International Workshop on

Holography and Condensed Matter

Department of Physics, University of Perugia

September 24 - 25, 2015

HoloGrav
Network

Thursday, September 24

9:30 - 10:15	**Johanna Erdmenger**	*Magnetic impurities and universality in AdS/CMT*
10:15 - 11:00	**Veselin Filev**	*Testing AdS/CFT with flavours on a computer*
11:00 - 11:30		Coffee break
11:30 - 12:15	**Charlotte Kristjansen**	*Holographic one-point functions*
12:15 - 13:00	**Maria Vozmediano**	*Hall viscosity and chiral anomaly in Weyl semimetals*
13:00 - 14:30		Lunch
14:30 - 15:15	**Nicodemo Magnoli**	*Thermo-electric transport properties in holography with momentum dissipation*
15:15 - 16:00	**Niko Jokela**	*Custom-made holographic matter*
16:00 - 16:30		Coffee break
16:30 - 17:15	**Francisco Peña Benitez**	*AC conductivity of a holographic strange metal*

Friday, September 25

9:30 - 10:15	**Valentina G. Puletti**	*Finite temperature monopole correlators in holographic liquids*
10:15 - 11:00	**Simon Hands**	*Monte Carlo Simulation of a Quantum Critical Point in Graphene*
11:00 - 11:30		Coffee break
11:30 - 12:15	**Larus Thorlacius**	*Classical and quantum temperature fluctuations via holography*
12:15 - 13:00	**Alfonso Ramallo**	*Holographic flavors in Chern-Simons matter theories*
13:00 - 14:30		Lunch
14:30 - 15:15	**Camilla Coletti**	*Large-Area Highly-Crystalline Graphene: Synthesis, Characterization and Possible Applications*
14:30 - 15:15	**Peter Orland**	*Seeing Asymptotic Freedom in a Large-N Correlator*
16:00 - 16:30		Coffee break
16:30 - 17:15	**Nick Evans**	*Vacuum Alignment in Holographic Graphene*

Abstracts

Johanna Erdmenger

Max Planck Institute for Physics

Thursday 9:30 - 10:15

Magnetic impurities and universality in AdS/CMT

Veselin Filev

Dublin Institute for Advanced Studies

Thursday 10:15 - 11:00

Testing AdS/CFT with flavours on a computer

I report on a current effort to test the AdS/CFT correspondence with flavours. I describe our approach to the lattice simulations of the BFSS and Berkooz-Douglas matrix models and outline their holographic descriptions. In the case of the BFSS matrix model we confirm the previously observed excellent agreement of the two approaches. I also present some preliminary results for the Berkooz-Douglas matrix model.

Charlotte Kristjansen

Niels Bohr Institute

Thursday 11:30 - 12:15

Holographic one-point functions

We calculate one-point functions of non-protected operators in a holographic set-up of relevance for condensed matter physics. The one-point functions are expressed as an overlap between Bethe eigenstates of an integrable spin chain and a matrix product state. This matrix product state, moreover, turns out to be closely connectioned to the Néel state, i.e. the ground state of the anti-ferromagnetic Heisenberg spin chain.

Maria A. H. Vozmediano

Instituto de Ciencia de Materiales de Madrid

Thursday 12:15 - 13:00

Hall viscosity and chiral anomaly in Weyl semimetals

Weyl semimetals (WSM) (the 3D graphene) are a material realization of Lorentz violating massless QED in (3+1) dimensions. The recent experimental confirmation has opened a new lab to explore anomaly related phenomena, and a number of experimental observations have already been

reported. In graphene, lattice deformations couple to the electronic current in the form of "elastic gauge fields" axial in nature.

In this talk we will see that elastic axial gauge fields are also present in the Weyl semimetals. Among the new response functions associated to them, we will show that WSM have an intrinsic Hall viscosity whose coefficient is related to the AAA triangle anomaly. An overview of the experimental situation regarding WSM will also be presented.

Reference: "Hall viscosity from elastic gauge fields in Dirac crystals", Alberto Cortijo, Yago Ferreiros, Karl Landsteiner, and Maria A. H. Vozmediano, arXiv:1506.05136 (2015).

Nicodemo Magnoli

University of Genova

Thursday 24, 14:30 - 15:15

Thermo-electric transport properties in holography with momentum dissipation

I will provide an analytical derivation of the transport coefficients of the simplest momentum dissipating model in gauge/gravity where the lack of momentum conservation is realized by means of an explicit graviton mass in the bulk. I will also investigate the possibility of formulating Planckian bounds on the diffusion constants in different holographic models featuring momentum dissipation.

Niko Jokela

University of Helsinki

Thursday 15:15 - 16:00

Custom-made holographic matter

We engineer holographic fluids in most general ways. We discuss the thermodynamics and transport properties for all these finite density systems at once at finite temperature, magnetic field, and quark mass. A highly non-trivial check of the validity of our results comes from verifying the Einstein relation in the most perverse situation with anyonic fluids with Lifschytz scaling and hyperscaling violation.

Francisco Peña Benitez

INFN Section of Perugia and University of Perugia

Thursday 16:30 - 17:15

AC conductivity of a holographic strange metal

In this talk I will show you the frequency dependence of the optical conductivity for a holographic non relativistic model. The system shows in the UV a power law. Some features related with the

existence of a Drude peak and its relation to the so called pair creation and drag conductivities will be discussed. Finally I will discussed the existence of power laws in more general holographic setups.

