## New connections: chaos, field theory and quantum gravity



# **Report of Contributions**

Type: not specified

## Symmetries of TTbar-deformed CFTs and their holographic avatars

Tuesday 17 January 2023 09:00 (1 hour)

I will discuss the classical and quantum symmetries of TTbar-deformed CFTs. These symmetries are infinite in number and, in a certain basis, organise into a Virasoro x Virasoro algebra with the same central charge as that of the undeformed CFT. I will present a quantum, abstract proof of the existence of these symmetries and three different - and fully explicit - classical perspectives: Hamiltonian, Lagrangian and holographic. Finally, I will show that the asymptotic symmetries of the three-dimensional asymptotically linear dilaton background in string theory, which is conjecturally dual to the "single-trace" TTbar deformation, take an identical form to those of TTbar-deformed CFTs, thus further strengthening this proposed connection.

Presenter: GUICA, Monica (Paris Saclay)

Type: not specified

#### Localizing information in quantum gravity

Tuesday 17 January 2023 10:15 (1 hour)

Locality is a powerful property of quantum field theory and implies that information can be strictly localized in regions of space, and is completely inaccessible from far away. On the other hand, the holographic nature of quantum gravity suggests that the theory is ultimately non-local and that information can never be localized deep inside some spacetime region, but rather is always accessible from the boundary. This is meant to hold as a non-perturbative statement and it remains to be understood whether quantum information can be localized within G\_N perturbation theory. In this talk, I will address this problem from the point of view of the AdS/CFT correspondence. I will construct candidate local operators that can be used to localize information deep inside the bulk. They have the following two properties: they act just like standard HKLL operators to leading order at large N, but commute with the CFT Hamiltonian to all orders in 1/N. These operators can only be constructed in a particular class of states which have a large energy variance, for example coherent states corresponding to semi-classical geometries. The interpretation of these operators is that they are dressed with respect to a feature of the state, rather than to the boundary. The construction only works for sufficiently complicated states with large energ

Presenter: BELIN, Alexandre

Type: not specified

#### Subalgebra-subregion duality: emergence of space and time in holography

Tuesday 17 January 2023 16:45 (1 hour)

n holographic duality, a higher dimensional quantum gravity system emerges from a lower dimensional conformal field theory (CFT) with a large number of degrees of freedom. We propose a formulation of duality for a general causally complete bulk spacetime region, called subalgebrasubregion duality, which provides a framework to describe how geometric notions in the gravity system, such as spacetime subregions, different notions of times, and causal structure, emerge from the dual CFT.

Subalgebra-subregion duality generalizes and brings new insights into subregion-subregion duality (or equivalently entanglement wedge reconstruction). It provides a mathematically precise definition of subregion-subregion duality and gives an independent definition of entanglement wedges without using entropy. Geometric properties of entanglement wedges, including those that play a crucial role in interpreting the bulk as a quantum error correcting code, can be understood from the duality as the geometrization of the additivity anomaly of certain algebras.

Using general boundary subalgebras rather than those associated with geometric subregions makes it possible to find duals for general bulk spacetime regions, including those not touching the boundary. Applying subalgebra-subregion duality to a boundary state describing a single-sided black hole also provides a precise way to define

mirror operators.

Presenter: LIU, Hong (MIT)

Partition function for a volume of  $\cdots$ 

Contribution ID: 4

Type: not specified

### Partition function for a volume of space

Tuesday 17 January 2023 18:00 (1 hour)

We consider the quantum gravity partition function that counts the dimension of the Hilbert space of a spatial region with topology of a ball and fixed proper volume, and evaluate it in the leading order saddle point approximation. The result is the exponential of the Bekenstein-Hawking entropy associated with the area of the saddle ball boundary. This generalizes the classic Gibbons-Hawking computation which corresponds to the special case when the fixed volume is that of the static patch of de Sitter spacetime, and exhibits the holographic nature of nonperturbative quantum gravity in finite volumes of space.

