and one then sees that gauge invariance here is achieved by gauge-independence, as the gauge-dependent gluon propagators (which enter into all possible gluon exchanges between quarks and/or antiquarks) exactly cancel out everywhere. In this way, the non-perturbative sums over Feynman graphs reduce to an explicit, gauge-independent functional expression.

Because of a new property called "Effective Locality", which appears after such multiple gluon exchange, and requires that a distinction be made between "Ideal" and Realistic" QCD, Feynman diagrams may be replaced by "Bundle Diagrams", in which a few "gluon bundles", exchanged between quarks and/or antiquarks, serve to define the essence of a physical amplitude. Our first results are the analytic estimation of quark binding potentials to form model pions and nucleons, and the determination of a nucleon-nucleon scattering and binding potential, as the simplest (and probably the first) example of Nuclear Physics from basic QCD.

Grandou, Thierry: "On Some Technical Aspects of the QCD Effective Locality Property"

Science, Wisdom says, is heavily dependent on details'. Some non-customary functional aspects of the Quantum Field Theory context will be evoked and discussed in relation to a recently discovered property of non-perturbative QCD. The latter, that we have called Effective Locality, will be reviewed in this session by

Pr. H. M. Fried. Here, related rigorous mathematical statements, as well as other preliminary results will be proposed.

Hanada, Masanori: "Universality of Phases in QCD and QCD-Like Theories"

We argue that the whole or the part of the phase diagrams of QCD and QCD-like theories should be universal in the large-N_c limit through the orbifold equivalence. The whole phase diagrams, including the chiral phase transitions and the BEC-BCS crossover regions, are identical between $SU(N_c)$ QCD at finite isospin chemical potential and $SO(2N_c)$ and $Sp(2N_c)$ gauge theories at finite baryon chemical potential. Outside the BEC-BCS crossover region in these theories, the phase diagrams are also identical to that of $SU(N_c)$ QCD at finite baryon chemical potential. We give examples of the universality in some solvable cases: (i) QCD and QCD-like theories at asymptotically high density where the controlled weak-coupling calculations are possible, (ii) chiral random matrix theories of different universality classes, which are solvable large-N (large volume) matrix models of QCD. Our results strongly suggest that, to investigate the chiral phase transition and the QCD critical point at finite baryon chemical potential, one can instead use sign-free QCD at finite isospin chemical potential outside the BEC-BCS crossover region.

Hashimoto, Koj: "Rapid Thermalization by Baryon Injection in Gauge/Gravity Duality"

Using the AdS/CFT correspondence for strongly coupled gauge theories, we calculate thermalization of mesons caused by a time-dependent change of a baryon number chemical potential. On the gravity side, the thermalization corresponds to a horizon formation on the probe flavor brane in the AdS throat. Since heavy ion collisions are locally approximated by a sudden change of the baryon number chemical potential, we discuss implication of our results to RHIC and LHC experiments, to find a rough estimate of rather rapid thermalization time-scale $t < 1$ [fm/c]. We also discuss universality of our analysis against varying gauge theories

Hautmann, Francesco: "Forward Hard Processes in Hadronic Collisions"

We give an introduction to QCD theory aspects of forward high-pT hadroproduction and the role of upcoming measurements in the forward region at the LHC. We discuss recent progress in QCD calculations for forward hard processes that are designed to résumé to all orders in the strong coupling QCD logarithmic corrections both in the hard transverse momentum and in the large rapidity interval. In particular, we discuss Monte Carlo applications to final-state observables associated with the hadroproduction of a forward and a central jet at the LHC, and present numerical predictions for the jet spectra and angular correlations.

Heslop, Paul: "Dualities for Scattering Amplitudes in Maximally Supersymmetric Gauge Theory"

I will review weak-weak dualities relating scattering amplitudes to Wilson loops on the one hand and more recently correlation functions on the other. The Wilson loop duality has lead to both numerical and analytic results for MHV scattering amplitudes at two-loops and beyond, including the determination of two loop MHV n-point scattering amplitudes for any n in a certain kinematical regime which I will review. The duality with correlation functions (which will be discussed in more detail in Eden's talk) has been extended to all scattering amplitudes in the theory, as I shall review.

