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The Pursuit of Quantum Gravity: Memoirs of Bryce DeWitt from 1946 to 2004

By Cécile DeWitt Morette

Springer 2011

Hardback: £31.99 €36.87 \$49.95

Bryce DeWitt's Lectures on Gravitation

By Bryce DeWitt (ed. Steven M Christensen)

Springer 2011

Paperback: £62.99 €73.80 \$89.95

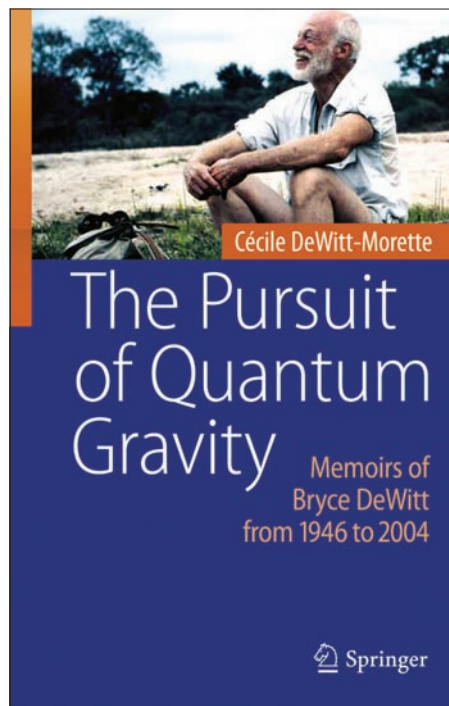
Bryce DeWitt made many deep contributions to quantum field theory, general relativity and quantum gravity. He generalized Richard Feynman's original approach to quantum gravity at the one-loop level, to a fully fledged, all-order quantization of non-abelian gauge theories, including ghosts. The formalism that he developed also transformed the way that we think about quantum field theory, although it took some time before his ideas percolated the community.

The Pursuit of Quantum Gravity is a charming and remarkable book put together by Cécile Morette, who became his wife and was to share his life for more than 50 years. Here we meet the man and his science. It is a remarkable story of vision, passion, independence and determination that led this scientist along such a difficult road, against all odds.

The material in the book is difficult to find elsewhere and it is not only highly informative but also a pleasure to read. For instance, the way that he organized an expedition to Mauritania to check the deflection of light by the Sun and thus verify the results from the 1919 eclipse by Arthur Eddington *et al.* There are also documents that are not easily accessible elsewhere, such as the essay that won him the first prize of the Gravity Research Foundation in 1953. It is quite remarkable how many aspects of the vision laid out in that paper that he was able to accomplish.

This book makes us aware of how much we owe Bryce DeWitt, and how deep and broad his influence has been. It pays homage to a truly great man – through the words of the person who knew and understood him best.

Back in 1971, he delivered a series of lectures on gravitation at Stanford University, before moving to the University of Texas at Austin. It has taken 40 years for them to be available to the physics community, but finally they are here as *Bryce DeWitt's Lectures on Gravitation*, thanks to the efforts of his former student



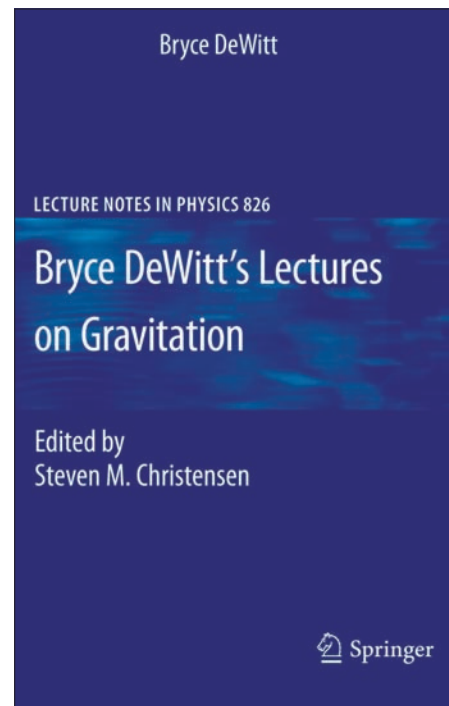
Steven M Christensen. Anyone who has seen the original realizes how grateful we should be to the editor for the large amount of work required in carrying out this task.

These lectures do not represent a standard introduction to the subject but rather DeWitt's unique way of presenting it. Along with standard topics that include special relativity, continuous groups and Riemannian manifolds, one finds a remarkable treatment of the study of asymptotic fields, the energy–momentum of the gravitational field, and above all the dynamics of the production and propagation of gravitational waves.

