

## BOOK REVIEW

**Book Review: *An Introduction to X-ray Physics, Optics, and Applications*** by Carolyn MacDonald (2017) Cambridge University Press, 368 pp. \$80.00 ISBN 9780691139654, E-book ISBN 9781400887736.

This book is written as a textbook for students studying the physics of X-rays, and the associated physics of technologies in which X-rays play a prominent role. It is divided into 15 chapters covering physical phenomena such as reflection, refraction, diffraction, absorption, and fluorescence, as well as applications such as imaging, various spectroscopies, and diffraction. It is refreshing to see a text that covers X-ray techniques in totality, since I'm not currently aware of any textbook that covers this particular combination of material. Information on most X-ray techniques can only be found individually, as small sections in textbooks covering much broader subjects in physics, chemistry, and engineering. Thus, there is definitely a need for a textbook such as this that uses a uniform approach to cover all X-ray applications.

The writing is generally very clear and concise. Terms and concepts are appropriately explained in language that would be understandable to someone with a reasonable background in physics. The content and subject matter of the book do, however, assume that the reader has already learned the basics of wave physics and optics. I therefore recommend the book for undergraduate/graduate cross-listed classes at the earliest, and is most appropriate for graduate level courses that cover, in whole or in part, the physics of X-rays. It can also serve as a highly useful reference for researchers whose work involves the use of X-rays. This audience is therefore very much in line with the target audience described in the preface of the book.

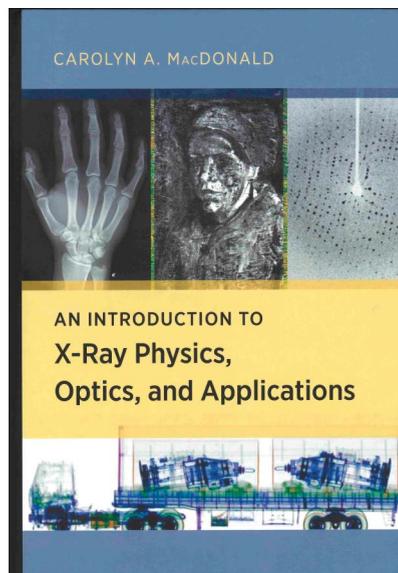
Each chapter contains a very rigorous and mathematical treatment of the phenomenon under consideration, complete with full derivations of formulas and the situations in which they apply. One strength of this book is the many illustrations that can be found in every section. Crisp, clear, and well-labeled color diagrams provide a visualization of the geometry of the process described in the text and are a tremendously useful accompaniment to the equations. Not every physics textbook with rigorous mathematical derivations contains adequate illustrations of the actual physical quantities the equations describe, and this book does an excellent job of avoiding that common issue. Occasional color photographs also illustrate the actual technology, or the results they produce, providing a welcome link between the subjects in the text and the real world.

The book also contains abundant example problems embedded in the text. Immediately after a new phenomenon, concept, or formula is introduced, a short series of related problems allows the reader to check their understanding by solving the problems on their own. These problems are usually, but not always, numeri-

cal problems utilizing equations from the text. While the provided solutions to the problems are always complete from a technical and mathematical standpoint, they are occasionally slightly lacking in descriptive detail, but never to the point that a conscientious reader would be unable to decipher the solution. There are also additional problems at the end of each chapter, whose solutions can be found at the end of the book. These problems make excellent homework material for a college course.

The organization of material logically flows from simpler material at the beginning, to more complex material and discussions of applications toward the end. It is organized into three parts, with Part I covering introductory material, Part II covering the physics of X-ray generation and the properties of X-ray beams, and Part III covering how X-rays interact with matter and the variety of analytical techniques these phenomena enable. Material in Chapter 2, which discusses applications in nuclear medicine, might ideally be better incorporated into latter chapters of the book, but is still understandable in its current location in Part I.