Iancu, Edmond: "Parton Branching at Strong Coupling from AdS/CFT"

Motivated by the experimental results at RHIC, which suggest that the deconfined QCD matter produced in the intermediate stages of a heavy ion collision might be strongly interacting, there is currently a large interest in understanding high energy processes in gauge theories at strong coupling. Whereas such issues cannot be addressed directly in QCD, it has become common practice to look for guidance at some special, conformally--invariant, gauge theories, whose strong--coupling limit can be studied using string theory techniques, via the AdS/CFT correspondence. Within this framework, one has studied parton evolutionand high--energy scattering at strong coupling and thus uncovered an interesting physical picture. Unlike at weak coupling, where bremsstrahlung favors the emission of soft and collinear partons, thus leading to well--collimated `jets', at strong coupling the parton split quasi--democratically, meaning that the energy and the momentum of the parent partons are evenly distributed among the daughter ones. This implies that there are no jets at strong coupling, nor pointlike constituents like the valence quarks. Such studies also revealed some limitations of the `supergravity approximation' on the string theory side in describing the strong--coupling limit on the gauge theory side.

Iancu, Edmond: "Interference effects in Jet Quenching"

The recent results at the LHC on dijet asymmetry in heavy ion collisions call for a fundamental understanding of the evolution of a relatively hard jet propagating through a QCD medium like the quark--gluon plasma. The dominant mechanism for jet quenching at weak coupling is medium--induced gluon radiation. This allows for relatively large emission angles, in qualitative agreement with the observations at the LHC, but in the course of the jet evolution these angles might be reduced by interference effects leading to angular ordering. We demonstrate that this is {\em not} the case: the interference effects for the medium--induced radiation are parametrically suppressed with respect to the corresponding direct emissions, meaning that the successive gluon emissions proceed independently from each other. Physically, this is so since the direct emissions can be delocalized anywhere throughout the medium and thus yield contributions proportional to the medium size L . On the contrary, the interference occurs only between gluons emitted at very

early times, within the characteristic time scales for quantum and color coherence between the two emitters, which in this regime are much smaller than *L*

Islam, Munir: "Proton Structure and Prediction of pp Elastic Scattering at LHC at Center-of-Mass Energy 7 TeV "

Our phenomenological investigation of high-energy pp and $\bar{p}p$ elastic scattering and study of low-energy models of nucleon structure have led us to a physical picture of the proton; namely, proton is a $q\bar{q}$ -condensate enclosed chiral bag. Based on this picture, we predict pp elastic differential cross section at LHC at c.m. energy 7 TeV. Experimental measurement of pp elastic $d\sigma / dt$ at LHC by the TOTEM Collaboration from |t| = 0 to 10 GeV^2 will test our model of proton structure. We also compare our prediction of $d\sigma / dt$ with the predictions of the Block et al. model and BSW (Bourrely, Soffer, Wu) model.

Jevick, Antal: "Higher Spin ADS Duality from CFT : A Constructive Approach"

We present a construction of AdS Higher-Spin Gravity in terms of bi-local collective field theory. The basic example of a 3D CFT given by the vector model is shown to produce a 4D HS Gravity in curved Anti de Sitter space-time. A mechanism for the emergence of the extra dimension is exemplified through the bi-particle dipole picture provided by the collective field. Implications of the construction on integrability and loop effects in Vasilievs Higher Spin Theory are given.

Kastanas, Alex: "Recent QCD Results from ATLAS"

Knutsson, Albert: "Recent Results from CMS"

Koshelkin, A. V.: "The Non-Perturbative Self-Consistent Model in SU(N) Gauge Field Theory"

The non-perturbative quasi-classical model in a gauge theory with the Yang-Mills (YM) field is developed. The self-consistent solutions of the Dirac equation in the SU(N) gauge field, which is in the eikonal approximation, and the Yang-Mills (YM) equations containing the external fermion current are solved. It shown that the developed model has the self-consistent solutions of the Dirac and Yang-Mills equations at N≥3 In this way, the solutions take place provided that the fermion and gauge fields exist simultaneously, so that the fermion current completely compensates the current generated by the gauge field due to self-interaction of it. The applications of the obtained solutions to QCD are considered in the context of the processes in the matter generated in collisions of heavy ions of high energies.

Kowalski, Henri: "Using HERA Data to Determine the BFKL Amplitude Infrared Behaviour"

In the talk I will show that HERA data can be described by a universal gluon density, which can be identified with a pomeron. The new precise data on F2 allow to

determine the properties of a Discrete-Pomeron solution to the BFKL equation. The DP structure is strikingly similar to the hard wall pomeron in ADS/CFT.

