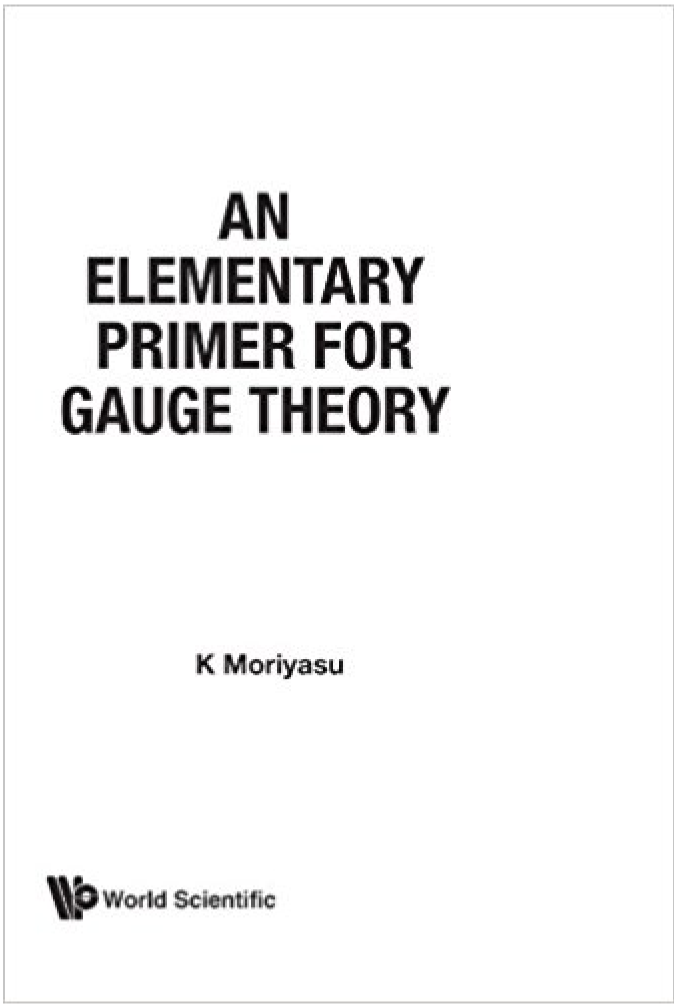
Elementary Primer For Gauge Theory, An



Synopsis

Gauge theory is now recognized as one of the most revolutionary discoveries in physics since the development of quantum mechanics. This primer explains how and why gauge theory has dramatically changed our view of the fundamental forces of nature. The text is designed for the non-specialist. A new, intuitive approach is used to make the ideas of gauge theory accessible to both scientists and students with only a background in quantum mechanics. Emphasis is placed on the physics rather than the formalism.

Book Information

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Customer Reviews

"This is a first-rate entry to the subject ... It is a deal deeper than the wordy analogies and parables that must suffice for the usual popular accounts." Scientific American, USA

Mathematicians, beware! This book is not for you!! The tiny amount of fibre bundle mathematics in this book is entirely from the physicist’s point of view. Connections are defined here as Lie-algebra-valued forms on the space-time manifold, not as connection forms on the principal bundle as mathematicians do it. (If you want the mathematical framework, see Bleecker’s "Gauge Theory and Variational Principles".)The strongest point of this book is that it motivates many aspects of gauge theory by explaining which parts of the subject arose in each stage of the progressive historical development of particle physics. The author assumes that the reader has a good background in quantum electrodynamics, and also a fair background in superconductivity theory. If you have a good understanding of fibre bundles, that won't help you at all....This book by Keihachiro Moriyasu (1940-1992), who was an experimental physicist (as far as I can tell from information on the internet), presents the historical development of gauge theory concepts for particle physics, showing how the theoretical ideas were modified and extended from the time of classical EM gauge invariance (which was already known in 1870) up to 1983. Unfortunately the W and Z bosons were verified experimentally only in 1983, apparently a few months after this book was written. But the predictions of masses and other properties explained in this book were verified by experiment.The author begins the story with Weyl's general-relativity-based "gauge theory", which is really only important because it explains the confusing name of the subject. It should really be called "phase-curvature-field theory", or something like that, because what is now called "gauge theory" involves connection forms on principal bundles with compact structure groups, which are more like bundles of phases, nothing to do with scaling groups.Then the author progresses through the various stages of the historical development, including especially the 1954 Yang-Mills theory, which did not get very much approbation at first because they required zero rest-mass, the technical difficulties of breaking gauge symmetry to introduce non-zero mass (the 1961-1964 spontaneous symmetry breaking developments), the 1967/68 Weinberg-Salam theory, and applications of Y-M theory to (non-quantum) chromodynamics. Regrettably the W and Z boson experimental verification occurred just a little bit too late to be included in this book.All in all, it's a valuable little 177-page book which helps to make sense of the big heavy gauge theory books which you can buy now. One minor fault is the use of footnotes for all references, which is great for a 10-page research paper, but not so great for a 177-page book. The other minor fault is that the author did not seem to understand the fibre bundle point of view at all. The mathematics in this book is very weak, particularly in the first 14 pages. Luckily I persevered, because at page 22, when the author starts explaining physics, there are many valuable insights which I have not seen in other presentations of gauge theory. I have put exclamation marks in the margin at very numerous points in this book. For example, on page 26, the author explains why SU(2) is the group chosen for isotopic-spin in Y-M theory. It seems totally obvious when it is explained properly! (Mathematicians need such explanations. Probably physicists don't.)

