Updated: December 23, 2025

ExU Annual Meeting (2025) Timetable

December 25, 2025

	Title	Speaker	Chair
15:00–16:15	Informal discussions		
16:15–17:30	(Special Colloquium) Field Theory, Condensed Matter, and Quantum Information: Historical and Personal Perspectives	Masaki Oshikawa (ISSP, UTokyo)	Takayanagi

December 26, 2025

	Title	Speaker	Chair
9:00–9:20	Registration		
9:20–9:40	Opening remarks: *Prof. Tadashi Takayanagi*		
9:40–10:10	A01 group report	Tomoyuki Morimae (YITP, Kyoto U.)	Nakajima
10:10–10:40	B01 group report	Norihiro Iizuka (NTHU, Taiwan)	
10:40–11:10	Break		
11:10–11:40	Reports from Publicly Offered Research (10 min each)		
	Spacetime, unconventionally emergent	Masataka Watanabe (UTokyo)	Iizuka
	Quantum Universe and Singularity from Quantum Information	Kotaro Tamaoka (Nihon U.)	
	Quantum black strings in particle physics models	Yuta Hamada (KEK)	
11:40-14:00	Lunch		
14:00–14:30	B02 group report	Masaki Tezuka (Kyoto U.)	Morimae
14:30–15:10	Reports from Publicly Offered Research (10 min each)		
	Novel magnetic phenomena in frustrated random spin systems via large scale computations and real material data	Tokuro Shimokawa (OIST)	Morimae
	Theoretical exploration of mixed-state topological phases	Masaki Oshikawa (ISSP, UTokyo)	
	Dynamics and entanglement in open quantum systems	Kohei Kawabata (ISSP, UTokyo)	
	Investigation of topological phases and transitions via quantum control, quantum entanglement, and duality	Shunsuke Furukawa (Keio U.)	
15:10–15:40	Break		
15:40–16:20	Gong Show (titles in Detailed Programme)		Okunishi
16:20–18:00	Posters – *Audience: please vote for best posters from this session!*		
18:15–20:00	Information exchange meeting (working dinner)		

December 27, 2025

9:00–9:30	B03 group report	Akihiro Ishibashi (Nagoya U.)	M.Hotta
9:30–10:00	C01 group report	Tadashi Takayanagi (YITP, Kyoto U.)	
10:00–10:30	Break		
10:30–11:10	Reports from Publicly Offered Research (10 min each)		
	Emergent physics from quantum entanglement	Tokiro Numasawa (ISSP, UTokyo)	Ishibashi
	Tensor netowrk study of quantum spin liquids in nonequilibrium systems	Ryui Kaneko (Sophia U.)	
	New Development of Lattice QCD in Hamiltonian Formalism	Yoshimasa Hidaka (YITP, Kyoto U.)	
	Entanglement Entropy in Quantum Field Theories with Tensor Renormalization Group	Yoshinobu Kuramashi (CCS, Tsukuba U.)	
11:10-13:00	Lunch		
13:00–13:30	C02 group report	Go Yusa (Tohoku U.)	Izumi
13:30-13:40	Break		
13:40-14:00	Gong Show (titles in Detailed Programme)		Shiromizu
14:00-15:50	Posters		

December 28, 2025

9:00–9:30	C03 group report	Tetsuya Shiromizu (Nagoya U.)	Ueda
9:30–10:00	D01 group report	Tatsuma Nishioka (Osaka U.)	
10:00–10:30	Break		
10:30–11:10	Reports from Publicly Offered Research (10 min each)		
	Entanglement in curved spacetimes: application of partner formula	Yasusada Nambu (Nagoya U.)	Nishioka
	Binary gravitational waves as probes of quantum graviton states	Sugumi Kanno (Kyushu U.)	
	Quantum entanglement in topological quantum spin liquids	Shota Suetsugu (UTokyo)	
	High acceleration field generation by short focused laser wake field acceleration to investigate the Unruh effect	Kotaro Kondo (QST)	
11:10-13:10	Lunch		
13:10–13:40	D02 group report	Kouichi Okunishi (Osaka Metro. U.)	Yusa
13:40–13:50	Buffer		
13:50–14:00	Remarks by the Advisory Board: *Prof. Akio Hosoya*		
14:00–14:10	Remarks by the Advisory Board: *Prof. Nobuyuki Imoto*		
14:10–14:20	Announcement of ExU Poster Awards		
14:20–14:30	Closing remarks: *Prof. Tadashi Takayanagi*		

Updated: December 23, 2025

Detailed Programme

Gong Show (December 26)

A1: Ryota Maeda
YITP, Kyoto U.

