Quantum Field Theory: Developments and Perspectives

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Book of Abstracts

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Complex matrix model duality

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The same complex matrix model calculates both tachyon scattering for the $c = 1$ non-critical string at the self-dual radius and certain correlation functions of half-BPS operators in $cN = 4$ super-Yang-Mills. It is dual to another complex matrix model where the couplings of the first model are encoded in the Kontsevich-like variables of the second. The duality between the theories is mirrored by the duality of their Feynman diagrams. Analogously to the Hermitian Kontsevich-Penner models, the graphs of the second model can be written as sums over discrete points in subspaces of the moduli space of punctured Riemann surfaces.

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Semiclassical strings exactly

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We present a systematic analytic treatment of semiclassical fluctuations around non-trivial solutions for the Green Schwarz string action in AdS5xS5 space. The 1-loop partition function for the cases of the minimal surface corresponding to a Wilson loop with parallel lines and for the folded string are considered, leading in the first case to a prediction for the subleading correction to the quark-antiquark potential in AdS, in the second to a detailed information on the strong coupling behavior of the dual gauge twist operators.

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Quantum Field Theory on Noncommutative Curved Spacetimes

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In this talk I show how to construct the quantum field theory of a free real scalar field on a class of noncommutative manifolds, obtained via deformation quantization using abelian Drinfel'd twists. I define action functionals in the framework of twist-deformed differential geometry, derive the associated equations of motion and solve them in terms of formal power series. In analogy to the commutative case, the space of solutions of the deformed wave equation can be equipped with a symplectic structure and thus can be quantized in terms of suitable *-algebras of field observables.

As an application, I present the convergent deformation of a simple FRW model and point out the similarities and differences to formal deformation quantization.

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Dark Energy from Quantum Matter

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We study the backreaction of free quantum fields on a flat Robertson-Walker spacetime. Apart from renormalization freedom, the vacuum energy density receives contributions from both the trace anomaly and the thermal nature of the quantum state. The former represents a dynamical realisation of dark energy, while the latter mimics an effective dark matter component. The semiclassical dynamics yield two classes of asymptotically stable solutions. The first reproduces the LCDM model in a suitable regime. The second lacks a classical counterpart, but is in excellent agreement with recent observations.

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Analytic Computation of t T production at Hadron Colliders

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We present new compact analytic one-loop helicity amplitudes for $t\bar{t}$ production at Hadron colliders. The results were obtained employing a combination of on-shell methods and advanced Feynman diagram techniques. In particular the tadpole, the rational and mass renormalization contributions were extracted from the latter approach. For the cut constructible pieces we used the method of generalized unitarity. Further improvements where obtained by applying the constraints coming from the universal singular behaviour.
The analytic expressions can be implemented in existing codes to provide faster and numerically more stable results for phenomenological studies.

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Vanishing Chiral Algebras

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The chiral algebras of two-dimensional theories with (0,2) supersymmetry are vertex-algebra generalizations of the chiral rings of (2,2) supersymmetric theories, the most famous of which is the quantum cohomology ring. We show that the chiral algebra of a (0,2) supersymmetric sigma model vanishes if the target space is a Kähler manifold with positive first Chern class. This implies that supersymmetry is spontaneously broken, therefore gives a physical proof of the Höhn-Stolz conjecture in the Kähler case. It also provides for string manifolds a refinement of Mori's theorem on rational curves in Fano varieties.

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Gravitational shock wave collision and matter equilibration in heavy ion collisions

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Successful applications of hydrodynamical simulation implies an early thermalization time of quark gluon plasma produced in heavy ion collisions. This suggests the quark gluon plasma is strongly coupled. Theoretical understanding of the equilibration of the strongly coupled matter remains an open problem. In this talk, we will study the matter equilibration in heavy ion collisions with holographic method. The relativistic nucleus are modelled by gravitational shock waves. We constructed the trapped surface associated with the collision of two shock waves. The area of the trapped surface gives a lower bound of the entropy production in heavy ion collisions. We will study the centrality dependence of the entropy production, and show the existence of critical impact parameter, beyond which thermalization is not possible. We will also comment on the applicability of different types of shock waves in modelling the real world nucleus.

