

Island Hopping 2020: from Wormholes to Averages

Report of Contributions

Contribution ID: 1

Type: **not specified**

Causal symmetry breaking: the EFT description of quantum chaos

Monday 16 November 2020 16:00 (1 hour)

Abstract:

Quantum chaotic systems are often defined via the assertion that their spectral statistics coincides with, or is well approximated by, random matrix theory. In this talk I will explain how the universal content of random matrix theory emerges as the consequence of a simple symmetry-breaking principle and its associated Goldstone modes. This approach gives a natural way to identify wormhole-like correlations, even for individual theories.

I will also discuss how to extend the Goldstone effective-field-theory approach to study operator correlation functions, and present some thoughts on how to understand causal symmetry breaking in holographic bulk gravity.

Presenter: SONNER, Julian

Contribution ID: 2

Type: **not specified**

The time to the black hole singularity from thermal one point functions

Monday 16 November 2020 17:00 (1 hour)

Presenter: MALDACENA, Juan

Contribution ID: 3

Type: **not specified**

Informal interactions/Virtual hanging

Monday 16 November 2020 18:00 (2 hours)

Contribution ID: 4

Type: **not specified**

Global symmetry, Euclidean gravity, and the black hole information problem

Monday 16 November 2020 20:00 (1 hour)

Presenter: HARLOW, Daniel

Contribution ID: 5

Type: **not specified**

Discussion Session: To average or not to average

Monday 16 November 2020 21:00 (1 hour)

Presenters: STANFORD, Douglas; BOUSSO, Raphael; GIDDINGS, Steve

Contribution ID: 6

Type: **not specified**

Collision in the interior of wormhole

Tuesday 17 November 2020 16:00 (1 hour)

Abstract:

The Schwarzschild wormhole has been interpreted as an entangled state. If Alice and Bob fall into each of the black hole, they can meet in the interior. We interpret this meeting in terms of the quantum circuit that prepares the entangled state. Alice and Bob create growing perturbations in the circuit, and we argue that the overlap of these perturbations represents their meeting. We compare the gravity picture with circuit analysis, and identify the post-collision region as the region storing the gates that are not affected by any of the perturbations.

Presenter: ZHAO, Ying

Contribution ID: 7

Type: **not specified**

Islands beyond AdS

Tuesday 17 November 2020 17:00 (1 hour)

Abstract:

I will discuss the appearance of islands and replica wormholes in flat and cosmological spacetimes. I will also discuss general consistency conditions that guide the search for such nontrivial saddles in the gravitational path integral.

Presenter: SHAGHOULIAN, Edgar

Contribution ID: **8**

Type: **not specified**

Informal interactions/Virtual hanging

Tuesday 17 November 2020 18:00 (2 hours)

Contribution ID: 9

Type: **not specified**

Observations of Hawking radiation: the Page curve and baby universes

*Tuesday 17 November 2020 20:00 (1 hour)***Abstract:**

It has long been argued that black holes can be modeled as unitary quantum systems with density of states given by the Bekenstein-Hawking formula. It now seems that this idea is realised within semiclassical gravity, without using details of the UV completion or assuming duality. I will describe this in an asymptotically flat setting using Lorentz-signature gravitational path integrals, concentrating on the predictions for observables. However, for this semiclassical picture to be coherent, we are forced to conclude that there are superselection sectors for asymptotic observers. These sectors are associated with the states of baby universes, which appear when we consider the Hilbert space interpretation of replica wormholes.

Presenter: MAXFIELD, Henry

Contribution ID: **10**

Type: **not specified**

Perturbative and Non-Perturbative Insights into Deformed JT Gravity using Random Matrix Ensembles.

Tuesday 17 November 2020 21:00 (1 hour)

Presenter: JOHNSON, Clifford

Contribution ID: 11

Type: **not specified**

A general approximation scheme for addressing the black hole information paradox

Wednesday 18 November 2020 16:00 (1 hour)

Abstract:

We develop a general approximation scheme for calculating quantum informational properties of a pure state that has equilibrated in a non-integrable quantum many-body system. For gravity systems, such as those involving black holes, this approximation gives a prescription for calculating entanglement entropies using Euclidean path integrals which is manifestly consistent with unitarity. Applied to recent models of evaporating black holes and eternal black holes coupled to baths, it provides a derivation of replica wormholes, and elucidates their mathematical and physical origins. In particular, it shows that replica wormholes can arise in a system with a fixed Hamiltonian, without the need for ensemble averages.

Presenter: LIU, Hong

Contribution ID: 12

Type: **not specified**

To average or not to average

Wednesday 18 November 2020 17:00 (1 hour)

Abstract:

In this talk I will describe a possible interpretation of genus two wormholes in AdS3 in terms of a suitable averaging procedure in the dual field theory, and connect this to random properties of OPE coefficients. I will discuss possible lessons from this for the question whether or not gravity is intrinsically an averaged theory. Mostly based on arXiv:2006.05499 with Alex Belin.