Non-Hermiticity of density matrix and traversable wormhole

We investigate the non-Hermiticity of density matrix in conformal field theory. Non-Hermiticity of density matrix has been proposed as an entanglement measure for causally connected two subsystems. We compute it in several setups qualitatively, including non Hermitian Hamiltonian systems. We also analyze their gravity dual descriptions, which become traversable wormholes in AdS geometry. This presentation is based on the ongoing work with J. Harper, T. Kawamoto, N. Nakamura, and T. Takayanagi.

A2: Nanami Nakamura
YITP

Revisiting the k-theorem with the ANEC

The fundamental theorem in renormalization group flows in two dimensions is the c-theorem, which dictates that the number of degrees of freedom must decrease monotonically along the renormalization group flow. The k-theorem claims that the number of charged degrees of freedom decreases monotonically as well. Here, k is the current central charge defined by the two-point function of the current. The new derivation of the c-theorem by using the three-point function sum rule and positivity of the averaged null energy (ANE) operator by Hartman and Mathys motivates us to seek a similar proof of the k-theorem. In the case of the k-theorem, the partial contact terms need to be taken into consideration. We shall first try to write down a naive sum rule with the ANE operator, ignoring the partial contact terms, and see that it gives contradictory results. Afterwards, we carefully analyze the partial contact terms to get the correct sum rule and complete the proof based on the positivity of the ANE operator.

A3: Kosei Fujiki
Yukawa Institute for Theoretical Physics

Analysis of dS/CFT from AdS/BCFT with a localized scalar field

The AdS/BCFT duality argues that a gravity dual of BCFT (boundary conformal field theory) can be constructed by inserting end-of-the-world (EOW) brane in AdS. In this presentation, we would like to apply the AdS/BCFT to analyze a lower dimensional dS/CFT. In particular, we consider a localized scalar field on the EOW brane and examine various scalar operator perturbations in dS/CFT to see how the conformal dimensions of the scalar operators affect the dynamics. This talk is based on the work arXiv:2501.05036 with Hiroki Kanda, and Michitaka Kohara and Tadashi Takayanagi.

A4: Dongsheng Ge

The university of Osaka

Composite defect QFTs and their physical relevance

Composite defects Quantum Field Theory represents a new regime where analytical tools are still at hand, though spacetime symmetries are further broken by introducing a sub-defect inside a conventional defect system. They can be explicitly constructed via localized interactions in vector O(N) models in fractional dimensions. In $d = 3 - \epsilon$ dimensions with a free bulk theory, they are found to be identical to a two-dimensional long-range Ising model with a pining type interface. Such an interface is shown to be non-factorizing in the IR limit.

A5: Taiichi Nakanishi

YITP, Kyoto U.

Symmetries in Field Theories with Foliation Structure

Phases of the matter are one of the main research topics in theoretical physics. In addition to conventionally studied phases, there are some quantum phases whose prominent feature is that they are characterized by the mathematical structure of the space manifold. In this talk, I will discuss the role of the mathematical structure, especially G-structure in physics and consider the relationship among field theories, lattice theories and mathematical structures. This talk is partly based on arXiv:2408.05048 with H. Ebisu, M. Honda and S. Shimamori.

A6: Kenya Tasuki

Yukawa Institute for Theoretical Physics, Kyoto University

Multi-entropy at Quantum Critical Points

Multi-entropy, a recently introduced generalization of bipartite entanglement entropy, has been proposed as a powerful probe of multipartite correlations; however, it has been little explored in explicit calculations for many-body systems so far. We investigate its scaling behavior in the one-dimensional transverse-field Ising model near the critical point. Numerical results from tensor network calculations quantitatively reproduce conformal field theory predictions at criticality and match exact solutions for the infinite chain derived via the Jordan-Wigner transformation. Finite-size scaling analysis further enables precise extraction of the critical field and central charge. We also perform a similar analysis for the XXZ model/compact scalar CFT and attempt to explore the von Neumann limit via analytic continuation. This is based on [arXiv:2506.10396] and an ongoing work.