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On BCFW shifts of integrands and integrals

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n this talk a first step is made towards the extension of Britto-Cachazo-Feng-Witten (BCFW) tree level on-shell recursion relations to integrands and integrals of scattering amplitudes to arbitrary loop order. Surprisingly, it is shown that the large BCFW shift limit of the integrands has the same structure as the corresponding tree level amplitude in any minimally coupled Yang-Mills theory in four or more dimensions. This implies that these integrands can be reconstructed from a subset of their 'single cuts'. The relation between shifts of integrands and shifts of its integrals is investigated explicitly at one loop. Two particular sources of discrepancy between the integral and integrand are identified related to UV and IR divergences. This is cross-checked with known results for helicity equal amplitudes at one loop. The nature of the on-shell residue at each of the single-cut singularities of the integrand is commented upon. Several natural conjectures and opportunities for further research present themselves.

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A Novel Algebraic Approach to Quantum and Classical Dualities

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Few non-perturbative tools available to the theoretical physicist are as widely useful as Dualities. These "connections" among diverse models (or one and the same model in different regions of its coupling space) can provide a wealth of qualitative and quantitative information up to exact critical couplings in favorable cases; which explains why dualities have been researched constantly over the last sixty years in fields ranging from Classical Statistical Mechanics to String Theory. In this talk we introduce a completely novel algebraic approach to dualities. By associating a "bond algebra" to any quantum Hamiltonian, dualities can be systematically searched for,
and dual variables computed algorithmically. It follows that that quantum dualities can be characterized as unitary transformations that can be explicitly computed. In this context, the connection between self-dualities and ordinary (Wigner) quantum symmetries is enormously clarified. Furthermore, through Feynman's path integral,
our technique provides also a new approach to classical dualities, thus affording a unified solution to the problem of finding dualities in classical and quantum models:
as an elementary example, the Krammers-Wannied duality of the classical Ising model and the duality of (sourceless) electromagnetism are shown to be the manifestation of one and the same property of these models' quantum renditions.
Quantum Field Theory (QFT) provides a most interesting and challenging scenario for the application of this novel technique. Hence though still under research, applications to dualities in QFTs is stressed.

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Non-supersymmetric Extremal RN-AdS Black Holes in N=2 Gauged Supergravity

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We investigate extremal Reissner-Nordstrom-AdS black holes in four-dimensional N=2 abelian gauged supergravity. We find a new attractor equation which is not reduced to the one in the asymptotically flat spacetime. We also argue a formula which is available even in the presence of the scalar potential. We apply them to the T^3-model and the STU-model in generic black hole charge distributions. In addition, focusing on the so-called T^3-model with a single neutral vector multiplet, we obtain non-supersymmetric extremal Reissner-Nordstrom-AdS black hole solutions with regular event horizons in the D0-D4 and the D2-D6 black hole charge configurations. The negative cosmological constant emerges even without the Fayet-Iliopoulos parameters.

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Holographic p-wave Superfluids

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We discuss holographic duals of strongly interacting gauge theories which show properties of superfluids. In this talk we consider p-wave superfluid condensates which in addition to an Abelian symmetry also break the spatial rotational symmetry. First we examine a phenomenological gravity setup, a non-Abelian Einstein-Yang-Mills theory, and therein construct black hole solutions with a vector hair at low temperature which are dual to the superfluid states. In this model we obtain that the phase transition to the superfluid phase is second order and becomes first order as we increase the number of charged degrees of freedom. Finally we embed this phenomenological model into string theory which allows us to identify the dual field theory explicitly. This dual field theory is a strongly coupled gauge theory which contains matter in the fundamental representation of the gauge group. In this sense it is similar to QCD. In this theory, the superfluid states may be interpreted as vector meson condensates which are also expected in QCD.