Presenter: VISSER, Manus (DAMTP Cambridge)

Type: not specified

## Thermal correlators in AdS/CFT, ANECs and the Bootstrap

Wednesday 18 January 2023 09:00 (1 hour)

The emergence of dynamical spacetime in the bulk in AdS/CFT, from metric fluctuations to black hole solutions, is an interesting challenge for the conformal bootstrap program. How are properties of the horizon and the singularity encoded in the CFT data? A set of minimal observables which plays an important role in this context are stress tensor correlators at finite temperature. I will discuss, from the bulk, how to calculate the thermal stress tensor two-point function and its decomposition in CFT data for multi-trace stress tensor operators. In the lightcone limit, the correlators are dominated by the ANEC and its higher spin generalizations. We further consider GB gravity in order to vary the stress tensor OPE coefficients and argue that when the ANEC is saturated, all the higher spin ANECs also are saturated. Moreover, the obtained data is consistent with ANEC interference effects. We end by discussing future directions such as universal features in the lightcone limit and how to probe deeper into the bulk using the bootstrap.

Presenter: KARLSSON, Robin (CERN)

New connectio  $\ \cdots \ /$  Report of Contributions

talk 10

Contribution ID: 6

Type: not specified

#### talk 10

Wednesday 18 January 2023 10:15 (1 hour)

Presenter: VERLINDE, Herman (Princeton University)

New connectio ··· / Report of Contributions

Black hole interiors and the emer ...

Contribution ID: 7

Type: not specified

## Black hole interiors and the emergence of time

**Presenter:** LAMPROU, Lampros (UBC)

Type: not specified

#### Entropy functions for supersymmetric AdS Black Holes

We consider supersymmetric  $AdS_3 \times Y_7$  solutions of type IIB and

 $AdS_2 \times Y_9$  solutions of D = 11 supergravity. These can arise as the

near horizon limit of black strings in  $AdS_5$  and and black holes in  $AdS_4$  spacetimes, respectively. We explain how novel extremisation techniques enable one to compute physical observables without explicitly solving Einstein equations. This allows one to identify infinite new classes of AdS\_3/d=2 SCFT pairs, as well obtain a microstate counting interpretation for infinite classes of supersymmetric black holes in AdS\_4.

A sub-class of examples correspond to branes wrapping certain two-dimensional orbifolds known as spindles and this

has opened up a new direction in AdS/CFT with novel connections to accelerating black holes.

Presenter: GAUNTLETT, Jerome (Imperial College)

New connectio  $\ \cdots \ /$  Report of Contributions

TBA

Contribution ID: 9

Type: not specified

#### TBA

Thursday 19 January 2023 16:45 (1 hour)

**Presenter:** MEINERI, Marco (Universite de Geneve (CH))

Narain-averaging the tensionless ····

Contribution ID: 10

Type: not specified

### Narain-averaging the tensionless string

Thursday 19 January 2023 18:00 (1 hour)

I will describe work in progress w/ B.Knighton, A.Kanargias, M. Usatyuk on finding a stringy embedding of ensemble-averaging. Specifically we consider the recent duality between Narain T<sup>c</sup> CFTs averaged over moduli space and exotic AdS\_3 U(1)<sup>c</sup> x U(1)<sup>c</sup> gravity. We generalise this by performing the average over the symmetric product orbifold of T<sup>c</sup> where the bulk dual now must include a discrete gauge group.

By considering the case c=4 and the addition of susy we make contact to the duality of the tensionless string on AdS\_3 x S^3 x T^4 and the symmetric orbifold orbifold of T^4.

Presenter: KAMES-KING, Joshua (EPFL)

New connectio ··· / Report of Contributions

New connections in celestial holo  $\,\cdots\,$ 

Contribution ID: 11

Type: not specified

## New connections in celestial holography

Friday 20 January 2023 09:00 (1 hour)

**Presenter:** PUHM, Andrea (Polytechnique)

New connectio ··· / Report of Contributions

Non-perturbative S-matrices from  $\cdots$ 

Contribution ID: 12

Type: not specified

## Non-perturbative S-matrices from dispersive iterations

Friday 20 January 2023 10:15 (1 hour)

Presenter: TOURKINE, Piotr (CNRS, LAPTh, Annecy)

New connectio  $\ \cdots \ /$  Report of Contributions

talk 17

Contribution ID: 13

Type: not specified

## talk 17

**Presenter:** MEINERI, Marco (Universite de Geneve (CH))

Black Holes in the Dual of Quant ...

