



## Neutrino

*Frank Close*

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Neutrinos are as near to nothing as anything we know, and so elusive that they are almost invisible. Frank Close tells the story of the neutrino, explaining their growing significance, and looking at how neutrino astronomy is at the threshold of enabling us to look into distant galaxies and to finding echoes of the Big Bang.

## Neutrino Details

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Author : Frank Close

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## From Reader Review Neutrino for online ebook

### Andy Iverson says

This book narrates the story of how we know what we currently know about neutrinos. As a byproduct, it also teaches exactly what it is we know about neutrinos. This was an easy-to-read book, which is quite an accomplishment for such a sciency piece of work. There was no math or anything. I was honestly a bit disappointed that it didn't go very in-depth on any complex concepts, especially the weak force and symmetry breaking (it essentially says "some people found out symmetry breaks"). But that might be a good thing for a lot of readers who don't necessarily care about the details.

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### Upom says

Considering the recent discovery of faster-than-light neutrinos, it seemed like a good idea to brush up on the subject. A concise and clear guide to the neutrino, and the men who discovered this particle. Though it profiles these brilliant men, biography does not get in the way of explaining the discovery process and science of these mysterious particles. I was also surprised to find out how many Italians there were in particle physics.

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### Kaye says

This book was decent, but I felt like the language could have been tighter. Close repeated himself quite often, and the flow of the ideas didn't always seem the most sensible when it came to presenting the history of the search for neutrinos. However, the science descriptions were very good, so this is a decent read.

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### Susanne Escher says

A decent account of the history of neutrinos. My only problems were that it was non-linear in a kinda repetitive way, the use of "creation" in a couple of places, and the fact that the name Niels Bohr was repeatedly misspelled. Still, a quick, easy and informative read about a part of science that really lends itself to storytelling.

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### Madhav Sinha says

The story of neutrino has been well told in a very accessible way, for those interested in the particle universe but not much keen on the related mathematics.

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### **David says**

A very clear and succinct book about this mysterious ghost particle. It traces the roots of the Neutrino from its start as a supposedly un-discoverable "convenience" to the dawn of neutrino science, which is literally the forefront of particle physics and cosmology today. Along the way you meet the famous and unsung heroes of the Neutrino story. Enjoyable and left me wanting an update to the latest research.

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### **Madison says**

I really enjoyed this concise explanation of what neutrinos are and how we came to know about them. My favorite snippet of the book was an interaction between the neutrino scientists and nuclear power plant managers, with the people at the power plant insisting that no neutrinos escape the plant, believing the scientists are enquiring about an environmental contaminant instead of a harmless particle.

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### **Peter says**

A reasonably detailed and (as far as I can tell) well-rounded account of the discovery, proof, and application of neutrinos in 20th and early 21st century science. In addition to explaining what neutrinos actually are and how they behave, the author also describes the life and work of the many key scientists who contributed to the field.

The fact that they were discovered at all is remarkable, and is a testament to the dedication of a tiny handful of people. This fact is brought forward very clearly in this book. The coverage of potential uses for neutrino detectors going forward is fascinating as well.

The writing is quite clear and engaging. My only criticism is that some information seems to be repeated, especially towards the end.

It's worth noting that this book was published before the infamous experiment which mistakenly seemed to show neutrinos travelling faster than light. As such, it's obviously not mentioned (unless the book has been updated since then).

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### **Rachael says**

A quick tour through the history of neutrino theory and experimentation, as well as a forward look. Close gets lightly into the physics, some of the odd side stories of the characters involved and descriptions of the experiments. Not a heavy duty book by any means, but does touch on nucleosynthesis, some basics of weak interactions and tries to describe neutrino oscillations.

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### **Kevin Orrman-Rossiter says**

A lucid well-written book. Provides a succinct general-science-reader level introduction to the elusive particle the neutrino. Hard to fault, I would have preferred a few more references - but I assume that the OUP editors know their audience quite well. Recommended for those who want to learn about neutrinos and also those who want an example of good science communication.

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### **Gabriel says**

This was a nice, brisk survey of the history of neutrino physics up through about 2005. It does not include any discussion of the most recent innovations in the field - hints for non-zero theta-13, plans for untangling the mass hierarchy or hunting for CP violation, etc. - but it is easily timely enough for the interested lay-person or even students in the field. The book is fast-paced and lucid, though as a professional physicist it is hard for me to really gauge its accessibility.

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### **Randy says**

Only two chapters in.. but Close is immediately, obviously a wonderful story teller.

This is (apparently) the story of Wolfgang Pauli, he of the Exclusion Principle, and Ray Price. Pauli for being the visionary who realized neutrinos must exist. Price for being the experimentalist who observed them, after decades of effort, and in the face of much naysaying.

I'm very pleased with the depth of the science, and also the lack of math and higher physics. It's an easy read, yet very informative.

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A short read. Interesting coverage of Pauli in particular, less of Price. Neat factoids on how neutrinos can be used for assessing the inner processes of stars (since they don't interact with the stuff of the sun, they make it here pretty unaffected. and if you can catch some and know they came from the sun, you can study them).

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### **Zoffix Znet says**

As other books by Frank Close, this one shines as a chunk of purest gold. The book elucidates incredible perseverance and belief of key individuals who played role in the discovery of a neutrino (the subatomic particle). You are taken on an exciting journey that begins with Wolfgang Pauli proposing neutrinos and, reflecting onto how elusive they are, offering a case of champagne to anyone who finds them. Over the course of the book, the neutrino gets found, the champagne gets delivered, and the incredible new possibilities open up.

