Random Matrices and Their Applications
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Preface

This volume represents the most recent trends in the random matrix theory with a special emphasis on the exchange of ideas between physical and mathematical communities. The main topics include:

- random matrix theory and combinatorics
- scaling limits; universalities and phase transitions in matrix models
- topologico-combinatorial aspects of the theory of random matrix models
- scaling limit of correlations between zeros on complex and symplectic manifolds

Most contributions are based on talks and series of lectures given by the authors during the MSRI semester "Random Matrix Models and Their Applications" in Spring 1999, and have an expository or pedagogical style.

One of the basic ideas of the MSRI semester was to bring together the leading experts, both physicists and mathematicians, to discuss the latest results in the theory of matrix models and its applications. The book follows this line: it is divided roughly in half between physics and mathematics. The papers by physicists (G. Cicuta; Ph. Di Francesco; V. Kazakov; G. Mahoux, M. Mehta, J.-M. Normand; P. Zinn-Justin) give an overview of different physical problems in which the random matrix theory plays a decisive role, along with a rich variety of methods and ideas used to solve the problems. This includes enumeration of Feynman graphs on Riemann surfaces in the context of two-dimensional quantum gravity, spin systems on random surfaces, "meander problem" and random foldings, enumeration of knots and links, phase transitions and critical phenomena in random matrix models, interacting matrix models, etc.

The papers by mathematicians are devoted to recent breakthrough results on the statistics of longest increasing subsequence in random permutations and related problems of representation theory (J. Baik, E. Rains; A. Borodin, G. Olshanski; A. Its, C. Tracy, H. Widom; K. Johansson; A. Okounkov), universality of correlations between zeros on complex and symplectic manifolds (P. Bleher, B. Shiffman, S. Zelditch), applications of Hankel matrices to the theory of random matrices (E. Basor, Y. Chen, H. Widom), orthogonal polynomials (M. Ismail), interpolation properties of the ensembles of random matrices (P. Forrester, E. Rains), and integrable systems in the theory of random matrix models (J. Harnad and P. van Moerbeke). The paper of I. Kostov, I. Krichever, M. Mineev-Vainstein, P. Wiegmann, and A. Zabrodin is written by physicists and mathematicians and it relates conformal maps to integrable systems and matrix models.

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