Many of the results found here cannot be found in other books or review articles on the subject, despite the number of years that have elapsed since they were presented. Take, for example, the treatment of the angular momentum carried by gravitational waves, where a cursory look at the relevant chapters shows why this book is different. The complexity of the algebra involved requires a combination of tenacity, wizardry and understanding that is difficult to find in any other master of general relativity. DeWitt's head-on, uncompromising approach is unique.

The book also has high historical value, showing how this maverick maven thought of the subject. It is a great tribute to his scientific legacy.

● Luis Álvarez-Gaumé, CERN.



Gravitation: Foundations and Frontiers

By T Padmanabhan

Cambridge University Press

Hardback: £50 \$85

E-book: \$68

The general theory of relativity – the foundation of gravitation and cosmology – may be as widely known today as Newton's laws were before Einstein proposed their geometric interpretation. That was around 100 years ago, yet many unanswered questions and issues are being revisited from the current perspective, such as: why is gravity described by geometry and why is the cosmological constant so extraordinarily fine-tuned in comparison with the scale of elementary particles?

In an active research field – where the universe at large meets the discoveries in particle physics – there is much need for textbooks based on research that address gravity in depth. Thanu Padmanabhan's book fills this need well and in a unique way. Within minutes of opening the rich, heavy, full, yet succinctly written 728 pages I realized that this is a new and personal view on general relativity, which leads beyond many excellent standard textbooks and offers a challenging training ground for students with its original exercises and study topics.

In the first 340 pages, the book presents the fundamentals of relativity in an approachable style. Yet, even in this

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“standard” part the text goes far beyond the conventional framework in preparing the reader in depth for mastering the “frontiers”. The titles of the following chapters speak for themselves: “Black Holes”, “Gravitational Waves”, “Relativistic Cosmology” and “Evolution of Cosmological Perturbations”, all of which address key domains in present-day research. Then, on page 591, the book turns to the quantum frontier and extensions of general relativity to extra dimensions, and to efforts to view it as an effective “emergent” theory.

This research-oriented volume is written in a format that is suitable for a primary text in a year-long graduate class on general relativity, although the lecturer is likely to leave a few of the chapters to self-study. “Padmanabhan” complements the somewhat older offerings of this type, such as “The Big Black Book” (*Gravitation* by Charles Misner, Kip Thorne and John Wheeler, W H Freeman 1973) or “Weinberg” (*Gravitation and Cosmology: Principles and Applications of the General Theory of Relativity*, Wiley 1972).

Naturally, this publication differs greatly from “text and no research” offerings, such as Ta-Pei Cheng’s *Relativity, Gravitation and Cosmology: A Basic Introduction* (OUP 2009) or Ray d’Inverno’s *Introducing Einstein’s Relativity* (OUP 1992). Any lecturer using these should consider adding “Padmanabhan” as an optional text to offer a wider view to students on what is happening in research today. In comparison with “Hartle” (*Gravity: An Introduction to Einstein’s General Relativity*, Addison-Wesley 2003), one cannot but

admire that “Padmanabhan” does not send the reader to other texts to handle details of computations; what is mentioned is also derived and explained in depth. Of course, “Hartle” is often used in a “first” course on gravity but frankly how often is there a “second” course?

“Padmanabhan” is, as noted earlier, voluminous, making it an excellent value for money because it contains the material of three contemporary books for the price of one. So who should own a copy? Certainly for any good library covering physics, the question is really not if to buy but how many copies. I also highly recommend it to anyone interested in general relativity and related fields because it offers a modern update. Students who have already had a “first” course in the subject and are considering taking up research in this field will find in “Padmanabhan” a self-study text to deepen their understanding. If you are a bookworm like me, you must have it, because it is a great read from start to finish.

● Johann Rafelski, *University of Arizona*.

Higher Speculations: Grand Theories and Failed Revolutions in Physics and Cosmology

