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The Pope of Physics: Enrico Fermi and the Birth of the Atomic Age

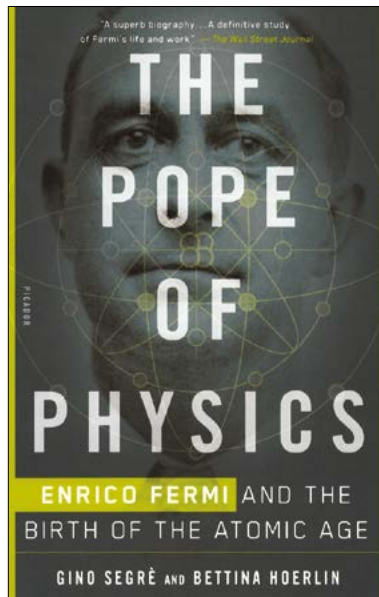
By Gino Segrè and Bettina Hoerlin
Henry Holton and Co.

Enrico Fermi can be considered as one of the greatest physicists of all time due to his genius creativity in both theoretical and experimental physics. This book describes his prodigious story, as a man and a scientist.

Born in Rome in 1901, Fermi spent the first part of his life in Italy, where he made his brilliant debut in theoretical physics in 1926 by applying statistical mechanics to atomic physics in a quantum framework, thus sealing the birth of what is now known as Fermi–Dirac statistics. In 1933 he postulated the original theory of weak interactions to explain the mysterious results on nuclear β decays. Having soon become a theoretical “superstar”, he then switched to experimental nuclear physics, leading a celebrated team of young physicists at the University of Rome, known as the “boys”. Among them were Edoardo Amaldi, Ettore Majorana, Bruno Pontecorvo, Franco Rasetti and Emilio Segrè. They nicknamed him “the Pope” since he knew and understood everything and was considered to be simply infallible. His discoveries on neutron-induced radioactivity and on the neutron slowing-down effect earned him the Nobel Prize in Physics in 1938.

Those were, however, difficult years for Fermi because of Italy’s inconsistent research strategy and harsh political situation of fascism and antisemitism. Fermi left with his family to go to the US in December 1938, using the Nobel ceremony as a chance to travel abroad. Initially at Columbia University, Fermi then moved to the “Met Lab” of the University of Chicago, which was the seed of the Manhattan Project. There, he created the first self-sustained nuclear reactor in December 1942. The breakthrough ushered in the nuclear age, leaving a lasting impact on physics, engineering, medicine and energy – not to mention the development of nuclear weapons. In 1944 Fermi moved to the Manhattan Project’s secret laboratory in Los Alamos. Within this project, he collaborated with some of the world’s top scientists, including Hans Bethe, Niels Bohr, Richard Feynman, John von Neumann, Isidor Rabi, Leo Szilard and Edward Teller. These were terrible times of war.

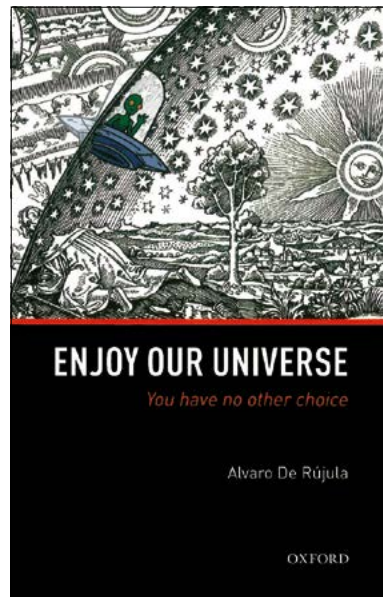
When the Second World War concluded, Fermi resumed his research activities with energy and enthusiasm. On the experimental



front he focused on nuclear physics, particle accelerators and technology, and early computers. On the theoretical front he concentrated on the origin of extreme high-energy cosmic rays. He also campaigned on the peaceful use of nuclear physics. As in Rome, in Chicago he was also the master of a wonderful school of pupils, among whom were several Nobel laureates. Fermi sadly died prematurely in 1954.

This book is about the epic life of Fermi, mostly known to the general public for the first ever nuclear reactor and the Manhattan Project, but to scientists for his theoretical and experimental discoveries – all diverse and crucial in modern physics – which always resulted in major advances. He remains less known as a personality or a public figure, and his scientific legacy is somehow underestimated. The merit of this book is therefore to bring Fermi’s genius within everyone’s reach.

Many renowned texts have been dedicated to Fermi until now, offering various perspectives on his life and his work. First of all on the personal life of Fermi, there is *Atoms in the Family* (1954) by his widow, Laura. Exhaustive information about Fermi’s outstanding works in physics can be found in the volume *Enrico Fermi, Physicist* (1970) by his friend and colleague Emilio Segrè, Nobel laureate and Gino Segrè’s uncle, and in *Enrico Fermi: Collected Papers*, two volumes published in the 1960s



by the University of Chicago. Also worth mentioning are: *Fermi Remembered* (2004), edited by Nobel laureate James W Cronin; *Enrico Fermi: His Work and Legacy* (2001, then 2004), edited by C Bernardini and L Bonolis, and *The Lost Notebook of Enrico Fermi* by F Guerra and N Robotti (2015, then 2017), both published by the Italian Physical Society–Springer. Finally, published almost at the same time as Segrè and Hoerlin’s book, is another biography of Fermi: *The Last Man Who Knew Everything* by D N Schwartz, the son of Nobel laureate Melvin Schwartz. In their “four-handed” book, Segrè and Hoerlin have highlighted with expertise the scientific biography of Fermi and his extraordinary achievements, and described with emotion the human, social and political aspects of his life.

