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Physics: Concepts and Practice

物理学：概念与实践

（英文版·文科类）

（美）拉里 D.柯克帕特里克（Larry D. Kirkpatrick）
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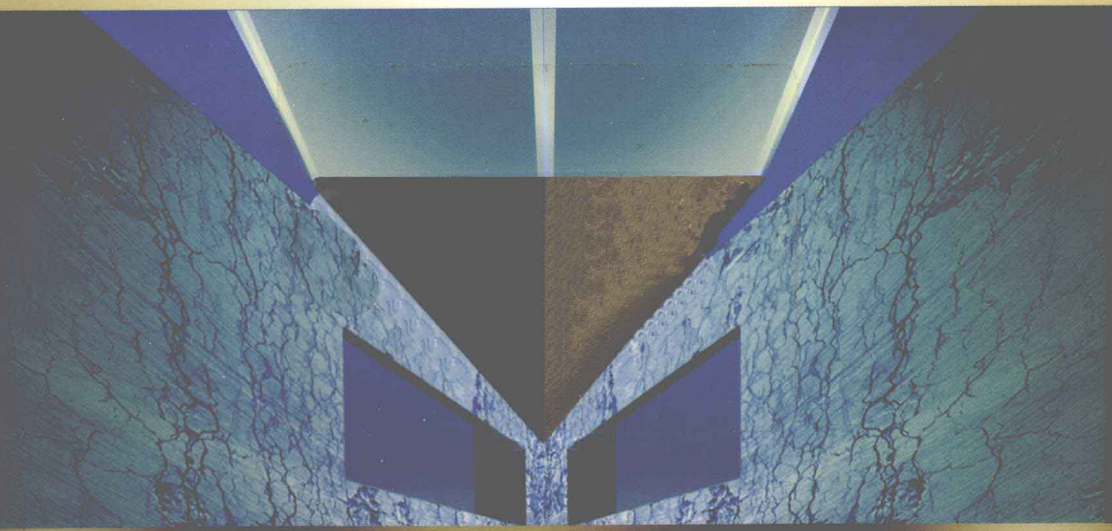

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本书是一本精心编著的、反映现代物理学最新发展的、适用于非理工科类的大学物理教材。本书语言简明，富有逻辑，使学生在有趣和愉悦的语言氛围中理解和掌握物理概念。同时，本书设置有“PHYSICS EVERYDAY”栏目，在全书28章的篇幅中用了44个专题实例生动地向学生展示了物理原理在日常生活中的各种实践和有趣的现象与应用，如液晶显示、荧光色、全息摄影、引力波、“无线”电池充电等。此外，本书还设置有章前图片、问题和解答，用于检查学生概念理解与否的“ARE YOU ON THE BUS?”栏目，针对数学基础偏弱的学生数学内容可略过而又不影响概念理解的“WORKING IT OUT”栏目、8篇配有大图的传记性短文“The Big Picture”以及每章章后大量的思考题和练习题（全书思考题1500多道，练习题500多道）。

本书主要内容包括九个部分：运动和引力基础，动量和能量守恒，相对论，物质的结构（包括热和热力学），波现象和声音，光和光学，电和磁，量子，原子核、基本粒子与物理学前沿。

本书为非理工科类，如文科、经济管理等专业大学生的大学物理教材，也是高校广大物理教师进行教学的优秀参考书，同时还是广大科学爱好者、大学生等学习和了解科学知识的优秀读物。

Physics: Concepts and Practice
Francis/Kirkpatrick

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出 版 说 明

我国加入WTO后，参与到越来越激烈的国际竞争中，而国际间的竞争实际上也是人才的竞争、教育的竞争。为了加快培养具有国际竞争力的高水平技术人才，加快我国教育改革的步伐，国家教育部出台了一系列倡导高校开展双语教学、引进原版教材的政策。以此为契机，机械工业出版社陆续推出了一系列影印版国外优秀教材，其内容涉及高等学校公共基础课，以及机、电、信息领域的专业基础课和专业课。

