Invariant Integrals in Physics

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Preface

In this book, basic laws of physics are derived from the law of energy conservation using invariant or path-independent integrals. This new approach allowed the present author to also discover some new laws generalizing Archimedes' buoyancy principle, Coulomb's Law of rolling, Newton's Law of gravity, Coulomb's Law for electric charges, and some others.

The book presents these findings; it is meant to be used in all walks of life and at school—wherever physics is necessary. For those who seek new opportunities for discovering new laws, it may be of a major interest. Some minimal mathematical knowledge, including the divergence theorem, elementary tensor skills, and analytical functions, would be helpful. However, the promise of discoveries much exceed these technical difficulties.

I express a deep gratitude to my son Yury G. Cherepanov who has a MS in math and a MA in business; he was an invaluable help in the preparation of this book.

Miami, USA
June 2019

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Honorary Life Member of the New York Academy of Sciences elected on December 8, 1976 together with Linus C. Pauling

Introduction

The value of an invariant integral does not depend on its path, surface, or volume of integration which can thus be deformed without changing this value. Invariant integrals express the laws of conservation of energy, mass, or momentum. Some path-independent contour integrals first appeared still in the eighteenth century in the works of Euler and Bernoulli and later played the main role in the mathematical theory of complex variables created by Cauchy, Riemann, and others. This theory found many applications to two-dimensional problems of fluid dynamics and elasticity. Recently, it appeared that invariant integrals in any dimensions can be used as the unique tool for deriving classical laws of physics and even for discovering some new laws.

The term "physics" comes from the ancient Greek "Φυσϊκη" which is the name of the most known book by Aristotle (384–322 BC), approximately translated as "nature." Today, physics is the main science that deals with energy, force, and matter of nature. Archimedes, Galileo Galilei, Isaac Newton, Gottfried Leibniz, Robert Hook, Leonhard Euler, Charles Coulomb, Georg Riemann, James Maxwell, Hendrik Lorentz, Jules Poincare, Albert Einstein, Nikolai Joukowski, John Eshelby, George Irwin, and others left their names on the main physical laws of nature. Some laws of these men are mentioned in Chap. 1, although they are set forth sometimes very differently from the traditional approach. In the rest of the book, there are no equations that would not belong to the present author, including the term "invariant integral" which was introduced about fifty years ago.

In this book, all physical laws are calculated from some invariant integrals which express the conservation of energy, mass, or momentum. This new approach allows us to unify the laws of theoretical physics, to simplify their derivation, and to discover some novel or more universal laws. For example, Newton's Law of gravity is generalized in order to take into account cosmic forces of repulsion and describe the growth and shape of the universe. Archimedes' principle of buoyancy is modified to take into account the surface tension of liquids. Even Coulomb's Laws describing the interaction of electric charges and the rolling friction are substantially repaired and generalized. For example, it appeared that relativistic electrons can interact in a weird way, namely, by attracting one another and coalescing into dense packs.

Moreover, invariant integrals provide an alternative to differential equations of the mathematical physics because they suggest a straightforward approach to the solution of boundary value problems. However, the corresponding numerical procedures are outside the framework of this book where one can find only exact analytical solutions. Physics today is still imperfect and sometimes self-contradicting, though. We say “vacuum” is a sort of nothing but it is in vacuum where some quite material and well-measured things like electromagnetic waves exist. Gravitation is an even more mysterious property of matter. Opposite to the general theory of relativity but based on numerous probes of the WMAP and Planck satellite missions over many years, the universe is flat which justifies the new approach to cosmology treated in this book.

The book can be a text for the special course “Invariant Integrals in Physics.” It can also serve as a complementary textbook for graduate students specializing in physics and its applications.

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