

# THE BEGINNING OF THE JOURNEY

Gravity attracts – this is such an obvious phenomenon that writing this book was not necessary to stress it. Less obvious is that, even before it appears in the form of physical interaction, gravity attracts our attention and our imagination. As soon as we are born, before developing a conscious relationship with the physical universe, we already know gravity at an instinctive level. For the rest of our lives, it will represent the only one of the four fundamental interactions of which we will have conscious awareness. And from which we will often try to escape.

I wrote this book with the desire to explain what gravity is and why – even though at a subconscious level – we are irresistibly attracted to it. To do this, I plan to take you on a journey through its observable effects and, in particular, into those regions of physics that have been revealed to us by Einstein's revolutionary theory of gravitation, namely general relativity. It will be a virtual journey of course, which will lead us to a place without borders – the realm of fundamental questions about which humanity wonders. But, like all travels, this one also has ambitions of enriching our vision of the world, extending our horizons and, finally, making us realise that we have learned something. For me, writing this book certainly represented all of this.

On the route that I propose, I will do my best to steer us away from the treacherous waters of erudition and technicalities. Instead, we will head out to open seas, making intuition our reference and imagination our guiding star. Along the way, we will make some stops; partly to catch our breath (given the

number of new concepts I will present in each chapter), but above all to find the calm necessary to answer some simple yet not trivial questions, such as:

*Why does an apple fall from the tree instead of floating in space? What is spacetime? What does its curvature consist of, and how is it produced? Can time be bent? How does a black hole work, and how can we 'build' one? How is it possible to photograph it if it does not emit light? What are gravitational waves, and why are they difficult to measure?*

As with any trip, it is good to be prepared for what awaits us and to pack in our luggage things we might need along the way. So, I will bring with me all I have learned in 30 years dedicated to the study of gravity and, in particular, to those aspects that are inextricably linked to the astrophysics of black holes, neutron stars and gravitational waves. The lessons I have learned in these decades have led me to a variety of predictions and discoveries. The latest achievements, working together with the Event Horizon Telescope Collaboration, have been the publication of the first images of the supermassive black holes at the centre of the M87 galaxy and of the Milky Way.

As for your luggage, it can be lighter and should contain just two essential elements: an abundance of imagination and a good deal of patience. The first will help you to find the answers that 'we in the trade' can easily read from the equations. On the other hand, the second will be helpful because not everything I write about will be immediately clear (although I can guarantee that it will be correct), and not everything you read will seem obvious, perhaps not even reasonable. However, if you arm yourself with imagination and patience, you can be sure you will find answers to each of the questions posed above, and you will come to understand the roles that spacetime and curvature play in explaining what gravity really is – this mysterious force by which we are all attracted.

Starting our journey from an irrational and neonatal instinct will lead us to the shores of pure amazement. Here, we will come

to understand what gravity really is and how some of its most bizarre expressions, such as neutron stars and black holes, actually work.

This will be our journey, from instinct to wonder, in Einstein's revolutionary universe.