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Book Review

Statistical Theory & Random Matrices. *Moshe Carmeli.* Marcel Dekker Inc., New York: Pure and Applied Math Service, 1983. 184 pages, $35.00.

Random matrices in physics go back to the early fifties, and were introduced by Landau and Smorodinskij, Wigner and Dyson to make predictions about spectral properties of highly excited nuclei. They supposed that the collective properties of the energy eigenvalue distribution of such systems could be profitably mimicked by the spectrum of statistical ensembles of finite rank Hermitian matrices, subject only to symmetry requirements.

Besides this application, which has been properly developed and matched with experimental results, random matrices play an important role today in understanding the possible manifestations of classical chaotic motion in quantum systems: it is likely that they could be considered as "abstract models" of chaotic quantum systems; indeed, some results showing a sort of universality of fluctuations in level distribution, provided by random matrices ensembles, seem to confirm this idea.

Professor Carmeli's book is an easy-flowing introduction to this field, valuable for the care provided in discussing step by step the physical meaning of the theory, which usually blocks beginners.

Chapter 1 is a brief dissertation on the application of random matrices to nuclear problems such as the statistics of energy levels and transition strengths. This is the only physical application considered in this work. Chapter 2 is an explanation of the necessity of statistical methods in dealing with nuclear sequences of levels. It contains the essence of the notion of complexity, which every statistical physicist should meet.

A minor misunderstanding, worth noting only because it is rather common, could arise from the identification of completely random sequences with Poisson sequences, put forward in Chapter 2. There is no reason in the theory of chaos for such a distinguished role of the Poisson sequence, which accounts only for a particular form of conditional probability of occurrence of eigenvalues on the energy axis.

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Chapter 3 deals with symmetry principles applied to random matrices. It sketches the geometrical properties implied by time-reversal and rotational symmetries. On this basis, Dyson's threefold-way, statistical ensembles are introduced: Gaussian (Chapters 4, 6, 9), orthogonal (Chapter 4), unitary (Chapter 5), and symplectic (Chapter 8).

Chapter 7 concerns the statistics of transition strengths, that is, level widths, while Chapter 10 provides a concluding summary. Two appendices on multivariate distributions have a certain interest for the advanced reader, their technical details contrasting sharply with the general tone of the book.

An introduction to fluctuation measures and ergodic problems is given in a third appendix. There is a large and almost complete list of references on the most recent approaches to the topics dealt with in the book, both from mathematical and the physical viewpoints.

This book, with its clear and well-organized exposition, is particularly suited for nonspecialist readers desiring a general view of the theory. More advanced readers, however, should refer to some works cited in the bibliography, particularly to Mehta's book *Random Matrices* or to the work of Brody et al. [*Reviews of Modern Physics*, **53** (1981)] to which the present book is greatly indebted.

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