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Book Review: *Statistics of Linear Polymers in Disordered Media*

Statistics of Linear Polymers in Disordered Media. Ed. B. K. Chakrabarti, Elsevier, Amsterdam, 2005.

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This volume is a collection of advanced reviews on statistical properties of linear polymer chains in disordered environments, e.g., porous media or disordered lattices. Many general problems in polymer statistics were solved in the early 1970s through the recognition by de Gennes and des Cloiseaux that the $n = 0$ limit of the n-vector magnetic model could describe configurational statistics of self-avoiding walks. However, a similar degree of success was not attained with problems of polymers in disordered media. There are no lack of brilliant conceptual advances and development of sophisticated formal tools. Nevertheless the problem of disorder is one that presents extreme difficulties as in many other fields in which it arises, and research in the field is as vigorous as ever, as attested to by this volume.

A sampling of a variety of topics is encapsulated in the several authoritative reviews. The subjects covered and the corresponding authors are: B. K. Chakrabarti: Polymers in random media: an introduction. [A general introduction to the subject matter covered in the volume together with an introduction to SAW (self-avoiding walk) statistics together with an exposition of how the size exponent is affected by parameters of the disordered medium] S. M. Bhattacharjee: Self-avoiding walks on lattices for various constrained and random geometries. [The effects of randomness are described on two levels; the randomness of the medium as described in terms of a random external potential, and the randomness intrinsic to the polymer chain itself. Few derivations are given]

A. J. Guttmann: Self-avoiding walks in constrained and random geometries: Series studies. [An encyclopedic review of statistical properties of SAW's in random geometries, wedges, strips, slabs, cubes, quasiperiodic tilings, on polygons and hyperbolic lattices. Properties of such SAW's are then used to model the denaturation transition of DNA, lipid vesicle collapse, and macromolecular desorption from the surface]

V. Blavatska, C. von Ferber, R. Folk and Yu Holovatch: Self-avoiding walks on non-random fractals using real-space renormalization group methods. [An overview of renormalization group methods in evaluating the partition function and consequent properties of polymers in disordered media. Models are devised to describe effects of disorder in terms of effective Hamiltonians. Renormalization group methods are then applied in the very long polymer limit. This chapter is mainly methodological, suggesting to the reader the various modifications to real-space renormalization methods required to deal with different forms of disorder]

D. Dhar and Y. Singh: Numerical properties of self-avoiding walks on deterministic and random fractals. [Various approaches to the properties of polymers on deterministic fractal lattices, the emphasis being on analytical real-space renormalization group techniques]

A. Ordemann, M. Porto and H. E. Roman: Localization problem of polymers in random media and the quantum mechanical analogy. [Properties of polymers on deterministic fractal lattices and dealt with using simulation and exact enumeration methods. Both this and the preceding chapter together give a thorough pedagogical introduction to the subject of polymers on fractals and are a significant focus of this volume]

Y. Y. Goldschmidt and Y. Shiferaw: Localization of polymers in random media: Analogy with quantum particles in disorder. [One of the best-written and informative chapters in the whole volume. The authors rely heavily on the mapping between a polymer in a disordered environment, describable in terms of a random external potential and a quantum particle in the same random external potential. They show how system volume plays a crucial role in this case and the pitfalls of not taking this role into account properly. The phenomenon of localization is explained in terms of the dominance of localized tail states of the Schrodinger equation and its connection with the 1-step symmetry-breaking solution. All of the details are formulated in an accessible, clear, and admirably pedagogical style. The general theory of a polymer in a disordered environment is then used to treat the problem of a polymer chain in a sea of hard obstacles that induce the localization-delocalization transition of the polymer chain]

P. Bhattacharyya and A. Chatterjee: Geometric properties of optimal and most probable paths on randomly disordered lattices. [Deals with a variant of a polymer chain in a disordered environment problem which is shown to reduce to finding the minimum energy and minimum free energy paths for optimal and most probable paths in a disordered environment. Also related to the traveling salesman problem]

G. D. J. Phillies: Phenomenology of polymer single-chain diffusion in solution. [A well-worth reading experimental contribution, giving an extremely thorough review of all of the experimental work on the motion of polymer chains through solutions of matrix polymers. A large amount of experimental data is reviewed and different suggested scaling forms for physical parameters are

compared and discussed. The author is to be commended for undertaking this extremely informative and exhaustive study of much of the presently available literature]

As should be evident, the exposition level is quite advanced, but there may nevertheless be material of interest to non-specialists.

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