String Theory Journal Club

General info

Journal clubs take place online on Tuesdays from 15:00 to 16:00.

Feel free to suggest papers in the comments section. Note that you can also add attachments and comment on other people's suggestions.

Important: You need to login to see and add comments.

Fall semester 2020

Journal club 03-11-2020

- Maxime Trepanier, King's College (TBA)

Journal club 27-10-2020

- Paul Ryan, Trinity College (TBA)

Journal club 20-10-2020

- Philine van Vliet, Information Paradox Part II: Entropy in gravitational systems

Journal club 13-10-2020

- Lorenzo Quintavalle, Information Paradox Part I: A Black Holes refresher

Spring semester 2020

Journal club 14-07-2020

- Alexander T. Kristensson (Niels Bohr Institute), "Thermodynamics of N=4 SYM at finite N"

  Abstract: The maximally Supersymmetric Yang Mills (SYM) theory is an SU(N) gauge theory that occurs many places in theoretical high-energy physics -- most notably in the famous AdS/CFT duality. On a compact space RxS^3, N=4 SYM theory exhibits a phase transition similar to the confinement/deconfinement phase transition of Quantum Chromo Dynamics (QCD). On the gravity side of the duality, this phase transition is believed to be dual to the Hawking-Page phase transition between a gas of gravitons and a black hole. In the last twenty years, there has been much progress in understanding the planar limit of the theory, where one takes N -> infinity. This progress has shown strong hints of the theory being integrable. The main focus of our research is to push this understanding beyond the planar limit to finite values of N. In this talk I will present our ongoing research on the thermodynamics of N=4 SYM at finite N. In particular, I will discuss various sub-sectors of the full algebra and show how to compute the exact partition functions for small values of N. In the su (2) sector, I will present the claim that the Hagedorn behaviour at N -> infinity is replaced by a phase transition of Lee-Yang type at finite N, characterized by a condensation of zeros in the complex fugacity plane.

Journal club 07-07-2020

- Matthias Volk (Niels Bohr Institute), "Geometry of Feynman Integrals in Twistor Space"

  Abstract: To compute scattering amplitudes in quantum field theory perturbatively, one has to evaluate integrals over loop momentum space known as Feynman integrals. In simpler cases (e.g. for low loop order) the integrals can often be expressed in terms of so-called multiple polylogarithms. However, explicit computations have shown that this fails for more complicated amplitudes and that new functions will be needed. One approach to a better understanding of these functions has been to analyze the geometry associated to a Feynman integral and interesting geometric objects such as elliptic curves, K3 surfaces and Calabi-Yau manifolds have been found. In this talk, we construct and analyze the geometry of a certain class of Feynman integrals known as traintracks that occur for example in N = 4 SYM or \phi^4 theory. In contrast to previous work, we describe the geometry directly in momentum twistor space. At two loops, we obtain an elliptic curve as the intersection of two quadrics. At three loops, we find a K3 surface as a branched surface over two elliptic curves in P^1 x P^1. Based on arXiv:2005.08771 together with C. Vergu.

Journal club 19-05-2020

- Junchen Rong, "Bootstrap and deconfined phase transition""

  Abstract: I will discuss how using conformal bootstrap to study the deconfined quantum
  critical point (DQCP), which describes the phase transition between anti-ferromagnetic Neel phase and the valence bond solid state phase. The continuum limit of the model is described by the three dimensional Abelian Higgs model.

Journal club 21-04-2020

- Niklas Henke, How tropical are seven-, eight- and nine-particle scattering amplitudes?

  Abstract,
  Using the symbol bootstrap, loop amplitudes of planar N=4 SYM theory can be obtained from their alphabet, the list of their singularities, whose letters coincide with the variables (rational functions) of certain cluster algebras. However, at eight and more particles these cluster algebras become infinite, whereas it is believed that the amplitudes only have finitely many distinct singularities. First discussing the application of cluster algebras to the seven-particle (N)MHV amplitude, I will show how the recently introduced mathematics of tropical geometry gives rise to a selection rule and present the thus obtained finite alphabets for eight and nine particles. Furthermore, I will discuss how infinite mutation sequences in cluster algebras also give rise to the algebraic singularities at eight particles.

