

Workshop

September 3-4, 2014

TIME	WEDNESDAY 3	THURSDAY 4
9:45-10:45	Vallier	Burda
10:45-11:15	Coffee	Coffee
11:15-12:15	Björnberg	Gomes
12:15-14:00	Lunch	Lunch
14:00-15:00	IFT Colloquim	Görllich
15:00-16:00	Schiappa	Vares
16:00-16:30	Coffee	Coffee
16:30-17:30	Nock	Napolitano
17:30-18:30	Garolera	Simm

Speakers and titles

Jakob Björnberg (Uppsala) *Local limits of random bipartite planar maps and random trees*

Random planar maps are central objects of study in modern random geometry. There is a well-known correspondence between bipartite (vertex-2-colourable) planar maps and labelled trees. Hence the theory of random trees is directly relevant to the study of random bipartite planar maps. In joint work with S. Stefansson we investigated random infinite graphs which arise as "local limits" of random bipartite planar maps, by using recent results on local limits of random trees. Our method yielded the existence of the local limit and a characterisation in terms of an infinite random tree. As an application, we used a recent result by Gurel-Gurevich and Nachmias to establish that random walk on the random infinite planar map is recurrent.

Zdzislaw Burda (Krakow) *Universal distribution of Lyapunov exponents for products of Ginibre matrices*

Starting from exact analytical results on singular values and complex eigenvalues of products of independent Gaussian complex random $N \times N$ matrices also called Ginibre ensemble we rederive the Lyapunov exponents for an infinite product. We show that for a large number t of product matrices the distribution of each Lyapunov exponent is normal and compute its t -dependent variance as well as corrections in a $1/t$ expansion. Originally Lyapunov exponents are defined for singular values of the product matrix that represents a linear time evolution. Surprisingly a similar construction for the moduli of the complex eigenvalues yields the very same exponents and normal distributions to leading order. We discuss a general mechanism for 2×2 matrices why the singular values and the radii of complex eigenvalues collapse onto the same value in the large- t limit. Thereby we rederive Newman's triangular law which has a simple interpretation as the radial density of complex eigenvalues in the circular law and study the commutativity of the two limits $t \rightarrow \infty$ and $N \rightarrow \infty$ on the global and the local scale. As a mathematical byproduct we show that a particular asymptotic expansion of a Meijer G-function with large index leads to a Gaussian.

Blai Garolera (Barcelona) *Applied localization*

In this talk I will discuss some of the many applications, properties and undeniable beauty of Wilson loop operators in gauge theories, concentrating specially in superconformal quantum field theories. The main tools I will be using are symmetry constraints, the AdS/CFT correspondence and the localization technique of Witten and Pestun.

João Gomes (DAMTP, Cambridge) *Quantum gravity and exact holography*

I'll show how to use localization in supergravity to compute exactly the free energy on AdS space and show the holographic correspondence beyond the large N limit. As an example, I'll consider the partition function of supergravity on AdS2 which computes the number of states of a supersymmetric black hole. After an intricate sum over geometries and topologies guided by number theoretic objects we obtain integrality of the answer. I'll also show how to extend these techniques to the AdS4/ABJM correspondence to compute in the bulk exactly in N and λ the perturbative partition function which is given by an Airy function as computed from the gauge theory.

Andrzej Görllich (NBI, Copenhagen) *Simplicial quantum gravity in four dimensions*

We introduce a simplicial regularization of four dimensional quantum gravity via Causal Dynamical Triangulations (CDT). In this non-perturbative and background independent framework, a quantum universe with a global shape of a Euclidean deSitter spacetime emerges as dynamically generated background geometry. Although no degrees of freedom were frozen, the measurements of the scale factor are well described by an effective action which agrees with the 'minisuperspace' model. We present recent results on the phase structure of the model and the transfer matrix approach. Further, we discuss microscopic and macroscopic properties of the geometry of the background universe.