By Helge Kragh

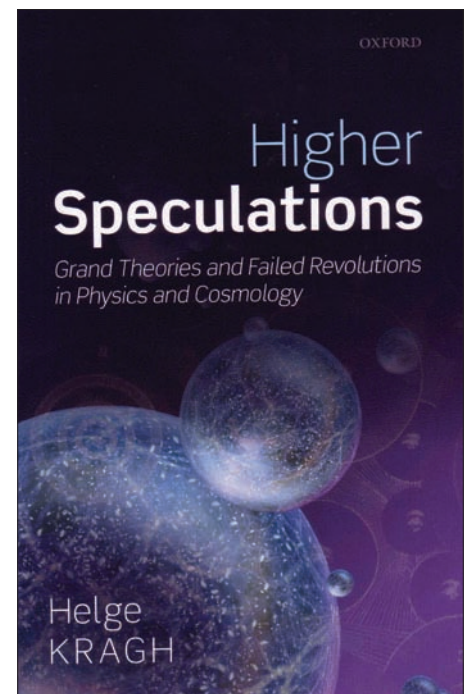
Oxford University Press

Hardback: £35 \$63

Over the past 60 years, high-energy physics has gone through various stages of development characterized by a varying degree of speculation. The bootstrap programme (based on the S-matrix approach) of the early 1960s was thought to be empirically more motivated than a field-theoretical description of strong interactions. Today, gauge theories are at the heart of strong interactions even if confinement and the transition between partonic and hadronic degrees of freedom are not completely understood. The development of science is full of speculations, conjectures and useful mistakes.

The themes touched on in this book by historian Helge Kragh are certain to be of interest to the current generation of physicists, even if the inspiration of the author is more historical and, to some extent, philosophical. In some parts, the text might have been more terse and synthetic but, overall, the author’s reflections are timely.

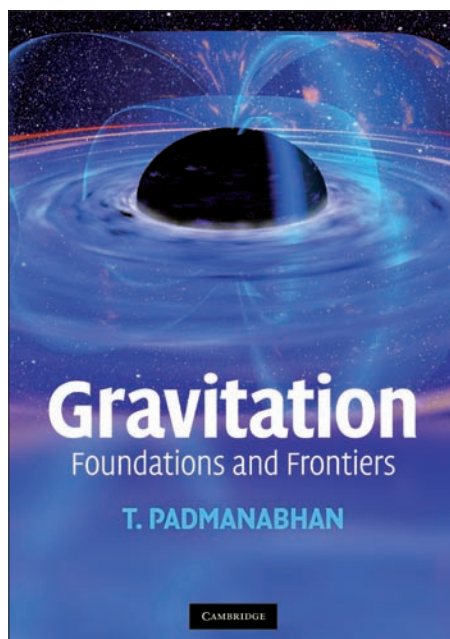
The first part (consisting of six chapters) starts with the cosmological vision of René Descartes and ends with an interesting account of the bootstrap programme. The second part deals with comparatively modern speculations such as the varying constants of nature (invoked by Paul Dirac,



Robert Dicke and others), the cyclic models of the universe, the anthropic principle and the multiverse. Chapter 11 focuses on string theory and quantum gravity while chapter 12 deals with astrobiology.

Even without this book, every particle physicist would subscribe to the suggestion that the criteria for the validity of a physical speculation seem to become experimentally less demanding as time goes by. Some theorists are now studying models having, in the most conservative cases, thousands of parameters and zillions of vacua. To select the right vacuum (i.e. our universe) in this multiple universe, the techniques of statistical mechanics are employed together with the tenets of the so-called anthropic principle. While some practitioners claim that the anthropic principle is simply a new name for what used to be called fine-tuning, the themes that Kragh discusses are often taken seriously and become the subject of heated debates, even in the popular press.

A general and panoramic historical view, such as the one conveyed here by Kragh, might help physicists to understand that the potential threats of modern science are not the conjectures or even the bold theoretical mistakes. There are healthy speculations (which are motivated empirically) and “failed revolutions” i.e. those conjectures that lose the character of falsifiable hypotheses but remain a fashionable way of thinking. While healthy speculations can be ruled out by experiments, failed revolutions have many analogies with religious belief. The historical overview suggests, in this



respect, that science has made tremendous progress in the past century not only thanks to the healthy speculations, but also despite the failed revolutions. There are no reasons to doubt that the same will happen in the years to come.

● Massimo Giovannini, CERN and INFN
Milan-Bicocca.

Books received

Dynamical Symmetry

By Carl E Wulman

World Scientific

Hardback: £75 \$109

E-book: \$142

Whenever systems are governed by continuous chains of causes and effects, their behaviour exhibits the consequences of dynamical symmetries – many of them far from obvious. *Dynamical Symmetry* introduces the reader to Sophus Lie's discoveries of the connections between differential equations and continuous groups that underlie this observation. It develops and applies the mathematical relations between dynamics and geometry that result. Much material is new and some has only recently appeared in research journals.

Proceedings of the Fifth Meeting on CPT and Lorentz Symmetry

By V Alan Kostelecký (ed.)