A7: Haruki Nakayama

The University of Osaka, Particle Physics Theory Group

Holographic defect CFTs with Dirichlet end-of-the-world branes

We construct a holographic model of defect conformal field theories (DCFTs) with defects of codimension greater than one. Our construction generalizes the AdS/BCFT model by anchoring the end-of-the-world brane on defects at the asymptotic AdS boundary and imposing Dirichlet boundary conditions for the metric on the brane. We compute the defect entropy and defect free energy and show that the defect C-function is always non-negative. We further study holographic defect-localized RG flows triggered by a localized scalar field on the brane and show that the defect C-theorem holds. We also verify that our model reproduces the expected forms of correlation functions in DCFTs.

A8: Kotaro Shinmyo
YITP
Entropic Interpretation of Einstein Equation in dS/CFT

Building on the AdS/CFT paradigm—where the first law of entanglement entropy enables reconstruction of the bulk Einstein equations from boundary data—this talk explores the de Sitter counterpart. In dS/CFT, the first-law dynamics of pseudo entropy provide an analogous route to reconstruct the bulk Einstein equations on a complex de Sitter saddle (rather than real Lorentzian dS).

A9: Atis Yosprakob
YITP, Kyoto University
Representing the ground state of gauge theories as tensor networks

Tensor network methods provide a powerful language for exploring quantum many-body systems, including gauge theories. In this poster, we review different approaches to representing the ground state of such theories within tensor network frameworks. We highlight constructions that enforce gauge invariance directly in the network, such as approaches based on Gaussian states and those based on spin-network formalism.

A10: Masashi Kawahira
Kobe University
An emergent higher-form symmetry from type IIB superstring theory

We investigate a higher-form symmetry in type IIB superstring theory, which possesses an $SL(2,\mathbb{Z})$ symmetry. From the point of view of the low-energy effective field theory, the $SL(2,\mathbb{Z})$ symmetry is treated as a gauge symmetry. Hence, an 8-form global symmetry $\mathbb{Z}_1 2^{[8]}$ emerges as a quantum symmetry. In this paper, we present an explicit construction of the topological operator associated with the $\mathbb{Z}_1 2^{[8]}$ symmetry. In this construction, the discriminant $\Delta(\ )$ plays a central role. As a result, it becomes manifest that $\mathbb{Z}_1 2^{[8]}$ is the solitonic symmetry of 7-branes. Furthermore, taking into account the extensions of the duality group, we also discuss what global symmetries emerge when considering not $SL(2,\mathbb{Z})$ but $Mp(2,\mathbb{Z})$, $GL(2,\mathbb{Z})$, and $Pin_+(2,\mathbb{Z}) = GL_+(2,\mathbb{Z})$.

A11: Michitaka Kohara
YITP
Universes on Branes and Their Holographic Description

The idea of "brane cosmology," where cosmological dynamics are realized on a brane, was proposed several decades ago and has been expected to provide quantum-gravitational corrections beyond Einstein gravity. In this poster, we discuss what kinds of universes can emerge on branes corresponding to boundary conformal field theories (BCFTs). We may also address a holographic description on de Sitter branes.

A12: Shono Shibuya

Nagoya U.

Wormhole corrections to observables in de Sitter JT gravity

Recent studies in wormholes suggest important features of quantum gravity such as discreteness of Hilbert space. In a specific model called Jackiw-Teitelboim (JT) gravity, which is a two dimensional quantum model of AdS blackhole, we may explicitly calculate effects of wormholes. However, less is known about wormholes in de Sitter space. In this presentation, I will introduce our aim to compute wormhole effects in de Sitter JT gravity by making use of sine-dilaton model and its embedding to specific matrix model.

A13: Daisuke Yoshida

Naogya University

Apparent Horizons Associated with Dynamical Black Hole Entropy

We define entropic marginally outer trapped surfaces (E-MOTSs) as a generalization of apparent horizons. We then show that, under first-order perturbations around a stationary black hole, the dynamical black hole entropy proposed by Hollands, Wald, and Zhang, defined on a background Killing horizon, can be expressed as the Wall entropy evaluated on an E-MOTS associated with it. Our result ensures that the Hollands–Wald–Zhang entropy reduces to the standard Wald entropy in each stationary regime of a dynamical black hole, thereby reinforcing the robustness of the dynamical entropy formulation.

A14: Stig Lundgren

Nagoya University

A generalization of the ADM mass for asymptotically Euclidean manifolds of weak regularity

We propose a new definition of the ADM mass for asymptotically Euclidean manifolds inspired by the definition of mass for weakly regular asymptotically hyperbolic manifolds by Gicquaud and Sakovich. This version of the mass allows one to work with metrics of local Sobolev regularity and we show, under suitable asymptotic assumptions, that the mass is finite, invariant under a change of coordinates at infinity and that it agrees with the classical ADM mass in the smooth setting. We also provide an expression in terms of the Ricci tensor that agrees with the Ricci version of the ADM mass studied by Herzlich.

