

BOOKSHELF

Very High Energy Cosmic Gamma Radiation: A Crucial Window on the Extreme Universe

by Felix A Aharonian,
World Scientific. Hardback ISBN
9810245734, £65 (\$107).

Astronomy – the study of all kinds of cosmic radiation – meets particle physics at the highest gamma-ray energies. This book offers the opportunity for particle physicists to cross the bridge between the two disciplines. They will discover the nature and properties of the extreme sources in the universe able to emit photons at energies higher than 10 GeV.

Very-high-energy astrophysics is entering a new era with the recent achievement by the High Energy Stereoscopic System (HESS) of the first spatially resolved high-energy gamma-ray image of an astronomical object, the supernova remnant RX J1713.7-3946 (*CERN Courier* January/February 2005 p30). This image confirms that supernova remnants are at the origin of cosmic rays.

The lead author of the paper in *Nature* that described the HESS results was Felix Aharonian, the author of this book. Here he uses his expertise to provide a broad and comprehensive overview of the study of cosmic gamma rays, from energies of about 10 GeV to 10 TeV. In nearly 500 pages, he covers all aspects of the field including the theoretical ground of gamma-ray emission and absorption mechanisms, as well as the status of detection facilities. The main part of the book is, however, devoted to the phenomenology of the various sources of very-high-energy gamma rays.

With more figures than equations, the author guides us through the world of supernova remnants, pulsars, jets of quasars and microquasars, and clusters of galaxies. He even discusses the implications for cosmology, as derived from the interaction of very-high-energy gamma rays with the diffuse extragalactic background radiation. As complete as this book tends to be, however, I am a little surprised to find notable omissions, including gamma-ray bursts and the possible annihilation-radiation of weakly interacting massive particles (WIMPs), which are mentioned but not discussed.

Nevertheless, this book with its extensive list of references is a very valuable introduction to the astrophysics of high-energy gamma-ray radiation. Well structured and with its more mathematical parts left for the appendix, it is also suitable for a quick



Supernova remnants, such as the Crab Nebula, figure among the many high-energy gamma-ray sources described by Aharonian. (Courtesy European Southern Observatory.)

search for a specific topic. It can therefore be used as a reference book for this fascinating “last electromagnetic window” on the cosmos, a topic destined to evolve very rapidly in the coming years.

Marc Türlér, INTEGRAL Science Data Centre and Geneva Observatory.

The Essential Turing by B Jack Copeland (ed.), Oxford University Press. Hardback ISBN 0198250797, £50 (\$98). Paperback ISBN 0198250800, £14.99 (\$24.95).

At high school I once received a mathematics prize in the form of two volumes on calculus. I was very pleased until I discovered that they contained not a single diagram or figure. Everything was explained with words and mathematical formulae only. Alan Turing’s most important paper, “On computable numbers, with an application to the Entscheidungsproblem”, similarly lacks any diagram of his famous tape-manipulating machine.

Turing was of course the father of modern computing, and the aim of Jack Copeland’s book is to present some of his important papers in three ways: the original, a guide to the original, and some historical critiques. The guides prove to be very useful since they are not bound by the inhibition against figures that seems to have existed in Turing’s time.

First a health warning is in order. This is not

a book for armchair reading by the faint-hearted! I’m not a mathematician and despite Copeland’s efforts I became lost several times. To get the best out of this book, read it at a desk and have a notepad and pencil handy – and an eraser. It was said of Gauss’s published proofs that one had to thaw them before they could be read. This is what you have to do here, even with some of Copeland’s own material. And there are still too few diagrams.

That said, this is an utterly interesting book. Be prepared for some hard work, but you will be rewarded with a fascinating new view on the birth of the computer.

