50 + ε Years of Conformal Bootstrap

Report of Contributions

https://agenda.infn.it/e/38761

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

O(N) x O(2) model from 3D to 4D - the tale of disappearing fixed points

Monday, 19 February 2024 09:00 (1 hour)

O(N) x O(2) model furnishes an example of a system where unitary fixed points exist in a range of N above some N_c(d), where N_c(d) is a rapidly varying function. I will describe how N_c(d) can be found using the conformal bootstrap. Joint work with Marten Reehorst, Balt van Rees, and Benoit Sirois.

Presenter: RYCHKOV, Slava (IHES, Bures-sur-Yvette)

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

Gravity from quantum mechanics of finite matrices

Friday, 23 February 2024 12:00 (45 minutes)

In the first part I will briefly review the Banks-Fishcler-Shenker-Susskind (BFSS) and the Berenstein-Maldacena-Nastase (BMN) conjectures relating M-theory and Matrix Quantum Mechanics (MQM) of N × N matrices. In particular, I will differentiate between the weaker form (large N) and the stronger form (finite N) of the conjectures.

In the second part, I will focus on quantum mechanics. After explaining the techniques and subtleties of finding an effective description of a strongly coupled system, I will show that the BMN MQM at strong coupling and finite N describes non-relativistic free particles in a harmonic trap. The energy spectrum predicted by this Hamiltonian matches the supergravity excitation spectrum around the PP-wave background, if we further assume the existence of bound states.

Presenter: ZHAO, Xiang (EPFL)

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

Trace anomalies and the dilation-graviton amplitude

Wednesday, 21 February 2024 11:00 (45 minutes)

We consider 3+1 dimensional Quantum Field Theories (QFTs) coupled to the dilaton and the graviton. We show that the graviton-dilaton scattering amplitude receives a universal contribution which is helicity flipping and is proportional to (Δc − Δa) along any RG flow, where Δc and Δa are the differences of the UV and IR c- and a-trace anomalies respectively. This allows us to relate (Δc − Δa) to spinning massive states in the spectrum of the QFT. We test our predictions on a simple example of a massive free scalar. We discuss possible applications.

Presenter: KARATEEV, Denis (University of Geneva)

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

Improving the Five-Point Bootstrap

Tuesday, 20 February 2024 14:30 (1 hour)

I'll describe an improved approach to computing conformal blocks and applying the conformal bootstrap to 5-point correlation functions, giving new results for OPE coefficients involving multiple spinning operators in the 3d Ising CFT.

Presenter: POLAND, David (Yale University)

Contribution ID: **5** Type: **not specified**

Fuzzy Sphere regularization of 3D CFTs: A recent progress

Thursday, 22 February 2024 09:00 (1 hour)

I will talk our recent progress in applying fuzzy sphere regularization to study 3D CFTs. After a brief introduction of the basic idea of fuzzy sphere regularization, I will then focus on its advanced applications, particularly, how to extract non-local universal information of CFTs such as the RG monotonic F-function as well as various properties of conformal defect.

Presenter: HE, Yin-Chen (Perimeter Institute)

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

Twist-4 trajectories and missing local operators

Monday, 19 February 2024 11:00 (45 minutes)

In this talk, I will discuss the structure of spinning operators in CFTs. Specifically, there is a tension between the idea that all spinning operators belong to Regge trajectories with data analytic in spin, and the fact that the number of local operators below a given twist grows with spin. This means that Regge trajectories, suitably defined through light-ray operators, must decouple from all local correlation functions at the spins where local operators are missing, requiring infinitely many conditions for a single trajectory. I will explain how to resolve this tension by demonstrating that the vanishing conditions in all correlators follow from a single condition related to the normalisation of the light-ray operator. This will be illustrated by considering the Wilson-Fisher fixed point, where we can explicitly construct the light-ray operators of twist-4 trajectories at complex spin, and directly observe the vanishing conditions at low integer spin.

Presenter: HENRIKSSON, Johan (IPhT, Saclay)

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

AdS three-body problem at large spin

Friday, 23 February 2024 11:00 (45 minutes)

Motivated by the problem of understanding multi-twist operators in general CFTs, I will discuss the large-spin leading-twist three-particle states in AdS. In particular, I will explain that thanks to the AdS curvature this particular limit of the three-body problem is tractable. The large spin limit effectively becomes a semiclassical limit of a Berezin-Toeplitz Hamiltonian, which allows us to analyze the leading-twist spectrum analytically. Work in progress with Jeremy Mann.

