Internship proposal 2024

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Random geometry of non-unitary conformal field theories

The team of Jesper Jacobsen works on the precise characterisation of random critical phenomena in two dimensions, using exact methods of conformal field theory, quantum integrability and lattice algebras. We study models of percolation, self-avoiding walks, random clusters, and spin domain walls, to mention but a few. These models have obvious applications in statistical physics, but they can also be related to 1D transport models and quantum Hall type transitions in 2D electron gases. The current forefront of research is the determination of correlation functions in such models, in terms of the non-local geometrical degrees of freedom.

In this stimulating and fast-moving field, two proposals seem well adapted to the time frame of an internship. But other options are possible, depending on the tastes and interests of the intern.

The first proposal is motivated by a recently introduced model of (algebraic) spider webs, which are extended branching interfaces on a lattice. We have some exact understanding of the underlying models by means of their quantum group symmetries, but correlation functions are poorly understood. To access them we need a transfer matrix description of the geometrical degrees of freedom. If this can be achieved, it opens the route to the determination of new fractal dimensions and crossing probabilities for spider webs.

The second proposal is motivated by the very recent (October 2023) exact determination by probability theorists of the fractal dimension of the conducting piece of a percolation cluster, the so-called backbone. Twenty years ago we defined an unusual kind of transfer matrix for this problem. To understand geometrical correlation functions on the percolation backbone, we believe that one should first understand better the properties of this transfer matrix in terms of lattice algebras, and more precisely the affine Temperley-Lieb algebra.

The internship can lead to a thesis in the same or a similar domain of theoretical physics.