Solving Holographic Theories

Report of Contributions

https://indico.global/e/3548

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

Strings from Feynman Diagrams

Monday 16 December 2024 09:30 (45 minutes)

Over 50 years ago, 't Hooft observed the similarity between the Feynman diagram expansion of a large N gauge theory and the topological expansion of a string theory. The purpose of this talk is to make this idea precise for a protected subsector of the AdS/CFT correspondence. Concretely, we show how the Feynman diagram expansion of correlation functions in N=4 SYM preserving half the supersymmetry can be explicitly recast as a dual sum over closed strings. Each individual Feynman diagram maps on to one worldsheet configuration. The weight of the diagram translates to the exponential of the Nambu-Goto action of the dual string.

Presenter: MAZENC, Edward

Contribution ID: **2** Type: **not specified**

Supersymmetric index of black holes and black strings

Monday 16 December 2024 10:30 (45 minutes)

The supersymmetric index of a microscopic theory has a macroscopic dual formulation in terms of a gravitational path integral. I will discuss supersymmetric non-extremal ("finite-temperature") saddle-points of this gravitational index. I will show how a class of 5d solutions can be constructed using the 4d-5d lift. These solutions compute the index of black holes and black strings in asymptotically flat 5d space, even in the absence of an AdS near-horizon region. I will then present a novel decoupling limit of the black string solution in the limit that the 5d temperature vanishes, which gives a finite-temperature BTZ black hole that computes the index in AdS3/CFT2.

Presenter: MURTHY, Sameer

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

Long Range Asymptotic Baxter-Bethe Ansatz for N=4 BFKL

Monday 16 December 2024 11:45 (45 minutes)

We demonstrate that the Balitsky-Fadin-Kuraev-Lipatov regime of maximally supersymmetric Yang-Mills theory can be explicitly solved up to the L+1 order in weak coupling by uncovering a novel long-range asymptotic Baxter-Bethe ansatz for trajectories with L scalar fields. The set of equations we have found is reminiscent of the Beisert-Eden-Staudacher equations for local operators but instead applies to non-local operators corresponding to the horizontal Regge trajectories. We also verify and give new predictions for the light-ray operator spectrum by resummation of the leading singularities in our result.

Presenter: GROMOV, Nikolay

Contribution ID: **4** Type: **not specified**

Discussion

Monday 16 December 2024 14:30 (1h 30m)

Presenters: RANGAMANI, Mukund; GOPAKUMAR, Rajesh (ICTS-TIFR, Bengaluru)

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

1/N corrections from quantum M2 branes

Tuesday 17 December 2024 09:30 (45 minutes)

We will review recent work on semiclassical quantization of 11d supermembrane in $AdS_3 \times S^7/Z_k$. In the case of M2 configuration dual to supersymmetric Wilson loop 1-loop M2 brane correction matches $1/N$ correction in exact localization result in the ABJM theory. Considering 1-loop corrections to semiclassical M2 brane states generalizing spinning strings in $AdS_4 \times S^4$ one can get predictions for the $1/N$ corrections to anomalous dimensions of the dual ABJM operators.

Presenter: TSEYTLIN, Arkady (Imperial College London)

Contribution ID: **7** Type: **not specified**

N=4 SYM in large-charge limits

Tuesday 17 December 2024 10:45 (45 minutes)

I will discuss some recent progress in computing certain correlators of four half-BPS operators in N=4 SYM, with two heavy and two light operators, which we will refer to as heavy-heavy-light-light (HHLL) correlators. We'll consider the HHLL correlators in various interesting regimes (e.g. large-charge 't Hooft limit) as well as the integrated version of the HHLL correlators and their relations to supersymmetric localisation.

Presenter: WEN, Congkao

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

Modular Properties of the Low Energy Expansion

Modular forms arise in two rather distinct contexts in type II superstring scattering amplitudes. Firstly, the coefficients of terms in the low energy expansion of the integrand of the genus-one amplitude are integrals of non-holomorphic modular forms over the complex structure, τ, of the world-sheet torus. These are superpositions of modular graph forms (MGFs) which have been the subject of much recent mathematical interest.

