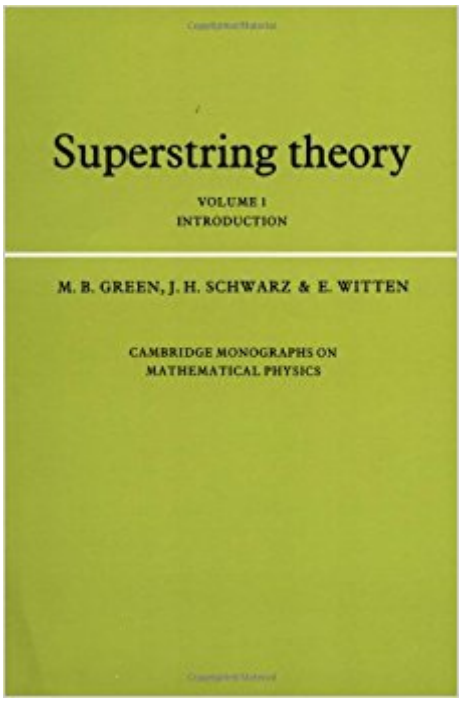
Superstring Theory: Volume 1, Introduction (Cambridge Monographs On Mathematical Physics)



Synopsis

In recent years, superstring theory has emerged as a promising approach to reconciling general relativity with quantum mechanics and unifying the fundamental interactions. Problems that have seemed insuperable in previous approaches take on a totally new character in the context of superstring theory, and some of them have been overcome. Interest in the subject has greatly increased following a succession of exciting recent developments. This two-volume book attempts to meet the need for a systematic exposition of superstring theory and its applications accessible to as wide an audience as possible.

Book Information

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Customer Reviews

"...extremely useful to the beginning student..." Donald Marolf, University of California Santa Barbara, American Journal of Physics

A systematic analysis of superstring theory and its applications is written for a wide audience's accessibility. Volume 1 provides a self contained introduction, beginning with an elementary treatment of the bosonic string. Volume 2 delves more deeply into topics of current interest and presents many topics from recent research papers.

This is a great book, and the costumer service is very good.

Anyone interested in learning string theory could perhaps start with the current formulation involving D-branes and M theories. This is certainly possible and will lead one to the frontiers of research. However, it would not perhaps give one an appreciation of string theory that would be obtained by persuing a study that explains how it arose in the study of the strong interaction . This book, written by three giants in string theory, will give the reader such a study, and was the first book to appear on the subject. The book is a monograph, and not a textbook, since no exercises appear, but it could still serve as a reference and "required reading" for courses in string theory. The learning of string theory can be a formidable undertaking for those who lack the mathematical background. Indeed, a proper understanding of string theory, not just a forma one, will require a solid understanding of algebraic and differential geometry, algebraic topology, and complex manifolds. There are many books on these subjects, but I do not know of one what will give the student of string theory an in-depth understanding of the relevant mathematics. These two volumes include two rather lengthy chapters on mathematics, one on differential geometry and the other on algebraic geometry. The mastery of these two chapter will give readers a formal understanding of the mathematics, and will allow them to perform calculations in string theory efficiently, but do not give the insight needed for extending its frontiers. There have been a few books published on string theory since these two volumes appeared, but they too fail in this regard (and some even admit to doing so). To gain the necessary insight into the mathematics will entail a very time-consuming search of the early literature and many face-to-face conversations with mathematicians. The "oral tradition" in mathematics is real and one must embed onself in it if a real, in-depth understanding of mathematics is sought. The physics of string theory though is brought out with incredible skill by the authors, and the historical motivation given in the introduction is the finest in the literature. Now legendary, the origin of string theories in the dual models of the strong interaction is discussed in detail. The Veneziano model, as discussed in this part, has recently become important in purely mathematical contexts, as has most every other construction in string theory. The mathematical results that have arisen from string theory involves some of the most fascinating constructions in all of mathematics, and mathematicians interested in these will themselves be interested in perusing these volumes, but will of course find the approach mathematically non-rigorous. Some of the other discussions that stand out in the book include: 1. The global aspects of the string world sheet and the origin of the moduli space, along with its connection to Teichmuller space. 2. The world-sheet supersymmetry and the origin of the integers 10 and 26 as being a critical dimension. In this discussion, the authors give valuable insight on a number of matters, one in particular being why the

introduction of an anticommuting field mapping bosons to bosons and fermions to fermions does not violate the spin-statistics theorem. 3. The light-cone gauge quantization for superstrings. The authors show that the manifestly covariant formalism is equivalent to the light-cone formalism and is ghost-free in dimension 10. The light-cone gauge is used to quantize a covariant world-sheet action with space-time supersymmetry, with this being Lorentz invariant in dimension 10. This allows, as the authors explain in lucid detail, the unification of bosonic and fermionic strings in a single Fock space. 4. Current algebra on the string world sheet and its origin in the need for distributing charge throughout the string, rather than just at the ends. The origin of heterotic string theory is explained in this context.

At one time volumes I and II of "Superstring theory" would have been essential reading for serious students of string theory. However, the way we think of string theory today is very different from the way it was formulated in these classic texts. The core is still the same, but the advent of D-branes, various dualities and M-theory have radically changed the way we see string theory. This is not to mention all the other progress in string theory such as the extensive work on black hole physics. Still this book should not be missed.Volume I stands on its own as an excellent introduction to superstring theory. However, other than showing general relativity appears in the low energy limit of string theory, potential observable consequences are mainly put off until volume II. Most of the arguments for the physical relevance of string theory are based on self-consistency and finiteness.Following a historical tour of the origins of string theory as a dual model, the main topic is introduced, string theory as a candidate for the quantum theory of gravity and providing a grand unified field theory. The obvious question, what makes a theory based on one-dimensional objects is better than one based on zero-dimensional objects, is thoughtfully considered. Several arguments are given. The first chapter closes out with an overview of string interactions.Starting with the simple physical idea that the action of a string is the area of the worldsheet, the authors develop bosonic string theory. Different approaches to quantizing strings in flat spacetime are presented with two of the main results being the calculation of the critical dimension and the central change.The flat spacetime calculations are generalized to a curved spacetime. The low energy effective action is derived, with the amazing result that in this limit string theory reproduces general relativity. Conformal invariance clearly plays an important role throughout this, but general conformal field theory is never explicitly developed. I would have liked to seen is a more explicit treatment of general conformal field theory, but that’s a matter of personal taste. All this is done in less than 200 pages!The book then moves on to cover superstring theory. From this point on bosonic and

superstrings are considered in parallel where appropriate. It starts off adding fermions onto the worldsheet. This theory is quantized in an approach that parallels that of the bosonic string (operator expansion, light-cone gauge, BRST). It then moves on to show the connection of worldsheet supersymmetry to spacetime supersymmetry.The types of superstrings developed are Type I, Type IIA, Type IIB and heterotic (with various gauge symmetries). As a side note on perspective, these are described as different string theories, but the advent of M-theory they are currently seen as different solutions to one theory.The book wraps up with very through calculations of tree level scattering amplitudes.Undoubtedly this is an excellent book. The only questions are, "How well does it hold up, is it still essential reading"? It definitely holds up very well. I consider it essential reading, however I think the point could be argued. I doubt anybody would argue that people specializing in string theory would profit by reading it.

Classic must-have

Why I still recommend this book rather than Polchinski’s book is because this book presents more motivation and physics of string theory. In the 90s, there was string duality revolution, a side-effect of which is that string theorists neglect experiments.

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