eNLarge Horizons

Monday 1

Chairs: Y. Makeenko / M. García Pérez

Time	Speaker	Title
9:45 - 10:00	Welcome	
10:00 - 11:00	G. Dunne	Uniform Resurgence and Large N
11:00 - 11:30	Coffee	
11:30 - 12:30	M. Unsal	Analytic continuation of path integrals and new exact saddles
12:30 - 13:00	M. Anber	Thermal phase transitions in pure Yang-Mills via supersymmetry for all gauge groups
13:00 - 15:00	Lunch	
15:00 - 16:00	A. Pineda	Phenomenology of renormalons and the OPE from lattice regularization: the gluon condensate and the heavy quark pole mass
16:00 - 16:30	Coffee	
16:30 - 17:30	M. Caselle	Hagedorn spectrum and thermodynamics of SU(N) Yang-Mills theories.
17:30 - 18:00	R. Pourhasan	Holographic Renyi entropy for Lovelock theory

G. Dunne
Title: Uniform Resurgence and Large N
Abstract: The Nekrasov-Shatashvili limit for the low-energy behavior of N=2 and N=2* supersymmetric SU(2) gauge theories is encoded in the spectrum of the Mathieu and Lamé equations, respectively. Resurgent asymptotic analysis of these spectra using all-orders WKB leads to new insights into, and non-perturbative effects in, the transitions between different physical regimes. It also illustrates behavior closely analogous to large N limits in various matrix models.

M. Unsal
Title: Analytic continuation of path integrals and new exact saddles
Abstract: I will discuss a new perspective on path integration, which is inspired from resurgence theory and employs some tools of Picard-Lefschetz theory. The implications seem to be dramatic. Some saddles that are historically thought to be non-exact actually turn out to be exact! There are also new complex saddles, providing real contributions to path integrals and observables. I will give examples from simple quantum mechanics, but the construction apply to QFT as well. I will also briefly discuss the concept of hidden topological angles in QFT and QM.

M. Anber
Title: Thermal phase transitions in pure Yang-Mills via supersymmetry for all gauge groups

A. Pineda
Title: Phenomenology of renormalons and the OPE from lattice regularization: the gluon condensate and the heavy quark pole mass
Abstract: We study the operator product expansion of the plaquette (gluon condensate) and the self-energy of an infinitely heavy quark. We first compute their perturbative expansions to order alpha35 and alpha20, respectively, in the lattice scheme. In both cases we reach the asymptotic regime where the renormalon behavior sets in. Subtracting the perturbative series, we obtain the leading non-perturbative corrections of their respective operator product expansions. In the first case we obtain the gluon condensate and in the second the binding energy of the heavy quark in the infinite mass limit. The results are fully consistent with the expectations from renormalons and the operator product expansion.

M. Caselle
Title: Hagedorn spectrum and thermodynamics of SU(N) Yang-Mills theories.
Abstract: We discuss the equation of state in the confing regime of SU(N) Yang- Mills theories in (2+1) and (3+1) dimensions. We show that the results are described very well by a gas of massive, non-interacting glueballs, provided one assumes that, in addition to the known particles lighter than the two-particle threshold, the theory features a physical spectrum described by an exponentially growing Hagedorn density, which can be modelled by a bosonic closed-string model.

R. Pourhasan
Title: Holographic Renyi entropy for Lovelock theory.
Abstract: We extend the calculations of holographic Renyi entropy introduced in arXiv:1110.1084 to third order Lovelock gravity. While we observe a first order phase transition for topological 3rd order Lovelock black holes in a relevant range of the Lovelock coefficients, we investigate the implication of this phase transition for holographic Renyi entropy.

eNLarge Horizons

Tuesday 2

Chairs: A. Schwimmer / R. Narayanan

Time	Speaker	Title
10:00 - 11:00	E. Poppitz	Strings from domain walls in SYM and QCD(adj)
11:00 - 11:30	Coffee	
11:30 - 12:30	P. Orland	Exact Correlator at Large-N at Large and Small Distances
12:30 - 13:00	L. Jonke	Dynamical and Quenched Random Matrices and Homolumo Gap
13:00 - 15:00	Lunch	
15:00 - 16:00	M. Okawa	Recent results in twisted reduced models
16:00 - 16:30	Coffee	
16:30 - 17:30	A. Cherman	Emergent symmetries in large N gauge theories
17:30 - 18:00	A. Chatzistavrakidis	The SO(d,d) matrix model
18:00 - 18:30	A. Misra	Non-Kaehler Resolved Warped Deformed Conifolds and Black M3-Branes in a Large-N Limit

