Statistical mechanics, Algebra, and Geometry

Report of Contributions

https://indico.global/e/9634

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

Symmetric Orbfiolds, thermal universality and stringy von Neumann algebras

Monday 3 February 2025 10:15 (1 hour)

Symmetric orbifolds are 2d CFTs with universal properties in the large N limit, mimicking many desired properties of holographic CFTs. In particular, the thermal partition function is universal and agrees with that of 3D gravity. I will present some new results for the universality of symmetric orbifolds: the thermal correlation functions at large N agree with those on the BTZ background. Along the way, I will also discuss other results for correlation functions in heavy states which, even though they never dominate the canonical ensemble, still display universality. I will then interpret these results in terms of von Neumann algebras, in a context where the bulk dual is known to be a tensionless string in AdS_3.

Presenter: BELIN, Alexandre (Universita & INFN, Milano-Bicocca (IT))

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

TBA

Monday 3 February 2025 16:00 (1 hour)

Presenter: DE BOER, Jan (Nikhef National institute for subatomic physics (NL))

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

A microscopic model of de Sitter spacetime with an observer

Monday 3 February 2025 17:15 (1 hour)

I describe a simple microscopic quantum mechanical model of low-dimensional de Sitter holography with an observer. Using semiclassical gravity and elementary thermodynamic considerations, I'll derive a formula for the total entropy of a 3D de Sitter universe with an observer. I then show that this entropy formula exactly matches the known spectral density of the double scaled SYK model.

Presenter: VERLINDE, Herman (Princeton University)

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

discussion

Monday 3 February 2025 20:30 (1 hour)

Presenter: PARTICIPANTS

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

Gravitational Boundary Modes in Finite Volume

Tuesday 4 February 2025 09:00 (1 hour)

n order to understand the structure of the Hilbert space of gravitational theories, we study one of its universal sectors: the "large gauge"modes, which live on (asymptotic) boundaries. For low-dimensional AdS gravity, we can move them away from the conformal boundary and find that the resulting theory is related to the $T\bar{T}$ deformation. I will discuss how this "beyond-Wilsonian" theory organizes itself, using its symmetries as a guide to examine how local it is and where it starts to differ from the classical expectation.

Presenter: MONTEN, Ruben (CERN)

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

Chaos, Eigenstate Thermalization, and 3D Gravity

Tuesday 4 February 2025 10:15 (1 hour)

In recent years, it has become clear that the path integral of semiclassical 3D gravity offers a "coarse-grained" description of its holographic 2D CFT. This relationship is particularly transparent when considering the statistical moments of operator product expansion (OPE) coefficients in the CFT. In this talk, I will explore the statistical properties of OPE coefficients through the perspective of quantum chaos. I will introduce an ensemble of OPE data defined as the minimal solution to crossing consistent with approximate unitary invariance. Notably, this ensemble is constructed without relying on any specific matrix or tensor model. The ensemble predicts new contributions to the sum over topologies in 3D gravity, which are precisely realised by novel topologies in the bulk.

Presenter: LISKA, Diego (Universite de Geneve (CH))

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

Krylov complexity and the bulk Hilbert space of DSSYK

Tuesday 4 February 2025 16:00 (1 hour)

Within the framework of the AdS/CFT correspondence, the time dynamics of black holes in the bulk hints to the existence of boundary observables that evolve for very long time-scales. It was conjectured that quantum complexity has the correct features to be a candidate boundary observable. However, none of the proposed notions of quantum complexity yielded a precise bulk-boundary correspondence until recently. In this talk we will provide such a precise match by focusing on a particular notion of quantum complexity, known as Krylov complexity. We will begin with an overview of this boundary observable and of its properties for chaotic and integrable quantum systems. We will then focus on double-scaled SYK (DSSYK) and show how the so-called chord basis fits naturally within the Krylov construction. We will show that in the limit where DSSYK is dual to JT gravity, Krylov complexity of the infinite-temperature thermofield double state evolving in time on the boundary has a precise gravitational description in the bulk —making it the first microscopic instance of complexity to have a precise geometric description. Finally, we will discuss Krylov complexity for the time evolution of an operator in DSSYK. We will show that also in this case, in the limit associated with gravity, Krylov complexity has a well-defined geometric interpretation in the bulk.

