Talk Presentations

Time Table

Time	Mon	Tue	Wed	Thu	Fri
10:00 - 11:00	Discussion	Jevicki	Takayanagi & Hao	Noumi	Galante
11:00 - 12:00		Camargo	Basak	Park	Anous
12:00 - 14:00	Lunch break	Lunch break	Lunch break	Lunch break	Lunch break
14:00 - 15:00	Yoon	Miyaji	Zenoni	Chen	Discussion
15:00 - 16:00	Jahnke	Bak	Das	Sin	
16:00 - 16:30	Break	Gong show	Gong show	Break	
16:30 - 17:30	Tezuka	Poster session	Poster session	Lee	
17:30 - 18:00					

List of Presenters

- Tarek Anous (Queen Mary U. London)
- Dongsu Bak (U. of Seoul)
- Jaydeep Kumar Basak (GIST)
- Hugo Camargo (GIST)
- Heng-Yu Chen (NTU)
- Sumit Das (U. of Kentucky)
- Damián A. Galante (Kings College London)
- Viktor Jahnke (GIST)
- Antal Jevicki (Brown U.)
- Bum-Hoon Lee (CQUeST)
- Masamichi Miyaji (YITP)
- Toshifumi Noumi (Tokyo U.)
- Jeong-Hyuck Park (Sogang U.)
- Sang-Jin Sin (Hanyang U.)
- Tadashi Takayanagi & Peng-Xiang Hao (YITP)
- Masaki Tezuka (Kyoto U.)
- Junggi Yoon (APCTP)
- Nicolo Zenoni (YITP)

Abstract of Presentations

Tarek Anous (Queen Mary U. London)

Title: The Schwinger model: a case study in de Sitter QFT

Abstract: Perturbative calculations in de Sitter are a particularly thorny: They are riddled with IR ambiguities and, at late times, signal the breakdown of the standard EFT paradigm. I will start with a light review of these issues and will motivate why exactly solvable models can be a useful tool for organizing our thoughts. To motivate these claims, I will work through a particularly simple example of such an exactly solvable model: QED in two dimensions on a fixed de Sitter background.

Dongsu Bak (U. of Seoul)

Title: Discrete bulk spectrum in JT gravity?

Abstract: In this talk, I would like to talk about how to get the discrete bulk spectrum naturally in the framework of direct canonical quantization of gravity theories. I will present some supporting evidences of the proposal including the behavior of Krylov spread complexity.

Jaydeep Kumar Basak (GIST)

Title: A New Genuine Multipartite Entanglement Measure

Hugo Camargo (GIST)

Title: Higher-Order Krylov State Complexity in Random Matrix Quenches

Abstract: In quantum many-body systems, time-evolved states typically remain confined to a smaller region of the Hilbert space known as the Krylov subspace. The time evolution can be mapped onto a one-dimensional problem of a particle moving on a chain, where the average position defines Krylov state complexity or spread complexity. Generalized spread complexities associated with higher-order moments provide finer insights into the dynamics. In this talk I discuss the time evolution of generalized spread complexities following a quantum quench protocol in random matrix theory for different initial states and examine the robustness of the peak as a signal of quantum chaotic behavior.

Heng-Yu Chen (NTU)

Title: Exploring Complex Saddles and Geometries through Holography

Abstract: Studying gravitational path integral often leads one to encounter complex saddles and the corresponding geometries, some may have interesting physical interpretations while others may be unphysical, it is therefore interesting to study them through the lens of

holography. In this talk, I will report some recent progresses in this direction by applying holography correspondence for both asymptotically Anti de-Sitter and de-Sitter spacetimes. We employ the suitable analytic continuations of dual CFT correlation functions, the method of mini-superspace, and resurgence to explore these complex saddles. In the process we will provide the geometric interpretations for them, which are consistent with the holography correspondences. The work was done in collaborations with Yasuaki Hikida, Yusuke Taki and Takahiro Uetoko.