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Arithmetic Quantum Gravity

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It has been realized long ago that spacetime singularities generically appear in the classical theory of general relativity, and it is expected that such singularities will be resolved through quantum effects. The classical BKL analysis leads to a cosmological billiards description of space-time near the singularity, which is in general not integrable, but instead chaotic. The shape of the billiard tables is determined by the given theory and can be identified with the Weyl chamber of an infinite-dimensional Kac-Moody Lie algebra, and also with (half) the fundamental domain of the modular group with respect to different kinds of integers. This implies that the wavefunction of the universe has to be an (odd) Maass waveform automorphic under the (generalized) modular group. For example, in the case of D=4 pure gravity, the billiard is taking place in the fundamental domain of the modular group PSL(2,Z), whereas in D=11 supergravity, it is given by the fundamental domain of the modular group with respect to integer octonions. The wavefunction goes to zero in the limit towards the singularity, and it is generically complex and oscillating, an analytic continuation is impossible. Numerical as well as analytical investigations of the dynamics of semiclassical wavepackets confirm these results.

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Effective theory methods for heavy coloured (s)particles at hadron colliders

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Perturbative corrections to pair production process of heavy coloured particles (such as top quarks or supersymmetric partners of quarks and gluons) are enhanced for small velocities of the heavy particles. This enhancement is due to emission of soft gluons and the exchange of Coulomb gluons. I will discuss the use of effective theory methods to disentangle the two effects and perform a simultaneous resummation of higher-order corrections from these two sources. Numerical results for squark-antisquark and top-antitop production at the Tevatron and the LHC will be presented.

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J/Psi production with NRQCD: HERA, Tevatron, RHIC and LHC

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The factorization theorem of nonrelativistic QCD (NRQCD) is a framework for the production and decay of heavy quarkonia. In order to establish NRQCD it is necessary to show the significance of the color-octet (CO) contributions and the universality of the "long distance matrix elements" (LDME) in different high energy processes. We have now succeeded in calculating the cross section of both J/Psi photo- and hadroproduction at next-to-leading order within the NRQCD framework, including the CO contributions. We performed a combined fit of the CO LDMEs to Tevatron and HERA data. We compared our results also with recent PHENIX data from RHIC and CMS data from the LHC. Thus we have shown that hadro- and photoproduction can be consistently described by NRQCD: The data from all experiments can be well described by the sum of color singlet and color octet contributions, while the color singlet contributions alone fall short of the data by far.

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Asymptotic symmetries of 3D higher-spin gauge theories and W-algebras

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We discuss the relation between W-algebras and asymptotic symmetries of higher-spin gauge theories coupled to three-dimensional gravity with a negative cosmological constant. We first show how to describe interactions for higher-spin gauge fields D=2+1 via G x G Chern-Simons actions. Then we identify the asymptotically AdS solutions of the field equations and we show that their asymptotic symmetries are given by two copies of a centrally extended W-algebra selected by G. The central charge is the one identified by Brown and Henneaux in pure gravity.

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Chiral symmetry breaking in an expanding plasma

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I discuss the effect of an expanding plasma on probe matter by studying
time-dependent D7 brane embeddings in the holographic dual of an expanding viscous plasma in the presence of an external magnetic field B. The main focus
will be on the chiral phase transition and the behavior of the chiral condensate as a function of time and B.

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Extremal Three-point Correlators in Kerr/CFT

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We compute three-point correlation functions in the near-extremal, near-horizon region of a Kerr black hole, and compare to the corresponding finite-temperature conformal field theory correlators. For simplicity, we focus on scalar fields dual to operators $calO_h$ whose conformal dimensions obey $h_3 = h_1 + h_2$, which we name \emph{extremal} in analogy with the classic $AdS_5 \times S^5$ three-point function in the literature. For such extremal correlators we find perfect agreement with the conformal field theory side, provided that the coupling of the cubic interaction contains a vanishing prefactor $\propto h_3 - h_1 - h_2$. In fact, the bulk three-point function integral for such extremal correlators diverges as $1/(h_3 - h_1 - h_2)$. This behavior is analogous to what was found in the context of extremal AdS/CFT three-point correlators. As in AdS/CFT our correlation function can nevertheless be computed via analytic continuation from the non-extremal case.