The second context in which modular forms arise is in the elucidation of the low energy expansion of type IIB amplitudes, for which $SL(2,\mathbb{Z})$ is the S-duality group and τ is identified with the complex coupling constant. In this case, the coefficient functions, which get contributions from all genera as well as from instantons, are known as S-dual modular forms (SMF). This case has been understood in great detail from the holographic viewpoint where modular covariance is associated with Montonen–Olive duality of $\mathcal{N} = 4$ $SU(N)$ SUSY Yang–Mills.

In both cases the coefficients of the low energy expansion are linear combinations of 'Generalised Eisenstein Series' $\mathcal{E}(s, s_1, s_2)$ that satisfy inhomogeneous Laplace eigenvalue equations of the form
\begin{equation}
\left(\Delta_\tau - s(s-1)\right) \mathcal{E}(s, s_1, s_2) = E(s_1, \tau) E(s_2, \tau),
\end{equation}
where $E(s_i, \tau)$ is a non-holomorphic Eisenstein series. The eigenvalue s is an integer and for MGFs $s_1, s_2 \in \mathbb{N}^+$ while for SMFs $s_1, s_2 \in \mathbb{N}^+ + \frac{1}{2}$. This talk will describe a number of recent results concerning lattice solutions to these equations and their connections to string theory.

Presenter: GREEN, Michael (Departm.of Physics(QMW-Coll.))

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

Discussion

Tuesday 17 December 2024 14:30 (1h 30m)

Presenters: EBERHARDT, Lorenz; ALDAY, Luis Fernando (Utrecht University)

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

Exploring the Bootstrap Method in the BFSS Model

Wednesday 18 December 2024 09:30 (45 minutes)

The bootstrap method offers a powerful framework for solving theoretical models by systematically solving the optimization problem from the constraints imposed by kinematic and dynamic equalities and inequalities. This approach has demonstrated remarkable efficacy in tackling matrix models, especially in the large N limit and in scenarios complicated by sign problems. In this presentation, we explore the application of the bootstrap method across diverse models, with a particular emphasis on its implementation in the BFSS model, highlighting its potential to address longstanding challenges in this context.

Presenter: ZHENG, Zechuan

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

Thermal Bootstrap of Matrix Quantum Mechanics

Wednesday 18 December 2024 10:45 (45 minutes)

Matrix QM bootstrap is a method which utilizes the equations of motion together with norm positivity to allow for a numerical determination of moments to high precision. I will cover the general principles and some of the recent advances. In Particular, I will explain how to extend the bootstrap to finite temperatures and present comparisons of the results for 1 Matrix QM to analytic methods.

Presenter: GABAI, Barak (EPFL - Ecole Polytechnique Federale Lausanne (CH))

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

The polarised IKKT model

Wednesday 18 December 2024 11:45 (45 minutes)

The IKKT matrix model provides a holographic framework in which all spacetime dimensions are emergent. Despite being much more technically tractable than large N field theory path integrals, the model remains poorly understood. This is largely because the 'timeless'nature of the model means that the standard renormalisation group interpretation of the emergent 'radial'dimension is not immediately applicable. I will discuss a supersymmetric deformation of the IKKT integral that gives a practical handle on the model. I will show how well-established phenomena, including brane polarisation in the presence of background fluxes, arise in this context and thereby allow the rudiments of a holographic dictionary to be established.

