

Preface

This is an introductory textbook of particle physics for upper undergraduate students. The book is based on lectures given at British, American and Indian Universities over several years. The idea of writing a textbook on this subject was mooted some forty years ago. But it was never easy to write on a subject like particle physics which started expanding explosively in sixties and seventies. All this happened due to the development of high energy accelerators and sophisticated detecting systems on the experimental side, paralleled by new concepts on the theoretical side. And it became very difficult to keep pace with the rapidly changing scenario. Now, when the dust is settled down and the underlined physics is understood in a big way, although quite a bit is still obscure, there appears a justification in expounding the basic ideas of particle physics in the form of a textbook. It is attempted to survey the major developments in particle physics during the past 100 years. In Rutherford's time and early 1950s, only a few Elementary particles were known and the existence of neutrino was taken for granted. At that time, the entire knowledge of elementary particles and cosmic rays was so scanty that it could be accommodated in a single chapter. But, a few decades ago, particle physics branched off from nuclear physics and became virtually an independent discipline. No text book would be balanced until equal weightage is given to these two disciplines. There is also a complementary textbook on nuclear physics available by the same author.

The development of the subject is so fascinating that we were inclined to present the historical facts in the chronological order. The prerequisites for the use of this book are the elements of quantum mechanics comprising Schrodinger's equation and applications, Born's approximation, the golden rule, differential equations and Vector Calculus.

Basic concepts are explained with line diagrams wherever required. An attempt is made to strike a balance between theory and experiment. Theoretical predictions are compared with latest observations to show agreement or discrepancies with the theory. The subject matter is developed in each chapter with necessary mathematical details. Feynman diagrams are used extensively to explain the fundamental interactions.

The subject matter in various chapters is so much intimately connected that the logical sequential presentation of various topics becomes a vexing problem. For example, from the point of view of introducing quarks, the logical sequence would be strong, electromagnetic, weak and electroweak interactions, but from the point of view of introducing Feynman's diagrams, the desirable sequence would be electromagnetic, weak, electroweak and strong interactions, which is why one finds variance in sequences for both Nuclear and Particle physics in various textbooks. The only remedy is to make cross references to the chapters which were studied before and to those in which the relevant material is anticipated.

At the end of each chapter, a set of questions is given. A large number of worked examples are given. A comparable number of unworked problems with answers is delivered in the book to test the understanding of the student. The examples and problems are not necessarily of plug-in type but are given to explain the underlying physics. Various useful appendices are provided at the end of the book.

Murphy, TX

Anwar Kamal

Note: These two volumes are the last books by my father Dr. Ahmad Kamal, the work he had conceived as his dream project and indeed his scientific masterpiece. Unfortunately, he passed away before he could see his manuscript in print. While we have tried our best to bring the publishing process to as satisfactory conclusion as possible, we regret any errors you may discover, in particular, that some of the references could not be as completely specifically cited as would otherwise be the case. We trust that these errors however do not compromise the quality or standard of the content of the text.

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Particle Physics

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2014, XXII, 529 p. 275 illus., Hardcover

ISBN: 978-3-642-38660-2