

Kyoto-NTU High Energy Physics Workshop 2018

November 24-27, 2018

OIST Conference Center

Organizers:

Kentaroh YOSHIDA (Kyoto University),

Heng-Yu CHEN (National Taiwan University),

Yu-Tin HUANG (National Taiwan University),

Yasha NEIMAN (OIST),

Chika AZAMA (OIST)

This workshop is supported by OIST

Schedule

Saturday, November 24 (OIST Conference Center, Meeting Room 1)

08:00- Breakfast at Chura Hall, Seaside House 3rd floor

12:30-14:00 Lunch set at Café Grano (Please hand your lunch ticket to Grano staff)

14:00–14:45 **Hideki Kyono (Kyoto University)**

Title: “Conformal Partial Waves and AdS Diagrams”

14:45–16:15 **Evgeny Skvortsov (Albert Einstein Institute and Lebedev Institute)**

Title: “Strong Homotopy Algebras from Higher Spin Symmetries”

16:15–17:00 **Takaaki Ishii (Kyoto University)**

Title: “Turbulent and chaotic strings in holography”

Sunday, November 25 (OIST Conference Center, Meeting Room 1)

08:00- Breakfast at Chura Hall, Seaside House 3rd floor

10:00–11:30 **Julian Sonner (University of Geneva)**

Title: “Quantum thermalisation and what it can teach us about black holes”

11:30-11:45 coffee break

11:45–12:30 **Vyacheslav Lysov (OIST)**

Title: “Dual Fluid for the Kerr Black Hole”

12:30-14:00 Lunch set at Café Grano, OIST Center Building Level B
(Please hand your lunch ticket to Grano staff)

14:00-14:45 **Yu-Tin Huang (National Taiwan University)**
Title: TBA

14:45-15:05 **Chia-Kai Kuo (National Taiwan University)**
Title: “Dualities for planar Ising networks”

15:05-15:25 **Jun-ichi Sakamoto (Kyoto University)**
Title: “Local β -deformations and Yang-Baxter sigma model”

15:25-15:55 Coffee break

15:55-16:40 **Yoshinori Matsuo (National Taiwan University)**
Title: “Black holes and vacuum energy”

Monday, November 26 (OIST Conference Center, Meeting Room 1)

08:00- Breakfast set at Café Grano, OIST Center Building Level C
(Please hand your breakfast ticket to Grano staff)

10:00-11:30 **Kazuya Yonekura (Kyushu University)**
Title: “Black hole information and Reeh-Schlieder theorem”

11:30-11:45 coffee break

11:45-12:30 **Yihong Wang (National Taiwan University)**
Title: “A Vertex Operator Algebra Construction of BCJ Numerator”

12:30-14:00 Lunch buffet at Café Grano, OIST Center Building Level B
(Please hand your lunch ticket to Grano staff)

14:00-14:45 **Koji Tsumura (Kyoto University)**
Title: “Symmetry and geometry in generalized Higgs sector”

14:45-15:05 **Yu Hamada (Kyoto University)**
Title: “Gauge invariant regularization for perturbative chiral gauge theory”

15:05–15:25 Suguru Okumura (Kyoto University)

Title: “Regular solutions in a deformed Jackiw-Teitelboim model”

15:25–15:45 Ming-Zhi Chung (National Taiwan University)

Title: “The Simplest Massive S-Matrix - From Minimal Coupling to Black Holes”

15:45–16:15 Coffee break

16:15–17:00 Song He (Institute of Theoretical Physics, CAS)

Title: “On Positive Geometries, Cluster Algebras and Scattering Amplitudes”

19:00–21:00 Dinner at Chura Hall, Seaside House 3rd floor

Tuesday, November 27 (OIST Conference Center, Meeting Room 1)

*08:00- Breakfast set at Café Grano, OIST Center Building Level C
(Please hand your breakfast ticket to Grano staff)*

10:00–11:30 Sudip Ghosh (OIST)

Title: “Coarse grained measures of quantum information”

