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# An Introduction to Relativistic Processes and the Standard Model of Electroweak Interactions

Second Edition

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# Preface

The natural framework of high-energy physics is relativistic quantum field theory. This is a complex subject, and it is difficult to illustrate it in all its aspects within a normal undergraduate course in particle physics, while devoting a sufficient attention to phenomenological aspects. However, in the small-wavelength limit, the semi-classical approximation is, in many cases of practical relevance, accurate enough to provide reliable predictions without entering the technicalities connected with radiative corrections. In particular, in the framework of the semi-classical approximation it is possible to obtain, in a limited number of pages, the expressions for relativistic cross sections and decay rates in a self-contained and rigorous presentation, starting from the basic principles of Quantum Mechanics. Furthermore, even in the case of the standard model of Electroweak Interactions, the construction of the theory in the semi-classical approximation is exhausted by the study of the classical Lagrangian; many difficult problems, such as those related to the unphysical content of gauge theories, can be dealt with by means of simple prescriptions.

These are the reasons that have determined our choice to base these lecture notes on the semi-classical approximation to relativistic quantum field theory. We believe that this approach leads to a description of the most relevant physical processes in high-energy physics, which is adequate to an undergraduate level course on fundamental interactions.

Of course, the lack of control on radiative corrections has some drawbacks, because they induce transitions which are absent at the semi-classical level. Important examples are the anomalies, the role of intermediate unstable particles and relevant processes such as the Higgs decay into a pair of photons. We have decided to present a simple discussion on each of these subjects, referring the reader to the literature for a complete presentation.

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Genoa, February 2014

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