Preface

Just imagine this scene: a physicist at a party mentions his/her profession casually to a new acquaintance. In most cases the reaction is a puzzled look and protests such as "But Physics is so dry!" or "I could never understand it" or "At school, Physics was my *bête noire.*"

We believe that physics, far from being dry, can be and should be made beautiful, inspiring and enjoyable. For many students or casual readers, physics may indeed be hard, but the difficulty stems usually from the mathematical formalism which is used to explain it. Even a children's story can be extremely hard to understand, if it is narrated in a language unknown to the listener. Mathematics is the language of physics. It is requisite, if the goal is scientific research or nontrivial applications. It may even be your best guide in subfields, such as atomic and nuclear physics, where many of the concepts and results are almost in contradiction with our daily experience, and the abstractions of quantum mechanics prevail.

Yet, a basic understanding of the achievements of modern physics should be part of the culture of each of us, just as well as a basic knowledge of music, literature and art. Giants, such as Einstein, Bohr, Heisenberg and Gell-Mann (to quote just a few), represent pinnacles of human creativity and ingenuity, just as well as Shakespeare, Leonardo, Beethoven and Bach. Everybody should have access to the wonders and glamour of modern physics, even if only a few possess the mathematical tools, which are usually required for a deeper understanding.

Thus the goal of our book is to simplify the path to those who have the intellectual curiosity, but not the mathematical skills, which are needed to approach physics through the customary channels. But at the same time we need to stress that we wish to simplify, but *not* oversimplify. As in the famous aphorism attributed to Einstein: *everything should be made as simple as possible, but not simpler.* Our goal is divulgation, yet we wish to maintain a solid scientific style. This is necessary, because physics is *not* a fairy tale from some imaginary world, even if sometimes its abstract nature makes it appear as such. We must learn to distinguish bad physics from good physics and to understand, when we read an article in a newspaper what is the likely truth behind the patronizing words of the journalist.

Our journey begins in the first three chapters with an introduction to what physics is and what it is not (or should not be). We also provide some of the essential mathematics, kept as elementary as possible, and a glimpse of the world of experimental physics. Physics is, after all, an *a posteriori* science, i.e. it must begin from the observation of the phenomenology around us.

Then, in the next three chapters, we continue with what is currently known as *Classical Physics*. Some of the readers will probably be more interested in *Modern Physics,* i.e. in the developments of physics from the beginning of the twentieth century, including relativity and quantum mechanics. However, Newton's intuition about gravity (i.e. that it is the same force on the surface of the earth and among celestial bodies) and Maxwell's unification of electricity and magnetism are truly awe-inspiring. Nowadays they are so much ingrained in our cultural environment, that they seem almost obvious. Toddlers, who keep dropping all kinds of things from high chairs to the despair of their parents, are better physicists than their elders because they have not yet lost their sense of wonder.

The next five chapters are devoted to modern physics. Relativity and quantum mechanics are first introduced and then applied to the study of the extremely small (Atomic and Nuclear physics, Elementary Particles) and of the extremely large (the Universe itself). The following Chap. 12 is the odd man out, since it abandons mainstream physics to follow the ever expanding field of the application of physics methodologies to multidisciplinary problems.

Finally, Chap. 13 tries to present a foretaste of the future, starting with a discussion of current *open problems*. In order to reverse the established fact that *short-term scientific predictions are always too optimistic, while long-term predictions are invariably too timid*, this chapter allows some amusing speculations, belonging maybe more to the realm of science fiction than of physics, but rigorous in preserving logical consistency.

To conclude, the goals of this book are a continuous quest for simplicity within the constraints of scientific accuracy over a broad range of modern physics. Consequently, in our opinion, it provides useful background reading and tools for those who would like to study physics, even if not as their main discipline. For those who are beginning a physics degree, it provides an overview of the entire subject, before they immerse themselves in the technical details of some of its many specialized branches. Finally, it will hopefully answer some of the questions that tantalize the *armchair philosopher*, who resides in all of us at all ages.

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