Topical issue on Geometry, Integrability and Nonlinearity in Condensed Matter Physics

Recent developments in the study of nonlinear phenomena have led to the realization that a combination of the concepts of integrability, geometry and topology provides a new powerful framework for describing a great variety of physical systems. It was therefore felt that the compilation of a special issue comprising articles on the interdisciplinary topic of Geometry, Integrability and Nonlinearity in Condensed Matter Physics, would indeed be timely. The enthusiastic response and support that we received from the active researchers in this subject, when we organized an International Conference on the above topic from July 15 to July 20, 2001, in Bansko, Bulgaria, provided a further motivation for undertaking this task.

As the topic is interdisciplinary in nature, the articles in this volume contain new results on a wide range of subjects. These include among others, integrable equations and the interplay between geometry and nonlinearity, the role of optical solitons in communication (and, possibly, computation), common nonlinear and geometrical aspects of condensed matter, field theory, and so on. The increasingly important role played by geometry and topology in diverse areas such as the quantum Hall effect, localization, deformation and elasticity, quasiparticle kinetics and dynamics, spin systems, membranes, is highlighted in some of the articles. There are papers in which essential links of nonlinearity to differential geometry are identified and many elegant mathematical methods are presented. Some other articles focus on how the mathematical tools of geometry and nonlinear analysis can be applied to solve certain physical problems.

Given the vast range of titles, it was difficult to strictly divide the contributions into distinct categories. Except for the pedagogical introductory article by Rajaraman titled "CP_N Solitons in Quantum Hall Systems", which essentially "sets the stage" for the various themes covered, we have grouped the articles broadly under the following headings: Geometry, integrability and mathematical physics; Solitons: Interaction phenomena, nonlinear optics; Condensed matter physics; Soft condensed matter physics; Quantum phenomena.

We gratefully acknowledge the support from Los Alamos National Lab, USA; Université de Cergy-Pontoise, France; The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy and the Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria, in putting this special volume together. We believe that the cross-fertilization and synergy of a host of ideas in seemingly disparate fields of physics would lead to the natural emergence of new paradigms, which in turn could pave the way for collaborative research to arrive at new solutions of complex nonlinear problems. It is our hope that this topical issue will be useful in providing an impetus for achieving this broad objective.

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