ABSTRACTS

Online Workshop
”Frontiers of Holography-III"

Link[http://www.mathnet.ru/conf1986]

December 6 - December 17 2021, Steklov Mathematical Institute, Moscow

Organizers

Steklov Mathematical Institute of Russian Academy of Sciences, Moscow

Steklov International Mathematical Center, Moscow

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December 6 (Monday)

Resolving Black Holes singularities in Analytic infinite derivative theories of gravity

15:00-16:00(CET) Alexey Koshelev (*UBI*)

In my talk I will show that Analytic infinite derivative gravity in any dimension represents the most general gravity action ever needed to extract propagator around maximally symmetric spacetimes. Moving on, I will show that such a theory is geodesically complete leading to the resolution of the Black Hole singularities. Thus singular blackholes (Schwarzschild as an example) can be understood as non-singular compact objects still with a horizon, whose core is governed by the mass and the effective scale of the non-locality.

December 7 (Tuesday)

From strings to QCD: The study of doubly heavy hadrons

15:00-16:00(CET) Oleg Andreev (*Munich Iniversity*)

We will discuss the string theory constructions for the QQq and $QQ\bar{q}\bar{q}$systems. Following the hadro-quarkonium picture the potential is a function of separation between the heavy quarks. The results show the universality of the string tension and factorization at small separations expected from heavy quark-diquark symmetry. The potentials look very similar at small quark separations but at larger separations they differ. The reason for this is that the flattening of the potentials happens at two well-separated scales as follows from the two different mechanisms: string breaking by light quarks for QQq and string junction annihilation for $QQ\bar{q}\bar{q}$.

Holographic studies of energy losses in Kerr-AdS$_5$

16:00-17:00(CET) Anastasia Golubtsova (*JINR*)

The 5-dimensional Kerr-AdS black holes are holographically dual to the thermal ensemble of N=4 SYM at strong coupling on the cylinder $R\times S^3$ This allows to describe a rotating quark-gluon plasma using classical gravity in Kerr-Ad$_5$. We calculate the thermodynamical quantities of Kerr-Ad$_5$ and find that the rotation affects on the Hawing-Page phase transition.

Using the holographic prescription we calculate the energy of a static quark under the assumption that the rotational parameters are small. In the holographic description, the heavy quark can be considered through a string hanging towards the black hole horizon with a fixed endpoint attached to the boundary of the Kerr-Ad$_5$ background. We show that at high temperatures the contribution from the rotation is suppressed, thus the result turns to be as for the case of the planar black brane. We also present the general formulae for the holographic drag forces acting on a heavy quark for the case of two arbitrary rotational parameters.

December 8 (Wednesday)

Generalized 3D instanton crystals

14:00-15:00 (CET) Matti Jarvinen (*APCTP*)

Nuclear matter at large number of colors is necessarily in a solid phase. In particular holographic nuclear matter takes the form of a crystal of instantons of the flavor group. I analyze the three-dimensional crystal structures and the orientation patterns for the two-body potential motivated by holographic duality. I use simulations of large ensembles of instantons to identify the lattice structure and orientations for various parameter values of the two-body potential. The resulting phase diagram is surprisingly complex, including a variety of ferromagnetic and antiferromagnetic crystals with various global orientation patterns, and various "non-Abelian"crystals where orientations have no preferred direction. The simulation results are augmented by analytic analysis of the long-distance divergences, and numerical computation of the (divergence free) energy differences between the non-Abelian crystals, which precisely determine the structure of the phase diagram.

A semi-holographic model of non-Fermi liquids

15:00-16:00 (CET) Giuseppe Policastro (*Ecole Normale Superieure*)

In recent years, the holographic correspondence has been used in many contexts to explore properties of strongly coupled systems that are hard to explain by conventional methods. One instance of such systems is given by the high-T superconductors, which exhibit non-Fermi liquid behavior in the so-called "strange metal"phase above the critical temperature. I will discuss the holographic constructions of these systems, and in particular a model that I and my collaborators are currently investigating, based on a semi-holographic approach. I will discuss the results for the transport properties, in particular I will show that under certain conditions an emergent linear-in-T behavior of the longitudinal resistivity appears over a significant range of temperatures.