Presenter: SHIR, Ruth

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

poster session

Tuesday 4 February 2025 17:15 (1 hour)

Presenter: PARTICIPANTS

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

discussion

Tuesday 4 February 2025 20:30 (1 hour)

Presenter: PARTICIPANTS

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

Bra-Ket Wormholes

Wednesday 5 February 2025 09:00 (1 hour)

Based on 2408.08351 and some work in progress. We study a model for the initial state of the universe based on a gravitational path integral that includes connected geometries which simultaneously produce bra and ket of the wave function. We argue that a natural object to describe this state is the Wigner distribution, which is a function on a classical phase space obtained by a certain integral transform of the density matrix. We work with Lorentzian de Sitter Jackiw-Teitelboim gravity in which we find semiclassical saddle-points for pure gravity, as well as when we include matter components such as a CFT and a classical inflaton field. We also discuss different choices of fixing time reparametrizations. In the regime of large universes our connected geometry dominates over the Hartle-Hawking saddle and gives a distribution that has a meaningful probabilistic interpretation for local observables. It does not, however, give a normalizable probability measure on the entire phase space of the theory.

Presenter: KAMES KING, Joshua

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

Spinning up the black hole –string correspondence

Wednesday 5 February 2025 10:15 (1 hour)

The correspondence principle between strings and black holes is a general framework for matching black holes and massive states of fundamental strings at a point where their physical properties (such as mass, entropy and temperature) smoothly agree with each other. As such it offers a statistical interpretation of black hole entropy. I will discuss the extension of this correspondence principle to rotating black holes and strings. Several puzzles arise when attempting to include rotation, but they can be resolved by adding novel ingredients to the correspondence: dynamical features, non-stationary configurations and shapes of strings and black holes. As a test of this proposal I will compare the sizes of rotating strings and black holes for small, typical, and large values of the angular momentum.

Presenter: PUHM, Andrea

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

discussion

Wednesday 5 February 2025 20:30 (1 hour)

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

Stringy Causal Structure from Algebras”

Thursday 6 February 2025 09:00 (1 hour)

We will discuss the emergence of Stringy spacetime from the chaos in modular flow of future algebras.
We will discuss the modular ergodic hierarchy, and prove a sufficient condition for the emergence of Stringy AdS_2 from modular intersections.

Presenter: LASHKARI, Nima

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

An intrinsic cosmological observer

Thursday 6 February 2025 10:15 (1 hour)

There has been much recent interest in the necessity to include an observer degree of freedom in the description of local algebras in semiclassical gravity. In this talk, I will describe an example where the observer can be constructed intrinsically from the quantum fields. This construction involves the slow-roll inflation example recently analyzed by Chen and Penington, in which the gauge-invariant gravitational algebra arises from averaging over modular flow in a local patch. I will relate this procedure to the Connes-Takesaki theory of the flow of weights for type III von Neumann algebras, and further show that the resulting gravitational algebra can naturally be presented as a crossed product. This leads to a decomposition of the gravitational algebra into quantum field and observer degrees of freedom, with different choice of observer being related to changes in frame for the algebra. I will also connect this example to other constructions of type II algebras in semiclassical gravity, and argue they all share the common feature of being the result of gauging modular flow.

Presenter: SPERANZA, Antony (University of Illinois, Urbana-Champaign)

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

TBA

Thursday 6 February 2025 16:00 (1 hour)

Presenter: JAFFERIS, Daniel

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

Strings from Feynman Diagrams

Thursday 6 February 2025 17:15 (1 hour)

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 (ETH Zürich)

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

discussion

Thursday 6 February 2025 20:30 (1 hour)

Presenter: PARTICIPANTS

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

Thermal Bootstrap of Matrix Quantum Mechanics

Friday 7 February 2025 09:00 (1 hour)

I will explain the implementation of a bootstrap method that combines Schwinger-Dyson equations, thermal inequalities, and semidefinite relaxations of matrix logarithm in the ungauged one-matrix quantum mechanics, at finite rank N as well as in the large N limit, to determine finite temperature observables. I will show plots of these observables (determined using the bootstrap) that interpolate between available analytic results in the low and high temperature limits respectively as well as bounds on thermal phase transitions. Finally, I will show preliminary results in the ungauged two-matrix quantum mechanics.

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

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

Operator product expansion, geodesics and black hole singularities

Friday 7 February 2025 10:15 (1 hour)

We observe features of black hole singularities in finite temperature holographic correlators of generic scalar operators.
We also elucidate the relation between geodesics in the AdS-Schwarzschild background and the Operator Product Expansion in the boundary CFT.

Presenter: PARNACHEV, Andrei