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Mathieu moonshine and the elliptic genus of K3

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It has recently been conjectured by Eguchi, Ooguri and Tachikawa that the elliptic genus of K3 can be written in terms of dimensions of Mathieu group M24 representations. We provide explicit formulae for the corresponding twining characters and verifying that they satisfy the expected modular properties. This allows us to identify the decomposition of all expansion coefficients in terms of dimensions of M24-representations. For the first 500 coefficients we verify that the multiplicities are indeed all non-negative integers. This represents very compelling evidence in favour of the conjecture.

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Matter and Dark Matter from False Vacuum Decay

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I discuss tachyonic preheating associated with the spontaneous breaking of B-L, the difference of baryon and lepton number: Reheating occurs through the decays of heavy Majorana neutrinos which are produced during preheating and in decays of the Higgs particles of B-L breaking. Baryogenesis is an interplay of nonthermal and thermal leptogenesis, accompanied by thermally produced gravitino dark matter. The proposed mechanism simultaneously explains the generation of matter and dark matter, thereby relating the absolute neutrino mass scale to the gravitino mass.

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Affine sl(N) conformal blocks from N=2 SU(N) gauge theories

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Alday and Tachikawa have recently proposed a relation between conformal blocks in a two-dimensional theory with affine sl(2) symmetry and instanton partition functions in four-dimensional conformal N=2 SU(2) quiver gauge
theories in the presence of a certain surface operator. I will describe how to extend this proposal to a relation between conformal blocks in theories with affine sl(N) symmetry and instanton partition functions in conformal
N=2 SU(N) quiver gauge theories in the presence of a surface operator. I will also discuss the extension to non-conformal N=2 SU(N) theories.

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Wrapped branes, consistent truncations and AdS/CMT

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Branes wrapping calibrated cycles of special holonomy manifolds provide supersymmetric AdS solutions in String and M-theory. We show that, associated to those backgrounds, consistent truncations retaining massive modes, down to a lower dimensional matter-coupled supergravity theory with that AdS as its vacuum, can be performed. We discuss a particular AdS4 example in M-theory and comment on the applications of the model to (3+1)-dimensional holographic superconductors and non-relativistic holography.

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Universal properties of screening in strongly coupled plasmas

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The talk deals with the analysis of universal properties of two physical observables in strongly coupled plasmas in heavy-ion collisions (for example at RHIC). By using the AdS/CFT correspondence expectation the free energy and the screening length of a heavy quark-antiquark pair and a baryon configuration will be computed. In order to study general properties of these quantities, which can be compared with experimental results or lattice QCD calculations, I analyse therefore the conformal N = 4 supersymmetric Yang-Mills theory, a deformed 1-parameter metric and a 2-parameter metric, which is a solution to the supergravity equations
of motion. The main statement is that the screening value in conformal N = 4 supersymmetric Yang-Mills theory is a lower bound for a wide class of metric models.

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Closed flux tubes and their string description: a lesson by lattice gauge theories

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During the last decade, much effort has been invested in the investigation of the effective string description of the flux-tube in SU(N) gauge theories;
this has been done both analytically and numerically (by means of extracting the flux-tube spectrum using the machinery of lattice gauge theories). Using lattice techniques, we calculate the energy spectrum of a confining flux tube that is closed around a spatial torus (this is also called a torelon), as a function of its length. We do so for various SU(N) gauge theories in D=3+1 and D=2+1 dimensions, and for various values of spin, parity and longitudinal momentum. In D=2+1 most of the low-lying states are described by the spectrum of Nambu-Goto bosonic string in flat space-time, while some other states show small deviations that vanish quickly with the flux-tube length. In D=3+1 we find that most of the low-lying states are well described by Nambu-Goto; so far this resembles our findings in D=2+1. However, and in contrast to the situation in D=2+1,
we see that there are some states with particular quantum numbers, that show large deviations from the Nambu-Goto spectrum and which display a very slow (if any) approach to that spectrum as the flux tube length increases.

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Space-like string surfaces in AdS_3 x S^3 of vacuum type

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Minimal surfaces in AdS with closed light-like polygonal boundaries play an important role for gluon scattering amplitudes in N=4 SYM theory. However, explicit formulae are available for the tetragon case only. As the string dual to N=4 SYM lives in AdS_5 x S^5 a more complete treatment should also involve the spherical factor with similar boundary conditions. We construct and classify all space-like minimal surfaces in AdS_3 x S^3 which globally admit coordinates with constant induced metric on both factors. Up to O(2,2) x O(4) transformations all these surfaces, are parameterized by four real parameters. The classes of surfaces correspond to different regions in this parameter space and show quite different boundary behavior. After embedding in AdS_5 x S^5 we calculate the regularized area for solutions with a boundary spanned by a four point scattering s-channel momenta configuration.