Presenter: DE BOER, Jan

Contribution ID: 13

Type: **not specified**

Informal interactions/Virtual hanging

Wednesday 18 November 2020 18:00 (2 hours)

Contribution ID: 14

Type: **not specified**

Gravity without Ensembles

Wednesday 18 November 2020 20:00 (1 hour)

Presenter: SULLY, Jamie

Contribution ID: 15

Type: **not specified**

Discussion: Firewalls

Wednesday 18 November 2020 21:00 (1 hour)

Presenters: ALMHEIRI, Ahmed; JAFFERIS, Daniel; VERLINDE, Herman

Contribution ID: 16

Type: **not specified**

Holographic duality for averaged free CFTs

*Thursday 19 November 2020 16:00 (1 hour)***Abstract:**

I will describe how the modular bootstrap leads us toward a holographic duality for 2d Narain CFTs averaged over moduli. The bulk theory is a 3d Chern-Simons-like theory of “U(1) gravity.” Although this theory has no Einstein term, it has composite gravitons and other features similar to ordinary 3d gravity, so it may be a good place to test ideas about ensemble averaging in holographic duality.

Presenter: HARTMAN, Tom

Contribution ID: 17

Type: **not specified**

More on Holographic duality for averaged free CFTs

*Thursday 19 November 2020 17:00 (1 hour)***Abstract:**

I will continue to explore the idea that certain theories of gravity in Anti-de Sitter space are dual to an average over an ensemble of quantum theories, rather than to a specific quantum theory. The average over Narain's family of two-dimensional conformal field theories which describe free bosons is given by the Siegel-Weil formula, which can be computed at any genus and for disconnected boundaries. The result takes the form of a sum over geometries as one would expect in a theory of gravity. But the gravitational theory looks more like a Chern-Simons theory than like Einstein gravity, and several mysteries remain.

Presenter: MALONEY, Alex

Contribution ID: **18**

Type: **not specified**

Informal interactions/Virtual hanging

Thursday 19 November 2020 18:00 (2 hours)

Contribution ID: 19

Type: **not specified**

Some comments on wormholes and factorization

*Thursday 19 November 2020 20:00 (1 hour)***Abstract:**

Spacetime wormholes have played an important role in recent progress in black hole physics. However, in the context of AdS/CFT, these wormholes lead to a basic puzzle: the “factorization problem”, introduced by Maldacena and Maoz. In this talk we will explore this issue in some simple models, including Marolf and Maxfield’s topological model, JT gravity, and the SYK model. These models are described by ensemble averages of quantum systems; the factorization problem is solved by focusing on single members of the ensemble. In gravitational theories like JT gravity and the topological model, this involves introducing many additional spacetime boundaries in path integral computations. We find that there is a simple effective description common to these models, where the many additional boundaries are replaced by a single “dynamical” boundary. A variant of this effective description also applies to the SYK model. This effective description involves a peculiar modification to the sum over geometries; it requires us to identify a “diagonal” subset of the contributions of the dynamical boundaries with the wormhole. This rule has somewhat different origins in the full description of the gravitational theories and the SYK model. We briefly comment on how this might be relevant to conventional, non-averaged AdS/CFT.

Presenter: SAAD, Phil

Contribution ID: 20

Type: **not specified**

Wormholes, random matrices, and (non-)factorization in $d>2$

Thursday 19 November 2020 21:00 (1 hour)

Abstract:

In the first half of this talk, I will discuss wormholes in pure 3d Euclidean gravity with negative cosmological constant. We compute a wormhole amplitude, the path integral over Euclidean spaces which smoothly connect two hyperbolic regions with torus boundary and topology torus times line. This is a 3d version of the “double trumpet” of JT gravity. From this amplitude we extract the leading two-point fluctuation statistics of highly spinning BTZ microstates near threshold. These statistics precisely match a random matrix ansatz. This is evidence that, if 3d gravity is a consistent theory of gravity, then it is dual to an ensemble rather than a single CFT.

In the second half, I will discuss recent progress in constructing Euclidean wormholes in $d>2$ dimensional pure Einstein gravity. These configurations are also generalizations of the JT double trumpet, in particular they are not saddle points of the gravity action. They are instead “constrained instantons.” For fixed bottleneck size, we have shown that some of these wormholes are completely stable in Einstein gravity. These wormholes can be easily embedded into supergravity, in which they are generically unstable to brane nucleation. However, we find a class of wormholes with AdS-scale bottlenecks in $EAdS_5 \times S^5$ supergravity which are stable against obvious potential brane instabilities. These wormholes may pose a factorization paradox for the duality between $N=4$ super Yang-Mills and IIB string theory on $AdS_5 \times S^5$.

Presenter: JENSEN, Kristan

Contribution ID: 21

Type: **not specified**

Gravitational Perturbations of Extreme Kerr Revisited

Friday 20 November 2020 16:00 (1 hour)

Presenter: CASTRO, Alejandra

Contribution ID: 22

Type: **not specified**

Discussion: The Final State

Friday 20 November 2020 17:00 (1 hour)

Presenters: PUHM, Andrea; MALDACENA, Juan; RAJU, Suvrat

Contribution ID: 23

Type: **not specified**

Informal interactions/Virtual hanging

Friday 20 November 2020 18:00 (2 hours)

Contribution ID: 24

Type: **not specified**

Life without pythons would be so simple

Friday 20 November 2020 20:00 (1 hour)

Presenter: PENINGTON, Geoff

Contribution ID: 25

Type: **not specified**

Confinement, Wormholes, and Cosmology

Friday 20 November 2020 21:00 (1 hour)

Presenter: VAN RAAMSDONK, Mark