A15: Tanay Pathak

Kyoto University

Full Eigenstate Thermalization in Integrable Spin Systems

The Eigenstate Thermalization Hypothesis(ETH) is a standard tool to understand the thermalization properties of an isolated quantum system. Its generalization to higher order correlations of matrix elements of local operators, dubbed the full ETH, predicts the decomposition of higher-order correlation function into thermal free cumulants. In this poster, I will discuss some numerically test of the predictions of full ETH using exact diagonalization in two spin models: Ising spin model and the XXZ Heisenberg model. The differences from the behavior of full ETH prediction in chaotic systems are highlighted and contrasted along the way. I also discuss that although in these integrable spin models the dynamics of the four-time correlators, specifically the out of time ordered correlator (OTOC), is encoded in the fourth order free cumulant, it exhibits late-time dynamics that is different from nonintegrable systems.

A16: Kohei Fukai
UTokyo
Integrability in the SYK model

We clarify the integrability of the clean SYK model. We derive the R-matrix and mutually commuting higher charges for the clean SYK model, and provide their exact solutions. Interestingly, the R-matrix is that of the critical transverse field Ising model. This work reveals an unexpected connection between the SYK model and the critical Ising model; both are famous models, but this relationship was previously unknown.

A17: Yunhyeon Jeong
Dept. of Physics, Tohoku University
Challenge for expansion of quantum Hall edge universe

Our goal is to create a new experimental platform in which we play analogic cosmological experiments in material: quantum Hall edges. The quantum Hall edge is a promising 1+1 dimensional physical system that can be easily deformed in an experiment way and its property of conformal symmetry gives us an expectation of conformally flat expanding universe. However, it is non-trivial that conformal symmetry is preserved at the expanding quantum Hall edge, and we need the experimental technique to reveal the property of the expanding edge. In this presentation, I introduce our recent work for the expanding edge from theoretical and experimental points of view.

A18: Ryotaro Ohno
Tohoku University
Magnetic torque study of α-RuCl3 under in-plane field rotation

Quantum spin liquids (QSLs) represent unconventional states of matter in which the spins do not show long-range order down to absolute zero temperature. These states are predicted to exhibit topological order and to host fractionalized quasiparticles. The Kitaev model on a honeycomb lattice provides an exactly solvable realization of a QSL, characterized by bond-dependent Ising interactions. In this model, spin degrees of freedom fractionalize into emergent Majorana fermions and Z2 fluxes, making it a promising platform for topological quantum computation based on anyons. α-RuCl3 is one of the promising candidates for realizing the Kitaev model. The Kitaev QSL state is anticipated in the field regime where magnetic order is suppressed, while at higher magnetic fields the nature of the ground state and its low-energy excitations remain unresolved. In this study, we investigate the high-field phase of α-RuCl3 by performing magnetic torque measurements under in-plane field rotation. We will show the results of the measurements and discuss the high-field phase.

A19: Sota Takeshige

Tohoku University

Edge structures of spinful $\nu = 2/3$ fractional quantum Hall states

The fractional quantum Hall state is realized at fractional Landau level fillings such as ν=1/3 and ν=2/3. The ν=1/3 quantum Hall state is spin-polarized and is thought to have a single channel at the edge of the system. On the other hand, the ν=2/3 quantum Hall state is spin-unpolarized, and its edge structure is expected to exhibit new properties different from those of the ν=1/3 state. Since the edge spin structure in the ν=2/3 state has not yet been clarified, we calculate it using DMRG. We will report the obtained edge spin structure and its influence on bulk properties.

A20: Yuichi Sata

Tohoku University

Mechanism of Anyon Creation at the Edge of the $\nu = 1/3$ Fractional Quantum Hall System

In the fractional quantum Hall state, an incompressible liquid is realized in the bulk region, while edge states formed at its boundaries give rise to dissipationless topological transport properties. Furthermore, anyons carrying fractional charge and obeying fractional statistics emerge as elementary excitations. The purpose of this study is to numerically investigate the behavior of anyons at the edge. To this end, we generate anyons by introducing and applying a local potential and analyze microscopic structural changes from the stripe-like edge states reported in previous studies [1]. In this presentation, we report results obtained for the filling factor ν=1/3.