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N-soliton solutions in field and string theory

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Solitonic solutions play an important role in both field and string theory. Due to Pohlmeyer there is a certain map between solitons in those two theories. Motivated by recent advances in the context of AdS/CFT I will present a method (dressing method) to generate N-soliton solutions and I will further present exact results. The talk will be mainly based on the recent paper arXiv:1005.1066.

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Deterministic Quantum Field theory in Compact Space-Time

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We propose an unexplored quantization method in field theory. It is based on the assumption of dynamic space-time intrinsic periodicities for relativistic fields, which in turn can be regarded as dual to extra-dimensional fields. In a generalization of the AdS/CFT correspondence, we obtain a unified and consistent interpretation of Special Relativity and Quantum Mechanics in terms of Deterministic Geometrodynamics.

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Smearing versus localising sources in flux compactifications

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We investigate whether vacuum solutions in flux compactifications that are obtained with smeared sources still survive when the sources are localised. This seems to rely on whether the solutions are BPS or not. First we consider a set of BPS solutions that all relate to the GKP solution through T-duality: (p+1)-dimensional solutions from spacetime-filling Op planes with a conformally flat internal space and p-dimensional solutions with orientifolds that wrap a 1-cycle inside an everywhere negatively curved twisted torus. The relation between the solution with smeared orientifolds and the localised version is worked out in detail. Then we consider a class of non-BPS AdS4 solutions that exist for non-ISD fluxes and with smeared D3-branes. This casts serious doubts on the stringy consistency of non-BPS solutions that are obtained in the limit of smeared sources.

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Strong CP problem reconciles Thermal Leptogenesis with Gravitino Dark Matter

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Many extensions of the Standard Model predict super-weakly interacting particles, which typically have to decay before Big Bang Nucleosynthesis (BBN). The entropy produced in the decays may help to reconcile thermal leptogenesis and BBN in scenarios with gravitino dark matter, which is usually difficult due to late decays of the next-to-lightest supersymmetric particle (NLSP) spoiling the predictions of BBN. We study this possibility for a general neutralino NLSP.

We elaborate general properties of the scenario and strong constraints on the entropy-producing particle. As an example, we consider the saxion from the axion multiplet and show that, while enabling a solution of the strong CP problem, it can also produce a suitable amount of entropy.

The talk is based on work presented in arXiv:1008.1740.

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Hidden $b\bar{b}$ tetraquark spectroscopy and evidence in Belle data near the $\Upsilon(5S)$ resonance

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In the past several years, experiments at the two B-factories, BaBar and Belle, and at the Tevatron collider, CDF and D0, have discovered an impressive number of new hadronic states in the mass region of the charmonia labeled as X, Y and Z, which, however, defy a conventional $c\bar{c}$ charmonium interpretation. Different frameworks have been suggested to describe the observed states, among which the tetraquark model is a promising candidate. According to Heavy Quark symmetry the puzzling states should find their counterpart in the $b\bar{b}$ sector. This talk provides an overview of the calculation of doubly bottom tetraquark masses, discusses their evidence in the R_b-scan performed by BaBar and presents a tetraquark interpretation of the anomalous Belle data found near the $\Upsilon(5S)$ resonance.

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Anomaly Mediation from String Theory

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I shall study anomaly mediated supersymmetry breaking in type IIB string theory and use the results to test the supergravity formula for anomaly mediated gaugino masses. This involves calculating the one-loop gaugino masses for models of D3-branes on orbifold singularities in a three-form flux background by calculating the annulus correlator of two gauginos with a three-form flux insertion.

