MP 10: AdS/CFT

Time: Thursday 9:30–13:00 Location: HL 001

Invited Talk MP 10.1 Thu 9:30 HL 001

Conformal field theories from line defects and holography — •Valentina Forini — Humboldt-Universität zu Berlin, Germany

Wilson lines are a prototypical example of defect in quantum field the- ory. I will discuss the superconformal case, in which the one-dimensional defect conformal field theory that they define is particularly interesting. There, a number of techniques can be used (among them, the conformal bootstrap, supersymmetric localization and holography) to learn more about their behaviour in the nonperturbative regime.

MP 10.2 Thu 10:00 HL 001

Constant intrinsic curvature surfaces in AdS/CFT — •Mario Flory[1], Ramesh Chandra[2], Jan de Boer[2], Michal Heller[3], Sergio Hörtner[4], and Andrew Rolph[2] — [1]Jagiellonian University — [2]University of Amsterdam — [3]Ghent University — [4]Max Planck Institute for Gravitational Physics

More than 130 years ago, Jean-Gaston Darboux remarked that surfaces of constant extrinsic curvature seem to play a much more prominent role in mathematical physics than surfaces of constant intrinsic (Gaussian) curvature. At least in the AdS/CFT correspondence, this observation seems to hold true to this day, as evidenced e.g. by the success of the Ryu-Takayanagi formula. Here, motivated by recent studies of so called holographic complexity measures and their connection with the gravitational action, I will comment on a possible role that constant intrinsic curvature surfaces might play in the holographic dictionary. I will also show how such surfaces can be constructed particularly easily in an AdS_3 background.

MP 10.3 Thu 10:20 HL 001

Implications from RMT universality on orientable/unorientable Weil-Petersson Volumes — •Torsten Weber[1], Jarod Tall[2], Fabian Haneder[1], Juan Diego Urbina[1], and Klaus Richter[1] — [1]Universität Regensburg, Regensburg, Deutschland — [2]Washington State University, Pullman, USA

In recent years the discovery of an AdS/CFT like correspondence of quantum JT gravity and a distinct random matrix model has led to an intense cross-fertilisation of the a priori distinct fields of quantum gravity and quantum chaos. In this spirit we use the well-known concept of random matrix universality and study its implications on the gravitational dual. Specifically we focus here on the spectral form factor (SFF) which serves as a prime example showcasing universality on the matrix model side. We study its connection to the objects appearing in its computation on the gravitational side, the volumes of the moduli space of hyperbolic 2-manifolds known as Weil-Petersson (WP) volumes. As a first example of this program we present our results for the bosonic and orientable case of JT where we find that the universal results yields a set of non-trivial constraints to be obeyed by the WP volumes. We continue by discussing our ongoing work on the bosonic unorientable case where we find WP volumes of structures different from the orientable WP volumes. While reproducing the expected agreement with the universal result micro-canonically we find that the structure of the canonical SFF deriving from these volumes necessitates a refined computation on the universal RMT side by which we are able to reproduce its key features.

MP 10.4 Thu 10:40 HL 001

Genus expansions and non-factorisation in periodic orbit sums: a proposal for holography in two-dimensional quantum gravity — •Fabian Haneder, Torsten Weber, Camilo Moreno, Juan Diego Urbina, and Klaus Richter — Universität Regensburg, Regensburg, Deutschland

In recent years, low dimensional quantum gravitational models have found fruitful application in holography due to dualities between such models and various random matrix models [D. Stanford, E. Witten, arXiv: 1907.03363]. An open problem in the generalisation of this work to higher dimensional quantum gravity is the question of how a single quantum system can produce non-factorising correlation functions like the ones found in random matrix models and expected in generic theories with quantum gravity due to the contribution from wormhole geometries.

In this talk, we show that generic chaotic quantum systems, after introducing a novel dynamical average utilising correlations between the actions of classical periodic orbits [M. Sieber, K. Richter, Phys. Scr. 2001 128], exhibit correlation functions that take the form of genus expansions one would expect in (2-dimensional) quantum gravity. For a specific choice of system, a particle moving geodesically on a hyperbolic 3-manifold, which is described by the mathematically exact Selberg trace formula, we find agreement to leading order in the genus expansion of the one- and two-point correlation functions of the heat kernel with the corresponding partition functions of topological 2d gravity, the gravitational dual of the Kontsevich matrix model.

20 min. break

MP 10.5 Thu 11:20 HL 001

JT gravity on hyperbolic lattices as an Ising model — •Jonathan Karl, Johanna Erdmenger, Zhuo-Yu Xian, and Yannick Thurn — Julius Maximilians Universität Würzburg

In recent years the search for a holographic duality, which is based on tessellations of the hyperbolic plane has gained momentum and the construction of suitable boundary theories has been considered in the literature. We propose a discrete analog of JT gravity, defined on hyperbolic lattices as a dual bulk theory. We calculate the resolvent function, which is related to the partition function, by mapping the gravity theory to an Ising model. Furthermore, we propose a realisation of discrete JT gravity as a matrix integral.

