Undergraduate Lecture Notes in Physics

For further volumes:
http://www.springer.com/series/8917

Undergraduate Lecture Notes in Physics (ULNP) publishes authoritative texts covering topics throughout pure and applied physics. Each title in the series is suitable as a basis for undergraduate instruction, typically containing practice problems, worked examples, chapter summaries, and suggestions for further reading.

ULNP titles must provide at least one of the following:

- An exceptionally clear and concise treatment of a standard undergraduate subject.
- A solid undergraduate-level introduction to a graduate, advanced, or non-standard subject.
- A novel perspective or an unusual approach to teaching a subject.

ULNP especially encourages new, original, and idiosyncratic approaches to physics teaching at the undergraduate level.

The purpose of ULNP is to provide intriguing, absorbing books that will continue to be the reader's preferred reference throughout their academic career.

Series Editors

Antonis Modinos

From Aristotle to Schrödinger

The Curiosity of Physics

Springer

Antonis Modinos
Emeritus Professor of Physics
National Technical University of Athens
Athens
Greece

ISSN 2192-4791 ISSN 2192-4805 (electronic)
ISBN 978-3-319-00749-6 ISBN 978-3-319-00750-2 (eBook)
DOI 10.1007/978-3-319-00750-2
Springer Cham Heidelberg New York Dordrecht London

Library of Congress Control Number: 2013943981

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Raise now the third Olympus, on which
Science shall be enthroned.

She is the only reality, laughterless, and yet

What smile, what gold or silver, is sweeter
than her face?

Away with Olympian mists! If the heart is a
miracle, the mind is its eye!

Kostis Palamas, Twelve Lays of the Gipsy

Translated by George Thomson

Preface

The romantic poet Samuel Taylor Coleridge, born in 1772, was an amateur chemist and had a lively interest in all science. He opined that: *the activity of science being necessarily performed with the passion of hope, it is poetical*. And when one looks at the collective effort of humanity to understand and describe in an intelligible manner the ways of nature, the process of doing so passing from generation to generation and from one epoch to the next, he may reasonably claim that there is an inspiring epic story second to none, poetic indeed! And yet one must admit that there is no easy way to tell this story.

There are many books (some very good) which endeavour to tell the story of physics (or some branch of physics) without using any mathematics at all. However good these books are, they miss at least half of the story. They are not good enough for the student and teacher of physics who knows that physics would not be the exact science it is without mathematics. The present book is intended primarily for the student and teacher of physics and assumes a familiarity with mathematics beyond high school, for the text to be fully appreciated. The book aims not only to say *who has done what*, but to do so in a way that contributes to a better understanding of physics and how it progresses. However, knowing that too much mathematics will be a hindrance to many readers, I chose a middle way; I use a minimum of mathematics, by which I mean the descriptive power of its symbols, but very little mathematical calculation as such, except in some of the exercises. Moreover, the mathematical concepts needed for the telling of the story are introduced along the way. They are part of the story. Neither do I aim to present a complete history of physics and all its achievements past and present. That lies beyond my ability. I tried to put together a meaningful story of the main events (ideas and facts) from Aristotle to Schrödinger as they developed historically. Though the emphasis is on the physics (observation, experiment, theory, some applications), the story is supplemented by short sections on the lives and times of the main protagonists. My story ends with the development of quantum mechanics (Chap. 13). Some important applications of quantum mechanics to atoms, molecules and solids are described in Chap. 14. Finally, in Chap. 15, devoted to the very small and the very large, I refer very briefly to recent developments (of the last 50 years or so) in nuclear particle physics and in cosmology (a comprehensive review of these developments lying beyond the scope of the present book). I included a few exercises at the end of each chapter. Some of

these relate directly to formulae given in the text, and some deal with applications not dealt with in the text.

Though the book is meant primarily for the student and teacher of physics, it will be of interest, I hope, to other scientists and to historians of science, and also to curious minds of any age or profession who wish to know something about science, how it started, relatively simple, and how it developed to its present day magnificence and sophistication.

I would like to thank Andreas Kyritsakis for his valuable assistance in the preparation of the diagrams.

A. Modinos

Contents