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Status of sub-GeV Hidden Particle Searches

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Hidden sectors are frequently proposed as part of the physics beyond the standard model. Since their interactions with the visible sectors are very weak, so are the current experimental bounds. In fact, those sectors might even contain particles with masses in the sub-GeV range that have so far escaped detection. Among those weakly interacting slim particles (WISPs) are hidden U(1) gauge bosons, the CP-odd Higgs of the NMSSM, and other axion-like particles.
From a top-down perspective, such particles arise from string compactifications that reproduce the NMSSM and/or contain (multiple) hidden U(1)s. Additionally, they are of great interest in many models that seek to interpret recent terrestrial and astrophysical anomalies (e.g. e+e- excesses observed by PAMELA, annual modulation signal reported by DAMA/LIBRA) in terms of dark matter.
We present constraints from various meson decays, $g-2$ as well as beam dump and reactor experiments on those hidden sector particles with masses below the muon threshold. The NMSSM CP-odd Higgs and generally any pseudoscalar is required to be heavier than 210 MeV or have couplings to fermions that are four orders of magnitude below those of the SM Higgs. Hidden photons of the same mass range are also severely constrained yet not excluded and can be searched for at future beam dump experiments.

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Ladder Topologies for Massive 3-Loop Operator Matrix Elements

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We calculate massive 3-loop graphs for operator matrix elements which belong to ladder topologies. These diagrams contribute to the $O(\alpha_s^3)$ heavy flavor corrections to the deep-inelastic structure function $F_2(x, Q^2)$. The diagrams are represented in terms of generalized hypergeometric and Appell-functions, which lead to nested sums of hypergeometric terms equipped with harmonic sums. These sums can be solved applying modern summation technologies in $\Pi\Sigma$−fields. An algorithmic approach to compute these diagrams is presented.

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The $O(\alpha_s^3)$ Massive Operator Matrix Elements of $O(n_f)$ for the Structure Function $F_2(x, Q^2)$

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The contributions $\propto n_f$ to the $O(\alpha_s^3)$ massive operator matrix elements describing the heavy flavor Wilson coefficients in the limit $Q^2 \gg m^2$ were computed for the structure function $F_2(x, Q^2)$ and transversity for general values of the Mellin variable N. Here, for two matrix elements, $A_{qq,Q}^{\mathsf{PS}}(N)$ and $A_{qg,Q}(N)$, the complete result has been obtained. A first independent computation of the contributions to the 3−loop anomalous dimensions $\gamma_{qg}(N)$, $\gamma_{qq}^{\mathsf{PS}}(N)$, and $\gamma_{qq}^{\mathsf{NS,(TR)}}(N)$ has been performed. In the computation advanced summation technologies for nested sums over products of hypergeometric terms with harmonic sums have been used. For intermediary results generalized harmonic sums occured, while the final results could be expressed by nested harmonic sums only.

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Structure of the broken phase of the sine-Gordon model

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We present the IR behavior of the flow of the sine-Gordon model in d=2 using functional renormalization at the local potential approximation. We demonstrate that the broken phase exhibits a continuum of non-perturbative IR fixed points that can not be seen using the usual Fourier expansion. We also show that that the phase boundary remains valid when starting with a strongly coupled bare theory, and that these IR fixed points are reached the same way -exhibiting a generalized universality.

We then discuss the use of the average action -a necessary step to study wave function renormalization-where the regulator breaks periodicity and demonstrate that the phase boundary is independent of the choice of the regulator. We also show that the structure of the IR flow is preserved by the regulator qualitatively and partially quantitatively.

Finally, we discuss the structure of the sine-Gordon model in higher dimensions and show that the fixed points disappear and that the flow possibly run into a singularity.

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Thrust distribution at N^3LL with power corrections and precision determination of alpha_s