11:30-11:45 coffee break

11:45–12:30 Kentaroh Yoshida (Kyoto University)

Title: “Holographic duals for non-relativistic systems emerging from modified flow equations”

*12:30-14:00 Lunch buffet at Café Grano, OIST Center Building Level B
(Please hand your lunch ticket to Grano staff)*

14:00–14:45 Wenliang Li (OIST)

Title: “Conformal bootstrap without using unitarity”

(Last modified: Nov. 22)

Titles and Abstracts

<Saturday, November 24: 14:00-14:45>

Speaker: Hideki Kyono (Kyoto University)

Title: Conformal Partial Waves and AdS Diagrams

Abstract: In this talk, we discuss a useful orthogonal basis to expand four point functions in d -dimensional CFT which is so-called conformal partial waves. Conformal partial waves have the bulk interpretation in $d+1$ dimensional AdS, and it can be also applied to analyze AdS diagrams. Through the orthogonality, the conformal block expansion of AdS diagrams is systematically obtained. We will also discuss the crossing kernel which is the inner product of t - and s -channel conformal partial waves, and the possible application to bootstrap problems. This talk is based on a work in progress with Heng-Yu Chen.

<Saturday, November 24: 14:45-16:15>

Speaker: Evgeny Skvortsov (Albert Einstein Institute and Lebedev Institute)

Title: Strong Homotopy Algebras from Higher Spin Symmetries

Abstract: Higher spin symmetries come in a number of different guises - either as gauge symmetry of (yet and still) hypothetical higher spin theories or as a slightly-broken global symmetry in a number of interesting conformal field theories in the large- N limit. Some of these CFT's exhibit a number of remarkable dualities in three dimensions, e.g. the bosonization duality. Both aspects of higher spin symmetries can be captured by certain strong homotopy algebras that we define and construct. It turns out that these strong homotopy algebras are related to (non-commutative) deformation quantisation and topological string theory, which we also discuss.

<Saturday, November 24: 16:15-17:00>

Speaker: Takaaki Ishii (Kyoto University)

Title: Turbulent and chaotic strings in holography

Abstract: I will talk about nonlinear dynamics in the time evolution of classical strings in holography. First, I study nonlinear perturbations of the open string in Poincare AdS dual to the flux tube for the quark-antiquark potential in $N=4$ SYM and show that turbulent behavior is observed in its time evolution. This is then generalized to global AdS, and the relation of the turbulent phenomenon and string's boundary condition is discussed. Besides, I also consider the motion of a closed string in a nonintegrable geometry for which I employ AdS soliton and discuss the turbulent behavior from the viewpoint of chaos.

<Sunday, November 25: 10:00-11:30>

Speaker: Julian Sonner (University of Geneva)

Title: Quantum thermalisation and what it can teach us about black holes

Abstract: Using holographic duality, black hole formation and evaporation is mapped to the process of thermalisation of highly excited initial states in the dual conformal field theory (CFT). In recent years, renewed progress in directly addressing this question from a field theory perspective was made, thanks to new non-perturbative techniques which are especially powerful in the semi-classical regime, that is for CFT with a large central charge, c . This has brought new impetus to the study of chaotic quantum systems, both with respect to their spectral properties and their semi-classical dynamics. I will review some of this progress before moving on to a discussion of the precise mechanism of thermalisation in large- c CFT with a holographic dual and its relation to the so-called eigenstate thermalization hypothesis (ETH). I will end with some comments on their relation to the (perceived) non-unitarity of quantum black holes.

<Sunday, November 25: 11:45-12:30>

Speaker: Vyacheslav Lysov (OIST)

Title: Dual Fluid for the Kerr Black Hole

Abstract: Rotating black holes are algebraically special solutions to vacuum Einstein equation. We show that such solutions admit a dual fluid description. An explicit form of the Kerr solution allows us to write an explicit dual fluid solution and investigate its stability using energy balance equation. We show that the dual fluid is stable because of high algebraic speciality of the Kerr geometry.