E. Poppitz
Title: Strings from domain walls in SYM and QCD(adj)
Abstract: Strings between static quarks in $SU(N_c)$ QCD with nf adjoint fermions, including N=1 Super Yang-Mills (SYM), are studied in the calculable regime on $R^3 \times S^1$. They have many qualitatively new features not previously known. The difference from other realizations of abelian confinement is due to the composite nature of magnetic bions, whose Dirac quantum with fundamental quarks is two, and to the unbroken part of the Weyl group. In particular we show that strings are composed of two domain walls, that quarks are not confined on domain walls, that strings can end on domain walls, and that "Y" or "Delta" baryons can form. We also discuss their lightest modes, decompactification limit and outstanding questions.

P. Orland
Title: Exact Correlator at Large-N at Large and Small Distances
Abstract: I will discuss the asymptotically free SU(N) X SU(N) nonlinear sigma model (principal chiral model) in one space and one time dimension. Saddle-point methods do not work at large N, as the diagrams are truly planar. The exact two-point function is determined by the form factor axioms and the exact S matrix. At large distances, this function decays exponentially. A new analysis reveals that at short distances, this function behaves as $\log^2(mx)$. This fully nonperturbative result agrees exactly with the prediction of the perturbative renormalization group.

L. Jonke
Title: Dynamical and Quenched Random Matrices and Homolumo Gap
Abstract: We consider a rather general type of matrix model, in which the fluctuations of the matrix are partly given by some fundamental randomness and partly dynamically. We then study the homolumo-gap effect, which means that we study how the level density for the single-fermion Hamiltonian matrix gets attenuated near the Fermi surface. In the limit of large number of eigenvalues N and for quenched randomness dominating the quantum mechanical one we show how the gap formed. In the first approximation the homolumo gap is characterized by the absence of single-fermion levels between two steep gap boundaries. The filled and empty level densities are in this approximation just pushed, each to its side. In the next approximation these steep drops in the spectral density are smeared out to have an error-function shape. The studied model could be considered as a first step towards the more general case of considering a whole field of matrices defined say on some phase space - rather than a single matrix.

M. Okawa
Title: Recent results on twisted reduced models
Abstract: I review recent progess in large N twisted space-time reduced models. Topics include large N volume independence, 2 loop PT, string tension, renormalized coupling constant, glueball mass, meson spectrum and adjoint fermions.

A. Cherman
Title: Emergent symmetries in large N gauge theories
Abstract: The fact that the large N limit of confining gauge theories is a free limit in terms of the physical degrees of freedom, glueballs and mesons, has powerful implications, some of which became appreciated only recently. I will review the tension between, and implications of, two famous properties of large N theories, volume independence and Hagedorn spectra. In non-supersymmetric adjoint QCD, this tension is especially severe, and I will explain evidence in favor of a conjecture that it is resolved in a striking way: the theory develops an emergent fermionic symmetry in the large N limit.

A. Chatzistavrakidis
Title: The SO(d,d) matrix model
Abstract: A matrix model with SO(d,d) symmetry is constructed and investigated. The construction is based on an Eguchi-Kawai reduction with starting point a generalized Yang-Mills theory on the standard Courant algebroid. It is argued that the model captures the dynamics of phase space, extending the dynamical spacetime picture of known reduced matrix models. This is supported by a set of classical solutions of its equations of motion, which corresponds to phase spaces of noncommutative curved manifolds and points to a new mechanism of emergent gravity.

A. Misra
Title: Non-Kaehler Resolved Warped Deformed Conifolds and Black M3-Branes in a Large-N Limit
Abstract: We will discuss the construction of type IIA mirror a la Strominger Yau Zaslow prescription and its M-theory uplift in the delocalized limit resulting in black M3-branes=asymptotically black M5-branes wrapping large integer sum of two-spheres in AdS5xM6 of type IIB backgrounds involving non-Kaehler resolved warped deformed conifolds in the presence of [fractional]D3 and wrapped D7-branes relevant to thermal QCD with fundamental quarks, in a large N limit referred to as 'MQGP' limit. As this large-N limit includes taking a finite (~<1) string coupling g_s but a large g_sN, it is expected to be relevant to the study of sQGP and can be meaningfully addressed only within M theory. By evaluating the SU(3) structure torsion classes of the type IIB background, we show its approximate Kaehlerity and show that the local three-torus relevant to SYZ mirror construction obeys the same constraint as a maximal T^2-invariant special Lagrangian three-cycle of deformed conifolds. We also discuss thermodynamical/hydrodynamical properties as well as evaluation of a variety of transport coefficients and speed of sound from correlation functions of gauge and metric fluctuations.

