Electromagnetism

Volume 2

There are four forces in our universe. Two act only at the very smallest scales and one only at the very biggest. For everything inbetween, there is electromagnetism. The theory of electromagnetism is described by four gloriously simple and beautiful vector calculus equations known as the Maxwell equations. These are the first genuinely fundamental equations that we meet in our physics education and they survive, essentially unchanged, in our best modern theories of physics. They also serve as a blueprint for what subsequent laws of physics look like.

This textbook takes us on a tour of the Maxwell equations and their many solutions. It starts with the basics of electric and magnetic phenomena and explains how their unification results in waves that we call light. It then describes more advanced topics such as superconductors, monopoles, radiation, and electromagnetism in matter. The book concludes with a detailed review of the mathematics of vector calculus.

David Tong is a Professor of Theoretical Physics at the University of Cambridge and a Fellow of Trinity College. He is known for his contributions to quantum field theory and its application to diverse areas of physics, including particle physics, condensed matter, cosmology, and quantum gravity. His lecture notes on theoretical physics have gained a global following due to their clear explanations and easy-going, accessible style.

Lectures on Theoretical Physics

Volume 1: Classical Mechanics
Volume 2: Electromagnetism
Volume 3: Quantum Mechanics
Volume 4: Fluid Mechanics
Volume 5: You may need to be patient

Electromagnetism

Lectures on Theoretical Physics, Volume 2

DAVID TONG
University of Cambridge

CAMBRIDGE UNIVERSITY PRESS

Shaftesbury Road, Cambridge CB2 8EA, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of Cambridge University Press & Assessment, a department of the University of Cambridge.

We share the University's mission to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/highereducation/isbn/9781009594622

DOI: 10.1017/9781009594660

When citing this work, please include a reference to the DOI 10.1017/9781009594660

First published 2025

Printed in the United Kingdom by CPI Group Ltd, Croydon CR0 4YY

A catalogue record for this publication is available from the British Library

A Cataloging-in-Publication data record for this book is available from the Library of Congress

ISBN 978-1-009-59462-2 Hardback
ISBN 978-1-009-59465-3 Paperback

For Dad

Contents