Contribution ID: 14

Type: not specified

#### **Black Holes in the Dual of Quantum Mechanics**

Friday 20 January 2023 11:30 (1 hour)

I will motivate and study a holographic duality between on one hand a theory of superconformal quantum mechanics, and on the other, M-theory on a particular background. I will exhibit a broad class of black hole solutions, whose entropy must be captured by a degeneracy of states in the quantum mechanics. Through an asymptotic study of the superconformal index in the supergravity regime, I will provide such a microstate counting for those black holes that are supersymmetric. I will finally speculate on the role of dualities of this form in understanding the basic building blocks of holography for higher-dimensional CFTs

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

Type: not specified

#### Thermalization and Chaos in 1+1d QFTs

Monday 16 January 2023 09:00 (1 hour)

Nonintegrable QFTs are expected to thermalize and exhibit emergence of hydrodynamics and chaos. In weakly coupled QFTs, kinetic theory captures local thermalization; such a versatile tool is absent away from the perturbative regime. I will present analytical and numerical results using nonperturbative methods to study thermalization at strong coupling. I will show how requiring causality in the thermal state leads to strong analytic constraints on the thermodynamics and out-of-equilibrium properties of any relativistic 1+1d QFT. I will then discuss Lightcone Conformal Truncation (LCT) as a powerful numerical tool to study thermalization of QFTs. Applied to \phi^4 theory in 1+1d, LCT reveals eigenstate thermalization and onset of random matrix universality at any nonzero coupling. Finally, I will discuss prospects for observing the emergence of hydrodynamics in QFTs using Hamiltonian truncation.

Presenter: DELACRÉTAZ, Luca (UNIGE)

How to Compute Nonperturbativ ...

Contribution ID: 16

Type: not specified

#### How to Compute Nonperturbative Scattering Amplitudes

Monday 16 January 2023 10:15 (1 hour)

I will present a nonperturbative recipe for directly computing the S-matrix in strongly-coupled QFTs. The method makes use of spectral data obtained in a Hamiltonian framework and can be applied to a wide range of theories, including potentially QCD. After discussing the general approach, I will demonstrate its application to the specific example of the 2+1d O(N) model at large N, using energy eigenstates computed with Hamiltonian truncation to reproduce the full 2-to-2 scattering amplitude for arbitrary (complex) center-of-mass energy. I will also discuss many avenues for future applications and generalizations

Presenter: WALTERS, Matthew Thomas (Universite de Geneve (CH))

semiclassical gravity = statistical ····

Contribution ID: 17

Type: not specified

## semiclassical gravity = statistical physics

Monday 16 January 2023 16:45 (1 hour)

Presenter: DE BOER, Jan (University of Amsterdam)

Complexity Coarse-Graining in B  $\,\cdots\,$ 

Contribution ID: 18

Type: not specified

### **Complexity Coarse-Graining in Black Hole** Information

Monday 16 January 2023 18:00 (1 hour)

Presenter: ENGELHARDT, Netta (MIT)

New connectio  $\ \cdots \ /$  Report of Contributions

Dinner at Sources

Contribution ID: 19

Type: not specified

## **Dinner at Sources**

Sunday 15 January 2023 19:30 (1h 30m)

New connectio  $\cdots$  / Report of Contributions

Black hole interiors and the emer ...

Contribution ID: 20

Type: not specified

## Black hole interiors and the emergence of time

Wednesday 18 January 2023 16:45 (1 hour)

Presenter: LAMPROU, Lampros (UBC)

Entropy functions for supersym ...

Contribution ID: 21

Type: not specified

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