Presenter: MANN, Jeremy (King's College London)

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

Bootstrapping Boundary QED

Thursday, 22 February 2024 14:30 (1 hour)

There is a graphene-like boundary conformal field theory which consists of charged conformal degrees of freedom confined to a surface interacting with a photon in the bulk. A long introduction will develop several features of this theory: its relation to graphene and three dimensional QED; ways to introduce supersymmetry; its behavior under the action of SL(2,Z). Then I will talk about recent work describing our efforts to subject this theory to the numerical conformal bootstrap.

Presenter: HERZOG, Christopher (King's College London)

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

Gradient Properties of RG Flows

Monday, 19 February 2024 16:30 (1 hour)

Presenter: STERGIOU, Andreas (King's College London)

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

Taming Mass Gap with Anti-de Sitter Space

Monday, 19 February 2024 12:00 (45 minutes)

Anti-de-Sitter space acts as an infra-red cutoff for asymptotically free theories, allowing interpolation between a weakly-coupled small-sized regime and a strongly-coupled flat-space regime. I will discuss this interpolation for theories in two dimensions from the perspective of boundary conformal theories. The appearance of a singlet marginal operator destabilizes a gapless phase existing at a small size, triggering a boundary renormalization group flow to a gapped phase that smoothly connects to flat space.

Presenter: DI PIETRO, Lorenzo (University of Trieste)

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

Bootstrap and experiments in condensed matter and particle physics

Monday, 19 February 2024 14:30 (1 hour)

The bootstrap method explores fundamental consistency conditions to constrain physical observations. These consistency conditions often translate into highly non-trivial numerical problems. The application of the bootstrap method in physics crucially depends on advancements in numerical techniques. In this talk, I will review recent developments in bootstrap numerics, and show that, with advanced numerics, formal constraints such as unitarity and crossing symmetries lead to precise predictions for experimental phenomena in condensed matter and high energy physics.

Presenter: SU, Ning (Caltech)

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

Revisiting Lattice and Matrix Bootstrap

Tuesday, 20 February 2024 11:00 (45 minutes)

This presentation focuses on the lattice and matrix bootstrap methods, distinguished by their utilization of the equation of motion as bootstrap constraints. These methods share key characteristics with the closely related fields of quantum mechanics bootstrap and many-body bootstrap. I will discuss the latest results in bootstrap finite N lattice gauge theory, including the calculation of string tension through the bootstrap approach. Additionally, the presentation will cover the application of the relaxation method to the bootstrap of matrix quantum mechanics (MQM), with a particular emphasis on the ground state of MQM.

Presenter: ZHENG, Zechuan (Perimeter Institute)

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

Bootstrapping Mesons at large N

Wednesday, 21 February 2024 09:00 (1 hour)

I will review recent progress in constraining the meson sector of large N QCD from a modern bootstrap perspective

Presenter: RASTELLI, Leonardo (Stony Brook University)

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

Bounds on QCD observables: hadronic strings, glueball scattering, and meson spectrum

Wednesday, 21 February 2024 14:30 (1 hour)

The numerical S-matrix Bootstrap establishes non-perturbative universal bounds on physical observables extracted from scattering amplitudes in any dimension.
Often, from a bound, it is possible to extract the extremal amplitudes and learn valuable lessons on non-perturbative physics.
In this talk, I will review some of the most recent applications of Bootstrap to QCD observables.
First, I will discuss the bounds on the quark-antiquark potential in 3d and 4d, and show how the QCD world-sheet axion emerges from the extremal amplitudes.
Next, I will focus on the bounds of coupling constants among SU(3) glueballs that rely only on rigorous properties of QFTs in four dimensions.
Finally, I will briefly show some preliminary results obtained by injecting the experimentally available data on \pi\pi scattering.
The goal is to start a precision physics program for hadronic physics based on bootstrap methods.

Presenter: GUERRIERI, Andrea (Perimeter Institute and University of Padova)

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

Bootstrapping gauge theories

Thursday, 22 February 2024 11:00 (45 minutes)

We propose the Gauge Theory Bootstrap, a method to compute the pion S-matrix that describes the low energy physics of the strong interaction and other similar gauge theories. The phase shifts of the S0, P1, S2 waves obtained are in good agreement with experimental results. The only numerical inputs are the quark mass m_q, the QCD scale Lambda_QCD, the pion mass m_\pi and the pion decay constant f_\pi without any other experimental data. We make use of the form-factor bootstrap recently proposed by Karateev, Kuhn and Penedones together with a finite energy version of the SVZ sum rules.

