



**ISTITUTO NAZIONALE DI FISICA NUCLEARE**  
Gruppo Collegato di Parma (Sezione di Milano Bicocca)

## **HoloGAST**

5-6 November 2014 Parma  
DiFeST aula Rutherford

### **Schedule:**

#### **Wednesday 5**

- 11.30 Charlotte Kristjansen (NBI, Copenhagen)  
"Graphene from a string theoretical perspective" (I)
- 15.00 Andrea Marini (Perugia University and INFN Perugia)  
"Holographic models of a double monolayer semimetal"
- 16.45 Daniele Marmiroli (Nordita, Stockholm)  
"Phase structure of  $N=2^*$  SYM on ellipsoids"

#### **Thursday 6**

- 10.00 Natalia Pinzani-Fokeeva (Amsterdam University)  
"Effective actions for fluids from holography and the membrane paradigm"
- 11.45 Troels Harmark (NBI, Copenhagen)  
"Spin matrix theory: A quantum mechanical model for the AdS/CFT correspondence"
- 15.00 Aldo Cotrone (Florence University and INFN Firenze)  
"Holographic QCD with Dynamical Flavors"
- 16.45 Charlotte Kristjansen (NBI, Copenhagen)  
"Graphene from a string theoretical perspective" (II)

## Abstract

### **Charlotte Kristjansen**

*Graphene from a string theoretical perspective (I & II)*

We will explain how the particle/string duality makes it possible to study the strong coupling limit of certain two-dimensional systems which have some similarities with graphene. In particular, we will discuss how the quantum Hall effect could be seen to appear from the stringtheoretical point of view.

### **Andrea Marini**

*Holographic models of a double monolayer semimetal*

The formation of intra-layer and inter-layer exciton condensates in two models of a double monolayer semimetal is studied in the strong coupling limit using AdS/CFT duality. In both models we find a rich phase diagram which includes phase transitions between inter-layer and intra-layer condensates as the charge densities and the separation of the layers are varied. The tendency to inter-layer condensation is strongest when the charge densities are balanced so that the weak coupling electron and hole Fermi surfaces would be nested. For systems with multiple species of massless Fermions, we find a novel phase transition where the charge balance for nesting occurs spontaneously.

### **Daniele Marmiroli**

*Phase structure of  $N=2^*$  SYM on ellipsoids*

We analyse the phase structure of an  $N=2$  massive deformation of  $N=4$  SYM theory on an four-dimensional ellipsoid using recent results on supersymmetric localisation. Besides the 'tHooft coupling  $\lambda$ , the relevant parameters appearing in the theory and discriminating between the different phases are the hypermultiplet mass  $M$  and the deformation (or squashing) parameter  $Q$ . The master field approximation of the matrix model associated to the analytically continued theory in the regime  $Q \ll 2M$  and on the compact space, is exactly solvable and does not display any phase transition, similarly to  $N=2$   $SU(N)$  SYM with  $2N$  massive hypermultiplets. In the strong coupling limit, equivalent in our settings to the decompactification of the four-dimensional ellipsoid, we find evidence that the theory undergoes an infinite number of phase transitions starting at finite coupling and accumulating at  $\lambda = \infty$ . Quite interestingly, the threshold points at which transitions occur can be pushed towards the weak coupling region by letting  $Q$  approach  $2M$ .

### **Natalia Pinzani-Fokeeva**

*Effective actions for fluids from holography and the membrane paradigm*

Motivated by recent reformulations of hydrodynamics as an effective field theory in this talk I will show how to derive the low energy dissipationless effective action for conformal fluids from holography. I will give a precise geometrical interpretation of the emerging Goldstone bosons in terms of a family of spatial geodesics extending between the conformal boundary of the AdS back brane background and a finite cutoff in the interior of spacetime. I will argue how such effective action might be inconsistent on its own unless dissipative effects are included. This can be done by coupling the UV effective action to the near horizon IR part of the spacetime which we replace for simplicity with a membrane paradigm type boundary condition. I will also discuss the limits of validity of such approximation.

**Troels Harnark**

*Spin matrix theory: A quantum mechanical model for the AdS/CFT correspondence*

We introduce a new quantum mechanical theory called Spin Matrix theory (SMT). SMT describes N=4 super-Yang-Mills theory (SYM) near zero temperature critical points in the grand canonical phase diagram. Even though SMT is a non-relativistic quantum mechanical theory it contains a variety of phases mimicking the AdS/CFT correspondence.

**Aldo Cotrone**

*Holographic QCD with Dynamical Flavors*

Gravity solutions describing the Witten-Sakai-Sugimoto model of holographic QCD with dynamical flavors are presented. The field theory is studied in the Veneziano limit, at first order in the ratio of the number of flavors and colors. The gravity solutions are analytic and dual to the field theory either in the confined, low temperature phase or in the deconfined, high temperature phase with small baryonic charge density. The phase diagram and the flavor contributions to vacuum (e.g. string tension and hadron masses) and thermodynamical properties of the dual field theory are then deduced. The phase diagram of the model at finite temperature and imaginary chemical potential, as well as that of the unflavored theory at finite theta angle are also discussed in turn, showing qualitative similarities with recent lattice studies. Interesting degrees of freedom in each phase are discussed.