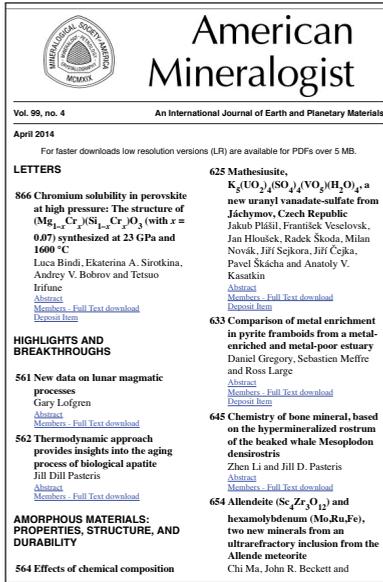
Overall, this textbook presents a comprehensive, rigorous, but understandable explanation of X-ray physics and the many contexts in which this physics is useful in modern technologies. I would highly recommend this book to any student or researcher with an adequate background in physics who is seeking advanced knowledge of any system that utilizes X-rays. The book fills a much-needed void in providing detailed information on a multitude of X-ray applications in one source.



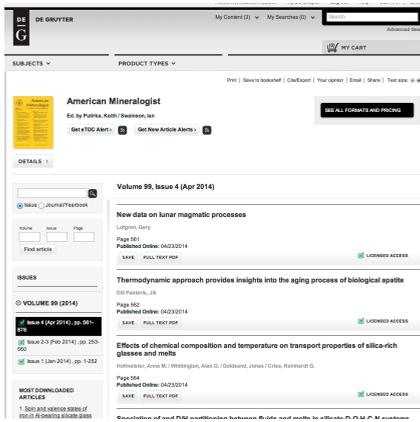
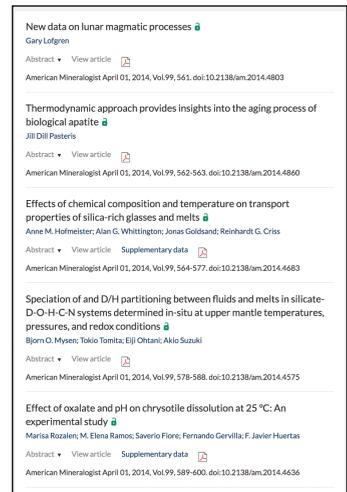
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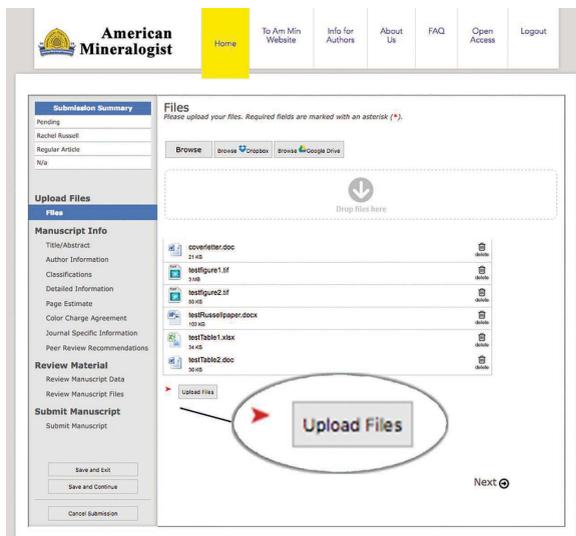
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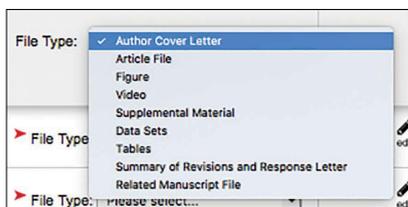
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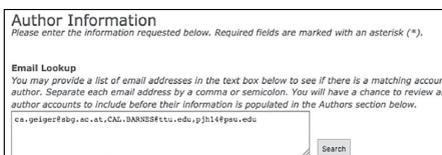
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