Presenter: HE, Yifei (École normale supérieure)

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

Advanced Non-Perturbative Techniques in N=4 SYM Theory

Thursday, 22 February 2024 16:30 (1 hour)

I will report on recent advances in Bootstrability – a method merging Integrability and Conformal Bootstrap to extract CFT data in integrable conformal gauge theories such as N=4 SYM. We will discuss the method in applications to the 1D defect CFT. Integrability not only produces a spectrum in this theory but also provides information in the form of integrated correlators. Combining this information we obtain very sharp rigorous numerical bounds for the structure constant of the first non-protected states, giving this observable with seven digits precision for the ‘t Hooft coupling in the intermediate coupling region $\lambda/\sqrt{4\pi}\sim 1$, with the error decreasing quickly at large ‘t Hooft coupling.

We also studied the problem of bounding directly a 4-point function at generic cross ratio. Our numerical bounds give an accurate determination of the 4-point function for physical values of the cross ratio.

Presenter: GROMOV, Nikolay (King’s College London)

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

T\bar T and J\bar T - deformed CFTs: symmetries, correlators and generalisations

Tuesday, 20 February 2024 09:00 (1 hour)

Presenter: GUICA, Monica (CERN)

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

Advancing the Multipoint Bootstrap

Tuesday, 20 February 2024 16:30 (1 hour)

Multipoint correlation functions of scalar operators provide access to new CFT data that is invisible to scalar 4-point functions. Most importantly, they may be exploited to probe multitwist operators. In this talk I shall survey some recent advances in both the numerical and lightcone bootstrap for 6-point correlators, based on joint work with A. Antunes, S. Harris, A. Kaviraj, J. Mann, L. Quintavalle.

Presenter: SCHOMERUS, Volker (DESY)

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

Bootstrapping N = 4 SYM for all N and coupling

Wednesday, 21 February 2024 12:00 (45 minutes)

We combine supersymmetric localization with the numerical conformal bootstrap to bound the scaling dimension and OPE coefficient of the lowest-dimension operator in N = 4 SU(N) super-Yang-Mills theory for a wide range of N and Yang-Mills couplings g. We find that our bounds are approximately saturated by weak coupling results at small g. Furthermore, at large N our bounds interpolate between integrability results for the Konishi operator at small g and strong-coupling results, including the first few stringy corrections, for the lowest-dimension double-trace operator at large g. In particular, our scaling dimension bounds describe the level splitting between the single- and double-trace operators at intermediate coupling.

Presenter: CHESTER, Shai (Imperial College London)

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

Multi-trace operators in CFTs

Friday, 23 February 2024 09:00 (1 hour)

In this talk I will discuss how to deal with multi-trace operators, in particular in the context of N=4 Super Yang Mills. I will review their relevance in computing holographic correlators and discuss recent developments on how to treat them.

Presenter: BISSI, Agnese (ICTP Trieste)

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

Numerical bootstrap for points and lines

Thursday, 22 February 2024 12:00 (45 minutes)

I will describe how to constrain the spectrum of local operators and boundary conditions, in two dimensions, using the numerical bootstrap. Crossing and unitarity constrain the correlators of four local operators, two local operators and a boundary, and two boundaries. This allows to explore a multi-dimensional parameter space involving bulk and boundary data: I will show a few examples of the bounds one can obtain.

Presenter: MEINERI, Marco (University of Torino)

Contribution ID: **24** Type: **not specified**

Finding fixed points in the epsilon expansion

Tuesday, 20 February 2024 12:00 (45 minutes)

Presenter: OSBORN, Hugh (Cambridge University)

Contribution ID: **25** Type: **not specified**

A new twist on spin

Wednesday, 21 February 2024 16:30 (1 hour)

I will describe new kinematic variables to describe correlation functions of conserved currents in CFTs. In these variables there is a tantalizing connection to scattering amplitudes in flat space. Work in progress with Daniel Baumann, Gregoire Mathys and Facundo Rost.

Presenter: PIMENTEL, Guilherme (Scuola Normale Superiore)

Contribution ID: **26** Type: **not specified**

Positivty bounds on massive vectors

Wednesday, 21 February 2024 17:30 (30 minutes)

Presenter: BERTUCCI, Francesco (University of Pisa)

Contribution ID: **27** Type: **not specified**

Thermal one-point blocks

Monday, 19 February 2024 17:30 (30 minutes)

We compute one-point blocks in thermal Conformal Field Theories on S^1 \times S^{d-1}. Specifically, we derive the Casimir for spinning representations and solve it with an ansatz. Potential applications to (holographic) correlators will also be discussed.

Presenter: RUSSO, Francesco (University of Pisa)