Journal club 07-04-2020

- Fabrizio Neri: Physics and geometry of knots-quivers correspondence

Journal club 09-03-2020

- Matteo Parisi, Amplituhedra: Scattering Amplitudes from Geometry

  Abstract:

  The Amplituhedra A(n,k,m) are generalisations of polytopes introduced as a geometric construction encoding scattering amplitudes in planar N=4 supersymmetric Yang-Mills theory (SYM). These are extracted from a differential form, the canonical form of the Amplituhedron, which emerges from a purely geometric definition.

  Following my recent works, I will explain how the Jeffrey-Kirwan residue, a powerful concept in symplectic and algebraic geometry, computes the canonical form for whole families of objects, namely for Amplituhedra of type A(n,1,m), which are cyclic polytopes and for their conjugates A(n,n-m-1,m) for even m, which are not polytopes.

  This method connects to the rich combinatorial structure of triangulations of Amplituhedra, captured by what we refer to as ‘Secondary Geometry’. For polygons, this is the `Associahedron', explored by Stasheff in the sixties; for polytopes, it is the `secondary polytope' constructed by the Gelfand's school in the nineties. Whereas, for Amplituhedra, we are the first to initiate the studies of what we called the ‘Secondary Amplituhedra’. The latter encodes all representations of scattering amplitudes, many not obtainable with any physical method, together with their algebraic relations produced by global residue theorems.

  Finally, I will briefly illustrate some of the recent geometric directions in my work on the Amplituhedron in momentum space and new exciting developments connecting the (secondary geometry of) m=2 amplituhedron with the positive tropical Grassmannian. This object has been appearing in dozens of papers in the physics community in the last year, both in bootstrapping loop amplitudes in planar N=4 SYM and in computing (a generalisation of) biadjoint scalar amplitudes.

Journal club 03-03-2020

- Lorenzo Quintavalle, Celestial Sphere Amplitudes

  Abstract:
  Over the recent years there has been many developments in the study of four-dimensional Quantum Field Theories through a CFT description on the Celestial sphere. The aim of this Journal club is to review the basic ideas behind Celestial sphere amplitudes. We will start from the discussion of asymptotic symmetries in electrodynamics, to then describe soft theorems taking the case of Scalar QED as an example. We will see how this suggests a 2D CFT interpretation, and therefore introduce the concept of Celestial sphere amplitudes.

Journal club 25-02-2020 (TBA)

Journal club 18-02-2020

- Madalena Lemos (CERN), Surface defects in 4d superconformal theories and chiral algebras (This seminar will take place in **Building 3 Seminar room BAH 2**)

  Abstract:
  We study symmetry constraints on BPS surface defects in four-dimensional superconformal field theories, showing how supersymmetry imposes relations on anomaly coefficients. Turning to dynamics, we analyze a protected subsector of N=(2,2) surface defects that is captured by a two-dimensional chiral algebra. We discuss how to compute observables of interacting defects from the chiral algebra, including the aforementioned anomaly coefficients.

Journal club 11-02-2020 (Integrability school)

Journal club 04-02-2020

- Taro Kimura (Bourgogne U.), Yet another affinization of geometric Langlands correspondence

  Abstract:
  One of the implications of the geometric Langlands correspondence is the isomorphism between conformal blocks of W-algebra and affine Lie algebra. This correspondence has a natural q-deformation, providing a relation between q-deformation of W-algebra and quantum affine algebra. In this talk, I'll discuss yet another affinization of this correspondence between doubly affine W-algebra and quantum toroidal algebra, based on the formalism of quiver W-algebra. I'll also mention its possible physical interpretation in gauge theory with the surface defects.

Journal club 28-01-2020

- Federico Carta (DESY), Supersymmetry Enhancement

Journal club 21-01-2020

- Lorenzo Quintavalle (DESY), Celestial sphere amplitudes

Journal club 10-12-2019

- Fabrizio del Monte (SISSA), Class S theories and isomonodromic deformations on the torus.

