Lecture Notes in Physics

Springer
Berlin
Heidelberg
New York
Barcelona
Budapest
Hong Kong
London
Milan
Paris
Santa Clara
Singapore
Tokyo

The Editorial Policy for Proceedings

The series Lecture Notes in Physics reports new developments in physical research and teaching – quickly, informally, and at a high level. The proceedings to be considered for publication in this series should be limited to only a few areas of research, and these should be closely related to each other. The contributions should be of a high standard and should avoid lengthy redraftings of papers already published or about to be published elsewhere. As a whole, the proceedings should aim for a balanced presentation of the theme of the conference including a description of the techniques used and enough motivation for a broad readership. It should not be assumed that the published proceedings must reflect the conference in its entirety. (A listing or abstracts of papers presented at the meeting but not included in the proceedings could be added as an appendix.)

When applying for publication in the series Lecture Notes in Physics the volume's editor(s) should submit sufficient material to enable the series editors and their referees to make a fairly accurate evaluation (e.g. a complete list of speakers and titles of papers to be presented and abstracts). If, based on this information, the proceedings are (tentatively) accepted, the volume's editor(s), whose name(s) will appear on the title pages, should select the papers suitable for publication and have them refereed (as for a journal) when appropriate. As a rule discussions will not be accepted. The series editors and Springer-Verlag will normally not interfere with the detailed editing except in fairly obvious cases or on technical matters.

Final acceptance is expressed by the series editor in charge, in consultation with Springer-Verlag only after receiving the complete manuscript. It might help to send a copy of the authors' manuscripts in advance to the editor in charge to discuss possible revisions with him. As a general rule, the series editor will confirm his tentative acceptance if the final manuscript corresponds to the original concept discussed, if the quality of the contribution meets the requirements of the series, and if the final size of the manuscript does not greatly exceed the number of pages originally agreed upon. The manuscript should be forwarded to Springer-Verlag shortly after the meeting. In cases of extreme delay (more than six months after the conference) the series editors will check once more the timeliness of the papers. Therefore, the volume's editor(s) should establish strict deadlines, or collect the articles during the conference and have them revised on the spot. If a delay is unavoidable, one should encourage the authors to update their contributions if appropriate. The editors of proceedings are strongly advised to inform contributors about these points at an early stage.

The final manuscript should contain a table of contents and an informative introduction accessible also to readers not particularly familiar with the topic of the conference. The contributions should be in English. The volume's editor(s) should check the contributions for the correct use of language. At Springer-Verlag only the prefaces will be checked by a copy-editor for language and style. Grave linguistic or technical shortcomings may lead to the rejection of contributions by the series editors. A conference report should not exceed a total of 500 pages. Keeping the size within this bound should be achieved by a stricter selection of articles and not by imposing an upper limit to the length of the individual papers. Editors receive jointly 30 complimentary copies of their book. They are entitled to purchase further copies of their book at a reduced rate. As a rule no reprints of individual contributions can be supplied. No royalty is paid on Lecture Notes in Physics volumes. Commitment to publish is made by letter of interest rather than by signing a formal contract. Springer-Verlag secures the copyright for each volume.

The Production Process

The books are hardbound, and the publisher will select quality paper appropriate to the needs of the author(s). Publication time is about ten weeks. More than twenty years of experience guarantee authors the best possible service. To reach the goal of rapid publication at a low price the technique of photographic reproduction from a camera-ready manuscript was chosen. This process shifts the main responsibility for the technical quality considerably from the publisher to the authors. We therefore urge all authors and editors of proceedings to observe very carefully the essentials for the preparation of camera-ready manuscripts, which we will supply on request. This applies especially to the quality of figures and halftones submitted for publication. In addition, it might be useful to look at some of the volumes already published. As a special service, we offer free of charge LaTeX and TeX macro packages to format the text according to Springer-Verlag's quality requirements. We strongly recommend that you make use of this offer, since the result will be a book of considerably improved technical quality. To avoid mistakes and time-consuming correspondence during the production period the conference editors should request special instructions from the publisher well before the beginning of the conference. Manuscripts not meeting the technical standard of the series will have to be returned for improvement.