<Sunday, November 25: 14:00-14:45>

Speaker: Yu-Tin Huang (National Taiwan University)

Title: TBA

Abstract: TBA

<Sunday, November 25: 14:45-15:05>

Speaker: Chia-Kai Kuo (National Taiwan University)

Title: Dualities for planar Ising networks

Abstract: Recently Galashin and Pylyavskyy give a new connection between 2D planar Ising networks (in a disk) and positive orthogonal Grassmannian ($OG_{\geq 0}$ for short). Under the dualities, the observables in planar Ising networks can be written as the positive sum of minors in $OG_{\geq 0}$ and manifest the positivity property.

In this talk, we will provide an microscopic understanding of the dualities based on amalgamation. And using the correspondence, we introduce two recursive methods for computing correlators of planar Ising networks.

<Sunday, November 25: 15:05-15:25>

Speaker: Jun-ichi Sakamoto (Kyoto University)

Title: Local β -deformations and Yang-Baxter sigma model

Abstract: Homogeneous Yang-Baxter (YB) deformation of $AdS_5 \times S^5$ superstring is revisited. In this talk, I explain that homogeneous YB deformations are equivalent to β -deformations of the $AdS_5 \times S^5$ background when the classical r-matrices consist of bosonic generators. This talk is based on arXiv:1803.05903.

<Sunday, November 25: 15:55-16:40>

Speaker: Yoshinori Matsuo (National Taiwan University)

Title: Black holes and vacuum energy

Abstract: Static spherically symmetric black-hole-like solutions to the semi-classical Einstein equation are studied. We show that there are no divergences around the Schwarzschild radius even for the Boulware vacuum, if the back reaction from the vacuum energy is taken into account. The solutions have no event horizon. Instead, there is a local minimum in the radius, like geometries around the neck of the wormhole. The local minimum of the radius becomes the apparent horizon when the black hole is evaporating by the Hawking radiation. Information can get away from the apparent horizon since it is time-like because of the negative vacuum energy.

<Monday, November 26: 10:00-11:30>

Speaker: Kazuya Yonekura (Kyushu University)

Title: Black hole information and Reeh-Schlieder theorem

Abstract: I will talk about implications of the Reeh-Schlieder theorem on the black hole information problem. In particular, I will argue that the Reeh-Schlieder theorem implies that “information” cannot be localized, and hence there is no well-defined concept of “information which is inside/outside event horizon”. Therefore, I claim that the black hole information problem is not well-formulated from the beginning.

<Monday, November 26: 11:45-12:30>

Speaker: Yihong Wang (National Taiwan University)

Title: A Vertex Operator Algebra Construction of BCJ Numerator

Abstract: The fact that BCJ numerators can be tuned to have antisymmetry and satisfy Jacobi identity leads to the speculation of a underlying Lie algebra. Despite various efforts, such algebra hasn't been found. In this talk, I will show how promoting such numerators to string level would help tackle this problem. In string theory, BCJ numerators can be written as the vacuum expectation value of some successive skewed commutators of vertex operators.

<Monday, November 26: 14:00-14:45>

Speaker: Koji Tsumura (Kyoto University)

Title: Symmetry and geometry in generalized Higgs sector

Abstract: We formulate a generalization of Higgs effective field theory (HEFT) to include arbitrary number of extra neutral and charged Higgs bosons. The relationship between the finiteness of the electroweak oblique corrections and perturbative unitarity of the scattering amplitudes involving the Higgs bosons and the longitudinal gauge bosons is clarified in this setup: we verify that once the tree level unitarity is ensured, then oblique parameters' one-loop finiteness is automatically guaranteed. We also obtain formulas which relates the coefficients of the S and U parameter divergences with the scattering amplitudes which can be measured in future collider experiments.