引进国外优秀原版教材，在有条件的学校推动和开展英语授课或双语教学，自然也引进了先进的教学思想和教学方法，这对提高我国自编教材的水平，加强学生的英语实际应用能力，促进我国的高等教育尽快与国际接轨，都有积极的推动作用。

为了做好教材的引进工作，机械工业出版社特别成立了由著名专家组成的国外高校优秀教材审定委员会。这些专家对实施双语教学作了深入细致的调查研究，对引进原版教材提出了许多建设性意见，并慎重地对每一本将要引进的原版教材一审再审，精选再精选，确认教材本身的质量水平，以及权威性和先进性，以期所引进的原版教材能适应我国学生的外语水平和学习特点。在引进工作中，审定委员会还结合我国高校教学课程体系的设置和要求，对原版教材的教学思想和方法的先进性、科学性严格把关，同时尽量考虑原版教材的系统性和经济性。

这些教材出版后，我们将及时地将其推荐给各高校选用，并将根据各高校的双语教学计划，举办原版教材的教师培训。希望高校师生在使用教材后及时反馈意见和建议，使我们更好地为教学改革服务。

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Preface

This textbook is intended for a conceptual course in introductory physics for students majoring in fields other than science, mathematics, or engineering. It will work very well in courses for future teachers.

Writing this book has been an exercise in translation. We have attempted to take the logic, vocabulary, and values of physics and communicate them in an entirely different language. A good job of translating requires careful attention to both languages, that of the physicist and that of the student. In some areas the physics is so abstract that it took creative bridges to span the gulf between the languages. We are indebted to the many students who shared their confusions with us and wrestled with the clarity of our translations. We are equally indebted to the many physicists who shared our search for the proper word or metaphor that comes closest to capturing the abstract, elusive idea.

Mathematics is the structural foundation for all of the physics world view. As stated previously, this textbook translates most of the ideas into longer, less tightly structured sentences. Still, the mathematics holds much of the beauty and power of physics, and we want to offer a glimpse of this for students whose mathematical background is adequate. Therefore, the more mathematical presentations within the textbook have been placed in boxes labeled *Working It Out* to make the textbook friendlier to those students in courses that do not include this material. These boxes allow the students to skip over the more mathematical material without loss of continuity in the conceptual development of the physics ideas.

Coverage

The topics covered in this book are the fundamental topics in classical and modern physics. The book is divided into nine parts. *The Big Picture* interludes set the theme for the sections that follow.

- Part I (Chapters 1–5) opens with an introduction to the physicists' world view and then deals with the fundamentals of motion, including Newton's three laws of motion. This part ends with a careful look at gravity, our most familiar force.
- Part II (Chapters 6–8) reexamines motion through an investigation of three fundamental conservation laws: momentum, energy, and angular momentum.
- Part III (Chapters 9–10) explores the concepts involved in classical, special, and general relativity.

- In the beginning of Part IV (Chapters 11–14), we set the stage for expanding our understanding of energy by investigating the structure of matter, first macroscopically, then microscopically. This part ends with a study of thermodynamics, including heat, temperature, internal energy, heat engines, and entropy.
- Part V (Chapters 15–16) develops the basic properties of wave phenomena and applies them to a study of sound and music. It also gives the reader a background that will be helpful in understanding much of quantum physics.
- Part VI (Chapters 17–19) covers the study of light and optics, starting with the general question of the basic nature of light, covering interesting applications, and ending with consequences of the wave nature of light.
- Part VII (Chapters 20–22) covers the basic concepts in electricity and magnetism, including a careful examination of simple circuits and the nature of electromagnetic waves.
- In Part VIII (Chapters 23–24), we develop the story of the quantum, starting with the discovery of the electron and ending with quantum physics.
- The final section of the textbook, Part IX (Chapters 25–28), takes the student deeper into the study of the structure of matter by looking at the nucleus and eventually the fundamental particles. It ends with a look at some of the frontiers of physics.

New to this Edition

After soliciting comments from physics teachers and students, we carefully considered each suggestion and used many of them in reworking the entire textbook. We simplified explanations of some phenomena; updated developing areas, such as elementary particles and cosmology; and added new explanatory material.