Presenter: HARTNOLL, Sean

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

Discussion

Wednesday 18 December 2024 14:30 (1h 30m)

Presenters: LIN, Henry; KOMATSU, Shota (CERN)

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

Towards Hamiltonian String Field Theory, and Dirichlet Walls

Thursday 19 December 2024 09:45 (45 minutes)

I will present preliminary work towards formulating string field theory in a Hamiltonian (equal time slice) formalism. This problem is closely related (via a Wick rotation) to the problem of finding consistent End-Of-The-World boundary conditions for string scattering, in which the metric satisfies Dirichlet boundary conditions (rather than Neumann). In defining the transition amplitudes, two fundamental problems arise: (i) string worldsheets have tadpoles which transgress across the boundary infinitely often, and (ii) when a string does cross the boundary, it can cross multiple times. However, I believe that both of these problems can be overcome (at least at tree level) by clever resummation tricks.

Presenter: WALL, Aron

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

Bootstrapping Higher-Derivative Corrections in M-theory

Thursday 19 December 2024 11:00 (45 minutes)

We study higher-derivative corrections to the graviton scattering amplitude in M-theory, via the stress tensor correlator of 3d N=8 ABJM theory. We use the conformal bootstrap combined with an integral constraint derived from supersymmetric localization in order to constrain semishort OPE coefficients appearing in the stress tensor correlator. We obtain islands that are significantly more precise than those in previous studies that did not use the integral constraint. Using these islands, we can estimate the powers and coefficients in a large central charge expansion. This allows us to accurately read off the N3LO contribution, from the protected Dˆ6Rˆ4 correction, and also estimate the N4LO contribution, from the unprotected Dˆ8Rˆ4 correction.

Presenter: DEMPSEY, Ross

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

Bootstrapping observables in Planar N=4 SYM

Thursday 19 December 2024 12:00 (45 minutes)

In this talk, we explore the bootstrap approach for various observables in planar maximally supersymmetric Yang-Mills theory, including the spectral data, stress-tensor correlator, and energy-energy correlator (EEC). We begin by demonstrating why the conventional bootstrap approach fails in the planar limit. Then, we introduce a set of sum rules derived from dispersion relations, specifically designed for this context. By combining these sum rules with integrated constraints from supersymmetric localization and data from integrability, we set up a numerical bootstrap problem that yields rigorous, two-sided bounds on the OPE coefficients, the four-point correlation function, and the EEC at any value of the coupling in the planar limit. In this talk, we present some of these bounds.

Presenter: ZAHRAEE, Zahra

Contribution ID: **17** Type: **not specified**

Discussion

Thursday 19 December 2024 14:30 (1h 30m)

Presenters: SU, Ning (California Institute of Technology & Massachusetts Institute of Technology); PUFU, Silviu

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

Holographic correlators beyond maximal supersymmetry

Friday 20 December 2024 09:30 (45 minutes)

I will summarize an example of the AdS/CFT correspondence between a 4d N=1 SCFT arising as a mass deformation of the N=4 SYM theory and an AdS_5 flux background of type IIB string theory. The SCFT does not admit a weakly coupled description which makes the calculation of its correlation functions challenging. I will explain how one can leverage the bulk gravitational description, in conjunction with new advances in Exceptional Field Theory and consistent truncations in supergravity, to explicitly calculate two- and three-point correlation functions of BPS and non-BPS operators in the planar limit of the SCFT. I will also discuss how these gravitational results agree nicely with calculations of the superconformal index as well as superconformal Ward identities in the 4d N=1 SCFT.

Presenter: Prof. BOBEV, Nikolay (KU Leuven Association)

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

AdS solutions of string field theory

Friday 20 December 2024 10:45 (45 minutes)

Strings in anti-de Sitter (AdS) spacetime offer prototypical instances of holography, yet a first-principles formulation of string theory in most of such backgrounds remains underdeveloped. In this talk, we explore how string field theory provides a systematic framework for studying strings in AdS. Beginning with a gentle introduction to string field theory, we discuss two main examples: (1) finite-radius AdS3 with mixed fluxes, where the Ramond-Ramond flux is treated perturbatively, and (2) AdS5 in the large-radius expansion

Presenter: CHO, Minjae (Brown University)