<Monday, November 26: 14:45-15:05>

Speaker: Yu Hamada (Kyoto University)

Title: Gauge invariant regularization for perturbative chiral gauge theory

Abstract: We propose a novel gauge-invariant regularization for the perturbative chiral gauge theory. Our method consists of the two ingredients: use of the domain-wall fermion to describe a chiral fermion with Pauli-Villars regulators and application of the dimensional regularization only to the gauge field. This regularization is implemented in the Lagrangian level, unlike other gauge-invariant regularizations (eg. the covariant regularizations). We show that the Abelian (fermion number) anomaly is reproduced correctly in this formulation.

<Monday, November 26: 15:05-15:25>

Speaker: Suguru Okumura (Kyoto University)

Title: Regular solutions in a deformed Jackiw-Teitelboim model

Abstract: We study deformations of a particular (1+1)-dimensional dilaton gravity model, so called the Jackiw-Teitelboim (JT) model, by employing the Yang-Baxter deformation technique. In a original frame, the deformation makes the spacetime structure around the boundary change drastically and a new naked singularity appears. However, by employing a Weyl transformation to the deformed model, we obtain a Liouville dilaton gravity model with a cosmological constant term. Then regular solutions can be constructed by using $SL(2)$ transformations. For a black hole solution, the Bekenstein-Hawking entropy is computed from the area law. This entropy can also be reproduced by evaluating the boundary stress tensor with an appropriate counter-term.

<Monday, November 26: 15:25-15:45>

Speaker: Ming-Zhi Chung (National Taiwan University)

Title: The Simplest Massive S-Matrix - From Minimal Coupling to Black Holes

Abstract: We start from the general structure of 3pt amplitudes and show that the piece we call minimal coupling matches to effective action of Kerr black holes. This corresponds to the fact that black holes have no hair. From the minimal coupling amplitude, we can construct tree and 1-loop amplitudes for black hole scattering to extract the classical potential for different order of spin

<Monday, November 26: 16:15-17:00>

Speaker: Song He (Institute of Theoretical Physics, Chinese Academy of Sciences)

Title: On Positive Geometries, Cluster Algebras and Scattering Amplitudes

Abstract: I will give an overview on some recent progress connecting positive geometries, cluster algebras and scattering amplitudes.

<Monday, November 27: 10:00-11:30>

Speaker: Sudip Ghosh (OIST)

Title: Coarse grained measures of quantum information

Abstract: In this talk I will consider the problem of defining measures of quantum information in cases where the space spanned by the set of accessible observables does not form an algebra, i.e. it is not closed under products. This setting is relevant for the study of localized quantum information in theories of gravity where the set of approximately-local operators in a region may not be closed under arbitrary products. While one cannot naturally associate a density matrix with a state in this setting, it is still possible to define a modular operator for a state, and distinguish between two states using a relative modular operator. I will show how a novel class of relative-entropy-like quantities can be defined using the spectrum of these operators and also describe their applications for studying bulk reconstruction and subregion-dualities in AdS/CFT.

<Monday, November 27: 11:45-12:30>

Speaker: Kentaroh Yoshida (Kyoto University)

Title: Holographic duals for non-relativistic systems emerging from modified flow equations

Abstract: An intriguing result presented by Aoki and Yokoyama is that an anti de Sitter space can be derived from a CFT data by considering a flow equation. A natural observation is that given a certain data on the boundary system, the associated geometry would be able to emerge as a flow, *even beyond the conformal case*. As the first step along, we examine this scenario for non-relativistic systems with anisotropic scaling symmetry, such as Lifshitz field theories and Schrodinger invariant theories. Indeed, we derive holographic duals for these systems, namely Lifshitz spacetimes and Schrodinger spacetimes, by employing the associated two-point functions as the boundary data and modifying the flow equation itself.

<Monday, November 27: 14:00-14:45>

Speaker: Wenliang Li (OIST)

Title: Conformal bootstrap without using unitarity

Abstract: The conformal bootstrap program attempts to solve conformal field theories using general principles. I will discuss a new conformal bootstrap method, which generalizes Gliozzi's determinant method and does not use unitarity.