

Preface

The four fundamental forces in nature, gravitation, electromagnetic, weak, and strong nuclear forces, are based on a single idea of the 19th century, the Riemann curvature. The vast amount of experimental data and theoretical development in high energy physics has confirmed that concept. Only very recently, Einstein's gravitational field, which originated the geometric paradigm for physics, has shown signs that it needs an improvement to explain the gravitational observations in modern cosmology, where Einstein's gravitational field can describe only about 4% of the gravitational interaction in the universe. On the other hand, at the quantum scale Einstein's gravitational field has resisted all attempts to quantization. Therefore, something appears to be missing to complete the idea of Riemann.

In the past 20 years we have debated with colleagues, teachers, collaborators, and students on the different forms in which geometry and the physics of the fundamental interactions mix. The overall feeling is that the understanding of the geometry of the fundamental interactions has become too complex to grasp within the standard professional lifetime of a graduate student of physics, mathematics, astronomy, and engineering to understand what is going on, specially within the current productivity syndrome. Hence the proposal of this book to supply a blend of what is known and what is not explained.

Therefore, the program of this book is about theoretical research with emphasis on inducing a debate, whenever possible, on how to fix and improve existing theories which have reached their applicability and prediction limits. We start with concepts of physical space since Kant, going through the evolution of the idea of space-time, symmetries and its associated connections, the Yang-Mills theory, and ending with gravitation, including a conceptual discussion on the deficiencies of Riemann curvature, which is the central theme of the book.

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M.D. Maia

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Maia, M.D.

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