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### **Tim Turnip says**

As expected, I was completely out of my element here. Too much Science. However, I understood enough of it to see what was going on. Kind of. Here's brief outline.

Neutrinos are byproducts of beta decay, a type of radioactivity where mass turns into energy or something. So these scientists were examining this and they found that something was wrong- there were some particles missing from the transformation. Pauli, a scientist back then (early to mid-20th century) had an idea that there was a massless, chargeless, invisible particle that was carrying away the missing energy. He was basically right. The neutrino, which in Italian means Little Neutron, has almost no mass, is very hard to detect, moves with relative speeds, and has no charge, much like a neutron, its namesake. There are three types of neutrinos- tau-neutrinos, muon-neutrinos, and electron-neutrinos. This is based on the particle that is released alongside the neutrino. Taus and muons are just heavier electrons. And then there was a lot more complicated ideas and all, with detectors involving ice, some special light that revealed the presence of a neutrino, and heavy water.

This book was really well scripted, and was not just meant for uber-scientists. You just need some understanding of matter, Matter and Energy conservation, a tiny bit of Special Relativity (know what  $e=mc^2$  means) and you should be able to interpret most of it. Now I'm going to read Anti-Matter by Frank Close

And let me know if I left out any really important details, or am plain wrong, or if you know about neutrinos and can explain them to me in the comments! Thanks.

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### **Cade says**

This book weaves together two different books. One is a qualitative description of what neutrinos are and how they behave. This makes interesting reading, and it is the reason I originally picked this book up. However, the other part of this book is an exciting historical account of the way scientists have thought about, sought, and found neutrinos. This aspect of the book reads as easily as a fictional narrative, and this is what made this book a page-turner that I had trouble putting down. None of that is to say this book has two separate parts. Both features are woven together smoothly throughout the book. This interwoven dualism captures and reflects (probably not coincidentally) the interplay between theoretical and experimental physics at the frontiers of science in the last century.

After reading this book, I went and added several more books by Frank Close to my future reading list.

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### **aimee says**

Yay!

Frank Close does a pretty good job of explaining not only what neutrinos are (remarkably strange little critters), but also how they came to be posited and proven, over the space of decades.

And in telling the story of the neutrino, he also ably tells the story of the scientists behind it, including at least one unexpected (well, when he set out to write the book) protagonist.

Thoroughly recommended. I'm going to be seeking out more of his work...

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## **Noah Soudrette says**

I picked up this book because of all the recent news about the possibility of faster-than-light Neutrinos. I had decided to read all I could about them. About two years ago I had begun reading Frank Close's book on antimatter and in looking at his bibliography saw he had a book on Neutrinos. Since his book is the only non-textbook about said particle, my choice was simple. This slim volume is cleanly written and a relatively easy read for the layman. There were only a few times where I became admittedly confused, but I found if I just kept going, most of my confusion cleared up. In the end, this book is really a human story. A tale of a handful of men who dedicated their lives to proving what they thought was unprovable.

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## **Rachel says**

A great work of popular science writing, just the right level of depth. Close tells the story of the elementary particle known as the neutrino and the many scientists who studied it. At its least interesting, it reads like particularly friendly physics textbook. I most enjoyed reading about the one most dramatic experiment in neutrino history, which involved building massive tanks of cleaning fluid in the deepest caverns of abandoned mines to detect neutrinos emitted from the Sun while eliminating all other cosmic ray interference.

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## **Dale says**

The neutrino is a pesky critter: nearly impossible to detect and changing flavor at the drop of a hat. Enrico Fermi and Bruno Pontecorvo were the first to realize that neutrinos must exist (based on conservation of spin), but it was to be a long time from those first conjectures to the first definitive detection of a neutrino. There are actually three flavors of neutrino (corresponding to the three leptons: electrons, muons, and tau particles), plus their anti-neutrino counterparts. It turns out that any given neutrino detection experiment can't just detect any neutrino: if you are looking for a muon neutrino and an electron neutrino happens by, you won't see it. In fact, you won't see many muon neutrinos either, because their chance of interacting with matter is about the same as your chance of winning the lottery 3 times in a row. Neutrinos that formed shortly after the big bang are mostly still zipping through space, completely unaware that anything exists in the universe.

Making things more difficult for the experimenter is that neutrinos change flavor in flight: solar electron neutrinos spontaneously become muon neutrinos on their journey, and change back with a now known frequency, resulting in 2/3 fewer electron neutrinos reaching the earth than were predicted.

Frank Close does a good job telling this story. I would have liked to see more diagrams and maybe an equation or two, and photographs of the gigantic neutrino detectors would have been nice, but he gets the story across even without the visual aids. So, kudos.

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## **Andy Love says**

This is a short book, but a comprehensive one, covering the initial conceptualization of neutrinos, the

original attempts to actually detect such an evasive particle and the incredible improvements in detection in the modern era that have validated our models of the solar interior and the details of supernova explosions, and may provide new insights into gamma ray bursts and the core of the Milky Way. It's both interesting and inspiring to read about the immense effort involved in discovering new science, and the determination of the scientists to ensure that their conclusions are correct, by resolutely investigating and eliminating all sources of error in their measurements.

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