Sumit Das (U. of Kentucky)

Title: Comments on Time-dependent Backgrounds in 2d String Theory

Damián A. Galante (Kings College London)

Title: Timelike boundaries in an expanding universe

Abstract: One of the difficulties in establishing a holographic duality in expanding universes is the lack of an asymptotic timelike boundary. In this talk, I will discuss recent progress in understanding the problem of gravity in the presence of a finite timelike boundary. I will focus on the case of conformal boundary conditions in which the conformal class of the induced metric and the trace of the extrinsic curvature at the boundary are fixed. Remarkably, in this case, there exist cavities in de Sitter with a cosmological horizon that have positive specific heat. I will present recent results both in Lorentzian and Euclidean signature and discuss possible implications for holography. Based on 2310.08648, 2402.04305 and 2412.16305.

Viktor Jahnke (GIST)

Title: Operator Spectral Statistics, Chaos, and Asymptotic Freeness in Quantum Many-Body Systems

Abstract: A classical dynamical system can be viewed as a probability space equipped with a measure-preserving time evolution map, admitting a purely algebraic formulation in terms of the algebra of bounded functions on the phase space. Similarly, a quantum dynamical system can be formulated using an algebra of bounded operators in a non-commutative probability space equipped with a time evolution map. We refer to specific elements of the algebra as *observables* in both cases. Chaos, in either setting, can be characterized by statistical independence between observables at $t = 0$ an $t \to \infty$, leading to the vanishing of cumulants involving these observables -- a property known as mixing. In the quantum case, the notion of independence is replaced by free independence, which only emerges in the thermodynamic limit $N \to \infty$ (asymptotic freeness). In this work, we investigate the emergence of asymptotic freeness in quantum many-body systems undergoing a transition from chaotic to integrable

dynamics.

Antal Jevicki (Brown U.)

Title: Matrix Thermofield at Large N

Abstract: Construction of Thermofield theory of Large N Matrix Models is given with application of numerical techniques.

Bum-Hoon Lee (CQUeST)

Title: Black Holes and Cosmology with the Gauss-Bonnet term

Abstract: The dilaton-Einstein-Gauss-Bonnet (dEGB) Gravity is one of the simplest extensions of Einstein's gravity with the higher curvature term. We focus on the implication of this theory to the black holes and cosmological evolution. There exists a minimum mass below which no black hole solution exists. We also briefly mention the Black Hole thermodynamics. In the cosmological solutions, it opens new possible phases: “Slow-roll”, “fast-roll”, and “kination” at the higher temperatures, in addition to the well-accepted radiation dominant, matter dominant, and cosmological constant dominant phases of the standard cosmological model. We discuss the gravitational waves produced in this new phase and its implication.

Masamichi Miyaji (YITP)

Title: Aspects of Non-perturbative Hilbert Space for Gravity

Abstract: Recently, with the identification of matrix integral and the gravitational path integral of JT gravity, we had a significant progress in our understanding of non-perturbative correspondence between bulk geometry and the boundary quantum state. In this talk, we will explain aspects of such mapping between black hole interior geometry and the boundary quantum state, constructing "maximal volume operator" in the boundary theory. Using such operator, we confirm the Susskind's conjecture that the late time two sided BH is equal superposition of black holes and white holes. If time allows, we will also comment on applications to de Sitter JT gravity.

Toshifumi Noumi (Tokyo U.)

Title: Holographic Entanglement Entropy in the FLRW Universe

Jeong-Hyuck Park (Sogang U.)

Title: Vacuum Solutions to Einstein Double Field Equation

Abstract: After introducing Einstein Double Field Equation as the unifying description of the

closed string massless sector, I will discuss two vacuum solutions. One is wormhole and the other is cosmology.

Sang-Jin Sin (Hanyang U.)