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Wednesday 3

Chairs: M. Panero / C. Hoyos

Time	Speaker	Title
10:00 - 11:00	M. Teper	The spectrum of confining flux tubes: lattice calculations and theoretical interpretation
11:00 - 11:30	Coffee	
11:30 - 12:30	B. Lucini	The spectrum of Large-N gauge theories
12:30 - 13:00	N. S. Karthik	Phase of the fermion determinant using Wilson fermions
13:00 - 15:00	Lunch	
15:00 - 16:00	S. Sugimoto	Holographic study of 3 dim YM-CS theory with defects
16:00 - 16:30	Coffee	
16:30 - 17:30	S. Bolognesi	Solitons, Large N and Holography
17:30 - 18:00	H. Steinacker	Squashed fuzzy extra dimensions from coadjoint orbits in N=4 SYM with large rank

21:00 Conference Dinner

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M. Teper
Title: The spectrum of confining flux tubes: lattice calculations and theoretical interpretation
Abstract: Lattice calculations of the spectra of closed confining flux tubes in SU(N) gauge theories in both 2+1 and 3+1 dimensions have revealed these to have a remarkable simplicity – they follow closely the simplest 'Nambu-Goto' string spectrum for almost all flux tube lengths. Recent theoretical analyses of the associated effective string action, both for strings that are long (universal terms) and shorter (approximate in- tegrability), have done much to clarify why this is so. I describe the lattice results and summarise the recent theoretical analysis.

B. Lucini
Title: The spectrum of Large-N gauge theories
Abstract: Lattice calculations for SU(N) gauge theories in the large-N limit are reviewed and recent results for the glueball and the meson spectrum are discussed.

N. S. Karthik
Title: Phase of the fermion determinant using Wilson fermions
Abstract: We study the phase of fermion determinant non-perturbatively using Wilson fermions with various interesting U(1) gauge field backgrounds on a three dimensional torus. This offers a gauge covariant framework to understand the induced Chern-Simons-like term at various fermion masses. We find a hitherto unknown parity even phase that is present when both electric and magnetic fields are present at finite temperature. We also briefly describe a parity covariant method using Wilson fermions to study the condensates in many flavor theory.

S. Sugimoto
Title: Holographic study of 3 dim YM-CS theory with defects

S. Bolognesi
Title: Solitons, Large N and Holography
Abstract: I will present some recent results about the relations between large flux limit and solitons, in particular regarding nonAbelian vortices and magnetic bags in hyperbolic space. I will also discuss an holographic example of large flux soliton used to describe high-density baryonic matter.

H. Steinacker
Title: Squashed fuzzy extra dimensions from coadjoint orbits in N=4 SYM with large rank
Abstract: We find new vacuum solutions of SU(M) N=4 super-Yang-Mills deformed by a totally antisymmetric cubic soft SUSY breaking term, and analogous $R^4{}_\theta \times K_M$ solutions of the IKKT matrix model with flux term. The solutions are interpreted in terms of 4- and 6-dimensional fuzzy branes K_M in extra dimensions, describing self-intersecting projections of compact flag manifolds of SU(3). The classical manifolds are recovered in the large M limit, providing either a 6-fold covering of the internal space near the origin, or a triple self-intersection spanning all 6 internal directions. The solutions have lower energy than the trivial vacuum, and there are no negative modes. The massless modes are identified explicitly. The backgrounds lead to chiral fermionic zero modes localized at the intersections. They have a Z_3 family symmetry originating from the Weyl group rotations, potentially leading to interesting low-energy physics. Analogous spinning solutions are obtained in undeformed N=4 SYM.