Landsteiner, Karl: "Anomalies and Transport Coefficients"

Axial anomalies give rise to interesting new transport phenomena such as the "chiral magnetic effect". I will discuss how the associated transport coefficients can be studied via Kubo formulas at weak and strong coupling, the latter via gauge gravity duality. Finally I will argue for a new "chiral gravito-magnetic" (or vortical) effect due to the presence of mixed gauge-gravitational anomalies

Leonidov, Andry: "Complex Networks: a New Synthesis"

Lilley, Marc: "Observational Signatures of a Non-Singular Bouncing Cosmology"

We begin with an overview of standard inflationary cosmology and then motivate the study of singularity-free cosmologies. We then introduce a cosmological scenario in which inflation is preceded by a bounce. In this scenario, the primordial singularity, one of the major shortcomings of inflation, is replaced by a non-singular bounce, prior to which the universe undergoes a phase of contraction. We give a detailed study of the transfer through the bounce of cosmological perturbations sourcing today's large scale structure. We show that the bouncing phase induces oscillations superimposed on the nearly scale-invariant primordial spectra for scalar and tensor cosmological perturbations. We discuss the effects of these oscillations in the cosmic microwave background and in the power spectrum of matter in the universe. We propose a new way to indirectly measure the spatial curvature energy density parameter in the context of this model.

Mazzucato, Luca: "Computing Anomalous Dimensions at Strong Coupling"

We introduce a method to compute the anomalous dimension of short operators in N=4 super Yang-Mills theory at strong coupling, where they are described in terms of superstring states in an anti-de Sitter background. We focus on the Konishi multiplet, dual to the first massive level of the superstring, and compute the one-loop correction to its anomalous dimension at strong coupling, using the pure spinor formalism for the superstring.

Moffat, John: "Ultraviolet Complete Quantum Field Theory "

The consequences of an ultraviolet complete quantum field theory (QFT) for particle physics and quantum gravity are presented. The theory avoids the need for a renormalizable QFT to obtain finite scattering amplitudes in particle physics and quantum gravity. An electroweak model is proposed without a Higgs particle. Consequences for non-perturbative QFT are presented.

Morita, Takeshi: "Phase Structure of Yang-Mills Theory on a Small Torus"

We consider D+2 dimensional large N pure Yang-Mills theory on a T^{D+2} and take the

radii of T^D small such that the theory reduces to a 2 dimensional gauge theory. We find that we can analytically solve this theory in a certain limit. We show that the theory has 4 phases and determine the order of the phase transitions between them. These phase transitions are related to the confinement/deconfinement transition in the original D+2 dimensional YM theory and consistent with known lattice results. We also consider a gravity dual of this theory in D=8 case and find a problem of the holographic method. Similar problems in holography would generally appear in the thermodynamics of the non-supersymmetric gauge theories and we propose a resolution.

Mueller, Berndt: "Thermolization in QCD and AdS/CFT"

Nattrass, Christine: "Recent Results – ALICE"

Nesterenko, Alexander: "The Effects Due to Hadronization in the Inclusive Tau Lepton Decay"

The inclusive tau lepton hadronic decay is studied in the framework of dispersive approach to QCD. It is shown that the effects due to nonvanishing mass of the lightest allowed hadronic decay mode play a valuable role in the theoretical description of this strong interaction process. Nonperturbative constraints, which relevant dispersion relation imposes on the low-energy behavior of hadronic vacuum polarization function, are discussed.

Oliveira, Orlando: "From Running Gluon Mass to Chiral Symmetry Breaking"

The gluon propagator is one of the fundamental Green's functions of QCD. It is an essential ingredient in, for example, the modeling of the Schwinger-Dyson equation used to describe hadronic phenomenology. From the Landau gauge gluon propagator, computed with lattice QCD methods, we discuss its interpretation as a massive propagator and measure the gluon mass as a function of the momenta. Special attention is given to the mass at infrared scales. In the last part of the talk, the gluon mass and chiral symmetry breaking are related via an effective model for QCD.

Orginos, Kostas: "Properties of Systems with Baryon Number Two"

I will review recent lattice QCD calculations of properties of two-hadron systems. I will discuss the formalism and the methods that allow Euclidean finite volume calculations to access observables such as elastic scattering phase shifts and hadronic matrix elements of multiparticle states. Results from recent calculations of the NPLQCD collaboration will be presented.

Poppitz, Erich: ``Magnetic Bions, Multiple Adjoints, and Seiberg-Witten Theory"

We study in detail the magnetic bion confinement mechanism in QCD-like theories with arbitrary numbers of adjoint Weyl fermions on R**3xS**1. In the case of one Weyl adjoint flavor, we show how it can be smoothly deformed into the mechanism

of confinement in Seiberg-Witten theory on R**4. This demonstrates quite explicitly that the only analytically controlled examples of confinement in continuum supersymmetric (Seiberg-Witten) and nonsupersymmetric (QCD(adj)-a magnetic bion version of Polyakov's mechanism) represent facets of the same phenomenon.