  Abstract:

  In the last few years there have been many new results connecting (linear quiver) N=2 class S theories, and the topological strings that engineeer them, to the theory of isomonodromic deformations on the sphere and their q-deformations. These gauge theories are constructed by compactifying the 6d N=(0,2) SCFT on a punctured Riemann Sphere, whose moduli, which are the marginal deformations of the gauge theory, are the times of the isomonodromic flows. The aim of this talk is to show how this connection can be extended beyond the case of genus zero, for more general (asymptotically superconformal) class S theories. We will discuss in detail the case of circular quiver gauge theories, that are obtained from the N=(0,2) SCFT on punctured tori, and see how the genus one case displays new qualitative features that are absent on the sphere, due to the possibility of various inequivalent vector bundles, and how this actually provides new interesting relations satisfied by the gauge theory partition function.

Journal club 03-12-2019

- Jack Foster (Southampton University): Cluster Adjacency, Tropical Geometry, and Scattering Amplitudes

  Abstract: I will discuss two new areas of interest in scattering amplitudes: cluster adjacency and tropical geometry. The former describes how the analytic structure of planar amplitudes in N=4 Super Yang-Mills is controlled by mathematical objects called cluster algebras. The latter has been used to calculate amplitudes in the biadjoint phi^3 theory, which I will discuss briefly, but it also has implications for cluster adjacency.

Journal club 26-11-2019

- Francesco Galvano (Torino): Emitted radiation and geometry (This seminar will take place in **Building 3 Seminar room BAH 2**)

  Abstract: We discuss the computation of the radiated energy by an accelerated heavy particle. This quantity is captured by the one-point function of the stress energy tensor in presence of a Wilson line. In a N=2 superconformal theory we prove that this observable is exactly related to a small geometric deformation of the background geometry. In a four dimensional case, supersymmetric localization allows to express the emitted energy in terms of a matrix model on a squashed sphere.

Journal club 19-11-2019

- No seminar scheduled.

Journal club 12-11-2019

- Zhengwen Liu: Scattering Equations and Multi-Regge Kinematics

  Abstract**:** The scattering equations, a system of algebraic equations connecting the space of kinematic invariants and the moduli space of punctured Riemann spheres, provide a novel way to construct scattering amplitudes. In this framework, the tree-level S-matrix in many quantum field theories can be reformulated as a multiple integral that is entirely localized on the zeroes of the scattering equations. After presenting a very minimal introduction to the scattering equations, I will discuss the asymptotic behavior of the scattering equations in the so-called Multi-Regge kinematic regime and the corresponding factorizations of amplitudes in gauge theory and gravity.
  References**:**
  Multi-Regge kinematics and the scattering equations
  Gravitational Scattering in the High-Energy Limit

Journal club 05-11-2019

- Yuta Sekiguchi (U. Bern, AEC), O(d,d) transformations preserve classical integrability.

Abstract: We studied the classical integrability of O(d,d) transformations including not only O(d,d;Z) duality but also global O(d,d;R) deformation. The latter is known in the traditional literature to generate so-called current-current (JJbar) deformations of 2D CFTs. In this talk, I first plan to give brief reviews Yang-Baxter deformations of string backgrounds as well as the doubled sigma model. Then I will present how to construct the Lax pairs in the O(d,d) deformed WZNW models via O(d,d) map through very easy examples. The resulting Lax connections are in general non-local because they depend on the winding modes. Finally I will briefly comment on open questions under consideration in relation to the recent irrelevant integrable deformation. This talk is based on the recent work [1907.03759] with Domenico Orlando, Susanne Reffert and Kentaroh Yoshida.

Journal club 29-10-2019

- Till Bargheer: Exact Four-Point Functions: Genus Expansion and Strong Coupling (This seminar will take place in **Building 3 Seminar room BAH 2**)

  Using integrability, correlation functions of local operators in planar N=4 super Yang-Mills theory can be computed by reconstructing the dual worldsheet from a set of "hexagon" patches via "gluing" (performing complete state sums over mirror Bethe states). After reviewing this general procedure, I will explain how it can be used to compute a certain class of four-point correlators as an exact function of the coupling at any order in the 1/Nc genus expansion, and how the resulting series can be re-summed (via a suitable matrix model) to recover the full Nc dependence. If time permits, I will also comment on the strong-coupling limit of these correlators.

Journal club 22-10-2019

- Gleb Kotousov: "Reflection operators in integrable QFT".

Journal club 15-10-2019

- Sylvain Lacroix, Gauge Theory And Integrability, III (focusing on the second part about "disorder defects").

Summer 2019

Journal club 08-10-2019

- Alessandro Pini, Extremal Correlators and Random Matrix Theory.