

PREFACE

The use of concepts borrowed from topology has led to major advances in theoretical physics in recent years.

In quantum field theory, the pioneering work by Skyrme and follow-ups on classical solutions of Yang-Mills-Higgs theories has led to the discovery of the non-perturbative sectors of gauge theory.

Topology has also found its way into condensed matter physics. Classification of defects in ordered media by homotopy theory is a well-known example (see e.g. Kleman and Toulouse, *Les Houches XXXV*, 1980).

More recently, topology and condensed matter physics have again met in the realm of the fractional quantum Hall effect. Experimental progress in molecular beam epitaxy techniques leading to high-mobility samples allowed the discovery of this remarkable and novel phenomenon. These developments lead also to the attribution of the 1998 Nobel Prize in physics to Laughlin, Störmer and Tsui.

The notions of fractional charge as well as fractional statistics can be interpreted by a topological interaction of infinite range. So it is natural to find in the *Les Houches* series a school devoted to quantum Hall physics, intermediate statistics and Chern-Simons theory. This session also included some one-dimensional physics topics like the Calogero-Sutherland model and some Luttinger-liquid physics.

Polymer physics is also related to topology. In this field topological constraints may be described by concepts from knot theory and statistical physics. Hence this session also included Brownian motion theory related to knot theory.

The school started with a theoretical survey by Steve M. Girvin on the quantum Hall effect, including recent developments on skyrmions. An experimental review was given at the same time by Mansour Shayegan. Chern-Simons theories were discussed by Gerald Dunne. The physics of anyons and quantization in two dimensions was presented by Jan Myrheim. One-dimensional statistics was reviewed by Alexios Polychronakos. Hubert Saleur discussed conformal field theory and recent applications to impurity problems. The evidence for fractional charge in shot noise measurements was presented by D. Christian Glattli. Serguei Nechaev and Bertrand Duplantier presented Brownian motion, braid group theory and the link with knot theory. A seminar by Vincent Croquette was devoted to recent applications to DNA physics.

A general overview of the role of topology in physics was given by David Thouless. The very notion of topological quantum numbers was illustrated by various examples from quantum Hall physics to superfluids. Vortices were also a common theme in a seminar given by Eric Akkermans.

The all-important role of disorder in the quantum Hall effect was discussed in a review seminar by John Chalker and a more specialized talk by Jean Desbois, who concentrated on a model with a random magnetic field.

Matthew P.A. Fisher was unfortunately unable attend the session as originally scheduled. However, he kindly produced the lecture notes that are included in this volume. We are very grateful to him for this. The lectures by Bertrand Duplantier led to no written version at all, contrary to the school tradition.

There were two sessions devoted to participant's seminars and the list of these is given at the end of the book.

We were able to admit only a limited number of participants among all the many highly qualified people who applied. We hope that the quick publication of this volume will give everyone access to some of the benefits of this school.

This session LXIX was possible thanks to support from:

- Université Joseph Fourier, Grenoble, the Ministère de l'Éducation Nationale, de la Recherche et de la Technologie (MENRT), the Centre National de la Recherche Scientifique (CNRS) and the Commissariat à l'Énergie Atomique (CEA);
- the Division for Scientific Affairs of NATO whose ASI program included this session;
- thanks are also due to the NSF of U.S.A.

Orientations and choices were approved by the Scientific Board of the École de Physique des Houches.

Last, but not least, very special thanks are due to Ghislaine d'Henry, Isabel Lelièvre and Brigitte Rousset for their valuable assistance during the preparation of this session as well as during the session. Thanks are also due to "Le Chef" as well as to all the people in Les Houches who made this wonderful session possible.

A. Comtet
T. Jolicœur
S. Ouvry
F. David