

In this book, Carolyn MacDonald provides a comprehensive introduction to the physics of a wide range of x-ray applications, optics, and analysis tools. Theory is applied to practical considerations of optics and applications ranging from astronomy to medical imaging and materials analysis.

Emphasizing common physical concepts that underpin diverse phenomena and applications of x-ray physics, the book opens with a look at nuclear medicine, motivating further investigations into scattering, detection, and noise statistics. The second section explores topics in x-ray generation, including characteristic emission, x-ray fluorescence analysis, bremsstrahlung emission, and synchrotron and laser sources. The third section details the main forms of interaction, including the physics of photoelectric absorption, coherent and Compton scattering, diffraction, and refractive, reflective, and diffractive optics. Applications in this section include x-ray spectroscopy, crystallography, and dose and contrast in radiography. A bibliography is included at the end of every chapter, and solutions to chapter problems are provided in the appendix.

Based on a course for advanced undergraduates and graduate students in physics and related sciences and also intended for researchers, *An Introduction to X-Ray Physics, Optics, and Applications* offers a thorough survey of the physics of x-ray generation and of interaction with materials.

- Common aspects of diverse phenomena emphasized
- Theoretical development tied to practical applications
- Suitable for advanced undergraduate and graduate students in physics or related sciences, as well as researchers
- Examples and problems include applications drawn from medicine, astronomy, and materials analysis
- Detailed solutions are provided for all examples and problems

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“This excellent addition to the literature on modern x-ray usage will be a valuable aid to students and professional researchers. It covers the basic physics of x-ray generation and interactions with matter and includes many practical applications of current interest as well as excellent diagrams and photos in every chapter. All major sources of x rays, optics, coherence, spectroscopy, and diffractions are explained clearly.”

—**David Attwood, University of California, Berkeley**

“With breadth and depth, this insightful book provides a comprehensive survey of x-ray physics and x-ray optics. It fills a void in the pedagogy of x-ray physics, and will serve as an excellent reference for medical and x-ray physicists for many years to come.”

—**Andrew Maidment, University of Pennsylvania**

“Offering summary formulae on a great number of topics, students will find this book handy. It focuses on x-ray optics and imaging technologies and does a nice job of providing example problems and their solutions.”

—**Chris Jacobsen, Northwestern University**

“Covering a broad range of topics, from x-ray scattering and spectroscopy to detectors and x-ray optics, this textbook will serve as a useful reference for students and researchers.”

—**Aaron M. Lindenberg, Stanford University**

Jacket images (top, left to right): Fig. 1. Courtesy of Michael Flynn, University of Michigan. Fig. 2. From *Journal of Analytical Atomic Spectrometry* (2011) / The Royal Society of Chemistry. Fig. 3. From *Proceedings of the 46th Annual Denver X-ray Conference* (1997) / Courtesy of Scott Rohrbach. (Bottom) Fig. 4 © American and Science Engineering, Inc.

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