UNIVERSITÄT BIELEFELD

Faculty of Physics
Faculty of Mathematics

THE UNIVERSITY OF MELBOURNE

Seminar

Bielefeld - Melbourne Random Matrices

Gregory Schehr

Laboratoire de Physique Théorique et Modèles Statistiques

Non-interacting trapped fermions: from GUE to multi-critical matrix models

I will discuss a system of N one-dimensional free fermions in the presence of a confining trap $V(x) $. For the harmonic trap $V(x) \propto x^2$ and at zero temperature, this system is intimately connected to random matrices belonging to the Gaussian Unitary Ensemble (GUE). In particular, the spatial density of fermions has, for large N, a finite support and it is given by the Wigner semi-circular law. Besides, close to the edges of the support, the spatial quantum fluctuations are described by the so-called Airy-Kernel, which plays an important role in random matrix theory. We will then focus on the joint statistics of the momenta, with a particular focus on the largest one $p_{\rm max}$. Again, for the harmonic trap, momenta and positions play a symmetric role and hence the joint statistics of momenta is identical to that of the positions. Here we show that novel ``momentum edge statistics" emerge when the curvature of the potential vanishes, i.e. for "flat traps" near their minimum, with $V(x) \sim x^{2n}$ and $n>1$. These are based on generalisations of the Airy kernel that we obtain explicitly. The fluctuations of $p_{\rm max}$ are governed by new universal distributions determined from the n-th member of the second Painlevé hierarchy of non-linear differential equations, with connections to multi-critical random matrix models, which have appeared, in the past, in the string theory literature.

Wednesday, 14 October 2020, 0900 hrs CEST

Zoom Konferenzschaltung— Please contact Gernot Akemann (akemann@physik.uni-bielefeld.de) for details regarding access

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