George Napolitano (Lund) *Ising model on random planar Lorentzian triangulation*

In recent years, random graphs have been used to construct discrete models of quantum gravity, most notably the Causal Dynamical Triangulation model. Here, the path-integral over spacetime geometries is replaced by the sum over certain class of triangulations, called Lorentzian triangulations. In this framework, matter can be taken into account by coupling statistical mechanical models with the random triangulation. In this talk, I will discuss the annealed coupling between an Ising model, without external magnetic field, and a random planar Lorentzian triangulation. In particular, I will show recent results on the finiteness of the partition function and the existence of at least 2 Gibbs measures, at sufficient low temperature.

Andre Nock (Queen Mary, London) *Statistics of K-Matrices in Quantum Chaotic Scattering*

A scattering process can completely be characterized by its K-matrix. For chaotic quantum systems it can be modelled within the framework of Random Matrix Theory, where either the K-matrix itself or its underlying Hamiltonian is taken as a random matrix. I will show that both approaches are equivalent for a broad class of unitary invariant ensembles of random matrices, using correlation functions of products and ratios of integer powers of characteristic polynomials. We will discover that for orthogonal invariant ensembles one needs instead correlation functions of half-integer powers, and I will present results for a few of these correlation functions in the limit of large GOE-matrices along with some further examples where these objects also arise.

Ricardo Schiappa (IST, Lisbon) *Touring the resurgent structure of random matrices and strings*

Resurgent analysis opens a new window into the nonperturbative structure beyond asymptotic perturbative expansions which appear everywhere throughout Theoretical and Mathematical Physics. We shall briefly review the main ideas behind these techniques, illustrating them in several examples such as the large N expansion of random matrices and gauge theories, or within the string theoretic genus expansion. Explicit nonperturbative solutions may be constructed in the form of transseries, yielding very high-precision numerical checks of the large-order behavior of the perturbative and multi-instantonic asymptotic expansions, and further opening new windows into the phase structure of gauge and string theories at complex coupling.

Nicholas Simm (Queen Mary, London) *Mesoscopic spectral statistics and the fractional Brownian motion process with $H=0$*

In this talk I will discuss links between objects from random matrix theory and Gaussian fields with logarithmic correlations. The most famous example of such a field is the continuum 2d Gaussian free field which plays an important role in quantum field theory, among other areas. I will describe how various spectral statistics in (Hermitian) random matrix theory behave essentially like one-dimensional cuts of this field, provided that the size of the matrix in question goes to infinity. Since such fields are too irregular to exist pointwise, we construct a regularization based on generalizing the stochastic integral representing fractional Brownian motion. The latter field (which is logarithmically correlated) turns out to govern the statistics of characteristic polynomials of high-dimensional random matrices at mesoscopic scales. The proof is based on the steepest descent method for Riemann-Hilbert problems.

Thomas Vallier (Helsinki) *Bootstrap percolation on the random graph G_{np}*

Bootstrap percolation on the random graph G_{np} is a process of spread of "activation" on a given realization of the graph with a given number of initially active nodes. At each step those vertices which have not been active but have at least $r \geq 2$ active neighbors become active as well. We consider the n vertices with global connections inherited from the structure of the graph G_{np} , meaning that any two vertices share an edge with probability p independently of the others. The presentation is based on the article "Bootstrap percolation on the random graph G_{np} " by Janson, Luczak, Turova and Vallier. Among other results, they study the size A^* of the final active set depending on the number of vertices active at the origin as a function of n (the number of vertices) and $p = p(n)$ (the probability of connections) which is written $a_0(n,p) = a_0$. The model exhibits a sharp phase transition: depending on the parameters of the model the final size of activation with a high probability is either $n - o(n)$ or it is $o(n)$. I will give a pictorial introduction to the model and explain briefly the approach of the authors to derive the threshold for bootstrap percolation on G_{np} .

Maria Eulalia Vares (UFRJ, Rio de Janeiro) *Phase transitions in layered systems*

This is a joint work (in progress) with Luiz Renato Fontes (IME-USP), Domingos Marchetti (IF-USP), Immacolata Merola (L'Aquila), and Errico Presutti (L'Aquila). We study phase transitions for a class of Ising spin systems on the two-dimensional square lattice, for which there are horizontal interactions given by a ferromagnetic Kac potential with range $1/\gamma$ and small nearest neighbor ferromagnetic vertical interaction.