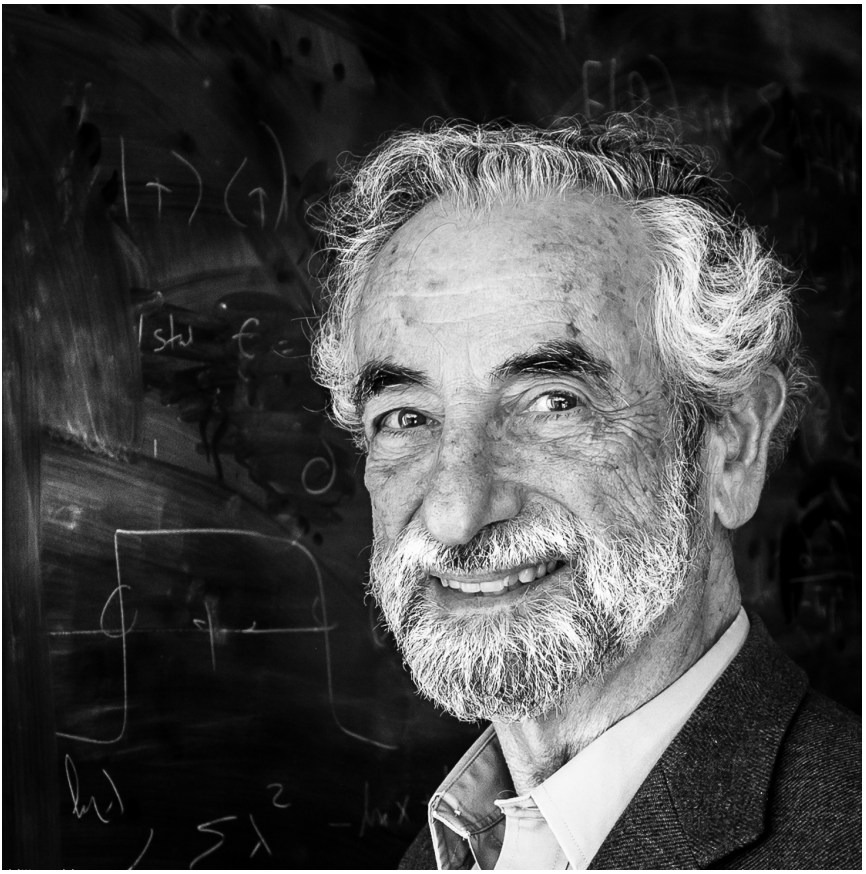

Preface

With these two volumes we would like to celebrate some of the many contributions of Elliott Lieb to the fields of mathematics and physics. They appear on the occasion of his 90th birthday and, in the name of all contributors, we would like to send him our best wishes!

Elliott has made fundamental contributions to vast swathes of mathematics and physics and he has developed powerful new tools and methods in the style of the greatest minds in science. His work is characterized by a fruitful interaction between physics and mathematics that enriches both disciplines. He has broken new grounds in many areas in mathematics and physics, including analysis, integrable systems, as well as quantum and statistical physics.

We do not attempt to give a comprehensive list of Elliott's achievements here, but rather invite the reader to browse the various chapters of these books to get an overview of the many areas Elliott has made fundamental contributions to. Among the highlights, let us just mention

- the exact solution of the ice model (and the invention of the Temperley–Lieb algebra a few years later) which is widely recognized as a paradigm of exact solvability in statistical mechanics;
- his landmark contributions towards understanding the stability of matter problem in quantum mechanics (including the invention of the Lieb–Thirring inequalities, which have since become an indispensable tool in many questions in modern analysis);
- the proof of the strong subadditivity of the von Neumann entropy, also known as the data processing inequality in quantum information theory, which continuous to play an essential role in the modern and very active theory of quantum computation.

The far reaching impact of Elliott's work is clearly manifested in the numerous concepts that bear his name. Besides the already mentioned Lieb–Thirring inequalities and the Temperley–Lieb algebra, these include the Brascamp–Lieb and Berezin–Lieb inequalities, the Lieb–Oxford inequality giving a precise estimate on correlation energies in Coulomb systems (which is of particular importance in modern density functional theory in quantum chemistry), the Lieb–Liniger model of bosons in one dimension, and the Lieb–Robinson bounds for propagation in quantum spin systems, just to mention a few. The reader is invited to consult the *list of themes* at the back of these books, where an extensive (although not exhaustive) list of concepts Elliott has worked on is given, together with a reference to the various chapters where these concepts play an important role.

The goal of this book is to demonstrate the impact of Elliott's work on a very broad range of topics in mathematics and physics. Many chapters are directly concerned with Elliott's work and the resulting subsequent developments, while others are only loosely connected to it. We have tried to cover most of the areas Elliott has made groundbreaking contributions to, but we have certainly not managed to cover all of them, despite the 1300 pages of these two volumes.

We are grateful to Apostolos Damialis and the staff at EMS Press for their support. Most importantly, we wish to thank all contributors to these volumes for their efforts.

Elliott, we wish you good health and numerous fruitful years to come in mathematics, in physics and in life in general!

May 2022

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Mathieu Lewin
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