There are 6 top books written on gauge theory today, including a brand new one from the pioneer in the field (Quigg, see below) for $70 US, and a great little Dover edition for under $12 (Gauge Theory and Variational Principles (Dover Books on Physics)). None, however, give as intuitive and quasi-mathematical a description of the importance of gauge theory in unifying particle physics as this little gem.On top of that, this is the ONLY one of the bunch that works well on Kindle! The reason isn't that the publisher has some e-reader magic that everyone else forgot about, it is that the author avoids many of the complex differential equations, matrix calculus, tensors, etc. needed to correctly explain this representational system mathematically (in general), and where he does use partial differential equations, they are the tiny "mice type" versions that don't break in the middle of a page. Indeed, the author uses analogies and descriptions, plus geometry, much like the famous Fenyman "clocks," which allowed intelligent non physicists to understand QED at a level previously reserved for those with years of graduate work in physics and math. Even so, the PDE's that ARE given are daunting (see level considerations in last two paragraphs below).I say this even though I'm an applied mathematician. Even if you intend to study gauge math (God bless you) at some point, this little pony will truly help you get there with the verbal adjuncts to the math. There are minimal (and only tiny) LaTex equation systems to be slaughtered on e-readers (and the English descriptions fill them in well), so don't hesitate to save money by picking it up on Kindle.Obviously the Hadron collider, Higgs, etc. have greatly updated gauge theory, but not to the detriment of this book. The foundations are all here, and date to pre-1960 (60-80 in the case of the foundations and Weyl, leading up to Yang-Mills, which itself dates back to 1954), and this great little text will give you the intuitive foundation to fill in on more recent discoveries. Even if you are buying the latest and greatest by the master himself (Quigg) for almost $70 (Gauge Theories of the Strong, Weak, and Electromagnetic Interactions: Second Edition), this little volume on Kindle, at a fraction of the price, will help you get through grad-level expositions like Quigg with much more facility. Highly recommended, including for intelligent lay readers and advanced HS students.I've read all the best selling books on gauge available, and used a number of them to teach classes in applied math, and this ranks at the top for clarity, despite the missing and newer equations and adjustments to the theory based on more recent new particle attribute discoveries.Level warning: Some reviews have pegged this at "intelligent layman/ advanced High School." Huh? Are we talking about China or Germany? I tutor AP HS and beginning undergrad kids in calc, and know very few who study partial differential equations before Junior year UNDERGRAD. For example, Gauge indifference is "intuitively" related to Einstein linking time-space to geometric curvature, via gauge vectors, but you still need to get the basics of relativity (at a pde/tensor level) AND QED to understand the equations this author uses. The value is that even if you skip the equations, he takes the time to give geometric analogies and explain, in English, what the equations mean at a "gist" level. Laplacians and Lagrangians are a must at some point before translating to the higher math also.Intelligent layfolk: The best exposition of gauge theory for a layman I've found that does NOT require good differential equation skills is Schumm:Â Deep Down Things: The Breathtaking Beauty of Particle Physics. He does a marvelous job of relating SU(N) groups to the Standard Model in general, and puts everything in the bigger context of why we even care about field invariance between models and unobservables/ measurables.

This is a very good book for someone just getting started in Gauge Theory. Although a more modern edition should be issued, since a lot has happened since 1983.

Very good!!!!!!