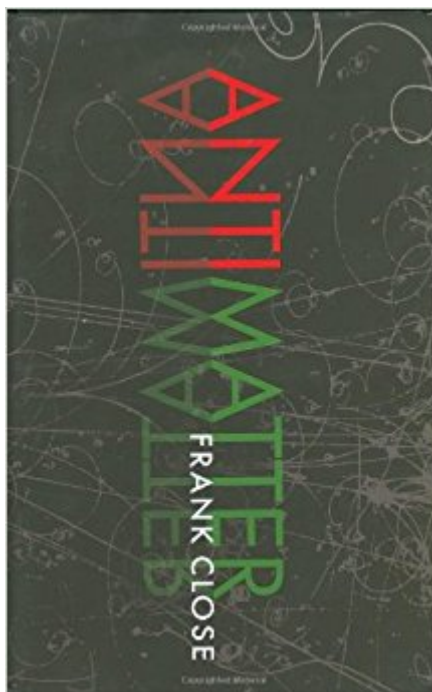


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# Antimatter



## Synopsis

Of all the mind-bending discoveries of physics--quarks, black holes, strange attractors, curved space--the existence of antimatter is one of the most bizarre. It is also one of the most difficult, literally and figuratively, to grasp. Antimatter explores this strange mirror world, where particles have identical yet opposite properties to those that make up the familiar matter we encounter everyday, where left becomes right, positive becomes negative, and where--should matter and antimatter meet--the resulting flash of blinding energy would make even thermonuclear explosions look feeble by comparison. Antimatter is an idea long beloved of science-fiction writers--but here, renowned science writer Frank Close shows that the reality of antimatter is even more intriguing than the fiction. We know that at one time antimatter and matter existed in perfect counterbalance, and that antimatter then perpetrated a vanishing act on a cosmic scale that remains one of the great mysteries of the universe. Today, antimatter does not exist normally, at least on Earth, but we know that it is real, as scientists are now able to make small pieces of it in particle accelerators, such as that at CERN in Geneva. Looking at the remarkable prediction of antimatter and how it grew from the meeting point of relativity and quantum theory in the early 20th century, at the discovery of the first antiparticles, at cosmic rays, annihilation, antimatter bombs, and antiworlds, Close separates the facts from the fiction about antimatter, and explains how its existence can give us profound clues about the origins and structure of the universe. For all those wishing to take a closer look at the flip side of the visible world, this lucidly written book shines a bright light into a truly strange realm. "Beautifully written... This book will inspire a sense of awe in even the most seasoned of physics readers." --Amanda Geffer, *New Scientist* "This is a must read for fans of science and science fiction alike." --John Gribbin, [www.bbcfocusmagazine.com](http://www.bbcfocusmagazine.com)

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## Customer Reviews

This compact book is a wonderful source of information on antimatter and offers us a meticulously researched account of the nature, properties and applications of the often overlooked entities in the fantastic antiworld around us. Chemistry World A meticulously researched account of the nature, properties and application of the ...antiworld around us. Dennis Rouvray, Chemistry World ...worth reading for its beautifully concise history of one vital aspect of twentieth-century particle physics Mark Ronan, Times Literary Supplement His prose is clear, the concepts always understandable, his analysis always insightful. Mark Greener, Fortean Times Beautifully written..This book will inspire a sense of awe in even the most seasoned of physics readers. Amanda Gefter, New Scientist This is a must read for fans of science and science fiction alike. Dr John Gribbin, [www.bbcfocusmagazine.com](http://www.bbcfocusmagazine.com)

Frank Close, OBE, is Professor of Physics at Oxford University and a Fellow of Exeter College. He was formerly vice president of the British Association for Advancement of Science and Head of the Theoretical Physics Division at the Rutherford Appleton Laboratory. He is the author of several books, including the best-selling *Lucifer's Legacy*, and the winner of the Kelvin Medal of the Institute of Physics for his "outstanding contributions to the public understanding of physics."