Title: Holographic mean field theory and its applications

Abstract: The mean field theory is the hard core of the in the theory of new quantum ground state for many particle system with gap creation. However, it corresponds to the presence of relevant operator that can destroy the Fermi surface. This means that the coupling diverges in the low enough energy. Therefore it means that any interesting mean field theory calculation that gives finite gap corresponds to the coupling regime where perturbation calculation is invalid. Holographic mean field theory is a systematic overcome of this difficulty by employing the gauge gravity duality. We apply this formalism to Mott insulator, Superconductivity as well as Kondo physics and discover a new phenomena as well as reproducing the main feature of the corresponding system. We can also use this formalism to the chiral condensation by using the holographic version of Gross-Nevueo model or Nambu-Jona-Rasinio model.

Tadashi Takayanagi & Peng-Xiang Hao (YITP)

Title: Bulk reconstruction of de Sitter space and Flat space from CFT

Abstract: In the first part of this talk (will be presented by T. Takayanagi), we present a bulk reconstruction in dS/CFT for locally excited states in de Sitter space by using the CFT descriptions. In the latter part of this talk (will be presented by P. Hao), we extend a similar construction to a flat space holography.

Masaki Tezuka (Kyoto U.)

Title: Sparse Sachdev-Ye-Kitaev-like models: spectral correlations and information scrambling

Abstract: Finding and understanding simplified versions of quantum mechanical models with holographic correspondence to gravity may pave the way for simulating quantum gravity by early fault-tolerant quantum computing.

Sparse versions of the Sachdev-Ye-Kitaev (SYK) model reproduce essential features of the original SYK model while reducing the number of disorder parameters. In [1] we proposed a further simplification of the model, where we set the nonzero couplings to be ± 1, rather than being sampled from a continuous distribution such as Gaussian. We demonstrated that strong correlations in the eigenenergy spectrum, leading to the quick onset of the random matrix universality, is realized more efficiently in terms of the number of nonzero terms. In [2] we

investigated information recovery in various time-independent Hamiltonian systems and showed that information recovery is possible in the SYK model and its binary sparse version, but not in all chaotic models, which highlights the difference between information recovery and quantum chaos based on the energy spectrum or the out-of-time-ordered correlators. Furthermore, we constructed a model of Pauli spin operators with 4-local interactions by replacing Majorana fermions in the SYK model with spin operators [3]. Our numerical results reveal a striking quantitative coincidence between the spin model and the SYK model, suggesting that this spin model is strongly chaotic and, perhaps, may have applications in holography. Finally, we discuss the singular value spectral statistics and complexity in non-hermitian sparse SYK models [4].

[1] Masaki Tezuka, Onur Oktay, Enrico Rinaldi, Masanori Hanada, and Franco Nori, "Binary-coupling sparse Sachdev-Ye-Kitaev model: An improved model of quantum chaos and holography", Phys. Rev. B 107, L081103 (2023). (arXiv:2208.12098)
[2] Yoshifumi Nakata and Masaki Tezuka, "Hayden-Preskill recovery in Hamiltonian systems", Phys. Rev. Research 6, L022021 (2024).
[3] Masanori Hanada, Antal Jevicki, Xianlong Liu, Enrico Rinaldi, and Masaki Tezuka (in alphabetical order), "A model of randomly-coupled Pauli spins", J. High Energ. Phys. 2405 (2024) 280 (2024).
[4] Pratik Nandy, Tanay Pathak, and Masaki Tezuka (in alphabetical order), "Probing quantum chaos through singular-value correlations in the sparse non-Hermitian Sachdev-Ye-Kitaev model", Phys. Rev. B 111, L060201 (2025). (arXiv:2406.11969)

Junggi Yoon (APCTP)
Title: TBA

Nicolo Zenoni (YITP)
Title: Probing dS bubbles with holographic tools
Abstract: Holography for dS, unlike asymptotically AdS, is hindered by the absence of a natural timelike boundary. In this talk, we discuss solutions involving a dynamical bubble of dS embedded in a Schwarzschild-AdS spacetime, then equipped with a genuine timelike boundary. As an obstacle in probing the dS bubble, the inflating region lies behind the black hole horizon. To circumvent the issue, we employ holographic tools capable of exploring the black hole interior. Based on the results, we briefly comment on the implications on the putative dual state.