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A traditional method for determining the strong coupling constant (QCD) with high precision is the analysis of jet cross sections at e+ e- colliders. Event-shape distributions play a special role as they have been extensively measured with small experimental uncertainties and are theoretically clean and accessible to high-order perturbative computations. The strong coupling constant alpha_s plays a crucial role in all leptonic (LEP) and hadronic (LHC) collider experiments. Many interesting quantities also depend on its value (quark masses, mixing angles, new-physics searches…). The current world average is largely dominated by the lattice uncertainties. Our determination has similar precision as the lattice one (~1%) although the central value is much lower. Our value has been recently confirmed by DIS analyses. We give a factorization formula for the thrust distribution based on soft-collinear effective theory. The result is applicable for all tau, i.e. in the peak region, in the tail region, and in the far-tail region. The formula includes O(\alpha_s^3) fixed-order QCD results, resummation of singular partonic \alpha_s^j ln^k(\tau)/tau terms with N3LL accuracy, hadronization effects from fitting a universal nonperturbative soft function defined in factorization, bottom mass effects, QED corrections, and the dominant top-mass dependent terms from the axial-anomaly. We do not rely on a Monte Carlo generator to determine nonperturbative effects, since hadronization corrections obtained from MCs are not compatible with perturbative higher order analyses. Instead our treatment of hadronization corrections is based on fitting nonperturbative matrix elements in field theory, which are moments of the nonperturbative soft function. Our result is alpha_s(mZ)=0.1135 \pm (0.0002)_expt \pm (0.0005)_hadr \pm (0.0009)_pert, with chi2/dof=0.91.

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Properties of the QCD vacuum induced by strong magnetic field (a lattice study).

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We study some properties of the non-Abelian vacuum in the presence of external magnetic field. Orders of magnitude of the field have been chosen to be relevant for the recent experiments with heavy ion collisions.
As a framework we used the quenched SU(3) lattice gauge theory with tadpole-improved Luescher-Weisz action and chirally invariant lattice Dirac operator. Within this approach the following results have been obtained:

- The strong enough magnetic field turns the vacuum into an anisotropic conductor with some finite conductivity along the field.
- The chiral symmetry breaking is enhanced by the magnetic field. The corresponding chiral condensate has been calculated as a function of the field.
- There are non-zero local fluctuations of both electric/chiral charge and electromagnetic current in direction of the magnetic field. These fluctuations can be recognized as an evidence of the Chiral Magnetic Effect (CME), which is observed by the STAR Collaboration in heavy ion collisions at RHIC.
- There is a paramagnetic polarization of the vacuum. The corresponding chiral magnetization as well as susceptibility has been calculated and compared with other theoretical estimations.

We have found a good coincidence of the numerics and existing experimental numbers, which is an argument in favour of validity of the quenched approximation at least for this kind of problems.

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B_s mixing and non-minimal flavour violating supersymmetry

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Effects of gluino-squark loops on B_s mixing are discussed in the context of non-minimal flavour violating MSSM. Special attention is paid to the recent data of like-sign dimuon charge asymmetry from D0.

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Four-dimensional conformal supergravity from N=4 gauged supergravity on asymptotically AdS_5

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We consider N=4 SU(2)⊗U(1) gauged supergravity on asymptotically AdS_5
backgrounds. By a near-boundary analysis we determine the boundary-dominant
components of the bulk fields from their partially gauge-fixed field equations.
The residual bulk symmetries are found to act on the boundary fields as four-dimensional
diffeomorphisms, N=2 supersymmetry and (super-)Weyl transformations. This shows that,
asymptotically, the N=4 supergravity multiplet yields the N=2 Weyl multiplet on the boundary.

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N=2 flavored SYM Theory on S^3 in an external magnetic field.

Author: Veselin Filev[None]

I focus on a recenly studied quantum phase transition in flavored N=2 SYM on S^3. I describe the general set up of our holographic study. I briefly review the nature of the phase transition and discuss the meson spectrum of the theory with emphasis on structure of the spectrum at vanishing bare mass. I discuss the cases of both 1+3 and 1+2 dimensional fundamental fields. I discuss the effect of an external magnetic field on the phase transition. I describe the phase diagram of the theory and analyze the meson spectrum.

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R-Parity violating decays of NLSPs at the LHC

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Supersymmetric extensions of the Standard Modell with small R-parity and lepton number breaking naturally yield a consistent cosmology incorporating primordial nucleosynthesis, leptogenesis, and gravitino dark matter. Since the gravitino is no longer stable, its highly supressed decays should lead to characteristic signatures in high-energy cosmic rays. This talk examines the implications of constraints on gravitino lifetime from recent astrophysical data for the decays of the next-to-lightest superparticle (NLSP) at the LHC.