Reno, Hallsie: "Neutrinos from Charm Production: Atmospheric and Astrophysical Applications"

Cosmic ray production of charmed particles and their subsequent semileptonic decays to neutrinos, are important contributors to high energy neutrino fluxes produced in the Earth's atmosphere and in astrophysical sources of the cosmic rays themselves. Large neutrino telescopes aim to measure astrophysical neutrinos, and the IceCube detector has published limits on the high energy atmospheric lepton flux. Here, the theoretical evaluation of the neutrino fluxes is described, with a focus on the uncertainties associated with these high energy flux predictions.

Ruggieri, Marco: "The Critical End Point of Quantum Chromodynamics Detected by Chirally Imbalanced Quark Matter"

We suggest the idea, supported by concrete calculations within chiral models, that the critical endpoint of the phase diagram of Quantum Chromodynamics with three colors can be detected, by means of Lattice simulations of grand-canonical ensembles with a chiral chemical potential, μ_5, conjugated to chiral charge density. In fact, we show that a continuation of the critical endpoint of the phase diagram of Quantum Chromodynamics at finite chemical potential, μ to a critical end point in the temperature-chiral chemical potential plane, is possible. This study paves the way of the mapping of the phases of Quantum Chromodynamics at finite μ by means of the phases of a fictitious theory in which μ is replaced by μ_5.

Sarcevic, Ina: "Probing Dark Matter with Neutrinos from the Galactic Center"

Sazdjian, Hagop: ``The gauge invariant quark Green's function in QCD2"

The gauge invariant quark Green's function, defined with a path-ordered phase factor along a straight-line, is studied in two-dimensional QCD in the large N_c limit by means of an exact integrodifferential equation. It is found to be infrared finite with singularities represented by an infinite number of threshold type branch points starting at non-zero positive mass values. The analytic expression of the Green's function for all momenta will be presented.

Schoeffel Laurent: "Diffraction at HERA" on behalf of the H1 and ZEUS Collaborations

Semikoz, Dmitri: "Ultra-High Energy Nuclei Source in Virgo Galaxy Cluster"

We propose a new method to search for heavy nuclei sources, on top of background, in the Ultra-High Energy Cosmic Ray data. We apply this method to the 69 events

recently published by the Pierre Auger Collaboration and find a tail of events for which it reconstructs the source at a few degrees from the Virgo galaxy cluster. We investigate the ability of current and future experiments to validate or rule out this possibility, and discuss several alternative solutions which could explain the existing anisotropy in the Auger data.. The existence of nuclei sources in the sky opens the road for a self-consistent description of Auger data.

Stanev, Todor: "Ultrahigh Energy Cosmic Rays: Detection and Analysis"

We discuss the detection of the highest energy nuclei that reaches and exceeds 10^{11} GeV by the HiRes experiment and the Southern Auger Observatory. The analysis of such events is based on the extension of the hadronic interaction models two orders of magnitude above the current CMS accelerator measurements. We briefly discuss the models used by air shower experiments**..**

Stanley, Eugene: ``*Isolated Networks and Coupled Networks – A Brief Introduction"*

We will introduce the ``modern theory of networks'' in terms understandable to the nonspecialist. Then we will describe specific characterize networks, whether they appear in internet, airline routes, or even networks of sexual contacts.

As an example, we will discuss very recent work, emphasizing its direct applicability to specific problems of preventing network breakdown. The key concept is that systems comprised of more than one network are vastly more susceptible to failure cascades than isolated networks. We also discuss potential applications to understanding financial breakdowns.

This work was carried out in collaboration with a number of colleagues, chief among whom are S. Havlin & R. Parshani (Bar-Ilan), S. V. Buldyrev (Yeshiva U), T. Preis and J. J. Schneider (Mainz), X. Gabaix (MIT and Princeton), X. Huang, J. Gao, V. Plerou, G. Paul, and P. Gopikrishnan (Boston University).

Sugimoto, Shigeki: "QCD and String Theory"

I will review the basic idea and some of the interesting results in a holographic dual description of QCD.

Tan, Chung-I: "Holographic Double Diffractive Higgs Production"

The holographic approach to double diffractive Higgs production is presented for the AdS graviton/Pomeron. The goal is to provide a predictive phenomenology for the strong coupling expansion of QCD. This is the first step to set up the frame work for the double diffractive Higgs production in anticipation of experimental observations at the LHC. Comparisons are made with the weak coupling approach based on the BFKL Pomeron models and soft Regge parameterizations.