[1] Takuya Ito, et al. , Phys.Rev. B 103, 115107(2021)

A21: Mizuki Yamaguchi

UTokyo

Complete integrability classification of the Bose-Hubbard model with general on-site terms

In quantum many-body systems, integrable and non-integrable systems are distinguished by the existence of local conserved quantities. Precisely, in one-dimensional systems with nearest-neighbor interactions, a system is defined as integrable if it possesses a k-local conserved quantity for all natural numbers k $\geq$ 3, whereas it is considered non-integrable if it lacks a k-local conserved quantity for any k. This seemingly non-exhaustive definition is supported by an empirical principle, referred to as the dichotomy, which states that quantum many-body systems either possess all such conserved quantities or none at all [1,2]. To date, no counterexamples have been found, and rigorous proofs have been provided for inversion-symmetric S = 1/2 systems [3] and for SU(2)-symmetric systems with arbitrary spin S [4].

In this presentation, we report the first counterexamples to the dichotomy, discovered in a certain class of models [5]. Specifically, we analyzed a generalized Bose–Hubbard model, $H = \sum_i (b_i^\dagger b_{i+1} + b_i b_{i+1}^\dagger + g_i)$, including non-Hermitian on-site terms. For general on-site parameters g and natural numbers k, we completely determined whether the model admits a k-local conserved quantity.

Our analysis revealed models in the non-Hermitian parameter regime that (i) possess only a 3-local conserved quantity (and none for other k), and (ii) lack only a 4-local conserved quantity while retaining all others. These provide genuine counterexamples to the long-standing dichotomy. Furthermore, we identified intriguing models that admit a k-local conserved quantity for all k, yet cannot be solved by the conventional Bethe ansatz. Since all previously known models with full sets of conserved quantities coincided with generalized Bethe-solvable models, including those with non-difference Yang–Baxter equations, this finding indicates a breakdown of the established correspondence.

[1] M. P. Grabowski, P. Mathieu. J. Phys. A 28, 4777–4798 (1995)
[2] T. Gombor, B. Pozsgay. Phys. Rev. E 104, 054123 (2021)
[3] M. Yamaguchi, Y. Chiba, N. Shiraishi. arXiv:2411.02162
[4] N. Shiraishi, M. Yamaguchi. arXiv:2504.14315
[5] M. Yamaguchi, N. Shiraishi. (in preparation)

A22: Kodai Sugizaki
Tohoku U.

Electrical measurement of edge excitations in quantum Hall systems

The quantum Hall effect is a phenomenon that arises in two-dimensional semiconductors under strong magnetic fields at cryogenic temperatures. At the sample edges, charge density waves known as edge excitations propagate unidirectionally. In this presentation, we will discuss an electrical method for detecting these edge excitations and future prospects.

A23: Taiki Karezaki
Tohoku U.

Observation of bulk excitations in the fractional quantum hall system

The quantum Hall system is a phenomenon that arises when a two-dimensional electron system is exposed to a strong magnetic field at ultra-low temperatures. Under these conditions, the two-dimensional electron system separates into an incompressible bulk and a compressible edge. By applying a pulsed voltage to a metallic gate, charge density waves can be excited in the bulk. In this presentation, we will discuss a method for observing bulk excitations and outline prospects for future research.

A24: Hiromasa Tajima
Nagoya U.

Information during Inflation with Stochastic Formalism

During the inflationary phase of the universe, quantum fluctuations and the spatial expansion can lead to eternal inflation. From the viewpoint of the equation of motion, however, the duration of inflation appears to be limited by the Gibbons–Hawking entropy, implying that inflation cannot last eternally. This argument, however, does not capture the global spatial expansion effect of eternal inflation. To clarify this point, we employ the stochastic formalism of inflation. In this poster, we reinterpret the bound on the duration of inflation from an perspective of information, and show that eternal inflation can be consistent with the reinterpreted bound once the effect of global expansion is taken into account in a specific model.

Gong Show (December 27)

B1: Ryui Kaneko

Sophia University

Initializing quantum neural network states using tensor network representations

We propose an efficient method of approximately mapping matrix product states onto restricted Boltzmann machine wave functions with multinomial hidden units, using canonical polyadic (CP) decomposition. This approach enables the construction of well-conditioned initial neural quantum states for many-body ground-state calculations in polynomial time with the number of variational parameters. Increasing the CP decomposition rank can systematically bring the initial states closer to the true ground states. We validate our method using the transverse-field Ising model and discuss its potential for broader applications to systems with complex nodal structures in their ground-state wave functions.