MP 10.6 Thu 11:40 HL 001

HyperCells and HyperBloch: open-source software packages for studying hyperbolic lattices based on triangle groups — •Patrick M. Lenggenhager[1,2,3,4,5], Joseph Maciejko[4], and Tomáš Bzdušek[1,2] — [1]University of Zurich, Switzerland — [2]Paul Scherrer Institute, Villigen PSI, Switzerland — [3]ETH Zurich, Switzerland — [4]University of Alberta, Edmonton, Canada — [5]Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

Hyperbolic lattices form the analogue of periodic structures in the hyperbolic plane and have been experimentally realized as networks in metamaterial platforms. The lattices possess discrete translation symmetry. However, due to the negative curvature, the resulting translation group is noncommutative which complicates not only the formulation of band theory but also the construction of periodic boundary conditions (PBC). Both infinite lattices and finite clusters with PBC can be conveniently described in terms of triangle groups.

I will introduce two recently released software packages, called HyperCells and HyperBloch, which provide convenient tools to construct connected and symmetric unit cells, including the associated translations, define arbitrary tight-binding models on them, and apply the supercell method for hyperbolic band theory to gain access at infinite-lattice eigenstates and -energies. The construction is based on an algebraic description of the lattice in terms of the corresponding triangle group, which facilitates a discussion of not only the translation symmetry but point-group symmetries as well. I will discuss examples and show some recent results.

MP 10.7 Thu 12:00 HL 001

Entanglement in interacting Majorana chains and transitions of von Neumann algebras — •Pablo Basteiro, Giuseppe Di Giulio, Johanna Erdmenger, and Zhuo-Yu Xian — Institute for Theoretical Physics and Astrophysics and Würzburg-Dresden Excellence Cluster ct.qmat, Julius Maximilians University Würzburg, Am Hubland, 97074 Würzburg, Germany

We consider Majorana lattices with two-site interactions in the form of a general function of the fermion bilinear. The model is exactly solvable in the limit of large number N of on-site fermions. For four-site chains, we detect a first order quantum phase transition by tuning the relative hopping strength between sites, which manifests itself in a discontinuous entanglement entropy. Inspired by recent analyses of the AdS/CFT correspondence, we identify type I_∞, type II_1, and type III operator algebras in various limits of the phase diagram. In the strongly interacting limit, we find that an abrupt change between type II_1 and I_∞ algebras occurs at the phase transition point.

MP 10.8 Thu 12:20 HL 001

Page Curve Dynamics and Tunneling Effects in Fermionic Systems — •Rishabh Jha and Stefan Kehrein — Institute for Theoretical Physics, Friedrich-Hund-Platz 1, 37077 Göttingen, University of Göttingen, Germany

Motivated by the physics of Page curve in black holes, we study the entanglement dynamics in many-body physics of a fermionic chain and reproduce Page-like curve for entanglement growth between an arbitrary bi-partition where one is significantly smaller (called the system that can be free or contain interactions) than the other (called the environment that is kept free of interactions). The entanglement grows up and then bends down much like what we expect from a Page curve, thereby creating "self-purification" or "zero-variance" states for which we provide evidence by plotting the energy variance of the environment. Moreover, we find an acute sensitivity on the tunneling strength between the system and the environment for both the Page-like dynamics as well as the creation of "zero-variance" states. Interestingly all tunneling effects we find are universal across a range of spinless and spinful fermionic interactions. We finally study the entanglement structures for different interactions that give us insight behind this universality.

MP 10.9 Thu 12:40 HL 001

Entanglement Negativity in T$\overline{\text{T}}$-deformed CFT$_2$s — •Lavish Chawla[1,2], Debarshi Basu[2], and Boudhayan Paul[2] — [1]Jagiellonian University, 30-348, Krakow, Poland — [2]Indian Institute of Technology Kanpur, 208016 Kanpur, Uttar Pradesh, India

We apply a suitable replica technique to develop a perturbative expression for the entanglement negativity of bipartite mixed states in T$\overline{\text{T}}$-deformed CFT$_2$s up to the first order in the deformation parameter. Utilizing our perturbative construction we compute the entanglement negativity for various bipartite mixed states involving two disjoint intervals, two adjacent intervals, and a single interval in a T$\overline{\text{T}}$-deformed CFT$_2$ at a finite temperature, in the large central charge limit. Subsequently, we advance appropriate holographic constructions to compute the entanglement negativity for such bipartite states in T$\overline{\text{T}}$-deformed thermal CFT$_2$s dual to BTZ black holes in a finite cut-off bulk geometry and find agreement with the corresponding field theoretic results in the limit of small deformation parameter.