Readers familiar with Fermi’s story will enjoy this book, which is as scientifically sound as a textbook but at the same time bears the gripping character of a novel.

● Luisa Cifarelli, Università di Bologna and Centro Fermi (Roma), Italy.

Enjoy Our Universe, You Have No Other Choice

By Alvaro De Rújula

Oxford University Press

Scientific essays well suited to the interested layperson are notoriously difficult to write. It is then not surprising that various popular books, articles and

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internet sites recycle similar analogies – or even entire discussions – to explain scientific concepts with the same standardised, though very polished, language. CERN theorist Alvaro De Rújula recently challenged this unfortunate and relatively recent trend by proposing a truly original and unconventional essay for agile minds. There are no doubts that this book will be appreciated not only by the public but also by undergraduate students, teachers and active scientists.

Enjoy our Universe consists of 37 short chapters accounting for the serendipitous evolution of basic science in the last 150 years, roughly starting with the Faraday–Maxwell unification and concluding with the discovery of the Higgs boson and of gravitational waves. While going through the “fun” of our universe, the author describes the conceptual and empirical triumphs of classical and quantum field theories without indulging in excessive historic or technical details. Those who had the chance to attend lectures or talks given by De Rújula will recognise the “parentheses” (i.e. swift digressions) that he literally opens and closes in his

presentations with gigantic brackets on the slides. A rather original glossary is included at the end of the text for the benefit of general readers.

This book is also a collection of opinions, reminiscences and healthy provocations of an active scientist whose contributions

Science should always be discussed with a joyful and playful attitude.

undeniably shaped the current paradigm of fundamental interactions. This is a bonus for practitioners of the field (and for curious colleagues), who will often find the essence of long-standing diatribes hidden in a collection of apparently innocent jokes or in the caption of a figure. As the author tries to argue in his introduction, science should always be discussed with that joyful and playful attitude we normally use when talking

about sport and other interesting matters not immediately linked to the urgencies of daily life.

One of the most interesting subliminal suggestions of this book is that physics is not a closed logical system. Basic science in general (and physics in particular) can only prosper if the confusion of ideas is tolerated and encouraged, at least within certain reasonable limits.

The text is illustrated with drawings by the author himself and this aspect, among others, brings to mind an imaginative popular essay by George Gamow (*Gravity* 1962), where the author drew his own illustrations (unfortunately not in colour) with a talent comparable to De Rújula's. The inspiration in this book is also a reminder of the autobiographical essay of Victor Weisskopf written almost 30 years ago, entitled *The Joy of Insight*, which echoes the enjoyment of the universe and suggests that the true motivation for basic science is the fun of curiosity: all the rest is irrelevant. So, please, enjoy our universe since you have no other choice!

● Massimo Giovannini, CERN, and INFN Milan-Bicocca, Italy.



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Books received

Relativity in Modern Physics

By Nathalie Deruelle and Jean-Philippe Uzan
Oxford University Press



A century after its formulation by Einstein, the theory of general relativity is at the core of our interpretation of various astrophysical and cosmological observations – from neutron stars and black-hole formation to the accelerated expansion of the universe. This new advanced textbook on relativity aims to present all the different aspects of this brilliant theory and its applications. It brings together, in a coherent way, classical Newtonian physics, special relativity and general relativity, emphasising common underlying principles.

The book is structured in three parts around these topics. First, the authors provide a modern view of Newtonian theory, focusing on the aspects needed for understanding quantum and relativistic contemporary physics. This is followed by a discussion of special relativity, presenting relativistic dynamics in inertial and

accelerated frames, and an overview of Maxwell's theory of electromagnetism.

In the third part the authors delve into general relativity, developing the geometrical framework in which Einstein's equations are formulated, and present many relevant applications, such as black holes, gravitational radiation and cosmology.

This book is aimed at undergraduate and graduate students, as well as researchers wishing to acquire a deeper understanding of relativity. But it could also appeal to the curious reader with a scientific background who is interested in discovering the profound implications of relativity and its applications.

Hadrons at Finite Temperature

By Samimath Mallik and Sourav Sarkar
Cambridge University Press



In high-energy physics laboratories, experiments use heavy-ion collisions to investigate the properties of matter at extremely high temperature and density, and to study the quark–gluon plasma. This monograph explains the ideas involved in the

theoretical analysis of the data produced in such experiments. It comprises three parts, the first two of which are independent but lay the ground for the topics addressed later.

The book starts with an overview of the (vacuum) theory of hadronic interactions at low energy: vacuum propagators for fields of different spins are introduced and then the phenomenon of spontaneous symmetry breaking leading to Goldstone bosons and chiral perturbation theory are discussed.

The second part covers equilibrium thermal field theory, which is formulated in the real time method. Finally, in the third part, the methods previously developed are applied to the study of different thermal one- and two-point functions in the hadronic phase, using chiral perturbation theory.

The book includes chosen exercises proposed at the end of each chapter and fully worked out. These are used to provide important side results or to develop calculations, without breaking the flow of the main text. Similarly, some of the results mentioned in the text are derived in a few appendices. It is a useful reference for graduate students interested in relativistic thermal field theory.



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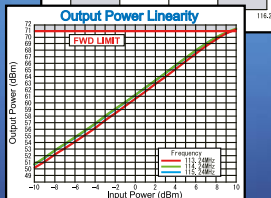
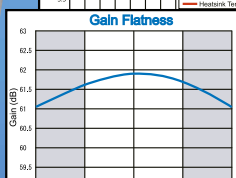
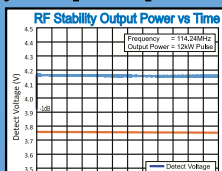
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