Université Pierre et Marie Curie PARIS 6

Habilitation à diriger des recherches

Spécialité : Physique Théorique

présentée par

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Sujet :

Physique statistique de modèles contraints sur réseaux réguliers et aléatoires: des pliages aux méandres

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Abstract

This dissertation discusses the statistical properties of strongly constrained systems intimately linked to problems of *folding* of two-dimensional discrete lattices, either regular or random.

In the first part, we consider precisely the folding of two-dimensional lattices: the problem is to fold a lattice along its edges while keeping its faces undeformed. We study in details the case of the triangular lattice, for which several models of folding are discussed, corresponding to several "target spaces". The link between foldings, colorings and fully packed loop gases is discussed. We finally extend our description to the case of folding of random triangulations.

The second part is devoted to fully packed loop gases, i.e. loops visiting all the nodes of a lattice. In the case of random lattices, our study will reveal how the bipartite nature of the lattice does change the statistical properties of the system. A particular attention is paid to Hamiltonian cycles, corresponding to the case where the lattice is covered by a single loop, and for which an irrational configuration exponent is predicted for an apparently harmless combinatorial problem.

Finally, the third part is devoted to meanders, an apparently simple combinatorial problem (count the configurations of a circuit crossing a river at a given number of bridges) which remains unsolved to this day. After giving a few exact results for some variants of the problem, we study the asymptotic properties (at large number of bridges) of meanders. Their formulation as a gas of fully packed loops on random graphs allows to predict irrational configuration exponents which are tested numerically. The link between meanders and foldings of random quadrangulations is also established.