December 9 (Thursday)

Distinguishability in Random States, Eigenstates, and Gravity

15:00-16:00 (CET) Jonah Kudler-Flam (*Chicago University*)

Recently, there has been significant progress in solving the black hole information problem from explicit calculations of the entropy of Hawking radiation, confirming consistency of gravity with unitarity. One aspect of the information problem left unresolved by entropy calculations is the distinguishability of different black hole microstates: why do different microstates appear to lead to the same final (thermal) state? I will address this problem by studying the distinguishability of radiation coming from different black holes. In parallel, I will present a derivation of the subsystem eigenstate thermalization hypothesis for a class of chaotic many-body systems as well as generalizations to tensor network states.

Aspects of hydrodynamic convergence and transport bounds

16:00-17:00(CET) Saso Grozdanov (*University of Ljubljana*)

A closer investigation of the complex analytic structure of correlation functions and dispersion relations has in recent years been able to shed new light on transport and quantum chaos, particularly in holographic theories. In the first part of this talk, I will discuss some new surprising results on the convergence radius of hydrodynamics in holographic theories at finite 't Hooft coupling. This analysis will proceed, as previously at infinite coupling, via the analysis of complex spectral curves. In the second part of the talk, I will review the construction of the univalence bounds on transport coefficients and outline a set of potentially general observations regarding the univalence properties of diffusion and sound.

December 10 (Friday)

Moving black branes and Lifshitz hydrodynamics at generic z

15:00-16:00(CET) Larus Thorlacius (*University of Iceland*)

Quantum critical fluids with Lifshitz symmetry, or Lifshitz fluids for short, have interesting properties that set them aside from more conventional fluid systems. In particular, a Lifshitz fluid with a generic dynamical critical exponent $z > 1$ does not have boost symmetry meaning that a moving fluid is physically distinct from a fluid at rest in a moving coordinate frame. We show how a relatively simple Einstein-Maxwell-Dilaton model provides a concrete holographic realisation of Lifshitz fluids. In this setting, a black brane at generic z carrying linear momentum along the boundary corresponds to a non-equilibrium steady state of the fluid. We obtain the stress tensor complex for the dual field theory via a suitably defined holographic renormalisation procedure and demonstrate that the expected hydrodynamic relations for a Lifshitz perfect fluid are satisfied.

December 13 (Monday)

Towards deriving a gravity dual to complexity

16:00-17:00(CET) Michal Heller (*Max Planck Institute for Gravitational Physics*) What are boundary interpretations of holographic complexity proposals and what are gravity duals to complexity are important open questions. I will discuss two ongoing efforts to answer them, which are based on searching for a gravity dual of a circuit cost and, through minimization of the latter object, to a gravity dual of bona fide complexity. Based on 2101.01185 and an ongoing work.

Causal connectability between quantum systems and the black hole interior in holographic duality

17:00-18:00(CET) Hong Liu (*MIT*)

In holographic duality an eternal AdS black hole is described by two copies of the boundary CFT in the thermal field double state. This identification still has many puzzles, including the boundary descriptions of the event horizons, the interiors of the black hole, and the singularities. Compounding these mysteries is the fact that, while there is no interaction between the CFTs, observers from them can fall into the black hole and interact. We will address these issues in this talk. In particular, we (i) present a boundary formulation of infalling observers; (ii) show that in any holographic systems, a sharp event horizon can only emerge in the infinite N limit; (iii) give an explicit construction in the boundary theory of an evolution operator for a family of bulk in-falling observers, making manifest the boundary emergence of the black hole horizons, the interiors, and the associated causal structure. A by-product is a concept called causal connectability, which is a criterion for any two quantum systems (which do not necessarily have a known gravity dual) to have an emergent sharp horizon structure.