For further information please contact Springer-Verlag, Physics Editorial Department II, Tiergartenstrasse 17, D-69121 Heidelberg, Germany

R. López-Peña R. Capovilla R. García-Pelayo
H. Waelbroeck F. Zertuche (Eds.)

Complex Systems and Binary Networks

Guanajuato Lectures
Held at Guanajuato, México
16–22 January 1995

Springer

Editors

Ramón López-Peña
Henri Waelbroeck
Instituto de Ciencias Nucleares, UNAM
Apdo. Postal 70-543
México, D.F., 04510, México

Riccardo Capovilla
Depto. de Física, CINVESTAV IPN
Apdo. Postal 14-740
México, D.F., 07000, México

Ricardo García-Pelayo
Instituto de Física, UNAM
Apdo. Postal 20-364
México, D.F., 01000, México

Federico Zertuche
Instituto de Investigaciones en Matemáticas Aplicadas
y en Sistemas, Sección Cuernavaca, UNAM
Apdo. Postal 48-3
62251 Cuernavaca, Morelos, México

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Complex systems and binary networks : Guanajuato lectures, held at Guanajuato, México, 16 - 22 January 1995 / R. López-Peña ... (ed.). - Berlin ; Heidelberg ; New York ; Barcelona ; Budapest ; Hong Kong ; London ; Milan ; Paris ; Tokyo : Springer, 1995
(Lecture notes in physics ; 461)
ISBN 3-540-60339-5
NE: López-Peña, Ramón [Hrsg.]; GT

ISBN 3-540-60339-5 Springer-Verlag Berlin Heidelberg New York

Typesetting: Camera-ready by the authors
SPIN: 10514988 55/3142-543210 - Printed on acid-free paper

Preface

A leading figure in Complex Systems once said: "Complex Systems are like beauty: You know it when you see it". This sentences gives rise, of course, to ample epistemological considerations. The most cheerful which comes to our mind is a remark due to Benoit Mandelbrot: At an early stage of the development of a subject, a certain vagueness in the definition is advantageous in that it doesn't limit future paths of evolution.

But we prefer to focus on the first sentence. Inspired by that sweeping definition, we have taken a direct, hands-on approach to this subject, which is wide open, multiple and open to joyful innovations. The origin of the list of topics is therefore our unbounded desire to learn and explore, which we hope the reader shares.

The mathematics of complex systems weaves its web over a wide range of fields. From the theory of information to knot theory, from neural computing to evolution theory, from galaxy formation to the birth of universes, most areas of modern physics stand to receive some new insight from complex systems theory.

Conversely, in order to understand complex systems one must draw inspiration from various sources and break free from overspecialization. That is the practical motivation for this work. To promote the cross-fertilization of ideas, we attempted to select a sampling of contributions such that each has something to learn from every other, and something to offer in return.

The book is structured so as to begin with those contributions which help to set up a general theoretical framework, and end with selected applications to particular areas of physics, in particular biophysics (RNA), statistical physics (Ising and Potts models) and astrophysics and cosmology.

In the attempts to measure complexity Chaitin's stands out for its naturalness. It is also deeply bound to Gödel's theorem, on the mathematics side, and to statistical mechanics and information theory on the physics side.

In the next section, Kauffman succeeds in giving a very clear introduction to knot theory, a subject which has a reputation for being intimidating, and in spelling out its applications to statistical mechanics and topological field theory.

To cap the theoretical structures and move into applications, Stadler offers a mathematical framework to accommodate all problems which can be formulated in terms of a "fitness landscape" over hypercubes, from the Travelling Salesman Problem to RNA secondary structures.

Derrida, a world authority on binary networks, gives us a solid introduction to this topic and to the statistical mechanics related to it, with an emphasis on the physical applications of complexity.

Finally, Smolin proposes a view of the Universe which challenges the imagination, from self-organizing models of galaxy formation to the birth of baby universes and the condensation of structure constants.

Of course no single book can possibly contain an exhaustive list of the developments of complex systems theory. Instead, we have attempted to provide a palette of colors, which the reader is invited to blend into a painting more faithful to his/her own interest and imagination.

Mexico City
August 1995

R. García-Pelayo
H. Waelbroeck

Contents