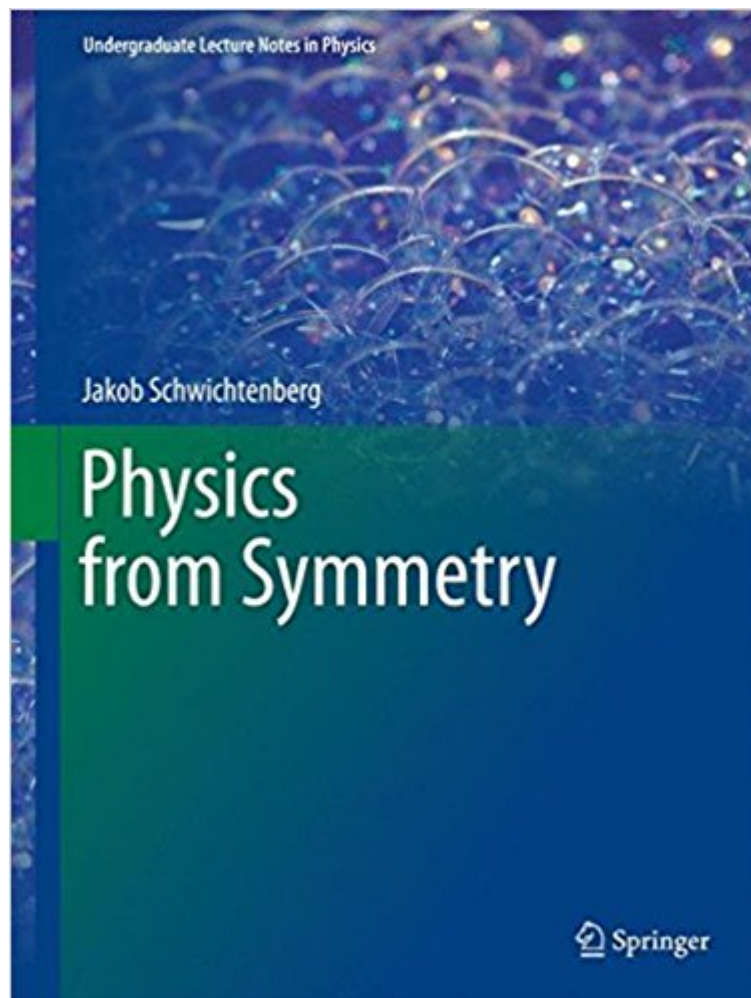




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# Physics From Symmetry (Undergraduate Lecture Notes In Physics)



## Synopsis

This is a textbook that derives the fundamental theories of physics from symmetry. It starts by introducing, in a completely self-contained way, all mathematical tools needed to use symmetry ideas in physics. Thereafter, these tools are put into action and by using symmetry constraints, the fundamental equations of Quantum Mechanics, Quantum Field Theory, Electromagnetism, and Classical Mechanics are derived. As a result, the reader is able to understand the basic assumptions behind, and the connections between the modern theories of physics. The book concludes with first applications of the previously derived equations.

## Book Information

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“The main purpose of this book is to present an updated modern approach to physical theories thorough symmetry methods. | this book describes rather well the not always easy to understand subject of symmetry methods in physics, and will be a valuable addition to the bibliography for any interested reader, and even for the expert |.” • (Rutwig Campoamor-Stursberg, zbMATH 1330.81005, 2016) “This book should be a must for every science and math undergraduate. It is the right way to introduce physics to young students and a significant improvement on the way in which undergraduate courses started with classical physics. The beauty of the subject is made obvious and the built up of the field of physics is clearly illustrated; without compromising on the maths. | I would recommend this book to anybody.” • (Rudy Blyweert, .com, October, 2015)

This is a textbook that derives the fundamental theories of physics from symmetry. It starts by introducing, in a completely self-contained way, all mathematical tools needed to use symmetry ideas in physics. Thereafter, these tools are put into action and by using symmetry constraints, the fundamental equations of Quantum Mechanics, Quantum Field Theory, Electromagnetism, and Classical Mechanics are derived. As a result, the reader is able to understand the basic assumptions behind, and the connections between the modern theories of physics. The book concludes with first applications of the previously derived equations.