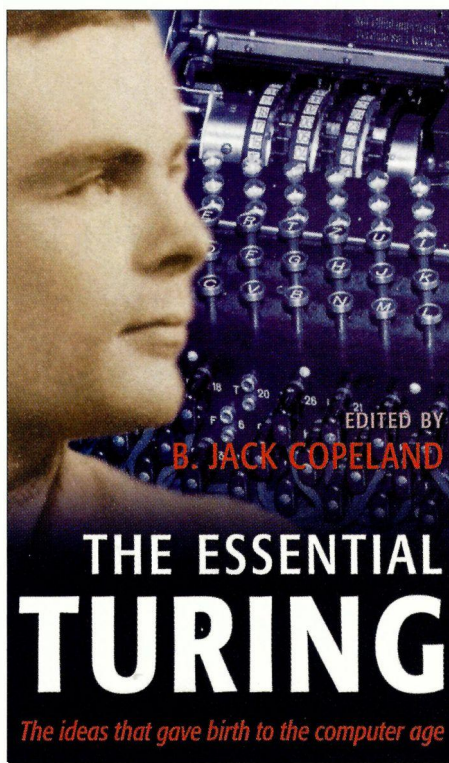
Here, for the first time, are bundled together the most influential papers of Turing in the original. Reading “On computable numbers...” I could not help but wonder what the reviewers of the London Mathematical Society must have thought when they received it in 1936. There is plenty of maths in the paper, to be sure, but this business of computing machines, tapes, erasing stuff, moving left and right, and all the strange conventions – could this be a serious research topic? The paper is very compact given that it exposes all the fundamental questions of computing in a mere 40 pages. Studying it is a most thrilling experience: it gave me a glimpse into the mind of the genius, struggling with a totally new concept, feverishly trying to compress

into a single article all the miraculous stuff he sees with his mind's eye.

A minor complaint is that Turing's papers have been re-typeset and this gives an odd feeling. I think I would have preferred a good facsimile of the originals to this immaculate computer-crafted output. It would also have made the book even more attractive.

There is, however, much more to the book than just the papers and Copeland's guides. A great deal of history is woven into it, creating a somewhat strange hybrid between a biography, a history book and a textbook for a course on the philosophy of computing. There are letters from Turing to his mother about the strangeness of life in America, and other material that almost clashes with the very mathematical treatment of proofs in logic. But the historical-biographical intermezzos are welcome passages where you can relax.

I was pleased with the the book's high accuracy and the exposure of the real roles of Turing and John Von Neumann in the development of computing. There is also



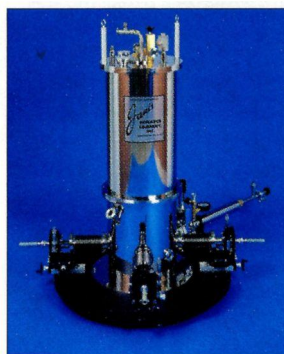
plenty of previously unpublished material here, based on war archives that were released only in 1996. Transcripts of BBC radio debates on machine intelligence in which Turing took part are fascinating reading.

Copeland, like other biographers of Turing, shows a slight bias in favour of his hero. But what a hero he was: we get the seminal papers plus the best explanation of the Enigma episode I have read, and also the much less known work on artificial intelligence and artificial life that kept Turing preoccupied in the last years of his life. Of this phenomenal work most of us know only the famous Turing Test – how many know he also worked on neural networks and simulation of morphogenesis at a time when computers ran at 1 MHz with a few kilobytes of memory?

Strangely, the book contains no references to websites. There is www.turingarchive.org/, where scans of the original papers can be viewed, and www.alanturing.net/, Copeland's own site about Turing.

Robert Cailliau, CERN.

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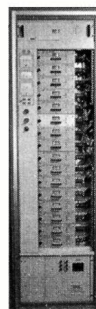
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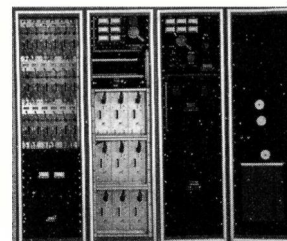
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