Vaman, Diana: "Real-Time AdS/CFT and Applications: Jet Quenching and Second Order Hydrodynamics"

I will introduce a prescription for computing real-time correlators in AdS/CFT using insights from finite temperature real-time field theory formalism. This particular prescription amounts to adapting the finite-temperature analog of Veltman's circling rules to tree-level Witten diagrams. Several checks are made: the KMS identities and the largest time equation are verified, and the zero-temperature limit is reproduced. Following this prescription, causal 3-point correlators are computed using causal supergravity propagators, joined at a bulk vertex integrated only up to the horizon. This result is expected based on analyticity, since the retarded n-point functions are obtained by analytic continuation from the imaginary time Green's function, and based on causality considerations.The real-time correlators can be used via Kubo-type formulae to compute the response functions. For example, the computation of the 1-point R-charge density in N=4 4d super Yang-Mills theory at finite temperature, allows tracking the evolution of a high-energy jet moving through the strongly coupled plasma. A rather unexpected finding is that while none of the jet survives past a distance which scales with the jet energy as $E^{1/3}$, most of the jet stops at a smaller distance, proportional to $EL^{1/4}$, where L is the size of the region where the jet was initially created. Turning on a finite chemical potential does not change these findings. I will conclude with a simple explanation for the typical $EL^{1/4}$ stopping distance.

Vanhove Pierre: "The Momentum Kernel of Gauge and Gravity Theories"

We show that the multileg tree-level amplitudes in Yang-Mills and gravity take similar form when using a momentum kernel. This momentum kernel is a universal object constructed from the kinematics invariants, that allows to derive all the relations between the color-ordered tree-level amplitudes in gauge theories. These relations imply the existence of minimal basis for gauge and gravity tree amplitudes. We will present various new forms for multileg tree amplitudes in Yang-Mills and Gravit, and discuss surprising links between gravity and certain combinations of kinematic and color factors in gauge theory. We will make some comments about higher-loop generalisation.

Veneziano, Gabriel: "Transplanckian Scattering of Particles, Strings, and Branes"

Werner, Klaus: "Quark-Gluon Plasma in Proton-Proton Scattering at the LHC?"

We discuss recent experimental results from proton-proton scattering at 7 TeV ("Ridge", Bose-Einstein correlations, spectra) and their interpretation in terms of a scenario of a hydrodynamical expansion initiated by flux tube initial conditions.

***Yang, Gang*: "A step to Off-shell: from Amplitudes to Form Factors in N=4 SYM"**

There have been significant developments in the study of scattering amplitudes in N=4 SYM in past ten years, which not onlyprovide powerful computational techniques but also reveal remarkable hidden structures of the theory such as the duality between amplitudes and Wilson loops. On the other hand, there are other important observables such as correlation functions. It is therefore interesting to see if these developments have implication for computing such quantities. One very special object is the so-called form factor. Compared to amplitudes, they are defined not only with on-shell asymptotic states but also with one off-shell operator inserted. Such objects are in some sense the hybrid of on-shell quantities (such as scattering amplitudes) and off-shell quantities (such as correlation functions). In this talk, I will show that form factors inherit many nice properties of scattering amplitudes. This may open an avenue for studying more complicated off-shell quantities.

Yang, Yi: "High Energy Scattering and Symmetries in String Theory"

We study scattering of higher spin string states at arbitrary mass levels in both the fixed angle and the Regge regimes. In the fixed angle regime, we obtain the infinite ratios among high-energy amplitudes of different string states. We further calculate the string scattering amplitudes in the Regge regimes. We conjecture that those ratios in the fixed angle regime can be completely extracted from the scattering amplitudes in the Regge regimes. We argue that these ratios correspond to certain symmetries in string theory, which make the UV behavior of string theory much softer than that in field theory, e.g. QCD. We finally prove our conjecture by using a signless Stirling number identity in combinatorial theory.

Yi, Piljin: "D4/D8 Holographic QCD"

Zappala, Dario: "Quasi-Particlel Degrees of Freedom in Finite Temperature SU(N) Gauge Theories"

Pure gauge SU(N), with N = 3,4,6 lattice data at finite temperature are analyzed above the deconfinement temperature T_c, within a model of transversely polarized quasi-particle modes having a temperature-dependent mass m(T). Particular attention is devoted to the scaling of the interaction measure Delta = (e - 3p)/T^4 with N and to the role of the gluon condensate and of the screening mass.