- The in-chapter check questions have been renamed *On the Bus* boxes to better illustrate their function of confirming that the reader is "on the bus" before we continue on.
- In an effort to help students gain confidence in their ability to solve physics problems, we have added many new *Working It Out* boxes throughout the text.
- The end-of-chapter Conceptual Questions and Exercises were revised to refresh the sets. Many were replaced with new questions, and others were revised to present new scenarios and numeric values.
- Where appropriate, we added new conceptual questions at the end of the *Physics Everyday* boxes (88 new questions in all). These questions can be assigned as homework to encourage students to read about these connections between physics and their everyday lives. A new *Physics Everyday* box on "Monumental Metric Mistakes" was added to Chapter 1.

Acknowledgments

Physicists and physics teachers who gave freely of their time to explore the many options of explaining the physics world view with a minimum of mathematics include our colleagues Jeff Adams, John Carlsten, William Hiscock, Robert Swenson, and George Tuthill from Montana State University, as well as the late Arnold Arons (University of Washington), Larry Gould (University of Hartford), and Bob Weinberg (Temple University). We appreciate the special efforts of Montana State University photography graduate David Rogers for many of the photographs used in the textbook. We would also like to thank the many students who have studied from this textbook and provided us with valuable feedback.

We are also grateful to Gerry Wheeler, who almost 30 years ago suggested to Larry Kirkpatrick that they write a textbook. Neither Larry nor Gerry could have written a textbook by himself, but together they produced a textbook that has become a best-seller. In the process of understanding the physics, interacting with students to learn how to present physics to a nontechnical audience, and discussing how best to capture the excitement of classroom teaching in a textbook, they became much better physics teachers . . . and lifelong friends. Gerry is the executive director of the National Science Teachers Association. NSTA is fortunate to have his creative mind and his extraordinary ability to work with people for the betterment of science education. We wish him continued success.

The following reviewers were very helpful in producing this edition:

ANDREW BOUDREAUX, *Western Washington University*
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The final chapter on *frontiers* poses unique challenges, as the topics are truly on the frontiers. We especially want to thank Jeff Adams, Neil Cornish, William Hiscock (all Montana State University), the late Robert S. Panvini (Vanderbilt University), and Chris Waltham (University of British Columbia) for contributing and updating essays and assisting us to understand these topics.

We would like to thank our emeritus colleague Pierce Mullen for carefully checking the historical accuracy of the textbook, for writing all but two of the biographical sketches, and for providing many insights into the history of physics.

The current edition continues to benefit from the efforts of our colleague Jeff Adams, who spent many hours revising old conceptual questions and exercises and designing many innovative and thought-provoking new ones. Thanks also to Andrew Bourdreaux (Western Washington University), who painstakingly checked the textual material of all chapters and interludes for accuracy, and to Sytil Murphy for her careful work on the comprehensive index.

Finally, we would like to thank the staff at Cengage Learning, for their professionalism, enthusiasm, and generous support: Mary Finch, Publisher; Nicole Mollica, Marketing Manager; and Trudy Brown, in-house Project Manager. This book would not be of this high quality without the help of those who worked closely with us: Peter McGahey for his diligent and careful work as Senior Developmental Editor and for keeping us on schedule; Katherine Wilson, who oversaw the production of the book as senior project manager at Lachina Publishing Services; Greg Gambino for his beautiful new *Stick Man* illustrations; Dena Digilio-Betz for finding excellent photographs; and Amy Schneider for her careful work in editing the manuscript.

After giving serious consideration to each of the reviewers' suggestions, we made the final decisions and therefore accept the responsibility for any errors, omissions, and confusions that may remain in the textbook. We would, of course, appreciate receiving any comments that you may have. Send comments and suggestions to Greg Francis, Physics, Montana State University, Bozeman, MT 59717-3840 or via e-mail at francis@physics.montana.edu.

Larry D. Kirkpatrick
Gregory E. Francis
Montana State University

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