Very nice organization of material. Concepts are covered well. The only source I found as an engineering grad student to really understand lie groups and algebras while also introducing myself to advanced physics, all unified under the amazing concept of symmetry. The book seems to have a lot of typos, hopefully they'll fix that in the next edition.

Excellent text book ! It's so recommend. If you're a zero order student in groups as well as in scalar field theory, go deeply and you won't be regretted. Enjoy it !

Undergraduates, today and in the future, are so lucky to have this book. It's the book I wish I had as an undergraduate, it would have saved a lot of time and misplaced effort. Future undergraduates will not have to experience the frustration of trawling through various dense texts, on topics within this new book, but were written for a much more advanced reader. The book's author has done a great job of defining the mathematical tools and drawing together the various strands using symmetry ideas in an almost conversational style but without any loss of rigor. Jakob has a wonderful way of describing and simplifying a seemingly complex notion, although that will be of no surprise to those who follow his mathematics and physics blog at [jakobschwichtenberg.com](http://jakobschwichtenberg.com). Once a reader has read, and studied, the book they will be in the fantastic position of being able to read and understand some of the higher level texts and science papers on topics that follow on from the book. This new text is easily the best book on, symmetry and physics, at this level; in fact I think it's the best book on any topic at undergraduate level period! Jakob should be rightly proud in producing such an excellent book at his first attempt. I'm really looking forward to see what he produces in the future.

Although I applaud the general intent of this book, the result is of such erratic quality that I simply cannot recommend it. First off, the book is packed with typos and errors. It doesn't appear to have

been proof-read by any competent reviewer. Then, the author has adopted a great deal of idiosyncratic notation, offered without clear explanation, and not used in a consistent manner. And most damaging, the book fails to clearly separate discussion of Lie Groups from the discussion of Lie Algebras. The two concepts are defined but then completely blurred in the subsequent text. The discussion is heavy on manual derivations of commutation relations and representations - which is good to see. But all that has been done more clearly and efficiently many times over the past 125 years.

This is a fantastic book that deserves the widest possible audience. I had read Stenger's "The Comprehensible Cosmos" a few years back, which was a semi-popular stab at deriving physical theory from symmetric considerations, and have since spent years finding a book that could do this for me in a more rigorous way. Most were rather above my level (I have an undergraduate degree in pure math), or simply ill-motivated. This book keeps certain things simple and does not shy from spelling things out here and there; there is always a balance to be struck, and I feel the author achieves this difficult task admirably. While the book strives to be self-contained, you may find it easier if you have had some exposure to Abstract Algebra and tensor notation (although Schwichtenberg wisely restricts most tensors in the book to matrices). For the notation I have found it helpful to have on hand Fleisch's "A Student's Guide to Vectors and Tensors" and, while you'll surely find Abstract Algebra books aplenty at all levels, I've looked to Stilwell's "Naive Lie Theory" (if only for the elementary proof of the Baker-Campbell Hausdorff formula). Nevertheless, in almost every case I went to another book for an explanation, I have found an author's note in the margin later on that explained what I was confused about. This book is excellent for self-study. So I am finally gaining a deep understanding on the character of physical law; this approach has profound explanatory power. If you have ever wondered why nature is the way it is and not some other, this book can give you new tools to approaching an answer. Overall, a very fine, deep physics book.

This is the book I've been looking for all these years - a clear, concise, well-written summary, from an introductory level, of advanced (for me, at least) physics topics connected by the common thread of symmetry. More specifically, the introductory presentation of symmetry and Lie Groups makes this ordinarily complex topic clear and understandable! I also appreciate the level of presentation - no boring topics such as ropes and pulleys, inclined planes with sliding boxes, etc., no historical fluff and filler (that made me change from physics to chemistry); the chapters start with the really

interesting stuff: Special Relativity; Symmetry Tools; Lagrangian Formalism; Classical Mechanics; Electrodynamics; Noether's Theorem; QM Operators; Klein-Gordon & Dirac Equations; Symmetry of Spin Fields; Schrodinger Eq; and Quantum Field Theory. Plus an Appendix reviewing Calculus and Linear Algebra. The book contains much more than these topics, but this gives an indication of the level and scope involved. Overall, an excellent, almost magical, text covering all the major areas of physics in an accessible manner. Highly recommended!

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