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Thursday 4

Chairs: J.L. Barbón

Time	Speaker	Title
10:05 - 11:05	A. Armoni	The Quark Condensate in Multi-Flavour QCD - Planar Equivalence Confronting Lattice Simulations
11:05 - 11:35	Coffee	
11:35 - 12:35	J. R. Peláez	Light scalars as non-ordinary mesons from their Nc behavior
12:35 - 13:05	V. Filev	Testing AdS/CFT with flavours on a computer
13:05	Lunch - free catering	

A. Armoni
Title: The Quark Condensate in Multi-Flavour QCD - Planar Equivalence Confronting Lattice Simulations

J. R. Peláez
Title: Light scalars as non-ordinary mesons from their Nc behavior
Abstract: We review how the 1/Nc expansion has provided some of the strongest evidence for the identification of the controversial light scalar mesons as non-ordinary mesons, i.e., not predominantly of a quark-antiquark nature.

V. Filev
Title: Testing AdS/CFT with flavours on a computer

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Friday 5

Chairs: A. Armoni / H. Neuberger

Time	Speaker	Title
11:00 - 11:30	Coffee	
11:30 - 12:30	R. Yacoby	On 3d Bosonization from Supersymmetry
12:30 - 13:00	H. Soltanpanahi	Nonequilibrium dynamics in nonconformal plasma
13:00 - 15:00	Lunch	
15:00 - 16:00	M. Bochicchio	An asymptotic solution of large-N QCD, and of large-N n=1 SUSY YM
16:00 - 16:30	Coffee	
16:30 - 17:30	S.- J. Rey	Planar Limits, Newton's Constants, and AdS/CFT Interpolation

R. Yacoby
Title: On 3d Bosonization from Supersymmetry
Abstract: Bosonization in 3d is a conjectured equivalence between a Chern-Simons gauge theory coupled to a fundamental scalar, to another such theory that is coupled to a fermion. At large N, this duality received substantial support by matching certain planar 2-point and 3-point functions, the thermal free energy and some S-matrix elements in those theories. I will show that some details of this large N duality can be simply deduced from a duality of a 'parent' supersymmetric theory. That such a relation exists was already noted in the past, and we will generalize and simplify it. Assuming that the supersymmetric duality is correct, the duality map of single-trace operators in the non-supersymmetric theories can be determined unambiguously. In particular, one can argue that all planar correlators in the non-supersymmetric theories must map correctly under the proposed duality map, or else the supersymmetric duality is incorrect. The method we will discuss could potentially be used as a simple prescription to deduce other large N dualities in non-supersymmetric theories, from supersymmetric dualities whose validity is generally more well established.

H. Soltanpanahi
Title: Nonequilibrium dynamics in nonconformal plasma
Abstract: We investigate the behaviour of the lowest nonhydrodynamic modes in a class of holographic models which exhibit an equation of state closely mimicking the one determined from lattice QCD. We compute the lowest quasinormal mode frequencies for a range of scalar self-interaction potentials and find that the damping of the quasinormal modes at the phase transition/ crossover falls off by a factor of around two from conformality after factoring out standard conformal temperature dependence. The damping encoded in the imaginary part of the frequencies turns out to be correlated with the speed of sound and is basically independent of the UV details of the model. We also find that the dynamics of the nonhydrodynamic degrees of freedom remains ultralocal, even to a higher degree, as we deviate from conformality. These results indicate that the role of nonhydrodynamic degrees of freedom in the vicinity of the crossover transition may be enhanced.

M. Bochicchio
Title: An asymptotic solution of large-N QCD, and of large-N n=1 SUSY YM
Abstract: We find an asymptotic solution for two-, three- and, to some extent, multi-point correlators of local gauge-invariant operators, in a lower- spin sector of massless large-N QCD (and of n=1 SUSY YM), in terms of glueball and meson propagators, in such a way that the solution is asymptotic in the ultraviolet to renormalization-group improved perturbation theory, by means of a new purely field-theoretical technique that we call the asymptotically-free bootstrap, based on a recently- proved asymptotic structure theorem for two-point correlators. The asymptotically-free bootstrap provides as well asymptotic S-matrix amplitudes in terms of glueball and meson propagators. Remarkably, the asymptotic S-matrix depends only on the unknown particle spectrum, but not on the anomalous dimensions, as a consequence of the LSZ reduction formulae. Very many physics consequences follow, both practically and theoretically. In fact, the asymptotic solution sets the strongest constraints on any actual solution of large-N QCD (and of n=1 SUSY YM), and in particular on any string solution.

S.- J. Rey
Title: Planar Limits, Newton's Constants, and AdS/CFT Interpolation