



NOVATHÈME



Patterns in Physics

Toward a Unifying Theory

AUTHOR	RÉJEAN PLAMONDON
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SUMMARY

Why are there four basic forces of Nature and where do they come from? Why does any massive body in the Universe experience an intrinsic rotation? What is the link between the speed of light and the gravitational, Boltzmann and Planck constants? What are the relationships between electron mass, the Avogadro number, vacuum permittivity, and the masses of the Sun and the Earth? Are dark matter and dark energy necessary to explain the observable Universe? Can the lepton family be reduced to two members? These are just a few of the many questions that this scientific work addresses and to which it provides potential answers.

When various pattern analysis methods are applied to study the Universe, this leads to considering the four interactive forces of Nature as emerging blueprints, and the fundamental constants as numerical primitives. Starting from two basic premises, the principles of interdependence and of asymptotic congruence, and using a statistical pattern recognition paradigm based on Bayes' law and the central limit theorem, Einstein's global field equation is generalized to incorporate a probabilistic factor that better reflects the interconnected role of space-time curvature and matter-energy density, providing a novel starting point to redirect our long-term quest for the unification of physics.

TARGET AUDIENCE

This book aims to lay out the groundwork from which a theory for bridging the gap between quantum mechanics and general relativity could be built. It should excite the curiosity of many scientists interested in the search for new patterns that could lead to the unification of physics, more specifically graduate and undergraduate students, postgraduates, researchers, engineers and academics working in the area of fundamental and theoretical physics, quantum mechanics, general relativity, astrophysics and cosmology.

AUTHOR

Réjean Plamondon is a professor in the Electrical Engineering Department at École Polytechnique de Montréal. His main research interests deal with pattern recognition, human motor control, neurocybernetics, biometry and theoretical physics. As a full member of the Canadian Association of Physicists and the Ordre des ingénieurs du Québec, Professor Plamondon is also a lifetime Fellow of the NIAS, the IAPR and the IEEE.

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Foreword

Acknowledgements

CHAPTER 1

Introduction

CHAPTER 2

The origin of Newton's law

Putting general relativity into a probabilistic context.

Principle of interdependence. The emergence of Newton's law of gravitation. Asymptotic congruence.

CHAPTER 3

The intrinsic link between the speed of light, the gravitational and the Boltzmann constants

The numerical value of c and the Pioneer 10/11 anomaly. The numerical value of G , of the Boltzmann constant, the electron and proton masses and the Avogadro number.

CHAPTER 4

The symmetric metric, the Sun's mass, the Hubble constant and the cosmic microwave background

The spherically symmetric metric. Investigating the solar system. Modelling a general star. An extendable model. The Hubble constant. Cosmic microwave background. The black hole and gravitational collapse.

CHAPTER 5

A detailed study of the symmetric metric

The symmetric metric and the field equations. The geodesics. The motion of massive particles. The motion of photons. Investigating a stellar system interior.

CHAPTER 6

The axisymmetric metric, dark matter, dark energy and the cosmological constant

An axisymmetric solution. Investigating the solar system. A galaxy model. Dark matter. A Universe model. Cosmological constant and dark energy.

CHAPTER 7

A detailed study of the axisymmetric metric

The axisymmetric metric. The geodesics. The equatorial orbits. The circular equatorial orbits. The radial equatorial geodesics.

CHAPTER 8

The Planck constant, the electric charge and the emergence of Coulomb's law

The convergence error and the Planck constant. The electric charge, the permittivity of the vacuum and a link with Coulomb's law. The permeability of vacuum. The Heisenberg principle. A potential pathway to quantum field theory. The latent existence of magnetic monopoles.

CHAPTER 9

The weak and strong interactions, the fine structure constant and the neutrinos

The three residual interactions. The weak and strong fields and potentials. The fine structure constant. Energy conservation and neutrinos.

CHAPTER 10

General conclusion

Appendix A Generalizing to other systems of units

Appendix B Christoffel symbols and Riemann tensor for the symmetric metric

Appendix C Unsuccessful attempts at offset removal

Appendix D Axisymmetric energy equation

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Presses internationales

Polytechnique

P.O. Box 6079, Station Centre-Ville

Montréal (Québec) H3C 3A7

Canada

Tel. 514 340 3286

Fax 514 340 5882

pip@polymtl.ca

www.pressespoly.ca