Preface

Enrico Fermi was born in Rome in 1901; his scientific production started in 1921 and ended in 1954 with his death. At the beginning of his activity, only two fundamental forces of nature were known, gravitation and electromagnetism, and only two elementary particles, the hydrogen nuclei (protons) and electrons. In the mid 1950s, the fundamental forces, with the addition of the strong and weak nuclear interactions, were four, and over thirty elementary particles were known. In little less than thirty years, the conception of matter underwent such a radical and unprecedented change to make perhaps that period, for the amount and rapidity of the acquisition of new notions, a unique one in the history of the Western scientific thought.

Fermi's research deeply marked those thirty years, not only for the number and importance of his results but mostly for their historical role. It may happen indeed that enormously important scientific achievements are the result of long and tenacious researches and are the culmination of a carefully planned project. There are also discoveries that are perhaps less extraordinary, but lead to unexpected reorganizations of the acquired knowledge, dismantle the standard methodological principles and the commonly accepted notions, and point to new, unforeseen directions for the scientific enterprise. In his scientific itinerary, which we are going to revisit together, Fermi succeeded in both objectives.

The documents about Fermi's research depict a composite array of diverse scientific interests, crossing many areas of physics, both experimental and theoretical. However, Fermi's scientific biography is not just an ordered collection of documents. The specific result, the scientific paper, is not an inert object, well defined and limited by the objectives declared in the introduction and the results described in the conclusion. We must enter the document, clarify its structure, and section it to highlight its diverse causal connections with other documents, which not only delineate a more articulate research itinerary, but also anchor it to its scientific context.

However, this work of establishing the causal connections underlying a scientist's research itinerary raises subtle interpretative questions. The links indeed are not always explicit, and to unveil them one needs to examine other sources, such as

personal reminiscences, letters, popular and review papers, and also completely external elements, such as the political and cultural events that took place in the relevant historical period. Sometimes one does not find direct connections to other documents, but rather links with elements that belong to what we could call the "global maps," that is, those networks of connections among the various elements of a certain discipline which the scientific community regards as well established.

The global maps, like the scientific itineraries, are deeply conditioned by some general regulating principles. Let us considerer, for instance, the postulate that the duration of a time interval does not depend on the reference frame where it is measured, which was at the basis of mechanics till the birth of the theory of relativity, or the idea that the elementary particles, such as the electrons, cannot be created or destroyed, which underlay all research on the nuclear structure until the early 1930s.

So, by means of "research itineraries" and "global maps," we shall analyze how Fermi was able to establish a number of concepts that turned out to be fundamental for the elementary particle physics. The structure of this text will reflect this twofold path. The first chapter has a biographical nature, while the second and fourth are devoted to the description of the global maps of nuclear physics before and after 1933, a date which is a kind of divide; Fermi's 1933 theory on β-decay decreed indeed the end of what we call the "nuclear protophysics" and opened the way to the construction of what still nowadays is called "nuclear physics." The third and fifth chapters are devoted to Fermi's research itineraries during those two periods.

I would like to end this brief introduction with a caveat. The book contains several notes and references to the appendixes, which have a didactic nature; they aim to help the reader to understand the content of the theories that we are describing. This book indeed is also addressed to those who, while not being specialists, are interested in Fermi's figure and want to understand his work in some detail.

Finally, I want to conclude by thanking three persons; without their unconditional personal and scientific help, this book would have not been written. I want to thank them in the simplest way, just with their names, in alphabetical order: thank you Claudio, thank you Ori, thank you Ugo.

Genova, Italy Giuseppe Bruzzaniti

Note on the sources

Fermi's works have been published in two volumes: E. Fermi, *Note e memorie (Collected papers),* Accademia Nazionale dei Lincei — The University of Chicago Press, Rome and Chicago 1962. The two volumes are here referred to as *CPF I* and *CPF II.*

The papers cited as "E. Fermi [number]" refer to the list of Fermi's works at pages 321–333.

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