B2: Peng-Xiang Hao

YITP, Kyoto University

Flat Space Holography via AdS/BCFT

We study a new class of AdS/BCFT setups, where the world-volumes of end-of-the-world branes (EOW branes) are given by flat spaces, to explore flat space holography from an AdS bulk. We show that they provide gravity duals of CFTs in the presence of null boundaries. Our holographic calculations lead to many new predictions on entanglement entropy, correlation functions and partition functions for CFTs with null boundaries. By considering a bulk region between two EOW branes, we present an AdS/BCFT explanation that the flat space gravity is dual to a Carrollian CFT (CCFT), including the swing surface calculation of entanglement entropy.

B3: Hirotaka Yoshino

Osaka Metropolitan University

Simulations of a system with a Kaluza-Klein bubble in a black string

In order to develop a new method for proving the existence of extra dimensions, I consider the possibility of presence of Kaluza-Klein bubbles in our universe which are astronomically observable. Witten's Kaluza-Klein (KK) bubble of nothing is a surface at which the radius of the extra dimension becomes zero, and it expands approximately at the speed of light. For this reason, the formation of the KK bubble is considered to be harmful to outside environments. However, I consider that there would be a possibility that the expansion of a KK bubble becomes slower or even stops due to the interaction with outside matter and black objects, and I explore such a possibility through numerical relativity. In my previous paper [PRD111, 084048 (2025)], I generated the initial data for a system with a KK bubble and a black string. In this poster, I would like to report the current status of time-domain simulations. As the first step, I simulate a SO(3)-symmetric black string with space-dependent compactification radius with/without the KK bubble.

B4: Masato Nozawa

Osaka Institute of Technology

Kerr-Schild formalism for the Benenti-Francaviglia metric

The Benenti-Francaviglia (BF) metric, involving ten arbitrary functions, provides the most general form of a spacetime metric that admits two mutually commuting Killing vectors and an irreducible Killing tensor. Within this broad class, we focus on a special subclass characterized by eight arbitrary functions, which is distinguished by the existence of a shear-free null geodesic congruence. For this degenerate BF metric, we explore its Kerr-Schild deformation. By requiring that the deformed metric preserves circularity, we demonstrate that it can again be cast into the degenerate BF form, modulo the replacement of a single structure function. We apply the present algorithm to $\mathcal{N} = 2$ gauged supergravity and obtain a dyonic generalization of the Chong-Cvetič-Lü-Pope rotating black hole solution, by taking the background metric to be a solution of the Einstein-scalar gravity. In addition, we investigate the five-dimensional nonconformal deformation of the degenerate BF metric. Remarkably, under the circularity condition, the Kerr-Schild deformation leads to precisely the same class of nonconformal deformations of the degenerate BF geometry, up to the replacement of a structure function. This family of solutions encompasses, as notable examples, the doubly rotating Myers-Perry-AdS black hole and the Lü-Mei-Pope black lens.

B5: Yuheng Sui

Keio University

System-environment entanglement phase transitions for open boundary conditions

A quantum channel described by a CPTP map generally turns a pure quantum state into a mixed state, which can be viewed as development of system-environment entanglement. We study a phase transition in the system-environment Renyi entanglement entropy (EE) when the XXZ chain with open boundary conditions is subject to continuous density measurements. We show that the EE exhibits a volume law followed by a subleading logarithmic term; the coefficient of the latter changes from 0 to 1/4 as a function of the measurement strength. We also study the expectation value of a certain twist operator in the doubled Hilbert space formalism, that is expected to detect the phase transition. We compare our results with previous results for the periodic boundary condition as well as the boundary renormalization group analysis.

B6: Yoshinori Matsuo

Nagoya University

Self-gravitating strings and quantum effects in two-dimensional gravity

It is expected that when the string coupling is taken to be sufficiently small, a black hole turns into a bound state of self-gravitating fundamental strings. This state would be described by the Horowitz-Polchinski solution. In this presentation, we discuss the Horowitz-Polchinski solution in two dimensions, which describes the geometry near the surface of the bound state of self-gravitating strings in the large-dimension limit, in a similar fashion to the two-dimensional black hole, which describes the near horizon geometry of the Schwarzschild black hole in the large-dimension limit. As quantum effects

are taken into calculations in the RST model, and the Horowitz-Polchinski solution in the RST model contains background radiation in a similar fashion to the Hartle-Hawking vacuum around a black hole.