World Scientific

Hardback: £77 \$118

E-book: \$153

The 5th Meeting on CPT and Lorentz Symmetry focused on tests of these fundamental symmetries and related theoretical issues. Topics included searches for CPT and Lorentz violations, ranging from studies of birefringence and dispersion from cosmological sources, through laboratory and gravimetric tests of gravity to spectroscopy of hydrogen and antihydrogen. Theoretical discussions included physical effects at the level of the Standard Model, general relativity and beyond; the possible origins and mechanisms for Lorentz and CPT violations; and issues in field theory, particle physics, gravity and string theory.

An Introduction to String Theory and D-brane Dynamics with Problems and Solutions (2nd edition)

By Richard J Szabo

Imperial College Press

Hardback: £42 \$68

E-book: \$88

This book provides both an introduction to the rudiments of perturbative string theory and a detailed introduction to the more current topic of D-brane dynamics. The

rapid but coherent introduction to the subject is perhaps what distinguishes this text from others on string theory or D-branes. The presentation is pedagogical, with material based on mini-courses in theoretical high-energy physics delivered by the author at various summer schools. This second edition includes an appendix with solutions to the exercises and expands on some of the technical material.

Heisenberg's Quantum Mechanics

By Mohsen Razavy

World Scientific

Hardback: £74 \$120

Paperback: £42 \$61

E-book: \$156

This detailed account of quantum theory puts the emphasis on the Heisenberg equations of motion and the matrix method. It features a deep treatment of fundamental concepts, such as the rules for constructing quantum-mechanical operators and the classical-quantal correspondence; the exact and approximate methods based on the Heisenberg equations; the determinantal approach to the scattering theory and the LSZ reduction formalism. The uncertainty relations for a number of different observables are derived and discussed. There is also a chapter on the quantization of systems with nonlocalized interaction.

Lectures on Gravitation

By Ashok Das

World Scientific

Hardback: £61 \$99

Paperback: £30 \$48

E-book: \$129

This compilation covers the lectures for a one-semester course on gravitation given at the University of Rochester. Starting from a simple description of geometry, the topics are systematically developed through to the big-bang theory with a simple derivation of the cosmic-background temperature. Several informative examples are worked out in detail.

Polarized Sources, Targets and Polarimetry: Proceedings of the 13th International Workshop

By G Ciullo, M Contalbrigo and P Lenisa (eds.)

World Scientific

Hardback: £82 \$126

E-book: \$164

Recent experimental results, new ideas and prototypes in the field of nuclear gaseous and solid polarized targets and polarimetry feature in these proceedings from the biennial meeting on the topics of polarized sources, targets and polarimetry. The topics covered include polarized electron sources,

polarized proton and deuterium sources, polarized internal targets, polarized ^3He ion sources and targets, polarimetry (e, p, d) at low and high energy, polarized antiprotons and polarized solid targets.

Practical Guide to Computer Simulations

By Alexander K Hartmann

World Scientific

Hardback: £67 \$108

Paperback: £40 \$64

After working through this book, the reader will possess the background knowledge, starting from program design, programming in C, fundamental algorithms and data structures, random numbers and debugging, all of the way to data analysis, presentation and publishing. The reader will be equipped to perform complete projects from the first idea to final publication. All techniques are explained using many examples in C. The C codes and solutions are readily available in the accompanying CD-ROM.

Predicted and Totally Unexpected in the Energy Frontier Opened by the LHC: Proceedings of the International School of Subnuclear Physics

By Antonino Zichichi (ed.)

World Scientific

Hardback: £148 \$238

Paperback: \$309

These are the proceedings from the International School of Subnuclear Physics held in Erice on 29 August – 7 September 2008. Topics include: “Predicted signals at the LHC from technicolour”; “How supercritical string cosmology affects the LHC”; “Progress on the ultraviolet finiteness of supergravity”; “Quantum gravity from dynamical triangulation”; “Status of superstring and M-theory”; “Strongly-coupled gauge theories”; “Strongly interacting matter at high energy-density”; “The nature and the mass of neutrinos, Majorana vs Dirac”; and “The anomalous spin-distributions in the nucleon”.

Wavefronts and Rays: As Characteristics and Asymptotics

By Andrej Bóna and Michael A Slawinski

World Scientific

Hardback: £62 \$90

The purpose of this text book is to provide a background of physics and underlying mathematics for the concept of rays. The emphasis on and presentation of the theory of characteristics, which defines the rays, accentuate the beauty and versatility of this theory. The mathematical rigour of the formulation is played down to highlight the physical meaning and make the subject accessible to a wider audience.