

UNDERSTANDING PHYSICS

David Cassidy
Gerald Holton
James Rutherford

With 571 Illustrations, with 6 in Full Color



Springer

David Cassidy
Professor of Natural Science
Natural Science Program
Hofstra University
Hempstead, NY 11549
USA
chmdcc@Hofstra.edu

Gerald Holton
Mallinckrodt Professor of Physics and History
of Science, Emeritus
358 Jefferson Physical Laboratory
Harvard University
Cambridge, MA 02138
USA

James Rutherford
Education Advisor
American Association for Advancement
of Science
Washington, DC 20005
USA

Series Editors

John P. Ertel
Department of Physics
United States Naval Academy
572 Holloway Road
Annapolis, MD 21402-5026
USA
jpe@nadn.navy.mil

Robert C. Hilborn
Department of Physics
Amherst College
Amherst, MA 01002
USA
rchilborn@amherst.edu

Cindy Schwarz
Department of Physics and
Astronomy
Vassar College
Poughkeepsie, NY 12601
USA
schwarz@vaxsar.vassar.edu

David Peak
Department of Physics
Utah State University
Logan, UT 84322
USA
peakd@cc.usu.edu

Thomas Rossing
Department of Physics
Northern Illinois University
De Kalb, IL 60115
USA
rossing@physics.niu.edu

Library of Congress Cataloging-in-Publication Data

Cassidy, David C., 1945-

Understanding physics / David Cassidy, Gerald Holton, F. James Rutherford.
p. cm. — (Undergraduate texts in contemporary physics)

Rev. ed. of: The project physics course. 1971.

Includes bibliographical references and index.

ISBN 0-387-98756-8 (pbk. : acid-free paper)

1. Physics. I. Holton, Gerald James. II. Rutherford, F. James (Floyd James), 1924-
III. Harvard Project Physics. Project physics course. IV. Title. V. Series.

QC23.2 .C37 2002
530—dc21

2002020937

ISBN 0-387-98756-8

Printed on acid-free paper.

© 2002 Springer-Verlag New York, Inc.

All rights reserved. This work may not be translated or copied in whole or in part without the written permission of the publisher (Springer-Verlag New York, Inc., 175 Fifth Avenue, New York, NY 10010, USA), except for brief excerpts in connection with reviews or scholarly analysis. Use in connection with any form of information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed is forbidden.

The use in this publication of trade names, trademarks, service marks, and similar terms, even if they are not identified as such, is not to be taken as an expression of opinion as to whether or not they are subject to proprietary rights.

Printed in the United States of America.

9 8 7 6 5 4 3 2 1

SPIN 15110102

Springer-Verlag New York Berlin Heidelberg
A member of BertelsmannSpringer Science+Business Media GmbH

To the students and instructors whose advice, while using
the draft versions of the text and guides, helped to improve our work greatly;
and to Joan Laws, whose quiet expertise all these years
helped to bring the project to success.