B7: Norihiro Tanahashi
Kyoto University
Physics-informed neural network solves minimal surfaces in curved spacetime

We develop a flexible framework based on physics-informed neural networks (PINNs) for solving boundary value problems involving minimal surfaces in curved spacetimes, with a particular emphasis on singularities and moving boundaries. By encoding the underlying physical laws into the loss function and designing network architectures that incorporate the singular behavior and dynamic boundaries, our approach enables robust and accurate solutions to both ordinary and partial differential equations with complex boundary conditions. We demonstrate the versatility of this framework through applications to minimal surface problems in anti-de Sitter (AdS) spacetime, including examples relevant to the AdS/CFT correspondence (e.g. Wilson loops and gluon scattering amplitudes) popularly used in the context of string theory in theoretical physics.

B8: John Moore
Tohoku U.
False vacuum decay in the fractional quantum Hall liquid

False vacuum decay (FVD) is a process by which phase transitions can occur in quantum fields, and it is central to understanding cosmic inflation and the electroweak phase transition in some theories of the early universe. Outside of this cosmological context, FVD is a fundamental quantum phenomenon which may be studied at an energy scale accessible to laboratory experiments by observing quantum many-body systems undergoing a first-order phase transition. This offers the chance to directly observe FVD induced by quantum fluctuations. We seek to study this mechanism of FVD by temporal and spatial measurements in the fractional quantum Hall (FHQ) liquid.

B9: Takahiro Waki
YITP
Celestial holography meets dS/CFT

We establish a concrete link between celestial amplitudes and cosmological correlators. Our approach begins with a map from quantum field theories (QFTs) in ((D+2))-dimensional Euclidean space to theories on the ((D+1))-dimensional sphere, realized through a Weyl rescaling and Fourier transform. By analytic continuation, this construction extends to a relation between QFTs in Minkowski spacetime ($\mathbb{M}^{D+2}$) and de Sitter spacetime (dS^{D+1}) with the Bunch–Davies vacuum. Combining this with celestial holography, we demonstrate that extrapolated bulk operators in de Sitter space can be represented as operators on the celestial sphere (S^D). This framework provides a systematic bridge between celestial holography and the dS/CFT correspondence, enabling the transfer of computational tools and physical insights across the two formalisms.

B10: Naoki Ogawa

YITP(Kyoto Univ.)

Celestial Current via dS/CFT

Celestial holography has emerged as a candidate for flat–space holography, proposing that quantum gravity in d+2 dim. asymptotically flat spacetimes is dual to a d dim. conformal field theory (CFT) living on the celestial sphere (S^d). In our previous work (arXiv:2507.17558), we clarified the celestial dictionary for scalar fields by leveraging the dS/CFT framework. In this poster we extend the analysis to gauge sectors (Maxwell theory and Einstein gravity). On the celestial side, it is known that primary operators with integer conformal dimensions give rise to conserved currents. We trace the origin of these integer-dimension primaries to dS/CFT.

B11: Kanato Goto

The University of Osaka

de Sitter holography with external reference universe– gravitational dressing & quantum error correction

We explore a new framework of de Sitter holography by introducing an external reference universe that naturally implements gravitational dressing of bulk operators. This clarifies how local bulk information is encoded in boundary degrees of freedom while respecting diffeomorphism invariance. We further interpret the mechanism through quantum error correction, where the reference universe serves as an auxiliary register ensuring robust encoding against errors. Our proposal offers a unified perspective linking holography, dressing, and error correction, opening new avenues for understanding quantum gravity in expanding universes.

B12: Kazuya Yamashita

QIQB, The University of Osaka

Developing Hamiltonian engineering and construction of a high-resolution imaging system toward OTOC measurements

In experimental studies of quantum many-body systems based on quantum information, a quantum simulator using cold atom systems is a promising platform. We have been developing a system to study measurement-induced quantum phase transitions and to measure out-of-time-ordered correlators (OTOC) in cold quantum gases. We have achieved quantum degeneracy of Li atoms and loaded them into a two-dimensional optical lattice. As a preparation for the Hamiltonian engineering required for OTOC measurements, we are constructing a fast-switching bias field and the Froquet optical lattice, and also a high-resolution imaging system for the measurement of the entanglement entropy. In the poster, we will present the details of our experiments and the current status of the project.

B13: Ryu Hayakawa

Kyoto U.

