

PAFT 2017 – Problemi Attuali di Fisica Teorica

Current Problems in Theoretical Physics

XXIII Edition – April 7- 11, 2017

Lloyd's Baia Hotel – Vietri sul Mare (Italy)

Quantum Fields and Gravity

Chairperson: Mauro Carfora

Tuesday, April the 11th

9:15-10:00 **Exotic RG Flows from Holography**

Elias Kiritsis

Crete Center for Theoretical Physics

Holographic RG flows are studied in an Einstein-dilaton theory with a general potential. The superpotential formalism is utilized in order to characterize and classify all solutions that are associated to asymptotically AdS space-times. Such solutions correspond to holographic RG flows and are characterized by their holographic β -functions. Novel solutions are found that have exotic properties from a RG point-of view. Some have β -functions that are defined patch-wise and lead to flows where the β -function changes sign without the flow stopping. Others describe flows that end in non-neighboring extrema in field space. Finally others describe regular flows between two minima of the potential and correspond holographically to flows driven by the VEV of an irrelevant operator in the UV CFT. We explore the implications for the existence of limit cycle in unitary

10:00-10:30 **Scalar fields in AdS with arbitrary boundary conditions**

Hugo Ferreira

Pavia University

Anti-de Sitter is not a globally hyperbolic spacetime. When studying a field theory in anti-de Sitter, one needs an appropriate choice of boundary conditions at the conformal boundary such that the classical field equation is well-posed. Moreover, at the level of the standard formulation of quantum field theory, the existence of physical quantum states, the so-called Hadamard states, is only guaranteed (and defined) on globally hyperbolic spacetimes. In this talk, I consider a massive scalar field in anti-de Sitter and analyse all of the acceptable boundary conditions, including the commonly used Dirichlet boundary conditions as a particular example. I show that both the

classical and quantum field theory is well-defined for these choices and, in particular, we can have a natural definition of a physically relevant, Hadamard state for all choices of boundary conditions.

10:30-11:00 **On The Relationship between Black Holes Phase Transitions and The Shear Viscosity in Dual QFTs**

Matteo Taveri

Cagliari University

Usually, one uses holographic dualities to learn about transport coefficients in the hydrodynamic limit of strongly coupled QFTs by investigating bulk gravity configurations. However, it is still possible to change the paradigm, i.e. to use transport properties of the dual quantum field theory to infer about the behaviour of bulk gravity solutions. Following this perspective, in this talk I will show, using the AdS/CFT framework, that transport coefficients computed in a quantum field theory can lead to a better understanding of black hole physics. In particular, I will focus on the shear viscosity and its relationship with thermodynamics of charged black holes. Interestingly enough, I will show that the shear viscosity to entropy density ratio in the hydrodynamic limit of the QFT dual to charged black holes exhibits a temperature-dependent hysteresis, reflecting the rich phase structure, in particular metastabilities and Wan der Walls-like behaviour, of charged black holes.

11:00-11:30

Coffee Break

11:30-12:15 **Teichmüller theory in 3D gravity**

Francesco Bonsante

Pavia University

Originally motivated by Witten proposal to quantize 3D gravity, several connections between gravity in dimension 3 and the theory of Riemann surfaces has been pointed out in the last decades. A major breakthrough in this theory was given by G. Mess who provided a full classifications of globally hyperbolic structures of constant curvature in terms of the Teichmüller space of the Cauchy surface. As a matter of fact, those connections get a new insight in the theory of Riemann surfaces and turned useful even to prove new results about Riemann surfaces.

In the talk I will give a general overview of this theory highlighting the most recent results and the main open questions.

12:15-12:45

Instantons and box counting

Matteo Poggi

SISSA

Taking inspiration from Nekrasov's renowned work on Seiberg-Witten prepotential, we are working to extend its result to a more generic brane configuration (D0-D6). In particular we used Jeffrey-Kirwan residue technique to do a direct computation of the partition function on the system. We also verified a factorization conjecture formulated by mathematicians. Works are in progress to find the integrable system behind our configuration.

15:15-16:00

Computing the relativistic Universe

Eloisa Bentivegna

Scuola Superiore di Catania

Over the past few years, numerical techniques have enabled the study of various cosmological processes in three dimensions and full General Relativity. In this talk, I will review these techniques and illustrate the resulting nonlinear relativistic corrections to phenomena such as the large-scale dynamics, the formation of gravitational structures, and the optical properties in different cosmological scenarios. I will conclude presenting the Einstein Toolkit, one of the free-software infrastructures used for cosmological Numerical Relativity.

16:00-16:30

Surfaces of constant Gaussian curvature in Minkowski (2+1)-space.

Andrea Seppi

Pavia University

We will discuss the problem of existence and uniqueness of space-like surfaces of negative constant Gaussian curvature K in (2+1)-dimensional Minkowski space. This problem is related to the Dirichlet problem for an equation of Monge-Ampère type on the unit disc. Moreover, K -surfaces with bounded second fundamental form are essentially parameterized by the tangent space of universal Teichmüller space, at the trivial element.

16:30-17:00

Coffee Break

17:00-17:30

Toward an information theoretic description of quantum space-time

Goffredo Chirco

Max Planck Institute for Gravitational Physics

We consider the possibility to derive the geometric characterisation of space-time from a quantum information theoretic description of the gravitational field in the non-perturbative regime, within the general setting of the background-independent approaches to quantum gravity. We present two new results along this direction: the calculation of the quantum Fisher metric tensor for a specific class of spin network states; the interpretation of a class of quantum black hole models proposed in LQG by means of general quantum typicality arguments.

17:30-18:00 **Black hole's unusual properties**

Antonia Micol Frassino

Goethe-Universität Frankfurt am Main

In this talk, I will investigate interesting properties of some black hole solutions. In particular, I will focus on the phase transitions that can take place when the cosmological constant is included in the Einstein's equations and the case of nonlocal theories.