December 14 (Tuesday)

Entanglement Islands in Braneworlds

15:00-16:00(CET) Hao Geng (*Harvard University*)

Entanglement island is a recently emergent concept playing an important role in resolving the black hole information paradox. In these resolution proposals the black hole is coupled to a bath which absorbs the radiation from the black hole and we can calculate the entanglement entropy of the black hole radiation as a function of time by studying the bath. The results are consistent with Page's argument that the entanglement entropy versus time diagram obeys unitarity– a Page curve. In higher dimensions, this calculation of the Page curve can be done only in braneworld models. More precisely, the Karch-Randall braneworld models and for AdS black holes. A closer look at the braneworld models tells us that the graviton is massive as the massless graviton mode is not normalizable. However, this effect of having a massive graviton is induced by coupling the black hole to a bath which is a universal feature of all the resolution proposals in higher dimensions. Several attempts to construct entanglement islands for massless gravity using braneworld give us many interesting new setups to study quantum gravity– including a codimension two holography in AdS (wedge holography) and Page curve for de Sitter radiation. Though these attempts didn't provide us with entanglement islands for massless gravity in asymptotically AdS spaces. We will see that a more careful study tells us that in a large set of situations entanglement islands don't exist in massless gravity theories. In the talk I will give a complete review of this line of research.

The volume of the black hole interior at late times

16:00-17:00(CET) Gabor Sarosi (*CERN*)

The volume of the interior of a two-sided eternal black hole classically grows forever. I will show that in JT gravity, summing the non-perturbative contribution of higher topologies leads to a saturation of the volume of the interior at times exponential in the entropy of the black hole. I will explain that this is evidence for the conjecture that the size of the interior is related to the complexity of the holographically dual quantum state.

December 15 (Wednesday)

Enstrophy and black hole supertranslations

15:00-16:00(CET) Natalia Pinzani Fokeeva (*MIT*)

Enstrophy is an approximately conserved quantity in 2+1 dimensional fluid flows that has dramatic consequences for the phenomenology of nonrelativistic turbulence: it implies an inverse energy cascade. In this talk, I will present an algorithm on how to construct an enstrophy current for generic fluid flows (relativistic and non). In addition, I will show how a subset of certain horizon symmetries of 3+1 dimensional AdS black holes also lead to enstrophy conservation in the dual holographic fluid theory.

18:00-19:00(CET) Jorit Kruhoff (*Stanford University*)

TBA

December 16 (Thursday)

Geometry of Krylov Complexity

15:00-16:00(CET) Pawel Caputa (*Warsaw University*)

I will describe geometric aspect of the operator growth and Krylov complexity from a new perspective of symmetries and coherent states. As the main examples I will talk about operator growth and Krylov complexity in the SYK model and in 2d CFTs. Based on arXiv: 2109.03824 [hep-th] and arXiv: 2110.10519 [hep-th].

Nonlocal gravity and F(R) models

16:00-17:00(CET) Sergey Vernov (*MSU*)

A class of modified gravity models with analytic functions of the d'Alembert operator that has been proposed as a possible way of resolving the singularities problems in cosmology is considered. We demonstrate that the connection with f(R) gravity models is a useful tool to obtain exact solutions in this class of nonlocal models

December 17 (Friday)

Holographic QCD in the NICER era

15:00-16:00(CET) Niko Jokela (*University of Helsinki*)

TBA

Anisotropic solutions for a holographic light-quark model with an external magnetic field

16:00-17:00(CET) Kristina Rannu/Pavel Slepov (*PFUR/MIAN*)

Confinement/deconfinement phase diagram for light quarks in magnetic field is discussed. For this purpose a five-dimensional fully anisotropic holographic model is considered. This model is supported by Einstein-dilaton-three-Maxwell action effectively describing light quarks behaviour. It also takes into account spacial anisotropy of the QGP produced in heavy-ion collisions and large chemical potentials. Influence of magnetic field on thermodynamical properties of QGP and confinement/deconfinement phase transition depending on spacial anisotropy is investigated.