Computational complexity of Berry phase estimation in topological phases of matter

The Berry phase is a fundamental quantity in the classification of topological phases of matter. In this paper, we present a new quantum algorithm and several complexity-theoretical results for the Berry phase estimation (BPE) problems. Our new quantum algorithm achieves BPE in a more general setting than previously known quantum algorithms, with a theoretical guarantee. For the complexity-theoretic results, we consider three cases. First, we prove BQP-completeness when we are given a guiding state that has a large overlap with the ground state. This result establishes an exponential quantum speedup for estimating the Berry phase. Second, we prove dUQMA-completeness when we have *a priori* bound for ground state energy. Here, dUQMA is a variant of the unique witness version of QMA (i.e., UQMA), which we introduce in this paper, and this class precisely captures the complexity of BPE without the known guiding state. Remarkably, this problem turned out to be the first natural problem contained in both UQMA and co-UQMA. Third, we show PdUQMA[log]-hardness and containment in PPGQMA[log] when we have no additional assumption. These results advance the role of quantum computing in the study of topological phases of matter and provide a pathway for clarifying the connection between topological phases of matter and computational complexity.

B14: Daichi Kagamihara

Chuo University

Stabilizer Renyi entropy of 3-uniform hypergraph states

Nonstabilizerness, or magic, measures the deviation of a quantum state from stabilizer states. Since stabilizer states can be efficiently simulated classically, nonstabilizerness characterizes states that are difficult to simulate classically. Although many measures of nonstabilizerness are computationally demanding, the recently introduced stabilizer Rényi entropy (SRE) can be evaluated with relatively low cost and has thus been applied to many-qubit systems. Hypergraph states are non-stabilizer states, which are generated by multi-qubit controlled-Z gates such as the CCZ gate, and they possess finite SRE. In this work, we study the SRE of 3-uniform hypergraph states, which are generated solely by CCZ gates. We show that their SRE can be computed efficiently and present numerical results for several examples.

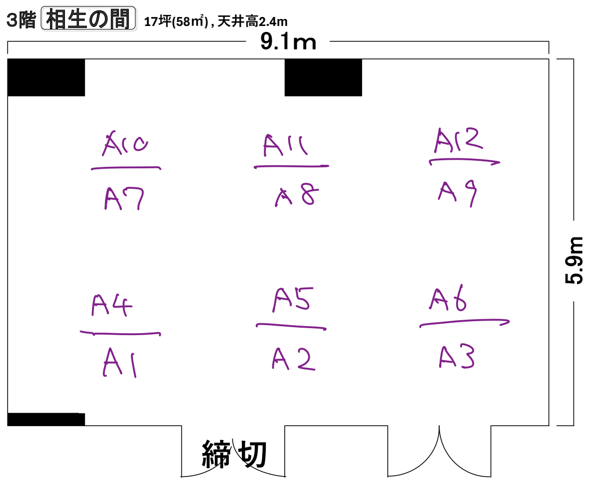
B15: Seiji Terashima

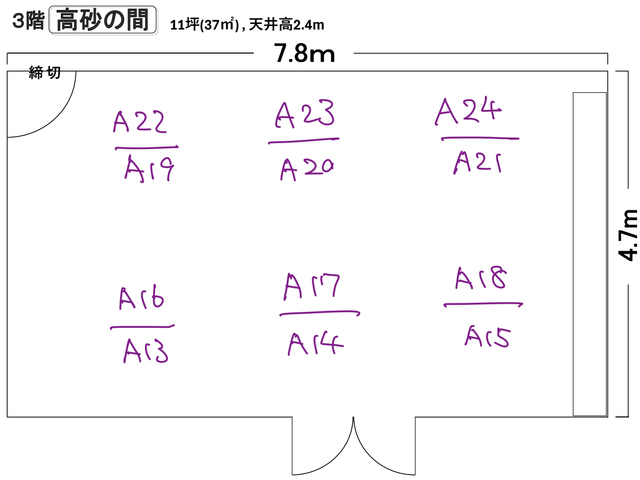
YITP, Kyoto

Bulk reconstruction and subregion in AdS/CFT

We investigate how the quantum gravity theory emerges from the CFT (bulk reconstruction) when considering a subregion in the context of AdS/CFT. The study of subregions is crucial for understanding quantum gravity, particularly in areas such as black hole physics. Notably, we demonstrate that even in simple subregions, such as the AdS-Rindler patch, bulk local operators cannot be fully reconstructed—an outcome that contradicts conventional wisdom. Specifically, while a bulk reconstruction reproducing the two-point function exists, we show that higher-point functions, such as the three-point function, become ill-defined.

Poster venue: December 26





Poster venue: December 27