Physicist Frank Close offers a short but enlightening look at a frequently misunderstood aspect of physical reality in his book *Antimatter*. In about 150 pages, Close delivers a solid summary of the historical and current research into the nature of the tricky particles, especially the positron. As a physics buff, albeit a non-technical one, Close's descriptions and narrative are easy to follow and not overly-detailed. He keeps close to his main points, explaining the nature of antimatter and exposing some of the latest experiments into its properties, without overburdening the reader with dense technical interjections. While I thought I understood antimatter prior to reading this book, Close provided a strong overview that supplements the understanding of most any popular physics reader, myself included. Close explores many of the theories surrounding the symmetries between normal matter and antimatter, as well as offering some thoughts on why we might see a universe which appears to be largely devoid of antimatter. While a small handful of antimatter particles have

been created in labs around the world, as well as a few dozen antihydrogen atoms, the mysterious lack of antimatter in the universe remains one of the questions needing a great deal of further research to explain. Close uses the Tunguska event to explore the possibility that a chunk of antimatter could have caused the currently unexplained explosion in 1908 (Close determines it was not antimatter, but leaves the question open until the latter chapters). The author also debunks most of the antimatter properties and usages found in Dan Brown's *Angels and Demons*, as well as the idea that antimatter is likely to supplement traditional sources of energy found on the planet. Popular physics readers have good cause to pick up this tightly-focused book, and will almost certainly learn things about antimatter that aren't covered in many sources. A solid, very quick read that can be knocked out in an afternoon, I recommend this book to anyone interested in physics wanting to gain a reasonable understanding of this mysterious and interesting subset of the science.

At 148 pages, Mr. Close has produced a very nice little book on antimatter. It is well written, concise, and articulate, and can quite comfortably be read in just one sitting. To the point throughout, there is no spare or wasted verbiage here. Just a quick "in-and-out" on antimatter. The text contains no math whatsoever. As such, any person with a passing familiarity/interest in astronomy and particle physics will have no trouble reading and completely comprehending this book. (The book probably will be a little uncomfortable at first for readers who do not know what a positron or antiproton is, for example, but I suspect that the average reader of this book will already have a general interest in physics or astronomy such that the level of the book should not intimidate in any way whatsoever.) I particularly appreciated the length to which Mr. Close went to to de-bunk the idea promulgated implicitly in the movie *"Angels and Demons"* that antimatter explosive devices are just around the corner. Thank God they are not. Also debunked is the possibility that the Tunguska explosion in 1908 was the result of a piece of antimatter colliding with the Earth. Lamentably, Mr. Close also dashes hope for antimatter propulsion to the stars any time soon. All-in-all, if you wanted a short and sweet introduction to antimatter, you'll really enjoy this book.

Some highlights are\*The light produced in the sun starts out as a positron, which combines with an electron to produce a gamma ray photon, deep inside the sun. It takes 100,000 years for that photon to reach the surface of the sun and escape, by which time its wavelength has changed to that of visible light, by a process of electron-positron creation followed by their recombination into a photon, over and over again for a thousand centuries.\*The author shows you the trick that Dirac

used to get rid of the exponent 2 in his equation to give it nice properties, so that it predicted electron spin and the positron. He needed to find a number with certain properties that no number can have, so he used a 2 by 2 matrix instead! When he moves up to 3-space it becomes a 4 by 4 matrix predicting spin.\*The 1908 meteor that destroyed a large tract of land in Siberia was probably made of antimatter.\*When you have a PET scan you ingest an analog of sugar that emits positrons, which combine with electrons and produce gamma rays. These are detected by the scanner and determine whether your cancer has spread.

This is an enjoyable discussion of modern particle physics. Although I would not characterize this as easy reading, the finest aspect of the book for me was how clearly and cogently Professor Close writes about this highly complex subject. One example of Close's excellent choice of language was his reference to energy "congealing into matter" in accordance with Einstein's theory of  $E=mc^2$ , at the time of the Big Bang. The book is structured around the history of the study of antimatter, beginning with Paul Dirac's formula which predicts the existence of antimatter, and the discovery of various subatomic particles throughout the twentieth century. Close explains how these developments relate to the conditions that would be necessary for antimatter to be found, created, stored and potentially used in modern applications. His conclusions are those of a world class physicist, rather than an a novelist, and he fittingly ends the book: "With such inspirations in fact, who needs fiction?"

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