Valentina Giangreco Puletti

University of Iceland

🕓 Friday 9:30 - 10:15

Finite temperature monopole correlators in holographic liquids

Magnetic monopole operators are non-local observables that couple to the charged sector of a theory. They carry non-perturbative information about the corresponding IR physics encoded in their correlation functions and provide an order parameter for transitions between compressible phases of matter. These features make them particularly suitable for the study of quantum states by means of gauge/gravity duality. We review the bulk realisation of monopole operators in a top-down approach, extending previous work by Sachdev and Iqbal, and then present new results on monopole two-point functions in various holographic liquids at finite temperature.

Simon Hands

Swansea University

🕓 Friday 10:15 - 11:00

Monte Carlo Simulation of a Quantum Critical Point in Graphene

I review how electrostatic interactions between relativistic electrons moving in a 2d sheet can lead to a Mott insulating phase induced by electron-hole pair condensation for sufficiently strong coupling, the transition between metallic and insulating phases defining a quantum critical point. Results from numerical simulations of a lattice effective field theory are presented revealing the critical number of species N below which the QCP exists, and its N-dependent characteristics. I then focus on voltage-biassed bilayer graphene, for which $N = 4$, which formally resembles QCD with non-zero isospin chemical potential and hence has no Sign Problem. Results for the carrier density, superfluid exciton condensate, and quasiparticle dispersion suggest a Fermi surface at non-zero voltage distorted by strong interactions.

Larus Thorlacius

University of Iceland

🕓 Friday 11:30 - 12:15

Classical and quantum temperature fluctuations via holography

We study local temperature fluctuations in a 2+1 dimensional CFT on the sphere, dual to a

black hole in asymptotically AdS spacetime. The fluctuation spectrum is governed by the lowest-lying hydrodynamic modes of the system whose frequency and damping rate determine whether temperature fluctuations are thermal or quantum.

Alfonso Ramallo

University of Santiago de Compostela

Friday 12:15 - 13:00

Holographic flavors in Chern-Simons matter theories

I will review the construction of holographic duals of Chern-Simons matter theories with unquenched flavors, following the approach started in the paper 1105.6045. In particular, I will focus on the construction of the gravity background with massive flavors and on the realization of quantum Hall effect on the worldvolume of D6-brane probes with internal flux.

Camilla Coletti

Center for Nanotechnology Innovation @ NEST, Istituto Italiano di Tecnologia

Friday 24, 14:30 - 15:15

Large-Area Highly-Crystalline Graphene: Synthesis, Characterization and Possible Applications

With its unconventional two-dimensional electron gas properties and exceptional thermal, optical and mechanical characteristics, graphene holds great potential for a wide variety of technological applications. However, the limited lateral dimension of graphene flakes obtained via micromechanical cleaving restricts the access to conventional surface science techniques for fundamental studies and is a serious hurdle towards the implementation of a scalable technology. Synthesis via chemical vapor deposition (CVD) is a promising approach toward a scalable production of highly-crystalline graphene. In this talk, the growth, characterization and modification of the electronic properties of large-area graphene on a variety of substrates ranging from copper (Cu) [1], to silicon carbide (SiC) [2], to hexagonal boron nitride (h-BN) will be discussed. In all instances highly-crystalline material is obtained, with great potential for a number of applications such as electronics and photonics [3,4].

References:

[1] V. Miseikis, D. Convertino, N. Mishra, M. Gemmi, T. Mashoff, S. Heun, N. Haghighian, F. Bisio, M. Canepa, V. Piazza, C. Coletti, 2D Materials 2 (1), 014006 (2015).

[2] U. Starke, S. Forti, K.V. Emtsev, C. Coletti, MRS Bulletin, Volume 37 (12), pp. 1177-1186 (2012).

[3] F. Bianco, V. Miseikis, D. Convertino, J.-H. Xu, F. Castellano, H. E. Beere, D. A. Ritchie, M. S. Vitiello, A. Tredicucci, C. Coletti, Optics Express 23 (9), 11632-11640 (2015).

[4] D. Spirito, S. Kudera, V. Miseikis, C. Giansante, C. Coletti, R. Krahne, Journal of Physical Chemistry C, accepted.

Peter Orland

Baruch College, City University of New York

Friday 17:15 - 16:00

Seeing Asymptotic Freedom in a Large-N Correlator

The sigma model of a field in SU(N) in 1+1 dimensions 1) is asymptotically free and 2) has applications in the study of gauge theories (massive gauge theory in 1+1 dimensions, q-qbar potentials in 2+1-dimensional Yang-Mills). The large-N Feynman diagrams of this sigma model are planar, hence mean-field/saddle-point methods do not work.

Exact correlators were eventually found by combining large-N methods with the form-factor bootstrap. Until recently, the behavior of these expressions was known in the infrared, but not tested in the ultraviolet. In this talk, I will describe the asymptotic ultraviolet form of the correlator of the scaling field. Although no perturbation theory was used in its derivation, its form confirms the result of the perturbative renormalization group.

Nick Evans

University of Southampton

Friday 16:30 - 17:15

Vacuum Alignment in Holographic Graphene

Somewhat inspired by graphene in which 2+1d Dirac fermions couple to strongly coupled 3+1d QED I investigate the D3/probe D5 holographic system. A magnetic field induces fermion condensation on the probe and there is a complex temperature vs chemical potential phase structure including a BKT transition at zero T with μ. The transition can be phenomenologically distorted into various non-mean field transitions. When two layers are introduced an additional dynamical mass generation can occur with condensation of fermions between different layers. With a B field a dynamical vacuum alignment problem results and we investigate the phase structure. In the presence of chemical potential as well it is possible to realize a phase with both condensation mechanisms present. Finally I consider how to describe the holographic graphene between two mirrors that compactify the gauge theory mimicing ideas for how real graphene could be made more strongly coupled in the lab. Condensation with the mirror graphene sheet is possible and a complex phase structure again results.