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

String perturbation theory of Klebanov-Strassler throat

Friday 20 December 2024 11:45 (45 minutes)

In this talk, I will explain how to study string perturbation theory of the Klebanov-Strassler solution in the large radius approximation based on open-closed superstring field theory. Combining the large radius expansion and a double scaling limit, we find a perturbative background solution of open-closed superstring field theory that corresponds to the Klebanov-Strassler solution. To illustrate the utilities of this approach, we break supersymmetry of the background by placing a stack of anti-D3-branes at the tip of the throat. We then find a perturbative open string background solution to the third order in the large radius approximation, which agrees with the well-known supergravity analysis of Kachru-Pearson-Verlinde (KPV) on the stability of the anti- D3-brane supersymmetry breaking. The perturbative background solution to the open string field theory we found is expected to be dual to an NS5-brane probing the KS solution.

Presenter: KIM, Manki (CERN)

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

Black Holes in the Berkooz-Douglas Matrix Model

I will review the holographic duality enjoyed by the strongly-coupled limit of U(K) BFSS with N fundamental hypermultiplets, and compare it to that of plain BFSS and BMN. I will describe the construction of a broad class of black hole solutions, whose description in supergravity can be trusted at large K and N. By studying an index of the matrix model, I will recover precisely the Bekenstein-Hawking entropy of BPS black holes, as a degeneracy of BPS states in the matrix model.

Presenter: MOULAND, Rishi (DAMTP, University of Cambridge)

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

Modular Properties of the Low Energy Expansion

Modular forms arise in two rather distinct contexts in type II superstring scattering amplitudes. Firstly, the coefficients of terms in the low energy expansion of the integrand of the genus-one amplitude are integrals of non-holomorphic modular forms over the complex structure, τ, of the world-sheet torus. These are superpositions of modular graph forms (MGFs) which have been the subject of much recent mathematical interest.

The second context in which modular forms arise is in the elucidation of the low energy expansion of type IIB amplitudes, for which $SL(2,\mathbb{Z})$ is the S-duality group and τ is identified with the complex coupling constant. In this case, the coefficient functions, which get contributions from all genera as well as from instantons, are known as S-dual modular forms (SMF). This case has been understood in great detail from the holographic viewpoint where modular covariance is associated with Montonen–Olive duality of $\mathcal{N} = 4$ $SU(N)$ SUSY Yang–Mills.

In both cases the coefficients of the low energy expansion are linear combinations of 'Generalised Eisenstein Series' $\mathcal{E}(s, s_1, s_2)$ that satisfy inhomogeneous Laplace eigenvalue equations of the form
\begin{equation}
\left(\Delta_\tau - s(s-1)\right) \mathcal{E}(s, s_1, s_2) = E(s_1, \tau) E(s_2, \tau),
\end{equation}
where $E(s_i, \tau)$ is a non-holomorphic Eisenstein series. The eigenvalue s is an integer and for MGFs $s_1, s_2 \in \mathbb{N}^+$ while for SMFs $s_1, s_2 \in \mathbb{N}^+ + \frac{1}{2}$. This talk will describe a number of recent results concerning lattice solutions to these equations and their connections to string theory.

Presenter: GREEN, Michael (Departm.of Physics(QMW-Coll.))

Contribution ID: **23** Type: **not specified**

Black Holes in the Berkooz-Douglas Matrix Model

Tuesday 17 December 2024 11:45 (45 minutes)

I will review the holographic duality enjoyed by the strongly-coupled limit of U(K) BFSS with N fundamental hypermultiplets, and compare it to that of plain BFSS and BMN. I will describe the construction of a broad class of black hole solutions, whose description in supergravity can be trusted at large K and N. By studying an index of the matrix model, I will recover precisely the Bekenstein-Hawking entropy of BPS black holes, as a degeneracy of BPS states in the matrix model.

Presenter: MOULAND, Rishi (DAMTP, University of Cambridge)