MP 1: Quantum Information and Complexity

Zeit: Montag 16:00–18:35 Raum: Z6 - SR 1.012

Hauptvortrag MP 1.1 Mo 16:00 Z6 - SR 1.012

Quantum Information and Topological Complexity in AdS/CFT — •René Meyer[1], Raimond Abt[1], Johanna Erdmenger[1], Haye Hinrichsen[1], Charles M. Melby-Thompson[1], Christian Northe[1], and Ignacio A. Reyes[1,2] — [1]Institut für Theoretische Physik und Astrophysik, Julius-Maximilians-Universität Würzburg, Am Hubland, 97074 Würzburg — [2]Instituto de Fisica, Pontificia Universidad Catolica de Chile, Casilla 306, Santiago, Chile

Recently, using the AdS/CFT correspondence exciting new relations are being established between aspects of quantum information theory and of the geometry of black holes in Anti de Sitter space-times. After a concise review of the roles of entanglement measures such as e.g. the entanglement entropy as well as of the computational complexity within the AdS/CFT correspondence, I discuss the notion of subregion complexity of a 2D critical state from three different viewpoints: the AdS3/CFT2 correspondence, random tensor networks, and kinematic space. From the AdS3/CFT2 point of view I explain how in the discontinuity of subregion complexity as given by the volume within the Ryu-Takayanagi surface is related to the Euler characteristic of the respective bulk regions via the Gauss-Bonnet theorem. I then discuss how the volume of these sub regions can be calculated in kinematic space, which is the space of geodesics on the time-slice of AdS3, and present a new CFT expression of subregion complexity. Finally, I present results that qualitatively reproduce the discontinuity in complexity in a tensor network approach. Based on arXiv:1710.01327 [hep-th].

MP 1.2 Mo 16:45 Z6 - SR 1.012

Bulk Volumes in AdS/CFT from Kinematic Space — •Raimond Abt — TP III, Universität Würzburg, Deutschland

Some important new insights into the AdS/CFT correspondence and its relation to quantum information theory are provided by the concept of kinematic space. In AdS3/CFT2, kinematic space is the space of all geodesics in a constant time slice of AdS3 with endpoints at the boundary of the time slice. Kinematic space allows to find explicit expressions for geometric quantities, such as lengths of curves in the time slice of AdS3, in terms of entanglement entropies on the CFT side. Kinematic space is therefore a powerful tool to determine how quantum information aspects of the CFT are encoded in the geometry of AdS. In addition to curves, also volumes in AdS are an interesting quantity to study in context of quantum information. In particular, volumes may be used to define a concept of complexity. This is an information theoretic quantity measuring how involved a particular quantum operation is. In my talk I present an expression for volumes in terms of entanglement entropies that can be motivated and proven by using kinematic space, and discuss its relation to complexity.

15 mitn. break

MP 1.3 Mo 17:15 Z6 - SR 1.012

Discrete scale invariance in holography revisited — •Mario Flory — Institute of Physics, Jagiellonian University, Łojasiewicza 11, 30-348 Kraków, Poland

In 2013, K. Balasubramanian presented a 5+1 dimensional holographic toy model that allows for an exact solution to Einstein's equations in the bulk in which the isometries of AdS_5 appear to be broken to an isometry group describing a discretely scale invariant and Poincaré invariant setup. We investigate this solution in more detail. By analytically solving the Killing equations, we prove that the full AdS_5 isometry group is still present, although in a somewhat hidden way. We will also comment on the prospects of finding other holographic models which allow for solutions with discrete scale invariance or scale invariance without conformal invariance in the future.

MP 1.4 Mo 17:35 Z6 - SR 1.012

Non-local observables in AdS/CFT: finite temperature results — •Nina Miekley[1,2] and Johanna Erdmenger[1,2] — [1]Julius-Maximilians-Universitaet Wuerzburg, Germany — [2]Max-Planck-Institut für Physik, Munich, Germany

The AdS/CFT correspondence relates strongly coupled field theories to theories containing gravity. One interesting aspect are non-local observables, for instance the two-point function, the Wilson loop and the entanglement entropy. Their dual descriptions are associated to minimal surfaces. We derive a closed, analytic form of the aforementioned observables for d-dimensional finite temperature CFTs dual to Schwarzschild-AdS. Of particular interest is the high-temperature limit, where our results allow insights into new physical behaviour, e.g. a violation of the area theorem for entanglement entropy and a renormalisation of the quark mass.

MP 1.5 Mo 17:55 Z6 - SR 1.012

Subregion Complexities from Kinematic Space — •Christian Northe — TP3 Universitaet, Wuerzburg, Deutschland

We consider subregion complexity within the AdS3/CFT2 correspondence. Using the Gauss-Bonnet theorem we evaluate this quantity for specific examples. In particular, we find a discontinuity when there is a change in the RT surface, given by a topological contribution. There is no further temperature dependence of the subregion complexity. We further propose a CFT expression for this complexity based on kinematic space, and use it to reproduce some of our explicit gravity results. We thus obtain and discuss a concrete matching of results for subregion complexity between gravity and CFT expressions.

MP 1.6 Mo 18:15 Z6 - SR 1.012

Computational complexity in tensor networks and holography — •Ignacio Reyes — Institut fuer Theoretische Physik und Astronomie, Universitaet Wuerzburg, Am Hubland, 97074

We consider the proposal of subregion complexity in holography, which associates the volume enclosed by minimal surfaces in AdS-spaces (Ryu-Takayanagi surfaces) with computational complexity.

We argue that this measures the complexity of data-compression algorithm, and describe recent progress on how to match the calculations coming from AdS/CFT to explicit tensor network constructions, using MERA and random tensor networks. We consider black hole geometries.